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19-21 Harvey Avenue, Moorebank – Development Application Acoustic Report

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Report Title: 19-21 Harvey Avenue, Moorebank – Development Application Acoustic 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.

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1 INTRODUCTION

This Acoustic Report has been prepared to address Council concerns in the pre-DA Advice regarding potential acoustic issues associated with the proposed development.

The project involves demolition of two existing dwellings and construction of a multi-residential development on the site of 28 apartments over six levels with two levels of basement car parking.

Figure 1-1 shows an aerial view of the site.

Figure 1-2 shows the proposed development site plan.

In general, for a residential development, potential acoustic issues relate to noise impacts on the development from external noise sources and impacts of noise generated by the development itself on neighbours.

Figure 1-1 Site Aerial Photograph © Nearmap.com

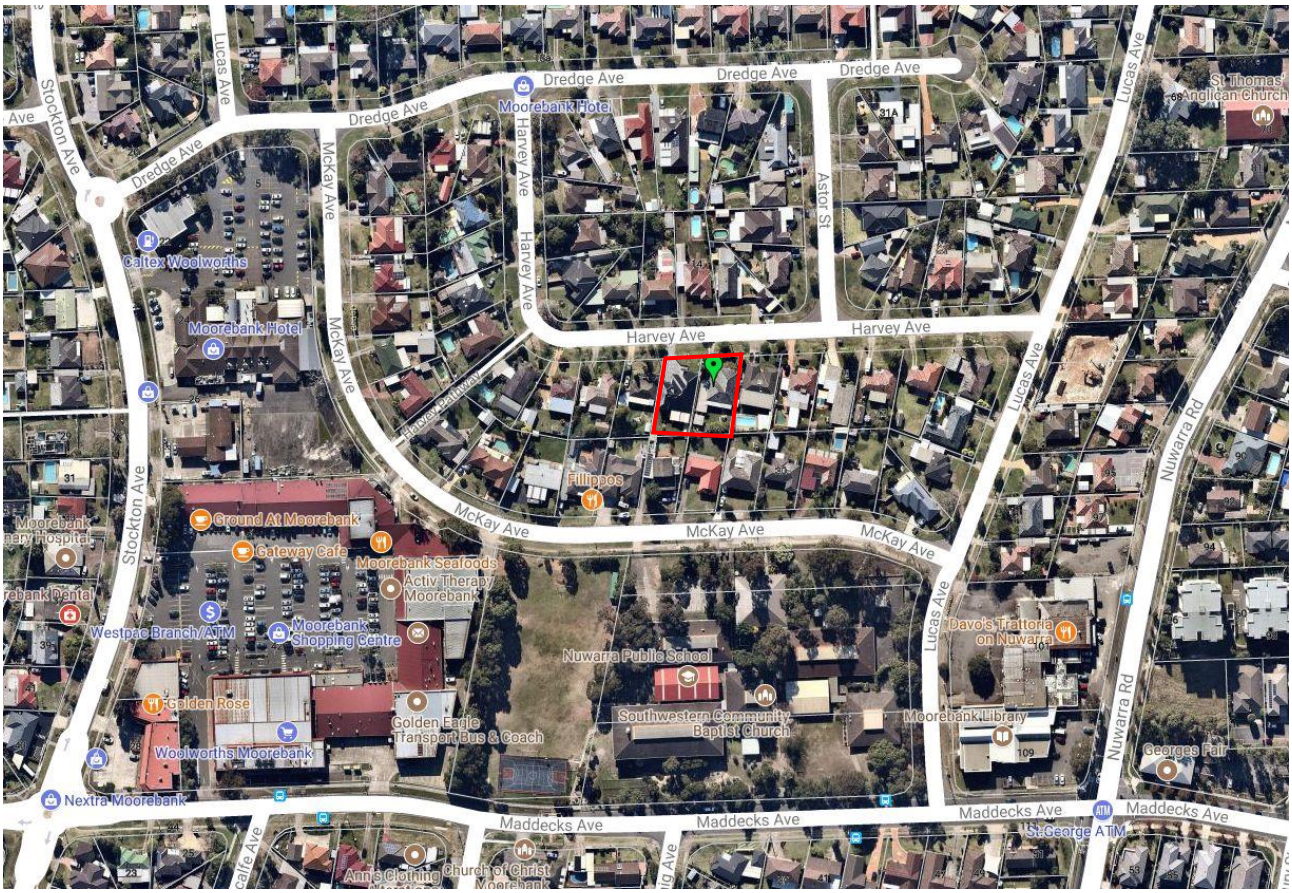
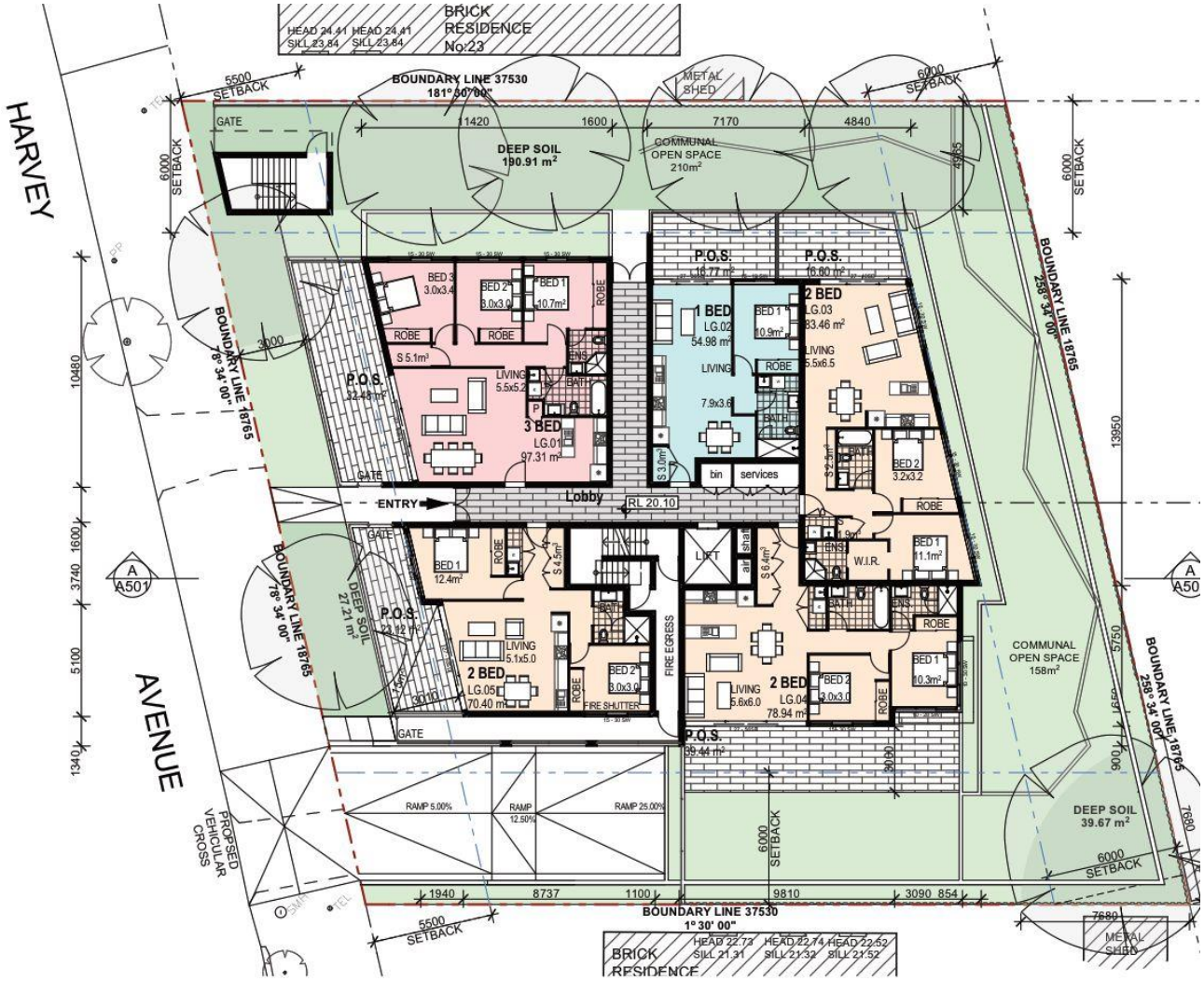


Figure 1-2 Site Plan and 3D Perspective



2 NOISE CRITERIA

2.1 Background Sound Levels

Background sound levels have been measured in the rear yard of 19 Harvey Avenue using an unattended noise data logger from 1st to 11th August 2017. Details are included in the Appendix. Background sound levels were found to be:

- Daytime, 7am-6pm: 40dBA
- Evening, 6pm-10pm: 40dBA
- Night-time, 10pm-7am: 36dBA

In general, allowable noise emission from a noise source is based on the ambient background sound level in the absence of the source, using a criterion of "$L_{Aeq,15\text{-}minute} \leq$ background + 5dBA".

In NSW legislation, outdoor residential air-conditioning units and hot-water heat pumps have additional noise constraints. See Section 2.2.

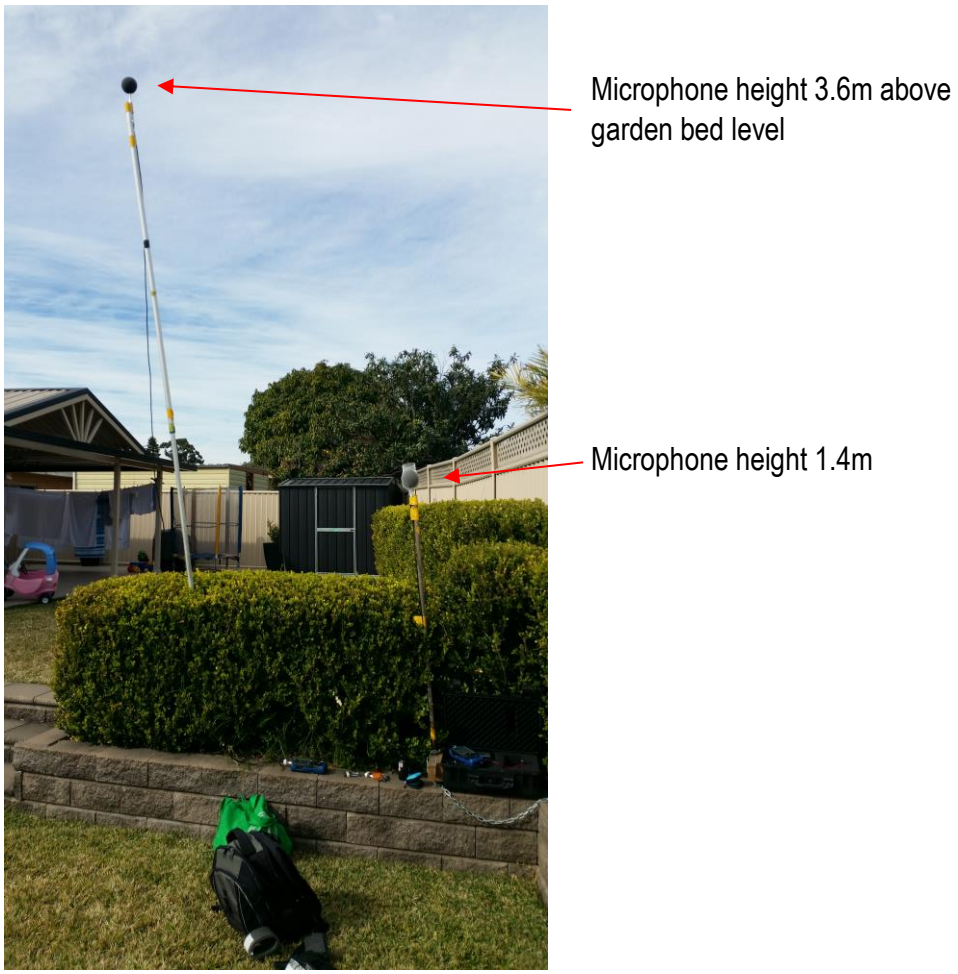
2.1.1 Background Sound Levels at Elevated Heights

In general, background sound levels at high level above the ground are higher than at low level. This is due to higher acoustic shielding closer to the ground due to boundary fences and buildings. In general, this difference has been measured by this office at around 2-4dBA. A short-term operator-attended measurement was carried out at this site. See Figure 2-1 below. Measurement details below:

- NTi Audio XL2 Acoustic Analyser with MA2211 Class 1 Microphone at 1.4m
- NTi Audio XL2-TA Type Approved Acoustic Analyser with MA2230 Class 1 Microphone at 3.6m
- Pulsar Model 105 Acoustic Calibrator
- Measurement carried out on the afternoon of 11 August 2017. Meteorological conditions were fine during the measurement period.
- Measurement 1 from 1:53-2:03pm. L_{A90} was 42.6dBA and 47.0dBA, respectively.
- Measurement 2 from 2:03-2:13pm. L_{A90} was 40.7dBA and 45.1dBA, respectively.
- Difference in $L_{A90,10\text{-}minute}$ levels was 4.4dBA for both measurements.

For the purposes of this assessment, 2dBA has been used as the difference between L90 at ground level apartments and at higher-level apartments.

Figure 2-1 Photograph of Sound Level Meter Microphones at Different Heights



2.2 Protection of the Environment (Noise Control) Regulation 2008

The relevant clause in the *POEO (Noise Control) Regulation* is contained in Part 4 > Division 2 > Subdivision 1 > Clause 52, viz:

> **52 Air conditioners and heat pump water heaters**
>
> 1. A person must not cause or permit an air conditioner or heat pump water heater to be used on residential premises in such a manner that it emits noise that can be heard within a habitable room in any other residential premises (regardless of whether any door or window to that room is open):
>
> (a) before 8 am or after 10 pm on any Saturday, Sunday or public holiday, or
>
> (b) before 7 am or after 10 pm on any other day.
>
> Maximum penalty: 100 penalty units in the case of a corporation, 50 penalty units in the case of an individual.

2. A person is not guilty of an offence under subclause (1) in relation to a heat pump water heater if the conduct alleged to give rise to the offence occurs within 6 months after the commencement of this Regulation.

3. A person is not guilty of an offence under subclause (1) unless:
   (a) the person has, within 7 days after causing or permitting an air conditioner or heat pump water heater to be used in such a manner, been warned by an authorised officer or enforcement officer not to cause or permit the air conditioner or heat pump water heater to be used in that manner, and
   (b) the person causes or permits an air conditioner or heat pump water heater to be used in that manner within 28 days after the warning has been given.

4. In this clause:

heat pump water heater means a device that heats water using the energy generated from the compression of a gas.

2.3 Allowable Site Noise Emission

A noise logger was installed at the site from August 1 – 11, 2017. Details of the noise logging are included in the Appendix at the end of this Report. A summary of the background noise levels is included in the discussion below.

In general, up until 10pm, 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 "$L_{Aeq,15\text{-}minute} \leq$ background + 5dBA". After 10pm, air-conditioning equipment and hot-water heat pumps have additional restrictions as per the POEO Regulation. Therefore, the specific allowable noise limit depends on the background sound level measurements carried out for the site.

From the noise logger data, the background sound levels are as follows:

- Daytime (7am-6pm): Background 40dBA
- Evening (6pm-10pm): Background 40dBA
- Night-time (10pm-7am): Background 36dBA

The noise criteria apply to each apartment within the site but also to the cumulative (that is, total) noise emission from 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.

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 the habitable room of any other dwelling after 10pm. For practical reasons, this usually means an allowable noise level at say 1m outside the neighbouring residential facade of "background – 10dBA". Therefore, for this project, the allowable noise emission is:

- Daytime (7am-6pm): 45dBA
- Evening (6pm-10pm): 45dBA
- Night-time (10pm-7am): 41dBA for equipment except for A/C and hot water
- Night-time (10pm-7am): 26dBA 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 ensure that the design of the project is completed so that the above noise limits are complied with.

3 POTENTIAL NOISE IMPACTS ON THE SITE

The site is located in a residential suburban area. The site is zoned R4. It is currently surrounded by one-storey and two-storey residences.

In Figure 1-1, it can be seen that nearby noise generators include:

- Newbridge Road (traffic)
- Nuwarra Road (traffic),
- Maddecks Avenue (traffic),
- Stockton Avenue (traffic),
- Nuwarra Public School,
- Moorebank Shopping Centre.

The nearby major roads are 180-320m away. Traffic noise is discussed in the following sub-section of the Report. The site is 100m from the rear of Moorebank Shopping Centre – it is considered that this noise source is sufficiently distant so as not to impact the site. The closest noise source to the site is Nuwarra Public School.

The website of Nuwarra Public School indicates approximately 350 students attend the school. The main play area is the playground on the western side of the school. The acoustic centre of this playground is approximately 120m from the proposed development site. Due to the height of the proposed development, some of the residential apartments may have direct line-of-sight to the playground. During daytime, for elevated noise receivers, the background sound level is 42dBA.

School yard noise generation is approximately 75dBA per child. (See for example, Parramatta Council DCP. Also, this level is within the range nominated for child care centres by the Association of Australian Acoustical Consultants. Primary school children on average are expected to be within this range). This results in a predicted noise level of 50dBA at the façade of the proposed development. School playground noise is usually assessed on the basis of "background + 10dBA" – this is because the noise of children playing is often considered less objectionable than industrial noise upon which the noise guidelines are generally based, and also because school outdoor play times are of relatively short duration and are at a fixed predictable time each day. During daytime, for the upper levels of this development, background sound levels are 42dBA. Therefore, the noise guideline for schoolyard noise would be 52dBA. Therefore, the predicted school noise complies with the guideline and the acoustic impact on the development is acceptable.

3.1 Traffic Noise

The following references have been used for guidance:

- Infrastructure SEPP,

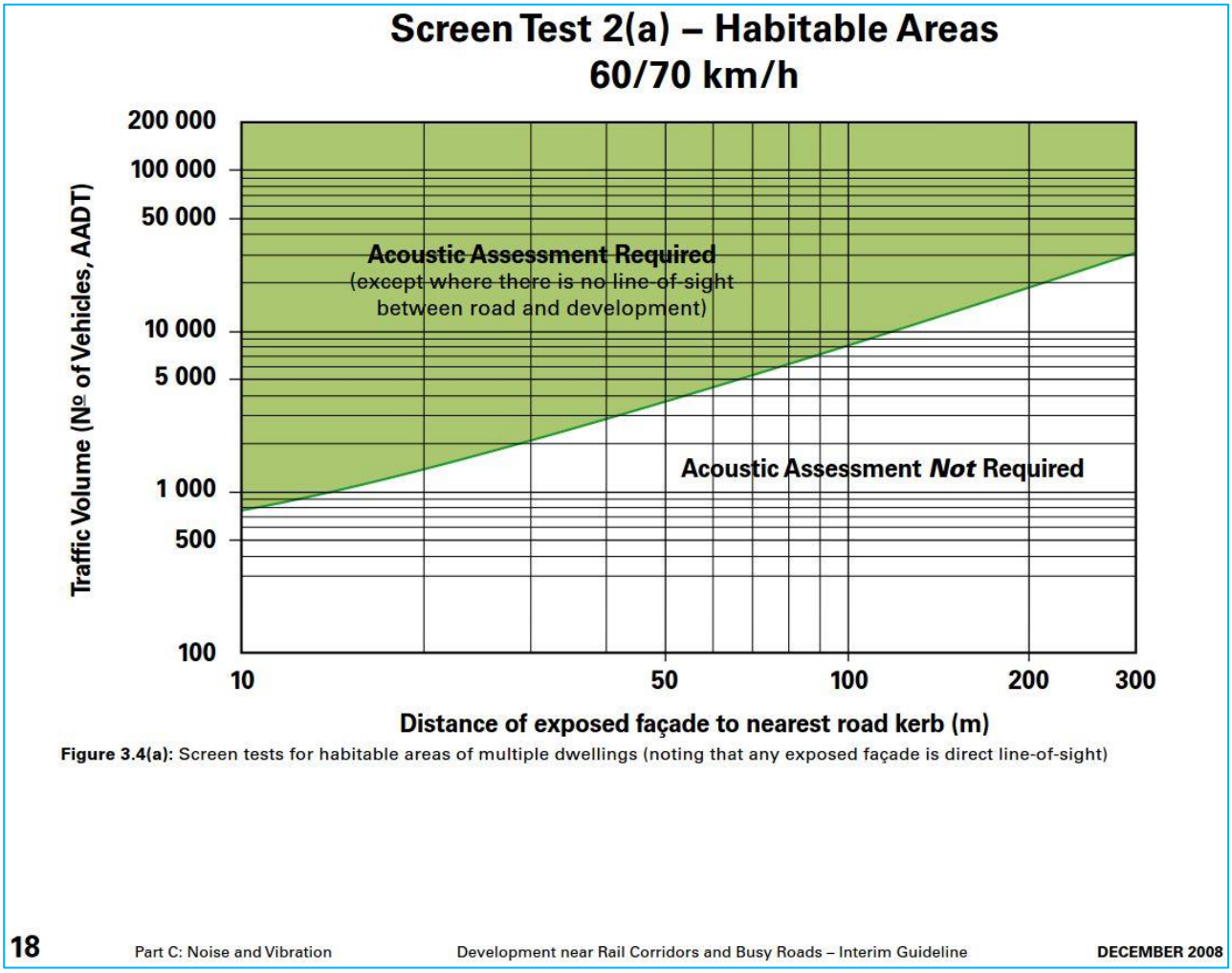
- NSW Department of Planning, *Development Near Rail Corridors And Busy Roads – Interim Guideline*
- RMS website with traffic volume information:

  http://www.rms.nsw.gov.au/about/corporate-publications/statistics/traffic-volumes/aadt-map/index.html#/?z=6

The RMS traffic volume viewer indicates approximately 45,000 vehicles per day (AADT) on Newbridge Road but there is no traffic count information for the other roads listed. This suggests that the traffic volume is below 10,000 on each of these roads.

The NSW Department of Planning Guideline document indicates that for 10,000 vehicles per day, no acoustic assessment is required when developments are greater than about 120m from the road. In this case, the corresponding closest site boundaries are 180m to 230m from Maddecks Avenue, Nuwarra Road and Stockton Avenue. Therefore, it is considered that these roads do not provide significant traffic noise impact on the site. See Figure 3-1 below.

Figure 3-1 Screening Test from NSW Department of Planning Guideline Document



In the case of Newbridge Road, upper levels of the development may be exposed to traffic noise from approximately 45,588 vehicles per weekday. Acoustic calculations have been carried out using CoRTN (Calculation of Road Traffic Noise) calculation methodology. Calculation notes below.

- The future northern residential façade faces towards Newbridge Road.
- The distance from the façade to the centre of the roadway is 318m.
- Traffic volume is 36,007 from 7am to 10pm.
- Heavy vehicle percentage is 10.7% from 7am to 10pm.
- Traffic volume is 8,732 from 10pm to 7am.
- Heavy vehicle percentage is 11.6% from 10pm to 7am.
- Traffic speed is an average of 70km/hour.

See Figure 3-2 for the location of the RMS traffic counter and part of the raw data table.

The calculated noise level at the northern façade of the development (including +2.5dBA for façade-reflection) is:

- 58dBA $L_{Aeq,15\text{-}hour}$ (7am to 10pm)
- 54dBA $L_{Aeq,9\text{-}hour}$ (10pm to 7am)

These calculated values take into account traffic volume, percentage heavy vehicles, road speed, distance from the road, height of the noise receiver (in this case the sixth floor of the development) and shielding by the houses and other buildings between Newbridge Road and the site.

The noise goals for the development are taken from the Infrastructure SEPP, which are expanded upon in more detail in the NSW Department of Planning *Guideline* document. These are shown in Table 3-1 below.

Table 3-1 Traffic Noise Criteria

Room	Window Condition	NSW DoP *Guideline*
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 $L_{Aeq,15hr}$

It is commonly assumed that outside-to-inside noise reduction via open windows is 10dBA. This value is quoted in RMS and EPA literature.

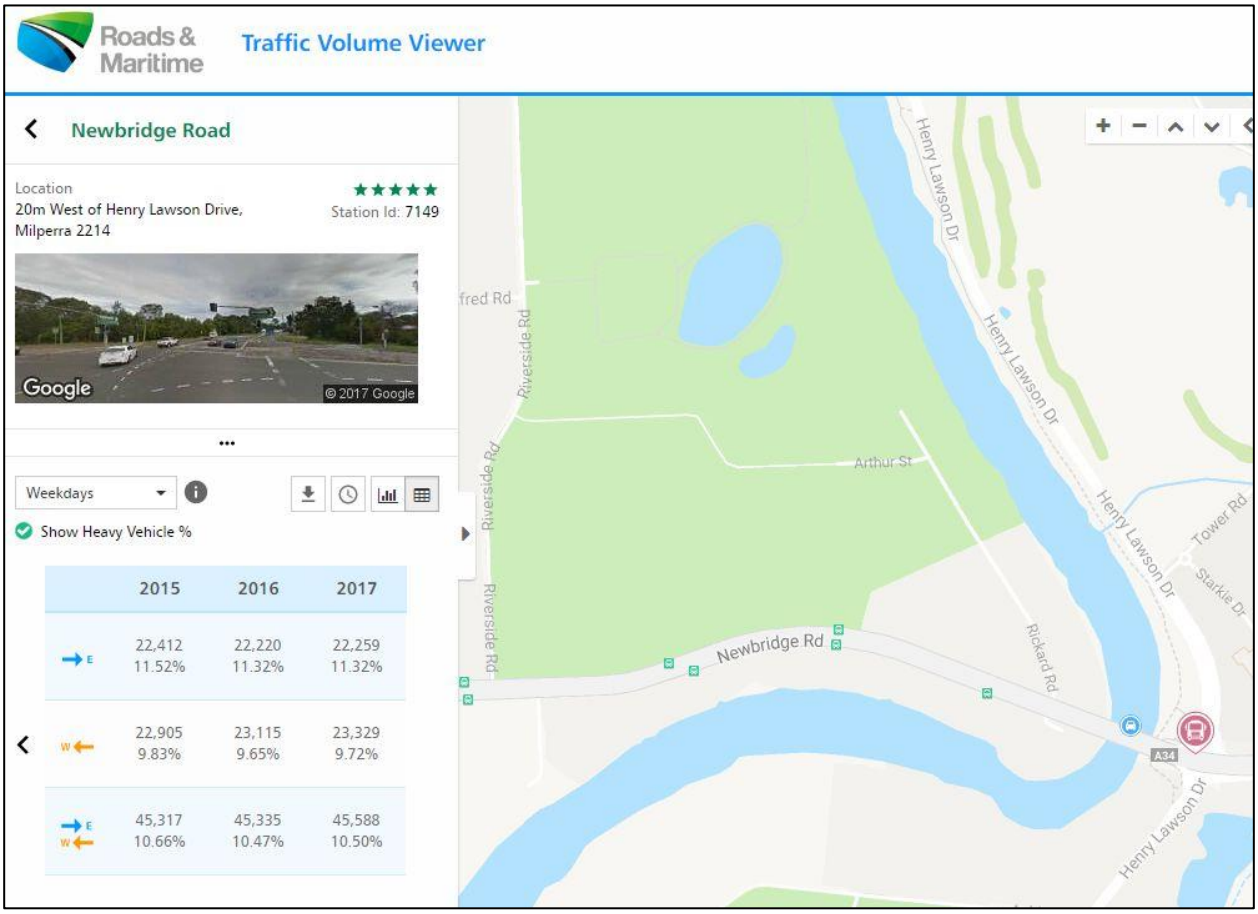
The calculated noise levels within the rooms of the development, based on conventional (standard) glazing and the calculated traffic noise levels shown above, are as shown in Table 3-2 below.

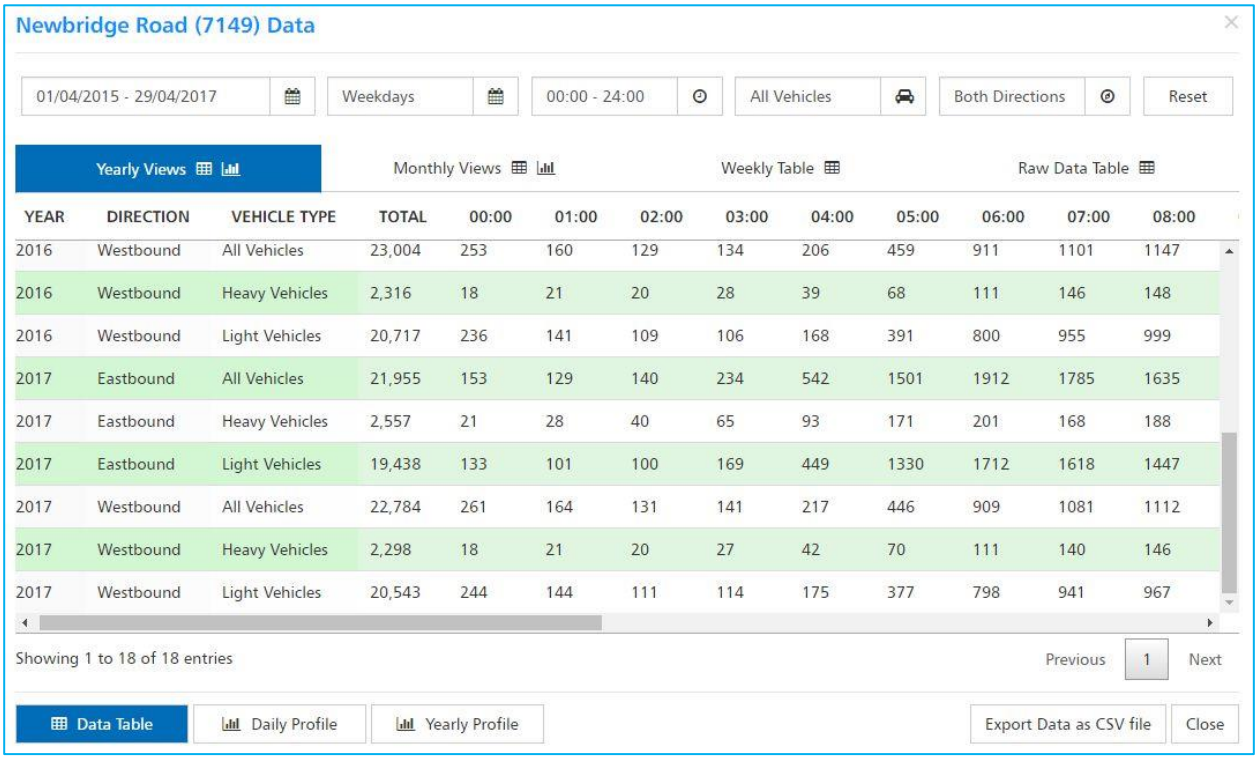
Table 3-2 Calculated Indoor Traffic Noise Goals for the Most Exposed Façade of the Development

Room	Window Condition	Calculated Indoor Traffic Noise	Complies
Bedrooms	Windows closed	34dBA $L_{Aeq,9hr}$	Yes
	Windows open	44dBA $L_{Aeq,9hr}$	Yes
Other Habitable Rooms	Windows closed	38dBA $L_{Aeq,15hr}$	Yes
	Windows open	48dBA $L_{Aeq,15hr}$	Yes

The indoor traffic noise levels comply with the NSW Department of Planning *Guideline* and no special glazing treatments are required.

Figure 3-2 RMS Traffic Volume Viewer Newbridge Road





4 POTENTIAL NOISE EMISSION FROM THE SITE

The potential noise generated by the development includes:

- Outdoor residential air-conditioning;
- Basement ventilation fans such as car park fans and garbage room fans;
- Other ventilation fans such as apartment toilet-kitchen-laundry exhaust fans;
- Cars entering and exiting the development via the driveway ramp;
- People talking on balconies.

4.1 Mechanical Services Noise Emission

Noise emission from the ventilation fans can be controlled in a straightforward manner by acoustic design and installation measures. In principle, if there are a number of different noise sources at a site, then the allowable noise goal for each one should be lower than the total site allowable noise emission. In this case, car park fans, air-conditioning condensers (all of them) and apartment exhaust fans (all of them) are considered as individual sources so the noise goal for each one is 5dBA lower than the allowable noise goal for the whole site (or in this case, 40dBA instead of 45dBA). For example:

- A typical apartment exhaust fan (toilets, etc) Sound Power Level is around 55dBA. If all of the apartments on one façade are running their fan at the same, time, the noise emission at a distance of 6m from the façade of the building would be 40dBA. This complies with the noise goal set even without acoustic measures. Simple acoustic measures include a 1.2m length of R1.0 insulated flexible duct between the fan inside the ceiling of an apartment and the exterior building façade.

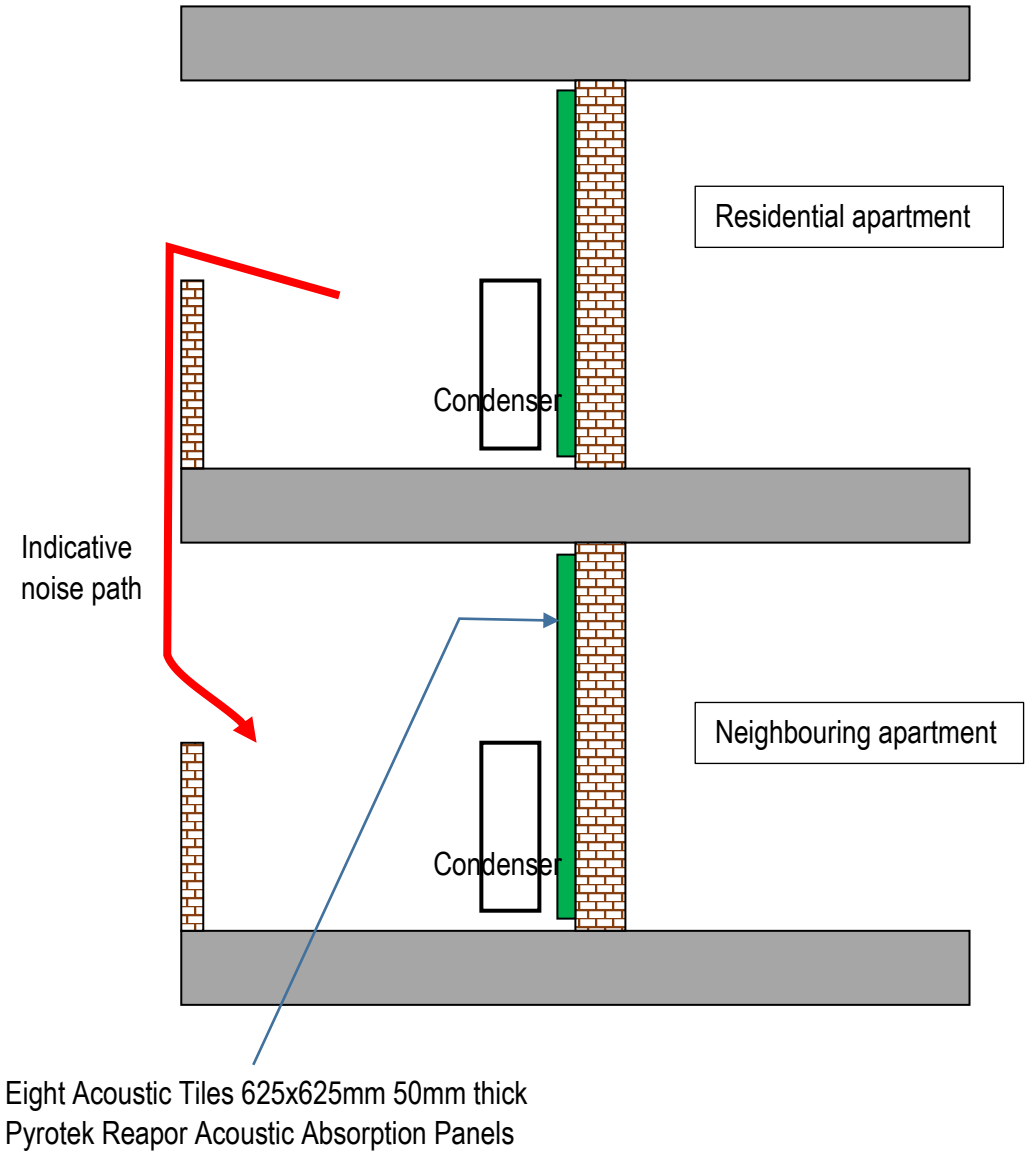
- A typical car park fan for a car park of 39 spaces is around 90dBA. In order to meet the goal of 40dBA at the boundary of the site – or for that matter, at the nearest balcony or window of an apartment of the same development – the following acoustic measures can be implemented:

    - Acoustic duct attenuators both before and after the fan, acoustically lined ductwork, vibration-isolation of the fan. These are standard straightforward noise control measures in these situations.

Regarding outdoor condensers, these are typically installed on the balcony of apartments. A reputable brand for the proposed size of apartments will have a Sound Power level of around 67dBA at full power and around 62dBA during typical inverter-mode operation. In order to meet a noise goal of 40dBA at neighbouring properties, as well as at the balcony of adjoining apartments, the following acoustic treatment is recommended – see Figure 4-1.

Note that it is usually impractical to provide acoustic treatment to permit operation of residential air-conditioners after 10pm. Therefore, there these should be installed on a time-clock and/or a building By-Law to this affect.

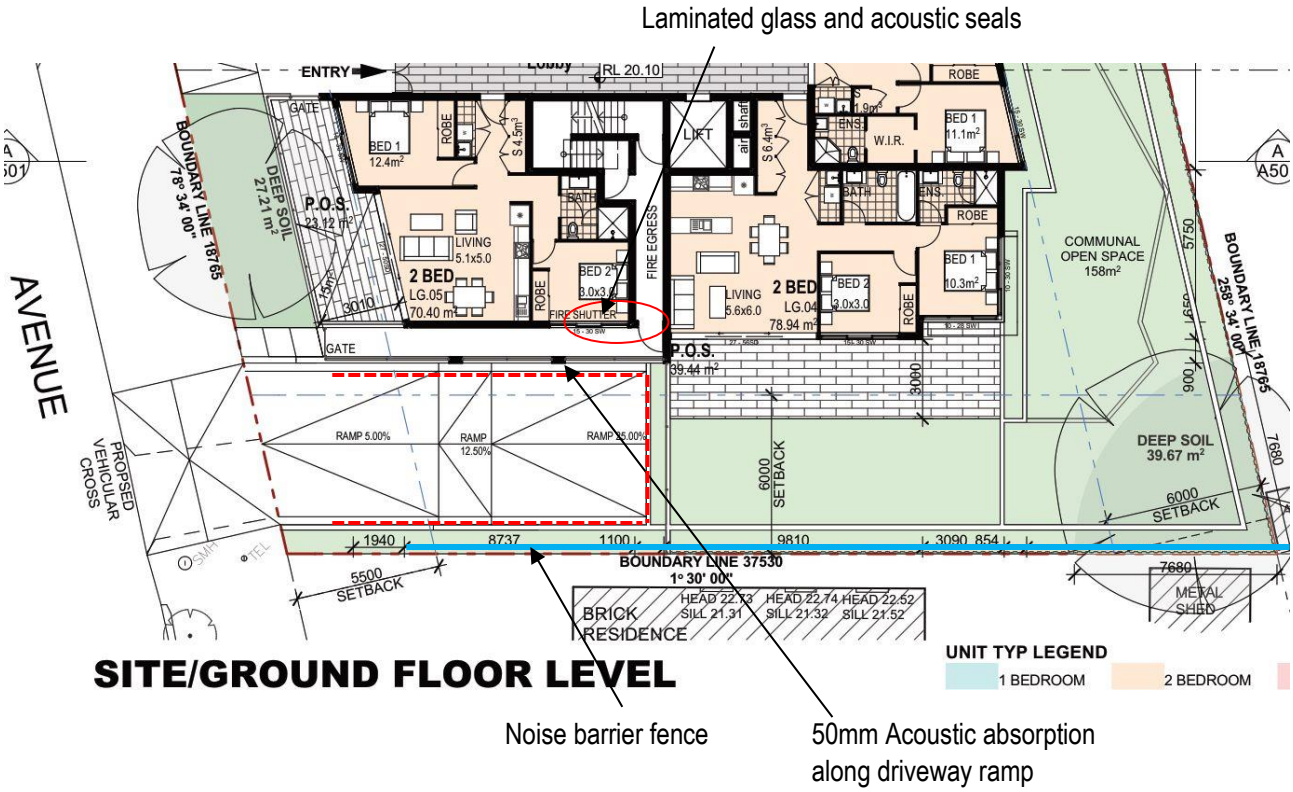
Figure 4-1 Typical Condenser installation on an apartment balcony for operation up until 10pm



4.2 Driveway Noise

In general, for activities associated with a development after 10pm, it is considered appropriate to assess the potential for sleep disturbance due to intermittent noise events which produce short-term high noise levels. In this case, there are cars that may be entering or exiting the driveway ramp near to the neighbouring boundary. See Figure 4-2.

Figure 4-2 Plans – Driveway Ramp



Noise measurements of car park activities for car parks, such as car doors closing and car engines starting, have been carried out for many projects. The noise source levels are as shown in Table 4-1.

Table 4-1 Intermittent Car Activity Noise, L_{Amax} at 1m, dBA

Activity	Range	Log Average
Car starting	78-95	87
Car door closing	74-94	86
Car accelerating	82-93	89

The logarithmic average levels shown in Table 4-1 are the appropriate ones for the assessment of this type of intermittent noise.

The allowable noise level for sleep disturbance assessment is discussed in the EPA documents *Noise Guide for Local Government* (NGLG) and the *Road Noise Policy* (RNP). These guidelines are summarised below:

- Screening threshold of "Background + 15dBA", assessed using $L_{A1(60\text{-seconds})}$ or L_{Amax}, assessment location 1m outside bedroom windows;
- Maximum internal noise levels below 50–55dBA are unlikely to cause awakening reactions;
- One or two noise events per night, with maximum internal noise levels of 65–70dBA, are not likely to affect health and wellbeing significantly;
- Open windows provide around 10dBA noise reduction.

In this case, the background + 15dBA screening threshold after 10pm is 51dBA.

The predicted sleep arousal noise levels generated by the proposed development are as follows:

- 62dBA L_{Amax} externally at 1m to the façade of the residence nearest to the driveway ramp. This exceeds the screening threshold and so it is necessary to consider indoor noise levels of noise intrusion.
- 42dBA L_{Amax} internally with windows closed in the neighbouring dwelling;
- 52dBA internally, with windows open.

The calculated indoor levels comply with the guidelines in the Road Noise Policy.

The above calculated levels are based on the following assumptions – see Figure 4-2:

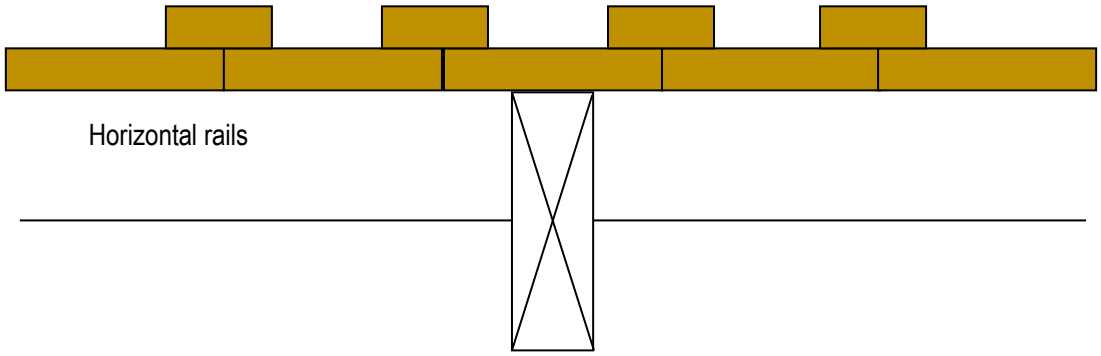
- Install 50mm thick acoustic absorption treatment to the side walls of the basement access ramp, for a distance of 10m.
- Install 1.8m solid boundary fence at least 10kg/m^2 mass-per-unit-area between the site and the adjoining property at 17 Harvey Avenue. See Figure 4-3.

Note, it is also recommended that the following rooms of the potentially most affected apartments within the development itself should have the window fitted with 6.38mm laminated glass and be fitted with Schlegel Q-lon Acoustic Seals;

- Bedroom 2 of Apartment LG.05
- Bedroom 1 and 2 of Apartment L1.10

Figure 4-3 Example of Timber Noise Fence

Example of timber Noise Fence – 150x25mm timber planks with 50x25mm planks covering the joins



Acoustic barrier materials (options):

- Minimum 25mm thick solid timber. For example, 150x25mm timber palings tightly butted together, together with overlapping cover pieces 50x25mm, OR
- 6.38mm laminated glass, OR
- 15mm minimum thickness clear acrylic, OR
- 7.5mm exterior-grade fibre cement sheet, OR
- Solid masonry; OR
- Any combination of the above materials / constructions

4.3 Other Noise

It is recommended that the basement garage door should be fitted with a soft-start motor and the door panels and door hinges should be of a low-noise type. Guide rails and garage motors should be vibration-isolated from the building to minimise potential impacts on apartments above.

Stormwater drains located on the driveway ramp should be a low noise type – such as plastic or if metal then the grate must be lined with durable rubber lining to prevent the metal clanging as cars drive over it.

5 BUILDING CODE OF AUSTRALIA

The residential apartments in this development will be Class 2 as defined in Volume One of the Building Code of Australia (National Construction Code). Part F5 of the BCA nominates minimum sound insulation requirements for bounding walls and floors of residential apartments. These must be implemented in the design stage of the project for the Construction Certificate.

5.1 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 virtually identical 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.

5.2 Sound Insulation Provisions of the BCA

The following Tables summarise the Acoustic Provisions of the BCA.

Table 5-1 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 "separates" 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 5-3.

Table 5-2 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 $L_{n,w}$	* 62 $L_{nT,w}$

- 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 without special acoustic provisions.

Table 5-3 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.

6 CONSTRUCTION NOISE

If there is any rock-breaking proposed then specialist acoustic advice should be sought. Otherwise, the Builder and demolition and earthworks sub-contractors should employ good practice to ensure that construction activities minimise noise impacts on neighbouring dwellings. This includes construction of solid hoardings 3-4m high, notifying neighbours in advance of noisy activities and managing potentially noisy activities such as truck movements, concrete pours and concrete pumps.

7 CONCLUSION

This Report has considered potential acoustic implications of the proposed development. This includes noise impacts on the development as well as noise generated by the development. All of the potential acoustic issues can be managed to comply with published guidelines. The development will not cause a noise nuisance.

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 or LAE	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 Logger

A noise logger was installed in the rear yard of 19 Harvey Avenue to monitor ambient and background sound levels. See the photograph below.

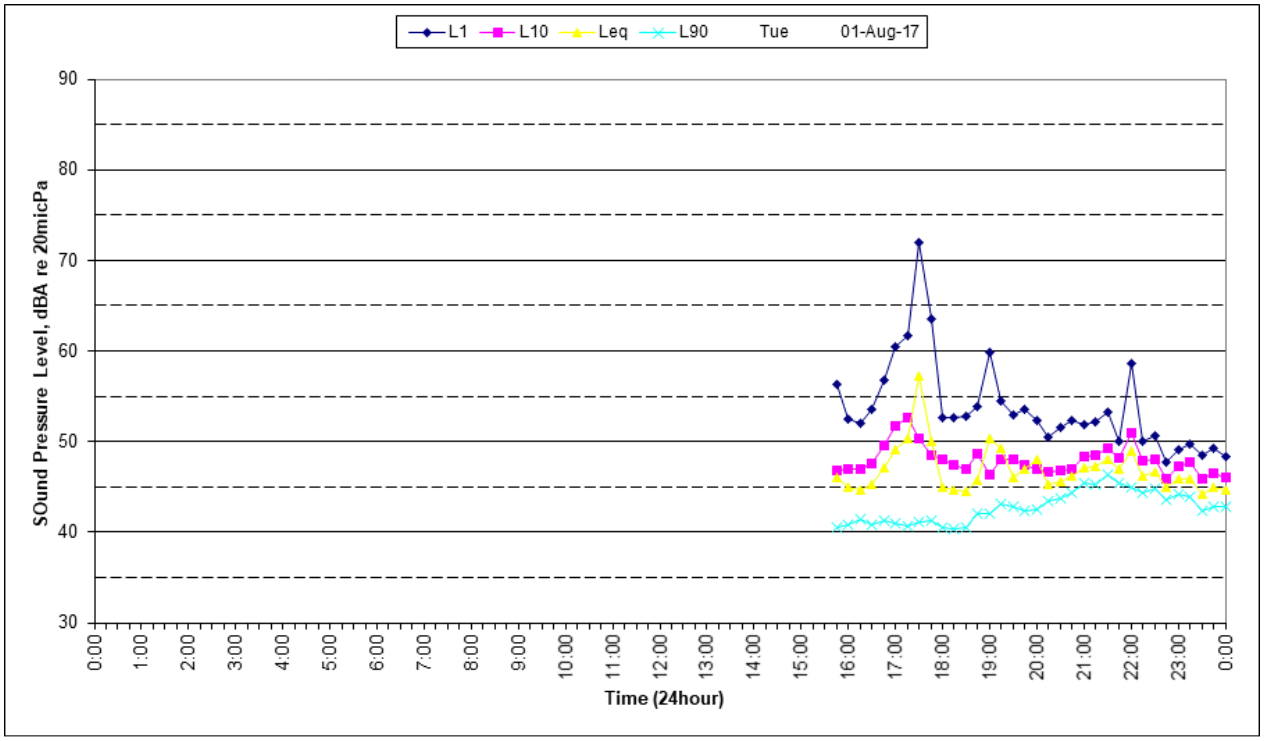
Figure 9-1 Noise logger installed at front yard of the site

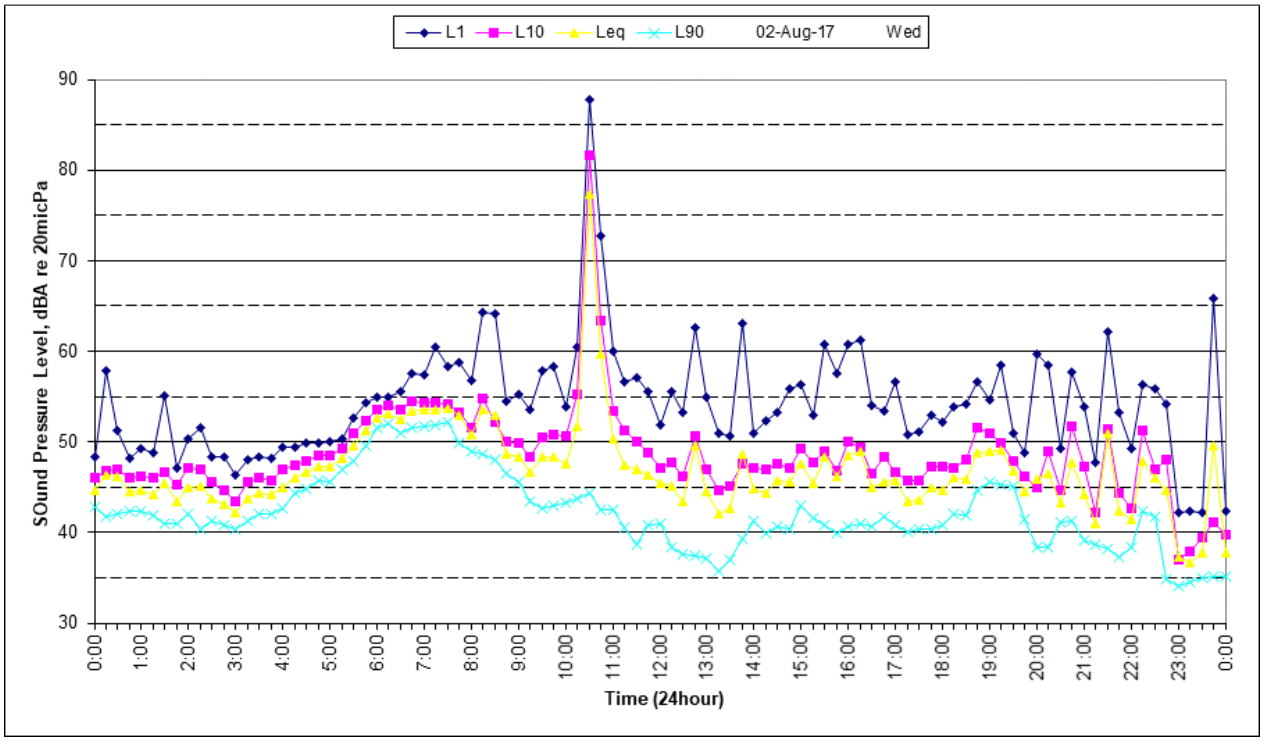
An NTi Audio XL2 Acoustic Analyser with Class 1 Microphone was used for this project. The device was set to 15-minute sampling periods, A-weighted and fast response. This equipment continuously monitors noise levels and stores statistical noise level descriptors for each sampling period. The equipment calibration was checked before and after the survey and no significant drift was noted.

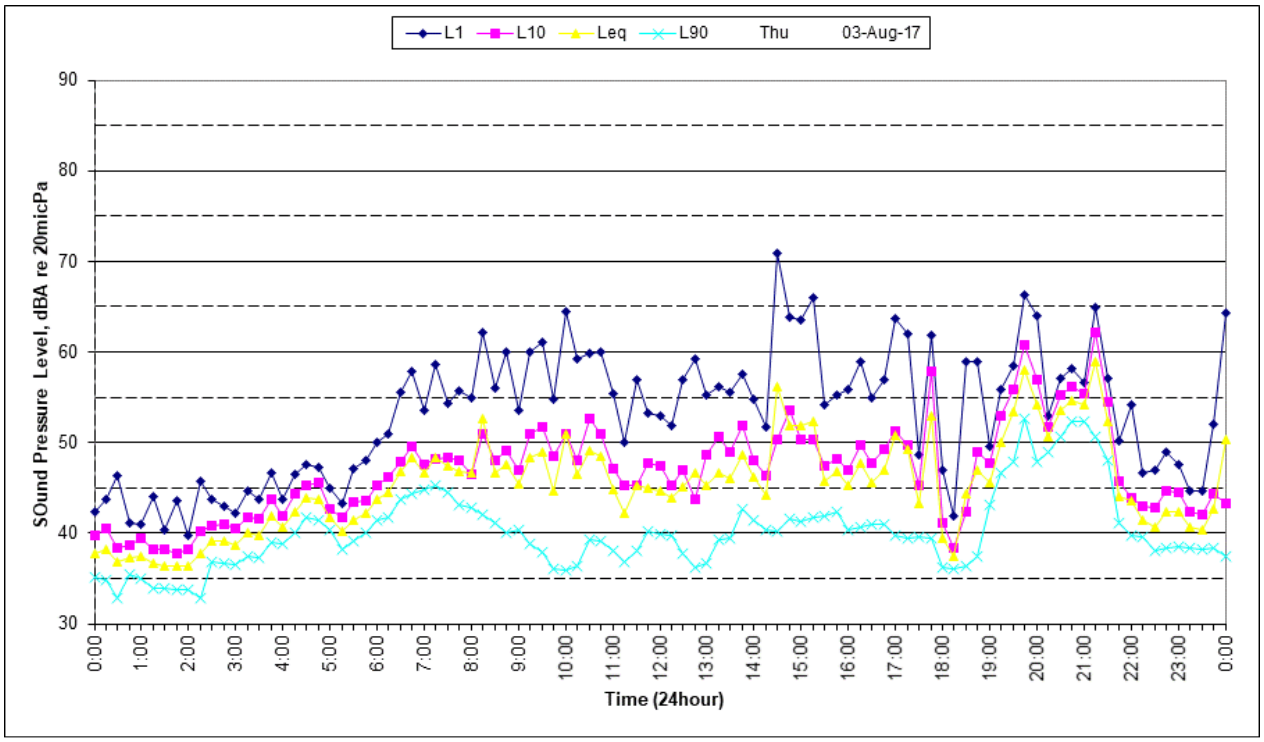
The logger determines L_{A1}, L_{A10}, L_{A90} and L_{Aeq} levels of the ambient noise. L_{A1}, L_{A10} and L_{A90} are the levels exceeded for 1%, 10% and 90% of the sample time, respectively. The L_{A1} is indicative of maximum noise levels due to individual noise events such as the occasional pass-by 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



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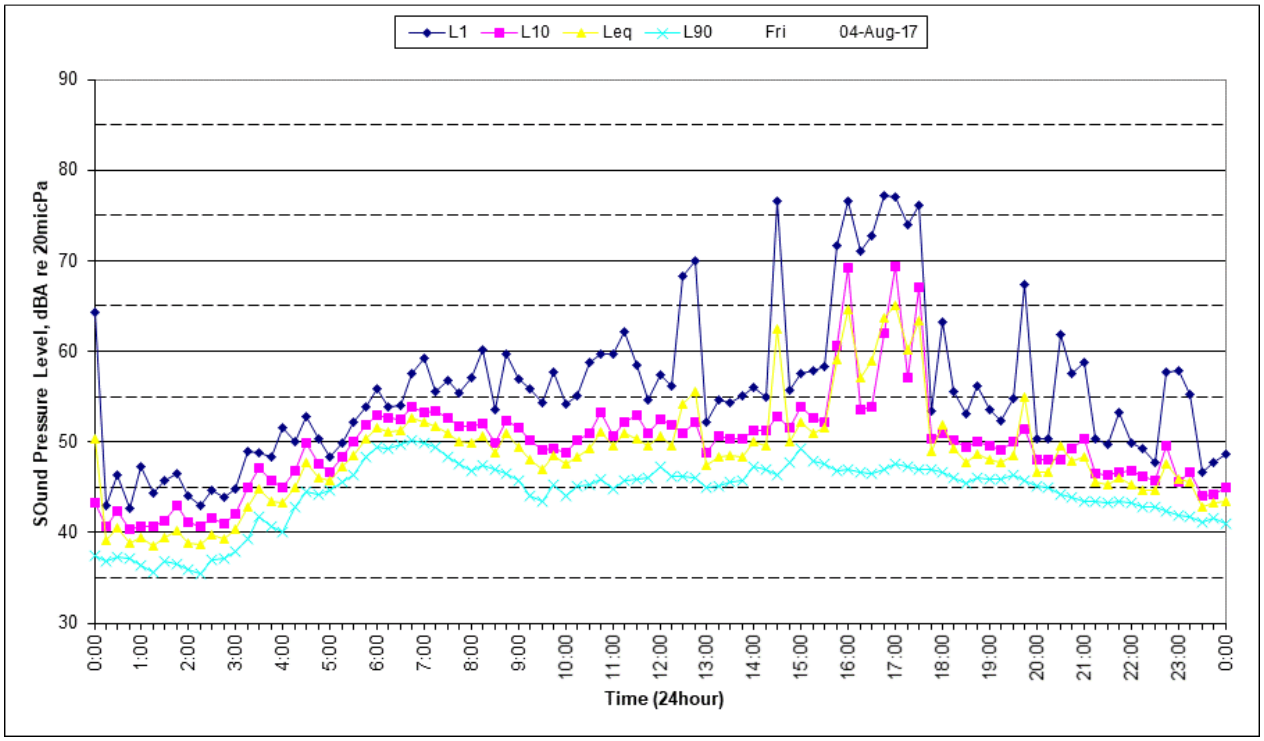
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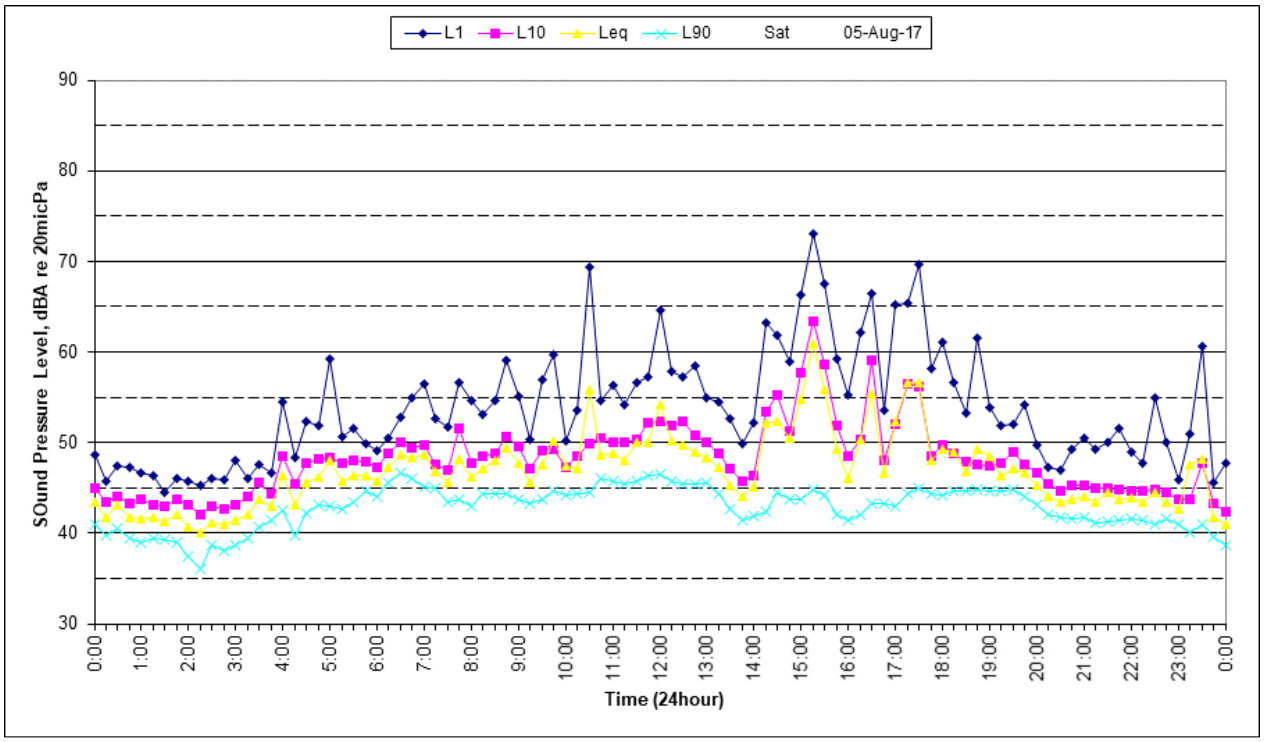
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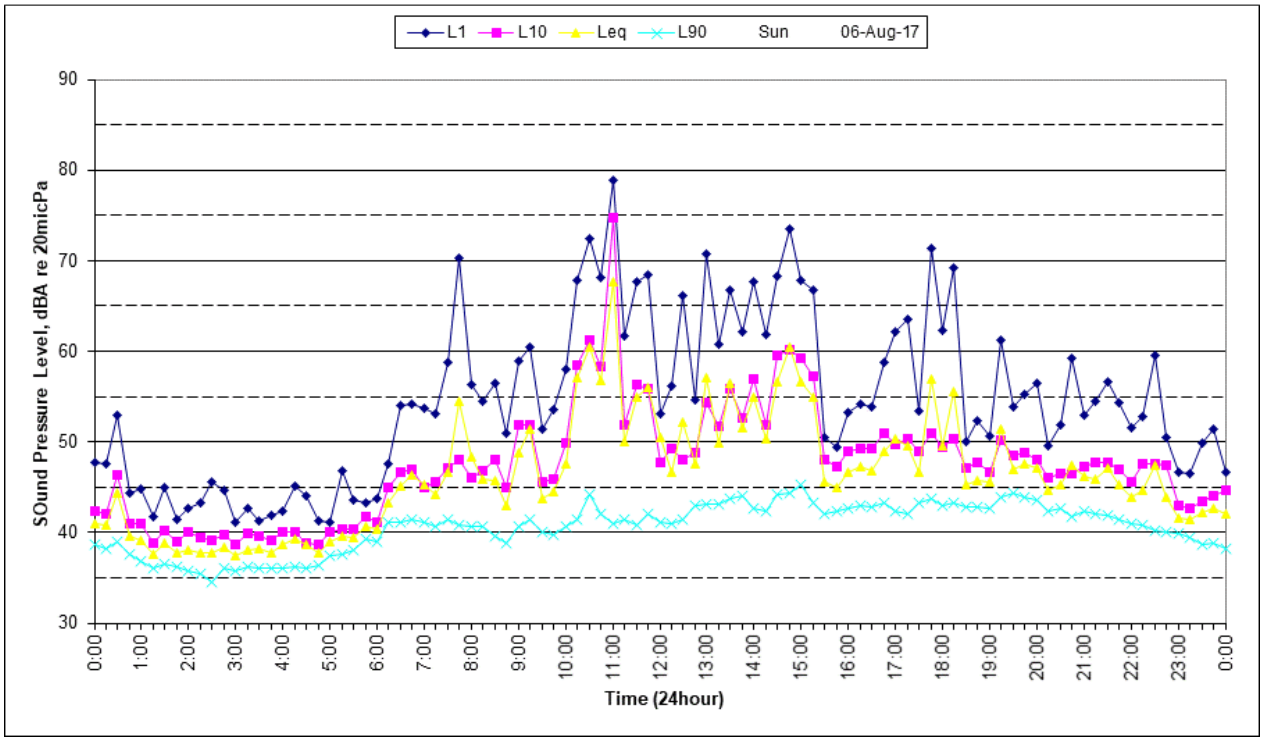
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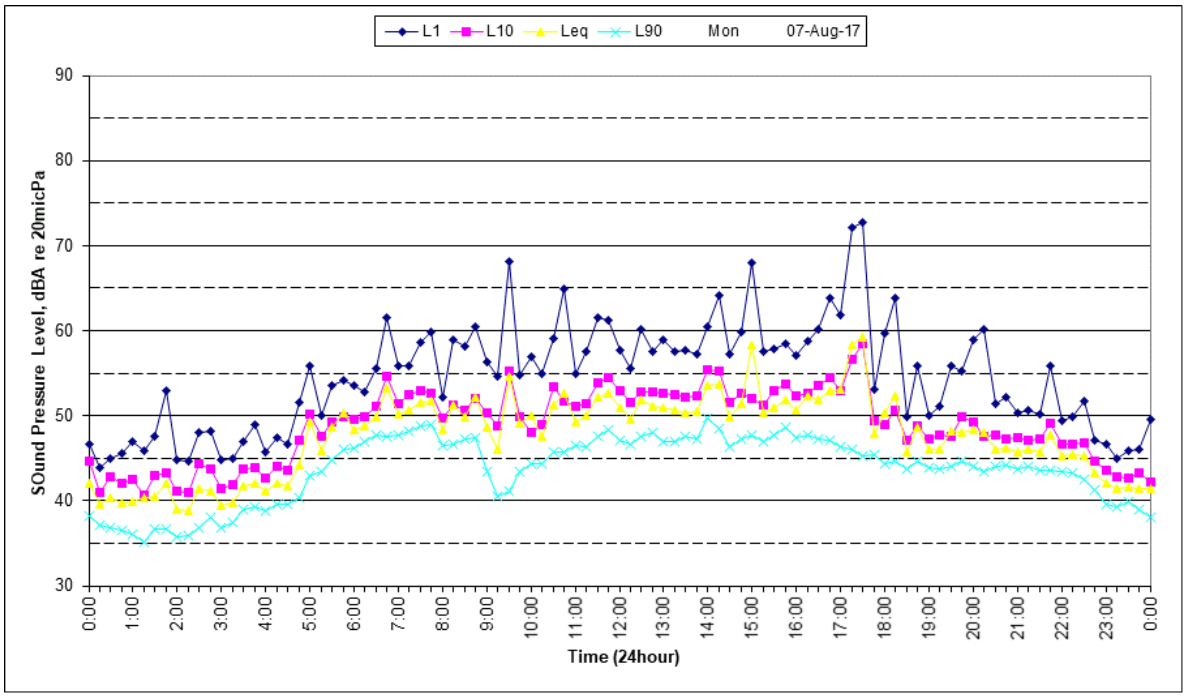
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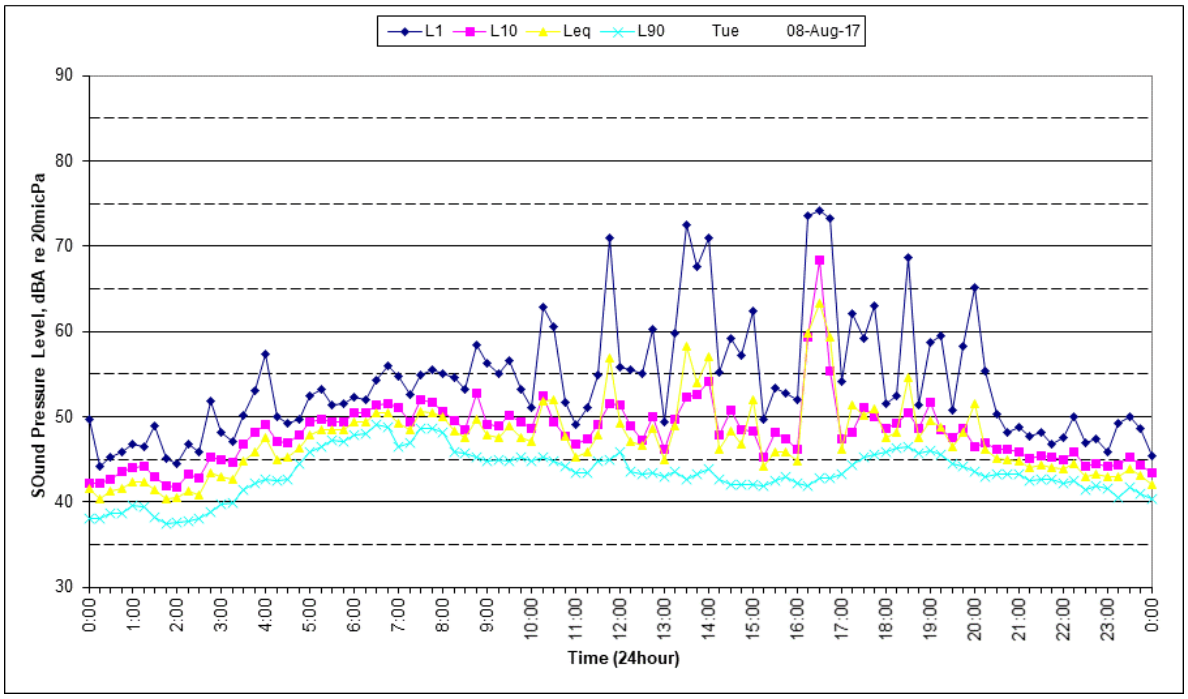
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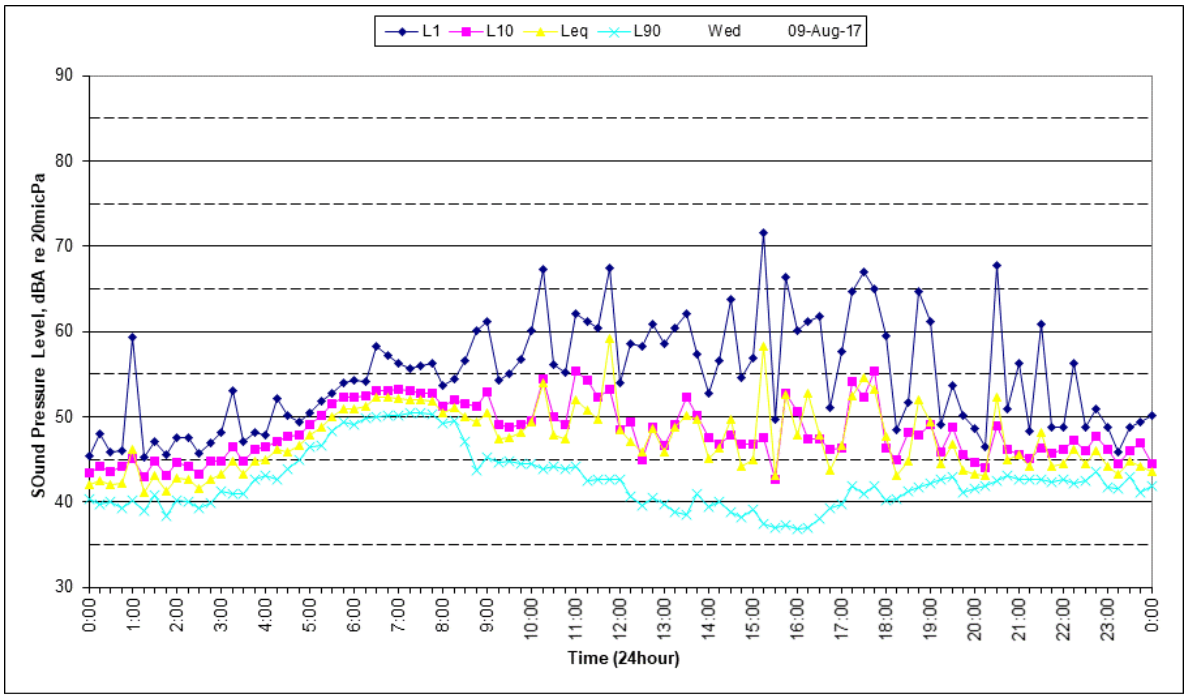
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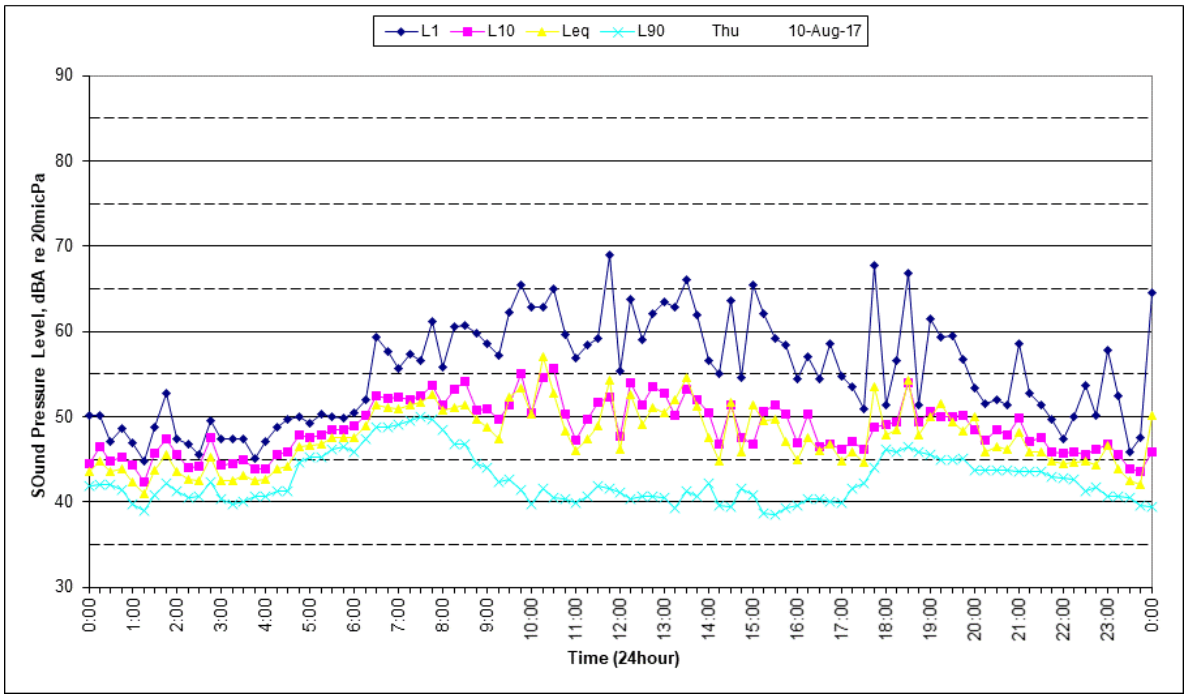
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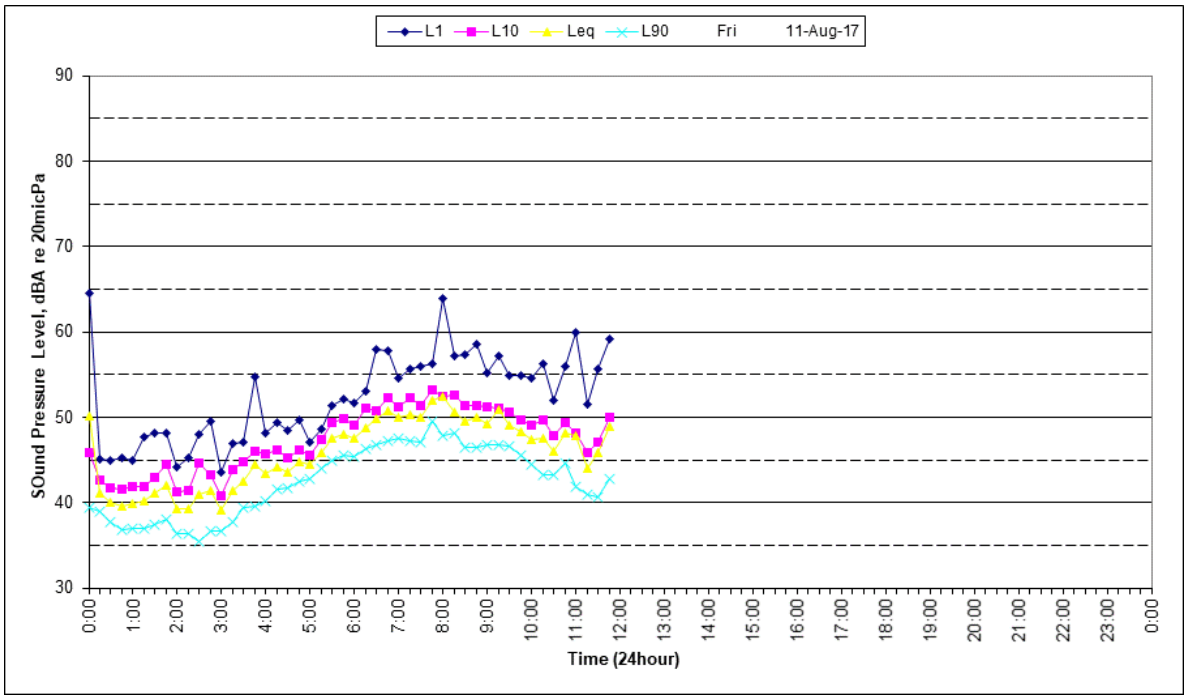
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