Hamilton Harbour Development Application

Environmental Noise Assessment

Hamilton Harbour Unit Trust

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Development Application

Prepared for

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Table of Contents

1.0 Introduction

1.1 Project Description

Leighton Properties and Devine Limited are in a joint venture to develop a site located at 483 – 485 Kingsford Smith Drive (KSD), Hamilton. The site is bounded by KSD, Harbour Road and Hercules Street as shown in Figure 1. The project, identified as Hamilton Harbour, includes the design and construction of two 10-storey commercial buildings, two multistorey residential buildings, two standalone retail pavilions, and two levels of basement carparking. The commercial buildings are located along the property boundary bordering KSD with the residential buildings located towards the southern end of the site.

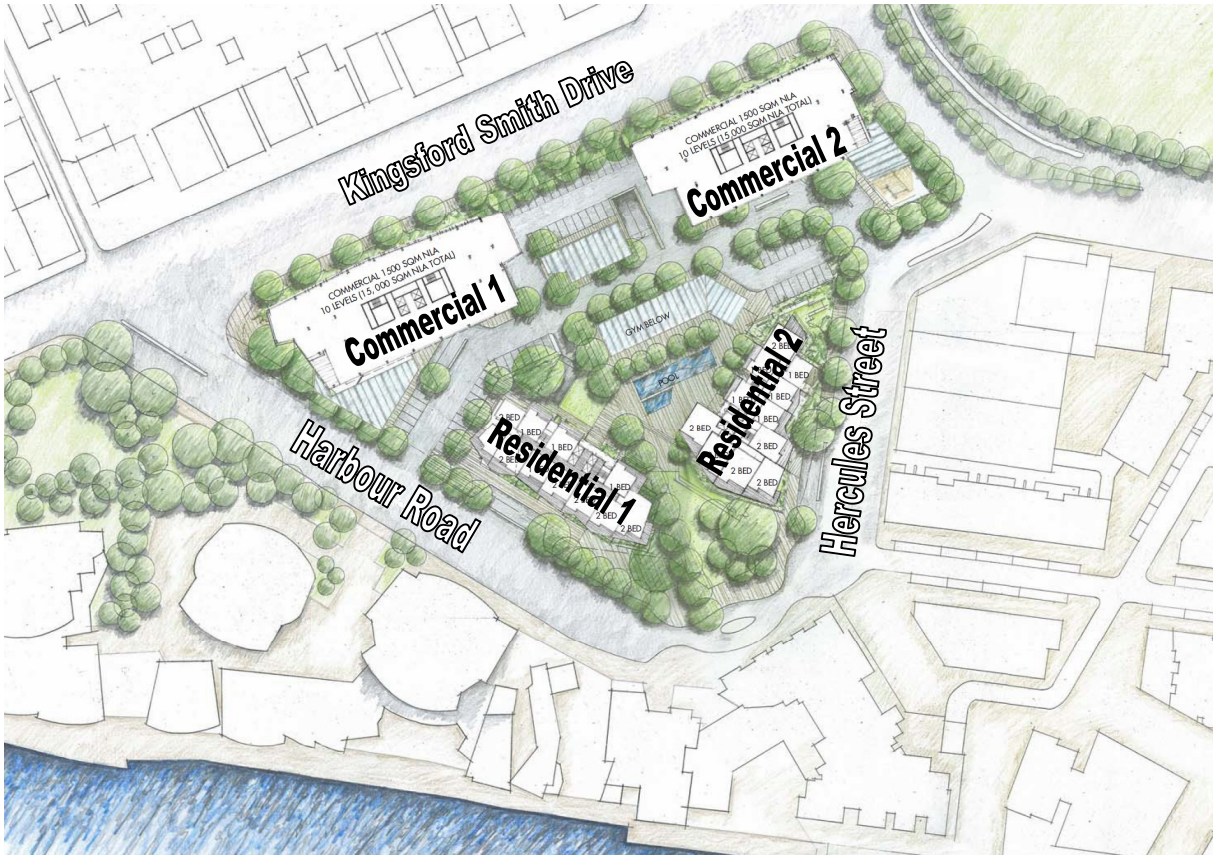


Figure 1 - Layout Sketch from the Master Plan

The proposed commercial buildings consist of ground floor retail space combined with nine levels of 'A Grade' base building commercial office space. Both buildings are to achieve a five star NABERS Energy rating and five star Green Building Council of Australia (GBCA) rating (Green Star). The approximate combined NLA for both commercial buildings is 38,000 m^2.

The proposed residential buildings, identified as Residential 1 and Residential 2, are 22 and 19 storeys respectively. These buildings include a mix of moderate to high quality apartments with a total of 416 units. The development also includes a heated lap pool and recreational pool.

The Hamilton Harbour site is located within the Northshore Hamilton Urban Development Area (UDA). The Northshore Hamilton UDA includes land between Kingsford Smith Drive and the Brisbane River, extending from Bretts Wharf to the west and the Gateway Motorway to the east.

Development of UDA sites is controlled by the Urban Land Development Authority (ULDA). Accordingly the Development Approval (DA) will be lodged with the ULDA.

1.2 Critical Issues for Project

The key acoustical issues associated with the development application for the project are:

Commercial Buildings

- Recommendations for criteria relating to noise intrusion and environmental noise emission
- Indicative design of the commercial base building façade to control traffic noise intrusion;
- Control of noise emission from plantrooms and plant areas to meet criteria for environmental noise emission from the site;

Residential Buildings

- Recommendations for criteria relating to noise intrusion and environmental noise emission acoustic separation, impact noise control and internal noise levels;
- Preliminary design of the residential building façade to control traffic noise
- Control of noise emission from plantrooms and plant areas;
- Control of noise intrusion from plant located on site;
- Acoustic separation between apartments
- Acoustic separation of common areas such as lifts to tenancies;
- Control/management of noise from retail areas, cafés, restaurant, and swimming pool which have potential to impact on the proposed residential buildings.

This report recommends minimum acoustic performance criteria and indicative constructions required for the project as referenced from applicable acoustic design codes and regulations governing the site.

Nomenclature used in this report is detailed in Appendix A - Glossary of Acoustic Terms.

2.0 Existing Noise Environment

2.1 Noise Measurements

An ambient noise survey was conducted at two locations on the proposed Hamilton Harbour site between Tuesday 16 September and Monday 22 September, 2008. Attended noise measurements were also undertaken at the beginning and end of logging. The purpose of this survey was to gain an understanding of the existing noise environment at the site. The measured average background noise levels are used in setting noise criteria and the measured $L_{A10,\ 18hr}$ noise levels have been used to validate the road traffic noise model. The difference between the measured $L_{Aeq\ 1hr\ max}$ and $L_{A10,\ 18hr}$ noise levels is also used when assessing road noise intrusion.

Figure 2 - Noise Logging Locations

Logging Location A was approximately 30 metres from KSD and 20 metres from Harbour Road on a floor pad of a demolished building which can be seen in Figure 2 Logging Location B was approximately 115 metres from KSD and 15 metres from Harbour Road at the southern end of the site. Solid perimeter fencing approximately 2.4 metres in height surrounds the bulk of the site. As a result neither logger had direct line of sight to surrounding road. Accordingly the influence of road traffic on logged noise levels is lower than would be experienced without solid fencing.

The reduction in the average background noise levels will result in slightly more conservative noise emission criteria. However, it is considered that this reduction is similar to that which will be experienced when the commercial buildings are constructed at the front of the site. These barriers will

be included in the road traffic noise model of the current situation. In addition, a reduction in the measured $L_{A10, 18hr}$ noise levels does not impact on the validation of the road traffic noise model since barriers are included in this model, but excluded from the forecast road traffic noise model.

2.2 Ambient Background Noise

The measured ambient noise data and traces are presented in Appendix B - Noise Level Traces. The results are summarised below in Table 1

Table 1 - Summary of Logged Noise Levels

Descriptor	Measured Sound Pressure Level, dB(A)	
	Logging Location A	Logging Location B
$L_{Aeq, 24hr}$	59	57
$L_{A10, 18hr}$	62	59
L_{A90} (6am-6pm), Day	55	53
L_{A90} (6pm-10pm), Evening	56	56
L_{A90} (10pm-6am), Night	48	48
$L_{Aeq\ 1hr\ max}$ (6am-6pm), Day	62	61
$L_{Aeq\ 1hr\ max}$ (6pm-10pm), Evening	62	65[1]
$L_{Aeq\ 1hr\ max}$ (10pm-6am), Night	61	57

Note: 1. Elevated noise level due to car park movements associated with Swim School located on part of the subject site. This use is being discontinued to facilitate the development.

The ambient and background noise level at both Logging Locations was controlled by traffic noise on KSD. Sporadic road traffic along Harbour Road also contributed to the ambient noise environment. A number of aircraft movements overhead were also noted.

2.3 Instrumentation

The instrumentation used for measuring the ambient noise are summarised in Table 2.

Table 2 – Noise Measurement Instrumentation

Instrument	Serial Number
B&K 2250 Type 1 Integrating Sound Level Meter	2600403
Rion NC-74 Sound Calibrator	34483758
Rion NL21 Type 2 Noise Logger	00187448
Rion NL21 Type 2 Noise Logger	00465349

3.0 Design Criteria

The Northshore Hamilton Interim Land Use Plan specifies that the design, siting and layout of the development must address noise impacts where appropriate. However, the ULDA do not have specific noise criteria for UDA sites.

The following standards, legislation and guidelines are proposed for assessing noise impacts associated with this site.

- Queensland Environmental Protection (Noise) Policy 1997
- Queensland Environmental Protection Regulations 1998
- Brisbane City Council (BCC) City Plan Noise Impact Assessment Planning Scheme Policy (NIAPSP) and associated Noise Methodologies Guidelines
- Building Code of Australia (BCA)
- Australian Standard AS/NZS 2107:2000 *Acoustics – Recommended design sound levels and reverberation times for building interiors*.
- AS1055.1 & .2 *Acoustics – Description and Measurement of Environmental Noise* Part 1 General procedures, Part 2 Application to specific situations
- AS2021:2000 *Aircraft noise intrusion – Building siting and construction*

Strictly speaking the BCC NIAPSP does not apply to this site. However, this method of assessment is recommended for the following reasons.

- The system provides a degree of flexibility in noise assessments that is well suited to this type of development
- Use of NIAPSP provides a level of amenity commensurate with other developments in the area.
- Non-compliance with NIAPSP increases the risk of future building occupants claiming the building is not 'fit for purpose' or similar claims

It should be noted that commercial buildings are not considered noise sensitive and therefore are not typically assessed against the NIAPSP in terms of noise intrusion.

3.1 Environmental Noise Emission Criteria

Noise emission from the site is to be governed by the provisions of the Environmental Protection Policy - EPP (Noise) 1997, Environmental Protection Regulation (EPR) 1998, and Brisbane City Council's Noise Impact Assessment Planning Scheme Policy.

3.1.1 EPR 1998 – Mechanical Plant

This noise emission is governed by the Queensland Environmental Protection Regulation 1998, clause **6Z** which states:

> *"An occupier of premises at or for which there is air-conditioning equipment must not use or allow the use of the equipment –*
>
> *a) from 7am to 10pm on any day if it makes noise or causes noise to be made of more than 50 dB(A); or*
> *b) before 7am or after 10pm on any day if it makes noise or causes noise to be made of more than the higher of the following-*
> *i). 40 dB(A);*
> *ii). 5 dB(A) above the background noise level.*

In practice, where the night-time criterion exceeds the daytime criterion we apply the daytime limit throughout. The noise generated by plant should be steady, broad-band noise free from annoying characteristics such as tones, rattles etc. Based on ambient noise measurements previously taken at the site, the following specific noise criteria are applicable at the boundaries of the property:

- 50 dB(A) from 7am to 10 pm
- 50 dB(A) from 10 pm to 7am

3.1.2 EPR 1998 – Pool and Spa Pumps

This noise emission is governed by the Queensland Environmental Protection Regulation 1998, clause 6Y which states

> *(1) An occupier of premises at or for which there is a spa blower or a pump for a swimming pool or spa pool must not use or allow the use of the spa blower or the pump—*
>
> *(a) before 7 a.m. or after 10 p.m. on any day if it makes audible noise or causes audible noise to be made; or*
>
> *(b) from 7 a.m. to 7 p.m. on any day if it makes noise or causes noise to be made of more than 50 dB(A); or*
>
> *(c) from 7 p.m. to 10 p.m. on any day if it makes noise or causes noise to be made of more than 5 dB(A) above the background noise level.*

Condition 1(a) does not apply if the noise is no more than 5 dB(A) above the background noise level. In practice, where the night-time criterion exceeds the daytime criterion we apply the daytime limit throughout. Based on ambient noise measurements taken at the site, the following specific noise criteria are applicable for noise emission from spa pumps at the boundaries of the property:

- 50 dB(A) from 7am to 7 pm
- 50 dB(A) from 7 pm to 10 pm
- 50 dB(A) from 10 pm to 7am

3.1.3 BCC NIAPSP – Background Creep

E.1 Applicability of Methodology
This methodology relates to emissions from all noise sources during all time periods. It is applied in addition to one or more of the above methods.

E.2 Noise Limits
The LA90,T noise level emitted from the source should not exceed the levels specified in the following table:

Noise area category	Permissible level of exceedance of L_{A90},T for the appropriate time of day		Where the background levels already exceed the stated levels in AS1055.2 without the proposed development.
	Where there is residential development	Where there is no residential development	
R1	By 5 dB(A)	N/A	The development's noise contribution must still comply with the stated levels in AS1055.2
R2	By 5 dB(A)	N/A	
R3	By 0 dB(A)	By 10 dB(A)	
R4			
R5			
R6			

This northern boundary of the site can be described by the R5 noise category *Areas with very dense transportation or in commercial districts or bordering industrial districts*. The remainder of the site is

best described by the R4 noise category *Areas with dense transportation or some commerce or industry*. The corresponding average background A-weighted sound pressure levels $L_{A90,T}$ from AS1055.2 shown in column 4 of Table 3 below.

Table 3 – BCC Background Creep Criteria Applicable at the Site

Location	Time Period	Average Background L_{A90} dB(A)		
		Measured	AS1055.2	Criteria
Front of Site (Logging Location A)	Day	55	60	55
	Evening	56	55	55
	Night	48	50	48
Rear of Site (Logging Location B)	Day	53	55	53
	Evening	55	50	50
	Night	48	45	45

3.2 Noise Intrusion and Internal Design Levels

3.2.1 Australian Standard AS2107 – Steady State Noise

Internal noise criteria relate to traffic noise intrusion, and to air conditioning and other constant noise sources within buildings. These noise levels relate not only to the ambience of the space but also play an important role in maintaining acoustic privacy between spaces. The purpose of setting internal noise criteria is to provide a balance between rooms being too noisy (i.e. uncomfortable noise levels but good privacy), and rooms being too quiet (i.e. comfortable noise levels, but poor privacy). Furthermore the cost of achieving lower noise levels and constructing higher performance partitions and ceilings can become prohibitive and impractical.

Internal noise levels at Hamilton Harbour will be controlled by traffic noise intrusion through the façade and mechanical plant noise. The targets for total noise within each space are given in the Australian Standard, *AS2107:2000 Acoustics – Recommended design sound levels and reverberation times for building interiors.* Accordingly, mechanical plant noise, noise from externally located plant and traffic noise are each to be designed to meet the *satisfactory* level from Table 4. The target for the overall internal noise level in the space considering all noise sources should therefore not exceed the *maximum* levels specified in Table 4.

Retail and commercial spaces are not considered 'noise sensitive' under the definitions of the Environmental Protection Regulation. Noise goals for these spaces have been included in this table however to provide guidance as to how these will be addressed in the design.

Table 4 – Recommended Design Sound Levels

Type of Occupancy/Activity	Recommended Design Sound Level $L_{Aeq,T}$ dB(A)		Recommended Reverberation Time (T), s
	Satisfactory	Maximum	
RESIDENTIAL BUILDINGS			
Houses and apartments near major roads–			
Living Areas	35	45	–
Sleeping Areas	30	40	–
Work Areas	35	45	–
Apartment common areas (e.g. foyer, lift lobby)	45	55	*
OFFICE BUILDINGS			
Board and conference rooms	35	40	0.6 to 0.8
Cafeterias and food courts	45	50	*
Computer rooms	45	50	*
Corridors and lobbies	45	50	0.4 to 0.6
General office areas	40	45	0.4 to 0.6
Private offices	35	40	0.6 to 0.8
Public Spaces	40	50	0.5 to 1.0
Restrooms and tea rooms	40	45	0.4 to 0.6
Toilets	50	55	–
Undercover carparks	55	65	–
SHOP BUILDINGS			
Show rooms	45	50	*
Small retail stores (general)	45	50	*
Specialty shops (where detailed discussion is necessary in transactions)	40	45	*

Note: * Minimise Reverberation Time as far as practical

Where a specific noise has annoying characteristics such as tonality, repetitiveness, intermittency or impulsiveness an additional penalty of 5 dB(A) is applicable to the noise

Emergency Plant

Emergency generators and similar plant operating infrequently are able to make an additional 5 – 10 dB(A) noise compared to that specified in Table 4 above. Generators used for load curtailment will need to meet the specified criteria

3.2.2 BCC NIAPSP – AS2107:2000 & External Recreational Spaces

The BCC NIAPSP also references the AS/NZS 2107 :2000, however it also provides recommended noise limits for external recreational spaces, refer below.

> *B,2.3 Special Notes about Outdoor Recreation Areas*
>
> *AS2107:2000 does not include limits for outdoor recreation areas. A reasonable level of outdoor amenity must be maintained for residential and other similar uses in areas where outdoor recreation may occur. In such areas the maximum L_{eq} in any one hour period should not exceed 60 dB(A) and the L_{eq} averaged over a 24 hour period should not exceed 55 dB(A)."*

3.3 Sleep Disturbance

3.3.1 BCC NIAPSP – Sleep Disturbance

In addition to NIAPSP the BCC have also issued the draft Noise Methodologies Guideline (NMG) January 2001, which addresses the issues raised in the NIAPSP. The relevant section of the NMG states:

> ***D Sleep Disturbance due to Noise Sources Other than Aircraft***
>
> *"D.1 Application*
>
> *This methodology applies to noise sources operational during the night period (2200 – 0700) that are neither steady nor quasi-steady. Examples include carpark noise, hammering and other short duration noise events. This method is not applicable for road traffic. This methodology is suitable for assessing both emissions and immisions.*
>
> *D.2 Noise Limits*
> *D.2.1 General*
>
> *Research adopted by the World Health Organisation (WHO), concludes that for short duration variable noise sources the onset of sleep disturbance commences at internal L_{max} levels of 45 dB(A). Accordingly, for these noise sources measured internal maximum noise levels in area categories:*
>
> - *R1 – R3 must not regularly exceed 45 dB(A) ; &*
> - *R4 – R6 must not regularly exceed 50 dB(A)*
>
> *Here "regularly" refers to the likelihood the noise levels would be exceeded by certain events (e.g. passing trucks) throughout the night."*

Accordingly, as the residential portion of site has been categorised as R4 the sleep disturbance criterion is 50 dB(A).

3.3.2 Griefahn

Griefahn [*Acoustics Australia vol 20 No 2 August 1992* pages 43-47] developed a Noise Dose vs Response curve for sleep disturbance from traffic noise. Her research related to noise induced awakenings from trucks in particular, with varying numbers of truck movements occurring during the night. This is useful in providing guidance as to the assessment of noise emission from one-off or occasional events that would not be considered 'regular' events during the night-time period.

For intermittent or short-duration noise events. Griefahn shows that there are zero awakenings amongst 90 percent of the exposed population (including the aged) if maximum noise levels inside bedrooms are:

- 59.4 dB(A) for 2 noise events per night
- 54.1 dB(A) for 10 noise events per night, and
- 53.6 dB(A) for 30 noise events per night.

Griefahn also notes that at an absolute level of 53.2 dB(A) measured indoors, there are zero awakenings in 90 percent of the population. This level "represents the upper risk which must not be exceeded in order to avoid long-term effects on health".

On this basis, any events which occur less than three times per night will be assessed against a limit of 59 dB(A) L_{Amax}.

3.4 Acoustic Separation Ratings

3.4.1 Internal Acoustic Separation for Commercial Base Building

This assessment considers commercial base building only. Accordingly, internal acoustic separation advice will be limited to the building core (i.e. lifts, stairwell, amenities) only. The acoustic ratings and typical constructions required to provide speech privacy for other areas is normally part of the fit-out.

3.4.2 Internal Wall Privacy and Noise Transmission Criteria for Apartments

The Building Code of Australia (BCA) recommends minimum noise isolation treatments to limit noise transfer between spaces in residential buildings. The proposed design ratings for Hamilton Harbour will meet or exceed the current BCA provisions.

3.5 Summary of Criteria

The environmental noise criteria applicable to the Hamilton Harbour development have been summarised in Table 5 below.

Table 5 – Acoustic Design Criteria Summary

Authority	Item	Applicable Area	Descriptor	Goal dB(A)
Environmental Noise Emission Criteria				
Environmental Protection Regulation 1998	Mechanical Plant Noise Emission	Property Boundaries	$L_{Aeq, adj}$ Day	50
			$L_{Aeq, adj}$ Night	50
	Pool and Spa Pumps	Property Boundaries	$L_{Aeq, adj}$ Day	50
			$L_{Aeq, adj}$ Evening	50
			$L_{Aeq, adj}$ Nigh	50
Brisbane City Council	General Environmental Noise Emission	Property Boundaries Adjoining KSD	$L_{A90,T}$ Day	55
			$L_{A90,T}$ Evening	50
			$L_{A90,T}$ Night	45
			L_{Amax}	50/59[1]
		Property Boundaries Adjoining Harbour Road and Hercules Street	$L_{A90,T}$ Day	55
			$L_{A90,T}$ Evening	50
			$L_{A90,T}$ Night	45
			L_{Amax}	50/59[1]
Noise Intrusion Objectives				
Brisbane City Council	Noise Intrusion	Commercial or Retail Areas	No set criteria	
		Apartment common areas (e.g. foyer, lift lobby)	$L_{Aeq, T}$	55[2]
		Living areas	$L_{Aeq, T}$	45[2]
		Bedrooms	$L_{Aeq, T}$	40[2]
AS/NZS 2107:2000	Noise Intrusion	General Office	$L_{Aeq, T}$	45[2]
		Retail	$L_{Aeq, T}$	50[2]
		Apartment common areas (e.g. foyer, lift lobby)	$L_{Aeq, T}$	55[2]
		Living areas	$L_{Aeq, T}$	45[2]
		Bedrooms	$L_{Aeq, T}$	40[1,2]

Note: 1. The 50 dB(A) L_{Amax} criterion is applicable for regular occurrences at night-time only (10 pm to 6 am). Events occurring less than three times per night will be assessed against a limit of 59 dB(A) L_{Amax}.

2. Mechanical services noise should be designed to be at least 5 dB(A) below these criteria

4.0 Description of Noise Sources

4.1 External Noise Intrusion

As discussed in Section 2.0, a site inspection and noise survey were undertaken to determine the existing ambient noise environment. The ambient noise environment surrounding the Hamilton Harbour site is characterised by high levels of road traffic noise.

The site layout is such that the commercial buildings are located along the property boundary bordering KSD and therefore provide a degree of acoustic screening for the residential buildings from road traffic noise associated with KSD, as shown in Figure 3.

Figure 3 - 3D Mock-up from the Master Plan

4.1.1 Road Traffic Noise

Kingsford Smith Drive is a four lane road which carries high traffic volumes. Accordingly, there is a potential for excessive noise levels inside spaces and at external recreation areas.

Traffic volumes along Kingsford Smith Drive are forecast to increase in the future. BCC have advised that the following traffic volumes are expected at the subject site.

Table 6 – Kingsford Smith Drive - Road Traffic Volumes

Year	AADT	18 hour traffic flow1	% Heavy Vehicles
2007	69000	64860	11
2021	77000	72380	11

Note: 1. Assumes 18 hour traffic flow is 94% of AADT

Based on Bassett's experience from previous projects undertaken in this area, the preliminary forecast road traffic noise levels are shown in Table 7 below.

Table 7 - Preliminary Road Traffic Noise Forecasts

Location	Forecast Free Field Road Traffic Noise Level dB(A) $L_{Aeq\ (1\ hour)}$
Commercial building facade –northern (fronting KSD)	Up to 76
Residential building façade	Up to 61

We are currently developing a 3D noise model for the purpose of more accurately forecasting the road traffic noise impact on the proposed development. The results of this modelling will be used to develop architectural treatments to mitigate road traffic noise intrusion. It is expected that high performance glazing systems (i.e. up to 12.76mm single laminated glass) may be required to mitigate the most exposed bedrooms in the residential buildings. These requirements could be reduced by limiting the ratio of façade glazing to sensitive spaces such as bedrooms.

4.1.2 Aircraft Noise

The site falls beneath a major flight path to the Brisbane International Airport. A preliminary review indicates that the site falls outside the ANEF 20 contour. Therefore aircraft noise is not expected to be a key consideration in the design of the building façade. It is expected that this noise will be generally controlled by the façade treatments required for road traffic noise intrusion.

4.2 Environmental Noise Emission

4.2.1 Mechanical Plant Noise

Mechanical plant noise has potential to impact significantly on sensitive areas of the development. It is expected that new mechanical plant associated with the development will be the main source of plant noise at the development and may require treatment. The following sources of noise may be used at the development: pumps, fans, air handling units, condensers, cooling towers, etc. In order to minimise these potential noise impacts consideration will be given to the location and selection of plant to minimise the level of treatment required.

Noise from mechanical plant on site will be controlled to ensure noise levels at nearby noise sensitive receptors comply with the EPA requirement of 50 dB(A) for day, evening and night.

Treatments to plantrooms and externally located plant to control noise emission will be determined during detailed design phases once specific plant has been selected. Techniques used to control this noise emission may consist of a combination of:

- Enclosed Plantrooms
- Silencers
- Lined ductwork
- Acoustic barriers
- Acoustic louvres
- Acoustically rated doors
- Lining of plantrooms with 50 mm 32 kg/m^3 acoustic insulation
- Selection of quiet plant

4.2.2 Pedestrian and Retail Noise

Noise from pedestrians on footpaths and external retail areas can potentially be audible within the commercial and residential buildings. It is expected that this noise will be generally controlled by the façade treatments required for road traffic noise intrusion.

In addition noise associated with the proposed restaurant and café areas will need to be considered, including outdoor dining. It is expected that noise from these activities will be controlled on site using a noise management plan.

4.2.3 Refuse Collection

The collection of garbage from the site may generate noise that has the potential to be considered a nuisance. The noise generated from garbage collection will typically be from: garbage trucks, lifting and placement of garbage bin, and the noise of garbage falling into the garbage collector. It is expected that refuse collection occurs during the day-time period and is no more intrusive than existing refuse collection activities in the area.

4.2.4 Car Park & Driveway Use

Noises associated with car park use such as doors slamming, idling engines, accelerating cars etc. have the potential to cause annoyance at neighbouring residential areas. The potential for noise from the car park to be considered annoying is greatest during the night. Vehicle movements associated with a commercial development are expected to occur predominantly between the house of 8 am and 6 pm, with occasional movements between 6 am and 8 am, and between 6 pm and 8 pm. Turnover rates for commercial buildings are generally low and the amount of traffic generated on nearby roads such as KSD is negligible compared to existing traffic flows. Vehicle movements during night-time hours (i.e. between 10 pm and 6 am) is expected to be low.

Roller doors and other access doors to carpark are to be selected and maintained to avoid squealing, slamming, banging, etc. Speed bumps, guttering, grates, etc. within car parks or on driveways are to be installed in such a fashion to not generate noise when vehicles drive over them. For example, poorly fitting metal grates in a concrete frame are to be avoided.

4.2.5 Swimming Pool and Common Areas

Noise arising from the use of the swimming pool and common areas has potential to impact the proposed residential buildings, particularly late at night. Noise associated with the swimming pool will be managed using appropriate signage and by limiting access to the pool late at night. The behaviour of tenants in common areas will be controlled by the Body Corporate.

5.0 Conclusions

Noise intrusion from road traffic and aircraft has been described in Section 4.1. Strictly speaking, a commercial development is not classified as ‘noise sensitive’ under the definitions of NIAPSP and the EPP (Noise). However, for completeness objectives for controlling noise intrusion into the both the residential and commercial components of this development are outlined in Section 3.5. Noise intrusion to sensitive uses can be controlled to meet the nominated objectives.

Sources of potential noise emission from the site have been described in Section 4.2 of this report. Noise emission criteria have been nominated for mechanical plant, refuse collection and other activities at the site in Section 3.5. Noise emissions from these activities can be controlled to meet the nominated criteria.

Accordingly, there are no acoustic site conditions that would preclude the proposed development from complying with the appropriate noise criteria identified in this report.

Appendix A - Glossary of Acoustic Terms

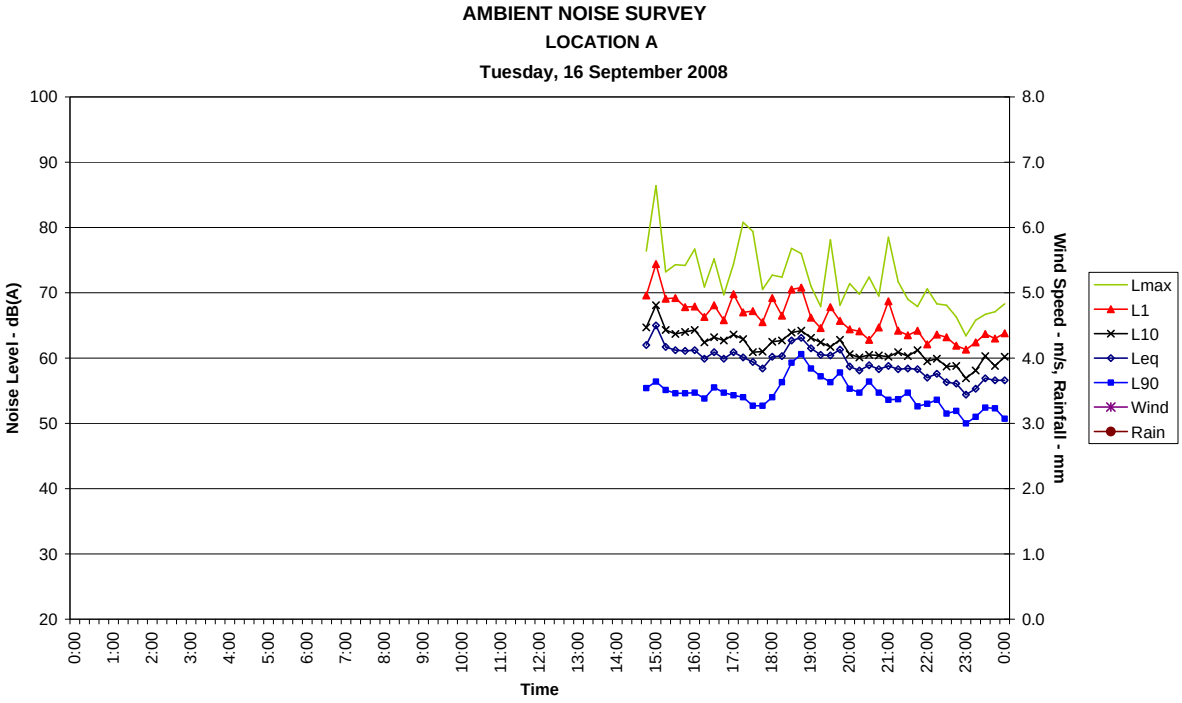
Appendix A Glossary of Acoustic Terms

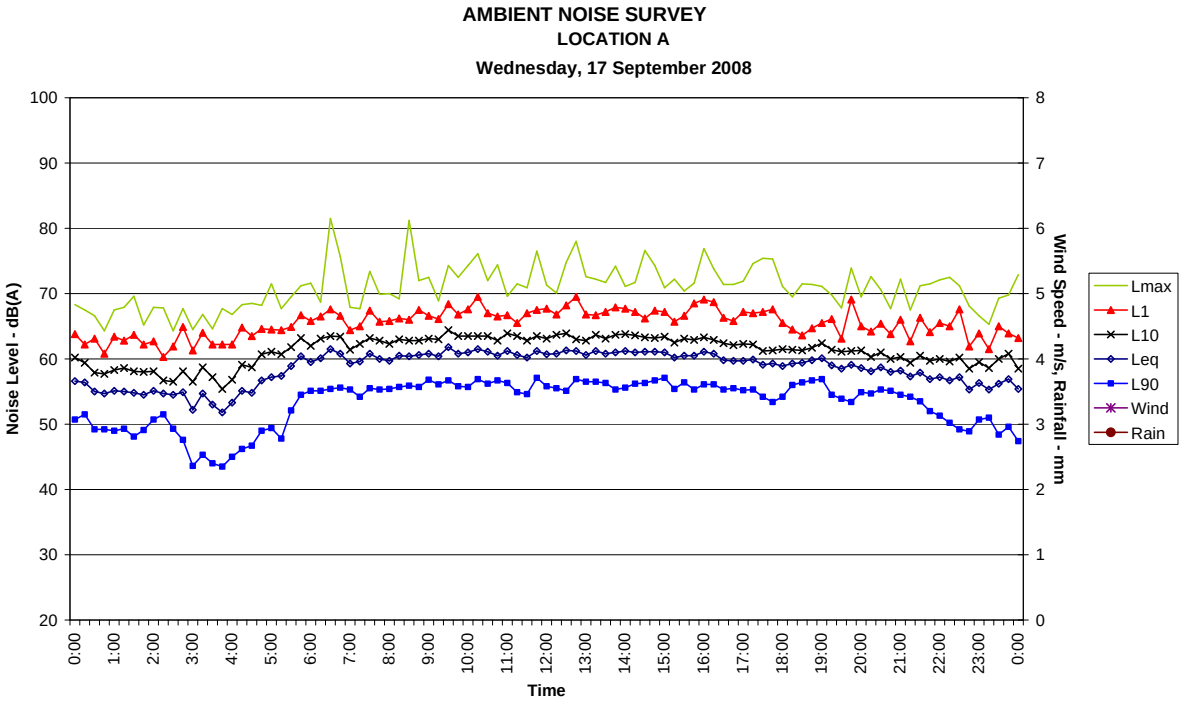
'A' Weighted	Frequency filter applied to measured noise levels to represent how humans hear sounds.
Ambient Sound	The all-encompassing sound at a point being a composite of sounds from near and far.
Background sound	The ambient sound in the absence of the sound under investigation.
dB	The decibel (dB) is a logarithmic unit of measurement that is commonly used to express sound pressure level. An increase of 3 dB corresponds to an approximate doubling of sound power. When applied to sound, an increase of 10dB corresponds approximately to a perceived doubling of loudness; typically 0 dB is the threshold of hearing and 120 dB is the threshold of pain.
dB(A)	'A' Weighted overall sound pressure level.
D_W	Weighted Level Difference – Single number that represents the noise reduction in sound between two adjoining enclosed spaces. The result includes the actual noise reduction for the installed partition and ceiling systems. The higher the D_W, the greater the noise isolation between enclosed spaces. D_W has superseded NIC as the Australian Standard for acoustically rating room to room noise isolation. See NIC Below
Flanking transmission	The transmission, between two rooms sharing a common partition, of sound generated in the air of one of them via all paths except that through the common partition.
Free field	A sound field in a medium of such extent that the effects of the boundaries are negligible throughout the region of interest.
Frequency (Hz)	The human ear responds to sound in the frequency range of 20 Hertz to 20,000 Hz. A combination of sound pressure and frequency determine perceived loudness. The centre frequency of an octave is double the frequency of the lower octave. Sound measurements are usually taken at 16 one third octave bands between 50 and 5000 Hz.
Impact sound transmission level	In a given frequency band, between two rooms situated above the other: the average octave band sound pressure level, throughout the lower room, produced by impacts delivered by a standard tapping machine to the floor of the upper room.
Intermittent noise	A noise whose sound pressure level suddenly drops to the background level several times during the period of observation, the time during which the level remains at a constant value different from that of the background level being of the order of 1s or more.
L_{10}	Noise level exceeded for 10% of the measurement period. This represents the upper intrusive noise level and is often used to represent traffic/ music noise.
L_{90}	Noise level exceeded for 90% of the measurement period. This represents the background noise level excluding nearby sources.
L_{eq}	Energy averaged noise level over the measurement period. This measure is commonly used when comparing the criterion noise level under the Environmental Noise Regulations and for comparison with relevant standards for air conditioning noise.
Masking	The raising of a listener's threshold of hearing for a given sound due to the presence of another sound.
NIC	Noise Isolation Class – Single number that represents the noise reduction in sound between two adjoining enclosed spaces. The result includes actual noise reduction for the installed partition and ceiling systems.

NR	Noise Rating - Single number evaluation of the background noise level. The NR level is normally around 5 dB below the 'A' weighted noise level.
R_W	Weighted Sound Reduction Index – Laboratory test measurement procedure that provides a single number indication of the acoustic performance of a partition or single building element. The higher the R_W, the greater the noise isolation between enclosed spaces. R_W has superseded STC as the accepted Australian Standard for acoustically rating partitions or building elements. See STC Below
Reverberation	The persistence of sound in a space after a sound source has been stopped.
Sound Absorption	a). Reduction of intensity of sound waves on refection b). The property possessed by materials, objects or media of dissipating sound energy.
Sound Power Level	The total sound energy radiated from a source per unit of time. Ten times the logarithm to the base 10 of the ratio of a given power to a reference power.
STC	Sound Transmission Class - Laboratory test measurement procedure that provides a single number indication of the acoustic performance of a partition or single building element. Calculation procedures for STC are defined in AS 1276-1979. The higher the STC, the greater the noise isolation between enclosed spaces.
Steady-state noise	A noise having negligibly small fluctuations of sound pressure level within the period of observation.
Transondent	Acoustically transparent.

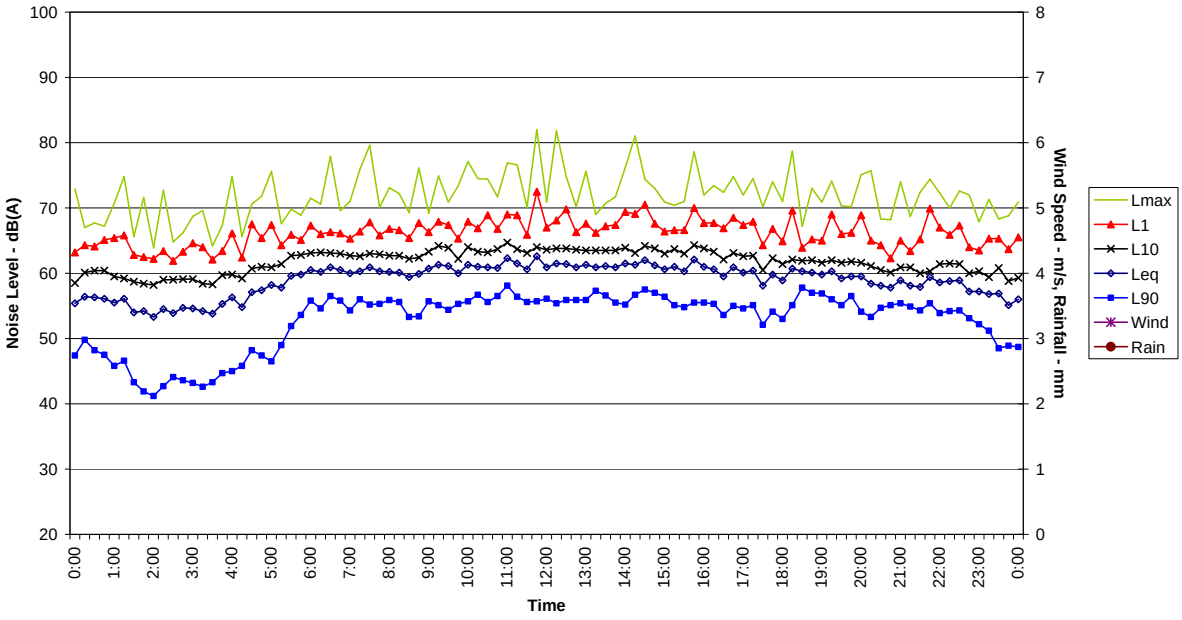
Appendix B - Noise Level Traces

Noise Level Traces – Logging Location A

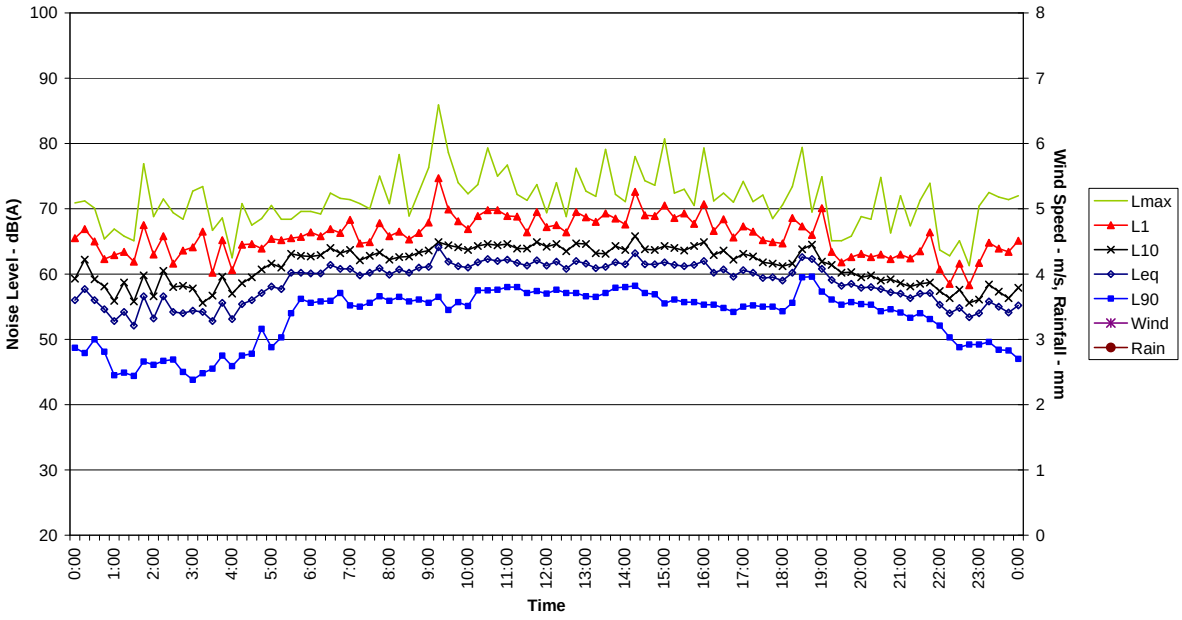




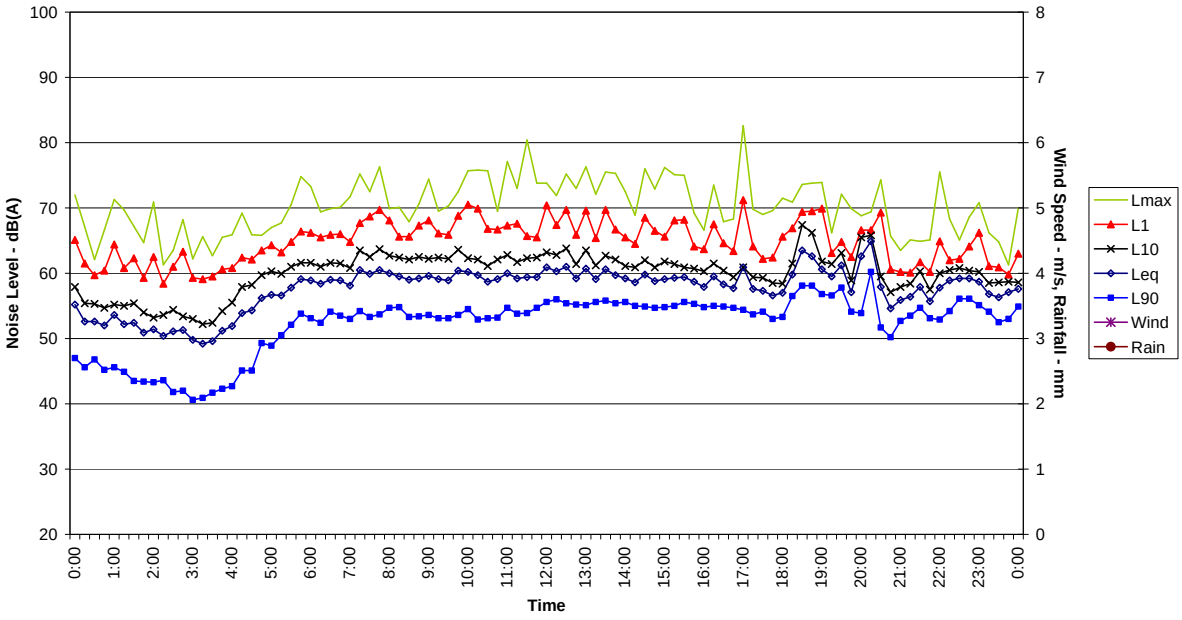
AMBIENT NOISE SURVEY
LOCATION A
Thursday, 18 September



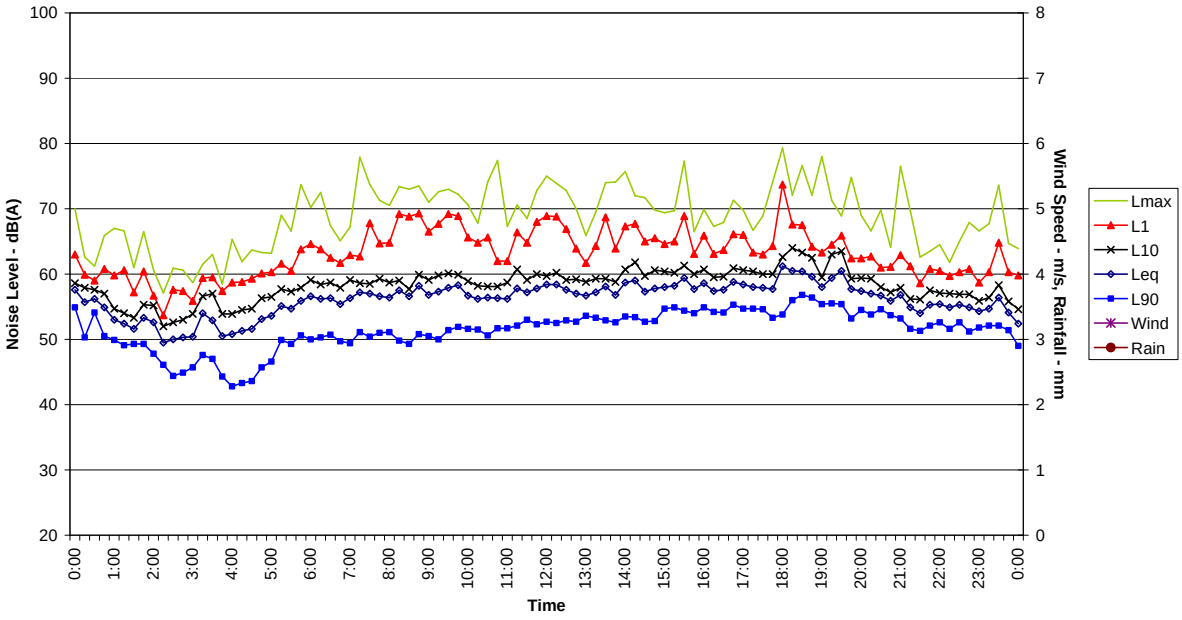
AMBIENT NOISE SURVEY
LOCATION A
Friday, 19 September 2008

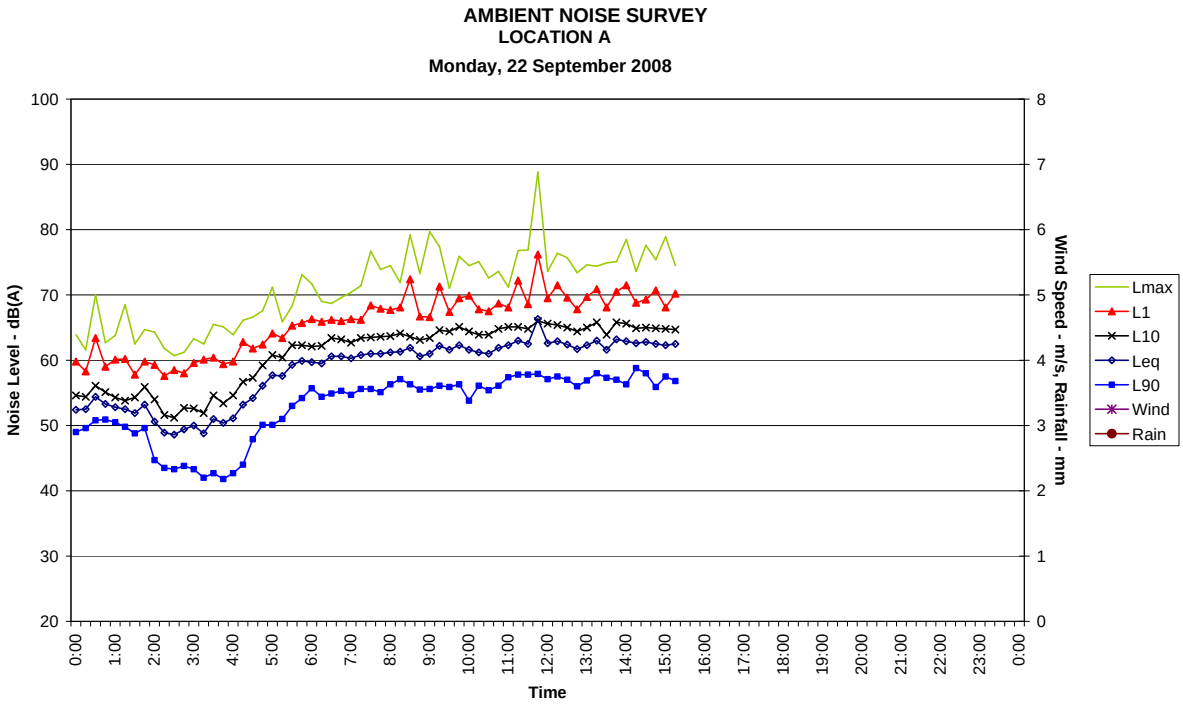


AMBIENT NOISE SURVEY
LOCATION A
Saturday, 20 September 2008

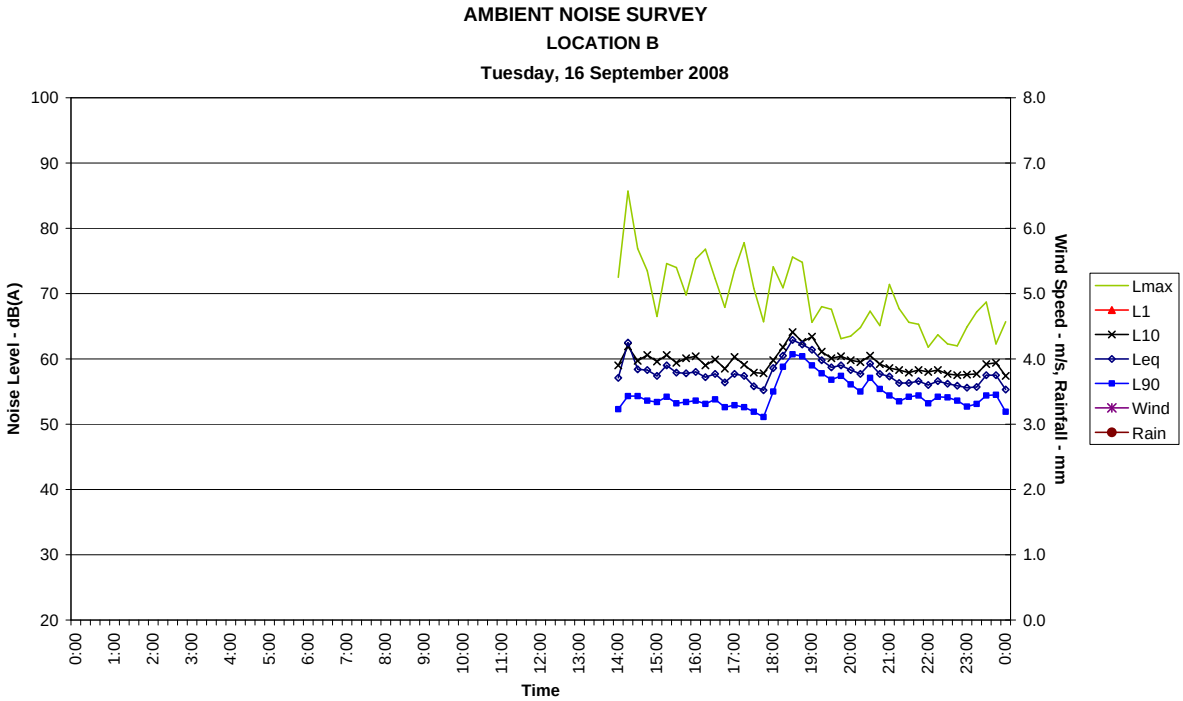


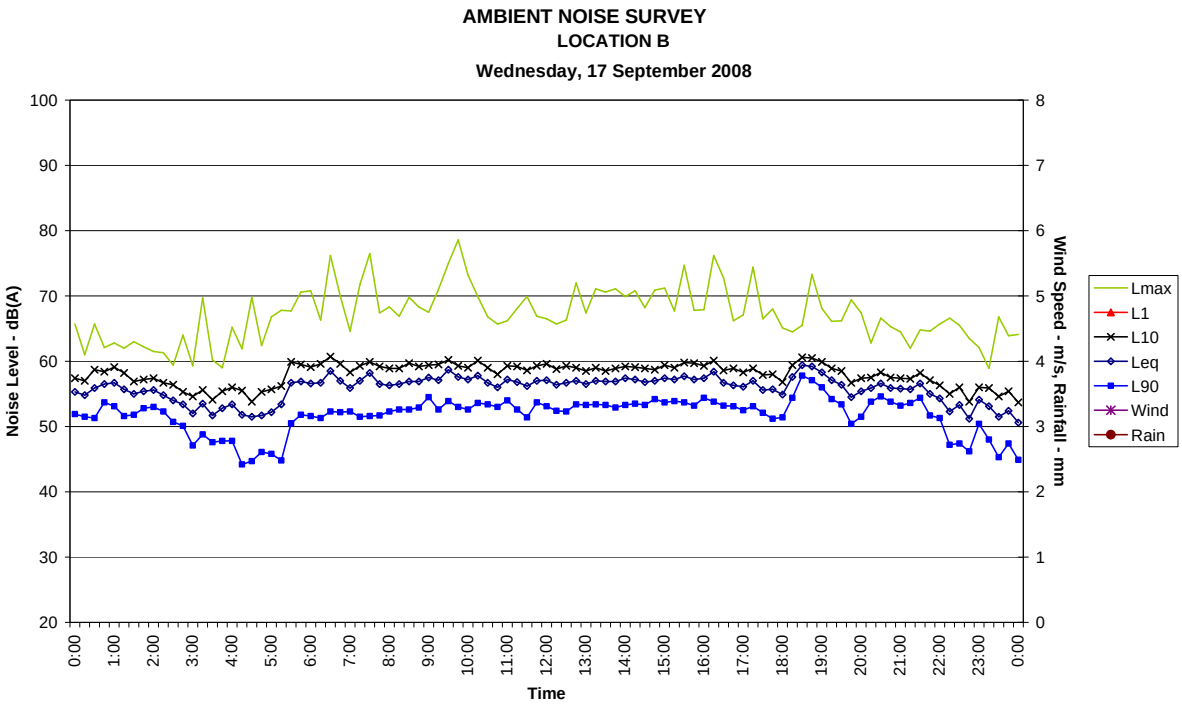
AMBIENT NOISE SURVEY
LOCATION A
Sunday, 21 September 2008

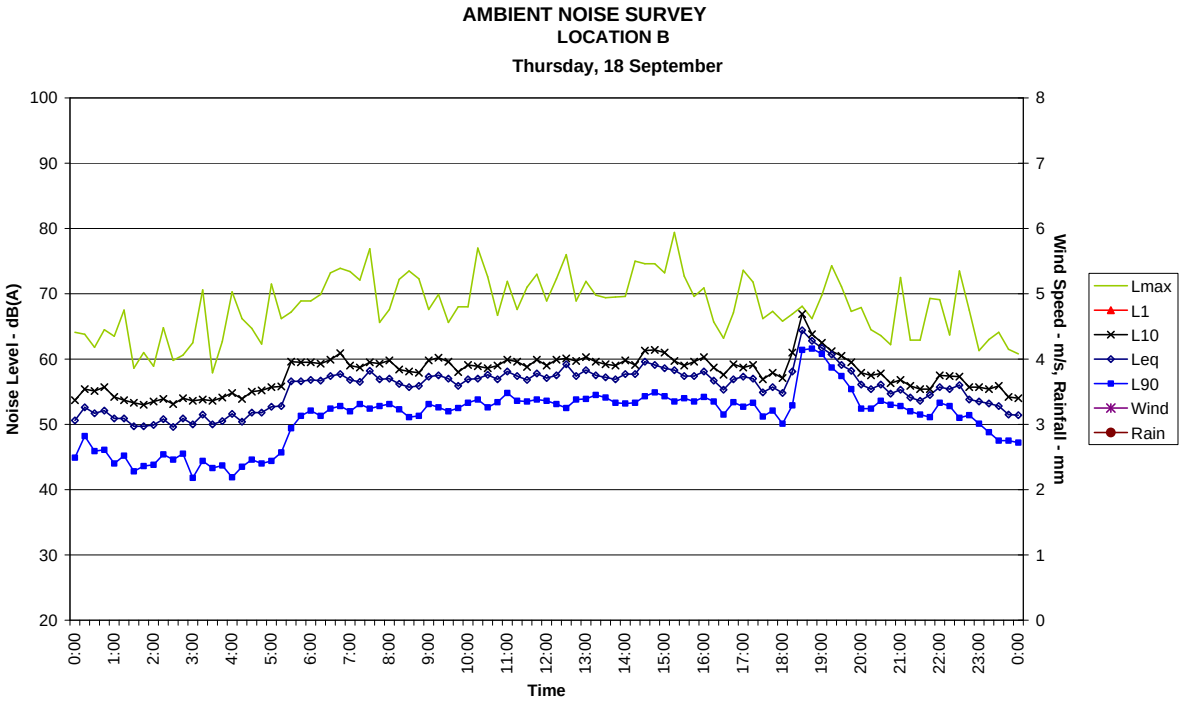




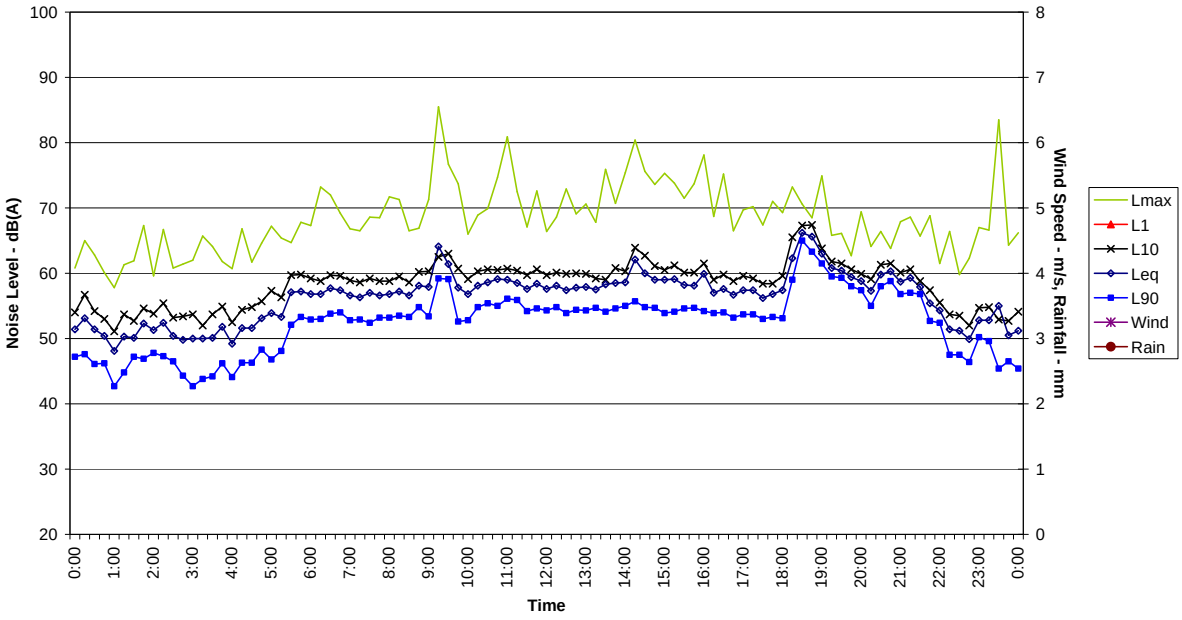
Noise Level Traces – Logging Location B



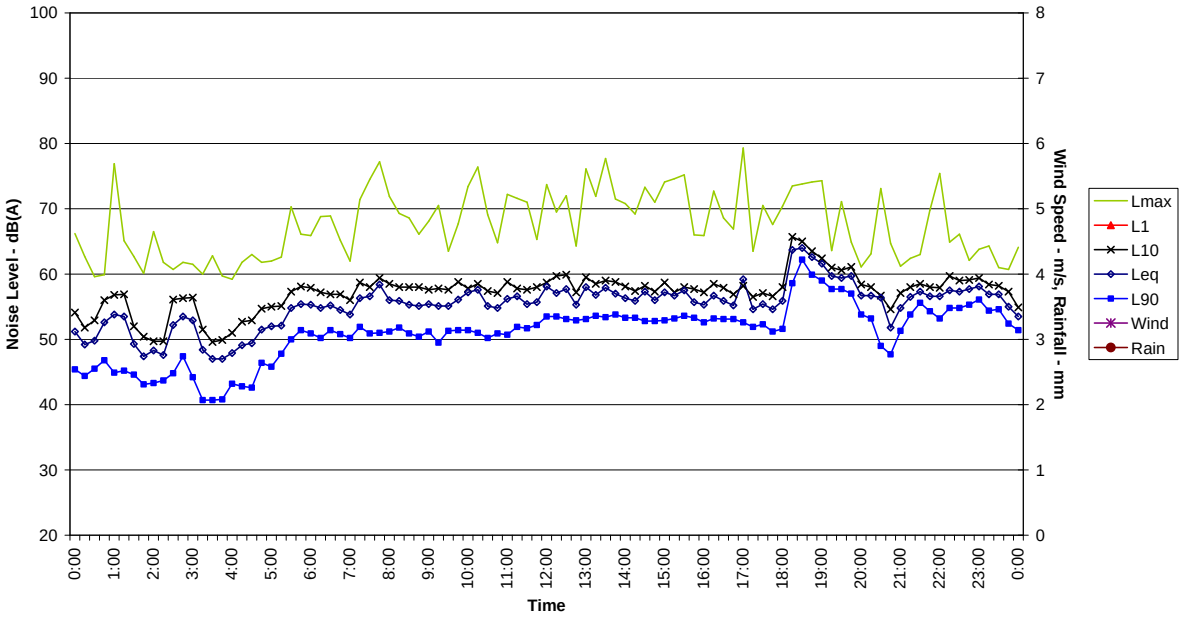

AMBIENT NOISE SURVEY
LOCATION B
Wednesday, 17 September 2008
Noise Level - dB(A)
Wind Speed - m/s, Rainfall - mm
Time
Lmax
L1
L10
Leq
L90
Wind
Rain


AMBIENT NOISE SURVEY
LOCATION B
Thursday, 18 September
Noise Level - dB(A)
Wind Speed - m/s, Rainfall - mm
Time
Lmax
L1
L10
Leq
L90
Wind
Rain

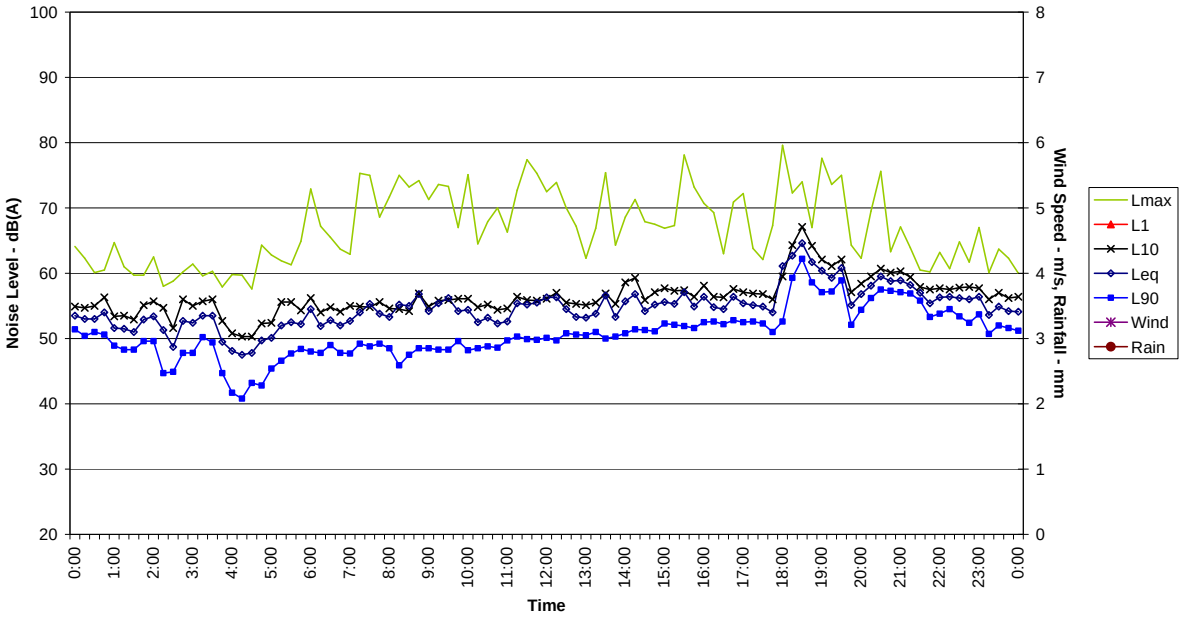
AMBIENT NOISE SURVEY
LOCATION B
Friday, 19 September 2008



AMBIENT NOISE SURVEY
LOCATION B
Saturday, 20 September 2008



AMBIENT NOISE SURVEY
LOCATION B
Sunday, 21 September 2008



AMBIENT NOISE SURVEY
LOCATION B
Monday, 22 September 2008