REVERB ACOUSTICS

Noise and Vibration Consultants

Noise Impact Assessment
Club Adamstown
Residential Development
Brunker Road
Adamstown NSW

July 2012

Prepared for Club Adamstown Limited
Report No. 12-1657-R1

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

REVERB ACOUSTICS PTY LTD
ABN 90 045 630 639 ACN 142 127 768
PO Box 181 ADAMSTOWN NSW 2289
Telephone: (02) 4950 9222 Facsimile: (02) 4950 9232
email: sbradyreverb@gmail.com

TABLE OF CONTENTS

1 INTRODUCTION

Reverb Acoustics has been commissioned to conduct a noise impact assessment for a new residential development to be located in the carpark of Club Adamstown, Brunker Road, Adamstown. The purpose of this assessment is to theoretically determine the noise impact from activities associated with the existing club (mechanical plant, amplified entertainment, patron activity, carpark activity, etc), and nearby commercial developments within habitable spaces of the proposed development, and to ensure that noise levels comply with the requirements of AS/NZS2107-2000, the Office of Environment and Heritage (OEH), and Newcastle City Council (NCC). Further assessment has also been undertaken to determine the noise impact the new development may have upon nearby neighbours (mechanical plant, vehicle movements, etc).

The assessment was requested by Club Adamstown Limited to form part of and in support of a Development Application to NCC and to ensure any noise control measures are incorporated into the design.

2 TECHNICAL REFERENCE / DOCUMENTS

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".*

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

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.*

NSW Environment Protection Authority (1992). *Environmental Noise Control Manual*

Plans supplied by The Design Partnership. Note that variations from design, supplied to us, may affect our acoustic recommendations.

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

3 DESCRIPTION OF THE PROPOSAL

Club Adamstown Limited intends to construct a residential development in the rear carpark of the club. The site is located in a predominantly commercial area, with the existing club and commercial premises to the east, the Nags Head Hotel and a public carpark to the north east, and residential development to the north and west. As such, noise associated with the club, nearby hotel and carparks have the potential to impact upon the amenity of future occupants of the proposed development. Nearest neighbours and noise sources identified during our site visits are shown below in Figure 1.

Figure 1 – Location Plan

LEGEND:

R1 S.-storey res. (Club owned).	R2 S-storey residences	R3 S-storey residences
R4 3-storey res units	R5 Nags Head Hotel	R6 Commercial
R7 Commercial	R8 Commerial	L9 Mechanical plant
L10 Mechanical plant	L11 Alfresco Gaming	L12 Mechanical plant
R13 S-storey res.		

4 EXISTING ACOUSTIC ENVIRONMENT

Long term monitoring was conducted by Reverb acoustics at the front boundary of 57 Date Street for a previous Application by the club (Location 1). Results of this survey are shown below in Table 1.

Table 1: Summary of Noise Logger Results, dB(A)
57 Date Street (Loc'n 1)

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*	43	40	35	--	--	--
LAeq	--	--	--	65	62	56

The above data was collected quite some time ago and the acoustic environment in the receiver area may have changed. Additional attended monitoring was conducted by Reverb Acoustics in July 2012 at the corner of Victoria Street and Date Street over 15 minute periods during the day, evening and night (See Figure 1). All measurements were conducted using a Svan 949 Sound Level Meter. This instrument is Type 1 accuracy, in accordance with the requirements of AS1259, and has the capability to measure steady, fluctuating, intermittent and/or impulsive sound, and to compute and display percentile noise levels for the measuring period. The instrument was calibrated with a Brüel and Kjaer 4230 sound level calibrator producing 94dB at 1kHz before and after the monitoring period, as part of the instruments' programming and downloading procedure, and showed an error less than 0.5dB.

Table 2 shows a summary of our noise surveys, including the Assessment Background Level's (ABL's) for the day, which were determined according to the procedures described in the OEH's Industrial Noise Policy (INP) and with reference to guidelines detailed in Australian Standard AS1055-1997, "Acoustics - Description and Measurement of Environmental Noise, Part 1 General Procedures".

Table 2: Attended Monitoring Results, dB(A) – Cnr Date & Victoria Streets (Loc'n 2)

Time	Date	L1	L90	Leq
10:00	2/02/11	86	45	66
19:20	2/02/11	84	42	62
23:15	3/02/11	76	37	54

To provide a measure of conservatism the long-term (Location 1) has been adopted for assessment purposes.

The Sound Pressure Level's (SPL's) of additional noise sources identified during our site visits are listed below:

Item	*SPL dB(A),L1*	*Comments*
Mechanical plant (L9)	65	@ 3m
Mechanical plant (L10)	69	@ 3m
Alfresco gaming (L11)	<40	East bdry carpark
Mechanical plant (L12)	72	@3m
Cars in club carpark	73	passby at 3m
Cars/patrons rear Nags Head Hotel	77	at carpark entry
Amplified entertainment	inaudible	proposed site

5 CRITERIA

5.1 Site Noise/Mechanical Plant

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, i.e. acoustic environment dominated by traffic generated urban hum, and industrial noise contributions are more than 6dB(A) below the recommended Leq in the adjacent residential area, so the recommended Acceptable Noise Level (ANL) applies in this case, i.e. no ANL reduction required for industrial noise contributions. 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 5 specifies the applicable base objectives for the proposal at nearest residences. 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 3: - Base Noise Level Objectives

Period	Intrusiveness Criterion	Amenity Criterion
Day	48 (43+5)	60
Evening	45 (40+5)	52 (62-10)
Night	40 (35+5)	46 (56-10
Receiver Type: Urban (See DECCW's INP - Table 2.1)		

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

Day **48dB LAeq,15 Minute** 7am to 6pm Mon to Sat or 8am to 6pm Sun and Pub Hol.
Evening **45dB LAeq,15 Minute** 6pm to 10pm
Night **40dB LAeq,15 Minute** 10pm to 7am Mon to Sat or 10pm to 8am Sun and Pub Hol.

The INP's criteria are external limits, therefore internal criteria must also be applied for habitable rooms within future Units. Section 4.1.2 of the OEH's Interim Construction Noise Guideline (ICNG) suggests a conservative estimate of the difference between internal and external noise levels is 10dB, which we are in agreement with for a window open 20% to provide ventilation. Section 4.1.2 also suggests that the greater reductions can be achieved for fixed glazing and once again we are in agreement. Based on the above, the following internal criteria apply for habitable rooms within any future residence:

Living Areas:
45dB(A),Leq – 10dB(A) = **35dB(A),Leq (internal)**
Bedrooms:
40dB(A),Leq – 10dB(A) = **30dB(A),Leq (internal)**

5.2 Short Term Noise Events

Section 2.4.5 of the OEH's Noise Guide for Local Government states *"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 future residents likely to receive noise from patrons and vehicles in the carpark. Based on an average minimum background noise level of 35dB(A),L90 for night the sleep arousal criterion is set at **50dB(A),L1(1min)** at the bedroom window of any affected residential receiver.

6 METHODOLOGY

6.1 Mechanical Plant Noise

Mechanical plant selection and location is not known at this stage, we have therefore assumed that air conditioning plant will be located on balconies of each unit, while carpark exhaust fans will be located in the Level 1 plant room with exhaust outlets at roof level. Our client has indicated that possibly two packaged air conditioning units, servicing transitory spaces, may be located on the roof. Calculations are based on the above assumptions and using sound levels sourced from our library of technical data.

The sound power of anticipated plant is propagated to nearest receivers taking into account sound intensity losses due to spherical spreading, acoustic barriers, etc. Additional minor losses such as molecular absorption, directivity and ground absorption have been 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.

6.2 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 manufacturers' data and/or 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 sound power level of each activity was determined according to the procedures described in AS2102 or AS1217 as appropriate, and theoretically propagated at to nearby receivers. Propagation calculations were carried out using the following in-house equation. 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.

Equation 1:

$$L_{eq},T = Lw - \left[10 \log (20 \log R + 8) + 10 \log \frac{(D \times N)}{T} \right]$$

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

7 ANALYSIS AND DISCUSSION

7.1 Received Noise – External Noise Sources

The following Table shows a sample calculation of received noise levels from activities/equipment associated with activities associated with the club and nearby commercial developments for a worst-case situation (i.e. at conclusion of a function at the club during the late evening), propagated to the bedroom on the east facade of Unit 200, located on Level 2. All calculations are based on distances scaled from plans supplied by Design Partnership and through measurement during our site visits.

Table 4: Received Noise – External Noise Sources, dB(A),Leq
Propagated to First Level Bedroom

Activity	Cars C'park	Patrons C'park	Plant (L9)	Plant (L10)	Plant (L12)	Patrons (L11)	Patrons Nags H Carpark
Lw dB(A)	91	95	83	87	90	65	95
Ave Dist to rec (m)	10	15	20	35	35	30	40
Duration of event	5 sec	5 sec	15 min	15 min	15 min	15 min	30 sec
No. of events	30	5	1	1	1	1	3
Barrier loss/Directivity	2	0	2	4	2	8	0
Rec dB(A),Leq	**53.2**	**47.9**	**47.0**	**44.1**	**49.1**	**19.5**	**45.0**
Combined	**57**						
Criteria (even/night)	**45dB(A),Leq (15 min) / 40dB(A),Leq (15 min)**						
Impact	**12/17**						

Table 5: Received Noise – Short Duration Events dB(A),L1 (10pm-7am)
Propagated to First Level Bedroom

Activity	Cars C'park	Patrons C'park	Plant (L9)	Plant (L10)	Plant (L12)	Patrons (L11)	Patrons Nags H Carpark
Lw dB(A)	91	95	83	87	90	65	95
Ave Dist to rec (m)	10	15	20	35	35	30	40
Barrier loss/Directivity	2	0	2	4	2	8	0
Rec dB(A),L1	**61**	**64**	**47**	**44**	**49**	**20**	**55**
Criteria (even/night)	**50dB(A),L1 (1 min)**						
Impact	**11**	**14**	**-**	**-**	**-**	**-**	**5**

As can be seen by the above results, noise from nearby external activities/equipment is predicted to be exceed the criteria by 12dB(A) during the evening and 17dB(A) at night at the external facade of the bedroom. Similarly exceedances of 5-14dB(A) are predicted from short-term events. The Units will be air conditioned, therefore windows may be closed to reduce impacts from noise. However, the adopted internal criteria of **35dB(A),Leq (15 min)** and **30dB(A),Leq (15 min)** will still be exceeded given that a standard window will only attenuate 10dB(A) when closed. Glazing to the bedroom must therefore be modified acoustically. Theoretical calculations reveal that all glazing within the bedroom must achieve an Rw34 rating. This can typically be achieved with laminated glass and acoustic seals fitted at sliders. See Section 8 for glazing schedule and required design modifications.

7.2 Received Noise – Site Vehicles

Vehicles entering and leaving the carpark have the potential to disturb nearby residents. Due to the non-continuous nature of site activities, noise impacts are assessed using Equation 1 shown previously. The noise levels used in our calculations are the average maximum predicted noise levels produced at the residential boundary. Addition of the received Sound Pressure Level (SPL) from each noise source gives the total SPL at the receiver, which is then compared to the relevant criterion. Where noise impacts above the criterion are identified, suitable noise control measures are implemented and reassessed to demonstrate satisfactory received noise levels.

A worst-case situation for site activities has been assessed for a 15 minute peak period as follows:

- 40 vehicles enter or leave via the same exit/entry in a single assessment period.
- 5 vehicles are stationary at the exit for approximately 10 seconds to await their turn to exit/enter the site.
- Vehicles accelerate to leave the site.
- A truck enters the site via Date Street to be unloaded at the Service Bay and exits via Victoria Street on completion (note deliveries will not occur at night).

Table 6 shows a summary of received noise levels from site vehicles, propagated to nearest residential receivers in Date Street.

Table 6: Calculated SPL, Carpark Activities - Propagated to Nearest Receivers

Receiver Loc'n	Received Noise (Day/Even/Shoulder)					Noise Control Required
	Period	dB(A),Leq	Crit	dB(A),L1	Crit	
Single-storey	Day	46	48	-	N/A	Yes
Residence	Evening	**46**	45	-	N/A	"
R1	Night	36	40	47	50	"
Single-storey	Day	45	48	-	N/A	No
Residences	Evening	45	45	-	N/A	"
R2	Night	38	40	**55**	50	"
Single-storey	Day	43	48	-	N/A	No
Residences	Evening	43	45	-	N/A	"
R3	Night	37	40	**54**	50	"
3-storey	Day	46	48	-	N/A	No
Res Units	Evening	**46**	45	-	N/A	"
R4	Night	38	40	**55**	50	"
Single-storey	Day	43	48	-	N/A	Yes
Residence	Evening	43	45	-	N/A	"
R13	Night	36	40	47	50	"

The above results show that activities associated with the carparks (vehicles, customers) will generally be compliant with the criteria at all nearby receivers during normal and peak periods at day and night, with the exception of minor 1dB(A) exceedances at R1 and R4 during the evening. However, it is highly unlikely that deliveries will occur at the same time as peak vehicle movements in the carpark, implying compliance. Note that a 2100mm high acoustic fence is required between south residences and the development. See Figure 2 Section 8 for fence locations.

It is also noted that 4-5dB(A) exceedances of the sleep arousal criterion may occur at receivers R2-R4 during the night from vehicles as they accelerate from the site. This can easily be addressed by erecting signs at all entry/exit points reminding patrons/residents to consider the amenity of nearby neighbours and leave the site quietly. See Section 8 for required acoustic modifications.

7.3 Received Noise - Site Mechanical Plant

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 the OEH's INP. In respect to the above, a planning limit of **40dB(A),Leq** for night (10pm-7am) applies at the boundary of the nearest residential neighbour from plant associated with the proposal.

The number and location of noise generating items associated with the development is unknown at this time, although we assume quiet split system air conditioning units will more than likely be installed on the balcony of each residential unit. Air conditioning plant associated with the retail areas is typically either located within the carpark or on the roof. Carpark exhaust outlets are also expected for the basement carpark. We have therefore listed below the anticipated type and number of plant items for a typical development of this size.

Option 1:

Location	*Plant Item*
Apartment Balconies	Split system air con
Roof	Carpark exhaust/intake (x3)
Roof/Carpark	Retail air con (x2)

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.

A sample calculation of noise produced by nearest future air conditioning condensers on Unit balconies is shown in Table 7 below, propagated to nearest receivers.

Table 7: Calculated SPL – Air Conditioning Condensers on Balconies

		Octave Band Centre Frequency, Hz							
Item	**dB(A)**	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**
Combined Lw, (x5)	**75**	49	61	64	66	68	71	65	55
Barrier loss[1]		4	4	5	6	8	10	12	14
SPL at receiver	**34**	12	24	26	27	27	28	20	8
Criterion (night)	**40**								
Impact	**0**								

1. Enclosed balustrade 800-900mm in height.

As can be seen by the above results, noise from plant on balconies will be compliant with the criteria at nearest residential boundaries providing solid glass or similar balustrade is erected at balcony perimeters.

See Section 8 for necessary noise control modifications for all mechanical plant associated with the new development.

8 NOISE CONTROL RECOMMENDATIONS

8.1 Glazing Windows/Sliding Doors

a) 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 7 were performed for all building elements of the proposed development. From these calculations, a schedule of required glazing has been compiled, shown below. ***Note that our calculations account for the cumulative noise impact from all significant noise sources***. 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 6-8mm clear float glass.
Type C: Single glaze laminated glass
Type D: IGU or double-glaze.

Note: The typical glazing shown in the following Table 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 8: Glazing Schedule

Facade	Unit No/Location	Room Use	Required Rw Must Achieve for Compliance	Typical Glazing System (Not for Specification)
GROUND LEVEL				
North	1,2	All Bed	**34**	Type C or D
		All Liv/Din/Kitch	**32**	Type C
West	2-9	All Bed	**33**	Type C
		All Liv/Din/Kitch	**31**	Type C
FIRST LEVEL				
North	100-102	All Bed	**34**	Type C or D
		All Liv/Din/Kitch	**32**	Type C
West	102,3-9,103	All Bed	**33**	Type C
		All Liv/Din/Kitch	**31**	Type C
South	103,104	All Bed	**33**	Type C
		All Liv/Din/Kitch	**31**	Type C
		All Bath/WC/Lndry		Type C
SECOND LEVEL/THIRD LEVEL				
North	200-203,300-303	All Bed	**34**	Type C or D
		All Liv/Din/Kitch	**32**	Type C
West	203-213,303-313	All Bed	**33**	Type C
		All Liv/Din/Kitch	**31**	Type C
South	213-216,313-316	All Bed	**33**	Type C
		All Liv/Din/Kitch	**31**	Type C
		All Bath/WC/Lndry	**29**	Type B or C
East	200,216-225 300,316-325	All Bed	**34**	Type C or D
		All Liv/Din/Kitch	**32**	Type C

Table 8: Glazing Schedule

Facade	Unit No/Location	Room Use	Required Rw Must Achieve for Compliance	Typical Glazing System (Not for Specification)
FOURTH LEVEL				
North	402	All Bed	**33**	Type C
		All Liv/Din/Kitch	**30**	Type C
West	402-411	All Bed	**32**	Type C
		All Liv/Din/Kitch	**30**	Type C
South	411,412	All Bed	**33**	Type C
		All Liv/Din/Kitch	**30**	Type C
		All Bath/WC/Lndry	**29**	Type B or C
	Common Room	All glazing	**30**	Type C
		All doors	**28**	Type B or C
East	412-420	All Bed	**33**	Type C
		All Liv/Din/Kitch	**32**	Type C
FIFTH LEVEL				
West	500-503	All Bed	**33**	Type C
		All Liv/Din/Kitch	**30**	Type C
East	504-507	All Bed	**33**	Type C
		All Liv/Din/Kitch	**30**	Type C

8.2 Mechanical Ventilation

b) AS/NZS2107-2000 requires mechanical ventilation to be installed in habitable rooms where criteria are exceeded. This is generally in the form of air conditioning, although other methods such as Passive Acoustic Ventilators or Aeropac Wall Ventilators may be installed as alternatives. Note that alternate options while effective will not heat or cool a room.

We consider mechanical ventilation necessary for all bedrooms and living rooms of Units, although selection is the responsibility of the purchaser.

8.3 Roof/Ceiling Construction

c) Construction should consist of *either* reinforced concrete *or* sisalation or wire mesh laid down on roof trusses. This is to be completely covered with a 30-40mm foil faced building blanket or similar (in situations where trusses are at centres close enough to avoid excessive sagging of the blanket, the sisalation/wire mesh may be omitted). If Terra Cotta or concrete roof tiles are preferred, the building blanket may be omitted. Close off eaves gaps with timber trimmers/noggings between trusses, followed by placement of roof sheeting (an alternative for steel framed construction is to provide 2 layers S3/R3 insulation in ceiling void, tightly packed at the building perimeter at 600mm width). All upper level ceilings are to consist of an impervious ceiling of 1 layer 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 $6/m^2 for R3 batts).

8.4 Balconies

d) To reduce the field of view of the noise source (i.e. external noise sources), enclosed balustrade minimum 800-900mm in height is recommended for balconies to all residential units, consisting of FC sheeting, stud frame, masonry or fixed glass panels. A suitable gap of say 50-100mm is permitted at floor level to allow cleaning, hosing, etc.

8.5 Wall Construction

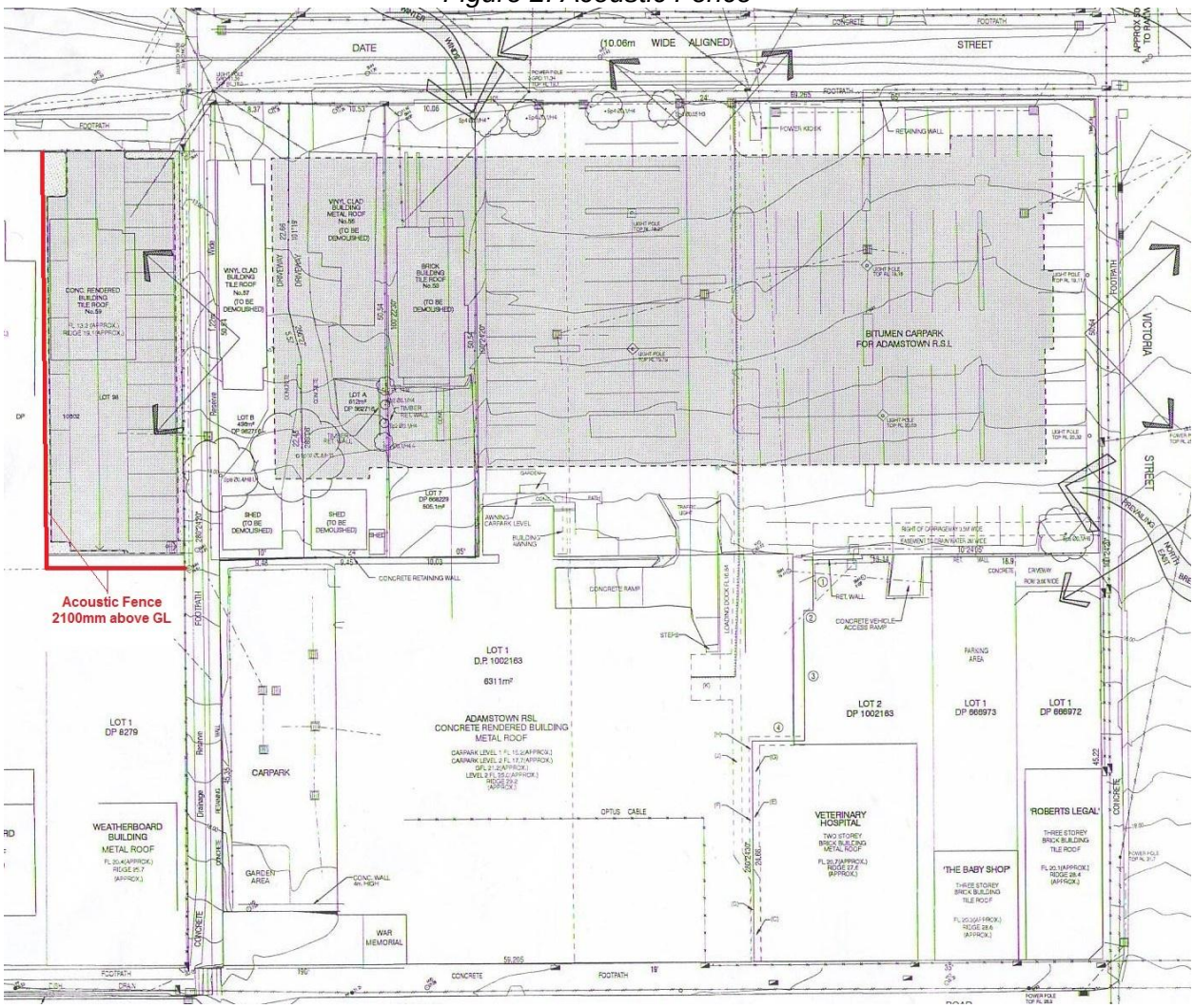
e) Brick veneer/masonry construction is acceptable. Where external brickwork stops below the height of the stud frame, plasterboard, Villaboard, or similar, is to be fixed to the outside of the stud frame to fill the void. The infill material is to extend from the top of the top plate to a point in line 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.

f) All lightweight cladding such as (Colorbond, etc) is to be backed with either 6mm fibre cement sheeting (Villaboard, Hardiflex) or 10mm construction plywood.

8.6 Acoustic Fence

g) An acoustic fence 2100mm above ground level must be erected at the locations shown in Figure 2 below. An acoustic fence is one which is impervious from the ground to the recommended height, and is typically constructed from lapped and capped or similar. No significant gaps should remain in the fence to allow the passage of sound below the recommended height. Other construction options are available if desired, providing the fence is impervious and of equivalent or greater surface mass than the above construction options.

Figure 2: Acoustic Fence



8.6 Mechanical Plant

h) All carpark exhaust discharge points must be suitably attenuated and preferably be located in shielded locations. Any exhaust plant in an exposed location that produces a sound pressure level in excess of 65dB(A) at a distance of 1 metre from the discharge point must be acoustically treated. Available noise control options include installation of in-duct silencers, installing directional exhausts stacks, or erecting acoustic barriers. If barriers are required they 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. The barrier must be no closer than 500mm and 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 absorbent foam to reduce reverberant sound (fibrous infills are not recommended as they will deteriorate if wet), i.e. we recommend 25mm Woodtex (available through Enviro Acoustics). 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.

i) As previously stated, enclosed balustrade 800-900mm in height, is recommended for all residential units to provide an effective barrier for air conditioning plant located on balconies.

j) Acoustic louvres are to be installed in the walls of the ground level Pump Room and level 1 Fan Room in preference to standard ventilation 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

k) Acoustic barriers must be erected along the perimeter of any plant deck located on the roof or other exposed location of the development. The barriers must fully enclose the deck and be minimum 300mm above the top of the highest plant item. 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.

l) Once selection and location of all plant has been finalised, details should be forwarded to the acoustic consultant for approval.

m) 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. Once the plant layout has been finalised, details should be forwarded to the acoustic consultant to incorporate appropriate acoustic measures.

9 CONCLUSION

A noise impact assessment for a new residential development to be located in the carpark of Club Adamstown, 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 impacting upon the development has resulted in the compilation of a schedule of minimum glazing thicknesses and types, roof/ceiling and wall construction, etc, to ensure the acoustic amenity of future occupants is ensured. **The typical glazing systems shown in Table 8 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 our recommended glass in a standard window 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.

In conclusion, providing the recommendations given in this report are implemented, noise from activities associated with the existing Club, people on city streets and activities associated with nearby commercial/retail businesses will comply with the requirements of the AS/NZS2107-2000, the OEH and NCC within habitable spaces of the proposed development. We therefore see no acoustic reason why the proposal should be denied.

REVERB ACOUSTICS

S. Brady.

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.
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.
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.
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).