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Transportation Noise Assessment

Watson Land Near Intersection of Safety Bay Road and Kwinana Freeway

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Prepared for:
CLE & Perron Developments

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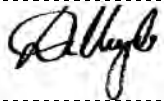
Verified	Daniel Lloyd 
Date:	7 November 2014

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1 INTRODUCTION

Perron Developments are proposing to subdivide land referred to as the Watson Land, being Lots 921, 922 and 3 and being to the west of the Kwinana Freeway, north of Safety Bay Road and east of Baldivis Road – refer *Figure 1.1*.

As the subject site is to be residential and is in close proximity to the Kwinana Freeway, being a major road, it is a requirement to undertake an acoustic assessment in order to assess the potential noise impacts and possible mitigation/management options.

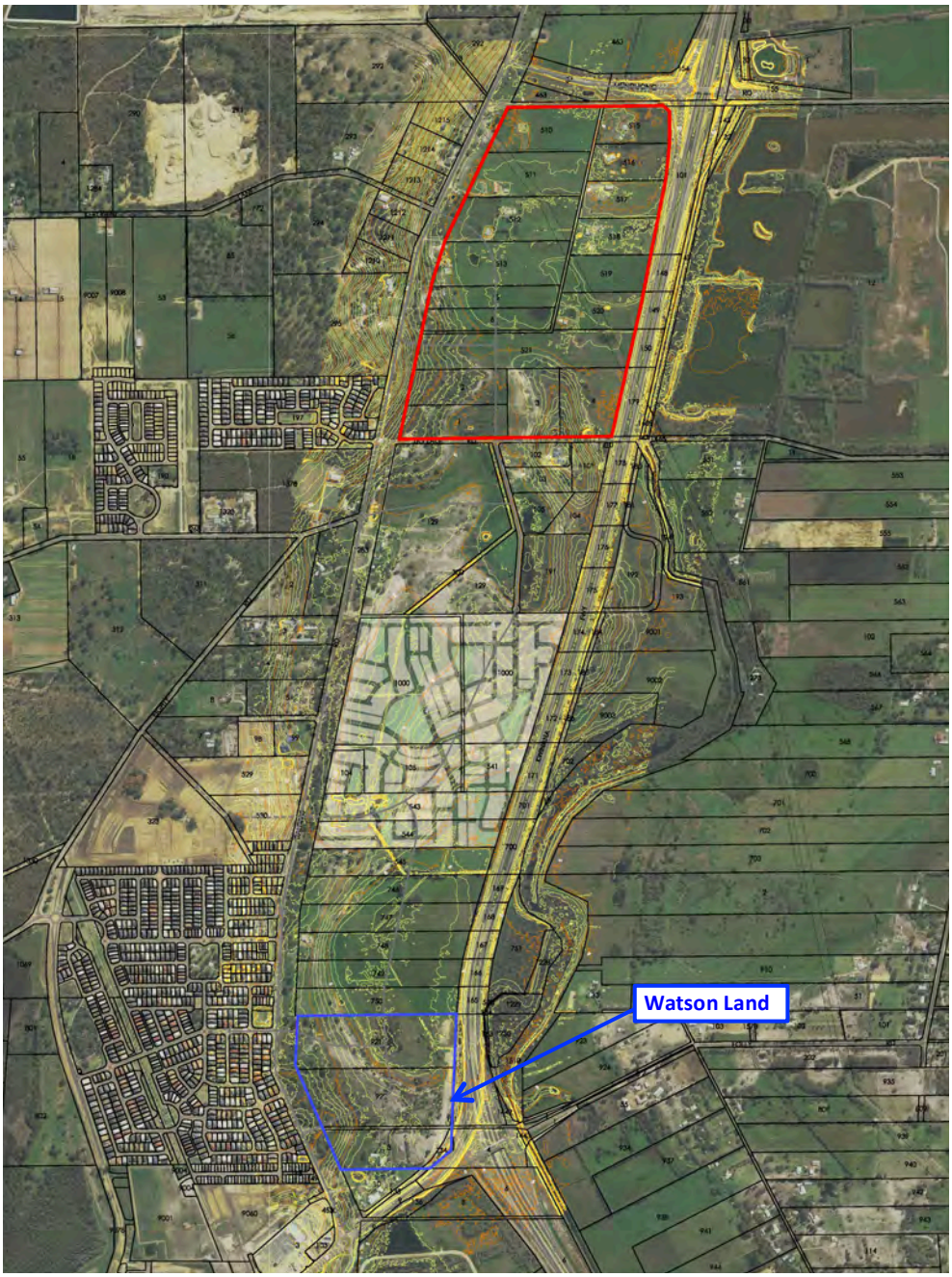


Figure 1-1 Subject Site Locality (Source: CL Site Plan No. 2304-03A-01E)

Figure 1-2 provides the proposed concept for the subdivision.

Figure 1-2 Proposed Subdivision Concept (Source: CLE Plan No. 2304-94C-03)

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 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, but noise levels are likely to be within the 5 dB margin (i.e. less than the *limit*), mitigation measures should be implemented by the developer with a view to achieving the *target* levels in at least one outdoor living area on each residential lot. Where indoor spaces are planned to be facing any outdoor area in the *margin*, mitigation measures should be implemented to achieve acceptable indoor noise levels in those spaces.

In areas where the *limit* is exceeded (i.e. above $L_{Aeq(Day)}$ of 60dB(A) or $L_{Aeq(Night)}$ of 55dB(A)), a detailed noise assessment is to be undertaken. 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.

3 METHODOLOGY

Noise measurements 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 at four (4) locations 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 instruments used were ARL Type 316 noise data loggers with the microphone 1.4 metres above ground level in free-field conditions – refer *Figures 3-1 to 3-4*. The loggers were located on and near the subject site, as shown on *Figure 3-5*. Each logger was programmed to record hourly L_{A1}, L_{A10}, L_{A90}, and L_{Aeq} levels. This instrument complies with the requirements of *Australian Standard 2702-1984 Acoustics – Methods for the Measurement of Road Traffic Noise*. The loggers were 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.

Figure 3-1 Logger Near Mundijong Road

Figure 3-2 Logger Near Kwinana Fwy North

Figure 3-3 Logger Near Kwinana Fwy South

Figure 3-4 Logger Near Safety Bay Road

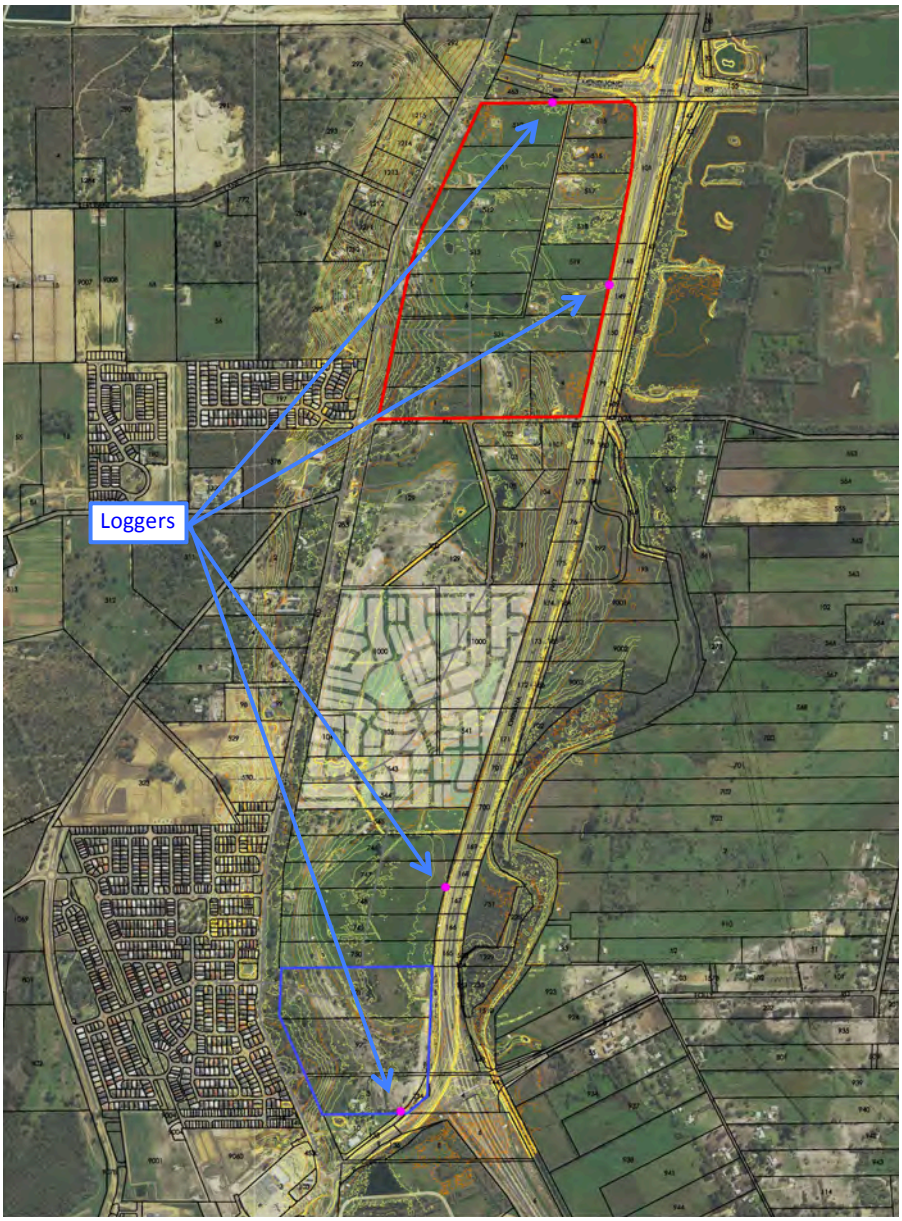


Figure 3-5 Logger Localities

3.2 Noise Modelling

The computer programme *SoundPLAN 7.2* 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 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 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 mostly based on that provided by CLE, which is a combination of site survey and Landgate data. In addition, this data was combined with other already on file, particularly in relation to the Perth Bunbury Highway project.

Future buildings have 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 single storey buildings are assumed to have a height of 3.5 metres. Buildings have included those as part of this development, future buildings for the adjoining Lot 10 to the south and barriers and buildings proposed for the adjoining Lot 750 to the north.

Design levels for the subdivision were provided by Wood & Grieve, dated 13 July 2013. Note that design levels for adjoining future developments at Lot 10 were not available so the existing topography has been used. Indicative levels are available and have been used for Lot 750 to the north.

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*.

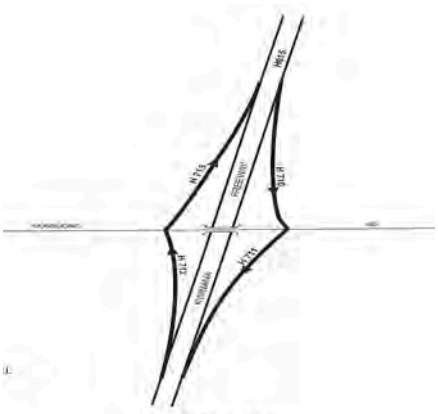
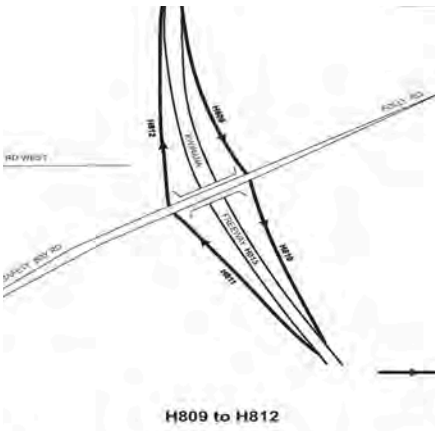
Table 3-1 Noise Relationship Between Different Road Surfaces

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

Kwinana Freeway has an open graded asphalt road surface and this is expected to also exist in the future.

Freeway on/off ramps generally consist of both dense and open graded asphalt with *Table 3-2* providing the information obtained from MRWA.

Table 3-2 Road Surfaces for On/Off Ramps

	**H710** OGA for 300m (from Kwin Fwy) and then DGA for remaining 50m **H711** DGA for 60m (from Mundijong Rd) and then OGA for remaining 330m **H712** OGA for 320m (from Kwin Fwy) and then DGA for remaining 60m **H713** DGA for 70m (from Mundijong Rd) and then OGA for remaining 280m
	**H809** DGA for all 390m **H810** DGA for all 390m **H811** DGA for all 410m **H812** DGA for all 370m

It is assumed Safety Bay Road and Mundijong Road are both currently dense graded asphalt and will remain this in the future.

- Vehicle Speed

  Kwinana Freeway has a posted speed of 100km/hr.

  Mundijong Road has a posted speed of 70km/hr whilst Safety Bay Road has a posted speed of 80km/hr.

  The posted speeds change on the on ramps from 70km/hr to 100km/hr at approximately 250 metres from Mundijong/Safety Bay Road and similarly on the off ramp from 100km/hr to 70km/hr.

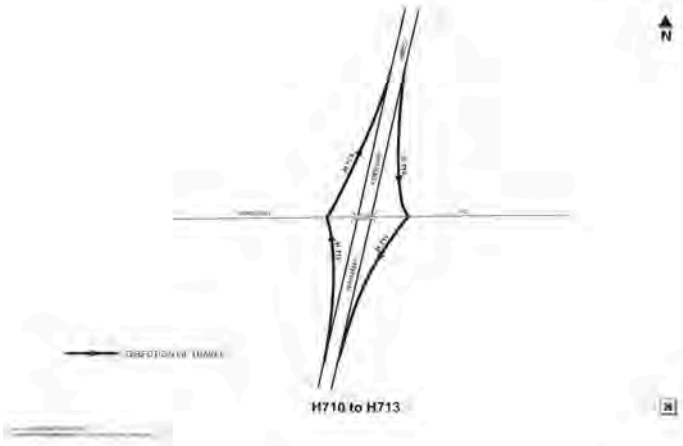
- Traffic Volumes –

  The most recent short term traffic counts were obtained from MRWA, generally being from 2012/13 with some data south of Safety Bay Road being 2011/12, which was then increased to estimated 2012/13 volumes. Also note that no traffic data was available for Folly Road, however this is expected to carry only very low volumes. The existing traffic volume information is summarised on *Figure 3-6*.

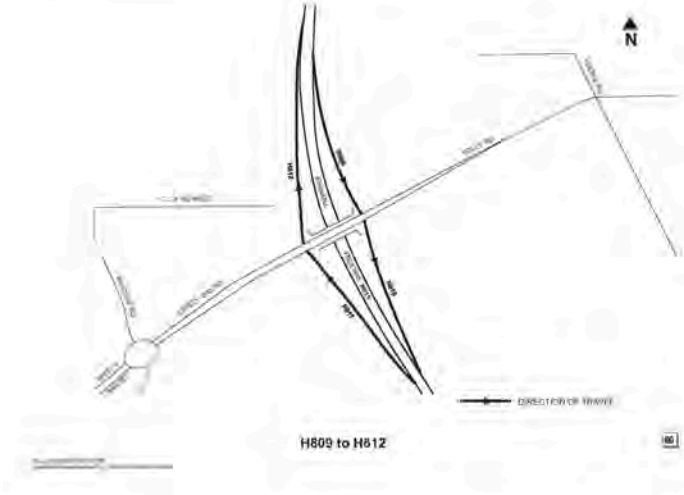
  The forecast 2031 traffic volumes were requested and obtained from MRWA. This has again been summarised in the same format as the existing traffic volumes in *Figure 3-7*, with *Figure 3-8* showing the plot provided by MRWA.

  It should be noted that only the 24-hour future volumes are provided by MRWA. It is considered that with the increase in traffic volumes, the percentage within an 18-hour period will increase over time so this has been estimated by adopting a 95% minimum relationship between the 18-hour and 24-hour volumes. Where the existing traffic volumes had a higher percentage relationship, the existing has been used.

  It was also advised by MRWA that the network in this area, particularly that in relation to Mundijong Road, west of the Freeway, is under review.

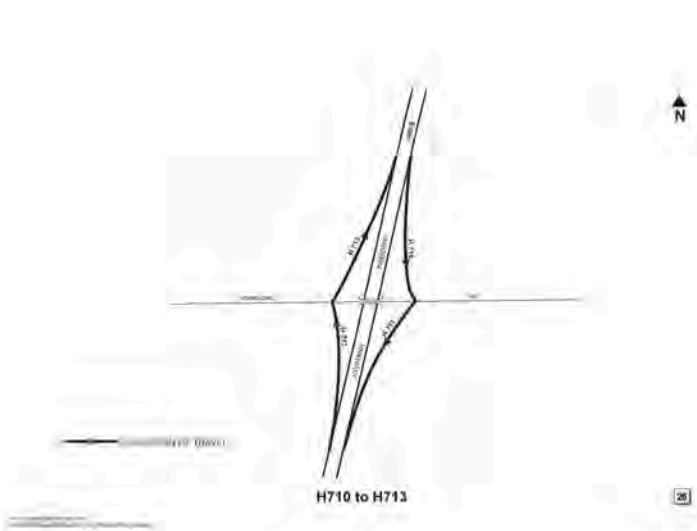


Road Name	Section	Direction	24hr Volume	% Heavy	% 18hr	18hr Cars	18hr Trucks
Kwinana Fwy	N of Ramp H710	Southbound	33617	9.2	95.3	29090	2947
Kwinana Fwy	Under Mundijong Road	Southbound	31212	9.4	95.5	27006	2802
Kwinana Fwy	S of Ramp H711	Southbound	31594	9.6	95.6	27304	2900
Kwinana Fwy	Under Safety Bay Road	Southbound	21783	9.0	95.8	18990	1878
Kwinana Fwy	S of Ramp H810	Southbound	22121	10.1	96.6	19211	2158
Kwinana Fwy	Off Ramp H710	Southbound	2405	10.6	96.3	2069	245
Kwinana Fwy	On Ramp H711	Southbound	382	11.8	93.7	316	42
Kwinana Fwy	Off Ramp H712	Northbound	100	11.8	93.7	83	11
Kwinana Fwy	On Ramp H713	Northbound	2181	10.6	96.3	1877	223
Mundijong Road	E of Kwinana Fwy	Eastbound	1995	11.3	95.9	1697	216
Mundijong Road	E of Kwinana Fwy	Westbound	2106	10.4	96.1	1813	210
Mundijong Road	W of Kwinana Fwy	Eastbound	2521	13.1	91.3	2000	302
Mundijong Road	W of Kwinana Fwy	Westbound	2759	9.9	96.6	2401	264



Kwinana Fwy	N of Ramp H713	Northbound	30083	10.8	88.1	23641	2862
Kwinana Fwy	Under Mundijong Road	Northbound	27902	9.9	87.9	22098	2428
Kwinana Fwy	N of Ramp H812	Northbound	28002	9.9	86.1	21723	2387
Kwinana Fwy	Under Safety Bay Road	Northbound	20784	10.5	88.6	16481	1934
Kwinana Fwy	S of Ramp H811	Northbound	20741	11	90.3	16669	2060
Kwinana Fwy	Off Ramp H809	Southbound	9811	8.3	86.4	7773	704
Kwinana Fwy	On Ramp H810	Southbound	338	9	97	298	30
Kwinana Fwy	Off Ramp H811	Northbound	43	8.3	86.4	34	3
Kwinana Fwy	On Ramp H812	Northbound	7218	9	97	6371	630
Folly Road	E of Kwinana Fwy	Eastbound	100	3	96	93	3
Folly Road	E of Kwinana Fwy	Westbound	100	3	96	93	3
Safety Bay Road	W of Kwinana Fwy	Eastbound	13036	9	97	11507	1138
Safety Bay Road	W of Kwinana Fwy	Westbound	12626	8.3	86.4	10003	905

Figure 3-6 Existing Traffic Volumes



Road Name	Section	Direction	24hr Volume	% Heavy	% 18hr	18hr Cars	18hr Trucks
Kwinana Fwy	N of Ramp H710	Southbound	48600	5	95.3	44000	2316
Kwinana Fwy	Under Mundijong Road	Southbound	43500	5	95.5	39465	2077
Kwinana Fwy	S of Ramp H711	Southbound	49700	5	95.6	45138	2376
Kwinana Fwy	Under Safety Bay Road	Southbound	36100	6.0	95.8	32509	2075
Kwinana Fwy	S of Ramp H810	Southbound	37800	6	96.6	34324	2191
Kwinana Fwy	Off Ramp H710	Southbound	5100	4.0	96.3	4712	196
Kwinana Fwy	On Ramp H711	Southbound	6200	7.0	95.6	5509	415
Kwinana Fwy	Off Ramp H712	Northbound	4600	6.0	95.6	4132	264
Kwinana Fwy	On Ramp H713	Northbound	5900	4.0	96.3	5452	227
Mundijong Road	E of Kwinana Fwy	Eastbound	10300	5	95.9	9384	494
Mundijong Road	E of Kwinana Fwy	Westbound	9700	5	96.1	8856	466
Mundijong Road	W of Kwinana Fwy	Eastbound	12200	6	95	10895	695
Mundijong Road	W of Kwinana Fwy	Westbound	9300	5	96.6	8535	449
Kwinana Fwy	N of Ramp H713	Northbound	51400	5	95	46389	2442
Kwinana Fwy	Under Mundijong Road	Northbound	45500	5	95	41064	2161
Kwinana Fwy	N of Ramp H812	Northbound	50100	5	95	45215	2380
Kwinana Fwy	Under Safety Bay Road	Northbound	35000	6	95	31255	1995
Kwinana Fwy	S of Ramp H811	Northbound	36700	6	95	32773	2092
Kwinana Fwy	Off Ramp H809	Southbound	13700	3	95	12625	390
Kwinana Fwy	On Ramp H810	Southbound	1700	5	97	1567	82
Kwinana Fwy	Off Ramp H811	Northbound	1700	5	95	1534	81
Kwinana Fwy	On Ramp H812	Northbound	15000	3	97	14114	437
Folly Road	E of Kwinana Fwy	Eastbound	200	3	96	186	6
Folly Road	E of Kwinana Fwy	Westbound	200	3	96	186	6
Safety Bay Road	W of Kwinana Fwy	Eastbound	16700	3	97	15713	486
Safety Bay Road	W of Kwinana Fwy	Westbound	15400	3	95	14191	439

Figure 3-7 Existing Traffic Volumes

Figure 3-8 Future Traffic Volumes as Provided by MRWA

3.2.3 Ground Attenuation

The ground attenuation has been assumed to be 0.2 (20%) within the road reserves, 0.5 (50%) throughout the future subdivision, except for the public open space that were set to 1.00 (100%). Note 0.0 represents hard reflective surfaces such as 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 $L_{A10,18hour}$ noise level. The WAPC Policy however uses $L_{Aeq(Day)}$ and $L_{Aeq(Night)}$. The relationship between the parameters varies depending on the composition of traffic on the road (volumes in each period and percentage heavy vehicles).

To calibrate the noise model, the conversion between parameters is based on the relationship obtained from the noise monitoring.

For future traffic with the increase in traffic volumes, it is expected the $L_{Aeq(Day)}$ will only be 1.5 dB less than the $L_{Aeq(Night)}$, however the difference between the $L_{Aeq(Day)}$ and $L_{Aeq(Night)}$ will increase to at least 5 dB so that the $L_{Aeq(Day)}$ value in the future will be the critical parameter in terms of noise compliance.

4 RESULTS

4.1 Noise Monitoring

The results of the noise monitoring are summarised below in *Tables 4-1 to 4-4* and shown graphically in *Figures 4-1 to 4-4*.

Table 4-1 Measured Average Noise Levels – Logger Adjacent Mundijong Road

Date	Average Weekday Noise Level, dB			
	$L_{A10,18hour}$	$L_{Aeq,24hour}$	$L_{Aeq\ (Day)}$	$L_{Aeq\ (Night)}$
Wednesday 19 June 2013	54.6	52.9	53.3	50.7
Thursday 20 June 2013	53.9	53.1	53.3	52.0
Friday 21 June 2013	57.3	54.5	55.1	52.2
Saturday 22 June 2013	54.7	52.4	52.9	50.1
Sunday 23 June 2013	53.3	50.8	51.8	45.1
Monday 24 June 2013	54.8	52.7	53.2	50.5
Tuesday 25 June 2013	54.8	52.9	53.6	50.7
Weekday Average	**55.1**	**53.2**	**53.7**	**51.2**

Table 4-2 Measured Average Noise Levels – Logger Adjacent Kwinana Freeway (North)

Date	Average Weekday Noise Level, dB			
	$L_{A10,18hour}$	$L_{Aeq,24hour}$	$L_{Aeq\ (Day)}$	$L_{Aeq\ (Night)}$
Wednesday 19 June 2013	62.8	60.0	60.5	57.2
Thursday 20 June 2013	62.4	59.4	60.0	56.5
Friday 21 June 2013	63.8	60.9	61.5	57.7
Saturday 22 June 2013	61.0	58.3	59.0	54.8
Sunday 23 June 2013	60.7	59.1	60.2	51.0
Monday 24 June 2013	61.3	59.2	59.7	56.4
Tuesday 25 June 2013	62.0	59.8	60.1	58.2
Weekday Average	**62.4**	**59.9**	**60.4**	**57.2**

Table 4-3 Measured Average Noise Levels – Logger Adjacent Kwinana Freeway (South)

Date	Average Weekday Noise Level, dB			
	$L_{A10,18hour}$	$L_{Aeq,24hour}$	$L_{Aeq\ (Day)}$	$L_{Aeq\ (Night)}$
Wednesday 19 June 2013	67.1	64.5	65.1	61.6
Thursday 20 June 2013	66.9	64.3	64.9	61.2
Friday 21 June 2013	67.6	64.7	65.4	61.3
Saturday 22 June 2013	65.0	62.5	63.2	58.3
Sunday 23 June 2013	65.9	63.7	64.8	55.6
Weekday Average	**67.2**	**64.5**	**65.1**	**61.4**

Table 4-4 Measured Average Noise Levels – Logger Adjacent Safety Bay Road

Date	Average Weekday Noise Level, dB			
	$L_{A10,18hour}$	$L_{Aeq,24hour}$	$L_{Aeq\ (Day)}$	$L_{Aeq\ (Night)}$
Wednesday 19 June 2013	58.5	55.9	56.6	52.4
Thursday 20 June 2013	57.9	55.5	56.1	52.3
Friday 21 June 2013	58.3	55.8	56.4	53.0
Saturday 22 June 2013	55.7	53.7	54.4	50.2
Sunday 23 June 2013	55.4	53.3	54.4	46.2
Monday 24 June 2013	56.9	55.1	55.8	51.8
Tuesday 25 June 2013	57.8	55.9	56.6	52.1
Weekday Average	**57.9**	**55.6**	**56.3**	**52.3**

Figure 4-1: Background Noise Monitoring Adjacent Mundijong Road

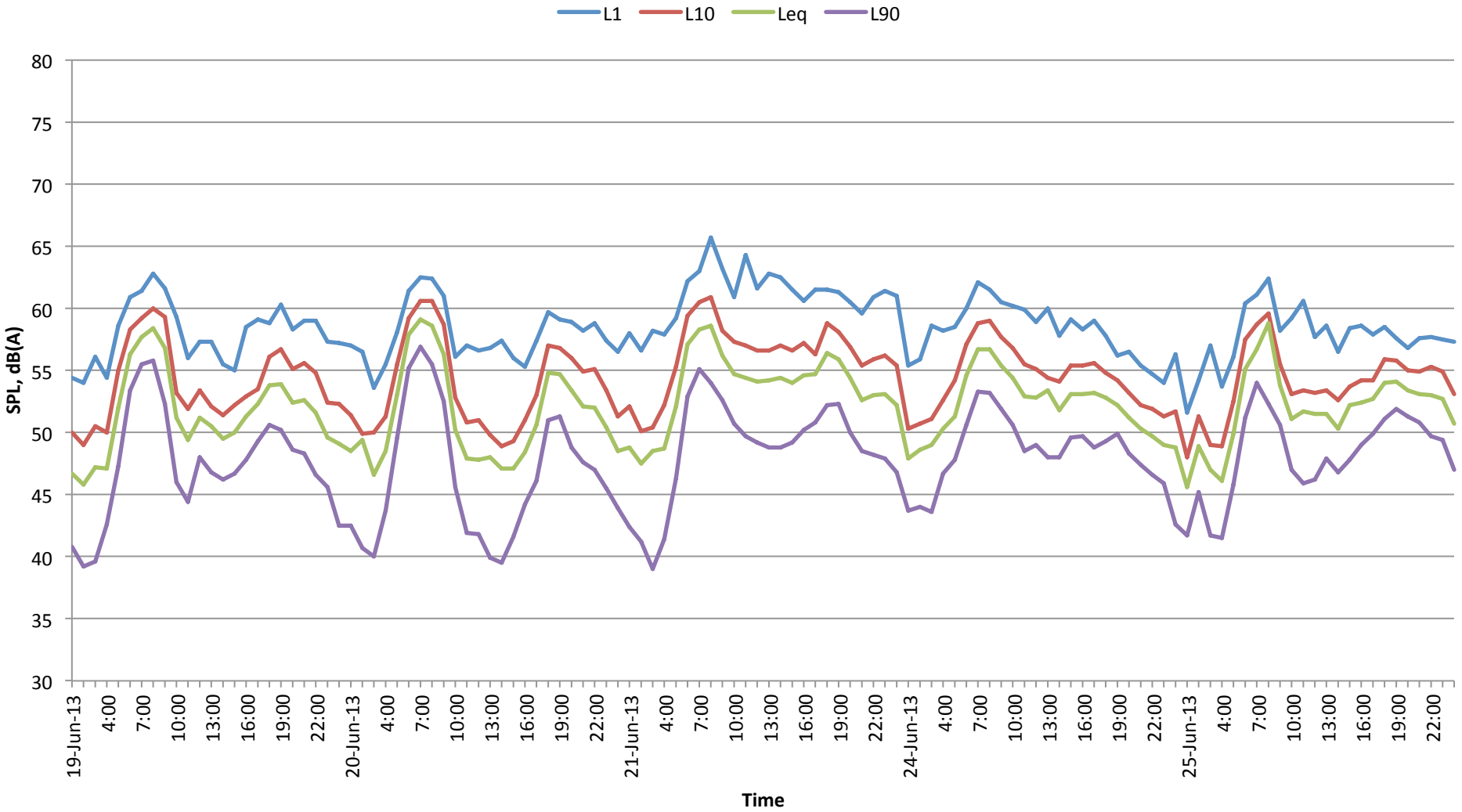


Figure 4-2: Background Noise Monitoring Adjacent Kwinana Freeway (Lot 520)

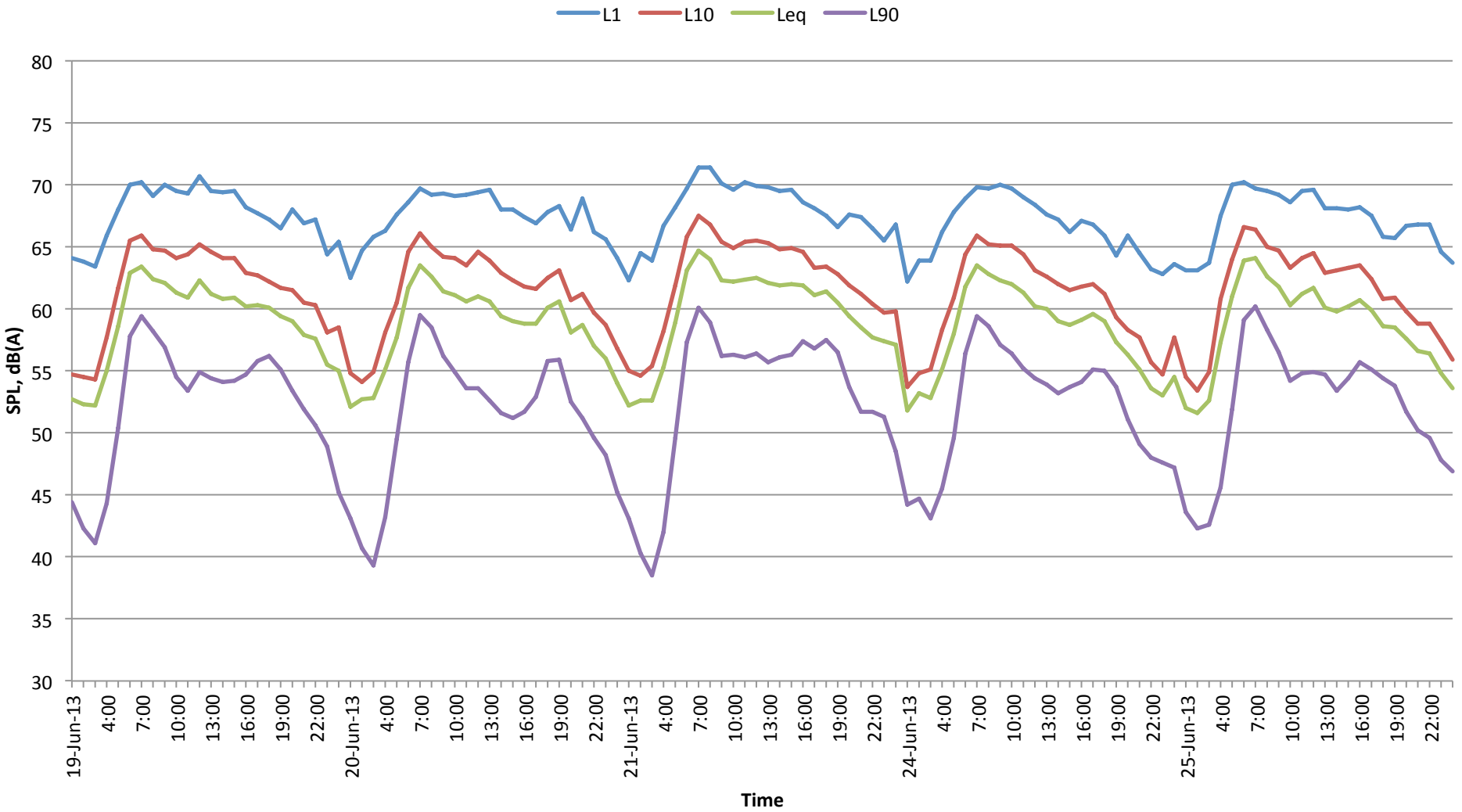


Figure 4-3: Background Noise Monitoring Adjacent Kwinana Freeway (Lot 748)

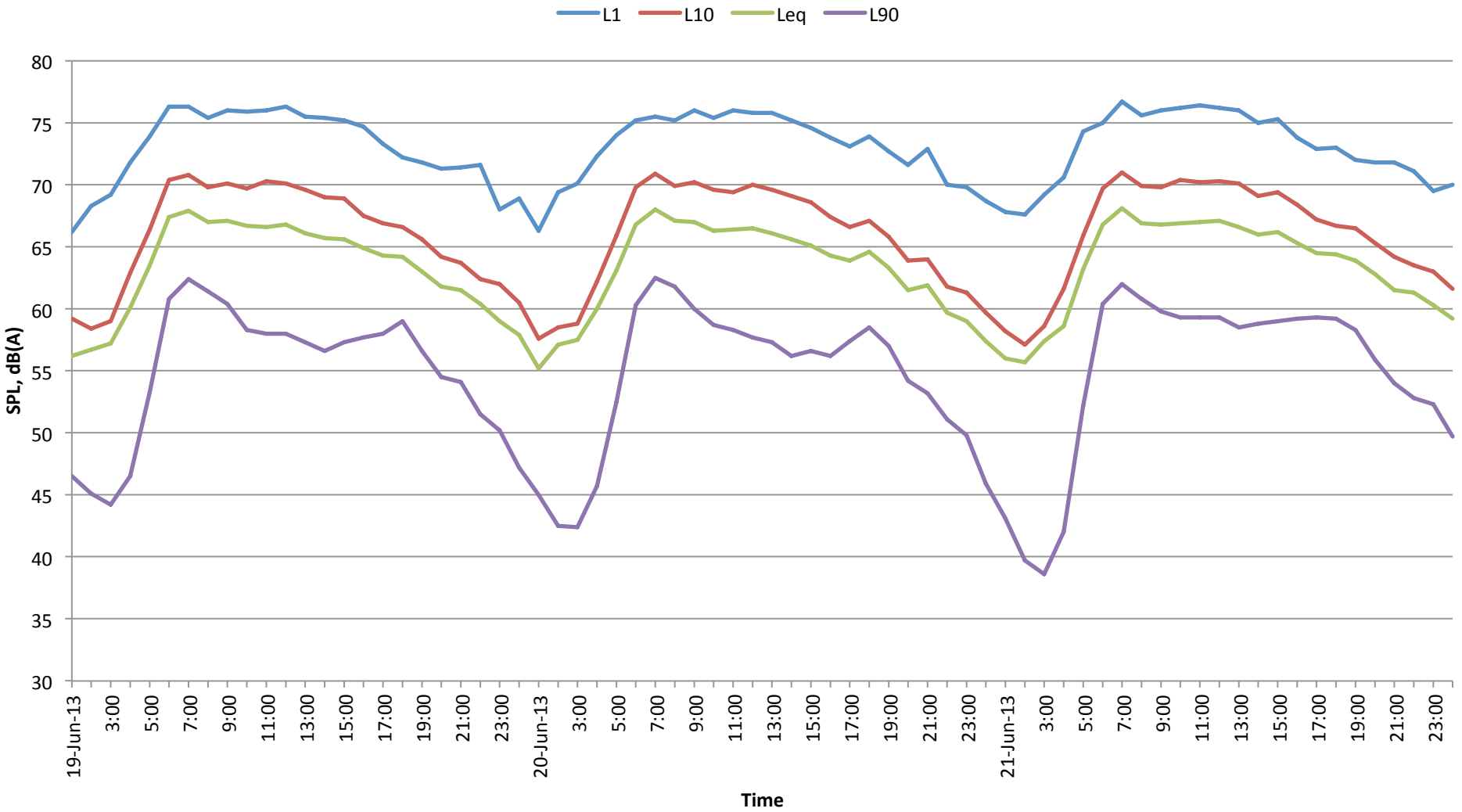
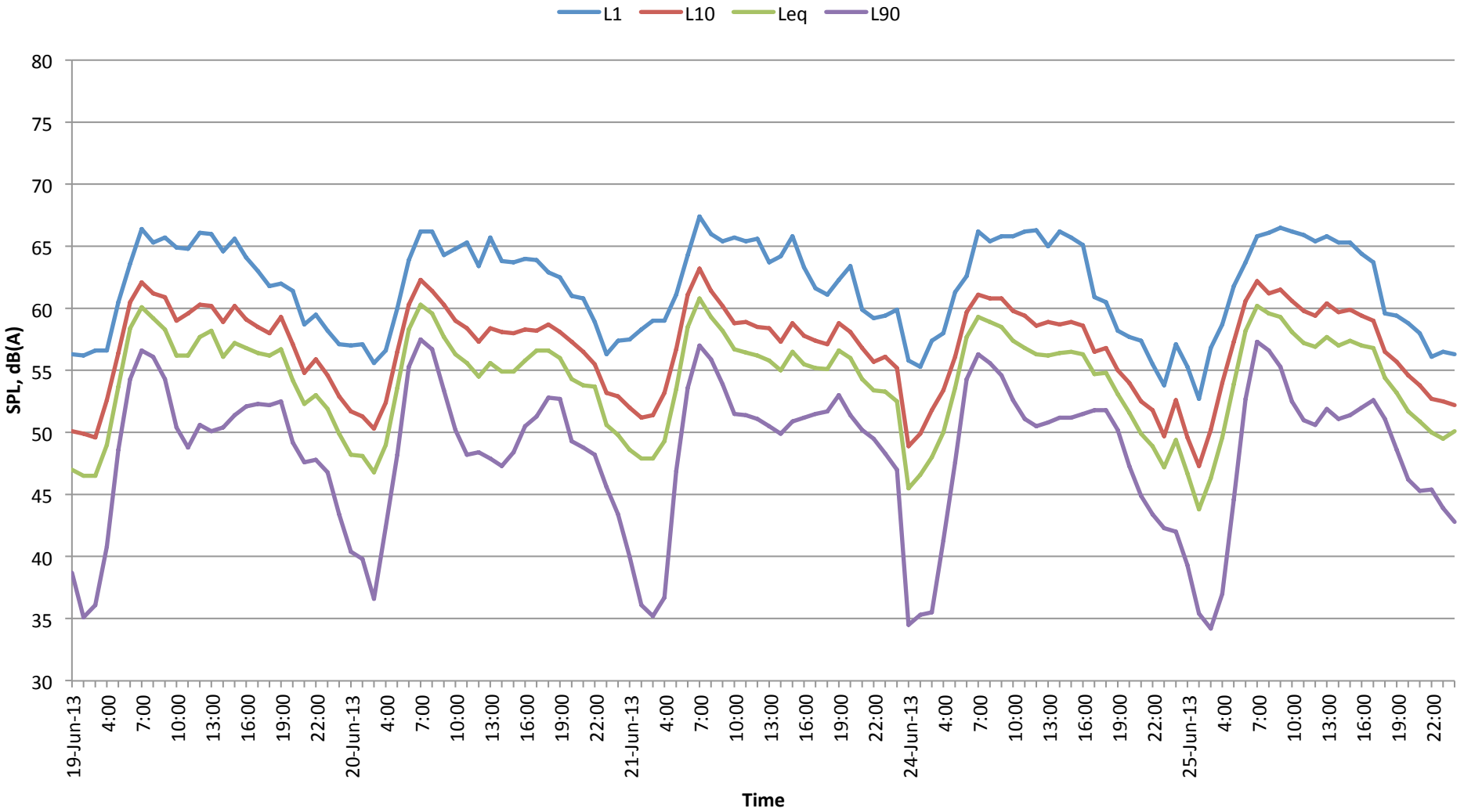


Figure 4-4: Background Noise Monitoring Adjacent Safety Bay Road



The average differences between selected parameters are shown below in *Table 4-5*.

Table 4-5 Differences Between Parameters

Location	Average Weekday Noise Level, dB	
	$L_{A10,18hour} - L_{Aeq(Day)}$	$L_{Aeq\ (Day)} - L_{Aeq(Night)}$
Mundijong Road	1.4	2.5
Kwinana Freeway North	2.1	3.2
Kwinana Freeway South	2.1	3.7
Safety Bay Road	1.6	3.9

4.2 Noise Modelling

The noise modelling for existing conditions is provided in *Figure 4-5* as an $L_{Aeq(Day)}$ noise level contour plot.

The noise contours for future conditions are then provided in *Figure 4-6*. Note that as modelling reflects future (2031) conditions, buildings and walls for the adjoining developments have been included.

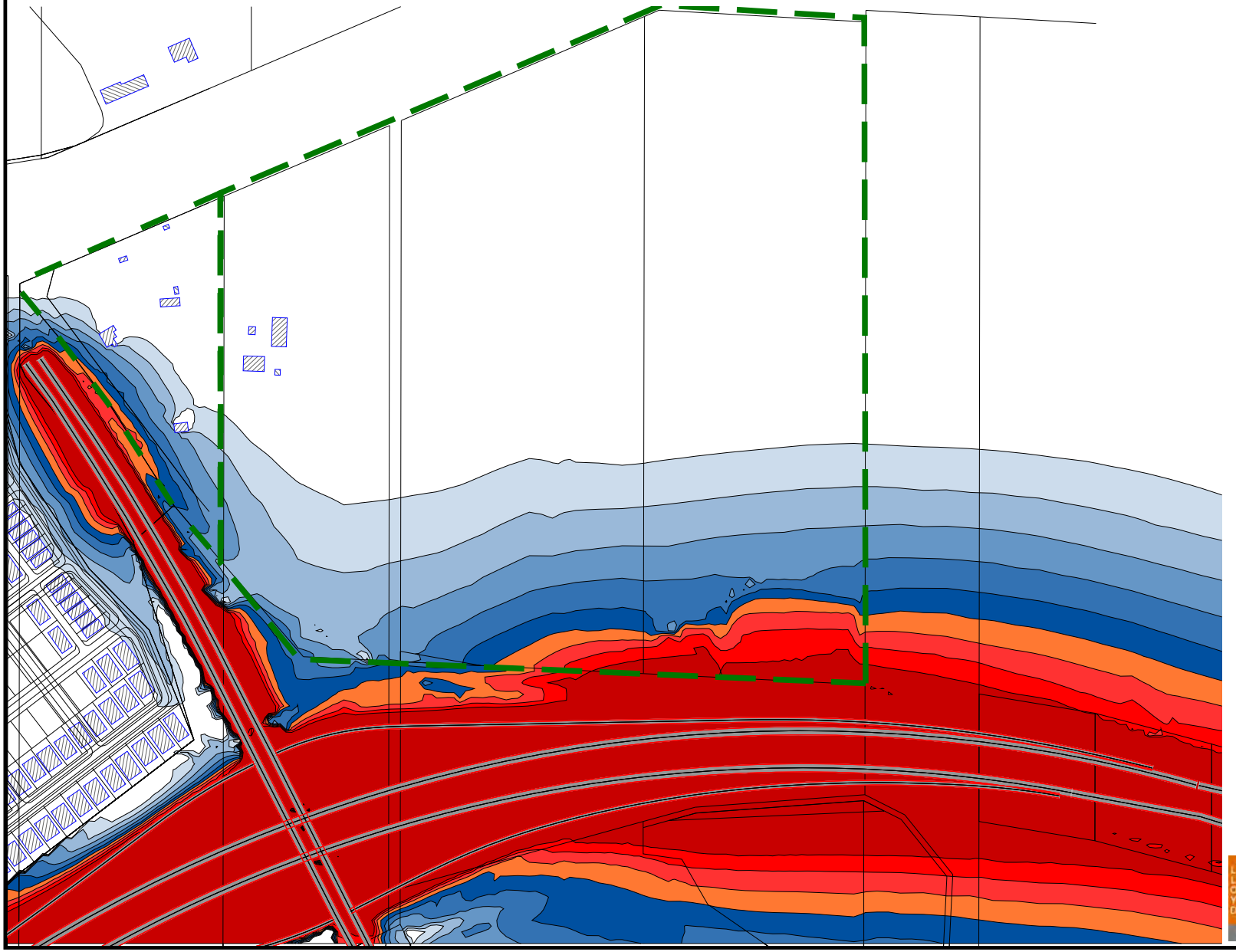
It can be seen that predicted noise levels at the nearest houses will be above the *target* and therefore noise control is to be considered. An option for noise control to comply with the Policy is:

- Increase the height of the boundary wall for approximately 150 metres from 1.8 metres to 2.2 metres as shown on *Figure 4-7*.
- Incorporate notifications on titles for lots above the *target*.
- Require dwellings above the *target* to incorporate Package A treatments – refer *Appendix A*.

Figure 4-5

Watson Land Residential Subdivision

LAeq(Day) Noise Level Contours - Existing



Noise levels
LAeq,Day dB

	< 55
55 <=	< 56
56 <=	< 57
57 <=	< 58
58 <=	< 59
59 <=	< 60
60 <=	< 61
61 <=	< 62
62 <=	< 63
63 <=	

Signs and symbols

- Road Source
- Road Surface
- Building
- Study Area

11 April 2014

Length Scale 1:5000

0 25 50 100 150 200 m

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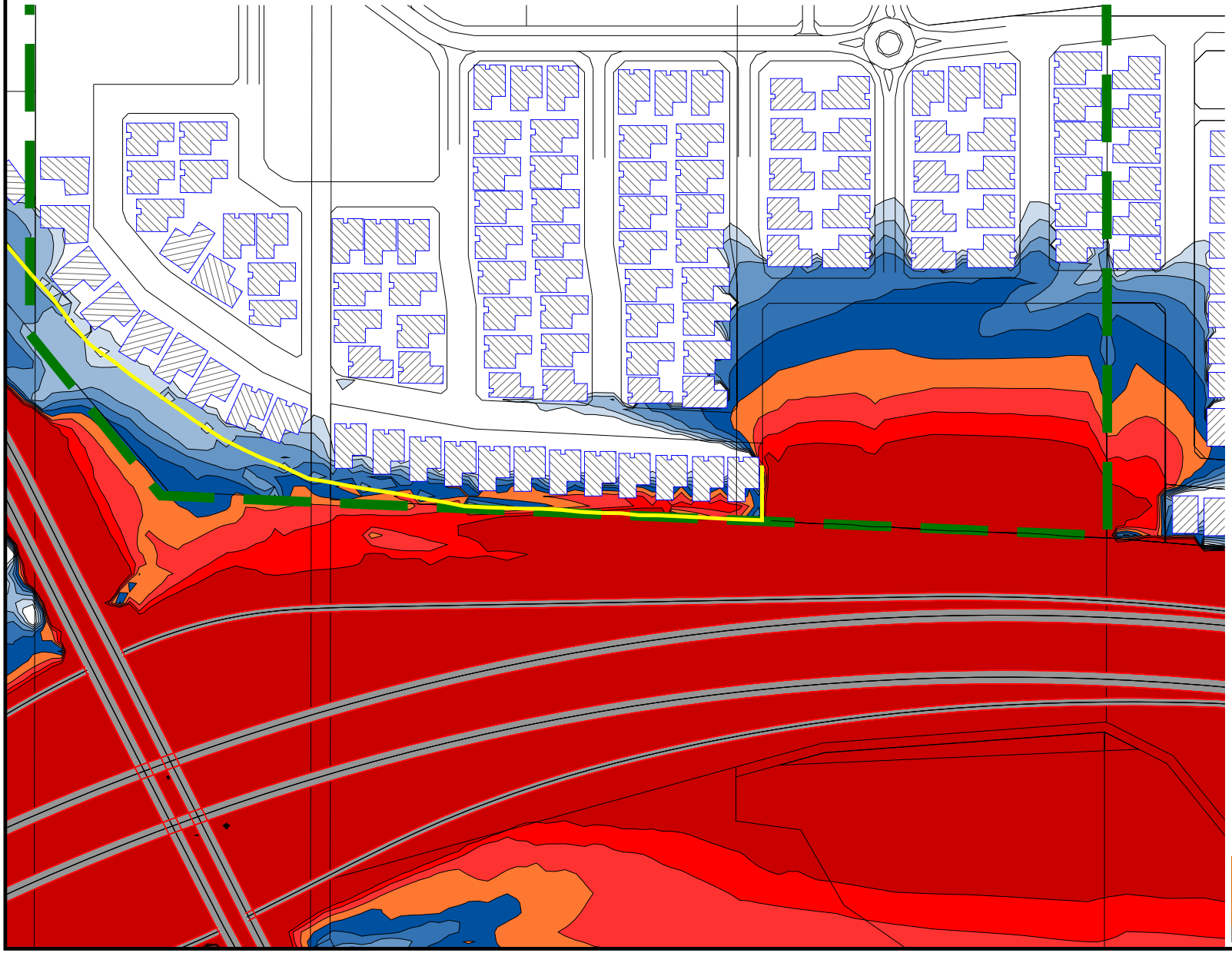
Watson Land Residential Subdivision

LAeq(Day) Noise Level Contours - Future with 1.8m High Wall
Includes Design Levels for Watson Land and Land to North.

Figure 4-6



Noise levels
LAeq,Day dB

	< 55
55 <=	< 56
56 <=	< 57
57 <=	< 58
58 <=	< 59
59 <=	< 60
60 <=	< 61
61 <=	< 62
62 <=	< 63
63 <=	

N

Signs and symbols

- Road Source
- Road Surface
- Building
- Study Area
- Walls - 1.8m High

7 November 2014

Length Scale 1:3000

0 15 30 60 90 120 m

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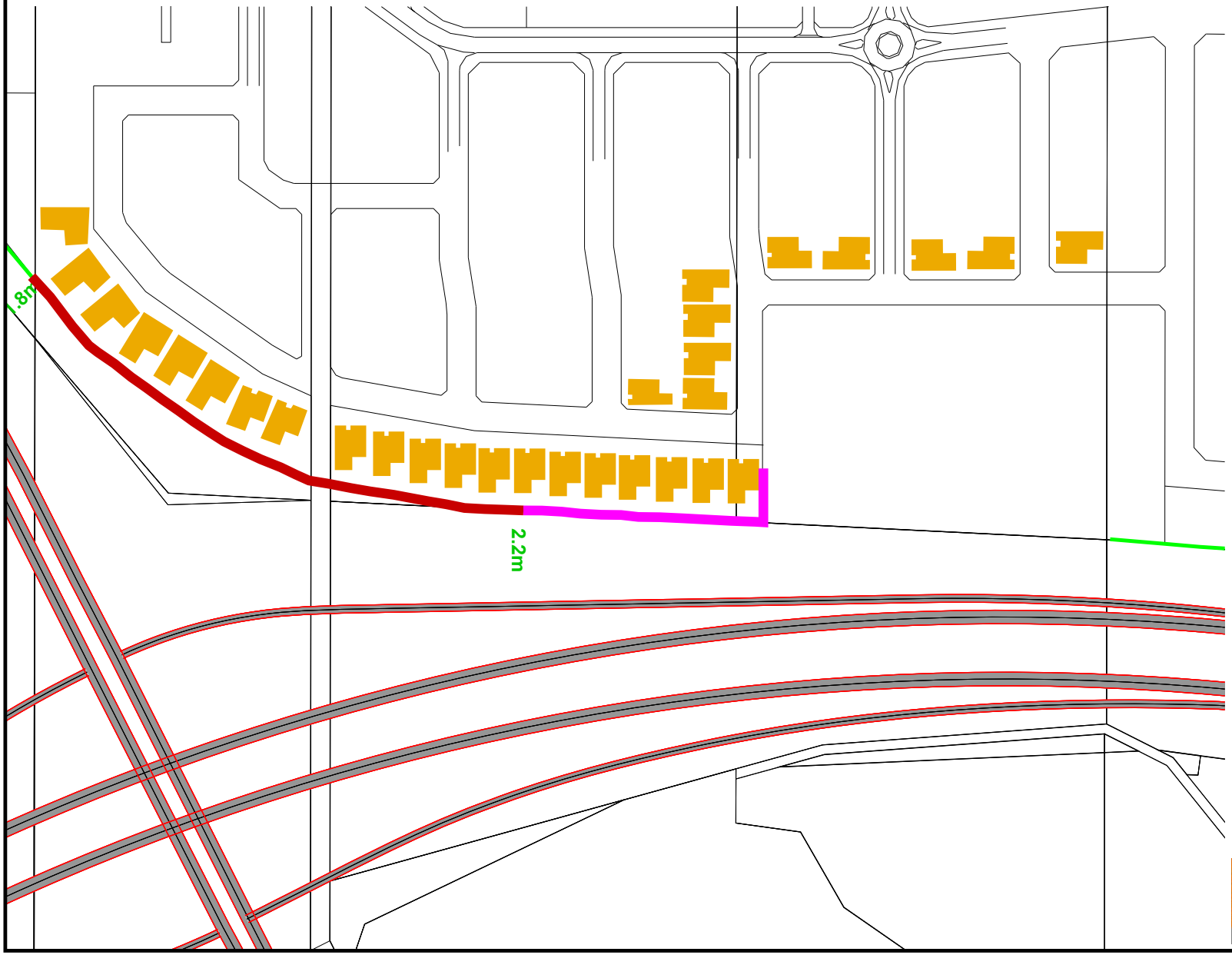
Watson Land Residential Subdivision

Noise Mitigation Option to Comply with SPP5.4

Figure 4-7



Signs and symbols

- Road Source
- Road Surface
- Package A Treatment
- Walls By Others
- Walls - 1.8m High
- Walls - 2.2m High

7 November 2014

Length Scale 1:3000

0 15 30 60 90 120 m

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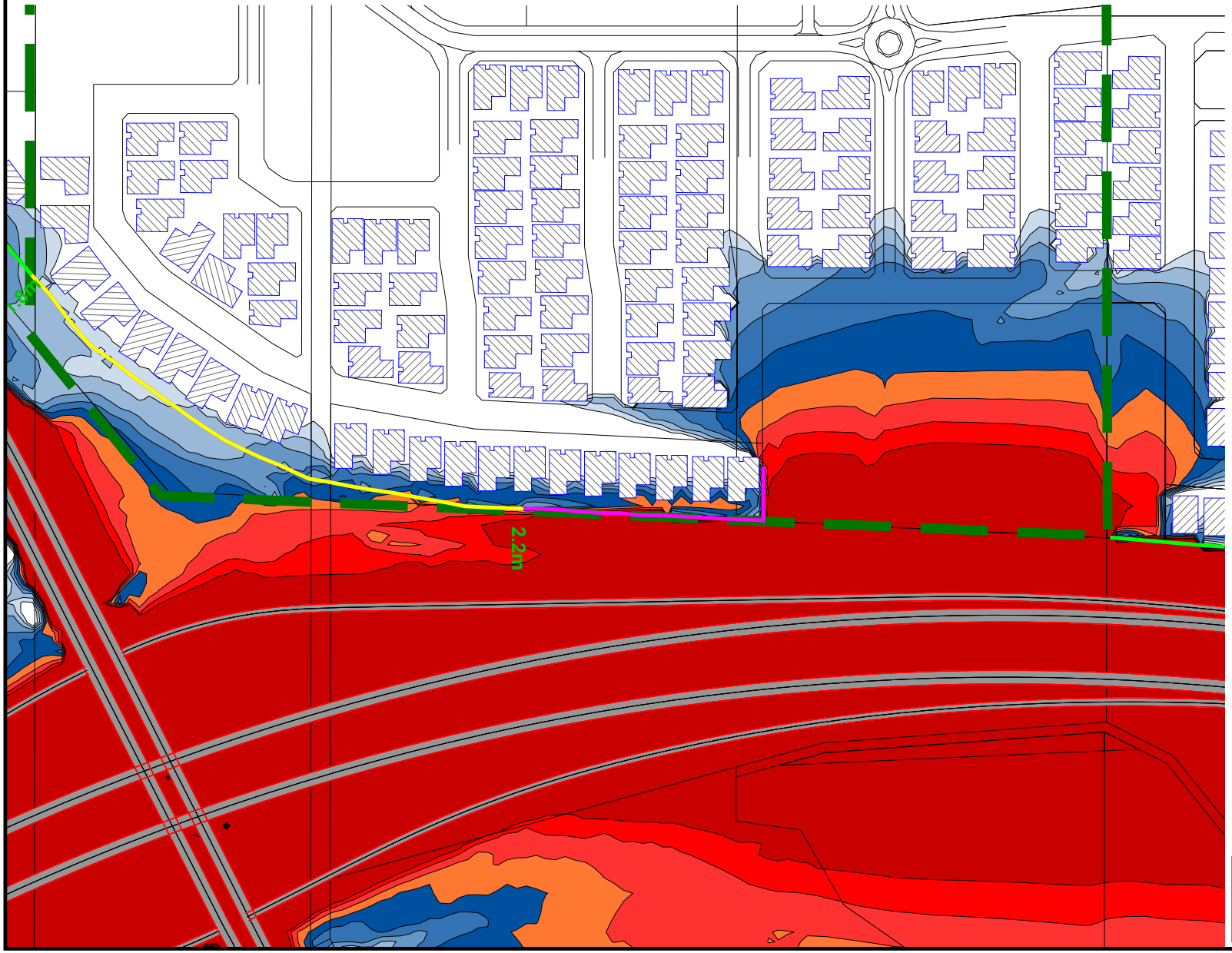
Watson Land Residential Subdivision

LAeq(Day) Noise Level Contours - Future with Designed High Wall
Includes Design Levels for Watson Land and Land to North

Figure 4-8



Noise levels
LAeq,Day dB

	< 55
55 <=	< 56
56 <=	< 57
57 <=	< 58
58 <=	< 59
59 <=	< 60
60 <=	< 61
61 <=	< 62
62 <=	< 63
63 <=	

Signs and symbols

- Road Source
- Road Surface
- Building
- Study Area
- Walls By Others
- Walls - 1.8m High
- Walls - 2.2m High

7 November 2014

Length Scale 1:3000

0 15 30 60 90 120 m

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5 ASSESSMENT & CONCLUSION

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* at some parts of the development. To comply with the Policy, the following noise control option is provided:

- Increase the height of the boundary wall for approximately 150 metres from 1.8 metres to 2.2 metres as shown on *Figure 4-7*.
- Incorporate notifications on titles for lots above the *target*.
- Require dwellings above the *target* to incorporate Package A treatments – refer *Appendix A*.

Should any of the 'affected' dwellings be proposed as double storey, they will require a specific assessment once the house plans are available. The reason for this is that the upper floor will not receive the same amount of barrier attenuation as the ground floor. Such an assessment is to be undertaken by a suitably qualified acoustical consultant being a member firm of the Association of Australian Acoustical Consultants (AAAC).

Similarly, the Package A treatment is a default deemed to satisfy construction sufficient of providing an acceptable internal amenity where external noise levels are up to the *limit* (e.g. 60 dB $L_{Aeq(Day)}$). This means that where external noise levels are less than the *limit*, there may be scope to reduce the deemed to satisfy provisions. Should a home owner wish to deviate from the default Package A standard, this is to be supported by an assessment undertaken by a suitably qualified acoustical consultant based on the proposed building plans.

Appendix A

DEEMED TO SATIFY 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 road/rail corridor	• 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 corridor	• 6mm (minimum) laminated glazing • Closed eaves • Mechanical ventilation/airconditioning
	Away from corridor	No requirements
Living and work areas[2]	Facing corridor	• 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 corridor	• 6mm (minimum) laminated glazing • Closed eaves • Mechanical ventilation/airconditioning
	Away from corridor	No requirements
Other indoor areas	Any	No requirements

[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 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.

Mechanical ventilation/airconditioning

Where outdoor noise levels are above the "target", both Packages A and B require mechanical ventilation or airconditioning to ensure that windows can remain closed in order to achieve the indoor noise standards.

In implementing Packages A and B, the following need to be observed:

- Evaporative airconditioning systems will not meet the requirements for Packages A and B because windows need to remain open;
- Refrigerative airconditioning systems need to be designed to achieve fresh air ventilation requirements;
- air inlets need to be positioned facing away from the transport corridor where practicable;
- 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).

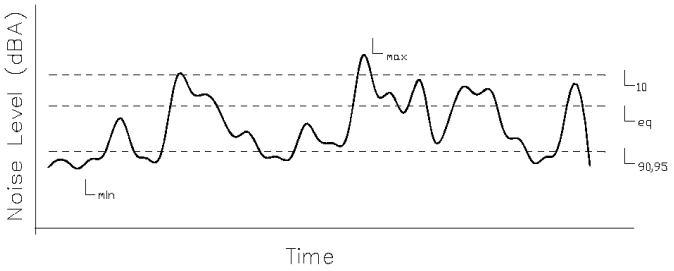
$L_{Aeq,8hour}$ / $L_{Aeq\ (Night)}$
The $L_{Aeq\ (Night)}$ level is the logarithmic average of the hourly L_{Aeq} levels from 10.00 pm to 6.00 am on the same day.

$L_{Aeq,16hour}$ / $L_{Aeq\ (Day)}$
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 33.0m	> 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