ACOUSTIC ASSESSMENT REPORT

Residential Flat Building Development
84 Tallawong Road Rouse Hill NSW

Report To:

Janhvi Chadha

ARCHIDROME
SUITE # 2, 25 MONTVIEW PDE, HORNSBY HEIGHTS, N.S.W. 2077 JANHVI@ARCHIDROME.NET

Report By:

NG Child & Associates

31 August 2017

`

DOCUMENT CONTROL REGISTER

Project Reference	CA17/126/1002
Project Name	Acoustic Assessment of a Proposed Residential Flat Building Development at 84 Tallawong Road Rouse Hill NSW
Document Title	Acoustic Assessment Report: Residential Flat Building Development 84 Tallawong Road Rouse Hill NSW (August 31st, 2017)
Document Reference	Tallawong Road – Acoustic Assessment Report (Final) - 200917 - Word
Issue Type	Electronic
Attention	Janhvi Chadha

Version	Date	Document Reference	Prepared By	Checked By	Approved By
1	31 August 2017	Tallawong Road – Acoustic Assessment Report (Version 1) - 310817 - Word	NGC	HMC	NGC
Final	31 August 2017	Tallawong Road – Acoustic Assessment Report (Final) 200917 - Word	NGC	HMC	NGC

TABLE OF CONTENTS

APPENDICES

LIST OF DIAGRAMS

LIST OF TABLES

EXECUTIVE SUMMARY

This report presents an acoustic and vibration assessment of a proposed residential development at 84 Tallawong Road Rouse Hill NSW. The assessment has been undertaken in accordance with relevant acoustic and vibration requirements, standards and guidelines.

ACOUSTICS

Key Findings

In relation to acoustic matters, it is our professional opinion, based on a consideration of the various plans and drawings describing the project; subject to the adoption and implementation of the various recommendations presented in this report, and summarised below, that indoor sound levels associated with the proposed development will comply with the most stringent applicable internal noise guidelines, namely that sound levels no greater than 35 dBA will be achieved in all bedrooms during the 10:00pm to 7:00am night-time period, and sound levels no greater than 40 dBA will be achieved in all other habitable rooms within the development, at all times.

On the same basis, it is our professional opinion that the development as proposed, once again subject to the adoption and implementation of the various recommendations presented in this report, that the proposed development will have no inappropriate or non-compliant acoustic impact on any potentially affected receivers.

Recommendations

The following recommendations, which are identified in the text of this report, are made to ensure the compliance of internal acoustics with the relevant guidelines and requirements. These recommendations are that:

1. **External Glazing - Windows:** Glass with a minimum acoustic rating equivalent to 6 mm float glass is used in all external windows. A higher acoustically rated glass, such as 6.38 mm laminated glass, may also be used if required for design or safety purposes.

2. **External Glazing - Balconies:** Glass with a minimum acoustic rating equivalent to 6.38 mm laminated glass is used for the windows and doors from the various residential units to the associated external balconies, and window and door frames should be sealed into façade openings using a polyurethane sealant such as “Bostik Fireban One”, or equivalent, and acoustic seals (such as Schlegel Q-Lon or equivalent) should be used to provide additional acoustic protection.

3. **Balconies:** Adjoining balconies should be separated by solid form blades or end walls, and if air conditioner condenser units are to be located on balconies, solid form external walls or balustrades to a minimum height of 1000 mm should be installed.

4. **Internal Walls:** Internal walls, including inter tenancy walls, should be constructed and installed in accordance with the details included in this report.

5. **Floors:** Floor slab construction to be of minimum 200 mm reinforced concrete with density greater than 2200 kg/m^3 with suspended plasterboard ceiling below, to achieve an Rw+Ctr in excess of 50. The use of resilient hung ceilings is recommended where hard floor finishes are proposed above the slab. For carpet floor coverings within all living spaces and bedrooms, the use of standard carpet underlay is expected to meet floor impact isolation requirements. Hard floor coverings are proposed for wet areas such as kitchens, bathrooms and laundries. It is recommended that tiles are laid on top of 10 mm thick “Embelton ImpactaMat” acoustic underlay (or equivalent).

6. **Services:** Internal services should be fitted with acoustic insulation as detailed in this report, and in accordance with relevant BCA requirements.

7. **Roof/Ceiling Insulation:** Roof or ceiling insulation should be installed between the roof and the Level 3 residential units below to provide acoustic protection from any future indirect or reflected sound waves generated by possible future traffic growth on Tallawong Road, and from any other external sources. Typically, minimum rated insulation materials used for thermal insulation purposes are likely to include R 3.5 insulation between the building roof and the boarding rooms on Level 3 below, together with a foil layer and possibly an R 1.0 blanket, and materials suitable for thermal insulation purposes will also be suitable for the relatively minor level of acoustic insulation required.

8. **BCA Requirements:** Standard BCA and other internal acoustic design and construction considerations, including but not limited to those summarised in Section 5.5.7 and Appendix A of this report, are applied to all aspects of the construction of the various residential units within the proposed development;

9. **Plant & Equipment:** Any mechanical plant and equipment required for the development will be specified and/or designed and installed such that acoustic noise emissions are consistent with the internal acoustic environments required, and that any penetrations from ductwork and/or pipework will not reduce the acoustic performance of other building design features;

10. **Retail Spaces:** Subject to the use of standard laminated glazing with a minimum acoustic attenuation capability equivalent to 6.38 mmm laminated safety glass on the Tallawong Road or south-western facades of the eight proposed retails spaces in Lot 1 of the development, no undue or non-compliant acoustic impact is projected at affected residential or commercial receivers.

11. **Acoustic Certification:** Appropriate certification and validation of the acoustic performance of any plant and equipment associated with the proposed development is provided prior to construction, and prior to occupation, as reasonably required;

12. **Design & Construction Implications of Bush Fire Risk:** As far as possible, typical design and construction implications resulting from the bushfire risk rating of the property have been taken into account in the external window, door and glazing recommendations presented in this report. However, design and construction implications associated with bushfire risk are considered in detail, in the companion report *Design & Construction Implications of Bush Fire Risk: Residential Building Development, 84 Tallawong Road Rouse Hill NSW (Version 1; NG Child & Associates, August 31st, 2017)*, and any more stringent external window and door treatments required for that purpose should be treated as additional to those described here; and

13. **Noise Management Plan – Construction:** A noise management and control plan will need to be developed and applied to the construction phase of the proposed development, in accordance with established procedures and practices.

It should be noted that all materials or material types mentioned in this report have been suggested solely on the basis of acoustic performance. Any other properties of these materials, including fire rating and chemical properties should be checked with the suppliers or other specialised bodies to ensure fitness for non-acoustic purposes.

VIBRATION

Key Finding

Both maximum and average vibration levels measured in metres per second per second (m/s^2) were found to be substantially lower than relevant “preferred” and “maximum” criteria levels, and on this basis both continuous and impulsive vibration levels measured at the proposed development site are assessed as being safe and appropriate for the residential development proposed.

Recommendation

In our professional opinion, no recommendations or actions are required to achieve vibrational compliance at the proposed development site.

Noel Child BSc (Hons), PhD, MIEA, MRACI
Visiting Fellow, Engineering
University of Technology, Sydney
Principal, NG Child & Associates

31 August 2017

1 INTRODUCTION

Archidrome and its client Benefit Property Corporation are involved in the prospective development of a residential flat building at 84 Tallawong Road Rouse Hill NSW.

Archidrome engaged NG Child & Associates to undertake an acoustic assessment of the proposed development, to a standard and in in a form suitable for submission to Blacktown City Council, the local government consent authority at interest.

NG Child & Associates has considerable experience in the evaluation and assessment of residential development. Noel Child is a suitably qualified and experienced person to undertake the various assessments required. His CV has been included for reference at Appendix E.

This document describes the acoustic assessment undertaken; presents the findings and recommendations of that assessment, and presents those findings and recommendations in a report form suitable for submission to Blacktown City Council as part of the Development Application submission for the proposed project.

2 SITE & ASSESSMENT DETAILS

2.1 LOCATION

The location of 84 Tallawong Road Rouse Hill is shown highlighted in blue in Figure 2.1 below.

The direction of north is towards the top of the diagram, and an approximate indication of scale is included below.

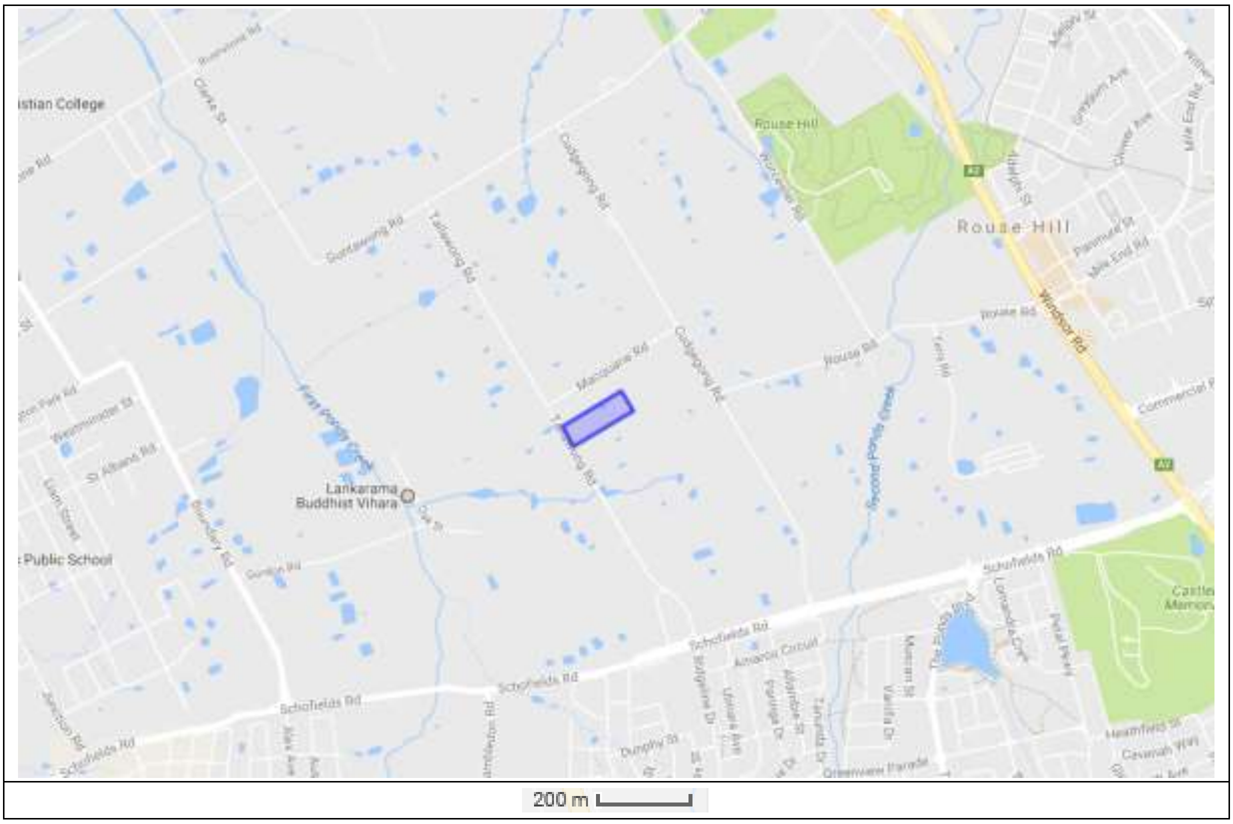


Figure 2.1 – Location of 84 Tallawong Road Rouse Hill

A recent (July 22nd, 2017) satellite photograph of the site area is provided in Figure 2.2, on the following page.

Figure 2.2 – Satellite Photograph of 84 Tallawong Road Rouse Hill (July 22nd, 2017)

The site comprises land of approximate area 20,000 square metres with frontage to Tallawong Road. The nearest significant thoroughfares intersecting Tallawong Road are Macquarie Road to the north, and Schofields Road to the south.

The site adjoined by other existing acreage properties.

A recent photograph of the 84 Tallawong Road site is provided in Figure 2.3, on the following page.

2.2 LAND DETAILS & ZONING

The proposed site falls within the local government area of Blacktown City Council, and relevant local government consents and approvals regarding site and the proposed development reside with that Council.

Zoning details applicable to the site and nearby areas are provided in Figure 2.4, on the following page, based on information available from the Blacktown Local Environment Plan 2015.

The 84 Tallawong Road site is shown at the centre of the diagram, outlined and shaded in yellow.

The land is formally defined as Lot 63 in Deposited Plan Number 30186.

Figure 2.3 – View of the Site from Tallawong Road

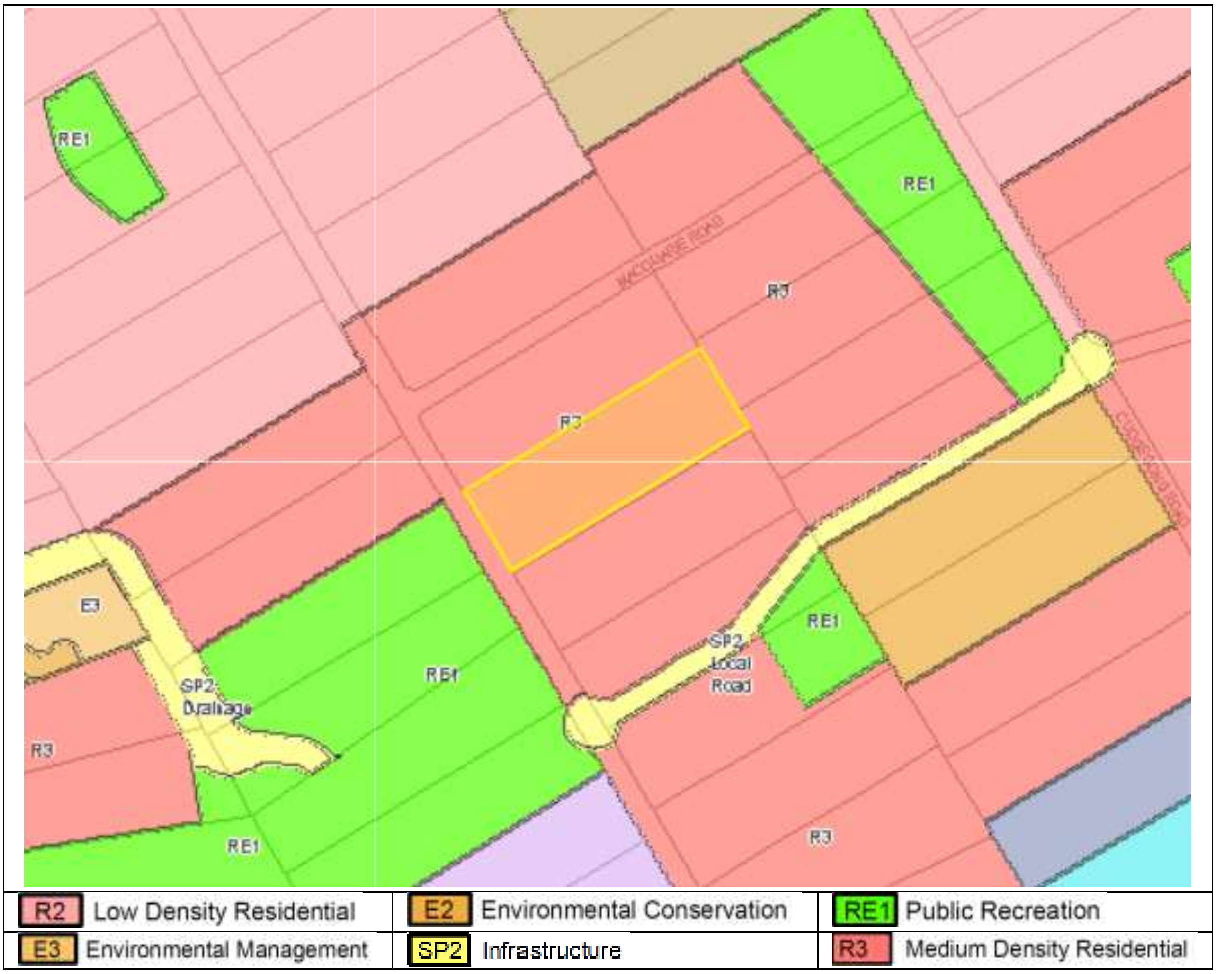


Figure 2.4 – Zoning Details

3 PROPOSED DEVELOPMENT

The proposed development involves the construction of a multilevel flat building, incorporating retail spaces on the ground floor, and a possible level of affordable housing.

The development is described in the plans and drawings provided in Figures 3.1 to 3.10 on subsequent pages, as follows:

Figure 3.1	Proposed 3-Lot Sub-Division
Figure 3.2	Site Plan
Figure 3.3	Lot 1 Site & Ground Floor Plan
Figure 3.4	Lot 2 Site & Ground Floor Plan
Figure 3.5	Lot 3 Site & Ground Floor Plan
Figure 3.6	Lot 1 Level 1 Plan
Figure 3.7	Lot 1 Level 2 Plan
Figure 3.8	Lot 1 Level 3 Plan
Figure 3.9	Proposed Lot 1 Sections
Figure 3.10	Lot 2 Level 1 Plan
Figure 3.11	Lot 2 Level 2 Plan
Figure 3.12	Lot 2 Level 3 Plan
Figure 3.13	Proposed Level 2 Sections
Figure 3.14	Lot 3 Level 1 Plans
Figure 3.15	Lot 3 Level 2 Plans
Figure 3.16	Lot 3 Level 3 Plans
Figure 3.17	Proposed Lot 3 Sections

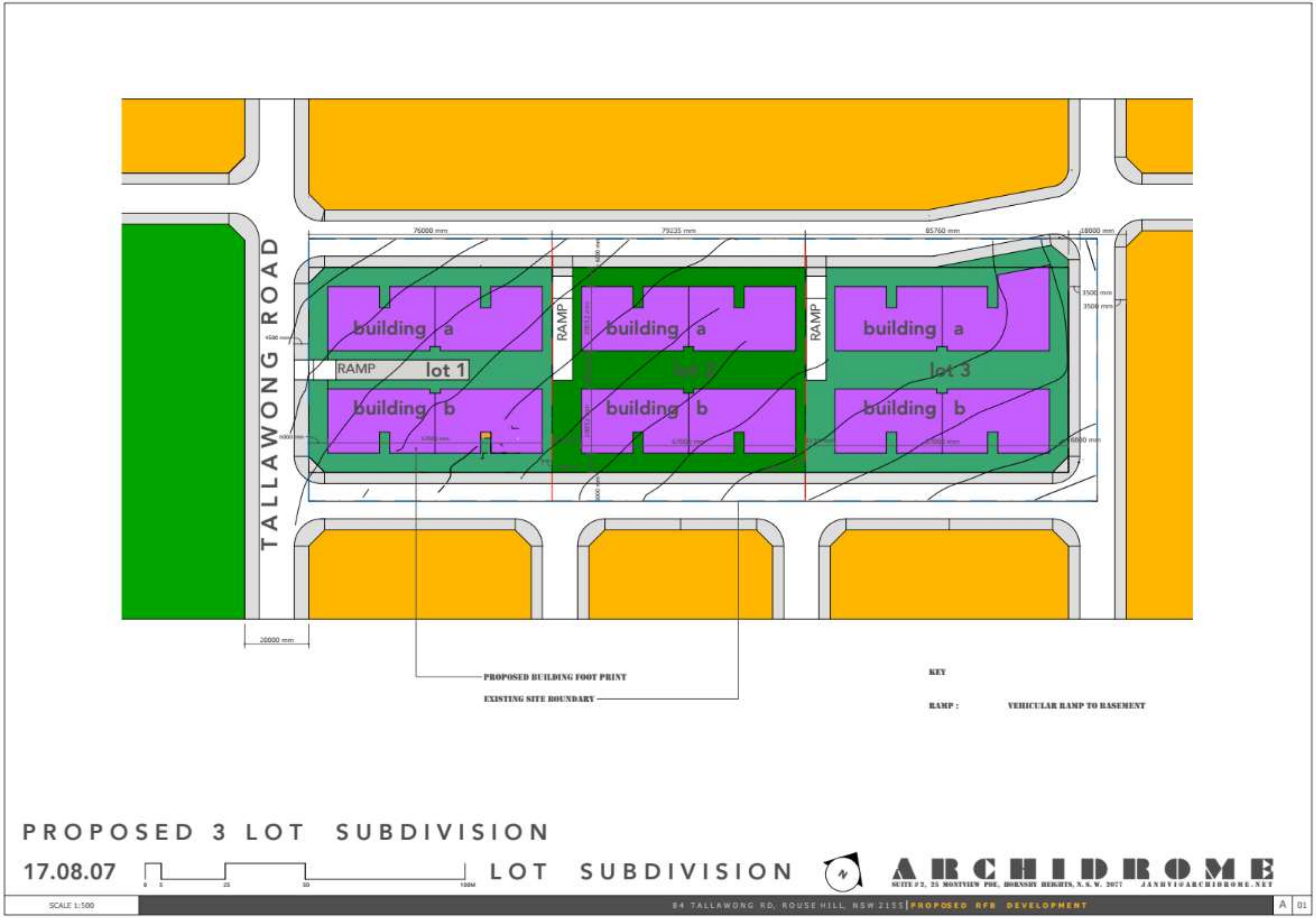


Figure 3.1 – Proposed 3-Lot Sub-Division

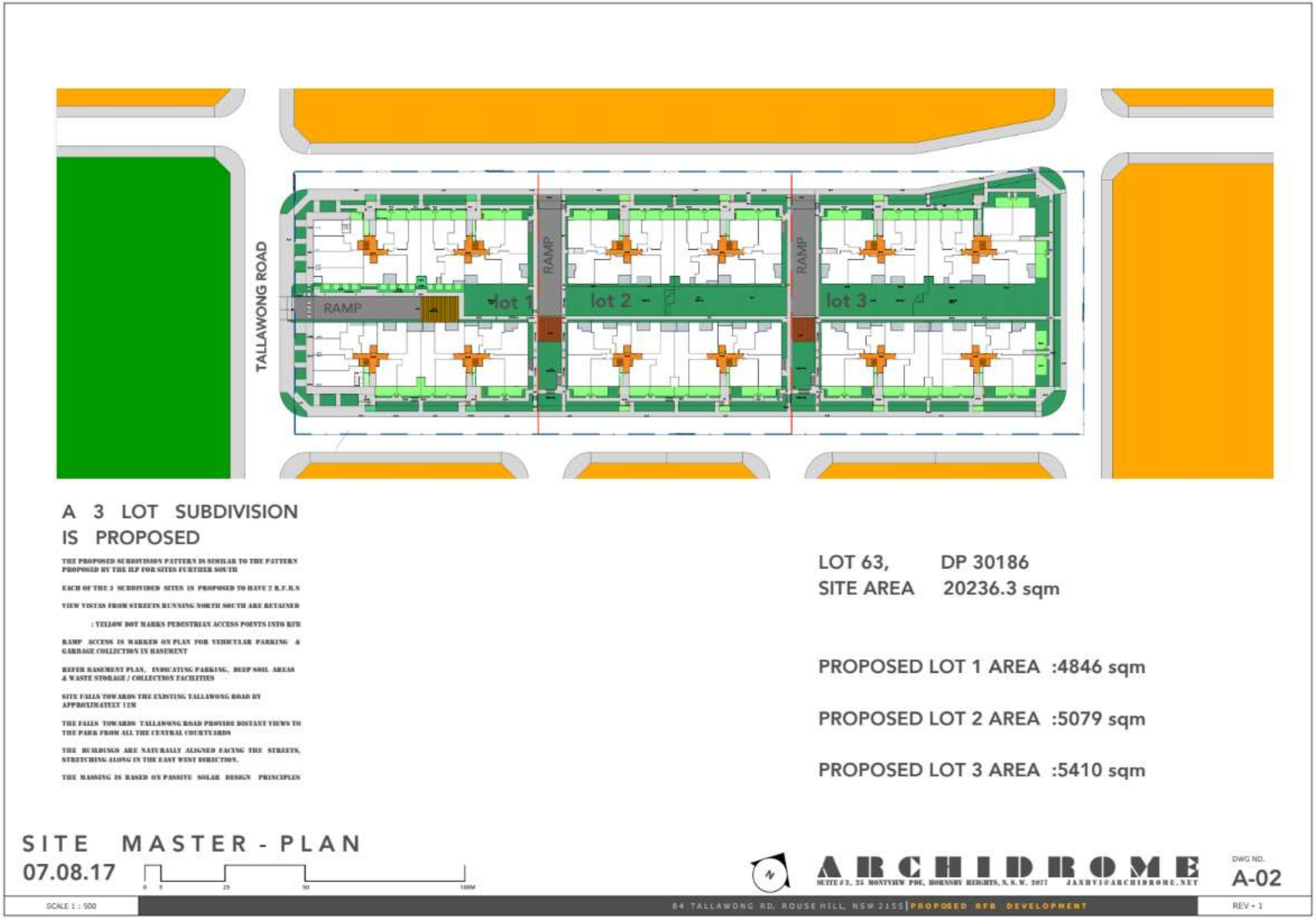


Figure 3.2 – Site Plan

Figure 3.3 – Lot 1 Site & Ground Floor Plan

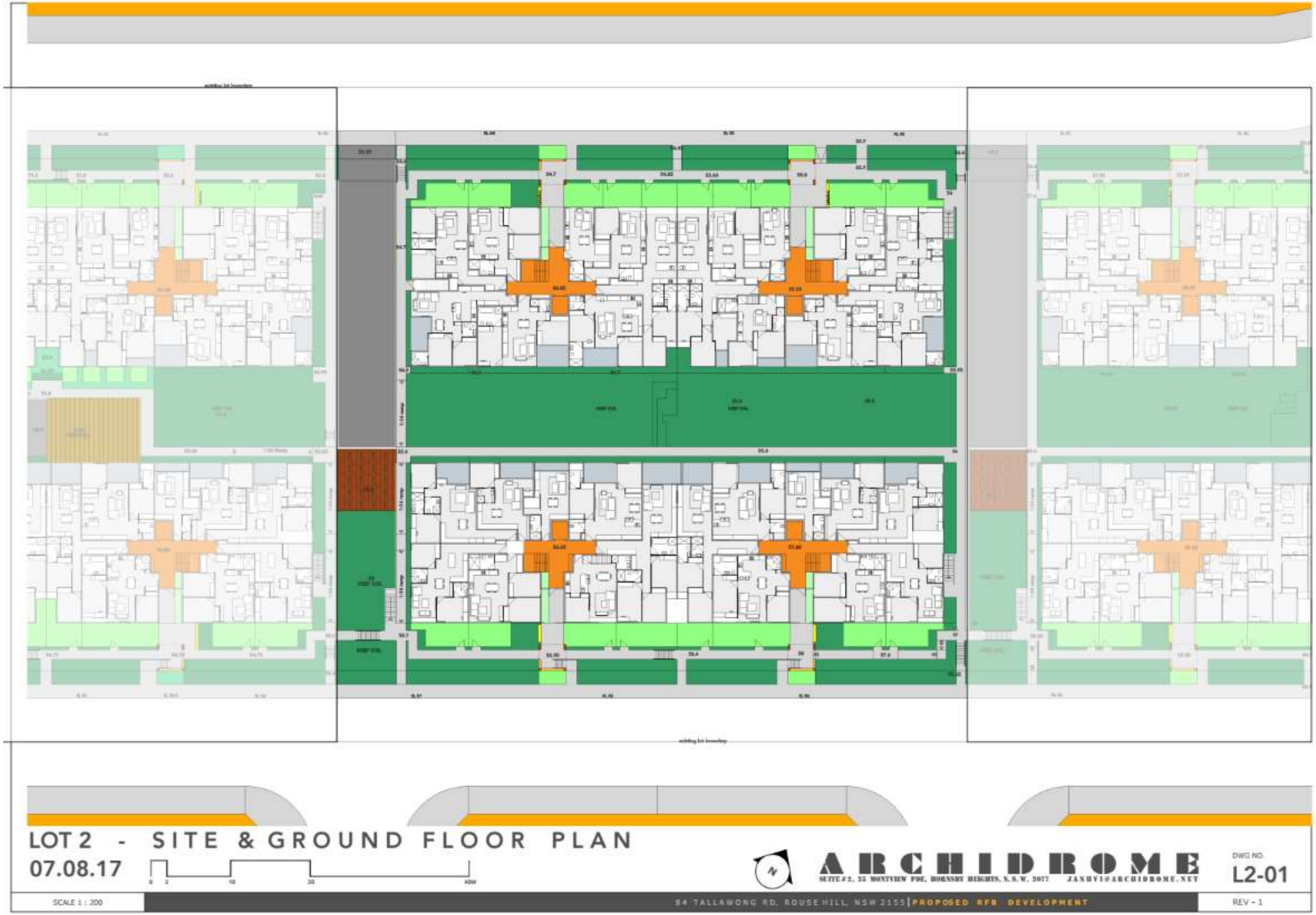


Figure 3.4 – Lot 2 Site & Ground Floor Plan

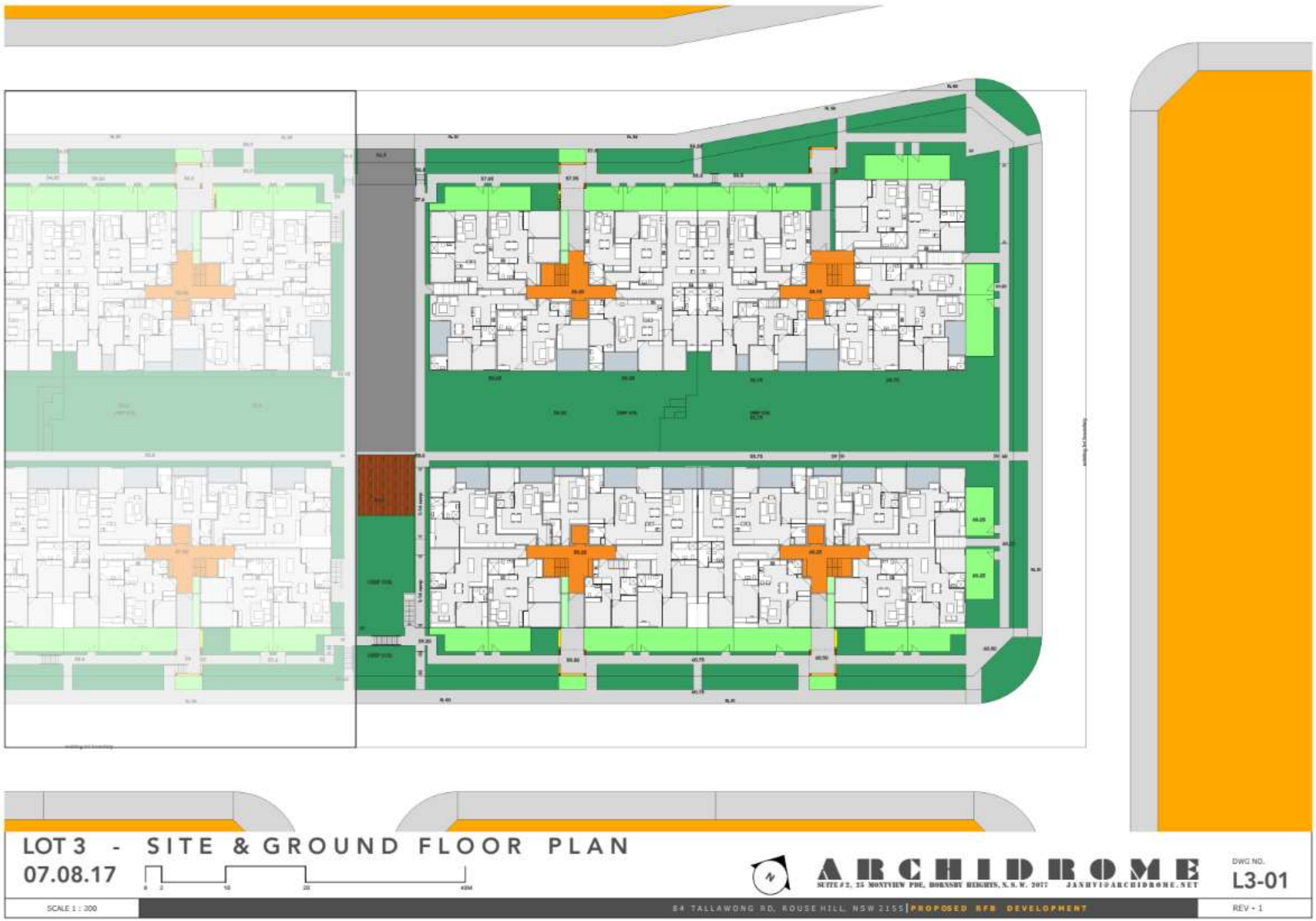


Figure 3.5 – Lot 3 Site & Ground Floor Plan

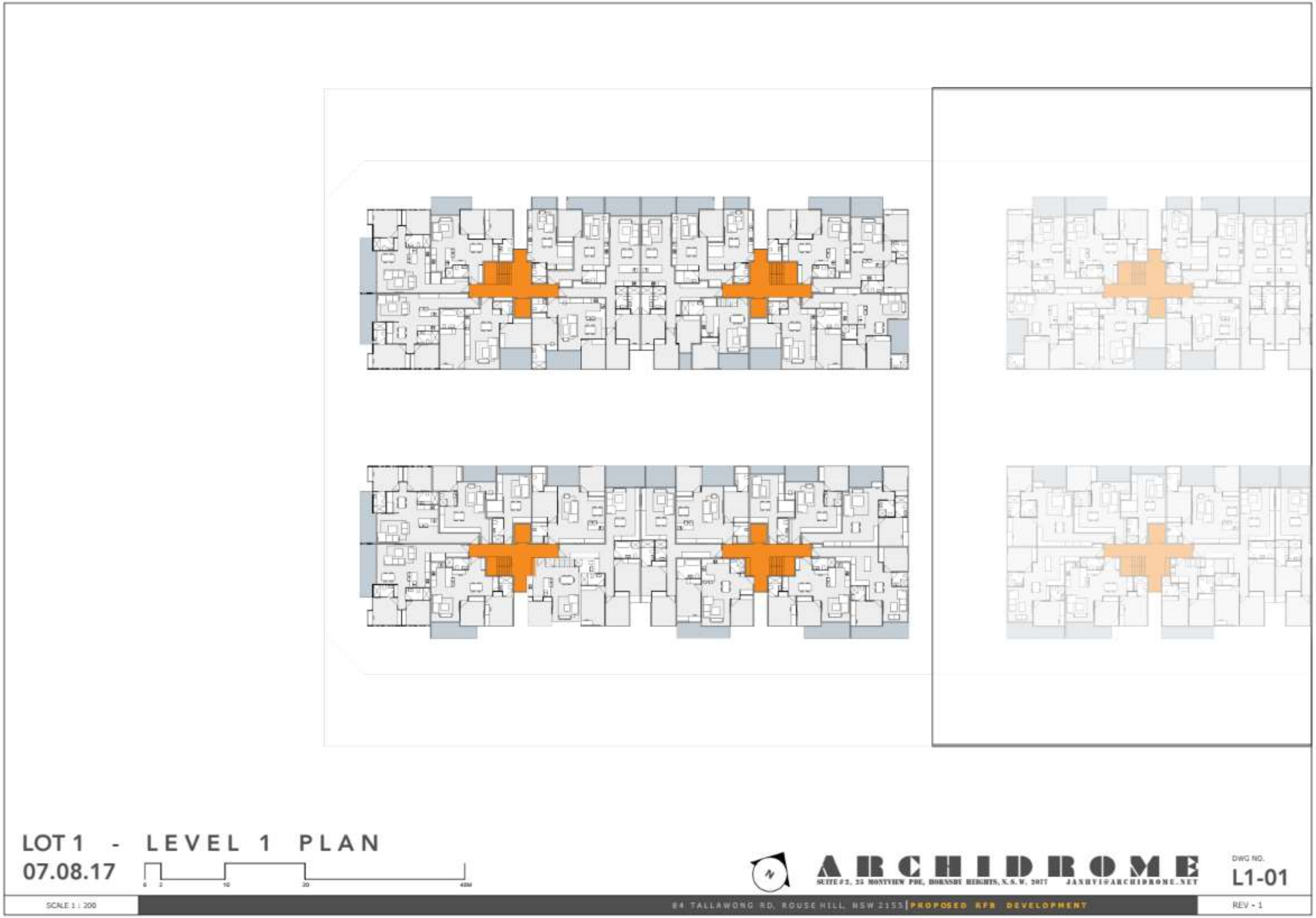


Figure 3.6 – Lot 1 Level 1 Plan

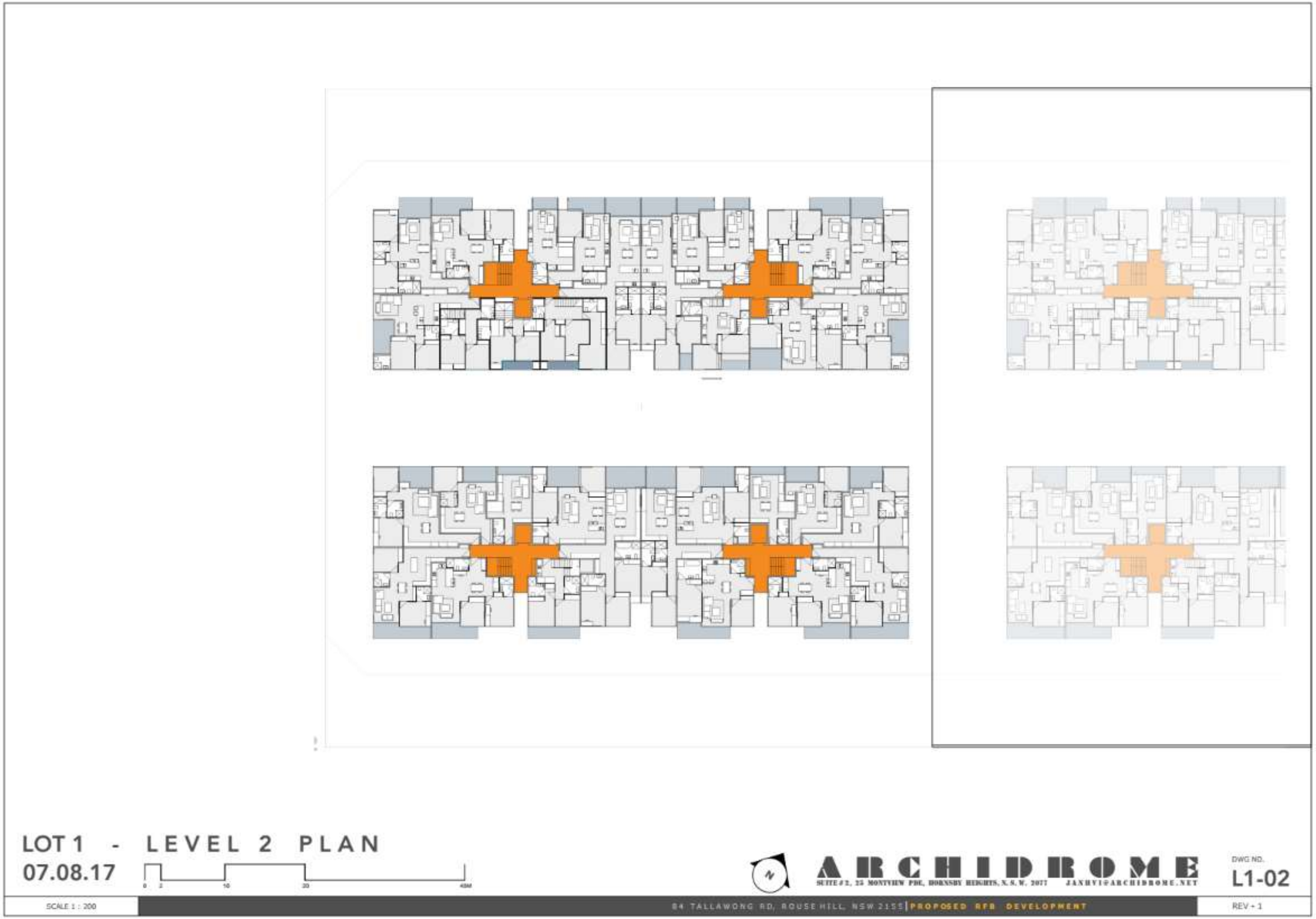


Figure 3.7 - Lot 1 Level 2 Plan

Figure 3.8 – Lot 1 Level 3 Plan

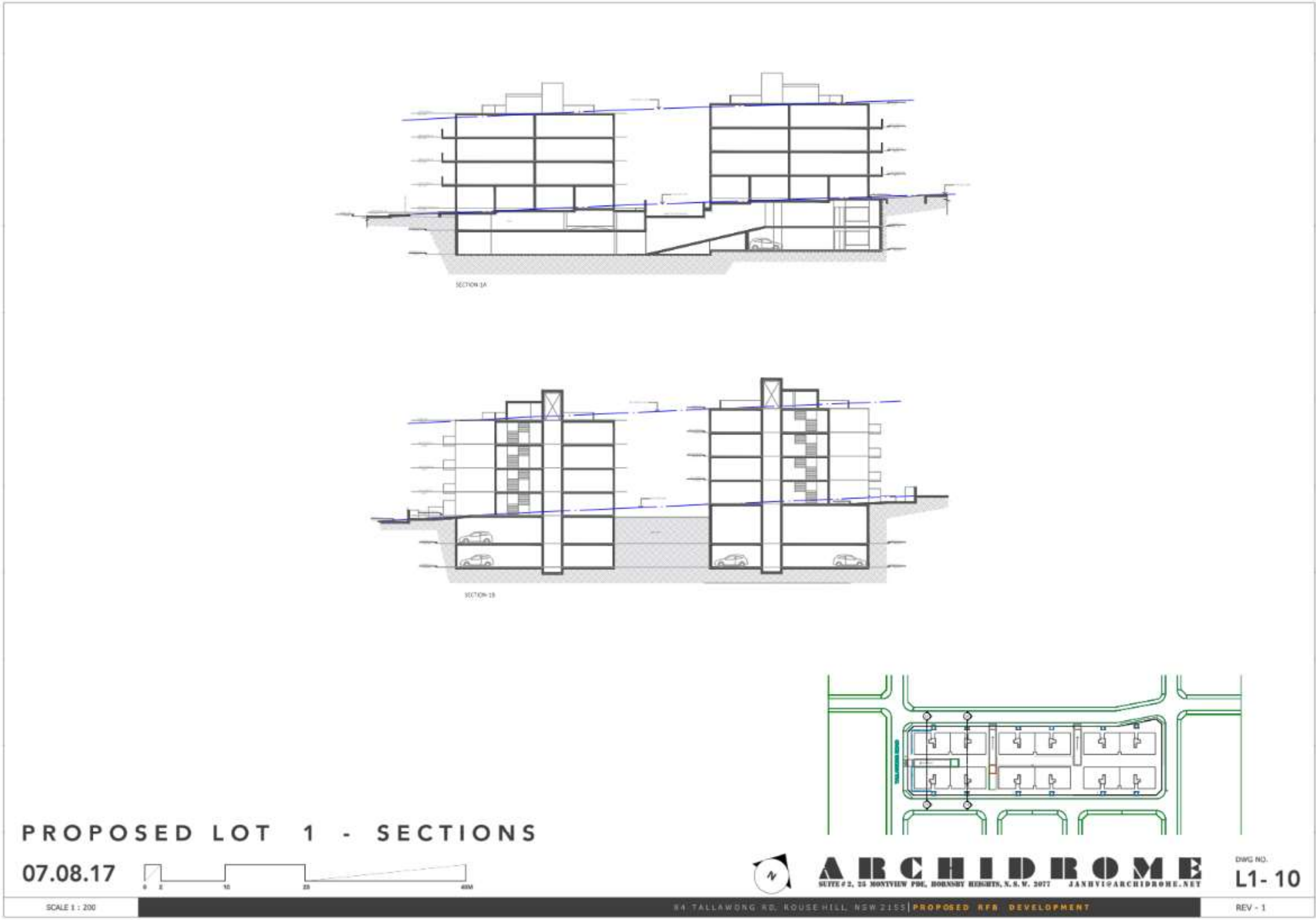


Figure 3.9 – Proposed Lot 1 Sections

Figure 3.10 – Lot 2 Level 1 Plan

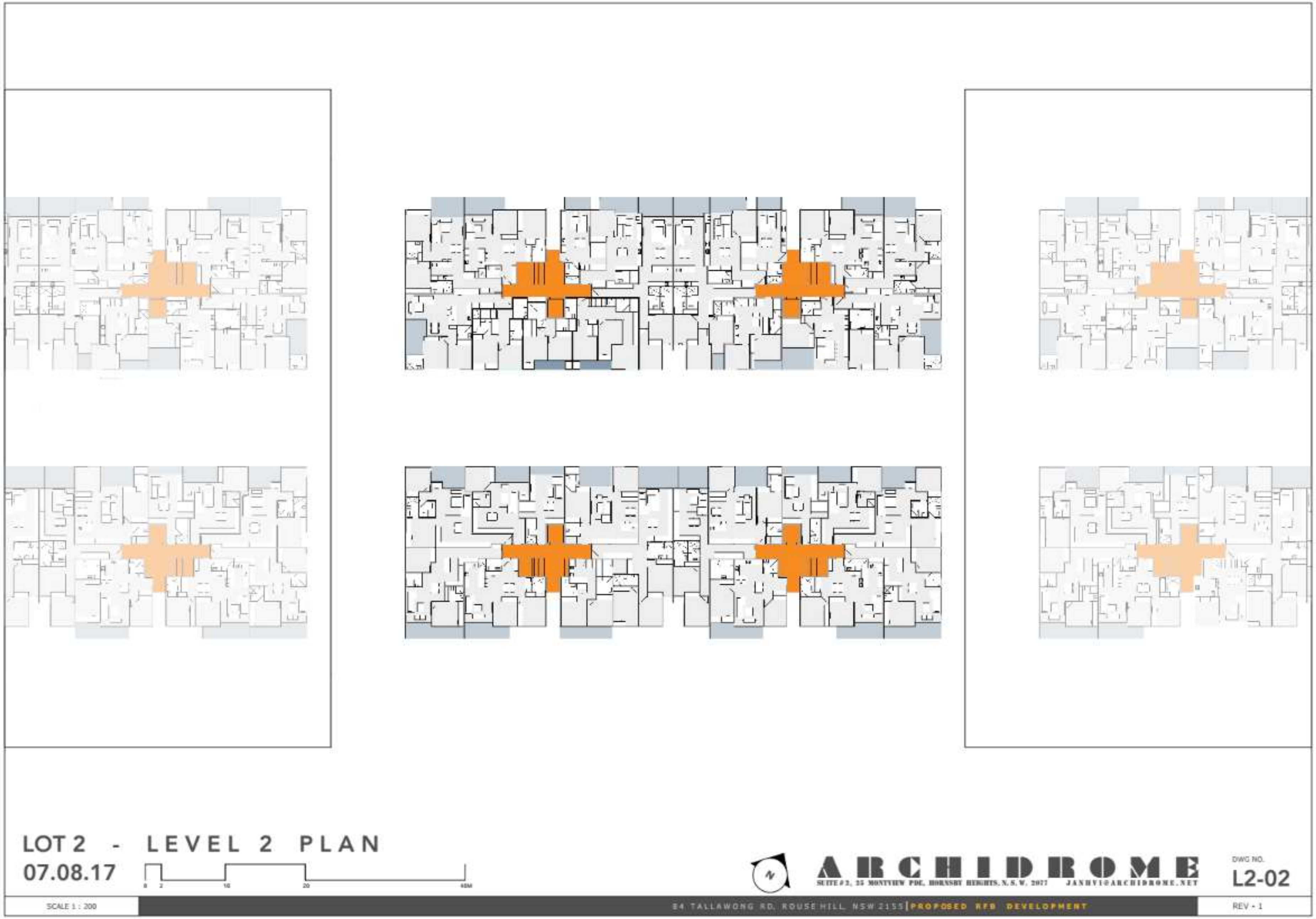


Figure 3.11 – Lot 2 Level 2 Plan

Figure 3.12 – Lot 2 Level 3 Plan

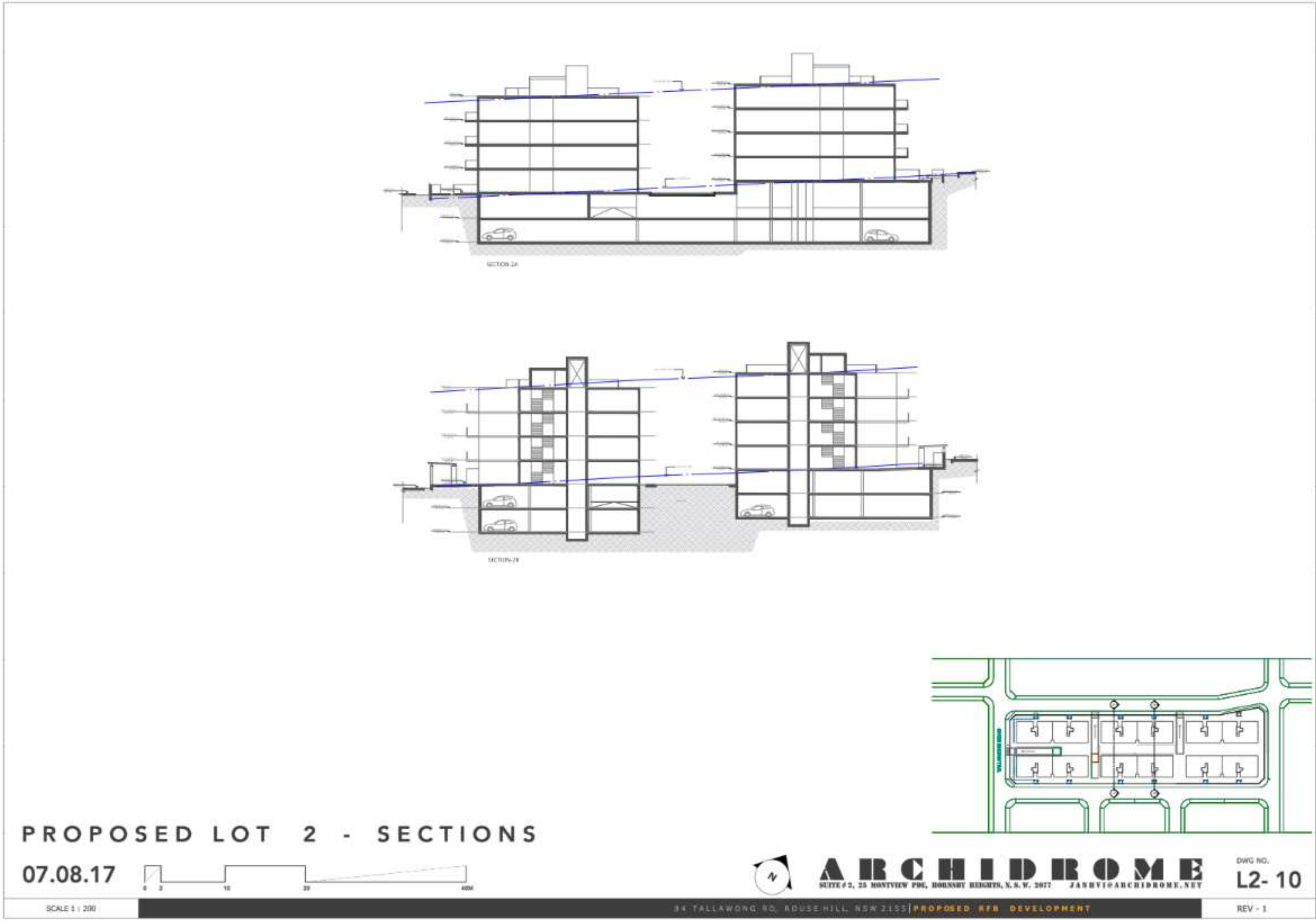


Figure 3.13 – Proposed Lot 2 Sections

Figure 3.14 – Lot 3 Level 1 Plan

Figure 3.15 – Lot 3 Level 2 Plan

Figure 3.16 – Lot 3 Level 3 Plans

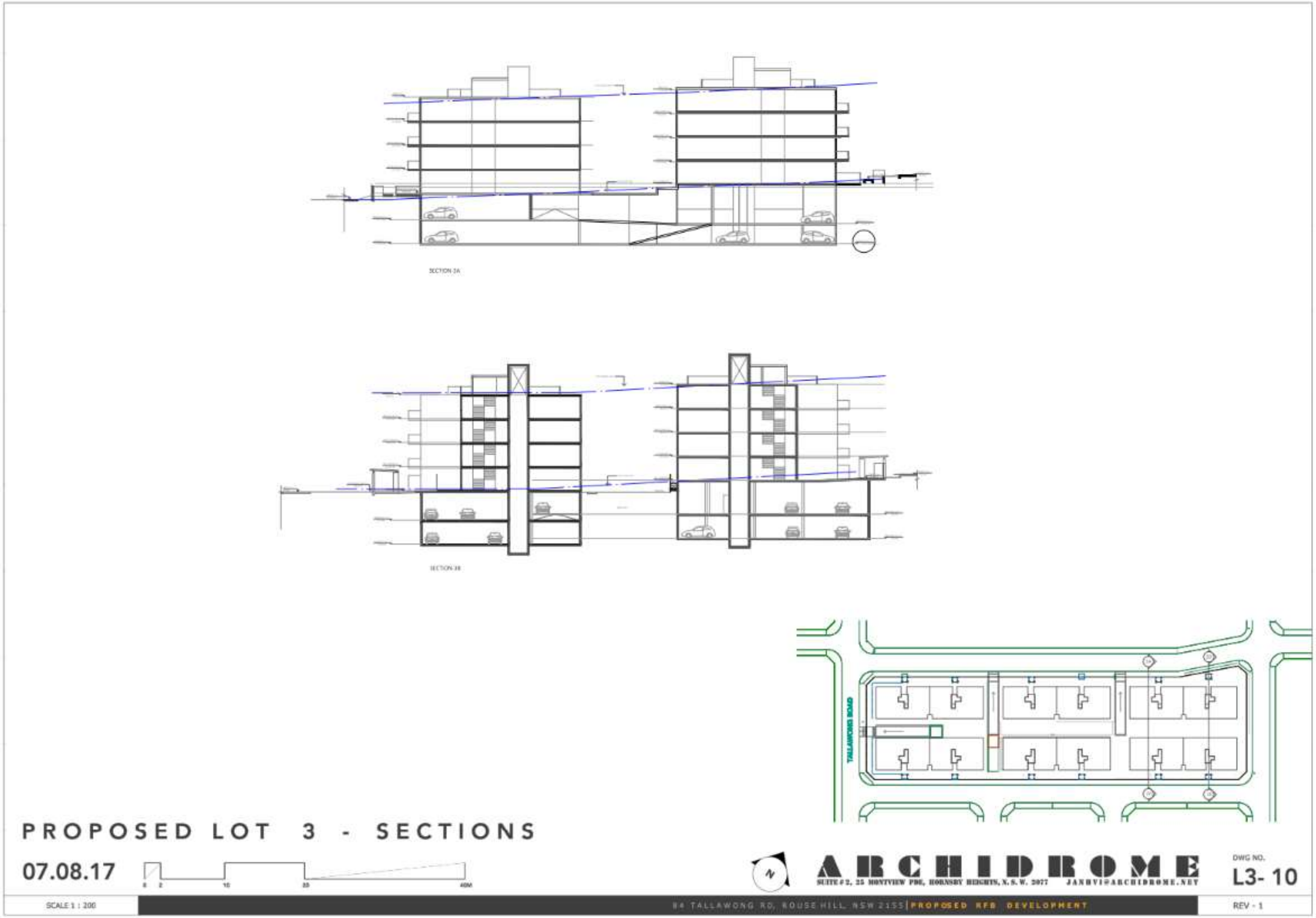


Figure 3.17 – Proposed Lot 3 Sections

4 ACOUSTIC ASSESSMENT GUIDELINES

4.1 GENERAL GUIDELINES

A summary of relevant acoustic assessment and reporting guidelines has been included below, for reference.

Noise Guide for Local Government (2009), NSW Office of Environment & Heritage (OEH);

Australian Building Codes Board (ABCB) Regulation Impact Statement (August 2012);

NSW Government Department of Planning Infrastructure SEPP 2007; and

NSW Industrial Noise Policy (1999), NSW Office of Environment & Heritage (OEH).

AS 3671 Road Traffic Noise Intrusion

AS 1055 Parts 1, 2 and 3 - 1997 Acoustics - Description and Measurement of Environmental Noise

AS 2107 - 1987 Acoustics - Recommended design sound levels and reverberation times for building interiors

State Environmental Planning Policy (Infrastructure) 2007

The requirements of these guidelines have been taken into account in the assessment presented in this document.

4.2 BLACKTOWN CITY COUNCIL

Details of Blacktown City Council policies and guidelines in relation to acoustic issues and performance are provided in the Blacktown Local Environment and Development Control Plans.

These guidelines have been taken into account in the assessment presented in this document.

4.3 INDUSTRIAL NOISE POLICY

Any noise criteria described in the NSW Industrial Noise Policy that are relevant to the proposed development will be taken into account in the services proposed.

The noise criterion set out in the INP depends on whether existing noise levels in a given area are close to recommended amenity levels for different types of residential receiver, for example whether the receivers in question are urban, rural, near existing roads and so on. In this case, the potential receivers in question appear to be both commercial and residential in nature.

The Industrial Noise Policy requires that the following actions or circumstances are taken into account in the acoustic assessment of a development of the type proposed:

- ❑ Identify the existing level of noise, or noise background
- ❑ Determine what weather conditions should be used when predicting noise background
- ❑ Assess noise levels that will be involved with the various aspects of the proposed development
- ❑ Assess noise from the proposed development at residential receivers
- ❑ Assess noise from the proposed development at industrial/commercial receivers
- ❑ Apply the urban/industrial interface amenity category, if required
- ❑ Identify the appropriate receiver amenity category
- ❑ Apply amenity criteria in high traffic noise areas
- ❑ Take into account any cumulative noise from multiple developments
- ❑ Identify which of the amenity or intrusive criteria apply
- ❑ Take into account maximum noise levels during shoulder periods
- ❑ Consider the tonality - sliding scale test
- ❑ Apply duration correction, if required

- Sleep disturbance
- Present the results of the acoustic assessment in appropriate report form

Further comments on some of these assessment criteria are included in Sections 4.6 to 4.9, below.

4.4 INTRUSIVENESS CRITERION

As set out in the various reference guidelines listed above, where existing noise levels are low, noise levels from a proposed new (or changed) operation are limited by the intrusiveness criterion.

In such cases, the L_{Aeq} noise level resulting from the impact of any new or substantially changed operation should not exceed the Rating Background Level (RBL) applicable to the residential receivers in question by more than 5dBA.

4.5 AMENITY CRITERION

The amenity criterion sets an upper limit to control the L_{Aeq} noise level from all industrial sources for daytime, evening and night time periods respectively. In accordance with the relevant acoustic criteria and guidelines listed, “maximum” recommended incremental noise levels for these periods are all 5 dBA higher than the “acceptable” levels mentioned in the various NSW acoustic guidelines.

4.6 INTERPRETATION OF CRITERIA

Where noise levels from industrial sources are close to or above the 5dBA maximum increment over the existing Rating Background Level, as recommended in the NSW Industrial Noise Policy, then the amenity criterion, which incorporates a sliding scale to set limits, becomes relevant. The sliding scale prevents the overall noise level exceeding the acceptable level as a result of a new noise source.

The amenity criterion also needs to consider the possibility of other developments which may affect aggregate noise levels in any given situation.

4.7 SLEEP DISTURBANCE

Intermittent noises such as trucks and loading dock activities during the night time period are not directly addressed by the Industrial Noise Policy. In order to minimise any risk of sleep disturbance to affected residential receivers as a consequence of operations that occur during the night time period (10:00pm – 7:00am), the NSW Office of Environment & Heritage (OEH) recommends that:

> *Sleep disturbance is assessed as the emergence of the $L_{A\ (1\ minute)}$ level above the $L_{A90\ (15\ minute)}$ level at the time. Appropriate screening criteria for sleep disturbance are determined to be an $LA1_{(I\ minute)}$ level 5dBA above the Rating Background Level (RBL) for the night time period.*

This approach to the assessment of sleep disturbance has been discussed with the NSW OEH by the author of this assessment proposal.

The NSW OEH has confirmed that this is the correct and accepted way to undertake the assessment of sleep disturbance.

4.8 NOISE FROM PLANT & EQUIPMENT

Council requires that noise from plant and equipment associated with the development will not exceed measured background sound levels at any property boundary by more than 5 dBA.

This requirement has been addressed in the acoustic assessment presented in this document.

4.9 SUMMARY OF ACOUSTIC GUIDELINES & REQUIREMENTS

Taking into account all relevant guidelines, the acoustic conditions that will be required to be demonstrated in relation to the proposed development are as follows:

The effect of noise from external sources on the apartment development:

Type of Occupancy	Noise Level dBA	Applicable Time Period
Sleeping Areas (Bedrooms)	35	Night (10 pm to 7 am)
Other Habitable Rooms (excluding garages, kitchens, bathrooms and hallways)	40	At any time

The principal source of external noise appears to be road traffic on Tallawong Road.

However, all other potential noise sources have been considered as part of the assessment.

Demonstration that these outcomes will be achieved, and the design and structural approaches needed to do so, has been one of the key purposes of this acoustic assessment.

The effect of noise from the apartment development on nearby receivers:

Type of Receiver	Noise Level dBA	Applicable Time Period
Nearby Residential Properties	+ 5dBA (max)	At any time
Nearby Commercial Properties	65 dBA (max)	At any time

The requirement in relation to the impact of noise associated with the apartment development on nearby residential properties is that such noise is not permitted to result in an increase of more than 5 dBA at the boundary between the apartment development and the nearest residence.

The requirement in relation to the impact of noise associated with the apartment development on nearby commercial properties is that such noise is not permitted to result in a noise level of greater than 65 dBA at the boundary between the apartment development and any nearby commercial property.

These requirements regarding the acoustic or noise impact of the proposed residential development on nearby properties have been carefully considered as part of this acoustic assessment.

4.10 VIBRATION ASSESSMENT

4.10.1 Introduction & Overview

Where occupants can detect vibration in buildings, this may potentially impact on their quality of life.

Typical sources of vibration include construction and excavation equipment, rail and road traffic, and industrial machinery.

In this case, vibration caused by road traffic on nearby roads is considered to be the principal potential sources of vibration at the proposed development site, although the measurement based assessment method adopted, as described below, takes in to account all potential sources of vibration.

Individuals can detect building vibration values that are well below those that can cause any risk of damage to the building or its contents.

The level of vibration that affects amenity is lower than that associated with building damage.

This means that if detected levels of vibration fall below the criteria levels applicable to human response, then as an automatic consequence levels of vibration are, to an even greater extent, below those involving risk to building or structural integrity.

4.10.2 Types of Vibration

Vibration in buildings can be caused by many different external sources, including industrial, construction and transportation activities.

The vibration may be continuous (with magnitudes varying or remaining constant with time), impulsive (such as in shocks) or intermittent (with the magnitude of each event being either constant or varying with time).

Continuous, impulsive or intermittent vibration are defined as follows:

Continuous vibration continues uninterrupted for a defined period (usually throughout daytime and/or night-time).

This type of vibration is assessed on the basis of weighted metres per second acceleration values (m/sec^2).

Impulsive vibration is a rapid build up to a peak followed by a damped decay that may or may not involve several cycles of vibration (depending on frequency and damping).

It can also consist of a sudden application of several cycles at approximately the same amplitude, providing that the duration is short, typically less than 2 seconds.

Impulsive vibration (no more than three occurrences in an assessment period) is also assessed on the basis of acceleration values.

Intermittent vibration can be defined as interrupted periods of continuous (e.g. a drill) or repeated periods of impulsive vibration (e.g. a pile driver), or continuous vibration that varies significantly in magnitude.

It may originate from impulse sources (e.g. pile drivers and forging presses) or repetitive sources (e.g. pavement breakers), or sources which operate intermittently, but which would produce continuous vibration if operated continuously (for example, intermittent machinery, railway trains and traffic passing by).

This type of vibration is assessed on the basis of vibration dose values.

In this case, the only apparent source of potential vibrational impacts is the operation of road traffic, and the potential vibration source is considered to be primarily continuous in nature.

The assessment of vibration requires the use of an overall frequency-weighted value for each axis (x, y and z directions).

This overall value is assessed against the preferred value for the relevant axis.

it is important to note that vibration may enter the body along different orthogonal axes, i.e. x-axis (back to chest), y-axis (right side to left side) or z-axis (foot to head) (see Figure 4.1). The three axes are referenced to the human body.

Thus, vibration measured in the horizontal plane should be compared with x- and y-axis criteria if the concern is for people in an upright position, or with the y- and z-axis criteria if the concern is for people in a lateral position (e.g. asleep at night).

When measured vibration values exceed the preferred values, then mitigation measures to meet the preferred values should be considered.

Where measured values are lower than the preferred values, vibration is generally found not to be an issue of concern, and no further remedial actions are required.

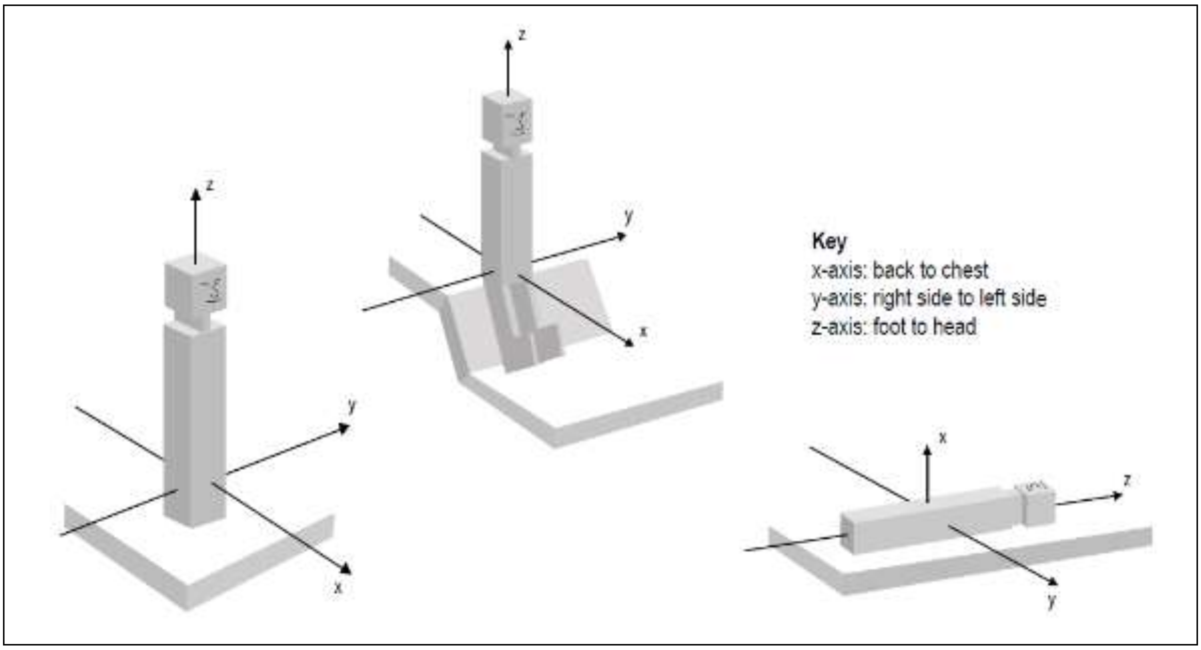


Figure 4.1 - Axes for Assessment of Human Exposure to Vibration (BS 6472–1992)

4.10.3 Relevant Standards

Over the past two decades, ISO, British and Australian Standards for vibration evaluation and assessment have converged. BS 6472–1992, *Evaluation of human exposure to vibration in buildings (1 Hz to 80 Hz)*, ISO 2631.1–1997, *Mechanical vibration and shock – Evaluation of human exposure to whole-body vibration – Part 1: General requirements*, and ISO 2631.2–1989, *Evaluation of human exposure to whole-body vibration – Part 2: Continuous and shock induced vibration in buildings (1–80 Hz)*, contain the most recent advances in vibration evaluation.

This assessment has taken these standards fully into account.

5 ACOUSTIC MEASUREMENTS

5.1 UNATTENDED BACKGROUND MEASUREMENTS

Unattended noise monitoring was conducted at the site between Monday 17th and Sunday 23rd July 2017.

The noise monitor was installed in a representative location at the rear of the existing residence at the site, and secured by locked chain to a metal ground spike for security. The location is indicated by the letter "A" in Figure 5.1, below.

Figure 5.1 – Background Acoustic & Vibration Monitoring Locations

The recording microphone was located 1000 mm above ground level, in free field conditions.

5.2 INSTRUMENTATION

The noise monitoring equipment used for these measurements was a Brüel & Kjaer 2238 noise monitoring terminal, incorporating a Brüel & Kjaer 2238 sound level meter. The instrument was set to A-weighted, fast response, and was programmed to monitor on a continuous basis over 15-minute sampling periods, and to store sound level descriptors for later detailed analysis. The equipment calibration was checked before and after the survey and no significant drift was noted.

5.3 ACOUSTIC PARAMETERS

The logger was set to measure the Lmax, LAmin, LA90 and LAeq levels of the existing sound or noise environment. The LAmax measure reflects the highest noise level recorded during each monitoring period, and is indicative of maximum noise levels due to individual noise events such as the occasional pass-by of a heavy vehicle on Tallawong Road.

The LA90 level is generally adopted as the background noise level, excluding road and rail; traffic noise influences.

The LAeq level is the Equivalent Continuous Sound Level and has the same sound energy over the sampling period as the actual noise environment with its fluctuating sound levels.

The LAeq is accepted for acoustic assessment purposes as the standard descriptor for environmental noise that is noise including influences such as road and rail traffic noise

The LAeq measure has been used for that purpose in this assessment.

Weather during the measurement period was consistently fine, and no adjustments to the measured data (to take into account extreme meteorological conditions) were required, or applied.

Detailed reports of sound level measurements have been included for reference at Appendix B. Summaries of the key LA90 and LAeq descriptors for the seven days of the monitoring period are shown in Table 5.1, below.

Table 5.1 – Unattended Background Noise Level Monitoring Results

	Mean logarithmic LA90 Day-time (7:00am to 6:00pm) *	**Mean logarithmic LA90 Evening (6:00pm to 10:00pm)**	**Mean logarithmic LA90 Night-time (10:00pm to 7:00am)**
Mon 17 July 2017	42.0833	40.0625	35.1406
Tue 18 July 2017	44.5455	39.4063	37.6806
Wed 19 July 2017	44.5833	39.8125	35.5000
Thu 20 July 2017	44.9318	40.1250	35.5833
Fri 21 July 2017	44.2500	38.5000	33.5781
5 Working Days	**44.0360**	**39.8516**	**35.9761**
Sat 22 July 2017	38.6875	36.2813	32.9844
Sun 23 July 2017	38.2708	35.9688	31.9531
2 Day Weekend	**38.4792**	**36.1250**	**32.4688**
	Mean logarithmic LAeq Day-time (7:00am to 6:00pm) *	**Mean logarithmic LAeq Evening (6:00pm to 10:00pm)**	**Mean logarithmic LAeq Night-time (10:00pm to 7:00am)**
Mon 17 July 2017	50.0521	47.5000	40.9844
Tue 18 July 2017	50.5795	47.0000	42.8750
Wed 19 July 2017	50.5729	46.5625	43.3594
Thu 20 July 2017	51.0682	46.7188	42.7500
Fri 21 July 2017	50.6979	45.6875	39.9688
5 Working Days	**50.5682**	**46.9453**	**42.4922**
Sat 22 July 2017	48.6458	45.5625	40.2813
Sun 23 July 2017	48.0625	44.9063	40.1563
2 Day Weekend	**48.3542**	**45.2344**	**40.2188**

* Sundays and Public Holidays daytime commences 8:00am

A summary of the LA90 and LAeq noise measures for the 2-day weekend and 5-day working week periods, as used in this assessment, is presented in Table 4.2, on the following page.

Table 5.2 – Noise Monitoring Summary

	Mean logarithmic LA90 Day-time (7:00am to 6:00pm) *	Mean logarithmic LA90 Evening (6:00pm to 10:00pm)	Mean logarithmic LA90 Night-time (10:00pm to 7:00am)
5 Working Days	44.0	39.9	36.0
2 Day Weekend	38.5	36.1	32.5
	Mean logarithmic LAeq Day-time (7:00am to 6:00pm) *	Mean logarithmic LAeq Evening (6:00pm to 10:00pm)	Mean logarithmic LAeq Night-time (10:00pm to 7:00am)
5 Working Days	50.6	46.9	42.5
2 Day Weekend	48.4	45.2	40.2

* Sundays and Public Holidays daytime commences 8:00am

5.4 RATED BACKGROUND SOUND LEVELS

The acoustic measurements described in Section 5.3 above effectively quantify external noise with the potential to impact on the proposed development, with the general acoustic background without road and rail traffic noise identified by the LA90 measure, and existing road and rail traffic noise by the LAeq measure.

In this case, daytime and night-time background sound levels are both relevant to the assessment.

Daytime external sound levels are relevant to the requirement to achieve a maximum sound level of 40 dBA in any habitable room within the development, at any time.

Daytime external sound levels are the highest measured (refer Section 4.3), and therefore conditions that achieve required indoor sound levels in the case of daytime external noise levels will also achieve these outcomes in other periods, when external sound levels are lower.

Night-time external sound levels are relevant to the requirement to achieve a maximum sound level of 35 dBA in any bedroom within the development during the night-time (10:00pm – 7:00am) period.

Rated Background Sound Levels for this assessment project, based on the data presented in Section 5.3, are identified in Table 5.3, below.

Table 5.3 – Rated Background Sound Levels

Rated Background Sound Levels for Assessment Purposes	
Daytime:	
LA90	44
LAeq	51
Night-time:	
LA90	36
LAeq	43

These rated background levels have been rounded to the first decimal place, and are the highest average parameters recorded during the seven-day period of continuous monitoring, on the basis that guideline criteria for sound levels within habitable rooms at the proposed residential development are required to be achieved at all times, and therefore need to take into account the highest background sound levels measured.

6 ACOUSTIC ASSESSMENT

6.1 INTRODUCTION

The acoustic assessment of the proposed development requires consideration of both the impacts that existing environmental sound and noise levels might have on the proposed development and its future residents and occupants, and also the likely acoustic impacts that the development and its associated activities might have on potentially affected individuals, residences and activities.

ACOUSTIC IMPACTS ON THE DEVELOPMENT

Existing external noise that will impact on the development will include:

- Human activity in the vicinity of the development;
- Operation of mechanical devices near the development;
- Noise generated by traffic on Tallawong Road and other nearby roads;
- Noise generated on the nearby rail line; and
- Any other existing environmental noise.

Preliminary consideration of the proposed development, and the development site, suggests that noise generated by road and rail traffic will be the primary external acoustic factors.

Consideration of the impacts of external noise on the proposed development, including actions necessary to ensure that relevant internal sound levels are achieved, is presented in Section 5.3, below.

ACOUSTIC IMPACTS OF THE DEVELOPMENT

Noise generated by the development itself will include:

- Human activity associated with the development;
- Traffic noise associated with the development; and
- Operation of mechanical plant associated with the development.

Consideration of the acoustic impacts that the proposed development will have on neighbouring premises is presented in Section 6.4, below.

6.2 RATED BACKGROUND SOUND LEVELS

The acoustic measurements described in Section 4 of this report effectively quantify external noise with the potential to impact on the proposed development, with the general acoustic background without road and rail traffic noise identified by the LA90 measure, and background noise including existing road and rail traffic noise indicated by the LAeq measure. In this case, both daytime and night-time background sound levels are relevant.

Daytime external sound levels are relevant to the requirement to achieve a maximum sound level of 40 dBA in any habitable room within the development, at any time.

Daytime external sound levels are the highest measured (refer Section 4), and therefore conditions that achieve required indoor sound levels in the case of daytime external noise levels will also achieve these outcomes in other periods, when external sound levels are lower.

Night-time external sound levels are relevant to the requirement to achieve a maximum sound level of 35 dBA in any bedroom within the development during the night-time (10:00pm – 7:00am) period.

Based on the background data described in Section 4, the rated background sound levels adopted for this assessment, in accordance with relevant acoustic assessment guidelines, are as shown in Table 6.1, on the following page.

Table 6.1 – Rated Background Sound Levels

Rated Background Sound Levels for Assessment Purposes	
Daytime:	
LA90	44
LAeq	51
Night-time:	
LA90	36
LAeq	43

These rated background levels have been rounded to the nearest whole decibel, and are the highest average parameters recorded during the seven-day period of continuous monitoring, on the basis that guideline criteria for sound levels within habitable rooms at the proposed residential development are required to be achieved at all times, and therefore need to take into account the highest background sound levels measured.

6.3 SOUND TRANSMISSION RATINGS

The Building Code of Australia (BCA) requires that building elements have certain levels of insulation from airborne noise and impact sound.

Regulatory guidelines require that certain maximum sound or noise levels are achieved, or achievable, within the internal spaces of boarding houses and other residential structures.

The weighted sound reduction index (Rw) is the measure used to describe the acoustic performance of the various building elements making up a construction system.

Rw is a single number quantity for the airborne sound insulation rating of building elements.

As the acoustic performance of a material or construction improves, the higher the Rw value will be.

Rw ratings are determined by laboratory tests of a specimen of the construction system. The specimen is fixed within a frame to form the wall between two test chambers.

A high noise level is generated in one room and the difference in sound level between the source room and the receiver room represents the transmission loss through the test specimen.

The measurements are conducted over a range of sound frequencies. The Rw rating is then determined by comparing the results with reference curves.

Correction factors (C and Ctr) can be added to Rw to take into account the characteristics of particular sound spectra and indicate the performance drop of the wall in the corresponding sound frequency range.

The correction factor C relates to mainly mid to high frequency noise. The correction factor Ctr relates to lower to medium frequency noise.

The weighted sound reduction index is quoted as Rw (C, Ctr), where C and Ctr are correction factors representing different noise sources.

For example, if a wall is measured as Rw 54(-1, -4) the value of the index when the lower frequency correction factor (Ctr) is applied is:

$$Rw + Ctr = 54 + (-4)$$
$$Rw + Ctr = 50$$

In practice, small gaps and cracks which permit even minor air leakage will provide a means for sound transmission, leading to lower field performance.

This degradation in acoustic performance should be recognised, and an appropriate allowance made when selecting a tested system to achieve a particular Rw rating when installed.

The sound transmission class (STC) was the method that was used previously to measure acoustic performance.

The requirements of the BCA have changed to comply with international regulations and Rw is now used.

The STC was based on different criteria and did not include any correction factors.

6.4 ACOUSTIC IMPACTS ON THE PROPOSED DEVELOPMENT

6.4.1 General Considerations

The proposed development will be subject to the impact of noise generated by a range of external activities, including noise generated on Tallawong Road and other local roads.

An important part of this assessment is to consider those potential impacts, and to ensure that acoustic amenity consistent with relevant guidelines can be achieved in the various habitable rooms and bedrooms within the proposed development.

6.4.2 Design and Layout

Assessment of acoustic impacts needs to take into account the design and layout of the proposed development.

Plans included in Section 3 indicate that the proposed development will comprise three buildings, or Lots, proposed to be developed sequentially.

Lot 1 will be developed first, and will include retail spaces to the Tallawong Road frontage, together with a range of studio, I-bedroom, 2-bedroom and 3-bedroom residential apartments.

Lots 2 and 3 will comprise residential spaces only, once again in the form of studio, I-bedroom, 2-bedroom and 3-bedroom residential apartments.

Specific details for each of the three Lots, based on the plans and drawings included in Section 3, are summarised below.

These details have been adopted for acoustic assessment purposes.

Lot 1

Residential Units	
Studio	17
1 Bedroom	16
2 Bedroom	70
3 Bedroom	14
Total Number of Residential Units	**117**
Retail Spaces	
Total Number of Shops	**8**

Lot 2

Residential Units	
Studio	16
1 Bedroom	16
2 Bedroom	78
3 Bedroom	13
Total Number of Residential Units	**123**
Retail Spaces	
Total Number of Shops	**0**

Lot 3

Residential Units	
Studio	20
1 Bedroom	16
2 Bedroom	78
3 Bedroom	13
Total Number of Residential Units	**127**
Retail Spaces	
Total Number of Shops	**0**

6.4.3 Acoustic Implications of Design & Layout

The layout and design of the proposed development has the following acoustic implications:

- The eight retail spaces along the Tallawong Road façade of Lot 1 will be subject to acoustic impacts from traffic on Tallawong Road, however noise emissions and impacts from these retail spaces on the residential units in all three Lots will be substantially attenuated (or reduced) by solid structural elements in the case of Lot 1, and by solid structural elements and distance in the cases of Lots 2 and 3;

- The proposed residential units will be exposed to existing and future external ambient noise through external windows and doors (including balconies), but will otherwise enjoy the acoustic protection provided by the solid structural elements of the proposed buildings;

- The proposed residential units will be acoustically shielded by current and future road traffic noise from Tallawong Road by a combination of building bulk; distance and the acoustic attenuation provided by external building elements including solid form external walls, and associated glazed windows and doors; and

- Residential units with balcony frontages to external building walls will be shielded from acoustic influences both from adjoining units and external sources by the balcony structures themselves.

6.5 BUILDING DESIGN CONSIDERATIONS & RECOMMENDATIONS

6.5.1 Basic Construction & Noise Intrusion

The external walls of the proposed building will comprise masonry or masonry clad material, with a timber or metal framed and metal ort tile clad roof.

External masonry or masonry clad walls building elements provide very effective acoustic insulation and, noise intrusion will be mainly through lighter elements such as glazed doors and windows, and potentially through the roof structure.

The solid masonry external wall sections, whether solid or clad, will provide an acoustic reduction, or attenuation of at least 40 dBA (refer Appendix A), based on the known acoustic characteristics of such materials.

This in turn means that the worst case rated external environmental (road traffic) noise levels of 51 dBA (daytime) and 43 dBA (night-time) as summarised in Table 6.1 will be reduced by these structural elements to levels well below the most stringent internal noise requirement, which is in the most demanding case 35 dBA, and more typically 40 dBA (maximum) in bedrooms at night.

Quite clearly, even future increases in road traffic and other external noise resulting from development and growth in the Tallawong Road area will be very comfortably accommodated in terms of noise levels in the internal spaces of the proposed development by any reasonable masonry based external wall systems.

The remaining building elements that will influence indoor noise levels within the residential development are the external (glazed) window and doors.

6.5.2 Projected Acoustic Impact at the External Building Facades

The acoustic implications of the proposed development design and layout are summarised in 6.4.3 above.

These implications can be quantified, and the measured rated background sound levels adjusted as appropriate, to estimate the actual acoustic impact at the exterior of the proposed development.

This information can in turn be used to determine whether the external windows and doors can deliver the required internal noise levels, and what acoustic characteristics of the windows and doors will be required to achieve that outcome.

The various acoustic adjustments involved are summarised below:

- **Balconies:** It is assumed that the balconies fitted to the Level 1, 2 and 3 residential units in Lots 1, 2 and 3 of the proposed development will comprise reinforced suspended concrete floors, solid form balustrades, and solid form end blades or walls. These structures will provide a degree of acoustic shielding to the windows and doors within, with the suspended floors providing an effective against external noise from beneath. Allowing for the intrusion of reflected noise through the open areas of the balconies, and elevation above ground level, a conservative noise reduction of 6 – 12 dBA is estimated, based on past experience with similar projects. To ensure a conservative assessment, the lower range has been adopted.

- **Acoustic Shielding from Building Bulk:** Internal spaces, including bedrooms, will enjoy a varying degree of acoustic shielding from the bulk of the three proposed buildings themselves. A conservative noise reduction of 0 - 10 dBA is estimated, based on past experience with similar projects, and the data presented in Appendix A. The quantum of this attenuation due to building bilk will depend on the distance of the affected residential units from the Tallawong Road frontage, and the associated road traffic noise source. Once again, to ensure a conservative assessment, a conservative approach to the acoustic attenuation involved has been adopted.

- **Distance from Tallawong Road:** Traffic on Tallawong Road is anticipated to be one of the principal noise sources in this case, and a reduction in rated background sound levels can be expected with increased distance from this noise source. In this case, a conservative estimated reduction in background noise levels of between 2 and 8 dBA is estimated to apply to residential units on the basis of the increasing distance of Lots 1, 2 and 3 from Tallawong Road, based on past experience with similar projects.

- **Internal Attenuation:** No noise reduction due to internal attenuation has been allowed, as the sleeping rooms and other habitable spaces are typically bounded on at least one side by an external building wall.

6.5.3 Acoustic Attenuation Required from Glazed Elements

As indicated previously, relevant acoustic guidelines require that a maximum sound level of 40 dBA is achievable in all habitable rooms within the proposed residential development at all times, and a maximum sound level of 35 dBA (the most stringent possible requirement) or 40 dBA (more typically) is achievable in all bedrooms within the proposed residential development during designated night-time hours, that is between 10:00pm and 7:00am (refer Section 3).

Achieving the relevant indoor noise levels, as previously summarised, will require appropriate levels of sound attenuation from the external windows and doors of the building.

This attenuation will rely on the use of building materials and in particular glazing materials with the acoustic properties needed to reduce or attenuate the external noise levels impacting on the building to the required extent.

The acoustic attenuation characteristics of typical glazing options are summarised in Table 6.2, below.

Table 6.2 – Typical Noise Reduction from Various Glazing Options

Glazing Option	Typical STC Rating
Single	
3M float glass	25
mm float glass	26 - 27
mm float glass	27 - 29
10 mm float glass	33 - 35
6.38 mm laminated glass	30 - 33
10.38 mm laminated glass	34 - 36
Double	
Double glazed mm – 12 mm gap – mm	30 - 35
Double glazed 6.38 mm lam – 8 mm gap – mm	35 - 40
Double window set up with 100 mm air gap	40 - 45

Sources: Pilkington's; Technical Specifications
Australian Building Codes Board (2007), *Building Codes of Australia Volume 1 and 2*, AGPS Canberra

6.5.4 Recommended Glazing Requirements

The external structural walls of the proposed building will provide more than adequate acoustic attenuation to achieve the sound levels required in the various internal building spaces, as indicated by the acoustic characteristics summarised for various building elements in Appendix A.

The acoustic "vulnerability" of the building is provided by the various external windows and doors, where attenuation characteristics are quite naturally lower than those that apply to the solid external walls.

Based on the analysis presented above, and to ensure that required sound internal sound levels are achieved under all circumstances and at all times, it is recommended that glass with acoustic qualities as a minimum equivalent to 5 mmm float glass is fitted to all external windows and doors, except in cases where for safety or other design reasons safety glass such as 6.38 mm laminated glass is required, which may be the case for windows and doors between internal rooms and associated balconies.

The use of appropriately specified aluminium framed glazed doors, aluminium framed windows and aluminium sliding doors can provide the reduction in sound levels required.

To achieve this outcome, window frames will need to be sealed into the façade opening using a polyurethane sealant such as "Bostik Fireban One", or equivalent. The use of appropriate acoustic seals (Schlegel Q-Lon or equivalent) is essential to achieve the acoustic performance and attenuation in sound levels required.

6.5.5 Mechanical Ventilation or Air Conditioning

If windows are required to be closed to meet the internal noise criteria, consideration would need to be given to achieving compliance with the natural ventilation provisions of Australian Standard 1668.2 *The use of ventilation and air-conditioning in buildings- Ventilation design for indoor air contaminant control*, and associated Blacktown City Council requirements.

In this case, however, the low measured external sound levels (refer Tables 5.1 and 6.1) indicate that these circumstances will not apply in this case, and that this will be the case even if a relatively significant increase in background sound levels occurs over time as a consequence of development in the Tallawong Road area.

In general, in occupancies/spaces where the use of acoustic seals is required, mechanical ventilation or air conditioning will also be involved.

Any mechanical ventilation or air conditioning system should be designed such that any penetrations from ductwork and/or pipework will not reduce the acoustic performance of external building constructions.

6.5.6 Roof or Ceiling Insulation

The recommendations set out in 6.5.3 above relate to the glazing detail required to achieve the attenuation or reduction in noise from external sources, including traffic on Tallawong Road, considered necessary to achieve the sound levels required in the various habitable rooms within the proposed development.

The use of ceiling insulation is also recommended to provide the internal spaces on Level 3 of Lots 1, 2 and 3 with acoustic protection from indirect or reflected sound waves generated by traffic on Tallawong Road, and in particular potential future increases in noise levels from that source.

A mineral wool based ceiling insulation equivalent to Bradford SoundScreen™ 2.5 with a minimum Rw rating of 43 is recommended. The use of this type of insulation, in conjunction with the glazing treatments recommended in 6.5.3 above, will combine to ensure that both direct and reflected acoustic impacts are attenuated, and that the required internal sound levels are achieved under all anticipated external acoustic conditions.

It is probable that the design and construction of the building may well have included the ceiling insulation recommended above in any event to satisfy typical thermal insulation requirements, however these recommendations are made without that assumption, with the intention of ensuring compliance with relevant acoustic guidelines under all foreseeable circumstances.

6.5.7 Internal Acoustics for Residential Spaces

The following considerations are included for reference in relation to internal design and acoustic aspects of the various residential spaces within the proposed development:

WALLS

- All inter-tenancy walls and corridor walls to be constructed to full height to underside of floor slab and/or roof.

- Inter-tenancy wall construction to be two rows of 4mG metal studs with a minimum 20cm gap, 2 layers of 75 mm thick 11-14kg/m^3 glass wool insulation (or similar), within the cavity, and 1 layer of 13 mm thick fire rated plasterboard on the one side and 2 layers of 13 mm thick fire rated plasterboard on the other side.

- Corridor wall construction to be staggered 4mG metal studs on a 92 mm track with 1 layer of 16 mm thick fire rated plasterboard fixed to each side of the track and 110 mm thick 11- 14kg/m^3 glass wool insulation (or similar) within the cavity. Internal wall construction around bathrooms to be 13 mm fire rated plasterboard on either side of a 4mG stud.

- Lift shaft wall construction (if applicable) to be a single leaf of 150 mm thick reinforced concrete and a layer of 13 mm thick fire rated plasterboard on a 4mG metal stud with minimum 20cm air gap between studwork and concrete and 75 mm thick 11-14kg/m3 glass wool insulation (or similar) within cavity.

FLOORS

- Floor slab construction to be of minimum 200 mm reinforced concrete with density greater than 2500kg/m^3 with suspended plasterboard ceiling below, to achieve an Rw+Ctr in excess of 50.

- The use of resilient hung ceilings is recommended where hard floor finishes are proposed above the slab.

- For carpet floor coverings within all living spaces and bedrooms, the use of standard carpet underlay is expected to meet floor impact isolation requirements.

- Hard floor coverings are proposed for wet areas such as kitchens, bathrooms and laundries. It is recommended that tiles are laid on top of 10 mm thick "Embelton ImpactaMat" acoustic underlay (or equivalent).

DOORS

- Entry doors to the apartments shall be a 38-40 mm solid core fire rated door with full perimeter acoustic seals, achieving Rw 30 and above. Acoustic seals shall be equivalent to "Raven PM10" for the sides and the top and equivalent to "Raven R38" drop seal at the bottom.

6.5.8 Sound Insulation Rating of Services

Ceilings over wet areas containing hydraulic piping to be constructed from a layer of 13 mmm thick plasterboard with ceiling cavity filled with 75 mm thick 11-14kg/m^3 glass wool insulation.

All penetrations in the ceilings to be acoustically sealed, including any recessed light fittings in the ceiling.

Hydraulic piping contained in ceilings above dry areas to be lagged with "Soundlag 4525C" (or equivalent).

Ceilings to be constructed from a layer of 13 mm thick plasterboard with a 75 mm thick 11-4G/m^3 glass wool insulation blanket for 500 mm either side of pipe work.

Riser construction within habitable areas to be constructed from 2 layers of 13 mm thick fire rated plasterboard on inner layer of a 4mG metal stud and 1 layer of 13 mm thick fire rated plasterboard on outer layer, with 75 mm thick 11-14kg/m^3 glass wool insulation within riser and wall cavities, with all plasterboard joints to be sealed, and the system to be appropriately reviewed to ensure compliance with fire rating requirements.

Riser construction within wet areas to be constructed from a layer of 13 mm thick fire rated plasterboard with 75 mm thick 11-14kg/m^3 glass wool insulation within riser cavity. All plasterboard joints to be sealed and the system reviewed to ensure compliance with fire rating requirements.

6.5.9 Sound Isolation of Pumps

Any point of connection between the service pipes in a building and any pumps (circulation or other) will require a flexible coupling at the point of connection.

6.6 ACOUSTIC IMPACTS OF THE PROPOSED DEVELOPMENT

The proposed development will involve a range of activities that involve the generation of noise, and that therefore have the potential to impact on nearby individuals and activities.

6.6.1 Human Activity

Human activity within the development will result in noise generation, but within normal and reasonable boundaries the magnitude of the resulting sound levels is not considered likely to have a significant impact on neighbouring receivers.

Noise generated by individual residents of the proposed development will be subject to existing regulatory limits and constraints, and any individual issues will be controlled through these mechanisms, as is the case in the community generally.

In a general sense, it is our professional opinion that noise generated by human activity within the proposed development will be secondary in acoustic impact to the dominant noise source, which is road traffic on nearby roads.

6.6.2 Traffic Noise Generation with Development

The proposed development will involve car parking in the undercroft car parks, and possibly although to a far lesser extent along Tallawong Road.

The anticipated increase in vehicle movements from the subject site is not forecast to be of acoustic concern in comparison with the effect of existing and projected road traffic noise at neighbouring receivers, including residential receivers.

6.6.3 Mechanical Plant

Mechanical plant associated with the proposed development can have the potential to impact on neighbouring properties.

At this stage of the project, the selection of the type and location of mechanical plant associated with the proposed development has not yet been finalised.

At the detailed design stage of the project the selected plant noise levels will be assessed with respect to established noise criteria.

Should any exceedances of established noise criteria be indicated, it is envisaged that standard noise control measures will be adopted to ensure that the acoustic amenity of nearby residences is maintained.

Indicative engineering treatment methods that can be adopted in such circumstances include:

- Appropriate and judicious positioning of plant and equipment behind built elements to provide acoustic shielding;

- The use of acoustic screens/enclosures if required;
- The use of silencers; and
- The use of acoustically lined ductwork.

The following summary of strategies for the management of noise emissions from typical mechanical plant items associated with residential buildings of the type proposed is provided as a general guideline, based on previous professional experience.

Car park supply and exhaust fans: These fans, in the event that they are required, would typically be housed within plant rooms within the basement car parks. These fans typically incorporate acoustic treatment being duct lining to the intake and discharge, use of silencers and/or acoustic louvers. The required treatment will be determined at the detailed design stage.

Kitchen supply and exhaust fans: These fans will be located in bulkhead ducted horizontally to the façade, and will incorporate typical acoustic treatment including duct lining to the intake and discharge, use of silencers and/or acoustic louvres.

Toilet exhaust fans: These fans will also be located in bulkhead ducted horizontally to the façade, and will incorporate typical acoustic treatment including duct lining to the intake and discharge, use of silencers and/or acoustic louvres.

Accordingly, it our conclusion that with appropriate acoustic treatment, if required, items of mechanical plant as detailed above can be designed to comply with relevant mechanical plant noise objectives.

It is noted that the control and management of noise associated with mechanical plant will be required to take into account potential impacts on both potential receivers external to the proposed development, and on the of the residential and retail spaces within the proposed development itself.

6.6.4 Balconies

The plans of the development included in Section 1 of this document include balconies from the various residential units to the external walls of the three proposed residential complexes – Lots 1, 2 and 3.

Prospective noise generated by “normal and reasonable” human activity in those spaces is considered very unlikely to impact on nearby receivers, once again because road traffic noise will be the dominant acoustic influence.

However, to ensure that noise generated within individual balconies does not unduly impact on neighbouring balconies and other residential units within the proposed development, it is recommended that normal and prudent acoustic design and construction practices apply, including solid-form balustrades and end blades (or walls) to all balconies.

6.6.5 Impacts at the Nearest Residential Boundary

The proposed development will adjoin existing residential properties along the north-western and south-eastern boundaries, and on the opposite side of Tallawong Road to the south-west.

The development will also adjoin a prospective residential development on currently vacant land to the north-east.

It is required that any noise generated by activities within the proposed development will not result in an increase of greater than 5dBA in the existing background LA90 measure (the existing background in the absence of road traffic noise).

In our professional opinion, the measures described in detail above that are required to ensure that indoor noise levels no greater than 35 dBA in bedroom at night, and no greater than 40 dBA in other habitable rooms at any time, will also provide an acoustic environment that will ensure that no adverse noise emissions are imposed on neighbouring residential properties.

Noise generated within the various residential units will be contained by the external wall and window systems detailed above, and noise generated within the various balconies will be contained by the structural aspects of those spaces (refer 6.6.4, above).

6.6.6 Impacts at Industrial and Commercial Boundaries

The NSW Industrial Noise Policy requires that new developments do not have an acoustic impact greater than 65 dBA at any affected industrial and commercial properties. In this case, the only commercial properties potentially subject to acoustic impact will be the eight retail spaces proposed for the Tallawong Road frontage of Lot 1.

In our opinion, the solid form concrete/masonry structural walls that will separate the residential units from these retail spaces will very readily ensure that any acoustic impact from the residential units on these retail (commercial) spaces will be substantially less than the 65 dBA level allowed by the NSW Industrial Noise Policy.

On this basis, the proposed development will have no detrimental acoustic impact at the boundary of any industrial or commercial property.

6.7 RETAIL SPACES

Lot 1 of the proposed development includes eight retail spaces along the south-western or Tallawong Road frontage.

The residential units included in Lot 1 will be shielded from any noise generated within these retail spaces by solid form structural elements (including concrete/masonry form walls and floor/roof elements), and acoustic impact on adjoining residential units will be effectively controlled by these structural elements below those required.

It is anticipated that for design and safety reasons, glazing along the Tallawong Road frontage of the retail spaces will comprise laminated safety glass.

Taking into account the acoustic attenuation properties of the minimum thickness 6.38 mm laminated safety glass likely to be considered for this purpose (refer Table 6.2), any likely noise levels within these retail spaces will be effectively contained by the external glazing used, and taking into account the likely dominate acoustic effect of traffic on Tallawong Road, noise from the retail spaces will not result in an impact of greater than 5 dBA on the nearest potentially affected residential receivers external to the development, which will be those on the opposite side of Tallawong Road.

6.8 CONSTRUCTION NOISE

This assessment deals with the acoustic impacts that will apply to the proposed residential development in an ongoing sense. It deals with the sound levels that are required to be achieved in the bedrooms and other habitable rooms within the development; indicates what measures are required to ensure that these sound levels can be achieved, and confirms that these required sound levels can be achieved.

The assessment also considers the noise or acoustic impacts that the development will have on neighboring receivers, and confirms that these impacts will comply with relevant acoustic guidelines.

The proposed development, if approved, will also involve a construction phase, which will be required to comply with appropriate noise control guidelines.

While construction noise falls outside the strict scope of this assessment, appropriate noise management plans and controls, in accordance with relevant local government and other guidelines, will need to be developed and applied, and this requirement can be expected to be a condition of the approval of any prospective Development Application.

6.9 STATE ENVIRONMENTAL PLANNING POLICY (INFRASTRUCTURE) 2007

State Environment Planning Policy (Infrastructure) 2007 requires, in the case of a residential development adjacent to a road accommodating average daily traffic volumes of 40,000 or more, that sound levels no greater than 35 dBA will be achieved in all bedrooms during the 10:00pm to 7:00am night-time period, and sound levels no greater than 40 dBA will be achieved in all other habitable rooms within the development, at all times.

While Tallawong Road does not currently and is not in the future projected to carry such traffic volumes, and the requirements of the Infrastructure SEPP do not apply in this case, the internal sound levels required by the Infrastructure SEPP are achieved in any case.

6.10 VIBRATION

The proposed development site is subject to possible vibrational impacts from traffic on nearby roads.

A vibration assessment is presented in Section 7.

6.11 KEY FINDING

The key finding of this acoustic assessment is that, subject to the implementation of the various recommendations included in this report, in particular recommendation regarding external window and door systems, sound levels within the various residential spaces associated with the proposed development will comply with the strictest relevant acoustic guidelines and requirements, in that sound levels no greater than 35 dBA will be achieved in all bedrooms during the 10:00pm to 7:00am night-time period; sound levels no greater than 40 dBA will be achieved in all other habitable rooms within the development, at all times, and no undue or non-compliant acoustic impacts will be imposed on any neighbouring residential or commercial properties.

7 VIBRATION ASSESSMENT

7.1 INTRODUCTION & OVERVIEW

Where occupants can detect vibration in buildings, this may potentially impact on their quality of life.

Typical sources of vibration include construction and excavation equipment, rail and road traffic, and industrial machinery. In this case, while vibration caused by road and rail traffic in the general vicinity of the development are the principal potential vibration sources, the measurement based assessment method adopted, as described below, takes in to account all potential sources of vibration.

Individuals can detect building vibration values that are well below those that can cause any risk of damage to the building or its contents. The level of vibration that affects amenity is lower than that associated with building damage.

This means that if detected levels of vibration fall below the criteria levels applicable to human response, then as an automatic consequence levels of vibration are, to an even greater extent, below those involving risk to building or structural integrity.

7.2 TYPES OF VIBRATION

Vibration in buildings can be caused by many different external sources, including industrial, construction and transportation activities. The vibration may be continuous (with magnitudes varying or remaining constant with time), impulsive (such as in shocks) or intermittent (with the magnitude of each event being either constant or varying with time).

Continuous, impulsive or intermittent vibration are defined as follows:

Continuous vibration continues uninterrupted for a defined period (usually throughout daytime and/or night-time). This type of vibration is assessed on the basis of weighted metres per second acceleration values (m/sec^2).

Impulsive vibration is a rapid build up to a peak followed by a damped decay that may or may not involve several cycles of vibration (depending on frequency and damping). It can also consist of a sudden application of several cycles at approximately the same amplitude, providing that the duration is short, typically less than 2 seconds. Impulsive vibration (no more than three occurrences in an assessment period) is also assessed on the basis of acceleration values.

Intermittent vibration can be defined as interrupted periods of continuous (e.g. a drill) or repeated periods of impulsive vibration (e.g. a pile driver), or continuous vibration that varies significantly in magnitude. It may originate from impulse sources (e.g. pile drivers and forging presses) or repetitive sources (e.g. pavement breakers), or sources which operate intermittently, but which would produce continuous vibration if operated continuously (for example, intermittent machinery, railway trains and traffic passing by). This type of vibration is assessed on the basis of vibration dose values.

In this case, the obvious apparent source of potential vibrational impacts is the continuous operation of vehicular traffic on nearby roads and rail traffic on the nearby rail line, and the potential vibration source is considered to be primarily continuous in nature.

The assessment of vibration requires the use of an overall frequency-weighted value for each axis (x, y and z directions). This overall value is assessed against the preferred value for the relevant axis.

it is important to note that vibration may enter the body along different orthogonal axes, i.e. x-axis (back to chest), y-axis (right side to left side) or z-axis (foot to head) (see Figure 7.1). The three axes are referenced to the human body. Thus, vibration measured in the horizontal plane should be compared with x- and y-axis criteria if the concern is for people in an upright position, or with the y- and z-axis criteria if the concern is for people in a lateral position (e.g. asleep at night).

When measured vibration values exceed the preferred values, then mitigation measures to meet the preferred values should be considered.

Where measured values are lower than the preferred values, vibration is generally found not to be an issue of concern, and no further remedial actions are required.

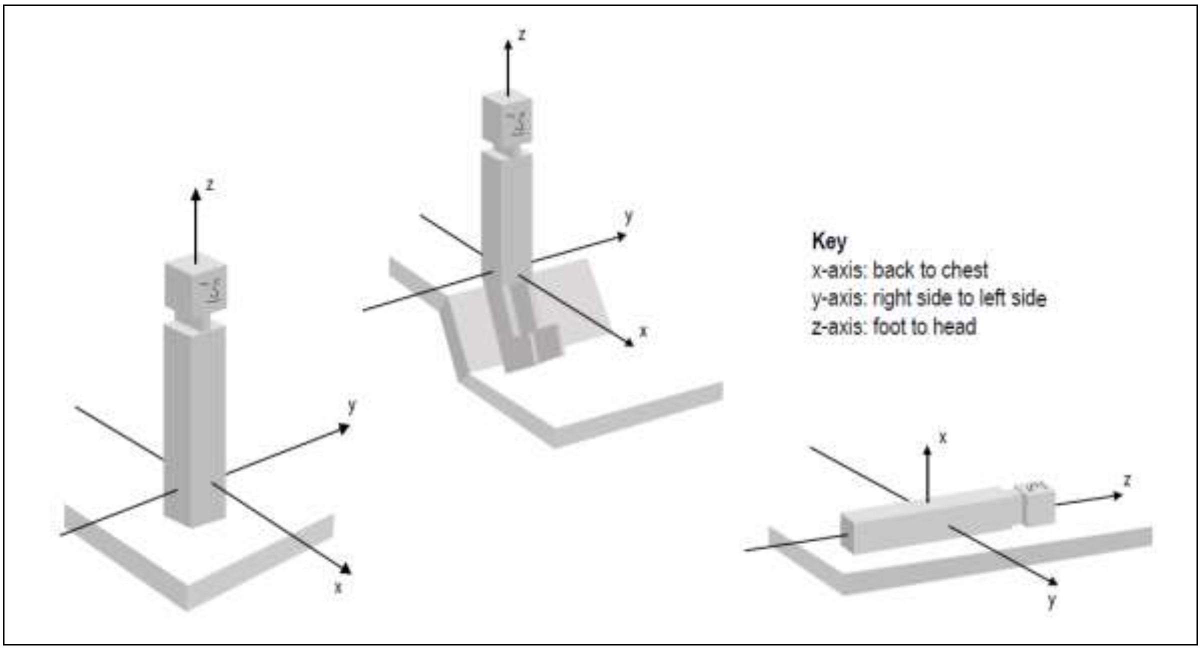


Figure 7.1 - Axes for Assessment of Human Exposure to Vibration (BS 6472–1992)

7.3 RELEVANT STANDARDS

Over the past two decades, ISO, British and Australian Standards for vibration evaluation and assessment have converged. BS 6472–1992, *Evaluation of human exposure to vibration in buildings (1 Hz to 80 Hz)*, ISO 2631.1–1997, *Mechanical vibration and shock – Evaluation of human exposure to whole-body vibration – Part 1: General requirements*, and ISO 2631.2–1989, *Evaluation of human exposure to whole-body vibration – Part 2: Continuous and shock induced vibration in buildings (1–80 Hz)*, contain the most recent advances in vibration evaluation.

This assessment has taken these standards fully into account.

7.4 MEASUREMENT OF VIBRATION

Vibration measuring systems combine transducers (typically piezoelectric accelerometers or geophones); signal-conditioning equipment, and a data recording and analysis system.

The transducer is required to be firmly mounted so that both the magnitude and frequency of the ground vibration is accurately measured.

In this case, the transducer was oriented in the direction of the major identified potential vibration source (Tallawong Road), and fixed to an aluminium spike driven firmly in the soil layer.

The location of the vibration monitoring instrument is shown as “A” in Figure 7.2, on the following page.

The instrument used was a Benstone Instruments v-Pod II Vibration Meter, as illustrated in Figure 7.3, mounted within a weatherproof and secure mounting case.

The overall system was secured by a locked chain to a ground spike.

Figure 7.2 – Location of Vibration Meter

Figure 7.3 – Benstone Instruments v-Pod II Vibration Meter

7.5 MEASUREMENTS

Vibration measurements were recorded over a twenty-four-hour period commencing at 7:00am on Thursday July 20th, 2017.

Results for both the z and x/y axes are shown in Table 7.1 below. The fifteen-hour period between 7:00am and 10:00pm Thursday July 20th, 2017 was adopted as an indicator of daytime vibration, and the nine-hour period between 10:00pm on Thursday July 20th and 7:00 am Friday July 21st was adopted as an indicator of night-time vibration.

Peak and average results were recorded, and are shown in Table 7.1

Table 7.1 – Vibration Measurement Results (Units: m/sec^2)

	z-axis		x & y axes	
	maximum	average	maximum	average
Daytime (7:00am – 10:00pm)	0.002	0.001	0.0022	0.0013
Night-time (10:00pm - 7:00am)	0.002	0.001	0.0013	0.001

7.6 GUIDELINES

"Preferred" and "maximum" values for human exposure to continuous and impulsive vibration are set out in Table 7.2, on the following page.

These guidelines are based on the information from *Managing Environmental Noise, Assessing Vibration – a technical guideline (February 2006)*, described in Section 3.8.2, and include frequency ranges between 1 and 80 Herz (Hz).

This guideline presents vibration criteria that use the parameter of acceleration root mean square (rms), measured in metres per second per second (m/s^2).

Table 7.2 – Vibration Guidelines (Units: m/sec^2)

Type of Receiver/Time Period	Preferred		Maximum	
	z-axis	x & y Axes	z-axis	x & y Axes
Continuous Vibration				
Residential - Daytime (7:00am – 10:00pm)	0.010	0.0071	0.020	0.014
Residential - Night-time (10:00pm - 7:00am)	0.007	0.005	0.014	0.010
Impulsive Vibration				
Residential - Daytime (7:00am – 10:00pm)	0.30	0.21	0.60	0.42
Residential - Night-time (10:00pm - 7:00am)	0.10	0.071	0.20	0.14

(Source: Managing Environmental Noise, Assessing Vibration – a technical guideline, NSW OEH, February 2006)

7.7 ASSESSMENT

Results of the measurements recorded on Thursday July 20th and Friday July 21st, 2017 are summarised in Table 7.3, on the following page.

Table 7.3 also compares the measured results with relevant guideline criteria.

Results that comply with relevant criteria are highlighted in green.

Results exceeding relevant guideline criteria are highlighted in red.

Table 7.3 – Vibration Results Compared to Guideline Levels (Units: m/sec^2)

Type of Receiver/Time Period		Preferred		Maximum	
		z-axis	x & y Axes	z-axis	x & y Axes
Continuous Vibration					
Residential - Daytime (7:00am – 10:00pm)	**Guideline**	**0.010**	**0.0071**	**0.020**	**0.014**
	Measured Maximum	0.002	0.0022	0.002	0.0022
	Measured Average	0.001	0.0013	0.001	0.0013
Residential - Night-time (10:00pm - 7:00am)	**Guideline**	**0.007**	**0.005**	**0.014**	**0.010**
	Measured Maximum	0.002	0.0013	0.002	0.0013
	Measured Average	0.001	0.001	0.001	0.001
Impulsive Vibration					
Residential - Daytime (7:00am – 10:00pm)	**Guideline**	**0.30**	**0.21**	**0.60**	**0.42**
	Measured Maximum	0.004	0.0026	0.004	0.0026
	Measured Average	0.002	0.0015	0.002	0.0015
Residential - Night-time (10:00pm - 7:00am)	**Guideline**	**0.10**	**0.071**	**0.20**	**0.14**
	Measured Maximum	0.002	0.0013	0.002	0.0013
	Measured Average	0.001	0.001	0.001	0.001

7.8 FINDINGS

The findings of this vibration assessment are as follows:

1. Daytime and night-time vibration levels were measured at a point adjacent to the proposed development site in accordance with relevant procedures, protocols and standards between Thursday July 20th and Friday July 21st, 2017;

2. The maximum and average vibration levels measured in metres per second per second (m/s^2) were found to be substantially lower than relevant “preferred” and “maximum” criteria levels for both continuous and impulsive vibration as defined in the NSW Office of Environment & Heritage document *Managing Environmental Noise, Assessing Vibration – a technical guideline (February 2006)*;

3. On this basis, both continuous and impulsive vibration levels measured at the 84 Tallawong Road site are assessed as being safe and appropriate for the residential development proposed (as described in this document); and

4. On this basis, no particular mitigation measures will be required at the development in respect of vibration issues.

7.9 DISCUSSION

The results of this vibration assessment indicate relatively low vibration impact at the proposed development site from any source, and in particular from the most likely probable potential sources – that is road traffic on Tallawong Road.

The absence of vibration impact from these sources can be explained by the following factors:

1. **Relatively Low Traffic Volumes:** Traffic volumes on Tallawong Road are relatively low;

2. **Smooth Pavement Surfaces:** Relevant road pavement surfaces are of relatively high quality, and smooth, which minimises the generation of vibration; and

3. **Controlled Speed:** Road traffic adjacent to the proposed development is subject to speed moderation due to the statutory residential speed limit applicable, thereby reducing vibration effects.

8 FINDINGS & RECOMMENDATIONS

This report presents an acoustic and vibration assessment of a proposed residential development at 84 Tallawong Road Rouse Hill NSW. The assessment has been undertaken in accordance with relevant acoustic and vibration requirements, standards and guidelines.

8.1 ACOUSTICS

8.1.1 Key Findings

In relation to acoustic matters, it is our professional opinion, based on a consideration of the various plans and drawings describing the project; subject to the adoption and implementation of the various recommendations presented in this report, and summarised below, that:

- Indoor sound levels associated with the proposed development will comply with the most stringent applicable internal noise guidelines, namely that sound levels no greater than 35 dBA will be achieved in all bedrooms during the 10:00pm to 7:00am night-time period, and sound levels no greater than 40 dBA will be achieved in all other habitable rooms within the development, at all times; and

- The proposed development will have no inappropriate or non-compliant acoustic impact on any potentially affected receivers.

8.1.2 Recommendations

The following recommendations, which are identified in the text of this report, are made to ensure the compliance of internal acoustics with the relevant guidelines and requirements:

1. **External Glazing - Windows:** Glass with a minimum acoustic rating equivalent to 6 mm float glass is used in all external windows. A higher acoustically rated glass, such as 6.38 mm laminated glass, may also be used if required for design or safety purposes.

2. **External Glazing - Balconies:** Glass with a minimum acoustic rating equivalent to 6.38 mm laminated glass is used for the windows and doors from the various residential units to the associated external balconies, and window and door frames should be sealed into façade openings using a polyurethane sealant such as “Bostik Fireban One”, or equivalent, and acoustic seals (such as Schlegel Q-Lon or equivalent) should be used to provide additional acoustic protection.

3. **Balconies:** Adjoining balconies should be separated by solid form blades or end walls, and if air conditioner condenser units are to be located on balconies, solid form external walls or balustrades to a minimum height of 1000 mm should be installed.

4. **Internal Walls:** Internal walls, including inter tenancy walls, should be constructed and installed in accordance with the details included in this report.

5. **Floors:** Floor slab construction to be of minimum 200 mm reinforced concrete with density greater than 2200 kg/m^3 with suspended plasterboard ceiling below, to achieve an Rw+Ctr in excess of 50. The use of resilient hung ceilings is recommended where hard floor finishes are proposed above the slab. For carpet floor coverings within all living spaces and bedrooms, the use of standard carpet underlay is expected to meet floor impact isolation requirements. Hard floor coverings are proposed for wet areas such as kitchens, bathrooms and laundries. It is recommended that tiles are laid on top of 10 mm thick “Embelton ImpactaMat” acoustic underlay (or equivalent).

6. **Services:** Internal services should be fitted with acoustic insulation as detailed in this report, and in accordance with relevant BCA requirements.
7. **Roof/Ceiling Insulation:** Roof or ceiling insulation should be installed between the roof and the Level 3 residential units below to provide acoustic protection from any future indirect or reflected sound waves generated by possible future traffic growth on Tallawong Road, and from any other

external sources. Typically, minimum rated insulation materials used for thermal insulation purposes are likely to include R 3.5 insulation between the building roof and the boarding rooms on Level 3 below, together with a foil layer and possibly an R 1.0 blanket, and materials suitable for thermal insulation purposes will also be suitable for the relatively minor level of acoustic insulation required.

8. **BCA Requirements:** Standard BCA and other internal acoustic design and construction considerations, including but not limited to those summarised in Section 5.5.7 and Appendix A of this report, are applied to all aspects of the construction of the various residential units within the proposed development;

9. **Plant & Equipment:** Any mechanical plant and equipment required for the development will be specified and/or designed and installed such that acoustic noise emissions are consistent with the internal acoustic environments required, and that any penetrations from ductwork and/or pipework will not reduce the acoustic performance of other building design features;

10. **Retail Spaces:** Subject to the use of standard laminated glazing with a minimum acoustic attenuation capability equivalent to 6.38 mmm laminated safety glass on the Tallawong Road or south-western facades of the eight proposed retails spaces in Lot 1 of the development, no undue or non-compliant acoustic impact is projected at affected residential or commercial receivers.

11. **Acoustic Certification:** Appropriate certification and validation of the acoustic performance of any plant and equipment associated with the proposed development is provided prior to construction, and prior to occupation, as reasonably required;

12. **Design & Construction Implications of Bush Fire Risk:** As far as possible, typical design and construction implications resulting from the bushfire risk rating of the property have been taken into account in the external window, door and glazing recommendations presented in this report. However, design and construction implications associated with bushfire risk are considered in detail, in the companion report *Design & Construction Implications of Bush Fire Risk: Residential Building Development, 84 Tallawong Road Rouse Hill NSW (Version 1; NG Child & Associates, August 31st, 2017)*, and any more stringent external window and door treatments required for that purpose should be treated as additional to those described here; and

13. **Noise Management Plan – Construction:** A noise management and control plan will need to be developed and applied to the construction phase of the proposed development, in accordance with established procedures and practices.

It should be noted that all materials or material types mentioned in this report have been suggested solely on the basis of acoustic performance. Any other properties of these materials, including fire rating and chemical properties should be checked with the suppliers or other specialised bodies to ensure fitness for non-acoustic purposes.

8.2 VIBRATION

8.2.1 Key Finding

Both maximum and average vibration levels measured in metres per second per second (m/s^2) were found to be substantially lower than relevant “preferred” and “maximum” criteria levels, and on this basis both continuous and impulsive vibration levels measured at the proposed development site are assessed as being safe and appropriate for the residential development proposed.

8.2.2 Recommendation

In our professional opinion, no recommendations or actions are required to achieve vibrational compliance at the proposed development site.

9 AUTHORISATION & LIMITATIONS

NG Child & Associates has based this report on the data, methods and sources described herein.

Subject to the limitations described within the report, it is the view of NG Child & Associates that this report presents an accurate and reliable assessment of the acoustic and vibration environment applicable at and in the immediate vicinity of the residential development proposed for 84 Tallawong Road, Rouse Hill NSW.

The information presented in this document has been prepared by NG Child & Associates exclusively for the use of Archidrome and its client Benefit Property Corporation, and for submission to the local government consent authority at interest as required in relation to the proposed development.

This document should not be used for any purposes other than those of Archidrome and its client Benefit Property Corporation in relation to the development described in this report.

Noel Child BSc (Hons), PhD, MIEA, MRACI
Visiting Fellow, Engineering
University of Technology, Sydney
Principal, NG Child & Associates

31 August 2017

GLOSSARY

Most environments are affected by environmental noise which continuously varies, largely as a result of road traffic. To describe the overall noise environment, a number of noise descriptors have been developed and these involve statistical and other analysis of the varying noise over sampling periods, typically taken as 15 minutes. These descriptors, which are demonstrated in the graph overleaf, are here defined.

Maximum Noise Level (LAmax) – The maximum noise level over a sample period is the maximum level, measured on fast response, during the sample period.

LA1 – The LA1 level is the noise level which is exceeded for 1% of the sample period. During the sample period, the noise level is below the LA1 level for 99% of the time.

LA10 – The LA10 level is the noise level which is exceeded for 10% of the sample period. During the sample period, the noise level is below the LA10 level for 90% of the time. The LA10 is a common noise descriptor for environmental noise and road traffic noise.

LAeq – The equivalent continuous sound level (LAeq) 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. This measure is also a common measure of environmental noise and road traffic noise.

LA50 – The LA50 level is the noise level which is exceeded for 50% of the sample period. During the sample period, the noise level is below the LA50 level for 50% of the time.

LA90 – The LA90 level is the noise level which is exceeded for 90% of the sample period. During the sample period, the noise level is below the LA90 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 (daytime, evening and night time) for each day. It is determined by calculating the 10th percentile (lowest 10th percent) background level (LA90) for each period.

RBL – The Rating Background Level for each period is the median value of the ABL values for the period over all of the days measured. There is therefore an RBL value for each period – daytime, evening and night time.

APPENDIX A

Building Code of Australia (BCA)
Summary of Internal Acoustic Requirements

Building Code of Australia (BCA)
Summary of Internal Acoustic Requirements

The Building Code of Australia (BCA) nominates various ratings for airborne noise isolation and impact noise isolation. The ratings and abbreviations used are as follows:

Rw – Weighted sound reduction index. The Rw is a typical measure for the sound insulation performance for a wall or floor system in a laboratory. The Rw in the BCA is used for the selection of appropriate construction systems.

Rw+Ctr – Weighted sound reduction index with spectrum adaptation term. The Rw+Ctr is the weighted sound reduction index with a correction factor Ctr added that helps to quantify the low frequency performance. The Rw+Ctr in the BCA is used for the selection of appropriate construction systems.

DnT, w – Weighted standardised level difference. The DnT, w is a typical measure for the sound insulation performance for a wall or floor system in a laboratory. The DnT, w in the BCA is used for the determination of airborne noise in the field.

DnT, Rw+Ctr – Weighted standardised level difference with spectrum adaptation term. The DnT, Rw+Ctr is the weighted standardised level difference with a correction factor Ctr added that helps to quantify the low frequency performance. The DnT, Rw+Ctr in the BCA is used for the determination of airborne noise in the field.

Ln, win – Weighted normalised impact sound pressure level with spectrum adaptation term. The Ln, win is a typical measure of the impact/structure borne noise between two spaces in a laboratory. A reduction in the Ln, win corresponds to an improvement in impact isolation. The Ln, win in the BCA is used for the selection of appropriate impact isolation systems.

Lent, win – Weighted standardised impact sound pressure level with spectrum adaptation term. The Lent, win is a typical measure of the impact/structure borne noise between two spaces in the field. A reduction in the Lent, win corresponds to an improvement in impact isolation. The Lent, win in the BCA is used for the determination of impact noise in the field.

The ratings used for airborne noise isolation and impact noise isolation are here defined:

FSTC – Field sound transmission class. The FSTC is a typical measure for the sound insulation performance for a wall or floor system in a building.

IIC – Impact isolation class. The IIC is a typical measure of the impact/structure borne noise between two spaces in a laboratory.

BCA sound insulation ratings applicable to this project are listed in Tables A-1 and A-2 below.

Table A-1 Sound Insulation Ratings of Walls and Floors – Class 2 or 3

Situation	Lab	Field	Impact
Apartment wall separating different sole occupancies (Same room-type each side, e.g. habitable adjoin habitable)	50 RW +Ctr	45 DnT,w+Ctr	No
Apartment wall separating a habitable room (not a kitchen) from a bathroom, sanitary compartment, laundry or kitchen in another sole occupancy	50 RW +Ctr	45 DnT,w+Ctr	Yes
Apartment wall separating a stairway, public corridor, public lobby or the like; or part of a different classification	50 RW	45 DnT,w	No
Apartment wall separating a plant room or lift shaft	50 RW	45 DnT,w	Yes
Apartment door to a stairway, public corridor, public lobby or the like	30 RW	25 DnT,w	NA
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	50 RW + Ctr	45 DnT,w+Ctr	-
	62 Ln,w+CI	62 LnT,w+CI	-

Table A-2 Sound Insulation Ratings of Walls Services: Class 1, 2, 3 & 9c

Situation	Lab	Field	Impact
Duct, soil, waste or water supply pipe serving or passing through more than one sole occupancy to a habitable room (not a kitchen)	40 Rw+Ctr	NA	NA
Duct, soil, waste or water supply pipe serving or passing through more than one sole occupancy to a kitchen or non-habitable room	25 Rw+Ctr	NA	NA
Storm water pipe passing through a sole occupancy to a habitable room (not a kitchen)	40 Rw+Ctr	NA	NA
Storm water pipe passing through a sole occupancy to a kitchen or non-habitable room	25 Rw+Ctr	NA	NA

Note: Part F5.6 of the BCA requires a flexible coupling to be used at the point of connection between the service pipes in a building and any pump (not applicable to Class 1 buildings).

The City of Sydney DCP sound insulation ratings applicable to this project are listed in Table A-3 below.

Table A-3 Sound Insulation Ratings of Walls and Floors

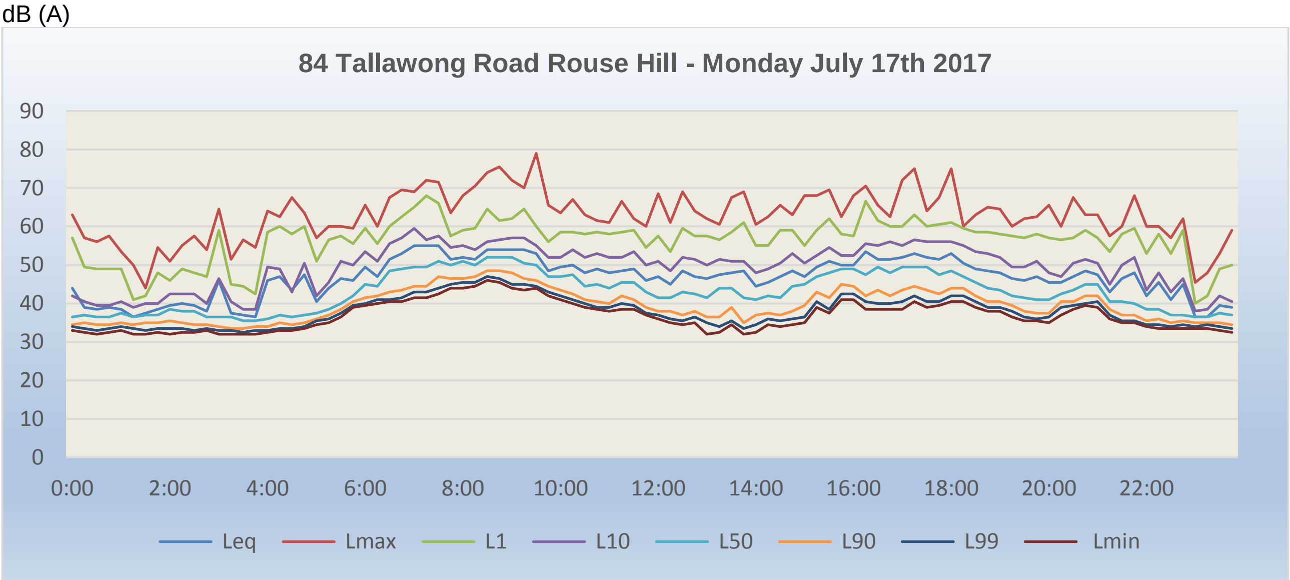
Situation	Lab	Field	Impact
Apartment wall separating different sole occupancies (Same room-type each side, e.g. habitable adjoin habitable)	NA	50 FSTC	No
Apartment wall separating a habitable room (not a kitchen) from a bathroom, sanitary compartment, laundry or kitchen in another sole occupancy	NA	55 FSTC	Yes
Apartment wall separating a stairway, public corridor, public lobby or the like; or part of a different classification	NA	50 FSTC	No
Apartment floor separating different sole occupancies (Same room-type each side, e.g. habitable adjoin habitable)	NA	50 IIC	
	NA	50 FSTC	
Apartment floor separating a habitable room (not a kitchen) from a bathroom, sanitary compartment, laundry or kitchen in another sole occupancy	NA	55 FSTC	NA
Apartment floor separating different sole occupancies or a plant room, stairway, public corridor, hall way or the like	NA	50 IIC	-

APPENDIX B

Background Noise Monitoring Data

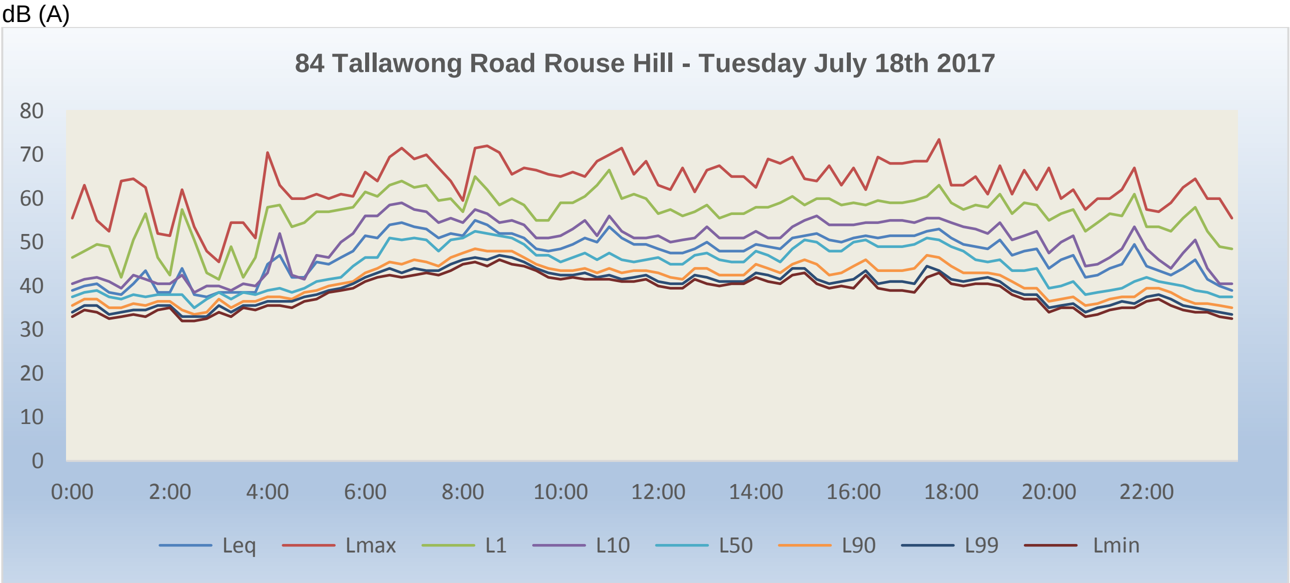
Monday July 17th, 2017

dB (A)



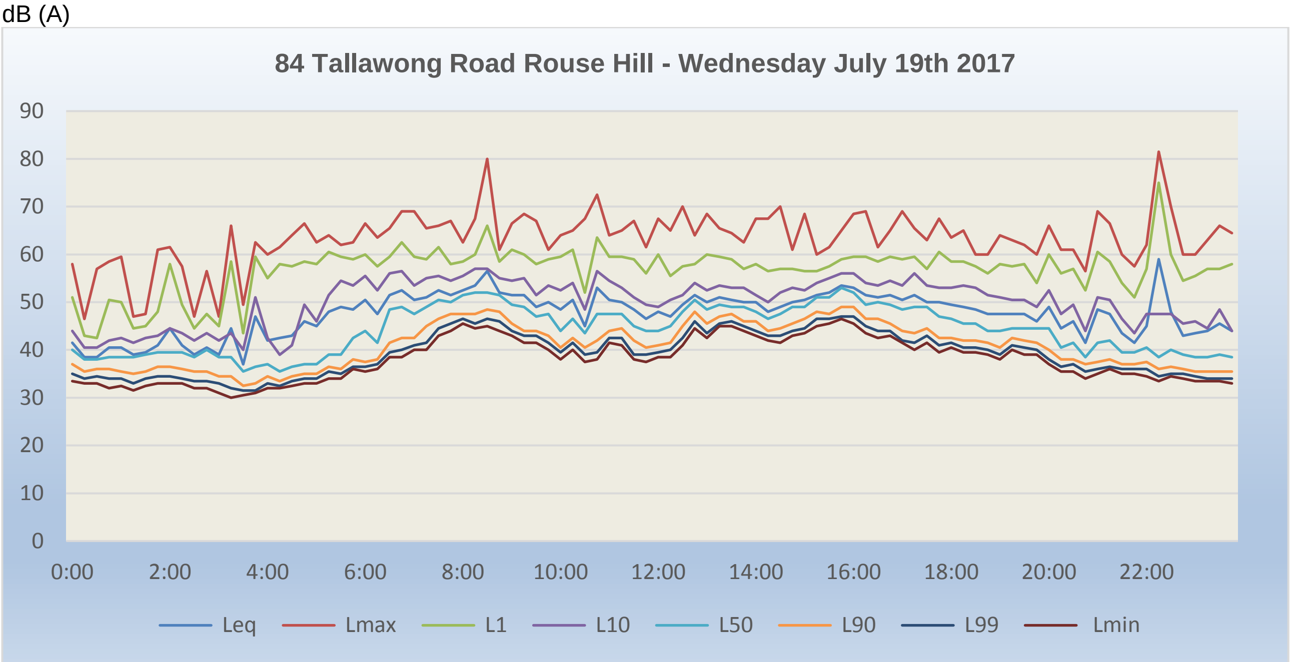
Tuesday July 18th, 2017

dB (A)



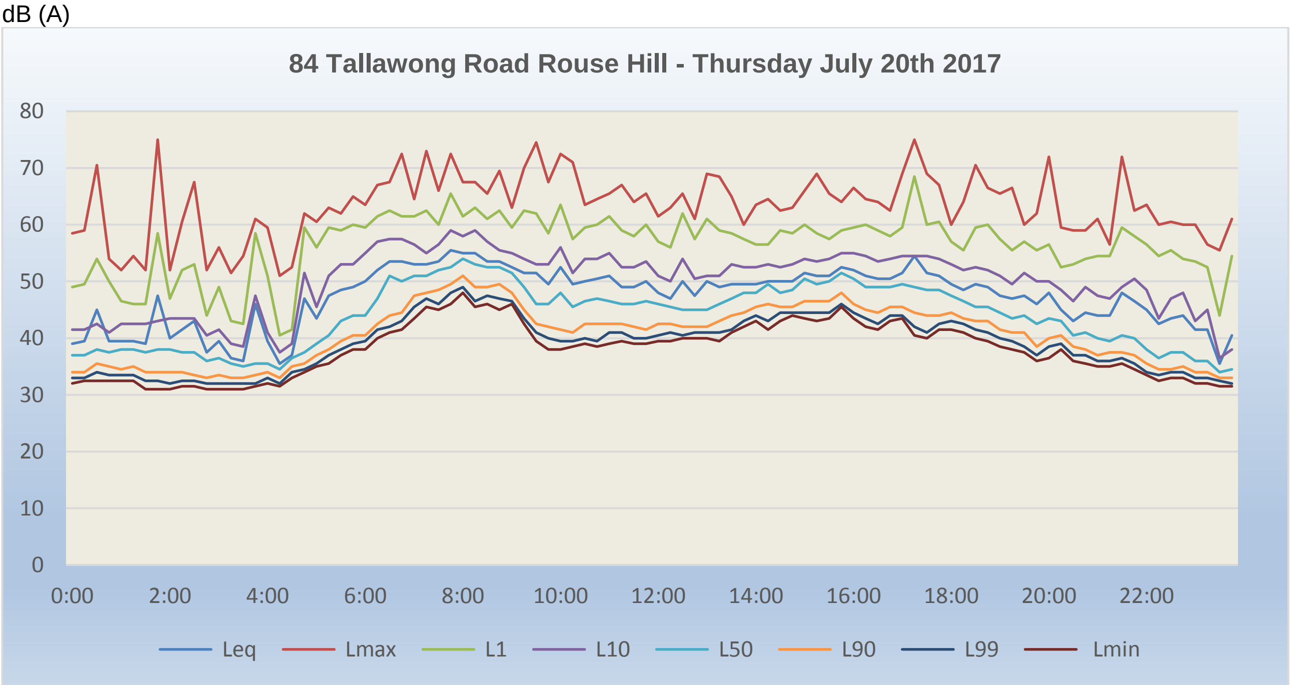
Wednesday July 19th, 2017

dB (A)



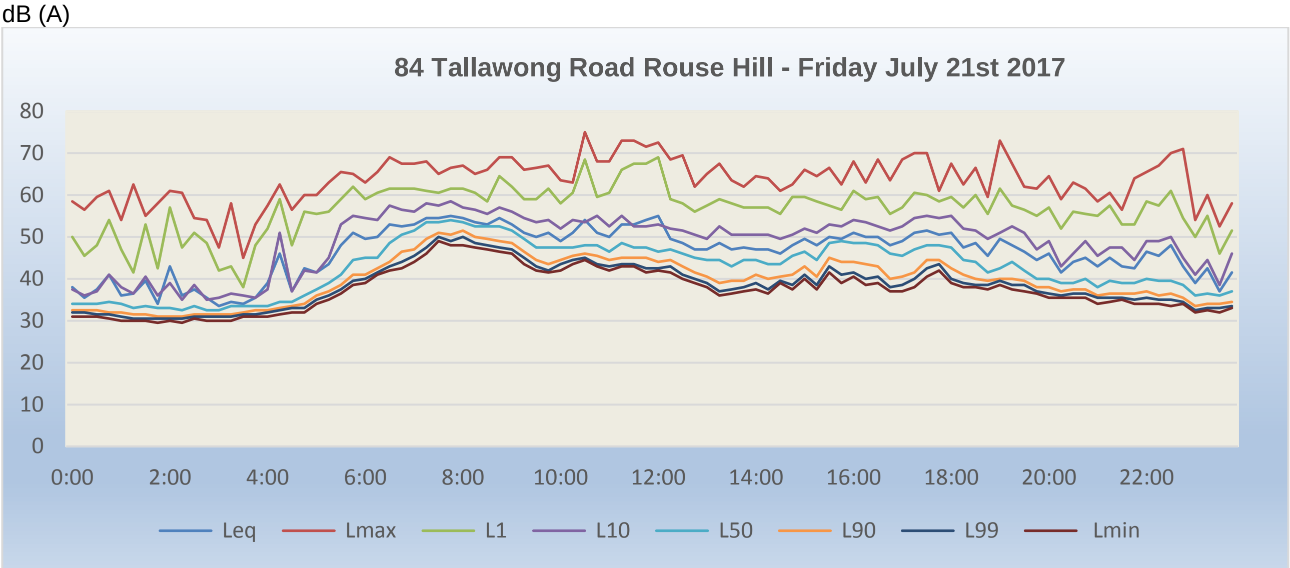
Thursday July 20th, 2017

dB (A)



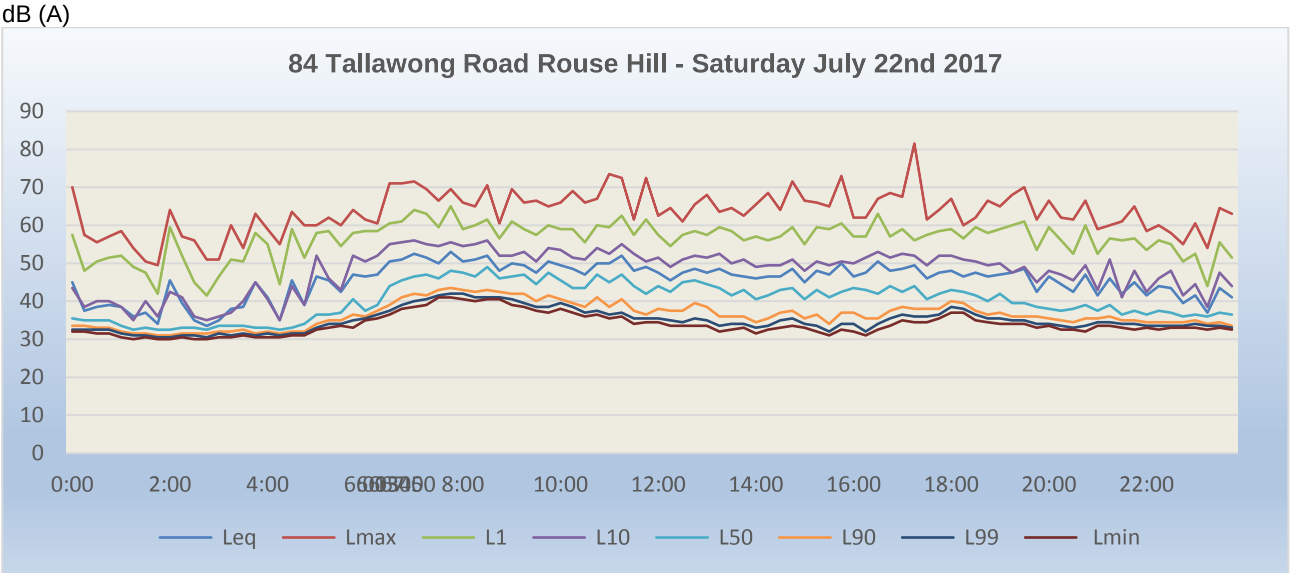
Friday July 21st, 2017

dB (A)



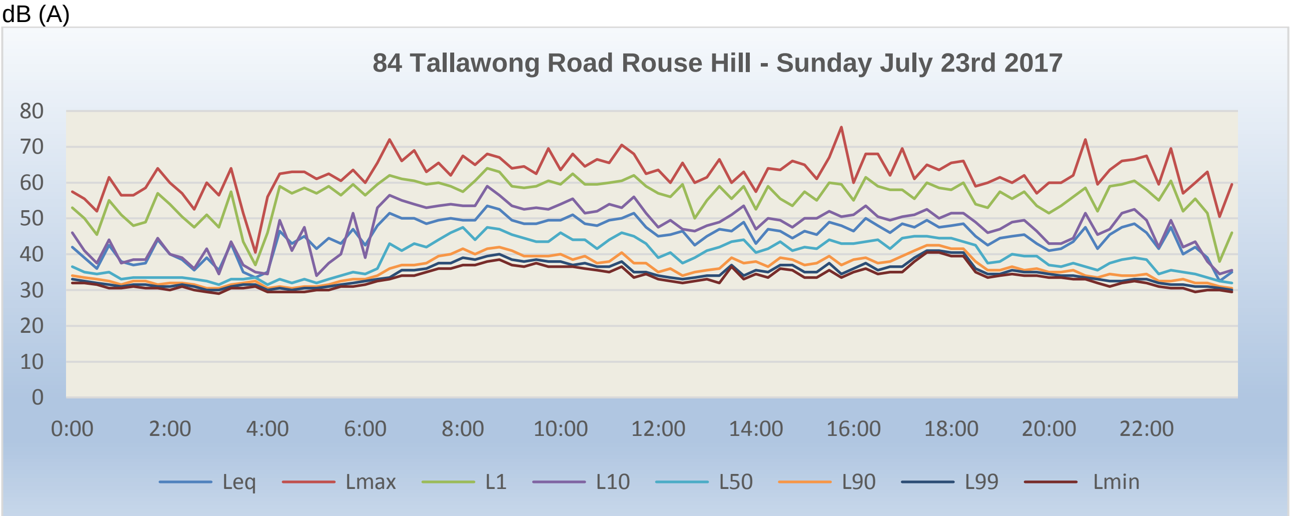
Saturday July 22nd, 2017

dB (A)



Sunday July 23rd, 2017

dB (A)



84 Tallawong Road Rouse Hill NSW
Summary of Background Noise Monitoring Data

	Leq			Lmax			L1			L10		
	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night
Monday 17 July 2017	50.0521	47.5000	40.9844	66.7396	63.5313	56.8281	59.5208	57.8438	50.8281	53.4479	50.8750	42.9063
Tuesday 18 July 2017	50.5795	47.0000	42.8750	66.7841	62.7813	59.2361	59.3068	57.3438	52.4167	53.5227	50.5625	44.8750
Wednesday 19 July 2017	50.5729	46.5625	43.3594	66.0417	62.1875	59.7656	58.8750	56.7188	53.7656	53.5938	49.8125	44.8438
Thursday 20 July 2017	51.0682	46.7188	42.7500	66.4432	63.5313	59.8194	59.9545	56.2500	52.3750	53.9886	49.9688	45.0694
Friday 21 July 2017	50.6979	45.6875	39.9688	66.6042	62.9688	58.9531	60.1458	56.3438	51.1875	53.5625	48.8438	41.2031
Weekday Average	50.5682	46.9453	42.4922	66.5021	63.0078	58.9123	59.4143	57.0391	52.3464	53.6383	50.3047	44.4236

	Leq			Lmax			L1			L10		
	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night
Saturday 22 July 2017	48.6458	45.5625	40.2813	66.7500	63.8438	58.2969	58.8958	57.2500	51.8594	52.0729	47.9688	41.5000
Sunday 23 July 2017	48.0625	44.9063	40.1563	64.9271	62.5313	58.8281	58.5729	56.2188	52.0625	51.5938	48.0313	40.7500
Weekend Average	48.3542	45.2344	40.2188	65.8385	63.1875	58.5625	58.7344	56.7344	51.9609	51.8333	48.0000	41.1250

	L50			L90			L99			Lmin		
	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night
Monday 17 July 2017	46.6875	43.1875	37.2656	42.0833	40.0625	35.1406	40.1667	38.5313	34.0313	38.9063	37.4063	33.1719
Tuesday 18 July 2017	48.2727	42.6250	39.9722	44.5455	39.4063	37.6806	42.7841	37.8438	36.4722	41.6591	36.7813	35.4722
Wednesday 19 July 2017	48.3021	42.9063	38.5156	44.5833	39.8125	35.5000	42.8750	38.4063	33.9844	41.6250	37.3438	32.8125
Thursday 20 July 2017	48.6136	42.9688	38.4722	44.9318	40.1250	35.5833	43.1136	38.6563	34.3750	41.9318	37.3750	33.3750
Friday 21 July 2017	47.8229	41.2188	35.5625	44.2500	38.5000	33.5781	42.5208	37.2813	32.7500	41.3958	36.3438	31.8906
Weekday Average	47.9690	42.9219	38.5564	44.0360	39.8516	35.9761	42.2348	38.3594	34.7157	41.0305	37.2266	33.7079
Saturday 22 July 2017	44.0000	39.3438	34.7656	38.6875	36.2813	32.9844	36.6563	34.9375	32.2344	35.3958	33.8438	31.5156
Sunday 23 July 2017	42.9271	38.9375	33.6719	38.2708	35.9688	31.9531	36.3958	34.9063	31.1875	35.1771	34.0313	30.4063
Weekend Average	43.4635	39.1406	34.2188	38.4792	36.1250	32.4688	36.5260	34.9219	31.7109	35.2865	33.9375	30.9609

APPENDIX C

Unattended Background Sound Level Monitoring Raw Data

Table C1 – Raw Noise Monitoring Data (17-23 July 2017)

Date	Time	Leq	Lmax	L1	L10	L50	L90	L99	Lmin
17/7/17	0:00	44	63	57	42	36.5	34.5	34	33
		39	57	49.5	40.5	37	35	33.5	32.5
		38.5	56	49	39.5	36.5	34.5	33	32
		39	57.5	49	39.5	36.5	34.5	33.5	32.5
		38.5	53.5	49	40.5	37.5	35	34	33
		36.5	50	41	39	36.5	34.5	33.5	32
		37.5	44	42	40	37	35	33	32
		38.5	54.5	48	40	37	35	33.5	32.5
	2:00	39.5	51	46	42.5	38.5	35.5	33.5	32
		40	55	49	42.5	38	35	33.5	32.5
		39.5	57.5	48	42.5	38	34.5	33	32.5
		38	54	47	40	36.5	34.5	33.5	33
		46	64.5	59	46.5	36.5	34	33	32
		37.5	51.5	45	40.5	36.5	33.5	33	32
		37	56.5	44.5	38.5	35.5	33.5	32.5	32
		36.5	54.5	42.5	38.5	35.5	34	33	32
	4:00	46	64	58.5	49.5	36	34	33	32.5
		47	62.5	60	49	37	35	33.5	33
		43.5	67.5	58	43	36.5	34.5	33.5	33
		47.5	63.5	60	50.5	37	35	34	33.5
		40.5	57	51	42	37.5	36	35.5	34.5
		44	60	56.5	45.5	38.5	37	36	35
		46.5	60	57.5	51	40	38.5	37.5	36.5
		46	59.5	55.5	50	42	40.5	39.5	39
	6:00	49.5	65.5	59.5	53.5	45	41.5	40	39.5
		47	60	55.5	51	44.5	42	41	40
		51.5	67.5	60	55.5	48.5	43	41	40.5
		53	69.5	62.5	57	49	43.5	41.5	40.5
		55	69	65	59.5	49.5	44.5	43	41.5
		55	72	68	56.5	49.5	44.5	43	41.5
		55	71.5	66	57.5	51	47	44	42.5
		51.5	63.5	57.5	54.5	50	46.5	45	44
	8:00	52	68	59	55	51	46.5	45.5	44
		51.5	70.5	59.5	54	50	47	45.5	44.5
		54	74	64.5	56	52	48.5	47	46
		54	75.5	61.5	56.5	52	48.5	46.5	45.5
		54	72	62	57	52	48	45	44
		54	70	64.5	57	50.5	46.5	45	43.5
		53	79	60	55	50	46	44.5	44
		48.5	65.5	56	52	47	44.5	43	42
	10:00	49.5	63.5	58.5	52	47	43.5	42	41
		50	67	58.5	54	47.5	42.5	41	40
		48	63	58	52	44.5	41	40	39
		49	61.5	58.5	53	45	40.5	39	38.5
		48	61	58	52	44	40	39	38
		48.5	66.5	58.5	52	45.5	42	40	38.5
		49	62	59	53.5	45.5	41	39.5	38.5
		46	60	54.5	50	43	39	37.5	37
	12:00	47	68.5	57.5	51	41.5	38	37	36
		45	61	53.5	48.5	41.5	38	36	35
		48.5	69	59.5	52	43	37	35.5	34.5
		47	64	57.5	51.5	42.5	38	36.5	35
		46.5	62	57.5	50	41.5	36.5	35	32

		47.5	60.5	56.5	51.5	44	36.5	34	32.5
		48	67.5	58.5	51	44	39	35.5	34.5
		48.5	69	61	51	41.5	35	33.5	32
	14:00	44.5	60.5	55	48	41	37	34.5	32.5
		45.5	62.5	55	49	42	37.5	36	34.5
		47	65.5	59	50.5	41.5	37	35.5	34
		48.5	63	59	53	44.5	38	36	34.5
		47	68	55	50.5	45	39.5	36.5	35
		49.5	68	59	52.5	47	43	40.5	39
		51	69.5	62	54.5	48	41.5	38.5	37.5
		50	62.5	58	52.5	49	45	42.5	41
	16:00	50	68	57.5	52.5	49	44.5	42.5	41
		53.5	70.5	66.5	55.5	47.5	42	40.5	38.5
		51.5	65.5	61.5	55	49.5	43.5	40	38.5
		51.5	62.5	60	56	48	42	40	38.5
		52	72	60	55	49.5	43.5	40.5	38.5
		53	75	63	56.5	49.5	44.5	42	40.5
		52	64	60	56	49.5	43.5	40.5	39
		51.5	67.5	60.5	56	47.5	42.5	40.5	39.5
	18:00	53	75	61	56	48.5	44	42	40.5
		50.5	60	59.5	55	47	44	42	40.5
		49	63	58.5	53.5	45.5	42	40.5	39
		48.5	65	58.5	53	44	40.5	39	38
		48	64.5	58	52	43.5	40.5	39	38
		46.5	60	57.5	49.5	42	39.5	38	36.5
		46	62	57	49.5	41.5	38	36.5	35.5
		47	62.5	58	51	41	37.5	36	35.5
	20:00	45.5	65.5	57	48	41	37.5	36.5	35
		45.5	60	56.5	47	42.5	40.5	39	37
		47	67.5	57	50.5	43.5	40.5	39.5	38.5
		48.5	63	59	51.5	45	42	40	39.5
		47.5	63	57	50.5	45	42	40.5	39
		43	57.5	53.5	45	40.5	38.5	37	36
		46.5	60	58	50	40.5	37	35.5	35
		48	68	59.5	52	40	37	35.5	35
	22:00	42	60	53	43.5	38.5	35.5	34.5	34
		45.5	60	58	48	38.5	36	34.5	33.5
		41	57	53	43	37	35	34	33.5
		45	62	59	46.5	37	35.5	34.5	33.5
		36.5	45.5	40	38	36.5	35	34	33.5
		36.5	48	42	38.5	36.5	35	34.5	33.5
		39.5	53	49	42	37.5	35	34	33
		39	59	50	40.5	37	34.5	33.5	32.5
18/7/17	0:00	39	55.5	46.5	40.5	37.5	35.5	34	33
		40	63	48	41.5	38.5	37	35.5	34.5
		40.5	55	49.5	42	39	37	35.5	34
		38.5	52.5	49	41	37.5	35	33.5	32.5
		38	64	42	39.5	37	35	34	33
		40.5	64.5	50.5	42.5	38	36	34.5	33.5
		43.5	62.5	56.5	41.5	37.5	35.5	34.5	33
		38.5	52	46.5	40.5	38	36.5	35.5	34.5
	2:00	38.5	51.5	42.5	40.5	38	36.5	35.5	35
		44	62	57.5	42.5	38	34.5	33	32
		38	53.5	50.5	38.5	35	33.5	33	32
		37.5	48	43	40	37	34	33	32.5
		38.5	45.5	41.5	40	38.5	37	35.5	34

		38.5	54.5	49	39	37	35	34	33
		38.5	54.5	42	40.5	38.5	36.5	35.5	35
		38.5	51	46.5	40	38	36.5	35.5	34.5
	4:00	45	70.5	58	43	39	37.5	36.5	35.5
		47	63	58.5	52	39.5	37.5	36.5	35.5
		42	60	53.5	42.5	38.5	37	36.5	35
		42	60	54.5	41.5	39.5	38.5	37.5	36.5
		45.5	61	57	47	41	39	38	37
		45	60	57	46.5	41.5	40	39	38.5
		46.5	61	57.5	50	42	40.5	39.5	39
		48	60.5	58	52	44.5	41	40.5	39.5
	6:00	51.5	66	61.5	56	46.5	43	42	41
		51	64	60.5	56	46.5	44	43	42
		54	69.5	63	58.5	51	45.5	44	42.5
		54.5	71.5	64	59	50.5	45	43	42
		53.5	69	62.5	57.5	51	46	44	42.5
		53	70	63	57	50.5	45.5	43.5	43
		51	67	59.5	54.5	48	44.5	43.5	42.5
		52	64	60	55.5	50.5	46.5	45	43.5
	8:00	51.5	59.5	57	54.5	51	47.5	46	45
		55	71.5	65	57.5	52.5	48.5	46.5	45.5
		54	72	62	56.5	52	48	46	44.5
		52	70.5	58.5	54.5	51.5	48	47	46
		52	65.5	60	55	51	48	46.5	45
		51	67	58.5	54	49.5	46.5	45.5	44.5
		48.5	66.5	55	51	47	45	44	43.5
		48	65.5	55	51	47	44	43	42
	10:00	48.5	65	59	51.5	45.5	43.5	42.5	41.5
		49.5	66	59	53	46.5	43.5	42.5	42
		51	65	60.5	55	47.5	44	43	41.5
		50	68.5	63	51.5	46	43	42	41.5
		53.5	70	66.5	56	47.5	44	42.5	41.5
		51	71.5	60	52.5	46	43	41.5	41
		49.5	65.5	61	51	45.5	43.5	42	41
		49.5	68.5	60	51	46	43.5	42.5	41.5
	12:00	48.5	63	56.5	51.5	46.5	43	41	40
		47.5	62	57.5	50	45	42	40.5	39.5
		47.5	67	56	50.5	45	41.5	40.5	39.5
		48.5	61.5	57	51	47	44	42.5	41.5
		50	66.5	58.5	53.5	47.5	44	42	40.5
		48	67.5	55.5	51	46	42.5	41	40
		48	65	56.5	51	45.5	42.5	41	40.5
		48	65	56.5	51	45.5	42.5	41	40.5
	14:00	49.5	62.5	58	52.5	48	45	43	42
		49	69	58	51	47	44	42.5	41
		48.5	68	59	51	45.5	43	41.5	40.5
		51	69.5	60.5	53.5	48.5	45	44	42.5
		51.5	64.5	58.5	55	50.5	46	44	43
		52	64	60	56	50	45	41.5	40.5
		50.5	67.5	60	54	48	42.5	40.5	39.5
		50	63	58.5	54	48	43	41	40
	16:00	51	67	59	54	50	44.5	41.5	39.5
		51.5	62	58.5	54.5	50.5	46	43.5	42.5
		51	69.5	59.5	54.5	49	43.5	40.5	39.5
		51.5	68	59	55	49	43.5	41	39
		51.5	68	59	55	49	43.5	41	39

		51.5	68.5	59.5	54.5	49.5	44	40.5	38.5
		52.5	68.5	60.5	55.5	51	47	44.5	42
		53	73.5	63	55.5	50.5	46.5	43.5	43
	18:00	51	63	59	54.5	49	44.5	41.5	40.5
		49.5	63	57.5	53.5	48	43	41	40
		49	65	58.5	53	46	43	41.5	40.5
		48.5	61	58	52	45.5	43	42	40.5
		50.5	67.5	61	54.5	46	42.5	41	40
		47	61	56.5	50.5	43.5	41	39	38
		48	66.5	59	51.5	43.5	39.5	38	37
		48.5	62	58.5	52.5	44	39.5	38	37
	20:00	44	67	55	47.5	39.5	36.5	35	34
		46	60	56.5	50	40	37	35.5	35
		47	62	57.5	51.5	41	37.5	36	35
		42	57.5	52.5	44.5	38	35.5	34	33
		42.5	60	54.5	45	38.5	36	35	33.5
		44	60	56.5	46.5	39	37	35.5	34.5
		45	62	56	48.5	39.5	37.5	36.5	35
		49.5	67	61	53.5	41	37.5	36	35
	22:00	44.5	57.5	53.5	48.5	42	39.5	37.5	36.5
		43.5	57	53.5	46	41	39.5	38	37
		42.5	59	52.5	44	40.5	38.5	37	35.5
		44	62.5	55.5	47.5	40	37	35.5	34.5
		46	64.5	58	50.5	39	36	35	34
		41.5	60	52.5	44	38.5	36	34.5	34
		40	60	49	40.5	37.5	35.5	34	33
		39	55.5	48.5	40.5	37.5	35	33.5	32.5
19/7/17	0:00	41.5	58	51	44	40	37	35	33.5
		38.5	46.5	43	40.5	38	35.5	34	33
		38.5	57	42.5	40.5	38	36	34.5	33
		40.5	58.5	50.5	42	38.5	36	34	32
		40.5	59.5	50	42.5	38.5	35.5	34	32.5
		39	47	44.5	41.5	38.5	35	33	31.5
		39.5	47.5	45	42.5	39	35.5	34	32.5
		41	61	48	43	39.5	36.5	34.5	33
	2:00	44.5	61.5	58	44.5	39.5	36.5	34.5	33
		41	57.5	49.5	43.5	39.5	36	34	33
		39	47	44.5	42	38.5	35.5	33.5	32
		40.5	56.5	47.5	43.5	40	35.5	33.5	32
		39	47	45	42	38.5	34.5	33	31
		44.5	66	58.5	43.5	38.5	34.5	32	30
		37	49.5	43.5	40	35.5	32.5	31.5	30.5
		47	62.5	59.5	51	36.5	33	31.5	31
	4:00	42	60	55	42.5	37	34.5	33	32
		42.5	61.5	58	39	35.5	33.5	32.5	32
		43	64	57.5	41	36.5	34.5	33.5	32.5
		46	66.5	58.5	49.5	37	35	34	33
		45	62.5	58	46	37	35	34	33
		48	64	60.5	51.5	39	36.5	35.5	34
		49	62	59.5	54.5	39	36	35	34
		48.5	62.5	59	53.5	42.5	38	36.5	36
	6:00	50.5	66.5	60	55.5	44	37.5	36.5	35.5
		47.5	63.5	57.5	52.5	41.5	38	37	36
		51.5	65.5	59.5	56	48.5	41.5	39.5	38.5
		52.5	69	62.5	56.5	49	42.5	40	38.5
		50.5	69	59.5	53.5	47.5	42.5	41	40

		51	65.5	59	55	49	45	41.5	40
		52.5	66	61.5	55.5	50.5	46.5	44.5	43
		51.5	67	58	54.5	50	47.5	45.5	44
	8:00	52.5	62.5	58.5	55.5	51.5	47.5	46.5	45.5
		53.5	67.5	60	57	52	47.5	45.5	44.5
		56.5	80	66	57	52	48.5	46.5	45
		52	61	58.5	55	51.5	48	46	44
		51.5	66.5	61	54.5	49.5	45.5	44	43
		51.5	68.5	60	55	49	44	43	41.5
		49	67	58	51.5	47	44	43	41.5
		50	61	59	53.5	47.5	43	41.5	40
	10:00	48.5	64	59.5	52.5	44	40.5	39.5	38
		50.5	65	61	54	46.5	42.5	41.5	40
		45	67.5	52	48.5	43.5	40.5	39	37.5
		53	72.5	63.5	56.5	47.5	42	39.5	38
		50.5	64	59.5	54.5	47.5	44	42.5	41.5
		50	65	59.5	53	47.5	44.5	42.5	41
		48.5	67	59	51	45	42	39	38
		46.5	61.5	56	49.5	44	40.5	39	37.5
	12:00	48	67.5	60	49	44	41	39.5	38.5
		47	65	55.5	50.5	45	41.5	40	38.5
		49.5	70	57.5	51.5	48	45	42.5	41
		51.5	64	58	54	50.5	48	46	44.5
		50	68.5	60	52.5	48.5	45.5	43.5	42.5
		51	65.5	59.5	53.5	49.5	47	45.5	45
		50.5	64.5	59	53	49	47.5	46	45
		50	62.5	57	53	49	46	45	44
	14:00	50	67.5	58	51.5	48	46	44	43
		48	67.5	56.5	50	46.5	44	43	42
		49	70	57	52	47.5	44.5	43	41.5
		50	61	57	53	49	45.5	44	43
		50.5	68.5	56.5	52.5	49	46.5	44.5	43.5
		51.5	60	56.5	54	51	48	46.5	45
		52	61.5	57.5	55	51	47.5	46.5	45.5
		53.5	65	59	56	53	49	47	46.5
	16:00	53	68.5	59.5	56	52	49	47	45.5
		51.5	69	59.5	54	49.5	46.5	45	43.5
		51	61.5	58.5	53.5	50	46.5	44	42.5
		51.5	65	59.5	54.5	49.5	45.5	44	43
		50.5	69	59	53.5	48.5	44	42	41.5
		51.5	65.5	59.5	56	49	43.5	41.5	40
		50	63	57	53.5	49	44.5	43	41.5
		50	67.5	60.5	53	47	42.5	41	39.5
	18:00	49.5	63.5	58.5	53	46.5	42.5	41.5	40.5
		49	65	58.5	53.5	45.5	42	40.5	39.5
		48.5	60	57.5	53	45.5	42	40.5	39.5
		47.5	60	56	51.5	44	41.5	40	39
		47.5	64	58	51	44	40.5	39	38
		47.5	63	57.5	50.5	44.5	42.5	41	40
		47.5	62	58	50.5	44.5	42	40.5	39
		46	60	54	49	44.5	41.5	40	39
	20:00	49	66	60	52.5	44.5	40	38	37
		44.5	61	56	47.5	40.5	38	36.5	35.5
		46	61	57	49.5	41.5	38	37	35.5
		41.5	56.5	52.5	44	38.5	37	35.5	34
		48.5	69	60.5	51	41.5	37.5	36	35

		47.5	66.5	58.5	50.5	42	38	36.5	36
		43.5	60	54	46.5	39.5	37	36	35
		41.5	57.5	51	43.5	39.5	37	36	35
	22:00	45	62	57	47.5	40.5	37.5	36	34.5
		59	81.5	75	47.5	38.5	36	34.5	33.5
		48	70	60	47.5	40	36.5	35	34.5
		43	60	54.5	45.5	39	36	35	34
		43.5	60	55.5	46	38.5	35.5	34.5	33.5
		44	63	57	44.5	38.5	35.5	34	33.5
		45.5	66	57	48.5	39	35.5	34	33.5
		44	64.5	58	44	38.5	35.5	34	33
20/7/17	0:00	39	58.5	49	41.5	37	34	33	32
		39.5	59	49.5	41.5	37	34	33	32.5
		45	70.5	54	42.5	38	35.5	34	32.5
		39.5	54	50	41	37.5	35	33.5	32.5
		39.5	52	46.5	42.5	38	34.5	33.5	32.5
		39.5	54.5	46	42.5	38	35	33.5	32.5
		39	52	46	42.5	37.5	34	32.5	31
		47.5	75	58.5	43	38	34	32.5	31
	2:00	40	52	47	43.5	38	34	32	31
		41.5	60.5	52	43.5	37.5	34	32.5	31.5
		43	67.5	53	43.5	37.5	33.5	32.5	31.5
		37.5	52	44	40.5	36	33	32	31
		39.5	56	49	41.5	36.5	33.5	32	31
		36.5	51.5	43	39	35.5	33	32	31
		36	54.5	42.5	38.5	35	33	32	31
		46	61	58.5	47.5	35.5	33.5	32	31.5
	4:00	39.5	59.5	51	41	35.5	34	33	32
		35.5	51	40.5	37.5	34.5	33	32	31.5
		37	52.5	41.5	39	36.5	35	34	33
		47	62	59.5	51.5	37.5	35.5	34.5	34
		43.5	60.5	56	45.5	39	37	35.5	35
		47.5	63	59.5	51	40.5	38	37	35.5
		48.5	62	59	53	43	39.5	38	37
		49	65	60	53	44	40.5	39	38
	6:00	50	63.5	59.5	55	44	40.5	39.5	38
		52	67	61.5	57	47	42.5	41.5	40
		53.5	67.5	62.5	57.5	51	44	42	41
		53.5	72.5	61.5	57.5	50	44.5	43	41.5
		53	64.5	61.5	56.5	51	47.5	45.5	43.5
		53	73	62.5	55	51	48	47	45.5
		53.5	66	60	56.5	52	48.5	46	45
		55.5	72.5	65.5	59	52.5	49.5	48	46
	8:00	55	67.5	61.5	58	54	51	49	48
		55	67.5	63	59	53	49	46.5	45.5
		53.5	65.5	61	57	52.5	49	47.5	46
		53.5	69.5	62.5	55.5	52.5	49.5	47	45
		52.5	63	59.5	55	51.5	48	46.5	46
		51.5	70	62.5	54	49	45	43.5	42.5
		51.5	74.5	62	53	46	42.5	41	39.5
		49.5	67.5	58.5	53	46	42	40	38
	10:00	52.5	72.5	63.5	56	48	41.5	39.5	38
		49.5	71	57.5	51.5	45.5	41	39.5	38.5
		50	63.5	59.5	54	46.5	42.5	40	39
		50.5	64.5	60	54	47	42.5	39.5	38.5
		51	65.5	61.5	55	46.5	42.5	41	39

		49	67	59	52.5	46	42.5	41	39.5
		49	64	58	52.5	46	42	40	39
		50	65.5	60	53.5	46.5	41.5	40	39
	12:00	48	61.5	57	51	46	42.5	40.5	39.5
		47	63	56	50	45.5	42.5	41	39.5
		50	65.5	62	54	45	42	40.5	40
		47.5	61	57.5	50.5	45	42	41	40
		50	69	61	51	45	42	41	40
		49	68.5	59	51	46	43	41	39.5
		49.5	65	58.5	53	47	44	41.5	41
		49.5	60	57.5	52.5	48	44.5	43	42
	14:00	49.5	63.5	56.5	52.5	48	45.5	44	43
		50	64.5	56.5	53	49.5	46	43	41.5
		50	62.5	59	52.5	48	45.5	44.5	43
		50	63	58.5	53	48.5	45.5	44.5	44
		51.5	66	60	54	50.5	46.5	44.5	43.5
		51	69	58.5	53.5	49.5	46.5	44.5	43
		51	65.5	57.5	54	50	46.5	44.5	43.5
		52.5	64	59	55	51.5	48	46	45.5
	16:00	52	66.5	59.5	55	50.5	46	44.5	43.5
		51	64.5	60	54.5	49	45	43.5	42
		50.5	64	59	53.5	49	44.5	42.5	41.5
		50.5	62.5	58	54	49	45.5	44	43
		51.5	69	59.5	54.5	49.5	45.5	44	43.5
		54.5	75	68.5	54.5	49	44.5	42	40.5
		51.5	69	60	54.5	48.5	44	41	40
		51	67	60.5	54	48.5	44	42.5	41.5
	18:00	49.5	60	57	53	47.5	44.5	43	41.5
		48.5	64	55.5	52	46.5	43.5	42.5	41
		49.5	70.5	59.5	52.5	45.5	43	41.5	40
		49	66.5	60	52	45.5	43	41	39.5
		47.5	65.5	57.5	51	44.5	41.5	40	38.5
		47	66.5	55.5	49.5	43.5	41	39.5	38
		47.5	60	57	51.5	44	41	38.5	37.5
		46	62	55.5	50	42.5	38.5	37	36
	20:00	48	72	56.5	50	43.5	40	38.5	36.5
		45	59.5	52.5	48.5	43	40.5	39	38
		43	59	53	46.5	40.5	38.5	37	36
		44.5	59	54	49	41	38	37	35.5
		44	61	54.5	47.5	40	37	36	35
		44	56.5	54.5	47	39.5	37.5	36	35
		48	72	59.5	49	40.5	37.5	36.5	35.5
		46.5	62.5	58	50.5	40	37	35.5	34.5
	22:00	45	63.5	56.5	48.5	38	35.5	34	33.5
		42.5	60	54.5	43.5	36.5	34.5	33.5	32.5
		43.5	60.5	55.5	47	37.5	34.5	34	33
		44	60	54	48	37.5	35	34	33
		41.5	60	53.5	43	36	34	33	32
		41.5	56.5	52.5	45	36	34	33	32
		35.5	55.5	44	36.5	34	33	32.5	31.5
		40.5	61	54.5	38	34.5	33	32	31.5
21/7/17	0:00	38	58.5	50	37.5	34	32.5	32	31
		35.5	56.5	45.5	36	34	32.5	32	31
		37.5	59.5	48	37	34	32.5	31.5	31
		41	61	54	41	34.5	32	31.5	30.5
		36	54	47	38	34	32	31	30

		36.5	62.5	41.5	36.5	33	31.5	30.5	30
		39.5	55	53	40.5	33.5	31.5	30.5	30
		34	58	42.5	36	33	31	30.5	29.5
	2:00	43	61	57	39	33	31	30.5	30
		36	60.5	47.5	35	32.5	31	30.5	29.5
		37.5	54.5	51	38.5	33.5	31.5	31	30.5
		35.5	54	48.5	35	32.5	31.5	31	30
		33.5	47.5	42	35.5	32.5	31.5	31	30
		34.5	58	43	36.5	33.5	31.5	31	30
		34	45	38	36	33.5	32	31.5	31
		35.5	53	48	35.5	33.5	32.5	31.5	31
	4:00	39	57.5	52	37.5	33.5	32.5	32	31
		46	62.5	59	51	34.5	33	32.5	31.5
		37	56.5	48	37	34.5	33.5	33	32
		42.5	60	56	42	36	34	33	32
		41.5	60	55.5	41.5	37.5	36	35	34
		43.5	63	56	45	39	37	36	35
		48	65.5	59	53	41	38.5	37.5	36.5
		51	65	62	55	44.5	41	39.5	38.5
	6:00	49.5	63	59	54.5	45	41	40	39
		50	65.5	60.5	54	45	42.5	41.5	41
		53	69	61.5	57.5	48.5	44	43	42
		52.5	67.5	61.5	56.5	50.5	46.5	44	42.5
		53	67.5	61.5	56	51.5	47	45.5	44
		54.5	68	61	58	53.5	49.5	47.5	46
		54.5	65	60.5	57.5	53.5	51	50	49
		55	66.5	61.5	58.5	54	50.5	49	48
	8:00	54.5	67	61.5	57	53.5	51.5	50	48
		53.5	65	60.5	56.5	52.5	50	48.5	47.5
		53	66	58.5	55.5	52.5	49.5	48	47
		54.5	69	64.5	57	52.5	49	47.5	46.5
		53	69	62	56	51.5	48.5	47	46
		51	66	59	54.5	49.5	46.5	45	43.5
		50	66.5	59	53.5	47.5	44.5	43	42
		51	67	61.5	54	47.5	43.5	42	41.5
	10:00	49	63.5	58	52	47.5	44.5	43.5	42
		51	63	60.5	54	47.5	45.5	44.5	43.5
		54	75	68.5	53.5	48	46	45	44.5
		51	68	59.5	55	48	45.5	43.5	43
		50	68	60.5	52.5	46.5	44.5	43	42
		53	73	66	55	48.5	45	43.5	43
		53	73	67.5	52.5	47.5	45	43.5	43
		54	71.5	67.5	52.5	47.5	45	42.5	41.5
	12:00	55	72.5	69	53	46.5	44	42.5	42
		49.5	68.5	59	52	47	44.5	43	41.5
		48.5	69.5	58	51.5	46	43	41	40
		47	62	56	50.5	45	41.5	40	39
		47	65	57.5	49.5	44.5	40.5	39	38
		48.5	67.5	59	52.5	44.5	39	37	36
		47	63.5	58	50.5	43	39.5	37.5	36.5
		47.5	62	57	50.5	44.5	39.5	38	37
	14:00	47	64.5	57	50.5	44.5	41	39	37.5
		47	64	57	50.5	43.5	40	37.5	36.5
		46	61	55.5	49.5	43.5	40.5	39.5	39
		48	62.5	59.5	50.5	45.5	41	38.5	37.5
		49.5	66	59.5	52	46.5	43	41	40

		48	64.5	58.5	51	44.5	40.5	38.5	37.5
		50	66.5	57.5	53	48.5	45	43	41.5
		49.5	62.5	56.5	52.5	49	44	41	39
	16:00	51	68	61	54	48.5	44	41.5	40.5
		50	63	59	53.5	48.5	43.5	40	38.5
		50	68.5	59.5	52.5	48	43	40.5	39
		48	63.5	55.5	51.5	46	40	38	37
		49	68.5	57	52.5	45.5	40.5	38.5	37
		51	70	60.5	54.5	47	41.5	40	38
		51.5	70	60	55	48	44.5	42.5	40.5
		50.5	61	58.5	54.5	48	44.5	43.5	42
	18:00	51	67.5	59.5	55	47.5	42.5	40	39
		47.5	62.5	57	52	44.5	41	39	38
		48.5	66.5	60	51.5	44	40	38.5	38
		45.5	59.5	55.5	49.5	41.5	39.5	38.5	37.5
		49.5	73	61.5	51	42.5	40	39.5	38.5
		48	67.5	57.5	52.5	44	40	38.5	37.5
		46.5	62	56.5	51	42	39.5	38.5	37
		44.5	61.5	55	47	40	38	37	36.5
	20:00	46	64.5	57	49	40	38	36.5	35.5
		41.5	59	52	43	39	37	36	35.5
		44	63	56	46	39	37.5	36.5	35.5
		45	61.5	55.5	49	40	37.5	36.5	35.5
		43	58.5	55	45.5	38	36	35.5	34
		45	60.5	57.5	47.5	39.5	36.5	35.5	34.5
		43	56.5	53	47.5	39	36.5	35.5	35
		42.5	64	53	44.5	39	36.5	35	34
	22:00	46.5	65.5	58.5	49	40	37	35.5	34
		45.5	67	57.5	49	39.5	36	35	34
		48	70	61	50	39.5	36.5	35	33.5
		43	71	54.5	45	38.5	35.5	34.5	34
		39	54	50	41	36	33.5	32.5	32
		42.5	60	55	44.5	36.5	34	33	32.5
		37	52.5	46	38.5	36	34	33	32
		41.5	58	51.5	46	37	34.5	33.5	33
22/7/17	0:00	45	70	57.5	43.5	35.5	33.5	32.5	32
		37.5	57.5	48	38.5	35	33.5	32.5	32
		38.5	55.5	50.5	40	35	33	32.5	31.5
		39	57	51.5	40	35	33	32.5	31.5
		38.5	58.5	52	38.5	33.5	32	31.5	30.5
		36	54	49	35	32.5	31.5	31	30
		37	50.5	47.5	40	33	31.5	31	30.5
		34	49.5	42	36	32.5	31	30.5	30
	2:00	45.5	64	59.5	42.5	32.5	31	30.5	30
		39.5	57	52	41	33	31.5	31	30.5
		35	56	45	36	33	31.5	31	30
		33.5	51	41.5	35	32.5	31.5	30.5	30
		35	51	46.5	36	33.5	32	31.5	30.5
		38	60	51	37	33.5	32	31	30.5
		38.5	54	50.5	40	33.5	32.5	31.5	31
		45	63	58	45	33	31.5	31	30.5
	4:00	41	59	55	40.5	33	32	31.5	30.5
		35	55	44.5	35	32.5	31.5	31	30.5
		45.5	63.5	59	44	33	32	31.5	31
		39	60	51.5	39	34	32	31.5	31
		46.5	60	58	52	36.5	34	33	32.5

		45.5	62	58.5	46	36.5	35	34	33
		42.5	60	54.5	43	37	35	34	33.5
		47	64	58	52	40.5	36.5	35	33
	6:00	46.5	61.5	58.5	50.5	37.5	36	35.5	35
		47	60.5	58.5	52	39	37.5	36.5	35.5
		50.5	71	60.5	55	44	39	37.5	36.5
		51	71	61	55.5	45.5	41	39	38
		52.5	71.5	64	56	46.5	42	40	38.5
		51.5	69.5	63	55	47	41.5	40.5	39
		50	66.5	59.5	54.5	46	43	41.5	41
		53	69.5	65	55.5	48	43.5	42	41
	8:00	50.5	66	59	54.5	47.5	43	42	40.5
		51	65	60	55	46.5	42.5	41	40
		52	70.5	61.5	56	49	43	41	40.5
		48	60.5	56.5	52	46	42.5	41	40.5
		50	69.5	61	52	46.5	42	40.5	39
		49.5	66	59	53	47	42	39.5	38.5
		47.5	66.5	57.5	50.5	44.5	40	38.5	37.5
		50.5	65	60	54	47.5	41.5	38.5	37
	10:00	49.5	66	59	53.5	45.5	40.5	39.5	38
		48.5	69	59	51.5	43.5	39.5	38.5	37
		47	66	55.5	51	43.5	38.5	37	36
		50	67	60	54	47	41	37.5	36.5
		50	73.5	59.5	52.5	45	38.5	36.5	35.5
		52	72.5	62.5	55	47	40.5	37	36
		48	61.5	57.5	52.5	44	37.5	35.5	34
		49	72.5	61.5	50.5	42	36.5	35.5	34.5
	12:00	47.5	62.5	57.5	51.5	44	38	35.5	34.5
		45.5	64.5	54.5	49	42.5	37.5	35	33.5
		47.5	61	57.5	51	45	37.5	34.5	33.5
		48.5	65.5	58.5	52	45.5	39.5	35.5	33.5
		47.5	68	57.5	51.5	44.5	38.5	35	33.5
		48.5	63.5	59.5	52.5	43.5	36	33.5	32
		47	64.5	58.5	50	41.5	36	34	32.5
		46.5	62.5	56	51	43	36	34	33
	14:00	46	65.5	57	49	40.5	34.5	33	31.5
		46.5	68.5	56	49.5	41.5	35.5	33.5	32.5
		46.5	64	57	49.5	43	37	35	33
		48.5	71.5	59.5	51	43.5	37.5	35.5	33.5
		45	66.5	55	48	40.5	35.5	34	33
		48	66	59.5	50.5	43	36.5	33.5	32
		47	65	59	49.5	41	34	32	31
		50	73	60.5	50.5	42.5	37	34	32.5
	16:00	46.5	62	57	50	43.5	37	34	32
		47.5	62	57	51.5	43	35.5	32	31
		50.5	67	63	53	42	35.5	34	32.5
		48	68.5	57	51.5	44	37.5	35.5	33.5
		48.5	67.5	59	52.5	42.5	38.5	36.5	35
		49.5	81.5	56	52	44	38	36	34.5
		46	61.5	57.5	49.5	40.5	38	36	34.5
		47.5	64	58.5	52	42	38	36.5	35.5
	18:00	48	67	59	52	43	40	38.5	37
		46.5	60	56.5	51	42.5	39.5	38	37
		47.5	62	59.5	50.5	41.5	37.5	36.5	35
		46.5	66.5	58	49.5	40	36.5	35.5	34.5
		47	65	59	50	42	37	35.5	34

		47.5	68	60	47.5	39.5	36	35	34
		48.5	70	61	49	39.5	36	35	34
		42.5	61.5	53.5	45	38.5	36	34	33
	20:00	46.5	66.5	59.5	48	38	35.5	34	33.5
		44.5	62	56	47	37.5	35	33.5	32.5
		42.5	61.5	52.5	45.5	38	34.5	33	32.5
		47	66.5	60	49.5	39	35.5	33.5	32
		41.5	59	52.5	43	37.5	35.5	34.5	33.5
		46	60	56.5	51	39	36	34.5	33.5
		42	61	56	41	36.5	35	34	33
		45	65	56.5	48	37.5	35	34	32.5
	22:00	41.5	58.5	53.5	42.5	36.5	34.5	33.5	33
		44	60	56	46	37.5	34.5	33.5	32.5
		43.5	58	55	48	37	34.5	33.5	33
		39.5	55	50.5	41.5	36	34.5	33.5	33
		41.5	60.5	52.5	44.5	36.5	35	34	33
		37	54	44	38.5	36	34	33.5	32.5
		43.5	64.5	55.5	47.5	37	34.5	33.5	33
		41	63	51.5	44	36.5	33.5	33	32.5
23/7/17	0:00	42	57.5	53	46	36.5	34	33	32
		39	55.5	50	41	35	33.5	32.5	32
		36	52	45.5	37.5	34.5	33	32	31.5
		42.5	61.5	55	44	35	32.5	31.5	30.5
		38	56.5	51	37.5	33	31.5	31	30.5
		37	56.5	48	38.5	33.5	32.5	31.5	31
		37.5	58.5	49	38.5	33.5	32.5	31.5	30.5
		44	64	57	44.5	33.5	31.5	31	30.5
	2:00	40	60	54	40	33.5	32	31	30
		38.5	57	50.5	39	33.5	32	31.5	31
		35.5	52.5	47.5	36	33	31.5	31	30
		39	60	51	41.5	32.5	30.5	30	29.5
		35.5	56.5	47.5	34.5	31.5	30.5	30	29
		43	64	57.5	43.5	33	31.5	31	30.5
		35	51.5	43.5	37	33	32	31.5	30.5
		33.5	40.5	37	35	33.5	32.5	31.5	31
	4:00	35	56	46	34.5	31.5	30.5	30	29.5
		46.5	62.5	59	49.5	33	31	30.5	29.5
		43	63	57	41	32	30.5	30	29.5
		45	63	58.5	47.5	33	31	30.5	29.5
		41.5	61	57	34	32	31	30.5	30
		44.5	62.5	59	37.5	33	31.5	31	30
		43	60.5	56.5	40	34	32.5	31.5	31
		47	63.5	59.5	51.5	35	33	32	31
	6:00	42.5	60	56.5	39	34.5	33	32.5	31.5
		48	65.5	59.5	53	36	34	33	32.5
		51.5	72	62	56.5	43	36	33.5	33
		50	66	61	55	41	37	35.5	34
		50	69	60.5	54	43	37	35.5	34
		48.5	63	59.5	53	42	37.5	36	35
		49.5	65.5	60	53.5	44	39.5	37.5	36
		50	62	59	54	46	40	37.5	36
	8:00	49.5	67.5	57.5	53.5	47.5	41.5	39	37
		49.5	65	60.5	53.5	44	40	38.5	37
		53.5	68	64	59	47.5	41.5	39.5	38
		52.5	67	63	56.5	47	42	40	38.5
		49.5	64	59	53.5	45.5	41	38.5	37

		48.5	64.5	58.5	52.5	44.5	39.5	38	36.5
		48.5	62.5	59	53	43.5	39.5	38.5	37.5
		49.5	69.5	60.5	52.5	43.5	39.5	38	36.5
	10:00	49.5	63.5	59.5	54	46	40	38	36.5
		51	68	62.5	55.5	44	38.5	37	36.5
		48.5	64.5	59.5	51.5	44	39.5	37.5	36
		48	66.5	59.5	52	41.5	37.5	36.5	35.5
		49.5	65.5	60	54	44	38	36.5	35
		50	70.5	60.5	53	46	40.5	38	36.5
		51.5	68	62	56	45	37.5	35	33.5
		47.5	62.5	59	51.5	43	37.5	35	34.5
	12:00	45	63.5	57	47.5	39	35	34	33
		45.5	60	56	49.5	40.5	36	33.5	32.5
		46.5	65.5	59.5	47	37.5	34	33	32
		42.5	60	50	46.5	39	35	33.5	32.5
		45	61.5	55	48	41	35.5	34	33
		47	66.5	59	49	42	36	34	32
		46.5	60	55.5	51	43.5	39	37	36.5
		49	63	59	53.5	44	37.5	34	33
	14:00	43	57.5	52.5	47	40.5	38	35.5	34.5
		47	64	59	50	41.5	36.5	35	33.5
		46.5	63.5	55.5	49.5	43.5	39	37	36
		44.5	66	53.5	47.5	41	38.5	37	35.5
		46.5	65	57.5	50	42	37	35	33.5
		45.5	61	55	50	41.5	37.5	35	33.5
		49	67	60	52	44	39.5	37.5	35.5
		48	75.5	59.5	50.5	43	37	34.5	33.5
	16:00	46.5	60	55	51	43	38.5	36	35
		50	68	61.5	53.5	43.5	39	37.5	36
		48	68	59	50.5	44	37.5	35.5	34.5
		46	62	58	49.5	41.5	38	36.5	35
		48.5	69.5	58	50.5	44.5	39.5	36.5	35
		47.5	61	55.5	51	45	41	39	38
		49.5	65	60	52.5	45	42.5	41	40.5
		47.5	63.5	58.5	50	44.5	42.5	41	40.5
	18:00	48	65.5	58	51.5	44.5	41.5	40.5	39.5
		48.5	66	60	51.5	43.5	41.5	40.5	39.5
		45	59	54	49	42.5	38	36	35
		42.5	60	53	46	37.5	35.5	34.5	33.5
		44.5	61.5	57.5	47	38	35.5	34.5	34
		45	60	55.5	49	40	36.5	35.5	34.5
		45.5	62	57.5	49.5	39.5	35.5	35	34
		43	57	53.5	46.5	39.5	36	35	34
	20:00	41	60	51.5	43	37	35	34.5	33.5
		41.5	60	53.5	43	36.5	35	34	33.5
		43.5	62	56	44.5	37.5	35.5	34	33
		47.5	72	58.5	51.5	36.5	34	33.5	33
		41.5	59.5	52	45.5	35.5	33.5	33	32
		45.5	63.5	59	47	37.5	34.5	32.5	31
		47.5	66	59.5	51.5	38.5	34	32.5	32
		48.5	66.5	60.5	52.5	39	34	33	32.5
	22:00	46	67.5	58	49.5	38.5	34.5	33	32
		41.5	59.5	55	42	34.5	32.5	32	31
		47.5	69.5	60.5	49.5	35.5	32.5	31.5	30.5
		40	57	52	42	35	33	31.5	30.5
		42	60	55.5	43.5	34.5	32	31	29.5

		39	63	51.5	38	33.5	32	31	30
		32.5	50.5	38	34.5	32.5	31	30.5	30
		35	59.5	46	35.5	32	30.5	30	29.5

APPENDIX D

Acoustic Comparisons

84 Tallawong Road Rouse Hill

Projected Sound Levels Compared to Common Noise Events

NOISE LEVEL (dB)		THE LEVEL OF COMMON SOUNDS	PROJECTED SITE NOISE	
			OUTDOOR	INDOOR
	Threshold of Pain			
140		Jet Engine (25 metre distance) – 140 dB		
130				
120		Jet Take-Off (100 metre distance) – 120 dB		
	Extreme			
110		Rock Band		
		Chainsaws at 25 metres (104 dB – 107 dB) Jet Flyover at 400 metres - 105 dB		
100				
	Very Noisy			
90		Pneumatic Drill		
		Heavy Truck, 40km/h, 7a distance (87dBA - 90 dB) Motor Car at 7 (80dBA) Motor Bikes (2-Wheel) 70dBA – 92dBA)		
80				
	Noisy	Average Street Traffic (40km/h, 7 metre distance)		
70				
		Lawn Mower at 30 metres 70dBA Vacuum Cleaner at 3 metres - 67 dB Normal Speech at 1 metre - 65 dB Business Office (60 dB – 65 dB) Inside an Average Residence- 60 dB		
60				
	Moderate	Large Business Office 60 dB (55 dB – 65 dB)		
50		Dishwasher – Next Room 50 dB		
		Typical Living Room at Night (40 dB – 45 dB)		
40				
	Quiet			
30		Library (30 dB – 34 dB) Soft Whisper at 2 metres 30 dB		
		Typical Bedroom at Night (25 dB – 30 dB) Concert Hall Background 4D Slight Rustling of Leaves 20 dB		
20				
	Almost Silent	Broadcast & recording Studio 16 dB		
10				
0	***Silent***	Threshold of Human Hearing		

External Sound Levels (dBA, LAeq)	Internal Sound Levels (dBA, LAeq)

(Source: Australian Acoustic Association; NG Child & Associates)

APPENDIX E

Noel Child
Summary of Qualifications, Capability & Experience

1 PERSONAL DETAILS

Full Name: Noel George CHILD
Profession: Consultant in Environmental Assessment and Management
Date of Birth: 6th December 1946
Nationality: Australian
Experience: > 30 Years
Address: 22 Britannia Road, Castle Hill, NSW, 2154
Contact: **Phone**: 61 2 9899 1968 **Fax**: 61 2 9899 1797 **Mobile:** 0409 393024

2 CAPABILITY AND EXPERIENCE - SHORT SUMMARY

Noel Child is a successful and experienced commercial and technical professional with over 30 years' experience in a variety of senior level appointments and assignments, within both the corporate and private sectors, with a particular focus on strategic, infrastructure and environmental applications.

Noel's experience includes senior management at both the State and National levels in the Australian petroleum industry, and a number of senior consultancies for both government and corporate clients. His record reflects the ability to develop and achieve positive commercial outcomes through effective planning and communication; critical and objective analysis; and quality task completion and delivery at both the personal and team level.

His management responsibilities have included transport, environmental, safety, and general operational activities at a national level, while his formal professional training includes strategic management, environmental, engineering and business disciplines. He has undertaken a number of senior corporate appointments with distinction, and been successfully involved in the ownership and operation of a major petroleum distribution and marketing company in regional Australia. More recently, working through his own businesses Environment Australia and NG Child & Associates, he has applied his knowledge and experience in the areas of strategic management, infrastructure development, energy and the environment on a consultancy and contractual basis to a number of private and public sector clients, both nationally and internationally.

Noel has had post-graduate training in several technical and commercial disciplines, and provides specialised teaching input, by invitation, to post graduate engineering and business management courses conducted by the Faculties of Business and Engineering at Sydney's University of Technology. He has strong affiliations with a number of international corporations and agencies, and has worked closely with both the regulators and the regulated in a number of aspects of environmental management, assessment and performance. He has also been recognised as an independent expert on engineering, and environmental issues by the Land and Environment Court of NSW.

Noel has a detailed understanding of environmental engineering and associated processes, and has specific experience and expertise in the fields of acoustics, air quality, electromagnetic field assessment, electrolysis and stray current assessment, contaminated site assessment, and liquid and solid waste management. He also provides post graduate teaching input on environmental engineering issues to post graduate courses at the University of Technology, Sydney, and La Trobe and Monash Universities in Melbourne.

3 EDUCATION, QUALIFICATIONS AND AFFILIATIONS

BE, PhD (Chemical Engineering), UNSW, Sydney
Master of Business Studies, University of New South Wales, Sydney
B.Sc. (Hons) Applied Chemistry (Environmental), University of Technology, Sydney
Graduate Diploma (Environmental Engineering and Management), UNSW, Sydney
Qualified Environmental Auditor, Standards Australia
Member, Royal Australian Chemical Institute, 1972/2017
Member, Institution of Engineers, Australia, 1972/2017
Member, Clean Air Society of Australia and New Zealand, 1992/2017
Member, Australian Natural Gas Vehicle Council, 1996/2004
Executive Director, Australasian Natural Gas Vehicles Council, 2003/2004
Visiting Fellow, Institute for Sustainable Futures, UTS, 1995/2002
Research Fellow, Faculty of Civil & Environmental Engineering, UTS, 1996/2017
Research Associate, New York Academy of Sciences, 2000/2017

4 RECENT ASSIGNMENTS & EXPERIENCE

Impact Group (and client) (2015/16) – Acoustic and vibration assessment of an affordable housing development project at Collett Avenue and James Ruse Drive Parramatta, including preliminary, development application, tender documentation and post construction phases of the project.

Armada Architecture and Master Planning (and clients) 2015-2017 – Environmental assessments of various prospective child care centre developments throughout the Sydney area, including preliminary site investigations, air quality assessments, acoustic assessments and electromagnetic field assessments.

Kaunitz Yeung Architecture (2016) – Electromagnetic field and air quality assessments of a child care centre development project at 60 Dickson Avenue Artarmon NSW.

Australian Consulting Architects (Current) – Electromagnetic, stray current and electrolysis assessments of development projects at Field Place Telopea; Windsor Road Vineyard; Camden Valley way Horningsea Park and others.

Futurespace/Renascent (Current) – Environmental assessment of proposed child care centre development at Waterloo Road Macquarie park and Cleveland Street Strawberry Hills, including general environmental, acoustic assessment, air quality and electromagnetic field assessment.

Thyssen Transrapid Australia (Current) – Adviser on technical and operational issues associated with the development and construction of a high-speed magnetic levitation train systems within the People's Republic of China, and elsewhere, including electrolysis, electromagnetic and stray field effects.

Trumen Corporation (Current) – Environmental assessment, including acoustic and contamination assessment and certification, of mixed use and child care centre development projects at Waine Street Freshwater, Fitzroy Street Marrickville, and at Huntley Street Alexandria, NSW.

Commonwealth Bank (Current) – Environmental assessment, including general, acoustic, air quality, electromagnetic field and wind impact assessment, of a new child care centre development to be located on Level 2 of Darling Park Power 2, Sussex Street, Sydney.

First Impressions Property – Environmental assessment of a proposed child care centre at Ralph Street Alexandria NSW, including Preliminary (Stage 1) Site Contamination Assessment, and Electromagnetic Field Assessment.

LEDA Holdings – Environmental Assessment of a proposed child care centre at 32 Cawarra Road Caringbah NSW, including general environmental, acoustic, air quality and electromagnetic field assessments.

Universal Property Group (Current) – Environmental assessment of a proposed multi building, multi-level residential development at Garfield Street, Wentworthville NSW, including general environmental, site and soil contamination and preliminary geotechnical assessments.

McCormack (Current) – Stage 2, 3 and 4 Environmental Site Assessment of 7,9 & 11 Bayard Street, Mortlake, NSW as part of the process of assessing the site for medium density residential development, and obtaining a site audit statement confirming the suitability of the site for this purpose. Work inclusive of the assessment of all relevant environmental impacts.

Gundagai Meat Processors (Current) – Review and enhancement of solid and liquid waste processing and management systems at GMP's Gundagai abattoir, including the on-site treatment of waste streams from meat processing and other operations.

Campbelltown City Council (Current) – Peer review of acoustic assessments submitted to Campbelltown City Council regarding assessment of the acoustic impacts of proposed developments including a major truck maintenance facility and the expansion of Macarthur Square shopping centre, including the conduct of noise measurements.

Brenchley Architects (2009 - Current) – Acoustic assessments of proposed residential and commercial developments at Elizabeth Street Sydney; Spit Road Mosman, Botany Road Waterloo, Cranbrook Street, Botany and Bellevue Hill Road, Bellevue Hill NSW.

BJB Design (2009 - Current) – Acoustic, air quality and odour assessments of residential and commercial developments at Botany Road, Botany and Cranbrook Street Botany.

Bovis Lend Lease (Current) – Environmental assessment of a major development site at Darling Walk, Darling Harbour NSW, including a detailed review of air quality, electromagnetic field and acoustic issues for review by the NSW Department of Planning.

Penrith City Council (2012/13) – Preparation of the Penrith City Council response to the NSW Government Long Term Transport Plan, including consideration of transport and associated environmental issues affecting the Penrith Local Government Area.

Harry Azoulay & Michael Bell Architects (2012) – Assessment of the environmental impacts on and from a proposed child care and early learning centre at Chatswood, NSW. Assessments lodged with and adopted by Willoughby City Council.

Wollondilly Shire Council (2012) – Preliminary environmental assessment and review of the proposed development of a second Sydney airport at Wilton, including a preliminary assessment of acoustic impacts.

White Horse Coffee (2011) – Air quality and odour assessment regarding a boutique coffee roasting and drying operation at 7/3-11 Flora Street, Kirrawee, and NSW.

Michael Bell Architects & Clients (2004 to Current) – Assessment of the environmental impacts, including acoustic impacts, associated with various child care centre applications in suburban Sydney, and the Sydney CBD, including the development of plans for the management and control of such impacts.

NSW Roads & Traffic Authority (2004 to Current) – Review of international technologies, systems & applications in relation to the treatment of motor vehicle exhaust emissions and associated air pollution within and discharged from road tunnels, in accordance with the conditions of approval for the M5 East Motorway

Federal Airports Corporation (1995/1996) – Preliminary environmental and ground transport studies for the proposed Sydney West Airport, including consideration of all relevant environmental issues.

Isuzu-GM (2003 to Current) – Representations to Environment Australia and the Department of Transport and regional Services regarding the emission performance standards of Japanese sourced medium and heavy natural gas trucks, with the aim of having the current Japanese emission standard accepted within the Australian design Rule 80 series of vehicle emission standards.

City of Sydney (2005 - 2007) – Assessment of air quality and odour issues associated with a proposed redevelopment of craft studios and associated facilities at Fox Studios, Moore Park, Sydney, and review of air quality monitoring stations in the Sydney CBD area, in part as a basis for monitoring the air quality and potential health cost impacts of transport congestion and modes.

Warren Centre for Advanced Engineering, University of Sydney (2000 to 2003) – Contribution to the report "Sustainable Transport for Sustainable Cities", a major government and private enterprise funded study into the future sustainability of transport in Sydney and adjoining regions, including in particular a review of associated environmental issues. Study received the 2003 Bradfield Award for Engineering Excellence from the Australian Institute of Engineers.

United Kingdom Department of the Environment (1994) – Contribution to the development of revised environmental guidelines for air, soil and groundwater water quality.

United States Environmental Protection Agency (1994) - Contribution to an international team developing strategies for the control and management of air pollution in seven major US cities.

5 CORPORATE EXPERIENCE

NG Child & Associates

- **1992--Present**, Managing Principal - Responsible for all aspects of the conduct of a private engineering and environmental consultancy, including administration, marketing, team coordination and technical and professional delivery.

Western Fuel Distributions Pty Limited, Australia

- **1984-92** Managing Principal. - Responsible for all aspects of the management and development of one of the largest private petroleum distributorships then operating in Australia, with a peak annual sales volume of 70 million litres, turnover of $30 million per annum, a direct staff of thirty, and a network of some 40 retail and wholesale agency outlets. This position included direct personal accountability for all aspects of storage, distribution and environmental performance.

Caltex Oil Australia Limited

- **1982-84** General Manager, Marketing and Operations. Responsible for the management and operation of Caltex Australia's marketing, storage, warehousing, distribution, environmental and safety functions, including seaboard terminal and marine operations.
- **1980-82** National Consumer Marketing Manager. Responsible for Caltex Australia's national consumer, industrial and distributor marketing activities.

Golden Fleece Petroleum Limited

- **1977 - 1980** Manager Operations, NSW. Responsible for the overall management of the distribution, warehousing, seaboard terminal and lubricant production activities of Golden Fleece Petroleum in New South Wales, including environmental, occupational health and safety matters.

Esso Australia Limited

- **1976-77** SA Manager, Marketing and Operations. Responsible for all aspects of the management of Esso's petroleum, lubricant and LPG storage, distribution and marketing throughout South Australia.
- **1975-76** Refinery Manager. Responsible for all engineering, operational and environmental aspects of the joint Esso/Mobil refinery at Port Stanvac in South Australia.
- **1975** Manager, Process Operations, Port Dixon Refinery, Malaysia. Six-month special assignment at the Esso Petroleum Refinery, Port Dixon, Malaysia.
- **1971-75** Senior Analyst, Logistics and Corporate Strategy Departments, Esso Sydney Head office.

6 SOME REPORTS & PUBLICATIONS

- **High Speed Rail – Benefits for the Nation,** Keynote address at the UNSW Institute of Environmental and Urban Studies International High Speed Rail Seminar, August 2013.
- **High Speed Trains in Australia: Connecting Cities and Energising Regions**; with the Hon Peter Nixon AO, October 2010.
- **Sydney's High Residential Growth Areas: Averting the Risk of a Transportation Underclass**, World Transport & Environmental Forum, Reims France, June 2006.
- **The M5 East Road Tunnel: Implications for Ventilation, Air Quality and Emission Treatment Systems**, International Road Transport and Tunneling Forum, Graz Austria, May 2006.
- **Transport Fuels in Australia: The Folly of Australia's Increasing Reliance on Imported Crude Oil**, Submission to the Australian Senate Rural and Regional Affairs and Transport Committee Inquiry into Australia's Future Oil Supply and Alternative Transport Fuels, February 2006.
- **The Japan 2003 CNG Emission Standard & the Emission Performance of the Isuzu 4HF-1-CNG: The Case for Acceptance under ADR80**. Submission on behalf of Isuzu GM Australia to the Commonwealth Department of Transport and Regional Services, June 2004.
- **M5 East Freeway: A Review of Emission Treatment Technologies, Systems and Applications**, NSW RTA and NSW Department of Planning, April 2004.
- **Future Directions: Challenges & Opportunities in the Australian CNG Vehicle Industry**, ANGVC, December 2002
- **High Speed Rail in Australia: Beyond 2000** (with the Hon Peter Nixon), November 2000
- **Review of Options for the Treatment or "Filtration" of Tunnel Gases and Stack Emissions**, City of Sydney. January 2003
- **A Comparative Analysis of Energy and Greenhouse Performance: Austrans Ultras Light Rail System**, Bishop Austrans Limited, January 2003
- **Engineering and Environmental Aspects of Enclosing the Cahill Expressway Cutting**, City of Sydney, May 2001.
- **M5 East Motorway: Proposed Single Emission Stack at Turrella – Review of Air Quality Impacts and Consideration of Alternative Strategies**, Canterbury City Council, February 1999

7 PERSONAL & PROFESSIONAL REFERENCES

- The Hon Peter Nixon AO, Former Federal Transport Minister
- John Black, Professor Emeritus of Civil & Transport Engineering, University of NSW
- Mr Stephen Lye, Development Manager, Trumen Corporation, Sydney.
- Mr Peter Han, Project Director, Commonwealth Bank, Sydney
- Mr Michael Bell, Principal, Michael Bell Architects, Sydney.
- Mr Barry Babikian, Brenchley Architects
- Mr Luke Johnson, Assistant General Manager, Wollondilly Shire Council
- Mr Bernie Clark, Chief Executive, Thyssen Australia
- Mr Alan Ezzy, Former Chairperson, NSW Flood Mitigation Authority.
- Professor Vigid Vigneswaran, Faculty of Civil & Environmental Engineering, University of Technology, Sydney.
- Mr Merv Ismay, General Manager, Holroyd City Council, Sydney NSW
- Dr Jack Mundey, Past Chairman Historic Houses Trust, Environmentalist
- Alex Mitchell, Journalist

Noel G Child
31 August 2017

ATTACHMENT A
Client Reference List

Acre Woods Childcare Pty Ltd
Armada Architecture
Australian Commonwealth Environmental Protection Agency
Australian Consulting Architects
Australian Federal Airports Corporation
Australian Federal Department of Transport and Regional Development
Bovis Lend Lease
Brenchley Architects
Campbelltown City Council
Canterbury City Council, Sydney, NSW
Commonwealth Banking Corporation
Environment Protection Authority of NSW
Exxon Chemical
Fairfield City Council, Sydney, NSW
First Impressions Property
FreightCorp, Sydney, NSW
Futurespace
GM - Isuzu
Guangxi Environment Protection Bureau
Gundagai Meat Processors
Hong Kong Department of the Environment
Hornsby and Ku-ring-gai Councils, Sydney, NSW
Impact Group
Kaunitz Yeung Architecture
LEDA Holdings
Little Learning School
Michael Bell Architects
Minter Ellison
Mobil Oil Australia, Associated
NSW Roads & Traffic Authority
Ove Arup & Partners
Qantas Airways
Queensland Ports Corporation
Renascent
Shell Australia
Sinclair Knight Merz
Skouras and Mabrokardatos
Southern Sydney Regional Organisation of Councils (SSROC)
State Rail Authority of NSW
Stephen Davidson Property Investments
Sydney Skips & Galaxy Waste
The City of Sydney
The Western Sydney Alliance of Mayors
Thyssen Krup Transrapid Australia
Tom Howard QC
Trumen Corporation
UK Department of the Environment
United States Environment Protection Agency
University of Technology, Sydney
Warren Centre for Advanced Engineering, University of Sydney
Waverley Council, Sydney, NSW
Western Sydney Parklands Trust
Wollondilly Shire Council