REVERB ACOUSTICS

Noise and Vibration Consultants

Noise Impact Assessment
Private Hospital & Medical Centre
31-33 Smith Street
Charlestown NSW

September 2022

Prepared for The Trustee for GPV Charlestown Trust
Report No. 22-2722-R1

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

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1 INTRODUCTION

Reverb Acoustics has been commissioned to conduct a noise impact assessment for a proposed private hospital and medical centre at 31-33 Smith Street, Charlestown. The purpose of this assessment is to determine the noise impact, within habitable spaces of the development from passing road traffic and commercial activity, and to ensure that noise levels comply with the requirements of the Roads and Maritime Services (RMS), Department of Planning and Environment (DPE), NSW Environment Protection Authority (EPA) and Lake Macquarie City Council (LMCC). Further assessment has also been carried out to determine the noise impact mechanical plant and site activities (i.e. vehicle movements) associated with the proposed development may have on nearby neighbours.

The Assessment was requested by The Trustee for GPV Charlestown Trust in support of and to accompany a Development Application to LMCC 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 (2011). *NSW Road Noise Policy.*

NSW Environment Protection Authority (2017). *Noise Policy for Industry.*

NSW Environment Protection Authority (2009). *Interim Construction Noise Guideline.*

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".*

RTA (October 2002). *Guide to Traffic Generating Developments.*

AS 2107-2016 *“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 Archadia Projects Pty Ltd, Version 1.5, dated September 2022. 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 for a nearby development in Smith Street. Additional attended noise level measurements were conducted at the south, east and west boundaries of the site during peak day and night periods (M1, M2 ,M3). The selected locations are representative of the acoustic environment in the receiver areas and considered acceptable locations for determination of the background noise in accordance with Fact Sheet B of the EPA's Noise Policy for Industry (NPfI). A summary of our results is shown below in Table 1.

Table 1: Summary of Long-Term Monitoring – Location 2, 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	48	45	36	--	--	--
LAeq	--	--	--	59	59	55
Monitoring Location M1 – Pacific Highway						
Current Leq, peak (day) = 64.5dB(A)			Current Leq, 1hr (night) = 61.0dB(A)			
Monitoring Location M2 – Frederick Street						
Current Leq, peak (day) = 65.0dB(A)			Current Leq, 1hr (night) = 57.0dB(A)			
Monitoring Location M3 – Smith Street						
Current Leq, peak (day) = 61.0dB(A)			Current Leq, 1hr (night) = 55.0dB(A)			

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.

Figure 1: Site Plan

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

Item	*SPL dB(A),Lmax*	*Comments*
School Children (S1)	48	@ 10m
Vehicle Movements (S2)	65	passby at 3m
Roof-Top Exhaust Plant (S3)	58	passby at 3m
Vehicles/Customers (S4)	62	@ 10m
Vehicle Movements (S5)	65	passby at 3m
Vehicle Movements (S6)	65	passby at 3m
Truck Movements (S7)	81	passby at 3m
Vehicle Movements (S8)	65	passby at 3m
Truck Movements (S9)	81	passby at 3m
Roof-Top Mech Plant (S10)	52	@ 10m

4 ASSESSMENT 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 2107-2016 *"Acoustics-Recommended Design Sound Levels and Reverberation Times for Building Interiors"* and are detailed below.

Room Type	dBA
HEALTH BUILDINGS	
Consulting rooms	40 – 45
Delivery suites	45 – 50
Dining areas	40 – 45
Intensive care wards	40 – 45
Kitchens, sterilizing & service areas	<55
MRI/CT scan/x-ray/ultra sound	45 – 50
Nurses stations	40 – 45
Office areas	35 – 45
Operating theatres	40 – 50
Patient lounge	40 – 45
Post op/pre op/recovery rooms	40 – 45
Pharmacies	45 – 50
Staff rooms	40 – 45
Surgeries/treatment/procedure rooms	40 – 45
Utility rooms	50 – 60
Ward bedrooms	35 – 40
Waiting rooms/reception areas	40 – 50

4.2 Mechanical Plant / Site Noise

Noise from industrial noise sources scheduled under the Protection of Environment Operations Act is assessed using the EPA's NPfI. However, local Councils and Government Departments may also apply the criteria for land use planning, compliance and complaints management. The NPfI 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 is based on the total industrial noise in an area in relation to the noise levels from the development to be assessed. Project Noise Trigger 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 areas is dominated by traffic on nearby roads, and commercial/light industrial activity during the day, evening and night. Reference to Table 2.2 of the NPfI shows that all receiver areas are classified as urban. The Project Amenity Level is derived by subtracting 5dB(A) from the recommended amenity level shown in Table 2.2.

A further +3dB(A) adjustment is required to standardise the time periods to LAeq,15 minute. The adjustments are carried out as follows:

Recommended Amenity Noise Level (Table 2.2) – 5dB(A) +3dB(A)

In high traffic areas where the existing traffic noise levels are 10dB or more above the recommended amenity level, the Amenity Level is derived by subtracting 15dB(A) from the existing traffic noise level.

Table 2 below specifies the applicable project intrusiveness and amenity noise trigger levels for the proposed redevelopment.

Table 2: - Base Noise Level Objectives

Period	Intrusiveness Criteria	Amenity Criteria
Day	53 (48+5)	58 (60-5+3)
Evening	50 (45+5)	48 (50-5+3)
Night	41 (36+5)	43 (45-5+3)
Receiver Type: Urban (See EPA's NPfI - Table 2.2)		

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

Day **53dB LAeq,15 Minute** 7am to 6pm Mon to Sat or 8am to 6pm Sun and Pub Hol.
Evening **48dB LAeq,15 Minute** 6pm to 10pm
Night **41dB LAeq,15 Minute** 10pm to 7am Mon to Sat or 10pm to 8am Sun and Pub Hol.

Commercial Premises
62dB LAeq,15 Minute when in use

4.3 Maximum Noise Level Event Assessment - Sleep Arousal Impact on Neighbours

Section 2.5 of EPA's NPfI requires a detailed maximum noise level event assessment to be undertaken where the subject development/premises night-time noise levels exceed the following:

- LAeq (15 minute) 40dB(A) or the prevailing RBL plus 5dB whichever is greater, and/or
- LAFmax 52dB(A) or the prevailing RBL plus 15dB, whichever is greater.

The detailed assessment should cover the maximum noise level, the extent to which the maximum noise level exceeds the RBL, and the number of times this happens during the night.

5 METHODOLOGY

5.1 Road Traffic Noise

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 2022 was calculated as follows:

measured noise + facade correction = received noise (2022)

Applying the above formula gives:

PACIFIC HIGHWAY:				
Day	65.5dB(A) + 2.5dB(A) =	**68.0dB(A) Leq15hr**	7am - 10pm
Night	60.0dB(A) + 2.5dB(A) =	**62.5dB(A) Leq15hr**	10pm – 7am
FREDERICK STREET:				
Day	63.0dB(A) + 2.5dB(A) =	**65.5dB(A) Leq15hr**	7am - 10pm
Night	57.0dB(A) + 2.5dB(A) =	**59.5dB(A) Leq15hr**	10pm – 7am
SMITH STREET:				
Day	60.5dB(A) + 2.5dB(A) =	**63.0dB(A) Leq15hr**	7am - 10pm
Night	55.0dB(A) + 2.5dB(A) =	**57.5dB(A) Leq15hr**	10pm – 7am

No current RMS traffic station is located near the site along adjoining roads. We have therefore assumed 25,000 vehicles pass the site each day along Pacific Highway and 15,000 vehicles each day along Frederick and Smith Streets. A typical figure of 5% heavy vehicles has been adopted for all roads. The AADT's for the year 2022 were applied to our computer programme, based on the EPA 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 adopted AADT figures and 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.

The EPA 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 RMS publications - Traffic Volume Data for Hunter and Northern Regions, 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 Site Noise/Mechanical Plant

The sound power level of each activity impacting on the site 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 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:

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

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

6 ANALYSIS

6.1 Road Traffic Noise (Impact on Development)

Shown below is a sample calculation detailing the procedure followed in order to calculate required glazing for a typical Consulting Room on Level 1, facing Pacific Highway. The traffic noise level at the outer face of the glazing is calculated as follows,

Table 3: Sample Calculation - Traffic Impact at Level 1 Consulting Room West Facade

		Octave band Sound Pressure Levels, dB(A)							
Propagation calculation	**dB(A)**	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**
Facade traffic noise, Leq	68	44	52	53	57	59	56	50	42
Architectural shielding[1]		0	0	0	0	0	0	0	0
Directivity/distance Correction[2]		-1	-1	-1	-1	-1	-1	-1	-1
Traffic noise at window	67	43	51	52	56	58	55	49	41

1. Intervening structure. 2. Includes angle of incidence correction.

As the criterion for Consulting Rooms is 40dB(A), see Section 4.1, the required traffic noise reduction is *TNR* = 67-40 = 27dB(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 = 3.0m²
S_f = Surface area of floor = 13m²
h = Ceiling height, assumed to be 2.5m
T_{60} = Reverberation time, 0.8 seconds
C = No. of components = 2 (glazing, wall)

Using the values listed above gives
TNA = 25dB(A) for the glazing

Substituting this value into the equation given in Clause 3.4.3.1 of AS3671 gives
Rw = *TNA* + 6 ≈ 31

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 2-3dB higher than required on site. Therefore, the windows in the Consulting Rooms must have a tested Rw34 rating. Based on typical laboratory performance data the glazing would consist of single-glaze laminated or Vlam Hush glass fitted with acoustic seals at sliders. Similar calculations to those above have been performed for windows and doors on affected facades. From these calculations, a glazing schedule has been compiled. See Section 4.

DPE's Guideline states that if road traffic noise criteria cannot be met with windows open then they must be shut, if desired, while also meeting the ventilation requirements of the Building Code of Australia (BCA). This does not preclude the use of operable windows, however, the National Construction Code (NCC) states that when the minimum criteria cannot be met, mechanical ventilation is required (ref: Section 3.1.2 ABCB Indoor Air Quality, 2016). We understand that all habitable rooms will be provided with air conditioning, satisfying this requirement.

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 External Noise Sources (Impact on Development)

The following Tables show sample calculations to predict received noise levels from activities/equipment associated with nearby commercial developments propagated to typical Consulting Rooms on Level 1, along the west facade, facing the Pacific Highway. All calculations are based on distances scaled from plans supplied by Archadia Projects Pty Ltd and through measurement during our site visits.

Table 4: Received Noise – External Noise Sources, dB(A),Leq
Propagated to Level 1 Consulting Rooms – West Facade

Item/Activity	Lw dB(A)	Ave Dist Rec (m)	Duration (sec)	No. of Events	Barrier Loss/Dir	Received dB(A)
S1. School Children	76	130	900	50	24	2
S2. Vehicle Movements	82	80	10	10	18	8
S3. Roof-Top Exhaust	86	60	900	2	8	37
S4. Vehicles/Customers	90	50	10	15	12	28
S5. Vehicle Movements	82	40	10	5	12	17
S6. Vehicle Movements	82	35	10	10	2	32
S7. Truck Movements	98	35	10	2	2	41
S8. Vehicle Movements	82	40	10	10	2	30
S9. Truck Movements	98	40	10	2	2	39
S10. Roof-Top Mech Plant	80	80	900	2	12	25
				Combined		**44**
				Criteria (Night)		**35**
				Impact		**9**

As can be seen by the above results, noise from nearby external activities/equipment is predicted to exceed the criteria by up to 9dB(A). A standard window will only attenuate approximately 10-15dB(A) when closed. Glazing must therefore be modified acoustically. Theoretical calculations reveal that glazing within nearest habitable rooms must achieve ≥Rw32 rating. This can typically be achieved with single-glaze laminated or Vlam Hush glass and acoustic seals fitted at sliders. See Section 7 for glazing schedule and required design modifications.

6.3 Mechanical Plant (Impact from Development 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 EPA's NPI. In respect to the above, a planning limit of **41dB(A),Leq** for night (10pm-7am) has been adopted at the boundary or facade of nearest residences, and **62dB(A),Leq** at commercial receivers. All plant will be located on the dedicated roof-top plant deck or within roof-top plant room. Two options are proposed, i.e. air cooled chiller option and air cooled VRV option. At this stage plant selections have not been finalised, therefore, noise emission data will be sourced from manufacturer's data for similar sized plant.

Chillers (x12) or VRV (x7)
Electric HP Chillers (x6)
CW Pump (x1)
HHW Pump (x1)
DHW Pump (x1)

Noise produced by the proposed plant is propagated to residential locations taking into account sound intensity losses due to geometric 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 anticipated roof-top plant is shown in following Table, propagated south east to nearest multi-storey residential apartments (R3).

Table 5: Calculated SPL – Roof-Top Mechanical Plant
Propagated South East to Nearest Residential Receivers (R3)

		Octave Band Centre Frequency, Hz							
Item	**dB(A)**	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**
Combined Lw plant	**92**	67	76	84	87	85	83	80	73
Barrier loss[1]		5	5	5	4	3	1	0	0
SPL at receiver	**37**	11	20	28	31	30	30	28	21
Criterion (night)	**41**								
Impact	**0**								

1. Intervening structures.

Results in the above Table show that noise emissions from anticipated plant is predicted to be compliant with the EPA (and therefore Council) criteria at nearest residences, based on typical source noise levels and providing plant is installed at the specified locations. Predicted noise levels are below 55dB(A),Leq at nearest commercial receivers, which is compliant with the adopted criterion of 62dB(A),Leq.

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

Item	*Max SPL at a Dist of 1 metre*	*Lw*
Air Conditioning Condenser/Chiller	70dB(A)	76dB(A)
Exhaust Discharge	68dB(A)	74dB(A)

See Section 7 for further recommendations.

6.4 Vehicles in Carparks (Impact from Dev'p on Neighbours)

Section 3.5 of the RMS' Guide to Traffic Generating Developments suggest that commercial developments produce 2 vehicle movements for every 100m² of floor area. This equates to approximately 250 vehicle movements/hour or 80 vehicle movements in a worst-case 15 minute assessment period. Fewer vehicles are expected out of hours (10pm-7am), with perhaps 40 vehicle movements in each 15 minute period. The following Table shows calculation to predict received noise levels from site vehicles, propagated to nearest residential boundaries (R5). All calculations are based on distances scaled from plans supplied by our client and through physical measurement during our site visits.

Table 6 shows calculations to predict the cumulative noise impact during peak day periods at nearest future residential boundaries south east of the site (R3) with no noise control in place.

Table 6: Received Noise - Site Activities dB(A),Leq (Day)
Propagated South East to nearest Residential Boundaries (R3)

Item/Activity	Lw dB(A)	Dist to Rec (m)	Duration (sec)	No. of Events	Barrier Loss/Dir	Received dB(A)
Car Enter/Exit Smith St	82	60	5	40	3	29
Care enter/exit Frederick St	82	90	5	40	6	22
Car drive in carpark	80	60	20	80	4	35
Car reverse in carpark	76	60	10	40	4	25
				Combined		**36**
				Criteria (Day/Evening)		**53/48**
				Impact		**-/-**

As can be seen by the results in Table 6, the cumulative noise impact from all site activities associated with the carpark is predicted to be compliant with the criteria at nearest residential receivers south east of the site (R3). Table 7 shows a summary of predicted noise impacts during all time periods at all nearby receivers.

Table 7: Summary Received Noise – All Nearby Residential Receivers

Receiver Loc'n	Received Noise (Day/Evening/Night)						
	Period	dB(A),Leq	Crit	Impact	dB(A),Lm	Crit	Impact
Residences South East R3	Day	36	53	-	-	N/A	-
	Evening	36	48	-	-	N/A	-
	Night	32	41	-	40	52	-
Commercial R1, R2, R4-R7	Day	44	62	-	-	N/A	-
	Evening	44	62	-	-	N/A	-
	Night	40	62	-	-	N/A	-

As can be seen by the above results, noise associated with the site will generally be compliant with the criteria during all time periods at all nearby receivers, providing acoustic strategies detailed in Section 7 are implemented.

7 NOISE CONTROL RECOMMENDATIONS

7.1 Glazing

7.1.1 Glass installed in window assemblies must comply with AS1288-2006. Materials, construction and installation of all windows are to comply with the requirements of AS2047-2014. 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 Table, 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 or Vlam Hush glass
Type D: Double-glaze system or Insulating Glass Unit (IGU)

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 8: Glazing Schedule

Facade	Location	Required Rw Must Achieve for Compliance	Typical Glazing System (Not for Specification)
LEVEL 1			
West	All Consulting	**34**	Type C or D
	All Waiting	**31**	Type C
	Entry	**28**	Type B or C
	Pharmacy	**30**	Type C
North	Waiting	**30**	Type C
	All Staff	**28**	Type B or C
East	Staff	**28**	Type B or C
	All Consulting	**32**	Type C
	Imaging	**30**	Type C
	All Pathology	**32**	Type C
	Entry	**26**	Type B
	All Skin Clinic	**32**	Type C
South	All Skin Clinic	**33**	Type C or D
	All Pharmacy	**30**	Type C
LEVEL 2 / LEVEL 3			
West	All Consulting	**33**	Type C or D
	Foyer	**29**	Type B or C
	All Day Rehab	**31**	Type C
North	All Consulting	**32**	Type C
East	All Consulting	**31**	Type C
	All Foyer	**27**	Type B
South	All Consulting	**32**	Type C
	All Day Rehab	**30**	Type C
LEVEL 4			
West	All	**33**	Type C or D
North	All	**31**	Type C
East	All	**31**	Type C
South	All	**32**	Type C

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.

7.2.2 Install an impervious ceiling of 1 sheet of taped and set 10mm plasterboard or suspended acoustic tile ceiling. 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 Masonry construction is acceptable. These high mass building elements will adequately attenuate low frequency noise produced by passing traffic.

7.3.2 Lightweight cladding (i.e. Shadowclad, Colorbond, or similar) should include internal lining 1 sheet taped and set 13mm 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 Mechanical Plant

7.4.1 No acoustic modifications will be necessary for individual items of mechanical plant that are not located on the plant deck, with noise emission levels below the following:

Item	Max SPL dB(A) @ 1 metre	Maximum Lw, dB(A)
Air Conditioning Condenser/Chiller	70dB(A)	76dB(A)
Exhaust Discharge	68dB(A)	74dB(A)

7.4.2 If noise emissions from exhaust plant exceed the limits shown in Item 7.4.1, 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 *either* Acoustisorb panels (available through Modular Walls) *or* 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.

7.4.3 If noise emissions from individual items of air conditioning plant exceed the limits shown in Item 7.4.1, acoustic barriers must be constructed between the plant and residences. Barrier construction should consist of *either* Acoustisorb panels (available through Modular Walls) *or* 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), and must be minimum 300mm above the top of the plant item.

7.4.4 The contractor responsible for supplying and installing the plant should be asked to supply evidence that installed plant meets specified noise emission limits, or that noise control included with the plant is effective in reducing the sound level to the specified limit. Once selection and location of plant has been finalised, details should be forwarded to the acoustic consultant for approval.

7.4.5 It should be noted that no penalties have been applied for tonality produced by mechanical plant, therefore the contractor's attention is drawn to the fact that the plant will 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 and equipment 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.

7.4.6 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.

7.5 Carpark

7.5.1 Parapet walls minimum 1200mm above FGL must be erected at the carpark perimeter where louvred openings are installed to provide natural ventilation.

7.5.2 To avoid tyre squeal, polished concrete finish is not recommended for floors in carparks.

8 CONCLUSION

A noise impact assessment for a proposed private hospital and medical centre at 31-33 Smith Street, Charlestown, has been completed, resulting in noise control recommendations summarised in Sections 7 of this Report. The report has shown that the site is suitable for the intended purpose, providing our recommendations are implemented. An assessment of external noise impacting on the development has resulted in the compilation of a schedule of minimum glazing, wall, roof construction, etc, to meet the requirements of the EPA, DPE and RMS. The recommended construction 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 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.

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

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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.