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Environmental Noise Assessment

Change of Use (Boxing Gym), #44 Boranup Avenue, Clarkson

Reference: 18034353-01 Revision 1

Prepared for:
Maison Samardali

Report: 18034353-01 Revision 1

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Date:	Rev	Description	Prepared By	Verified
22/03/18	0	Issued to Client	Olivier Mallié	-
20/05/18	1	Car doors included.	Olivier Mallié	-

Table of Contents

List of Tables

List of Figures

Appendices

1 INTRODUCTION

It is proposed to convert the ground floor offices located at #44 Boranup Avenue, Clarkson (refer *Figure 1-1*) into a boxing gym.

The offices are located within a mixed-use complex with apartments above. It is noted that all surrounding properties are commercial premises, with the exception of the neighbouring residential property at 42 Boranup Avenue and along Observatory Drive on the north side of the site.

It is understood the boxing gym will be used by the residents of #44 Boranup Avenue and members of the public, and therefore noise associated with car parking is also considered. Parking for the boxing gym is understood to be provided at the rear of the building.

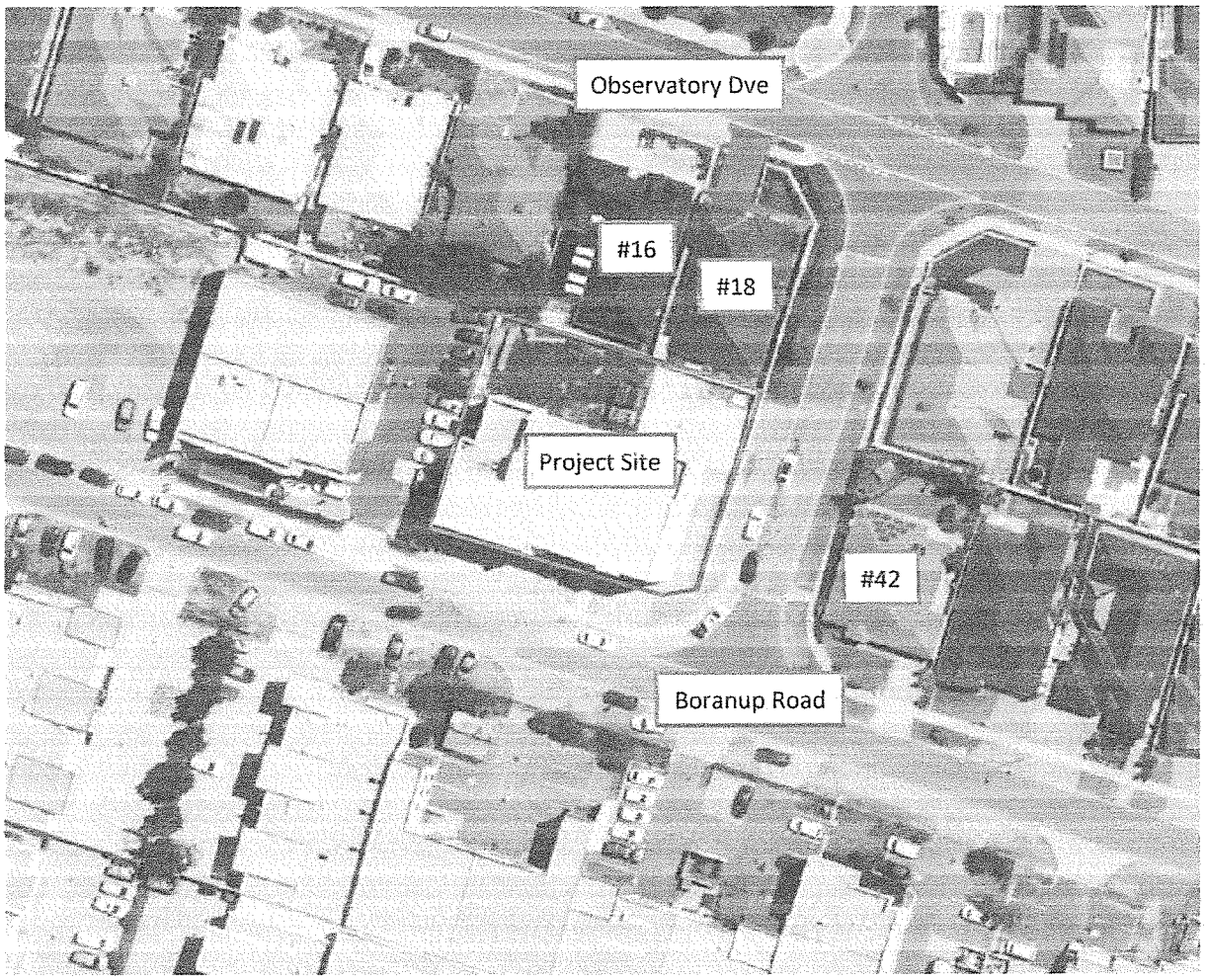


Figure 1-1 Project Site (City of Wanneroo Mapping)

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

2 CRITERIA

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

Regulation 7 defines the prescribed standard for noise emissions as follows:

"7. (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;

ii. impulsiveness; and

iii. modulation,

when assessed under regulation 9"

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..."

Tonality, impulsiveness and modulation are defined in Regulation 9. Noise is to be taken to be free of these characteristics 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 after the adjustments of *Table 2-1* are made to the noise emission as measured at the point of reception.

Table 2-1 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

Note: The above are cumulative to a maximum of 15dB.

The baseline assigned levels (prescribed standards) are specified in Regulation 8 and are shown in *Table 2-2*.

Table 2-2 Baseline Assigned Noise 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	All hours	60	75	80

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, applicable at the noise sensitive premises has been calculated as 3 dB, as shown in *Table 2-3* and based on the land use map shown in *Appendix B*. The transport factor was taken to be 0 dB as modelled traffic data for Neerabup Road from MRWA suggests a traffic count much less than 15,000 vpd in 2016, and no recent traffic count for Neerabup Road is available.

Table 2-3 Influencing Factor Calculation

Description	Within 100 metre Radius	Within 450 metre Radius	Total
Industrial Land	0 %	0 %	0 dB
Commercial Land	35 %	17 %	2.6 dB
Transport Factor			0 dB
Total			**3 dB**

Table 2-4 shows the assigned noise levels including the influencing factor and transport factor at the receiving locations.

Table 2-4 Assigned Noise 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)	48	58	68
	0900 to 1900 hours Sunday and public holidays (Sunday)	43	53	68
	1900 to 2200 hours all days (Evening)	43	53	58
	2200 hours on any day to 0700 hours Monday to Saturday and 0900 hours Sunday and public holidays (Night)	38	48	58
Noise sensitive premises: any area other than highly sensitive area	All hours	60	75	80
Commercial	All hours	60	75	80

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.

It must be noted the assigned noise levels above apply outside the receiving premises and at a point at least 3 metres away from any substantial reflecting surfaces.

However, in the case of the apartments above, it is considered there is no land associated with the sensitive use and, therefore, based on regulation 19(2)(b), the noise emissions from the boxing gym were assessed within the dwellings. In accordance with regulation 19(4), adjustments of 10 dB and 15 dB are to be made where the assessment is made indoors and the windows are open or closed respectively

For the surrounding sensitive receivers, given the close proximity between buildings and fences, the noise emissions were assessed at a point 1 metre away from building facades and a -2 dB adjustment was made to the predicted noise levels to account for reflected noise.

It is noted the assigned noise 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*, which is 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 Environment 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.

3 METHODOLOGY

Computer modelling has been used to predict the noise emissions from the site. The software used was *SoundPLAN 8.0* with the ISO 9613 algorithms (ISO 17354 compliant) selected. These algorithms have been selected as they include the influence of wind. Input data required in the model are:

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

Internal noise levels to the apartments above the boxing gym were predicted based on various inputs including internal noise levels within the gym and ceiling/floor construction.

The software used for internal noise predictions was Insul version 9.0

3.1 Meteorological Information

Meteorological information utilised is provided in *Table 3-1* 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 3-1 Modelling Meteorological Conditions

Parameter	Day (0700-1900)	Night (1900-0700)
Temperature (°C)	20	15
Humidity (%)	50	50
Wind Speed (m/s)	Up to 5m/s	Up to 5m/s
Wind Direction*	All	All

* Note that the modelling package used allows for all wind directions to be modelled simultaneously.

It is generally considered that compliance with the assigned noise levels needs to be demonstrated for 98% of the time, during the day and night periods, for the month of the year in which the worst-case weather conditions prevail. In most cases, the above conditions occur for more than 2% of the time and therefore must be satisfied.

3.2 Topographical Data

Based on the site plan provided and *Google Earth* publicly available elevation data, a 3-dimensional model was developed, which included ground elevations, the existing residences and building.

It is noted the ground is at level in a east-west direction but slopes down heading north, resulting in the houses along the north boundary (#16 and #18 Observatory Drive) to be approximately 2.5

metres below the site's ground floor level. The house at #42 Boranup Avenue is however considered to be level with the site.

3.3 Buildings and Receivers

The existing building was incorporated in the model, with the ground floor based on the plans shown in *Appendix A*.

Surrounding buildings were also included in the noise model, as these can provide noise shielding but also reflection paths. The nearest residential buildings are single storey houses and these were modelled at 3.5 metres high with the receiver at 1.5 metres above local ground.

The construction and acoustic performance of the existing office space was assumed to be as follows:

- Floor slab to apartment(s) above is minimum 200mm thick concrete. In line with the National Construction Code (2016), the minimum performance of the floor/ceiling was taken to be $R_w + C_{tr}$ of 50.
- External walls are assumed to achieve at least Rw + Ctr of 45 e.g. 250mm cavity brickwork or 150mm thick concrete tilt panels.
- All external glazing assumed to achieve minimum R_w 29 e.g. standard sliding window with 4mm glass.

3.4 Fences

Sheet metal fences e.g. *Colorbond* fence 1.8 metres high are located on top of the retaining wall along the north boundary and on the west boundary of the house at #42 Boranup Avenue.

A 3D model overview is presented in *Figure 3-1* showing the gym's external glazing (light grey) and the upper floor apartments receivers (yellow stars).

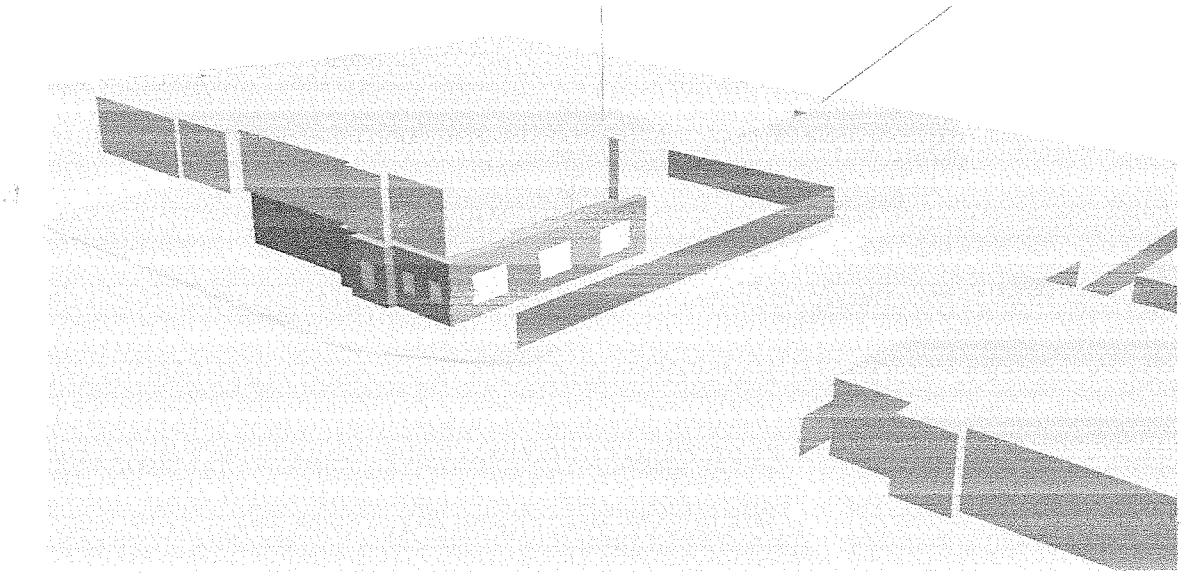


Figure 3-1 3D Model of Surroundings (South-East Elevation)

3.5 Ground Absorption

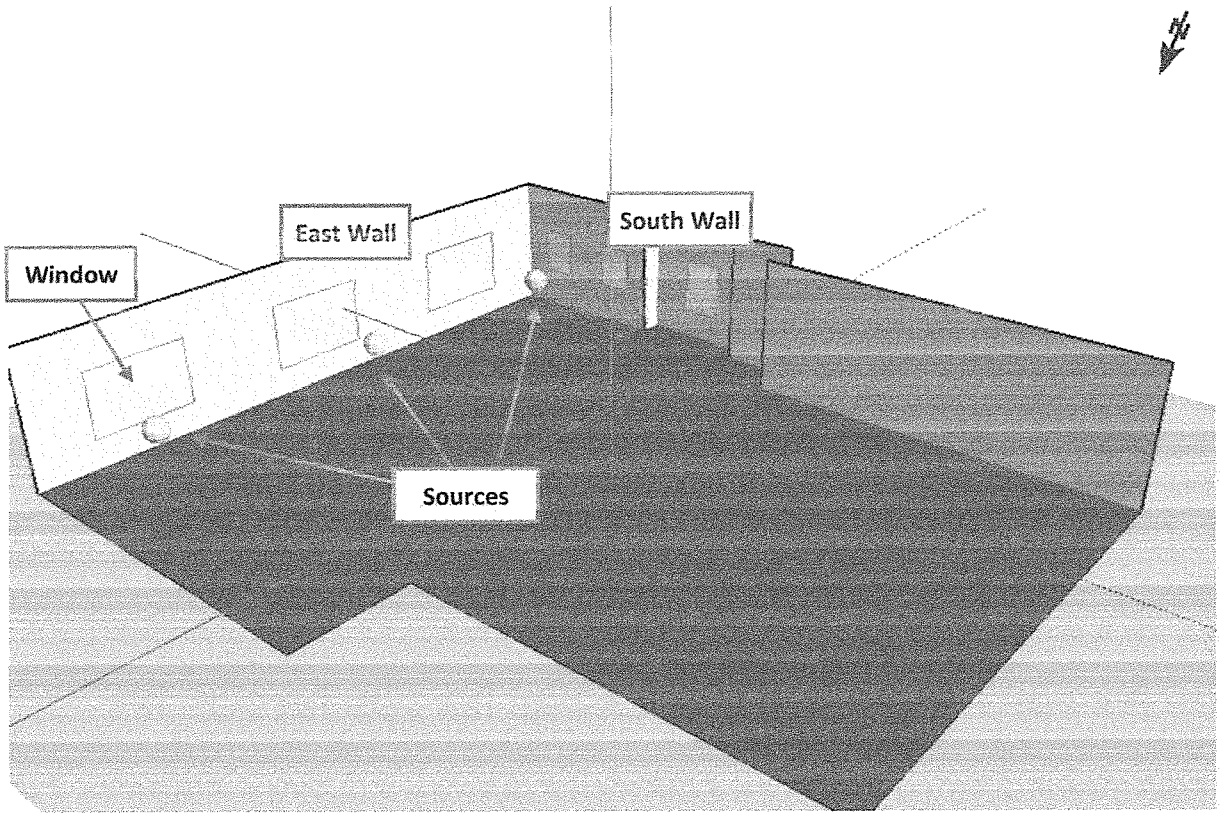
Ground absorption varies from a value of 0 to 1, with 0 being for an acoustically reflective ground (e.g. asphalt, concrete) and 1 for acoustically absorbent ground (e.g. turf/soft landing products). In this instance, a value of 0.0 has been used across the site and surroundings.

3.6 Source Sound Levels

The source sound levels used in the modelling are provided in *Table 3-2*.

The main source of noise from the proposed boxing gym was considered to be impact noise from using training pads or punch bags as there will be no music being played internally, or other type of 'cross-fit' training classes.

Given the available floor area of the gym, three point sources were modelled within the proposed gym to represent three possible locations for punch bag(s). The internal sources were modelled at 1.5m above floor level and 2 metres away from the east external wall – refer sketch below:



The modelling software was then used to calculate the noise breakout via the various facade elements based on room size and internal finishes.

Table 3-2 Source Sound Power Levels, dB

Description	Octave Band Centre Frequency (Hz)								Overall dB(A)	Modelled Height, m
	63	125	250	500	1k	2k	4k	8k		
Hits on Punch Bag, L_{max}	94	99	95	95	90	93	89	84	**98**	**1.5**
Car Door Closing (L_{Amax})	99	97	92	84	81	75	73	-	**88**	**1.0**

4 RESULTS

4.1 Gym Noise

The noise levels were predicted at the closest receivers and are presented in *Table 4-1*. *Figures 4-1* and *4-2* also show the predicted noise levels as contour maps at ground level for the gym's east windows open and closed respectively, as well as the location of each receiver.

It is noted the north external wall does not have any glazing or other openings and is set back from the boundary by 12 metres, therefore noise breakout to the receivers along Observatory Drive was considered negligible. In addition, the south windows are fixed glass and therefore cannot be open.

Table 4-1 Predicted Gym Noise Levels, dB L_{Amax}

Receiver	Windows Open	Windows Closed
Gym Ceiling (Internal)	*80*	*80*
Upper Floor Apt, East Wall Glazing (bedrooms)	47	73
Upper Floor Apt, South Wall Glazing (bedrooms)	42	55
#42 Boranup Avenue	28	50

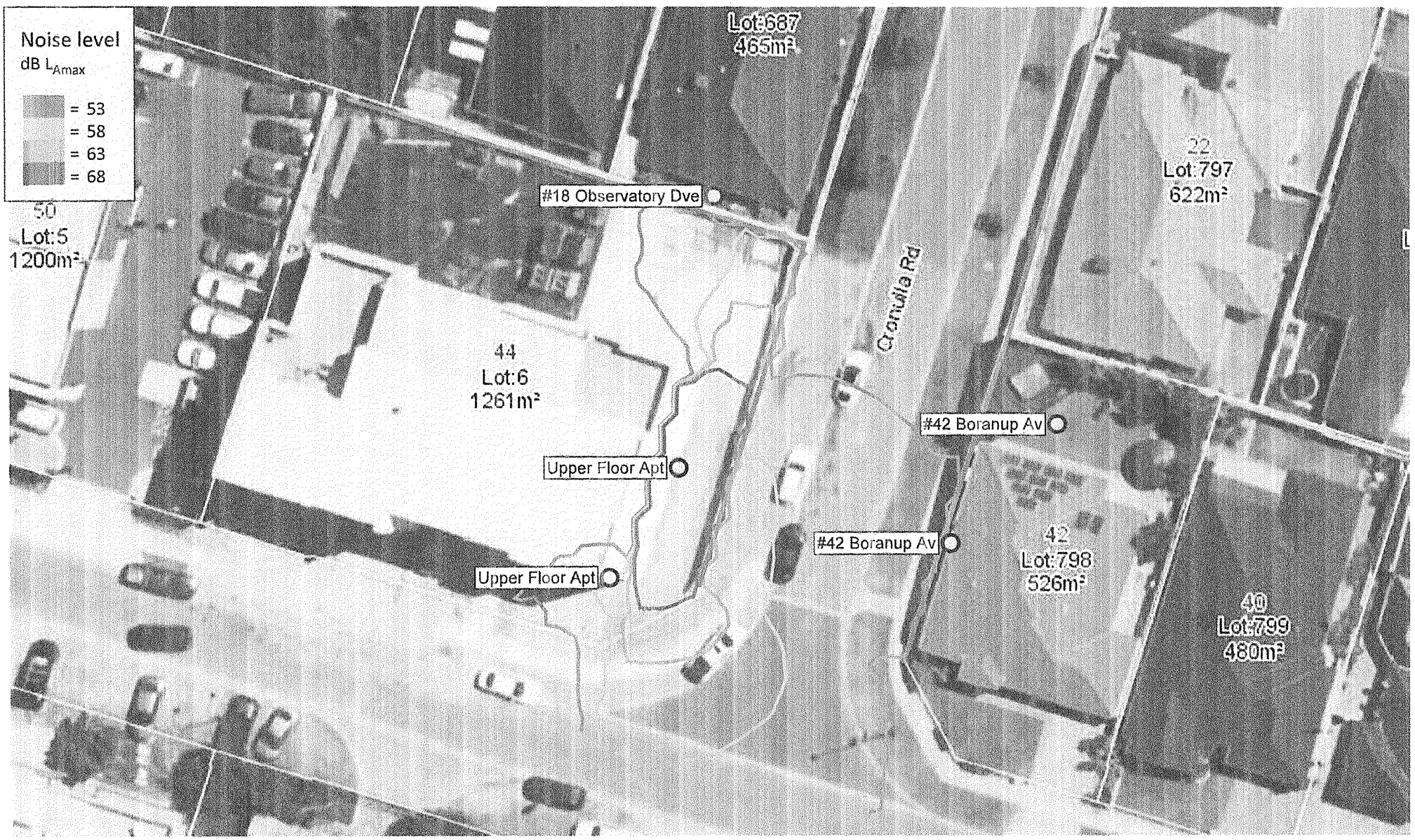
Based on the internal noise levels above, the noise levels within the bedrooms of the upper floor apartments were then predicted, as shown in *Table 4-2*.

Table 4-2 Predicted Internal Noise Levels from Gym, dB L_{Amax}

Description	Via Floor
Ceiling Noise Level	80
Noise Level Within Bedroom via Floor Slab	30
Level Adjustment for Doors and Windows Closed	+15
Assessable Level, dB(A)	45

#44 Boranup Avenue - Proposed Boxing Gym Noise Contours (1.5m AGL)
All Windows in East Wall Open

Figure 4-1



Signs and symbols

- Receiver
- Fence / Retaining Wall

N

21-Mar-18

Length Scale 1:400

0 2 4 8 12 m

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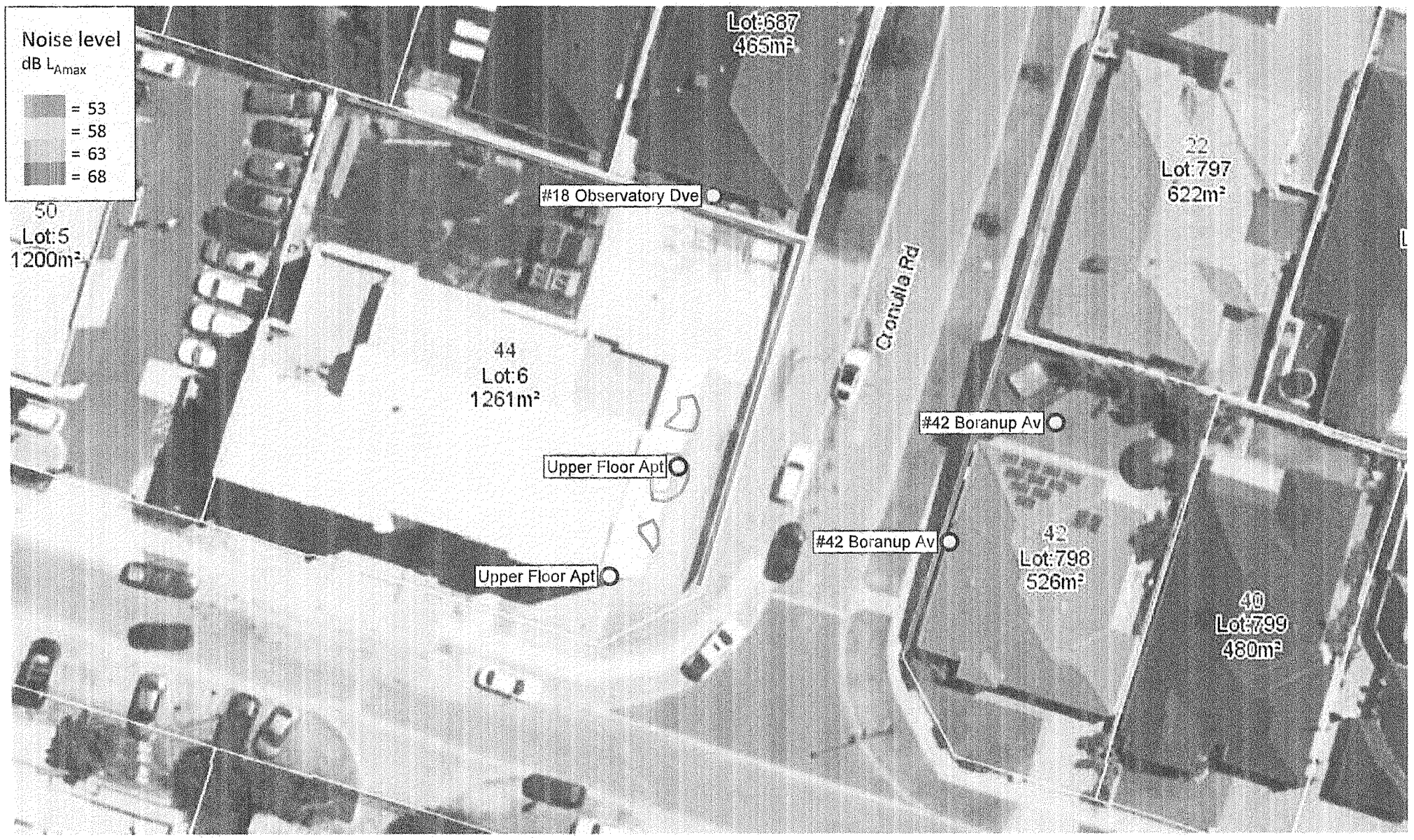
#44 Boranup Avenue - Proposed Boxing Gym Noise Contours (1.5m AGL)
All Windows in East Wall Closed

Figure 4-2



Signs and symbols

- Receiver
- Fence / Retaining Wall

N

21-Mar-18

Length Scale 1:400

0 2 4 8 12 m

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4.2 Car Doors Noise

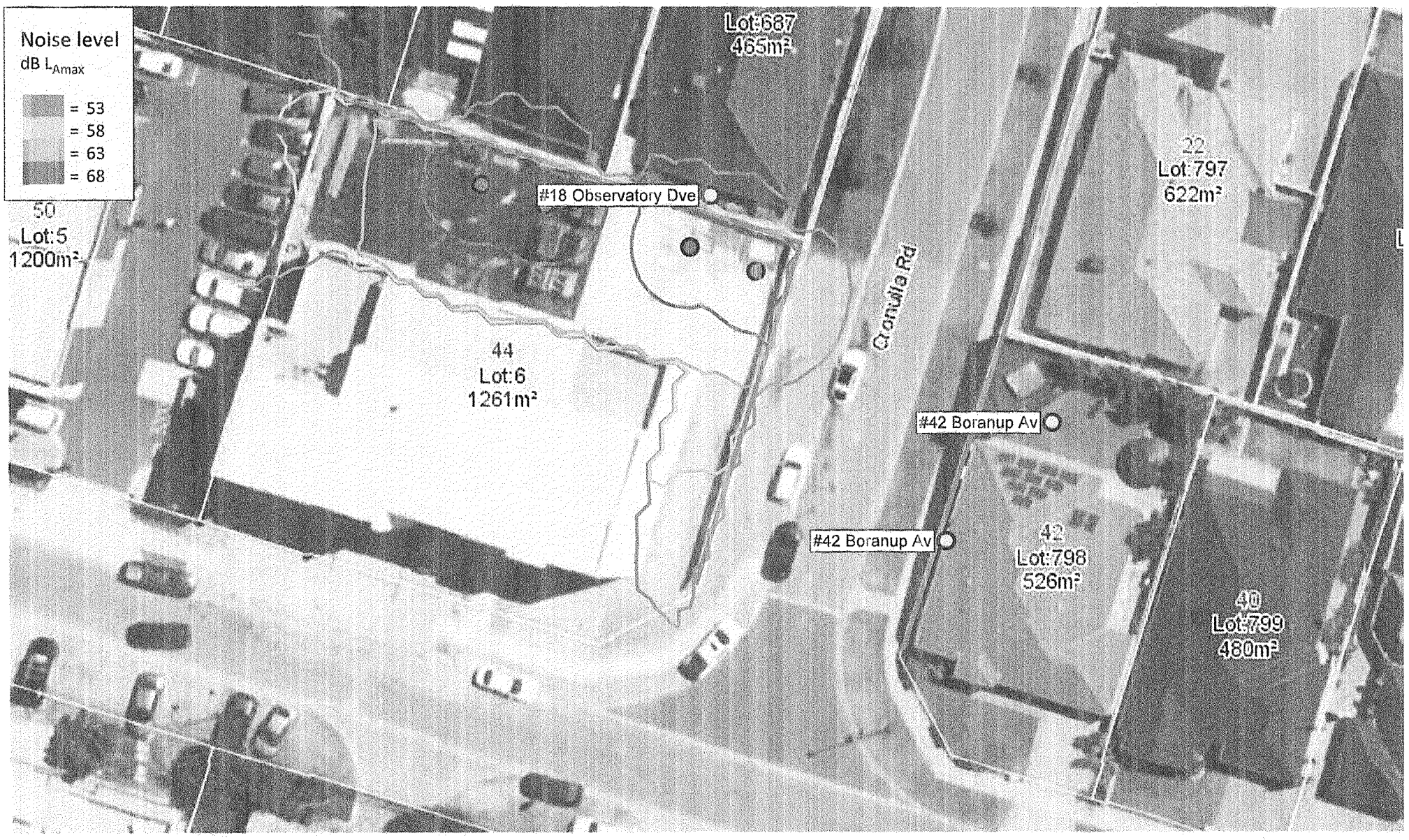
The noise levels from car doors closing in the rear car park were predicted at the closest receivers and are presented in *Table 4-3*. *Figures 4-3* and *4-4* also show the predicted noise levels as contour maps at ground level (1.5m AGL) and at the upper floor (5.1m AGL).

Table 4-3 Predicted Noise Levels, dB L_{Amax}

Receiver	Car Doors	Most Significant Source
Upper Floor Apt, North Wall Glazing	62	Bays 3-12
Upper Floor Apt, East Wall Glazing (bedrooms)	56	Bay 14
Upper Floor Apt, South Wall Glazing (bedrooms)	40	Bay 14
#42 Boranup Avenue	44	Bay 14
#16 Observatory Drive	52	Bays 5-7
#18 Observatory Drive	53	Bays 11-13

#44 Boranup Avenue - Car Doors Closing Noise Contours Ground Floor (1.5m AGL)

Figure 4-3



Signs and symbols

- Receiver
- Fence / Retaining Wall

N

19-May-18

Length Scale 1:400

0 2 4 8 12 m

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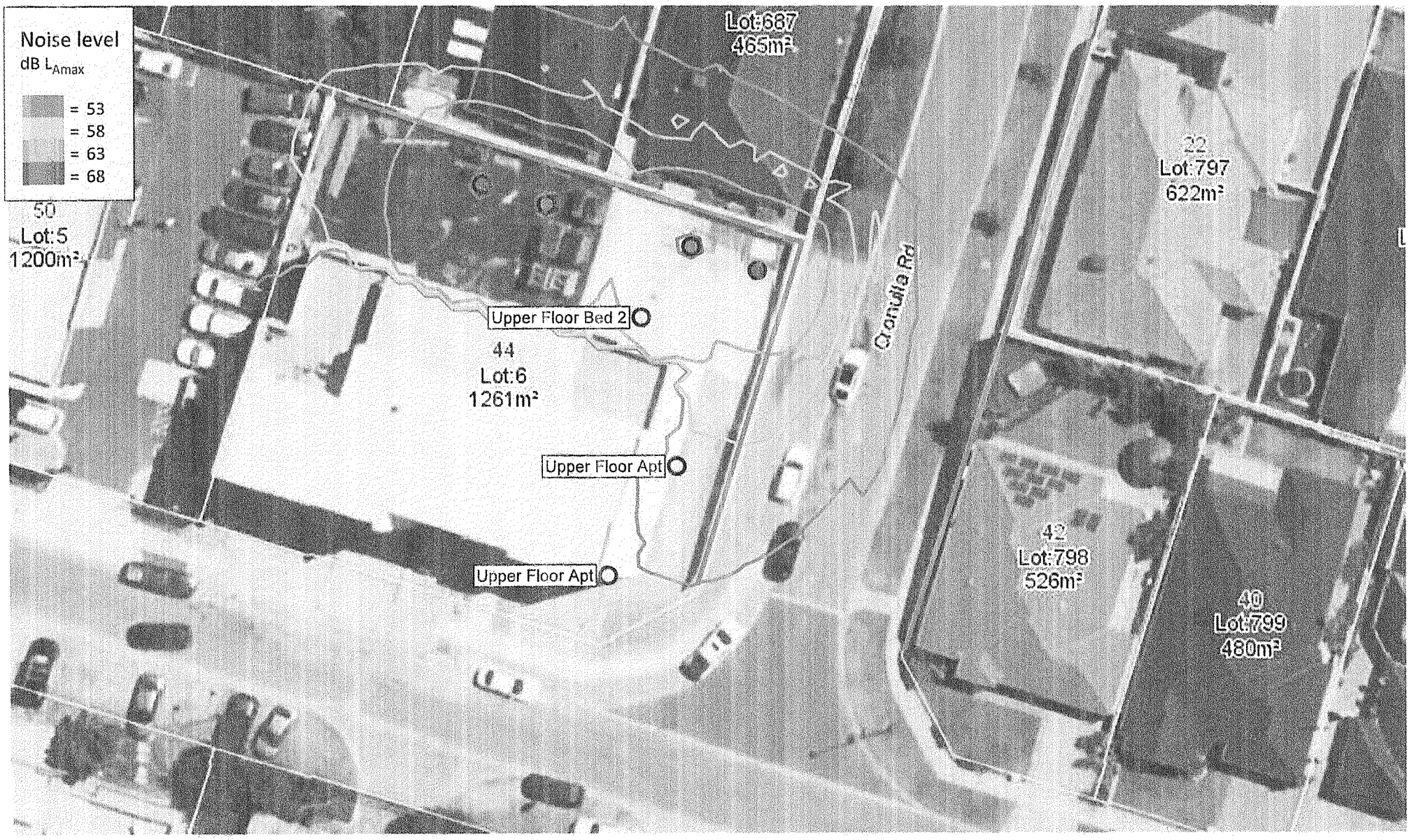
#44 Boranup Avenue - Car Doors Closing Noise Contours Upper Floor (5.1m AGL)

Figure 4-4



5 ASSESSMENT

It is understood the boxing gym will be used by the residents of #44 Boranup Avenue and members of the public, with the operating hours extending into the evening / night-time period i.e. before 7am or after 7pm.

Based on the above, and given the nature of the noise emissions being only short events, it is considered that the applicable criteria is the L_{Amax} assigned noise level of 58 dB.

5.1 Gym Windows Open

From the modelling results, the highest predicted noise level is 73 dB(A) at the east facade of the upper floor apartment for a case when the windows in the east wall of the gym are open. Given the nature of the source and predicted level the noise emissions would be impulsive at night-time and therefore a +10 dB penalty would be applicable (refer *Table 2-1*). The assessable level would then be 83 dB L_{Amax}, which would exceed the night-time assigned level of 58 dB L_{Amax} by 25 dB. It is noted the least stringent assigned level of 68 dB L_{Amax} for the daytime period would also be exceeded by 15 dB.

At the closest external receiver at #42 Boranup Avenue, the predicted noise level is 50 dB L_{Amax}. Again, given the nature of the source and predicted level, the noise emissions would be considered impulsive at night-time and therefore a +10 dB penalty would be applicable (refer *Table 2-1*). The assessable level would then be 60 dB L_{Amax}, which would exceed the night-time assigned level of 58 dB L_{Amax} by 2 dB.

5.2 Gym Windows Closed

Under this scenario the noise levels reduce significantly, with the highest predicted noise level then being 47 dB L_{Amax} at the east facade of the upper floor apartment. Given the nature of the source, it may be possible for the noise emissions to be impulsive at night-time, and therefore a +10 dB penalty would be applicable (refer *Table 2-1*). The assessable level would then be 57 dB L_{Amax}, which would comply with the night-time assigned level of 58 dB L_{Amax}.

At the closest external receiver at #42 Boranup Avenue, the predicted noise level is 28 dB L_{Amax} which readily complies with the assigned noise level.

With the gym's windows closed the noise levels within the upper apartments' bedroom would become more prominent, and the assessable level would be 45 dB L_{Amax} (refer *Table 4-2*). This level readily complies with the assigned level. It is noted that given the floor slab construction and the low predicted level of 30 dB L_{Amax}, the noise emissions were not considered to contain any annoying characteristics.

5.3 Car Doors Closing

From the modelling results, the highest predicted noise level at a neighbouring receiver is 53 dB L_{Amax} (#18 Observatory Drive). Given the nature of the source the noise emissions would be impulsive at night-time and therefore a +10 dB penalty would be applicable (refer *Table 2-1*). The assessable level is then 63 dB L_{Amax}, which complies with the daytime assigned level of 68 dB L_{Amax}, however exceeds the night-time assigned level of 58 dB L_{Amax} by 5 dB.

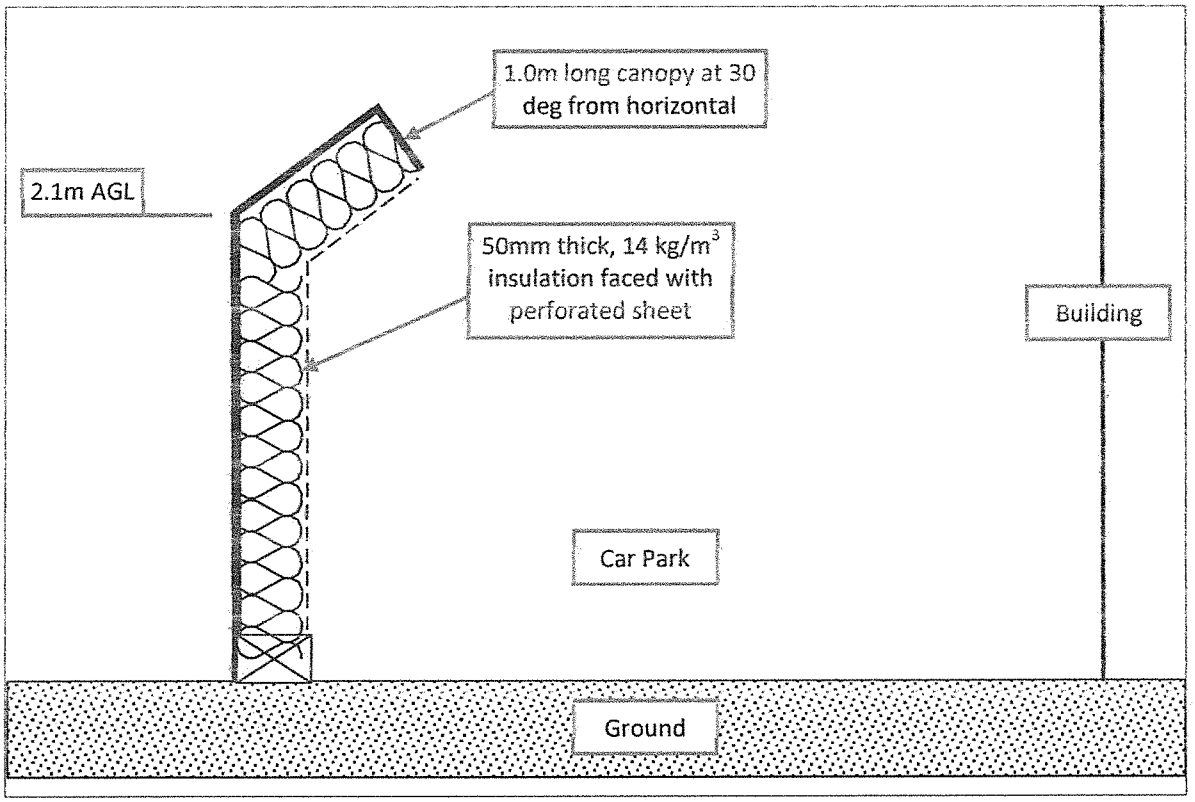
In addition to the above, it is noted noise levels up to 62 dB(A) are predicted at the north facade of the upper floor apartments as a result of cars parking in bays 3 to 12. Including the +10 dB penalty for impulsiveness (refer *Table 2-1*) results in an assessable level of 72 dB L_{Amax}, which exceeds the daytime assigned noise level of 68 dB L_{Amax} by 4 dB, and night-time assigned level of 58 dB L_{Amax} by 14 dB.

However, it is understood that parking at the rear of the premises is already provided for the residents and, as such, the noise impact from doors closing in the car park will be no different whether it is a resident's car emitting the noise e.g. early departure for work or late return, or a patron attending a gym class. Should this view be accepted, then no noise mitigation would be required.

In a case where full compliance with the night-time assigned noise level of 58 dB L_{Amax} is deemed necessary, then the following mitigation options would be required:

- Upgrade all glazing incorporated in the north and east facades of the apartments to achieve an acoustic rating of R_w 31 e.g. 6mm glass in good frame closing on compressible seals. This is assumes that since the apartments are 'internal' receivers, compliance can be assessed within the premises in accordance with regulation 19(2)(b).

- The fence height along the north boundary is to be increased to 2.1 metres and incorporate a cantilevered canopy 1 metre long, angled 30 degrees from horizontal and with the underside lined with acoustic absorption – refer sketch below for details.



Alternatively to the above, gym classes could be restricted to the daytime only i.e. 7am-7pm Monday to Saturday and 9am to 7pm on Sunday and public holidays, noting that compliance at receivers within #44 Boranup Avenue is achieved if assessed within an apartment with windows closed and standard 4mm glazing.

6 CONCLUSIONS

It is proposed to convert the ground floor offices located at #44 Boranup Avenue, Clarkson into a boxing gym, understood to be used by the residents of #44 Boranup and members of the public.

Based on the modelling and assessment carried out, the noise emissions from the boxing gym can comply with the Regulations at all times provided that:

- The gym's windows in the east wall remain closed during training sessions, and
- No music be played within the gym.

In relation to car doors closing in the car park, it is understood that parking at the rear of the premises is already provided for the residents and, as such, the noise impact from doors closing in the car park will be no different whether it is a resident's car emitting the noise e.g. early departure for work or late return, or a patron attending a gym class. As such, no noise mitigation would be required to specifically address noise emissions from patrons' car doors only.

However, should full compliance with the assigned noise level of 58 dB L_{Amax} is deemed necessary i.e. gym classes occur during the evening or night-time periods as defined in the Regulations, then the following mitigation options would be required:

- Upgrade all glazing incorporated in the north and east facades of the apartments to achieve an acoustic rating of R_w 31 e.g. 6mm glass in good frame closing on compressible seals. This is assumes that since the apartments are 'internal' receivers, compliance can be assessed within the premises in accordance with regulation 19(2)(b).

- The fence height along the north boundary is to be increased to 2.1 metres and incorporate a cantilevered canopy 1 metre long, angled 30 degrees from horizontal and with the underside lined with acoustic absorption (refer *Section 5.3* for details).

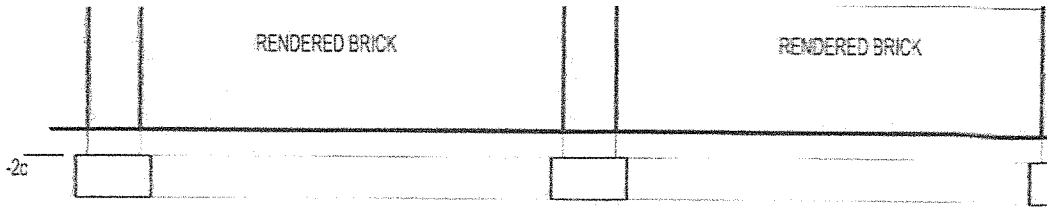
Alternatively to the above, the gym classes could be held during the daytime only i.e. 7am-7pm Monday to Saturday and 9am to 7pm on Sunday and public holidays.

Appendix A

Development Plans

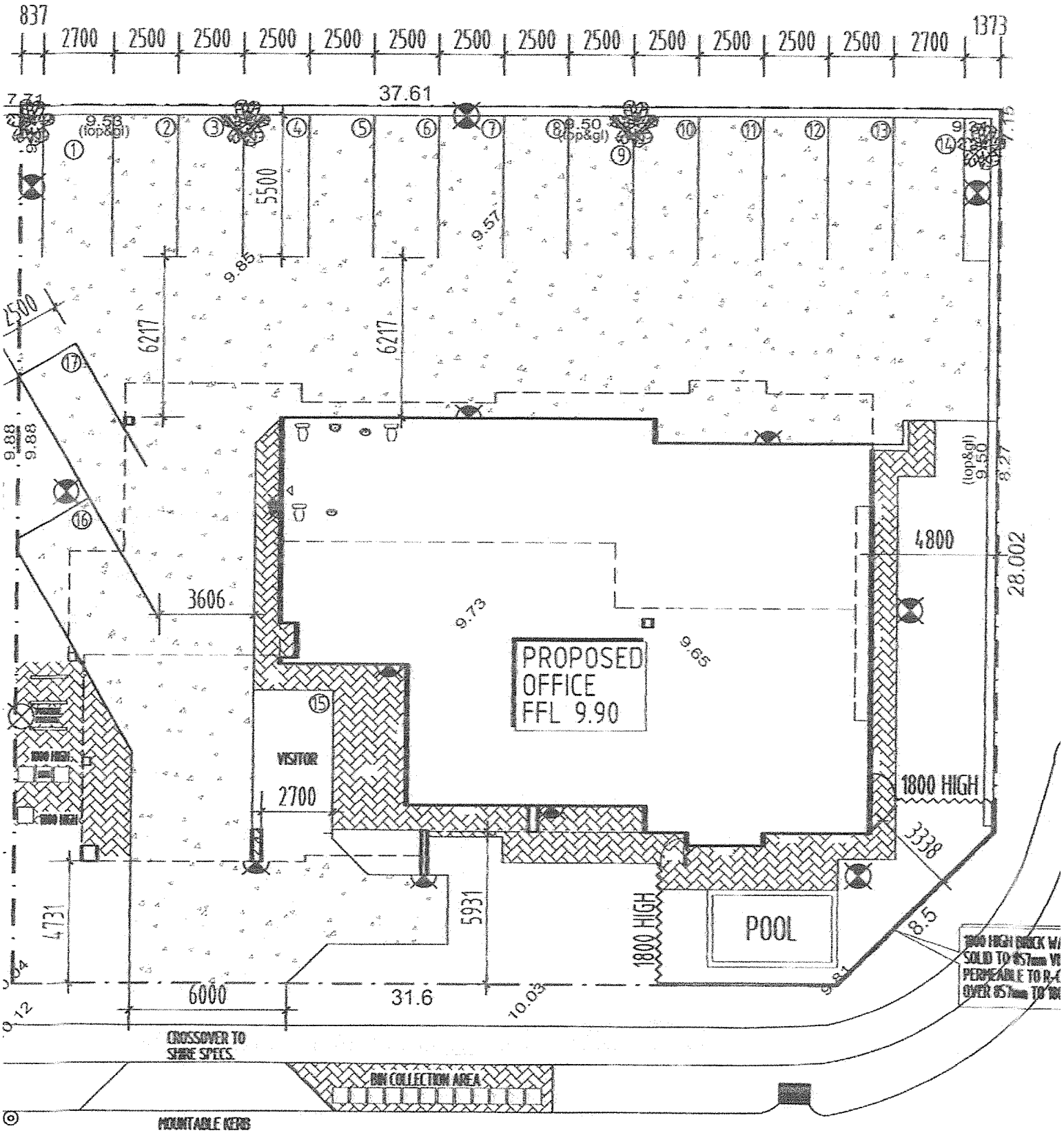
CURITY LIGHTING

WALL MOUNTED



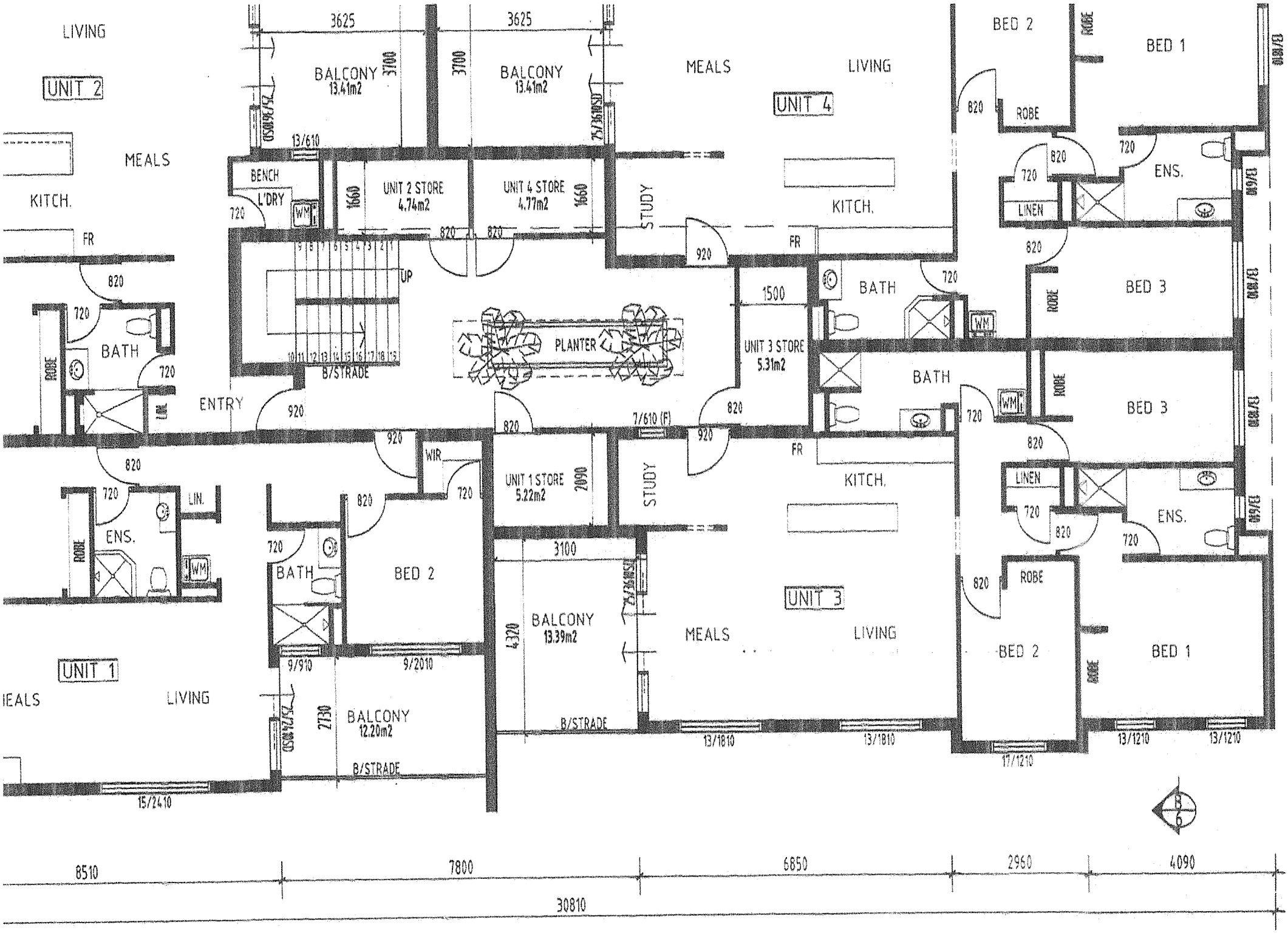
TYPICAL FRONT FENCE DETAIL

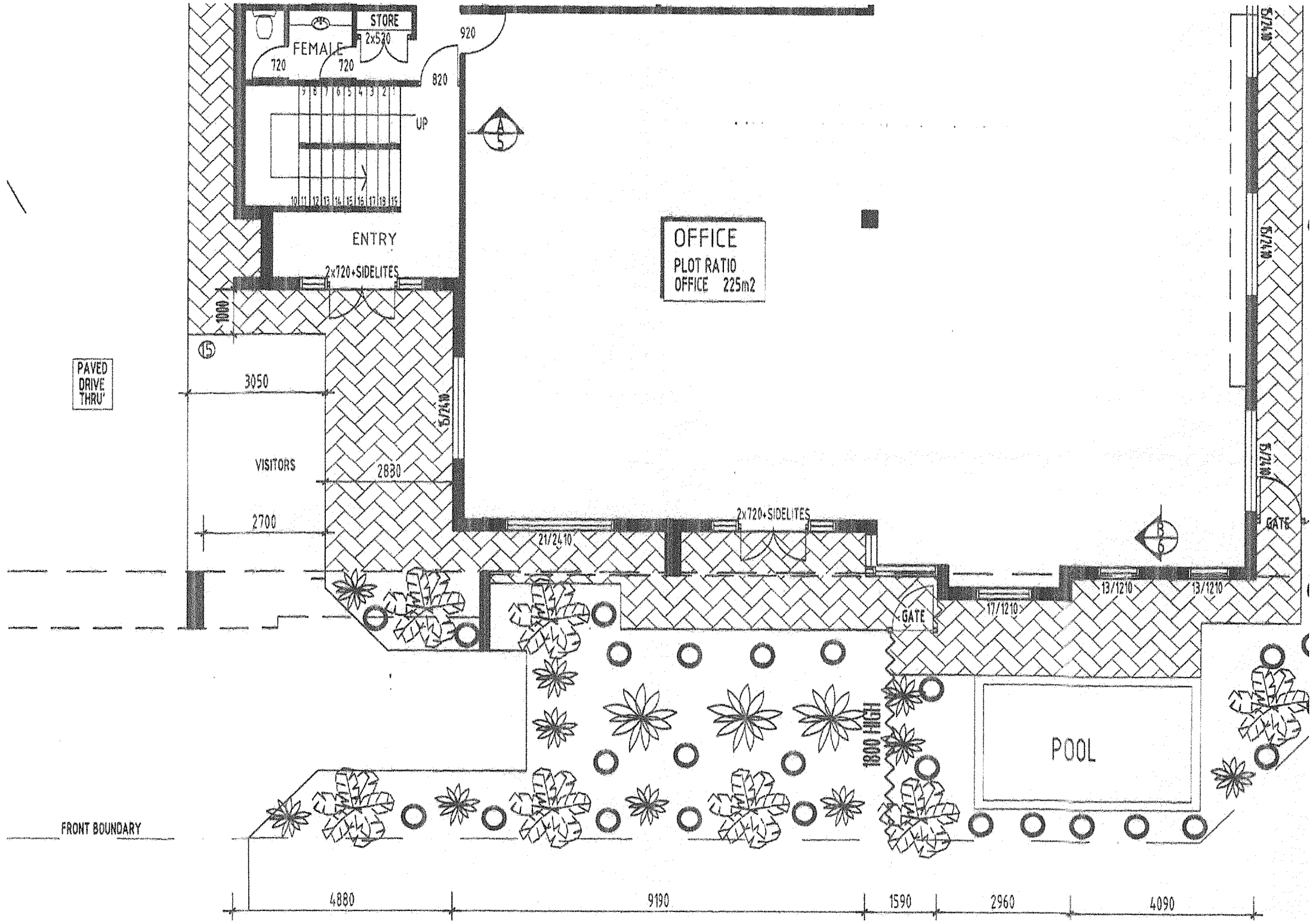
SCALE 1:25

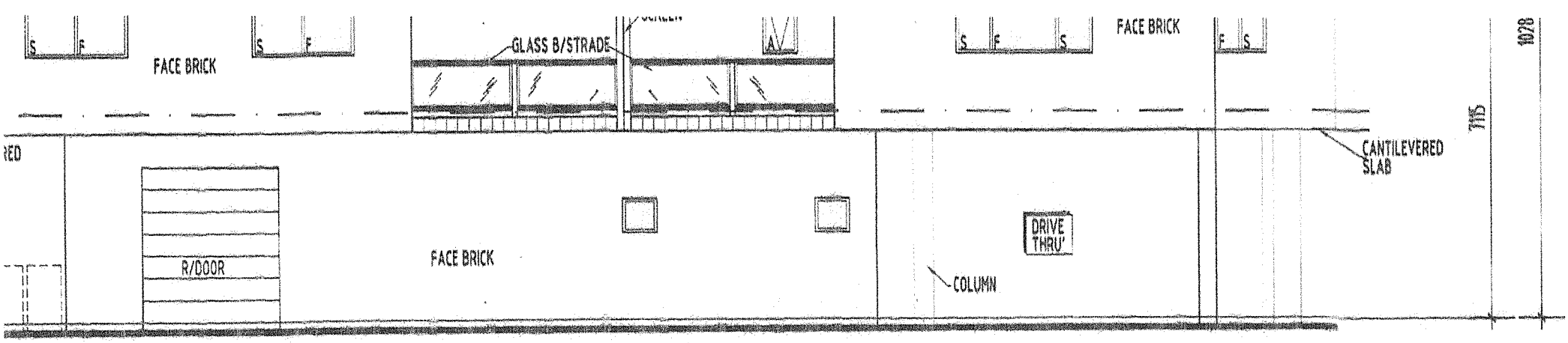


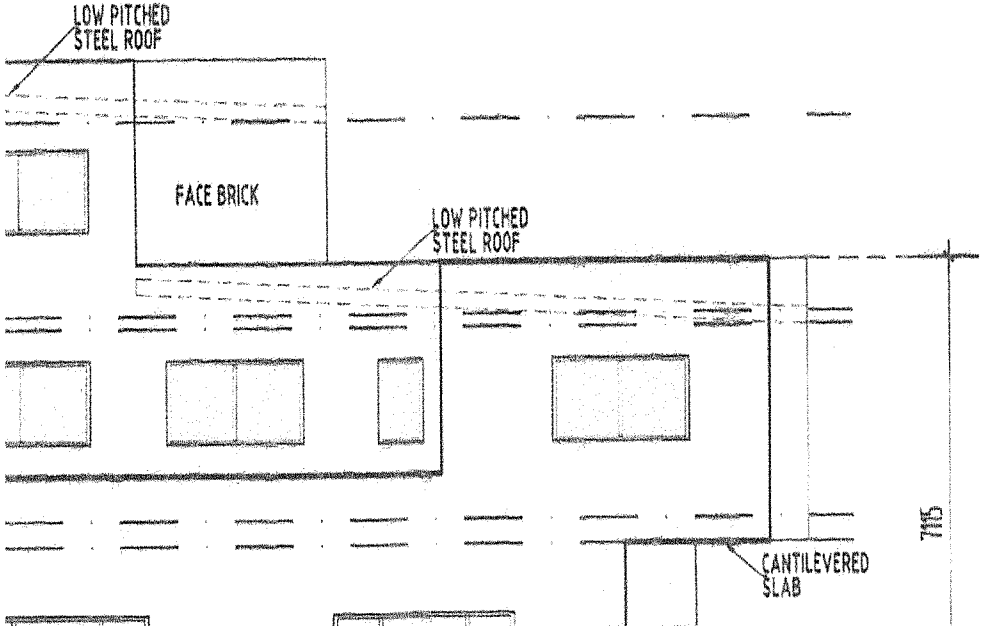
PLOT RATIO

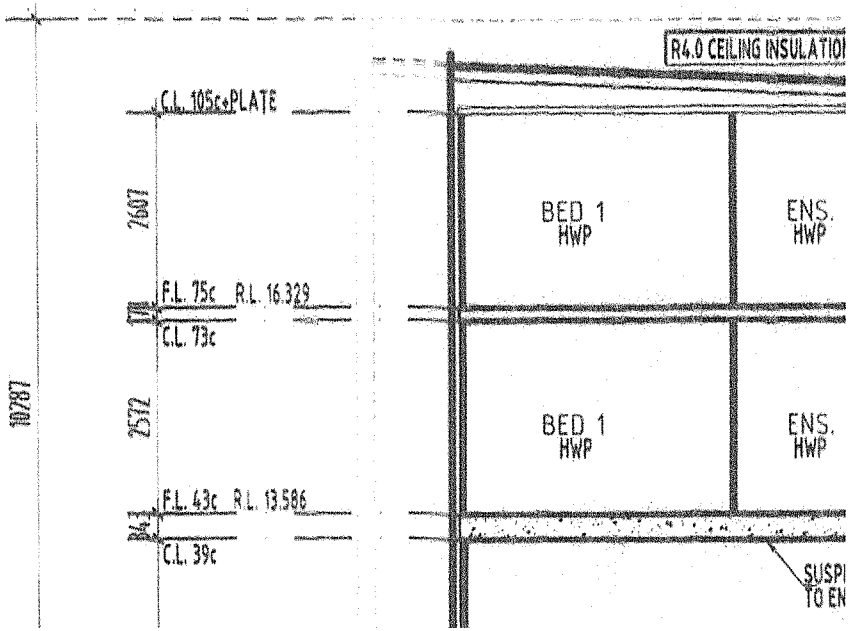
TOTAL AREA (PLOT RATIO) = 825.37m2

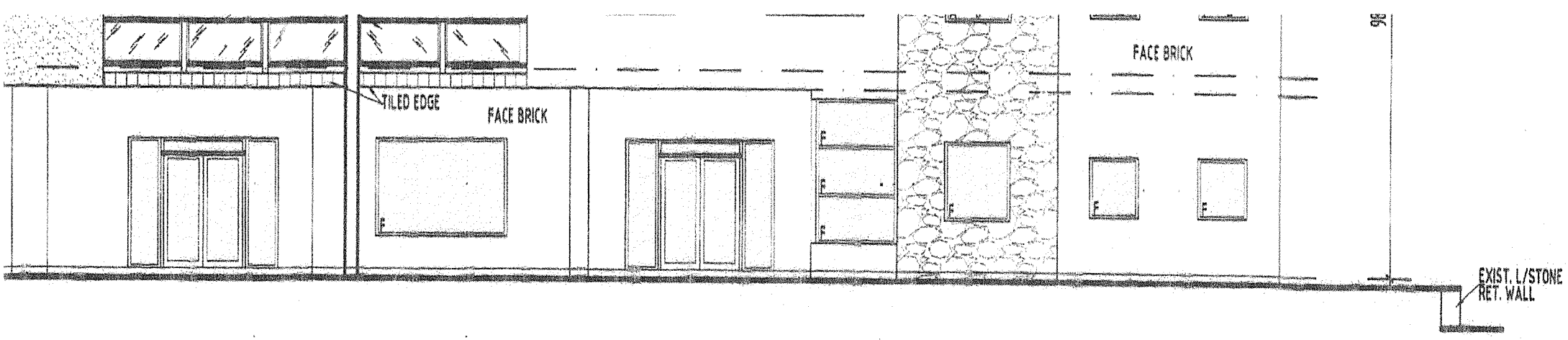

UNIT 2
LIVING
MEALS
KITCH.
FR
820
720
BATH
ROBE
LIN.
ENTRY
920
ENS.
WM
UNIT 1
IEALS
LIVING
15/2410
3625
BALCONY
13.41m2
3100
13/610
BENCH
L'DRY
WM
720
1660
UNIT 2 STORE
4.74m2
820
UP
B/STRADE
WIR
820
720
BATH
BED 2
9/910
9/2010
2730
BALCONY
12.20m2
B/STRADE
UNIT 1 STORE
5.22m2
2090
STUDY
920
820
7/610 (F)
PLANTER
3100
BALCONY
13.39m2
4320
B/STRADE
13/1810
MEALS
LIVING
UNIT 3
UNIT 4 STORE
4.77m2
1660
STUDY
920
820
1500
UNIT 3 STORE
5.31m2
KITCH.
FR
BATH
720
WM
BATH
720
WM
KITCH.
FR
UNIT 4
MEALS
LIVING
BED 2
ROBE
820
ROBE
BED 1
720
820
ENS.
LINEN
720
820
BED 3
ROBE
BED 3
ROBE
820
LINEN
720
820
ENS.
720
820
ROBE
BED 2
ROBE
BED 1
13/1210
13/1210
17/1210
8510
7800
6850
2960
4090
30810

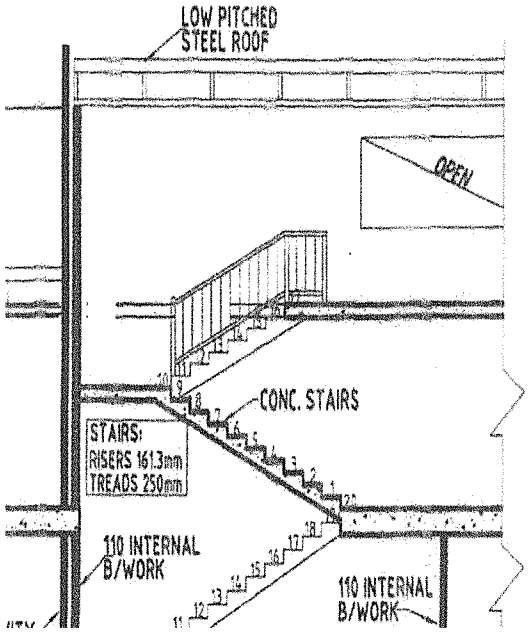

STORE
2x520
FEMALE
720
720
920
820
UP
ENTRY
2x720+SIDELITES
1000
OFFICE
PLOT RATIO
OFFICE 225m2
PAVED DRIVE THRU'
3050
VISITORS
2830
2700
5/2410
21/2410
2x720+SIDELITES
GATE
13/1210
13/1210
17/1210
GATE
1800 HIGH
POOL
FRONT BOUNDARY
4880
9190
1590
2960
4090


FACE BRICK
GLASS B/STRADE
FACE BRICK
CANTILEVERED SLAB
R/DOOR
FACE BRICK
DRIVE THRU'
COLUMN
7115
1028


LOW PITCHED STEEL ROOF
FACE BRICK
LOW PITCHED STEEL ROOF
CANTILEVERED SLAB
7115

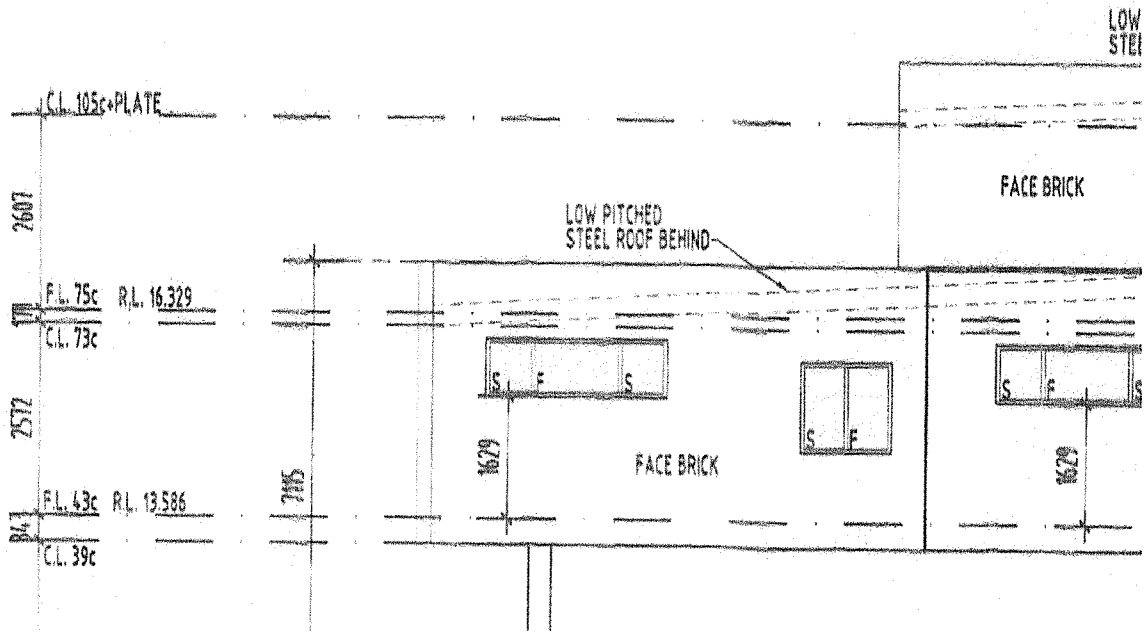

R4.0 CEILING INSULATIO
C.L. 105c PLATE
2607
BED 1 HWP
ENS. HWP
F.L. 75c R.L. 16.329
C.L. 73c
10787
2572
BED 1 HWP
ENS. HWP
F.L. 43c R.L. 13.586
C.L. 39c
SUSPI TO EN

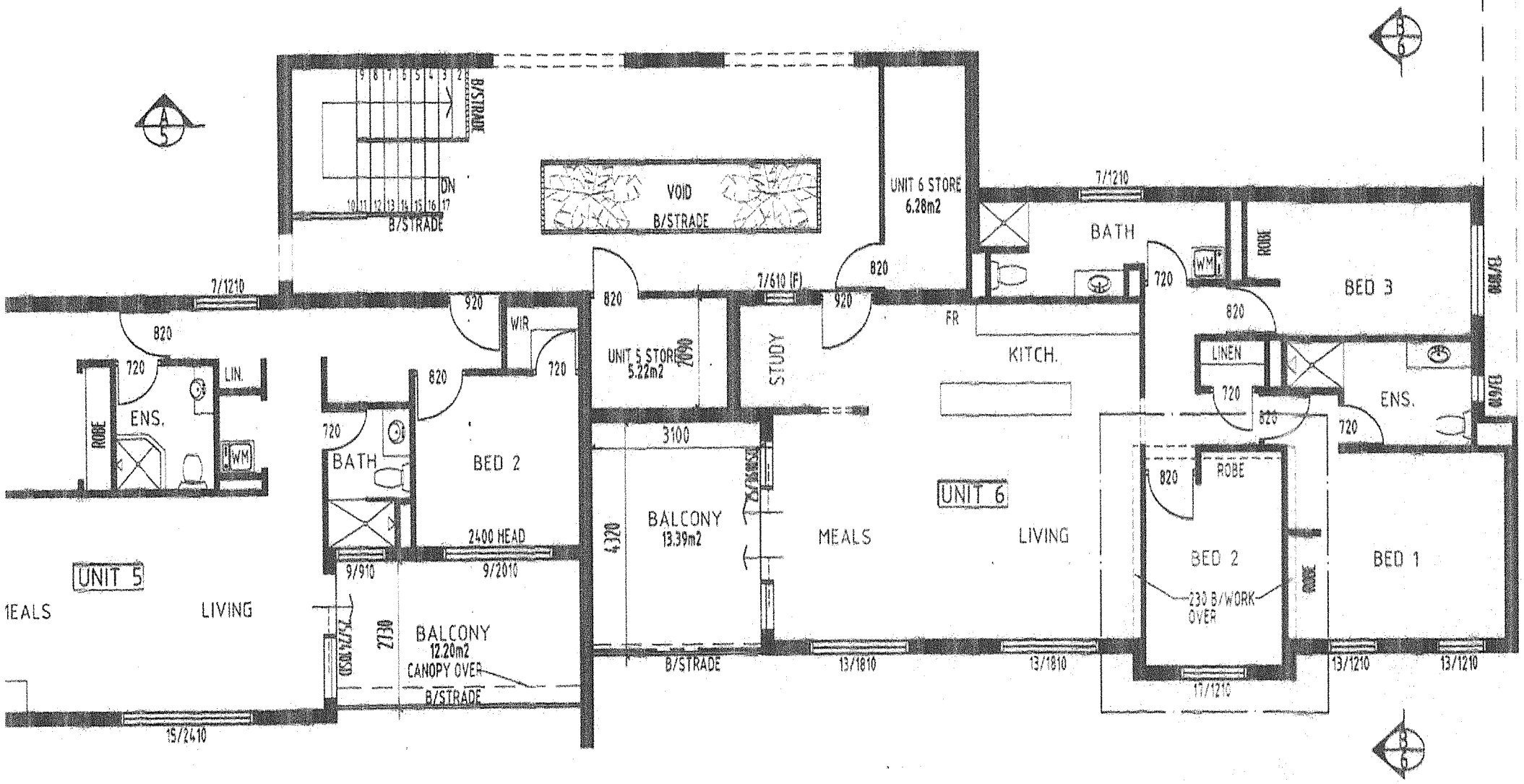




NOTE:
ROOF FRAME TO COMPLY WITH AS. 1684.2-2010 AMNDT 1 2012

BALUSTRADE TO COMPLY WITH A.S. AND BCA PART 3.9.2




B/STRADE
DN
B/STRADE
VOID
B/STRADE
UNIT 6 STORE
6.28m2
7/1210
BATH
WM
ROBE
BED 3
820
720
7/610 (F)
820
920
920
WIR
820
720
UNIT 5 STORE
5.22m2
STUDY
FR
KITCH.
LINEN
720
820
ENS.
720
LIN.
ROBE
ENS.
WM
720
BATH
820
BED 2
3100
BALCONY
13.39m2
4320
UNIT 6
MEALS
LIVING
ROBE
820
BED 2
BED 1
2400 HEAD
9/910
9/2010
UNIT 5
1EALS
LIVING
2730
BALCONY
12.20m2
CANOPY OVER
B/STRADE
230 B/WORK
OVER
B/STRADE
13/1810
13/1810
13/1210
13/1210
17/1210
15/2410
8510
7800
6850
2960
4090

Appendix B

Land Use Map

#44 Bonarup Avenue - Proposed Boxing Gym
Land Use Map

Appendix B

Signs and symbols

Comercial Land Use

21-Mar-18

Length Scale 1:5000

0 25 50 100 150 m

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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 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.

Sound Power Level (L_w)

Under normal conditions, a given sound source will radiate the same amount of energy, irrespective of its surroundings, being the sound power level. This is similar to a 1kW electric heater always radiating 1kW of heat. The sound power level of a noise source cannot be directly measured using a sound level meter but is calculated based on measured sound pressure levels at known distances. Noise modelling incorporates source sound power levels as part of the input data.

Sound Pressure Level (L_p)

The sound pressure level of a noise source is dependent upon its surroundings, being influenced by distance, ground absorption, topography, meteorological conditions etc and is what the human ear actually hears. Using the electric heater analogy above, the heat will vary depending upon where the heater is located, just as the sound pressure level will vary depending on the surroundings. Noise modelling predicts the sound pressure level from the sound power levels taking into account ground absorption, barrier effects, distance etc.

L_{ASlow}

This is the noise level in decibels, obtained using the A frequency weighting and the S (Slow) time weighting as specified in IEC 61672-1:2002. Unless assessing modulation, all measurements use the slow time weighting characteristic.

L_{AFast}

This is the noise level in decibels, obtained using the A frequency weighting and the F (Fast) time weighting as specified in IEC 61672-1:2002. This is used when assessing the presence of modulation only.

L_{APeak}

This is the greatest absolute instantaneous sound pressure in decibels using the A frequency weighting as specified in IEC 61672-1:2002.

L_{Amax}

An L_{Amax} level is the maximum A-weighted noise level during a particular measurement.

L_{A1}

An L_{A1} level is the A-weighted noise level which is exceeded for one percent of the measurement period and is considered to represent the average of the maximum noise levels measured.

L_{A10}

An L_{A10} level is the A-weighted noise level which is exceeded for 10 percent of the measurement period and is considered to represent the "*intrusive*" noise level.

L_{Aeq}
The equivalent steady state A-weighted sound level ("equal energy") in decibels which, in a specified time period, contains the same acoustic energy as the time-varying level during the same period. It is considered to represent the "average" noise level.

L_{A90}
An L_{A90} level is the A-weighted noise level which is exceeded for 90 percent of the measurement period and is considered to represent the *"background" noise level*.

One-Third-Octave Band
Means a band of frequencies spanning one-third of an octave and having a centre frequency between 25 Hz and 20 000 Hz inclusive.

L_{Amax} assigned level
Means an assigned level which, measured as a $L_{A\,Slow}$ value, is not to be exceeded at any time.

L_{A1} assigned level
Means an assigned level which, measured as a $L_{A\,Slow}$ value, is not to be exceeded for more than 1% of the representative assessment period.

L_{A10} assigned level
Means an assigned level which, measured as a $L_{A\,Slow}$ value, is not to be exceeded for more than 10% of the representative assessment period.

Tonal Noise
A tonal noise source can be described as a source that has a distinctive noise emission in one or more frequencies. An example would be whining or droning. The quantitative definition of tonality is:

the presence in the noise emission of tonal characteristics where the difference between -

(a) the A-weighted sound pressure level in any one-third octave band; and

(b) the arithmetic average of the A-weighted sound pressure levels in the 2 adjacent one-third octave bands,

is greater than 3 dB when the sound pressure levels are determined as $L_{Aeq,T}$ levels where the time period T is greater than 10% of the representative assessment period, or greater than 8 dB at any time when the sound pressure levels are determined as $L_{A\,Slow}$ levels.

This is relatively common in most noise sources.

Modulating Noise
A modulating source is regular, cyclic and audible and is present for at least 10% of the measurement period. The quantitative definition of modulation is:

a variation in the emission of noise that —

(a) is more than 3 dB $L_{A\,Fast}$ or is more than 3 dB $L_{A\,Fast}$ in any one-third octave band;

(b) is present for at least 10% of the representative.

Impulsive Noise

An impulsive noise source has a short-term banging, clunking or explosive sound. The quantitative definition of impulsiveness is:

a variation in the emission of a noise where the difference between $L_{A\,peak}$ and $L_{A\,Max\,slow}$ is more than 15 dB when determined for a single representative event;

Major Road

Is a road with an estimated average daily traffic count of more than 15,000 vehicles.

Secondary / Minor Road

Is a road with an estimated average daily traffic count of between 6,000 and 15,000 vehicles.

Influencing Factor (IF)

$$= \frac{1}{10}(\%\ \text{Type}\ A_{100} + \%\ \text{Type}\ A_{450}) + \frac{1}{20}(\%\ \text{Type}\ B_{100} + \%\ \text{Type}\ B_{450})$$

where:

$\%\ \text{Type}\ A_{100}$ = the percentage of industrial land within a100m radius of the premises receiving the noise

$\%\ \text{Type}\ A_{450}$ = the percentage of industrial land within a 450m radius of the premises receiving the noise

$\%\ \text{Type}\ B_{100}$ = the percentage of commercial land within a100m radius of the premises receiving the noise

$\%\ \text{Type}\ B_{450}$ = the percentage of commercial land within a 450m radius of the premises receiving the noise

+ Traffic Factor (maximum of 6 dB)

= 2 for each secondary road within 100m

= 2 for each major road within 450m

= 6 for each major road within 100m

Representative Assessment Period

Means a period of time not less than 15 minutes, and not exceeding four 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.

Background Noise

Background noise or residual noise is the noise level from sources other than the source of concern. When measuring environmental noise, residual sound is often a problem. One reason is that regulations often require that the noise from different types of sources be dealt with separately. This separation, e.g. of traffic noise from industrial noise, is often difficult to accomplish in practice. Another reason is that the measurements are normally carried out outdoors. Wind-induced noise, directly on the microphone and indirectly on trees, buildings, etc., may also affect the result. The character of these noise sources can make it difficult or even impossible to carry out any corrections.

Ambient Noise

Means the level of noise from all sources, including background noise from near and far and the source of interest.

Specific Noise

Relates to the component of the ambient noise that is of interest. This can be referred to as the noise of concern or the noise of interest.

Peak Component Particle Velocity (PCPV)

The maximum instantaneous velocity in mm/s of a particle at a point during a given time interval and in one of the three orthogonal directions (x, y or z) measured as a peak response. Peak velocity is normally used for the assessment of structural damage from vibration.

Peak Particle Velocity (PPV)

The maximum instantaneous velocity in mm/s of a particle at a point during a given time interval and is the vector sum of the PCPV for the x, y and z directions measured as a peak response. Peak velocity is normally used for the assessment of structural damage from vibration.

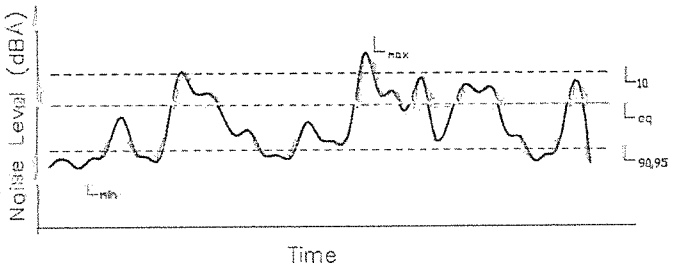
RMS Component Particle Velocity (PCPV)

The maximum instantaneous velocity in mm/s of a particle at a point during a given time interval and in one of the three orthogonal directions (x, y or z) measured as a root mean square (rms) response. RMS velocity is normally used for the assessment of human annoyance from vibration.

Peak Particle Velocity (PPV)

The maximum instantaneous velocity in mm/s of a particle at a point during a given time interval and is the vector sum of the PCPV for the x, y and z directions measured as a root mean square (rms) response. RMS velocity is normally used for the assessment of human annoyance from vibration.

Chart of Noise Level Descriptors



Typical Noise Levels