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Transportation Noise Assessment

Lot 9000 Bussell Highway, Margaret River

Reference: 22057327-01 draft 1

Prepared for:
Yolk Property Group

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1. INTRODUCTION

It is proposed to subdivide land at Lot 9000 Bussell Highway, Margaret River (refer *Figure 1-1*) with the proposed subdivision plan shown in *Figure 1-2*. The site adjoins Bussell Highway and Perimeter Road, which are considered a 'Major Traffic Route' in accordance with the PlanWA Maps, such that a noise assessment is required against *State Planning Policy No. 5.4 Road and Rail Noise*, being the subject of this report.

Figure 1-1: Subdivision Location (Source: DPLH PlanWA)

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

Figure 1-2: Subdivision Layout

2. CRITERIA

The criteria relevant to this project is provided in *State Planning Policy No. 5.4 Road and Rail Noise* (hereafter referred to as SPP 5.4) produced by the Western Australian Planning Commission (WAPC). SPP 5.4 is supported by the *Road and Rail Noise Guidelines* (the Guidelines) and the Department of Planning, Lands and Heritage mapping. The objectives of SPP 5.4 are to:

- Protect the community from unreasonable levels of transport noise;
- Protect strategic and other significant freight transport corridors from incompatible urban encroachment;
- Ensure transport infrastructure and land-use can mutually exist within urban corridors;
- Ensure that noise impacts are addressed as early as possible in the planning process; and
- Encourage best practice noise mitigation design and construction standards.

Table 2-1 sets out noise targets that are to be achieved by proposals under which SPP 5.4 applies. Where the targets are exceeded, an assessment is required to determine the likely level of transport noise and management/mitigation required.

Table 2-1: Noise Targets for Noise Sensitive Land-Use

Scenario	Outdoor Noise Target		Indoor Noise Target	
Noise-sensitive land-use and/or development	55 dB $L_{Aeq(Day)}$	50 dB $L_{Aeq(Night)}$	40 dB $L_{Aeq(Day)}$ (Living and Work Areas)	35 dB $L_{Aeq(Night)}$ (Bedrooms)

Notes:

- Day period is from 6am to 10pm and night period from 10pm to 6am.
- The outdoor noise target is to be measured at 1-metre from the most exposed, habitable[1] facade of a noise sensitive building.
- For all noise-sensitive land-use and/or development, indoor noise targets for other room usages may be reasonably drawn from Table 1 of Australian Standard/New Zealand Standard AS/NZS 2107:2016 *Acoustics – Recommended Design Sound Levels and Reverberation Times for Building Interiors* (as amended) for each relevant time period.
- Outdoor targets are to be met at all outdoor areas as far as is reasonable and practicable to do so using the various noise mitigation measures outlined in the Guidelines.

The application of SPP 5.4 is to consider anticipated traffic volumes for the next 20 years from when the noise assessment has been undertaken.

[1] *A habitable room is defined in State Planning Policy 3.1 as a room used for normal domestic activities that includes a bedroom, living room, lounge room, music room, sitting room, television room, kitchen, dining room, sewing room, study, playroom, sunroom, gymnasium, fully enclosed swimming pool or patio.*

3. METHODOLOGY

Noise measurements and modelling have been undertaken in accordance with the requirements of SPP 5.4 and associated Guidelines, as described in *Section 3.1* and *Section* ***Error! Reference source not found.***.

3.1. Site Measurements

Noise monitoring was undertaken on site using two (2) Ngara Noise Data Logger (S/N: 97803E & 9780F7)) (refer *Figure 3-1*). The logger was programmed to record hourly L_{A1}, L_{A10}, L_{A90}, and L_{Aeq} levels. The logger 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 holds current laboratory calibration certificate for the logger.

The microphone was approximately 1.4 metres above existing ground level and approximately 14 and 55 metres respectively from the edge of Bussell Highway and Perimeter Road main carriageway. The measurements were recorded between 20th and 24th June 2022.

Figure 3-1: Photograph of Sound Level Meter on Site

3.2. Noise Modelling

The computer program *SoundPLAN 8.2* was utilised incorporating the *Calculation of Road Traffic Noise* (CoRTN) algorithms, modified to reflect Australian conditions. The modifications included the following:

- Vehicles were separated into heavy (Austroads Class 3 upwards) and non-heavy (Austroads Class 1 and 2) with non-heavy vehicles having a source height of 0.5 metres above road level and heavy vehicles having two source heights at 1.5 metres and 3.6 metres above road level;
- A -0.8 dB correction has been applied to the lower level heavy vehicle noise source and -8.0 dB to the higher level noise source based on the *Transportation Noise Reference Book*; Paul Nelson (1987), so as to provide consistent results with the CoRTN algorithms;
- Adjustments of -0.8 dB and -1.7 dB have been applied to the predicted levels for the 'free-field' and 'at façade' cases respectively, 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 (March 1983).

Predictions are made at heights of 1.4 metres above ground floor level for single storey buildings and 4.2 metres above ground floor level for possible first floors of double storey buildings. The noise is predicted at 1-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 and these are discussed in *Section 3.2.1* to *Section 3.2.5*.

3.2.1. Ground Topography

Topographical data was obtained via Google Earth spot heights. For the purposes of this assessment, the existing ground contours are assumed to represent the ground level of the subdivision.

Indicative building outlines have been included as these can provide barrier attenuation when located between a source and a receiver, in much the same way as a hill or wall. All buildings are assumed to be single storey with heights of 3.5 metres. This means where modelling is undertaken to a possible upper floor, the noise is predicting above these building outlines.

3.2.2. Road Surface

The corrections applied for different road surface finishes are provided in *Table 3-1*.

Table 3-1: Noise Relationship Between Different Road Surfaces

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

The existing road surface is assumed to be dense graded asphalt and assumed to remain unchanged into the future.

3.2.3. Vehicle Speed

The existing posted speed is currently 80 km/hr on Bussell Highway and 100 km/hr on the Perimeter Road and assumed to remain unchanged into the future.

3.2.4. Traffic Volumes

Existing traffic volumes were obtained from Main Roads WA Traffic Map. We were instructed by Main Roads WA (Thomas Ng, Traffic Modelling Analyst) to use a compound growth rate in the order of 1.2% per annum to calculate the Forecast 2041 traffic volumes. *Table 3-2* provides the traffic volumes used in the noise modelling. Note that the percentage heavy vehicles are assumed to be the same in the future as existing.

Table 3-2: Traffic Information Used in Noise Modelling

Road	Parameter	Scenario			
		Existing – 2021/22		Future – 2041	
		North/East bound	South/West bound	North/East bound	South/West bound
Bussell Highway	18-hour Volume	1980	1991	2484	2497
	% Heavy	14	14	14	14
Perimeter Road	18-hour Volume	703	724	882	908
	% Heavy	19	19	19	19

3.2.5. Ground Attenuation

The ground attenuation has been assumed to be 0.0 (0%) for the roads; 1.0 (100%) between the road and subdivision; and 0.6 (60%) within the subdivision. Noting that 0.0 represents hard reflective surfaces such as water and 1.0 represents absorptive surfaces such as grass.

4. RESULTS

4.1. Noise Monitoring

The results of the noise monitoring are summarised in *Table 4-1* and *Table 4-2* and shown graphically in *Figure 4-1* and *Figure 4-2.*

Table 4-1: Measured Average Noise Levels at Bussell Hwy Logger

Date	Parameter			
	$L_{A10,18hour}$, dB	$L_{Aeq,24hour}$, dB	$L_{Aeq(Day)}$, dB	$L_{Aeq(Night)}$, dB
Monday, 20 June 2022	61.5	61.8	63.5	48.8
Tuesday, 21 June 2022	63.3	61.5	63.2	49.9
Wednesday, 22 June 2022	63.1	62.3	63.9	50.1
Thursday, 23 June 2022	64.1	62.8	64.5	51.7
Friday, 24 June 2022	64.1	62.4	64.1	51.3
Average	**63.2**	**62.2**	**63.8**	**50.4**

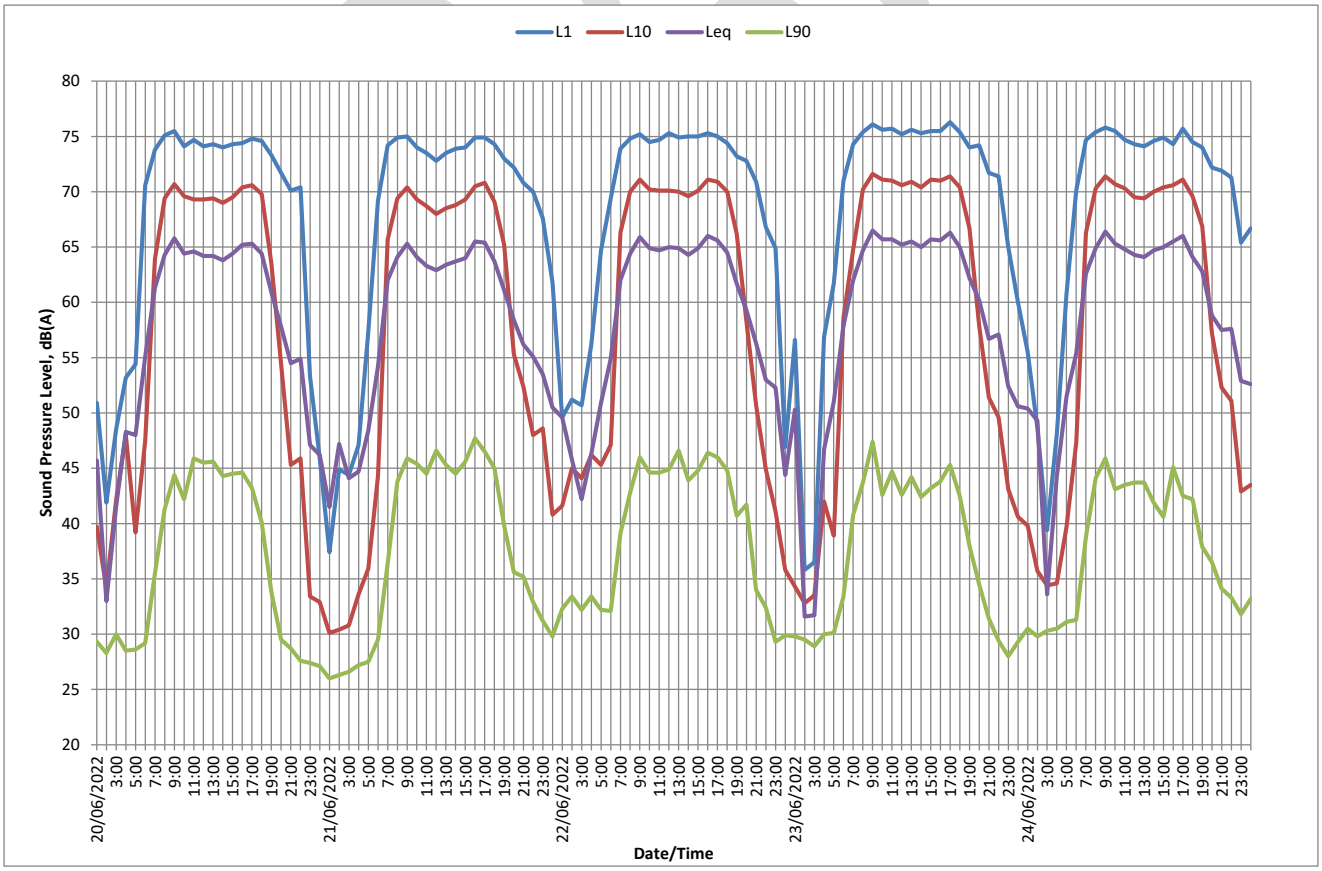


Figure 4-1: Hourly Noise Measurement Results at Bussell Hwy Noise Logger

Table 4-2: Measured Average Noise Levels at Perimeter Rd Logger

Date	Parameter			
	$L_{A10,18hour}$, dB	$L_{Aeq,24hour}$, dB	$L_{Aeq(Day)}$, dB	$L_{Aeq(Night)}$, dB
Monday, 20 June 2022	53.4	53.0	54.7	40.7
Tuesday, 21 June 2022	51.5	50.3	51.9	40.9
Wednesday, 22 June 2022	53.3	51.4	53.1	40.1
Thursday, 23 June 2022	53.5	51.6	53.2	42.5
Friday, 24 June 2022	52.9	50.4	51.9	41.4
Average	**52.9**	**51.3**	**53.0**	**41.1**

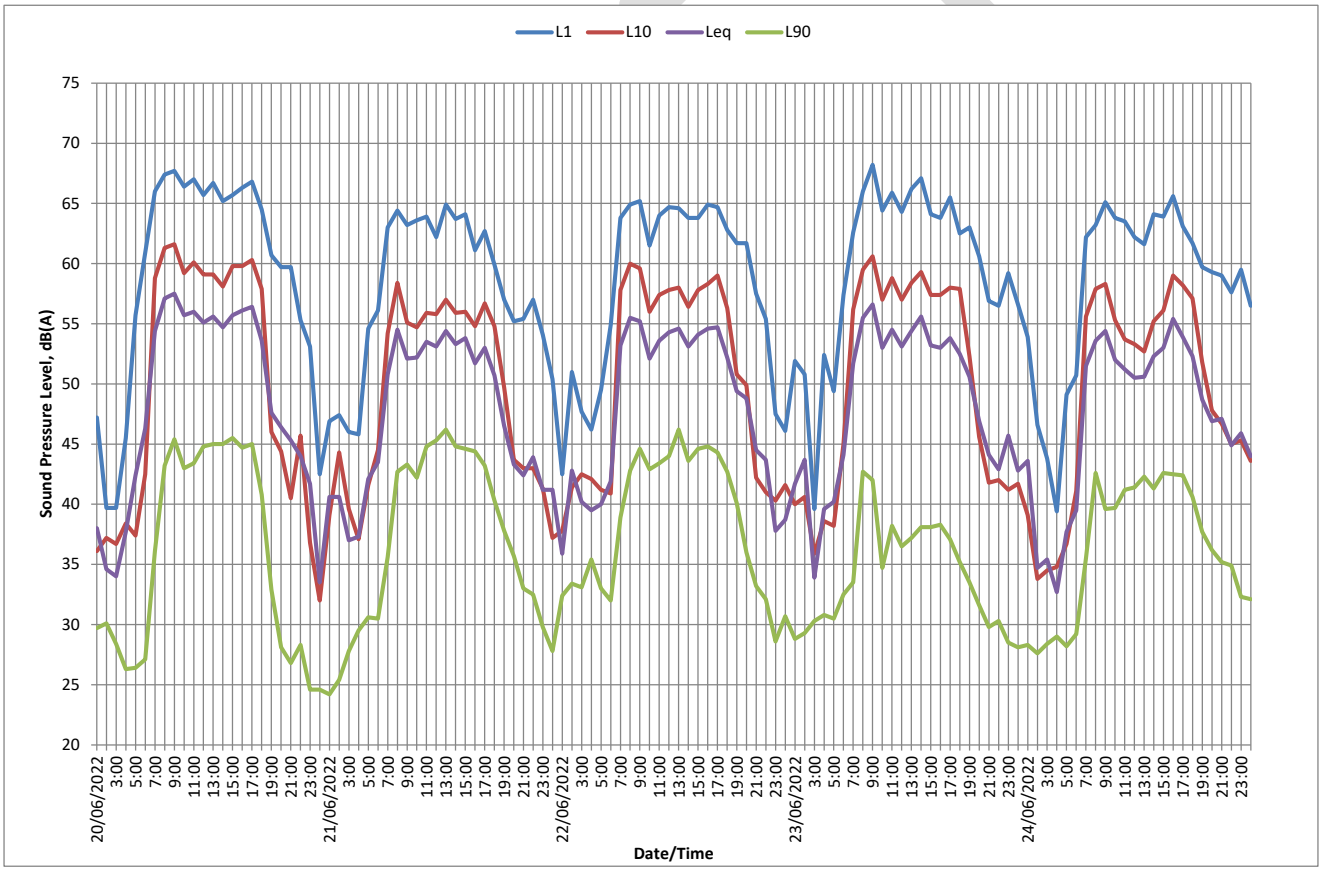


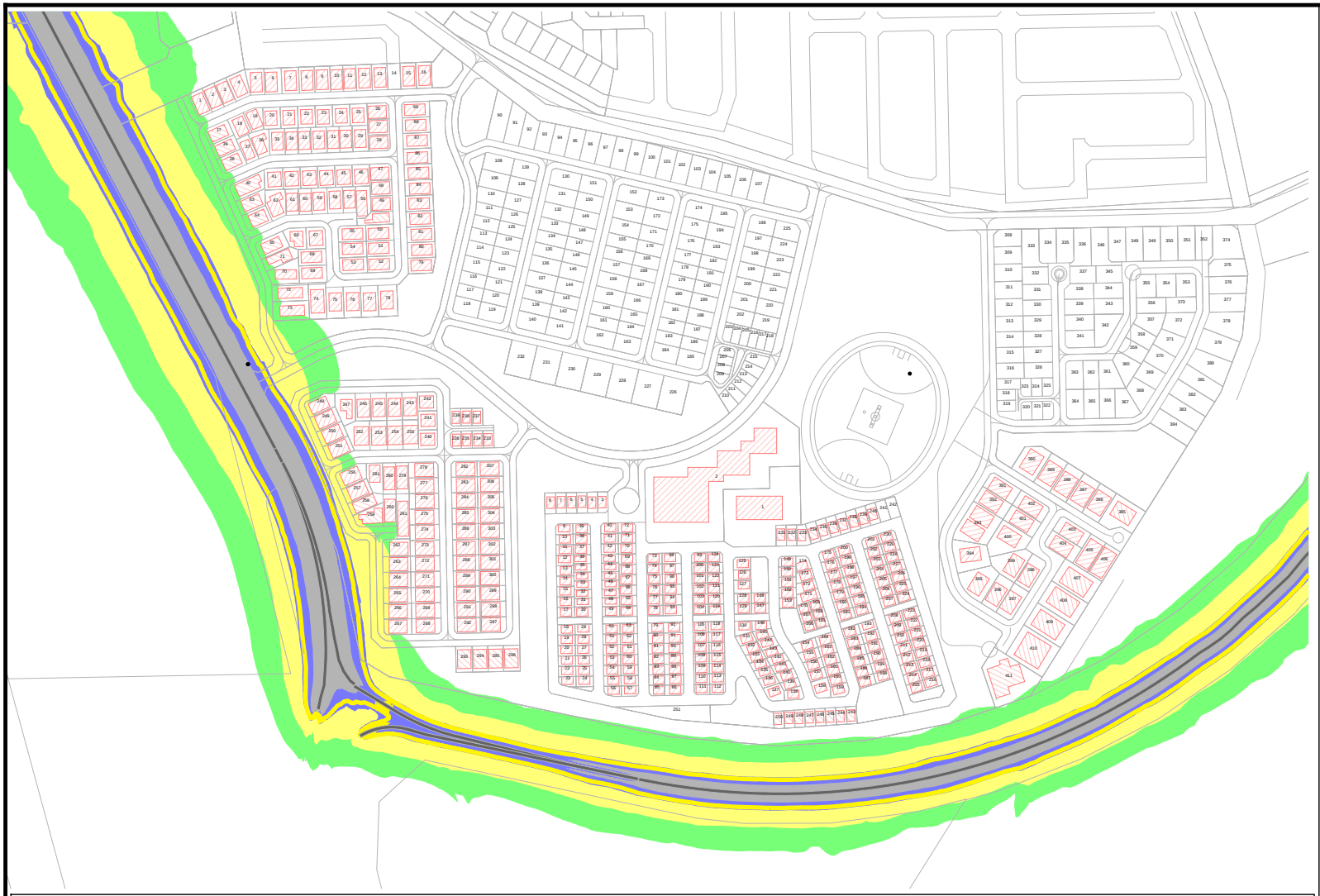
Figure 4-2: Hourly Noise Measurement Results at Perimeter Rd Noise Logger

The average difference between the weekday $L_{Aeq(Day)}$ and $L_{Aeq(Night)}$ is 13.4 dB for Bussell Highway and 11.9 dB for Perimeter Road. This same difference has been assumed to exist in future years. As the difference between these two parameters is more than 5 dB, it is the daytime noise that will dictate compliance or otherwise (refer *Section* ***Error! Reference source not found.***).

4.2. Noise Modelling

The noise model was initially set-up for existing conditions and calibrated to the noise measurement location. The model is then updated to include the proposed subdivision, indicative buildings and future traffic volumes, maintaining the same model calibration. The results of the noise modelling are provided as noise contour plots in *Figure 4-3* and *Figure 4-4* representing ground floor and first floor respectively.

Figure 4-3



Noise levels
$L_{Aeq,Day}$ dB

<= 55	
<= 56	Exposure A
<= 57	
<= 58	
<= 59	Exposure B
<= 60	
<= 61	
<= 62	
<= 63	Exposure C
<= 64	
<= 65	
<= 66	
> 66	Exposure D

SPP 5.4 (Sep 2019)

Signs and symbols

Road

Building

N

Length Scale

0 25 50 100 150 200 250 m

Lot 9000 Bussell Highway, Margaret River - Proposed Subdivision
Future Noise Level Contours

$L_{Aeq(Day)}$ Noise Level Contours Based on Future Conditions
Ground Floor Level

SoundPlan v8.2
CoRTN Algorithms

20 December 2022

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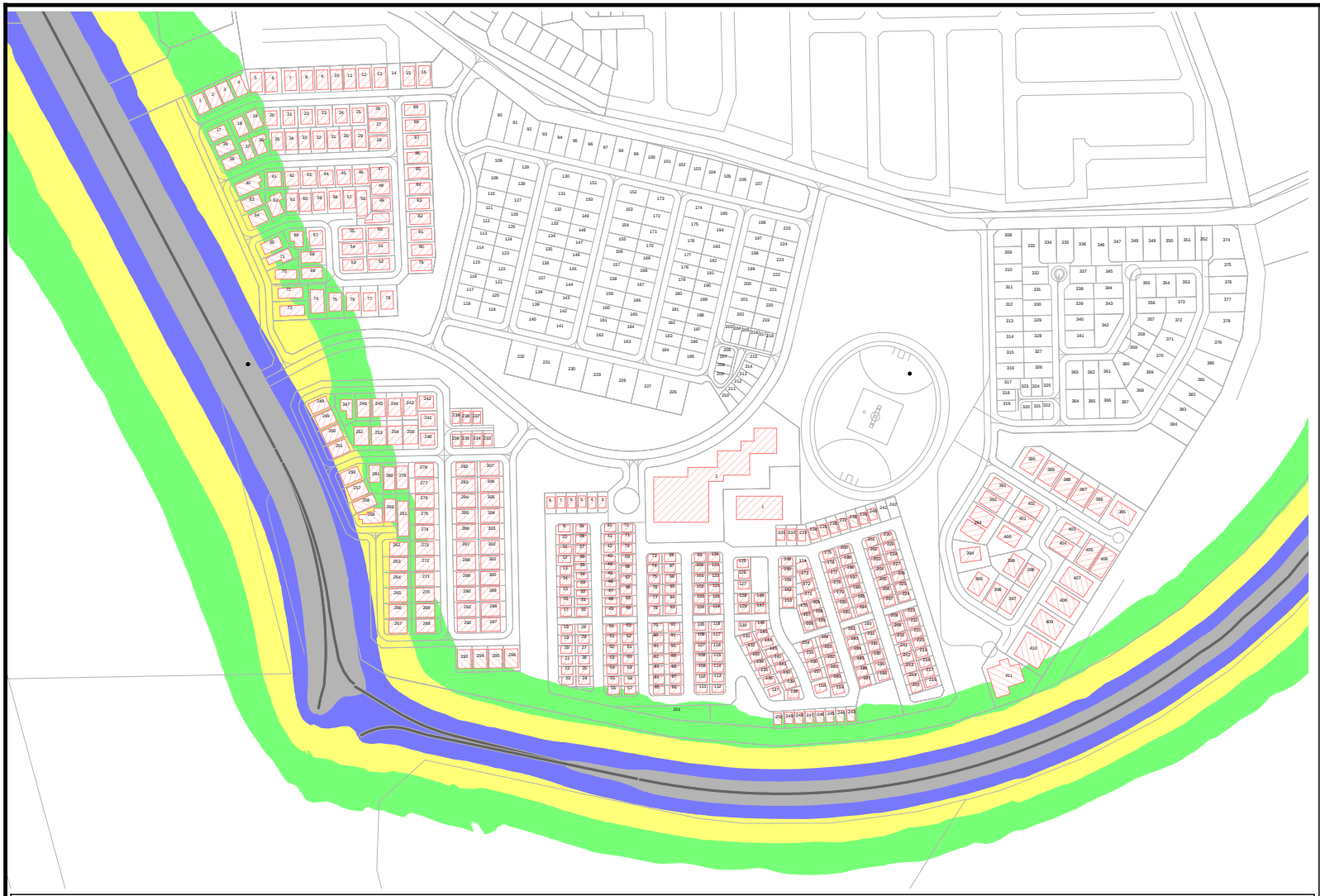
Figure 4-4



Noise levels
$L_{Aeq,Day}$ dB

<= 55	
<= 56	Exposure A
<= 57	
<= 58	
<= 59	Exposure B
<= 60	
<= 61	
<= 62	
<= 63	Exposure C
<= 64	
<= 65	
<= 66	
> 66	Exposure D

SPP 5.4 (Sep 2019)

Signs and symbols

Road

Building

N

Length Scale

0 25 50 100 150 200 250 m

Lot 9000 Bussell Highway, Margaret River - Proposed Subdivision
Future Noise Level Contours

$L_{Aeq(Day)}$ Noise Level Contours Based on Future Conditions
Upper Floor Level

SoundPlan v8.2
CoRTN Algorithms

20 December 2022

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5. ASSESSMENT

The objectives of SPP 5.4 are to achieve:

- Indoor noise levels specified in *Table 2-1* in noise-sensitive areas (e.g. bedrooms and living rooms or houses); and
- A reasonable degree of acoustic amenity for outdoor living areas on each residential lot.

Where the outdoor noise targets of *Table 2-1* are achieved, no further noise controls are necessary. With reference to *Section 4.2*, it is evident the outdoor noise target will be exceeded at some lots.

It should be noted that to mitigate noise to below the outdoor noise target using noise barriers, is not considered reasonable or practicable for this subdivision. Therefore, noise mitigation will be limited to facade protection to the houses.

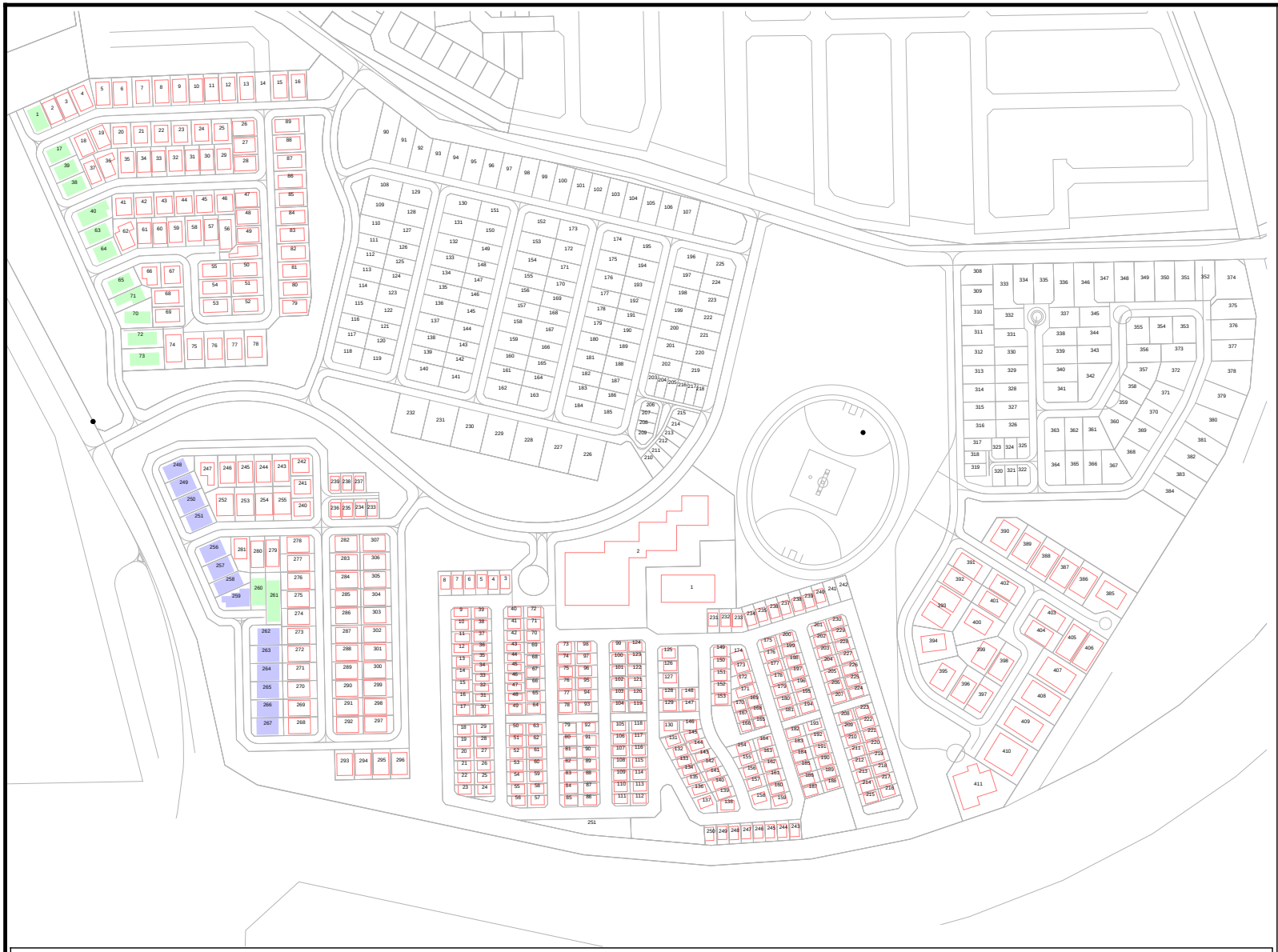
With reference to the various Exposure Levels, these are:

- Exposure C – 63 to 66 dB $L_{Aeq(Day)}$;
- Exposure B – 59 to 62 dB $L_{Aeq(Day)}$;
- Exposure A – 56 to 58 dB $L_{Aeq(Day)}$;

The proposed facade packages to address road traffic noise are provided in *Figure 5-1* and *Figure 5-2*, being for the ground and first floor respectively.

In addition, to the facade packages, where the backyards of lots are affected by traffic noise exceeding the outdoor noise targets (as shown in *Figures 5-1 and 5-2*), they must be protected by a fence or similar structure to achieve reasonable noise levels in the outdoor living area. For lots that front the road, the house will act as a barrier to the alfresco area at the rear, however when backing-on or side-on, a barrier 2.0 metre (Package A) or 2.4 metre (Package B and C) high must be constructed on boundary to shield the alfresco area. The required screening is described in the tables in *Appendix A.*

Figure 5-1



Key

- No Treatment Required
- "Package A" Treatment
- "Package B" Treatment
- "Package C" Treatment

Length Scale

0 25 50 100 150 200 250 m

Lot 9000 Bussell Highway, Margaret River - Proposed Subdivision
Facade Treatment Requirements at Ground Floor Level

20 December 2022

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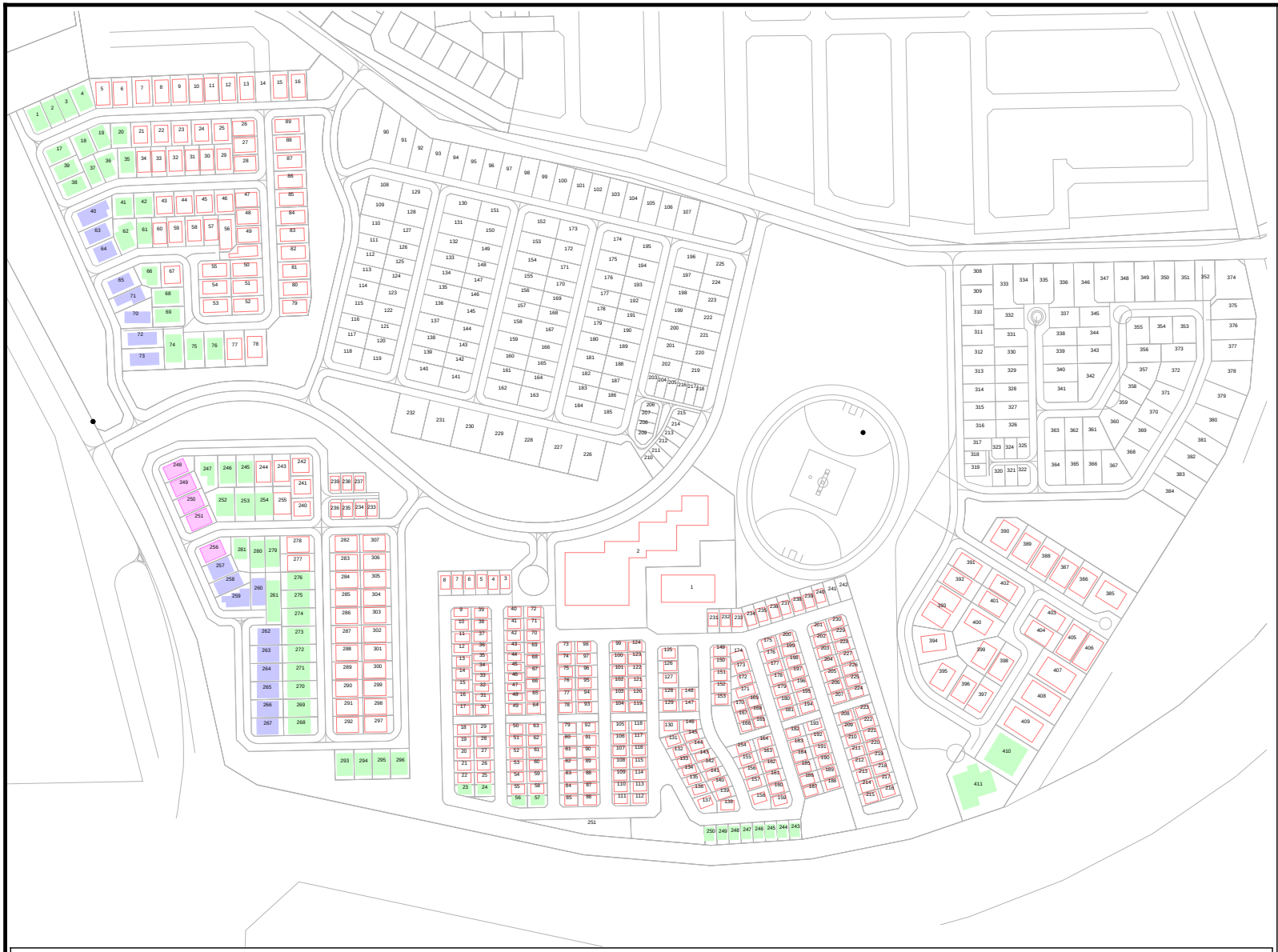
Figure 5-2



Key

- No Treatment Required
- "Package A" Treatment
- "Package B" Treatment
- "Package C" Treatment

Length Scale

0 25 50 100 150 200 250 m

Lot 9000 Bussell Highway, Margaret River - Proposed Subdivision
Facade Treatment Requirements at Upper Floor Level

20 December 2022

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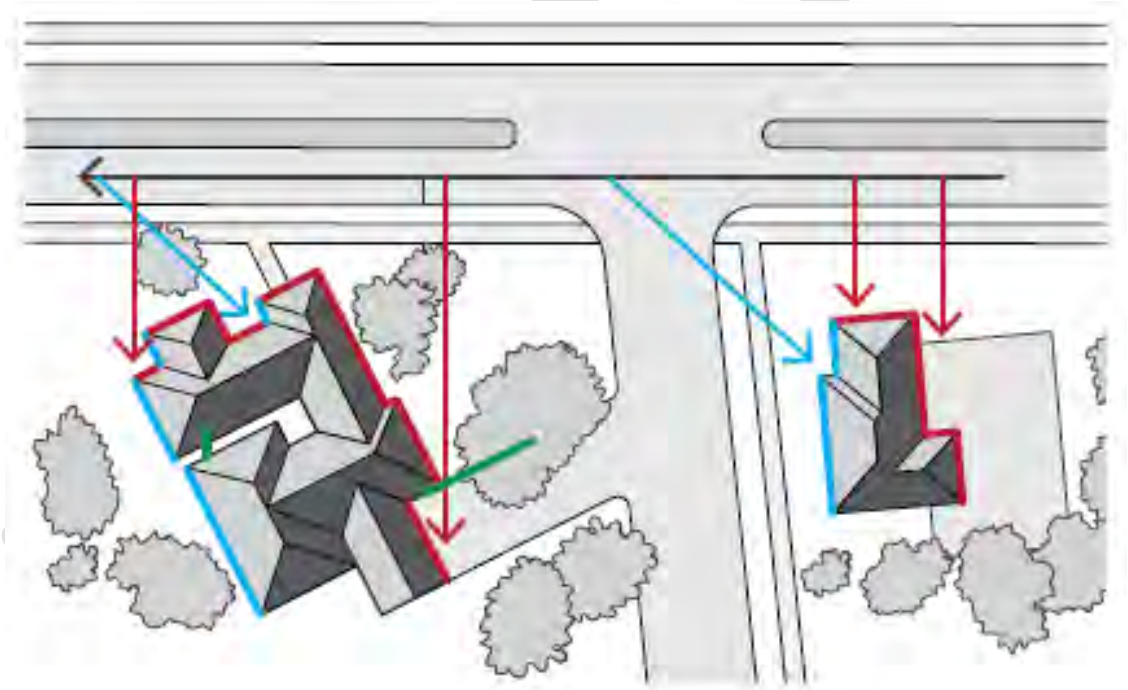
Appendix A – Quiet House Packages

The packages and information provided on the following pages are taken from *Road and Rail Noise Guidelines* (September 2019).

Where outdoor and indoor noise levels received by a noise-sensitive land-use and/or development exceed the policy's noise target, implementation of quiet house requirements is an acceptable solution.

With regards to the packages, the following definitions are provided:

- **Facing** the transport corridor (red): Any part of a building façade is 'facing' the transport corridor if any straight line drawn perpendicular (at a 90 degree angle) to its nearest road lane or railway line intersects that part of the façade without obstruction (ignoring any fence).
- **Side-on** to transport corridor (blue): Any part of a building façade that is not 'facing' is 'side-on' to the transport corridor if any straight line, at any angle, can be drawn from it to intersect the nearest road lane or railway line without obstruction (ignoring any fence).
- **Opposite** to transport corridor (green): Neither 'side on' nor 'facing', as defined above.



Quiet House Package A

56-58 dB $L_{Aeq(Day)}$ & 51-53 dB $L_{Aeq(Night)}$

Element	Orientation	Room	
		Bedroom	Indoor Living and Work Areas
External Windows	Facing	• Up to 40% floor area ($R_w + C_{tr} \geq 28$): – Sliding or double hung with minimum 10mm single or 6mm-12mm-10mm double insulated glazing; – Sealed awning or casement windows with minimum 6mm glass. • Up to 60% floor area ($R_w + C_{tr} \geq 31$): – Sealed awning or casement windows with minimum 6mm glass.	• Up to 40% floor area ($R_w + C_{tr} \geq 25$): – Sliding or double hung with minimum 6mm single or 6mm-12mm-6mm double insulated glazing; • Up to 60% floor area ($R_w + C_{tr} \geq 28$); • Up to 80% floor area ($R_w + C_{tr} \geq 31$).
	Side On	As above, except $R_w + C_{tr}$ values may be 3 dB less or max % area increased by 20%.	
	Opposite	No specific requirements	
External Doors	Facing	• Fully glazed hinged door with certified $R_w + C_{tr} \geq 28$ rated door and frame including seals and 6mm glass.	• Doors to achieve $R_w + C_{tr} \geq 25$: – 35mm Solid timber core hinged door and frame system certified to R_w 28 including seals; – Glazed sliding door with 10mm glass and weather seals.
	Side On	As above, except $R_w + C_{tr}$ values may be 3 dB less.	
	Opposite	No specific requirements	
External Walls	All	• $R_w + C_{tr} \geq 45$: – Two leaves of 90mm thick clay brick masonry with minimum 20mm cavity; or – Single leaf of 150mm brick masonry with 13mm cement render on each face; or – One row of 92mm studs at 600mm centres with: ▪ Resilient steel channels fixed to the outside of the studs; and ▪ 9.5mm hardboard or fibre cement sheeting or 11mm fibre cement weatherboards fixed to the outside; ▪ 75mm thick mineral wool insulation with a density of at least 11kg/m^3; and ▪ 2 x 16mm fire-rated plasterboard to inside.	
Roofs and Ceilings	All	• $R_w + C_{tr} \geq 35$: • Concrete or terracotta tile or metal sheet roof with sarking and at least 10mm plasterboard.	
Outdoor Living Areas		At least one outdoor living area located on the opposite side of the building from the transport corridor and/or at least one ground level outdoor living area screened using a solid continuous fence or other structure of minimum 2 metres height above ground level.	

Quiet House Package B

59-62 dB $L_{Aeq(Day)}$ & 54-57 dB $L_{Aeq(Night)}$

Element	Orientation	Room	
		Bedroom	Indoor Living and Work Areas
External Windows	Facing	• Up to 40% floor area ($R_w + C_{tr} \geq 31$): – Fixed sash, awning or casement with minimum 6mm glass or 6mm-12mm-6mm double insulated glazing. • Up to 60% floor area ($R_w + C_{tr} \geq 34$): – Fixed sash, awning or casement with minimum 10mm glass or 6mm-12mm-10mm double insulated glazing.	• Up to 40% floor area ($R_w + C_{tr} \geq 28$): – Sliding or double hung with 6mm-12mm-10mm double insulated glazing; – Sealed awning or casement windows with minimum 6mm glass. • Up to 60% floor area ($R_w + C_{tr} \geq 31$); • Up to 80% floor area ($R_w + C_{tr} \geq 34$).
	Side On	As above, except $R_w + C_{tr}$ values may be 3 dB less or max % area increased by 20%.	
	Opposite	As above, except $R_w + C_{tr}$ values may be 6 dB less or max % area increased by 20%.	
External Doors	Facing	• Fully glazed hinged door with certified $R_w + C_{tr} \geq 31$ rated door and frame including seals and 10mm glass.	• Doors to achieve $R_w + C_{tr} \geq 28$: – 40mm Solid timber core hinged door and frame system certified to R_w 32 including seals; – Fully glazed hinged door with certified $R_w + C_{tr} \geq 28$ rated door and frame including seals and 6mm glass.
	Side On	As above, except $R_w + C_{tr}$ values may be 3 dB less or max % area increased by 20%.	
	Opposite	As above, except $R_w + C_{tr}$ values may be 6 dB less or max % area increased by 20%.	
External Walls	All	• $R_w + C_{tr} \geq 50$: – Two leaves of 90mm thick clay brick masonry with minimum 50mm cavity between leaves and 25mm glasswool or polyester (24kg/m^3). Resilient ties used where required to connect leaves. – Two leaves of 110mm clay brick masonry with minimum 50mm cavity between leaves and 25mm glasswool or polyester insulation (24kg/m^3). – Single leaf of 220mm brick masonry with 13mm cement render on each face. – 150mm thick unlined concrete panel or 200mm thick concrete panel with one layer of 13mm plasterboard or 13mm cement render on each face. – Single leaf of 90mm clay brick masonry with: ▪ A row of 70mm x 35mm timber studs or 64mm steel studs at 600mm centres; ▪ A cavity of 25mm between leaves; ▪ 50mm glasswool or polyester insulation (11kg/m^3) between studs; and ▪ One layer of 10mm plasterboard fixed to the inside face.	
Roofs and Ceilings	All	• $R_w + C_{tr} \geq 35$: – Concrete or terracotta tile or metal sheet roof with sarking and at least 10mm plasterboard ceiling with R3.0+ fibrous insulation.	
Outdoor Living Areas		At least one outdoor living area located on the opposite side of the building from the transport corridor and/or at least one ground level outdoor living area screened using a solid continuous fence or other structure of minimum 2.4 metres height above ground level.	

Quiet House Package C

63-66 dB $L_{Aeq(Day)}$ & 58-61 dB $L_{Aeq(Night)}$

Element	Orientation	Room	
		Bedroom	Indoor Living and Work Areas
External Windows	Facing	• Up to 20% floor area ($R_w + C_{tr} \geq 31$): – Fixed sash, awning or casement with minimum 6mm glass or 6mm-12mm-6mm double insulated glazing. • Up to 40% floor area ($R_w + C_{tr} \geq 34$): – Fixed sash, awning or casement with minimum 10mm glass or 6mm-12mm-10mm double insulated glazing.	• Up to 40% floor area ($R_w + C_{tr} \geq 31$): – Fixed sash, awning or casement with minimum 6mm glass or 6mm-12mm-6mm double insulated glazing. • Up to 60% floor area ($R_w + C_{tr} \geq 34$): – Fixed sash, awning or casement with minimum 10mm glass or 6mm-12mm-10mm double insulated glazing.
	Side On	As above, except $R_w + C_{tr}$ values may be 3 dB less or max % area increased by 20%.	
	Opposite	As above, except $R_w + C_{tr}$ values may be 6 dB less or max % area increased by 20%.	
External Doors	Facing	• Not recommended.	• Doors to achieve $R_w + C_{tr} \geq 30$: – Fully glazed hinged door with certified $R_w + C_{tr} \geq 31$ rated door and frame including seals and 10mm glass; – 40mm Solid timber core side hinged door, frame and seal system certified to R_w 32 including seals. Any glass inserts to be minimum 6mm.
	Side On	As above, except $R_w + C_{tr}$ values may be 3 dB less or max % area increased by 20%.	
	Opposite	As above, except $R_w + C_{tr}$ values may be 6 dB less or max % area increased by 20%.	
External Walls	All	• $R_w + C_{tr} \geq 50$: – Two leaves of 90mm thick clay brick masonry with minimum 50mm cavity between leaves and 25mm glasswool or polyester insulation (24kg/m^3). Resilient ties used where required to connect leaves. – Two leaves of 110mm clay brick masonry with minimum 50mm cavity between leaves and 25mm glasswool or polyester insulation (24kg/m^3). – Single leaf of 220mm brick masonry with 13mm cement render on each face. – 150mm thick unlined concrete panel or 200mm thick concrete panel with one layer of 13mm plasterboard or 13mm cement render on each face. – Single leaf of 90mm clay brick masonry with: ▪ A row of 70mm x 35mm timber studs or 64mm steel studs at 600mm centres; ▪ A cavity of 25mm between leaves; ▪ 50mm glasswool or polyester insulation (11kg/m^3) between studs; and ▪ One layer of 10mm plasterboard fixed to the inside face.	
Roofs and Ceilings	All	• $R_w + C_{tr} \geq 40$: – Concrete or terracotta tile roof with sarking, or metal sheet roof with foil backed R2.0+ fibrous insulation between steel sheeting and roof battens; – R3.0+ insulation batts above ceiling; – 2 x 10mm plasterboard ceiling or 1 x 13mm sound-rated plasterboard affixed using steel furring channel to ceiling rafters.	
Outdoor Living Areas		At least one outdoor living area located on the opposite side of the building from the transport corridor and/or at least one ground level outdoor living area screened using a solid continuous fence or other structure of minimum 2.4 metres height above ground level.	

Mechanical Ventilation requirements

In implementing the acceptable treatment packages, the following mechanical ventilation / air-conditioning considerations are required:

- Acoustically rated openings and ductwork to provide a minimum sound reduction performance of R_w 40 dB into sensitive spaces;
- Evaporative systems require attenuated ceiling air vents to allow closed windows;
- Refrigerant based systems need to be designed to achieve National Construction Code fresh air ventilation requirements;
- Openings such as eaves, vents and air inlets must be acoustically treated, closed or relocated to building sides facing away from the corridor where practicable.

Notification

Notifications on title advise prospective purchasers of the potential for noise impacts from major transport corridors and help with managing expectations.

The Notification is to state as follows:

This lot is in the vicinity of a transport corridor and is affected, or may in the future be affected, by road and rail transport noise. Road and rail transport noise levels may rise or fall over time depending on the type and volume of traffic.

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 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_{eq}**

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

- **L_1**

The L_1 level represents the noise level exceeded for 1 percent of the measurement period and is considered to represent the average of the maximum noise levels measured.

- **L_{10}**

The L_{10} level represents the noise level exceeded for 10 percent of the measurement period and is considered to represent the "intrusive" noise level.

- **L_{90}**

The L_{90} level represents the noise level exceeded for 90 percent of the measurement period and is considered to represent the "background" noise level.

- **$L_{Aeq(Day)}$**

The $L_{Aeq(Day)}$ level is the logarithmic average of the L_{Aeq} levels from 6.00am to 10.00pm.

- **$L_{Aeq(Night)}$**

The $L_{Aeq(Night)}$ level is the logarithmic average of the L_{Aeq} levels from 10.00pm to 6.00am.

- **$L_{A10,18hour}$**

The $L_{A10,18hour}$ level is the arithmetic average of the hourly L_{A10} levels between 6.00am and midnight.

- **$L_{Aeq,24hour}$**

The $L_{Aeq,24hour}$ level is the logarithmic average of the L_{Aeq} levels from over an entire day.

- **Noise-sensitive land use and/or development**

Land-uses or development occupied or designed for occupation or use for residential purposes (including dwellings, residential buildings or short-stay accommodation), caravan park, camping ground, educational establishment, child care premises, hospital, nursing home, corrective institution or place of worship.

- **R_w**

This is the weighted sound reduction index. It is a single number rating determined by moving a grading curve in integral steps against the laboratory measured transmission loss until the sum of the deficiencies at each one-third-octave band, between 100 Hz and 3.15 kHz, does not exceed 32 dB. The higher the R_w value, the better the acoustic performance.

- **C_{tr}**

This is a spectrum adaptation term for airborne noise and provides a correction to the R_w value to suit source sounds with significant low frequency content such as road traffic or home theatre systems. A wall that provides a relatively high level of low frequency attenuation (i.e. masonry) may have a value in the order of – 4 dB, whilst a wall with relatively poor attenuation at low frequencies (i.e. stud wall) may have a value in the order of -12 dB.

- **About the Term 'Reasonable'**

An assessment of reasonableness should demonstrate that efforts have been made to resolve conflicts without comprising on the need to protect noise-sensitive land-use activities. For example, have reasonable efforts been made to design, relocate or vegetate a proposed noise barrier to address community concerns about the noise barrier height? Whether a noise mitigation measure is reasonable might include consideration of:

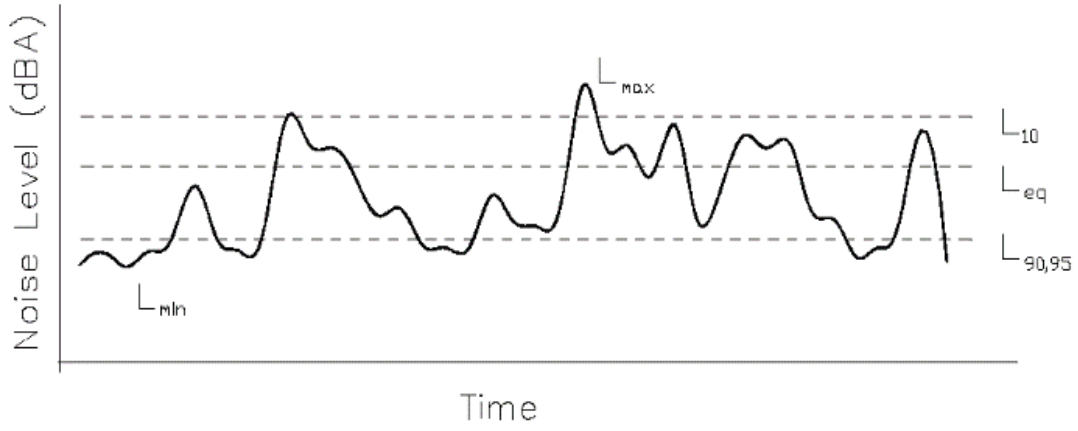
- The noise reduction benefit provided;
- The number of people protected;
- The relative cost vs benefit of mitigation;
- Road conditions (speed and road surface) significantly differ from noise forecast table assumptions;
- Existing and future noise levels, including changes in noise levels;
- Aesthetic amenity and visual impacts;
- Compatibility with other planning policies;
- Differences between metropolitan and regional situations and whether noise modelling requirements reflect the true nature of transport movements;
- Ability and cost for mobilisation and retrieval of noise monitoring equipment in regional areas;
- Differences between Greenfield and infill development;
- Differences between freight routes and public transport routes and urban corridors;
- The impact on the operational capacity of freight routes;
- The benefits arising from the proposed development;
- Existing or planned strategies to mitigate the noise at source.

- **About the Term 'Practicable'**

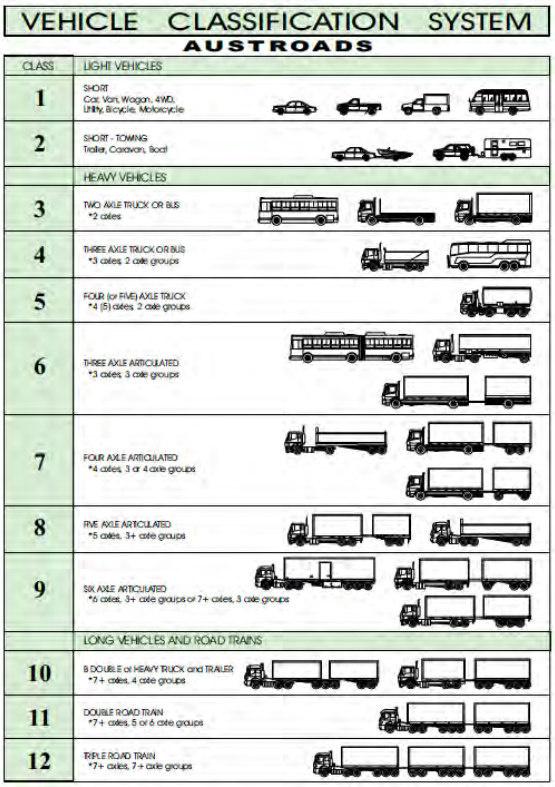
'Practicable' considerations for the purposes of the policy normally relate to the engineering aspects of the noise mitigation measures under evaluation. It is defined as "reasonably practicable having regard to, among other things, local conditions and circumstances (including costs) and to the current state of technical knowledge" (*Environmental Protection Act 1986*). These may include:

- Limitations of the different mitigation measures to reduce transport noise;
- Competing planning policies and strategies;
- Safety issues (such as impact on crash zones or restrictions on road vision);
- Topography and site constraints (such as space limitations);
- Engineering and drainage requirements;
- Access requirements (for driveways, pedestrian access and the like);
- Maintenance requirements;
- Bushfire resistance or BAL ratings;
- Suitability of the building for acoustic treatments.

- **Chart of Noise Level Descriptors**



- **Austroads Vehicle Class**



- **Typical Noise Levels**