REVERB ACOUSTICS

Noise and Vibration Consultants

Noise Impact Assessment
Birdwood Park Development
Site B – RAC & ILU Facility
Little King Street
Newcastle West NSW

May 2016

Prepared for RSL Life Care
Report No. 16-1967-R1

Building Acoustics - Council/OEH Submissions - Modelling - Compliance - Certification

REVERB ACOUSTICS PTY LTD
ABN 26 142 127 768 ACN 142 127 768
PO Box 181 ADAMSTOWN NSW 2289
Telephone: (02) 4947 9980
email: sbradyreverb@gmail.com

TABLE OF CONTENTS

1 INTRODUCTION

Reverb Acoustics has been commissioned to conduct a noise impact assessment for the proposed Birdwood Park Development, Site B, Little King Street, Newcastle West. The purpose of this assessment is to determine the noise impact, within habitable spaces of the development, and to ensure that noise levels comply with the requirements of the Roads and Maritime Services (RMS), Department of Planning and Infrastructure (DoPI), Office of Environment and Heritage (OEH) and Newcastle City Council (NCC). Further assessment has also been carried out to determine the noise impact mechanical plant and vehicle movements associated with the proposed development may have on nearby neighbours.

The Assessment was requested by RSL Lifecare in support of and to accompany a Development Application to NCC and to ensure any noise control measures required for the development are incorporated during the design stages.

2 TECHNICAL REFERENCE / DOCUMENTS

NSW Environment Protection Authority (1999). *Environmental Criteria for Road Traffic Noise*

Department of Environment, Climate Change and Water (2010). *Draft Road Noise Policy.*

NSW Environment Protection Authority (2000). *Industrial Noise Policy*

Department of Environment and Climate Change NSW (2007). *Noise Guide for Local Government.*

Department of Planning (2008). *"Development near Rail Corridors and Busy Roads - Interim Guidelines".*

AS 2107-2000 *"Acoustics-Recommended Design Sound Levels and Reverberation Times for Building Interiors".*

AS 1276.1-1999 *"Acoustics – Rating of sound insulation in buildings and of building elements. Part 1: Airborne sound insulation".*

Plans supplied by EJE Architecture, Issue 1, dated April 2016. Note that variations from design supplied to us may affect the acoustic recommendations.

A Glossary of commonly used acoustical terms is presented in Appendix A to aid the reader in understanding the Report.

3 EXISTING ACOUSTIC ENVIRONMENT

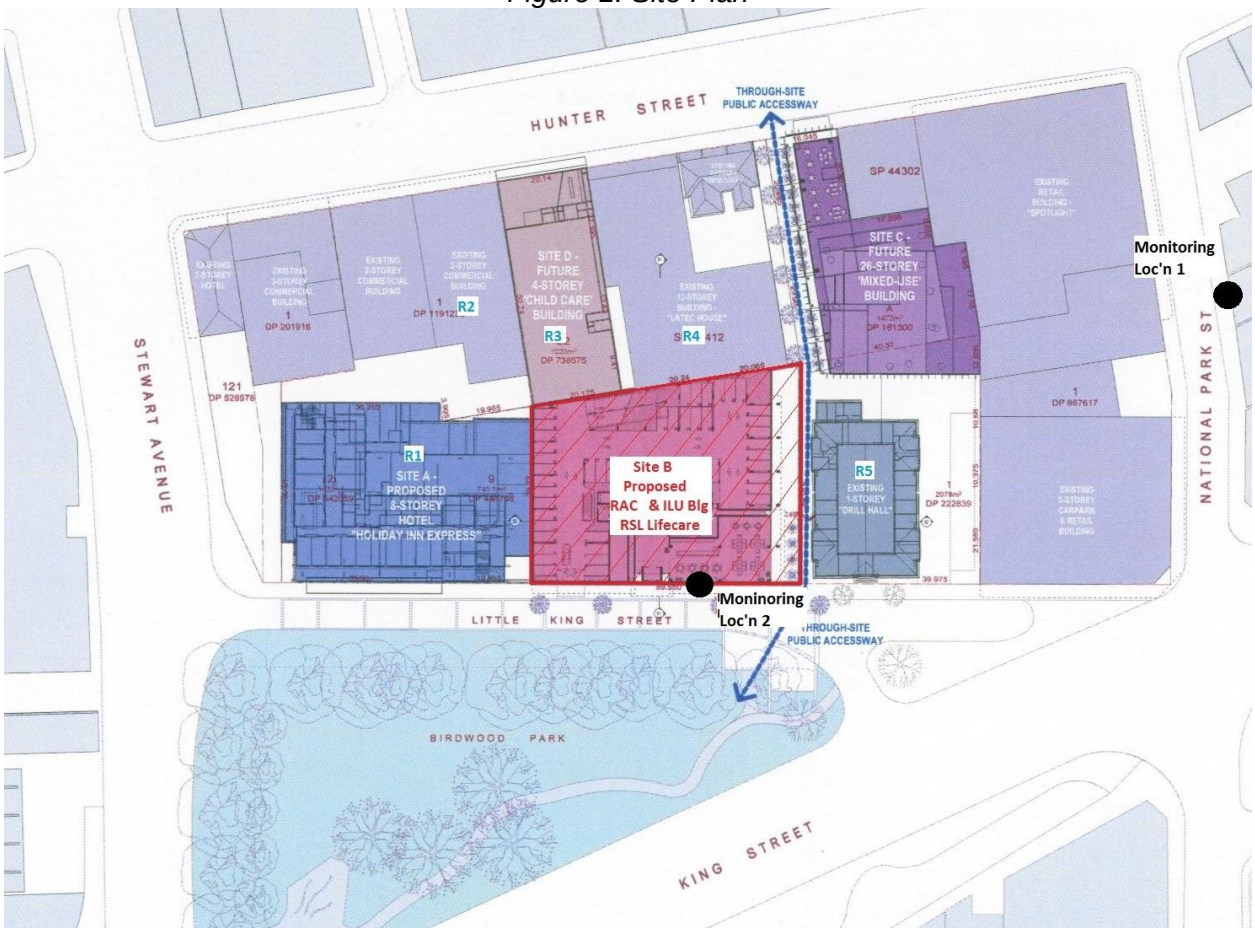
Long-term background noise level measurements were conducted by Reverb Acoustics in November 2015 at a nearby development in National Park Street, approximately 60 metres from the Hunter Street intersection. Additional attended noise level measurements were conducted at Monitoring Locations 2 during peak traffic periods along Little King Street using a Type 1, Svan 949 environmental noise logging monitor (see Figure 1). The selected locations are representative of the acoustic environment in the receiver area and are considered acceptable locations for determination of background noise levels in accordance with Appendix B of the OEH's Industrial Noise Policy (INP). A summary of our results are shown in Table 1.

Site, weather and measuring conditions were all satisfactory during our surveys. We therefore see no serious reason to modify the results because of influencing factors related to the site, weather or our measuring techniques.

Table 1: Summary of Long-Term Monitoring – Location 1, dB(A)

Time Period	Background L90			Ambient Leq		
	Day 7am-6pm	Evening 6pm-10pm	Night 10pm-7am	Day 7am-6pm	Evening 6pm-10pm	Night 10pm-7am
RBL	50	46	41	--	--	--
LAeq	--	--	--	61	61	56
Little King Street (Monitoring Location 2)						
Current Leq, peak (day) = 61dB(A)			Current Leq, 1hr (night) = 56dB(A)			

Figure 1: Site Plan



4 CRITERIA

4.1 Road Traffic Noise

Criteria for the assessment of quasi-steady-state noise sources, such as continuous road traffic and mechanical services, are sourced from AS/NZS 2107-2000 *"Acoustics-Recommended Design Sound Levels and Reverberation Times for Building Interiors"* and are detailed below.

Room Type	dBA
RESIDENTIAL BUILDINGS	
Houses and apartments near major roads	
Living areas	35 – 45
Sleeping areas	30 – 40
Common areas (foyer, lobby)	45 – 55
SHOP BUILDINGS	
Small retail stores	45 – 50
Enclosed carparks	55 – 65

DoPI's *"Development near Rail Corridors and Busy Roads - Interim Guidelines*" (released in December 2008) is a more recent document for assessment of road traffic noise impacts on residential developments. Limits specified within the Policy, which are virtually identical to those in AS/NZS2107-2000 are shown below:

Type of Occupancy	*Noise Level in dB(A)*	*Applicable Time Period*
Sleeping areas (bedroom)	35	Night 10pm to 7am
Other habitable rooms (excluding garages, kitchens bathrooms & hallways)	40	At any time

4.2 Mechanical Plant / Site Noise

Noise from industrial noise sources scheduled under the Protection of Environment Operations Act is assessed using the OEH's INP. However, local Councils may also apply the criteria for land use planning, compliance and complaints management. The INP specifies two separate criteria designed to ensure existing and future developments meet environmental noise objectives. The first limits intrusive noise to 5dB(A) above the background noise level and the other aims to protect against progressively increasing noise in developing areas, based on the existing (Leq) noise level from industrial noise sources. Project Specific Noise Levels are established for new developments by applying both criteria to the situation and adopting the more stringent of the two.

The existing L(A)eq for the receiver area is dominated by traffic on nearby roads and some commercial activity. Reference to Table 2.1 of the INP shows that the area is classified as urban. Industrial noise contributions are more than 6dB(A) below the recommended Leq, so the recommended Acceptable Noise Level (ANL) applies in this case, i.e. no ANL reduction required for industrial noise contributions. Table 2 below specifies the applicable base objectives for the proposed development. In high traffic areas where the existing traffic noise levels are at least 10dB above the Acceptable Noise Level, the high traffic amenity criterion applies.

Table 2: - Base Noise Level Objectives

Period	Intrusiveness Criteria	Amenity Criteria
Day	55 (50+5)	60
Evening	51 (46+5)	50
Night	46 (41+5)	45
Receiver Type: Urban (See OEH's INP - Table 2.1)		

Project specific noise levels, determined as the more stringent of the intrusiveness criteria and the amenity / high traffic criteria, are as follows:

Day **55dB LAeq,15 Minute** 7am to 6pm Mon to Sat or 8am to 6pm Sun and Pub Hol.
Evening **50dB LAeq,15 Minute** 6pm to 10pm
Night **45dB LAeq,15 Minute** 10pm to 7am Mon to Sat or 10pm to 8am Sun and Pub Hol.

4.3 Sleep Arousal

Chapter 19-3 of OEH's ENCM and Section 2.4.5 of their Noise Guide for Local Government state *"the L1 level of any specific noise source should not exceed the background noise level (L90) by more than 15dB(A) when measured outside the bedroom window"*. This criterion is applied to residential situations between the hours of 10.00pm and 7.00am where a receptor's sleep may be interrupted by noise. It is applied in this case to nearby neighbours likely to receive noise from vehicle entering, leaving and manoeuvring on the site.

Based on the measured background noise level of 41dB(A),L90 for night at the site (10pm to 7am), the sleep arousal criterion is set at **56dB(A),L1(1 min)** at the bedroom window of any affected apartment.

5 METHODOLOGY

5.1 Traffic Noise Levels

Applicable noise level metrics, namely, for the day and night are those calculated from our measurements at the site. A +2.5dB(A) facade adjustment needs to be applied to our results, as measurements were conducted in the free-field. Received traffic noise for 2015 was calculated as follows:

received noise (2015) + facade correction = received noise (2015)

Applying the above formula gives:

Day	61.0dB(A)	+ 2.5dB(A)	=	**63.5dB(A) Leq15hr**	7am – 10pm
Night	56.0dB(A)	+ 2.5dB(A)	=	**58.5dB(A) Leq9hr**	10pm – 7am

Reference to nearby RMS traffic stations indicate that approximately 30,000 vehicles pass the site along King Street, projected to the year 2016. A figure of 5% heavy vehicles has been adopted. It should be noted that the projected AADT figure of 30,000 vehicles for the year 2016 is unlikely, as RMS data indicates a trend of decreasing traffic over the last 5 years in the Newcastle CBD. However, in the absence of any current detailed traffic studies, we have used this figure for calculation purposes. The AADT for the year 2016 was applied to our computer programme, based on the OEH and RMS approved CORTN Method of Traffic Noise Prediction, and noise levels were calculated to the theoretical facade at each level of the development. The CoRTN values are merely arbitrary, as calculated noise levels are adjusted to correlate with our measured peak external noise levels, with the intention is to provide a (theoretical) means of determining the degree of noise control required for a particular building component.

Equivalent continuous noise levels were calculated for each traffic lane separately on the basis that the noise source (i.e. the traffic) was located in approximately the centre of the respective lane. In particular, this gives an accurate estimation of the location of bus and truck exhausts which are generally located on the right hand side, being approximately at the same point for both traffic directions. Our calculations have been modified to compensate for the differing acoustic centres of cars and heavy vehicles, by modelling each separately and logarithmically adding received noise levels.

5.1.1 CoRTN Model Conversion

The OEH released their ECRTN in June 1999 and RNP in 2011, which specify modified assessment periods for day and night, namely, Leq,15hr (7am to 10pm) and Leq,9hr (10pm to 7am). These assessment periods have rendered the original Australian version of the CoRTN model invalid, which was designed to assess the impact over a single 24 or 18 hour period. Consequently, modification of the Model is required to adequately describe the new metrics.

The CoRTN algorithm pertaining to traffic flow percentages has been modified by inserting all AADT figures for arterial roads, contained in RTA publications - Traffic Volume Data for Hunter and Northern Regions, 1998, and establishing AADT figures for the applicable day and night periods. Our CoRTN model was then calibrated against long term measurements made at locations with reliable AADT figures.

5.2 Mechanical Plant

Referenced to the supplied plans reveals that the majority of mechanical plant will be located on small decks on each level, in the Level 13 plant room and carpark plant rooms. We further understand that carpark exhaust outlets will be on the roof.

The exact selection of air conditioning plant has not been finalised at this stage. As such, typical noise levels for proposed plant have been sourced from similar types of developments. The sound power of the proposed plant is propagated to residential locations taking into account sound intensity losses due to geometric spreading, with additional minor losses such as molecular absorption, directivity and ground absorption ignored in the calculations. As a result, predicted received noise levels are expected to slightly overstate actual received levels and thus provide a measure of conservatism. Comparison of the predicted noise levels produced by the plant and the allowable level are then compared to give the noise impact at the receiver.

5.3 Site Noise

Future noise sources on the site cannot be measured at this time, consequently typical noise levels from similar developments have been sourced from our library of technical data. This library has been accumulated from measurements taken in many similar situations on other sites, and allows theoretical predictions of future noise impacts at each receiver and recommendations concerning noise control measures to be incorporated in the design of the site.

The calculated acoustic sound power (dB re 1pW) for all likely noise sources on the site is then theoretically propagated to the receiver, taking into account attenuation due to distance, topographical features and any intervening barriers. Atmospheric absorption, directivity and ground absorption have been ignored in the calculations. Where noise impacts above the criteria are identified, suitable noise control measures are implemented and reassessed to demonstrate satisfactory received noise levels in the residential area.

Intermittent noise sources were assessed using the following in-house mathematical formula.

Equation 1:

$$L_{eq},T = Lw - \quad 10\ log\ (2\ \pi\ r^2)\ + 10\ log\ \frac{(D\ x\ N)}{T}$$

Where *Lw is sound power level of source (dB(A))*
R distance to receiver (m)
D is duration of noise of each noise event (sec)
N is number of events
T is total assessment period (sec)

6 ANALYSIS

6.1 Received Noise Levels – Road Traffic (Impact on Development)

Shown below is a sample calculation detailing the procedure followed in order to calculate required glazing for the Unit 44 on RAC Level 2, facing King Street. The traffic noise level at the outer face of the glazing is calculated as follows,

Table 3: Sample Calculation - Traffic Impact at Unit 44 RAC Level 2

		Octave band Sound Pressure Levels, dB(A)							
Propagation calculation	**dB(A)**	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**
Facade traffic noise, Leq[1]	64	44	52	53	57	59	56	50	42
Architectural shielding		0	0	0	0	0	0	0	0
Directivity/distance Correction[2]		1	1	1	1	1	1	1	1
Traffic noise at window	63	43	51	52	56	58	55	49	41

1. The RAC Units will be occupied during the day as well as at night, therefore, traffic noise levels during the day have been adopted for assessment purposes. 2. Includes angle of incidence correction.

As the criterion for the RAC Unit is Lounge/Dining Room is 35dB(A), see Section 4.1, the required traffic noise reduction is *TNR* = 63-35 = 28dB(A). The traffic noise attenuation, *TNA*, required of the glazing is calculated according to the equation given in Clause 3.4.2.6 of AS 3671,

$$TNA = TNR + 10\log_{10}[(S/S_f) \times 3/h \times 2T_{60} \times C] \qquad \textit{equation 1}$$

where
S = Surface area of glazing = $5m^2$
S_f = Surface area of floor = $19m^2$
h = Ceiling height, assumed to be 2.5m
T_{60} = Reverberation time, s
C = No. of components = 2 (glazing, wall)

Assuming that the room is acoustically average (neither too 'live' nor too 'dead') equation 9.26 in *Noise and Vibration Control*, L.L. Beranek, 1971, gives a reverberation time of 0.46s. Consequently, the value of 0.5s was used in equation 1.

Using the values listed above gives
TNA = 26dB(A) for the glazing

Substituting this value into the equation given in Clause 3.4.3.1 of AS3671 gives
Rw = *TNA* + 6 ≈ 32.

As can be seen by the above results, the glazing must have a tested Rw32 rating. Published sound insulation performance in terms of Rw or STC ratings relate to partitions tested in ideal laboratory conditions or opinions based on such measurements. Field conditions (eg. flanking paths, penetrations, air leaks etc) caused by lack of supervision of workmanship or inadequate attention to detail at design/specification stage can reduce the Rw rating. For this reason, we recommend selecting partition systems with a laboratory Rw rating 1-2dB higher than required on site. Therefore, the glazing in the RAC Unit must have a tested Rw33 rating. Based on typical laboratory performance data the glazing would consist of single-glaze laminated glass fitted with acoustic seals at sliders.

Similar calculations to those in the previous above have been performed for windows and doors on affected facades. From these calculations, a schedule of required glazing has been compiled. See Section 7.

6.2 Received Noise – Alfresco Dining Area (Impact on Development)

Outdoor dining areas are provided for customers on the east side of the Ground Level Retail Tenancy. As such, noise from customers has the potential to produce unacceptable noise for occupants of the development. Due to the location of the establishment (i.e. not in the entertainment district), younger, "rowdier" patrons are not expected to frequent the venue, rather smaller groups consisting of couples intending to enjoy a quiet meal and drink will be more typical. In saying this, a typical worst-case situation has been assessed based on the maximum seated capacity and additional patrons purchasing take-away meals. To create our acoustic model, we have assumed a worst-case situation where up to 30 patrons may be seated in the outdoor area of congregating in the area during peak periods.

The sources were placed randomly over the available area and the combined source noise level was theoretically propagated to nearest receivers, with allowances made for shielding provided by intervening structures, where appropriate. The sound pressure level (SPL) at the receiver is then compared to the criterion. Where noise impacts above the criteria are identified, suitable noise control measures are implemented and reassessed to demonstrate satisfactory received noise levels.

Table 4 shows calculation of the noise impact from patrons in the outdoor area, propagated to nearest apartments.

Table 4: SPL Noise Impact, Patrons in Outdoor Area, dB(A),Leq
Propagated to Nearest RAC Units

		Octave Band Centre Frequency, Hz								
Item	**dB(A)**	**31.5**	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**
Source Lw[1]	83	15	32	73	77	78	76	72	61	53
SPL at RAC Units	**48**	**12**	**27**	**41**	**44**	**43**	**38**	**32**	**19**	**8**
Crit (night)	**43**									
Impact	**-**									

1. 30 patrons placed randomly over available area.

As can be seen by results in the above Table, noise from patrons in the outdoor area may exceed the criteria during peak periods, particularly if the business operates during the late evening or night. Patron numbers are expected to reduce after 10pm, however, thicker and heavier laminated glass will be required for habitable areas to ensure compliance. See Section 7 for required noise control. In conjunction with modifications to affected building facades, responsible staff should monitor the outdoor area to ensure patrons consider the amenity of nearby residents.

6.3 Received Noise Mechanical Plant (Impact of Dev'p on Neighbours)

Council prefers the background noise level of the area to be maintained, although, in certain circumstances may permit the noise level in question to exceed the prevailing background noise level by 5dB(A), provided the sound is bland and free from impulsive and/or tonal components. This is in agreement with conditions contained within OEH's INP. In respect to the above, a planning limit of **45dB(A),Leq** for night (10pm-7am) has been adopted at the boundary or facade of nearest residences.

Reference to the supplied plans indicates that plant for the RAC Units and retail outlet will be located in the upper carpark plant room and plant for the ILU's will be located on small plant decks on each level, with the exception of Level 13 where plant will be located in the dedicated plant room. We have further assumed that carpark exhaust outlets may also be located on the roof.

As the exact type of plant is not known at this stage, we have sourced information from our library of technical data. The sound power of the proposed plant is propagated to residential locations taking into account sound intensity losses due to spherical spreading and barrier insertion loss provided by intervening structures, with additional minor losses such as molecular absorption, directivity and ground absorption ignored in the calculations. As a result, predicted received noise levels are expected to slightly overstate actual received levels and thus provide a measure of conservatism. Comparison of the predicted noise levels produced by the plant and the allowable level are then compared to give the noise impact at the receiver.

Sample calculations of noise produced by roof-top plant is shown in following Table, propagated north to multi-storey residential apartments (R4).

Table 5: Calculated SPL – Level 13 Plant Room
Propagated North to Nearest Residential Receivers (R2)

		Octave Band Centre Frequency, Hz							
Item	**dB(A)**	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**
Combined Lw	**95**	69	78	83	87	89	90	85	75
Barrier loss[1]		5	5	5	5	5	5	4	3
TL louvre[2]		4	6	9	13	14	12	12	8
SPL at receiver	**40**	21	28	31	31	32	35	30	26
Criterion (night)	**45**								
Impact	**-**								

1. Intervening Structures 2. Acoustic louvre.
NOTE: Generator not included in calculations as it will only operate during emergencies

Results in the above Table show that noise emissions from anticipated plant is predicted to be compliant with the OEH (and therefore Council) criteria at nearest residences, based on typical source noise levels and providing plant is installed at the specified location within the plant room.

No acoustic barriers are required adjacent to individual air conditioning items on smaller plant decks on each level or roof-top exhaust plant providing noise emissions are below the specified limits:

Item	*Max SPL at a Dist of 1 metre*
Air Conditioning on small decks	68dB(A)
Exhaust Discharge	72dB(A)

See Section 7 for further recommendations.

6.4 Ground/Level 1 Carparks (Impact of Dev'p on Neighbours)

Vehicles entering, leaving and manoeuvring within the carparks of the proposed development have the potential to cause disturbance to nearby neighbours. Natural ventilation grills may be incorporated along exposed facades, which also provide a means of noise leakage. Vehicles within the carparks will be travelling at approximately 10km/h and will be under slight acceleration at times as they negotiate ramps. Previous noise tests by Reverb Acoustics suggest that a vehicle in good mechanical order will produce a sound power level of 83-85dB(A) under these conditions, thus resulting in an acceptable level of approximately 40dB(A)Leq or 51dB(A),L1 at the nearest residential receivers. It should be noted that, if more than one vehicle were to enter the carparks simultaneously, received noise levels would be raised. For instance, if 3 cars were travelling within the car park, in exposed locations, a combined noise level as high as 45dB(A) may be experienced at nearest receivers. To further reduce noise levels, we recommend positioning ventilation grills behind retaining walls or along facades facing away from residences (particularly to the north).

Noise from carparks comes from short-term individual events (door slams, raised speech) rather than continuous traffic. These sources have a sound power level in the order of 85-88dB(A), which corresponds to 52-55dB(A) Lmax at the residential boundary, which is compliant with the sleep arousal criterion of 56dB(A).

7 DISCUSSION AND RECOMMENDATIONS

7.1 Glazing Construction

Glass installed in window assemblies must comply with AS1288-1994. Materials, construction and installation of all windows are to comply with the requirements of AS2047-1999. Similar calculations to those in Section 6 were performed for all building elements of the proposed development. From these calculations, a schedule of required glazing has been compiled, shown below. The glazing systems, sighted in the following Tables, are presented as a guide for the supplier:

Glazing Systems: Type A: Standard glazing. No acoustic requirement.
Type B: Single-glaze 5-8mm clear float glass.
Type C: Single glaze laminated glass
Type D: Insulating Glass Unit (IGU) or double-glaze.

Note: The typical glazing shown in the following Tables should be used as a guide only. The supplier of the window/door must be able to provide evidence from a registered laboratory that the complete system will achieve the specified Rw performance, i.e. do not simply install our recommended glass in a standard window frame.

Table 6: Glazing Schedule

Facade	Location	Room Use	Required Rw Must Achieve for Compliance	Typical Glazing System (Not for Specification)
GROUND/FIRST				
South	Foyer	Transitory	**-**	No acoustic requirement
	Retail Space	Retail	**28**	Type B
East	Retail Space	Retail	**28**	Type B
LEVELS 2-3				
South	8-16,38-46	All	**33**	Type C
	Liv/Din	All	**28**	Type B
East	16-24,46-54	All	**31**	Type C
North	24,54	All	**29**	Type B or C
	25-30,1,55-60,31	All	**27**	Type B
	Liv/Din	All	**-**	No acoustic requirement
West	1-5,31-35	All	**28**	Type B
	6-8,36-38	All	**31**	Type C
LEVEL 4				
South	01-04	All Bed	**31**	Type C
		All Living	**29**	Type B or C
East	04,05	All	**28**	Type B
North	05	All	**28**	Type B
	06-08	All Bed	**28**	Type B
		All Liv	**26**	Type B
West	01,08	All	**28**	Type B

Table 6: Glazing Schedule

Facade	Location	Room Use	Required Rw Must Achieve for Compliance	Typical Glazing System (Not for Specification)
LEVELS 5-7				
South	All ILU's	All Bed	**30**	Type C
		All Living	**28**	Type B
East	All ILU's	All	**28**	Type B
North	All ILU's	All Bed	**28**	Type B
		All Liv	**26**	Type B
West	All ILU's	All	**28**	Type B
LEVELS 8-12				
South	All ILU's	All Bed	**30**	Type C
		All Living	**27**	Type B
East	All ILU's	All	**27**	Type B
North	All ILU's	All Bed	**28**	Type B
		All Liv	**25**	Type B
West	All ILU's	All	**27**	Type B
LEVEL 13				
South	ILU 73	All Bed	**30**	Type C
		All Liv/Din	**27**	Type B
	Comm Centre 1	Recreation	**26**	Type B
East	Comm Centre 1	Recreation	**26**	Type B
	Comm Centre 2	Recreation	**26**	Type B
North	Comm Centre 2	Recreation	**26**	Type B
	ILU 74	All Bed	**28**	Type B
		All Liv/Din	**26**	Type B

7.2 Roof/Ceiling Construction

7.2.1 Roof construction may consist of *either* reinforced concrete *or* sisalation or wire mesh laid down on roof trusses/purlins. This is to be completely covered with a 30-40mm foil faced building blanket hard under the roof sheeting (in situations where joists are at centres close enough to avoid excessive sagging of the blanket, the sisalation/wire mesh may be omitted). Close off gaps between purlins and roof sheeting with Unisil Eaves Filler Strips, bituminous compound, or similar. Install an impervious ceiling of 1 sheet of taped and set 10mm plasterboard. To further assist in low frequency attenuation, all ceiling voids should contain a layer of fibreglass or rockwool insulation. The insulation is to be installed in addition to, not in lieu of the building blanket. Specialised acoustic insulation is preferred, however, dense thermal insulation (eg, R3 batts) will suffice and is much less expensive ($15/m^2 for Rockwool 350 and $5/m^2 for R3 batts).

7.3 Wall Construction

7.3.1 Brick veneer/cavity brick//masonry construction is acceptable. Where external brickwork stops below the height of the stud frame, plasterboard, Villaboard, or similar, is to be fixed to the outside of the stud frame to fill the void. The infill material is to extend from the top of the top plate to a point in line with the bottom of the top course of brickwork. Alternatively, an overside noggin is to be fixed to the underside of the top plate to project within 10-20mm of the inside surface of the external wall.

7.3.2 Lightweight cladding (i.e. Shadowclad, Colorbond, or similar) should include internal lining 1 sheet taped and set 13mm fire rated plasterboard, and a cavity infill of R1.5/S1.5 fibreglass or polyester insulation. The external face of all lightweight cladding should also be backed with either 6mm fibre cement sheeting (Villaboard, Hardiflex) or 10mm construction plywood.

7.4 Balconies

7.4.1 To reduce the field of view of the noise source (i.e. traffic), enclosed balustrade is recommended for all residential units, consisting of stud wall lined with FC sheeting, masonry or fixed glass panels to a height of 800-900mm. Vertical gaps between each panel that do not exceed 125mm are permitted. A gap of say 50-100mm is permitted at floor level to allow cleaning, hosing, etc

7.5 Mechanical Plant

7.5.1 Acoustic louvres in preference to standard ventilation louvres are required for any openings in Level 13 plant room walls. The louvres must have the following insertion loss values (typically Fantech SBL1, Nap Silentflo 300S Line or Robertson Type 7010):

Required Insertion Loss Values for Acoustic Barriers/Plant Room Louvres – dB

	Octave Band Centre Frequency, Hz							
	63	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**
NR	10	12	15	19	20	18	18	14
STL	4	6	9	13	14	12	12	8

7.5.2 All walls and roof to the Level 13 plant room must be internally lined with 13mm fire rated plasterboard or 9mm FC sheeting, and a cavity insulation of R2/S2 insulation. Other options are acceptable, providing details are sent to Reverb Acoustics for approval.

7.5.3 No acoustic barriers are required adjacent to roof-top exhaust plant unless noise emissions from individual items are above an SPL in excess of 72dB(A) at a distance of 1 metre in which case acoustic barriers must be constructed to enclose the fan discharge. Barriers must fully enclose at least three sides towards any residence. In our experience, a more efficient and structurally secure barrier is one that encloses all four sides. The barrier must extend at least 600mm above and below the fan centre and/or the discharge outlet and must be no further than 1200mm from the edges of the exhaust. Barrier construction should consist of an outer layer of one sheet of 12mm fibre cement sheeting (Villaboard, Hardiflex), or 19mm marine plywood. The inside (plant side) is to be lined with an absorbent foam to reduce reverberant sound (fibrous infills are not recommended as they will deteriorate if wet), Note that variations to barrier construction or alternate materials are not permitted without approval from the acoustical consultant. Barrier construction is based solely on acoustic issues. Visual, wind load issues must be considered and designed by appropriately qualified engineers.

7.5.4 No acoustic barriers are required adjacent to air conditioning plant on small decks at each level unless noise emissions from individual items are above an SPL in excess of 68dB(A) at a distance of 1 metre in which case acoustic barriers equal in height to the highest plant item must be erected between the plant and residences. Barrier construction is to consist of an outer layer of 12mm fibre cement sheeting, 25mm construction plywood, Hebel Powerpanel, or similar material, with an absorbent inner surface of Woodtex (available through Enviro Acoustics Ph. 9605 1333) fixed to furring channels, with a cavity infill of S1.5 polyester insulation. The acoustic barrier must continue at least 300mm below the top of the plant deck. An alternative to the above is to erect parapet walls at the building perimeter to the specified height.

7.5.5 Where plant intended to be installed on the site produces noise in excess of specified levels, noise control will be required to ensure satisfactory noise emissions. The contractor responsible for supplying and installing the plant should be asked to supply evidence that installed plant meets this noise emission limit, or that noise control included with the plant is effective in reducing the sound level to the specified limit.

7.5.6 It should be noted that no penalties have been applied for tonality in our calculations, therefore the tenderer's attention is drawn to the fact that mechanical plant may be near sensitive receivers and it is vitally important that units are free from specifically annoying characteristics (eg. tones, squeaks, pulsations etc). Careful selection of plant, equipment, piping and ducting systems is recommended to ensure quiet and vibration free operation in compliance with the specified noise criteria. Replacement and/or modification will be necessary to all systems causing undue noise or vibration exceeding the specified criteria.

7.5.7 Once the plant layout and selection has been finalised, details should be forwarded to the acoustic consultant for approval. Revision of the plant layout may result in modification to acoustic recommendations.

7.6 Basement Carpark

7.6.1 Any louvres in external walls of carparks that are required to provide natural ventilation should be positioned on facades facing away from residences. Alternatively, acoustic louvres will be required in preference to standard louvres. The louvres must have the following insertion loss values (typically Fantech SBL1, Nap Silentflo 300S Line or Robertson Type 7010):

Required Insertion Loss Values for Acoustic Barriers/Plant Room Louvres – dB

	Octave Band Centre Frequency, Hz							
	63	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**
NR	10	12	15	19	20	18	18	14
STL	4	6	9	13	14	12	12	8

These are probably the easiest and most economical methods of construction currently to hand, although many other combinations can be made to achieve the same result. Discussions with either your building consultant or architect may give rise to other more economical noise control options for carrying out the work, subject to review by us.

7.7 Retail Tenancies

7.7.1 Given the variability of the proposed retail outlet occupancies, it is not possible to specify exact acoustic controls on a case-to-case basis. For example, a cafe may require exhaust or refrigeration plant, while no significant noise is expected from a sales office. In addition, the tenancy of retail outlets is usually dynamic dependent upon the success or otherwise of the occupant. For this reason, the onus is upon the tenant to ensure noise emission is kept to a minimum.

Future tenants should be assessed on a case to case basis and required to submit their own Noise Impact Assessment to Council, if noise generating activities are anticipated.

8 CONCLUSION

A noise impact assessment for the proposed Birdwood Park Development, Site B, Little King Street, Newcastle West, has been completed. The report has shown that the site is suitable for the intended purpose, providing our recommendations are implemented. An assessment of external noise impacts upon the development has resulted in the compilation of a schedule of minimum glazing, wall, roof construction, etc, to meet the requirements of the OEH and RMS. The recommended construction shown in Table 6 should be used as a guide only. The supplier of the window/door must be able to provide evidence from a registered laboratory that the complete system will achieve the specified Rw performance. Do not simply install the recommended glazing in a standard frame.

The guidelines herein are preliminary in that the selection of building materials depends on user/client requirements, space limitations, budgetary constraints and practicalities that relate to the acoustic design of suites. Adequate building facade design may be achieved through many different combinations of materials, all of which may achieve the same result, subject to review by us.

We have designed exposed facades of the building to ensure maximum noise level passbys from heavy vehicles are below 55-60dB(A). This upper limit is generally considered the threshold at which awakenings may occur.

In conclusion, providing the recommendations given in this report are implemented, external noise impacts (i.e. road traffic, etc), will comply with the requirements of the OEH, RMS, DoPI and NCC within habitable spaces of the proposed development. We therefore see no acoustic reason why the proposal should be denied.

REVERB ACOUSTICS

Steve Brady A.A.A.S. M.A.S.A.
Principal Consultant

APPENDIX A
Definition of Acoustic Terms

Definition of Acoustic Terms

Term	Definition
dB(A)	A unit of measurement in decibels (A), of sound pressure level which has its frequency characteristics modified by a filter ("A-weighted") so as to more closely approximate the frequency response of the human ear.
Rw/STC	Weighted Noise Reduction Index/Sound Transmission Class. The ability of a partition to attenuate sound, in dB. Given as a single number representation.
Lw	Sound Power Level radiated by a noise source per unit time re 1pW.
Leq	Equivalent Continuous Noise Level - which, lasting for as long as a given noise event has the same amount of acoustic energy as the given event. Used in NSW as a descriptor for intrusive noise from industrial premises.
L90	The noise level which is equalled or exceeded for 90% of the measurement period. An indicator of the mean minimum noise level, and is used in Australia as the descriptor for background or ambient noise (usually in dBA).
L10	The noise level which is equalled or exceeded for 10% of the measurement period. L_{10} is an indicator of the mean maximum noise level, and is generally used in Australia as the descriptor for intrusive noise (usually in dBA).
ABL	*Assessment Background Level* – A single figure representing each individual assessment period (day, evening, night). Determined as the L90 of the L90's for each separate period.
RBL	*Rating Background Level* – The overall single figure background level for each assessment period (day, evening, night) over the entire monitoring period.