Noise Impact Assessment

Proposed Rezoning

7 Concord Street, Concord West

Report Number 610.15449

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Table of Contents

TABLES

FIGURES

APPENDICES

1 INTRODUCTION

SLR Consulting Pty Ltd (SLR) was engaged by Elton Consulting to conduct a noise impact assessment from the potential noise emissions generated by Homebush Bay Drive onto the proposed residential development at 7 Concord Street, Concord West.

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

2 DEVELOPMENT DESCRIPTION

The proposed development is located at 7 Concord Street, Concord West as presented in **Figure 1**. The surrounding area is a mix of commercial premises to the south and residential lots to the east and north.

The noise environment at this site is dominated by traffic noise from Homebush Bay Drive. Homebush Bay Drive is an arterial road with two lanes in each direction. The noise environment at the site is dominated by constant road traffic noise from Homebush Bay Drive.

Figure 1 Aerial Photograph

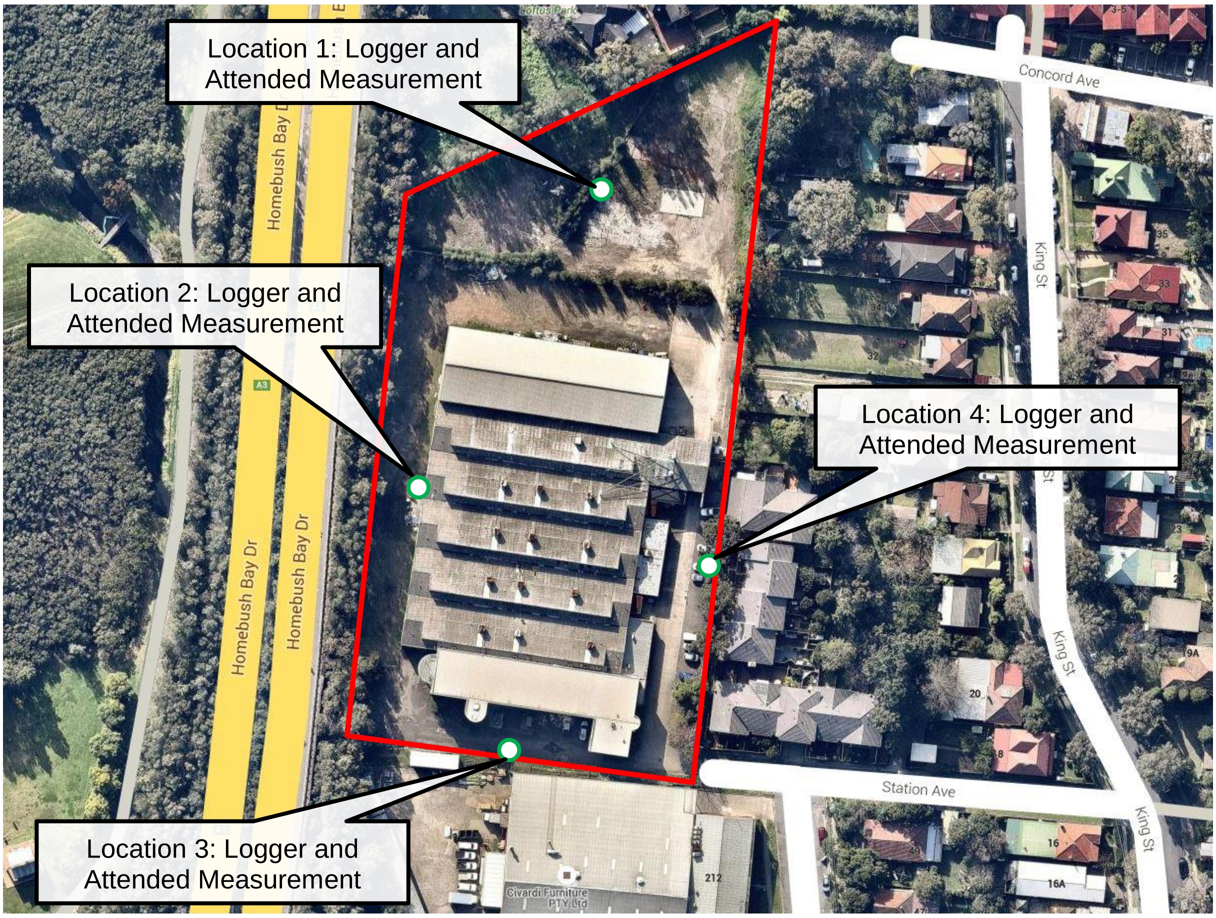


Image courtesy of NearMap

3 NOISE MONITORING

3.1 Unattended Monitoring

In order to characterise the existing acoustical environment of the area, unattended noise monitoring was conducted between Tuesday 21 July and Wednesday 29 July 2015 at the locations presented in **Figure 1**.

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

Location 1 to location 3 were selected to measure road traffic noise levels at the proposed future facade location to Homebush Bay Drive, to determine the acoustical treatment required to achieve acceptable internal noise levels. Location 4 was selected to measure the background noise levels experienced at neighbouring residential receivers, in order to determine noise emission criteria for the development.

Instrumentation for the survey comprised four SVAN 957 environmental noise loggers (serial numbers 23247, 20675, 23244 and 21884) fitted with microphone windshields. Calibration of the loggers was checked prior to and following measurements. 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 B**. The charts present each 24 hour period by incorporating the L_{A1}, L_{A10}, L_{Aeq} and L_{A90} noise levels for the corresponding 15 minute periods.

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

3.2 Data Processing – Road Traffic Noise Intrusion

In order to assess road traffic noise impacts on the site, the data obtained from the noise logging has been processed to establish representative ambient noise levels over the time periods defined in the Environment Protection Authority (EPA) *Road Noise Policy* (RNP). The results are presented in **Table 1**.

Table 1 Measured L_{Aeq} Road Traffic Noise Descriptors

Logger	$L_{Aeq(15hour)}$	$L_{Aeq(9hour)}$
1	63 dB	59 dB
2	69 dB	65 dB
3	63 dB	57 dB
4	57 dB	51 dB

The L_{Aeq} (A-weighted equivalent noise level) represents the logarithmic average noise energy during the measurement period. The “15 Hour” represents the daytime period between 7:00 am and 10:00 pm and “9 Hour” represents the night time period between 10:00 pm and 7:00 am.

3.3 Attended Noise Monitoring

Operator-attended measurements were conducted on Tuesday 21 July and Wednesday 22 July 2015 at the locations presented in **Figure 1.**

The measurements were performed using a calibrated Bruel & Kjaer Type 2260 Sound Level Meter (Serial number: 2414605). Instrument calibration was checked before and after measurements, with variation in calibrated levels not exceeding ±0.5 dB. The acoustic instrumentation employed was designed to comply with the requirements of AS IEC 61672.1—2004 - *Electroacoustics—Sound level meters, Part 1: Specifications* and carries current manufacturer calibration certificates.

A summary of the attended measurements are tabulated in **Table 2**.

Table 2 Operator Attended 15-minute Ambient Noise Survey

Location/ Description	Date/ Start time/ Weather	Primary Noise Descriptor (dB re 20 µPa)					Description of Noise Emission, Typical Maximum Levels LAmax (dB)
		LAmax	LA1	LA10	LA90	LAeq	
Location 1 7 Concord Avenue North Facade	21/07/2015 14:00 Wind: 4 m/s Temp: 20 ºC	73	68	64	60	63	Cars: 61-66 Trucks: 64-69 Birds: 58-61 Airplane: 73
Location 2 7 Concord Avenue West Facade	21/07/2015 14:30 Wind: 4 m/s Temp: 20 ºC	77	73	70	66	68	Cars: 68-72 Trucks: 72-77 Motorbikes: 69, 70 Airplanes: 75, 76
Location 3 7 Concord Avenue South Facade	21/07/2015 15:02 Wind: 4 m/s Temp: 20 ºC	77	68	64	60	63	Cars: 63-66 Trucks: 67-73 Nearby Furniture Factory: 62-77 Motorbike: 69
Location 4 7 Concord Avenue East Facade	22/07/2015 9:20 Wind: 3 m/s Temp: 12 ºC	76	62	54	49	53	Birds: 52-76 Traffic: 52-56 Nearby Furniture Factory: 55-59

3.4 Data Processing – Noise Emission

In order to assess the acoustical implications of the development at nearby sensitive receivers, the measured background noise data from Logger 4 was processed in accordance with the Environmental Protection Authority (EPA) *Industrial Noise Policy* (INP, January 2000).

Table 3 details the Rating Background Level (RBL) and LAeq noise levels recorded during the daytime, evening and night-time periods taken from Logger 4. 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 3 Measured Ambient Noise Levels Corresponding to EPA Industrial Noise Policy Assessment Time Periods

Daytime1		Evening1		Night-time1	
RBL2	LAeq3	RBL2	LAeq3	RBL2	LAeq3
48	57	49	55	42	52

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

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

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

4 NOISE ASSESSMENT CRITERIA

4.1 Residential – Noise Intrusion

The Department of Planning and Infrastructure's *Development near Rail Corridors and Busy Roads – Interim Guideline* (2008) aims to assist in the planning, design and assessment of developments in, or adjacent to, busy roads and supports the specific provisions of State Environmental Planning Policy (SEPP Infrastructure) 2007 in relation to road traffic noise.

Clause 87 (rail) and 102 (road), states that Council must not grant consent to development for a building with a residential use on land that is impacted by rail or road noise or vibration as per the SEPP unless it is satisfied that appropriate measures will be taken to ensure that the following L_{Aeq} levels are not exceeded:

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

Further, if internal noise levels with windows or doors open exceed the criteria by more than 10 dBA, 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 National Construction Code 2014.

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*.

4.2 Noise Emissions

Responsibility for the control of noise emissions in New South Wales is vested in Local Government and the NSW Environment Protection Authority (EPA).

The EPA oversees the Industrial Noise Policy which provides a framework and process for deriving noise criteria. The Industrial Noise Policy criteria for industrial noise sources have two components:

- Controlling the intrusive noise impacts for residents and other sensitive receivers in the short term; and
- Maintaining noise level amenity of particular land uses for residents and sensitive receivers in other land uses.

Intrusiveness Criterion – Industrial Noise

For assessing intrusiveness, the background noise generally needs to be measured. The intrusiveness criterion essentially means that the equivalent continuous noise level (L_{Aeq}) of the source should not be more than 5 dBA above the measured Rated Background Level (RBL), over any 15 minute period.

Amenity Criterion

The amenity criterion is based on land use and associated activities (and their sensitivity to noise emission). The cumulative effect of noise from industrial sources needs to be considered in assessing the impact. The criteria relate only to industrial-type noise sources and do not include road, rail or community noise. The existing noise level from industry is measured. If it approaches the criterion value, then noise levels from new industrial-type noise sources, (including air-conditioning mechanical plant) need to be designed so that the cumulative effect does not produce total noise levels that would significantly exceed the criterion.

Area Classification

The Industrial Noise Policy, for the purposes of determining the appropriate noise amenity criteria, characterises an "Urban" noise environment as an acoustical environment that:

- Is dominated by 'urban hum' or industrial source noise
- Has through traffic with characteristically heavy and continuous traffic flows during peak periods
- Is near commercial districts or industrial districts
- Has any combination of the above,

Where "urban hum" means the aggregate sound of many unidentifiable, mostly traffic-related sound sources.

For the purposes of this assessment, the area surrounding the nearest sensitive receivers satisfies the "Urban" area classification.

Project Specific Noise Levels

Having defined the area type, 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 4**. These criteria are nominated for the purpose of assessing potential noise impacts from the proposed development.

In this case, the ambient noise environment is not controlled by industrial noise sources but rather, road traffic noise and therefore the amenity criteria becomes the Acceptable Noise Level (ANL). For each assessment period, the more stringent of the amenity or intrusive criteria are adopted as marked in bold in **Table 4**.

Table 4 Operational Noise Criteria for Receivers Surrounding the Development Site

Receiver	Time of Day	ANL 1 LAeq(period)	Measured RBL 2 LA90(15minute)	Measured LAeq(period) Noise Level)	Criteria for New Sources	
					Intrusive LAeq(15minute)	Amenity 3 LAeq(period)
Residential	Day	60	48	57	**53**	61
	Evening	50	49	55	54	**45**
	Night	45	42	52	47	**42**

Note 1: ANL = "Acceptable Noise Level" for residences in Urban Areas.
Note 2: RBL = "Rating Background Level".
Note 3: Assuming existing noise levels are unlikely to decrease in the future.

4.3 Internal Sound Insulation Requirements

The development shall be designed and constructed to meet the National Construction Code Series Building Code of Australia (NCC 2015) requirements, most notably Part F5 which relates to *Sound Transmission and Insulation*.

Table 5 details the minimum acoustic performance required for the project.

Table 5 NCC 2015 Sound Insulation Requirements

Construction	NCC Requirements	
	Laboratory Rating	**Verification**
Walls between sole occupancy units	Rw + Ctr not < 50	DnT,w + Ctr not < 45
Walls between a bathroom, sanitary compartment, laundry or kitchen in one sole occupancy unit and a habitable room (other than a kitchen) in an adjoining unit	Rw + Ctr not < 50 and **Must have a minimum 20 mm cavity between two separate leaves**	DnT,w + Ctr not < 45 "Expert Judgment" Comparison to the "Deemed to satisfy" Provisions
Walls between sole occupancy units and a plant room or lift shaft	Rw not < 50 and **Must have a minimum 20 mm cavity between two separate leaves1**	DnT,w not < 45
Walls between sole occupancy units and a stairway, public corridor, public lobby or the like, or parts of a different classification	Rw not < 50	DnT,w not < 45
Door assemblies located in a wall between a sole-occupancy unit and a stairway, public corridor, public lobby or the like	Rw not < 30 2	DnT,w not < 25
Floors between sole-occupancy units or between a sole-occupancy unit and a plant room, lift shaft, stairway, public corridor, public lobby or the like, or parts of a different classification	Rw + Ctr not < 50 Ln,w + CI not > 62	DnT,w + Ctr not < 45 L'nT,w + CI not > 62
Soil, waste, water supply and stormwater pipes and ductwork to habitable rooms	Rw + Ctr not < 40	n/a
Soil, waste, water supply and stormwater pipes and ductwork to kitchens and other rooms	Rw + Ctr not < 25	n/a
Intra-tenancy Walls	There is no statutory requirement for airborne isolation via intra-tenancy walls.	

Note 1: A wall must be of "discontinuous construction" if it separates a sole occupancy unit from a plant room or lift shaft. Clause F5.3(c) defines "discontinuous construction" as a wall having a minimum 20 mm cavity between two separate leaves with no mechanical linkage except at the periphery.

Note 2: Clause FP5.3(b) in the 2014 NCC states that the required insulation of a floor or wall must not be compromised by a door assembly.

5 NOISE ASSESSMENT

5.1 Road Traffic Noise Intrusion

Road traffic noise intrusion has been assessed based on project drawing provided by Antoniades Architects dated November 2015 as illustrated in **Figure 2**.

Based upon the road traffic measurement results presented in **Table 1**, the noise levels incident upon the proposed future facades are summarised in **Table 6**.

Figure 2 Facade Indicators

Table 6 Facade Incident Noise Levels

Facade Indicator	Daytime (7:00 am - 10:00 pm) LAeq(15hour)	Night (10:00 pm - 7:00 am) LAeq(9hour)
Red	69	65
Blue	63	59
Green	63	57
Orange	57	51

As a guide, well designed and installed standard 4 mm window glazing will typically attenuate external noise levels by approximately 20 dB with windows closed and 10 dB with windows open (allowing for natural ventilation). The predicted internal noise levels for standard facade glazing are presented in **Table 7**.

Table 7 Predicted Internal Noise Levels – Standard Glazing

Facade Indicator	Occupancy Area	Descriptor	Internal Noise Level (dBA)		Internal Noise Level Criteria (dBA)1
			Windows Open	Windows Closed	
	Sleeping areas	LAeq(9hour)	55	45	35
	Other habitable areas	LAeq(15hour)	59	49	40
	Sleeping areas	LAeq(9hour)	49	39	35
	Other habitable areas	LAeq(15hour)	53	43	40
	Sleeping areas	LAeq(9hour)	47	37	35
	Other habitable areas	LAeq(15hour)	53	43	40
	Sleeping areas	LAeq(9hour)	42	32	35
	Other habitable areas	LAeq(15hour)	51	41	40

Note 1: Criteria to be achieved with windows closed.

The predicted internal noise levels indicate that with standard-glazed windows open, internal noise level criteria presents exceedances within sleeping and habitable areas adjoining all facades, based on the assessed floor plans.

Alternative ventilation should be provided to all rooms to enable the occupants to close windows during noisier periods. Any such ventilation design must meet the requirements of the National Construction Code 2015.

Internal noise level criteria within sleeping areas as indicated in yellow in **Figure 2** will be achieved utilising standard glazing and windows closed. Noise levels within these rooms with windows open are also within the 10 dB limit whereby alternative ventilation would otherwise be required.

5.2 Mechanical Plant Noise Emission

Precise details of the mechanical ventilation / air conditioning plant selection are unknown at this stage, as this will take place 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 subject development. The criteria for noise emissions from mechanical plant and equipment are documented in **Table 4**. Detailed assessment and verification of mechanical noise emissions should be carried out prior to construction.

6 RECOMMENDATIONS

6.1 Road Traffic Noise Intrusion

Calculation of noise reduction performance requirements for building elements was undertaken using methodology contained in Australian Standard AS 3671:1989 *Acoustics – Road traffic noise intrusion – Building siting and construction.*

Recommendations are based on a typical reverberation time of 0.5 seconds within rooms. Critical details such as facade component dimensions and floor plans are unavailable at this stage. As such, the recommendations are considered <u>in-principle and as a guide only</u>.

Construction recommendations <u>must</u> be reviewed at detailed design when building details are finalised.

Glazing

In-principle glazing recommendations to meet specific internal noise levels are provided in **Table 8**. Recommendations are based on a typical reverberation time of 0.5 seconds. Laboratory tested acoustical certification for rated glazing systems should accompany the commissioned glazing systems.

Table 8 In-principle Glazing Recommendation

Facade Indicator	Occupancy Area	Minimum Rw
	Sleeping areas	36
	Other habitable areas	34
	Sleeping areas	30
	Other habitable areas	28
	Sleeping areas	28
	Other habitable areas	28
	Sleeping areas	24
	Other habitable areas	28

Roof/Ceiling Construction

Minimum RW 50

An in-principle design example includes:

- Pitched tiled roof with 350g/m2 sarking or steel sheet roof with minimum Bradford Anticon 55 insulation over battens;
- Ceiling joists or trusses supporting RONDO Furring Channel clipped to Gyprock Resilient Mounts;
- 1 layer of 13 mm Gyprock Soundchek plasterboard fixed to the furring channel;
- Bradford 215 Gold Batts 4.0 insulation in ceiling cavity; and
- If skylights, heat extraction units etc. are to be provided, then care should be taken to ensure that such units are properly constructed and all penetrations are properly sealed off so as not to degrade the sound insulation rating of the roof/ceiling system.

External Wall Construction

Minimum RW 45

An in-principle design example includes:

Brick Veneer Construction

- 110 mm brickwork;
- 90 mm timber studs at 600 mm centres with 12 mm minimum width cavity between studs and masonry wall;
- 75 mm Glasswool batts (11 kg/m3) in cavity; and
- 10 mm plasterboard internally, directly fixed to stud work.

6.2 Mechanical Plant Noise Emissions

It is envisaged that the mechanical plant noise sources will be controllable by common engineering methods that may consist of:

- Selection of low-noise units
- Judicious location
- Barriers/enclosure
- Silencers
- Acoustically lined ductwork

The selected mechanical equipment <u>must</u> be reviewed and assessed for conformance with established criteria at the detailed design stage of the project when specific plant selection and location is determined. At the Construction Certificate stage of the project appropriate noise control measures can be determined.

7 CONCLUSION

SLR Consulting Australia Pty Ltd has conducted a DA stage noise impact assessment of a proposed rezoning & residential development at 7 Concord Street, Concord West.

The assessment has examined the following areas of acoustical significance:

- Road traffic noise intrusion to internal spaces
- Noise emissions from mechanical plant
- Internal sound insulation requirements between occupancy areas
- Noise assessment presents an urban environment, with heavy traffic flows during peak periods
- Although the $L_{Aeq(15hour)}$ of 69 dBA can be considered significant, façade walls and glazing can be designed to meet criteria.

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

- In-principle measures that will be required to control road traffic noise intrusion to internal spaces.
- Appropriate intrusive industrial noise emission criteria.

Based upon the findings of this assessment, the development as proposed appears satisfactory in terms of its general planning arrangement. Acceptable internal noise levels may be achieved within residential apartments with the incorporation of the in-principle recommendations outlined in **Section 6**. Building construction must be reviewed at detailed design stage in order to determine acoustical requirements specific to the final building design.

SLR finds this site to be deemed suitable for residential rezoning and feasible on the basis of acoustics.

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 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 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

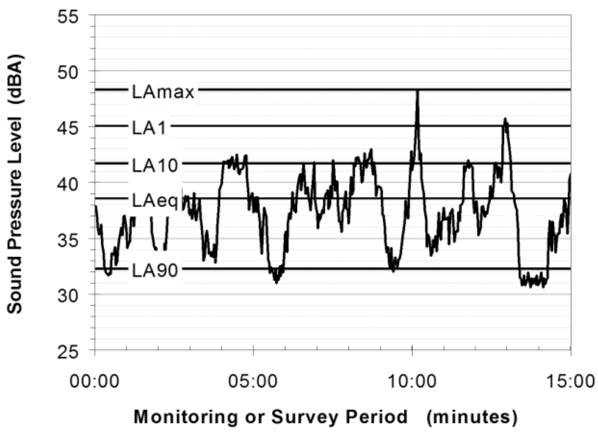
The Sound Power of a source is the rate at which it emits acoustic energy. As with Sound Pressure Levels, Sound Power Levels are expressed in decibel units (dB or dBA), but may be identified by the symbols SWL or LW, or by the reference unit 10-12 W.

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 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 exceed 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.

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" LA90 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 (LAeq, LA10, 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

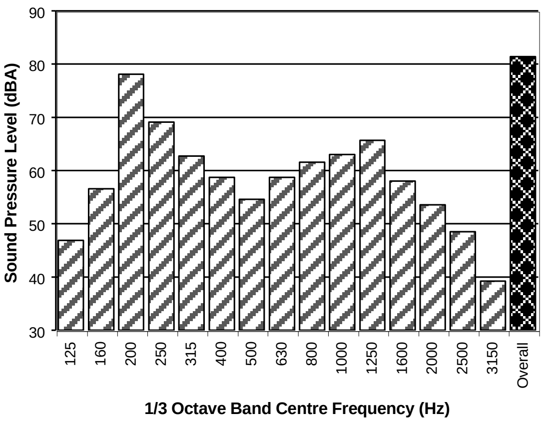
Frequency analysis is the process used to examine the tones (or frequency components) which make up the overall noise or vibration signal. This analysis was traditionally carried out using analogue electronic filters, but is now normally carried out using Fast Fourier Transform (FFT) analysers.

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 Over-Pressure

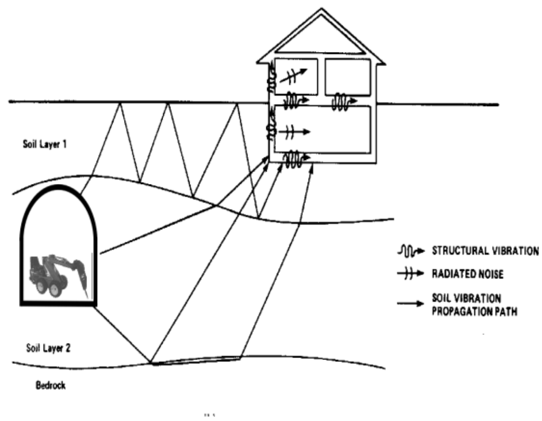
The term "over-pressure" is used to describe the air pressure pulse emitted during blasting or similar events. The peak level of an event is normally measured using a microphone in the same manner as linear noise (ie unweighted), at frequencies both in and below the audible range.

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

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

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

The following figure presents 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.

1 Sound Level or Noise Level

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

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

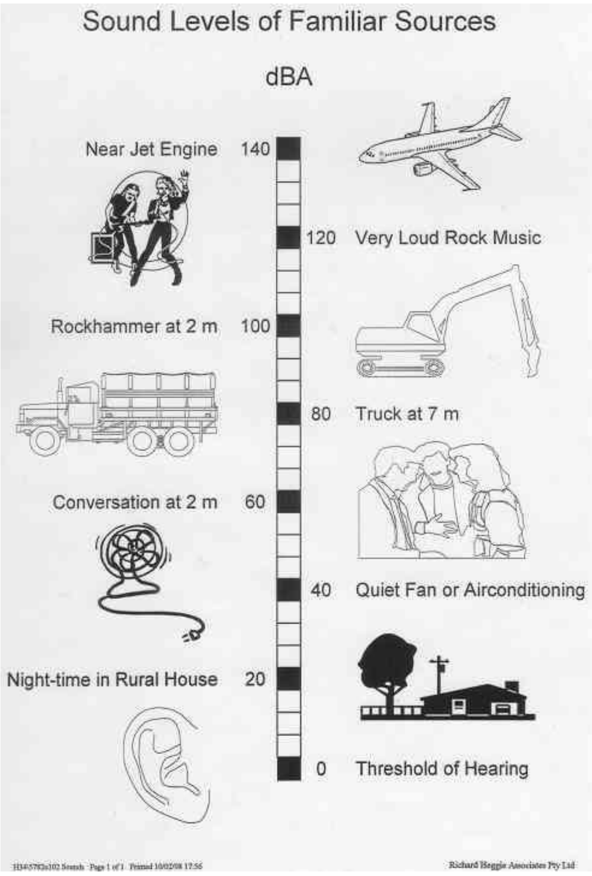
The symbols SPL, L or L_P are commonly used to represent Sound Pressure Level. The symbol L_A represents A-weighted Sound Pressure Level. The standard reference unit for Sound Pressure Levels expressed in decibels is 2×10^{-5} Pa.

2 "A" Weighted Sound Pressure Level

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

People's hearing is most sensitive to sounds at mid frequencies (500 Hz to 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 figure below lists examples of typical noise levels



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

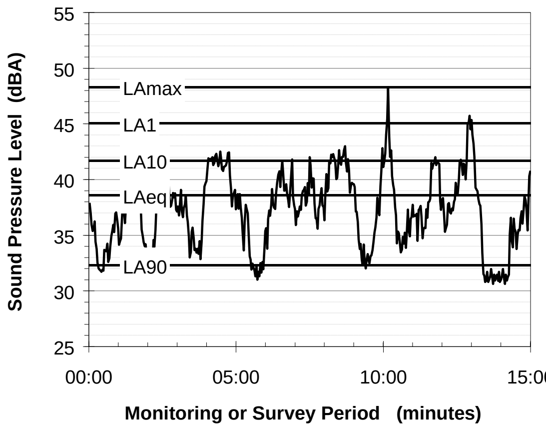
The Sound Power of a source is the rate at which it emits acoustic energy. As with Sound Pressure Levels, Sound Power Levels are expressed in decibel units (dB or dBA), but may be identified by the symbols SWL or L_W, or by the reference unit 10^{-12} W.

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

4 Statistical Noise Levels

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

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



Of particular relevance, are:

L_{Amax}	The maximum noise level during the 15 minute interval
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

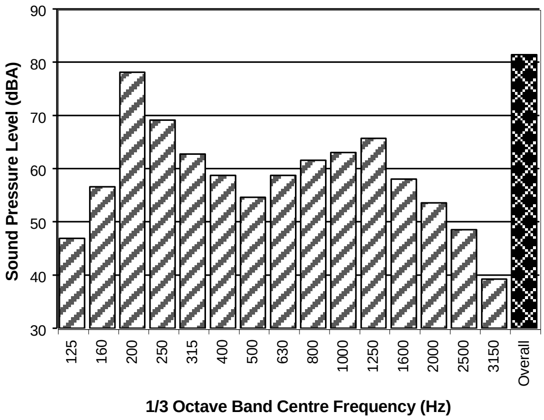
Frequency analysis is the process used to examine the tones (or frequency components) which make up the overall noise or vibration signal. This analysis was traditionally carried out using analogue electronic filters, but is now normally carried out using Fast Fourier Transform (FFT) analysers.

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

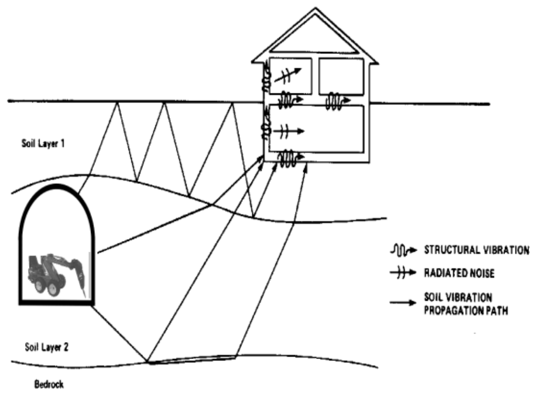
The term “over-pressure” is used to describe the air pressure pulse emitted during blasting or similar events. The peak level of an event is normally measured using a microphone in the same manner as linear noise (ie unweighted), at frequencies both in and below the audible range.

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

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

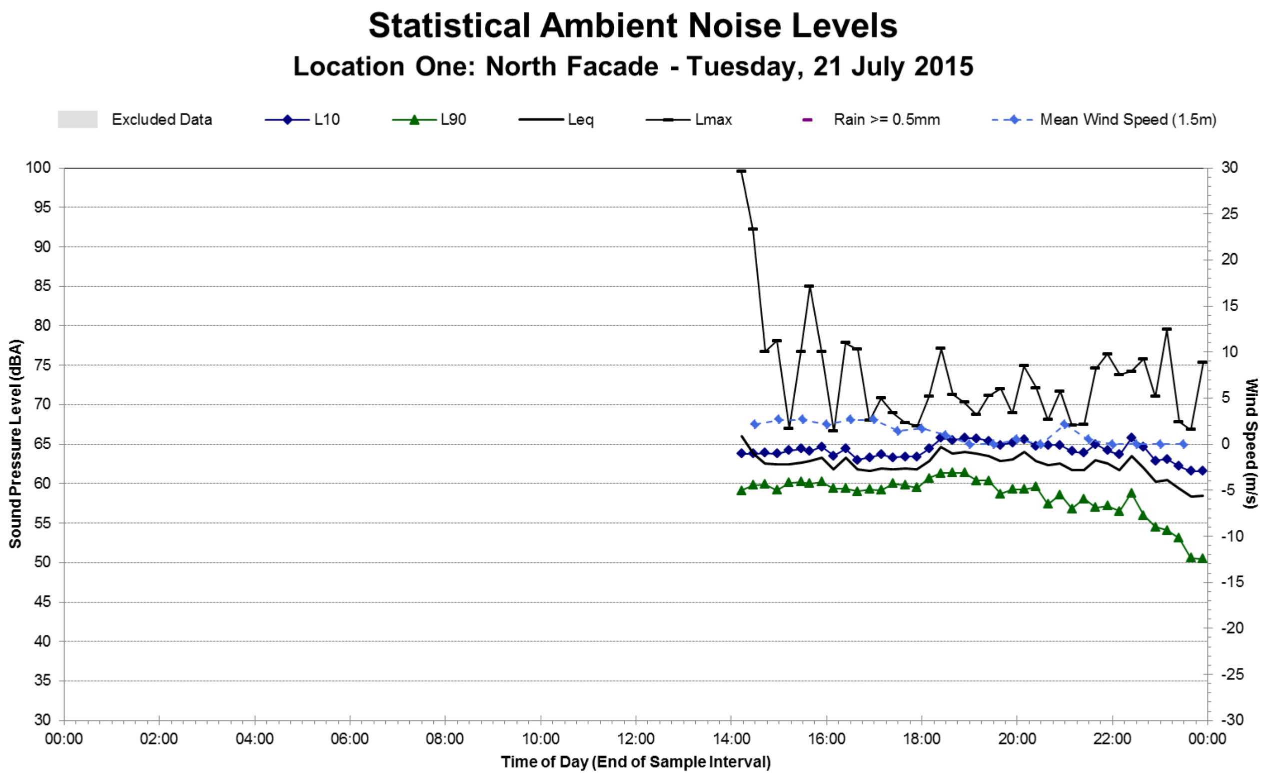
Typical sources of ground-borne or structure-borne noise include tunnelling works, underground railways, excavation plant (eg rockbreakers), and building services plant (eg fans, compressors and generators).

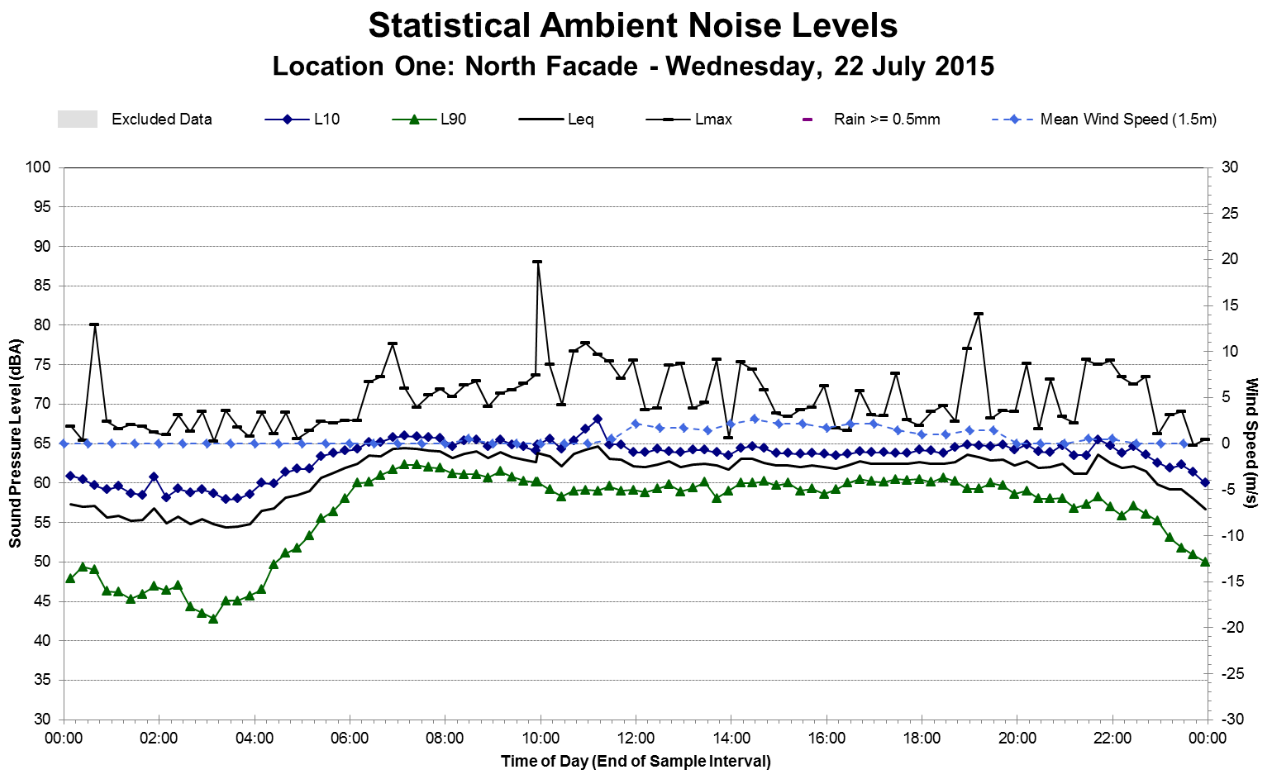
The following figure presents the various paths by which vibration and ground-borne noise may be transmitted between a source and receiver for construction activities occurring within a tunnel.

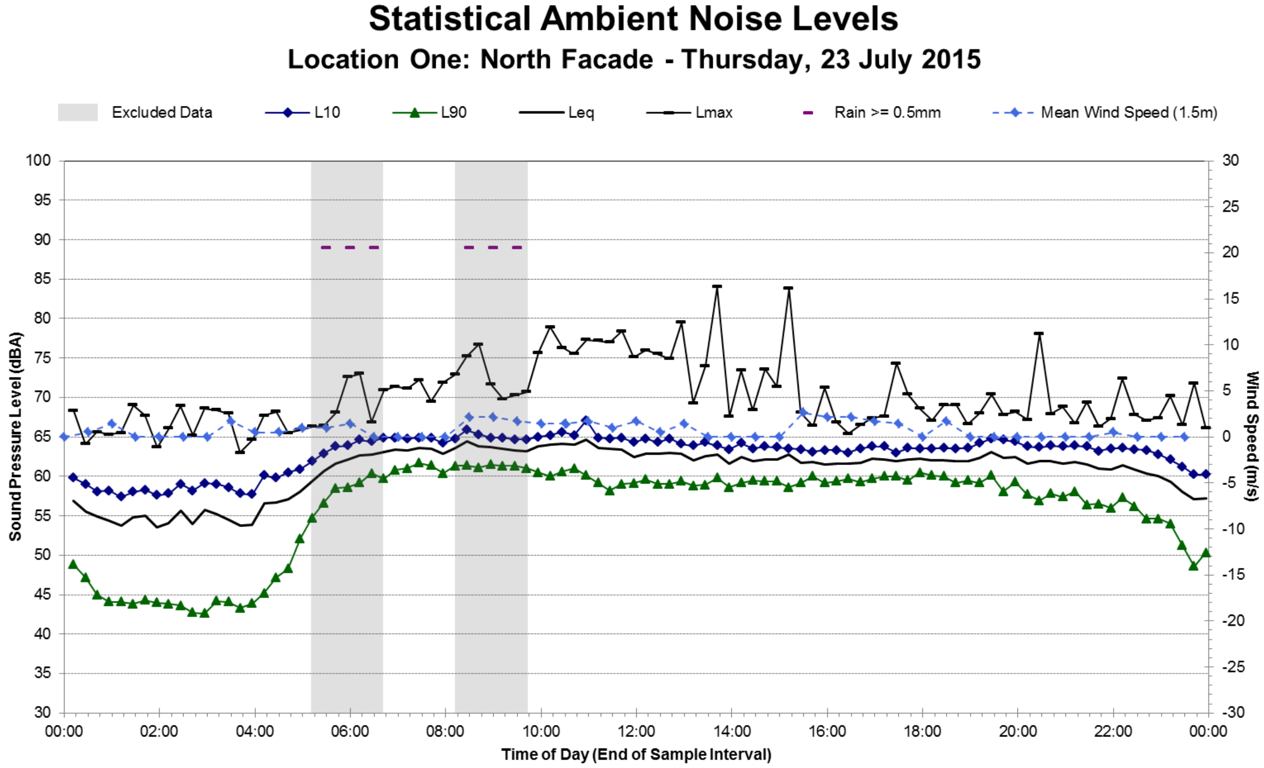


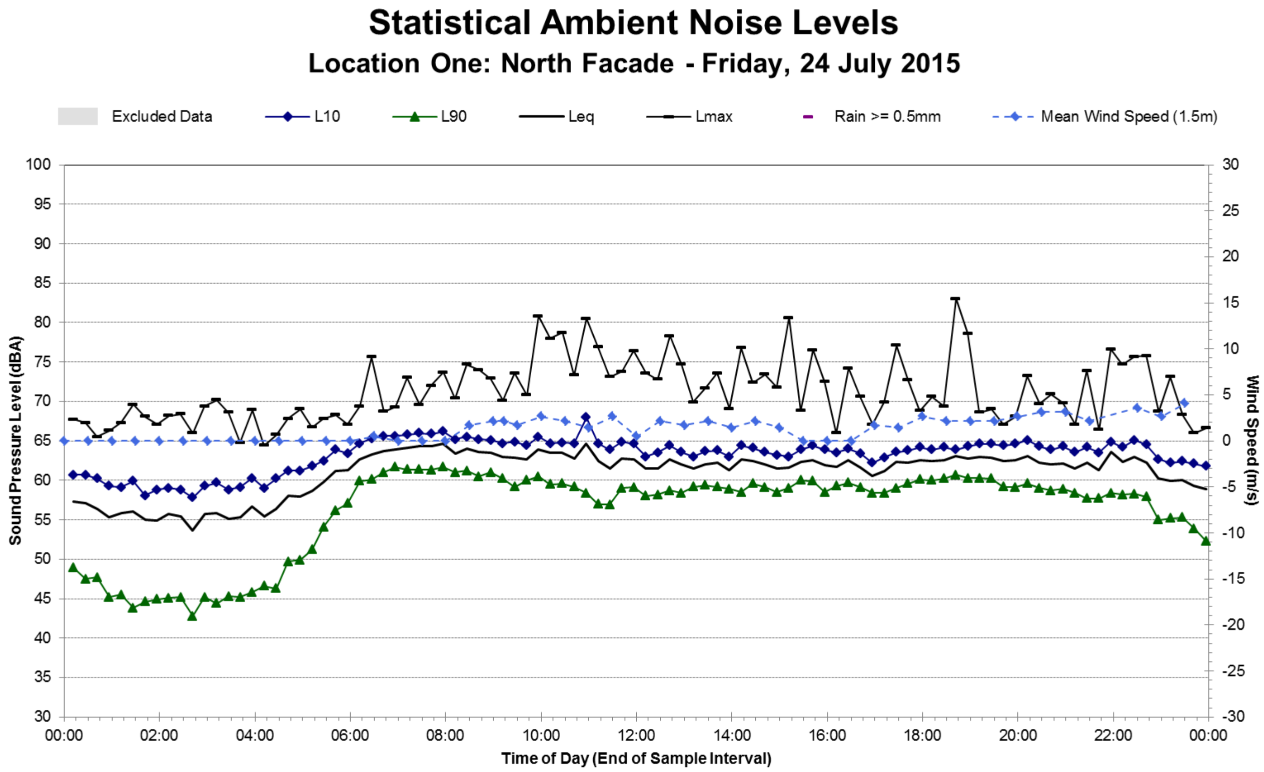
The term “regenerated noise” is also used in other instances where energy is converted to noise away from the primary source. One example would be a fan blowing air through a discharge grill. The fan is the energy source and primary noise source. Additional noise may be created by the aerodynamic effect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

Daily Noise Monitoring – Location One

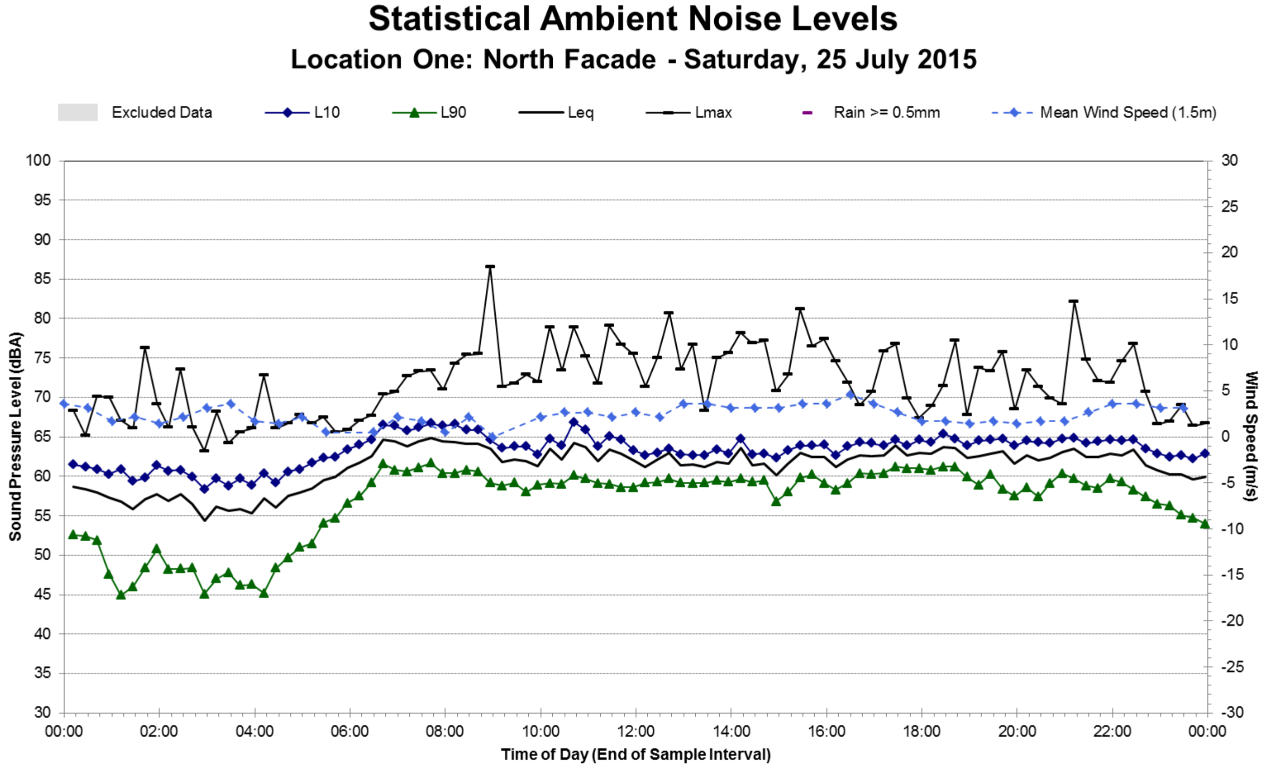


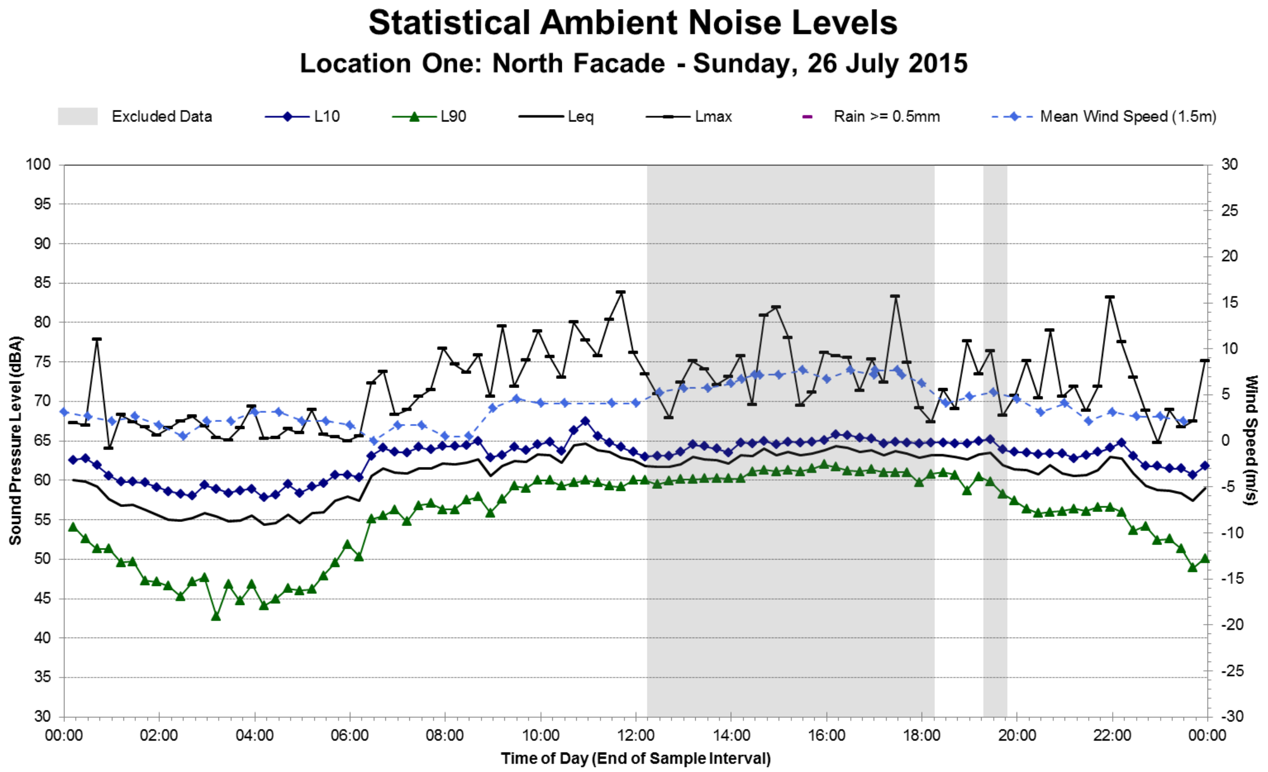



Statistical Ambient Noise Levels
Location One: North Facade - Thursday, 23 July 2015
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
Location One: North Facade - Friday, 24 July 2015
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)

Daily Noise Monitoring – Location One

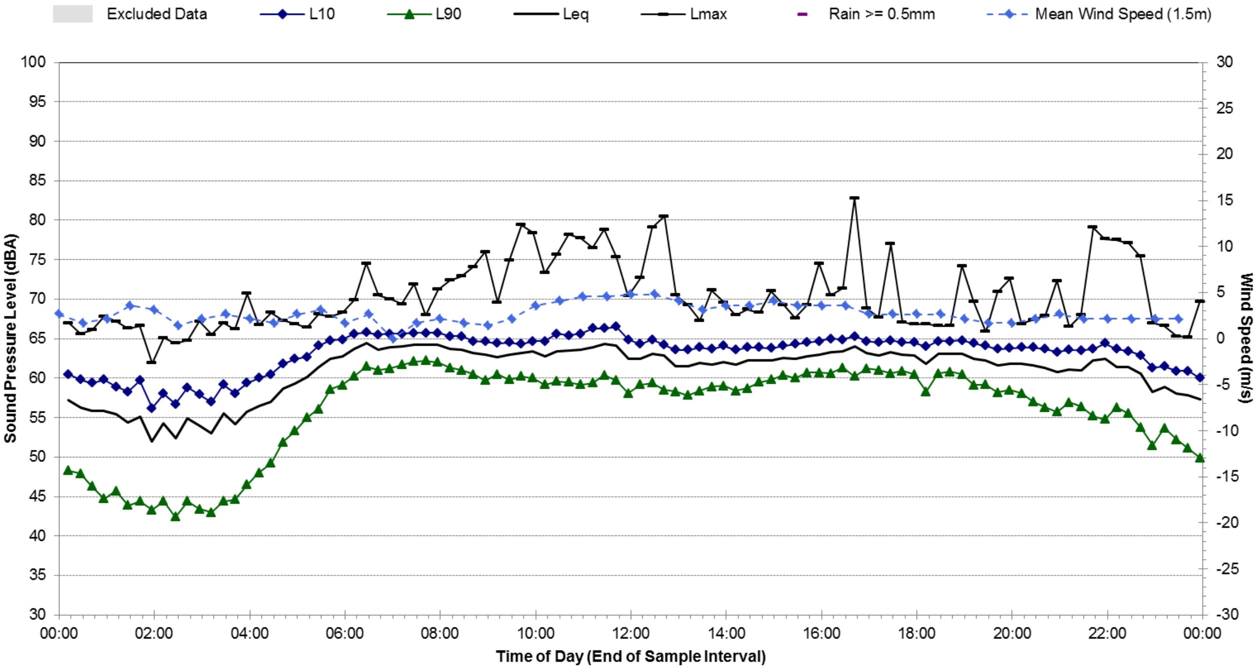




Daily Noise Monitoring – Location One

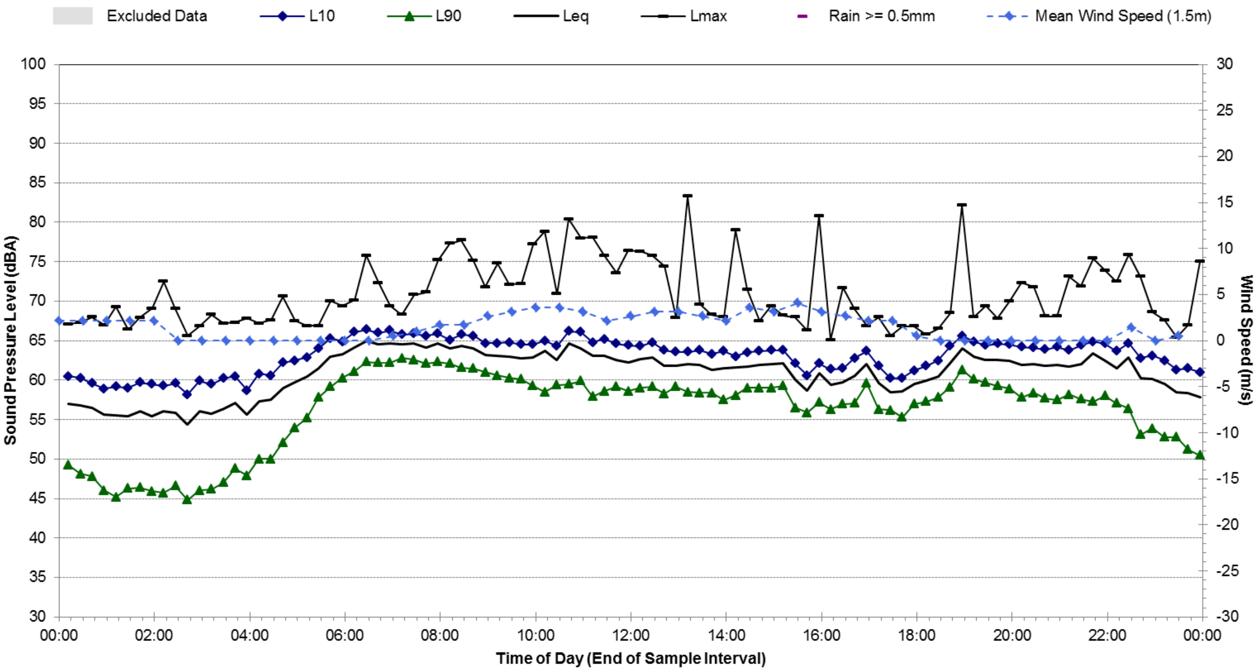
Statistical Ambient Noise Levels

Location One: North Facade - Monday, 27 July 2015

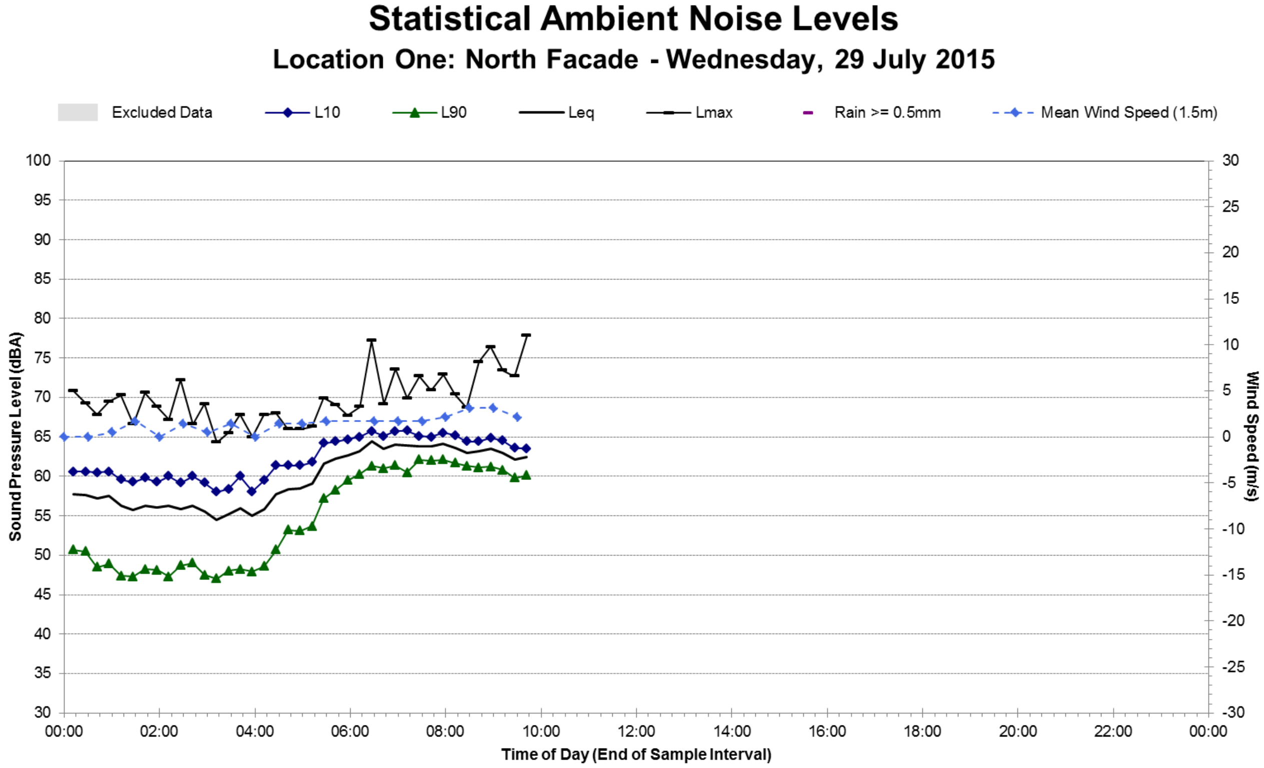


Statistical Ambient Noise Levels

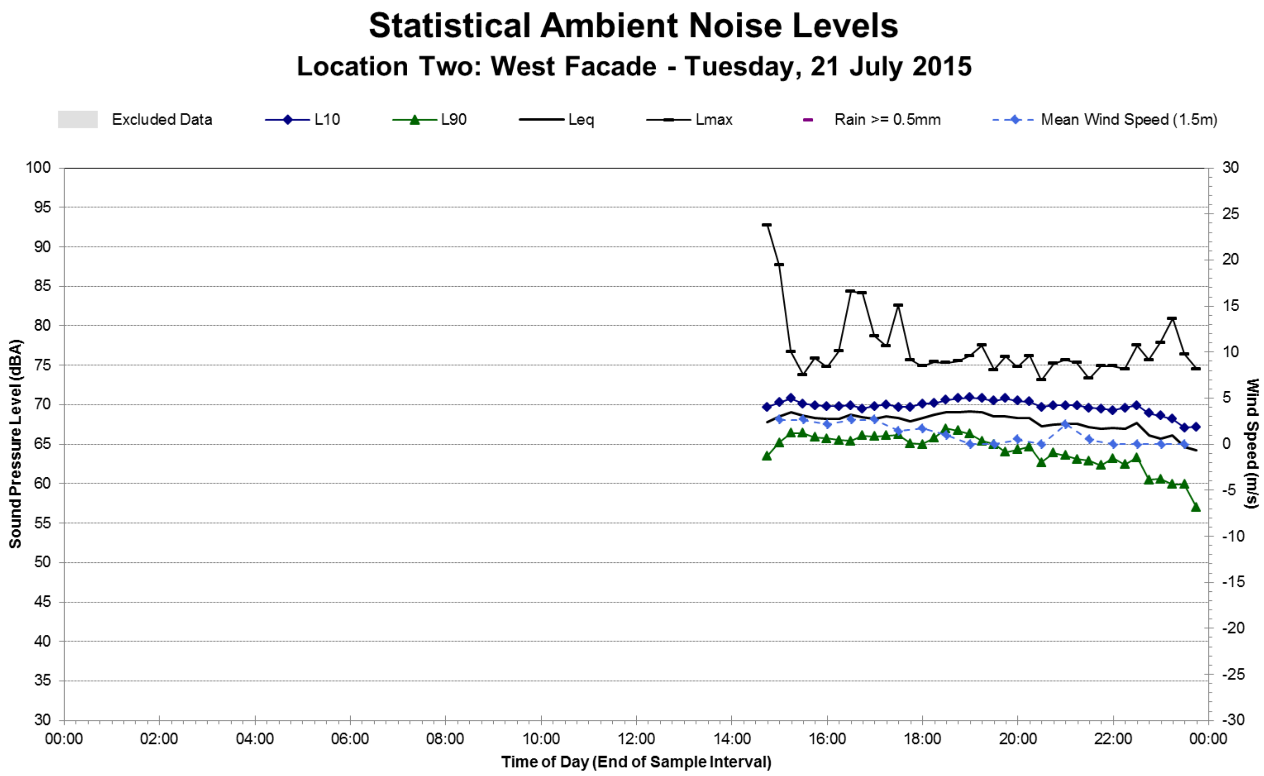
Location One: North Facade - Tuesday, 28 July 2015

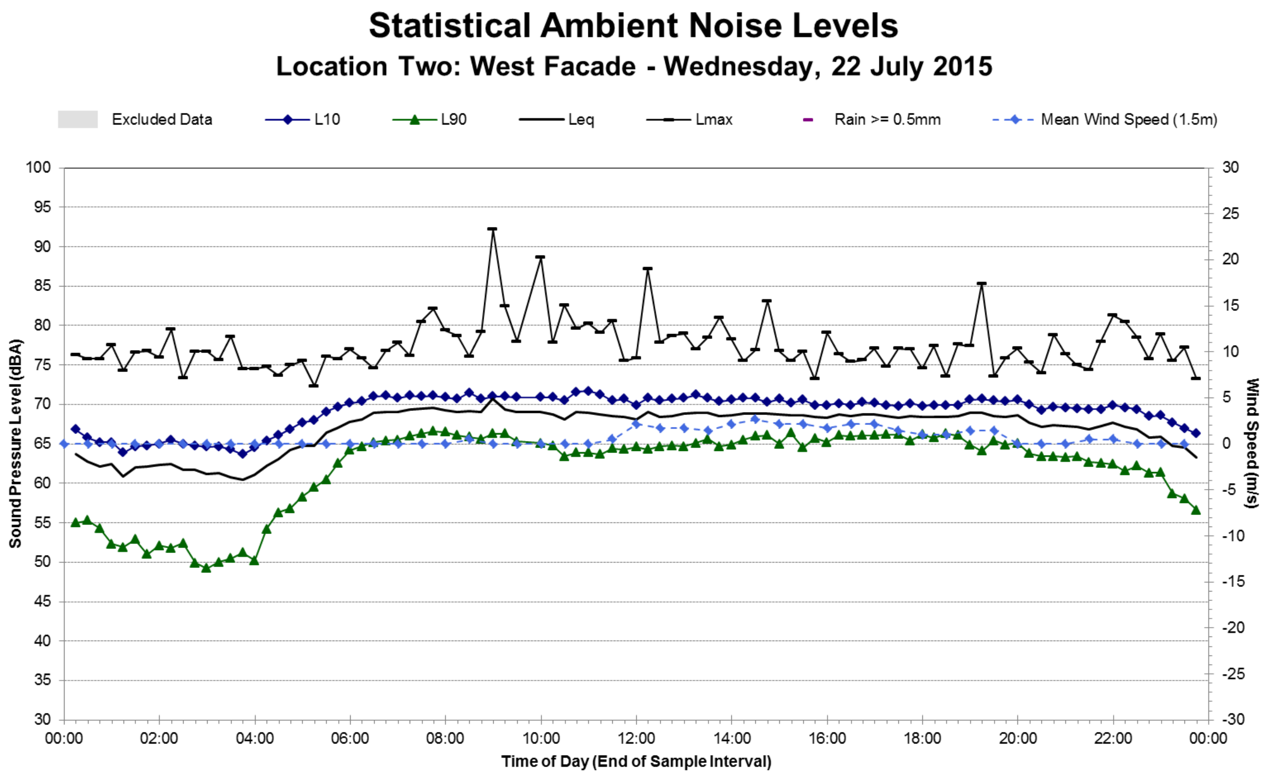


Daily Noise Monitoring – Location One

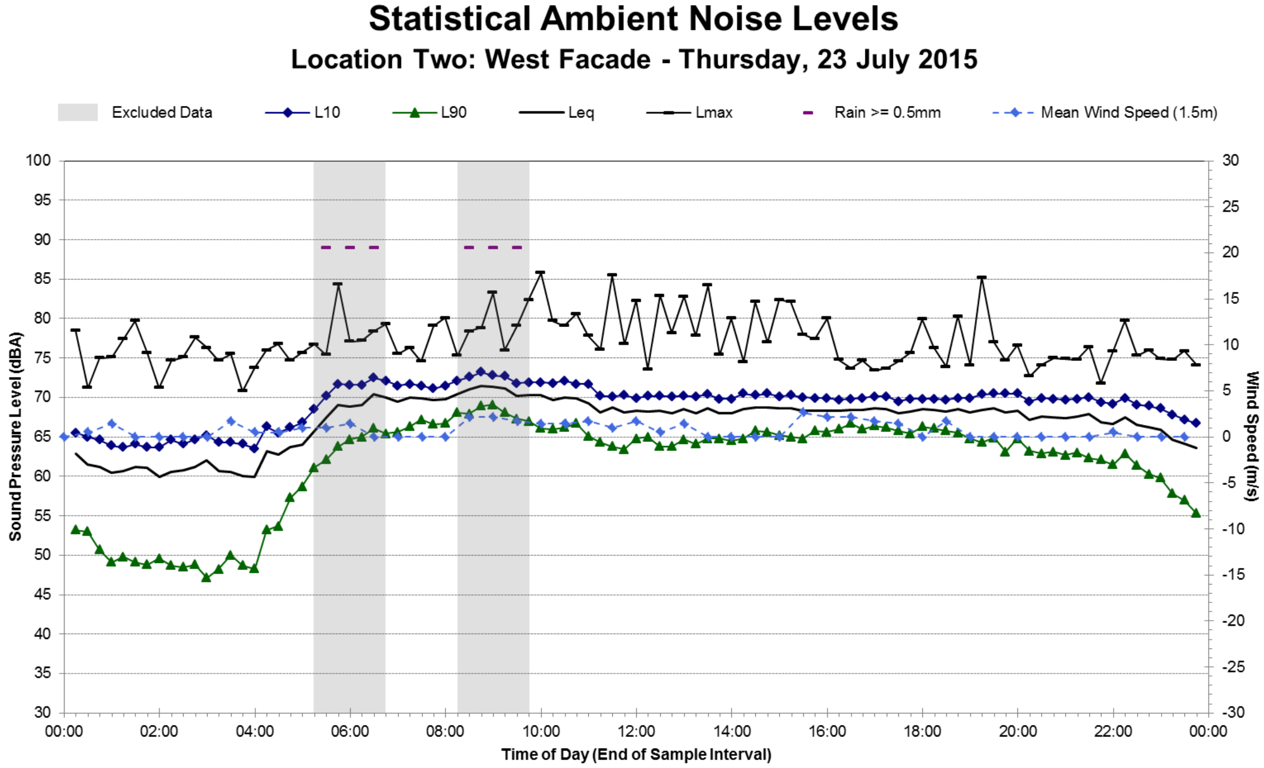


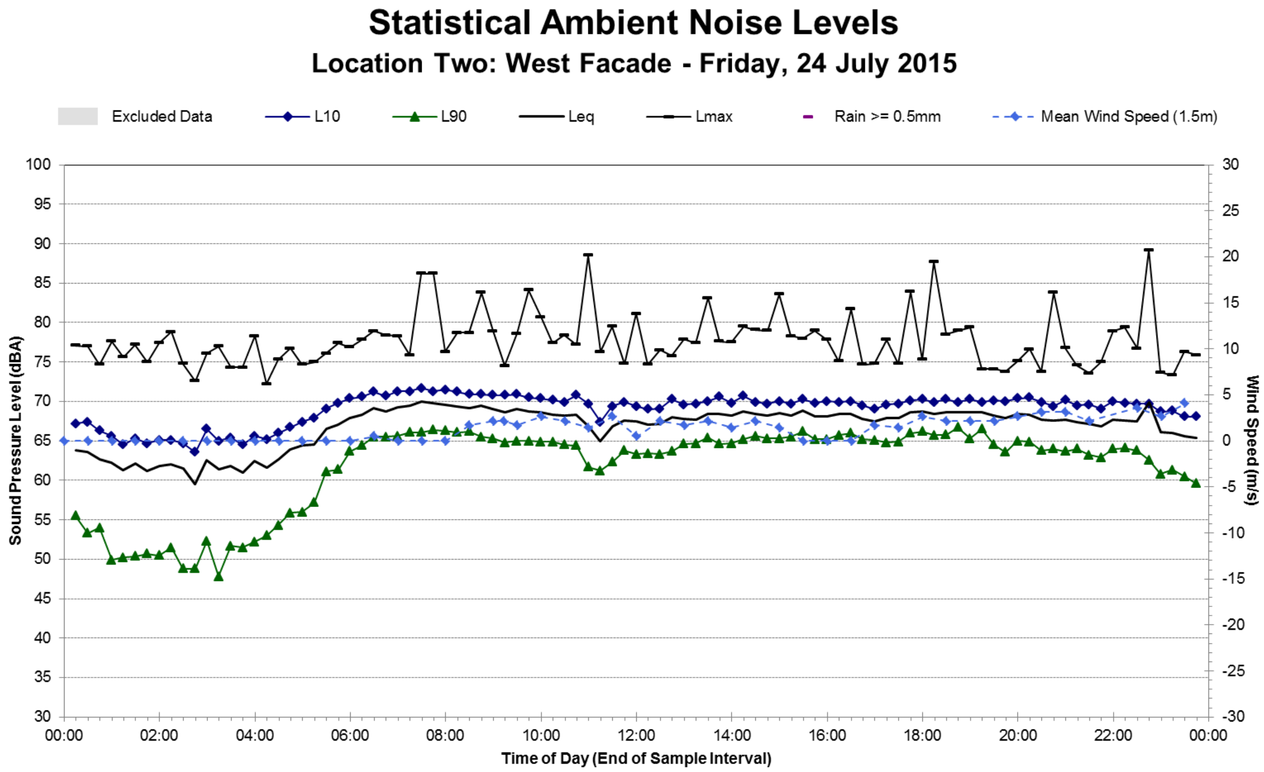
Daily Noise Monitoring – Location Two

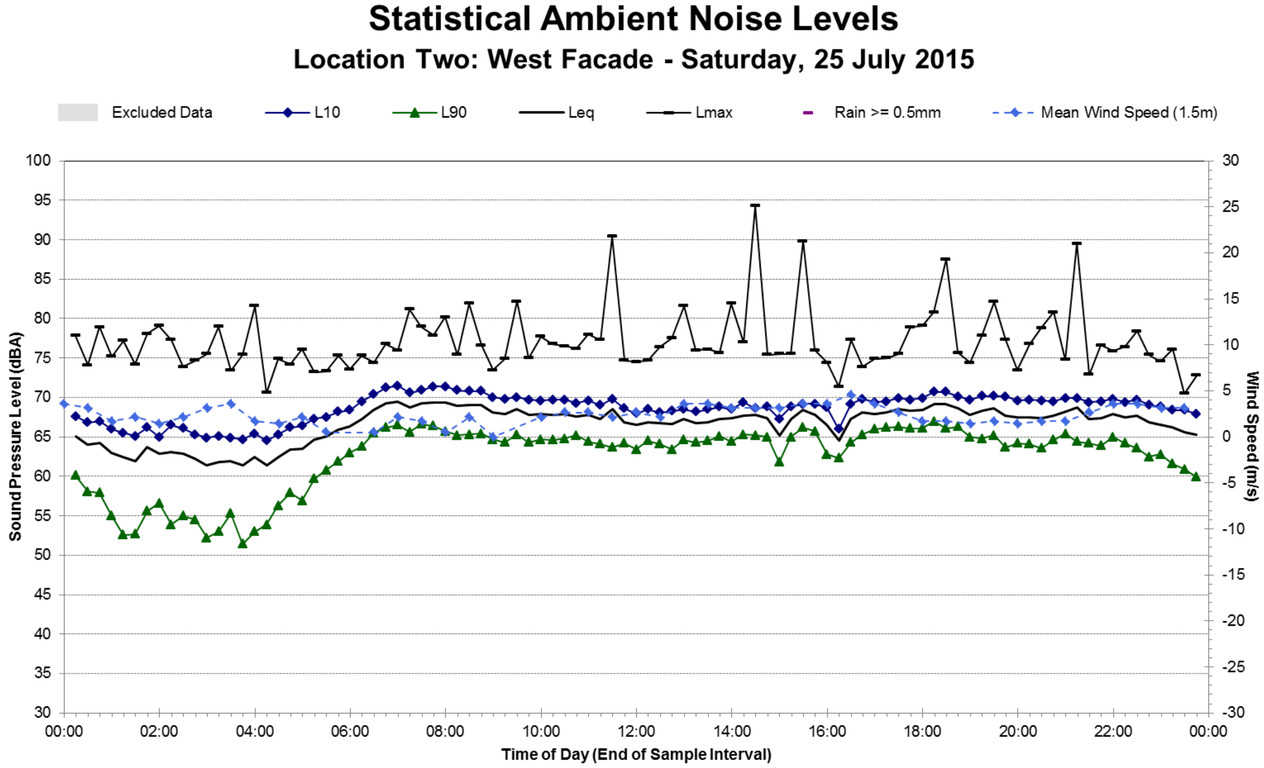


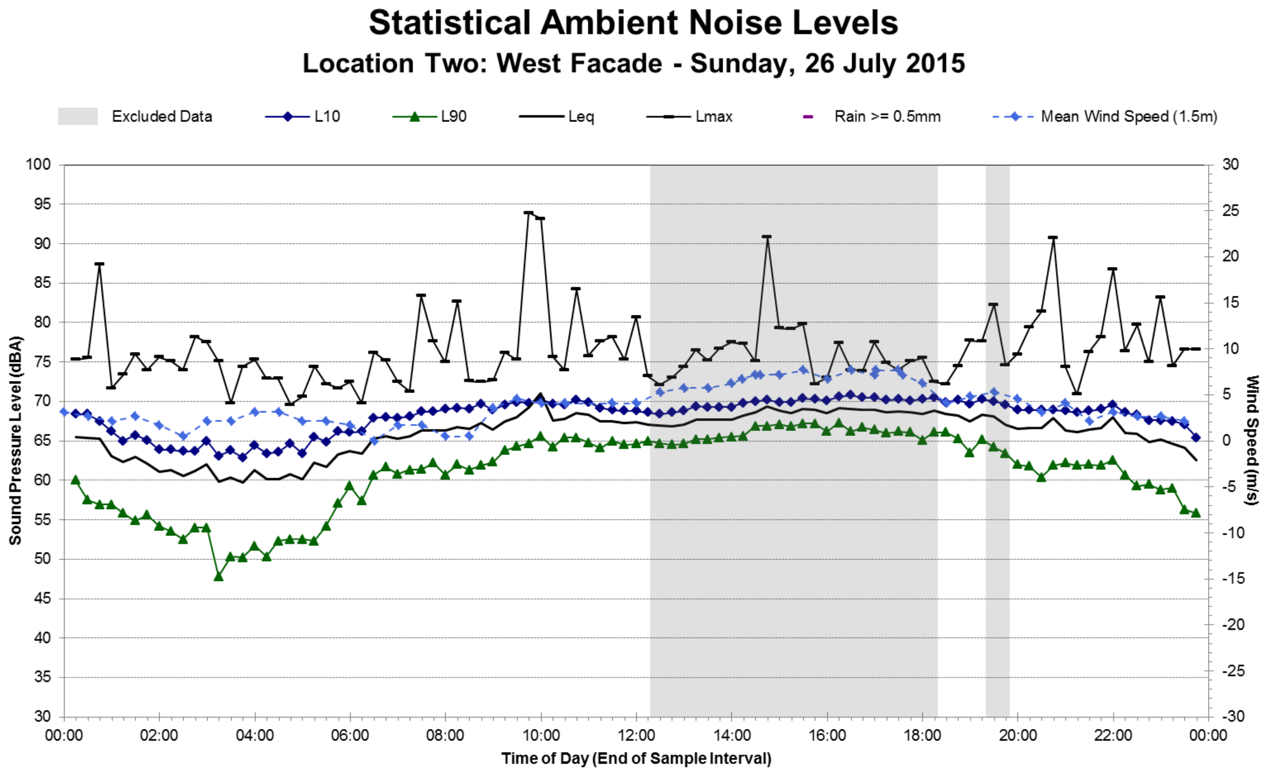


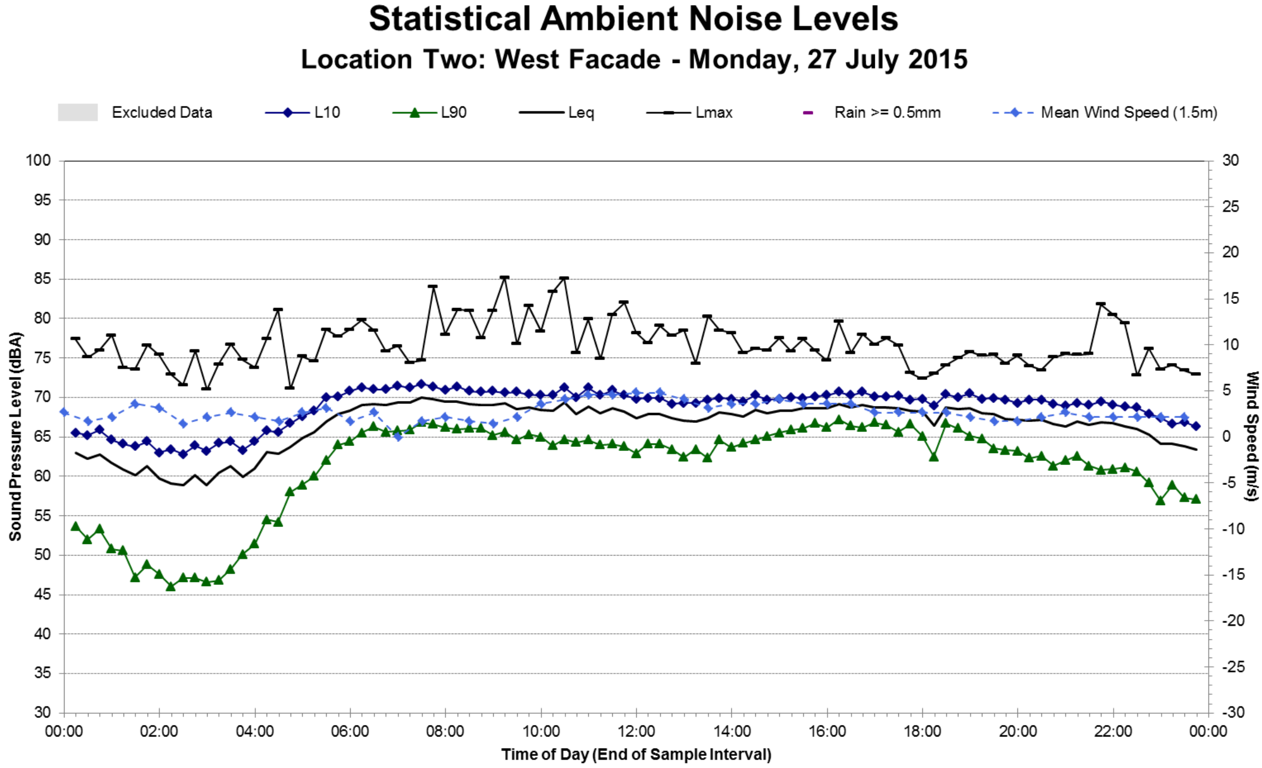
Daily Noise Monitoring – Location Two






Statistical Ambient Noise Levels
Location Two: West Facade - Saturday, 25 July 2015
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
Location Two: West Facade - Sunday, 26 July 2015
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
Location Two: West Facade - Monday, 27 July 2015
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)
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
-30
-25
-20
-15
-10
-5
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5
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15
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08:00
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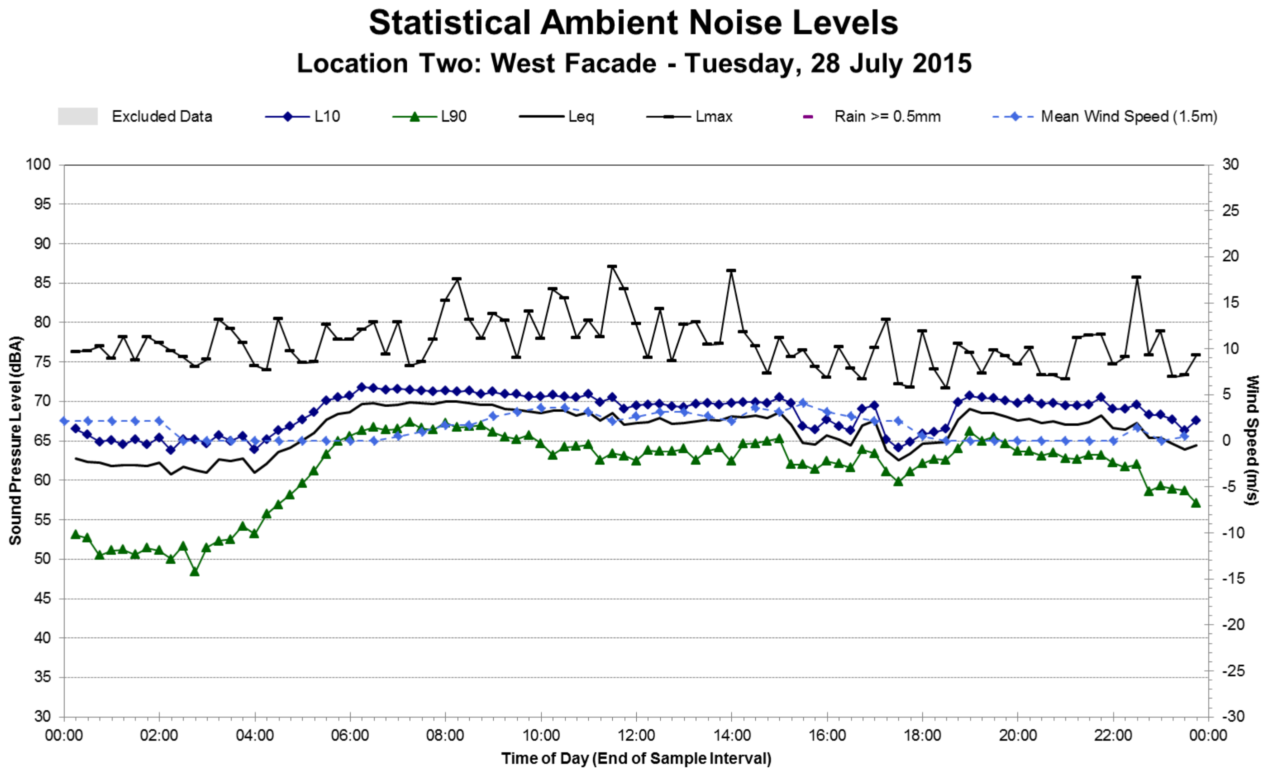
12:00
14:00
16:00
18:00
20:00
22:00


Statistical Ambient Noise Levels
Location Two: West Facade - Tuesday, 28 July 2015
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)
100
95
90
85
80
75
70
65
60
55
50
45
40
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-25
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-10
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5
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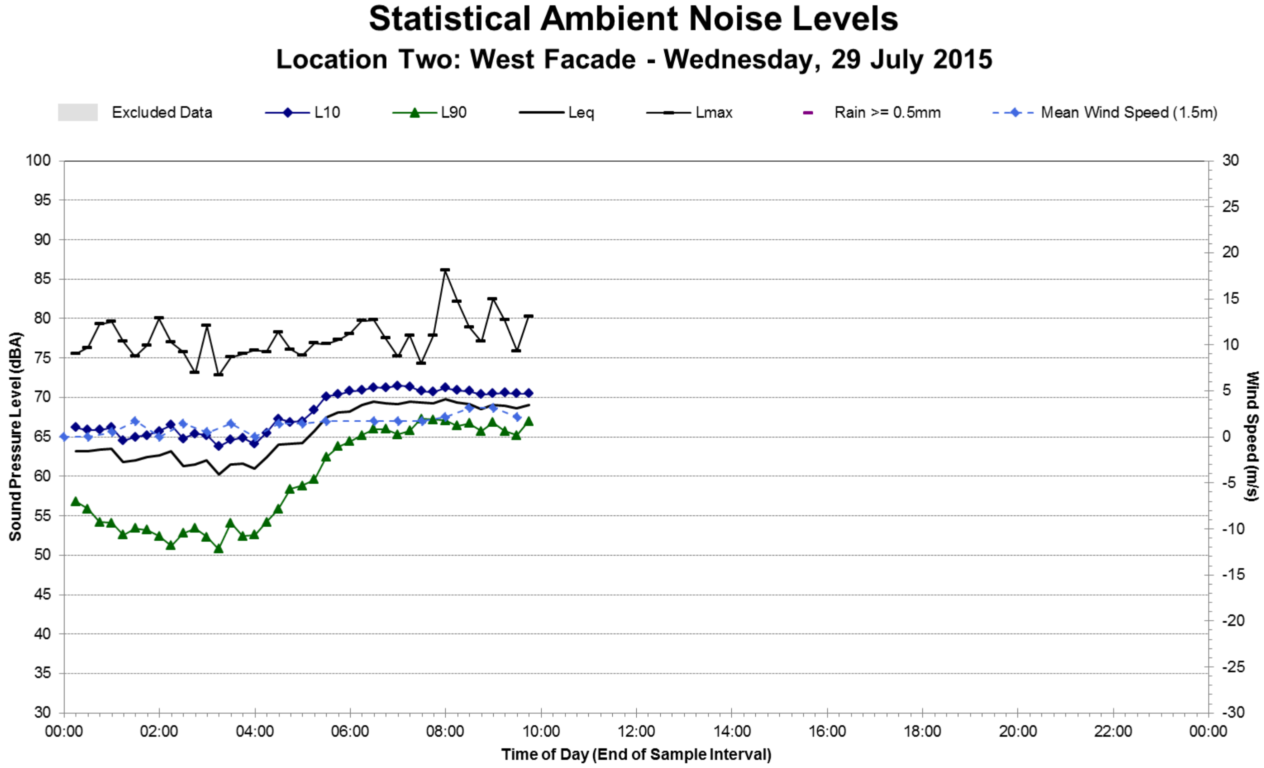
20:00
22:00


Statistical Ambient Noise Levels
Location Two: West Facade - Wednesday, 29 July 2015
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)
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
-5
-10
-15
-20
-25
-30
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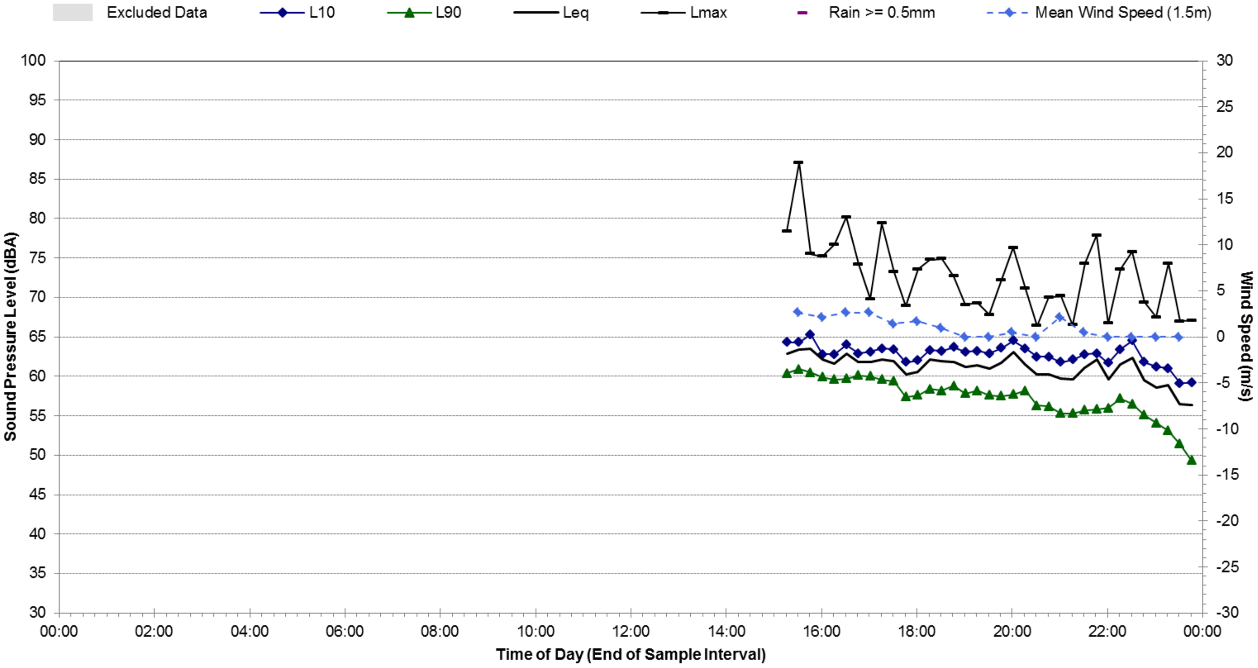
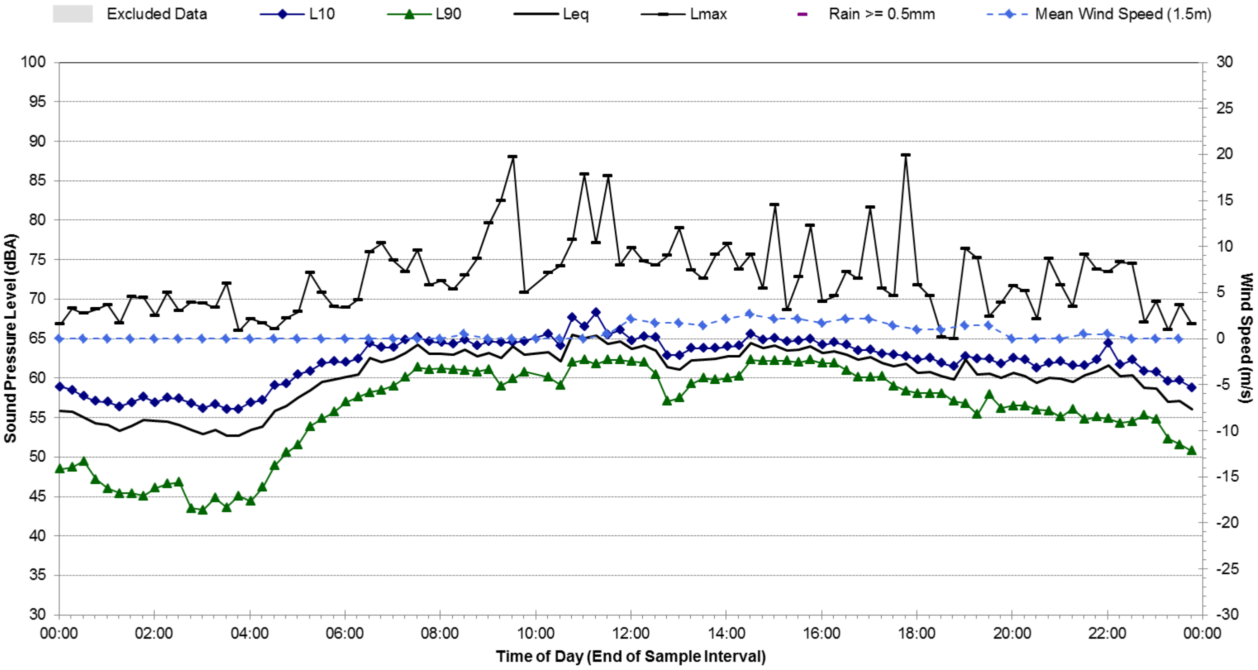
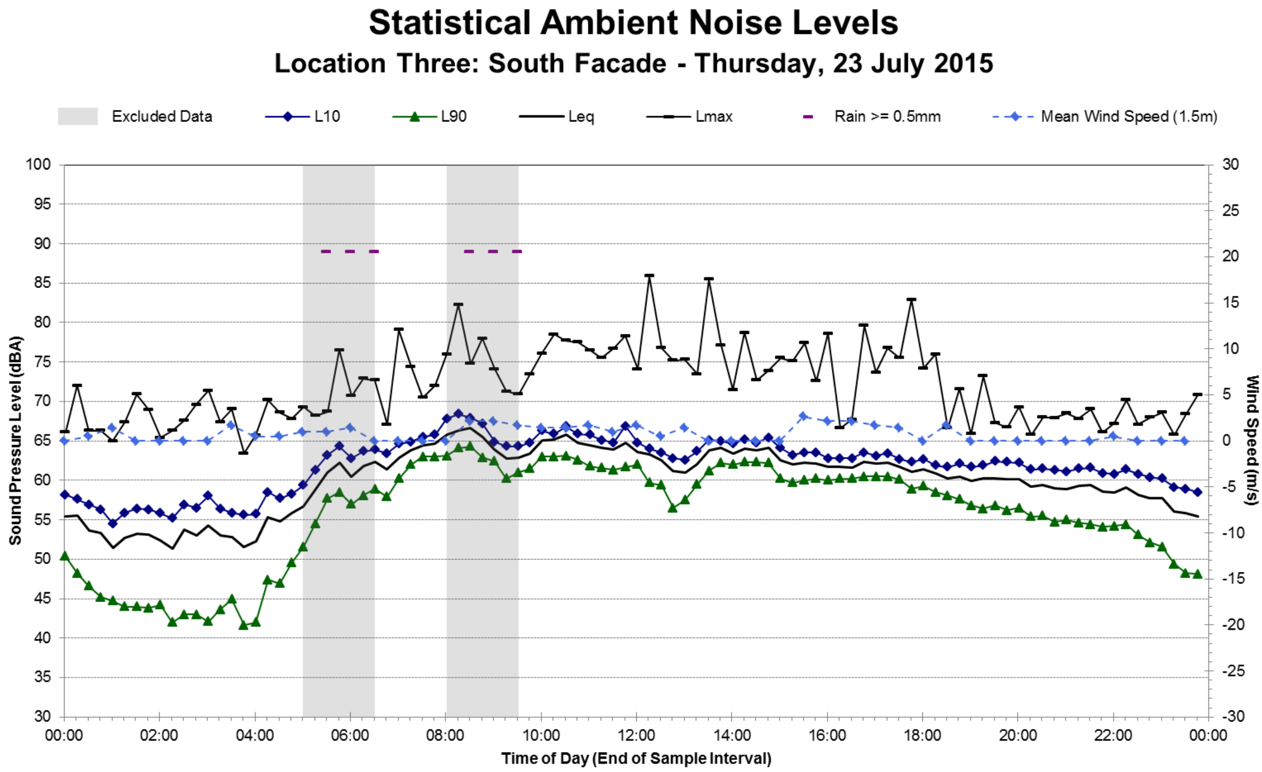
20:00
22:00
00:00

Statistical Ambient Noise Levels
Location Three: South Facade - Tuesday, 21 July 2015

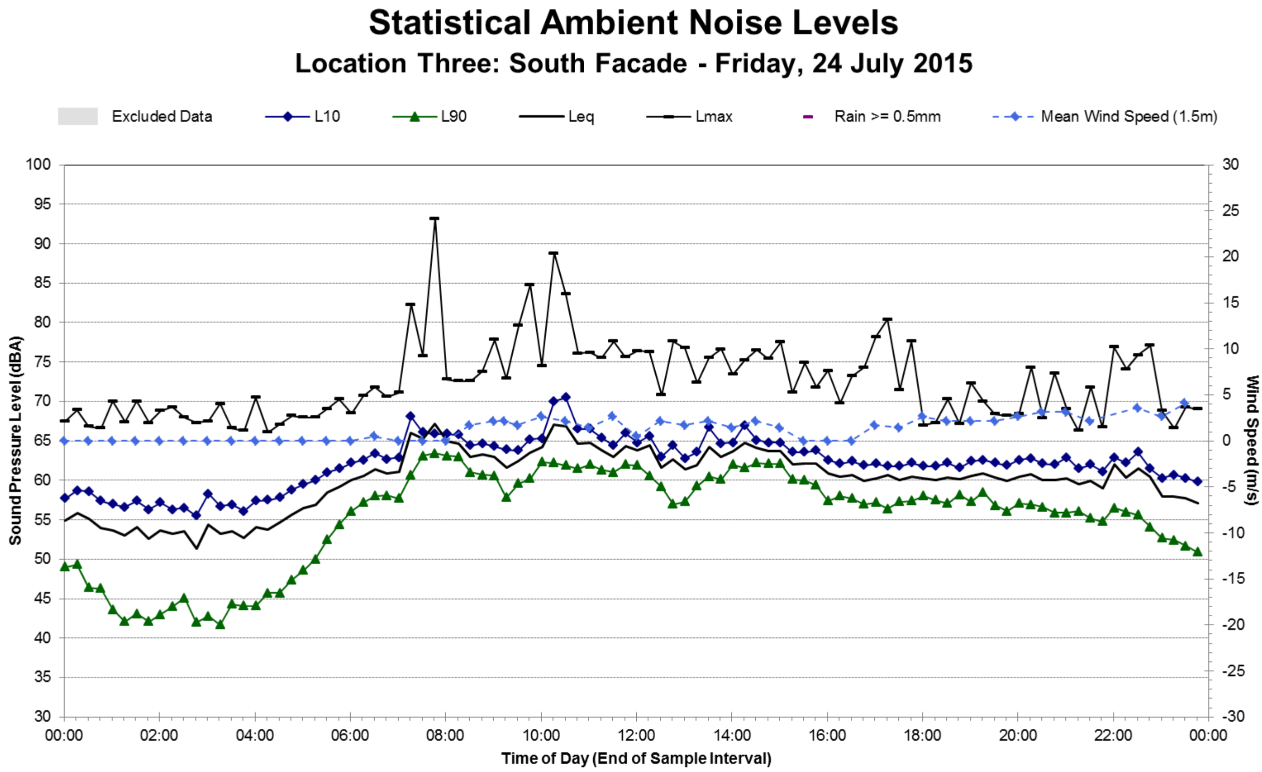


Statistical Ambient Noise Levels
Location Three: South Facade - Wednesday, 22 July 2015



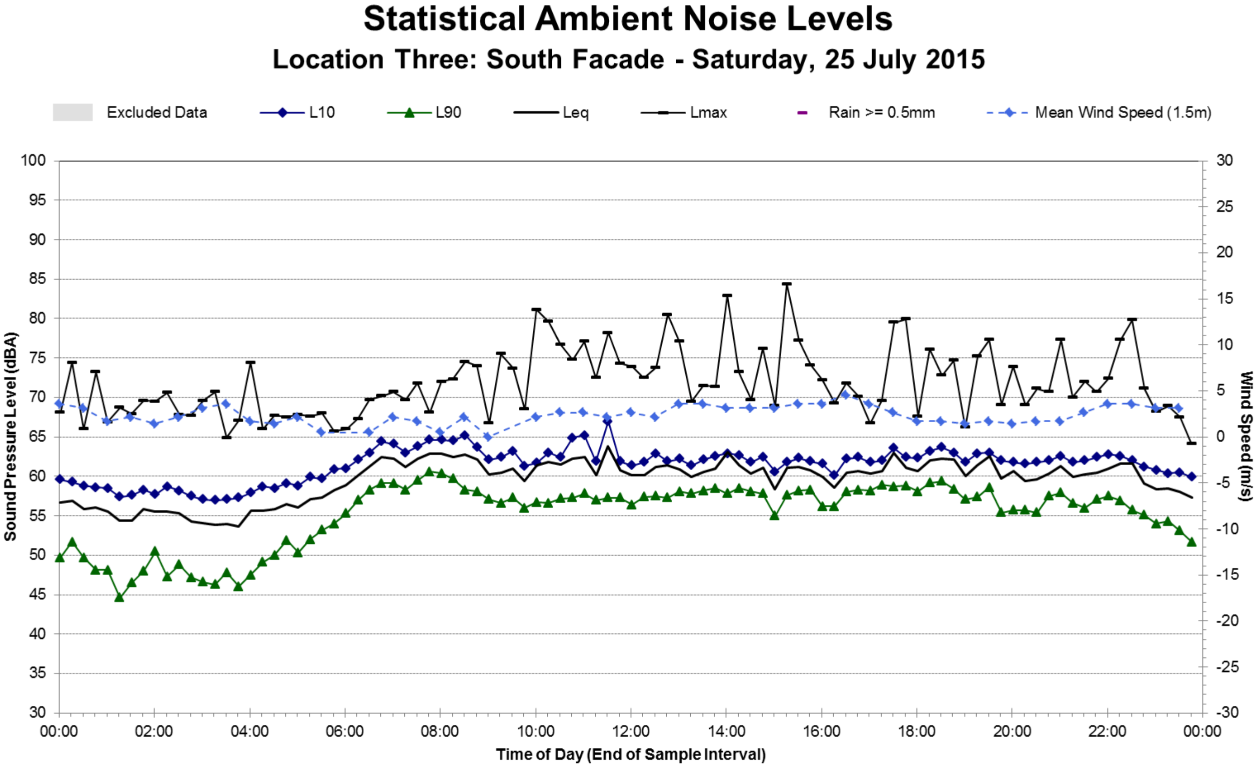


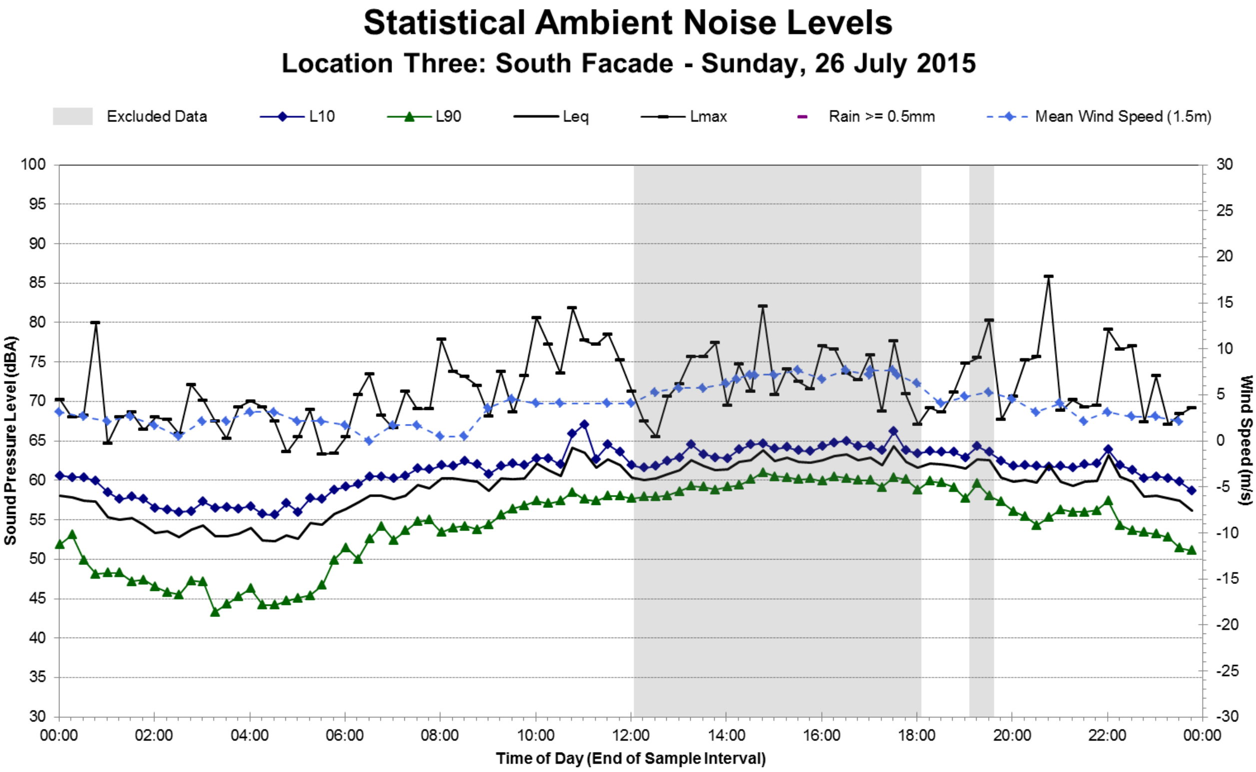
Statistical Ambient Noise Levels
Location Three: South Facade - Thursday, 23 July 2015
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)



Statistical Ambient Noise Levels
Location Three: South Facade - Friday, 24 July 2015
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)

Daily Noise Monitoring – Location Three

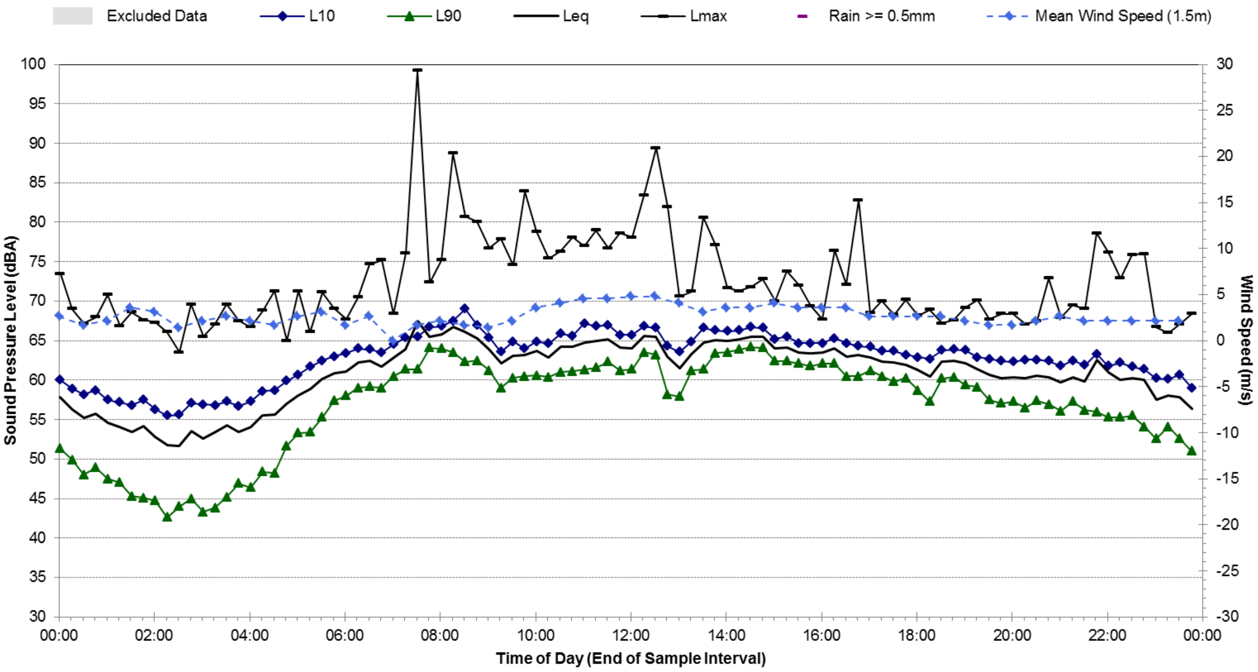




Daily Noise Monitoring – Location Three

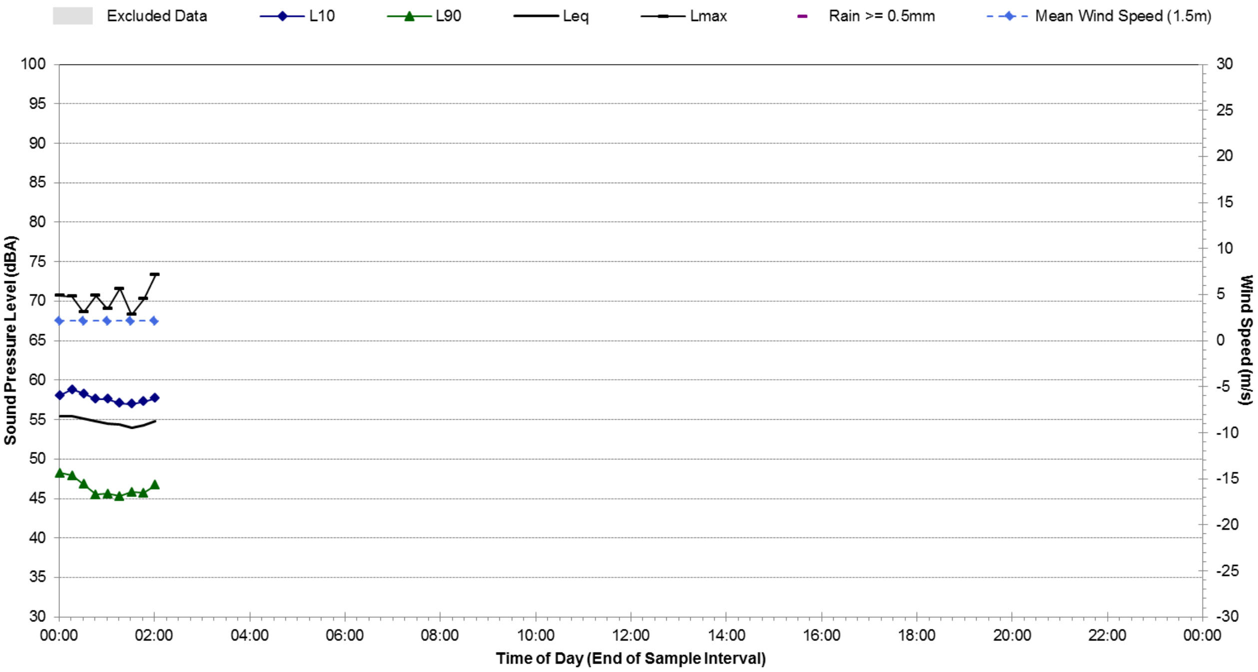
Statistical Ambient Noise Levels

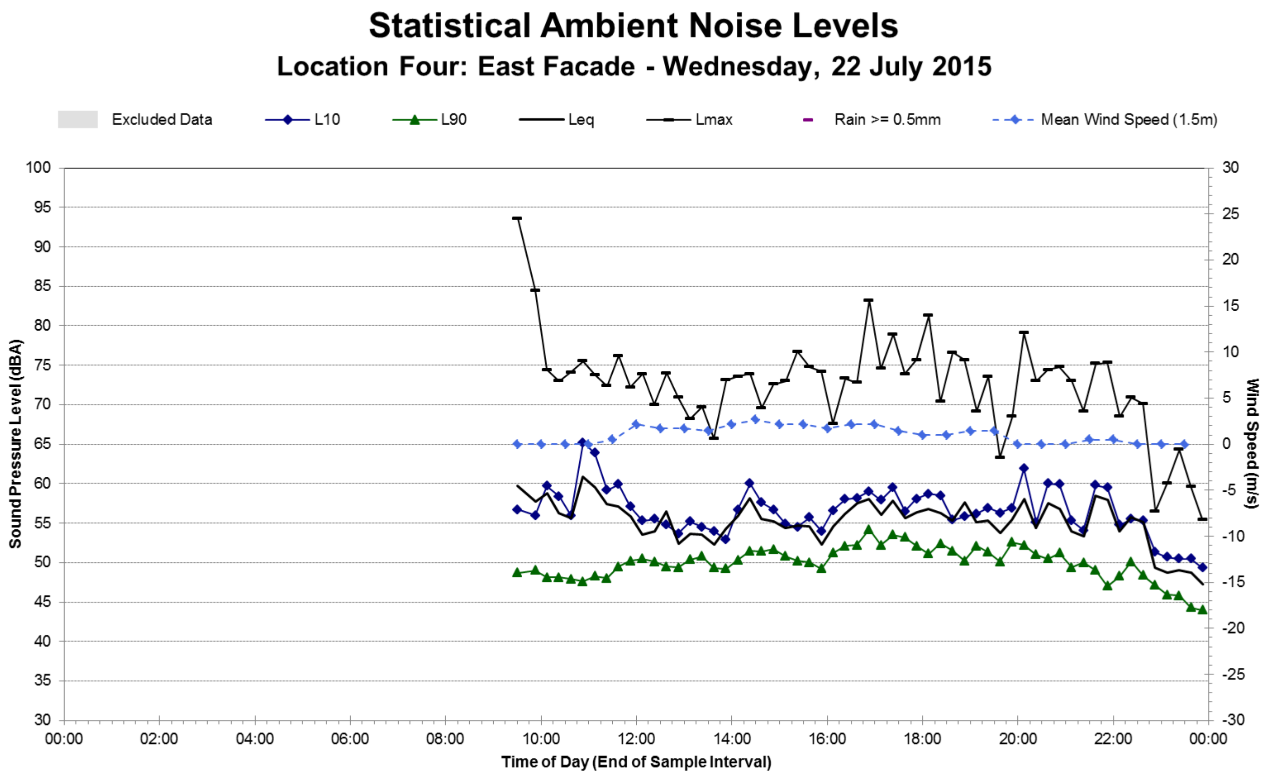
Location Three: South Facade - Monday, 27 July 2015

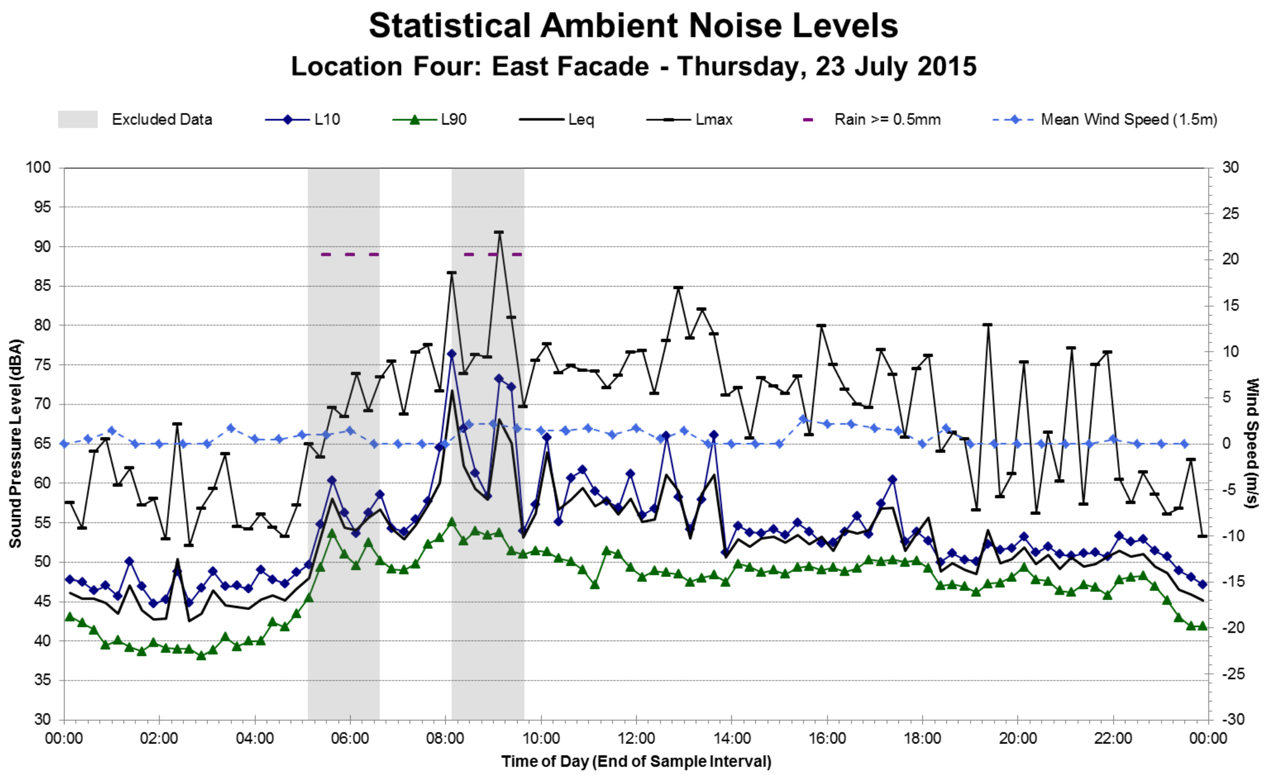


Statistical Ambient Noise Levels

Location Three: South Facade - Tuesday, 28 July 2015



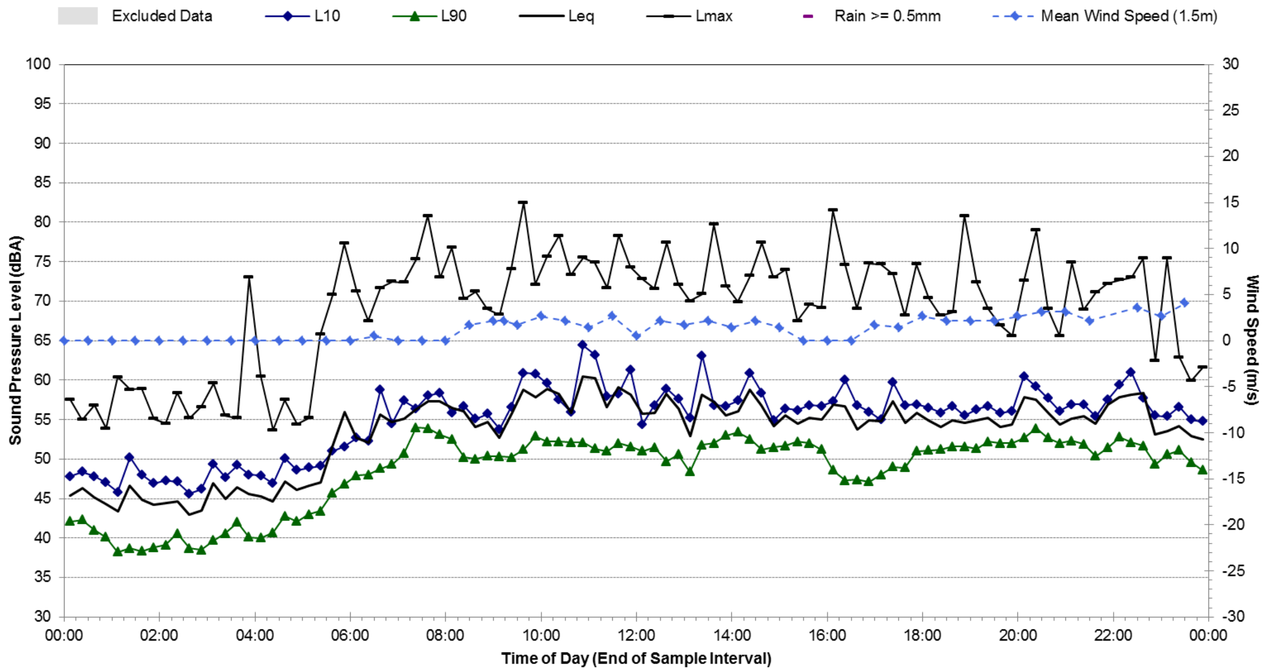

Statistical Ambient Noise Levels
Location Four: East Facade - Wednesday, 22 July 2015
Excluded Data
L10
L90
Leq
Lmax
Rain >= 0.5mm
Mean Wind Speed (1.5m)
Sound Pressure Level (dBA)
Wind Speed (m/s)
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
Location Four: East Facade - Thursday, 23 July 2015
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)

Daily Noise Monitoring – Location Four

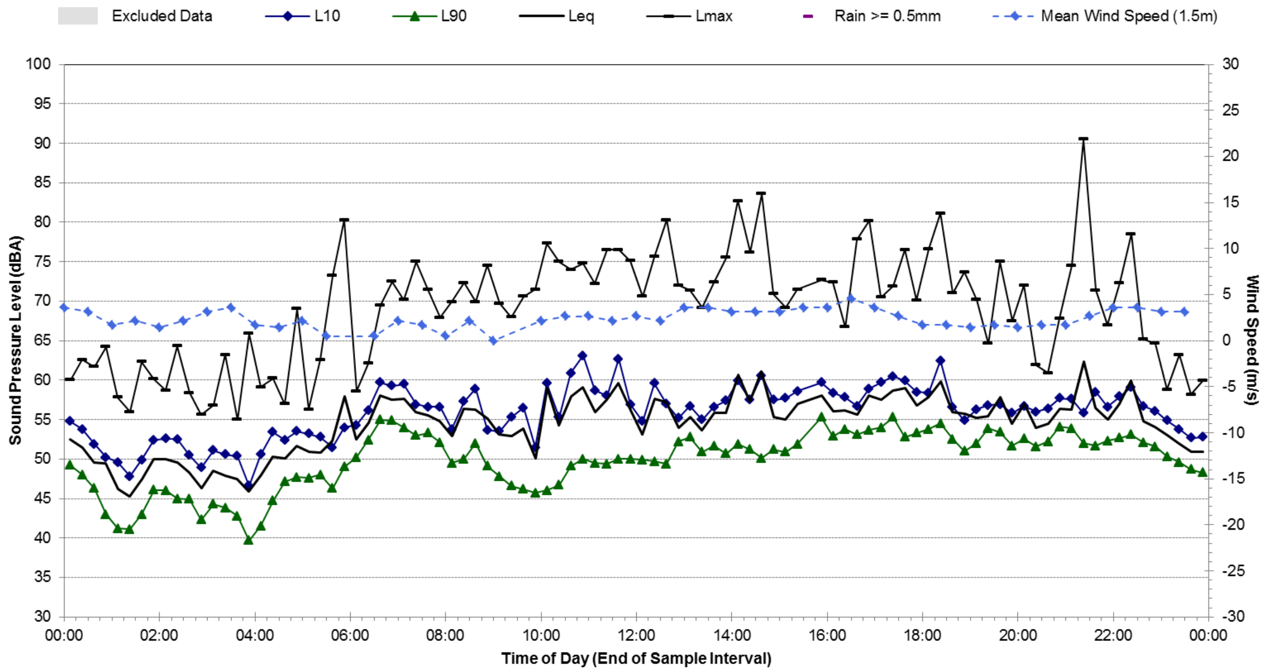
Statistical Ambient Noise Levels

Location Four: East Facade - Friday, 24 July 2015

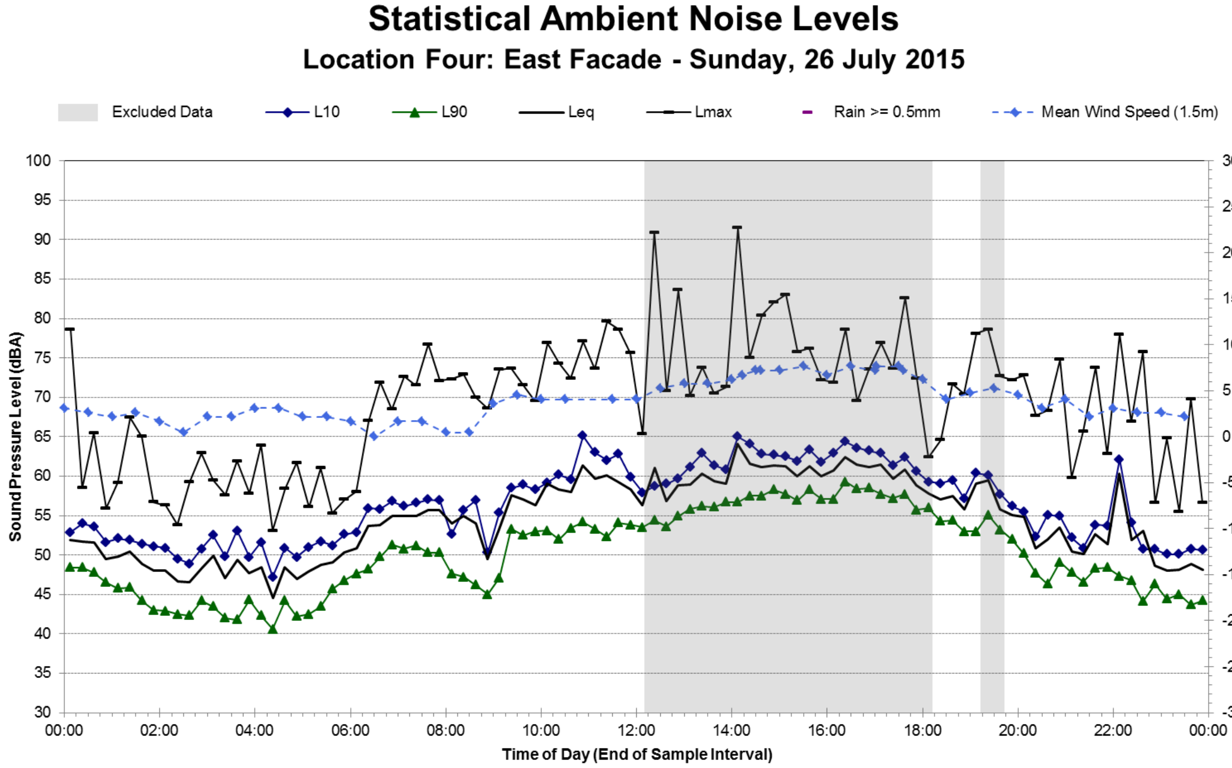


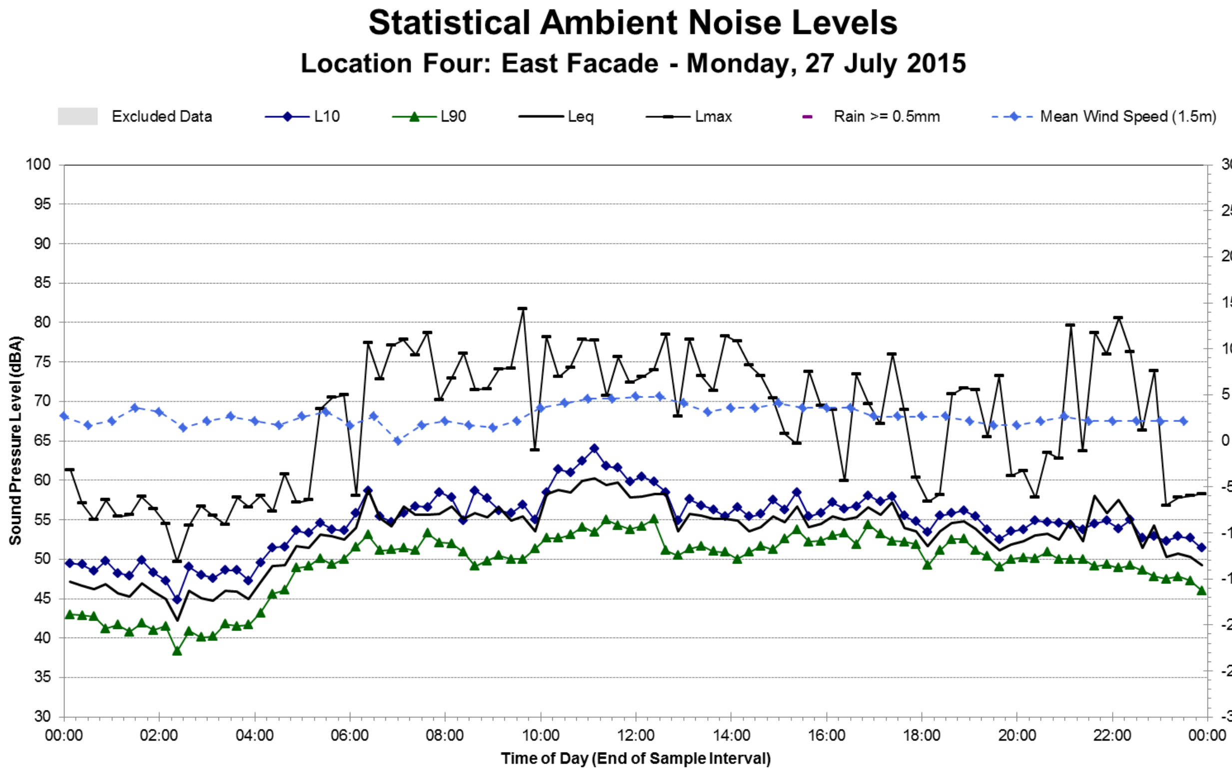
Statistical Ambient Noise Levels

Location Four: East Facade - Saturday, 25 July 2015

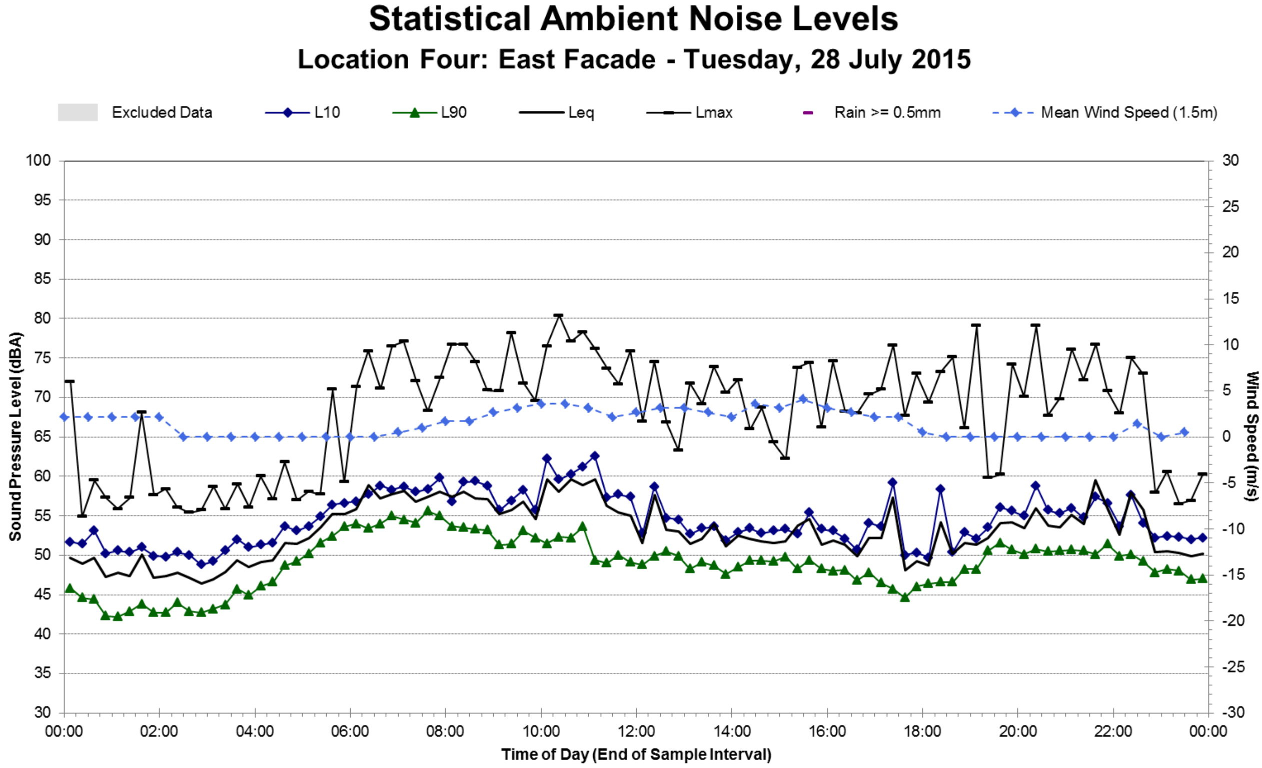


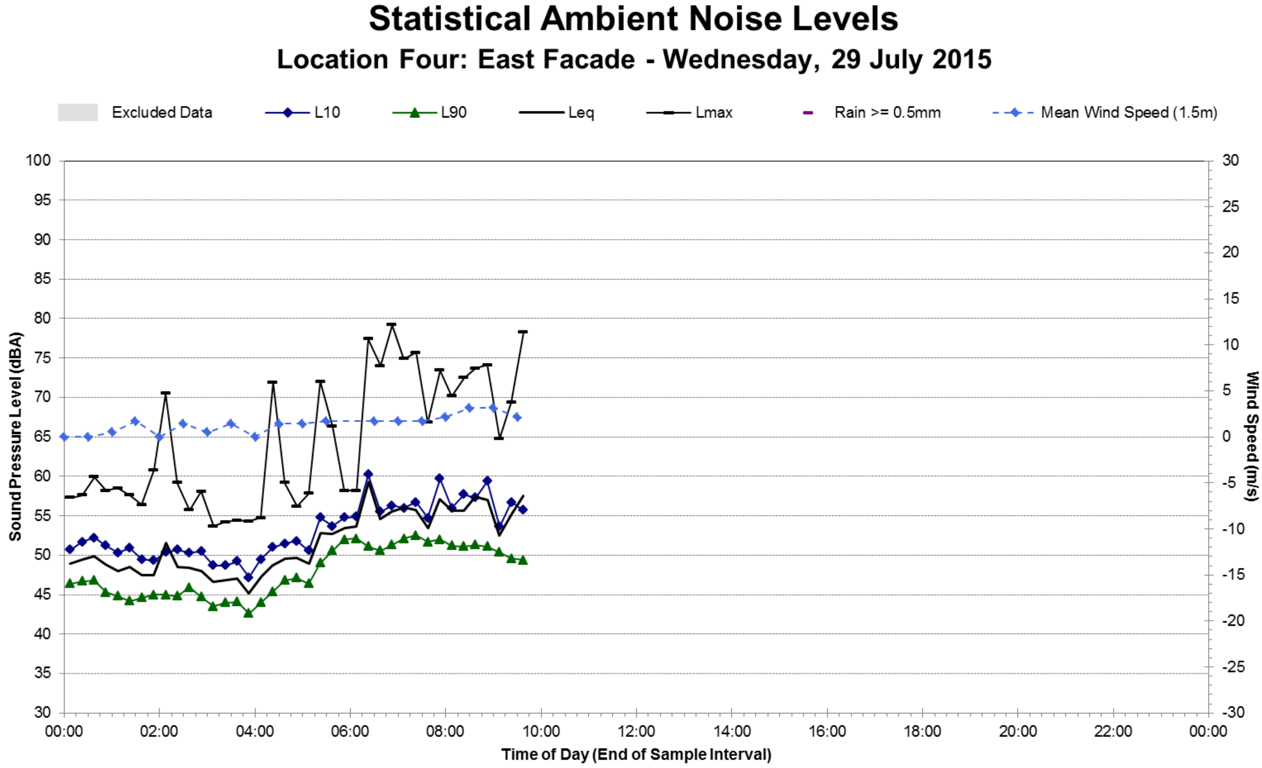
Daily Noise Monitoring – Location Four





Daily Noise Monitoring – Location Four





Appendix F

Report 610.15449

DA Drawings

7 CONCORD AVE CONCORD WEST

CONCEPT MASTER PLAN

7 CONCORD AVE, CONCORD WEST

DECEMBER 2015

ANTONIADES ARCHITECTS

The site has a series of overlays that provide both opportunity and constraints in considering the Master plan.

OPPORTUNITIES

- Located less than 300m from Concord West Neighbourhood Centre.
- Located within 250m of Concord West train station providing an excellent public transport link.
- Close proximity to recreational facilities of Powells Creek Reserve, Bicentennial park and Olympic park.
- Located in a band of residential re-development along the railway line of up to 10 storeys.
- Excellent views of Bicentennial park and potential water views from upper floors towards Parramatta River.

CONSTRAINTS

- Limited vehicle access to the Concord West precinct and the site by a single feeder road (George Street).
- Limited pedestrian access to Rhodes Town Centre and no direct vehicle access through Liberty Grove.
- Noise and visual impacts from Homebush Bay Drive to the west of the site.
- Adjacent low density to the east limits height along the eastern boundary with potential overshadowing and privacy impacts.
- Current entry to the site is restricted to a single entrance on Station Ave.

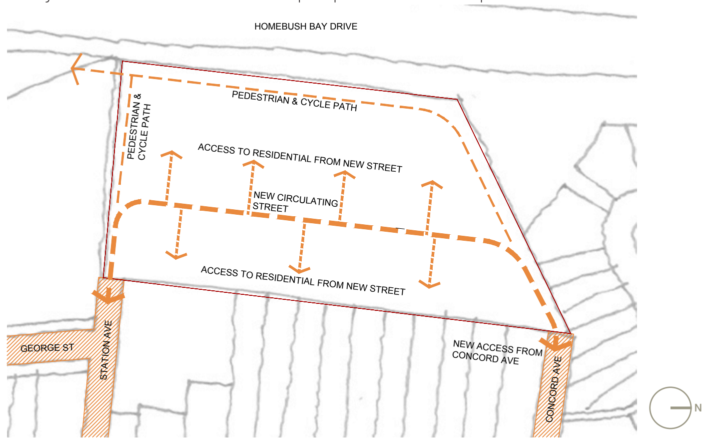
DESIGN RESPONSE

The master plan was developed around four major guiding principles which are consistant with the intent of the Concord West Precinct Master Plan:

- Access and circulation
- Height and setback
- Landscape and open space
- Flooding

The development of each of these guiding principles have provided valuable input on how the master plan should relate to the site, environment and its surroundings.

They each ensure that the proposed development will have excellent amenity as well as maintaining amenity to the neighbours and their future development.



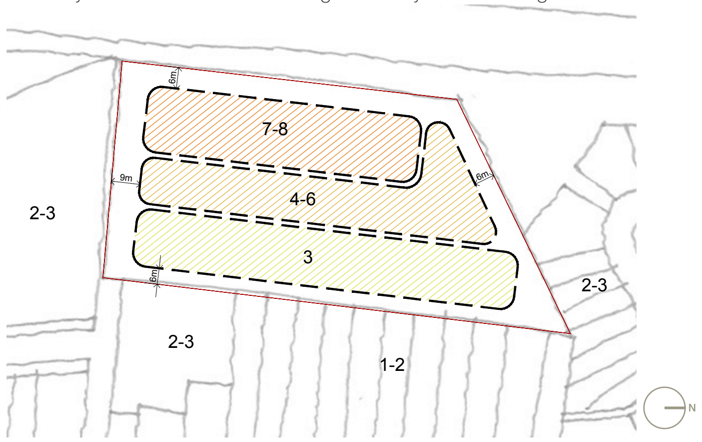
ACCESS AND CIRCULATION

A new street is introduced to the site to link the western ends of Station Ave and Concord Ave. This new tree lined street will become the primary circulation path for vehicles and pedestrians within the development. It will provide visitor street parking as well as access to underground parking. Pedestrians will also utilise this street to enter the residential buildings.

Active surveillance will be provided by overlooking residences to ensure the street is safe and secure.

The proposed new street also has the added advantage of removing two dead ends of Station Ave and Concord Ave to provide a formal loop to those streets. This will enhance the usability and accessibility of the existing road network.

A new bicycle / pedestrian link is proposed along Homebush Bay Drive linking to Station Ave, Concord Ave and pedestrian link to Liberty Grove.



HEIGHT AND SETBACK

The building height strategy has been developed to minimise any adverse impacts to the surrounding neighbours.

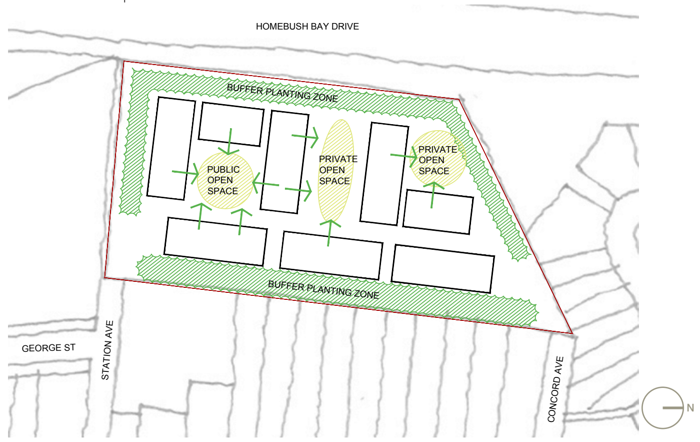
The eastern most portion of the site will generally have a height limit of 3 storeys to respond to the bordering low density residences. This will minimise potential overshadowing and privacy impacts.

Liberty Grove development immediately to the north is generally 2 storeys in height on top of a 2m high retaining wall. It is proposed that the northern portion of the site be limited to 4 storeys.

Homebush Bay Drive is located along the western boundary of the site with Bicentennial Park further West. Homebush Bay Drive is the main source of noise to the site. Building height of up to 8 storeys is suitable as it will form an acoustic barrier to buffer the noise from the rest of the site. The eight storey building is positioned away from the existing low density houses so that it will not cause any overshadowing or privacy issues. The western building will have excellent amenity in the form of park and district views from upper floor apartments.

Building setbacks to be designed in line or exceed the requirement of State Environmental Planning Policy 65. For example building separation of 12m for building up to 4 storeys and 18m for building up to 7 storeys to be allowed.

A setback of 9m to the south is proposed to allow for the future development of adjacent property to the same height without compromising its amenity. A setback of 9m is proposed to Homebush Bay Drive to provide usable outdoor space and buffer zone.

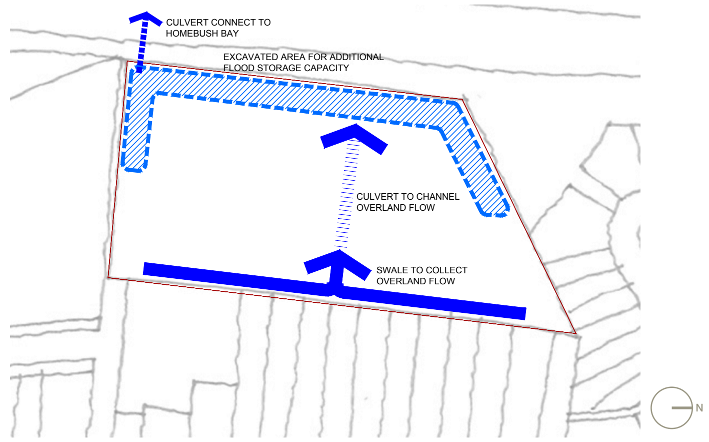


LANDSCAPE AND OPEN SPACE

It is essential to create a planted buffer zone to the perimeter of the site. This will not only screen the proposed development but also provide an important environmental resource providing a habitat for local wildlife and mitigate pollution. To the north is the back of Liberty Grove development and its 3m high retaining wall. To the west is Homebush Bay Drive which is a source of noise pollution and visually unappealing. An industrial warehouse is located to the south of the site. Screening is also required to the east from the townhouses and low rise dwellings to provide privacy.

The creation of courtyard space is integral to any design solution, providing usable outdoor space whether public or private. Courtyard allow solar access to surrending apartments and provide excellent amenity by the provision of green spaces that can be enjoyed by the residents and the wider community.

The provision of outdoor open space also provides the opportunity to articulate the facade of long building. By strategically positioning open space as well as separation between buildings, allows views out from the open spaces and reduces the visual impact of the buildings.



FLOODING

The site is subject to flooding, significant considerations were given to ensure the proposed development will not have any adverse impacts on flood water level both on and adjacent to the site.

All habitable spaces are designed to be above 1 in 100 ARI level with sufficient freeboard to comply with council requirements. Access roads are positioned to ensure continuous access to the buildings in the event of flooding.

A swale is designed inside the eastern boundary, that will capture any potential overland flow that could enter from the east. This will then be channeled through a culvert above the basement to the other side of the site. Water would subsequently drain by the existing culvert under Homebush Bay Drive.

It is proposed that the rear and side setback areas are to be excavated to increase the flood storage capacity of the site.

This proposal will improve the current drainage conditions to the east by removing the current building that is acting like a dam and the improved drainage method will allow water to drain quicker than it currently does.



Numbers Indicate maximum Number of Building Storeys



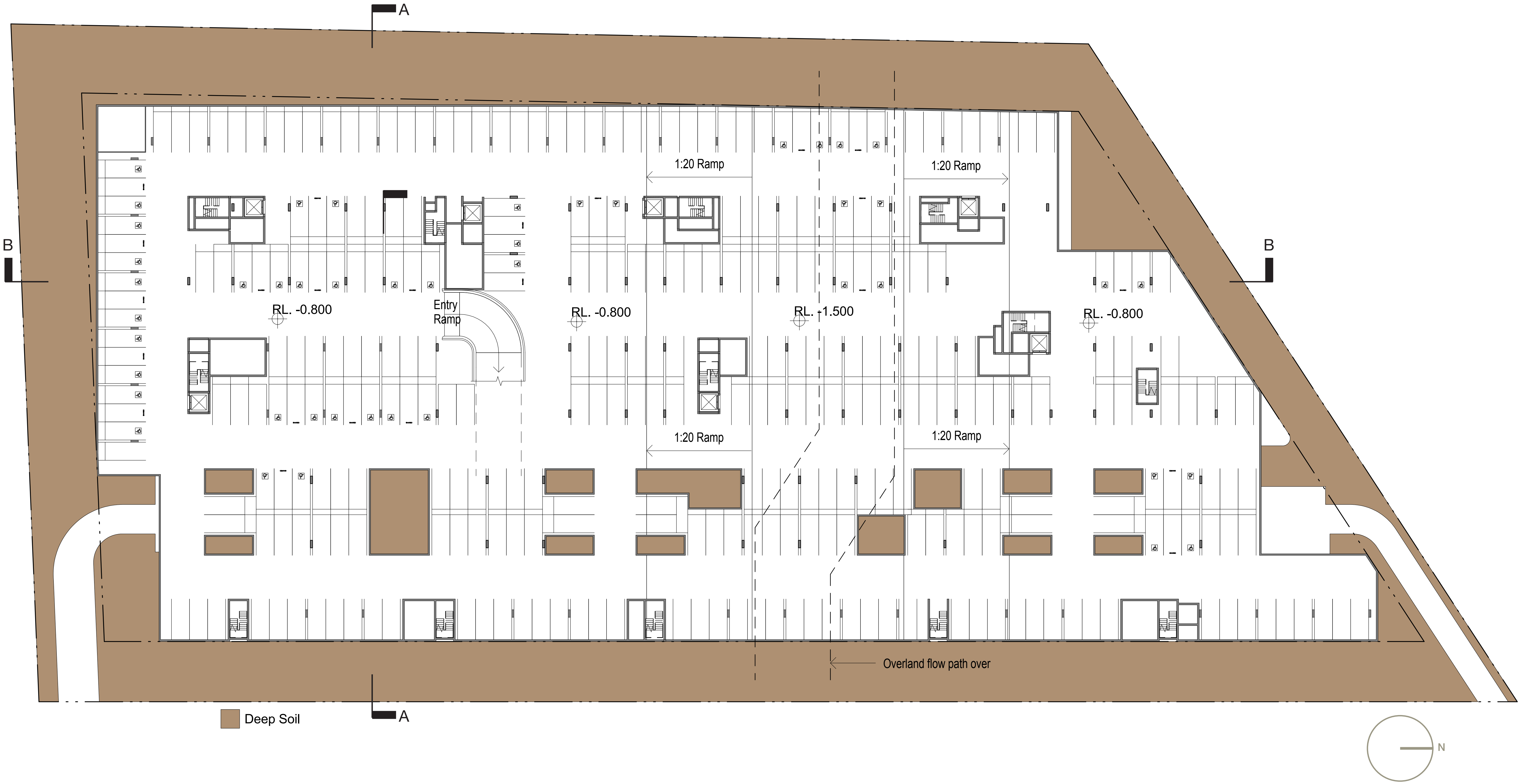
CONCEPT MASTER PLAN

7 CONCORD AVE, CONCORD WEST

DECEMBER 2015 AA.MPN.1202

SITE PLAN

ANTONIADES ARCHITECTS



CONCEPT MASTER PLAN

7 CONCORD AVE, CONCORD WEST
DECEMBER 2015 AA.MPN.1202

BASEMENT PLAN

ANTONIADES ARCHITECTS



CONCEPT MASTER PLAN

7 CONCORD AVE, CONCORD WEST
DECEMBER 2015 AA.MPN.1202

GROUND FLOOR PLAN

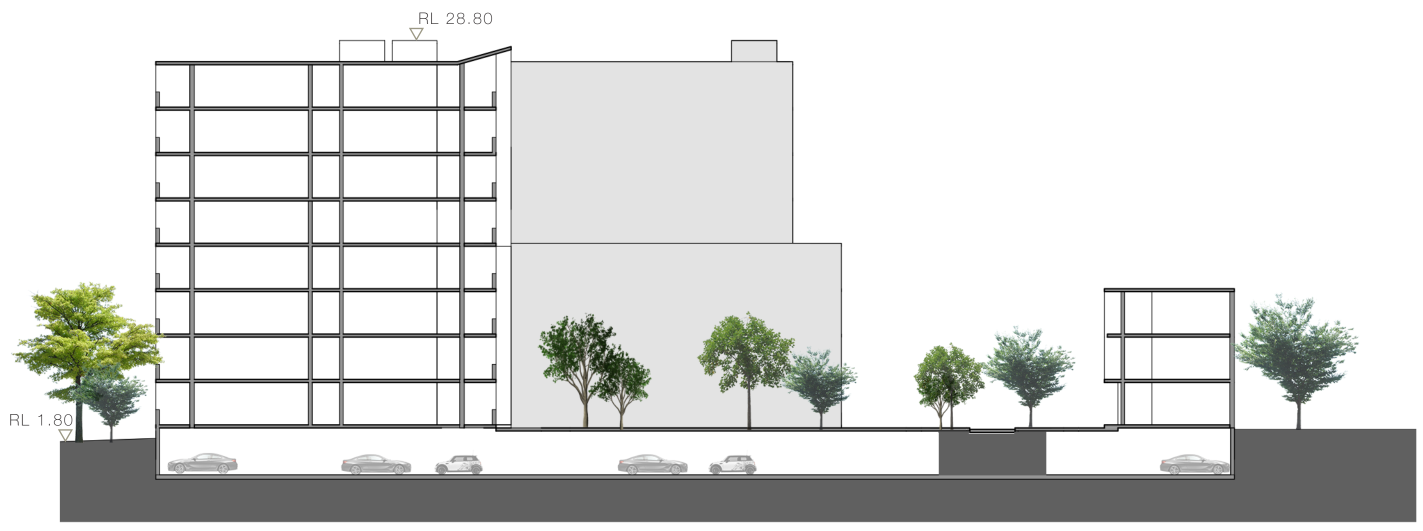
ANTONIADES ARCHITECTS

CONCEPT MASTER PLAN

7 CONCORD AVE, CONCORD WEST
DECEMBER 2015 AA.MPN.1202

TYPICAL UPPER FLOOR PLAN

ANTONIADES ARCHITECTS



SECTION A

SECTION B

CONCEPT MASTER PLAN

7 CONCORD AVE, CONCORD WEST
DECEMBER 2015 AA.MPN.1202

SECTIONS

ANTONIADES ARCHITECTS

CONCEPT MASTER PLAN
7 CONCORD AVE, CONCORD WEST
DECEMBER 2015 AA.MPN.1202

PERSPECTIVE

ANTONIADES ARCHITECTS

CONCEPT MASTER PLAN

7 CONCORD AVE, CONCORD WEST
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PERSPECTIVE

ANTONIADES ARCHITECTS

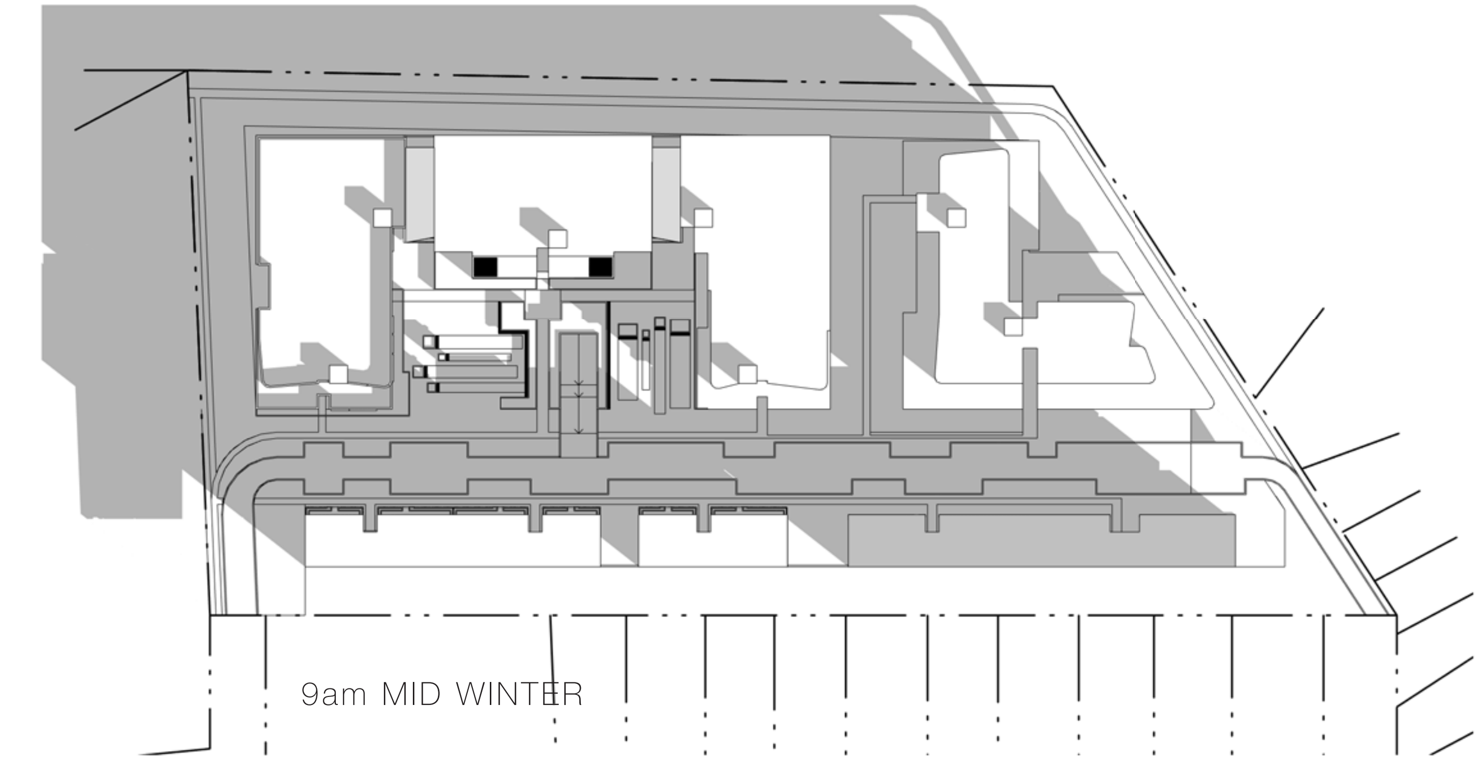
  

CONCEPT MASTER PLAN

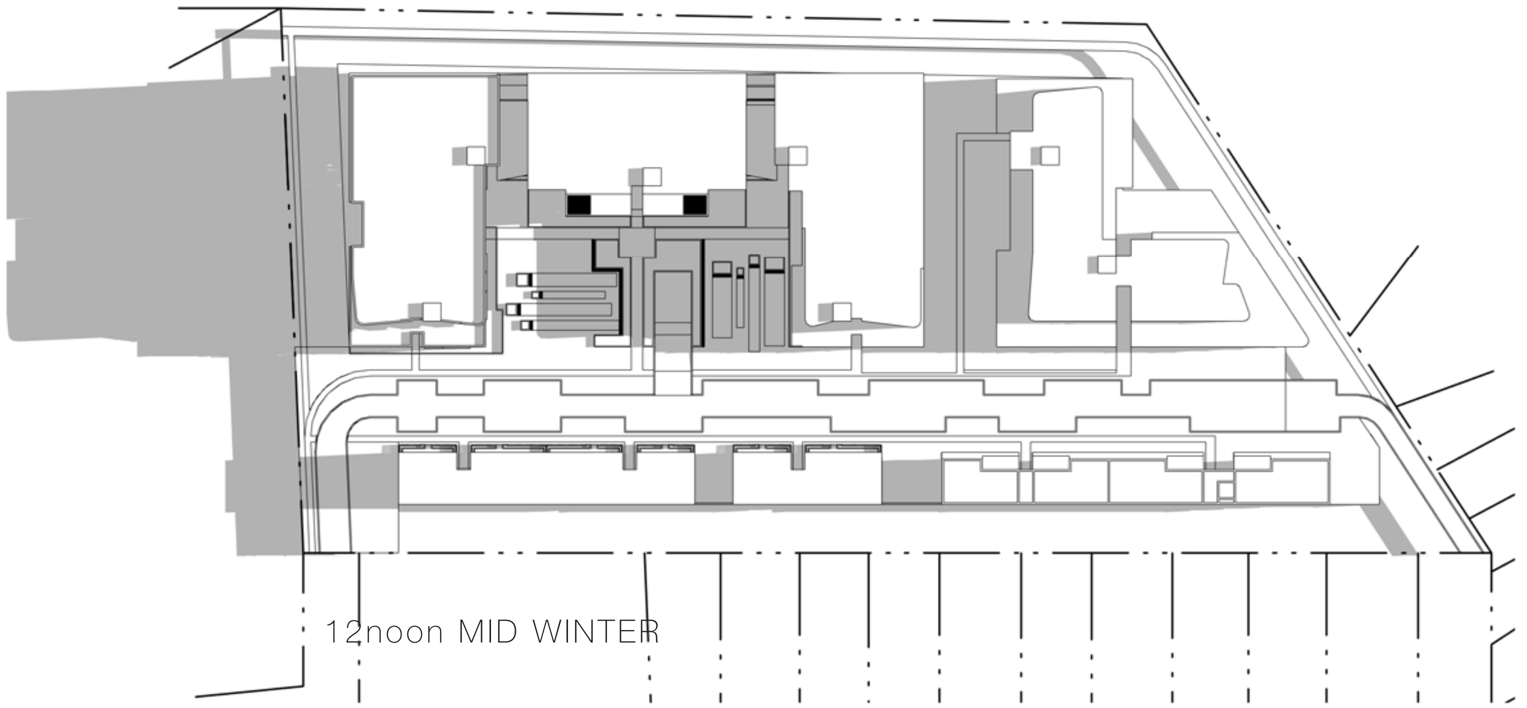
7 CONCORD AVE, CONCORD WEST
DECEMBER 2015 AA.MPN.1202

PERSPECTIVE

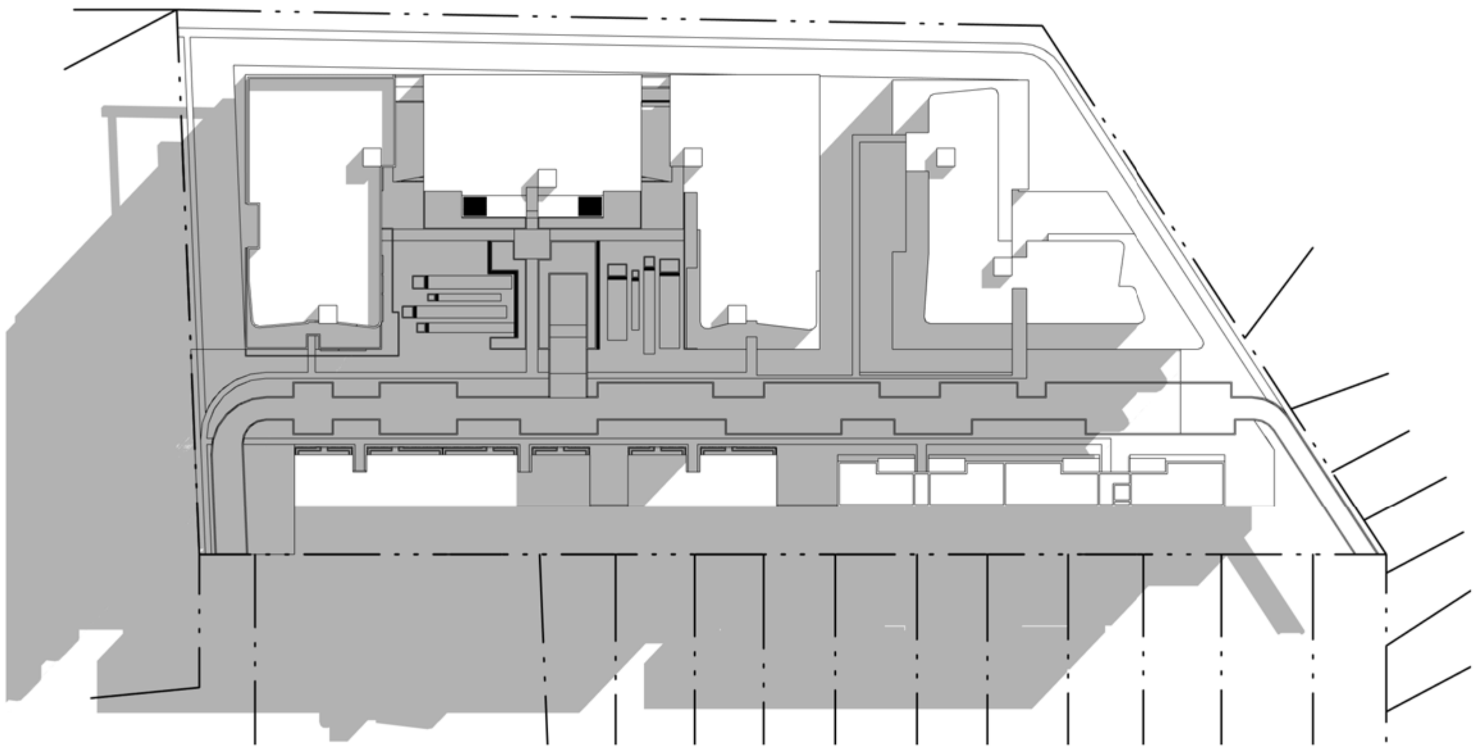
ANTONIADES ARCHITECTS



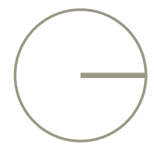
9am MID WINTER



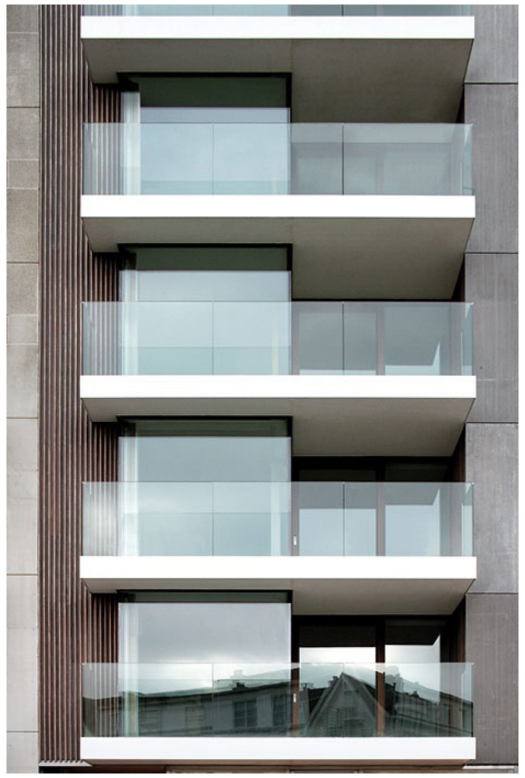
12noon MID WINTER

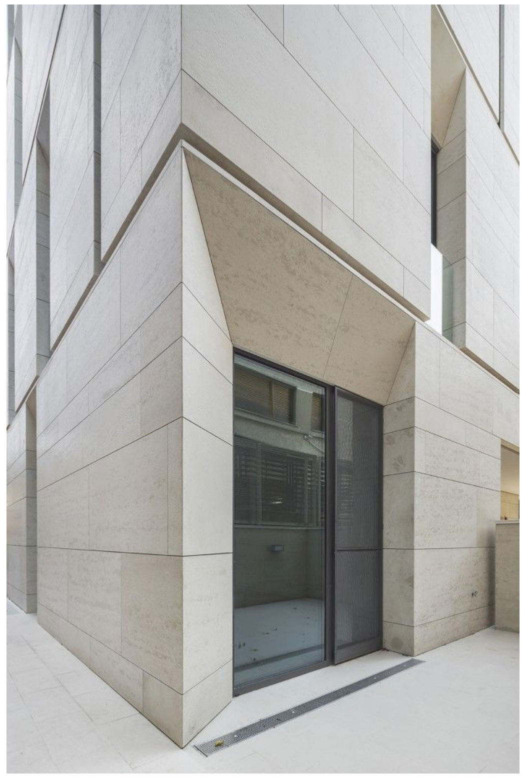


3pm MID WINTER









BENCHMARK IMAGES

ANTONIADES ARCHITECTS

UNIT MIX

	Building 1						Building 2				Building 3			
	Studio	1 Bed	1 Bed +	2 Bed	2 Bed +	3 Bed	1 Bed +	2 Bed	2 Bed +	3 Bed	1 Bed	2 Bed	3 Bed	4 Bed
Ground Floor	1	2	5	16	2	2	2	9		1	3	5	2	
Level 1	1	2	5	16	2	2	2	9		1	3	5	2	
Level 2	1	2	5	16	2	2	2	9		1	3	5	2	
Level 3	1	2	5	16	2	2	2	9		1				
Level 4	1	1	6	15		3	1	3		2				
Level 5	1	1	6	15		3	1	3		2				
Level 6			2	18		3								
Level 7			2	18		3								
Level 8														
Total	6	10	36	130	8	20	10	42	0	8	9	15	6	0
%	2.9%	4.8%	17.1%	61.9%	3.8%	9.5%	11.9%	50.0%	0.0%	9.5%	30.0%	50%	20%	0%
Total	210						84				30			

Total Studio	6	2.0%
Total (1 Bed)	19	6.3%
Total (1 Bed +)	46	15.3%
Total (2 Bed)	187	62.3%
Total (2 Bed +)	8	2.7%
Total (3 Bed)	34	11.3%
Total (4 Bed)	0	0.0%
Total Apartments	**300**	

AMENITY : SOLAR ACCESS

	2 Hours Solar Access	Cross Ventilation
Ground Floor	30	31
Level 1	30	31
Level 2	36	31
Level 3	26	21
Level 4	24	20
Level 5	25	20
Level 6	18	14
Level 7	23	14
Total	212	182
%	70.7%	60.7%

Solar Access	**212**	70.7%
Cross Ventilation	**182**	60.7%

GFA

	Building 1	Building 2	Building 3
Ground	2413	1081	759
Level 1	2413	1081	759
Level 2	2413	1081	759
Level 3	2413	1081	
Level 4	2269	633	
Level 5	2269	633	
Level 6	2148		
Level 7	2148		
Total	18486	5590	2277

Total GFA	26353 sqm
Site Area	15021 sqm
FSR	1.75:1

* GFA Area measured to internal face of external wall, excluding lift shaft, fire stair, parking, garbage storage and handling facilities

PARKING

	Code	Required	Provided
Studio	1	6	330
1 Bed	1	19	
1 Bed +	1	46	
2 Bed	1	187	
2 Bed +	1	8	
3 Bed	1	34	
4 Bed	1	0	
Visitors	0.1	30	
Total Residents		330	
Total Required		330	

- Current Achieved GFA figures to be confirmed following design development.
- All figures presented in this chart are preliminary and refer to schematic designs prepared by Antoniades Architects Pty Ltd.