Lloyd George Acoustics
PO Box 717
Hillarys WA 6923
T: 9401 7770 F:9300 4199
E: terry@lgacoustics.com.au W: www.lgacoustics.com.au

Transportation Noise Assessment

Meadowbrook Estate Lifestyle Village, Boyanup

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Prepared for:
Preston Green Pty Ltd

Member Firm of Association of Australian Acoustical Consultants

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Lloyd George Acoustics Pty Ltd

ABN: 79 125 812 544

PO Box 717
Hillarys WA 6923

T: 9300 4188 / 9401 7770
F: 9300 4199

Contacts	Daniel Lloyd	Terry George	Mike Cake	Matt Moyle
E:	daniel@lgacoustics.com.au	terry@lgacoustics.com.au	mike@lgacoustics.com.au	matt@lgacoustics.com.au
M:	0439 032 844	0400 414 197	0438 201 071	0412 611 330

Prepared By:	Terry George 
Position:	Project Director
Date:	6 September 2014

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1 INTRODUCTION

It is proposed to construct a lifestyle village in Boyanup, located as shown below in *Figure 1-1*. The site will comprise of a number of modular type buildings with some located to the west, in close proximity to South Western Highway. As such, this report considers the impact from road traffic noise to the site and provides recommendations to comply with relevant criteria in Western Australia.

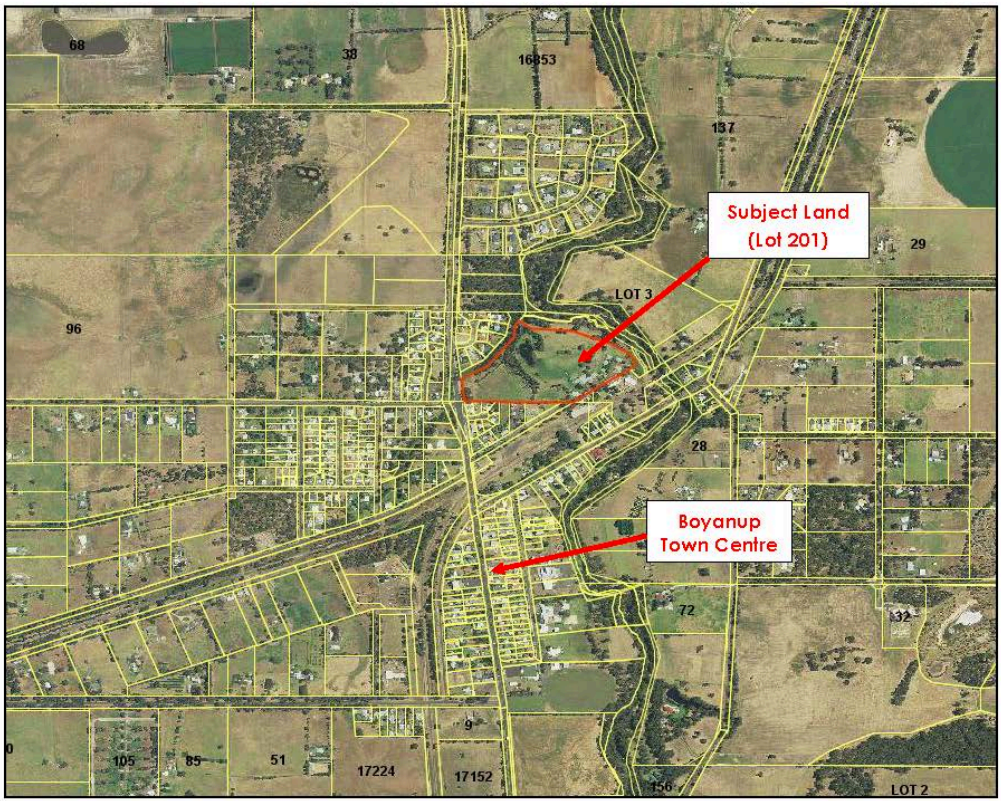

Figure 1-1 Site Locality

In addition to the road traffic noise, there is an existing freight line to the south of the site, which is separated from the site by a number of buildings. Advice from Public Transport Authority (PTA) and Brookfield Rail (BR) is that there are no trains between Picton and Boyanup or Boyanup and Donnybrook and it is unknown at this stage whether the line will be used again in the future. Irrespective of the current status of the line, consideration has been given to potential noise and vibration levels.

Appendix B contains a description of some of the terminology used throughout this report.

2 CRITERIA

2.1 Noise Criteria

The criteria relevant to this assessment is the *State Planning Policy 5.4 Road and Rail Transport Noise and Freight Considerations in Land Use Planning* (hereafter referred to as the Policy) produced by the Western Australian Planning Commission (WAPC). The objectives in the Policy are to:

- Protect people from unreasonable levels of transport noise by establishing a standardised set of criteria to be used in the assessment of proposals;
- Protect major transport corridors and freight operations from incompatible urban encroachment;
- Encourage best practice design and construction standards for new development proposals and new or redevelopment transport infrastructure proposals;
- Facilitate the development and operation of an efficient freight network; and
- Facilitate the strategic co-location of freight handling facilities.

The Policy's outdoor noise criteria are shown below in *Table 2-1*. These criteria applying at any point 1-metre from a habitable façade of a noise sensitive premises and in one outdoor living area.

Table 2-1 Outdoor Noise Criteria

Period	Target	Limit
Day (6am to 10pm)	55 dB $L_{Aeq(Day)}$	60 dB $L_{Aeq(Day)}$
Night (10pm to 6am)	50 dB $L_{Aeq(Night)}$	55 dB $L_{Aeq(Night)}$

Note: The 5 dB difference between the target and limit is referred to as the margin.

In the application of these outdoor noise criteria to new noise sensitive developments, the objectives of this Policy is to achieve -

- acceptable indoor noise levels in noise-sensitive areas (e.g. bedrooms and living rooms of houses); and
- a 'reasonable' degree of acoustic amenity in at least one outdoor living area on each residential lot.

If a noise sensitive development takes place in an area where outdoor noise levels will meet the *target*, no further measures are required under this policy.

In areas where the *target* is exceeded, customised noise mitigation measures should be implemented with a view to achieving the *target* in at least one outdoor living area on each residential lot, or if this is not practicable, within the *margin*. Where indoor spaces are planned to be facing outdoor areas that are above the *target*, mitigation measures should be implemented to achieve acceptable indoor noise levels in those spaces.

2.2 Vibration Criteria

Exposure limits for vibration are normally defined in terms of a multiplying factor that is applied to the base curves defined in Australian Standard 2670.2:1990 *Evaluation of Human Exposure to Whole-Body Vibration Part 2: Continuous and Shock Induced Vibration in Buildings (1 to 80Hz)*. The base curve is the point at which adverse comment is considered rare. It also states that at levels above the base curve, vibration may or may not give rise to adverse comment depending on circumstances. The measure of human annoyance is a velocity (mm/s) root mean squared (rms). The multiplying factors are given in Appendix A of AS 2670.2-1990 and it is typical for Curve 2 to be used. The Curve 2 vibration level varies with direction (radial, transverse, vertical) and frequency. For the vertical direction, the vibration level is consistent at 0.199mm/s from 8 to 80Hz.

It should be noted that AS2670.2 has been withdrawn, however is still used by the Department of Environment Regulation (DER) for such assessments.

3 METHODOLOGY

Noise measurements alongside the road and modelling have been undertaken in accordance with the requirements of the Policy as described below in *Sections 3.1 and 3.2*.

3.1 Site Measurements

Noise monitoring was undertaken alongside South Western Highway in order to:

- Quantify the existing noise levels;
- Determine the differences between different acoustic parameters ($L_{A10,18hour}$, $L_{Aeq(Day)}$ and $L_{Aeq(Night)}$); and
- Calibrate the noise model for existing conditions.

The instrument used was an ARL Type 316 noise data logger (refer *Figure 3-1*), located 3 metres within the western boundary of the site, with the microphone 1.4 metres above ground level. The logger was programmed to record hourly L_{A1}, L_{A10}, L_{A90}, and L_{Aeq} levels. This instrument complies with the instrumentation requirements of *Australian Standard 2702-1984 Acoustics – Methods for the Measurement of Road Traffic Noise*. The logger was field calibrated before and after the measurement session and found to be accurate to within +/- 1 dB. Lloyd George Acoustics also holds current laboratory calibration certificate for the loggers.

The noise data collected was verified by inspection and professional judgement. Where hourly data was considered atypical, an estimated value was inserted and highlighted by bold italic lettering.

As the freight railway is not currently in use, noise and vibration measurements could not be undertaken. As such, file data has been referenced to allow assessment to be undertaken.

Figure 3-1 Typical Logger Field Set-up

3.2 Noise Modelling

The computer programme *SoundPLAN 7.3* was utilised, where for road traffic the *Calculation of Road Traffic Noise* (CoRTN) algorithms were incorporated, modified to reflect Australian conditions. The modifications included the following:

- Vehicles were separated into heavy (Austroads Class 3 upwards) and non-heavy (Austroads Classes 1 & 2) with non-heavy vehicles having a source height of 0.5 metres above road level and heavy vehicles having two sources, at heights of 1.5 metres and 3.6 metres above road level, to represent the engine and exhaust respectively. By splitting the noise source into three, allows for less barrier attenuation for high level sources where barriers are to be considered. Note that corrections are applied to the exhaust of –8.0 dB (based on Transportation Noise Reference Book, Paul Nelson, 1987) and to the engine source of –0.8 dB, so as to provide consistent results with the CoRTN algorithms for the no barrier scenario;
- An adjustment of –1.7 dB has been applied to the predicted levels based on the findings of An Evaluation of the U.K. DoE Traffic Noise Prediction; Australian Road Research Board, Report 122 ARRB – NAASRA Planning Group 1982.

For freight trains, the Nordic Rail Prediction Method (Kilde Rep. 130) has been used within *SoundPLAN 7.3*. The Nordic Rail Prediction Method (Kilde Rep. 130) algorithm is for generic train types in Europe and requires modification to align with measured noise levels of locomotives and wagons used in the Perth region. In addition, to accurately predict the effect of barriers (hills, buildings or walls), the noise source height of the locomotive was raised from the model standard of 0.5 metres to 4.0 metres above the railhead.

Predictions are made at heights of 1.4 metres above ground floor level and at 1.0 metre from an assumed building façade (resulting in a + 2.5 dB correction due to reflected noise).

Various input data are included in the modelling such as ground topography, road design, traffic volumes etc. These model inputs are discussed below.

3.2.1 Ground Topography, Road Design & Cadastral Data

Topographical data was based on that provided by MPM.

Existing buildings have also been included as these can provide barrier attenuation when located between a source and receiver, in much the same way as a hill or wall provides noise shielding. All buildings are assumed to be single storey with a height of 3.5 metres.

Finished floor levels were not available at the time of this study so the assumed levels have been shown on the contour drawings.

Should the layout or levels of the proposed dwellings change, then the assessment should be reviewed.

3.2.2 Traffic Data

Traffic data includes:

- Road Surface – The noise relationship between different road surface types is shown below in *Table 3-1*.

Table 3-1 Noise Relationship Between Different Road Surfaces

Road Surfaces						
Chip Seal			Asphalt			
14mm	10mm	5mm	Dense Graded	Novachip	Stone Mastic	Open Graded
+3.5 dB	+2.5 dB	+1.5 dB	0.0 dB	-0.2 dB	-1.0 dB	-2.5 dB

The existing and future road surface is assumed to be a worn chip seal.

- Vehicle Speed – The existing and future posted speeds are 60km/hr.

- Road Traffic Volumes – Main Roads were contacted to obtain relevant traffic volumes. It was advised that the existing volumes are 6,500 vehicles per day, with 14% of these being heavy vehicles. Assuming a growth rate of 4% per annum, future (2031) volumes will be around 12,600 vehicles per day. The percentage heavy vehicles are assumed to be the same in the future as existing.

- Rail Traffic Volumes – With the line currently not in use, an assumption of 1 freight train per hour has been assumed with each train being 400 metres long pulled by a D Class locomotive. This results in the $L_{Aeq(Night)}$ being more critical for trains.

3.2.3 Ground Attenuation

The ground attenuation has been assumed to be 0.2 (20%) for the road and 0.5 (50%) elsewhere. Note 0.0 represents hard reflective surfaces such as water and 1.00 represents absorptive surfaces such as grass.

4 RESULTS

4.1 Noise Monitoring

The results of the noise monitoring are summarised below in *Table 4-1* and shown graphically in *Figure 4-1*.

Table 4-1 Measured Average Noise Levels: South Western Highway

Date	Average Weekday Noise Level, dB			
	$L_{A10,18hour}$	$L_{Aeq,24hour}$	$L_{Aeq\ (Day)}$	$L_{Aeq\ (Night)}$
Tuesday 29 July 2014	65.0	63.1	64.3	58.8
Wednesday 30 July 2014	65.4	63.1	644	57.7
Thursday 31 July 2014	64.8	62.5	63.7	57.4
Friday 1 August 2014	66.0	62.6	63.9	57.3
Monday 4 August 2014	65.2	62.5	63.8	57.8
Weekday Average	**65.3**	**62.7**	**64.0**	**57.8**

The average differences between the weekday $L_{A10,18hour}$ and $L_{Aeq(Day)}$ is 1.3 dB and this conversion has been used in the modelling. The average differences between the weekday $L_{Aeq(Day)}$ and $L_{Aeq(Night)}$ is 6.2 dB. This same difference has been assumed to exist in future years. As such, it is the daytime noise levels that will dictate compliance for road traffic since these are at least 5 dB more than night-time levels.

4.2 Noise Modelling

The road noise model was initially set-up to reflect existing conditions to enable model calibration. The existing $L_{Aeq(Day)}$ noise level contours are shown on *Figure 4-2*.

The road model was then changed to reflect future conditions, including increased traffic volumes and proposed dwellings. The contours associated with this future scenario are shown on *Figure 4-3*. More detailed analysis shows that the closest dwellings to South Western Highway are calculated to experience noise levels of up to 69 dB $L_{Aeq(Day)}$.

The results of the rail model are shown on *Figure 4-4* showing that the $L_{Aeq(Night)}$ is around x dB at the nearest dwellings.

Figure 4-5 shows the results of typical vibration measurements, 25 metres from the railway track.

Figure 4-1: Noise Monitoring Results

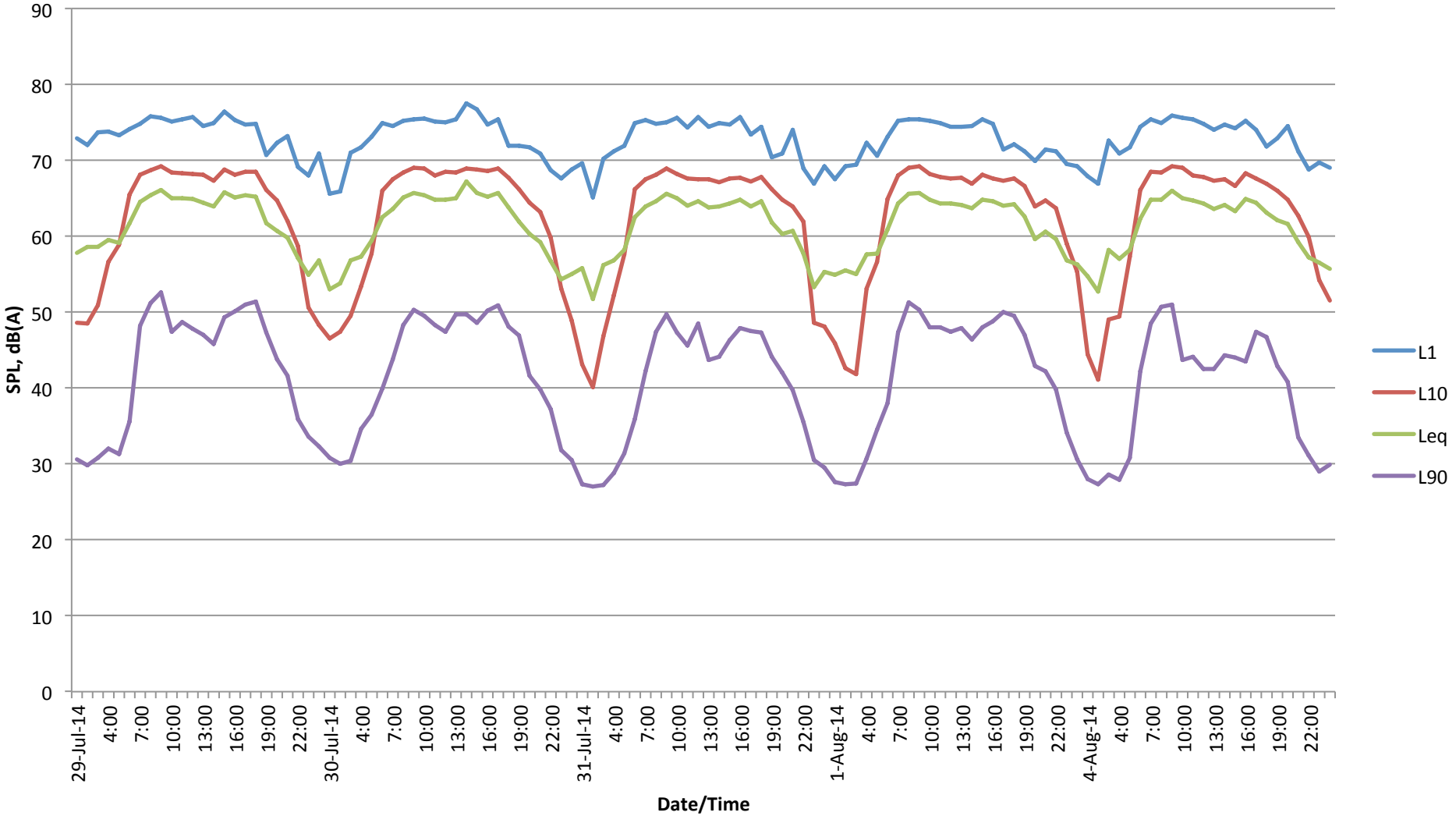

Figure 4-2

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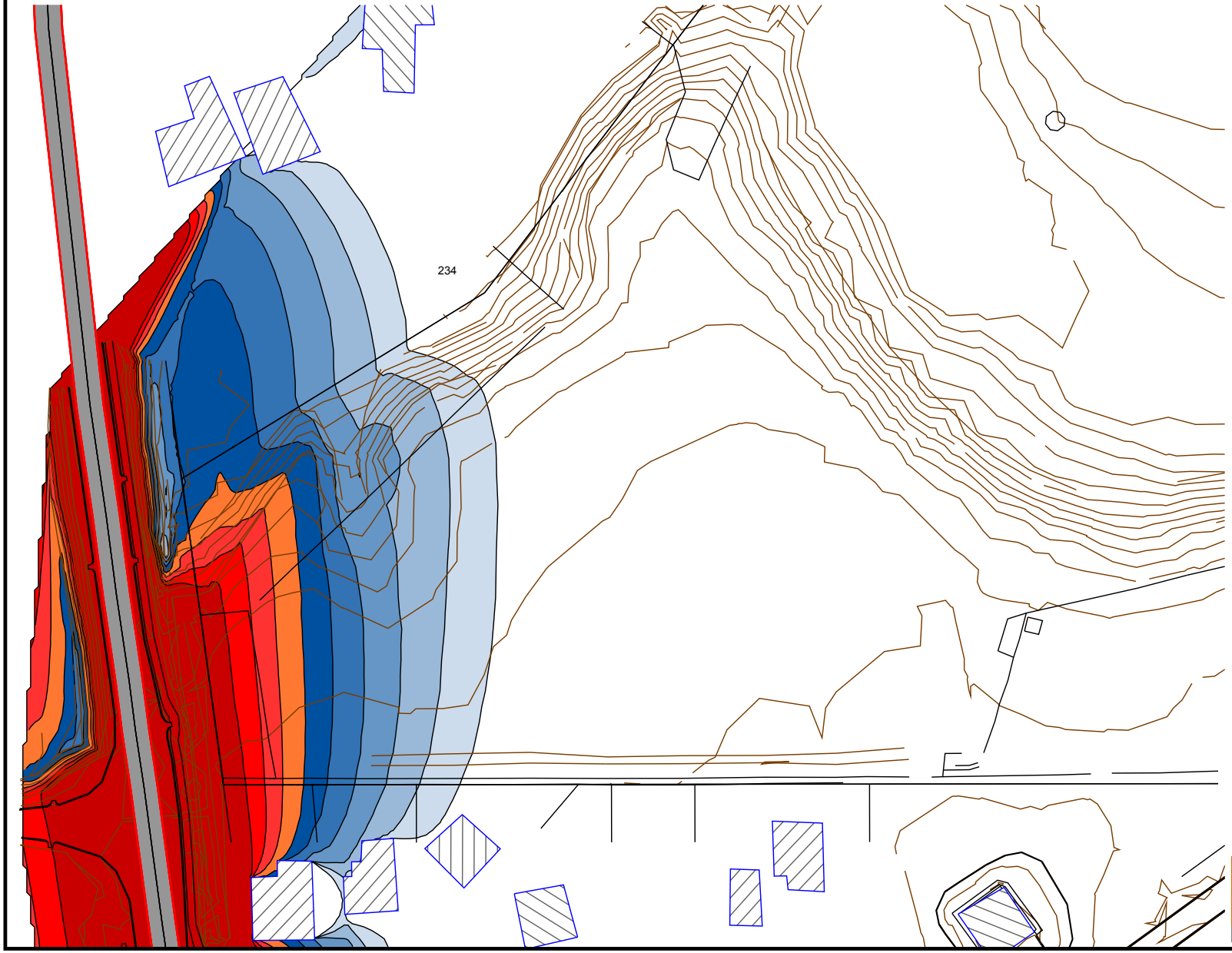

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Figure 4-3

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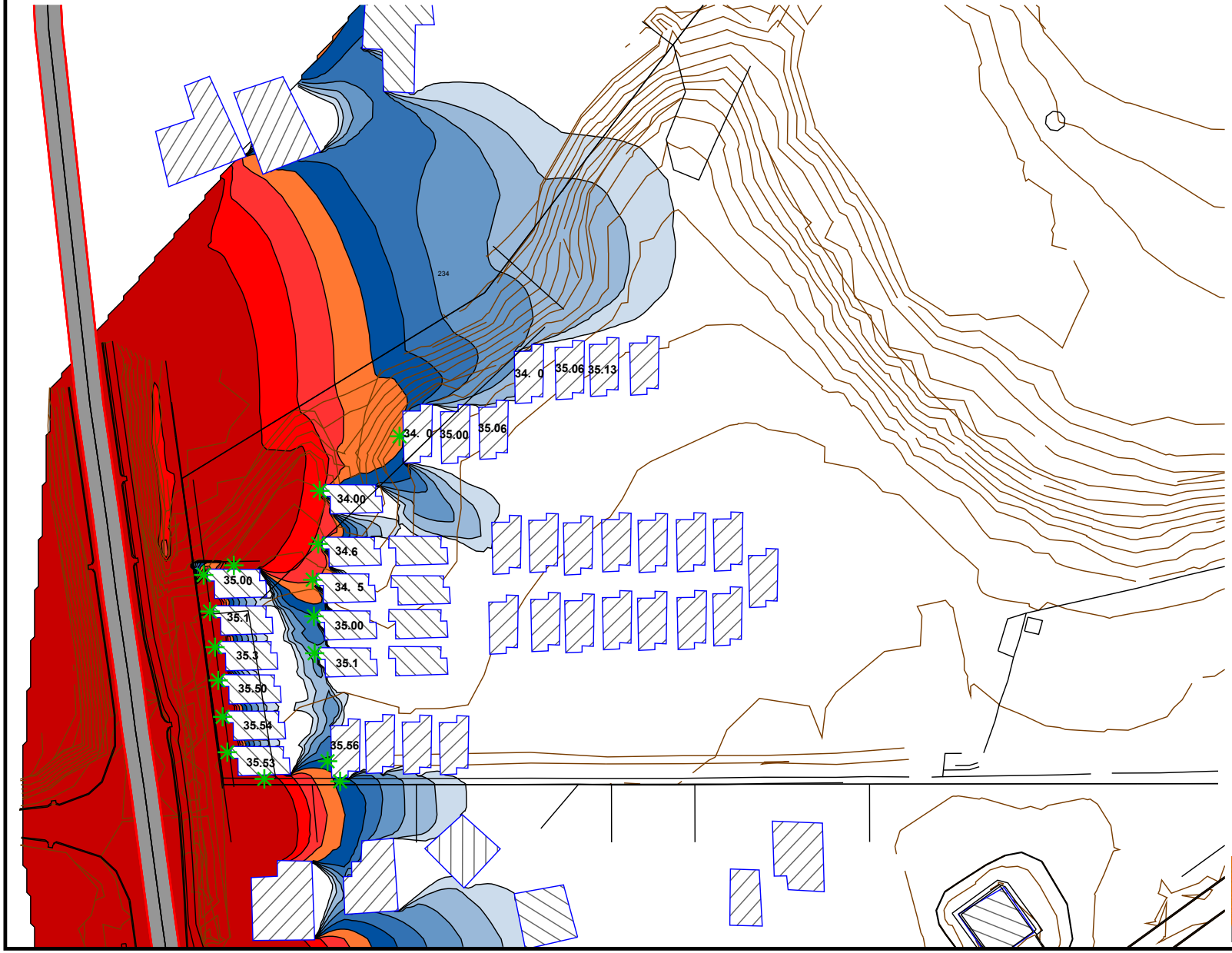

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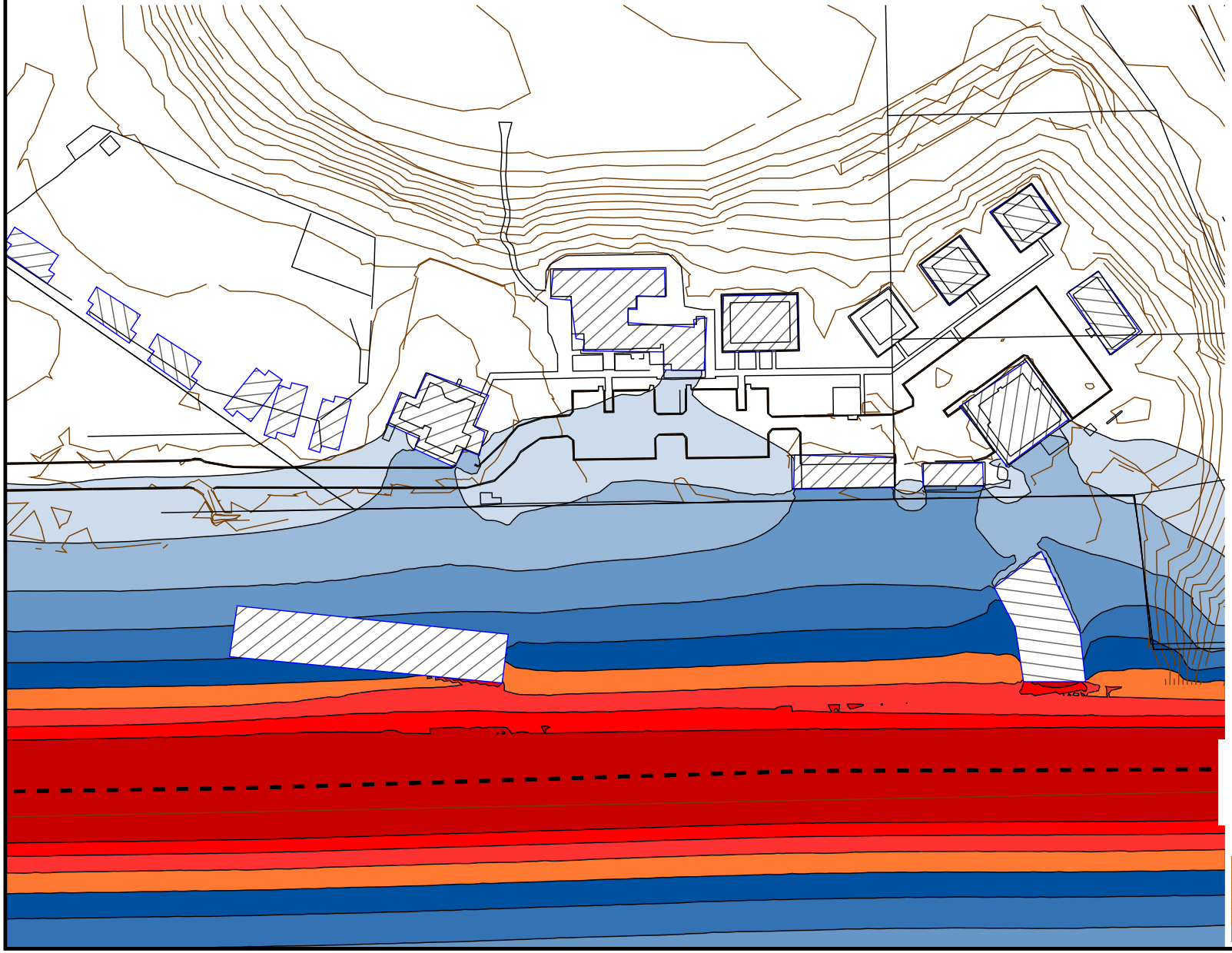
Figure 4-4



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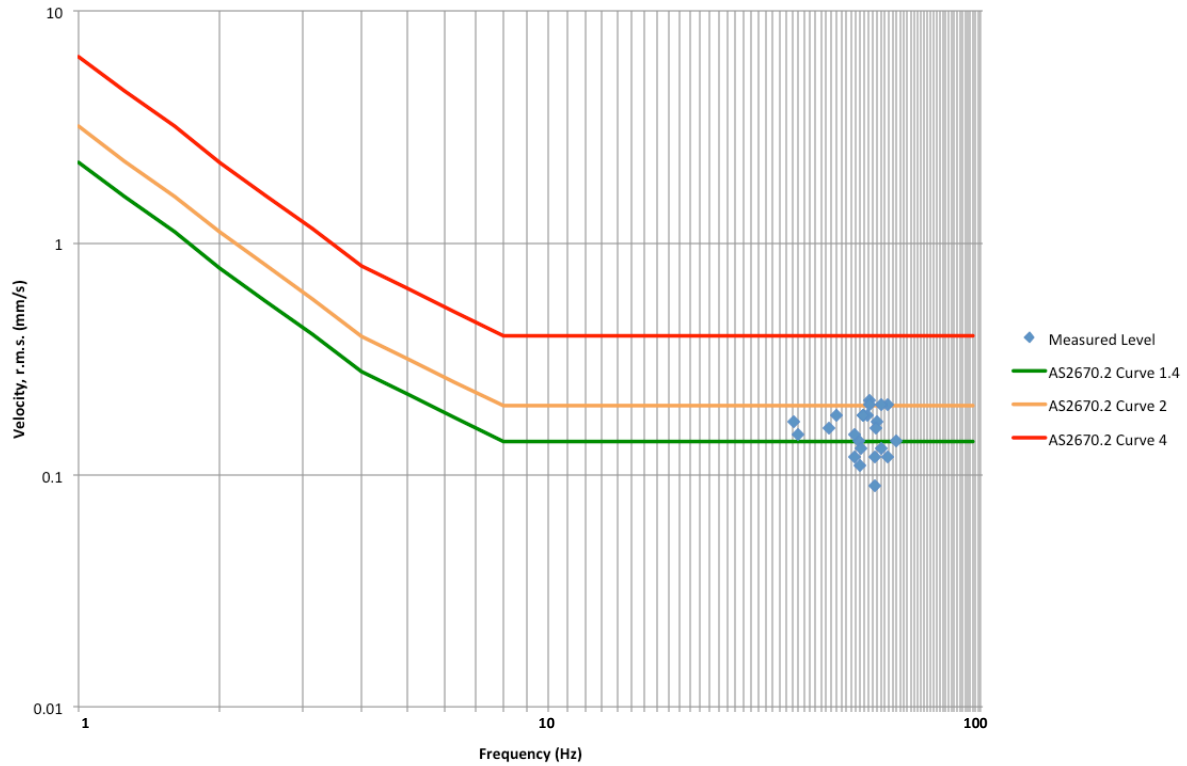

Figure 4-5 25m From Railway Track Vertical RMS Vibration Velocity

5 ASSESSMENT

The objectives of the criteria are for noise at all houses to be no more than the *limit* and preferably no more than the *target*. Where the *target* is achieved, no further controls are required. Where the *limit* is achieved or noise levels are within the *margin* (between the *limit* and *target*), further controls are necessary.

With no noise control, road traffic noise levels for future dwellings will be above the ***target***. As such, consideration has been given to the construction of noise walls. It is considered impracticable to achieve the ***target*** with the construction of noise walls alone with the height of the wall needing to be above 4 metres, which is a commonly adopted maximum acceptable wall height in Western Australia.

A minimum wall height (relative to finished floor level) to achieve the *limit* was determined to be 2.3 metres high alongside South Western highway with two returns at 1.8 metres high as shown on *Figure 5-1*, noise contour plot. Note that the wall is to be of free of gaps and be constructed of a minimum surface mass of 15kg/m^2. Whilst this wall will protect the closest row of houses, there are still others further away that will be exposed to noise levels above the ***target***.

With regards to rail noise, on the basis of 1 train movement per hour, noise levels at the nearest future dwellings will be below the ***target*** and therefore no further treatment is required.

Vibration is likely to comply at a distance of 25 metres from the railway. The closest dwelling is at a distance of around 85 metres and therefore vibration compliance will be achieved.

With reference to *Figure 5-2*, the following is recommended:

- Where residences are predicted to experience future noise levels between, and including, 61 dB and 63 dB $L_{Aeq(Day)}$, Package B is to be incorporated (refer *Appendix A*). Alternative constructions may be acceptable if supported by a report undertaken by a suitably qualified acoustical consultant (member from of the Association of Australian Acoustical Consultants (AAAC)) once the lots specific building plans are available.

- Where residences are predicted to experience future noise levels between, and including, 56 dB and 60 dB $L_{Aeq(Day)}$, Package A is to be incorporated (refer *Appendix A*). Alternative constructions may be acceptable if supported by a report undertaken by a suitably qualified acoustical consultant once the lots specific building plans are available.

- All affected lots are to have notifications on lot titles as per the Policy requirements – refer *Appendix A*.

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Figure 5-1

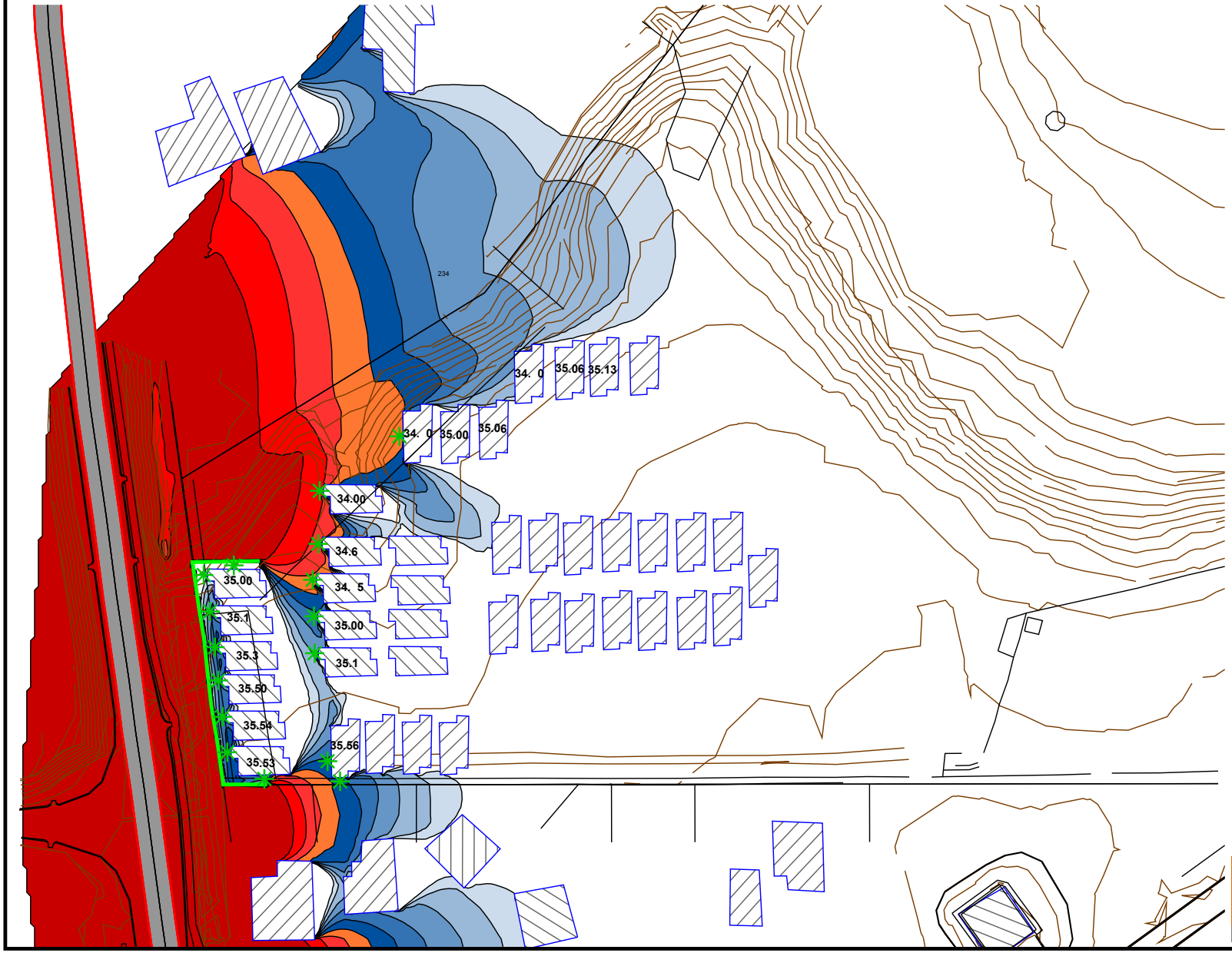

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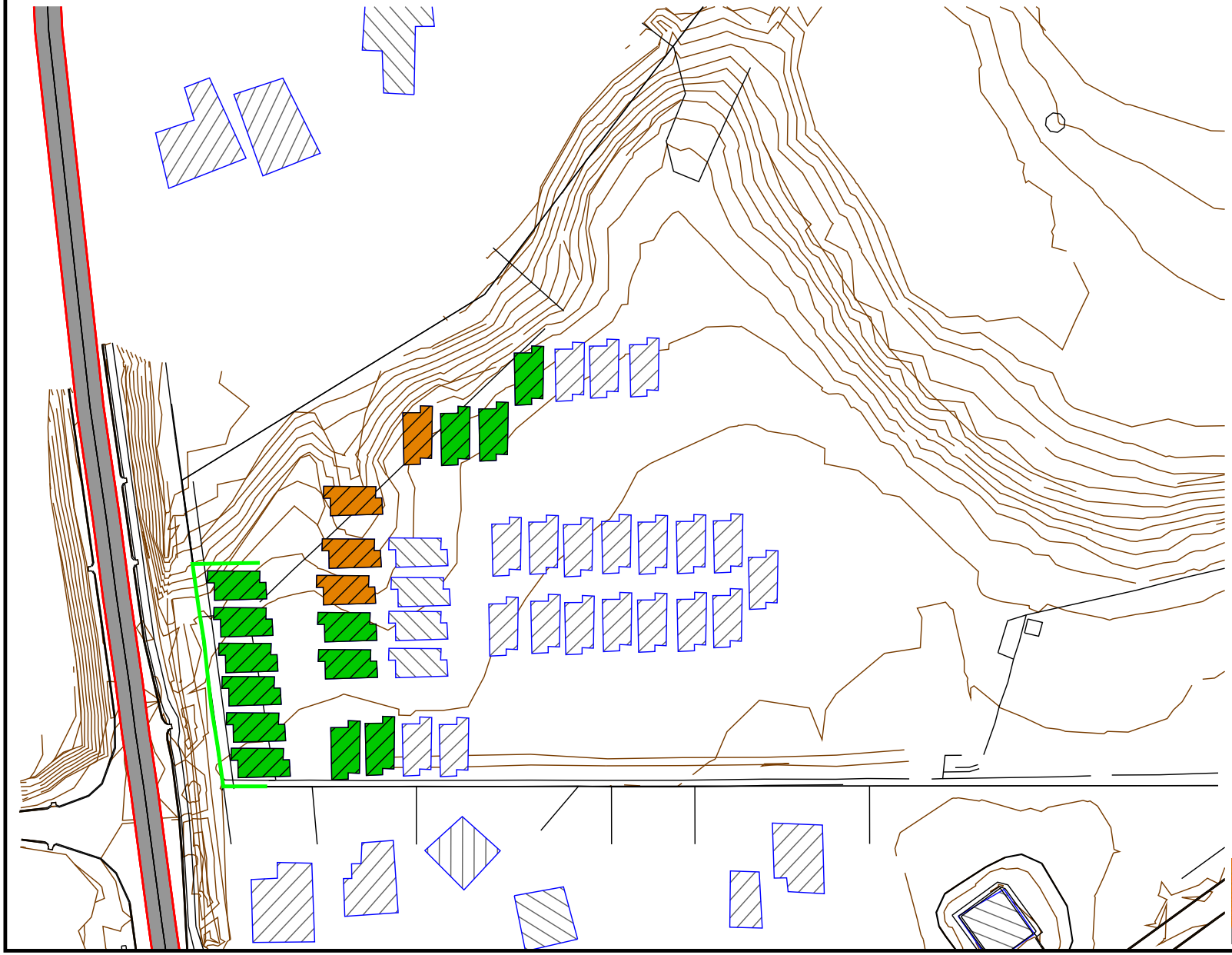
Figure 5-2



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Appendix A

DEEMED TO SATISFY CONSTRUCTION STANDARDS

Package A: Noise levels within the *margin*

The following noise insulation package is designed to meet the indoor noise standards for residential developments in areas where noise levels exceed the noise *target* but are within the *limit*.

Area type	Orientation	Package A measures
Indoors		
Bedrooms	Facing SWH	• 6mm (minimum) laminated glazing • Fixed, casement or awning windows with seals • No external doors • Closed eaves • No vents to outside walls/eaves • Mechanical ventilation/airconditioning[1]
	Side-on to SWH	• 6mm (minimum) laminated glazing • Closed eaves • Mechanical ventilation/airconditioning
	Away from SWH	No requirements
Living and work areas[2]	Facing SWH	• 6mm (minimum) laminated glazing • Fixed, casement or awning windows with seals • 35mm (minimum) solid core external doors with acoustic seals[3] • Sliding doors must be fitted with acoustic seals • Closed eaves • No vents to outside walls/eaves • Mechanical ventilation/airconditioning
	Side-on to SWH	• 6mm (minimum) laminated glazing • Closed eaves • Mechanical ventilation/airconditioning
	Away from SWH	No requirements
Other indoor areas	Any	No requirements
All	All	• Walls, roof/ceiling and elevated floors to be minimum R_w 45 construction

[1] See section on Mechanical ventilation/airconditioning for further details and requirements.
[2] These deemed-to-comply guidelines adopt the definitions of indoor spaces used in AS 2107-2000. A
[2] These deemed-to-comply guidelines adopt the definitions of indoor spaces used in AS 2107-2000. A
comparable description for bedrooms, living and work areas is that defined by the Building Code of Australia as a "habitable room". The Building Code of Australia may be referenced if greater clarity is needed. A living or work area can be taken to mean any "habitable room" other than a bedroom. Note that there are no noise insulation requirements for utility areas such as bathrooms. The Building Code of Australia describes these utility spaces as "non-habitable rooms".
[3] Glazing panels are acceptable in external doors facing the transport corridor. However these must meet the minimum glazing requirements.

Package B: Noise levels above the *limit* but within 3 dB

The following noise insulation package is designed to meet the indoor noise standards for residential developments in areas where noise levels exceed the *limit* by no more than 3 dB.

Area type	Orientation	Package B measures
Indoors		
Bedrooms	Facing SWH	• 6.5mm (minimum) VLam Hush glazing • Fixed, casement or awning windows with seals • No external doors • Closed eaves • No vents to outside walls/eaves • Mechanical ventilation/airconditioning[4]
	Side-on to SWH	• 6.5mm (minimum) VLam Hush glazing • Closed eaves • Mechanical ventilation/airconditioning
	Away from SWH	No requirements
Living and work areas[5]	Facing SWH	• 6.5mm (minimum) VLam Hush glazing • Fixed, casement or awning windows with seals • 40mm (minimum) solid core external doors with acoustic seals[6] • Sliding doors must be fitted with acoustic seals • Closed eaves • No vents to outside walls/eaves • Mechanical ventilation/airconditioning
	Side-on to SWH	• 6mm (minimum) laminated glazing • Closed eaves • Mechanical ventilation/airconditioning
	Away from SWH	No requirements
Other indoor areas	Any	No requirements
All	All	• Walls, roof/ceiling and elevated floors to be minimum R_w 50 construction

Mechanical ventilation/airconditioning

[4] See section on Mechanical ventilation/airconditioning for further details and requirements.
[5] These deemed-to-comply guidelines adopt the definitions of indoor spaces used in AS 2107-2000. A comparable description for bedrooms, living and work areas is that defined by the Building Code of Australia as a "habitable room". The Building Code of Australia may be referenced if greater clarity is needed. A living or work area can be taken to mean any "habitable room" other than a bedroom. Note that there are no noise insulation requirements for utility areas such as bathrooms. The Building Code of Australia describes these utility spaces as "non-habitable rooms".
[6] Glazing panels are acceptable in external doors facing the transport corridor. However these must meet the minimum glazing requirements.

Where outdoor noise levels are above the "target", mechanical ventilation or airconditioning is required to ensure that windows can remain closed in order to achieve the indoor noise standards.

In implementing ventilation, the following need to be observed:

- Evaporative airconditioning systems may not meet the requirements because windows need to remain open. Where evaporative is preferred, the design is to be reviewed and approved by a suitably qualified acoustical consultant being a member firm of the Association of Australian Acoustical Consultants (AAAC);
- Refrigerative airconditioning systems need to be designed to achieve fresh air ventilation requirements;
- air inlets need to positioned facing away from the transport corridor where practicable; and
- ductwork needs to be provided with adequate silencing to prevent noise intrusion.

Notification

Notifications on certificates of title and/or advice to prospective purchasers advising of the potential for noise impacts from road and rail corridors can be effective in warning people of the potential impacts of transport noise. Such advice can also bring to the attention of prospective developers the need and opportunities to reduce the impact of noise through sensitive design and construction of buildings and the location and/or screening of outdoor living areas.

Notification should be provided to prospective purchasers, and required as a condition of subdivision (including strata subdivision) for the purposes of noise-sensitive development or planning approval involving noise-sensitive development, where external noise levels are forecast or estimated to exceed the "target" criteria as defined by the Policy. In the case of subdivision and development, conditions of approval should include a requirement for registration of a notice on title, which is provided for under section 12A of the Town Planning and Development Act and section 70A of the Transfer of Land Act. An example of a suitable notice is given below.

Notice: This property is situated in the vicinity of a transport corridor, and is currently affected, or may in the future be affected, by transport noise. Further information about transport noise, including development restrictions and noise insulation requirements for noise-affected property, are available on request from the relevant local government offices.

Appendix B

Terminology

The following is an explanation of the terminology used throughout this report.

Decibel (dB)
The decibel is the unit that describes the sound pressure and sound power levels of a noise source. It is a logarithmic scale referenced to the threshold of hearing.

A-Weighting
An A-weighted noise level has been filtered in such a way as to represent the way in which the human ear perceives sound. This weighting reflects the fact that the human ear is not as sensitive to lower frequencies as it is to higher frequencies. An A-weighted sound level is described as L_A dB.

L_1
An L_1 level is the noise level which is exceeded for 1 per cent of the measurement period and is considered to represent the average of the maximum noise levels measured.

L_{10}
An L_{10} level is the noise level which is exceeded for 10 per cent of the measurement period and is considered to represent the "*intrusive*" noise level.

L_{90}
An L_{90} level is the noise level which is exceeded for 90 per cent of the measurement period and is considered to represent the "*background*" noise level.

L_{eq}
The L_{eq} level represents the average noise energy during a measurement period.

$L_{A10,18hour}$
The $L_{A10,18\ hour}$ level is the arithmetic average of the hourly L_{A10} levels between 6.00 am and midnight. The *CoRTN* algorithms were developed to calculate this parameter.

$L_{Aeq,24hour}$
The $L_{Aeq,24\ hour}$ level is the logarithmic average of the hourly L_{Aeq} levels for a full day (from midnight to midnight).

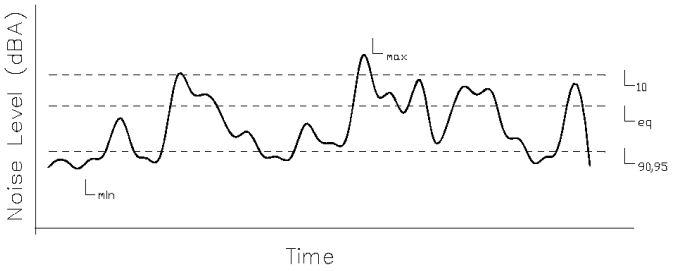
$L_{Aeq,8hour}$ / $L_{Aeq\ (Night)}$
The $L_{Aeq\ (Night)}$ level is the logarithmic average of the hourly L_{Aeq} levels from 10.00 pm to 6.00 am on the same day.

$L_{Aeq,16hour}$ / $L_{Aeq\ (Day)}$
The $L_{Aeq\ (Day)}$ level is the logarithmic average of the hourly L_{Aeq} levels from 6.00 am to 10.00 pm on the same day. This value is typically 1-3 dB less than the $L_{A10,18hour}$.

Satisfactory Design Sound Level
The level of noise that has been found to be acceptable by most people for the environment in question and also to be not intrusive.

Maximum Design Sound Level
The level of noise above which most people occupying the space start to become dissatisfied with the level of noise.

Chart of Noise Level Descriptors



Austroads Vehicle Class

AUSTROADS Vehicle Classification System

Level 1 Length (indicative) Type	Level 2 Axles and Axle Groups Axles	Groups	Level 3 Vehicle Type Typical Description	AUSTROADS Classification Class	Parameters	Typical Configuration
			LIGHT VEHICLES			
Short up to 5.5m		1 or 2	**Short** Sedan, Wagon, 4WD, Utility, Light Van, Bicycle, Motorcycle, etc	1	d(1) ≤ 3.2m and axles = 2	
	3, 4 or 5	3	**Short - Towing** Trailer, Caravan, Boat, etc	2	groups = 3 d(1) > 2.1m, d(1) ≤ 3.2m, d(2) ≥ 2.1m and axles = 3, 4 or 5	
			HEAVY VEHICLES			
Medium 5.5m to 14.5m	2	2	**Two Axle Truck or Bus**	3	d(1) > 3.2m and axles = 2	
	3	2	**Three Axle Truck or Bus**	4	axles = 3 and groups = 2	
	> 3	2	**Four Axle Truck**	5	axles > 3 and groups = 2	
Long 11.5m to 19.0m	3	3	**Three Axle Articulated** Three axle articulated vehicle, or Rigid vehicle and trailer	6	d(1) > 3.2m, axles = 3 and groups = 3	
	4	> 2	**Four Axle Articulated** Four axle articulated vehicle, or Rigid vehicle and trailer	7	d(2) < 2.1m or d(1) < 2.1m or d(1) > 3.2m axles = 4 and groups > 2	
	5	> 2	**Five Axle Articulated** Five axle articulated vehicle, or Rigid vehicle and trailer	8	d(2) < 2.1m or d(1) < 2.1m or d(1) > 3.2m axles = 5 and groups > 2	
	≥ 6	> 2	**Six Axle Articulated** Six axle articulated vehicle, or Rigid vehicle and trailer	9	axles = 6 and groups > 2 or axles = 6 and groups = 3	
Medium Combination 17.5m to 36.5m	> 6	4	**B Double** B Double, or Heavy truck and trailer	10	groups = 4 and axles > 6	
	> 6	5 or 6	**Double Road Train** Double road train, or Medium articulated vehicle and one dog trailer (M.A.D.)	11	groups = 5 or 6 and axles > 6	
Large Combination Over 33.5m	> 6	> 6	**Triple Road Train** Triple road train, or Heavy truck and three trailers	12	groups > 6 and axles > 6	

Definitions: Group: Axle group, where adjacent axles are less than 2.1m apart; Groups: Number of axle groups; Axles: Number of axles (maximum axle spacing of 10.0m); d(1): Distance between first and second axle; d(2): Distance between second and third axle

Typical Noise Levels