

Transportation Noise Assessment

Aura Western Village

Trinity Estate, Alkimos

Reference: 18054435-03B

Prepared for:
Satterley

Report: 18054435-03B

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Date:	Rev	Description	Prepared By	Verified
22-Dec-20	0	Issued to Client	Matt Moyle	Daniel Lloyd
14-Apr-21	A	Revised Layout	Matt Moyle	Daniel Lloyd
9-Jan-24	B	Revised Subdivision Layout	Matt Moyle	Daniel Lloyd

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1 INTRODUCTION

This report relates to Aura Western Village of Trinity Estate in Alkimos. As this subdivision is located adjacent to a major road (Marmion Avenue), an assessment of the traffic noise impacts is required. Previously, Lloyd George Acoustics prepared a transportation noise assessment for:

- Aura Stages 32A in May 2018 (LGA Ref: 18054435-01);
- Aura Stages 33A and 33B in October 2020 (LGA Ref: 18054435-02);
- Trinity Aura (Revised Layout) April 2021 (LGA Ref: 18054435-03A).

This report follows the same methodology as those prepared previously, while providing recommendations to reflect the latest Subdivision Layout for unreleased Stages.

For a general locality map, refer to *Figure 1-1* with the subdivision layout (subject areas of change highlighted) is shown in *Figure 1-2*.

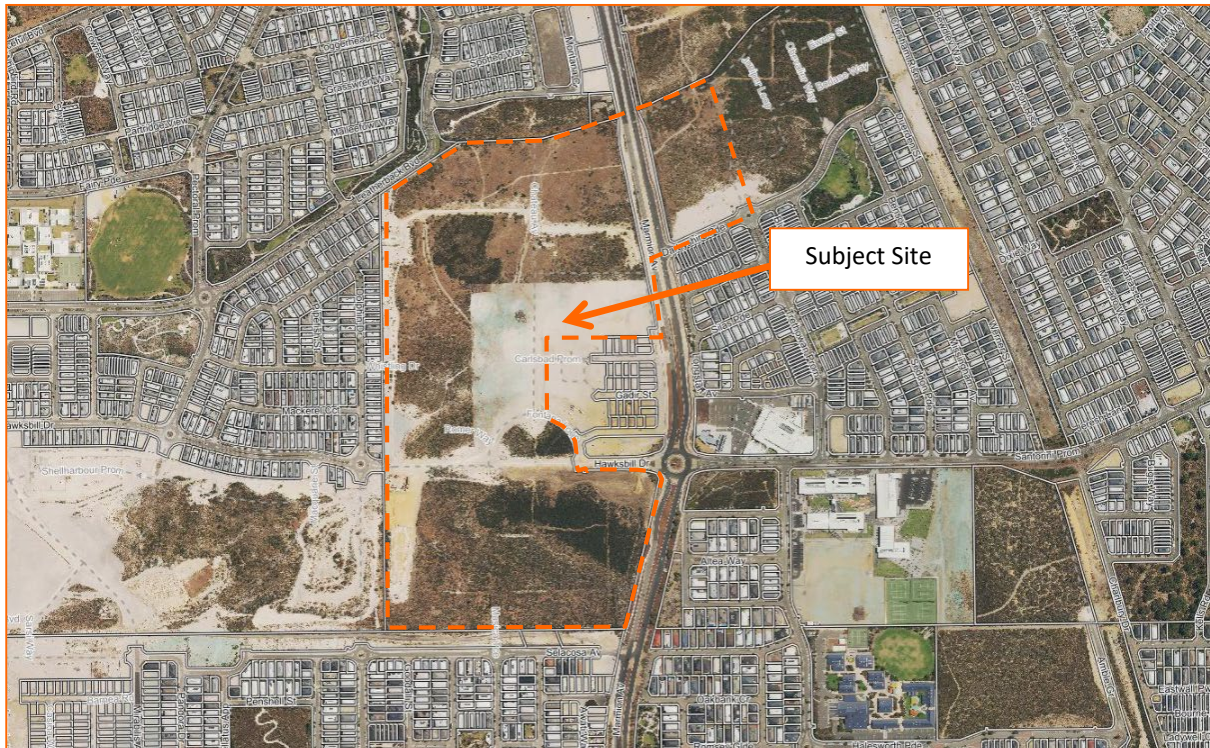


Figure 1-1 Project Locality (City of Wanneroo Intramaps)

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

2 CRITERIA

The criteria relevant to this assessment is the *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). 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

Outdoor Noise Target		Indoor Noise Target	
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, habitable¹ facade of the noise sensitive building.
- For all noise-sensitive land-use and/or development, indoor noise targets for other room usages may be reasonable 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 is undertaken.

In the application of the noise targets, the objective is to achieve:

- indoor noise levels specified in *Table 2-1* in noise-sensitive areas (e.g. bedrooms and living rooms of houses and school classrooms); and
- a reasonable degree of acoustic amenity for outdoor living areas on each residential lot. For non-residential noise-sensitive developments, for example schools and childcare centres, the design of outdoor areas should take into consideration the noise target.

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 the Policy as described below in *Section 3.1* and *Section 3.2*.

3.1 Site Measurements

Noise monitoring was undertaken adjacent 40 metres from the nearest carriageway of Marmion Avenue, in close proximity to the proposed subdivision (approximately 150m north of Santorini Promenade). The monitoring was undertaken between 4 and 8 December 2020 noting that Marmion Avenue is now a dual carriageway (4 lanes in total) in this area. The data is used to determine the differences between acoustic parameters $L_{Aeq(Day)}$ and $L_{Aeq(Night)}$ and to calibrate the noise model.

The instrument used was an ARL Ngara noise data logger. Sound pressure levels were measured in accordance with Australian Standard 2702-1984: *Acoustics - Method For Measurement of Road Traffic Noise*. The logger was placed in free field with a microphone height of 1.4 metres above ground floor level.

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 logger.

From the hourly measurements, the $L_{Aeq(Day)}$ and $L_{Aeq(Night)}$ values were determined for each complete measurement day. These results were averaged and the mean level reported.



Figure 3-1 Noise Data Logger on Site

The noise data collected was verified by inspection and professional judgement. Where hourly data was considered atypical, an estimated value was inserted as required by MRWA.

3.2 Noise Modelling

The computer programme *SoundPLAN 8.0* 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 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.

Predictions are made at heights of 1.4 m above ground floor level for single storey houses and 4.2 m for double storey houses. The noise is predicted at 1.0 metre from an assumed building facade 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.

Note that in order to maintain consistency with other stages of Trinity Estate, noise model inputs have been generally maintained from the previous assessments in May 2018 and October 2020, however updates to traffic data have been obtained to match the updated site monitoring.

3.2.1 Ground Topography, Road Design & Cadastral Data

Topographical data for the finished earthworks was provided by GHD. Road and surrounding land ground levels were obtained from Landgate and previous project involvement on the Trinity Estate development (also by GHD).

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.

3.2.2 Traffic Data

Traffic data includes:

- Road Surface – The existing and future road surface is assumed to be dense-graded asphalt. The noise relationship between the various road surfaces is provided in *Table 3-1*. As a guide, 14 mm chip seal would be the noisiest surface and open-graded asphalt the quietest.

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	-1.5 dB	-2.5 dB

- Vehicle Speed – The existing and future posted speed throughout the project area is assumed to be 80km/h.
- Traffic Volumes – Existing and future traffic volumes used in the modelling have been provided by Main Roads. The current 2020 traffic volumes, based on the most recent intersection counts along Marmion Avenue (site LM01231), are assumed to be 24,100 vehicles per day (combined). The future (2043) traffic volumes are predicted to be 42,900 vehicles per day based on LVP ROM24 Modelling (Provided by Thomas Ng, Modelling analyst, Ref No. 41731). It was advised that the future traffic was calibrated with the existing network model and allowance for Romeo Road connection to Mitchell Freeway. The current and future percentage of heavy vehicles is assumed to be 5%.

3.2.3 Ground Attenuation

The ground attenuation has been assumed to be 0.0 (0%) within the road reserve, 0.75 (75%) within the subdivision. Note 0.0 represents hard reflective surfaces such as asphalt and water and 1.00 represents absorptive surfaces such as grass.

3.2.4 Parameter Conversion

The CoRTN algorithms used in the *SoundPLAN* modelling package were originally developed to calculate the $L_{A10,18\text{hour}}$ noise level. The Policy however uses $L_{Aeq(\text{Day})}$ and $L_{Aeq(\text{Night})}$. The relationship between the parameters varies depending on the composition of traffic on the road (volumes in each period and percentage heavy vehicles). The *SoundPLAN* model converts these parameters based on the findings from the technical paper *Converting the UK Traffic Noise Index $L_{A10,18h}$ to EU Noise Indices for Noise Mapping*; TRL Limited. The results are also compared against the measured data for consistency.

4 RESULTS

4.1 Noise Monitoring

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

Table 4-1 Measured Average Noise Levels Adjacent to Marmion Ave

Date	Average Weekday Noise Level, dB		
	L _{A10,18hour}	L _{Aeq (Day)}	L _{Aeq (Night)}
4/12/20	62.0	60.7	53.3
7/12/20	60.7	60.8	51.9
8/12/20	60.9	60.6	52.0
Weekday Average	61.2	60.7	52.4

The average differences between the weekday L_{Aeq(Day)} and L_{Aeq(Night)} is greater than 5 dB. As such, it is the day period noise levels that will dictate compliance. Therefore the modelling will only consider the day period levels. The average difference between L_{A10,18hour} and L_{Aeq(day)} is 0.5 dB and this factor has been used throughout the future prediction results.

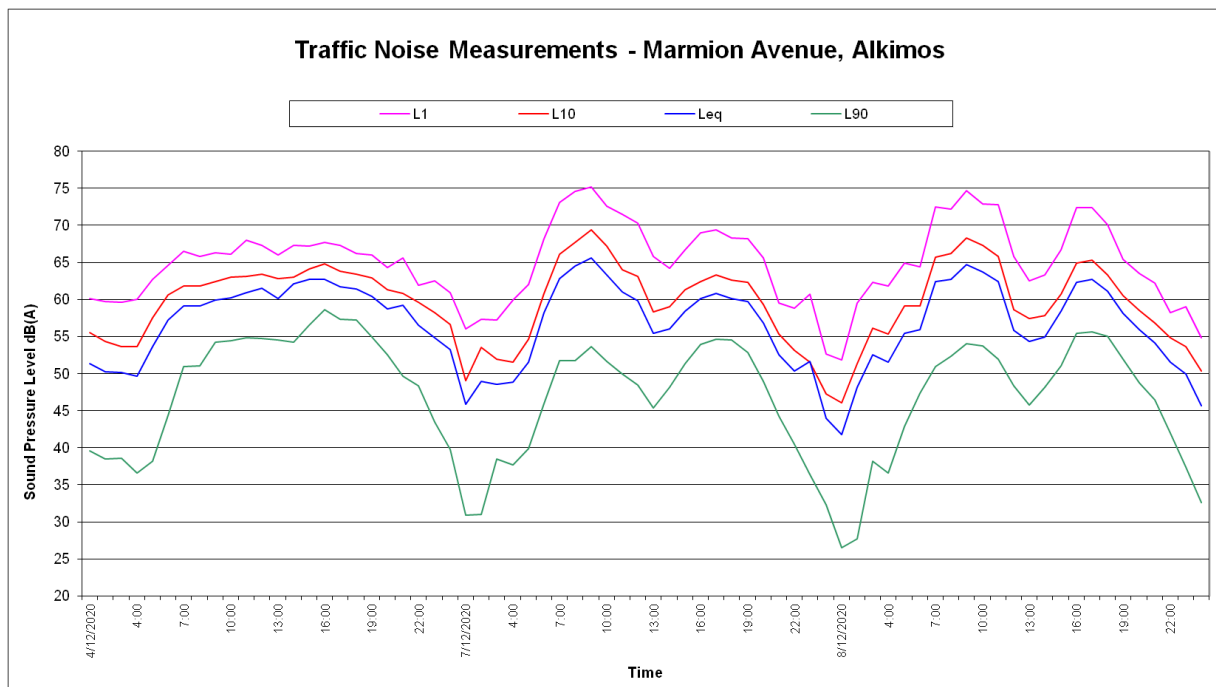
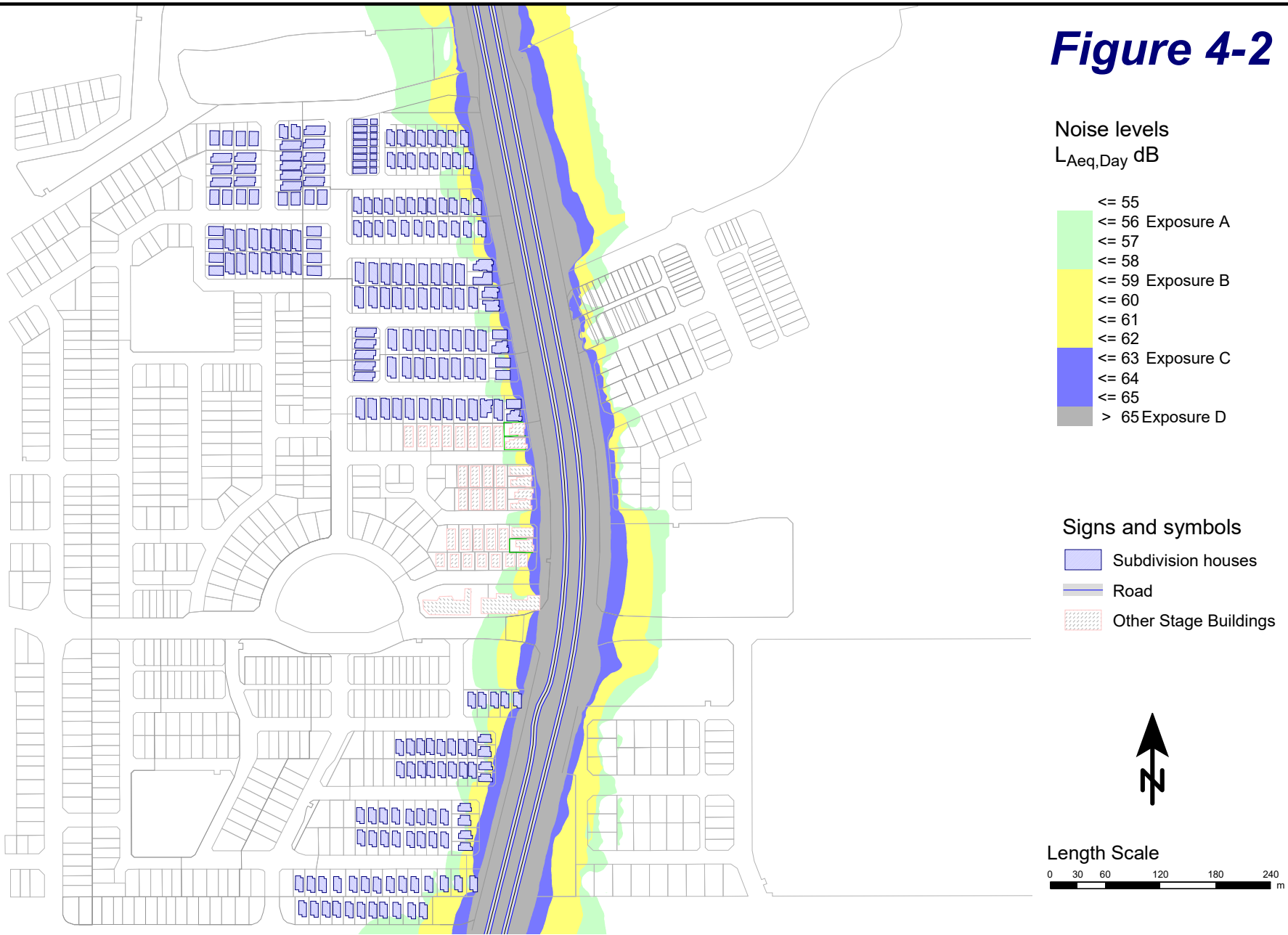


Figure 4-1 Noise Monitoring Results Adjacent to Marmion Avenue

4.2 Noise Modelling

The results of the noise modelling for future conditions, are provided in *Figure 4-2* for ground floor, and *Figure 4-3* for upper floors.

Figure 4-2

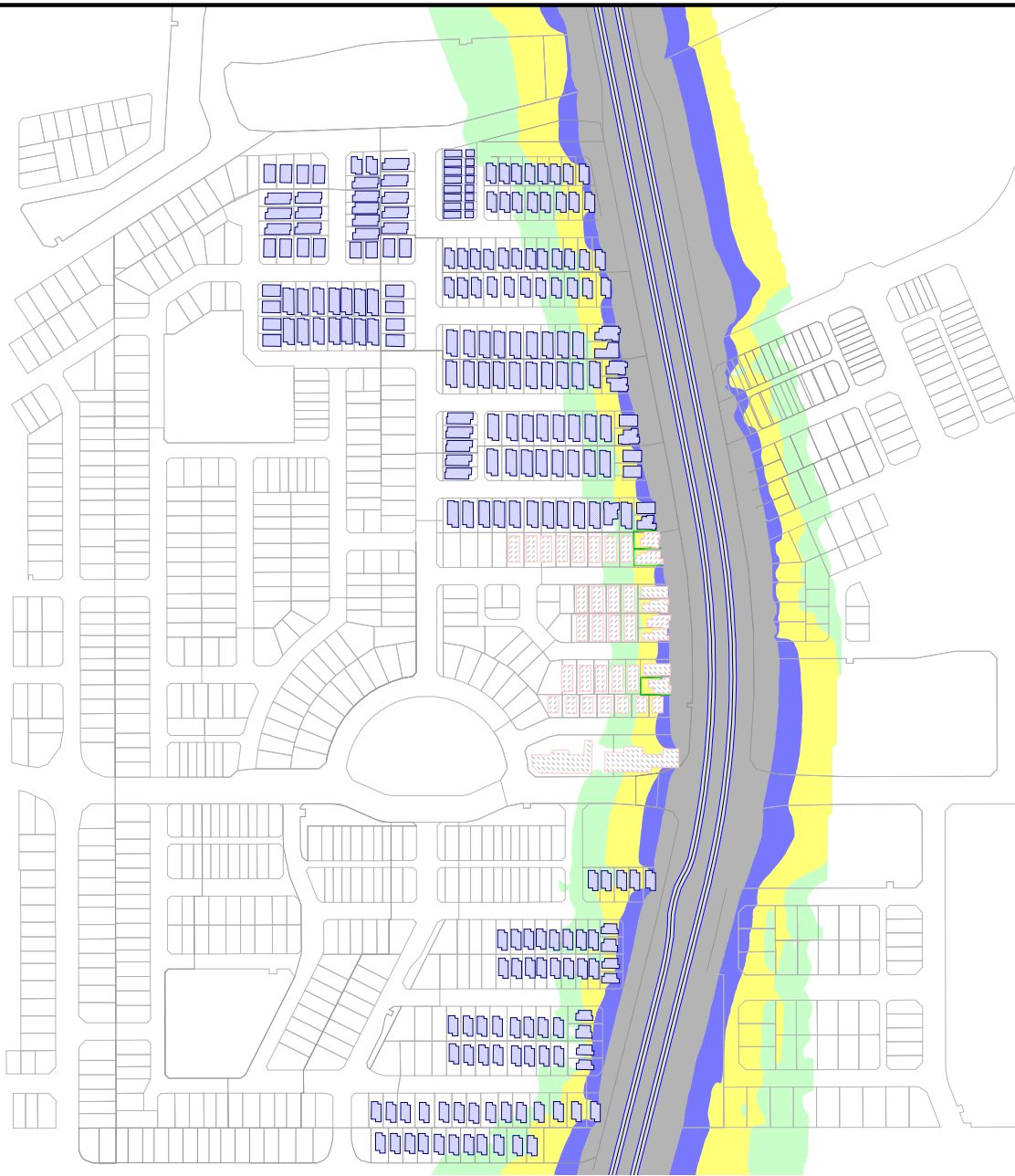


Trinity Western Village - Ground Floor
 $L_{Aeq,(Day)}$ Noise Level Contours - Future (2043) Traffic Volumes



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

Figure 4-3



Noise levels
 $L_{Aeq,Day}$ dB

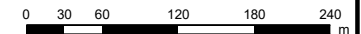
- <= 55
- <= 56 Exposure A
- <= 57
- <= 58
- <= 59 Exposure B
- <= 60
- <= 61
- <= 62
- <= 63 Exposure C
- <= 64
- <= 65
- > 65 Exposure D

Signs and symbols

-  Subdivision houses
-  Road
-  Other Stage Buildings



Length Scale



Trinity Western Village - First Floor
 $L_{Aeq,(Day)}$ Noise Level Contours - Future (2043) Traffic Volumes



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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 of houses and school classrooms); 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 controls are necessary.

With reference to the predicted noise levels in *Section 4.2*, it is evident the outdoor noise target will be exceeded. It is understood that barrier mitigation along Marmion Avenue is not practicable as part of the development, therefore noise impacts would need to be addressed using façade protection. The Policy provides “deemed to comply” facade packages (Package A, B and C) where traffic noise is above the outdoor target.

As such, the following is recommended:

- Where lots are above the outdoor noise target, the following Packages (refer *Appendix A*) are required:
 - Package A where noise levels are between 56 dB and 58 dB $L_{Aeq(Day)}$;
 - Package B where noise levels are between 59 dB and 62 dB $L_{Aeq(Day)}$;
 - Package C where noise levels are between 63 dB and 66 dB $L_{Aeq(Day)}$;
 - Specialist Advice where noise levels are greater than 66 dB $L_{Aeq(Day)}$.

Alternative constructions from the deemed to satisfy packages may be acceptable if supported by a report undertaken by a suitably qualified acoustical consultant (member firm of the Association of Australasian Acoustical Consultants (AAAC)), once the lots specific building plans are available.

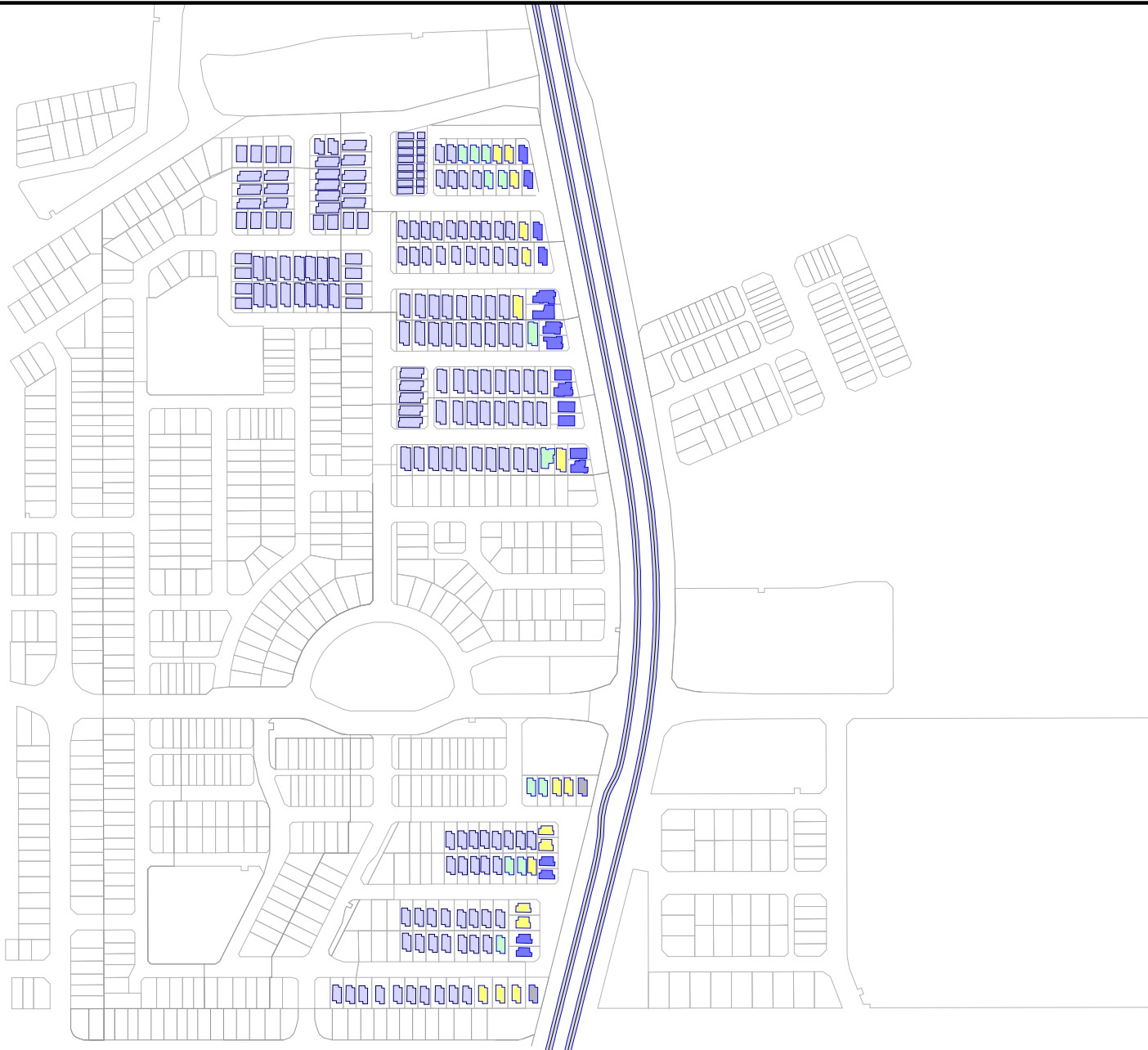
- All affected lots are to have notifications on lot titles as per SPP 5.4 requirements – refer *Appendix A*.

The proposed noise mitigation is provided on *Figure 5-1* and *Figure 5-2*, being for the ground and first floor respectively.

It should be noted that specialist advice could also be sought for any house design above the outdoor target, if desired, and can provide a customised facade design. This advice can be sought by a builder at the time of development of individual lots.

Affected lots are also to incorporate a notification on lot title as per the Policy requirements – refer *Appendix A*.

Figure 5-1

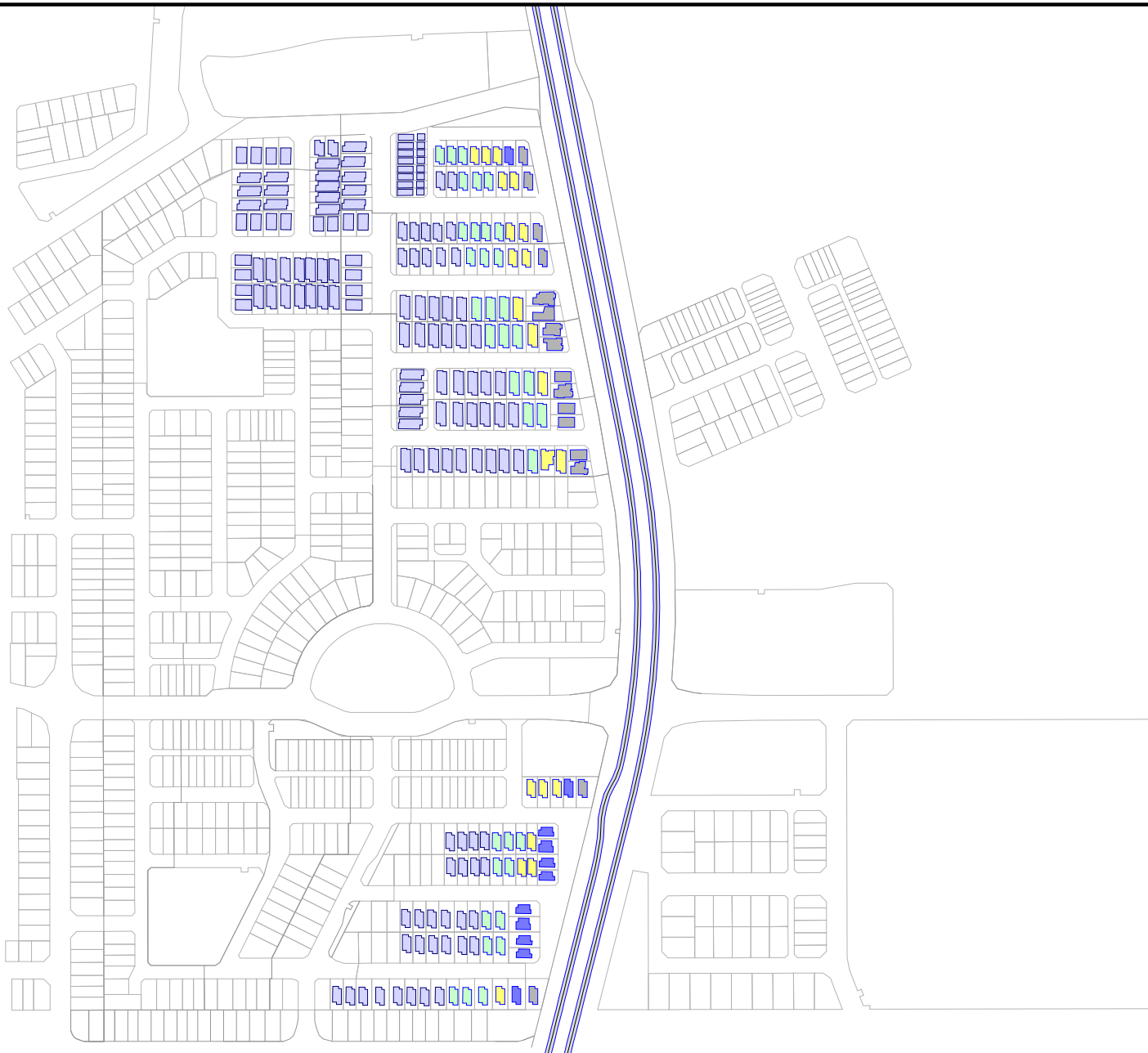






Trinity Western Village, Alkimos - Required Façade Treatments - Ground Floor

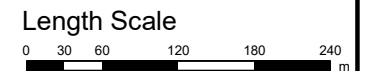


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Figure 5-2



- Signs and symbols
-  "Package A" Required
 -  "Package B" Required
 -  "Package C" Required
 -  Specialist Advice



Trinity Western Village, Alkimos - Required Façade Treatments - First Floor



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6 CONCLUSION

The results of this assessment show that assuming no noise control measures, there are a number of lots predicted to receive a future road traffic noise level that will be above the *target* criteria at ground floor and at upper floor level. Therefore under the requirements of the *State Planning Policy 5.4 Road and Rail Noise* the following noise mitigation measures are required as detailed in *Section 5* of this assessment.

In addition to the mitigation measures, the following should be considered:

- For dwellings requiring Packages A, B, C, Specialist Advice or alternative treatment to the deemed to satisfy can be accepted if supported by a report by a suitable qualified acoustical engineer (member firm of the Association of Australian Acoustical Consultants);
- All affected lots are to have notifications on lot titles as per the Policy requirements – refer *Appendix A*.
- All affected lots are to provide one outdoor entertaining area on the opposite side to the transport corridor (refer *Appendix A* for specific requirements for each Package).

Appendix A

Deemed to Comply Facade Packages

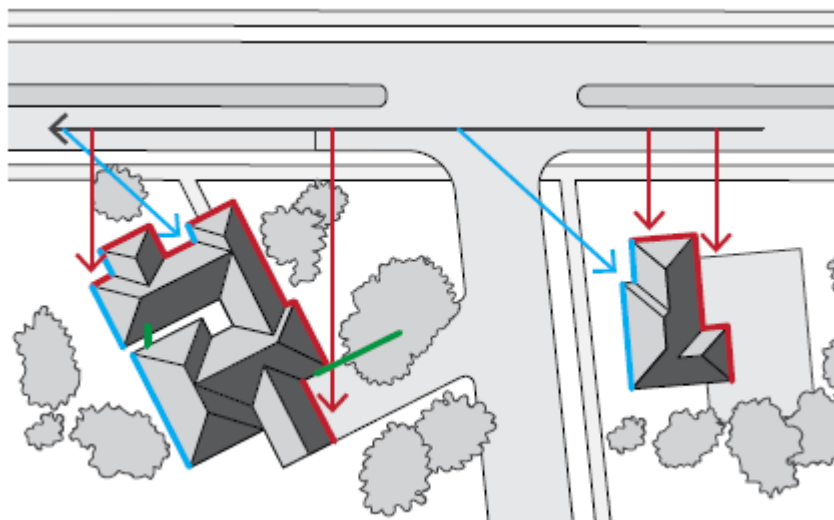
The packages and information provided on the following pages are taken from *Road and Rail Noise Guidelines* (September 2019).

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.

The quiet house packages are not the only solution to achieving acceptable internal transport noise levels. A suitably qualified acoustical engineer or consultant may also determine more tailored acoustic design requirements for buildings in a transport noise corridor by carrying out acoustic design in accordance with relevant industry standards. This includes the need to meet the relevant design targets specified in AS/NZS 2107:2016 for road traffic noise.

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 $L_{Aeq}(\text{Day})$ & 51-53 dB $L_{Aeq}(\text{Night})$

Element	Orientation	Room	
		Bedroom	Indoor Living and Work Areas
External Windows	Facing	<ul style="list-style-type: none"> • Up to 40% floor area ($R_w + C_{tr} \geq 28$): <ul style="list-style-type: none"> ○ 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 ($R_w + C_{tr} \geq 31$): <ul style="list-style-type: none"> ○ Sealed awning or casement windows with minimum 6mm glass. 	<ul style="list-style-type: none"> • Up to 40% floor area ($R_w + C_{tr} \geq 25$): <ul style="list-style-type: none"> ○ 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	<ul style="list-style-type: none"> • Fully glazed hinged door with certified $R_w + C_{tr} \geq 28$ rated door and frame including seals and 6mm glass. 	<ul style="list-style-type: none"> • Doors to achieve $R_w + C_{tr} \geq 25$: <ul style="list-style-type: none"> ○ 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	<ul style="list-style-type: none"> • $R_w + C_{tr} \geq 45$: <ul style="list-style-type: none"> ○ 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: <ul style="list-style-type: none"> ▪ 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 11kgkg/m³; and ▪ 2 x 16mm fire-rated plasterboard to inside. 	
Roofs and Ceilings	All	<ul style="list-style-type: none"> • $R_w + C_{tr} \geq 35$: <ul style="list-style-type: none"> ○ 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 $L_{Aeq}(\text{Day})$ & 54-57 dB $L_{Aeq}(\text{Night})$

Element	Orientation	Room	
		Bedroom	Indoor Living and Work Areas
External Windows	Facing	<ul style="list-style-type: none"> Up to 40% floor area ($R_w + C_{tr} \geq 31$): <ul style="list-style-type: none"> Fixed sash, awning or casement with minimum 6mm glass or 6mm-12mm-6mm double insulated glazing. Up to 60% floor area ($R_w + C_{tr} \geq 34$): <ul style="list-style-type: none"> Fixed sash, awning or casement with minimum 10mm glass or 6mm-12mm-10mm double insulated glazing. 	<ul style="list-style-type: none"> Up to 40% floor area ($R_w + C_{tr} \geq 28$): <ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> Fully glazed hinged door with certified $R_w + C_{tr} \geq 31$ rated door and frame including seals and 10mm glass. 	<ul style="list-style-type: none"> Doors to achieve $R_w + C_{tr} \geq 28$: <ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> $R_w + C_{tr} \geq 50$: <ul style="list-style-type: none"> 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: <ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> $R_w + C_{tr} \geq 35$: <ul style="list-style-type: none"> 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 $L_{Aeq}(\text{Day})$ & 58-61 dB $L_{Aeq}(\text{Night})$

Element	Orientation	Room	
		Bedroom	Indoor Living and Work Areas
External Windows	Facing	<ul style="list-style-type: none"> Up to 20% floor area ($R_w + C_{tr} \geq 31$): <ul style="list-style-type: none"> Fixed sash, awning or casement with minimum 6mm glass or 6mm-12mm-6mm double insulated glazing. Up to 40% floor area ($R_w + C_{tr} \geq 34$): <ul style="list-style-type: none"> Fixed sash, awning or casement with minimum 10mm glass or 6mm-12mm-10mm double insulated glazing. 	<ul style="list-style-type: none"> Up to 40% floor area ($R_w + C_{tr} \geq 31$): <ul style="list-style-type: none"> Fixed sash, awning or casement with minimum 6mm glass or 6mm-12mm-6mm double insulated glazing. Up to 60% floor area ($R_w + C_{tr} \geq 34$): <ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> Not recommended. 	<ul style="list-style-type: none"> Doors to achieve $R_w + C_{tr} \geq 30$: <ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> $R_w + C_{tr} \geq 50$: <ul style="list-style-type: none"> 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: <ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> $R_w + C_{tr} \geq 40$: <ul style="list-style-type: none"> 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 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.

L₁

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.

L₁₀

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.

L₉₀

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 $L_{A10,18\text{ hour}}$ 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 $L_{Aeq,24\text{ hour}}$ 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 $L_{A10,18\text{hour}}$.

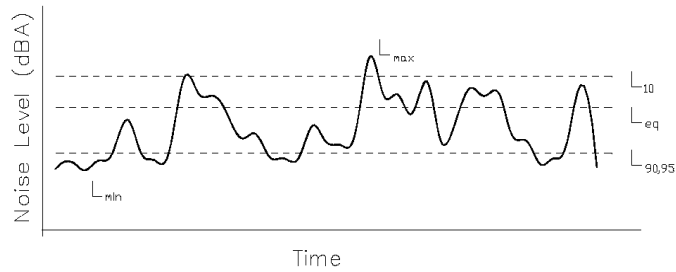
Satisfactory Design Sound Level

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



Austrroads Vehicle Class

AUSTROADS Vehicle Classification System

Level 1 Length (m)	Level 2 Axles and Axle Groups	Level 3 Vehicle Type	AUSTROADS Classification		
Type	Class	Typical Description	Class	Parameters	Typical Configuration
Short up to 5.5m	1 or 2	Short Sedan, Wagon, 4WD, Utility, Light Van, Minivan, Microbus, etc.	1	$d(1) \leq 3.2m$ and axles = 2	
		Short - Towing Trailer, Caravan, Boat, etc. etc.	2	groups = 3 $d(1) > 2.1m$, $d(1) \leq 3.2m$, $d(2) \leq 2.1m$ and axles = 3, 4 or 5	
Medium 5.5m to 14.5m	2	Two Axle Truck or Bus	3	$d(1) > 3.2m$ and axles = 2	
	3	Three Axle Truck or Bus	4	axles = 3 and groups = 2	
	>3	Four Axle Truck	5	axles = 3 and groups = 2	
Long 14.5m to 19.5m	3	Three Axle Articulated Three axle articulated vehicle or rigid vehicle and trailer	6	$d(1) > 3.2m$, axles = 3 and groups = 3	
	4	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	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	Six Axle Articulated Six axle articulated vehicle or rigid vehicle and trailer	9	axles = 6 and groups = 2 or axles = 6 and groups = 3	
	>6	8 Double 8 Double or Heavy truck and trailer	10	groups = 4 and axles = 5	
Medium Combination 14.5m to 30.5m	>6	5 or 6 Double Road Train Double road train, or Medium articulated vehicle and one dog trailer (M.A.T.)	11	groups = 5 or 6 and axles = 6	
Large Combination Over 33.0m	>6	>6 Triple Road Train Triple road train, or Heavy truck and three trailers	12	groups = 6 and axles = 6	

Definitions:
 Group: Axle groups whose adjacent axles are less than 2.1m apart
 Class: 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

