Noise Management Report

Panorama Battery Energy Storage System (BESS)

Panorama BESS Subco Pty Ltd

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SLR Project No.: 660.30234.00000

14 September 2023

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Revision Record

Revision	Date	Prepared By	Checked By	Authorised By
660.30234-R04-v1.1	15 March 2023	Stephen Shoesmith	Kiera Plumridge	Stephen Shoesmith
660.30234-R04-v1.0	15 March 2023	John Sleeman	Aaron McKenzie	John Sleeman
660.30234-R04-v0.1	10 March 2023	John Sleeman	Aaron McKenzie	John Sleeman

Basis of Report

This report has been prepared by SLR Consulting Australia (SLR) with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with Panorama BESS Subco Pty Ltd (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.

This report is for the exclusive use of the Client. No warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from SLR.

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

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1.0 Introduction

Panorama BESS SubCo Pty Ltd (Panorama BESS SubCo) proposes to construct, operate and decommission a Battery Energy Storage System (BESS) with a capacity of 100 Megawatts (MW) 200 Megawatt Hours (MWH) and associated ancillary infrastructure adjacent to an existing 132 Kilovolt (kV) substation operated by TransGrid in Evans Plains, NSW (henceforth referred to as 'the Project').

Panorama BESS SubCo have engaged SLR Consulting Australia Pty Ltd (SLR) to prepare than Environmental Impact Statement (EIS) and associated technical assessments to address the requirements of the Secretary of the NSW Department of Planning and Environment (DPE), known as the SEARs for the project, SSD-50587460 dated 9 December 2022.

SLR's Noise Impact Assessment, dated March 2023 identified that predicted LAeq, 15-minute noise levels have the potential to exceed the Noise Management Levels (NMLs) at certain times during construction. The assessment also identified that operational noise is predicted to be below the project noise trigger levels (PNTL) at all identified receivers. Cumulative noise levels during noise enhancing weather conditions (i.e., worst-case) are expected to remain below the most stringent night time criteria of 35 dBA.

In accordance with the SEARs, this draft Noise Management Plan has been prepared for submission as part of the EIS. The draft Noise Management Plan focuses on construction activities and would be reviewed and if necessary revised prior to the commencement of construction.

1.1 Proposal Description

The Project will involve the development, construction, operation, and eventual decommissioning of a BESS with a capacity of 100 MW, 200 MWH adjacent to the existing 132 kV substation operated by TransGrid. The BESS will consist of SolBank BESS containers (or enclosures) in 'back-to-back' formation in two north-south aligned rows. Each SolBank container has dimensions of 6058 mm by 2438 mm by 2896 mm, with an approximate weight of 30,000 kg. The BESS will be supported by inverters which will convert the electricity from the BESS and connect to the existing TransGrid substation via approximately 100 m of 132kV underground cable. The Project Site Plan is presented in

Figure 2.

The key elements of the Project include the following:

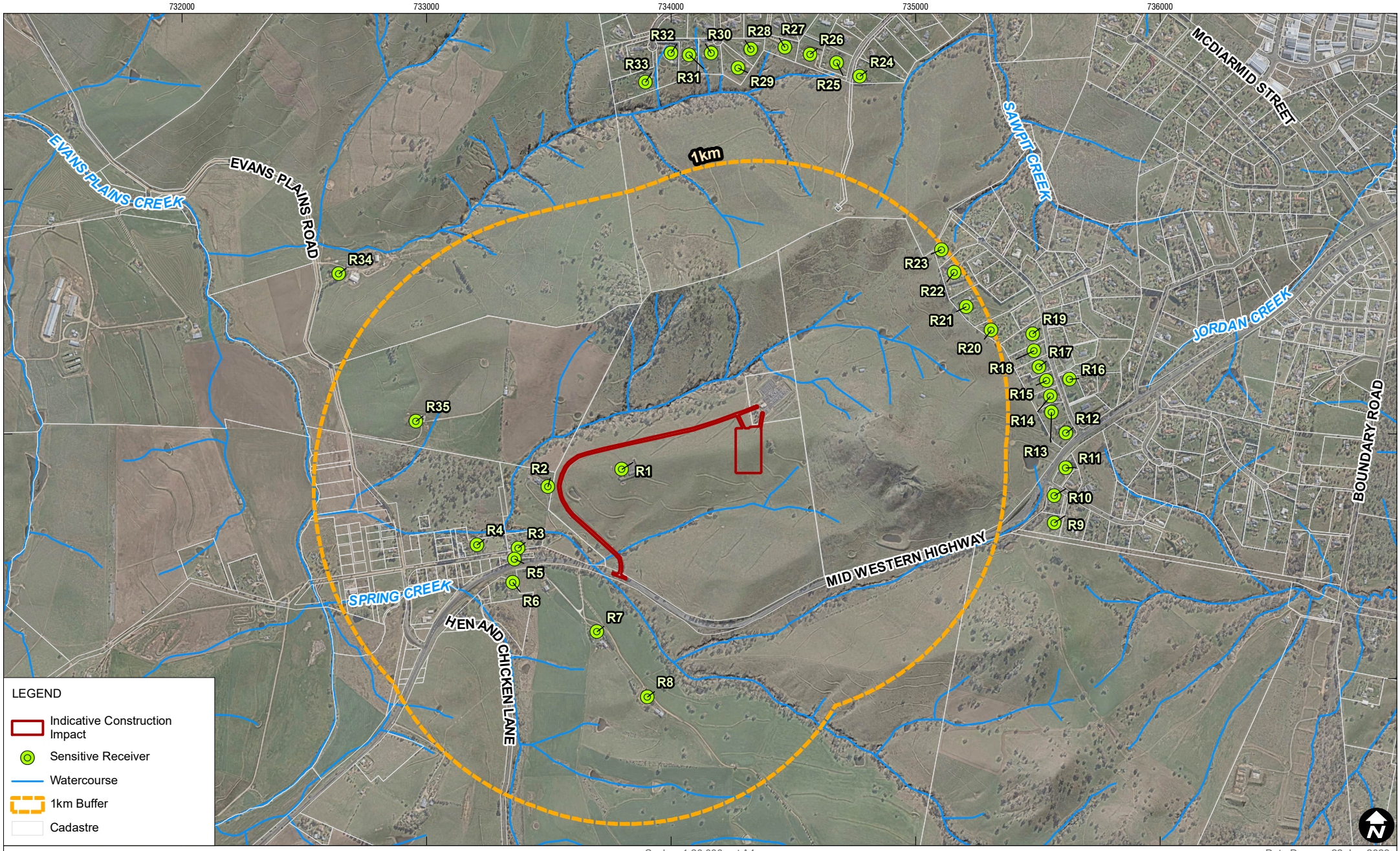
- Installation and operation of a SolBank BESS including battery enclosures, inverters, and transformers;
- Associated ancillary infrastructure including:
  - A 132kV underground cable connecting a 33/132kV switch building to the existing substation;
  - Formalisation of existing access from Mid-Western Highway and existing access road within Lot 2 DP 864272 to accommodate heavy vehicles;
  - Proposed access road from the BESS to connect to the existing access road within Lot 2 DP 864272;
  - Operations and maintenance building;
  - Stormwater management infrastructure, lighting, and security fencing; and
  - Construction laydown areas.

- Decommissioning of the SolBank BESS at the EOL include disassembly and removal of associated infrastructure from the site, to be returned as close as possible to its existing condition.

Construction of the Project is anticipated to take approximately 14 to 15 months. It is expected that the operational life of the Project would be approximately 20 years, after which the BESS would be decommissioned and the infrastructure removed, returning the site to its original use.

The main construction activities will include:

- Transport of construction personnel, associated heavy and light vehicles, and materials to and from site on a day-to-day basis, dependent on construction schedule;
- Site establishment works including vegetation clearing, bulk earthworks, and temporary construction compound;
- Road works to formalise internal site access road to accommodate heavy vehicles, construction of new access road from the BESS to connect to the existing access road within Lot 2 DP 864272, and construction of upgrade to the Mid Western Highway site entry to provide a Basic Left Turn (BAL) treatment at the access driveway crossover;
- Construction of concrete pad and installation of O&M building, battery enclosures, and inverter stations;
- Construction of underground 132 kV transmission cable and switch building to facilitate connection to the existing Transgrid 132 kV substation in the north-eastern portion of the site;
- Construction of ancillary works including stormwater management infrastructure, emergency night lighting, and security fencing;
- Water use for dust suppression, brought to site in water tankers; and
- Removal of temporary construction facilities, and rehabilitation of disturbed areas following completion of construction of the Project.



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Coordinate System: GDA 1994 MGA Zone 55

Date Drawn: 22-Jun-2023
Project Number: 660.30234.00000

Data Source: Basedata NSW SS, December 2021
Aerial imagery supplied by Nearmap (May, 2023)
Elevation data supplied by DCS Spatial Services (July, 2019)

SLR

SENSITIVE RECEIVERS

FIGURE 1

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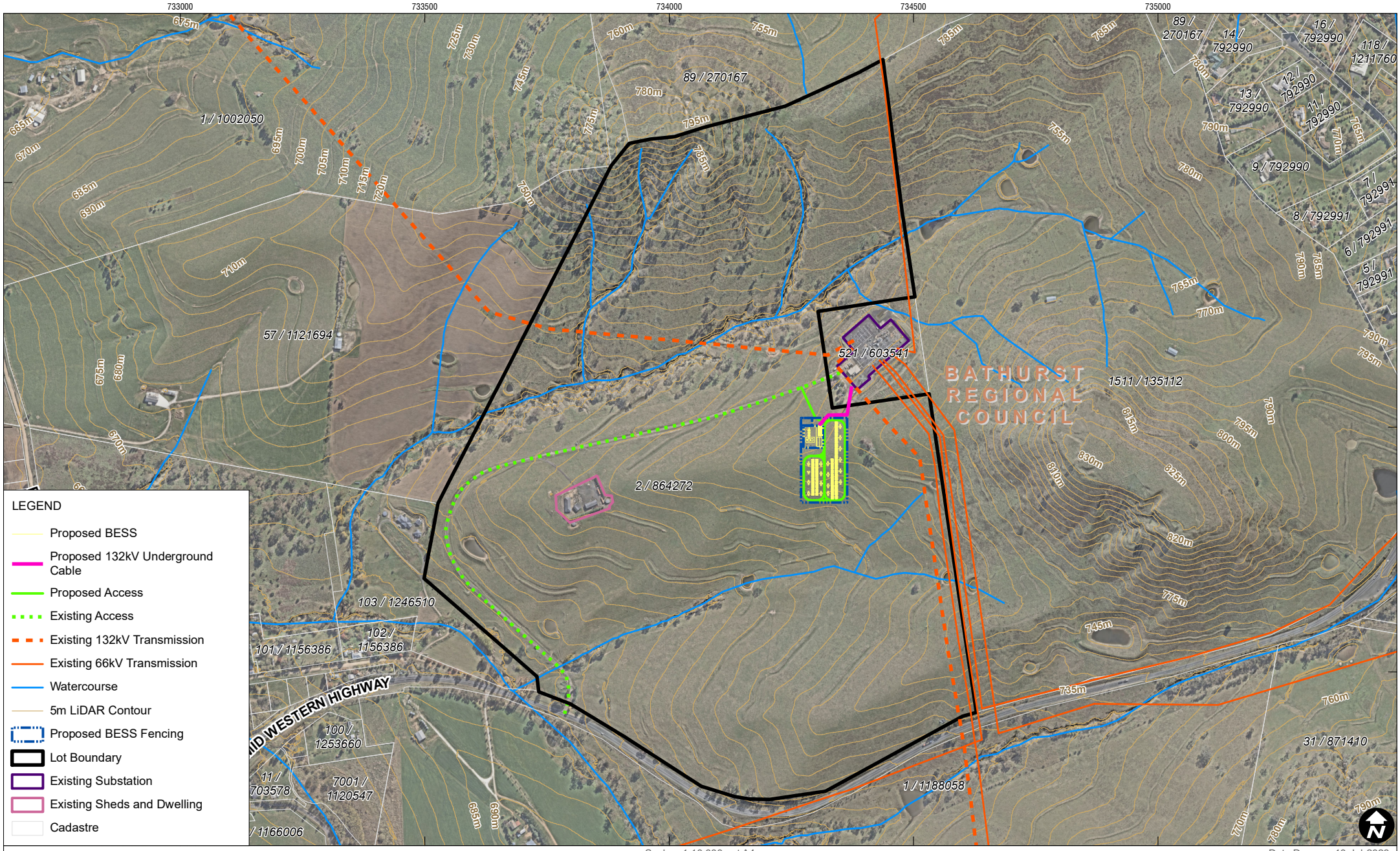

Scale: 1:10,000 at A4
Coordinate System: GDA 1994 MGA Zone 55

Date Drawn: 10-Jul-2023
Project Number: 660.30234.00000

Data Source: Basedata NSW SS, December 2021
Aerial imagery supplied by Nearmap (May, 2023)
Elevation data supplied by DCS Spatial Services (July, 2019)

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PROJECT SITE PLAN

FIGURE 2

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1.2 Nearest Receivers

The nearest sensitive receivers are presented in **Figure 1** and summarised in **Table 1**. The Transgrid electricity substation located adjacent to the Facility has been identified as an industrial receiver. The nearest receivers, with a detailed listing in Appendix B of the Noise Impact Assessment (**Appendix B**).

Table 1: Nearest Surrounding Sensitive Receivers

ID	Address	Receiver Type	Distance (m)	Direction
R1	800 Mid Western Highway, Evans Plains	Residential	490	West
R2	16 Stewart Street, Evans Plains	Residential	790	West
R3	24 Stewart Street, Evans Plains	Residential	950	West-South-West
R7	831 Mid Western Highway, Evans Plains	Residential	870	South-West
R35	403 Evans Plains Road, Evans Plains	Residential	1340	West
R9-R11	McLennan Close, Robin Hill	Residential	1210	East-South-East
R12-R23	Windemere Road, Robin Hill	Residential	990	North-East
R24-R33	Hartwood Avenue, Robin Hill	Residential	1,480	North
	Transgrid Substation	Industrial	100	North-North-East

Notes 1. The typical closest distance to receivers is shown

2.0 Existing Noise Environment

2.1 Background and Ambient Noise Levels

The existing noise environment was characterised through noise monitoring at the nearest residences. The measured noise levels were used to determine the ambient and to establish existing background noise levels at the nearest noise-sensitive receivers, for the development of the construction and operational criteria. A summary of the unattended and attended results are presented in **Table 2.**

Table 2: Summary of Ambient and Background Noise Levels

Location ID	Address	Measured Noise Level (dBA)[1]					
		Rating Background Levels (LA90)[2]			Ambient Noise Levels (LAeq)		
		Day	Evening	Night	Day	Evening	Night
L01	800 Mid-Western Hwy, Evans Plains	35 (26)[3]	30 (28)[3]	30 (30)[3]	53	45	51
L02	44 Windemere Road, Robin Hill	35 (31)[3]	30 (28)[3]	30 (22)[3]	54	50	47
L03	270 Hartwood Avenue, Robin Hill	35 (30)[3]	30 (30)[3]	30 (27)[3]	60	58	51

Note 1: NPfI assessment periods – Daytime: 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: 10:00 pm to 8:00 am Monday to Saturday, 10:00 pm to 8:00 am Sundays and Public Holidays

Note 2: The RBL noise level is representative of the “average minimum background sound level”, or simply the background level.

Note 3: The NPfI minimum RBL value has been used due to the measured RBL (as shown in brackets) being below the NPfI minimum value.

3.0 Assessment Criteria

3.1 Construction Noise Assessment Criteria

Noise Management Levels (NMLs) adopted for the Project are presented in **Table 3** and have been determined in accordance with The NSW *Interim Construction Noise Guideline* (ICNG). The works are proposed to occur during Standard Construction Hours so only the daytime NMLs have been adopted for the project.

It is important to note that the NMLs are not mandatory limits, however as construction noise levels are predicted or measured to be above the NMLs, feasible and reasonable work practices to minimise noise emissions are proposed in **Table 3** below.

Table 3: NMLs for Residential Receivers

Receiver Type	Representative Background Monitoring Location	Noise Management Level (LAeq(15minute) – dBA)				Sleep Disturbance Screening Criteria (RBL +15 dB)
		Standard Construction (RBL +10 dB)	Out of Hours (RBL +5 dB)			
		Daytime	Daytime[1]	Evening	Night-time	
Residential	L01	45	40	37	35	45
Industrial	-	60	60 (when in use)			-

Note 1: This refers to the period on Saturday between 7am – 8am and 1pm – 6pm, on Sunday and public holidays between 8am – 6pm.

3.2 Construction Vibration

3.2.1 Categories of Vibration in Structures

Construction vibration criteria adopted for the Project are presented in **Table 4** and have been determined in accordance with the EPA's "*Assessing Vibration: A Technical Guideline*" (DEC 2006).

Table 4: Vibration Velocity Damage Risk and Annoyance Risk Criteria (mm/s)

Receiver Area	Damage Risk (mm/s)		Annoyance Risk (mm/s)	
	Horizontal	Vertical	Horizontal	Vertical
Residential/Dwellings	7.5	7.5	1.2	0.45
Commercial/Offices	25	25	1.6	0.6
Industrial/Workshops			3.2	1.2
Reinforced structures (i.e., concrete buildings)			-	-
Mechanical (On/Off)[1]	20/5	20/5	-	-
Subsurface structures	50-100	50-100	-	-

Note 1: 'On' refers to when machinery is turned on, and 'Off' is when machinery is off. Criteria are stricter for 'Off' as machinery is more likely to be damaged by vibration when it is not operating due to potential for brinelling.

3.3 Road Traffic Noise

Construction vibration criteria adopted for the Project are presented in **Table 5** and have been determined in accordance with the NSW EPA *Road Noise Policy* (RNP).

Table 5: RNP Criteria for Assessing Project Traffic 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	LAeq(15hour) 60 (external)	LAeq(9hour) 55 (external)
Local roads	Existing residences affected by additional traffic on existing local roads generated by land use developments	LAeq(1hour) 55 (external)	LAeq(1hour) 50 (external)

4.0 Construction Noise Assessment

Construction noise impacts were predicted by modelling the noise emissions, taking into account source sound level emissions and locations, screening effects, receiver locations, ground topography and noise attenuation due to spherical spreading and atmospheric absorption.

The significant noise generating aspect of the construction phase includes:

- Site Establishment;
- Enabling and earthworks; and
- Civil works and build construction.

4.1 Construction Activities and Sound Power Levels

The Panorama BESS is expected to have a design and construction duration of approximately 12 months. This would include a three-month design period and a nine-month construction, testing and commissioning.

4.1.1 Working Hours

The works would be undertaken during Standard Construction Hours, as outlined in the ICNG. These are:

- 7.00 am to 6.00 pm Monday to Friday
- 8.00 am to 1.00 pm on Saturdays
- No work on Public Holidays or Sundays.

It is not expected that there would be any requirement for works during evening or night-time periods.

4.1.2 Construction Equipment

The types, numbers and corresponding Sound Power Level's (SPL) of equipment proposed for construction are shown in **Table 6** and **Table 7.**

Table 6: Proposed Construction Equipment

Construction Component	Construction Period	Equipment Involved at the Work Site	
		Equipment Type	Number of Items
Project	**TBA**		
Site Establishment	Daytime	Bobcat/Skid Steer 15t excavator 12-15t Trucks Hand tools Enabling Mobile Crane 80-100 tonne Grass Slasher/Lawn Mower Generator 100KVA	1 1 1 1 1 1 1 1
Enabling	Daytime	30t excavator Grader Water cart	1 1 1

Construction Component	Construction Period	Equipment Involved at the Work Site	
		Equipment Type	Number of Items
Project	**TBA**		
		Vibrating Smooth Drum Roller	1
		12-15t Trucks	1
		Hand tools Enabling	2
		Telehandler	1
		Generator 100KVA	1
Construction	Daytime	Concrete Trucks / Agitator	1
		12-15t Trucks	2
		Roller (for Asphalt)	1
		Pad foot	1
		Hand tools	2
		Grader 14H	1
		Water Truck	1
		Generator 100KVA	1
		Telehandler	1
		Excavator 30 tonne	1
		Skid steer	1
		Hydrovac	1
		Flatbed Truck	1
		Mobile Crane 80 tonne	1

Notes 1. The equipment numbers represent the maximum operational in a typical 15 minute period.

Table 7: Equipment Sound Power Levels

Facility Construction Equipment	Overall SWL LAeq(15minute) (dBA re 1□W)
Excavator (30 tonne)	110
10 to 15t Trucks	108
Concrete Truck / Agitator	109
Mobile Crane (100 tonne)	104
Generator	103
Vibratory Roller	109
Grader 14G	108
Bobcat	104
Forklift	101
Hand tools	94
Elevated Work Platform	97

Notes The overall SWLs are based on SLRs database and the NSW Roads and Maritime Construction Noise and Vibration Guideline.

4.2 Construction Noise Impact

Construction noise impacts predicted are presented in **Table 8.**

Table 8: Predicted Daytime Construction Intrusive $L_{Aeq\ (15\ minute)}$ Noise Levels (dBA re 20 µPa)

Receiver [1]	LAeq Noise Level			
	Daytime Project Specific NML	Scenario 1 - Site Establishment	Scenario 2 - Enabling and Earthworks	Scenario 3 - Civil Works and Construction
800 Mid Western Highway, Evans Plains	45	44	**46**	**46**
16 Stewart Street, Evans Plains	45	**48**	**48**	**48**
24 Stewart Street, Evans Plains	45	37	38	38
831 Mid Western Highway, Evans Plains	45	35	37	38
403 Evans Plains Road, Evans Plains	45	30	32	32
McLennan Close, Robin Hill	45	< 10	< 10	< 10
Windemere Road, Robin Hill	45	31	34	35
Hartwood Avenue, Robin Hill	45	24	26	27
Transgrid Substation	75	65	68	69

Notes 1. At receivers in Mc Lennan Close, Windemere Road and Hartwood Avenue the highest noise level for receivers in the area is presented.

The results represent the worst-case noise levels where all equipment in each scenario is working concurrently. Accordingly for most construction activities, it is expected that the construction noise levels would frequently be lower than predicted. There is expected to be minor exceedances at two residences during construction related to truck movements on the project access road. At all other residential receivers noise levels are below 40 dBA, due to the large distances to the access road and site.

4.3 Construction Vibration

Minimum working distances for typical vibration intensive construction equipment are shown in **Table 9.**

Table 9: CNVG Recommended Minimum Working Distances from Vibration Intensive Equipment

Plant Item	Rating/Description	Minimum Distance	
		Cosmetic Damage (BS 7385)	Human Response (AVTG)
Vibratory Roller	1-2 tonne	5 m	15 m to 20 m
	2-4 tonne	6 m	20 m
	4-6 tonne	12 m	40 m
	7-13 tonne	15 m	100 m
	13-18 tonne	20 m	100 m
	>18 tonne	25 m	100 m
Small Hydraulic Hammer	300 kg (5 to 12 t excavator)	2 m	7 m
Medium Hydraulic Hammer	900 kg (12 to 18 t excavator)	7 m	23 m
Large Hydraulic Hammer	1,600 kg (18 to 34 t excavator)	22 m	73 m
Piling Rig – Bored	≤ 800 mm	2 m (nominal)	4 m

Plant Item	Rating/Description	Minimum Distance	
		Cosmetic Damage (BS 7385)	Human Response (AVTG)
Jackhammer	Hand held	1 m (nominal)	2 m

Note 1: More stringent conditions may apply to heritage or other sensitive structures.

Given the large distance offset (> 100 m) to the closest sensitive receivers (Transgrid building), vibration is unlikely to be perceptible and impacts are unlikely to occur.

4.4 Construction Traffic

The proposed construction is expected to generate of the order 20 return light vehicle trips and one return heavy vehicle trip per day. That would be approximately 42 vehicle movements (in and out) per day.

Construction traffic would generally access the site from the Mid-Western Highway. Based on existing daily traffic volumes on the Mitchell Highway the Project is not anticipated to increase road traffic noise during construction by more than 2 dBA.

4.5 Construction Mitigation Measures

Noise mitigation measures shown in **Table 10** will be implemented to minimise the potential impacts from the works.

Table 10: Standard Construction Recommended Mitigation and Management Measures

Measure
Project Planning
Less noise and vibration intensive construction techniques for rock breaking and concrete sawing will be used
Works will be completed during standard daytime construction hours detailed in **Section 3.2.3**.
Truck routes to site will be in accordance with the approved Construction Traffic Management Plan (CTMP).
Scheduling
High-noise or vibration generating works will be carried out in continuous blocks no longer than three hours in length, with a minimum respite period of one hour between each block. 'Continuous' includes any period during which there is less than a one hour respite between ceasing and recommencing these works. High-noise or vibration generating works conducted outside standard construction hours (where approved) will be limited to no more than two consecutive nights except where there is a Duration Respite (see below). For night-works these periods will be separated by no less than one week, and limited to six nights per month. Where possible, high-noise and vibration generating works will be completed before 11 pm.
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 numbers will be undertaken in accordance with the CCS.
Site Layout
Where practicable, work compounds, parking areas, and equipment and material stockpiles will be positioned away from noise-sensitive locations and take advantage of existing screening from local topography.
Equipment that is noisy will be started away from sensitive receivers
Training
Training will be provided to all personnel on noise and vibration requirements for the project. Inductions and toolbox talks to be used to inform personnel of the location and sensitivity of surrounding receivers.
Plant and Equipment Source Mitigation

Measure
All construction plant and equipment used on Site must be, in addition to other requirements: a) regularly inspected and maintained in an efficient condition; b) operated in a proper and efficient manner.
Where practicable, tonal reversing alarms (beepers) will be replaced with non-tonal alarms (squawkers) on all equipment in use (subject to occupational health and safety requirements).
Noisy equipment will be sited behind structures that act as barriers, or at the greatest distance from the noise-sensitive area; or orienting the equipment so that noise emissions are directed away from any sensitive areas, to achieve the maximum attenuation of noise.
Noise generating equipment will be regularly checked and effectively maintained, including checking of hatches/enclosures regularly to ensure that seals are in good condition and doors close properly against seals.
Dropping materials from a height will be avoided.
Loading and unloading will be carried out away from noise sensitive areas, where practicable.
Trucks will not queue outside residential properties. Truck drivers will avoid compression braking as far as practicable.
Truck movements will be kept to a minimum, i.e. trucks are fully loaded on each trip.
Community Consultation
Notifications will be provided to the affected community where high impacts are anticipated or where out of hours works are required. Notification will be a minimum of 24 hours.
Where complaints are received, work practices will be reviewed and feasible and reasonable practices implemented to minimise any further impacts.
Monitoring
Noise and/or vibration monitoring will be conducted (as appropriate) in response to any complaints received to verify that levels are not substantially above the predicted levels.
Vibration
Vibratory compactors will not be used closer than 30 m from residential and educational buildings unless vibration monitoring confirms compliance with the vibration criteria.
Where there is a risk that vibration activities may cause damage to nearby structures and buildings or if these are located within the minimum working distance from the construction activity, a building condition inspection will be undertaken at least three weeks before the construction activity commences.
The Building Condition Inspection Reports will contain photographs of the inspected properties and include details of the inspectors' qualification and expertise, together with a list of any identified defects, where relevant. The reports will be submitted to the owner before the commencement of any vibration intensive activities.
A copy of the Building Condition Inspection Reports and CNVMP will be submitted to the Proponent at least 10 working days prior to commencement of piling, excavation by hammering or ripping, compaction, demolition operations, or any activity which may cause damage through vibration.

4.5.1 Safeguards and Provisions for Monitoring

- Operational compliance has been achieved with the assumption that noise emission sources include:
- 52 x Battery Storage Containers with LW of 79 dBA.
- 18 x Twin Skid Compact Units comprising two invertors and one low voltage to high voltage transformer. LW of 88 dBA to each side; and 94 dBA to one end plus 80 dBA for the transformer.
- 1 x Control Room HVAC with LW of 80 dBA.
- On this basis the following safeguards and provisions are provided:

- During detailed design / equipment procurement, ensure that the BESS noise emission sources achieve quantities and sound power levels equal to or lower than presented in this report. If overall BESS noise emissions are expected to be higher, additional assessment should be considered. The potential for tonal noise from the inverter units will need to be carefully considered during the detailed design / equipment procurement, such that the specified inverter sound power levels are met if a 5 dB tonal penalty is applicable.
- Where new and improved BESS technology becomes available within the life of the project, replacement of BESS equipment should aim to achieve sound power levels equal to or lower than presented in this report. If overall BESS noise emissions are expected to be higher, additional assessment should be considered.

4.5.2 Revision

The Noise Management Plan will be reviewed and if necessary revised following determination.

5.0 Conclusion

SLR has been engaged to assess the potential construction and operational noise emissions from the proposed Battery Energy Storage System (BESS) at the existing Transgrid substation located off the Mid Western Hwy in Bathurst NSW.

The BESS will include battery storage containers, inverters, low voltage-high voltage (LV-HV) step-up transformers, high voltage underground feeders, connection to the Transgrid substation and associated roads, tracks, fences, and control building.

The BESS will primarily be on automatic control 24 hours per day 7 days per week with very little human intervention. The functioning of the BESS will typically be controlled by the BESS control system. This control system will automatically determine the state of charge or dis-charge as required.

The construction noise assessment identified that predicted LAeq, 15 minute noise levels have the potential to exceed the Noise Management Levels (NMLs) at certain times when the noisiest works are occurring. The worst-case impacts are, however, only likely to occur for relatively short times of the total project duration and the works would be limited to Standard Daytime Construction Hours, with no evening or night-time works required. A number of best-practice mitigation and management measures have been recommended to be applied, where feasible and reasonable, to control and minimise the impacts during construction as far as practicable.

The operational noise assessment identified that all predicted LAeq, 15 minute noise levels for the proposed operations of the BESS are below the project noise trigger levels (PNTL) at all the identified receivers. Cumulative noise emissions from the Panorama BESS (including substation) and the Transgrid substation were also considered. Cumulative LAeq, 15 minute noise levels during noise enhancing weather conditions (i.e., worst-case) are expected to remain below the most stringent night time criteria of 35 dBA.

Operational emissions of the Panorama BESS are therefore predicted to be compliant with the NPfI requirements for all assessment periods. As such no further recommendations for noise reducing mitigation or management measures are provided in this report. Suitable safeguards and provisions for monitoring have been recommended to assist operational noise levels being maintained below the applicable PNTL.

Based on the findings of this report and assuming the recommendations and/or safeguards are applied, the proposal is considered appropriate from an acoustic standpoint.

6.0 References

CONCAWE – Report no. 4/18; The propagation of noise from petroleum and petrochemical complexes to neighbouring communities, Prepared by C.J. Manning, M.Sc., M.I.O.A. Acoustic Technology Limited (Ref.AT 931), CONCAWE, Den Haag May 1981.

International Organisation for Standardisation (ISO) 17534 – 2015 – (ISO 17534, 2015) – Acoustics - Software for the Calculation of Sound Outdoors.

Department for Environment, Food and Rural Affairs (DEFRA), Noise Database for Prediction of Noise on Construction and Open Sites, December 2004.

British Standard BS7385: Part 2-1993 (BS 7385) - Evaluation and Measurement for Vibration in Buildings — Part 2 – Guide to Damage Levels from Ground-borne Vibration.

NSW Department of Environment and Conservation – NSW Environmental Noise Management – Assessing Vibration: A Technical Guideline (AVTG), February 2006

NSW Department of Environment and Climate Change (DECC) – NSW Interim Construction Noise Guideline (ICNG), July 2009.

Standards Australia AS 2436–2010 (AS 2436, 2010) – Guide to Noise and Vibration Control on Construction, Demolition and Maintenance Sites.

Roads and Maritime Services (RMS) - Construction Noise and Vibration Guideline (CNVG), dated August 2016

Transport for NSW (TfNSW) - Construction Noise and Vibration Strategy (CNVS), ST-157/4.1, April 2019

NSW Environment Protection Authority – Noise Policy for Industry (NPfI), October 2017.

Appendix A Acoustic Glossary

Noise Management Report

Panorama Battery Energy Storage System (BESS)

Panorama BESS Subco Pty Ltd

SLR Project No.: 660.30234.00000

14 September 2023

1. Sound Level or Noise Level

The terms 'sound' and 'noise' are almost interchangeable, except that 'noise' often refers to unwanted sound.

Sound (or noise) consists of minute fluctuations in atmospheric pressure. The human ear responds to changes in sound pressure over a very wide range with the loudest sound pressure to which the human ear can respond being 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 LP are commonly used to represent Sound Pressure Level. The symbol LA 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. 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 Evaluati
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 t quiet
50	General Office	
40	Inside private office	Quiet to very quiet
30	Inside bedroom	
20	Recording studio	Almost silen

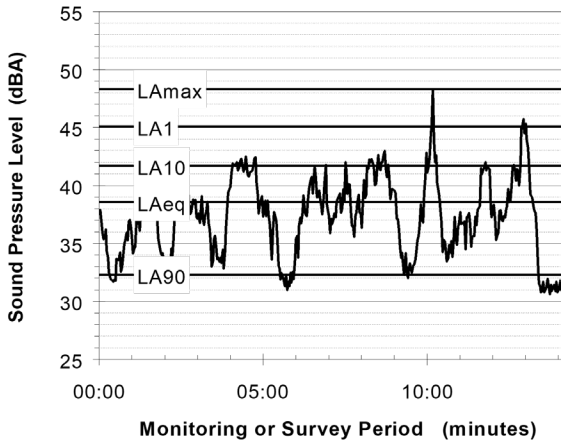
Other weightings (e.g., B, C and D) are less commonly used than A-weighting. Sound Levels measured without any weighting are referred to as 'linear', and the units are expressed as dB(lin) or dB.

The relationship between Sound Power and Sound Pressure is similar to the effect of 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 LAN, where LAN is the A-weighted sound pressure level exceeded for N% of a given measurement period. For example, the LA1 is the noise level exceeded for 1% of the time, LA10 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:

LA1 The noise level exceeded for 1% of the 15 minute interval.

LA10 The noise level exceeded for 10% of the 15 minute interval. This is commonly referred to as the average maximum noise level.

LA90 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.

LAeq 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.

5. Frequency Analysis

Frequency analysis is the process used to examine the tones (or frequency components) which make up the overall noise or vibration signal.

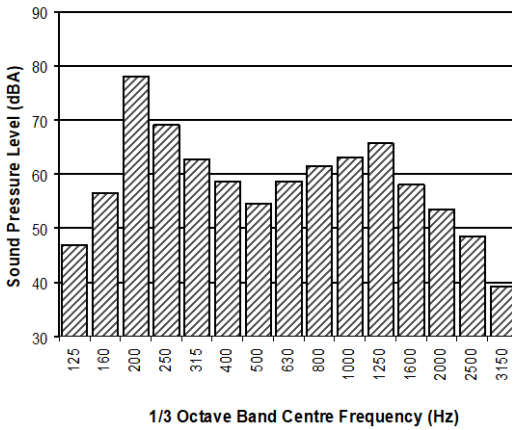
The units for frequency are Hertz (Hz), which represent the number of cycles per second.

Frequency analysis can be in:

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 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.



6. Annoying Noise (Special Audible Characteristics)

A louder noise will generally be more annoying to nearby receivers than a quieter one. However, noise is often also found to be more annoying and result in larger impacts where the following characteristics are apparent:

- **Tonality** - tonal noise contains one or more prominent tones (i.e., differences in distinct frequency components between adjoining octave or 1/3 octave bands), and is normally regarded as more annoying than 'broad band' noise.
- **Impulsiveness** - an impulsive noise is characterised by one or more short sharp peaks in the time domain, such as occurs during hammering.
- **Intermittency** - intermittent noise varies in level with the change in level being clearly audible. An example would include mechanical plant cycling on and off.
- **Low Frequency Noise** - low frequency noise contains significant energy in the lower frequency bands, which are typically taken to be in the 10 to 160 Hz region.

7. 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.

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

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/Vo), where Vo is the reference level (10^{-9} m/s). Care is required in this regard, as other reference levels may be used.

8. 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.

9. Ground-borne Noise, Structure-borne Noise and Regenerated Noise

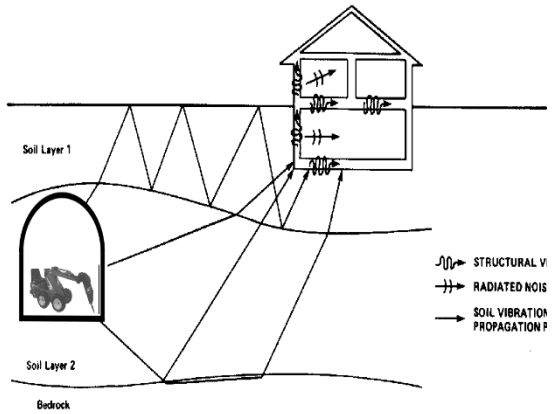
Noise that propagates through a structure as vibration and is radiated by vibrating wall and floor surfaces is termed 'structure-borne noise', 'ground-borne noise' or 'regenerated noise'. This noise originates as vibration and propagates between the source and receiver through the ground and/or building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

Typical sources of ground-borne or structure-borne noise include tunnelling works, underground railways, excavation plant (e.g., 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 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 (i.e., vertical, longitudinal and transverse).



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 Surrounding Sensitive Recievers and Predicted Noise Levels

Noise Management Report

Panorama Battery Energy Storage System (BESS)

Panorama BESS Subco Pty Ltd

SLR Project No.: 660.30234.00000

14 September 2023

ID	Address	Predicted Noise Level LAeq(15minute) (dBA)			
		Day	Day Enhanced	Night	Night Enhanced
R1	800 Mid Western Highway	30	35	28	33
R2	16 Stewart St DP1246510	31	32	16	21
R3	24 Stewart St	21	26	18	23
R4	30 Stewart St	18	23	16	21
R5	27 Stewart St	20	25	18	23
R6	849 Mid Western Highway	17	22	17	22
R7	831a Mid Western Highway DP1188058	21	26	20	26
R8	831b Mid Western Highway DP1188058	19	25	20	25
R9	9 McLennan Close	< 10	< 10	< 10	< 10
R10	7 McLennan Close	< 10	< 10	< 10	< 10
R11	6 McLennan Close	< 10	< 10	< 10	< 10
R12	3a Windemere Rd	< 10	< 10	< 10	< 10
R13	3b Windemere Rd	< 10	< 10	< 10	< 10
R14	16 Windemere Rd	< 10	< 10	< 10	< 10
R15	24 Windemere Rd	< 10	< 10	< 10	< 10
R16	34 Windemere Rd	< 10	< 10	< 10	< 10
R17	38 Windemere Rd	< 10	< 10	< 10	< 10
R18	44 Windemere Rd	< 10	< 10	< 10	< 10
R19	58 Windemere Rd	< 10	< 10	< 10	< 10
R20	60 Windemere Rd	17	22	18	23
R21	80 Windemere Rd	< 10	10	< 10	10
R22	92 Windemere Rd	< 10	< 10	< 10	< 10
R23	23 Windemere Road	< 10	< 10	< 10	< 10
R24	331 Hartwood Av	< 10	< 10	< 10	< 10
R25	260 Hartwood Av	< 10	< 10	< 10	< 10
R26	290 Hartwood Av	< 10	< 10	< 10	< 10
R27	120 Hartwood Av	< 10	< 10	< 10	< 10
R28	11 Hartwood Av	< 10	10	< 10	11
R29	21 Hartwood Av	< 10	< 10	< 10	< 10
R30	20 Hartwood Av	< 10	10	< 10	11
R31	70 Hartwood Av	< 10	< 10	< 10	< 10
R32	60 Hartwood Av	< 10	< 10	< 10	< 10
R33	50 Hartwood Av	< 10	< 10	< 10	< 10
R34	DP 1002050	< 10	14	< 10	15
R35	403 Evans Plains Road DP 1121694	14	13	19	

Appendix C Ambient Noise Graphical Results

Noise Management Report

Panorama Battery Energy Storage System (BESS)

Panorama BESS Subco Pty Ltd

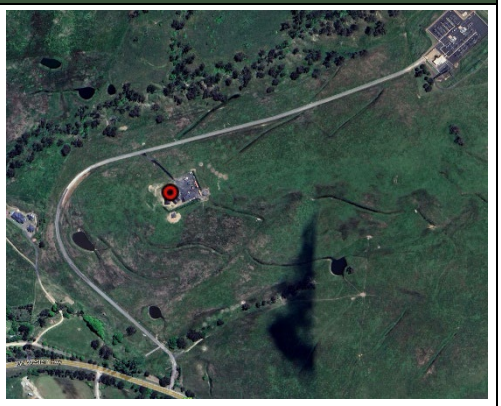
SLR Project No.: 660.30234.00000

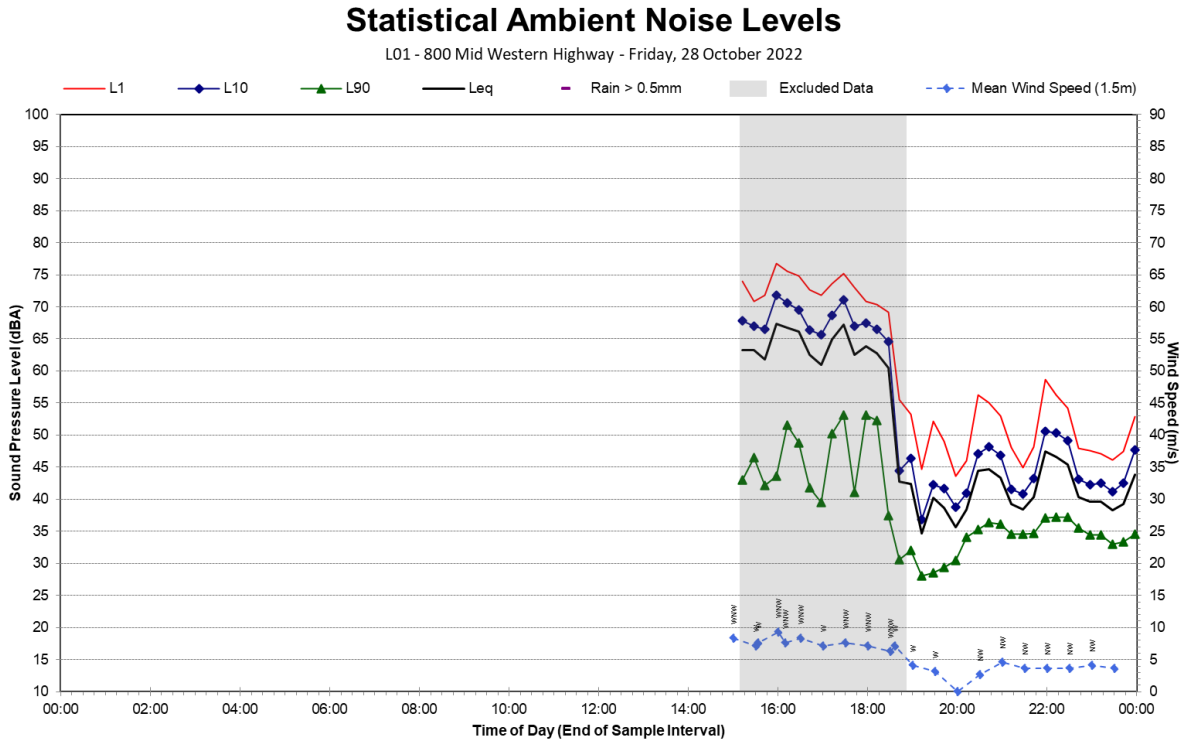
14 September 2023

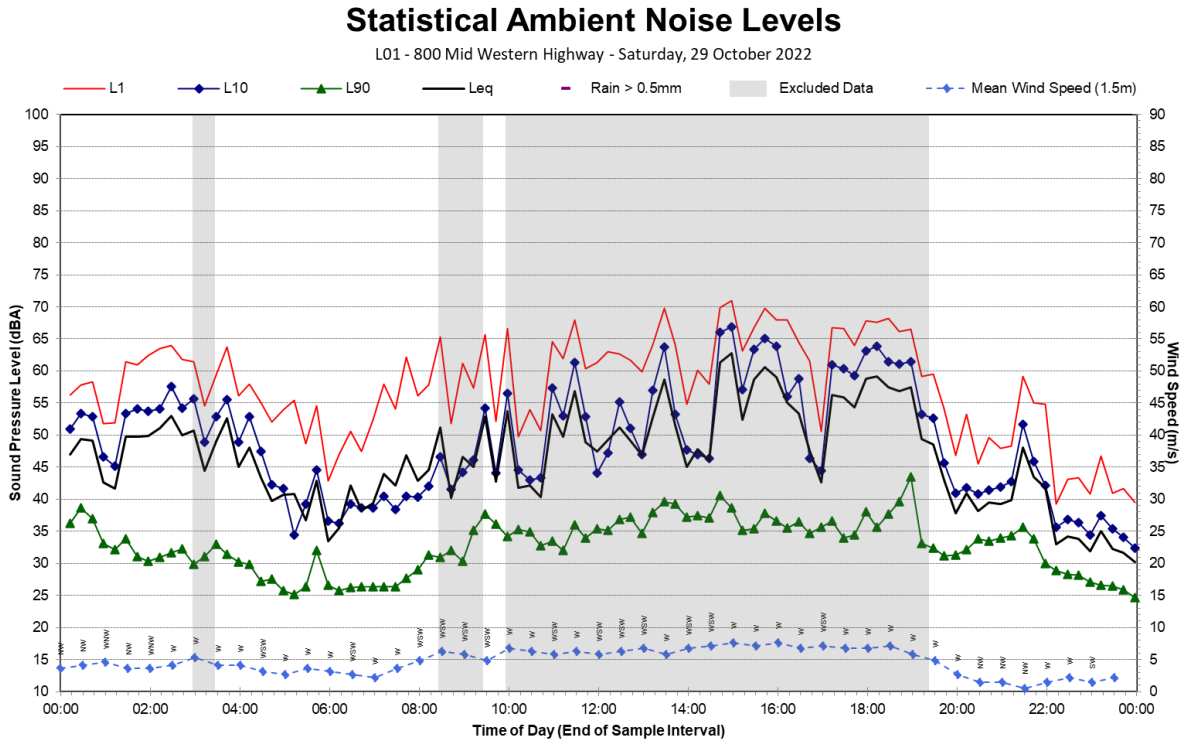
<table>
<tr><td>Noise Monitoring Location</td><td colspan="4">L01</td><td rowspan="2">Map of Noise Monitoring Location</td></tr>
<tr><td>Noise Monitoring Address</td><td colspan="4">800 Mid Western Highway, Evans Plains</td></tr>
<tr><td colspan="5">Logger Device Type: Svantek 957: Logger Serial No:20665
Sound Level Meter Device Type: Brüel and Kjær 2250, Sound Level Meter Serial No: 3008204

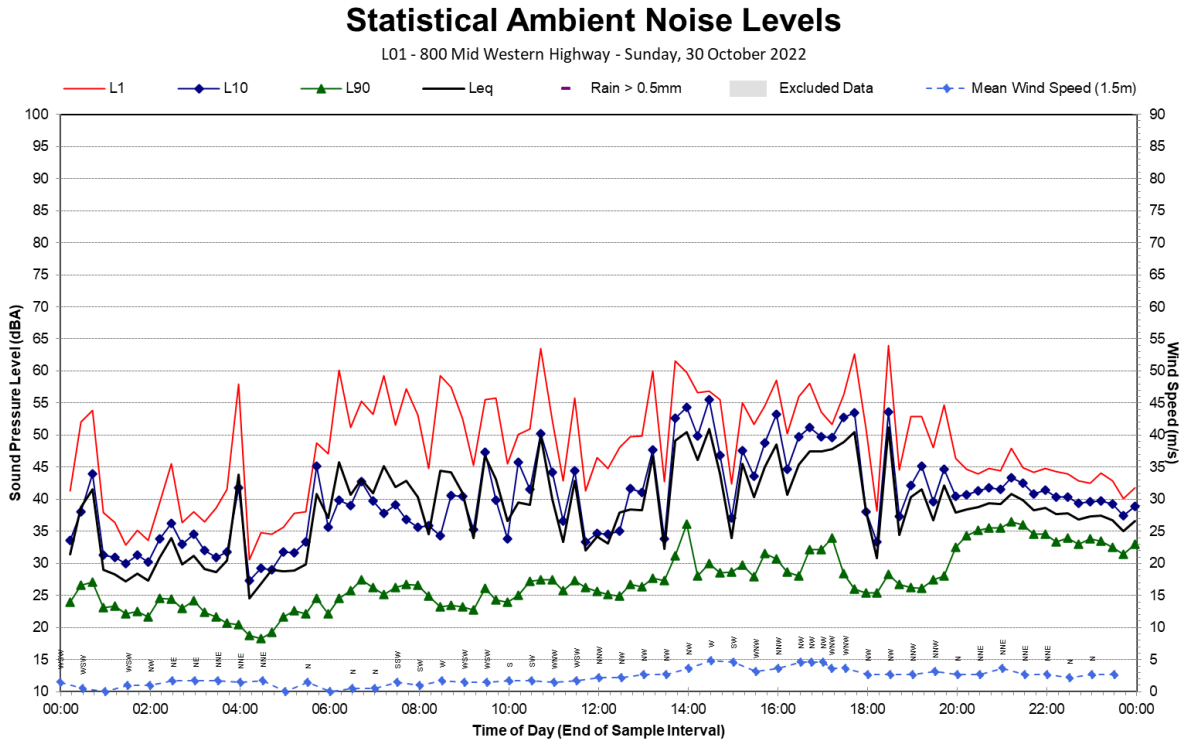
Ambient noise logger deployed at Evans Plains located at the residence front door pavement surrounded by open terrain.

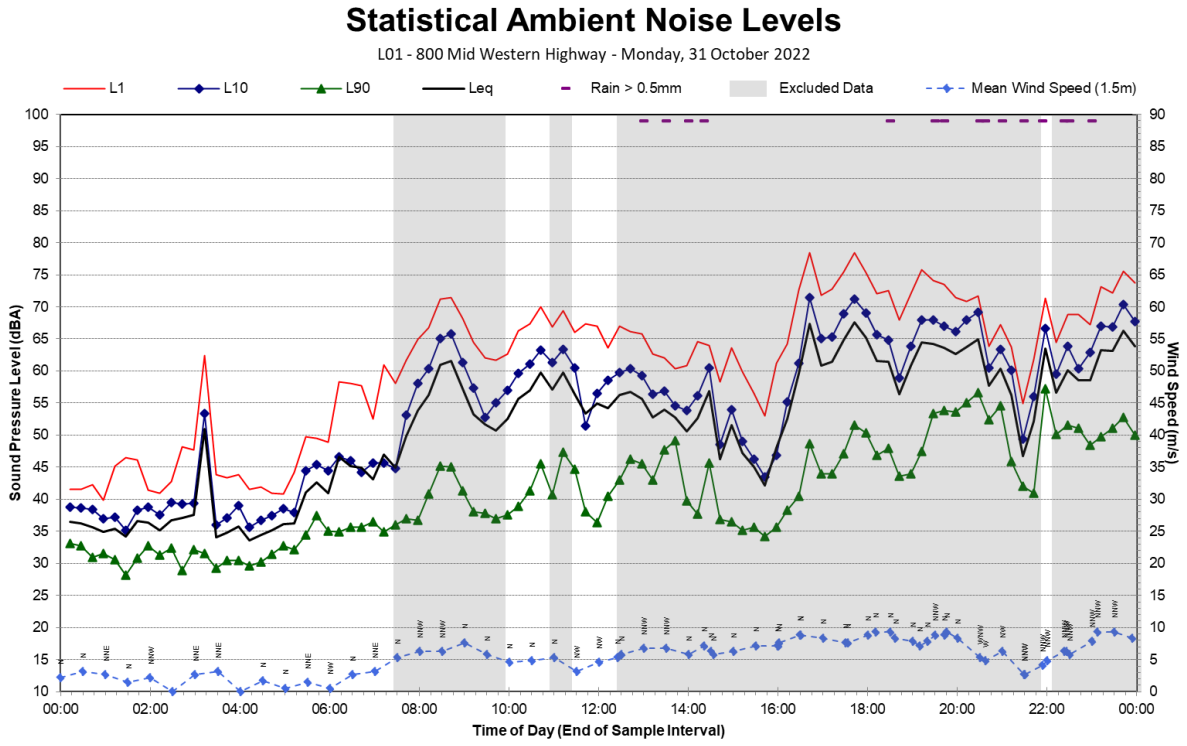
Attended noise measurements indicate the ambient noise environment at this location is influence by wildlife noise.

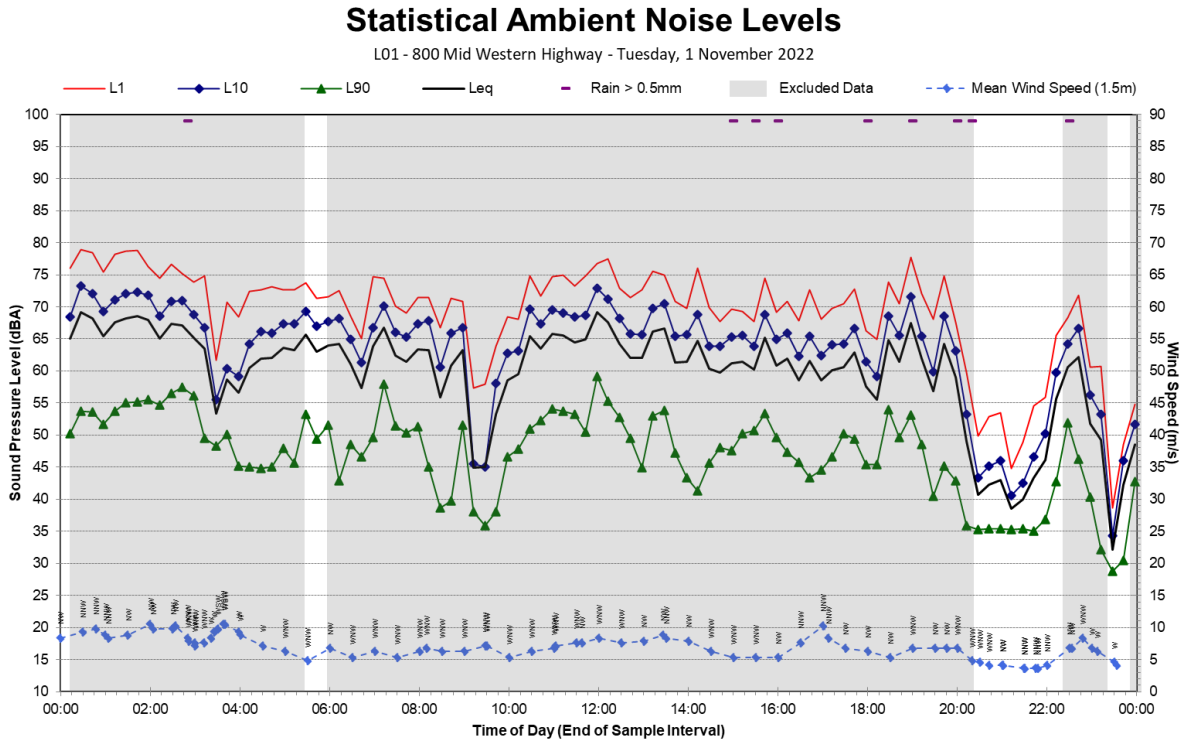
Recorded Noise Levels (LAmax) 22/11/2023:
Cows: 37-48 dBA
Wind: 37-41dBA
Workers: 48-54dBA</td><td>  </td></tr>
<tr><td colspan="5">Ambient Noise Logging Results – ICNG Defined Time Periods</td><td>Photo of Noise Monitoring Location</td></tr>
<tr><td rowspan="2">Monitoring Period</td><td colspan="4">Noise Level (dBA)</td><td rowspan="6">  </td></tr>
<tr><td>RBL</td><td>LAeq</td><td>L10</td><td>L1</td></tr>
<tr><td>Daytime</td><td>26</td><td>53</td><td>41</td><td>52</td></tr>
<tr><td>Evening</td><td>28</td><td>45</td><td>42</td><td>47</td></tr>
<tr><td>Night-time</td><td>30</td><td>51</td><td>40</td><td>44</td></tr>
<tr><td colspan="5">Ambient Noise Logging Results – RNP Defined Time Periods</td></tr>
<tr><td rowspan="2">Monitoring Period</td><td colspan="2">Noise Level (dBA)</td><td colspan="2"></td></tr>
<tr><td colspan="2">LAeq (period)</td><td colspan="2">LAeq (1 hour)</td></tr>
<tr><td>Daytime (7am - 10pm)</td><td colspan="2">58</td><td colspan="2">49</td></tr>
<tr><td>Night-time (10pm - 7am)</td><td colspan="2">52</td><td colspan="2">45</td></tr>
<tr><td colspan="5">Attended Noise Measurement Results</td></tr>
<tr><td rowspan="2">Date</td><td rowspan="2">Start Time</td><td colspan="3">Noise Level (dBA)</td></tr>
<tr><td>LA90</td><td>LAeq</td><td>LAmax</td></tr>
<tr><td>22/11/2023</td><td>2:33pm</td><td>35</td><td>43</td><td>53</td></tr>
</table>

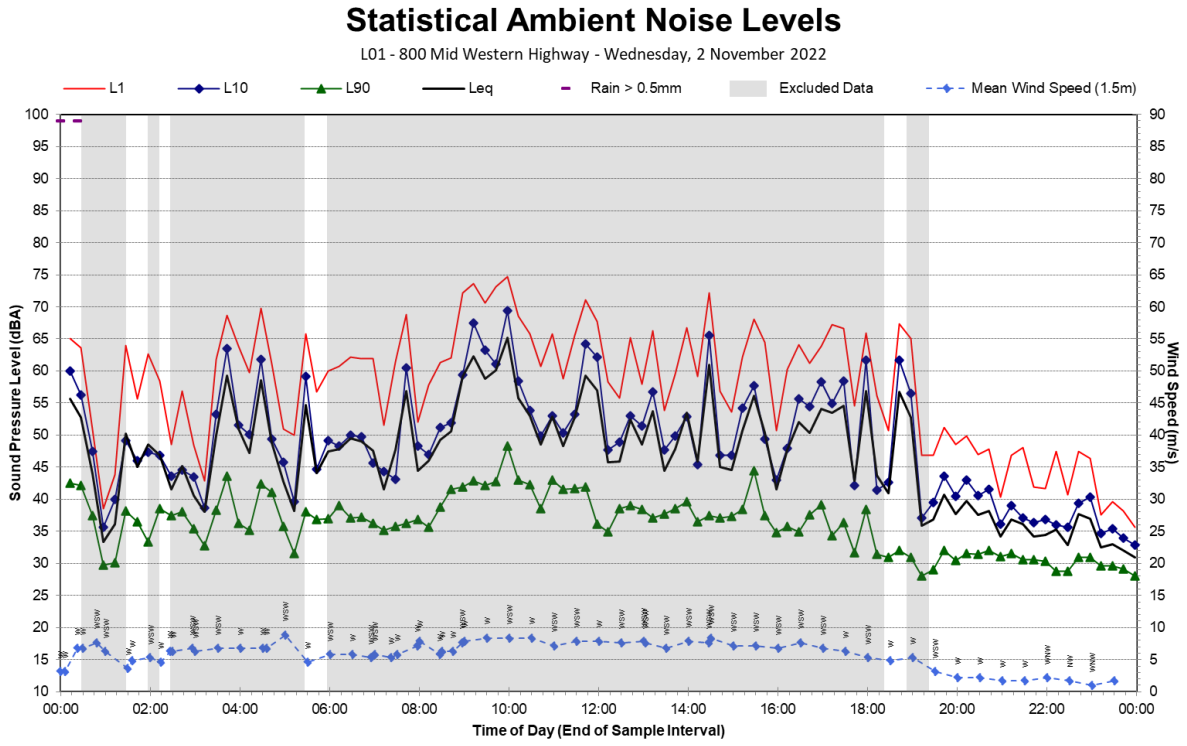

Statistical Ambient Noise Levels
L01 - 800 Mid Western Highway - Friday, 28 October 2022
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

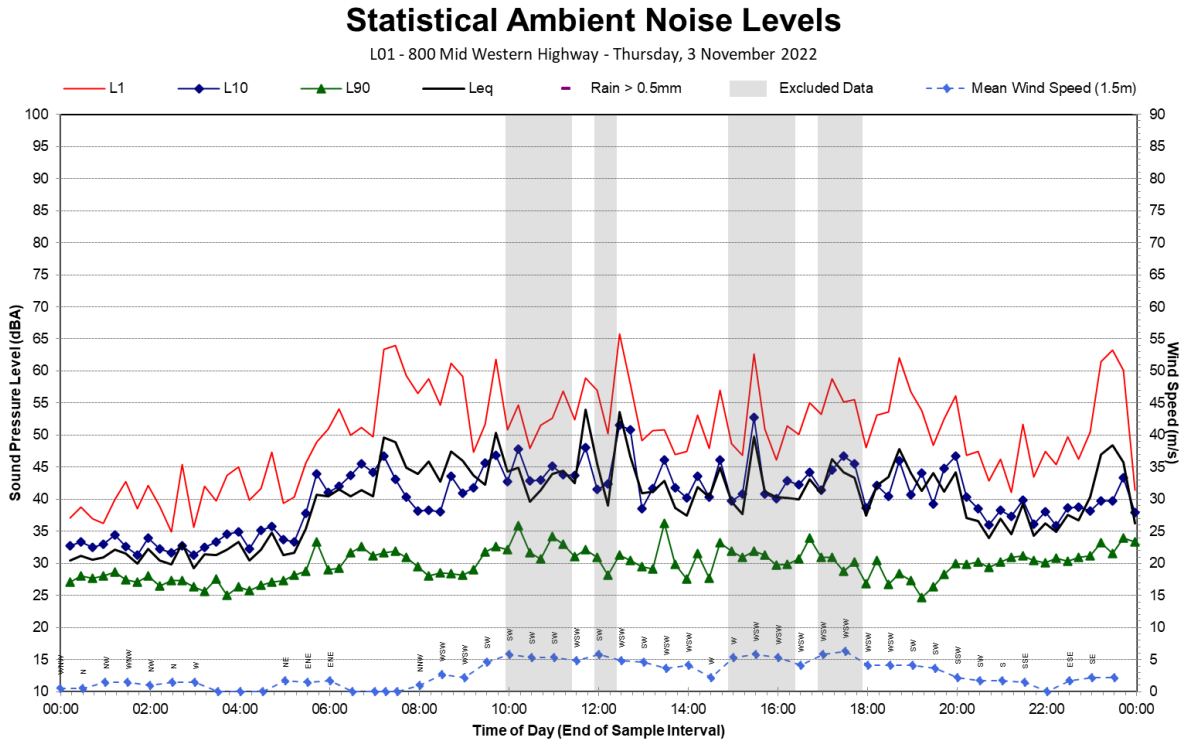

Statistical Ambient Noise Levels
L01 - 800 Mid Western Highway - Saturday, 29 October 2022
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

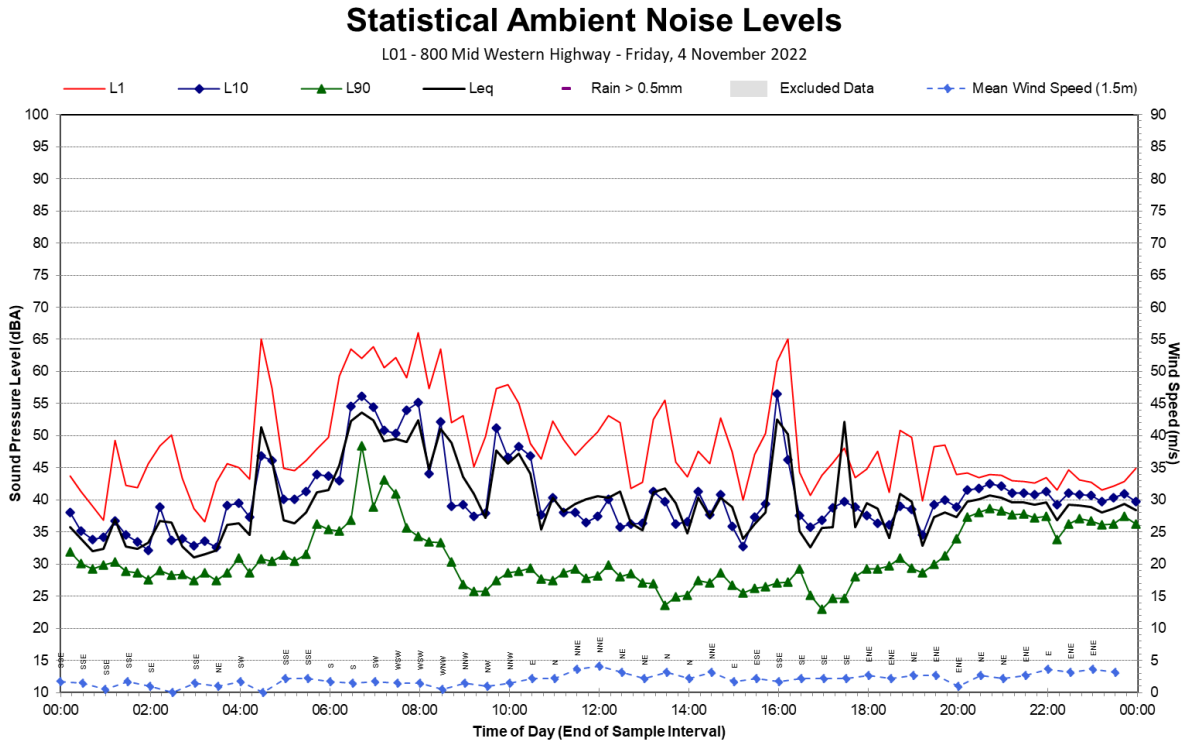

Statistical Ambient Noise Levels
L01 - 800 Mid Western Highway - Sunday, 30 October 2022
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L01 - 800 Mid Western Highway - Monday, 31 October 2022
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L01 - 800 Mid Western Highway - Tuesday, 1 November 2022
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

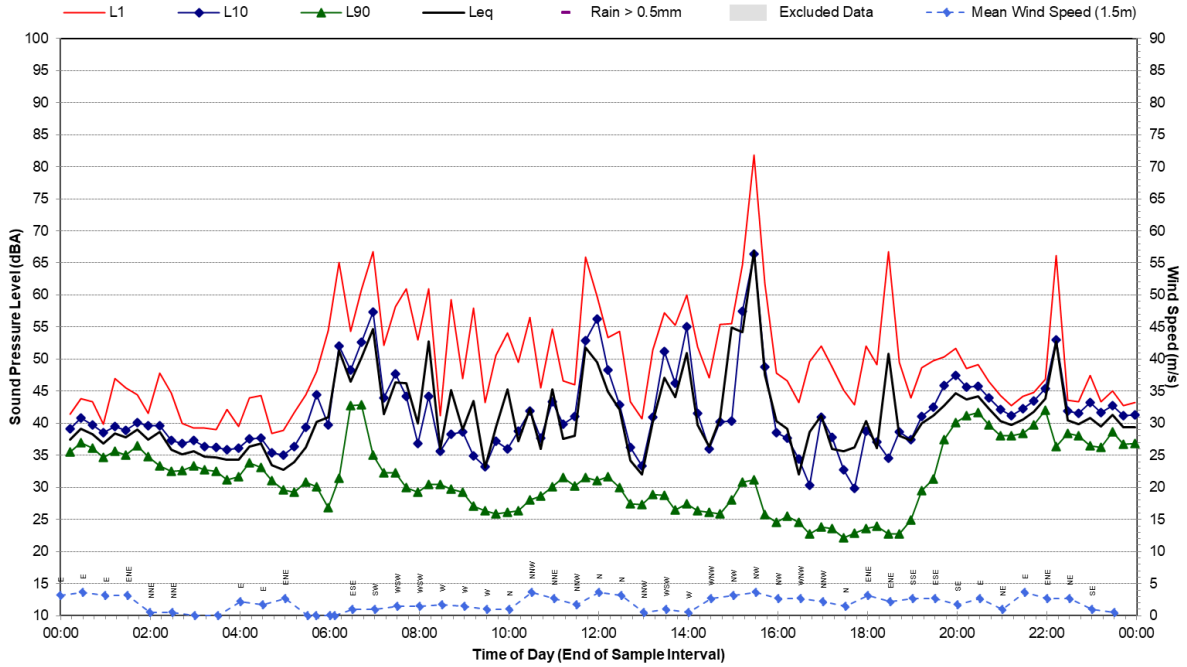

Statistical Ambient Noise Levels
L01 - 800 Mid Western Highway - Wednesday, 2 November 2022
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L01 - 800 Mid Western Highway - Thursday, 3 November 2022
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L01 - 800 Mid Western Highway - Friday, 4 November 2022
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

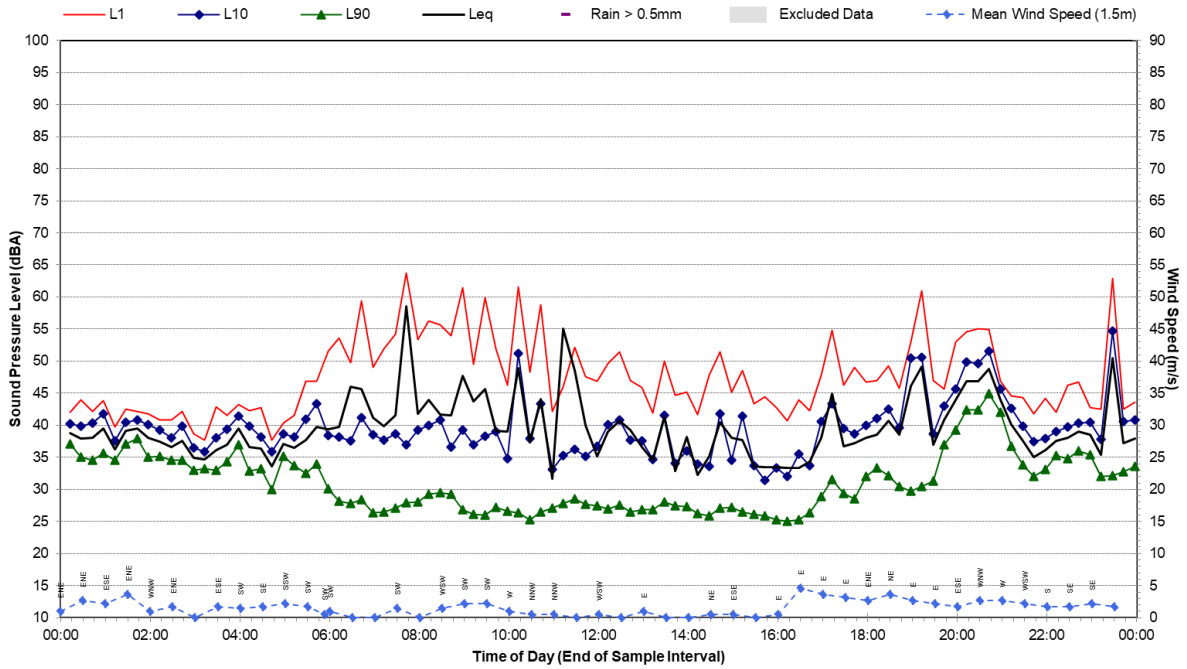
Statistical Ambient Noise Levels

L01 - 800 Mid Western Highway - Saturday, 5 November 2022



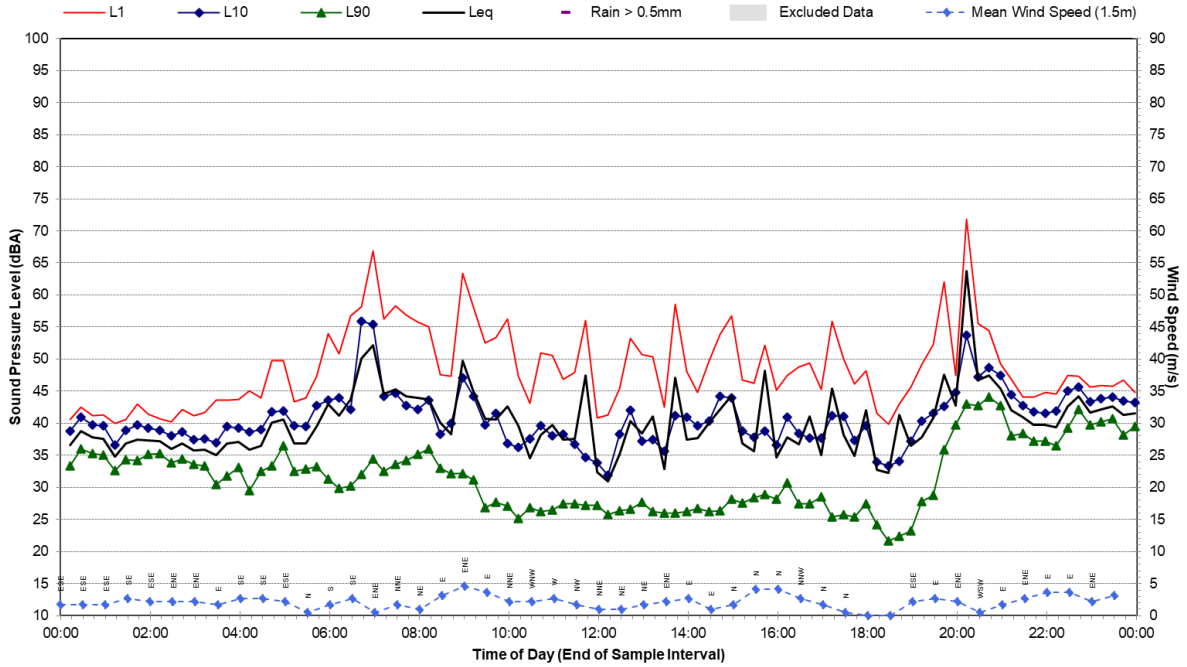
Statistical Ambient Noise Levels

L01 - 800 Mid Western Highway - Sunday, 6 November 2022



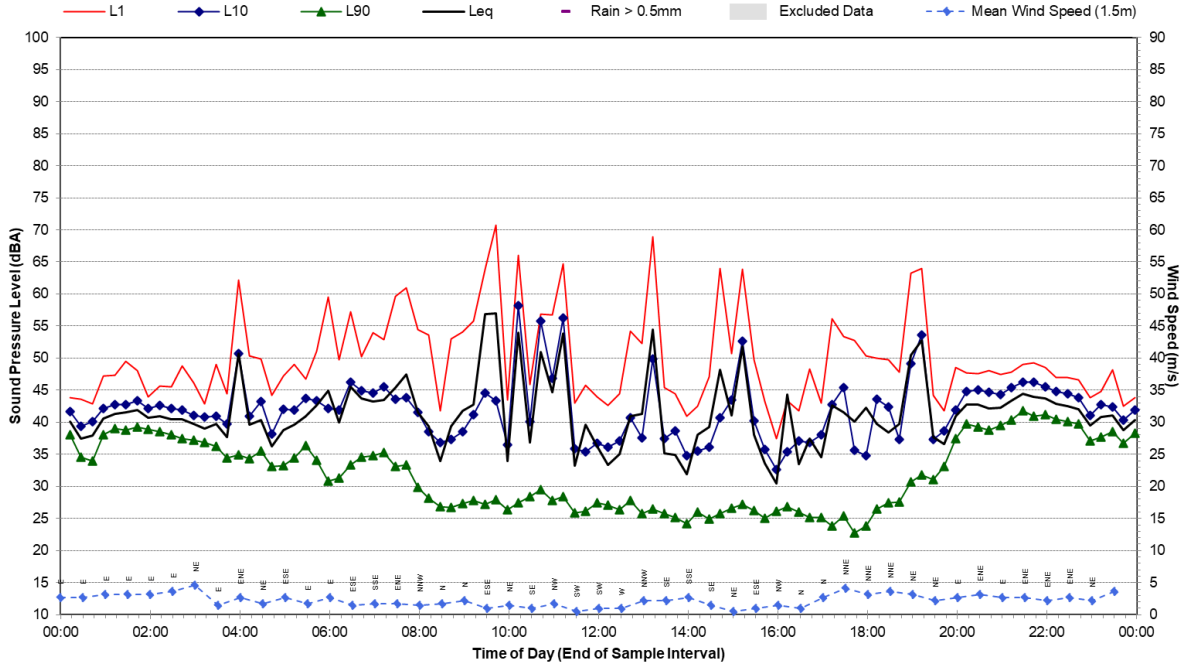
Statistical Ambient Noise Levels

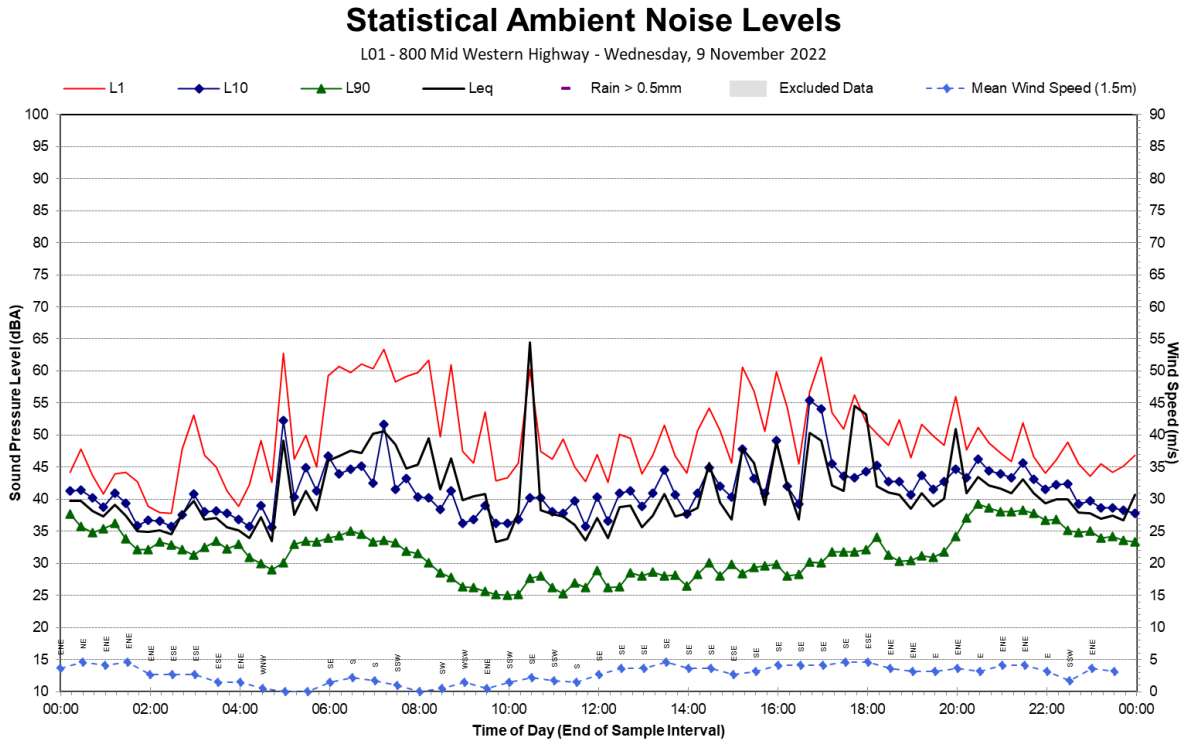
L01 - 800 Mid Western Highway - Monday, 7 November 2022

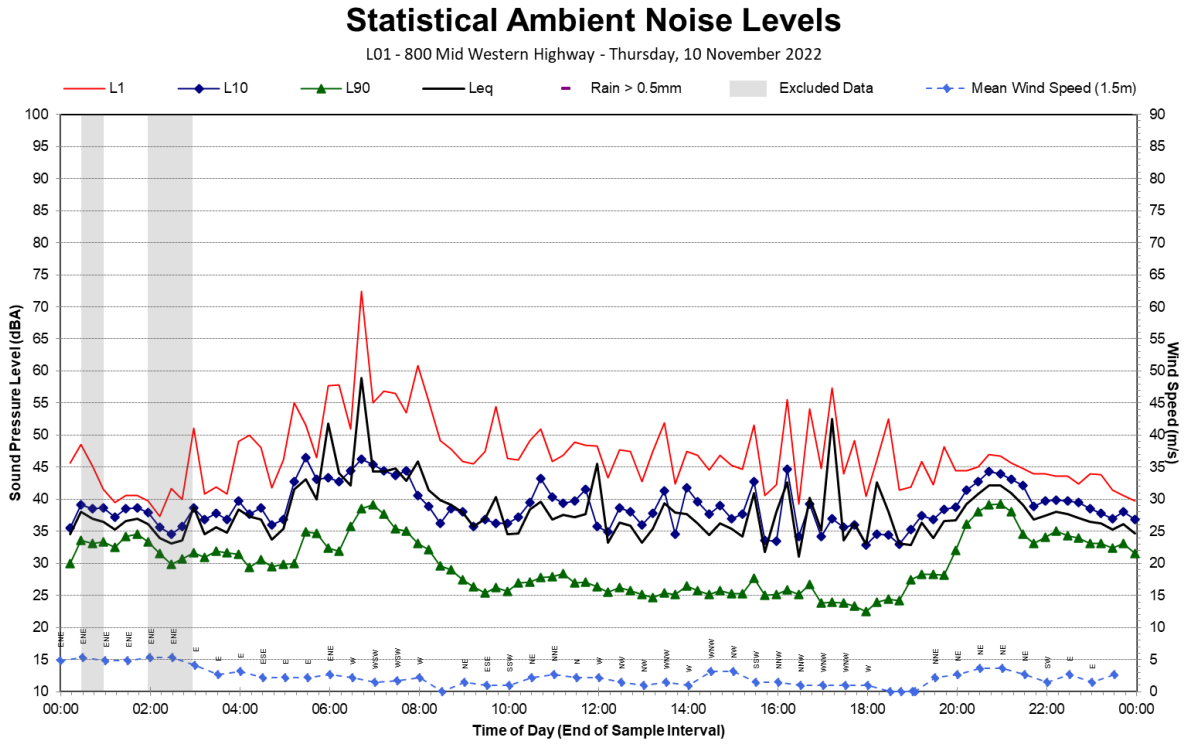


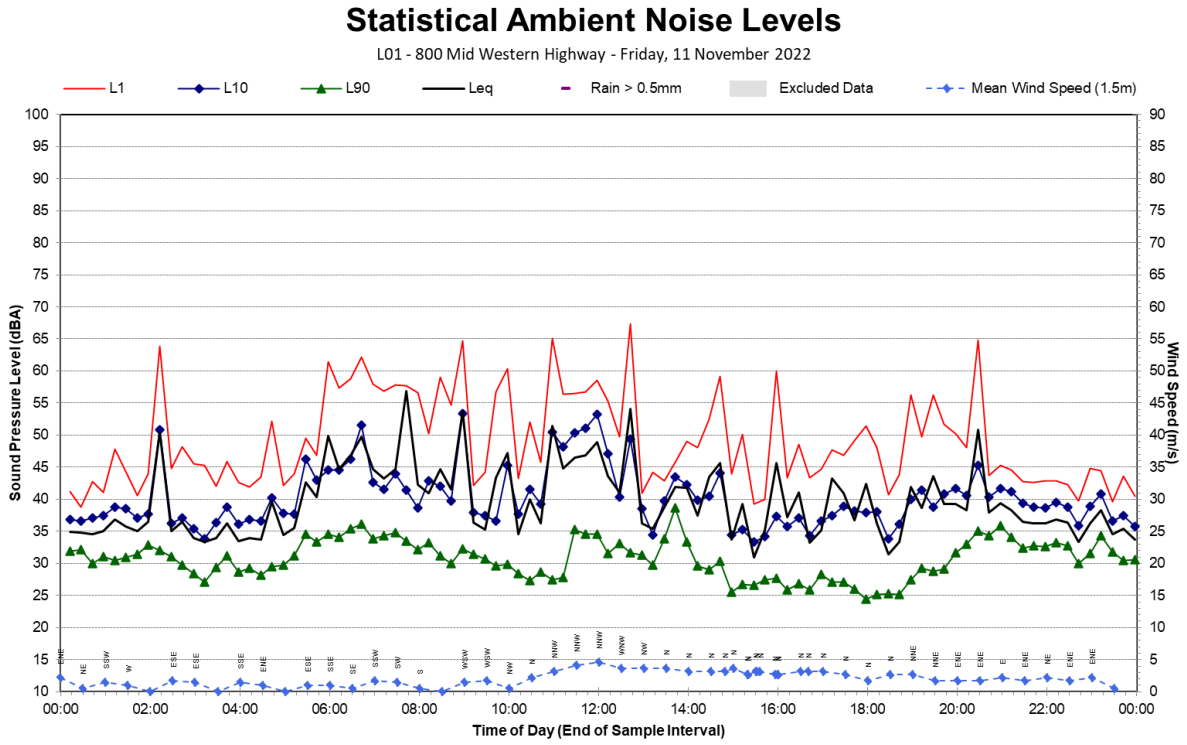
Statistical Ambient Noise Levels

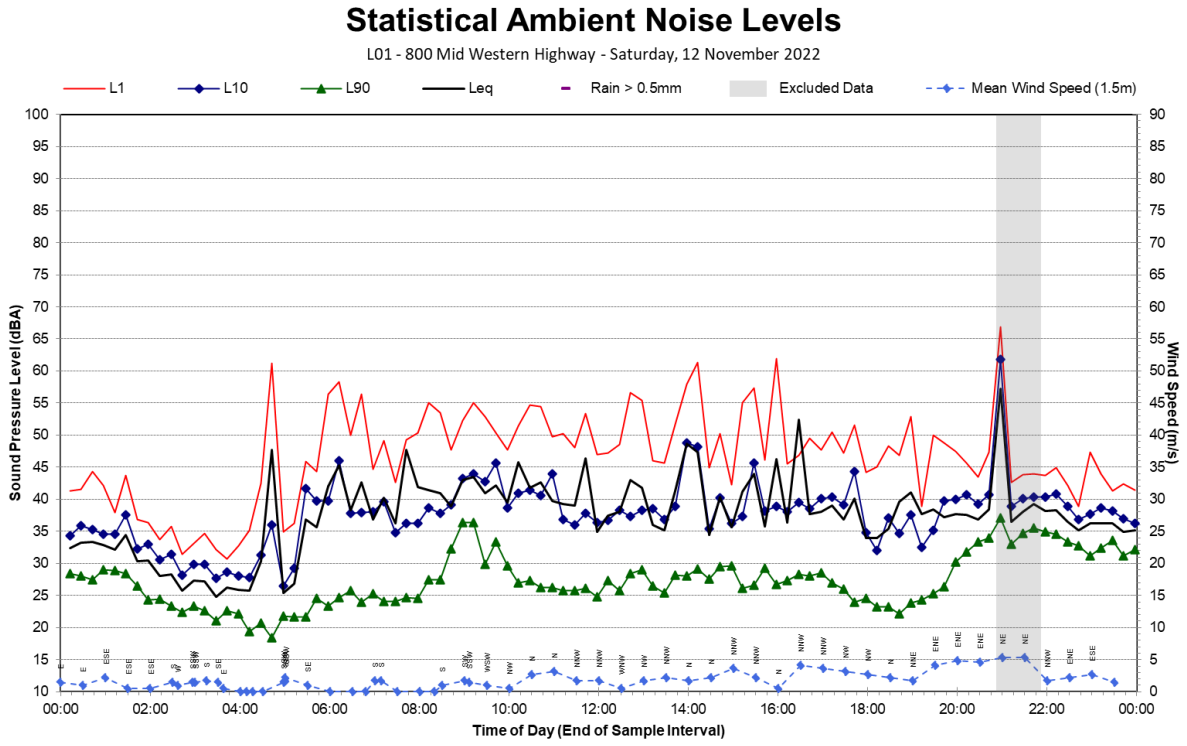
L01 - 800 Mid Western Highway - Tuesday, 8 November 2022

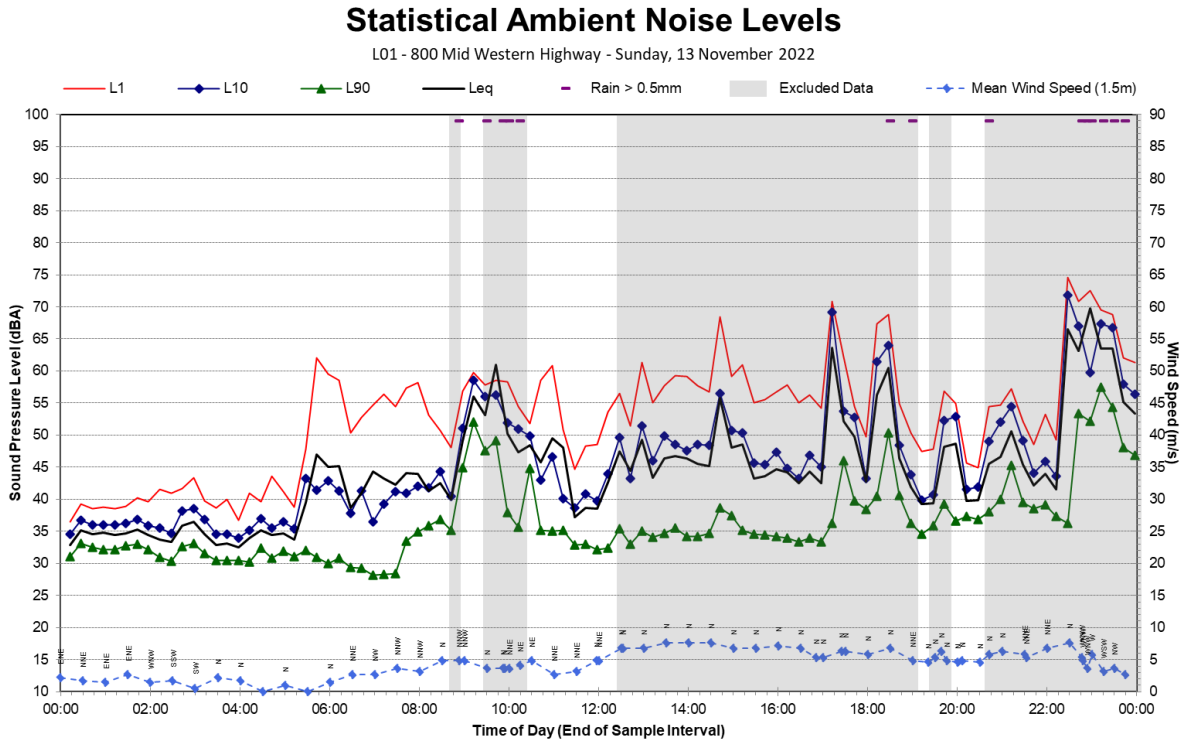


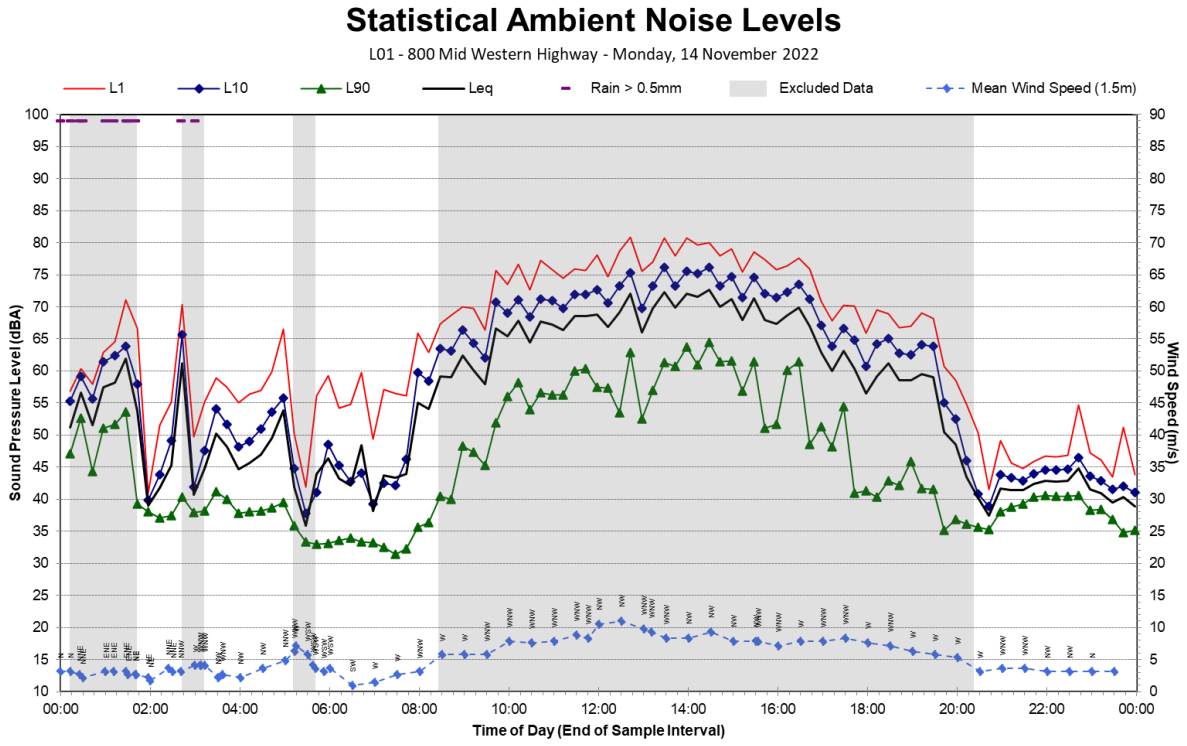

Statistical Ambient Noise Levels
L01 - 800 Mid Western Highway - Wednesday, 9 November 2022
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

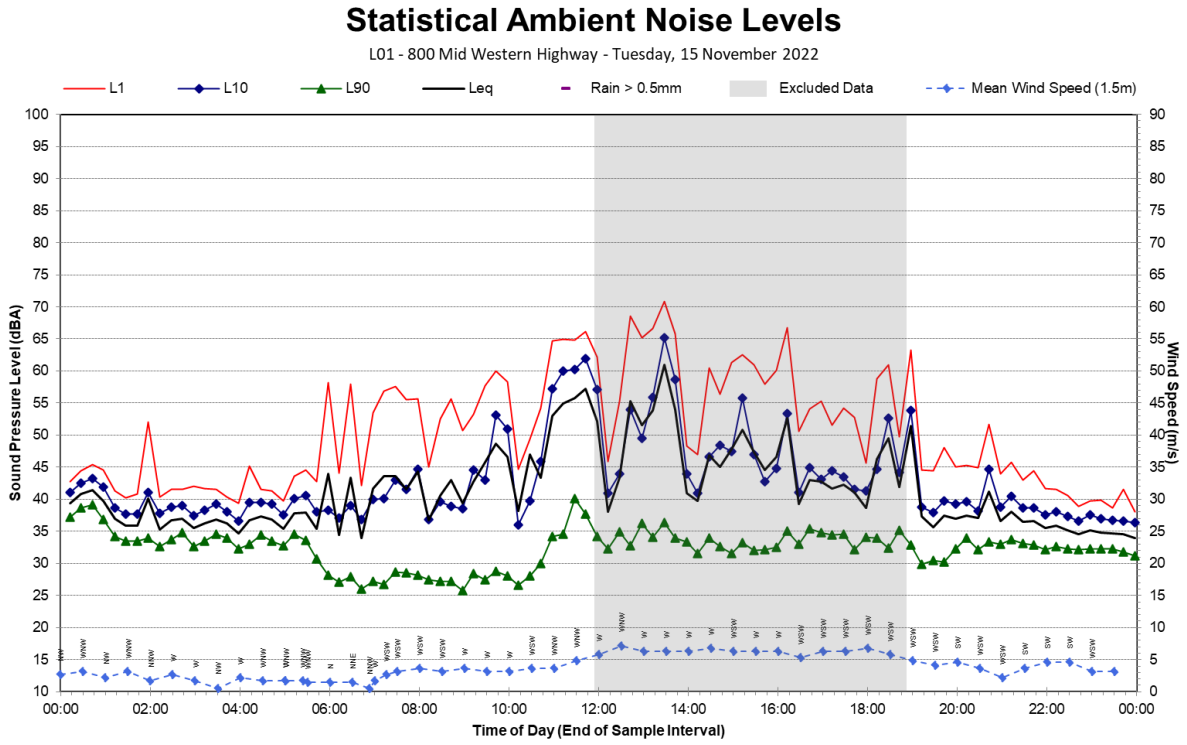

Statistical Ambient Noise Levels
L01 - 800 Mid Western Highway - Thursday, 10 November 2022
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

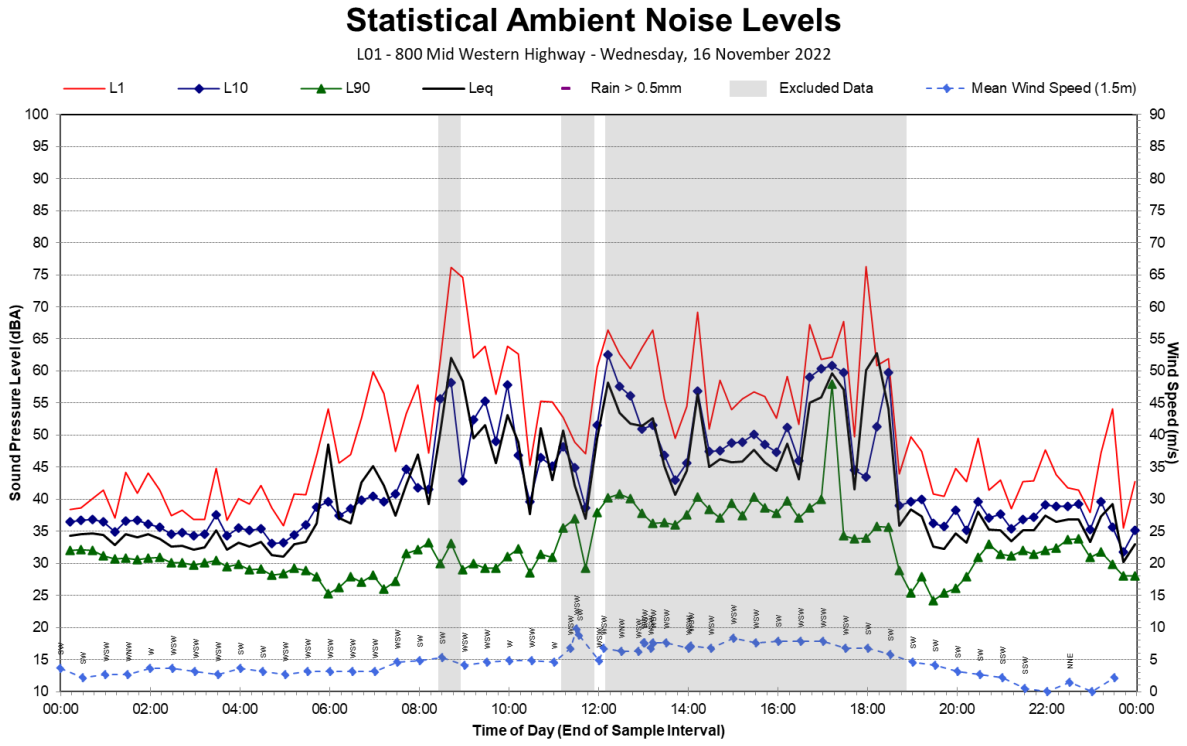

Statistical Ambient Noise Levels
L01 - 800 Mid Western Highway - Friday, 11 November 2022
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

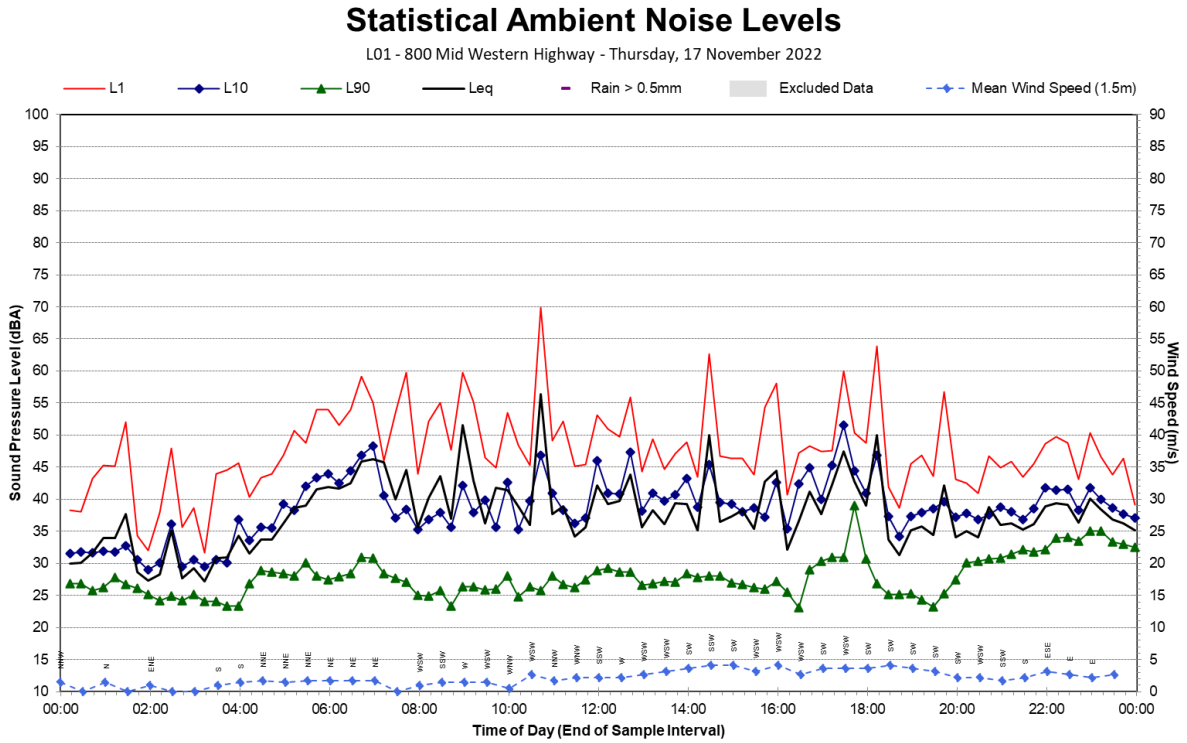

Statistical Ambient Noise Levels
L01 - 800 Mid Western Highway - Saturday, 12 November 2022
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

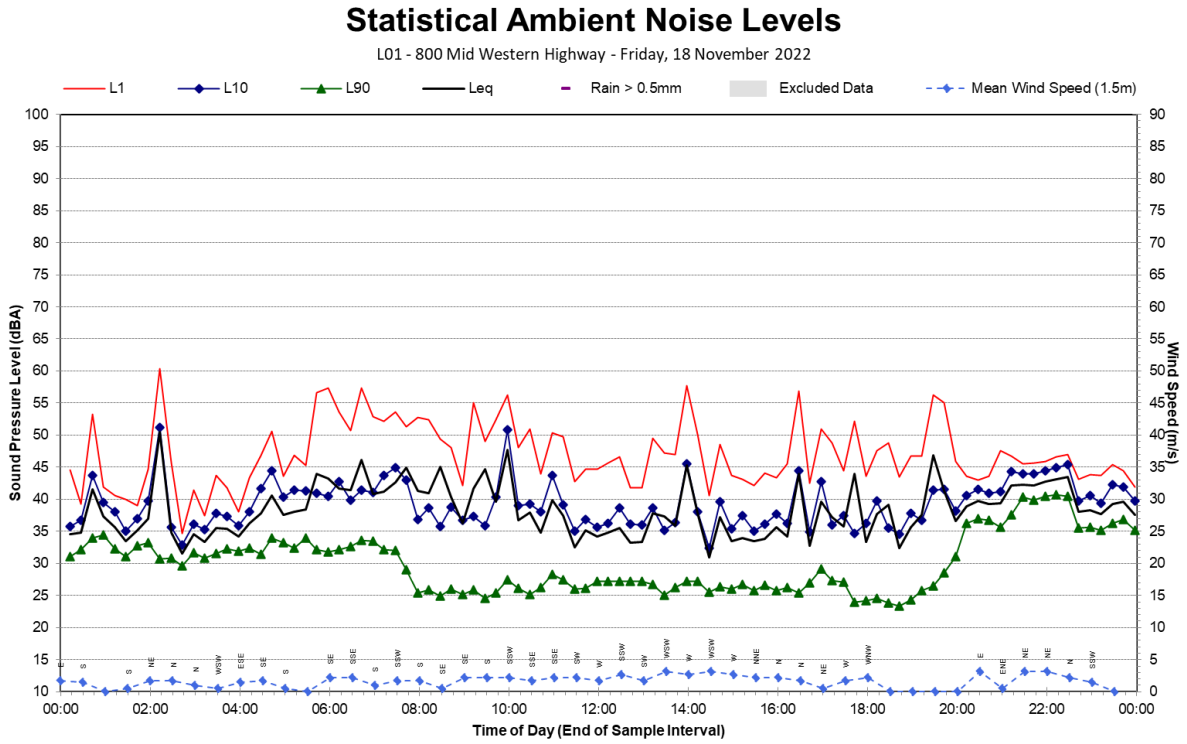

Statistical Ambient Noise Levels
L01 - 800 Mid Western Highway - Sunday, 13 November 2022
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

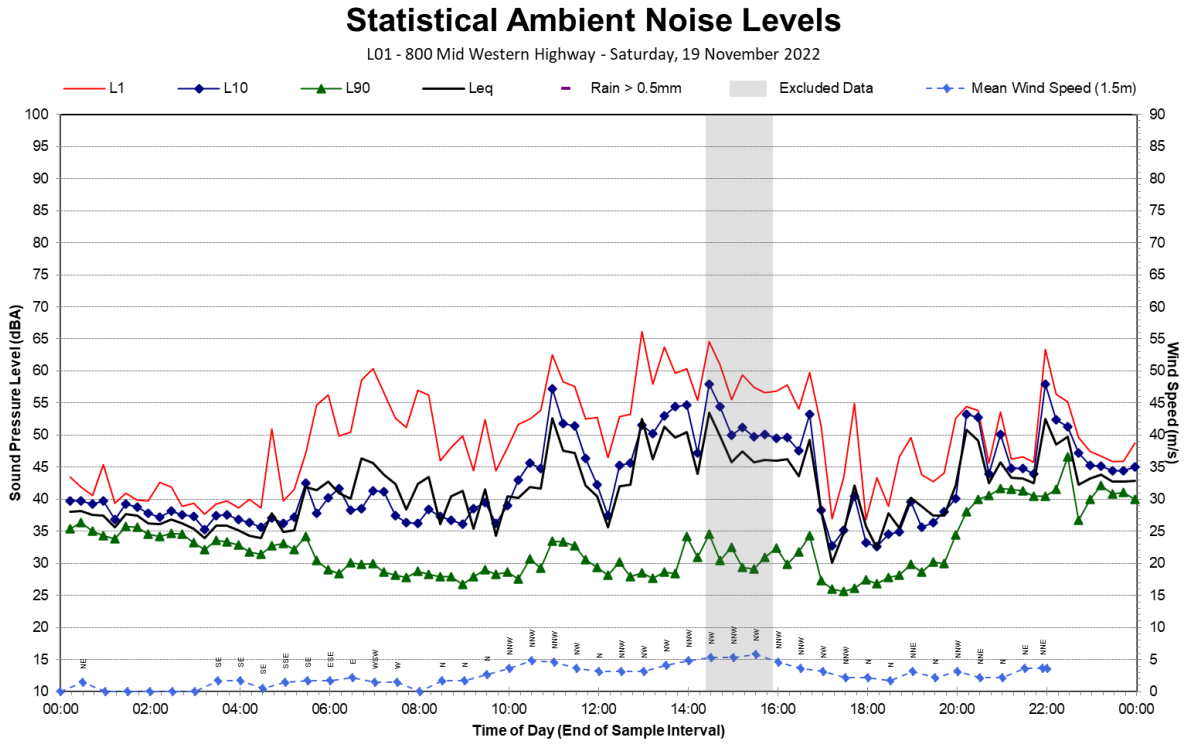

Statistical Ambient Noise Levels
L01 - 800 Mid Western Highway - Monday, 14 November 2022
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

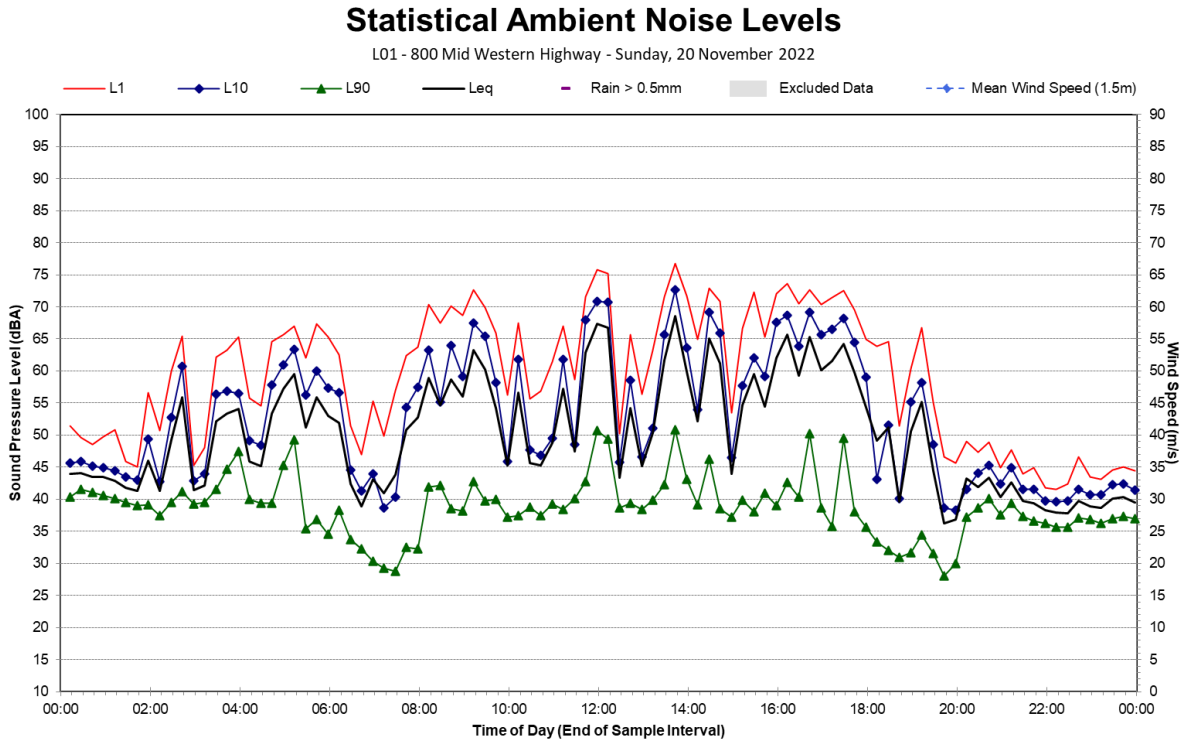

Statistical Ambient Noise Levels
L01 - 800 Mid Western Highway - Tuesday, 15 November 2022
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

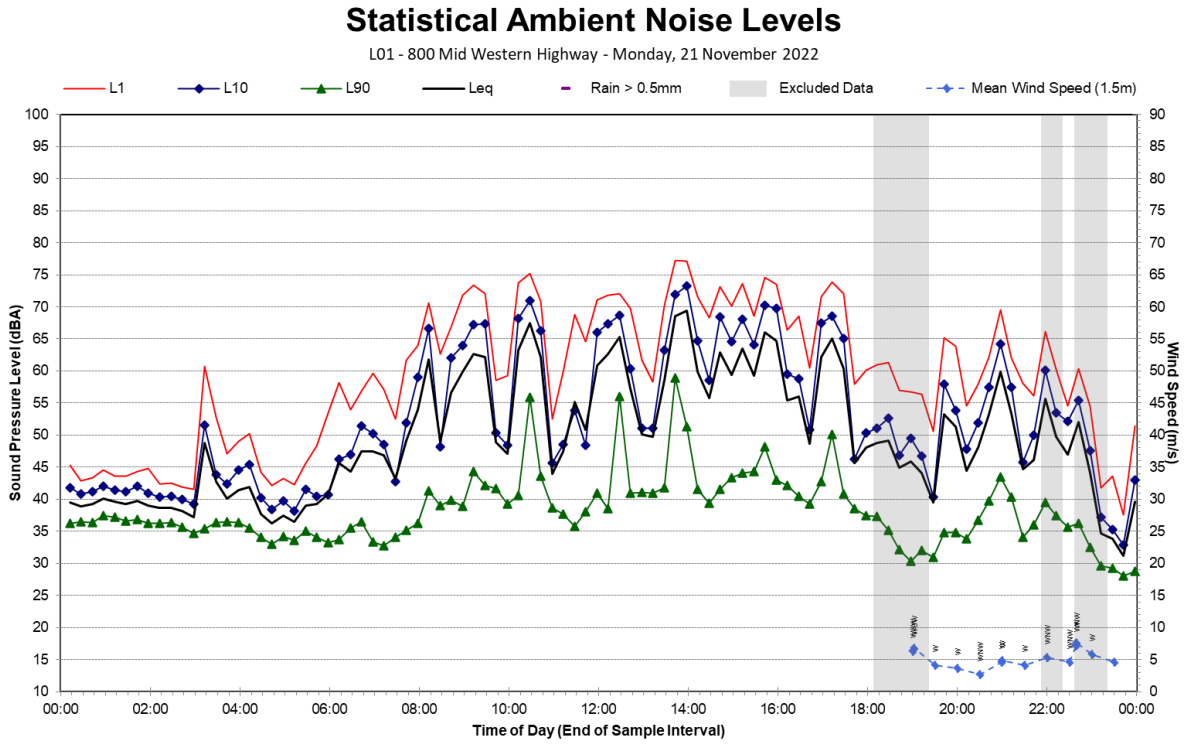

Statistical Ambient Noise Levels
L01 - 800 Mid Western Highway - Wednesday, 16 November 2022
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

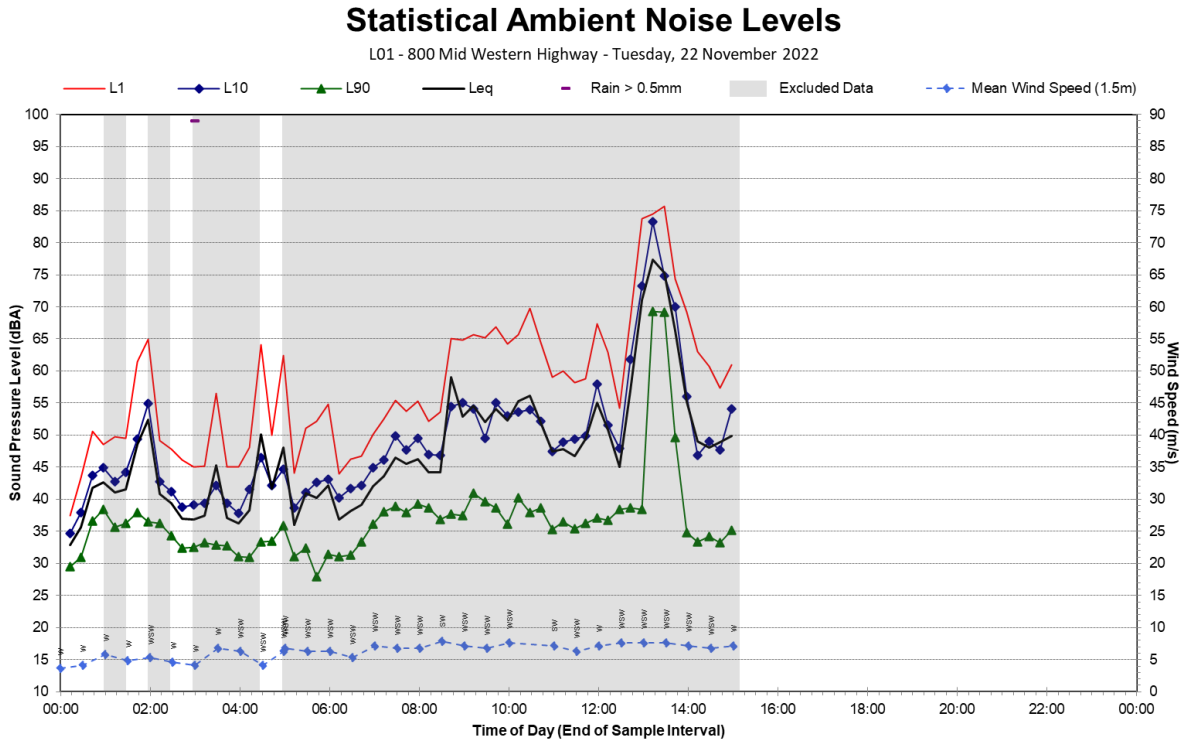

Statistical Ambient Noise Levels
L01 - 800 Mid Western Highway - Thursday, 17 November 2022
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L01 - 800 Mid Western Highway - Friday, 18 November 2022
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

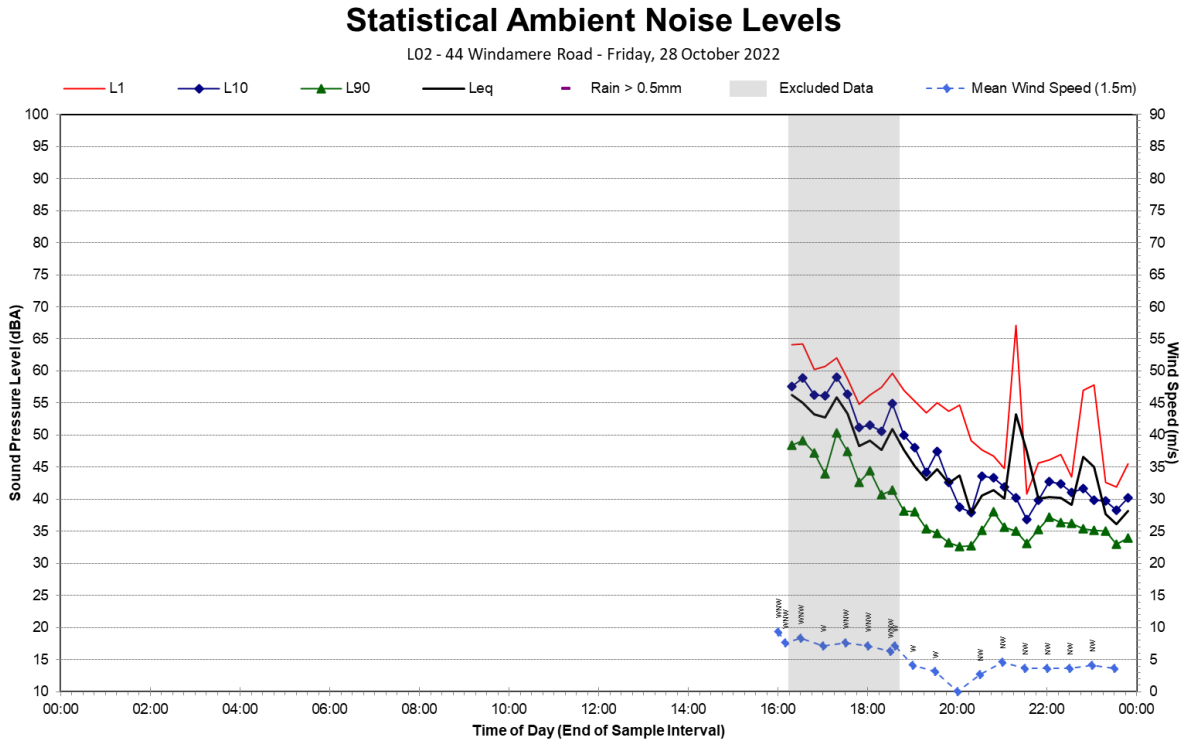

Statistical Ambient Noise Levels
L01 - 800 Mid Western Highway - Saturday, 19 November 2022
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

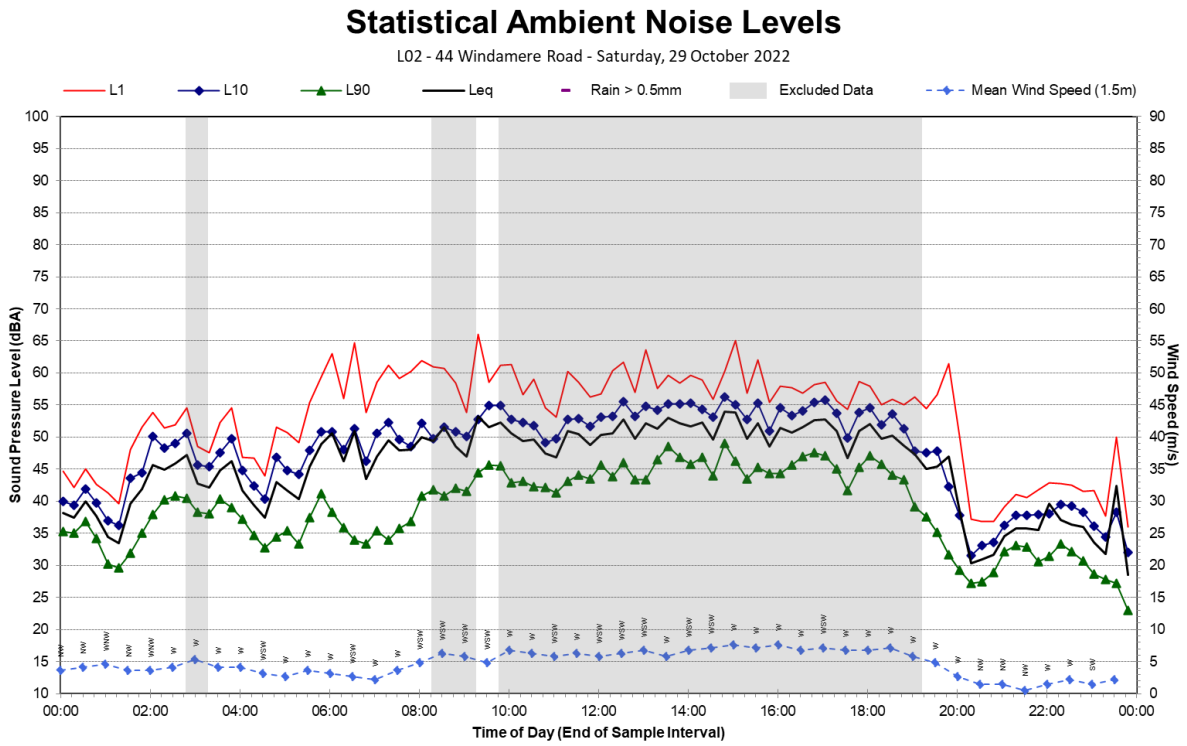

Statistical Ambient Noise Levels
L01 - 800 Mid Western Highway - Sunday, 20 November 2022
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

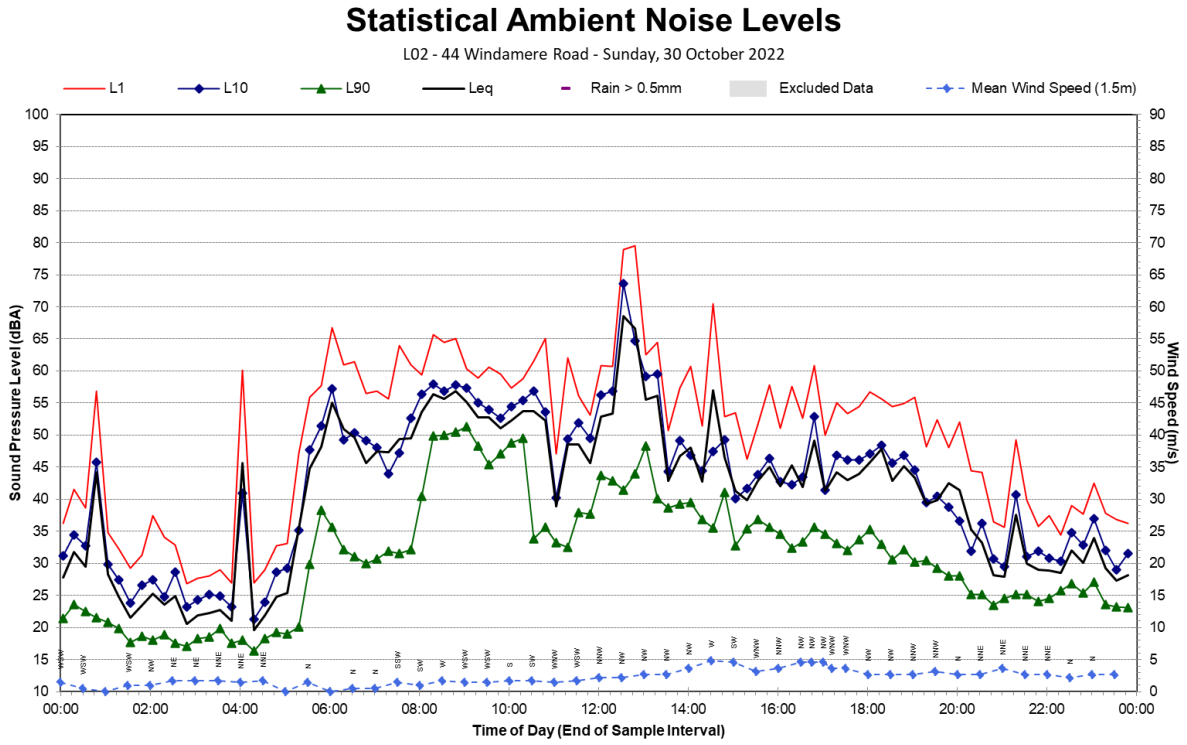

Statistical Ambient Noise Levels
L01 - 800 Mid Western Highway - Monday, 21 November 2022
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

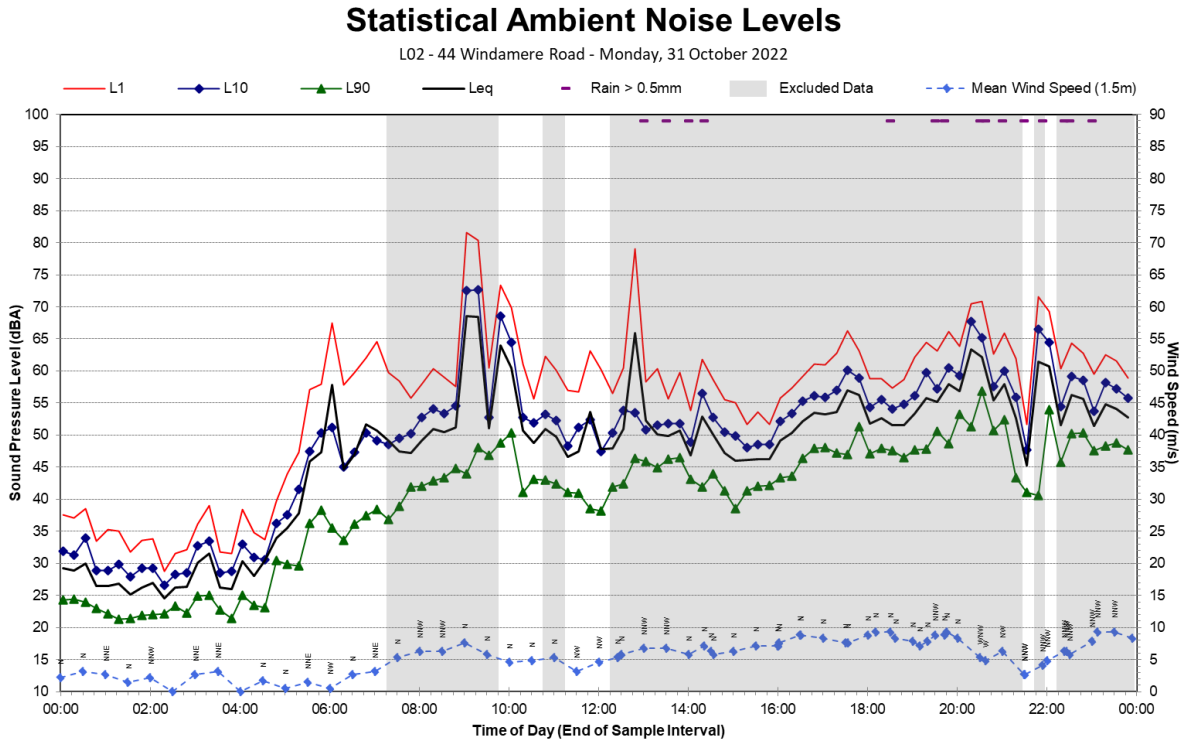

Statistical Ambient Noise Levels
L01 - 800 Mid Western Highway - Tuesday, 22 November 2022
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

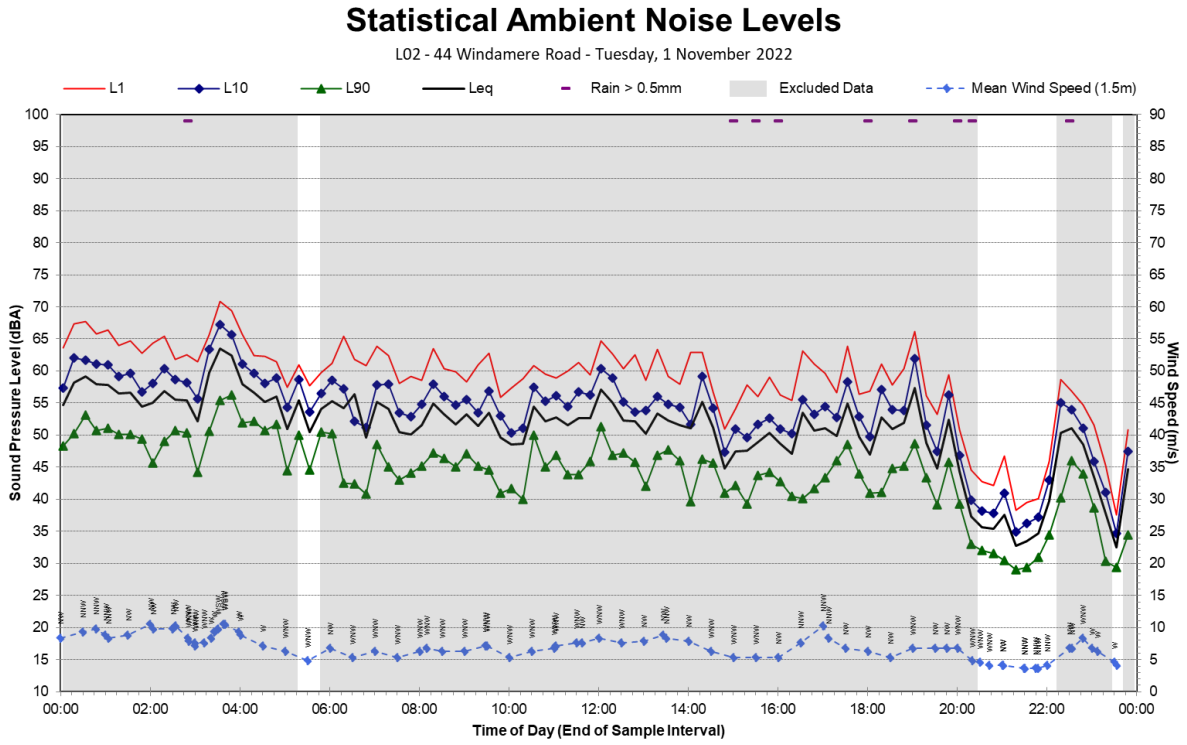
Noise Monitoring Location	L02				Map of Noise Monitoring Location
Noise Monitoring Address	**44 Windamere Road, Robin Hill**				
Logger Device Type: Svantek 957: Logger Serial No:20665 Sound Level Meter Device Type: Brüel and Kjær 2250, Sound Level Meter Serial No: 3008204 Ambient noise logger deployed at 44 Windamere Road located at the residence back garden surrounded by open terrain. Attended noise measurements indicate the ambient noise environment at this location is influence by wildlife noise. Recorded Noise Levels (LAmax) 22/11/2023: Wind: 34-50dBA Birds: 45-50dBA					
Ambient Noise Logging Results – ICNG Defined Time Periods					**Photo of Noise Monitoring Location**
Monitoring Period	**Noise Level (dBA)**				
	RBL	**LAeq**	**L10**	**L1**	
Daytime	31	54	48	58	
Evening	28	50	43	51	
Night-time	22	47	33	39	
Ambient Noise Logging Results – RNP Defined Time Periods					
Monitoring Period	**Noise Level (dBA)**				
	LAeq (period)		**LAeq (1 hour)**		
Daytime (7am - 10pm)	53		54		
Night-time (10pm - 7am)	49		46		
Attended Noise Measurement Results					
Date	**Start Time**	**Noise Level (dBA)**			
		LA90	**LAeq**	**LAmax**	
22/11/2023	2:02pm	40	46	53	

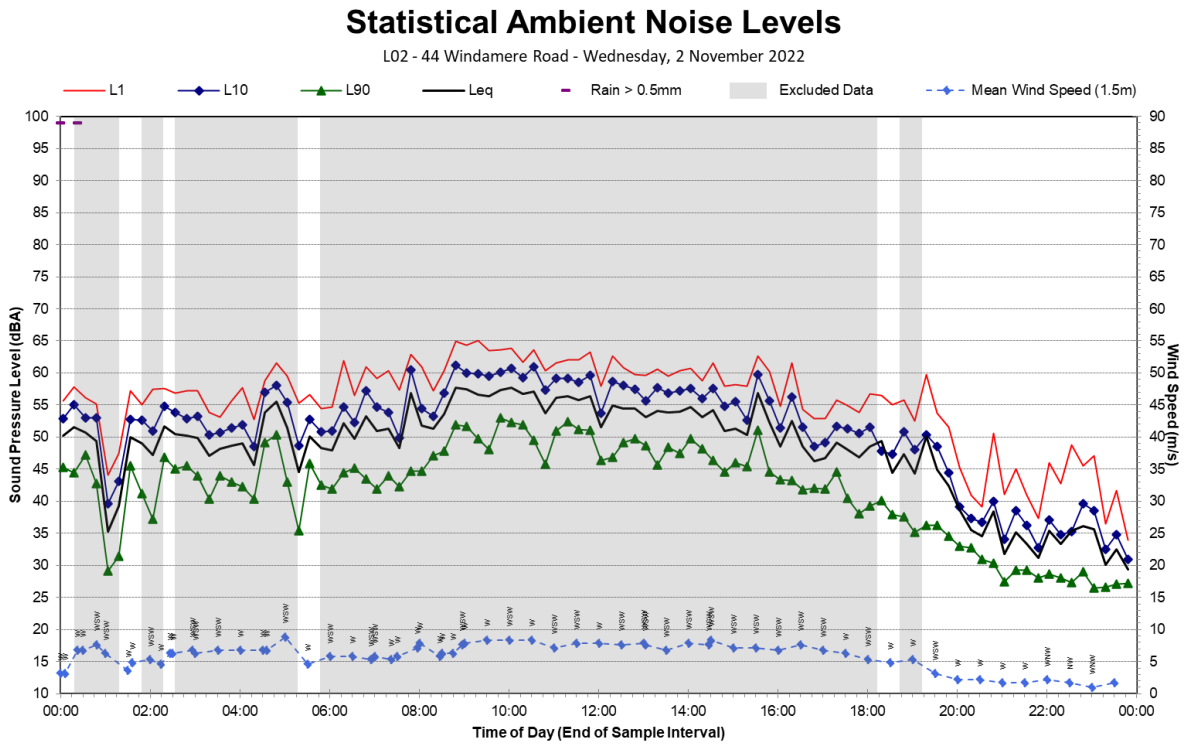

Statistical Ambient Noise Levels
L02 - 44 Windamere Road - Friday, 28 October 2022
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

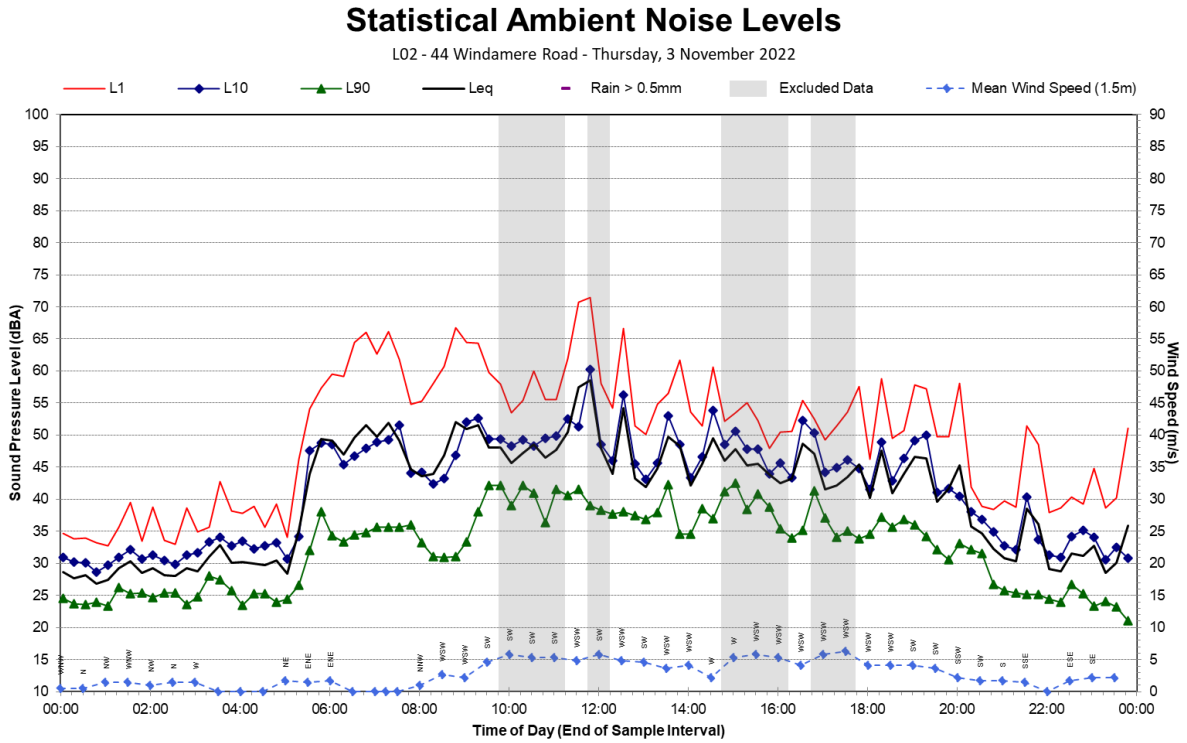

Statistical Ambient Noise Levels
L02 - 44 Windamere Road - Saturday, 29 October 2022
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

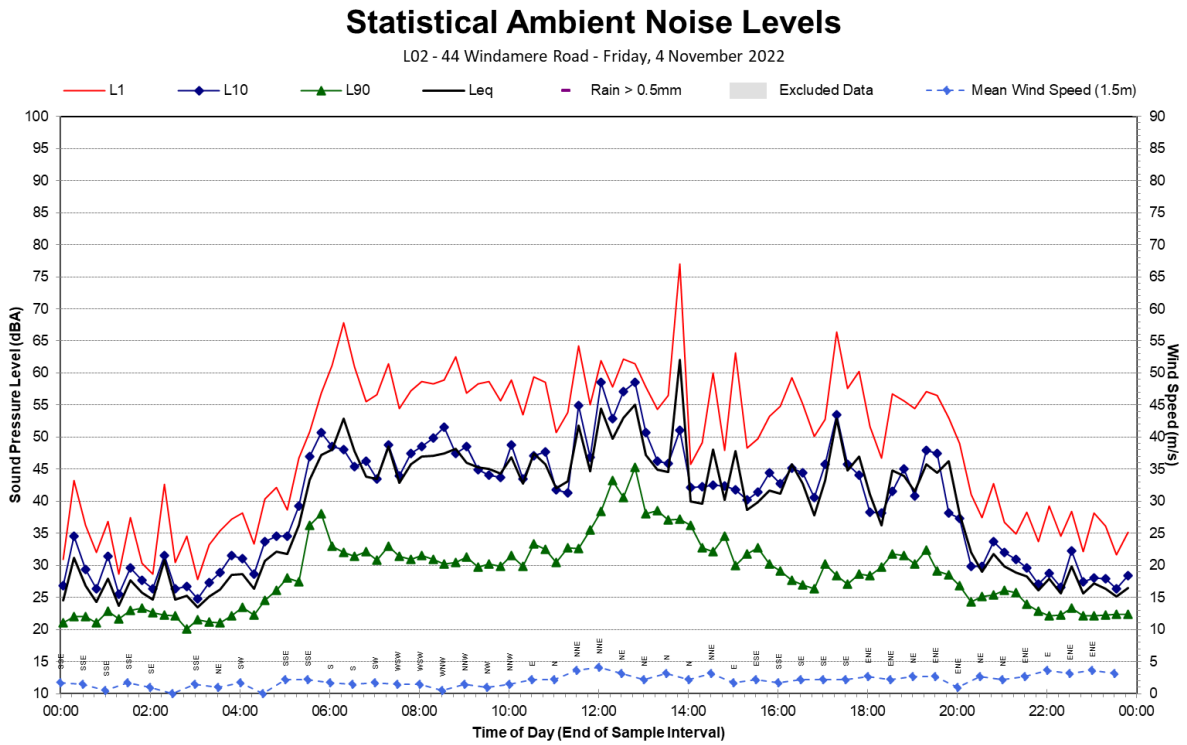

Statistical Ambient Noise Levels
L02 - 44 Windamere Road - Sunday, 30 October 2022
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

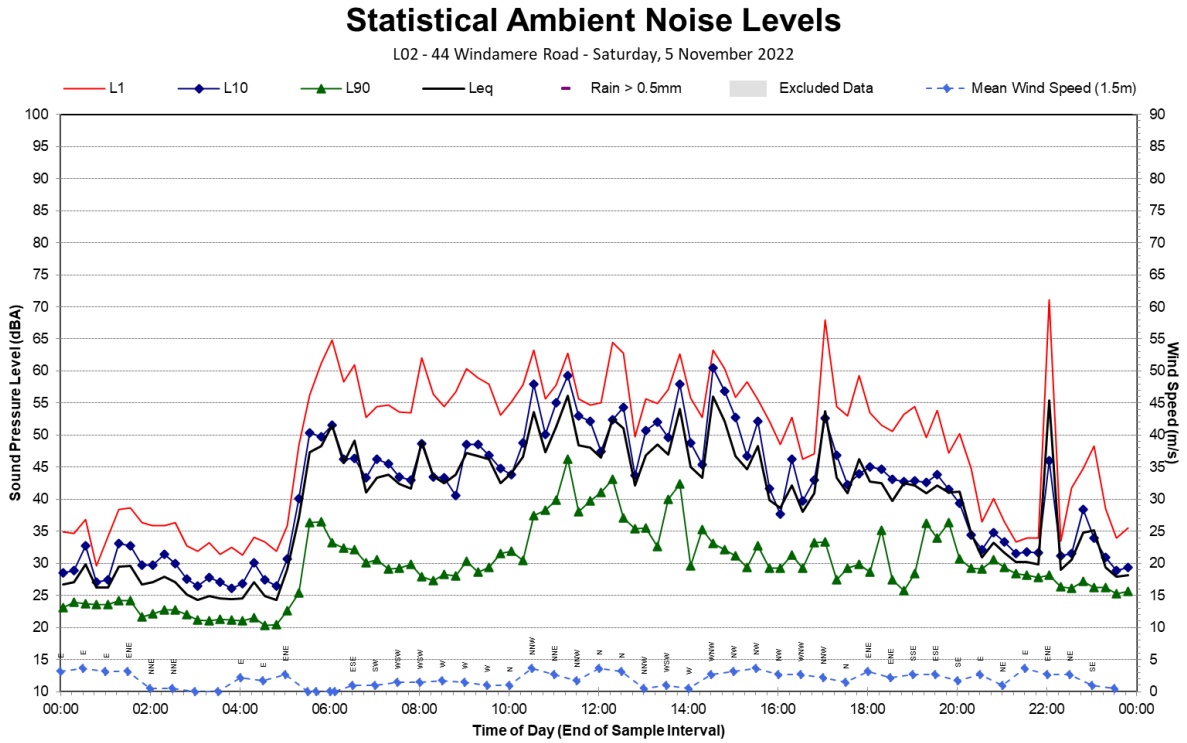

Statistical Ambient Noise Levels
L02 - 44 Windamere Road - Monday, 31 October 2022
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

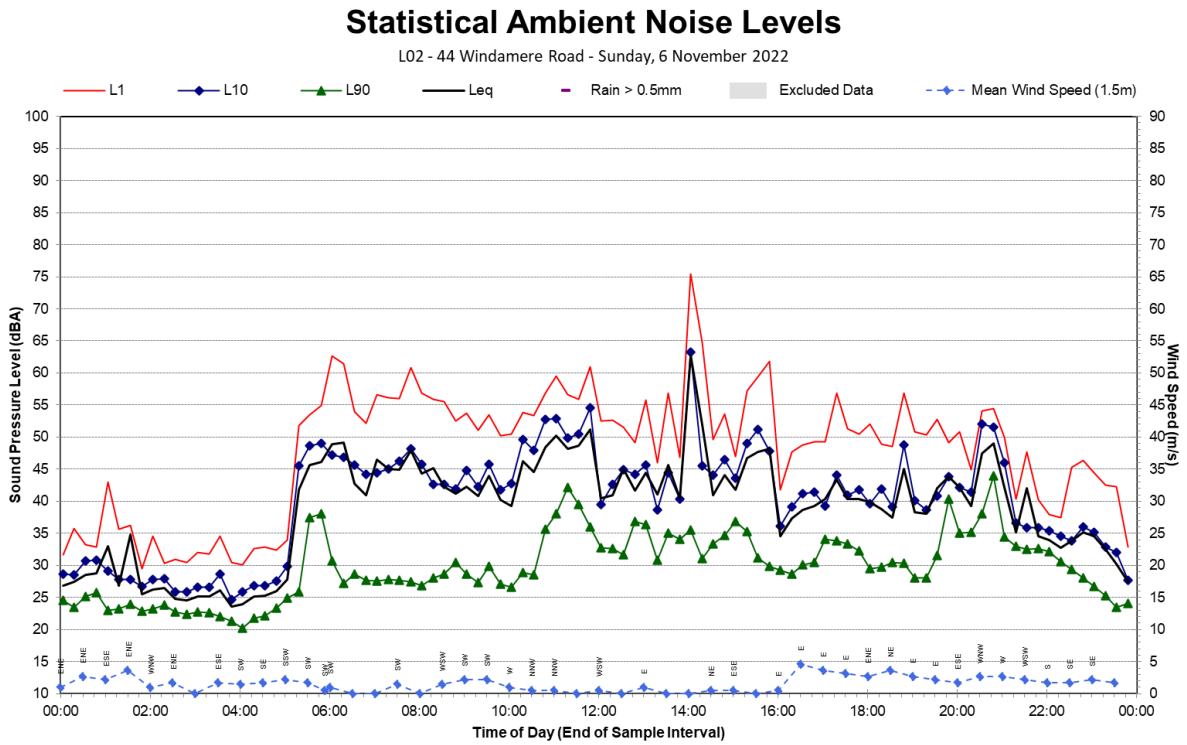

Statistical Ambient Noise Levels
L02 - 44 Windamere Road - Tuesday, 1 November 2022
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

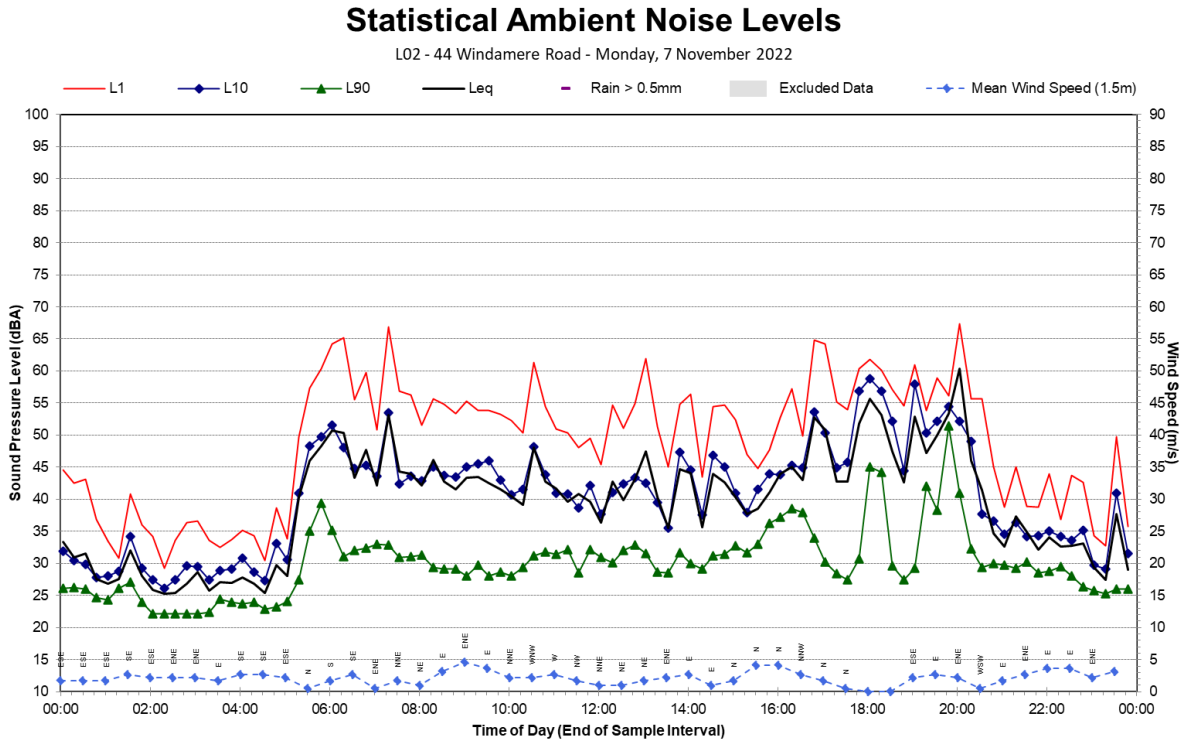

Statistical Ambient Noise Levels
L02 - 44 Windamere Road - Wednesday, 2 November 2022
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

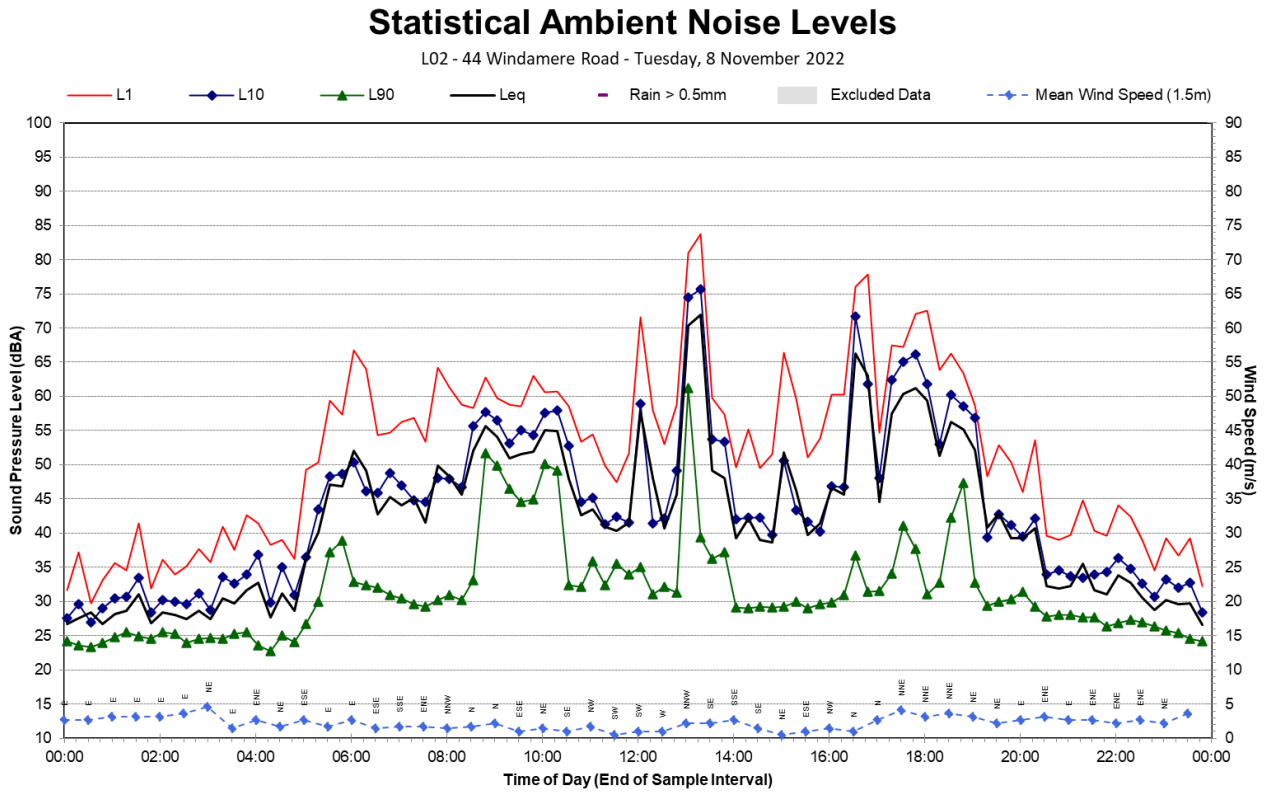

Statistical Ambient Noise Levels
L02 - 44 Windamere Road - Thursday, 3 November 2022
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

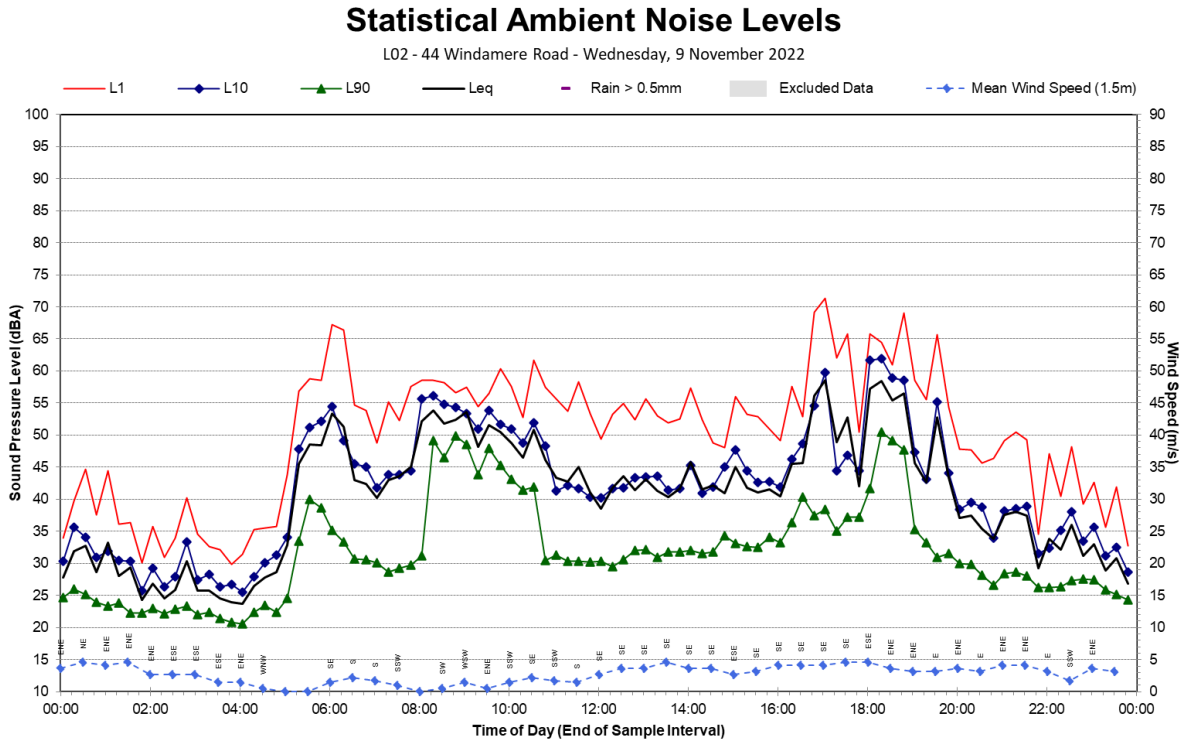

Statistical Ambient Noise Levels
L02 - 44 Windamere Road - Friday, 4 November 2022
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

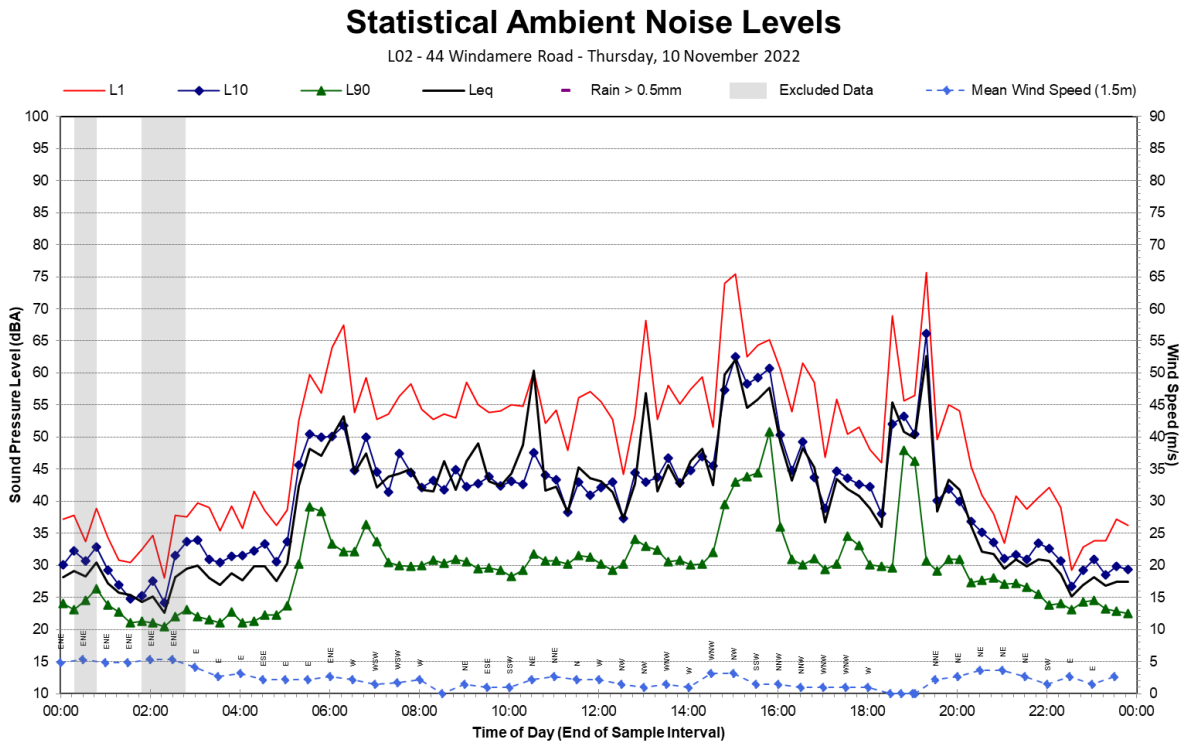

Statistical Ambient Noise Levels
L02 - 44 Windamere Road - Saturday, 5 November 2022
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

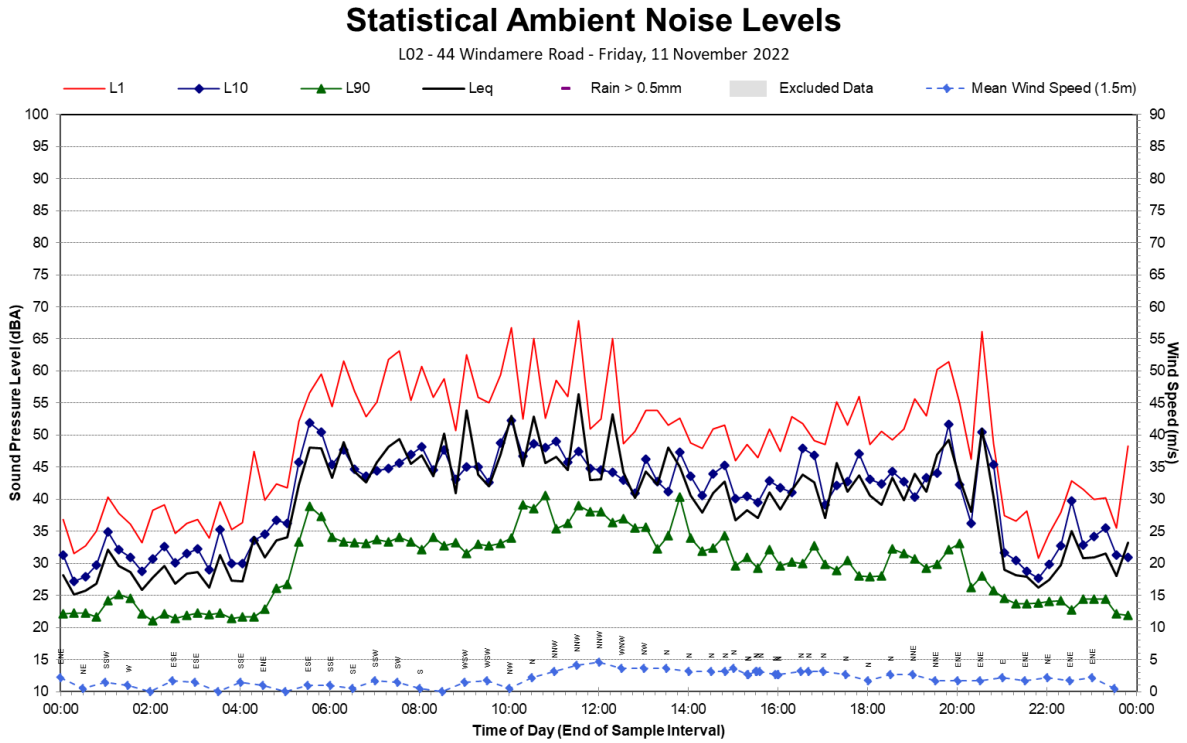

Statistical Ambient Noise Levels
L02 - 44 Windamere Road - Sunday, 6 November 2022
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

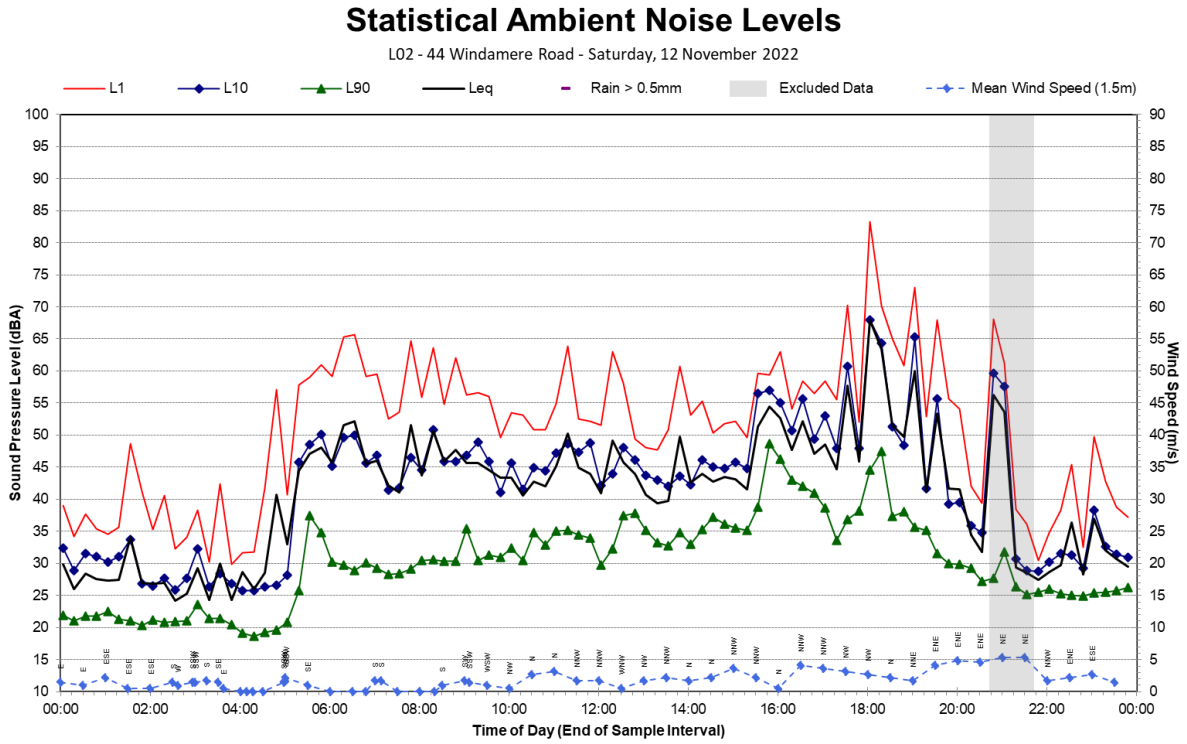

Statistical Ambient Noise Levels
L02 - 44 Windamere Road - Monday, 7 November 2022
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

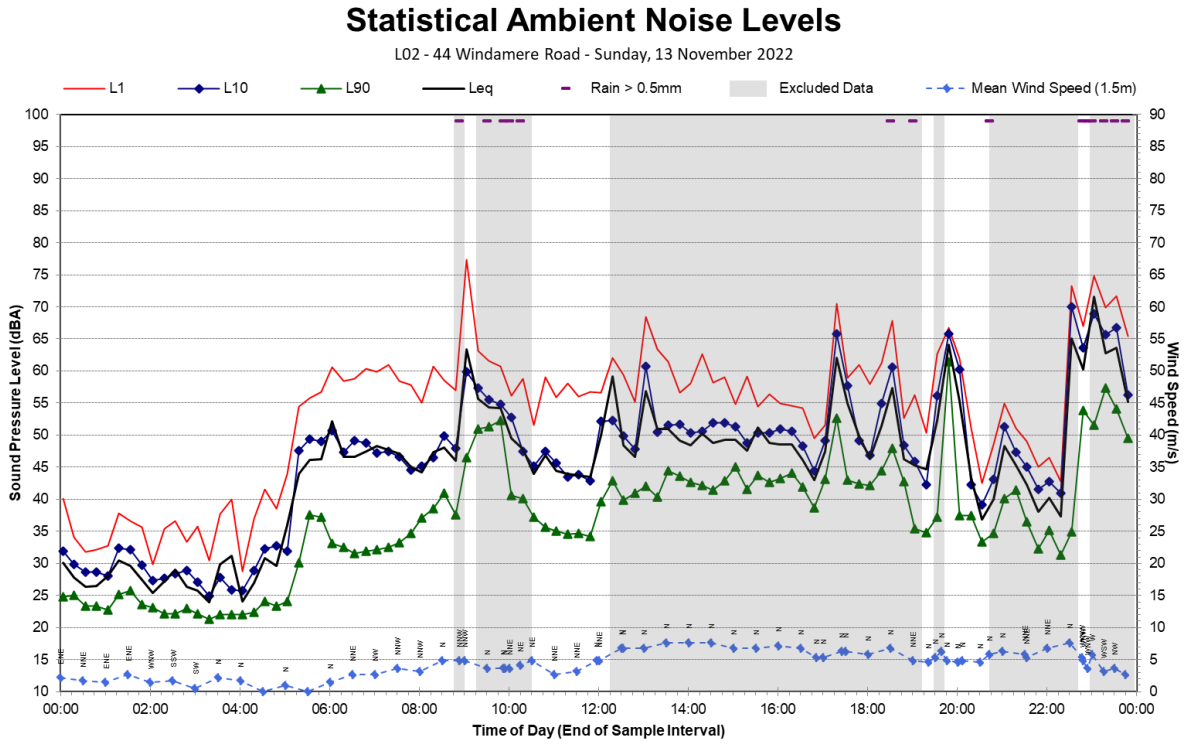

Statistical Ambient Noise Levels
L02 - 44 Windamere Road - Tuesday, 8 November 2022
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

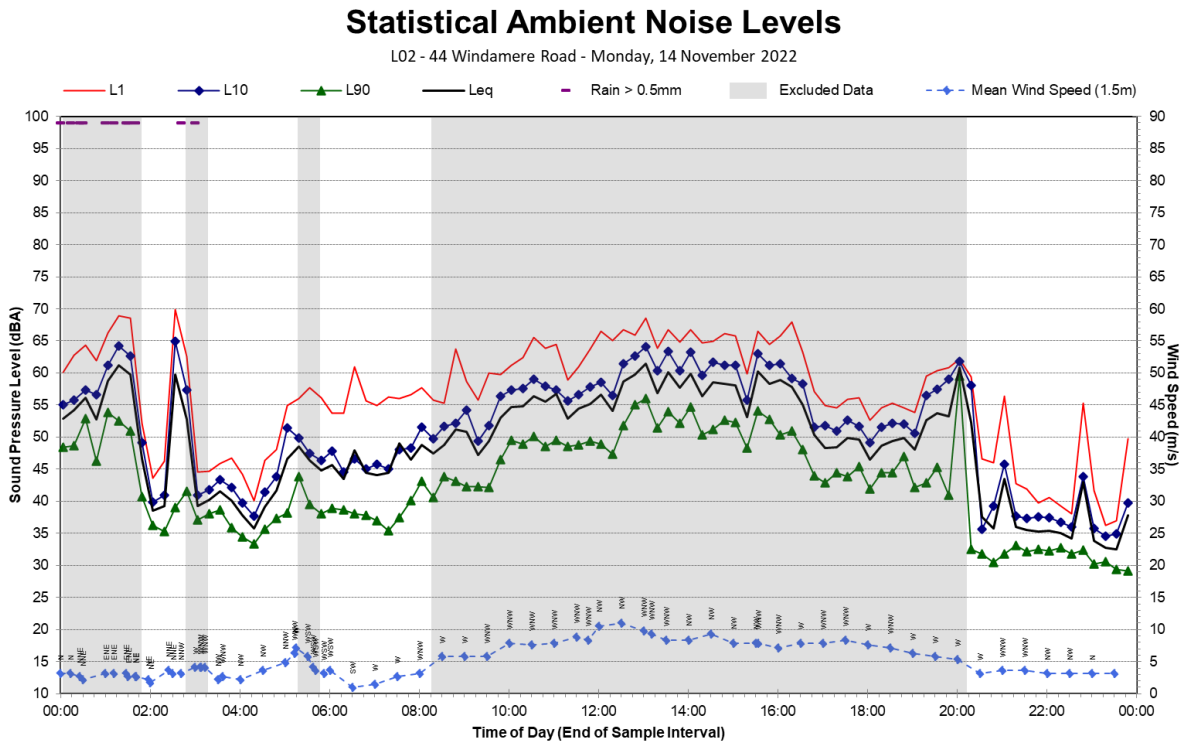

Statistical Ambient Noise Levels
L02 - 44 Windamere Road - Wednesday, 9 November 2022
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

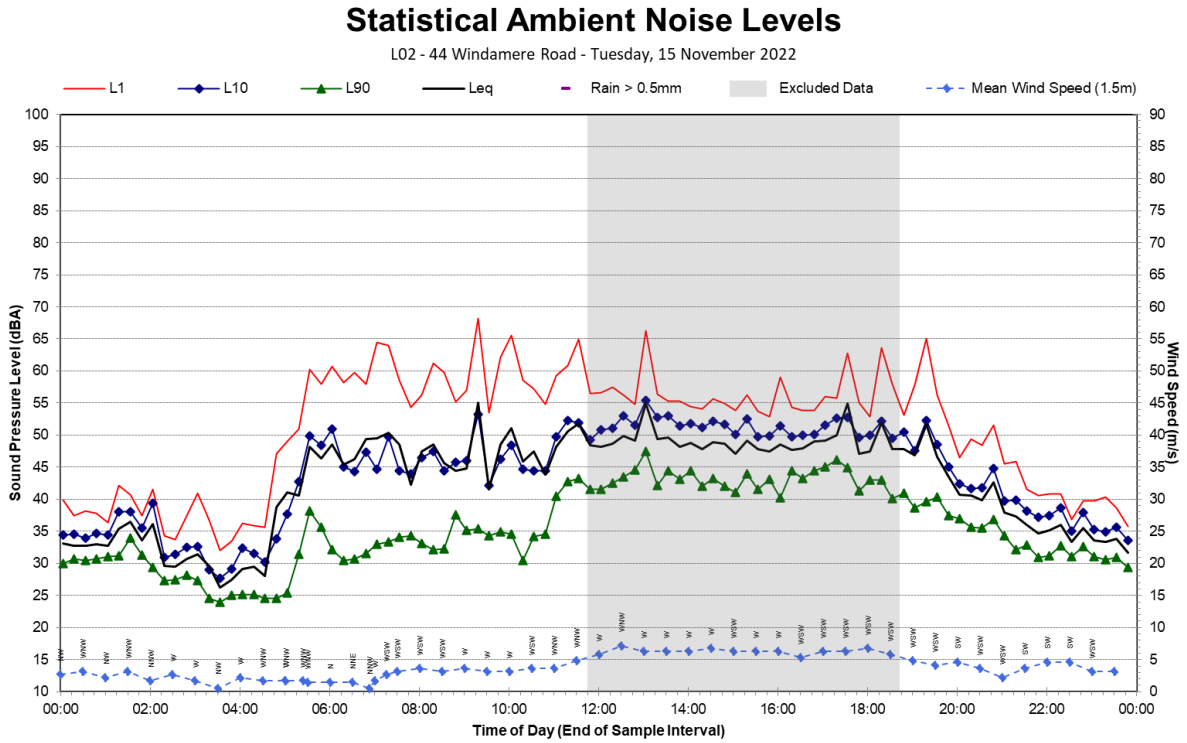

Statistical Ambient Noise Levels
L02 - 44 Windamere Road - Thursday, 10 November 2022
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

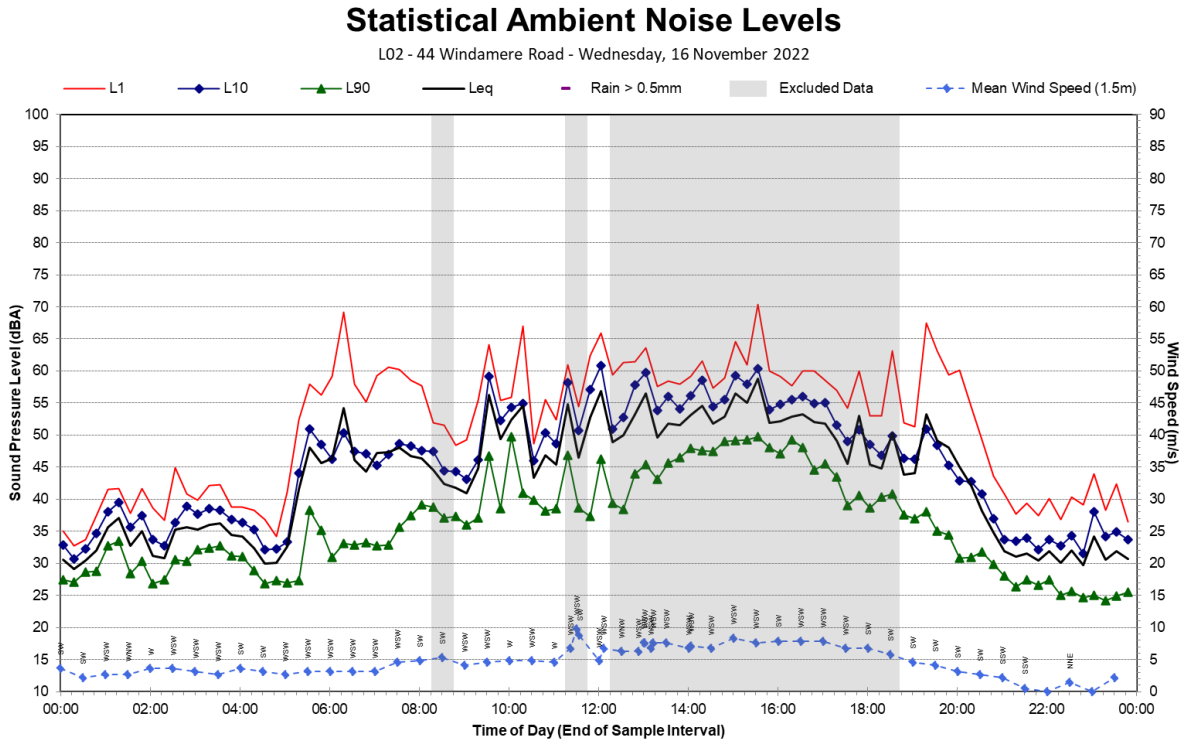

Statistical Ambient Noise Levels
L02 - 44 Windamere Road - Friday, 11 November 2022
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

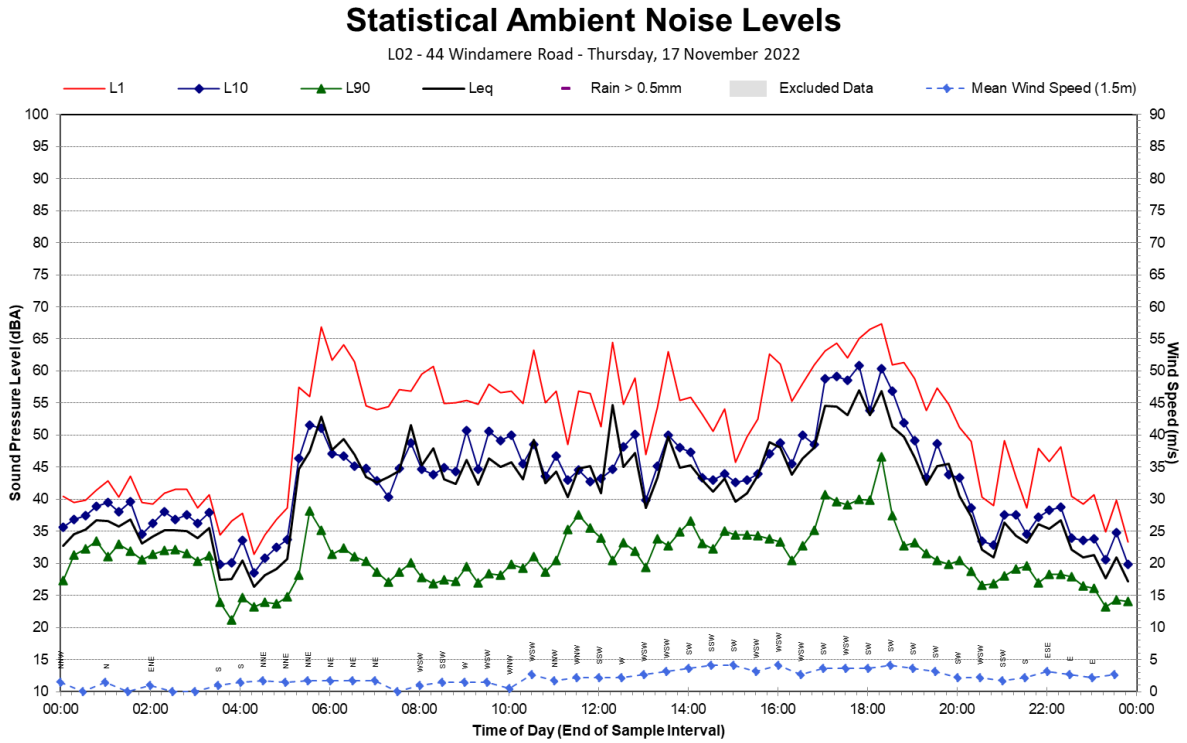

Statistical Ambient Noise Levels
L02 - 44 Windamere Road - Saturday, 12 November 2022
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

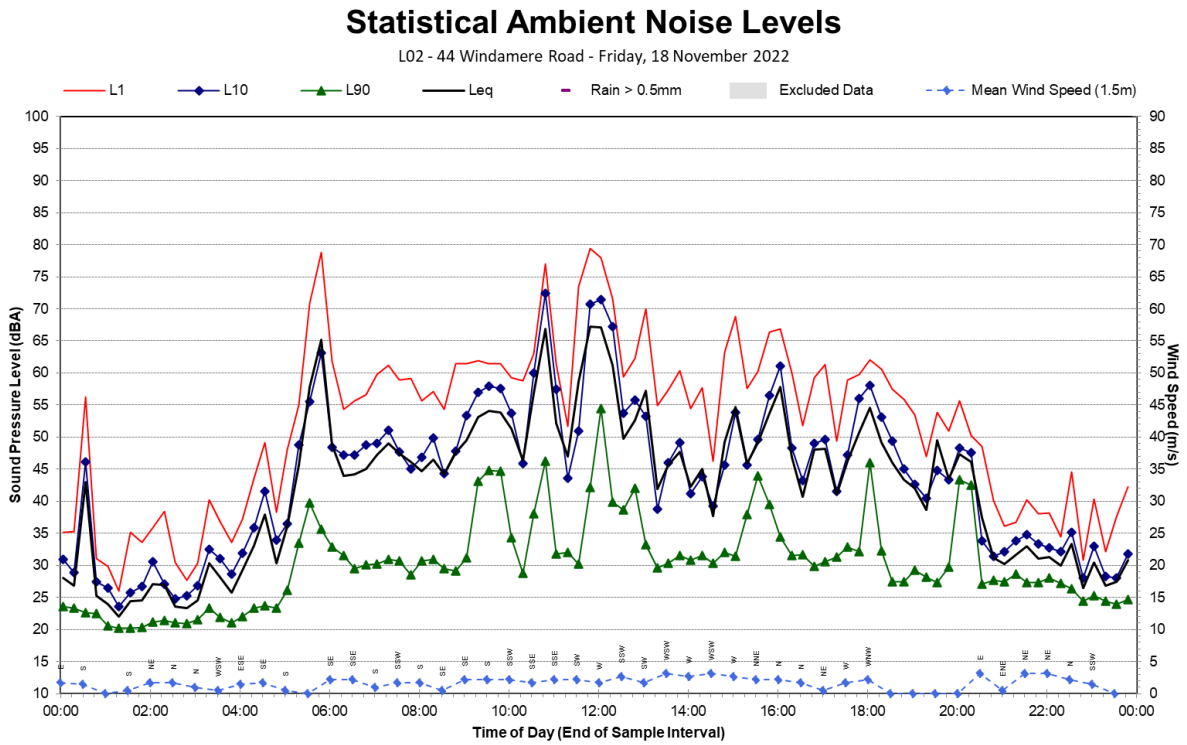

Statistical Ambient Noise Levels
L02 - 44 Windamere Road - Sunday, 13 November 2022
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

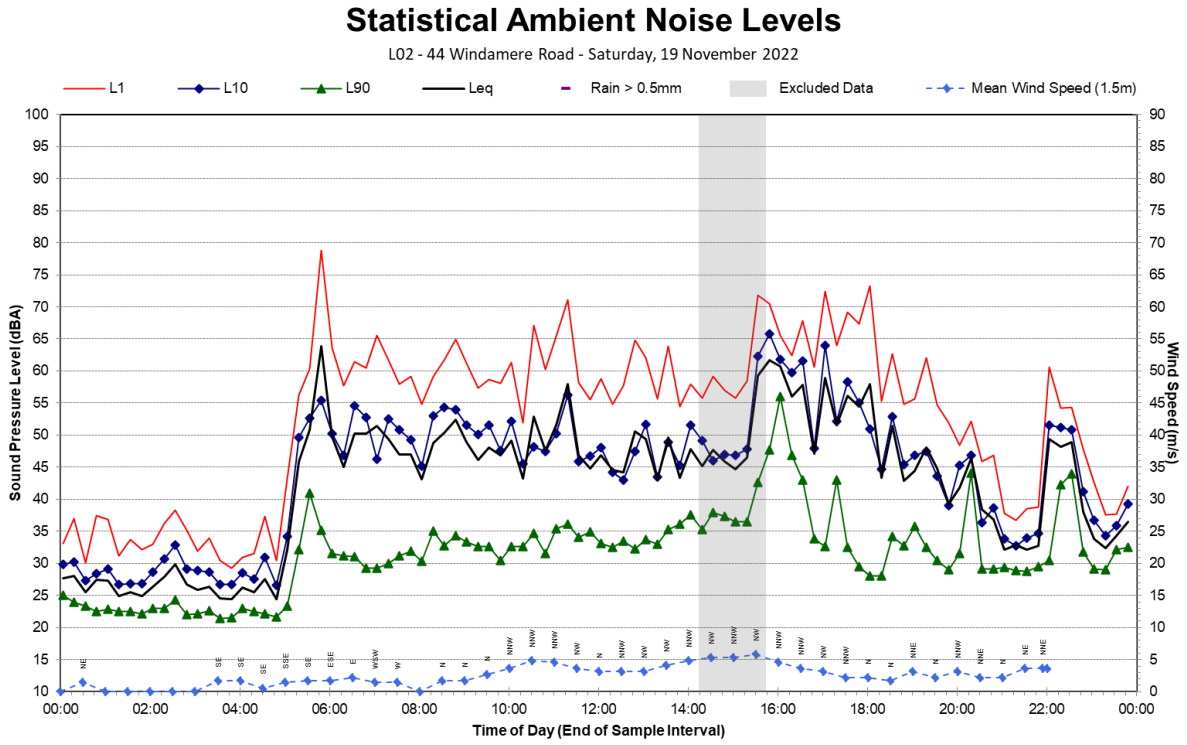

Statistical Ambient Noise Levels
L02 - 44 Windamere Road - Monday, 14 November 2022
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

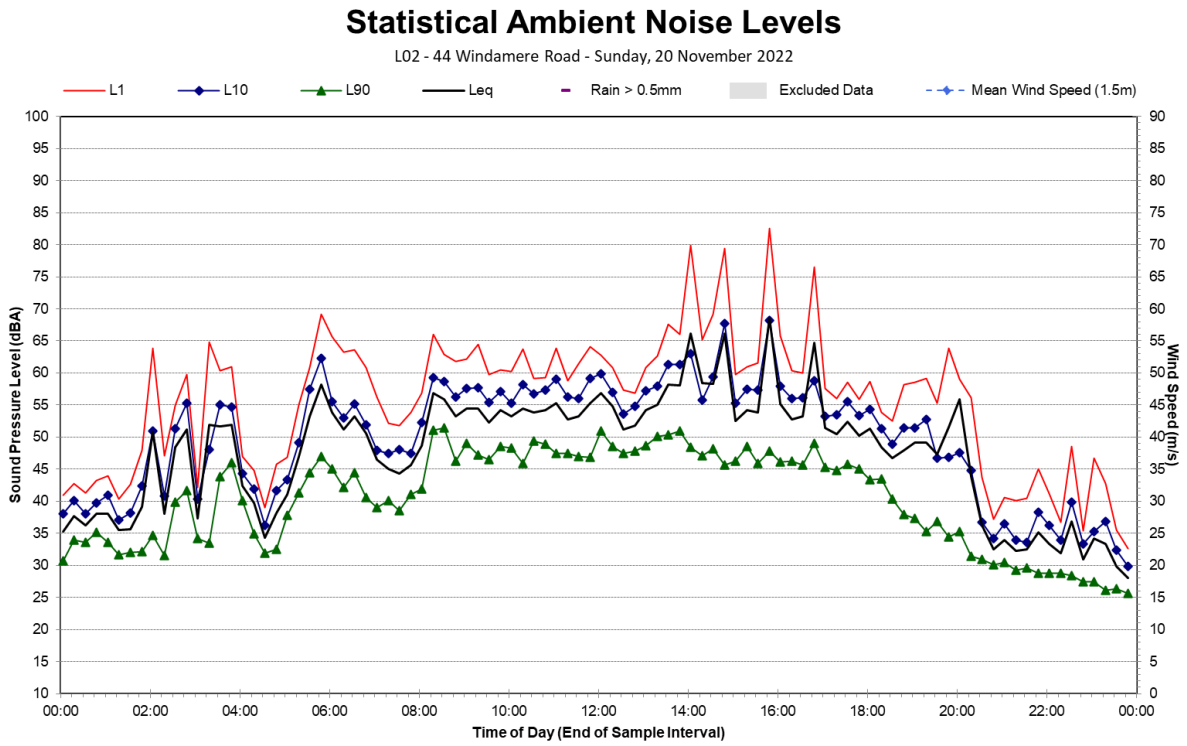

Statistical Ambient Noise Levels
L02 - 44 Windamere Road - Tuesday, 15 November 2022
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

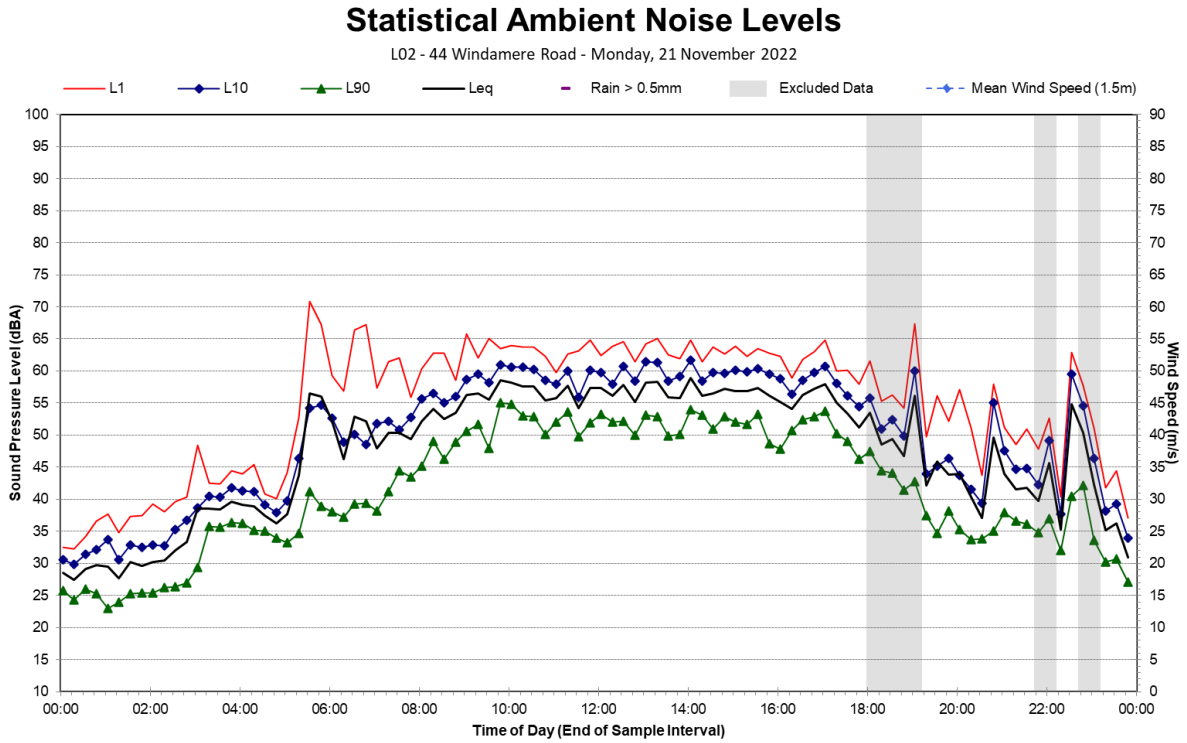

Statistical Ambient Noise Levels
L02 - 44 Windamere Road - Wednesday, 16 November 2022
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

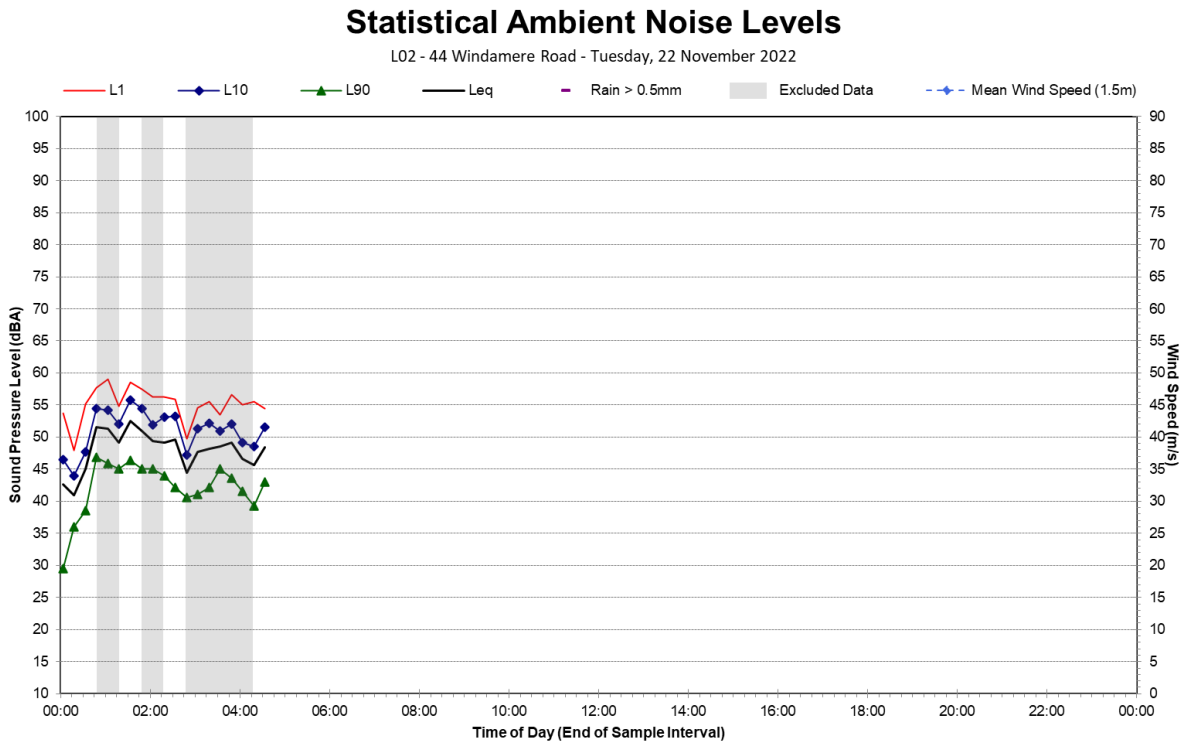

Statistical Ambient Noise Levels
L02 - 44 Windamere Road - Thursday, 17 November 2022
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L02 - 44 Windamere Road - Friday, 18 November 2022
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L02 - 44 Windamere Road - Saturday, 19 November 2022
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L02 - 44 Windamere Road - Sunday, 20 November 2022
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L02 - 44 Windamere Road - Monday, 21 November 2022
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L02 - 44 Windamere Road - Tuesday, 22 November 2022
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

<table>
<tr><th>Noise Monitoring Location</th><th colspan="4">L03</th><th rowspan="2">Map of Noise Monitoring Location</th></tr>
<tr><td>Noise Monitoring Address</td><td colspan="4">270 Hartwood Avenue, Robin Hill</td></tr>
<tr><td colspan="5">Logger Device Type: Svantek 957: Logger Serial No:20665
Sound Level Meter Device Type: Brüel and Kjær 2250, Sound Level Meter Serial No: 3008204

Ambient noise logger deployed at 270 Hartwood located at the residence back garden surrounded by open terrain.

Attended noise measurements indicate the ambient noise environment at this location is influence by wildlife noise.

Recorded Noise Levels (LAmax) 22/11/2023:
Wind: 45-50dBA
Birds: 43dBA</td><td> 
</td></tr>
<tr><td colspan="5">Ambient Noise Logging Results – ICNG Defined Time Periods</td><td>Photo of Noise Monitoring Location</td></tr>
<tr><td rowspan="2">Monitoring Period</td><td colspan="4">Noise Level (dBA)</td><td rowspan="5">  </td></tr>
<tr><td>RBL</td><td>LAeq</td><td>L10</td><td>L1</td></tr>
<tr><td>Daytime</td><td>30</td><td>60</td><td>44</td><td>52</td></tr>
<tr><td>Evening</td><td>30</td><td>58</td><td>43</td><td>49</td></tr>
<tr><td>Night-time</td><td>30</td><td>51</td><td>40</td><td>45</td></tr>
<tr><td colspan="5">Ambient Noise Logging Results – RNP Defined Time Periods</td></tr>
<tr><td rowspan="2">Monitoring Period</td><td colspan="4">Noise Level (dBA)</td></tr>
<tr><td colspan="2">LAeq (period)</td><td colspan="2">LAeq (1 hour)</td></tr>
<tr><td>Daytime (7am - 10pm)</td><td colspan="2">61</td><td colspan="2">63</td></tr>
<tr><td>Night-time (10pm - 7am)</td><td colspan="2">53</td><td colspan="2">44</td></tr>
<tr><td colspan="5">Attended Noise Measurement Results</td></tr>
<tr><td rowspan="2">Date</td><td rowspan="2">Start Time</td><td colspan="3">Noise Level (dBA)</td></tr>
<tr><td>LA90</td><td>LAeq</td><td>LAmax</td></tr>
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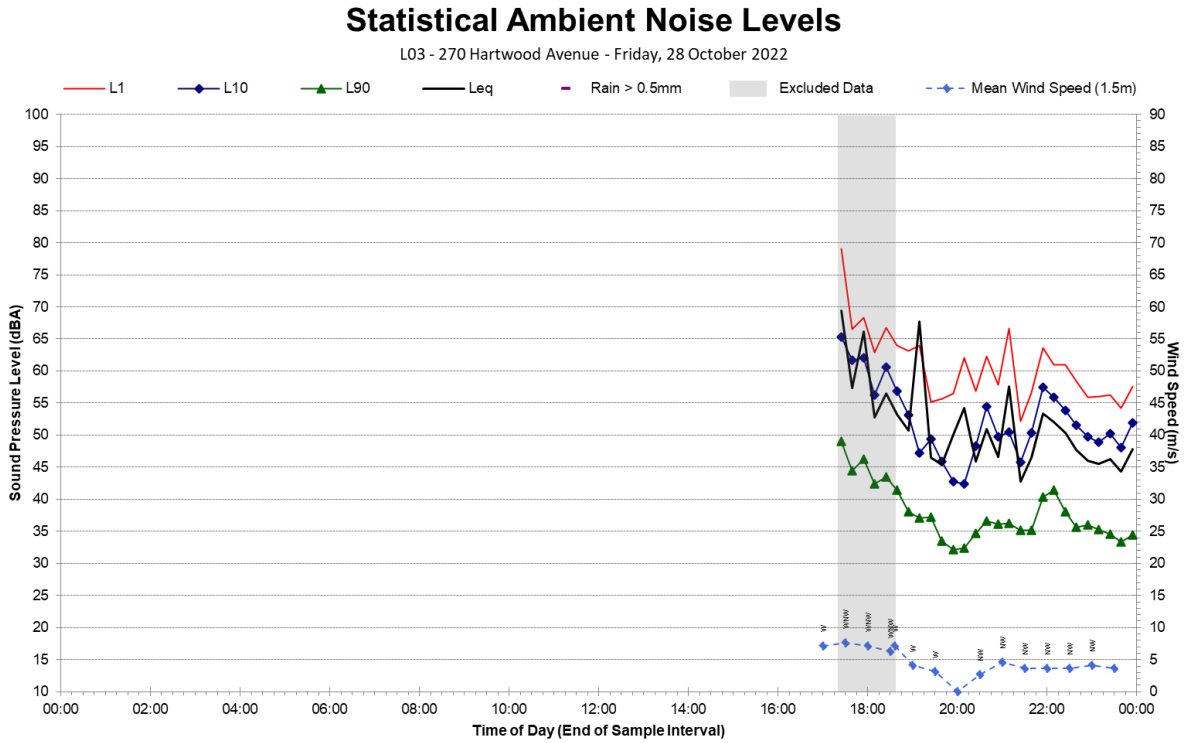
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L10
L90
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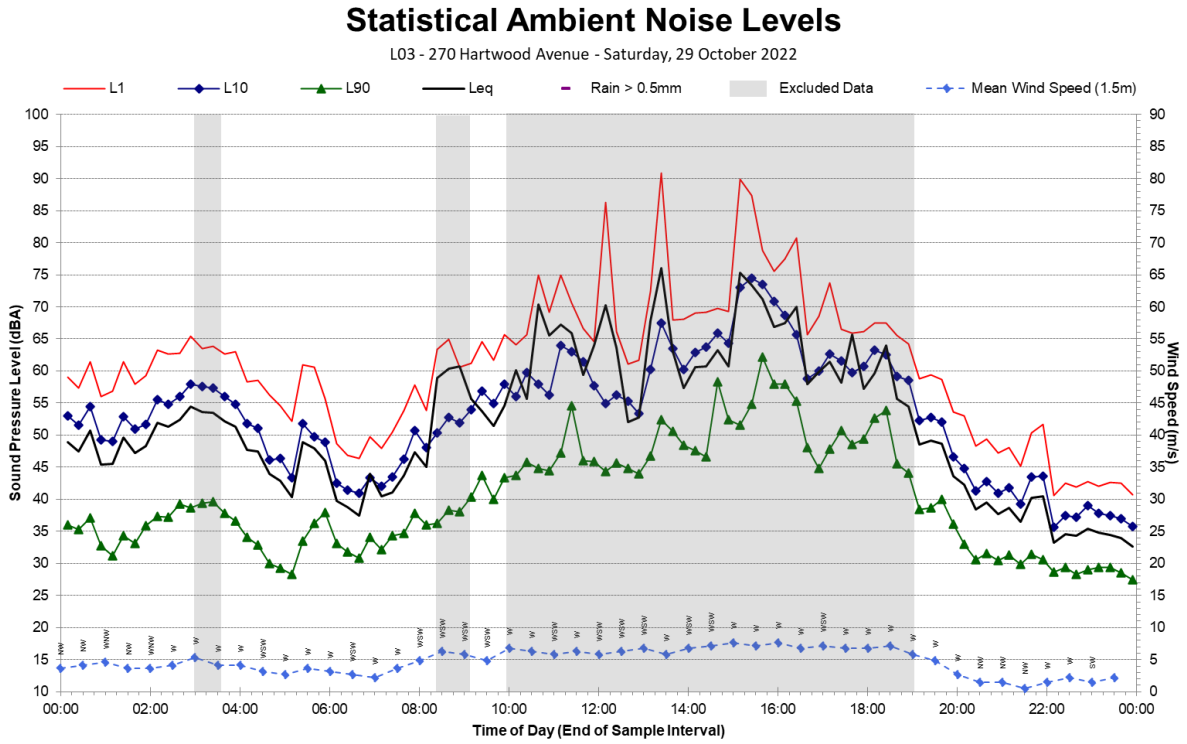
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)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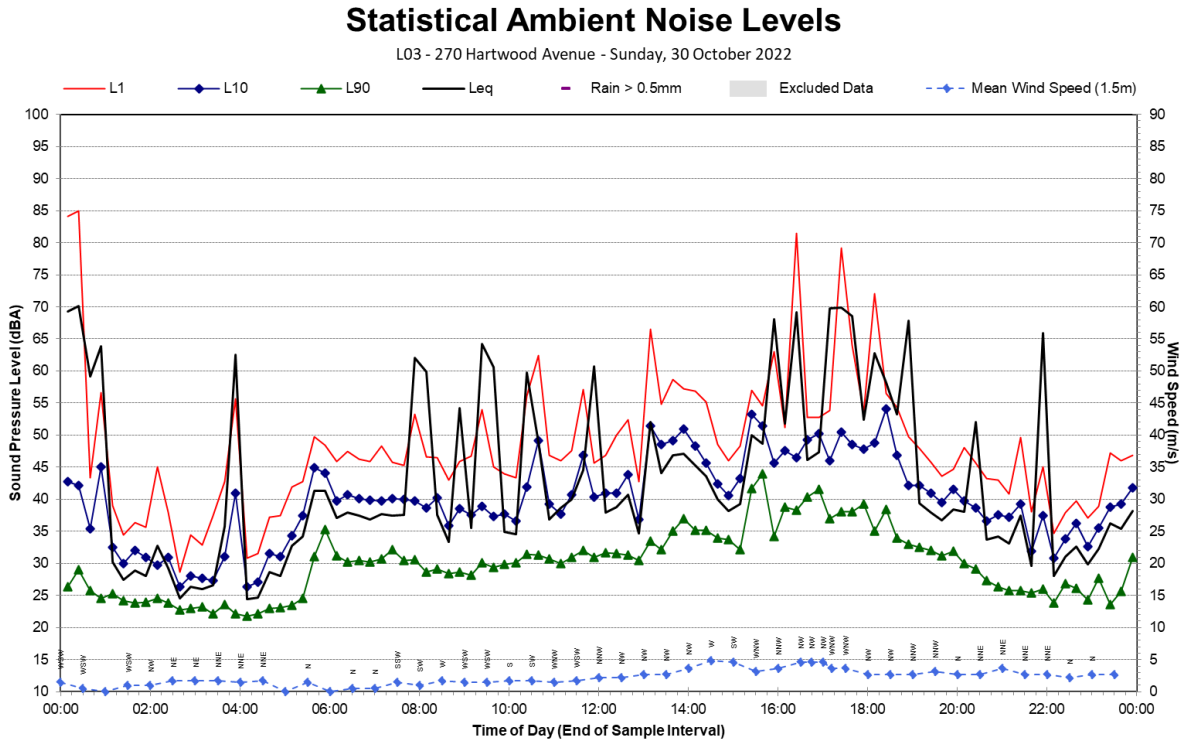
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
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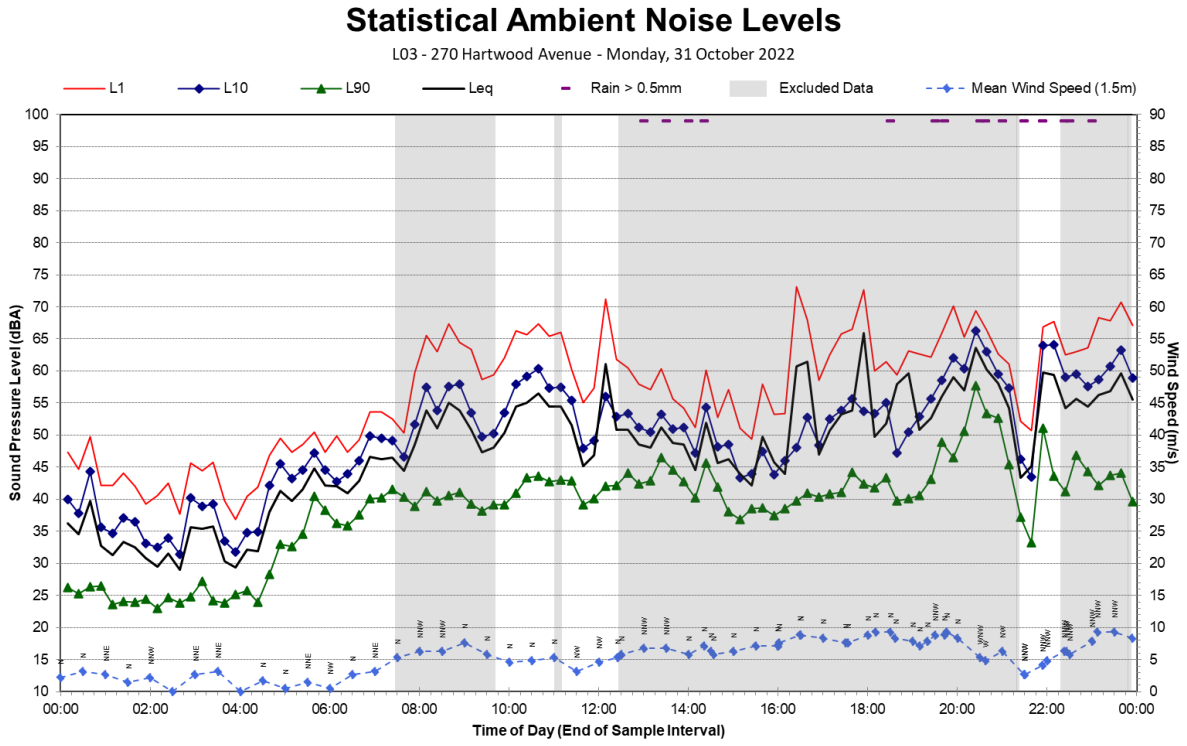
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
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L1
L10
L90
Leq
Rain > 0.5mm
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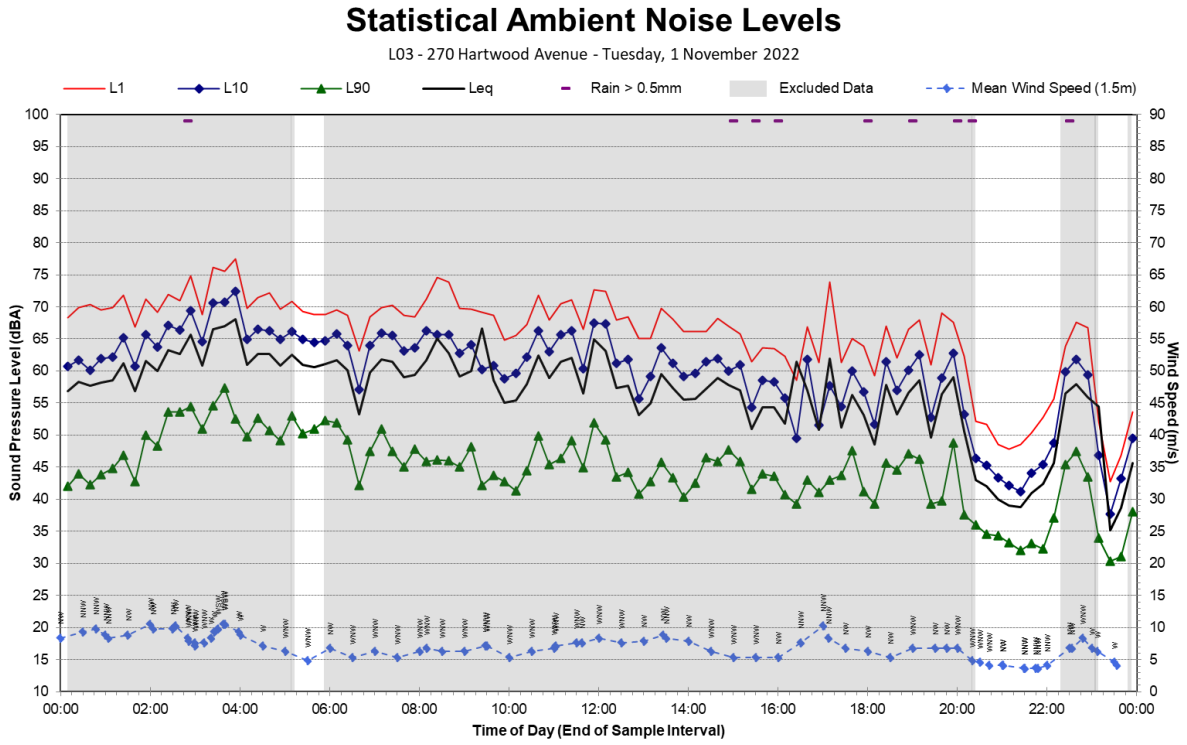
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)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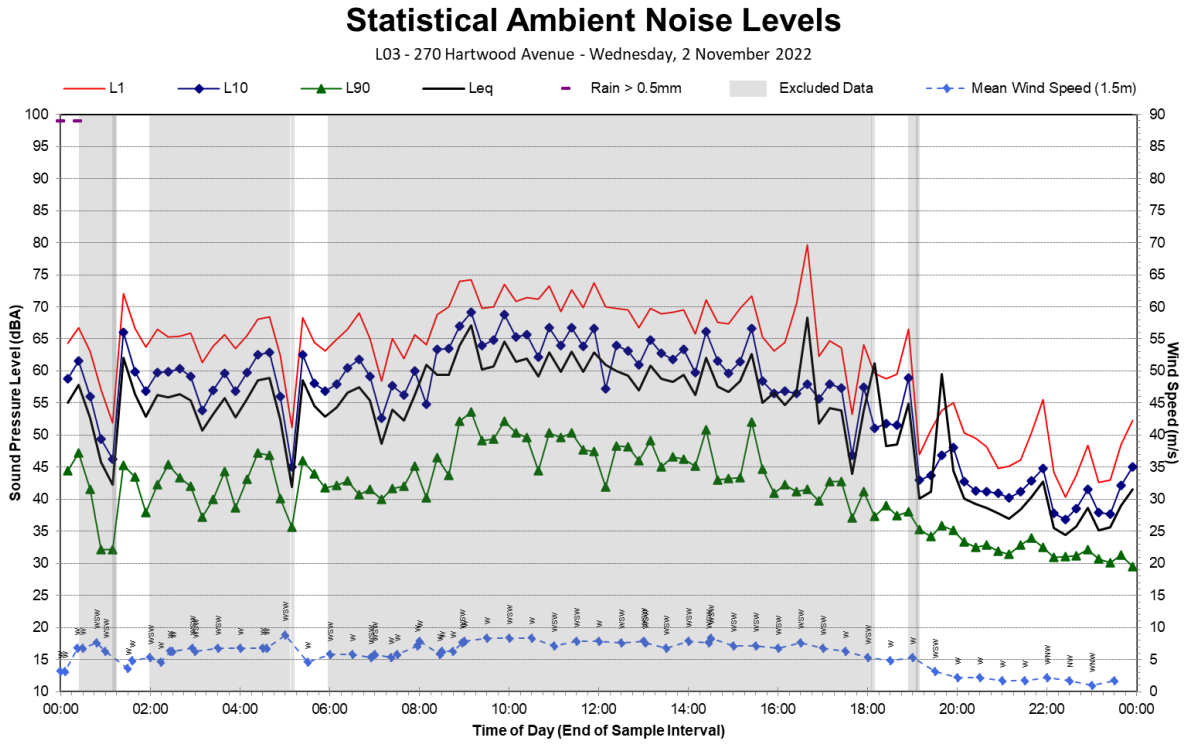
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)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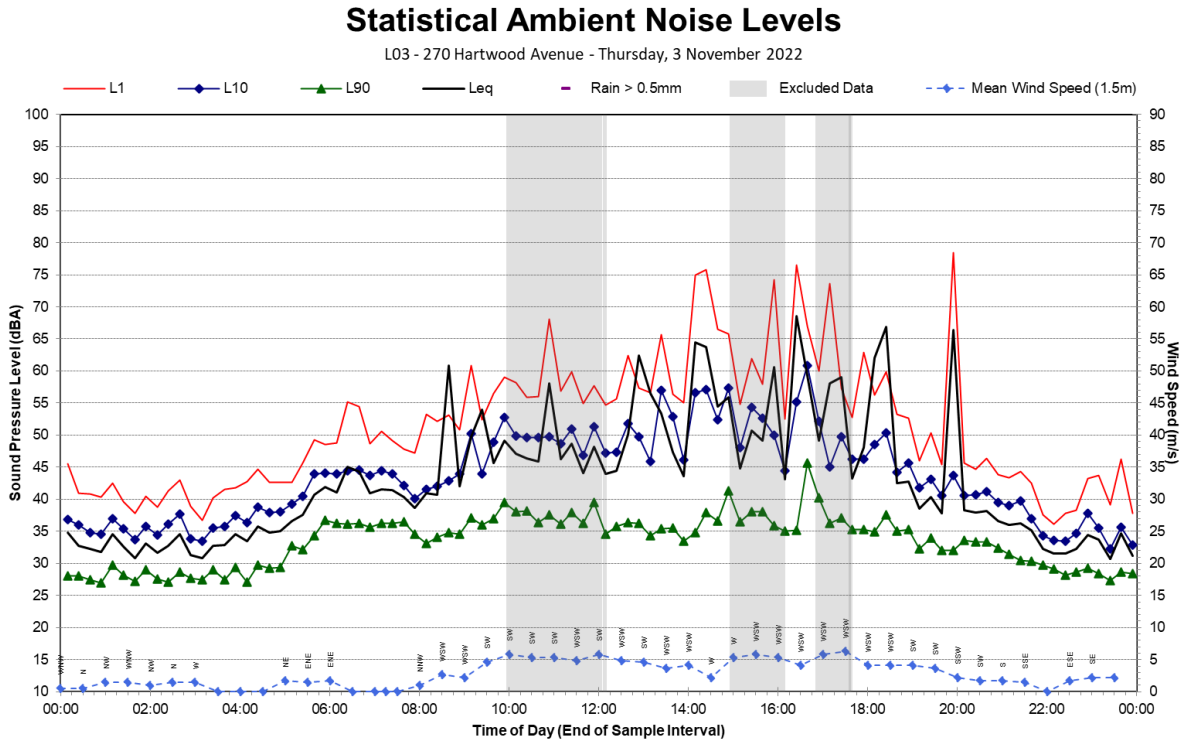
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
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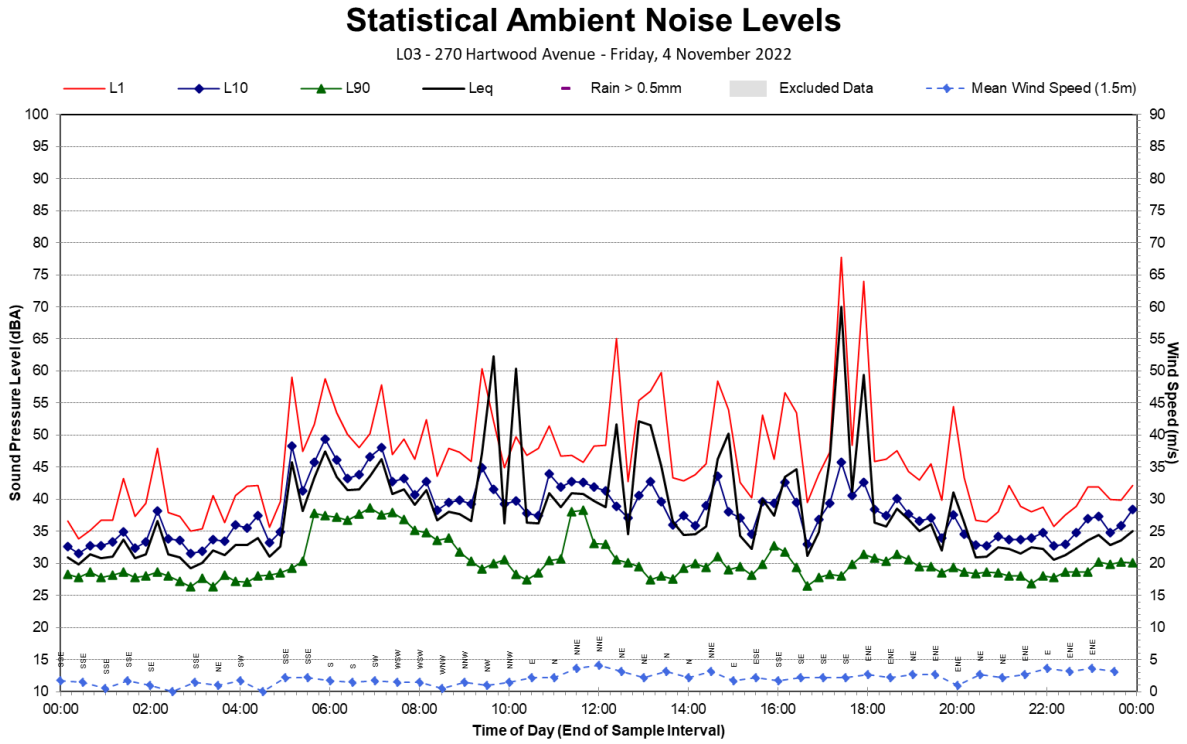
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)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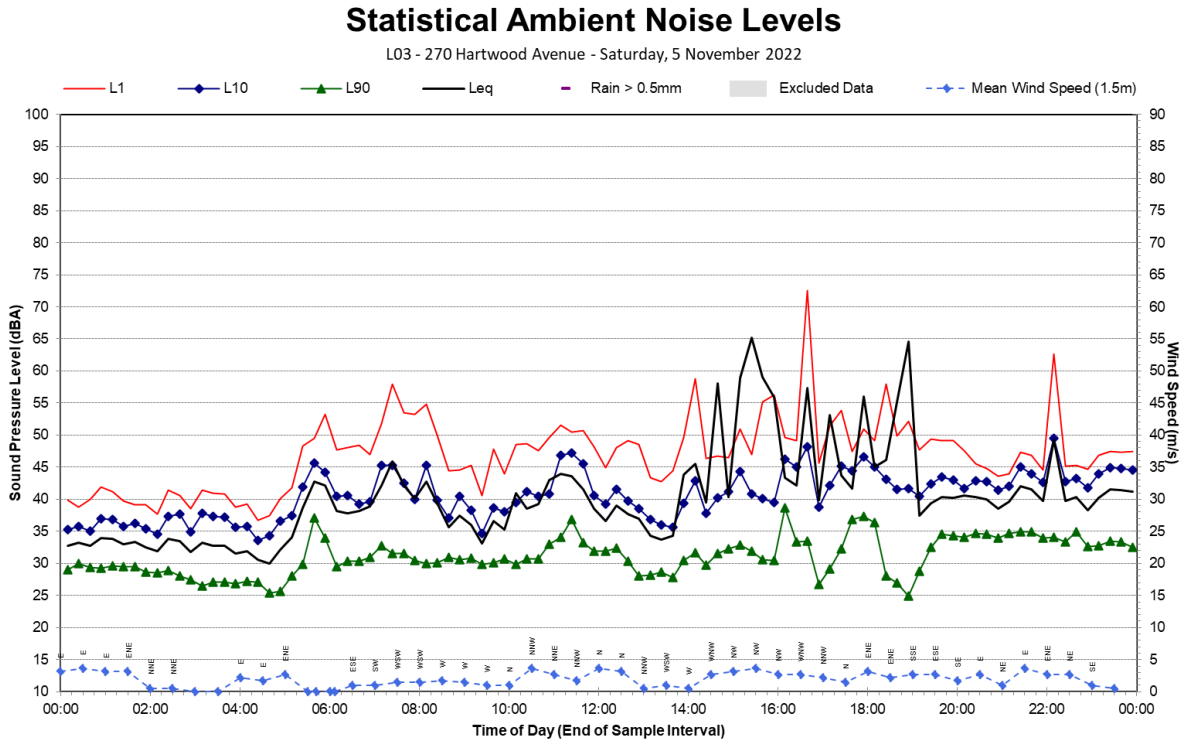
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)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L1
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L90
Leq
Rain > 0.5mm
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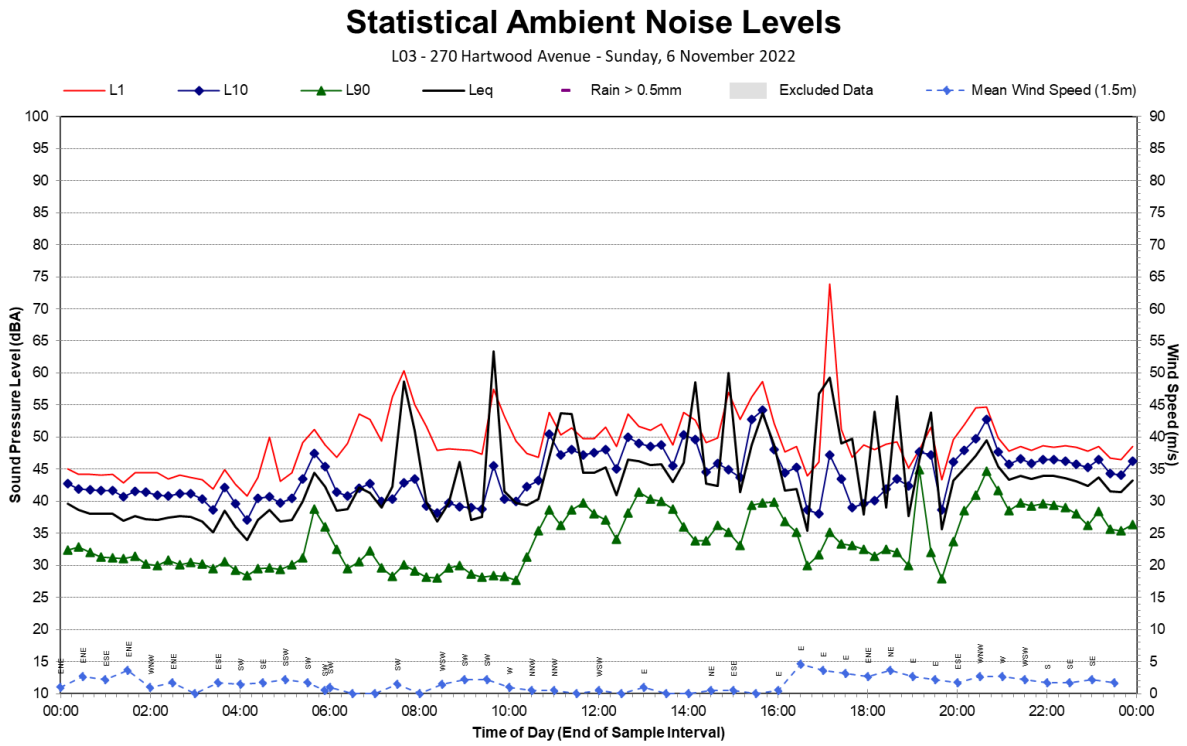
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)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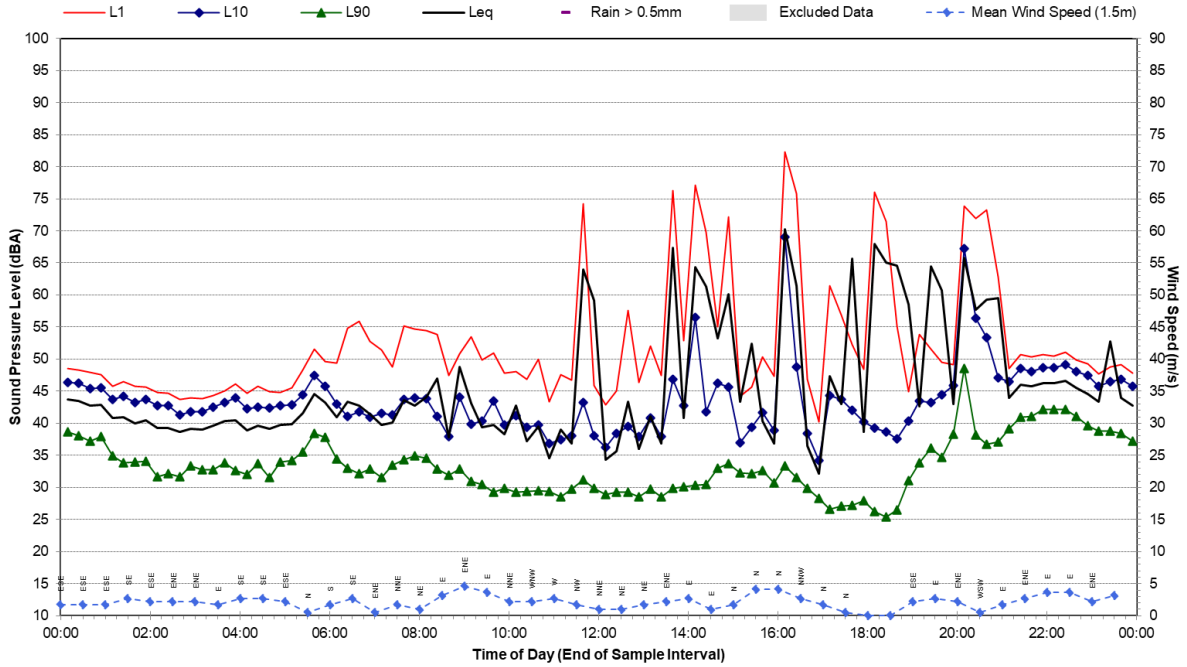
L03 - 270 Hartwood Avenue - Sunday, 6 November 2022
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

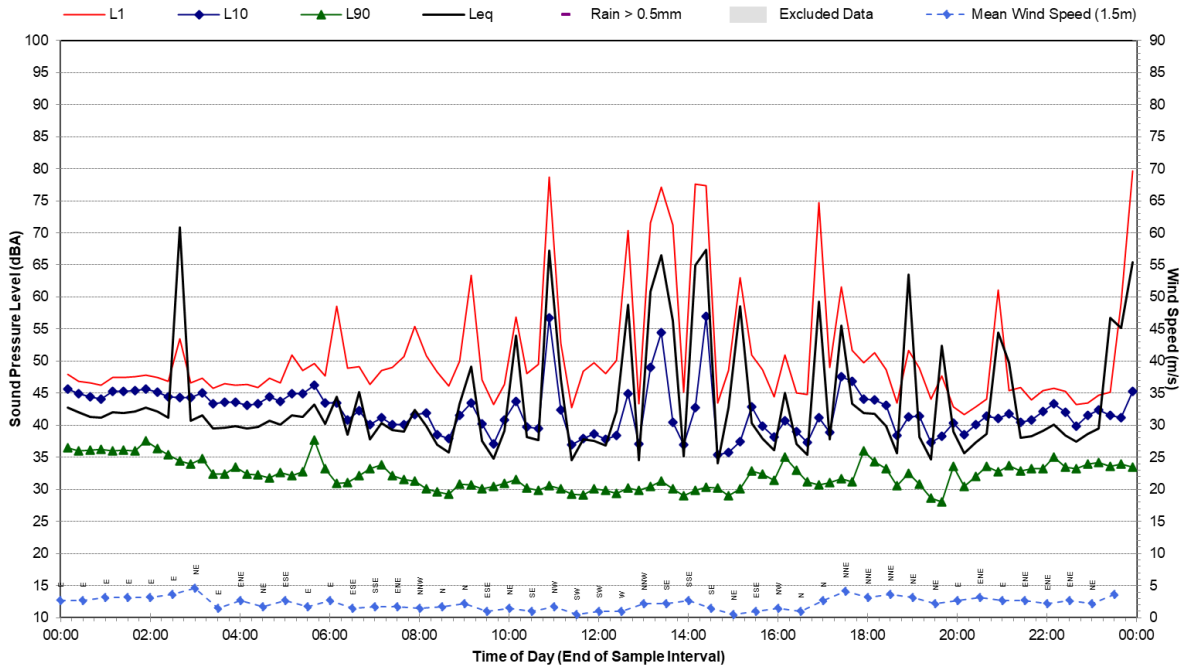
Statistical Ambient Noise Levels

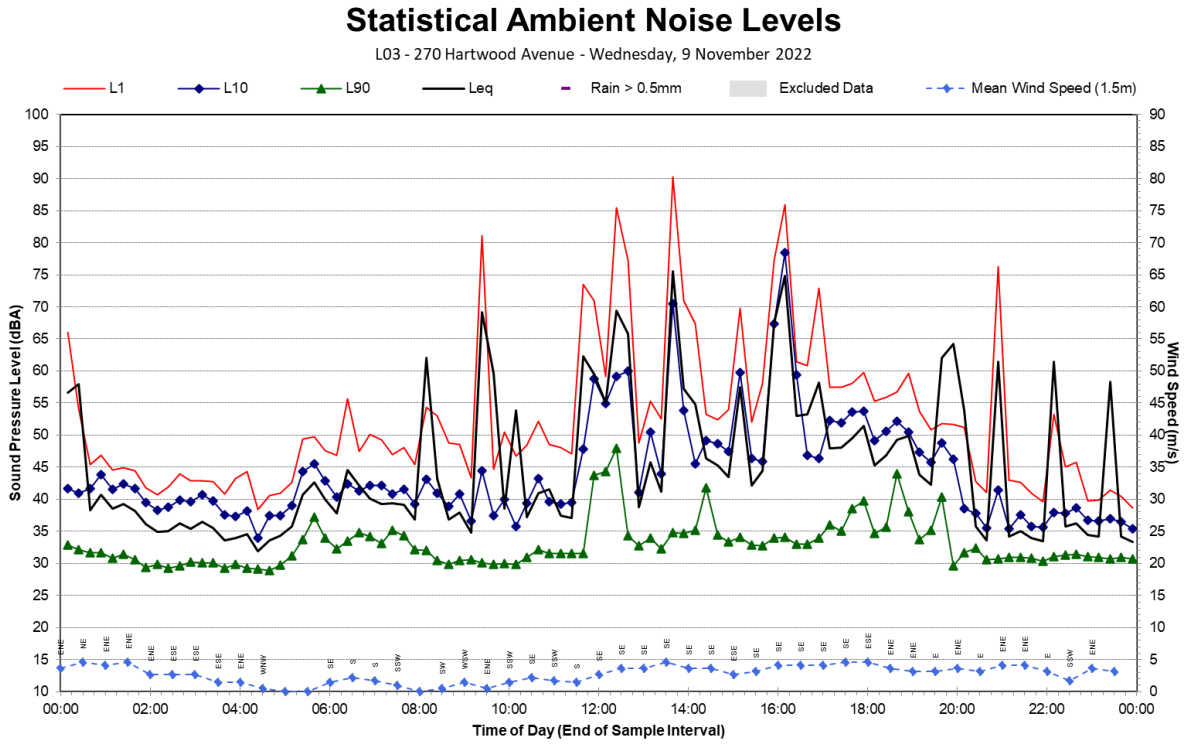
L03 - 270 Hartwood Avenue - Monday, 7 November 2022

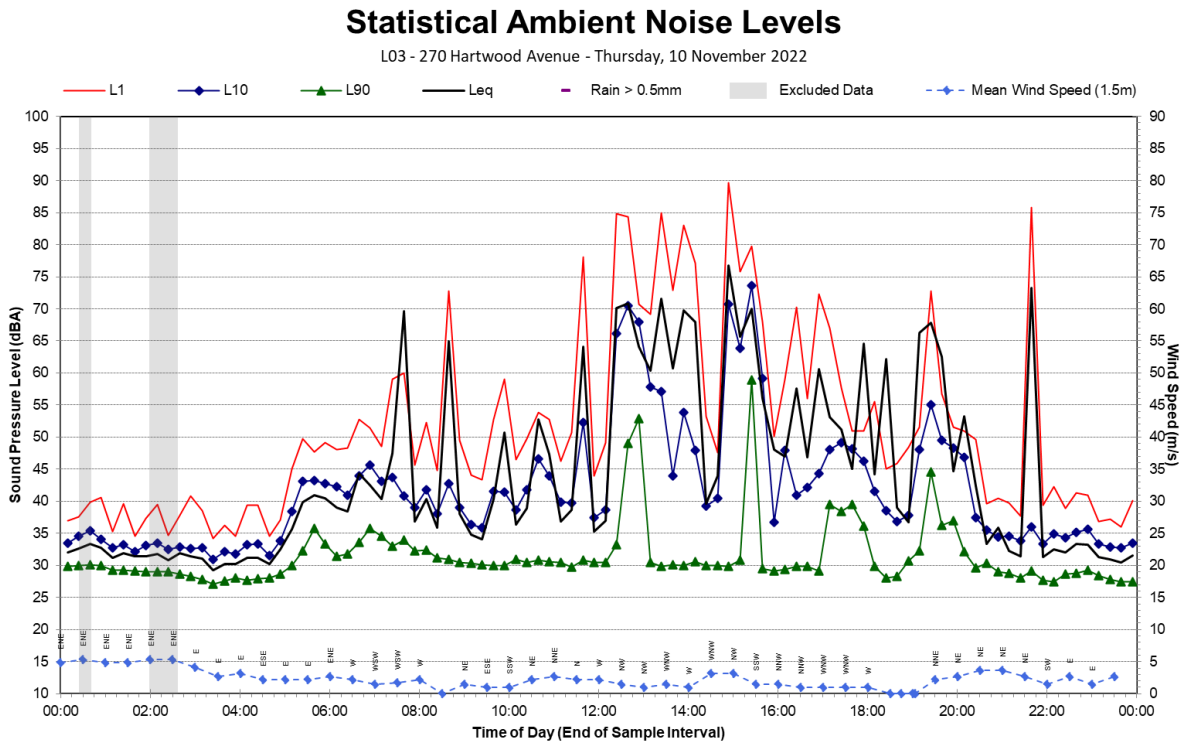


Statistical Ambient Noise Levels

L03 - 270 Hartwood Avenue - Tuesday, 8 November 2022




Statistical Ambient Noise Levels
L03 - 270 Hartwood Avenue - Wednesday, 9 November 2022
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
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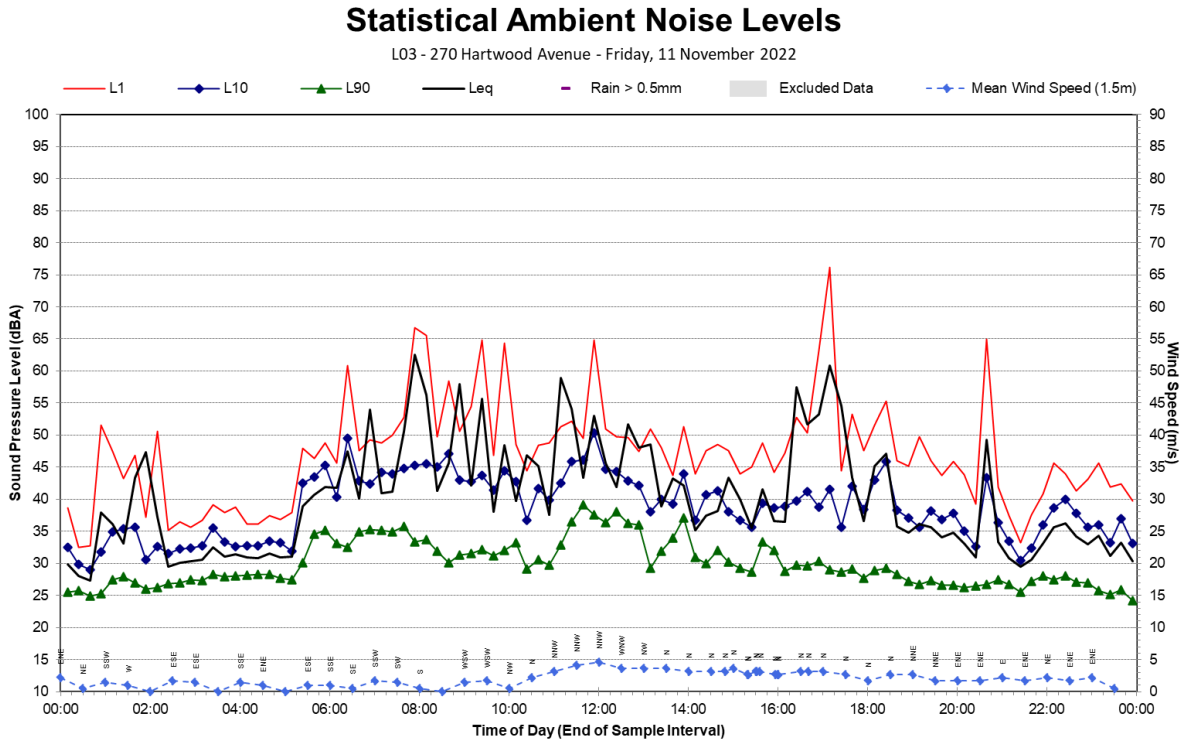
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L03 - 270 Hartwood Avenue - Friday, 11 November 2022
L1
L10
L90
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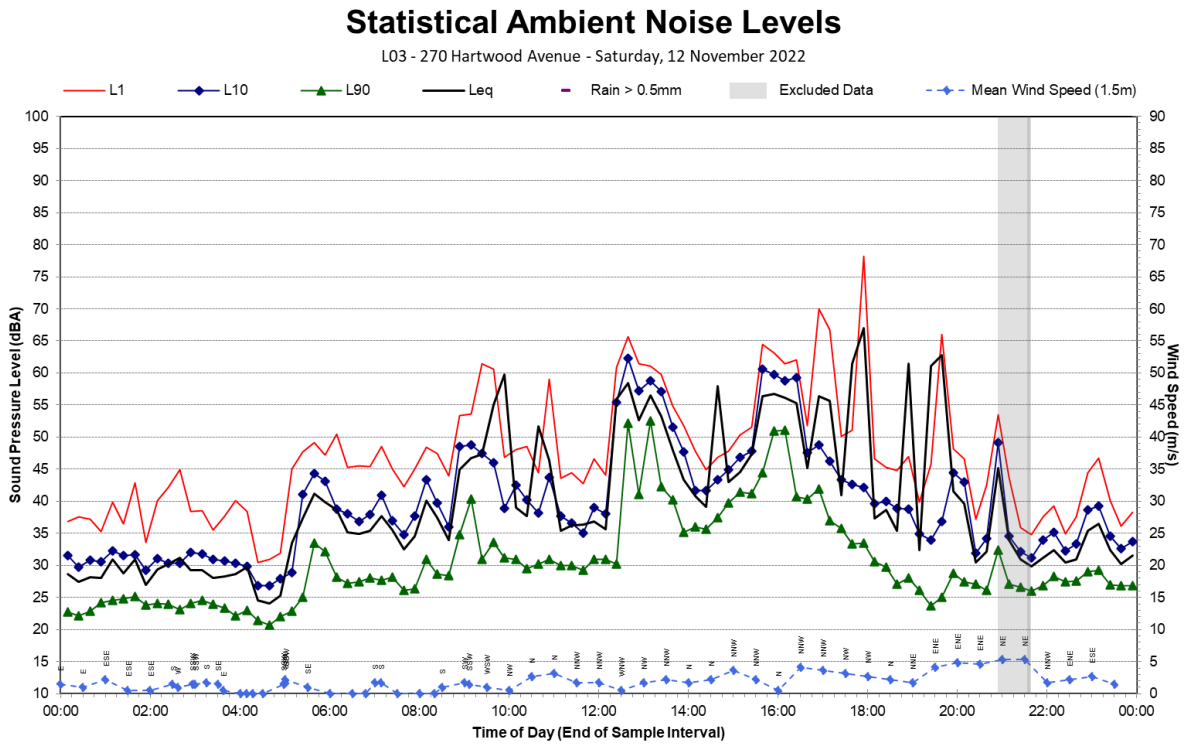
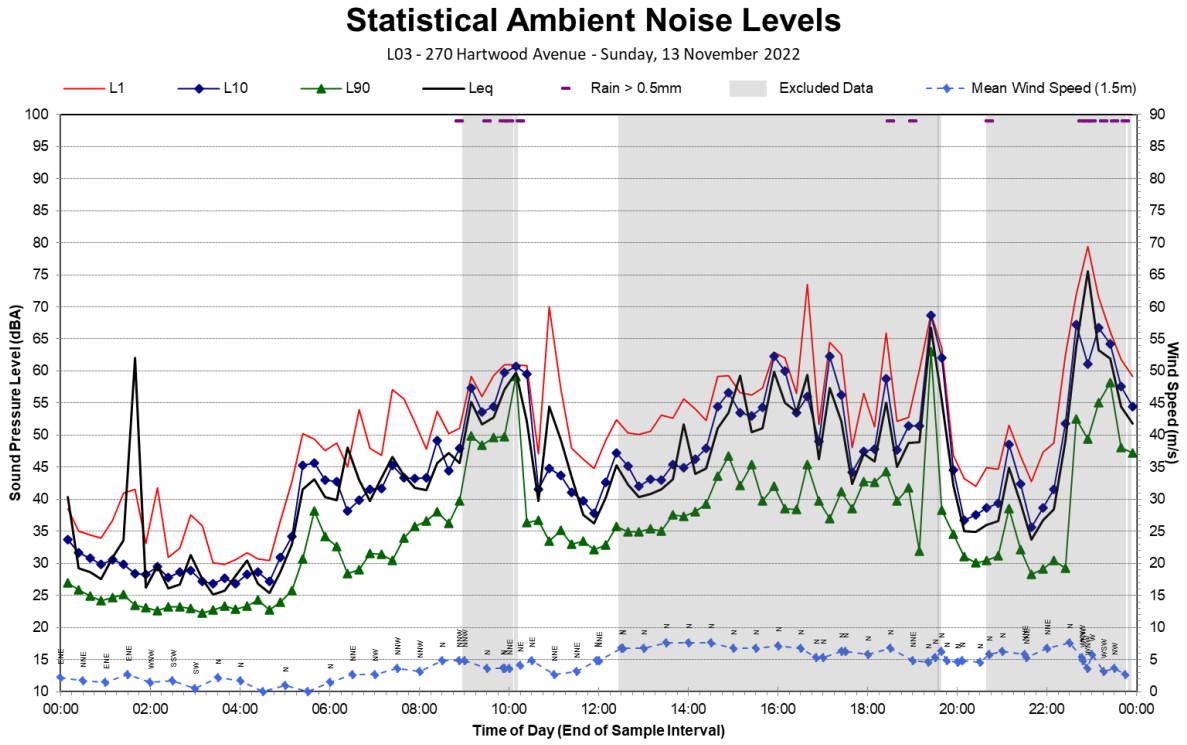
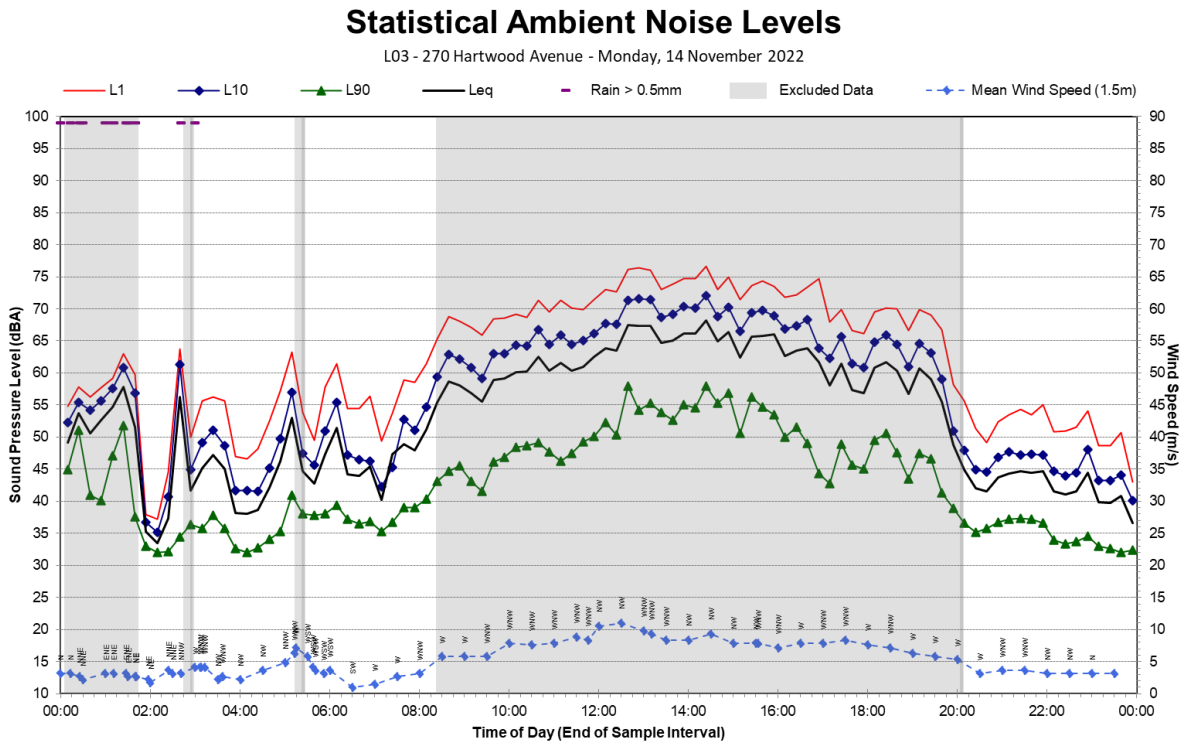
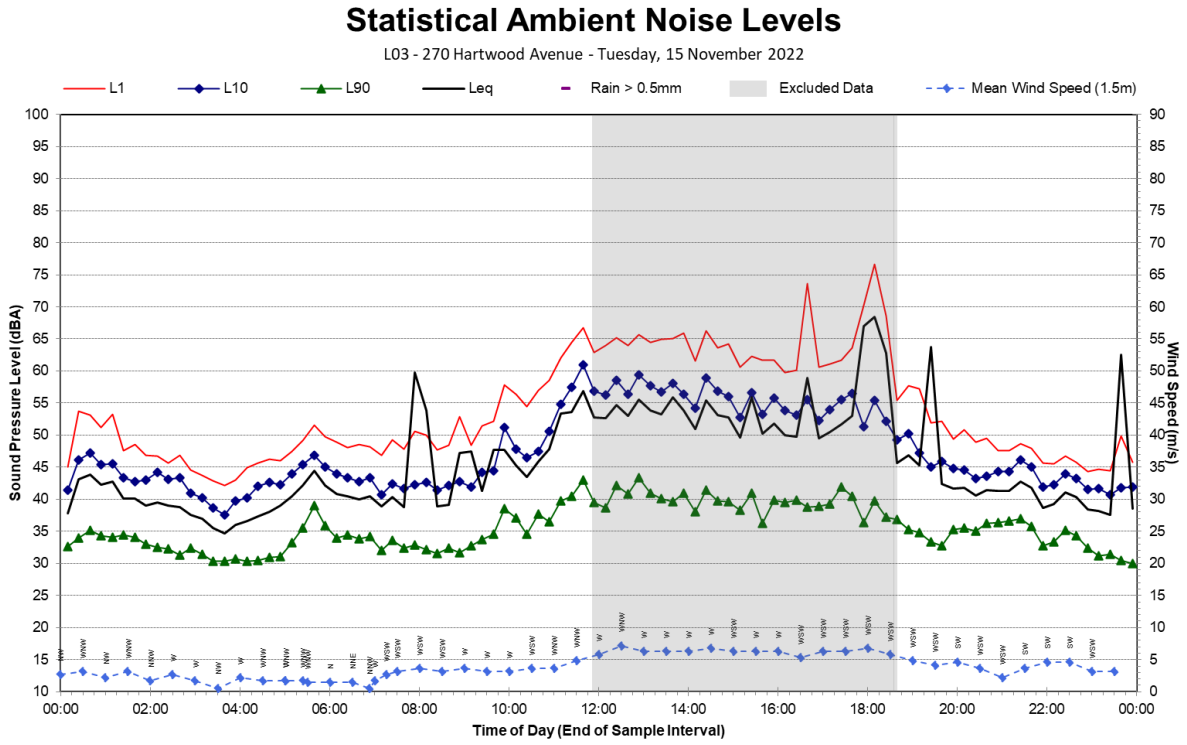
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L03 - 270 Hartwood Avenue - Saturday, 12 November 2022
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L03 - 270 Hartwood Avenue - Sunday, 13 November 2022
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L03 - 270 Hartwood Avenue - Monday, 14 November 2022
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
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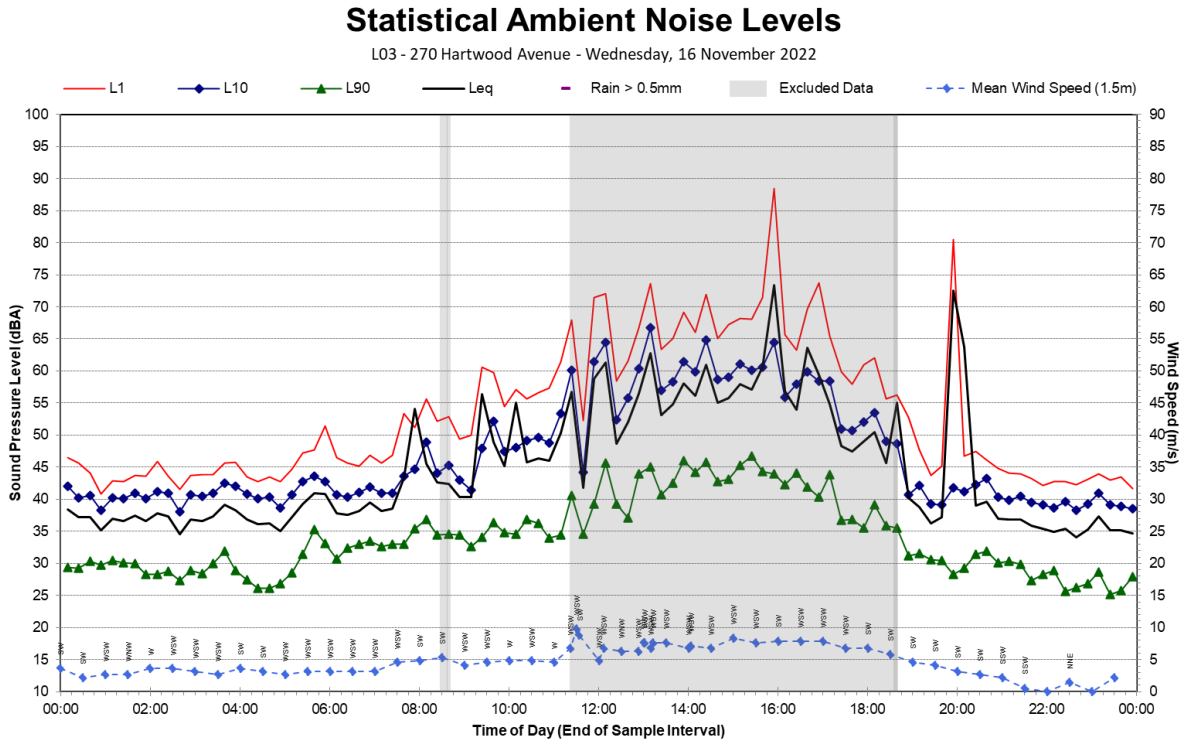
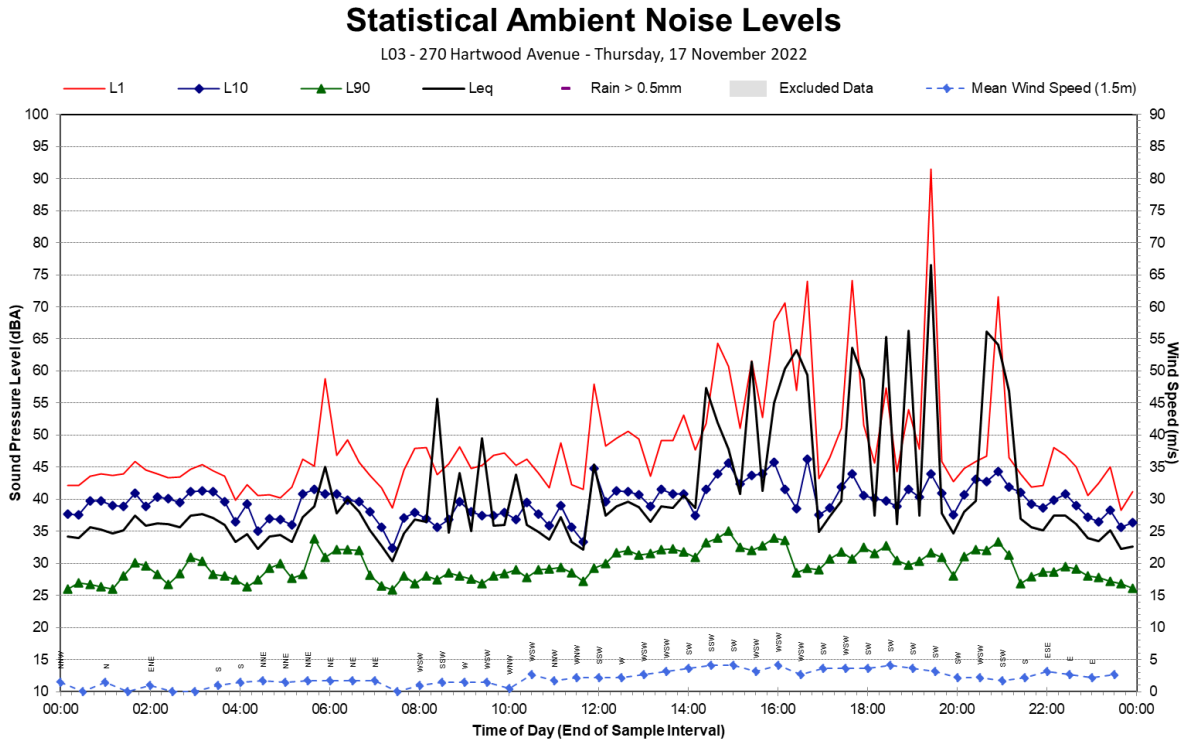
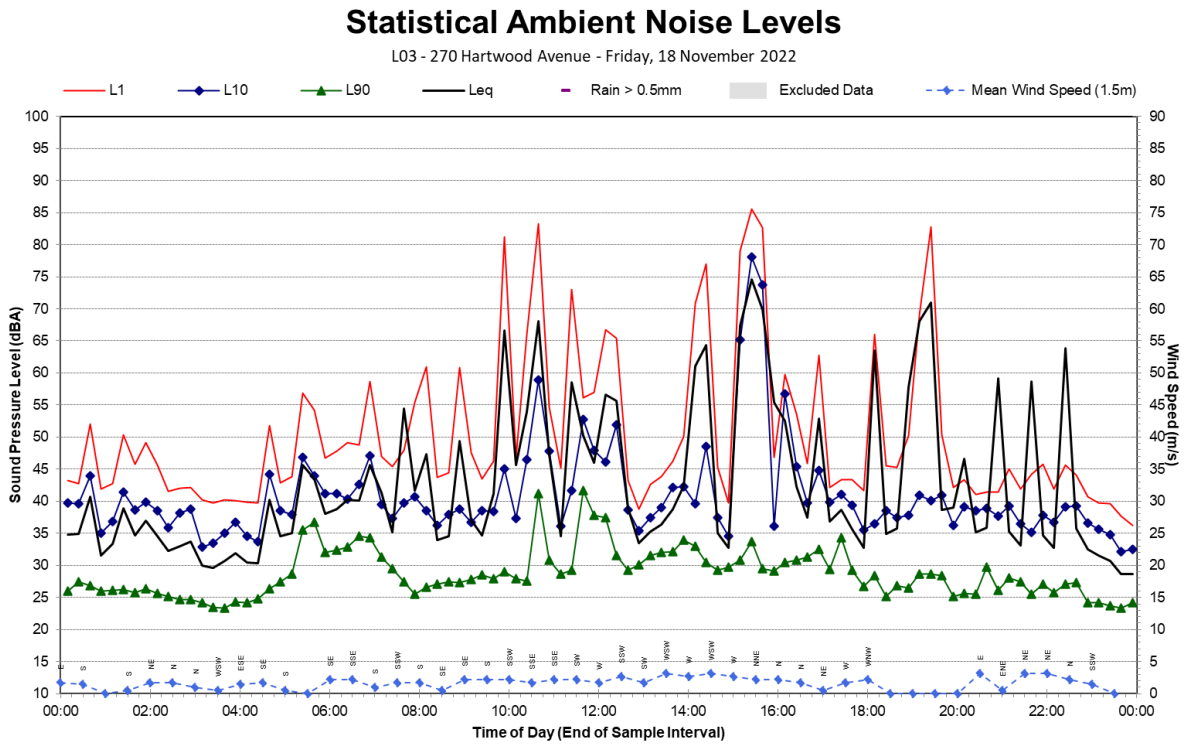
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L03 - 270 Hartwood Avenue - Wednesday, 16 November 2022
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L03 - 270 Hartwood Avenue - Thursday, 17 November 2022
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L03 - 270 Hartwood Avenue - Friday, 18 November 2022
L1
L10
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Leq
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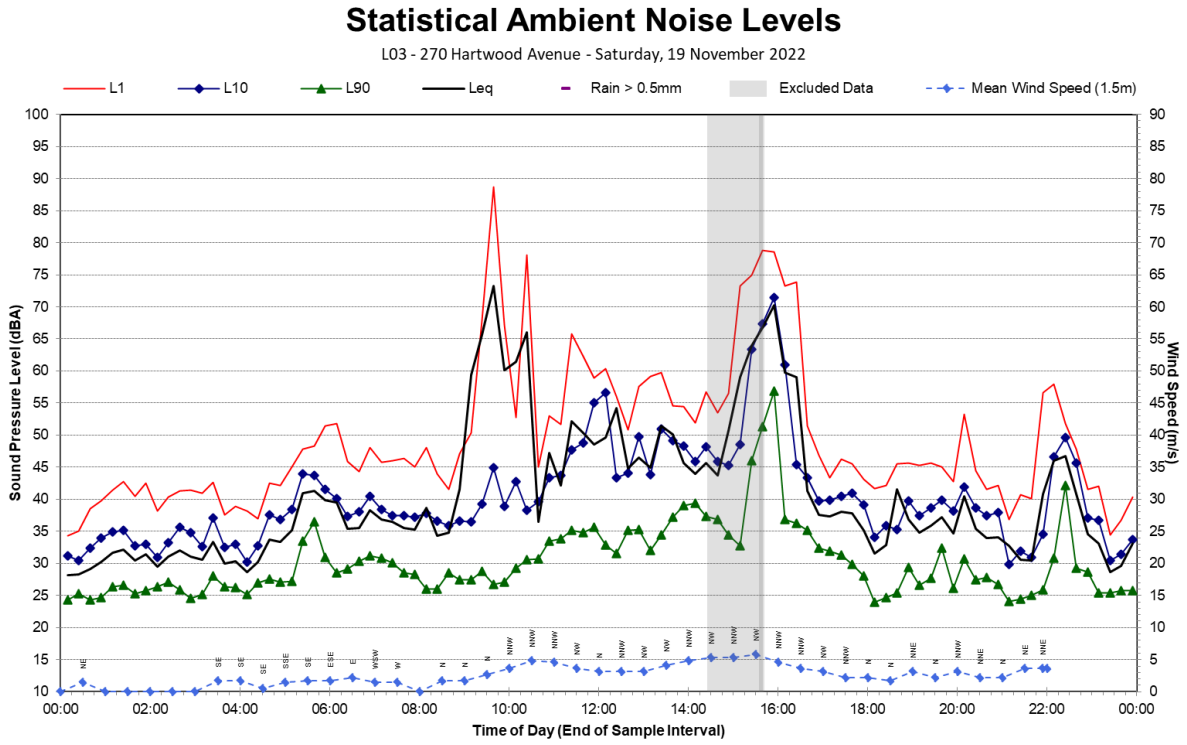
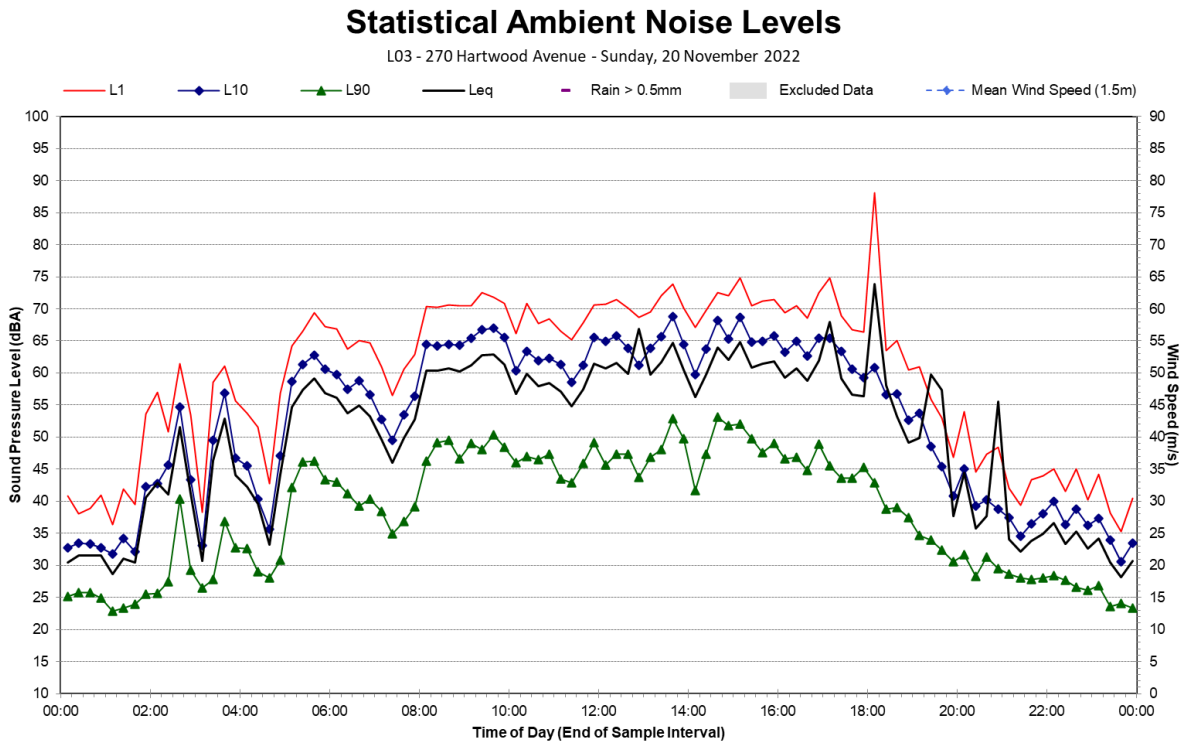
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L03 - 270 Hartwood Avenue - Saturday, 19 November 2022
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
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L1
L10
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Leq
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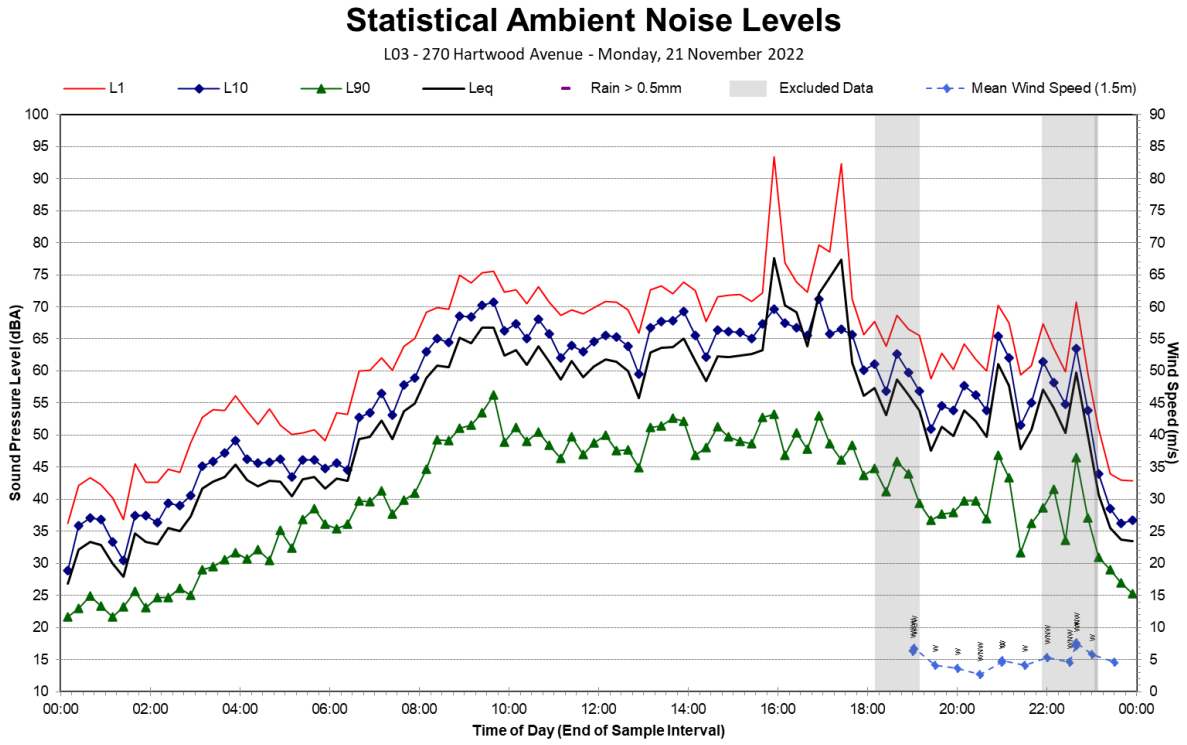
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
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L1
L10
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Leq
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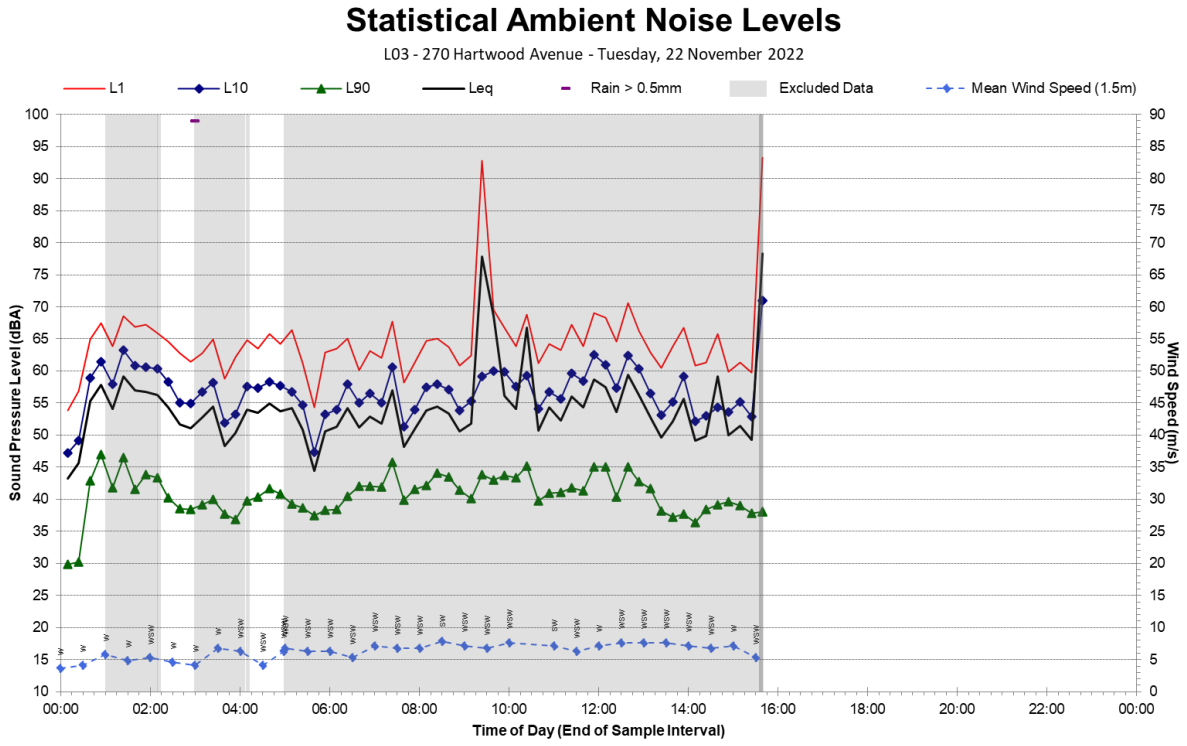
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L03 - 270 Hartwood Avenue - Tuesday, 22 November 2022
L1
L10
L90
Leq
Rain > 0.5mm
Excluded Data
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

Appendix D Construction Vibration Assessment Criteria

Noise Management Report

Panorama Battery Energy Storage System (BESS)

Panorama BESS Subco Pty Ltd

SLR Project No.: 660.30234.00000

14 September 2023

Vibration – Building Structures Cosmetic Damage Risk

Most commonly specified 'safe' structural vibration limits are designed to minimise the risk of cosmetic damage such as surface cracks and are set well below the levels that have potential to cause structural damage. British Standard BS 7385 Part 2-1993 Evaluation and measurement for vibration in buildings Part 2, provides frequency-dependent vibration limits related to the cosmetic damage risk. Noting, cosmetic damage is very minor in nature, is readily repairable and does not affect the structural integrity of the building.

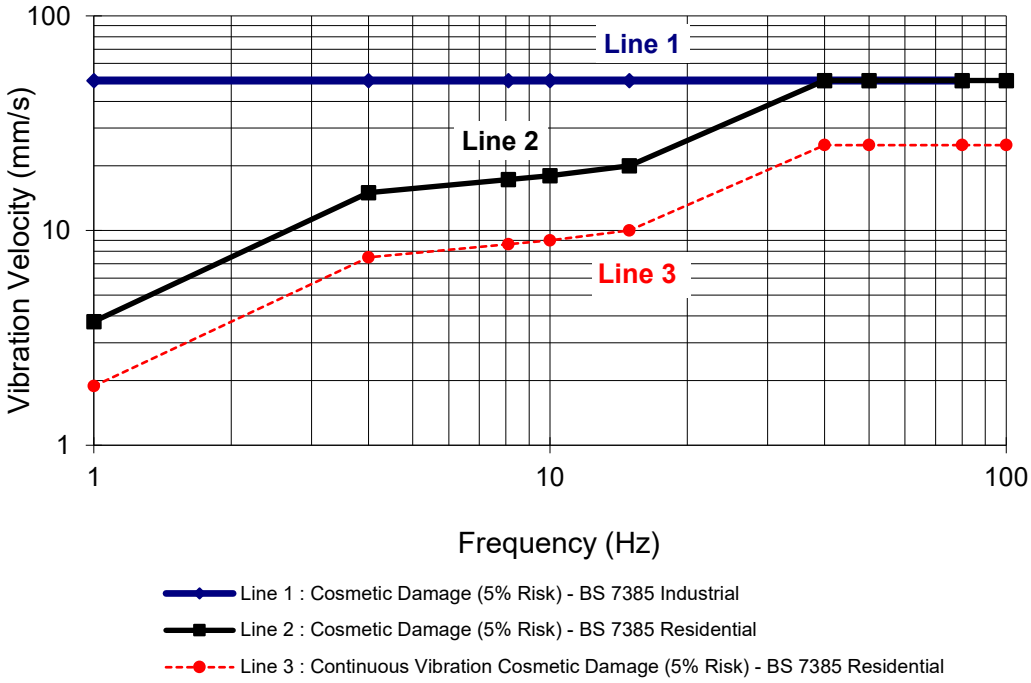
The BS 7385 Part 2-1993 sets guide values for building vibration based on the lowest vibration levels above which damage has been credibly demonstrated. These levels are judged to give a minimum risk of vibration induced damage, where minimal risk for a named effect is usually taken as a 95% probability of no effect. Sources of vibration that are considered in the standard include demolition, blasting (carried out during mineral extraction or construction excavation), piling, ground treatments (e.g., compaction), construction equipment, tunnelling, road and rail traffic and industrial machinery.

The recommended limits (guide values) for transient vibration to ensure minimal risk of cosmetic damage to residential and industrial buildings are presented numerically in **Table D1** and graphically in **Figure D1.**

Table D1: 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

Figure D1: Graph of Transient Vibration Guide Values for Cosmetic Damage



BS 7385 Part 2-1993 goes on to state that cosmetic damage is possible at vibration magnitudes which are greater than twice those given in Table D1, and damage to a building structure may occur at values greater than four times the tabulated values. It is also noteworthy that extra to the guide values nominated in Table D1, the BS 7385 Part 2-1993 states that:

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

Also that:

> *"A building of historical value should not (unless it is structurally unsound) be assumed to be more sensitive."*

BS 7385 Part 2-1993 states that the guide values in Table D1 relate predominantly to transient vibration which does not give rise to resonant responses in structures and low-rise buildings. Where the dynamic loading caused by continuous vibration (i.e., rock breaking or sheet piling) may give rise to dynamic magnification due to resonance, especially at the lower frequencies where lower guide values apply, then the guide values in Table D1 may need to be reduced by up to 50%.

For construction activities involving intermittent vibration sources such as rock breakers, piling rigs, vibratory rollers, excavators and the like, the predominant vibration energy occurs at frequencies greater than 4 Hz (and usually in the 10 Hz to 100 Hz range). On this basis, a conservative vibration damage screening level per receiver type is given below:

- Unreinforced or light framed structures: 7.5 mm/s.
- Reinforced or framed structures: 25.0 mm/s

Vibration - Buried Pipework

The German Standard DIN 4150-3:1999 "Structural Vibration Part 3: Effects of vibration in structures" provides guideline values for evaluating the effect of vibration on buried pipework. The values are based on the assumption that pipes have been manufactured and laid using current technology. Additional considerations may be required at junctions. The recommended limits for short term vibration to ensure minimal risk of damage are presented numerically in Table D2.

Table D2: Guideline Values for Vibration - Effects of Short Term Vibration on Buried

Pipe Material	Vibration Measured on the Pipe[1] (ppv mm/s)
Steel (including welded pipes)	100
Clay, concrete, reinforced concrete, pre-stressed concrete, metal (with or without flange)	80
Masonry, plastic	50

Note 1: Mounting equipment directly onto pipes may not be possible. If the vibration source is not immediately next to the pipework, measurements can be made on the ground surface to obtain an estimate. Generally, this vibration level will be greater than the level measured directly on the pipework.

Vibration - Human Comfort

EPA's *"Assessing Vibration: A Technical Guideline"* (DEC 2006) is based on the information set out in British Standard 6472-1992 "*Evaluation of Human Exposure to Vibration in Buildings (1 Hz to 80 Hz)*". This standard defines levels of building vibration associated with a "low probability of adverse comment" from occupants. The applicable levels for continuous daytime activities are shown in Table D3.

Table D3: Vibration Levels with "Low Probability of Adverse Comment" (1 Hz to 80

Building Type	Peak Floor Vibration	Peak Floor Vibration (Z Vertical)
Residential	0.8 mm/s to 1.6 mm/s	0.3 mm/s to 0.6 mm/s
Commercial/Offices	1.6 mm/s	0.6 mm/s
Industrial/Workshops	3.2 mm/s	1.2 mm/s

Appendix E Construction Scenarios and Equipment Sound Power Levels

Noise Management Report

Panorama Battery Energy Storage System (BESS)

Panorama BESS Subco Pty Ltd

SLR Project No.: 660.30234.00000

14 September 2023

Table C1: Construction Noise Modelling Scenarios

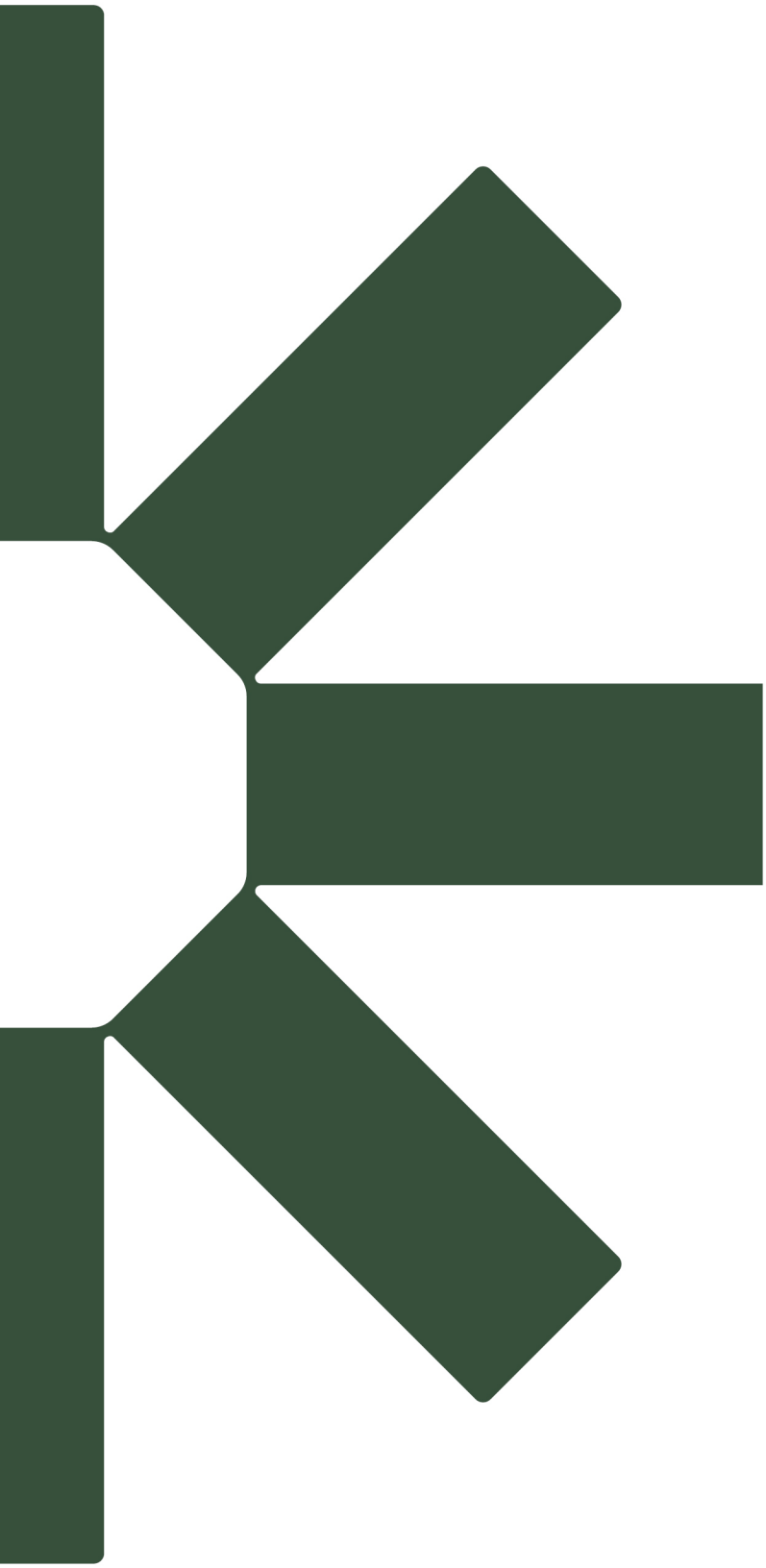
Construction Component	Construction Period	Equipment Involved at the Work Site	
		Equipment Type	Number of Items
Project	**TBA**		
Site Establishment	Daytime	Bobcat/Skid Steer	1
		15t excavator	1
		12-15t Trucks	1
		Hand tools Enabling	1
		Mobile Crane 80-100 tonne	1
		Grass Slasher/Lawn Mower	1
		Generator 100KVA	1
			1
Enabling	Daytime	30t excavator	1
		Grader	1
		Water cart	1
		Vibrating Smooth Drum Roller	1
		12-15t Trucks	1
		Hand tools Enabling	2
		Telehandler	1
		Generator 100KVA	1
Construction	Daytime	Concrete Trucks / Agitator	1
		12-15t Trucks	2
		Roller (for Asphalt)	1
		Pad foot	1
		Hand tools	2
		Grader 14H	1
		Water Truck	1
		Generator 100KVA	1
		Telehandler	1
		Excavator 30 tonne	1
		Skidsteer	1
		Hydrovac	1
		Flatbed Truck	1
		Mobile Crane 80 tonne	1

Table C2: Equipment Sound Power Levels

Facility Construction Equipment	Overall SWL LAeq(15minute) (dBA re 1□W)
Excavator (30 tonne)	110
10 to 15t Trucks	108
Concrete Truck / Agitator	109
Mobile Crane (100 tonne)	104
Generator	103
Vibratory Roller	109
Grader 14G	108
Bobcat	104
Forklift	101

Facility Construction Equipment	Overall SWL LAeq(15minute) (dBA re 1□W)
Hand tools	94
Elevated Work Platform	97

Notes The overall SWLs are based on SLRs database and the NSW Roads and Maritime Construction Noise and Vibration Guideline.



Making Sustainability Happen