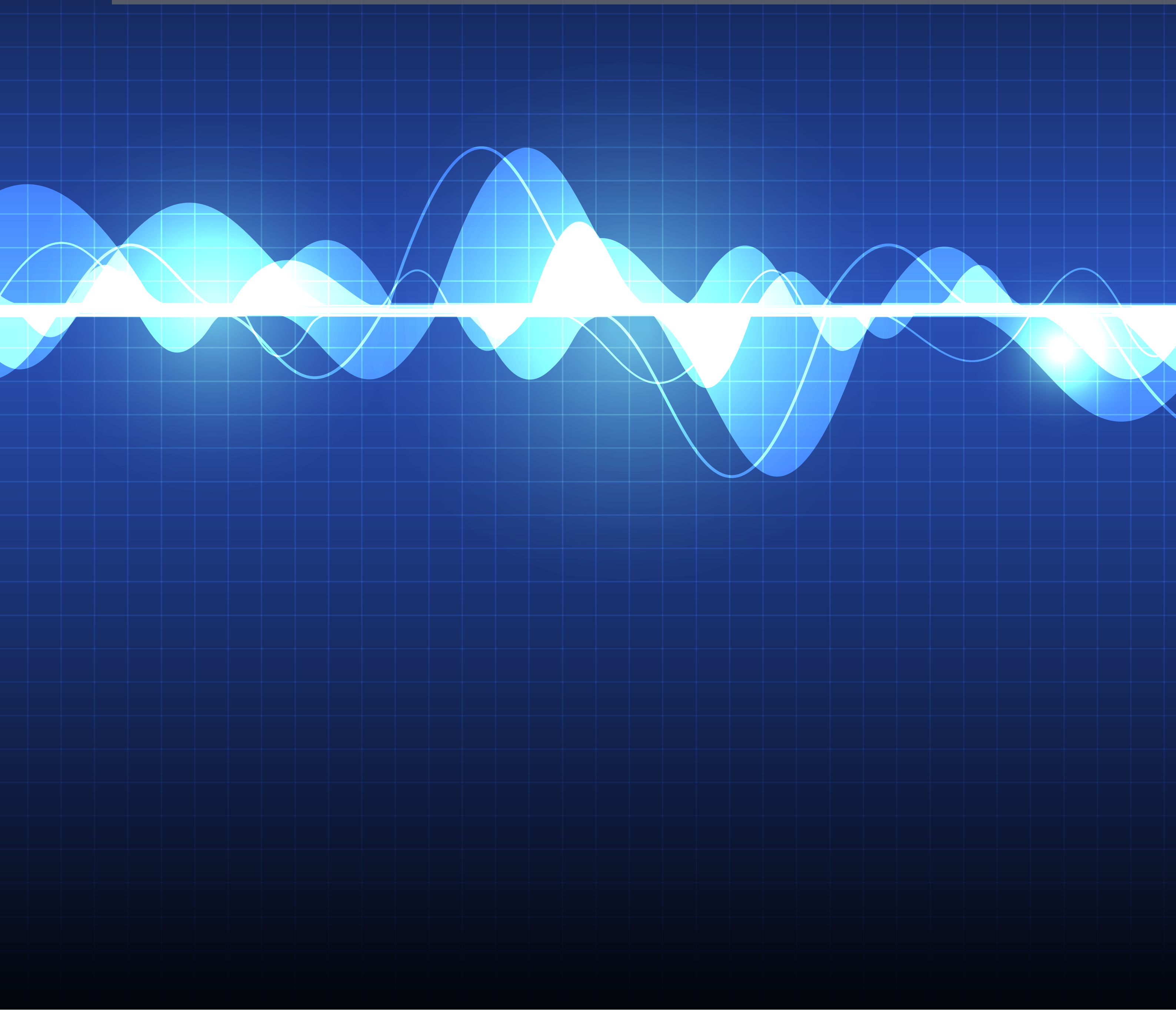

Noise and Vibration Impact Assessment

Mornington Battery Energy Storage System

Prepared for Maoneng Australia Pty Ltd
June 2021

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Noise and Vibration Impact Assessment

Mornington Battery Energy Storage System

Report Number

S200257 RP5

Client

Maoneng Australia Pty Ltd

Date

11 June 2021

Version

v8 Final

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11 June 2021

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11 June 2021

This report has been prepared in accordance with the brief provided by the client and has relied upon the information collected at the time and under the conditions specified in the report. All findings, conclusions or recommendations contained in the report are based on the aforementioned circumstances. The report is for the use of the client and no responsibility will be taken for its use by other parties. The client may, at its discretion, use the report to inform regulators and the public.

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Appendices

Tables

Figures

1 Introduction

1.1 Background

Maoneng Australia Pty Limited (Maoneng) is proposing to develop the Mornington battery energy storage system (BESS) (the project).

The proposed BESS would be located at 17 Thornells Road, Tyabb, Victoria and the associated overhead transmission line would traverse into a portion of the adjoining allotment at 21 Thornells Road, which is the Tyabb substation (Figure 1.1 and Figure 1.2).

EMM Consulting Pty Limited (EMM) has been engaged by Maoneng to prepare a planning permit application for the project under the Victorian *Planning and Environment Act 1987* (P&E Act). This noise and vibration impact assessment (NVIA) has been prepared by EMM to support the planning permit application.

The scope of the noise and vibration impact assessment was limited to the proposed BESS site (17 Thornells Road) with the associated transmission line connection to the existing Tyabb substation (21 Thornells Road) not changing the results of the assessment, given the low operating noise emissions associated with a transmission line.

Throughout this document, the term 'site' refers to the proposed BESS site at 17 Thornells Road.

1.2 Project description

The project aims to improve electricity grid reliability and network stability by drawing energy from the electricity grid during off-peak periods for battery storage and dispatching energy to the grid during peak periods. Mornington BESS would have the power rating of 240 MW with a storage capacity of 480 MW/hrs.

Australia's energy market is undergoing significant changes and utility scale batteries are pivotal to enabling the shift from a fossil fuel energy baseload to renewable energy. The Mornington BESS would connect to the electricity network via the existing AusNet Services Limited (AusNet) Tyabb Substation, which is located immediately west of the site.

Additionally, Mornington Peninsula is subject to fluctuations in demand for electricity as a result of seasonal tourism. Battery storage is one form of demand response and while this project cannot guarantee outage prevention alone, it will contribute to improving regional electricity reliability.

The project conceptually comprises the following key components:

- Batteries enclosed within approximately 1,600 battery containers, associated inverters and transformers and an underground cable network.
- An onsite 33/220 kilovolt (kV) substation.
- A switch room.
- A control room.
- An overhead transmission line connecting the on-site substation to the adjacent Tyabb Substation.
- Internal access roads.
- A temporary construction laydown area.

- An operations and maintenance building.
- Security fencing and fire safety equipment.

1.3 Site description

The site is located within the Mornington Peninsula Shire Local Government Area (LGA) and is zoned as Special Use Zone (SUZ) 1 (Port Related Uses) under the Mornington Peninsula Planning Scheme (MPPS).

The site was selected by Maoneng primarily due its proximity to the existing Tyabb Substation. The site generally comprises topographically flat land that has largely been cleared of native woodland vegetation. The site has an approximate footprint of 6.7 hectares (ha).

The site is located off the unsealed Thornells Road on land previously used for horticultural activities (fruit orchard). The surrounding land use is a mixture of rural residential dwellings on large allotments, several of which operate as 'hobby' farms, smaller tracts of agricultural land and a variety of commercial / industrial activities. Tyabb town centre is approximately 2 kilometres (km) from the site.

1.4 Purpose of this report

This NVIA supports the planning permit application for the proposed battery energy storage system (BESS). It documents the existing noise environment, applicable impact assessment criteria, source of noise and vibration, noise modelling of operational and construction activities including traffic and assessment of predicted impacts relative to criteria.

This NVIA consists of the following sections:

- A description of the local setting and surrounds of the site.
- A description of the existing environment, including existing noise environment.
- A list of plant and equipment adopted for noise modelling of construction and operation of the proposed BESS.
- Noise modelling of operational and construction noise emissions including noise enhancing meteorological scenarios.
- Assessment of road traffic noise as a result of project related vehicles on public roads.
- An overview of compliance, noise mitigation measures and residual impacts where relevant.

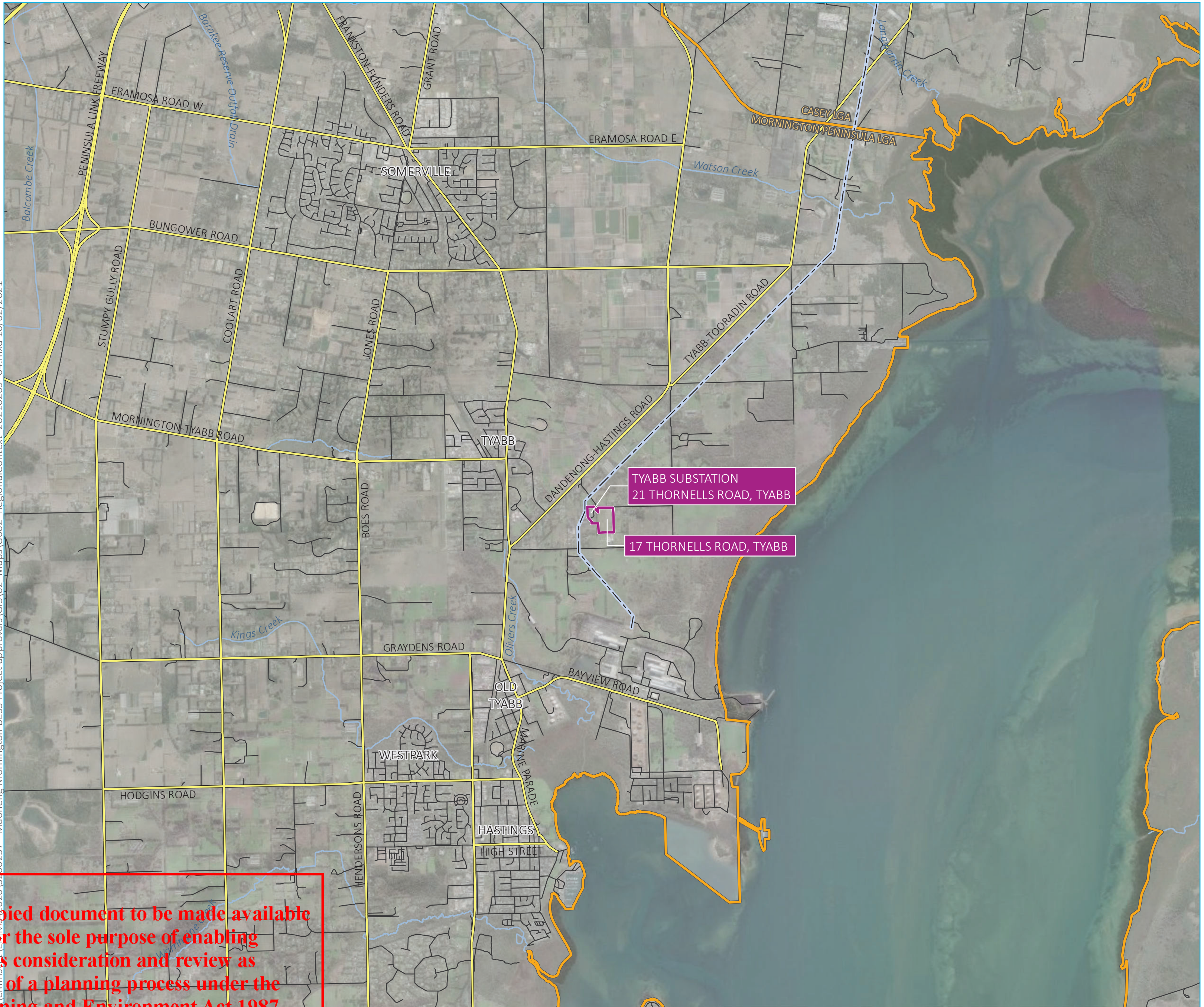
The NVIA has been prepared in general accordance with the guidelines specified in:

- Environment Protection Authority, Victoria (EPA VIC) 2011 Publication 1411, Noise from Industry in Regional Victoria (NIRV);
- Environment Protection Authority, Victoria (EPA VIC) 2020 Publication 1834, Civil construction, building and demolition guide (CCBDG);
- Environment Protection Authority, Victoria (EPA VIC) 1996 Publication 480 Best Practice Environmental Management – Environmental Guidelines for Major Construction Sites;
- Vic Roads (VR) 2005, Traffic Noise Reduction Policy (TNRP);

- Australian and New Zealand Environment Council 1990, Technical basis for guidelines to minimise annoyance due to blasting overpressure and ground vibration;
- British Standard 6472 – 2008, Evaluation of human exposure to vibration in buildings (1-80Hz); and
- German Standard DIN 4150 Part 2 1975.

1.5 Other relevant reports

This NVIA has been prepared with reference to other technical reports that were prepared as part of the Mornington BESS planning permit application. The other relevant report referenced in this NVIA is the Traffic Impact Assessment (EMM 2021), appended to the planning permit application.



KEY
- Subject site
- Existing 200 kV transmission line
- Major road
- Minor road
- Named watercourse
- Local government area

INSET KEY
- Major road
- National park/reserve
- State forest

Site location in regional context

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Mornington BESS
Noise and vibration impact assessment
Figure 1.1

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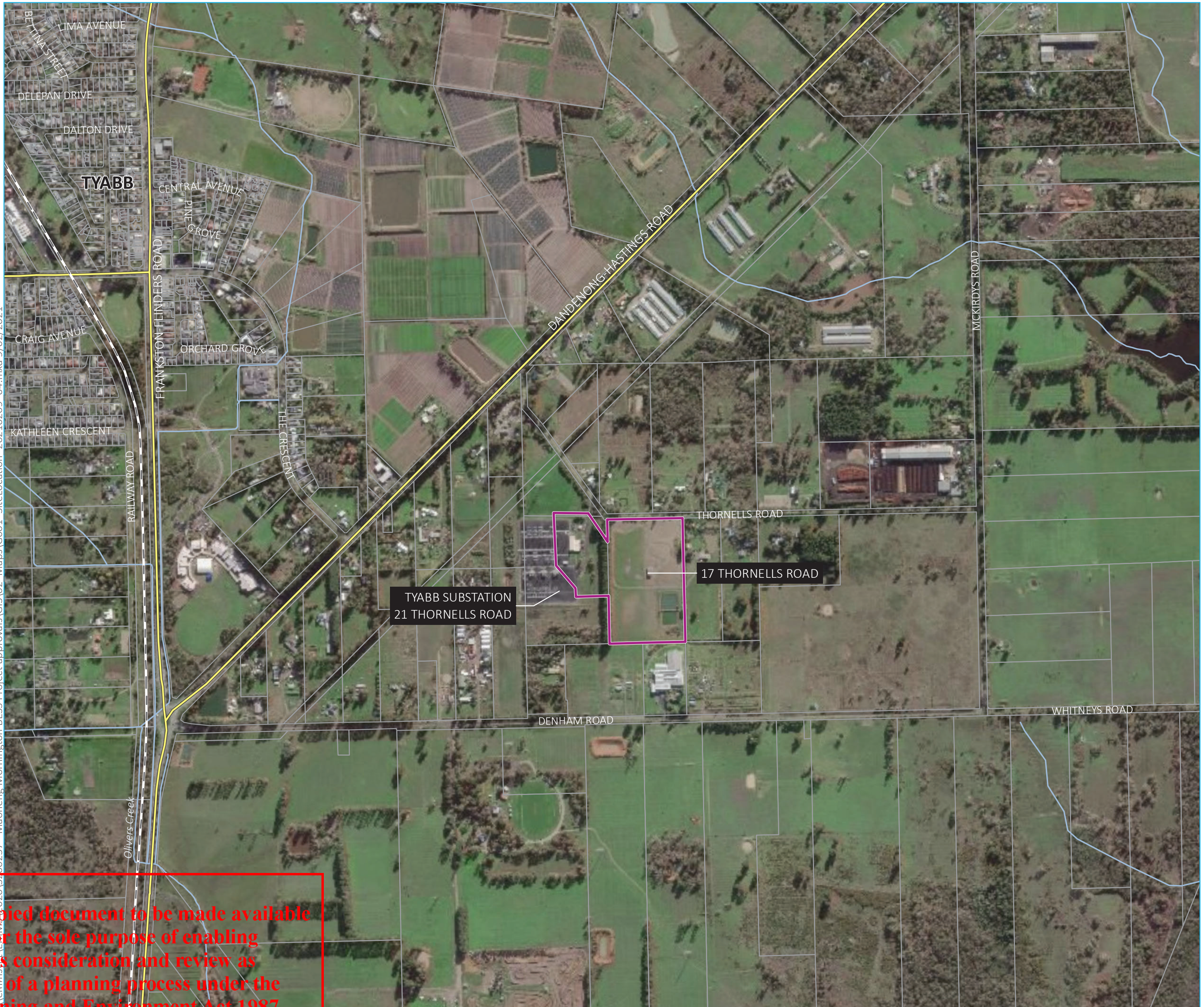
Maoneng Mornington BESS Project approvals\GIS\02_Maps\G002_RegionalContext_20210209_04.mxd 10/02/2021



KEY

- Subject site
- Cadastral boundary
- Rail line
- Major road
- Watercourse/drainage line

INSET KEY

- Major road
- National park/reserve
- State forest

Source: EMM (2021); Maoneng (2020); DELWP (2019); GA (2011); ASGC (2006)

0 250 500 m

GDA 1994 MGA Zone 55

N

Local context

Maoneng Australia Pty Limited
Mornington BESS
Noise and vibration impact assessment
Figure 1.2

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2 Project description

2.1 Overview

The project will have a power rating of 240 MW with a storage capacity of 480 MW/hrs, and will include:

- up to 1,600 lithium ion battery enclosures with associated inverters (88) and transformers (88);
- a 33/220 kV substation, a medium voltage switch room and a control room;
- underground cables connecting BESS infrastructure;
- an overhead transmission line from the onsite substation to AusNet's Tyabb substation; and
- internal access tracks, operations and maintenance building, temporary construction laydown area, vehicle parking, water tanks for firefighting purposes and security fencing.

The battery supplier has not been selected, however, the specific technology will comprise a common lithium-ion battery technology, being Lithium ion phosphate (LFP), Lithium Nickel Manganese Cobalt Oxide (NMC), or Lithium Manganese Oxide (LMO). Each battery bank will have storage capacity of approximately 2 to 4 MWh. The final capacity per bank will depend on the final technology chosen.

Batteries will likely be housed within standard 40-foot shipping containers or similar - approximately 13 m long, 3 m wide and 3 m high. Alternatively, batteries may be housed within modular enclosures of a similar size. Each container unit will be fully self-contained and ready to install. Batteries will be placed on concrete hardstands and are expected to be raised 300 millimetres (mm) to 600 m above the mapped 1 in 100-year flood event. Footings for battery enclosures would be around 300 mm, inverters/transformers and larger equipment approx. 600 mm and substation approximately 1 m. Battery rows will be separated by a permeable surface.

Adjacent to each battery container would be an inverter and transformer required to convert direct current (DC) to alternating current (AC) and step up the voltage to 33 kV. Inverters and transformers would be fully self-contained and ready to install following delivery. Inverters and transformers would be installed on concrete hardstand raised above the 1 in 100-year flood level.

A switch room and control room will be constructed to control the delivery of electricity to and from the site and allow remote operation. In addition, an onsite substation is required to transform medium voltage to high voltage (and reverse) requiring the construction of either a 33 kV/220 kV substation installed on a concrete hardstand and elevated above the 1 in 100-year flood level.

2.2 The site

Maoneng spent considerable time identifying land options for the proposed project in the local and regional area.

The proposed site was selected for the following key reasons:

- Location includes a portion of the adjacent Tyabb substation which can accept energy from the proposed battery with a power rating of up to 240 MW of energy from the BESS.
- Location being close to the load (ie close to high population and high demand areas).

- Minimal environmental constraints on the site (ie the site is largely cleared of dense woodland vegetation; it is not subject to any planning overlays and has good access to the road network).

- Size (ie the large site provides space for the required setbacks and buffers to minimise any potential amenity impacts on the surrounding residences).

The site is 6.7 ha; however, the development footprint is anticipated to be up to 4.3 ha.

The expected operational life of the BESS is 15 years (as per supplier warranty); however, it is anticipated that the operational life of the project will be extended by an additional 15 years through infrastructure upgrades. The site would operate 24 hours 7 days a week.

2.3 Construction

The construction period will last for approximately nine months, with two to three months of peak construction anticipated and comprise:

- Stage 1: Site establishment, including demolition of existing farm shed, earthworks and any drainage requirements, construction of concrete hardstands, civil works - two months.

- Stage 2: Delivery of BESS infrastructure – three months.

- Stage 3: Installation of BESS infrastructure (containerised units, transformer, switch room, control room and O&M) and electrical works – four months.

2.3.1 Construction workforce

There is expected to be a maximum of 150 employees onsite during the peak construction period (which would occur during stage 2 and 3).

No permanent on-site staff are required during operations as the BESS will be operated remotely. Maintenance for cleaning, grass cutting and inspection of equipment would be conducted every one to three months subject to requirements.

2.3.2 Vehicles and movements

Operational traffic is anticipated to be negligible for the unmanned site with a maximum of two one-way vehicle trips per day, with an average of four one-way trips per week. Envisaged construction traffic including over size and over mass vehicles (OSOM) is summarised in Table 2.1.

Table 2.1 Construction traffic

Construction stage	Estimated vehicle trips per day		
	Light vehicles	Heavy vehicles	OSOM vehicles
Stage 1: Site establishment	40	7	5
Stage 2: Delivery of BESS infrastructure	60	5	5
Stage 3: Installation of BESS infrastructure	60	5	-

2.3.3 Construction plant and equipment

The typical plant and equipment inventory for each construction phase are listed in Table 2.2.

Table 2.2 Indicative plant and equipment list

Plant/equipment	Type/size	Estimated number		
		Stage 1	Stage 2	Stage 3
Dozer	CAT D6-D9	1	-	-
Grader	CAT 12G	1	-	-
Excavator	35 tonne	1	-	-
Roller	35 Smooth drum	1	-	-
Bobcat	Tracked	1	-	-
Front end loader		1	-	-
Trucks	Rigid tipper / delivery	2	2	2
Concrete trucks	-	1	-	-
Drilling rig	SM 14	1	-	-
Light vehicles	-	4	4	4
Crane	25T Franna or similar	0	2	1
Forklift	Rough Terrain 5T	0	2	-
Hand tools	various	0	2	2

Source: Maoneng

2.4 Operation

Operational noise sources associated with the BESS would include the battery cubicles, medium voltage transformers, inverters and high voltage transformer prior to connection to the Tyabb substation. The specific operational plant considered in this assessment are discussed in more detail in Section 5.4.

3 Existing environment

The site surrounds accommodate a variety of residential, agricultural and light industrial uses including Tyabb substation to the west of the proposed development site. To the south of the site is Western Port Coolstores and an industrial food storage and processing facility, whilst to the west of the substation is a Holcim concrete batching plant.

It is understood that the identified existing uses are predominantly daytime operation only. However, there may be plant and equipment that operates 24/7 for cool stores and the Tyabb substation is a 24/7 facility.

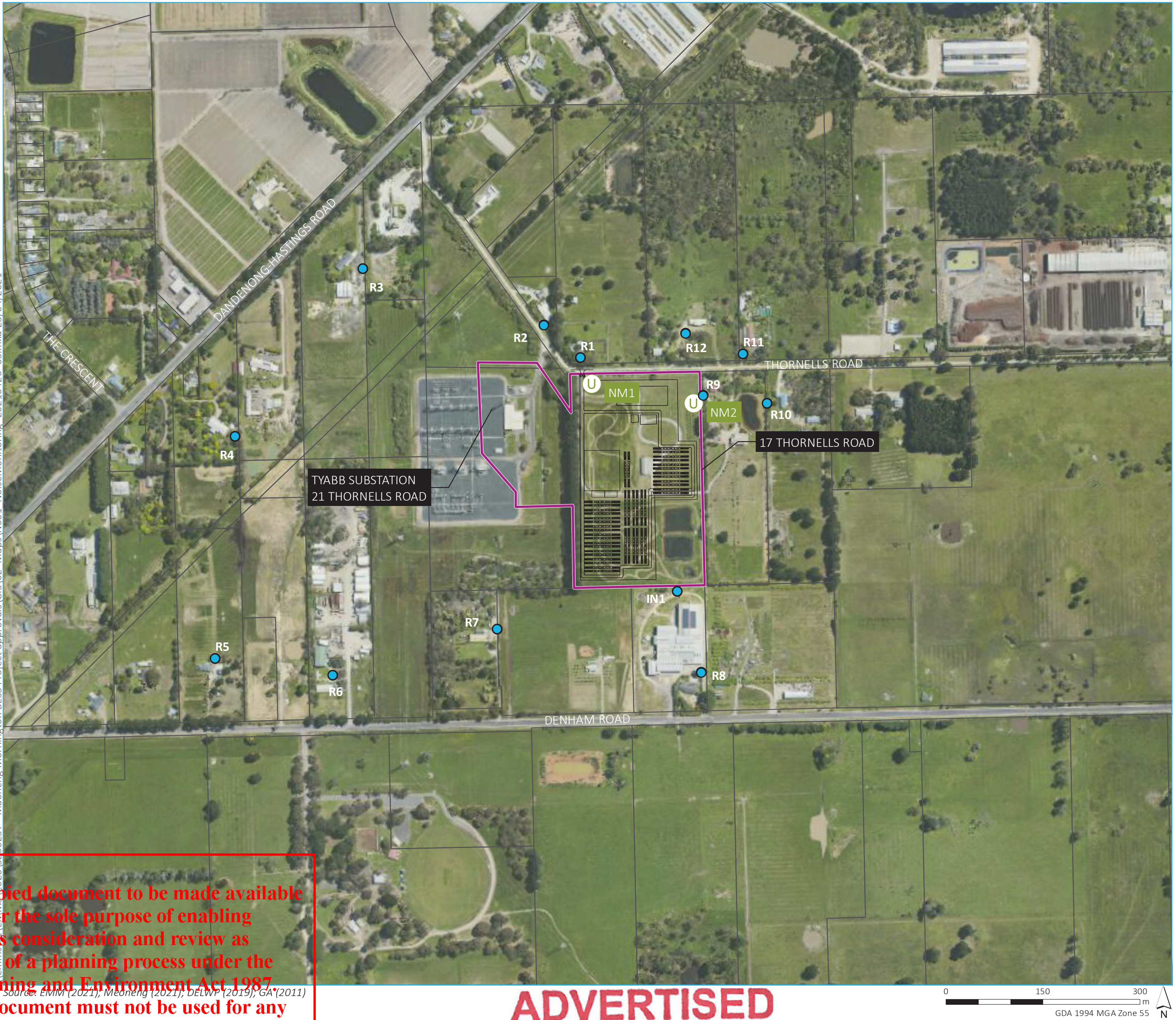
3.1 Noise and vibration assessment locations

The nearest representative noise sensitive locations to the proposed BESS have been identified for the purpose of assessing potential noise and vibration impacts. These locations were selected to represent the range and extent of noise impacts from the site. Details are provided in Table 3.1 and their locations are shown in Figure 3.1. They are referred to in this report as assessment locations.

Table 3.1 Noise assessment locations

ID	Address	Classification	Easting	Northing
R1	20 Thornells Road, Tyabb	Residential	342863	5763009
R2	22-26 Thornells Road, Tyabb	Residential	342806	5763059
R3	15 Dandenong-Hastings Road, Tyabb	Residential	342526	5763147
R4	11 Dandenong-Hastings Road, Tyabb	Residential	342328	5762887
R5	94 Denham Road, Tyabb	Residential	342297	5762543
R6	90 Denham Road, Tyabb	Residential	342479	5762517
R7	66 Denham Road, Tyabb	Residential	342734	5762589
IN1	3/36 Denham Road, Tyabb	Industrial	343013	5762647
R8	36 Denham Road, Tyabb	Residential	343050	5762521
R9	15 Thornells Road, Tyabb	Residential	343053	5762950
R10	13 Thornells Road, Tyabb	Residential	343152	5762938
R11	14 Thornells Road, Tyabb	Residential	343115	5763015
R12	16 Thornells Road, Tyabb	Residential	343026	5763046

GDA 94 MGA Zone 55



Source: EMM (2021), Meoneng (2021), DELWP (2019), GA (2011)

KEY

- Subject site
- Site layout
- Noise assessment location
- Noise monitoring location - unattended
- Cadastral boundary

Noise monitoring and assessment locations

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Mornington BESS
Noise and vibration impact assessment
Figure 3.1

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3.2 Background noise survey

To establish the existing ambient noise environment of the area, unattended noise surveys and operator-attended aural observations were conducted at monitoring locations as guided by the procedures described in Australian Standard AS 1055-1997 - *Acoustics - Description and Measurement of Environmental Noise* and *Noise from Industry in Regional Victoria* (NIRV) Section 3.

Noise monitoring was conducted at two noise monitoring locations considered to be representative of the range of noise levels likely to be experienced by residential assessment locations in the vicinity of the site. The logger locations were selected after inspection of the site and its surrounds, giving due consideration to other noise sources which may influence the readings (eg domestic air-conditioners), the proximity of assessment locations to the site, security issues for the noise monitoring device and gaining permission for access from the residents or landowners.

The monitoring locations selected are presented in Table 3.2 and shown in Figure 3.1.

Table 3.2 Noise monitoring locations

ID	Address	Instrumentation
NM1	17 Thornells Road (west)	ARL Serial No. 878113
NM2	17 Thornells Road (east)	ARL Serial No. 878125

The noise loggers were programmed to record statistical noise level indices continuously in 15-minute intervals, including the L_{Amax}, L_{A1}, L_{A10}, L_{A50}, L_{A90}, L_{A99}, L_{Amin} and the L_{Aeq}. Calibration of all instrumentation was checked prior to and following monitoring. Drift in calibration did not exceed ±0.5 dB. All equipment carried appropriate and current National Association of Testing Authorities (NATA) (or manufacturer) calibration certificates.

A summary of existing background and ambient noise levels is given in Table 3.3. Results are provided for each day in Appendix A.

Table 3.3 Summary of existing background and ambient noise

Monitoring location	Period[1]	Rating background level (RBL)[2], dBA	Measured $L_{Aeq, period}$ noise level[3], dBA
NM1 – 17 Thornells Road (west)	Day	39	59
	Evening[4]	42	54
	Night	39	50
NM2 – 17 Thornells Road (east)	Day	36	55
	Evening[4]	38	55
	Night	36 (37[5])	57

1. For the purpose of establishing the existing noise environmental, the time periods as per NIRV were taken as: Day: 7 am to 6 pm Monday to Friday, 7 am to 1 pm Saturdays; Evening: 6 pm to 10 pm all days, 1 pm to 6 pm Saturdays, 7am to 6 pm Sundays and public holidays; Night: 10 pm to 7 am all days.
2. The RBL was used to represent the background noise level and represented the median of the 90th percentile of the measured LA90 levels for each time period.
3. The energy averaged noise level over the measurement period and representative of general ambient noise.
4. Measurements showed a consistent noise signature of higher noise levels over the evening period in both noise measurement locations.
5. Night RBL should not be more than day or evening

4 Assessment criteria

4.1 Construction noise

EPA Victoria utilise *Civil construction, building and demolition guide* (CCBDG) (EPA publication 1834) (EPA Victoria, 2020), specifically Section 4 to address construction and demolition noise. The purpose of the guideline is to protect residential premises from unreasonable noise. Commercial and other premises affected by noise should be considered and reasonable measures implemented to reduce impacts. The guideline recommends normal construction hours where noise from construction activities is audible at residential premises (ie assessment locations), as follows:

- Monday to Friday 7 am to 6 pm; and
- Saturday 7 am to 1 pm.

The CCBDG provides no specific noise levels for construction works conducted during the normal hours referenced above. However, does specify that noise reduction measures should be developed during early project planning, with larger projects preparing a noise management plan (NMP) potentially as part of an Environmental Management Plan (EMP) for the works. For works during normal hours the following measures apply to manage noise impacts:

- Where work is conducted in a residential area or other noise-sensitive location, use the lowest-noise work practices and equipment that meet the requirements of the job.
- Site buildings, access roads and plant should be positioned such that the minimum disturbance occurs to the locality. Barriers such as hoardings or temporary enclosures should be used. The site should be planned to minimise the need for reversing of vehicles.
- All mechanical plant is to be silenced by the best practical means using current technology. Mechanical plant, including noise-suppression devices, should be maintained to the manufacturer's specifications. Internal combustion engines are to be fitted with a suitable muffler in good repair.
- Fit all pneumatic tools operated near a residential area with an effective silencer on their air exhaust port.
- Install less noisy movement/reversing warning systems for equipment and vehicles that will operate for extended periods, during sensitive times or in close proximity to sensitive sites. Occupational health and safety requirements for use of warning systems must be followed.
- Turn off plant when not being used.
- All vehicular movements to and from the site to only occur during the scheduled normal working hours, unless approval has been granted by the relevant authority.
- Where possible, no truck associated with the work should be left standing with its engine operating in a street adjacent to a residential area.
- Special assessment of vibration risks may be needed, such as for pile-driving or works structurally connected to sensitive premises.

- Noise from the site needs to comply with the requirements of the schedule, except for:
  - unavoidable works; and
  - night period low-noise or managed-impact works approved by the local authority.

Where activities are to be conducted outside of normal hours noise is should not exceed the level outlined in Table 4.1.

Table 4.1 NCG construction noise levels for residences

Time of day	NML $L_{Aeq,15min}$	Application
Weekend and evening period: 6pm to 10pm Monday to Friday 1pm to 10pm Saturdays 7am to 10pm Sundays and public holidays	RBL + 10 dB	For works up to 18 months in duration
	RBL + 5 dB	For works >18 months in duration
Night period: 10pm to 7am Monday to Sunday and public holidays	n/a	Noise to be inaudible within a habitable room of any residential premises

Source: Noise Control Guidelines Publication 1254 (EPA, VIC)

4.2 Construction vibration

EPA Victoria utilise *Best Practice Environmental Management – Environmental Guidelines for Major Construction Sites* (EPA publication 480) (EPA Victoria, 1996), specifically Section 5 to provide some guidance on the assessment of vibration from construction activities. However, the information is qualitative and recommends assessments be conducted where sensitive receivers are located within 50m of vibration generating works. Receivers are located greater than 50m from the proposed works, however for completeness this assessment has considered the quantitative requirements of:

- German Standard DIN 4150 Part 2 1999;
- BS 6472 – 2008, Evaluation of human exposure to vibration in buildings (1-80Hz); and
- Australian and New Zealand Environment Council 1990, Technical basis for guidelines to minimise annoyance due to blasting overpressure and ground vibration.

4.2.1 Human perception of vibration

Humans can detect vibration levels which are well below those of any risk of damage to a building or its contents.

The actual perception of motion or vibration may not in itself be disturbing or annoying. An individual's response to that perception, and whether the vibration is "normal" or "abnormal", depends very strongly on previous experience and expectations, and on other connotations associated with the perceived source of the vibration. For example, the vibration that a person responds to as "normal" in a car, bus or train is considerably higher than what is perceived as "normal" in a shop, office or dwelling.

Human tactile perception of random motion, as distinct from human comfort considerations, was investigated by Diekmann and subsequently updated in German Standard DIN 4150 Part 2. On this basis, the resulting degrees of perception for humans are suggested by the vibration level categories given in Table 4.2.

Table 4.2 suggests that people will just be able to feel floor vibration at levels of approximately 0.15 millimetres per second (mm/s) and that the motion becomes "noticeable" at a level of approximately 1 mm/s.

Table 4.2 Peak vibration levels and human perception of motion

Approximate vibration level	Degree of perception
0.10 mm/s	Not felt
0.15 mm/s	Threshold of perception
0.35 mm/s	Barely noticeable
1 mm/s	Noticeable
2.2 mm/s	Easily noticeable
6 mm/s	Strongly noticeable
14 mm/s	Very strongly noticeable

Note: These approximate vibration levels (in floors of building) are for vibration having a frequency content in the range of 8 Hertz (Hz) to 80 Hz.

i British Standard 6472 – 2008, Evaluation of human exposure to vibration in buildings (1-80Hz)

BS 6472 presents preferred and maximum vibration values for the use in assessing human responses to vibration and provides recommendations for measurement and evaluation techniques. At vibration values below the preferred values, there is a low probability of adverse comment or disturbance to building occupants. Where all feasible and reasonable mitigation measures have been applied and vibration values are still beyond the maximum value, it is recommended that the operator negotiate directly with the affected community.

The Standard defines three vibration types and provides direction for assessing and evaluating the applicable criteria. The standard provides examples of the three vibration types and has been reproduced in Table 4.3.

Table 4.3 Examples of types of vibration

Continuous vibration	Impulsive vibration	Intermittent vibration
Machinery, steady road traffic, continuous construction activity (such as tunnel boring machinery).	Infrequent: Activities that create up to 3 distinct vibration events in an assessment period, eg occasional dropping of heavy equipment, occasional loading and unloading. Blasting is assessed using ANZEC (1990).	Trains, intermittent nearby construction activity, passing heavy vehicles, forging machines, impact pile driving, jack hammers. Where the number of vibration events in an assessment period is three or fewer these would be assessed against impulsive vibration criteria.

Continuous vibration associated with compaction of fill on the site is most relevant to the construction of the proposal.

Intermittent vibration is assessed using the vibration dose concept which relates to vibration magnitude and exposure time.

Intermittent vibration is representative of heavy vehicle pass-bys and construction activities such as impact hammering, rolling or some general excavation work.

Acceptable values for intermittent vibration in terms of vibration dose values (VDV) which requires the measurement of the overall weighted rms (root mean square) acceleration levels over the frequency range 1 Hz to 80 Hz.

To calculate VDV the following formula is used:

$$VDV = \left[\int_{0}^{T} a^4(t)dt \right]^{0.25}$$

Where VDV is the vibration dose value in $m/s^{1.75}$, *a (t)* is the frequency-weighted rms of acceleration in m/s^2 and *T* is the total period of the day (in seconds) during which vibration may occur.

The acceptable VDV for intermittent vibration are reproduced in Table 4.4.

Table 4.4 Acceptable vibration dose values for intermittent vibration

Location	Daytime		Night time	
	Preferred value, $m/s^{1.75}$	Maximum value, $m/s^{1.75}$	Preferred value, $m/s^{1.75}$	Maximum value, $m/s^{1.75}$
Critical areas	0.10	0.20	0.10	0.20
Residences	0.20	0.40	0.13	0.26
Offices, schools, educational institutions and places of worship	0.40	0.80	0.40	0.80
Workshops	0.80	1.60	0.80	1.60

Notes: 1. Daytime is 7 am to 10 pm and night-time is 10 pm to 7 am.
2. These criteria are indicative only, and there may be a need to assess intermittent values against continuous or impulsive criteria for critical areas.

There is a low probability of adverse comment or disturbance to building occupants at vibration values below the preferred values. Adverse comment or complaints may be expected if vibration values approach the maximum values.

4.2.2 Structural vibration

i Australian Standard AS 2187.2 – 2006

In terms of the most recent relevant vibration damage criteria, Australian Standard AS 2187.2 - 2006 *Explosives* - Storage *and Use - Use of Explosives* recommends that the frequency dependent guideline values and assessment methods given in BS 7385 Part 2-1993 *Evaluation and measurement for vibration in buildings Part 2* be used as they are "applicable to Australian conditions".

The standard sets guide values for building vibration based on the lowest vibration levels above which damage has been credibly demonstrated. These levels are judged to give a minimum risk of vibration induced damage, where minimal risk for a named effect is usually taken as a 95% probability of no effect.

Sources of vibration that are considered in the standard include demolition, blasting (carried out during mineral extraction or construction excavation), piling, ground treatments (eg compaction), construction equipment, tunnelling, road and rail traffic and industrial machinery.

The recommended limits (guide values) for transient vibration to manage minimal risk of cosmetic damage to residential and industrial buildings are presented numerically in Table 4.5 and graphically in Figure 4.1.

Table 4.5 Transient vibration guide values – minimal risk of cosmetic damage

Line[1]	Type of Building	Peak component particle velocity in frequency range of predominant pulse	
		4 Hz to 15 Hz	15 Hz and above
1	Reinforced or framed structures Industrial and heavy commercial buildings	50 mm/s	50 mm/s
2	Unreinforced or light framed structures; Residential or light commercial type buildings	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above

Notes: Refers to the "Line" in Figure 4.1

The standard notes that the guide values in Table 4.5 relate predominantly to transient vibration which does not give rise to resonant responses in structures and low-rise buildings.

Where the dynamic loading caused by continuous vibration is such as to give rise to dynamic magnification due to resonance, especially at the lower frequencies where lower guide values apply, then the guide values in Table 4.5 may need to be reduced by up to 50%.

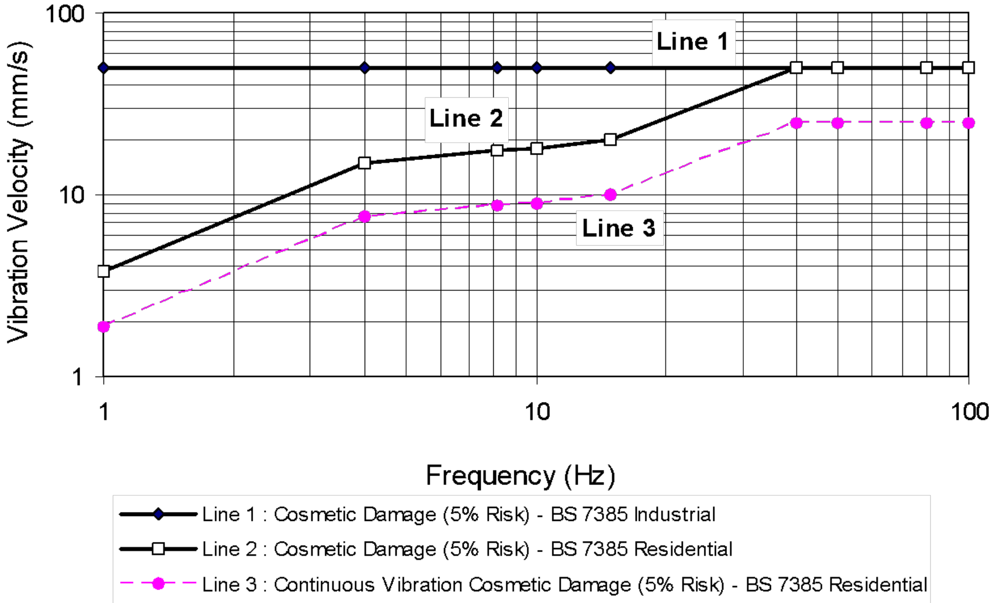


Figure 4.1 Graph of transient vibration guide values for cosmetic damage

In the lower frequency region where strains associated with a given vibration velocity magnitude are higher, the guide values for building types corresponding to Line 2 are reduced. Below a frequency of 4 Hz where a high displacement is associated with the relatively low peak component particle velocity value, a maximum displacement of 0.6 mm (zero to peak) is recommended. This displacement is equivalent to a vibration velocity of 3.7 mm/s at 1 Hz (as shown in Figure 4.1).

Fatigue considerations are also addressed in the standard and it is concluded that unless calculation indicates that the magnitude and number of load reversals is significant (in respect of the fatigue life of building materials) then the guide values in Table 4.5 should not be reduced for fatigue considerations.

In order to assess the likelihood of cosmetic damage due to vibration, AS2187 specifies that vibration measurements should be undertaken at the base of the building and the highest of the orthogonal vibration components (transverse, longitudinal and vertical directions) should be compared with the criteria curves presented in Table 4.5.

It is noteworthy that in addition to the guide values nominated in Table 4.5 the standard states that:

> Some data suggests that the probability of damage tends towards zero at 12.5 mm/s peak component particle velocity. This is not inconsistent with an extensive review of the case history information available in the UK.

ii German Standard DIN 4150-3:1999

The German Standard DIN 4150 - Part 3: 1999, provides the strictest guideline levels of vibration velocity for evaluating the effects of vibration in structures. The limits presented in this standard are generally recognised to be conservative.

The DIN 4150 values (maximum levels measured in any direction at the foundation, or maximum levels measured in (x) or (y) horizontal directions, in the plane of the uppermost floor), are summarised in Table 4.6 and shown graphically in Figure 4.2.

For residential and commercial type structures, the standard recommends safe limits as low as 5 mm/s and 20 mm/s respectively. These limits increase with frequency values above 10 Hz. The operational frequency of construction plant typically ranges between 10 Hz to 30 Hz, and hence according to DIN 4150, the safe vibration guide limit range for dwellings is 5 to 15 mm/s. For reinforced commercial type buildings, the limit is as low as 20 mm/s, while for heritage or sensitive structures the lower limit is 3 mm/s.

Table 4.6 Structural damage guideline values of vibration velocity – IN4150

Line*	Type of structure	Vibration Velocity in mm/s			
		At foundation at a frequency of			Plane of floor of uppermost storey
		1 Hz to 10 Hz	10 Hz to 50 Hz	50 Hz to 100 Hz	All frequencies
1	Buildings used for commercial purposes, industrial buildings and buildings of similar design	20	20 to 40	40 to 50	40
2	Dwellings and buildings of similar design and/or use	5	5 to 15	5 to 20	15
3	Structures that because of their particular sensitivity to vibration do not correspond to those listed in Lines 1 or 2 and have intrinsic value (eg buildings that are under a preservation order)	3	3 to 8	8 to 10	8
1	Buildings used for commercial purposes, industrial buildings and buildings of similar design	20	20 to 40	40 to 50	40

Notes: 1. "Line*" refers to curves in Figure 1 of DIN4150.
2. For frequencies above 100 Hz the higher values in the 50 Hz to 100 Hz column should be used.

These levels are "safe limits", for which damage due to vibration effects is unlikely to occur. "Damage" is defined in DIN 4150 to include even minor non-structural effects such as superficial cracking in cement render, the enlargement of cracks already present, and the separation of partitions or intermediate walls from load bearing walls.

Should such damage be observed without vibration levels exceeding the “safe limits” then it is likely to be attributable to other causes. DIN 4150 also states that when vibration levels higher than the “safe limits” are present, it does not necessarily follow that damage will occur.

As indicated by the guide levels from DIN 4150 in Table 4.6, high frequency vibration has less potential to cause damage than lower frequencies. Furthermore, the “point source” nature of vibration from plant causes the vibratory disturbances to arrive at different parts of nearby large structures in an out-of-phase manner, thereby reducing its potential to excite in-phase motion of the low order modes of vibration in such structures.

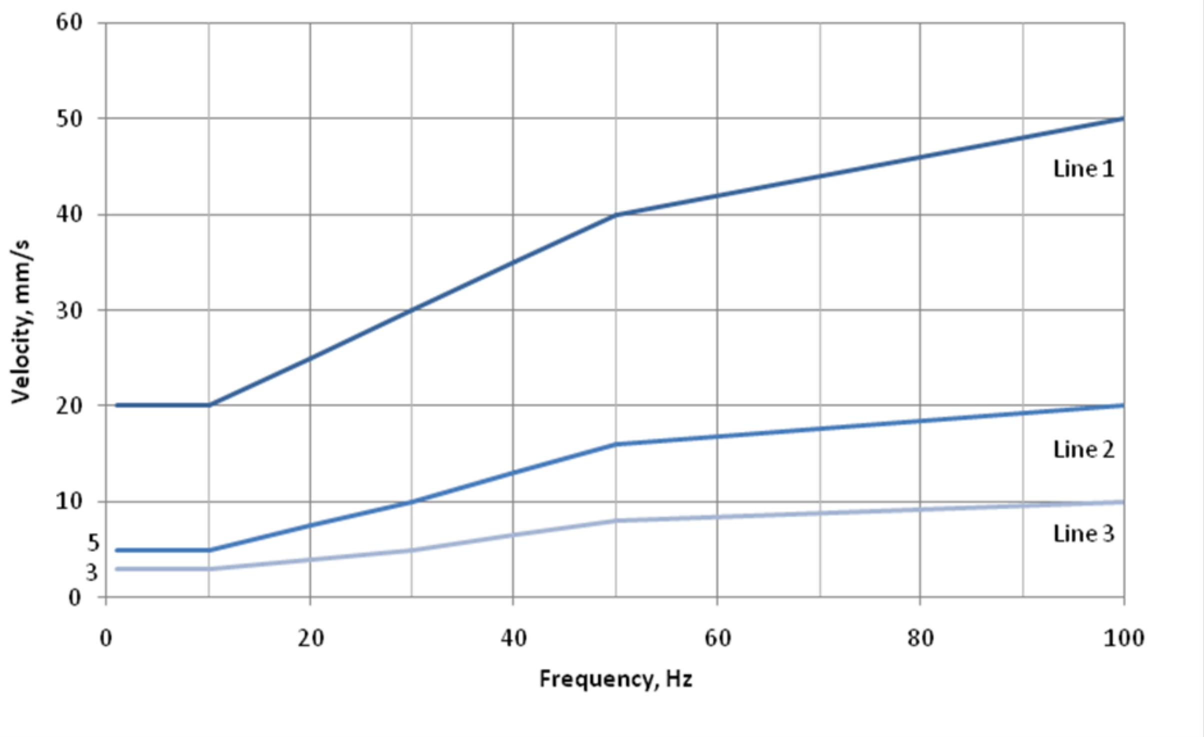


Figure 4.2 DIN4150 structural damage guideline values of vibration velocity

The potential effect of vibration on particular structures can vary depending on many factors including their existing structural integrity and use.

4.3 Operational noise

Following the construction and commissioning of proposed BESS there will be noise emissions from plant and equipment. There are two key industrial noise control documents currently used in Victoria for the assessment of operational noise:

- State Environment Protection Policy – Control of Noise from Commerce, Industry and Trade No. N-1 (SEPP N-1) (Victorian Government, 1989); and
- Noise from Industry in Regional Victoria (NIRV): Recommended maximum noise levels from commerce, industry and trade premises in regional Victoria (EPA publication 1411) (EPA Victoria, 2011).

SEPP N-1 is applicable for sensitive receivers located in a *Major Urban Area (MUA)*, with potential impact from industrial noise. A ‘*Major Urban Area*’ is defined in SEPP N-1 as:

- parts of *Melbourne* that is within the *SEPP N-1 boundary,* refer to Figure 9; or

- parts of *Melbourne* that extends beyond the *SEPP N-1 boundary*, but is within the *Melbourne Urban Growth Boundary* (UGB), refer to Figure 9; or
- Land within the '*Major Urban Area'* boundary of an Urban Centre with a population greater than 7000, refer to Figure 10; or
- Land zoned either Residential Zone, Industrial Zone, Business Zone or Urban Growth Zone that is transected by the '*Major Urban Area'* boundary of an Urban Centre with a population greater than 7000, then the whole of that zone shall be considered as part of the MUA.

The NIRV guideline is applicable for noise sensitive areas in rural areas outside of those areas outlined above that may potentially be impacted from industrial noise. A rural area is defined by NIRV as:

> A rural area is land that is not within a major urban area. It includes land in cities or towns with population below 7000, and rural locations outside major urban areas' (EPA Victoria, 2011).

The site and nearby sensitive assessment locations surrounding the site are located beyond the SEPP N-1 area (Figure 4.3) and the Melbourne Urban Growth boundary (EPA Victoria, 2011) and are therefore assessable against the NIRV guideline.

The NIRV is the EPA Victoria's mechanism for managing the impact of noise from proposed new and existing industrial and commercial premises on residential and other noise-sensitive land uses. It sets the maximum noise level allowed in a noise sensitive area from commercial/industrial premises subject to time of day and land use zoning.

There are five steps to consider in the development of maximum allowable noise levels. The first step is to determine the land-use zones of the receiving zone[1] and generating zone[2]. Once the receiving and generating zones are known, then using Table 1 in the NIRV guideline, the Zone Noise Levels are developed for each time period. The obtained Zone Noise Levels are then adjusted depending on the receiver-to-source distance to obtain the maximum allowable planning noise levels.

In a situation where background noise levels may be higher than usual for a rural area due to traffic noise or coastal noise, background noise monitoring may be undertaken, and an adjustment of the Zone Noise Levels made accordingly to determine the maximum allowable noise levels.

Despite the project site not being located within a background relevant area[3], noise monitoring (Section 3.2) was undertaken for this assessment to establish prevailing background noise levels.

[1] Receiving zone – land use zone where the noise sensitive areas are located

[2] Generating zone – land use zone where the noise source is located

[3] Background relevant area – sensitive noise assessment area where background noise levels may be higher than typical for a rural area. Included areas that are exposed to significant traffic noise and coastal area.

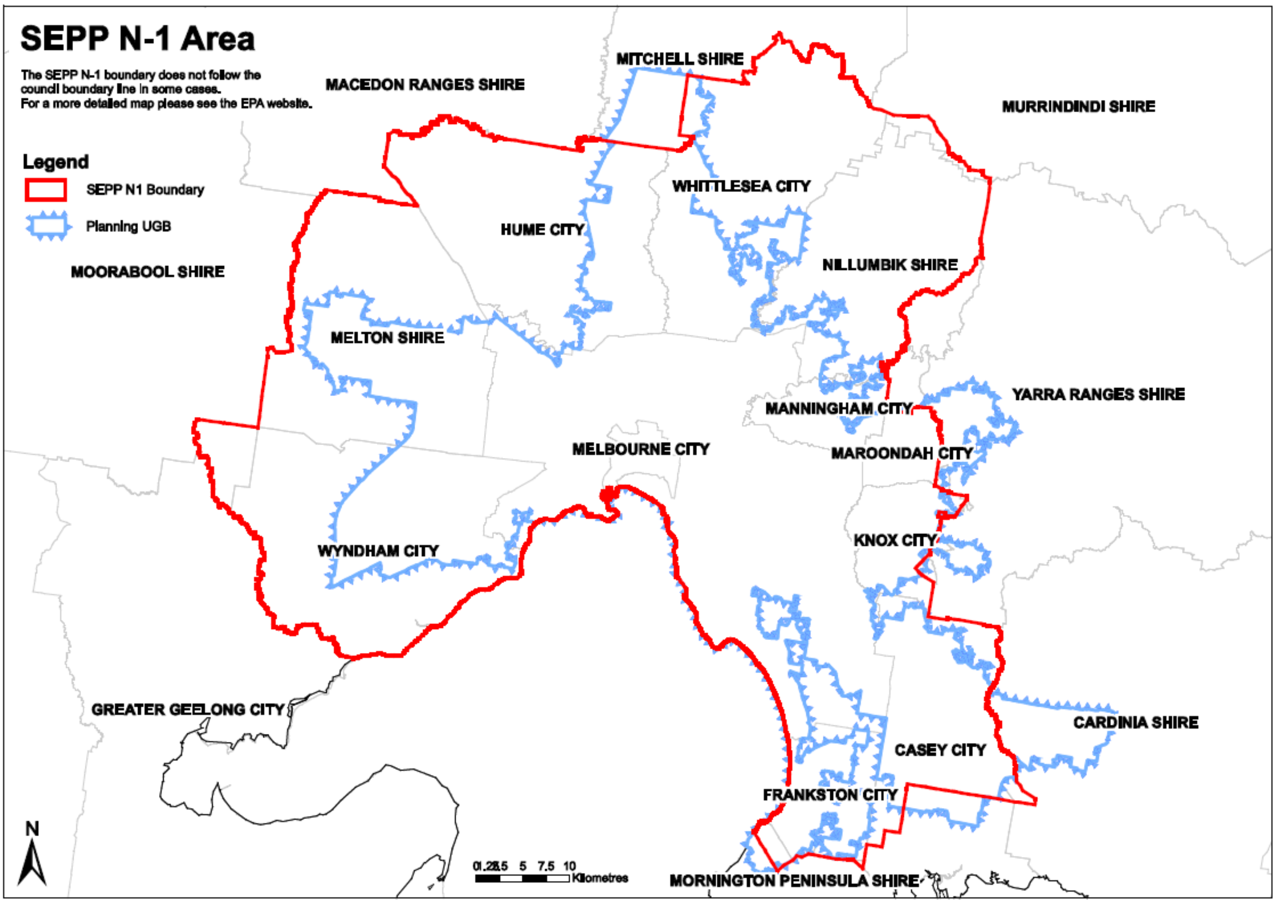


Figure 4.3 Area covered by SEPP N1

The following NIRV steps were followed to develop the noise criteria for sensitive noise receiving area under:

- **STEP 1: Identification of Zones:** Table 1 of the NIRV (EPA Publication 1411, 2011):
  - Special Use Zone 1 (SUZ1) generating zone (Industrial 1 Zone >25 MW development) and SUZ1 for receivers (however as for agricultural use apply Farming Zone/Rural Agricultural Zone):
    - Day 53 dBA
    - Evening 48 dBA
    - Night 43 dBA
- **STEP 2: Distance adjustment levels:** One decibel is to be subtracted for every 100 metres of 'receiver distance' where the noise generator and noise receiving locations are in different landuse zones, as stipulated in the NIRV, same contiguous zone therefore no adjustment;
  - Day 53dBA
  - Evening 48dBA
  - Night 43dBA

- **STEP 3:** Base noise level check. Check distance adjusted noise levels from step 2 against the following base noise levels for each period:
  - Day 45 dBA
  - Evening 37 dBA
  - Night 32 dBA

For each period, the greater of the distance- adjusted level and the base noise level is adopted:

- **STEP 4. Background level check and adjustment:** A background level assessment may be required where the location of the noise sensitive receivers is considered to be situated within a background relevant area. Considering potential noise from the existing Tyabb substation, noise monitoring was undertaken (Section 3.2) and considering the measured background noise levels and stipulated adjustments, the relevant noise level for assessment would be:

  NM1 (R1 and R2)

  - Day 47 dBA L_{A90} 39 +8
  - Evening 47 dBA L_{A90} 42 +5
  - Night 44 dBA L_{A90} 39 +5

  NM2 (all other residential receivers)

  - Day 44 dBA L_{A90} 36 +8
  - Evening 43 dBA L_{A90} 38 +5
  - Night 41 dBA L_{A90} 36 +5

- **STEP 5. High traffic noise areas:** applies to background-relevant areas affected by high traffic-noise levels. The site and noise sensitive receivers are not exposed to noise from high traffic roads.

Table 4.7 presents the derived NIRV noise criteria applicable for the identified nearest sensitive residential receivers.

Table 4.7 NIRV noise criteria for noise sensitive receivers, LAeq

NIRV Step	Day[1]	Evening[2]	Night[3]
NM1 – Assessment locations R1 and R2			
1	53	48	43
2[4]	53	48	43
3[5]	53 (45)	48 (37)	43 (32)
4[6]	50	47	44
5[7]	n/a	n/a	n/a
NIRV assessment criteria	**53**	**48**	**44**

Table 4.7 NIRV noise criteria for noise sensitive receivers, LAeq

NIRV Step	Day[1]	Evening[2]	Night[3]
NM2 – All other residential assessment locations			
1	53	48	43
2[4]	53	48	43
3[5]	53 (45)	48 (37)	43 (32)
4[6]	50	45	41
5[7]	n/a	n/a	n/a
NIRV assessment criteria	**53**	**48**	**43**

Notes:
1. Day – 7am to 6pm (Monday to Friday), 7am to 1pm (Saturday)
2. Evening – 6pm to 10pm Monday to Friday, 1pm to 10pm Saturday and 7am to 10pm Sunday
3. Night – 10pm to 7am all days
4. No adjustment as same contiguous zoning and closest residences <100m
5. Base level check
6. Background L_{A90} noise level +8dB (Day) and +5dB (evening and night)
7. High traffic area not applicable

For the existing industrial premises to the south identified as IN1 at 3/36 Denham Road, Tyabb the relevant NIRV noise criteria are L_{Aeq} 56 dB, 51 dB and 46 dB for day, evening and night respectively. Considering time when industrial premises IN1 is in use, the levels of 56 dB day and 51 dB night are most relevant.

The Applying NIRV Guide outlines (on page 10) a series of factors that should be taken into account by regulators, such as DELWP, when determining whether or not to permit, in respect of new land uses to which the NIRV applies. Some departures from the recommended noise levels contained in the NIRV are as follows:

- whether the proponent has reduced noise as far as practicable;
- whether the proponent has demonstrated a net benefit for the proposal;
- whether the proponent has explored alternative outcomes with the community to address the noise risks; and
- whether the proponent has proposed measures to address the residual noise risks.

In EMM's view, the extracts from both the NIRV and the Applying NIRV Guide demonstrate that there is no requirement for projects to meet the recommended noise limits set out in the NIRV and that consideration can be given by regulators to permitting departures from those limits in appropriate circumstances.

4.4 Road traffic noise

The proposal project's construction related road traffic require assessment for potential noise impacts. In the absence of other guidelines, this assessment has considered Vic Roads (VR 2005) Traffic Noise Reduction Policy (TNRP) to assess potential road traffic noise impacts on residences. The TNRP has three components to limit noise:

- **Category A**: – for residential dwellings, aged persons homes, hospitals, motels, caravan parks and other buildings of a residential nature, the noise level objective will be 63 dBA L10 (18hr) measured between 6am and midnight.

- **Category B**: - for schools, kindergartens, libraries and other noise-sensitive community buildings the noise level objective will be 63 dBA L10 (12hr) between 6am and 6pm.

- Where the noise level adjacent to **Category A** or **B** buildings prior to road improvements is less than 50 dBA L10 (18hr), consideration will be given to limiting the noise level increase to 12 dBA.

5 Assessment method

5.1 Noise modelling

This section presents the methods and base parameters used to model construction noise and vibration and operational emissions from the proposed BESS.

Operational and construction noise levels were predicted using a computer-generated model using DGMR Software proprietary modelling software, iNoise. The model utilised international standard ISO 9613-2:1996 'Acoustics – Attenuation of sound during propagation outdoors'. As per Section 1 of the standard:

> The method predicts the equivalent continuous A-weighted sound pressure level (as described in parts 1 to 3 of ISO 1996) under meteorological conditions favourable to propagation from sources of known sound emission.
>
> These conditions are for downwind propagation, as specified in 5.4.3.3 of ISO 1996-2:1987 or, equivalently, propagation under a well-developed moderate ground-based temperature inversion, such as commonly occurs at night.

The model calculates total noise levels at assessment locations from concurrent operation of multiple noise sources. It considers factors that influence noise propagation such as the lateral and vertical location of plant, source-to-receptor distances, ground effects, atmospheric absorption, topography of the site and surrounding area and applicable meteorological conditions.

The model was populated with 3-D topography of the project area and surrounding area, extending out past nearest assessment locations. Plant and equipment representing the range of proposed construction and operation scenarios was placed at locations which would represent worst case noise levels throughout the construction and operational scenarios.

5.2 Construction noise

5.2.1 Times

Construction of the BESS would be during daytime hours only and has an envisaged duration of up to nine months. Key stages in construction of the site will include:

- bulk earthworks, filling, compaction and drainage;
- trenching and boring of foundations for battery modules, inverters, transformers and transmission line towers;
- modular battery, inverter, transformer and transmission line installation and commissioning; and
- control building, switch room, O & M building and substation construction.

5.2.2 Equipment sound power levels

The construction noise impact assessment has adopted sound power levels from the EMM noise database for plant and equipment items used on similar projects. Plant and equipment items, sound power levels and quantities adopted in the noise modelling are summarised in Table 5.1.

Construction for the project will involve the installation of battery modules and associated infrastructure. Site preparation will be the starting phase of the construction works. The need for heavy civil works such as grading/levelling and compaction will be minimised as site is predominately flat and cleared.

Some heavier earth moving will likely be required for certain project infrastructure (eg substations and BESSs).

Site establishment works and preparation for construction may include:

- the establishment of a temporary construction site compound in a fenced-off area within the development footprint including:
    - a site office;
    - containers for storage;
    - parking areas; and
    - temporary laydown areas;
- construction of access tracks and installation of boundary fencing;
- site survey to confirm infrastructure positioning and placement; and
- geotechnical investigations to confirm the ground condition.

Upon completion of the site establishment and pre-construction activities described above, construction will typically be as follows:

- Trenching, driven or screw piles for slabs.
- Install mounting bases.
- Installation of battery modules, inverters and transformers.
- Installation of medium voltage and high voltage cables.
- Complete substation augmentation.
- Establishment of the BESS compound.
- Test and commission project infrastructure.

The assumed list of plant and equipment for each construction scenario provided in Table 5.1 are considered to be representative of a worst-case period of construction in an active works area. However, due to the practicalities of constructing a project of this nature, the plant and equipment quantities may vary from time-to-time to cater for the requirements of the project's construction. The construction noise impact assessment has adopted sound power levels from the Department of Environment, Food and Rural Affairs (DEFRA) and EMM noise database for plant and equipment items used on similar projects.

If the actual fleet of plant and equipment required varies significantly from that assumed within Table 5.1, a risk assessment of the proposed works will be undertaken to determine the likelihood of noise impacts on surrounding residential receivers. Appropriate management and mitigation measures will be used, where required. As described in Section 7, the CEMP will include the risk assessment protocol and detail the management and mitigation measures to be implemented during construction consistent with the best practice requirements.

Table 5.1 Typical construction plant and equipment

Description	Equipment	Quantity	Item $L_{Aeq,15min}$	Overall $L_{Aeq,15min}$
Stage 1 – Site establishment	Dozer	2	110	119
	Grader	1	104	
	Excavator	2	107	
	Roller	1	116	
	Bobcat	2	103	
	Front End Loader	1	107	
	Road truck (deliveries)	2	106	
	Concrete truck	2	106	
	Drilling Rig SM 14	1	106	
	Light vehicle	4	76	
Stage 2 – Delivery of BESS infrastructure	Road truck (deliveries)	2	106	113
	Light vehicle	4	76	
	Crane	2	106	
	Forklift	2	106	
	Hand tools	2	80	
Stage 3 – Installation of BESS Infrastructure	Road truck (deliveries)	2	106	111
	Light vehicle	4	76	
	Crane	2	106	
	Hand tools	2	80	

1. Standard hours: Monday to Friday 7 am to 6 pm, Saturday 7 am to 1 pm and no construction work on Sundays or public holidays.
2. Plant and equipment items have been assumed to operate continuously in any 15-minute period unless otherwise specified.
3. Day: 7 am to 6 pm Monday to Saturday; 8 am to 6 pm Sundays and public holidays; Evening: 6 pm to 10 pm; Night: 10 pm to 7 am Monday to Saturday; 10 pm to 8 am Sundays and public holidays.

5.2.3 Noise predictions

i Single point predictions

In order to assess a potential worst-case construction scenario, the assessment has considered the identified plant and equipment in Table 5.1 operating continuously over a 15 minute period. Construction noise levels were predicted to the assessment locations listed in Table 3.1 and identified in Figure 3.1

ii Noise contours

Further to the above approach and acknowledging adjacent industrial land uses and other residential areas to the north, east, south and west of the site, noise contours have been generated for the day construction activities to evaluate noise exposure surrounding the site.

5.2.4 Noise enhancing meteorology

Construction is proposed to occur during day hours only with modelling of construction noise considering standard ISO9613 weather conditions.

5.3 Construction vibration

5.3.1 Mobile plant and equipment

Safe working distances for typical items of vibration intensive plant are listed in Table 5.2. The safe working distances are quoted for both “Cosmetic Damage” (refer British Standard BS 7385) and “Human Comfort” (refer British Standard BS 6472-1).

Table 5.2 Recommended safe working distances for vibration intensive plant

Plant Item	Rating/Description	Safe working distance	
		Cosmetic damage (BS 7385)	Human response (BS 6472)
Medium hydraulic hammer	(900 kg - 12 to 18t excavator)	7 m	23 m
Large hydraulic hammer	(1600 kg - 18 to 34t excavator)	22 m	73 m
Vibratory pile driver	Sheet piles	2 m to 20 m	20 m
Pile boring	≤ 800 mm	2 m (nominal)	N/A
Vibratory Rollers	<50kN (Typically 1-2 tonnes)	5 m	15 to 20 m
	<100kN (Typically 2-4 tonnes)	6 m	20 m
	<200kN (Typically 4-6 tonnes)	12 m	40 m
	<300kN (Typically 7-13 tonnes)	15 m	100 m
	>300kN (Typically 13-18 tonnes)	20 m	100 m
	>300kN (>18 tonnes)	25 m	100 m

Source: From Transport Infrastructure Development Corporation Construction’s Construction Noise Strategy (Rail Projects), November 2007 – based on residential building.

Safe work distances relate to continuous vibration. For most construction activity, vibration emissions are intermittent in nature. The safe working distances are therefore conservative.

The safe working distances presented in Table 5.2 are indicative and will vary depending on the item of plant and local geotechnical conditions. They apply to cosmetic damage of typical buildings under typical geotechnical conditions.

The safe working distances have been used to assess the potential for contraction vibration impacts based on proposed construction activities.

5.4 Operations noise

5.4.1 Design drawings

The acoustic assessment has been based on preliminary layout drawing (Appendix B). In addition, the noise model has considered the proposed acoustic barriers (4m in height) as outlined in Figure 6.2.

5.4.2 Plant and equipment

Noise impact from the general operation of the project was considered at assessment locations outlined in Section 3.1, with the closest residential assessment locations (R1 and R9) approximately 60 m from the development footprint for the battery cubicle area.

As part of the detailed design process, the final locations for potential noise-generating infrastructure, in particular the substations and BESS facilities, will consider the distance between this type of infrastructure and nearby non-project related residences, so as to minimise operational noise impacts, where practicable.

Noise sources considered during the operational phase of the project include battery cubicles, power conversion systems (PCS) and high voltage transformers. Envisaged operational noise sources are shown in Table 5.3.

Table 5.3 Operational noise source sound power levels

Noise source	L_{Aeq} sound power level per unit, dB[1]
Battery Cubicles (x1600)	71
PCS /Inverters (x88) [2]	88
LV-MV transformers (3.5 MVA x88) [3]	66
MV-HV transformer (250 MVA x1) [3]	92

1. The combined noise levels will be subject to final quantity, configuration and layout of equipment as well as any noise attenuating measures
2. Inverters are typically tonal and a 5dB penalty has been considered for these items
3. Based on maximum reduced limit AS60076.10 specifications with 5dB tonal penalty to MV-HV transformer only

5.4.3 Noise predictions

i Single point predictions

In order to assess potential operational noise, the assessment has considered the identified plant and equipment in Table 5.3 operating continuously over a 15 minute period. Operational noise levels were predicted to the assessment locations listed in Table 3.1 and identified in Figure 3.1.

A review of the operational utilisation of similar facilities such as the Ballarat Battery and the Hornsdale Power Reserve BESS facility have confirmed that charge and discharge rates do not occur at the rated capacity of the BESS, with maximum utilisation typically 80% of peak system capacity during day/evening periods, and less than 50% during the night period. For the purpose of assessment of the Tyabb BESS, the modelling has considered the following typical operational utilisation capacity:

- Day/Evening 100% utilisation; and
- Night 60% utilisation (±5%).

ii Noise contours

Further to the above approach and acknowledging adjacent industrial land uses and other residential areas to the north, east, south and west of the site, noise contours have been generated for the day/evening (Figure 6.2) and night (Figure 6.3) operational activities to determine the potential extent of noise exposure.

5.4.4 Noise enhancing meteorology

Noise modelling was conducted using Brüel & Kjær Predictor noise modelling software. The model utilised international standard ISO 9613-2:1996 'Acoustics – Attenuation of sound during propagation outdoors'. As per Section 1 of the standard:

> The method predicts the equivalent continuous A-weighted sound pressure level (as described in parts 1 to 3 of ISO 1996) under meteorological conditions favourable to propagation from sources of known sound emission.
>
> These conditions are for downwind propagation, as specified in 5.4.3.3 of ISO 1996-2:1987 or, equivalently, propagation under a well-developed moderate ground-based temperature inversion, such as commonly occurs at night.

A summary of modelling conditions for which noise predictions have been provided are shown in Table 5.4.

Table 5.4 Conditions adopted in the model

Assessment condition	Period	Temperature	Relative humidity
ISO9613	Day/Evening	20°C	60%
	Night	0°C	90%

1. Downwind conditions in accordance with ISO9613 algorithm – Section 5 and 8.
2. Moderate inversion.

5.5 Road traffic noise

The Calculation of Road Traffic Noise (CoRTN) and US EPA Federal Highways (FHWA) methods were considered in the assessment of road traffic noise. Where traffic flows were low (<200 vehicles per hour) the FHWA procedures were adopted as it is more sensitive to low traffic volumes. Where traffic volumes were greater than 200 vehicles per hour the CoRTN methodology was adopted. A summary of the road sections and assessment methodology is provided in Table 5.5.

Table 5.5 Road segments considered in noise assessment

ID	Road segment/name	AADT	Assessment methodology
1	Dandenong-Hastings Road	9,555	CoRTN
2	Thornells Road	Minimal existing traffic	FHWA[1]

1. FHWA adopted to traffic assessment due to low traffic volumes.

Road traffic movements associated with construction and operation of the BESS have been referenced from the Traffic Impact Assessment (EMM 2020) and adapted to suit TNRP assessment requirements (Section 4.5.3).

Road traffic noise levels from the project have been assessed by calculating existing and existing plus project traffic at representative residential assessment locations using FHWA and CoRTN methods. The following assumptions have been adopted:

- Speed limit for Dandenong Hastings Road 90 km/h (as signposted).
- Speed limit for Thornells Road 60 km/h (as signposted; in practice likely 40-50 km/h).

- There are no buildings or other intervening objects that will act like a noise barrier between the road and the noise assessment point (ie we are assessing the locations directly exposed to the road).
- A facade reflection has been added to predicted noise levels as appropriate for each calculation method.

Operational traffic associated with the proposal would typically be restricted to occasional maintenance vehicles only with expected maximum of five vehicles a day. Accordingly, operational traffic from the site is not considered a concern and was not assessed further in this report.

6 Impact assessment

6.1 Construction noise

6.1.1 Single point predictions

In accordance with procedures outlined in Section 5.2, prediction of construction noise levels is provided in Table 6.2 for normal day periods under ISO9613 weather conditions. The construction noise level presented for each assessment location represents the energy-average noise level over a 15-minute period and assumes all plant operating concurrently.

The proponent will manage construction noise levels through construction noise management methods detailed in a construction noise management plan as discussed further in Section 7. Construction is to be conducted during normal hours of 7am to 6pm Monday to Friday and 7am to 1pm Saturday.

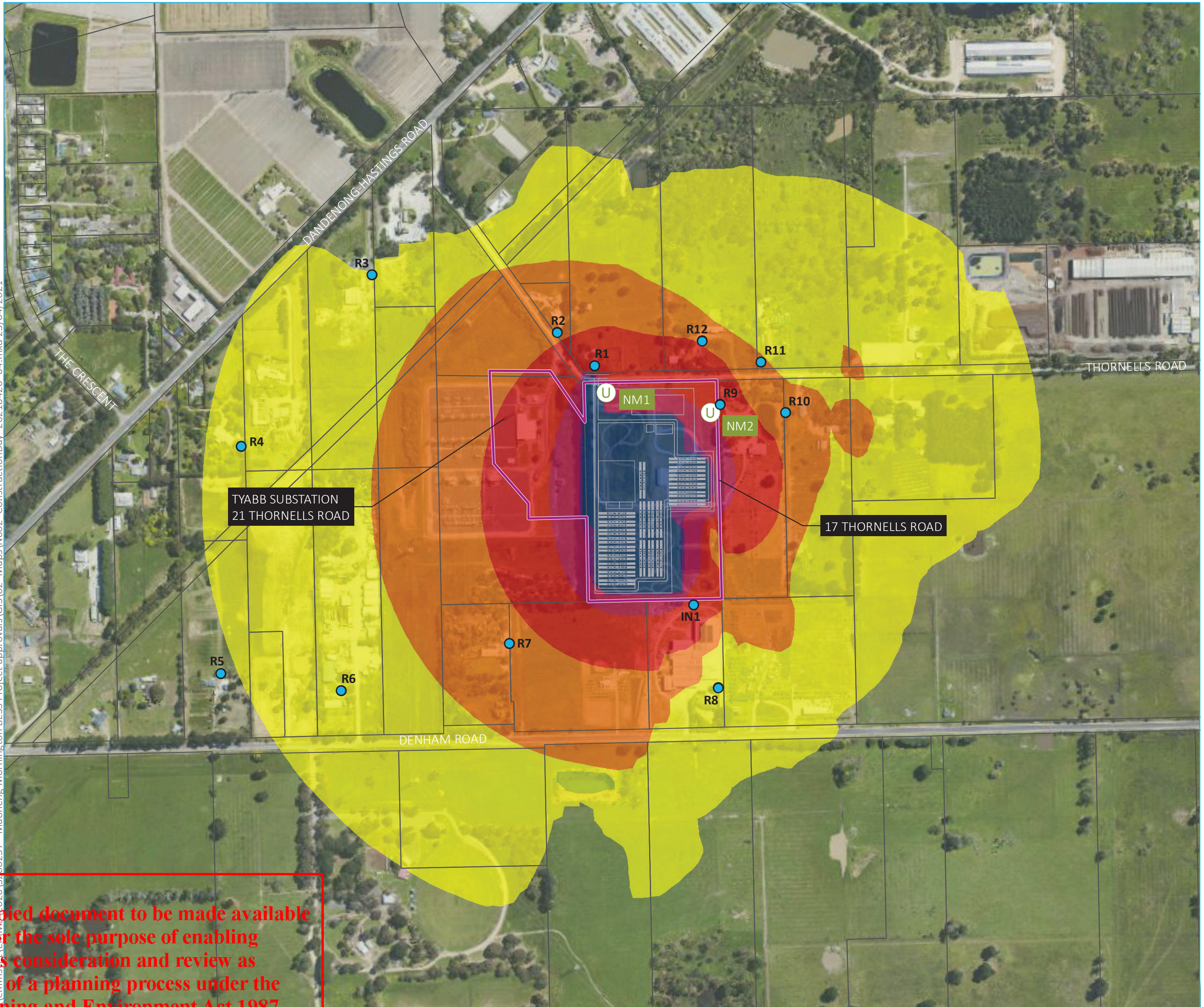
Table 6.1 Predicted construction noise levels

Assessment location	Classification	Period	Predicted construction noise level, dB $L_{Aeq,15min}$	Noise to be managed in accordance with the CNMP and procedures of NCG Section 2
R1	Residential	Normal hours	64	yes
R2	Residential	Normal hours	63	yes
R3	Residential	Normal hours	59	yes
R4	Residential	Normal hours	52	yes
R5	Residential	Normal hours	51	yes
R6	Residential	Normal hours	50	yes
R7	Residential	Normal hours	52	yes
IN1	Industrial	Normal hours	59	yes
R8	Residential	Normal hours	52	yes
R9	Residential	Normal hours	63	yes
R10	Residential	Normal hours	57	yes
R11	Residential	Normal hours	55	yes
R12	Residential	Normal hours	60	yes

Where works outside of normal hours are unavoidable, noise should be managed in accordance with the noise limits of the NCG Section 2 as presented in Section 4.1 of this report. Works outside of normal hours would typically require approval from the relevant regulatory authority and be justified with specialist acoustic assessment of the proposed works to be undertaken.

6.1.2 Contours

Predicted $L_{Aeq,15minute}$ noise contours representing the worst-case noise level footprint from the project construction is provided in Figure 6.1. The figure represents the predicted construction noise levels under ISO9613 noise enhancing conditions.



KEY

- Subject site
- Site layout
- Cadastral boundary
- Noise assessment location
- Noise monitoring location - unattended

Day period noise level contour range ($dB_{LAeq,15min}$)

- < 50
- 50 - 55
- 55 - 60
- 60 - 65
- 65 - 70
- 70 - 75
- > 75

Construction noise contours, day, ISO 9613

Maoneng Australia Pty Limited
Mornington BESS
Noise and vibration impact assessment
Figure 6.1

EMM creating opportunities

6.2 Construction vibration

In relation to human comfort response, the safe working distances in Table 5.2 relate to continuous vibration and apply to residential assessment locations. For most construction activities, vibration emissions are intermittent in nature and for this reason, higher vibration levels, occurring over shorter periods are allowed, as discussed in BS 6472-1.

The nearest residences (R1 and R9) are located approximately 70 m to the closest proposed construction activities. These assessment locations are beyond the safe working distances for structural damage and subject to size of vibratory roller required, likely below the levels for human response (Table 2.7). Vibration impacts from construction at residential assessment locations are considered unlikely.

The safe working distances for cosmetic damage should be monitored throughout the construction process. Based on the safe working distances guide in Table 5.2, if construction is within 25 m of sensitive structures, then work practices should be reviewed so that the safe working distance in Table 5.2 are followed.

If safe working distances need to be encroached, real time vibration monitoring with audible and visual alarms should be installed at vibration sensitive structures so actual vibration levels can be monitored and managed appropriately in real-time.

6.3 Operational noise

6.3.1 Single point predictions

In accordance with procedures outlined in Section 5.4.3, prediction of single point operational noise levels are provided in Table 6.2 for day, evening and night periods. The levels presented for each assessment location represents the energy-average noise level over a 15 minute period and assumes all plant operating concurrently under ISO9613 noise enhancing conditions.

Table 6.2 Predicted operational noise levels – ISO9613

Assessment location	Classification	Period	NIRV NL, dB	Predicted noise level, dB $L_{Aeq,15min}$	Satisfies NIRV NL Y/N (dB)
R1	Residential	Day	53	45	Y
		Evening	48	45	Y
		Night	44	42	Y
R2	Residential	Day	53	43	Y
		Evening	48	43	Y
		Night	44	40	Y
R3	Residential	Day	53	37	Y
		Evening	48	37	Y
		Night	43	34	Y
R4	Residential	Day	53	37	Y
		Evening	48	37	Y
		Night	43	34	Y
R5	Residential	Day	53	33	Y
		Evening	48	33	Y
		Night	43	31	Y

Table 6.2 Predicted operational noise levels – ISO9613

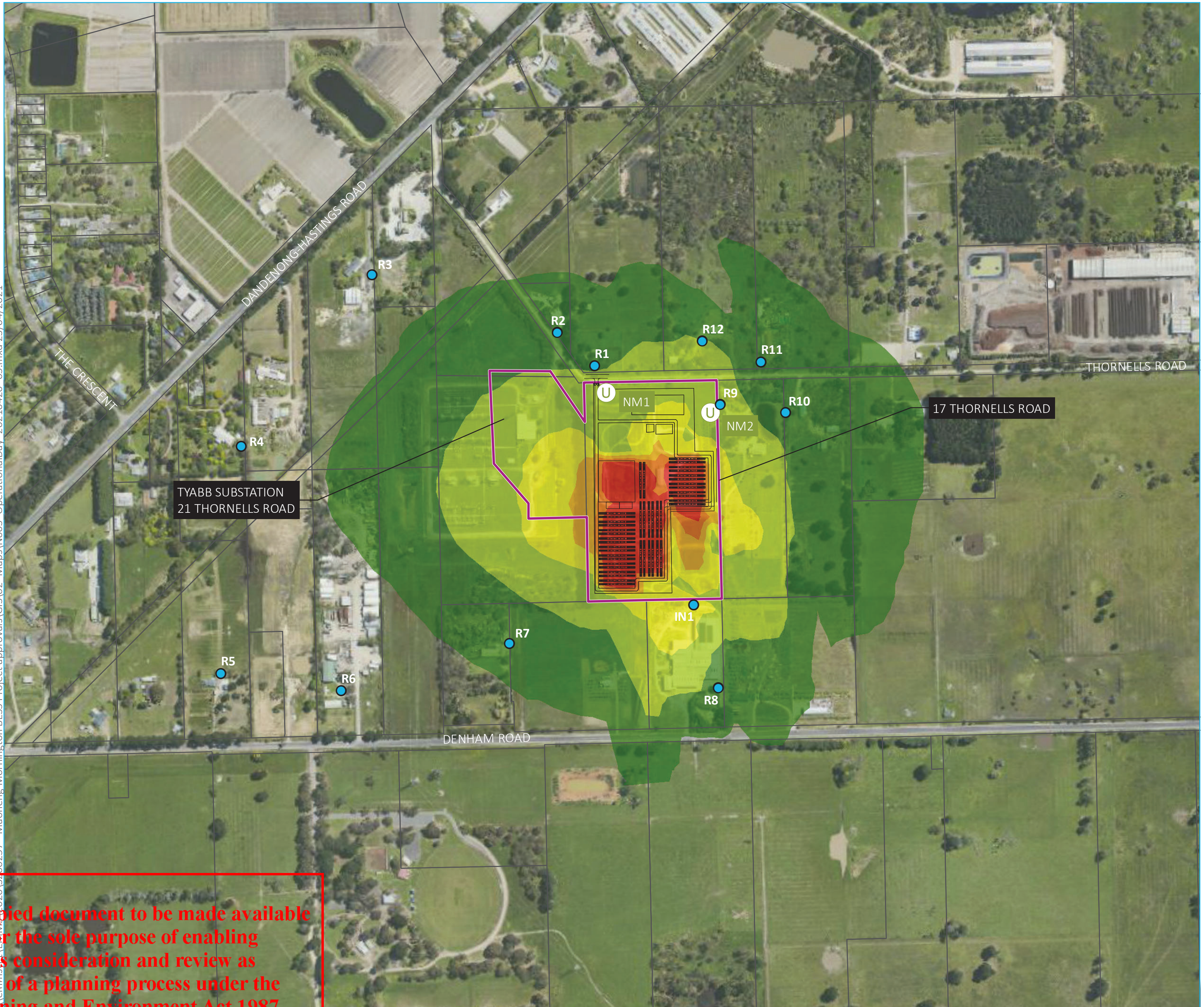
Assessment location	Classification	Period	NIRV NL, dB	Predicted noise level, dB $L_{Aeq,15min}$	Satisfies NIRV NL Y/N (dB)
R6	Residential	Day	53	36	Y
		Evening	48	36	Y
		Night	43	33	Y
R7	Residential	Day	53	42	Y
		Evening	48	42	Y
		Night	43	39	Y
IN1	Industrial	Day	56	51	Y
		Evening	51	51	Y
		Night	46	47	n/a
R8	Residential	Day	53	41	Y
		Evening	48	41	Y
		Night	43	38	Y
R9	Residential	Day	53	47	Y
		Evening	48	47	Y
		Night	43	**44**	N (+1)
R10	Residential	Day	53	43	Y
		Evening	48	43	Y
		Night	43	40	Y
R11	Residential	Day	53	42	Y
		Evening	48	42	Y
		Night	43	39	Y
R12	Residential	Day	53	45	Y
		Evening	48	45	Y
		Night	43	42	Y

Exceedances of NIRV NL shown in **bold**. Noise mitigation options are discussed in Section 7
Day/Evening – 100% capacity utilisation
Night – 60% capacity utilisation

Noise modelling has demonstrated the NIRV NLs are satisfied at all assessment locations during day and evening. Notwithstanding the selection of plant and equipment on acoustic performance and the provision of strategically located acoustic barriers on the site surrounding the battery cubicles, during the night a negligible noise exceedance of 1 dB is predicted for R9. Assessment location R9 forms part of the project and an agreement between the proponent and the owner of R9 would be sought to address the residual noise impacts.

6.3.2 Contours

Predicted $L_{Aeq,15min}$ noise contours representing day/evening and night operations are provided in Figure 6.2 and Figure 6.3 respectively. The figures represent the predicted operational noise levels during ISO9613 conditions for day/evening and night.



KEY
- Subject site
- Site layout
- Cadastral boundary
- Noise assessment location
- Noise monitoring location - unattended

Day period noise level contour range ($dB_{LAeq,15min}$)
- 40 - 45
- 45 - 50
- 50 - 55
- 55 - 60
- 60 - 65
- > 65

Source: EMM (2021), Meoneng (2021), DELWP (2019), GA (2011)

0 150 300 m

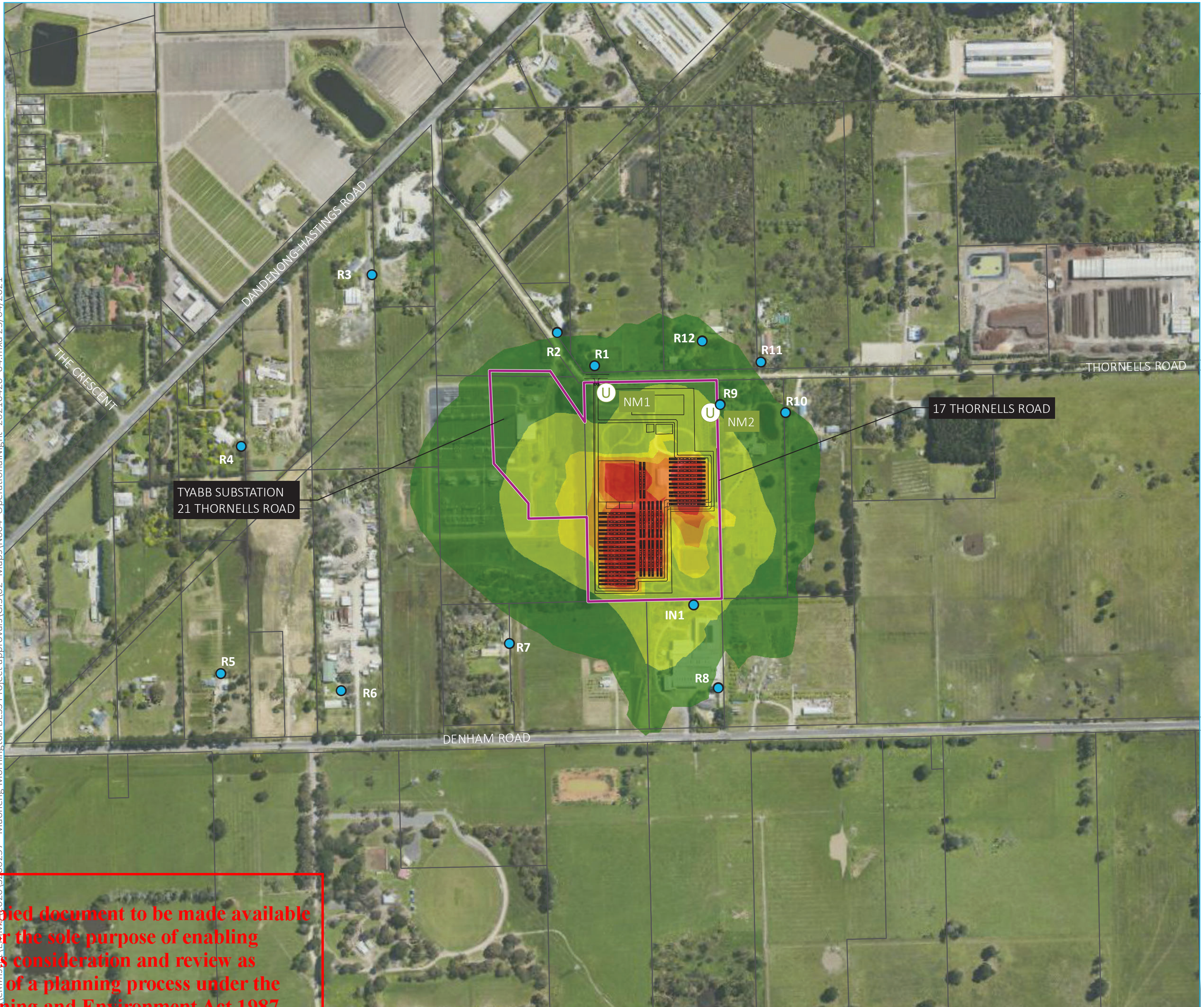
GDA 1994 MGA Zone 55

N

Operational noise contours,
day/evening, ISO 9613

Maoneng Australia Pty Limited
Mornington BESS
Noise and vibration impact assessment
Figure 6.2

EMM
creating opportunities



Source: EMM (2021), Meoneng (2021), DELWP (2019), GA (2011)

KEY

- Subject site
- Site layout
- Cadastral boundary
- Noise assessment location
- (U) Noise monitoring location - unattended

Night period noise level contour range ($dB_{LAeq,15min}$)

- 40 - 45
- 45 - 50
- 50 - 55
- 55 - 60
- 60 - 65
- > 65

Operational noise contours, night, ISO 9613

Maoneng Australia Pty Limited
Mornington BESS
Noise and vibration impact assessment
Figure 6.3

EMM creating opportunities

6.4 Road traffic noise

Road traffic noise level predictions for peak generation construction traffic are provided in Table 6.3. Traffic volumes were provided by Maoneng to represent the peak generation of light (LV) and heavy vehicles (HV) associated with the construction of the BESS facility. Construction would be restricted to normal daytime hours only.

Table 6.3 Road traffic noise calculations, Day (7am to 10pm)

ID	Approximate distance from nearest carriageway	Road segments	Existing movements[1]			Existing plus project movements			Noise level increase due to the Project, $L_{A10,18hour}$
			Total	%HV	Calculated level, $L_{A10,18hour}$	Total	%HV	Predicted level, $L_{A10,18hour}$	
1	20m	Dandenong Hastings Road	7644	6.9	59.1	7813	6.9	59.2	<0.1
2	17m	Thornells Road	60	9.1	48.4	186	8.0	55.4	7.0

Assessment of day ($L_{A10,18hour}$) construction traffic predictions confirm compliance with the $L_{A10,18hr}$ criterion of 63 dB for road segments likely to be used by vehicles associated with the BESS. The assessment also confirmed that existing road traffic noise levels on Thornells Road would not increase by 12 dB or more.

7 Management of impacts

Environmental management measures for noise and vibration associated with construction and vibration are provided in this section. It is assumed that a construction environmental management plan (CEMP) and an environmental management plan (EMP) will be developed for construction and operation phases respectively, and these measures will be included in the CEMP/EMP[4].

7.1 Construction noise and vibration

The EMP will also address noise and vibration management and mitigation options (where required) prior to construction. The EMP will detail how construction noise and vibration impacts will be minimised and managed in accordance with NCG Section 2.

The EMP will outline a procedure to:

- measure construction noise levels at early stages to validate the predicted construction noise levels;
- re-evaluate the predicted construction noise levels at assessment locations, and where required review noise management and mitigation measures to reduce levels where practical. This may include (but is not limited to):
  - use the lowest-noise work practices and equipment that meet the requirements of the job;
  - position site buildings, access roads and plant such that the minimum disturbance occurs to the locality. Barriers such as hoardings or temporary enclosures should be used. The site should be planned to minimise the need for reversing of vehicles;
  - ensure all mechanical plant is silenced using the best practical means using current technology. Mechanical plant, including noise-suppression devices, should be maintained to the manufacturer's specifications. Internal combustion engines are to be fitted with a suitable muffler in good repair;
  - fit all pneumatic tools operated near a residential area with an effective silencer on their air exhaust port;
  - install less noisy movement/reversing warning systems for equipment and vehicles that will operate for extended periods, during sensitive times or in close proximity to sensitive sites. Occupational health and safety requirements for use of warning systems must be followed;
  - turn off plant when not being used;
  - ensure all vehicular movements to and from the site to only occur during the scheduled normal working hours, unless approval has been granted by the relevant authority;
  - where possible, no truck associated with the work should be left standing with its engine operating in a street adjacent to a residential area;

[4] The subsequent introduction of the transmission line across a portion of 21 Thornells Road is not considered to significantly impact the results of this NVIA. Nonetheless, the CEMP and the EMP will include 17 and the applicable portion of 21 Thornells Road.

- special assessment of vibration risks may be needed, such as for pile-driving or works structurally connected to sensitive premises; and
- ensure noise from the site complies with the requirements of the schedule, except for:
    - unavoidable works; and
    - night period low-noise or managed-impact works approved by the local authority.

7.2 Operational noise and vibration

The data provided for this assessment layers worst case scenario design inputs with worst case scenario operating procedures (100% and 60% based on validated utilisation data from similar facilities at Ballarat and Hornsdale) under worst case environmental conditions. This is to say it models a scenario of the largest system size using equipment with the highest noise emissions charging at the fastest rate in a downwind event.

The resultant noise modelling has predicted the potential for a negligible technical 1 dB exceedance at R9 at night during 60% utilisation, at 50% utilisation compliance is predicted for R9. Assessment location R9 forms part of the project and an agreement between the proponent and the owner of R9 would be sought to address the residual noise impacts.

Negligible noise exceedances at R9 will be capable of being satisfactorily dealt with by way of one or more appropriately framed conditions of a planning permit that require the proponent to observe particular operational limits for the project that are designed to mitigate or minimise the generation of noise at particular times of the day / night or the provision of a negotiated agreement.

During the detailed design phase of the project all plant and equipment will be reviewed to ensure noise levels predicted in this NVIA can be achieved through either:

- selection of plant and equipment;
- site layout and orientation of equipment;
- provision of acoustic barrier four metres in height;
- utilisation and operational procedures consistent with the assumptions in this NVIA; or
- a combination of the above measures.

Potential exceedances may be dealt with by way of the imposition of an appropriately formulated operational noise limit condition on any planning permit granted in respect of the Mornington BESS. We consider that such an approach is appropriate for dealing with assessment location R9. Potential exceedances are appropriate in the circumstances of this particular planning application on the basis that:

- assessment location R9 is associated with the proposed BESS facility;
- the Mornington BESS was modelled on a worst case operational utilisation of 100% during the day and evening, and around 60% utilisation at night (within + or - 5%); and
- such operational utilisation is very unlikely to occur, as it is at odds with the purpose and commercial drivers of operating a battery project, as operational utilisation data from the Ballarat Battery and the Hornsdale BESS illustrate.

An EMP will be prepared to manage environmental impacts during the operational phase of the project. For operations, the EMP will address noise management and mitigation options (where required) prior to commencement of operations.

The EMP will describe how operational noise levels will be managed where predicted noise levels above the NIRV noise levels have been identified. The EMP would address noise mitigation and management to reduce operational noise levels at the potentially most affected assessment location based on the findings of this assessment as a minimum.

The EMP will outline a procedure to:

- measure operational noise levels at early stages during commissioning or within 3 months of operation to validate the predicted operational noise levels.
- re-evaluate the predicted operational noise levels at assessment locations, and where required review noise management, mitigation measures and site management to reduce levels where required. This may include (but is not limited to):
  - provision of additional acoustic barriers;
  - selecting quieter equipment; and
  - measuring operational noise levels at assessment locations, especially during the evening and night-time period, if relevant, and implementing further noise management and mitigation measures where an exceedance of NIRV noise levels is identified.

Affected landholders will be consulted prior to commencement of operation where an exceedance of NIRV noise levels has been predicted and should be notified of proposed mitigation measures that will be used to manage operational noise levels.

With effective implementation of plant and equipment selection, acoustic barriers and battery utilisation strategies, operational noise can be managed to meet the NIRV noise level requirements for all sensitive assessment locations.

8 Conclusion

This NVIA has been prepared to support the Planning Permit Application for the Mornington BESS at Tyabb, Victoria. It has documented the methods and results, the initiatives built into the project design to avoid and minimise associated impacts, and the mitigation and management measures recommended to address any residual impacts not able to be feasibly and reasonably avoided.

Construction noise levels will be managed in accordance with the procedures of the *Noise Control Guidelines* (NCG) (EPA publication 1254) (EPA Victoria, 2008), Section 2 with works restricted to normal daytime hours. An assessment of the noise exposure from the envisaged construction activities has been provided, including predicted levels to sensitive receiver areas.

The potential for vibration impacts on residents and vibration sensitive structures near construction has been assessed. The nearest residence to construction activity is assessment locations R2 and R9 are more than 70 m away from construction activities. The assessment locations are outside of the safe working distances required to maintain acceptable human response subject to size of vibratory roller and structural vibration levels. Vibration impacts from construction at residential assessment locations are therefore unlikely.

The safe working distances for cosmetic damage should be monitored throughout the construction process. If construction is within 25 m of sensitive structures, then work practices should be reviewed so that the safe working distances presented herein are followed.

Operational noise associated with the BESS has confirmed compliance with NIRV requirements for all sensitive receiver locations during the day and evening assessment periods. For the night period a technical negligible exceedance of 1 dB (is predicted for R9. Assessment location R9 forms part of the project and an agreement between the proponent and the owner of R9 would be sought to address the residual noise impacts. A range of at source, barrier and operational management mitigations have been considered to address residual noise exceedances. During the detailed design phase all aspects of the BESS would be reviewed including site utilisation to ensure that the NIRV noise criteria can be achieved.

The potential for road traffic noise impacts on public roads due to project traffic has been assessed in accordance with relevant Vic Roads (VR 2005) *Traffic Noise Reduction Policy* (TNRP). In summary, road traffic noise levels are predicted to satisfy TNRP assessment requirements for Dandenong Hastings Road and Thornells Road for peak site traffic movements during the construction period.

With the effective management and incorporation of mitigation measures listed in Section 7 in place, noise and vibration emissions from the project can be designed to satisfy relevant guidelines, standards and policies.

References

Environment Protection Authority, Victoria (EPA VIC) 2011 Publication 1411, Noise from Industry in Regional Victoria (NIRV)

Environment Protection Authority, Victoria (EPA VIC) 2011 Publication 1413, Applying NIRV to Proposed and Existing Industry (Applying NIRV Guideline)

Environment Protection Authority, Victoria (EPA VIC) 2020 Publication 1834, Civil construction, building and demolition guide (CCBDG)

Environment Protection Authority, Victoria (EPA VIC) 1996 Publication 480 Best Practice Environmental Management – Environmental Guidelines for Major Construction Sites

Vic Roads (VR) 2005, Traffic Noise Reduction Policy (TNRP)

Australian and New Zealand Environment Council 1990, Technical basis for guidelines to minimise annoyance due to blasting overpressure and ground vibration

British Standard 6472 – 2008, Evaluation of human exposure to vibration in buildings (1-80Hz) Environmental Noise Management – Assessing Vibration: a technical guideline (DEC 2006)

German Standard DIN 4150 Part 2 1975

EMM 2021, Traffic Impact Assessment, EMM Consulting

Abbreviations

Abbreviation	Term
ARL	Acoustic Research Laboratories
CEMP	Construction Environmental Management Plan
DEFRA	Department of Environment, Food and Rural Affairs (United Kingdom)
EMM	EMM Consulting Pty Limited
EMP	Environmental Management Plan
FHWA	US EPA Federal Highways
HV	heavy vehicle
LGAs	local government areas
LV	light vehicle
MW	megawatts
NATA	National Association of Testing Authorities
NL	Noise level
NML	Noise management level
NVIA	Noise and vibration impact assessment
OOH	out of hours
PPV	peak particle velocity
RBL	rating background level
TNRP	Traffic Noise Reduction Policy
VDV	vibration dose value

Glossary

Table G.1 Project and technical terms

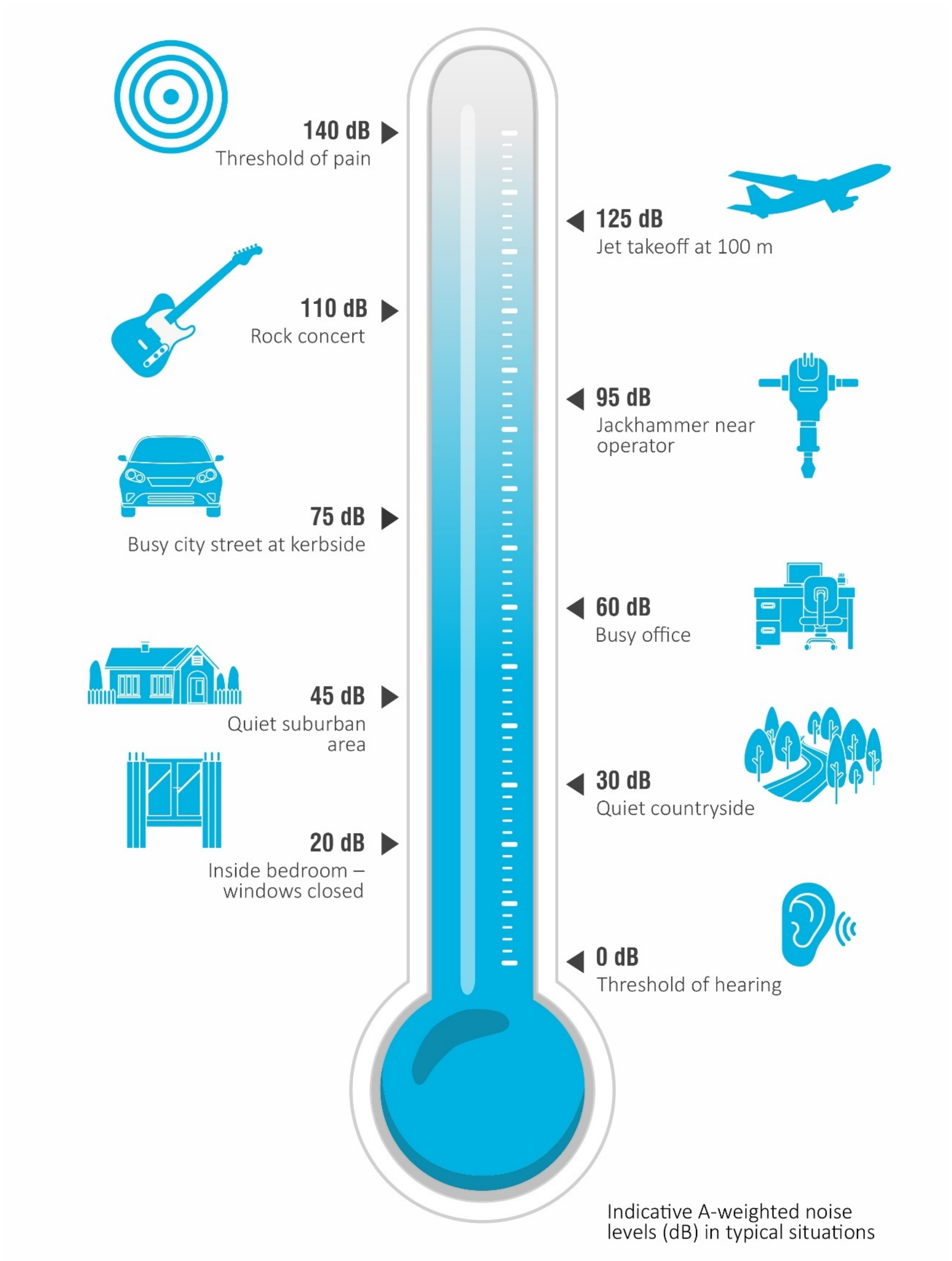
Term	Meaning
ABL	The assessment background level (ABL) is defined in the INP as a single figure background level for each assessment period (day, evening and night). It is the tenth percentile of the measured L90 statistical noise levels.
Amenity noise criteria	The amenity noise criteria relate to existing industrial noise. Where industrial noise approaches base amenity noise criteria, then noise levels from new industries need to demonstrate that they will not be an additional contributor to existing industrial noise. See Section 3.1 for more detail.
Day period	Monday-Saturday: 7 am to 6 pm, on Sundays and public holidays: 8 am to 6 pm.
dBA	Noise is measured in units called decibels (dB). There are several scales for describing noise, the most common being the 'A-weighted' scale. This attempts to closely approximate the frequency response of the human ear.
dBC	Noise is measured in units called decibels (dB). There are several scales for describing noise, with the 'C-weighted' scale typically used to assess low frequency noise.
Evening period	Monday-Sunday: 6 pm to 10 pm EIS Environmental impact statement FGJV Future Generation Joint Venture Intrusive noise criteria. The intrusive noise criteria refers to noise that intrudes above the background level by more than 5 dB. The intrusiveness criterion is described in detail in Section 3.1.
L1	The noise level exceeded for 1% of the time.
L10	The noise level which is exceeded 10% of the time. It is roughly equivalent to the average of maximum noise level.
L90	The noise level that is exceeded 90% of the time. Commonly referred to as the background noise level.
Leq	The energy average noise from a source. This is the equivalent continuous sound pressure level over a given period. The Leq(15min) descriptor refers to a Leq noise level measured over a 15-minute period.
Lmax	The maximum sound pressure level received during a measuring interval.
Night period	Monday-Saturday: 10 pm to 7 am, on Sundays and public holidays: 10 pm to 8 am.
NCG	Noise Control Guidelines
NIRV	Noise from Industry in Regional Vitoria
NVIA	Noise and vibration impact assessment.
RBL	The rating background level (RBL) is an overall single value background level representing each assessment period over the whole monitoring period. The RBL is used to determine the intrusiveness criteria for noise assessment purposes and is the median of the average background levels.
Sound power level (Lw)	A measure of the total power radiated by a source. The sound power of a source is a fundamental property of the source and is independent of the surrounding environment.

Common noise levels

The table below gives an indication as to what an average person perceives about changes in noise levels. Examples of common noise levels encountered on a daily basis are provided in the figure below.

Table G.2 Perceived change in noise

Change in sound level (dB)	Perceived change in noise
3	just perceptible
5	noticeable difference
10	twice (or half) as loud
15	large change
20	four times as loud (or quarter) as loud.



Source: Road Noise Policy (DECCW 2011)

Figure G.1 Common sources of noise with levels

Appendix A

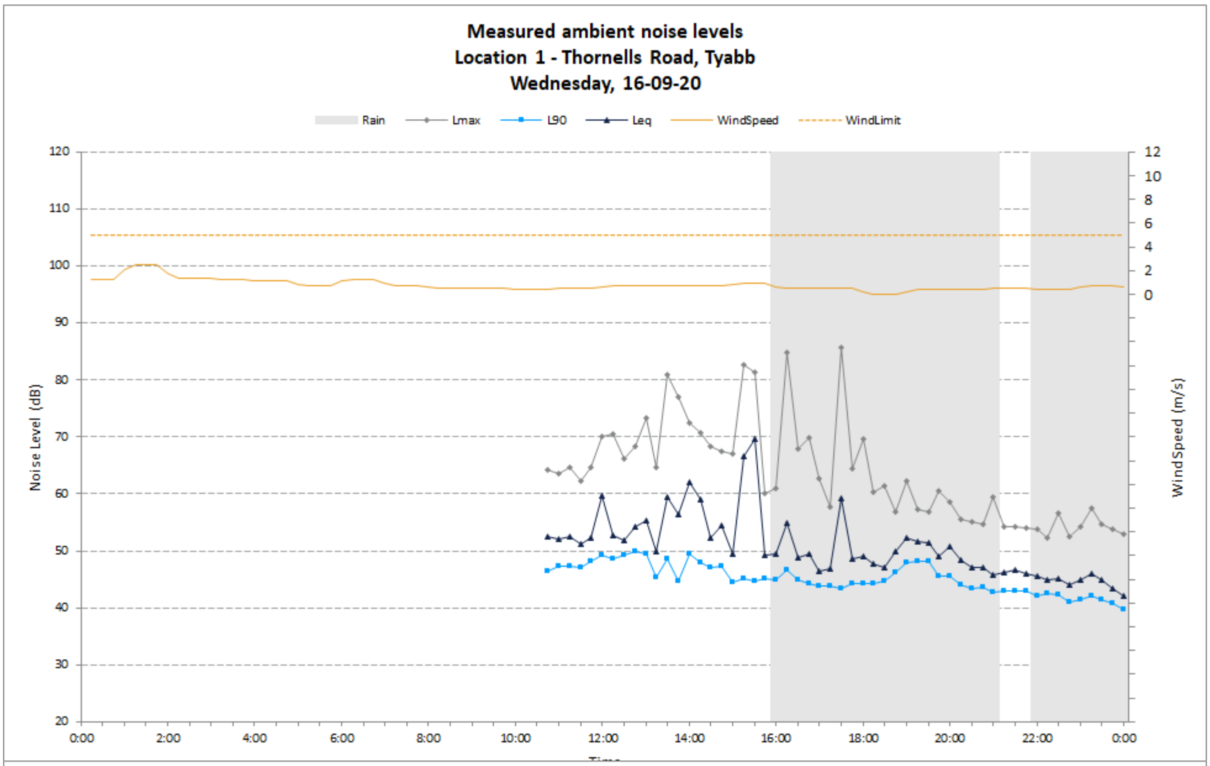
Long-term unattended noise monitoring results

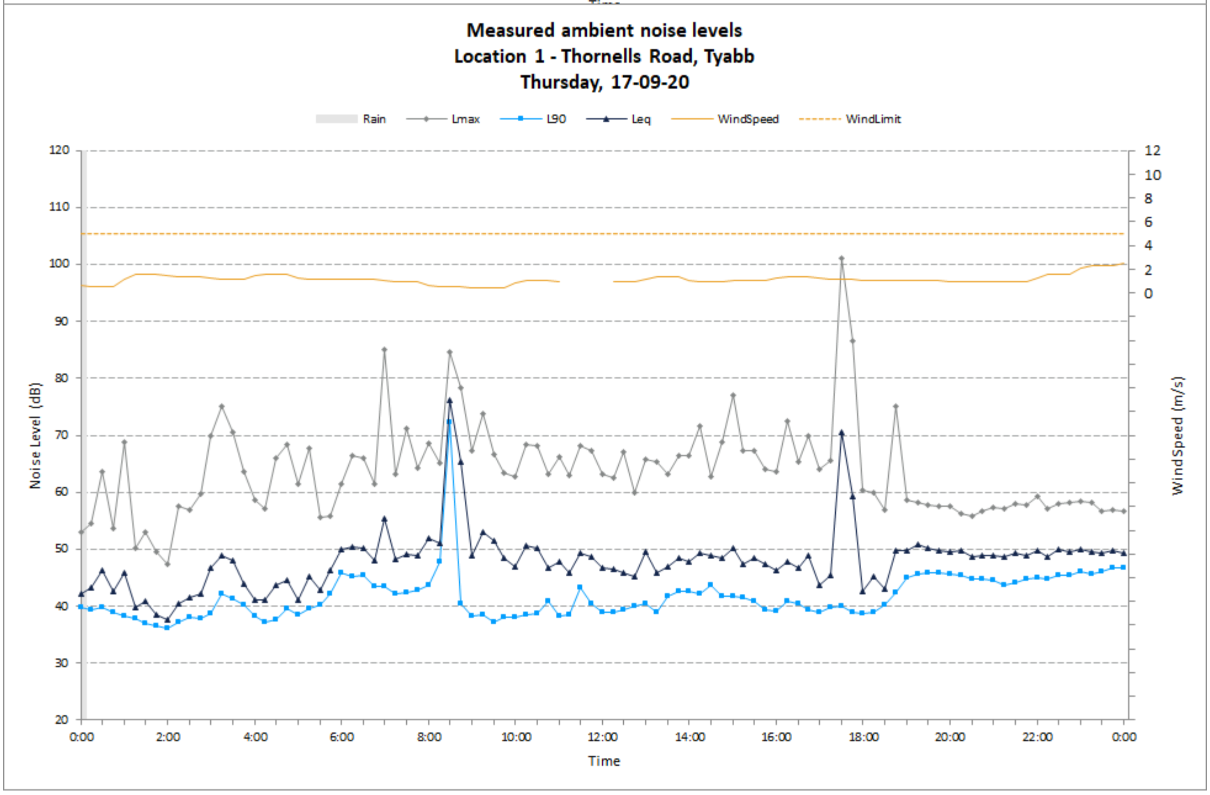
A.1 Long-term unattended noise monitoring results

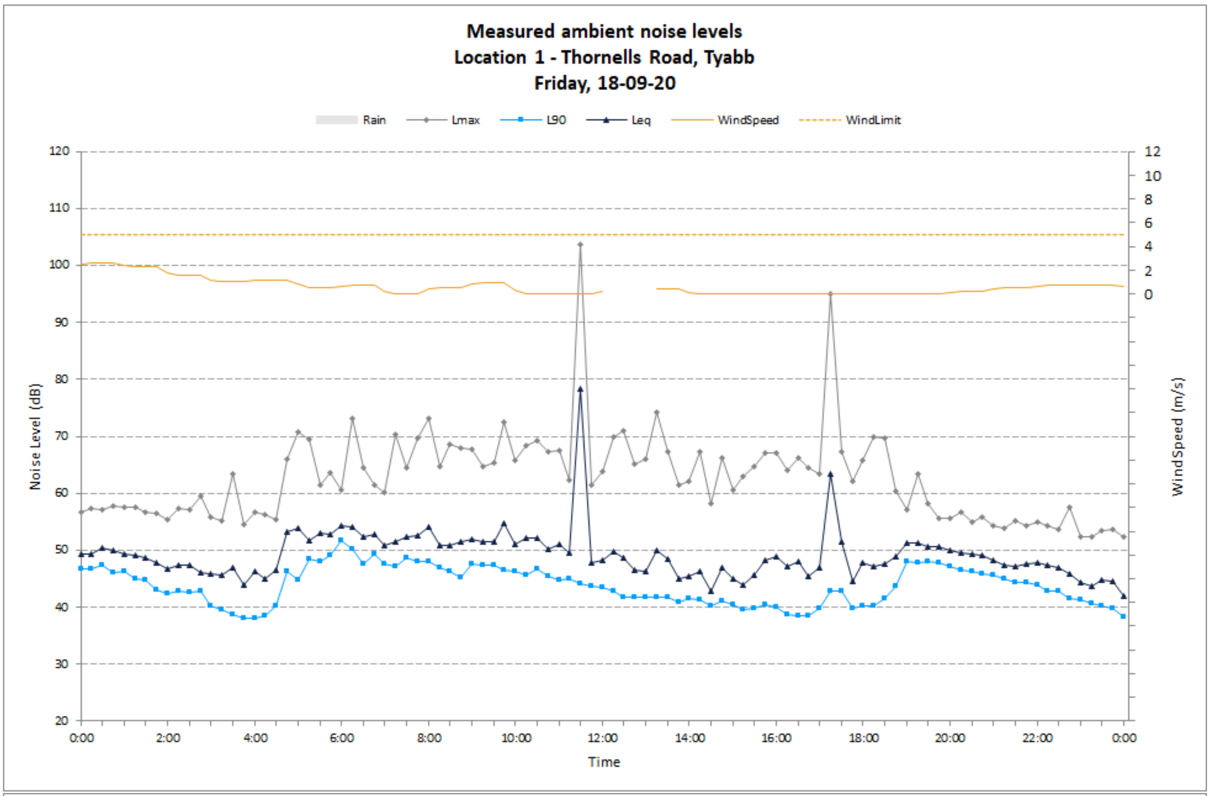
Table A.1 Background noise monitoring summary, NM1 17 Thornells Road, Tyabb

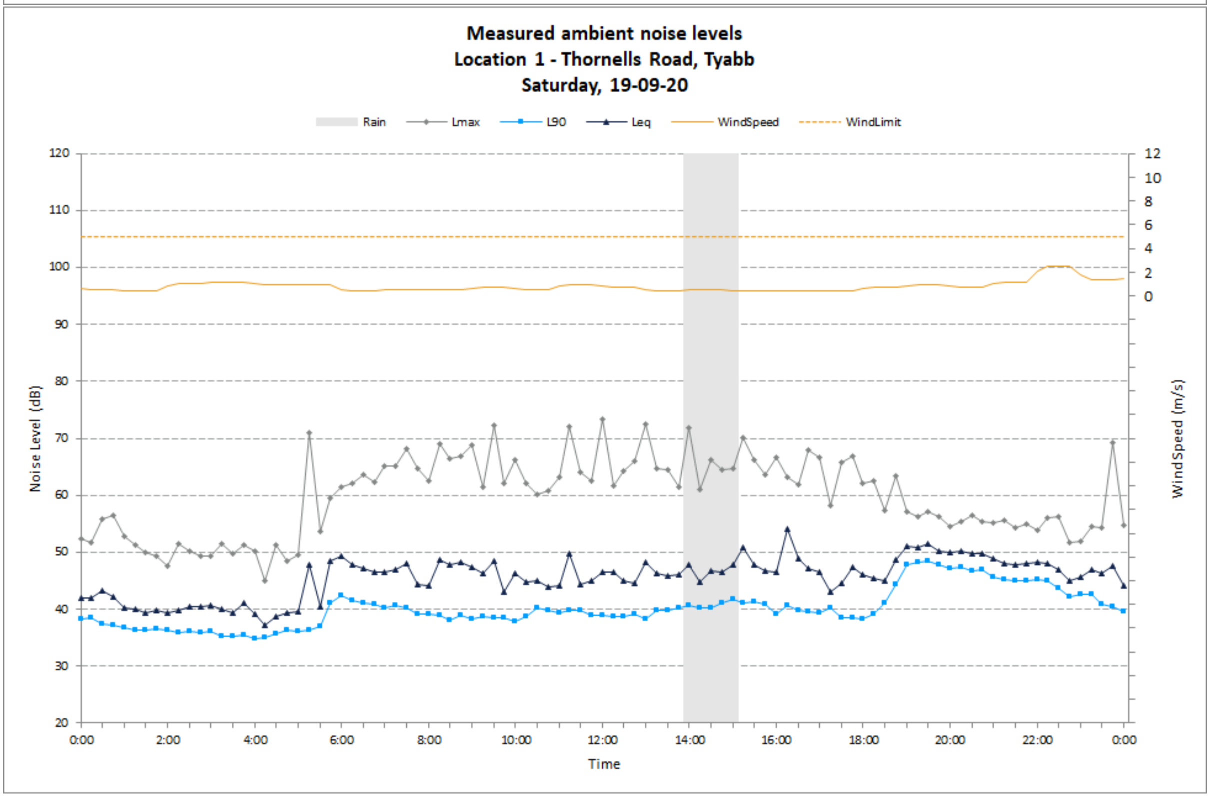
Date	ABL Day[2]	ABL Evening[2]	ABL Night[2]
Wednesday, 16-09-20	0	0	0
Thursday, 17-09-20	38	40	39
Friday, 18-09-20	40	42	35
Saturday, 19-09-20	38	41	37
Sunday, 20-09-20	41	0	42
Monday, 21-09-20	39	43	38
Tuesday, 22-09-20	47	42	40
Wednesday, 23-09-20	41	37	34
Thursday, 24-09-20	0	0	36
Friday, 25-09-20	0	0	40
Saturday, 26-09-20	0	41	41
Sunday, 27-09-20	36	42	40
Monday, 28-09-20	36	39	39
Tuesday, 29-09-20	38	0	37
Wednesday, 30-09-20	0	45	42
Thursday, 01-10-20	42	47	40
Rating Background Level (RBL)[1]	**39**	**42**	**39**

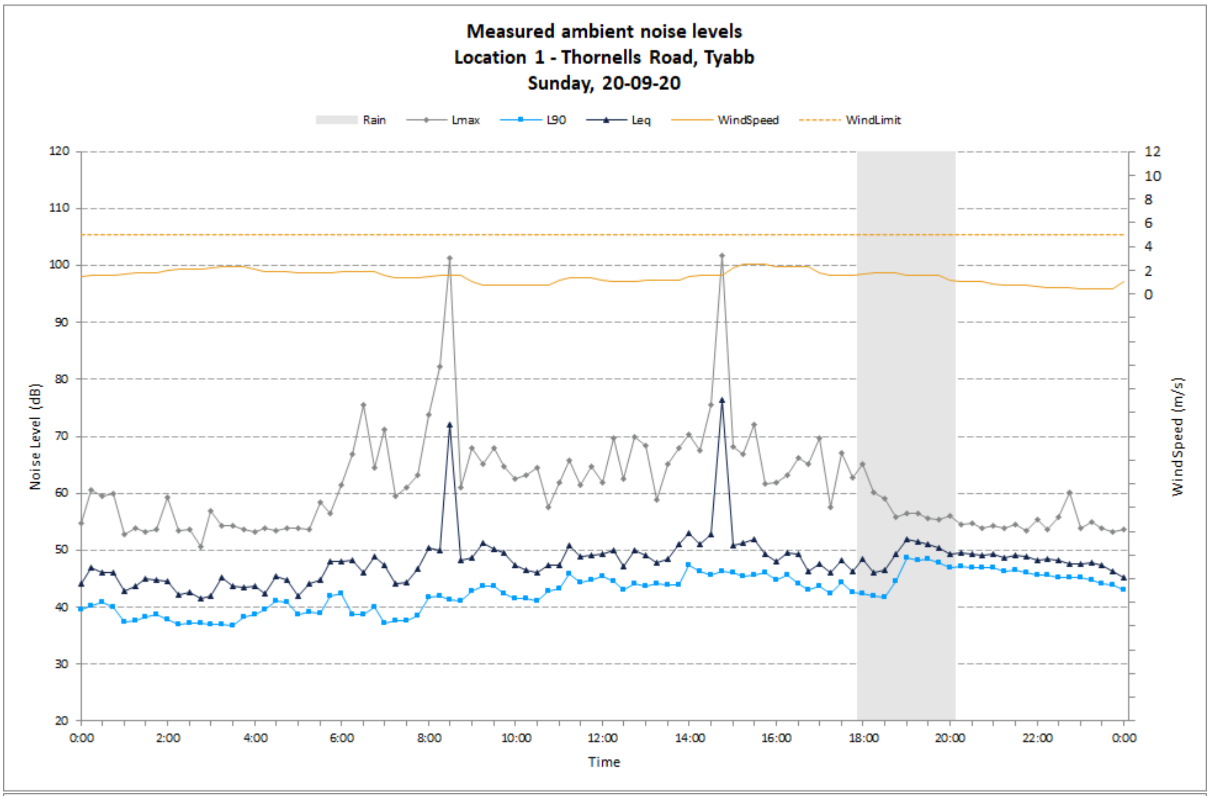
Notes: 1. Adopted RBL is as per NPfI minimum background threshold. Actual RBL shown in brackets.
2. A “0” indicates insufficient data samples due to adverse weather or other extraneous effects.

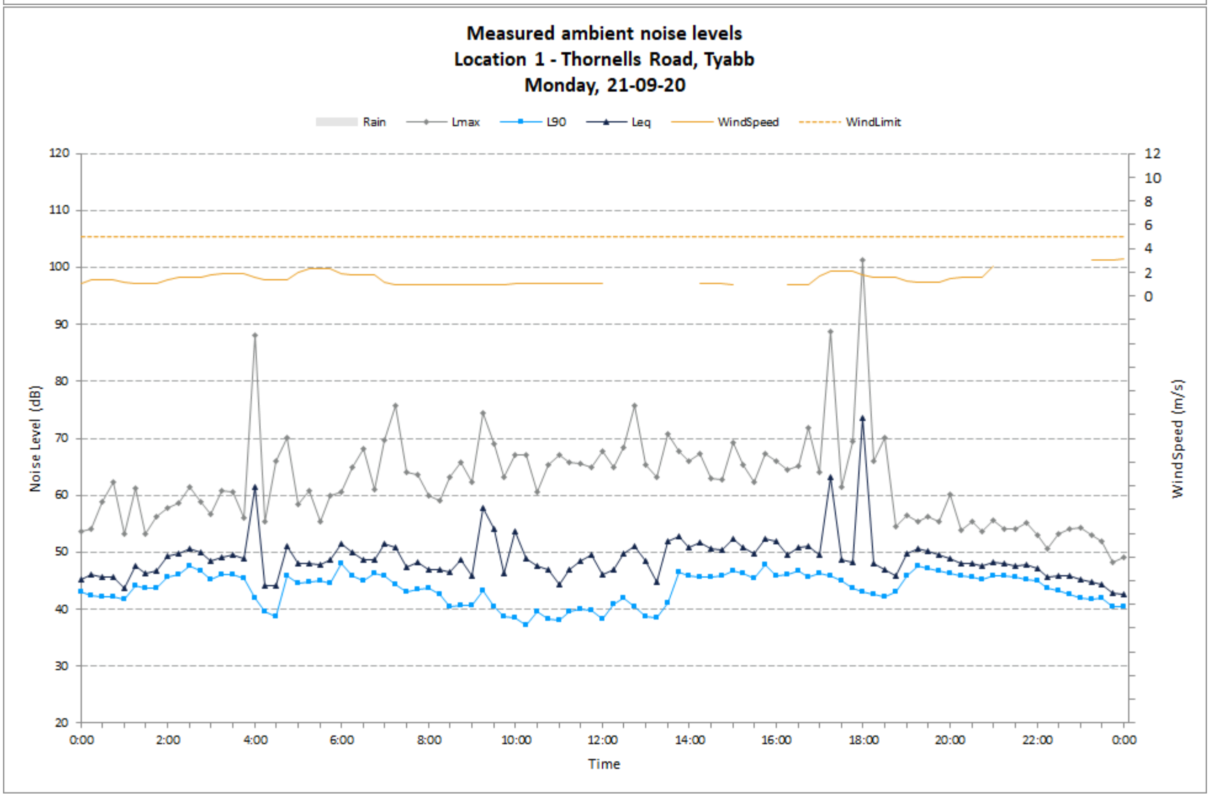

Measured ambient noise levels
Location 1 - Thornells Road, Tyabb
Wednesday, 16-09-20
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
WindSpeed (m/s)
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
0:00

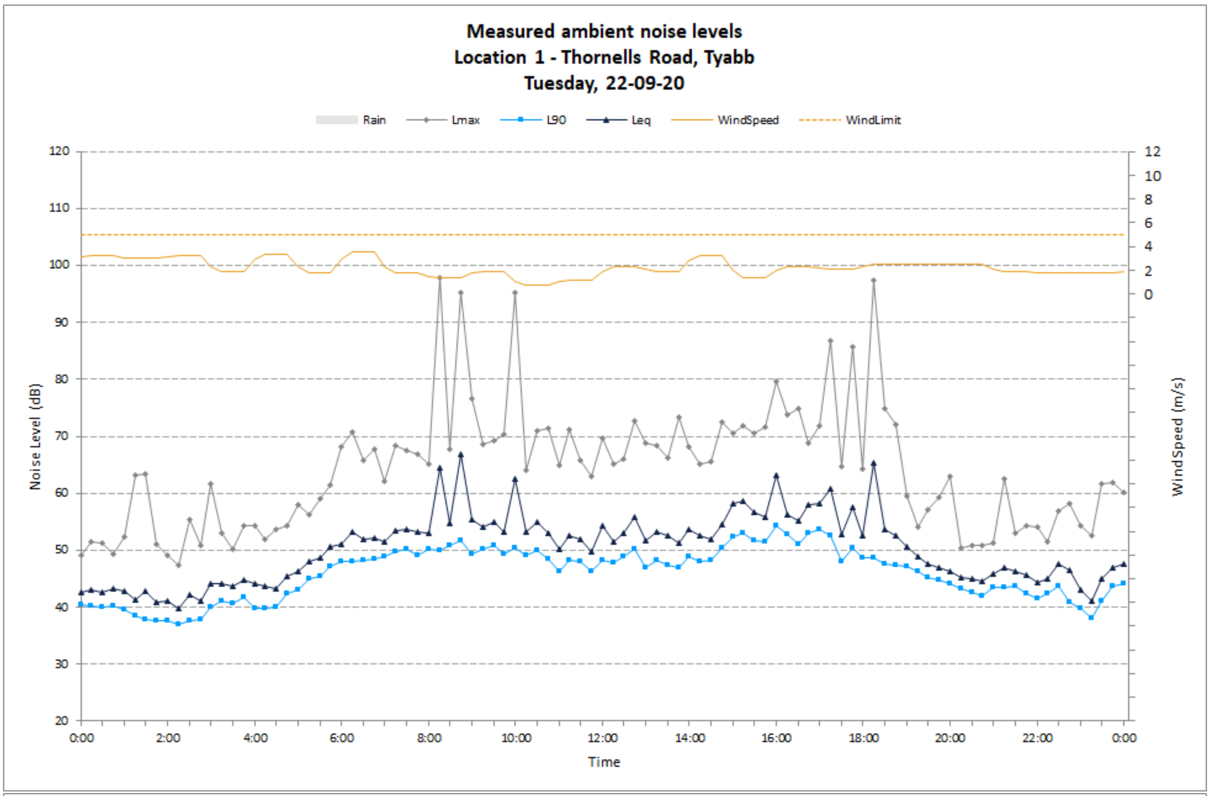

Measured ambient noise levels
Location 1 - Thornells Road, Tyabb
Thursday, 17-09-20
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
WindSpeed (m/s)
Time


Measured ambient noise levels
Location 1 - Thornells Road, Tyabb
Friday, 18-09-20
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
WindSpeed (m/s)
Time

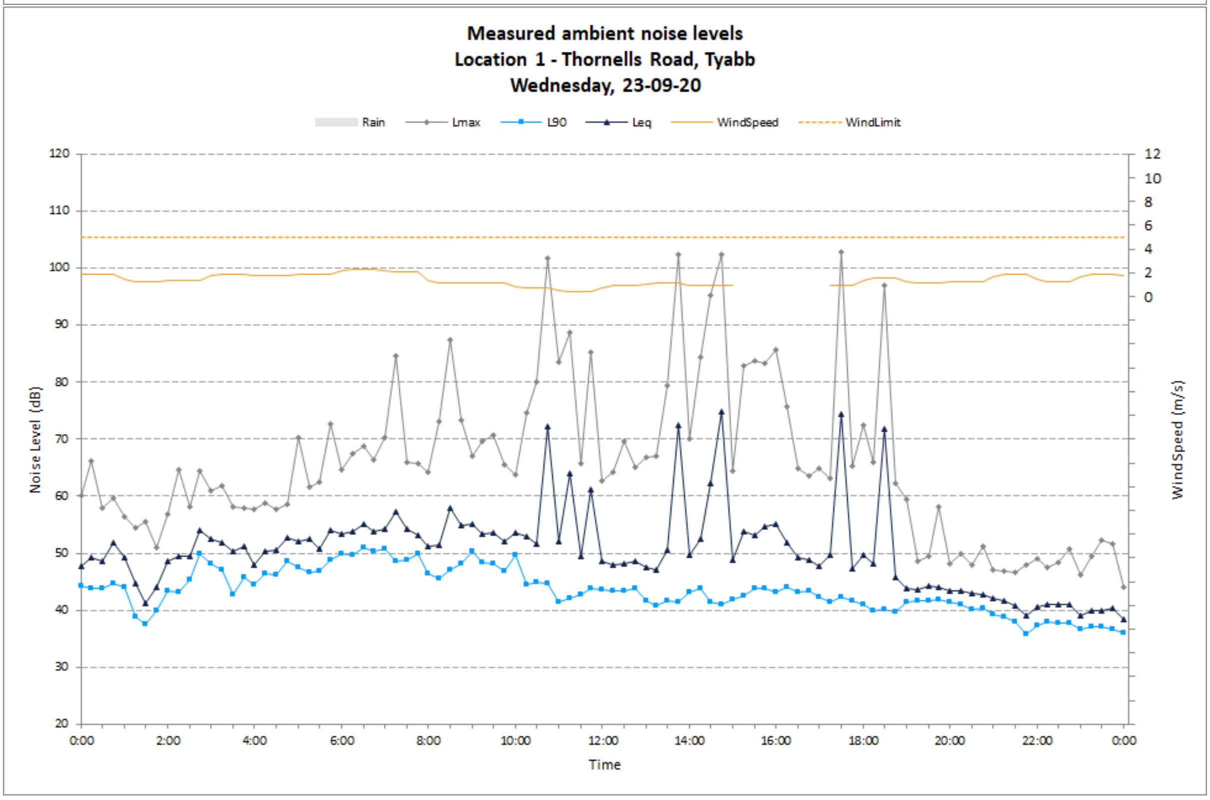

Measured ambient noise levels
Location 1 - Thornells Road, Tyabb
Saturday, 19-09-20
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
WindSpeed (m/s)
Time


Measured ambient noise levels
Location 1 - Thornells Road, Tyabb
Sunday, 20-09-20
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
WindSpeed (m/s)
Time

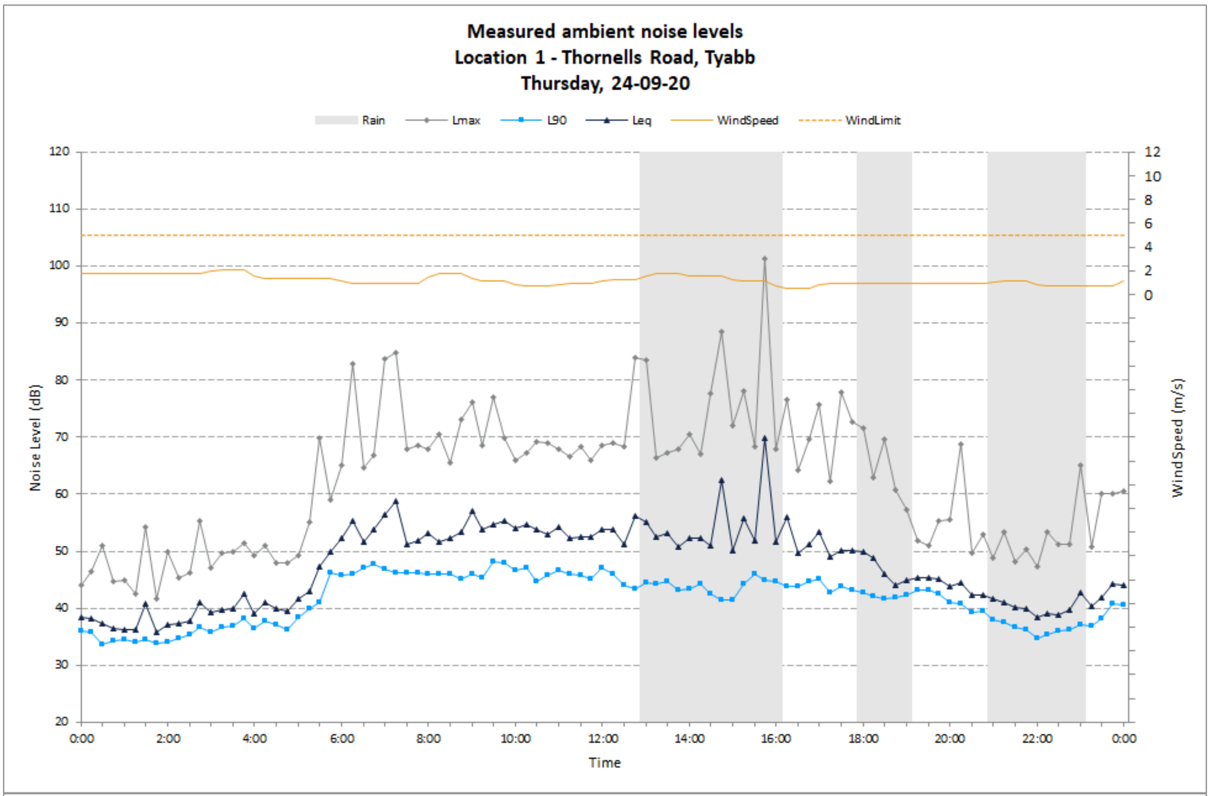

Measured ambient noise levels
Location 1 - Thornells Road, Tyabb
Monday, 21-09-20
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
WindSpeed (m/s)
Time

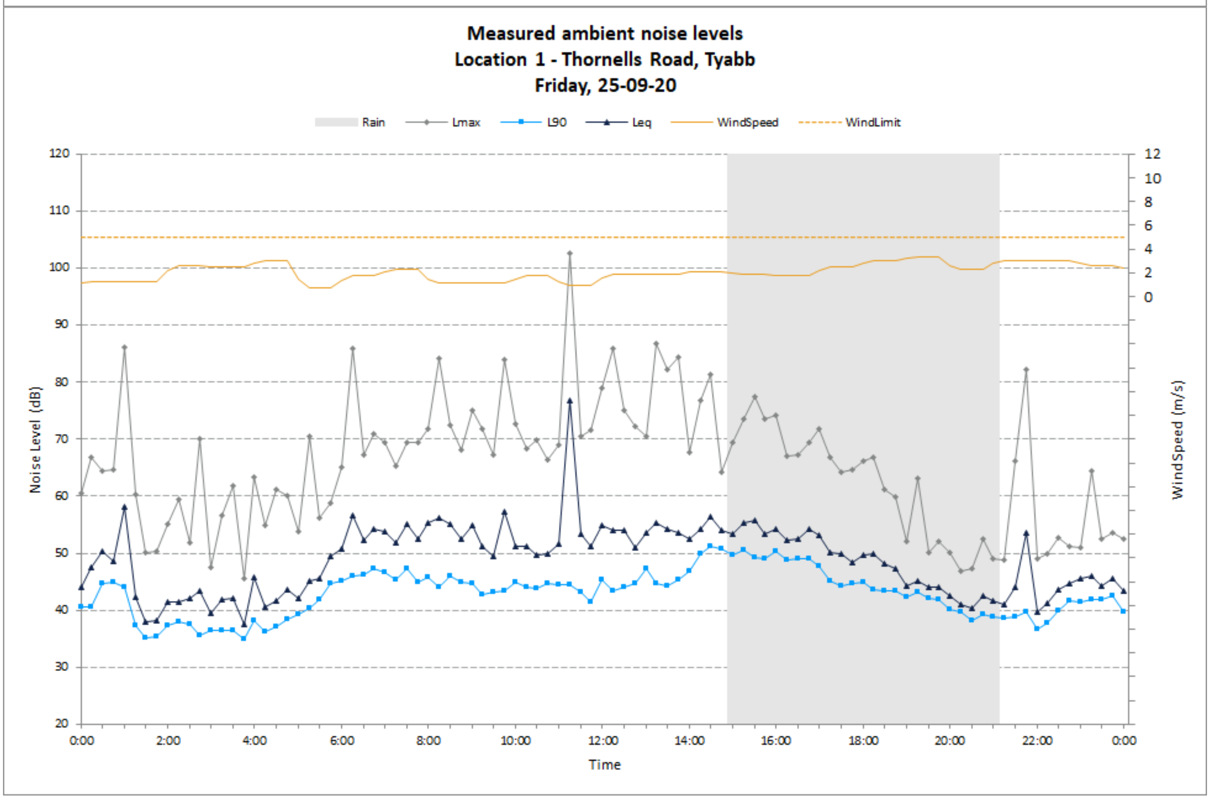


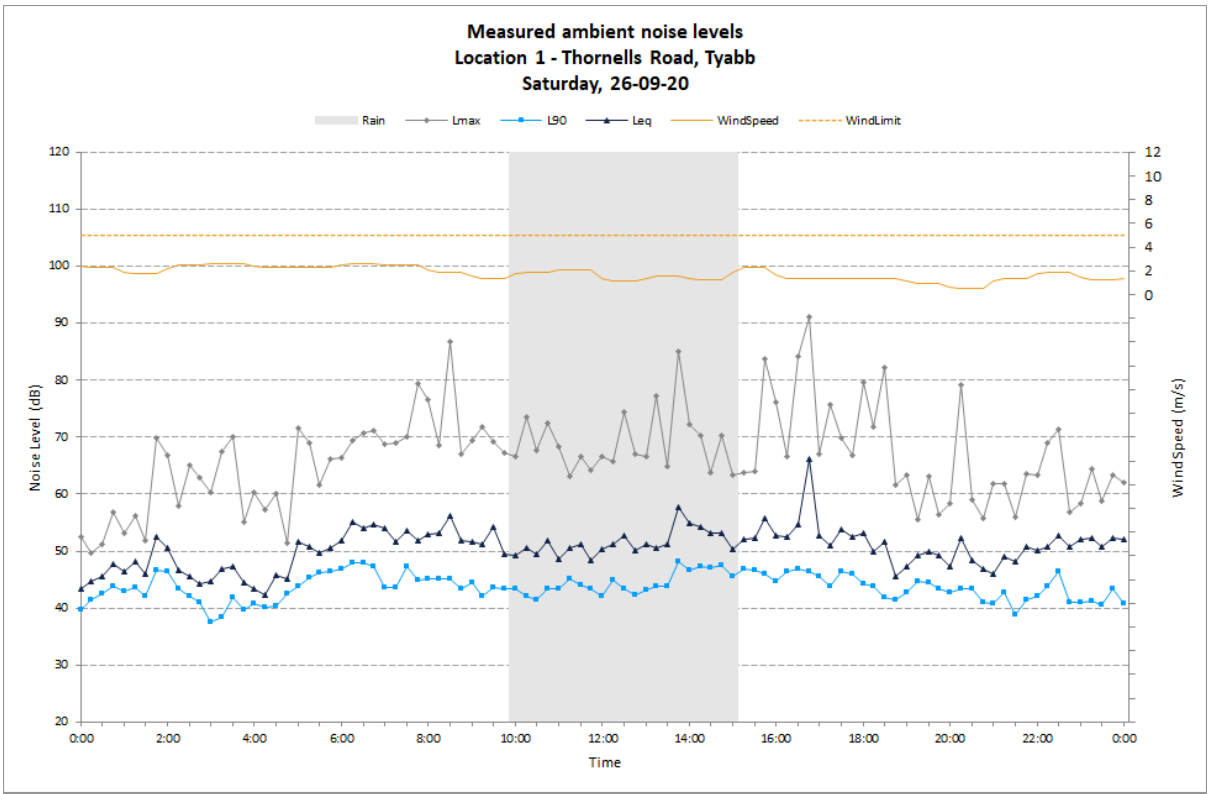
Measured ambient noise levels
Location 1 - Thornells Road, Tyabb
Tuesday, 22-09-20
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
Wind Speed (m/s)
Time



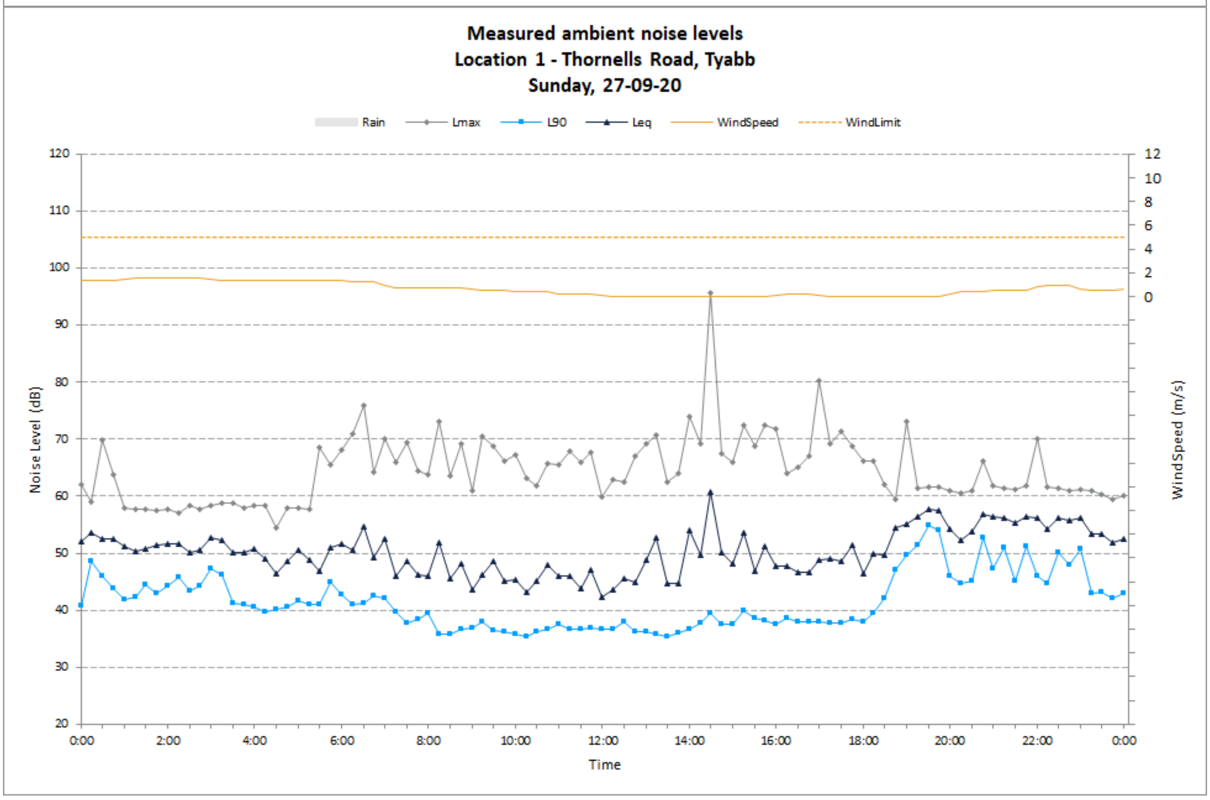
Measured ambient noise levels
Location 1 - Thornells Road, Tyabb
Wednesday, 23-09-20
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
Wind Speed (m/s)
Time


Measured ambient noise levels
Location 1 - Thornells Road, Tyabb
Thursday, 24-09-20
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
WindSpeed (m/s)
Time

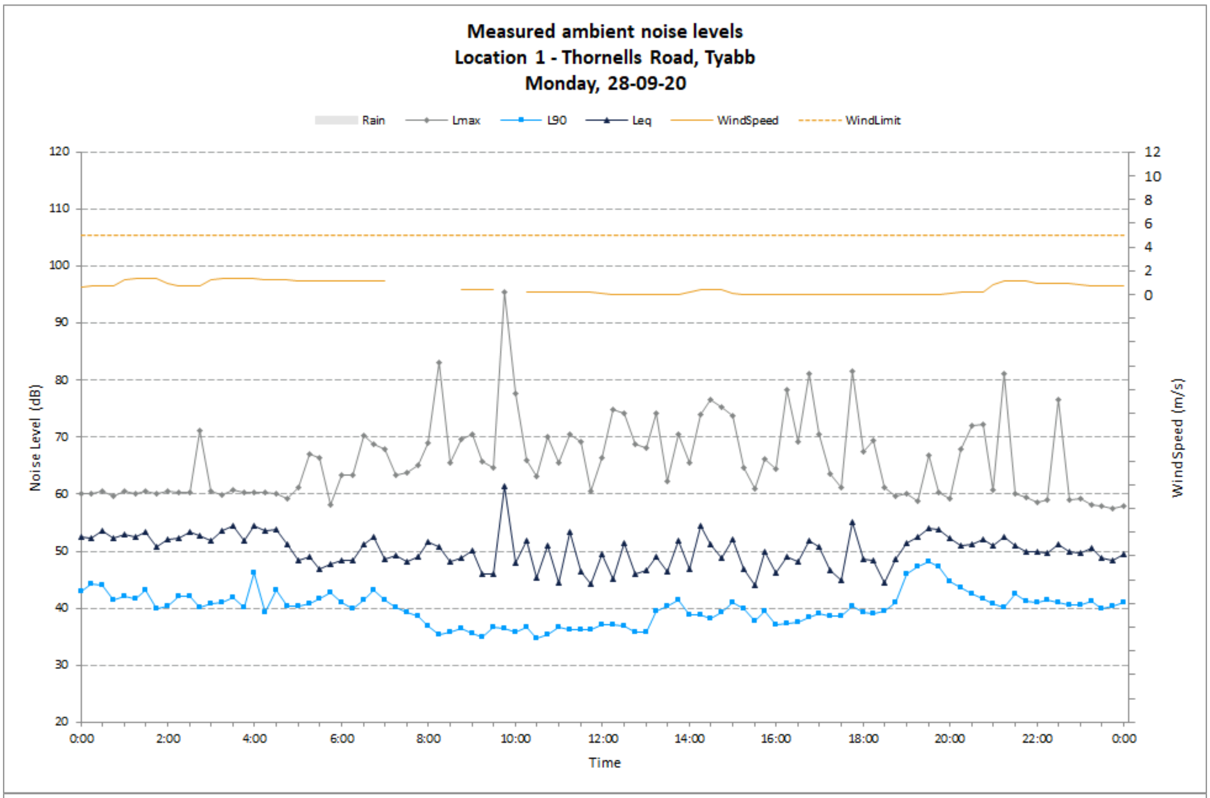

Measured ambient noise levels
Location 1 - Thornells Road, Tyabb
Friday, 25-09-20
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
WindSpeed (m/s)
Time

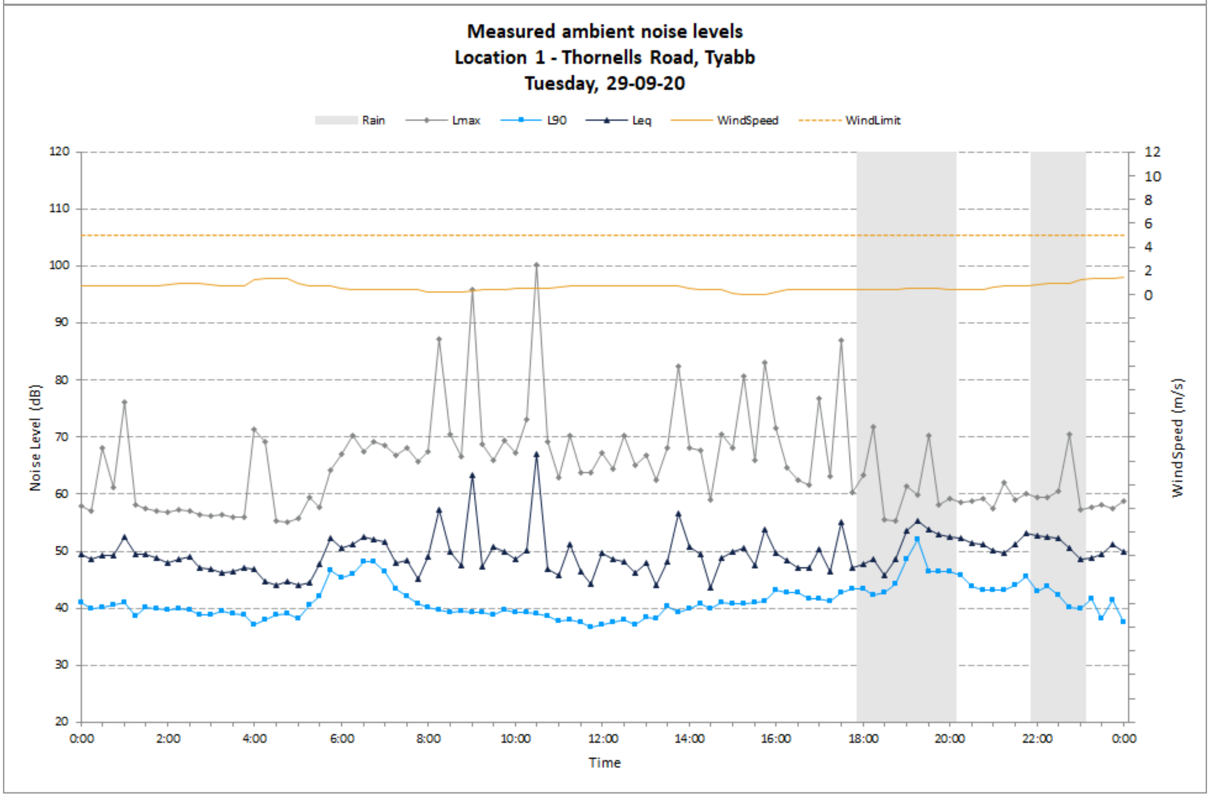


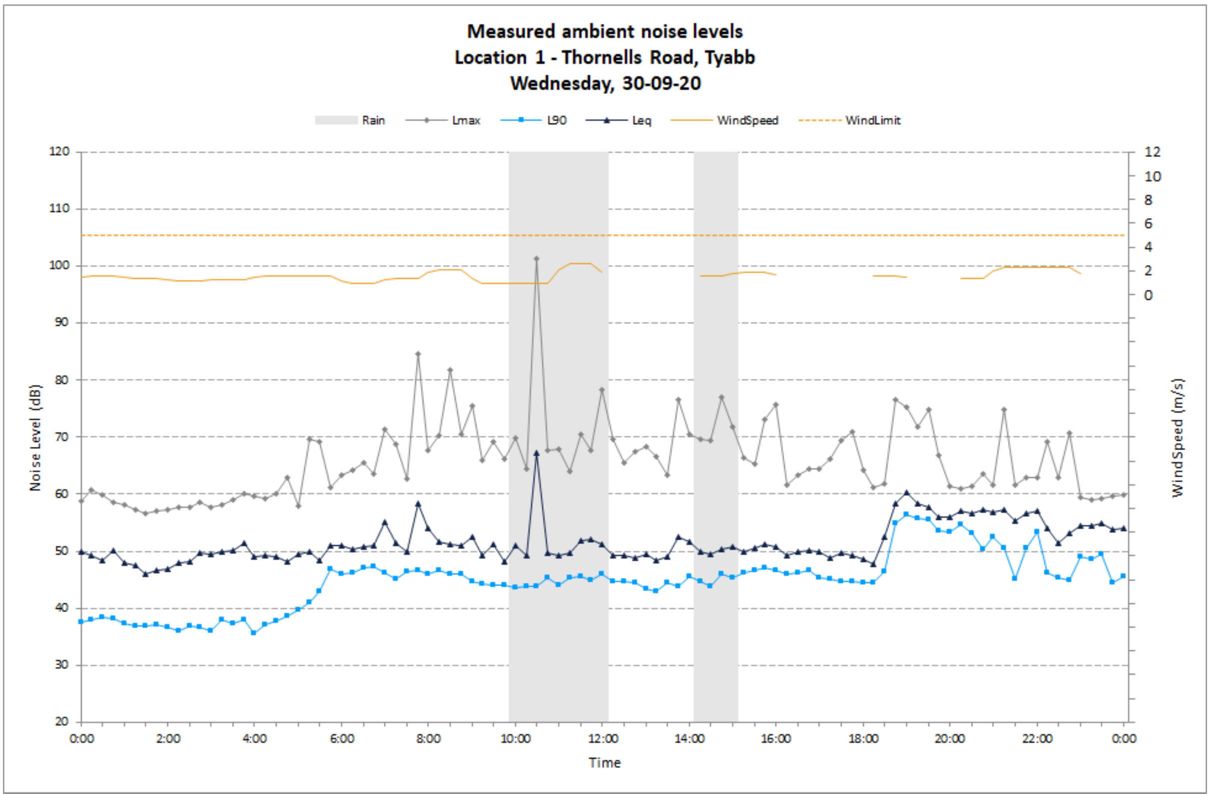
Measured ambient noise levels
Location 1 - Thornells Road, Tyabb
Saturday, 26-09-20
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
WindSpeed (m/s)
Time



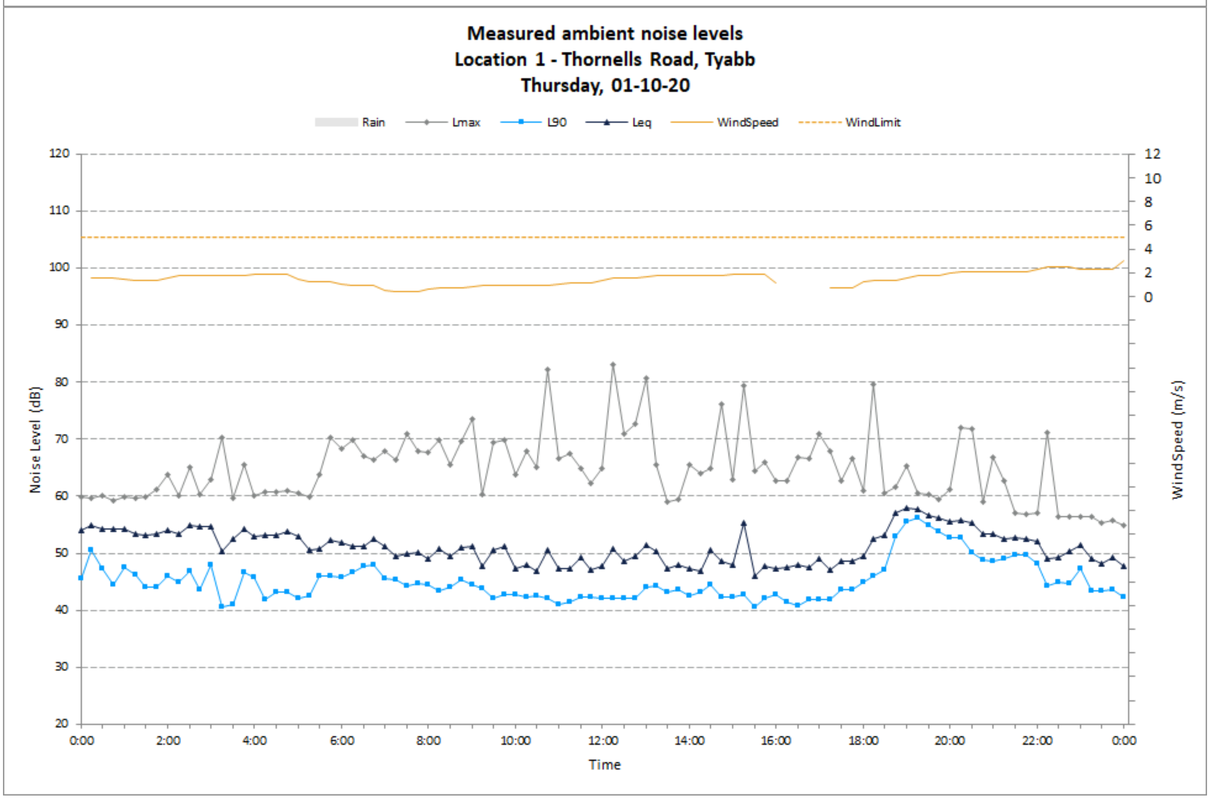
Measured ambient noise levels
Location 1 - Thornells Road, Tyabb
Sunday, 27-09-20
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
WindSpeed (m/s)
Time


Measured ambient noise levels
Location 1 - Thornells Road, Tyabb
Monday, 28-09-20
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
WindSpeed (m/s)
Time

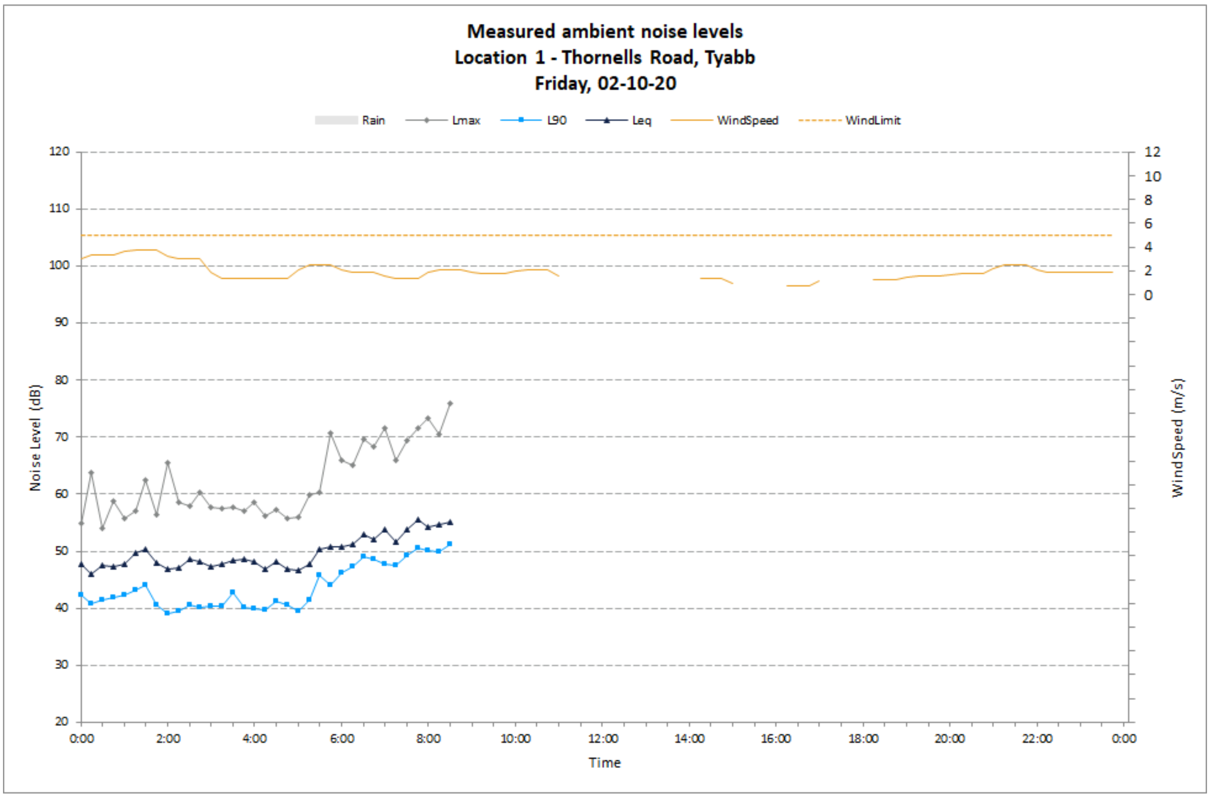

Measured ambient noise levels
Location 1 - Thornells Road, Tyabb
Tuesday, 29-09-20
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
WindSpeed (m/s)
Time



Measured ambient noise levels
Location 1 - Thornells Road, Tyabb
Wednesday, 30-09-20
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
WindSpeed (m/s)
Time



Measured ambient noise levels
Location 1 - Thornells Road, Tyabb
Thursday, 01-10-20
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
WindSpeed (m/s)
Time

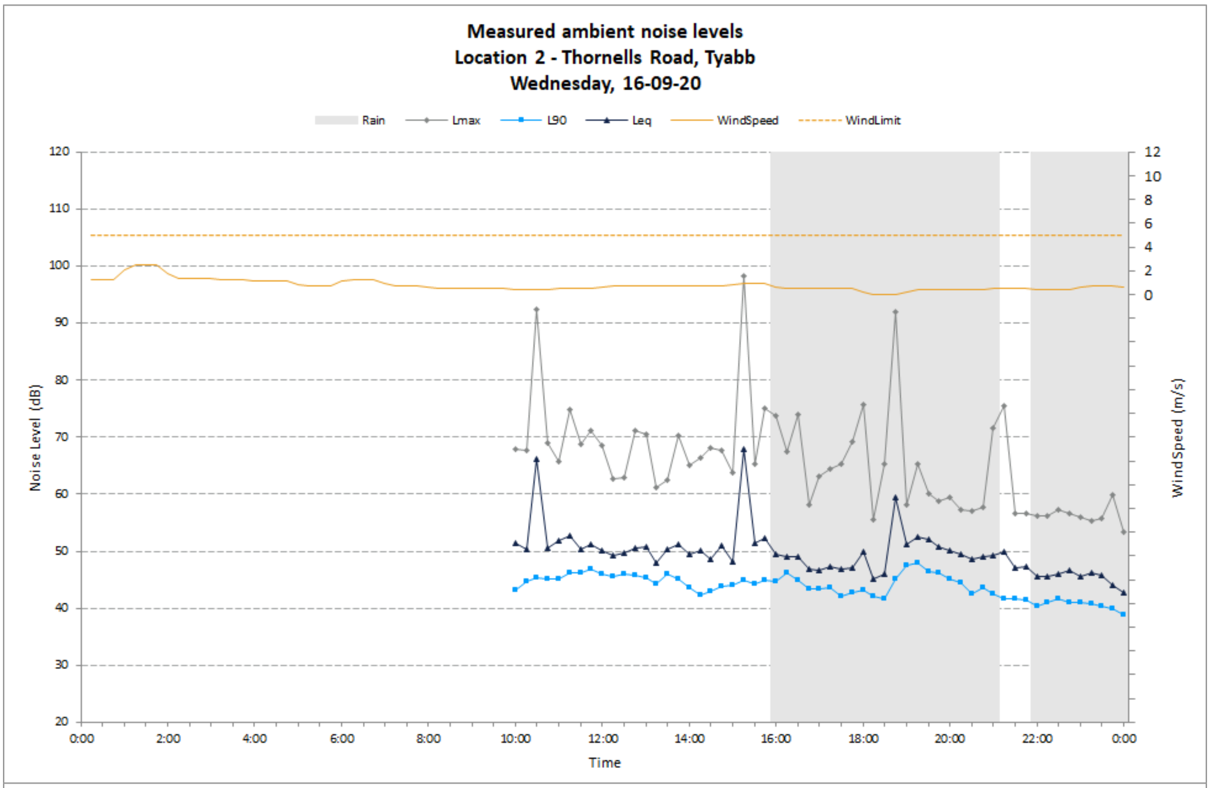


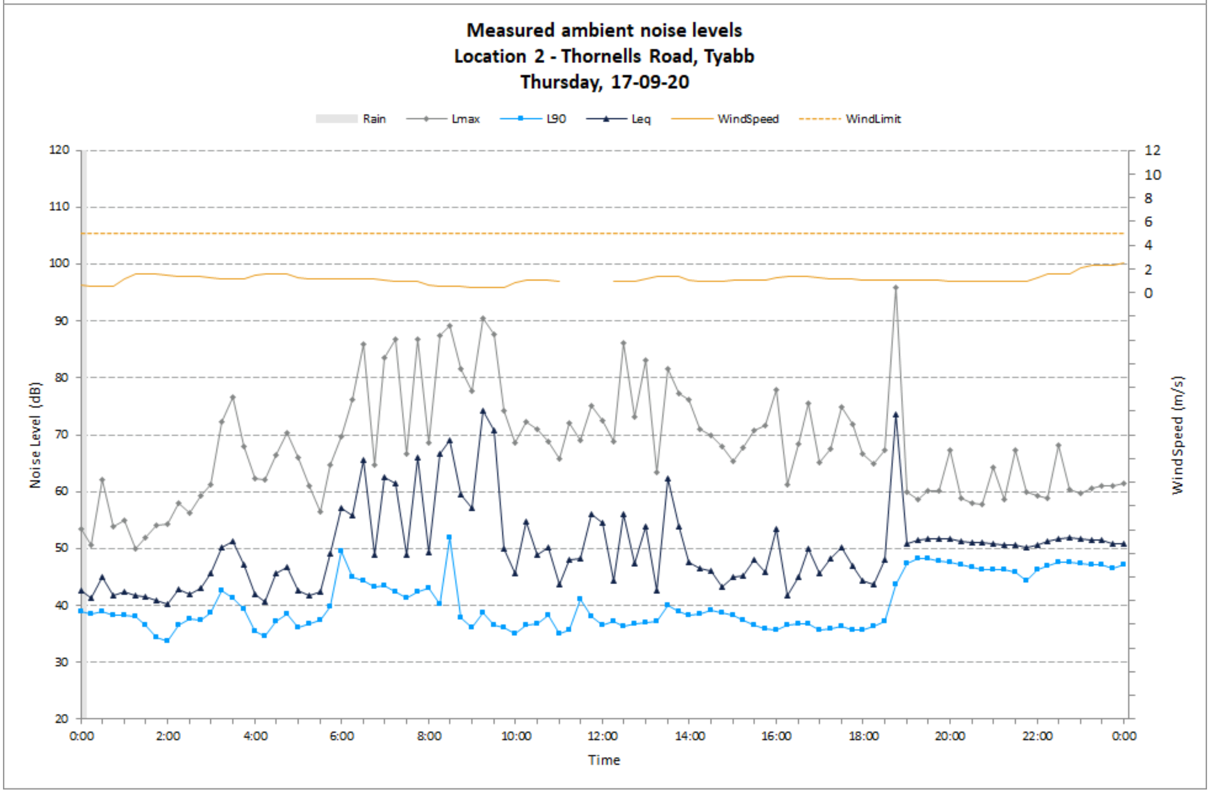
Measured ambient noise levels
Location 1 - Thornells Road, Tyabb
Friday, 02-10-20
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
WindSpeed (m/s)
Time

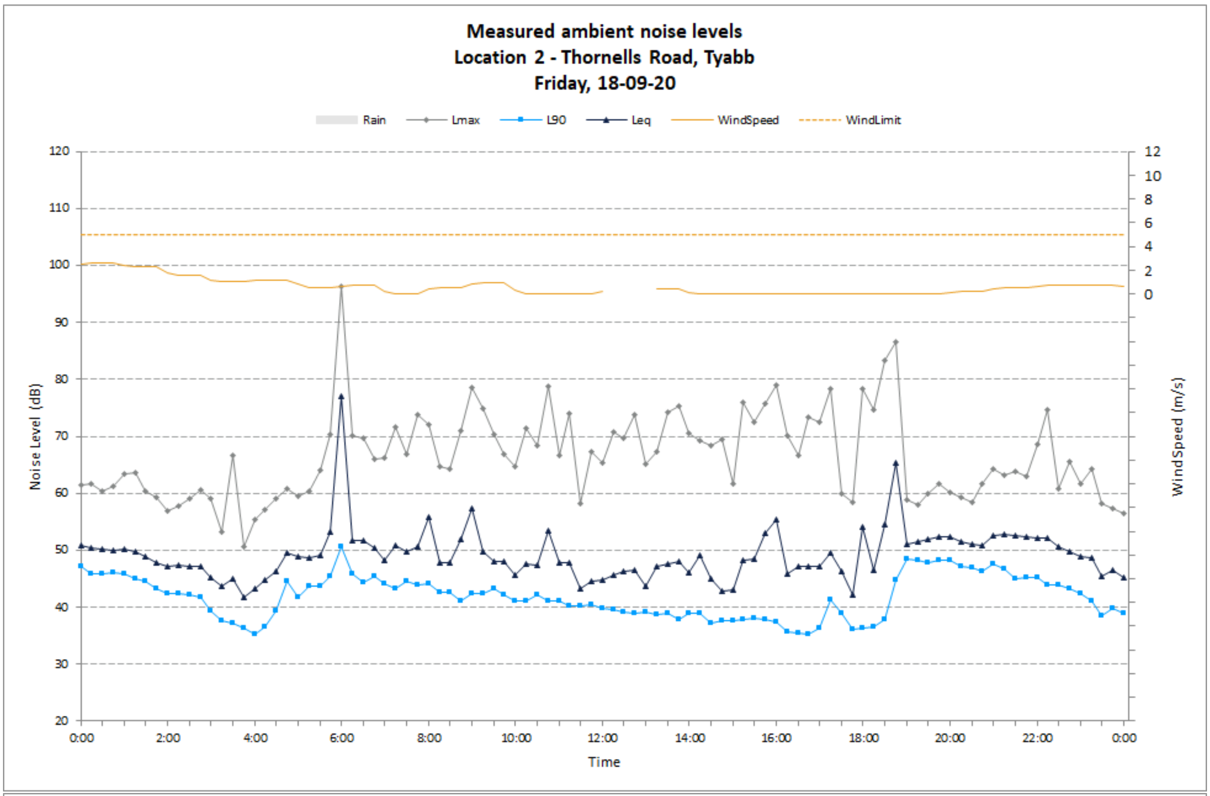
Table A.2 Background noise monitoring summary, NM2

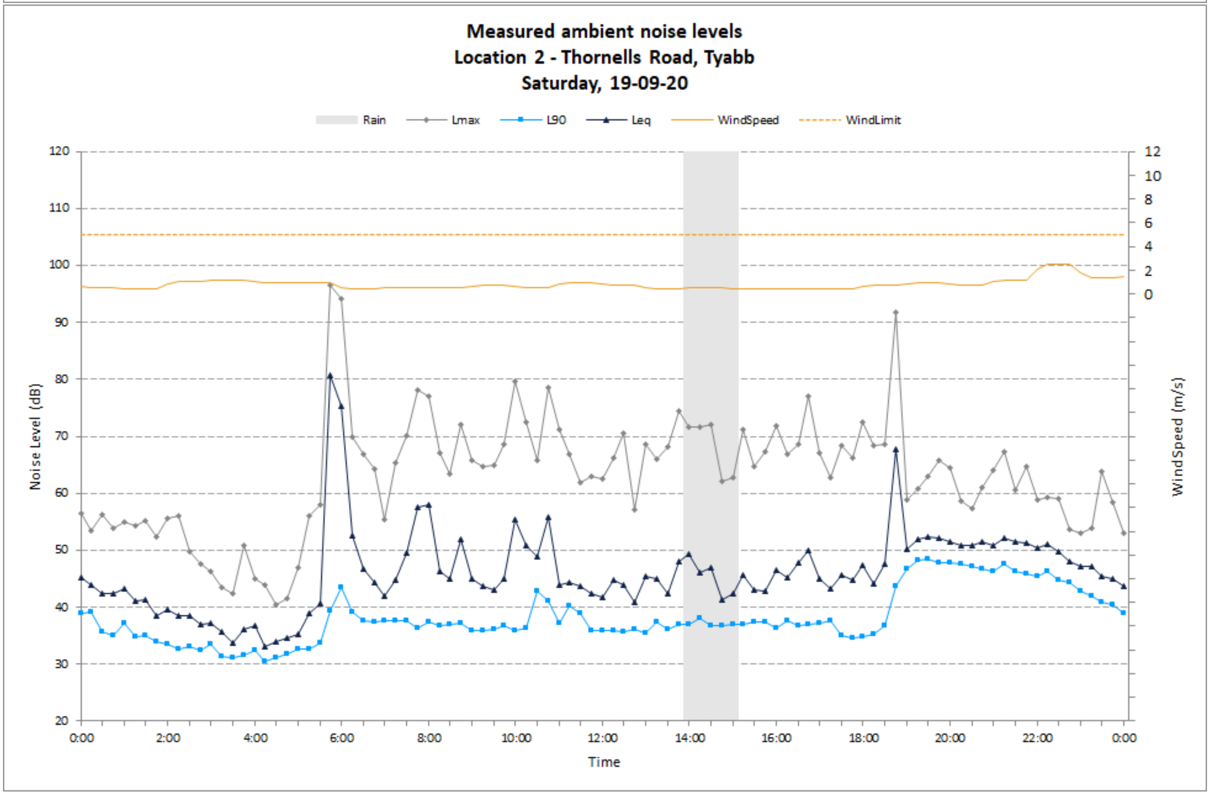
Date	ABL Day[2]	ABL Evening[2]	ABL Night[2]
Wednesday, 16-09-20	0	0	0
Thursday, 17-09-20	36	37	37
Friday, 18-09-20	36	38	31
Saturday, 19-09-20	35	37	34
Sunday, 20-09-20	41	0	41
Monday, 21-09-20	37	42	37
Tuesday, 22-09-20	47	43	39
Wednesday, 23-09-20	41	39	33
Thursday, 24-09-20	0	0	34
Friday, 25-09-20	0	0	38
Saturday, 26-09-20	0	38	36
Sunday, 27-09-20	34	37	37
Monday, 28-09-20	33	37	34
Tuesday, 29-09-20	36	0	33
Wednesday, 30-09-20	0	45	39
Thursday, 01-10-20	41	44	38
Friday, 02-10-20	0	0	0
Rating Background Level (RBL)[1]	**36**	**38**	**37**

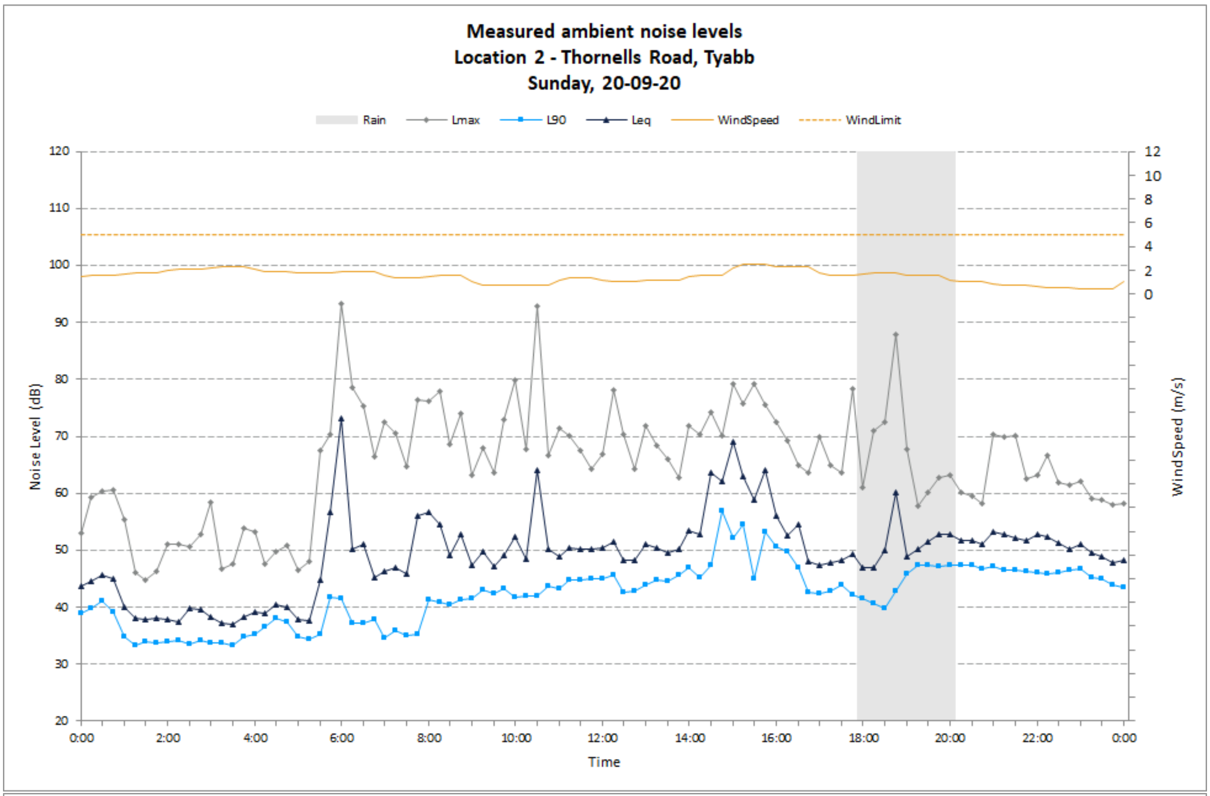
Notes: 1. Adopted RBL is as per NPfI minimum background threshold. Actual RBL shown in brackets.
2. A "0" indicates insufficient data samples due to adverse weather or other extraneous effects.

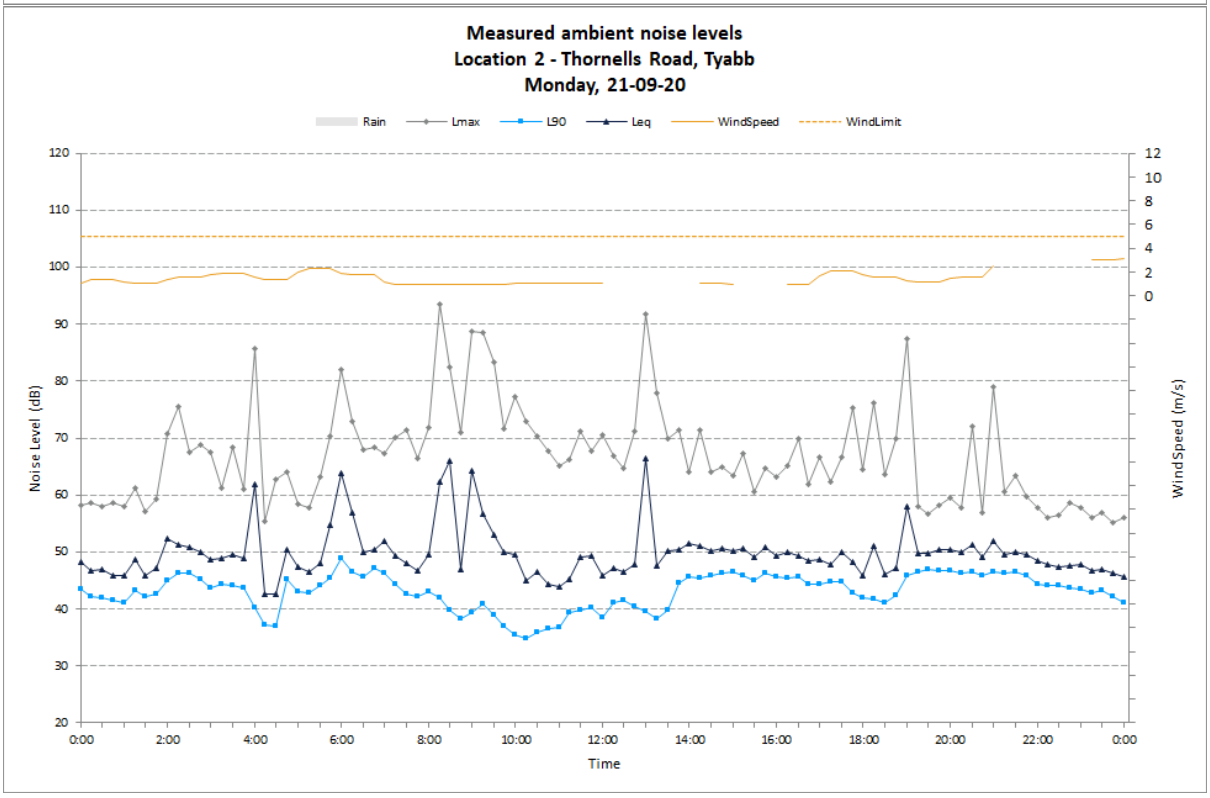

Measured ambient noise levels
Location 2 - Thornells Road, Tyabb
Wednesday, 16-09-20
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
WindSpeed (m/s)
Time

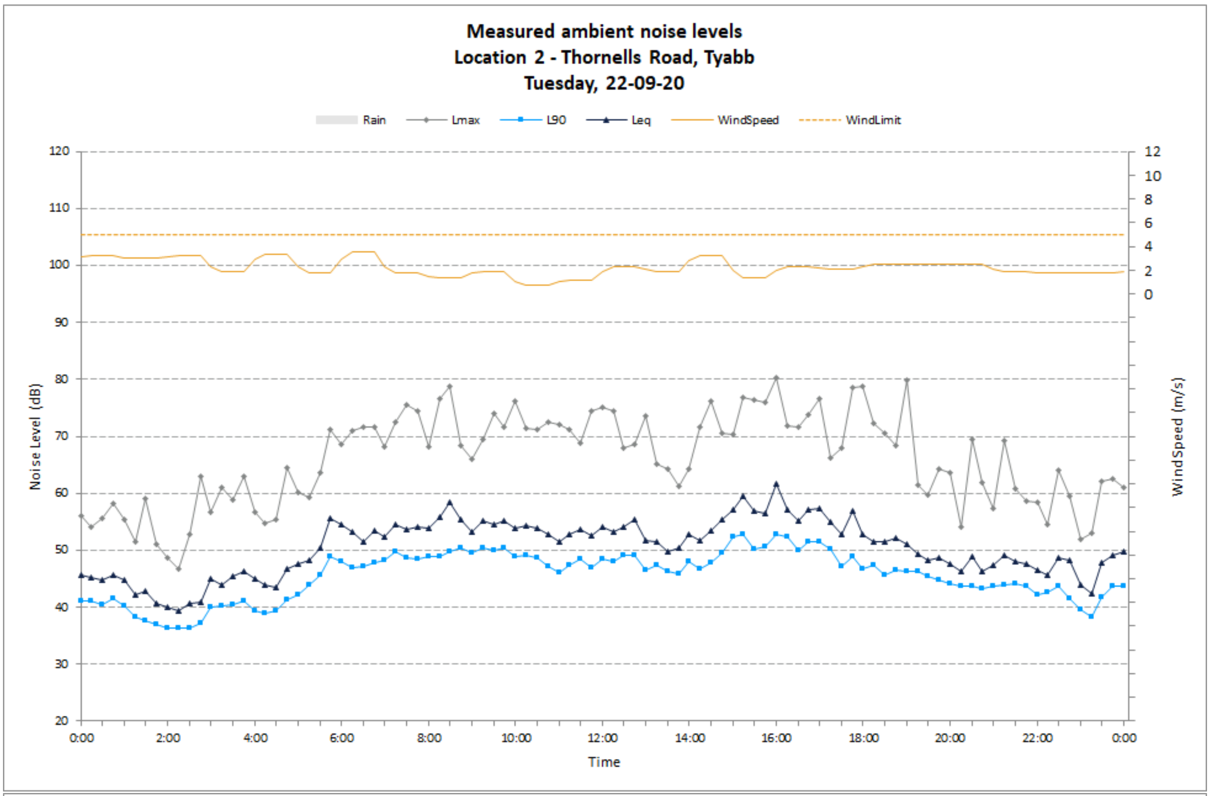

Measured ambient noise levels
Location 2 - Thornells Road, Tyabb
Thursday, 17-09-20
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
WindSpeed (m/s)
Time

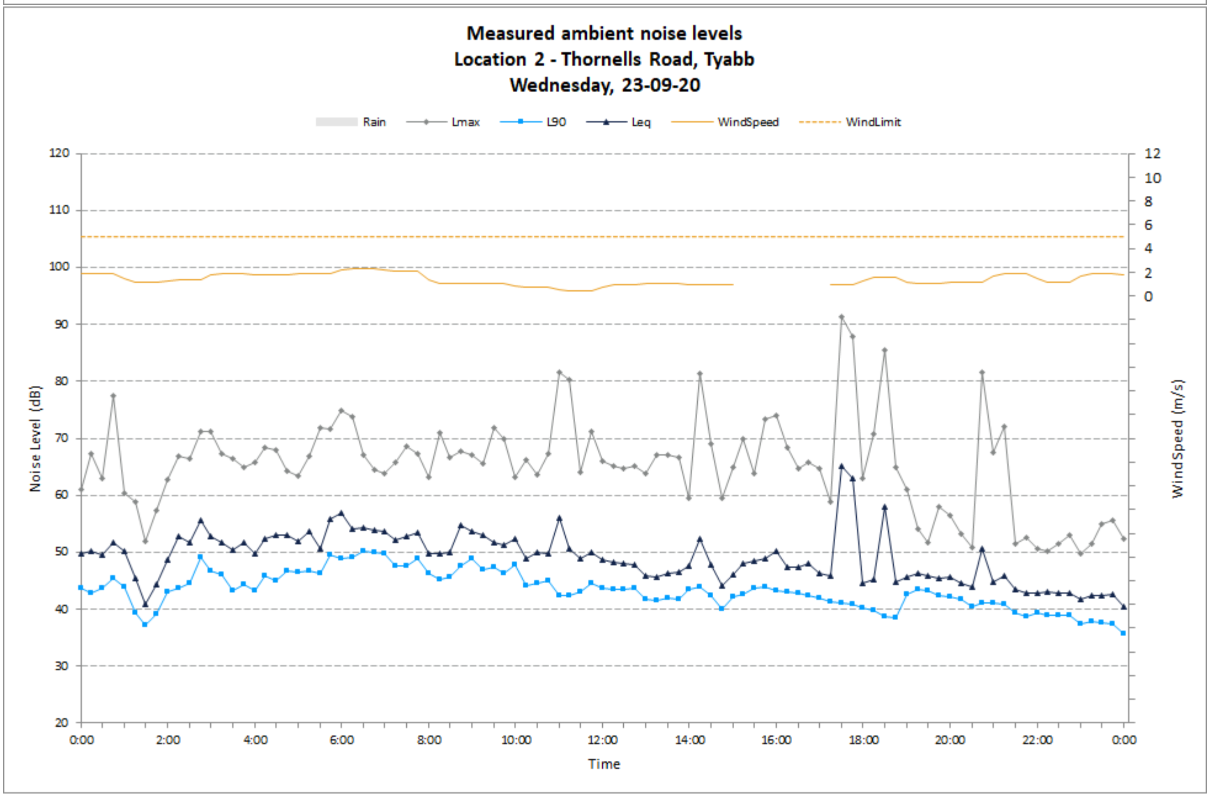

Measured ambient noise levels
Location 2 - Thornells Road, Tyabb
Friday, 18-09-20
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
WindSpeed (m/s)
Time


Measured ambient noise levels
Location 2 - Thornells Road, Tyabb
Saturday, 19-09-20
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
WindSpeed (m/s)
Time

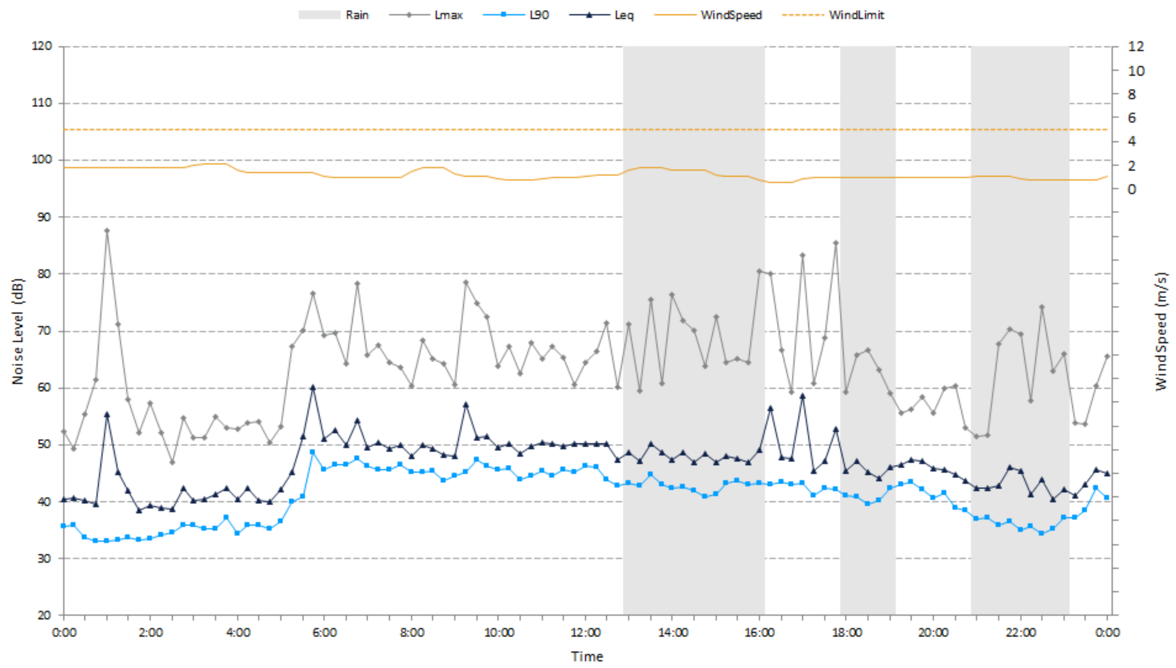

Measured ambient noise levels
Location 2 - Thornells Road, Tyabb
Sunday, 20-09-20
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
WindSpeed (m/s)
Time


Measured ambient noise levels
Location 2 - Thornells Road, Tyabb
Monday, 21-09-20
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
WindSpeed (m/s)
Time

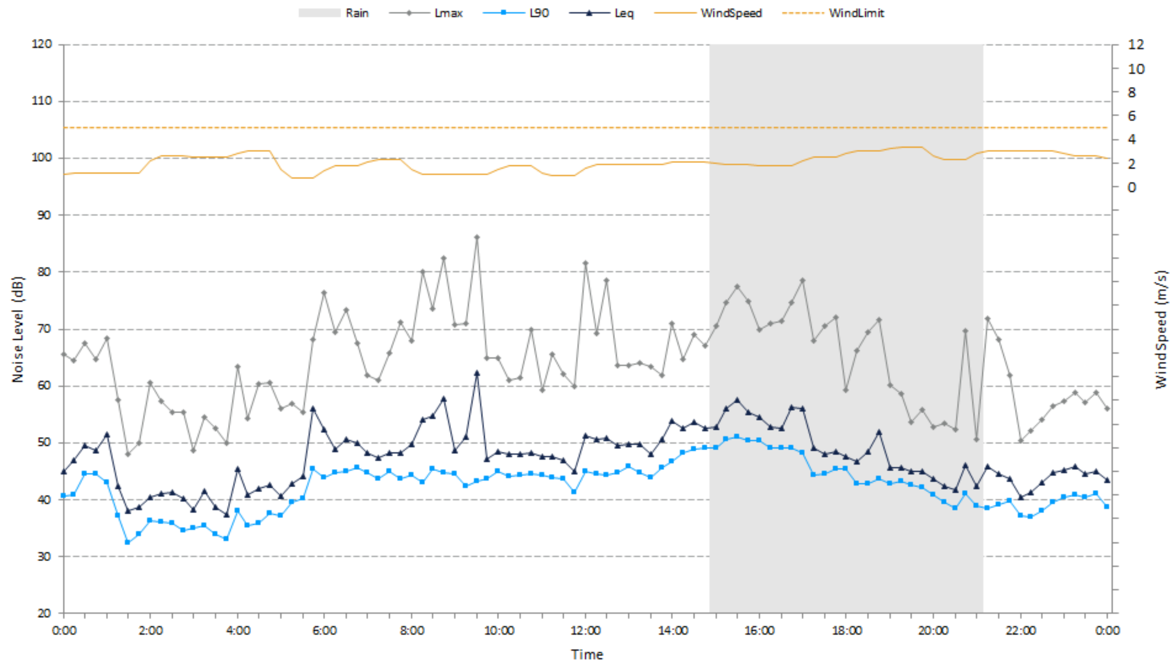

Measured ambient noise levels
Location 2 - Thornells Road, Tyabb
Tuesday, 22-09-20
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
WindSpeed (m/s)
Time

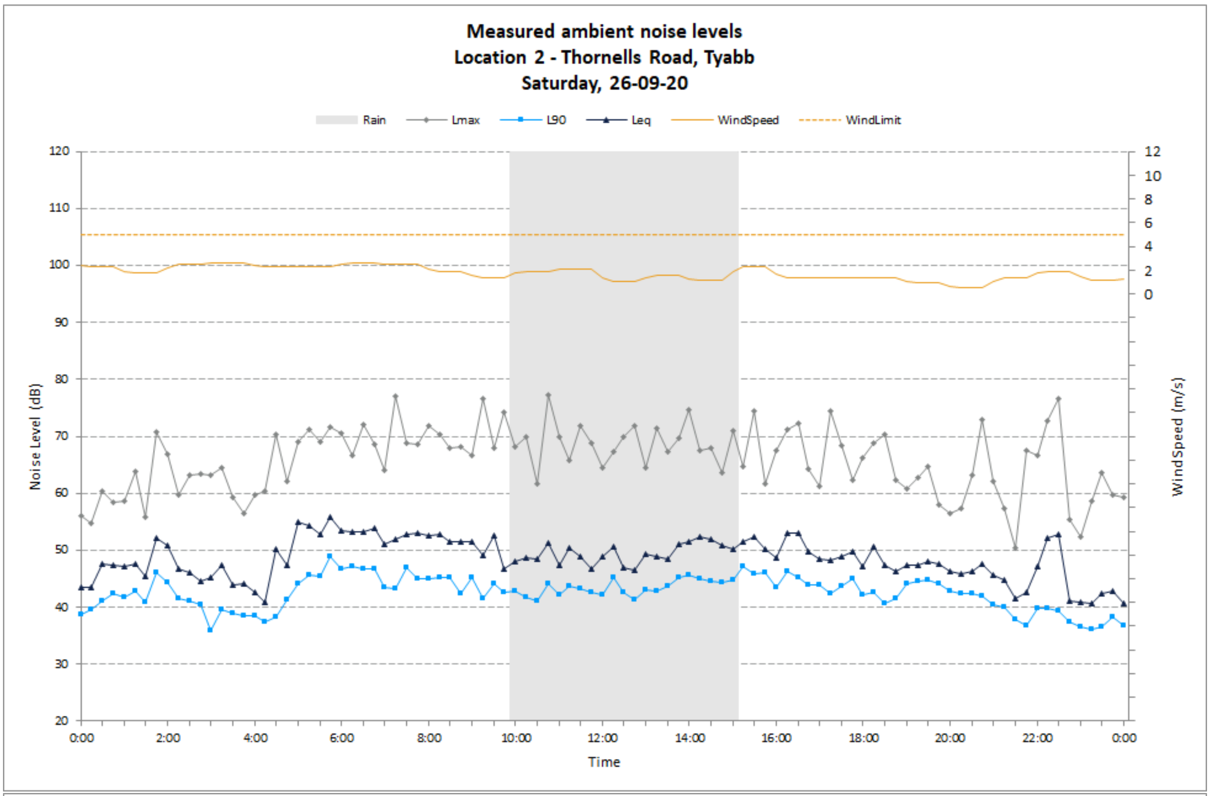

Measured ambient noise levels
Location 2 - Thornells Road, Tyabb
Wednesday, 23-09-20
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
WindSpeed (m/s)
Time

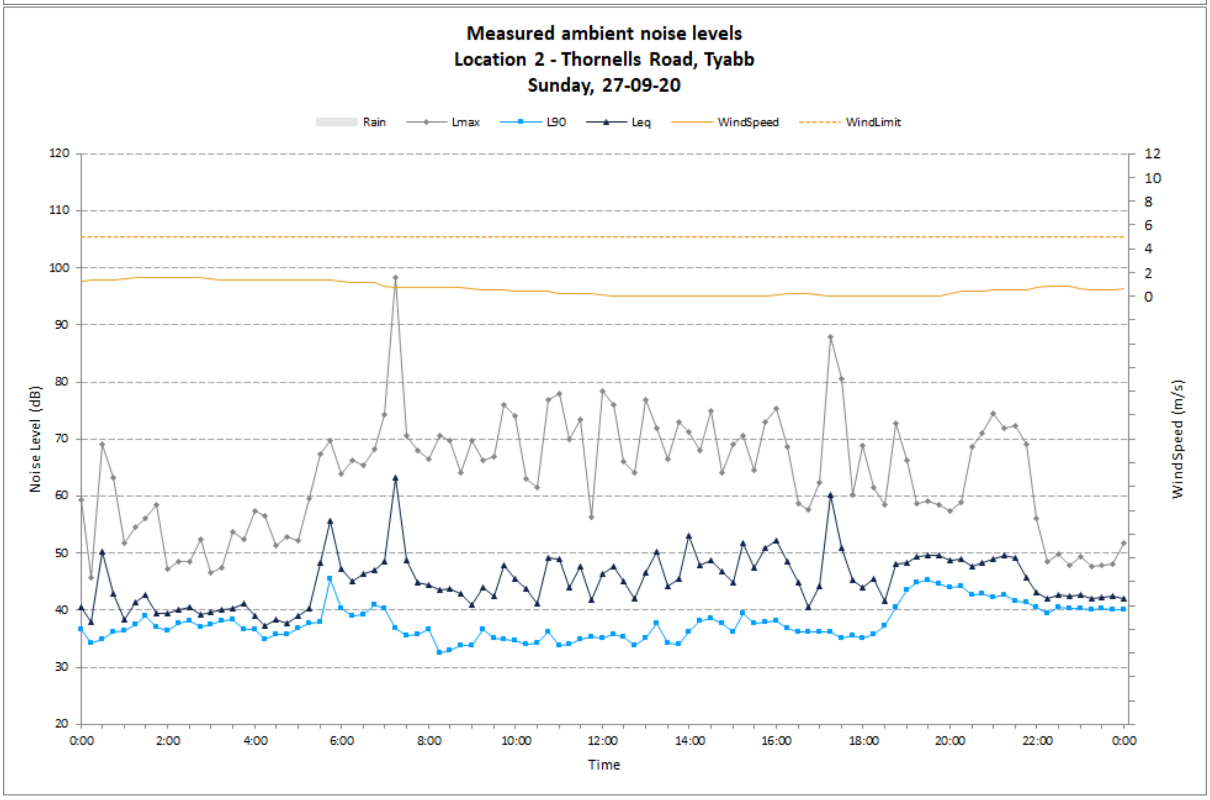
Measured ambient noise levels
Location 2 - Thornells Road, Tyabb
Thursday, 24-09-20

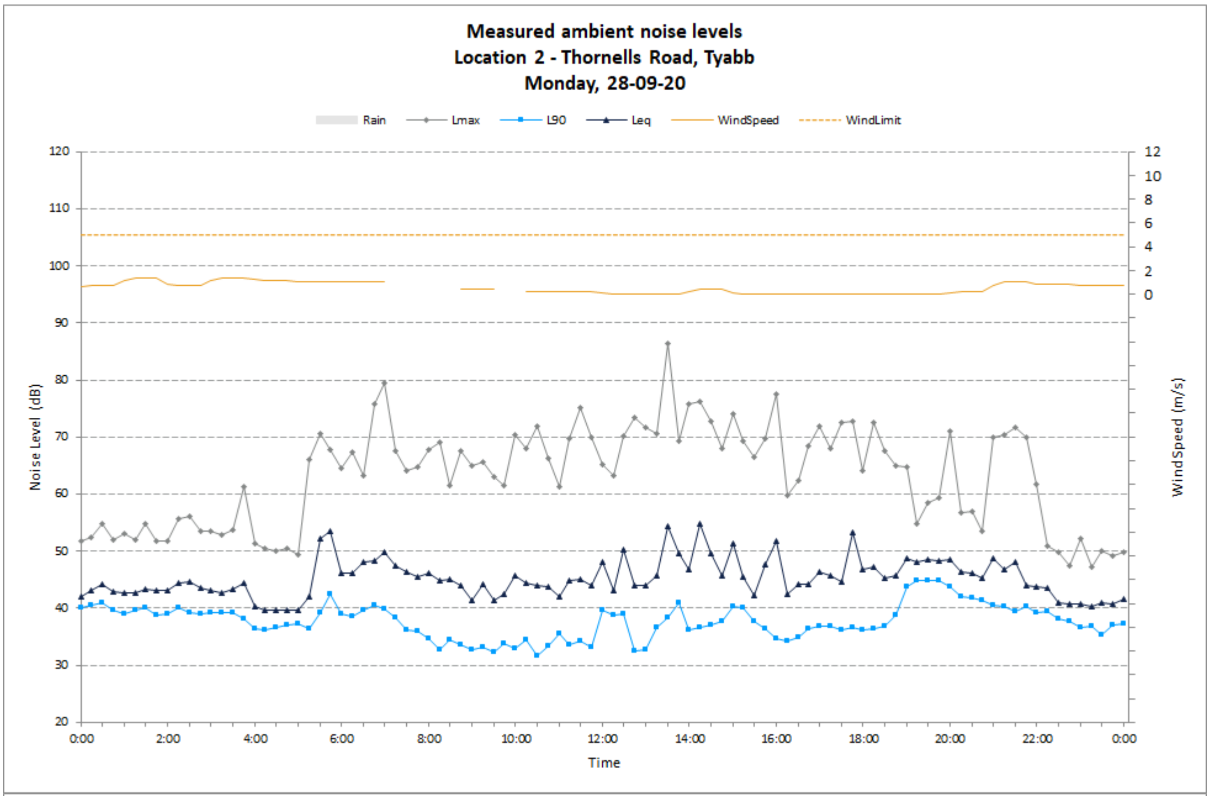


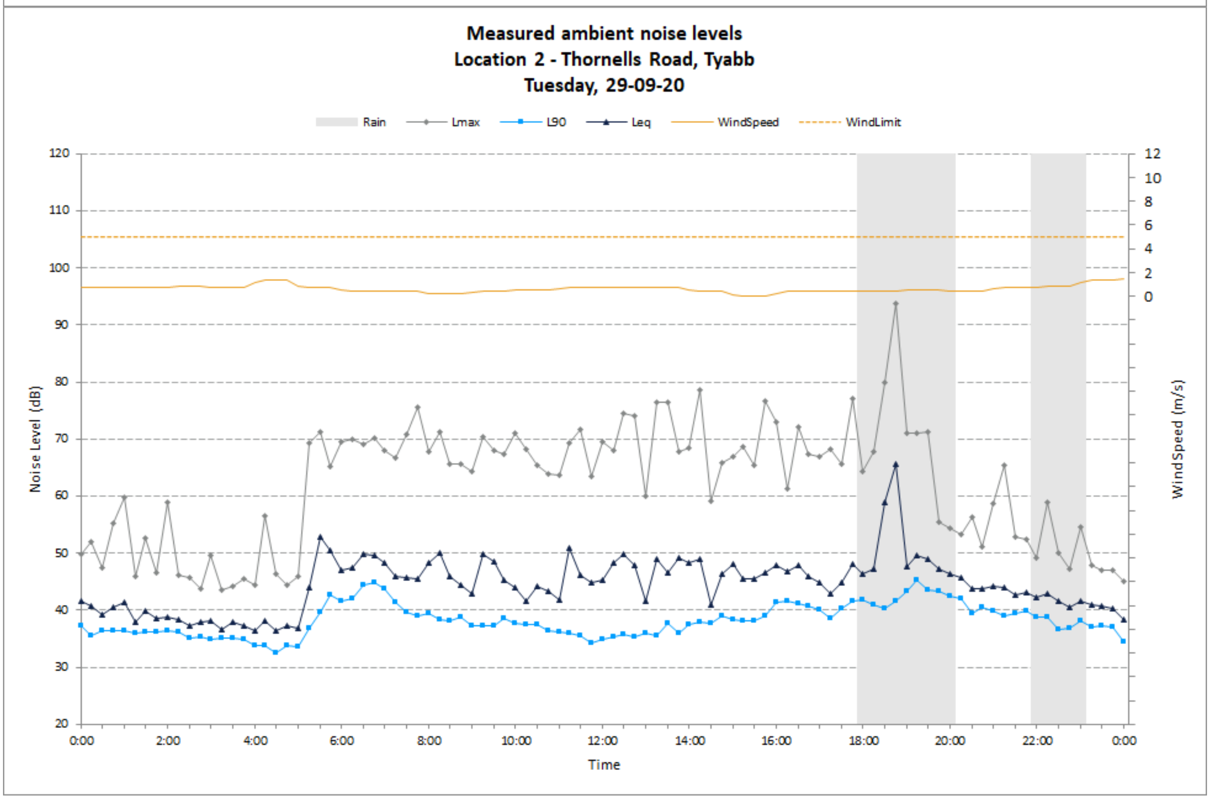
Measured ambient noise levels
Location 2 - Thornells Road, Tyabb
Friday, 25-09-20

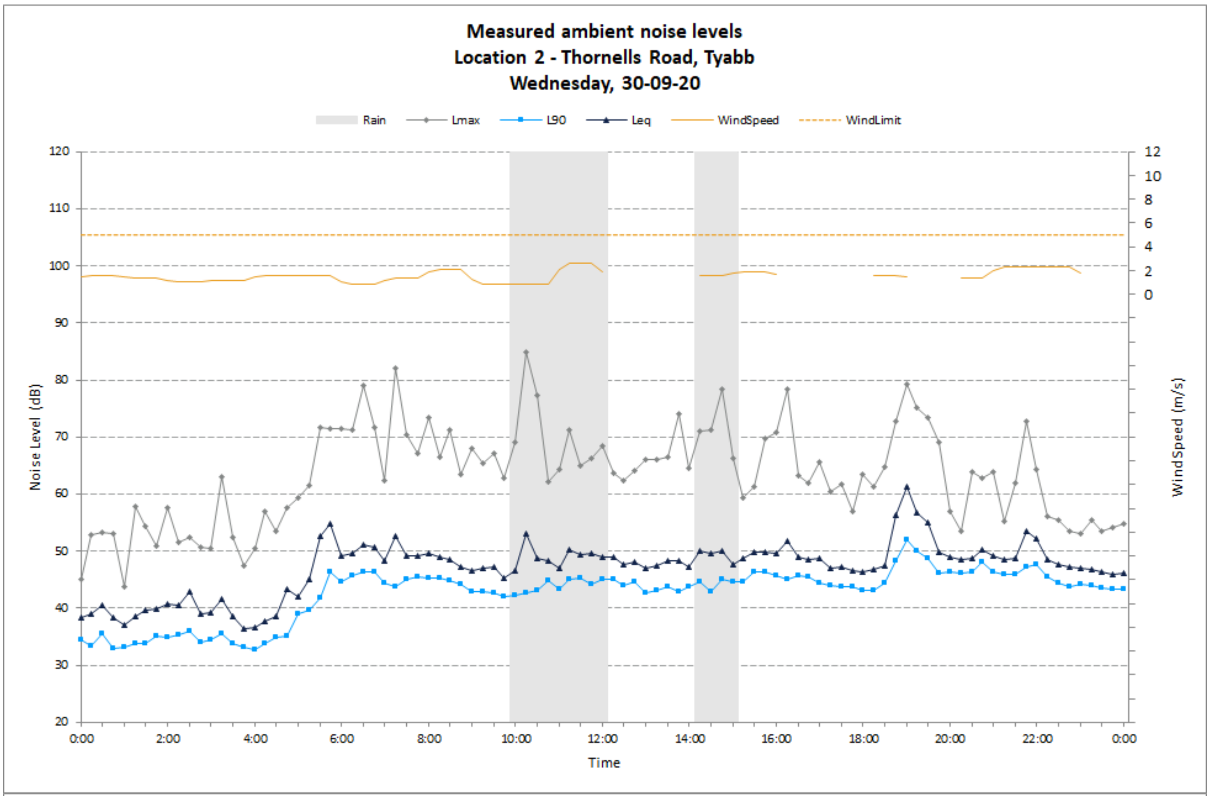



Measured ambient noise levels
Location 2 - Thornells Road, Tyabb
Saturday, 26-09-20
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
WindSpeed (m/s)
Time

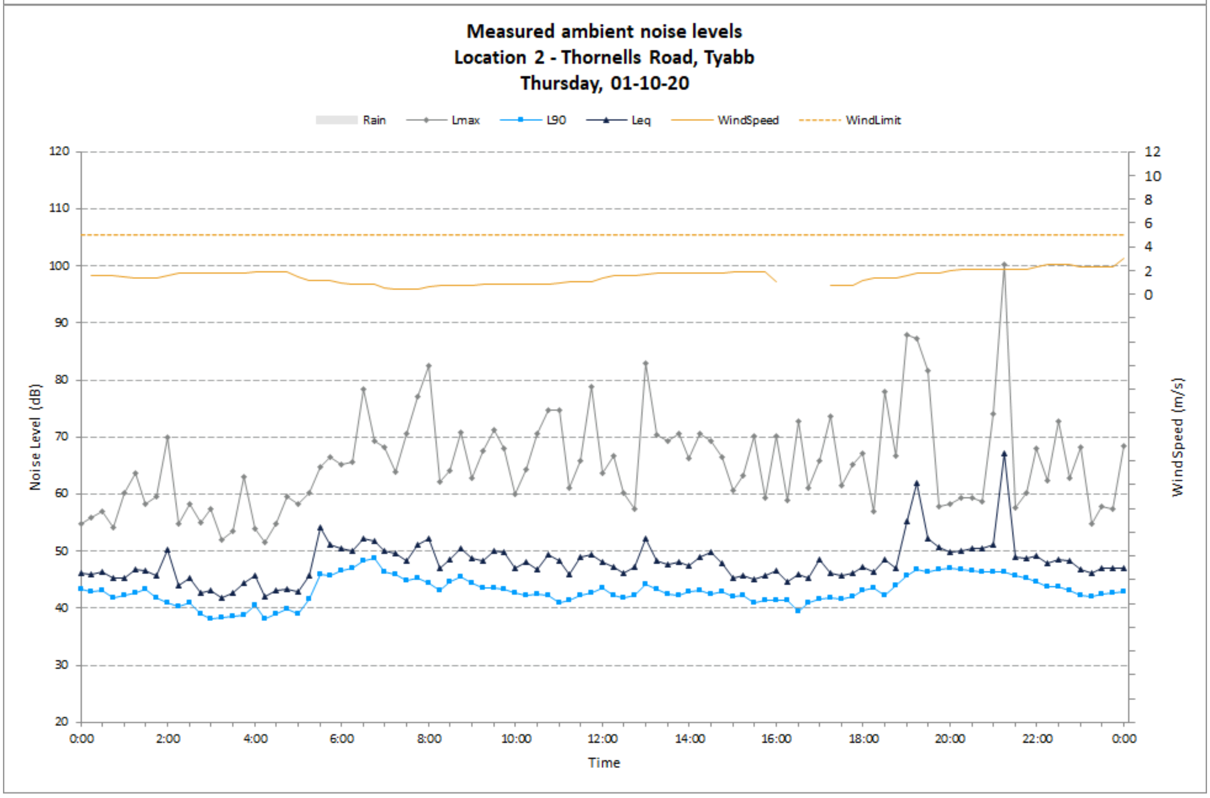

Measured ambient noise levels
Location 2 - Thornells Road, Tyabb
Sunday, 27-09-20
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
WindSpeed (m/s)
Time


Measured ambient noise levels
Location 2 - Thornells Road, Tyabb
Monday, 28-09-20
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
WindSpeed (m/s)
Time

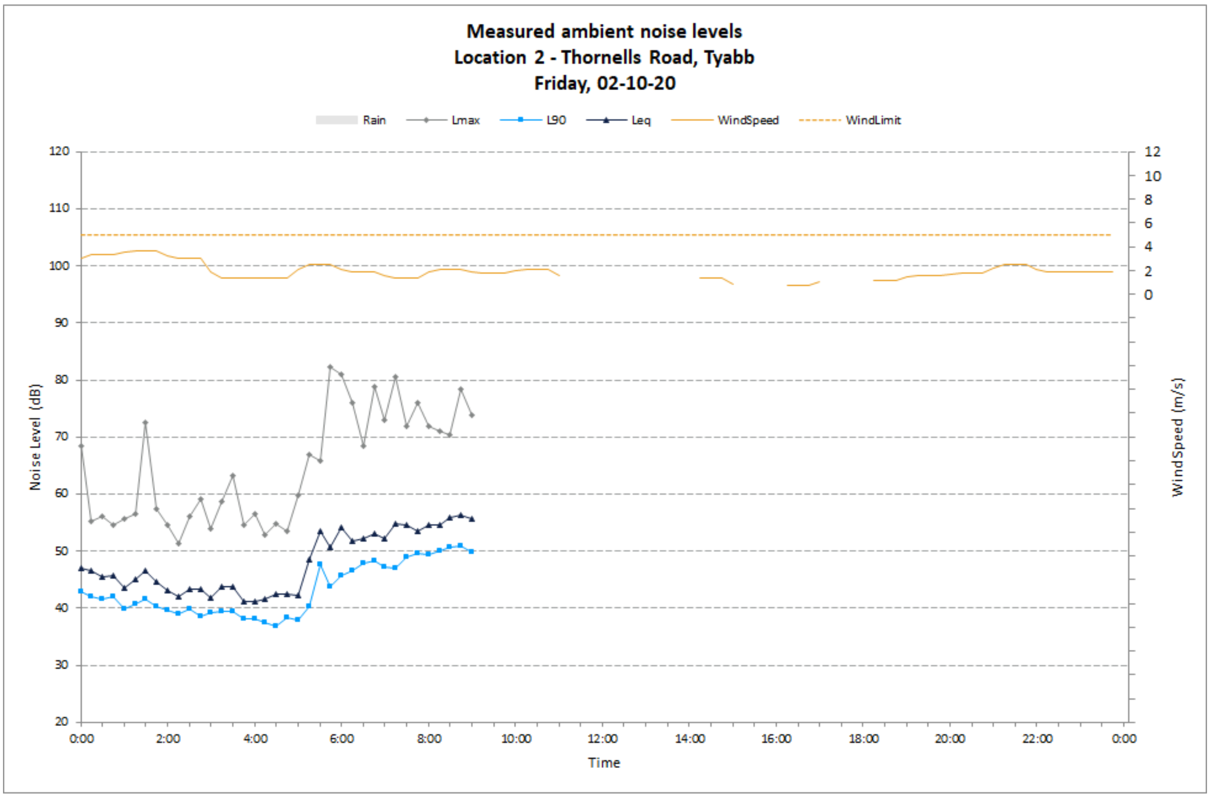

Measured ambient noise levels
Location 2 - Thornells Road, Tyabb
Tuesday, 29-09-20
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
WindSpeed (m/s)
Time



Measured ambient noise levels
Location 2 - Thornells Road, Tyabb
Wednesday, 30-09-20
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
Wind Speed (m/s)
Time

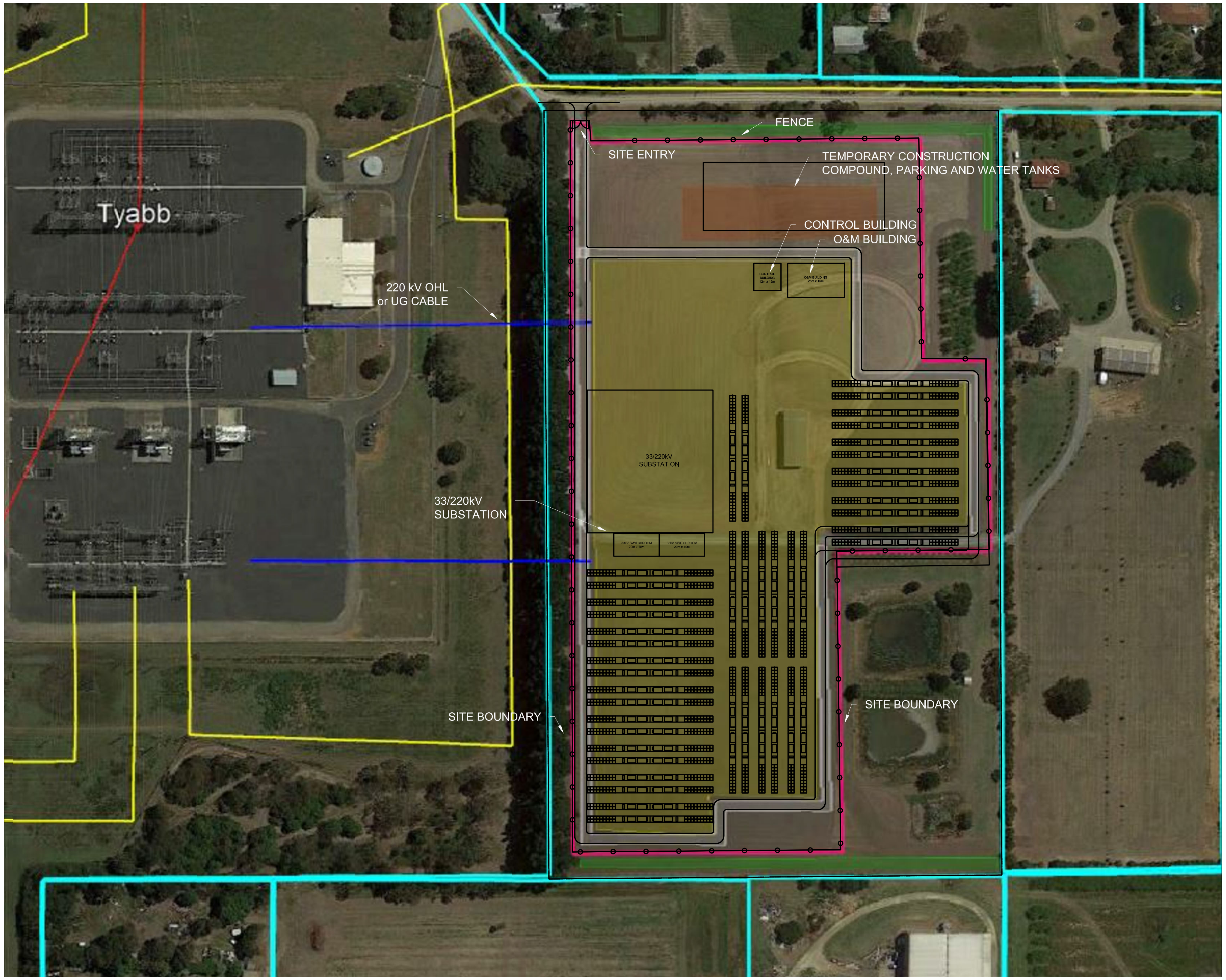


Measured ambient noise levels
Location 2 - Thornells Road, Tyabb
Thursday, 01-10-20
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
Wind Speed (m/s)
Time


Measured ambient noise levels
Location 2 - Thornells Road, Tyabb
Friday, 02-10-20
Rain
Lmax
L90
Leq
WindSpeed
WindLimit
Noise Level (dB)
WindSpeed (m/s)
Time
120
110
100
90
80
70
60
50
40
30
20
12
10
8
6
4
2
0
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
0:00

Appendix B

Site layout



ACTUAL SITE

VENDOR 1
SYSTEM SPECIFICATION
Facility Nameplate: 240MW AC / 480MW.Hr AC (BoL)
Qnty - 88 PCS Units, 88 MV Transformers, 1584 Battery Enclosures
APPROX. 3 HECTARES OF BESS INFRASTRUCTURE

SITE COORDINATES:
38°16'1.56"S, 145°12'13.39"E

SITE PLAN

1:2000

REV	REVISION DESCRIPTION	DRWN BY	CHKD BY	APPR BY	DATE
A	PRELIMINARY CONCEPTUAL LAYOUT	ES			26-03-2021

STATUS: PRELIMINARY	PROJECT TITLE: TYABB		SHEET: 1 OF 1
	PROJECT LOCATION: 17 THORNELLS RD, TYABB, VIC		SCALE: 1:2000
	DRAWING TITLE: BESS SITE LAYOUT		REVISION: A / SHEET SIZE: A3
	PROJECT CODE: MNG-TYABB-BESS	DWG NUMBER: MNG-TYABB-BESS-01	

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