74-76 SEVILLE STREET, FAIRFIELD EAST

Proposed Vehicle Waste Transfer Station & Resource Recovery Facility
Noise & Vibration Assessment

Prepared for:

Hassani Investments & Hussain Group Investments
c/o Hamptons Property Services
PO Box 954
EDGECLIFF NSW 2027

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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 Hassani Investments & Hussain Group Investments (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

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DOCUMENT CONTROL

Reference	Date	Prepared	Checked	Authorised
610.18609-R05-v2.0	14 May 2020	David O'Brien	Aaron Miller	Aaron Miller
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1 INTRODUCTION

SLR Consulting Australia Pty Ltd (SLR) has been engaged by Hamptons Property Services Pty Ltd (Hamptons) on behalf of Hassani Investments Pty Ltd & Hussain Group Investments Pty Ltd (H&H) to carry out a noise and vibration assessment of a proposed Vehicle Waste Transfer Station and Resource Recovery Facility, to be located at 74-76 Seville Street, Fairfield East.

The noise and vibration assessment will support a Development Application to change the use of an existing industrial site to operate a waste transfer station and resource recovery facility.

This report presents the methodology, criteria and recommendations regarding the following specific areas of acoustical significance:

- Noise emissions from operational activities including vehicle movements, loading dock activities and waste recovery activities.
- Noise emissions from any increase in traffic on surrounding roads due to the addition of the premises.

No construction activities are proposed for the site, consequently no assessment of construction noise and vibration impacts has been undertaken.

The following policies have been used to develop the noise criteria and to predict noise emissions:

- Noise Policy for Industry (NPfI, 2017) – NSW Environment Protection Authority (EPA)
- Road Noise Policy (RNP, 2011) – EPA

A glossary of acoustic terminology used throughout this report is provided in **Appendix A**.

2 PROJECT LOCATION AND DESCRIPTION

2.1 Site Location

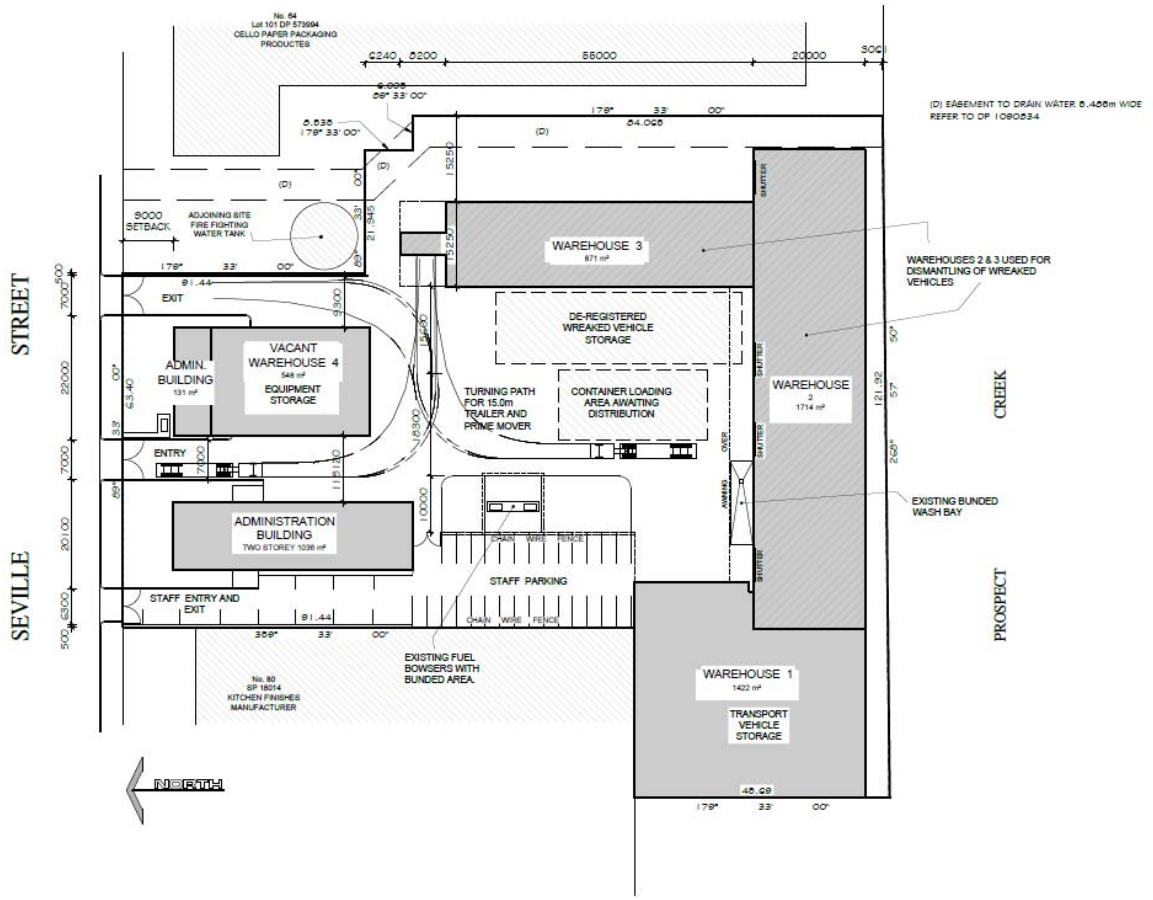
The site of the proposed Facility is 74-76 Seville Street, Fairfield East, shown in **Figure 1**.

Figure 1 Development Site Location

2.2 Project Description

The Project Site layout is provided in **Figure 2**.

Figure 2 Site Layout



The proposed operating hours of the Facility are provided in **Table 1**.

Table 1 Proposed Operating Hours

Day	Hours of Operation
Monday to Friday	7:00 am to 5:00 pm
Saturday	7:00 am to 12:00 pm
Sunday	Closed

The project is located in an industrial precinct. The property to the north is a large bulky goods premises operated by Fantastic Furniture which has regular deliveries and dispatches. Warehousing and manufacturing facilities are located to the east and west of the development. The nearest sensitive receivers are located to the south and west and are detailed in **Section 4.1**.

The following noise-producing activities will occur at the site:

- Flatbed trucks (5 t tare) will deliver vehicles to be wrecked. They will enter the site through the 'Entry' shown in **Figure 2** and park in the 'container loading area awaiting distribution'.
- Petrol forklifts (with a Safe Working Load capacity of 1.2 t and fitted with tonal reversing alarms) will remove the vehicles from the flatbed trucks to be wrecked and place them in the 'Warehouse 2' area shown in **Figure 2**. Any components containing heavy and rare earth metals are then extracted from the car using typical mechanical tools such as hoists and compressor powered rattle guns.
- Following completion of the wrecking in Warehouse 2, the vehicles will then be stacked in the 'De-registered wrecked vehicles' area shown in **Figure 2**.
- Wrecked vehicles will then be loaded on to flatbed trucks parked in the 'container loading area awaiting distribution' and exit the facility via the 'exit' shown in **Figure 2** on to Seville Street.
- Warehouse 1 is to be used for storing the fleet of seven flatbed vehicles overnight. Warehouse 3 is currently not being used, but it is anticipated that it will be used for wrecking vehicles in future.

It is proposed that the facility will receive delivery of up to 40 vehicles per day, with an annual average of 9100 vehicles (approximately 25 per day). Peak vehicle movements will occur between the hours of 11:00 am to 2:00 pm and 4:00 pm to 5:00 pm, and average vehicle movements will occur between the hours of 8:00 am to 11:00 am and 2:00 pm to 4:00 pm.

The existing administration buildings are equipped with mechanical plant for air conditioning purposes, no changes are proposed in this regard. Given that the units are located on the rooftop which is surrounded by a parapet wall and the intervening distance to sensitive receivers, it is not expected that these units will be problematic from a noise perspective and are not assessed further.

It is also noted that there is a carpark on the western edge of the development. No change of use is proposed for this area. Given the considerable shielding provided to this space and the intervening distance to sensitive receivers, it is not expected that car parking noise will be problematic and is not assessed further.

The nearest residential areas (and hence residential receivers) are described in detail in **Section 4**.

3 NOISE AND VIBRATION CRITERIA

3.1 Operational Noise Criteria

This section outlines criteria for assessing the potential impacts of noise generated by the proposed development on the surrounding noise sensitive receivers.

3.1.1 Operational Noise – Industrial Noise Emissions

The NSW Environment Protection Authority's (EPA's) *Noise Policy for Industry* (NPfI, 2017) outlines the procedure for assessing noise emissions from industrial noise sources, such as mechanical plant and equipment.

The process involves determining project noise trigger levels at existing noise-sensitive receivers surrounding a proposed development, predicting whether emissions from the development are likely to exceed the established levels and result in potential noise impacts, and reducing the predicted levels through feasible and reasonable mitigation strategies.

The Project Noise Trigger Level is the lower (ie the more stringent) value of the project intrusiveness noise level and project amenity noise level. The project intrusiveness noise level aims to protect against significant changes in noise levels, whilst the project amenity noise level seeks to protect against cumulative impacts from industry and maintain amenity for particular land uses.

Typically, the intrusiveness level would inform the project noise trigger level in areas with little industry (and/or ambient noise levels), whereas the amenity level would inform the project noise trigger level in areas with higher existing background noise levels.

3.1.1.1 Intrusiveness Noise Level

The intrusiveness noise level is based on the measured existing background noise levels. In accordance with the NPfI, the equivalent continuous noise level (L_{Aeq}) of the source should not exceed the measured Rating Background Level (RBL) at a residence by more than 5 dBA over any 15 minute period within any assessment period.

Intrusive noise levels are only applied to residential receivers (residences). For other receiver types, only the amenity levels apply.

3.1.1.2 Amenity Noise Level

The recommended amenity noise level represents the total industrial noise at a receiver location, whereas the project amenity level represents the objective for noise from a single industrial development. The project area is considered to be suburban.

3.1.1.3 Project Noise Trigger Levels

The results of the unattended noise monitoring (refer to **Section 4.2.1**) have been used to establish the Project Noise Trigger Levels which would be used to assess the potential industrial impacts associated with the Project at the surrounding receivers.

The project noise trigger levels are the more stringent of the intrusiveness and amenity noise levels and are marked in bold and shaded as shown below in **Table 2**. Note that only the daytime criteria (between 7:00 am and 6:00 pm on Monday through to Saturday) are applicable to this development as this is the only time period that corresponds with the proposed operating hours.

Table 2 Indicative Project Noise Trigger Levels

Area / NCA	Period	Representative Noise Logger[1]	Recommended Amenity Noise Level $L_{Aeq(period)}$	Measured Noise Level (dBA)		Project Noise Trigger Levels $L_{Aeq(15minute)}$ (dBA)	
				RBL[2]	$L_{Aeq(period)}$	Intrusiveness	Amenity[3,4]
01	Daytime	L01	55	40	50	**45**	53
02	Daytime	L02	55	42	58	**47**	53

Note 1: The noise catchment areas and logging locations are shown in **Figure 3**.

Note 2: RBL = Rating Background Level.

Note 3: The project amenity noise level is the recommended amenity noise level minus 5 dB, as detailed within the NPfI.

Note 4: To standardise the time periods for the intrusiveness and amenity noise levels, the NPfI assumes that the LAeq(15minute) noise level is equal to the LAeq(period) noise level plus 3 dB.

3.2 Additional Road Traffic Noise Criteria

For traffic operating on public roads to and from the subject site, the EPA's *Road Noise Policy* (RNP) is appropriate for assessing potential road traffic noise impacts. The relevant noise criteria for existing residences affected by additional traffic on existing sub-arterial roads are reproduced in **Table 3**.

Table 3 Road Traffic Noise Criteria

Road Category	Type of Project / Land Use	Day (7:00 am to 10:00 pm)	Night (10:00 pm to 7:00 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 dBA	$L_{Aeq(9hour)}$ 55 dBA

Note 1: All criteria are external, applicable at 1 m from the facade of the nearest affected residence.

In addition to the noise criteria in **Table 3**, the RNP recommends the following:

> *"For existing residences and other sensitive land uses affected by additional traffic on existing roads generated by land use developments, any increase in the total traffic noise level should be limited to 2 dB above that of the corresponding 'no build option'.*

3.3 Vibration

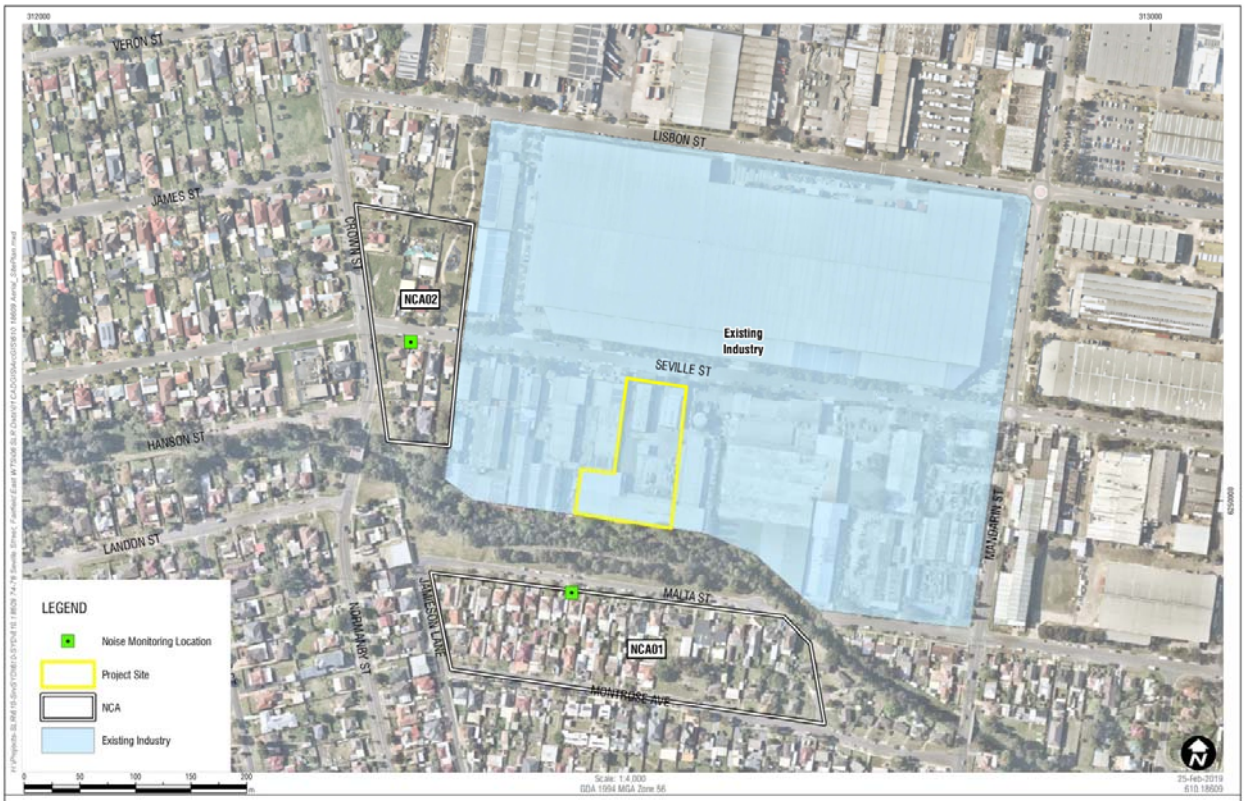
Vibration impacts on other receivers are expected to be negligible during operations. The nearby industrial receivers are not considered to be sensitive to vibration and the residential receivers are too distant to be subjected to vibration impacts. On this basis vibration is not considered further.

4 EXISTING ENVIRONMENT

4.1 Noise Sensitive Receivers

The nearest sensitive receivers are residential properties located to the west and south, at a distance of around 220 m and just under 100 m, respectively. The area located to the southern boundary of the site is parkland. The nearest receivers are shown in **Figure 3**.

Figure 3 Noise Measurement Locations



Noise Catchment Areas (NCAs) have been defined which represent the land uses surrounding the project. These and details of the nearest potentially affected sensitive receivers are described in **Table 4**.

Table 4 Sensitive Receivers

NCA	Description	Type/Use
NCA01	Existing residential receivers to the south of the Seville Street compound. The nearest residential receivers are around 100 m from the works.	Residential
NCA02	Existing residential receivers to the west of the Seville Street compound along Seville Street. The nearest residential receivers are around 220 m from the compound.	Residential

4.2 Ambient Noise Survey

In order to characterise the existing acoustical environment of the area, unattended noise monitoring was conducted between the dates of 13 February and 20 February 2019 at the logging locations shown in **Figure 3**.

Additionally, 15-minute attended noise measurements were conducted at the locations indicated in **Table 7** to determine the character of the existing acoustic environment of the local area. Instrumentation for the noise surveys is detailed within **Table 5**.

Table 5 Noise Monitoring Equipment List

Equipment	Serial Number	Location
ARL EL316 Environmental Noise Logger	16-103-494	100 Seville Street - Location 1 Unattended
ARL EL316 Environmental Noise Logger	16-203-526	88 Malta Street - Location 2 Unattended
Brüel & Kjær 2260 Sound Level Meter	2487418	Location 1 and 2 Attended. On-site measurements
Brüel & Kjær 4231 Calibrator	2218228	All

Calibration of the logging devices was checked prior and after the measurements and the drift was within acceptable tolerances (±1 dB). All equipment carried appropriate and current NATA or manufacturer calibration certificates.

Logger locations were selected with consideration to the noise sources which may influence readings, security issues for noise monitoring equipment and accessibility from residents and landowners. Positions were selected to capture a representative sample of the ambient noise character of the site in order to establish the noise emission criteria. The measured locations were considered to be 'free-field'.

The measured data has been filtered to remove data affected by adverse weather conditions following reference to the weather reports recorded at the Bureau of Meteorology (BOM) Bankstown Airport weather station.

Daily graphs representing the measured noise data are attached in **Appendix B**. The graphs represent each 24-hour period by incorporating the L_{A10}, L_{A90}, L_{Aeq} and L_{Amax} noise levels for the corresponding 15-minute periods.

4.2.1 Unattended Noise Monitoring

To assess the acoustical implications of industry on the levels of noise received at nearby potentially sensitive receivers, the measured data at the noise logging position was processed in accordance with the requirements of the NPfI.

Table 6 details the Rating Background Level (RBL) and L_{Aeq} noise levels recorded during the daytime, evening and night-time periods.

Data affected by adverse meteorological conditions and by spurious and uncharacteristic events has been excluded from the results and were also excluded from the data used to determine the noise emission criteria.

Table 6 Measured Ambient Noise Levels Corresponding to EPA NPfI Assessment Time Periods

Noise Monitoring Location	Period[1]	Measurement Parameter (dBA)	
		L_{A90} (RBL)[2]	L_{Aeq} [3]
Location 1 88 Malta Street	Daytime	40	50
	Evening	41	48
	Night-time	37	46
Location 2 100 Seville Street	Daytime	42	58
	Evening	40	57
	Night-time	35	53

Note 1: For Monday to Saturday, Daytime: 7:00 am - 6:00 pm; Evening: 6:00 pm - 10:00 pm; Night-time: 10:00 pm - 7:00 am. On Sundays and Public Holidays, Daytime: 8:00 am - 6:00 pm; Evening: 6:00 pm -10:00 pm; Night-time: 10:00 pm - 8:00 am.

Note 2: The RBL noise level is representative of the "average minimum background sound level" (in the absence of the source under consideration), or simply the background level.

Note 3: The L_{Aeq} is essentially the "average sound level". It is defined as the steady sound level that contains the same amount of acoustical energy as a given time-varying sound.

4.2.2 Attended Noise Monitoring

Operator attended noise monitoring measurements provide a context and noise level characteristics for the unattended noise measurements. A summary of the attended measurements is tabulated in **Table 7**.

Table 7 Operator Attended 15-minute Ambient Noise Surveys

Location/ Description	Date/ Start time/ Weather	Primary Noise Descriptor (dB re 20 µPa)				Comments
		L_{AFmax}	L_{AFmin}	L_{Aeq}	L_{A90}	
Location 1 88 Malta Street	13/2/2019 11:55 Fine	67	39	50	43	No atypical events or noises. Dominated by natural fauna, faint industry during periods of still wind.
Location 2 100 Seville Street	13/2/2019 12:34 Fine	86	41	61	43	Road Traffic dominated.

It was observed that at Location 2, noise was dominated by road traffic, comprising mostly light vehicles and trucks entering or exiting the Fantastic Furniture warehouse. The dominant industrial noise component originated from operations at the Fantastic Furniture warehouse.

Two 15-minute measurements were conducted at the site. One measurement within the centre of the project site floor, and one by Seville Road along Fantastic Furniture. The measurement and the typical L_{Amax} noise levels observed are presented in **Table 8** below. Other one-minute measurements of different activities and sources were also carried out on 13 February 2019 and these are detailed in **Table 9**.

To assist in the above, the proponent made available forklift vehicles, a rattle gun, etc, to be able to measure noise levels which will occur at the proposed operation. The proponent also arranged for a flatbed truck to deliver a vehicle and for the vehicle to be taken from the flatbed truck by forklift.

Table 8 Attended 15 Minute Measurements, Conducted within the Industrial Premises.

Measurement Details	Measured Noise Levels (dBA)			Description of Ambient Noise Source – Typical L_{Amax} Levels
	L_{A90}	L_{Aeq}	L_{Amax}	
13 February 2019 9:50 am 15 min Inside Complex[1]	53	60	80	Reversing Alarms on Forklift: 73 dBA. General impact within ground with 3x forklifts in use: 75 dBA. Loaded truck pass-by: 80 dBA. Rattle Gun in Warehouse 2: 80 dBA. 4x4 with Trailer (loaded) pass-by: 78 dBA.
13 February 2019 10:17 am 15 min On Seville Street	51	64	84	Rattle Gun in Warehouse 2: 70 dBA. Activities from Fantastic Furniture: up to 84 dBA. Truck pass-by (from another site): 80 dBA. Loaded truck from facility, exiting to the east: 76 dBA.

Note 1: Near the containing loading area in **Figure 2**.

Table 9 Short Term Attended Measurements

Location	Description	Measured Noise Levels (dBA)	
		L_{Aeq}	L_{Amax}
Warehouse 2	Two forklifts using reversing alarms and one rattle gun	77	97
	One rattle gun and one forklift	74	87
	General activities	72	89
Container Loading Area	Flatbed truck enter and reverse	68	77
	Flatbed truck idling during forklift removal of car	68	84
	Forklift removal of car and flatbed exit	66	75
	Flatbed passing through site	72	81

4.3 Additional Road Traffic Noise

In order to assess environmental noise impacts from the additional road traffic noise to be created by the development, the data obtained from the noise logging has been processed in order to establish representative ambient noise levels during the time periods listed in **Table 3.**

Results are presented in **Table 10**, and represent the traffic noise levels associated with the usage of Seville Street and Crown Street. The results include a 2.5 dB correction to convert results in the free field to results 1 m from the most-affected facade.

Table 10 Measured L_{Aeq} values during monitoring period

Logger Location	$L_{Aeq(15hour)}$	$L_{Aeq(9hour)}$
Logger 2 at 100 Seville St	61	55

Note 1: The L_{Aeq} descriptor represents the logarithmic average noise energy during the measurement period. The '15-hour' represents the daytime period between 7:00am to 10:00pm, and '9-hour' represents the night time period between 10:00pm to 7:00am.

5 NOISE IMPACT

5.1 Operational Noise

5.1.1 Wrecking and Loading Dock Activities

Based on the operations described in **Section 2.1** and the noise measurements undertaken on and around the site described in **Section 4.2.2**, there are two primary sources of operational noise:

- Wrecking activities that will occur within Warehouse 2.
- Loading dock activities that will occur in the container loading area.

For the purposes of this noise assessment, SLR has assumed the following worst-case scenario for any 15 minute period:

- Two forklifts and two rattle guns are operating continuously within Warehouse 2 for the entire 15 minute period. Based on the short term attended measurements in **Table 9**, SLR has conservatively assumed a worst-case reverberant $L_{Aeq(15minute)}$ sound pressure level of 80 dBA within Warehouse 2.
- Four flatbed trucks will enter the site, be unloaded/loaded in the container loading area and subsequently exit the site, with at least two flatbeds idling within the container loading area throughout the entire 15 minute period. Based on the short term attended measurements in **Table 9**, the trucks are conservatively assumed to have a sound power level of 95 dBA.

Considering that the proposed Facility will receive a maximum of 40 deliveries per day, it is conservatively assumed that all of these would be spread across the peak times of 11:00 am to 2:00 pm and 4:00 pm to 5:00 pm, which would result in 10 deliveries per hour during these times. It is subsequently assumed that as a worst case, four of these 10 deliveries would occur within a 15 minute period.

SLR has constructed a SoundPLAN model incorporating ground contours and the surrounding industrial buildings and has calculated the cumulative noise levels at the nearest sensitive receivers for both calm and prevailing weather conditions; these noise levels are compared to the intrusiveness criteria (provided in **Table 2**) in **Table 11**.

Table 11 Predicted Operational Noise Levels

Noise Catchment Area	Predicted $L_{Aeq(15minute)}$ Sound Pressure Level at Receiver (dBA)	Daytime Intrusiveness Criterion (dBA)	Exceedance?
NCA01	45[1]	45	No
NCA02	<35[1]	47	No

Note 1: This includes a +5 dB penalty for the tonal reversing alarms of the forklifts.

5.2 Additional Road Traffic Noise

The noise levels presented in **Table 10** presents the total traffic noise in the area, including some flatbed truck pass-bys from the facility itself. The $L_{Aeq(15\ hour)}$ noise level presented in **Table 10** exceeds the $L_{Aeq(15\ hour)}$ criterion presented in **Table 3** by 1 dB.

In order to assess the likely increase in road traffic noise levels compared to the "pre-existing" option, SLR has calculated the impact of the total noise emissions from vehicles entering and exiting the proposed Facility, incorporating the following assumptions:

- 80 flatbed trucks would pass by the receivers on Seville Street during any one 15 hour period. This corresponds to the maximum of 40 deliveries in one day and assumes each truck passes by twice.
- The sound exposure level (L_{AE}) of each pass-by is 80 dBA. This is based on the representative measured noise levels presented in **Table 8**.

The resulting calculated $L_{Aeq(15\ hour)}$ noise level of vehicle deliveries to the proposed Facility is 52 dBA. This means that the deliveries would contribute up to 0.6 dB to the measured $L_{Aeq(15\ hour)}$ noise level of 61 dBA presented in **Table 10**. If it is assumed that only 50 passbys occurred (corresponding to the average delivery rate of 25 trucks per day) then the deliveries would be contributing up to 0.4 dB.

6 RECOMMENDATIONS AND CONLUSION

6.1 Recommendations

Considering that the conservative worst-case scenarios were marginally compliant and that Facility operations would only be faintly audible at the nearest sensitive receiver when measured during the daytime, the development is considered feasible on the basis of noise emissions and is expected to comply with the requirements of the NPfI. However, SLR makes the following recommendations:

- Any tonal reversing alarms to be used by forklifts and flatbeds should be replaced with broadband (quacker) alarms. Given the distance to the nearest sensitive receivers, broadband alarms are more likely to blend in with the background noise. And, in this case, the 5 dB tonal penalty assumed in the worst-case scenario noise predictions would no longer apply.
- Where possible, deliveries should be staggered and spread evenly over the operating hours. The predicted operational noise levels presented in **Table 11** demonstrate that four deliveries within a 15-minute period will result in marginal compliance with the NPfI intrusiveness criterion at the nearest sensitive receivers; therefore the number of deliveries within any 15-minute period should be limited to a maximum of four.
- The noise predictions are based on noise emissions from a “typical” flatbed truck. During SLR’s site visit, at least one flatbed truck in the area was observed to be particularly loud. While trucks used to deliver vehicles to the site will be beyond the control of the proponent, the proponent should take steps to advise the owners of any such flatbed trucks, eg delivery vehicles with defective mufflers or other faults that cause them to be particularly loud, to address the situation as soon as practicable, with the ultimate mitigation control mechanism of not allowing such vehicles on site if the owners have been given sufficient warning over a reasonable period of time.

6.2 Conclusion

SLR has undertaken a noise assessment of a proposed Vehicle Recycling & Transfer Facility, to be located at 74-76 Seville Street, Fairfield East.

The development is considered feasible on the basis of acoustics and is expected to comply with the requirements of the NPfI.

SLR recommends that all site vehicles be fitted with broadband alarms, rather than tonal reversing alarms.

In addition, SLR recommends that deliveries are staggered and spread evenly over the operating hours where possible, and that all equipment is maintained to be in good working order. Provided that there are not more than four deliveries within any 15-minute period during the daytime, the development is expected to comply with the requirements of the NPfI.

APPENDIX A

Acoustic Terminology

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Acoustic Terminology

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 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

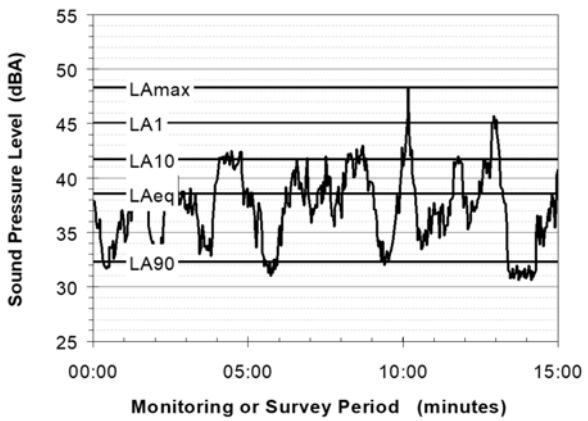
The Sound Power of a source is the rate at which it emits acoustic energy. As with Sound Pressure Levels, Sound Power Levels are expressed in decibel units (dB or dBA), but may be identified by the symbols SWL or LW, or by the reference unit 10^{-12} W.

The relationship between Sound Power and Sound Pressure 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 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.

5. Frequency Analysis

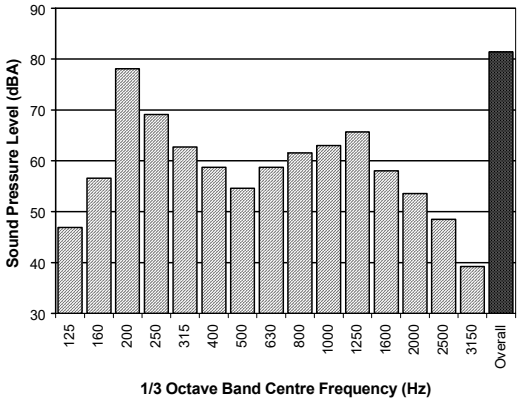
Frequency analysis is the process used to examine the tones (or frequency components) which make up the overall noise or vibration signal.

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

Frequency analysis can be in:

- 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 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 (ie 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.

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 (ie vertical, longitudinal 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/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

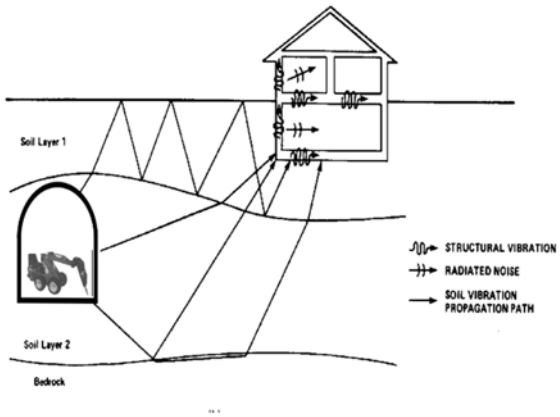
People are able to 'feel' vibration at levels lower than those required to cause even superficial damage to the most susceptible classes of building (even though they may not be disturbed by the motion). An individual's perception of motion or response to vibration depends very strongly on previous experience 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 (eg rockbreakers), and building services plant (eg fans, compressors and generators).

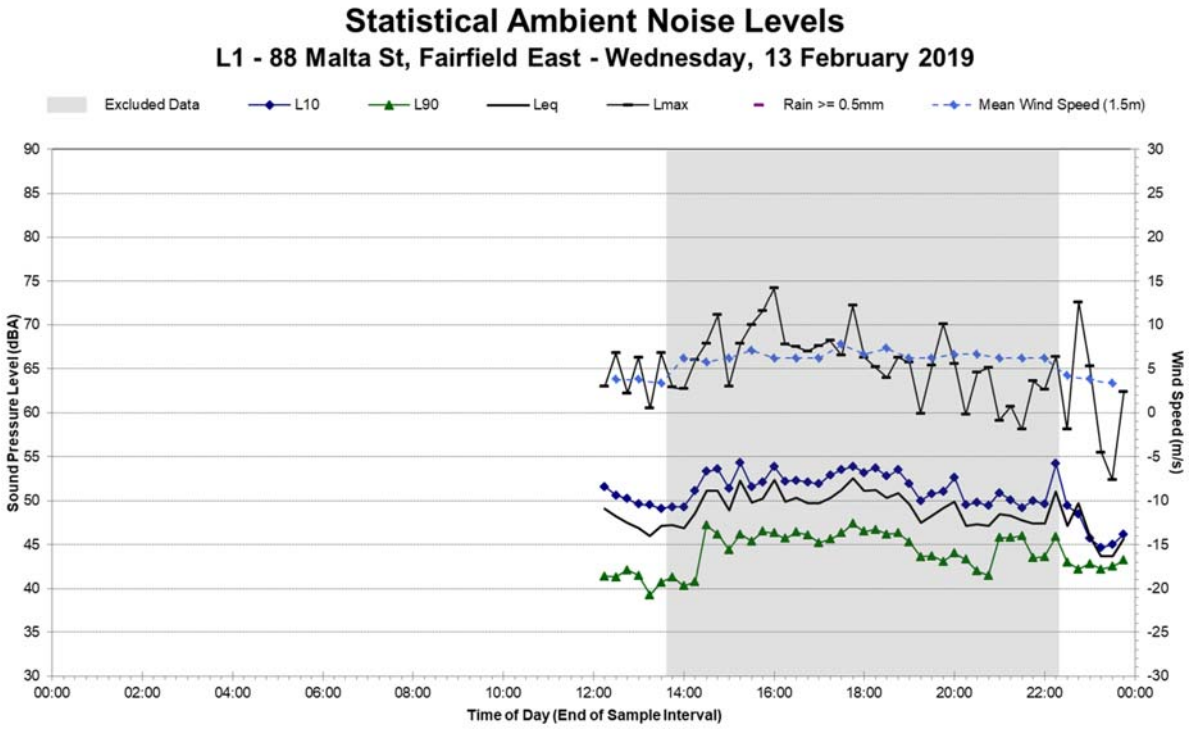
The following figure presents an example of the various paths by which vibration and ground-borne noise may be transmitted between a source and receiver for construction activities occurring within a tunnel.

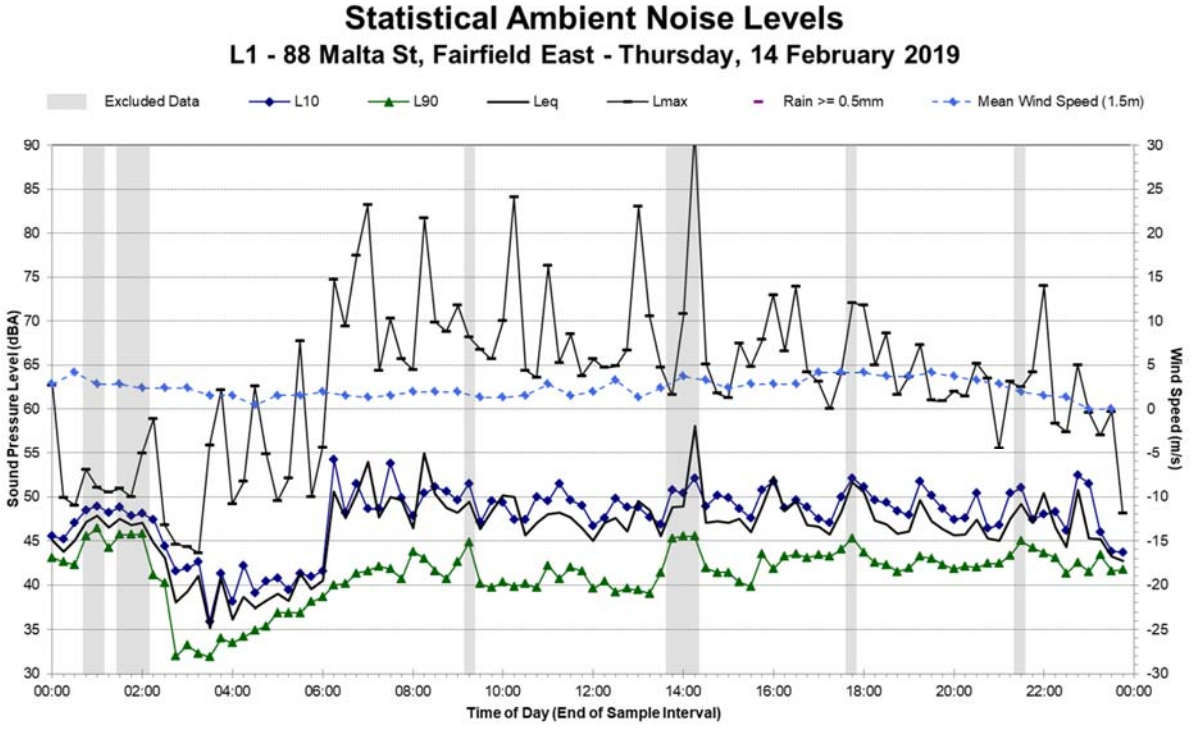


The term 'regenerated noise' is also used in other instances where energy is converted to noise away from the primary source. One example would be a fan blowing air through a discharge grill. The fan is the energy source and primary noise source. Additional noise may be created by the aerodynamic effect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

APPENDIX B

Daily Noise Monitoring Plots


Statistical Ambient Noise Levels
L1 - 88 Malta St, Fairfield East - Wednesday, 13 February 2019
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L1 - 88 Malta St, Fairfield East - Thursday, 14 February 2019
Excluded Data
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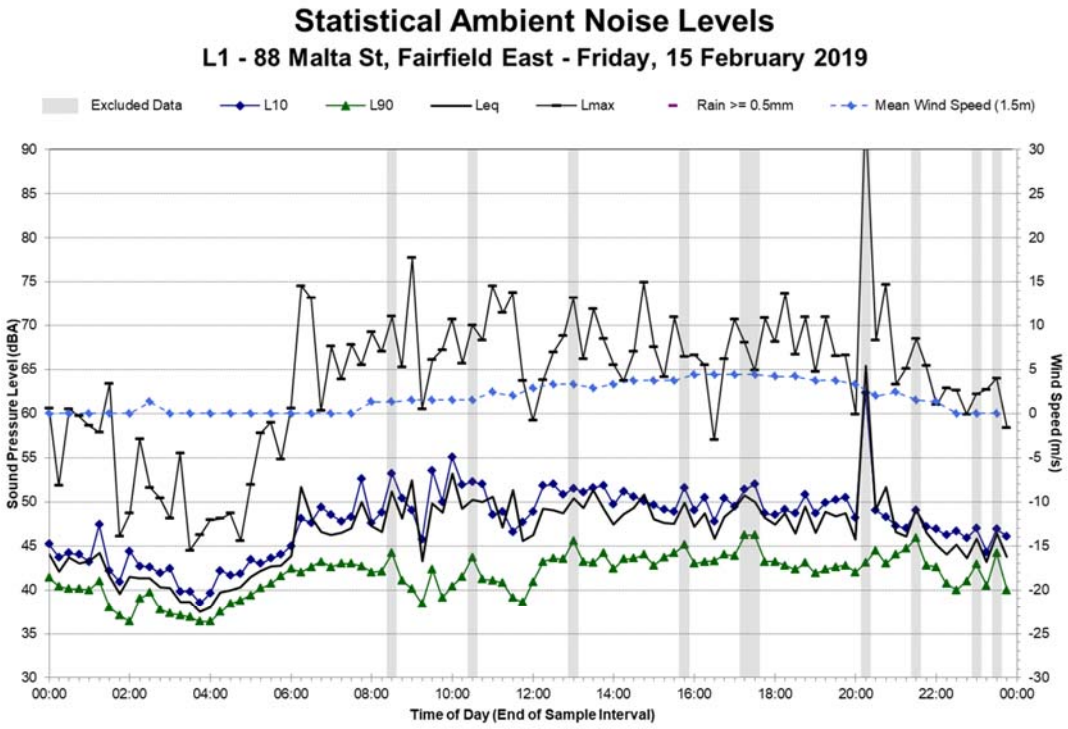
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L1 - 88 Malta St, Fairfield East - Friday, 15 February 2019
Excluded Data
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L90
Leq
Lmax
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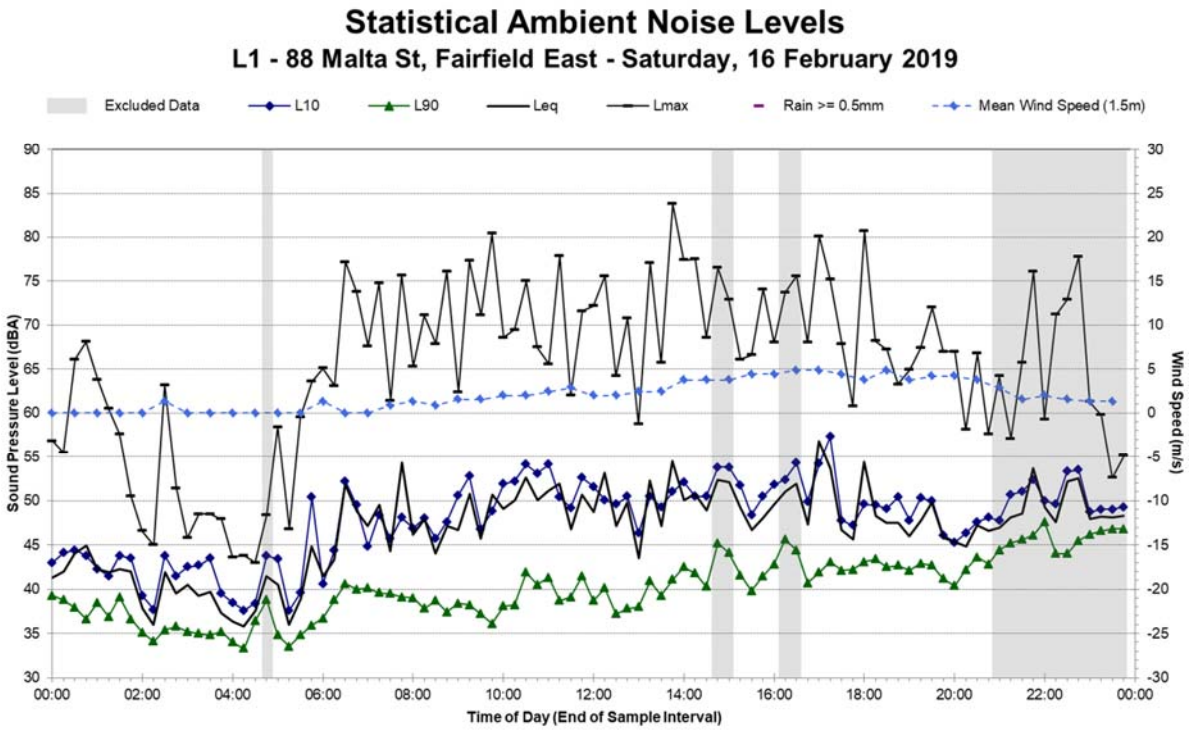
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L1 - 88 Malta St, Fairfield East - Saturday, 16 February 2019
Excluded Data
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Leq
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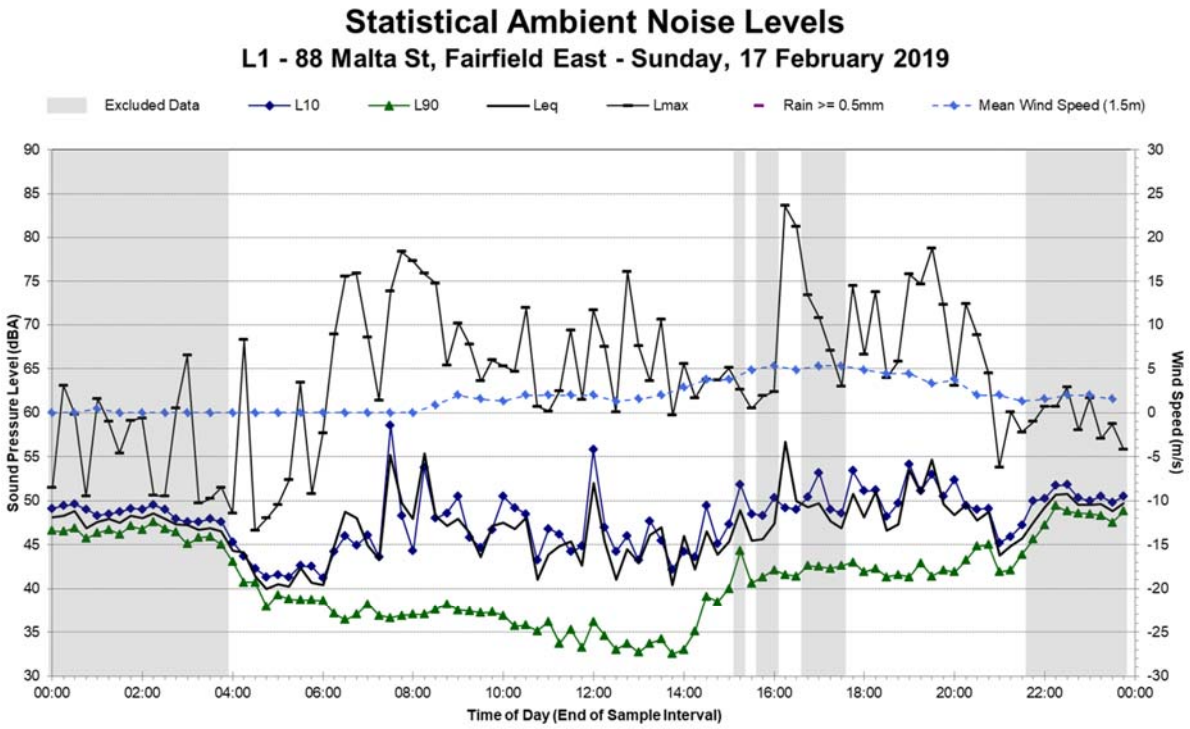
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L1 - 88 Malta St, Fairfield East - Sunday, 17 February 2019
Excluded Data
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Leq
Lmax
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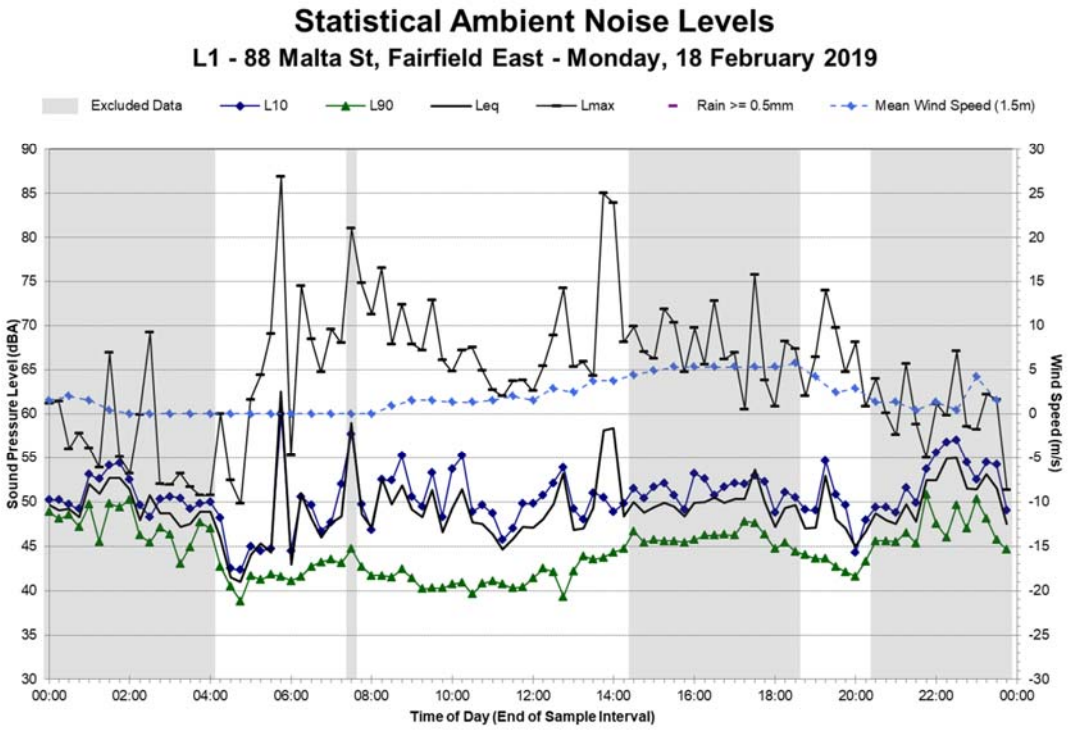
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L1 - 88 Malta St, Fairfield East - Monday, 18 February 2019
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Lmax
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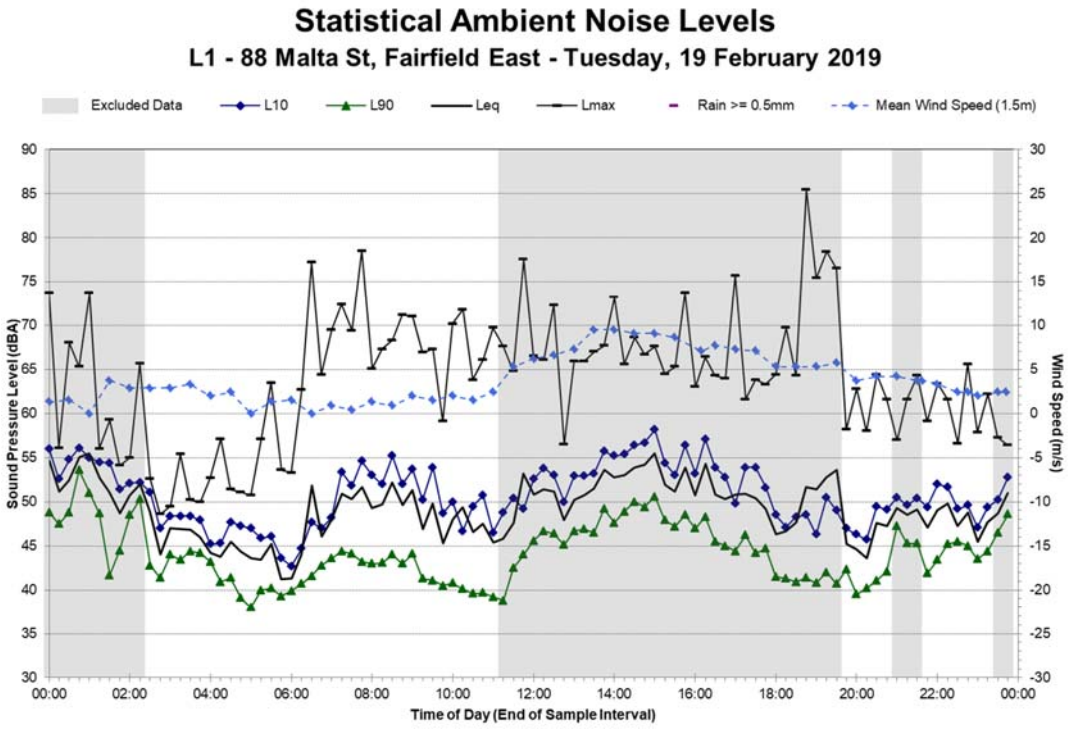
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
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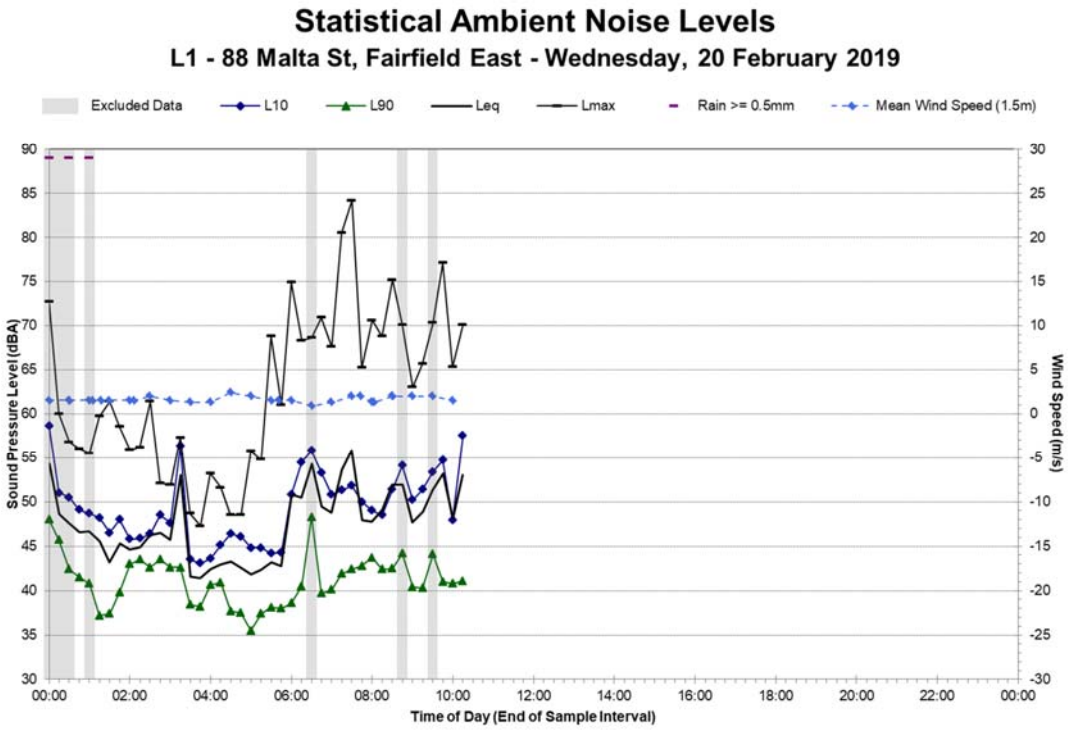
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)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L1 - 88 Malta St, Fairfield East - Wednesday, 20 February 2019
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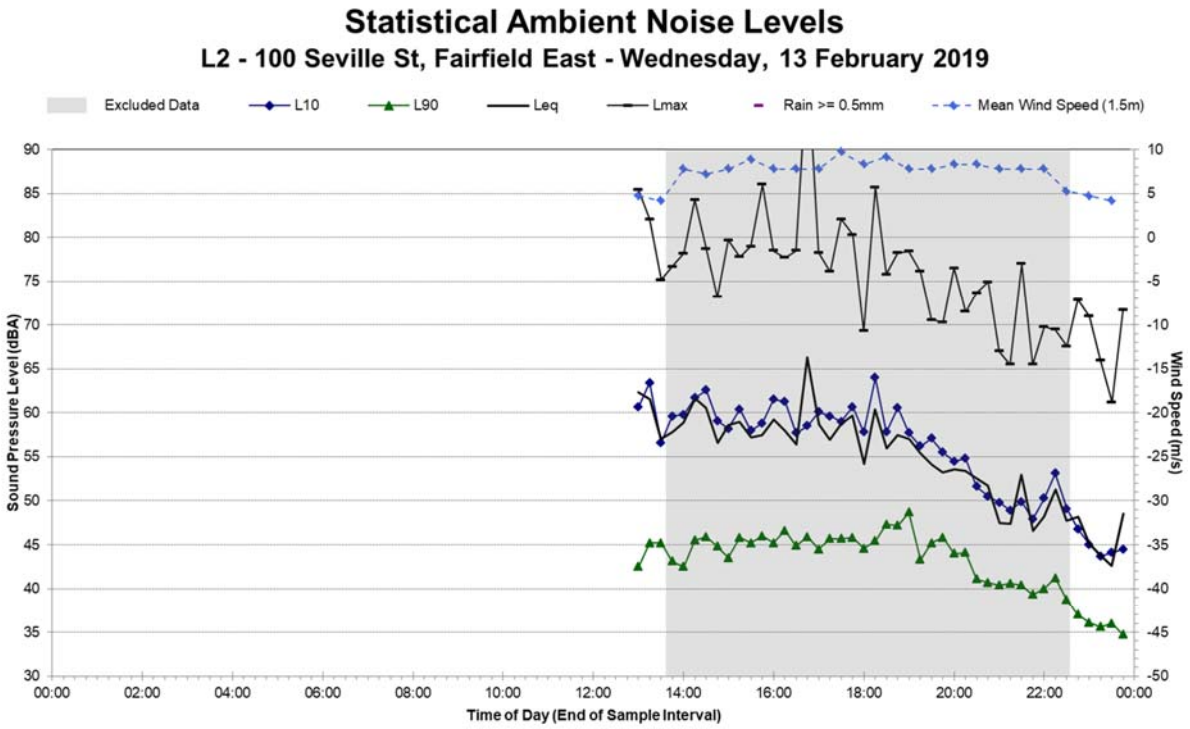
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L2 - 100 Seville St, Fairfield East - Wednesday, 13 February 2019
Excluded Data
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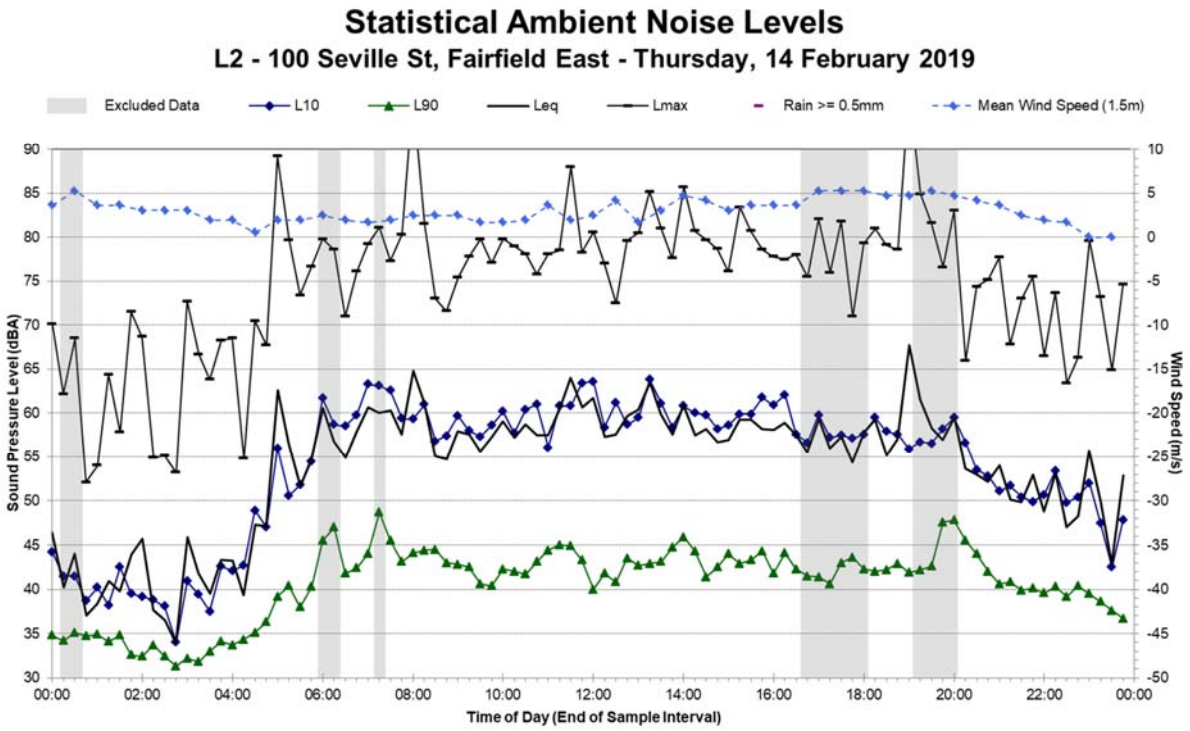
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L2 - 100 Seville St, Fairfield East - Thursday, 14 February 2019
Excluded Data
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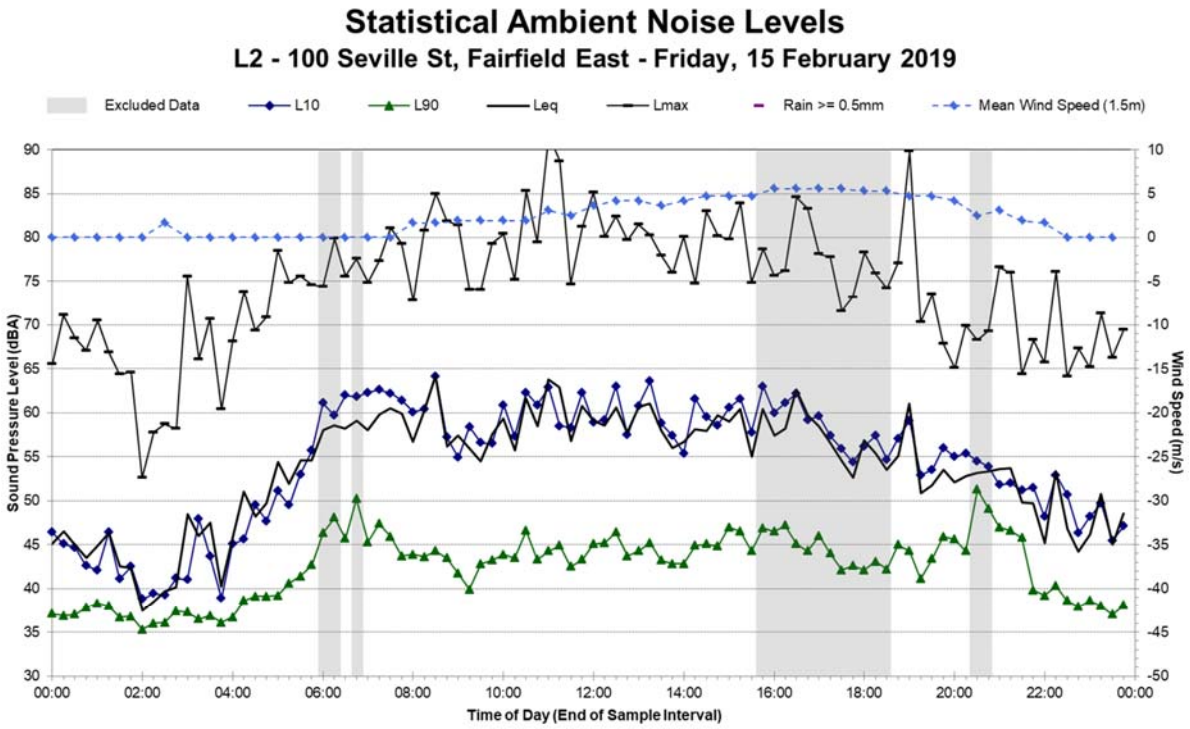
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L2 - 100 Seville St, Fairfield East - Friday, 15 February 2019
Excluded Data
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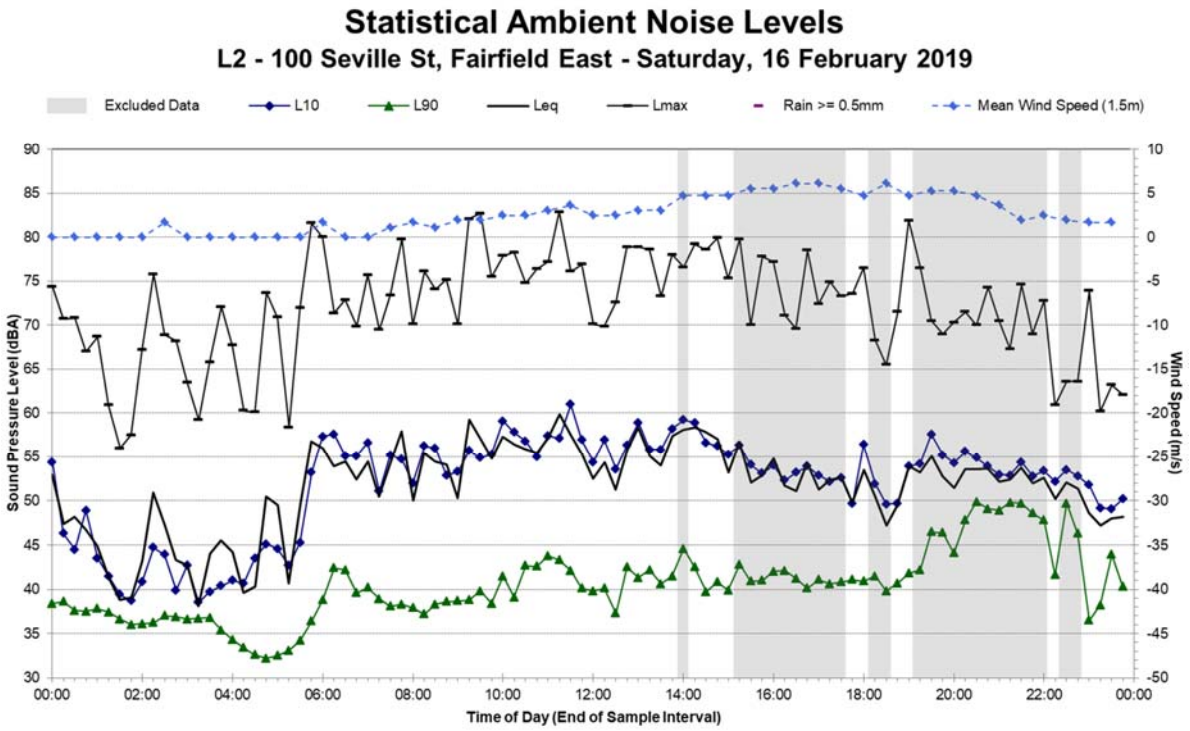
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


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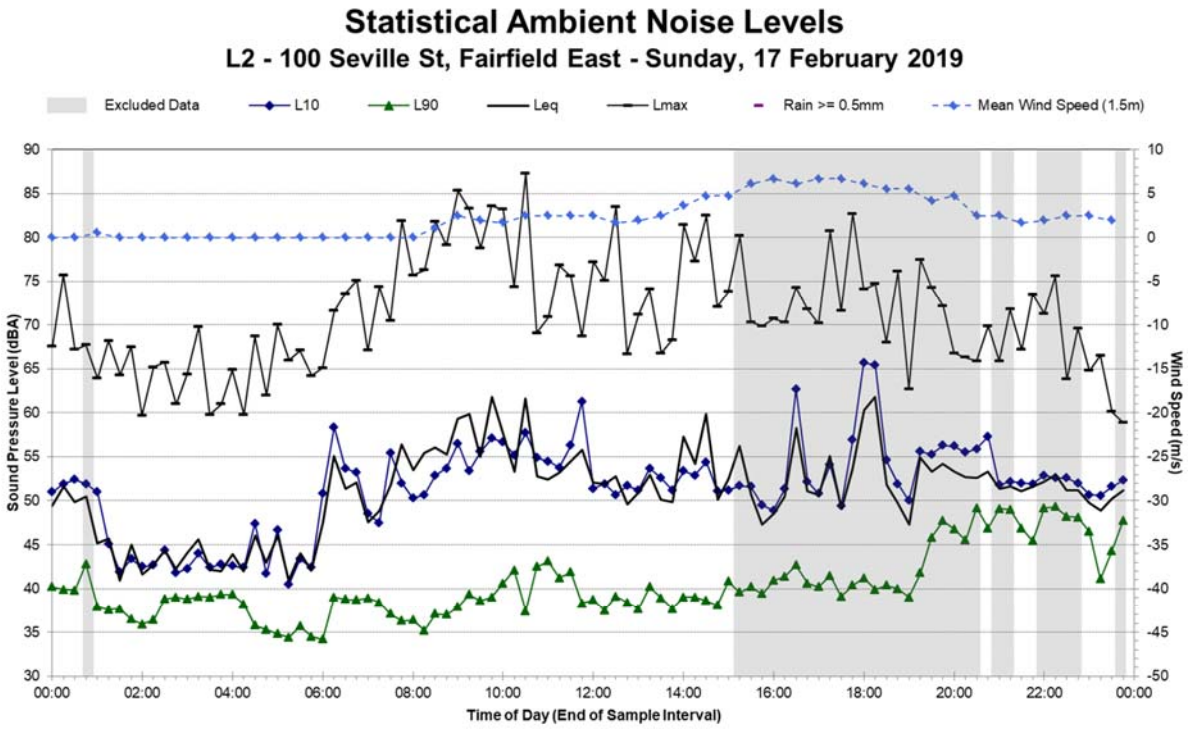
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)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Wind Speed (m/s)
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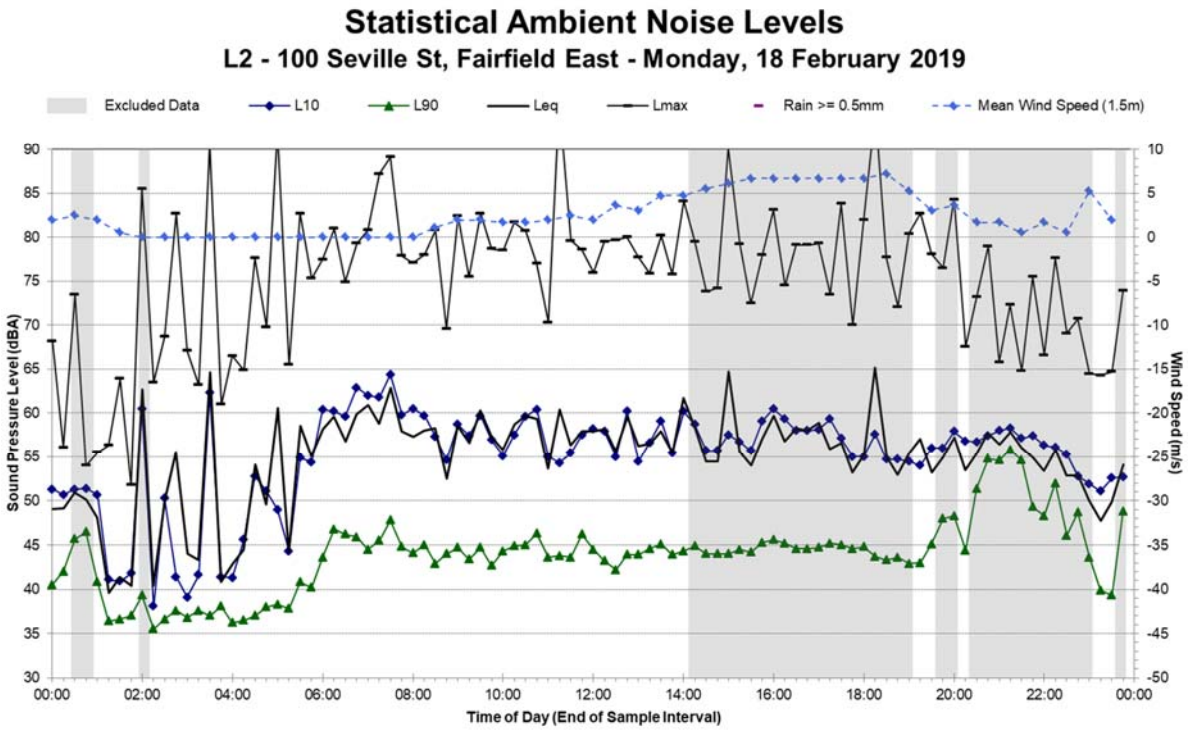
Statistical Ambient Noise Levels
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Excluded Data
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Lmax
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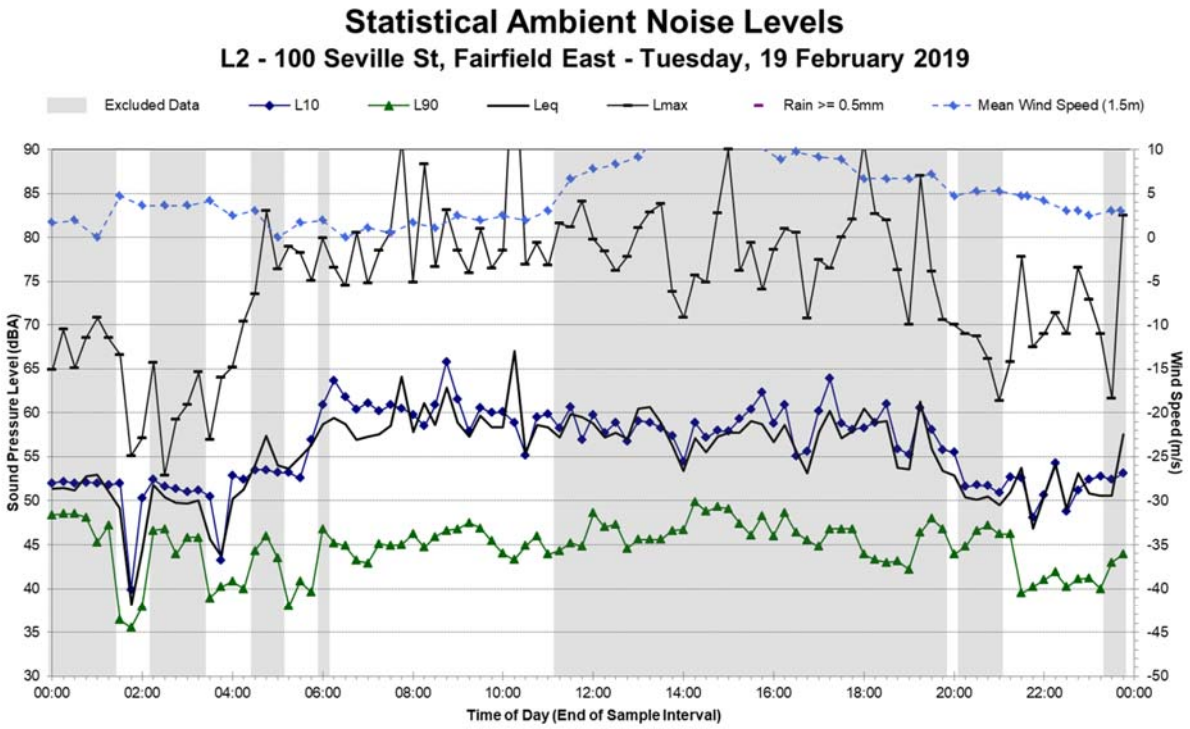
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)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Mean Wind Speed (1.5m)
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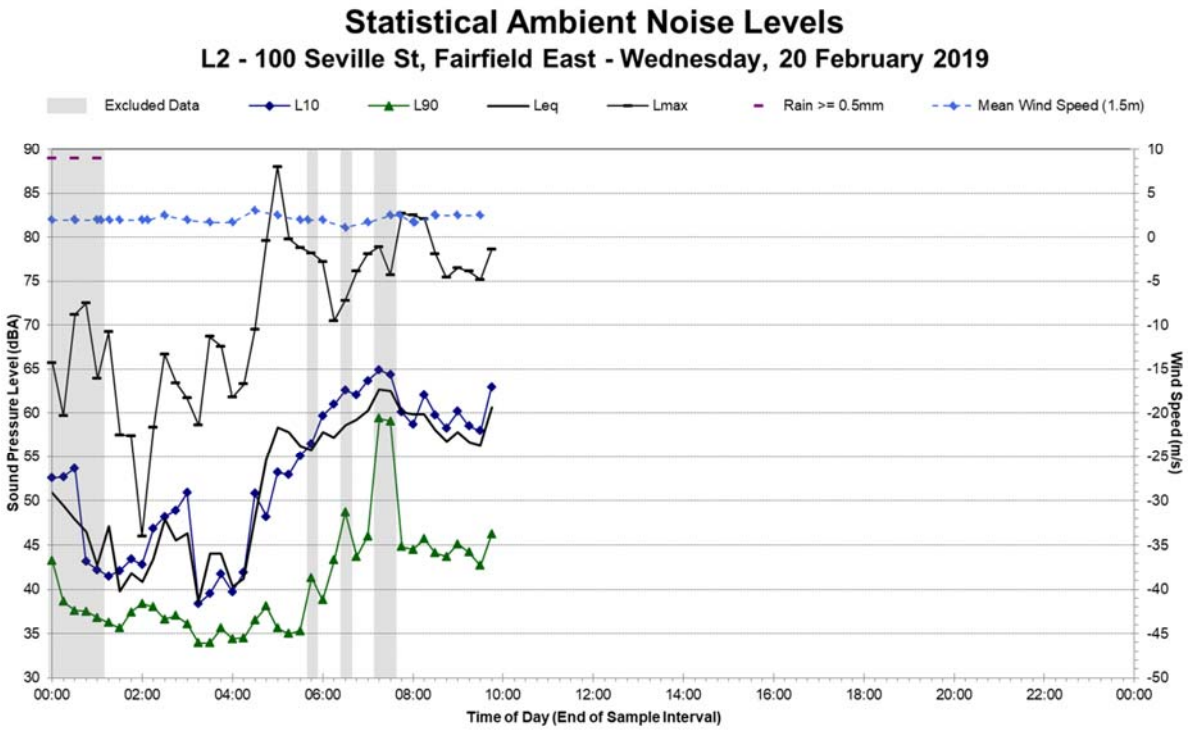
Time of Day (End of Sample Interval)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