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DA Noise Impact Assessment

Proposed AMAN Residential Care Facility

20-21 Boorea Avenue, Lakemba

Report Number 610.17246-R01

9 June 2017

Lebanese Muslim Association (LMA)

c/-Impact Property Consultancy Pty Ltd (Impact Group)

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Version: v0.1

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DOCUMENT CONTROL

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1 INTRODUCTION

SLR Consulting Australia Pty Ltd (SLR) has been commissioned by Impact Property Consultancy Pty Ltd (Impact Group) on behalf of the Lebanese Muslim Association (LMA) to prepare a noise impact assessment (NIA) for a proposed AMAN Residential Care Facility (RCF) to be located at 20-21 Boorea Avenue, Lakemba. The NIA is required for the proposed RCF development application (DA) to determine the feasibility of the proposed site usage on the basis of acoustics. The NIA is to support the DA Submission to Canterbury Council for amendment to Schedule 1 Additional Permitted Uses to allow development for the purposes of a Residential Care Facility at 21 Boorea Avenue, Lakemba.

This assessment addresses the noise impact of the existing road traffic and industrial noise on the amenity of the proposed RCF, sets criteria for noise emissions from the proposed RCF with respect to mechanical plant and establishes appropriate acoustical design requirements for sound insulation between residential apartments.

Acoustic terminology used in this report is summarised in **Appendix A**.

2 SITE DESCRIPTION

2.1 Site Location and Surroundings

The proposed RCF site is located at 20-21 Boorea Avenue, Lakemba.

The site is surrounded by a mix of commercial/industrial and residential properties as follows:

- A series of detached residential dwellings occupy land to the south-east fronting Boorea Avenue;
- An industrial development is located to the east providing a primary frontage to Fraser Street;
- A detached dwelling house is located to the west fronting Wangee Road;
- The Mam Ali bin Abi Taleb Mosque is located to the south-west fronting Wangee Road; and
- A series of mixed industrial / commercial buildings are located to the north and north-west on the opposite side of the drainage canal, providing both Wangee Road and Punchbowl Road.

The proposed RCF site is currently occupied as follows:

- A single storey detached residential dwelling is contained within the southern portion of the site located at 20 Boorea Avenue,
- An industrial development comprising a factory/warehouse is contained within the northern portion of the site located at 21 Boorea Avenue.

Figure 1 shows the location of the proposed RCF.

Figure 1 Proposed RCF Site Location

2.2 Proposed RCF

The proposed RCF would accommodate 112 beds to be split into 40 double bed rooms and 32 single bed rooms. It is understood that the proposed RCF would include a basement carpark accommodating approximately 40 cars, one ambulance parking space and a formalised servicing bay capable of accommodating vehicles up to and including Small Rigid Vehicles (SRVs). DA drawings are attached in **Appendix B**.

The proposed RCF would generate employment for up to 100 people, whereby a maximum of 30 staff will be on-site at any one time. Employee shift times are proposed to be as follows:

- 6:00 am to 3:00 pm
- 2:30 pm to 11:00 pm
- 10:30 pm to 7:00 am

Visiting hours are proposed to be during daytime and evening only (7:00 am to 10:00 pm).

3 AMBIENT NOISE MONITORING

3.1 Unattended Monitoring

In order to characterise the existing acoustical environment of the area, unattended noise monitoring was conducted between Friday, 21 April 2017 and Wednesday, 3 May 2017 at the locations shown in **Figure 1** (Refer to Location 1 (Unattended) and Location 2 (Unattended)).

The locations of the unattended monitoring equipment (loggers) were selected with consideration of other noise sources which may influence readings and security issues for the noise monitoring equipment and access.

The logger at location 1 was positioned on the canopy in the backyard of 20 Boorea Avenue; microphone was located at approximately 3 m above the ground. Location 1 (supplemented by attended measurements) was chosen to be representative of the existing environment in the vicinity of the proposed RCF site (accounting for industrial and traffic noise) while considering security and access issues.

The logger at Location 2 was positioned in the front yard of 13 Boorea Avenue. The results obtained from the logger was chosen to measure background noise levels experienced at neighbouring residential receivers, in order to determine noise emission criteria for the proposed development.

Instrumentation for the survey comprised SVAN environmental noise loggers (serial number 27253 and 21425) fitted with microphone windshield. Calibration of the loggers was checked prior to and following measurement. Drift in calibration did not exceed ±0.5 dB. All equipment carried appropriate and current NATA (or manufacturer) calibration certificates.

Charts presenting summaries of the measured daily noise data are attached in **Appendix C**.

The measured data have been filtered to remove periods affected during adverse weather conditions following consultation of weather data recorded at the Bureau of Meteorology (BOM) Olympic Park weather station. The filtered data is shown in **Appendix C**.

It is noted that data from Friday, 21 April 2017 to Tuesday, 25 April 2017 have been excluded from the analysis as this period is still part of the school holiday period and includes a public holiday.

3.2 Noise Monitoring Results

The data has been processed in accordance with the NSW *Industrial Noise Policy* (INP 2000) time periods to determine the Rating Background Levels (RBL) and existing ambient L_{Aeq} noise levels at the proposed RCF site. The results of the unattended noise logging have also been processed in accordance with the NSW *Road Noise Policy* (DECCW 2011) time periods to determine the daytime and night-time levels of road noise.

The processed noise monitoring results are presented in **Table 1**, **Table 2** and **Table 3**.

Table 1 Ambient Noise Levels – NSW INP Time Periods

Location	Measurement Descriptor	Measured Noise Level (dB re 20 µPa)		
		Daytime (7 am – 6 pm)	Evening (6 pm – 10 pm)	Night-time (10 pm – 7 am)
Location 1	L_{Aeq}	52	48	46
	RBL (Background)	44	42	38
Location 2	L_{Aeq}	53	50	47
	RBL (Background)	42	41	38

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

Table 2 Road Noise Levels – NSW RNP Arterial Road Time Periods

Location	$L_{Aeq(15\ hour)}$ (dB re 20 µPa) 7 am – 10 pm External Noise Level	$L_{Aeq(9hour)}$ (dB re 20 µPa) 10 pm – 7 am External Noise Level
Location 1	52	47

Note: Location 2 data is not applicable to arterial road traffic noise assessment.

Table 3 Road Noise Levels – NSW RNP Local Road Time Periods

Location	$L_{Aeq(1\ hour)}$ (dB re 20 µPa) 7 am – 10 pm External Noise Level	$L_{Aeq(1)}$ (dB re 20 µPa) 10 pm – 7 am External Noise Level
Location 1	55	55
Location 2	56	54

3.3 Attended Noise Monitoring

Short-term attended noise monitoring was conducted on Wednesday 3 May 2017 at the locations indicated in **Figure 1** (refer to Location 3 (Operator-Attended) and Location 4 (Operator-Attended)) in order to qualify the noise environment in the vicinity of the proposed RCF.

Instrumentation for the survey comprised a Brüel & Kjær Type 2260 sound level meter (serial number 2414604). The measurement was conducted in accordance with AS 1055.1-1997: *Acoustics - Description and measurement of environmental noise - General procedures*. Calibration of the sound level meter was checked prior to and following measurement. Drift in calibration did not exceed ±0.5 dB. All equipment carried appropriate and current NATA (or manufacturer) calibration certificates.

Attended noise survey results are presented in **Table 4**.

Table 4 Attended Noise Survey Results

Date/Start Time Weather	Operator-attended Noise Measurement Location	Primary Noise Descriptor (dB re 20 µPa)					Typical maximum Levels (dBA)
		LAeq	LAmax	LA1	LA10	LA90	
Day 03/05/17 1649 hrs	Location 3	53	69	62	56	47	Bird: 54-69 Exhaust Fans: 46-47 Ambulance Alarm: 48-49 Road Traffic: 51-62
Day 03/05/17 1706 hrs	Location 3	51	68	60	53	46	Bird: 55-68 Car Horn: 50-61 Exhaust Fan: 46 Neighbouring workshop: 50-53 Road Traffic: 46-58
Day 03/05/17 1727 hrs	Location 4	50	68	60	50	47	Bird: 51-68 Car Horn: 47-48 Exhaust Fan: 46-47 Neighbouring workshop: 51-53 Plane: 54-65 Truck from Neighbouring Workshop: 66 Road Traffic: 48-58

Attended measurements were used to supplement the unattended logger data at location 1 to quantify the unshielded noise levels from road traffic on Punchbowl Road and industrial/commercial operations to the north.

4 NOISE ASSESSMENT GUIDELINES AND CRITERIA

4.1 Noise Criteria Overview

This NIA addresses the following:

- Noise Intrusion onto the RCF
- Noise Emissions from the RCF
- Acoustical design requirements for sound insulation between residential apartments

4.1.1 Noise Intrusion onto the RCF

The proposed RCF has the potential to be impacted by the following noise sources:

- Existing traffic noise from Punchbowl Road and Wangee Road
- Industrial noise from nearby industries (including mechanical plant noise)

To assess the noise intrusion onto the proposed RCF the following guidelines have been used:

- The Department of Planning and Infrastructure's *Development near Rail Corridors and Busy Roads – Interim Guideline* (2008) (Referred to in this report as DRCBR)
- The NSW Government's *Road Noise Policy* (DECCW, 2011) (Referred to in this report as the RNP)
- The NSW Industrial Noise Policy (Referred to in this report as the INP)

4.1.2 Noise Emissions from the RCF – Residential

The proposed RCF emissions that have the potential to impact onto the nearby receivers are:

- Proposed RCF Mechanical plant
- Vehicles travelling on site
- Additional road traffic generated by the proposed RCF on Boorea Avenue and Merrick Avenue

To assess the noise emissions from the proposed RCF onto the nearby receivers the following guidelines are used:

- The INP
- The RNP

4.3 Noise Guidelines and Criteria Summary

Table 5 summarises the assessment activities, type of noise associated, corresponding guideline, criteria and corresponding sections in this report.

Table 5 Summary of the Assessment Type and Corresponding Criteria

Assessment Type	Noise Type	Guideline	Criteria	Section in the report
Noise Intrusion onto the proposed RCF – Internal Design Criteria	Road Traffic	Development near Rail Corridors and Busy Roads Interim Guideline 2008 - DRCBR	RCF Design Internal Criteria Bedrooms 35 dBA (10 pm – 7 pm) Living areas 40 dBA	**Section 4.3.1, Section 5.1**
	Industrial	Industrial Noise Policy- INP	No criteria for RCF Design Internal Criteria But INP used to determine existing industrial noise onto RCF (INP used in correlation with Development near Rail Corridors and Busy Roads Interim Guideline 2008)	**Section 4.3.2, Section 5.1**
Noise Emissions from the proposed RCF	Mechanical	Industrial Noise Policy- INP	Criteria for Design of proposed RCF mechanical plant – 43 dBA Intrusive criteria and 40 dBA amenity criteria at nearest receivers	**Section 4.3.2, Section 5.2.1**
	Vehicles travelling on site	Industrial Noise Policy- INP + Road Noise Policy - RNP	43 dBA Intrusive criteria and 40 dBA amenity criteria at nearest receivers 53 dBA Sleep disturbance screening criteria	**Section 4.3.2, Section 4.3.3, Section 5.2.2.2**
	Road Traffic	Road Noise Policy - RNP	Offsite Residence in Boorea Avenue LAeq(1hour) 55 dBA (7 pm – 10 pm) LAeq(1hour) 50 dBA (10 pm – 7 pm)	**Section 4.3.3, Section 5.2.2.1**

4.3.1 Department of Planning and Infrastructure's Development near Rail Corridors and Busy Roads – Interim Guideline (2008) - DRCBR

The DRCBR requires that a development for residential use must satisfy the consent authority that appropriate measures will be taken to ensure that the following L_{Aeq} levels are not exceeded:

- In any bedroom in the building – 35 dBA at any time 10:00 pm–7:00 am
- Anywhere else in the building (other than a garage, kitchen, bathroom or hallway) – 40 dBA at any time.

In addition, the DRCBR sets that seniors housing should be located or designed to ensure that the effects of adverse noise is minimised on occupants.

If internal noise levels with windows or doors open exceed the criteria by more than 10 dB, the design of the ventilation for these rooms should enable occupants to close windows during noisier periods, and also meet the ventilation requirements of the Building Code of Australia.

Where windows must be kept closed, the adopted ventilation systems must meet the requirements of the Building Code of Australia and Australian Standard 1668 – *The use of ventilation and air conditioning in buildings*.

Additional guidance on acceptable airborne noise levels from road traffic is provided in the EPA NSW Road Noise Policy (Refer to **Section 4.3.3**)

4.3.2 NSW Industrial Noise Policy

The NSW Industrial Noise Policy (INP) is applicable to noise emission from mechanical and other sources of continuous noise-generation. The INP focuses on the noise emitted from industrial sites and how this may affect the amenity of nearby receivers. The INP does not provide internal criteria for sleeping and living areas. However, the INP provides procedures to assess the noise levels likely to be expected outside the proposed RCF. Those noise levels can be used as a basis to design the proposed RCF. The INP is used for the following:

- Determining the existing ambient noise levels likely to impact upon the proposed RCF and to help in the design of the proposed RCF (Noise Intrusion)
- To set a criteria for the noise emission from the proposed RCF upon the community.

The INP has the following broad objectives:

- Controlling **intrusive** noise impacts (to residences only)
- Maintaining noise level **amenity** for residential and other land uses over the medium to long-term.

Where an intrusive and an amenity criterion are established for a receiver, the more stringent of the two criteria applies.

4.3.2.1 Intrusiveness Criterion

For assessing intrusiveness, the background noise level of the area needs to be established. The intrusiveness criterion essentially requires the equivalent continuous noise level (L_{Aeq}) of a noise source to not exceed the measured RBL by more than 5 dB, over any 15 minute period.

4.3.2.2 Amenity Criterion

The amenity assessment is based on noise criteria specific to the land use and associated activities. The amenity criteria are shown in **Table 6** and relate only to industrial-type noise and do not include road, rail or community noise. If present, the existing noise level from industry is generally measured. If it approaches the criterion value, then noise levels from new industries need to be designed so that the cumulative effect does not produce noise levels that would significantly exceed the criterion. The cumulative effect of noise from industrial sources also needs to be considered in assessing the impact. The correction to be applied to the source to account for existing levels of industrial noise is shown in **Table 7**.

Table 6 Amenity Criteria - Recommended L_{Aeq} Noise Levels from Industrial Noise Sources

Type of Receiver	Indicative Noise Amenity Area	Time of Day	Recommended L_{Aeq} Noise Level	
			Acceptable	Recommended Maximum
Residence	Rural	Day	50 dBA	55 dBA
		Evening	45 dBA	50 dBA
		Night	40 dBA	45 dBA
	Suburban	Day	55 dBA	60 dBA
		Evening	45 dBA	50 dBA
		Night	40 dBA	45 dBA
	Urban	Day	60 dBA	65 dBA
		Evening	50 dBA	55 dBA
		Night	45 dBA	50 dBA

Type of Receiver	Indicative Noise Amenity Area	Time of Day	Recommended L_{Aeq} Noise Level	
			Acceptable	Recommended Maximum
Residence	Urban/Industrial Interface - for existing situations only	Day	65 dBA	70 dBA
		Evening	55 dBA	60 dBA
		Night	50 dBA	55 dBA
School classrooms - internal	All	Noisiest 1-hour period when in use	35 dBA	40 dBA
Active recreation area (eg School playground, golf course)	All	When in use	55 dBA	60 dBA
Commercial premises	All	When in use	65 dBA	70 dBA
Industrial premises	All	When in use	70 dBA	75 dBA

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

Table 7 Modification to Acceptable Noise Level (ANL)[1] to Account for Existing Level of Industrial Noise

Total existing L_{Aeq} noise level from industrial sources, dB(A)	Maximum L_{Aeq} noise level for noise from new sources alone, dB(A)
≥ Acceptable noise level plus 2	If existing noise level is likely to decrease in future: acceptable noise level minus 10 If existing noise level is unlikely to decrease in future: existing level minus 10
Acceptable noise level plus 1	Acceptable noise level minus 8
Acceptable noise level	Acceptable noise level minus 8
Acceptable noise level minus 1	Acceptable noise level minus 6
Acceptable noise level minus 2	Acceptable noise level minus 4
Acceptable noise level minus 3	Acceptable noise level minus 3
Acceptable noise level minus 4	Acceptable noise level minus 2
Acceptable noise level minus 5	Acceptable noise level minus 2
Acceptable noise level minus 6	Acceptable noise level minus 1
< Acceptable noise level minus 6	Acceptable noise level

Note 1: ANL = recommended acceptable L_{Aeq} noise level for the specific receiver, area and time of day from

4.3.2.3 Modifying Factors

Modifying factors are to be applied to the predicted noise levels if the source noise, at the receiver, is low frequency, tonal or intermittent in nature.

4.3.2.4 Sleep Disturbance

The INP considers sleep disturbance as the emergence of the $L_{A1(1minute)}$ level above the $L_{A90(15minute)}$ level at the time. Appropriate screening criteria for sleep disturbance are determined to be an $L_{A1(1minute)}$ level 15 dBA above the Rating Background Level (RBL) for the night-time period (10:00 pm to 7:00 am). When the criterion is not met, a more detailed analysis may be required.

Additional guidance on sleep disturbance is provided in the RNP (Refer to **Section 4.3.3**).

4.3.2.5 Project Specific Noise Levels

The processed results of the unattended noise monitoring have been used to determine project specific noise criteria. The intrusive and amenity criteria for nearby residential premises are presented in **Table 8**. These criteria are nominated for the purpose of assessing potential noise impacts from the proposed development.

In accordance with INP guidelines, the project specific noise levels for residential receivers in the vicinity of the proposed development are the more stringent of the amenity or intrusive criteria as shown in bold in **Table 8**. In this case the area surrounding the site is controlled by transportation noise and industrial noise sources during the day and by transportation noise during the evening and night-time so the amenity criterion becomes equal to the Recommended Amenity Criteria for Residences in a Suburban Area during the evening and night-time.

The proposed RCF site is located in the industrial zone just at the limit with the residential (suburban) zone. The suburban criteria are therefore considered appropriate to the residences in the vicinity of the project site as a conservative approach.

Table 8 NSW INP Criteria for Continuous Operational Noise Emissions to Nearby Residences

Location	Time of Day	ANL[1] (period) dBA	Measured RBL[2] $L_{A90(15minute)}$ dBA	Measured $L_{Aeq(15minute)}$ dBA	Criteria for New Sources[3]		Sleep Disturbance Criteria
					Intrusive $L_{Aeq(15minute)}$	Amenity $L_{Aeq(Period)}$	
Location 1	Day	55	44	52	49	52	N/A
	Evening	45	42	48	47	45	N/A
	Night	40	38	46	43	40	53
Location 2	Day	55	42	53	47	47	N/A
	Evening	45	41	50	46	45	N/A
	Night	40	38	47	**43**	**40**	53

Note 1: ANL Acceptable Noise Level for a suburban area.
Note 2: RBL Rating Background Level.
Note 3: Assuming existing noise levels unlikely to decrease.
Note 4: Project Specific Criteria are shown in bold.
Note 5: Sleep disturbance applies during the night-time period.

Note that the intrusive criterion is applicable over any 15 minute period whereas the amenity level is applicable over the whole daytime, evening or night-time period, as appropriate.

4.3.3 RMS Road Noise Policy (RNP)

For traffic operating on public roads, the RNP is appropriate for assessing potential road traffic noise impacts.

The RNP identifies strategies that address the issue of road traffic noise from:

- Existing roads.
- New road projects.
- Road redevelopment projects.
- New traffic-generating developments.

The RNP noise criteria aim to protect amenity inside and immediately around permanent residences, schools, hospitals and other sensitive land uses, rather than at all points in a given locality, which would not be practical or possible. Although it is not mandatory to achieve the noise assessment criteria in the RNP, project proponents need to provide justification if it is not considered feasible or reasonable to achieve them.

The guideline recognises that there are generally more opportunities to minimise noise impacts from new roads and road corridors, especially those in greenfield locations, through judicious road design and land use planning. The scope to reduce noise impacts from existing roads and corridors is more limited.

Boorea Avenue is considered to be a Local road. The RNP specifies this class of road as the following:

> *Local Road – A road handling local traffic and characteristically having low or intermittent traffic flows.*

The RNP describes a minor impact to be an increase of up to 2 dB, which is considered to be a barely perceptible change to the average person.

Table 9 presents the corresponding RNP criteria for land use developments with potential to create additional traffic on local roads.

Table 9 Road Traffic Noise Criteria for Residential Land Uses

Road Category	Land Use	Assessment Criteria	
		Day 7 am to 10 pm	Night 10 pm – 7 am
Local Roads	Existing residents affected by additional traffic on existing local roads generated by land use developments	$L_{Aeq(1hour)}$ 55 dBA	$L_{Aeq(1hour)}$ 50 dBA

The RNP also includes a review of international sleep disturbance research and concludes that:

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

4.4 Internal Sound Insulation Requirements

The proposed RCF will be required to comply with the provisions relating to *Sound Transmission and Insulation* under Part F5 of the National Construction Code Series Building Code of Australia (NCC 2016).

Table 10 details the minimum acoustic performance requirements documented in the NCC for building Class 9c.

Table 10 NCC 2016 Sound Insulation Requirements

Performance Requirements	2016 NCC - Deemed to Satisfy Provisions
Walls between sole occupancy units	Part F5.5(c)(i) Rw not < 45
Walls between a sole occupancy unit and a bathroom, sanitary compartment (not being an associated ensuite), plant room or utilities room	Part F5.5(c)(ii) Rw not < 45
Walls between a sole occupancy unit and a kitchen or laundry	Part F5.5(c)(ii), Part F5.5(d) and F5.3(b)(ii) Rw not < 45 Wall to meet required impact sound insulation rating[1]
Floors between sole-occupancy units	Part F5.4(b) Rw not < 45
Soil, waste, water supply and stormwater pipes and ductwork to habitable rooms	Part F5.6 $R_w + C_{tr}$ not < 40
Soil, waste, water supply and stormwater pipes and ductwork to kitchens and other rooms	Part F5.6 $R_w + C_{tr}$ not < 25
Intra-tenancy Walls	There is no statutory requirement for airborne isolation via intra-tenancy walls.

Note 1: A wall must have a sound insulation rating of:

(A) For other than masonry, be two or more separate leaves without rigid mechanical connection except at the periphery; or

(B) Be identical with a prototype that is no less resistant to the transmission of impact sound when tested in accordance with Specification F5.5 than a wall listed in Table 2 of Specification F5.2.

5 ACOUSTIC ASSESSMENT AND DESIGN RECOMMENDATIONS

5.1 Noise Intrusion onto the Proposed RCF – Traffic and Industrial Noise

Industrial and road traffic noise intrusion have been assessed based on project drawings provided by Thomson_Adsett, dated 10 May 2017 (Refer to **Appendix B**).

Based upon the measurement results presented in **Table 1**, **Table 2**, **Table 3** and **Table 4**, the potentially maximum noise levels incident upon the proposed most exposed facade are summarised in **Table 11**. It is noted that contribution from industrial noise and traffic noise is not differentiable from the logger data. As a result, 2 worst case scenarios have been assessed. The more stringent is used to design the facades of the proposed RCF.

Table 11 Predicted External Noise Level onto the Proposed RCF

Assessment	Assumption	Most Exposed Facade	Noise Descriptor[3]	External Noise Level (at proposed RCF facade)
1	All noise recorded at Location 1 (Unattended) is traffic noise from Punchbowl Road (Collector Road)	North-West (Facing Punchbowl Road)	Daytime LAeq (15hour)[4] Night-time LAeq (9hour)[4]	57 dBA[1,2] 52 dBA[1,2]
2	All noise recorded at Location 1 (Unattended) is industrial noise	All	Daytime LAeq(15min)[5] Evening LAeq(15min)[5] Night-time LAeq(15min)[5]	60 dBA[6,7,8] 48 dBA[6] 46 dBA[6]

Note 1: Results have been corrected to account for the distance of the logger compared to the road.

Note 2: Values rounded to the nearest 1 dB and inclusive of the +2.5 dB facade corrections.

Note 3: Noise descriptor in accordance with Type of road.

Note 4: Daytime period is 7 am – 10 pm, Night-time period is 10 pm – 7 am.

Note 5: Daytime period is 7 am – 6 pm, Evening period is 6 pm – 10 pm, Night-time period is 10 pm – 7 am.

Note 6: Assume that industries around proposed RCF are operating during daytime only.

Note 7: Assume 5 dBA penalty for potential intermittent source based on attended measurements undertaken at Location 3 and Location 4.

Note 8: Assume 3 dBA increases in noise level to account for exhausts on top of industrial building roof that might not have been picked up by logger based on attended measurements undertaken at Location 3 and Location 4.

It is estimated that with doors and windows open the internal noise levels will be up to approximately 50 dBA during the daytime and 42 dBA during the night-time. It is therefore noted that this will likely not comply with the nominated criteria (35 dBA for bedrooms and 40 dBA for other habitable rooms) for open doors and windows. As such, it is recommended that mechanical ventilation should be provided to all habitable rooms to allow doors and windows to be closed as a noise mitigation measure.

On the basis of the calculated results in **Table 11**, it is recommended that the glazing systems should achieve a minimum airborne sound insulation performance of 31 dBA. Typically these systems will be required to have a laminated glass panel with 6.38 mm thickness. However the glazing frame and windows seals should also be designed to achieve this performance. Non-glazing systems should be designed to achieve a minimum airborne sound insulation performance of 50 dB Rw.

The above recommendation should be reviewed during detailed design stages.

5.2 Noise Emissions from the Proposed RCF

5.2.1 Proposed RCF Mechanical Plant

Precise details of the mechanical ventilation / air conditioning plant selection are unknown at this stage. This information will become available during the detailed design phase of the project.

The external noise emissions of mechanical plant associated with the development should be controlled so that the operation of such plant does not adversely impact upon neighbouring residential receivers and occupants within the proposed development. The criteria for noise emissions from mechanical plant and equipment are documented in **Section 4.3.2.5**. Detailed assessment and verification of mechanical noise emissions should be carried out prior to construction.

5.2.2 Proposed RCF Road Traffic Noise

5.2.2.1 Off-site Traffic

This assessment is based on available data from the Traffic and Parking Impact Assessment prepared by Stanbury Traffic Planning dated May 2017 and from existing traffic from the current warehouse provided by the warehouse site manager.

According to the Traffic and Parking Impact Assessment, surveys on Boorea Avenue and Merrick Avenue were undertaken on Tuesday, 2 May 2017 and indicated that during peak hour less than 50 vehicles travelled on these roads. It is also noted that during the site survey no heavy vehicles were recorded.

According to the warehouse site manager, up to 2 heavy vehicles travel to site per day with an average of up to 1 heavy vehicle per day.

Proposed RCF generated peak light vehicles and heavy vehicles are estimated to be up to 29 movements and 1 movement respectively per hour.

The existing and proposed traffic noise levels have been predicted by modelling the road traffic along Boorea Avenue and Merrick Avenue using the Calculation of Road Traffic Noise (CoRTN) prediction method. The predicted road traffic noise levels are compared to the existing traffic flow noise predictions together with the logger results at Location 2 and are presented in **Table 12**.

The offset distances to the existing residences adjacent to the proposed Boorea Avenue transport route have been estimated to be 14 m and the offset distance for the existing residences adjacent to the proposed Merrick Avenue transport route have been estimated to be 11 m.

Table 12 Predicted Traffic Noise Levels

Route	Peak Time period	Peak Traffic Flows				Predicted Noise Level, dBA $L_{Aeq(1hour)}$		Predicted Noise Level Increase, dB	RNP Criteria for local road	Measured Noise Levels
		Current Traffic		Additional Traffic generated by RCF		Current	Projected			
		Light	Heavy	Light	Heavy					
Boorea Avenue	Daytime	30	1[1]	15	1[1]	53	54	1.5	55	56
	Night-time	10	1[1]	15	0	49	51	2.2	50	54
Merrick Avenue	Daytime	30	1[1]	14	1[1]	54	55	1.5	55	-
	Night-time	10	1[1]	14	0	50	52	2.0	50	-

Note 1: The heavy vehicles from the existing warehouse are replaced by the heavy vehicles from the proposed RCF.

Note 2: Existing data not available – Assumption was made for the current night-time peak data.

Note 3: Assume 50% of additional traffic on Boorea Avenue and 50% on Merrick Avenue.

It is noted that existing measured noise levels on Boorea Avenue are already exceeding the RNP criteria.

Based on the modelling results presented in **Table 12**, with the addition of the proposed RCF, increase in noise levels is predicted to be below the 2 dBA allowance criteria during daytime.

Increase in noise levels is predicted to be up to 2.2 dBA during the night-time period which is marginally above the RNP allowance criteria. The increase in 2 dBA is considered as a minor impact according to the RNP and is likely to be barely noticeable to the average person.

However, the proposed site being located in a cul-de-sac, the increase in traffic is likely to be “visually” and audibly noticeable to nearby residents located in the cul-de-sac being 16 Boorea Avenue, 18 Boorea Avenue, 13 Boorea Avenue, 15 Boorea Avenue and 17 Boorea Avenue.

It is also noted that no heavy vehicles traveling at night-time have been included in the road traffic predictions for the proposed traffic generated by the RCF. Best management practices should be implemented to limit noise due to traffic such as (but not limited to) scheduling heavy vehicles to access site during daytime only and limiting visitors access to daytime only.

It is noted that the site is currently zoned as industrial and could have the potential to generate up to 2 truck movements per hour and up to 14 light vehicles movement per hour resulting in predicted noise levels higher than the predicted noise levels of the proposed RCF.

5.2.2.2 On-site Traffic Noise – Carpark

It is noted that the proposed carpark will be located underground. Only cars moving from Boorea Avenue into the access ramp are likely to be audible at the residence located to the south ie 18 Boorea Avenue, 17 Boorea Avenue, 15 Boorea Avenue and 13 Boorea Avenue.

Based on a worst case scenario of 8 vehicles utilising the car park in a 15-minute period, the $L_{Aeq(15minute)}$ noise level due to carpark activity would be in the order of 57 dB at the nearest receiver south of the proposed RCF, 18 Boorea Avenue. The $L_{Aeq(15minute)}$ noise level due to carpark activity would be in the order of 45 dBA, 44 dBA and 43 dBA at 17 Boorea Avenue, 15 Boorea Avenue and 13 Boorea Avenue respectively.

With the inclusion of a 1.9 m high solid noise barrier to be located between the access ramp and 18 Boorea Avenue (Refer to **Figure 1**), the $L_{Aeq(15minute)}$ noise level is predicted to meet the intrusive criterion of 43 dBA and night-time $L_{Aeq(9hours)}$ level is predicted to be below the amenity criteria of 40 dBA.

The $L_{Aeq(15minute)}$ noise level due to carpark activity is predicted to exceed the intrusive criteria by up to a marginal 2 dBA and 1 dBA at 17 Boorea Avenue and 15 Boorea Avenue, respectively.

Whilst it is noted that the intrusive criteria is likely to be exceeded during night-time at 17 Boorea Avenue and 15 Boorea Avenue, the amenity of the residences is preserved. Furthermore, the predicted levels are below the sleep disturbance screening criteria of 53 dBA and therefore traffic on the proposed RCF site is unlikely to create sleep disturbance to nearby residences.

6 CONCLUSION

SLR Consulting Australia has conducted a DA stage noise impact assessment of the proposed RCF to be located at 20-21 Boorea Avenue, Lakemba.

The assessment has examined the following areas of acoustic significance:

- Road traffic and industrial noise intrusion to internal spaces
- Noise emission from mechanical plant and on-site traffic from the Proposed RCF onto nearby residences
- Additional traffic generated by the proposed RCF onto nearby residences
- Internal Sound Insulation Requirements (NCC).

The results of noise measurements conducted in the area have been used to determine:

- In-principle measures that will be required to road traffic noise and industrial noise intrusion to internal spaces.
- Appropriate industrial noise emission criteria from the proposed RCF.

Based upon the findings of this assessment, the proposed development as proposed appears satisfactory in terms of its general planning arrangement. Acceptable internal noise levels can be achieved within residential apartments with the incorporation of the recommended controls outlined in **Section 5.1**.

Maximum emissions of the RCF mechanical plant to protect the amenity of the nearby residents have been discussed in **Section 5.2.1**.

Off-site traffic assessment (discussed in **Section 5.2.2.1**) indicates that increase in traffic noise due to the proposed RCF has the potential to be noticed by nearby residents however the existing industrial site could have the potential to generate more traffic on adjacent local roads than the proposed RCF. Best management practice should be used such as limiting truck movements to daytime and visitors access to daytime and evening only.

On-site traffic assessment indicates that with the inclusion of the recommended controls outlined in **Section 5.2.2.2**, the amenity of the nearby receivers will be preserved.

The proposed development is therefore feasible on the basis of acoustics.

Acoustic Terminology

1 Sound Level or Noise Level

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

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

The symbols SPL, L or 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 4000 Hz), and less sensitive at lower and higher frequencies. Thus, the level of a sound in dBA is a good measure of the loudness of that sound. Different sources having the same dBA level generally sound about equally loud.

A change of 1 dBA or 2 dBA in the level of a sound is difficult for most people to detect, whilst a 3 dBA to 5 dBA change corresponds to a small but noticeable change in loudness. A 10 dBA 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 pneumat hammering	
80	Kerbside of busy street	Loud
70	Loud radio or television	
60	Department store	Moderate to quiet
50	General Office	
40	Inside private office	Quiet to very quiet
30	Inside bedroom	
20	Recording studio	Almost silent

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

3 Sound Power Level

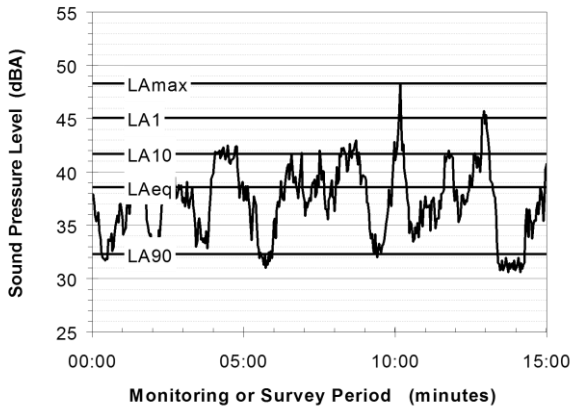
The Sound Power of a source is the rate at which it emits acoustic energy. As with Sound Pressure Levels, Sound Power Levels are expressed in decibel units (dB or dBA), but may be identified by the symbols SWL or LW, or by the reference unit 10^{-12} W.

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

4 Statistical Noise Levels

Sounds that vary in level over time, such as transportation 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 exceed for 10% of the 15 minute interval. This is commonly referred to as the average maximum noise level.

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

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

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

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

5 Tonality

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

6 Impulsiveness

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

7 Frequency Analysis

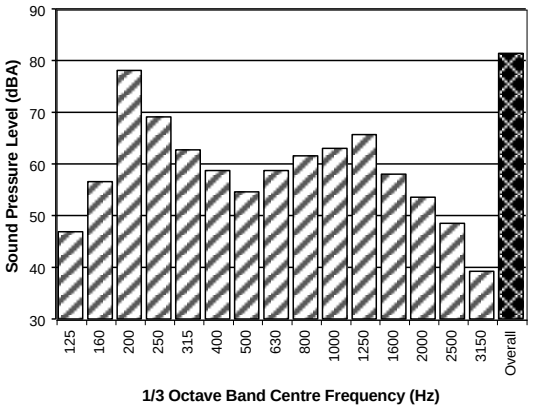
Frequency analysis is the process used to examine the tones (or frequency components) which make up the overall noise or vibration signal. This analysis was traditionally carried out using analogue electronic filters, but is now normally carried out using Fast Fourier Transform (FFT) analysers.

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

Frequency analysis can be in:

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

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



8 Vibration

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

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

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

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

9 Human Perception of Vibration

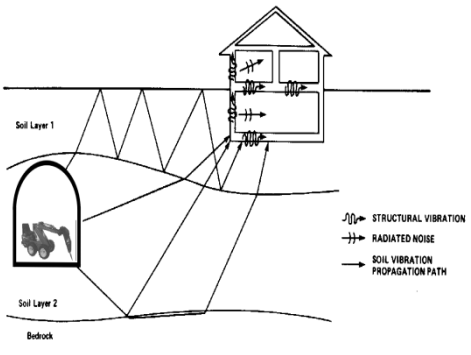
People are able to 'feel' vibration at levels lower than those required to cause even superficial damage to the most susceptible classes of building (even though they may not be disturbed by the motion). An individual's perception of motion or response to vibration depends very strongly on previous experience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

10 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 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

DA Drawings

0 1 2 3 5 10m

rev	date		init.
1	10-05-2017	Preliminary Issue	PS

Residential Aged Care Masterplan - 112 beds

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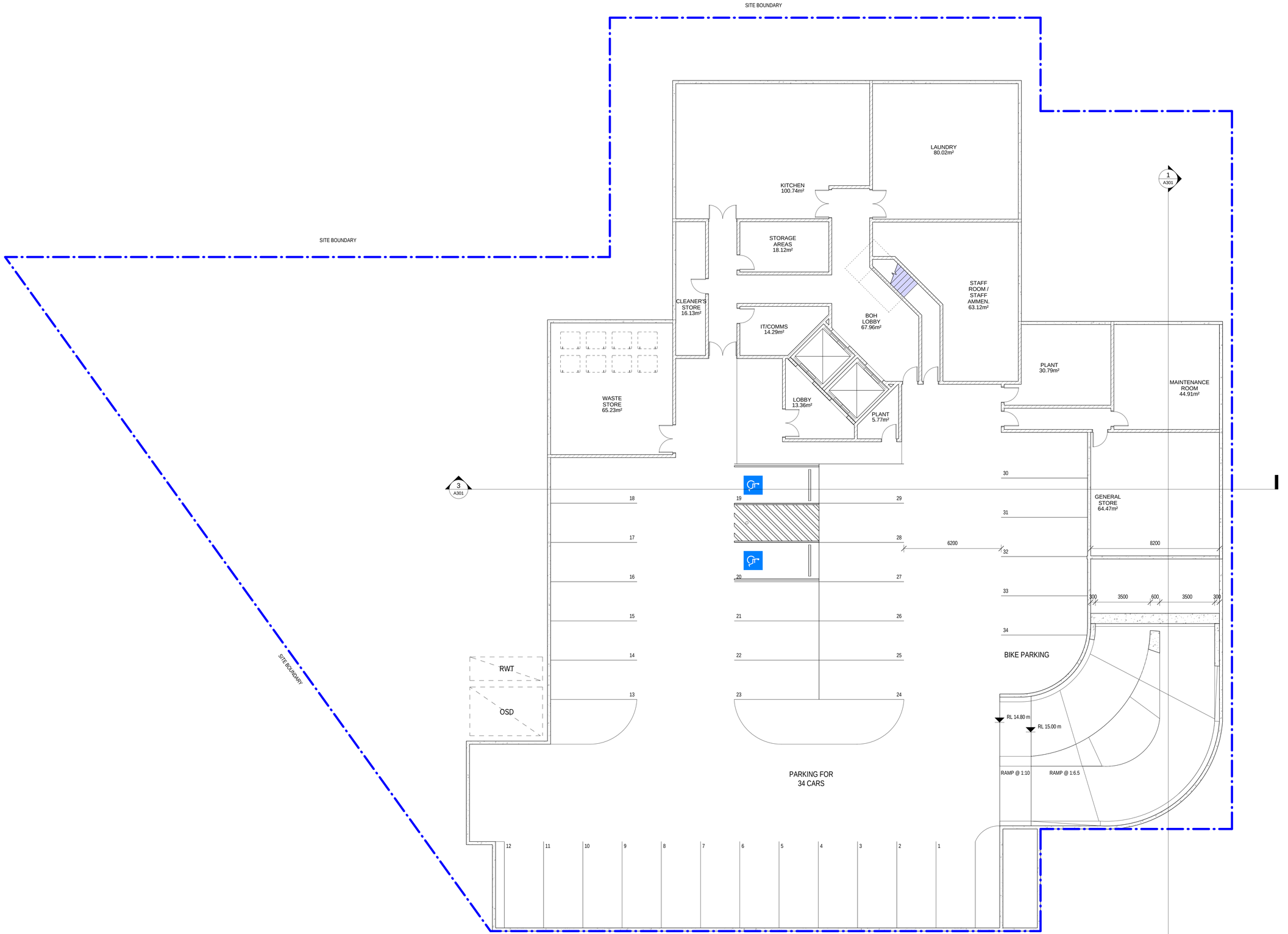
SITE PLAN

1 : 200 @ B1

10-05-2017

A100

rev. 1



0 1 2 3 5 10m

1 10-05-2017 Preliminary Issue PS

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BASEMENT PLAN

1 : 100 @ B1

10-05-2017

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0 1 2 3 5 10m

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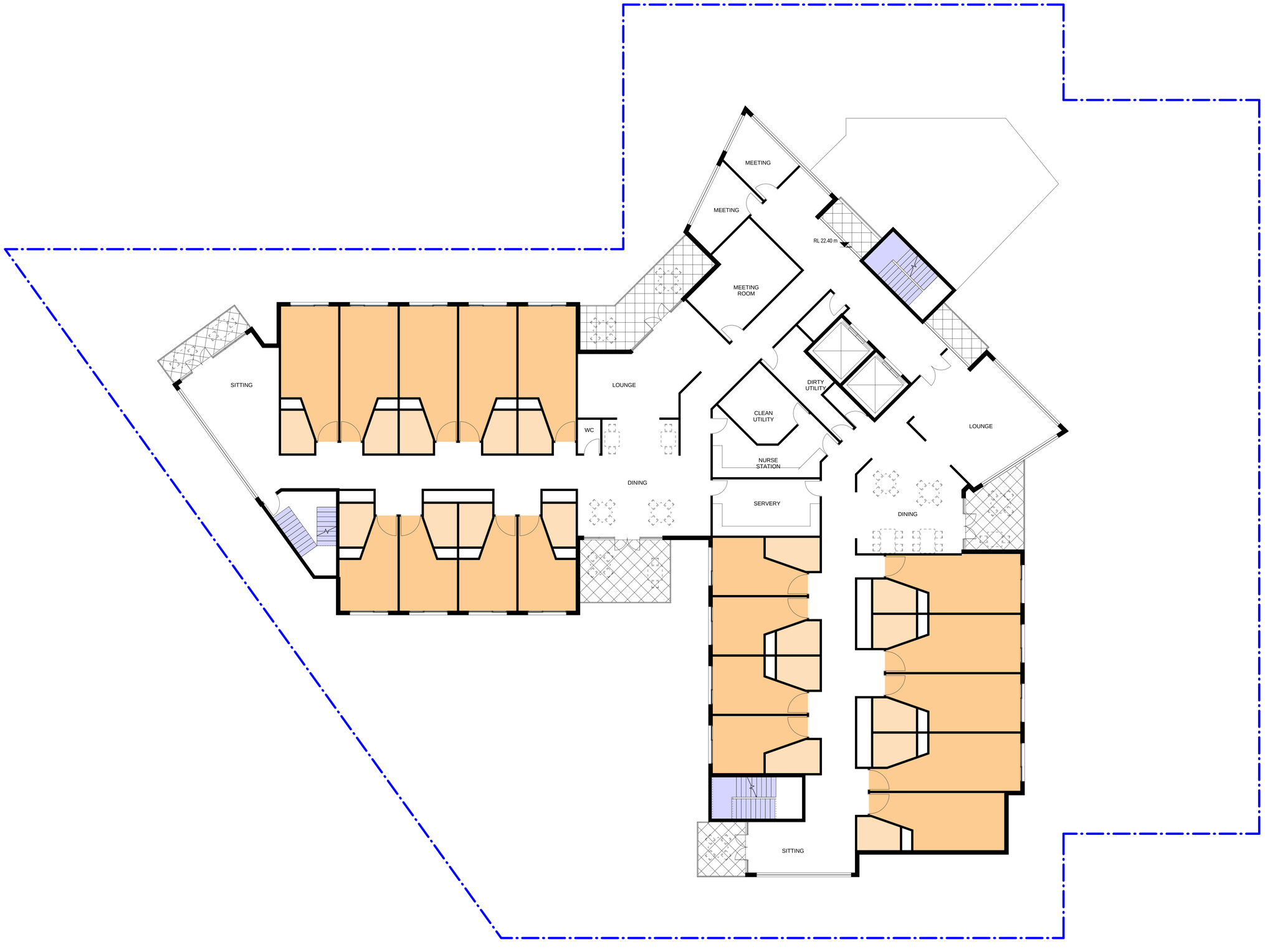
GROUND FLOOR PLAN

1 : 100 @ B1 10-05-2017

A202 rev. 1



0 1 2 3 5 10m

1 10-05-2017 Preliminary Issue PS

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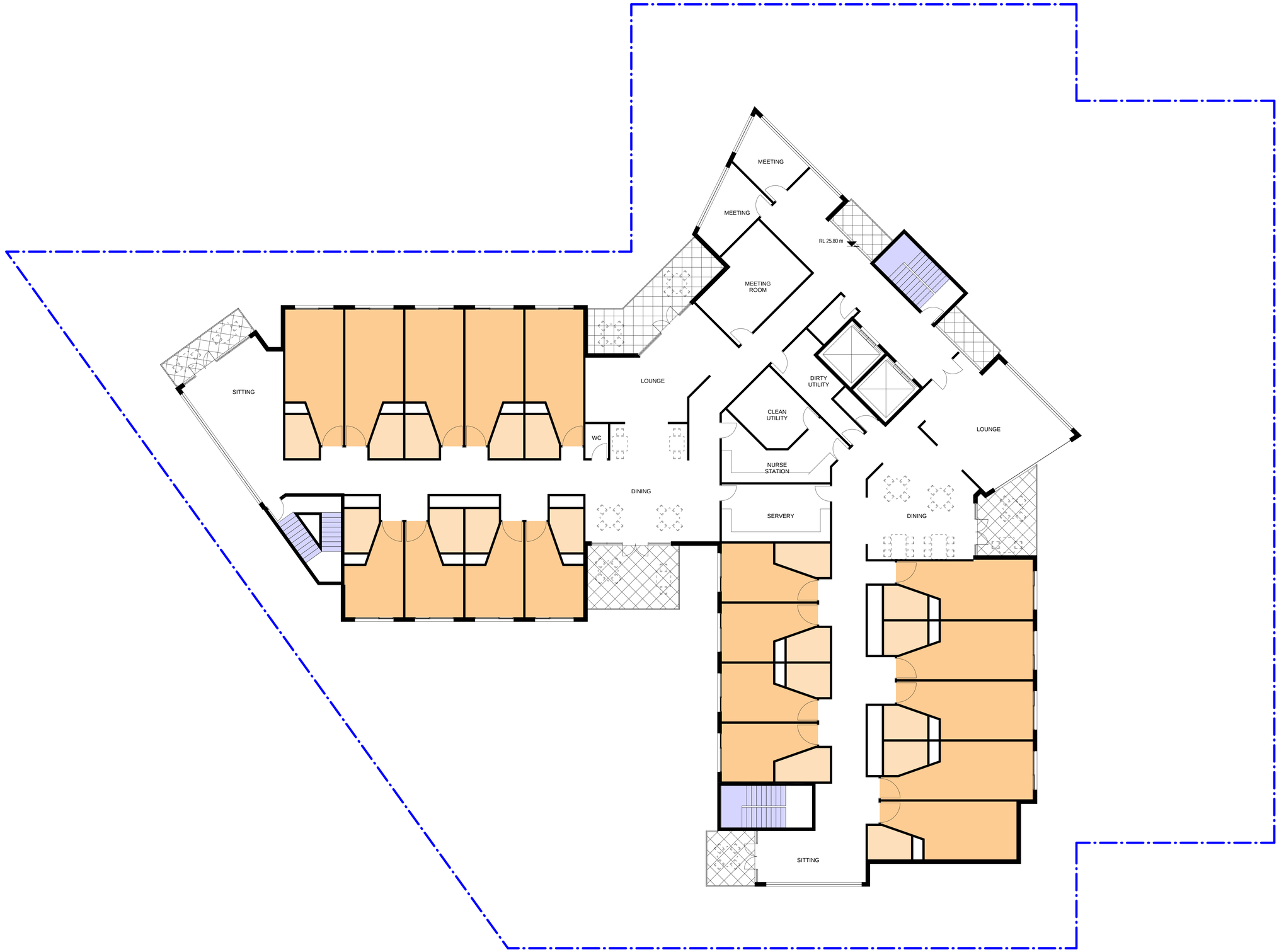
FIRST FLOOR PLAN

1 : 100 @ B1 10-05-2017

A203 rev. 1



0 1 2 3 5 10m

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1	10-05-2017	Preliminary Issue	PS

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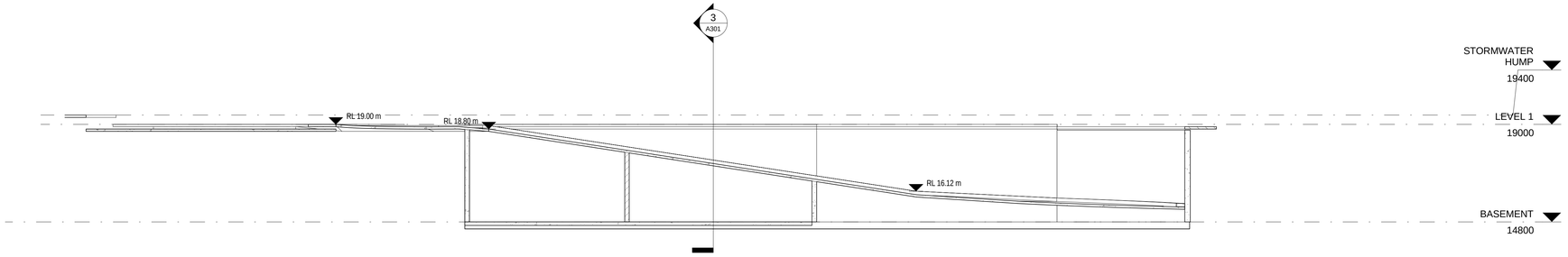
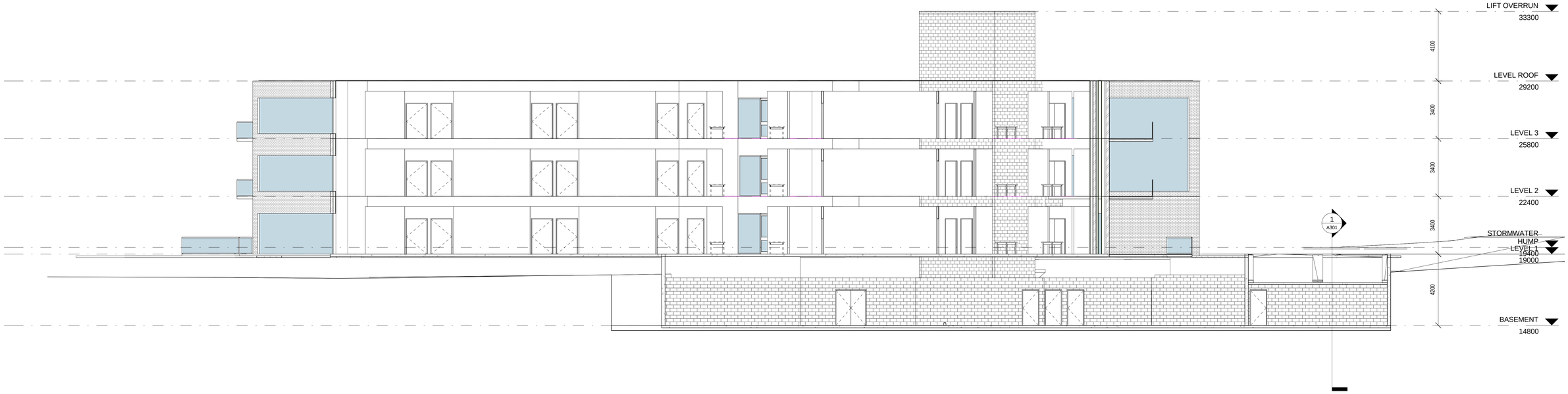
SECOND FLOOR PLAN

1 : 100 @ B1 10-05-2017

A204 rev. 1



1 A201 Section 4
1 : 100



3 A201 Section 1
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0 1 2 3 5 10m

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1	10-05-2017	Preliminary Issue	PS

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SECTIONS

1 : 100 @ B1 10-05-2017

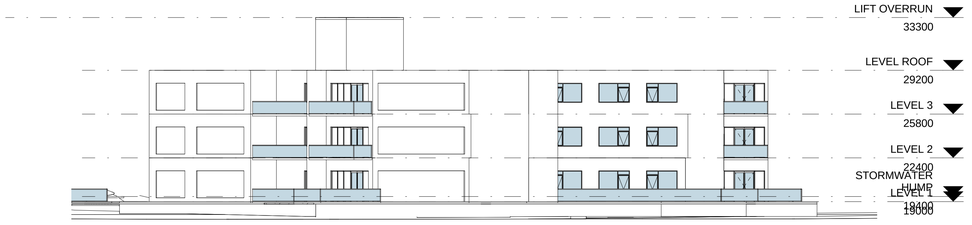
A301 rev. 1

1 A100 **Elevation 1**

1 : 200

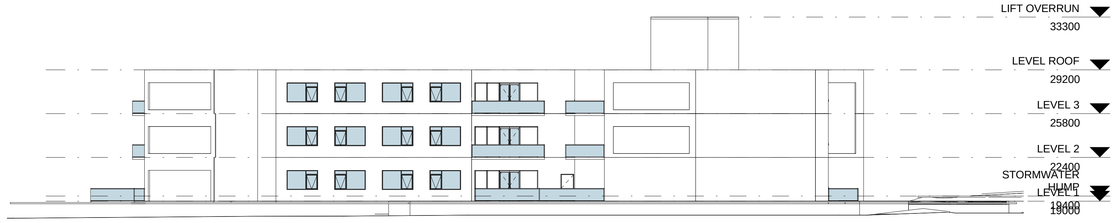
2 A100 **Elevation**

1 : 200



3 A100 **Elevation**

1 : 200



4 A100 **Elevation**

1 : 200

0 1 2 3 5 10m

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1	10-05-2017	Preliminary Issue		PS

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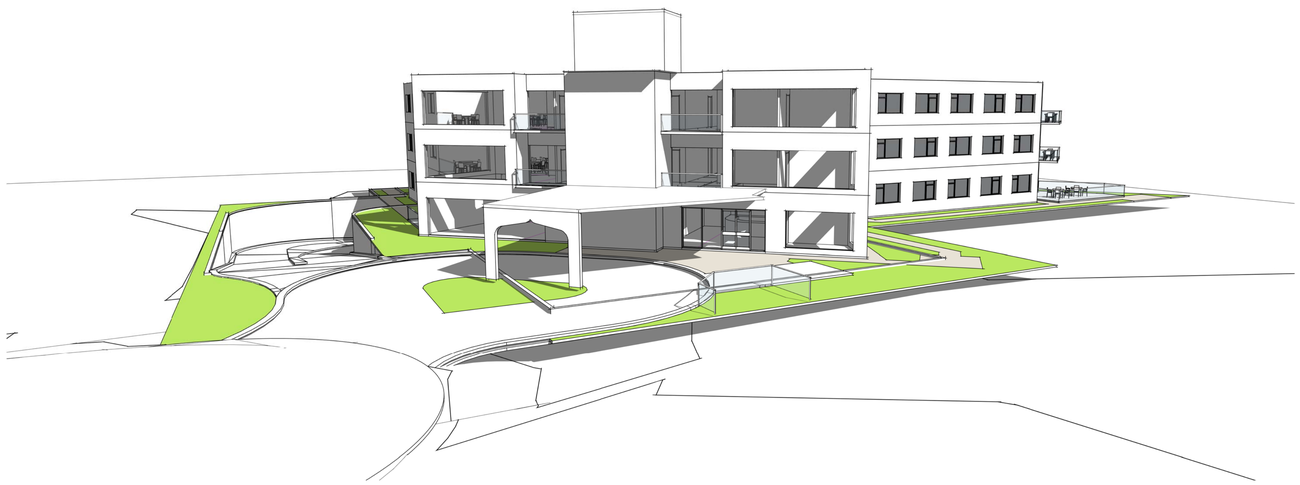
ELEVATIONS

1 : 200 @ B1

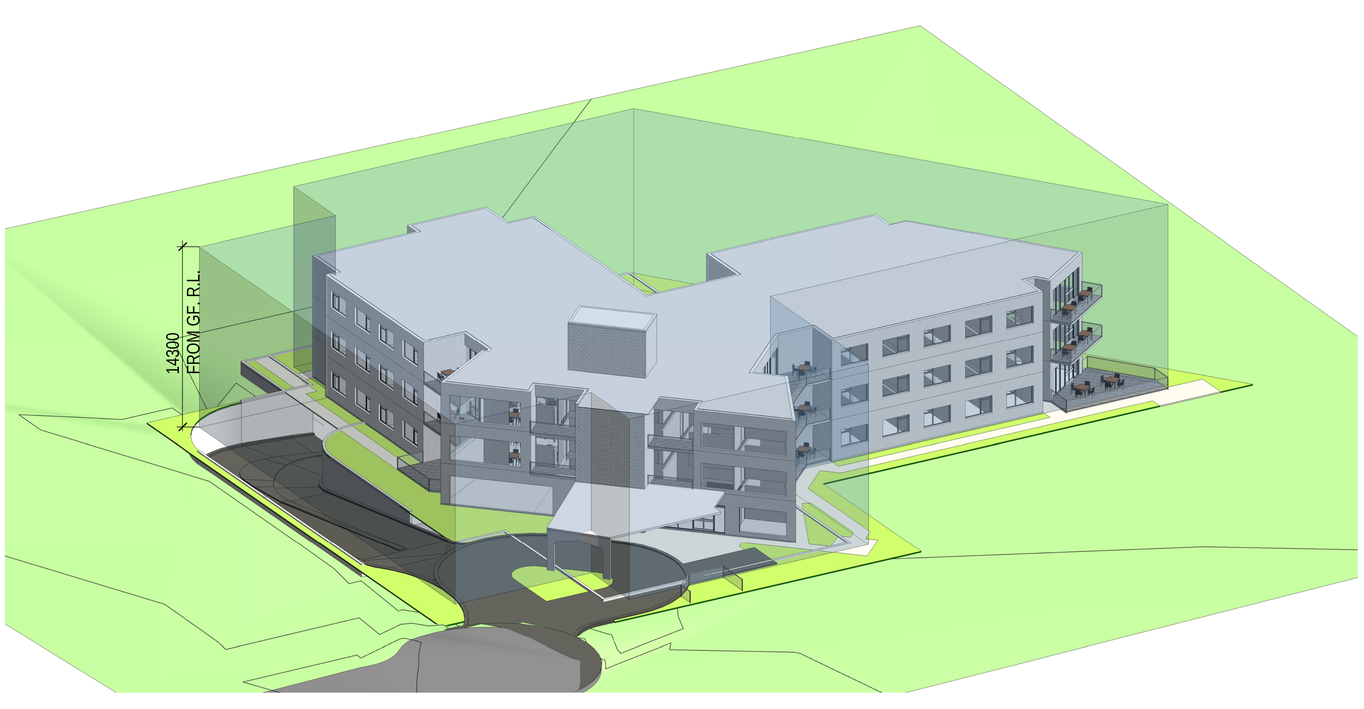
10-05-2017

A302

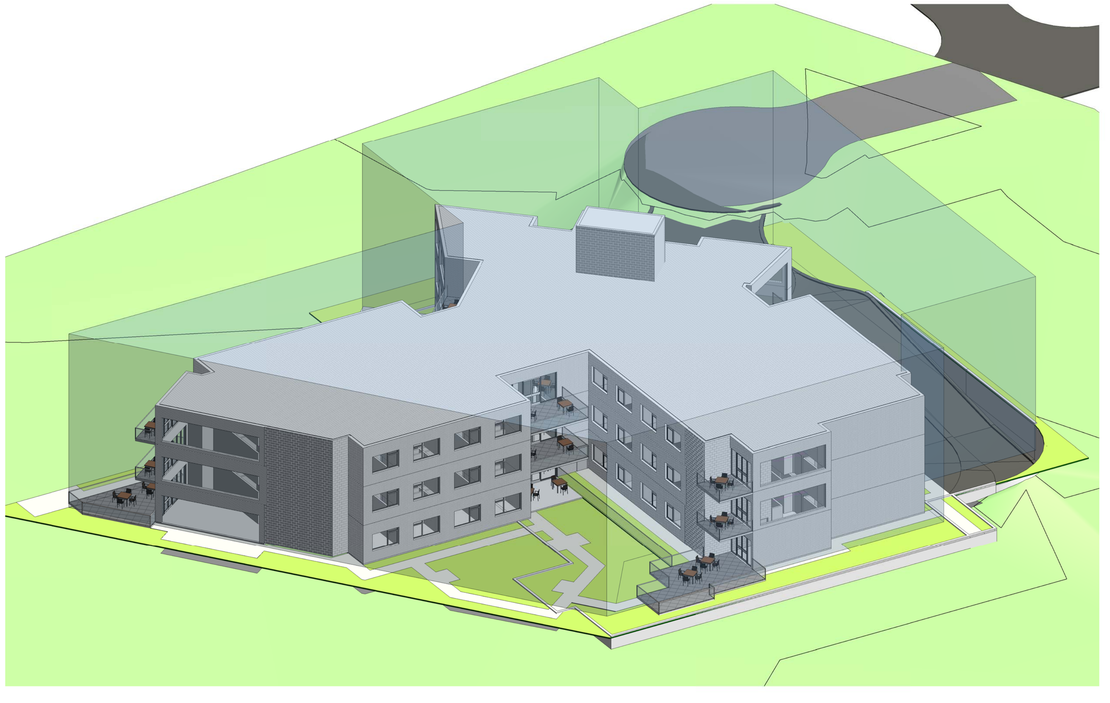
rev. 1



1 ENTRANCE VIEW



2 AXON 1



3 AXON 2

0 1 2 3 5 10m

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1	10-05-2017	Preliminary Issue	PS

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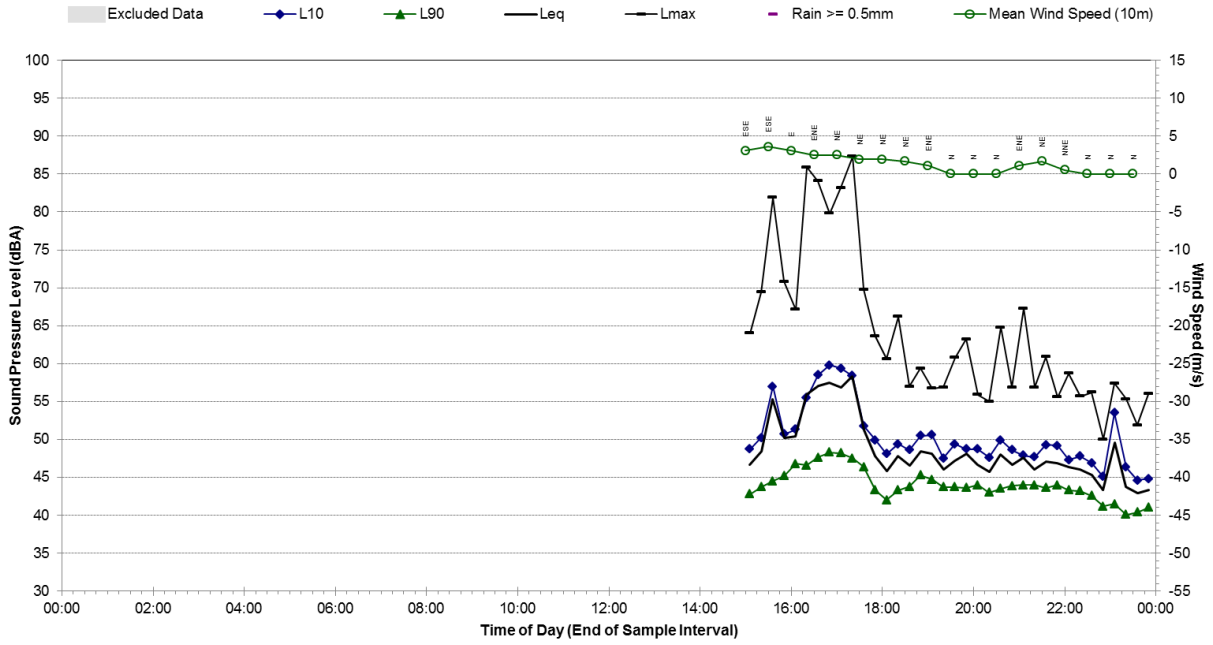
3D VIEWS

@ B1 10-05-2017

A303 rev. 1

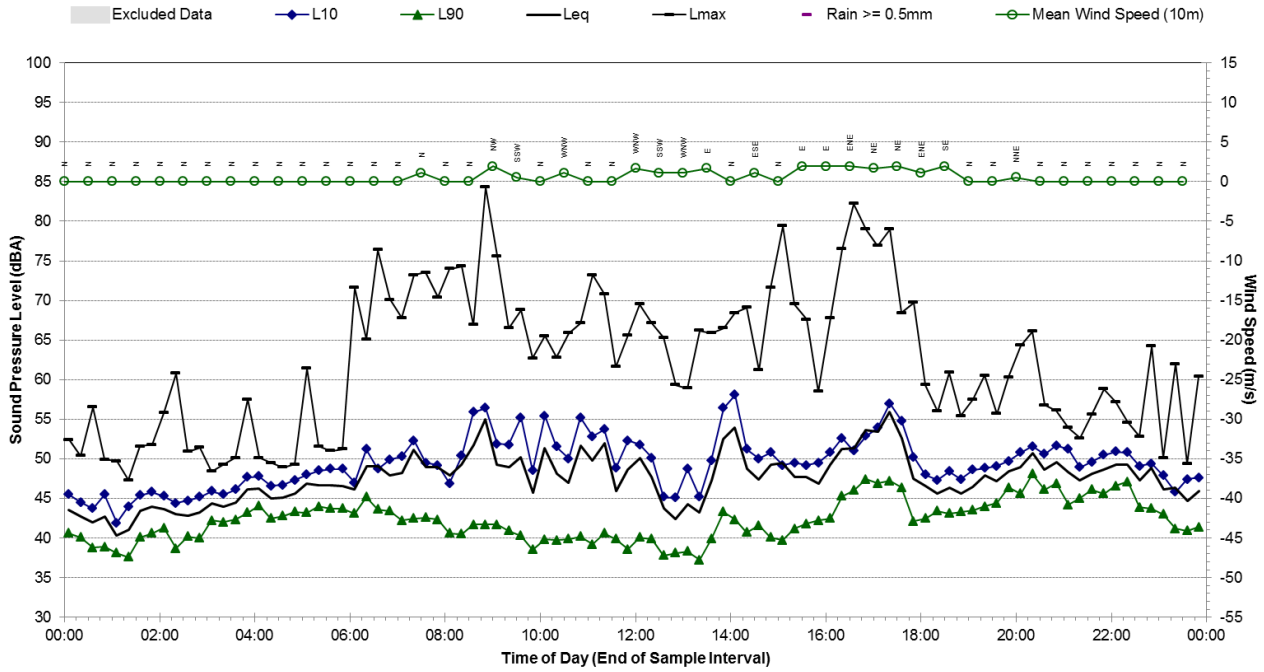
Statistical Ambient Noise Levels

Location 1 - Boorea Avenue - Friday, 21 April 2017



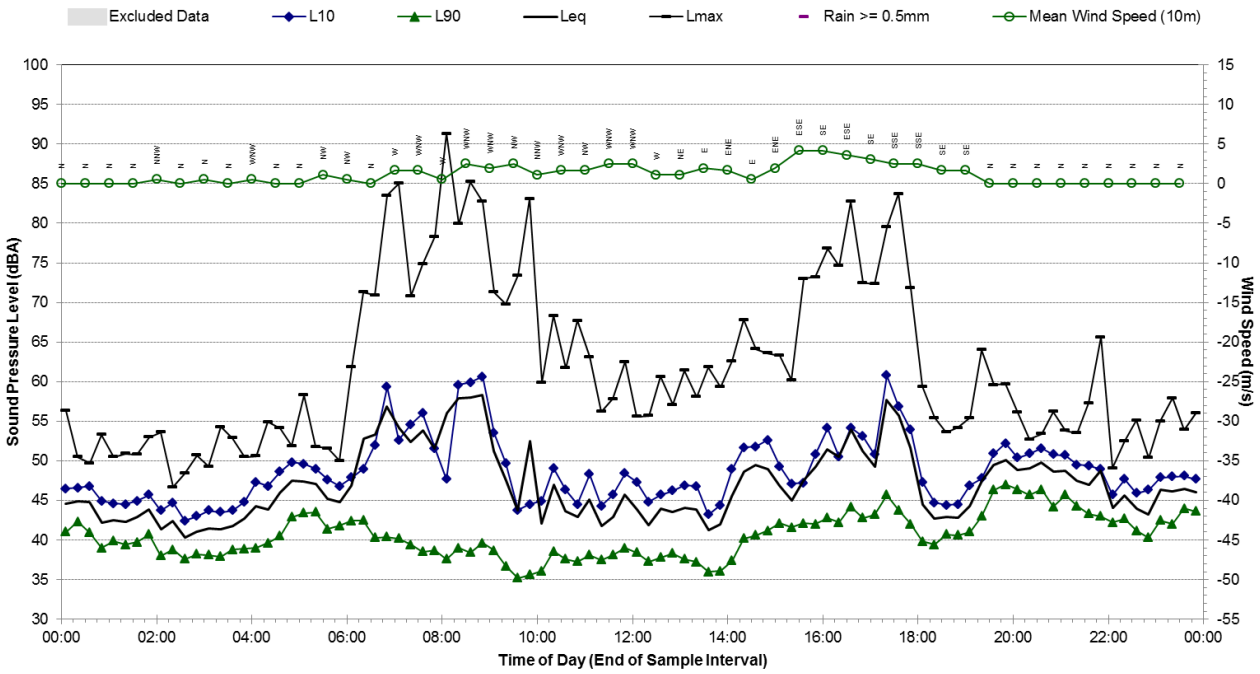
Statistical Ambient Noise Levels

Location 1 - Boorea Avenue - Saturday, 22 April 2017



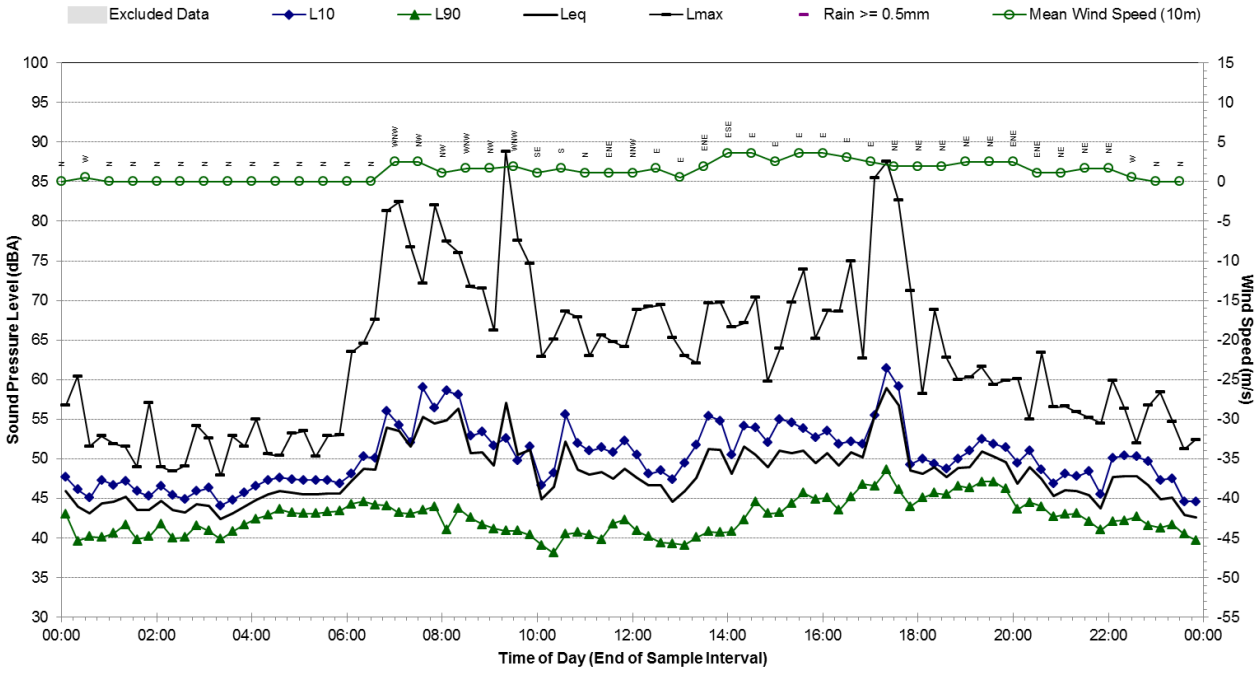
Statistical Ambient Noise Levels

Location 1 - Boorea Avenue - Sunday, 23 April 2017



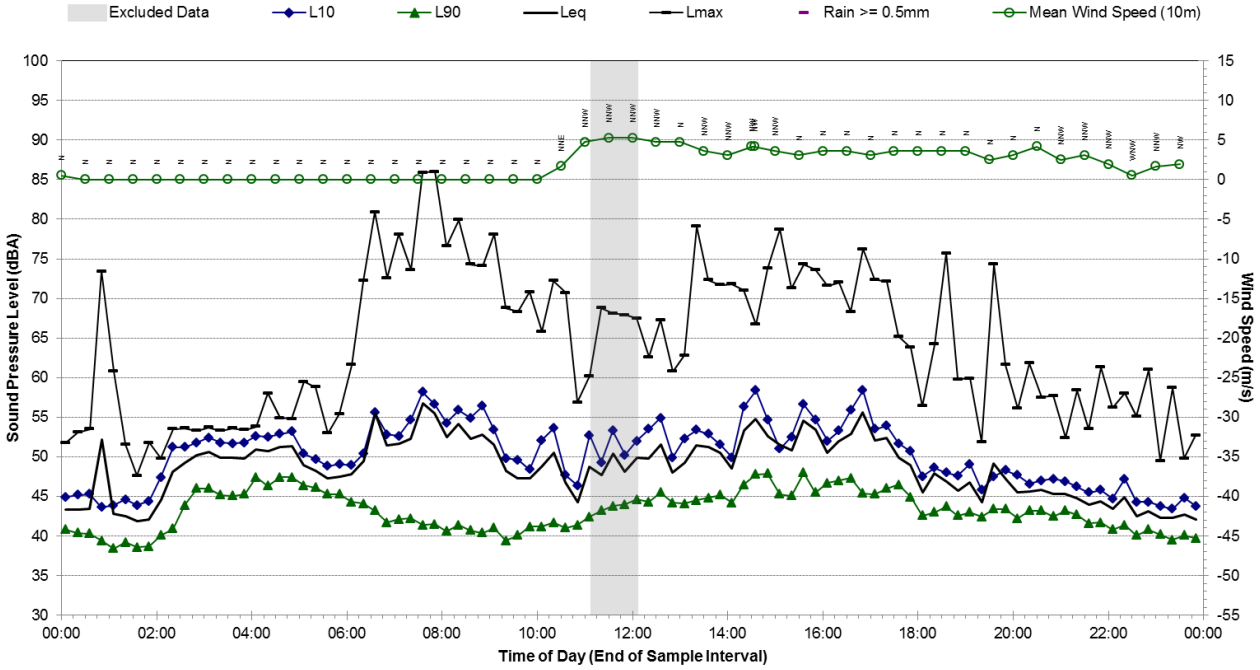
Statistical Ambient Noise Levels

Location 1 - Boorea Avenue - Monday, 24 April 2017



Statistical Ambient Noise Levels

Location 1 - Boorea Avenue - Tuesday, 25 April 2017



Statistical Ambient Noise Levels

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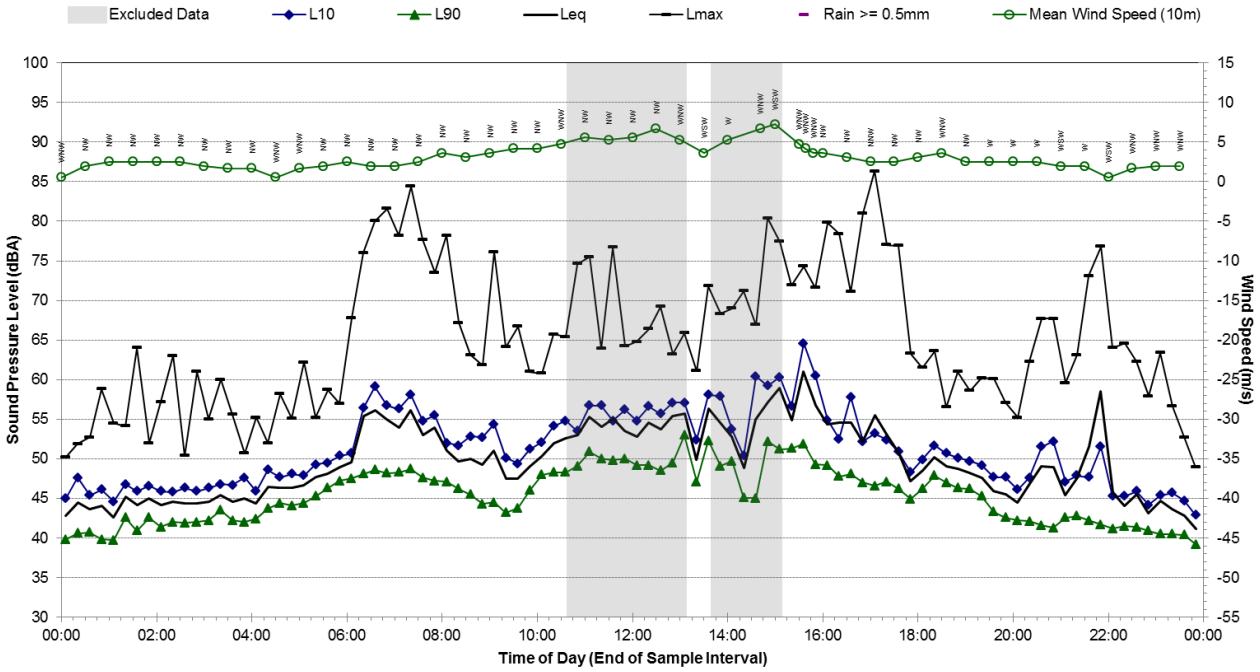
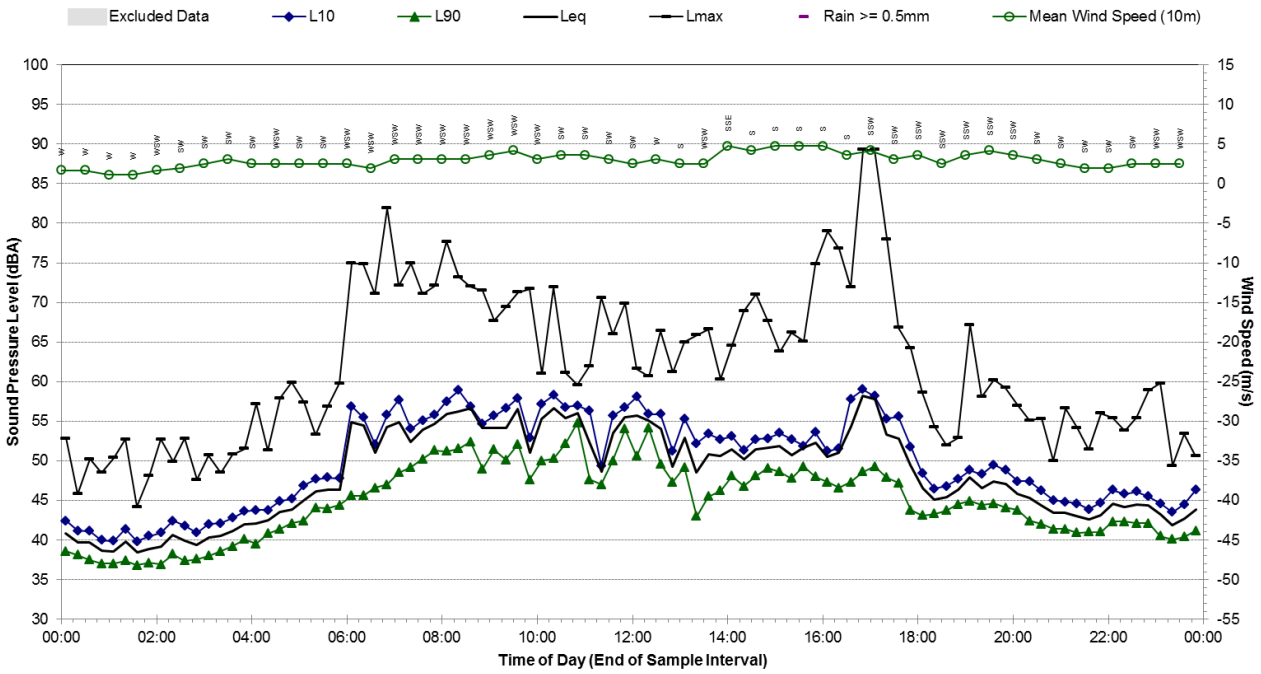


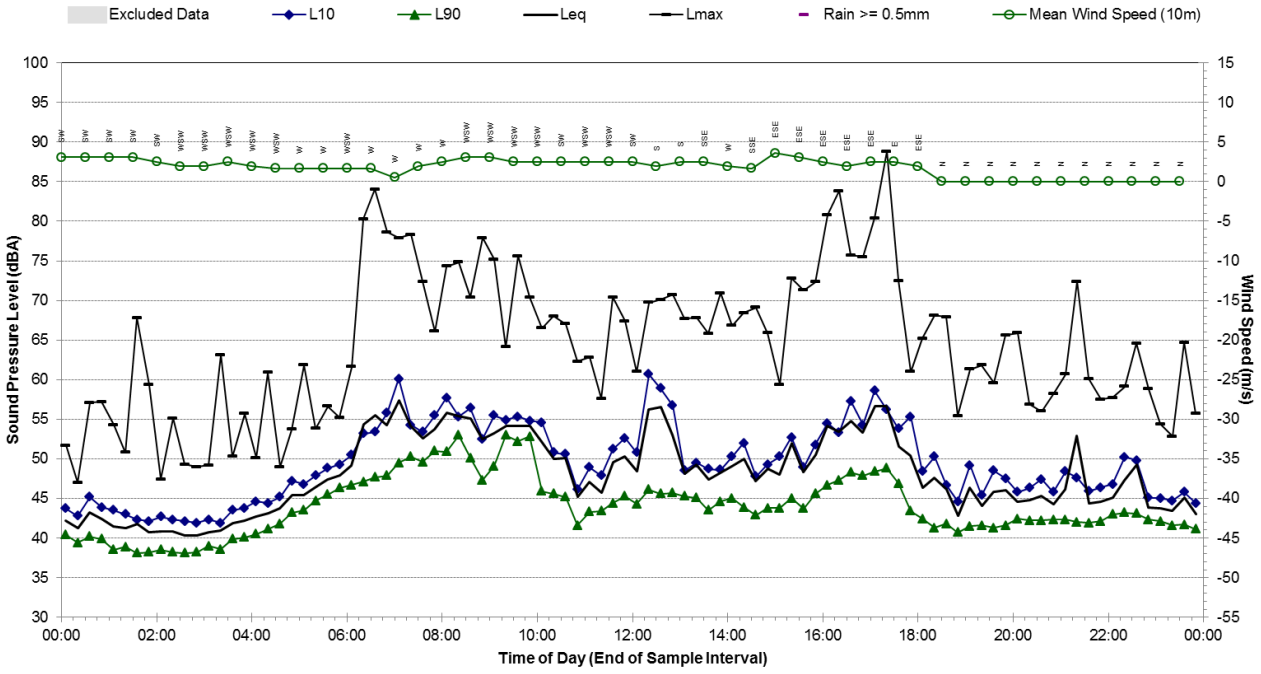
Statistical Ambient Noise Levels

Location 1 - Boorea Avenue - Thursday, 27 April 2017



Statistical Ambient Noise Levels

Location 1 - Boorea Avenue - Friday, 28 April 2017



Statistical Ambient Noise Levels

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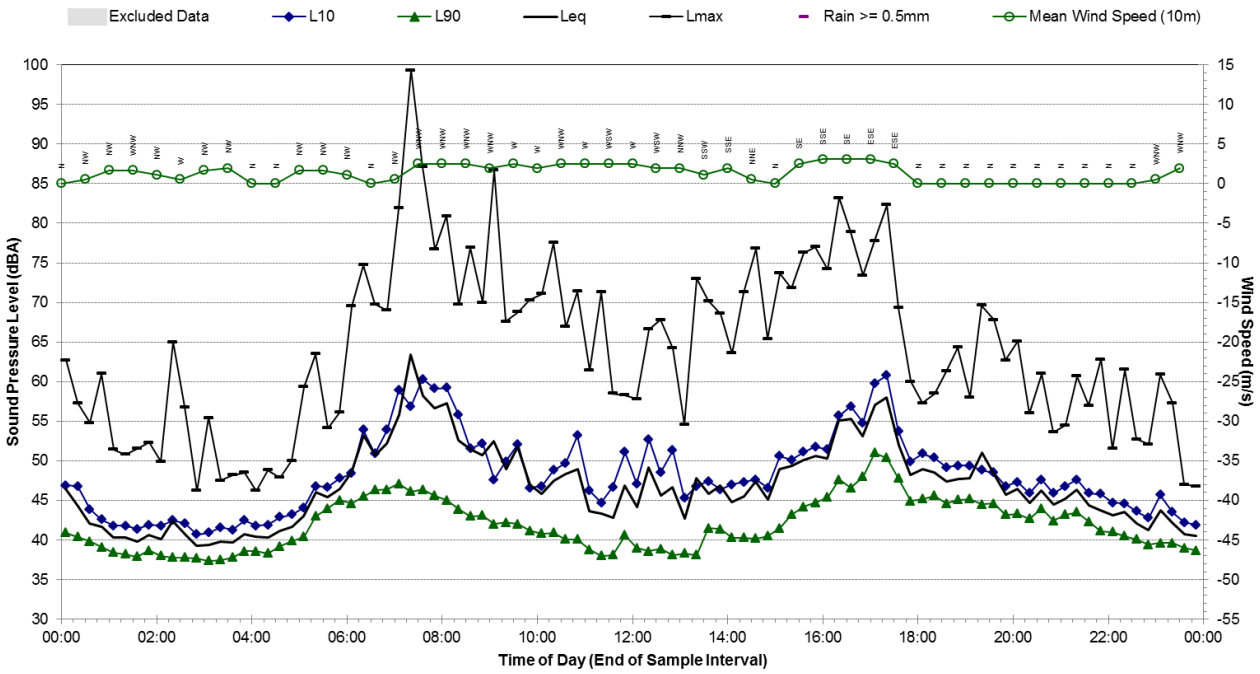

Statistical Ambient Noise Levels

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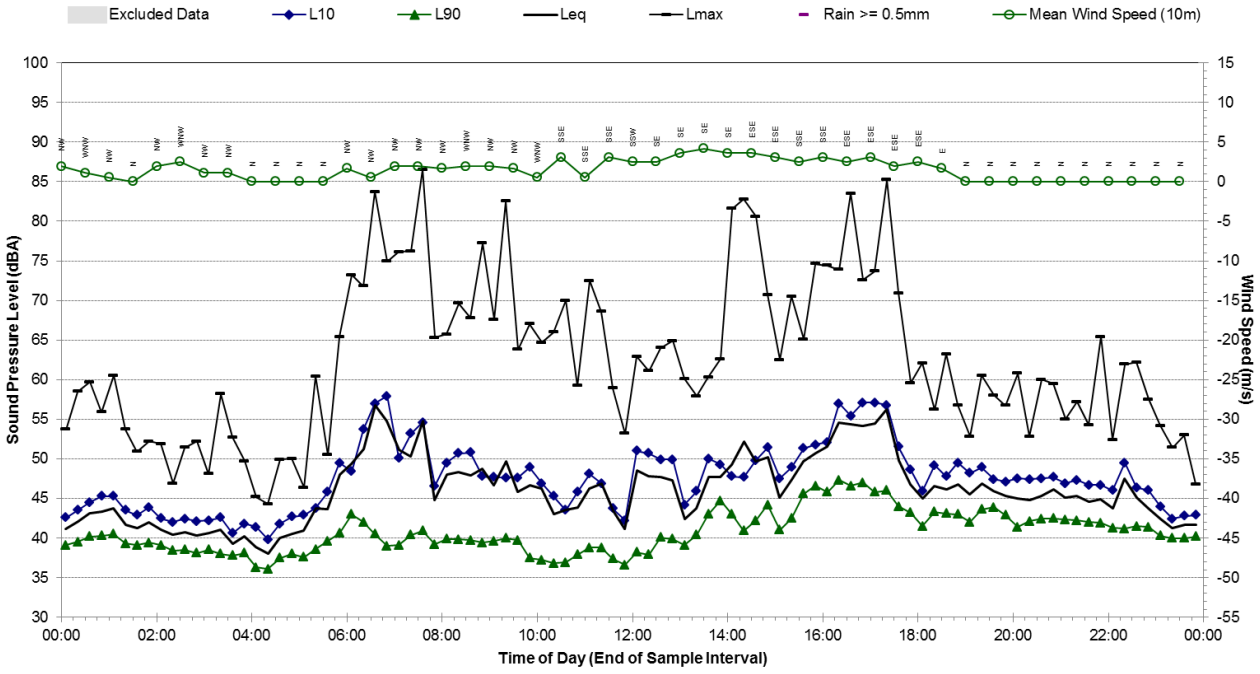
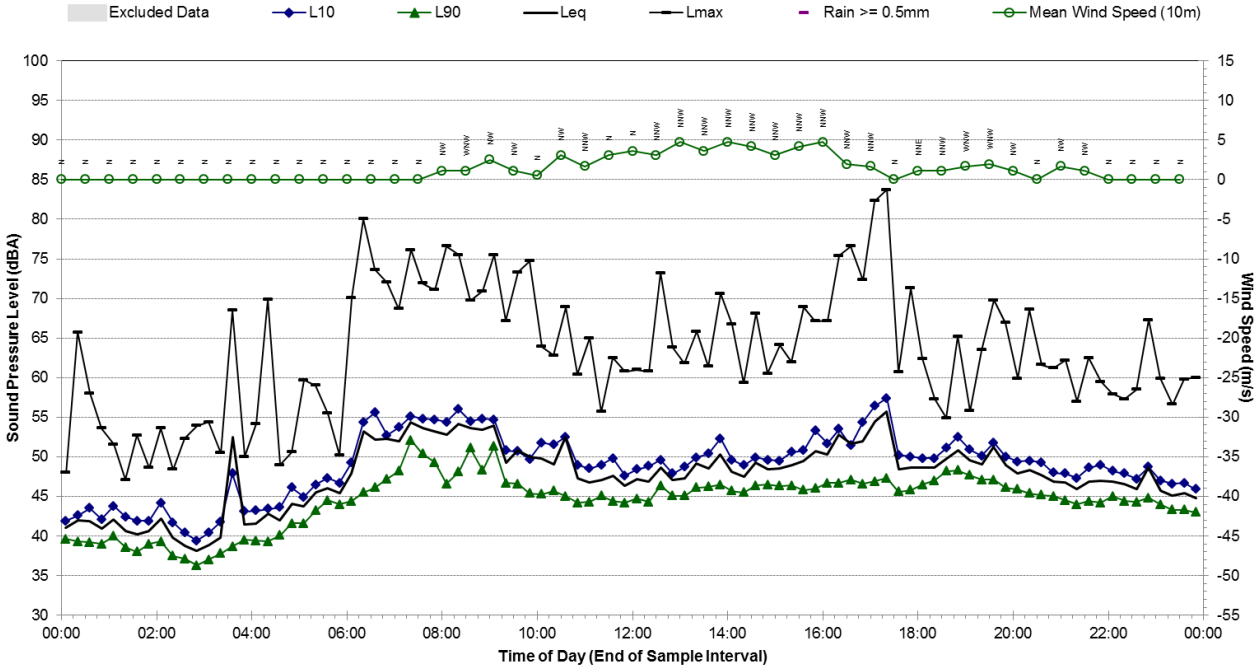


Statistical Ambient Noise Levels

Location 1 - Boorea Avenue - Monday, 1 May 2017



Statistical Ambient Noise Levels

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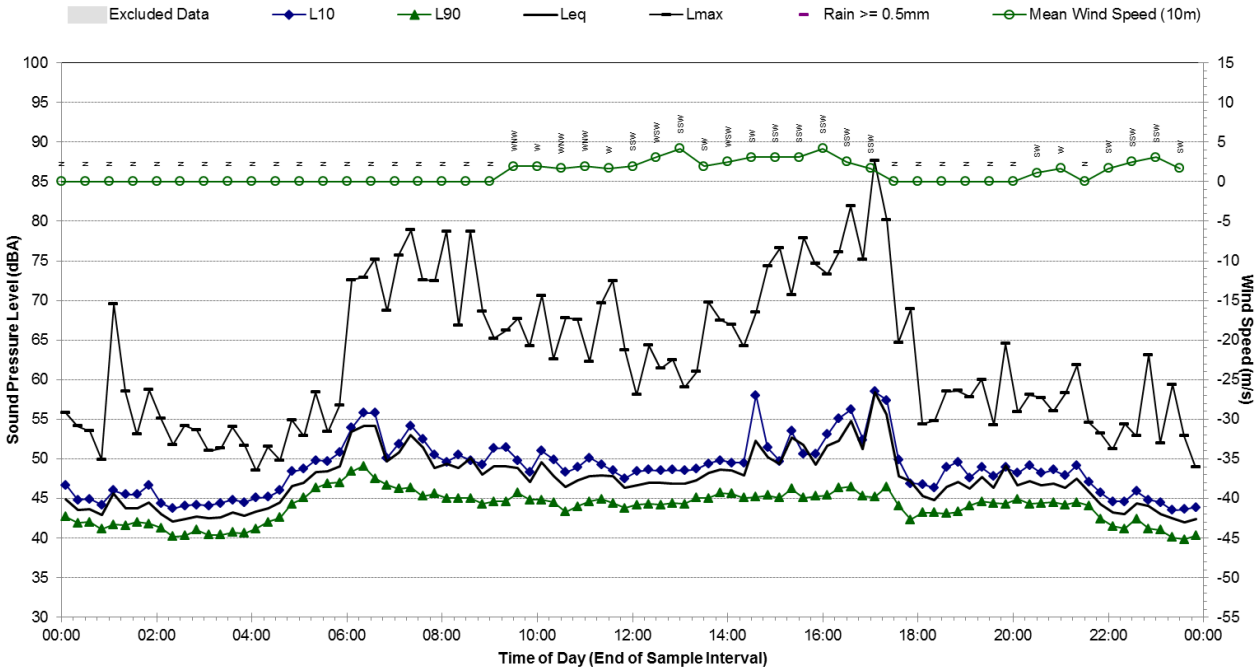
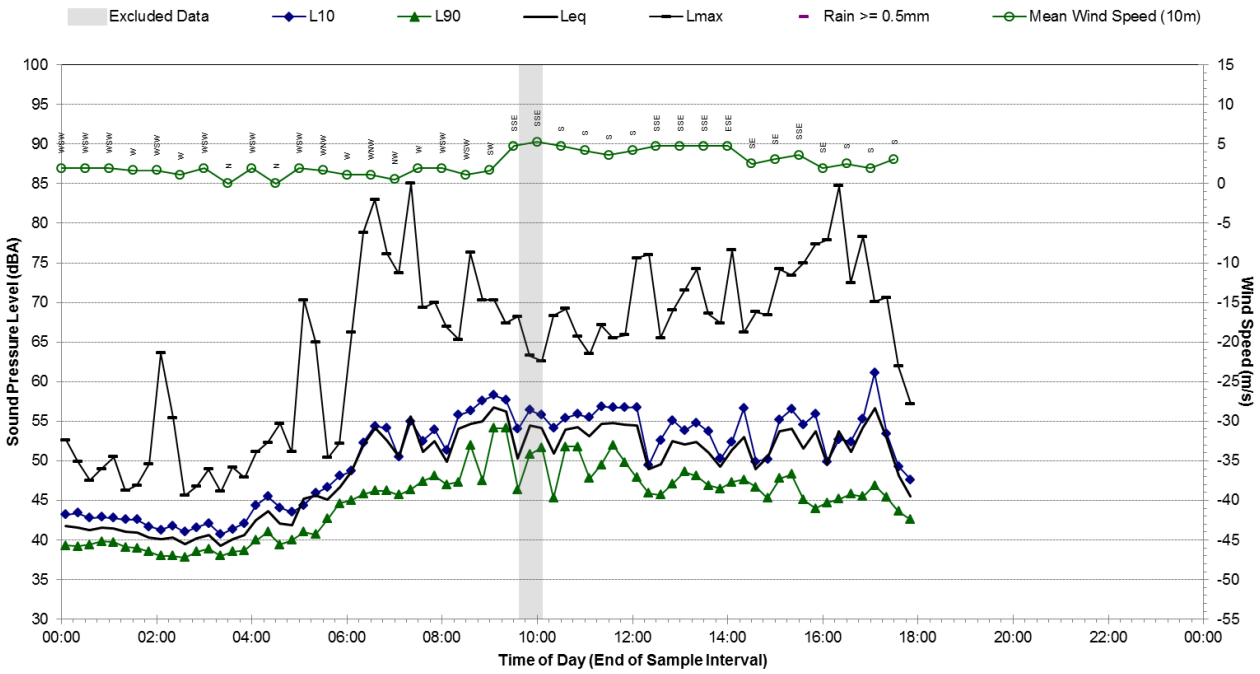


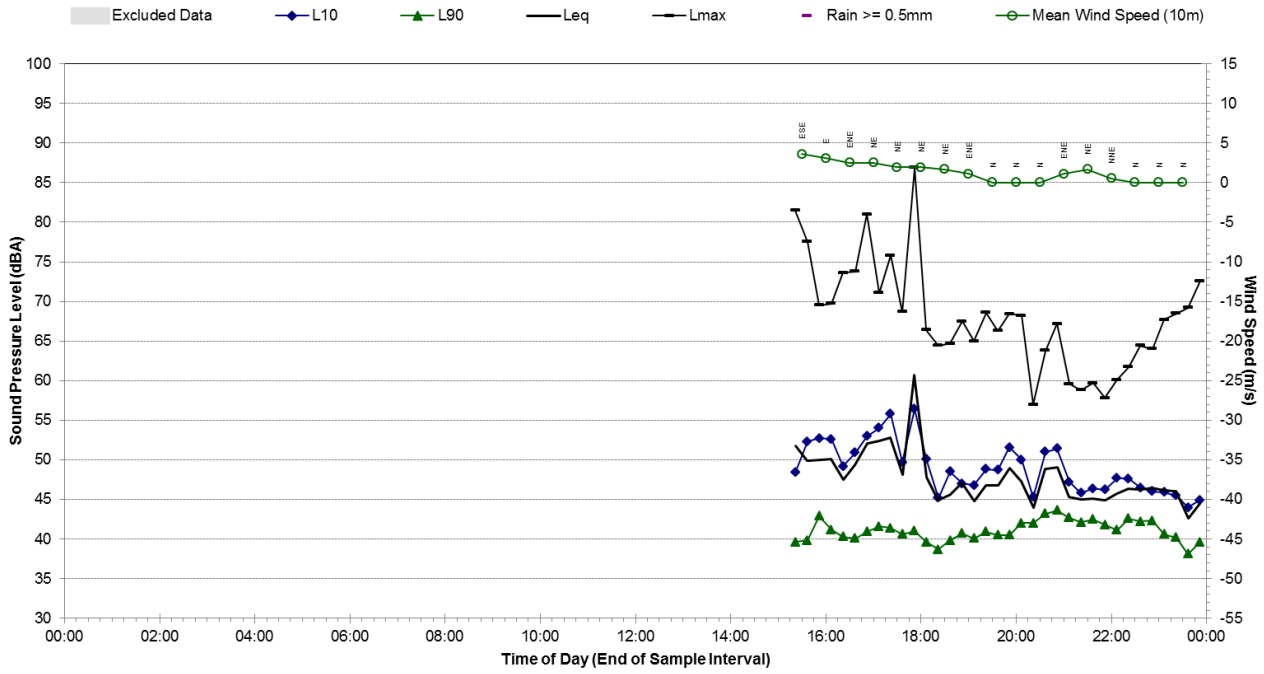
Statistical Ambient Noise Levels

Location 1 - Boorea Avenue - Wednesday, 3 May 2017



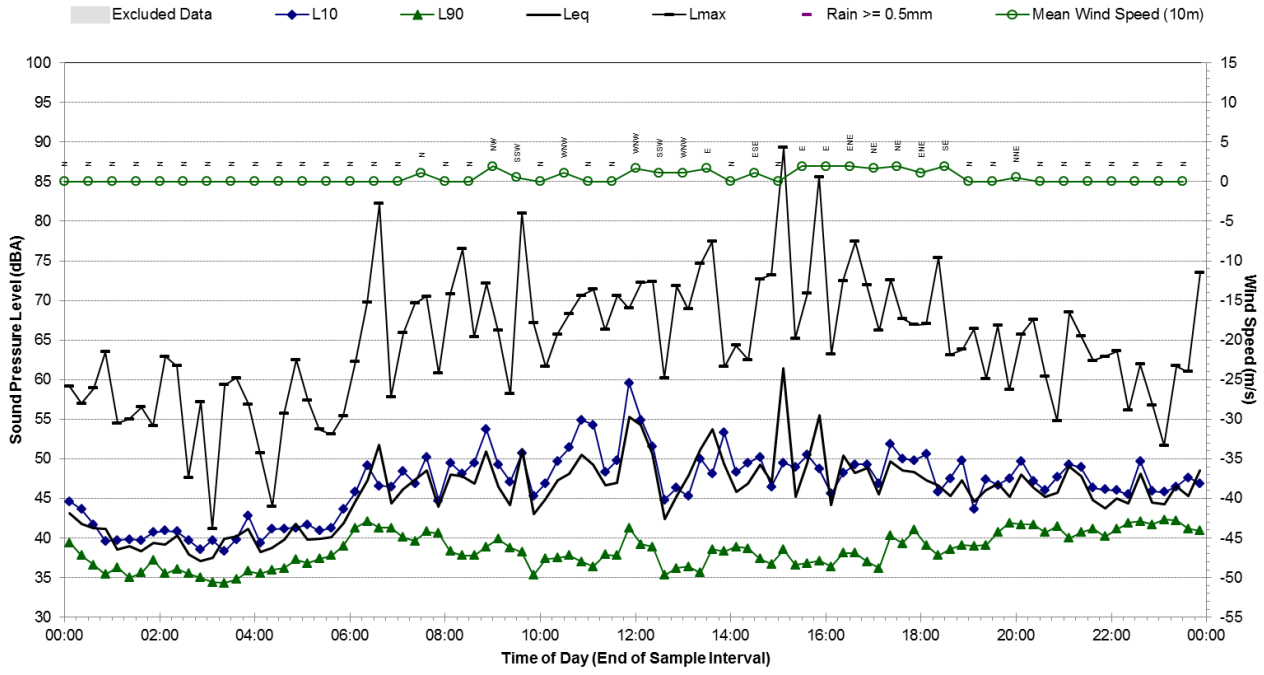
Statistical Ambient Noise Levels

Location 2 - 13 Boorea Avenue - Friday, 21 April 2017



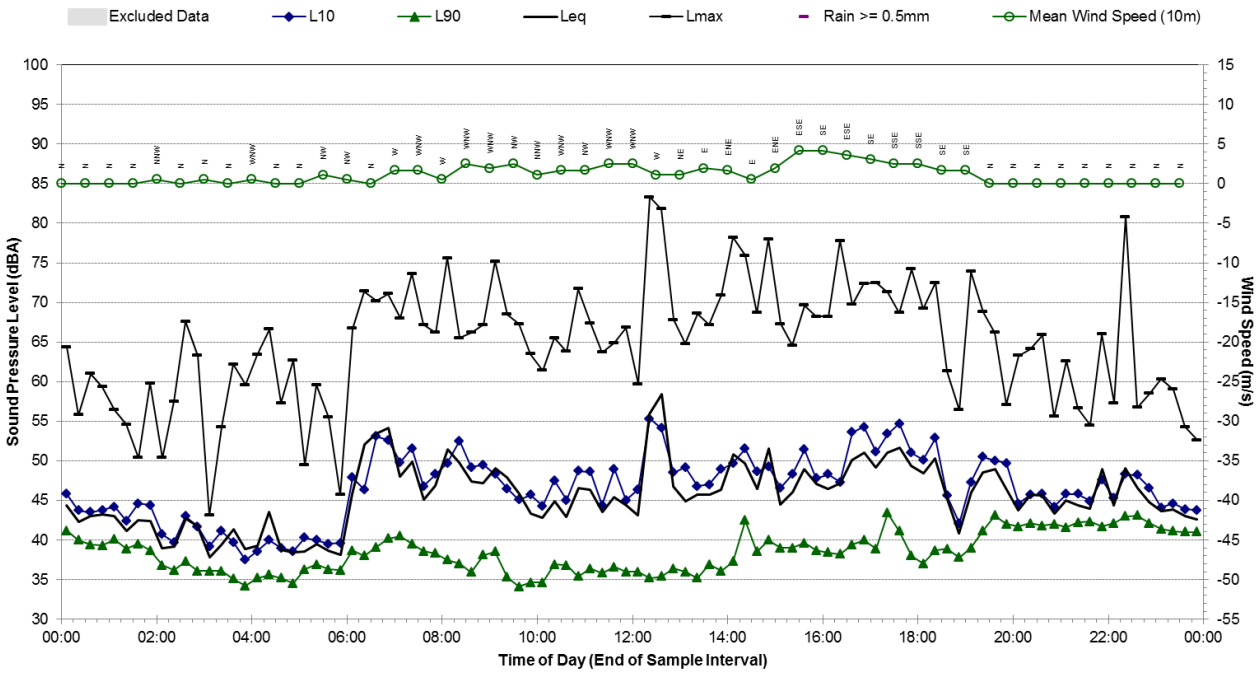
Statistical Ambient Noise Levels

Location 2 - 13 Boorea Avenue - Saturday, 22 April 2017



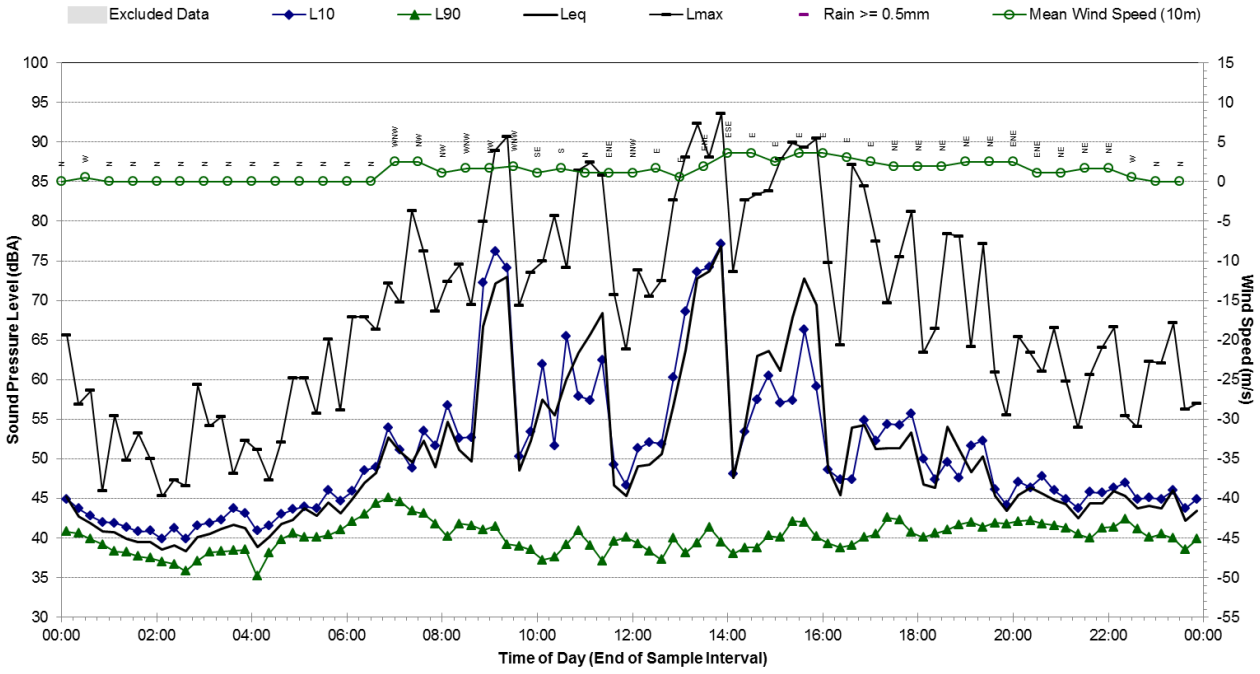
Statistical Ambient Noise Levels

Location 2 - 13 Boorea Avenue - Sunday, 23 April 2017



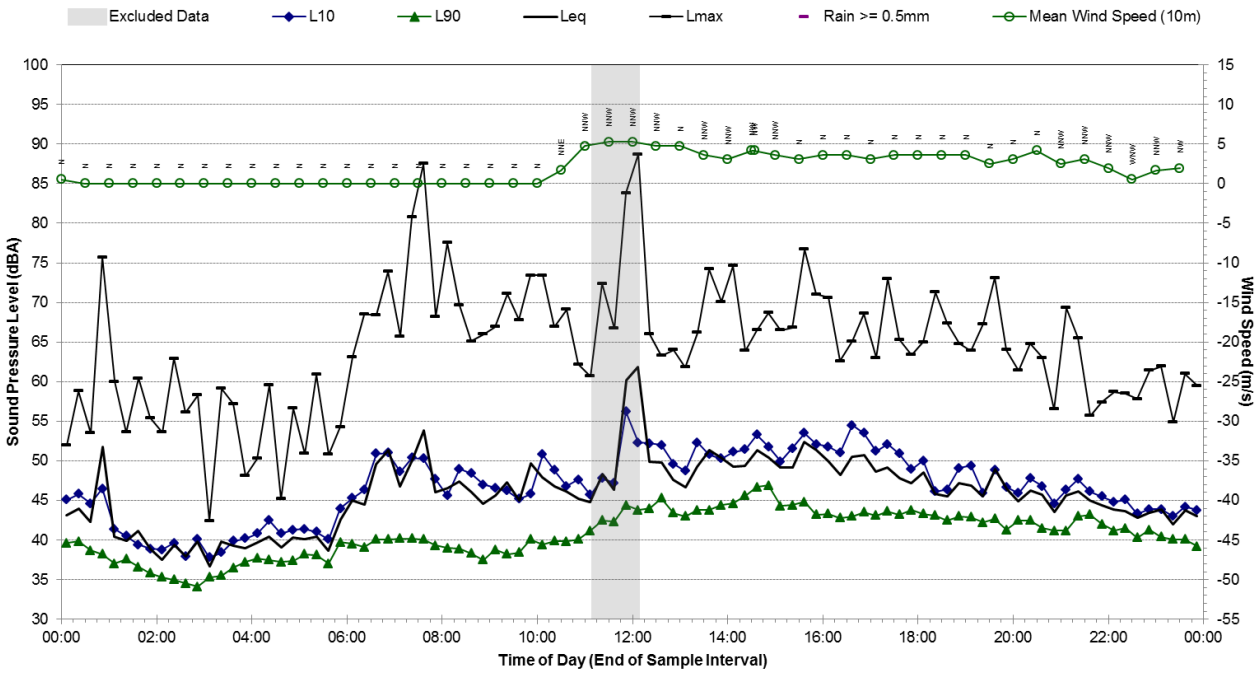
Statistical Ambient Noise Levels

Location 2 - 13 Boorea Avenue - Monday, 24 April 2017



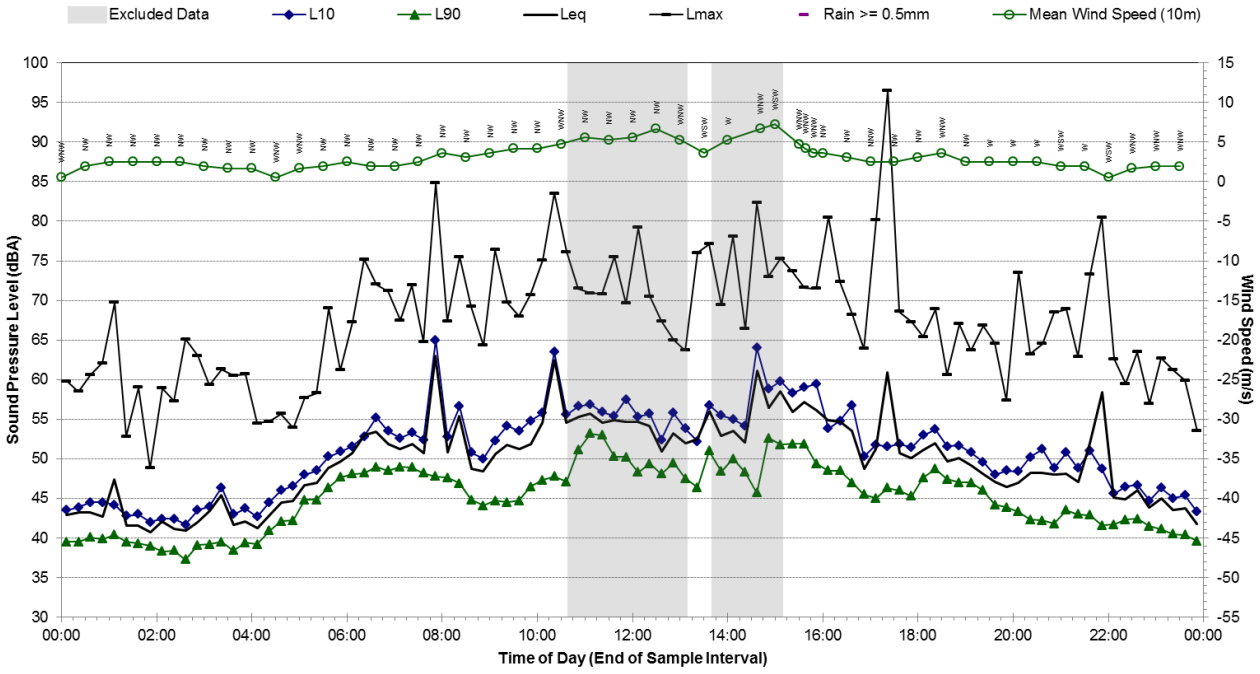
Statistical Ambient Noise Levels

Location 2 - 13 Boorea Avenue - Tuesday, 25 April 2017



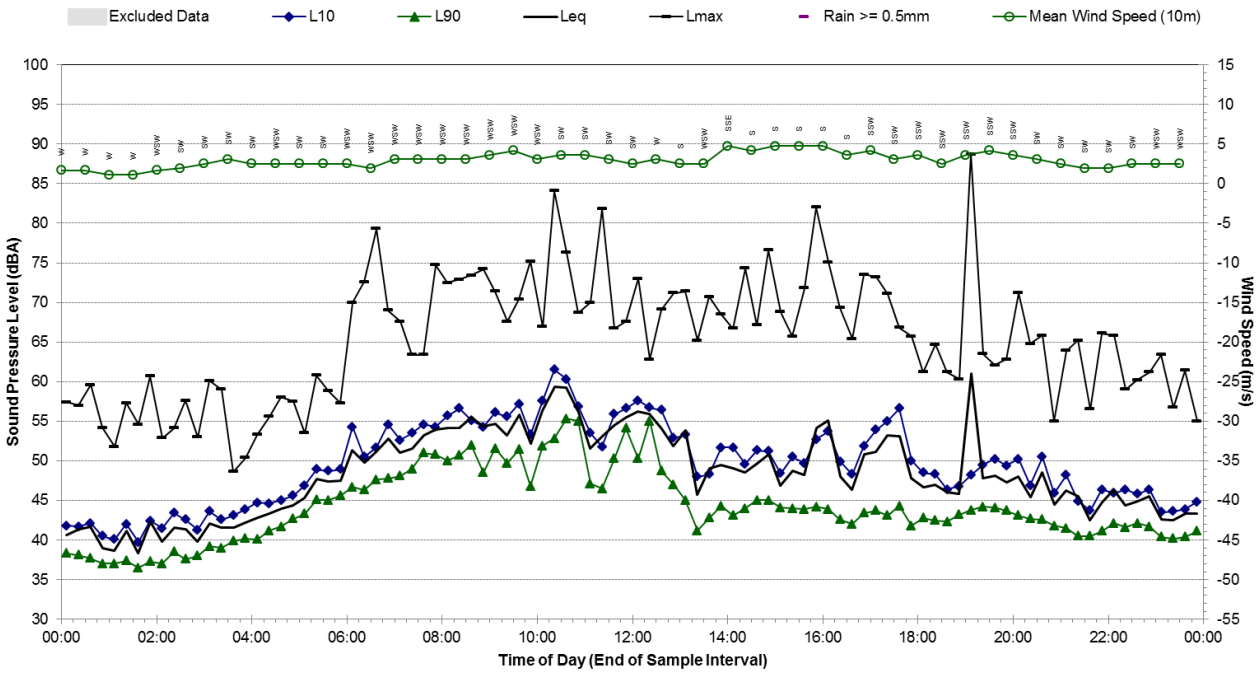
Statistical Ambient Noise Levels

Location 2 - 13 Boorea Avenue - Wednesday, 26 April 2017



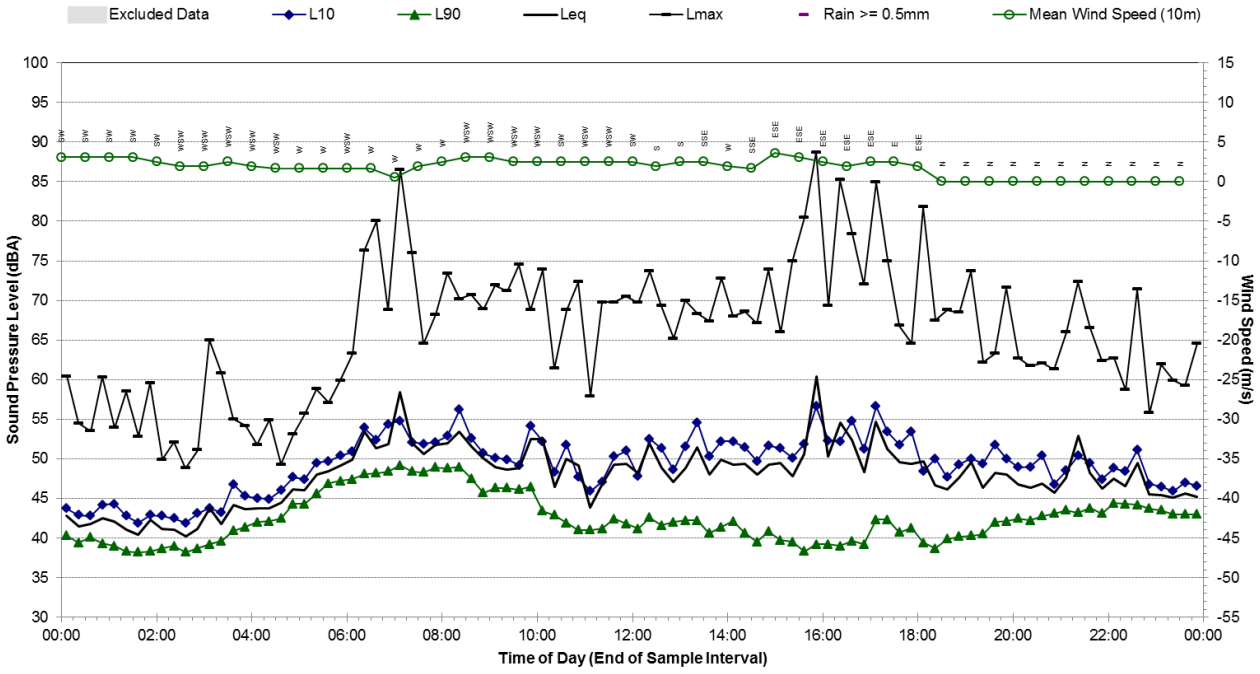
Statistical Ambient Noise Levels

Location 2 - 13 Boorea Avenue - Thursday, 27 April 2017



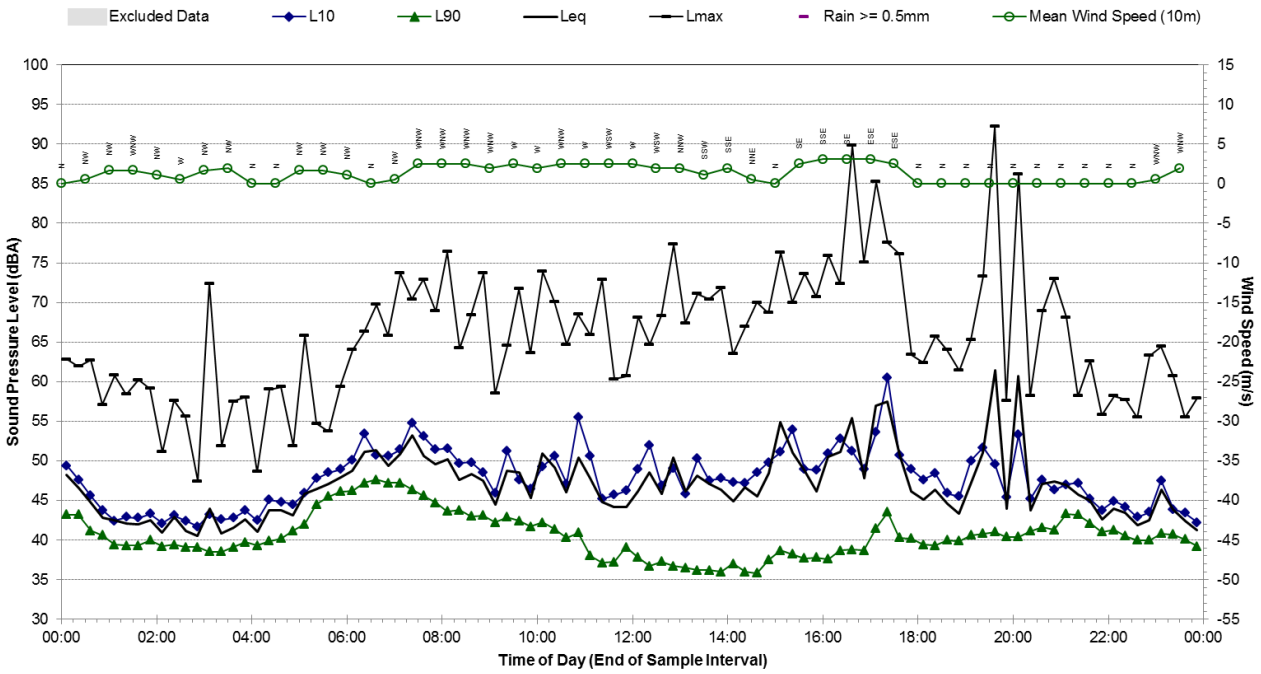
Statistical Ambient Noise Levels

Location 2 - 13 Boorea Avenue - Friday, 28 April 2017



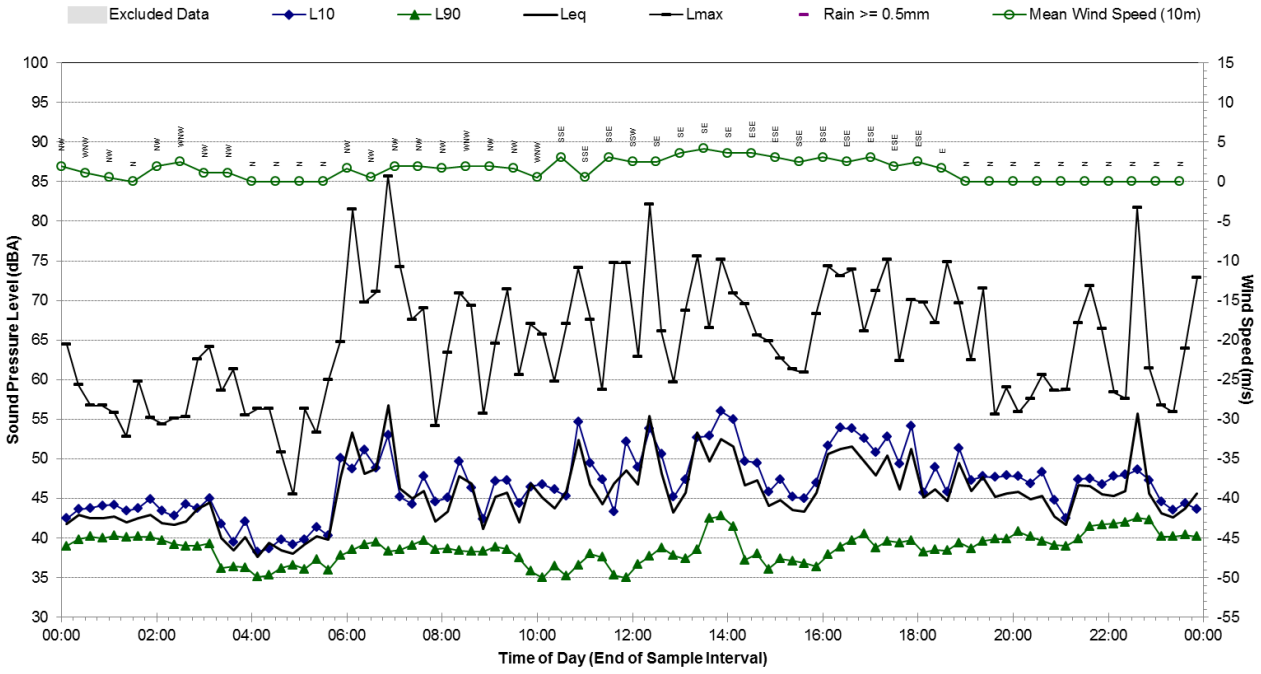
Statistical Ambient Noise Levels

Location 2 - 13 Boorea Avenue - Saturday, 29 April 2017



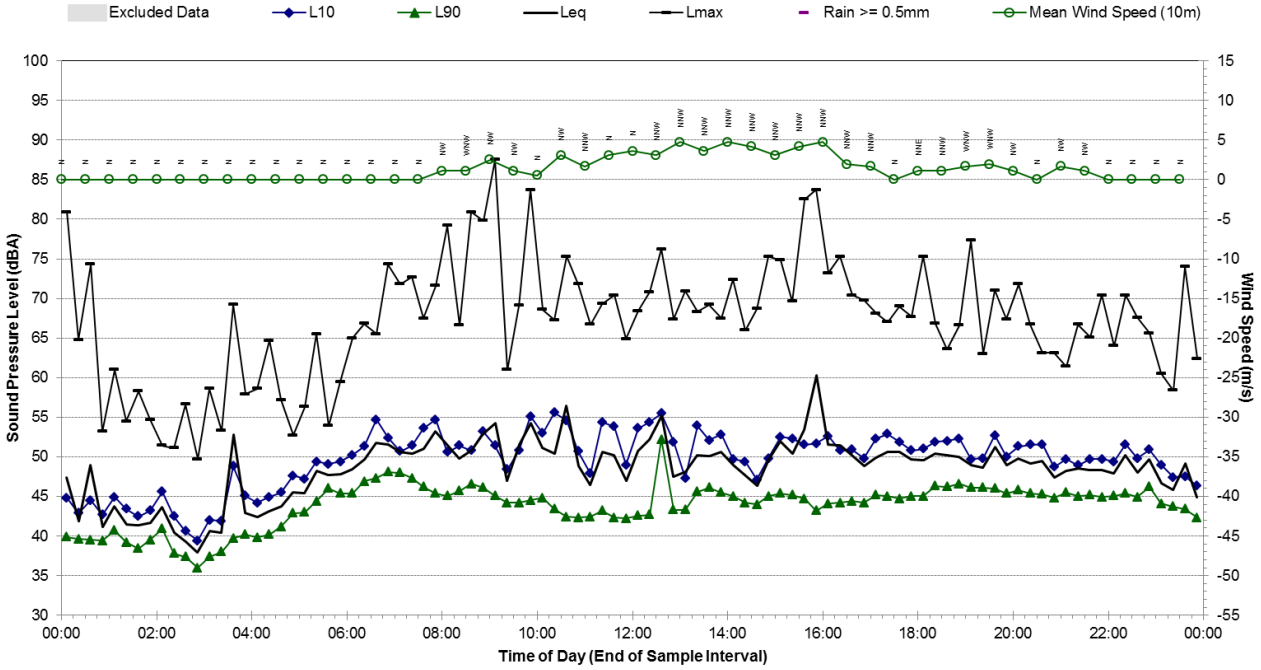
Statistical Ambient Noise Levels

Location 2 - 13 Boorea Avenue - Sunday, 30 April 2017



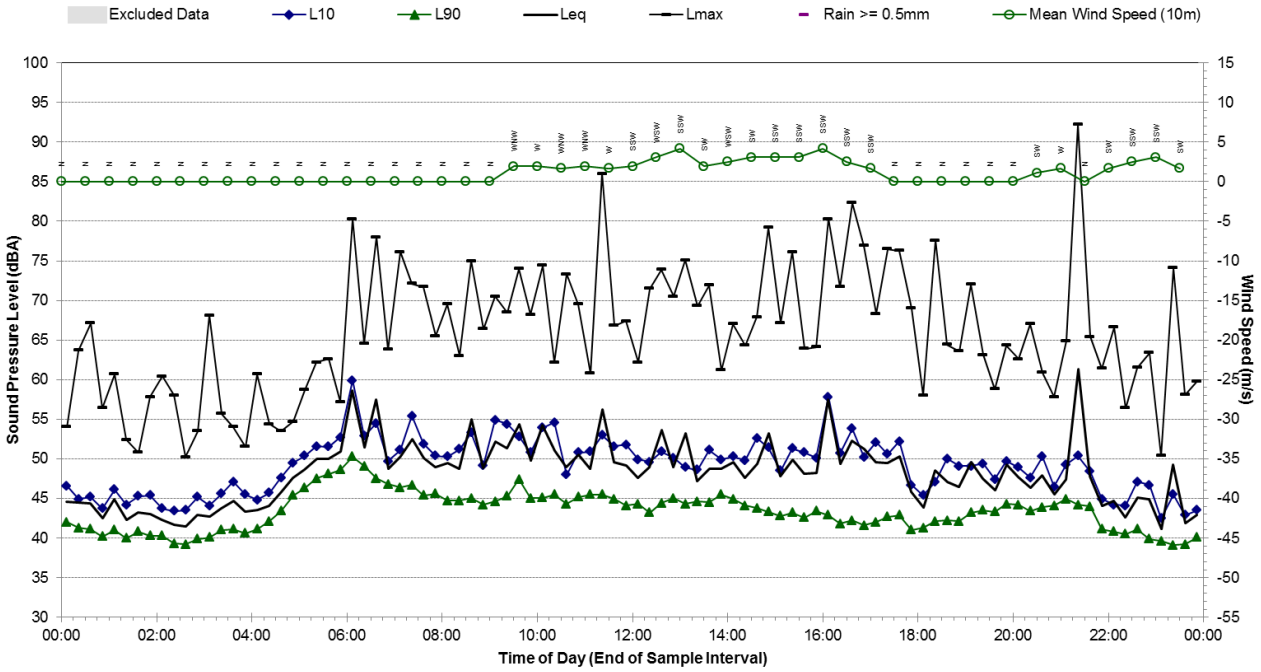
Statistical Ambient Noise Levels

Location 2 - 13 Boorea Avenue - Monday, 1 May 2017



Statistical Ambient Noise Levels

Location 2 - 13 Boorea Avenue - Tuesday, 2 May 2017



Statistical Ambient Noise Levels

Location 2 - 13 Boorea Avenue - Wednesday, 3 May 2017