P20/3862

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Transportation Noise Assessment

Lot 4225 North Lake Road, Kardinya "The Heights"

Reference: 15113394-01 Draft.docx

Prepared for:
Pindan

Member Firm of Association of Australian Acoustical Consultants

Report: 15113394-01 Draft.docx

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Prepared By:	Terry George 
Position:	Project Director
Date:	26 November 2015

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1 INTRODUCTION

Pindan is proposing to subdivide Lot 4225 North Lake Road in Kardinya and also construct the residential dwellings. *Figure 4-1* provides the site locality and *Figure 4-2* the proposed subdivision layout. The houses closest to North Lake Road are single storey to the extreme north (Lot 1) and south (Lot 41) and double storey between (Lots 13 to 18), fronting North Lake Road.

North Lake Road is a major road, currently carrying around 34,000 vehicles per day. As such, a noise assessment is required to be undertaken, in order to comply with *State Planning Policy 5.4 Road and Rail Transport Noise and Freight Considerations in Land Use Planning*. This report satisfies this requirement by undertaking the assessment and specifying façade construction requirements.

Figure 1-1 Proposed Subdivision Location

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

Figure 1-2 Proposed Subdivision Layout

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 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, 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.

For residential buildings, "acceptable indoor noise levels" are taken to be $L_{Aeq\ (Day)}$ 40 dB in living and work areas and $L_{Aeq\ (Night)}$ 35 dB in bedrooms. These levels fall within the range of the Recommended Design Sound Levels for houses and apartments near major roads, as given in Australian Standard AS 2107:2000 *Acoustics – Recommended design sound levels and reverberation times for building interiors*.[1]

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 one location 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.

[1] The "acceptable indoor noise levels" for residential buildings are exactly midway between the "satisfactory" and "maximum" recommended design sound levels for houses and apartments near major roads.

The instrument used was an ARL Type 316 noise data logger, located 17 metres from the edge of the road, with the microphone 1.4 metres above ground level. The logger was programmed to record hourly L_{A1}, L_{A10}, L_{A90}, and L_{Aeq} levels. This instrument complies with the instrumentation requirements of *Australian Standard 2702-1984 Acoustics – Methods for the Measurement of Road Traffic Noise*. The logger was field calibrated before and after the measurement session and found to be accurate to within +/- 1 dB. Lloyd George Acoustics also holds current laboratory calibration certificate for the loggers.

3.2 Noise Modelling

The computer programme *SoundPLAN 7.4* 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 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, traffic volumes etc. These model inputs are discussed below.

3.2.1 Ground Topography, Road Design & Cadastral Data

Topographical data was based on that provided by Pindan's from a Brown McAllister Survey. This was then extended to include the extents of North Lake Road by combining with the City of Melville's intramap data.

The closest future buildings have also been included in the noise model based on the floor plans provided by Pindan (refer *Appendix A*) and the floor levels shown in *Figure 1-2*. The first row of buildings can provide significant barrier attenuation to those behind.

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

The existing and future road surface is assumed to be dense graded asphalt.

- Vehicle Speed – The existing and future posted speeds is assumed to be 70km/hr.
- Traffic Volumes – Information used in the modelling is provided in *Table 3-2*.

Table 3-2 Traffic Information Used in the Modelling

Parameter	Scenario			
	Existing (July 2014)[1]		Future - 2031[2]	
	Northbound	Southbound	Northbound	Southbound
24 Hour Volume	16,930	16,590	32,370	32,370
% Heavy	4.2%	4.2%	5.0%	5.0%

Notes:

1. Obtained from July 2014 MRWA traffic count.
2. Value has been estimated.

3.2.3 Ground Attenuation

The ground attenuation has been assumed to be 0.0 (0%) for the road and 0.5 (50%) throughout the subdivision. 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).

As noise monitoring was undertaken, the relationship between the parameters is based on the results of the monitoring – refer *Section 4.1*.

4 RESULTS

4.1 Noise Monitoring

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

Table 4-1 Measured Average Noise Levels – 17m from North Lake Road

Date	Average Weekday Noise Level, dB			
	$L_{A10,18hour}$	$L_{Aeq,24hour}$	$L_{Aeq\ (Day)}$	$L_{Aeq\ (Night)}$
Wednesday 11 November 2015	63.9	60.8	62.2	54.8
Thursday 11 November 2015	64.1	60.9	62.3	54.8
Friday 11 November 2015	64.1	60.7	62.0	55.7
Weekday Average	**64.0**	**60.8**	**62.1**	**55.1**

The average differences between the weekday $L_{A10,18hour}$ and $L_{Aeq(Day)}$ is 1.9 dB and this conversion has been used in the modelling. The average differences between the weekday $L_{Aeq(Day)}$ and $L_{Aeq(Night)}$ is 7.0 dB. This same difference has been assumed to exist in future years. As such, it is the daytime noise levels that will dictate compliance since these are at least 5 dB more than night-time levels.

4.2 Noise Modelling

The noise model was initially set-up to reflect existing conditions and then calibrated against the *Section 4.1* noise monitoring. Once calibrated, the noise model is then changed to reflect future conditions including the proposed development and future traffic volumes.

The future noise modelling is provided in *Figures 4-2 & 4-3* as $L_{Aeq(Day)}$ noise level contour, modelled at ground level and upper floor level. Detailed calculations have then been undertaken where a habitable room is exposed to an external noise level above the ***target*** (55 dB $L_{Aeq(Day)}$) and reported in *Table 4-2*.

Figure 4-1: Noise Monitoring Results

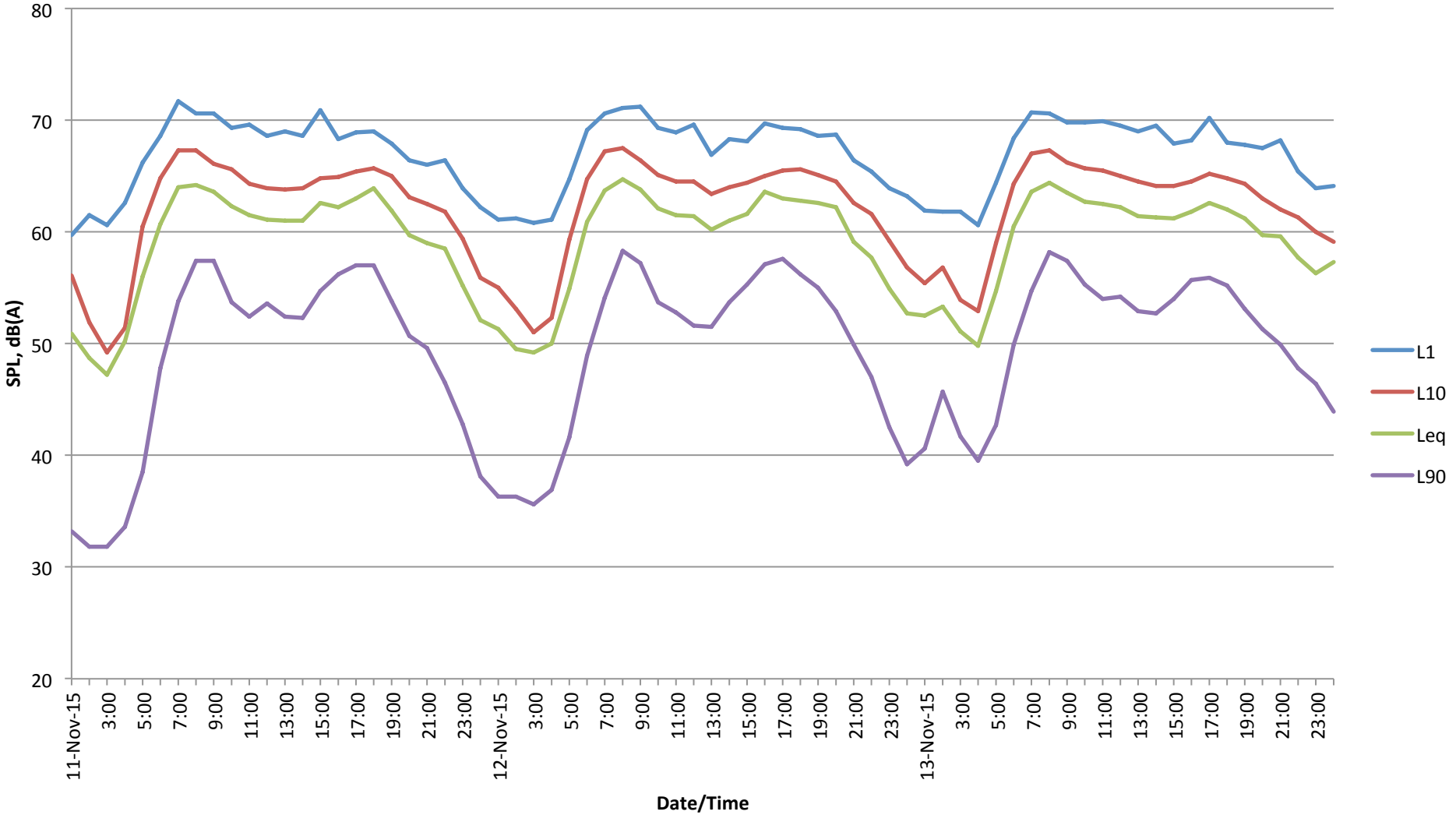

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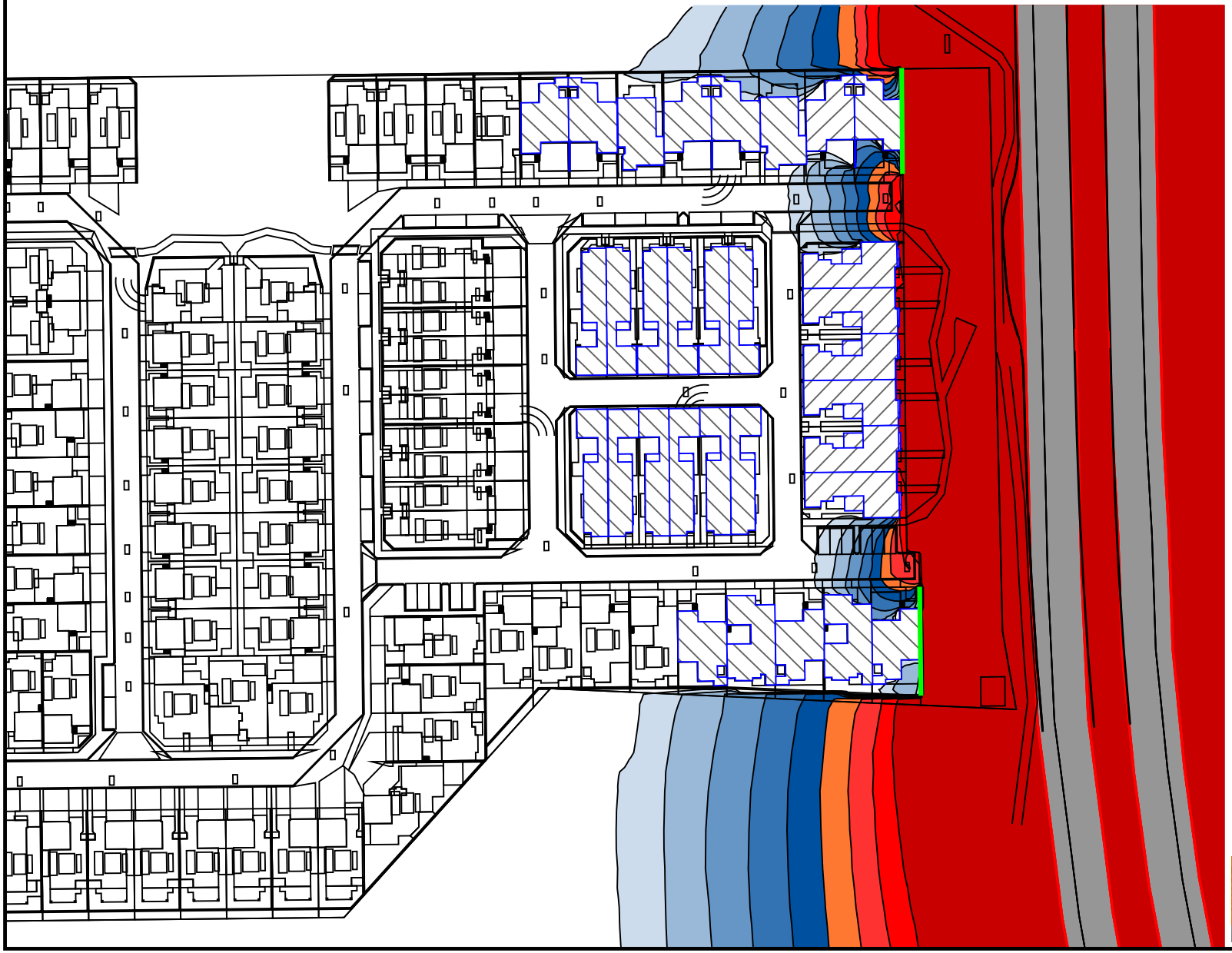
Figure 4-2

The Heights - Kardinya

LAeq(Day) Noise Level Contours: Ground Floor



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 Surface
- Building
- 1.8m Wall

26 November 2015

Length Scale 1:1200

0 5 10 20 30 40 m

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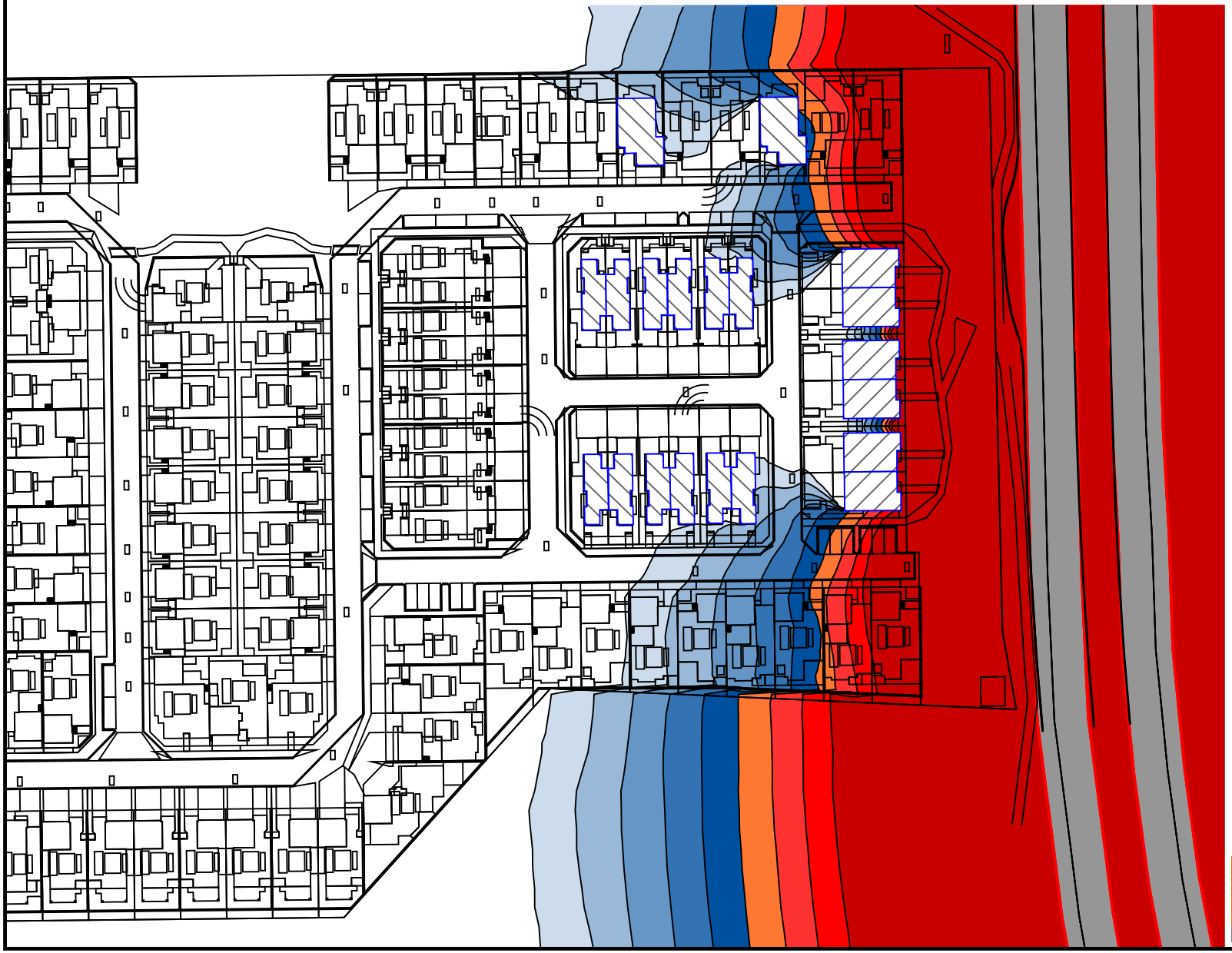
Figure 4-3

The Heights - Kardinya

LAeq(Day) Noise Level Contours: Upper Floor



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 Surface
- Building
- 1.8m Wall

26 November 2015

Length Scale 1:1200

0 5 10 20 30 40 m

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Table 4-2 Predicted Future 2031 Noise Levels

Lot - Room	$L_{Aeq(Day)}$, dB	$L_{Aeq(Night)}$, dB
Lot 1 - Bed 1	58	51
Lot 1 - Bed 2 (SD)	50	43
Lot 1 - Bed 3 / Outdoor	59	52
Lot 1 - Kitchen / Entry	59	52
Lot 1 - Living (SD) / Outdoor	58	51
Lot 2 - Bed 1	51	44
Lot 2 - Bed 2 (SD)	50	43
Lot 2 - Bed 3	51	44
Lot 2 - Kitchen / Entry	56	49
Lot 2 - Living (SD)	53	46
Lot 3 - Dining	53	46
Lot 3 - Dining (SD)	57	50
Lot 3 - Entry	45	38
Lot 3 - Study/Office	54	47
Lot 3 Upper - Bed 1	59	52
Lot 3 Upper - Bed 1 (SD)	49	42
Lot 3 Upper - Bed 2	60	53
Lot 3 Upper - Bed 3	60	53
Lot 3 Upper - Bed 4	59	52
Lot 4 - Bed 1	48	41
Lot 4 - Bed 2	47	40
Lot 4 - Bed 3	56	49
Lot 4 - Kitchen/Entry	47	40
Lot 4 - Living	56	49
Lot 6 Upper - Bed 1	53	46
Lot 6 Upper - Bed 1 (SD)	47	40
Lot 6 Upper - Bed 2	56	49
Lot 6 Upper - Bed 3	56	49
Lot 6 Upper - Bed 4	56	49

Note: Highlighted cells indicate noise level above *target*.

Lot - Room	$L_{Aeq(Day)}$, dB	$L_{Aeq(Night)}$, dB
Lot 13 - Bed 1	64	57
Lot 13 - Dining (SD)	47	40
Lot 13 - Living	54	47
Lot 13 Upper - Activity	67	60
Lot 13 Upper - Bed 2	63	56
Lot 13 Upper - Bed 3	53	46
Lot 13 Upper - Bed 4	49	42
Lot 14 - Bed 1	65	58
Lot 14 - Dining (SD)	40	33
Lot 14 - Living	44	37
Lot 14 Upper - Activity	67	60
Lot 14 Upper - Bed 2	59	52
Lot 14 Upper - Bed 3	49	42
Lot 14 Upper - Bed 4	49	42
Lot 15 - Bed 1	65	58
Lot 15 - Dining (SD)	40	33
Lot 15 - Living	45	38
Lot 15 Upper - Activity	67	60
Lot 15 Upper - Bed 2	59	52
Lot 15 Upper - Bed 3	49	42
Lot 15 Upper - Bed 4	49	42
Lot 16 - Bed 1	64	57
Lot 16 - Dining (SD)	40	33
Lot 16 - Living	45	38
Lot 16 Upper - Activity	67	60
Lot 16 Upper - Bed 2	58	51
Lot 16 Upper - Bed 3	49	42
Lot 16 Upper - Bed 4	49	42

Note: Highlighted cells indicate noise level above *target*.

Lot - Room	$L_{Aeq(Day)}$, dB	$L_{Aeq(Night)}$, dB
Lot 17 - Bed 1	64	57
Lot 17 - Dining (SD)	40	33
Lot 17 - Living	45	38
Lot 17 Upper - Activity	67	60
Lot 17 Upper - Bed 2	59	52
Lot 17 Upper - Bed 3	49	42
Lot 17 Upper - Bed 4	49	42
Lot 18 - Bed 1	63	56
Lot 18 - Dining (SD)	45	38
Lot 18 - Living	53	46
Lot 18 - Upper Activity	66	59
Lot 18 - Upper Bed 2	62	55
Lot 18 - Upper Bed 3	52	45
Lot 18 - Upper Bed 4	49	42
Lot 19 Upper - Activity	56	49
Lot 19 Upper - Bed 2	52	45
Lot 19 Upper - Bed 3	57	50
Lot 20 Upper - Activity	47	40
Lot 20 Upper - Bed 2	52	45
Lot 20 Upper - Bed 3	56	49
Lot 38 Upper - Activity	48	41
Lot 38 Upper - Bed 2	51	44
Lot 38 Upper - Bed 3	56	49
Lot 39 Upper - Activity	47	40
Lot 39 Upper - Bed 2	51	44
Lot 39 Upper - Bed 3	56	49
Lot 40 Upper - Activity	56	49
Lot 40 Upper - Bed 2	51	44
Lot 40 Upper - Bed 3	56	49

Note: Highlighted cells indicate noise level above *target*.

Lot - Room	$L_{Aeq(Day)}$, dB	$L_{Aeq(Night)}$, dB
Lot 41 - Bed 1	58	51
Lot 41 - Bed 2 (SD)	50	43
Lot 41 - Bed 3 / Outdoor	57	50
Lot 41 - Kitchen / Entry	59	52
Lot 41 - Living (SD) / Outdoor	57	50
Lot 42 - Bed 1 (SD)	50	43
Lot 42 - Bed 2	49	42
Lot 42 - Bed 3	53	46
Lot 42 - Dining (SD)	49	42
Lot 42 - Living/Entry	58	51

Note: Highlighted cells indicate noise level above *target*.

5 ASSESSMENT

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 *target* is exceeded, further controls are necessary.

Noise levels in the outdoor living areas of all lots is below the *target*, with the exception of Lots 1 and 41. These lots are being provided with a 1.8 metre high solid masonry wall. Predicted future noise levels are 59 dB $L_{Aeq(Day)}$ and 57 dB $L_{Aeq(Day)}$ in Lots 1 and 41 respectively. Whilst these are above the *target*, noise levels are below the *limit* and therefore still considered to be a 'reasonable' acoustic amenity and therefore satisfy the requirements of the Policy.

For those rooms where external noise levels are shown to be above the *target*, *Table 5-1* provides the required treatments.

Table 5-1 Required Upgrades to Achieve Satisfactory Indoor Noise Levels

Lot - Room	Recommended Construction
Dining Lot 3 Living Lot 41	Glass to be minimum 6mm thick. Sliding door frame to be good quality with perimeter brush or acoustic seals.
Activity – Lots 19, 40 Bed 2 – Lot 6 Bed 3 – Lots 4, 6, 19, 20, 38, 39, 40, 41 Bed 4 – Lot 6 Living – Lot 4 Kitchen – Lot 2	Glass to be minimum 6mm thick. Window frame to be good quality sliding with brush seals or awning with compressible foam seals.

Lot - Room	Recommended Construction
Living – Lot 1	Glass to be minimum 6.38mm thick laminated. Sliding door frame to be good quality with perimeter double row brush seals or acoustic seals.
Bed 1 – Lots 1, 3, 41 Bed 2 – Lots 3, 14, 15, 16, 17 Bed 3 – Lots 1, 3 Bed 4 – Lot 3 Kitchen – Lots 1, 41, Living – Lot 42	Glass to be minimum 6.38mm thick laminated. Window frame to be good quality awning with compressible foam seals.
Bed 1 – Lots 13, 14, 15, 16, 17, 18 Bed 2 – Lots 13, 18	Glass to be minimum 6.5mm thick VLam Hush. Window frame to be good quality awning with compressible foam seals. External wall to have minimum 50mm thick, 14kg/m^3 glasswool or polyester insulation between studs.
Activity – Lots 13, 14, 15, 16, 17, 18	Glass to be minimum 10.38mm thick laminated. Window frame to be good quality awning with compressible foam seals. Ceiling to be 1 x 13mm sound-rated plasterboard. Lights to be surface mounted or recessed downlights to be acoustically rated to R_w 30 or boxed over in plasterboard. External wall to have minimum 50mm thick, 14kg/m^3 glasswool or polyester insulation between studs.
Entry - Lots 1, 2, 41, 42	Entry door to be 35mm thick, solid timber core door with full perimeter seals. Any glass inserts to be minimum 6mm thick.

6 CONCLUSION

To satisfy the requirements of the *State Planning Policy 5.4 Road and Rail Transport Noise and Freight Considerations in Land Use Planning*, the following is required:

- Boundary wall to Lots 1 and 41 to be minimum 1.8 metres high (relative to finished floor level). Wall is to be free of gaps, of solid construction and of a material having a minimum surface mass of 12kg/m^3.
- Construction to implement recommendations of *Table 5-1* or approved equivalent.
- All affected lots (1, 2, 3, 4, 6, 13, 14, 15, 16, 17, 18, 19, 20, 38, 39, 40, 41 & 42) are to have notifications on lot titles as per the Policy requirements:

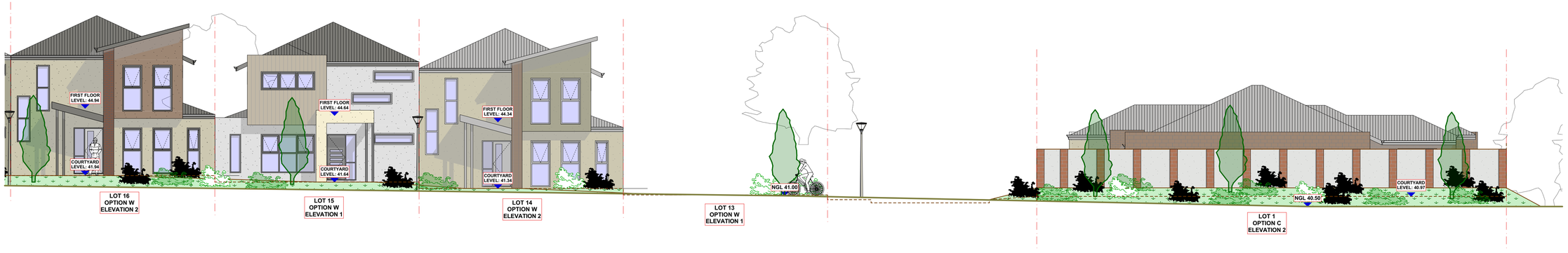
  Notice: This lot is situated in the vicinity of a transport corridor and is currently affected, or may in the future be affected, by transport noise. Transportation noise controls and Quiet House design strategies at potential cost to the owner may be required to achieve an acceptable level of noise reduction. Further information is available on request from the relevant local government offices.

In order to achieve the satisfactory internal noise levels to affected lots, will require windows to be closed to affected rooms and as such, mechanical ventilation (and/or air-conditioning) should be considered for these rooms.

Appendix A

HOUSE FLOOR PLANS

A - STREET ELEVATION - 1
1:100



A - STREET ELEVATION - 2
1:100

A - OVERALL STREET ELEVATION
1:175

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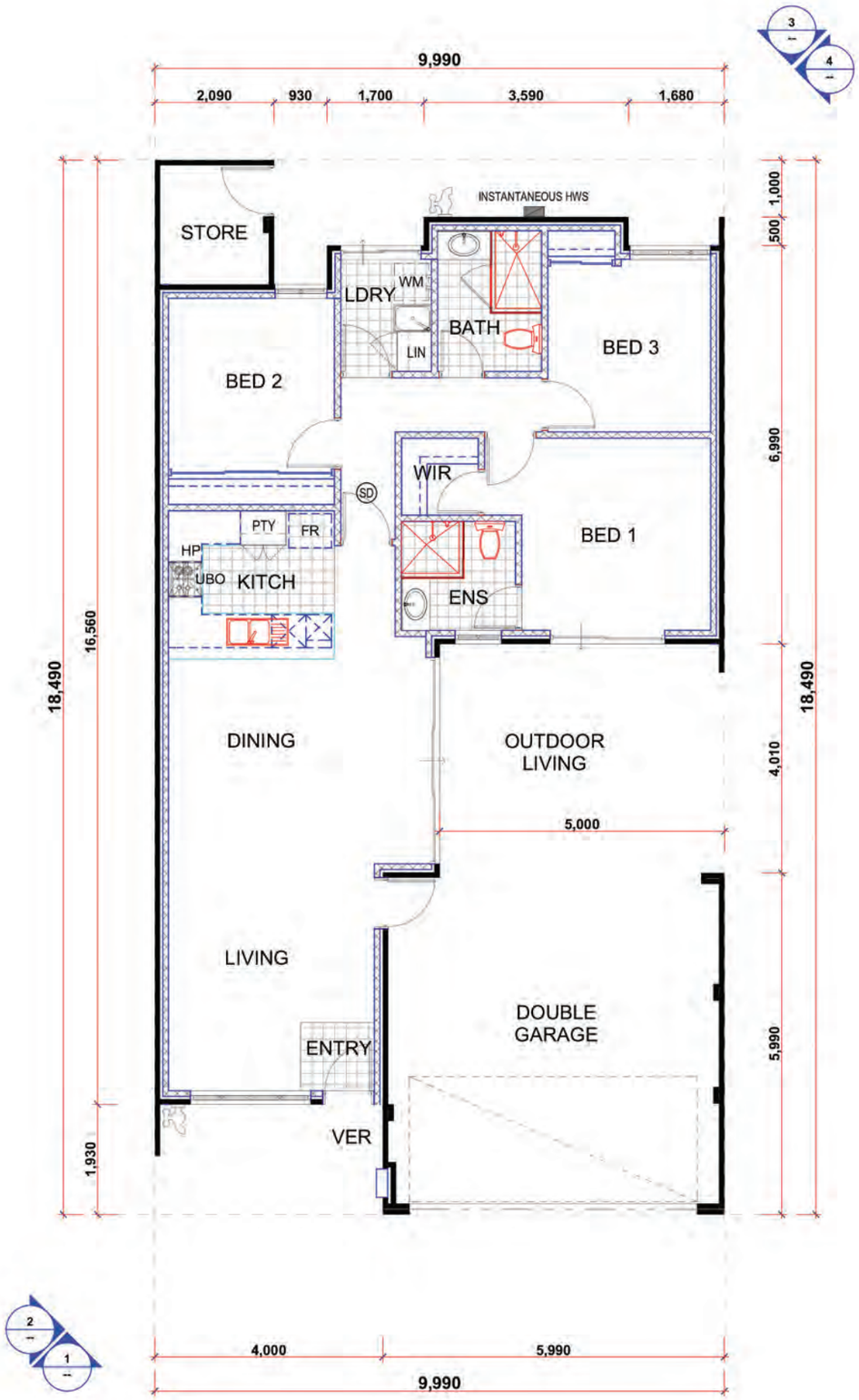
- OPTION 2 -

THE HEIGHTS
KARDINYA

LOT 4225 NORTH LAKE ROAD, KARDINYA
STREET ELEVATION - A
Dwg N°: DA - A06
Date: 23/11/2015
Rev: Y

VILLA TYPE - B

P20/3862



AREAS

FLOOR PLAN	STORE
A: 106.3 m²	A: 4.6 m²
CARPORT	PORCH
A: 35.4 m²	A: 2.3 m²
TOTAL	
A: 148.6 m²	
P: 69.3 m	

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Proposed **LOT 4225 NORTH LAKE ROAD, KARDINYA**

Client **PINDAN**

DEVELOPMENTAL APPLICATION

Rev	Date	Description	Dr	Ch
A	07/05/15	DESIGN DEVELOPMENT	MR	
B	26/05/15	DD - ELEVATION AMENDS	MR	
C	05/06/15	DEVELOPMENT APPLICATION	MR	
D	11/06/15	DEVELOPMENT APPLICATION	MR	
E	26/06/15	CONTRACT DRAWINGS	MR	
F	6/07/15	COUNCIL AMENDS	BL	

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Drawing **FLOOR PLAN**

Dwg Nº **DA -**

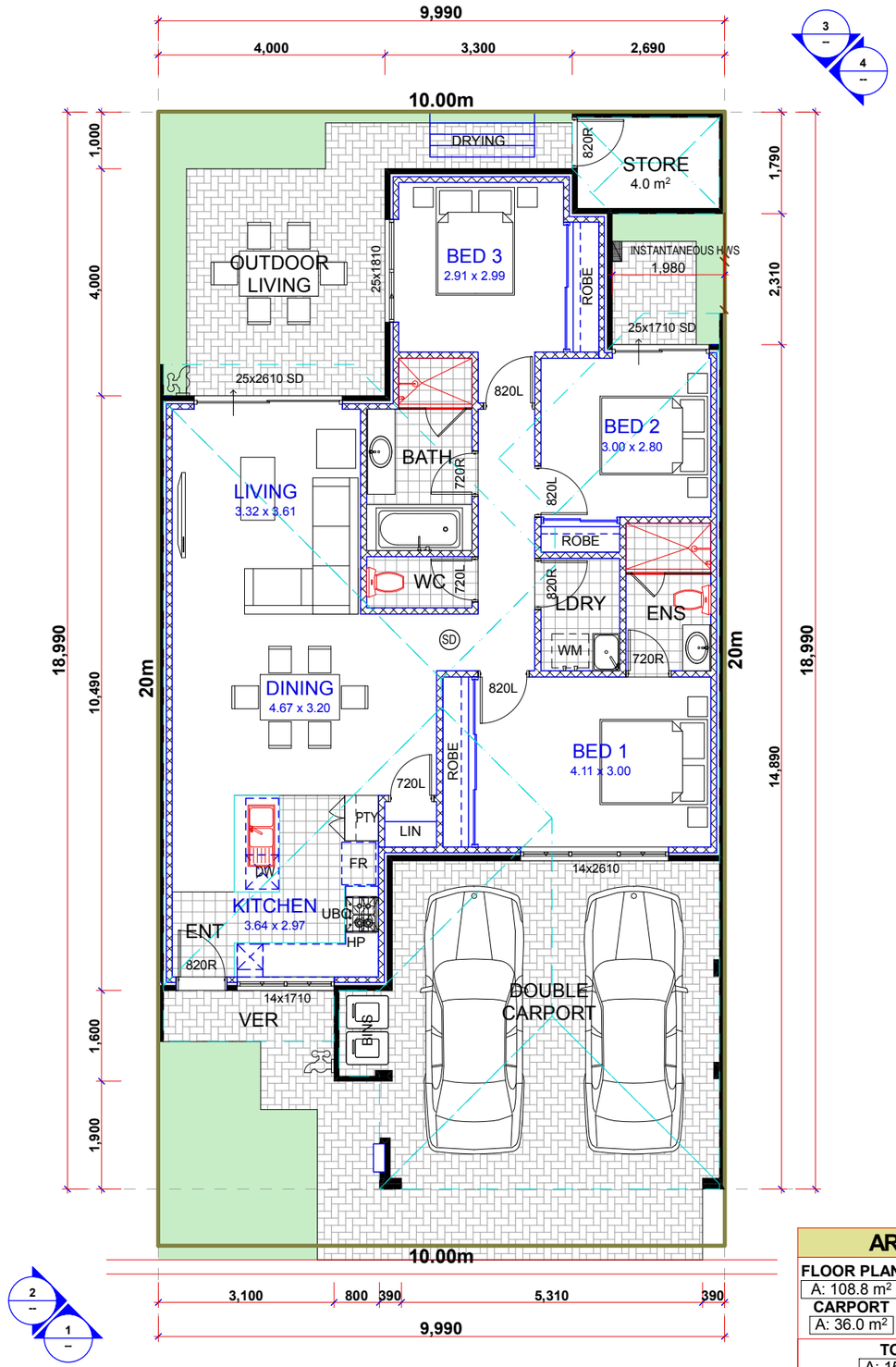
Job Nº **DES 2014 - 7**

Rev: **F**

Scale **1:100 @ A3**

VILLA TYPE - C

P20/3862



NOTE:
REFER TO ELEVATIONS
FOR PLACEMENT OF WINDOWS

AREAS

FLOOR PLAN	STORE
A: 108.8 m²	A: 4.7 m²
CARPORT	VER
A: 36.0 m²	A: 5.0 m²
TOTAL	
A: 154.4 m²	
P: 61.9 m	

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E	26/06/15	CONTRACT DRAWINGS	MR	
F	6/07/15	COUNCIL AMENDS	BL	

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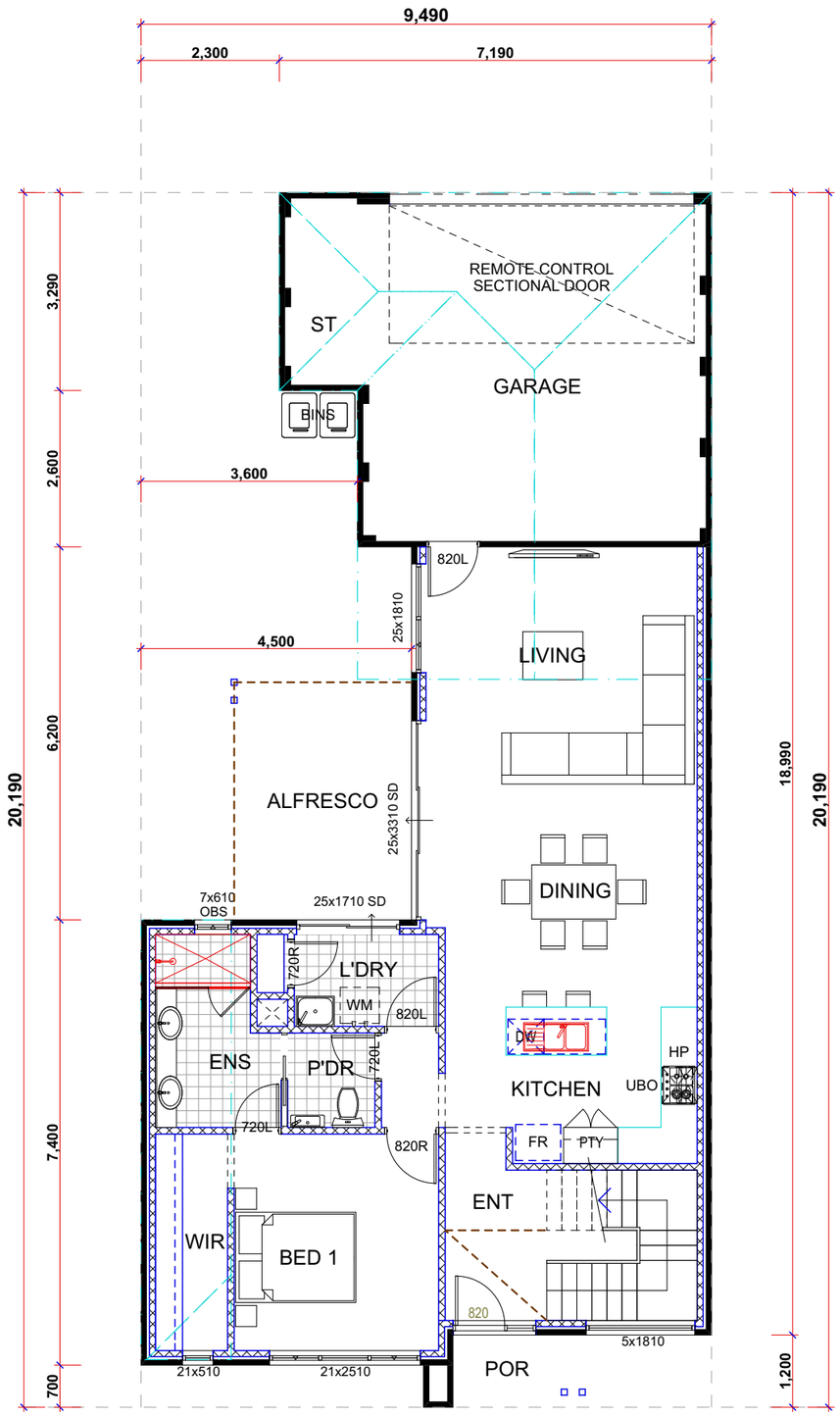
Drawing **FLOOR PLAN**

Dwg N° **DA -**

Job N° **DES 2014 - 7**

Rev: **F**

Scale **1:100 @ A3**



1
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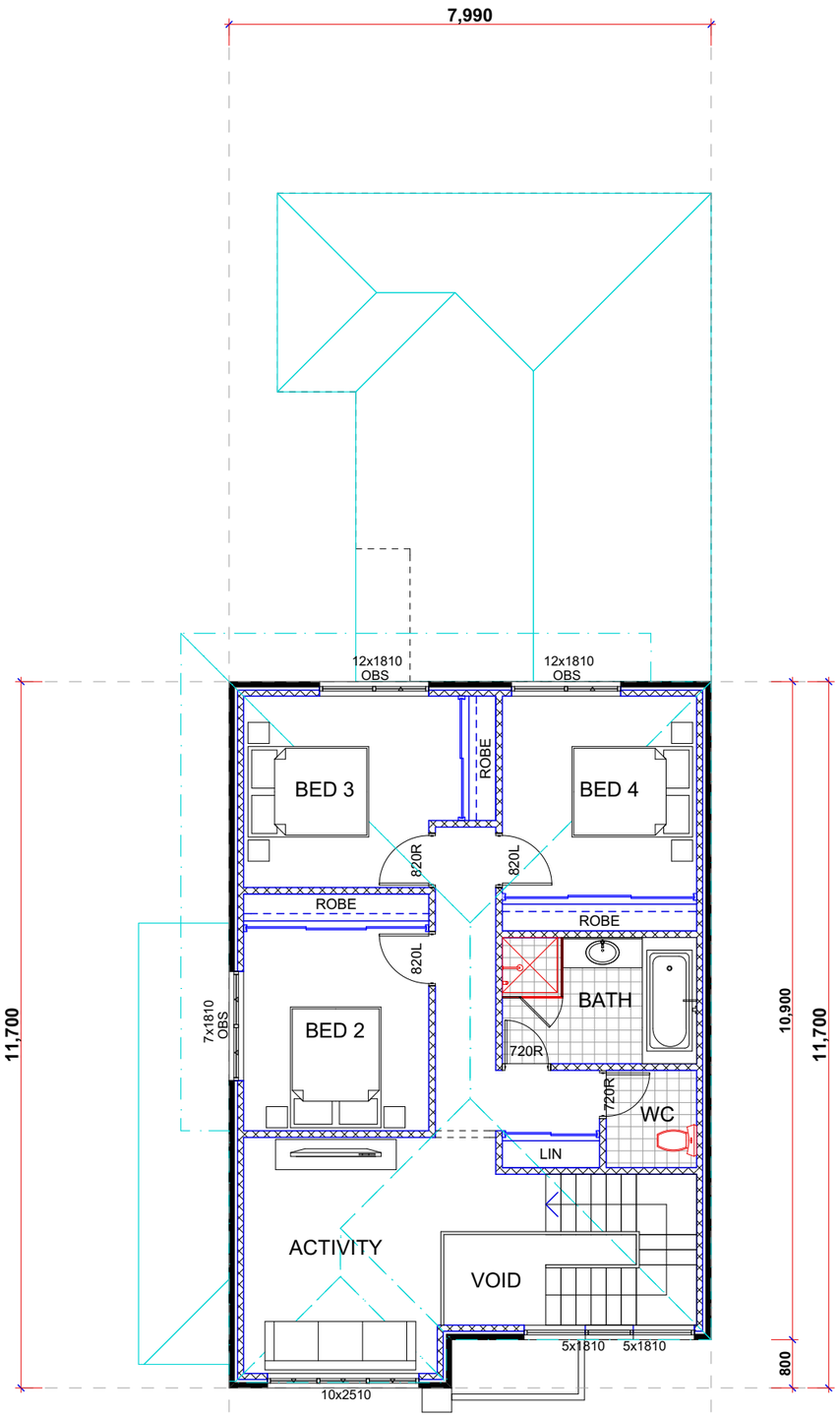
GROUND FLOOR PLAN
1:100

GF - AREAS	
FLOOR PLAN	STORE
A: 99.8 m²	A: 4.6 m²
PORCH	GARAGE
A: 2.2 m²	A: 33.9 m²
TOTAL	
A: 152.6 m²	
P: 63.8 m	



1
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UPPER FLOOR PLAN
1:100

FF - AREAS	
FLOOR PLAN	BALCONY
A: 81.3 m²	A: 9.7 m²
TOTAL	
A: 110.2 m²	
P: 60.0 m	

TOWN HOUSE TYPE - W

P20/3862

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191 Great Eastern Hwy, Po Box 93, Belmont WA 6984
Tel: (08) 9471 5300 Fax: (08) 9277 6133 www.pindan.com.au

Proposed
LOT 4225 NORTH LAKE ROAD, KARDINYA

Client
PINDAN

DEVELOPMENTAL APPLICATION

Rev	Date	Description	Dr	Ch
A	09/11/15	DESIGN DEVELOPMENT	BL	

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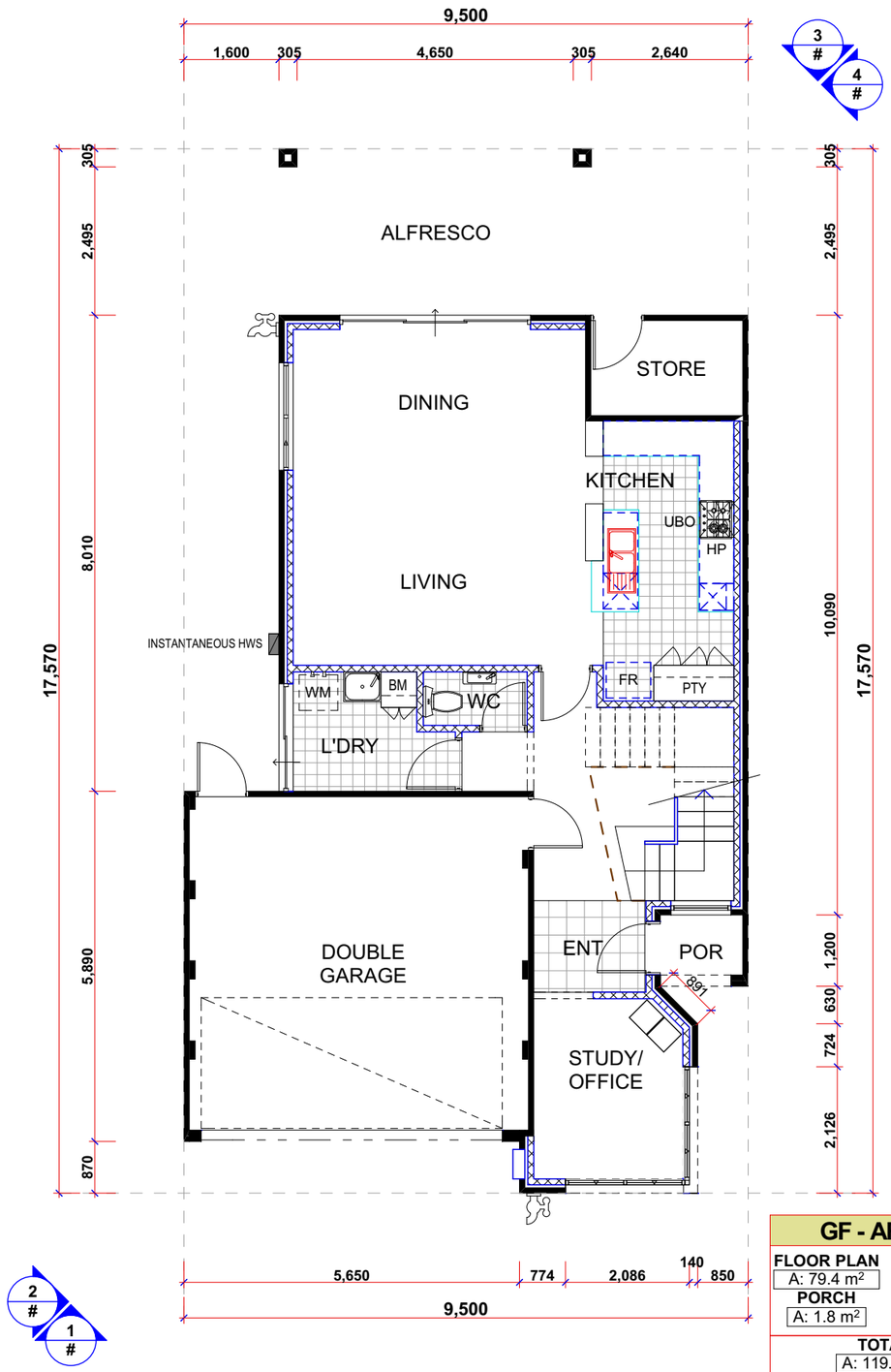
Drawing
FLOOR PLANS

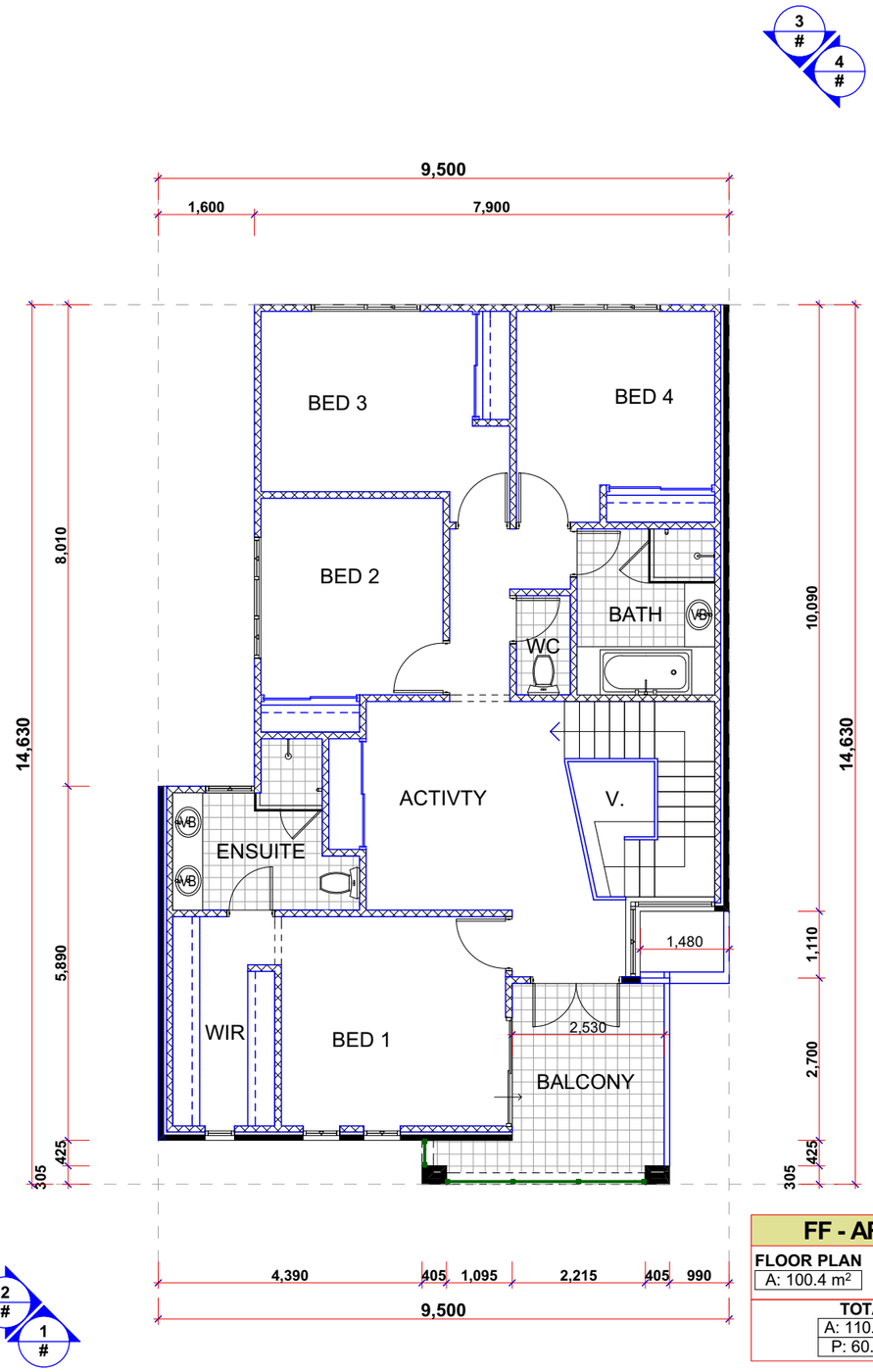
Dwg Nº
DA -

Job Nº
DES 2014 - 7

Rev:
A

Scale
1:100 @ A3





GF - AREAS

FLOOR PLAN	STORE
A: 79.4 m²	A: 4.5 m²
PORCH	**GARAGE**
A: 1.8 m²	A: 33.8 m²

TOTAL
A: 119.4 m²
P: 49.4 m

FF - AREAS

FLOOR PLAN	BALCONY
A: 100.4 m²	A: 9.9 m²

TOTAL
A: 110.3 m²
P: 60.3 m

TOWN HOUSE TYPE - X

P20/3862

ELEVATION 2

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Proposed **LOT 4225 NORTH LAKE ROAD, KARDINYA**

Client **PINDAN**

DEVELOPMENTAL APPLICATION

Rev	Date	Description	Dr	Ch
A	29/10/15	DESIGN DEVELOPMENT	MR	

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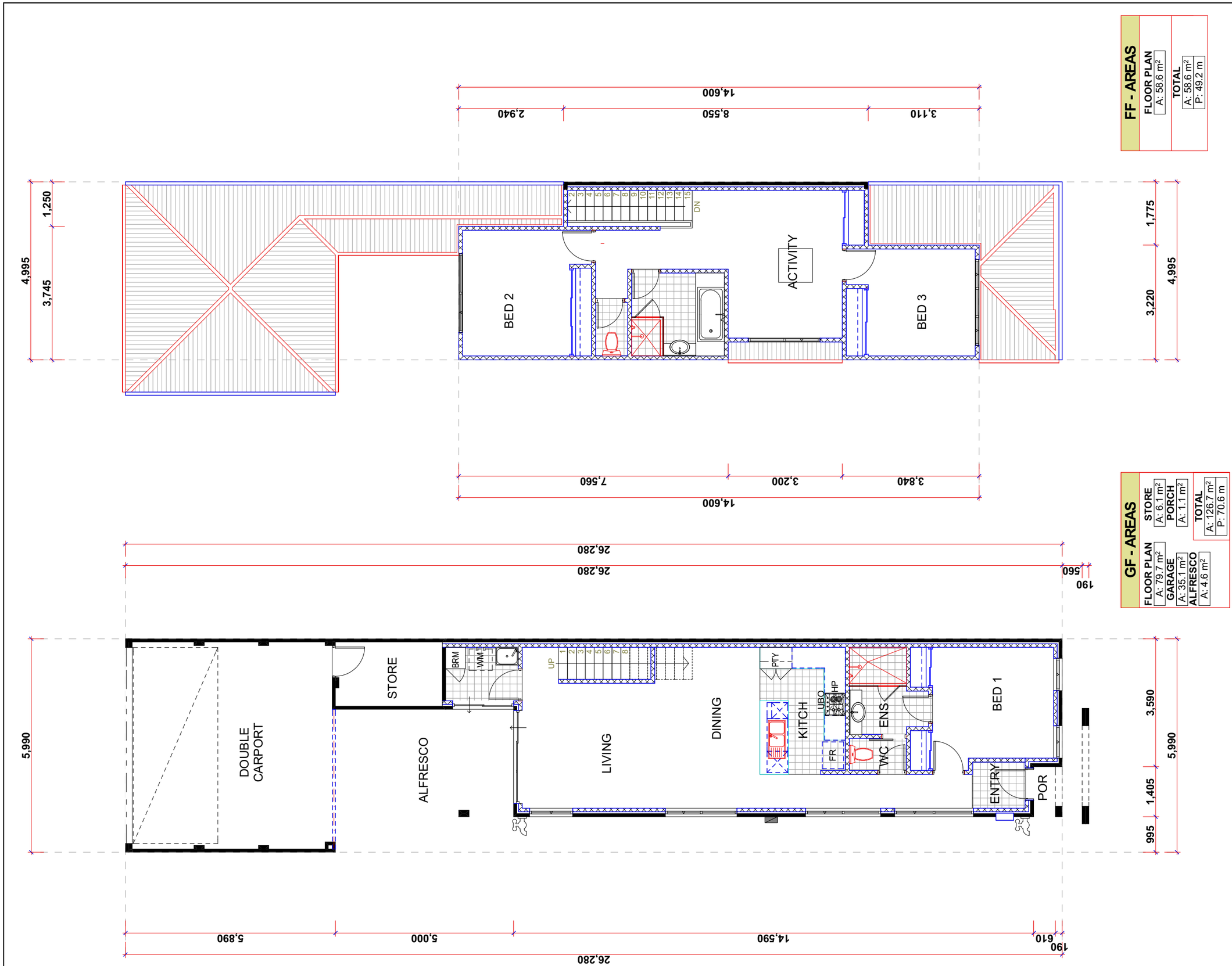
Drawing **FLOOR PLANS**

Dwg Nº **DA -**

Job Nº **DES 2014 - 7**

Rev: **A**

Scale **1:100 @ A3**



FF - AREAS

FLOOR PLAN	A: 58.6 m²
TOTAL	A: 58.6 m²
	P: 49.2 m

GF - AREAS

STORE	A: 6.1 m²
PORCH	A: 1.1 m²
FLOOR PLAN	A: 79.7 m²
GARAGE	A: 35.1 m²
ALFRESCO	A: 4.6 m²
TOTAL	A: 126.7 m²
	P: 70.6 m

TOWN HOUSE TYPE - Z

P2073862

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Proposed
LOT 4225 NORTH LAKE ROAD, KARDINYA

Client
PINDAN

DEVELOPMENTAL APPLICATION

Rev	Date	Description	Dr	Ch
A	26/11/15	DESIGN DEVELOPMENT	MR	

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Drawing
FLOOR PLANS

Dwg Nº
DA -

Job Nº
DES 2014 - 7

Rev:
A

Scale
1:100 @ A3

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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 $L_{A10,18hour}$.

R_w

This is the weighted sound reduction index and is similar to the previously used STC (Sound Transmission Class) value. 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 -14 dB.

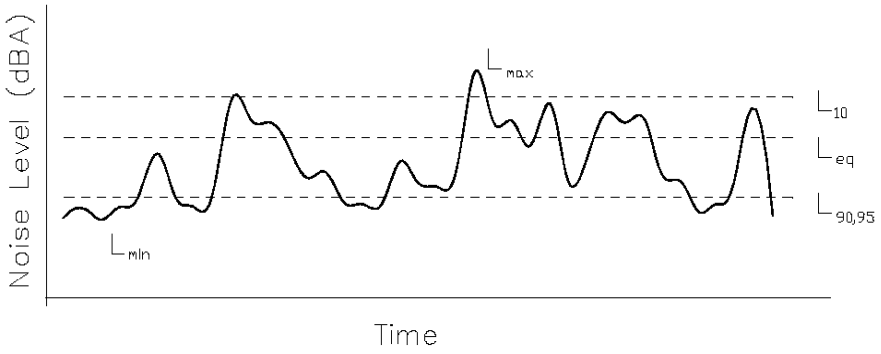
Satisfactory Design Sound Level

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)	Level 2 Axles and Axle Groups		Level 3 Vehicle Type	AUSTROADS Classification		
Type	Axles	Groups	Typical Description	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