16 CHAPMAN STREET, WERRINGTON

Precinct Subdivision
Noise Impact Assessment - Development Application

Prepared for:

GLN Planning Pty Ltd
Level 10, 70 Pitt Street
SYDNEY NSW 2000

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BASIS OF REPORT

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1 Introduction

SLR Consulting Australia Pty Ltd (SLR) has been engaged by GLN Planning to undertake a noise impact assessment in relation to the proposed subdivision of 16 Chapman Street, Werrington (the Precinct).

The proposal includes residential dwellings in the northern two-thirds of the site with the southern portion of the site being proposed to be subdivided into light industrial lots, as shown below in **Figure 1** and **Figure 2**.

1.1 Scope of this Report

The aims of this assessment are to:

- Identify existing sources of noise at the site and potentially affected sensitive receivers
- Summarise the findings of existing noise surveys completed in the area
- Summarise the construction noise and operational noise impact assessment of the proposal
- Identify feasible and reasonable noise mitigation and management measures to be incorporated in the detailed design and construction planning stage of the proposal.

1.2 Noise Sources Potentially Impacting on the Precinct

Noise sources that have the potential to impact on the proposal include:

- **Rail noise** from the existing T1 Western Line. The T1 Western Line is located to the immediate north of the Precinct. Werrington Station is to the east of the Precinct and Kingswood Station is to the west. This existing line has both passenger and freight services during the daytime and night-time periods.
- **Road traffic** noise from the Great Western Highway. The Great Western Highway is the busiest road near the Precinct. It is, however, over 450 m to the south of the Precinct, meaning road traffic noise impacts are unlikely.

  As part of the redevelopment of the Precent, several internal roads would be constructed as shown in **Figure 2**. These roads are assumed to be local roads with low volumes of traffic that would not significantly affect nearby receivers, except for the east-west road which services the industrial units which has been included in the assessment.
- **Industrial noise** from new industrial areas within the Precinct. There is also potential for noise from mechanical plant at the various residential areas of the Precinct (such as air conditioners).
  - At this early stage in the proposal, the industrial uses of the Precinct are not defined but could include uses such as vehicle repair stations, warehouse distribution centres, resource recovery facilities, etc. Depending on the final use, there is potential for impacts from mechanical plant, warehouse noise, car parking movements, truck deliveries, etc, on nearby receivers.

1.3 Terminology

This report uses specific acoustic terminology. A glossary is provided in **Appendix A**.

Figure 1 Proposed Subdivision

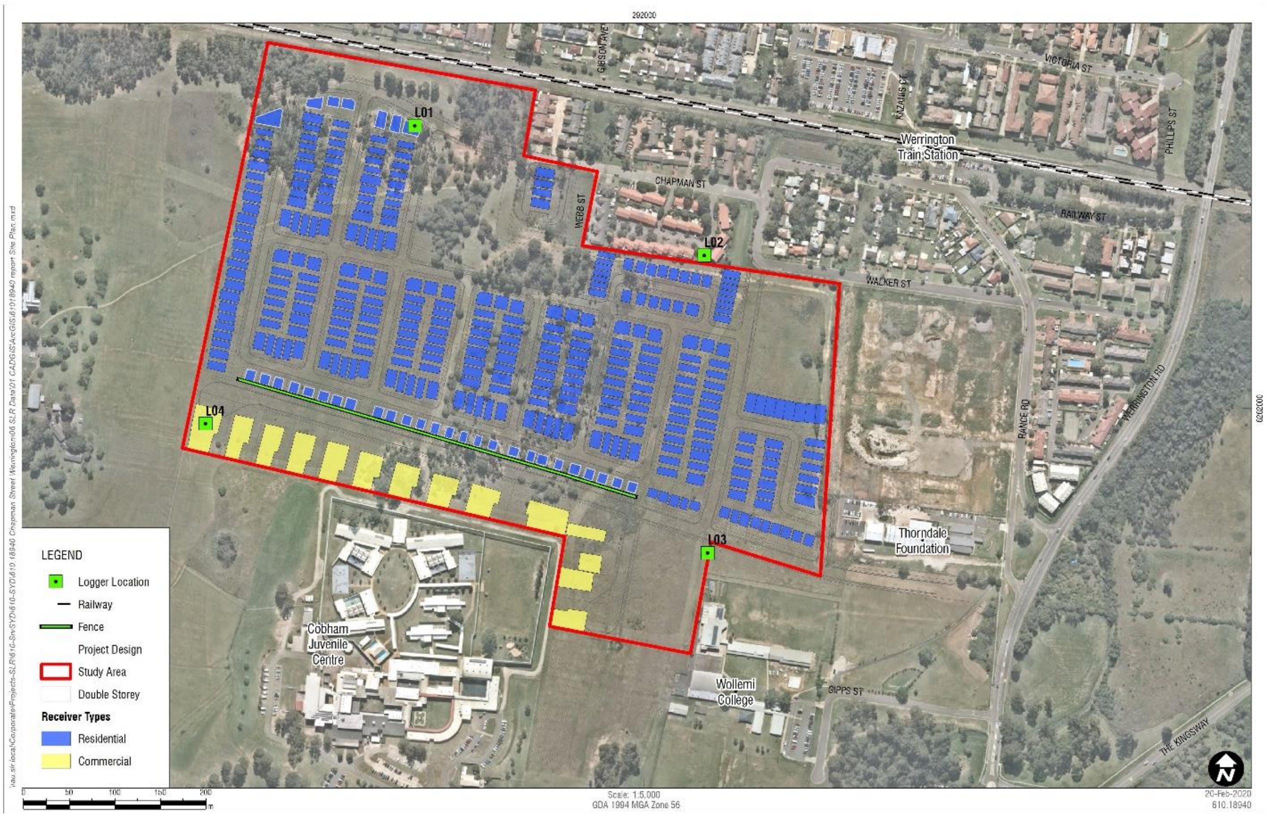
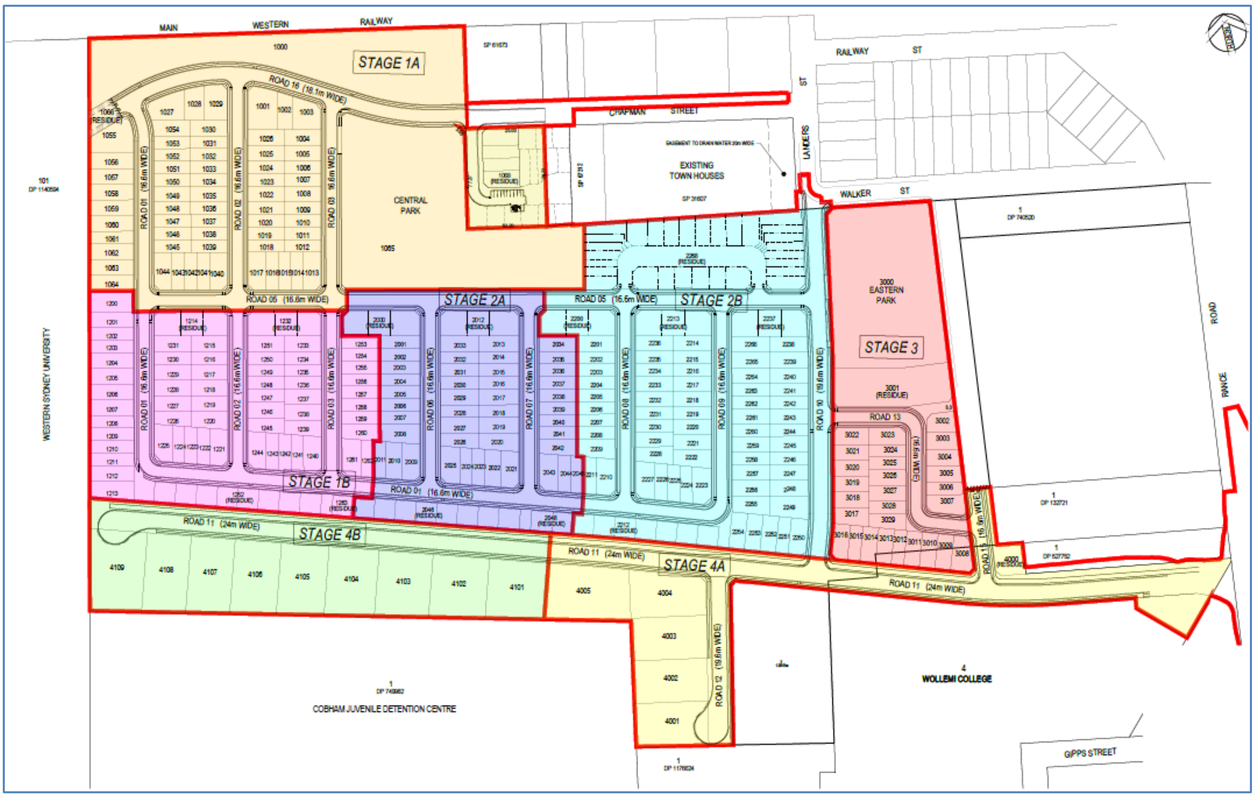


Figure 2 Proposed Site Layout



2 Existing Environment

The existing noise environment at the site is controlled by general environmental noise, train passbys in the northern portion of the site and distant road traffic noise from the surrounding road network. The nearest major road is the Great Western Highway, which is 450 m to the south of the Precinct.

The southern portion of the site is also affected to a lesser degree by noise from Wollemi College and Cobham Juvenile Centre, which includes occasional bells and PA announcements.

2.1 Unattended Ambient Noise Monitoring

Unattended noise monitoring was completed at the site in June and July 2019. The measured noise levels have been used to determine the existing noise environment and to set operational criteria for noise from the future industrial uses at the site.

The noise monitoring equipment continuously measured existing noise levels in 15-minute periods during the daytime, evening and night-time. All equipment carried current National Association of Testing Authorities (NATA) calibration certificates and the calibration was checked before and after each measurement.

The noise monitoring data has been processed to exclude noise from extraneous events and/or data affected by adverse weather conditions, such as strong wind or rain.

A summary of the ambient noise monitoring is provided in **Table 1** and the locations are shown in **Figure 1**.

Table 1 Summary of Existing Ambient Noise Levels

Location	Address	Measured Noise Levels (dBA)					
		Background Noise (RBL)			Average Noise (L_{Aeq})		
		Day	Evening	Night	Day	Evening	Night
L.01	16 Chapman Street, Werrington	39	43	36	55	56	54
L.02	15/4-12 Chapman Street, Werrington	37	44	37	57	48	46
L.03	16 Chapman Street, Werrington (Wollemi College)	38	46	39	51	50	48
L.04[1]	16 Chapman Street, Werrington	38	44	37	48	48	46

Note 1: Logger L.04 was observed to drift greater than 2 dB during the monitoring survey period. The logger data is presented as indicative only and has not been used in the assessment.

Details of each monitoring location together with graphs of the measured daily noise levels are in **Appendix B**.

2.2 Attended Noise Monitoring

Short-term attended noise monitoring was completed on Thursday 27 June 2019 and Monday 8 June 2019. The attended measurements allow the contributions of the various noise sources at each location to be determined. Detailed observations from the attended measurements are provided in **Appendix B**.

3 Criteria

3.1 Airborne Road and Rail Noise

The NSW Government's State Environmental Planning Policy (Infrastructure) 2007 (the SEPP) was introduced to aid the delivery of infrastructure across the State.

In accordance with the SEPP, Table 3.1 of the NSW Department of Planning and Infrastructure's *Development near Rail Corridors and Busy Roads – Interim Guideline* (the DP&I Guideline), provides noise criteria for residential and non-residential buildings. These criteria are summarised in **Table 2**.

Table 2 DP&I Interim Guideline Noise Criteria

Residential Buildings		
Type of Occupancy	**Noise Level (dBA)**	**Applicable Time Period**
Sleeping areas (bedroom)	35	Night 10 pm to 7 am
Other habitable rooms (excl. garages, kitchens, bathrooms & hallways)	40	At any time
Non-Residential Buildings		
Type of Occupancy		**Recommended Max Noise Level (dBA)**
Educational Institutions including Child Care Centres		40
Places of Worship		40
Hospitals	Wards	35
	Other Noise Sensitive Areas	45

Note 1: Airborne noise is calculated as $L_{Aeq(15hour)}$ daytime and $L_{Aeq(9hour)}$ night-time.

If internal noise levels with windows or doors open exceed the above criteria by more than 10 dB, then a natural ventilation path from a non-noise affected facade or forced ventilation system for the habitable rooms may be necessary to allow residents to leave windows closed during noisy periods.

It is generally accepted that internal noise levels in a dwelling are 10 dB lower than external noise levels with the windows open, and 20 dB lower than external noise levels with the windows closed and standard glazing.

As the noise model predicts external noise levels, the internal noise goals have been adjusted by 10 dB for open windows and 20 dB for closed windows and standard glazing to provide external noise goals. The external noise goals applicable for the proposal are provided in **Table 3**.

Table 3 External Noise Goals Applicable to the Proposal

Type of Occupancy		External Noise Goals (dBA)[1,2]		Applicable Time Period
		Windows Open	Windows Closed	
Residential Buildings[3]				
Sleeping areas (bedrooms)		45	55	Night-time (10:00 pm to 7:00 am)
Other habitable rooms (excluding garages, kitchens, bathrooms and hallways)		50	60	At any time
Non-Residential Buildings				
Educational institutions including childcare centres		50	60	Whenever in use
Places of worship		50	60	Whenever in use
Hospitals	- Wards	45	55	Whenever in use
	- Other noise sensitive areas	55	65	Whenever in use

Note 1: Airborne noise is calculated as $L_{Aeq(15hour)}$ for the daytime and $L_{Aeq(9hour)}$ for the night-time.

Note 2: External noise goals are applicable 1 m from the external facade of a habitable room.

Note 3: These noise goals apply to all forms of residential buildings as well as aged care and nursing home facilities.

Where road/rail noise levels exceed the ‘windows open’ criteria, residential receivers will require windows and doors to be closed and alternative ventilation arrangements must therefore be provided.

Where road/rail noise levels exceed the ‘windows closed’ criteria, upgraded building/facade construction may be required, along with the alternative ventilation.

3.2 Industrial Noise Criteria

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

3.2.1 Trigger Levels

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

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

For this assessment, the area surrounding the proposal is considered to be ‘suburban’.

3.2.2 Project Specific Criteria

The noise emission trigger levels for noise from the future industrial uses of the Precinct are provided in **Table 4** The project noise trigger level is the lowest value of the intrusiveness or amenity noise level for each period and these are shown below in bold.

Table 4 Project Specific Nosie Trigger Levels

Monitoring Location	Period	Representative Noise Logger	Recommended Amenity Noise Level $L_{Aeq(period)}$	Measured Noise Level (dBA)		Project Noise Trigger Levels $L_{Aeq(15minute)}$ (dBA)	
				RBL[1]	$L_{Aeq(period)}$	Intrusiveness	Amenity[2,3]
1	Daytime	L01	55	39	55	**44**	53
	Evening	L01	45	39 (43 actual)	56	**44**	44[4]
	Night-time	L01	40	36	54	**41**	42[4]
2	Daytime	L02	55	37	57	**42**	53
	Evening	L02	45	37 (44 actual)	48	**42**	43
	Night-time	L02	40	37	46	42	**38**
3	Daytime	L03	55	38	51	**43**	53
	Evening	L03	45	38 (46 actual)	50	**43**	43
	Night-time	L03	40	38 (39 actual)	48	43	**38**

Note 1: RBL = Rating Background Level. In accordance with the NPfI, evening and night-time RBLs are taken to be no higher than the daytime for the purpose of setting the corresponding Intrusiveness criteria.

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

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

Note 4: Project amenity level was set at 15 dB below the existing road traffic noise level, as outlined in the NPfI.

3.3 Construction Noise

3.3.1 NSW Interim Construction Noise Guideline

The NSW *Interim Construction Noise Guideline* (ICNG) is used to assess and manage impacts from construction noise on residences and other sensitive land uses in NSW.

The ICNG contains procedures for determining project specific Noise Management Levels (NMLs) for sensitive receivers based on the existing background noise in the area. The 'worst-case' noise levels from construction of a project are predicted and then compared to the NMLs in a 15-minute assessment period to determine the likely impact of the project.

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

Residential Receivers

The ICNG approach for determining NMLs at residential receivers is shown in **Table 5**.

Table 5 ICNG NMLs for Residential Receivers

Time of Day	NML $L_{Aeq(15minute)}$	How to Apply
Standard hours Monday to Friday 7:00 am to 6:00 pm Saturday 8:00 am to 1:00 pm No work on Sundays or public holidays	RBL + 10 dBA	• The noise affected level represents the point above which there may be some community reaction to noise. • Where the predicted or measured LAeq(15minute) is greater than the noise affected level, the proponent should apply all feasible and reasonable work practises to meet the noise affected level. • The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75 dBA	• The highly noise affected level represents the point above which there may be strong community reaction to noise. • Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restructuring the hours that the very noisy activities can occur, taking into account: • Times identified by the community when they are less sensitive to noise (such as before and after school for works near schools or mid-morning or mid-afternoon for works near residences. • If the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	RBL[1] + 5 dBA	• A strong justification would typically be required for works outside the recommended standard hours. • The proponent should apply all feasible and reasonable work practices to meet the noise affected level. • Where all feasible and reasonable practises have been applied and noise is more than 5 dBA above the noise affected level, the proponent should negotiate with the community.

Note 1: The RBL is the Rating Background Level and the ICNG refers to the calculation procedures in the NSW *Industrial Noise Policy* (INP). The INP has been superseded by the NSW EPA *Noise Policy for Industry* (NPfI).

Summary of Residential NMLs

The residential NMLs for the project have been determined using the results from the unattended existing noise monitoring (see **Section 2**) and are shown in **Table 6**.

Table 6 Residential Receiver Construction Noise Management Levels

NCA	Representative Background Monitoring Location	Noise Management Level ($L_{Aeq(15minute)}$ – dBA)			
		Standard Construction (RBL +10 dB)	Out of Hours (RBL +5 dB)		
		Daytime	Daytime[1]	Evening [2]	Night-time[2]
L.01	16 Chapman Street, Werrington	49	44	44	41
L.02	15/4-12 Chapman Street,	47	42	42	42
L.03	16 Chapman Street, Werrington	48	43	43	43
L.04	16 Chapman Street, Werrington	48	43	43	42

Note 1: Daytime out of hours is 7 am to 8 am and 1 pm to 6 pm on Saturday, and 8 am to 6 pm on Sunday and public holidays.

Note 2: In accordance with the NPfI, evening and night-time RBLs are taken to be no higher than the daytime for the purpose of setting the corresponding NML

'Other Sensitive' Land Uses and Commercial Receivers

'Other sensitive' land uses include receivers such as educational institutes, medical facilities, outdoor recreational areas and commercial properties. The ICNG NMLs for 'other sensitive' receivers are shown in **Table 7**.

Table 7 ICNG NMLs for 'Other Sensitive' Receivers

Land Use	Noise Management Level $L_{Aeq(15minute)}$ (Applied when the property is in use)
Classrooms at schools and other education institutions	Internal noise level 45 dBA[1]
Hospital wards and operating theatres	Internal noise level 45 dBA[1]
Places of Worship	Internal noise level 45 dBA[1]
Active recreation areas (characterised by sporting activities and activities which generate their own noise or focus for participants)	External noise level 65 dBA
Passive recreation areas (characterised by contemplative activities that generate little noise and where benefits are compromised by external noise intrusion)	External noise level 60 dBA
Community centres	Refer to the recommended 'maximum' internal levels in AS 2107 for specific uses
Commercial	External noise level 70 dBA

Note 1: The criteria are specified as an internal noise level for this receiver category.

4 Impact Assessment

A computer noise model was developed to predict road and rail noise levels across the proposed Precinct. SoundPLAN has been used and is a software package which allows noise predictions to be made in a 3D environment and includes a digitised ground map including the future earthworks topography of the site, the location and acoustic power levels of significant noise sources, and the location of noise-sensitive receivers.

At this early stage in the project, the design of the residential dwellings in the Precinct is not finalised. Indicative building sizes have therefore been used in the model as follows:

- All dwellings have been assumed to be single storey except the northern-most lots which face the rail corridor in the north west portion and the southern lots which adjoin the industrial area, which are double storey as shown in **Figure 1**.
- A 1.8 m boundary fence has also been included on the top of the retaining wall in this location, which is also shown in **Figure 1**.

4.1 Rail Noise

Existing rail noise levels have been predicted in the subdivision during the daytime and night-time periods. The results of the predictions are provided in **Figure 3** as grid noise maps that represent the predicted existing noise level at 1.5 m above ground level.

The daytime noise predictions represent the period from 7 am to 10 pm and the night-time period is 10 pm to 7 am.

Figure 3 Existing Rail Noise – Daytime and Night-time Grid Noise Maps

The results show that existing rail traffic noise levels are generally limited to the northern area of the Precinct. The nearest buildings to the rail line are of residential use and are predicted to have noise levels in the region of 59 dBA during the daytime and 57 dBA during the night-time.

The highest noise levels are however limited to the residential lots in the north western portion of the subdivision, with noise levels in the rest of the site being considerably lower due to increased separation distance and intervening shielding provided by other buildings.

Residential buildings on the rows further back from the rail alignment are predicted to be subject to noise levels of around 50 to 55 dBA during the daytime and 45 to 50 dBA during the night-time, depending on angle of view to the rail.

4.2 Road Traffic Model

Road traffic noise levels have been predicted across the proposed subdivision during the daytime and night-time periods. The results are provided below in **Figure 4** as grid noise maps that represent the predicted existing road traffic noise levels at 1.5 m above ground level.

The daytime noise predictions represent the period from 7 am to 10 pm and the night-time period is 10 pm to 7 am.

Figure 4 Existing Road Traffic Noise – Daytime and Night-time Grid Noise Maps

The nearest residential lots in the Precinct are over 450 m from the Great Western Highway and are generally shielded by the industrial uses on the southern boundary. As a result, noise levels at the nearest residential receivers in the Precinct are predicted to be less than 50 dBA during the daytime and less than 45 dBA during the night-time, and compliant with the criteria in **Table 3**.

Road traffic noise levels due to the internal east-west road are predicted to be around 55 dBA during the daytime and 50 dBA during the night-time at the adjacent residential lots to the north.

4.3 Industrial Noise

The future uses of the industrial area are not defined at this early stage of the project but could include light industrial uses such as vehicle repair stations, warehouse distribution centres, resource recovery facilities, etc.

Indicative noise modelling to determine the potential industrial noise impacts has been completed using the following assumed sources of noise in the worst-case 15-minute period:

- A truck delivery for 50% of the industrial lots, with reversing beepers for three of the trucks
- A roller shutter door opening, one forklift and people speaking in the hardstand area for each lot
- It is assumed the industrial uses only operate during daytime hours.

4.3.1 Predicted Industrial Noise Levels

The predicted industrial noise impacts across the Precinct are shown in **Figure 5**. The left image shows the predicted 15-minute noise level at each receiver and the right image shows receivers which are predicted to exceed the most stringent NPfI daytime criteria of 42 dBA (see **Table 4**).

Figure 5 Industrial Noise Impacts – Daytime

The above shows that the worst-case noise levels are predicted to be up to approximately 55 dBA for the facades of lots which overlook or have line of sight to the industrial area, which exceeds the 42 dBA daytime criteria.

While exceedances of the criteria are predicted due to industrial noise, it is noted that the calculations are indicative and are based on several assumptions. The potential for industrial noise impacts would be further investigated when detailed assessments are completed at the Development Application stage for each industrial lot.

4.4 Rail Vibration

The nearest lots in the north western portion of the site are over 60 m away from the rail corridor, which is considered sufficient for impacts from rail vibration to be unlikely.

4.5 Construction Noise

At this early stage in the project the construction methodology and equipment required to complete the works have not been finalised. The following typical construction equipment, shown in **Table 8**, are considered likely to be used however should be confirmed during the later design stage.

The table includes typical Sound Power Levels associated with each item. Also included are the predicted noise levels at typical offset distances. These distances are representative of the typical offset distances between the construction works and nearest receiver.

Table 8 Construction Scenarios and Equipment

Equipment	Used for	LAeq Sound Power Level (dBA)	LAeq Noise Levels at Offset Distance (dBA)			
			10 m	20 m	50 m	100 m
20t Excavator	Bulk excavation, clearing and grubbing	99	71	65	57	51
Air compressor + attachments	Hand tools and minor demolition work	93	65	59	51	45
Articulated dump truck	Cart materials within site	100	72	66	58	52
Backhoe trenching	Move small amounts of materially locally	103	75	69	61	55
Bobcat	Minor detailed excavation and filling	104	76	70	62	56
Bulk cement carrier	Delivery of bulk cement	103	75	69	61	55
Cherry picker	Services relocation work	97	69	63	55	49
Cold miller	Profiling existing pavements	111	83	77	69	63
Concrete agitator truck	Delivery of small batches of concrete	107	79	73	65	59
Crane	Bridge and general lifting works	106	78	72	64	58
Dozer (small)	Stockpile management and ripping	112	84	78	70	64
Lighting tower	Night work (if required)	77	49	43	35	29
Plate compactor	Minor compaction work	108	80	74	66	60
Rock breaker	Demolition work	121	93	87	79	73
Roller smooth and pad-foot	Compaction of sub-base and base materials	100	72	66	58	52
Semitrailer	Delivery of materials to site	103	75	69	61	55
Slipform paving machine	For laying concrete base	104	76	70	62	56
Trencher	Installation of services and sub-soil drainage	102	74	68	60	54
Vacuum suction truck	Potholing	100	72	66	58	52

The nearest potentially affected receivers are existing residential receivers located around 10 to 50 m to the north and east of the Precinct, along with Cobham Juvenile Centre and Wollemi College to the south. The above shows that for the majority the construction equipment, the worst-case noise levels are likely to be in the range of 50 dBA to 85 dBA when equipment is operating adjacent to these receivers.

The worst-case noise levels would occur during works which use highly noise intensive equipment such as rock-breakers. Works involving less noisy items would result in considerably lower impacts.

In relation to the daytime residential NMLs in this area of 47 to 49 dBA at L01 and L02 respectively (see **Table 6**), together with the appropriate criteria for educational receivers (see **Table 7**) it is likely that exceedances will be apparent when construction works are located within close proximity of the nearest receivers.

5 Mitigation and Recommendations for Impacts

5.1 Operational Impacts

The residential receivers which are located close to sources of transportation noise will likely be affected by noise impacts and noise mitigation measures will need to be incorporated into the design of the site.

5.1.1 Noise Barriers

Noise barriers can be an effective way to reduce road or rail noise impacts. A noise barrier could potentially be considered in the north west portion of the Precinct, however it is noted that the rail line is on embankment in this area (and therefore elevated with respect to the surrounding ground), meaning a large height barrier would be required to effectively block line of sight. The length of the barrier would also be limited to the boundary of the Precinct and noise would still impact the site from the west, meaning the barrier would likely be ineffective.

For these reasons, a noise barrier in this location is unlikely to be considered appropriate and has not been considered further.

5.1.2 Precinct Layout

The layout of the Precinct should be configured to locate less noise sensitive usages near to major source of noise, where possible. The subdivision layout shows industrial uses in the south, which provides shielding from the Great Western Highway and the juvenile centre to the rest of the site. A buffer zone is also provided to the north of the industrial areas via the internal site road which provides a separation distance to the nearest residential dwellings. An internal site road is also used to provide separation from the nearest receivers to the rail corridor.

Larger, high density residential apartment buildings can also be used close to sources of transportation noise to act as noise barriers to shield lower density residential areas behind. Where structures are used to provide shielding to internal areas of the Precinct, the use of multi-storey buildings of at least two storeys provides the most benefit.

The effect of this principle is shown below in **Figure 6** and **Figure 7**. The first image illustrates how uninterrupted noise levels can propagate across a site, whereas the second image illustrates the effect of intervening structures. The comparison shows that significantly lower noise levels can be achieved if acoustic considerations are appropriately applied to the site layout early on in a project.

Figure 6 Cross Sectional Noise Map – Without Intervening Structures

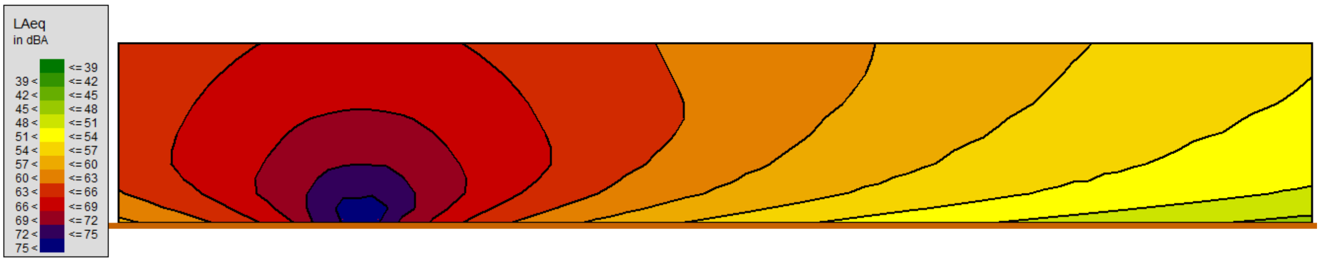
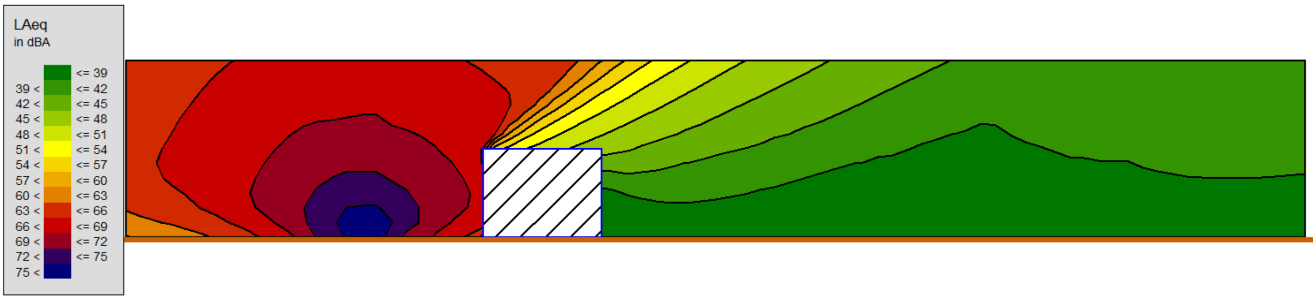


Figure 7 Cross Sectional Noise Map – With Intervening Structures



The current layout has double storey buildings in the north western portion of the site (see **Figure 1**), which help to mitigate noise levels to the rest of the site.

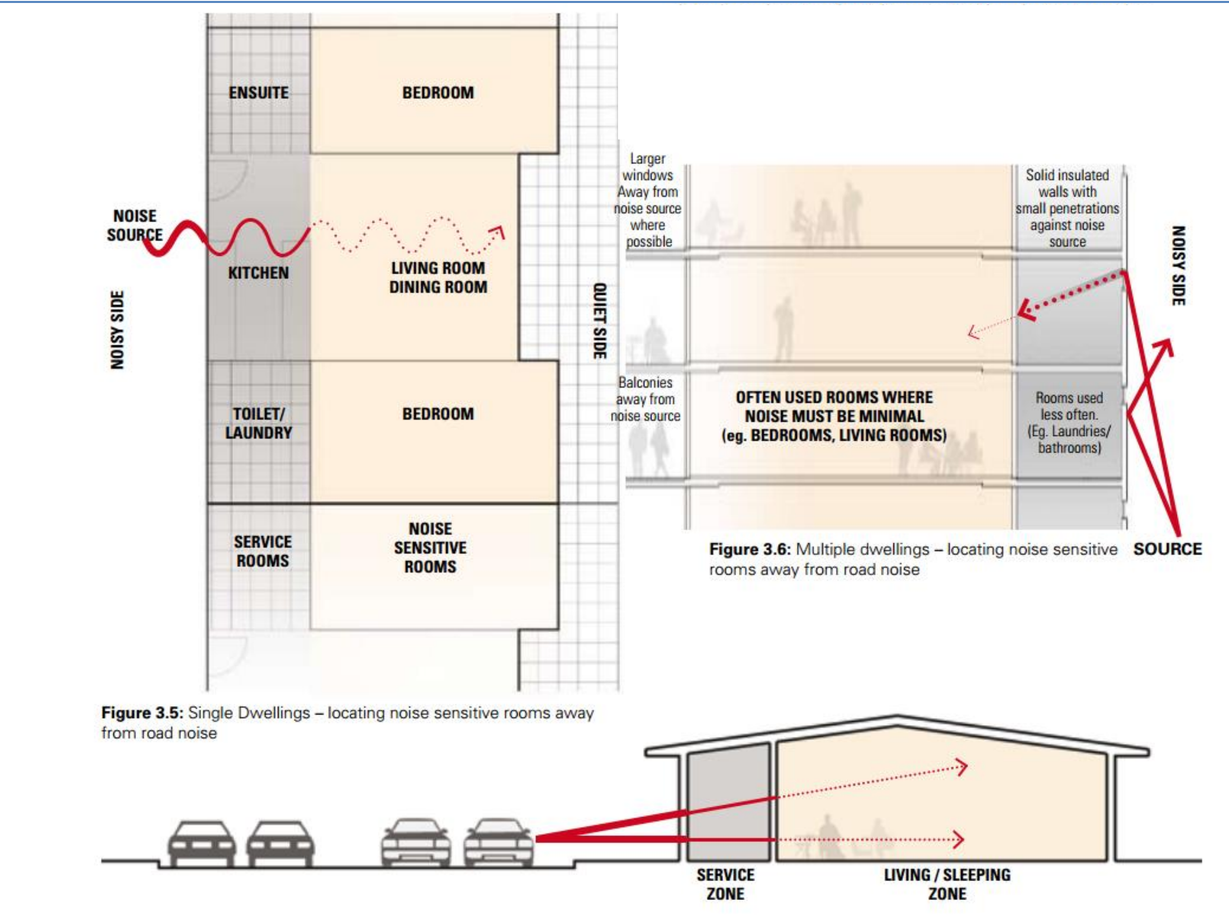
The facades of buildings used as barriers which face sources of noise should incorporate noise mitigation principles into their building design, such as locating less sensitive usages on the most noise exposed facades, to ensure appropriate internal noise conditions. This is further discussed in the following section.

5.1.3 Internal Layout of Buildings

Where residential buildings are required to be located close to sources of transportation noise, the layout of the buildings can be optimised to minimise noise intrusion into sensitive areas. Buildings can be constructed so that noise insensitive areas such as kitchens, storage areas and laundries are located closer to the noise source.

An example of how residential buildings can be designed to shield sensitive sleeping and living areas is shown in **Figure 8**.

Figure 8 Examples of Design Orientation and Room Layout



Note: Taken from DP&I *Development near Rail Corridors and Busy Roads – Interim Guideline*.

5.1.4 Upgraded Facades and Mechanical Ventilation – At-Property Treatment

Where residual impacts remain after the optimisation of site layout and building design, the upgrading of facade elements of noise affected sensitive spaces can be used as a final mitigation approach to achieve appropriate internal noise levels.

Examples include using masonry external facades on the most exposed facades and reducing the number of windows to minimise noise intrusion into sensitive areas.

Where residential buildings are required to be located near to the existing rail line, it is likely that increased facade and/or glazing performance would be required due to relatively high external noise levels. Mechanical ventilation would also be required in certain locations so that residents are able to keep windows closed during noisy periods, whilst maintaining adequate air flow.

Rail Noise

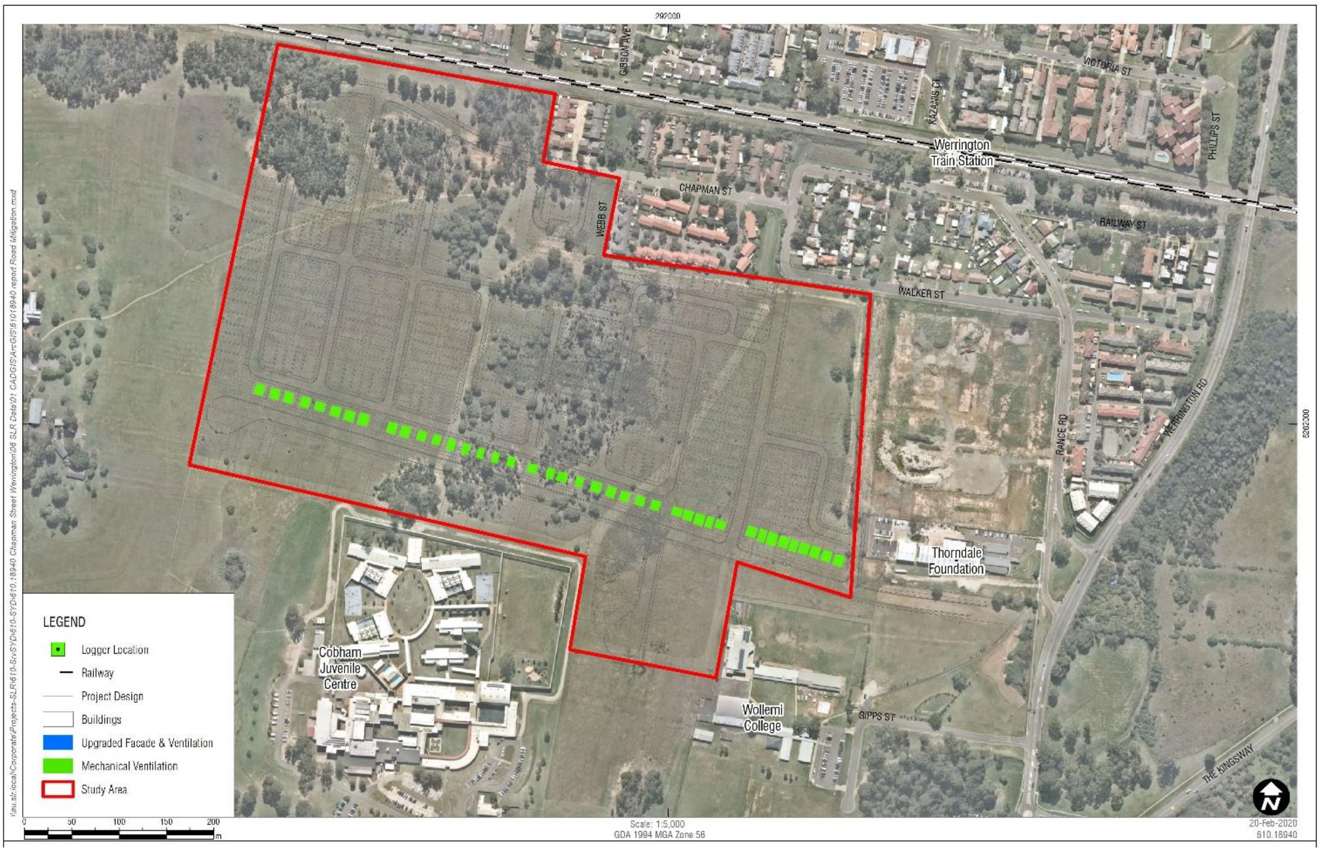
The indicative requirements for upgraded facades and mechanical ventilation due to existing rail noise, assuming no noise barriers are installed, are shown in **Figure 9**.

Figure 9 Indicative Locations for Upgraded Facades and Mechanical Ventilation – Existing Rail Noise

Road Noise

The indicative requirements for upgraded facades due to road traffic noise from the internal east-west road are shown in **Figure 10**.

Figure 10 Indicative Locations for Upgraded Facades and Mechanical Ventilation – Road Noise



Indicative Specifications

Noise ingress generally involves several pathways and is most common via the windows, doors, ventilation openings and roofs. The overall sound reduction of a building element is dependent upon the mass of the construction, the effective area and the extent of any gaps or openings. Glazing on facades exposed to transportation noise usually represents the weak acoustic link in the building construction.

The following typical noise reductions in **Table 9** are likely to be required for the lots identified as requiring at-property treatment, based on typical facade, window and room sizings.

It is noted that this information should be regarded as indicative and the extent of treatment will depend on the exact location of the lot, the individual dwelling facade sizes, the window area, room volume and orientation to the rail corridor. As such, these recommendations should be reviewed as the project progresses.

The necessary Weighted Noise Reduction (Rw) sound transmission loss performance of the various building facade elements are presented in **Table 10**. Deemed-to-comply construction details, as taken from the DP&I Guideline, are presented in **Figure 11**.

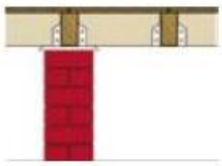
Table 9 Summary of Likely Facade Noise Reduction Requirements

Section (affected lot numbers)	Noise Level, $L_{Aeq(period)}$ (dBA)		Required Facade Noise Reduction (dB)	Indicative Treatment Category
	Predicted	Applicable Internal Criteria		
Northern most lots (1001, 1002, 1003, 1027, 1028, 1029 and 1055)	59 57	40 – Non-sleeping Area 35 – Sleeping Area	19 22	2 and mechanical ventilation

Table 10 R_w of Building Elements

Category of Noise Control Treatment	R_w of Building Elements (minimum assumed)				
	Windows/Sliding Doors	Frontage Facade	Roof	Entry Door	Floor
Category 1	24	38	40	28	29
Category 2	27	45	43	30	29
Category 3	32	52	48	33	50
Category 4	35	55	52	33	50
Category 5	43	55	55	40	50

Figure 11 Deemed-to-Comply Construction Details – Category 2

Category No.	Building Element	Standard Constructions	sample
2	**Windows/Sliding Doors**	Openable with minimum 6mm monolithic glass and full perimeter acoustic seals	
	Frontage Facade	**Timber Frame or Cladding Construction:** 6mm fibre cement sheeting or weatherboards or plank cladding externally, 90mm deep timber stud or 92mm metal stud, 13mm standard plasterboard internally with R2 insulation in wall cavity.	
		Brick Veneer Construction: 110mm brick, 90mm timber stud frame or 92mm metal stud, minimum 50mm clearance between masonry and stud frame, 10mm standard plasterboard internally.	
		Double Brick Cavity Construction: 2 leaves of 110mm brickwork separated by 50mm gap	
	Roof	Pitched concrete or terracotta tile or metal sheet roof with sarking, 10mm plasterboard ceiling fixed to ceiling joists, R2 insulation batts in roof cavity.	
	Entry Door	40mm solid core timber door fitted with full perimeter acoustic seals	
	Floor	1 layer of 19mm structural floor boards, timber joist on piers	
		Concrete slab floor on ground	

5.2 Industrial Noise

Noise from industrial development in the Precinct would be required to be assessed against the noise goals in **Table 4**, noting that the criteria relate to total noise from the cumulative impact of all industrial sources in the area.

At this stage of the development the industrial uses are yet to be finalised. While exceedances of the criteria are predicted for lots which overlook the industrial area, it is noted that the calculations are indicative and are based on several assumptions and likely represent a worst-case scenario.

It is noted that the lots which are identified as potentially being impacted by industrial noise are also predicted to be impacted by road traffic noise from the internal east-west road. These lots are already identified as likely requiring mechanical ventilation to mitigate road traffic noise (see **Figure 10**), which would also assist with mitigating any potential future industrial noise impacts.

The extent of the industrial noise impacts would depend of the type of industrial activities carried out in the Precinct at the various industrial and commercial lots. The potential for industrial noise impacts would be further investigated when detailed assessments are completed at Development Application stage for each industrial lot.

5.3 Construction Impacts

Where predicted or measured noise levels exceed the NMLs the ICNG recommends that all feasible and reasonable work practices are applied in order to minimise noise.

The following measures are recommended to be used to control the impacts as far as practicable.

5.3.1 Construction Noise and Vibration Management Plan

A Construction Noise and Vibration Management Plan should be prepared prior to commencing works which would include:

- Identification of nearby sensitive receivers
- Description of works, construction equipment and hours works would be completed in
- Criteria for the project and relevant licence and approval conditions
- Requirements for noise and vibration monitoring
- Details of how community consultation would be completed
- Procedures for handling complaints
- Details on how respite would be applied where ongoing high impacts are seen at certain receivers.

5.3.2 Construction Hours

In order to minimise the potential impacts at surrounding receivers, the proposed construction works should be undertaken during the preferred daytime construction hours, where possible:

- Monday to Friday 7:00 am to 6:00 pm.
- Saturday 8:00 am to 1:00 pm.
- No Work on Sundays or Public Holidays.

For residential construction works including road upgrades, it is recognised that there would be instances where work outside the preferred daytime construction hours may be required, for example during delivery of oversized plant or emergencies.

Where works are required outside of standard construction hours, site specific assessments of the proposed works would need to be undertaken.

5.3.3 Feasible and Reasonable Mitigation

The project should apply all feasible and reasonable mitigation measures to minimise the impacts, particularly during noise intensive works.

The following example measures should be considered to minimise the potential impacts from the works:

- Undertaking site inductions and work team briefings to create awareness of nearby sensitive receivers and the importance of minimising noise emissions.
- Ensuring any spoil is placed and not dropped into awaiting trucks.
- Establishing load points as far as practicable from sensitive receivers.
- Use of less noise-intensive equipment, where feasible and reasonable.
- Site compounds should be located away from sensitive receiver locations as far as practical in order to minimise the potential impacts.
- Maintenance work on all construction plant should be carried out away from sensitive receivers as far as practical and completed during standard daytime construction hours.
- The staging of the project should aim to avoid construction works next to occupied dwellings as far as practicable.

6 Conclusion

This report provides an assessment of the potential noise impacts at the proposed subdivision of 16 Chapman Street, Werrington, on the basis on noise monitoring completed at the site.

The impact of existing road and rail noise on the subdivision varies across the site with the most affected locations being situated adjacent the T1 Western Line.

Noise impacts are also expected from road traffic noise on the internal east-west road and also from industrial sources of noise from the future industrial and commercial lots near the southern boundary of the Precinct.

Mitigation strategies have been recommended which include acoustically optimising the site layout, using intervening multistorey buildings to provide shielding to the rest of site and designing building layouts to place less noise sensitive usages near to source of noise.

Where residual impacts exist, noise mitigation through building design may be required for a number of lots which are close to sources of rail noise. This could be achieved through the use of upgraded facade elements, such as windows and doors.

Rooms on facades exposed to road, rail or industrial noise impacts would likely also need mechanical ventilation to enable windows to be kept closed as a noise mitigation measure.

The preferred mitigation strategy for the proposal would be determined at a later stage in the project.

Based on the assessment of the potential impacts and the requirement for mitigation, the proposed development is considered feasible and supported from a noise standpoint.

APPENDIX A

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 x 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

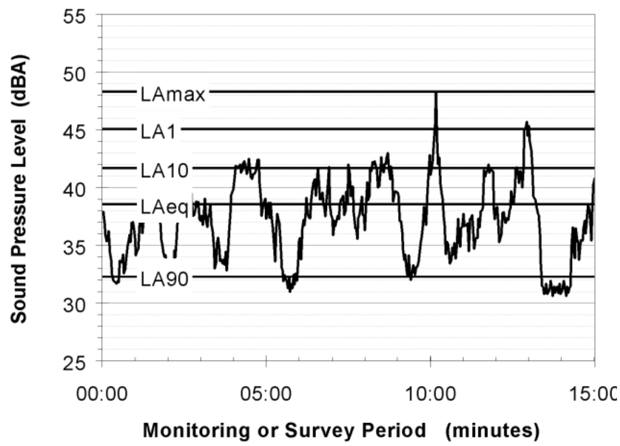
The Sound Power of a source is the rate at which it emits acoustic energy. As with Sound Pressure Levels, Sound Power Levels are expressed in decibel units (dB or dBA), but may be identified by the symbols SWL or LW, or by the reference unit 10^{-12} W.

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 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

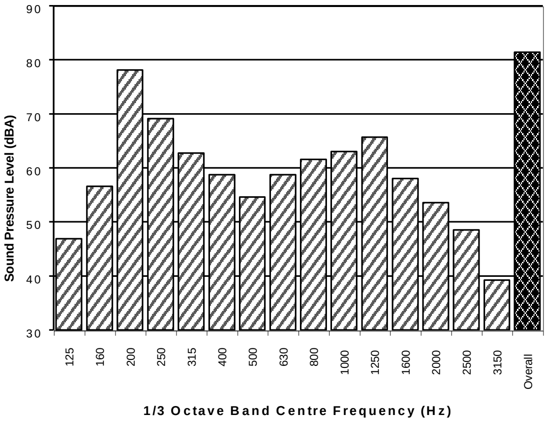
Frequency analysis is the process used to examine the tones (or frequency components) which make up the overall noise or vibration signal.

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

Frequency analysis can be in:

- 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

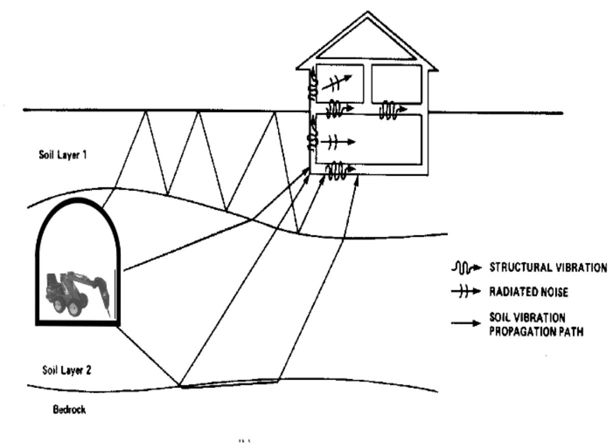
People are able to 'feel' vibration at levels lower than those required to cause even superficial damage to the most susceptible classes of building (even though they may not be disturbed by the motion). An individual's perception of motion or response to vibration depends very strongly on previous experience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

Noise Logging Graphs

Noise Monitoring Location	L.01
Noise Monitoring Address	16 Chapman Street, Werrington

Logger Device Type: Svantek 957, Logger Serial No: 20677

Ambient noise logger deployed within existing public open land, extended to approximately 2.5 – 3 m above ground level.
Logger located with view of the T1 rail line to the north. The purpose of this logger was to establish existing rail noise and calibration of rail noise model.

Map of Noise Monitoring Location

Ambient Noise Logging Results – ICNG Defined Time Periods

Monitoring Period	Noise Level (dBA)			
	RBL	LAeq	L10	L1
Daytime	39	55	50	67
Evening	43	56	51	68
Night-time	36	54	46	65

Ambient Noise Logging Results – RNP Defined Time Periods

Monitoring Period	Noise Level (dBA)	
	LAeq(period)	LAeq(1hour)
Daytime (7am-10pm)	56	58
Night-time (10pm-7am)	54	58

Attended Noise Measurement Results

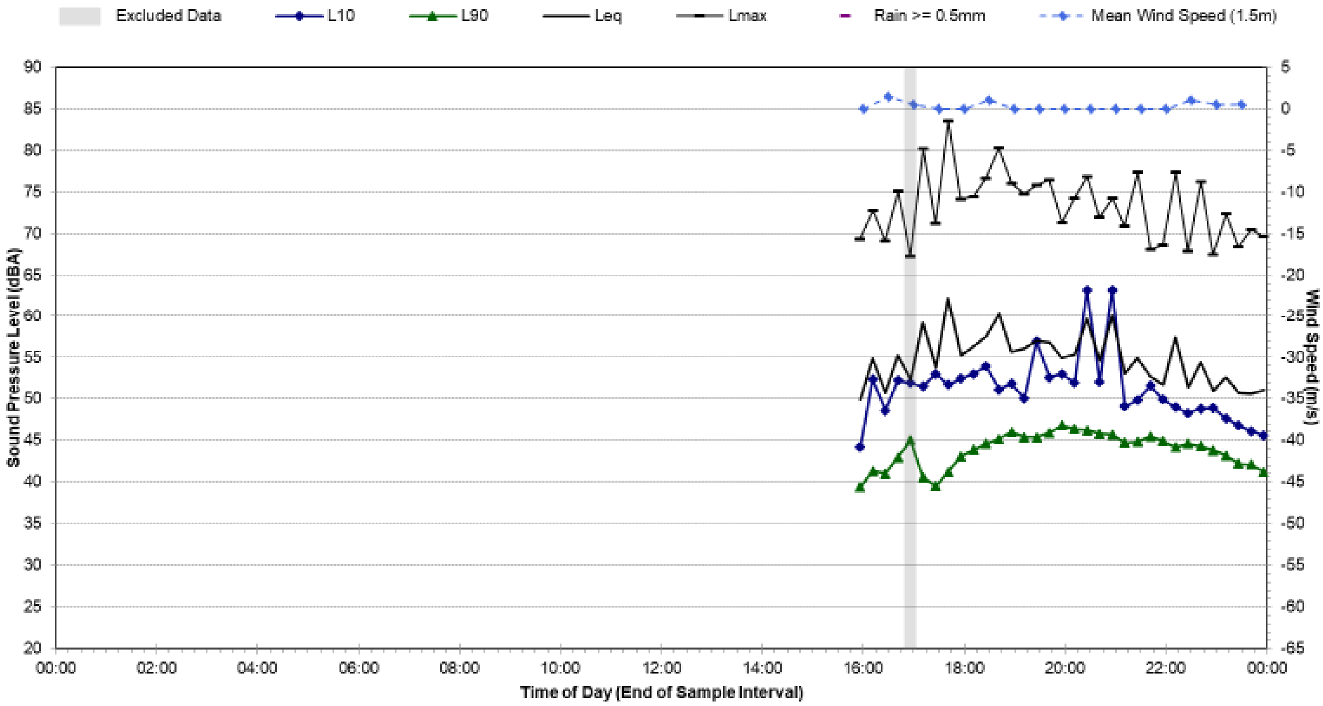
Date	Start Time	Measured Noise Level (dBA)		
		LA90	LAeq	LAmax

Photo of Noise Monitoring Location

Note1: 8 July excluded from data

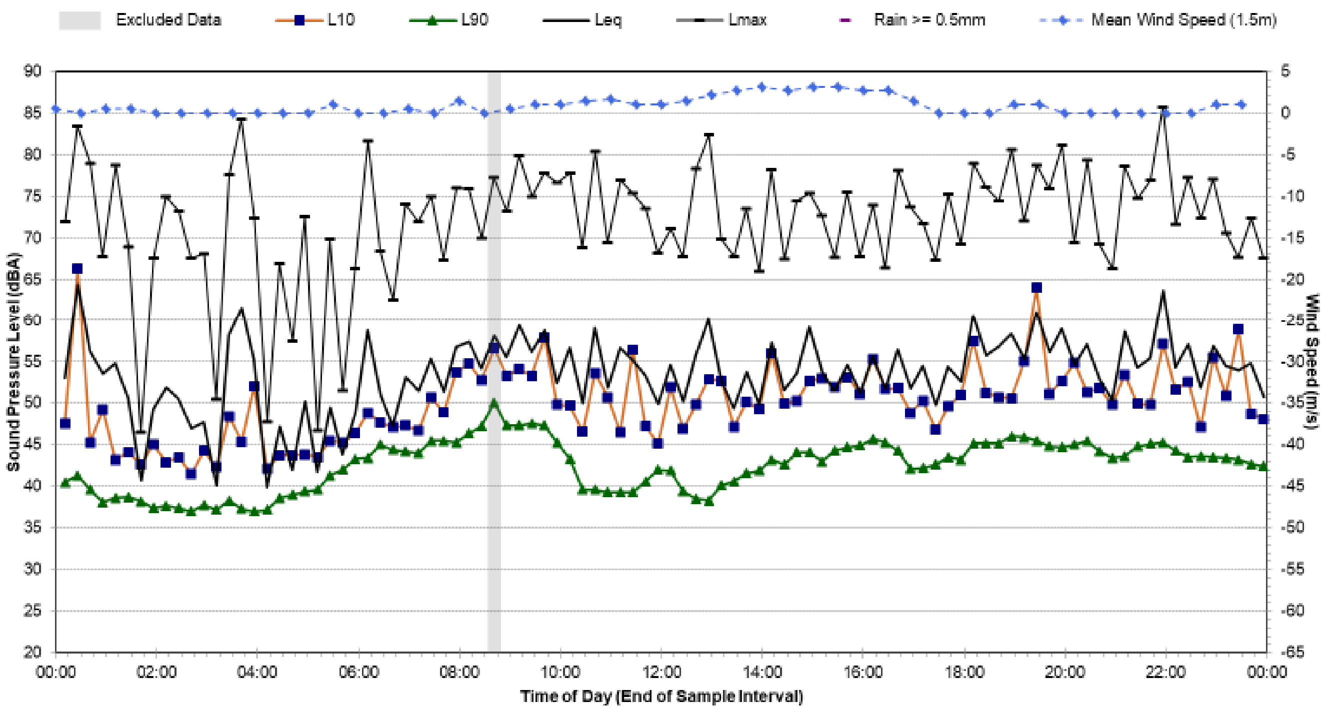
Statistical Ambient Noise Levels

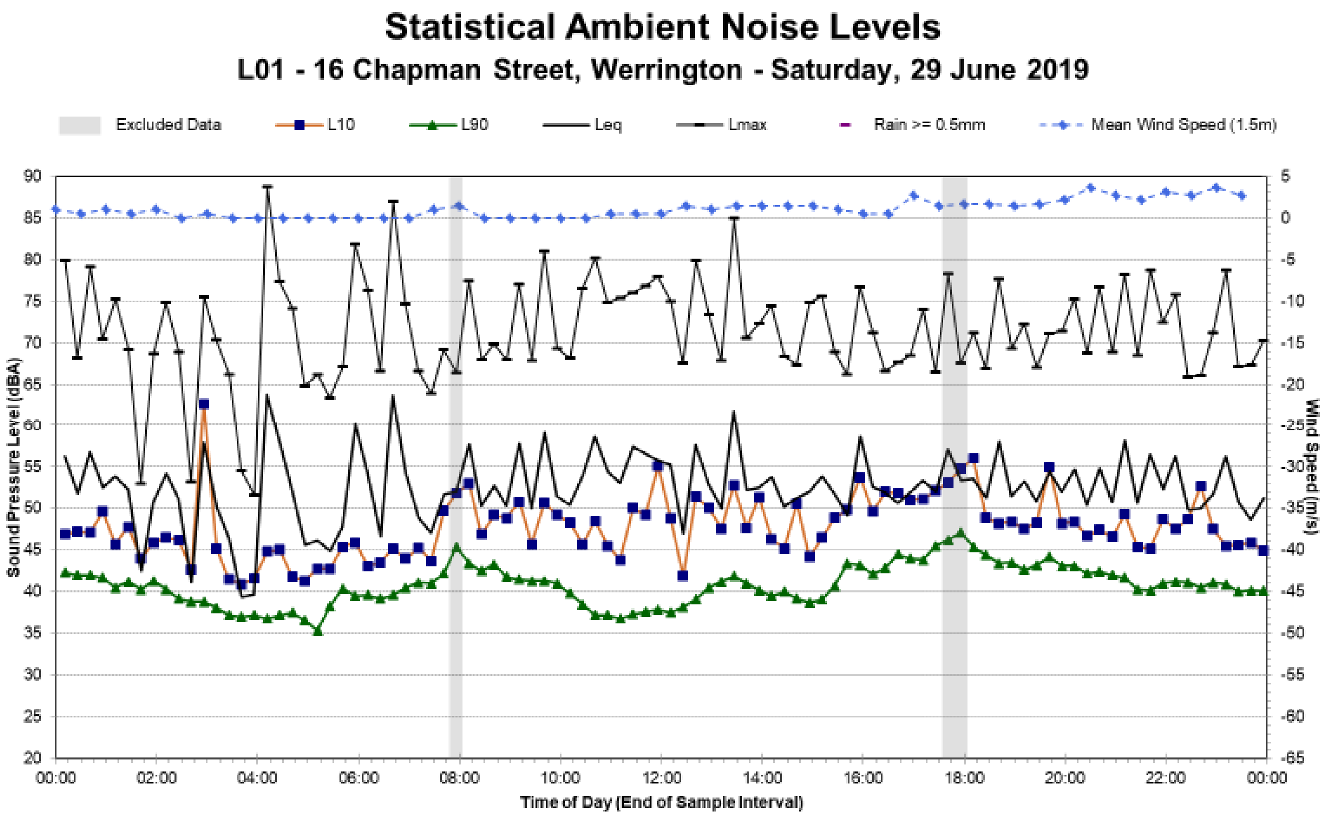
L01 - 16 Chapman Street, Werrington - Thursday, 27 June 2019

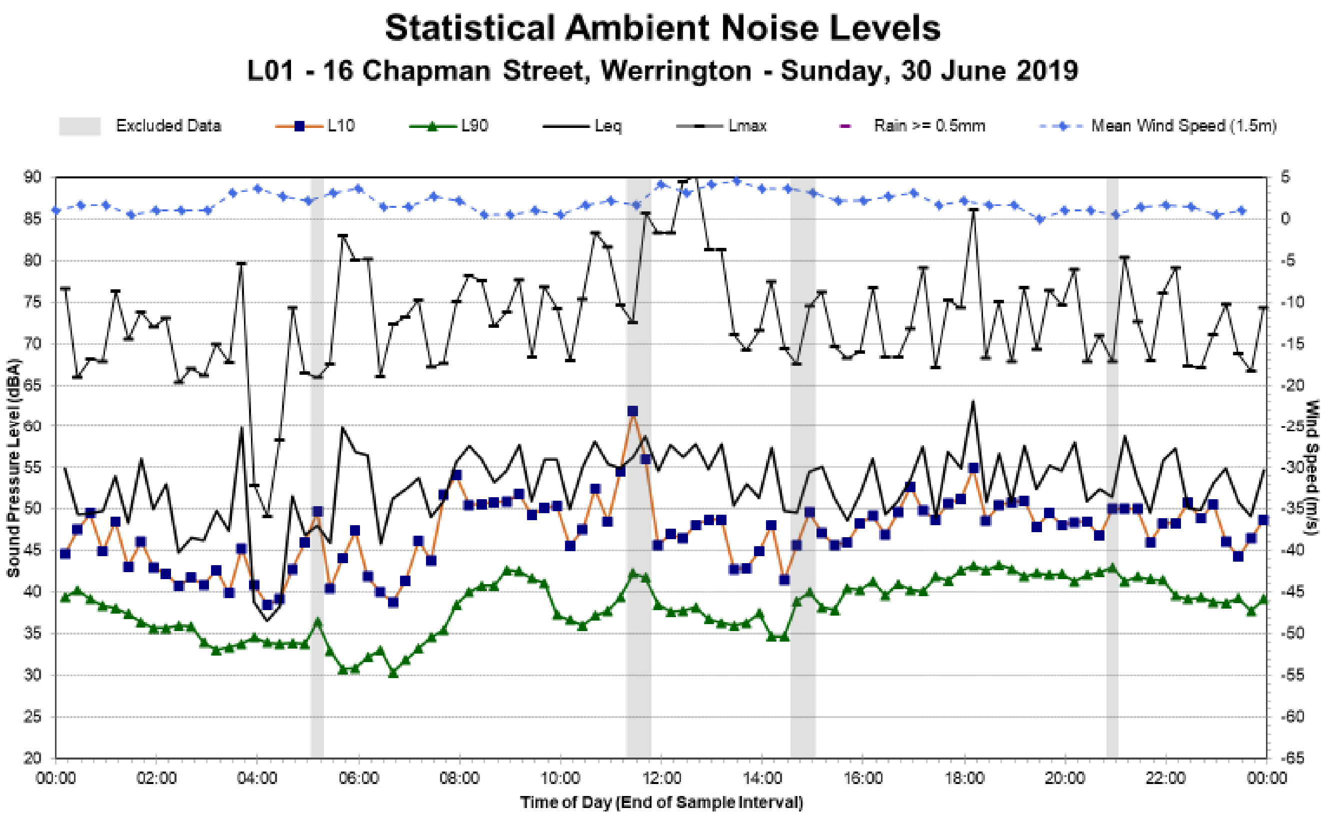


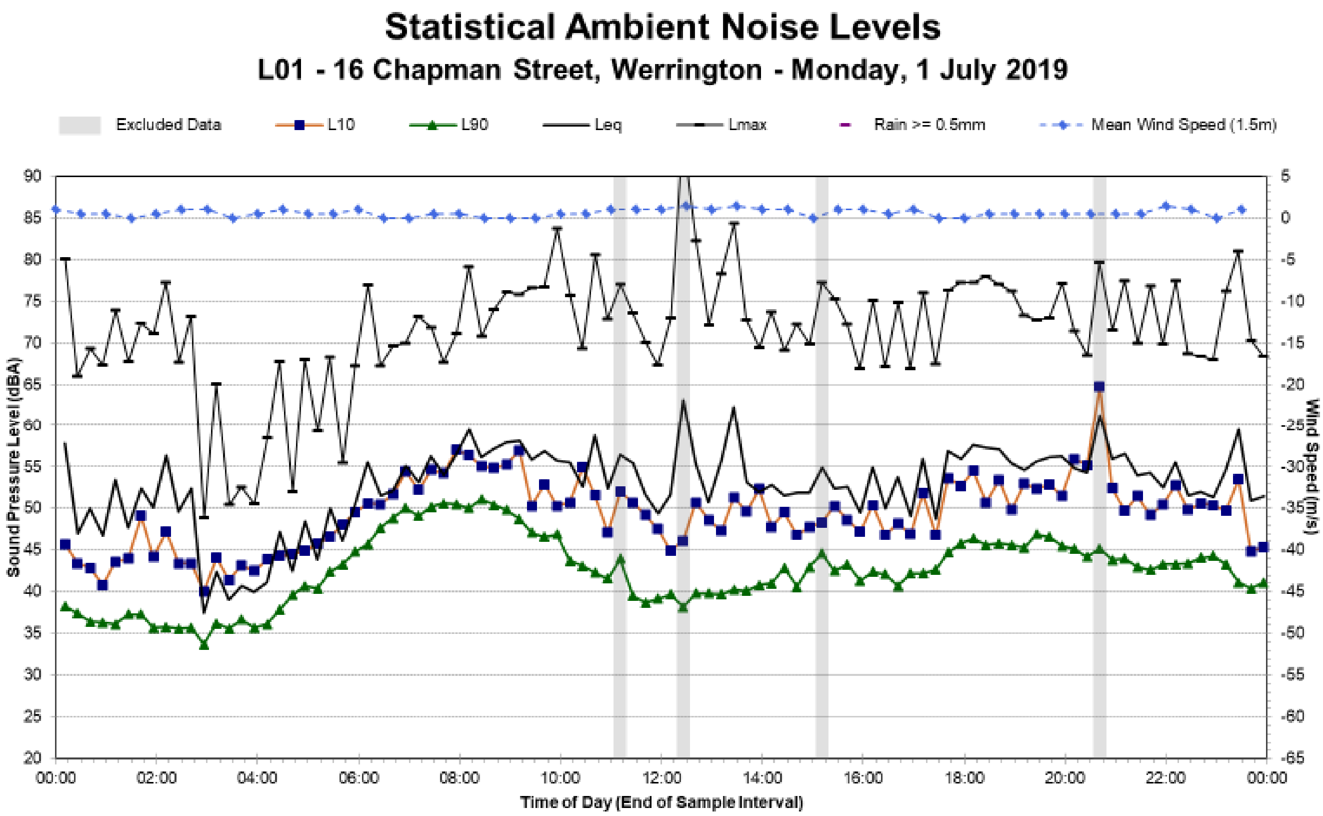
Statistical Ambient Noise Levels

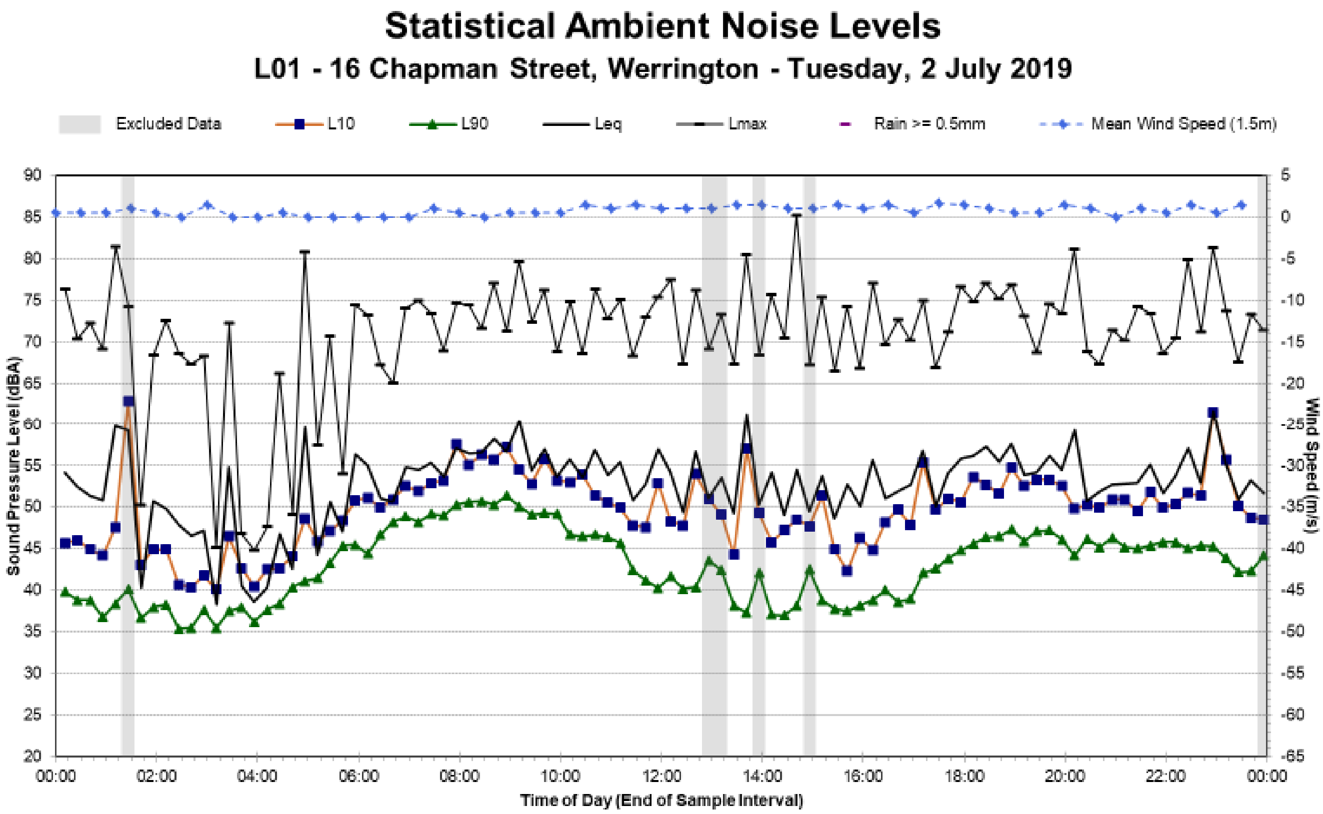
L01 - 16 Chapman Street, Werrington - Friday, 28 June 2019




Statistical Ambient Noise Levels
L01 - 16 Chapman Street, Werrington - Saturday, 29 June 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
L01 - 16 Chapman Street, Werrington - Sunday, 30 June 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
L01 - 16 Chapman Street, Werrington - Monday, 1 July 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
L01 - 16 Chapman Street, Werrington - Tuesday, 2 July 2019
Excluded Data
L10
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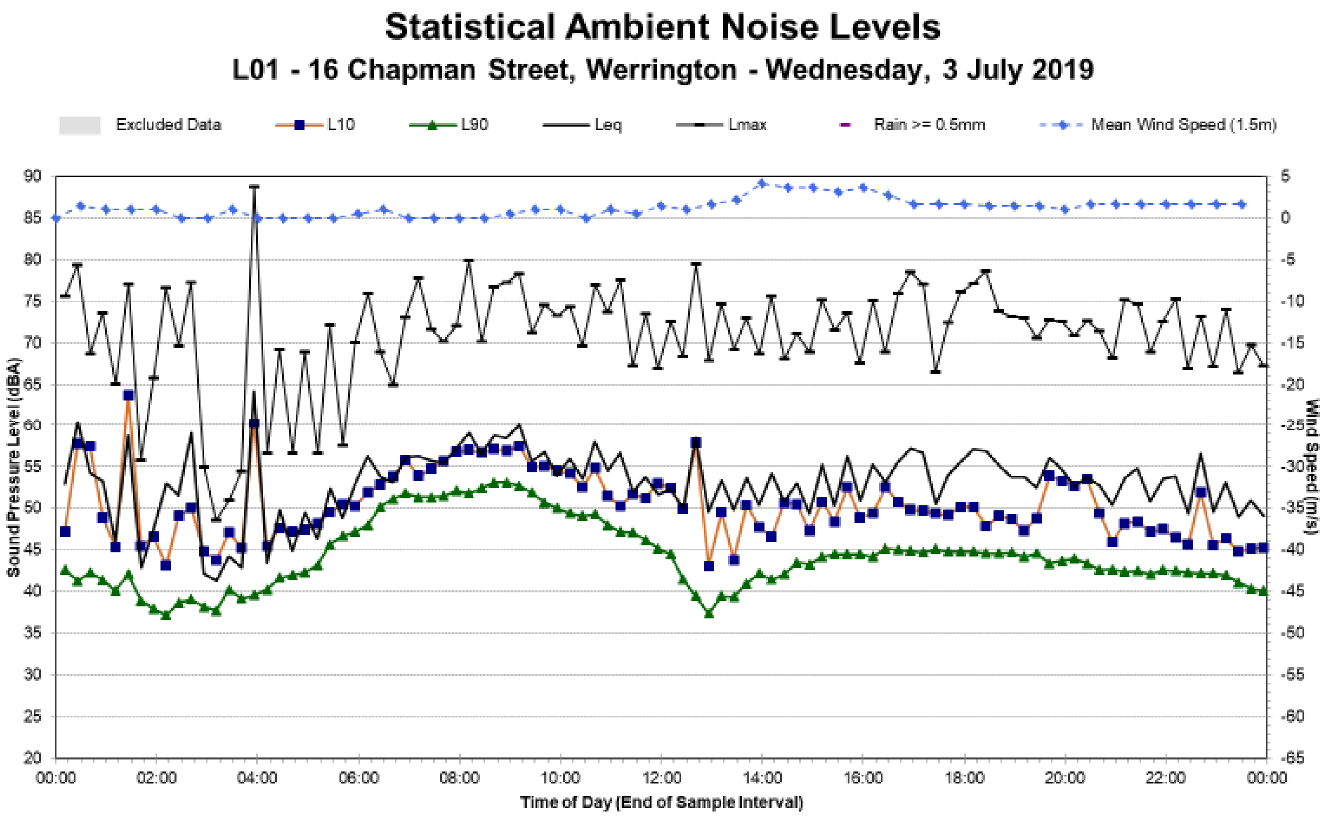
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L01 - 16 Chapman Street, Werrington - Wednesday, 3 July 2019
Excluded Data
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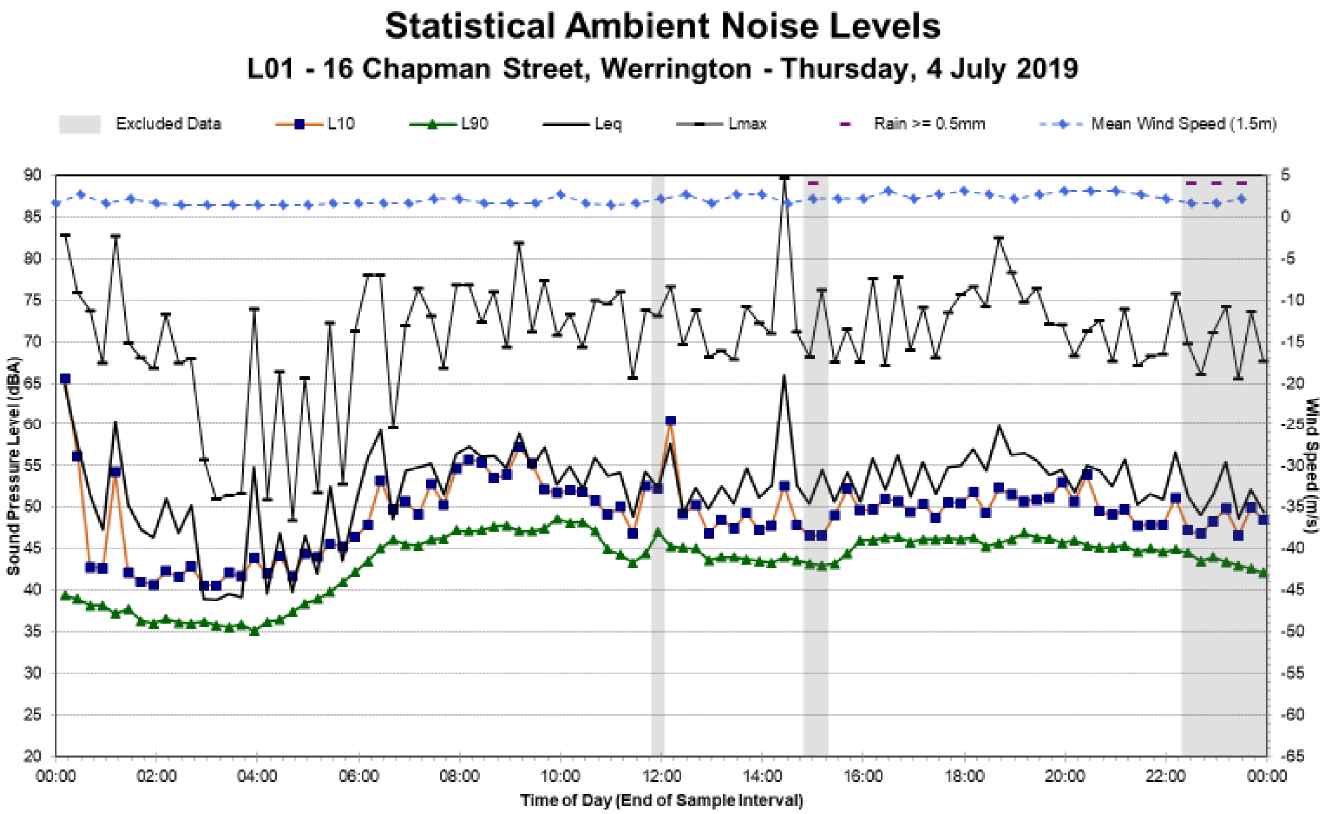
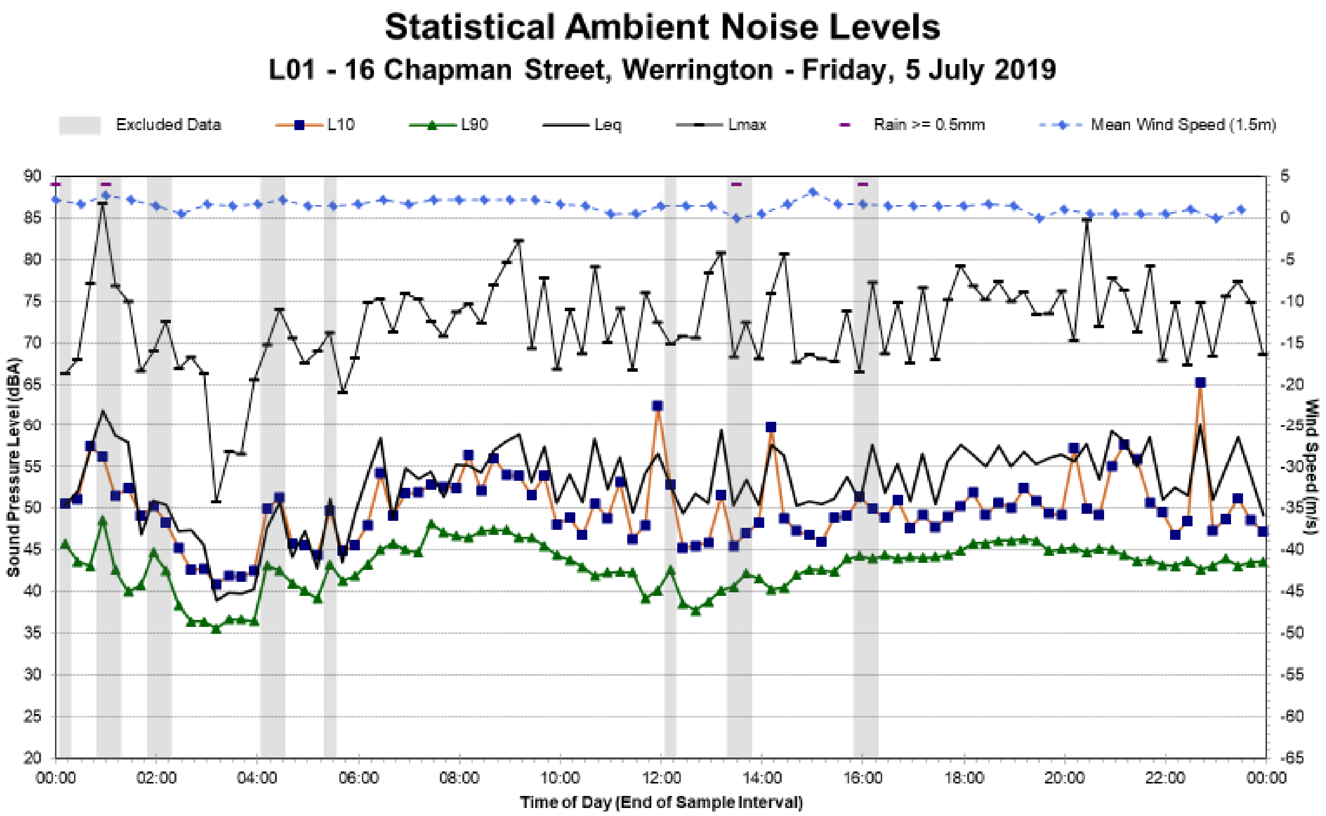
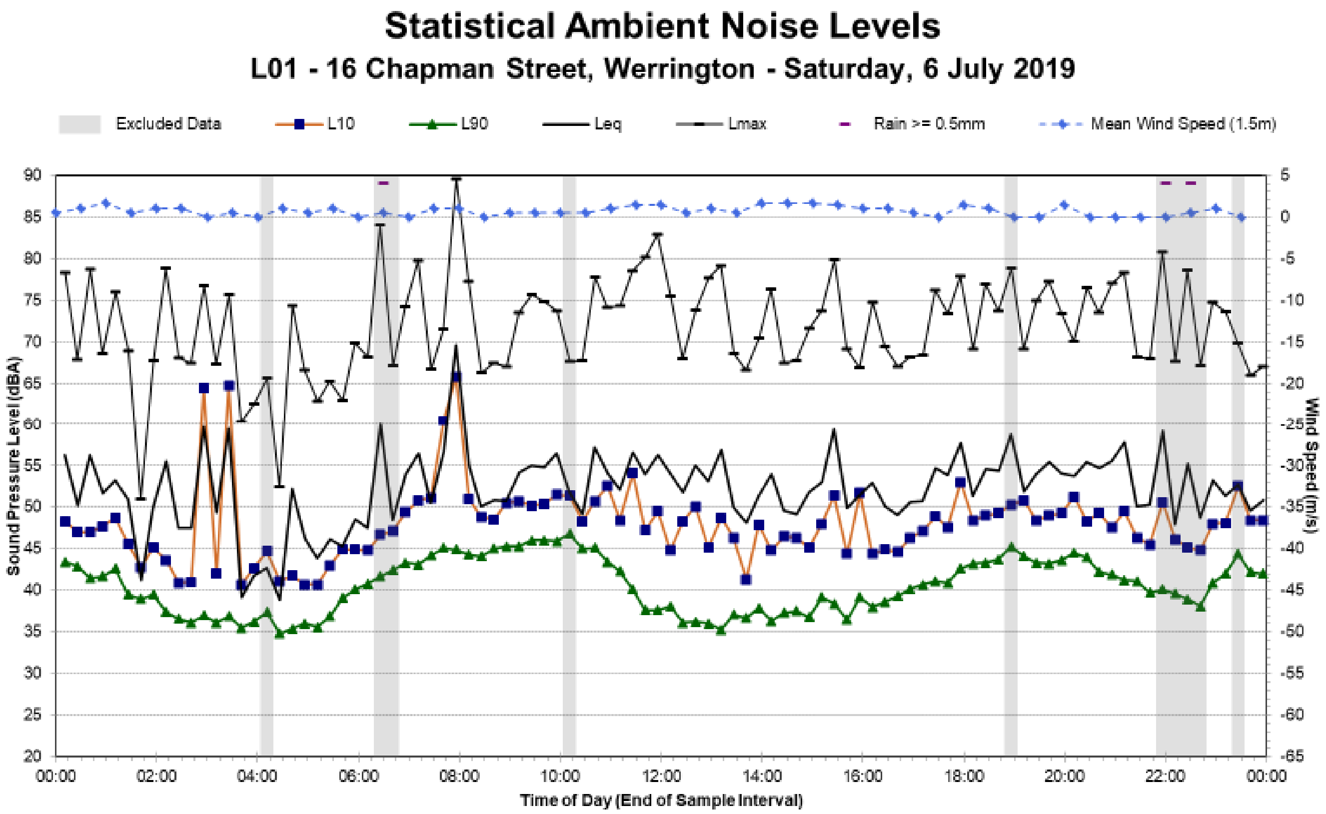
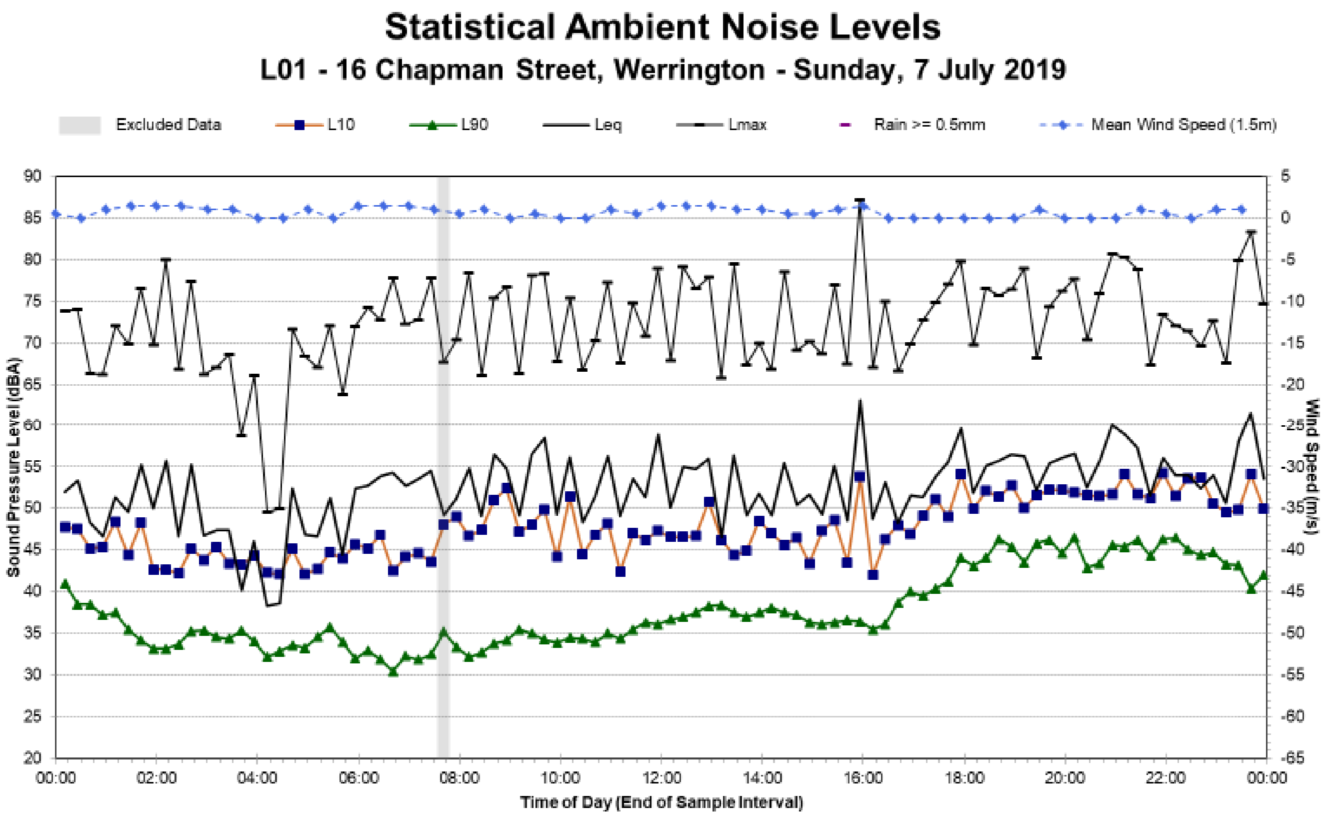
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

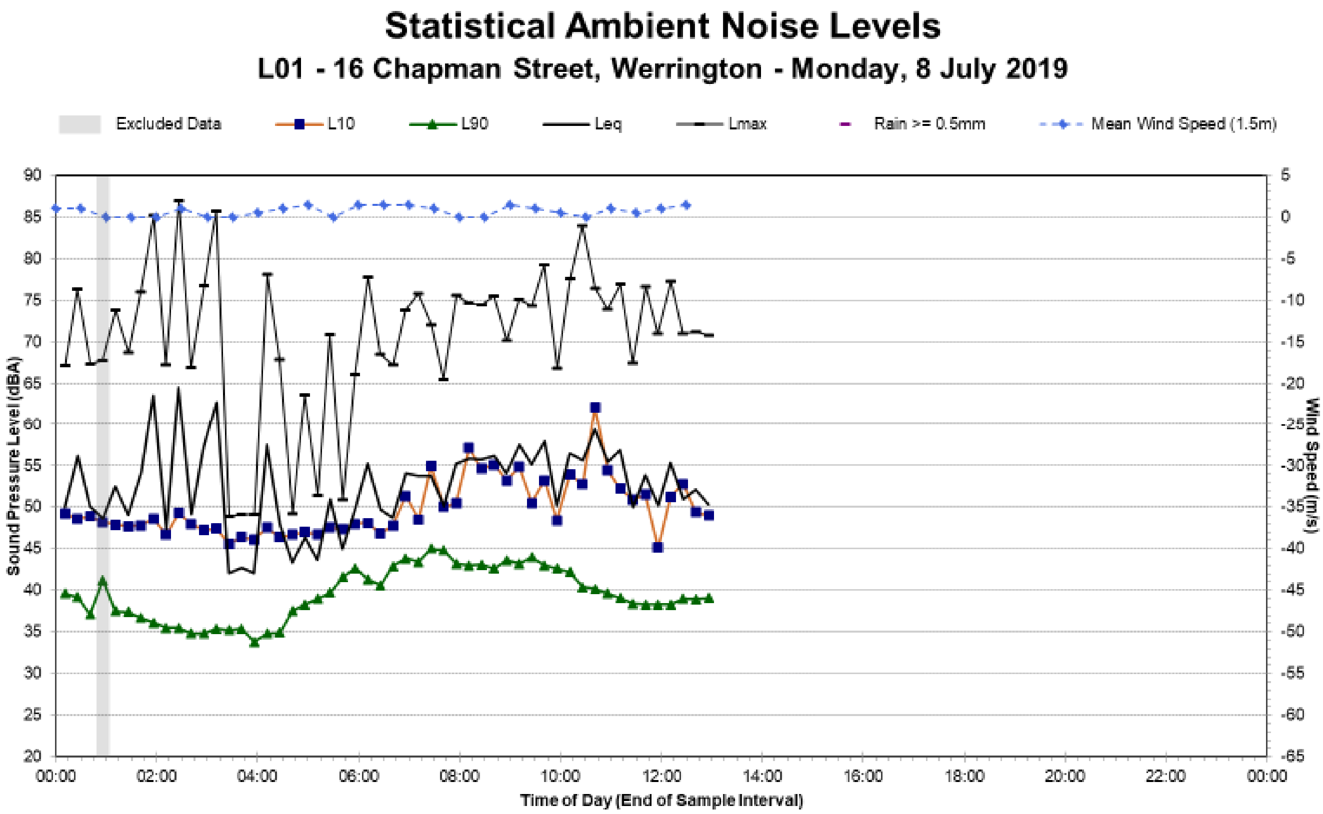

Statistical Ambient Noise Levels
L01 - 16 Chapman Street, Werrington - Thursday, 4 July 2019
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L01 - 16 Chapman Street, Werrington - Friday, 5 July 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
L01 - 16 Chapman Street, Werrington - Saturday, 6 July 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
L01 - 16 Chapman Street, Werrington - Sunday, 7 July 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
L01 - 16 Chapman Street, Werrington - Monday, 8 July 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)

Noise Monitoring Location	L.02
Noise Monitoring Address	**15/4-12 Chapman Street, Werrington**

Logger Device Type: Svantek 957, Logger Serial No: 20674
Sound Level Meter Device Type: Brüel and Kjær 2270, Sound Level Meter Serial No: 3008204

Ambient noise logger deployed at residential address 15/4-12 Chapman Street, Werrington. Logger located within cluster of units adjacent to precinct proposed location.

Attended noise measurements indicate the ambient noise environment at this location is dominated by overhead aircraft, natural fauna and birdsong, trains along the T1 line and some local traffic along Chapman Street.

Recorded Noise Levels (LAmax):
8/07/2019: Birdsong 43 – 50, Rail 45 – 48, Aircraft 40 – 53, Trucks 50.

Map of Noise Monitoring Location

Ambient Noise Logging Results – ICNG Defined Time Periods

Monitoring Period	Noise Level (dBA)			
	RBL	**LAeq**	**L10**	**L1**
Daytime	37	57	51	60
Evening	44	48	49	54
Night-time	37	46	45	50

Ambient Noise Logging Results – RNP Defined Time Periods

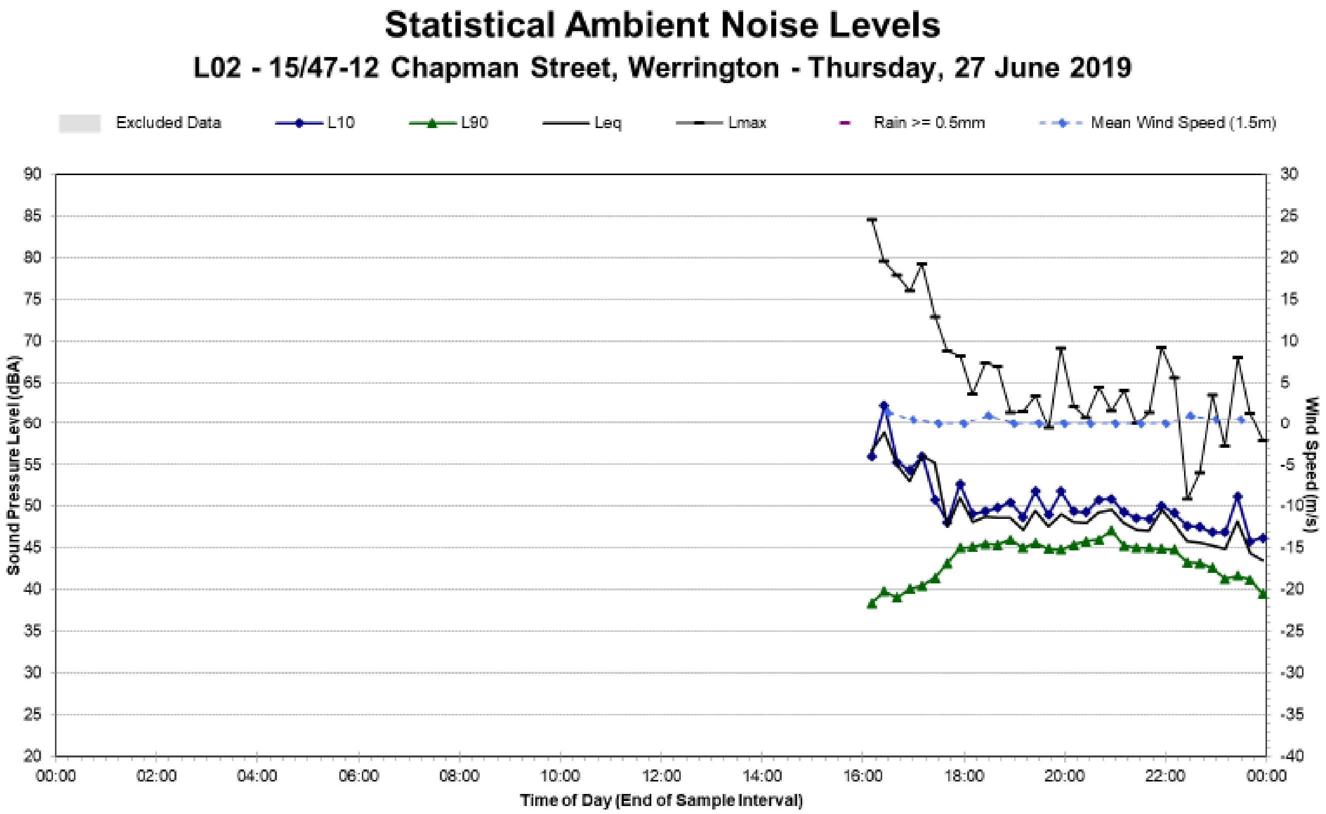
Monitoring Period	Noise Level (dBA)	
	LAeq(period)	**LAeq(1hour)**
Daytime (7am-10pm)	55	50
Night-time (10pm-7am)	46	60

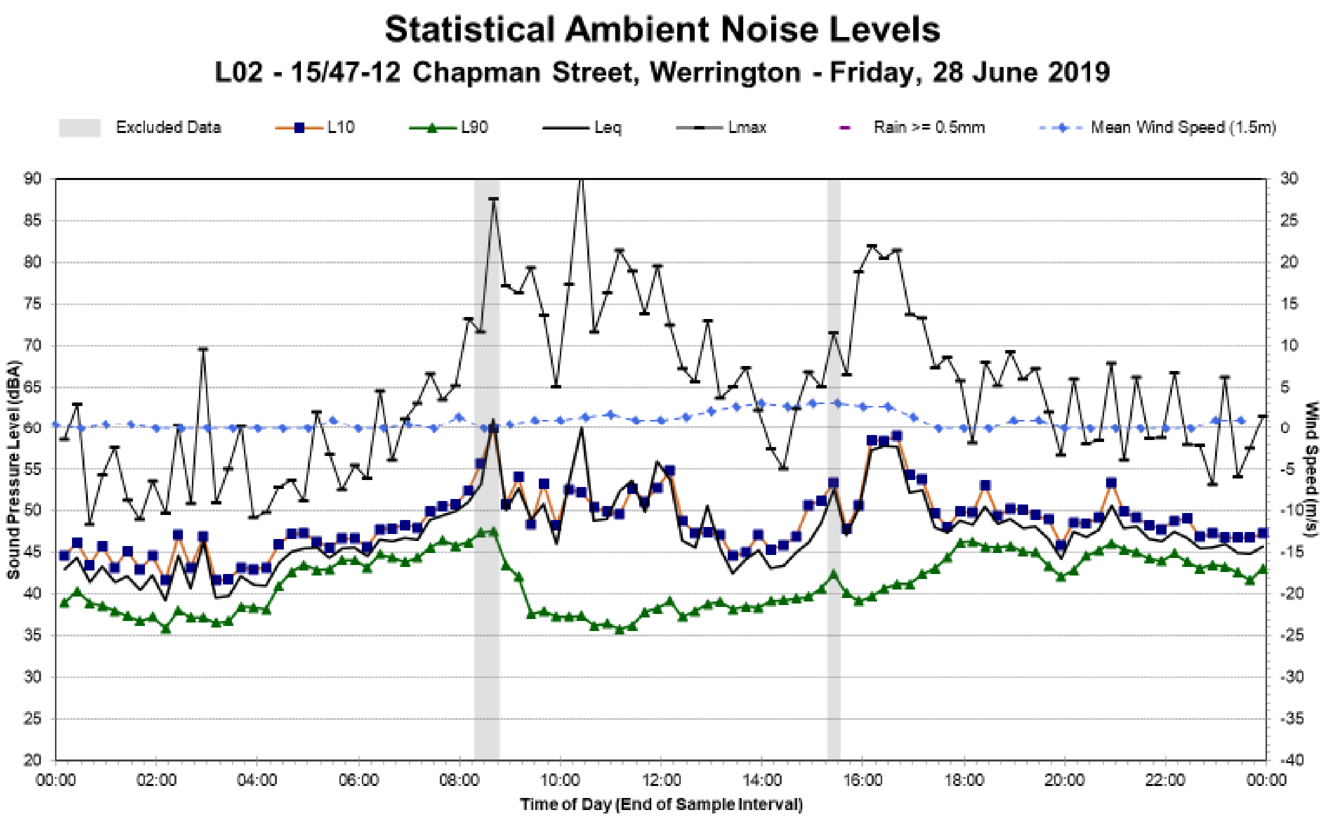
Attended Noise Measurement Results

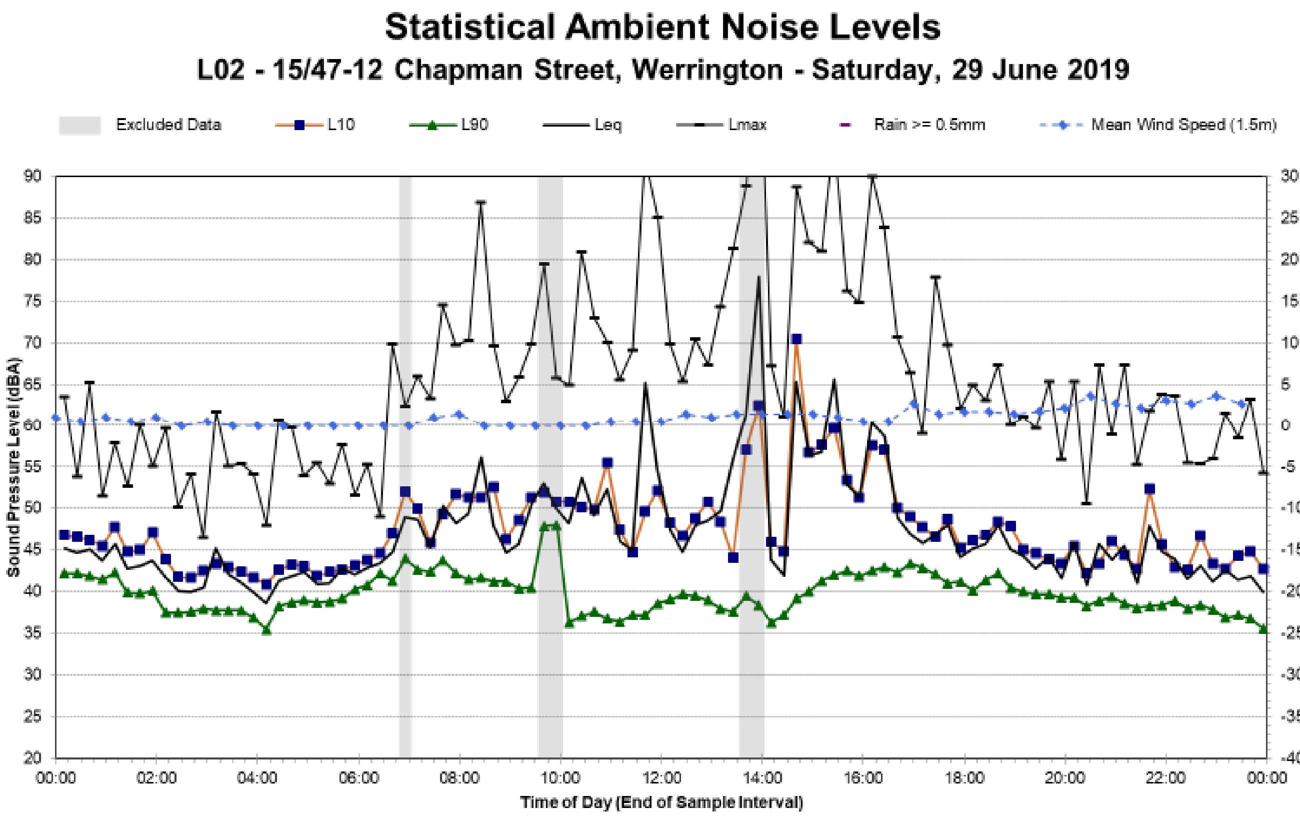
Date	Start Time	Measured Noise Level (dBA)		
		LA90	**LAeq**	**LAmax**
8/07/2019	11:40	35	45	73

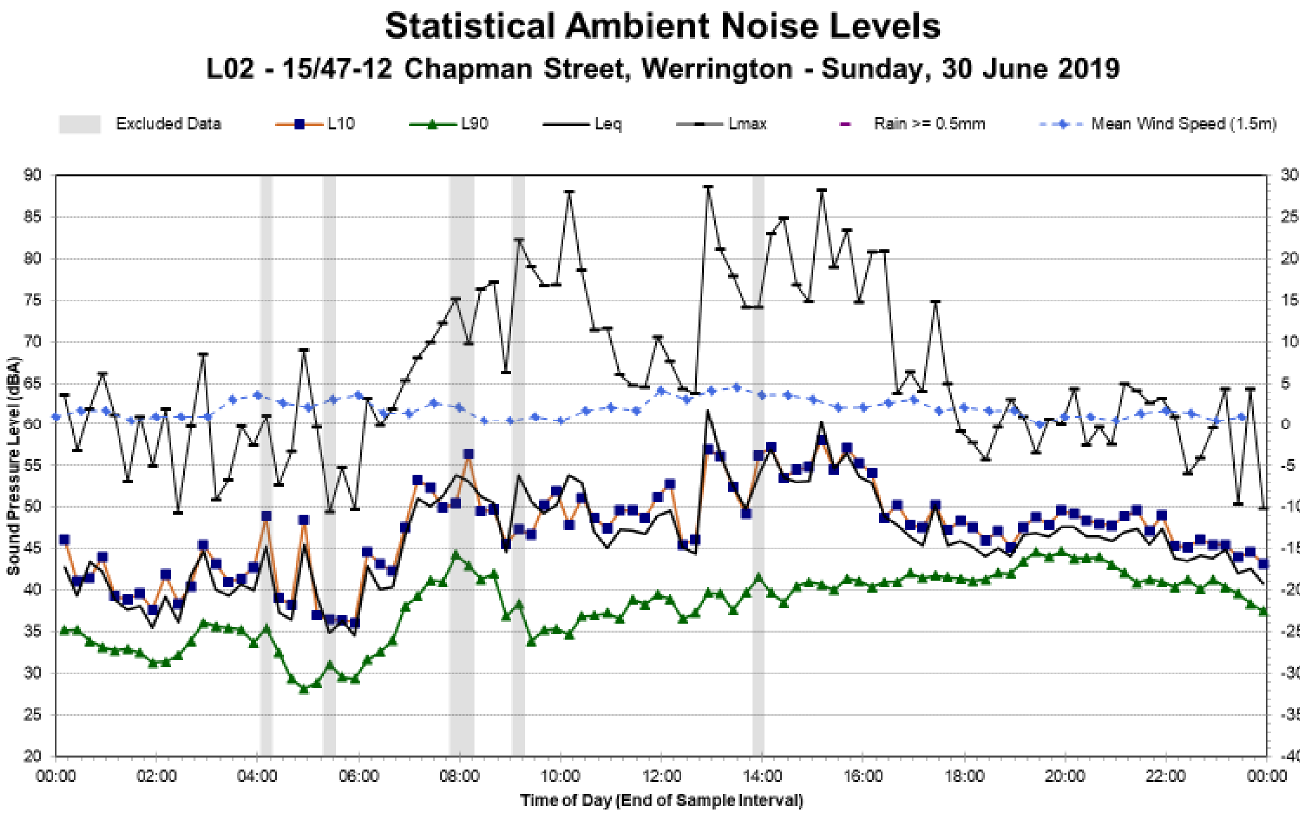
Note 1: 8 July excluded from data

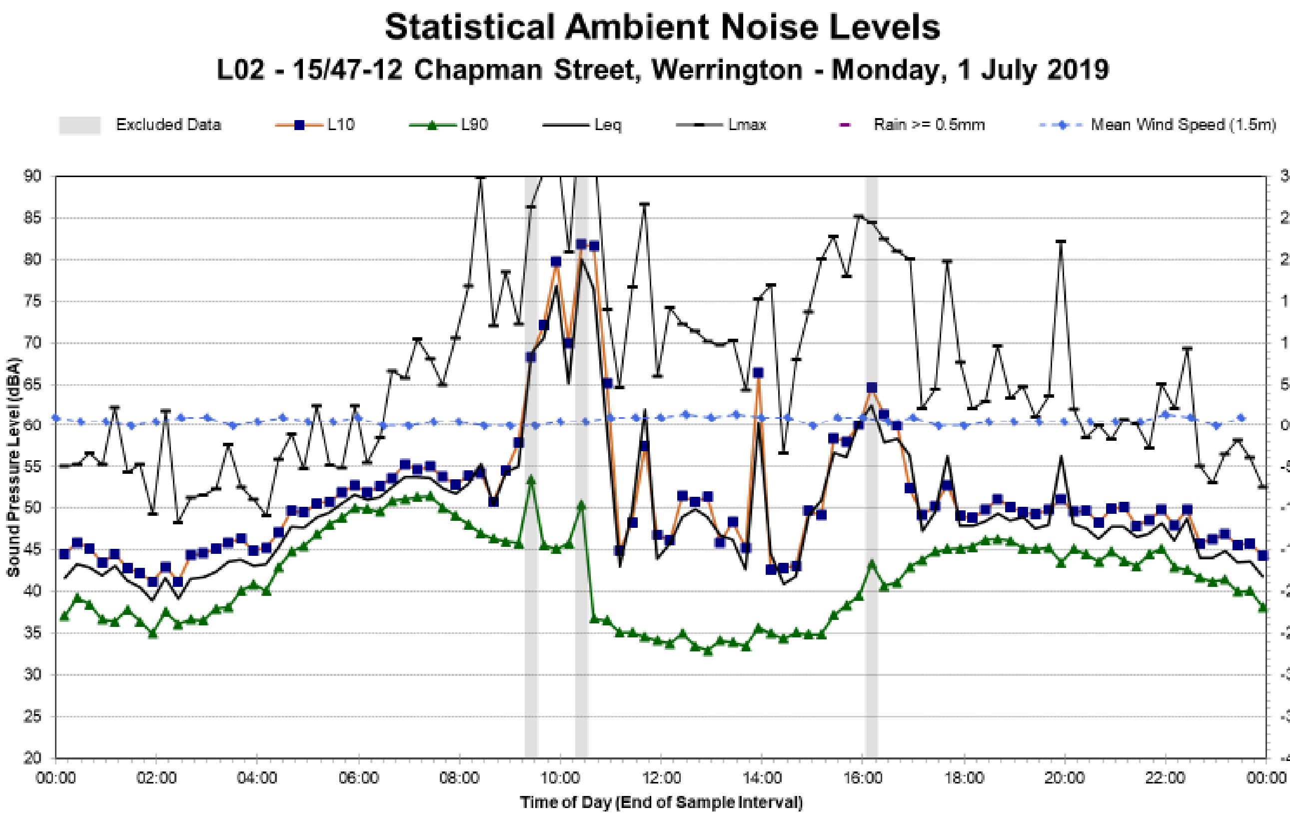
Photo of Noise Monitoring Location


Statistical Ambient Noise Levels
L02 - 15/47-12 Chapman Street, Werrington - Thursday, 27 June 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)

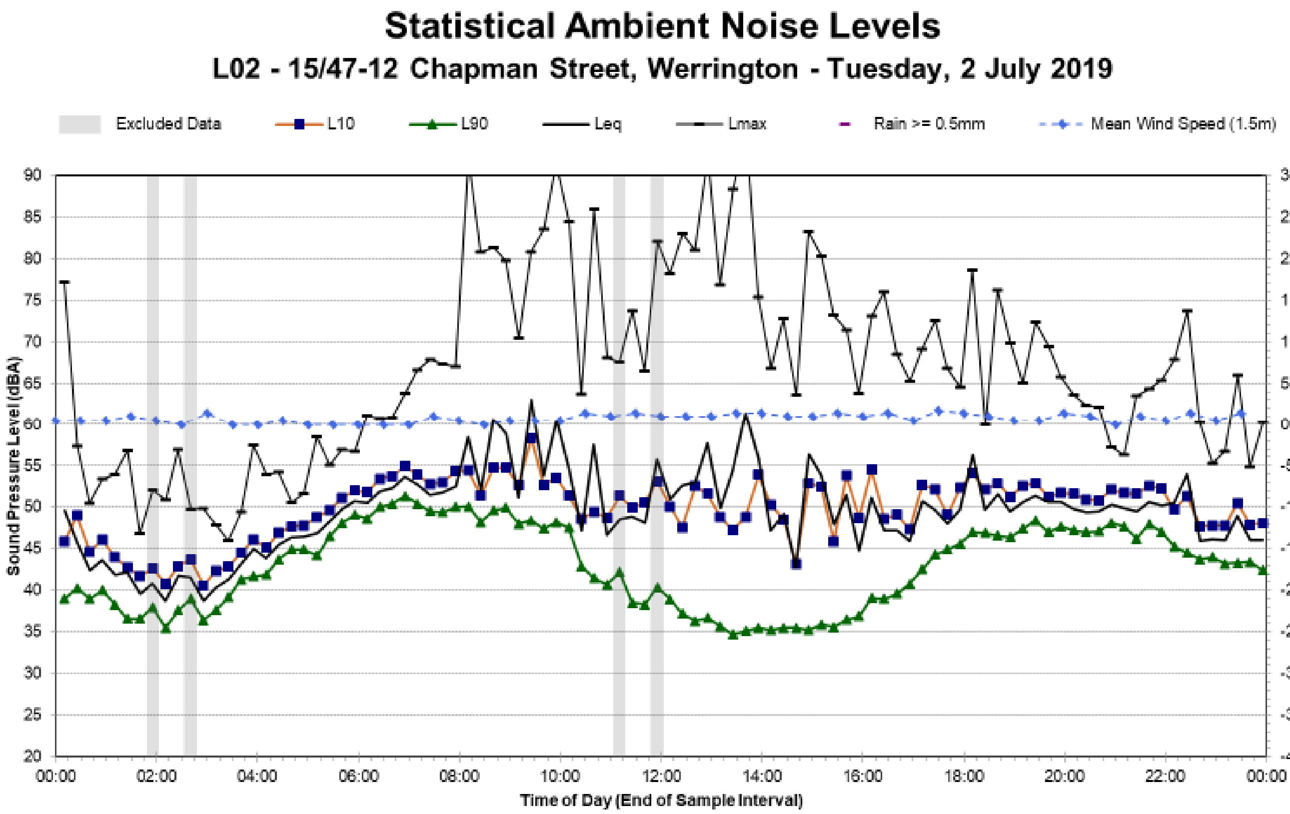

Statistical Ambient Noise Levels
L02 - 15/47-12 Chapman Street, Werrington - Friday, 28 June 2019
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L02 - 15/47-12 Chapman Street, Werrington - Saturday, 29 June 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)

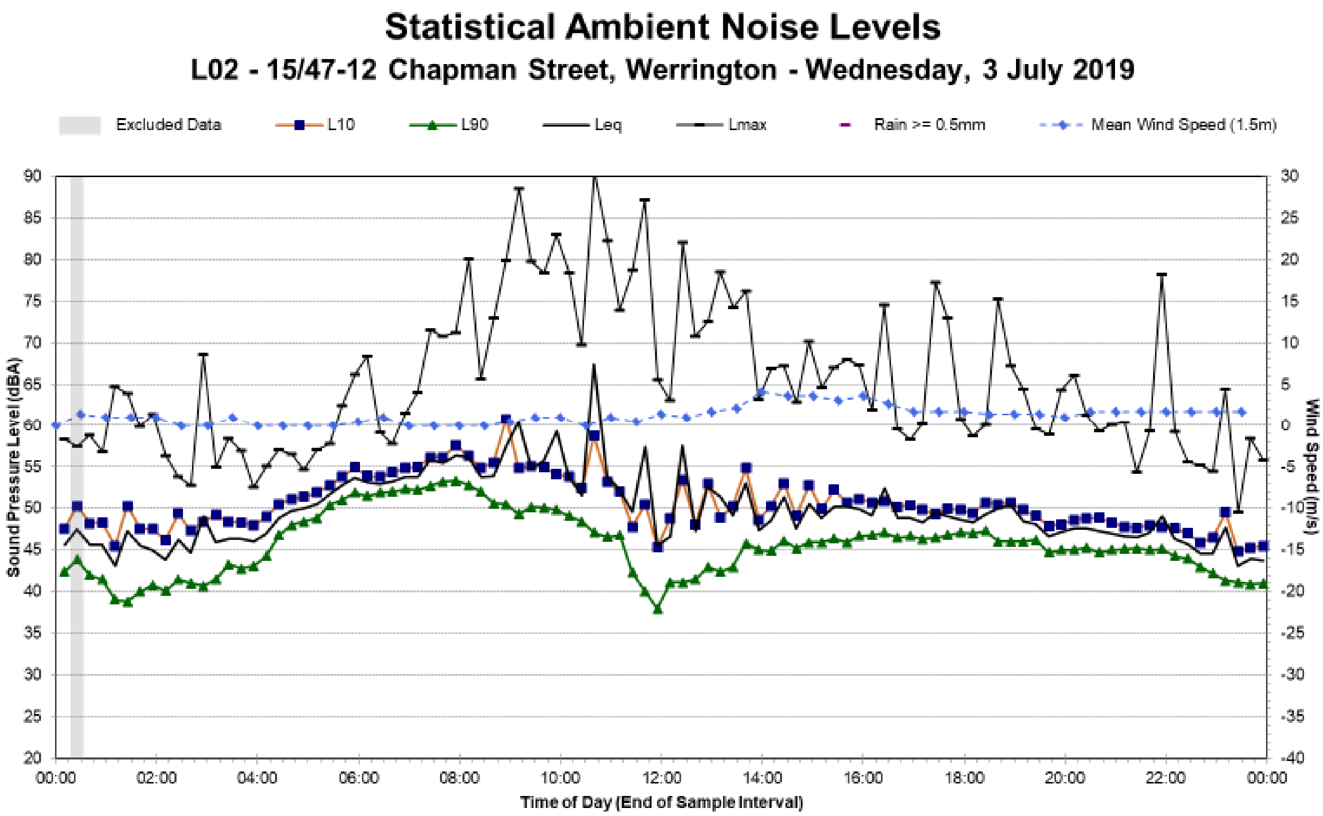

Statistical Ambient Noise Levels
L02 - 15/47-12 Chapman Street, Werrington - Sunday, 30 June 2019
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)



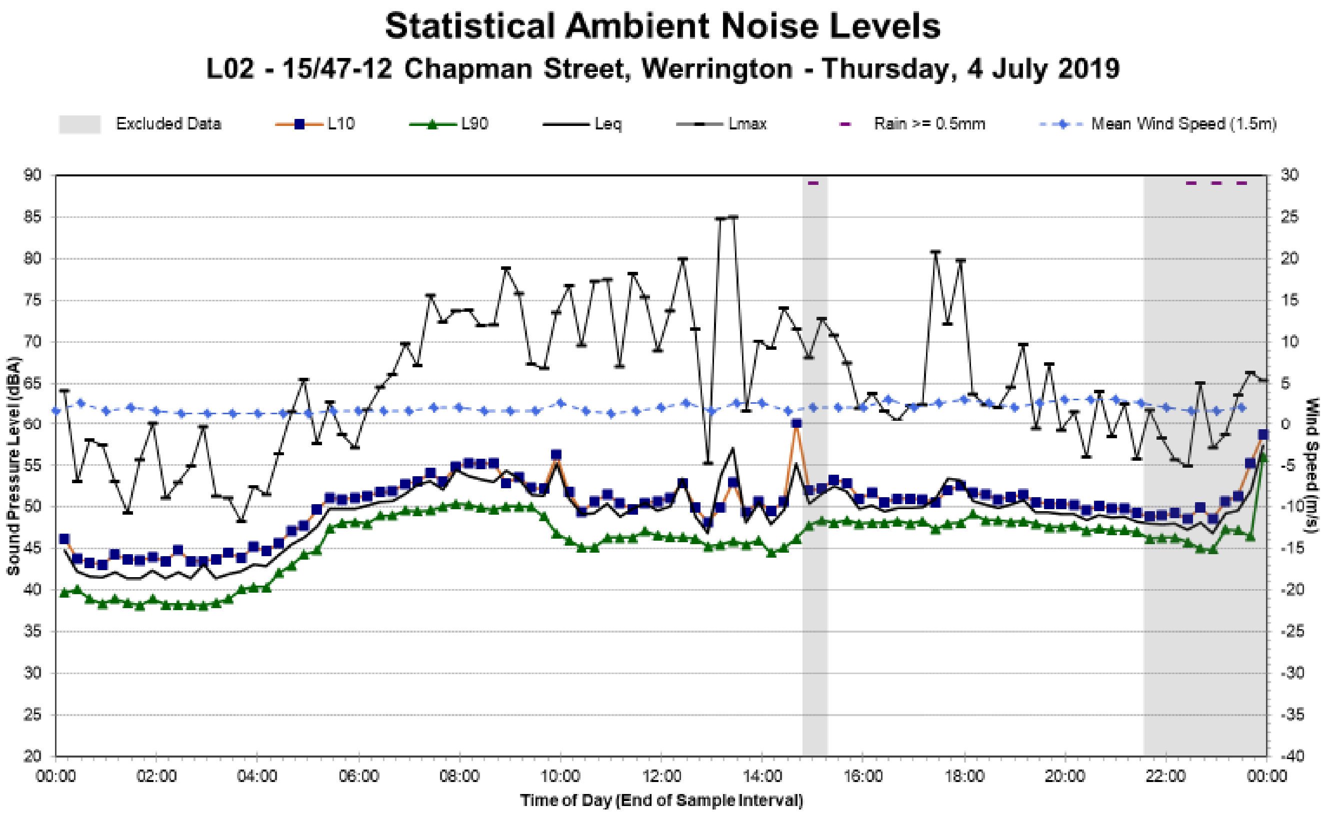
Statistical Ambient Noise Levels
L02 - 15/47-12 Chapman Street, Werrington - Monday, 1 July 2019
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)



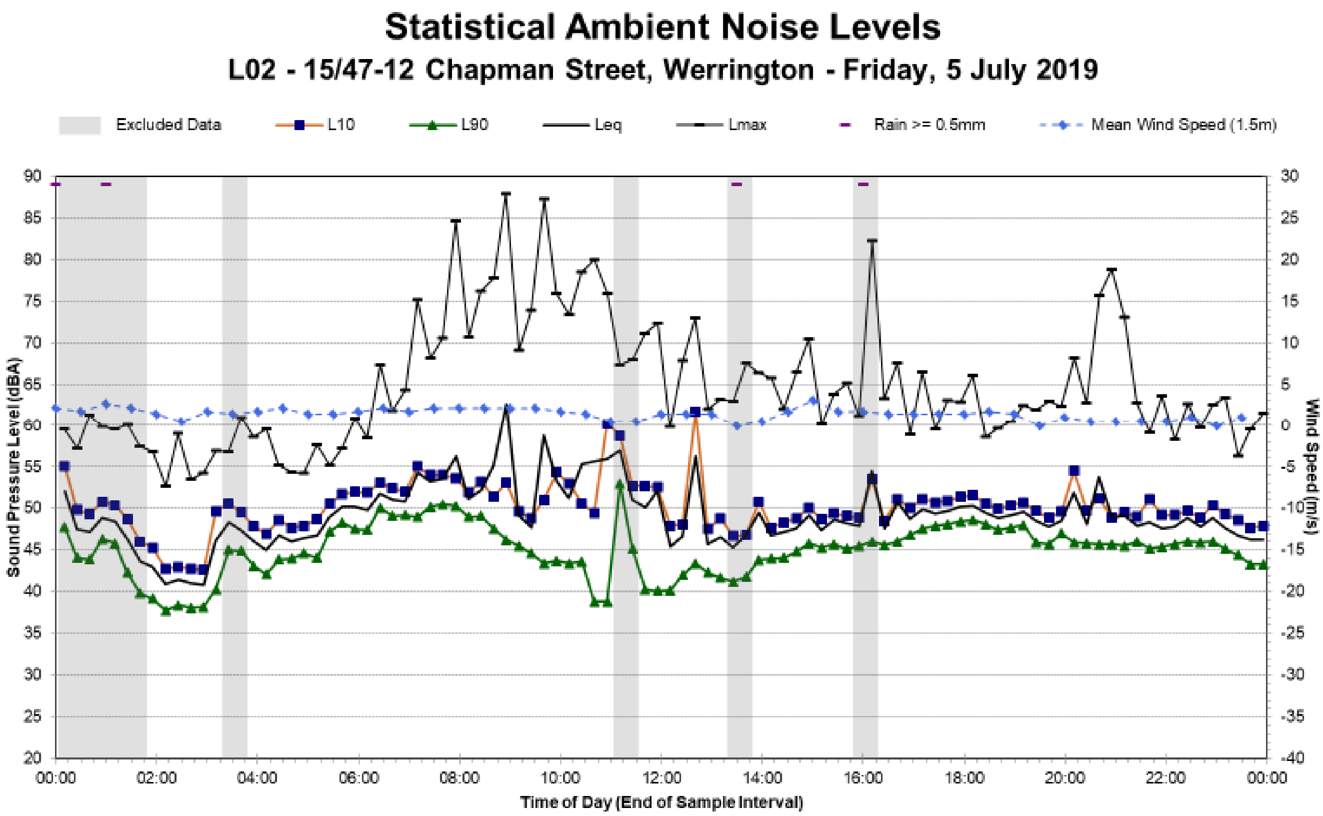
Statistical Ambient Noise Levels
L02 - 15/47-12 Chapman Street, Werrington - Tuesday, 2 July 2019
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)



Statistical Ambient Noise Levels
L02 - 15/47-12 Chapman Street, Werrington - Wednesday, 3 July 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
L02 - 15/47-12 Chapman Street, Werrington - Thursday, 4 July 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
L02 - 15/47-12 Chapman Street, Werrington - Friday, 5 July 2019
Excluded Data
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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)
90
85
80
75
70
65
60
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50
45
40
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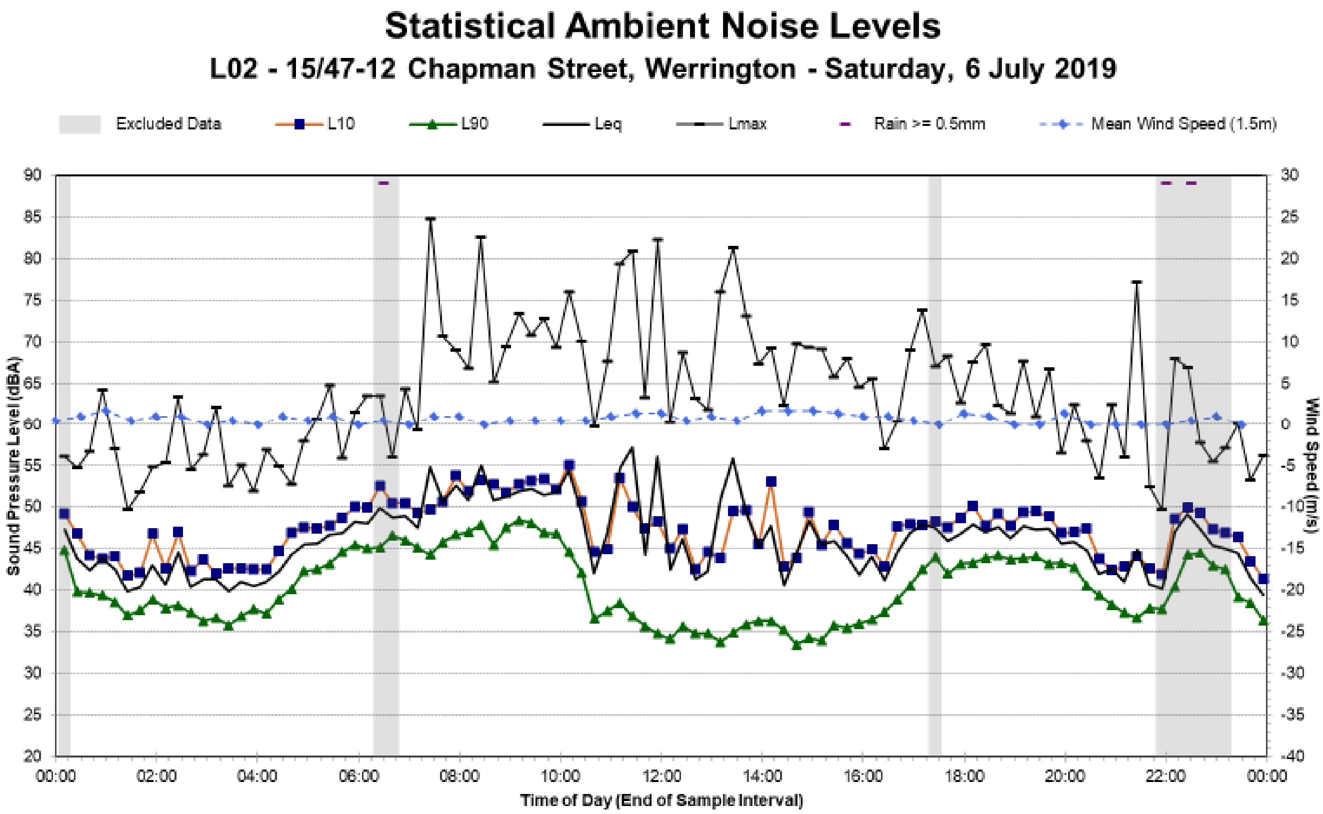
Statistical Ambient Noise Levels
L02 - 15/47-12 Chapman Street, Werrington - Saturday, 6 July 2019
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)
90
85
80
75
70
65
60
55
50
45
40
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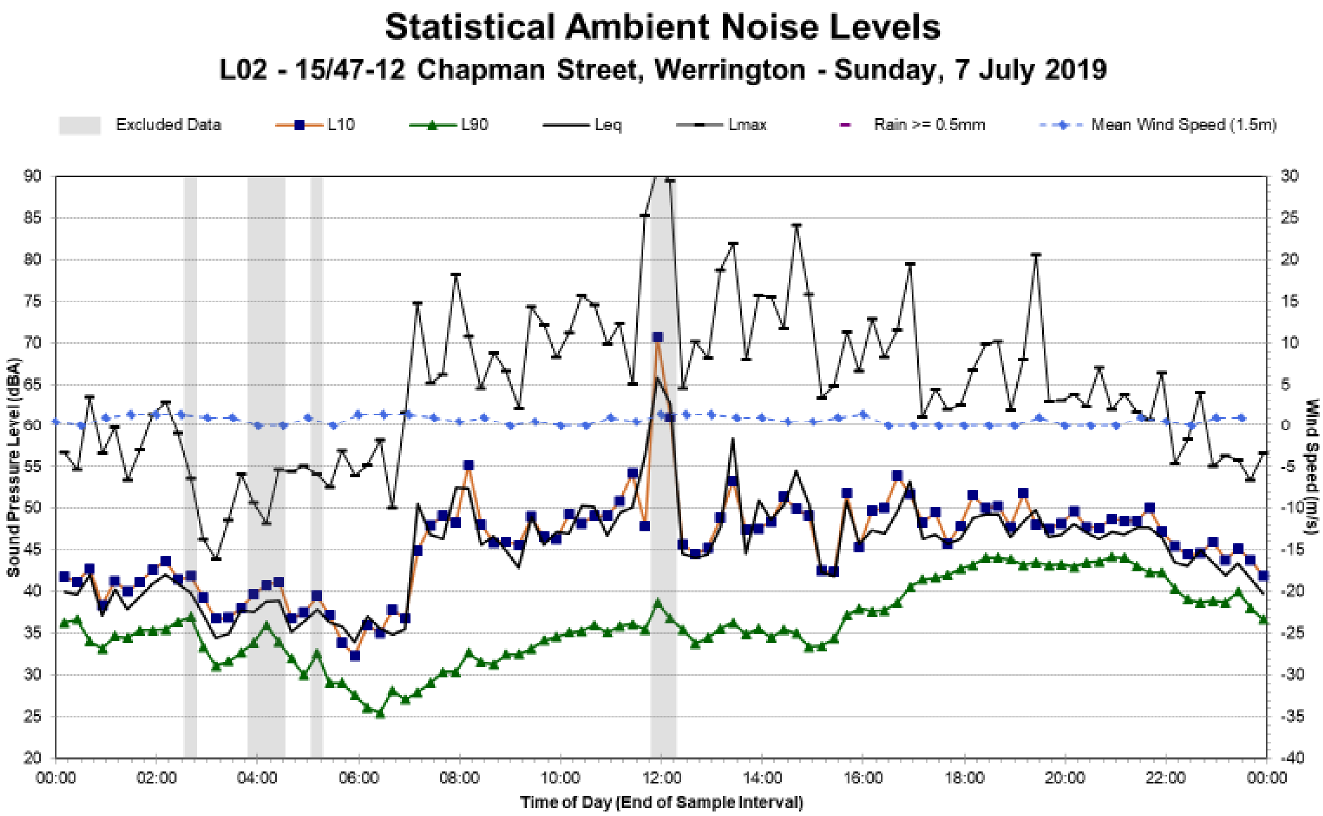
Statistical Ambient Noise Levels
L02 - 15/47-12 Chapman Street, Werrington - Sunday, 7 July 2019
Excluded Data
L10
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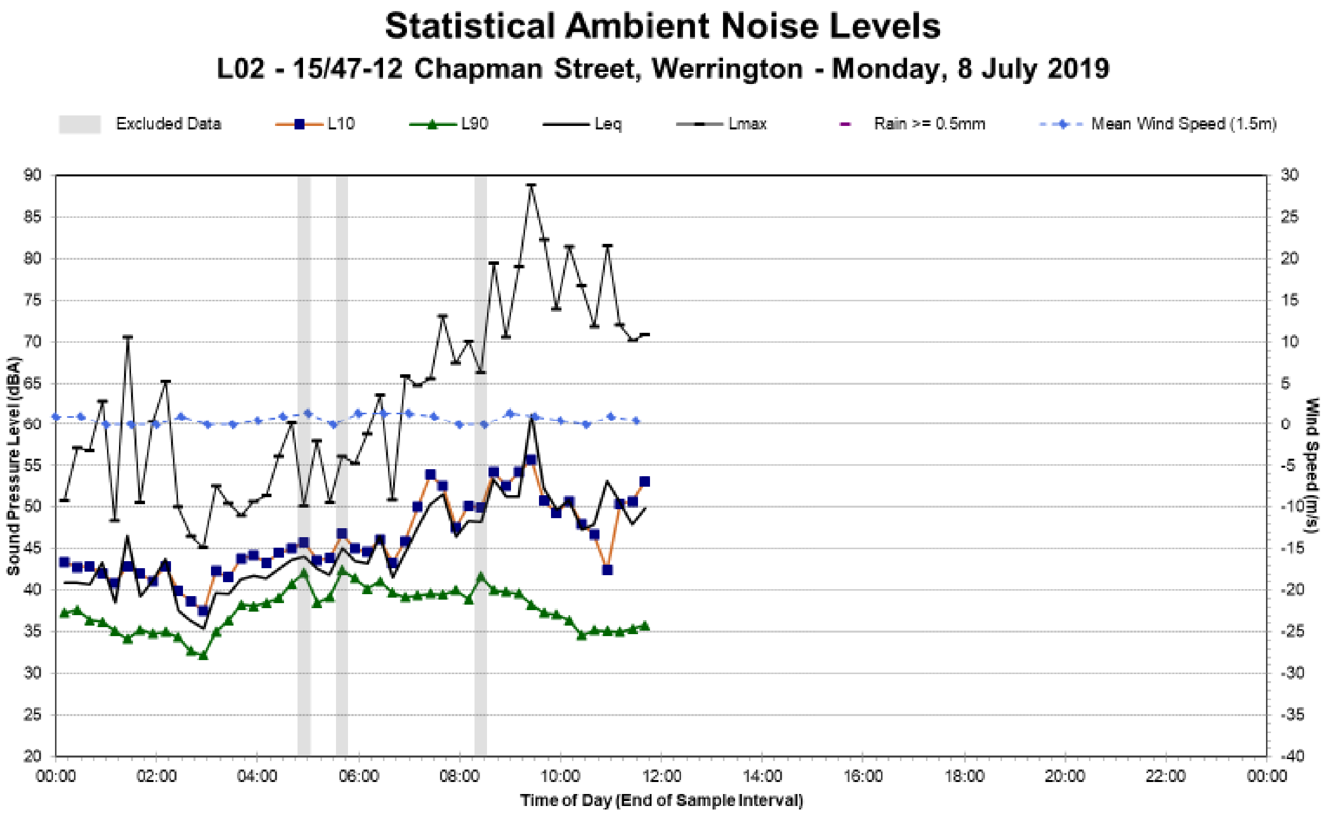
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L02 - 15/47-12 Chapman Street, Werrington - Monday, 8 July 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)

Noise Monitoring Location	L.03
Noise Monitoring Address	**16 Chapman Street, Werrington**

Logger Device Type: Brüel and Kjær 2250L, Logger Serial No: 3004636
Sound Level Meter Device Type: Brüel and Kjær 2270, Sound Level Meter Serial No: 3008204

Ambient noise logger deployed at residential address 50 m north of the Wollemi College within the 16 Chapman Street Precinct proposed location.
Attended noise measurements indicate the ambient noise environment at this location is dominated by natural fauna and bird song, distant trains along the T1 line, overhead aircraft, and distant traffic along the Great Western Highway.

Recorded Noise Levels (LAmax):
27/06/2019: Birdsong 45 – 50, Rail horn 50, Motorbike along GWH 50, Aircraft 46 – 58, PA from Juvenile Centre 46.

Map of Noise Monitoring Location

Ambient Noise Logging Results – ICNG Defined Time Periods

Monitoring Period	Noise Level (dBA)			
	RBL	**LAeq**	**L10**	**L1**
Daytime	38	51	48	56
Evening	46	50	51	54
Night-time	39	48	48	52

Ambient Noise Logging Results – RNP Defined Time Periods

Monitoring Period	Noise Level (dBA)	
	LAeq(period)	**LAeq(1hour)**
Daytime (7am-10pm)	50	56
Night-time (10pm-7am)	48	54

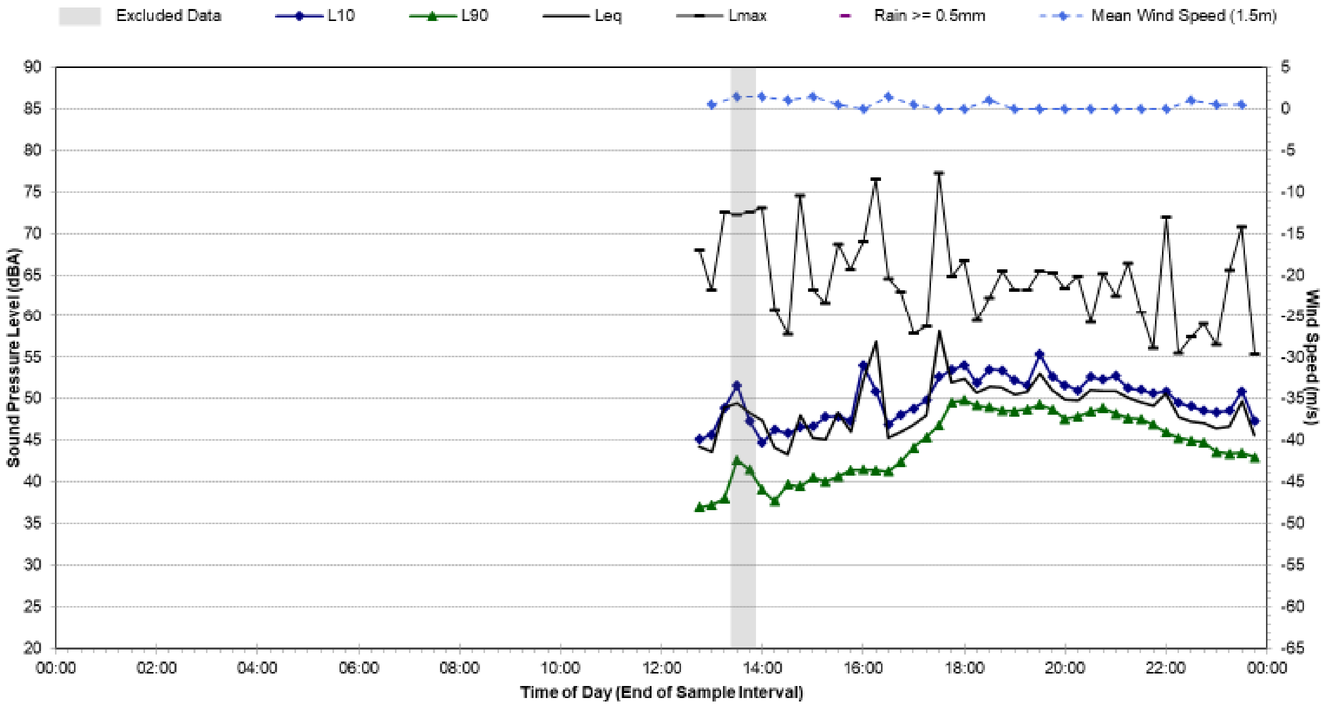
Attended Noise Measurement Results

Date	Start Time	Measured Noise Level (dBA)		
		LA90	**LAeq**	**LAmax**
27/06/2019	12:35	37	42	59

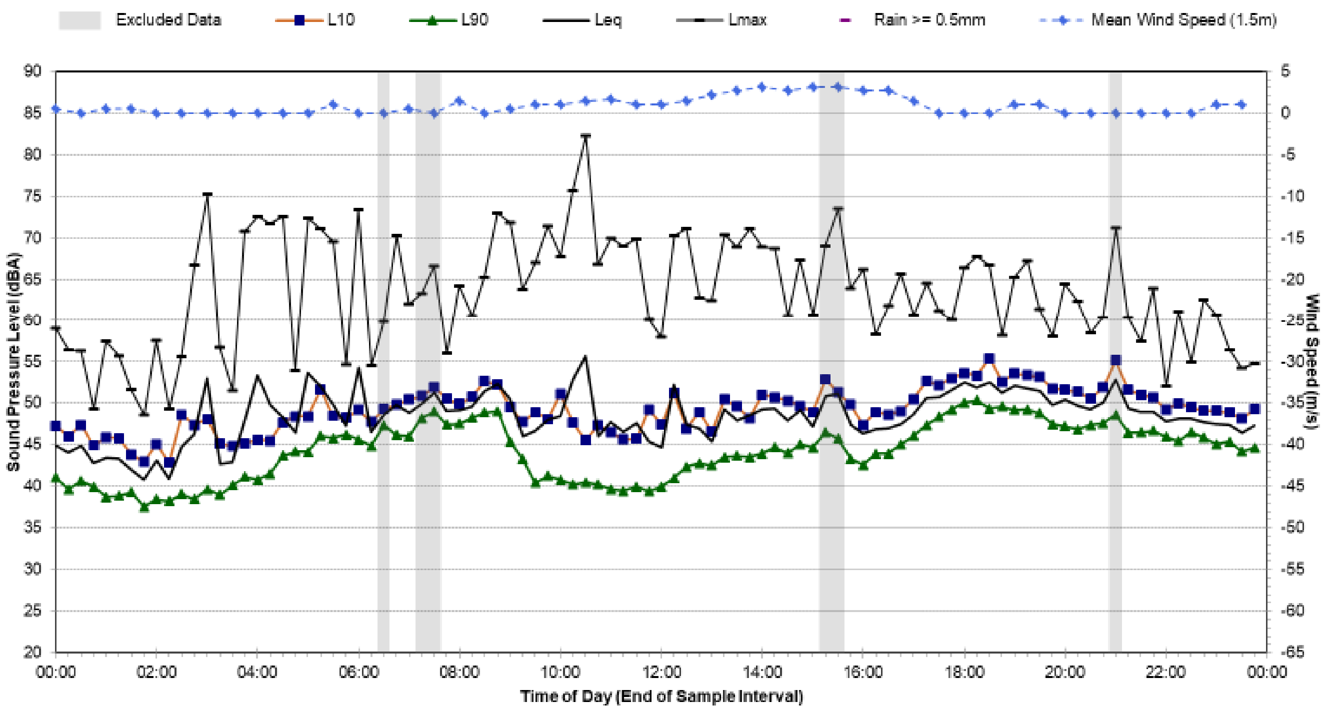
Photo of Noise Monitoring Location

Note 1: 8 July excluded from data

Statistical Ambient Noise Levels
L02 - 16 Chapman St, Werrington (Wollemi College) - Thursday, 27 June 2019

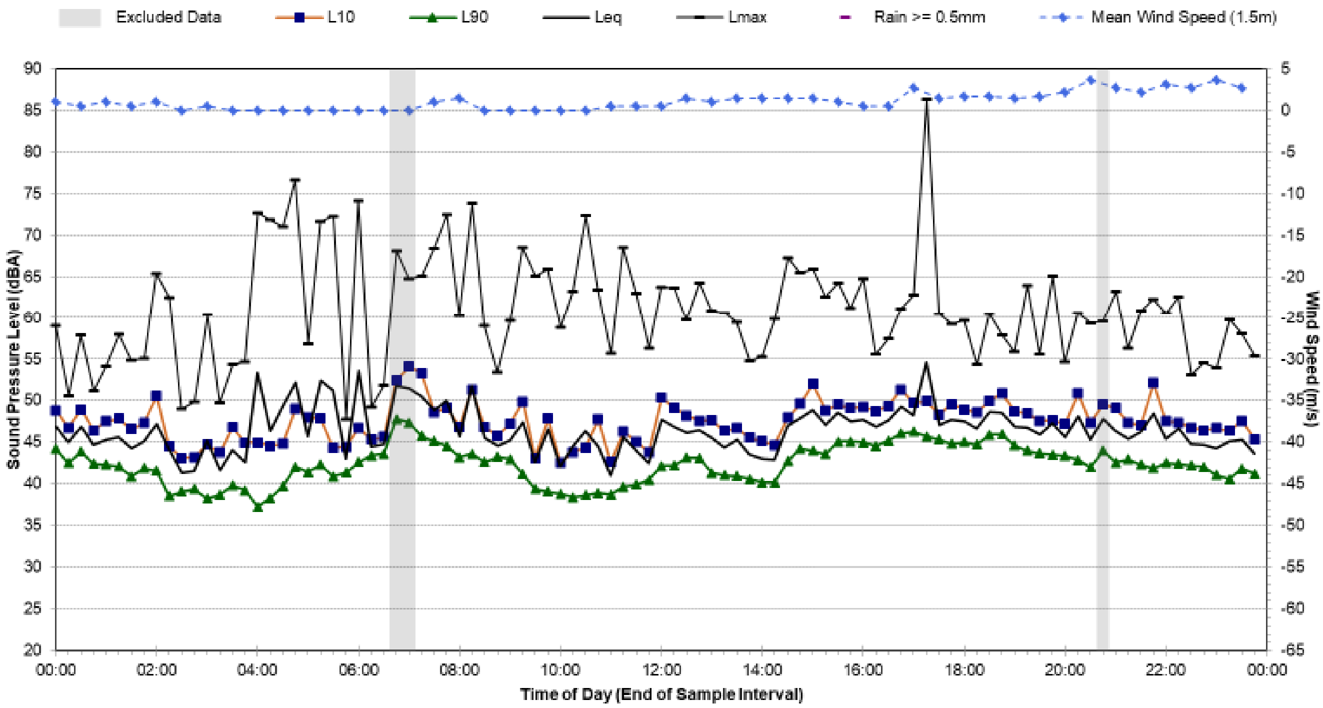


Statistical Ambient Noise Levels
L02 - 16 Chapman St, Werrington (Wollemi College) - Friday, 28 June 2019



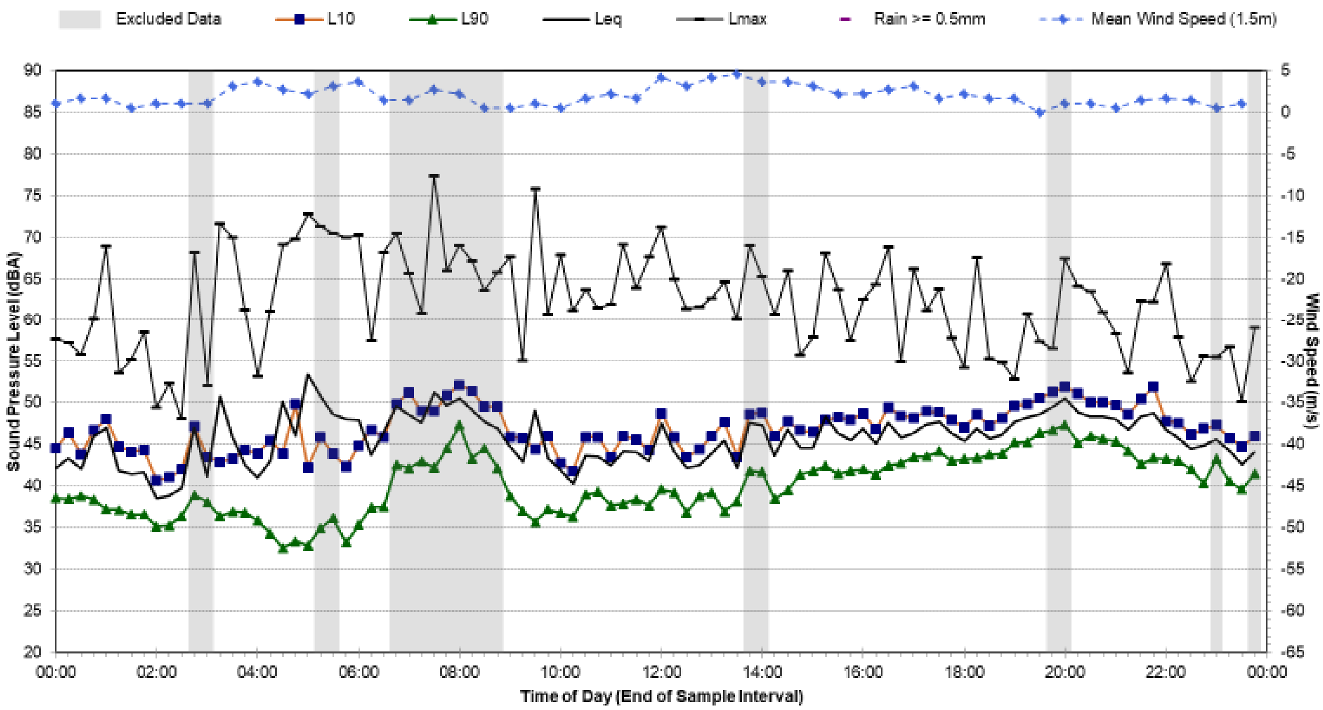
Statistical Ambient Noise Levels

L02 - 16 Chapman St, Werrington (Wollemi College) - Saturday, 29 June 2019



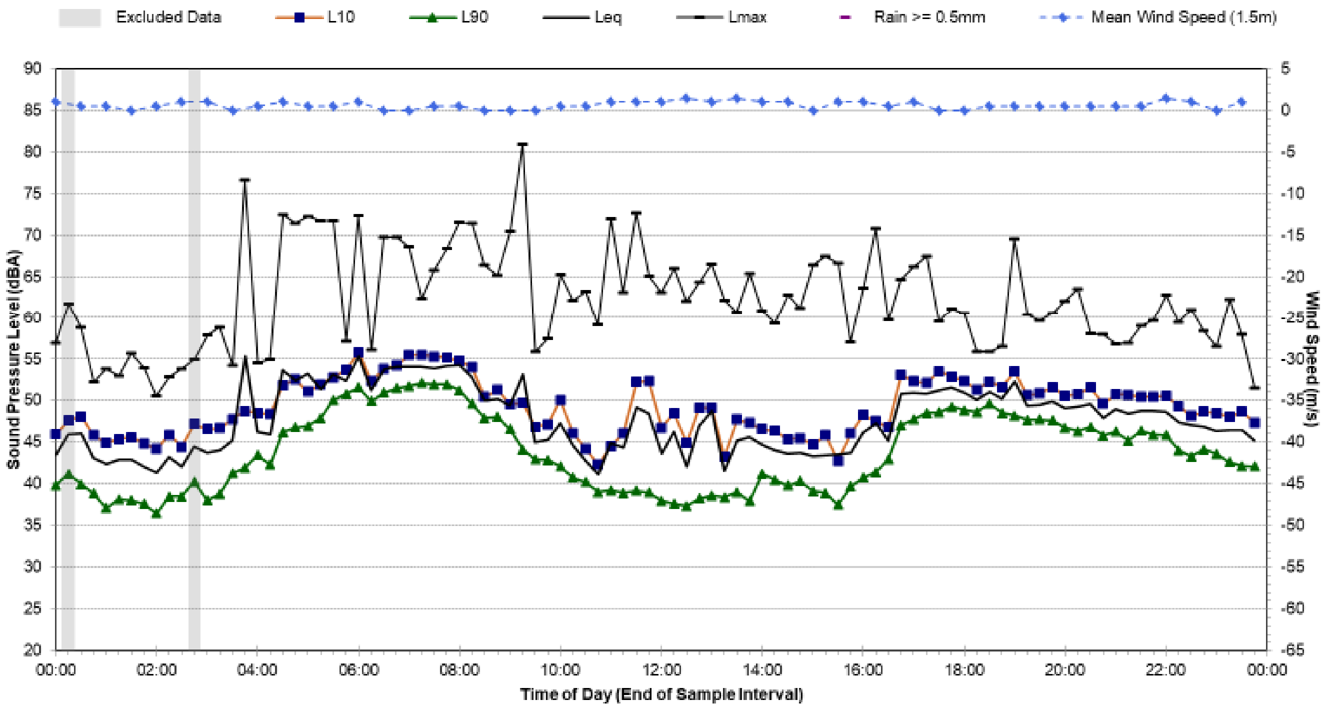
Statistical Ambient Noise Levels

L02 - 16 Chapman St, Werrington (Wollemi College) - Sunday, 30 June 2019



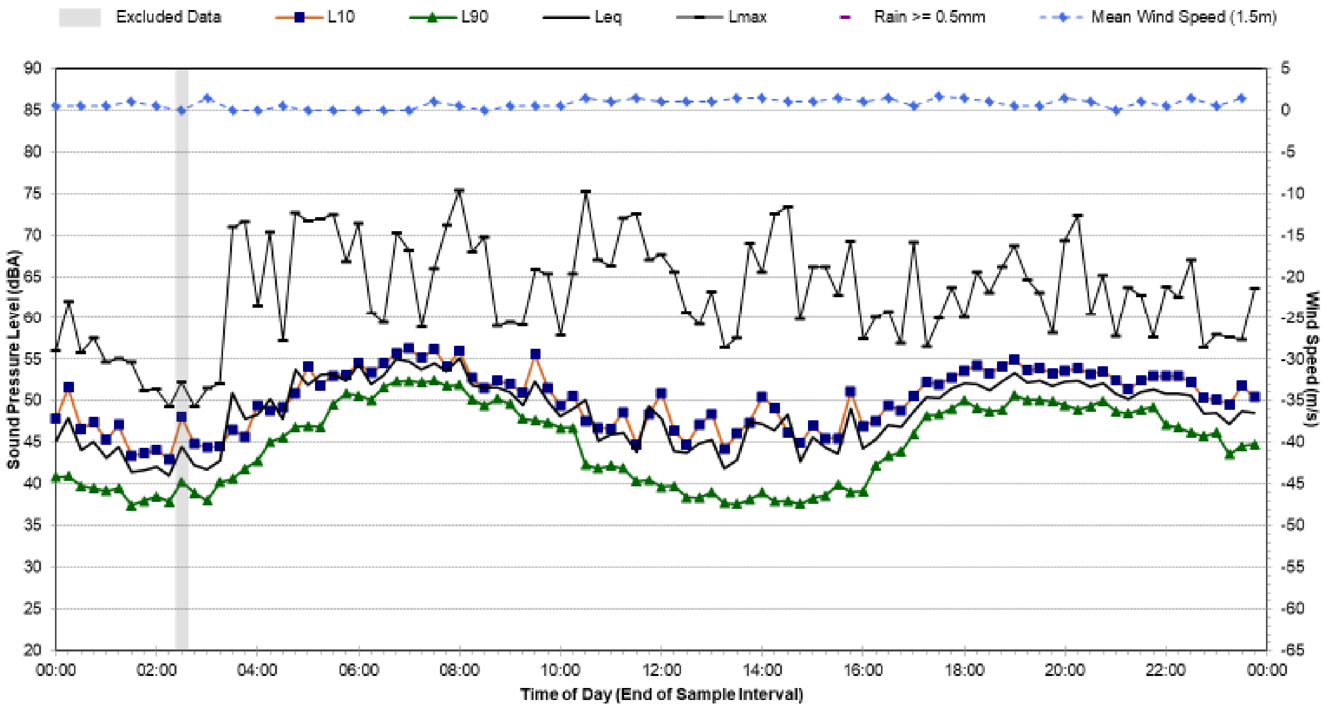
Statistical Ambient Noise Levels

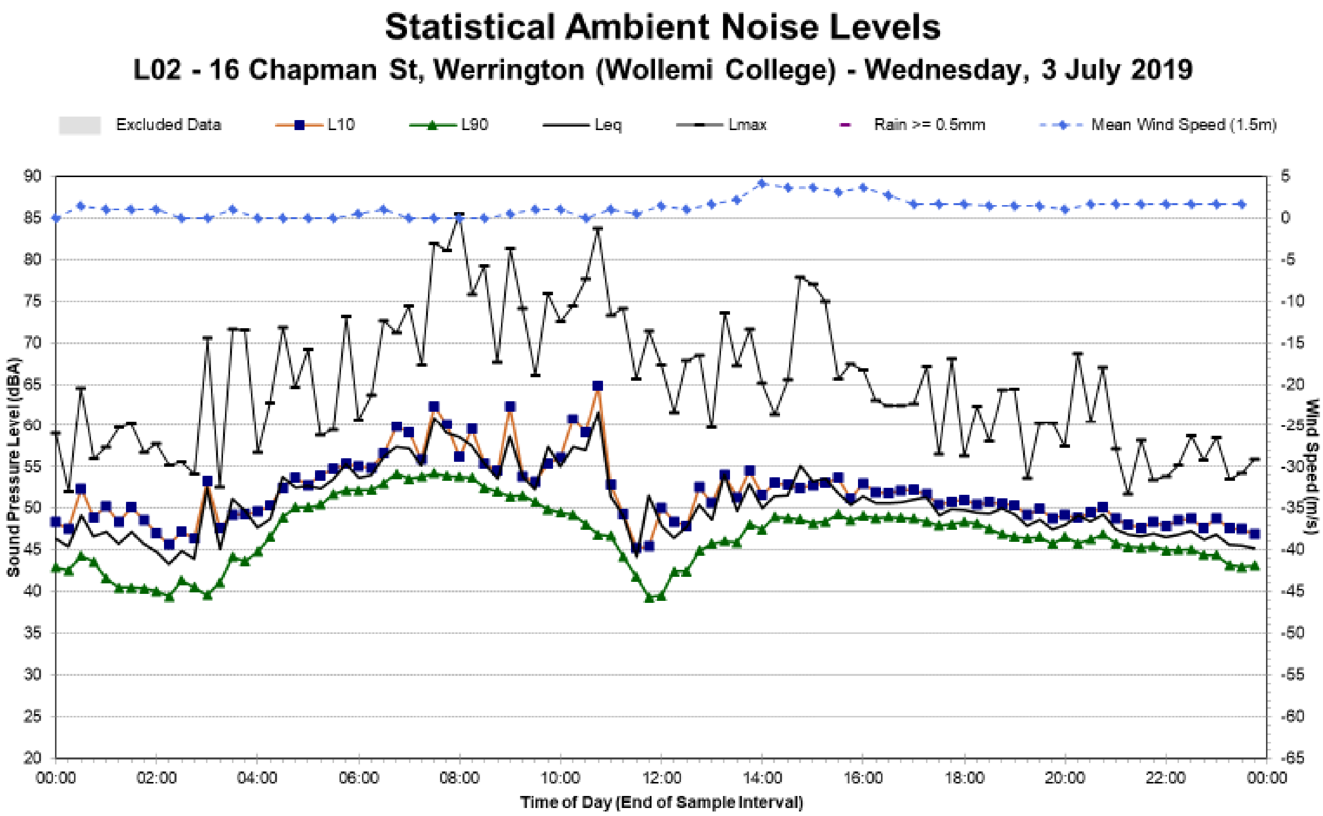
L02 - 16 Chapman St, Werrington (Wollemi College) - Monday, 1 July 2019

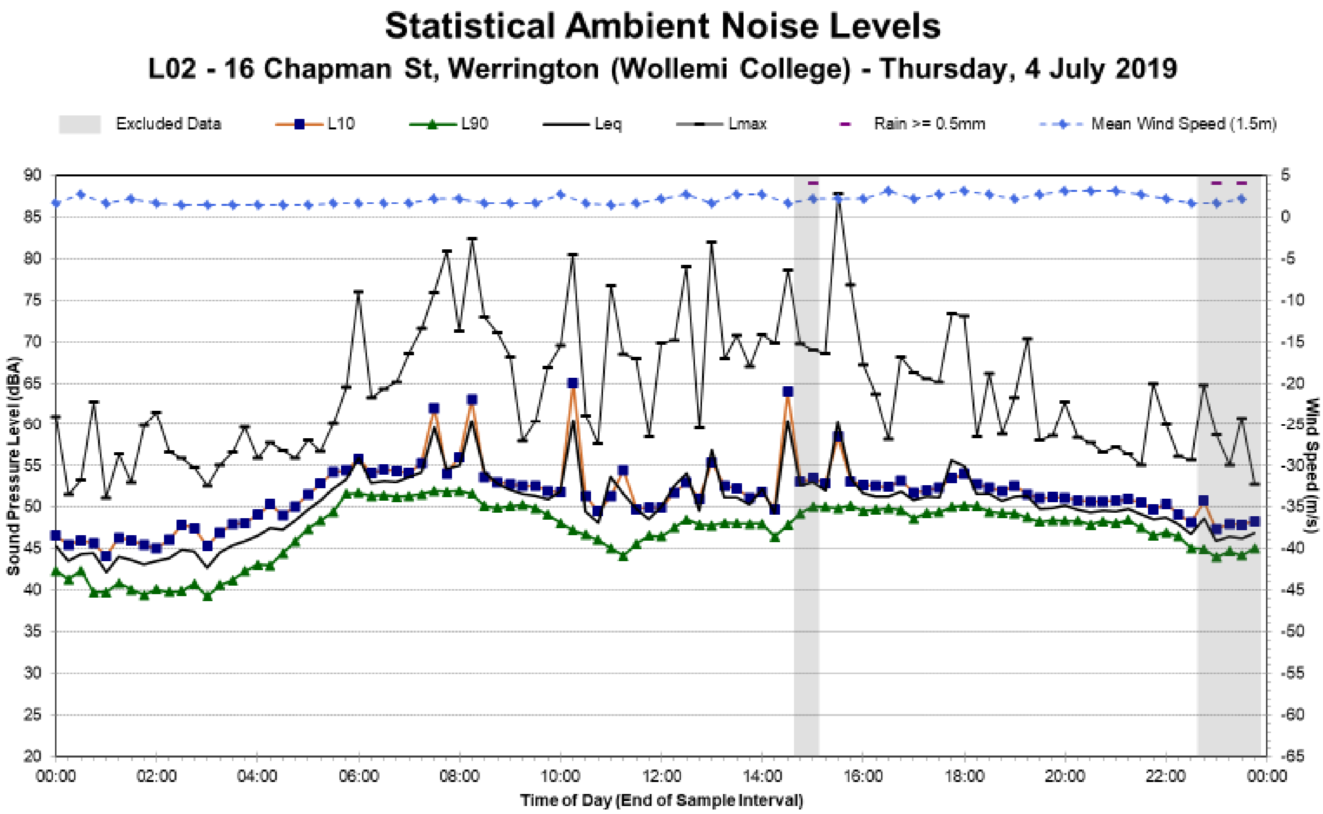


Statistical Ambient Noise Levels

L02 - 16 Chapman St, Werrington (Wollemi College) - Tuesday, 2 July 2019

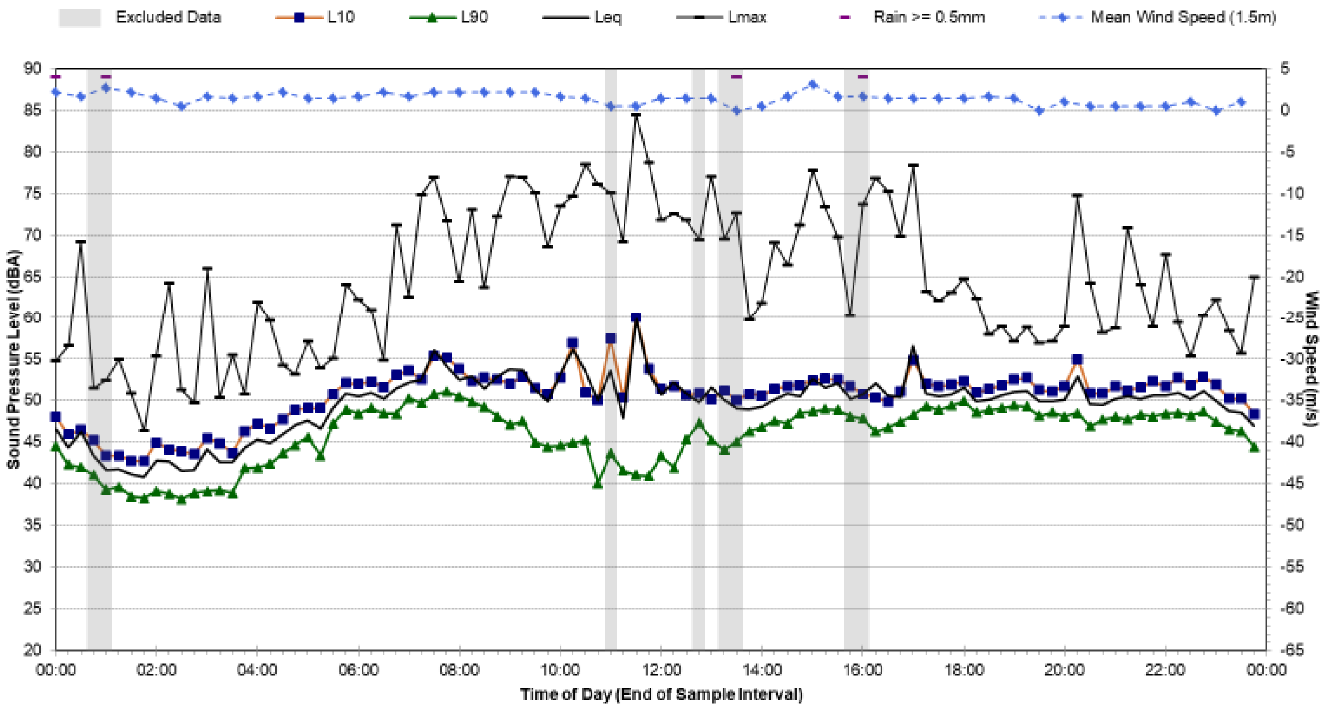



Statistical Ambient Noise Levels
L02 - 16 Chapman St, Werrington (Wollemi College) - Wednesday, 3 July 2019
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L02 - 16 Chapman St, Werrington (Wollemi College) - Thursday, 4 July 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)

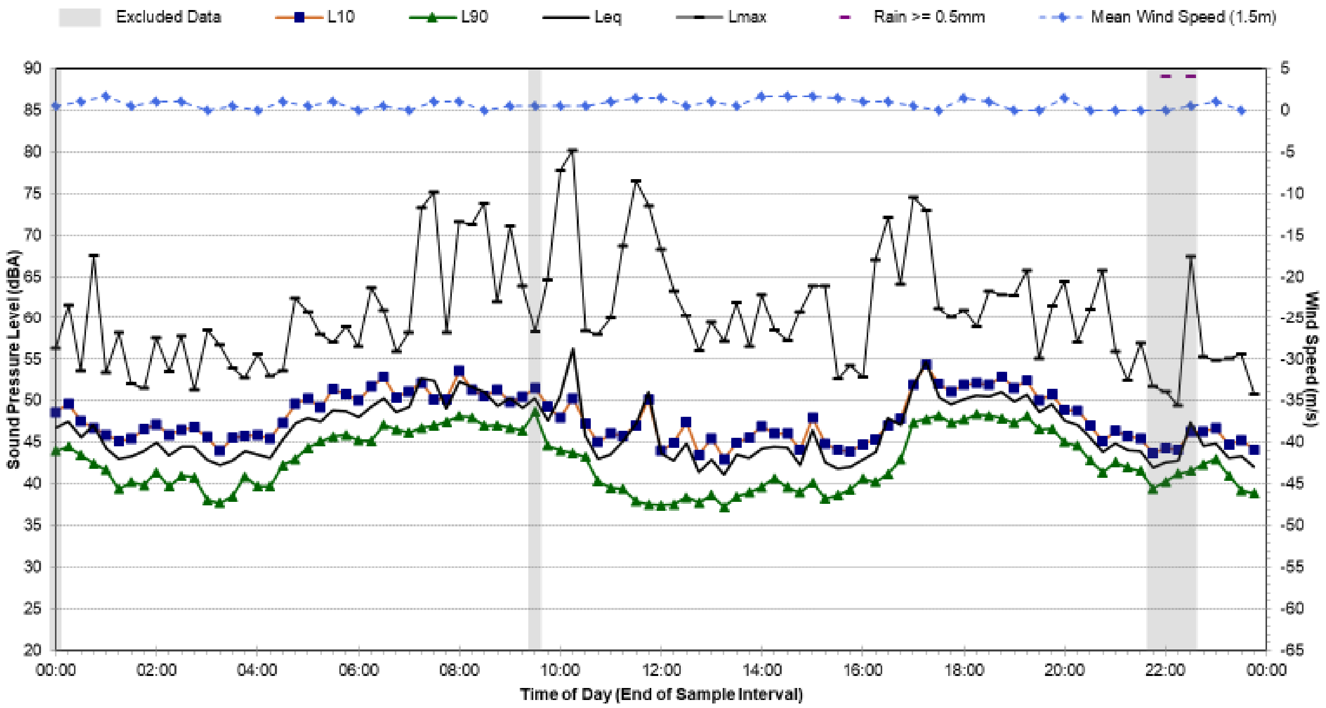
Statistical Ambient Noise Levels

L02 - 16 Chapman St, Werrington (Wollemi College) - Friday, 5 July 2019



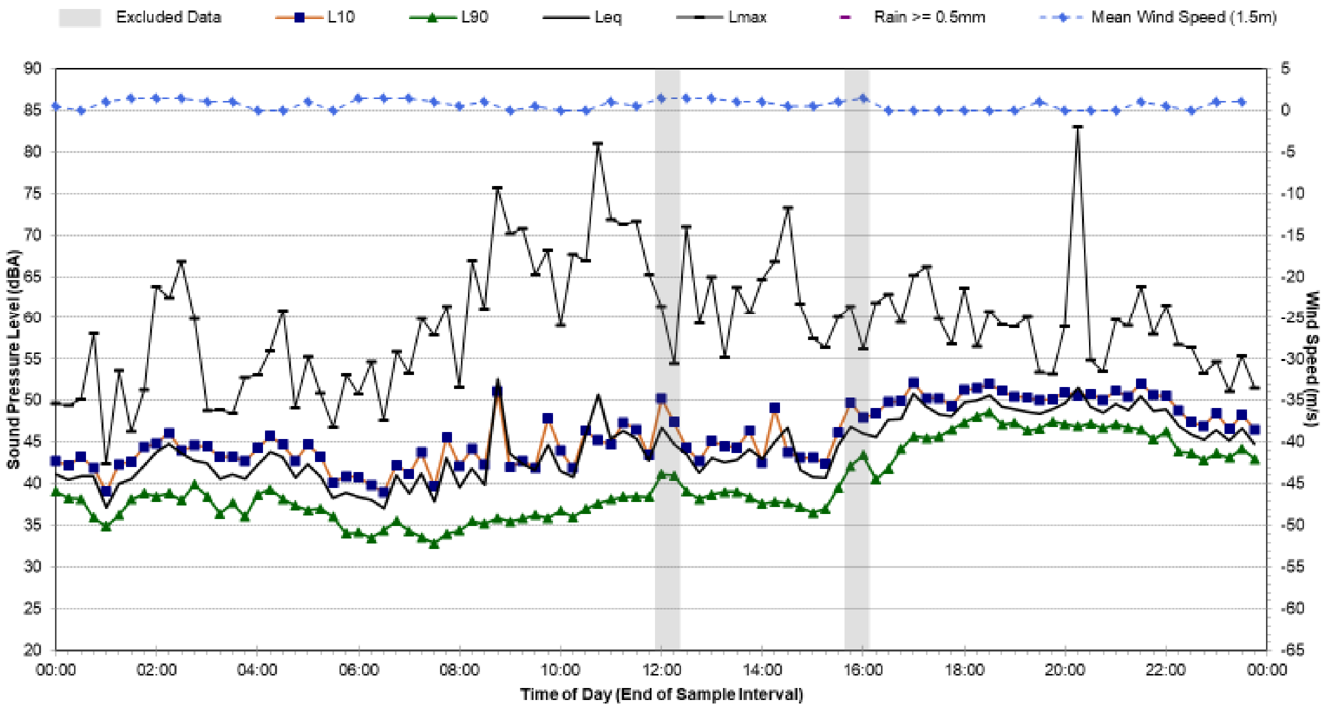
Statistical Ambient Noise Levels

L02 - 16 Chapman St, Werrington (Wollemi College) - Saturday, 6 July 2019



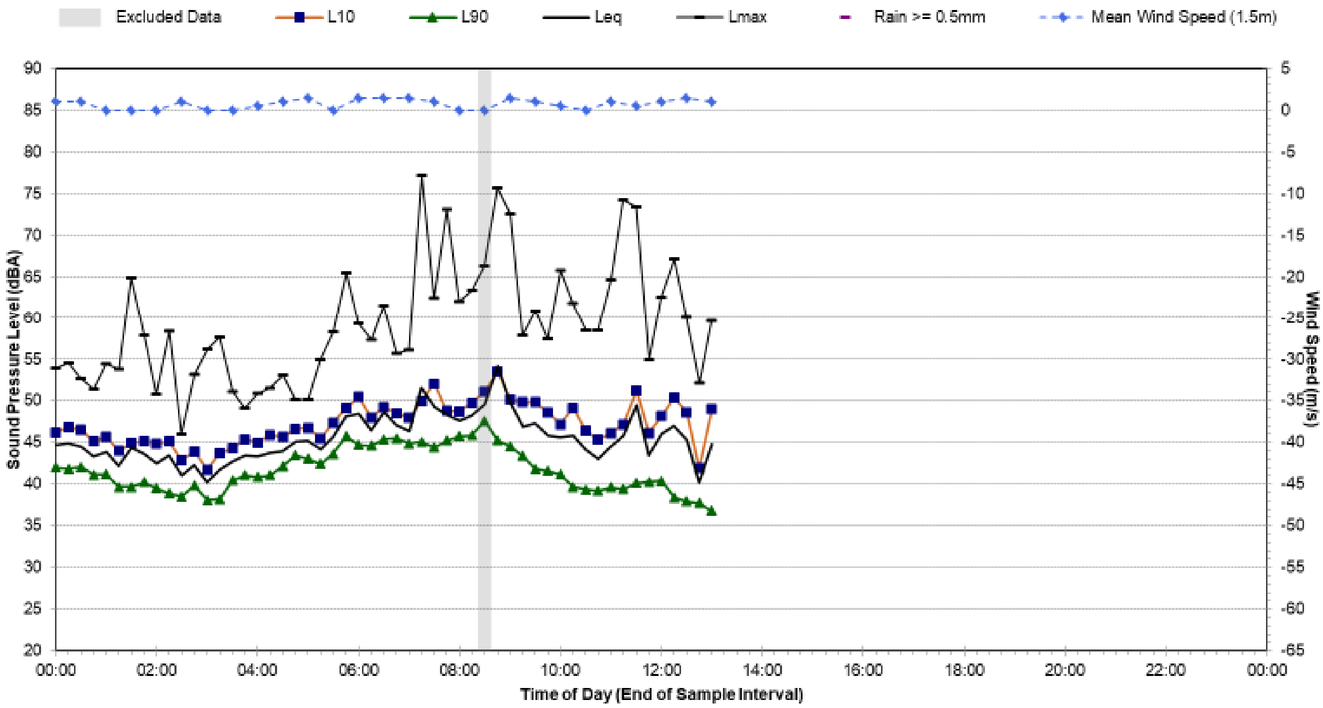
Statistical Ambient Noise Levels

L02 - 16 Chapman St, Werrington (Wollemi College) - Sunday, 7 July 2019



Statistical Ambient Noise Levels

L02 - 16 Chapman St, Werrington (Wollemi College) - Monday, 8 July 2019



Noise Monitoring Location	L.04
Noise Monitoring Address	16 Chapman Street, Werrington

Logger Device Type: Svantek 957, Logger Serial No: 21423
Sound Level Meter Device Type: Brüel and Kjær 2270, Sound Level Meter Serial No: 3008204

Ambient noise logger deployed at with the 16 Chapman Street Precinct Development proposal, approximately 160 m west north-west of the Cobham Juvenile Centre.

Attended noise measurements indicate the ambient noise environment at this location is dominated by natural fauna and birdsong, distant traffic along the Great Western Highway, overhead aircraft and trains along the T1 line.

Recorded Noise Levels (LAmax):
27/06/2019: Birdsong 40 – 56, Distant bikes along GWH 44 – 48, Aircraft 50, Rail movements 42 – 52, Distant truck brakes 46 – 48.

Map of Noise Monitoring Location

Ambient Noise Logging Results – ICNG Defined Time Periods

Monitoring Period	Noise Level (dBA)			
	RBL	LAeq	L10	L1
Daytime	38	48	46	53
Evening	44	48	49	53
Night-time	37	46	46	51

Ambient Noise Logging Results – RNP Defined Time Periods

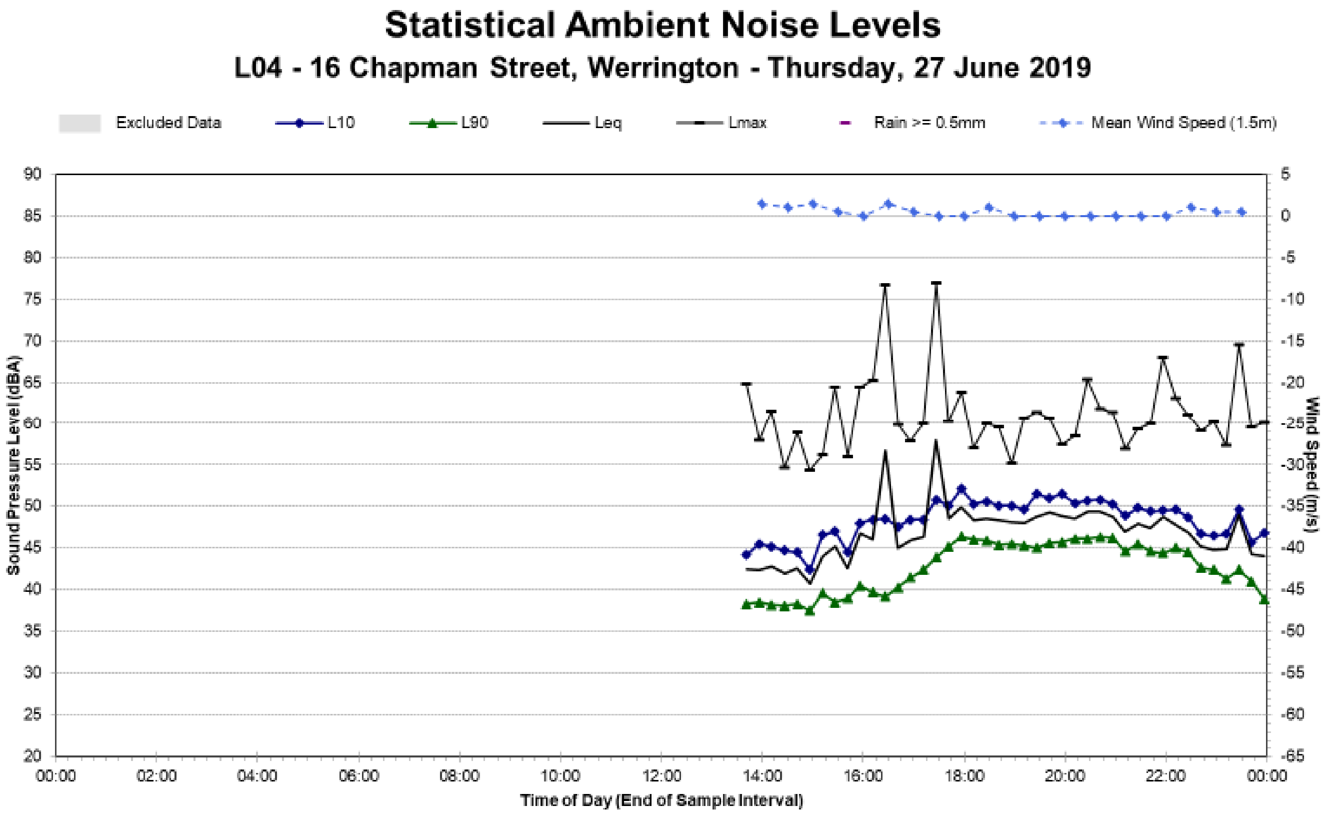
Monitoring Period	Noise Level (dBA)	
	LAeq(period)	LAeq(1hour)
Daytime (7am-10pm)	48	52
Night-time (10pm-7am)	46	52

Attended Noise Measurement Results

Date	Start Time	Measured Noise Level (dBA)		
		LA90	LAeq	LAmax
27/06/2019	13:20	40	43	64

Note 1: Calibration drift of 2 dB was observed. 8 July removed from data

Photo of Noise Monitoring Location


Statistical Ambient Noise Levels
L04 - 16 Chapman Street, Werrington - Thursday, 27 June 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)
90
85
80
75
70
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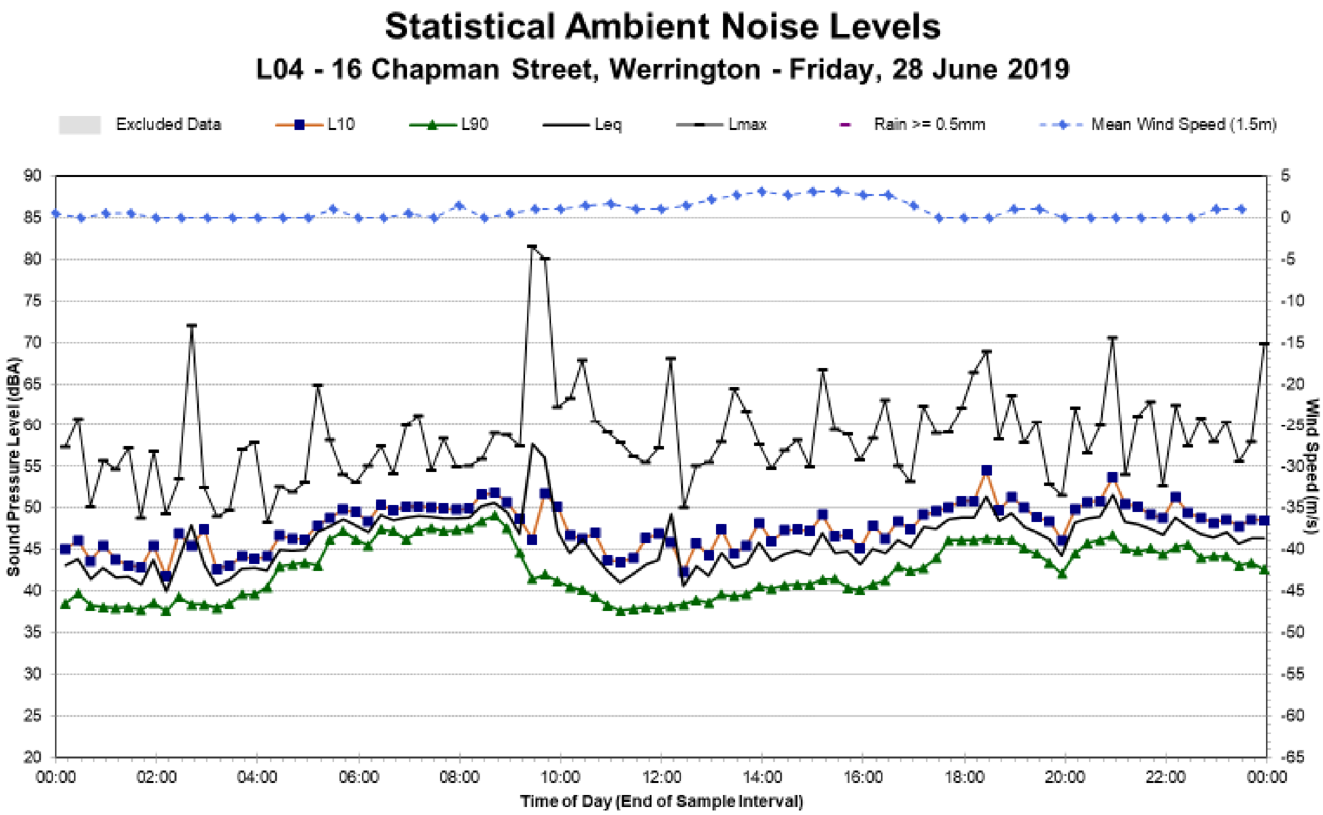
Statistical Ambient Noise Levels
L04 - 16 Chapman Street, Werrington - Friday, 28 June 2019
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)
90
85
80
75
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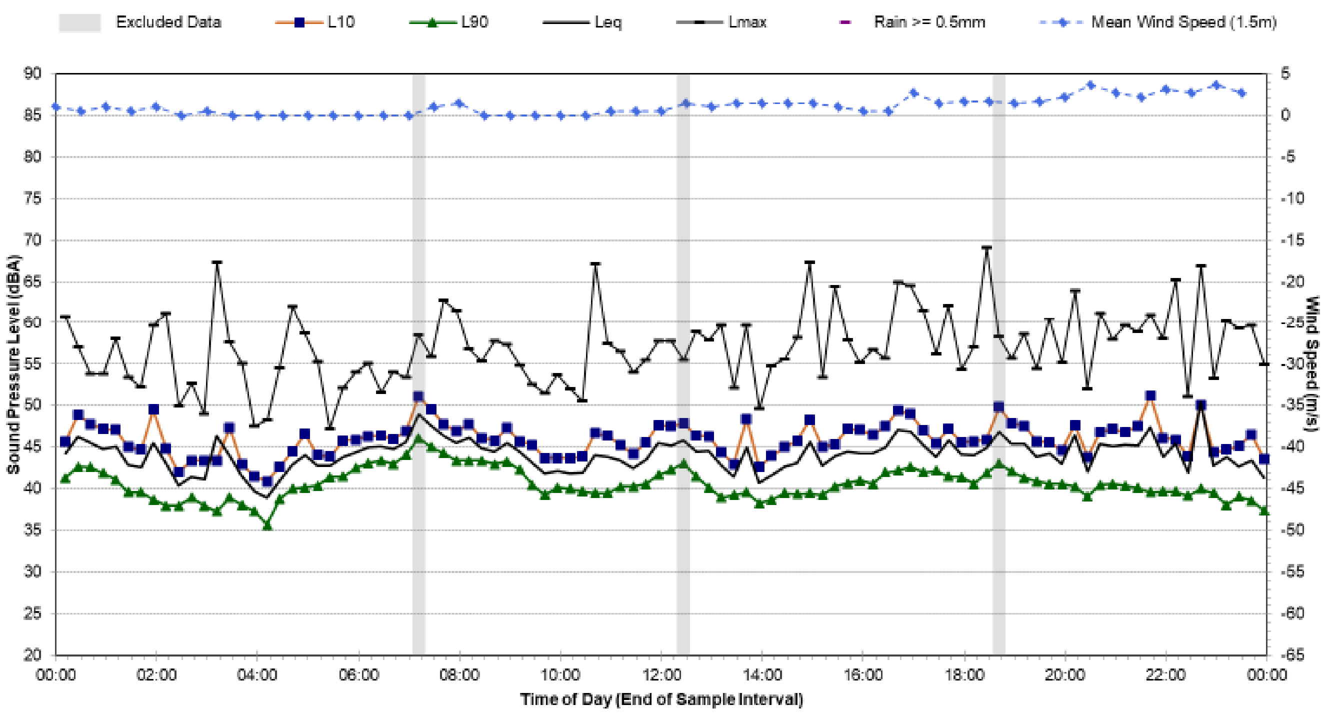
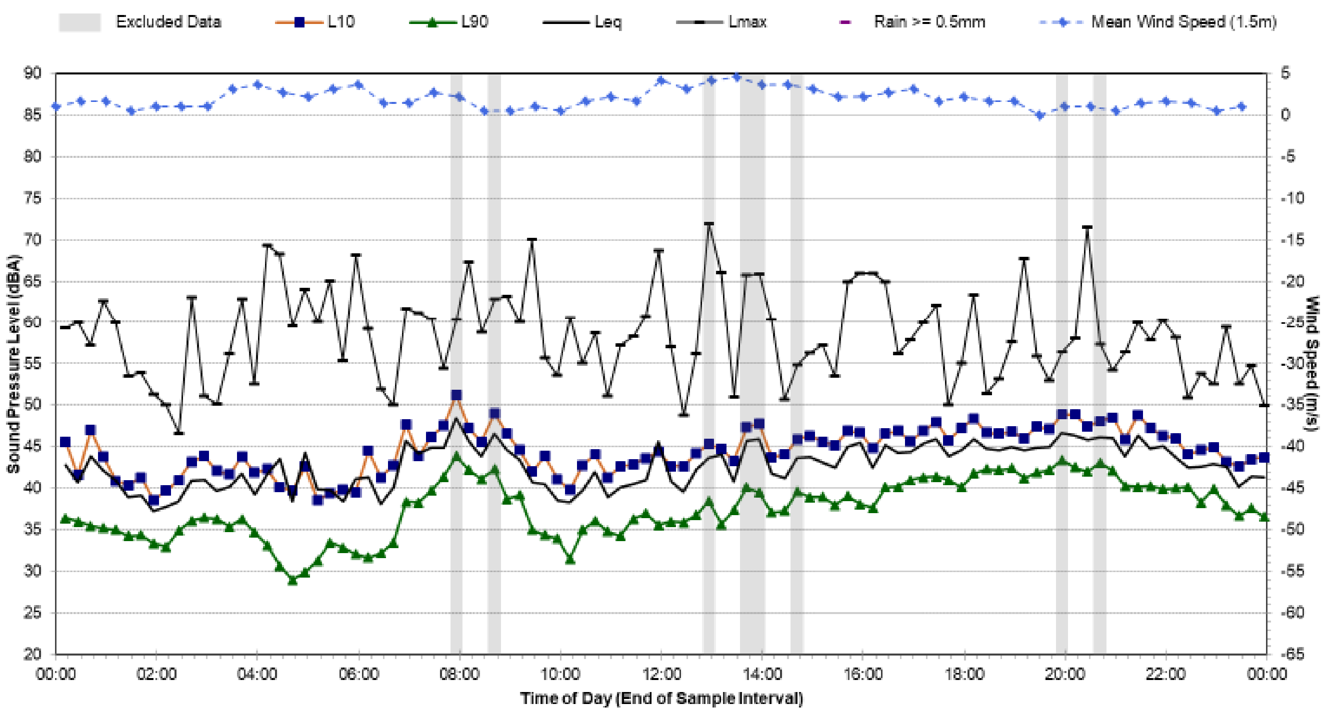
Statistical Ambient Noise Levels

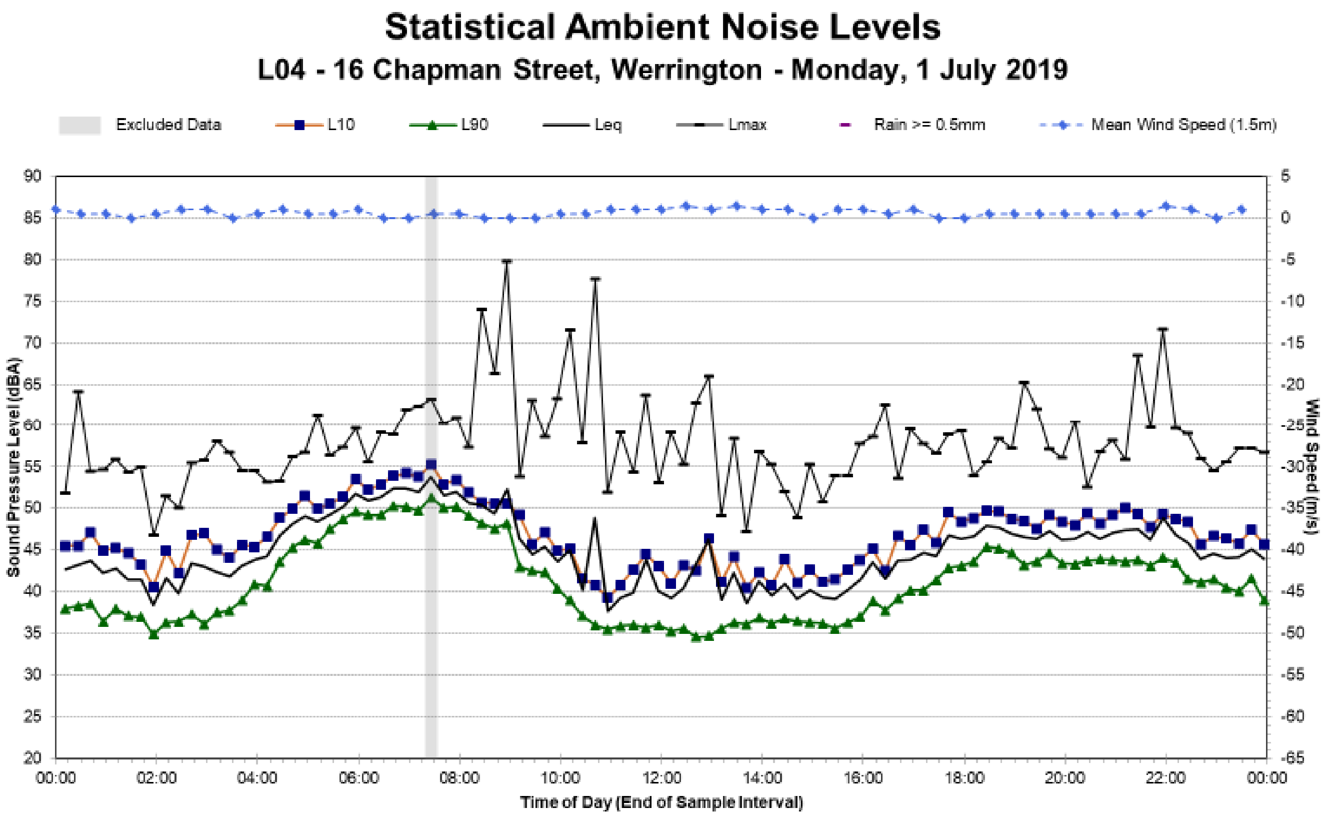
L04 - 16 Chapman Street, Werrington - Saturday, 29 June 2019

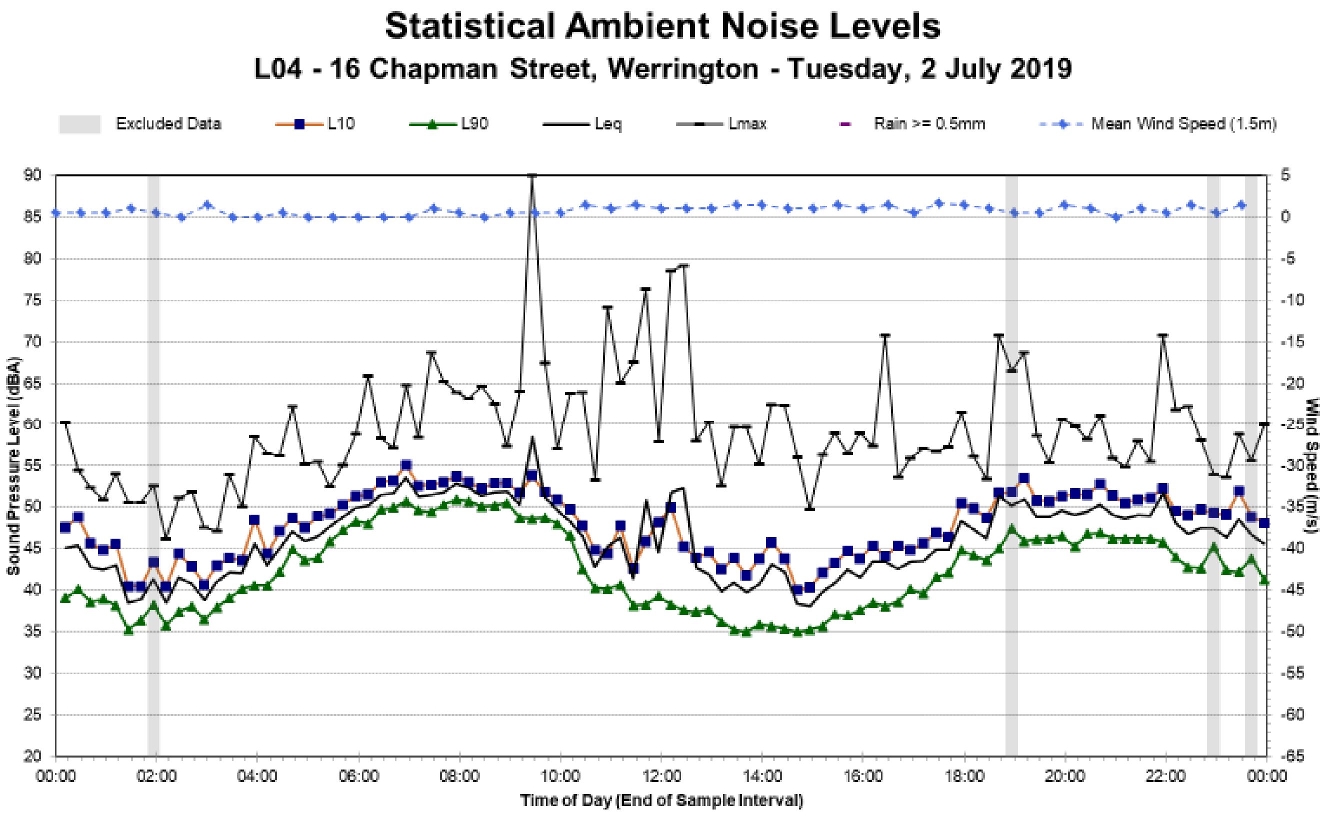


Statistical Ambient Noise Levels

L04 - 16 Chapman Street, Werrington - Sunday, 30 June 2019




Statistical Ambient Noise Levels
L04 - 16 Chapman Street, Werrington - Monday, 1 July 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
L04 - 16 Chapman Street, Werrington - Tuesday, 2 July 2019
Excluded Data
L10
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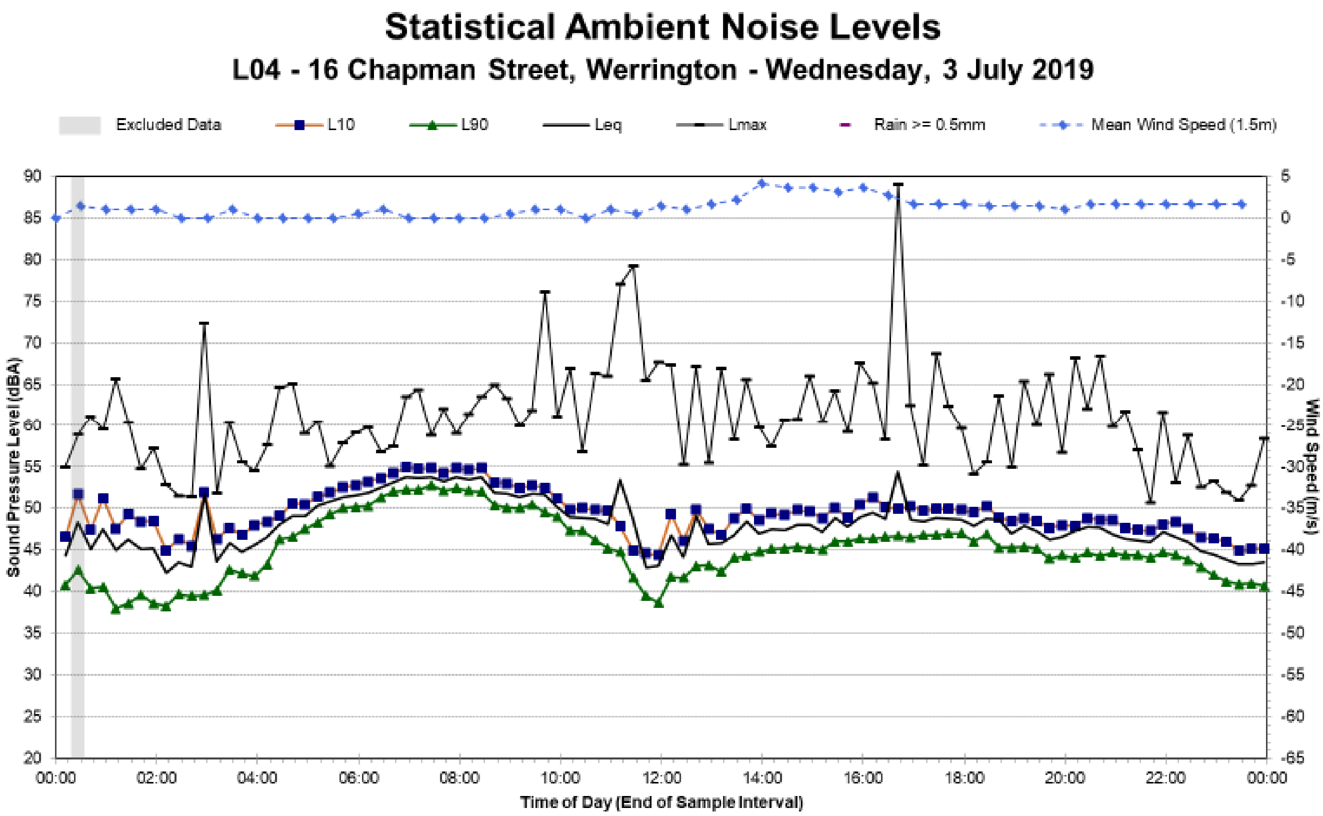
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L04 - 16 Chapman Street, Werrington - Wednesday, 3 July 2019
Excluded Data
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Lmax
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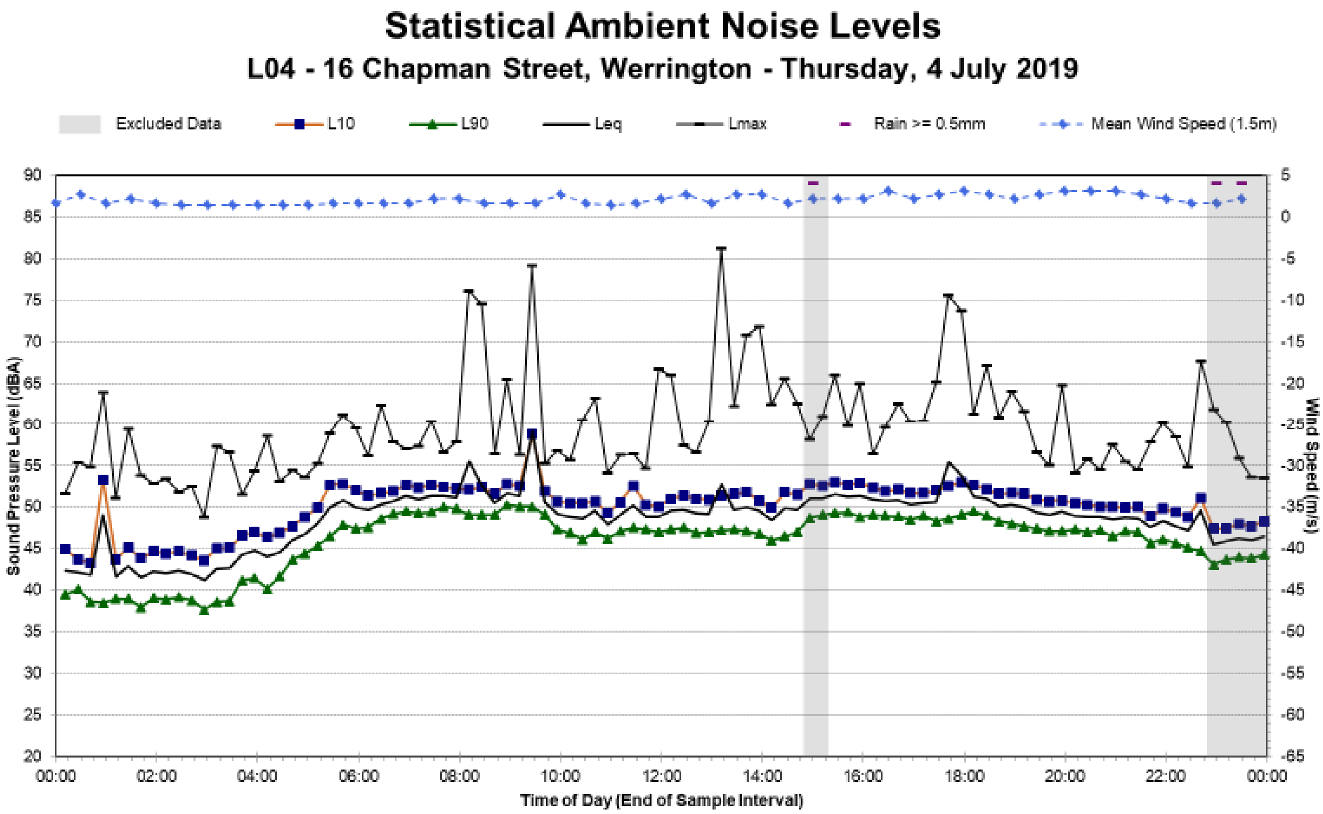
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
L04 - 16 Chapman Street, Werrington - Thursday, 4 July 2019
Excluded Data
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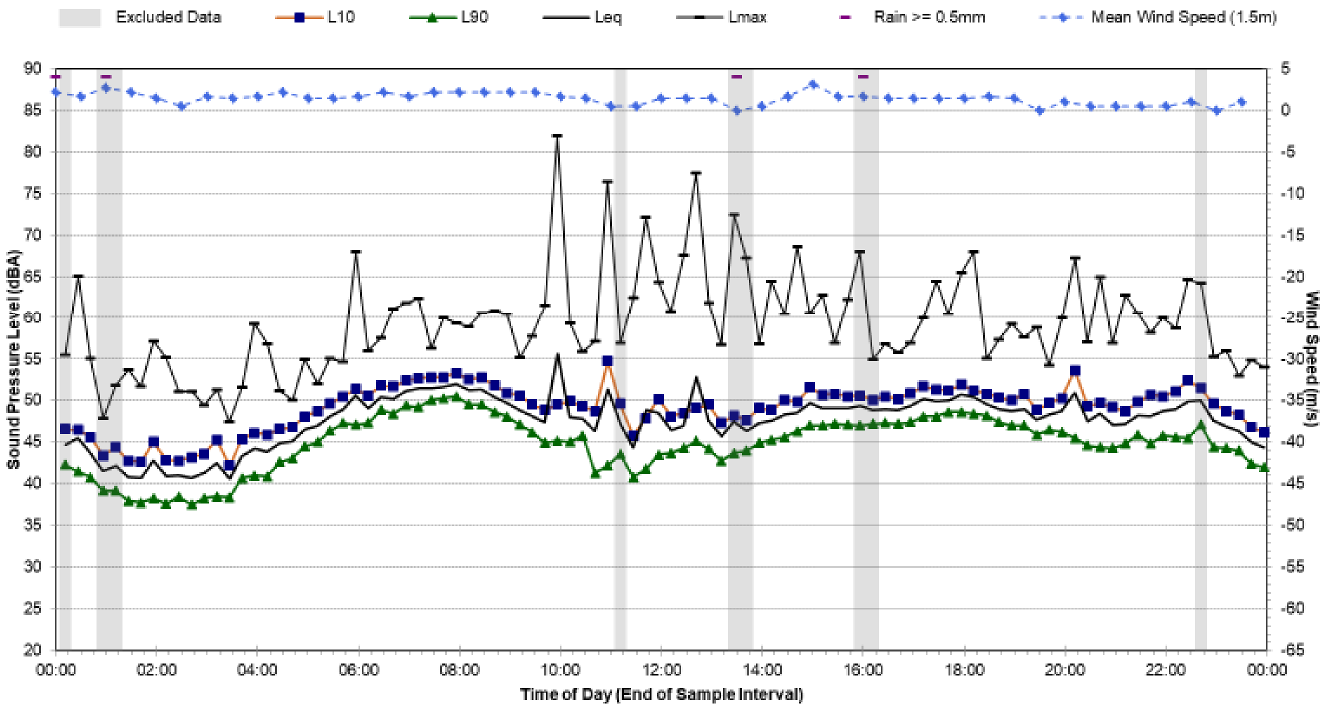
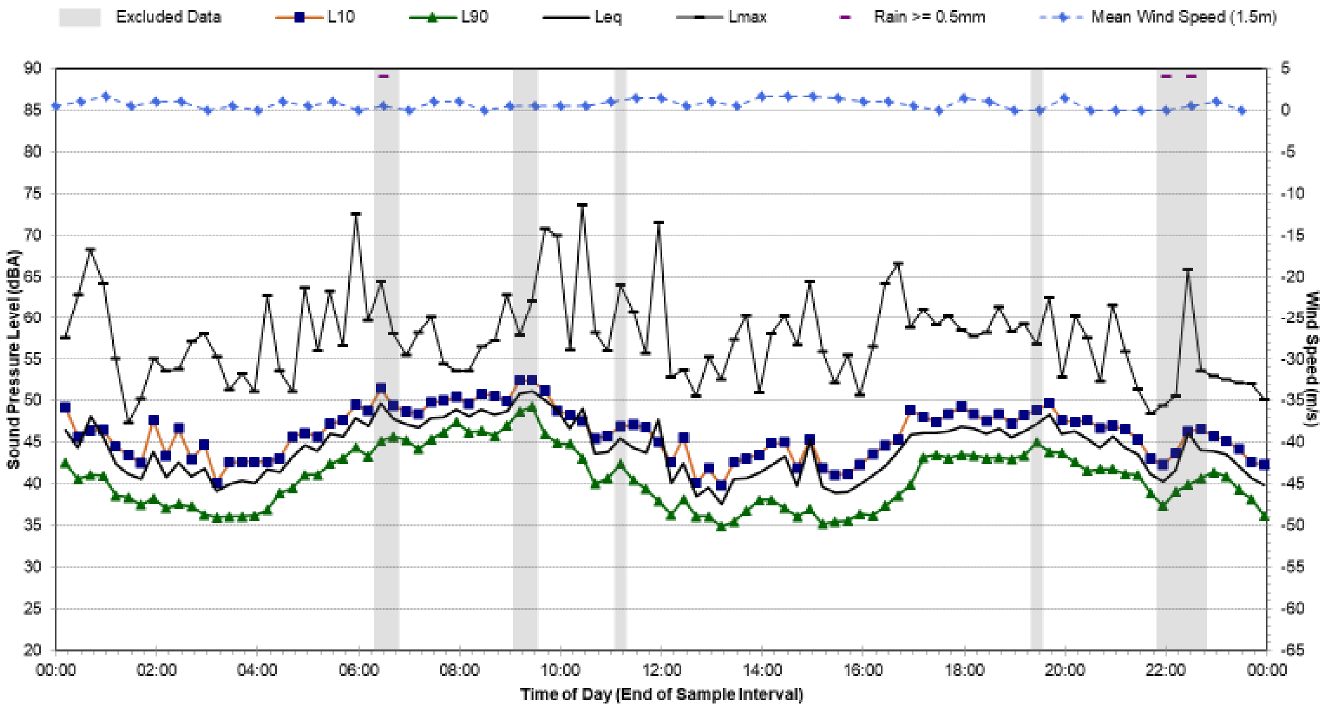
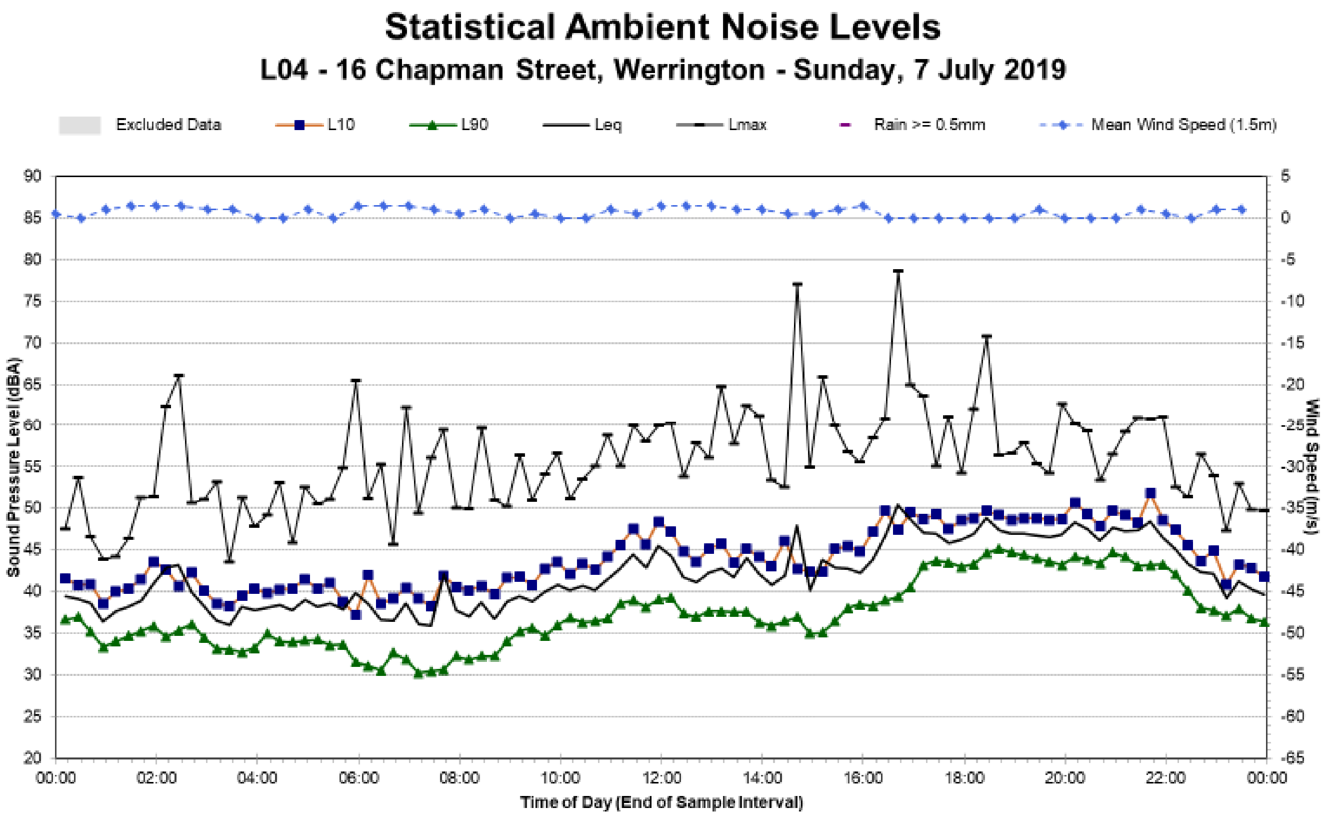
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)

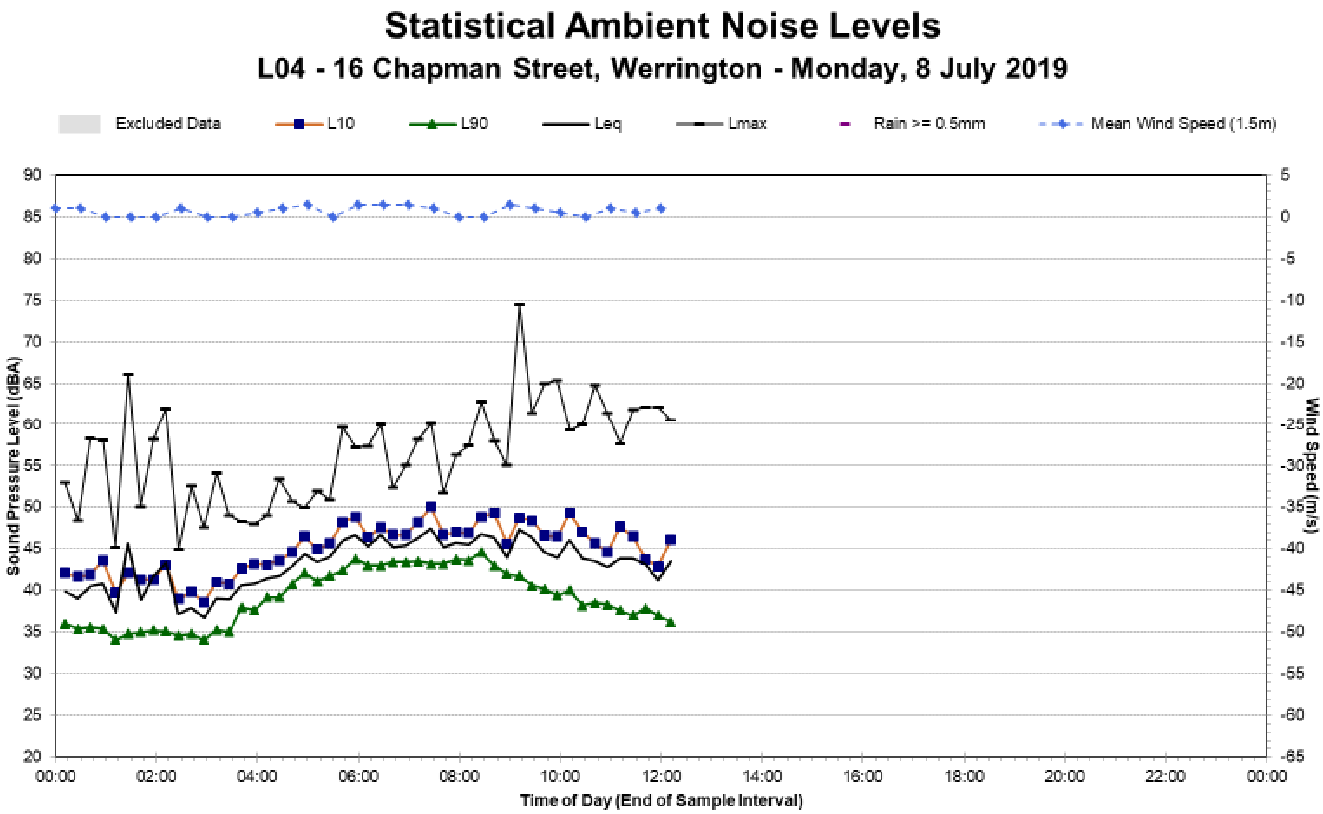
Statistical Ambient Noise Levels
L04 - 16 Chapman Street, Werrington - Friday, 5 July 2019



Statistical Ambient Noise Levels
L04 - 16 Chapman Street, Werrington - Saturday, 6 July 2019




Statistical Ambient Noise Levels
L04 - 16 Chapman Street, Werrington - Sunday, 7 July 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
L04 - 16 Chapman Street, Werrington - Monday, 8 July 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)

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