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207-211 Hoxton Park Road, Cartwright – Acoustic and Traffic Noise Report

15 March 2017

Report prepared For:

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Report Prepared by:

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Report Title: 207-211 Hoxton Park Road, Cartwright – Traffic Noise Report

Please note that this correspondence has only addressed the acoustical issues discussed. Other aspects of building design, such as fire-rating, structural and waterproofing considerations must be referred to others. All Figures are intended as Sketches showing intent for Acoustic purposes.

Table of Contents

1 INTRODUCTION

1.1 Summary

This Acoustic Report is to accompany the Development Application for the project. The project is the construction of twenty six residential apartments. A noise logger has been used to determine traffic noise impacts on the site. Recommendations have been made for the glazing to the apartments to ensure that indoor acoustic amenity from traffic noise complies with published guidelines.

1.2 Introduction

The project involves construction of twenty six residential units over five levels. The site covers three existing single storey residential premises.

Figure 1-1 through to Figure 1-4 show the site aerial photograph, site plan and some Architectural drawings, respectively.

The following documents have been used in preparing this assessment:

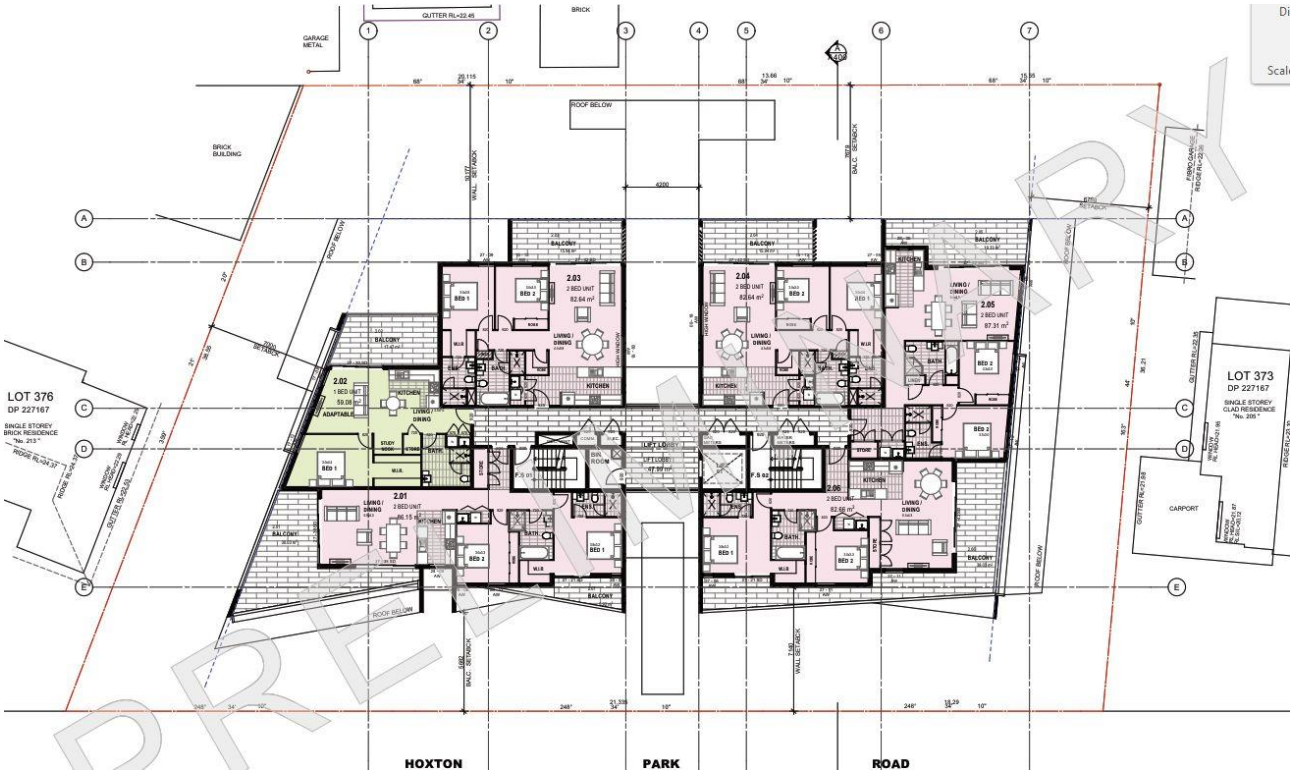
- Liverpool Council *Development Control Plan 2008 Part 3.7 Residential Flat Buildings*
- NSW Department of Planning *Development Near Rail Corridors And Busy Roads – Interim Guideline*
- State Environmental Planning Policy (Infrastructure) 2007 (Infrastructure SEPP)
- Architectural Drawings prepared by Algorry Zappia & Associates Pty Ltd; P4724, A102, A104, A200 – A206, A300, A301, A400.

Due to the proximity of Hoxton Park Road, the development will be affected by traffic noise. The purpose of this Acoustic Report is to provide construction recommendations to ensure adequate indoor acoustic amenity in accordance with published guidelines.

Figure 1-1 Site Aerial Photograph © Nearmap.com 2017

Figure 1-2 Existing And Future Site Plan

Figure 1-3 Floor Plans, Levels 1-3 and Level 4



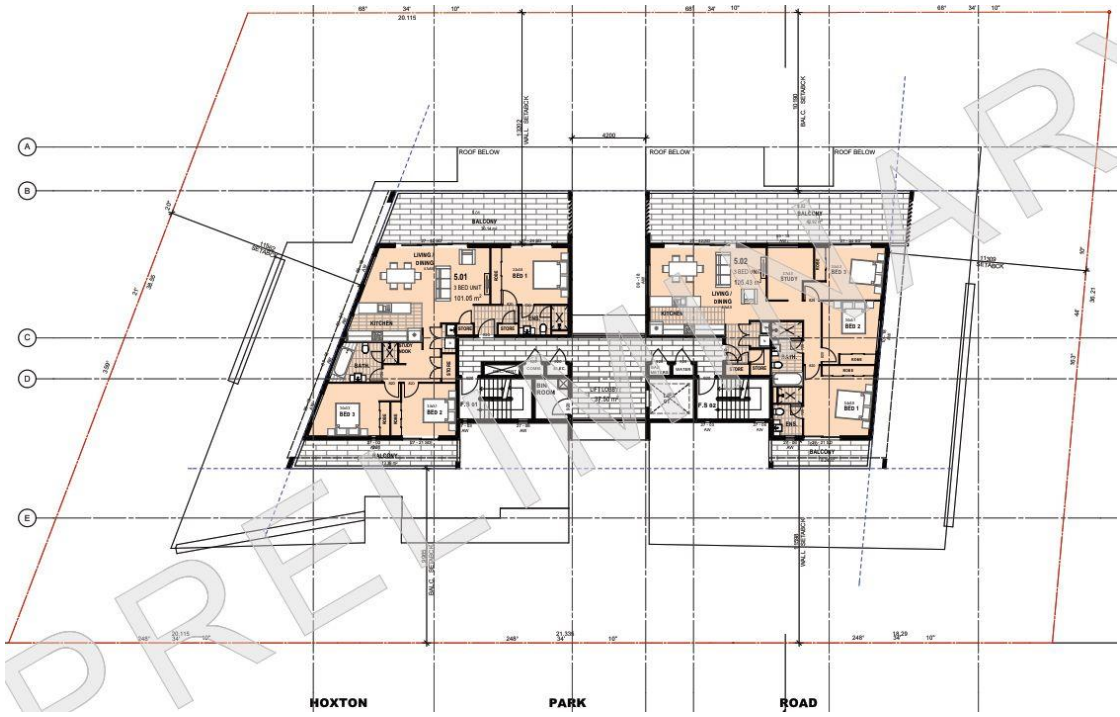


Figure 1-4 Site Front Elevation (Hoxton Park Road Frontage)

2 TRAFFIC NOISE CRITERIA

2.1 Liverpool Council DCP

Council's DCP includes general clauses about traffic noise impacts and amenity of occupants of dwellings adjoining "classified" roads.

Section 9 *Amenity and Environmental Impact* of Part 3.7 of the DCP 2008 includes a Section on *Acoustic Impact*, viz:

Acoustic Impact

Objective

To ensure a high level of amenity by protecting the privacy of residents within residential flat buildings.

Controls

1. Noise attenuation measures should be incorporated into building design to ensure acoustic privacy between on-site and adjoining buildings.

2. Buildings having frontage to a Classified Road or a railway and impacted upon by rail or traffic related noises must incorporate the appropriate noise and vibration mitigation measures into the design in terms of the site layout, building materials and design, orientation of the buildings and location of sleeping and recreation areas.

3. The proposed buildings must comply with the Environment Protection Authority criteria and the current relevant Australian Standards for noise and vibration and quality assurance.

4. Arrange dwellings within a development to minimise noise transition between dwellings by:

   - Locating busy, noisy areas next to each other and quieter areas next to other quiet areas, for example, living rooms with living rooms, bedrooms with bedrooms
   - Using storage or circulation zones within an dwelling to buffer noise from adjacent dwellings, mechanical services or corridors and lobby areas
   - Minimising the amount of common walls with other dwellings.
   - Design the internal dwelling layout to separate noisier spaces from quieter spaces by:

- Grouping uses within a dwelling - bedrooms with bedrooms and service areas like kitchen, bathroom, and laundry together.

In this project the NSW Department of Planning *Interim Guideline* will be used. This satisfies the indoor noise levels in Australian Standards AS2107.

2.2 Infrastructure SEPP

The Infrastructure SEPP document provides target indoor noise levels. These are expanded upon in more detail in the NSW Department of Planning *Guideline*. The levels are shown in Table 2-1 below.

Table 2-1 Traffic Noise Criteria

Room	Window Condition	Infrastructure SEPP
Bedrooms	Windows closed	35dBA $L_{Aeq,9hr}$
	Windows open	45dBA $L_{Aeq,9hr}$
Other Habitable Rooms	Windows closed	40dBA $L_{Aeq,15hr}$
	Windows open	50dBA $L_{Aeq,15hr}$

Note that if the indoor levels for the "windows open" condition cannot be met then habitable rooms are required to be provided with a form of alternative outside air ventilation.

3 NOISE MEASUREMENTS

3.1 Traffic Noise

Traffic noise measurements were carried out at the site using an unattended noise data logger. The unattended noise data logger was on site from 24 February to 2 March, 2017. The weather was mixed during the measurement period, however, the daily traffic noise pattern was clearly able to be established. Appendix B includes the full details of the noise logging and graphical record. The measurement data is summarised in Table 3-1 below.

Table 3-1 Measurement Summary

Noise Measurement Description	Location	Logger Data
$L_{Aeq,15hr}$ (7am-10pm)	11m from front bdy	66.2 dBA
$L_{Aeq,9hr}$ (10pm-7am)	11m from front bdy	62.2 dBA

- Note that the noise logger was installed 1m in front of a house façade so would have included façade reflection of +2.5dBA.

The noise logger had the following distances to the centreline of the two carriageways of Hoxton Park Road:

- 27m
- 51m

The future front façade of the apartment building is set 4m closer to Hoxton Park Road. The future rear façade of the building is 15m further away from Hoxton Park Road.

The calculations of traffic noise have taken into account orientation of the façade with respect to the traffic stream, which affects the field of view of the traffic noise source and hence the traffic noise exposure. Façade-reflected traffic noise levels have been determined as follows:

- Front façade: 67dBA daytime and 63dBA night-time.
- Side façade: 64dBA daytime and 60dBA night-time.
- Rear façade: 57dBA daytime and 50dBA night-time.

4 RECOMMENDED NOISE CONTROL MEASURES

Note that the site is predominantly affected by traffic noise from Hoxton Park Road. There was no audible industrial noise at the site during site visits.

4.1 Glazing Recommendations

Table 4-1 summarises the recommended glazing acoustic ratings. These are the sound insulation properties of the windows required in order to meet the NSW Department of Planning indoor noise goals. For reference purposes, the following glass thicknesses would be expected to achieve the nominated ratings:

- "Conventional": This refers to weight-for-size glass that conforms to the Australian Standard and is only required to provide modest levels of sound insulation against external noise. Typically, these windows provide sound insulation around Rw+Ctr 20.
- Rw+Ctr 22: 4mm glass
- Rw+Ctr 24-26: 5mm glass
- Rw+Ctr 28-30: 6.38mm laminated glass
- Rw+Ctr 31-33: 10.38mm laminated glass

Note that the windows provided for this project should have valid test certificates from a recognised acoustic laboratory or *otherwise* be accompanied by evidence that the windows and window frames can provide the required sound insulation rating. Typically this means that window frames should be sturdy and windows fitted with acoustic seals equivalent to Schlegel.

Figure 4-1 and Table 4-1 summarise the acoustic treatment required.

Table 4-1 Glazing Minimum Sound Insulation Requirements, Rw+Ctr

Apartments	Room(s)	Glazing (typical minimum glass thickness)	Alternative Ventilation ?
Zone 1	Kitchen-Dining / Living Area	Rw+Ctr 30 (6.38mm)	Yes
	Bedrooms	Rw+Ctr 30 (6.38mm)	Yes
Zone 2	Kitchen-Dining & Living Area	Rw+Ctr 27 (6mm)	Yes
	Bedrooms	Rw+Ctr 27 (6mm)	Yes
Zone 3	Kitchen-Dining & Living Area	Rw+Ctr 22 (4mm)	Yes
	Bedrooms	Rw+Ctr 22 (4mm)	Yes

Notes

- Sound insulation is specified in terms of the Rw+Ctr performance descriptor. This is a better performance indicator for traffic noise than Rw on its own.
- All apartments will require alternative ventilation.
- Please note that if a sound insulation performance is nominated for a room then alternative ventilation is required. Rooms marked "Conventional" do not require alternative ventilation or specific sound-rated glass. Options for alternative ventilation this are discussed in the next section of the Report.
- The calculations have been done based on carpeted bedrooms and hard floors in the living areas. Rooms with hard floors (timber or tiles) are more reverberant and so the traffic noise ingress is higher.
- Where windows may require minimum thermal performance (refer to others) then the acoustic sound insulation performance also needs to be met. Normally, the window sub-contractor prepares a glazing schedule which includes the thermal AND acoustic (and possibly other) performance requirements for each window. Window and glass selections are then made from the combined performance requirements for each window. The installer must confirm that the acoustic performance requirements outlined here are satisfied – e.g. by reference to relevant acoustic test reports for the particular manufacturer's window system. If there is any doubt, please refer to the Acoustic Consultant.

Figure 4-1 Acoustic Treatment Zones

4.2 Roof-Ceiling and External Walls

The roof-ceiling should be insulated with minimum R3.0 insulation batts laid over the ceiling. Metal roof should be fitted with R1.5 anti-condensation blanket installed directly under the roof; a tiled roof should have heavy-duty sarking installed under the tiles.

The calculations are based on solid brick, cavity brick or insulated brick veneer construction (minimum R1.5 insulation batts) for the external walls.

4.3 Alternative Ventilation

When windows are required to be kept closed in order to meet the indoor traffic noise goals in habitable rooms, then alternative ventilation must be provided to those rooms.

The provision of alternative ventilation can be achieved in a number of ways. Some of these are described in principle below. This presentation is suitable for the Development Application stage of a project. As the design evolves, a mechanical engineer should confirm that the final design complies with the requirements of the relevant ventilation Standard.

Option 1

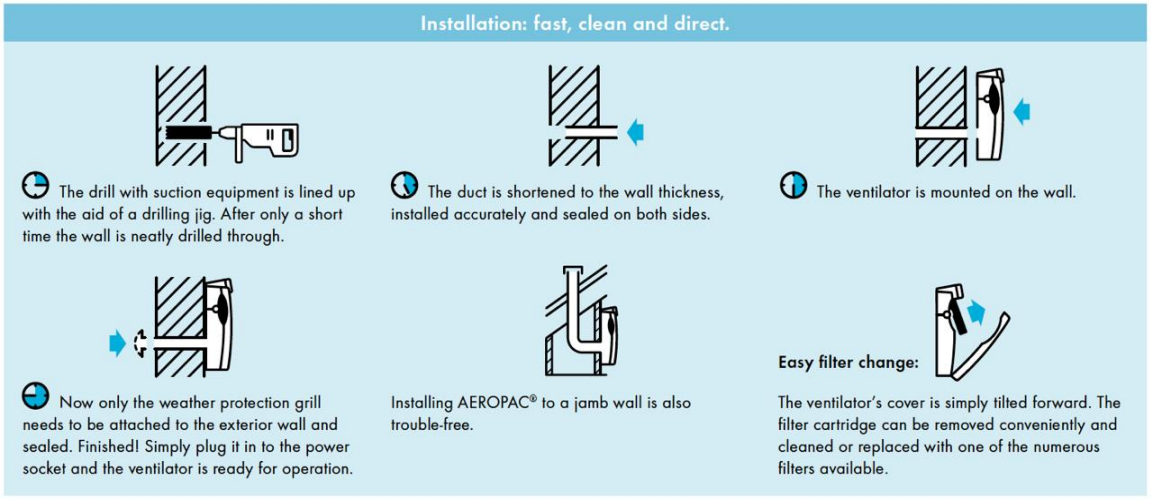
Fully ducted air-conditioning with the provision of Outside Air included. Many domestic air-conditioning systems do not include outside air by default – it must be specified at the time of tendering/ordering. Commercial ducted air-conditioning systems usually do have provision for outside air as a standard feature.

Option 2

A proprietary wall-mounted ventilation system, such as Aeropac, can be installed. Aeropac units are approximately $700 each (per habitable room). These are available from Acoustica, www.acoustica.com.au , ph: 1300 722 825.

Figure 4-2 Example of proprietary wall-mounted ventilation unit that provides air filtering as well as noise control

See www.acoustica.com.au for pricing and installation instructions



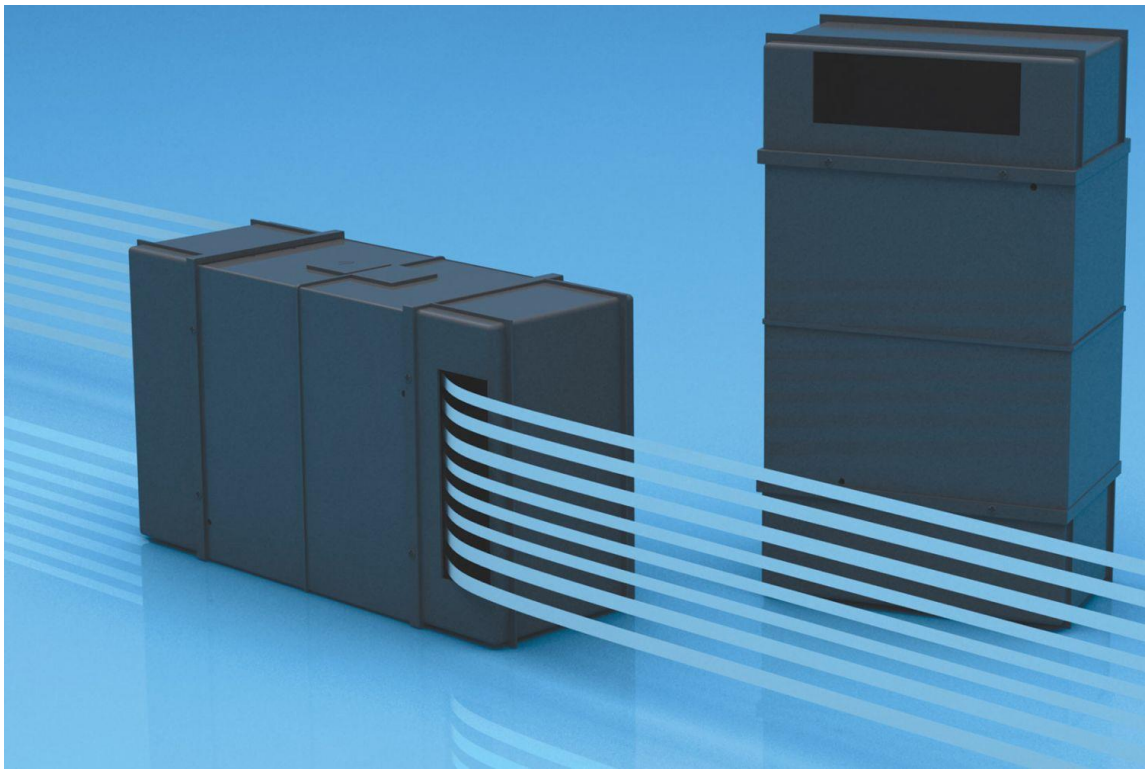
In all cases a Mechanical Engineer should certify that the ventilation requirements have been met.

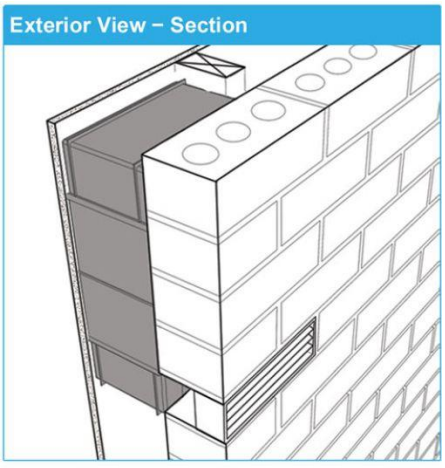
Option 3

Provision of an attenuated air inlet in an external faced and an oversized exhaust fan in the ensuite or bathroom. *Attenuated air inlet* could be a proprietary unit such as "Silenceair". Silenceair is particularly suited to brick veneer construction.

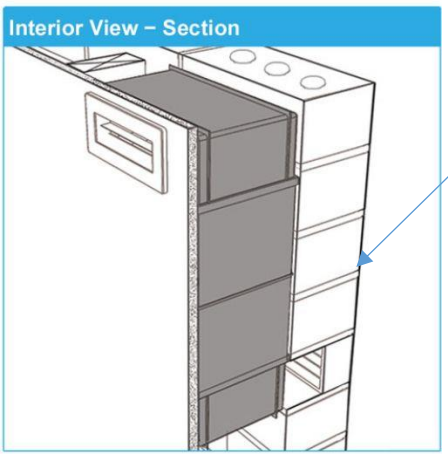
One SilenceAir device is required in every bedroom and other small habitable room. Two such devices are required in open-plan living areas.

Figure 4-3 SilenceAir external ventilation "bricks"





Silenceair 140 vent. Shown here installed in a brick veneer wall.



Silenceair® units are approximately $180 each. Available from www.silenceair.com

Note that *quiet-running* toilet/laundry/kitchen exhaust fan and undercut doors (15-25mm) is essential to ensure that flow-through ventilation occurs.

Option 4

Similar to Option 3 but with an alternative attenuated air inlet provided by the Builder. This could consist of a simple external air grille in the brick wall, connected to a 1.2m long internally insulated plasterboard bulkhead.

In all cases, a mechanical engineering consultant should certify that the ventilation requirements have been met.

5 ALLOWABLE NOISE EMISSION FROM THE SITE

5.1 General Noise Emission

Noise emission from the development should comply with Council noise emission limits and with the NSW Protection of the Environment (Noise Control) Regulation 2008. This includes noise emission from any lot or apartment within the development to any other apartment.

A noise logger was installed at the site from 24 February to 2 March, 2017. Details of the noise logging are included in the Appendices at the end of this Report. A summary of the site background noise levels is included in the discussion below.

Noise emission from a site, for example, air-conditioning equipment, hot-water heat pumps, pool pumps, exhaust fans and so on should comply with the general noise criterion of "background + 5dBA" up until 10pm. After 10pm, air-conditioning equipment and hot-water heat pumps have additional restrictions – see below. Therefore, the specific allowable noise limit depends on the measurements that have been carried out for the site.

Ambient background noise has been determined as follows:

- Daytime (7am-6pm): Background 53dBA
- Evening (6pm-10pm): Background 50dBA
- Night-time (10pm-7am): Background 44dBA

The noise emission limits that are outlined below apply to each apartment within the site but also to the cumulative (that is, total) noise emission from the whole of the site (that is, ALL of the apartments). Note that the noise emission limits should apply to the cumulative noise emission from all noise generating equipment at a particular noise receiver, including noise receivers within the development such as each individual residential apartment.

The EPA *Industrial Noise Policy* (INP) provides a description of "noise receiver areas", such as 'residential in suburban area', urban, semi-rural and so on. In this case, the noise receiver areas is categorised as 'residential in an urban area' on account of being subject to heavy traffic flows and being close to a Business Zone.

The EPA *Industrial Noise Policy* (INP) provides the following recommended noise amenity criteria for residential noise receivers in urban areas:

- Daytime (7am-6pm): 60dBA
- Evening (6pm-10pm): 50dBA
- Night-time (10pm-7am): 45dBA

The existing levels of industrial noise at the site would not require modification to these noise goals. The project specific noise level goals will be the lower of "background + 5dBA" (that is, the intrusiveness criterion) and the amenity criteria above.

Note that the NSW Protection of the Environment (Noise Control) Regulation 2008 stipulates that noise from residential air-conditioners and hot-water heat-pumps must be *inaudible* inside any other dwelling after 10pm. For practical reasons this usually means an allowable noise level at the boundary (or say 1m outside the neighbouring residential facade) of "background – 10dBA". Therefore, for this project, the allowable noise emission is:

- Daytime (7am-6pm): 58dBA
- Evening (6pm-10pm): 50dBA
- Night-time (10pm-7am): 45dBA for equipment except for A/C and hot water
- Night-time (10pm-7am): 34dBA for A/C condensers and hot water heat pumps

The mechanical sub-contractor should be provided with a copy of this Acoustic Report and should design the project so that the above noise limits are complied with.

6 BUILDING CODE OF AUSTRALIA

6.1 To Achieve BCA Compliance

On 1st may 2004, the Building Code of Australia introduced significantly upgraded acoustic provisions for separation between apartments in Class 2 and Class 3 buildings. This document is referred to as *BCA 2004*. On 1st May 2005, BCA 2005 came into effect, and so on with 2006, 2007, etc. The acoustic provisions have remained the same since they were upgraded in BCA 2004. Determination of compliance with the acoustic provisions of the BCA (Part F5) is outlined in the following clauses of the BCA;

- A0.4 *Compliance with the BCA*.
- A0.5 *Meeting the Performance Requirements*.
- A0.8 *Alternative Solutions*.
- A0.9 *Assessment methods*.
- A2.2 *Evidence of Suitability*.

Compliance is determined when **one** or more of the following is satisfied (refer to the BCA Part A0.5(a) and Part A0.9):

1. The Deemed-to-Satisfy Provisions of the BCA are implemented. **[Part A0.5(a)]**

or

2. In-situ acoustic tests after the building is completed satisfy the Verification Methods. **[Part A0.9(b)(i)]**

or

3. Evidence is provided that the constructions that are required to have a certain acoustic rating under the BCA have that rating *under Clause **A2.2** of the BCA*. This includes an acoustic test report issued by a suitable acoustic testing laboratory or a certificate from a professional engineer or other appropriately qualified person. An Acoustic Test Report by a laboratory that is not NATA accredited can still be considered to comply with Clause A2.2(vi) of the BCA..

or

4. Evidence is provided that the constructions that are required to have a certain acoustic rating under the BCA have that rating *by comparison with the Deemed-to-Satisfy Provisions*. **[Part A0.5(b)(ii) and Part A0.9(c)]**

or

5. By Expert Judgement. The BCA defines this as the judgement of an expert who has the qualifications and experience to determine whether a Building Solution complies with the Performance Requirements. **[Part A0.9(d)]**

   A brief extract of the author's resume is provided below. It is considered that the author satisfies the requirements to provide Expert Judgement as defined in the BCA.

   The Author has an Honours Degree in Mechanical Engineering and has been consulting in Acoustics since 1990. In that time, I have worked for Vipac Engineers

& Scientists Pty Ltd and member firms of the Association of Australian Acoustical Consultants (AAAC): Renzo Tonin & Associates Pty Ltd, Peter R Knowland & Associates Pty Ltd (now trading as PKA Acoustic Consulting) and Wilkinson Murray & Associates Pty Ltd. Direct sound insulation experience includes carrying out hundreds of sound insulation tests of building elements, both in-situ and in acoustic laboratories, supervising such tests in acoustic laboratories for manufacturers, investigating the acoustic performance of construction systems on behalf of manufacturers, advising various manufacturers on Acoustic issues, including the CSR companies (CSR Gyprock, CSR Bradford, CSR Hebel, PGH), Boral Masonry, C & M Bricks, Tontine Insulation, James Hardie, Regupol, Ultrafloor and others.

6.2 Sound Insulation Provisions of the BCA

The following Tables summarise the Acoustic Provisions of the BCA.

Table 6-1 BCA Sound Insulation Ratings of Walls and Doors

Item	Situation	Laboratory test	Field Test	Impact Insulation
1	Apartment wall separating different sole occupancies (Same room-type each side, eg habitable adjoining habitable)	50 R_W +Ctr	45 $D_{nT,w}$+Ctr	No
2	Apartment wall separating a habitable room (not a kitchen) from a bathroom, sanitary compartment, laundry or kitchen in another sole occupancy	50 R_W +Ctr	45 $D_{nT,w}$+Ctr	Yes
3	Apartment wall separating a stairway, public corridor, public lobby or the like; or part of a different classification	50 R_W	45 $D_{nT,w}$	No
4	Apartment wall separating a plant room or lift shaft	50 R_W	45 $D_{nT,w}$	Yes
5	Apartment door to a stairway, public corridor, public lobby or the like	30 R_W	25 $D_{nT,w}$	NA

- Field acoustic performance is usually lower than Laboratory tested performance. This is accounted for in the BCA.
- In the case of open-plan living-kitchen areas, this author adopts the approach that the dividing wall between the apartments is the wall that provides "separation" between the living area on one side and the habitable room on the other side. Therefore the provisions of Item (2) above will apply in order to satisfy Clause F5.5(a)(iii)(A) of the BCA.
- **For Deemed-To-Satisfy constructions, the BCA prohibits chasing into masonry elements of party walls; *even for cavity masonry walls*.** Curiously, there is no such prohibition for Alternative Solutions but the Sound Insulation requirements for water supply pipes still needs to be met, as outlined in Table 6-3.

Table 6-2 BCA Sound Insulation Ratings of Floors

Item	Situation	Acoustic Characteristic	Laboratory test	Field Test
6	Apartment floor separating different sole occupancies or a plant room, lift shaft, stairway, public corridor, public lobby or the like; or parts of a different classification	Airborne Sound Insulation	50 R_W +Ctr	45 $D_{nT,w}$+Ctr
7		Impact Sound Insulation	* 62 $L_{n,w}$+C_I	* 62 $L_{nT,w}$+C_I

- It is considered that the 62dB number nominated in the BCA corresponds to a level of impact noise that provides VERY poor acoustic amenity.
- The recommended level of acoustic amenity is $L_{nT,w} \leq 55$. This is the minimum performance recommended by the Association of Australian Acoustical Consultants (AAAC), www.aaac.org.au, and the Australian Acoustical Society (AAS), and corresponds to a *Three-Star* Acoustical Rating in the AAAC's Six-Star scale of acoustical performance. This is also the requirement in City of Sydney Council.
- The only cases in which I consider the BCA acoustic performance acceptable for hard floors is for small tiled areas at the entry to apartments (less than $0.5m^2$) and small kitchens (less than $6m^2$). For tiled or timber floors in an apartment that are above *living areas* of the other apartment below, the minimum rating that is considered acceptable by this author is Four-Stars.
- It is recommended *not* to have hard floor finishes in an apartment above bedrooms of another apartment.

Table 6-3 BCA Sound Insulation Ratings of Services

Item	Situation	Adjacent Room	Laboratory test
8	If a duct, soil, waste or water supply pipe, including a duct or pipe that is located in a wall or floor cavity, serves or passes through more than one sole-occupancy unit, the duct or pipe must be separated from the rooms of any sole-occupancy unit by construction with a nominated acoustic rating.	Habitable room	40 R_W +Ctr
9		Kitchen (not open-plan) or other non-habitable room	25 R_W +Ctr

If a storm water pipe passes through a sole-occupancy unit it also must comply with these separation requirements.

Other provisions in the BCA pertaining to services:

- Sound Isolation of pumps. A flexible coupling must be used at the point of connection between the service pipes in a building and any circulating or other pump. **[Part F5.7]**

Other provisions in the BCA pertaining to services in Deemed-To-Satisfy construction:

- Services must not be chased into concrete or masonry elements. **[Specification 5.2.2(e)(i)]**
- In the case of a water supply pipe that serves only one sole-occupancy unit, the pipe must not be fixed to the wall leaf on the side adjoining any other occupancy unit and have a clearance not less than 10mm to the other wall leaf. **[Specification 5.2.2(e)(iii)(B)]**
- Electrical outlets must be offset from each other at least 100mm for masonry walls and at least 300mm for other wall materials. **[Specification 5.2.2(e)(iv)]**

- **For Deemed-To-Satisfy wall constructions, a water supply pipe must only be installed in the cavity of discontinuous construction. [Specification 5.2.2(e)(iii)(A)]**

Note that these provisions of the BCA also apply to **supply** pipes, **stormwater** pipes and **mechanical ducts**. These potential noise sources were not accounted for in previous editions of the BCA.

7 CONCLUSION

This Acoustic Report has been prepared in order to accompany the Development Application for the residential apartment building proposed at Hoxton Park Road, Cartwright. It provides construction recommendations for sound insulation of the apartments from exterior noise. If the recommendations contained within this Report are correctly implemented then the project will comply with the relevant NSW Department of Planning indoor traffic noise criteria.

8 APPENDIX A - GLOSSARY OF TERMS

Most locations where ambient noise is studied are affected by environmental noise which varies continuously, largely as a result of variations in road traffic. To describe the overall noise environment, a number of noise descriptors are used. These involve sampling the varying sound level for a defined time period (e.g. 15 minutes, or for the 9-hours from 10pm to 7am). Statistical and other analysis of the varying sound level are carried out. These descriptors are described below.

Maximum Noise Level (L_{Amax})	The maximum noise level over a sample period is the maximum level, measured on fast response, during the sample period.
L_{A1}	The L_{A1} level is the noise level which is exceeded for 1% of the sample period. During the sample period, the noise level is below the L_{A1} level for 99% of the time.
L_{A10}	The L_{A10} level is the noise level which is exceeded for 10% of the sample period. During the sample period, the noise level is below the L_{A10} level for 90% of the time. The L_{A10} has in the past been used as descriptor for environmental noise and road traffic noise.
L_{Aeq}	The equivalent continuous sound level (L_{Aeq}) is the energy average of the varying noise over the sample period and is equivalent to the level of a constant noise which contains the same energy as the varying noise environment. (In simple terms it is the average sound level). This descriptor is usually used to measure environmental noise and road traffic noise.
L_{A50}	The L_{A50} level is the noise level which is exceeded for 50% of the sample period. During the sample period, the noise level is below the L_{A50} level for 50% of the time.
L_{A90}	The L_{A90} level is the noise level which is exceeded for 90% of the sample period. During the sample period, the noise level is below the L_{A90} level for 10% of the time. This measure is commonly referred to as the **background noise level**.
ABL	The Assessment Background Level is the single figure background level representing each assessment period (day, evening and night) for each day. It is determined by calculating the 10^{th} percentile (lowest 10^{th} percent) background level (L_{A90}) for each period.
RBL	The Rating Background Level for each period is the medium value of the ABL values for the period over all of the days measured. There is therefore an RBL value for each period, day, evening and night.
SEL	Single Event noise Level. This is a shorthand means to describe the acoustic energy of a noise event. Technically it is the same acoustic energy compressed to fit into 1 second; i.e. L_{Aeq} + 10 x Log (duration in seconds of the noise event).

9 APPENDIX B

9.1 Noise Loggers

A noise logger was installed at the front of the property in order to monitor traffic noise levels. See the photograph below.

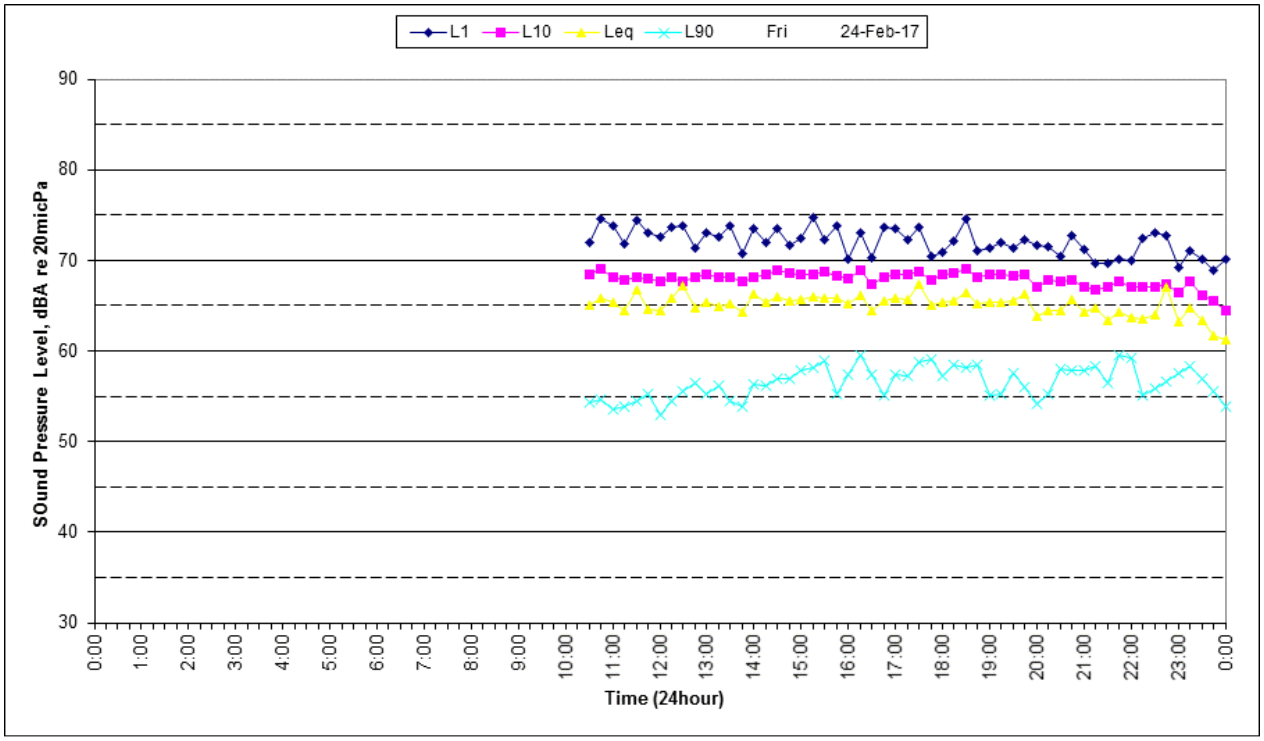
Figure 9-1 Noise logger installed at front boundary of the site

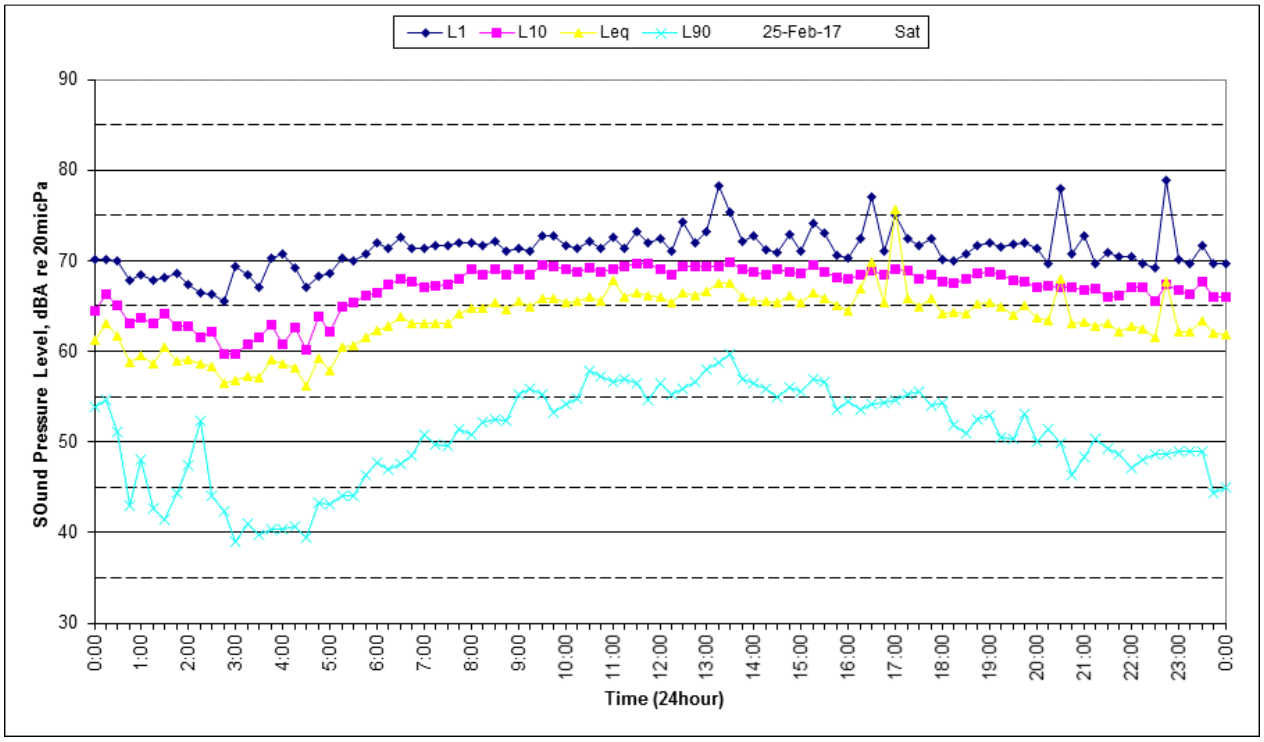
An NTi Audio XL2 Acoustic Analyser was used for this project. The device was set to 15-minute sampling periods, A-weighted and fast response. This equipment continuously monitors noise levels and stores statistical noise level descriptors for each sampling period. The equipment calibration was checked before and after the survey and no significant drift was noted.

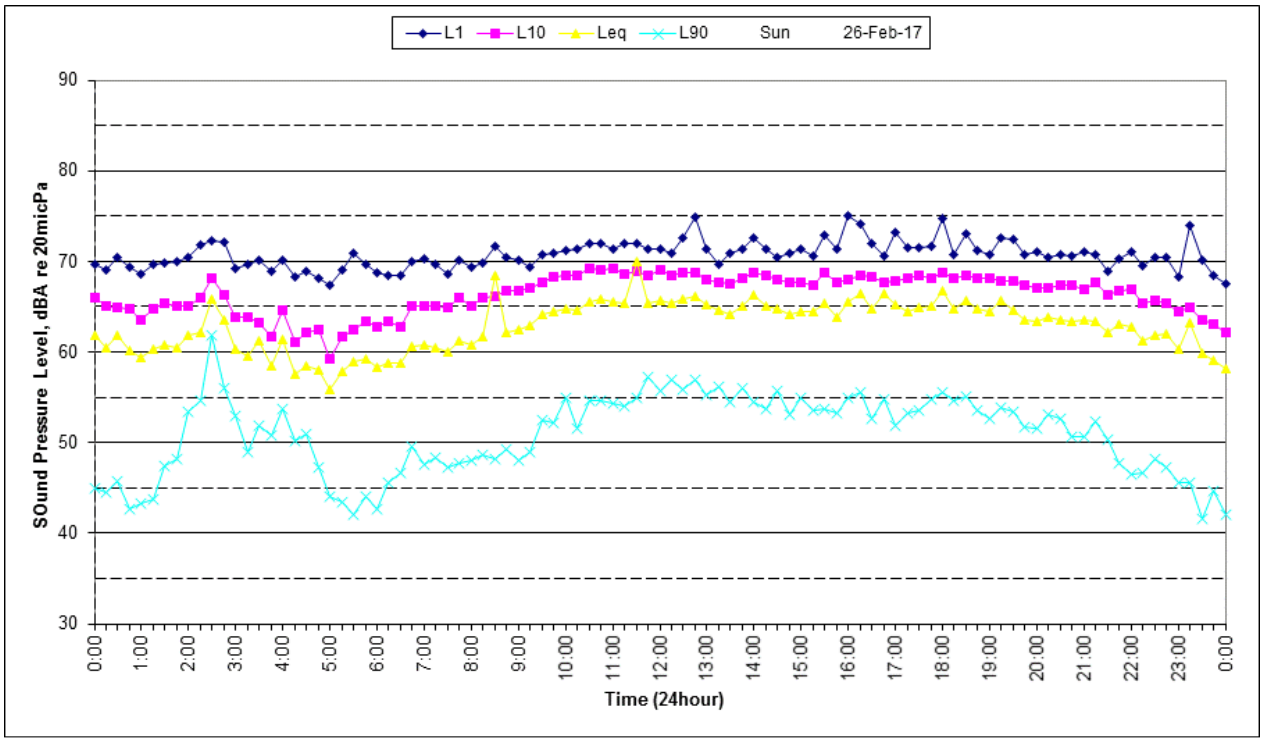
The logger determines L_{A1}, L_{A10}, L_{A90} and L_{Aeq} levels of the ambient noise. L_{A1}, L_{A10} and L_{A90} are the levels exceeded for 1%, 10% and 90% of the sample time, respectively. The L_{A1} is indicative of maximum noise levels due to individual noise events such as the occasional pass-by of a heavy vehicle or aircraft. The L_{A90} level is normally taken as the background noise level during the relevant period. L_{Aeq} is the energy-average sound level during the measurement; in simple terms it can be thought of as the average sound level.

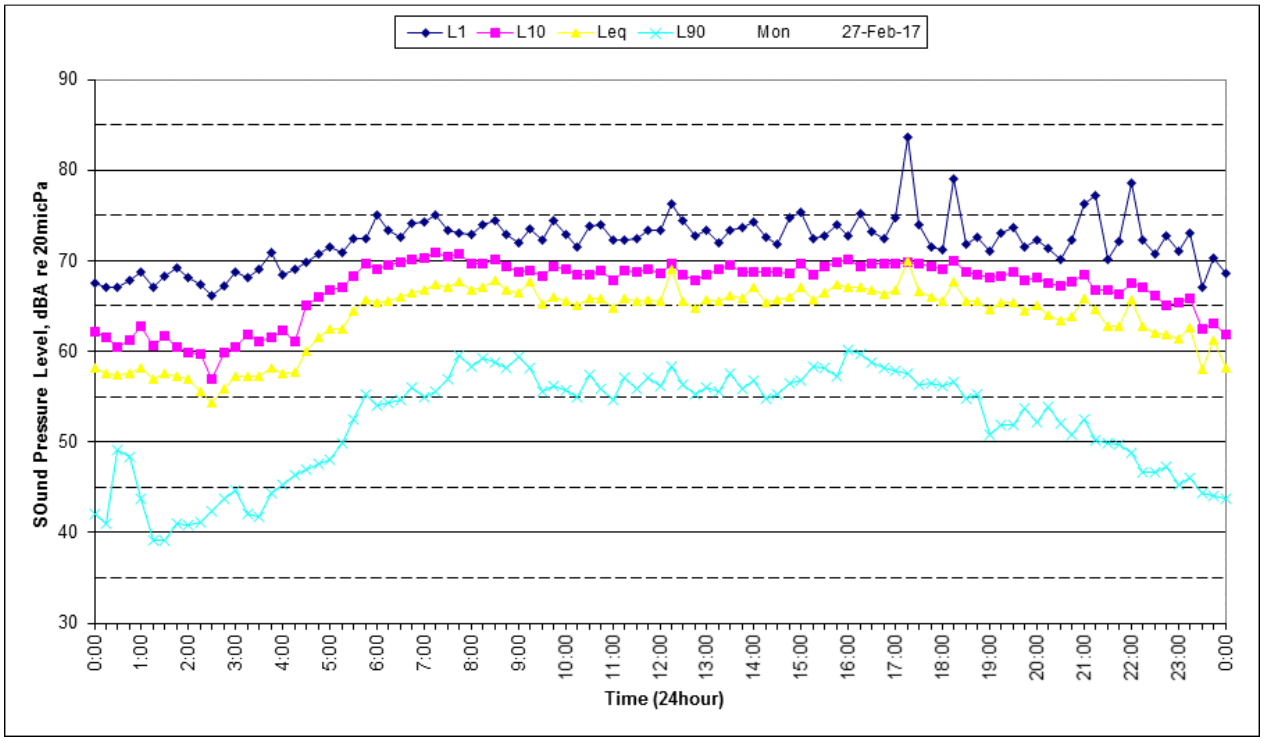
The graphical results of the noise logging are shown on the following pages.

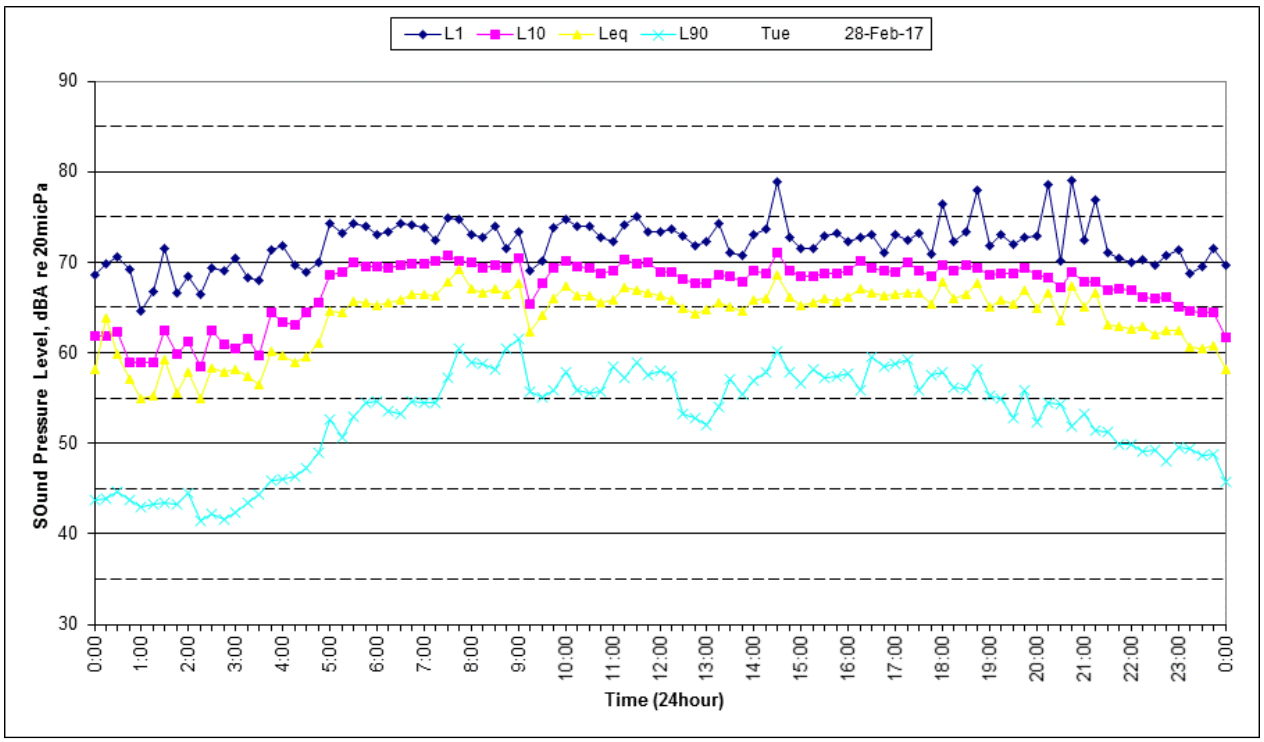
9.2 Noise Logger Graphs

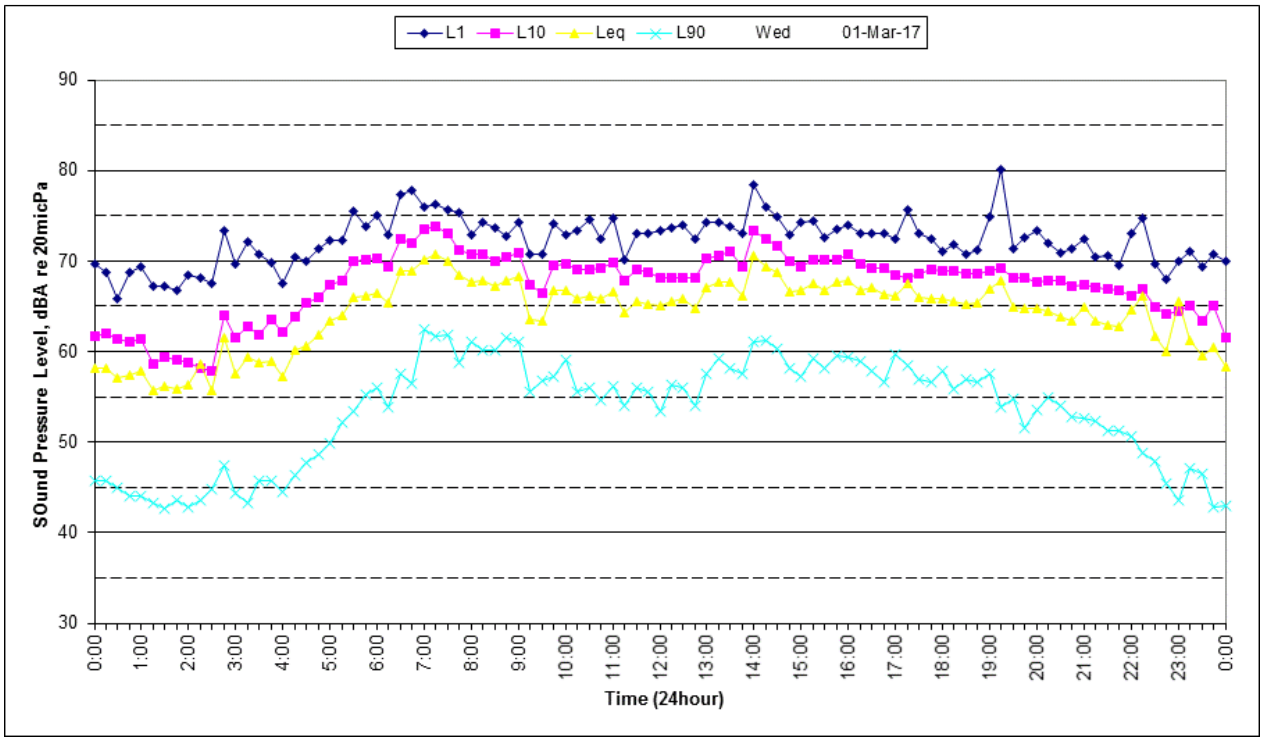


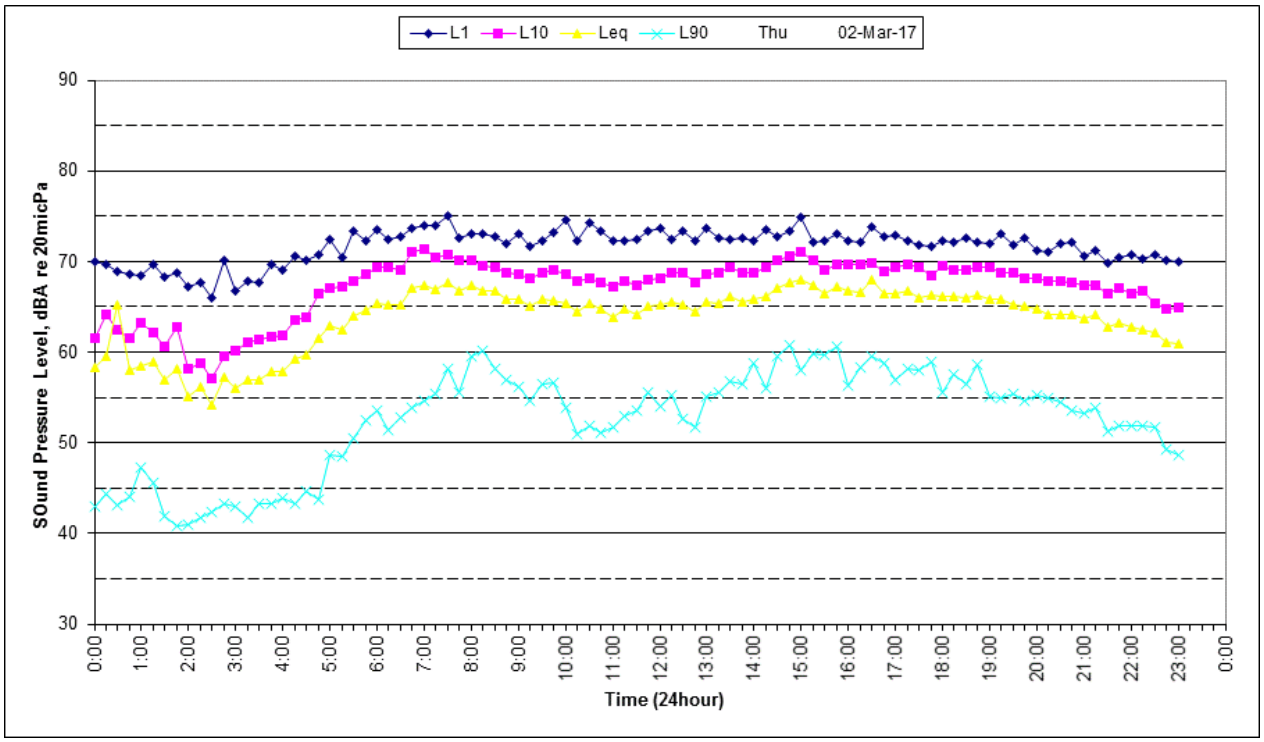



L1
L10
Leq
L90
Sun
26-Feb-17
SOund Pressure Level, dBA re 20micPa
90
80
70
60
50
40
30
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
0:00
Time (24hour)


L1
L10
Leq
L90
Mon
27-Feb-17
SOund Pressure Level, dBA re 20micPa
90
80
70
60
50
40
30
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
0:00
Time (24hour)


L1
L10
Leq
L90
Tue
28-Feb-17
SOund Pressure Level, dBA re 20micPa
90
80
70
60
50
40
30
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
0:00
Time (24hour)


L1
L10
Leq
L90
Wed
01-Mar-17
SOund Pressure Level, dBA re 20micPa
90
80
70
60
50
40
30
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
0:00
Time (24hour)


L1
L10
Leq
L90
Thu
02-Mar-17
SOund Pressure Level, dBA re 20micPa
90
80
70
60
50
40
30
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
0:00
Time (24hour)