Project No: 232268R

Noise Assessment
Proposed Residential Subdivision
212 - 216 Queen Street, Muswellbrook, NSW

Prepared for:

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CONTENTS

1.0 - INTRODUCTION

This report presents the results, findings and recommendations arising from an acoustic assessment for a proposed residential subdivision of Stages 6 and 7 of the Northview Estate, 212 – 216 Queen Street, Muswellbrook, NSW. The subdivision site is shown in **Figure 1**.

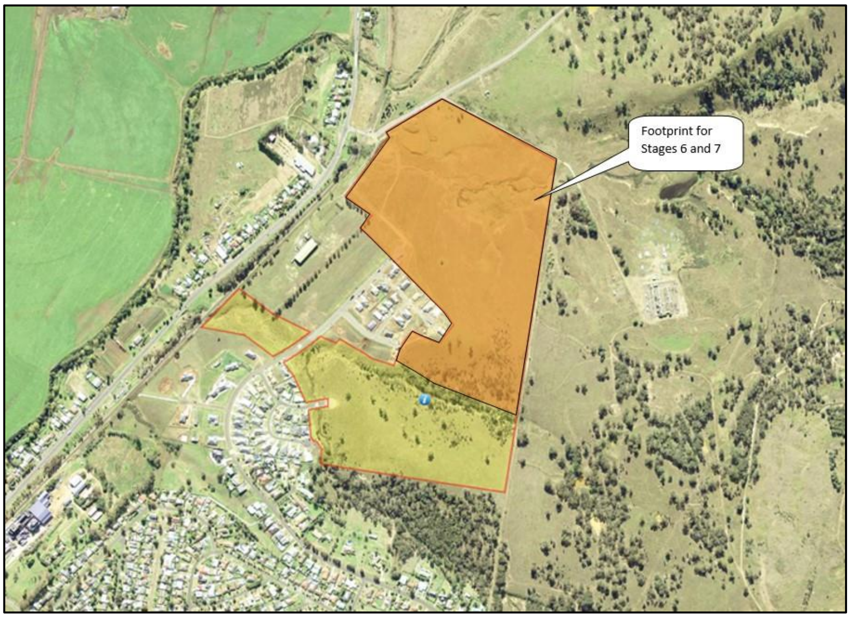

Figure 1 – Site Location

The site is close to the Main North Rail Line (MNRL) and the existing alignment of the New England Highway (NEH). It is also adjacent to the future Muswellbrook bypass road which will pass just to the north.

The investigation is to support a Development Application to Muswellbrook Shire Council (MSC) for the subdivision.

2.0 - TERMS AND DEFINITIONS

Table 1 contains the definitions of commonly used acoustical terms and is presented as an aid to understanding this report.

TABLE 1 DEFINITION OF ACOUSTICAL TERMS	
Term	Definition
dB(A)	The quantitative measure of sound heard by the human ear, measured by the A-Scale Weighting Network of a sound level meter expressed in decibels (dB).
SPL	Sound Pressure Level. The incremental variation of sound pressure above and below atmospheric pressure and expressed in decibels. The human ear responds to pressure fluctuations, resulting in sound being heard.
Lw	Sound Power Level radiated by a noise source per unit time re 1pW.
STL	Sound Transmission Loss. The ability of a partition to attenuate sound, in dB.
Leq	Equivalent Continuous Noise Level - taking into account the fluctuations of noise over time. The time-varying level is computed to give an equivalent dB(A) level that is equal to the energy content and time period.
L1	Average Peak Noise Level - the level exceeded for 1% of the monitoring period.
L10	Average Maximum Noise Level - the level exceeded for 10% of the monitoring period.
L90	Average Minimum Noise Level - the level exceeded for 90% of the monitoring period and recognised as the Background Noise Level. In this instance, the L90 percentile level is representative of the noise level generated by the surrounds of the residential area.

3.0 – NOISE CRITERIA

As described above, parts of the proposed subdivision site are near the MNRL and the NEH. The future Muswellbrook Bypass Road will also pass just to the north of Stage 7 of the development.

Criteria for the assessment of potential noise impacts have, therefore, been adopted from the NSW Department of Planning publication *"Development near Rail Corridors and Busy Roads - Interim Guideline" (Guideline)* and the "*NSW Road Noise Policy"* (RNP). These publications outline the relevant noise planning levels that are detailed in **Table 2**. These noise criteria apply to internal areas of a residence only.

TABLE 2 NOISE CRITERIA		
Type of Occupancy	**Time Period**	**Internal Noise Level**
Sleeping areas (bedrooms)	Night (10pm to 7am)	35 dB(A) Leq (9 hr)
Other habitable rooms (excluding garages, kitchens, bathrooms and hallways)	At any time	40 dB(A) Leq (15 hr)

The Guideline advises that land use developers must meet the internal noise goals in the Infrastructure SEPP (Department of Planning NSW, 2007).

The Infrastructure SEPP is aimed at facilitating the effective delivery of infrastructure across NSW. Key objectives of this planning policy were to:

- protect the safety and integrity of key transport infrastructure from adjacent development; and
- ensure that adjacent development achieves an appropriate acoustic amenity by meeting the internal noise criteria specified in the Infrastructure SEPP.

The Infrastructure SEPP states that if the development is for the purpose of a building for residential use, the consent authority must be satisfied that appropriate measures will be taken to ensure that the relevant Leq levels are not exceeded.

These criteria originated from the Rail Infrastructure Corporation (RIC) publication "Consideration of Rail Noise and Vibration in the Planning Process" (2003) where it is explicit that the criteria apply with windows and doors closed.

The Guideline also states that "if internal noise levels with windows and doors open exceed the criteria by more than 10 dB(A), the design of ventilation for these rooms should be such that occupants can leave windows closed, if they so desire, and also meet the ventilation requirements of the Building Code of Australia."

4.0 - VIBRATION CRITERIA

Floor vibration levels in habitable rooms should comply with the criteria in the EPA's guideline "*Assessing vibration: a technical guideline*" (Vibration Guideline). The Vibration Guideline defines the vibration associated with events such as train passbys as Intermittent.

The Vibration Guideline indicates that the assessment of intermittent vibration should be done using a vibration dose value (VDV), which is defines as the fourth root interval with respect to time of the acceleration after it has been weighted. The VDV is fully described in British

Standard BS 6472: 1992 "*Evaluation of Human Exposure to Vibration in Buildings (1Hz to 80Hz)*".

Table 3 shows the acceptable VDV's for intermittent vibration taken from Table 2.4 of the Vibration Guideline.

TABLE 3 ACCEPTABLE VDV's FOR INTERMITTENT VIBRATION ($m/s^{1.75}$)		
Area, Time	Preferred Value	Maximum Value
Residential – Day	0.20	0.40
Residential – Night	0.13	0.26

Day time is between 7am and 10pm

The calculation of the individual vibration dose values (VDVi) are based on the equations detailed in Section 2.4.1 of the Vibration Guideline. The calculations take into account vibration level and duration.

In addition to this **Table 4** presents a summary of likely human perception to various vibration levels.

TABLE 4 HUMAN PERCEPTION OF VIBRATION	
Vibration Levels, mm/s	**Likely Perception**
0.15	Perception threshold
0.35	Barely noticeable
1.0	Noticeable
2.2	Easily noticeable
6.0	Strongly noticeable
14.0	Very strongly noticeable
Ref: German Standard DIN 4150 (1986)	

5.0 - NOISE ASSESSMENT

The location of the site in relation to the MNRL, NEH and the future bypass road is shown in **Figure 2**.

On the figure, the approximate location of the bypass road has been drawn indicatively as a red line. On the figure, the NEH cuts across the top left hand corner of the page and the MNRL lies to the south east and parallel to that road.

Figure 2 – Existing and Future Roads

The site is, therefore potentially impacted by noise and vibration from trains travelling on the (MNRL) and from vehicles travelling on the NEH and the future bypass.

5.1 NOISE MEASUREMENTS

To determine potential rail noise and vibration impacts a series of noise and vibration measurements of train pass bys were made near the north western boundary of the site on Thursday 16th March, 2023. Further noise measurements were made at other locations on the same day.

The measurement locations are shown on **Figure 3**.

The data from these measurements were supplemented with data from measurements made near the site previously by Spectrum Acoustics. Previous measurements were made on Wednesday 15th December 2021 at Lot 55 Queen Street. The location of this measurement is also shown on Figure 3.

All of the noise measurements were made using a Bruel & Kjaer Type 2250 precision sound level analyser. This instrument has Type 1 characteristics as defined in *AS1259.2-1990 "Acoustics – Sound Level Meters – Integrating – Averaging"*. Calibration of the sound level meter was carried out before and after the measurements using a Bruel & Kjaer Type 4231 calibrator.

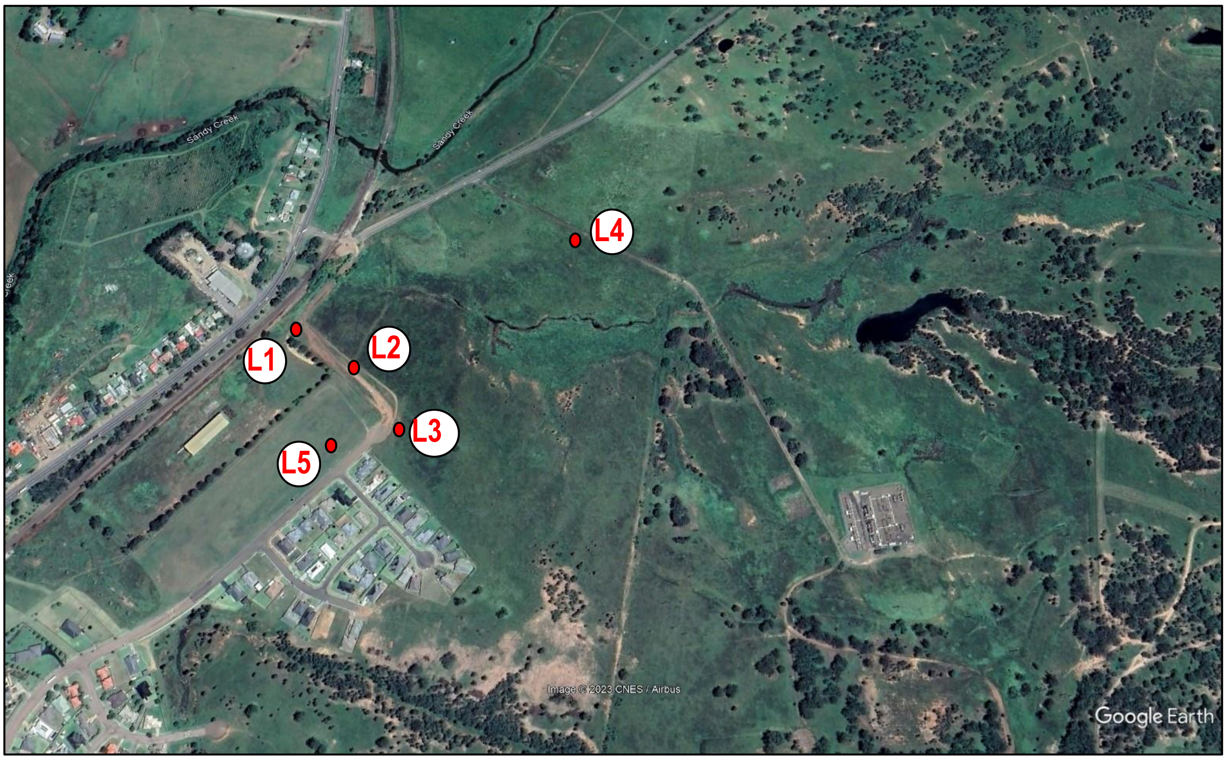

Figure 3 – Noise & Vibration Monitoring Locations

The site is at the northern edge of the township of Muswellbrook. The nature of train movements here is that they are typically travelling at low speeds. For freight and coal trains, the noise from diesel engines is a significant contributor to received noise, particularly as these trains travel up grade. The engine noise is present relatively briefly as the train moves past a reception point. The rattle from empty carriages and occasional wheel squeal also contribute to noise emissions.

The site is in close to the level crossing at Sandy Creek Road and, therefore, freight and coal trains are unlikely to stop in this vicinity so "bunching" noise from couplers impacting on each other etc. would not be a regular feature of the train noise.

Trains, typically, activate their signal horn before entering the level crossing.

At location L1 the measurements were made of three trains passing the site between approximately 8:00 am and 11.00 am. The measurements captured the noise from two coal trains and one freight train.

At location L2 the measurement was made of one freight train passing the site at 11:15 am.

At locations L3 and L4 the measurements were made of traffic noise only.

At location number 5 the measurements were made of four trains passing the site between approximately 1:30 am and 4.00 am (in December 2021). The measurements captured the noise from three coal trains and one freight train.

The worst case noise level for trains passing each location was used to calculate the Leq (1hr) level for determining potential impacts at future receivers.

For example, at L1 the worst case noise from a train was 75 dB(A) for 2 minutes and 30 seconds for a coal train.

Coal and freight train movements along the line are dependent upon many factors and schedules may vary for different days and times of year. For the calculation of a conservative scenario the movement of three coal trains in an hour at night was assessed as being a worst case.

This equates to a night time received noise level for the trains, at location 1, of **66 dB(A) Leq (1 hour)**.

Published timetables for passenger train movements along the line at this point show that there are four passenger trains per day. Noise from passenger trains will be at significantly lower levels and shorter duration than the freight or coal trains and will not add to the overall Leq (1hr) noise level.

The Leq (1hr) train noise levels for each location, calculated from the site measurements as per the discussion above are shown in **Table 5**.

TABLE 5
TRAIN NOISE LEVELS dB(A)

Location	Leq (1hr)
L1	66
L2	60
L3	55

Large parts of the site also have line of sight to the New England Highway. This road carries a mix of light and heavy vehicle traffic, but at night the mix is dominated by heavy vehicles. The Leq noise levels of the road traffic were also measured during the train noise monitoring programmes.

At each location, the measured existing road traffic noise was more than 10 dB(A) lower than the calculated Leq (1hr) noise from trains. Any consideration of noise control to attenuate the train noise will, therefore, more than adequately attenuate the existing road traffic noise.

Traffic flow on the current alignment of the NEH will decrease significantly upon completion of the Muswellbrook Bypass Road.

The approximate location of the future Muswellbrook Bypass Road is shown in Figure 2. The potential for noise impacts from that bypass road was modelled in the noise and vibration assessment undertaken by AECOM in 2021 ("*Noise and Vibration Technical Report – Muswellbrook Bypass Construction and Operation Noise and Vibration Assessment"* by AECOM Australia Job No. 60619756, dated 1 - Sept – 21 (AECOM)).

AECOM developed a computer noise model of the bypass road. The model was used to produce future predicted contours of traffic noise levels based on projected traffic flows for 2037.

The relevant noise contours from AECOM are reproduced below. **Figure 4** shows the modelled noise contours for day time and **Figure 5** shows the modelled noise contours for night time.

Figure 4 – Modelled Daytime Noise Contours – Bypass Road

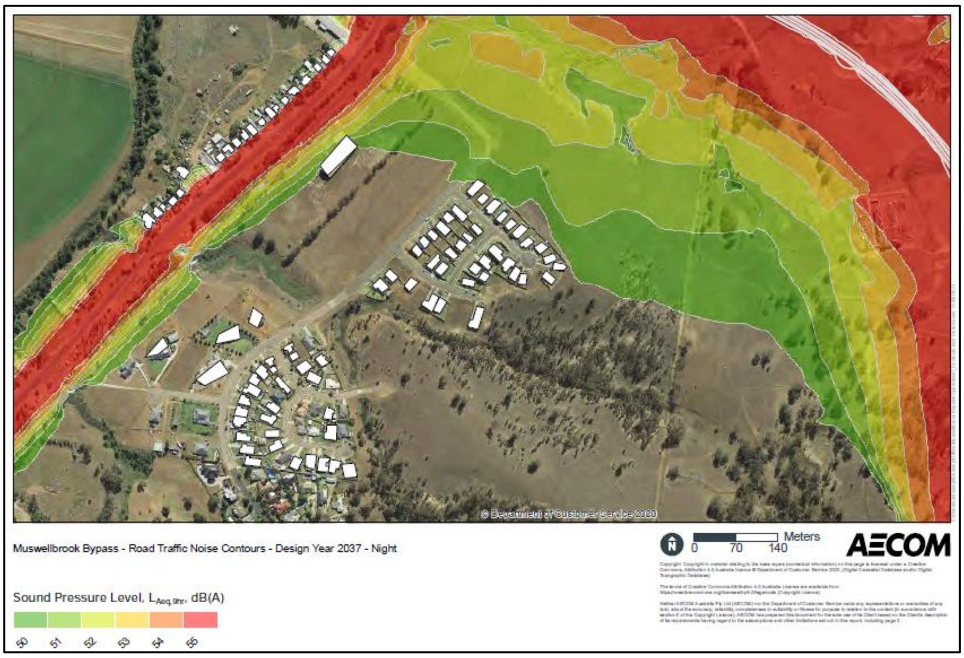

Figure 5 – Modelled Night-time Noise Contours – Bypass Road

6.0 - RESULTS AND DISCUSSION

6.1 Predicted Noise Levels

The current application is for a residential subdivision. A proposed Lot Layout for the subdivision is shown in **Figure 6** (the approximate location of the MNRL is shown as a dashed line).

The noise contours in Figures 4 and 5 show that the 55 dB(A) contour is close to the northern parts of the proposed subdivision. The lot layout shows that there are five large lots which extend to the northern boundary of the site. The building envelopes for these lots will be confined to the southern sections of the lots.

The approximate location of the Leq (1hr) train noise level contours, as extrapolated from the site measurements, and calculated per the discussion in Section 5.1, are also shown on Figure 6.

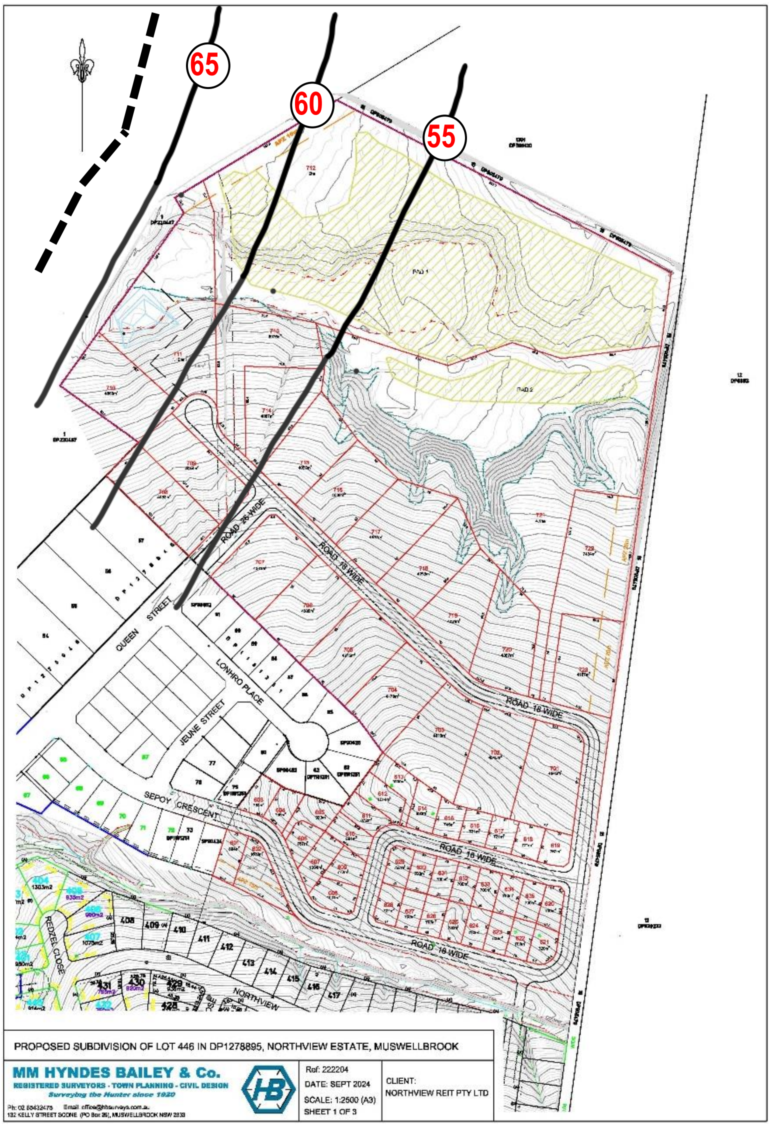

Figure 6 – Proposed Lot Layout and Train Noise Contours

At the time of this assessment there were no defined building envelopes in the subdivision. It is anticipated that individual dwelling designs will be lodged to council under the local government regulations in the future. A generic approach to possible noise control options is, therefore, taken here.

Based on the train noise measurements made on site and, assuming standard ground conditions and no acoustic barriers, the predicted worst case train noise level at the boundary of the closest lots to the rail line would be approximately 65 dB(A) Leq (1hr).

Considering the location of the roads, and the topography of the lots, it is most likely that any residences will be located towards the eastern end of the lots near the rail line. Noise levels at the most affected facades of such houses would be around 62 to 63 dB(A) Leq (1hr).

The Environmental Noise Management Manual (ENMM) details that the facade of a single glazed, light framed house, with the windows closed, will typically attenuate up to 20 dB(A) of traffic noise (note with the windows open it will attenuate up to 10 dB(A)). The acoustic weak point in a typical residence is through glazing (windows and/or glass doors) with line of sight to the noise source.

This would indicate that an external noise level of 63 dB(A) Leq (1hr) will result in internal noise levels of about 43 dB(A) Leq (1hr), in a typical residence with windows closed.

This implies that the internal noise levels would exceed the adopted noise criterion by approximately 3 dB(A) for living areas and 8 dB(A) for sleeping areas which have windows in facades with full line of sight to the rail line.

In such circumstance, noise control would need to be applied in order to achieve compliance with the adopted internal noise criteria in relation to the train noise.

Based on a “typical” house design the necessary noise reduction could usually be achieved with standard house design and the inclusion of windows to bedrooms (facing the rail line) with Rw up to about 33 to 35 (say 6.5mm “Hush” glass or acoustically similar) and windows to living spaces (facing the rail line) with Rw up to about 30 to 32 (say 6.38mm laminated glass).

Standard wall and roof/ceiling design would, typically, be sufficient to attenuate the train noise at this level.

Note that the comments above are indicative only and the actual noise control requirements would need to be calculated based on specific analysis of final house design.

At locations further removed from the rail line the received train noise levels would be lower than those indicated above and the requirement for noise control would be lessened.

The noise contours shown in Figure 5 indicate that the future night time traffic noise might be up to about 53 to 54 dB(A) Leq (9hr) at the most potentially affected future residences.

Similar assumptions to those detailed above show that internal noise levels at these residences, and with windows in facades with full line of sight to the road, would be lower than the adopted noise criterion for sleeping areas during the night.

Based on the contours in Figure 4 the internal noise levels during the day time would also be lower than the adopted noise criterion.

This would imply that standard building design would be adequate to achieve the adopted internal noise criteria in relation to the road traffic noise.

6.2 General Acoustic Guidelines

The following section provides comments in relation to the application of good acoustic principles into residential design to optimise the acoustic amenity of future occupants.

Figure 7 is a reproduction of Figure B2 from the Guideline showing a hypothetical situation of a dwelling adjacent to a busy road (for the current assessment a rail line may be substituted for the road). Acoustic consultants often use the Guideline (and Figure B2 specifically) in recommending if and what architectural modifications to achieve the recommended noise levels.

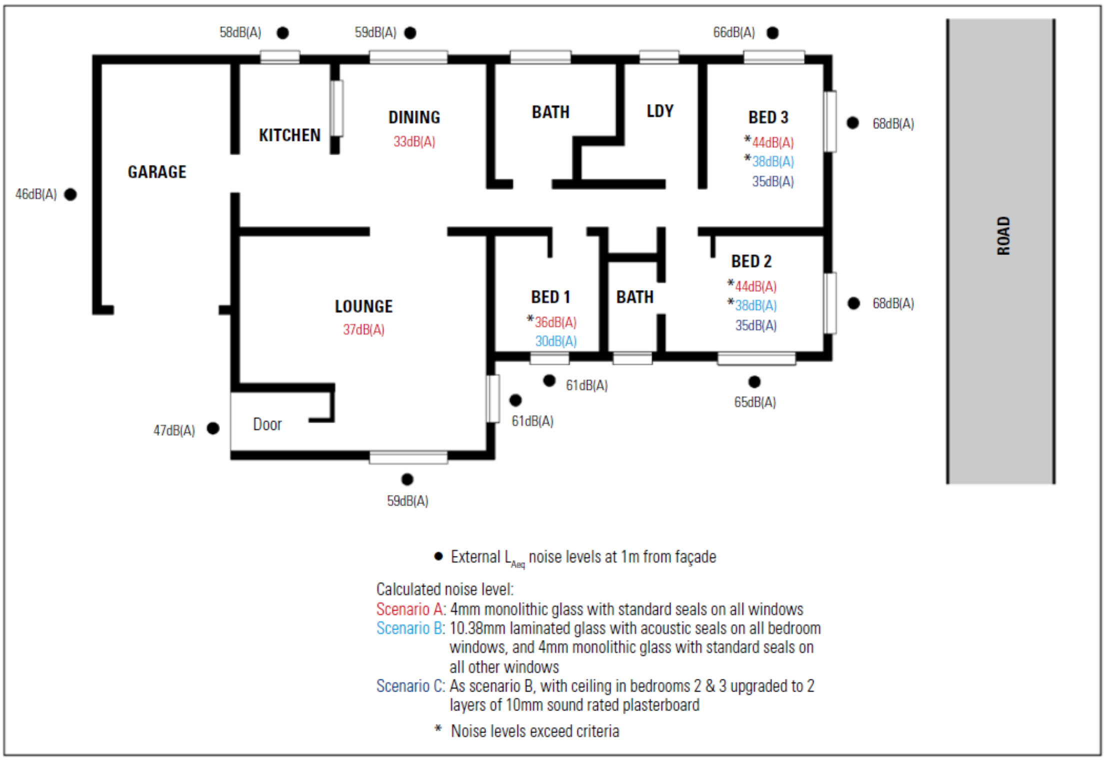

Figure 7. Traffic noise reduction for various construction types.

Figure 7 shows that standard building construction with 4mm glass in the windows, for the floor plan as shown, provides up to 24dB reduction in traffic noise. Reference to Figure 7 shows that, for the proposed subdivision, a reduction of the required magnitude would be readily achieved using standard construction techniques.

6.3 Building Treatments

The acoustic treatment for any residence requires specific analysis based on floor plans and the surface area of the various building elements which are potentially exposed to a noise source.

In general terms, however, the Guideline indicates that where a new residential development is planned to occur near a busy road or rail line, appropriate building design, layout and construction techniques should be applied to minimise noise intrusion and provide suitable internal noise levels for sleeping and other uses.

The following sections provide some general information in relation to incorporating sound acoustic practises in house design.

6.3.1 Walls

Typically walls are not a significant noise transmission path. Walls of lightweight construction (e.g. weatherboard, compressed fibrous cement sheeting, timber slats, timber sheeting etc.) provide less noise insulation than masonry walls to low frequency noise. At particularly noisy sites lightweight cladding should include adequate acoustic insulation in the wall cavity.

Whether the walls are masonry or of light-weight construction, the wall's insulation capacity will be weakened if it contains ventilators, doors or windows of a lesser insulation capacity. To improve insulation response, ventilators can be treated with sound-absorbing material or located on walls which are not directly exposed to the external noise.

6.3.2 Windows

In acoustic terms windows are one of the weakest parts of a facade. An open or acoustically weak window will severely negate the effect of an acoustically strong facade. Whenever windows are incorporated in a building design their effect on acoustic performance of the building facade should be considered. Reducing the number and/or glazed area of windows and/or appropriately positioning them away from the road can be beneficial.

Proper sealing is crucial to the success of noise reduction of windows. To prevent sound leaks, windows should be caulked (with a flexible sealant such as mastic or silicone) thoroughly from the inside, and outside between the wall opening and the window frame. Usually the best option is use one of the many commercially available double glazed or laminated windows with acoustic seals.

Laminated glass is usually cheaper and easier to install than double glazing and is relatively effective in reducing moderate to high levels of traffic noise as indicated previously in this report. Double-glazing: is cost-effective when a very high level of noise attenuation is required. When using double-glazing, the wider the air space between the panes the higher the insulation.

Other factors influencing the acoustic performance of windows include:

- Window seals: ensure windows are fitted with high quality acoustic seals and close windows to reduce internal noises levels.

- Reduction in window size, recognising that reducing the proportion of window to wall size from 50% to 25% reduces noise by only 3 decibels.

- Increase the glass thickness: the thicker the glass the more noise resistance it provides. However, glass thickness is only practical up to a point before the costs exceed the acoustic benefits of increasing glass thickness.

- The presence of absorbent materials on the window reveals will improve noise insulation.

- Window frames and their installation in wall openings must be air tight and operable. Windows must incorporate acoustic seals for optimal noise insulation.

In summary, it is considered that, based on the measured and calculated noise adequate internal noise levels can be achieved within the proposed residences using a combination of reasonable and feasible noise control options.

7.0 - VIBRATION ASSESSMENT

Rail vibration screening tests from Section 3.5.1 of the Guideline are shown in **Figure 8**.

The lot layout shows that the closest facade of any proposed residence would be approximately 50m from the rail line. Figure 8 shows that the zone requiring assessment of rail vibration impacts for single residences ends at 25m from the rail line, which indicates that there unlikely to be any rail vibration impacts at any residences in the subdivision.

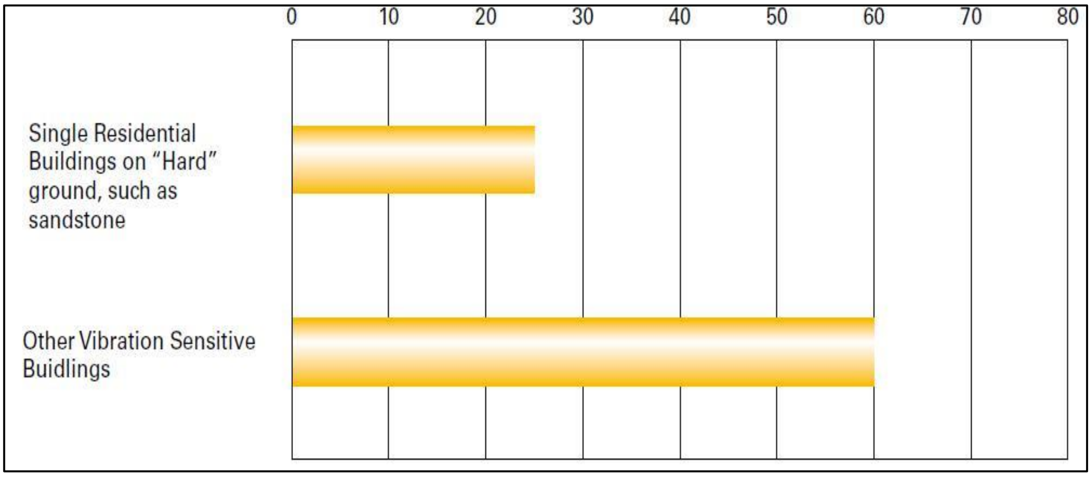

Figure 8. Rail Vibration Screening Test

To confirm the low potential for adverse vibration impacts, vibration levels from three train pass bys were measured at the same site as for the attended noise measurements at location L1, as shown on Figure 2. This location is approximately 30m from the MNRL.

The vibration meter was set to continuously measure vibration in each of the x, y and z planes. The maximum vibration event recorded was at 0.42 mm/sec and was the result of a coal train passing by.

The calculation of the individual vibration dose values (VDVi) is based on the equations detailed in Section 2.4.1 of the Guideline. The calculations take into account vibration level and duration. The average pass by time for the coal and freight trains was 2 minutes.

The vibration level during each train pass by is not consistent for the entire duration as it is typically characterised by a brief peak followed by a period of lesser vibration.

Based on the site measurements, a theoretical scenario was considered where two coal trains passed the site with a vibration level of 0.42 mm/sec (maximum measured) for an average of 120 seconds and a freight train for 80 seconds with the results shown in **Table 6**.

TABLE 6
MEASURED TRAIN VIBRATION LEVELS and CALCULATED VIBRATION DOSE

Type	Duration (sec)	PPV (Lmax mm/s)	ai	VDVi
Coal	120	0.42	0.07	0.07
Coal	120	0.42	0.07	0.07
Freight	80	0.42	0.06	0.06
				VDV 0.09

The results in Table 6 show that the total vibration dose from the assessed worst case pass bys does not exceed the preferred value for night time for a residence. The VDV is less than the preferred value for day time.

The resultant VDV is significantly influenced by the vibration level and duration of the pass bys of the freight train. This is due to the assumed duration of the vibration event. In reality the vibration dose will be lower than that shown in Table 6 as the worst case vibration level only occurs briefly as the locos of the train pass.

In addition to this, the closest residence will be further from the MNRL than the measurement location. As a rule of thumb, in most typical ground conditions, the decrease in vibration levels is inversely proportional to distance. That is, at double the distance from the rail line, the vibration level would be halved, so from 30m (measurement location) to 50m (possible residence facade) the vibration level would be almost half of that measured.

As most people do not readily notice vibration levels of less than 0.5 mm/s, future residents at the proposed dwellings are unlikely to notice vibration caused by train pass bys and no further assessment of vibration is considered warranted.

8.0 - CONCLUSION

An acoustical assessment has been conducted into the potential noise and vibration impacts at a proposed residential subdivision of Stages 6 and 7 of the Northview Estate, 212 – 216 Queen Street, Muswellbrook, NSW.

The results of site noise measurements and theoretical calculations have shown elevated noise from the trains and road traffic has the potential to create adverse impacts at some sections of the subject land.

The assessment has shown, however, that relatively common noise control treatments and options can be employed to achieve an adequate acoustic amenity at any future residences that may be constructed in the area. A summary of general recommendations for architectural treatments (upgraded glazing to bedrooms and living rooms with windows facing the rail line) is shown in **Table 7**.

TABLE 7
LOTS REQUIRING APGRADED GLAZING

Lot #	Minimum Rw	Typical glazing
708	30	5mm toughened / 6.38mm laminate
709	30	5mm toughened / 6.38mm laminate
710	33	6.5mm Vlam Hush laminate
711	33	6.5mm Vlam Hush laminate
712	30	5mm toughened / 6.38mm laminate
713	30	5mm toughened / 6.38mm laminate

There are no potential vibration impacts.

Based on these findings, we see no acoustic reason why the proposed subdivision should not be approved.