PLANNING PANELS VICTORIA

IN THE MATTER OF: Amendment C372
to the Greater Geelong Planning Scheme

Statement of Evidence of Gillian Lee

Prepared for: Waurn Ponds Unit Trust & Echin Pty Ltd
Instructed by: Norton Rose Fulbright

Date of last site inspection: 15 August 2019
Date of Statement of Evidence: 15 August 2019

Document reference: Ev 001 20190696

6 Gipps Street Collingwood 3066 VIC Australia
T: +613 9416 1855 | F: +613 9416 1231
A.C.N. 006 675 403 | marshallday.com

1.0 NAME AND ADDRESS

1.1 GILLIAN LEE

1.2 Associate of Marshall Day Acoustics Pty Ltd (MDA)

1.3 6 Gipps Street, Collingwood Victoria 3066

2.0 AREA OF EXPERTISE

2.1 For over 10 years I have worked in the field of acoustics and noise control.

2.2 My qualifications and experience are detailed in Appendix A.

2.3 I have expertise to make this statement because I have been involved in environmental noise impact assessments for major environmental projects such as roads, power stations, quarries, mines and industrial plants.

3.0 SCOPE

3.1 Waurn Ponds Unit Trust (WPT) and Echin Pty Ltd, seek Amendment C372 to the Greater Geelong Planning Scheme to rezone land at 35 & 69-93 Hams Road, Waurn Ponds for residential development under planning permit applications 662/2017 and 663/2017 ("the development site").

3.2 I have undertaken a high-level review of an acoustic report prepared by Watson Moss Growcott Acoustics Pty Ltd (WMG) in relation to the substation. In particular, I have been requested to identify the types of noise mitigation measures that could be used to address substation noise levels on the development site.

3.3 MDA has previously prepared the following documents in relation to noise at the site:

- Rp001 R01 20171434_*Hams Road Waurn Ponds_Planning Noise Assessment*, dated 11 October 2018
- Lt001 R01 20190696 *35 & 69-93 Hams Road – Waurn Ponds Substation*, dated 31 July 2019.

3.4 Norton Rose Fulbright, on behalf of WPT and Echin Pty Ltd, has engaged MDA to undertake the following:

- Review the briefing letter and materials provided by Norton Rose Fulbright on 5 August 2019;
- Confer with instructing solicitors and counsel where necessary;
- Prepare an expert report considering the acoustic matters arising from the Amendment, and advise on any change to my opinion since the documents listed above were prepared; and
- Appear at the Panel hearing of this matter, which has been scheduled for 22, 23, 26 and 27 August 2019.

3.5 The following documents, were reviewed:

- *Waurn Ponds Zone Substation* report (Ref: 12142-3ng) dated 9 April 2018, prepared by Watson Moss Grocott Acoustics
- Letter of objection prepared by Spiire (Ref: 305658) dated 24 April 2019
- Overall Subdivision Masterplan dated 24 July 2019, included as Appendix B

3.6 I prepared this statement of evidence with the assistance of the Marshall Day Acoustics' staff members listed in Table 1.

Table 1: Assisting MDA staff members

Staff member	Title	Tasks	Qualification
Christophe Delaire	Co-CEO	Review of evidence	Masters Degree in Engineering (French Equivalent)

4.0 SUMMARY OF OPINIONS

4.1 I adopt the MDA Letter R01 20190696 *35 & 69-93 Hams Road – Waurn Ponds Substation*, dated 31 July 2019, attached as Appendix B, as the basis for my expert witness statement and evidence.

4.2 A summary of my comments and recommendations are provided below for reference.

4.3 MDA submitted the report Rp001 R01 20171434_*Hams Road Waurn Ponds_Planning Noise Assessment,* dated 11 October 2018 and attached as Appendix D, which nominated a range of mitigation controls for traffic and rail noise at dwellings within the proposed development.

4.4 That report did not include an assessment of noise from the Powercor substation and noted that noise from the substation would be addressed separately.

4.5 WMG has prepared a report in relation to potential noise emanating from the substation (Ref: 12142-3ng, dated 9 April 2019). The assessment identifies EPA Publication 1411 *Noise from Industry in Regional Victoria* (NIRV) as the relevant noise guideline, and sets out noise criteria for the day, evening and night periods.

4.6 I have reviewed and confirmed the noise criteria referenced in the WMG report, provided in Table 2 for reference.

Table 2: NIRV recommended maximum noise levels – proposed dwellings within development

Period	Recommended Maximum Noise Level, dB L_{eff}
Day	46
Evening	41
Night	36

4.7 The WMG assessment is based on attended measurements and predictive noise modelling to determine likely noise levels at the development site due to the substation.

Broadly, the findings of the report are as follows:

- The dominant noise sources at the site include 3 transformers, one of which requires a chiller to operate
- The equipment typically runs continuously, albeit under various operating conditions according to the weather and load requirements at any particular time
- Noise data for the equipment has been provided for a range of operating conditions (e.g. transformer fans on or off, chiller operating at various capacities), based on attended measurements
- Each of the items of equipment exhibited prominent tonal characteristics, which would typically require a 5 dB character adjustment to the effective noise level in accordance with NIRV (Noise from Industry in Regional Victoria)
- Assuming the operating conditions that result in the highest source noise levels, predicted noise levels at the nearest point on the development site could be as high as 55 dB L_{eff} (including a 5 dB character adjustment for tonality), which exceeds the day, evening and night NIRV criteria.

4.8 MDA has conducted noise assessments for other terminal stations around Melbourne in the past. A review of the MDA noise source database for transformers and chillers indicated operating levels consistent with those reported by WMG.

4.9 A high-level review of the noise calculations shows good agreement with the predicted noise levels presented in the WMG report. I therefore agree that noise mitigation would be required to achieve the NIRV criteria at the development site.

4.10 NIRV requires that when the recommended noise levels are exceeded, steps must be taken by the industrial or commercial operator to reduce noise.

4.11 Options for reducing noise levels from the substation site recommended by WMG included the following:

- *Reduce noise at the source, such as by removing the chiller or not using it at night; replacing the fans on Transformer 2 with quieter fans if possible; replacing Transformer 2 with a new transformer that has quieter fans and does not require a chiller; replacing the chiller with a noise-reduced model*
- *Installing noise barriers around the perimeter of the substation. Noise barriers have a finite noise reduction capability and 5 m has been taken to be a height beyond which it is unlikely that approval would be gained for noise barriers. Municipalities are often reluctant to allow noise barriers higher than 3 m in the vicinity of residential development, but 4 m may be feasible if residential dwellings are not directly adjacent*

4.12 Broadly, I agree that the noise mitigation options presented by WMG could reduce noise at the development site. However, the degree of noise reduction provided by each of the mitigation options would need to be confirmed with a more detailed assessment following discussions with both the developer and Powercor, as it is likely that some mitigation will need to be directed to the transformers and chiller on the substation site. The following commentary is provided to inform the selection of mitigation options.

4.13 As noted in the WMG report, provision of a 5 m noise barrier is unlikely to result in compliance with the NIRV evening and night criteria without additional mitigation provided for the substation plant.

4.14 The WMG report also referred to a mitigation option involving a buffer between the substation site and the development site.

4.15 A buffer outside the substation boundary would need to be in the order of 330 m in order to provide sufficient attenuation of noise to achieve the night period NIRV noise limit. This buffer zone is based on calculations assuming all plant is operating and propagates equally in all directions, and includes a 5 dB penalty for tonality. This is likely to be considered impractical as it would require more than half the development site to be used as a buffer.

4.16 Other mitigation forms may include provision of a suitable chiller enclosure to attenuate noise, in conjunction with other mitigation treatments to the transformers, and/or localised screening around the transformers and chiller on site, as has been incorporated at other metropolitan terminal station and substation sites.

4.17 Alternatively, building forms on the proposed development site could potentially be used to provide screening to the subject site from their built form, provided they are at least two storeys high, constructed as terraces with no space between, and utilise closed facades which do not include any openable elements (i.e. any windows would need to be fixed closed on the interfaces with the substation site).

4.18 Built forms or noise barriers constructed on the interface with the Powercor site would need to account for the easement where it is understood no construction can occur. A resulting gap in a noise barrier or built form would need detailed design to maintain compliance with the NIRV criteria at noise-sensitive locations close to the gap, either through provision of additional screening, or facade-based treatments to dwellings.

4.19 Provision of a road around the Powercor site, while not providing a sufficient buffer distance on its own merit, could allow for the use of a perimeter noise barrier at the Powercor site to be separated from dwellings locations, therefore reducing consideration relating to overshadowing of new residential locations.

4.20 A combination of approaches may also be an appropriate outcome.

4.21 Implementation of treatments on the substation site would require the cooperation of Powercor. To provide assurances to Powercor, a commitment to cooperate on noise control measures could be implemented through a planning agreement. It is understood that this type of cooperation was the intention of the proposed condition to be incorporated into the Design Development Overlay for the subject site (DD045).

4.22 The WMG report notes that existing dwellings to the north and east of the substation site are within the NIRV major urban area boundary for Geelong, and therefore would be subject to different noise criteria than the proposed residential uses within the development site. The WMG report does not define the criteria that would be applicable at the existing dwellings, but notes it would result in a higher noise limits than would apply at the proposed residential development.

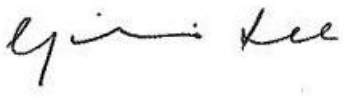
4.23 The WMG report does not include an assessment of noise from the substation at existing dwellings.

4.24 Consideration of noise at the existing dwellings may be prudent when selecting noise mitigation treatment options for the substation noise sources. For example, noise mitigation treatment that reduces noise from the plant on site would decrease noise levels at existing dwellings as well as at the proposed development, whereas construction of a noise barrier between the substation and proposed development would only reduce noise to the proposed development, and may actually increase noise levels at existing dwellings due to reflections from the barrier surface, unless treated appropriately with absorptive materials.

4.25 The selected noise mitigation treatment will need to be decided in conjunction with Powercor and the proponents, should the mitigation involve changes to the Powercor site (e.g. replacement of plant, or construction of screening devices). However, it is considered that there are a range of mitigation options that are likely to allow compliance with the NIRV criteria for day, evening and night periods at the development site.

5.0 DECLARATION

I have made all the inquiries that I believe are desirable and appropriate and no matters of significance which I regard as relevant have to my knowledge been withheld from the Panel.



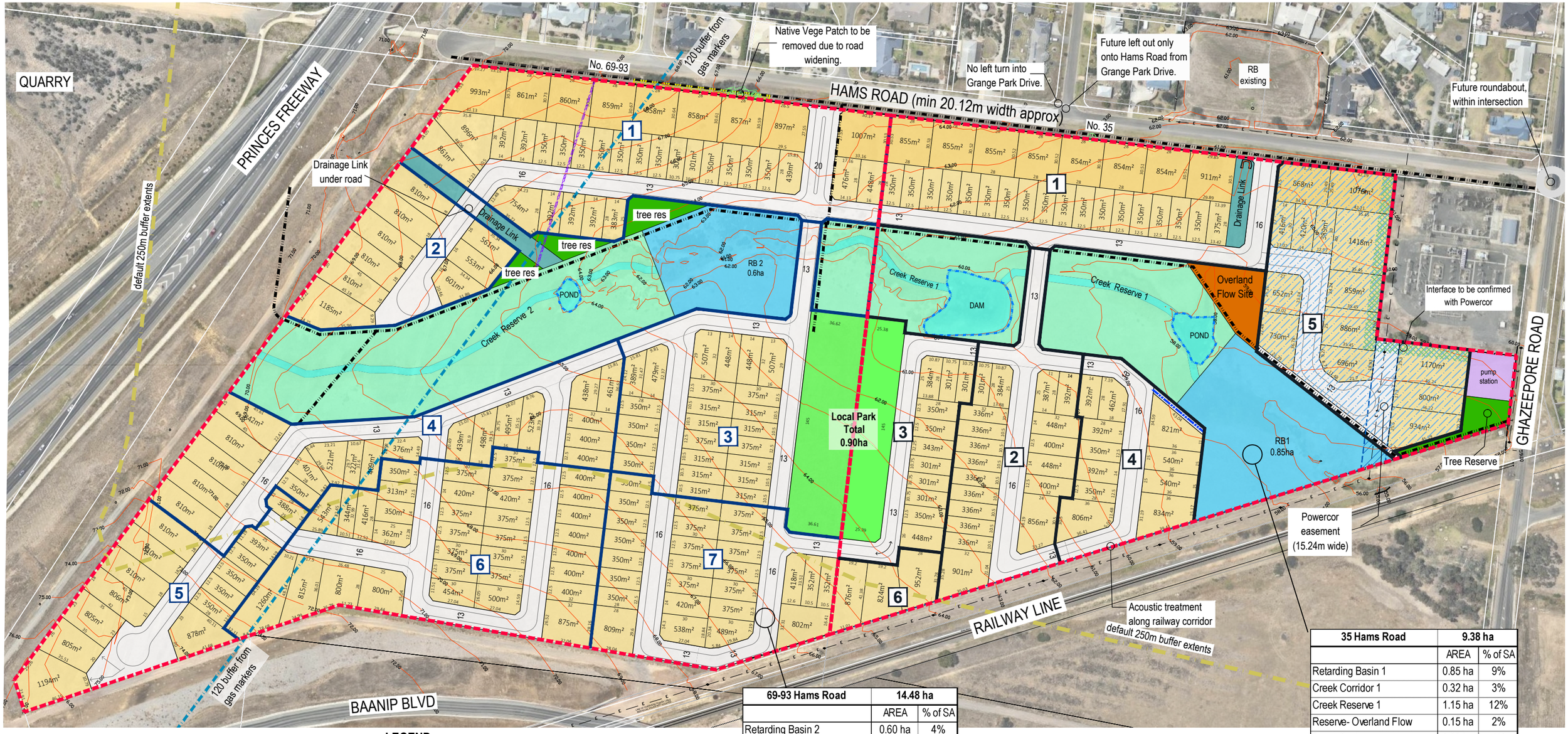
Signed

Dated 15 August 2019

APPENDIX A CURRICULUM VITAE – GILLIAN LEE

Name:	**Gillian Lee**	
Address:	6 Gipps Street Collingwood, Victoria 3066 Australia	
Qualifications:	B.MusTech	Bachelor of Music Technology, Queensland Conservatorium, Griffith University
Experience:	August 2018 - Present	Associate with Marshall Day Acoustics Pty Ltd, Melbourne Australia Consultants in acoustics and noise control. Responsibilities include consulting work in industrial noise control, architectural acoustics, building services noise control, environmental noise impact and hearing conservation.
	2015 – August 2018	Senior Consultant with Marshall Day Acoustics
	2011 - 2015	Consultant with Marshall Day Acoustics
	2009 - 2010	Studio Assistant at Leeders Farm Recording Studios Spooner Row, Norfolk UK Responsibilities included assistance on recording sessions, studio setup of equipment and recording/mixing duties.
	2006 - 2008	Consultant with Heggies (Acoustic Consultants), Brisbane, Australia. Consultants in acoustics and noise control. Responsibilities include consulting work in industrial noise control, transportation, planning work and environmental noise impact.

APPENDIX B OVERALL SUBDIVISION MASTERPLAN



PLAN NOTES

- Layout is subject to Council approval.
- Site Boundaries and Areas require confirmation via re-establishment survey.
- Further requirements may be needed but not finalized until the appropriate investigations have been reported, including but not limited to:
  - Feature Survey, Flora and Fauna, Arboricultural Survey,
  - Archaeological, Engineering Services, Traffic Engineering.

SOURCE DATA

- Surrounding boundary data via from supplied VICMAP digital data.
- Subject site details features via SMEC Urban Survey 3440895s-01.
- Aerial imagery via from Nearmap under agreement.
- Native Vege patch approx. via Practical Ecology Map 1 08/05/2018 (HZ3).
- Retarding Basin size and location via: Water technology 18/09/18.

DESIGN NOTES

- All existing trees to be removed unless capable of being retained at detailed design phase.
- Creek and RB sites still subject to detailed design approval.
- Larger Lots fronting Hams Rd in accordance with DPO.
- Flood zone area mitigated current Retarding Basin design.
- MD Superlot area adjacent to Power Substation TBC (south may be subject to overland flows).
- MD Superlot existing overhead electrical lines to be potentially relocated underground, subject to authority approval and detailed design.
- Courthead layout subject to detailed design Via Traffic Engineers.
- Location class of T1 (Residential as per AS 2885.1-2012) shall be maintained within 120m of the gas pipeline.

LEGEND

- SITE BOUNDARY
- 1 1 INDICATIVE RESIDENTIAL STAGING
- SHARED PATH
- ACCESS FOR RETARDING BASIN 1
- BUFFER DEFAULT (250m)
- BUFFER (120m offset gas markers)
- BUFFER *(interface & treatment to be confirmed)*
- EXISTING EASEMENT: TO BE REMOVED

Ghazeepore & Hams Road roundabout: subject to detailed design

"Patch of Grassy Woodland" within Hams Road southern verge, to be removed due to road widening.

Layout & interface over this area of No. 35 is subject to further discussions with Powercor and detailed design.

69-93 Hams Road	14.48 ha	
	AREA	% of SA
Retarding Basin 2	0.60 ha	4%
Creek Corridor 2	0.18 ha	1%
Creek Reserve 2	1.70 ha	12%
Drainage Link	0.12 ha	1%
Open Space - Local Park 2	0.53 ha	4%
sub total	*3.14 ha*	*22%*

NET DEVELOPABLE AREA	11.35 ha	
Local Roads	3.11 ha	21%
Tree Reserve	0.15 ha	1%
Residential Interface Lots	0.81 ha	6%
Residential Lot Area	7.28 ha	50%
sub total	*11.35 ha*	*78%*

RESIDENTIAL LOT YIELD	
Standard Residential	152
Average	*479 m²*
Residential Interface Lots	9
Average	*895 m²*
TOTAL:	***161***

COMBINED SITES	
Yield	**245**
Average	*513 m²*
NDA	17 .73 ha
Density	13.8 *lots/NDA*

35 Hams Road	9.38 ha	
	AREA	% of SA
Retarding Basin 1	0.85 ha	9%
Creek Corridor 1	0.32 ha	3%
Creek Reserve 1	1.15 ha	12%
Reserve- Overland Flow	0.15 ha	2%
Pump Station	0.09 ha	1%
Drainage Link	0.07 ha	1%
Open Space: Local Park 1	0.37 ha	4%
sub total	*3.00 ha*	*32%*

NET DEVELOPABLE AREA	6.38 ha	
Local Roads	1.82 ha	19%
Tree Reserve	0.09 ha	1%
Residential Interface Lots	0.88 ha	9%
Residential Lot Area	3.59 ha	38%
sub total	*6.38 ha*	*68%*

RESIDENTIAL LOT YIELD	
Standard Residential	74
Average	*485 m²*
Residential Interface Lots	10
Average	*883 m²*
TOTAL	**84**

TAYLORS
Urban Development | Infrastructure
8 / 270 Ferntree Gully Road, Notting Hill, Victoria, 3168
Tel: 61 3 9501 2800 | Web: taylorsds.com.au

N

0 25 50 75 metres
Scale 1:2500 @ A3

p:\20000-24999\20679\acad\urban design\concept plans\cad\mp20\20679_mp_20.dwg | SUB OA

Job No. 20679 | MP19 | SUB OA
Date. 24/07/19
By. AGT Ckd. AGT

WITHOUT PREJUDICE

35 & 69-93 Hams Road
Waurn Ponds
City of Greater Geelong

OVERALL SUBDIVISION MASTERPLAN

APPENDIX C MDA REPORT RP001 R01 20171434

MARSHALL DAY Acoustics

35 & 69-93 HAMS ROAD, WAURN PONDS
TRAFFIC NOISE ASSESSMENT

Rp 001 R03 20171434 | 11 October 2018

MARSHALL DAY Acoustics

6 Gipps Street
Collingwood VIC 3066
Australia
T: +613 9416 1855
ABN: 53 470 077 191
www.marshallday.com

Project: **35 AND 69-93 HAMS ROAD, WAURN PONDS**

Prepared for:

Waurn Ponds Unit Trust
C/- Urban Quarter WA
Level 2
48 Kishorn Road
Applecross
WA 6153

Echin Pty Ltd
C/- 3 Coleman Street #4-30
Singapore 179804

Attention: **Mr Roger Cooper**

Report No.: **Rp 001 R03 20171434**

Document Control

Status:	Rev:	Comments	Date:	Author:	Reviewer:
First	-	-	09/03/2018	SJM	GL
Second	1	Revised Masterplan	03/04/2018	SJM	GL
Second	2	Revised Masterplan	08/05/2018	SJM	GL
Final	3	Revised Masterplan	11/10/2018	SJM	GL

TABLE OF CONTENTS

1.0 INTRODUCTION

Taylors Development Strategists Pty Ltd, on behalf of Echin Pty Ltd and Waurn Ponds Unit Trust C/o Urban Quarter WA, are working on the development of land for residential use at 35 and 69 - 93 Hams Road in Waurn Ponds. Marshall Day Acoustics (MDA) has been requested to provide acoustic input for a town planning application for approximately 270 residential lots that abut Baanip Boulevard to the south and Geelong Ring Road to the west.

MDA measured traffic (Geelong Ring Road, Hams Road and Ghazeepore Road) and train noise levels at the site in 2013 (refer MDA report Rp001 R04 2013193ML, dated 10 June 2014).

Baanip Boulevard was opened in 2015 which links Geelong Ring Road to the west of the site to Ghazeepore Road that abuts the eastern boundary of the site. Due to the new traffic conditions it is considered important to re-asses noise from Ghazeepore Road.

However, in the interim since the MDA report was prepared, it is understood that the parcel of land between the existing Powercor substation in the north east corner of the site and the railway to the south will be utilised as a retarding basin (RB2 on the concept plan). As such, the boundary of lots to the east end of the site will now be set back from Ghazeepore road by approximately 100 m. Therefore, traffic noise to the Ghazeepore Road side of the site is likely to be less significant than rail noise.

In addition, there is a Powercor substation to the north east corner of the site. Watson Moss Growcott (WMG) undertook an assessment of noise from this facility in November 2017 which identified that it may exceed the applicable NIRV Recommended Maximum Noise Levels at several proposed lots within the development.

This report has been prepared to address potential noise impacts on the development due to adjacent roads and the Geelong/Warrnambool railway line to the south.

Noise due to the Powercor substation will be addressed separately.

Acoustic terminology used in this report is described in Appendix A.

2.0 SITE LOCATION AND SURROUNDINGS

The site is located at 35 and 69 - 93 Hams Road, Waurn Ponds and is bounded by:

- Hams Road to the north
- Geelong/Warrnambool railway line to the south with Baanip Boulevard beyond
- Powercor Waurn Ponds Terminal Station and Ghazeepore Road to the east
- Geelong Ring Road to Anglesea to the west.

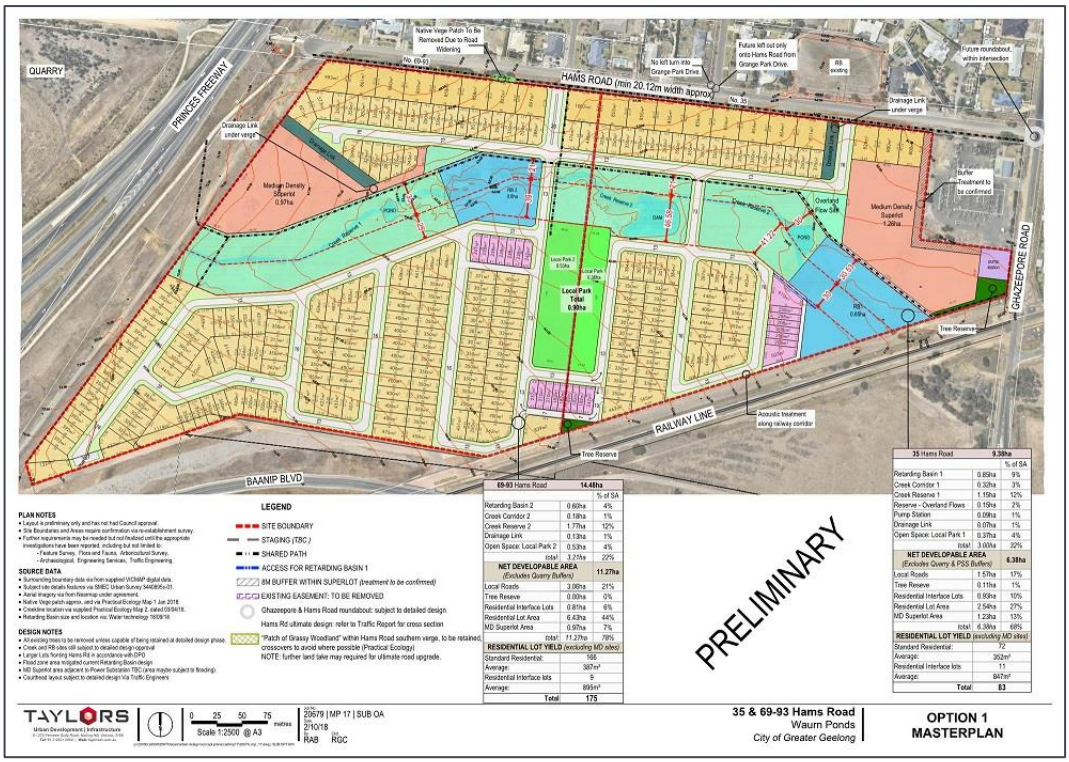
An aerial photo of the site is shown in Figure 1 and a site development concept plan is presented in Figure 1.

Figure 1: Site and surroundings (Source: Nearmap)

2.1 Project description

The development of the site will be exclusively residential, an indicative site drawing is presented in Figure 2.

Figure 2: Indicative site layout



2.2 PTV Referral Comments

Public Transport Victoria (PTV) provided referral comments in regard to the initial MDA report in a letter (ref: C372 Planning Permits 662-2017 & 663-2017), which requested the following with respect to noise:

> *The road and rail acoustic assessment which was undertaken as part of this proposal does not take into consideration a future Waurn Ponds train stabling facility which is being proposed south west of the site. The location for the Waurn Ponds train stabling facility has been selected and the site is proposed to be operational by the end of 2019. In addition, track duplication will also occur between South Geelong and the Waurn Ponds stabling site.*
>
> *It is anticipated train services between the Waurn Ponds stabling site and the Waurn Ponds station will increase. Freight services are also expected to increase in future.*
>
> *Given that passenger and freight train services which extend adjacent to the site will increase both during the day and at night the acoustic assessment should accurately reflect the increase in services and outline what potential acoustic mitigation measures may be required as part of the future development of the site.*

Noise due to the future train stabling facility is addressed herein as Section 6.4 and changes in noise level due to an increase in train pass-bys is addressed in Section 7.5.

2.3 Noise considerations

The proposed residential development will be impacted by the following sources:

- Train noise from the adjacent railway line
- Noise due to the future train stabling facility
- Traffic noise from the Geelong Ring Road and Baanip Boulevard
- Local commercial or industrial sites and associated operations (e.g. Powercor, which will be assessed by others).

Building facade insulation requirements to protect the amenity of future occupants from external rail and traffic noise will control the acoustic design of the building envelope. Noise from the other sources should comply with relevant statutory legislation or acceptable guidelines, as discussed herein.

3.0 EXISTING NOISE ENVIRONMENT

Consecutive measurements of road traffic noise levels were obtained at the western and southern boundaries of the site in order to calculate the existing traffic noise level in accordance with VicRoads *Traffic Noise Policy RDN 06-01*.

The measurement locations were selected so as to be representative of the facade of the nearest future dwelling to roads in the vicinity. It was observed that the prevailing noise environment was dominated by road traffic on Geelong Ring Road.

3.1 Unattended measurement data - traffic

Appendix C shows the monitoring locations, Appendix D provides further detail on the methodology, and measured traffic noise levels are summarised in Table 1.

Table 1: Measured traffic noise levels, dB

Description	Highest traffic noise level, $L_{10,18hr}$	Average weekday traffic noise level, $L_{10,18hr}$
Location 1	59	58
Location 2	56	55
Location 3	58	57
Location 4	56	55
Location 5	55	53

Measured ambient noise levels are summarised in Table 2 and presented graphically in Appendices E-I.

Table 2: Highest measured ambient noise levels, dB

Description	Highest ambient noise level, $L_{Aeq,15\ mins}$		
	Day	Evening	Night
Location 1	65	64	62
Location 2	69	71	60
Location 3	62	61	59
Location 4	65	57	57
Location 5	71	72	68

3.2 Unattended measurement data – rail

Consecutive measurements of rail traffic noise levels were obtained at the southern boundary of the site (Location 5) in order to compare with the Victorian Passenger Rail Infrastructure Noise policy (VPRINP) and are summarised in Table 3.

Table 3: Maximum and average rail noise levels, dB

Description	Night-time Average Noise Level, $L_{Aeq, 8hr}$	Maximum Noise Level, L_{Amax}		
		Day	Evening	Night
Location 5	62	93-100	90-100	80-100
95th percentile maximum of all night-time rail events				**90**

The above results show that the maximum noise levels from passing trains was 100 dB L_{Amax}, thus exceeding the VPRINP investigation thresholds residential uses near an existing rail corridor. 20 events above 85 dB L_{Amax} were measured during the night.

The VPRINP requires the assessment to be based on the 95th percentile of the maximum measured noise, which was 90 dB L_{Amax} during the night.

3.3 Weather conditions

It is noted that the graphical representations of the measured levels, given in Appendix E-I, show that a significant portion of the measurement period was affected by adverse atmospheric conditions. That is high wind or rain, based on BOM observations taken from Avalon Airport, the nearest weather station, which is approximately 34 km to the north of the site.

4.0 NOISE GUIDELINES

A range of guidelines and legislation is used in Victoria to assess and control environmental noise.

A summary of relevant guidelines referenced in Victorian noise assessments is presented in Table 4. Refer to Appendix J for further details.

Table 4: Relevant Victorian references and guidelines

Reference	Overview
VicRoads' *Traffic Noise Reduction Policy*	VicRoads has developed guidelines for noise mitigation at residential developments near major roads. Refer to Appendix J1 for further detail.
Australian/New Zealand Standard AS/NZS 2107:2016 *"Acoustics - Recommended design sound levels and reverberation times for building interiors"* (AS 2107)	Provides recommendations for acceptable internal noise levels. Table 1 of AS 2107 presents the recommended design sound levels for "houses and apartments in inner city areas or entertainment districts or near major roads", which is considered to be applicable to the development site. Refer to Appendix J2 for further detail.
Victorian Passenger Rail Infrastructure Noise Policy (VPRINP)	Released in April 2013. Section 5 of the policy sets out the conditions under which transport bodies must apply the policy. The policy sets 'investigation thresholds' for the assessment of noise. These are noise levels, which if exceeded, indicate that noise mitigation should be considered. Refer to Appendix J3 for further detail.
Sleep disturbance criteria sourced from NSW Road Noise Policy 2011 (Sleep disturbance criteria)	The provisions of this document are often referred to in Victoria for general guidance on potential sleep disturbance. Based on a review of research into sleep disturbance, the NSW policy nominates maximum internal night-time noise levels at noise sensitive locations which are unlikely to disturb sleep. Refer to Appendix J4 for further detail.

5.0 PRELIMINARY TRAFFIC NOISE ASSESSMENT

The following sections provide assessment against VicRoads policy and Australian Standard AS2107.

5.1 Traffic volumes

VicRoads typically require noise levels to be predicted based on the traffic volumes expected 10 years after the finalisation of the development. For the purposes of this assessment it has been assumed that that 'finalisation of the development' means the end of civil works, not construction of houses, therefore traffic conditions for 2029 have been estimated based on the latest available volumes (2015) and historical growth rates.

Table 5 provides a summary of the traffic information obtained from VicRoads' website.

Table 5: Traffic volumes (vehicles per day) and compositions obtained from VicRoads' website

		2006	2013	2014	2015	2016
Geelong Ring Road - North East Bound	All veh	4,400	5,000	5,200	5,300	5,400
	Trucks	720	810	860	850	840
	%HV	16	16	17	16	16
Geelong Ring Road - South West Bound	All veh	4,400	5,000	5,200	5,300	5,300
	Trucks	760	860	910	910	890
	%HV	17	17	18	17	17

These figures show an average growth 5% per annum from 2005 to 2016. Based on this growth rate, daily traffic volumes were calculated for 2028. The estimated volumes are shown in Table 6.

Table 6: Daily traffic volumes used in noise prediction

Carriageway	2016	2029
Geelong Ring Road - North East Bound	5,400	7,900
Geelong Ring Road - South West Bound	5,300	7,800

A traffic increase of this magnitude is estimated to raise the noise level at the west boundary of the site by less than 2 dB.

There is no data for Baanip Boulevard available on the VicRoads website. It has been assumed that this road will be subject to similar traffic flow increase as the Freeway.

5.1.1 Predicted traffic noise levels

Predicted nose levels have been based upon the measured traffic noise levels given in Table 8, the building layouts given in Appendix C and the traffic volumes detailed in Section 5.1.

VicRoads criteria for new residential developments adjacent to major roads is detailed in Appendix J2 and is applicable at ground floor level only.

The worst-case receptor to the west and south boundaries has been presented in Table 7.

Table 7: Predicted noise levels at ground floor level (2029), dB $L_{A10(18h)}$

	West boundary	South Boundary
Highest average weekday measured level	58	55
Facade correction	+2.5	+2.5
Estimated increase due to higher traffic volumes	+1.8	+1.8
Predicted noise level (2028)	**62**	**59**
VicRoads criteria	63	63
Compliance?	**Yes**	**Yes**

It can be seen that the predicted noise levels are within the VicRoads policy and it is considered therefore that no mitigation treatment is required under the terms of that policy.

However, it is considered appropriate to upgrade the construction of those facades which face the freeway such that compliance with AS2107is achieved.

Example building facade constructions that would allow the AS2107 noise levels to be met inside the development are outlined in Section 7.

6.0 PRELIMINARY RAIL NOISE ASSESSMENT

The following sections provide assessment against the Victorian Passenger Rail Infrastructure Noise policy

6.1 Daily rail usage

Analysis of the timetable for the Geelong/Warrnambool line indicates that there are no scheduled passenger services during the night-time period on the section of line that passes the Hams Road site.

However, it is understood that this may change in the future, as advised by PTV:

> *As part of the Geelong to Waurn Ponds project, TfV are undertaking design work to determine the project scope to allow for trains to operate from Waurn Ponds Station every 10 minutes during the peak periods. This will likely involve track duplication from South Geelong to the proposed Waurn Ponds train stabling site. The future services that will operate along this corridor include 10 minute service to Waurn Ponds, 5 return services per day to Warrnambool.*
>
> *In addition, freight services will also increase there is currently 1 freight train travelling in each direction daily, and this will increase to two train services travelling in each direction daily.*

To assist with the rail assessment, it is necessary to estimate train pass-by frequency at the site. A review of the Vline timetable for the Warrnambool (Via Colac and Geelong) service and the Melbourne to Geelong service, which terminates at Waurn Ponds, indicates the following daily weekday activity.

Table 8: Average weekday train movements past the site

Period	VLine Passenger Diesel		Diesel Freight
	Warrnambool (via Colac and Geelong)	Melbourne	
Day (0700 – 2200 hrs)	7	0	2*
Night (2200 – 0700 hrs)	0	0	

* - the measured data suggests that there are 1-2 freight train pass-bys per day. The time at which the pass-by occurs on each day can vary significantly.

6.2 Maximum noise levels due to trains

The 95th percentile of the measured maximum rail noise levels during the night was 90 dB L_{Amax}.

Predicted internal noise levels comply with the sleep disturbance criteria, based on the measured external noise levels and the constructions detailed in Section 5.3.

Note that compliance with the sleep disturbance criteria will not be achieved with the doors or windows open.

6.3 Victorian Passenger Rail Infrastructure Noise Policy

Maximum noise levels at the nearest future dwelling due to train pass-bys indicate that the investigation thresholds set down in the *Victorian Passenger Rail Infrastructure Noise Policy* are exceeded since rail events were measured to be above the policy investigation of threshold of 85 dB L_{Amax} during the night-time period.

In addition, the highest measured average noise level during the night due to rail was 62 dB $L_{Aeq,8hr}$ which exceeds the policy investigation threshold of 60 dB $L_{Aeq,8h.}$

It is considered therefore that noise mitigation measures are required under the terms of that policy.

Section 7 of the *Victorian Passenger Rail Infrastructure Noise Policy* gives two alternative paths of investigation regarding the mitigation of railway noise.

> *"1) Options that would avoid exposure to rail noise of the receivers (for example, places where people sleep) through the way land is used, for example:*
>
> *a) specifying the types of land use in proximity to rail infrastructure*
>
> *b) requiring set-back from the rail reserve*
>
> *c) encouraging the location of non-sensitive receivers (for example, commercial uses) in proximity to the rail corridor.*
>
> *2) Options that would reduce or mitigate the exposure to rail noise of the receivers through building and architectural treatments, for example:*
>
> *a) requiring developers to consider building orientation, placement on site and design of floor plans*
>
> *b) use of building materials including double-glazing that can help reduce or mitigate internal noise in a building.*
>
> *Note that options involving rail infrastructure design features are not applicable to a change in land use near an existing passenger rail corridor."*

6.4 Waurn Ponds train stabling facility

Publicly available information indicates that the proposed Waurn Ponds train stabling facility is likely to be located on land at 255 Reservoir Road in Mount Duneed at a distance of approximately three kilometres to the south west of the subject site. The location of land relative to the subject site is shown in Figure 3.

Figure 3: Stabling yard relative to the subject site

MDA considers that the introduction of the stabling yard, which is understood will be operational by 2019, will have no effect on the noise environment at the subject site due to the significant attenuation that would be provided by distance between the two sites.

Changes in noise level due to an increase in trains which will travel past the site to/from the stabling yard has been considered in Section 7.5.

7.0 RECOMMENDED CONSTRUCTIONS

Rail traffic noise exposure to the south boundary and road traffic noise to the east boundary of the development is considered to be high.

As is the case for any building that is exposed to significant external noise, the design criteria will not be achieved with windows open, however, the occupants have the option to close external windows and doors to significantly reduce noise intrusion.

Ventilation may be required in some rooms in order to allow the windows to remain closed. This should be addressed by the projects mechanical consultant.

In general, the glazing and facade construction requirements for facades with line of sight to the railway are driven by maximum internal levels due to train pass-bys, while those with line of sight to the Freeway are driven by average noise levels due to traffic.

It should be noted that the solid sections of the facade must be constructed of masonry or multiple layer materials as a lightweight facade will not provide sufficient noise insulation. Care should also be taken when specifying openings to the facade such as kitchen extract ducts or ventilation path ways to ensure that noise ingress through these does not undermine the noise insulation performance of the glazing and walls.

External sliding doors and openable windows must seal to a high standard.

Details of the proposed dwelling constructions are not available at this stage and therefore treatment for the proposed dwellings is based on a typical two storey construction.

Alternative constructions may be acceptable but should be reviewed by MDA prior to being documented.

7.1 Road traffic noise – Geelong Ring Road

From the concept plan, it is estimated that the nearest boundary of future dwellings at the western end of the site will be 50 m from the near side of Geelong Ring Road. The building facades will be set back from the boundary; however, the exact setback distance is unknown at this stage and therefore the assessment has been undertaken at the boundary.

7.1.1 VicRoads Policy

Noise levels due to road traffic at the nearest building facade to Geelong Ring Road in 2027 are likely to be in the region of 62 dB $L_{A10,\ 18hr}$. This is below the VicRoads policy noise level (refer Appendix K1) and it is considered therefore that no special treatment is required to the Geelong Ring Road boundary of the site.

7.1.2 AS2107

Noise levels due to road traffic are likely to be in the region of 62 - 65 dB $L_{Aeq,\ 15mins}$ during the daytime and 59 – 62 dB $L_{Aeq,\ 15mins}$ during the night.

Measured noise levels corrected for future traffic growth are 66 dB $L_{Aeq,\ 15min}$ for the daytime and 64 dB $L_{Aeq,\ 15mins}$ for the night.

As such, MDA recommends the following construction for buildings to the west end of the development with line of sight to the freeway:

- Facades with line of sight to the road: 9 mm compressed fibre cement sheet, 90 mm timber stud with insulation, 1 x 13 mm standard plasterboard
- Glazing to habitable rooms with line of sight to the road: 6.76 mm laminated glass
- Roof: metal deck with insulation and ceiling comprised of 1 x 10 mm standard plasterboard.

7.2 Road traffic noise – Baanip Boulevard

From the concept plan, it is estimated that the nearest boundary of future dwellings at the southern end of the site will be 40 m from the near side of Baanip Boulevard. The building facades will be set back from the boundary; however, the exact setback distance is unknown at this stage and therefore the assessment has been undertaken at the nearest lot boundary to the road.

7.2.1 VicRoads Policy

Noise levels due to road traffic at the nearest building facade to Baanip Boulevard are likely to be in the region of 59 dB $L_{A10, 18hr}$. This is below the VicRoads policy noise level (refer Appendix K1) and it is considered therefore that no special treatment is required to the Baanip Boulevard boundary of the site.

7.2.2 AS2107

The highest measured noise level due to road traffic was 65 dB $L_{Aeq, 15mins}$ during the daytime and 57 dB $L_{Aeq, 15mins}$ during the night.

Measured noise levels corrected for future traffic growth are 66 dB $L_{Aeq, 15min}$ for the daytime and 59 dB $L_{Aeq, 15mins}$ for the night.

As such, MDA recommends the following construction for buildings to the south side of the development with line of sight to the road, note that more stringent constructions apply to those lots directly adjacent to the railway, as discussed in Section 7.5:

- Facades with line of sight to the road: 6 mm compressed fibre cement sheet, 90 mm timber stud with insulation, 1 x 10 mm standard plasterboard
- Glazing to habitable rooms with line of sight to the road: 6.76 mm laminated glass
- Roof: metal deck with insulation and ceiling comprised of 1 x 10 mm standard plasterboard.

7.3 Road traffic noise – Hams Road

No special treatment is required to residences facing Hams Road in order to meet the internal noise level criteria of AS2107.

However, it should be noted that some lots to the west will have line of sight to the freeway and future dwellings should therefore be constructed in accordance with Section 7.1.2.

7.4 Road traffic noise – Ghazeepore Road

MDA measured traffic noise on Ghazeepore road in 2013 (refer MDA report Rp001 R04 2013193ML, dated 10 June 2014). At that time, the concept plan showed future dwellings at the eastern end of the site that were adjacent to the kerb of Ghazeepore Road.

In the interim, it is understood that the parcel of land between the existing Powercor substation in the north east corner of the site and the railway to the south will be utilised as a retarding basin (RB2 on the concept plan). As such, the boundary of lots to the east end of the site will now be set back from Ghazeepore road by approximately 100 m.

Note that the south, west and east facades of the nearest dwellings to RB2 will also have an interface with the railway and as such are addressed in Section 7.5.

7.5 Railway noise

From the concept plan, it is estimated that the boundary of future dwellings at the southern end of the site will be 25 m from the near side rail of the railway. The building facades will be set back from the boundary; however, the exact setback distance is unknown at this stage and therefore the assessment has been undertaken at the boundary. The measured noise levels have been taken as being representative of the likely noise exposure of a building located 25 m from the near side rail.

Details of the proposed dwellings are not available at this stage. Therefore, the following acoustic treatment is based on meeting the internal noise criteria for a typical two storey construction for lots within 100 m of the railway that have direct line of sight to it:

- Facades with line of sight to the railway: 110 mm brick, 90 mm timber stud with insulation, 1 x 10 mm standard plasterboard
- Glazing to habitable rooms with line of sight to the railway: 6/12/10.76 mm laminated glass
- Roof: metal deck with insulation and ceiling comprised of 2 x 10 mm standard plasterboard.

It has been assumed that the preference would be to upgrade the facades of dwellings instead of altering the layout of the subdivision or installing a noise barrier, however the following alternate solutions could be considered in lieu of facade upgrades:

- Orient dwellings on the boundary with the railway such that they act as a noise barrier. This would mean that the buildings would form a continuous line along the boundary and those facades facing the railway would be blank. Operable windows could be acceptable if they were within a light court which was not operable; or
- Install a noise barrier to the full extent of the southern boundary.

This section of track is part of the main interstate line from Melbourne to Adelaide and as such sees regular freight traffic.

The *Victorian Passenger Rail Infrastructure Noise Policy* does not apply to freight services, and therefore the internal noise criteria detailed in Appendix J is considered to be applicable.

The maximum noise level due to a freight train pass-by has been measured as 100 dB L_{Amax} during the night. It is considered that the recommendations for acoustic treatment to mitigate noise from passenger services, as discussed above, should be sufficient to mitigate noise from freight services.

It is noted that the frequency of both passenger and freight traffic past the site is set to increase in the future. However, the facade constructions detailed above are driven by the maximum noise level (dB L_{Amax}) which is not affected by the number of trains. Notwithstanding this, the NSW policy notes that from the research on sleep disturbance to date it can be concluded that:

- *maximum internal noise levels below 50–55 dB L_{Amax} are unlikely to awaken people from sleep*
- *one or two noise events per night, with maximum internal noise levels of 65–70 dB L_{Amax}, are not likely to affect health and wellbeing significantly.*

Therefore, an increase in the number of freight train pass-bys from two per day to four (as advised by PTV) is unlikely to alter the outcome of the assessment.

7.6 Notes on building constructions

The following points should be considered with respect to the recommended building constructions detailed herein:

- Should the builders select alternative windows for thermal insulation, care shall be taken such that the acoustic performance of such system meets the minimum sound transmission loss requirements. The final glazing selection will be dependent on size, function, and relevant Australian Design Standards. This assessment considers a typical of room size with total glazing areas of up to 8 m^2 per room at ground level and 3 m^2 at first floor level.
- For this assessment, split system air-conditioning systems have been assumed in preference to the more acoustically open evaporative type air conditioning systems. Ventilation paths may be required to be acoustically treated to control noise break-in and ensure that the sound insulation performance of the building envelope is not compromised. Suitable ventilation may include a ducted system with internal lining, an acoustically rated trickle vent system such as a Silenceair or Titon Trimvent system or an approved equivalent.

8.0 CONCLUSION

Taylors Development Strategists Pty Ltd, on behalf of Echin Pty Ltd and Waurn Ponds Unit Trust C/o Urban Quarter WA, are working on the development of land for residential use at 35 and 69 - 93 Hams Road in Waurn Ponds. Marshall Day Acoustics (MDA) has been requested to provide acoustic input to secure a planning permit for approximately 270 residential lots that abut Baanip Boulevard to the south and Geelong Ring Road to the west.

As part of the development, Marshall Day Acoustics Pty Ltd (MDA) has been commissioned to undertake a noise assessment to consider traffic and train noise intrusion to future dwellings.

MDA has carried out environmental noise assessment of the proposed development in accordance with the relevant Victorian EPA legislation, guidelines and accepted industry practice.

This assessment has been based on:

- Existing noise conditions determined from a measurement surveys at the site; and
- Criteria determined in accordance with the relevant Victorian guidelines and accepted industry practice.

It is considered that appropriate acoustic treatment can be implemented in the design in order to comply with the applicable noise criteria.

No noise mitigation measures are required in order to meet VicRoads policy to properties adjacent to Geelong Ring Road, Baanip Boulevard, Ghazeepore Road or Hams Road. However, the facade and glazing of dwellings with line of sight to each will need to be upgraded, and reviewed by a suitably qualified acoustic consultant at the detailed design stage, in order to achieve the requirements of AS2107 for sleeping and living areas.

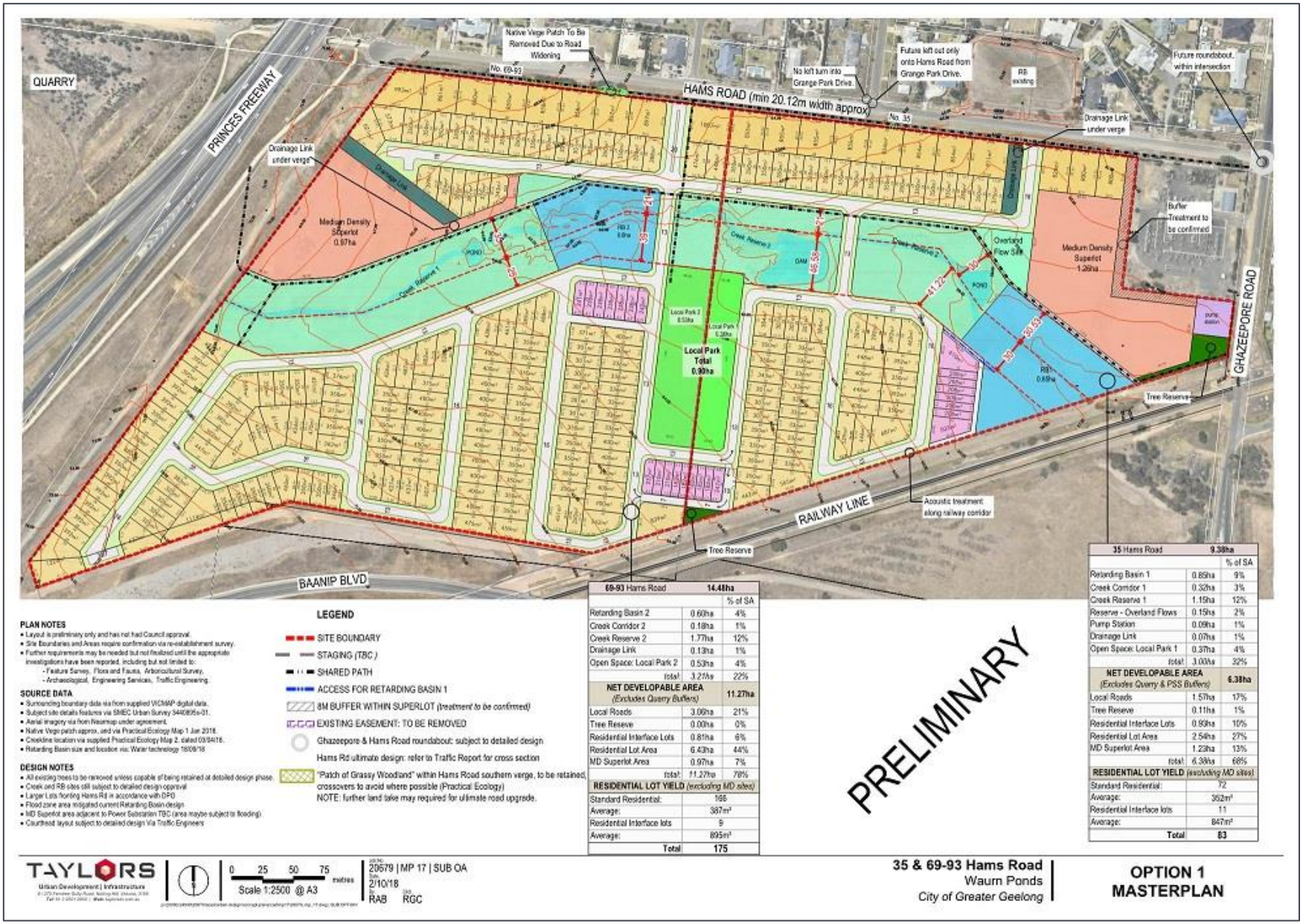
Measured rail noise levels have been assessed according to the *Victorian Passenger Rail Infrastructure Policy.* Existing maximum noise levels at the nearest proposed facades are likely to exceed the Policy threshold of 85dB L_{Amax}.

Therefore, specific acoustic treatments will be required to future properties along the southern boundary of the development site in order to control railway noise. Such treatments will need to be selected in consultation with a suitably qualified acoustic engineer at the detailed design stage.

APPENDIX A GLOSSARY OF TERMINOLOGY

dB	Decibel The unit of sound level.
Ambient	The ambient noise level is the noise level measured in the absence of the intrusive noise or the noise requiring control. Ambient noise levels are frequently measured to determine the situation prior to the addition of a new noise source.
A-weighting	The process by which noise levels are corrected to account for the frequency response of the human ear.
Octave Band	A range of frequencies where the highest frequency included is twice the lowest frequency. Octave bands are referred to by their logarithmic centre frequencies, these being 31.5 Hz, 63 Hz, 125 Hz, 250 Hz, 500 Hz, 1 kHz, 2 kHz, 4 kHz, 8 kHz, and 16 kHz for the audible range of sound.
$L_{Aeq, 15mins}$	The equivalent continuous (time-averaged) A-weighted sound level. This is commonly referred to as the average noise level over 15 minutes.
$L_{A10 (t)}$	The A-weighted noise level equalled or exceeded for 10% of the measurement period. This is commonly referred to as the average maximum noise level. The suffix "t" represents the time period to which the noise level relates, e.g. (8 h) would represent a period of 8 hours, (15 min) would represent a period of 15 minutes and (2200-0700) would represent a measurement time between 10 pm and 7 am.
Sound Insulation	When sound hits a surface, some of the sound energy travels through the material. 'Sound insulation' refers to ability of a material to stop sound travelling through it.
R_w	Weighted Sound Reduction Index A single number rating of the sound insulation performance of a specific building element. Rw is measured in a laboratory. Rw is commonly used by manufacturers to describe the sound insulation performance of building elements such as plasterboard and concrete.

APPENDIX B INDICATIVE SITE LAYOUT PLAN


QUARRY
PRINCES FREEWAY
HAMS ROAD (min 20.12m width approx
Native Vege Patch To Be Removed Due to Road Widening
No. 69-93
No left turn into Grange Park Drive.
Future left out only onto Hams Road from Grange Park Drive.
No. 35
RB existing
Future roundabout, within intersection
Drainage Link under verge
Drainage Link under verge
Medium Density Superlot 0.97ha
Creek Reserve 1
POND
RB1 0.6ha
Creek Reserve 2
DAM
Local Park 2 0.53ha
Local Park 1 0.28ha
Local Park Total 0.90ha
Overland Flow Site
Medium Density Superlot 1.26ha
Buffer Treatment to be confirmed
pump station
RB2 0.65ha
Tree Reserve
GHAZEEPORE ROAD
Acoustic treatment along railway corridor
RAILWAY LINE
Tree Reserve
BAANIP BLVD
PRELIMINARY
PLAN NOTES
• Layout is preliminary only and has not had Council approval.
• Site Boundaries and Areas require confirmation via re-establishment survey.
• Further requirements may be needed but not finalized until the appropriate investigations have been reported, including but not limited to:
- Feature Survey, Flora and Fauna, Arboricultural Survey,
- Archaeological, Engineering Services, Traffic Engineering.
SOURCE DATA
• Surrounding boundary data via from supplied VICMAP digital data.
• Subject site details features via SMEC Urban Survey 3440895x-01.
• Aerial imagery via from Nearmap under agreement.
• Native Vege patch approx. and via Practical Ecology Map 1 Jun 2018.
• Creekline location via supplied Practical Ecology Map 2, dated 03/04/18.
• Retarding Basin size and location via: Water technology 18/09/18
DESIGN NOTES
• All existing trees to be removed unless capable of being retained at detailed design phase.
• Creek and RB sites still subject to detailed design approval
• Larger Lots fronting Hams Rd in accordance with DPO
• Flood zone area mitigated current Retarding Basin design
• MD Superlot area adjacent to Power Substation TBC (area maybe subject to flooding)
• Courthead layout subject to detailed design via Traffic Engineers
LEGEND
SITE BOUNDARY
STAGING (TBC)
SHARED PATH
ACCESS FOR RETARDING BASIN 1
4M BUFFER WITHIN SUPERLOT (treatment to be confirmed)
EXISTING EASEMENT: TO BE REMOVED
Ghazeepore & Hams Road roundabout: subject to detailed design
Hams Rd ultimate design: refer to Traffic Report for cross section
"Patch of Grassy Woodland" within Hams Road southern verge, to be retained, crossovers to avoid where possible (Practical Ecology)
NOTE: further land take may required for ultimate road upgrade.
69-93 Hams Road 14.48ha
% of SA
Retarding Basin 2 0.60ha 4%
Creek Corridor 2 0.18ha 1%
Creek Reserve 2 1.77ha 12%
Drainage Link 0.13ha 1%
Open Space: Local Park 2 0.53ha 4%
total: 3.21ha 22%
NET DEVELOPABLE AREA (Excludes Quarry Buffers) 11.27ha
Local Roads 3.06ha 21%
Tree Reserve 0.00ha 0%
Residential Interface Lots 0.81ha 6%
Residential Lot Area 6.43ha 44%
MD Superlot Area 0.97ha 7%
total: 11.27ha 78%
RESIDENTIAL LOT YIELD (excluding MD sites)
Standard Residential: 166
Average: 387m²
Residential Interface lots 9
Average: 895m²
Total 175
35 Hams Road 9.38ha
% of SA
Retarding Basin 1 0.89ha 9%
Creek Corridor 1 0.32ha 3%
Creek Reserve 1 1.15ha 12%
Reserve - Overland Flows 0.15ha 2%
Pump Station 0.09ha 1%
Drainage Link 0.07ha 1%
Open Space: Local Park 1 0.37ha 4%
total: 3.00ha 32%
NET DEVELOPABLE AREA (Excludes Quarry & PSS Buffers) 6.38ha
Local Roads 1.57ha 17%
Tree Reserve 0.11ha 1%
Residential Interface Lots 0.93ha 10%
Residential Lot Area 2.54ha 27%
MD Superlot Area 1.23ha 13%
total: 6.38ha 68%
RESIDENTIAL LOT YIELD (excluding MD sites)
Standard Residential: 72
Average: 352m²
Residential Interface lots 11
Average: 847m²
Total 83
TAYLORS Urban Development | Infrastructure
0 25 50 75 metres
Scale 1:2500 @ A3
20679 | MP 17 | SUB OA
2/10/18
RAB RGC
35 & 69-93 Hams Road
Waurn Ponds
City of Greater Geelong
OPTION 1
MASTERPLAN

APPENDIX C UNATTENDED NOISE MONITORING LOCATIONS


Unattended noise monitor
Location 1
Subject site
Location 2
Location 5
Location 4
Location 3

APPENDIX D UNATTENDED NOISE MONITORING METHODOLOGY

Traffic and train noise levels at the site were measured using five Rion NL-31 precision integrating sound level meters fitted with windshields.

The microphones were mounted on tripods at a height of approximately 1.5 m above local ground level under freefield conditions.

Measurements were obtained using the 'F' response time and A-weighting frequency network. The equipment was checked before and after the survey and no significant calibration drifts were observed.

Consecutive measurements were obtained between 1400 hrs on Tuesday 30th January and 1200 hrs on Friday 9th February 2018.

Weather data has been taken from the Bureau of Meteorology's weather station at Avalon Airport, periods of high wind or significant rainfall have been highlighted in Appendix E to Appendix I. it should be noted that the measurements presented in the graphs have been calculated into 30-minute periods for the purposes of comparison with the weather data.

Figures 4 – 8 provide views of the monitoring locations.

Figure 4: Unattended noise monitor – Location 1

Figure 5: Unattended noise monitor – Location 2

Figure 6: Unattended noise monitor – Location 3

Figure 7: Unattended noise monitor – Location 4

Figure 8: Unattended noise monitor – Location 5

Tables 9 - 11 provide a summary of the measured noise levels.

Table 9: Measured road traffic noise levels

Period	Road Traffic Noise Level, $L_{A10\,(18\,h)}$ dB				
	Location 1	Location 2	Location 3	Location 4	Location 5
Tuesday, 30 Jan 2018	-*	-*	-*	-*	-*
Wednesday, 31 Jan 2018	59	56	57	56	55
Thursday, 01 Feb 2018	58	55	57	54	54
Friday, 02 Feb 2018	59	55	58	56	54
Saturday, 03 Feb 2018	55	53	57	54	53
Sunday, 04 Feb 2018	54	52	55	53	54
Monday, 05 Feb 2018	58	56	56	53	52
Tuesday, 06 Feb 2018	57	56	57	54	52
Wednesday, 07 Feb 2018	57	55	57	54	50
Thursday, 08 Feb 2018	58	55	57	55	52
Friday, 09 Feb 2018	-*	-*	-*	-*	-*
Average on weekdays	58	55	57	55	53

* - Incomplete period

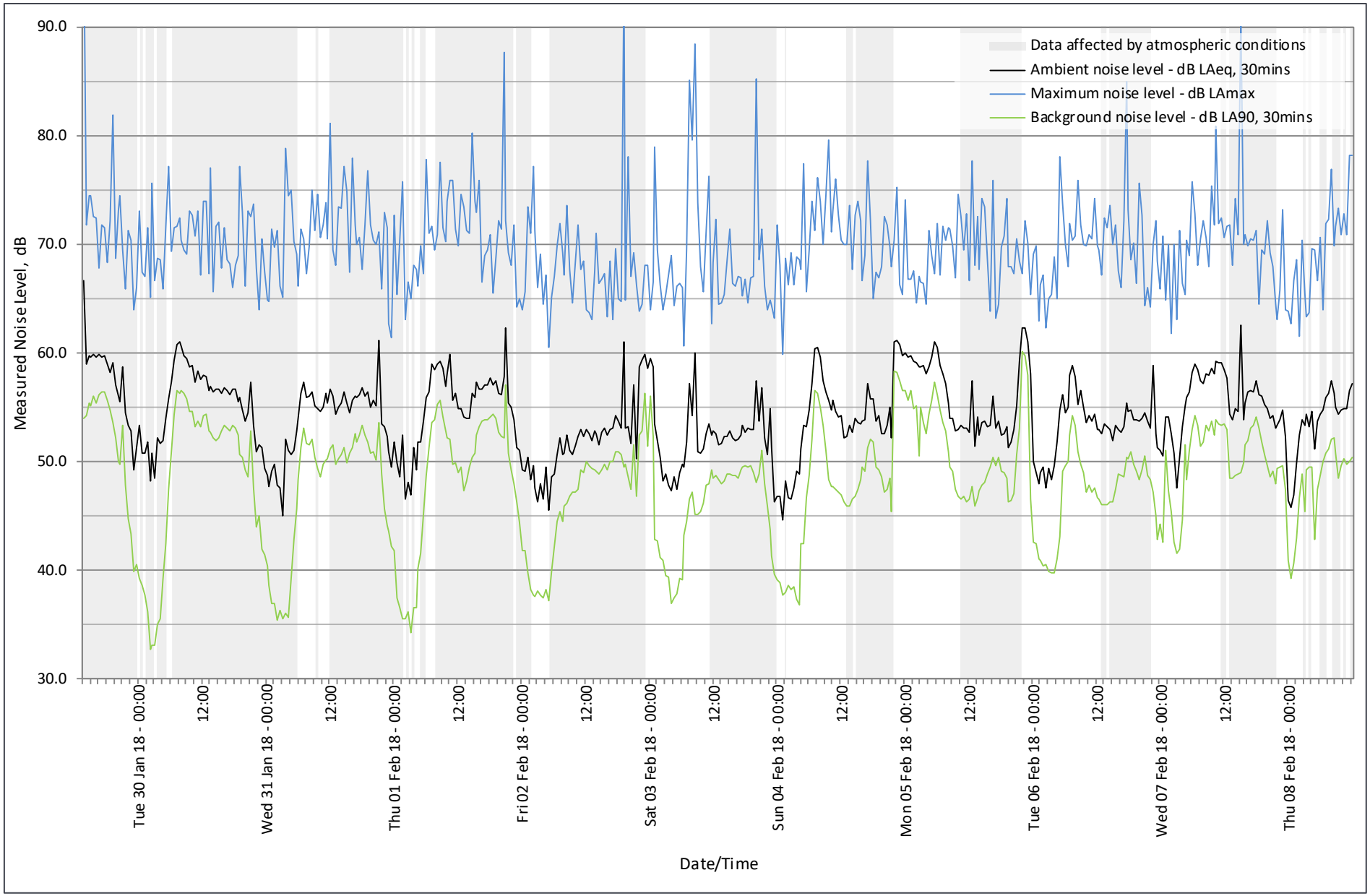
Table 10: Measured ambient noise levels – Night time

Period	Highest Ambient Noise Level, $L_{Aeq,15mins}$ dB				
	Location 1	Location 2	Location 3	Location 4	Location 5
Tuesday, 30 Jan 2018	61	58	57	55	66
Wednesday, 31 Jan 2018	58	55	57	55	64
Thursday, 01 Feb 2018	59	56	58	53	66
Friday, 02 Feb 2018	55	50	53	52	68
Saturday, 03 Feb 2018	60	51	54	53	66
Sunday, 04 Feb 2018	61	57	58	57	63
Monday, 05 Feb 2018	61	57	59	55	68
Tuesday, 06 Feb 2018	62	60	58	54	67
Wednesday, 07 Feb 2018	60	60	58	55	65
Thursday, 08 Feb 2018	57	55	58	55	66
Friday, 09 Feb 2018	-	-	-	-	-
Maximum	**62**	**60**	**59**	**55**	**68**

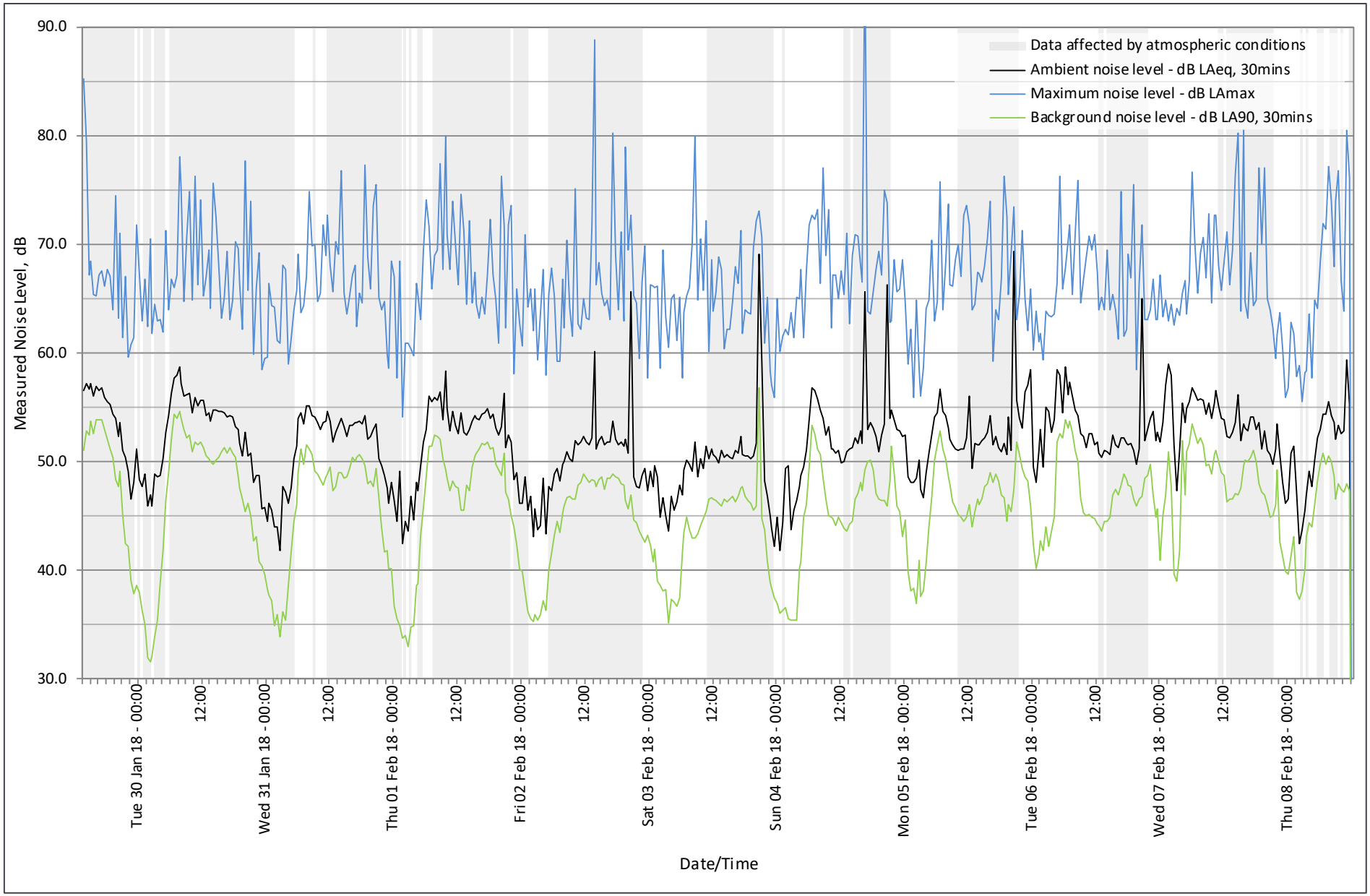
Table 11: Measured maximum noise levels – Night time

Period	Highest Noise Level, L_{Amax} dB				
	Location 1	Location 2	Location 3	Location 4	Location 5
Tuesday, 30 Jan 2018	77	72	72	71	94
Wednesday, 31 Jan 2018	79	69	74	74	89
Thursday, 01 Feb 2018	78	74	77	67	90
Friday, 02 Feb 2018	77	71	78	76	99
Saturday, 03 Feb 2018	79	70	70	78	88
Sunday, 04 Feb 2018	77	73	79	75	80
Monday, 05 Feb 2018	75	76	79	77	100
Tuesday, 06 Feb 2018	78	76	77	74	100
Wednesday, 07 Feb 2018	76	77	72	69	92
Thursday, 08 Feb 2018	73	72	74	74	96
Friday, 09 Feb 2018	-	-	-	-	-
Maximum	**79**	**76**	**79**	**77**	**100**

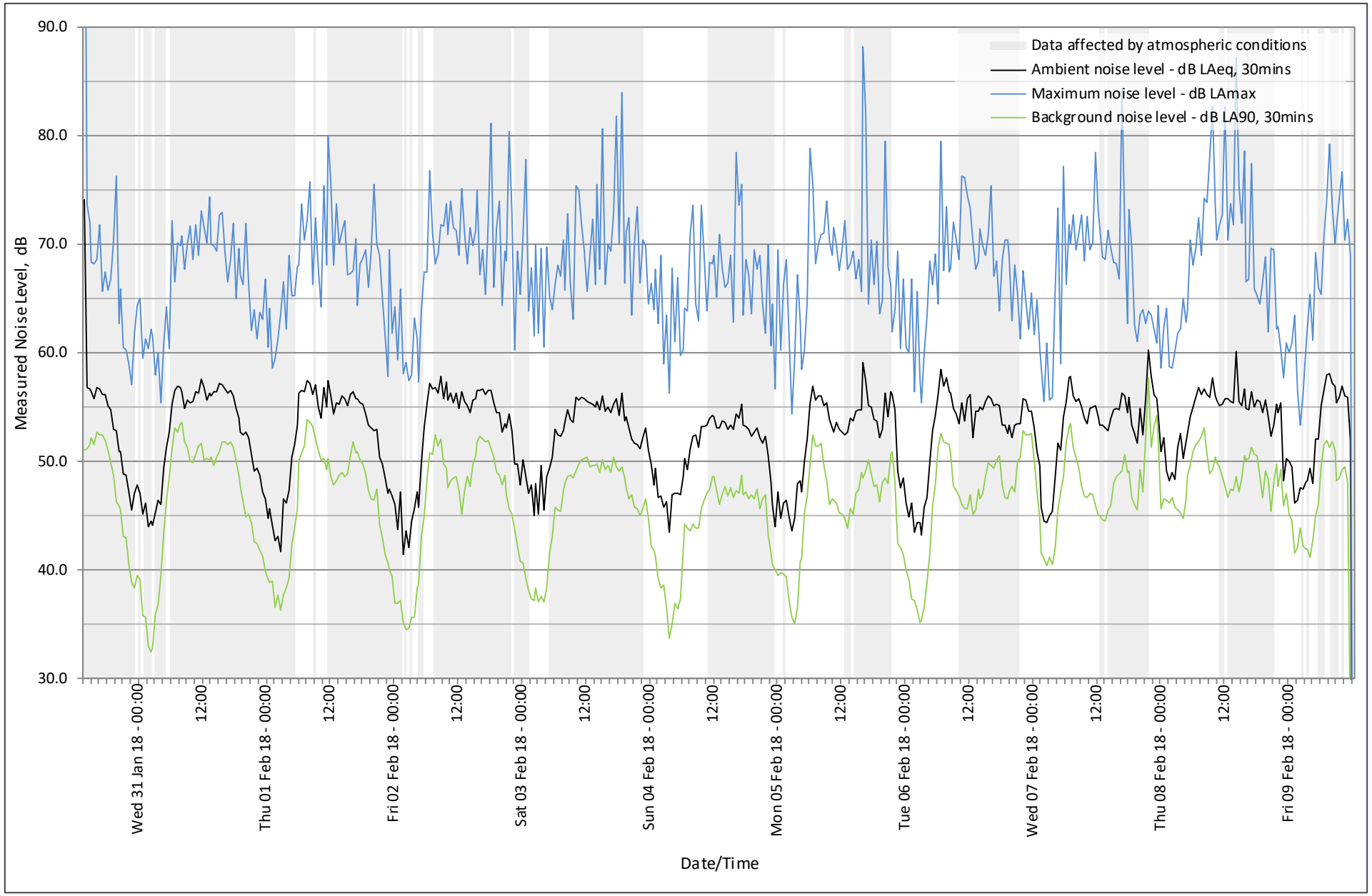
APPENDIX E UNATTENDED NOISE MONITORING RESULTS – LOCATION 1


Data affected by atmospheric conditions
Ambient noise level - dB LAeq, 30mins
Maximum noise level - dB LAmax
Background noise level - dB LA90, 30mins
Measured Noise Level, dB
90.0
80.0
70.0
60.0
50.0
40.0
30.0
Tue 30 Jan 18 - 00:00
12:00
Wed 31 Jan 18 - 00:00
12:00
Thu 01 Feb 18 - 00:00
12:00
Fri 02 Feb 18 - 00:00
12:00
Sat 03 Feb 18 - 00:00
12:00
Sun 04 Feb 18 - 00:00
12:00
Mon 05 Feb 18 - 00:00
12:00
Tue 06 Feb 18 - 00:00
12:00
Wed 07 Feb 18 - 00:00
12:00
Thu 08 Feb 18 - 00:00
Date/Time

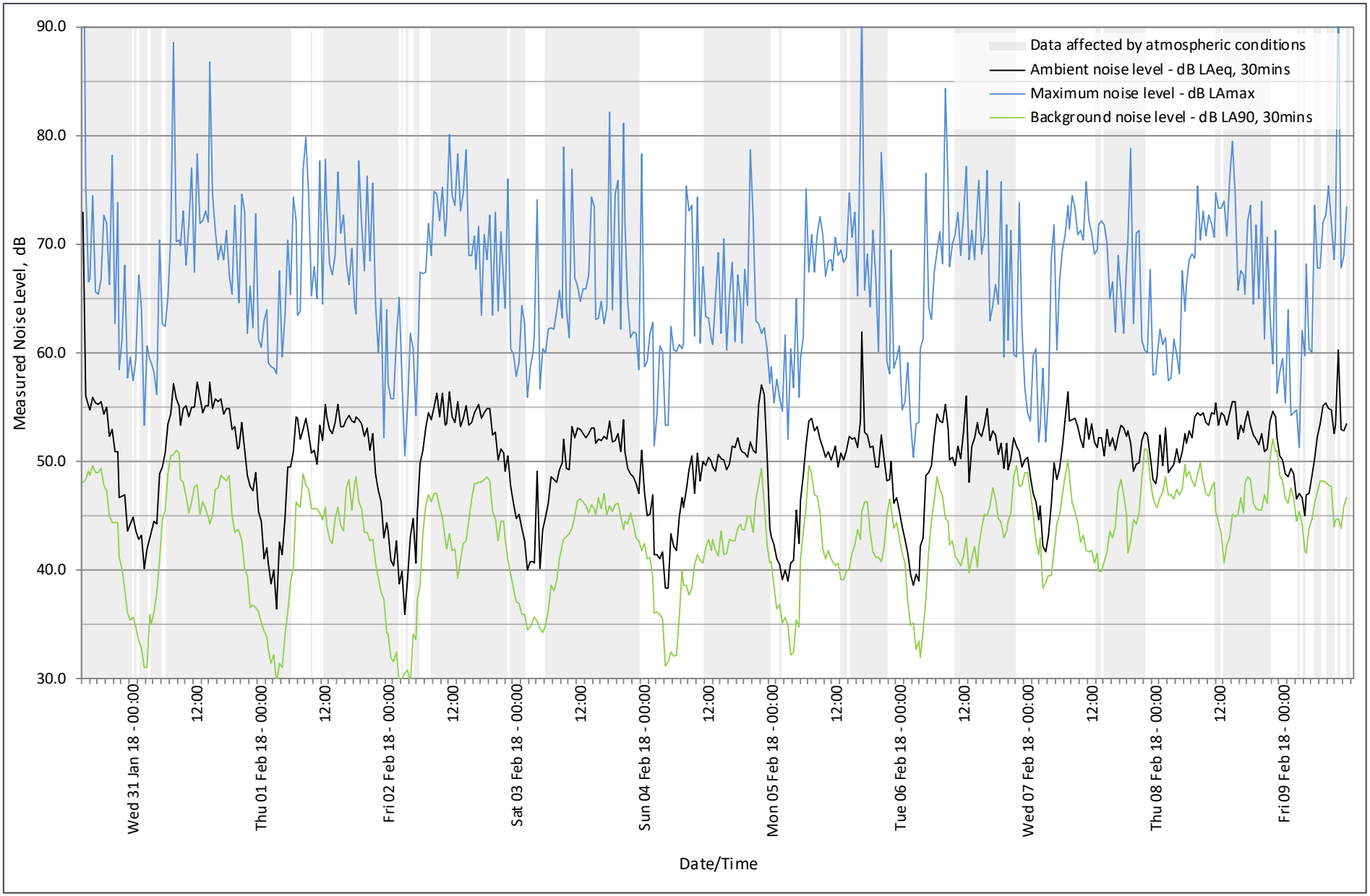
APPENDIX F UNATTENDED NOISE MONITORING RESULTS – LOCATION 2


Data affected by atmospheric conditions
Ambient noise level - dB LAeq, 30mins
Maximum noise level - dB LAmax
Background noise level - dB LA90, 30mins
Measured Noise Level, dB
90.0
80.0
70.0
60.0
50.0
40.0
30.0
Tue 30 Jan 18 - 00:00
12:00
Wed 31 Jan 18 - 00:00
12:00
Thu 01 Feb 18 - 00:00
12:00
Fri 02 Feb 18 - 00:00
12:00
Sat 03 Feb 18 - 00:00
12:00
Sun 04 Feb 18 - 00:00
12:00
Mon 05 Feb 18 - 00:00
12:00
Tue 06 Feb 18 - 00:00
12:00
Wed 07 Feb 18 - 00:00
12:00
Thu 08 Feb 18 - 00:00
Date/Time

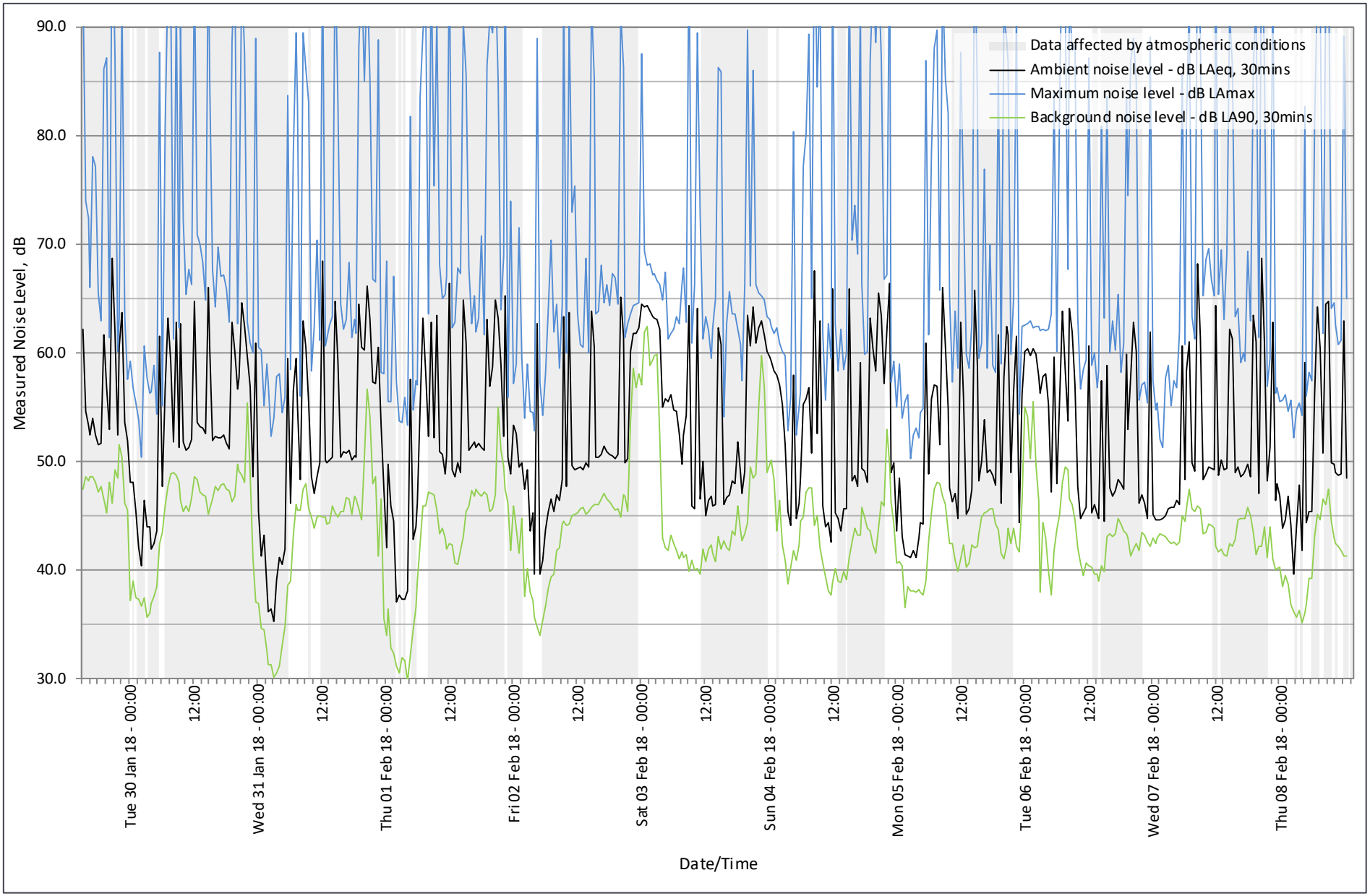
APPENDIX G UNATTENDED NOISE MONITORING RESULTS – LOCATION 3


Data affected by atmospheric conditions
Ambient noise level - dB LAeq, 30mins
Maximum noise level - dB LAmax
Background noise level - dB LA90, 30mins
Measured Noise Level, dB
90.0
80.0
70.0
60.0
50.0
40.0
30.0
Wed 31 Jan 18 - 00:00
12:00
Thu 01 Feb 18 - 00:00
12:00
Fri 02 Feb 18 - 00:00
12:00
Sat 03 Feb 18 - 00:00
12:00
Sun 04 Feb 18 - 00:00
12:00
Mon 05 Feb 18 - 00:00
12:00
Tue 06 Feb 18 - 00:00
12:00
Wed 07 Feb 18 - 00:00
12:00
Thu 08 Feb 18 - 00:00
12:00
Fri 09 Feb 18 - 00:00
Date/Time

APPENDIX H UNATTENDED NOISE MONITORING RESULTS – LOCATION 4


Data affected by atmospheric conditions
Ambient noise level - dB LAeq, 30mins
Maximum noise level - dB LAmax
Background noise level - dB LA90, 30mins
Measured Noise Level, dB
90.0
80.0
70.0
60.0
50.0
40.0
30.0
Wed 31 Jan 18 - 00:00
12:00
Thu 01 Feb 18 - 00:00
12:00
Fri 02 Feb 18 - 00:00
12:00
Sat 03 Feb 18 - 00:00
12:00
Sun 04 Feb 18 - 00:00
12:00
Mon 05 Feb 18 - 00:00
12:00
Tue 06 Feb 18 - 00:00
12:00
Wed 07 Feb 18 - 00:00
12:00
Thu 08 Feb 18 - 00:00
12:00
Fri 09 Feb 18 - 00:00
Date/Time

APPENDIX I UNATTENDED NOISE MONITORING RESULTS – LOCATION 5


Data affected by atmospheric conditions
Ambient noise level - dB LAeq, 30mins
Maximum noise level - dB LAmax
Background noise level - dB LA90, 30mins
Measured Noise Level, dB
90.0
80.0
70.0
60.0
50.0
40.0
30.0
Tue 30 Jan 18 - 00:00
12:00
Wed 31 Jan 18 - 00:00
12:00
Thu 01 Feb 18 - 00:00
12:00
Fri 02 Feb 18 - 00:00
12:00
Sat 03 Feb 18 - 00:00
12:00
Sun 04 Feb 18 - 00:00
12:00
Mon 05 Feb 18 - 00:00
12:00
Tue 06 Feb 18 - 00:00
12:00
Wed 07 Feb 18 - 00:00
12:00
Thu 08 Feb 18 - 00:00
Date/Time

APPENDIX J NOISE GUIDELINES

J1 Road Traffic Noise

VicRoads' *Traffic Noise Reduction Policy* recommends traffic noise level objectives that are used by VicRoads when building new roads or upgrading existing roads. In addition, VicRoads has developed guidelines for noise mitigation at residential developments near major roads. These guidelines recommend developers undertake some combination of the following:

- Erect traffic noise barriers of sufficient height and suitable construction in order to reduce external noise levels to 63 dB $L_{A10(18h)}$ or less at the worst-affected dwellings
- Provide sound insulation treatment to residential dwellings sufficient to achieve compliance with the recommended internal noise levels specified in Australian Standard 2107-2016 *Acoustics - Recommended design sound levels and reverberation times for building interiors.*

J2 Environmental noise

Australian Standard 2107-2016 *Acoustics - Recommended design sound levels and reverberation times for building interiors* provides recommendations for acceptable internal noise levels. Table 9 shows the recommended internal design sound levels stated in AS2107 for "*houses and apartments in inner city areas or entertainment districts or near major roads*", which is considered to be applicable to the proposed development.

Table 12: AS2107 recommended internal noise levels

Area	Recommended design sound level range, dB L_{Aeq}
Living areas	35-45
Sleeping areas	35-40
Work areas	35-45
Apartment common areas (e.g. lobbies)	45-50

Compliance with the lower level is preferred, but compliance with the maximum noise level is considered to be acceptable.

AS2107 does not specify the measurement procedure to determine whether compliance has been achieved but does state the following:

> *In situations where traffic (or other) noise levels may vary widely over a 24-hour period, measurements to assess compliance with this Standard should be taken at the relevant time according to the area of occupancy or activity in the building.*

Given the above, it could be argued that compliance measurements for bedrooms should be made during the period between 2200-0700 hrs (commonly referred to as the night period), although this does not allow for those occupants who may be shift workers or such like that may have a requirement to sleep during the day. For living and dining rooms, the compliance measurement should be made during the period between 0700-2200 hrs (commonly referred to as the day/evening period).

Further, AS2107 does not specify the noise measurement duration. It is recommended that compliance generally be assessed based on the typical worst-case 15-minute L_{Aeq} noise level throughout the relevant time period (e.g. night-time for bedrooms).

Higher quality developments should obviously aim to achieve lower levels of traffic noise intrusion. MDA's project experience shows that if internal noise levels in bedrooms or living areas exceed an hourly average of approximately 40 dB L_{Aeq} that the level of occupant dissatisfaction is likely to be relatively high.

An internal level of 35 dB L_{Aeq} within bedrooms at night has been selected in this case.

J3 Railway noise

The *Victorian Passenger Rail Infrastructure Noise Policy* was released in April 2013. Section 5 of the policy sets out the conditions under which transport bodies must apply the policy.

The policy sets 'investigation thresholds' for the assessment of noise. These are noise levels, which if exceeded, indicate that noise mitigation should be considered. It states that:

> *In considering changing land use near an existing passenger rail corridor, transport bodies and planning authorities should consider the receivers set out in Table B in Attachment 2. Transport bodies and planning authorities should consider whether the noise level produced at these receivers will exceed the investigation thresholds for the periods specified in Table B in Attachment 2.* [Table B of Attachment 2 is reproduced below as Table 13 in this report.]
>
> *If an assessment shows the investigation thresholds are not exceeded, noise impacts should be considered a secondary matter. This means no further action need be considered under this policy.*

The investigation thresholds are defined in terms of:

- $L_{Aeq,16h}$ – equivalent continuous daytime (0600-2200) noise level
- $L_{Aeq,8h}$ – equivalent continuous night-time (2200-0600) noise level
- L_{Amax} – maximum noise level.

Investigation thresholds for the redevelopment of land near existing rail infrastructure are presented in Table 13.

Table 13: Investigation thresholds for changing allowable land use near an existing rail corridor

Time	Type of receiver	Investigation thresholds		
Daytime (0600-2200)	Residential dwellings including aged person homes, hospitals, motels, caravan parks, and other buildings where people sleep. Noise sensitive community buildings including schools, kindergartens, libraries	65 dB $L_{Aeq,16h}$	or	85 dB L_{Amax}
Night-time (2200-0600)	Residential dwellings including aged person homes, hospitals, motels, caravan parks, and other buildings where people sleep.	60 dB $L_{Aeq,8h}$	or	85 dB L_{Amax}

The investigation thresholds are not design criteria. However, should the investigation thresholds be exceeded, then the following internal design criteria are recommended for residences adjacent to the Geelong/Warrnambool railway:

- Bedrooms: 55 dB L_{Amax}
- Other living areas: 60 dB L_{Amax}

These limits are based on a precedent set in the Victorian Civil and Administrative Tribunal (VCAT) regarding acceptable internal noise levels for residences adjacent to railway lines (Reference No. P2470/2003). In this case, a decision to grant a permit was made on the basis that the noise level of trains was not to exceed 55 dB L_{Amax} in bedrooms and 60 dB L_{Amax} in living areas.

J4 Sleep Disturbance

The NSW Road Noise Policy 2011 produced by the NSW EPA, provides guidance on potential for sleep disturbance. While the Policy applies strictly only in NSW, the provisions of the document are often referred to in Victoria for general guidance on potential sleep disturbance.

The NSW policy notes that from the research on sleep disturbance to date it can be concluded that:

- *maximum internal noise levels below 50–55 dB L_{Amax} are unlikely to awaken people from sleep*
- *one or two noise events per night, with maximum internal noise levels of 65–70 dB L_{Amax}, are not likely to affect health and wellbeing significantly.*

Since 2003, there have been two VCAT decisions which have recommended an internal noise limit of 50 dB L_{Amax} in bedrooms. However, there is no compelling case for the lower criterion as the decisions were not based on objective evidence presented to the Tribunal and are, in our opinion, unnecessarily restrictive. 55dB L_{Amax} is very close to the threshold of onset for noise-related sleep disturbance, and there is almost no significant difference (<1%) in reported levels of sleep disturbance between 55 dB L_{Amax} and 50 dB L_{Amax}.

These criteria (55 dB L_{Amax}) has now been accepted by Public Transport Victoria (PTV) in a letter dated 18 October 2012, in relation to a residential development in Braybrook. Further details can be provided if requested.

APPENDIX K NOISE AND WEATHER DATA

		Ambient noise level dB $L_{Aeq, 30mins}$					BOM weather data (Geelong Airport)		
Date	Time	Location 1	Location 2	Location 3	Location 4	Location 5	Wind (m/s)	Rain (mm)	Data acceptability
Tuesday, 30 January 2018	13:00						9	0	Unacceptable
Tuesday, 30 January 2018	13:30	59	56				9	0	Unacceptable
Tuesday, 30 January 2018	14:00	60	57	57			8	0	Unacceptable
Tuesday, 30 January 2018	14:30	60	57	57	56		8	0	Unacceptable
Tuesday, 30 January 2018	15:00	60	57	56	55	55	8	0	Unacceptable
Tuesday, 30 January 2018	15:30	60	56	56	55	53	9	0	Unacceptable
Tuesday, 30 January 2018	16:00	60	57	57	56	52	8	0	Unacceptable
Tuesday, 30 January 2018	16:30	60	57	57	55	54	8	0	Unacceptable
Tuesday, 30 January 2018	17:00	60	57	56	55	52	8	0	Unacceptable
Tuesday, 30 January 2018	17:30	59	56	56	55	51	8	0	Unacceptable
Tuesday, 30 January 2018	18:00	58	55	55	54	52	8	0	Unacceptable
Tuesday, 30 January 2018	18:30	59	55	55	55	62	8	0	Unacceptable
Tuesday, 30 January 2018	19:00	57	54	53	52	57	8	0	Unacceptable
Tuesday, 30 January 2018	19:30	56	54	53	53	53	7	0	Unacceptable
Tuesday, 30 January 2018	20:00	56	52	51	51	69	7	0	Unacceptable
Tuesday, 30 January 2018	20:30	59	54	51	51	62	7	0	Unacceptable
Tuesday, 30 January 2018	21:00	55	51	49	47	52	5	0	Unacceptable
Tuesday, 30 January 2018	21:30	53	50	49	47	60	4	0	Unacceptable
Tuesday, 30 January 2018	22:00	53	49	47	47	64	5	0	Unacceptable
Tuesday, 30 January 2018	22:30	49	47	45	44	54	4	0	Unacceptable
Tuesday, 30 January 2018	23:00	51	48	47	44	52	5	0	Unacceptable
Tuesday, 30 January 2018	23:30	53	51	48	45	48	3	0	Acceptable
Tuesday, 30 January 2018	0:00	51	48	47	44	48	3	0	Unacceptable
Wednesday, 31 January 2018	0:30	51	48	45	43	45	3	0	Acceptable
Wednesday, 31 January 2018	1:00	52	49	46	43	42	3	0	Unacceptable
Wednesday, 31 January 2018	1:30	48	46	44	40	40	3	0	Unacceptable
Wednesday, 31 January 2018	2:00	51	47	44	42	46	3	0	Unacceptable
Wednesday, 31 January 2018	2:30	48	46	44	43	44	2	0	Acceptable
Wednesday, 31 January 2018	3:00	52	49	45	43	44	4	0	Unacceptable
Wednesday, 31 January 2018	3:30	52	49	46	44	42	5	0	Unacceptable
Wednesday, 31 January 2018	4:00	52	49	46	44	42	3	0	Unacceptable
Wednesday, 31 January 2018	4:30	54	50	49	49	44	4	0	Unacceptable
Wednesday, 31 January 2018	5:00	56	53	51	49	62	3	0	Acceptable
Wednesday, 31 January 2018	5:30	57	54	53	51	48	3	0	Acceptable
Wednesday, 31 January 2018	6:00	59	56	55	53	57	3	0	Unacceptable
Wednesday, 31 January 2018	6:30	61	58	56	54	63	5	0	Unacceptable
Wednesday, 31 January 2018	7:00	61	58	57	57	59	4	0	Unacceptable
Wednesday, 31 January 2018	7:30	61	59	57	56	52	3	0	Unacceptable
Wednesday, 31 January 2018	8:00	60	57	56	55	63	4	0	Unacceptable
Wednesday, 31 January 2018	8:30	59	56	55	53	51	3	0	Unacceptable
Wednesday, 31 January 2018	9:00	59	56	56	55	63	4	0	Unacceptable
Wednesday, 31 January 2018	9:30	59	56	55	55	52	8	0	Unacceptable
Wednesday, 31 January 2018	10:00	57	54	55	54	51	6	0	Unacceptable
Wednesday, 31 January 2018	10:30	58	56	56	55	51	6	0	Unacceptable
Wednesday, 31 January 2018	11:00	58	55	56	55	52	8	0	Unacceptable
Wednesday, 31 January 2018	11:30	58	56	58	57	65	9	0	Unacceptable
Wednesday, 31 January 2018	12:00	58	56	57	56	54	8	0	Unacceptable
Wednesday, 31 January 2018	12:30	57	54	56	54	53	9	0	Unacceptable
Wednesday, 31 January 2018	13:00	57	54	56	55	53	9	0	Unacceptable
Wednesday, 31 January 2018	13:30	56	54	56	55	52	8	0	Unacceptable
Wednesday, 31 January 2018	14:00	57	55	56	57	66	9	0	Unacceptable
Wednesday, 31 January 2018	14:30	57	55	56	55	60	7	0	Unacceptable
Wednesday, 31 January 2018	15:00	56	55	57	56	52	8	0	Unacceptable
Wednesday, 31 January 2018	15:30	57	55	57	56	52	8	0	Unacceptable
Wednesday, 31 January 2018	16:00	56	55	57	56	52	8	0	Unacceptable
Wednesday, 31 January 2018	16:30	56	54	56	54	52	8	0	Unacceptable

		Ambient noise level dB $L_{Aeq, 30mins}$					BOM weather data (Geelong Airport)		
Date	Time	Location 1	Location 2	Location 3	Location 4	Location 5	Wind (m/s)	Rain (mm)	Data acceptability
Wednesday, 31 January 2018	17:00	57	54	56	55	52	8	0	Unacceptable
Wednesday, 31 January 2018	17:30	57	54	56	55	52	8	0	Unacceptable
Wednesday, 31 January 2018	18:00	56	53	55	53	51	7	0	Unacceptable
Wednesday, 31 January 2018	18:30	56	53	54	53	63	6	0	Unacceptable
Wednesday, 31 January 2018	19:00	55	52	53	51	60	7	0	Unacceptable
Wednesday, 31 January 2018	19:30	54	50	52	51	57	6	0	Unacceptable
Wednesday, 31 January 2018	20:00	54	53	53	54	58	6	0	Unacceptable
Wednesday, 31 January 2018	20:30	57	50	52	51	65	5	0	Unacceptable
Wednesday, 31 January 2018	21:00	53	51	51	49	62	5	0	Unacceptable
Wednesday, 31 January 2018	21:30	51	48	49	48	60	5	0	Unacceptable
Wednesday, 31 January 2018	22:00	51	49	49	47	57	4	0	Unacceptable
Wednesday, 31 January 2018	22:30	51	49	49	49	49	5	0	Unacceptable
Wednesday, 31 January 2018	23:00	49	46	47	45	61	5	0	Unacceptable
Wednesday, 31 January 2018	23:30	49	46	47	45	45	5	0	Unacceptable
Wednesday, 31 January 2018	0:00	48	44	45	41	41	6	0	Unacceptable
Thursday, 1 February 2018	0:30	49	46	46	42	43	5	0	Unacceptable
Thursday, 1 February 2018	1:00	50	46	44	41	38	5	0	Unacceptable
Thursday, 1 February 2018	1:30	48	44	43	39	36	4	0	Unacceptable
Thursday, 1 February 2018	2:00	48	44	43	40	36	5	0	Unacceptable
Thursday, 1 February 2018	2:30	45	42	42	36	35	5	0	Unacceptable
Thursday, 1 February 2018	3:00	52	48	46	43	39	4	0	Unacceptable
Thursday, 1 February 2018	3:30	51	47	46	41	41	4	0	Unacceptable
Thursday, 1 February 2018	4:00	51	46	47	45	41	5	0	Unacceptable
Thursday, 1 February 2018	4:30	51	47	50	49	42	4	0	Unacceptable
Thursday, 1 February 2018	5:00	53	50	52	49	59	4	0	Unacceptable
Thursday, 1 February 2018	5:30	54	51	53	51	46	1	0	Acceptable
Thursday, 1 February 2018	6:00	56	54	56	54	57	1	0	Acceptable
Thursday, 1 February 2018	6:30	57	54	57	54	59	0	0	Acceptable
Thursday, 1 February 2018	7:00	56	53	56	52	55	1	0	Acceptable
Thursday, 1 February 2018	7:30	56	55	57	53	48	1	0	Acceptable
Thursday, 1 February 2018	8:00	56	55	57	54	63	1	0	Acceptable
Thursday, 1 February 2018	8:30	55	54	56	52	61	2	0	Acceptable
Thursday, 1 February 2018	9:00	55	54	57	51	55	3	0	Unacceptable
Thursday, 1 February 2018	9:30	55	54	55	51	48	1	0	Acceptable
Thursday, 1 February 2018	10:00	55	53	54	50	47	2	0	Acceptable
Thursday, 1 February 2018	10:30	56	54	57	53	49	2	0	Acceptable
Thursday, 1 February 2018	11:00	55	54	55	52	50	3	0	Acceptable
Thursday, 1 February 2018	11:30	57	55	57	55	68	5	0	Unacceptable
Thursday, 1 February 2018	12:00	56	54	56	54	50	6	0	Unacceptable
Thursday, 1 February 2018	12:30	54	52	54	53	50	6	0	Unacceptable
Thursday, 1 February 2018	13:00	55	53	55	53	50	7	0	Unacceptable
Thursday, 1 February 2018	13:30	55	53	55	54	50	7	0	Unacceptable
Thursday, 1 February 2018	14:00	56	54	56	55	65	7	0	Unacceptable
Thursday, 1 February 2018	14:30	55	53	56	53	59	7	0	Unacceptable
Thursday, 1 February 2018	15:00	54	52	55	53	50	7	0	Unacceptable
Thursday, 1 February 2018	15:30	56	53	56	54	51	7	0	Unacceptable
Thursday, 1 February 2018	16:00	56	53	56	54	51	6	0	Unacceptable
Thursday, 1 February 2018	16:30	56	54	56	54	51	6	0	Unacceptable
Thursday, 1 February 2018	17:00	56	54	56	54	50	7	0	Unacceptable
Thursday, 1 February 2018	17:30	57	54	55	54	51	6	0	Unacceptable
Thursday, 1 February 2018	18:00	56	53	55	54	50	7	0	Unacceptable
Thursday, 1 February 2018	18:30	56	54	54	53	64	6	0	Unacceptable
Thursday, 1 February 2018	19:00	55	52	53	52	60	8	0	Unacceptable
Thursday, 1 February 2018	19:30	56	52	53	53	60	7	0	Unacceptable
Thursday, 1 February 2018	20:00	55	53	53	51	66	6	0	Unacceptable
Thursday, 1 February 2018	20:30	61	53	53	53	63	5	0	Unacceptable
Thursday, 1 February 2018	21:00	53	50	50	49	57	5	0	Unacceptable

		Ambient noise level dB $L_{Aeq, 30mins}$					BOM weather data (Geelong Airport)		
Date	Time	Location 1	Location 2	Location 3	Location 4	Location 5	Wind (m/s)	Rain (mm)	Data acceptability
Thursday, 1 February 2018	21:30	53	50	50	47	57	4	0	Unacceptable
Thursday, 1 February 2018	22:00	52	49	48	46	61	5	0	Unacceptable
Thursday, 1 February 2018	22:30	51	47	47	43	53	4	0	Unacceptable
Thursday, 1 February 2018	23:00	50	46	47	44	47	4	0	Unacceptable
Thursday, 1 February 2018	23:30	52	48	47	44	42	3	0	Unacceptable
Thursday, 1 February 2018	0:00	50	46	46	41	50	4	0	Unacceptable
Friday, 2 February 2018	0:30	49	44	44	40	46	3	0	Unacceptable
Friday, 2 February 2018	1:00	52	49	47	43	44	3	0	Unacceptable
Friday, 2 February 2018	1:30	47	42	41	39	37	3	0	Acceptable
Friday, 2 February 2018	2:00	48	44	44	40	38	3	0	Unacceptable
Friday, 2 February 2018	2:30	47	44	42	36	37	3	0	Acceptable
Friday, 2 February 2018	3:00	51	47	44	39	37	3	0	Unacceptable
Friday, 2 February 2018	3:30	49	45	46	43	38	3	0	Acceptable
Friday, 2 February 2018	4:00	52	48	47	45	58	2	0	Acceptable
Friday, 2 February 2018	4:30	52	47	46	41	43	3	0	Unacceptable
Friday, 2 February 2018	5:00	54	50	50	45	44	3	0	Unacceptable
Friday, 2 February 2018	5:30	56	52	53	50	46	2	0	Acceptable
Friday, 2 February 2018	6:00	56	53	55	51	55	3	0	Acceptable
Friday, 2 February 2018	6:30	59	56	57	53	63	3	0	Acceptable
Friday, 2 February 2018	7:00	58	55	57	55	58	2	0	Acceptable
Friday, 2 February 2018	7:30	59	56	57	54	52	3	0	Unacceptable
Friday, 2 February 2018	8:00	59	56	56	55	63	4	0	Unacceptable
Friday, 2 February 2018	8:30	58	56	58	56	52	4	0	Unacceptable
Friday, 2 February 2018	9:00	57	54	56	54	63	4	0	Unacceptable
Friday, 2 February 2018	9:30	58	58	57	56	51	5	0	Unacceptable
Friday, 2 February 2018	10:00	60	55	56	53	51	4	0	Unacceptable
Friday, 2 February 2018	10:30	56	53	56	53	49	4	0	Unacceptable
Friday, 2 February 2018	11:00	56	55	55	56	50	4	0	Unacceptable
Friday, 2 February 2018	11:30	55	53	56	54	66	4	0	Unacceptable
Friday, 2 February 2018	12:00	55	53	55	54	49	5	0	Unacceptable
Friday, 2 February 2018	12:30	54	54	56	55	49	5	0	Unacceptable
Friday, 2 February 2018	13:00	54	53	55	53	50	5	0	Unacceptable
Friday, 2 February 2018	13:30	54	52	55	54	49	5	0	Unacceptable
Friday, 2 February 2018	14:00	56	53	54	55	65	6	0	Unacceptable
Friday, 2 February 2018	14:30	56	54	56	53	61	6	0	Unacceptable
Friday, 2 February 2018	15:00	57	54	56	54	51	6	0	Unacceptable
Friday, 2 February 2018	15:30	57	54	56	54	51	6	0	Unacceptable
Friday, 2 February 2018	16:00	57	54	57	55	52	6	0	Unacceptable
Friday, 2 February 2018	16:30	57	54	57	55	51	7	0	Unacceptable
Friday, 2 February 2018	17:00	57	54	56	54	52	8	0	Unacceptable
Friday, 2 February 2018	17:30	58	55	57	54	51	7	0	Unacceptable
Friday, 2 February 2018	18:00	57	54	57	55	51	7	0	Unacceptable
Friday, 2 February 2018	18:30	57	54	55	55	63	7	0	Unacceptable
Friday, 2 February 2018	19:00	56	53	54	52	57	7	0	Unacceptable
Friday, 2 February 2018	19:30	56	52	54	53	59	6	0	Unacceptable
Friday, 2 February 2018	20:00	58	53	53	50	65	6	0	Unacceptable
Friday, 2 February 2018	20:30	62	56	53	51	63	6	0	Unacceptable
Friday, 2 February 2018	21:00	55	51	53	51	59	4	0	Unacceptable
Friday, 2 February 2018	21:30	55	52	54	49	52	4	0	Unacceptable
Friday, 2 February 2018	22:00	54	52	53	51	65	3	0	Acceptable
Friday, 2 February 2018	22:30	51	48	50	48	50	4	0	Unacceptable
Friday, 2 February 2018	23:00	51	49	50	46	49	4	0	Unacceptable
Friday, 2 February 2018	23:30	49	46	48	45	53	4	0	Unacceptable
Friday, 2 February 2018	0:00	49	46	50	45	52	3	0	Unacceptable
Saturday, 3 February 2018	0:30	50	49	49	44	49	3	0	Unacceptable
Saturday, 3 February 2018	1:00	48	45	47	43	50	3	0	Unacceptable
Saturday, 3 February 2018	1:30	50	47	48	40	47	3	0	Acceptable
Saturday, 3 February 2018	2:00	48	43	45	41	49	2	0	Acceptable

		Ambient noise level dB $L_{Aeq, 30mins}$					BOM weather data (Geelong Airport)		
Date	Time	Location 1	Location 2	Location 3	Location 4	Location 5	Wind (m/s)	Rain (mm)	Data acceptability
Saturday, 3 February 2018	2:30	46	46	48	41	44	2	0	Acceptable
Saturday, 3 February 2018	3:00	48	44	45	41	45	3	0	Acceptable
Saturday, 3 February 2018	3:30	47	44	50	49	40	3	0	Acceptable
Saturday, 3 February 2018	4:00	49	48	45	40	63	3	0	Acceptable
Saturday, 3 February 2018	4:30	46	43	48	44	40	2	0	Acceptable
Saturday, 3 February 2018	5:00	49	48	49	45	41	3	0	Unacceptable
Saturday, 3 February 2018	5:30	49	47	50	46	44	4	0	Unacceptable
Saturday, 3 February 2018	6:00	51	49	53	49	45	4	0	Unacceptable
Saturday, 3 February 2018	6:30	52	49	52	48	47	4	0	Unacceptable
Saturday, 3 February 2018	7:00	51	48	52	48	45	4	0	Unacceptable
Saturday, 3 February 2018	7:30	51	50	53	49	47	4	0	Unacceptable
Saturday, 3 February 2018	8:00	52	50	54	50	46	5	0	Unacceptable
Saturday, 3 February 2018	8:30	51	51	55	52	48	5	0	Unacceptable
Saturday, 3 February 2018	9:00	51	50	54	49	63	4	0	Unacceptable
Saturday, 3 February 2018	9:30	51	50	54	49	48	4	0	Unacceptable
Saturday, 3 February 2018	10:00	52	52	56	53	64	5	0	Unacceptable
Saturday, 3 February 2018	10:30	53	52	56	52	50	5	0	Unacceptable
Saturday, 3 February 2018	11:00	52	52	56	53	49	5	0	Unacceptable
Saturday, 3 February 2018	11:30	53	52	56	53	49	5	0	Unacceptable
Saturday, 3 February 2018	12:00	52	52	55	53	49	5	0	Unacceptable
Saturday, 3 February 2018	12:30	52	52	55	52	49	6	0	Unacceptable
Saturday, 3 February 2018	13:00	53	52	55	53	50	6	0	Unacceptable
Saturday, 3 February 2018	13:30	53	60	55	53	49	6	0	Unacceptable
Saturday, 3 February 2018	14:00	52	51	55	53	64	6	0	Unacceptable
Saturday, 3 February 2018	14:30	53	52	55	52	60	7	0	Unacceptable
Saturday, 3 February 2018	15:00	53	52	56	52	50	7	0	Unacceptable
Saturday, 3 February 2018	15:30	52	51	55	52	50	7	0	Unacceptable
Saturday, 3 February 2018	16:00	53	52	55	52	51	7	0	Unacceptable
Saturday, 3 February 2018	16:30	53	52	54	52	51	7	0	Unacceptable
Saturday, 3 February 2018	17:00	54	54	55	54	51	7	0	Unacceptable
Saturday, 3 February 2018	17:30	54	52	56	52	51	7	0	Unacceptable
Saturday, 3 February 2018	18:00	53	52	54	52	51	7	0	Unacceptable
Saturday, 3 February 2018	18:30	61	52	56	53	50	7	0	Unacceptable
Saturday, 3 February 2018	19:00	53	51	54	51	51	8	0	Unacceptable
Saturday, 3 February 2018	19:30	53	52	54	54	65	6	0	Unacceptable
Saturday, 3 February 2018	20:00	52	51	53	51	61	6	0	Unacceptable
Saturday, 3 February 2018	20:30	57	66	52	49	50	5	0	Unacceptable
Saturday, 3 February 2018	21:00	50	49	52	49	50	5	0	Unacceptable
Saturday, 3 February 2018	21:30	59	48	52	49	60	5	0	Unacceptable
Saturday, 3 February 2018	22:00	59	48	51	48	62	4	0	Unacceptable
Saturday, 3 February 2018	22:30	60	49	52	47	62	3	0	Unacceptable
Saturday, 3 February 2018	23:00	59	49	53	51	62	2	0	Acceptable
Saturday, 3 February 2018	23:30	59	47	51	47	64	2	0	Acceptable
Saturday, 3 February 2018	0:00	59	49	50	45	64	2	0	Acceptable
Sunday, 4 February 2018	0:30	53	48	48	45	64	2	0	Acceptable
Sunday, 4 February 2018	1:00	52	50	49	47	64	2	0	Acceptable
Sunday, 4 February 2018	1:30	50	49	47	41	63	1	0	Acceptable
Sunday, 4 February 2018	2:00	48	45	47	41	63	2	0	Acceptable
Sunday, 4 February 2018	2:30	49	47	46	41	63	2	0	Acceptable
Sunday, 4 February 2018	3:00	48	45	46	42	62	2	0	Acceptable
Sunday, 4 February 2018	3:30	47	44	43	38	55	2	0	Acceptable
Sunday, 4 February 2018	4:00	49	47	47	38	56	2	0	Acceptable
Sunday, 4 February 2018	4:30	47	45	47	43	55	2	0	Acceptable
Sunday, 4 February 2018	5:00	49	46	47	42	56	2	0	Acceptable
Sunday, 4 February 2018	5:30	50	48	47	42	55	2	0	Acceptable
Sunday, 4 February 2018	6:00	49	47	48	45	55	2	0	Acceptable
Sunday, 4 February 2018	6:30	52	49	50	47	53	2	0	Acceptable
Sunday, 4 February 2018	7:00	57	50	49	46	50	1	0	Acceptable

		Ambient noise level dB $L_{Aeq, 30mins}$					BOM weather data (Geelong Airport)		
Date	Time	Location 1	Location 2	Location 3	Location 4	Location 5	Wind (m/s)	Rain (mm)	Data acceptability
Sunday, 4 February 2018	7:30	54	50	51	47	52	1	0	Acceptable
Sunday, 4 February 2018	8:00	60	49	52	49	54	1	0	Acceptable
Sunday, 4 February 2018	8:30	51	52	52	50	64	2	0	Acceptable
Sunday, 4 February 2018	9:00	51	49	51	47	46	2	0	Acceptable
Sunday, 4 February 2018	9:30	51	50	53	51	46	2	0	Acceptable
Sunday, 4 February 2018	10:00	53	49	53	48	64	2	0	Acceptable
Sunday, 4 February 2018	10:30	53	51	53	50	46	3	0	Acceptable
Sunday, 4 February 2018	11:00	52	50	54	50	50	3	0	Unacceptable
Sunday, 4 February 2018	11:30	53	51	54	50	45	4	0	Unacceptable
Sunday, 4 February 2018	12:00	52	51	54	50	46	4	0	Unacceptable
Sunday, 4 February 2018	12:30	52	50	53	49	47	5	0	Unacceptable
Sunday, 4 February 2018	13:00	52	50	53	49	46	5	0	Unacceptable
Sunday, 4 February 2018	13:30	52	51	54	51	46	5	0	Unacceptable
Sunday, 4 February 2018	14:00	52	50	54	50	62	5	0	Unacceptable
Sunday, 4 February 2018	14:30	53	51	53	50	61	5	0	Unacceptable
Sunday, 4 February 2018	15:00	52	50	53	49	46	5	0	Unacceptable
Sunday, 4 February 2018	15:30	52	50	53	50	47	5	0	Unacceptable
Sunday, 4 February 2018	16:00	52	51	54	51	47	5	0	Unacceptable
Sunday, 4 February 2018	16:30	52	51	54	51	48	5	0	Unacceptable
Sunday, 4 February 2018	17:00	53	52	55	52	48	6	0	Unacceptable
Sunday, 4 February 2018	17:30	53	51	53	51	52	5	0	Unacceptable
Sunday, 4 February 2018	18:00	53	50	53	51	49	6	0	Unacceptable
Sunday, 4 February 2018	18:30	53	50	53	51	47	6	0	Unacceptable
Sunday, 4 February 2018	19:00	53	50	52	50	49	6	0	Unacceptable
Sunday, 4 February 2018	19:30	57	50	53	52	63	6	0	Unacceptable
Sunday, 4 February 2018	20:00	54	52	53	51	61	5	0	Unacceptable
Sunday, 4 February 2018	20:30	57	69	52	51	64	4	0	Unacceptable
Sunday, 4 February 2018	21:00	52	59	52	55	61	4	0	Unacceptable
Sunday, 4 February 2018	21:30	51	48	52	57	62	3	0	Unacceptable
Sunday, 4 February 2018	22:00	55	47	50	56	63	3	0	Unacceptable
Sunday, 4 February 2018	22:30	51	45	48	51	62	3	0	Unacceptable
Sunday, 4 February 2018	23:00	46	44	46	44	60	4	0	Unacceptable
Sunday, 4 February 2018	23:30	47	42	44	43	60	2	0	Acceptable
Sunday, 4 February 2018	0:00	47	45	47	42	59	2	0	Acceptable
Monday, 5 February 2018	0:30	45	42	45	41	58	2	0	Acceptable
Monday, 5 February 2018	1:00	48	44	46	41	58	3	0	Unacceptable
Monday, 5 February 2018	1:30	47	49	46	39	57	2	0	Acceptable
Monday, 5 February 2018	2:00	46	50	45	40	55	2	0	Acceptable
Monday, 5 February 2018	2:30	48	44	44	39	52	1	0	Acceptable
Monday, 5 February 2018	3:00	49	45	45	41	45	2	0	Acceptable
Monday, 5 February 2018	3:30	49	46	48	41	44	1	0	Acceptable
Monday, 5 February 2018	4:00	51	48	48	45	58	0	0	Acceptable
Monday, 5 February 2018	4:30	53	49	47	42	45	0	0	Acceptable
Monday, 5 February 2018	5:00	53	49	50	46	46	0	0	Acceptable
Monday, 5 February 2018	5:30	55	51	52	49	48	1	0	Acceptable
Monday, 5 February 2018	6:00	57	54	55	51	55	1	0	Acceptable
Monday, 5 February 2018	6:30	60	57	57	54	56	1	0	Acceptable
Monday, 5 February 2018	7:00	60	57	56	54	57	1	0	Acceptable
Monday, 5 February 2018	7:30	60	56	56	53	51	1	0	Acceptable
Monday, 5 February 2018	8:00	57	55	56	53	68	1	0	Acceptable
Monday, 5 February 2018	8:30	56	54	55	52	53	1	0	Acceptable
Monday, 5 February 2018	9:00	56	52	55	51	63	2	0	Acceptable
Monday, 5 February 2018	9:30	55	53	54	50	46	1	0	Acceptable
Monday, 5 February 2018	10:00	56	51	53	51	44	1	0	Acceptable
Monday, 5 February 2018	10:30	55	51	53	50	44	2	0	Acceptable
Monday, 5 February 2018	11:00	54	51	54	50	43	2	0	Acceptable
Monday, 5 February 2018	11:30	54	51	53	51	66	2	0	Acceptable
Monday, 5 February 2018	12:00	52	50	53	49	45	3	0	Acceptable

		Ambient noise level dB $L_{Aeq, 30mins}$					BOM weather data (Geelong Airport)		
Date	Time	Location 1	Location 2	Location 3	Location 4	Location 5	Wind (m/s)	Rain (mm)	Data acceptability
Monday, 5 February 2018	12:30	52	50	52	51	45	4	0	Unacceptable
Monday, 5 February 2018	13:00	53	51	53	50	44	3	0	Unacceptable
Monday, 5 February 2018	13:30	53	51	54	51	46	3	0	Unacceptable
Monday, 5 February 2018	14:00	54	51	54	52	46	3	0	Acceptable
Monday, 5 February 2018	14:30	54	52	55	52	66	4	0	Unacceptable
Monday, 5 February 2018	15:00	53	52	55	52	48	5	0	Unacceptable
Monday, 5 February 2018	15:30	54	53	55	51	49	6	0	Unacceptable
Monday, 5 February 2018	16:00	54	52	59	54	48	5	0	Unacceptable
Monday, 5 February 2018	16:30	57	66	57	62	59	5	0	Unacceptable
Monday, 5 February 2018	17:00	56	53	55	53	49	7	0	Unacceptable
Monday, 5 February 2018	17:30	56	54	55	52	49	6	0	Unacceptable
Monday, 5 February 2018	18:00	54	53	54	51	48	6	0	Unacceptable
Monday, 5 February 2018	18:30	54	52	54	51	63	6	0	Unacceptable
Monday, 5 February 2018	19:00	53	51	52	50	60	5	0	Unacceptable
Monday, 5 February 2018	19:30	53	52	53	49	58	6	0	Unacceptable
Monday, 5 February 2018	20:00	53	53	56	52	66	4	0	Unacceptable
Monday, 5 February 2018	20:30	55	66	54	50	63	4	0	Unacceptable
Monday, 5 February 2018	21:00	52	54	56	48	57	3	0	Unacceptable
Monday, 5 February 2018	21:30	61	55	56	48	62	2	0	Acceptable
Monday, 5 February 2018	22:00	61	54	55	50	66	3	0	Acceptable
Monday, 5 February 2018	22:30	61	53	49	46	49	2	0	Acceptable
Monday, 5 February 2018	23:00	60	53	48	47	50	1	0	Acceptable
Monday, 5 February 2018	23:30	60	52	48	45	43	1	0	Acceptable
Monday, 5 February 2018	0:00	60	52	46	44	48	1	0	Acceptable
Tuesday, 6 February 2018	0:30	60	49	45	43	43	2	0	Acceptable
Tuesday, 6 February 2018	1:00	59	48	46	42	41	2	0	Acceptable
Tuesday, 6 February 2018	1:30	59	48	43	40	41	1	0	Acceptable
Tuesday, 6 February 2018	2:00	59	48	44	39	41	2	0	Acceptable
Tuesday, 6 February 2018	2:30	59	50	44	40	42	2	0	Acceptable
Tuesday, 6 February 2018	3:00	59	47	43	39	41	3	0	Acceptable
Tuesday, 6 February 2018	3:30	58	47	46	42	43	2	0	Acceptable
Tuesday, 6 February 2018	4:00	59	49	47	43	44	1	0	Acceptable
Tuesday, 6 February 2018	4:30	60	51	50	49	44	2	0	Acceptable
Tuesday, 6 February 2018	5:00	61	52	53	49	61	2	0	Acceptable
Tuesday, 6 February 2018	5:30	61	54	54	50	49	2	0	Acceptable
Tuesday, 6 February 2018	6:00	59	54	56	52	56	2	0	Acceptable
Tuesday, 6 February 2018	6:30	58	57	58	54	57	2	0	Acceptable
Tuesday, 6 February 2018	7:00	57	55	57	54	57	2	0	Acceptable
Tuesday, 6 February 2018	7:30	55	54	58	53	52	2	0	Acceptable
Tuesday, 6 February 2018	8:00	54	53	56	55	66	2	0	Acceptable
Tuesday, 6 February 2018	8:30	54	52	56	53	61	2	0	Acceptable
Tuesday, 6 February 2018	9:00	53	52	55	50	55	3	0	Acceptable
Tuesday, 6 February 2018	9:30	53	51	54	50	48	2	0	Acceptable
Tuesday, 6 February 2018	10:00	53	51	53	50	46	3	0	Unacceptable
Tuesday, 6 February 2018	10:30	53	51	55	51	47	3	0	Unacceptable
Tuesday, 6 February 2018	11:00	53	51	54	50	45	3	0	Unacceptable
Tuesday, 6 February 2018	11:30	53	52	56	53	63	3	0	Unacceptable
Tuesday, 6 February 2018	12:00	57	56	56	56	56	3	0	Unacceptable
Tuesday, 6 February 2018	12:30	51	49	52	48	45	4	0	Unacceptable
Tuesday, 6 February 2018	13:00	54	52	55	51	46	4	0	Unacceptable
Tuesday, 6 February 2018	13:30	52	51	55	52	47	5	0	Unacceptable
Tuesday, 6 February 2018	14:00	54	52	55	54	66	5	0	Unacceptable
Tuesday, 6 February 2018	14:30	54	52	55	53	59	5	0	Unacceptable
Tuesday, 6 February 2018	15:00	53	52	55	52	48	5	0	Unacceptable
Tuesday, 6 February 2018	15:30	53	53	56	53	50	6	0	Unacceptable
Tuesday, 6 February 2018	16:00	56	54	56	55	54	6	0	Unacceptable
Tuesday, 6 February 2018	16:30	53	52	55	52	49	7	0	Unacceptable
Tuesday, 6 February 2018	17:00	54	52	55	53	49	7	0	Unacceptable

		Ambient noise level dB $L_{Aeq, 30mins}$					BOM weather data (Geelong Airport)		
Date	Time	Location 1	Location 2	Location 3	Location 4	Location 5	Wind (m/s)	Rain (mm)	Data acceptability
Tuesday, 6 February 2018	17:30	52	51	55	52	49	5	0	Unacceptable
Tuesday, 6 February 2018	18:00	53	51	53	51	48	5	0	Unacceptable
Tuesday, 6 February 2018	18:30	53	52	53	52	62	5	0	Unacceptable
Tuesday, 6 February 2018	19:00	51	51	53	49	46	5	0	Unacceptable
Tuesday, 6 February 2018	19:30	52	54	53	52	58	5	0	Unacceptable
Tuesday, 6 February 2018	20:00	53	51	52	49	62	4	0	Unacceptable
Tuesday, 6 February 2018	20:30	55	69	53	50	62	4	0	Unacceptable
Tuesday, 6 February 2018	21:00	59	56	53	52	49	4	0	Unacceptable
Tuesday, 6 February 2018	21:30	62	54	53	51	57	3	0	Acceptable
Tuesday, 6 February 2018	22:00	62	53	56	51	62	2	0	Acceptable
Tuesday, 6 February 2018	22:30	61	56	56	49	44	2	0	Acceptable
Tuesday, 6 February 2018	23:00	58	57	55	50	56	1	0	Acceptable
Tuesday, 6 February 2018	23:30	50	58	55	50	60	0	0	Acceptable
Tuesday, 6 February 2018	0:00	49	49	53	49	60	1	0	Acceptable
Wednesday, 7 February 2018	0:30	48	48	51	47	60	2	0	Acceptable
Wednesday, 7 February 2018	1:00	49	51	50	46	60	0	0	Acceptable
Wednesday, 7 February 2018	1:30	49	53	46	45	60	1	0	Acceptable
Wednesday, 7 February 2018	2:00	48	49	44	46	58	1	0	Acceptable
Wednesday, 7 February 2018	2:30	49	55	44	42	56	1	0	Acceptable
Wednesday, 7 February 2018	3:00	48	55	45	42	58	1	0	Acceptable
Wednesday, 7 February 2018	3:30	50	53	45	43	58	1	0	Acceptable
Wednesday, 7 February 2018	4:00	52	54	48	46	55	2	0	Acceptable
Wednesday, 7 February 2018	4:30	55	58	52	50	47	2	0	Acceptable
Wednesday, 7 February 2018	5:00	56	58	51	48	60	1	0	Acceptable
Wednesday, 7 February 2018	5:30	54	54	54	49	48	1	0	Acceptable
Wednesday, 7 February 2018	6:00	55	59	55	51	56	1	0	Acceptable
Wednesday, 7 February 2018	6:30	58	56	58	54	64	1	0	Acceptable
Wednesday, 7 February 2018	7:00	59	57	58	56	58	1	0	Acceptable
Wednesday, 7 February 2018	7:30	58	56	56	54	54	1	0	Acceptable
Wednesday, 7 February 2018	8:00	55	55	56	54	64	1	0	Acceptable
Wednesday, 7 February 2018	8:30	56	54	56	54	62	2	0	Acceptable
Wednesday, 7 February 2018	9:00	55	53	55	53	57	1	0	Acceptable
Wednesday, 7 February 2018	9:30	54	52	54	52	48	2	0	Acceptable
Wednesday, 7 February 2018	10:00	54	51	53	51	45	2	0	Acceptable
Wednesday, 7 February 2018	10:30	54	53	55	54	45	3	0	Acceptable
Wednesday, 7 February 2018	11:00	54	53	55	52	46	2	0	Acceptable
Wednesday, 7 February 2018	11:30	53	51	55	53	61	3	0	Acceptable
Wednesday, 7 February 2018	12:00	53	52	54	52	45	2	0	Acceptable
Wednesday, 7 February 2018	12:30	52	51	53	51	46	4	0	Unacceptable
Wednesday, 7 February 2018	13:00	53	50	53	52	45	3	0	Unacceptable
Wednesday, 7 February 2018	13:30	53	51	53	52	45	3	0	Acceptable
Wednesday, 7 February 2018	14:00	53	51	53	50	57	4	0	Unacceptable
Wednesday, 7 February 2018	14:30	52	51	54	53	45	5	0	Unacceptable
Wednesday, 7 February 2018	15:00	53	52	55	51	59	5	0	Unacceptable
Wednesday, 7 February 2018	15:30	53	52	55	52	47	6	0	Unacceptable
Wednesday, 7 February 2018	16:00	53	51	55	51	47	6	0	Unacceptable
Wednesday, 7 February 2018	16:30	53	52	56	52	47	6	0	Unacceptable
Wednesday, 7 February 2018	17:00	55	52	56	53	48	6	0	Unacceptable
Wednesday, 7 February 2018	17:30	55	52	54	53	48	6	0	Unacceptable
Wednesday, 7 February 2018	18:00	55	51	56	52	47	7	0	Unacceptable
Wednesday, 7 February 2018	18:30	54	52	53	53	60	6	0	Unacceptable
Wednesday, 7 February 2018	19:00	54	51	53	52	53	7	0	Unacceptable
Wednesday, 7 February 2018	19:30	54	50	52	49	58	7	0	Unacceptable
Wednesday, 7 February 2018	20:00	54	51	55	50	63	6	0	Unacceptable
Wednesday, 7 February 2018	20:30	55	65	52	50	60	6	0	Unacceptable
Wednesday, 7 February 2018	21:00	54	52	56	52	46	4	0	Unacceptable
Wednesday, 7 February 2018	21:30	53	53	60	53	47	4	0	Unacceptable
Wednesday, 7 February 2018	22:00	59	54	58	52	46	3	0	Acceptable

		Ambient noise level dB $L_{Aeq, 30mins}$					BOM weather data (Geelong Airport)		
Date	Time	Location 1	Location 2	Location 3	Location 4	Location 5	Wind (m/s)	Rain (mm)	Data acceptability
Wednesday, 7 February 2018	22:30	53	55	56	51	45	2	0	Acceptable
Wednesday, 7 February 2018	23:00	51	52	56	48	62	3	0	Acceptable
Wednesday, 7 February 2018	23:30	51	53	54	48	45	3	0	Acceptable
Wednesday, 7 February 2018	0:00	50	52	51	49	45	2	0	Acceptable
Thursday, 8 February 2018	0:30	54	54	52	52	45	2	0	Acceptable
Thursday, 8 February 2018	1:00	54	57	49	50	45	2	0	Acceptable
Thursday, 8 February 2018	1:30	53	59	48	53	45	1	0	Acceptable
Thursday, 8 February 2018	2:00	51	58	49	49	45	0	0	Acceptable
Thursday, 8 February 2018	2:30	47	51	48	49	46	0	0	Acceptable
Thursday, 8 February 2018	3:00	50	47	51	50	46	1	0	Acceptable
Thursday, 8 February 2018	3:30	53	51	53	51	46	1	0	Acceptable
Thursday, 8 February 2018	4:00	55	55	50	50	46	1	0	Acceptable
Thursday, 8 February 2018	4:30	56	54	52	51	46	2	0	Acceptable
Thursday, 8 February 2018	5:00	56	55	52	53	61	2	0	Acceptable
Thursday, 8 February 2018	5:30	58	56	54	52	48	3	0	Acceptable
Thursday, 8 February 2018	6:00	59	57	55	53	58	2	0	Acceptable
Thursday, 8 February 2018	6:30	58	56	56	52	61	3	0	Acceptable
Thursday, 8 February 2018	7:00	57	56	57	54	50	0	0	Acceptable
Thursday, 8 February 2018	7:30	57	56	56	54	49	0	0	Acceptable
Thursday, 8 February 2018	8:00	58	56	57	54	68	2	0	Acceptable
Thursday, 8 February 2018	8:30	58	54	56	54	61	3	0	Acceptable
Thursday, 8 February 2018	9:00	59	55	56	54	48	3	0	Acceptable
Thursday, 8 February 2018	9:30	58	54	58	53	49	2	0	Acceptable
Thursday, 8 February 2018	10:00	59	55	56	54	49	2	0	Acceptable
Thursday, 8 February 2018	10:30	59	56	56	54	49	3	0	Acceptable
Thursday, 8 February 2018	11:00	59	55	55	55	49	3	0	Unacceptable
Thursday, 8 February 2018	11:30	58	54	55	53	64	3	0	Unacceptable
Thursday, 8 February 2018	12:00	58	54	56	54	49	2	0	Acceptable
Thursday, 8 February 2018	12:30	54	52	56	54	50	4	0	Unacceptable
Thursday, 8 February 2018	13:00	54	52	55	53	49	6	0	Unacceptable
Thursday, 8 February 2018	13:30	55	53	55	54	49	5	0	Unacceptable
Thursday, 8 February 2018	14:00	55	54	60	55	62	6	0	Unacceptable
Thursday, 8 February 2018	14:30	63	56	56	56	61	5	0	Unacceptable
Thursday, 8 February 2018	15:00	54	52	55	52	49	5	0	Unacceptable
Thursday, 8 February 2018	15:30	55	53	57	53	49	5	0	Unacceptable
Thursday, 8 February 2018	16:00	56	53	55	53	49	6	0	Unacceptable
Thursday, 8 February 2018	16:30	57	53	55	54	49	6	0	Unacceptable
Thursday, 8 February 2018	17:00	56	54	56	55	49	6	0	Unacceptable
Thursday, 8 February 2018	17:30	57	54	55	53	50	6	0	Unacceptable
Thursday, 8 February 2018	18:00	56	53	56	52	49	6	0	Unacceptable
Thursday, 8 February 2018	18:30	56	54	55	52	63	7	0	Unacceptable
Thursday, 8 February 2018	19:00	55	51	54	51	61	6	0	Unacceptable
Thursday, 8 February 2018	19:30	55	53	56	52	47	6	0	Unacceptable
Thursday, 8 February 2018	20:00	54	51	54	51	69	6	0	Unacceptable
Thursday, 8 February 2018	20:30	54	51	52	51	61	5	0	Unacceptable
Thursday, 8 February 2018	21:00	53	50	53	54	48	4	0	Unacceptable
Thursday, 8 February 2018	21:30	53	51	55	55	51	3	0	Acceptable
Thursday, 8 February 2018	22:00	54	53	54	54	63	3	0	Acceptable
Thursday, 8 February 2018	22:30	55	51	55	52	46	1	0	Acceptable
Thursday, 8 February 2018	23:00	52	48	48	50	48	1	0	Acceptable
Thursday, 8 February 2018	23:30	46	46	50	50	47	2	0	Acceptable
Thursday, 8 February 2018	0:00	46	47	50	49	44	1	0	Acceptable
Friday, 9 February 2018	0:30	47	51	49	49	45	1	0	Acceptable
Friday, 9 February 2018	1:00	50	51	46	49	47	1	0	Acceptable
Friday, 9 February 2018	1:30	52	47	46	49	44	1	0	Acceptable
Friday, 9 February 2018	2:00	54	42	47	47	40	2	0	Acceptable
Friday, 9 February 2018	2:30	53	44	47	47	44	3	0	Unacceptable
Friday, 9 February 2018	3:00	54	45	48	47	48	2	0	Acceptable

		Ambient noise level dB $L_{Aeq, 30mins}$					BOM weather data (Geelong Airport)		
Date	Time	Location 1	Location 2	Location 3	Location 4	Location 5	Wind (m/s)	Rain (mm)	Data acceptability
Friday, 9 February 2018	3:30	53	47	48	45	42	3	0	Unacceptable
Friday, 9 February 2018	4:00	55	49	49	47	59	3	0	Acceptable
Friday, 9 February 2018	4:30	51	48	48	47	44	3	0	Acceptable
Friday, 9 February 2018	5:00	54	50	52	49	45	3	0	Acceptable
Friday, 9 February 2018	5:30	54	52	52	50	45	4	0	Unacceptable
Friday, 9 February 2018	6:00	55	53	55	52	56	3	0	Unacceptable
Friday, 9 February 2018	6:30	56	54	57	53	64	4	0	Unacceptable
Friday, 9 February 2018	7:00	56	54	58	55	60	3	0	Acceptable
Friday, 9 February 2018	7:30	57	55	58	55	51	3	0	Acceptable
Friday, 9 February 2018	8:00	56	54	57	55	65	3	0	Unacceptable
Friday, 9 February 2018	8:30	55	54	57	55	65	3	0	Unacceptable
Friday, 9 February 2018	9:00	54	52	55	52	50	4	0	Unacceptable
Friday, 9 February 2018	9:30	55	53	56	53	50	3	0	Acceptable
Friday, 9 February 2018	10:00	55	53	57	60	49	3	0	Unacceptable
Friday, 9 February 2018	10:30	55	53	56	53	49	3	0	Acceptable
Friday, 9 February 2018	11:00	56	59	56	53	49	3	0	Acceptable
Friday, 9 February 2018	11:30	57	55	52	53	63	3	0	Unacceptable

APPENDIX D MDA LETTER LT001 R01 20190696

Marshall Day Acoustics Pty Ltd
ABN: 53 470 077 191
6 Gipps Street
Collingwood VIC 3066
Australia
T: +613 9416 1855
www.marshallday.com

31 July 2019

Urban Quarter
Unit 8-9, 48 Kishorn Road
Applecross WA 6153

Attention: Mr David Barham

Dear David

WAURN PONDS SUBSTATION – NOISE MITIGATION REVIEW

Urban Quarter, on behalf of Waurn Ponds Unit Trust (WPT), seeks Amendment C372 to rezone land at 35 & 69-93 Hams Road, Waurn Ponds for residential development under planning permit applications 662/2017 and 663/2017 ("the development site").

Powercor operate the Waurn Ponds Zone Substation ("the substation") on adjoining land at 25 Hams Road. Spiire, on behalf of Powercor, objected to the amendment and permit applications in their current form on the basis of potential acoustic impacts on the proposed development from the substation.

Marshall Day Acoustics (MDA) has been engaged by Urban Quarter to undertake a high-level review of a report prepared by Watson Moss Growcott Acoustics Pty Ltd (WMG) in relation to the substation. In particular, it has been requested to identify the types of noise mitigation measures that could be used to address substation noise levels on the development site.

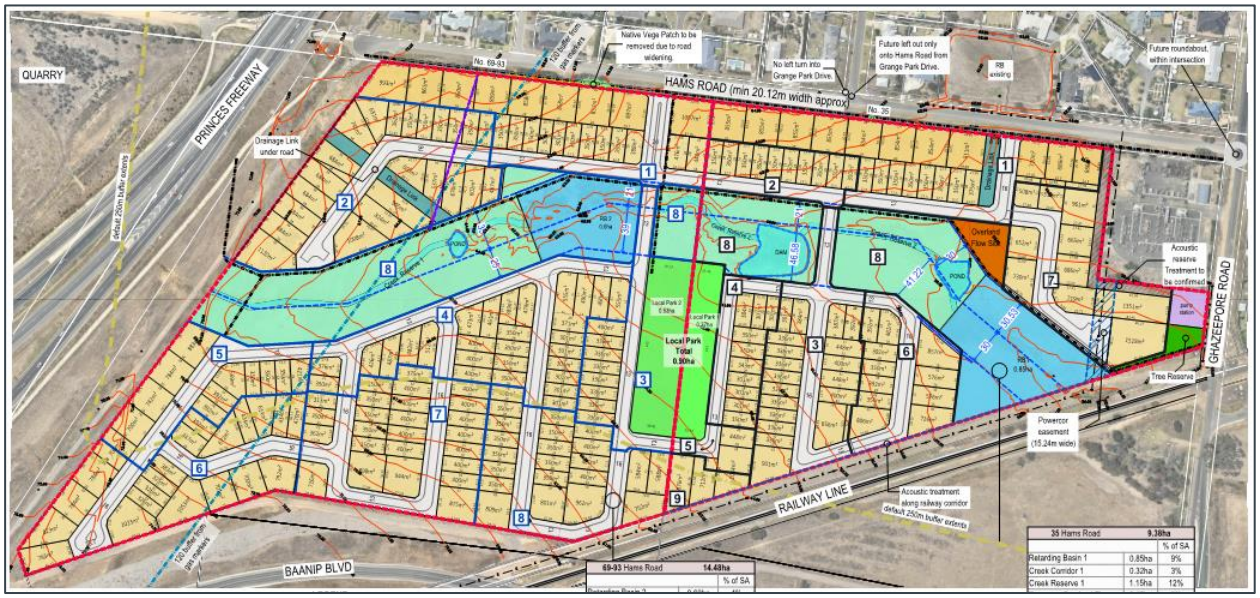
MDA has previously undertaken work in relation to the development site for town planning purposes (ref: Rp 001 R03 20171434_*35 Hams Road Waurn Ponds_Planning Noise Assessment*, dated 11 October 2018). The report was specifically concerned with rail and traffic noise and did not provide detailed commentary on the substation.

On 22 January 2018, a representative of MDA met with Powercor and Taylors at the substation site with the intention of taking noise measurements of the substation plant. The site was locked and Powercor were unable to provide access on the day. Subsequently, Powercor offered to engage another acoustic engineer to gather noise samples of the equipment. These measurements are documented in the WMG report referred to above.

SITE DESCRIPTION

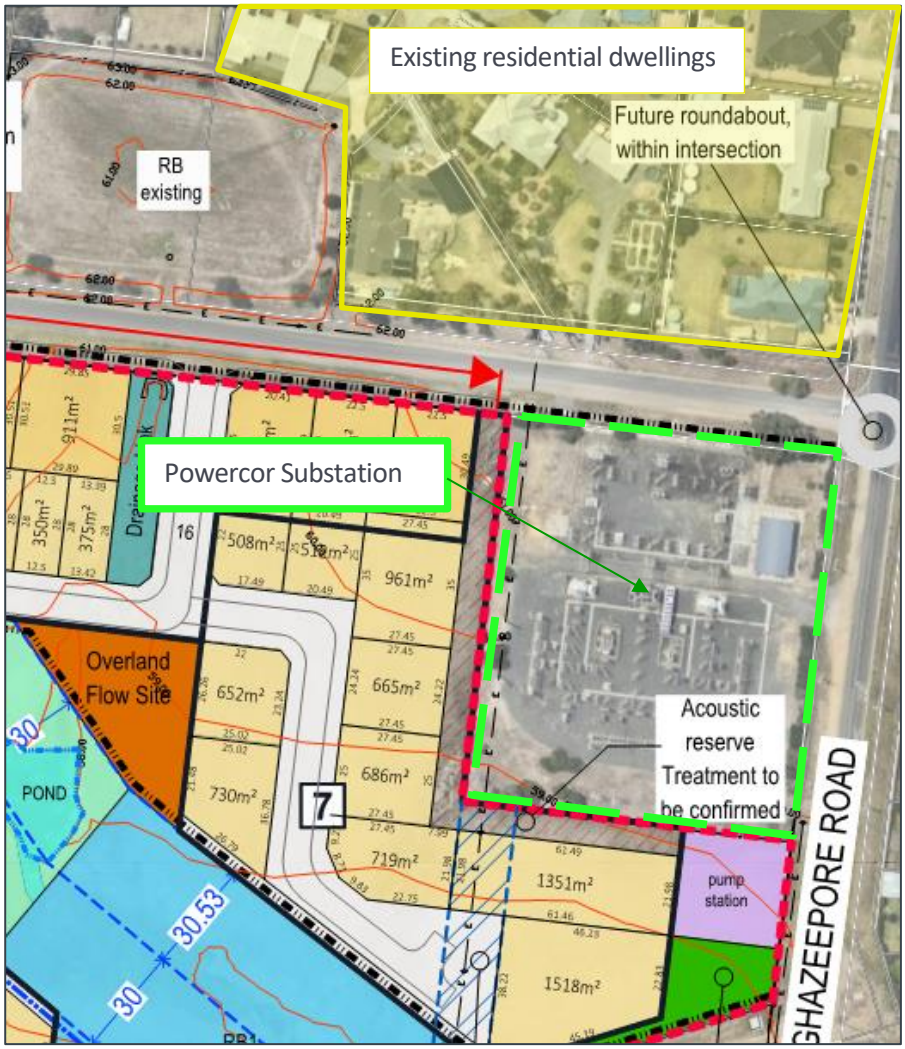
The development site is located at 35 and 69 - 93 Hams Road in Waurn Ponds. The draft master plan is contained in Figure 1.

Figure 1: Draft master plan - 35 & 69-93 Hams Road, Waurn Ponds



The existing substation operated by Powercor is located to the north-east of the development site, as shown in Figure 2. Existing dwellings are located to the north and east of the substation site, on Hams Road and Ghazeepore Road.

Figure 2: Substation adjacent development site



The existing dwellings to the north and east of the substation site are shown in Figure 3.

Figure 3: Existing dwellings close to substation site

WMG ACOUSTIC REPORT

WMG has prepared a report in relation to potential noise emanating from the substation (Ref: 12142-3ng, dated 9 April 2019). The assessment identifies EPA Publication 1411 *Noise from Industry in Regional Victoria* (NIRV) as the relevant noise guideline, and sets out noise criteria for the day, evening and night periods. MDA has reviewed and confirmed the noise criteria referenced in the WMG report, provided in Table 1 for reference.

Table 1: NIRV recommended maximum noise levels – proposed dwellings within development

Period	Recommended Maximum Noise Level, dB L_{eff}
Day	46
Evening	41
Night	36

The WMG assessment is based on attended measurements and predictive noise modelling to determine likely noise levels at the development site due to the substation.

Broadly, the findings of the report are as follows:

- The dominant noise sources at the site include 3 transformers, one of which requires a chiller to operate
- The equipment typically runs continuously, albeit under various operating conditions according to the weather and load requirements at any particular time
- Noise data for the equipment has been provided for a range of operating conditions (e.g. transformer fans on or off, chiller operating at various capacities), based on attended measurements
- Each of the items of equipment exhibited prominent tonal characteristics, which would typically require a 5 dB character adjustment to the effective noise level
- Assuming the operating conditions that result in the highest source noise levels, predicted noise levels at the nearest point on the development site could be as high as 55 dB L_{eff} (including a 5 dB character adjustment for tonality), which exceeds the day, evening and night NIRV criteria.

MDA has conducted noise assessments for other terminal stations around Melbourne in the past. A review of the MDA noise source database for transformers and chillers indicated operating levels consistent with those reported by WMG.

A high-level review of the noise calculations shows good agreement with the predicted noise levels presented in the WMG report. MDA therefore agree that noise mitigation would be required to achieve the NIRV criteria at the development site.

NIRV requires that when the recommended noise levels are exceeded, steps must be taken by the industrial or commercial operator to reduce noise.

NOISE MITIGATION OPTIONS

Options for reducing noise levels from the substation site recommended by WMG included the following:

- *Reduce noise at the source, such as by removing the chiller or not using it at night; replacing the fans on Transformer 2 with quieter fans if possible; replacing Transformer 2 with a new transformer that has quieter fans and does not require a chiller; replacing the chiller with a noise-reduced model*
- *Installing noise barriers around the perimeter of the substation. Noise barriers have a finite noise reduction capability and 5 m has been taken to be a height beyond which it is unlikely that approval would be gained for noise barriers. Municipalities are often reluctant to allow noise barriers higher than 3 m in the vicinity of residential development, but 4 m may be feasible if residential dwellings are not directly adjacent*

Broadly, MDA agree that the noise mitigation options presented by WMG could reduce noise at the development site. However, the degree of noise reduction provided by each of the mitigation options would need to be confirmed with a more detailed assessment following discussions with both the developer and Powercor, as it is likely that some mitigation will need to be directed to the transformers and chiller on the substation site. The following commentary is provided to inform the selection of mitigation options.

As noted in the WMG report, provision of a 5 m noise barrier is unlikely to result in compliance with the NIRV evening and night criteria without additional mitigation provided for the substation plant.

The WMG report also referred to a mitigation option involving a buffer between the substation site and the development site. A buffer outside the substation boundary would need to be in the order of 330 m in order to provide sufficient attenuation of noise to achieve the night period NIRV noise limit. This is likely to be considered impractical as it would require more than half the development site to be used as a buffer.

Other mitigation forms may include provision of a suitable chiller enclosure to attenuate noise, in conjunction with other mitigation treatments to the transformers, and/or localised screening around the transformers and chiller on site. Alternatively, building forms on the proposed development site could potentially be used to provide screening to the subject site from their built form, provided they are at least two storeys high, constructed as terraces with no space between, and utilise closed facades which do not include any openable elements (i.e. any windows would need to be fixed closed on the interfaces with the substation site. However, the use of townhouses asbarriers may not be consistent with the developer's preference to provide low-density housing on the development site. Provision of a road around the Powercor site, while not providing a sufficient buffer distance on its own merit, the use of a perimeter noise barrier at the Powercor site would be separated from dwellings locations, therefore reducing consideration relating to overshadowing of new residential locations.

A combination of approaches may also be an appropriate outcome.

Implementation of treatments on the substation site would require the cooperation of Powercor. To provide assurances to Powercor, a commitment to cooperate on noise control measures could be implemented through a planning agreement. It is understood that this type of cooperation was the intention of the proposed condition to be incorporated into the Design Development Overlay for the subject site (DD045).

Existing dwellings

The WMG report notes that existing dwellings to the north and east of the substation site are within the NIRV major urban area boundary for Geelong, and therefore would be subject to different noise criteria than the proposed residential uses within the development site. The WMG report does not define the criteria that would be applicable at the existing dwellings, but notes it would result in a higher noise limits than would apply at the proposed residential development.

The assessment of noise from the subject site according to the major urban area provisions of NIRV involves calculating recommended levels using the procedures detailed in *State Environment Protection Policy (Control of Noise from Commerce, Industry and Trade) No. N-1* (SEPP N-1). The recommended level using this procedure is based on the calculation of a noise limit at a receiver position, taking into account a zoning noise level derived from the land zoning types in the surrounding area and the background noise level.

The WMG report does not describe any background noise measurements. Noise monitoring was undertaken as part of the previous MDA noise study for the site, however the noise monitoring positions were selected on the basis of measuring noise from traffic and trains, and may not be considered representative of the background conditions at the nearest existing dwellings to the substation. The background levels collected by MDA however indicate that background noise levels during the night would be in the 'neutral' range.

In the absence of more reliable background noise level information, NIRV recommended levels based on a 'neutral' zoning have been derived to provide an indication of the criteria that may be applicable at existing dwellings. The indicative recommended levels for the existing dwellings are shown in Table 2.

Table 2: NIRV recommended levels – major urban area procedure and neutral background conditions – existing dwellings

Period	Day of week	Start time	End time	Measured background, L_{A90} dB	Zoning level, dB	Background relative to zoning level	Recommended level, L_{eff} dB
Day	Monday-Friday	0700hrs	1800hrs	44	50	Neutral	50
	Saturday	0700hrs	1300hrs				
Evening	Monday-Friday	1800hrs	2200hrs	41	44	Neutral	44
	Saturday	1300hrs	2200hrs				
	Sunday, Public holidays	0700hrs	2200hrs				
Night	Monday-Sunday	2200hrs	0700hrs	35	39	Neutral	39

The WMG report does not include an assessment of noise from the substation at existing dwellings.

However, the noise levels are likely to be similar to those predicted at the nearest areas within the proposed development; up to 55 dB L_{eff}, including a 5 dB adjustment for tonality. This noise level is higher than the indicative day, evening and night period recommended levels.

While this letter does not provide a detailed assessment of noise from the substation at existing dwellings, consideration of noise at the existing dwellings may be prudent when selecting noise mitigation treatment options for the substation noise sources. For example, noise mitigation treatment that reduces noise from the plant on site would decrease noise levels at existing dwellings as well as at the proposed development, whereas construction of a noise barrier between the substation and proposed development would only reduce noise to the proposed development, and may actually increase noise levels at existing dwellings due to reflections from the barrier surface.

SUMMARY

MDA has undertaken a review of the report prepared by WMG in relation to the Powercor substation located at 25 Hams Road, immediately adjacent the development site. In particular, it has been requested to identify the types of noise mitigation measures that could be used to address substation noise levels on the development site.

MDA has reviewed the WMG report and broadly agrees with the findings and recommendations. Mitigation measures recommended by WMG that are considered appropriate to reduce noise at the development site include:

- *Reduce noise at the source, such as by removing the chiller or not using it at night; replacing the fans on Transformer 2 with quieter fans if possible; replacing Transformer 2 with a new transformer that has quieter fans and does not require a chiller; replacing the chiller with a noise-reduced model*
- *Installing noise barriers around the perimeter of the substation. Noise barriers have a finite noise reduction capability and 5 m has been taken to be a height beyond which it is unlikely that approval would be gained for noise barriers. Municipalities are often reluctant to allow noise barriers higher than 3 m in the vicinity of residential development, but 4 m may be feasible if residential dwellings are not directly adjacent*

A buffer is considered impractical due to the degree of attenuation required; in this case a suitable buffer would need to provide approximately 330 m distance between the substation site and the development site, much more than the separation distance that exists between the substation and existing dwellings.

Additional noise mitigation options could also include:

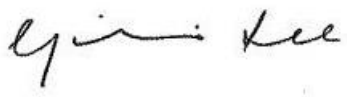
- provision of a suitable chiller enclosure to attenuate noise, in conjunction with other mitigation treatments to the transformers
- localised screening around the transformers and chiller on site
- building forms on the proposed development site could be used to provide screening to the subject site from their built form, provided they are at least two storeys high, constructed as terraces with no space between, and utilise closed facades which do not include any openable elements (i.e. any windows would need to be fixed closed on the interfaces with the substation site. However, it is noted that the townhouses-as-barrier approach may not be consistent with the developer's preference to provide low-density housing on the development site.

The selected noise mitigation treatment will need to be decided in conjunction with Powercor and Urban Quarter, should the mitigation involve changes to the Powercor site (e.g. replacement of plant, or construction of screening devices). However, it is considered that there are a range of mitigation options that could allow compliance with the NIRV criteria for day, evening and night periods at the development site.

Commentary has also been provided in relation to existing dwellings close to the substation site, which should be considered in any discussion regarding noise mitigation as some screening forms such as barriers or buildings have the potential to increase noise levels at existing dwellings due to reflections.

Yours faithfully

MARSHALL DAY ACOUSTICS PTY LTD



Gillian Lee

Associate

APPENDIX A GLOSSARY OF ACOUSTIC TERMS

A-weighting	The process by which noise levels are corrected to account for the non-linear frequency response of the human ear.
dB	Decibel. The unit of sound level.
Ambient	The ambient noise level is the noise level measured in the absence of the intrusive noise or the noise requiring control. Ambient noise levels are frequently measured to determine the situation prior to the addition of a new noise source.
L_{Aeq}	The equivalent continuous sound level. This is commonly referred to as the average noise level and is measured in dBA.
L_{A90}	The noise level exceeded for 90% of the measurement period, measured in dBA. This is commonly referred to as the background noise level.
L_w (or SWL)	Sound Power Level. The level of total sound power radiated by a sound source.

APPENDIX B NOISE CRITERIA

B1 Noise from Industry in Regional Victoria (NIRV) – Description

NIRV policy framework

The relevant guidelines for noise from industrial operations in regional Victoria are the EPA Publication 1411 *Noise from Industry in Regional Victoria (*NIRV). The guidelines came into effect in October 2011 and replace the former Information Bulletin N3/89 Interim guidelines for control of noise from industry in country Victoria (N3/89).

NIRV is a non-statutory guideline. This approach is applied in regional Victoria because the unique characteristics of rural areas, such as generally low ambient noise levels and large location-constrained, resource-based industries, mean that noise limits cannot always be achieved.

NIRV recommended maximum noise levels

NIRV provides recommended maximum noise levels (recommended levels) for existing and proposed industry.

The NIRV recommended levels for this site have been calculated by following the procedure outlined in Section 3.1 of NIRV Publication 1411 *Recommended maximum noise levels – general commerce, industry and trade*. Accordingly, the recommended maximum noise levels have been derived as shown in Table 1 with the applicable time periods.

Table 3: Applicable NIRV recommended levels

Period	Day	Evening	Night
Applicable time period	Mon-Fri 0700-1800hrs Sat 0700-1300hrs	Mon-Fri 1800-2200hrs Sat 1300-2200hrs Sun 0700-2200hrs	Mon-Sun 2200-0700hrs
Recommended levels	**46**	**41**	**36**