LIGHT HORSE INTERCHANGE BUSINESS HUB

State Significant Development Application (SSDA 9667)
Noise and Vibration Impact Assessment

Prepared for:

Western Sydney Parklands Trust
PO Box 3064
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BASIS OF REPORT

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

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SLR disclaims any responsibility to the Client and others in respect of any matters outside the agreed scope of the work.

DOCUMENT CONTROL

Reference	Date	Prepared	Checked	Authorised
610.18514-R02-v1.0	26 March 2019	Joshua Ridgway	Robert Hall	Robert Hall

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1 Introduction

Western Sydney Parklands Trust (WSPT) is proposing to develop a new industrial business hub adjacent to the Light Horse Interchange in Eastern Creek.

SLR Consulting Australia Pty Ltd (SLR) has been engaged by WSPT to prepare a Noise Impact Assessment (NIA) for Light Horse Interchange Business Hub (the development) to assess the potential noise impacts associated with the operation and construction of the project. This report forms part of the State Significant Development Application (SSDA) for the development.

This report addresses the Secretary's Environmental Assessment Requirements (SEARs) relevant to the development (SSD 9967) issued on 7 November 2018. Refer to **Section 4.1** for SEARs relevant to the noise and vibration assessment.

This report summarises the results of ambient noise measurements undertaken at the site and assesses the potential noise impacts on the surrounding sensitive receivers from construction and operation of the development.

The assessment uses specific acoustic terminology. An explanation of common terms is included in **Appendix A**.

2 Project Description

2.1 Development Layout

The development site is located to the southeast of the Light Horse Interchange, adjacent to the M4 and M7 Motorways. The development will consist of twelve warehouses situated across seven lots, along with associated offices, hardstands, parking and landscaping.

The development site is surrounded primarily by other commercial/industrial estates, along with the Sydney Motorsport Park to the east. A small number of isolated residential receivers are located to the north of the development site adjacent to Pikes Lane on Western Sydney Parklands land, and a private suburban residential area is located to the northwest.

The locations of the development and surrounding receivers are shown in **Figure 1**, with the proposed development layout shown in **Figure 2** and **Figure 3**.

Figure 1 Development Location, Sensitive Receivers Areas and Modelled Buildings

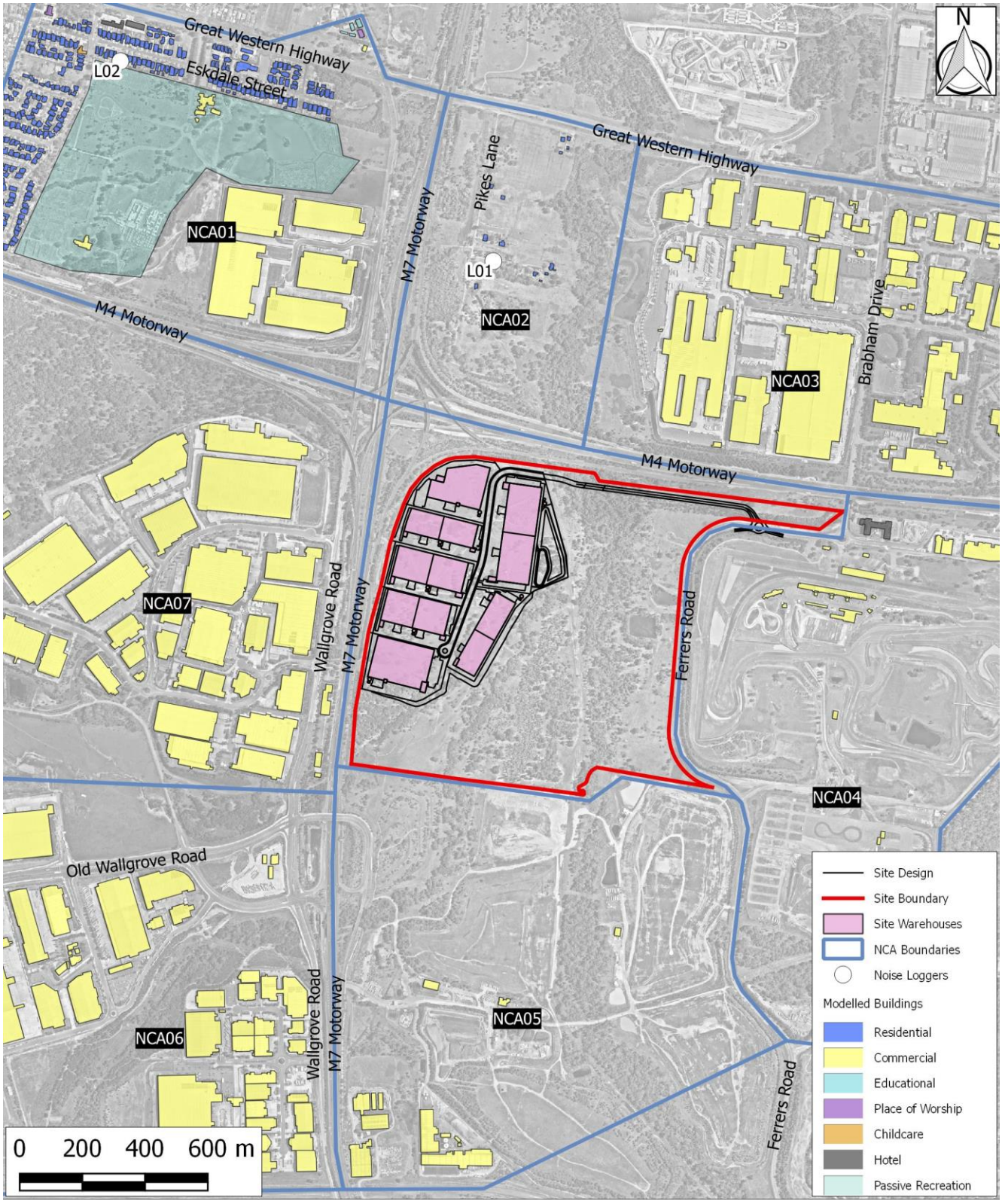
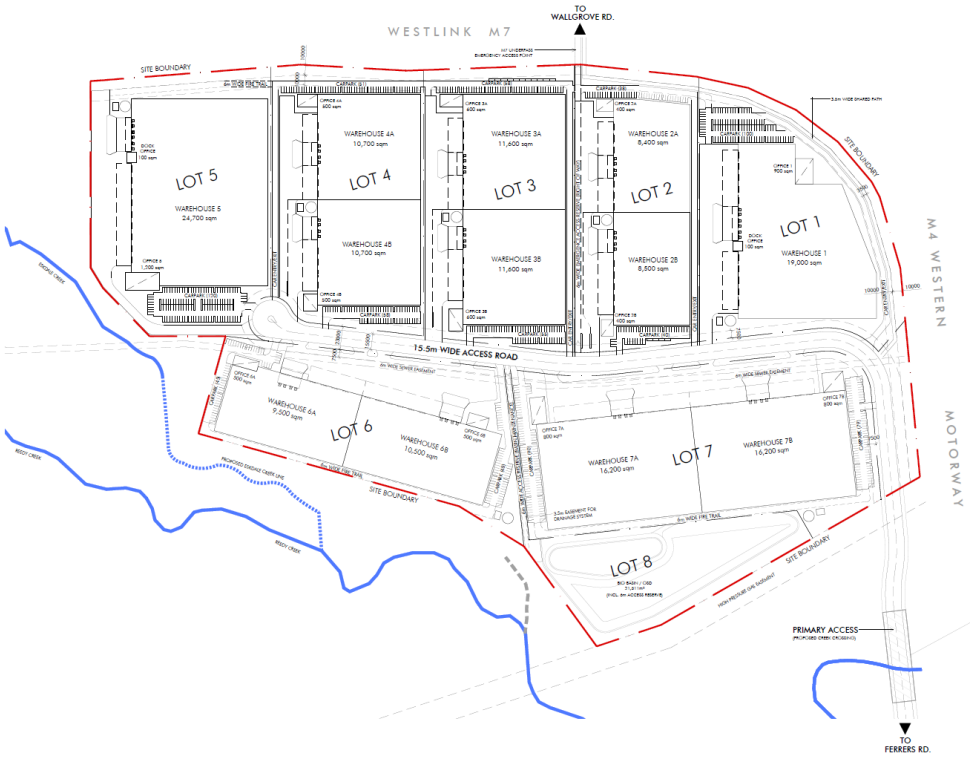


Figure 2 Proposed Development Layout

Note 1: Drawing provided by WSPT, dated March 2019.

Figure 3 Proposed Warehouse Layout

DEVELOPMENT DATA			
OVERALL SITE AREA			336,287m²
LOT 8 (RESIDUAL) - ESTATE BIO-BASIN/OSD			21,511m²
ACCESS ROAD RESERVE			21,127m²
TOTAL DEVELOPABLE AREA (LOT 1 TO 7)			293,639m²
TOTAL BUILDING AREA			165,500m²
FLOOR SPACE RATIO			56.4%
DEVELOPABLE LOT	W/H AREA	OFFICE AREA	TOTAL
LOT 1 SITE AREA (41,370m²)	19,000	1,000	20,000
LOT 2 SITE AREA (24,141m²)	16,900	800	17,700
LOT 3 SITE AREA (41,112m²)	33,200	1,200	34,400
LOT 4 SITE AREA (38,686m²)	21,400	1,000	22,400
LOT 5 SITE AREA (44,192m²)	24,700	1,300	26,000
LOT 6 SITE AREA (38,406m²)	20,000	1,000	21,000
LOT 7 SITE AREA (55,831m²)	20,400	1,600	34,000
TOTAL	157,600	7,900	165,500
CARPARK PROVISIONS			
TOTAL CARPARK REQUIRED			723 spaces
TOTAL CARPARK PROVIDED			787 spaces



Note 1: Drawing provided by WSPT, dated March 2019.

2.2 Operating Hours

Operating hours for the development are proposed to be 24 hours per day. Deliveries to and from the site could occur at any time during the opening hours, on any day of the week.

The identified sources of noise from the proposed facility include:

- Mechanical plant
- Internal warehouse operations
- Operation of the loading docks (hardstands)
- Truck and light vehicle movements on hardstands and in parking areas

The parking lots and hardstands for the development are adjacent to each warehouse with the main estate road running through the middle of the development. The primary access to the development is via a new estate road from Ferrers Road to the east of the development. An emergency-only access point is proposed on the western side of the development linking directly to Wallgrove Road via an existing underpass.

2.3 Nearest Sensitive Receivers

The area surrounding the development has been divided into seven Noise Catchment Areas (NCAs). The NCAs are representative of the different sensitive receiver types in the vicinity of the development.

The NCAs and sensitive receivers in the area around the development are detailed in **Table 1** and are shown in **Figure 1**.

Table 1 Sensitive Receivers

NCA	Direction from Development	Distance from Development to Closest Receiver	Description
NCA01	Northwest	500 m to commercial 950 m to other sensitive 1,150 m to residential	The closest receiver group in this area is a commercial/industrial estate located adjacent to the M4 and M7 Motorways. The suburban residential area of Minchinbury is located towards the rear of the NCA, south of Great Western Highway. St Anthony's Early Learning Centre (childcare), Iglesia Ni Cristo (place of worship) and Voyager Motel (hotel) are located in the north of the NCA amongst the residential receivers. Pinegrove Cemetery (passive recreation) is located between the commercial estate and the Minchinbury residential area. Eastern Creek Public School (educational) and Mount Saione Christian Centre (place of worship) are located to the north of Great Western Highway.
NCA02	North	500 m to residential	Several isolated residential receivers are located adjacent to Pikes Lane in the Western Sydney Parklands in this NCA.
NCA03	Northeast	150 m to commercial	This NCA comprises of several commercial/industrial estates.
NCA04	East	200 m to commercial 250 m to hotel	The Sydney Motorsport Park covers most of this NCA. The Alpha Hotel and a small commercial/industrial estate is located in the north of the NCA adjacent to Peter Brock Drive.
NCA05	South	850 m to commercial	This NCA comprises of the Eastern Creek Waste Management Centre and a commercial/industrial estate further to the south.
NCA06	Southwest	600 m to commercial	This NCA comprises of several commercial/industrial estates.
NCA07	West	100 m to commercial	This NCA comprises of several commercial/industrial estates.

3 Existing Environment

3.1 Unattended Ambient Noise Monitoring

Unattended noise monitoring was completed at the nearest residential receivers on Pikes Lane, Eastern Creek (NCA02) and Eskdale Street, Minchinbury (NCA01) in December 2018 to measure the existing ambient noise environment of the area.

The noise logger locations were selected with consideration of other noise sources which may influence the measurements, security of noise monitoring equipment and gaining access permission from residents and landowners.

Calibration of the loggers was checked prior to and following measurements, and drift in calibration did not exceed acceptable tolerances. All equipment carried appropriate and current NATA (or manufacturer) calibration certificates.

The measured data was processed with reference to the NSW EPA's *Noise Policy for Industry* (NPfI) and the data was filtered to remove extraneous noise events and periods affected by adverse weather conditions, based on Bureau of Meteorology automated weather station data (Horsley Park AWS 67119). A summary of the background noise monitoring locations and results are provided in **Table 2** and **Table 3**, and are shown in **Figure 1**.

Table 2 Ambient Noise Monitoring Locations

Noise Monitoring Location ID	Location Address	Representative Receiver Area	Monitoring Dates	Location Details
L01	51 Pikes Lane, Eastern Creek	NCA02	6 December 2018 to 17 December 2018	Noise logger deployed in open area adjacent to residence entrance driveway.
L02	60 Eskdale Street, Minchinbury	NCA01	6 December 2018 to 14 December 2018	Noise logger deployed in rear yard (southern side) of residence.

Table 3 Summary of Ambient Noise Levels

Location ID	Address	Measured Noise Level (dBA)[1]					
		Daytime		Evening		Night-time	
		RBL	LAeq	RBL	LAeq	RBL	LAeq
L01	51 Pikes Lane, Eastern Creek	47	52	47	51	41	52
L02	60 Eskdale Street, Minchinbury	41	50	43	50	38	46

Note 1: The Rating Background Levels (RBLs) and LAeq noise levels have been obtained from the measured data using the calculation procedures outlined in the NPfI.

Note 2: NPfI time periods – Day: 7:00 am to 6:00 pm Monday to Saturday, 8:00 am to 6:00 pm Sundays and public holidays; Evening: 6:00 pm to 10:00 pm; Night: the remaining periods.

Daily graphs representing the measured noise levels are contained in **Appendix B**. The graphs represent each 24 hour period during the survey and show the L_{Amax}, L_{A10}, L_{Aeq} and L_{A90} noise levels in 15-minute intervals.

3.2 Attended Noise Monitoring

Short-term attended noise monitoring was conducted on-site on Thursday 6 December 2018. The purpose of the attended measurements was to determine the various contributors to the acoustic environment. A summary of the attended monitoring is provided in **Appendix B**.

The attended measurements indicated that the ambient noise levels at L01 were dominated by road traffic noise from Great Western Highway to the north, M7 Motorway to the west and M4 Motorway to the south. Ambient noise levels at L02 were dominated by road traffic noise from M4 Motorway to the south and Great Western Highway to the north.

It is noted that existing industrial noise sources in the vicinity of the measurement locations were not audible during the attended noise monitoring.

3.3 Prevailing Weather Conditions

Certain meteorological/weather conditions can increase noise levels. This can occur during temperature inversions (where temperatures increase with height above ground level), or where there is a wind gradient (where wind speed increases with height).

In order to determine the prevailing weather conditions for the development area, 12 months of weather data (January to December 2016) was obtained from the Bureau of Meteorology automatic weather station at Horsley Park, which is approximately 5 km to the south of the development. This data was analysed to determine the frequency of noise-enhancing wind and temperature inversion conditions which may affect noise levels at the site.

3.3.1 Wind

Wind has the potential to increase noise at a receiver when it is light and stable, and blows from the direction of the source of noise to the receiver. At higher wind speeds, the noise produced by the wind can obscure noise generated from industrial and transport sources.

Wind effects need to be considered where wind is a feature of the project area. The NPfI states that where wind blows from the source to the receiver at speeds up to 3 m/s for more than 30% of the daytime, evening or night-time in any season, then wind is considered to be a feature of the area and noise level predictions must be made under these conditions.

The measured weather data was analysed to determine the frequency of occurrence of wind speeds up to 3 m/s in each period. The results of the wind analysis for the daytime, evening and night-time periods are presented in **Table 4**, **Table 5** and **Table 6**, respectively. In each table, the wind direction and percentage occurrence are those dominant during each season.

Table 4 Seasonal Frequency of Occurrence of Wind Speed Intervals in 2016 – Daytime

Season	Dominant Wind Direction	Frequency of Occurrence			
		Calm	Up to 2 m/s	2 to 3 m/s	Up to 3 m/s
Annual	N	10.2%	14.7%	5.7%	20.4%
Summer	NNE	11.2%	14.3%	7.3%	21.6%
Autumn	N	10.9%	15.9%	5.9%	21.8%
Winter	NW	12.8%	18.8%	5.6%	24.4%

Table 5 Seasonal Frequency of Occurrence of Wind Speed Intervals in 2016 – Evening

Season	Dominant Wind Direction	Frequency of Occurrence			
		Calm	Up to 2 m/s	2 to 3 m/s	Up to 3 m/s
Annual	ESE	17.8%	9.1%	6.1%	15.2%
Summer	E	9.5%	10.4%	10.3%	20.8%
Autumn	S	25.4%	12.1%	6.3%	18.4%
Winter	WSW	24.1%	15.3%	8.2%	23.5%

Table 6 Seasonal Frequency of Occurrence of Wind Speed Intervals in 2016 – Night-time

Season	Dominant Wind Direction	Frequency of Occurrence			
		Calm	Up to 2 m/s	2 to 3 m/s	Up to 3 m/s
Annual	SW	37.8%	17.9%	8.7%	26.6%
Summer	SSW	42.0%	18.7%	8.8%	27.5%
Autumn	SW, WSW	44.0%	21.0%, 20.7%	10.6%,9.7%	**31.6%, 30.3%**
Winter	WSW	32.1%	17.6%	9.9%	27.5%

The above indicates that during the daytime and evening periods, winds of up to 3 m/s did not exceed the 30% threshold during any season. However, the 30% threshold was exceeded during the night-time period in autumn, in both the SW and WSW directions.

On this basis, assessment of noise-enhancing weather during the daytime and evening periods is not required.

3.3.2 Temperature Inversions

Temperature inversions have the ability to increase noise levels by focusing sound waves towards sensitive receivers. Temperature inversions occur predominantly at night-time when the atmosphere is stable and temperatures are cooler. For a noise-enhancing temperature inversion to be a significant characteristic of the area, the NPfI requires it to occur for at least 30% of the total night-time during a season. This equates to approximately two nights per week.

There are seven atmospheric stability classes, ranging from extremely stable to extremely unstable, and these are shown in **Table 7**.

Table 7 Description of Atmospheric Stability Classes

Atmospheric Stability Class	Category Description
A	Extremely unstable
B	Moderately unstable
C	Slightly unstable
D	Neutral
E	Slightly stable
F	Moderately stable
G	Extremely stable

The measured weather data has been analysed to determine the frequency of occurrence of each stability class and is presented in **Table 8**. Noise-enhancing temperature inversions are categorised as atmospheric stability Class F or Class G.

Table 8 Night-time Stability Class Distribution – 2016

Stability Class	Frequency of Occurrence				
	Annual	Summer	Autumn	Winter	Spring
A	0.0%	0.0%	0.0%	0.0%	0.0%
B	0.0%	0.0%	0.0%	0.0%	0.0%
C	0.0%	0.0%	0.0%	0.0%	0.0%
D	39.5%	37.4%	34.7%	45.2%	41.5%
E	12.0%	11.7%	10.5%	12.4%	13.6%
F	12.9%	11.2%	13.7%	14.0%	12.9%
G	**35.5%**	**39.7%**	**41.1%**	28.5%	**32.0%**
F+G	**48.4%**	**50.9%**	**54.8%**	**42.4%**	**44.9%**

The above indicates that temperature inversions of Class F or Class G occur more than 30% of the night-time period during all four seasons. Therefore, noise-enhancing temperature inversions are required to be included in the assessment of noise impacts during the night-time period.

4 Noise and Vibration Assessment Criteria

4.1 Secretary's Environmental Assessment Requirements (SEARs)

The requirements of the project SEARs (SSD 9967) in relation to noise are reproduced in **Table 9**.

Table 9 Project SEARs (SSD 9967) Relevant to Noise and Vibration

Requirement	Where Addressed in this Document
The EIS must address the following specific matters: • **Noise and Vibration** – including:	Noted
• A quantitative noise and vibration impact assessment undertaken by a suitably qualified person in accordance with the relevant Environment Protection Authority guidelines and including an assessment of nearby sensitive receivers.	Construction noise and vibration – refer to **Section 5** Operational noise – refer to **Section 6**
• Cumulative impacts of other developments.	Refer to **Section 6.2**
• Details of proposed mitigation, management and monitoring measures.	Construction mitigation measures – refer to **Section 5.6** Operational mitigation measures – refer to **Section 6.3**

4.2 Construction Noise Guidelines

4.2.1 NSW Interim Construction Noise Guideline (ICNG)

The NSW *Interim Construction Noise Guideline* (ICNG) sets out ways to assess and manage the impacts of construction noise on residences and other sensitive land uses in NSW. The ICNG contains procedures for determining project specific Noise Management Levels (NMLs) for sensitive receivers based on the existing background noise in the area.

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

4.2.1.1 Residential Receivers

The approach provided in the ICNG for determining NMLs for a project at residential receivers is presented in **Table 10**.

More stringent requirements are placed on works that are completed outside of Standard Construction Hours which reflects the greater sensitivity of communities to noise impacts during these periods.

Table 10 Determination of NMLs for Residential Receivers

Time of Day	NML $L_{Aeq(15minute)}$[1]	How to Apply
Standard hours Monday to Friday 7:00 am to 6:00 pm Saturday 8:00 am to 1:00 pm No work on Sundays or public holidays	RBL + 10 dBA	• The noise affected level represents the point above which there may be some community reaction to noise. • Where the predicted or measured $L_{Aeq(15minute)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practises to meet the noise affected level. • The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.

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

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

Note 1 The RBL is the overall single-figure background noise level measured in each relevant assessment period (during or outside the recommended standard hours). The term RBL is described in detail in the NSW *Noise Policy for Industry*.

4.2.1.2 Sleep Disturbance

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

The ICNG lists five categories of works that may be required to be undertaken outside the recommended standard hours:

- The delivery of oversized equipment or structures that require special arrangements to transport on public roads
- Emergency work to avoid the loss of life or damage to property, or to prevent environmental harm
- Maintenance and repair of public infrastructure where disruption to essential services and/or considerations of worker safety do not allow work within standard hours
- Public infrastructure works that shorten the length of the project and are supported by the affected community.
- Works where a proponent demonstrates and justifies a need to operate outside the recommended standard hours.

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

A method for assessing sleep disturbance is contained in the EPA's *Noise Policy for Industry* (NPfI). Although the NPfI sleep disturbance criteria relates to industrial noise, it is also considered relevant for reviewing potential impacts from construction noise as a screening criteria to identify the need for further assessment.

The NPfI notes that a detailed maximum noise level assessment should be undertaken where a project results in night-time noise levels which exceed:

- 52 dBA L_{AFmax} or the prevailing background level plus 15 dB, whichever is the greater.

For this assessment, the existing background level plus 15 dB approach has been used.

4.2.1.3 Summary of Residential NMLs

The residential NMLs for the project have been determined using the background noise monitoring and are shown in **Table 11**.

Table 11 Residential Receiver Construction NMLs

NCA	Representative Background Monitoring Location	NML ($L_{Aeq(15minute)}$ – dBA)				Sleep Disturbance Screening Level (RBL+15 dB) (L_{Amax} dBA)
		Standard Construction Hours (RBL+10dB)	Out of Hours (RBL+5dB)			
		Daytime	Daytime	Evening	Night-time	Night-time
NCA01	L02	51	46	46[1]	43	53
NCA02	L01	57	52	52	46	56

Note 1: Where the evening RBL is higher than the daytime RBL, the daytime RBL has been adopted.

Note 2: No residential receivers are located in NCA03 to NCA07.

4.2.1.4 Other Sensitive Land Uses and Commercial Receivers

A number of non-residential land uses have been identified in the study area. These include 'other sensitive' land uses, such as educational institutes, childcare centres, places of worship and outdoor recreational areas, and commercial and industrial premises. The NMLs recommended in the ICNG for other sensitive receivers are shown in **Table 12**.

Table 12 ICNG NMLs for Other Sensitive Receivers

Land Use	NML $L_{Aeq(15minute)}$ (Applied when property is in use)
Classrooms at schools and other education institutions	Internal noise level 45 dBA[1]
Places of Worship	Internal noise level 45 dBA[1]
Active recreation areas (characterised by sporting activities and activities which generate their own noise or focus for participants)	External noise level 65 dBA
Passive recreation areas (characterised by contemplative activities that generate little noise and where benefits are compromised by external noise intrusion)	External noise level 60 dBA
Commercial	External noise level 70 dBA
Industrial	External noise level 75 dBA

Note 1: The criterion is specified as an internal noise level for this receiver category. As the noise model predicts external noise levels, it has been conservatively assumed that all schools and places of worship have openable windows and external noise levels are therefore 10 dB higher than the corresponding internal level, which is generally considered representative of windows being partially open for ventilation.

The ICNG references AS 2107 for criteria for other sensitive receivers which are not listed in the guideline. The AS2107 NMLs for other sensitive receivers are shown in **Table 13**.

Table 13 AS2107 NMLs for Other Sensitive Receivers

Use	Period	AS2107 Classification	NML $L_{Aeq(15minute)}$
Hotel	When in use	Hotels and motels (sleeping areas)	Internal noise level 40 dBA[1]

Note 1: It has been conservatively assumed that these receivers have openable windows and external noise levels are therefore 10 dB higher than the corresponding internal level.

The ICNG and AS2107 do not provide specific guideline noise levels for childcare centres. Childcare centres generally have internal play areas and sleeping areas. For internal play areas an internal NML of 55 dBA LAeq(15minute) has been adopted together with an internal NML of 40 dBA LAeq(15minute) (when in use) for sleeping areas.

On the assumption that windows and doors of childcare centres may be opened, an external NML of 65 dBA $L_{Aeq(15minute)}$ for play areas has been applied at the facade and would also be applicable to external play areas. For sleeping areas on the assumption that windows are open, an external NML of 50 dBA $L_{Aeq(15minute)}$ has been applied. Given specific layouts for childcare centres are unknown during the preparation of the NIA, a NML of 50 dBA has been used to assess construction noise impacts to childcare centres.

4.3 Construction Road Traffic Noise Guidelines

The potential impacts from construction traffic on public roads are assessed under the NSW EPA *Road Noise Policy* (RNP) and Roads and Maritime *Construction Noise and Vibration Guideline* (CNVG).

To assess noise impacts that may result from construction traffic, an initial screening test is first applied to evaluate if existing road traffic noise levels are expected to increase by more than 2 dB with the addition of construction traffic at nearby residential and other sensitive receivers. Where this is considered likely further assessment is required using the RNP base criteria shown in **Table 14**.

Table 14 RNP Criteria for Assessing Construction Vehicles on Public Roads

Road Category	Type of Project/Land Use	Assessment Criteria (dBA)	
		Daytime (7 am - 10 pm)	**Night-time (10 pm - 7 am)**
Freeway/ arterial/ sub-arterial roads	Existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments	$L_{Aeq(15hour)}$ 60 (external)	$L_{Aeq(9hour)}$ 55 (external)
Local roads	Existing residences affected by additional traffic on existing local roads generated by land use developments	$L_{Aeq(1hour)}$ 55 (external)	$L_{Aeq(1hour)}$ 50 (external)

4.4 Construction Ground-borne Noise Guidelines

Construction works can cause ground-borne noise impacts in nearby buildings when vibration generating equipment is in use. Vibration can be transmitted through the ground and into the structure of nearby buildings, which can then create audible noise impacts inside buildings. The ICNG provides evening and night-time ground-borne noise NMLs for residences to protect the amenity and sleep of residents. The ICNG ground-borne noise NMLs are:

- Evening $L_{Aeq(15minute)}$ 40 dBA
- Night-time $L_{Aeq(15minute)}$ 35 dBA

The NMLs only apply where internal ground-borne noise levels are higher than noise transmitted through the air. This situation can occur where buildings near to construction works have high performing facades which attenuate the airborne component or where sensitive internal areas do not have facades which face the construction works.

4.5 Construction Vibration Guidelines

The effects of vibration on buildings can be divided into three main categories:

- Those in which the occupants or users of the building are inconvenienced or possibly disturbed
- Those where the building contents may be affected
- Those in which the integrity of the building or the structure itself may be prejudiced.

4.5.1 Human Comfort Vibration

People can perceive vibration impacts when vibration generating construction works are located close to occupied buildings.

Vibration from construction works tends to be intermittent in nature and the EPA's *Assessing Vibration: a technical guideline* (2006) provides criteria for intermittent vibration based on the Vibration Dose Value (VDV). The 'preferred' and 'maximum' VDVs for human comfort impacts are shown in **Table 15**. Vibration generating activities should be designed to achieve the preferred values where an area is not already exposed to vibration. Where all feasible and reasonable measures have been applied, values up to the maximum may be used.

Table 15 Vibration Dose Values for Intermittent Vibration

Building Types	Assessment Period	Vibration Dose Value ($m/s^{1.75}$)	
		Preferred	**Maximum**
Critical Working Areas (eg hospital operating theatres, precision laboratories)	Day or Night-time	0.10	0.20
Residential	Daytime	0.20	0.40
	Night-time	0.13	0.26
Offices, schools, educational institutions and places of worship	Day or Night-time	0.40	0.80

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

4.5.2 Effects on Building Contents

Humans perceive vibration at levels well below those likely to cause damage to building contents. For most receivers, the human comfort vibration criteria are the most stringent and it is generally not necessary to set separate criteria for vibration effects on typical building contents.

Exceptions to this can occur when vibration sensitive equipment, such as electron microscopes which can have more stringent vibration requirements than those for human comfort, are located in buildings near to construction works. No such receivers have been identified in the study area.

4.5.3 Structural and Cosmetic Damage Vibration

If vibration from construction works is high enough it can cause damage to structural elements of affected buildings. The levels of vibration required to cause cosmetic damage tend to be at least an order of magnitude (10 times) higher than those at which people can perceive vibration. Examples of damage that can occur includes cracks or loosening of drywall surfaces, cracks in supporting columns and loosening of joints.

Structural damage vibration limits are contained in British Standard BS 7385.

BS 7385

British Standard BS 7385 recommends vibration limits for transient vibration which are judged to give a minimal risk of vibration induced damage to effected buildings. The limits for residential and industrial buildings are shown in **Table 16**.

Table 16 Transient Vibration Guide Values – Minimal Risk of Cosmetic Damage

Line	Type of Building	Peak Component Particle Velocity in Frequency Range of Predominant Pulse	
		4 Hz to 15 Hz	**15 Hz and Above**
1	Reinforced or framed structures. Industrial and heavy commercial buildings	50 mm/s at 4 Hz and above	
2	Unreinforced or light framed structures. Residential or light commercial type buildings	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above

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

For heritage buildings, the standard states that "a building of historical value should not (unless it is structurally unsound) be assumed to be more sensitive".

4.5.4 Minimum Working Distances for Vibration Intensive Works

Minimum working distances for typical vibration intensive construction equipment are provided in the CNVG and are summarised in **Table 17**. The minimum working distances are for both cosmetic damage (from BS 7358) and human comfort (from the NSW EPA Vibration Guideline) and are based on empirical data which suggests that where works are further from receivers than the quoted minimum distances then impacts are not considered likely.

Table 17 Recommended Minimum Working Distances from Vibration Intensive Equipment

Plant Item	Rating / Description	Minimum Distance	
		Cosmetic Damage (BS 7385)	**Human Response (NSW EPA Guideline)**
Vibratory Roller	< 50 kN (Typically 1-2t)	5 m	15 m to 20 m
	< 100 kN (Typically 2-4t)	6 m	20 m
	< 200 kN (Typically 4-6t)	12 m	40 m
	< 300 kN (Typically 7-13t)	15 m	100 m
	> 300 kN (Typically 13-18t)	20 m	100 m
	> 300 kN (Typically > 18t)	25 m	100 m
Small Hydraulic Hammer	300 kg - 5 to 12t excavator	2 m	7 m
Medium Hydraulic Hammer	900 kg - 12 to 18t excavator	7 m	23 m
Large Hydraulic Hammer	1600 kg - 18 to 34t excavator	22 m	73 m
Vibratory Pile Driver	Sheet piles	2 m to 20 m	20 to 100 m
Pile Boring	≤ 800 mm	2 m (nominal)	4 m
Jackhammer	Hand held	1 m (nominal)	2 m

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

4.6 Operational Noise Guidelines

4.6.1 Noise Policy for Industry

The *Noise Policy for Industry* (NPfI) was released in 2017 and sets out the NSW Environment Protection Authority's (EPA's) requirements for the assessment and management of noise from industry in NSW.

4.6.1.1 Trigger Levels

The NPfI describes 'trigger levels' which indicate the noise level at which feasible and reasonable noise management measures should be considered. Two forms of noise criteria are provided – one to account for 'intrusive' noise impacts and one to protect the 'amenity' of particular land uses.

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

For this assessment, the area surrounding the proposal is considered to be 'urban'. The NPfI specifies an 'urban' area as one which:

- is dominated by 'urban hum' or industrial source noise, where urban hum means the aggregate sound of many unidentifiable, mostly traffic and/or industrial related sound sources
- has through-traffic with characteristically heavy and continuous flows during peak periods
- is near commercial districts or industrial districts
- has any combination of the above.

4.6.1.2 Project Specific Criteria

The noise emission trigger levels for industrial noise generated by the facility are provided in **Table 18**. The Project Noise Trigger Level (PNTL) is the lowest value of the intrusiveness or amenity noise level for each period and are shown below in bold.

Table 18 Project Trigger Noise Levels

NCA	Receiver Type	Period	Recommended Amenity Noise Level $L_{Aeq(period)}$ (dBA)	Measured Noise Level (dBA)		Project Noise Trigger Levels $L_{Aeq(15minute)}$ (dBA)	
				RBL[1]	$L_{Aeq(period)}$	Intrusiveness	Amenity[2,3]
NCA01	Residential	Day	60	41	50	**46**	58
		Evening	50	41[4] (43 actual)	50	**46**	48
		Night	45	38	46	**43**	43
NCA02	Residential	Day	60	47	52	**52**	58
		Evening	50	47	51	52	**48**
		Night	45	41	52	46	**43**
NCA01	Childcare[5,6]	When in use	50	n/a	n/a	n/a	**48**
NCA01	Educational[5]	When in use	45	n/a	n/a	n/a	**43**
NCA01	Place of Worship[5]	When in use	50	n/a	n/a	n/a	**48**
NCA01, NCA04	Hotel[5,7]	Day	65	n/a	n/a	n/a	**63**
		Evening	55	n/a	n/a	n/a	**53**
		Night	50	n/a	n/a	n/a	**48**
NCA01	Passive Recreation	When in use	50	n/a	50[8]	n/a	**48**
All	Commercial	When in use	65	n/a	n/a	n/a	**63**

Note 1: RBL = Rating Background Level.

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

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

Note 4: RBL reduced to be no higher than the daytime RBL.

Note 5: The criterion is specified as an internal noise level for this receiver category. As the noise model predicts external noise levels, it has been conservatively assumed that all schools and places of worship have openable windows and external noise levels are therefore 10 dB higher than the corresponding internal level, which is generally considered representative of windows being partially open for ventilation.

Note 6: The NPfI and AS2107 do not provide specific guideline noise levels for childcare centres, as such an internal criteria of 40 dBA $L_{Aeq(15minute)}$ has been adopted.

Note 7: Recommended amenity noise level set at 5 dBA above relevant residential recommended amenity noise level, as outlined in the NPfI.

Note 8: This level is taken to be equal to the measured evening $L_{Aeq(period)}$ noise level at L02.

4.6.2 Sleep Disturbance

Guidance for assessing the potential for sleep disturbance impacts on nearby residences is provided in Section 2.5 of the NPfI, which states:

> *Where the subject development/premises night-time noise levels at a residential location exceed:*
>
> - $L_{Aeq,15min}$ 40 dB(A) or the prevailing RBL plus 5 dB, whichever is the greater, and/or
> - L_{AFmax} 52 dB(A) or the prevailing RBL plus 15 dB, whichever is the greater,
>
> *a detailed maximum noise level event assessment should be undertaken*

Note that the $L_{Aeq(15minute)}$ criteria would be equal to or higher than the Project Noise Trigger Levels outlined in **Table 18**. As such, the assessment against Project Noise Trigger Levels is considered to address this part.

The night-time sleep disturbance L_{Amax} screening noise levels for the residential areas in the vicinity of the development are presented in **Table 19**.

Table 19 Night-time Sleep Disturbance Screening Noise Levels

Residential Receiver Area	Noise Level (dBA)	
	Measured Night-time RBL	Sleep Disturbance Noise Level (L_{Amax})
NCA01	38	53
NCA02	41	56

The NPfI does not contain guidance for assessment of sleep disturbance at hotels. For the purpose of this assessment, sleep disturbance noise level of 10 dBA higher than the applicable recommended amenity noise level for hotels has been adopted.

5 Construction Noise and Vibration Assessment

Exact details on the construction of the development are not currently known at this stage of the project. As such, it has been necessary to make certain assumptions as to the type and location of equipment together with details regarding construction activities. These assumptions are defined in the following sections.

5.1 Construction Works

5.1.1 Working Hours

Where possible, the majority of construction works would be undertaken in accordance with the ICNG during the standard daytime working hours of:

- 7:00 am to 6:00 pm Monday to Friday
- 8:00 am to 1:00 pm on Saturdays.

Limited works may be conducted outside of these hours provided they are managed so as to generate noise levels below the relevant ICNG Noise Management Levels.

5.1.2 Construction Activity Source Noise Levels

General construction activities required to be undertaken in order to construct the development are listed in **Table 20**. Sound power levels for the typical operation of construction equipment used in the modelling have been taken from verified test data and global standards that form part of SLR's noise database.

Table 20 Sound Power Levels for Construction Equipment

ID	Construction Activity	Equipment	Operating minutes in 15-min period[2]	No of items in same location	Sound Power Level LWA (dB)	
					Item	Activity
W.001	Site Clearing and Earthworks	Dozer	15	1	100	116
		Dump Truck (approx. 15 tonne)	15	2	100	
		Excavator (25 tonne)	15	1	102	
		Front End Loader	15	1	112	
		Grader	15	1	108	
		Roller – Vibratory (12 tonne)[1]	15	1	105	
W.002	Construction of Roadways	Bitumen Spray Truck	15	1	100	111
		Line Marking Plant	15	1	98	
		Paving Machine	15	1	104	
		Roller – Vibratory (12 tonne)[1]	15	1	109	

ID	Construction Activity	Equipment	Operating minutes in 15-min period[2]	No of items in same location	Sound Power Level LWA (dB)	
					Item	Activity
W.003	Paving Works including Concrete Pours	Concrete Mixer Truck	7.5	1	106	112
		Concrete Pump	7.5	1	106	
		Concrete Vibrator	15	1	102	
		Paving Machine	15	1	104	
		Roller – Vibratory (12 tonne)[1]	15	1	109	
W.004	Construction of Warehouse and Office Buildings	Elevated Working Platform	15	2	97	107
		Flatbed Truck	15	1	100	
		Hand Tools (Electric)	15	4	96	
		Mobile Crane (100 tonne)	15	1	101	
W.005	Landscaping and Finishing Works	Hydromulching Equipment	15	1	97	102
		Skidsteer Loaders (approx 0.5 tonne)	15	1	97	
		Light Vehicle (Ute/4WD)	15	1	98	

Note 1: In accordance with the ICNG, for activities identified as particularly annoying (such as jackhammering, rock breaking and power saw operations), a 5 dB 'penalty' is added to the source sound power level when predicting noise using the quantitative method.

Note 2: This refers to the amount of time in minutes that individual items of equipment would be in use for during the worst-case 15 minute assessment period, based on site observations. Some items of plant, such as Concrete Pumps, are not typically used in a continuous manner.

5.2 Construction Airborne Noise Assessment

SoundPLAN has been used for modelling the airborne noise emissions from construction of the development using the ISO 9613 noise prediction algorithms. The three-dimensional model includes ground topography, buildings and representative noise sources.

5.2.1 Predicted Construction Airborne Noise Levels

A summary of the predicted noise levels (without additional mitigation) for each of the closest residential receivers for the various work activities is presented in **Table 21**.

A qualitative description of the NML exceedance bands is given below, noting that the impact of these potential exceedances would depend on the period in which they were to occur:

- Noise levels 1 to 10 dB above NML – impact would typically be marginal to minor
- Noise levels 11 dB to 20 dB above NML – impact would typically be moderate
- Noise levels >20 dB above NML – impact would typically be high

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

Table 21 Predicted Worst-Case Construction Airborne Noise Levels

NCA	Receiver Type	Period	NML	Predicted Noise Level - $L_{Aeq(15\ minutes)}$ (dBA)				
				W.001	W.002	W.003	W.004	W.005
NCA01	Residential	Daytime – Standard Hours	51	46	41	42	37	32
		Daytime – OOH	46	46	41	42	37	32
		Evening	46	46	41	42	37	32
		Night-time	43	46	41	42	37	32
	Childcare	When in use	50	39	34	35	30	<30
	Educational	When in use	55	43	38	39	34	<30
	Place of Worship	When in use	55	43	38	39	34	<30
	Hotel	When in use	50	42	37	38	33	<30
	Passive Recreation	When in use	60	45	40	41	36	31
	Commercial	When in use	70	51	46	47	42	37
NCA02	Residential	Daytime – Standard Hours	57	55	50	51	46	41
		Daytime – OOH	52	55	50	51	46	41
		Evening	52	55	50	51	46	41
		Night-time	46	55	50	51	46	41
NCA03	Commercial	When in use	70	61	56	57	52	47
NCA04	Hotel	When in use	50	58	53	54	49	44
	Commercial	When in use	70	57	52	53	48	43
NCA05	Commercial	When in use	70	44	39	40	35	30
NCA06	Commercial	When in use	70	47	42	43	38	33
NCA07	Commercial	When in use	70	56	51	52	47	42

Note 1: Green cell colour indicates noise levels 1 to 10 dB above NML; Yellow cell colour indicates noise levels 11 to 20 dB above NML; Red cell colour indicates noise levels >20 dB above NML.

Construction airborne noise levels up to 58 dBA are predicted at the nearest sensitive receivers.

No exceedances of the NMLs during daytime standard hours are predicted at any of the surrounding residential receivers during any of the works. No residential receivers are predicted to be Highly Noise Affected (>75 dBA).

Minor exceedances of the Out of Hours NMLs of up to 9 dBA are predicted at the nearest residential receivers during W.001 (site clearing and earthworks), W.002 (construction of roadways), and W.003 (paving works including concrete pours). However, it is understood that generally these works would not be conducted outside of standard construction hours.

Minor exceedances of the NMLs of up to 8 dBA at the hotel in NCA04 are predicted during W.001 (site clearing and earthworks), W.002 (construction of roadways), and W.003 (paving works including concrete pours).

No exceedances of the NMLs are predicted at other sensitive receivers during any period during any of the works.

Implementation of feasible and reasonable construction noise mitigation measures should be undertaken where exceedances of the NMLs are predicted. Construction noise and vibration mitigation measures are discussed in **Section 5.6**.

5.3 Construction Road Traffic Noise Assessment

The construction road traffic (heavy vehicles and employee vehicles) is anticipated to access the site from the north via Great Western Highway, Brabham Drive and Ferrers Road, and from the south via Horsley Drive and Ferrers Road.

Peak construction vehicle volumes are expected to be approximately 35 vehicle movements per hour (volumes provided by WSPT). This is anticipated to be split into 25 vehicles from the north and 10 vehicles from the south.

Existing peak traffic volumes on the construction routes has been extracted from the Traffic Impact Assessment (TIA) prepared by Ason Group (Ref 0541r03, dated 4 December 2018)

Construction road traffic noise predictions are shown in **Table 22**.

Table 22 Construction Traffic Noise Predictions

Road Name	Road Type	Existing Traffic Volume (Peak Hour)	Construction Traffic (Peak Movements)	Predicted Increase in Noise Level (dB)
Great Western Highway	Arterial Road	2,984	25	<0.5
Brabham Drive	Arterial Road	1,754	25	+0.6
Ferrers Road (east of site access)	Arterial Road	1,293	25	+0.6
Ferrers Road (south of site access)	Arterial Road	1,293	10	<0.5
Horsley Drive	Arterial Road	2,307	10	<0.5

Based on the above, the proposed construction traffic is predicted to result in a minimal increase in the overall traffic noise levels along the construction vehicle routes to the development.

Note that this is assessment is based on the peak vehicle movements and peak hour traffic, as this was the data available at the time of this assessment. During the rest of the daytime period when existing vehicle volumes are lower, increases in overall traffic noise levels due to construction traffic have the potential to be marginally higher than those outlined in the table above.

5.4 Construction Ground-borne Noise

Construction works can cause ground-borne noise impacts in nearby buildings when vibration generating equipment is in use. Ground-borne noise impacts should be considered where the ground-borne noise levels are higher than noise transmitted through the air, such as where buildings near to construction works have high performing facades which attenuate the airborne component.

The majority of receivers are sufficiently distant from the works for ground-borne noise impacts to be minimal. Due to the surface nature of the construction works for the development, airborne noise levels would typically be dominant over the ground-borne component where receivers are located near to construction works.

5.5 Construction Vibration Assessment

Vibration intensive items of plant proposed for use during the construction of the development would include vibratory rollers. These items of equipment are proposed to be used during site clearing and earthworks, construction of roadways, and paving works including concrete pours.

The nearest existing vibration sensitive receivers to the development construction works are commercial receivers located over 100 m to the west of the development. As such, there are no vibration sensitive receivers located within the minimum working distances outlined in **Table 17**. The separation distance between the works location and the nearest vibration sensitive receivers is considered sufficient to mitigate potential vibration generated from the site and specific vibration mitigation measures are not required.

5.6 Construction Noise and Vibration Mitigation Measures

The ICNG acknowledges that due to the nature of construction works it is inevitable that there will be impacts where construction is near to sensitive receivers. Examples of potential mitigation and management measures which could be applied to the project to minimise the impacts are provided below.

Specific strategies would be determined as the project progresses and detailed in the Construction Management Plan (CMP) for the project before any works begin. This plan provides a detailed assessment of the potential impacts from the work and define the site specific mitigation and management measures to be used to control the impacts, particularly where evening or night-time works are required.

5.6.1 Standard Mitigation

The Roads and Maritime Construction Noise and Vibration Guideline (CNVG) contains a number of standard measures for mitigating and managing construction impacts on development projects.

The measures are shown in **Table 23** and should be applied where feasible and reasonable to minimise the impacts from the works as far as practicable.

Table 23 Recommended Standard Mitigation and Management Measures

Action Required	Applies To	Details
Management Measures		
Implementation of any project specific mitigation measures required.	Airborne noise	Implementation of any project specific mitigation measures required.
Implement community consultation or notification measures.	Airborne noise Ground-borne noise & vibration	Notification detailing work activities, dates and hours, impacts and mitigation measures, indication of work schedule over the night time period, any operational noise benefits from the works (where applicable) and contact telephone number. Notification should be a minimum of 7 calendar days prior to the start of works. For projects other than maintenance works more advanced consultation or notification may be required. Please contact Roads and Maritime Communication and Stakeholder Engagement for guidance. Website (If required) Contact telephone number for community Email distribution list (if required) Community drop in session (if required by approval conditions).
Site inductions	Airborne noise Ground-borne noise & vibration	All employees, contractors and subcontractors are to receive an environmental induction. The induction must at least include: • all project specific and relevant standard noise and vibration mitigation measures • relevant licence and approval conditions • permissible hours of work • any limitations on high noise generating activities • location of nearest sensitive receivers • construction employee parking areas • designated loading/unloading areas and procedures • site opening/closing times (including deliveries) • environmental incident procedures.
Behavioural practices	Airborne noise	No swearing or unnecessary shouting or loud stereos/radios on site. No dropping of materials from height, throwing of metal items and slamming of doors.
Verification	Airborne noise Ground-borne noise & vibration	Where specified under Appendix C of the CNVG a noise verification program is to be carried out for the duration of the works in accordance with the Construction Noise and Vibration Management Plan and any approval and licence conditions.
Attended vibration measurements	Ground-borne vibration	Where required attended vibration measurements should be undertaken at the commencement of vibration generating activities to confirm that vibration levels are within the acceptable range to prevent cosmetic building damage.
Update Construction Environmental Management Plans	Airborne noise Ground-borne noise & vibration	The CEMP must be regularly updated to account for changes in noise and vibration management issues and strategies.
Building condition surveys	Vibration Blasting	Undertake building dilapidation surveys on all buildings located within the buffer zone prior to commencement of activities with the potential to cause property damage
Source Controls		
Construction hours and scheduling.	Airborne noise Ground-borne noise & vibration	Where feasible and reasonable, construction should be carried out during the standard daytime working hours. Work generating high noise and/or vibration levels should be scheduled during less sensitive time periods.

Action Required	Applies To	Details
Construction respite period during normal hours and out-of-hours work	Ground-borne noise & vibration Airborne noise	See Appendix C of the CNVG for more details on the following respite measures: • Respite Offers (RO) • Respite Period 1 (R1) • Respite Period 2 (R2) • Duration Respite (DR)
Equipment selection.	Airborne noise Ground-borne noise & vibration	Use quieter and less vibration emitting construction methods where feasible and reasonable. For example, when piling is required, bored piles rather than impact-driven piles will minimise noise and vibration impacts. Similarly, diaphragm wall construction techniques, in lieu of sheet piling, will have significant noise and vibration benefits. Ensure plant including the silencer is well maintained.
Plant noise levels.	Airborne-noise	The noise levels of plant and equipment must have operating Sound Power or Sound Pressure Levels compliant with the criteria in Appendix H of the CNVG. Implement a noise monitoring audit program to ensure equipment remains within the more stringent of the manufacturers specifications or Appendix H of the CNVG.
Rental plant and equipment.	Airborne-noise	The noise levels of plant and equipment items are to be considered in rental decisions and in any case cannot be used on site unless compliant with the criteria in Table 2 of the CNVG.
Use and siting of plant.	Airborne-noise	The offset distance between noisy plant and adjacent sensitive receivers is to be maximised. Plant used intermittently to be throttled down or shut down. Noise-emitting plant to be directed away from sensitive receivers. Only have necessary equipment on site.
Plan worksites and activities to minimise noise and vibration.	Airborne noise Ground-borne vibration	Locate compounds away from sensitive receivers and discourage access from local roads. Plan traffic flow, parking and loading/unloading areas to minimise reversing movements within the site. Where additional activities or plant may only result in a marginal noise increase and speed up works, consider limiting duration of impact by concentrating noisy activities at one location and move to another as quickly as possible. Very noise activities should be scheduled for normal working hours. If the work cannot be undertaken during the day, it should be completed before 11:00 pm. Where practicable, work should be scheduled to avoid major student examination periods when students are studying for examinations such as before or during Higher School Certificate and at the end of higher education semesters. If programmed night work is postponed the work should be re-programmed and the approaches in this guideline apply again.
Reduced equipment power	Airborne noise Ground-borne vibration	Use only the necessary size and power
Non-tonal and ambient sensitive reversing alarms	Airborne noise	Non-tonal reversing beepers (or an equivalent mechanism) must be fitted and used on all construction vehicles and mobile plant regularly used on site and for any out of hours work. Consider the use of ambient sensitive alarms that adjust output relative to the ambient noise level.

Action Required	Applies To	Details
Minimise disturbance arising from delivery of goods to construction sites.	Airborne noise	Loading and unloading of materials/deliveries is to occur as far as possible from sensitive receivers. Select site access points and roads as far as possible away from sensitive receivers. Dedicated loading/unloading areas to be shielded if close to sensitive receivers. Delivery vehicles to be fitted with straps rather than chains for unloading, wherever possible. Avoid or minimise these out of hours movements where possible.
Blasting regime	Airborne noise Ground-borne vibration	The noise and vibration impacts of blasting operations can be minimised by: • Choosing the appropriate blast charge configurations • Ensuring appropriate blast-hole preparation • Optimising blast design, location, orientation and spacing • Selecting appropriate blast times, and • Utilising knowledge of prevailing meteorological conditions. • AS 2187.2 Explosives-Storage, transport and use, Part 2: Use of Explosives provides more detailed advice on ground vibration and airblast overpressure impact minimisation options.
Engine compression brakes	Construction vehicles	Limit the use of engine compression brakes at night and in residential areas. Ensure vehicles are fitted with a maintained Original Equipment Manufacturer exhaust silencer or a silencer that complies with the National Transport Commission's 'In-service test procedure' and standard.
Path Controls		
Shield stationary noise sources such as pumps, compressors, fans etc.	Airborne noise	Stationary noise sources should be enclosed or shielded where feasible and reasonable whilst ensuring that the occupational health and safety of workers is maintained. Appendix D of AS 2436:2010 lists materials suitable for shielding.
Shield sensitive receivers from noisy activities.	Airborne noise	Use structures to shield residential receivers from noise such as site shed placement; earth bunds; fencing; erection of operational stage noise barriers (where practicable) and consideration of site topography when situating plant.
Receptor Control		
Structural surveys and vibration monitoring	Ground-borne vibration	Pre-construction surveys of the structural integrity of vibration sensitive buildings may be warranted. At locations where there are high-risk receptors, vibration monitoring should be conducted during the activities causing vibration.
See Appendix C of the CNVG for additional measures	Airborne noise Ground-borne vibration	In some instances additional mitigation measures may be required.

6 Operational Noise Assessment

Exact details on the various uses of the development are not currently known at this stage of the project. As such, it has been necessary to make certain assumptions as to the type and location of equipment together with details regarding operational measures. These assumptions are defined in the following sections.

6.1 Operational Noise Modelling

SoundPLAN has been used for modelling the noise emissions from the operation of the development using the Concawe industrial noise prediction algorithms. The three-dimensional model includes ground topography, buildings and representative noise sources.

Based on the analysis of prevailing weather conditions (refer to **Section 3.3**), the noise model includes neutral weather conditions during the daytime and evening periods, with noise-enhancing weather conditions during the night-time period, using an F-class temperature inversion with a 2 m/s source to receiver drainage flow.

6.1.1 Noise Model Inputs

In order to assess the operational noise impacts from the development, worst-case peak light and heavy vehicle movements have been modelled. Light vehicles have been modelled on the estate roads and in the car parking areas, and heavy vehicles on the estate roads and in the hardstand areas.

Vehicle volumes were provided by WSPT, taken from the Traffic Impact Assessment (TIA) prepared by Ason Group (Ref 0541r03, dated 4 December 2018). The following assumptions have been adopted based the information provided:

- Total vehicle movements per day – 7,078
- AM Peak (Daytime) – 420 vehicle movements, 80% arrivals, 20% departures
- PM Peak (Evening) – 340 vehicle movements, 20% arrivals, 80% departures
- Night-time Peak – approximately 30% of AM Peak volumes, ie 126 vehicle movements.
- Light vehicles comprise 72% of the total vehicles, with heavy vehicles the remaining 28%.
- Vehicle trips originate from the northwest (54%), north (20%), south (20%) and east (6%).
- All light and heavy vehicles access the site via the Ferrers Road entrance.
- Emergency access only via the Wallgrove Road entrance.

Based on the above, the modelled vehicle volumes have been divided amongst the warehouses onsite based on the floor area of each warehouse, ie bigger warehouses have more vehicle movements assigned to them than smaller warehouses.

The peak 1-hour volumes outlined above were further broken down to peak 15-minute volumes in order to assess the noise emissions against the NPfI criteria. The peak 1-hour volumes have been assumed to be spread evenly across each 15 minute period.

External forklift movements (ie outside of the warehouses) have been modelled in the at-grade dock areas of the hardstands (approximately 12 forklifts). It has been assumed that forklifts would operate continuously during any one 15-minute period. One forklift has been modelled operating externally in the hardstand areas for each of the ten warehouses.

Sound power levels and speed assumptions for the modelled vehicle movements are outlined in **Table 24**.

Table 24 Sound Power Levels for Onsite Vehicle Movements

Noise Source	Sound Power Level (SWL)	Average Speed
Heavy Vehicles	103 dBA[1]	25 km/h
Light Vehicles	96 dBA	40 km/h
Gas-powered Forklifts[2]	93 dBA	n/a

Note 1: Based on SLR's noise measurement database, this sound power level is typical of trucks travelling at low speeds, such as within industrial estates.

Note 2: If electric forklifts are proposed for the development, noise emissions from forklifts would be considerably lower than gas-powered forklifts.

External fixed plant has been conservatively modelled on the warehouse rooftops (approximately 28 units). Rooftop fixed plant units have been modelled with an assumed SWL of 90 dBA per unit.

In order to assess the possibility of sleep disturbance, in addition to the above noise sources, heavy vehicle brake releases and reverse alarms (non-tonal) have been modelled in the hardstand areas of the development with a sound power level (SWL) of 115 dBA.

6.2 Predicted Operational Noise Impacts

The predicted operational noise levels at the nearest receivers from industrial noise emissions are summarised in **Table 25**.

Table 25 Predicted Operational Noise Levels – Most-affected Receiver

NCA	Receiver Type	Period (weather)	$L_{Aeq(15\ minutes)}$ Noise Level (dBA)			Compliance?
			Project Noise Trigger Level	Predicted	Exceedance	
NCA01	Residential	Daytime (neutral)	46	32	-	Yes
		Evening (neutral)	46	32	-	Yes
		Night-time (neutral)	43	30	-	Yes
		Night-time (noise-enhancing)	*43*	*33*	-	*Yes*
	Childcare	Daytime (neutral)	48	<30	-	Yes
		Evening (neutral)	48	<30	-	Yes
		Night-time	n/a	n/a	-	Yes

NCA	Receiver Type	Period (weather)	$L_{Aeq(15\ minutes)}$ Noise Level (dBA)			Compliance?
			Project Noise Trigger Level	Predicted	Exceedance	
	Educational	Daytime (neutral)	43	<30	-	Yes
		Evening (neutral)	43	<30	-	Yes
		Night-time	n/a	n/a	-	Yes
	Place of Worship	Daytime (neutral)	48	<30	-	Yes
		Evening (neutral)	48	<30	-	Yes
		Night-time	n/a	n/a	-	Yes
	Hotel	Daytime (neutral)	63	<30	-	Yes
		Evening (neutral)	53	<30	-	Yes
		Night-time	48	<30	-	Yes
		Night-time (noise-enhancing)	*48*	*<30*	-	*Yes*
	Passive Recreation	Daytime (neutral)	48	30	-	Yes
		Evening (neutral)	48	30	-	Yes
		Night-time	n/a	n/a	-	Yes
	Commercial	Daytime (neutral)	63	37	-	Yes
		Evening (neutral)	63	36	-	Yes
		Night-time	n/a	n/a	-	Yes
NCA02	Residential	Daytime (neutral)	52	41	-	Yes
		Evening (neutral)	48	40	-	Yes
		Night-time (neutral)	43	38	-	Yes
		Night-time (noise-enhancing)	*43*	*41*	-	*Yes*
NCA03	Commercial	Daytime (neutral)	63	46	-	Yes
		Evening (neutral)	63	44	-	Yes
		Night-time	n/a	n/a	-	Yes
NCA04	Hotel	Daytime (neutral)	63	42	-	Yes
		Evening (neutral)	53	41	-	Yes
		Night-time	48	37	-	Yes
		Night-time (noise-enhancing)	*48*	*42*	-	*Yes*
	Commercial	Daytime (neutral)	63	41	-	Yes
		Evening (neutral)	63	38	-	Yes
		Night-time	n/a	n/a	-	Yes
NCA05	Commercial	Daytime (neutral)	63	31	-	Yes
		Evening (neutral)	63	30	-	Yes
		Night-time	n/a	n/a	-	Yes

NCA	Receiver Type	Period (weather)	$L_{Aeq(15\ minutes)}$ Noise Level (dBA)			Compliance?
			Project Noise Trigger Level	Predicted	Exceedance	
NCA06	Commercial	Daytime (neutral)	63	34	-	Yes
		Evening (neutral)	63	34	-	Yes
		Night-time	n/a	n/a	-	Yes
NCA07	Commercial	Daytime (neutral)	63	47	-	Yes
		Evening (neutral)	63	47	-	Yes
		Night-time	n/a	n/a	-	Yes

Note 1: **Bold** text indicates an exceedance of the project noise trigger level.

The above shows that operational noise levels from the development are predicted to comply with the project noise trigger levels at all identified sensitive receivers during the all periods under both neutral and noise-enhancing weather conditions.

As such, it is considered that no specific operational noise mitigation measures are required to be implemented.

It is noted that noise from existing industrial noise sources was not audible at the noise monitoring locations during the attended noise measurements. Regardless, the recommended amenity criteria was reduced by 5 dBA as outlined in the NPfI. As such, it is considered that cumulative operational noise impacts from the development and the existing industrial noise sources would not result in exceedance of the cumulative amenity noise criteria.

6.2.1 Sleep Disturbance

The predicted night-time L_{Amax} noise levels at the sensitive receivers in the vicinity of the development are presented in **Table 26**. Note that only receiver types where sleep disturbance is applicable have been included below.

Table 26 Summary of Predicted Sleep Disturbance Noise Levels – Most-affected Receiver

NCA	Receiver Type	Source	L_{AFmax} Noise Level (dBA)			Compliance?
			Criteria	Predicted	Exceedance	
NCA01	Residential	Truck Airbrake	53	37	-	Yes
	Hotel	Truck Airbrake	60	32	-	Yes
NCA02	Residential	Truck Airbrake	56	46	-	Yes
NCA04	Hotel	Truck Airbrake	60	44	-	Yes

The sleep disturbance noise levels are predicted to be below the criteria at all applicable receiver locations.

6.3 Operational Noise Mitigation Measures

As noted in the above sections, operational noise emissions from the development are not predicted to exceed the project noise trigger levels. As such, no specific operational noise mitigation measures (such as noise barriers) are required to be implemented.

Best management practices that would assist in minimising noise emissions from the site would be detailed in the site specific Operational Environmental Management Plan (OEMP) which would be developed before operations commence at the development. This document would have a section detailing any requirements relating to noise emissions from the development.

7 Summary of Impacts

7.1 Construction Noise and Vibration Impacts

7.1.1 Construction Airborne Noise Impacts

Construction airborne noise levels were predicted for five works activities:

- Site clearing, demolition and earthworks.
- Construction of roadways.
- Paving works including concrete pours.
- Construction of warehouse and office buildings.
- Landscaping and finishing works.

Noise levels up to 58 dBA are predicted at the nearest sensitive receivers.

No exceedances of the NMLs during daytime standard hours are predicted at any of the surrounding residential receivers during any of the works.

Minor exceedances of the Out of Hours NMLs of up to 9 dBA are predicted at the nearest residential receivers during site clearing and earthworks, construction of roadways, and paving works including concrete pours.

Minor exceedances of the NMLs of up to 8 dBA at the hotel in NCA04 are predicted during site clearing and earthworks, construction of roadways, and paving works including concrete pours.

No exceedances of the NMLs are predicted at other sensitive receivers during any of the works.

Implementation of feasible and reasonable construction noise mitigation measures should be undertaken where exceedance of the NMLs is predicted. General construction noise and vibration mitigation measures have been recommended in **Section 5.6**.

7.1.2 Construction Road Traffic Noise Impacts

Construction road traffic associated with the development is predicted to result in a minimal increase in the overall traffic noise levels along the construction vehicle routes to the development

7.1.3 Construction Ground-borne Noise Impacts

No ground-borne noise impacts are expected at the nearest sensitive receivers during the construction works.

7.1.4 Construction Vibration Impacts

No vibration impacts are expected at the nearest sensitive receivers during the construction works.

7.2 Operational Noise Impacts

Operational noise emissions associated with the development have been assessed against the appropriate *Noise Policy for Industry* trigger levels.

The assessment of operational noise impacts included modelling of light and heavy vehicle movements on the site, along with forklift operations and indicative fixed mechanical plant.

No exceedance of the project trigger levels are predicted at any of the identified sensitive receivers during any period.

Final details of operations and mechanical plant at the site are also not currently available and the potential noise impacts from the development should be reviewed for each future warehouse DA.

Best management practices that would assist in minimising noise emissions from the site should be adopted where feasible and reasonable.

APPENDIX A

Acoustic Terminology

1 Sound Level or Noise Level

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

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

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

2 'A' Weighted Sound Pressure Level

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

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

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

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

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

3 Sound Power Level

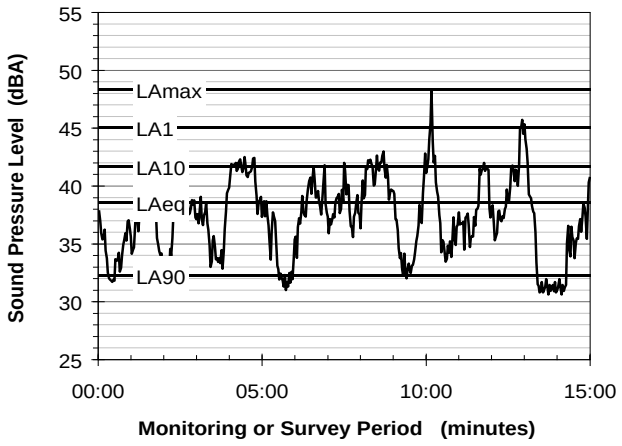
The Sound Power of a source is the rate at which it emits acoustic energy. As with Sound Pressure Levels, Sound Power Levels are expressed in decibel units (dB or dBA), but may be identified by the symbols SWL or Lw, or by the reference unit 10^{-12} W.

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

4 Statistical Noise Levels

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

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



Of particular relevance, are:

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

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

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

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

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

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

5 Tonality

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

6 Impulsiveness

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

7 Frequency Analysis

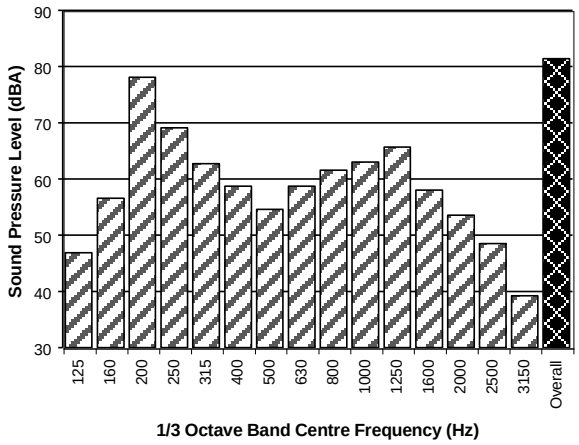
Frequency analysis is the process used to examine the tones (or frequency components) which make up the overall noise or vibration signal. This analysis was traditionally carried out using analogue electronic filters, but is now normally carried out using Fast Fourier Transform (FFT) analysers.

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

Frequency analysis can be in:

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

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



8 Vibration

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

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

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

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

9 Human Perception of Vibration

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

10 Over-Pressure

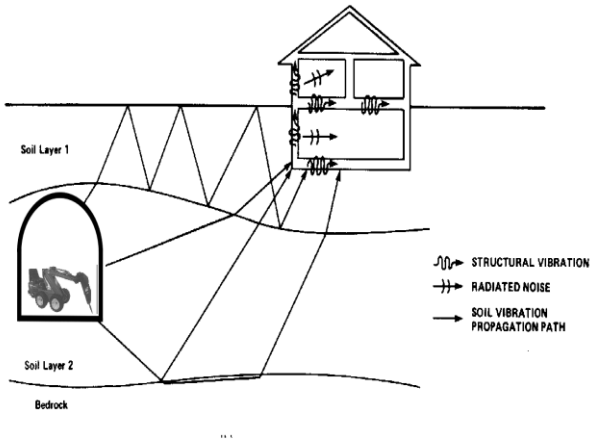
The term 'over-pressure' is used to describe the air pressure pulse emitted during blasting or similar events. The peak level of an event is normally measured using a microphone in the same manner as linear noise (ie unweighted), at frequencies both in and below the audible range.

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

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

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

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



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

APPENDIX B

Noise Monitoring Results

Noise Monitoring Location	L01
Noise Monitoring Address	**51 Pikes Lane, Eastern Creek**

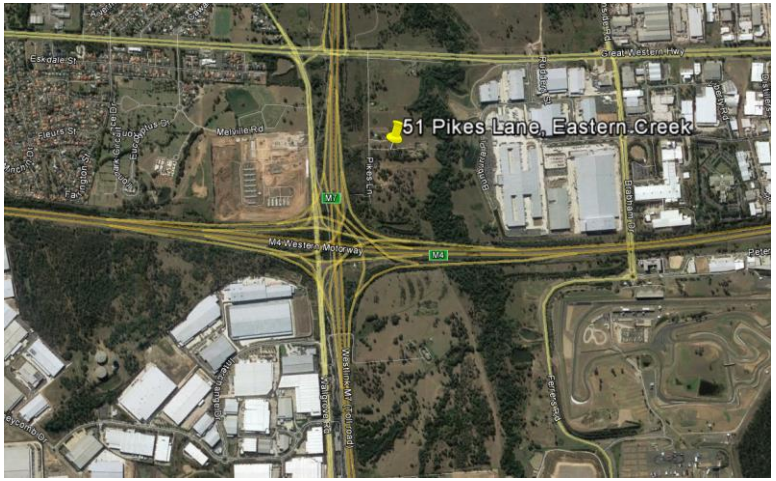
Logger Device Type: Svantek 957, Logger Serial No: 23247
Sound Level Meter Device Type: Brüel and Kjær 2260, Sound Level Meter Serial No: 2414604

Ambient noise logger deployed at residential address 51 Pikes Lane, Eastern Creek. Logger located in an open area approximately 250 m east of M7 Motorway, 450 m north of M4 Motorway and 500 m south of Great Western Highway.

Attended noise measurements indicate the ambient noise environment at this location is dominated by road traffic noise from M7 Motorway, M4 Motorway and Great Western Highway. Nearby animals (birds, rooster) at the residence also contribute to the LAeq at this location.

Recorded Noise Levels (LAmax):
06/12/2018: Road traffic M4/M7/Great Western Hwy: 50-59 dBA, Motorcycle: 61 dBA, Birds: 60-70 dBA, Animals: 55-59 dBA

Map of Noise Monitoring Location



Ambient Noise Logging Results – NPfI Defined Time Periods

Monitoring Period	Noise Level (dBA)			
	RBL	LAeq	L10	L1
Daytime	47	52	53	57
Evening	47	51	52	56
Night-time	41	52	50	54

Ambient Noise Logging Results – RNP Defined Time Periods

Monitoring Period	Noise Level (dBA)	
	LAeq(period)	LAeq(1hour)
Daytime (7am-10pm)	52	54
Night-time (10pm-7am)	53	57

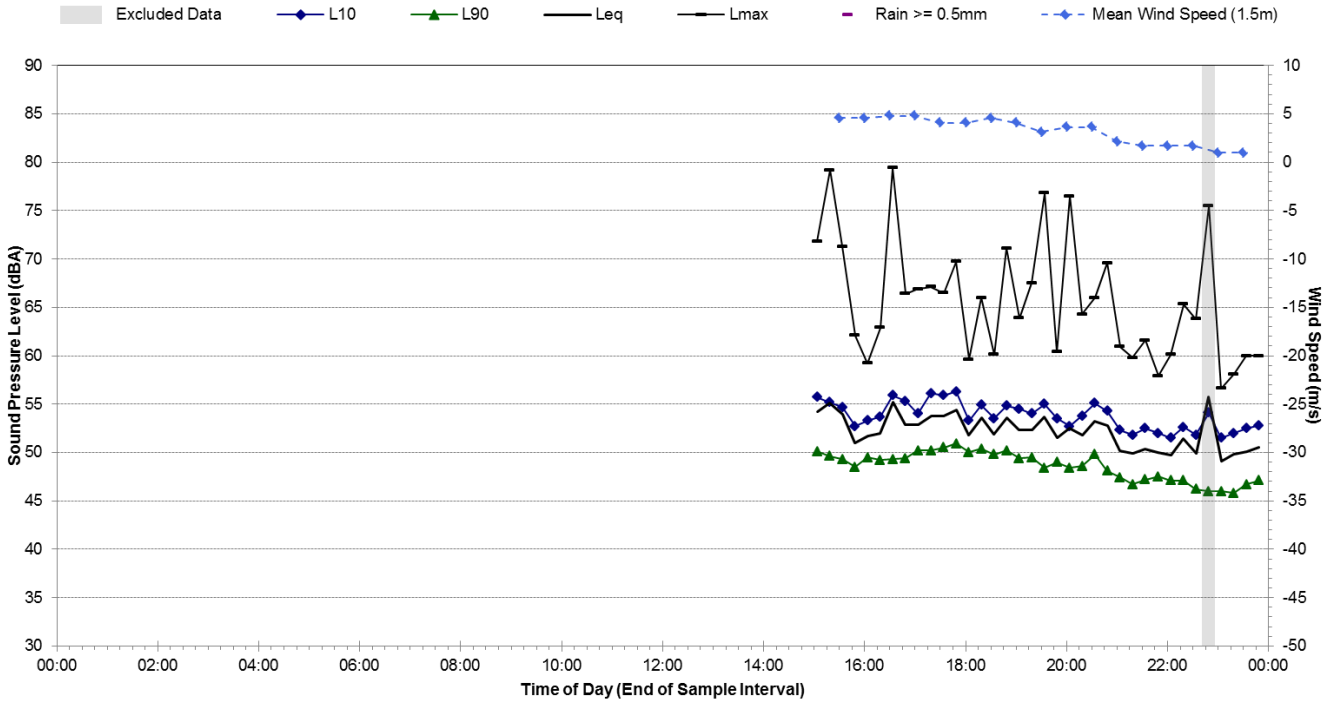
Attended Noise Measurement Results

Date	Start Time	Measured Noise Level (dBA)		
		LA90	LAeq	LAmax
06/12/2018	15:12	50	53	70

Photo of Noise Monitoring Location

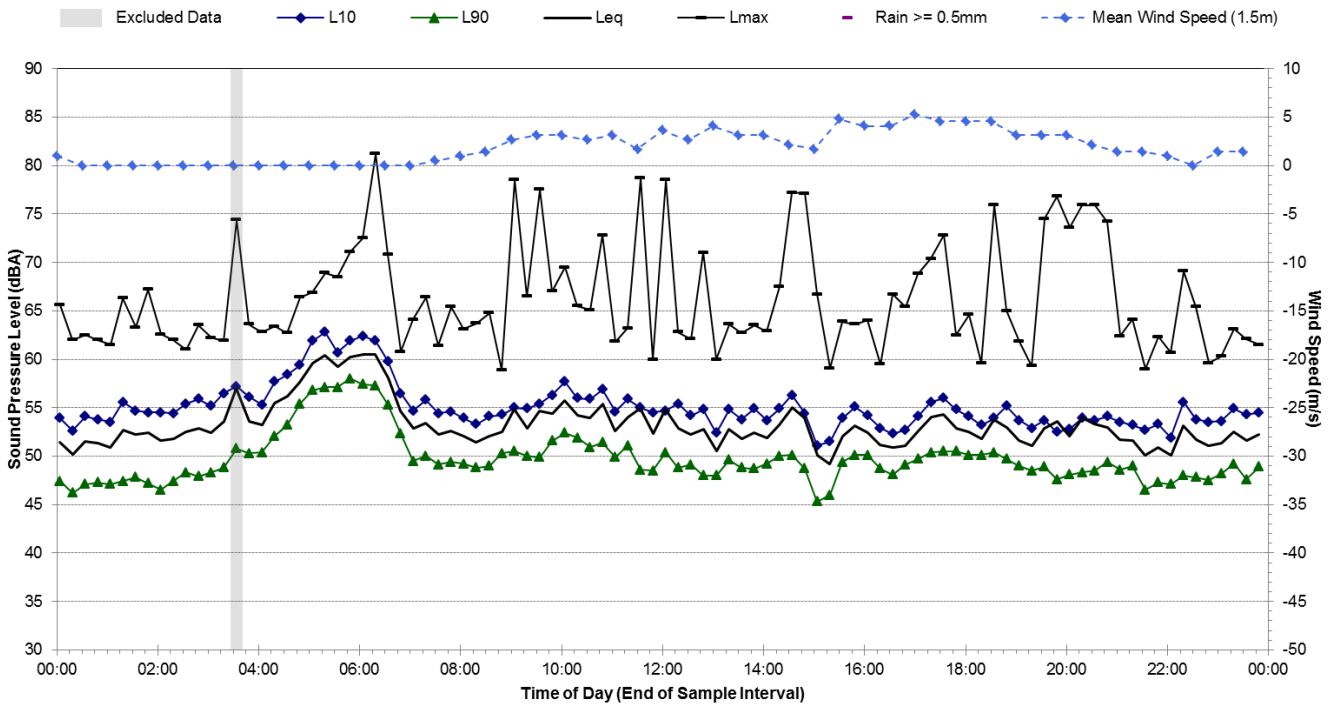
Statistical Ambient Noise Levels

L01 - 51 Pikes Lane, Eastern Creek - Thursday, 6 December 2018



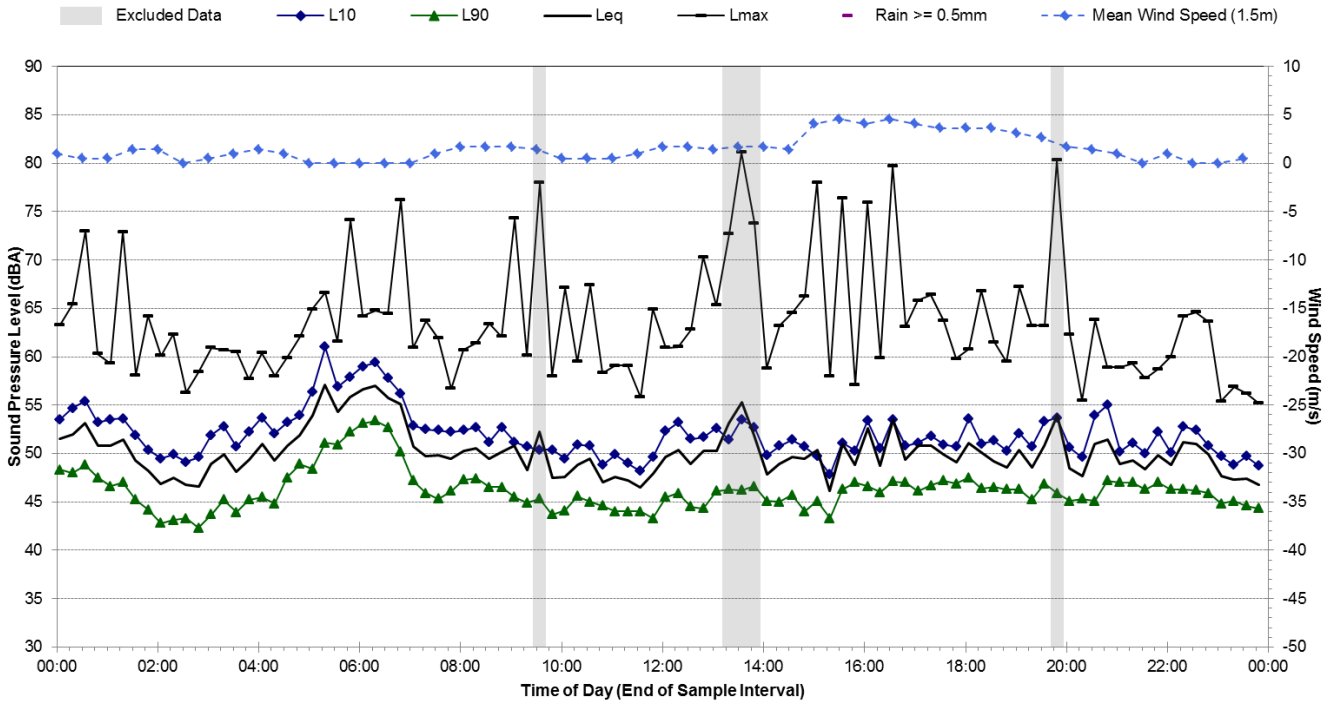
Statistical Ambient Noise Levels

L01 - 51 Pikes Lane, Eastern Creek - Friday, 7 December 2018



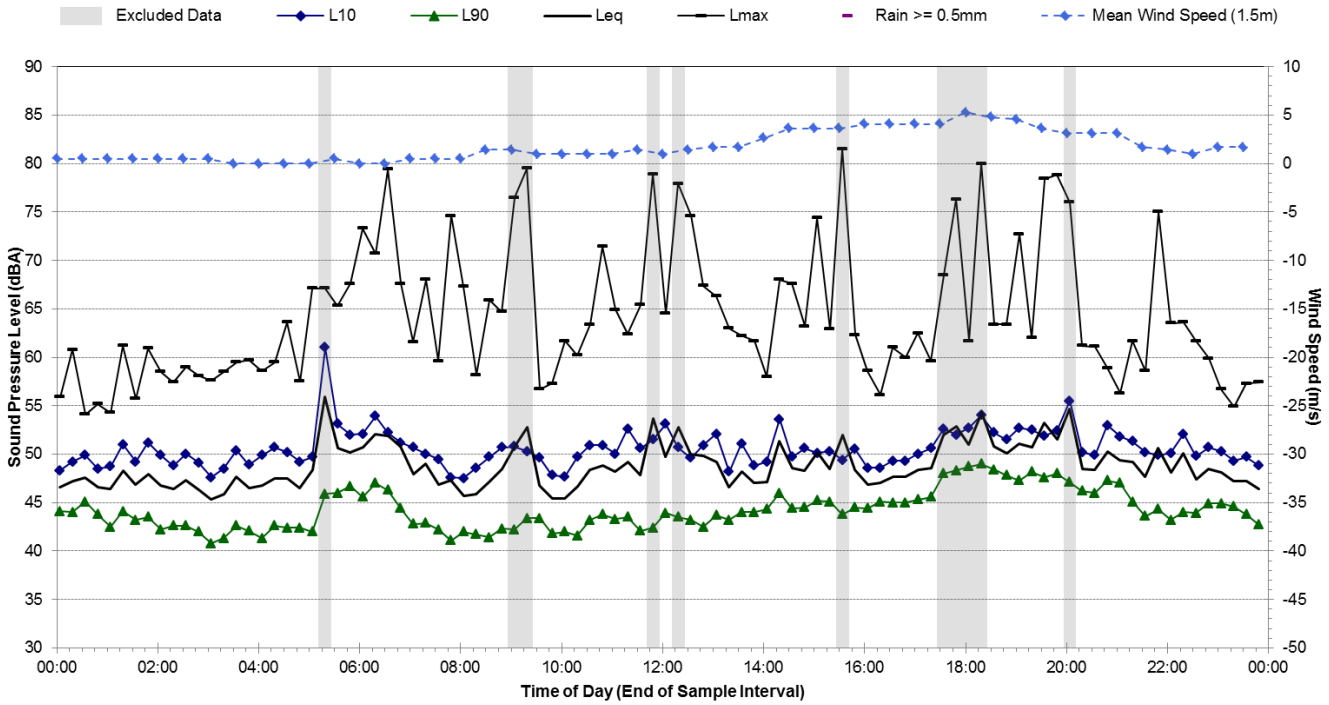
Statistical Ambient Noise Levels

L01 - 51 Pikes Lane, Eastern Creek - Saturday, 8 December 2018



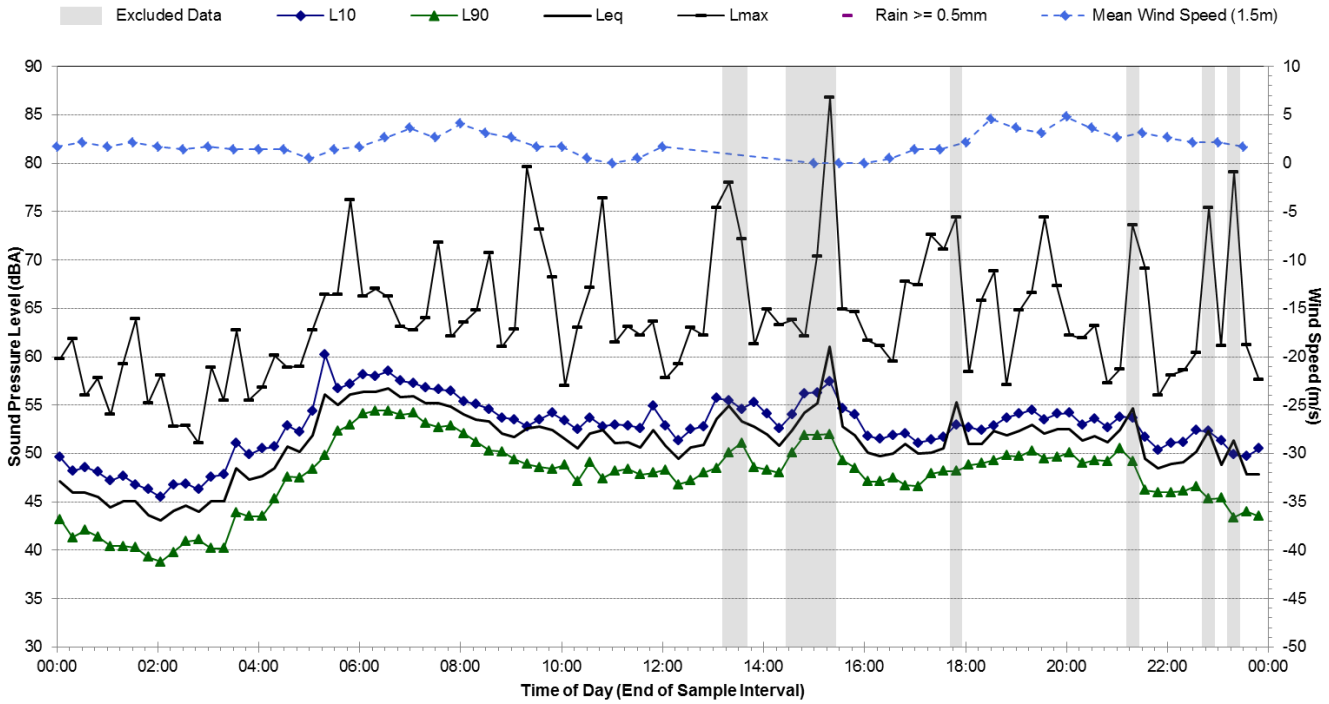
Statistical Ambient Noise Levels

L01 - 51 Pikes Lane, Eastern Creek - Sunday, 9 December 2018



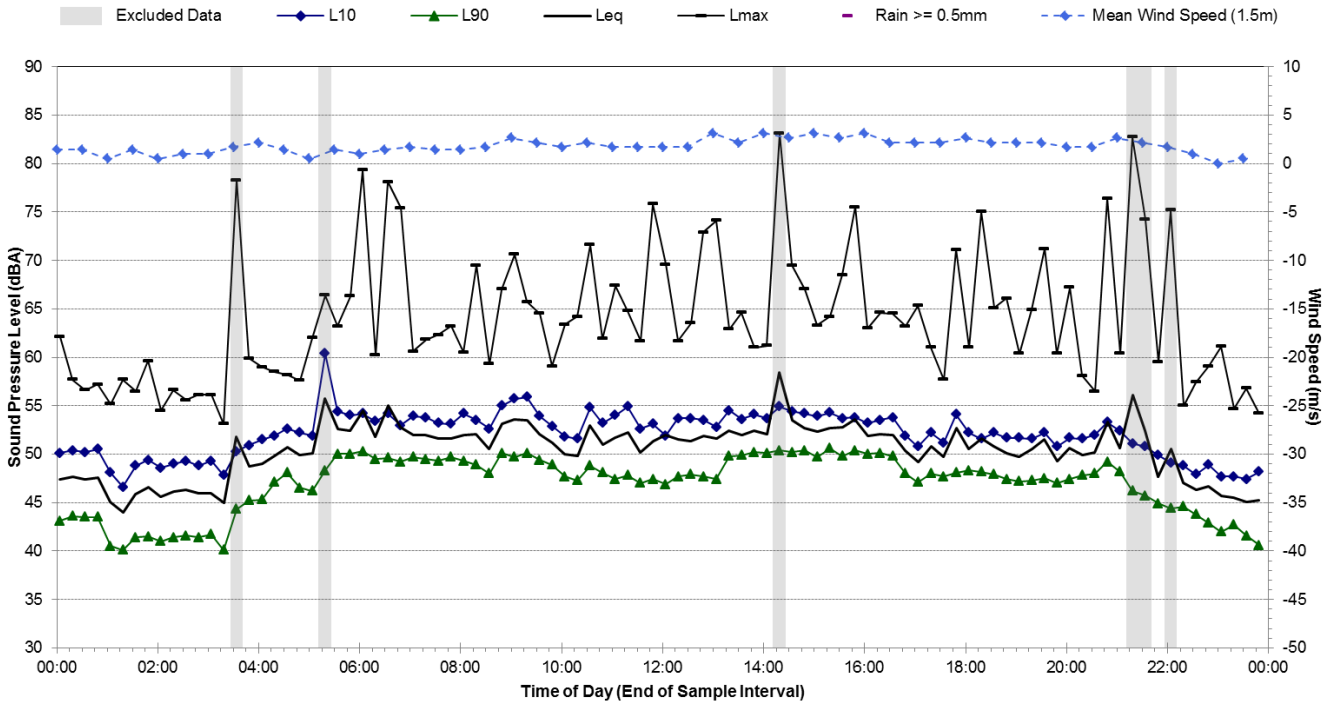
Statistical Ambient Noise Levels

L01 - 51 Pikes Lane, Eastern Creek - Monday, 10 December 2018



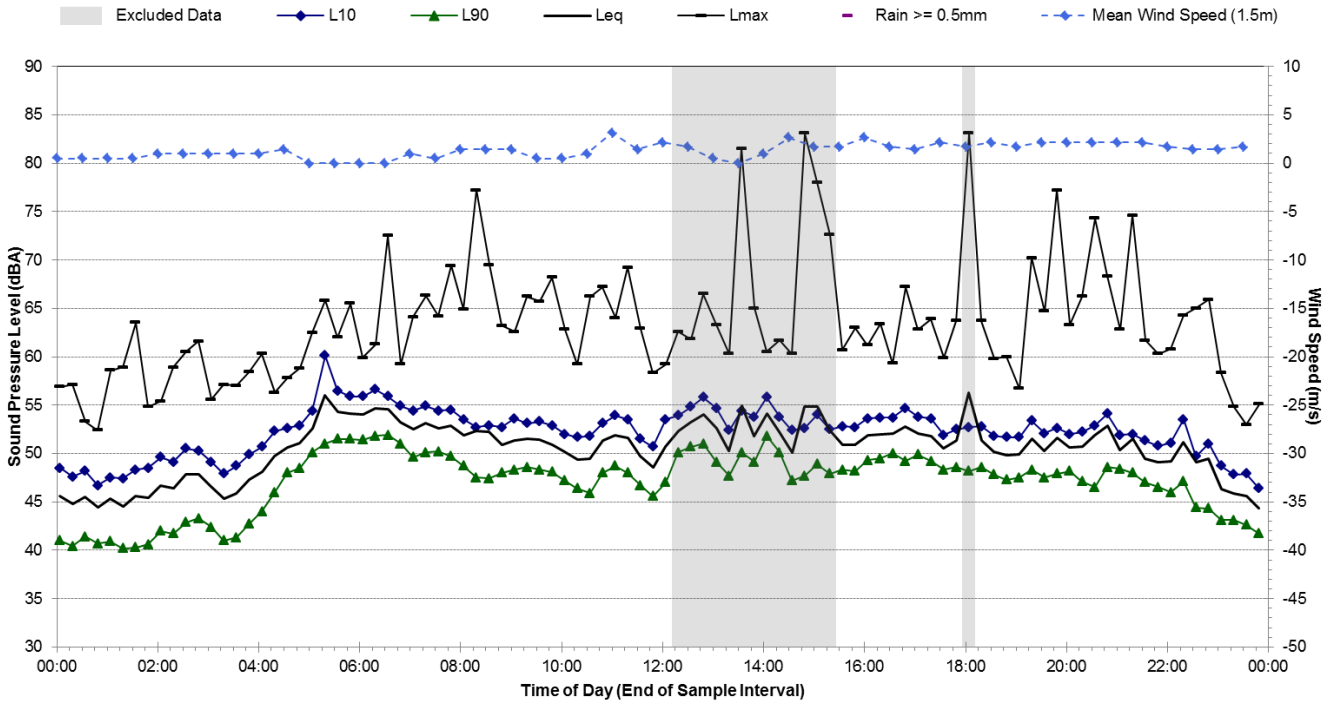
Statistical Ambient Noise Levels

L01 - 51 Pikes Lane, Eastern Creek - Tuesday, 11 December 2018



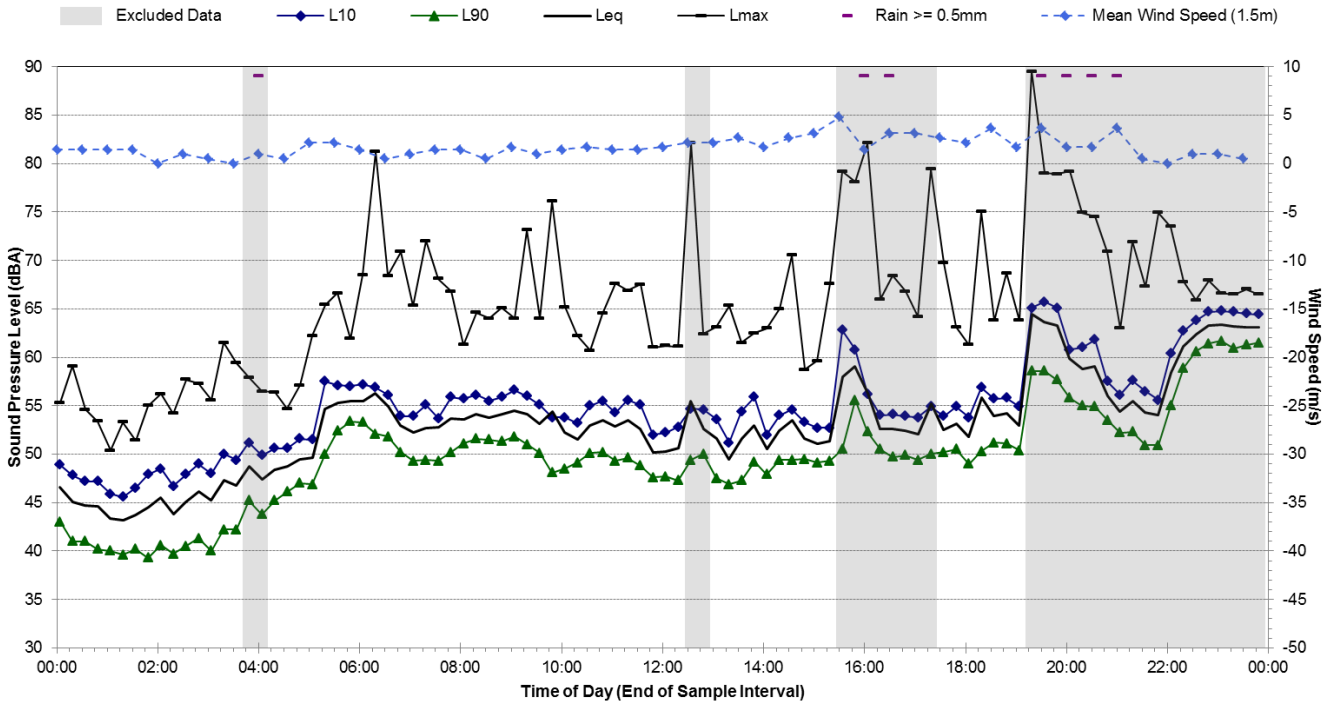
Statistical Ambient Noise Levels

L01 - 51 Pikes Lane, Eastern Creek - Wednesday, 12 December 2018



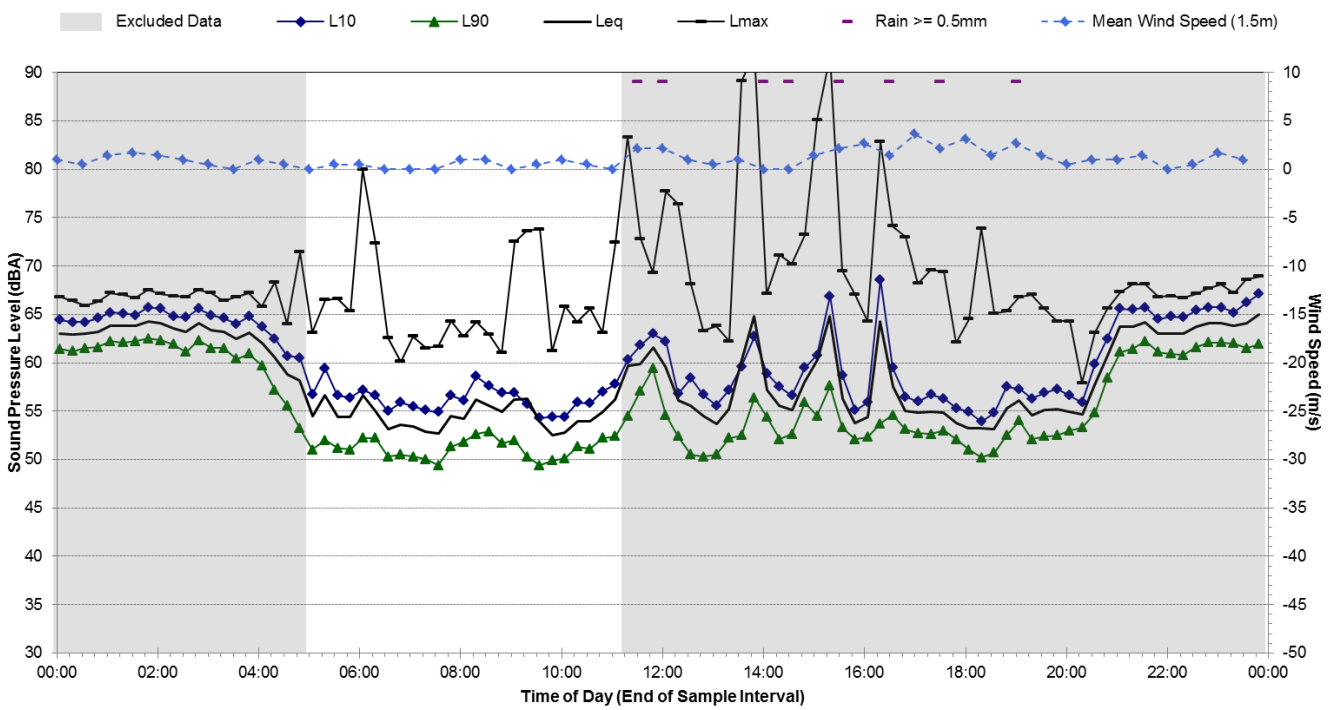
Statistical Ambient Noise Levels

L01 - 51 Pikes Lane, Eastern Creek - Thursday, 13 December 2018



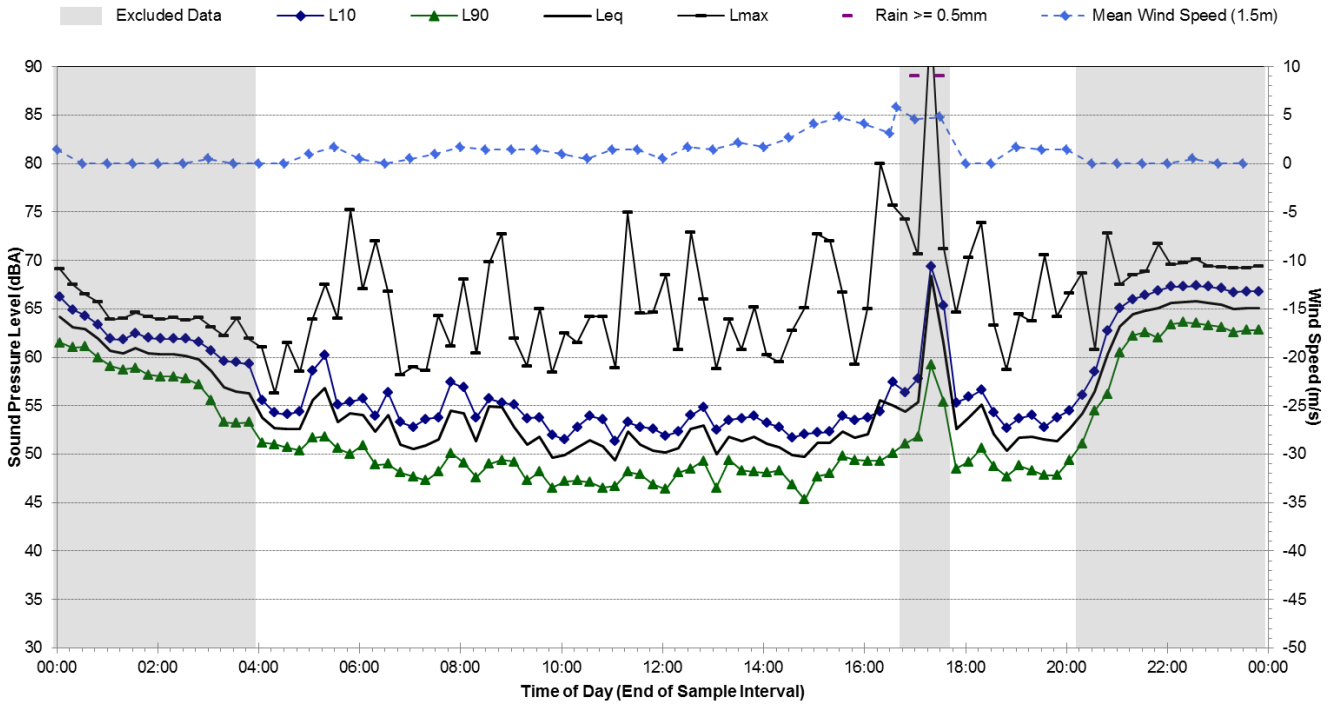
Statistical Ambient Noise Levels

L01 - 51 Pikes Lane, Eastern Creek - Friday, 14 December 2018



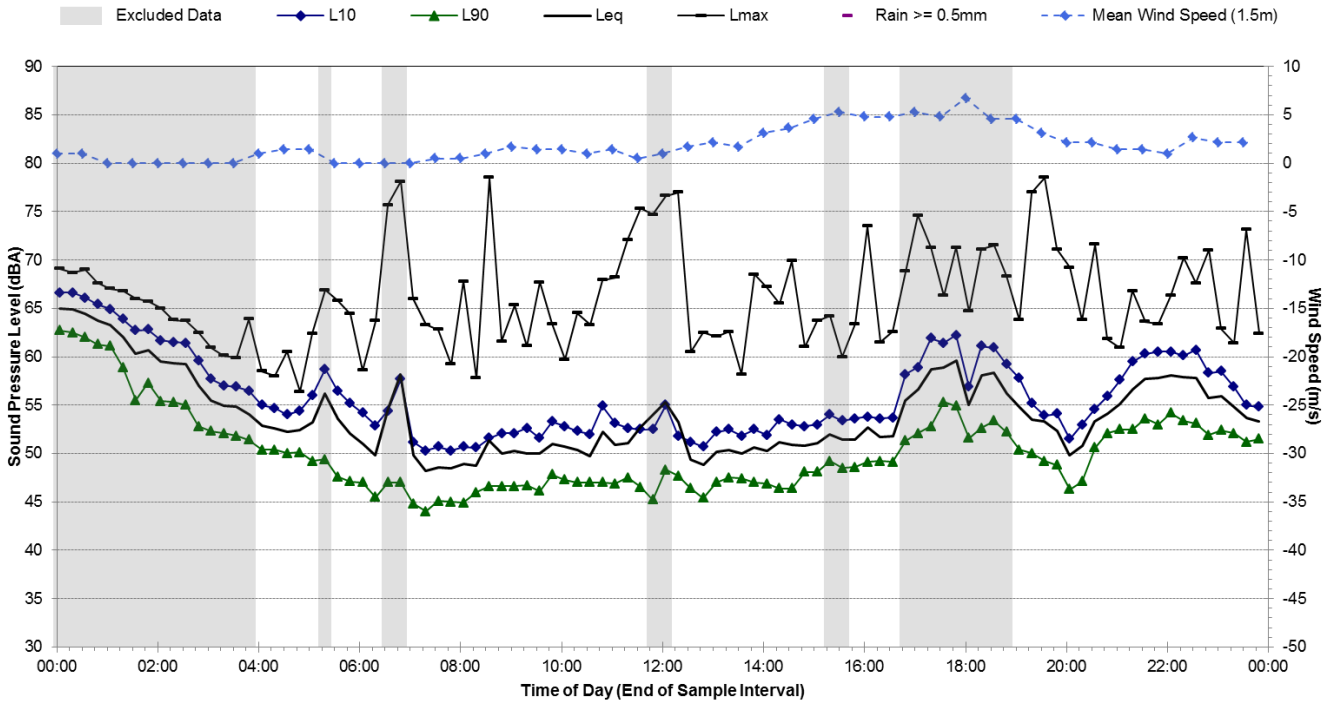
Statistical Ambient Noise Levels

L01 - 51 Pikes Lane, Eastern Creek - Saturday, 15 December 2018



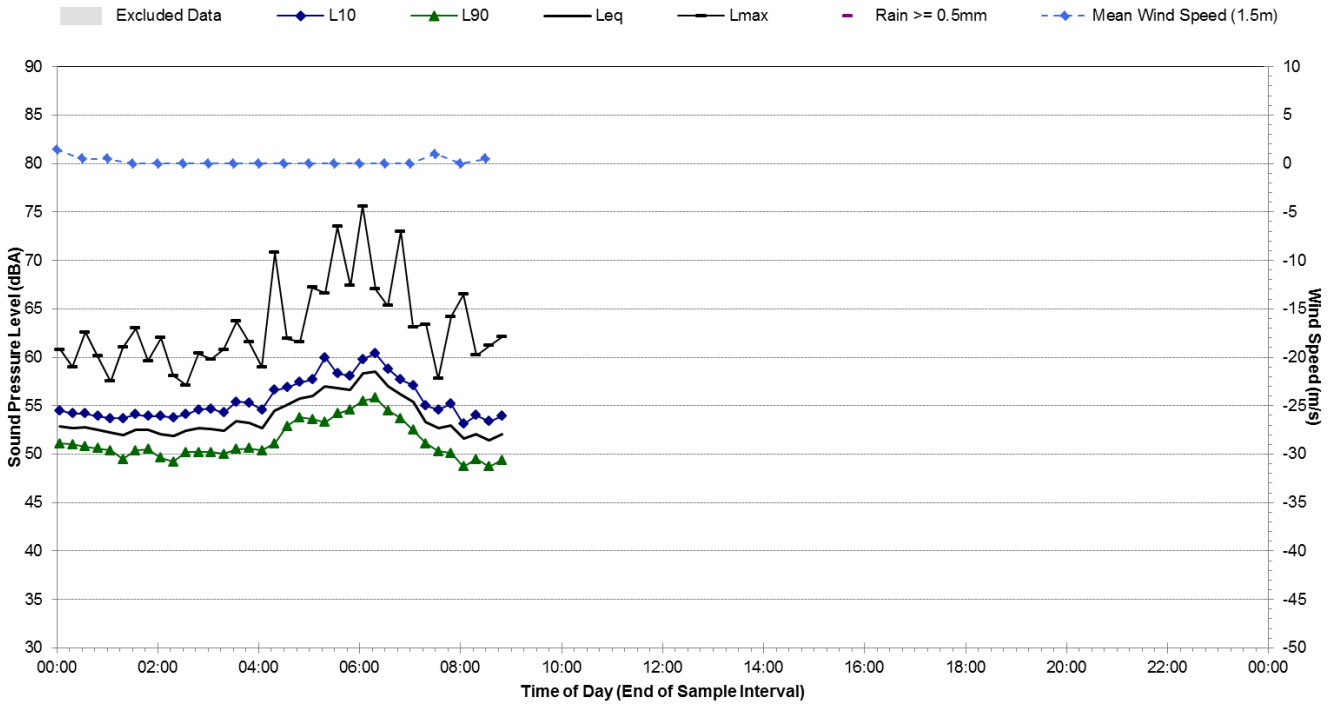
Statistical Ambient Noise Levels

L01 - 51 Pikes Lane, Eastern Creek - Sunday, 16 December 2018



Statistical Ambient Noise Levels

L01 - 51 Pikes Lane, Eastern Creek - Monday, 17 December 2018



Noise Monitoring Location	L02
Noise Monitoring Address	**60 Eskdale Street, Minchinbury**

Logger Device Type: Svantek 957, Logger Serial No: 25722
Sound Level Meter Device Type: Brüel and Kjær 2260, Sound Level Meter Serial No: 2414604

Ambient noise logger deployed at residential address 60 Eskdale Street, Minchinbury. Logger located in rear yard (southern side) of property approximately 150 m south of Great Western Highway, 750 m north of M4 Motorway and 1,000 m west of M7 Motorway. The logger did not have direct line of sight to any major roads.

Attended noise measurements indicate the ambient noise environment at this location is dominated by distant road traffic noise from Great Western Highway, M4 Motorway and M7 Motorway. Nearby animals (birds, dogs) in the area also contribute to the LAeq at this location.

Recorded Noise Levels (LAmax):
06/12/2018: Distant road traffic M4/M7/Great Western Hwy: 47-49 dBA, Dog barking: 60 dBA, Birds: 52-69 dBA.

Map of Noise Monitoring Location

Ambient Noise Logging Results – ICNG Defined Time Periods

Monitoring Period	Noise Level (dBA)			
	RBL	LAeq	L10	L1
Daytime	41	50	50	57
Evening	43	50	50	57
Night-time	38	46	45	49

Ambient Noise Logging Results – RNP Defined Time Periods

Monitoring Period	Noise Level (dBA)	
	LAeq(period)	LAeq(1hour)
Daytime (7am-10pm)	50	52
Night-time (10pm-7am)	47	50

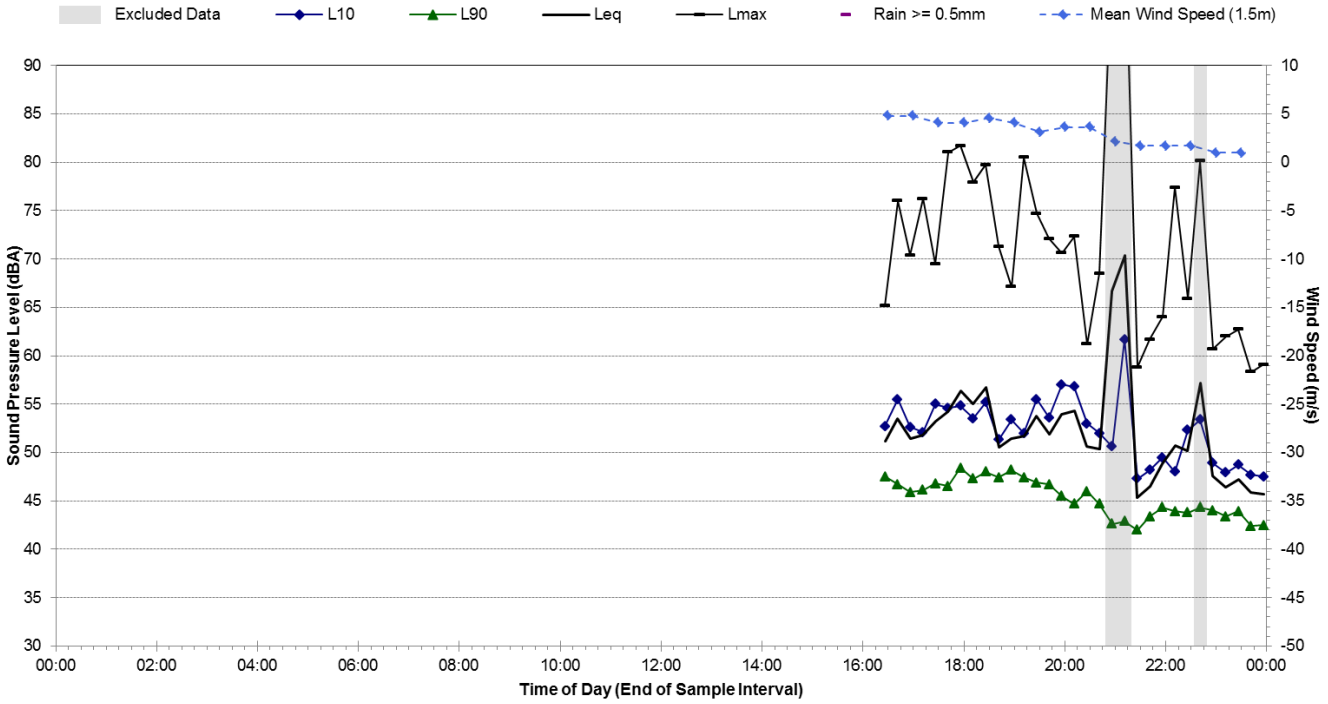
Attended Noise Measurement Results

Date	Start Time	Measured Noise Level (dBA)		
		LA90	LAeq	LAmax
06/12/2018	16:13	49	53	69

Photo of Noise Monitoring Location

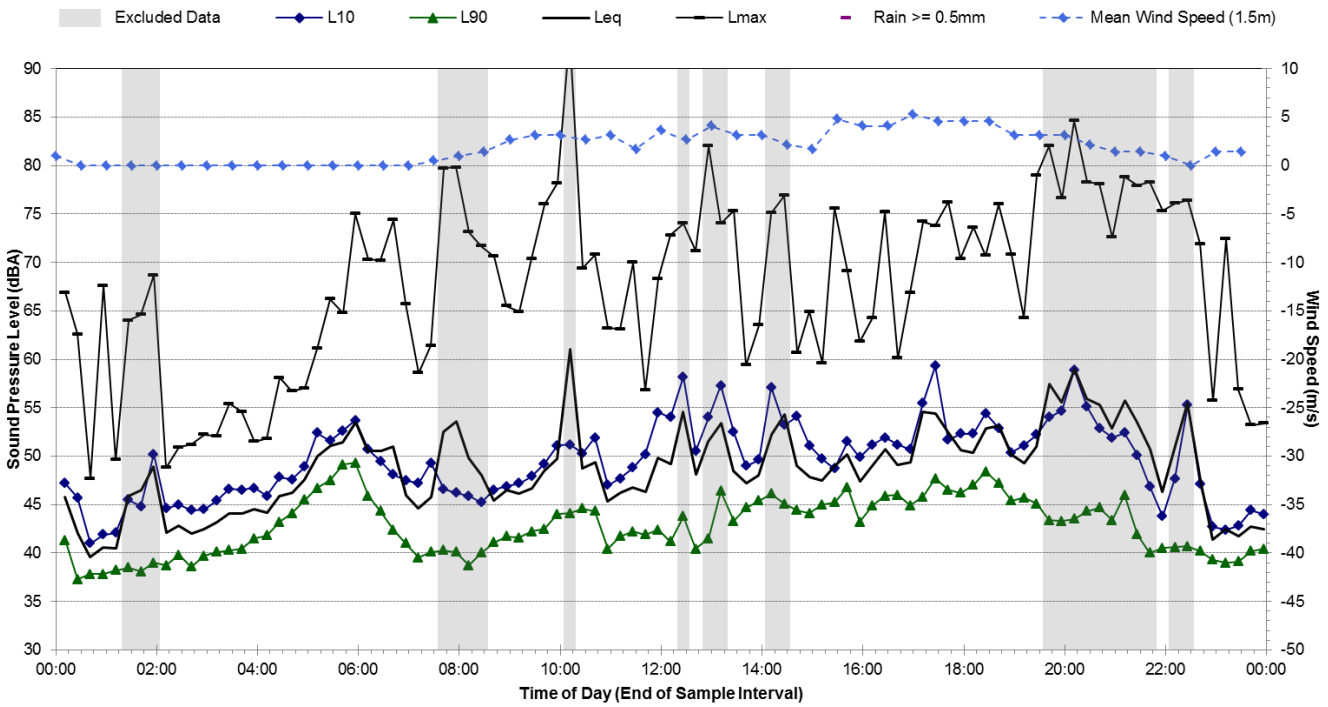
Statistical Ambient Noise Levels

L02 - 60 Eskdale Street, Minchinbury - Thursday, 6 December 2018



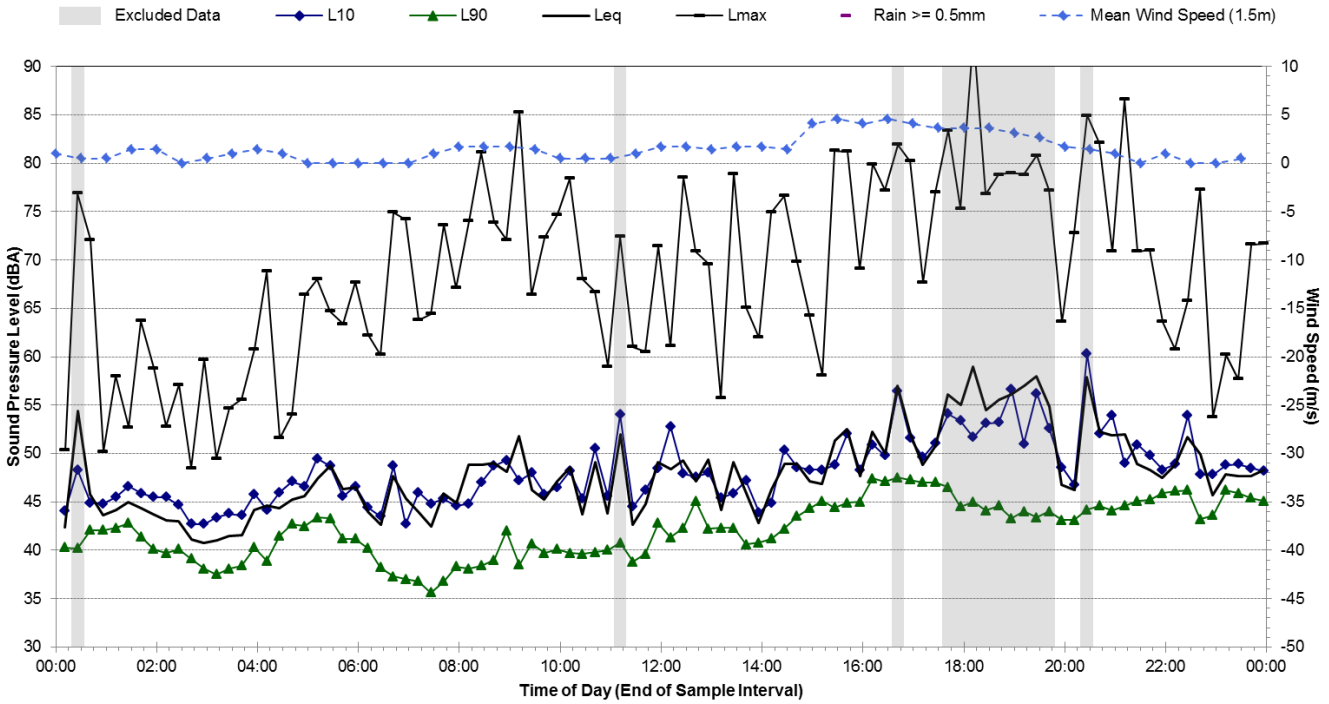
Statistical Ambient Noise Levels

L02 - 60 Eskdale Street, Minchinbury - Friday, 7 December 2018



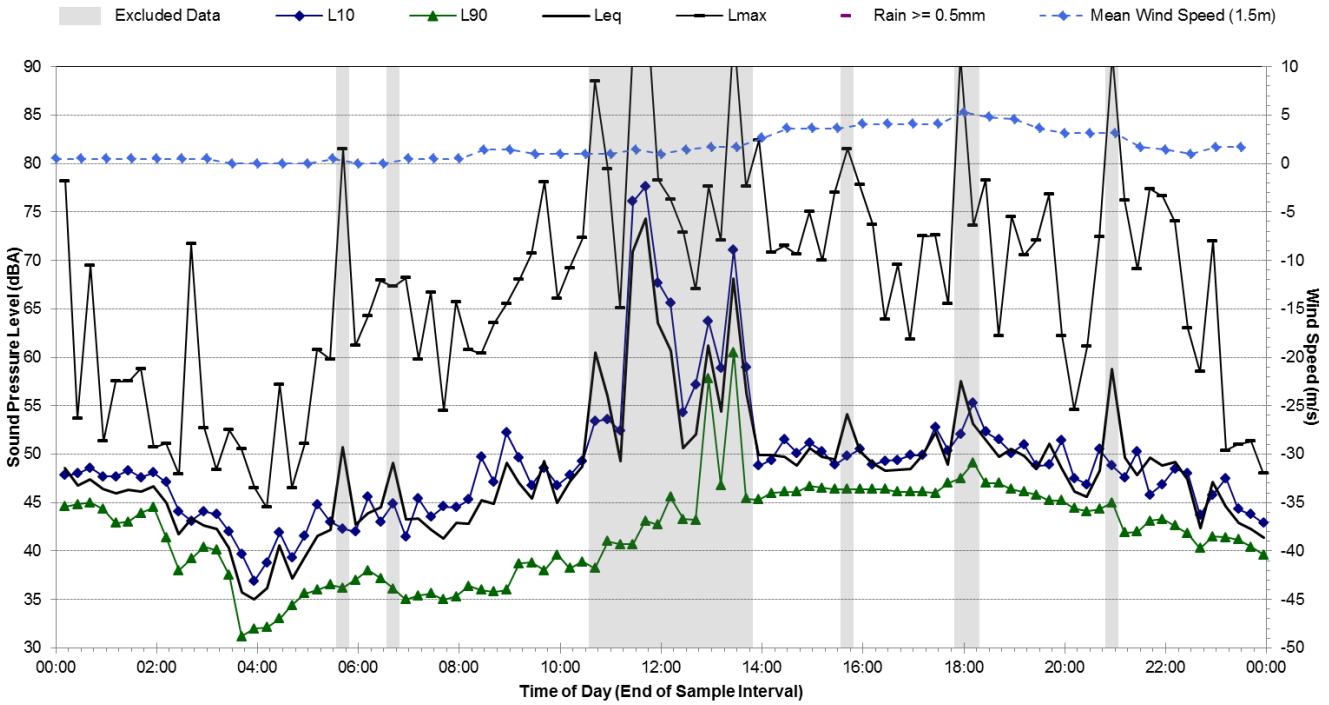
Statistical Ambient Noise Levels

L02 - 60 Eskdale Street, Minchinbury - Saturday, 8 December 2018



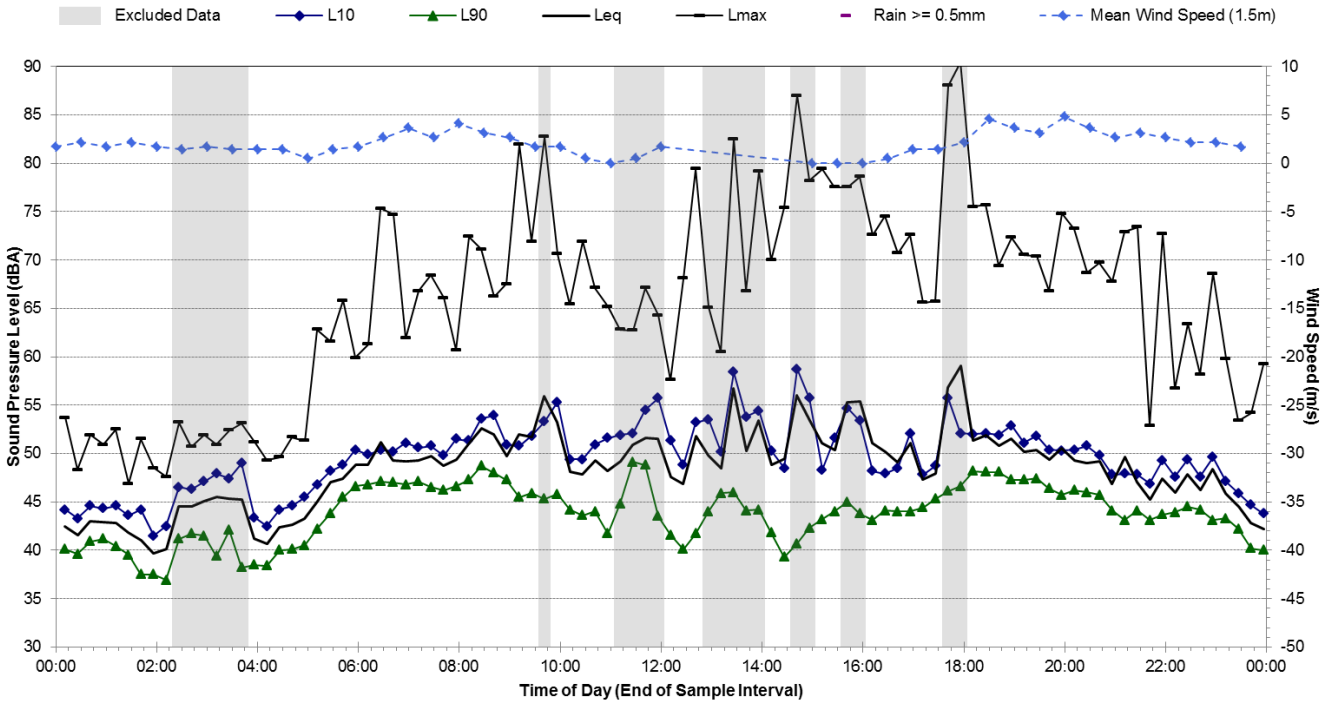
Statistical Ambient Noise Levels

L02 - 60 Eskdale Street, Minchinbury - Sunday, 9 December 2018



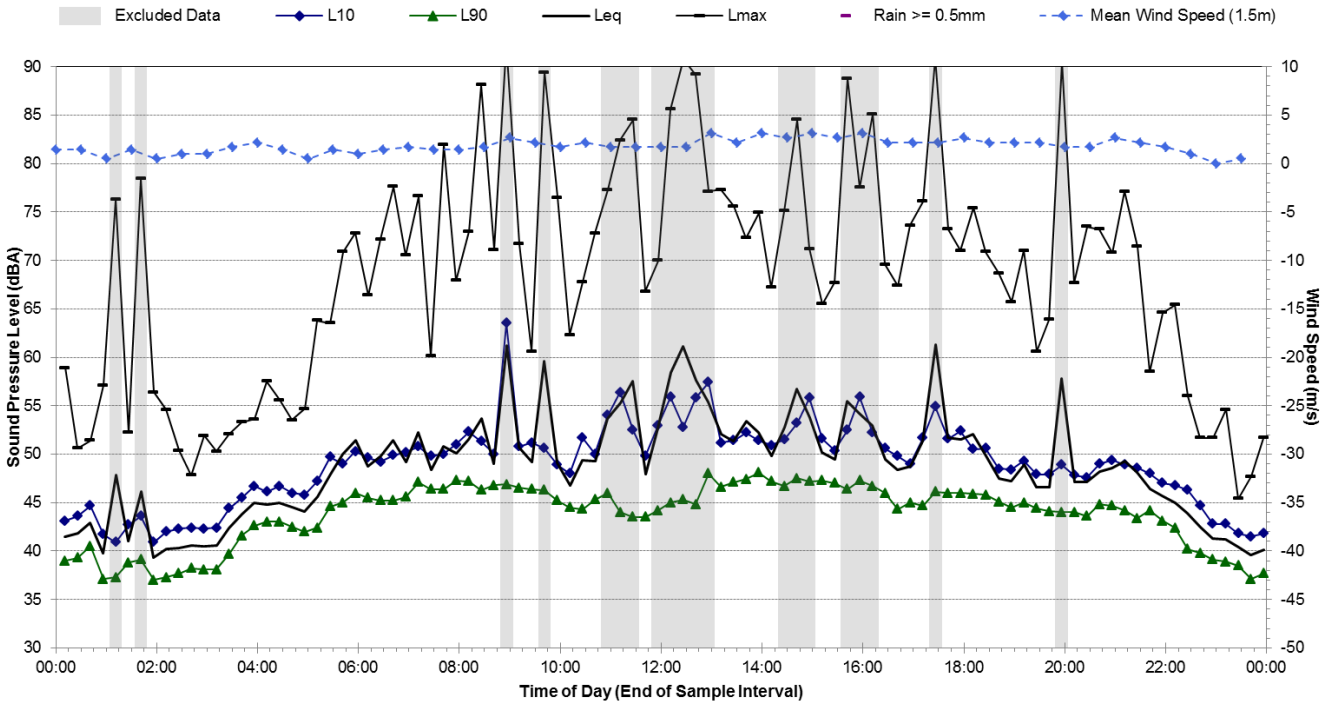
Statistical Ambient Noise Levels

L02 - 60 Eskdale Street, Minchinbury - Monday, 10 December 2018



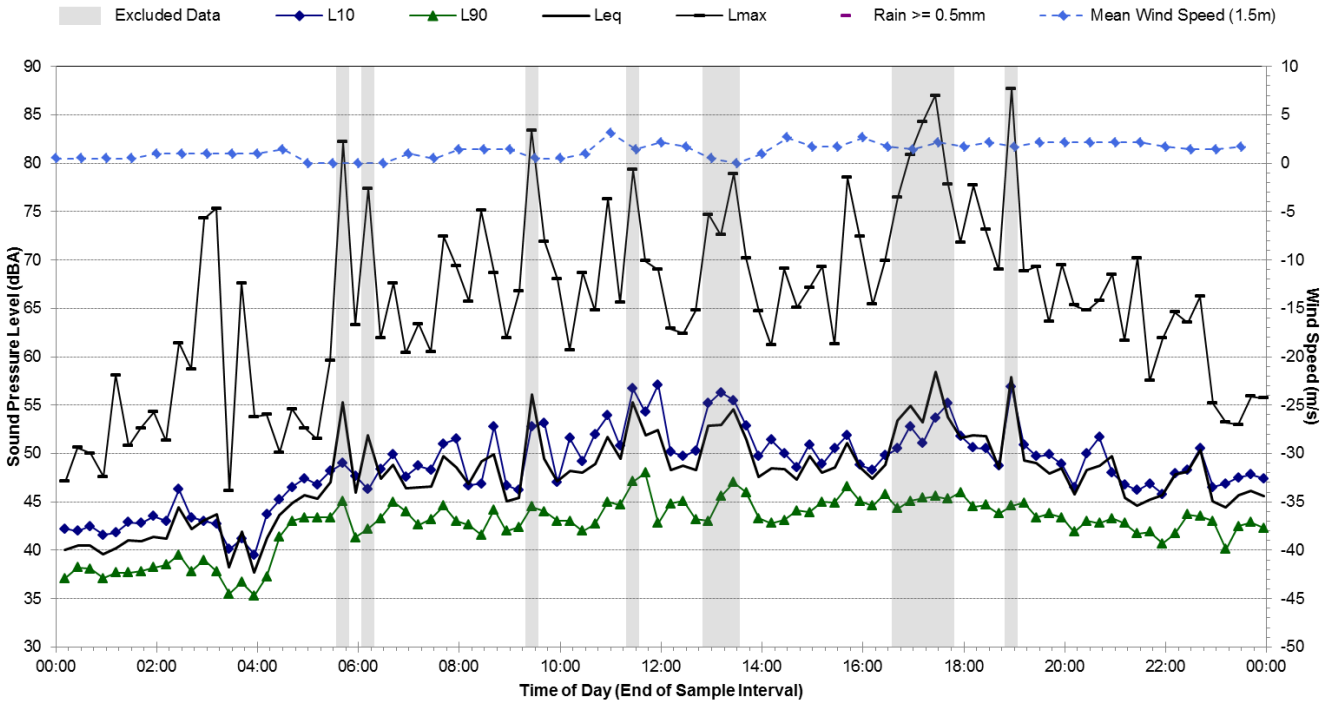
Statistical Ambient Noise Levels

L02 - 60 Eskdale Street, Minchinbury - Tuesday, 11 December 2018



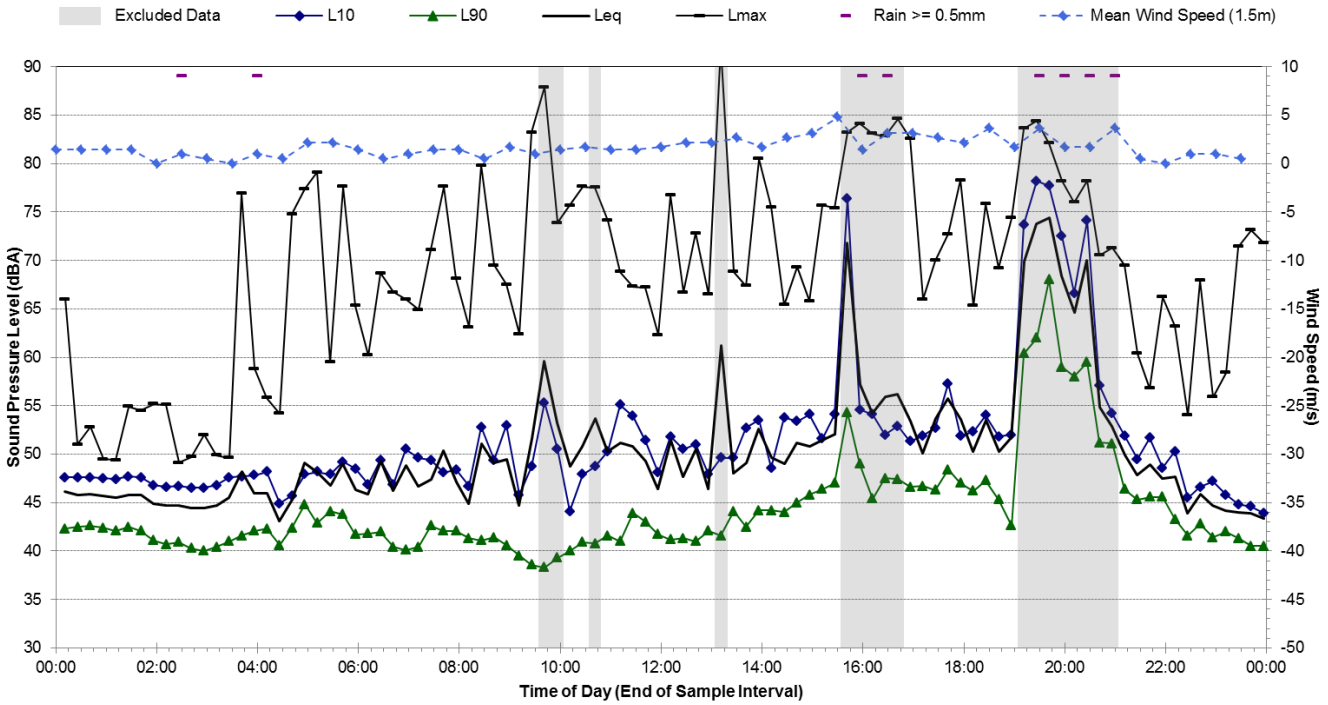
Statistical Ambient Noise Levels

L02 - 60 Eskdale Street, Minchinbury - Wednesday, 12 December 2018



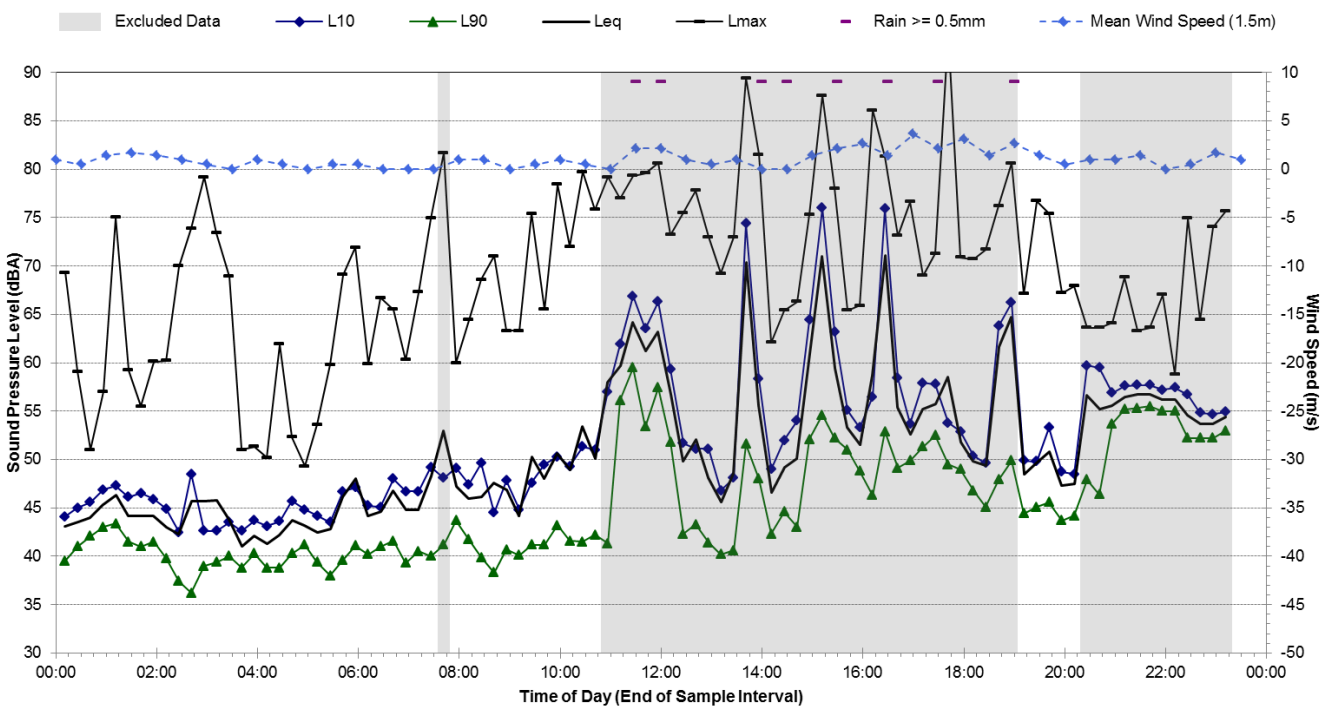
Statistical Ambient Noise Levels

L02 - 60 Eskdale Street, Minchinbury - Thursday, 13 December 2018



Statistical Ambient Noise Levels

L02 - 60 Eskdale Street, Minchinbury - Friday, 14 December 2018



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