

APPENDIX 5

Transportation Noise Assessment (Lloyd George)

Transportation Noise Assessment

North-east Baldvis District Structure Plan

Reference: 22107658-01A

Prepared for:
Stockland

Reference: 22107658-01A

Lloyd George Acoustics Pty Ltd

ABN: 79 125 812 544

PO Box 717

Hillarys WA 6923

www.lgacoustics.com.au

Contacts	General	Daniel Lloyd	Terry George	Matt Moyle
E:	info@lgacoustics.com.au	daniel@lgacoustics.com.au	terry@lgacoustics.com.au	matt@lgacoustics.com.au
P:	9401 7770	0439 032 844	0400 414 197	0412 611 330
Contacts	Rob Connolly	Daryl Thompson	Hao Tran	Matt Nolan
E:	rob@lgacoustics.com.au	daryl@lgacoustics.com.au	hao@lgacoustics.com.au	matt.nolan@lgacoustics.com.au
P:	0410 107 440	0420 364 650	0438 481 207	0448 912 604

This report has been prepared in accordance with the scope of services described in the contract or agreement between Lloyd George Acoustics Pty Ltd and the Client. The report relies upon data, surveys, measurements and results taken at or under the particular times and conditions specified herein. Any findings, conclusions or recommendations only apply to the aforementioned circumstances and no greater reliance should be assumed or drawn by the Client. Furthermore, the report has been prepared solely for use by the Client, and Lloyd George Acoustics Pty Ltd accepts no responsibility for its use by other parties.

Date	Rev	Description	Author	Verified
29-Nov-22	0	Issued to Client	Terry George	Matt Moyle
25-Jun-23	A	Updated plan and MRWA Comments	Terry George	-

CONTENTS

EXECUTIVE SUMMARY.....	i
1. INTRODUCTION.....	1
2. CRITERIA.....	3
2.1. Transport Noise	3
2.2. Environmental Noise	4
2.2.1. Regulations 7, 8 & 9.....	4
2.2.2. Regulation 16A.....	8
3. METHODOLOGY	9
3.1. Transport Noise Methodology	9
3.2. Environmental Noise Methodology.....	11
3.2.1. Meteorological Conditions	11
3.2.2. Topographical Data.....	12
3.2.3. Ground Absorption	12
3.2.4. Source Sound Levels	12
4. RESULTS	12
4.1. Transport Noise Results.....	12
4.2. Environmental Noise Results.....	12
5. ASSESSMENT.....	16
5.1. Transport Noise Assessment	16
5.2. Environmental Noise Assessment	17

List of Tables

Table 2-1: Noise Targets for Noise Sensitive Land-Use	3
Table 2-2 Adjustments Where Characteristics Cannot Be Removed	4
Table 2-3 Baseline Assigned Levels.....	5
Table 2-4 Assigned Levels	6
Table 3-1: Transport Corridor Classification and Trigger Distances	9
Table 3-1: Modelling Meteorological Conditions	11
Table 3-2: Source Sound Power Levels, dB.....	12
Table B-1: Relevant Roads	26

List of Figures

Figure 1-1: Subdivision Location (Source: DPLH PlanWA)	1
Figure 1-2: Preliminary Concept Plan	2
Figure 2-1: Influencing Factor Areas.....	7
Figure 3-1: Subject Site Locality in Relation to Transport Trigger Distances (Source: DPLH PlanWA)	9
Figure 3-2: Noise Exposure Forecast Table from Guidelines.....	10
Figure 4-1: Exposure Levels Across Subject Site	13
Figure 4-2: Noise Contour Plot – Jet Sprint Boats	14
Figure 4-3: Noise Contour Plot - Ski Boats.....	15
Figure 5-1: Recommended Mitigation Near Bonney’s Water Ski Park.....	18

Appendices

Appendix A – Quiet House Packages	19
Appendix B – Influencing Factor Calculation	25
Appendix C – Terminology	27

EXECUTIVE SUMMARY

This report identifies potential acoustic impacts in order to assist and support the North-east Baldivis District Structure Plan (DSP), and discusses how such impacts can be managed. Given the early stages of the project, this assessment is broad in its methodology and recommendations, which would be further refined as the project progresses into more detailed design stages.

With regard to road and rail traffic, a combination of noise walls/bunds and architectural packages will be implemented in order to comply with *State Planning Policy No. 5.4 Road and Rail Noise* (SPP 5.4). Consideration should also be given to vibration from passing freight trains as the design progresses. Whilst not specifically covered in SPP 5.4, the concept shows some houses may be relatively close to the freight line and therefore susceptible to perceptible vibration levels.

Noise from Ski Boats at Bonney's Water Ski Park may exceed the assigned levels at the nearest proposed houses. Whilst under the *Environmental Protection (Noise) Regulations 1997* the responsibility of controlling noise is on the noise emitter, to minimise the risk of complaints, it is proposed to incorporate notifications on title and architectural packages, as shown on *Figure 5-1*.

Noise from Jet Sprint Boat racing is significantly higher in noise level, although occurs infrequently. It will not be practicable for such an event to comply with the assigned levels at the proposed residences. It is therefore recommended that Stockland approach the Jet Sprint Park and assist in preparing a noise management plan for submission to the local government for approval by the CEO under regulation 16A.

1. INTRODUCTION

The area in Wellard shown in *Figure 1-1* has been identified as suitable for urban expansion. This report identifies potential noise impacts in order to assist and support the District Structure Plan (DSP), and discusses how such impacts can be managed. Given the early stages of the project, this assessment is broad in its methodology and recommendations, which would be further refined as the project progresses into more detailed design stages. The current concept plan is shown in *Figure 1-2*.

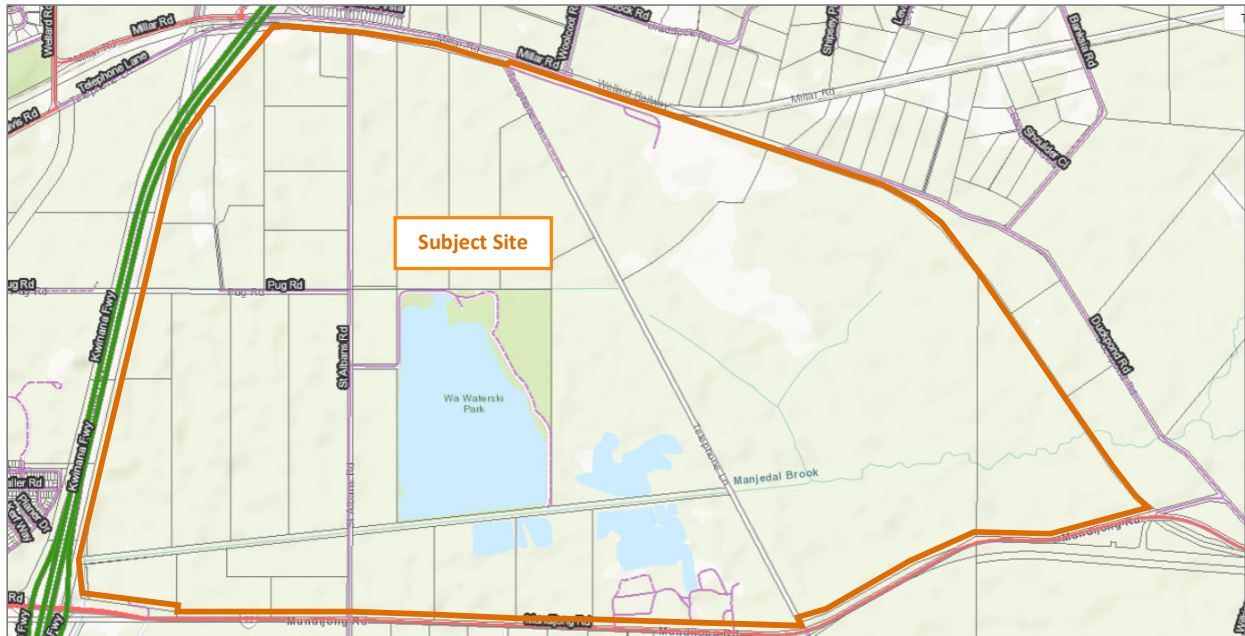


Figure 1-1: Subdivision Location (Source: DPLH PlanWA)

With regard to noise impacts, this report considers:

- Transportation Noise – Kwinana Freeway to the west, Mundijong Road to the south and the freight railway to the north; and
- Bonney’s WA Water Ski Park, also containing the Jet Sprint Park.

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

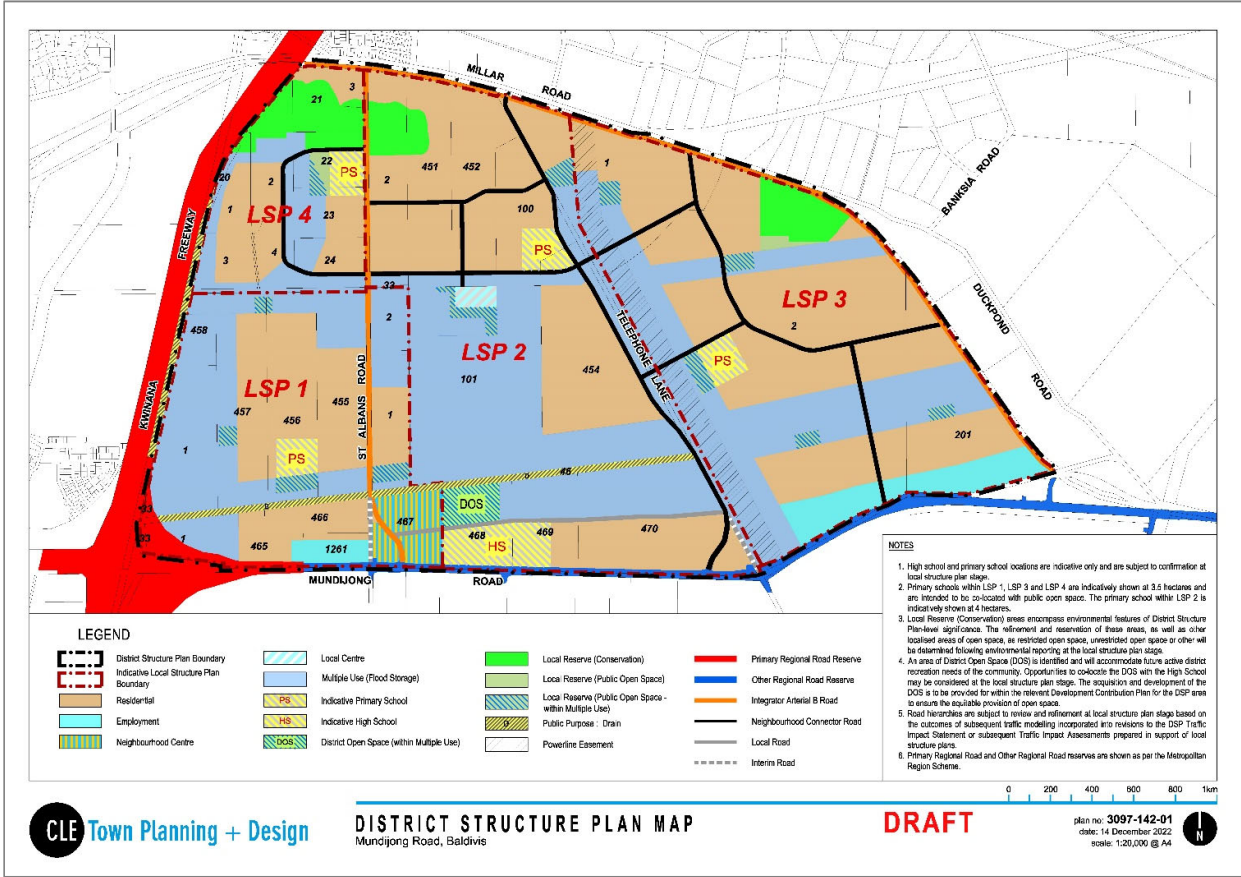


Figure 1-2: Preliminary Concept Plan

2. CRITERIA

2.1. Transport Noise

The criteria relevant to road and rail traffic noise 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 LAeq(Day)	50 dB LAeq(Night)	40 dB LAeq(Day) (Living and Work Areas)

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 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.

2.2. Environmental Noise

Environmental noise in Western Australia is governed by the *Environmental Protection Act 1986*, through the *Environmental Protection (Noise) Regulations 1997* (the Regulations).

2.2.1. Regulations 7, 8 & 9

This group of regulations provide the prescribed standard for noise as follows:

“7. Prescribed standard for noise emissions

- (1) *Noise emitted from any premises or public place when received at other premises –*
- (a) *must not cause, or significantly contribute to, a level of noise which exceeds the assigned level in respect of noise received at premises of that kind; and*
 - (b) *must be free of –*
 - (i) *tonality; and*
 - (ii) *impulsiveness; and*
 - (iii) *modulation,**when assessed under regulation 9.*
- (2) *For the purposes of subregulation (1)(a), a noise emission is taken to significantly contribute to a level of noise if the noise emission ... exceeds a value which is 5 dB below the assigned level at the point of reception.”*

Tonality, impulsiveness and modulation are defined in regulation 9 (refer *Appendix C*). Under regulation 9(3), “Noise is taken to be free of the characteristics of tonality, impulsiveness and modulation if -

- (a) *the characteristics cannot be reasonably and practicably removed by techniques other than attenuating the overall level of noise emission; and*
- (b) *the noise emission complies with the standard prescribed under regulation 7(1)(a) after the adjustments in the table [Table 2-2] ... are made to the noise emission as measured at the point of reception.”*

Table 2-2 Adjustments Where Characteristics Cannot Be Removed

Where Noise Emission is Not Music*			Where Noise Emission is Music	
Tonality	Modulation	Impulsiveness	No Impulsiveness	Impulsiveness
+ 5 dB	+ 5 dB	+ 10 dB	+ 10 dB	+ 15 dB

* These adjustments are cumulative to a maximum of 15 dB.

The assigned levels (prescribed standards) for all premises are specified in regulation 8(3) and are shown in *Table 2-3*. The L_{A10} assigned level is applicable to noises present for more than 10% of a representative assessment period, generally applicable to “steady-state” noise sources. The L_{A1} is for short-term noise sources present for less than 10% and more than 1% of the time. The L_{Amax} assigned level is applicable for incidental noise sources, present for less than 1% of the time.

Table 2-3 Baseline Assigned Levels

Premises Receiving Noise	Time Of Day	Assigned Level (dB)		
		L _{A10}	L _{A1}	L _{Amax}
Noise sensitive premises: highly sensitive area ¹	0700 to 1900 hours Monday to Saturday (Day)	45 + influencing factor	55 + influencing factor	65 + influencing factor
	0900 to 1900 hours Sunday and public holidays (Sunday)	40 + influencing factor	50 + influencing factor	65 + influencing factor
	1900 to 2200 hours all days (Evening)	40 + influencing factor	50 + influencing factor	55 + influencing factor
	2200 hours on any day to 0700 hours Monday to Saturday and 0900 hours Sunday and public holidays (Night)	35 + influencing factor	45 + influencing factor	55 + influencing factor
Noise sensitive premises: any area other than highly sensitive area	All hours	60	75	80
Commercial Premises	All hours	60	75	80
Industrial and Utility Premises	All hours	65	80	90

1. *highly sensitive area* means that area (if any) of noise sensitive premises comprising —
- (a) a building, or a part of a building, on the premises that is used for a noise sensitive purpose; and
 - (b) any other part of the premises within 15 metres of that building or that part of the building.

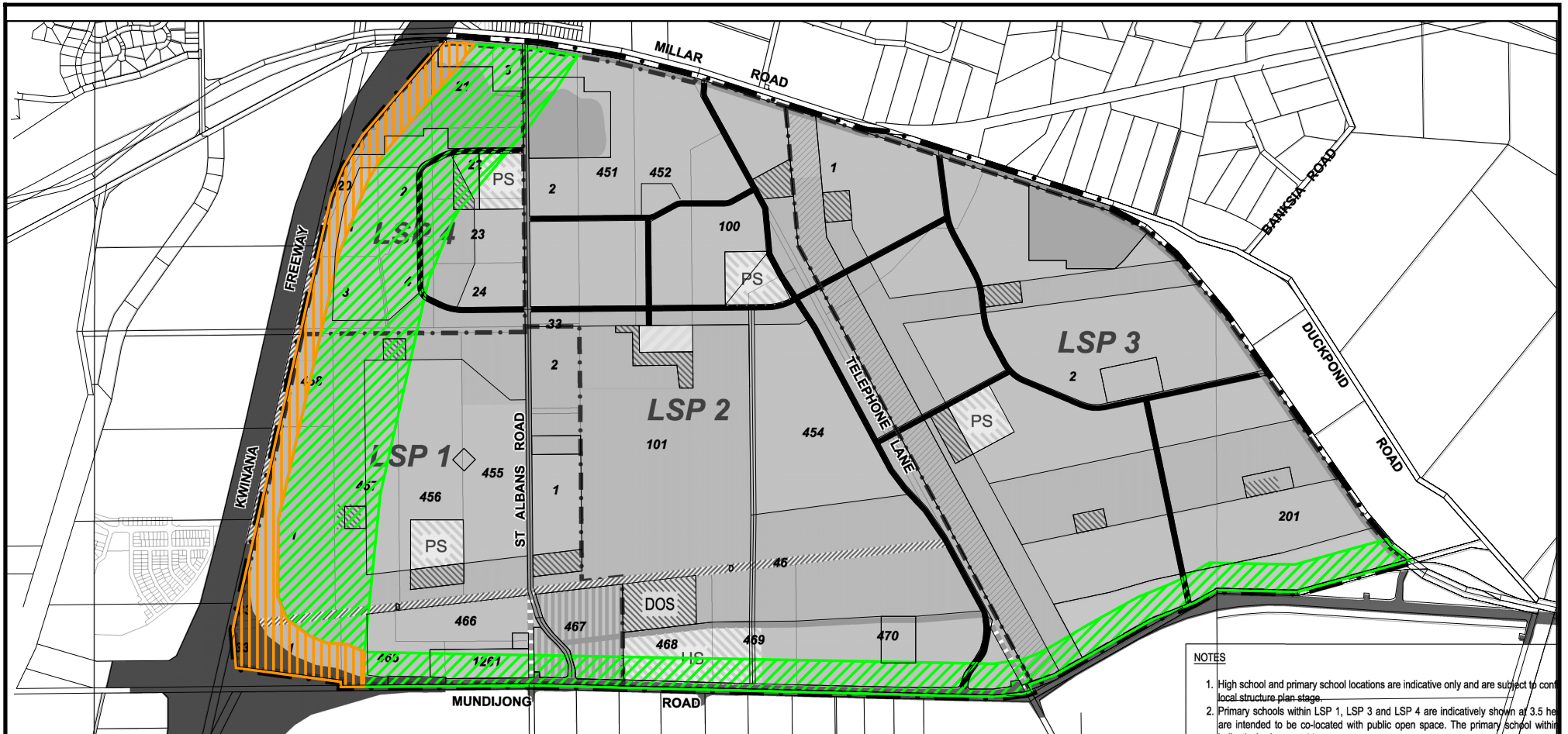
The influencing factor (IF), in relation to noise received at noise sensitive premises, is predominantly dependent on proximity to major and secondary roads only as determined in *Appendix B* noting no influencing factor has been included for land that is/will be zoned commercial. *Table 2-4* shows the assigned levels including the influencing factor and transport factor at the receiving locations. The influencing factor areas are shown on *Figure 2-1*.

Table 2-4 Assigned Levels

Premises Receiving Noise	Time Of Day	Assigned Level (dB)		
		L _{A10}	L _{A1}	L _{Amax}
Houses Within 100m of Kwinana Fwy Noise sensitive premises: highly sensitive area ¹	0700 to 1900 hours Monday to Saturday (Day)	51	61	71
	0900 to 1900 hours Sunday and public holidays (Sunday)	46	56	71
	1900 to 2200 hours all days (Evening)	46	56	61
	2200 hours on any day to 0700 hours Monday to Saturday and 0900 hours Sunday and public holidays (Night)	41	51	61
Houses Within 450m of Kwinana Fwy or 100m of Mundijong Rd Noise sensitive premises: highly sensitive area ¹	0700 to 1900 hours Monday to Saturday (Day)	47	57	67
	0900 to 1900 hours Sunday and public holidays (Sunday)	42	52	67
	1900 to 2200 hours all days (Evening)	42	52	57
	2200 hours on any day to 0700 hours Monday to Saturday and 0900 hours Sunday and public holidays (Night)	37	47	57

It must be noted the assigned levels above apply outside the receiving premises and at a point at least 3 metres away from any substantial reflecting surfaces. Where this was not possible to be achieved due to the close proximity of existing buildings and/or fences, the noise emissions were assessed at a point within 1 metre from building facades and a -2 dB adjustment was made to the predicted noise levels to account for reflected noise.


The assigned levels are statistical levels and therefore the period over which they are determined is important. The Regulations define the Representative Assessment Period (RAP) as “a period of time of not less than 15 minutes, and not exceeding 4 hours, determined by an inspector or authorised person to be appropriate for the assessment of a noise emission, having regard to the type and nature of the noise emission”. An inspector or authorised person is a person appointed under Sections 87 & 88 of the *Environmental Protection Act 1986* and include Local Government Environmental Health Officers and Officers from the Department of Water Environmental Regulation. Acoustic consultants or other environmental consultants are not appointed as an inspector or authorised person. Therefore, whilst this assessment is based on a 4-hour RAP, which is assumed to be appropriate given the nature of the operations, this is to be used for guidance only.




Wellard District Structure Plan Influencing Factor Areas

Applicable to Noise Sensitive Buildings Only

Signs and symbols

 + 2 dB Influencing Factor

 + 6 dB Influencing Factor



25 June 2023



Lloyd George Acoustics
by Terry George
terry@lgacoustics.com.au
(08) 9401 7770

Length Scale 1:22000



Figure 2-1

2.2.2. Regulation 16A

Regulation 16A applies to Motor Sport Venues, which includes racing of water craft. Under regulation 16AA, a venue can apply to the CEO to operate under a noise management plan, rather than having to comply with the normal assigned levels of *Section 2.2.1*. The reason for this is that the normal assigned levels are most applicable to noises that occur regularly, as opposed to that from a racing venue, where the noise is more sporadic (e.g. one race day a fortnight). A noise management plan is to:

- Contain a map (current at the time of the application) showing the motor sport venue, including the area where motor vessels are raced or prepared for racing and car parks used by competitors in races at and visitors to the venue; and
- Contain a description of the types of racing activities that can reasonably be expected to be conducted at the venue and classes of vehicles or vessels that can reasonably be expected to race at the venue; and
- Set out limitations on the racing activities to be conducted and the times during which racing activities may be conducted; and
- Contain details of reasonable and practicable measures to be implemented to control noise emissions from the venue during the conduct of a racing activity at the venue; and
- Contain details of when and the manner in which notice of racing activities at the venue is to be published or distributed to members of the public; and
- Specify the persons who will be responsible for implementing the approved noise management plan and sets out each person's responsibilities; and
- Contain a complaint response procedure.

It is understood that the Jet Sprint Park, located in the northeast corner of Bonney's WA Water Ski Park does not currently operate under such an Approval, however, one would be required due to the relatively high noise levels during racing. For information, the 2022/23 race program is:

- Saturday 5th November 2022;
- Saturday 26th November 2022;
- Saturday 10th December 2022;
- Saturday 7th January 2023;
- Saturday 28th January 2023;
- Saturday 11th February 2023;
- Saturday 25th February 2023;
- Saturday 11th March 2023;
- Saturday 25th March 2023; and
- Saturday 15th April 2023.

3. METHODOLOGY

3.1. Transport Noise Methodology

Trigger distances are nominated in SPP 5.4 as shown in *Table 3-1* and in *Figure 3-1*.

Table 3-1: Transport Corridor Classification and Trigger Distances

Transport Road Classification	Trigger Distance	Distance Measured From
<p>Strategic Freight and Major Traffic Routes</p> <p>Roads as defined by Perth and Peel Planning Frameworks and/or roads with either 500 or more Class 7 to 12 Austroads vehicles per day, and/or 50,000 per day traffic volume</p>	300 metres	Road carriageway edge
<p>Other Significant Freight/Traffic Routes</p> <p>These are generally any State administered road and/or local government road identified as being a future State administered road (red road) and other roads that meets the criteria of either ≥ 100 Class 7 to 12 Austroads vehicles daily or $\geq 23,000$ daily traffic count (averaged equivalent to 25,000 vehicles passenger car units under region schemes)</p>	200 metres	Road carriageway edge
<p>Freight Railways</p>	200 metres	Centreline of the closest track



Figure 3-1: Subject Site Locality in Relation to Transport Trigger Distances (Source: DPLH PlanWA)

Given the preliminary stage of this assessment, the approach is to follow the screening assessment procedure provided in the Guidelines. Table 2 of the Guidelines (refer Figure 3-2) provides expected forecast noise levels, which for road traffic is based on number of lanes. In the future (2041), Kwinana Freeway is expected to be a total of 7 lanes (4 northbound, 3 southbound), with Mundijong Road being 6 lanes (3 in each direction), west of St Albans Road and 4 lanes (2 in each direction) east of St Albans Road.

The forecast levels provided in the Guidelines assume open and level ground. The Guidelines allow a 4 dB reduction in noise level where:

- an existing building or structure screens more than 50% of the most exposed part of the noise-sensitive land-use; or
- where a solid continuous minimum 1.8 metre noise wall/fence exists or is proposed; or
- through a combination of permanent structures and terrain so there is no direct line of sight.

Once subdivided, reductions will occur by either physical noise controls (walls/bunds) and with the houses closest to the road shielding those further away.

Transport Corridor Classification	Number of lanes (both directions), including bus/priority lanes and entrances/exist ramps	Forecast noise exposure category based on lot distance(m) from edge of nearest main road carriageway (not entrance/exit ramps)																												Forecast Excess Noise Level, dB	Exposure Category	Policy requirements for noise-sensitive land-use and/or development
		10 adjacent	20	30	40	50	60	70	80	90	100	110	120	130	140	150	175	200	225	250	275	300										
Strategic freight/major traffic route • 500 or more Class 7-12 Austroads vehicles per day, or • 50,000+ vehicles per day	2 to 4 lanes	72	68	66	65	63	62	61	61	60	59	59	58	57	57	56	55	54	53	52	51	50	-	-	No further measures							
	5 to 6 lanes	74	70	68	66	65	64	63	62	61	61	60	59	59	58	57	56	55	54	53	52	51	50	-	A	Noise-sensitive land-use and/or development is acceptable, subject to:						
	7 to 8 lanes	76	72	69	68	66	65	64	64	63	62	62	61	60	60	59	58	57	56	55	54	53	52	-	B	Mitigation measures in accordance with an approved noise management plan;						
	9 to 10 lanes	77	73	70	69	67	66	65	65	64	63	63	62	61	61	60	59	58	57	56	55	54	53	-	C	or quiet house package as specified						
	10 or more lanes	78	74	71	70	68	67	66	66	65	64	64	63	62	62	61	60	59	58	57	56	56	-	C+								
Other significant freight / traffic routes • Any actual or planned future State Administered Road • Local Government Roads Carrying 100 or more Class 7 - 12 Austroads vehicles/day • 25,000+ vehicles per days vehicles/day	Urban Region Scheme areas 60-80 km/hr	1 to 2 lanes	67	64	62	61	60	59	58	57	56	56	55	54	54	53	53	52	51	50	49	48	47	12 to 15	D	Noise-sensitive land-use and/or development is not recommended. There is no default quiet house option due to excessive forecast noise. Professional design input is required in order to achieve compliance with relevant criteria. If noise-sensitive land-use and/or development is unavoidable, an approved noise management plan is required to demonstrate compliance with the noise target (see Table 1).						
	Urban Region Scheme areas 100+ km/hr	3 to 6 lanes	69	66	64	63	62	61	60	59	58	58	57	56	56	55	55	54	53	52	51	50	49									
	Rural areas 60-80 km/hr	1 to 2 lanes	70	67	65	64	63	62	61	60	59	59	58	57	57	56	56	55	54	53	52	51	50									
	Rural areas 100+ km/hr	3 to 4 lanes	74	70	68	66	65	64	63	62	61	61	60	60	59	59	58	57	56	55	54	53	52									
		1 to 2 lanes	62	59	57	56	55	54	53	52	51	51	50	49	49	48	48	46	45	44	43	42	41									
		3 to 4 lanes	66	63	61	60	59	58	56	56	55	54	53	53	52	52	51	50	49	48	47	46	45									
	1 to 2 lanes	67	64	62	61	60	59	58	57	56	55	54	54	53	53	52	51	50	49	48	47	46										
	3 to 4 lanes	69	66	64	63	62	61	60	59	58	57	56	56	55	55	54	53	52	51	50	49	48										
Railway Transport Corridor Classification		Forecast period average noise level and exposure category based on distance from nearest rail centreline (m)																														
		adjacent																														
Passenger railways	Fremantle, Midland and Thornlie main lines only	68	64	62	60	59	58	56	56	55	54	53	52	52	51	51	49	48														
	All other metro passenger rail lines, and where multiple metro rail services share the same transport corridor	70	66	64	62	61	60	58	57	56	55	54	54	53	52	51	50															
Freight railways, up to 1 movement per hour		72	68	65	63*	62*	60*	59*	58*	57*	57*	56	55	55	54	53	52	51														

Figure 3-2: Noise Exposure Forecast Table from Guidelines

3.2. Environmental Noise Methodology

This report considers and adopts information from previous projects. In 2018, work was undertaken on a proposed wakeboard and water-ski facility to be located in Anniebrook², with measurements obtained from Bonney's WA Water Ski Park. In 2019, measurements were undertaken of the Jet Sprint Park during a race day³.

To predict the noise from the two sites, computer modelling has been undertaken. The software used was *SoundPLAN 8.2* with the CONCAWE algorithms (ISO 171534-3 improved method) selected, as they include the influence of meteorological conditions. Input data required in the model are listed below and discussed in *Section 3.2.1* to *Section 3.2.4*:

- Meteorological Information;
- Topographical data;
- Ground Absorption; and
- Source sound power levels.

3.2.1. Meteorological Conditions

Meteorological information utilised is provided in *Table 3-2* and is considered to represent worst-case conditions for noise propagation. At wind speeds greater than those shown, sound propagation may be further enhanced, however background noise from the wind itself and from local vegetation is likely to be elevated and dominate the ambient noise levels.

Table 3-2: Modelling Meteorological Conditions

Parameter	Day (7.00am to 7.00pm) ²
Temperature (°C)	20
Humidity (%)	50
Wind Speed (m/s)	4
Wind Direction ¹	All
Pasquil Stability Factor	E

Notes:

1. The modelling package allows for all wind directions to be modelled simultaneously.
2. The conditions above are as defined in *Guideline: Assessment of Environmental Noise Emissions*; May 2021

Alternatives to the above default conditions can be used where one year of weather data is available and the analysis considers the worst 2% of the day and night for the month of the year in which the worst-case weather conditions prevail (source: *Draft Guideline on Environmental Noise for Prescribed Premises*, May 2016). In most cases, the default conditions occur for more than 2% of the time and therefore must be satisfied.

² *Environmental Noise Assessment, Wildwood Wake and Aqua Park*; Reference: 17104184-02, 8 January 2018

³ *Jet Sprint Park Noise Impact Assessment, West Coast Jet Sprint Club, St Albans Road, Baldavis*; Reference: 19034915-01, 29 April 2019

3.2.2. Topographical Data

Topographical data was adapted from publicly available information (e.g. *Google*) in the form of spot heights.

Future buildings were also represented in the noise model as 3.5 metre high blocks as per the *Figure 1-2* Concept Plan.

3.2.3. Ground Absorption

The ground absorption has been assumed to be 0.0 (0%) for the roads and 0.5 (50%) elsewhere, noting that 0.0 represents hard reflective surfaces such as water and 1.0 represents absorptive surfaces such as grass.

3.2.4. Source Sound Levels

The source sound power levels used in the modelling are provided in *Table 3-2* and as described in *Section 3.2*, sourced from previous projects.

Table 3-3: Source Sound Power Levels, dB

Description	Octave Band Centre Frequency (Hz)								Overall dB(A)
	63	125	250	500	1k	2k	4k	8k	
Jet Sprint Boat Racing – L ₁₀	131	136	135	131	131	129	122	113	136
Ski Boat – L ₁₀	109	113	104	102	92	89	85	82	103

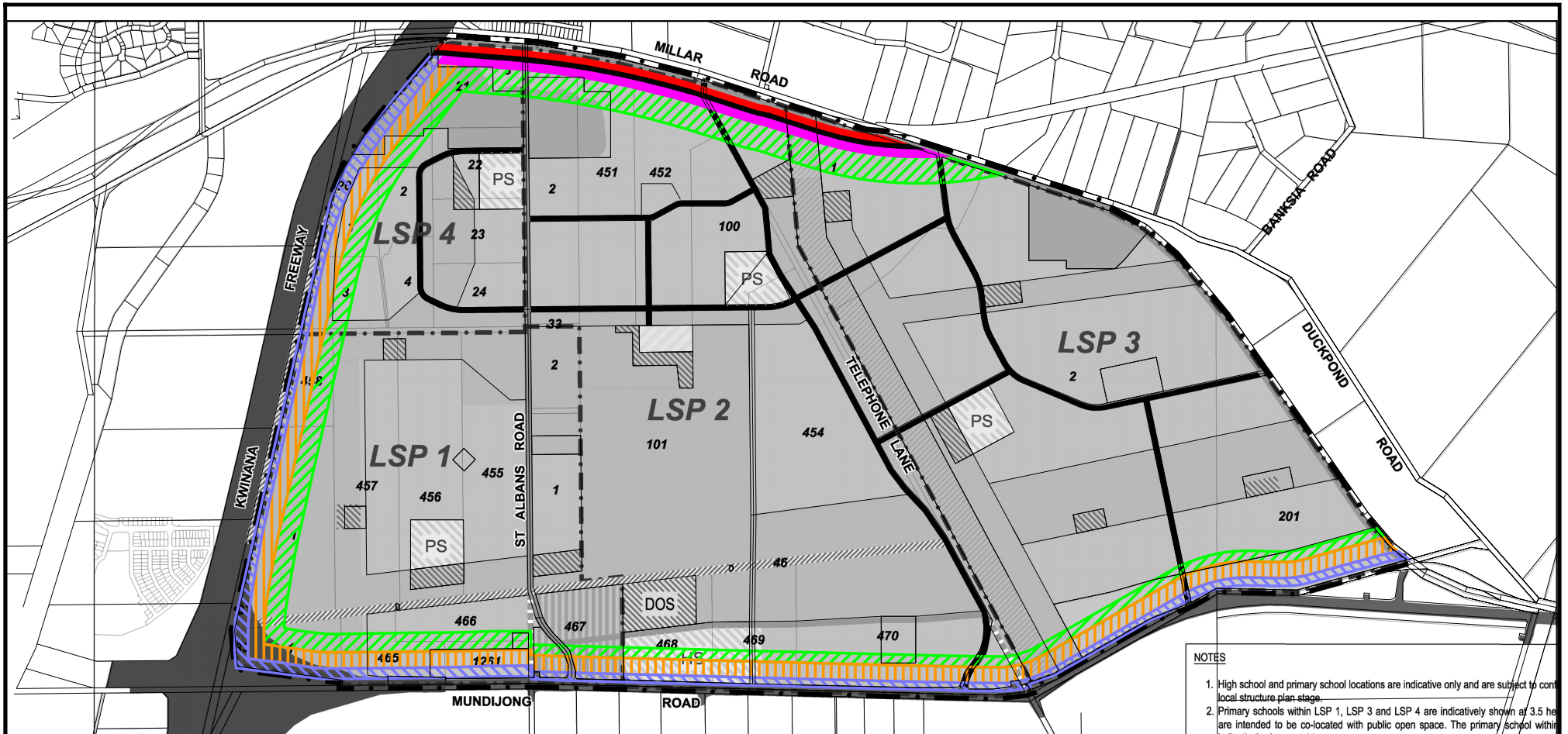
4. RESULTS

4.1. Transport Noise Results

The noise exposure forecast levels from the Guidelines have been plotted on *Figure 4-1* showing the extent of the Exposure A, B and C areas, assuming open ground. As discussed, the actual extent will likely be less than that shown once the actual noise levels are quantified, noise mitigation incorporated (e.g. noise walls) and once future houses are included, since these also provide attenuation to those located behind.

4.2. Environmental Noise Results

Two noise contour plots are provided representing the Jet Sprint Boats on a race day at the Jet Sprint Park (*Figure 4-2*) and two ski boats operating at Bonney's Water Ski Park (*Figure 4-3*).



NOTES

1. High school and primary school locations are indicative only and are subject to confirmation at local structure plan stage.
2. Primary schools within LSP 1, LSP 3 and LSP 4 are indicatively shown at 3.5 ha and are intended to be co-located with public open space. The primary school within LSP 2 is shown at 101.

Wellard District Structure Plan Exposure Levels for Transport Noise from Screening Assessment Procedure

Applicable to Noise Sensitive Buildings Only

Signs and symbols

-  Package A
-  Package B
-  Package C
-  Package A+
-  Package B+
-  Package C+



25 June 2023

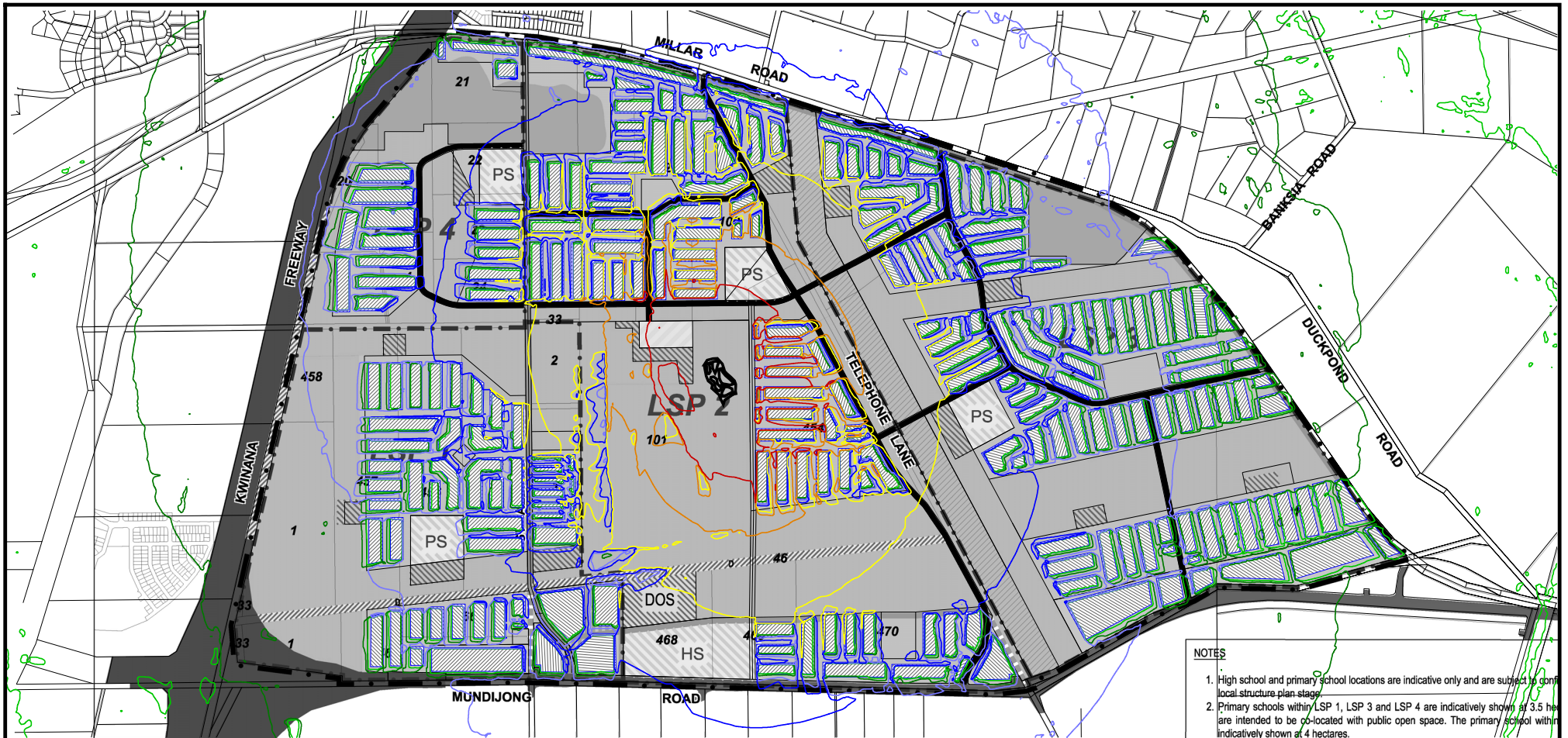


Lloyd George Acoustics
by Terry George
terry@lgacoustics.com.au
(08) 9401 7770

Length Scale 1:22000



Figure 4-1





- NOTES**
1. High school and primary school locations are indicative only and are subject to final local structure plan stage.
 2. Primary schools within LSP 1, LSP 3 and LSP 4 are indicatively shown at 3.5 hectares and are intended to be co-located with public open space. The primary school within LSP 2 is indicatively shown at 4 hectares.

Wellard District Structure Plan
LA10 Noise Level Contours - Jet Sprint Boats Racing








Ground Floor Level

SoundPLAN v8.2
 CONCAWE Algorithms


Signs and symbols

-  Building
-  Jet Sprint Park

Noise levels
 LA10 dB

-  = 45
-  = 50
-  = 55
-  = 60
-  = 65
-  = 70
-  = 75

25 June 2023



Lloyd George Acoustics
 PO Box 717
 HILLARYS WA 6923
 (08) 9401 7770

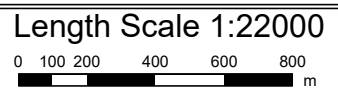
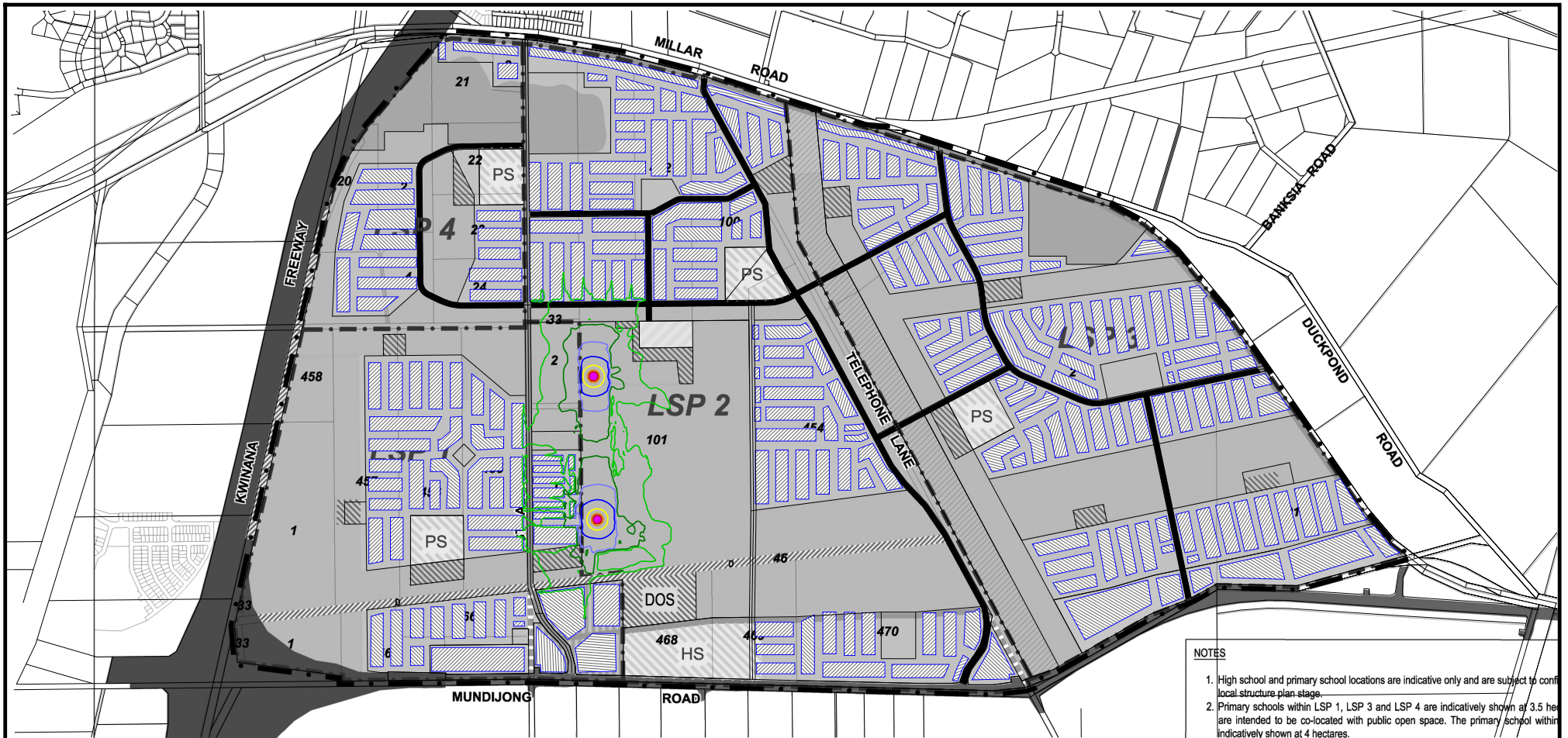


Figure 4-2





- NOTES
1. High school and primary school locations are indicative only and are subject to confirmation at the local structure plan stage.
 2. Primary schools within LSP 1, LSP 3 and LSP 4 are indicatively shown at 3.5 hectares and are intended to be co-located with public open space. The primary school within LSP 2 is indicatively shown at 4 hectares.

Wellard District Structure Plan
 LA10 Noise Level Contours - Ski Boats

Ground Floor Level

 SoundPLAN v8.2
 CONCAWE Algorithms

Signs and symbols
 Building
 Point source

Noise levels
 LA10 dB

	= 40
	= 45
	= 50
	= 55
	= 60
	= 65
	= 70

25 June 2023

Lloyd George Acoustics
 PO Box 717
 HILLARYS WA 6923
 (08) 9401 7770

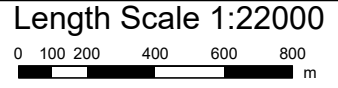


Figure 4-3



5. ASSESSMENT

5.1. Transport Noise 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 4.1*, it is evident the outdoor noise target will be exceeded at some lots. As detailed design progresses, the following noise controls will be considered:

- Where practicable, the **separation distance** from the transport corridors to a noise sensitive part of a development should be maximised. Methods to increase separation may be using local roads, any commercial parts and public open space as buffers.
- Physical barriers such as **noise walls/bunds** can be considered. However, there is some practicality with the height of noise walls that will limit their effectiveness to ground and first floors only. The urban design of such walls would also need to be considered if proposed.
- The **orientation** of lots should consider the acoustic outcomes. For instance, lots that front the corridor with a local road are advantageous as this normally means a garage takes up part of the lot frontage which does not require noise attenuation. This also means the alfresco area would normally be located on the side of the house opposite the corridor.
- Once the physical noise controls are implemented, further analysis will determine the extent of affected lots, with these incorporating **notifications on title** and **Quiet House Packages** (refer *Appendix A*).

The proposed concept plan can be managed to comply with the requirements of *State Planning Policy No. 5.4 Road and Rail Noise*.

It is noted that residences are proposed to be located within 30 metres of the freight railway. Whilst ground-borne vibration is not covered in SPP 5.4, this may present an issue and will require further analysis in the future. As a minimum, notifications on title will be required regarding potential vibration from passing trains. Depending on vibration levels, a trench or deep footings (which may be present in any case for a noise wall) may be required to minimise the transfer of vibration.

5.2. Environmental Noise Assessment

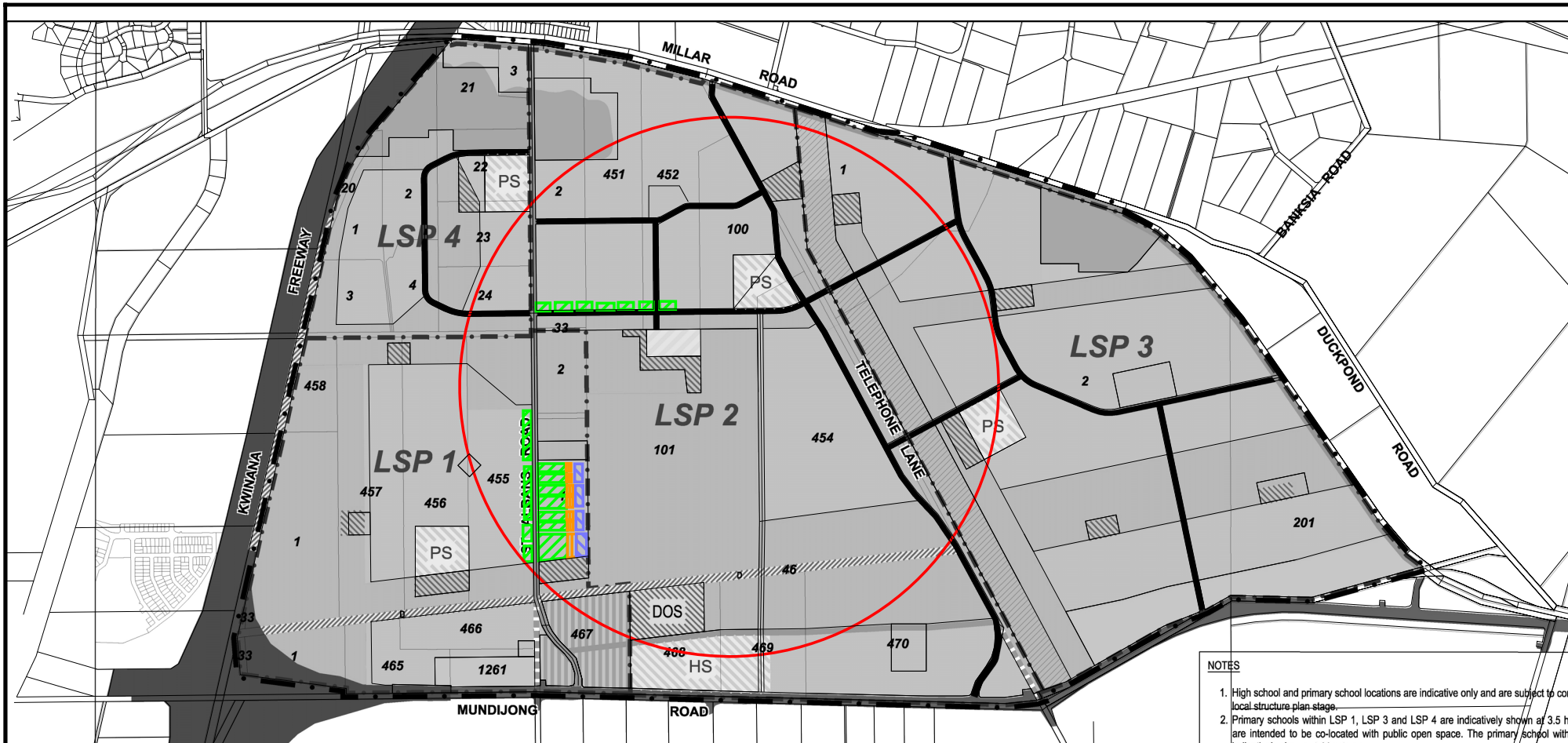
The Jet Boats race on a Saturday, during the day, at which time the assigned level at its lowest is 45 dB L_{A10} . Whilst there will be some residences where the assigned level is higher, the 45 dB L_{A10} assigned level is applicable to those closest to the facility. Exceedances of 35 dB above the daytime assigned level are predicted to the closest proposed residences immediately east and there is no practicable method to achieve this reduction such that the Baldivis Jet Sprint Park will need to approach the local government and determine their acceptance to a regulation 16A Noise Management Plan if they are to continue operating. Assuming this approach is accepted, notifications on title are recommended for any dwelling within 1 kilometre.

For the Ski Boats at Bonney's, the noise contours are more contained. Bonney's does operate on a Sunday such that the most stringent assigned level is 40 dB L_{A10} . With regard to environmental noise, the requirement is for the person making the noise to achieve compliance even when the residential development occurs after. To minimise the risk of complaints, the following will be incorporated:

- Notification on lot title for any residence where the predicted noise is above 40 dB L_{A10} ; and
- Architectural packages incorporated as generally shown on *Figure 5-1*.

Note that no consideration has been given to intrusive characteristics, particularly tonality given that the boats engines will be operating at variable speeds and with background noise during the day, are unlikely to be assessed as tonal.

Whilst the packages noted are for the control of road traffic noise, they will still be effective for noise from Bonney's and given developer's, local governments and builders familiarity with these packages, these have been adopted for simplicity. It is expected that as the development progresses, the affected lots will be further refined and detailed.







- NOTES**
1. High school and primary school locations are indicative only and are subject to confirmation at local structure plan stage.
 2. Primary schools within LSP 1, LSP 3 and LSP 4 are indicatively shown at 3.5 ha and are intended to be co-located with public open space. The primary school within LSP 2 is shown at 101.

**Wellard District Structure Plan
Noise Mitigation for Water Ski Park**

Applicable to Noise Sensitive Buildings Only

Signs and symbols

-  Package A
-  Package B
-  Package C
-  1km Notification for Jet Sprint Boats

25 June 2023



Lloyd George Acoustics
by Terry George
terry@lgacoustics.com.au
(08) 9401 7770

Length Scale 1:22000



Figure 5-1



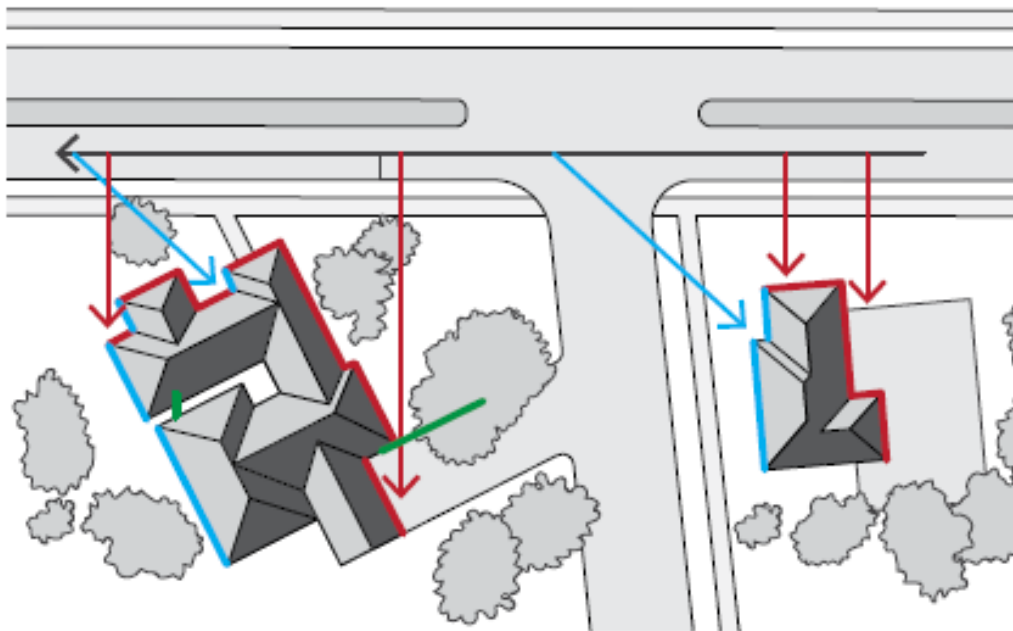
Appendix A – Quiet House Packages

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 $L_{Aeq}(\text{Day})$ & 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 11kg/m³; and 2 x 16mm fire-rated plasterboard to inside. 	
Roofs and Ceilings	All	<ul style="list-style-type: none"> $R_w + C_{tr} \geq 35$; 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/m³). 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/m³). 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/m³) 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 – Influencing Factor Calculation

The assigned levels combine a baseline assigned level with an influencing factor, with the latter increasing the assigned level on the basis of the existence of significant roads and commercial or industrial zoned land within an inner circle (100 metre radius) and an outer circle (450 metre radius) of the noise sensitive premises. The calculation for the influencing factor is:

$$= \frac{1}{10} (\% \text{ Type A}_{100} + \% \text{ Type A}_{450}) + \frac{1}{20} (\% \text{ Type B}_{100} + \% \text{ Type B}_{450})$$

where:

% Type A₁₀₀ = the percentage of industrial land within
a 100m radius of the premises receiving the noise

% Type A₄₅₀ = the percentage of industrial land within
a 450m radius of the premises receiving the noise

% Type B₁₀₀ = the percentage of commercial land within
a 100m radius of the premises receiving the noise

% Type B₄₅₀ = the percentage of commercial land within
a 450m radius of the premises receiving the noise

+ Transport Factor (maximum of 6 dB)

= 2 for each secondary road (6,000 to 15,000 vpd) within 100m

= 2 for each major road (> 15,000 vpd) within 450m

= 6 for each major road within 100m

From the Main Roads WA Traffic Map, *Table B-1* shows the relevant roads and their traffic counts within the inner (100 metre radius) and outer (450 metre radius) circles. The influencing factor calculated in *Table B-1* is combined with those baseline assigned levels of *Table 2-3*, resulting in the project assigned levels provided in *Table 2-4*.

Table B-1: Relevant Roads

Within 100m		Within 450m
Major Road (+ 6 dB)	Secondary Road (+ 2 dB)	Major Road Not Within 100m (+ 2 dB)
Kwinana Freeway (76,397 2020/21 #8214 & #8215)	Mundijong Road (6,786 2020/21 #8200)	Kwinana Freeway (76,397 2020/21 #8214 & #8215)

Appendix C – 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:

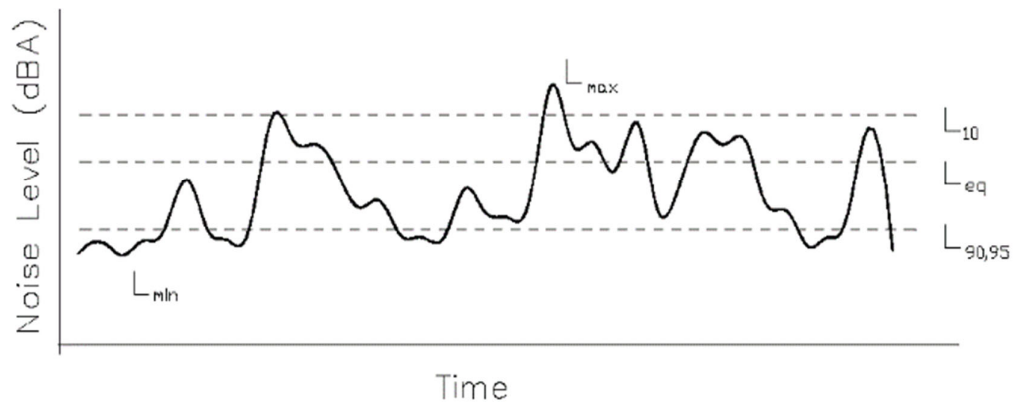
- The noise reduction benefit provided;
- The number of people protected;
- The relative cost vs benefit of mitigation;
- Road conditions (speed and road surface) significantly differ from noise forecast table assumptions;
- Existing and future noise levels, including changes in noise levels;
- Aesthetic 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'**

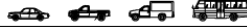











'Practicable' considerations for the purposes of the policy normally relate to the engineering aspects of the noise mitigation measures under evaluation. It is defined as "reasonably practicable having regard to, among other things, local conditions and circumstances (including costs) and to the current 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**



- Austrroads Vehicle Class

VEHICLE CLASSIFICATION SYSTEM	
AUSTRROADS	
CLASS	LIGHT VEHICLES
1	SHORT Car, Van, Wagon, 4WD, UTV, Bicycle, Motorcycle 
2	SHORT - TOWING Trailer, Caravan, Boat 
HEAVY VEHICLES	
3	TWO AXLE TRUCK OR BUS *2 axles 
4	THREE AXLE TRUCK OR BUS *3 axles, 2 axle groups 
5	FOUR (or FIVE) AXLE TRUCK *4 (5) axles, 2 axle groups 
6	THREE AXLE ARTICULATED *3 axles, 3 axle groups 
7	FOUR AXLE ARTICULATED *4 axles, 3 or 4 axle groups 
8	FIVE AXLE ARTICULATED *5 axles, 3+ axle groups 
9	SIX AXLE ARTICULATED *6 axles, 3+ axle groups or 7+ axles, 3 axle groups 
LONG VEHICLES AND ROAD TRAINS	
10	8 DOUBLE or HEAVY TRUCK and TRAILER *7+ axles, 4 axle groups 
11	DOUBLE ROAD TRAIN *7+ axles, 5 or 6 axle groups 
12	TRIPLE ROAD TRAIN *7+ axles, 7+ axle groups 

- Typical Noise Levels

