REVERB ACOUSTICS
Noise and Vibration Consultants

Noise Impact Assessment
Multi-Unit Development
Lot 10 Section 48 DP.758274
45 Raymond Terrace Road
East Maitland NSW

July 2025

Prepared for Croese Building Pty Ltd
Report No. 25-3021-R1

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

REVERB ACOUSTICS PTY LTD
ABN 26 142 127 768 ACN 142 127 768
PO Box 252 BELMONT NSW 2280
Telephone: (02) 4947 9980
email: sbradyreverb@gmail.com

1 INTRODUCTION

Reverb Acoustics has been commissioned to conduct a road traffic and rail traffic noise and vibration impact assessment for a proposed residential development at Lot 10 Section 48 DP.758274, No.45 Raymond Terrace Road, East Maitland. The purpose of the assessment is to theoretically determine the noise and vibration impact within habitable spaces from passing road traffic on Raymond Terrace Road and rail traffic on the North Coast Rail Line and to recommend acoustic modifications that must be incorporated into the design. Further assessment has been carried out to determine the noise impact on the development from activities and equipment associated with the light-industrial development located on the south side of the rail line. This noise and vibration impact assessment has been conducted with reference to NSW Department of Planning and Environment's (DPE's) Guideline, *Development near Rail Corridors and Busy Roads – Interim Guidelines* and the NSW Environment Protection Authority's (EPA's) Noise Policy for Industry (NPfI).

The Assessment was requested by Croese Building Pty Ltd to form part of and to support a Development Application to Maitland City Council (MCC), and to ensure that noise levels comply with the requirements of the EPA, DPE and MCC.

2 TECHNICAL REFERENCE / DOCUMENTS

AS/NZS 2107-2016 *"Acoustics-Recommended Design Sound Levels and Reverberation Times for Building Interiors"*.

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

State Rail Authority of NSW (1995) *"Rail related noise and vibration issues to consider in local environmental planning – development applications and building applications".*

Rail Infrastructure Corporation. (2003). *Interim Guidelines for Councils – Consideration of rail noise and vibration in the planning process.*

Rail Infrastructure Corporation. (2003). *Interim Guidelines for Applicants – Consideration of rail noise and vibration in the planning process.*

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

Plans supplied by Torren Bell Building Design, Rev E, dated 5 August 2025. Note that variations from the design supplied to us, may affect the acoustic recommendations.

ARTC (2020). *2020 Hunter Valley Corridor Capacity Strategy.*

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

3 EXISTING ACOUSTIC ENVIRONMENT

A background and ambient noise level survey was conducted using a Type 1, Svan 949 environmental noise logging monitor, installed at a nearby development, along Raymond Terrace Road. The selected location is representative of the acoustic environment in the receiver area and is considered an acceptable location for determination of the background noise in accordance with Fact Sheet B of the EPA's NPfI.

A summary of our logger results is shown in Table 1, including the Rating Background Levels (RBL's) for the day evening and night periods that have been calculated, according to the procedures described in the EPA's NPfI and by following the procedures and guidelines detailed in Australian Standard AS1055-1997, "Acoustics - Description and Measurement of Environmental Noise, Part 1 General Procedures". A complete set of logger results is not shown, but available on request.

Table 1: Summary of Noise Logger Results, 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	**40**	**37**	**35**	**--**	**--**	**--**
LAeq	**--**	**--**	**--**	**61**	**56**	**52**

4 CRITERIA

4.1 Road Traffic Noise (Internal Noise Levels)

State Environmental Planning Policy (Transport and Infrastructure) 2021 states the following:

2.120 Impact of road noise or vibration on non-road development
(1) This section applies to development for any of the following purposes that is on land in or adjacent to a road corridor for a freeway, a tollway or a transitway or any other road with an annual average daily traffic volume of more than 20,000 vehicles (based on the traffic volume data published on the website of the TfNSW) and that the consent authority considers is likely to be adversely affected by road noise or vibration—

(a) residential accommodation,
(b) a place of public worship,
(c) a hospital,
(d) an educational establishment or centre-based child care facility.

(2) Before determining a development application for development to which this clause applies, the consent authority must take into consideration any guidelines that are issued by the Planning Secretary for the purposes of this clause and published in the Gazette.

(3) If the development is for the purposes of a building for residential accommodation, the consent authority must not grant consent to the development unless it is satisfied that appropriate measures will be taken to ensure that the following LAeq levels are not exceeded:

(a) in any bedroom in the building - 35dB(A) at any time between 10.00 pm and 7.00 am,
(b) anywhere else in the residential accommodation (other than a garage, kitchen, bathroom or hallway) - 40dB(A) at any time.

(4) In this clause, freeway, tollway and transitway have the same meanings as they have in the *Roads Act 1993*.

Cognate performance requirements for residential developments can be sourced from DPE's *"Development near Rail Corridors and Busy Roads - Interim Guidelines*" (released in December 2008). Limits specified within the Policy, which are identical to SEPP (Transport and Infrastructure) 2021 will be used for the purpose of this assessment, 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

If criteria are exceeded by more than 10dB(A) with windows open, mechanical ventilation should be incorporated into the design of affected rooms.

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
RESIDENTIAL BUILDINGS	
Houses and apartments near major roads	
Living areas	35 – 45
Sleeping areas	35 – 40
Common areas (foyer, lobby)	45 – 50

The RMS describes criteria for the assessment of road traffic noise upon residential developments in their Environmental Noise Management Manual. Reference to Page 160 of the RTA's Manual, indicates that noise reduction measures for new developments should endeavour to meet the noise level targets set out in the EPA's Environmental Criteria for Road Traffic Noise (ECRTN). The ECRTN has been superceded by the NSW Road Noise Policy (RNP) which contains a number of criteria applied to a variety of road categories (freeway, arterial, sub-arterial and local roads) and situations (new, upgraded roads and new developments affected by road traffic). Table 2 shows the relevant category, taken from Table 3 of the RNP:

Table 2: - Extract from Table 3 of RNP Showing Relevant Criteria.

Road Category	Day	Night
New residential developments affected by noise from existing freeway/arterial /sub-arterial roads	60 LAeq,15hr	55 LAeq,9hr

Road categories are defined in the DRNP are as follows:

Freeway/arterial	Support major regional and inter-regional traffic movement. Freeways and motorways usually feature strict access control via grade separated interchanges.
Sub-arterial	Provide connection between arterial roads and local roads. May provide a support role to arterial roads during peak periods. May have been designed as local streets but can serve major traffic generators or non-local traffic functions. Previously designated as "collector" roads in ECRTN.
Local road	Provide vehicular access to abutting property and surrounding streets. Provide a network for the movement of pedestrians and cyclists, and enable socials interaction in a neighbourhood. Should connect, where practicable, only to sub-arterial roads.

Based on the above definitions Raymond Terrace Road is classified as an arterial road.

Table 3 summarises satisfactory internal noise levels for residences, used for the basis of this assessment.

Table 3: Internal Traffic Noise Level Criteria (Residential)

Location	Criteria – dB(A),Leq		Remarks
	Day	Night	
Sleeping areas	-	35	Windows closed
	-	45	Windows open
Other habitable rooms	40	-	Windows closed
	50	-	Windows open

Note that limits specified in the EPA documents are in agreement with those contained in AS/NZS 2107-2016 and DPE's Guideline. Therefore, the aim of the assessment is to ensure that the allowable noise levels shown above and in Table 3 are not (theoretically) exceeded within any habitable room due to road traffic noise. Transmission paths considered in the assessment are windows and doors with allowances made for shielding by balconies, intervening structures, etc.

4.2 Rail Traffic Noise (Internal Noise Levels)

4.2.1 Internal Noise Levels

State Environmental Planning Policy (Transport and Infrastructure) 2021 states the following:

2.100 Impact of rail noise or vibration on non-rail development
(1) This section applies to development for any of the following purposes that is on land in or adjacent to a rail corridor and that the consent authority considers is likely to be adversely affected by rail noise or vibration—

(a) residential accommodation,
(b) a place of public worship,
(c) a hospital,
(d) an educational establishment or centre-based child care facility.

(2) Before determining a development application for development to which this clause applies, the consent authority must take into consideration any guidelines that are issued by the Secretary for the purposes of this clause and published in the Gazette.

(3) If the development is for the purposes of residential accommodation, the consent authority must not grant consent to the development unless it is satisfied that appropriate measures will be taken to ensure that the following LAeq levels are not exceeded—

(a) in any bedroom in the residential accommodation—35 dB(A) at any time between 10.00 pm and 7.00 am,
(b) anywhere else in the residential accommodation (other than a garage, kitchen, bathroom or hallway)—40 dB(A) at any time.

Cognate performance requirements for residential developments can be sourced from DPE's *"Development near Rail Corridors and Busy Roads - Interim Guidelines*" (released in December 2008). Limits specified within the Policy, which are identical to SEPP (Infrastructure) 2007, will be used for the purpose of this assessment, 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

If criteria are exceeded by more than 10dB(A) with windows open, mechanical ventilation should be incorporated into the design of affected rooms.

4.2.2 External Noise Levels

DPE's. *"Development near Rail Corridors and Busy Roads - Interim Guidelines"*, does not specify limits for outdoor recreational areas associated with a dwelling. However, their Guideline, *"Interim Guideline for the Assessment of Noise from Rail Infrastructure Projects"* suggests a limit of **60dB(A),Leq**. We have therefore adopted this limit for assessment purposes.

4.3 Rail Traffic Vibration

4.3.1 Personal comfort

Various authorities have set maximum limits on allowable ground and building vibration in different circumstances and situations, all directed at personal comfort rather than building damage. This usually leads in virtually every situation to people who interpret the effects of a vibration to ultimately determine its acceptability. The most recent criteria for assessment of rail traffic vibration impacts upon occupants of a building are those contained in DPE's *"Development near Rail Corridors and Busy Roads - Interim Guidelines*". The Guideline recommends that the EPA's *Assessing Vibration: A Technical Guideline (2006)* should be used for the assessment of vibration. Limits set out in the Guideline are for vibration in buildings, and are directed at personal comfort for continuous, impulsive and intermittent vibrations. Table 4 shows the Vibration Dose Values for intermittent vibration activities such as train passbys, pile driving and use of vibrating rollers, taken from Table 2.4 of the Guideline, above which various degrees of adverse comment may be expected.

Table 4: Acceptable Vibration Dose Values ($m/s^{1.75}$)
Above which Degrees of Adverse Comment are Possible

Location	Day (7am-10pm)		Night (10pm-7am)	
	Preferred	Maximum	Preferred	Maximum
Critical areas #	0.10	0.20	0.10	0.20
Residences	0.20	0.40	0.13	0.26
Offices	0.40	0.80	0.40	0.80
Workshops	0.80	1.60	0.80	1.60

Hospital operating theatres, precision laboratories, etc.

4.3.2 Building Safety Criteria

Australian Standard AS2187.2-1993, dealing specifically with blasting vibration, specifies a maximum peak particle velocity of 10mm/sec for houses and a preferred limit of 5mm/sec where site specific studies have not been undertaken. German Standard DIN 4150 - 1986, Part 3 Page 2, specifies a maximum vibration velocity of 5 to 15 mm/sec in the foundations for dwellings and 3 to 8 mm/sec for historical and sensitive buildings, for the range 10 to 50Hz. British Standard BS 7385 Part 2, specifies a maximum vibration velocity of 15mm/sec at 4Hz increasing to 20mm/sec at 15Hz increasing to 50mm/sec at 40Hz and above, measured at the base of the building.

The above listed criteria vary from 3mm/sec up to 15mm/sec, therefore, the more conservative limit of **5mm/sec** will be adopted for the purposes of this assessment. It should be acknowledged, however, that intermittent ground vibration velocities at 5mm/sec are generally considered the threshold at which architectural (cosmetic) damage to normal dwellings may occur and velocities at 10mm/sec should not cause any significant structural damage, with the exception of the most fragile and brittle of buildings.

4.4 Light Industrial Development

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 aims to protect against progressively increasing noise in developing areas, based on the existing (Leq) noise level from industrial noise sources. 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, agricultural activity and some commercial/light industrial noise sources during the day, evening and night. Reference to Table 2.2 of the NPfI shows that all receiver areas are classified as rural. 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)

Table 5 below specifies the applicable project intrusiveness and amenity noise trigger levels for the proposed redevelopment.

Table 5: - Intrusiveness and Amenity Noise levels

Period	Intrusiveness Criteria	Amenity Criteria
Day	45 (40+5)	53 (55-5+3)
Evening	42 (37+5)	43 (45-5+3)
Night	40 (35+5)	38 (40-5+3)
Receiver Type: Suburban (See EPA's NPfI - Table 2.1)		

Project Noise Trigger Levels, determined as the more stringent of the intrusiveness criteria and the amenity / high traffic criteria, are as follows:

Day	**45dB LAeq,15 Minute**	7am to 6pm Mon to Sat or 8am to 6pm Sun and Pub Hol.
Evening	**42dB LAeq,15 Minute**	6pm to 10pm
Night	**38dB LAeq,15 Minute**	10pm to 7am Mon to Sat or 10pm to 8am Sun and Pub Hol.

4.4 Maximum Noise Level Event Assessment - Sleep Arousal

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 period.

5 METHODOLOGY

5.1 Road Traffic Noise

Attended road traffic noise level monitoring was conducted at an adjacent site, approximately 10 metres from the near lane of traffic on Raymond Terrace Road, during peak periods in March 2023. All measurements were conducted using a Svan 977 Sound Level Meter. This instrument is Class 1 accuracy, in accordance with the requirements of IEC 61672, 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. Table 6 shows a summary of monitoring results at the site.

Table 6: Measured Road Traffic Noise Levels, dB(A)

Time	Date	Lmax	Leq
08:15	9/03/23	81.5	61.5
23:00	9/03/23	80.0	56.0

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

5.2 Rail Traffic Noise

Reference to ARTC's Hunter Valley Corridor Capacity Strategy report 2013-2023 forecast that the frequency of coal trains using the rail line will be in the order of 149/day for the years 2014-2019. An additional 1-2 country ore/grain trains use the line each day, together with the occasional freight train. This equates to a maximum frequency of 155 trains per day, or up to 97 trains passing the site during the day (7am-10pm) and 58 trains during the night (10pm-7am).

Reference to Cityrail timetables indicates that up to 160 passenger trains may also pass the site each day. This equates to up to 100 passenger trains passing the site during the day (7am-10pm) and 60 passenger trains during the night (10pm-7am).

The predicted L(A)eq,1hr noise level for trains passing the site was calculated using the US EPA's Intermittent Traffic Noise calculation method. This method was adopted because train movements are not continuous, and have the same passby characteristic pattern as other vehicles. The mathematical formula used to calculate the Leq,T noise level for intermittent rail traffic noise is given in Equation 1 below:

$$L_{eq},T = L_b + 10\log\left[1 + \frac{ND}{T}\left(\frac{10^{(L\max - Lb)/10} - 1}{2.3} - \frac{(L_{\max} - L_b)}{10}\right)\right] \quad \text{...... } \textit{Equation 1}$$

Where L_b is background noise level, dB(A)
T is the time (min)
D is duration of noise of each train (min)
L_{MAX} is train noise, dB(A)
N is number of trains

Due to the expected increase in future rail traffic movements, site measurements of train passbys does not give a true indication of the rail traffic impact, therefore, noise levels of train passbys are based on the maximum carrying capacity of the rail line and measurements of conducted by Reverb Acoustics at the site. Typical average maximum train and background noise levels were measured at a nearby site approximately 20 metres from the rail line. The Lmax train noise levels used in Equation 1 are the maximum predicted noise levels produced at the facade from trains passing the site.

5.3 Rail Traffic Vibration

Typical vibration levels for train passbys were measured at nearby sites, at varying distances from the rail line and also sourced from our library of technical data for comparison purposes. Vibration levels of trains were measured with a Vibroch V801 Seismograph coupled to a triaxial geophone installed on hard packed earth. A sandbag was placed over the geophone during each measurement to ensure elevated readings were not recorded due to bouncing and movement, which may occur at higher vibration amplitudes. The unit is capable of measuring and storing peak Z-axis vibration velocities, as well as vibration in three directions simultaneously and gives peak velocity and acceleration on the x, y and z axes.

5.4 Received Noise - Light Industrial Development

The sound power level of each activity item of equipment associated with the nearby light-industrial development, 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 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:

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

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 AND DISCUSSION

6.1 Road Traffic Noise Levels (Impact on Development)

Applicable noise level metrics, namely, Leq (day peak) and Leq (night) are those calculated from our measurements at the site, following the methodology outlined in the EPA's RNP. A +2.5dB(A) facade adjustment must be applied, since our measurements were conducted in the free field.

Measured noise level + facade correction = received noise

Applying the above formula gives:

Day	61.5dB(A) + 2.5dB(A)	= **64.0dB(A) Leq, 15hr**	7am – 10pm
Night	56.0dB(A) + 2.5dB(A)	= **58.5dB(A) Leq, 9hr**	10pm – 7am

Shown below is a sample calculation detailing the procedure followed in order to calculate required glazing for Bedroom 2 of Proposed House 1, located on the north facade. The traffic noise level at the outer face of the glazing is calculated as follows,

Table 7: Sample Calculation - Traffic Impact at Bedroom 2 House 1

		Octave band Sound Pressure Levels, dB(A)							
Propagation calculation	**dB(A)**	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**
Facade traffic noise, Leq[1]	58	38	46	47	51	53	50	44	31
Architectural shielding[2]		-5	-5	-5	-5	-5	-5	-5	-5
Directivity/distance Correction[3]		-6	-6	-6	-6	-6	-6	-6	-6
Traffic noise at window	47	27	35	36	40	42	39	33	20

1. Measured noise level. 2. Intervening structures/enclosed balustrade. 3. Includes angle of incidence correction.

As the criterion for the Bedroom is 35dB(A), see Section 3.1, the required traffic noise reduction is *TNR* = 47-35 = 12dB(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 = 1.8m^2
S_f = Surface area of floor = 11.2m^2
h = Ceiling height, assumed to be 2.6m
T_{60} = Reverberation time, s
C = No. of components = 3 (glazing, wall, roof)

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 0.76s. Consequently, the value of 0.8s was used in equation 1.

Using the values listed above gives
TNA = 19dB(A) for the glazing

Substituting this value into the equation given in Clause 3.4.3.1 of AS3671 gives
$Rw = TNA + 6 \approx 25.$

As can be seen by the above results, the glazing must have a tested Rw25 rating. Based on typical laboratory performance data no special acoustic modifications will be required to comply with road traffic noise criteria. Therefore, standard construction will suffice. See further Sections of this report addressing rail traffic noise and vibration impacts on the development.

6.2 Rail Traffic Noise and Vibration (Impact on Development)

Measurements conducted by Reverb Acoustics at a nearby site reveal the following average maximum train noise passby levels at a distance of 15 metres from the rail line.

88dB(A),Lmax	Coal/Freight	79dB(A),Lmax	Passenger
81dB(A),Leq	Coal/Freight	74dB(A),Leq	Passenger

The following Table shows a sample calculation of the predicted rail traffic noise (LAeq,1hr) calculated to the facade of proposed House 3 in an exposed location, with allowance for topographical features and/or acoustic barriers.

Table 8: Received Train Noise Levels

	L(A)eq,15hr DAY	L(A)eq,9hr NIGHT
Rec Noise Level, Lmax.	89/80	89/80
Train frequency (coal/pass)	90/95	60/55
Average Bgd Noise, dB(A)	35	
Barrier loss #	6	6
Calculated train noise, Leq	**61.1**	**53.5**
Criteria (day/night)	**40 (internal)**	**35 (internal)**
Exceedance	**21.1**	**18.5**

1800mm high acoustic fence on south, west and east site boundaries

Theoretical results in the above table indicate that rail traffic noise impacting on the proposed residence may exceed DPE's limits. Therefore, in order to satisfy the requirements of their Guideline, acoustic modifications will need to be incorporated in the design of residence.

To put results into context, an L(A)eq,1hr impact of 21 implies that the facade of a residence must be capable of attenuating 21dB (i.e. 61dB(A),Leq(15r) – 40 = 21). Windows are typically the acoustic weak spot and standard 3-4mm glass will only achieve 15dB attenuation, if the window frames are fully sealed into the parent wall. Facades with an Leq(1hr) impact greater than 15dB(A), must have acoustical modifications incorporated in the design.

Attended vibration monitoring revealed that no perceptible vibration was recorded from train passbys at a distance greater than 20 metres from the rail line. Under certain circumstances, say if a large vibrating track maintenance machine was to pass the site and the resonant frequency of the ground happened to be an exact multiple of the driving frequency of the source, then higher vibration levels could be expected. However, it is doubtful that levels would reach a magnitude capable of causing any adverse comment or structural damage.

Vibration can be felt at levels well below those considered to cause structural damage. Complaints from occupiers are usually due to the belief that if vibration can be felt then it is likely to cause damage. Slamming of doors or footfall within a building can produce vibration levels above those produced by passing rail traffic. Passing trains will only produce loads, and therefore vibration, when their mass is accelerated, for example when hitting joins or deformities in rails. This emphasises the importance of properly maintained rail lines.

Vibration levels caused by trains passing the site are unlikely to cause direct failure, and it is considered the main action is triggering cracks in materials already subjected to stress or natural forces, however, as previously mentioned, this may also arise from internal forces such as slamming of doors. In our experience, vibration will only begin to trigger "natural cracking" at levels above 1mm/sec.

6.3 Nearby Noise Sources (Impact on Development)

The following Tables show sample calculations to predict noise levels from activities/equipment associated with nearby commercial/light-industrial developments, propagated to House 3. All calculations are based on distances scaled from plans supplied by Torren Bell Building Design and through measurement during our site visits.

Table 9: Received Noise – Nearby Light-Industrial Development, dB(A),Leq
House 3 West Facade

Item/Activity	Lw dB(A)	Dist to Rec (m)	Duration (sec)	No. of Events	Barrier Loss/Dir	Received dB(A)
Cars in Carpark (S1)	92	90	10	10	8	37
Roof-Top Mech plant (S2)	80	70	900	1	2	33
Workshop Activities (S3)	82	105	900	1	6	28
Truck Movements (S4)	102	80	30	1	6	35
Roof-Top Exhaust Plant (S5)	86	110	900	1	2	35
				Combined		**40**
				Criteria (D/E/N)		**45/42/38**
				Impact		**0/0/2**

Table 10: Received Noise – Short Duration Events dB(A),Lmax
Nearby Light-Industrial Development at House 3 South Facade

Location/Source	Cars (S1)	Mech (S2)	W'shop (S3)	Trucks (S4)	Exhaust (S5)
Lw, db(A)	92	80	82	102	86
Distance (m)	90	70	105	80	110
Received dB(A),Lmax	**37**	**33**	**28**	**50**	**35**
Criteria	**52dB(A),Lmax**				
Impact	**-**	**-**	**-**	**-**	**-**

As can be seen by the above results, noise from nearby commercial/light industrial development may exceed the criteria during the night at House 3. However, acoustic modifications specified to reduce rail traffic noise to acceptable levels are more stringent than those required to reduce industrial noise impacts. Therefore, no additional noise control modifications are required to reduce external noise from nearby commercial/light-industrial development, subject to recommendations detailed in Section 7.

7 RECOMMENDED NOISE CONTROL

7.1 Glazing – Windows/Sliding Doors

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.

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 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 11: Glazing Schedule

Facade	Room	Required Rw Must Achieve for Compliance	Typical Glazing System (Not for Specification)
HOUSE 3			
South	Bedroom W304	**33**	Type C
	Garage W303	**-**	No acoustic requirement
West	Ensuite W302	**28**	Type B
North	Bedroom W301	**29**	Type B or C
	Entry D301	**-**	No acoustic requirement
	Dining W309	**27**	Type B
	Living W308	**27**	Type B
East	Study W307	**30**	Type B or C
	Bath W306	**28**	Type B
	Bedroom W305	**31**	Type C
HOUSE 2			
South	Bedroom W204	**30**	Type B or C
	Garage W203	**-**	No acoustic requirement
West	Ensuite W202	**-**	No acoustic requirement
North	All	**-**	No acoustic requirement
East	Study W207	**27**	Type B
	Bath W206	**-**	No acoustic requirement
	Bedroom W205	**28**	Type B
HOUSE 1			
All	All	**-**	No acoustic requirement

7.2 Walls

7.2.1 Masonry, brick veneer construction is acceptable, internally lined with 10mm plasterboard, plus R2/S2 cavity insulation.

7.2.2 Where light-weight cladding is installed (i.e. Aluminium Composite Panel, Axon, Shadowclad, Weathertex, or similar) internal lining to rooms must be minimum 13mm plasterboard, plus R2/S2 cavity insulation.

77.3 Roof/Ceiling

7.3.1 Construction is to consist of Colorbond with a 30-40mm anticon 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 may be omitted). Close off eaves gaps with 2 layers S3/R3 insulation in ceiling void, tightly packed at the building perimeter at 600mm width, alternatively 1 layer R4.1 batts will suffice. All ceilings are to consist of 1 layer 10-13mm plasterboard.

7.3.2 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).

7.4 Ventilation

7.4.1 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, although, 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).

Recent studies have conclusively proven that a typical open window will reduce noise by 15dB(A) or more when contained within a masonry structure with no exposed flooring.

Table 12 shows road traffic design criteria at exposed facades and the predicted internal noise levels with windows open, to determine compliance.

Table 12: Internal Noise Assessment – Windows Open

Time Period	Predicted Traffic Noise level L(A)eq		Internal Criteria L(A)eq	Compliant YES/NO
	External	Internal		
Day	61	46	50	YES
Night	54	39	45	YES

Results in the above Table predict that internal traffic noise levels will comply with the requirements of the DPE Guideline. Furthermore, Part 10.6 of the ABCB Housing Provisions allows natural ventilation to be provided by an adjoining room that satisfies the internal traffic noise criteria, providing the adjoining room is not a sanitary compartment. Adjoining rooms satisfy this requirement. Therefore, artificial means of natural ventilation is not mandatory.

7.5 Acoustic Fence

7.5.1 An acoustic fence 1800mm above FGL is to be erected along the south, west and east site boundaries. Acceptable construction consists of Colorbond or lapped and capped timber. 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.

Note that in situation where existing fences on boundaries are constructed from the above-mentioned materials and also achieve the required 1800mm above FGL, replacement of existing fences will not be required.

7.6 External Noise Levels

7.6.1 External noise levels averaged over the day and night assessment periods at exposed facades will be below 55dB(A) within alfresco areas associated with each residence. This level is the adopted criterion of 60dB(A),Leq, therefore no special acoustic modifications will be required for proposed alfresco areas.

8 CONCLUSION

A noise impact assessment of road and rail traffic noise and vibration impacting on a proposed residential development at Lot 10 Section 48 DP.758274, No.45 Raymond Terrace Road, East Maitland, has been completed. Results show that the site is satisfactory for the intended purpose, providing our modifications are incorporated into the design. Recommendations to reduce internal noise levels to achieve the desired noise reduction and satisfy the requirements of DPE, the EPA and MCC have been made regarding roof/ceiling and wall construction, sealing of voids, minimum glazing requirements, etc. The recommended glazing shown in Tables 11 should be used as a guide only. The supplier of the window/door must be able to provide evidence that the complete system will achieve the specified Rw performance. Do not simply install our suggested glass type in a standard window frame.

The adopted train passby noise levels represent the average maximum noise level from train passbys. Therefore, individual train passbys may at times produce higher noise levels than those adopted. No significant increase in maximum received noise levels are expected in the future, as locomotive and rolling stock manufacturers are continuously developing noise reduction strategies addressing engine, exhaust and wheel noise. We conclude, with a high degree of confidence that vibration levels at the expected magnitudes will not cause direct structural damage or cause undue annoyance to the occupants. We suspect that one or more natural forces, as discussed in Section 6, will be the cause of any future damage. It should be noted, however, that vibration may be noticed on occasion while a person is standing or seated quietly. Other noticeable indicators may be rattling of window frames and ornaments, and possible visible movement of hanging pictures, etc.

In conclusion, providing the recommendations given in this report are implemented, road traffic noise and rail traffic noise and vibration levels will be compliant with DPE, EPA and MCC requirements. We therefore see no acoustic reason why the proposal should be denied.

Steve Brady M.A.S.A. A.A.A.S.
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	Weighted Sound Reduction Index. The ability of a partition to attenuate sound, in dB. Given as a single number representation.
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).
Lmax	The maximum level for the measurement period (usually in dBA)