Appendix T

Noise and vibration

MARINUS LINK

MARSHALL DAY Acoustics

MARINUS LINK

VICTORIA TERRESTRIAL & COASTAL PROCESSES

TECHNICAL NOISE AND VIBRATION REPORT

Rp 003 20191171 | 17 May 2024

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Report No.: **Rp 003 R01 20191171**

Document Control

Status:	**Rev:**	**Comments**	Date:	Author:	Reviewer:
Complete	-	-	17 May 2024	JA / BK	JA / BK
Revision	R01	Minor figure update	20 May 2024	JA	-

GLOSSARY AND ABBREVIATIONS

This section defines the key technical terms and abbreviations used within this report.

Abbreviations used for documents referenced within this report are provided in Appendix A.

Information about how sound is described and perceived is provided in Appendix B.

Term	Description
Ambient noise level	The noise level measured in the absence of the intrusive noise or the noise requiring control. Ambient noise levels are frequently measured to determine the situation prior to the addition of a new noise source.
A-weighting	A set of adjustments which are applied to sound pressure levels to account for variations in the human ear's perception of sound at different frequencies. The A-weighting may also be applied to sound power levels. Sound pressure levels or sound power levels that are adjusted by the A-weighting are expressed as dB L_A in accordance with international standard conventions. Alternative ways of expressing A-weighted decibels such as dBA or dB(A) are therefore not used within this report.
Decibel (dB)	The unit of sound pressure level and sound power level.
EES	Environment Effects Statement
EIS	Environmental Impact Statement
EMP	Environmental Management Plan
EPA Victoria	Environment Protection Authority Victoria
EPR	Environmental performance requirement
Frequency	The number of pressure fluctuation cycles per second of a sound wave. Measured in units of Hertz (Hz).
Hertz (Hz)	Hertz is the unit of frequency. One hertz is one cycle per second. One thousand hertz is a kilohertz (kHz).
HDD	Horizontal directional drilling – a trenchless construction method that installs ducts under obstacles and environmentally sensitive features by drilling, subject to suitable geotechnical conditions.
HVDC	High voltage direct current
kV	Kilovolt
L_{A90}	The A-weighted noise level exceeded for 90 % of the measurement period, measured in dB. This is commonly referred to as the background noise level.
$L_{Aeq,T}$	The A-weighted equivalent continuous sound level, measured in dB over a time period T. This is commonly referred to as the average noise level.
L_{eff}	A measure of noise from commercial, industrial and trade premises defined within EPA Publication 1826.4 *Noise limit and assessment protocol for the control of noise from commercial, industrial and trade premises and entertainment venues*. The effective noise level is the 30-minute equivalent sound pressure level, $L_{Aeq,30min}$, adjusted where relevant for duration, noise character and measurement position.
MDA	Marshall Day Acoustics Pty Ltd ATF Marshall Day Unit Trust
MLPL	Marinus Link Pty Ltd

Term	Description
MW	Megawatt
PPV	Peak Particle Velocity
The project	The proposed Marinus Link interconnector between Tasmania and Victoria, comprising land-based infrastructure in both Tasmania and Victoria, and subsea cable connections.
Sound power level (L_w)	A measure of the total sound energy emitted by a source and is independent of the distance from the source (it is therefore different to the sound pressure level which depends on distance from the source)
Sound pressure level	The change in atmospheric pressure caused by a sound wave. The sound pressure level (along with the frequency of the sound) relates to the perceived loudness of a sound source.
TasNetworks	Tasmanian Networks Pty Ltd
Tetra Tech Coffey	Tetra Tech Coffey Pty Ltd
VDV	Vibration Dose Value

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

APPENDICES

EXECUTIVE SUMMARY

Marinus Link Pty Ltd (MLPL) proposes to construct, operate, and maintain, a 1500 megawatt high voltage direct current (HVDC) electricity interconnector between Tasmania and Victoria. The interconnector is referred to as Marinus Link (the project) and would provide a second link between Tasmania's renewable energy resources and the national electricity grid. The project would be implemented as two 750 MW circuits to meet transmission network operation requirements in Tasmania and Victoria, and would extend from Heybridge in northwest Tasmania to the Latrobe Valley in Victoria. The link is intended to enable efficient energy trade, transmission and distribution from a diverse range of generation sources to where it is most needed, and increased energy capacity and security across the National Electricity Market (NEM).

The Australian, Tasmanian and Victorian governments determined that an environmental impact assessment of the project was required. As the project is proposed to be located within three jurisdictions, the Victorian Department of Transport and Planning (DTP), Tasmanian Environment Protection Authority (Tasmanian EPA) and Australian Department of Climate Change, Energy, Environment and Water (DCCEEW) have agreed to coordinate the administration and documentation of the three assessment processes. One Environmental Impact Statement (EIS) / Environmental Effects Statement (EES) is being prepared to address the requirements of DTP and DCCEEW. Two EISs are being prepared to address the Tasmanian EPA requirements for the Heybridge converter station and shore crossing.

This report presents the technical noise and vibration assessment of the Victorian terrestrial component of the project.

The assessment considers terrestrial sources of environmental noise and vibration associated with both the construction and operational stages of the project.

At the end of its operational lifespan (anticipated to be at least 40 years), the project would either be decommissioned or upgraded to extend the operational lifespan. If the project is decommissioned, all above-ground infrastructure would be removed, and associated land returned to the previous land use or as agreed with the landowner. All underground infrastructure would be decommissioned in accordance with the requirements of the time. This may include removal of infrastructure or some components remaining underground where it is safe to do so (or the impact of infrastructure remaining in the ground being lower than removing it). The types of equipment and processes associated with decommissioning are similar to construction. A separate assessment for the decommissioning phase has therefore not been conducted as part of this study, but associated noise levels would be readily manageable with the types of mitigation and management measures used to address construction noise and vibration. Requirements at the time would determine the scope of decommissioning activities and impacts. A decommissioning management plan would be prepared to outline how activities would be undertaken and potential impacts managed. The decommissioning management plan would be informed by an assessment of the environmental impacts of the proposed decommissioning activities at the time.

The report addresses the assessment requirements of:

- the Victorian Department of Transport and Planning EES guidelines detailed in the publication *Scoping Requirements - Marinus Link – Environmental Effects Statement*, dated February 2023
- Victorian legislation and guidelines for the assessment of noise and vibration.

The Commonwealth assessment guidelines for the EIS, documented in the publication *Guidelines for the Content of a Draft Environmental Impact Statement – Environment Protection and Biodiversity Conservation Act 1999 – Marinus Link underground and subsea electricity interconnector cable* (EPBC 2021/9053) were also reviewed and noted to establish noise assessment requirements that are specific to underwater noise and the subsea component of the project. However, there are no specific requirements concerning environmental noise or vibration associated with the terrestrial components of the project.

A risk-based assessment was used to evaluate noise and vibration impacts associated with construction and operation of the project. Given that noise and vibration is an inevitable consequence of the construction and operation of a major infrastructure project, it is the risk of harm as a result of noise, as defined by the Victorian *Environment Protection Act 2017* (EP Act), which is assessed in this study.

A central requirement under the EP Act is the general environmental duty (GED) to minimise the risk of harm so far as reasonably practicable, accounting for the potential adverse effects of noise on human health and amenity. In recognition of the GED, risk controls for both construction and operational noise have been nominated and factored in the assessment.

The noise-related risks are assessed by accounting for both their consequence (having regard to the noise level, character and duration) and likelihood. The objective of the risk assessment was to determine the appropriate risk controls in terms of Environmental Performance Requirements (EPRs).

The sensitive locations addressed in this report comprise buildings and areas used by people for purposes that are sensitive to noise and vibration. These locations are collectively referred to as receivers in this report. Natural areas in the vicinity of the project, such as national and state parks, are also considered.

Noise and vibration effects on fauna (terrestrial) are addressed in a separate technical study of ecology. Similarly, the Tasmanian and subsea components of the project are addressed in separate noise and vibration assessment reports.

Construction of the project would broadly involve transitory noise and vibration generating activities which occur along, and in the vicinity of, the project. Off-site truck movements on public roads are also a relevant source of environmental noise.

The key source of operational noise associated with the project addressed in this study is the proposed converter station which would comprise indoor and outdoor plant including transformers and cooling systems. Other minor sources of operational noise, which are not formally assessed in this study, include maintenance activities and a standby generator for the transition station option, which would be operated for testing (one hour every three months during daytime hours on weekdays) or in an emergency.

Construction noise and vibration

An assessment of construction noise has been conducted using the results of background noise monitoring at a selection of locations along the extent of the project, and noise modelling for the types of activities that are likely to result in the highest noise levels during construction. The noise modelling is based on empirical noise emission data sourced from Australian and British standards, and conservative assumptions about the amount of equipment that would be operating at any given time.

The project is proposed to be constructed in two stages over approximately six years.

Construction activities would generally occur during the normal working hours specified by EPA Publication 1834.1 *Civil construction, building and demolition guide* (Monday to Friday 0700 – 1800 hrs and Saturday 0700 – 1300 hours, excluding public holidays) except where unavoidable works are required.

Extended working hours resulting from unavoidable works relate to:

- drilling for the Victorian shore crossing at Waratah Bay which is expected to involve horizontal directional drilling (HDD) works occurring 24 hours per day, 7 days per week, to ensure the stability of the borehole;
- drilling for the Morwell River crossing where work is expected to continue 24 hours per day, 7 days per week, to ensure the stability of the borehole;
- works that need to be undertaken without a break in program, such as concrete pouring
- delivery of essential, oversized plant or equipment;
- time sensitive maintenance or repair of public infrastructure;
- emergency works required due to unforeseen circumstances; and
- protection and control commissioning work within the switching station.

Project activities would be scheduled to minimise the need for work outside of normal working hours. Where construction outside of normal working hours is required for any of the above reasons, relevant authorities and neighbours would be consulted on the nature, duration and potential impact of planned works.

Limiting most construction activities to normal working hours is one the main risk controls for construction noise. Other important risk controls for construction noise include limiting the duration of the works (i.e. completing the work as quickly as possible to reduce the duration of the noise), effective communication and engagement with affected receivers, selection of low noise emission plant, and mitigation of annoying noise characteristics such as tonality.

Construction noise modelling was conducted to:

- provide an indication of the range of noise levels that can be expected at the nearest noise sensitive locations during different stages of construction;
- inform an assessment of impact;
- identify work locations where additional priority should be given to noise controls; and
- inform the definition of appropriate risk controls in the form of EPRs that would apply to subsequent stages of the project to minimise the risk of harm from noise as far as reasonably practicable.

In relation to the noise of construction activities conducted during normal working hours, the assessment demonstrates that the risk of harm as a result of noise is low.

The main noise consideration for construction is the work that needs to be conducted outside of normal working hours. In particular, the need for continuous HDD works outside of normal working hours at the shore crossing and the Morwell River Crossing to ensure the stability of the boreholes. HDD works are expected to occur continuously for a period of up to 12 months at the shore crossing (total period for the construction of the shore crossing for both circuits of the project), and up to two weeks at the Morwell River crossing site. The assessment demonstrates the potential for medium risk of harm (i.e. annoyance and the potential for disturbance of sleep) associated with the HDD works at these sites.

EPRs have been recommended to minimise the risk of harm from construction noise and vibration so far as reasonably practicable. The EPRs comprise:

- **NV01: Conduct additional background noise monitoring**

  A requirement to obtain additional background noise data which will then inform the development of controls under NV02 and NV03.

- **NV02: Develop and implement a construction noise and vibration management plan (CNVMP)**

  A requirement for a comprehensive plan which describes all measures that would be used to minimise construction noise and vibration risks as far as reasonably practicable, based on updated information for the planned construction works and equipment selections. The risk controls must be proportionate to the risk of harm from noise.

- **NV03: Develop a detailed noise and vibration impact assessment (DNVIA) for construction activities at specific sites**

  A requirement for more detailed assessment and noise control planning for long-term work sites (e.g. the converter station) and sites involving extended periods of unavoidable works outside normal working hours (e.g. the shore crossing).

In accordance with the EPRs and the proposed environmental management framework (EMF) for the project, the CNVMP and DNVIAs would need to be verified by an independent environmental auditor (IEA). The IEA would also report on the implementation of the measures documented in the CNVMP and DNVIAs.

Provided that the EPRs are adhered to, and the CNVMP is fully implemented, the residual risk of noise impacts for all aspects of construction is low.

In relation to construction vibration, the assessment considers potential effects in terms of both the potential for cosmetic building damage and disturbance of human comfort. Based on the separating distances to construction activities, cosmetic damage to buildings is unlikely at most locations. However equipment such as vibratory rollers would need to be selected and used with caution to address the risk of cosmetic damage for any receivers within 25 m, and the risk of damage to an archaeological structure identified near one of the access tracks. Vibration may be perceptible at a receiver located less than 100 m from vibration intensive construction activities. However, the brief periods in which vibration may be perceived are expected to be acceptable, accounting for relevant international guidance concerning transient sources of vibration.

Operational noise

The operational noise assessment accounts for the Victorian converter station being located at either a site south of Driffield or Hazelwood adjacent to the existing terminal station.

The proposed design and equipment selections for the converter stations incorporate risk controls including acoustically rated buildings and selection of low noise emission plant (likely to involve the selection of plant with dedicated acoustic enclosures and fan speed restrictions).

Operational noise modelling has been conducted based on concept plans for the converter station, the proposed risk controls for noise, and noise emission data provided by MLPL for the main items of plant. The assessment addresses the requirements of the EP Act, the *Environment Protection Regulations 2021*, and EPA Publication 1826.4 *Noise limit and assessment protocol for the control of noise from commercial, industrial and trade premises and entertainment venues* (EPA Noise Protocol).

The predicted operational noise levels for both the Driffield and Hazelwood site are below the applicable noise limits determined in accordance with the Noise Protocol. However, in recognition of the influence that equipment selections and design of the converter station has on noise levels, the risk of operational noise impacts has been assessed as medium. Accordingly, EPRs have been recommended and comprise:

- **NV01: Conduct additional background noise monitoring**

  A requirement to obtain additional background noise data which will inform the design of the converter station (NV04), the operation noise management plan (NV05), and the operational noise compliance assessment report (NV06).

- **NV04: Design the converter station to minimise the risk of harm from noise so far as reasonably practicable**

  A requirement to systematically evaluate and select noise control options to minimise the risk of harm from operational noise so far as reasonably practicable, in accordance with the GED under the EP Act. The selected risk controls must be proportionate to the risk harm.

- **NV05: Prepare an operation noise management plan (ONMP) for the converter station and transition station sites**

  A requirement to document all measures to be implemented and maintained to minimise the risk of harm from operational noise so far as reasonably practical, in accordance with the GED under the EP Act. The plan must document noise monitoring requirements and procedures for investigating noise complaints and potential compliance issues.

- **NV06: Prepare an operational noise compliance assessment report**

  A requirement to verify the measures implemented to minimise the risk of harm from operational noise so far as reasonably practicable, including noise compliance monitoring.

Provided that the recommended EPRs are adhered to, the residual risk associated with the predicted operational noise impacts is low.

The above findings support that noise and vibration risks associated with construction and operation of the project can be controlled to acceptable levels by implementing suitable mitigation and management measures that address the EPRs.

1.0 INTRODUCTION

Marinus Link (the project) comprises a high voltage direct current (HVDC) electricity interconnector between Tasmania and Victoria, to allow for the continued trading and distribution of electricity within the National Energy Market (NEM).

On 12 December 2021, the Victorian Minister for Planning determined that the project requires an Environment Effects Statement (EES) under the *Environment Effects Act 1978* (EE Act), to describe the project's effects on the environment to inform statutory decision making.

Similarly, the project was referred to the Australian Minister for the Environment on 5 October 2021. On 4 November 2021, a delegate of the Minister for the Environment determined that the proposed action has the potential to have a significant impact on the environment and requires assessment and approval under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) before it can proceed. The delegate determined the project will be assessed under the EPBC Act by an environmental impact Statement (EIS).

In July 2022 a delegate of the Director of the Environment Protection Authority Tasmania determined that the project be subject to environmental impact assessment by the Board of the Environment Protection Authority (the Board) under the *Environmental Management and Pollution Control Act 1994* (Tas) (EMPCA).

As the project is proposed to be located within three jurisdictions, the Victorian Department of Transport and Planning (DTP), Tasmanian Environment Protection Authority and Australian Department of Climate Change, Energy, Environment and Water (DCCEEW) have agreed to coordinate the administration and documentation of the three assessment processes.

One EIS / EES is being prepared to address the requirements of DTP and DCCEEW. Two EISs are being prepared to address the Tasmanian EPA requirements for the Heybridge converter station and shore crossing.

This report has been prepared by Marshall Day Acoustics Pty Ltd (MDA) for the Victorian jurisdiction as part of the EIS / EES being prepared for DTP and DCCEEW.

1.1 Purpose of this report

This document presents the technical noise and vibration assessment of the Victorian terrestrial component of the project. The assessment considers sources of environmental noise and vibration associated with both the construction and operational stages of the project. Noise and vibration levels associated with decommissioning activities (i.e. decommissioning of the project) are expected to be similar to, or lower than, those experienced during the construction phase. A separate assessment for the decommissioning phase is therefore not warranted. The relevant noise mitigation measures nominated for the construction phase should also be applied during decommissioning.

Construction of the project would broadly involve transitory noise and vibration generating activities which occur along, and in the vicinity of, the project. Off-site truck movements on public roads are also a relevant environmental noise and vibration consideration. The primary source of operational noise associated with the project are the proposed converter stations which would comprise indoor and outdoor plant including transformers and cooling systems.

This report presents:

- details of the environmental noise and vibration criteria that apply to the project;
- the noise and vibration sensitive locations in the vicinity of the project;
- predicted construction noise and vibration levels at sensitive locations;
- predicted operational noise levels at sensitive locations;

- a risk assessment of the potential noise and vibration impacts of the project; and
- recommended environmental performance requirements (EPRs) for the mitigation and management of noise and vibration.

The sensitive locations addressed in this report comprise buildings and areas used by people for purposes that are sensitive to noise and vibration. These locations are collectively referred to as receivers in this report. Natural areas in the vicinity of the project, such as national and state parks, are also considered.

Noise and vibration effects on fauna (terrestrial) are addressed in a separate technical study of ecology. Similarly, the Tasmanian and subsea components of the project are addressed in separate noise and vibration assessment reports.

An important aspect of the noise and vibration assessment is the extent of the project and, particularly with respect to construction noise, the large area that needs to be considered to assess the potential noise and vibration impacts to sensitive locations along the project route. The assessment has therefore been conducted to inform strategic decision making about the project with respect to noise and vibration considerations.

This report forms part of an integrated approach to assessing potential impacts that could occur as a result of the project. Accordingly, the assessment considers the assessment requirements of both Victorian and Commonwealth governments.

1.2 Project overview

The project is a proposed 1500 megawatt (MW) high voltage direct current (HVDC) electricity interconnector between Heybridge in northwest Tasmania and the Latrobe Valley in Victoria (Figure 1). The project would provide a second link between the Tasmanian renewable energy resources and the national electricity grid enabling efficient energy trade, transmission and distribution from a diverse range of generation sources to where it is most needed, and would increase energy capacity and security across the NEM.

Marinus Link Pty Ltd (MLPL) is the proponent for the project and is a wholly owned subsidiary of TasNetworks. TasNetworks is owned by the State of Tasmania and owns, operates and maintains the electricity transmission and distribution network in Tasmania.

Tasmania has significant renewable energy resource potential, particularly hydroelectric power and wind energy. The potential size of the resource exceeds both the Tasmanian demand and the capacity of the existing Basslink interconnector between Tasmania and Victoria. The growth in renewable energy generation in mainland states and territories participating in the NEM, coupled with the retiring of baseload coal-fired generators, is reducing the availability of dispatchable generation that is available on demand.

Tasmania's existing and potential renewable resources are a valuable source of dispatchable generation that could benefit electricity supply in the NEM. The project would allow for the continued trading, transmission and distribution of electricity within the NEM. It would also manage the risks of a single interconnector across the Bass Strait and complement existing and future interconnectors on mainland Australia. The project is expected to facilitate the reduction in greenhouse gas emissions at a state and national level.

Interconnectors are a key feature of the future energy landscape. They allow power to flow between different regions to enable the efficient transfer of electricity from renewable energy generation zones to where the electricity is needed. Interconnectors can increase the resilience of the NEM and make energy more secure, affordable and sustainable for customers. Interconnectors are common around the world (including in Australia) and play a critical role in supporting Australia's transition to a clean energy future.

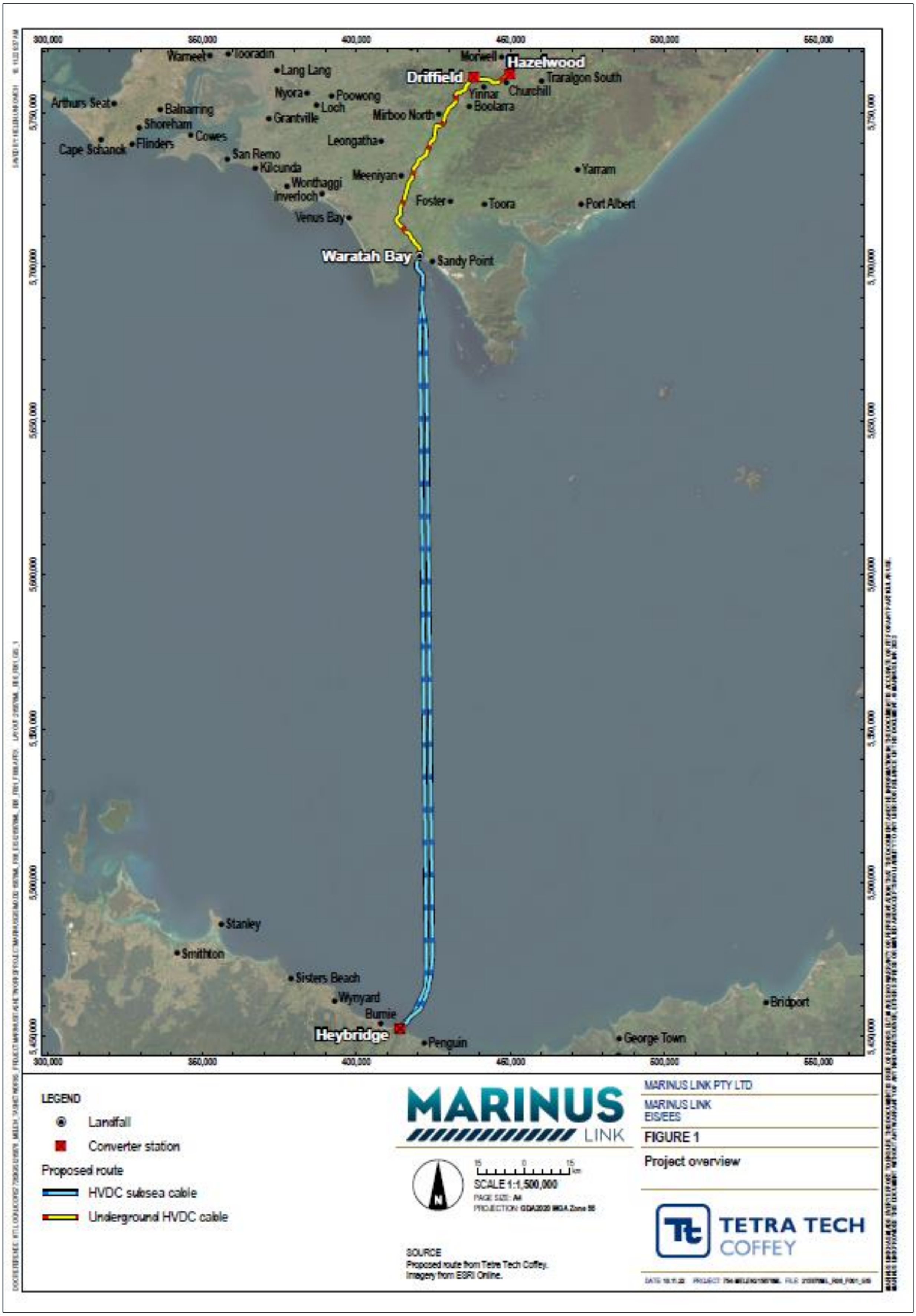

Figure 1: Project overview
(figure courtesy of Tetra Tech Coffey)

1.3 Assessment context

Construction and operation of the project has the potential to result in noise and vibration impacts at receivers in the area around the project, primarily consisting of residential dwellings.

The impacts can range from annoyance and minor disturbance of domestic and recreational activities (e.g. speech interference), potentially resulting in behavioural changes to adapt to the noise (e.g. avoiding outdoor areas or closing windows), through to complete disruption of typical residential activities and health impacts which may arise from sleep disturbance in some circumstances.

Environmental noise can also have an impact on areas such as state and national parks where natural soundscapes are valued for their tranquillity.

Environmental noise and vibration are therefore important considerations to be addressed as part of the EIS. Specifically, an assessment is required to identify and quantify the risk of noise and vibration impacts and determine the types of EPRs that should apply to the project to minimise the risks.

2.0 ASSESSMENT GUIDELINES

This section outlines the assessment guidelines relevant to the noise and vibration assessment and the linkages to other EIS/EES technical assessments. A single consolidated EIS/EES is being prepared to address the requirements of the Commonwealth and Victorian jurisdictions, including the requirement for an EES. This report will use the term EIS/EES going forward.

2.1 Commonwealth

The Commonwealth assessment guidelines for the EIS are documented in the publication *Guidelines for the Content of a Draft Environmental Impact Statement – Environment Protection and Biodiversity Conservation Act 1999* – Marinus Link underground and subsea electricity interconnector cable (EPBC 2021/9053) (the Commonwealth EIS Guidelines).

The Commonwealth EIS Guidelines establish noise assessment requirements that are specific to underwater noise and the subsea component of the project. However, there are no specific requirements concerning environmental noise or vibration and the terrestrial components of the project.

2.2 Victoria

The Victorian Department of Transport and Planning issued EES guidelines in the publication *Scoping Requirements – Marinus Link – Environmental Effects Statement* dated February 2023 (the Victorian EES scoping requirements).

The EES evaluation objectives and scoping requirements that are relevant to the assessment of noise and vibration associated with the project are documented in the following sections.

2.2.1 EES evaluation objective

The Victorian EES scoping requirements establish evaluation objectives which identify:

> *desired outcomes in the context of key legislative and statutory policies, as well as the principles and objectives of ecologically sustainable development, environment protection, net community benefit and healing Country. In accordance with the Ministerial Guidelines, they provide a framework to guide an integrated assessment of environmental effects and for evaluating the overall implications of the project.*

The evaluation objective relevant to the noise and vibration matters considered in this report is defined in Section 4.5 (Amenity, health, safety and transport) of the Victorian EES scoping requirements as follows:

> *Avoid and, where avoidance is not possible, minimise adverse effects on community amenity, health and safety, with regard to noise, vibration, air quality including dust, the transport network, greenhouse gas emissions, fire risk and electromagnetic fields.*

Section 4.1 (*Biodiversity and ecological values*) of the EES scoping requirements also identifies noise and vibration considerations relevant to terrestrial, aquatic and marine biodiversity and ecology, however these matters are considered in a separate report.

2.2.2 EES scoping requirements

The Victorian EES scoping requirements that are directly relevant to the assessment of noise and vibration are detailed in Table 1, along with the section of this report where the requirement is addressed.

Table 1: Victorian EES scoping requirements – noise and vibration

Aspects to be assessed	Scoping requirement	Report section
Key issues	Potential for adverse effects resulting from project-related noise, vibration, dust and electromagnetic fields at sensitive receivers during construction and operation.	Sections 1.1 & 4.0
Existing environment	Characterise background air quality and ambient noise near the project in established residential, farming, commercial and open space areas and at other sensitive land use and high amenity locations. Identify sensitive receptors that could be affected by noise, dust or electromagnetic fields.	Section 6.0
Likely effects	Assess effects of construction activities on the transport network, including on safety, amenity and accessibility. Assess potential effects on noise, vibration and air quality amenity at sensitive receivers, considering Victorian Environment Protection Act and its regulations and associated publications.	Section 7.0
Mitigation	Describe and evaluate both potential and proposed design responses and/or other mitigation measures (e.g. staging/scheduling of works) that could minimise noise and vibration.	Sections 7.1.8 & 7.2.7
Performance	Describe the framework for monitoring and evaluating the measures implemented to mitigate environmental amenity, human health, transport and safety effects and greenhouse gas emissions and contingencies.	Sections 7.1.8 & 7.2.7

2.3 Linkages to other reports

This report is informed by or informs the technical studies outlined in Table 2.

Table 2: Relevant technical studies

Technical study	Relevance to this assessment
Terrestrial ecology, ELA 2023	Noise level data presented in this report may be referenced in the biodiversity and ecology report prepared to address Section 4.1 of the Victorian EES scoping requirements.
Traffic and transport, Stantec 2023	Provides details of transport routes and heavy vehicle numbers during the construction of the project and informs the assessment of off-site transportation noise.
Aboriginal and historical cultural heritage, ELA 2023	Provides the location of an historical archaeological site where construction vibration related to a proposed access track is a consideration.

3.0 LEGISLATION, POLICY AND GUIDELINES

This section presents:

- legislation and guidelines for the assessment of environmental noise (sound); and
- guidelines for the assessment of vibration (in lieu of legislated quantitative vibration criteria).

3.1 Environmental noise

The environmental noise assessment requirements for the project are defined by the following Victorian government documents:

- *Environment Protection Act 2017;*
- *Environment Protection Regulations 2021*;
- *Environment Reference Standard* published 25 May 2021, and as amended by Environment Reference Standard No. S158 Gazette 29 March 2022;
- EPA Publication 1826.4 *Noise limit and assessment protocol for the control of noise from commercial, industrial and trade premises and entertainment venues* published May 2021; and
- EPA Publication 1834.1 *Civil construction, building and demolition guide* published September 2023.

The requirements and guidance of these documents is summarised below. Additional details and extracts from these documents are provided in Appendix C.

In addition, supplementary guidance that is referenced as part of the environmental noise assessment is also summarised.

3.1.1 Environment Protection Act 2017

The *Environment Protection Act 2017* (EP Act) provides the overarching legislated protection of the environment in Victoria and establishes mandatory requirements for the control of environmental noise.

Under the EP Act, operators of commercial, industrial or trade premises (industry premises) must:

- fulfil a general environmental duty (GED) to implement all reasonably practicable measures to minimise the risk of harm from noise; and
- not emit unreasonable noise.

Section 4 of the EP Act provides the following definition of harm:

> *In this Act, harm, in relation to human health or the environment, means an adverse effect on human health or the environment* (of whatever degree or duration) and includes—
>
> *(a) an adverse effect on the amenity of a place or premises that unreasonably interferes with or is likely to unreasonably interfere with enjoyment of the place or premises;*
>
> *(b) a change to the condition of the environment so as to make it offensive to the senses of human beings; or*
>
> *(c) anything prescribed to be harm for the purposes of this Act or the regulations*

The risk of harm that must be minimised under the EP Act therefore includes both health and amenity related impacts.

According to the EP Act, environmental noise is unreasonable if it is:

- prescribed to be unreasonable from an assessment against mandatory noise limits (see Section 3.1.3 and subsequently Section 7.2.4 and Section 7.2.5); or
- assessed to be unreasonable according to the following factors defined in the EP Act:
  - noise volume, intensity or duration;
  - noise character;
  - the time, place and other circumstances in which the noise is emitted;
  - how often the noise is emitted; and
  - any prescribed factors relating to the noise (frequency spectrum being a prescribed factor).

An assessment of compliance with the EP Act must therefore demonstrate that:

- all reasonably practicable measures would be implemented to reduce the risk of harm from noise;
- the project could achieve noise levels below the threshold prescribed to be unreasonable; and
- the project would not result in unreasonable noise according to the listed factors of the EP Act.

3.1.2 *Environment Protection Regulations 2021*

The *Environment Protection Regulations 2021* (EP Regulations) give effect to the EP Act by establishing prescriptive requirements for a range of environmental considerations including noise.

The noise requirements are defined according to the type of noise generating activity under consideration. The EP Regulations also define the types of noise sensitive areas where these requirements apply and the hours of different assessment time periods (i.e. day, evening and night).

The relevant elements of the EP Regulations are the requirements for the operational noise from commercial, industrial and trade premises (industry). The EP Regulations specify that the prediction, measurement, assessment or analysis of operational noise from industry within a noise sensitive area must be conducted in accordance with the EPA Noise Protocol (see Section 3.1.3).

Noise from industry is prescribed by the EP Regulations to be unreasonable for the purposes of the EP Act if it exceeds the noise limit determined in accordance with the EPA Noise Protocol.

3.1.3 EPA Publication 1826.4 (EPA Noise Protocol)

EPA Publication 1826.4 *Noise limit and assessment protocol for the control of noise from commercial, industrial and trade premises and entertainment venues* (the EPA Noise Protocol) defines a procedure for setting noise limits that apply to the operation of industry premises and entertainment venues in Victoria. The noise limits are applicable to the operational stage of the project. Compliance with the noise limits is mandatory.

The EPA Noise Protocol defines noise limits that are used to assess whether a noise is prescribed to be unreasonable in accordance with the EP Regulations and the EP Act. The noise limits apply at a 'noise sensitive area', which is defined by the EP Regulations as being *within 10 metres of the outside of the external walls* of buildings including dwellings, hotels, and schools. In rural areas, noise sensitive areas also include land within the boundary of campgrounds, caravan parks and certain types of tourist establishments.

The procedures for setting noise limits are defined separately for urban and rural areas. However, in both cases, the noise limits are defined by considering the land zoning in the area and the noise environment of the receiver. Separate noise limits are defined for the day, evening and night periods.

3.1.4 Environment Reference Standard

The *Environment Reference Standard* (ERS) was introduced under the EP Act and sets out environmental and human health outcomes that are sought to be achieved and maintained in Victoria. The outcomes are described by the ERS in terms of a collection of environmental values, indicators and objectives.

The environmental values of the ambient sound environment defined by the ERS relate to conditions that are conducive to domestic activities (conversation, recreation and sleep), learning, and appreciation and enjoyment of tranquillity in natural areas. The environmental values in most settings are defined using a quantitative indicator, and the objective for these indicators are defined according to the land use and planning zone. However, for natural areas, the indicator is qualitative and is based on an appraisal of sound quality that is conducive to human tranquillity and enjoyment of natural soundscapes.

Indicators and objectives for the ambient sound in different settings are defined to provide a basis for assessing actual and potential risks to the environment. They also provide a benchmark for comparing the state of the environment, or potential changes to the environment, to desired outcomes. However, the ERS is not a compliance standard. The primary function of the ERS is to provide an environmental assessment reporting benchmark which can be used as a reference point for decision makers to consider whether a proposal or activity is consistent with the environmental values identified in the ERS.

3.1.5 EPA Publication 1834.1

EPA Publication 1834.1 *Civil construction, building and demolition guide* (EPA Publication 1834.1) describes measures for managing noise and vibration from construction and decommissioning of a project. The guidance relates to:

- normal working hours, including scheduling works during normal hours, consultation with affected people and managing noise;
- justified unavoidable works that need to be conducted outside of normal working hours; and
- managing noise and vibration that cannot be eliminated or minimised by source control.

EPA Publication 1834.1 states that noise and vibration is to be minimised at all times, and that project developers should aim to constrain works to normal working hours. Where necessary, and subject to the approval of the relevant authority, construction activities outside normal working hours may occur for:

- low-noise impact works: inherently quiet or unobtrusive activities that do not have intrusive noise characteristics;
- managed-impact works: activities where the noise emissions are managed through actions specified in a noise and vibration management plan, and which do not have intrusive noise characteristics; and
- unavoidable works: activities that need to occur outside of normal working hours due to risks to life or property, potential traffic hazards (e.g. oversized deliveries), or certain types of construction work that cannot be stopped midway through the process (concrete pours and tunnelling works are cited as examples).

The EPA Publication 1834.1 time periods that must be accounted for when scheduling construction activities for major infrastructure projects are briefly summarised in Table 3. The summary includes the noise requirements specified in Table 4.3 of EPA Publication 1834.1. The following aspects of the noise requirements for evenings, weekends and night periods are noted:

- The noise requirements are only intended to be applied to construction activities that are justified to occur outside of hours. Importantly, the noise requirements are not intended as the basis for determining whether works outside of normal working hours is justified.
- The background noise levels used for defining the noise requirements should represent the background sound environment at the time of impact.
- The noise levels of construction are to be assessed using the A-weighted equivalent noise level, dB L_{Aeq}, plus character adjustments when tonality or impulsiveness is present (+ 2 dB each for just perceptible tonality and impulsiveness / +5 dB each for prominently audible tonality and readily detectible impulsiveness).

Table 3: EPA Publication 1834.1 period designations

Period	Days	Hours	Noise requirements
Normal working hours	Monday to Friday Saturday	0700 – 1800 hrs 0700 – 1300 hrs	All construction activity should occur during these hours unless the activity is justified as 'low-noise impact works', 'managed impact works' or 'unavoidable works'. Noise control requirements for this period are defined in terms of mitigation and management measures; noise limits are not defined for this period.
Evenings and weekend	Monday to Friday Saturdays Sunday & public holidays	1800 – 2200 hrs 1300 – 2200 hrs 0700 – 2200 hrs	Construction noise not to exceed the background noise by: • 10 dB or more for up to 18 months after project commencement • 5 dB or more after 18 months
Night	Any day	2200 – 0700 hrs	Noise must be inaudible within a habitable room of any residential premises (referenced in relation to 'low-noise impact works' and 'managed impact works').

3.1.6 Related Victorian guidelines

To support the application and use of the legislation and guidance summarised in the preceding sections, a range of Victorian EPA publications provide additional advice on matters of interpretation and technical assessment requirements. These publications include:

- EPA Publication 1992 *Guide to the Environment Reference Standard,* dated June 2021;
- EPA Publication 1996 *Noise guideline – assessing low frequency noise,* dated June 2021: and
- EPA Publication 1997 *Technical guide: Measuring and analysing industry noise and music noise,* dated June 2021.

The EPA also provides online guidelines relating to noise, including:

- commerce, industry and trade noise guidelines[1];
- noise advice for businesses[2]; and
- unreasonable noise guidelines[3].

Broader relevant industry guidance is also provided in:

- EPA Publication 1695.1 *Assessing and controlling risk for business,* dated 1 March 2019 (EPA Publication 1695.1); and
- EPA Publication 1856 *Reasonably practicable,* dated September 2020 (EPA Publication 1856).

3.2 Vibration

The EP Act defines noise as both sound and vibration. The provisions of the EP Act with respect to the GED and unreasonable noise therefore apply to both sound and vibration. However, there are no legislated or guideline quantitative criteria for the control of construction vibration levels in Victoria.

In lieu of Victorian quantitative vibration criteria, reference is made to the NSW Roads and Maritime Services publication *Construction Noise and Vibration Guideline* published August 2016 (NSW CNVG) for guidance.

The NSW CNVG sets out indicative minimum working distances from sensitive receivers for typical items of vibration intensive plant. The indicative minimum working distances are quoted for effects relating to cosmetic damage and human comfort.

The indicative minimum working distances defined in the NSW CNVG for human comfort are noted to be greater than for the avoidance of cosmetic damage. This reflects the thresholds for human exposure to vibration being lower than accepted thresholds for minor cosmetic damage to lightweight structures.

The indicative minimum working distances detailed in the NSW CNVG are the primary reference for assessing construction vibration related risks at the planning stage. The relevant criteria that would subsequently apply to any compliance monitoring are discussed in Appendix C5 and comprise:

- BS 6472-1:2008 *Guide to evaluation of human exposure to vibration in buildings* (BS 6472-1) for assessing the risks of disturbance of human comfort; and
- DIN 4150-3:2016-12 *Vibrations in buildings – Part 3: Effects on structures* (DIN 4150-3) for assessing the risk of vibration induced damage of building structures.

[1] https://www.epa.vic.gov.au/for-business/find-a-topic/noise-guidance-for-businesses/commerce-industry-and-trade-noise-guidelines

[2] https://www.epa.vic.gov.au/for-business/find-a-topic/noise/advice-for-businesses

[3] https://www.epa.vic.gov.au/for-business/find-a-topic/noise-guidance-for-businesses/unreasonable-noise-guidelines

4.0 PROJECT DESCRIPTION

This section presents:

- an overview of the project;
- the main construction activities associated that are relevant to noise and vibration; and
- the main sources of operational noise associated with the project.

4.1 Overview

The project would be implemented as two 750 MW circuits to meet transmission network operation requirements in Tasmania and Victoria. Each 750 MW circuit would comprise two power cables and a fibre-optic communications cable bundled together in Bass Strait and laid in a horizontal arrangement on land. The two 750 MW circuits would be installed in two stages with the western circuit being laid first as part of Stage 1 and the eastern cable in Stage 2.

The key project components for each 750 MW circuit from south to north are:

- HVAC switching station and HVAC-HVDC converter station at Heybridge in Tasmania. This is where the project would connect to the North West Tasmania transmission network being augmented and upgraded by the North West Transmission Developments (NWTD);
- Shore crossing in Tasmania adjacent to the converter station;
- Subsea cable across Bass Strait from Heybridge in Tasmania to Waratah Bay in Victoria;
- Shore crossing at Waratah Bay approximately 3 km west of Sandy Point;
- Land-sea cable joint where the subsea cables would connect to the land cables in Victoria, and a fibre optic terminal station;
- Land cables in Victoria from the land-sea joint to the converter station site in the Driffield or Hazelwood areas; and
- HVAC-HVDC converter station and expansion of the Hazelwood Terminal Station in Victoria, where the project would connect to the existing Victorian transmission network.

A transition station at Waratah Bay may also be required if there are different cable manufactures or substantially different cable technologies adopted for the land and subsea cables. The location of the transition station would also house the fibre optic terminal station in Victoria. However, regardless of whether a transition station is needed, a fibre optic terminal station will still be required in the same location.

Approximately 255 km of subsea HVDC cable would be laid across Bass Strait. The preferred technology for the project is two 750 MW symmetrical monopoles using ±320 kilovolt (kV), cross-linked polyethylene insulated cables and voltage source converter technology. Each symmetrical monopole would comprise two identical size power cables and a fibre-optic communications cable bundled together. The cable bundles for each circuit would transition from approximately 300 m apart at the HDD (offshore) exit to 2 km apart in offshore waters.

In Victoria, the shore crossing is proposed to be located at Waratah Bay with the route crossing at the Waratah Bay–Shallow Inlet Coastal Reserve. From the land-sea joint located behind the coastal dunes, the land cable would extend underground for approximately 90 km to the converter station. From Waratah Bay the cable would run northwest to the Tarwin River Valley and then travel to the north to the Strzelecki Ranges. The route crosses the ranges between Dumbalk and Mirboo North before descending to the Latrobe Valley where it turns northeast to Hazelwood. The Victorian converter station would be at either a site south of Driffield or Hazelwood adjacent to the existing terminal station.

The land cables would be directly laid in trenches or installed in conduits in the trenches. A construction area of 20 to 36 m wide would be required for laying the land cables and construction of joint bays. Temporary roads for accessing the construction area and temporary laydown areas would also be required to support construction. Where possible, existing roads and tracks would be used for access, for example, farm access tracks or plantation forestry tracks.

Land cables would be installed in ducts under major roads, railways, major watercourses and substantial patches of native vegetation using HDD, where geotechnical conditions permit. A larger area than the 36 m construction area would be required for the HDD crossings.

The assessment is focused on the Victorian section of the project. This report will inform the EIS/EES being prepared to assess the project's potential environmental effects in accordance with the legislative requirements of the Commonwealth and Victorian governments (see Figure 2).

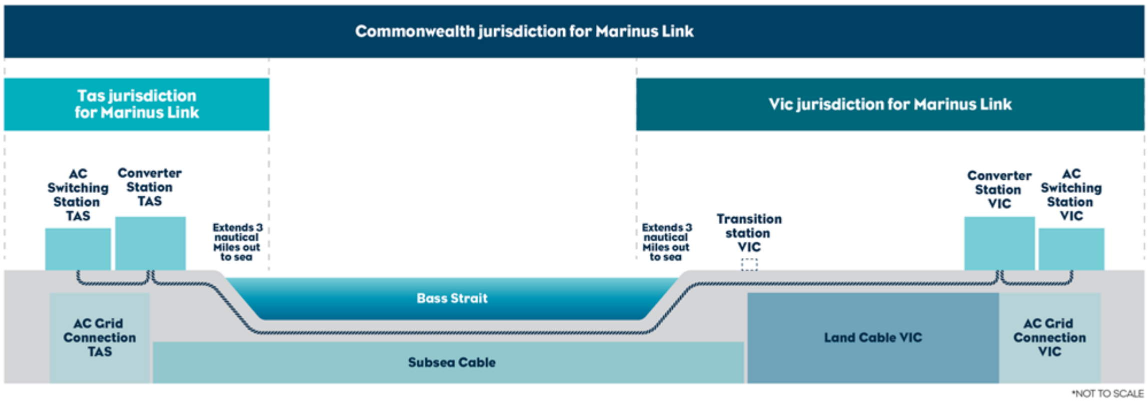

Figure 2: Project components considered under applicable jurisdictions (Marinus Link Pty Ltd 2022)

The project is proposed to be constructed in two stages over approximately five years. On this basis, Stage 1 of the project is expected to be operational by 2030, with Stage 2 to follow, with final timing to be determined by market demand. The project would be designed for an operational life of at least 40 years.

4.2 Construction

4.2.1 Proposed works

The project would be constructed in two 750 MW stages, with each stage having three cables bundled together in Bass Strait and laid in a single trench on land. The western circuit is referred to as Stage 1 and would be commissioned first. The eastern circuit is referred to as Stage 2 and would be commissioned after Stage 1.

For the land cables, the trench conduits and HDD ducts for both 750 MW links would be installed as part of Stage 1 to reduce disturbance to properties, land use and farming activities. Upfront installation of the conduits and ducts for both circuits would allow the cable lengths to be pulled between joint pits at a future date. This minimises the period when land is disturbed and provides flexibility for the timing of Stage 2.

Stage 1 would involve site establishment and hardstand areas constructed for the converter station, HVAC switching station and transition station sites. It would also involve all site establishment, civil works, trenching and installation of conduits, and installation of cable joint pits for Stage 1 and Stage 2. The land and subsea cables would be laid separately in each stage.

The works in Stage 2 would primarily be construction of the second HVDC Converter, laying of the Stage 2 land based and subsea cables, completing the testing and commissioning, and any remaining site rehabilitation. The timing of Stage 2 would depend on market conditions as well as other external factors, but MLPL's preference is to commission Stage 2 within 2 years of Stage 1.

Construction of the project would involve multiple noise generating activities. The main activities that are relevant to construction noise and vibration are listed in Table 4, along with an indication of the duration of the works.

Table 4: Main noise generating construction activities and duration / work rates

Activity	Typical duration / rate of activity
Victorian shore crossing	Approximately 12 months of horizontal directional drilling (HDD) to complete the shore crossing for Stage 1 and Stage 2
Access track and haul road construction	Approximately 100 to 150 m access track / haul road per week
Land cable – topsoil stripping and stockpiling	Topsoil stripping and stockpiling is estimated to occur at a rate of 100 to 150 m per day
Land cable – trenching	Approximately 100 to 300 m per day (depending on ground conditions)
Local feature crossings	Approximately 2 weeks of drilling
Cable installation	Approximately 1 km per day
Laydown areas and temporary facilities – civil works	Approximately 6 weeks (this relates to the construction of the laydown areas and facilities, which would then be used for a period of approximately 30 months)
Converter station – civil and structural works	Approximately 30 months
Converter station – building and plant assembly	Approximately 25 months
Off-site vehicle movements	Full duration of construction

The nominal timeframe for construction and installation of the Stage 1 land cable, including the Stage 2 land cable infrastructure to be installed as part of Stage 1, is approximately three years (35 months). The notional timeframe for the remaining construction and installation activities associated with the Stage 2 land cable is approximately two years (21 months).

At most locations along the extent of the land cable, the main noise generating construction activities would be transitory (e.g. access track construction and trenching which are expected to progress quickly). The locations of sustained construction activity primarily relate to the shore crossing, the converter station sites, transition site (if required), and the laydown areas.

4.2.2 Proposed construction hours

Construction activities would generally occur during the normal working hours specified by EPA Publication 1834.1 (Monday to Friday 0700 – 1800 hrs and Saturday 0700 – 1300 hrs, excluding public holidays) except where unavoidable works are required.

Extended working hours resulting from unavoidable works relate to:

- drilling for the Victorian shore crossing at Waratah Bay which is expected to involve HDD works occurring 24 hours per day, 7 days per week, for a period of approximately 12 months to ensure the stability of the bore hole;
- drilling for the Morwell River crossing where work may need to continue 24 hours per day, 7 days per week, for a period of approximately 2 weeks to ensure the stability of the bore hole;
- works that need to be undertaken without a break in program, such as concrete pouring;
- delivery of essential, oversized plant or equipment;
- time sensitive maintenance or repair of public infrastructure;
- emergency works required due to unforeseen circumstances; and
- protection and control commissioning work within the switching station.

Project activities would be scheduled to minimise the need for works outside of normal working hours. Where construction activity outside of normal hours is required for any of the above reasons, relevant authorities and neighbours would be consulted on the nature and duration of planned works.

4.3 Operation

The primary sources of operational noise associated with the project are the fixed items of plant to be located at the converter station.

The Victorian converter station would be located in the Driffield–Hazelwood area of the Latrobe Valley. Two potential converter station sites have been assessed in this study:

- Driffield converter station site: adjacent to the Hazelwood–Cranbourne/Rowville 500 kV transmission lines in HVP Plantations' Thorpdale plantation to the west of the Strzelecki Highway; and
- Hazelwood converter station site: adjacent to the southern boundary of the Hazelwood Terminal Station and Tramway Road.

The two sites are illustrated in the site plan reproduced in Figure 3.

The converter station would consist of two HVDC converters each housed in a separate building. The Driffield converter station would also require a switching station (the existing switching station would be utilised at the Hazelwood converter station site). Standby power generation is also required for the converter station and is included in the assessment.

Other minor sources of operational noise include maintenance activities, and a standby generator for the transition station option which would be operated for testing (one hour every three months during daytime hours on weekdays) or in an emergency. These minor sources of operational noise are not formally assessed in this study. However, the GED under the EP Act is applicable to these sources. The noise of the standby generator during testing and maintenance is also subject to the requirements of the EP Regulations and would need to comply with noise limits determined in accordance with the EPA Noise Protocol. Accordingly, while the transition station is not formally assessed at this stage, recommendations are subsequently provided for the standby generator to be addressed during the detailed design stage (see Section 7.5).

4.4 Decommissioning

The operational lifespan of the project is anticipated to be at least 40 years. At the end of its operational lifespan, the project would either be decommissioned or upgraded to extend the operational lifespan.

Decommissioning would be planned and carried out in accordance with regulatory and landowner or land manager requirements at the time. A decommissioning plan in accordance with approvals conditions would be prepared at least six months prior to planned end of service and decommissioning of the project.

Preparation of the decommissioning management plan would be informed by an assessment of the environmental impacts of the proposed decommissioning activities at the time. In advance, the noise and vibration levels associated with decommissioning activities (i.e. decommissioning of the project) are expected to be similar to or lower than those experienced during the construction phase.

Requirements at the time would determine the scope of decommissioning activities and impacts. The key objective of decommissioning would be to leave a safe, stable and non-polluting environment.

In the event that the project is decommissioned, all above-ground infrastructure would be removed, and associated land returned to the previous land use or as agreed with the landowner or land manager. Land use may include re-use for electricity transmission infrastructure, re-use for another purpose or return to previous land use where practicable.

Decommissioning activities required to meet the objective would include, as a minimum, removal of above ground buildings and structures. Remediation of any contamination and reinstatement and rehabilitation of the site would be undertaken to provide a self-supporting landform suitable for the end land use. Decommissioning and demolition of project infrastructure would implement the waste management hierarchy principles being avoid, minimise, reuse, recycle and appropriately dispose. Waste management would accord with applicable legislation at the time.

Decommissioning activities may include recovery of land and subsea cables and removal of land cable joint pits. Recovery of land cables would involve opening the cable joint pits and pulling the land cables out of the conduits, spooling them onto cable drums and transporting them to metal recyclers for recovery of component materials. The conduits and shore crossing ducts would be left in-situ as removal would cause significant environmental impact.

The concrete cable joint pits would be broken down to at least one metre below ground level and buried in-situ or excavated and removed. Subsea cables would be recovered by water jetting or removal of rock mattresses or armouring to free the cables from the seabed.

A decommissioning management plan would be prepared to outline how activities would be undertaken and potential impacts managed. A requirement to prepare a decommissioning management plan has been proposed within the Environmental Management Framework (EMF) for the project in the form of an environmental performance requirement (EPR). Specifically, an EPR designated as EMF05, titled *Develop and implement a land decommissioning management plan*, is discussed in EIS/EES Volume 5, *Chapter 2 – Environmental Management Framework*. The EPR specifies that the objective of the decommissioning plan is to minimise impacts during removal of infrastructure. This includes environmental noise and vibration impacts associated with decommissioning activities.

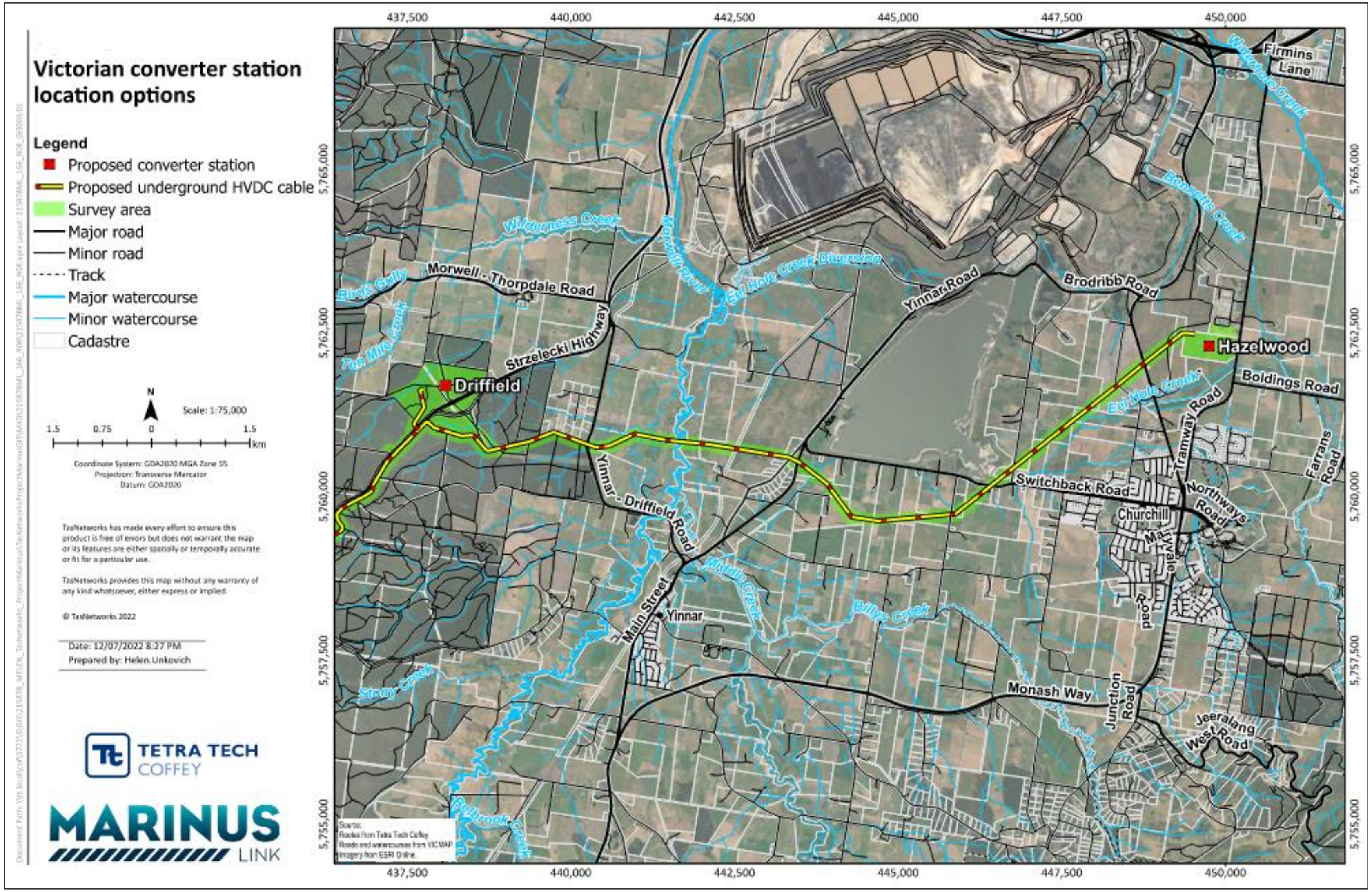

Figure 3: Victorian converter station location options
(figure courtesy of Tetra Tech Coffey)

5.0 ASSESSMENT METHOD

This section presents a summary of the methods used to assess noise and vibration associated with construction and operation of the project.

5.1 Study area – noise sensitive locations

The Victorian land cables and associated infrastructure are located along a corridor extending approximately 90 km from the Victorian shore crossing at Waratah Bay to the converter station.

The areas adjoining the project generally consist of sparsely populated agricultural areas. The two towns that are adjacent to the land project route are Buffalo and Dumbalk. Other populated areas in the vicinity of the route such as Churchill, Mirboo North, Sandy Bay, Stony Creek, and Waratah Bay are generally located more than 500 m from the land project route.

The noise and vibration sensitive locations considered in this report comprise houses and holiday accommodation (e.g. motels and B&Bs).

A total of 312 receivers categorised as residential buildings were identified within approximately 500 m of the project. Construction noise would extend to areas beyond 500 m from the project. However, a 500 m distance has been adopted to:

- represent the receivers expected to experience the highest construction and operational noise levels (and which largely determine the appropriate form of risk controls);
- enable the identification of the areas and activities where the greatest number of receivers would be affected by construction noise; and
- practically limit the study area for the assessment of temporary construction noise effects for a project extending over 90 km.

If the project is approved, receivers at locations beyond 500 m would need to be identified and accounted for in the development of a construction noise and vibration management plan (CNVMP); particularly in the vicinity of any locations where out of hours works are proposed as part of construction of the project.

The location of all identified receivers is illustrated in the map series presented in Appendix D.

In addition to receivers associated with building locations, environmental noise levels can also be a relevant consideration in recreational outdoor areas that are valued for their natural soundscape, primarily in relation to long-term or permanent sources of noise level change. These types of locations have also been considered in the assessment. The key sites considered in this assessment are the Waratah Bay – Shallow Inlet Coastal Reserve adjacent to the proposed Victorian shore crossing and the Cape Liptrap Coastal Park located approximately 4 km to the west of the shore crossing.

The noise of construction activity is also relevant to receivers located along roads which would experience construction related traffic to and from the project site, as well as receivers in the vicinity of access roads. Construction noise at these locations is expected to be more transient than at other receiver locations and they have been addressed in general terms only within the study.

5.2 Baseline characterisation

The baseline noise environment at receivers along the project route is relevant to the assessment of both the construction and operational stages of the project. In both cases, the baseline noise environment provides context to the predicted noise levels associated with the project. The baseline noise characterisation is also used for setting noise criteria applicable to construction work outside normal working hours and the operational stage of the project.

Given that the project extends over a large area through different environments, the baseline noise conditions along the route would vary due to factors such as the presence of localised background noise sources and proximity to natural and anthropogenic sources in the wider area (e.g. proximity to the coast or arterial roads).

To characterise the baseline noise environment, a survey of background noise levels was conducted at a selection of locations along the project route. The locations were chosen to represent different environments near key elements of the project (e.g. the candidate converter station sites and the proposed HDD local feature crossings). The scope and form of the survey was selected to obtain a broad indication of baseline noise conditions for the purposes of this assessment.

Baseline vibration levels at receivers along the route are expected to be very low. The assessment of potential vibration impacts from construction of the project is also solely based on the level of vibration which may be produced by different works (i.e. the criteria are not set at values relative to the background vibration levels). Accordingly, a survey of baseline vibration levels was not warranted and was not undertaken as part of this study.

5.3 Construction noise

5.3.1 Assessment basis

Construction of the project would involve temporary noise generating activities in proximity to existing receivers in the area.

The majority of the works are proposed to occur during normal working hours.

Unavoidable works outside of normal working hours would be required in some instances, including works during the evening, night, Saturday afternoons and Sunday/public holidays (i.e. the periods outside of designated normal working hours according to EPA Publication 1834.1). In particular, HDD work associated with the shore crossing is proposed to occur 24 hours per day for a period of up to 12 months, and would therefore involve drilling activity 24 hours a day. HDD work at the Morwell River crossing is also expected to occur continuously for a period of up to two weeks. MLPL has advised that the requirement for continuous drilling at these locations is to ensure the stability of the borehole.

The assessment therefore separately considers construction activity during normal working hours and unavoidable works outside of normal working hours. The unavoidable works includes construction activity which would continue during the evening and night, and on weekends/public holidays. Collectively, these works are assessed by considering potential impacts associated with the night component of works outside of normal working hours, on account of this being the most sensitive period.

In accordance with the GED under the EP Act, the risk of harm from construction must be minimised as far as reasonably practicable at all times. This is supported by the guidance of EPA Publication 1834.1 which provides recommendations for minimising the impacts of construction noise.

Noise criteria are not generally defined for assessing the acceptability of construction noise. Specifically, while EPA Publication 1834.1 sets objective noise requirements for weekends, evenings and night periods, these noise requirements are only intended to be used in situations when work outside of normal working hours is justified (i.e. noise levels below the noise requirements does not infer that construction activity outside of normal working hours would be acceptable). Further, the inaudibility requirement of EPA Publication 1834.1 for unavoidable works at night is not intended as a measurable criterion; the related guidance on objective levels are only intended for risk assessment purposes and work schedule planning.

Construction noise is therefore not assessed on a compliance basis. Reasonable and practicable controls are defined for construction noise risks. Construction noise modelling is then used to:

- provide an indication of the range of noise levels that can be expected at the nearest receivers during different stages of construction;
- inform an assessment of impact; and
- inform the definition of appropriate controls, in the form of EPRs, that would apply to subsequent stages of the project so that the risk of harm from noise is minimised as far as reasonably practicable.

Given the large scale of the project, a relevant consideration for assessing the noise impact is the distribution of noise levels across receivers in the study area. To describe the distribution, a set of reference levels has been defined for categorising the predicted construction noise levels associated with the project.

The base (minimum) reference levels have been defined based on the ERS and EPA Publication 1834.1 guidance for the day and night periods respectively (noting that out of hours works also includes evenings and weekends – the night is assessed to represent the most sensitive period outside of normal working hours). Supplementary higher values are defined to provide a way of categorising construction noise at levels that are higher than the base reference levels.

In all cases, the reference levels do not represent design targets or noise criteria, and they are not intended as an indication that noise below these levels would be acceptable. The GED to minimise the risk of harm from construction applies at all times and locations, irrespective of whether the predicted noise levels are above or below the reference levels. In accordance with the EP Act, and broader EPA guidance, minimising the risk of harm so far as reasonably practicable requires the use of controls which are proportionate to the risk of harm. Given that noise levels relate to the risk of harm, the predicted noise levels are among the factors to consider when assessing proportionate risk controls. However, other important factors contribute to the risk, including noise characteristics, the duration of the noise, and the timing of the noise. This means that the noise level is not the sole factor to consider when determining proportionate controls; other factors like duration and timing may be the most important consideration when determining proportionate controls in some situations.

The reference levels are therefore primarily used to:

- categorise the range of predicted noise levels and identify work locations which could result in the highest potential construction noise exposure, accounting for both the noise level and the number of affected receivers; and
- identify work locations where additional priority should be given to noise controls (whether in terms of managerial controls or engineering controls), based on the premise that increasing noise levels are one of the indicators of increasing importance of noise controls (and the concept of reasonable and practicable measures being those measures which are proportionate to the level of risk, per EPA Publication 1856).

The reference levels used in this assessment are separately defined in Table 5 and Table 6 for works that are proposed during and outside of normal working hours respectively (reference levels defined only for the night component of periods outside normal working hours). The reference levels are defined for different time periods spanning from 15 minutes to 16 hours. However, given that the construction noise predictions described in subsequent sections assume continuous and simultaneous operation of all equipment for assessment purposes, the equivalent noise level (L_{Aeq}) predictions are directly compared against the numerical values of the reference levels thresholds (i.e. time related adjustments are not applied to convert the predicted construction noise levels to 8-hour or 16-hour metrics).

While the assessment of construction noise outside normal working hours is based on the night period for this study, activities during the evening or on Sundays/public holidays which are justified as out of hours works must not exceed the noise requirements defined by EPA Publication 1834.1 (the background noise dependent levels described earlier in Section 3.1.5 of this report). The noise requirements of EPA Publication 1834.1 apply to the equivalent noise level of construction activities, including any applicable adjustments for noise character.

Table 5: Normal working hours – reference levels for categorising predicted noise levels

Reference noise level	Description
40 dB $L_{Aeq,16h}$	Corresponds to the indicator and objective established by the ERS for the day period for the types of land uses generally located near the project (Category IV land uses[4]). This represents a very low level for the assessment of temporary noise levels associated with construction. For example, the ERS indicator set at a value intended to account for noise which occurs 7 days per week during both the day and night period. In contrast, normal working hours do not include work on Sundays, Saturday afternoons or evening periods. However, consistent with EPA Victoria guidance on the application of the ERS, the ERS is relevant to construction noise and provides a benchmark for quantifying the extent of impacts.
55 dB $L_{Aeq,16h}$	A noise level of 55 dB $L_{Aeq,16h}$ is referenced as an indicator of increasing risk of people being highly annoyed from noise. This is based on the upper daytime target noise level defined in the WHO publication *Guidelines for Community Noise* dated 1999 (1999 WHO Guidelines[5]) which indicates few people are highly annoyed at levels below 55 dB $L_{Aeq,16h}$. The following additional points of context are noted: • Levels above 55 dB $L_{Aeq,16h}$ represent an increased risk of speech interference in outdoor settings (per the guidance of EPA publication 1992 *Guide to the Environment Reference Standard* dated 2021 which notes increased risk when ambient noise levels are above 55 – 60 dB $L_{Aeq,16h}$); and • At levels above 55 dB $L_{Aeq,16h}$, windows on exposed elevations of noise sensitive buildings, such as residential dwellings, would generally need to be closed for activities requiring a quiet environment (e.g. resting or reading). Similar to the ERS-based indicator level, the 1999 WHO Guideline value is intended to apply to noise sources which may persist throughout the day and evening, 7 days per week. This is a conservative aspect of using the value as a reference level for normal working hours which does not include such a wide range of sensitive time periods. Community response to noise is highly variable, and construction noise at levels below 55 dB $L_{Aeq,16h}$ could be regarded as annoying or intrusive by some people, depending on factors such as the context, time and duration of the work. This further emphasises why the reference levels do not constitute a test of acceptability, in terms of planning or individual responses. Conversely, as a guide to the suitability of 55 dB $L_{Aeq,16h}$ for use as a reference level, jurisdictions where noise limits are specified for construction activity during normal working hours normally set values higher than 55 dB $L_{Aeq,16h}$ in recognition of the specific considerations that apply to construction noise (the temporary duration of the noise and the practical constraints that apply to controlling construction noise). In accordance with the GED under the EP Act, the risk of harm from construction noise must be minimised as far as reasonably practicable at all locations. However, the 55 dB $L_{Aeq,16h}$ value is used as an indicator of the locations where noise control is an increasing priority, and is therefore used to identify locations referred to as priority management locations for noise.

[4] ERS Category IV land uses are described as "lower density or sparse populations with settlements that include smaller hamlets, villages and small towns that are generally unsuited for further expansion. Land uses include primary industry and farming" which is considered to represent the majority of receivers for the project.

[5] The 1999 WHO Guidelines provides guidance on thresholds for health-related impacts of noise levels including sleep disturbance and community annoyance, expressed in noise metrics that are commonly considered in noise impact assessments (e.g. the equivalent noise level). More recent publications by the WHO in 2009 and 2018 are based on updated research findings, however the recommendations relate to strategic noise parameters (e.g. average night noise levels over a period of one year) and remain complementary to the guidance contained in the 1999 publication.

Reference noise level	Description
75 dB $L_{Aeq,15min}$	Noise levels above 75 dB $L_{Aeq,15min}$ are referenced as an indicator of risk that sensitive locations are highly affected by construction noise, even if the noise occurs for a limited period (e.g. less than one week). Highly affected encompasses risks related to both annoyance and interference with indoor and outdoor activities in domestic and other noise sensitive settings. Speech in outdoor settings would be difficult and would require raised voices. Indoor noise levels would be intrusive and interfere with normal domestic activities, even with windows closed. Construction noise above these levels would typically only be tolerable for short periods when works must occur briefly at short separating distances. The 75 dB $L_{Aeq,15min}$ reference level is not a test of acceptability. Community response to noise is variable and noise levels below 75 dB $L_{Aeq,15min}$ would still represent a significant impact. However, given that community response to noise tends to vary less with increasing noise level, most locations would be considered highly affected at levels above 75 dB $L_{Aeq,15min}$. As a point of context to the use of 75 dB $L_{Aeq,15min}$ as a reference level to indicate that sensitive locations would be highly affected, comparable values are referenced in interstate and international guidelines. For example, 75 dB L_{Aeq} is referenced for construction noise in South Australia and NSW. The value is also referenced in New Zealand Standards and British Standards. In accordance with the GED under the EP Act, the risk of harm from construction noise must be minimised as far as reasonably practicable at all locations. However, the 75 dB $L_{Aeq,15min}$ value is used as an indicator of the locations where there is heightened priority for additional noise control (whether managerial or engineering controls), and is therefore used to identify locations referred to as high priority management locations for noise.

Table 6: Outside normal working hours – reference levels for categorising predicted noise levels for the most sensitive period (night)

Reference noise level	Description
25 dB $L_{Aeq,15min}$	Proposed external reference level for assessing the risk of audible noise inside a bedroom at night. EPA Publication 1834.1 states that where works outside normal working hours are justified, including low-noise impact works and managed impact works, the noise is required to be inaudible inside a habitable room of any residential premises. Inaudibility cannot be practically set using an objective criterion and is not intended as a measurable criterion. However, to predict construction, EPA Publication 1834.1 notes that a value equal to the background noise level could be used as reference for assessing the risk of audible construction noise. Where this approach is used, EPA Publication 1834.1 states that adjustments should be applied to consider the potential characteristics of the noise that increases its impacts (e.g. tonality and impulsiveness). The method is only provided to inform risk assessment regarding scheduling of works and is not intended to be used for compliance purposes. A reference level of 25 dB $L_{Aeq,15min}$ has been set on the basis that 25 dB L_{A90} is indicative of lower background noise levels along the project route (see baseline characterisation of the study area subsequently in section 6.0). While background noise levels will be lower during parts of the night at quieter locations, a construction noise level of 25 dB $L_{Aeq,15min}$ externally would equate to a low noise level inside a residential dwelling and would be difficult to hear (corresponding internal noise levels would be lower than 15 dB L_{Aeq} when windows are left partially open, and typically lower than 10 dB L_{Aeq} when windows are closed).
35 dB $L_{Aeq,8h}$	Corresponds to the indicator and objective established by the ERS for the night period for the types of land uses generally located near the project (Category IV). This represents a very low level for the assessment of temporary noise levels associated with unavoidable construction activity outside of normal working hours. However, consistent with EPA Victoria guidance on the application of the ERS, the ERS is relevant to construction noise and is referenced as a benchmark for quantifying the extent impacts.
42 dB $L_{Aeq,8h}$	Corresponds to the external target noise level (free-field) defined in the 1999 WHO Guidelines for the avoidance of sleep disturbance when windows are left partially open. This represents a low reference noise level for the assessment of temporary noise levels associated with unavoidable works that must be conducted outside normal working hours. However, the potential for sleep disturbance is an important consideration for assessing the effects of works conducted during the night. The reference level is used to identify locations where there is an increased risk of sleep disturbance from construction noise. It is noted that a more recent publication from the WHO in 2018 provides updated guidance on noise levels at night related to transportation noise. However, the 2018 publication notes that 1999 WHO guidelines remain valid for sources not covered by the publication (noting that industrial noise and construction are not covered by the 2018 publication).

5.3.2 Assessment process

The level of noise at each receiver as a result of construction of the project would vary significantly throughout the construction period, according to the stage of the construction, the proximity of the activities as the works progress, the types of equipment being used for each activity, and the duration of operation of each equipment item. The specific controls that are used to minimise construction noise related risks would also be subject to further development as the planning of the project progresses.

Predicting construction noise levels therefore necessitates a number of practical assumptions which result in a conservative assessment of construction noise levels, accounting for the key risk controls and likely construction processes/plant.

The following provides a summary of the process for predicting and assessing construction noise levels associated with the project:

- The proposed activities and construction methods described in the EIS project description, were reviewed to identify:
  - the broad categories of construction activity to be assessed e.g. topsoil stripping, access track construction and trenching;
  - the type and number of plant items associated with each main category of construction activity;
  - the anticipated timing and duration of each category of construction activity; and
  - the key controls for addressing construction noise risks.
- Based on data from Australian Standard AS 2436-2010 *Guide to noise and vibration control on construction, demolition and maintenance sites* (AS 2436) and British Standard BS 5228-1:2009+A1 2014 *Code of practice for noise and vibration control on construction and open sites – Part 1: Noise* (BS 5228-1), an inventory of representative noise emission data was developed for major noise generating plant items associated with each construction activity. In instances where data was not available in the standards, reference was made to historical MDA measurement data for similar types of equipment. This information was then used to develop overall aggregated noise emission values for each construction activity.
- Environmental noise modelling was carried out to:
  - predict the highest noise level at each identified sensitive receiver for each construction activity, based on the minimum separating distance between each construction activity and receiver (see Section 5.3.3 for further details regarding noise predictions); and
  - calculate the separating distance from each construction activity where the predicted noise level corresponds to the priority and high priority reference levels for construction noise control.
- The predicted noise levels for each receiver and activity were then collated by summing the number of receivers predicted to experience construction noise levels within discrete noise level ranges. This provides an indication of the extent of receivers expected to experience the highest predicted noise levels, and an indication of the predicted noise level range expected for the majority of receivers.
- Given the extent of locations where construction would occur during normal working hours, the separating distances from each construction activity were used for mapping purposes to identify the zones around each receiver where additional priority should be given to noise control measures.

The results of the above assessments and comparisons were used to assess the impact of construction noise and inform the definition of project-specific controls in the form of EPRs.

5.3.3 Noise prediction method

The standards AS 2436 and BS 5228-1 that are referenced for equipment noise emission data also define methods for predicting noise levels at receiver locations. However, the methods are relatively simple and are primarily intended for relatively short separating distances. As a result, the methods tend to overestimate noise levels at distant locations. In this respect, AS 2436 cautions against using the calculation method for separating distances greater than 100 m, as is the case for most of the receivers around the project.

Given the above, a more detailed noise prediction method has been used for the study. Specifically, noise predictions have been calculated using ISO 9613-2:1996 *Attenuation of sound during propagation outdoors – Part 2: General method of calculation* (ISO 9613-2). ISO 9613-2 defines a general-purpose noise prediction method that has become established as the primary international standard for calculating environmental noise from commercial and industrial plant.

ISO 9613-2 predicts noise levels for atmospheric conditions which increase receiver noise levels comprising either:

- a wind directed from the noise source to the receivers; or
- a moderate ground-based thermal inversion (a condition when temperatures increase with height above ground, as may occur on clear and still nights).

For the construction noise modelling of activities occurring over a wide range of locations, the calculations were made using the A-weighted level method described in Section 7.3.2 of ISO 9613-2. This method can be used for the prediction of noise levels over 'porous ground or mixed ground most of which is porous' (as is the case for the areas around the project) and for ground surface of any shape. This method is consistent with the approach outlined in Appendix B.2 of AS 2436; specifically the use of A-weighted noise levels for calculation of construction noise levels.

For construction noise modelling of unavoidable works outside of normal working hours (specifically, the shore crossing and Morwell River crossing), the frequency-based method of ISO 9613-2 was used. Mixed ground conditions (G = 0.5) were assigned for this aspect of the modelling, which assumes that 50 % of the ground cover is acoustically hard (G = 0), to account for potential variations in ground porosity. This is a conservative assessment choice since the ground conditions strictly correspond to porous conditions according to ISO 9613-2 (G = 1.0), which tend to result in lower predicted noise levels.

Conservative assumptions were adopted in applying ISO 9613-2 to predict noise levels from construction of the project. The following key aspects are noted:

- All equipment associated with each stage of construction activity was assumed to operate continuously and simultaneously. This is conservative as the intensity of equipment use would vary, and in many cases, equipment would not operate simultaneously or continuously.
- Ground profile:
  - general modelling: flat ground was assumed, providing a conservative approach for dealing with large areas as the potential screening effect of terrain is not accounted for
  - unavoidable works modelling: 3D terrain data from public/government data sources was referenced.
- Atmospheric conditions were set at a temperature of 10 °C and a relative humidity of 70 %. These values are commonly adopted across Australia to represent conditions which result in low

levels of atmospheric absorption of sound, in turn leading to slightly higher predicted noise levels.

5.4 Construction vibration

A high-level risk-based assessment of potential vibration associated with construction of the project is presented based on a comparison of the separating distances to each receiver with the minimum working distances set out in the guidance referenced from the NSW CNVG.

5.5 Operational noise

The converter station is the primary operational noise consideration for the project.

Operational noise levels associated with the converter station were assessed by:

- collating representative noise emission data provided by MLPL for the converter station plant, based on manufacturer data provided for comparable projects;
- reviewing the noise emission data and risk control strategy, having regard to the GED under the EP Act;
- preparing a 3D digital model of the site;
- predicting environmental noise levels using international standards for the calculation of environmental sound propagation; and
- comparing the predicted noise levels with mandatory noise limits determined in accordance with the EPA Noise Protocol.

Consideration was also given to the potential for unreasonable noise according to the listed factors defined by the EP Act.

The method selected to predict noise levels is ISO 9613-2, as used for the construction noise modelling. However, to assess operational noise levels, the octave band calculation method of ISO 9613-2 was used. Consistent with the calculations for construction noise, the method calculates predicted noise levels for atmospheric conditions which increase receiver noise levels. The following additional details of the modelling are noted:

- Ground conditions in the surrounding area were assigned a ground factor of G = 0.5

  This is a conservative assessment choice since the ground conditions strictly correspond to porous conditions according to ISO 9613-2 (G = 1.0), which tend to result in lower predicted noise levels.

- Receiver calculation height of 1.5 m

  This corresponds to the normal measurement height for conducting compliance measurements at receivers.

- Temperature 10 °C and relative humidity 70 %

  These represent conditions which result in relatively low levels of atmospheric sound absorption, resulting in slightly higher predicted noise levels.

Operational noise levels are assessed for the completed project and therefore account for the combined noise of the converter station plant associated with Stage 1 and Stage 2 of the project.

Other minor sources of operational noise, such as maintenance activities and a standby generator for the transition station option (only operated for testing one hour every three months during daytime hours on weekdays or in an emergency). These minor sources of operational noise are not formally assessed but are subject to the GED under the EP Act. The noise of the standby generator during testing and maintenance is also subject to the requirements of the EP Regulations and would need to comply with noise limits determined in accordance with the EPA Noise Protocol. Recommendations are therefore subsequently provided for the standby generator to be addressed during the detailed design stage (see Section 7.5).

5.6 Impact assessment

5.6.1 Overview

A risk-based assessment is used to evaluate noise and vibration impacts associated with construction and operation of the project. Given that noise and vibration is an inevitable consequence of the construction and operation of a major infrastructure project, it is the risk of harm to human health or the environment as a result of noise, as defined by the EP Act, which is assessed in this study. Risks are assessed by accounting for their consequence (accounting for noise level, character and duration) and likelihood. The objective of the risk assessment is to determine the appropriate risk controls.

There are multiple factors which influence both the consequence and likelihood of noise and vibration related risks. These include:

- the type of noise or vibration source being assessed and its characteristics (e.g. a continuous or varying noise source and its frequency characteristics);
- the nature of the noise or vibration source (e.g. an activity that can be readily modified or relocated versus an essential activity with limited opportunity to modify, relocate or reschedule)
- the environment in which the noise or vibration is produced (e.g. the context and the background level of noise or vibration);
- the time, duration and regularity of the noise or vibration;
- environmental factors which may change the background noise environment and/or the noise level of the source in question (e.g. wind conditions);
- the type and number of sensitive locations potentially affected by the noise or vibration
- the type of assessment being used to evaluate the risks (e.g. prediction or measurement-based assessments), and the level of information available for the assessment;
- the assessment framework for each noise and vibration source, and whether acceptable levels of noise and vibration are clearly defined (e.g. legislation which defines prescriptive compliance requirements in quantitative terms or management-based guidance); and
- the options available to mitigate or manage the noise or vibration source.

Alternative methods are available for conducting a combined assessment of risk consequence and likelihood, such as AS ISO 3100:2018 *Risk management – Guidelines* (AS ISO 3100) and EPA Publication 1695.1 *Assessing and controlling risk: A guide for business* (EPA Publication 1695.1). An adapted version of the risk consequence and likelihood guidance of AS ISO 3100 has been generally adopted for the project EIS. The risk consequence and likelihood descriptors of the adapted version of AS ISO 3100 are relevant to noise and vibration, however their definitions are based on prescriptive comparisons or events which are practically challenging to apply to noise and vibration. Key complicating factors are the varied and subjective reactions of individuals to sound and the challenge of distilling varied noise levels over large study areas into singular outcomes. This is particularly for effects related to the unavoidable noise of construction which is assessed and managed on the basis of a balance between amenity impacts and the benefits of new development. In light of these factors, reference was made to EPA Publication 1695.1 for guidance on definitions that could be practically applied to the assessment of noise and vibration. EPA Publication 1695.1 provides an example framework as depicted in Figure 4 and Figure 5 which includes the same number and range of descriptors for risk consequence and likelihood, but are defined more broadly in terms related to harm and health; considerations which are central to the assessment of noise and vibration under Victorian legislation. The EPA Publication 1695.1 guidance with respect to risk rating also aligns with contemporary approaches to noise and vibration management under Victorian legislation.

Accordingly, the consequence and likelihood definitions of EPA Publication 1695.1 have been adopted for the noise and vibration study. For consistency with EPA Publication 1695.1, the corresponding risk rating matrix has also been adopted for the noise and vibration assessment.

Permanent or long-term serious environmental harm / life threatening or long-term harm to health and wellbeing.	Consequence	Severe	Medium	High	High	Extreme	Extreme
Serious environment harm / high-level harm to health and wellbeing.		Major	Medium	Medium	High	High	Extreme
Medium level of harm to health and wellbeing or the environment over an extended period of time.		Moderate	Low	Medium	Medium	High	High
Low environmental impact / low potential for health and wellbeing impacts.		Minor	Low	Low	Medium	Medium	High
No or minimal environmental impact, or no health and wellbeing impacts.		Low	Low	Low	Low	Medium	Medium
			Rare	Unlikely	Possible	Likely	Certain
			Likelihood				
			Could happen but probably never will	Not likely to happen in normal circumst-ances	May happen at some time	Expected to happen at some time	Expected to happen regularly under normal circumst-ances

Figure 4: Example risk matrix reproduced from EPA Publication 1695.1

Risk level	Description
Extreme	Totally unacceptable level of risk. Stop work and/or take action immediately.
High	Unacceptable level of risk. Controls must be put in place to reduce to lower levels.
Medium	Can be acceptable if controls are in place. Attempt to reduce to *low*.
Low	Acceptable level or risk. Attempt to eliminate risk but higher risk levels take priority.

Figure 5: Description of risk ratings reproduced from EPA Publication 1695.1

Quantitative assessments of noise and vibration, such as measurement and prediction based studies, inform the assessment of both consequence and likelihood. For example, where there are clearly defined noise limits, low and minor consequence ratings are generally assigned to a compliant noise level. A moderate or higher consequence is generally only applicable to a non-compliant noise level, although a moderate rating may be applicable if there are multiple contributing factors which individually increase the consequence.

Defining quantitative thresholds to further separate consequence levels according to the wide range of factors outlined earlier is complex and subject to considerable uncertainty. Given these uncertainties, defining quantitative boundaries between each consequence level would involve the assignment of arbitrary thresholds which could be misleading and imply a greater level of assessment accuracy than is afforded by the current state of knowledge. To enable consequence levels to be practically assigned, it is therefore necessary for an element of the consequence ratings to be informed by qualitative assessment, accounting for the range of relevant factors.

A similar level of qualitative assessment is also required to determine the likelihood of the risk, accounting for the range of relevant factors.

5.6.2 Cumulative impact assessment

The EIS guidelines and EES scoping requirements both include requirements for the assessment of cumulative impacts. Cumulative impacts result from incremental impacts caused by multiple projects occurring at similar times and within proximity to each other.

To identify possible projects that could result in cumulative impacts, the International Finance Corporation (IFC) guidelines on cumulative impacts have been adopted. The IFC guidelines (IFC, 2013) define cumulative impacts as those that 'result from the successive, incremental, and/or combined effects of an action, project, or activity when added to other existing, planned, and/or reasonably anticipated future ones.'

The approach for identifying projects for assessment of cumulative impacts considers the following:

- Temporal boundary: the timing of the relative construction, operation and decommissioning of other existing developments and/or approved developments that coincides (partially or entirely) with the project
- Spatial boundary: the location, scale and nature of the other approved or committed projects expected to occur in the same area of influence as the project. The area of influence is defined at the spatial extent of the impacts a project is expected to have.

Proposed and reasonably foreseeable projects were identified based on their potential to credibly contribute to cumulative impacts due to their temporal and spatial boundaries. Projects were identified based on publicly available information at the time of assessment. The projects considered for cumulative impact assessment in Victoria are as follows:

- Delburn Wind Farm
- Star of the South Offshore Windfarm
- Offshore wind development zone in Gippsland including Greater Gippsland Offshore Wind Project (BlueFloat Energy), Seadragon Project (Floatation Energy), Greater Eastern Offshore Wind Farm (Corio Generation)
- Hazelwood Mine Rehabilitation Project
- Wooreen Energy Storage System.

Further information on each of the projects is included in Section 7.3.

The projects relevant to this assessment have been determined based on the potential for cumulative noise and vibration impacts. Out of the projects identified above, only the Delburn Wind Farm and Wooreen Energy Storage System project are relevant to this assessment, due to the interface with the Driffield converter station site and Hazelwood converter station site respectively. All other projects have not been considered in the cumulative impact assessment as they have no direct noise or vibration interface with the project on account of the large separating distances.

5.7 Stakeholder engagement

MLPL held a number of community drop-in sessions in the vicinity of the project to provide information about the proposed development and the EIS process, and enable the local community to ask questions about the project. The community sessions attended by representations of the noise and vibration assessment team are presented in Table 7.

Table 7: Community sessions attended by representatives of the noise and vibration assessment team

Location of community session	Date
Churchill (session 1)	Thursday 23 March 2023
Churchill (session 2)	Saturday 25 March 2023
Sandy Point (session 1)	Thursday 13 April 2023
Sandy Point (session 2)	Saturday 15 April 2023
Mirboo North	Thursday 27 April 2023
Dumbalk	Friday 28 April 2023
Meeniyan	Friday 28 April 2023
Fish Creek	Saturday 29 April 2023

Noise was not raised as a significant point of discussion or concern at any of the community events listed in Table 7.

5.8 Assumptions and limitations

The assessment is based on the following assumptions:

- Construction plant noise emissions: the make and model of equipment used to construct the project is unknown at this stage. Empirical noise emission data from standards and previous measurements are therefore assumed to represent the types of construction plant that are expected to be required. To provide a conservative assessment which is likely to overestimate construction noise levels, representative noise emission data was selected from the mid to upper range of the available empirical data.
- Construction activity: all plant associated with each of the construction activities are assumed to be operating simultaneously and producing their highest noise emissions for 100 % of an assessment time period. In practice, the noise emissions of individual plant items are likely to vary during an assessment time period (i.e. produce noise emissions lower than the assumed values) and some plant items would only operate for a portion of the time. The assessment assumption is therefore conservative and lead to higher predicted noise levels than is likely to occur in practice.
- Converter station plant noise emissions: the equipment selections for the project would be the subject of a commercial tender process during the detailed design phase of the project. Representative noise emission data provided by MLPL, based on manufacturer data provided for similar projects, has therefore been assumed for this assessment. The assumed data generally represents low noise emission equipment that has been selected to address site-specific noise constraints associated with the Tasmanian converter station site that is assessed in a separate study. The assumed emission data is expected to involve the use of proprietary noise attenuation systems and plant enclosures. The actual noise emissions of candidate plant items would need to be verified as part of the commercial tender process, and equipment selected to achieve assessment outcomes that are consistent with the findings of this study.

The following assessment limitations are noted:

- Receiver data: the project route is approximately 90 km long and the identified receivers in the vicinity of the project are generally limited to an area extending approximately 500 m either side of the project route. Construction noise would extend to areas beyond 500 m from the project, however the available receiver data set enables the identification of the receivers expected to experience the highest construction noise levels. In some locations, this limitation means that the count of receivers within the lower predicted noise bands will be underestimated. However, as the assessment and risk controls are determined by the predicted noise levels at the nearest receivers, this limitation is inconsequential to the assessment outcome.
- Baseline characterisation: a background noise survey was conducted to obtain a broad indication of baseline noise conditions for the purposes of this assessment. The background noise data is indicative only. If the project is approved, further background noise monitoring at key locations would be needed to enable definitive design and compliance assessment criteria to be set.
- Construction noise risk controls: specific details of the measures required to minimise construction noise risks as far as reasonably practicable will need to be determined when further information is available about the planned works and equipment selections. Further, given that much of the works would involve transitory activities which result in elevated noise levels for brief periods, managerial controls which prioritise minimising the duration of exposure to the noise (e.g. efficient work practices and careful scheduling) are expected to be among the most important controls. However the benefits from this type of control are not readily quantifiable in an impact assessment.
- Operational noise risk controls: specific details of the measures required to minimise operational noise risks as far as reasonably practicable will need to be determined while the design of the converter station (including equipment arrangement and positioning).

6.0 BASELINE CHARACTERISATION

The project route passes through a range of different areas varying from rural and sparsely populated areas to suburban environments.

In the more remote rural settings, background noise levels, which relate to the underlying level of noise, are likely to be low, with ambient (average) noise levels influenced by a variety of natural and anthropogenic noise sources including wildlife and wind disturbance of vegetation, through to agricultural activities, livestock and local traffic.

Background levels are likely be higher at receivers located in the vicinity of public roads, intensive farming activity or forestry operations, or in more densely populated suburban areas.

The criteria for construction noise specified in EPA Publication 1834.1 are based on background noise levels during the evening and night period. A survey of existing noise levels was conducted at a selection of locations along the project route. The locations were chosen to represent different environments near key elements of the project. These included examples of the locations where work outside of normal working hours is likely and the candidate sites being assessed for the converter station.

The noise survey comprised monitoring at 11 locations broadly distributed along the project route. Specifically, at each location, an unattended monitor was used to continuously sample noise levels during the day, evening and night periods. Measurements were conducted at the locations in Table 8 over a period of approximately 10 days between Monday 11 July and Friday 22 July 2022.

Local weather stations were also deployed at some of the locations to enable identification of periods affected by adverse weather (i.e. rain and windy conditions). At the locations where a weather station was not deployed, wind and rainfall were assessed based on a combination of data from the other weather stations and publicly available data from the Bureau of Meteorology monitoring station at Pound Creek.

Table 8: Noise monitoring locations

Area	Description
Site 1	Tramway Road, Hazelwood North At the site of the Hazelwood converter station. Existing dwelling in a rural environment characterised by noise from local roads.
Site 2	Switchback Road, Hazelwood Rural environment beyond the suburban areas of Churchill, subject to a mix of noise influences from local traffic as well as noise from power transmission infrastructure.
Site 3	Yinnar-Driffield Road, Driffield Rural environment characterised by noise from livestock and birds. Noise from a nearby local road may also affect the acoustic environment.
Site 4	HVP (off Fords Road) Located on land used by Hancock Victorian Plantations Holdings Pty Ltd (HVP) for plantation timber. Operational commercial/industrial site amid a rural environment characterised by noise from wildlife and distant highway traffic. While not noted during surveys, there is potential for noise due to commercial activities including truck movements within the plantation.

Area	Description
Site 5	Smallmans Road, Mardan Rural environment characterised by noise from livestock and birds, and distant traffic noise from a main road connecting rural areas.
Site 6	Meeniyan-Mirboo North Road, Dumbalk (north of Dumbalk) Rural environment characterised by noise from traffic on local roads, livestock and birds.
Site 7	Meeniyan-Mirboo North Road, Dumbalk (south of Dumbalk) Rural environment characterised by noise from traffic on local roads, livestock and wind.
Site 8	Buffalo-Stony Creek Road, Stony Creek Semi-rural environment characterised by noise from traffic on local roads, livestock and birds.
Site 9	Moores Road, Buffalo Semi-rural environment characterised by noise from traffic on local roads, livestock and birds.
Site 10	Waratah Road, Sandy Point Rural environment located approximately 1,600 m from the ocean, characterised by noise from traffic on local roads.
Site 11	Fish Creek-Waratah Road, Waratah Bay Rural environment located approximately 860 m from the ocean, characterised by noise from the ocean, wildlife and livestock.

The measured background noise levels for each location were analysed in accordance with the procedures outlined in Section 4.1 of the EPA Noise Protocol with the following exceptions:

- Weather conditions were characterised by frequent rainfall and periods of wind speed higher than Beaufort Wind Scale 3. Accordingly all noise data has been presented for the survey, with periods of inclement weather highlighted for reference.
- The lowest and median value of the daily period averaged values are presented.

Full survey details, including images of the monitoring locations, daily survey results and graphical results are presented in Appendix D.

A summary of the background noise levels is presented in Table 9.

Table 9: Measured background noise levels, period mean values dB L_{A90} per period

Location	Day 0700 – 1800 hrs Mon – Sat		Evening 1800 – 2200 hrs Mon – Sat 0700 hrs – 2200 hrs Sundays and public holidays		Night 2200 – 0700 hrs	
	Minimum	**Median**	**Minimum**	**Median**	**Minimum**	**Median**
Site 1	42	44	40	41	33	36
Site 2	35	37	39	60	35	43
Site 3	37	38	35	40	29	34
Site 4	31	34	32	37	28	32
Site 5	27	35	32	38	25	33
Site 6	30	33	30	33	27	28
Site 7	34	35	34	38	30	34
Site 8	32	35	33	40	29	33
Site 9	35	41	21	44	22	44
Site 10	33	39	36	39	31	38
Site 11	35	43	37	40	35	41

While the background noise levels represent the underlying quiet periods at each location, the total ambient noise levels (average/equivalent noise levels) during the day at most locations were in the range of 40-50 dB $L_{Aeq,1h}$, except on days when noise is likely to have been elevated by high winds and rain.

These results are consistent with expectations for the areas, and are likely to be representative of the range of background noise levels at most receivers along the proposed project route. This indicates that construction activities involving large plant items and high noise emission activities in proximity to receivers would likely be audible above the background noise environment at times.

MARSHALL DAY Acoustics

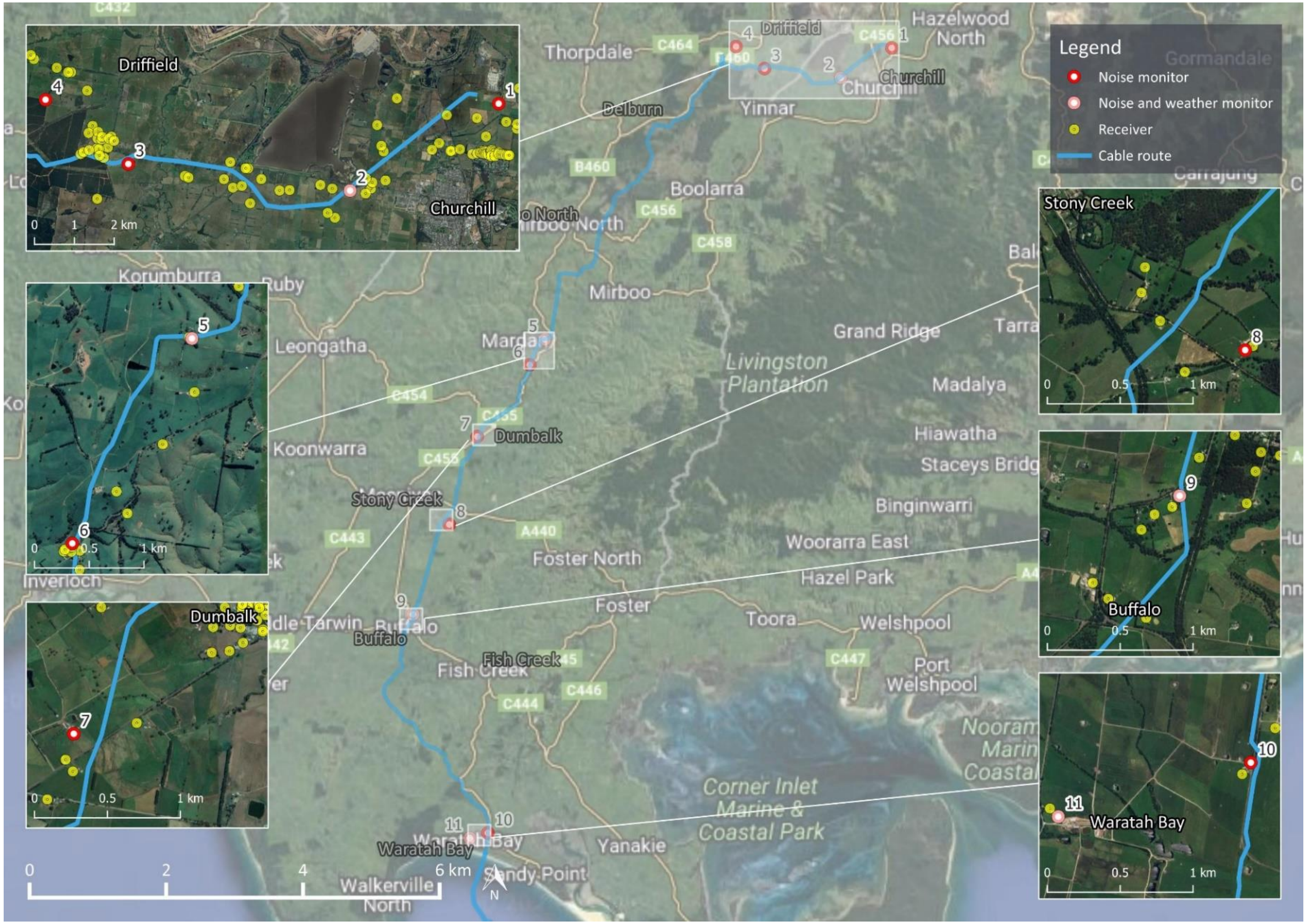

Figure 6: Noise survey locations

7.0 IMPACT ASSESSMENT

This section presents:

- an assessment of noise and vibration levels associated with construction of the project;
- an assessment of noise levels associated with operation of the project (environmental vibration is not a relevant consideration for the operational stage of the project);
- recommended EPRs for controlling noise and vibration risks; and
- a summary of the environmental noise and vibration risk assessment.

7.1 Construction noise and vibration

This section presents the proposed risk controls for construction noise and vibration, noise emission data which has been used to predict noise levels from key construction activities, followed by an assessment of construction noise and vibration.

The construction noise assessment is based on evaluation of key elements and activities:

- cable route construction (including access road construction, strip and stockpile works, site offices and laydown areas, and trenching);
- converter station construction (including earthwork/civil activities and infrastructure works)
- shore crossing construction;
- local feature crossing construction; and
- offsite transportation.

Construction of the project would involve a range of other activities, such as cable installation, pit construction, and potentially construction of a transition station to the north of the shore crossing. However, the activities selected for assessment provide a representation of the range of upper noise levels of construction, and are suitable for informing the overall assessment of risk and defining recommended EPRs. Noise modelling has therefore not been conducted for these other activities.

7.1.1 Risk controls

In accordance with the GED under the EP Act, the risks of harm as a result of construction noise and vibration must be minimised as far as reasonably practicable. The GED is an enduring requirement which applies to all stages of the construction, including the planning, preparation and work stages.

A suite of risk controls for construction noise and vibration are defined subsequently in this report in the form of EPRs. The EPRs set out the requirements for addressing the GED at all stages of construction.

In accordance with the EP Act, and broader EPA guidance, minimising the risk of harm so far as reasonably practicable requires the use of controls which are proportionate to the risk of harm. Noise levels are among the factors to consider when assessing proportionate risk controls. However, other important factors contribute to the risk, including noise characteristics, the duration of the noise, and the timing of the noise. This means that the noise level is not the sole factor to consider when determining proportionate controls. Other factors, like duration and timing, may be the most important consideration when determining proportionate controls in some situations.

Section 4.3 of EPA Publication 1834.1 sets out measures for managing noise and vibration during working hours. These measures address scheduling, community information and consultation, controls at noise source, vibration and regenerated noise, and noise reduction between noise source and receiver. Section 4.4 of EPA Publication 1834 subsequently describes measures for managing noise and vibration during working hours.

The measures documented in Section 4.3 and 4.4 of EPA Publication 1834.1 are relevant to the project and all relevant measures would need to be systematically evaluated as part of preparing a CNVMP.

The key controls factored in the assessment of construction noise are set out below:

- **Restricting most activities to normal working hours**

  The majority of the construction work is to be restricted to normal working hours as defined by EPA Publication 1834.1, (Monday to Friday 0700 – 1800 hrs and Saturday 0700 – 1300 hours, excluding public holidays) except where unavoidable works are required.

- **Defining dedicated process controls for unavoidable works outside normal working hours**

  The need for unavoidable works outside normal working hours, including night works, may occur for a range of reasons. These unavoidable works include HDD works for the shore crossing and the local feature crossing at Morwell River. Noise from these activities would be controlled by measures determined from a detailed noise impact assessment report prepared prior to commencement of the works, based on actual noise emission data for candidate plant selections. The detailed noise impact assessment would document manufacturer noise emission data, the results of updated 3D modelling, measures to minimise the risk of harm from noise as far as reasonably practicable, and noise monitoring requirements.

- **Minimising the duration of noise exposure**

  Efficient work practices and scheduling are relevant across the entire project for reducing the amount of time that receivers experience high noise levels. However, this form of management control is particularly important for transient sources of construction noise (e.g. mobile plant which progresses along the project route) where brief periods of high noise levels may be unavoidable. In these cases, minimising the duration of the noise and scheduling the activity to cause the least disturbance, are some of the most important controls.

- **Selecting low noise emission construction plant (general)**

  Major plant items are to be selected with low noise emissions, characterised by sound power levels that are equivalent to, or lower than, the values/ranges indicated in AS 2436, unless it can be demonstrated that adhering to these values would not be reasonably practicable.

- **Selecting low noise emission HDD plant for the shore crossing**

  Each HDD rig associated with the shore crossing (including ancillary plant) is to be selected to achieve a total sound power level of 110 dB L_{WA} or lower, unless it can be demonstrated that adhering to this value would not be reasonably practicable or increase the duration of exposure.

Refer to Section 7.1.8 for the proposed EPRs for construction noise and vibration. Full details of each EPR are then specified in Section 7.5 which collates the noise and vibration EPRs for both the construction and operation of the project.

7.1.2 Noise emission data

Representative noise emission data for the proposed construction equipment have been determined based on AS 2436 and BS 5228-1 as well as measured equipment noise levels sourced from historic MDA measurements. Table 10 summarises the noise emissions (sound power levels) for the main noise generating plant items associated with construction of the project that have been used for noise modelling purposes. In accordance with the proposed risk controls, major plant items are to be selected to achieve low noise emissions. In particular, each HDD rig (including ancillary plant) for the shore crossing is proposed to be selected to achieve a sound rating of 110 dB L_{WA} or less. However, to provide a conservative assessment in advance of actual equipment selections and manufacturer data, this item of plant has been modelled based on a more cautious value of 115 dB L_{WA} (in recognition of the shore crossing involving continuous HDD works for a period of approximately 12 months).

Table 10: Construction noise sources sound power data

Noise source	Sound power level, dB L_{WA}
Dozer	108
Dump truck	117
Excavator	107
Grader	110
Hand tools	116
HDD rig including ancillary pump equipment – local crossings	110
HDD rig including ancillary pump equipment – shore crossing	115
Light vehicles	100
Mobile crane	113
Non-slewing crane	104
Road truck	107
Roller	108
Tipper	107
Water truck	107
Wheeled loader	113

Overall aggregated total sound power levels for key construction activities have been determined based on the indicative equipment schedule presented in Table 11. Actual equipment choices and quantities for each task would vary as the design and construction method for the project is refined. Importantly, many items of equipment would only operate part of the time while the activity is taking place. This is an important point of context, as most of the reference levels used to assess the risk of harm relate to the average noise level over a number of hours (e.g. the daytime reference values from the ERS and 1999 WHO Guidelines relate to the average across a 16-hour period). The equipment quantities and choices therefore provide a conservative representation of the activity for risk assessment purposes.

The overall aggregated sound power levels for each of the main construction activities are detailed in Table 11. The assessment assumes that each item of plant associated with a task operates simultaneously at the same point. This is appropriate for construction activity occurring at distance from the receivers but will overestimate the noise of activity occurring close to the receivers (i.e. at reduced working distances where it is not physically possible for all of the equipment to be simultaneously working at the reduced distance).

In addition to the overall noise levels, the characteristics of the noise are an important factor which contributes to the risk of harm. In particular, noises characterised by tones, impulses or prominent low frequencies represent a greater risk of impact, and therefore also require consideration. Given the inherent conservatisms described above, and in lieu of specific equipment selections at this stage of the project, adjustments to the noise emission data or predicted noise levels for noise characteristics have not been applied in this assessment. However, these characteristics would need to be accounted for and addressed in the management of construction noise.

Table 11: Overall aggregated sound power levels of main construction activities

Construction activity	Plant/equipment	Approximate overall sound power level, dB L_{WA}
Access road construction	2x excavators, 1x dozer, 2x wheeled loaders, 2x dump trucks, 1x grader, 1x roller, 1x water truck, 2x tippers, 5x light vehicles, 1x hand tools	125
Strip and stockpile	2x excavators, 1x dozer, 1x tipper, 2x wheeled loaders, 2x dump trucks	120
Site offices and laydown areas	2x excavators, 1x dozer, 2x wheeled loaders, 2x dump trucks, 1x grader, 1x roller, 1x water truck, 2x tippers, 5x light vehicles, 1x hand tools	125
Trenching	1x trencher (or excavator), 1x dozer, 1x dump truck	120
Shore crossing	2x HDD rigs (including ancillary pumping equipment), 1x excavator, 1x dump truck, 5x light vehicles, 1x mobile crane, 2x road trucks	120
Local feature crossings	1x HDD rig (including ancillary pumping equipment), 1x road truck, 1x light vehicle	110
Converter station – earthworks/civil	2x excavators, 1x dozer, 1x wheeled loader, 2x dump trucks, 1x roller, 2x tippers, 5x light vehicles, 1x concrete agitator, 1x concrete saw	120
Converter station - infrastructure	5x light vehicles, 1x mobile crane, 4x hand tools, 3x non-slewing cranes	125

7.1.3 Cable route and converter station construction noise

Predicted noise levels

The predicted noise levels were calculated for each of the 312 identified receivers generally located within 500 m of the project, based on the activity noise emissions presented in Table 11 of Section 7.1.2.

Due to the size of the project, and therefore the number of receivers assessed (even with the study area generally limited to 500 m), the tabulated predicted noise levels for each receiver and construction activity represents a large dataset.

The predicted noise levels are therefore summarised to show the distribution of predicted construction noise levels for each activity. The summary is presented in Table 12 and is based on categorising the predicted noise levels in bands and then summing the number of receivers where the predicted noise levels are within each band. The bands range from a value of 40 to 75 dB L_{Aeq}, with the lower value corresponding to the ERS benchmark for the day period, and the upper value corresponding to the reference level from the reference level for highly affected locations (see Section 5.3.1 for a discussion of the reference levels used for categorising the predicted noise levels).

Note that the assessment summary in Table 12 is indicative only, as the receiver dataset has been practically limited to a distance of 500 m from the project. This enables the most sensitive working areas to be identified but does mean that the calculated number of receivers in the mid and lower noise level bands are lower than would be the case in reality (i.e. due to the presence of additional receivers not included in this study which are more than 500 m from the project).

The following additional notes apply to the prediction data that the Table 12 summary is based on:

- The predictions represent the noise level solely attributable to construction activities.
- The results summary is based on the worst-case L_{Aeq} noise level that each receiver may experience as a result of each construction activity. In many cases, particularly at locations where the predicted construction noise levels are relatively high, this would only relate to a brief period when the work is occurring near to the receiver.
- The noise from the main construction activities along the route would generally occur in sequence and the predictions are calculated for each separate activity (i.e. rather than the cumulative noise of construction on multiple work fronts).

Table 12: Number of receivers per predicted noise level band
(based on receivers within approximately 500 m)

Predicted level range, dB L_{Aeq}	Access road construction	Topsoil stripping and stockpiling	Site offices and laydown areas	Trenching	Converter station - earthworks/civil	Converter station - infrastructure
< 40 dB	0	22	188	20	257	235
40 - 55 dB	56	91	113	98	54	74
55 - 65 dB	168	157	8	154	1	3 [1]
65 - 75 dB	59	32	1	31	0	0
≥ 75 dB	29	10	2	9	0	0

1 All of the receivers where the predicted noise levels extend into the 55 – 65 dB L_{Aeq} range relate to the Hazelwood converter station site

Discussion

The effect of construction noise along the project route and at the converter stations, and the likelihood of adverse community reaction, depends on a range of factors, but importantly:

- the time of day when the works would occur;
- the noise level when the works would occur; and
- the duration of the period in which noise levels are elevated as a result of construction.

The above factors need to be accounted for when considering the potential effects of construction noise.

In terms of the time of day, construction of the project route and converter station is proposed to occur during the normal working hours specified by EPA Publication 1834.1 (Monday to Friday 0700 – 1800 hrs and Saturdays 0700 – 1300 hrs, excluding public holidays). The proposed working hours therefore avoid the most sensitive periods (i.e. evening and night).

In terms of noise levels, Victorian legislation and guidelines do not specify noise level criteria for construction activity occurring during normal working hours. Instead, the GED under the EP Act requires all reasonably practicable measures to be implemented to minimise the risk of harm at all work locations. However, to provide a basis for identifying priority and high priority locations for dedicated/site-specific noise controls, two noise level thresholds have been referenced (see discussion earlier in Section 5.3.1):

- Priority areas for noise mitigation and management areas: construction activity locations that result in predicted noise levels higher than 55 dB L_{Aeq} reference level at receivers.
- High priority areas for noise mitigation and management: construction activity locations that result in predicted noise levels higher than 75 dB L_{Aeq} reference level at receivers.

The summary presented in Table 12 indicates that most of the key construction activities would result in predicted noise levels above both the 55 dB and 75 dB L_{Aeq} thresholds at some point during construction of the project. This is to be expected given the large extent of the project, and the proximity of receivers to the construction activity, particularly where the route traverses more densely populated areas. Noise mitigation and management measures would therefore need to be prioritised in sensitive working locations, particularly those where receivers could experience noise above 75 dB L_{Aeq}.

The duration of the works is therefore a key variable to be factored when considering the predicted noise levels. Particularly as the duration of exposure to construction noise will differ markedly at different locations along the project.

In this respect, the activities that result in the highest predicted noise level, and the highest number of locations within the upper predicted noise level bands, are access track construction, topsoil stripping and stockpiling, and trenching. The highest predicted noise levels would only occur when the activity is closest to a receiver; noise levels would quickly reduce with increasing distance from the receiver. Importantly, all of these activities are expected to be completed relatively quickly, with the work front moving at more than 100 m per day for each activity (see work rates discussed in Section 4.2.1). This means that the highest noise levels above the thresholds for each activity would typically be experienced for less than one week. As an indication of this, Table 13 presents the approximate distance from each of these activities where a noise level of 55 and 75 dB L_{Aeq} is predicted to occur (i.e. beyond these distances, the predicted noise levels are below the thresholds).

Table 13: Reference level separating distances for construction activities that progress quickly

Reference level	Access road construction	Topsoil stripping and stockpiling	Site offices and laydown areas	Trenching
55 dB L_{Aeq}	640 m	385 m	640 m	385 m
75 dB L_{Aeq}	85 m	55 m	85 m	55 m

Given that the activities which result in the highest noise levels would only affect a given receiver for a limited time, and the activities would generally only occur during normal working hours, construction noise from these activities is practically manageable. However, the periods of increased noise levels would represent a disturbance to neighbouring receivers, and works at the nearest locations where predicted noise levels are above 75 dB L_{Aeq} have the potential to be highly annoying and intrusive. Dedicated noise mitigation and management measures are warranted to address the locations where the predicted noise levels are highest. Reducing the duration of exposure to the noise through efficient work practices and scheduling is one of the key noise mitigation measures for those activities which occur for a brief period.

In contrast, construction activities at the converter station sites and ongoing activity associated with the use of the site offices and laydown areas, would result in lower noise levels but over longer time periods. At the site offices and laydown areas, the noise would be intermittent and mainly associated with vehicle movements and construction material handling. At the converter station sites, the activities would be more regular, with extended periods of work associated with different stages of construction. Therefore, while the noise levels from construction activities at these locations would be lower, reasonable and practicable measures for the management of construction noise are still warranted, consistent with the GED under the EP Act, in recognition of the greater duration of exposure to the noise at these locations.

Noise management zone maps are presented in Appendix F which identify priority and high priority work locations for dedicated noise control measures. Specifically, these maps show the work locations where the highest predicted noise levels at the receivers are above 55 dB and 75 dB L_{Aeq} (see Section 5.3.1 for the basis of these reference levels).

The maps specifically address site office and laydown areas (four locations) and the converter station site (Hazelwood) where predicted noise levels are above the reference levels. In terms of activities such as access road construction, topsoil stripping, and stockpiling, the extent of the work locations where noise levels would be briefly above the reference levels is relatively high. For example, topsoil stripping and stockpiling would result in noise levels briefly above the 55 dB reference level for up to 38 % of the 90 km route. Conversely, activity resulting in noise levels above 75 dB L_{Aeq} is only expected at approximately 1 % of the 90 km route. Accordingly, mapping of these locations has not been conducted, on account of the extent of the locations and the brief time periods that these activities generate the highest noise levels. For management purposes, reference should instead be made to the separating distances noted in Table 13 as a guide to work locations where noise control measures for these activities should be prioritised.

AS 2436 provides guidance on selecting work practices to minimise adverse noise impacts, as well as information on consultation with neighbours and the community. These types of measures are appropriate for construction activities within the noise management zones. Effective communication with affected receivers, and efficient work scheduling to complete activities near receivers in the least amount of time, are among the most important measures for construction activities within the management zones.

It is however important to note that the GED under the EP Act requires all reasonably practicable measures to minimise the risk of harm to be implemented at all work locations (i.e. irrespective of whether a location is identified in the priority management zone maps).

An assessment of risk, based on these findings, is presented in Table 14.

Table 14: Cable route and converter station construction noise levels – risk assessment

Item	Rating	Comments
Risk consequence	Minor	High noise levels are predicted at a number of receivers along the project route. However, given the 90 km extent of the project route, the number of receivers where these levels are predicted is relatively low. Importantly, the highest noise levels relate to activities that progress quickly and would therefore occur relatively briefly.
Likelihood	Possible	The predicted construction noise levels are based on conservative assumptions. Noise levels in practice are expected to be lower than predicted for most of the time.
Overall risk	Medium	The applicable EPA Publication 1695.1 guidance for this rating is that the risk can be acceptable if controls are in place, and attempts should be made to reduce the risk to low.

The risk rating determined in Table 14 supports that noise controls are warranted for construction activities along the project route and at the converter station. Further discussion of controls is provided subsequently in Sections 7.1.8 and 7.5.

7.1.4 Shore crossing construction noise

Predicted noise levels

The predicted noise levels were calculated for all receivers within the available dataset, and account for the same level of activity occurring during and outside normal working hours. The predictions are based on the total activity noise emission presented in Table 11 of Section 7.1.1 (overall aggregated sound power level of 120 dB L_{WA} for all plant associated with the shore crossing HDD works).

The results are summarised in Table 15 according to the number of receivers where the predicted noise levels are above the reference levels described earlier in section 5.3.1.

Table 15: Shore crossing construction – summary of predicted noise levels

Period	Reference noise level, dB L_{Aeq}	Receivers with predicted noise levels above the reference noise level
Normal working hours	40 [1]	1
	55 [2]	0
	75 [3]	0
Night works	25 [4]	14 receivers within the available dataset. The western extent of the township of Sandy Point (nearest receivers approximately 2,800 m east of the shore crossing site).
	35 [5]	1
	42 [6]	0

1 ERS daytime objective
2 1999 WHO Guidelines reference level
3 Highly affected receivers
4 Audibility risk assessment level based on EPA Publication 1834.1
5 ERS night-time objective
6 1999 WHO Guidelines sleep disturbance criterion

Predicted noise levels at the receivers nearest to the shore crossing works are summarised in Table 16. Specifically, these are the receivers and populated areas where the predicted noise levels are above the 25 dB L_{Aeq} audibility risk assessment level for the night period, based on the guidance of EPA Publication 1834.1.

Table 16: Shore crossing construction – predicted noise levels at the nearest receivers

Receiver ID	Approximate distance from shore crossing, m	Direction from shore crossing	Predicted noise level, dB L_{Aeq}
B9000	1,400	North	42
B8984	1,600	Northwest	35
B8005	1,700	North	35
B8024	3,500	North	29
B8013	2,700	North	29
B8014	3,100	North	27
B8016	3,200	North	26
B8017	3,300	North	26
B8018	3,300	North	26
B8019	3,300	North	26
B8021	3,300	North	26
B8020	3,300	North	26
B8022	3,300	North	26
B8029	4,300	North	26
B8023	3,400	North	25
B8038	4,400	North	25
B8042	4,700	North	20
Sandy Point township	At least 2,800	East	Up to 28
Waratah Bay township	At least 3,500	West	Up to 25

In addition to identified receivers, the predicted range of noise levels for natural areas nearest to the shore crossing are presented in Table 17.

Table 17: Predicted noise level range at natural areas near the shore crossing

Area	Separating distance, m	Predicted noise levels, dB L_{Aeq}
Cape Liptrap Coastal Park	4,000 – 6,500	< 25
Waratah Bay – Shallow Inlet Coastal Reserve (coastal area adjacent to the works)	150 – 200	55 – 60 [1]

1 Predicted noise level assumes a reduction in noise level between 5 and 10 dB as a result of the screening effect of the dunes at the sections of coast that are nearest to the shore crossing.

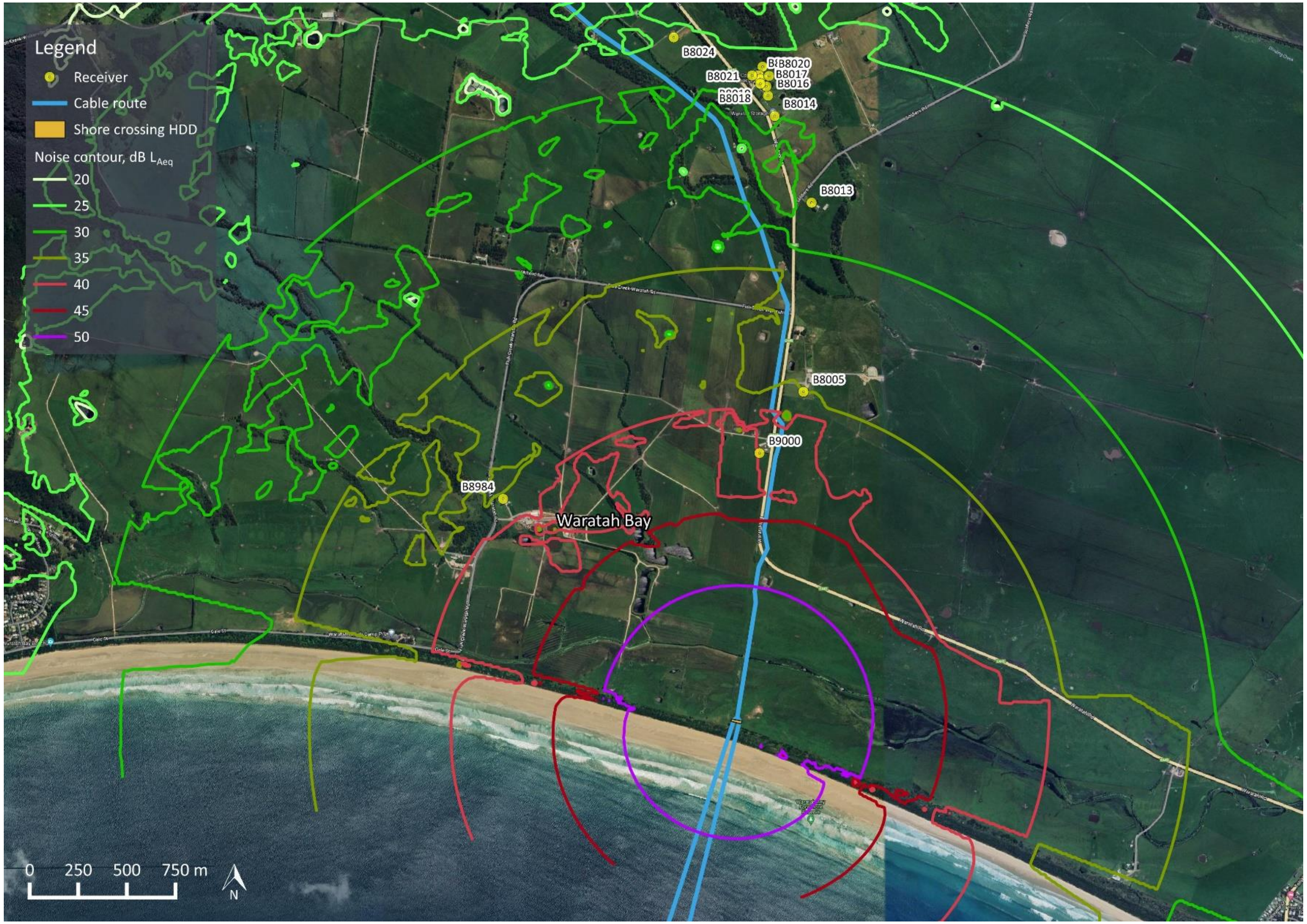

Figure 7: Shore crossing – HDD works predicted noise contours, dB L_{Aeq}

Discussion

The predicted receiver noise levels associated with construction of the shore crossing are generally relatively low, particularly for works conducted during normal working hours (almost all locations are below the ERS daytime objective which represents a stringent benchmark for construction noise).

However, construction activity at the shore crossing is expected to occur for a period of approximately 12 months and involve continuous HDD works during the day, evening and night periods. In relation to works continuing throughout the night, the predicted noise levels indicate the following:

- Fourteen (14) receivers where there is the potential for shore crossing works to be audible inside a dwelling at night (i.e. on account of the predicted noise level being above the 25 dB reference level used for gauging the risk of audible noise).
- A single receiver where the predicted noise level is above the ERS night-time reference level.
- Predicted noise levels at or below the reference level of 42 dB used for gauging the risk of sleep disturbance at all receivers.

Whether or not construction noise would be audible at all locations within the 25 dB L_{Aeq} reference level would depend on background noise levels and the construction and orientation of the dwellings at each receiver. In relation to background noise levels, the results of the survey at locations near to the shore crossing indicated elevated minimum background noise levels ranging from 29 to 33 dB $L_{A90,1h}$ (see detailed results for reference locations 10 and 11 in Appendix E11 and Appendix E12 respectively). This suggests a reduced risk of construction noise being audible at locations where the predicted noise levels are 30 dB L_{Aeq} or less. However, while elevated background noise levels are typical of coastal areas, the background survey was limited to a brief period and inclement weather was frequent occurrence at the time.

While construction noise of the shore crossing is likely to be audible at the neatest dwellings, the predicted noise levels at all receivers are below the 1999 WHO Guidelines sleep disturbance reference level. Notably, at all but the nearest receiver, predicted noise levels are 7 dB or more lower than the sleep disturbance reference level.

Based on the balance of the above considerations, the results demonstrate that the noise of HDD works at night is viable if an approval is obtained for justified unavoidable works outside normal working hours (based on the need for continuous drilling to maintain the stability of the borehole). However, the results demonstrate that dedicated noise mitigation and management measures need to be developed and implemented to minimise the risk of harm, as per the requirements of the GED under the EP Act.

Environmental noise levels in natural areas around the shore crossing works is also a relevant consideration. Shore crossing construction activities are likely to be audible at coast locations adjacent to the shore crossing (Waratah Bay – Shallow Inlet Coastal Reserve), and would therefore impact the natural soundscape qualities of this section of the reserve for the duration of the works. The effect of this impact is that visitors to the reserve seeking natural soundscapes are unlikely to utilise the sections of the coast near to the shore crossing while drilling works are occurring. At the Cape Liptrap Coastal Park, to the west of the shore crossing, predicted noise levels are much lower and are expected to be inaudible or difficult to discern in most conditions. Construction activities may be audible on some occasions when background noise levels are very low (noting the background noise levels near the coast are frequently elevated relative to inland rural locations) and atmospheric conditions favour noise propagation to the west of the shore crossing. Given the low predicted noise levels and the temporary nature of the construction works, the shore crossing works are not expected to diminish the value of the soundscape for visitors to the Cape Liptrap Coastal Park.

Based on the findings discussed above, an assessment of risk associated with the shore crossing construction noise is presented in Table 18.

Table 18: Shore crossing noise levels – risk assessment

Item	Rating	Comments
Risk consequence	Moderate	While the predicted noise levels are generally low, and the highest predicted noise levels relate to a small number of dwellings, there is the potential for audible construction noise within dwellings at night at multiple locations over an extended period. Further, while the predicted noise levels are below the sleep disturbance reference level at all locations, the result is marginal at the nearest receiver.
Likelihood	Possible	The predicted noise levels are based on relatively high assumed sound power levels for the drilling operations, are based on atmospheric conditions which increase noise levels, and assume simultaneous operation of other plant at the site. The risk assessment of audibility also accounts for low background noise levels, whereas background noise levels are generally expected to be elevated at the receivers in the vicinity of the shore crossing due to coastal noise sources. Therefore, while the risk consequence may occur at some time, it is likely that noise levels would be lower than predicted.
Overall risk	Medium	The applicable EPA Publication 1695.1 guidance for this rating is that the risk can be acceptable if controls are in place, and attempts should be made to reduce the risk to low.

The risk rating determined in Table 18 supports that noise controls are warranted for construction activities associated with the shore crossing. EPRs are discussed subsequently in Sections 7.1.8 and 7.5, including examples of the measures that are expected to meet the requirements.

7.1.5 Local feature crossing construction noise

Normal working hours

The predicted noise levels associated with HDD works at local feature crossings were calculated for:

- all of the 58 proposed local feature crossings, and accounting for drilling potentially occurring at either end of each crossing (i.e. a total of up to 126 potential drilling locations);
- all receivers within the available dataset; and
- continuous drilling activity during normal working hours.

The predictions are based on the total activity noise emission presented in Table 11 of Section 7.1.1 (overall aggregated sound power level of 110 dB L_{WA} for all plant associated with the local feature HDD crossing works).

The predicted noise levels for each local feature crossing site are summarised in Appendix H in terms of:

- the nearest receiver and the highest predicted noise level; and
- the number of receivers within the assessment reference levels for work during normal working hours.

Predicted noise levels at the nearest receivers range from less than 30 dB L_{Aeq} to a level of 66 dB L_{Aeq}.

Table 19: Number of receivers per predicted noise level band for local feature crossing HDD works (based on receivers within approximately 500 m)

Predicted level range, dB L_{Aeq}	Number of receivers
< 40 dB	85
40 - 55 dB	209
55 - 65 dB	17
65 - 75 dB	1
≥ 75 dB	0

The highest predicted noise level for each receiver as a result of any local feature crossing HDD works is presented in Appendix F.

Predicted noise levels that are specific to each local feature crossing are then presented in Appendix H (other than the Morwell Crossing, which is addressed subsequently in this section, based on detailed 3D modelling).

The highest predicted noise levels at most local feature crossing sites are higher than the 40 dB L_{Aeq} reference level of the ERS. Note that the ERS value is a long term strategic indicator which represents a very low noise level benchmark for brief periods of construction activity during normal working hours. As an indication of the overall extent of areas affected by elevated noise levels, there are 13 local feature crossing sites where the predicted noise level at the nearest receiver is above the 55 dB L_{Aeq} reference level; at each of these sites there are no more than four receivers where the predicted noise level is above 55 dB L_{Aeq}.

The predicted noise levels are therefore relatively low for construction activity during normal working hours, particularly given that the drilling component of works are only expected to occur for up to two weeks.

The comparisons set out above are primarily an indication of:

- the number receivers which may be affected by brief periods of construction noise; and
- the number of local feature HDD locations where noise control should be prioritised.

Importantly, the reference levels do not represent compliance criteria or a test of acceptability, and they are not to be understood as levels one can pollute up to or as design targets. In accordance with the GED under the EP Act, the risk of harm as a result of construction noise must be minimised at all receivers as far as reasonably practicable, irrespective of whether the predicted noise levels are below the reference levels.

Priorities for control and management of noise from HDD works during normal works hours are expected to comprise:

- minimising the duration of noise exposure as far as reasonably practicable through efficient work practices and scheduling;
- advance communications with all potentially affected residents to advise them of the planned works and, where scheduling is flexible, potentially identify dates when the works would be least disruptive;
- selection of HDD plant with the lowest available noise emissions; and
- temporary noise barriers where effective noise reductions are achievable with reasonably practicable configurations, provided that the net benefit of the barrier is not undermined by the noise of constructing the barrier or noise reflected from the barrier in other directions.

An assessment of risk based on these findings is presented in Table 20.

Table 20: Local feature crossing noise levels – risk assessment

Item	Rating	Comments
Risk consequence	Minor	The predicted noise levels are relatively low for works during normal working hours. However, noise would be clearly audible and may be considered intrusive at times.
Likelihood	Likely	The predicted noise levels are based on conservative assessment assumptions and are likely to be lower in practice. However, while the activity is only expected to occur for a period of up to two weeks, the works involve continuous drilling which would generate relatively consistent noise levels throughout normal working hours (in contrast to intermittent/transient noise of construction activity).
Overall risk	Medium	The applicable EPA Publication 1695.1 guidance for this rating is that the risk can be acceptable if controls are in place, and attempts should be made to reduce the risk to low.

The risk rating determined in Table 20 supports that noise controls are warranted for construction activities associated with local feature crossings. EPRs are discussed subsequently in Sections 7.1.8 and 7.5, including examples of the measures that are expected to meet the requirements.

Unavoidable works outside normal working hours

HDD works at local feature crossings are proposed to occur during normal working hours only at most sites. The one exception is the Morwell River crossing, where unavoidable work outside normal working hours is proposed. Specifically, HDD works for this crossing could occur continuously, 24 hours per day, for a period of approximately 2 weeks to maintain the stability of the borehole.

The nearest receiver to the Morwell Crossing (HDD works location reference TCM025) is approximately 600 m southeast of the eastern extent of the crossing.

The predicted noise levels at the nearest receivers are presented in Table 22. The results are based on the predicted noise level with the HDD works occurring at the end of the crossing which is nearest to each receiver (i.e. the worst-case end of the crossing for each receiver). The predicted noise levels are less than 25 dB L_{Aeq} at all other receivers.

A noise contour map illustrating the distribution of the predicted noise levels around the Morwell River crossing HDD works is presented in Figure 8. As per the tabular predictions, the predicted noise contours account for the possibility of the HDD works occurring at either end of the crossing. However, this means that the noise contours slightly overestimate the predicted noise levels, as the contours represent the combined predicted noise level of HDD works at either end location. In practice, the HDD works would not occur simultaneously at each end. The noise contours are therefore primarily indicative of noise distribution. Reference should be made to Table 22 for receiver-specific predicted noise levels.

The results are summarised in Table 21 according to the number of receivers where the predicted noise levels are above the reference levels described earlier in section 5.3.1.

Table 21: Morwell River crossing construction - summary of predicted noise levels

Period	Reference noise level, dB L_{Aeq}	Receivers with predicted noise levels above the reference noise level
Normal working hours	40 [1]	0
	55 [2]	0
	75 [3]	0
Night works	25 [4]	16
	35 [5]	1
	42 [6]	0

1 ERS daytime objective

2 1999 WHO Guidelines reference level

3 Highly affected receivers

4 Audibility risk assessment level based on EPA Publication 1834.1

5 ERS night-time objective

6 1999 WHO Guidelines sleep disturbance criterion

Table 22: Morwell River crossing – HDD works predicted noise contours, dB L_{Aeq}

Receiver	Direction from HDD works	Predicted noise level, dB L_{Aeq}
B8845	Southeast	37
B8843	Southeast	35
B8983	Northwest	35
B8981	Northwest	34
B8982	Northwest	33
B8863	West	33
B8892	Northwest	32
B8913	Northwest	32
B8975	Northwest	32
B8915	Northwest	31
B8972	Northwest	30
B8897	West	30
B8900	West	29
B8970	Northwest	29
B8865	West	28
B8833	East	26
B8887	West	25
B8954	Southwest	25
B8971	Northwest	25
B8965	West	25

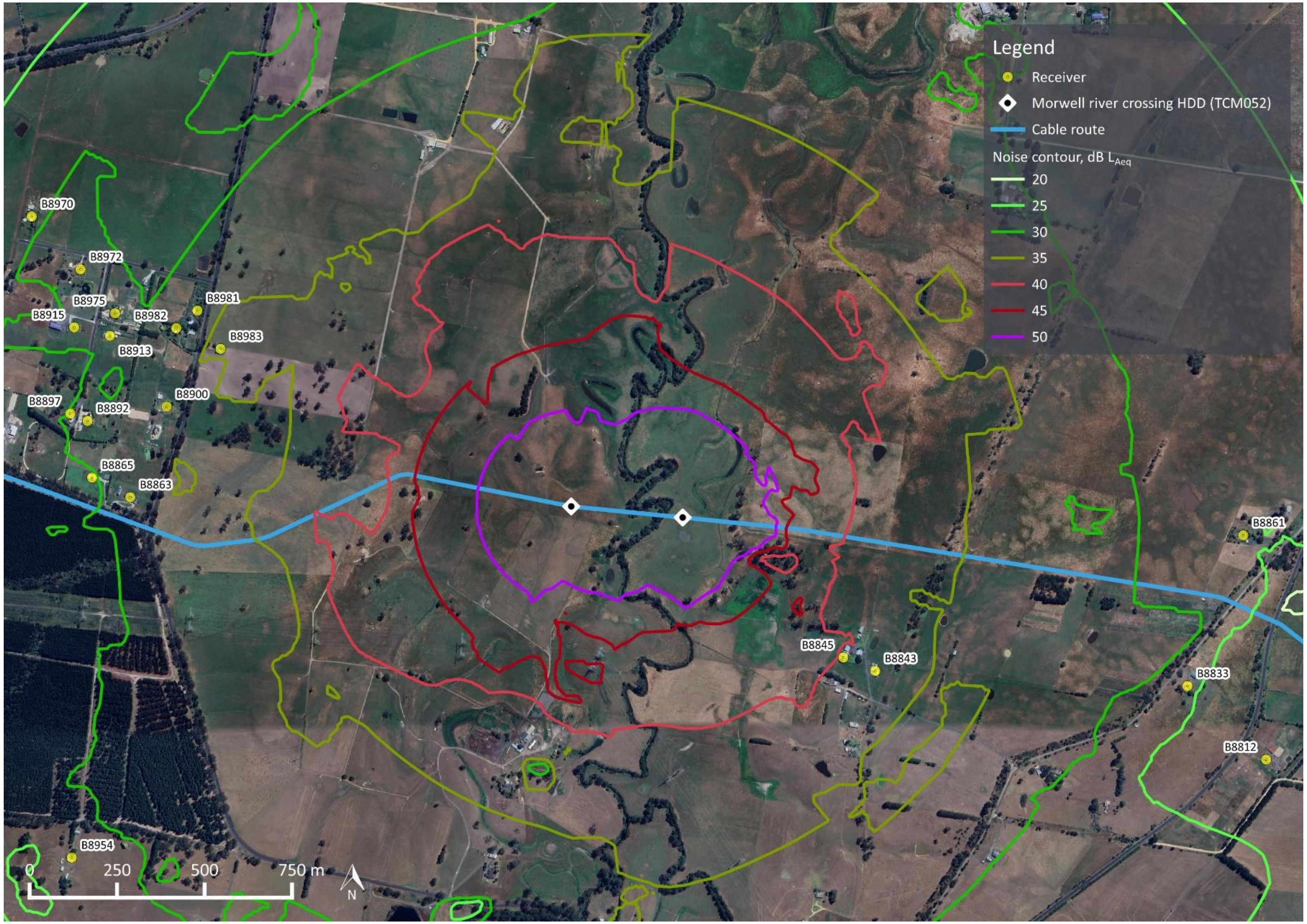

Figure 8: Morwell River crossing – HDD works predicted noise contours, dB L_{Aeq}
(indicative noise contours based on drilling at both ends of Morwell River crossing – refer to tabulated data for specific receiver values)

The predicted noise levels associated with construction of the Morwell River crossing are relatively low. For example, for the component of the works which occur during the day, the predicted noise levels are below the ERS daytime reference level at all receivers. For context, the ERS represents a stringent benchmark for assessing the temporary effects of construction noise.

In relation to the works that continue throughout the night, the predicted noise levels indicate the following:

- Sixteen (16) receivers where there is the potential for the Morwell River crossing works to be audible inside a dwelling at night (i.e. on account of the predicted noise level being above the 25 dB reference level used for gauging the risk of audible noise).
- A single receiver where the predicted noise level is above the ERS night-time reference level.
- Predicted noise levels at least 5 dB below the reference level of 42 dB used for gauging the risk of sleep disturbance at all receivers.

Based on the balance of the above considerations, the results demonstrate that the noise of HDD works at night is viable if an approval is obtained for justified unavoidable works outside normal working hours (based on the need for continuous drilling to maintain the stability of the borehole). However, the results demonstrate that dedicated noise mitigation and management measures need to be developed and implemented to minimise the risk of harm, as per the requirements of the GED under the EP Act.

Priorities for control and management of noise from HDD works at the Morwell River crossing are similar to the HDD works planned during normal working hours. However, works at the Morwell River crossing would also be subject to a requirement under the proposed CNVMP to prepare a detailed noise and vibration impact assessment which addresses key items including:

- a systematic evaluation of noise control options to minimise the risk of harm from construction noise and vibration as far as reasonably practicable, in accordance with the GED under the EP Act; and
- details of all noise control and management measures that are planned to be implemented to minimise the risk of harm from construction noise and vibration as far as reasonably practicable.

Based on the findings discussed above, an assessment of risk associated with the shore crossing construction noise is presented in Table 23.

Table 23: Morwell River crossing noise levels – risk assessment

Item	Rating	Comments
Risk consequence	Minor	While the predicted noise levels are generally low, and the highest predicted noise levels relate to a small number of dwellings, there is the potential for audible construction noise within dwellings at night at multiple locations over an extended period. Conversely, the predicted noise levels are below the sleep disturbance reference level and would only occur for a relatively short period.
Likelihood	Likely	The predicted noise levels are based on conservative assessment assumptions and are likely to be lower in practice. However, while the activity is only expected to occur for a period of up to two weeks, the works involve continuous drilling which would generate relatively consistent noise levels. Background noise levels in the vicinity of the Morwell River crossing may also be low, increasing the likelihood of audible noise inside the nearest dwellings.
Overall risk	Medium	The applicable EPA Publication 1695.1 guidance for this rating is that the risk can be acceptable if controls are in place, and attempts should be made to reduce the risk to low.

The risk rating determined in Table 23 supports that noise controls are warranted for construction activities associated with the shore crossing. EPRs are discussed subsequently in Sections 7.1.8 and 7.5, including examples of the measures that are expected to meet the requirements.

7.1.6 Offsite transportation noise

Construction of the project would generate additional heavy and light vehicle traffic on the public road network.

A portion of construction materials and equipment are to be sourced locally to the project. Equipment and materials arriving from overseas would arrive via the Port of Melbourne and then transported by the public road network to the project.

Construction materials would mostly be transported to the laydown areas and then re-distributed to work locations via access tracks and haul roads. The proposed laydown areas are located at:

- Waratah Bay;
- Buffalo (provisional);
- Stony Creek;
- Marden;
- Smallmans;
- Baromi (provisional);
- Mirboo North;
- Delburn Wind Farm; and
- Hazelwood.

The proposed heavy vehicle paths to the project are indicated in the Traffic report and are reproduced in Figure 9 and Figure 10.

Traffic movement data from the Traffic report indicates total daily heavy vehicle movements associated with different sections of the project. At the stage in the project when the greatest traffic is expected to be generated, the highest movement numbers for a single element of the project relate to the converter station and transition station, each equating to 40 heavy vehicles per day. A total of 66 heavy vehicle movements is noted for the laydown areas, however these movements are expected to be distributed between multiple laydown areas. The heavy movement numbers for an individual laydown area are therefore expected to be lower than the 40 vehicles noted for the converter station and transition station.

Most heavy vehicle movements in the vicinity of the project are expected to occur during normal working hours. Exceptions would apply for the delivery of oversized materials that need to be transported out of hours to reduce disruption and potential hazards on the road network.

The majority of the routes to the project site are along rural highways, which pass through sparsely populated land and several towns.

Noise levels from passing heavy vehicles have been estimated for receivers along the route. It is not considered practical or warranted for this type of noise source to review in detail the proximity of all potential receivers along each transport route. Accordingly, the estimates have been determined, for example, setbacks from the edge, ranging from 15 m to 100 m. Despite the routes being generally sparse in population, some receivers are expected to be located less than 15 m from the transport route and may experience noise levels higher than the estimate values.

The prediction method is based on a simple model of a moving point source of noise and does not account for potential site-specific factors such as ground attenuation, road conditions and shielding. The predictions are based on vehicles travelling at 100 km/h and a total of 40 heavy vehicles distributed evenly across a 10-hour working day. These predictions are primarily intended as an indication of the potential contribution of construction related vehicle movements to total road traffic noise levels along the routes. The estimated off-site construction traffic noise levels are presented in Table 24.

Table 24: Estimated heavy vehicle noise levels at varying distances

Distance from road, m	15	25	50	100
Estimated noise level, dB L_{Aeq}	56	54	51	48

The results in Table 24 indicate noise levels at locations near to the transport routes would be higher than the day period reference level from the ERS. This is however a very stringent benchmark for construction related traffic, and the noise of existing traffic movements are also likely to be above the ERS level in many instances. Further, the results are comparable to or lower than the assessment reference level considered in this assessment for identifying priority management zones.

The above are simplified comparisons to provide context to the predicted noise levels. However, in lieu of specific requirements, the comparison is sufficient to indicate that off-site traffic related to construction of the project is unlikely to warrant dedicated noise mitigation measures, particularly given the temporary nature of the associated impact.

An assessment of risk based on these findings is presented in Table 25.

Table 25: Local feature crossing noise levels – risk assessment

Item	Rating	Comments
Risk consequence	Minor	Construction traffic movements represent an intermittent source and the projected total daily vehicle movements are relatively low, even at the stage of the project when the greatest volume of traffic is anticipated.
Likelihood	Unlikely	The predicted noise levels are based on conservative assessment assumptions, but the range of the predicted noise levels and the number of locations potentially affected support that the noise of potential night-works would need to be controlled and carefully managed.
Overall risk	Low	The applicable EPA Publication 1695.1 guidance for this rating is that the level of risk is acceptable. Attempts to eliminate the risk should be made, but higher risk levels take priority.

Consistent with the risk rating guidance, practical steps to minimise the impact of construction traffic noise should be incorporated in the construction traffic management plan for the project. Practical measures are expected to comprise:

- scheduling the majority of heavy vehicle movements during normal working hours;
- utilising arterial roads to the greatest extent practicable to minimise movements on local roads;
- promoting considerate driving practices (restricted speed and limiting engine break usage in populated areas); and
- secure loading of materials to limit impact noise on uneven roads.

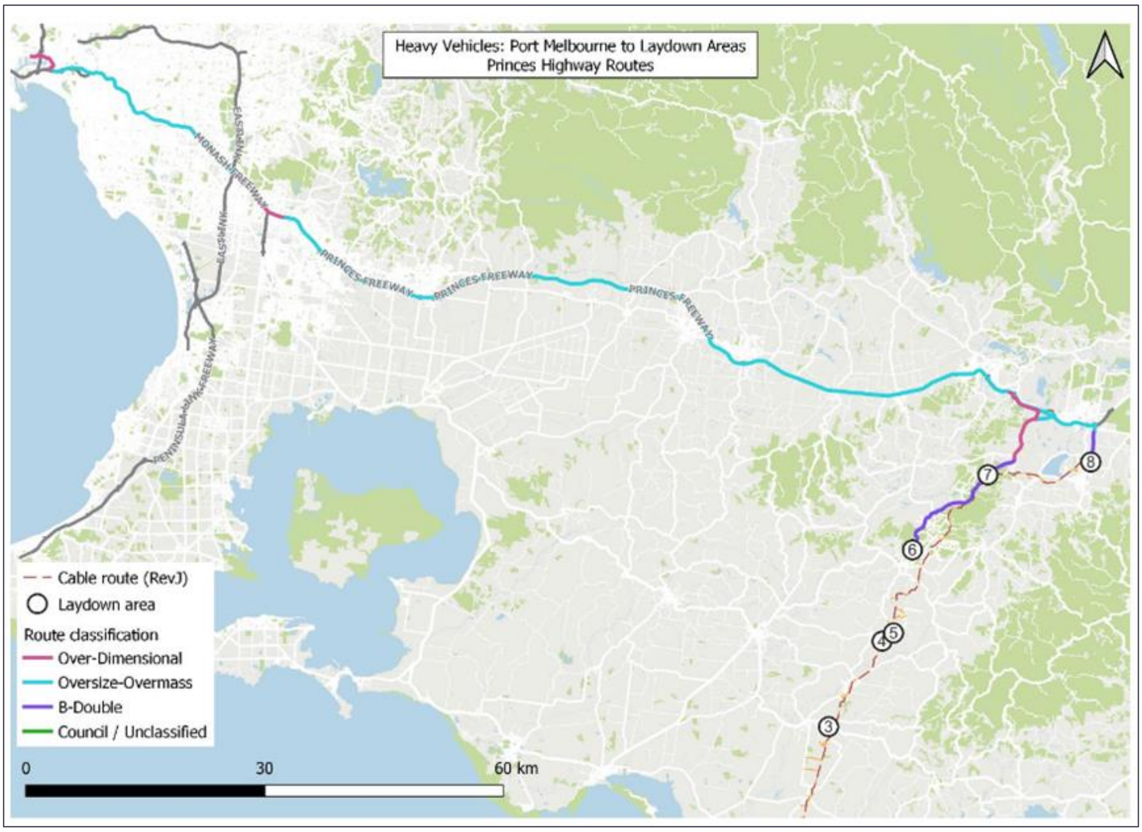

Figure 9: Heavy vehicle paths of travel from Melbourne utilising the Princes Freeway (reproduced from the Traffic report)

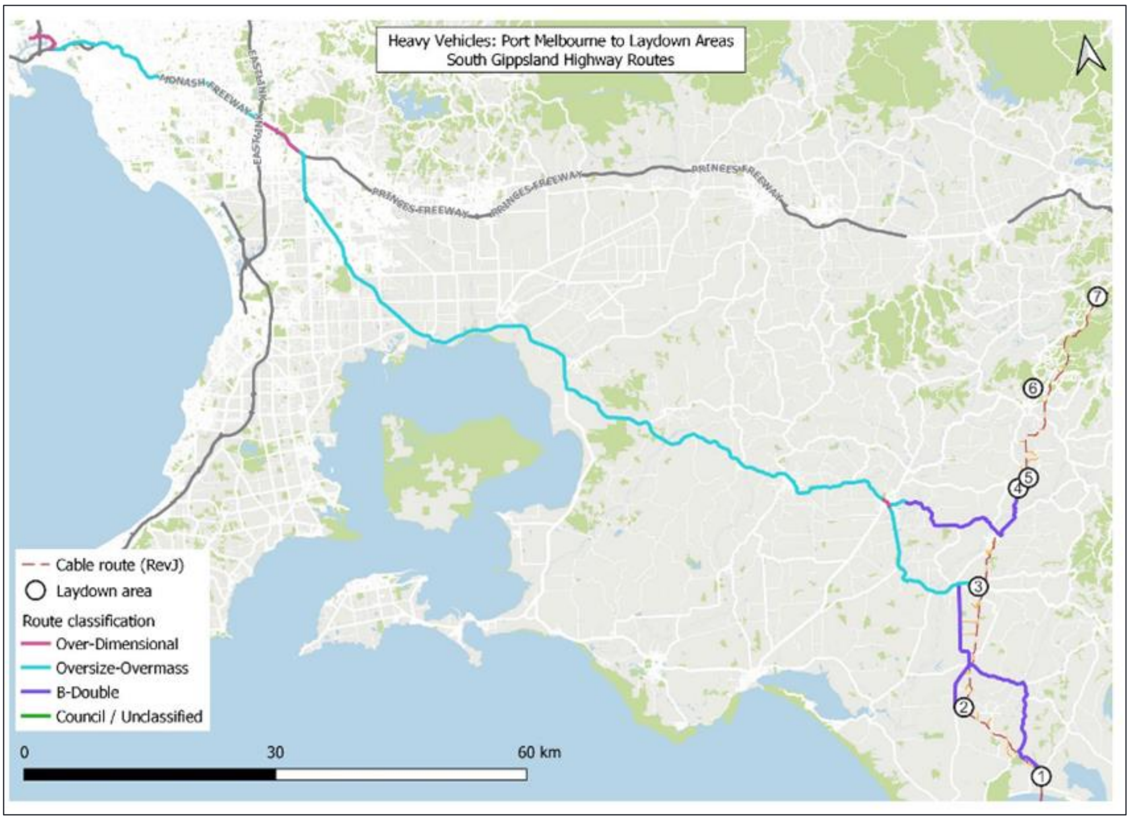

Figure 10: Heavy vehicle paths of travel from Melbourne utilising the South Gippsland Highway (reproduced from the Traffic report)

7.1.7 Construction vibration

Predicting vibration propagation through the ground is complex, and depends on several factors including damping, reflection and impedance in-ground conditions.

At this stage in the assessment process, the indicative minimum working distances outlined in the NSW CNVG, reproduced in Table 26, provide a reference for risk assessment purposes.

Table 26: Recommended minimum working distances for vibration intensive plant from sensitive receivers (reproduced from Table 2 of section 7.1 of the NSW CNVG)

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

The NSW CNVG notes that the actual minimum working distances will vary depending on the particular item of plant and local geotechnical conditions. The guideline also notes the values are defined in relation to cosmetic damage of typical buildings under typical geotechnical conditions and recommends vibration monitoring to confirm the minimum working distances at specific sites.

In relation to human comfort, the NSW CNVG notes that the indicative minimum working distances relate to vibration that is continuous in nature. The guideline also notes that for most construction activities, vibration emissions are intermittent in nature and, for this reason, higher vibration levels occurring over shorter periods are allowed.

For the vibration source with highest vibration (vibratory roller over 18 tonnes), the minimum working distance is 25 m for cosmetic damage to buildings and 100 m for human response.

The activities that are most relevant to ground vibration considerations are listed in Table 27, along with the minimum distance to the receiver, and the number of receivers within 25 m and 100 m of each activity (i.e. the minimum working distances for cosmetic damage and human response from the NSW CNVG).

Table 27: Construction activities relevant to ground vibration and relevant receiver distances

Activity	Distance to nearest receiver	Number of receivers within 25 m	Number of receivers within 100 m
Access road construction	12 m	5	99
Haul road construction	19 m	1	30
Converter station earthworks	391 m	0	0

Based on the data in Table 27, access road and haul road construction are the main activities to consider with respect to potential ground vibration. The minimum separating distances for these activities are within the range where there is risk of cosmetic damage to properties if vibration intensive construction plant is utilised; in particular, vibratory rollers rated at over 100 kN (typically 2-4 tonnes) based on the data presented in the NSW CNVG. However, the number of receivers where this is a risk is small and can be appropriately managed through a combination of appropriate plant selection, consultation with potentially affected receivers, and vibration monitoring if/where required.

At greater distances (i.e. beyond the distances where cosmetic damage is a relevant consideration), there is the potential for vibration to be perceptible. However, the minimum working distances of the CNVG relate to continuous vibration. The vibration emissions for construction activity are expected to be intermittent in nature and, for this reason, higher vibration levels occurring over shorter periods are generally permitted.

Other construction activities such as the HDD works would result in much lower ground vibration than the activities listed in Table 27, and would occur at greater distances (for example, the minimum separating distance between a potential HDD site and a receiver is 47 m – see Appendix G3), and therefore represent a low risk of vibration impacts.

In addition to occupied vibration sensitive locations, the Cultural Heritage Technical Study for the project identified an historical archaeological feature comprising a brick cistern at 64 Moores Road, Buffalo, in the vicinity of a proposed access track. A figure depicting the location of the cistern is reproduced from the Cultural Heritage Technical Study in Figure 11 below. The cistern is located 20-25 m from the nearest edge of the proposed access track. Due to the increased sensitivity of this type of structure to ground vibration, and the proximity of the cistern to the access track, there is a risk of damage to the structure if vibration intensive plant is used to construct the access track (or if the access track surface is not maintained when in use). As per residential locations close to the access track, this risk can be managed through a combination of appropriate plant selection and vibration monitoring.

Figure 11: Location of cistern relative to a project access track (reproduced from the Cultural Heritage Technical Study)

An assessment of risk based on the findings is presented in Table 28.

Table 28: Construction vibration – risk assessment

Item	Rating	Comments
Risk consequence	Minor	Most receivers are located well beyond the indicative distance where there is a risk of cosmetic building damage as a result of vibration intensive construction plant. However, some receivers, and an archaeological structure, are close enough for vibration to represent a risk of damage if vibration is not appropriately managed.
Likelihood	Unlikely	At the small number of locations that are within the indicative distance where there is a risk of cosmetic damage to building structures, and at the archaeological structure identified near one of the access tracks, the risks can be appropriately managed though suitable plant selections and vibration monitoring if/where required.
Overall risk	Low	The applicable EPA Publication 1695.1 guidance for this rating is that the level of risk is acceptable. Attempts to eliminate the risk should be made, but higher risk levels take priority.

7.1.8 Environmental performance requirements

The assessment of construction noise related risks presented in sections 7.1.3 to 7.1.6 generally indicate risk ratings ranging from low to medium. The construction vibration risk is rated as low.

The findings support that EPRs are warranted to minimise construction noise and vibration risks as far as reasonably practicable. Three (3) EPRs are proposed for this purpose:

- **NV01: Conduct additional background noise monitoring**

  The purpose of this EPR is to establish the requirement to obtain additional background noise data which will then inform the development of the CNVMP (NV02) and DNVIAs (NV03) for specific locations.

- **NV02: Develop and implement a construction noise and vibration management plan (CNVMP)**

  The purpose of the EPR is to establish the requirement of a comprehensive plan which describes all measures that would be used to minimise construction noise and vibration risks as far as reasonably practicable, based on updated information on the planned construction works and equipment selections. The risk controls must be proportionate to the risk of harm from noise.

- **NV03: Develop a detailed noise and vibration impact assessment (DNVIA) for construction activities at specific sites**

  The purpose of the EPR is to establish the requirement for more detailed assessment and noise control planning for long-term work sites (e.g. the converter station) and sites involving extended periods of unavoidable works outside normal working hours (e.g. the shore crossing).

Each of the above EPRs are specified in detail in Section 7.5.

7.1.9 Residual impacts

Provided that the EPRs are adhered to, the risk rating of the residual impacts would be limited to low to medium. The inherent and residual risks for each aspect of construction noise are summarised in Section 7.6.

7.2 Operational noise

The primary sources of operational noise associated with the project are the fixed items of plant to be located at the converter station.

This section presents:

- the risk controls accounted for in the noise assessment;
- details of the converter station noise sources and their noise emissions;
- predicted noise levels associated with operation of a converter station at the Driffield and Hazelwood sites being considered for the project;
- discussion of the predicted noise levels and the impacts;
- recommended EPRs for managing operational noise; and
- residual impacts based on compliance with the EPRs.

7.2.1 Risk controls

In accordance with the GED under the EP Act, the risks of harm as a result of operational noise from the project must be minimised as far as reasonably practicable. The GED is an enduring requirement which applies throughout the planning, design and operation of the project.

A complete suite of risk controls for operational noise are defined subsequently in this report in the form of EPRs. The EPRs set out the requirements for addressing the GED during the design and operational stages of the project. The key controls considered in the prediction and assessment of operational noise comprise:

- acoustically rated enclosures for a large portion of the plant at the site;
- specification of very low noise emission converter transformers; and
- specification of low noise emission cooling systems, including variable speed control systems to reduce noise levels during the night.

Further details of the plant selections and building designs are provided in the following section.

Refer to Section 7.2.7 for the proposed EPRs for operational noise. Full details of each EPR are then specified in Section 7.5 which collates the noise and vibration EPRs for both the construction and operation of the project.

7.2.2 Converter station noise sources and buildings

The key noise emitting external plant associated with the converter station are identical for the candidate sites being assessed and comprise:

- six converter transformers;
- six converter transformer coolers;
- four auxiliary transformers;
- two standby diesel generators; and
- two valve cooling banks (each comprising seven cooling units).

A converter station at the Driffield site would include a switching station however this does not include any power transformers or any other significant operational noise sources that are relevant to a noise assessment.

The key structures and buildings associated with each converter station are summarised in Table 29 on the following page.

MLPL provided noise emission data to assess the concept plan for the converter station. The data was derived by MLPL from example vendor data for similar projects. The noise emission data for certain plant items are relatively low and are the result of an iterative design process to reduce noise levels. The equipment selections were primarily determined by site-specific noise constraints relating to the Tasmanian converter station associated with the project (assessed in a separate technical study), where potential noise sensitive locations are planned at much shorter separating distances than at the Victorian sites. However, for consistency, the noise emission values selected for the Tasmanian converter station site have also been adopted for the design and assessment of the Victorian converter station sites.

The noise emission data for the plant indicates sound power levels generally ranging from 70 dB L_{WA} for auxiliary transformers through to 87 dB L_{WA} for the valve coolers. The key items of external plant with respect to noise emissions are the valve coolers and the converter transformers. The noise emissions for these equipment items are very low and would likely involve the selection of low noise emission plant and, in the case of the converter transformers, the use of proprietary noise attenuation measures such as enclosures.

A schedule of the equipment sound power levels used in the noise modelling is presented in Appendix I. The same equipment and sound power levels have generally been assumed for day and night operation at both the Driffield and Hazelwood converter station sites. The only exception relates to the valve coolers. The reduced noise emission values provided by MLPL for this assessment still relate to the plant operating at full capacity during maximum ambient design temperatures (in excess of 40 °C) when cooling demands will be greatest. In practice, ambient temperatures at night would typically be lower, and cooling demands would be lower. In the case of the Hazelwood converter station site, reduced noise emissions values for the valve coolers have been accounted for in the noise modelling of the night period. Specifically, an 8 dB reduction in noise levels has been accounted for in the night modelling to address site specific environmental noise constraints for the Hazelwood site (primarily related to potential cumulative noise considerations, and the conservative base noise assumed for the site). This reduction in night-time emission is consistent with the approach adopted for the Tasmanian converter station site and would likely involve the use of reduced fan speeds (implemented via variable speed control systems specified for the valve coolers).

An important point of context is that the final equipment selected for the project would be the subject of further design refinements and a commercial tendering process. The sound power data provided by MLPL is therefore indicative, and the noise modelling based on this data is primarily intended to inform an assessment of operational noise risk and suitable EPRs for the project.

Table 29: Converter station building descriptions

Building/room	Description
Two AC phase reactor halls	One hall for each stage of the project. Each hall would contain six valve reactors. The walls and roof have been assessed as lightweight sheet steel cladding, and allowance made for two ventilation opening ventilation openings (approximately 2 m^2 each on the west and east elevations of the halls).
Two DC side halls	One hall for each stage of the project. Each hall would contain two DC reactors. The walls and roof have been assessed as lightweight sheet steel cladding, and allowance made for two ventilation openings (approximately 2 m^2 each on the west and east elevations of the halls).
Two valve halls	One hall for each stage of the project. Each hall would contain converter modules and valves which are understood to produce low noise emissions relative to other plant at the site. Noise emission data is not available for the equipment located within these halls. For the purposes of this assessment, noise levels within these halls are assumed to be low and not contribute to the total predicted noise levels.
Two air handling unit (AHU) rooms	One room for each stage of the project. Each room would contain two air handling units (one each for the AC phase reactor halls and the DC side halls). The walls and roof have been assessed as lightweight sheet steel cladding.
Two AC filter buildings	One building for each stage of the project. Each building would contain three AC filter banks. The walls and roof have been assessed as lightweight sheet steel cladding for the Driffield Site. Upgraded constructions have been factored in the assessment of the Hazelwood site, in recognition of site-specific environmental noise constraints. The upgraded constructions comprise a proprietary ceiling beneath a lightweight steel roof, and walls comprising tilt-up concrete panels.

7.2.3 Operational noise requirements

The operational noise requirements under Victorian legislation that apply to both the Driffield and Hazelwood converter station sites are as follows:

- All reasonably practicable measures would need be implemented to reduce the risk of harm from noise.
- The project must achieve noise levels below the threshold prescribed to be unreasonable.
- The project must not produce unreasonable noise according to the listed factors of the EP Act.

The noise limits for the assessment of prescribed unreasonable noise are defined by the EP Regulations and determined separately for each site in accordance with the EPA Noise Protocol. The applicable noise limits for each site are presented subsequently in Sections 7.2.4 and 7.2.5.

In both instances, the noise limits apply to:

- the effective noise level (dB L_{eff}) of industry, being the equivalent noise level (dB L_{Aeq}) adjusted for character and duration where required; and
- the cumulative noise of all industry premises which contribute to noise levels at a receiver.

  (for proposed new development, the EPA Noise Protocol specifies that the cumulative noise contribution from existing and approved premises affecting receivers must be accounted for).

The EPA Noise Protocol states the following in relation to noise from emergency plant:

> *Where the noise source under consideration is equipment used solely in relation to emergencies, the relevant noise limit applying to the testing or maintenance of such equipment, as determined in clauses 1 to 15 or clauses 16 to 36 above, is increased by 10 dB for a day period and by 5 dB for all other periods.*

The EPA Noise Protocol notes the following in relation to emergency equipment and standby generators:

> *… a standby generator means a generator for electrical power used as an alternative to the mains supply in emergencies, or for a maximum period of 4 hours per month for maintenance purposes*

The standby generators are intended to provide an alternative to mains power in emergencies in emergencies. The noise limits for normal operation are therefore increased by 10 dB during the day period and 5 dB for all other periods for testing of the standby generators for maintenance purposes. However, routine testing of the standby generators would be restricted to once every 3 months during the day only on weekdays.

7.2.4 Driffield converter station

Noise limits

The Driffield site noise limits determined in accordance with the EPA Noise Protocol are listed in Table 30. These limits are higher than would normally apply in a rural area, due to the effect of the Special Use Zone the project is located in.

Table 30: Driffield converter station site – noise limits determined in accordance with the EPA Noise Protocol

Period	Day	Time	Noise limit, dB L_{eff}
Day	Monday to Saturday	0700 to 1800 hrs	58
Evening	Monday to Saturday	1800 to 2200 hrs	53
	Sunday and Public Holidays	0700 to 2200 hrs	
Night	Monday to Sunday	2200 to 0700 hrs the next day	48

Predicted noise levels

The predicted effective noise levels (dB L_{eff}) of the converter station at the Driffield site are presented in Table 31 for:

- typical operations: representative of normal operation for the day, evening and night period; and
- maintenance testing: normal operation of the converter station with maintenance testing of the two standby generators. Testing of the standby generators for maintenance purposes would be restricted to the day period.

The effective noise levels assume no adjustments for duration (i.e. continuous operation) or character. Character related adjustments are discussed subsequently.

The predicted noise levels are presented for the nearest receivers which are generally located from the north, northeast and east of the converter station site.

Table 31: Driffield converter station site – predicted noise levels, dB L_{eff}

Receiver	Location	Typical operations (base noise limit 48 dB L_{eff} at night)	Maintenance testing (noise limit 68 dB L_{eff} during the day [1])
B8943	Approximately 1,100 m north	22	30
B8944	Approximately 1,100 m north	21	29
B8931	Approximately 1,500 m north-northwest	20	28
B8870	Approximately 1,800 m east	18	26
B8874	Approximately 1,900 m east	18	26
B8964	Approximately 1,900 m northeast	18	25
B8965	Approximately 2,100 m northeast	16	25

1 Based on a 10 dB increase of the normal noise limit for brief periods of maintenance testing during the day

A noise contour map illustrating the distribution of the predicted operational noise levels around the converter station site is presented in Figure 12.

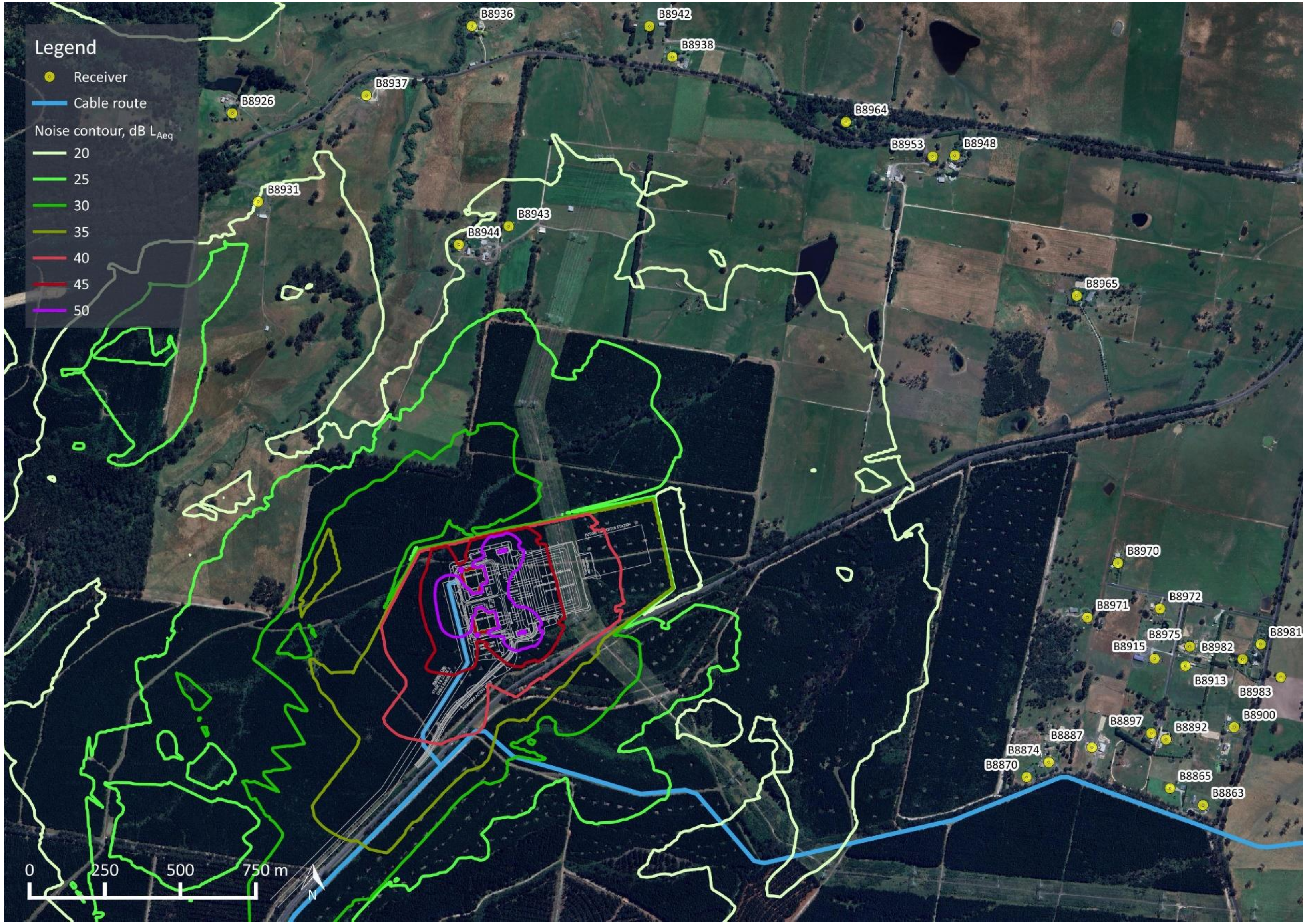

Figure 12: Driffield converter station site – typical operations (no standby generators) predicted noise contours, dB L_{eff}

Discussion

The predicted noise levels for typical operations are well below the minimum limit of 48 dB L_{eff} which applies to the night period. The predicted noise levels during maintenance testing of the standby generators are also well below the applicable limit for the day period (when maintenance testing of the standby generators would occur).

Compliance with the EPA Noise Protocol in itself is not an indication that the risk of harm has been minimised. This is particularly relevant to the Driffield converter station site on account of the applicable noise limits being relatively high.

However, the following key points of context are noted:

- The predicted noise levels are low for an infrastructure project and would be below the background noise level in many instances. For reference, the predicted noise levels are below the lowest hourly background value of 25 dB L_{A90} measured in the vicinity of the Driffield converter station site (see results for site 4 in Appendix E5).
- The low predicted noise levels relative to the background mean that a penalty for tonality is unlikely to be applicable. However, irrespective, the application of a penalty for tonality would be inconsequential to the assessment outcome at all locations i.e. even with a penalty for tonality, the adjusted predicted noise levels would remain below the noise limits.

Given the low predicted noise level relative to the background noise levels and the applicable noise limits, additional attenuation measures, over and beyond the attenuation measures associated with achieving the noise emission referenced in this assessment, are not expected to be warranted to demonstrate that:

- the proposed design meets the GED under the EP Act; and
- the noise would not be unreasonable under the EP Act.

However, irrespective of the predicted noise levels and compliance with the EPA Noise Protocol, the GED and unreasonable noise provisions of the EP Act remain applicable. The equipment must be selected, operated and maintained to minimise the risk of harm as a result of operational noise. Attention must be given to the control of noise characteristics with the potential to cause unreasonable noise; particularly tonality and low frequency noise which are the two main characteristics to consider for the type of plant in question.

7.2.5 Hazelwood converter station

Noise limits

Based on the current land zoning of the Hazelwood converter station site (Farming Zone), and in lieu of background noise data for noise sensitive locations (receivers) immediately adjoining the site[6], the applicable base (minimum) noise limits determined in accordance with the EPA Noise Protocol are listed in Table 32.

The available background noise data in the vicinity of the site indicates background noise levels around 33 dB L_{A90} or higher (see results for site 1 in section 6.0 and appendix E2) and suggests that higher noise limits may actually be applicable. The base noise limits are therefore conservative.

Two sets of base noise limits are defined: 'utility' and 'standard' base noise limits. The utility limits apply at most receivers located in the Farming Zone. The standard base noise limits apply at land zoned for residential purposes (e.g. the Rural Living Zone to the south of the site) and to some distant receivers in the Farming Zone.

Table 32: Hazelwood converter station site – base (minimum) noise limits, dB L_{eff}

Period	Day	Time	Utility base limit	Standard base limit
Day	Monday to Saturday	0700 to 1800 hrs	45	45
Evening	Monday to Saturday	1800 to 2200 hrs	39	37
	Sunday and Public Holidays	0700 to 2200 hrs		
Night	Monday to Sunday	2200 to 0700 hrs the next day	34	32

Predicted noise levels

The predicted total noise levels of the converter station at the Hazelwood site are presented in Table 33 and Table 34 for:

- typical operations: representative of normal operation for the day, evening and night period; and
- maintenance testing: normal operation of the converter station with maintenance testing of the two standby generators. Testing of the standby generators for maintenance purposes would be restricted to the day period.

The predicted effective noise levels are presented for the nearest receivers around the converter station site. The effective noise levels assume no adjustments for duration (i.e. continuous operation) or character. The potential for character related adjustments is discussed subsequently.

6 Permission to monitor at neighbouring properties was not available at the time of the background noise survey

Table 33: Predicted noise levels (normal operations) at receivers with utility base limits, dB L_{eff}

Receiver	Location	Day/Evening (base limits 45/39 dB L_{eff})	Night (base limit 34 dB L_{eff})
B9062	Approximately 400 m south-southwest	34	27
B9071	Approximately 700 m southeast	33	25
B9030	Approximately 900 m northeast	24	22
B8923	Approximately 900 m west-southwest	22	15

Table 34: Predicted noise levels (no standby generators) at receivers with standard base limits, dB L_{eff}

Receiver	Location	Day/Evening (base limits 45/37 dB L_{eff})	Night (base limit 32 dB L_{eff})
B9039	Approximately 1,900 m north-northeast	17	16
B9121	Approximately 1,200 m south	26	18

The predicted noise levels during normal operations with maintenance testing of two standby generators are presented in Table 35. Testing of the standby generators for maintenance purposes would be restricted to the day period.

Table 35: Predicted noise levels during the day with standby generators, dB L_{Aeff}

Receiver	Day (base limit 55 dB L_{eff} [1])
B8923	28
B9062	39
B9071	34
B9030	37
B9039	28
B9121	31

1 Based on a 10 dB increase of the noise limit for brief periods of maintenance testing during the day

A noise contour map illustrating the distribution of the predicted operational noise levels around the converter station site is presented in Figure 13 and Figure 14 for the day/evening and night periods respectively.

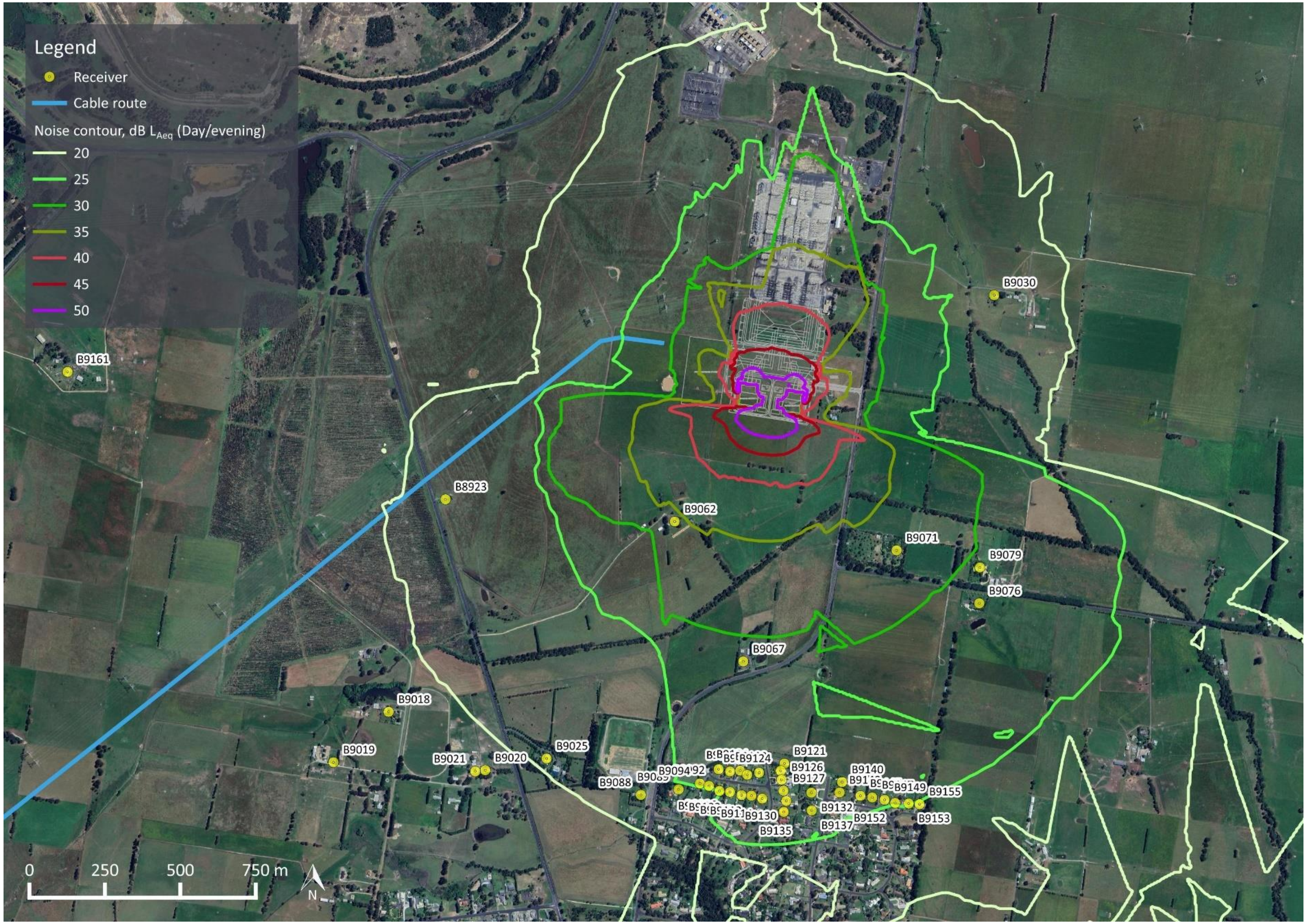

Figure 13: Hazelwood converter station site – typical operations (no standby generators) predicted noise contours, dB L_{eff} - day/evening

Figure 14: Hazelwood converter station site – typical operations (no standby generators) predicted noise contours, dB L_{eff} – night

Discussion

The predicted noise levels are below the applicable base noise limits for all time periods, accounting for both normal and maintenance operations (day only).

Compliance with the EPA Noise Protocol in itself is not an indication that the risk of harm has been minimised. However, the following key points of context are noted:

- The predicted noise levels are low for an infrastructure project and are likely to be lower than the background noise levels. For reference, the predicted noise levels are below the lowest hourly background value measured for each period in the vicinity of the Hazelwood converter station site (see measurement data for site 1 in Appendix E2 – lowest measured hourly values being 38 dB L_{A90}, 36 dB L_{A90} and 33 dB L_{A90} for the day, evening and night respectively).
- Predicted noise levels that are low relative to the background mean that a penalty for tonality is unlikely to be applicable. However, irrespective, the application of a penalty for tonality would be inconsequential to the assessment outcome at all locations i.e. even with a penalty for tonality, the adjusted predicted noise levels would remain below the noise limits.

The Hazelwood converter station site is an area where there is existing and proposed industry including:

- Hazelwood terminal station (existing), immediately to the north of the converter station site;
- Jeeralang A & B power station (existing), beyond to the north; and
- Wooreen Energy Storage System (proposed), beyond to the north.

Cumulative noise is therefore a potential consideration for receivers to the east, northeast and north of the Hazelwood converter station. However, the predicted noise levels are 10 dB lower than the applicable base limit at these receivers. This indicates that the converter station would not materially contribute to cumulative industry noise levels at or approaching the base noise limits.

Given the above findings, additional attenuation measures, over and beyond the attenuation measures associated with achieving the noise emission referenced in this assessment, are not expected to be warranted to demonstrate that:

- the proposed design meets the GED under the EP Act; and
- the noise would not be unreasonable under the EP Act.

However, irrespective of the predicted noise levels and compliance with the EPA Noise Protocol, the GED and unreasonable noise provisions of the EP Act remain applicable. The equipment must be selected, operated and maintained to minimise the risk of harm as a result of operational noise. Attention must be given to the control of noise characteristics with the potential to cause unreasonable noise; particularly tonality and low frequency noise which are the two main characteristics to consider for the type of plant in question.

7.2.6 Risk assessment

Based on the findings discussed above, an assessment of risk associated with operational noise associated with the converter station is presented in Table 36.

Table 36: Converter station operational noise levels – risk assessment

Item	Rating	Comments
Risk consequence	Minor	The predicted noise levels are likely to be below the background noise levels at receivers and well below the noise limits. Compliance with the noise limits does not indicate the risk has been minimised. Further, obligations with respect to the GED and unreasonable noise provisions of the EP Act remain applicable, particularly with respect to the control of any audible characteristics such as tonality and low frequency noise. However, the decisive factors in the risk consequence selection are the low predicted noise levels relative to the background noise levels, followed by the significant margin of compliance that is predicted.
Likelihood	Possible	While the predicted noise levels are low, the assessment is based on the selection of low noise emission plant generally and site-specific noise attenuation measures for the Hazelwood site. Given the predicted compliance margins, higher noise levels than predicted would not necessarily alter the assessment outcomes. However, attention to noise emissions would be required during subsequent design and equipment procurement to achieve outcomes that are consistent with the assessment findings and, importantly, avoid audible characteristics such as tonality and low frequency which could represent a residual risk of harm.
Overall risk	Medium	The applicable EPA Publication 1695.1 guidance for this rating is that the risk can be acceptable if controls are in place, and attempts should be made to reduce the risk to low.

The risk rating determined in Table 36 supports that EPRs are warranted to provide assurance that operational noise would be appropriately addressed during the design and commissioning of the project. Specifically, that the risk of harm from operational noise would be minimised so far as reasonably practicable, in accordance with the GED under the EP Act, accounting for both the level and character of the noise.

7.2.7 Environmental performance requirements

The assessment of operational noise risks presented in Section 7.2.6 indicate the risk rating is medium. This supports that EPRs are warranted to minimise the operational noise risk as far as reasonably practicable. Four (4) EPRs are proposed for this purpose:

- **NV01: Conduct additional background noise monitoring**

  The purpose of this EPR is to establish the requirement to obtain additional background noise data which will inform the design of the converter station (NV04) and the operational noise management plan (NV05).

- **NV04: Design the converter station to minimise the risk of harm from noise so far as reasonably practicable**

  The purpose of this EPR is to establish a requirement to systematically evaluate and select noise control options to minimise the risk of harm from operational noise so far as reasonably practicable, in accordance with the GED under the EP Act. The selected risk controls must be proportionate to the risk of harm.

- **NV05: Prepare an operation noise management plan for the converter station site**

  The purpose of this EPR is to establish a requirement to document all measures to be implemented and maintained to minimise the risk of harm from operational noise so far as reasonably practical, in accordance with the GED under the EP Act. The plan must document noise monitoring requirements and procedures for investigating noise complaints and potential compliance issues.

- **NV06: Prepare an operational noise compliance assessment report**

  The purpose of this EPR is to establish a requirement to verify the measures implemented to minimise the risk of harm from operational noise as far as reasonably practicable, including noise compliance monitoring.

Each of the above EPRs are specified in detail in Section 7.5.

7.2.8 Residual impacts

Provided that the EPRs are adhered to, the risk rating of the residual impacts of operational noise would be low. The inherent and residual risks for operational noise are summarised in section 7.6.

7.3 Cumulative impacts

Development and operation of multiple projects at the same time and in proximity to each other can lead to cumulative environmental impacts. The EIS therefore includes an assessment of the potential cumulative impacts associated with other proposed and foreseeable projects near the study area.

Other projects were identified for inclusion in the EIS cumulative impact assessment where they:

- are under construction;
- have receiver approvals but the project has not yet commenced construction;
- have officially commenced the approvals process and are in the process of developing applications; or
- have submitted approval application(s) but not yet been determined.

The projects being considered in the EIS are listed in Table 37 along with a brief summary of relevant available information.

Table 37: Projects being considered in the EIS cumulative impact assessment

Project	Description	Location	Status and timing	Relevance for noise and vibration assessment
Delburn Wind Farm	Wind farm with up to 33 turbines and related infrastructure including a battery energy storage system and a terminal station.	Located in the Strzelecki Ranges, south of the Latrobe Valley. The routes for the project and the Delburn Wind Farm run in close alignment through the Hancock Victorian Plantations P/L (HVP) pine timber plantation at Delburn.	Current status: Approved in March 2022. Construction to commence: 2023-2025 (18-24 months construction). Operation to commence: 2025.	Considered in the assessment due to proximity to Driffield converter station site.

Project	Description	Location	Status and timing	Relevance for noise and vibration assessment
Star of the South Offshore Wind Farm	Offshore wind farm with up to 200 turbines.	7-25 km off the south coast of Gippsland, and approximately 70 km from the project shore crossing. The proposed transmission line to connect the wind farm largely follows the Bass Link cable alignment and connects at Hazelwood in the Latrobe Valley.	Detailed planning/environmental approvals phase underway. Construction proposed to commence: around 2025. Operation to commence: 2030 onwards.	Not considered in assessment due to large distance of noise sources.
Hazelwood Mine Rehabilitation Project	Rehabilitation of former Hazelwood Mine and Power Station.	Latrobe Valley in Victoria, near the town of Morwell. The project and the Hazelwood Rehabilitation Project will have an interface at Hazelwood.	Current status: Detailed planning/environmental approvals phase underway. Approval expected in 2024. Assuming construction to commence in 2025. Operation expected to commence: 2029 onwards.	Considered in the assessment due to proximity to Hazelwood converter station site.
Wooreen Energy Storage System	Utility scale battery storage.	Located adjacent to Jeeralang gas-fired power station in Victoria's Latrobe Valley.	Current status: Approved in February 2023 and construction is expected to commence in 2024. Operation to commence: end of 2026.	Not considered in assessment due to large distance of noise sources.

The primary cumulative consideration that is relevant to the technical noise and vibration study is the potential for cumulative operational noise. While there is potential for cumulative construction noise to arise from the nearest projects, such as the Delburn Wind Farm and the Hazelwood Power Station rehabilitation, the risk of cumulative noise is low on account of the transient nature of construction impacts (particularly for the construction activities along the project route) and the separation of the projects.

In terms of cumulative operational noise, the relevant project interfaces to consider are:

- the Driffield converter station site and the Delburn Wind Farm; and
- the Hazelwood converter station site and the Wooreen Energy Storage System.

For noise assessment purposes, existing industry in the vicinity of the Hazelwood converter station site also requires consideration.

These interfaces are addressed below in Section 7.3.1 and Section 7.3.2.

7.3.1 Driffield converter site interface

The Driffield converter station site being considered for the project is located between the southern and northern clusters of wind turbines associated with the Delburn Wind Farm.

The converter station site is approximately 800 m north of the nearest proposed wind turbine location and between 5 and 6 km south-southwest of the terminal station associated with the Delburn Wind Farm.

Under Victorian legislation, the cumulative operational noise of industry must achieve the noise limits determined in accordance with the EPA Noise Protocol. However, the EPA Noise Protocol noise limits only apply to the ancillary infrastructure elements of wind farm projects. The noise associated with the wind turbines of a wind farm are assessed under separate requirements that apply solely to wind turbine noise.

In terms of cumulative industry noise, the nearest receivers to the Driffield converter station are located approximately 1,100 m to the north and the predicted effective noise level of the converter station is 22 dB L_{eff} (see predicted noise levels presented earlier in Section 7.2.4). The related infrastructure associated with the Delburn Wind Farm is located over 4,000 m north-northeast of these receivers and would therefore not materially contribute to noise levels at these locations. Similarly, at the receivers nearest to the related infrastructure associated with the Delburn Wind Farm, the predicted noise levels of the Driffield converter station would be significantly lower and would not materially contribute to total noise levels.

Based on the above, cumulative operational noise impacts are not expected to occur as a result of the Driffield converter station and the Delburn Wind Farm.

7.3.2 Hazelwood converter station site interface

Cumulative noise is a relevant consideration for the Hazelwood converter station where there are existing and proposed industry sites in the surrounding area. Existing industry includes the terminal station immediately to the north of the converter station site, and Energy Australia's Jeeralang gas-fired power station located approximately 1,100 north. The proposed Wooreen Energy Storage System is northeast of the Jeeralang power station and approximately 1,200 m north of the converter station site.

The receiver location most relevant to potential cumulative noise considerations is located approximately 900 m northeast of the Hazelwood converter station site and the predicted noise level of the converter station is 24 and 22 dB L_{eff} for day and night operation respectively (see predicted noise levels presented earlier in Section 7.2.5). These results are more than 10 dB below the applicable industry noise limit at this location and demonstrate that the converter station would not materially contribute to cumulative industry noise levels at or approaching the base noise limits. Similarly, at more distant receiver locations that are nearer to the Jeeralang power station and Wooreen Energy Storage System, the predicted noise levels of the converter station are significantly lower and would not materially contribute to industry noise levels.

Based on the above, the converter station at Hazelwood is not expected to be a material contributor to the cumulative noise of existing and proposed industry in the surrounding area. However, the assessment for the Hazelwood converter station site is based on the inclusion of dedicated noise controls in recognition of cumulative noise considerations. Accordingly, the EPRs for operational noise (see section 7.2.7) include a requirement for a design verification report to be produced during the design of the converter station. The report is to be based on updated modelling for the final converter station design and equipment selections, and address cumulative noise considerations in accordance with the EPA Noise Protocol.

7.4 Monitoring and review

Monitoring and review requirements are established as part of the EPRs for construction and operational noise detailed in Sections 7.1.8 and 7.2.7. respectively, and summarised in Section 7.5.

7.5 Environmental performance requirements

The recommended EPRs for the control of noise and vibration associated with construction and operation of the project are summarised in Table 38. The EPRs establish requirements at each stage of the project from design through to ongoing operation.

The objective of the EPRs is to minimise the risk of harm from noise and vibration associated with construction and operation of the project, so far as reasonably practicable, in accordance with the GED under the EP Act. Under the EP Act, the risks to be minimised include adverse effects on both human health and amenity. All references to harm in the EPRs relate to harm as defined by the EP Act, and therefore relate to adverse effects on both human health and amenity.

The EPRs are primarily directed at addressing noise and vibration levels at sensitive locations where people may reside, such as residential dwellings. The assessment also considered noise risks to natural areas (see assessment of Cape Liptrap Coastal Park and Waratah Bay – Shallow Inlet Coastal Reserve in Section 7.1.4). The value of the soundscape within the Cape Liptrap Coastal Park is not expected to be diminished by the construction works. However, the value of the soundscape at the section of the Waratah Bay – Shallow Inlet Coastal Reserve immediately adjacent to the works would be impacted for the duration of the works. The primary means of addressing noise for the adjoining natural area is to minimise the duration of the works, and minimise the overall noise emissions (sound power level) of the shore crossing plant as far as reasonably practicable. These measures are required to address noise levels at sensitive locations where people reside, and will inherently address noise levels at the adjoining natural area to the greatest extent that is reasonably practicable. A dedicated EPR for natural areas is therefore not warranted and is not included in the EPRs listed in Table 38.

The EPRs presented in this section are to be read in conjunction with the broader environmental management framework for the project which is addressed in Volume 5, Chapter 2 *Environmental Management Framework* of the EIS/EES. In particular, the following key items are noted:

- The EMF establishes a requirement for an independent environmental auditor (IEA) to verify the construction environmental management plan and any sub plans to these documents (such as the CNVMP). The IEA would also report on the implementation of the plans. The requirements for verification and reporting by the IEA are reiterated in the relevant noise and vibration EPRs presented in Table 38.
- The EMF establishes a requirement for a land decommissioning management through a dedicated EPR. The plan is required to document how decommissioning activities would be undertaken and potential impacts managed. The objective of the plan is to minimise impacts during removal of infrastructure. The decommissioning management plan prepared to address the EPR would need to address environmental noise and vibration impacts and would be approved by the Minister for Planning. An additional and separate EPR for noise and vibration associated with decommissioning activities has therefore not been documented in the EPRs presented subsequently in this section.
- Project works are defined as any physical activities undertaken for site establishment, construction, operation or decommissioning of the project.
- The project stage of construction includes design, any pre-construction activities that inform construction or to establish baseline conditions, temporary works, work site establishment, reinstatement, rehabilitation of construction areas, and any commissioning activities.

Table 38: Noise and vibration EPRs

<table>
<tr><th>EPR ID</th><th>Environmental performance requirement</th><th>Project stage</th></tr>
<tr><td>NV01</td><td>Conduct additional background noise monitoring
Prior to commencement of project works, conduct additional background noise monitoring for onshore receivers in the vicinity of the following project components:
• Shore crossing.
• Construction locations where unavoidable works outside of normal working hours could occur for a period of five or more days.
• Converter station.
• Communications building and transition station (if required).
The background noise monitoring data must:
• Inform the assessment of construction noise (EPR NV02 and NV03) and operational noise (EPR NV04, NV05 and NV06).
• Be conducted at a selection of locations which are representative of the receivers that could be impacted by construction of the project components listed above.
• Be conducted at representative locations for the shore crossing in the townships of Sandy Point and Waratah Bay.
The background noise monitoring and results analysis must be conducted in accordance with procedural guidance detailed in:
• EPA Victoria Publication 1826.4 Noise limit and assessment protocol for the control of noise from commercial, industrial and trade premises and entertainment venues (the EPA Noise Protocol)
• EPA Victoria Publication 1834.1 Civil construction, building and demolition guide
• EPA Victoria Publication 1997 Technical guide: Measuring and analysing industry noise and music noise
• Australian Standard 1055:2018 Acoustics - Description and measurement of environmental noise where relevant.
Data must be collected and analysed in formats which are suitable for the distinct assessment requirements of the EPA Noise Protocol and EPA Publication 1834.1.
The results must be documented in a background noise report and made available to EPA Victoria on request.</td><td>Construction</td></tr>
</table>

EPR ID	Environmental performance requirement	Project stage
NV02	**Develop and implement a construction noise and vibration management plan** Prior to commencement of project works, develop a construction noise and vibration management plan in consultation with EPA Victoria for onshore construction including the shore crossing. The construction noise and vibration management plan must describe the measures to be implemented during the onshore project works in Victoria to minimise the risk of harm from construction noise and vibration, so far as reasonably practicable, in accordance with the general environmental duty under the *Environmental Protection Act 2017* (Vic) (EP Act). The plan must document: • A description of all noise generating construction activities and their locations. This must include a schedule of equipment types and numbers for each activity and location. • A description of the proposed construction program including timing and duration of construction activities. This must include confirmation that the works will adhere to normal working hours specified in EPA Victoria Publication 1834.1 *Civil construction, building and demolition guide*, other than unavoidable works, low-noise works, or managed-impact works, that must occur outside normal working hours. • The results of additional background noise monitoring conducted under EPR NV01. • Details of the location, duration and type of unavoidable works, which may need to occur outside of normal working hours and the protocols that will apply for the management of unavoidable works outside normal working hours. These protocols must include a process for the justification and approval of any unavoidable works, managed-impact works, or low noise impact works that may be planned to occur outside the normal working hours. • The locations of the most sensitive working areas along the project alignment, including the extent of areas around unavoidable works where noise and vibration sensitive areas (receivers) need to be identified, where risk controls for noise and vibration are most important, based on the predicted construction noise levels. • A systematic evaluation of noise control options to minimise the risk of harm from operation noise so far as reasonably practicable. • A framework for the selection and implementation of risk controls that are proportionate to the risk of harm from noise, informed by factors including the noise level, noise character, work timing, and work duration. The existing noise environment and the number of affected receivers may also be relevant factors at some sites. • Details of all reasonable and practicable measures that are proposed to minimise the risk of harm as a result of noise and vibration associated with both on-site and off-site sources of construction activities (including heavy vehicle movements on local roads), including: – Requirements for the selection of major plant items with low noise emissions, characterised by sound power levels that are equivalent to, or lower than, the values/ranges indicated in AS 2436 *Guide to Noise and Vibration Control on Construction, Demolition and Maintenance Sites (Reconfirmed 2016)*, unless it can be demonstrated that adhering to these values would not be reasonably practicable.	Construction

EPR ID	Environmental performance requirement	Project stage
	– Measures for the control of potentially annoying characteristics such as tonality, impulsive and low-frequency noise (accounting for frequency spectrum as a prescribed characteristic where applicable). – A requirement for each HDD rig associated with the shore crossing (including ancillary plant) to achieve a total sound power level of 110 dB L_{WA} or lower, unless it can be demonstrated that adhering to this value would not be reasonably practicable or would increase the duration of exposure. – Scheduling protocols for minimising the potential disruption caused by high noise levels as a result of transient construction activities which occur near to receivers for brief periods. – Details of any locations where temporary screens or enclosures are identified as a reasonably practicable control measure, informed by updated construction noise modelling. • Details of any low-noise or managed-impact works which may need to occur outside of normal working hours and the protocols that will apply to the management of these works outside of normal working hours. • Requirements for monitoring noise and vibration of construction works, including unavoidable works. • The protocol for preparing detailed noise and vibration impact assessments (EPR NV03) including when they are required, the format, timing and process for review. The protocol must address all project works and specifically: – The shore crossing. – Locations where there is prolonged unavoidable works, managed-impact works, or low noise impact works outside of normal working hours. – The converter station. • Vibration controls and monitoring requirements, including details of the locations and circumstances in which vibration noise monitoring would be conducted for heritage structures including the cistern structure identified in Moores Road, Buffalo. • Communication protocols for notifying landholders in advance of the works occurring. • Noise complaint handling and response protocols, in accordance with the broader process for managing and responding to complaints received during construction (prepared under EPR S03). • Protocols for continual improvement of the construction noise and vibration mitigation measures informed by data sources including, but not limited to, audit findings, the community and stakeholder engagement framework (prepared under EPR S03), complaint reviews, noise modelling (e.g. as part of preparing detailed noise and vibration impact assessments under EPR NV03), and monitoring. The construction noise and vibration management plan must address the requirements and guidance of: • The general environmental duty under the EP Act. • EPA Victoria Publication 1834.1.	

EPR ID	Environmental performance requirement	Project stage
	• Australian Standard AS 2436. • EPA Victoria Publication 1996 *Noise guideline – assessing low frequency noise*. Both the construction noise and vibration management plan and the IEA review report of the plan must be made available to EPA Victoria on request. The construction noise and vibration management plan must be a sub plan to the CEMP and implemented during construction.	
NV03	**Develop a detailed noise and vibration impact assessment for construction activities at specific sites** Prior to commencement of noise generating work that could impact onshore sensitive receivers, a detailed noise and vibration impact assessment must be completed for construction in accordance with the protocol contained in the construction noise and vibration management plan (EPR NV02). Each assessment must: • Identify all relevant sensitive locations (receivers). • Determine the sound power level for all noise generating plant and equipment planned to be used for the activities being assessed. • Include information to demonstrate the selection, or the processes for selection, of low noise equipment, including consideration of any potentially annoying characteristics of the noise such as tones, impulses or prominent low frequencies. • Model predicted noise levels for the activities and plant being assessed. • Assess noise and vibration impacts on sensitive receivers. This must include an objective assessment of the risk of low frequency noise, informed by indicative estimations of low frequency noise levels. • Include a systematic evaluation of noise control options to minimise the risk of harm from construction noise and vibration so far as reasonably practicable. For unavoidable works outside of normal working hours, the noise control options evaluated should account for any feedback from consultations with the nearest affected receivers. • Include details of all noise and vibration controls and management measures to be implemented to minimise the risk of harm from construction noise and vibration so far as reasonably practicable. • Describe construction noise and vibration monitoring requirements, including verification noise testing (if warranted) to assess the effectiveness of the noise controls before commencing continuous unavoidable works outside of normal working hours. • Include protocols for providing respite in circumstances where residents are affected by prolonged exposure to elevated noise levels as a result of unavoidable works out of hours. • Comply with the controls and protocols documented in the construction noise and vibration management plan. The detailed noise and vibration impact assessments must address the requirements and guidance of:	Construction

EPR ID	Environmental performance requirement	Project stage
	• The general environmental duty under the *Environmental Protection Act 2017* (Vic). • EPA Victoria Publication 1834.1 *Civil construction, building and demolition guide*. • Australian Standard AS 2436-2010 *Guide to Noise and Vibration Control on Construction, Demolition and Maintenance Sites (Reconfirmed 2016).* • EPA Victoria Publication 1996 *Noise guideline – assessing low frequency noise*. Each detailed noise and vibration impact assessment must be reviewed by the independent environmental auditor (IEA), prior to commencement of the noise generating work under assessment. The detailed noise and vibration impact assessments and the IEA review reports must be made available to EPA Victoria on request. All of the recommended noise and vibration risk controls (including mitigation, management, monitoring and respite measures) established in the detailed noise and vibration impact assessment must be implemented during construction.	
NV04	**Design the converter station to minimise the risk of harm from noise so far as reasonably practicable** In accordance with the general environmental duty under the *Environmental Protection Act 2017* (Vic) (EP Act), the design process for the converter station must include a systematic evaluation of noise control options to minimise the risk of harm from operation noise so far as reasonably practicable. The evaluation must: • Consider site layout, equipment selection, and built form to control noise. • Address both the level and character of the noise, accounting for the assessable characteristics defined in the EPA Noise Protocol and prescribed characteristics under the EP Act. • Address normal operation and routine equipment testing. Prior to installing the converter station plant and any enclosing structures, prepare a design noise assessment report for the final converter station design. The report must: • Document the systematic evaluation of noise control options. • Describe the measures to be implemented to control environmental noise levels, demonstrating that all reasonable and practicable measures will be implemented to minimise the risk of harm as a result of noise, as required by the general environmental duty under the EP Act. • Confirm the applicable noise limits (normal operation and routine equipment testing) determined in accordance with EPA Victoria Publication 1826.4 *Noise limit and assessment protocol for the control of noise from commercial, industrial and trade premises and entertainment venues* (EPA Noise Protocol), accounting for the background monitoring data obtained for EPR NV01 and cumulative noise considerations. • Provide details of the noise frequency characteristics of key items of plant such as the transformers and valve coolers, and assessment of whether character adjustments are warranted. • Present predicted noise levels at noise sensitive locations (receivers) from operation of the converter station.	Construction

EPR ID	Environmental performance requirement	Project stage
	• Demonstrate that operational noise levels for the final design and equipment selections are predicted to comply with noise limits determined in accordance with the EPA Noise Protocol. • Present an assessment of the potential for prescribed characteristics under the EP Act. The design noise assessment report must be reviewed by the independent environmental auditor (IEA). Both the design noise assessment report and the IEA's review report must be made available to EPA Victoria on request.	
NV05	**Prepare an operation noise management plan for the converter station and transition station sites** As part of the Operation Environmental Management Plan (OEMP), develop an operation noise management plan for the converter station and transition station (if required) sites in consultation with EPA Victoria. The operation noise management plan must document: • The noise mitigation and management measures developed in design (EPR NV04) that apply to the operation and maintenance of the converter station. • The confirmed applicable noise limits determined in accordance with the EPA Noise Protocol, including for routine testing of plant that is used solely for emergencies (i.e. standby generators for the converter station and the transition station), determined under EPR NV04. • Procedures for, and timing of, noise monitoring to be carried out to assess compliance with the applicable noise limits when the converter station and transition station commences operation. • Details and timing of a noise compliance reporting to be submitted to EPA Victoria. • Details of any maintenance and monitoring measures that are required to maintain ongoing compliance with the *Environmental Protection Act 2017* (Vic) including the general environmental duty. • Procedures for routine testing of plant that is used solely for emergencies (e.g. regularity, days, and times of testing). • Procedures to investigate noise complaints or suspected noise compliance issues. • Protocols for continual improvement of the operation noise management plan, informed by data sources including but not limited to audit findings, complaint reviews and monitoring. The operation noise management plan must be made available to EPA Victoria on request. The operation noise management plan must be a sub plan to the OEMP and implemented during operation.	Operation

EPR ID	Environmental performance requirement	Project stage
NV06	**Prepare an operational noise compliance assessment report** Prepare an operation noise compliance assessment report based on: • An inspection of the converter station and transition station to confirm that the noise mitigation and management measures documented in the operational noise management plan (EPR NV05) have been fully implemented. • The results of noise monitoring conducted in accordance with the operation noise management plan (EPR NV05), to assess compliance with the applicable noise limits. The report must be submitted to EPA Victoria within six months of each stage of the converter station becoming fully operational.	Operation

7.6 Summary of risks

The inherent and residual risks for construction and operational noise are summarised in Table 39.

Table 39: Risk assessment summary

Affected value	Potential risk of harm	Project phase	Initial risk assessment			Environmental performance requirements	Residual risk assessment		
			Consequence	Likelihood	Risk		Consequence	Likelihood	Risk
Ambient noise environment	Airborne noise generated by construction activities associated with the project route and converter station during normal working hours impacting noise sensitive areas.	Construction	Minor	Possible	Medium	NV01 NV02 NV03	Minor	Unlikely	Low
Ambient noise environment	Airborne noise generated by construction of the shore crossing involving 24-hour work over an extended period, affecting noise sensitive areas (including disturbance of sleep) and natural areas valued for their soundscapes.	Construction	Moderate	Possible	Medium	NV01 NV02 NV03	Minor	Possible	Medium
Ambient noise environment	Airborne noise generated by construction of local feature crossings (other than Morwell River – see below) during normal working hours impacting noise sensitive areas.	Construction	Minor	Possible	Medium	NV01 NV02 NV03	Minor	Unlikely	Low
Ambient noise environment	Airborne noise generated by construction of the Morwell River crossing involving 24-hour work over a period of up to 2 weeks, affecting noise sensitive areas (including disturbance of sleep).	Construction	Minor	Possible	Medium	NV01 NV02 NV03	Minor	Unlikely	Low
Ambient noise environment	Airborne noise generated by heavy construction vehicles using the public road network during normal working hours affecting noise sensitive areas.	Construction	Minor	Unlikely	Low	NV02	Minor	Unlikely	Low

Affected value	Potential risk of harm	Project phase	Initial risk assessment			Environmental performance requirements	Residual risk assessment		
			Consequence	Likelihood	Risk		Consequence	Likelihood	Risk
Ambient vibration environment	Ground borne vibration generated by construction activities resulting in perceptible vibration in sensitive (habited) areas or building damage.	Construction	Minor	Unlikely	Low	NV02 NV03	Minor	Unlikely	Low
Ambient noise environment	Airborne noise generated by operation of the converter station affecting noise sensitive areas.	Operation	Minor	Possible	Medium	NV01 NV04 NV05 NV06	Minor	Unlikely	Low

8.0 CONCLUSION

A technical noise and vibration assessment of the Victorian terrestrial component of the project has been completed for submission with the environmental impact statement for the project.

A risk-based assessment was used to evaluate noise and vibration impacts associated with construction and operation of the project. Risks are assessed by accounting for both their consequence and likelihood. The objective of the risk assessment was to determine the appropriate risk controls.

Construction of the project would broadly involve transitory noise and vibration generating activities which occur along, and in the vicinity of, the project. Off-site truck movements on public roads are also a relevant environmental noise.

The primary source of operational noise associated with the project is the proposed converter station which would comprise indoor and outdoor plant including transformers and cooling systems.

Construction noise and vibration

In relation to the noise of construction activities conducted during normal working hours, the assessment demonstrates the risk is low.

The main noise consideration for construction is the work that needs to be conducted outside of normal working hours. In particular, the need for continuous HDD works outside of normal working hours at the shore crossing and the Morwell River Crossing to ensure the stability of the boreholes. HDD works are expected to occur continuously for a period of up to 12 months at the shore crossing (total period for the construction of the shore crossing for both circuits of the project), and up to two weeks at the Morwell River crossing site. The assessment demonstrates the potential for medium risk of harm (i.e. annoyance and the potential for disturbance of sleep) associated with the HDD works at these sites.

EPRs have been recommended to minimise the risk of harm from construction noise and vibration as far as reasonably practicable. The EPRs comprise:

- **NV01: Conduct additional background noise monitoring**

  A requirement to obtain additional background noise data which will then inform the development of controls under NV02 and NV03.

- **NV02: Develop and implement a construction noise and vibration management plan (CNVMP)**

  A requirement for a comprehensive plan which describes all measures that would be used to minimise construction noise and vibration risks as far as reasonably practicable, based on updated information for the planned construction works and equipment selections.

- **NV03: Develop a detailed noise and vibration impact assessment (DNVIA) for construction activities at specific sites**

  A requirement for more detailed assessment and noise control planning for long-term work sites (e.g. the converter station) and sites involving extended periods of unavoidable works outside normal working hours (e.g. the shore crossing).

In accordance with the EPRs and the proposed EMF for the project, the CNVMP and DNVIAs would need to be verified by an independent environmental auditor (IEA). The IEA would also report on the implementation of the measures documented in the CNVMP and DNVIAs.

Provided that the EPRs are adhered to, and the CNVMP is fully implemented, the residual risk of noise impacts for all aspects of construction is low.

In relation to construction vibration, the assessment considers potential effects in terms of both the potential for cosmetic building damage and disturbance of human comfort. Based on the separating distances to construction activities, cosmetic damage to buildings is unlikely at most locations. However, equipment such as vibratory rollers would need to be selected and used with caution to address the risk of cosmetic damage for any receivers within 25 m, and the risk of damage to an archaeological structure identified near one of the access tracks. Vibration may be perceptible at a receiver located less than 100 m from vibration intensive construction activities. However, the brief periods in which vibration may be perceived are expected to be acceptable, accounting for relevant international guidance concerning transient sources of vibration.

Operational noise

The assessment addresses the requirements of the *Environment Protection Act 2017*, the *Environment Protection Regulations 2021*, and EPA Publication a.4 *Noise limit and assessment protocol for the control of noise from commercial, industrial and trade premises and entertainment venues* (EPA Noise Protocol).

The proposed design and equipment selections for the converter stations incorporate risk controls including acoustically rated buildings and selection of low noise emission plant (likely to involve the selection of plant with dedicated acoustic enclosures and fan speed restrictions).

The predicted operational noise levels for both the Driffield and Hazelwood site are below the applicable noise limits determined in accordance with the EPA Noise Protocol. However, the assessment is based on the selection of low noise emission plant for the converter station, and site-specific noise mitigation for the Hazelwood site. In recognition of the influence that equipment selections and design of the converter station has on noise levels, the risk of operational noise impacts has been assessed as medium. Accordingly, EPRs to minimise the risk have been recommended and comprise:

- **NV01: Conduct additional background noise monitoring**

  A requirement to obtain additional background noise data which will inform the design of the converter station (NV04), the operational noise management plan (NV05), and the operational noise compliance assessment report (NV06).

- **NV04: Design the converter station to minimise the risk of harm from noise so far as reasonably practicable**

  A requirement to systematically evaluate and select noise control options to minimise the risk of harm from operational noise so far as reasonably practicable, in accordance with the GED under the EP Act. The selected risk controls must be proportionate to the risk of harm.

- **NV05: Prepare an operational noise management plan (ONMP) for the converter station site and transition station sites**

  A requirement to document all measures to be implemented and maintained to control operational noise risks, including noise monitoring requirements and procedures for investigating noise complaints and potential compliance issues.

- **NV06: Prepare an operational noise compliance assessment report**

  A requirement to verify the measures implemented to minimise the risk of harm from operational noise so far as reasonably practical, in accordance with the GED under the EP Act. The plan must document noise monitoring requirements and procedures for investigating noise complaints and potential compliance issues.

Provided that the recommended EPRs are adhered to, the risk associated with the residual impacts of operational noise is low.

The above findings support that noise and vibration risks associated with construction and operation of the project can be controlled to acceptable levels by implementing suitable mitigation and management measures that address the EPRs.

APPENDIX A REFERENCES

Australian Standard AS 2436-2010 *Guide to noise and vibration control on construction, demolition and maintenance sites*

British Standard BS 5228-1:2009+A12014 *Code of practice for noise and vibration control on construction and open sites – Part 1: Noise*

British Standard BS 6472-1:2008 *Guide to evaluation of human exposure to vibration in buildings*

British Standard BS 7385-2:1993 *Evaluation and measurement for vibration in buildings* Part 2

Deutsches Institut fur Normung (German Institute for Standards) DIN 4150-3:2016-12 *Vibrations in buildings – Part 3: Effects on structures*

Environment Protection Act 2017 (Victoria) (EP Act)

Environment Protection Regulations 2021 (Victoria) (EP Regulations)

Environment Reference Standard published 25 May 2021 (Victoria) (ERS)

EPA Publication 1695.1 *Assessing and controlling risk: A guide for business* (Victoria)

EPA Publication 1826.4 *Noise limit and assessment protocol for the control of noise from commercial, industrial and trade premises and entertainment venues* published May 2021 (Victoria) (EPA Noise Protocol)

EPA Publication 1834.1 *Civil construction, building and demolition guide* published September 2023 (Victoria)

EPA Publication 1856 Reasonably practicable, dated September 2020 (Victoria)

International Standards Organization ISO 9613-2:1996 *Attenuation of sound during propagation outdoors – Part 2: General method of calculation*

NSW Roads and Maritime Services publication *Construction Noise and Vibration Guideline* dated August 2016 (NSW CNVG)

Stantec Australia report *Marinus Link Project – Environmental Effects Statement – Technical Report – Traffic and Transport* dated November 2022

Victorian Department of Transport and Planning publication *Scoping Requirements - Marinus Link – Environmental Effects Statement* dated February 2023 (the Victorian EES scoping requirements).

World Health Organization (WHO) publication *Guidelines for Community Noise* dated 1999

APPENDIX B DESCRIPTION OF SOUND

Sound is an important feature of the environment in which we live; it provides information about our surroundings and influences our overall perception of amenity and environmental quality.

While sound is a familiar concept, its description can be complex. A glossary of terms and abbreviations is provided at the front of this report. This appendix provides general information about the definition of sound and the ways that different sound characteristics are described.

B1 Definition of sound

Sound is a term used to describe very small and rapid changes in the pressure of the atmosphere. Importantly, for pressure fluctuations to be considered sound, the rise and fall in pressure needs to be repeated at rates ranging from tens to thousands of times per second.

These small and repetitive fluctuations in pressure can be caused by many things such as a vibrating surface in contact with the air (e.g. the cone of a speaker) or turbulent air movement patterns. The common feature is a surface or region of disturbance that displaces the adjacent air, causing a very small and localised compression of the air, followed by a small expansion of the air.

These repeated compressions and expansions then spread into the surrounding air as waves of pressure changes. Upon reaching the ear of an observer, these waves of changing pressure cause structures within the ear to vibrate; these vibrations then generate signals which can be perceived as sounds.

The waves of pressure changes usually occur as complex patterns, comprising varied rates and magnitudes of pressure changes. The pattern of these changes will determine how a sound spreads through the air and how the sound is ultimately perceived when it reaches the ear of an observer.

B2 Physical description of sound

There are many situations where it can be useful to objectively describe sound, such as the writing or recording of music, hearing testing, measuring the sound environment in an area, or evaluating new man-made sources of sound.

Sound is usually composed of complex and varied patterns of pressure changes. As a result, several attributes are used to describe sound. Two of the most fundamental sound attributes are:

- sound pressure; and
- sound frequency.

Each of these attributes is explained in the following sections, followed by a discussion about how each of these attributes varies.

B2.1 Sound pressure

The compression and expansion of the air that is associated with the passage of a sound wave results in changes in atmospheric pressure. The pressure changes associated with sound represent very small and repetitive variations that occur amidst much greater pressures associated with the atmosphere.

The magnitude of these pressure changes influences how quiet or loud a sound will be; the smaller the pressure change, the quieter the sound, and vice versa. The perception of loudness is complex though, and different sounds can seem quieter or louder for reasons other than differences in pressure changes.

To provide some context, Table 40 lists example values of pressure associated with the atmosphere and different sounds. The key point from these example values is that even an extremely loud sound equates to a change in pressure that is thousands of times smaller than the typical pressure of the atmosphere.

Table 40: Atmospheric pressure versus sound pressure – example values of pressure

Example	Pascals (Pa)	Bars	Pounds per Square Inch (PSI)
Atmospheric pressure	100,000	1	14.5
Pressure change due to weather front	10,000	0.1	1.5
Pressure change associated with sound at the threshold of pain	20	0.0002	0.003
Pressure change associated with sound at the threshold of hearing	0.00002	0.0000000002	0.000000003

The pressure values in Table 40 also show that the range of pressure changes associated with quiet and loud sounds span over a very large range, albeit still very small changes compared to atmospheric pressure. To make the description of pressure changes more practical, sound pressure is expressed in decibels or dB.

To illustrate the pressure variation associated with sound, Figure 15 shows the repetitive rise and fall in pressure of a very simple and steady sound. This figure illustrates the peaks and troughs of pressure changes relative to the underlying pressure of the atmosphere in the absence of sound. The magnitude of the change in pressure caused by the sound is then described as the sound pressure level. Since the magnitude of the change is constantly varying, the sound pressure may be defined in terms of:

- peak sound pressure levels: the maximum change in pressure relative to atmospheric pressure i.e. the amplitude as defined by the maximum depth or height of the peaks and troughs respectively; or
- root Mean Square (RMS) sound pressure levels: the average of the amplitude of pressure changes, accounting for positive changes above atmospheric pressure, and negative pressure changes below atmospheric pressure.

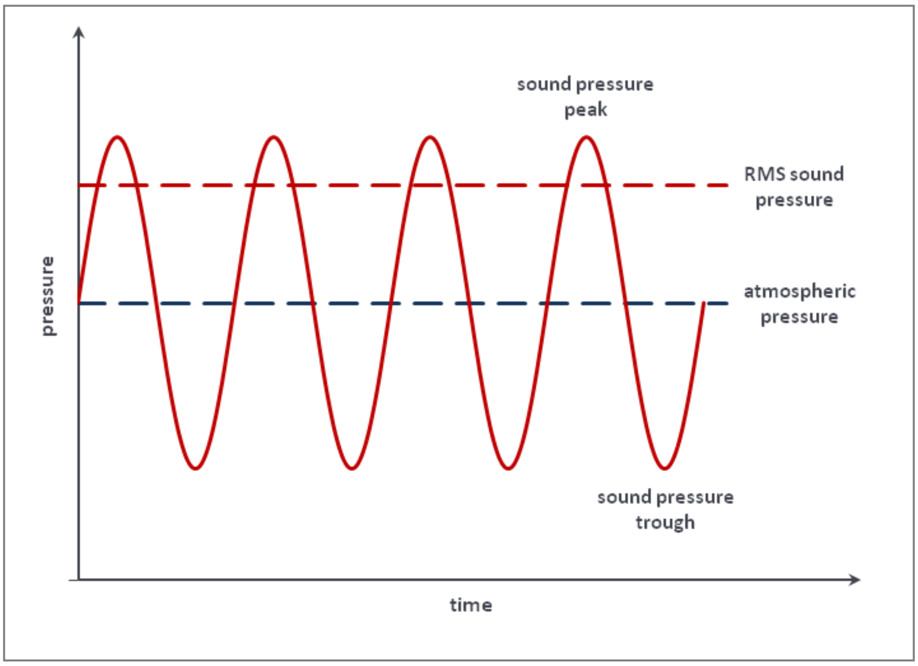

Figure 15: Pressure changes relative to atmospheric pressure associated with sound

B2.2 Frequency

Frequency is a term used to describe the number of times a sound causes the pressure to rise and fall in a given period. The rate of change in pressure is an important feature that determines whether it can be perceived as a sound by the human ear.

Repetitive changes in pressure can occur as a result of a range of factors with widely varying rates of fluctuation. However, only a portion of these fluctuations can be perceived as sound. In many cases, the rate of fluctuation will either be too slow or too fast for the human ear to detect the pressure change as a sound. For example, local fluctuations in atmospheric pressure can be created by someone waving their hands back and forth through the air; the reason this cannot be perceived as a sound is the rate of fluctuation is too slow.

At the rates of fluctuation that can be detected as sound, the rate will influence the character of the sound that is perceived. For example, slow rates of pressure change correspond to rumbling sounds, while fast rates correspond to whistling sounds.

The rate of fluctuation is numerically described in terms of the number of pressure fluctuations that occur in a single second. Specifically, it is the number of cycles per second of the pressure rising above, falling below, and then returning to atmospheric pressure. The number of these cycles per second is expressed in Hertz (Hz). This concept of cycles per second is illustrated in Figure 16 which illustrates a 1 Hz pressure fluctuation. The figure provides a simple illustration of a single cycle of pressure rise and fall occurring in a period of a single second.

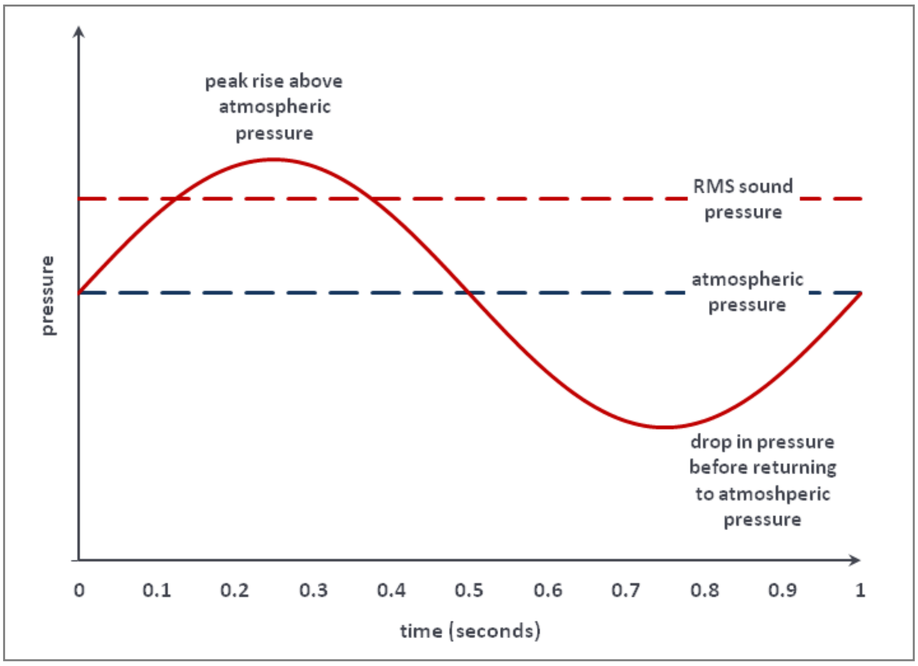

Figure 16: Illustration of a pressure fluctuation with a frequency of 1Hz

The rate that sound pressure rises and falls will vary depending on the source of the sound. For example, the surface of a tuning fork vibrates at a specific rate, in turn causing the pressure of the adjacent air to fluctuate at the same rate. Recalling the idea of pressure fluctuations from someone waving their hands, the pressure would fluctuate at the same rate as the hands move back and forth; a few times a second translating to a very low frequency below our hearing range (termed an infrasonic frequency). Examples of low and high frequency sound are easily recognisable, such as the low frequency sound of thunder, and the high frequency sound of crashing cymbals. To demonstrate the differences in the patterns of different frequencies of sound, Figure 17 illustrates the relative rates of pressure change for low, mid and high frequency sounds. Note that in each case the amplitude of the pressure changes remains the same; the only change is the number of fluctuations in pressure that occur over time.

Low frequency sounds:

20 to 200 Hz

Mid frequency sounds:

200 to 800 Hz

High frequency sounds:

greater than 800 Hz

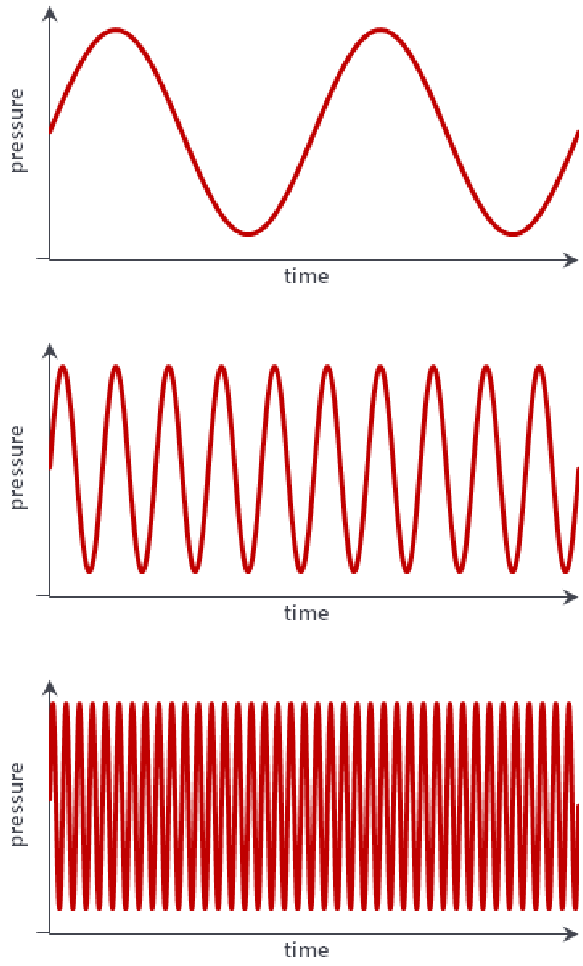

Figure 17: Examples of the rate of change in pressure fluctuations for low, mid and high frequencies

B2.3 Sound pressure and frequency variations

The preceding sections describe important aspects of the nature of sound, the changes in pressure and the changes in the rate of pressure fluctuations.

The simplest type of sound comprises a single constant sound pressure level and a single constant frequency. However, most sounds are made up of many frequencies, and may include low, mid and high frequencies. Sounds that are made up of a relatively even mix of frequencies across a broad range of frequencies are referred to as being 'broad band'. Common examples of broad band sounds include flowing water, the rustling of leaves, ventilation fans and traffic noise.

Further, sound quite often changes from moment to moment, in terms of both pressure levels and frequencies. The time varying characteristics of sound are important to how we perceive sound. For example, rapid changes in sound level produced by voices provide the component of sound that we interpret as intelligible speech. Variations in sound pressure levels and frequencies are also features which can draw our attention to a new source of sound in the environment.

To demonstrate this, Figure 18 illustrates an example time-trace of total sound pressure levels which varies with time. This variation presents challenges when attempting to describe sound pressure levels. As a result, multiple metrics are generally needed to describe sound pressure, such as the average, minimum or maximum noise levels. Other ways of describing sound include statistics for describing how often a defined sound pressure level is exceeded; for example, typical upper sound levels are often described as an L_{10} which refers to the sound pressure exceeded for 10 % of the time, or typical lower levels or lulls which are often described as an L_{90} which refers to the sound exceeded for 90 % of the time.

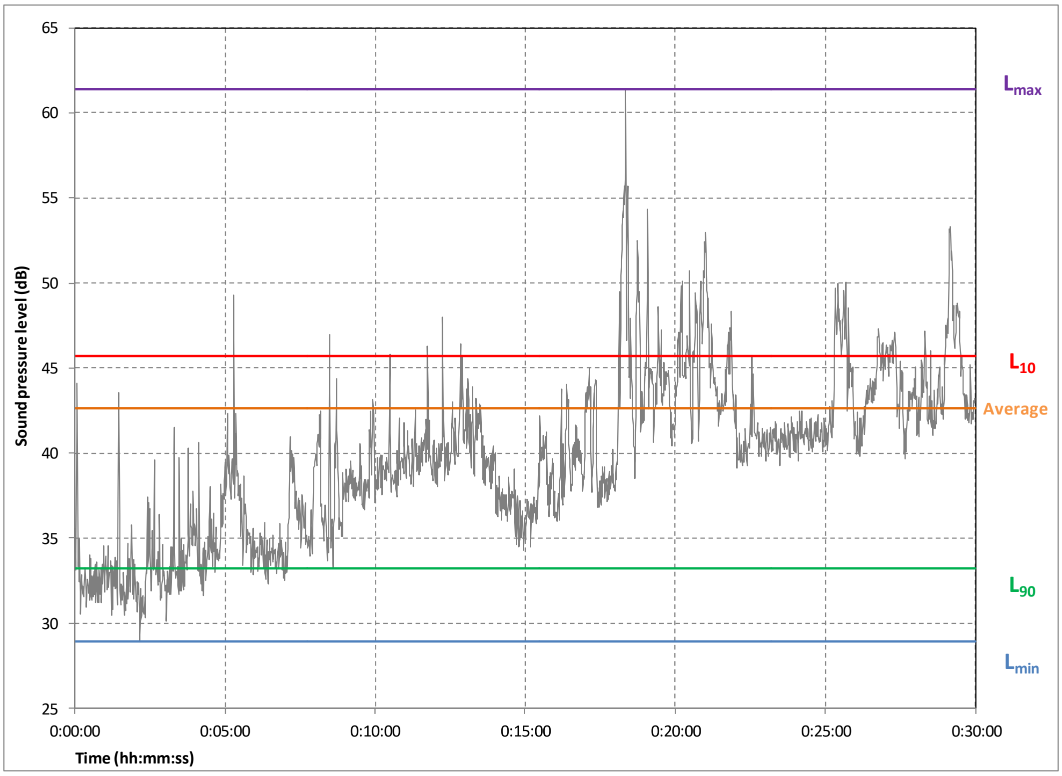

Figure 18: Example of noise metrics that may be used to measure a time-varying sound level

This example illustrates variations in terms of just total sound pressure levels, but the variations can also relate to the frequency of the sound, and frequently the number of sources affecting the sound.

These types of variations are an inherent feature of most sound fields and are an important point of context in any attempt to describe sound.

B3 Hearing and perception of sound

- This section provides a discussion of the use of the decibel to practically describe sound levels in a way that corresponds to the pressure levels the human ear can detect as sounds; and
- the relationship between sound frequency and human hearing.

The section concludes with a discussion of some of the complicating non-acoustic factors that influence our perception of sound.

B3.1 Sound pressure and the decibel

Previous sections discussed the wide range of small pressure fluctuations that the ear can detect as sound. Owing to the wide range of these fluctuations, the way we hear sound is more practically described using the decibel (dB). The decibel system serves two key purposes:

- Compressing the numerical range of the quietest and loudest sounds commonly experienced.

  As an indication of this benefit, the pressure of the loudest sound that might be encountered is around a million times greater than the quietest sound that can be detected. In contrast, the decibel system reduces this to a range of approximately 0-120 dB.

- Consistently representing sound pressure level changes in a way that correlate more closely with how we perceive sound pressure level changes.

  For example, a 10 dB change from 20-30 dB will generally be subjectively like a 10 dB change from 40-50 dB. However, expressed in units of pressure as Pascals, the 40-50 dB change is ten times greater than the 20-30 dB change. For this reason, sound pressure changes cannot be meaningfully communicated in terms of units of pressure such as Pascals.

Sound pressure levels in most environments are highly variable, so it can be misleading to describe what different ranges of sound pressure levels correspond to. However, as a broad indication, Table 41 provides some example ranges of sound pressure levels, expressed in both dB and units of pressure.

Table 41: Example sound pressure levels that might be experienced in different environments

Environment	Example Sound Pressure Level	
Outside in an urban area with traffic noise	50-70 dB	0.006-0.06 Pa
Outside in a rural area with distant sounds or moderate wind rustling leaves	30-50 dB	0.0006-0.006 Pa
Outside in a quiet rural environment in calm conditions	20-30 dB	0.0002-0.0006 Pa
Inside a quiet bedroom at night	<20 dB	0.0002 Pa

The impression of how much louder or quieter a sound is, will be influenced by the magnitude of the change in sound pressure. Other important factors will also influence this, such as the frequency of the sound which is discussed in the following section. However, to provide a broad indication, Table 42 provides some examples of how changes in sound pressure levels, for a sound with the same character, can be perceived.

Table 42: Perceived changes in sound pressure levels

Sound pressure level change	Indicative change in perceived sound
1 dB	Unlikely to be noticeable
2-3 dB	Likely to be just noticeable
4-5 dB	Clearly noticeable change
10 dB	Distinct change - often subjectively described as halving or doubling the loudness

The example sound pressure level changes in Table 42 are based on side-by-side comparison of a steady sample of sound heard at different levels. In practice, changes in sound pressure levels may be more difficult to perceive for a range of reasons, including the presence of other sources of sound, or gradual changes which occur over a longer period.

B3.2 Sound frequency and loudness

Although sound pressure level and the sensation of loudness are related, the sound pressure level is not a direct measure of how loud a sound appears to humans. Human perception of sound varies and depends on a number of physical attributes, including frequency, level and duration.

An example of the relationship between the sensation of loudness and frequency is demonstrated in Figure 19. The chart presents equal loudness curves for sounds of different frequencies expressed in 'phons'. Each point on the phon curves represents a sound of equal loudness. For example, the 40 phon curve shows that a sound level of 100 dB at 20 Hz (a very low frequency sound) would be of equal loudness to a level of 40 dB at 1,000 Hz (a whistling sound) or approximately 50 dB at just under 8,000 Hz (a very high pitch sound). The information presented is based on an international standard[7] that defines equal loudness levels for sounds comprising individual frequencies. In practice, sound is usually composed of many different frequencies, so this type of data can only be used as an indication of how different frequencies of sound may be perceived. An individual's perceptions of sound can also vary significantly. For example, the lower dashed line in Figure 19 shows the threshold of hearing, which represents the sounds an average listener could correctly identify at least 50 % of the time. However, these thresholds represent the average of the population. In practice, an individual's hearing threshold can vary significantly from these values, particularly at the low frequencies.

[7] ISO 226:2003 *Acoustics - Normal equal-loudness-level contours*, 2003

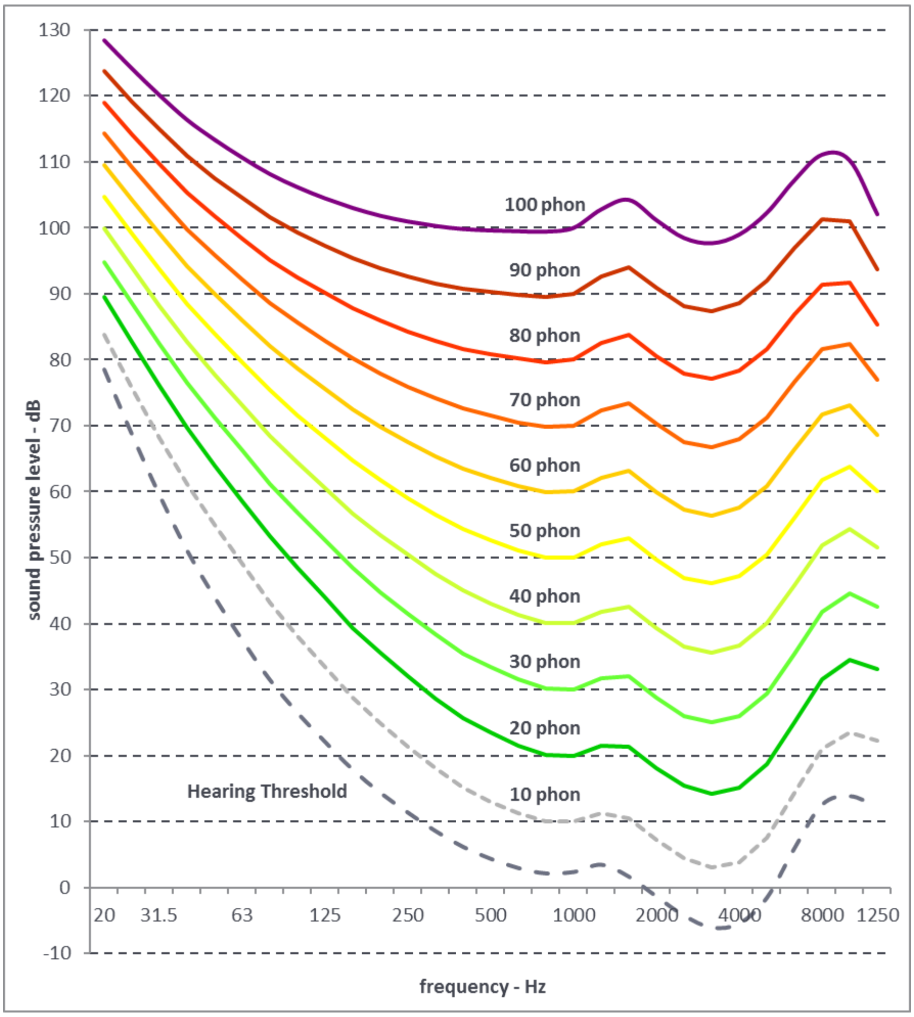

Figure 19: Equal loudness contours for pure tone sounds

The noise curves in Figure 19 demonstrate that human hearing is most sensitive at frequencies from 500 to 4000 Hz, which usefully corresponds to the main frequencies of human speech. The contours also demonstrate that sounds at low frequencies must be at much higher sound pressure levels to be judged equally loud as sounds at mid to high frequencies.

To account for the sensitivity of the ear to different frequencies, a set of adjustments were developed to enable sound levels to be measured in a way that more closely aligns with human hearing. Sound levels adjusted in this way are referred to as A-weighted sound levels.

B3.3 Interpretation of sound and noise

Human interpretation of sound is influenced by many factors other than its physical characteristics, such as how often the sound occurs, the time of day it occurs and a person's attitude towards the source of the sound.

For example, the sound of music can cause very different reactions, from relaxation and pleasure through to annoyance and stress, depending on individual preferences, the type of music and the circumstances in which the music is heard. This example illustrates how sound can sometimes be considered noise; a term broadly used to describe unwanted sounds or sounds that have the potential to cause negative reactions.

The effects of excess environmental sound are varied and complicated, and may be perceived in various ways including sensations of loudness, interference with speech communication, interference with working concentration or studying, disruption of resting/leisure periods, and disturbance of sleep. These effects can give rise to behavioural changes such as avoiding the use of exposed external spaces, keeping windows closed, or timing restful activities to avoid the most intense periods of disruption. Prolonged annoyance or interference with normal patterns can lead to possible effects on mental and physical health. In this respect, the World Health Organization (preamble to the *Constitution of the World Health Organization*, 1946) defines health in the following broad terms:

> *A state of complete physical, mental and social well-being and not merely the absence of disease or infirmity*

The World Health Organization Guidelines for Community Noise (Berglund, Lindvall, & Schwela, 1999) documents a relationship between the definition of health and the effects of community noise exposure by noting that:

> *This broad definition of health embraces the concept of well-being, and thereby, renders noise impacts such as population annoyance, interference with communication, and impaired task performance as 'health' issues.*

The reaction that a community has to sound is highly subjective and depends on a range of factors including:

- The hearing threshold of individuals across the audible frequency range. These thresholds vary widely across the population, particularly at the lower and upper ends of the audible frequency range. For example, at low frequencies the distribution of hearing thresholds varies above and below the mean threshold by more than 10 dB.
- The attitudes and sensitivities of individuals to sound, and their expectations of what is considered an acceptable level of sound or intrusion. This in turn depends on a range of factors such as general health and the perceived importance of sound amongst other factors relevant to overall amenity perception.
- The absolute sound pressure level of the sound in question. The threshold for the onset of community annoyance varies according to the type of sound; above such thresholds, the percentage of the population annoyed generally increases with increasing sound pressure level.
- The sound pressure level of the noise relative to background noise conditions in the area, and the extent to which general background noise may offer beneficial masking effects.
- The characteristics of the sound in question such as whether the sound is constant, continually varies, or contains distinctive audible features such as tones, low frequency components or impulsive sound which may draw attention to the noise.
- The site location and the compatibility of the source in question with other surrounding land uses. For example, whether the source is in an industrial or residential area.

- The attitudes of the community to the source of the sound. This may be influenced by factors such as the extent to which those responsible for the sound are perceived to be adopting reasonable and practicable measures to reduce their emissions, whether the activity is of local or national significance and whether the noise producer actively consults and/or liaises with the community.
- The times when the sound is present, the duration of exposure to increased sound levels, and the extent of respite periods when the sound is reduced or absent (for example, whether the sound ceases at weekends).

The combined influence of the above considerations means that physical sound levels are only one factor influencing community reaction to sound. Importantly, this means that individual reactions and attitudes to the same type and level of sound will vary within a community.

APPENDIX C LEGISLATION AND GUIDELINES

C1 *Environment Protection Act 2017*

The following key concepts and definitions are reproduced from the *Environment Protection Act 2017* (EP Act).

General environmental duty (Section 25(1)):

> *A person who is engaging in an activity that may give rise to risks of harm to human health or the environment from pollution or waste must minimise those risks, so far as reasonably practicable.*

Harm (EP Act Section 4(1)):

> *In this Act, harm, in relation to human health or the environment, means an adverse effect on human health or the environment (of whatever degree or duration) and includes—*
> *(a) an adverse effect on the amenity of a place or premises that unreasonably interferes with or is likely to unreasonably interfere with enjoyment of the place or premises; or*
> *(b) a change to the condition of the environment so as to make it offensive to the senses of human beings; or*
> *(c) anything prescribed to be harm for the purposes of this Act or the regulations*

Minimising harm (EP Act Section 6(1)):

> *A duty imposed on a person under this Act to minimise, so far as reasonably practicable, risks of harm to human health and the environment requires the person—*
> *(a) to eliminate risks of harm to human health and the environment so far as reasonably practicable; and*
> *(b) if it is not reasonably practicable to eliminate risks of harm to human health and the environment, to reduce those risks so far as reasonably practicable.*

Prohibition of unreasonable noise (EP Act Section 166):

> *A person must not, from a place or premises that are not residential premises—*
> *(a) emit an unreasonable noise; or*
> *(b) permit an unreasonable noise to be emitted*

Unreasonable noise definition (EP Act Section 3):

> ***unreasonable noise** means—*
> *(a) noise that is unreasonable having regard to the following—*
> *(i) its volume, intensity or duration;*
> *(ii) its character;*
> *(iii) the time, place and other circumstances in which it is emitted;*
> *(iv) how often it is emitted;*
> *(v) any prescribed factors; and*
> *(b) noise that is prescribed to be unreasonable noise; and*
> *(c) does not include noise prescribed not to be unreasonable noise*

C2 *Environment Protection Regulations 2021*

The following key definitions are reproduced from the *Environment Protection Regulations 2021* (EP Regulations).

Time periods for assessing commercial, industrial and trade premises (Regulation 116):

> *In this Division, in relation to noise emitted from commercial, industrial and trade premises—*
>
> ***day period** means Monday to Saturday (except public holidays), from 7 a.m. to 6 p.m.;*
>
> ***evening period** means—*
> - *(i) Monday to Saturday, from 6 p.m. to 10 p.m.; and*
> - *(ii) Sunday and public holidays, from 7 a.m. to 10 p.m.;*
>
> ***night period** means 10 p.m. to 7 a.m. the following day.*

Noise sensitive area for the assessment of commercial, industrial and trade premises (Regulation 4):

> ***noise sensitive area** means—*
> - *(a) that part of the land within the boundary of a parcel of land that is—*
>   - *(i) within 10 metres of the outside of the external walls of any of the following buildings—*
>   - *(A) dwelling (including a residential care facility but not including a caretaker's house);*
>   - *(B) a residential building;*
>   - *(C) a noise sensitive residential use; or*
>   - (ii) *within 10 metres of the outside of* the external walls of any dormitory, ward, bedroom or living room of one or more of the following buildings—
>   - *(A) a caretaker's house;*
>   - *(B) a hospital;*
>   - *(C) a hotel;*
>   - *(D) a residential hotel;*
>   - *(E) a motel;*
>   - *(F) a specialist disability accommodation;*
>   - *(G) a corrective institution;*
>   - *(H) a tourist establishment;*
>   - *(I) a retirement village;*
>   - *(J) a residential village; or*
>   - (iii) *within 10 metres of the outside of the external walls of a classroom or any room in which learning occurs in the following buildings* (during their operating hours)—
>   - *(A) a child care centre;*
>   - *(B) a kindergarten;*
>   - *(C) a primary school;*
>   - *(D) a secondary school; or*
> - *(b) subject to paragraph (c), in the case of a rural area only, that part of the land within the boundary of—*
>   - *(i) a tourist establishment; or*
>   - *(ii) a campground; or*
>   - *(iii) a caravan park; or*

Prescribed unreasonable noise from commercial, industrial and trade premises (Regulation 118)

> *For the purposes of paragraph (b) of the definition of unreasonable noise in section 3(1) of the Act, noise emitted from commercial, industrial and trade premises is prescribed to be unreasonable noise if the effective noise level of the noise exceeds—*
>
> *(a) the noise limit that applies at the time the noise is emitted; or*
>
> *(b) the alternative assessment criterion that applies at the time the noise is emitted if the assessment of an effective noise level is conducted at an alternative assessment location in accordance with the Noise Protocol.*

C3 Environment Reference Standard

The environmental values defined in the Environment Reference Standard (ERS) are reproduced in Table 43.

Table 43: Environmental values of the ambient sound environment

Environmental value	Description of environmental value
Sleep during the night	An ambient sound environment that supports sleep during the night
Domestic and recreational activities	An ambient sound environment that supports recreational and domestic activities in a residential setting
Normal conversation	An ambient sound environment that allows for normal conversation indoors without the need to raise voices
Child learning and development	An ambient sound environment that supports cognitive development and learning in children
Human tranquillity and enjoyment outdoors in natural areas	An ambient sound environment that allows for the appreciation and enjoyment of the environment for its natural condition and the restorative benefits of tranquil soundscapes in natural areas
Musical entertainment	An ambient sound environment that recognises the community's demand for a wide range of musical entertainment.

The ERS indicators and objectives for different land use categories are reproduced in Table 44. The definitions for each category are reproduced in Table 45.

Table 44: Indicators and objectives for the ambient sound environment

Land use category	Indicators	Objectives
Category I	Outdoor $L_{Aeq,8h}$ from 2200 hrs to 0600 hrs	55 dB L_{Aeq}
	Outdoor $L_{Aeq,16h}$ from 0600 hrs to 2200 hrs	60 dB L_{Aeq}
Category II	Outdoor $L_{Aeq,8h}$ from 2200 hrs to 0600 hrs	50 dB L_{Aeq}
	Outdoor $L_{Aeq,16h}$ from 0600 hrs to 2200 hrs	55 dB L_{Aeq}
Category III	Outdoor $L_{Aeq,8}$ from 2200 hrs to 0600 hrs	40 dB L_{Aeq}
	Outdoor $L_{Aeq,16h}$ from 0600 hrs to 2200 hrs	50 dB L_{Aeq}
Category IV	Outdoor $L_{Aeq,8h}$ from 2200 hrs to 0600 hrs	35 dB L_{Aeq}
	Outdoor $L_{Aeq,16h}$ from 0600 hrs to 2200 hrs	40 dB L_{Aeq}
Category V	Qualitative	A sound quality that is conducive to human tranquillity and enjoyment, having regard to the ambient natural soundscape

Table 45: Land use categories for the ambient sound environment

Land use category	General description	Planning zones
Category I	An urban form with distinctive features or characteristics of taller buildings, high commercial and residential intensity, and high site coverage.	Industrial Zone 1 (IN1Z) Industrial Zone 2 (IN2Z) Port Zone (PZ) Road 1 Zone (RDZ1) Capital City Zone (CCZ) Docklands Zone (DZ)
Category II	Medium rise building form with a strong urban or commercial character. Typically contains mixed land uses including activity centres and larger consolidated sites, and an active public realm.	Industrial Zone 3 (IN3Z) Commercial 1 Zone (C1Z) Commercial 2 Zone (C2Z) Commercial 3 Zone (C3Z) Activity Centre Zone (ACZ) Mixed Use Zone (MUZ) Road 2 Zone (RDZ2)
Category III	Lower rise building form including lower density residential development and detached housing typical of suburban residential settings or in towns of district or regional significance.	Residential Growth Zone (RGZ) General Residential Zone (GRZ) Neighbourhood Residential Zone (NRZ) Urban Floodway Zone (UFZ) Public Park and Recreation Zone (PPRZ) Urban Growth Zone (UGZ)
Category IV	Lower density or sparse populations with settlements that include smaller hamlets, villages and small towns that are generally unsuited for further expansion. Land uses include primary industry and farming.	Low Density Residential Zone (LDRZ) Township Zone (TZ) Rural Living Zone (RLZ) Green Wedge A Zone (GWAZ) Rural Conservation Zone (RCZ) Public Conservation and Resource Zone (PCRZ) Green Wedge Zone (GWZ) Farming Zone (FZ) Rural Activity Zone (RAZ)
Category V	Unique combinations of landscape, biodiversity and geodiversity. These natural areas typically provide undisturbed species habitat and enable people to see and interact with native vegetation and wildlife.	Natural areas are classified as land within Category V irrespective of the planning zones that apply to that land.
Category I, II, III or IV depending on surrounding land uses and the intent of the specific planning zone (which may have a diversity of uses) as specified in a schedule to the planning zone		Comprehensive Development Zone (CDZ) Priority Development Zone (PDZ) Special Use Zone (SUZ) Public Use Zone (PUZ)

Note: Urban Growth Zone (UGZ) is a Category III land use until the relevant precinct structure plan is adopted, at which time the approved land uses will determine the land use category.

C4 EPA Publication 1834

Key text extracts reproduced from Section 4.4 of EPA Publication 1834.1 *Civil construction, building and demolition guide*:

Where relevant, works outside normal working hours (Sunday, public holidays, evening and night-time) should be done in accordance with local laws or with an approval.

Projects should aim to constrain works to normal working hours. Where necessary, works or activities outside normal working hours may occur for:

- ***Low-noise impact works** – these are inherently quiet or unobtrusive, for example, manual painting, internal fitouts, and cabling. Low-noise works do not have intrusive characteristics such as impulsive noise or tonal movement alarms. The relevant authority must be contacted, and any necessary approvals sought.*
- ***Managed-impact works** – works where the noise emissions are managed through actions specified in a noise and vibration management plan (may be part of a broader environmental management plan), to minimise impacts on sensitive receivers. Managed-impact works do not have intrusive characteristics such as impulsive noise or tonal movement alarms.*

  You must contact the relevant authority and seek any necessary approvals. A noise and vibration management plan may need to be prepared or reviewed by a suitably qualified acoustic consultant or practitioner (see Work with an environmental consultant, EPA website).
- ***Unavoidable works** – are **works** which pose an unacceptable risk to life or property or a major traffic hazard and can be justified. Includes an activity which has commenced but cannot be stopped. You will need to demonstrate that planned unavoidable works cannot be reasonably moved to normal work hours. This requires additional consideration of potential noise and vibration generating activities and controls to minimise noise and vibration. These can be recorded within the noise and vibration management plan (may be part of a broader environmental management plan).*

  You must contact the relevant authority and seek any necessary approvals for unavoidable works. You should notify affected sensitive receivers of the intended work, its duration and times of occurrence. A noise and vibration management plan may need to be prepared or reviewed by a suitably qualified acoustic consultant or practitioner to address unavoidable works (see Work with an environmental consultant, EPA website).

Examples of unavoidable works may include:

- *the delivery of oversized plant or structures that police or other authorities determine require special arrangements to transport along 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*
- *tunnelling works including mined excavation elements and the activities that are required to support tunnelling works (i.e. spoil treatment facilities)*
- *rail occupations or works that would cause a major traffic hazard*
- *works where a proponent demonstrates and justifies a need to operate outside normal working hours such as work that once started cannot practically be stopped until completed such as concrete pouring or construction of diaphragm walls.*

C5 Construction vibration guidelines

In relation to cosmetic damage, the guidance contained in the NSW CNVG is based on the criteria contained in BS 7385-2:1993 *Evaluation and measurement for vibration in buildings Part 2* (BS 7835-2). For human comfort, the guidance is based on criteria on guidance from the former NSW Department of Environment and Conservation titled *Assessing Vibration: a technical guideline* dated February 2006.

C5.1 Human response to vibration

The NSW CNVG provides indicative minimum working distances that are a suitable guide for planning stage assessments of vibration and potential impacts to human comfort.

However, if construction vibration monitoring is found to be warranted during the construction stage of a project (e.g. as a result of activity occurring at distances less than or comparable to the indicative minimum working distances), it is necessary to refer to alternative guidance that specifies criteria that can be used to assess measured vibration levels.

In lieu of current Australian Standards that present vibration criteria for human responses, there are a number of international standards and reference documents available that provide relevant guidance. Of these, BS 6472-1:2008 *Guide to evaluation of human exposure to vibration in buildings* (BS 6472-1) is the most current of the relevant standards and is widely accepted within the industry.

BS 6472-1 provides a range of vibration dose value (VDV) levels to assess the likelihood of adverse comment from different types of vibration (constant, impulsive, occasional and intermittent). These are reproduced in Table 46. The VDV levels can be applied to all types of vibration and take into account the duration of exposure. This has practical benefits for situations where vibration may be generated from multiple different sources operating at different times and different locations.

Table 46: Vibration dose value ranges and probabilities of adverse comment within residential buildings

Place and time	Low probability of adverse comment $m{\cdot}s^{-1.75}$	Adverse comment possible $m{\cdot}s^{-1.75}$	Adverse comment probable $m{\cdot}s^{-1.75}$
Residential building 16 h day	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Residential building 8 h night	0.1 to 0.2	0.2 to 0.4	0.4 to 0.8

Note: The guideline targets are non-mandatory; they are goals that should be sought to be achieved through the application of feasible and reasonable mitigation measures.

The VDVs recommended in the document for vibration of an intermittent nature (i.e. construction works) are presented in Table 47. These represent the values which could be nominated in a construction noise and vibration management plan for the project, for reference in the event of construction vibration monitoring being warranted.

Table 47: Acceptable vibration dose values for intermittent vibration (VDV $m/s^{1.75}$)

Location	Day (0700 to 2200 hrs)		Night (2200 to 0700 hrs)	
	Preferred Value	**Maximum Value**	**Preferred Value**	**Maximum Value**
Residences	0.20	0.40	0.10	0.20
Offices, schools, educational institutions, places of worship	0.40	0.80	0.40	0.80
Workshops	0.80	1.60	0.80	1.60

Note: The guideline targets are non-mandatory; they are goals that should be sought to be achieved through the application of feasible and reasonable mitigation measures.

C5.2 Vibration damage to buildings and structures

The NSW CNVG provides indicative minimum working distances that are a suitable guide for planning stage assessments of vibration with respect to potential structural damage.

However, if construction vibration monitoring is found to be warranted during the construction stage of a project (e.g. as a result of activity occurring at distances less than or comparable to the indicative minimum working distances), it is necessary to refer to alternative guidance that specifies criteria that can be used to assess measured vibration levels.

There are no current Australian Standards that present vibration criteria for building damage. A widely referenced and accepted international standard for the assessment of building vibration is the German Standard DIN 4150-3:2016-12 *Vibrations in buildings – Part 3: Effects on structures* (DIN 4150-3). The structural damage criteria specified by DIN 4150-3 over the range 1–100 Hz are presented in Table 48. DIN 4150-3 specifies Peak Particle Velocity (PPV) as the assessable vibration parameter.

Table 48: Vibration limits according to DIN 4150-3

Line	Type of building	Guideline values for velocity, v_i, in mm/s (peak)				
		Foundation, all directions, i = x, y, z, at a frequency of			Topmost floor, horizontal direction, i = x, y	Floor slabs, vertical direction, i = z
		1-10 Hz	10-50 Hz	50-100 Hz[a]	All frequencies	All frequencies
1	Buildings used for commercial purposes, industrial buildings, and buildings of similar design	20	20-40	40-50	40	10
2	Residential buildings and buildings of similar design and/or occupancy	5	5-15	15-20	15	5
3	Structures that, because of their particular sensitivity to vibration, cannot be classified under lines 1 and 2 and are of great intrinsic value (e.g. listed buildings)	3	3-8	8-10	8	2.5[b]

NOTE Even if guideline values as in line 1, columns 2 to 5, are complied with, minor damage cannot be excluded.

[a] At frequencies above 100 Hz, the guideline values for 100 Hz can be applied as minimum values.
[b] Paragraph 2 of DIN 4150-3 5.1.2 shall be observed.

APPENDIX D IDENTIFIED NOISE SENSITIVE LOCATIONS (RECEIVERS)

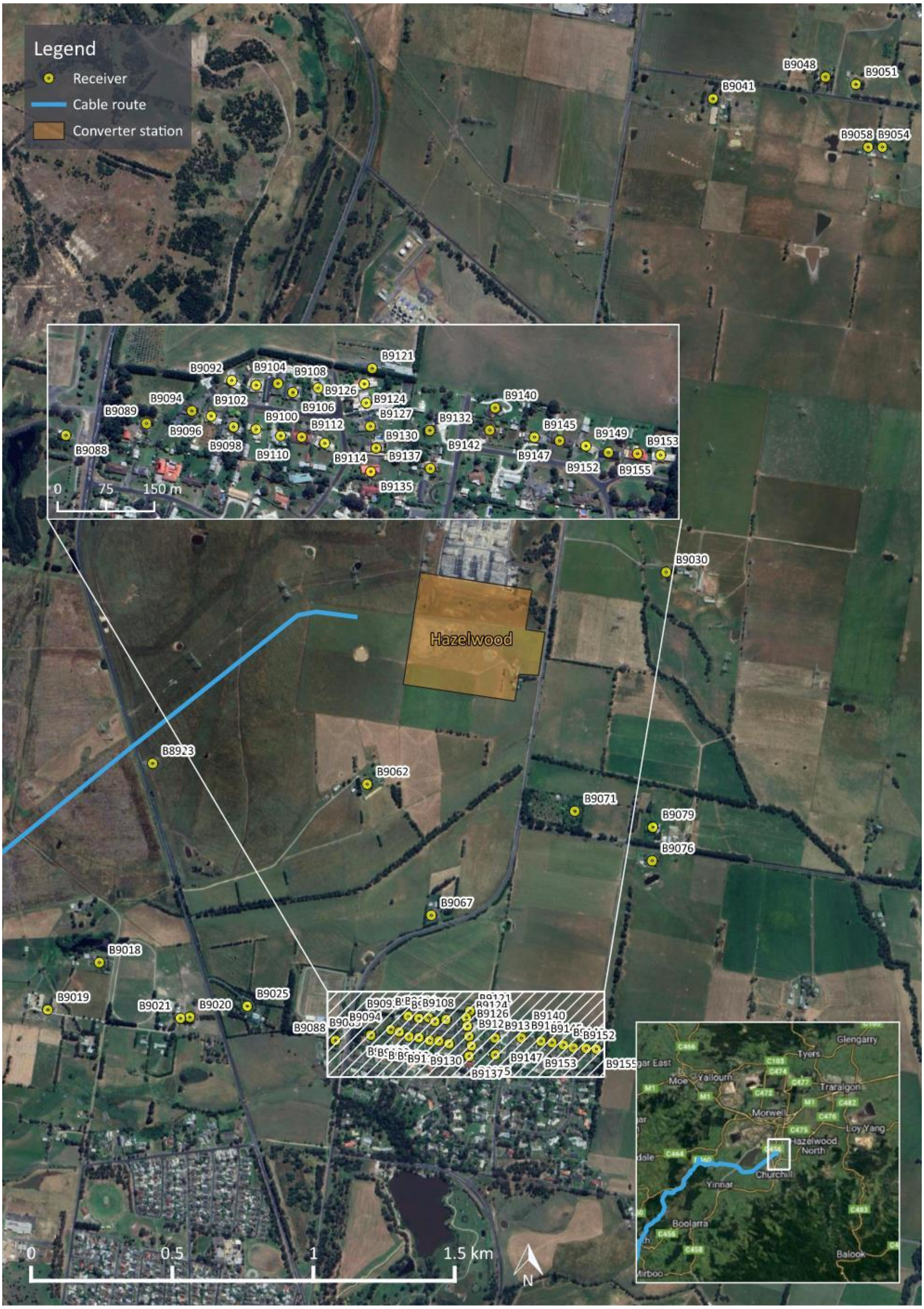

Figure 20: Identified receivers – plate 01

Figure 21: Identified receivers – plate 02

Marshall Day Acoustics

Figure 22: Identified receivers – plate 03

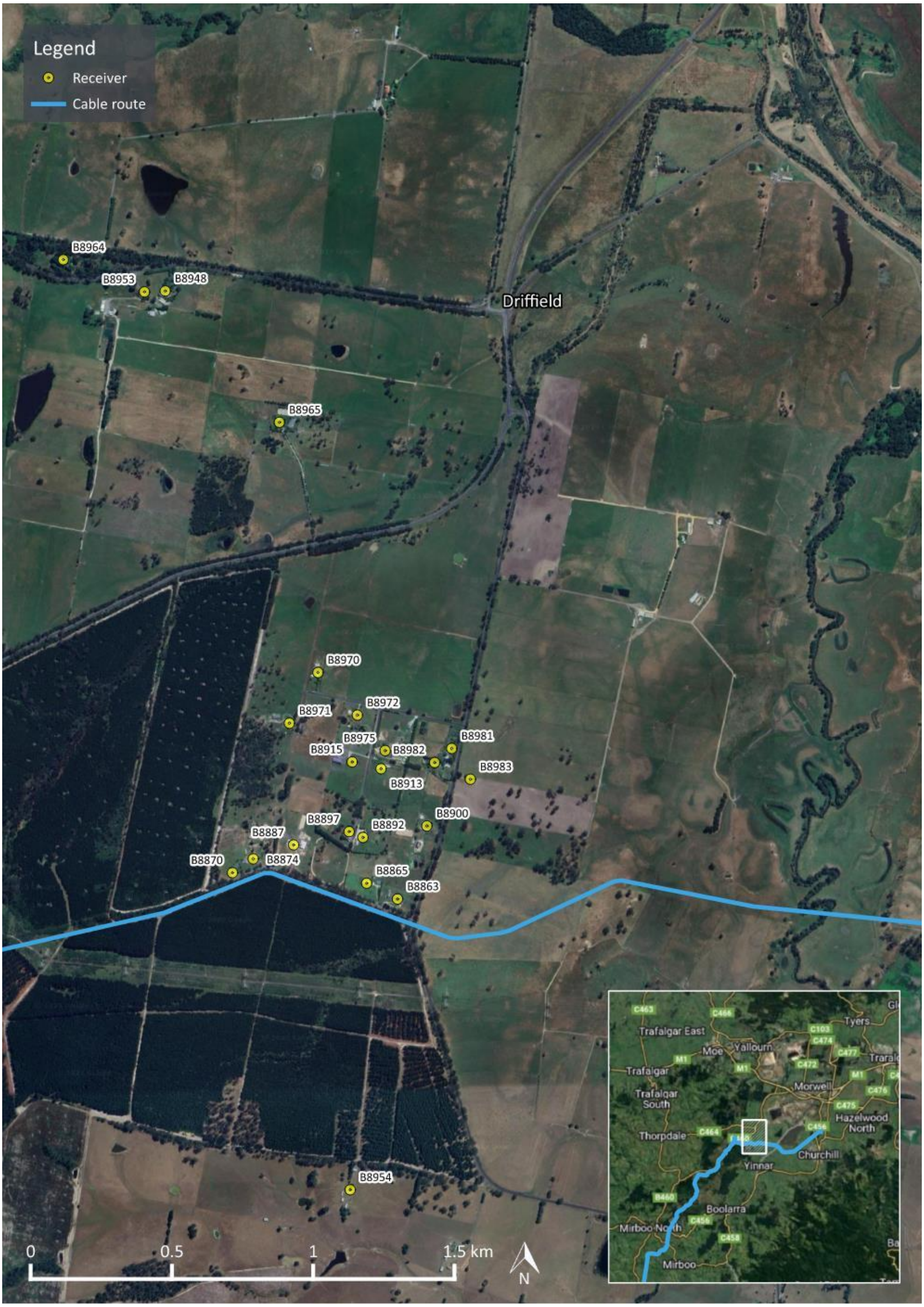

Figure 23: Identified receivers – plate 04

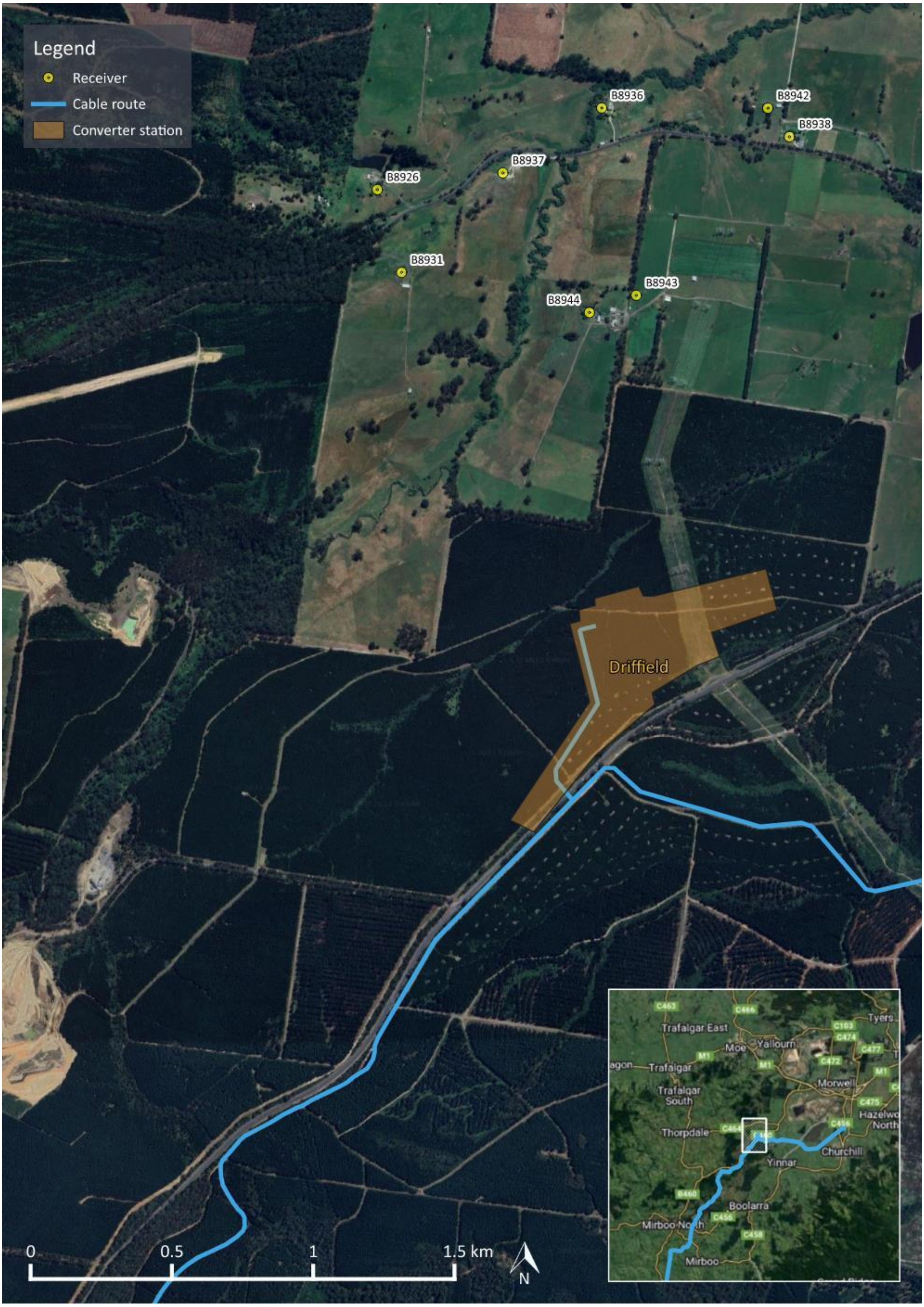

Figure 24: Identified receivers – plate 05

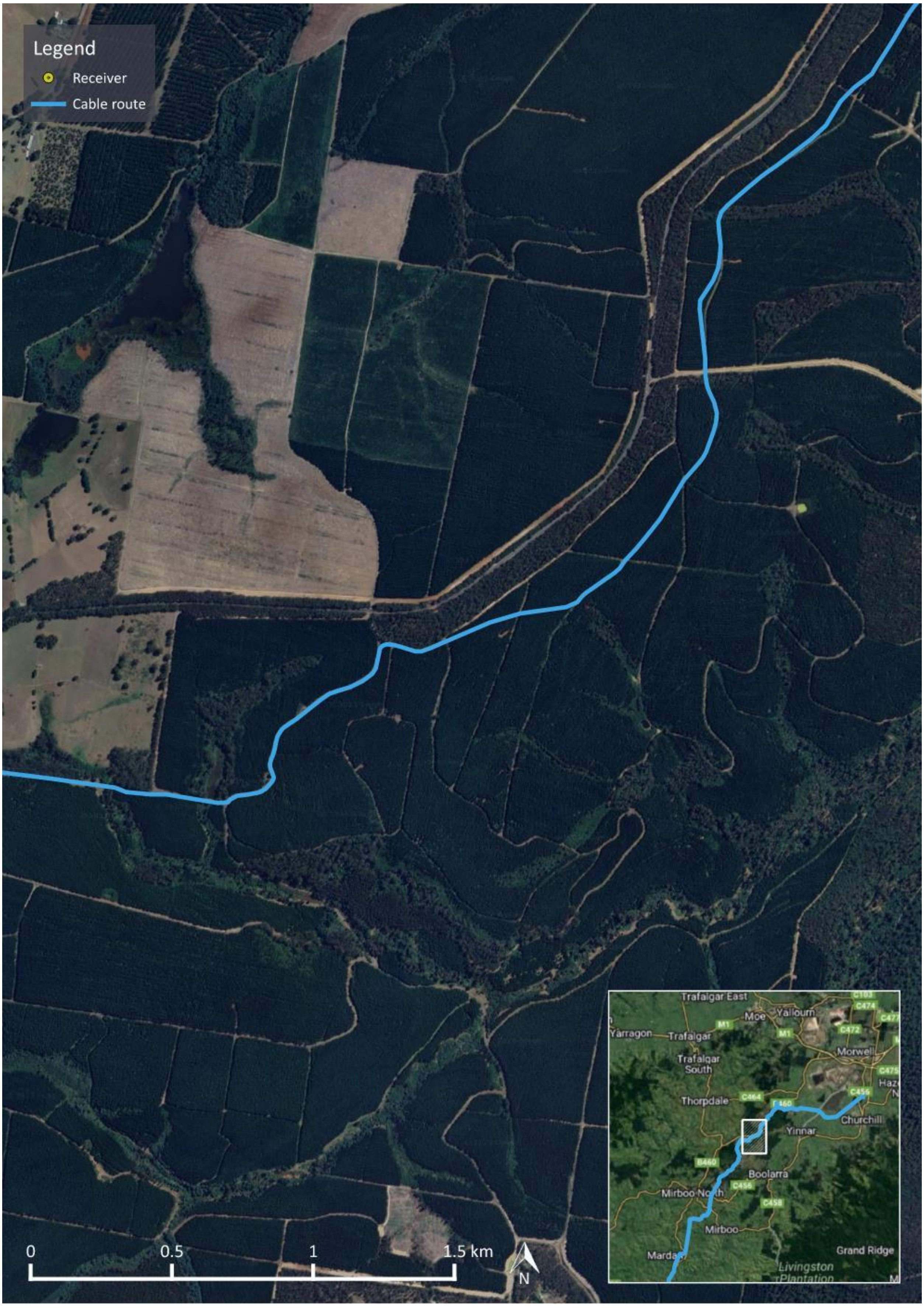

Figure 25: Identified receivers – plate 06

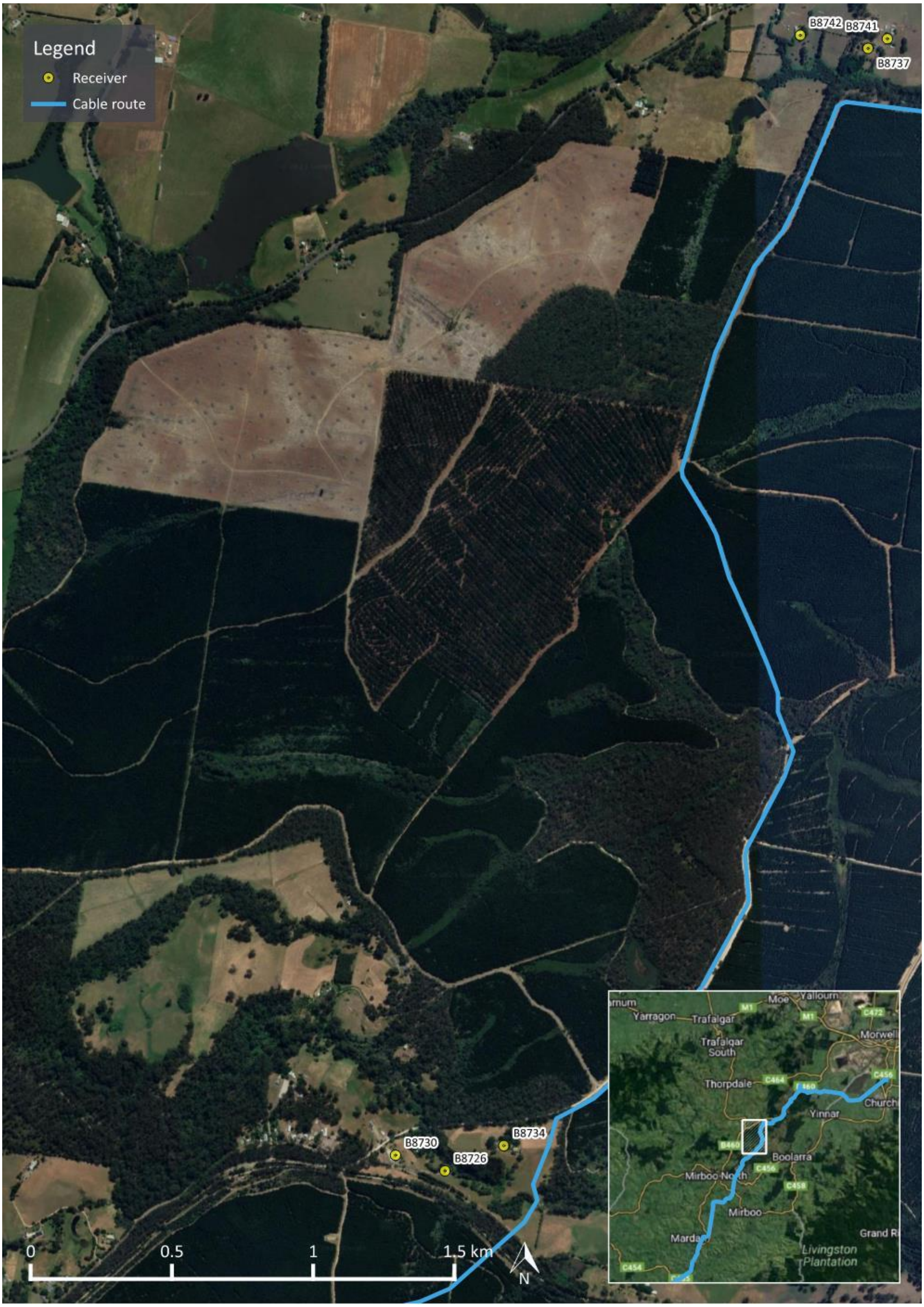

Figure 26: Identified receivers – plate 07

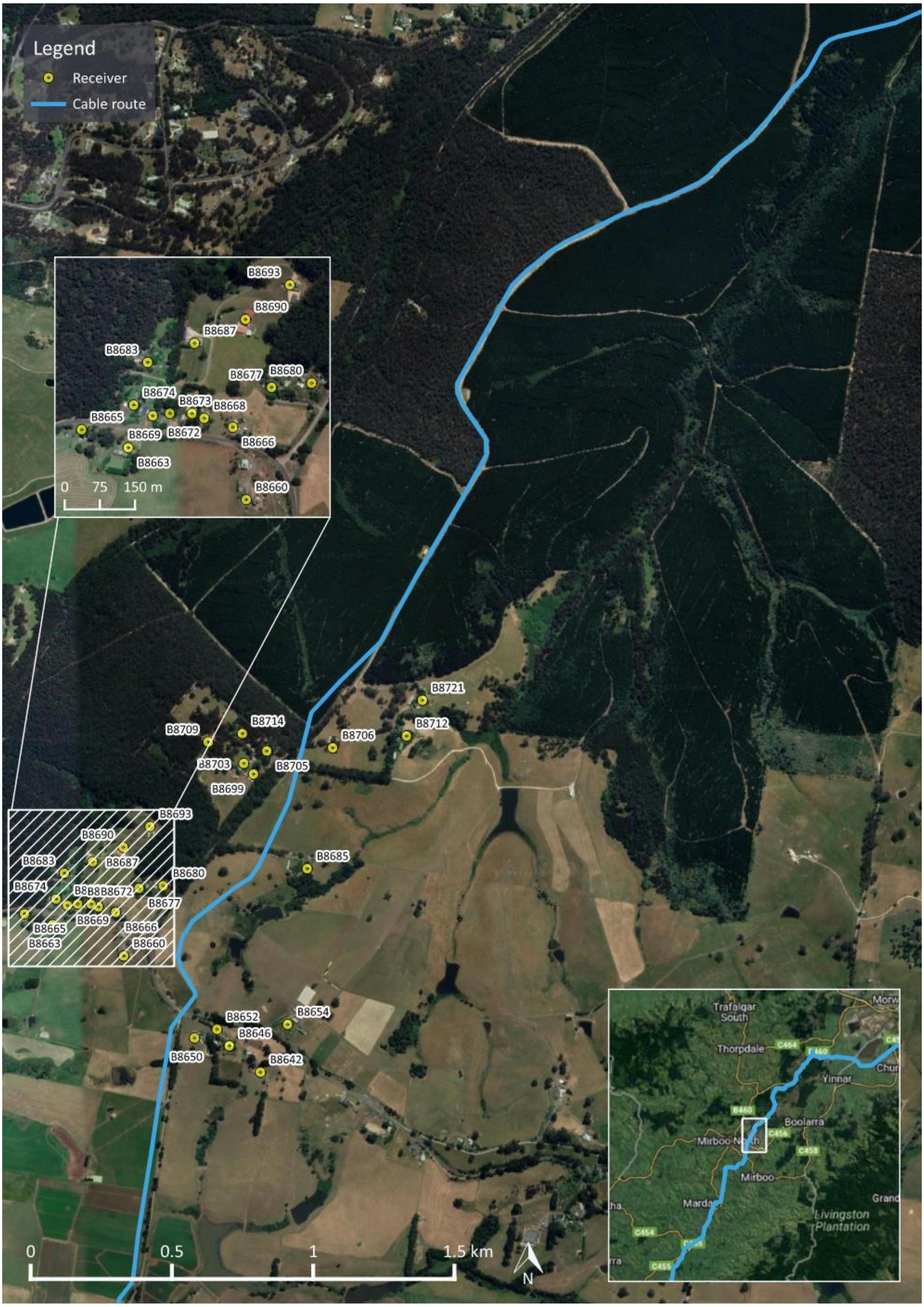

Figure 27: Identified receivers – plate 08

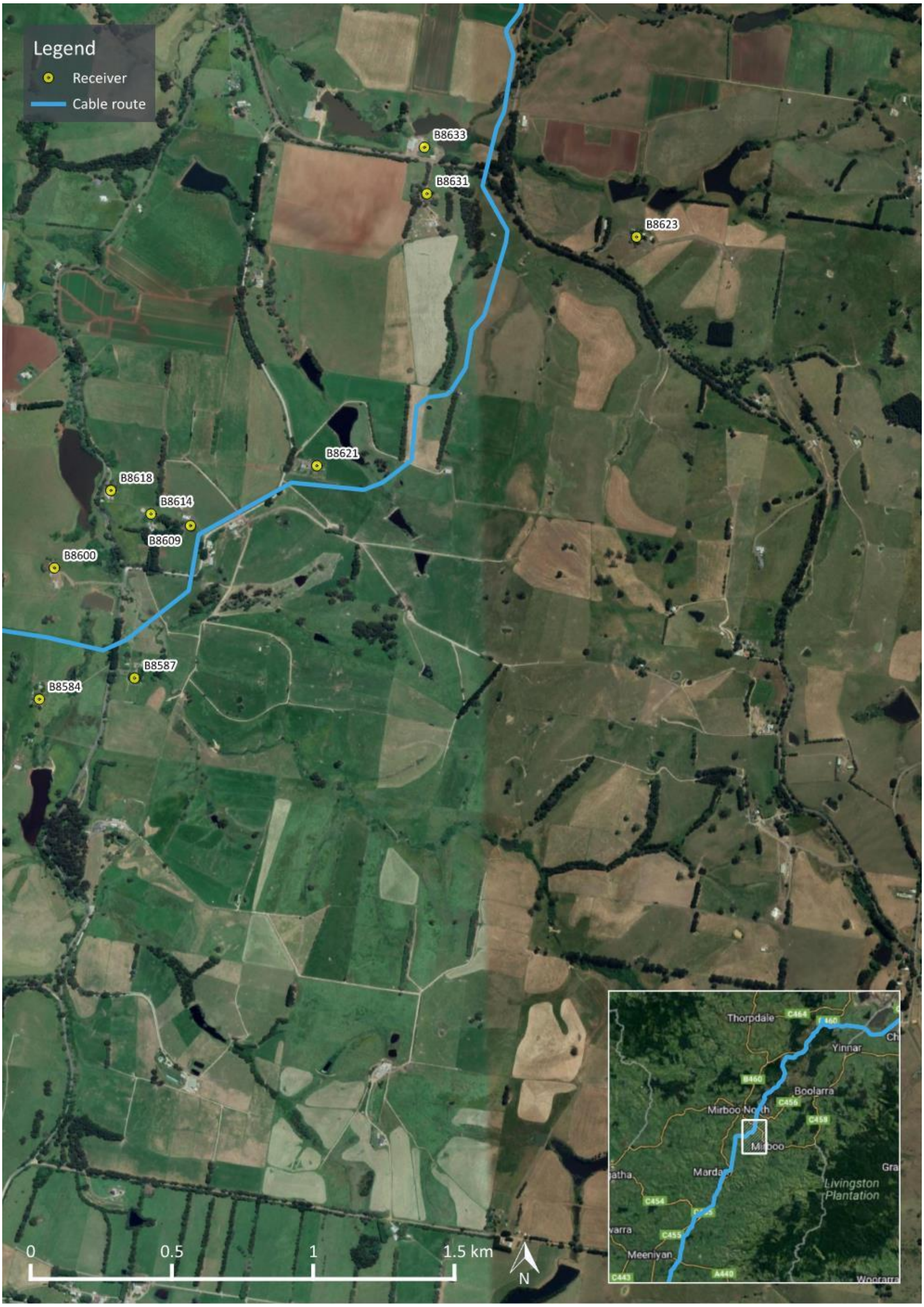

Figure 28: Identified receivers – plate 09

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Figure 29: Identified receivers – plate 10

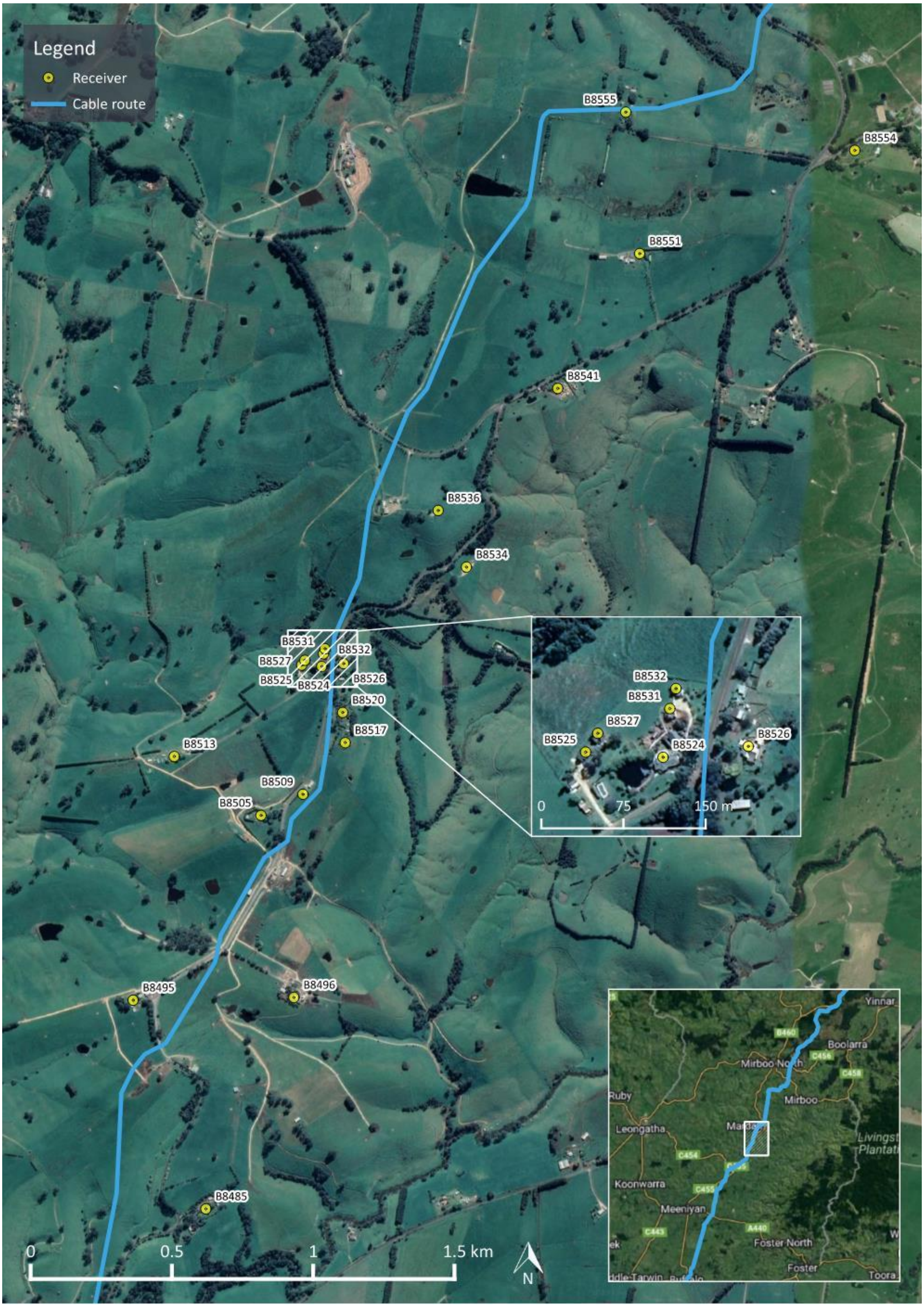

Figure 30: Identified receivers – plate 11

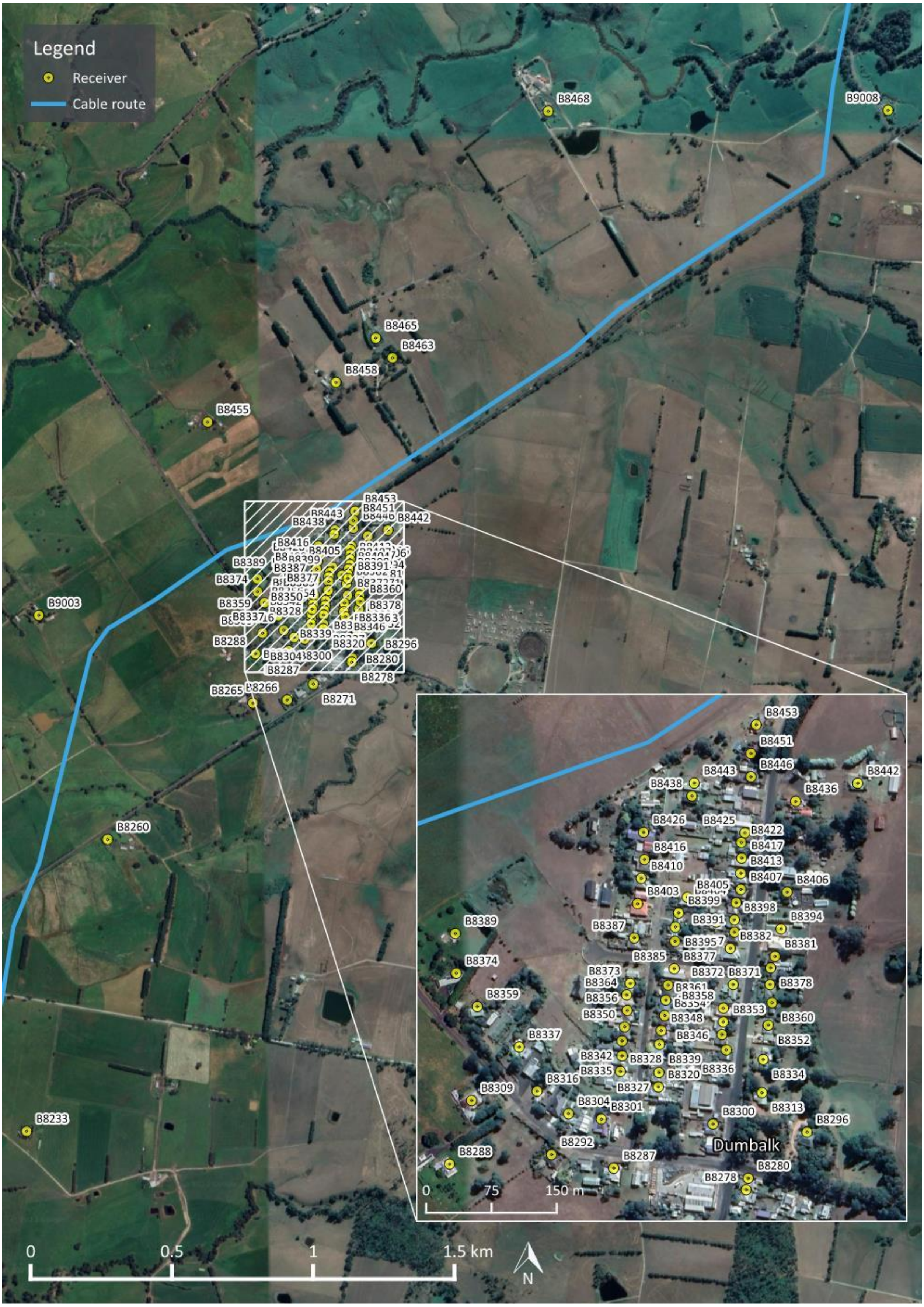

Figure 31: Identified receivers – plate 12

Figure 32: Identified receivers – plate 13

Figure 33: Identified receivers – plate 14

Figure 34: Identified receivers – plate 15

Figure 35: Identified receivers – plate 16

Figure 36: Identified receivers – plate 17

Figure 37: Identified receivers – plate 18

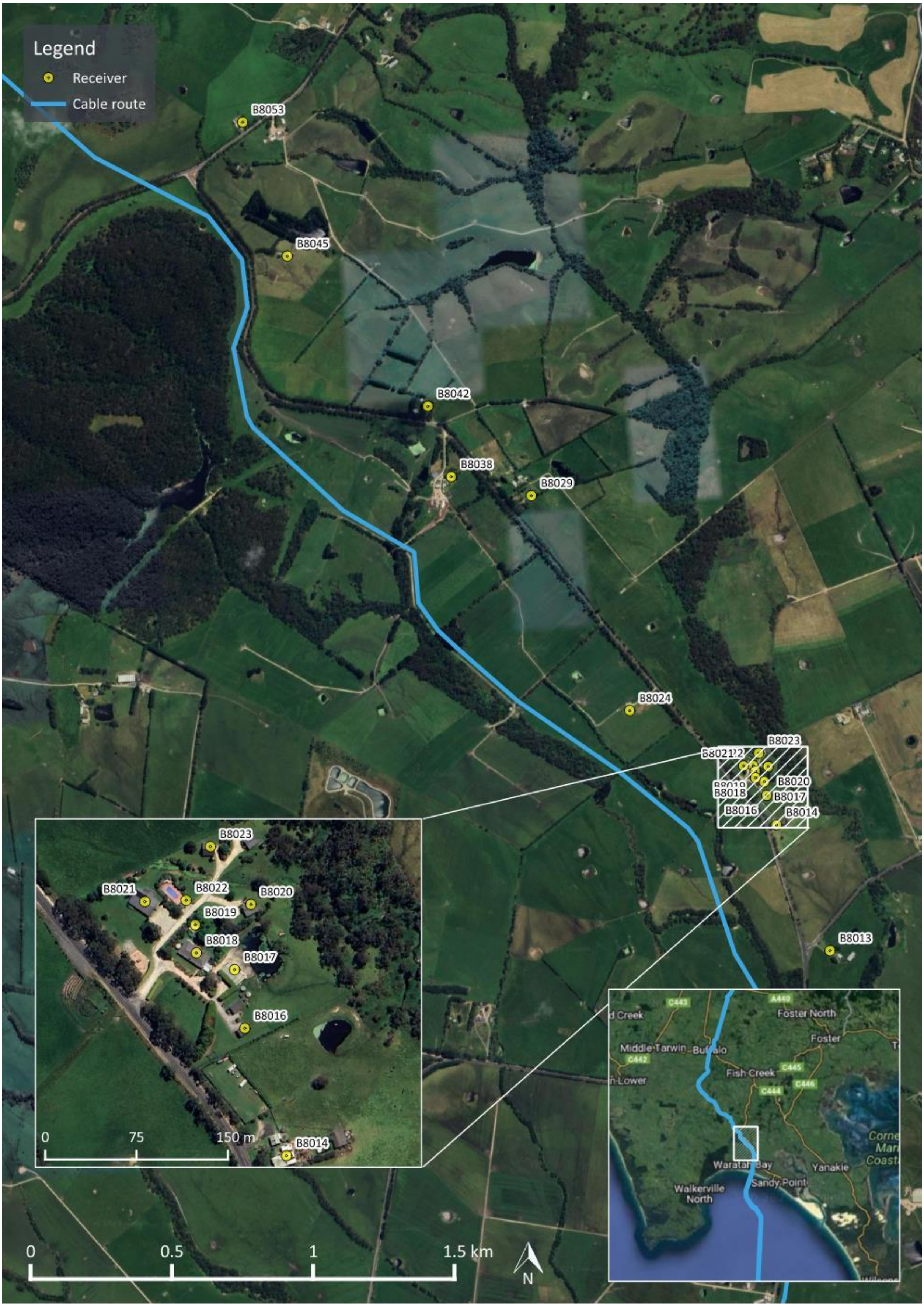

Figure 38: Identified receivers – plate 19

Figure 39: Identified receivers – plate 20

APPENDIX E BACKGROUND NOISE SURVEY

This appendix presents details of the background noise monitoring conducted between 11-22 July 2022 at a selection of sites in the vicinity of the project, including:

- monitoring equipment locations and installation photos;
- tabular measured background noise levels for each locations; and
- a time history of the measured background and ambient noise levels for each location.

All noise monitoring was undertaken using Class 1 sound level meters (highest class rating for environmental noise surveys). Instrument calibration conformed with the requirements of AS 1055:2018 *Acoustics – Description and measurement of environmental noise* (independent laboratory calibration and reference level checks during deployment and retrieval of the instrumentation).

The measured background noise levels for each location were analysed in accordance with the procedures outlined in Section 4.1 of EPA Publication 1826.4 *Noise limit and assessment protocol for the control of noise from commercial, industry and trade premises and entertainment venues*, with the following exceptions:

1. Weather conditions were frequently rainy or featured periods where the wind speed was higher than Beaufort Wind Scale 3; accordingly all noise data has been presented for the survey, with periods of inclement weather highlighted for reference.
2. In addition to the arithmetic average background ($L_{A90,1hr}$) values, the lowest and median background value has also been reported for each location.

The background noise levels, dB L_{A90}, are commonly used to gauge the potential for new noise sources to be intrusive on the existing noise environment. The total ambient noise environment, often measured by the average (equivalent) noise over the same period, is typically around 5 dB higher (note that this equivalent noise level includes all sounds present at the locations and is distinct from the mean or median background noise values). The ambient noise levels are illustrated on the measurement time history charts for each location.

E1 Background noise monitoring locations

Table 49: Monitoring equipment and locations

Site	Location	Equipment	Easting	Northing	Weather station
1	Tramway Road, Hazelwood North	01dB CUBE 10510	450,124	5,762,256	No
2	Switchback Road, Hazelwood	01dB CUBE 11276	446,381	5,760,073	Yes
3	Yinnar-Driffield Road, Driffield	01dB CUBE 11296	440,812	5,760,733	No
4	HVP (off Fords Road)	01dB DUO 10196	438,728	5,762,352	No
5	Smallmans Road, Mardan	01dB CUBE 10423	424,738	5,740,944	Yes
6	Meeniyan-Mirboo North Road, Dumbalk	01dB CUBE 11877	423,646	5,739,070	No
7	Meeniyan-Mirboo North Road, Dumbalk	01dB DUO 10197	419,807	5,733,831	No
8	Buffalo-Stony Creek Road, Stony Creek	01dB CUBE 10516	417,763	5,727,398	No
9	Moores Road, Buffalo	01dB CUBE 10512	415,108	5,720,820	Damaged
10	Waratah Road, Sandy Point	01dB DUO 10496	420,582	5,704,839	No
11	Fish Creek-Waratah Road, Waratah Bay	01dB CUBE 11289	419,261	5,704,471	Yes

At the locations where a weather station was not deployed, wind and rainfall were assessed based on a combination of data from the weather stations and publicly available data from the Bureau of Meteorology monitoring station at Pound Creek.

Figure 40: Site 1 – Tramway Road, Hazelwood North

Figure 41: Site 2 – Switchback Road, Hazelwood

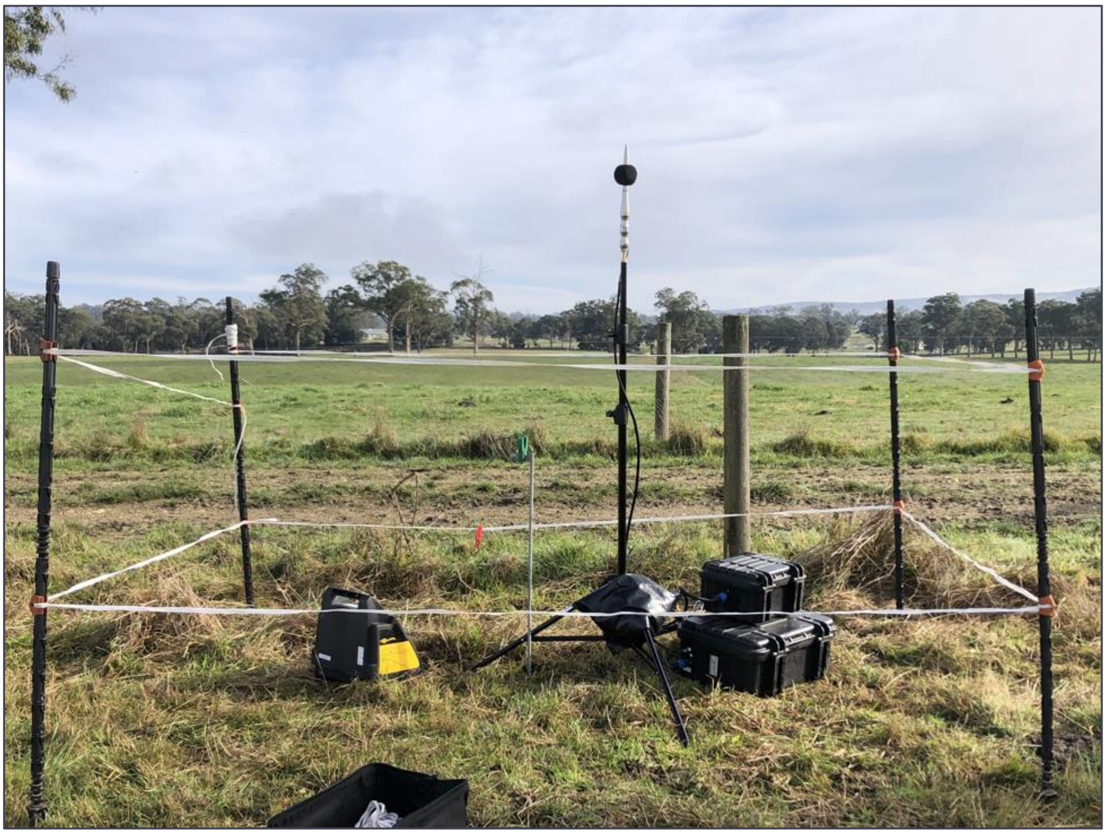

Figure 42: Site 3 – Yinnar-Driffield Road, Driffield

Figure 43: Site 4 – HVP (off Fords Road)

Figure 44: Site 5 – Smallmans Road, Mardan

Figure 45: Site 6 – Meeniyan-Mirboo North Road, Dumbalk

Figure 46: Site 7 – Meeniyan-Mirboo North Road, Dumbalk

Figure 47: Site 8 – Buffalo-Stony Creek Road, Stony Creek

Figure 48: Site 9 – Moores Road, Buffalo

Figure 49: Site 10 – Waratah Road, Sandy Point

Figure 50: Site 11 – Fish Creek-Waratah Road, Waratah Bay

E2 Measured noise levels – site 1

The measured background noise levels at site 1 are summarised in Table 50. Periods in which one or more measurement samples (1-hour samples) were affected as a result of rain and/or wind are designated by grey shading.

The time history of noise levels for site 1 is shown on the following page in Figure 51. The ambient (L_{Aeq}) and maximum (L_{Amax}) noise levels are also presented.

Table 50: Site 1 – background noise levels, dB $L_{A90,1h}$ – period mean values (minimum/maximum)

Date	Day 0700 – 1800 hrs Mon – Sat	Evening 1800 – 2200 hrs Mon – Sat 0700 – 2200 hrs Sun & PH	Night 2200 - 0700 hrs
11/07/2022 – Monday	Incomplete data for period	41 (39/43)	36 (31/48)
12/07/2022 – Tuesday	45 (39/51)	40 (36/45)	33 (29/43)
13/07/2022 – Wednesday	44 (40/49)	40 (37/44)	36 (33/45)
14/07/2022 – Thursday	42 (38/50)	41 (38/44)	36 (31/47)
15/07/2022 – Friday	44 (39/50)	41 (40/45)	35 (33/39)
16/07/2022 – Saturday	44 (40/46)	40 (38/44)	39 (36/44)
17/07/2022 – Sunday	n/a	43 (40/48)	45 (43/47)
18/07/2022 – Monday	46 (43/49)	42 (38/44)	Incomplete data for period
Minimum	**42 (38/46)**	**40 (36/43)**	**33 (29/39)**
Average	**44 (40/49)**	**41 (38/44)**	**37 (34/45)**
Median	**44 (40/49)**	**41 (38/44)**	**36 (33/45)**

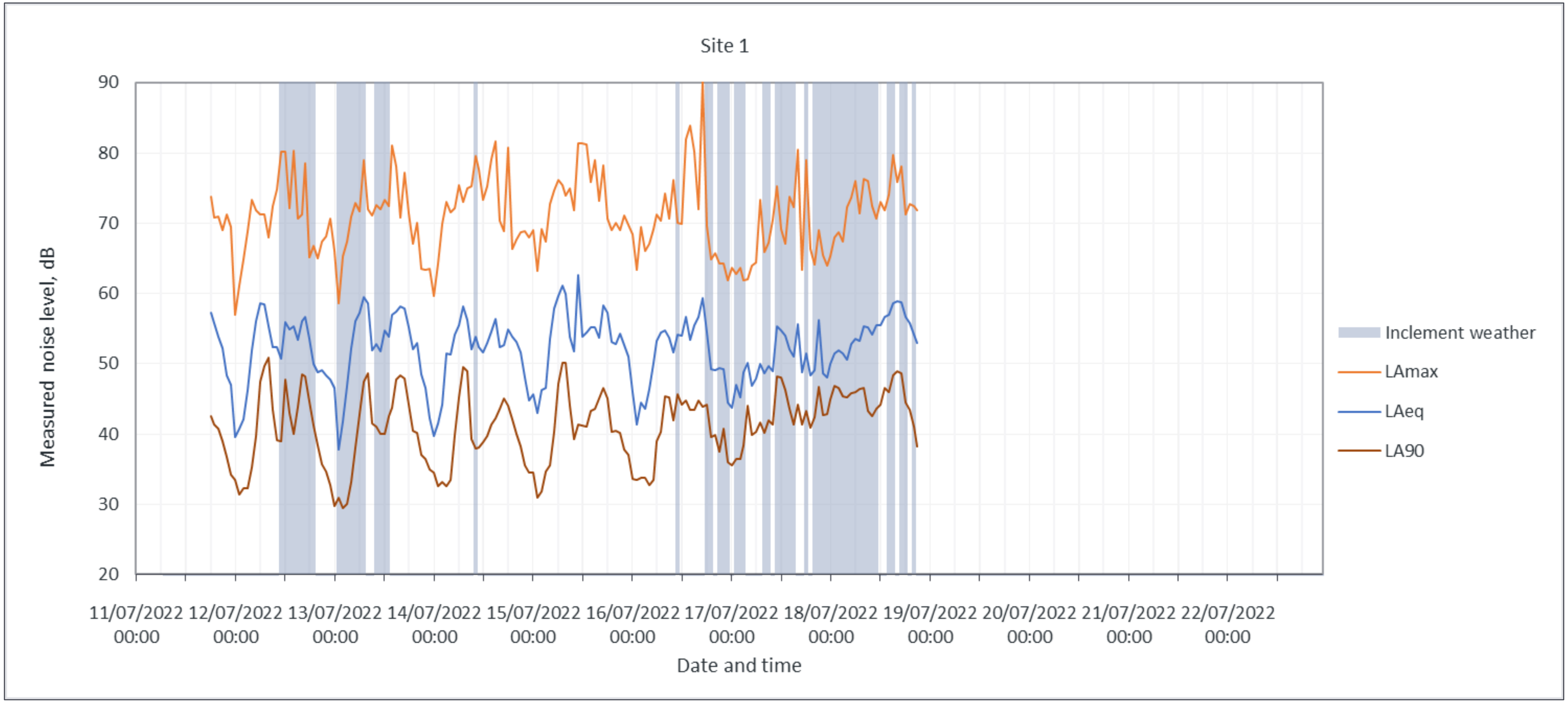

Figure 51: Site 1 – Tramway Road, Hazelwood north – measured noise levels in 1-hour intervals

E3 Measured noise levels – site 2

The measured background noise levels at site 2 are summarised in Table 51. Periods in which one or more measurement samples (1-hour samples) were affected as a result of rain and/or wind are designated by grey shading.

The time history of noise levels for site 2 is shown on the following page in Figure 52. The ambient (L_{Aeq}) and maximum (L_{Amax}) noise levels are also presented.

Table 51: Site 2 – background noise levels, dB $L_{A90,1h}$ – period mean values (minimum/maximum)

Date	Day 0700 – 1800 hrs Mon – Sat	Evening 1800 – 2200 hrs Mon – Sat 0700 – 2200 hrs Sun & PH	Night 2200 - 0700 hrs
11/07/2022 – Monday	Incomplete data for period	39 (37/45)	33 (31/37)
12/07/2022 – Tuesday	37 (31/45)	40 (36/46)	32 (28/35)
13/07/2022 – Wednesday	35 (30/44)	44 (31/67)	40 (29/65)
14/07/2022 – Thursday	37 (30/49)	58 (43/72)	41 (33/65)
15/07/2022 – Friday	39 (35/50)	53 (42/72)	44 (33/61)
16/07/2022 – Saturday	37 (32/56)	67 (57/74)	45 (37/66)
17/07/2022 – Sunday	n/a	48 (35/75)	46 (42/55)
18/07/2022 – Monday	39 (35/59)	75 (73/77)	54 (33/73)
19/07/2022 – Tuesday	35 (30/45)	74 (73/75)	58 (35/73)
20/07/2022 – Wednesday	38 (35/43)	72 (68/74)	42 (31/70)
21/07/2022 – Thursday	39 (37/44)	62 (36/73)	Incomplete data for period
Minimum	**35 (30/43)**	**39 (31/45)**	**35 (29/35)**
Average	**38 (33/51)**	**58 (50/68)**	**43 (33/60)**
Median	**37 (34/47)**	**60 (43/72)**	**43 (33/65)**

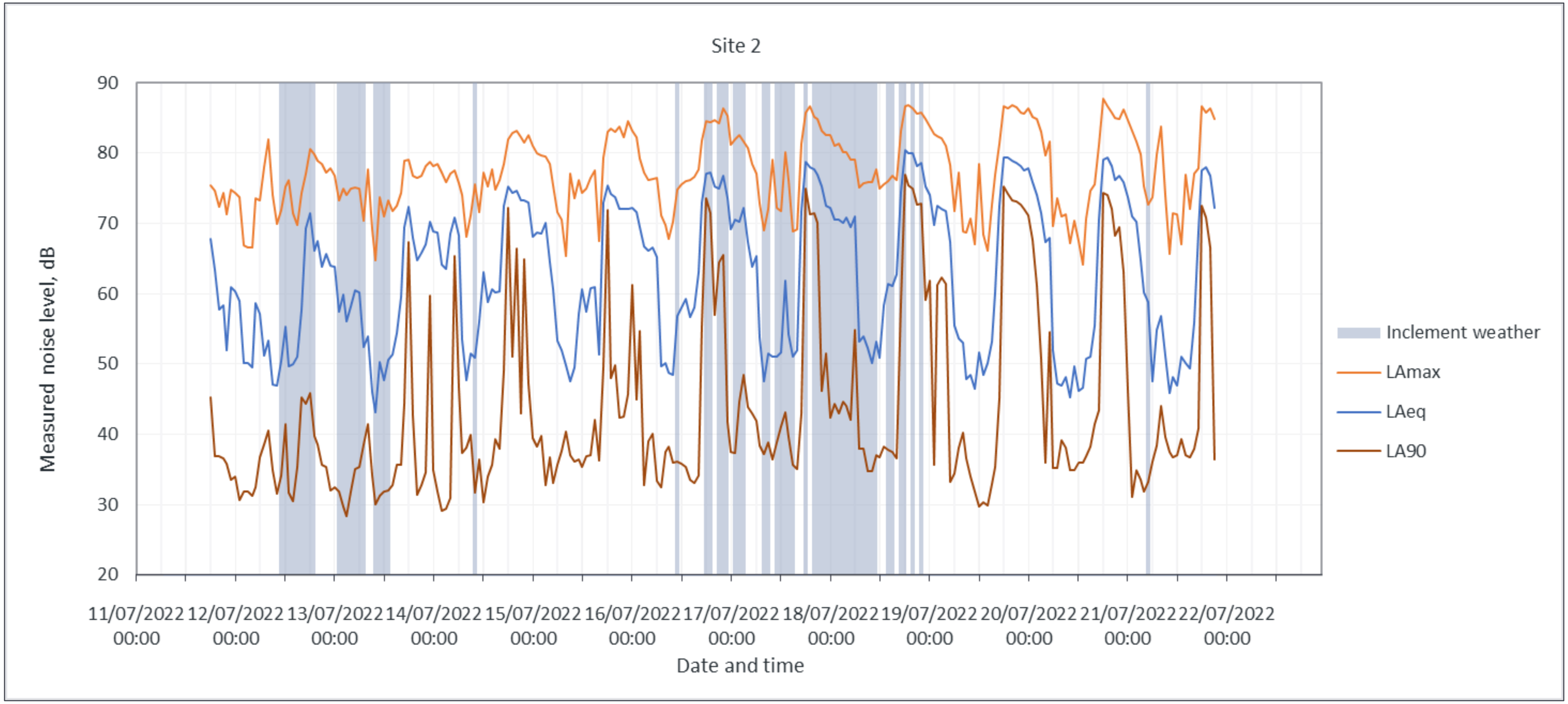

Figure 52: Site 2 – Switchback Road, Hazelwood – measured noise levels in 1-hour intervals

E4 Measured noise levels – site 3

The measured background noise levels at site 3 are summarised in Table 52. Periods in which one or more measurement samples (1-hour samples) were affected as a result of rain and/or wind are designated by grey shading.

The time history of noise levels for site 3 is shown on the following page in Figure 53. The ambient (L_{Aeq}) and maximum (L_{Amax}) noise levels are also presented.

Table 52: Site 3 – background noise levels, dB $L_{A90,1h}$ – period mean values (minimum/maximum)

Date	Day 0700 – 1800 hrs Mon – Sat	Evening 1800 – 2200 hrs Mon – Sat 0700 – 2200 hrs Sun & PH	Night 2200 - 0700 hrs
11/07/2022 – Monday	Incomplete data for period	38 (36/40)	34 (31/40)
12/07/2022 – Tuesday	37 (31/44)	36 (33/39)	29 (26/38)
13/07/2022 – Wednesday	38 (34/44)	35 (30/40)	31 (28/38)
14/07/2022 – Thursday	37 (32/43)	40 (38/42)	34 (32/39)
15/07/2022 – Friday	40 (38/44)	41 (37/44)	34 (32/36)
16/07/2022 – Saturday	38 (35/41)	42 (40/44)	42 (36/49)
17/07/2022 – Sunday	n/a	40 (38/43)	41 (39/43)
18/07/2022 – Monday	39 (36/44)	41 (39/43)	35 (33/39)
Minimum	**37 (31/41)**	**35 (30/39)**	**29 (26/36)**
Average	**39 (35/43)**	**39 (36/42)**	**35 (32/40)**
Median	**38 (35/44)**	**40 (37/42)**	**34 (32/39)**

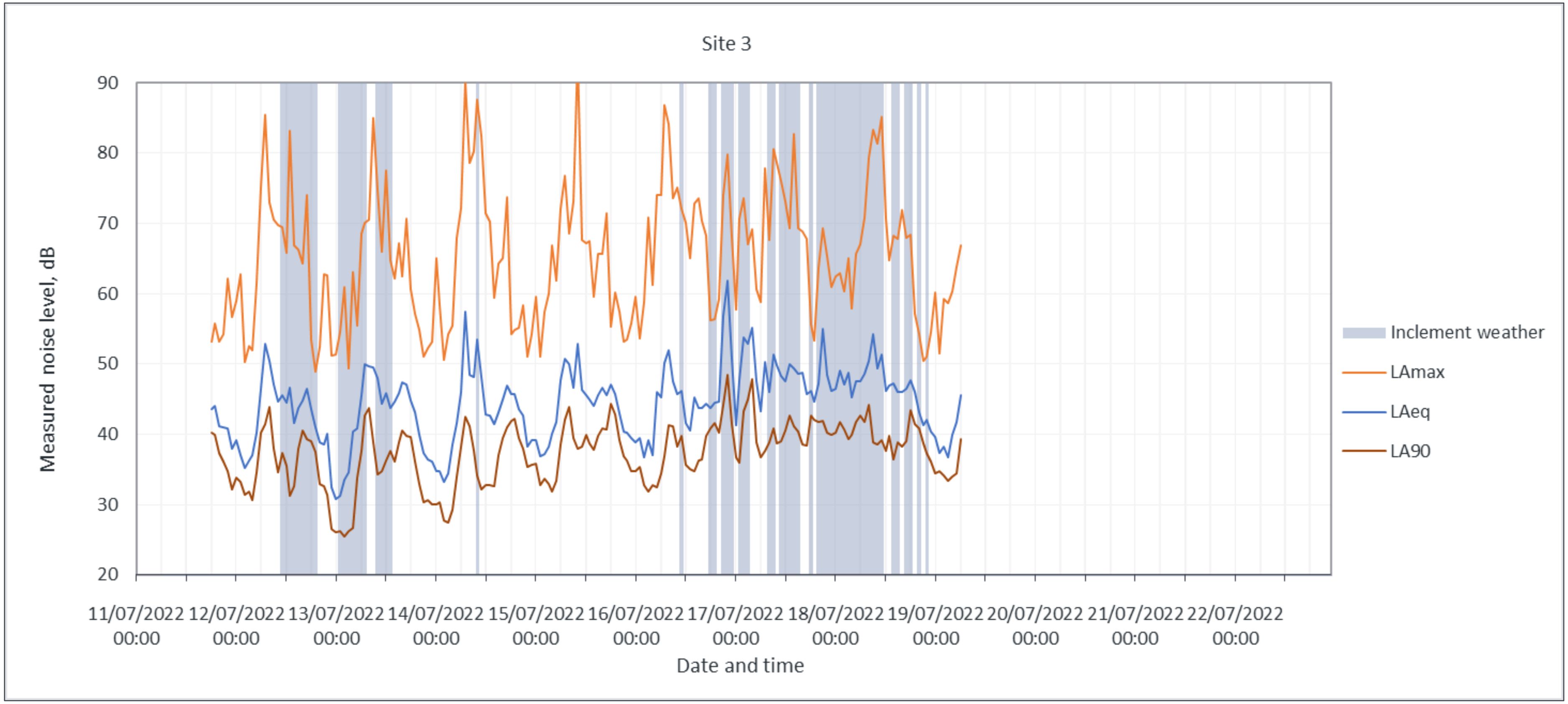

Figure 53: Site 3 – Yinnar-Driffield Road, Driffield – measured noise levels in 1-hour intervals

E5 Measured noise levels – site 4

The measured background noise levels at site 4 are summarised in Table 53. Periods in which one or more measurement samples (1-hour samples) were affected as a result of rain and/or wind are designated by grey shading.

The time history of noise levels for site 4 is shown on the following page in Figure 54. The ambient (L_{Aeq}) and maximum (L_{Amax}) noise levels are also presented.

Table 53: Site 4 – background noise levels, dB $L_{A90,1h}$ – period mean values (minimum/maximum)

Date	Day 0700 – 1800 hrs Mon – Sat	Evening 1800 – 2200 hrs Mon – Sat 0700 – 2200 hrs Sun & PH	Night 2200 - 0700 hrs
12/07/2022 – Tuesday	Incomplete data for period	32 (30/35)	28 (25/34)
13/07/2022 – Wednesday	33 (29/37)	33 (31/36)	31 (29/33)
14/07/2022 – Thursday	31 (27/36)	37 (35/39)	32 (27/36)
15/07/2022 – Friday	34 (31/40)	37 (35/41)	32 (30/34)
16/07/2022 – Saturday	35 (31/38)	40 (36/45)	41 (35/51)
17/07/2022 – Sunday	n/a	36 (32/43)	39 (37/40)
18/07/2022 – Monday	34 (32/36)	37 (35/39)	33 (31/37)
Minimum	**31 (27/36)**	**32 (30/35)**	**28 (25/33)**
Average	**34 (30/38)**	**36 (33/39)**	**33 (30/38)**
Median	**34 (31/37)**	**37 (35/39)**	**32 (30/36)**

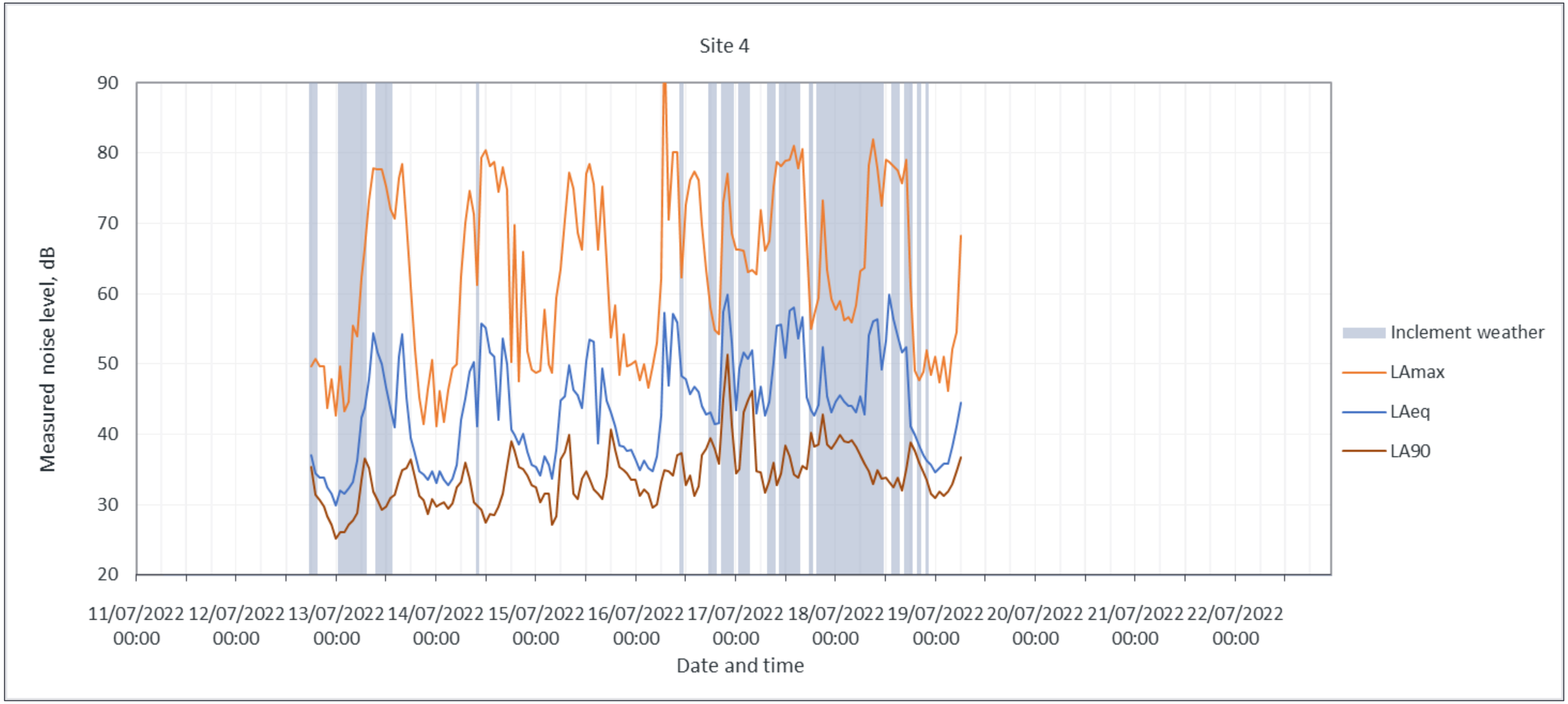

Figure 54: Site 4 – HVP (off Fords Road) – measured noise levels in 1-hour intervals

E6 Measured noise levels – site 5

The measured background noise levels at site 5 are summarised in Table 54. Periods in which one or more measurement samples (1-hour samples) were affected as a result of rain and/or wind are designated by grey shading.

The time history of noise levels for site 5 is shown on the following page in Figure 55. The ambient (L_{Aeq}) and maximum (L_{Amax}) noise levels are also presented.

Table 54: Site 5 – background noise levels, dB $L_{A90,1h}$ – period mean values (minimum/maximum)

Date	Day 0700 – 1800 hrs Mon – Sat	Evening 1800 – 2200 hrs Mon – Sat 0700 – 2200 hrs Sun & PH	Night 2200 - 0700 hrs
11/07/2022 – Monday	Incomplete data for period	39 (36/41)	29 (25/35)
12/07/2022 – Tuesday	33 (27/41)	32 (30/35)	27 (24/29)
13/07/2022 – Wednesday	34 (29/44)	33 (28/36)	25 (23/29)
14/07/2022 – Thursday	27 (18/32)	32 (31/34)	28 (27/31)
15/07/2022 – Friday	35 (33/40)	36 (33/40)	33 (28/39)
16/07/2022 – Saturday	37 (30/44)	45 (41/49)	48 (44/52)
17/07/2022 – Sunday	n/a	43 (31/51)	44 (41/49)
18/07/2022 – Monday	30 (19/37)	34 (32/35)	31 (26/35)
19/07/2022 – Tuesday	35 (31/39)	42 (41/44)	34 (28/38)
20/07/2022 – Wednesday	38 (33/42)	41 (39/42)	42 (33/48)
21/07/2022 – Thursday	46 (42/49)	48 (46/49)	39 (36/42)
Minimum	**27 (18/32)**	**32 (28/34)**	**25 (23/29)**
Average	**36 (29/42)**	**38 (36/41)**	**34 (30/39)**
Median	**35 (30/41)**	**38 (35/41)**	**33 (28/38)**

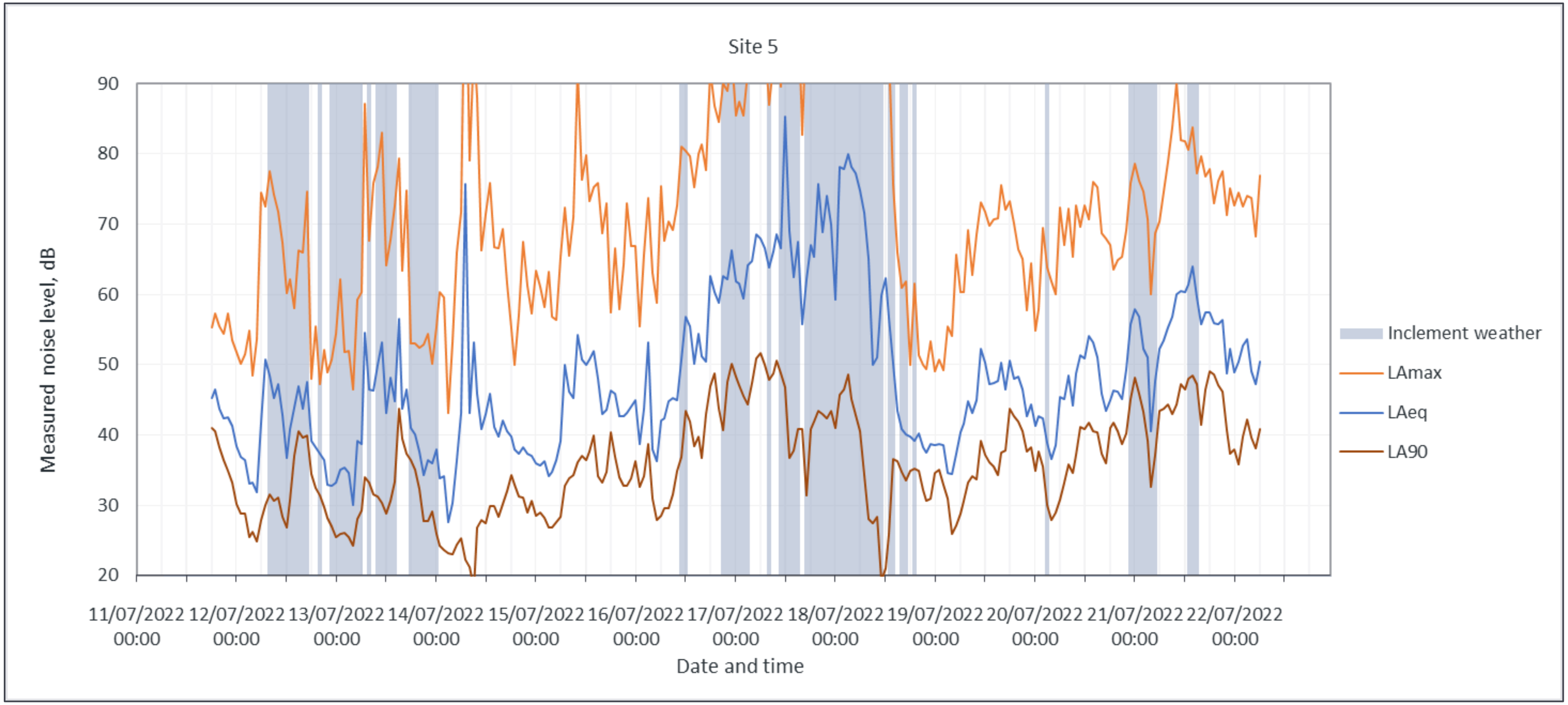

Figure 55: Site 5 – Smallmans Road, Mardan – measured noise levels in 1-hour intervals

E7 Measured noise levels – site 6

The measured background noise levels at site 6 are summarised in Table 55. Periods in which one or more measurement samples (1-hour samples) were affected as a result of rain and/or wind are designated by grey shading.

The time history of noise levels for site 6 is shown on the following page in Figure 56. The ambient (L_{Aeq}) and maximum (L_{Amax}) noise levels are also presented.

Table 55: Site 6 – background noise levels, dB $L_{A90,1h}$ – period mean values (minimum/maximum)

Date	Day 0700 – 1800 hrs Mon – Sat	Evening 1800 – 2200 hrs Mon – Sat 0700 – 2200 hrs Sun & PH	Night 2200 - 0700 hrs
11/07/2022 – Monday	Incomplete data for period	33 (33/35)	30 (28/32)
12/07/2022 – Tuesday	33 (30/37)	33 (31/34)	27 (24/29)
13/07/2022 – Wednesday	32 (30/36)	30 (28/31)	28 (27/29)
14/07/2022 – Thursday	30 (28/33)	37 (36/39)	34 (33/36)
15/07/2022 – Friday	36 (30/39)	35 (33/36)	28 (24/35)
16/07/2022 – Saturday	33 (30/38)	43 (41/47)	52 (50/55)
17/07/2022 – Sunday	n/a	47 (39/53)	45 (39/49)
18/07/2022 – Monday	34 (31/37)	34 (32/36)	28 (27/31)
19/07/2022 – Tuesday	30 (27/32)	33 (32/35)	28 (25/32)
20/07/2022 – Wednesday	32 (29/35)	33 (32/35)	Incomplete data for period
Minimum	**30** (27/32)	**30** (28/31)	**27** (24/29)
Average	**34** (31/38)	**35** (33/36)	**33** (31/36)
Median	**33** (30/37)	**33** (32/35)	**28** (27/32)

Figure 56: Site 6 – Meeniyan-Mirboo North Road, Dumbalk – measured noise levels in 1-hour intervals

E8 Measured noise levels – site 7

The measured background noise levels at site 7 are summarised in Table 56. Periods in which one or more measurement samples (1-hour samples) were affected as a result of rain and/or wind are designated by grey shading.

The time history of noise levels for site 7 is shown on the following page in Figure 57. The ambient (L_{Aeq}) and maximum (L_{Amax}) noise levels are also presented.

Table 56: Site 7 – background noise levels, dB $L_{A90,1h}$ – period mean values (minimum/maximum)

Date	Day 0700 – 1800 hrs Mon – Sat	Evening 1800 – 2200 hrs Mon – Sat 0700 – 2200 hrs Sun & PH	Night 2200 - 0700 hrs
11/07/2022 – Monday	Incomplete data for period	36 (34/39)	32 (30/34)
12/07/2022 – Tuesday	37 (28/47)	34 (30/37)	30 (29/32)
13/07/2022 – Wednesday	35 (32/39)	37 (34/39)	34 (31/39)
14/07/2022 – Thursday	34 (30/40)	38 (35/42)	34 (31/36)
15/07/2022 – Friday	36 (32/40)	40 (38/42)	34 (30/37)
16/07/2022 – Saturday	34 (30/39)	40 (39/42)	44 (40/49)
17/07/2022 – Sunday	n/a	41 (37/45)	40 (37/44)
Minimum	**34** (28/39)	**34** (30/37)	**30** (29/32)
Average	**36** (31/42)	**38** (35/40)	**35** (33/39)
Median	**35** (31/40)	**38** (35/40)	**34** (31/37)

Figure 57: Site 7 – Meeniyan-Mirboo North Road, Dumbalk – measured noise levels in 1-hour intervals

E9 Measured noise levels – site 8

The measured background noise levels at site 8 are summarised in Table 57. Periods in which one or more measurement samples (1-hour samples) were affected as a result of rain and/or wind are designated by grey shading.

The time history of noise levels for site 8 is shown on the following page in Figure 58. The ambient (L_{Aeq}) and maximum (L_{Amax}) noise levels are also presented.

Table 57: Site 8 – background noise levels, dB $L_{A90,1h}$ – period mean values (minimum/maximum)

Date	Day 0700 – 1800 hrs Mon – Sat	Evening 1800 – 2200 hrs Mon – Sat 0700 – 2200 hrs Sun & PH	Night 2200 - 0700 hrs
12/07/2022 – Tuesday	Incomplete data for period	37 (34/40)	29 (28/31)
13/07/2022 – Wednesday	35 (32/40)	33 (31/34)	30 (28/32)
14/07/2022 – Thursday	32 (30/37)	40 (39/42)	34 (29/41)
15/07/2022 – Friday	36 (34/39)	42 (40/44)	32 (28/38)
16/07/2022 – Saturday	35 (33/36)	40 (39/42)	47 (45/49)
17/07/2022 – Sunday	n/a	42 (38/48)	38 (35/42)
Minimum	**32 (30/36)**	**33 (31/34)**	**29 (28/31)**
Average	**36 (33/40)**	**38 (36/41)**	**35 (32/39)**
Median	**35 (33/39)**	**40 (39/42)**	**33 (28/39)**

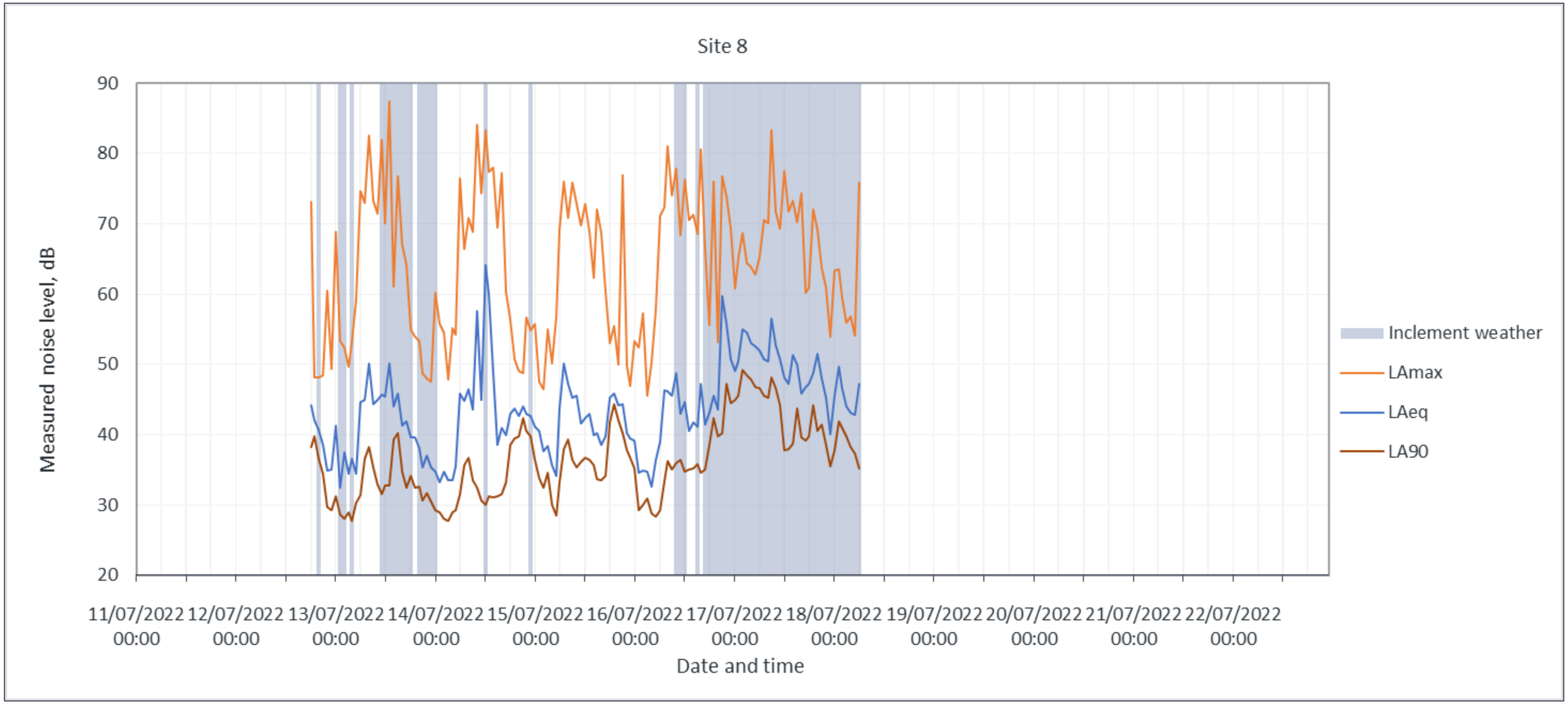

Figure 58: Site 8 – Buffalo-Stony Creek Road, Stony Creek – measured noise levels in 1-hour intervals

E10 Measured noise levels – site 9

The measured background noise levels at site 9 are summarised in Table 58. Periods in which one or more measurement samples (1-hour samples) were affected as a result of rain and/or wind are designated by grey shading.

The time history of noise levels for site 9 is shown on the following page in Figure 59. The ambient (L_{Aeq}) and maximum (L_{Amax}) noise levels are also presented.

Table 58: Site 9 – background noise levels, dB $L_{A90,1h}$ – period mean values (minimum/maximum)

Date	Day 0700 – 1800 hrs Mon – Sat	Evening 1800 – 2200 hrs Mon – Sat 0700 – 2200 hrs Sun & PH	Night 2200 - 0700 hrs
18/07/2022 – Monday	45 (36/58)	56 (44/62)	47 (39/54)
19/07/2022 – Tuesday	41 (30/49)	34 (26/37)	40 (35/43)
20/07/2022 – Wednesday	35 (23/48)	21 (19/25)	22 (19/30)
21/07/2022 – Thursday	40 (25/49)	55 (45/59)	55 (51/61)
Minimum	**35 (23/48)**	**21 (19/25)**	**22 (19/30)**
Average	**40 (29/51)**	**41 (33/46)**	**41 (36/47)**
Median	**41 (28/49)**	**44 (35/48)**	**44 (37/49)**

Figure 59: Site 9 – Moores Road, Buffalo – measured noise levels in 1-hour interval

E11 Measured noise levels – site 10

The measured background noise levels at site 10 are summarised in Table 59. Periods in which one or more measurement samples (1-hour samples) were affected as a result of rain and/or wind are designated by grey shading.

The time history of noise levels for site 10 is shown on the following page in Figure 60. The ambient (L_{Aeq}) and maximum (L_{Amax}) noise levels are also presented.

Table 59: Site 10 – background noise levels, dB $L_{A90,1h}$ – period mean values (minimum/maximum)

Date	Day 0700 – 1800 hrs Mon – Sat	Evening 1800 – 2200 hrs Mon – Sat 0700 – 2200 hrs Sun & PH	Night 2200 - 0700 hrs
12/07/2022 – Tuesday	Incomplete data for period	41 (39/43)	42 (39/44)
13/07/2022 – Wednesday	40 (36/44)	40 (38/41)	36 (34/40)
14/07/2022 – Thursday	36 (34/39)	36 (34/39)	35 (33/36)
15/07/2022 – Friday	39 (35/45)	39 (38/41)	31 (29/34)
16/07/2022 – Saturday	33 (30/37)	42 (38/50)	56 (51/60)
17/07/2022 – Sunday	n/a	47 (43/52)	45 (44/46)
18/07/2022 – Monday	41 (40/45)	38 (35/41)	38 (34/41)
19/07/2022 – Tuesday	36 (29/41)	38 (36/39)	Incomplete data for period
Minimum	**33 (29/37)**	**36 (34/39)**	**31 (29/34)**
Average	**39 (35/43)**	**39 (37/42)**	**40 (38/43)**
Median	**39 (35/44)**	**39 (38/41)**	**38 (34/41)**

Figure 60: Site 10 – Waratah Road, Sandy Point – measured noise levels in 1-hour intervals

E12 Measured noise levels – site 11

The measured background noise levels at site 11 are summarised in Table 60. Periods in which one or more measurement samples (1-hour samples) were affected as a result of rain and/or wind are designated by grey shading.

The time history of noise levels and periods of inclement weather (i.e. excluded periods) for site 11 is shown on the following page in Figure 61. The ambient (L_{Aeq}) and maximum (L_{Amax}) noise levels are also presented.

Table 60: Site 11 – background noise levels, dB $L_{A90,1h}$ – period mean values (minimum/maximum)

Date	Day 0700 – 1800 hrs Mon – Sat	Evening 1800 – 2200 hrs Mon – Sat 0700 – 2200 hrs Sun & PH	Night 2200 - 0700 hrs
12/07/2022 – Tuesday	Incomplete data for period	47 (46/49)	48 (45/51)
13/07/2022 – Wednesday	45 (42/51)	45 (44/46)	43 (42/45)
14/07/2022 – Thursday	42 (41/46)	39 (36/41)	38 (36/40)
15/07/2022 – Friday	40 (37/42)	38 (35/41)	35 (33/39)
16/07/2022 – Saturday	35 (31/40)	40 (35/44)	48 (44/54)
17/07/2022 – Sunday	n/a	46 (42/49)	47 (46/48)
18/07/2022 – Monday	46 (45/47)	45 (43/47)	47 (43/50)
19/07/2022 – Tuesday	42 (36/55)	46 (44/48)	37 (36/38)
20/07/2022 – Wednesday	39 (36/44)	38 (36/41)	38 (36/39)
21/07/2022 – Thursday	41 (37/50)	37 (36/38)	39 (37/40)
Minimum	**35** (31/40)	**37** (35/38)	**35** (33/38)
Average	**42** (38/47)	**42** (39/44)	**42** (40/44)
Median	**42** (37/47)	**40** (36/44)	**41** (39/43)

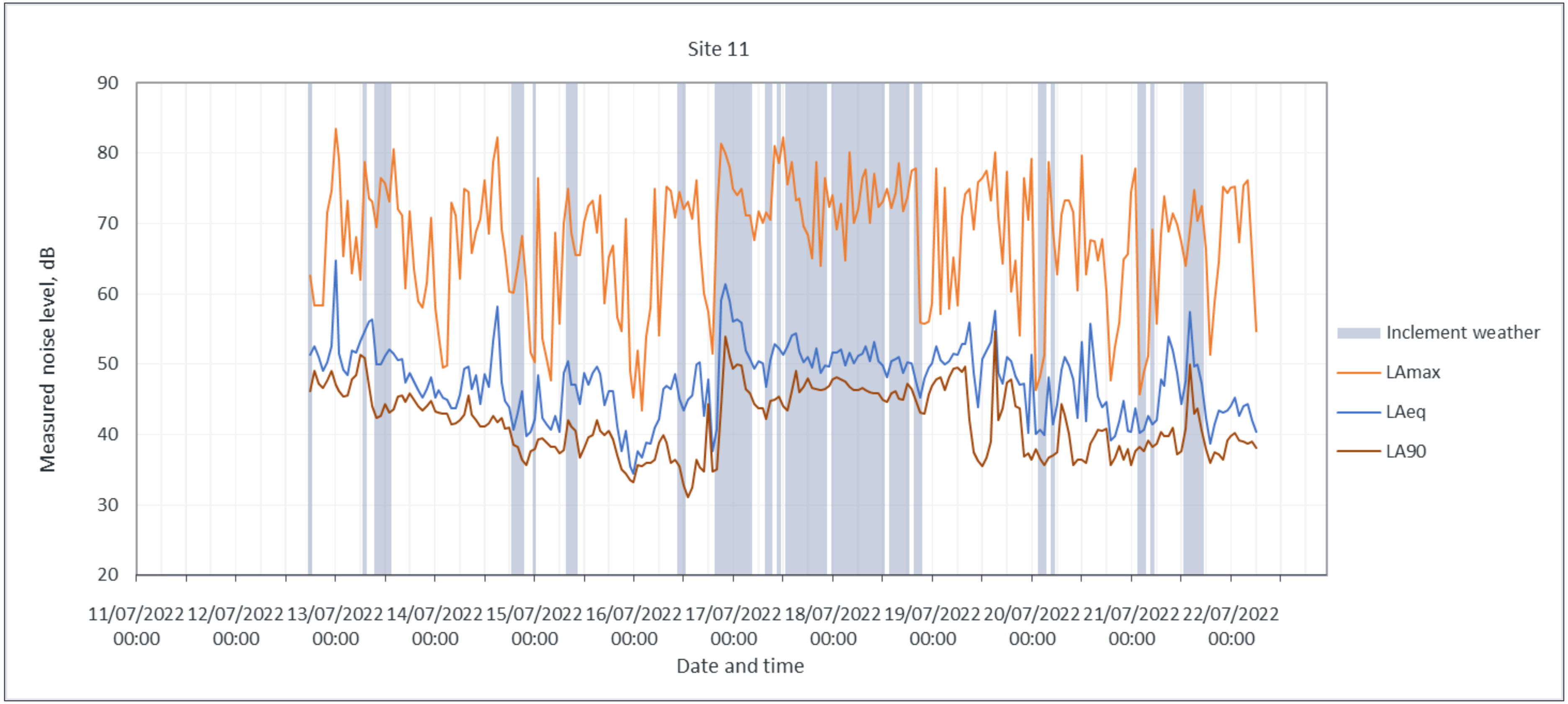

Figure 61: Site 11 – Fish Creek-Waratah Road, Waratah Bay – measured noise levels in 1-hour intervals

APPENDIX F CONSTRUCTION NOISE PREDICTIONS – CABLE ROUTE, CONVERTER & CROSSINGS

The highest predicted noise level at each receiver is presented in Table 61 for:

- work locations distributed along the project route;
- HDD works at local feature crossing sites; and
- converter station works.

All predictions in this table are based on the overall A-weighted prediction method of ISO 9613-2 and the shortest separating distance between each receiver and construction activity.

Note that construction noise predictions for the converter station are not provided for receivers that are remote from the converter station (predicted converter station construction noise levels are less than 20 dB L_{Aeq} at these remote locations).

Detailed noise modelling for the shore crossing and Morwell River crossing is provided in Section 7.1.4 and Section 7.1.5, based on the frequency spectrum prediction method of ISO 9613-2.

Further details of predicted noise levels for the local feature crossings are subsequently provided in Appendix H.

Table 61: Highest predicted construction noise levels – project route, converter station and local feature crossing

Receiver	Access road construction	Topsoil stripping and stockpiling	Site offices and laydown areas	Local feature crossing HDD	Trenching	Converter station - earthworks/ civil	Converter station - infrastructure
B8005	67	65	67	52	64	-	-
B8013	63	58	54	45	58	-	-
B8014	67	58	49	46	58	-	-
B8016	73	58	48	44	58	-	-
B8017	74	57	48	43	57	-	-
B8018	76	58	47	43	57	-	-
B8019	74	57	47	43	57	-	-
B8020	70	56	47	42	56	-	-
B8021	75	58	47	42	58	-	-
B8022	73	57	47	42	57	-	-
B8023	69	56	47	41	56	-	-
B8024	62	62	45	38	61	-	-
B8029	58	53	40	30	53	-	-
B8038	62	58	39	31	57	-	-
B8042	58	53	37	33	53	-	-
B8045	68	64	34	42	63	-	-
B8053	63	56	32	45	56	-	-
B8071	61	54	29	43	53	-	-

Receiver	Access road construction	Topsoil stripping and stockpiling	Site offices and laydown areas	Local feature crossing HDD	Trenching	Converter station - earthworks/ civil	Converter station - infrastructure
B8073	75	71	28	54	69	-	-
B8075	71	62	28	51	61	-	-
B8084	71	56	28	46	56	-	-
B8089	63	58	26	47	57	-	-
B8094	67	62	26	49	61	-	-
B8099	77	72	25	56	71	-	-
B8101	61	54	25	43	54	-	-
B8106	60	53	24	43	53	-	-
B8112	70	72	24	50	71	-	-
B8114	58	53	23	43	53	-	-
B8118	60	55	23	45	55	-	-
B8127	59	54	23	44	54	-	-
B8128	68	62	23	52	62	-	-
B8137	62	57	23	47	57	-	-
B8141	64	60	23	49	59	-	-
B8154	66	62	23	51	61	-	-
B8156	56	53	24	41	53	-	-
B8168	63	58	22	47	58	-	-
B8171	66	61	23	51	61	-	-
B8184	63	59	44	47	58	-	-
B8186	57	52	45	42	52	-	-
B8191	77	69	47	57	68	-	-
B8194	63	57	49	47	57	-	-
B8200	60	55	50	45	55	-	-
B8203	56	54	57	41	54	-	-
B8204	62	61	52	47	61	-	-
B8205	75	64	47	50	64	-	-
B8209	67	65	45	51	64	-	-
B8217	67	63	42	40	62	-	-
B8218	60	58	39	34	58	-	-
B8223	63	60	37	34	60	-	-

Receiver	Access road construction	Topsoil stripping and stockpiling	Site offices and laydown areas	Local feature crossing HDD	Trenching	Converter station - earthworks/ civil	Converter station - infrastructure
B8226	63	58	32	48	58	-	-
B8233	59	56	30	43	55	-	-
B8236	94	53	32	43	53	-	-
B8241	77	60	29	49	60	-	-
B8245	70	69	28	51	68	-	-
B8248	71	64	28	50	63	-	-
B8252	93	63	27	52	63	-	-
B8260	85	61	27	50	61	-	-
B8265	57	53	25	42	52	-	-
B8266	56	52	25	41	51	-	-
B8271	56	52	25	41	51	-	-
B8278	56	52	26	41	52	-	-
B8280	56	52	26	41	52	-	-
B8287	58	54	26	43	54	-	-
B8288	61	56	25	46	56	-	-
B8292	59	55	26	44	54	-	-
B8296	56	53	26	40	53	-	-
B8300	57	54	26	42	54	-	-
B8301	59	55	26	44	55	-	-
B8304	60	56	26	45	55	-	-
B8309	62	57	26	47	57	-	-
B8313	57	54	26	42	54	-	-
B8316	61	57	26	46	56	-	-
B8320	59	55	26	44	55	-	-
B8327	59	56	26	44	56	-	-
B8328	60	56	26	45	56	-	-
B8334	57	55	26	42	55	-	-
B8335	60	57	26	45	56	-	-
B8336	58	56	26	43	56	-	-
B8337	63	58	26	48	58	-	-
B8339	59	57	26	44	56	-	-

Receiver	Access road construction	Topsoil stripping and stockpiling	Site offices and laydown areas	Local feature crossing HDD	Trenching	Converter station - earthworks/ civil	Converter station - infrastructure
B8342	60	57	26	45	57	-	-
B8346	58	56	26	43	56	-	-
B8348	59	57	26	44	57	-	-
B8350	60	58	26	45	57	-	-
B8352	58	56	26	42	56	-	-
B8353	58	57	26	43	56	-	-
B8354	60	58	26	45	57	-	-
B8356	61	58	26	46	58	-	-
B8358	58	57	26	43	57	-	-
B8359	65	61	26	50	60	-	-
B8360	59	57	26	42	56	-	-
B8361	60	58	26	45	58	-	-
B8364	61	59	26	46	59	-	-
B8370	60	59	26	45	58	-	-
B8371	59	57	27	43	57	-	-
B8372	59	58	26	43	58	-	-
B8373	61	59	26	46	59	-	-
B8374	67	63	26	52	62	-	-
B8377	60	59	26	45	59	-	-
B8378	59	58	27	43	58	-	-
B8381	60	58	27	43	58	-	-
B8382	60	59	27	44	59	-	-
B8385	60	60	26	45	60	-	-
B8387	61	61	26	46	61	-	-
B8389	69	66	26	54	65	-	-
B8391	60	60	27	44	60	-	-
B8394	61	59	27	44	59	-	-
B8395	60	61	27	45	61	-	-
B8397	60	61	27	44	60	-	-
B8398	60	60	27	44	60	-	-
B8399	60	62	27	45	61	-	-

Receiver	Access road construction	Topsoil stripping and stockpiling	Site offices and laydown areas	Local feature crossing HDD	Trenching	Converter station - earthworks/ civil	Converter station - infrastructure
B8403	62	63	27	47	63	-	-
B8404	61	61	27	44	61	-	-
B8405	60	63	27	45	62	-	-
B8406	62	60	27	45	60	-	-
B8407	61	62	27	44	61	-	-
B8410	62	65	27	47	64	-	-
B8413	62	63	27	44	62	-	-
B8416	62	66	27	47	66	-	-
B8417	62	63	27	45	63	-	-
B8422	63	64	27	45	64	-	-
B8425	63	65	27	45	64	-	-
B8426	62	69	27	47	68	-	-
B8436	65	65	27	47	64	-	-
B8438	63	72	27	45	70	-	-
B8442	67	63	27	49	63	-	-
B8443	63	74	27	46	72	-	-
B8446	65	69	27	47	68	-	-
B8451	66	72	27	48	71	-	-
B8453	68	77	27	49	75	-	-
B8455	59	54	27	43	53	-	-
B8458	60	56	29	45	55	-	-
B8463	61	57	29	46	56	-	-
B8465	59	54	29	44	54	-	-
B8468	54	49	33	35	49	-	-
B8485	62	57	39	47	57	-	-
B8495	67	63	42	52	62	-	-
B8496	63	58	43	47	57	-	-
B8505	70	68	48	55	67	-	-
B8509	68	85	49	53	81	-	-
B8513	58	53	48	43	53	-	-
B8517	78	74	51	57	73	-	-

Receiver	Access road construction	Topsoil stripping and stockpiling	Site offices and laydown areas	Local feature crossing HDD	Trenching	Converter station - earthworks/ civil	Converter station - infrastructure
B8520	87	79	52	66	76	-	-
B8524	75	82	54	57	78	-	-
B8525	70	68	54	54	67	-	-
B8526	77	82	54	58	78	-	-
B8527	72	69	54	55	68	-	-
B8531	81	84	55	61	80	-	-
B8532	86	86	55	64	81	-	-
B8534	62	56	62	45	55	-	-
B8536	70	60	75	49	60	-	-
B8541	57	54	58	41	54	-	-
B8551	59	54	57	36	54	-	-
B8554	70	53	52	41	53	-	-
B8555	91	109	92	41	91	-	-
B8566	60	54	47	39	54	-	-
B8574	57	64	34	30	64	-	-
B8575	55	55	33	31	54	-	-
B8578	57	62	34	30	61	-	-
B8584	77	61	29	48	60	-	-
B8587	73	66	28	55	65	-	-
B8600	64	60	27	46	59	-	-
B8609	69	81	28	54	77	-	-
B8614	65	63	28	50	62	-	-
B8618	60	56	29	45	56	-	-
B8621	76	73	29	57	72	-	-
B8623	61	54	32	41	53	-	-
B8631	66	62	33	51	61	-	-
B8633	64	60	34	49	60	-	-
B8642	62	57	39	46	56	-	-
B8646	67	62	40	51	61	-	-
B8650	77	71	40	59	69	-	-
B8652	70	66	40	55	65	-	-

Receiver	Access road construction	Topsoil stripping and stockpiling	Site offices and laydown areas	Local feature crossing HDD	Trenching	Converter station - earthworks/ civil	Converter station - infrastructure
B8654	61	56	40	46	56	-	-
B8660	65	62	42	48	62	-	-
B8663	58	54	43	41	53	-	-
B8665	56	51	43	40	51	-	-
B8666	61	59	43	44	59	-	-
B8668	59	57	43	43	57	-	-
B8669	58	54	43	41	54	-	-
B8672	59	56	43	43	56	-	-
B8673	58	55	43	42	55	-	-
B8674	57	53	43	41	53	-	-
B8677	62	61	43	44	60	-	-
B8680	65	64	43	45	63	-	-
B8683	57	53	44	40	53	-	-
B8685	77	64	43	53	63	-	-
B8687	59	55	44	41	54	-	-
B8690	62	56	44	43	56	-	-
B8693	65	56	45	44	56	-	-
B8699	72	65	45	54	64	-	-
B8703	70	62	46	52	62	-	-
B8705	77	67	46	54	66	-	-
B8706	72	69	45	54	68	-	-
B8709	63	57	47	46	56	-	-
B8712	63	58	44	46	57	-	-
B8714	68	61	47	49	60	-	-
B8721	61	59	44	45	59	-	-
B8726	66	57	35	47	57	-	-
B8730	67	53	36	43	53	-	-
B8734	68	65	34	53	64	-	-
B8737	66	62	26	25	61	20	25
B8741	64	60	26	25	59	20	25
B8742	64	58	26	25	58	-	24

Receiver	Access road construction	Topsoil stripping and stockpiling	Site offices and laydown areas	Local feature crossing HDD	Trenching	Converter station - earthworks/ civil	Converter station - infrastructure
B8762	60	55	29	45	55	25	30
B8765	66	60	28	50	60	25	30
B8769	63	58	23	37	57	21	26
B8782	61	56	32	46	56	29	34
B8789	76	73	31	59	72	28	33
B8798	65	54	26	33	54	22	27
B8799	58	54	26	35	54	23	28
B8807	61	56	33	46	56	30	35
B8809	64	59	30	45	59	26	31
B8812	61	57	25	45	56	23	28
B8817	68	64	24	45	63	22	27
B8819	57	53	29	42	53	25	30
B8821	64	60	34	49	59	30	35
B8829	57	54	35	42	54	32	37
B8833	64	59	26	47	59	24	29
B8834	63	58	24	39	58	21	26
B8839	77	75	33	63	73	30	35
B8843	90	56	29	43	55	27	32
B8845	78	56	29	45	56	27	32
B8856	63	58	24	46	58	22	27
B8858	64	59	24	47	59	22	27
B8861	76	62	25	49	62	24	29
B8863	77	74	38	62	72	38	43
B8865	69	71	38	54	70	38	43
B8870	69	81	41	41	77	42	47
B8874	73	75	40	42	73	41	46
B8879	59	62	36	39	62	33	38
B8887	73	67	40	44	66	40	45
B8892	62	60	38	47	60	39	44
B8897	63	60	39	46	60	39	44
B8900	61	56	37	46	56	38	43

Receiver	Access road construction	Topsoil stripping and stockpiling	Site offices and laydown areas	Local feature crossing HDD	Trenching	Converter station - earthworks/ civil	Converter station - infrastructure
B8904	58	57	36	37	56	33	38
B8913	57	53	38	42	53	39	44
B8915	58	53	38	41	53	40	45
B8923	74	70	47	59	69	46	51
B8926	41	39	40	26	39	40	45
B8931	43	42	42	28	42	42	47
B8936	40	39	38	25	38	39	44
B8937	42	40	40	26	40	41	46
B8938	40	38	38	25	38	41	46
B8942	40	38	38	25	38	40	45
B8943	45	44	42	29	44	45	50
B8944	45	44	43	30	44	46	51
B8948	42	37	37	25	37	40	45
B8953	42	37	37	25	37	41	46
B8954	54	46	38	36	46	35	40
B8964	41	38	38	25	38	41	46
B8965	45	40	37	29	40	40	45
B8970	54	49	38	36	49	41	46
B8971	57	52	39	38	52	41	46
B8972	55	50	38	39	50	40	45
B8975	56	52	38	41	52	39	44
B8981	55	50	37	40	50	37	42
B8982	56	51	37	41	51	38	43
B8983	57	52	36	41	52	37	42
B8984	47	42	45	32	42	-	-
B9000	75	71	57	52	69	-	-
B9003	64	60	25	48	60	-	-
B9008	70	62	36	50	61	-	-
B9013	78	73	56	61	71	-	-
B9018	66	52	44	42	52	41	46
B9019	95	52	42	41	52	39	44

Receiver	Access road construction	Topsoil stripping and stockpiling	Site offices and laydown areas	Local feature crossing HDD	Trenching	Converter station - earthworks/ civil	Converter station - infrastructure
B9020	62	47	45	37	47	42	47
B9021	64	47	44	37	47	42	47
B9025	57	46	46	35	46	43	48
B9030	56	43	58	28	44	53	58
B9041	42	36	42	22	36	38	43
B9048	40	34	41	20	34	37	42
B9051	40	34	41	20	34	37	42
B9054	41	34	42	21	35	38	43
B9058	41	34	42	20	35	37	42
B9062	59	50	55	38	51	55	60
B9067	52	44	51	33	44	48	53
B9071	58	44	57	30	45	54	59
B9076	53	41	53	28	42	48	53
B9079	55	41	54	28	43	50	55
B9088	53	43	46	33	43	43	48
B9089	51	42	47	32	42	43	48
B9092	50	42	48	32	42	44	49
B9094	50	42	47	32	42	43	48
B9096	50	42	47	32	42	43	48
B9098	50	42	47	32	42	43	48
B9100	49	41	47	31	41	43	48
B9102	49	42	48	32	42	44	49
B9104	49	42	48	32	42	44	49
B9106	49	42	48	31	41	44	49
B9108	48	41	48	31	41	44	49
B9110	49	41	47	31	41	43	48
B9112	49	41	47	31	41	43	48
B9114	48	41	47	31	41	43	48
B9121	49	41	48	31	41	44	49
B9124	48	41	48	31	41	44	49
B9126	48	41	48	31	41	44	49

Receiver	Access road construction	Topsoil stripping and stockpiling	Site offices and laydown areas	Local feature crossing HDD	Trenching	Converter station - earthworks/ civil	Converter station - infrastructure
B9127	48	41	48	30	41	43	48
B9130	48	40	47	30	40	43	48
B9132	48	40	48	30	40	43	48
B9135	48	40	47	30	40	43	48
B9137	47	40	47	30	40	43	48
B9140	48	40	48	29	40	44	49
B9142	48	40	48	29	40	43	48
B9145	48	39	48	29	40	43	48
B9147	48	39	48	29	40	43	48
B9149	48	39	47	28	40	43	48
B9152	47	39	47	28	39	43	48
B9153	47	39	47	28	39	43	48
B9155	47	38	47	28	39	43	48
B9157	53	48	37	33	48	34	39
B9161	50	45	39	35	45	37	42

APPENDIX G PRIORITY MANAGEMENT ZONE MAPS

This appendix presents priority noise management zone maps for construction activity during normal working hours at the following locations:

- site office and laydown areas
- converter stations
- local feature crossings.

The priority noise management zone maps identify the activity locations where the highest predicted noise levels extend above 55 dB and 75 dB L_{Aeq} (see section 5.3.1 for the basis of these reference levels), corresponding to priority and high priority work locations for construction noise control.

Maps are only provided for the work locations where a construction activity results in predicted noise levels above the reference levels. For example, a map is only provided for the Hazelwood converter station site as there were no priority or high priority work locations identified at the Driffield converter station site. A map is also not provided for the shore crossing, as the predicted levels are below the reference levels for normal working hours (work outside of normal working hours is assessed separately and predicted noise level contours are presented in Section 7.1.4).

The maps are primarily for identifying priority work locations for dedicated noise control measures. It is important to note that the general environmental duty under the EP Act requires all reasonably practical measures to minimise the risk of harm to be implemented for all work locations (i.e. irrespective of whether a location is identified as a priority or high priority working location with respect to noise control).

G1 Site office and laydown areas

Figure 62: Prioritised management zones for site office and laydown areas – Hazelwood laydown area

Figure 63: Prioritised management zones for site office and laydown areas – Smallmans laydown area

Figure 64: Prioritised management zones for temporary facilities and laydown areas – Stony Creek

Figure 65: Prioritised management zones for temporary facilities and laydown areas – Waratah Bay

G2 Converter station

Figure 66: Prioritised management zones for Hazelwood converter station site – infrastructure works

G3 Local feature crossing works

Figure 67: Prioritised management zones for local feature crossing works – northern section of project

Figure 68: Prioritised management zones for local feature crossing works – southern section of project

APPENDIX H LOCAL FEATURE CROSSING WORKS – PREDICTED HDD NOISE LEVEL SUMMARY

This appendix presents a summary of the predicted noise levels associated with local feature crossing works in terms of:

- the nearest receiver and the highest predicted noise level for each proposed HDD location; and
- the number of receivers within the assessment reference levels defined separately for work during the night and during normal working hours.

All predictions in this appendix are based on the overall A-weighted prediction method of ISO 9613-2 and the shortest separating distance between each receiver and a local feature crossing.

The data is presented in Table 63 as pairs for each HDD location to indicate the results for drilling potentially occurring at either end of the crossing. The HDD location ID and description for each pair has a numeral suffix of “1” or“2”, with “1” identifying the end of the crossing which is nearest to a receiver.

The results are listed in Table 63 in descending order from the HDD location with the highest to the lowest predicted noise level.

The basis for the reference levels used in Table 63 is described in full in section 5.3.1 but are briefly summarised in Table 62 for ease of reference.

Table 62: Summary of reference levels used for categorising predicted noise levels

Period	Reference level, dB L_{Aeq}	Basis
Normal working hours	40	ERS daytime objective
	55	1999 WHO Guidelines reference level
	75	NSW ICNG level for highly affected receivers

Note that the receiver counts summarised in Table 63 are indicative only, as the receiver dataset has been practically limited to a distance of 500 m from the project. This enables the most sensitive working areas to be identified, but does mean that the calculated number of receivers in the mid and lower noise level bands are lower than would be the case in reality (i.e. due to the presence of additional receivers not included in this study which are more than 500 m from the project where the predicted construction noise levels would be within the lower and mid-range bands presented in Table 63).

Table 63: Local feature crossing works – predicted HDD noise level summary – nearest receiver and receiver counts (in order of highest predicted noise level)

HDD location ID and description	Nearest receiver			Number of receivers greater than:		
	ID	Distance, m	Predicted level, dB L_{Aeq}	40 dB L_{Aeq}	55 dB L_{Aeq}	75 dB L_{Aeq}
TCM034 - Meeniyan - Mirboo North Road (Loves Lane) north - 1	B8520	47	66	11	2	0
TCM034 - Meeniyan - Mirboo North Road (Loves Lane) north - 2	B8532	55	64	11	4	0
TCM058 - Nadenbouschs Road and gas pipeline - 1	B8839	64	63	6	1	0
TCM058 - Nadenbouschs Road and gas pipeline - 2	B8839	84	60	6	1	0
TCM051 - Yinnar - Driffield Road - 1	B8863	67	62	14	1	0
TCM051 - Yinnar - Driffield Road - 2	B8863	139	55	9	0	0
TCM072 - Large old trees - 1	B9013	73	61	1	1	0
TCM072 - Large old trees - 2	B9013	190	52	1	0	0
TCM042A - Boolarra - Mirboo North Road - 1	B8650	89	59	15	1	0
TCM042A - Boolarra - Mirboo North Road - 2	B8650	124	56	18	1	0
TCM057 - Switchback Road and Eel Hole Creek - 1	B8789	92	59	6	1	0
TCM057 - Switchback Road and Eel Hole Creek - 2	B8839	218	50	5	0	0
TCM074 - Incised gully adjacent to Fullerton Road - 1	B8650	92	59	14	1	0
TCM074 - Incised gully adjacent to Fullerton Road - 2	B8650	202	51	7	0	0
TCM061 - Monash Way - 1	B8923	93	59	1	1	0
TCM061 - Monash Way - 2	B8923	98	58	1	1	0
TCM037 - Meeniyan - Mirboo North Road - 1	B9013	104	58	3	1	0
TCM037 - Meeniyan - Mirboo North Road - 2	B9013	133	55	3	1	0
TCM067 - Buffalo - Stony Creek Road - 1	B8191	106	57	5	1	0

HDD location ID and description	Nearest receiver			Number of receivers greater than:		
	ID	Distance, m	Predicted level, dB L_{Aeq}	40 dB L_{Aeq}	55 dB L_{Aeq}	75 dB L_{Aeq}
TCM067 - Buffalo - Stony Creek Road - 2	B8191	125	56	5	1	0
TCM073 - Old Nicholls Road - 1	B8621	107	57	3	1	0
TCM073 - Old Nicholls Road - 2	B8621	207	51	4	0	0
TCM019 - Moore Road - 1	B8099	124	56	9	1	0
TCM019 - Moore Road - 2	B8099	167	53	9	0	0
TCM033 - Meeniyan - Mirboo North Road (Loves Lane) intersection - 1	B8505	131	55	8	1	0
TCM033 - Meeniyan - Mirboo North Road (Loves Lane) intersection - 2	B8505	150	54	6	0	0
TCM038 - Nicholls Road - 1	B8587	139	55	6	0	0
TCM038 - Nicholls Road - 2	B8587	148	54	6	0	0
TCM044 - Old Darlimurla Road and Atkins Lane - 1	B8705	143	54	11	0	0
TCM044 - Old Darlimurla Road and Atkins Lane - 2	B8706	147	54	9	0	0
TCM039 - Old Nicholls Road south - 1	B8609	146	54	6	0	0
TCM039 - Old Nicholls Road south - 2	B8609	204	51	6	0	0
TCM028A - Narrena Road - 1	B8389	149	54	74	0	0
TCM028A - Narrena Road - 2	B8389	183	52	73	0	0
TCM017A - Meeniyan - Promontory Road - 1	B8073	152	54	4	0	0
TCM017A - Meeniyan - Promontory Road - 2	B8073	204	51	4	0	0
TCM043 - Farm driveway - 1	B8685	161	53	14	0	0
TCM043 - Farm driveway - 2	B8685	163	53	18	0	0
TCM046 - Steep slope above Little Morwell River - 1	B8734	163	53	3	0	0

HDD location ID and description	Nearest receiver			Number of receivers greater than:		
	ID	Distance, m	Predicted level, dB L_{Aeq}	40 dB L_{Aeq}	55 dB L_{Aeq}	75 dB L_{Aeq}
TCM046 - Steep slope above Little Morwell River - 2	B8734	173	53	3	0	0
TCM027A - Meeniyan - Mirboo North Road (Dumbalk) - 1	B8252	176	52	5	0	0
TCM027A - Meeniyan - Mirboo North Road (Dumbalk) - 2	B8252	181	52	5	0	0
TCM018 - Buffalo Creek - 1	B8099	188	52	6	0	0
TCM018 - Buffalo Creek - 2	B8099	302	47	6	0	0
TCM020 - Neals Road - 1	B8128	188	52	12	0	0
TCM020 - Neals Road - 2	B8128	197	51	11	0	0
TCM062 - Waratah Road - 1	B8005	188	52	2	0	0
TCM062 - Waratah Road - 2	B9000	190	52	2	0	0
TCM031 - Meeniyan - Mirboo North Road (Loves Lane) south - 1	B8495	191	52	3	0	0
TCM031 - Meeniyan - Mirboo North Road (Loves Lane) south - 2	B8495	189	52	3	0	0
TCM068 - Gooleys Road - 1	B8245	196	51	6	0	0
TCM068 - Gooleys Road - 2	B8245	241	50	5	0	0
TCM040A - Boolarra South - Mirboo North Road - 1	B8631	203	51	3	0	0
TCM040A - Boolarra South - Mirboo North Road - 2	B8633	255	49	3	0	0
TCM025A - Dumbalk - Stony Creek Road - 1	B8209	208	51	2	0	0
TCM025A - Dumbalk - Stony Creek Road - 2	B8209	213	51	2	0	0
TCM047 - Native vegetation along property boundary - 1	B8734	218	50	3	0	0
TCM047 - Native vegetation along property boundary - 2	B8734	305	47	2	0	0

HDD location ID and description	Nearest receiver			Number of receivers greater than:		
	ID	Distance, m	Predicted level, dB L_{Aeq}	40 dB L_{Aeq}	55 dB L_{Aeq}	75 dB L_{Aeq}
TCM069 - Unnamed watercourse and farm infrastructure - 1	B8260	223	50	4	0	0
TCM069 - Unnamed watercourse and farm infrastructure - 2	B8260	351	46	3	0	0
TCM055 - Frasers Road - 1	B8765	227	50	4	0	0
TCM055 - Frasers Road - 2	B8765	228	50	5	0	0
TCM024A - Stony Creek - Dollar Road - 1	B8205	238	50	3	0	0
TCM024A - Stony Creek - Dollar Road - 2	B8205	292	48	3	0	0
TCM035 - Mardan dairy farm steep slope - 1	B8536	243	49	8	0	0
TCM035 - Mardan dairy farm steep slope - 2	B8532	279	48	10	0	0
TCM054 - Yinnar Road - 1	B8861	245	49	6	0	0
TCM054 - Yinnar Road - 2	B8861	276	48	6	0	0
TCM071 - Established shelter belt along farm driveway - 1	B8442	259	49	53	0	0
TCM071 - Established shelter belt along farm driveway - 2	B8442	306	47	43	0	0
TCM036 - Mardan Road - 1	B8536	277	48	3	0	0
TCM036 - Mardan Road - 2	B8536	304	47	3	0	0
TCM021 - Great Southern Rail Trail - 1	B8191	284	48	4	0	0
TCM021 - Great Southern Rail Trail - 2	B8184	369	45	3	0	0
TCM026 - Unnamed watercourse Dumbalk - 1	B8226	288	48	2	0	0
TCM026 - Unnamed watercourse Dumbalk - 2	B8226	319	47	2	0	0
TCM070 - Shelter belt and farm infrastructure - 1	B9003	293	48	4	0	0

HDD location ID and description	Nearest receiver			Number of receivers greater than:		
	ID	Distance, m	Predicted level, dB L_{Aeq}	40 dB L_{Aeq}	55 dB L_{Aeq}	75 dB L_{Aeq}
TCM070 - Shelter belt and farm infrastructure - 2	B9003	412	44	3	0	0
TCM045 - Grand Ridge Rail Trail and Pleasant Valley Road - 1	B8734	296	48	3	0	0
TCM045 - Grand Ridge Rail Trail and Pleasant Valley Road - 2	B8726	329	47	3	0	0
TCM032 - Meeniyan - Mirboo North Road (Loves Lane) - 1	B8496	306	47	3	0	0
TCM032 - Meeniyan - Mirboo North Road (Loves Lane) - 2	B8496	336	46	4	0	0
TCM022A - Stony Creek - 1	B8191	312	47	5	0	0
TCM022A - Stony Creek - 2	B8200	393	45	4	0	0
TCM030A - Steep slope above Tarwin River East Branch - 1	B8485	321	47	1	0	0
TCM030A - Steep slope above Tarwin River East Branch - 2	B8485	410	44	2	0	0
TCM063 - Unnamed watercourse waratah storage - 1	B8014	351	46	10	0	0
TCM063 - Unnamed watercourse waratah storage - 2	B8013	372	45	9	0	0
TCM015A - Fish Creek - Walkerville Road - 1	B8053	383	45	2	0	0
TCM015A - Fish Creek - Walkerville Road - 2	B8053	422	44	2	0	0
TCM029A - Tarwin River East Branch - 1	B9008	383	45	2	0	0
TCM029A - Tarwin River East Branch - 2	B9008	233	50	2	0	0
TCM014A - Waratah Road north - 1	B8005	398	45	2	0	0
TCM014A - Waratah Road north - 2	B8005	445	44	2	0	0
TCM053 - Morwell River floodrunner - 1	B8845	397	45	2	0	0
TCM053 - Morwell River floodrunner - 2	B8845	590	41	1	0	0

HDD location ID and description	Nearest receiver			Number of receivers greater than:		
	ID	Distance, m	Predicted level, dB L_{Aeq}	40 dB L_{Aeq}	55 dB L_{Aeq}	75 dB L_{Aeq}
TCM013A - Waratah Road south - 1	B9000	497	43	1	0	0
TCM013A - Waratah Road south - 2	B9000	586	41	1	0	0
TCM060 - Water supply pipeline - 1	B9018	521	42	3	0	0
TCM060 - Water supply pipeline - 2	B9018	521	42	3	0	0
TCM052 - Morwell River - 1	Section 7.1.5 (predictions based on 3D modelling)			Section 7.1.5 (predictions based on 3D modelling)		
TCM052 - Morwell River - 2	Section 7.1.5 (predictions based on 3D modelling)			Section 7.1.5 (predictions based on 3D modelling)		
TCM023A - South Gippsland Highway - 1	B8203	650	40	0	0	0
TCM023A - South Gippsland Highway - 2	B8203	738	39	0	0	0
TCM050 - Strzelecki Highway - 1	B8944	1663	30	0	0	0
TCM050 - Strzelecki Highway - 2	B8944	1729	29	0	0	0
TCM048 - Stony Creek forest - 1	B8734	1733	29	0	0	0
TCM048 - Stony Creek forest - 2	B8734	1817	29	0	0	0
TCM064 - Unnamed watercourse - 1	B8053	2107	27	0	0	0
TCM064 - Unnamed watercourse - 2	B8053	2336	25	0	0	0
TCM016A - Fish Creek - 1	B8071	2464	25	0	0	0
TCM016A - Fish Creek - 2	B8071	2696	24	0	0	0
TCM066 - Native vegetation shelter belt and drainage line - 1	B8071	3020	22	0	0	0
TCM066 - Native vegetation shelter belt and drainage line - 2	B8071	3086	22	0	0	0
TCM065 - Duncans Road - 1	B8053	3886	18	0	0	0

HDD location ID and description	Nearest receiver			Number of receivers greater than:		
	ID	Distance, m	Predicted level, dB L_{Aeq}	40 dB L_{Aeq}	55 dB L_{Aeq}	75 dB L_{Aeq}
TCM065 - Duncans Road - 2	B8053	3972	18	0	0	0

APPENDIX I CONVERTER STATION SOUND POWER LEVELS

The noise emission data provided by MLPL for the assessment are reproduced in Table 64.

Noise emission data was not available for the converter modules and valves that would be housed in the two valve halls. However, the converter modules and valves are understood to be low noise emission plant items that are not expected to materially contribute to environmental noise levels associated with the converter station.

Table 64: Sound power levels, dB L_{WA}
(note: all data including spectrum values are A-weighted)

	Octave band centre frequency, Hz							
Source name	**63**	**125**	**250**	**500**	**1000**	**2000**	**4000**	**Total**
AHU – valve hall	67	74	76	80	80	77	73	85
AHU – AC/DC yard	68	75	77	80	81	78	74	86
Auxiliary Transformer 1-3	57	59	65	63	61	59	57	70
Converter Transformer 1	53	82	71	64	58	57	44	82
Converter Transformer 2	51	80	69	62	56	55	42	80
Converter Transformer 3	49	78	67	60	54	53	40	78
Converter Transformer 4	53	82	71	64	58	57	44	82
Converter Transformer 5	51	80	69	62	56	55	42	80
Converter Transformer 6	49	78	67	60	54	53	40	78
DC Reactor 1-4	-	59	71	77	55	37	21	78
Transformer Cooler 1-6	64	66	73	76	66	64	63	80
Valve Cooler 1-14 [1]	74	82	84	76	72	68	67	87
Valve Reactor 1-12	n/a	66	78	84	62	44	28	85

1 The listed sound power levels for the valve coolers are for normal operation – reduced speeds and sound power levels are applied to the assessment of noise levels during the night at the Hazelwood converter station site (see Section 7.2.1)