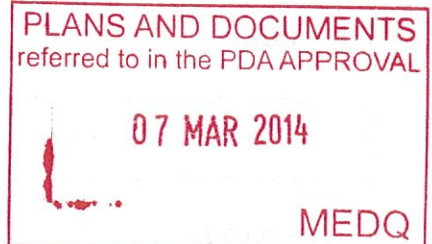


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Yarrabilba Development, Precinct 2

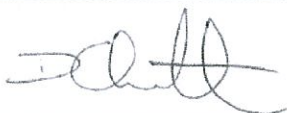
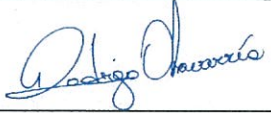
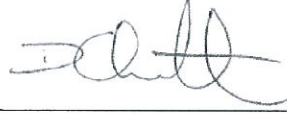
Traffic Noise Assessment



Report No. 70Q-13-0319-TRP-515727-1

24 Feb 2014

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PREPARED FOR: Lend Lease Communities (Yarrabilba) Pty Ltd Level 2, 349 Coronation Drive Milton Qld 4064 P O Box 1512, Milton Qld 4064 Contact: Wendy Truer Phone: +61 7 3292 2200		PREPARED BY: Vipac Engineers & Scientists Ltd Level 2, 146 Leichhardt Street Spring Hill, QLD 4000 AUSTRALIA e: brisbane@vipac.com.au t: +61 7 3377 0400 f: +61 7 3377 0499
AUTHOR:		
	Daniel Cheetham	Date: 24 Feb 201
	Project Engineer	
REVIEWED BY:		
	Rodrigo Olavarria	Date: 24 Feb 201
	Reviewing Engineer	
ISSUED BY:		
	Daniel Cheetham	Date: 24 Feb 201
	QA Representative	
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EXECUTIVE SUMMARY

Vipac Engineers & Scientists Ltd (Vipac) has completed a road traffic noise assessment for Precinct 2 of the Yarrabilba development on the Waterford-Tamborine Road. Noise impacts on the development have been assessed according to the Department of Transport and Main Roads, AS 3671:1989 and AS/NZS 2107:2000 noise policies.

Based on this assessment, 85 Lots in Precinct 2 were predicted to exceed the TMR traffic noise criteria at the ground floor level and 85 Lots at the first floor level. Some areas where final Lot layouts were not available, designated as blocks, exceeded the noise limits. In general, single storey residences located within 35m of the Yarrabilba Drive Road corridor boundary (in village P02 V03C and P02 V04A) and 45m from the western boundary of Precinct 2 (in village P02 V01) were predicted to exceed noise limits. Two storey residences within 50m of the Yarrabilba Drive road corridor (villages P02 V03 and V04) and within 90m of the western boundary of Precinct 2 (village P02 V01) were also predicted to exceed the noise limits.

For lots where the noise criteria are exceeded, the relevant floors require acoustic treatment. Glazing requirements were calculated and are detailed in this report. Calculations used worst case assumptions about room and window sizes. Less conservative requirements may be calculated according to AS3671 and AS2107 when final building plans are available.

For floors of Lots where the noise criteria is exceeded, acceptable indoor noise levels can be achieved with the glazing recommendations specified in this report, however external doors and windows of the noise affected rooms must remain closed. Under these conditions, alternative ventilation will be required. Alternative ventilation may include air-conditioning, borrowed ventilation, mechanically assisted ventilation or other suitable methods.

In conclusion, noise impacts associated with the proposed development can be controlled to an acceptable level by implementing the recommendations in this report.

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1. INTRODUCTION

Vipac Engineers & Scientists Ltd (Vipac) was commissioned by Lend Lease to provide a road traffic noise assessment for Precinct 2 of the Yarrabilba development, located on the Waterford-Tamborine Road.

The purpose of this assessment is to determine the road traffic noise impacts at residential Lots in Precinct 2.

Noise impacts have been assessed in accordance with the Department of Transport and Main Roads (TMR), AS 3671:1989 (AS3671) and AS/NZS 2107:2000 (AS2107) noise policies.

2. PROPOSED DEVELOPMENT AND SURROUNDING AREA

The site is located on the Waterford-Tamborine Road. The following information about the surrounding area was observed on site and is presented in Figure 2-1:

- North: Dowe Haven Equestrian Park and residential dwellings;
- East: Further development Stages;
- South: Further development Stages; and
- West: Precinct 1 of the development, and further west the Waterford Tamborine Road.

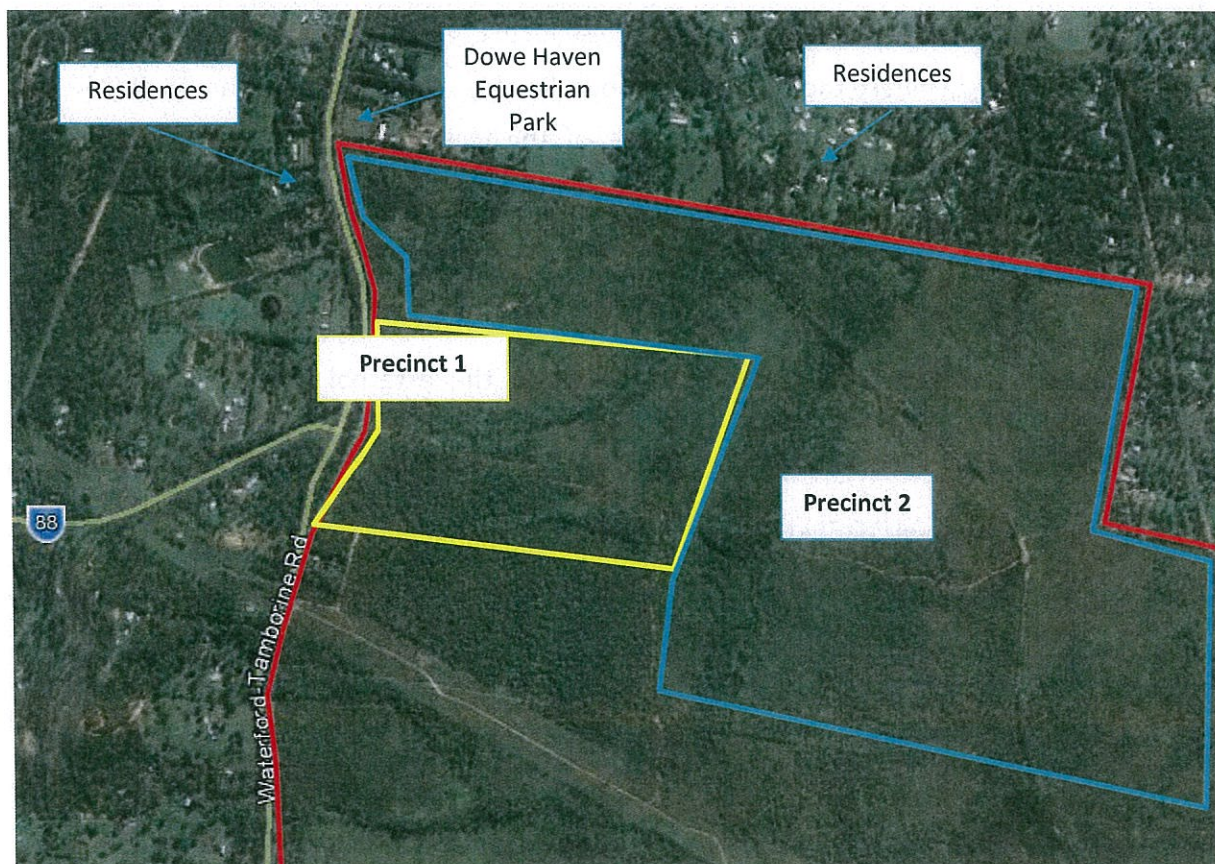


Figure 2-1: Aerial Photograph of the Site

The significant noise sources that may potentially impact on Precinct 2 are traffic noise from the Waterford –Tamborine Road, Yarrabilba Drive and Precinct 2 Road 1 (see Figure A-1).

3. NOISE POLICY

The applicable noise criteria are summarised in Table 3-1.

Table 3-1: Applicable Noise Policies

Noise Source	Applicable Noise Criteria
Road traffic noise	The Department of Transport and Main Roads' (TMR) Road Traffic Noise Management: Code of Practice (COP) AS/NZS 2107:2000 Acoustics—Recommended design sound levels and reverberation times for building interiors (AS2107) AS 3671:1989 Acoustics-Road traffic noise intrusion - Building Siting and Construction (AS3671)

The development stages are affected by traffic noise from the Waterford-Tamborine Road, which is a state controlled road, and adjacent to Yarrabilba Drive, which will be a major road in the future. Therefore, the Department of Transport and Main Roads' (TMR) 'Road Traffic Noise Management: Code of Practice' (COP) noise criteria have been adopted. The applicable road traffic noise limits are:

External noise limit at future residences:

- 57 dB(A) $L_{A10(18hr)}$ where the background noise level $L_{A90(8hr)}$ is less than 45 dB(A); and
- 60 dB(A) $L_{A10(18hr)}$ where the background noise level $L_{A90(8hr)}$ is greater than 45 dB(A).

Private open space:

- 57 dB(A) $L_{A10(18hr)}$ where the background noise level $L_{A90(8hr)}$ is less than 45 dB(A); and
- 60 dB(A) $L_{A10(18hr)}$ where the background noise level $L_{A90(8hr)}$ is greater than 45 dB(A).

Where external façade noise limits cannot be met, the TMR COP refers to AS/NZS 2107:2000 'Acoustics-Recommended design sound levels and reverberation times for building interiors' which has the following maximum indoor noise limits for residences near major roads:

- 40 dB(A) for bedrooms; and
- 45 dB(A) for living rooms.

Since Lots in Precinct 2 will be near a major road, the external noise limit of 60 dB(A) $L_{A10(18hr)}$ free field and the private open space noise limit of 60 $L_{A10(18hr)}$ of have been adopted for this assessment.

4. TRAFFIC NOISE MODELLING METHODOLOGY

Road traffic noise calculations were carried out using SoundPLAN noise modelling software. A 3D computational model was created based on the drawings provided.

The data and assumptions used in road traffic noise modelling are presented in Table 4-1. The road traffic flow data obtained from Cardno is presented in Table 4-2. The location of the modelled roads are presented in Figure A-1 in Appendix A.

Table 4-1: Data and Assumptions Used in Road Traffic Noise Modelling

Parameter	Data
Future Residence Receiver Heights	Ground Floor: 1.8m above building pad level First Floor: 4.6m above building pad level (assuming height of storeys as 2.8m) Assumed pad levels are included in Appendix B.
Buildings on Lots	Buildings on Lots have been considered in noise predictions when calculating noise at Lots not immediately adjacent to Yarrabilba Drive, in village P02 V03 and P02 V04. Buildings with dimensions 10 x 15m, 4m high, have been included in the noise model at worst case locations on Lots, i.e. where buildings will give the least shielding to the Lots behind them.
Terrain Data	131127_VIPAC_eaveglade_street.dwg, received from KN Group, 27/11/2013 - Nothern Area 1m Contours.dwg, received from KN Group, 3/11/2013 - Overall_Contours-Lidar-3m GridProjDatum.dwg, received from KN Group, 6/11/2012
Development Lot Layout	P02_Des_140205_ApplnRFI.dwg, received from Lend Lease 21/02/2014
Road Alignment	- P02_Des_140205_ApplnRFI.dwg, received from Lend Lease 21/02/2014 131011 VIPAC ultimate frontage and contours.dwg, received from Lend Lease, 1/11/2013
Calculation Method	UK's Calculation of Road Traffic Noise (CoRTN)
Road Traffic Volume Conversions - AADT to 18hr Traffic Flows	94%
Road Surface	Dense Graded Asphalt was modelled as the road surface for all roads. No road surface correction is applied to the base noise level calculated by SoundPLAN because the base noise level prediction assumes dense graded asphalt road surface.

Table 4-2: Road Traffic Data Used for Noise Modelling

Scenario	Road	AADT	18hr Road Traffic Volumes	%CV	Speed (km/h)
Existing	Waterford-Tamborine Rd	8,700	8,178	8%	90
Ultimate	Waterford-Tamborine Rd	42,350	8,178	8%	90
	Yarrabilba Drive	12,410	11,665	5%*	60
	Precinct 2 Road 1	5,530	5,198	5%*	60

* Conservative assumptions about %CV have been used, as the information was not available at the time of issue of the report. If the %CV is higher than 5%, revised noise modelling may need to be conducted

4.1 NOISE MODEL CALIBRATION

Noise monitoring was conducted on the Waterford-Tamborine Road, between 18th July 2011 and 27th July 2011. The road traffic noise modelling predictions differed from the noise measurement by +1.7 dB(A). A difference between predicted and measured result of less than 2 dB(A) is considered acceptable. A calibration factor of +1.7 dB(A) has been added to the Waterford-Tamborine Road noise source.

5. TRAFFIC NOISE MODELLING RESULTS

Predicted road traffic noise levels are up to 70 dB(A) $L_{A10(18hr)}$. This exceeds the applicable noise limit of 60 dB(A).

Predicted noise levels exceed the applicable noise limits by up to 10 dB(A) at the ground floor and 10 dB(A) at the first floor. 85 Lots exceed the noise limits at the ground floor and 85 Lots exceed the noise limits at the first floor as shown in Table 5-1 and Table 5-2.

Some areas where final Lot layouts were not available, designated blocks "A" to "Z" exceeded the noise limits. The locations of these areas are present in Figure A-2 to Figure A-3. In general, single storey residences located within 35m of the Yarrabilba Drive Road corridor boundary (in village P02 V03C and P02 V04A) and 45m from the western boundary of Precinct 2 (in village P02 V01) were predicted to exceed noise limits. Two storey residences within 50m of the Yarrabilba Drive road corridor (villages P02 V03 and V04) and within 90m of the western boundary of Precinct 2 (village P02 V01) were also predicted to exceed the noise limits.

Blocks exceeding the noise limits at the ground floor and first floor are shown in Table 5-3 and Table 5-4 respectively.

Table 5-1: Lots Exceeding Applicable External Noise Limits at the Ground Floor Level

Lot	L _{A10(18hr)} (dB(A))	Lot	L _{A10(18hr)} (dB(A))	Lot	L _{A10(18hr)} (dB(A))	Lot	L _{A10(18hr)} (dB(A))
1	66	83	67	292	63	512	65
2	68	84	66	293	62	513	66
3	69	85	67	294	62	514	66
20	68	130	68	350	69	515	66
21	67	131	62	351	69	580	64
22	67	135	69	352	68	581	65
23	67	136	64	353	69	582	65
24	68	137	61	354	69	583	65
25	68	190	63	355	69	584	65
26	68	191	64	356	69	585	65
27	68	192	64	357	69	586	65
28	68	193	64	490	69	587	65
29	68	194	64	491	68	588	66
30	68	195	63	492	68	589	61
31	68	196	63	493	68	591	66
43	64	197	63	494	68	592	66
70	68	200	64	495	68	593	66
71	61	260	64	496	68	594	66
79	62	266	64	508	65	595	66
80	68	287	63	509	65		
81	67	290	63	510	65		
82	66	291	62	511	65		

Table 5-2: Lots Exceeding Applicable External Noise Limits at the First Floor Level

Lot	L _{A10(18hr)} (dB(A))	Lot	L _{A10(18hr)} (dB(A))	Lot	L _{A10(18hr)} (dB(A))	Lot	L _{A10(18hr)} (dB(A))
1	68	83	68	292	65	512	67
2	69	84	68	293	64	513	67
3	70	85	69	294	64	514	67
20	69	130	69	350	70	515	67
21	68	131	64	351	70	580	66
22	68	135	70	352	69	581	66
23	68	136	66	353	70	582	66
24	69	137	64	354	70	583	66
25	69	190	65	355	70	584	66
26	69	191	65	356	70	585	66
27	69	192	65	357	70	586	66
28	69	193	65	490	70	587	67
29	69	194	65	491	69	588	67
30	69	195	65	492	69	589	63
31	69	196	65	493	69	591	67
43	65	197	65	494	69	592	67
70	69	200	65	495	69	593	67
71	64	260	65	496	69	594	67
79	64	266	65	508	66	595	67
80	69	287	65	509	66		
81	69	290	65	510	66		
82	68	291	63	511	66		

Table 5-3: Blocks Exceeding Applicable External Noise Limits at the Ground Floor Level

Lot	L _{A10(18hr)} (dB(A))	Lot	L _{A10(18hr)} (dB(A))	Lot	L _{A10(18hr)} (dB(A))	Lot	L _{A10(18hr)} (dB(A))
A	68	J	69	M	61	Q	62
B	69	K	66	O	63		
G	61	L	63	P	63		

Table 5-4: Blocks Exceeding Applicable External Noise Limits at the First Floor Level

Lot	L _{A10(18hr)} (dB(A))	Lot	L _{A10(18hr)} (dB(A))	Lot	L _{A10(18hr)} (dB(A))	Lot	L _{A10(18hr)} (dB(A))
A	69	J	70	P	65	V	61
B	70	K	68	Q	63	W	62
E	61	L	65	R	62	X	62
F	61	M	63	S	61	Y	61
G	63	N	61	T	61	Z	61
H	61	O	65	U	62		

Floors of future residences where the noise limits are exceeded will need to be designed and constructed according to the methods outlined in AS 3671:1989, "Acoustics-Road traffic noise intrusion - Building Siting and Construction" and the noise limits in AS2107 (see Section 3). Construction requirements are detailed in Section 5.2.

Noise contour maps are included in Appendix A. Predicted noise levels at all Lots exceeding the noise limits are presented in Appendix B.

Note that noise contour maps are interpolated and may have different Lot elevations to single point receivers. Results tables Table 5-1 to Table 5-4 and in Appendix B are the correct noise levels where noise contour maps and tables differ.

5.1 OUTDOOR RECREATIONAL SPACE

A traffic noise contour map of the predicted free field $L_{A10(18hr)}$ noise at the ground floor level has been included in Figure A-2 to Figure A-3 in Appendix A. It can be seen that most Lots have areas that are below the TMR 60 dB(A) $L_{A10(18hr)}$ noise limit.

All Lots have some areas where predicted road traffic noise levels are less than or equal to 66 dB(A). It is expected that when the buildings are constructed road traffic noise levels will be at least 8 dB(A) lower in the space shielded by the buildings. Therefore, all Lots will have areas that comply with the TMR 60 dB(A) $L_{A10(18hr)}$ private open space noise limit.

5.2 ARCHITECTURAL TREATMENTS

The TMR 60 dB(A) noise limit will be exceeded at some Lots in Precinct 2. Consequently, the building construction should be designed to achieve the recommended noise limits specified in AS2107 (See Section 3):

- Bedrooms: L_{Aeq} 40 dB(A)
- Other habitable Rooms: L_{Aeq} 45 dB(A)

The recommended acoustic ratings for all walls, windows and roofing were calculated using the procedures in Australian Standard AS3671 "Acoustics – Road Traffic Noise Intrusion Building Siting and Construction" using worst case assumptions about room dimensions and building orientations.

The assumed construction specifications for future residences are given in Table 5-5.

Table 5-5: The Assumed Construction Specifications for Future Residences

Item	Construction	Expected R_w
External Wall	Brick Veneer	52
	10mm plasterboard	
Ceiling and Roof	Sheet metal / Cement tiles	38
	10mm Plasterboard	
	R2.5 Batts Insulation	
Glazing and Frames	4mm Float	24

Glazing requirements are specified in Table 5-6. Where glazing acoustic requirements are not specified in Table 5-6, glazing ratings from Table 5-5 can be used.

Table 5-6: Required Glazing Construction for Residences on Lots exceeding External Noise Limits to Comply with Indoor Noise Limits

Village	Road	Floor	Room	Orientation of Façade	Required R_w Acoustic Rating of Glazing and Frames
P02 V01	Waterford-Tamborine Rd	Ground	Bedrooms	N	28
				S	26
				W	28
		First	Bedrooms	N	26
				S	26
				W	28

Village	Road	Floor	Room	Orientation of Façade	Required Rw Acoustic Rating of Glazing and Frames
Village P02 V03	South of Yarrabilba Dve	Ground	Bedrooms	N	36
				E	34
				W	34
			Living Rooms	N	31
				E	30
				W	30
		First	Bedrooms	N	37
				E	35
				W	35
			Living Rooms	N	33
				E	31
				W	31
	East of Precinct 2 Road 1*	Ground	Bedrooms	N	30
				S	30
				W	31
			Living Rooms	N	26
				S	26
				W	28
		First	Bedrooms	N	30
				S	30
				W	33
			Living Rooms	N	27
				S	27
				W	28
Village P02 V04	West of Precinct 2 Road 1*	Ground	Bedrooms	N	27
				S	27
				E	29
			Living Rooms	E	26
		First	Bedrooms	N	28
				S	28
				E	30
			Living Rooms	N	25
				S	25
				E	27
	North of Yarrabilba Dve	Ground	Bedrooms	E	34
				S	35
				W	34
			Living Rooms	E	29
				S	32
				W	29
		First	Bedrooms	E	34
				S	36
				W	34
			Living Rooms	E	30
				S	31
				W	30

* See Figure A-1

Table 5-6 lists the required R_w ratings (Weighted Sound Reduction Index) for glazing and frames. If consistency of glazing systems is preferred for each room, the higher of the required R_w ratings must be used.

It is required that the R_w performance ratings of the glazing systems (windows and frames) be certified by the supplier prior to installation. Glazing certificates will be required for building certification. Where glazing system requirements are considered high, the design or glazed surface area can be reduced to minimise the acoustic rating required.

For floors of Lots where the noise criteria is exceeded, acceptable indoor noise levels can be achieved with the glazing recommendations specified, however external doors and windows must remain closed. Under these conditions, alternative ventilation will be required. Alternative ventilation may include air-conditioning, borrowed ventilation, mechanically assisted ventilation or other suitable methods.

The recommended glazing requirements are conservative ratings based on preliminary data and assumptions about room sizes and component construction. It is recommended that building construction acoustic requirements be recalculated when final details of room dimensions and building component construction are available.

6. CONCLUSIONS

Vipac Engineers & Scientists Ltd (Vipac) has completed a road traffic noise assessment for Precinct 2 of the Yarrabilba development on the Waterford Tamborine Road. Noise impacts on the development have been assessed according to TMR and AS2107 noise policies.

Recommendations are given in this report for noise impacts to comply with applicable noise criteria.

In conclusion, noise impacts associated with the proposed development can be controlled to an acceptable level by implementing the recommendations in this report.

APPENDIX A: NOISE CONTOUR MAPS

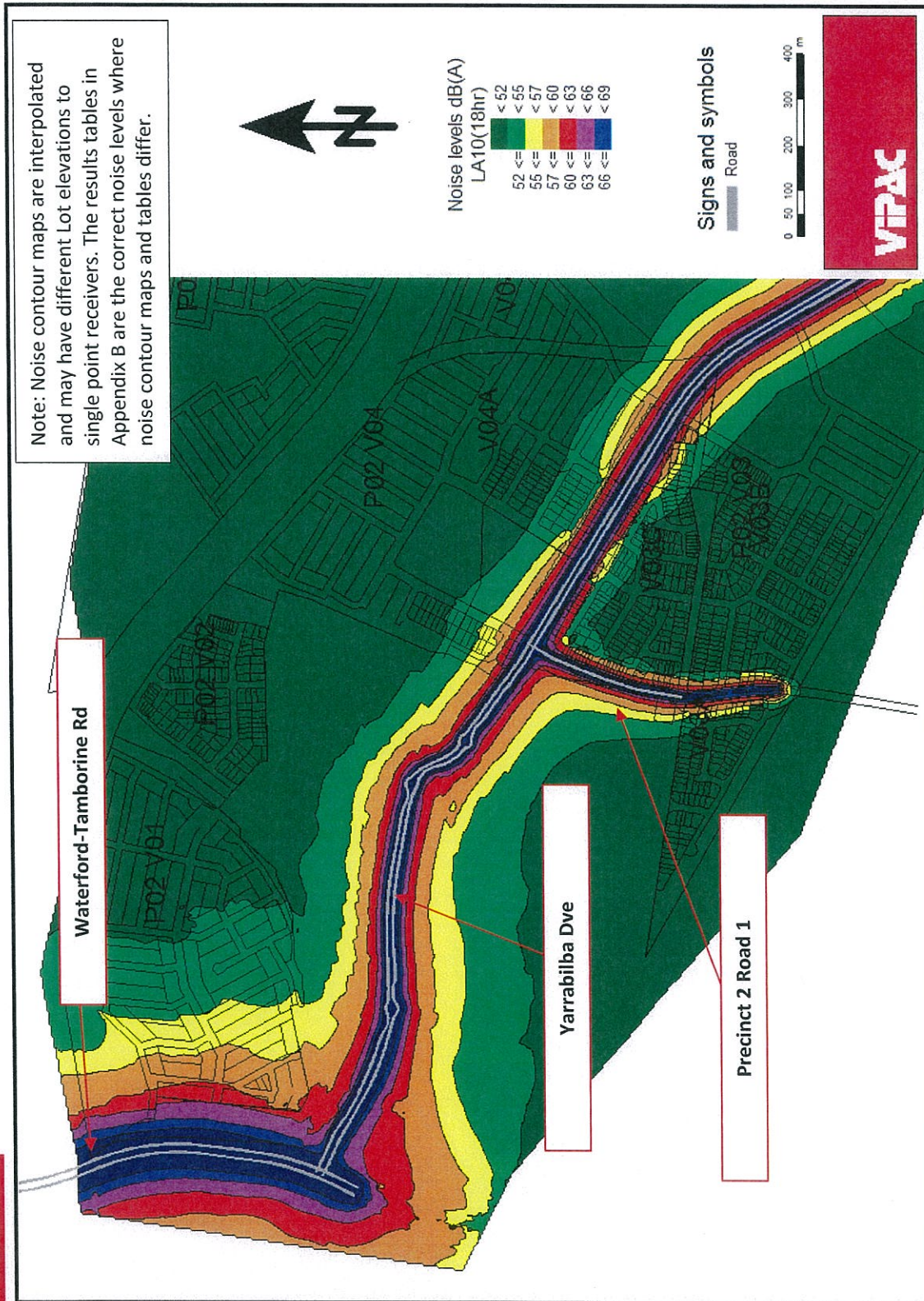


Figure A-1: Predicted Free Field $L_{A10}(18hr)$ Road Traffic Noise Levels at the Ground Floor - Overview

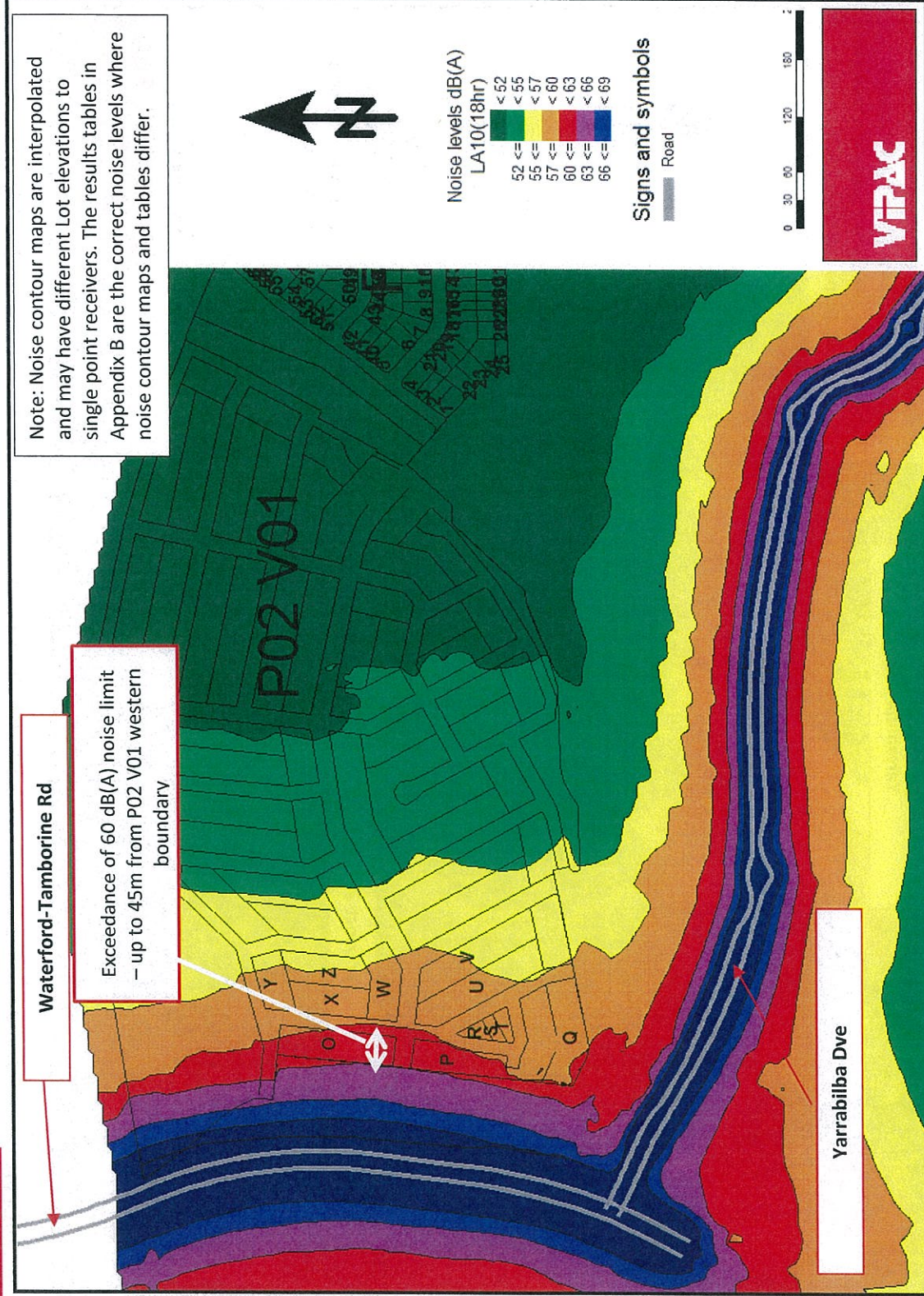


Figure A-2: Predicted Free Field $L_{A10(18hr)}$ Road Traffic Noise Levels at the Ground Floor – Village P02 V01

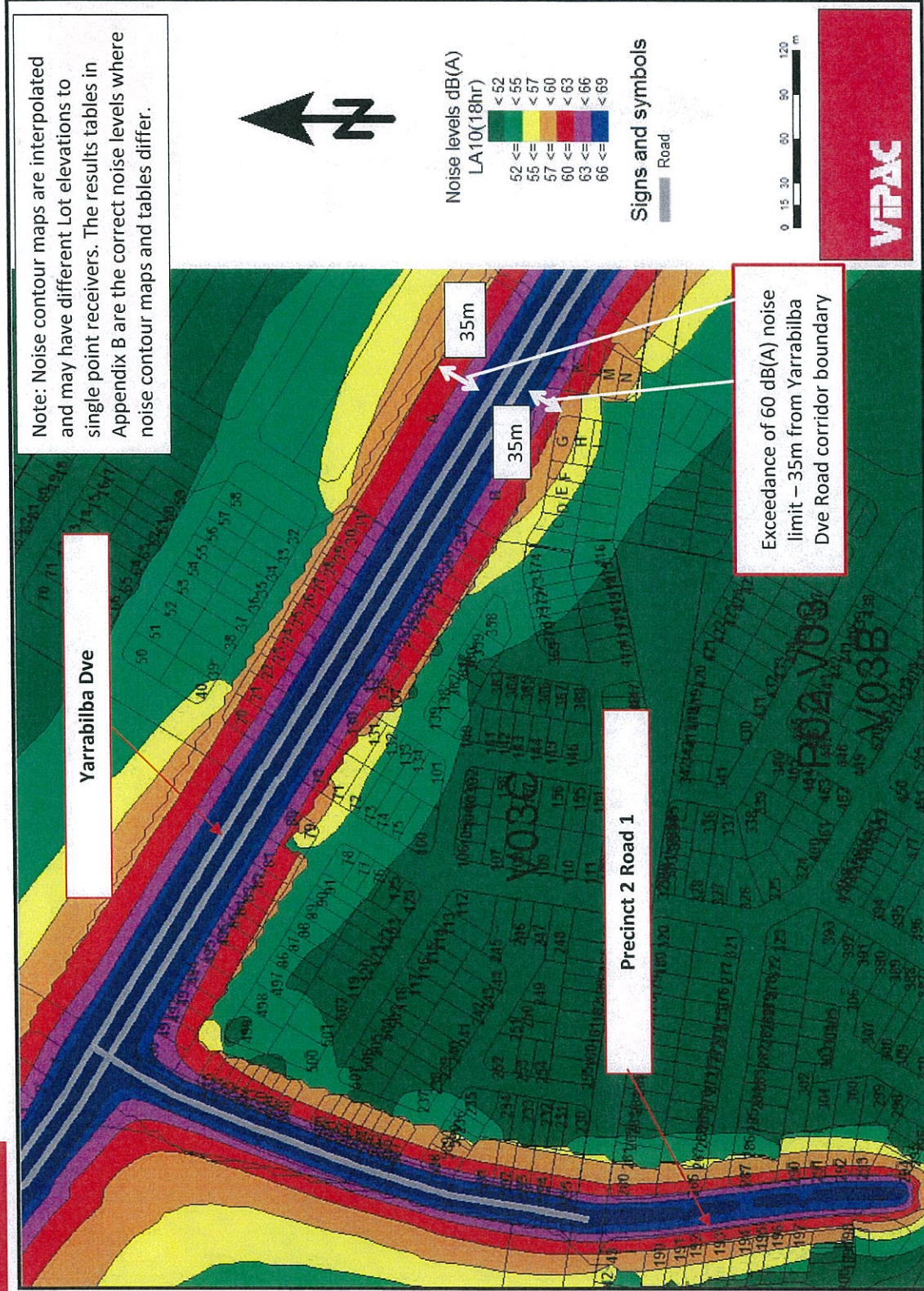


Figure A-3: Predicted Free Field $L_{A10}(18hr)$ Road Traffic Noise Levels at the Ground Floor – Villages PO2 V03 and V04

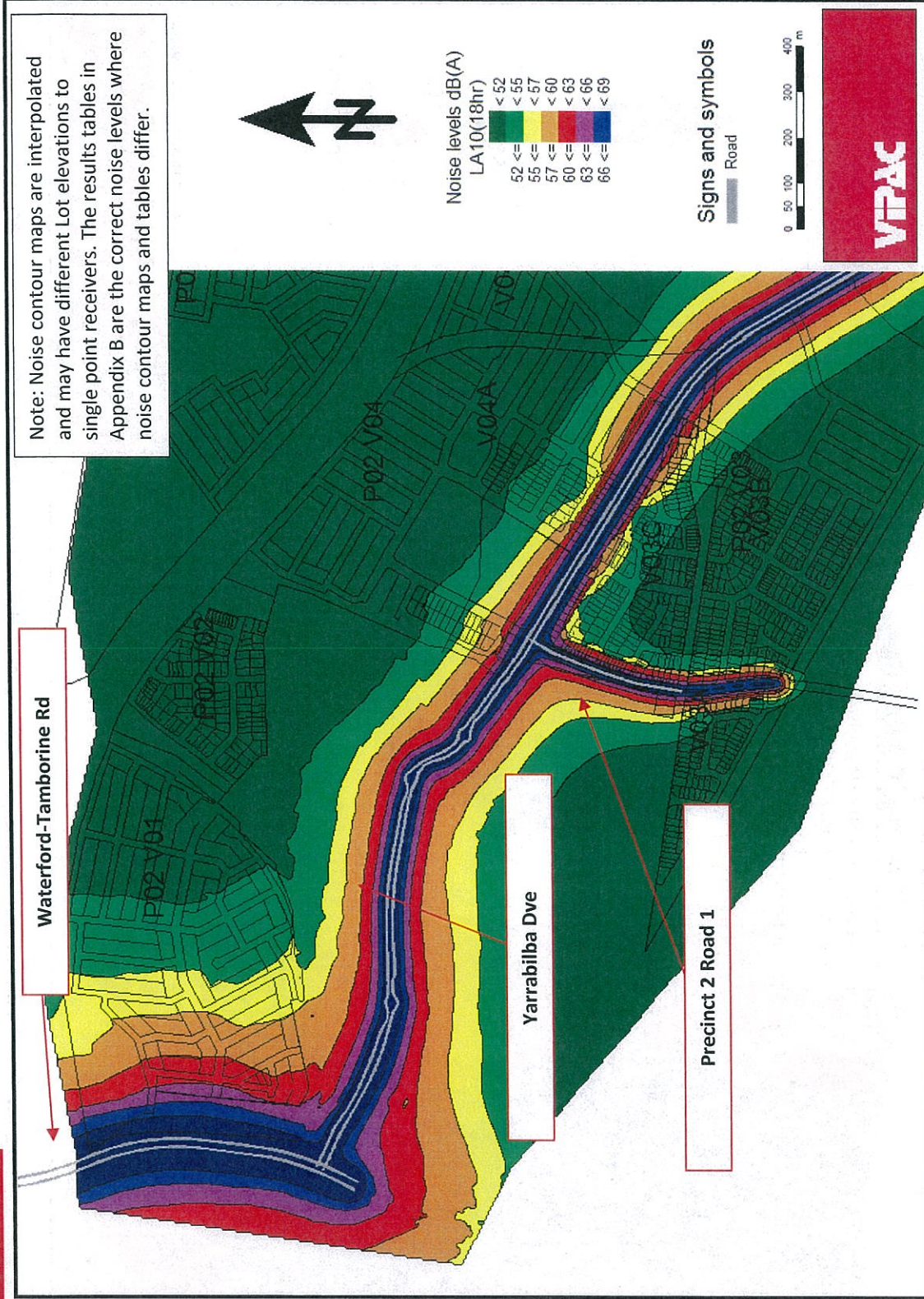


Figure A-4: Predicted Free Field $L_{A10(18hr)}$ Road Traffic Noise Levels at the First Floor – Overview

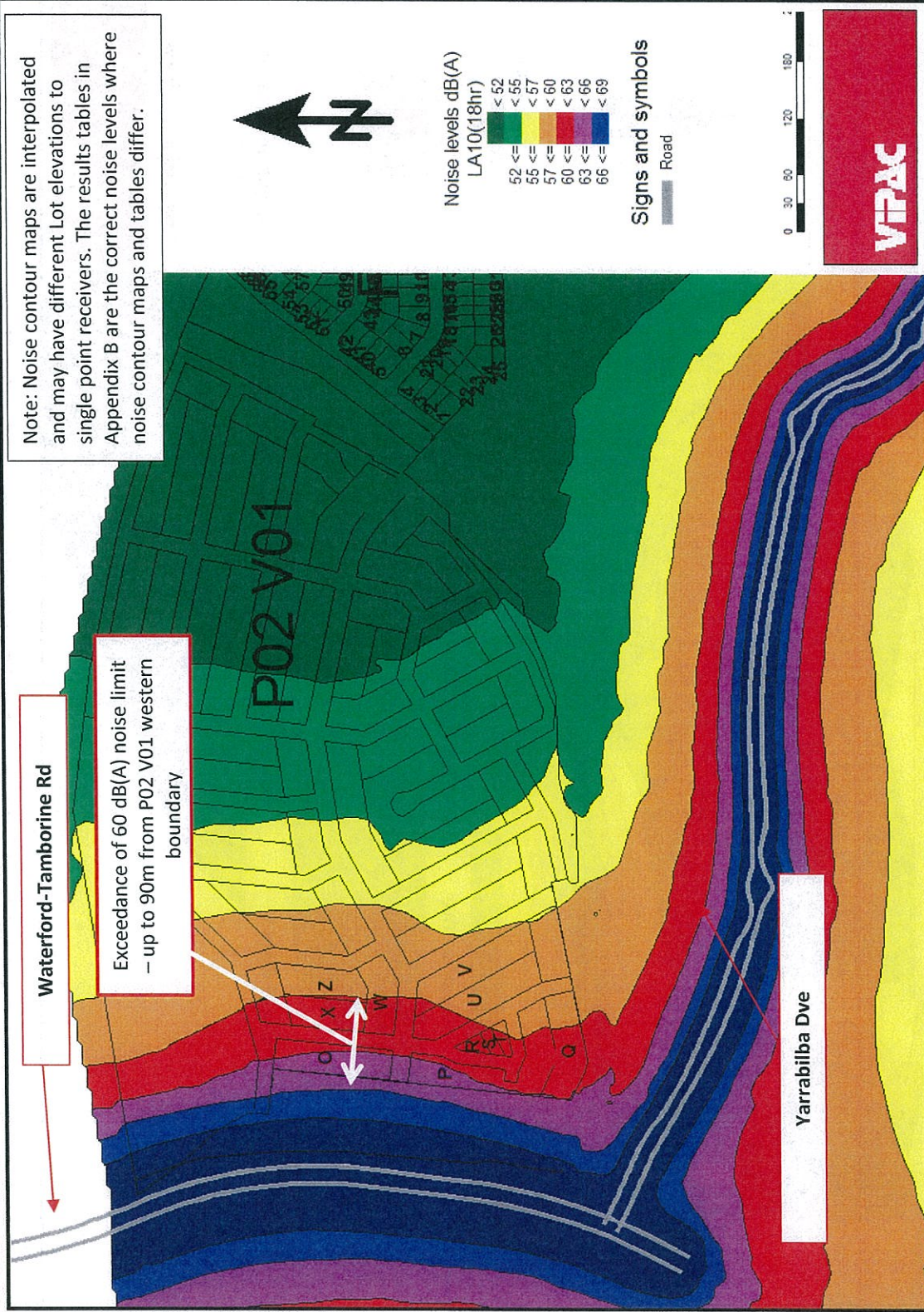


Figure A-5: Predicted Free Field $L_{A10(18hr)}$ Road Traffic Noise Levels at the First Floor – Village P02 V01

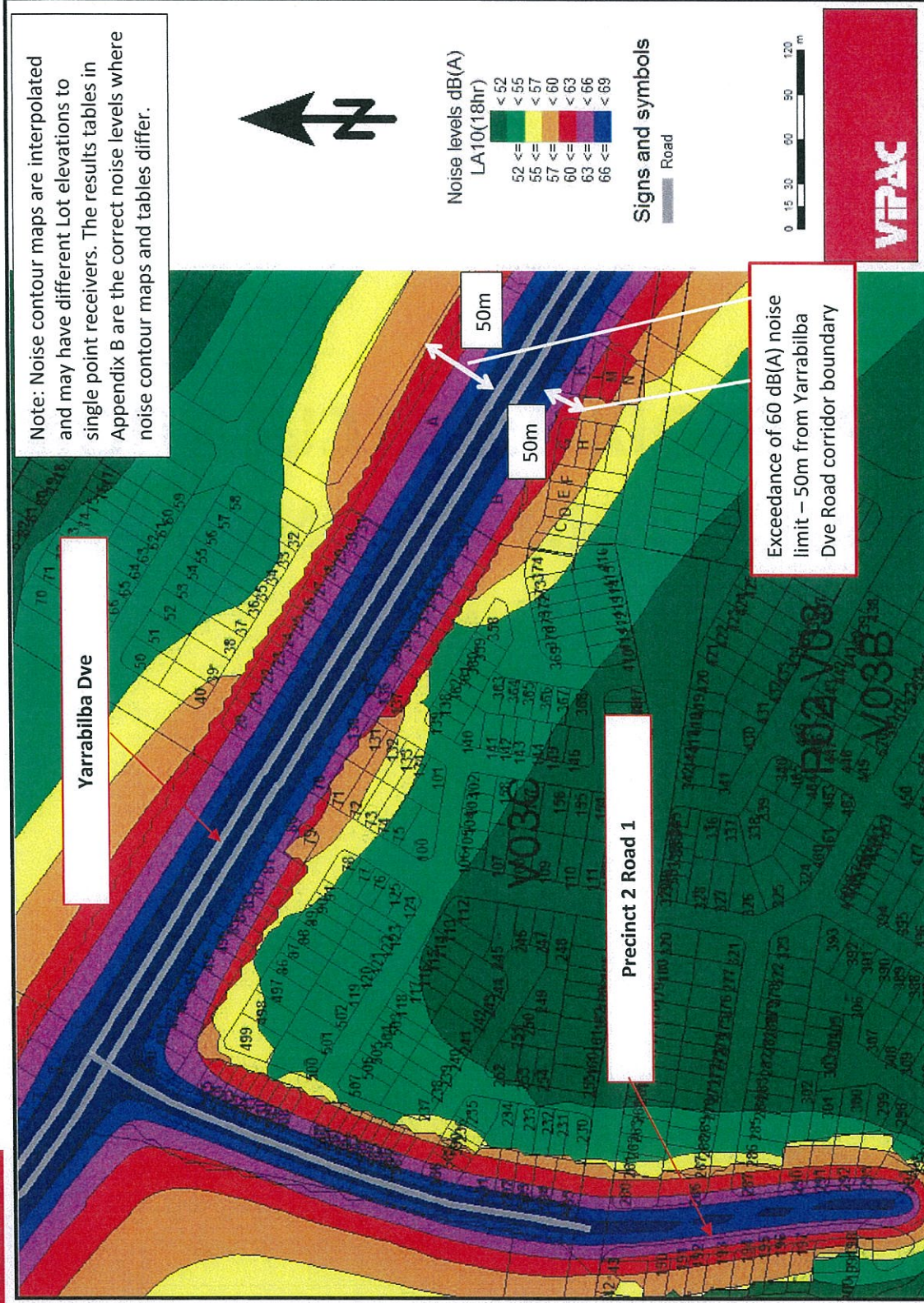


Figure A-6: Predicted Free Field $LA_{10}(18hr)$ Road Traffic Noise Levels at the First Floor – Village PO2 V03 and V04

APPENDIX B: CALCULATION RESULTS AND ASSUMED PAD LEVELS

Table B-1: Noise Modelling Results at Lots and Assumed Pad Heights

Lot	Assumed Building Pad AHD	Floor	L _{A10(18hr)} (dB(A))
1	31.57	Ground	66
		First	68
2	32.65	Ground	68
		First	69
3	33.73	Ground	69
		First	70
20	45.99	Ground	68
		First	69
21	46	Ground	67
		First	68
22	46	Ground	67
		First	68
23	46	Ground	67
		First	68
24	45.94	Ground	68
		First	69
25	45.57	Ground	68
		First	69
26	44.99	Ground	68
		First	69
27	44.41	Ground	68
		First	69
28	43.84	Ground	68
		First	69
29	43.24	Ground	68
		First	69
30	42.68	Ground	68
		First	69
31	42.09	Ground	68
		First	69
43	41.75	Ground	64
		First	65
70	46.52	Ground	68
		First	69
71	46.86	Ground	61
		First	64
79	45.74	Ground	62
		First	64
80	45.36	Ground	68
		First	69
81	44.61	Ground	67
		First	69
82	43.64	Ground	66
		First	68
83	42.87	Ground	67
		First	68
84	42.43	Ground	66
		First	68
85	41.87	Ground	67
		First	69

Lot	Assumed Building Pad AHD	Floor	L _{A10(18hr)} (dB(A))
130	46.71	Ground	68
		First	69
131	46.96	Ground	62
		First	64
135	45.83	Ground	69
		First	70
136	46.15	Ground	64
		First	66
137	46.42	Ground	61
		First	64
190	42.62	Ground	63
		First	65
191	43.06	Ground	64
		First	65
192	43.21	Ground	64
		First	65
193	43.43	Ground	64
		First	65
194	43.63	Ground	64
		First	65
195	43.64	Ground	63
		First	65
196	43.52	Ground	63
		First	65
197	43.18	Ground	63
		First	65
200	42.86	Ground	64
		First	65
260	42.82	Ground	64
		First	65
266	44	Ground	64
		First	65
287	44.49	Ground	63
		First	65
290	44.56	Ground	63
		First	65
291	44.22	Ground	62
		First	63
292	43.88	Ground	63
		First	65
293	43.06	Ground	62
		First	64
294	42.07	Ground	62
		First	64
350	45.58	Ground	69
		First	70
351	45.07	Ground	69
		First	70
352	44.61	Ground	68
		First	69
353	44.2	Ground	69
		First	70

Lot	Assumed Building Pad AHD	Floor	L _{A10(18hr)} (dB(A))
354	43.79	Ground	69
		First	70
355	43.3	Ground	69
		First	70
356	42.66	Ground	69
		First	70
357	41.87	Ground	69
		First	70
490	35.87	Ground	69
		First	70
491	36.78	Ground	68
		First	69
492	37.4	Ground	68
		First	69
493	38.07	Ground	68
		First	69
494	39.16	Ground	68
		First	69
495	40.33	Ground	68
		First	69
496	41.2	Ground	68
		First	69
508	36.95	Ground	65
		First	66
509	36.96	Ground	65
		First	66
510	36.86	Ground	65
		First	66
511	36.77	Ground	65
		First	66
512	36.67	Ground	65
		First	67
513	36.6	Ground	66
		First	67
514	36.51	Ground	66
		First	67
515	36.34	Ground	66
		First	67
580	37.45	Ground	64
		First	66
581	37.6	Ground	65
		First	66
582	37.67	Ground	65
		First	66
583	37.8	Ground	65
		First	66
584	37.93	Ground	65
		First	66
585	38.05	Ground	65
		First	66
586	38.18	Ground	65
		First	66

Lot	Assumed Building Pad AHD	Floor	L _{A10(18hr)} (dB(A))
587	38.32	Ground	65
		First	67
588	38.73	Ground	66
		First	67
589	39.46	Ground	61
		First	63
591	39.87	Ground	66
		First	67
592	40.57	Ground	66
		First	67
593	40.95	Ground	66
		First	67
594	41.37	Ground	66
		First	67
595	41.47	Ground	66
		First	67

Table B-2: Noise Modelling Results at Blocks and Assumed Pad Heights

Lot	Assumed Building Pad AHD	Floor	L _{A10(18hr)} (dB(A))
A	37.52	Ground	68
		First	69
B	39.91	Ground	69
		First	70
E	39.91	Ground	59
		First	61
F	39.27	Ground	60
		First	61
G	37.77	Ground	61
		First	63
H	38.33	Ground	59
		First	61
J	35.48	Ground	69
		First	70
K	35.74	Ground	66
		First	68
L	35.97	Ground	63
		First	65
M	36.08	Ground	61
		First	63
N	36.07	Ground	59
		First	61
O	55.4	Ground	63
		First	65
P	52.66	Ground	63
		First	65
Q	50.92	Ground	62
		First	63
R	53.05	Ground	59
		First	62
S	51.89	Ground	59
		First	61

Lot	Assumed Building Pad AHD	Floor	L _{A10(18hr)} (dB(A))
T	51.6	Ground	59
		First	61
U	51.33	Ground	60
		First	62
V	50.01	Ground	59
		First	61
W	54.43	Ground	60
		First	62
X	53.93	Ground	60
		First	62
Y	52.19	Ground	59
		First	61
Z	53.28	Ground	59
		First	61

