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Environmental Noise Impact Assessment

Proposed Mixed-Use Development
51 Kalang Road, Elanora Heights

REPORT No
7273-1.1R

DATE ISSUED
9 August 2021

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Revision History

Report	Date	Prepared	Checked	Comment
Draft	30/07/2021	Benjamin Lamont	William Wang	By email, for client review
Final	09/08/2021	Benjamin Lamont	William Wang	

Document R\7273-1.1R, 26 pages plus attachments

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TABLE OF CONTENTS

TABLES

1.0 EXECUTIVE SUMMARY

A mixed-use development is proposed to be located at 51 Kalang Road, Elanora Heights. Northern Beaches Council requires an acoustic report that assesses the environmental noise impact on the surrounding area.

The proposed mixed-use development is located within a residential area that primarily consists of single and double storey houses and adjacent to a commercial area to the north. The nearest potentially affected residences are located to the south at 49 Kalang Road and on the opposite side of Kalang Road to the west at 42 and 44A Kalang Road.

The proposed mixed-use Development consists of two commercial units on the ground floor level, three residential units on the first floor and two residential units on the second floor level. The proposal includes basement parking for thirteen cars. The main sources of noise from the proposed mixed-use development will include mechanical plant and vehicles entering and exiting the basement car park.

Acceptable noise limits are derived from the EPA's Noise Policy for Industry, the NSW Road Noise Policy and the NSW Protection of the Environment Operations (Noise Control) Regulation 2017 for intrusive noise impacts and sleep disturbance at each residence.

Calculations show that provided the recommendations in Section 6 are implemented the level of noise emission from the proposal is within acceptable noise limits at all receptor locations.

2.0 CONSULTING BRIEF

Day Design Pty Ltd has been engaged by Fortey & Grant Architecture on behalf of Mr Steve Djogo to assess the environmental noise impact of mixed-use development located at 51 Kalang Road, Elanora Heights. This commission involves the following:

Scope of Work:

- Inspect the site and environs
- Measure the background noise levels at critical locations and times
- Establish acceptable noise level criterion
- Quantify noise emissions from the proposed Mixed-Use Development.
- Calculate the level of noise emission, taking into account building envelope transmission loss, screen walls and distance attenuation
- Prepare a site plan identifying the development and nearby noise sensitive locations
- Provide recommendations for noise control (if necessary)
- Prepare an Environmental Noise Assessment Report.

3.0 PROJECT DESCRIPTION

3.1 Site Description

The mixed-use development is located within a residential area that primarily consists of single and double storey houses. Commercial premises are located adjacent to the site, in a northerly direction. The nearest potentially affected residences are located to the south at 49 Kalang Road and on the opposite side of Kalang Road to the west at 42 and 44A Kalang Road.

The development is located on land zoned as B2 – Local Centre by Pittwater Local Environmental Plan 2014.

The nearest noise sensitive receptors to the property, in various directions, are shown in Figure 1 and as follows in Table 1.

Table 1 Noise Sensitive Receptors

Receptor and Type	Address	Direction from site
R1 – Commercial	53 Kalang Road	North
R2 – Commercial	49A Kalang Road	East
R3 – Residential	49 Kalang Road	South
R4 – Residential	42 Kalang Road	South West
R5 – Residential	44A Kalang Road	West

3.2 Development Description

The proposed mixed-use Development consists of two commercial units on the ground floor level, three residential units on the first floor and two residential units on the second floor level. The proposal includes basement parking for thirteen cars. The main sources of noise from the proposed functions will include mechanical plant and vehicles entering and exiting the basement car park.

Figure 1 - Location Plan 51 Kalang Road, Elanora Heights

4.0 NOISE CRITERIA

4.1 Background Noise Level

In order to assess the severity of a possible environmental noise problem in a residential area it is necessary to measure the ambient background noise level at the times and locations of worst possible annoyance. The lower the background noise level, the more perceptible the intrusive noise becomes and the more potentially annoying.

The ambient L_{90} background noise level is a statistical measure of the sound pressure level that is exceeded for 90% of the measuring period (typically 15 minutes).

The Rating Background Level (RBL) is defined by the NSW EPA as the median value of the (lower) tenth percentile of L_{90} ambient background noise levels for the day, evening or night time periods, measured over a number of days during the proposed days and times of operation.

The places of worst possible annoyance are the two-storey residential units located to the west of the proposed mixed-use development. These potentially affected locations can be seen in Figure 1. The times of greatest annoyance will be during the night when the mechanical plant is operating.

Two environmental noise loggers were placed on the current premises at 51 Kalang Road, Elanora Heights, to determine the Rating Background Level, at ground level. These locations are shown on Figure 1 as Location 'A' and Location 'B'.

The measured noise levels are presented in the attached Appendix B and also in Table 1 below.

Table 2 Ambient Noise Levels – 78 Kalang Road, Elanora Heights, NSW

Location	Time Period	L_{90} Rating Background Level	Existing L_{eq} Noise Level
Location 'A' – 51 Kalang Road, Elanora Heights, NSW	Day (7 am to 6 pm)	**42 dBA**	**58 dBA**
	Evening (6 pm to 10 pm)	**36 dBA**	**54 dBA**
	Night (10 pm to 7 am)	**33 dBA**	**50 dBA**
Location 'B' – 51 Kalang Road, Elanora Heights, NSW	Day (7 am to 6 pm)	**37 dBA**	**52 dBA**
	Evening (6 pm to 10 pm)	**34 dBA**	**47 dBA**
	Night (10 pm to 7 am)	**30 dBA**	**46 dBA**

Meteorological conditions during the testing typically consisted of clear skies and a temperature of 9 to 23°C. Atmospheric conditions were ideal for noise monitoring. Noise measurements were therefore considered reliable and typical for the receptor area.

4.2 Protection of the Environments Operations (Noise Control) Regulation 2017

The Protection of the Environment Operations (Noise Control) Regulation 2017 Part 4, Division 2 states the following in regards to air conditioners:

'***45 Use of air conditioners on residential premises***

A person is guilty of an offence if:

(a) the person causes or permits an air conditioner to be used on residential premises in such a manner that it emits noise that can be heard within any room in any other residential premises (that is not a garage, storage area, bathroom, laundry, toilet or pantry) whether or not any door or window to that room is open:

(i) before 8 am or after 10 pm on any Saturday, Sunday or public holiday,

or

(ii) before 7 am or after 10 pm on any other day, and

(b) within 7 days of doing so, the person is warned by an authorised officer or enforcement officer not to cause or permit an air conditioner to be used on residential premises in that manner, and

(c) *the person again causes or permits an air conditioner to be used on residential premises in the manner referred to in paragraph (a) within 28 days after the warning has been given.*'

We predict that a noise level 5 dB less than the background noise level, will render the noise from the proposed air conditioners inaudible inside a habitable room of an adjacent residence.

The Rating Background Level at ground level of 51 Kalang Road, Elanora Heights was 33 dBA in the front yard and 30 dBA in the back yard at night. Therefore the acceptable L_{eq} noise criteria for air conditioners in this area at is:

Residential Receptors 'R3'

- (30 – 5 =) 25 dBA between 10 pm and 8 am on Saturday, Sunday or public holidays; and
- (30 – 5 =) 25 dBA between 10 pm and 7 am on any other day.

Residential Receptors 'R4' & 'R5'

- (33 – 5 =) 28 dBA between 10 pm and 8 am on Saturday, Sunday or public holidays; and
- (33 – 5 =) 28 dBA between 10 pm and 7 am on any other day.

These noise levels are assessed outside the most affected window of the nearby receptors.

4.3 NSW Noise Policy for Industry

The NSW Environment Protection Authority (EPA) published the *Noise Policy for Industry* (NPI) in October 2017. The *NPI* is specifically aimed at assessing noise from industrial noise sources listed in Schedule 1 of the Protection of the Environment Operations Act 1997 (POEO, 1997).

The proposed mixed-use development is not a 'scheduled premises' under the Protection of the Environment Operations Act 1997, as it is not required to hold a licence under that Act for operations at the site.

However, the *NPI* provides a useful framework to assess noise emission from non-scheduled premises, whether that premises produces intrusive or non-intrusive noise.

4.3.1 Project Intrusive Noise Levels

The EPA states in Section 2.3 of its NSW *NPI* (October 2017) that the intrusiveness of an industrial noise source may generally be considered acceptable if the level of noise from the source (represented by the L_{Aeq} descriptor), measured over a 15-minute period, does not exceed the rating background noise level by more than 5 dB when beyond a minimum threshold (EPA *NPI*, 2017, Section 2.3).

The Rating Background Level at Location 'A', the front of 51 Kalang Road, Elanora Heights was 42 dBA in the day, 36 dBA in the evening and 33 dBA at night.

Therefore the acceptable L_{eq} noise intrusiveness criteria in this area at ground level is:

- (42 + 5 =) 47 dBA during the day;
- (36 + 5 =) 41 dBA in the evening; and
- (33 + 5 =) 38 dBA at night.

The Rating Background Level at Location 'B', the rear of 51 Kalang Road, Elanora Heights was 37 dBA in the day, 34 dBA in the evening and 30 dBA at night.

Therefore the acceptable L_{eq} noise intrusiveness criteria in this area at ground level is:

- (37 + 5 =) 42 dBA during the day;
- (34 + 5 =) 39 dBA in the evening; and
- (30 + 5 =) 35 dBA at night.

4.3.2 Project Amenity Noise Levels

Depending on the type of area in which the noise is being made, there is a certain reasonable expectancy for noise amenity. The NSW NPI provides a schedule of recommended L_{eq} industrial noise levels that under normal circumstances should not be exceeded. If successive developments occur near a residential area, each one allowing a criterion of background noise level plus 5 dB, the ambient noise level will gradually creep higher.

The recommended L_{eq} noise levels below in Table 3 are taken from Section 2.4, Table 2.2 of the NPI.

Table 3 Amenity Noise Levels

Receiver	Noise Amenity Area	Time of Day	L_{Aeq} Noise Level, dBA
			Recommended amenity noise level
Residential	Suburban	Day	55
		Evening	45
		Night	40
Commercial	All	When In Use	65

The L_{Aeq} is determined over a 15-minute period for the project intrusiveness noise level and over an assessment period (day, evening and night) for the project amenity noise level. This leads to the situation where, because of the different averaging periods, the same numerical value does not necessarily represent the same amount of noise heard by a person for different time periods. To standardise the time periods for the intrusiveness and amenity noise levels, the *NPI* assumes that the **$L_{Aeq,15min}$** will be taken to be equal to the **$L_{Aeq, period}$ + 3 decibels (dB)** (Section 2.2 NPI).

Compliance with the amenity criteria will limit ambient noise creep. **Section 2.4** of the *NPI* states the following:

*'To ensure that industrial noise levels (existing plus new) remain within the recommended amenity noise levels for an area, a **project amenity noise level** applies for each new source of industrial noise as follows:*

- ***Project amenity noise level for industrial developments = recommended amenity noise level (Table 2.2) minus 5 dB (A)***

The following exceptions to the above method to derive the project amenity noise level apply:

3. *Where the resultant project amenity noise level is 10 dB or more lower than the existing industrial noise level. In this case the project amenity noise levels can be set at 10 dB below existing industrial noise levels if it can be demonstrated that existing industrial noise levels are unlikely to reduce over time.'*

In addition, the level of transport noise, road traffic noise in particular, may be high enough to make noise from an industrial source effectively inaudible, even though the L_{Aeq} noise level from that industrial noise source may exceed the project amenity noise level. In such cases the project amenity noise level may be derived from the $L_{Aeq, period (traffic)}$ minus 15 dBA.

The existing L_{eq} noise level at Location 'A' of 51 Kalang Road, Elanora Heights was 58 dBA during the day, 54 dBA in the evening, and 50 dBA at night. The existing L_{eq} noise level at Location 'B' of 51 Kalang Road, Elanora Heights was 52 dBA during the day, 47 dBA in the evening, and 46 dBA at night. Therefore the acceptable L_{eq} amenity criteria in this area at both locations for ground level is:

Residential Receptors 'R3', 'R4' & 'R5'

- (55 - 5 + 3 =) 53 dBA during the day;
- (45 - 5 + 3 =) 43 dBA in the evening; and
- (40 - 5 + 3 =) 38 dBA at night.

Commercial 'R1' & 'R2'

- (65 - 5 + 3 =) 63 dBA when in use.

4.4 Modifying Factors

Where a noise source contains certain characteristics, such as tonality, impulsiveness, intermittency or dominant low-frequency content, there is evidence to suggest that it can cause greater annoyance than other noise at the same noise level. On the other hand, some sources may cause less annoyance where only a single event occurs for a limited duration. Correction factors are to be applied to the noise from the source measured or predicted at the receiver before comparison with the criteria. AC500-10 in the Appendices is extracted from Table C.1 of the *NPI*.

In this case the noise is of a steady broadband nature, therefore modifying factors are not applicable.

4.5 Road Traffic Noise Criteria

The NSW Road Noise Policy, in Section 2.3.1, sets out road traffic noise assessment criteria for residential land uses in Table 3. The information in that table is extracted below in Table 4.

Table 4 Road Traffic Noise Assessment Criteria - Residential

Road Category	Type of project/land use	Assessment Criteria – dB(A)	
		Day (7 am – 10 pm)	Night (10 pm – 7 am)
Local roads	4. Existing residences affected by **additional traffic** on existing local roads generated by land use developments	$L_{Aeq, (1\ hour)}$ 55 (external)	$L_{Aeq, (1\ hour)}$ 50 (external)

4.6 Sleep Disturbance Criteria

The EPA's *Noise Policy for Industry* states in Section 2.5 that the potential for sleep disturbance from maximum noise level events from premises during the night-time period needs to be considered. Sleep disturbance is considered to be both awakenings and disturbance to sleep stages.

Sleep may be disturbed if the subject development night-time noise levels at a residential location exceed the following:

- $L_{Aeq,\ 15min}$ 40 dBA or the prevailing RBL plus 5 dB, whichever is greater; and/or
- L_{AFmax} 52 dBA or the prevailing RBL plus 15 dB, whichever is greater.

Where either of the above criteria are triggered, a detailed maximum noise level event assessment should be undertaken.

In this instance, consideration is given to the potential for sleep disturbance from the noise associated with cars arriving or leaving the car park between 10 pm and 7 am.

4.7 Project Noise Trigger Levels

The measured background noise levels at Location 'A', has been used to establish the project noise trigger levels at all receptor locations.

4.7.1 Residential Receptors 'R3', 'R4' & 'R5'

When all the above factors are considered, we find that the most stringent noise criterion at ground level is:

Residential Receptor – 'R3'

- **42 dBA** during the day;
- **39 dBA** in the evening; and
- **35 dBA** at night.

Residential Receptors – 'R4' & 'R5'

- **47 dBA** during the day;
- **41 dBA** in the evening; and
- **38 dBA** at night.

These criteria apply at the most-affected point on or within the residential property boundary. For upper floors, the noise is assessed outside the nearest window.

4.7.2 Commercial Receptors 'R1' and 'R2'

- **63 dBA** when in use.

4.7.3 Sleep Disturbance Criteria

The following criteria will be applied for sleep disturbance outside a bedroom window between 10 pm and 7 am at the nearby residential receptors:

Residential Receptor – 'R3'

- **52 dBA** L_{AFmax} between 10 pm and 7 am.

Residential Receptors – 'R4' & 'R5'

- **53 dBA** L_{AFmax} between 10 pm and 7 am.

4.7.4 On – Road Traffic Criteria

The following criteria will be at 1 metre from the most affected façade of 'R3', 'R4' and 'R5', for on – road traffic noise:

- **55 dBA** (external) $L_{eq,\ 1\ hour}$ between 7 am and 10 pm; and
- **50 dBA** (external) $L_{eq,\ 1\ hour}$ between 10 pm and 7 am.

4.7.5 Air Conditioners

The following criteria will be applied outside a ground floor window of any nearby residential receptor for air conditioner noise:

Residential Receptors 'R3'

- **25 dBA** between 10 pm and 8 am on Saturday, Sunday or public holidays; and
- **25 dBA** between 10 pm and 7 am on any other day.

Residential Receptors 'R4' & 'R5'

- **28 dBA** between 10 pm and 8 am on Saturday, Sunday or public holidays; and
- **28 dBA** between 10 pm and 7 am on any other day.

5.0 NOISE EMISSION

The main sources of noise from the mixed-use development are:

- Car movements within the site; and
- Mechanical plant noise.

The noise impact from the use of the car park and the mechanical plant has been calculated and established for the most affected residential receptors.

Calculations are based on plans prepared by Fortey + Grant Architecture Pty Ltd dated 23 April 2021 as shown in Appendix C.

5.1 Car Park Noise Emission

There is provision for car parking on site as shown in the attached Appendix A. The car park will provide parking for approximately 13 vehicles in the basement level.

The closest point of the driveway to the nearest residence is approximately 10 metres.

For the purpose of assessing the maximum typical noise emission from the car parking area, we have assumed that all cars may arrive or leave in any given hour. This equates to 3 vehicle trip in a 15 minute period.

We have assumed the flow of cars will halve during the night time period.

The sound exposure level (SEL) and sound power level spectrum of cars has been measured by Day Design at various locations and is given in Table 5.

Table 5 SEL & L_{AMax} Sound Power Levels of Cars

Description	dBA	Sound Power Levels (dB) at Octave Band Centre Frequencies (Hz)							
		63	125	250	500	1k	2k	4k	8k
SEL level of a car driving on a n inclined road at 10 km/h	**82**	90	87	80	78	77	72	70	64
SEL level of a car driving on a flat road at 40 km/h	**90**	94	89	87	87	88	80	72	66
$L_{AF,max}$ level of car entering – exiting car park on driveway	**92**	98	92	90	88	88	83	80	76

5.2 Mechanical Plant

The architectural drawings indicate there will be a lift, a basement level car park and a garbage storage area. We have assumed the car park and garbage room will require an exhaust fan to remove fumes with exhaust duct outlet located above the plant room.

We have assumed each residential unit will be serviced by individual air conditioning systems with the condenser units to be located on the balconies and each bathroom requires a toilet exhaust fan with a duct outlet through the roof.

We have assumed commercial units will be serviced by individual air conditioning systems with the condenser units to be located adjacent to the building façade above the plant room. We have also assumed the front commercial unit will require a kitchen exhaust fan.

The mechanical plant hasn't been selected yet and therefore we have only assumed typical noise levels used on similar developments. We have assumed the car park exhaust fan and air conditioning may operate 24 hours a day, 7 days a week.

A schedule of the sound power levels for mechanical plant is given in Table 6.

Table 6 Mechanical Plant L_{eq} Sound Power Levels

Description	dBA	Sound Power Levels (dB) at Octave Band Centre Frequencies (Hz)							
		63	125	250	500	1k	2k	4k	8k
Air Conditioner Unit - Commercial	**80**	87	84	83	77	73	68	62	59
Air Conditioner Unit - Residential	**68**	65	64	58	54	49	43	40	68
Garbage Exhaust Fan	**58**	47	46	55	58	54	46	43	35
Car Park Exhaust Fan	**80**	86	80	79	77	74	72	69	66
Kitchen Exhaust Fan	**92**	89	89	87	87	81	71	68	91
Toilet Exhaust Fan	**57**	48	56	57	54	53	45	38	48
Lift Motor	**62**	49	49	47	45	52	58	55	52

5.3 Predicted Noise Levels

Knowing the sound power level of a noise source (Tables 5–6), the sound pressure level (as measured with a sound level meter) can be calculated at a remote location using suitable formulae to account for distance losses and sound barriers.

5.3.1 Car Park

The predicted L_{eq} level of noise from cars entering and exiting the car park, at the most affected commercial receivers 'R1' and 'R2'; and residential receivers, 'R3', 'R4' and 'R5', is calculated to be as shown in Table 7.

Table 7 Predicted $L_{eq,\ 15\ minute}$ Noise Levels – Car Movements

Receptor Location	Predicted Noise Level (dBA)	Noise Criterion (dBA)	Compliance (Yes/No)
Commercial			
R1 – 53 Kalang Road			
When In Use	27	63	Yes
R2 – 49A Kalang Road			
When In Use	29	63	Yes
Residential			
R3 – 49 Kalang Road			
Day – 7 am to 6 pm	25	42	Yes
Evening – 6 pm to 10 pm	25	39	Yes
Night – 10 pm to 7 am	23	35	Yes
R4 – 42 Kalang Road			
Day – 7 am to 6 pm	30	47	Yes
Evening – 6 pm to 10 pm	30	41	Yes
Night – 10 pm to 7 am	28	38	Yes
R5 – 87 Kalang Road			
Day – 7 am to 6 pm	26	47	Yes
Evening – 6 pm to 10 pm	26	41	Yes
Night – 10 pm to 7 am	24	38	Yes

The levels of noise above in Table 7 are within the acceptable noise criterion in Section 4.7.1 and 4.7.2, and are therefore acceptable.

5.3.2 Mechanical Plant

The predicted $L_{eq,\ 15\ minute}$ noise level from the mechanical plant serving the proposed mixed-use development at the nearest adjacent residences, are calculated to be as shown in Table 8.

Table 8 Predicted $L_{eq,\ 15\ minute}$ Noise Levels – Mechanical Plant

Receptor Location	Predicted Noise Level (dBA)	Noise Criterion (dBA)	Compliance (Yes/No)
Commercial			
R1 – 53 Kalang Road			
When In Use	46	63	Yes
R2 – 49A Kalang Road			
When In Use	43	63	Yes
Residential			
R3 – 49 Kalang Road			
Day – 7 am to 6 pm	42	42	Yes
Evening – 6 pm to 10 pm	32	39	Yes
Night – 10 pm to 7 am	32	35	Yes
R4 – 42 Kalang Road			
Day – 7 am to 6 pm	42	47	Yes
Evening – 6 pm to 10 pm	26	41	Yes
Night – 10 pm to 7 am	26	38	Yes
R5 – 44A Kalang Road			
Day – 7 am to 6 pm	42	47	Yes
Evening – 6 pm to 10 pm	25	41	Yes
Night – 10 pm to 7 am	25	38	Yes

The predicted level of noise from mechanical plant at all of the residential receivers complies with the acceptable noise criteria in Section 4.7.1 and 4.7.2 of this report, and is therefore acceptable.

5.4 Sleep Disturbance – Use of Car Park Driveway

The L_{Amax} noise levels outside the windows of the nearby residential receivers 'R3', 'R4' and 'R5' from vehicles entering and exiting the car park are shown in Table 9.

Table 9 L_{Amax} Noise Levels – Sleep Disturbance – Vehicles Accessing the Car Park

Receptor Location	Predicted Noise Level (dBA)	Noise Criterion (dBA)	Compliance (Yes/No)
R3 – Residential – Ground Floor 49 Kalang Road	51	52	Yes
R4 – Residential – First Floor 42 Kalang Road	56	53	**No (+3 dB)**
R5 – Residential – First Floor 44A Kalang Road	52	53	Yes

It can be seen from Table 9 that the calculated L_{Amax} noise level at the residential receptor 'R4' due to vehicles entering and exiting the car park via the driveway exceeds the criteria in Section 4.7.3, and is therefore will require a maximum noise level assessment as shown in Section 6.1.

5.5 On – Road Traffic

Using the sound exposure level (SEL) sound power level of cars travelling on a flat road given in Table 5, the external $L_{eq,\ 1\ hour}$ noise levels at the three most affected receptor 'R3', 'R4' and 'R5', from noise associated with on – road traffic travelling on Kalang Road throughout day and night are calculated to be as shown in Table 10.

Table 10 Calculated $L_{eq,\ 1\ hour}$ Noise Levels – On – Road Traffic

Receptor Location	Calculated Noise Level (dBA)	Noise Criterion $L_{eq,\ 1\ hour}$ (dBA)	Compliance (Yes/No)
Day – 7 am to 10 pm			
R3 – Residential – Ground Floor 49 Kalang Road	45	55	Yes
R4 – Residential – First Floor 42 Kalang Road	45	55	Yes
R5 – Residential – First Floor 44A Kalang Road	41	55	Yes
Night – 10 pm to 7 am			
R3 – Residential – Ground Floor 49 Kalang Road	42	50	Yes
R4 – Residential – First Floor 42 Kalang Road	42	50	Yes
R5 – Residential – First Floor 44A Kalang Road	38	50	Yes

The predicted external levels of noise from on-road traffic are within the noise criteria in Section 4.7.4, and are therefore acceptable.

5.6 Air Conditioners

The noise levels from the first and second floor level air conditioner condensers assumed to be located adjacent to the façade of each unit in their respective balconies with a sound power level of 68 dBA calculated to outside the windows of the nearby residential receivers are shown in Table 11.

Table 11 Calculated L_{eq} Noise Levels – Air Conditioners Noise at Night

Receptor Location	Predicted Noise Level (dBA)	Noise Criterion (dBA) before 7 am and after 10 pm	Compliance (Yes/No)
R3 – Residential – Ground Floor 49 Kalang Road	21	25	Yes
R4 – Residential – First Floor 42 Kalang Road	21	28	Yes
R5 – Residential – First Floor 44A Kalang Road	20	28	Yes

It can be seen from Table 11 that the calculated L_{eq} noise level all of the residential receptors complies with the criteria in Section 4.7.5 and is therefore acceptable.

6.0 NOISE CONTROL RECOMMENDATIONS

6.1 Sleep Disturbance - Maximum Noise Level Event Assessment

There is potential for the sleep disturbance criteria to be exceeded at several neighbouring residential receivers from the use of the car park driveway.

Day Design has conducted a detailed maximum noise level event assessment of the existing ambient noise levels – particularly the L_{max} events - at Location 'A' to determine the likelihood of noise associated with the use of the car park drive way causing sleep disturbance at the most affected nearby residential receiver 'R4' (see Table 9). Compliance at the most affected nearby residential receiver will ensure compliance at all other receiver locations.

Table 12 shows the total L_{max} events greater than or equal to the sleep disturbance criteria of 52 dBA or more between 10 pm and 7 am over the assessment period.

Table 12 Total L_{max} Events at Location 'A' During Assessment Period

Receptor Location	Measured L_{max} Noise Level Events ≥ 52 dBA	Measured L_{max} Noise Level (dBA) Range ≥ 52 dBA
Night – 10 pm to 7 am (36 x 15 minute periods each night)		
Night 1 - 11/06/2021	36	53 - 77
Night 2 - 12/06/2021	34	52 - 78
Night 3 - 13/06/2021	30	55 - 84
Night 4 - 14/06/2021	32	54 - 79
Night 5 - 15/06/2021	27	54 - 89
Night 6 - 16/06/2021	35	54 - 84
Night 7 - 17/06/2021	31	53 - 87
Average per night	33	66
Total	226	-

Table 12 above shows that L_{max} noise events greater than or equal to 52 dBA are common at Location 'A' during the night periods. A total of 252 sample 15 – minute periods (night) were analysed, with 226, or 90%, featuring an L_{max} noise event greater than or equal to 52 dBA.

An average of 32 L_{max} noise events (out of 36) greater than or equal to 52 dBA were measured over the assessment period for each night period, with an average L_{max} noise level (greater than or equal to 52 dBA) of 66 dBA. As shown in Table 9, the predicted L_{max} noise level from noise associated with residents using the car park driveway at 'R4' is 56 dBA – which is the below the average L_{max} noise level on the Kalang street.

Day Design is of the opinion that due to the existing number and level of the L_{max} noise events greater than or equal to 52 dBA at Location 'A', the L_{max} noise events associated with the development site are not likely to cause sleep disturbance at 'R4', and will therefore be acceptable at all residential receiver locations.

6.2 Mechanical Plant

The selection of mechanical plant has not been finalised at this stage. For typical mechanical plant equipment with sound power levels not exceeding those listed in Table 6, it is reasonable and feasible to acoustically treat the associated plant area or equipment itself so that noise will not impact the neighbouring properties.

Once mechanical plant has been selected, a final assessment should be made, prior to the issue of a Construction Certificate. We recommend that the mechanical services engineers select mechanical plant equipment with the lowest sound power levels to reduce the amount of acoustic treatment necessary to achieve the noise criteria at nearby residential receivers.

We offer to provide detailed noise controls when specifications of the mechanical plant equipment have been finalised.

In the following section, we have provided examples of reasonable noise controls that may be implemented if necessary:

6.2.1 General Specifications

All mechanical plant should be vibration isolated from the building structure.

The vibration isolators should achieve a minimum static deflection of 5 mm. We recommend that fans mounted on the roof are not located directly above living areas or bedrooms.

6.2.2 Carbon Monoxide Monitoring System

A carbon monoxide monitoring system may be installed in the car park to activate the exhaust fans only when necessary.

6.2.3 Lined Ductwork

Ductwork should be internally lined for a minimum of 3 m on the intake and discharge side of the carpark exhaust fan with 50 mm thick insulation (min density 32 kg/m^3), faced with a minimum of 20% open area perforated steel or foil.

6.2.4 Silencers

Silencers should be installed on the intake and discharge side of the car park exhaust fan.

6.3 Construction Disclaimer

Recommendations made in this report are intended to resolve acoustical problems only. We make no claim of expertise in other areas and draw your attention to the possibility that our recommendations may not meet the structural, fire, thermal or other aspects of building construction.

We encourage clients to check with us before using materials or equipment that are alternative to those specified in our Acoustical Report.

7.0 CONCLUSION

Day Design was engaged to assess the level of noise emission from the proposed mixed-use development to be located at 51 Kalang Road, Elanora Heights.

Measurements and calculations show that, provided the recommendations in Section 6 of this report are implemented, the level of noise emitted by the mixed-use development at 51 Kalang Road, Elanora Heights will be able to meet the acceptable noise level requirements of The NSW Environment Protection Authority's Noise Policy for Industry, the NSW Road Noise Policy and NSW Protection of the Environment Operations (Noise Control) Regulation 2017 as detailed in Section 4 of this report.

Benjamin Lamont

Benjamin Lamont, BE (Aero) MEngSc (Mech),
Acoustical Engineer
for and on behalf of Day Design Pty Ltd

AAAC MEMBERSHIP

Day Design Pty Ltd is a member company of the Association of Australasian Acoustical Consultants, and the work herein reported has been performed in accordance with the terms of membership.

APPENDICES

Appendix A – Instrumentation
Appendix B – Ambient Noise Survey
Appendix C – Architectural Plans
AC108-1 to 4 – Glossary of Acoustical Terms
AC500-10 – Noise Policy for Industry, Modifying Factor Corrections

NOISE SURVEY INSTRUMENTATION

Noise level measurements and analysis in this report were made with instrumentation as follows:

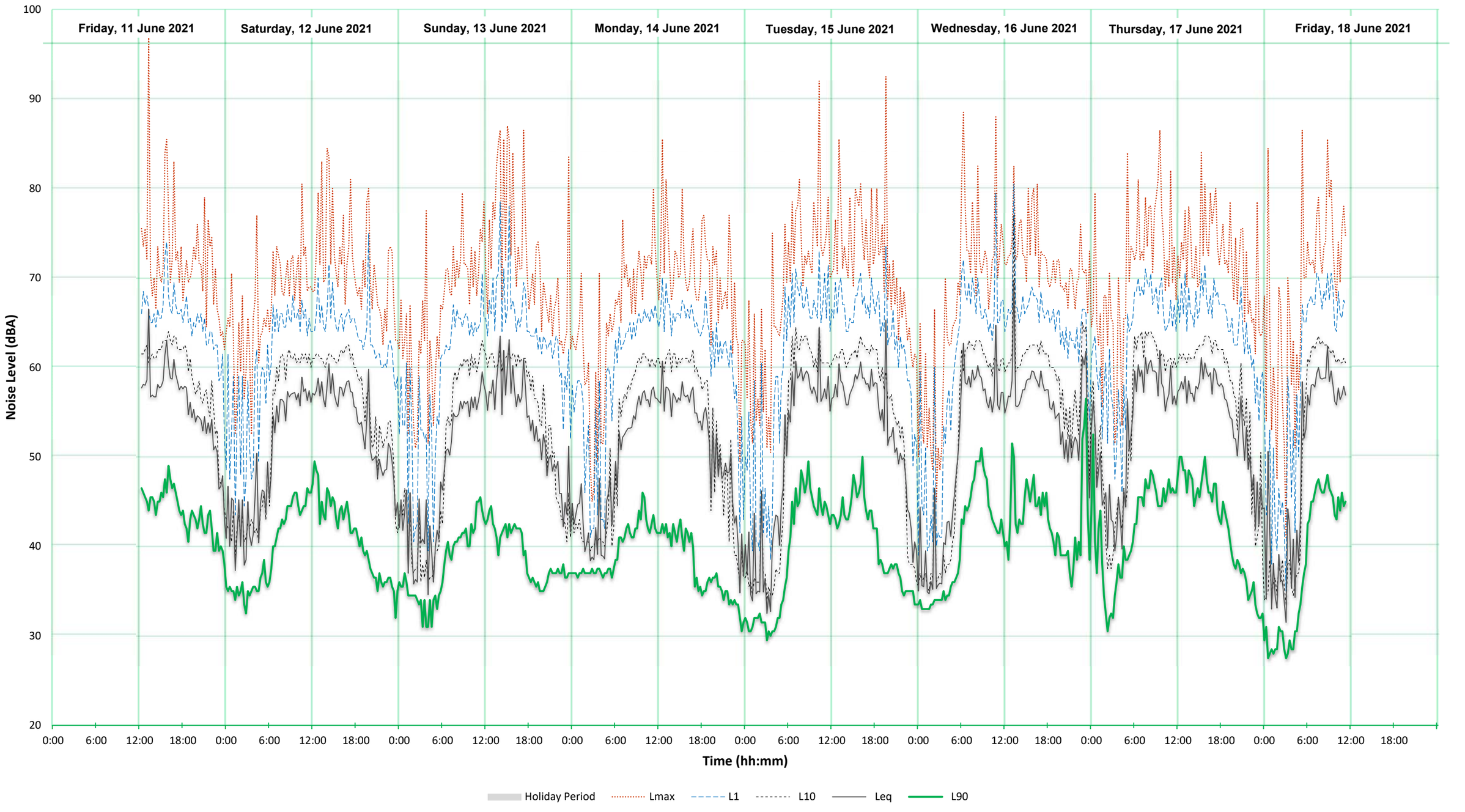
Table A1 Noise Survey Instrumentation

Description	Model No	Serial No
Infobyte Noise Logger(Type 2)	iM4	106
Condenser Microphone 0.5" diameter	MK 250	106
Infobyte Noise Logger(Type 2)	iM4	118
Condenser Microphone 0.5" diameter	MK 250	118

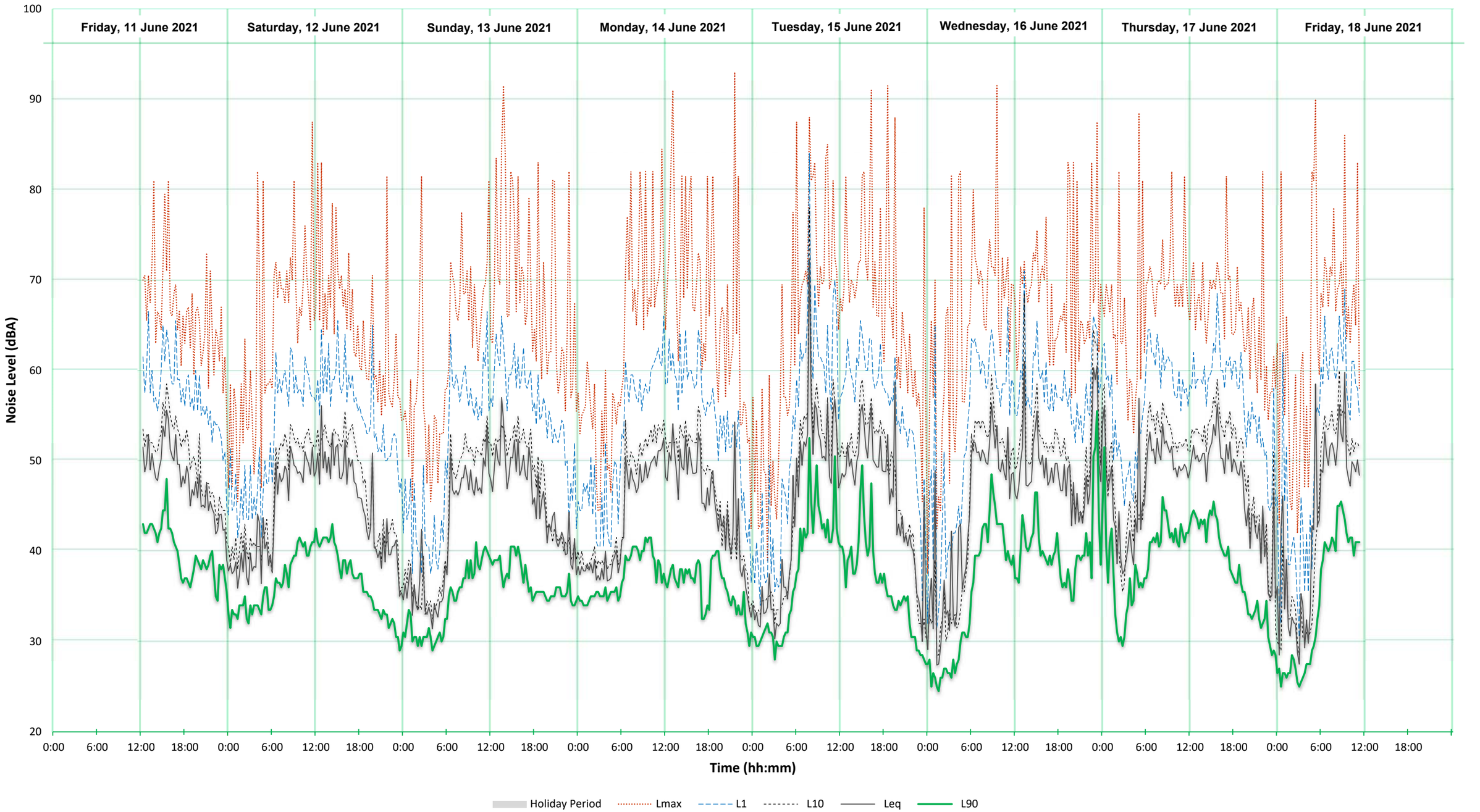
An environmental noise logger is used to continuously monitor ambient noise levels and provide information on the statistical distribution of noise during an extended period of time. The Infobyte Noise Monitor iM4 is a Type 2 precision environmental noise monitor meeting all the applicable requirements of AS1259 for an integrating-averaging sound level meter.

All instrument systems had been laboratory calibrated using instrumentation traceable to Australian National Standards and certified within the last two years thus conforming to Australian Standards. The measurement system was also field calibrated prior to and after noise surveys. Calibration drift was found to be less than 1 dB during attended and unattended measurements. No adjustments for instrument drift during the measurement period were warranted.

Located at Frontyard - 51 Kalang Road, Elanora Heights, NSW



Located at Backyard - 51 Kalang Road, Elanora Heights, NSW



Amendments

A	ISSUED FOR DA	23/04/21

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Project Details

SHOP TOP HOUSING AT

51 KALANG ROAD ELANORA HEIGHTS NSW 2101

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JG	JG	5/5/21

Job Number 2002

Scale As shown @ A3

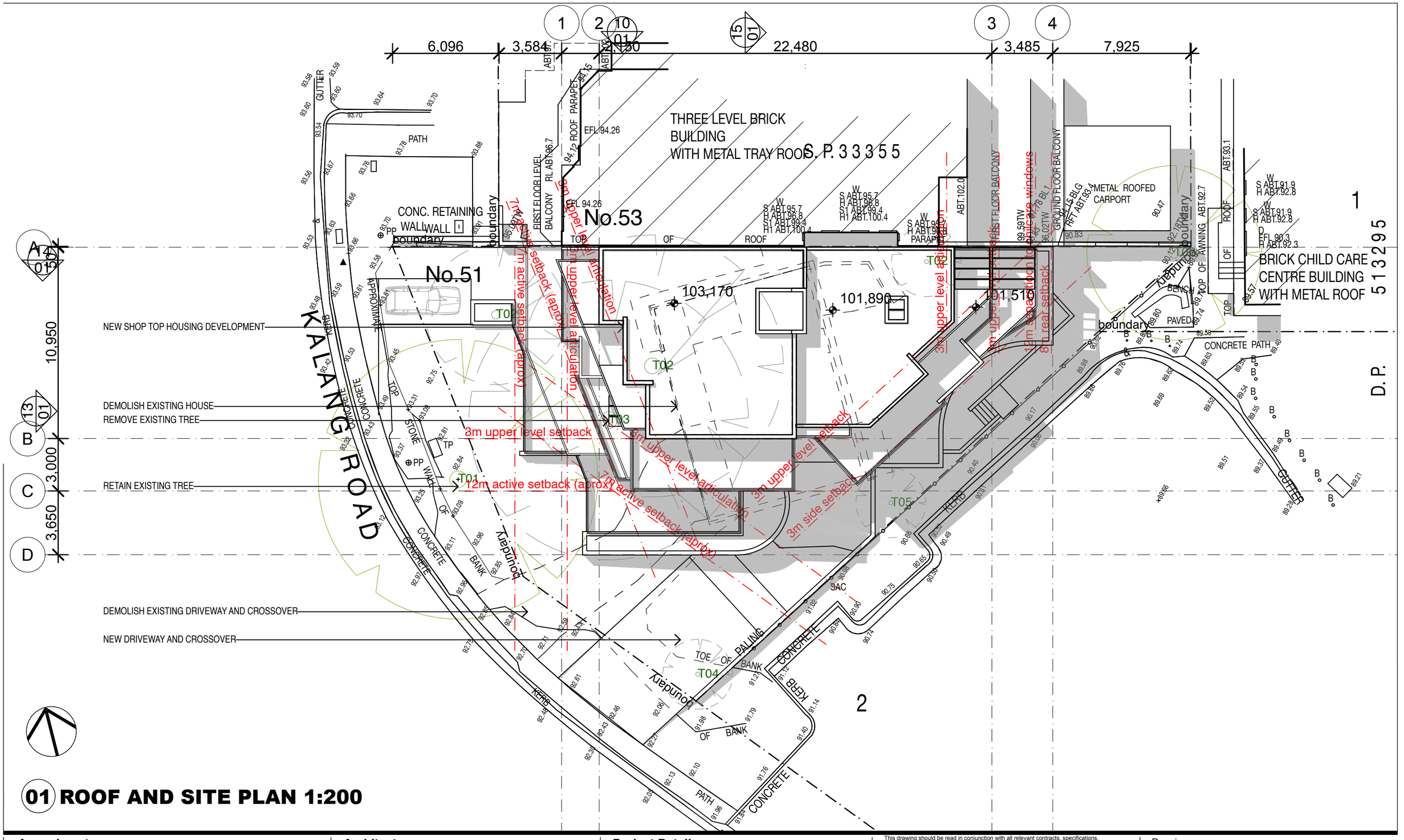
Drawing name

SITE ANALYSIS

Drawing Number

DA-00

Amendment **A**



01 ROOF AND SITE PLAN 1:200

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JG	JG	5/5/21

Job Number	2002
Scale	As shown @ A3

Drawing name

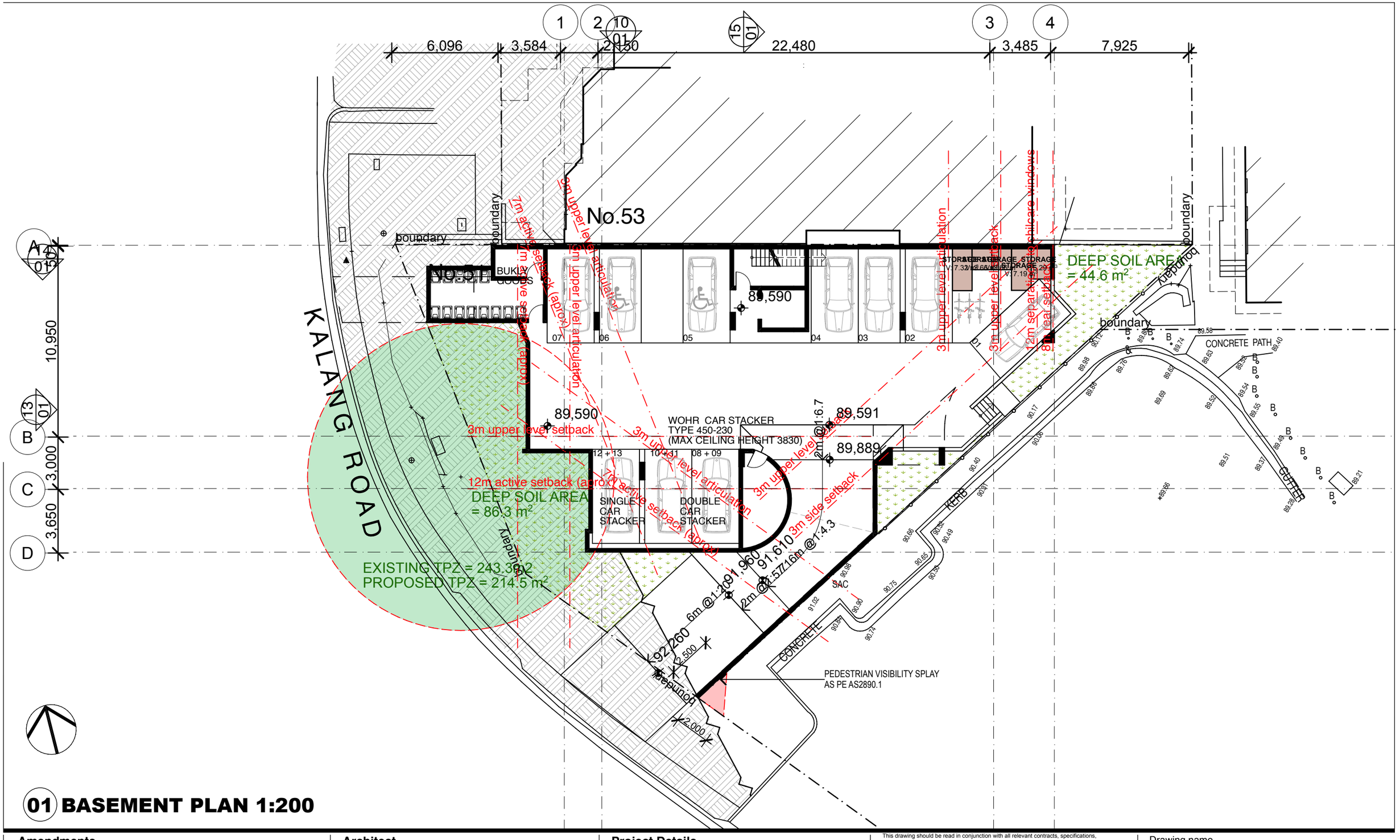
ROOF AND SITE PLAN

Drawing Number

DA-01

Amendment

A



01 BASEMENT PLAN 1:200

Amendments

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SHOP TOP HOUSING AT

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ELANORA HEIGHTS
NSW 2101

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Job Number 2002

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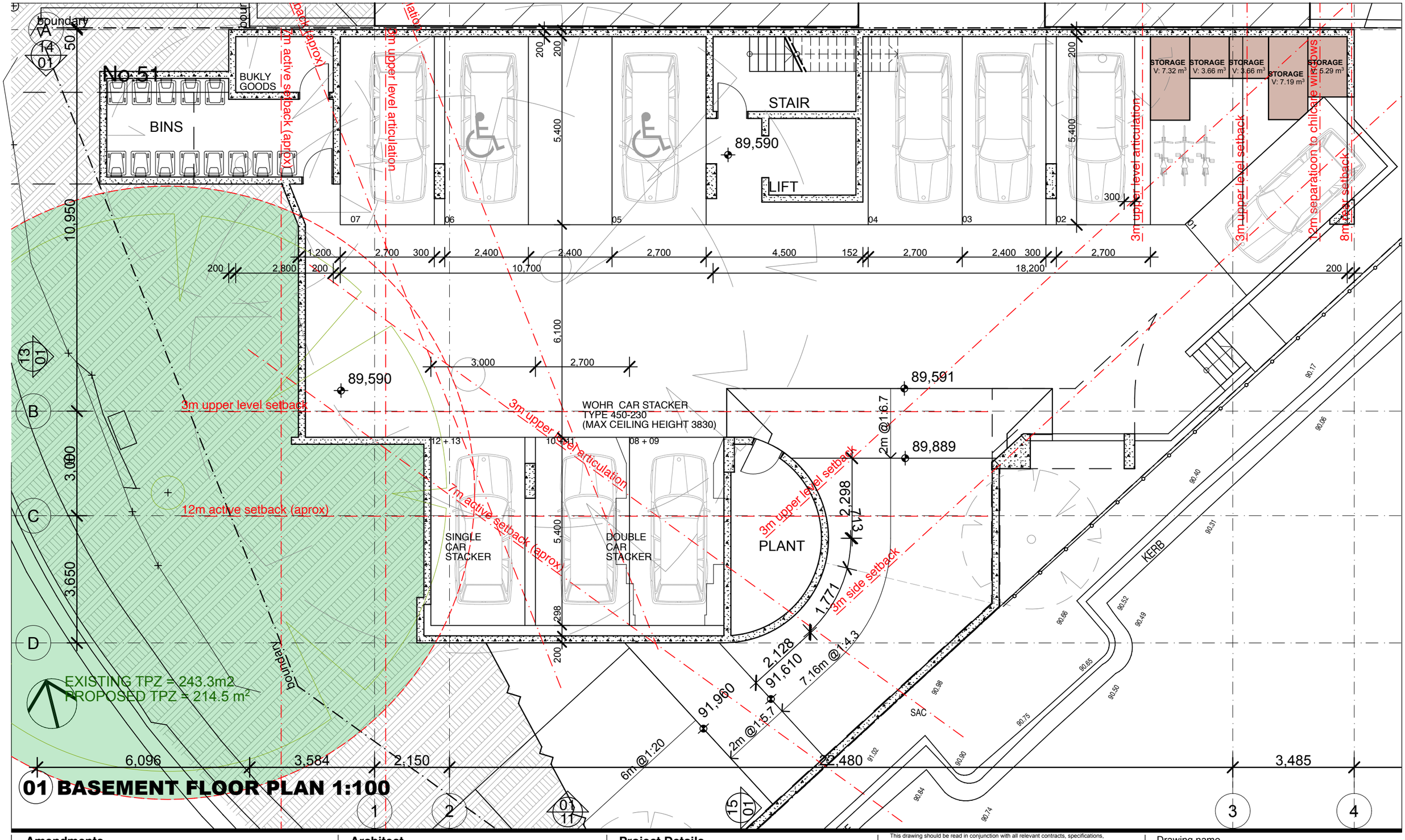
Drawing name

BASEMENT PLAN

Drawing Number **DA-02**

Amendment **A**



01 BASEMENT FLOOR PLAN 1:100

Amendments

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SHOP TOP HOUSING AT

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JG	JG	5/5/21

Job Number 2002

Scale As shown @ A3

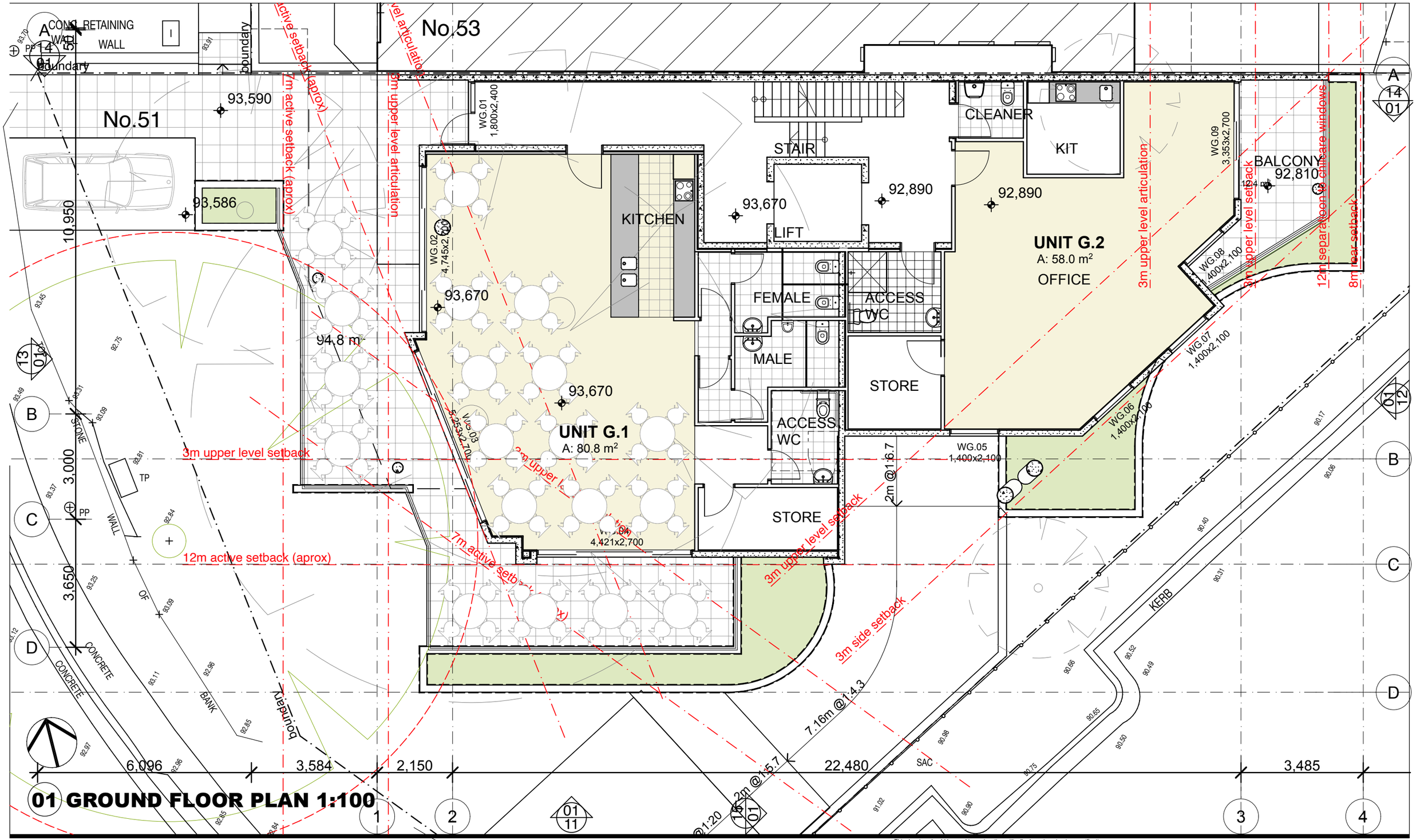
Drawing name

BASEMENT FLOOR PLAN

Drawing Number

DA-06

Amendment **A**



Amendments

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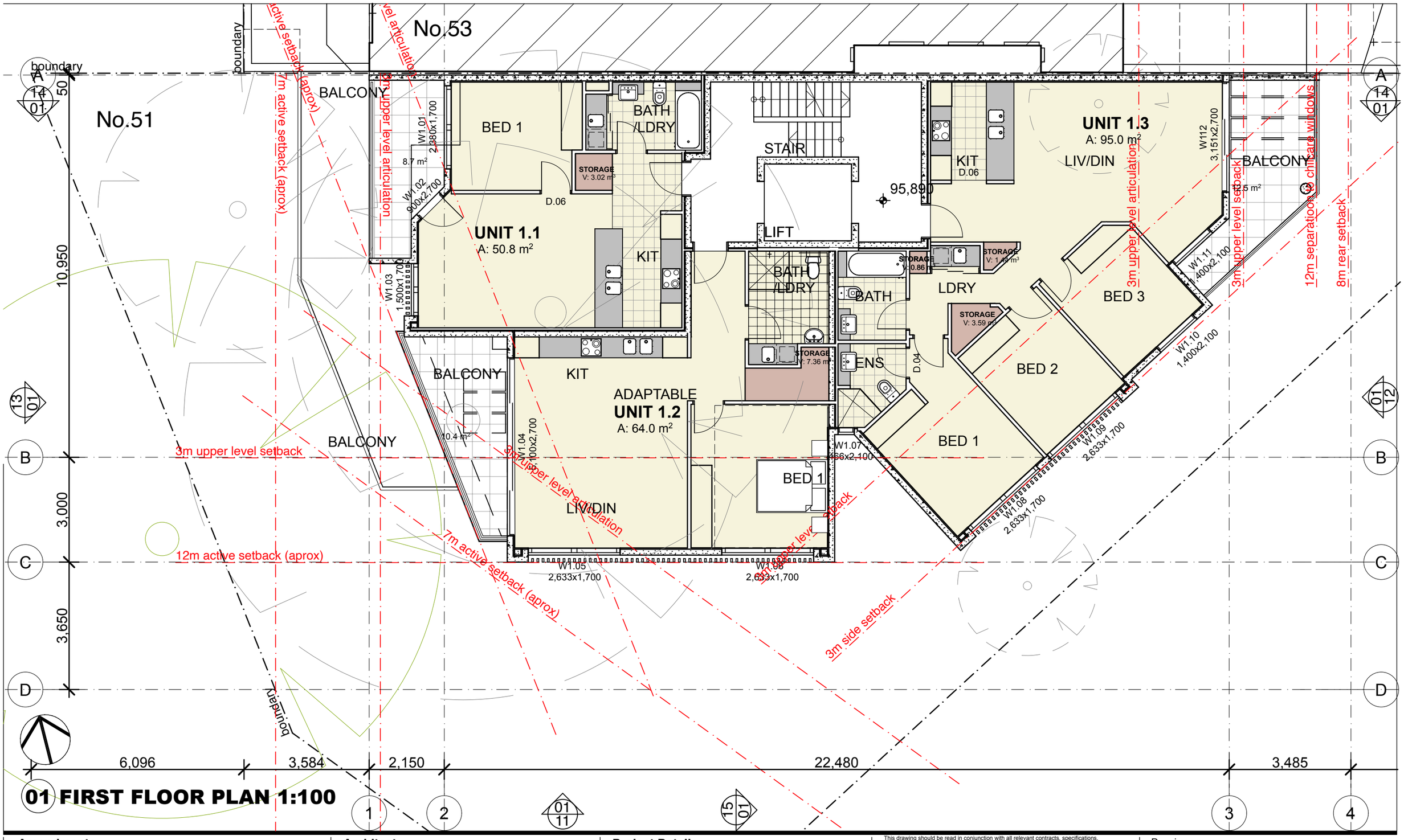
Drawing name

GROUND FLOOR PLAN

Drawing Number

DA-07

Amendment **A**



01 FIRST FLOOR PLAN 1:100

Amendments

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Job Number 2002

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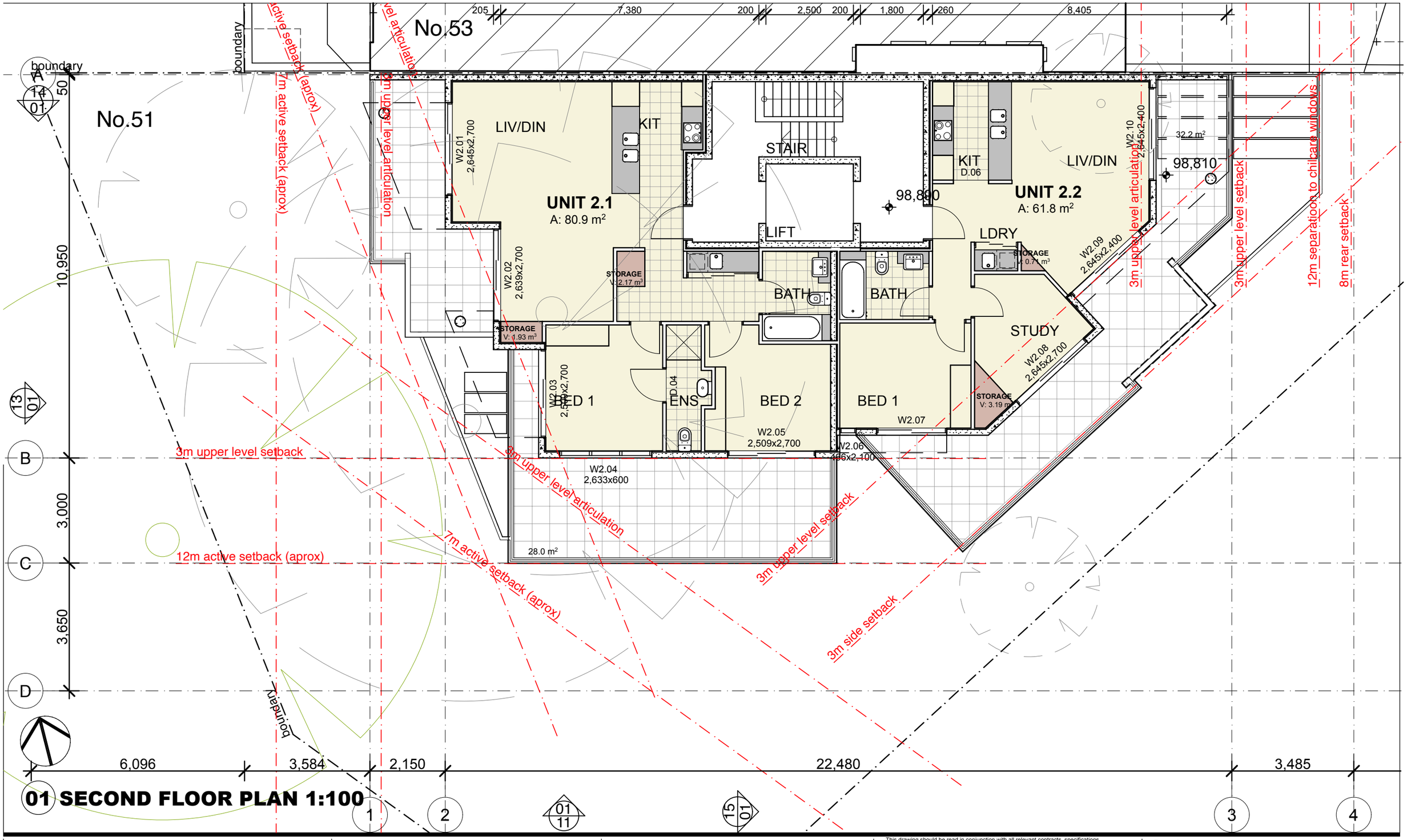
Drawing name

FIRST FLOOR PLAN

Drawing Number

DA-08

Amendment **A**



01 SECOND FLOOR PLAN 1:100

Amendments

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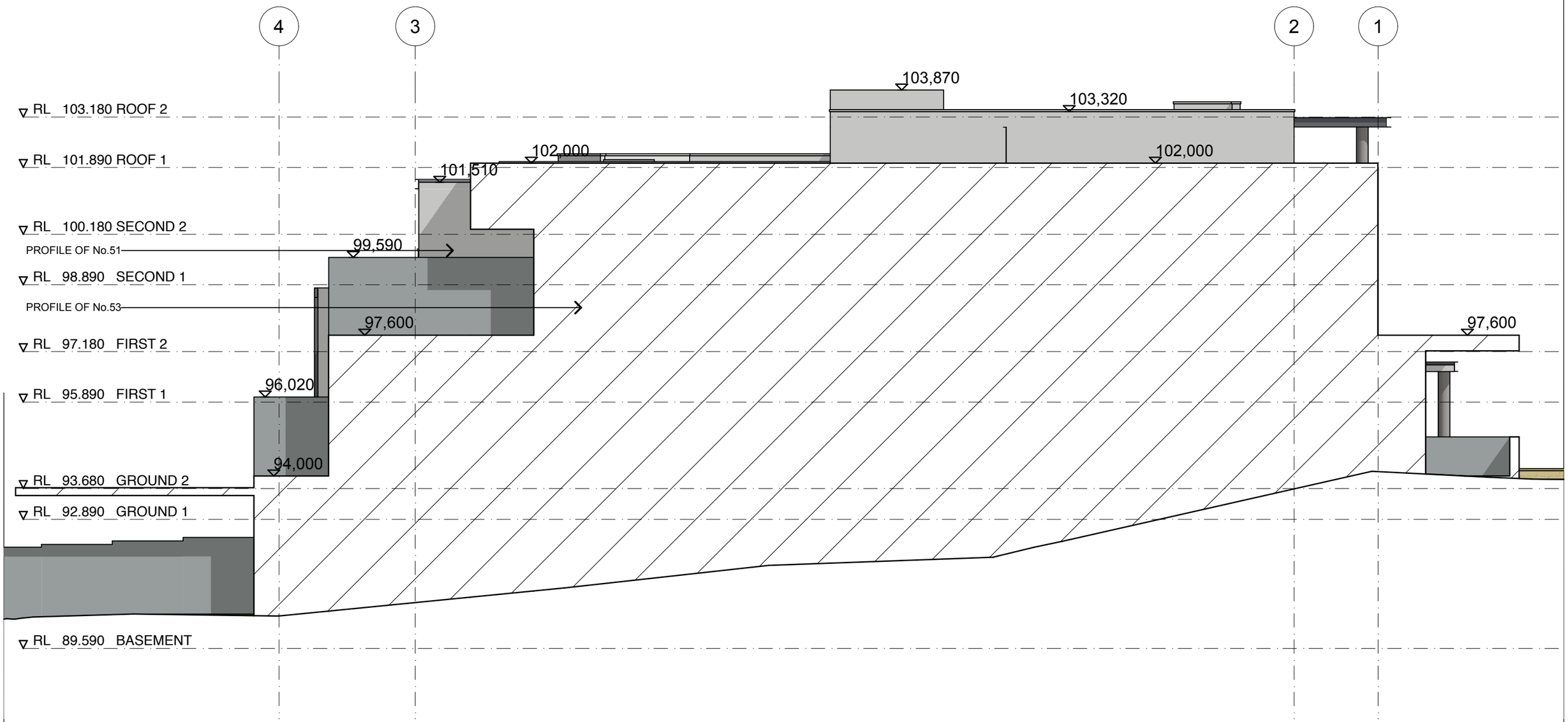
Drawing name

SECOND FLOOR PLAN

Drawing Number

DA-09

Amendment **A**



01 NORTH ELEVATION 1:100

Amendments

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SHOP TOP HOUSING AT

51 KALANG ROAD
ELANORA HEIGHTS
NSW 2101

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Job Number 2002

Scale As shown @ A3

Drawing name

NORTH ELEVATION

Drawing Number

DA-10

Amendment **A**

01 SOUTH ELEVATION 1:100

Amendments

A	ISSUED FOR DA	23/04/21

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SHOP TOP HOUSING AT

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Drawn	Approved	Date Printed
JG	JG	5/5/21

Job Number 2002

Scale As shown @ A3

Drawing name

SOUTH ELEVATION

Drawing Number **DA-11**

Amendment **A**

01 EAST ELEVATION 1:100

Amendments

A	ISSUED FOR DA	23/04/21

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SHOP TOP HOUSING AT

51 KALANG ROAD ELANORA HEIGHTS NSW 2101

Drawn	Approved	Date Printed
JG	JG	5/5/21

Job Number 2002

Scale As shown @ A3

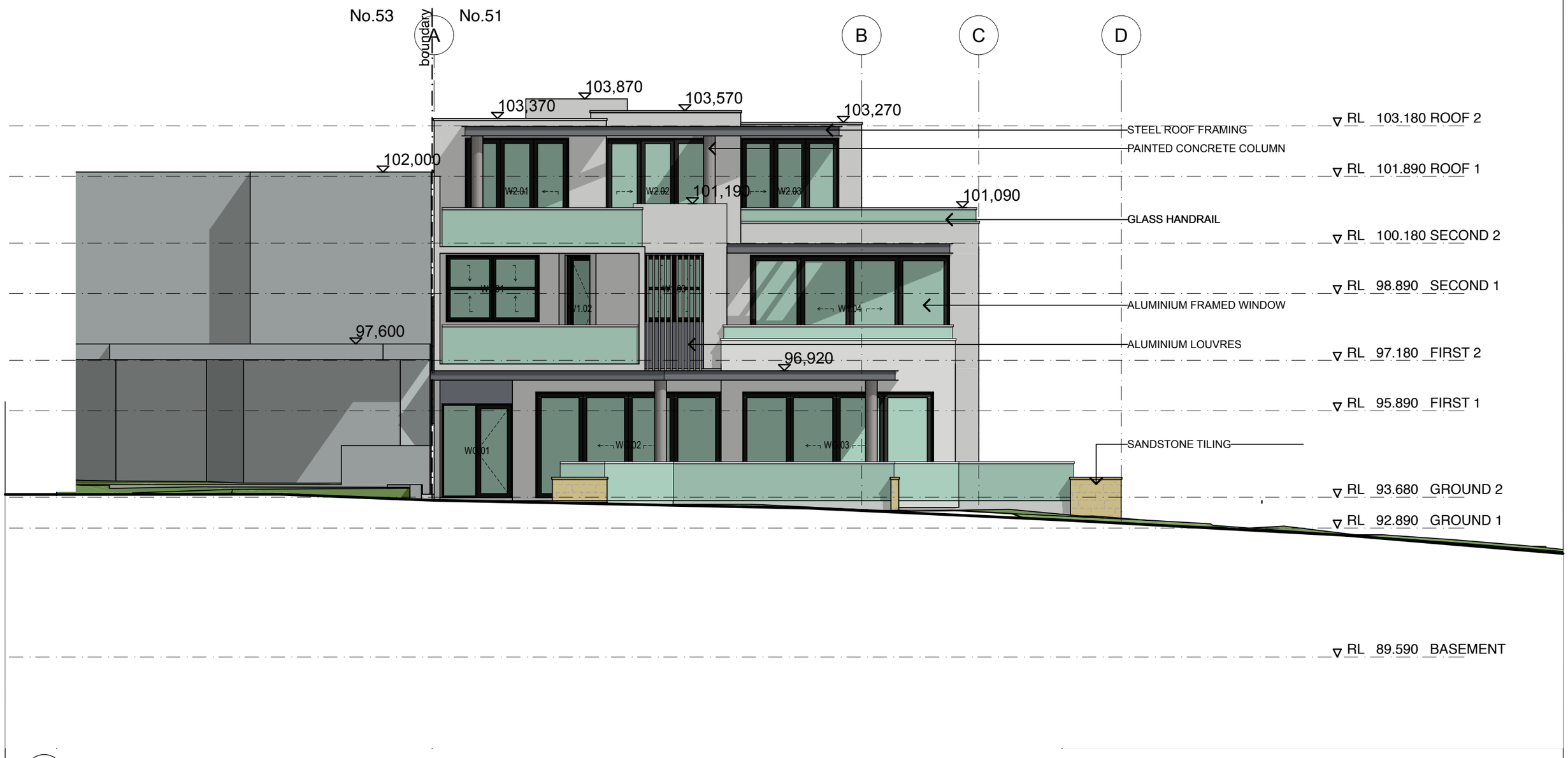
Drawing name

EAST ELEVATION

Drawing Number

DA-12

Amendment **A**



01 WEST ELEVATION 1:100

Amendments

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SHOP TOP HOUSING AT

51 KALANG ROAD
ELANORA HEIGHTS
NSW 2101

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JG	JG	5/5/21

Job Number 2002

Scale As shown @ A3

Drawing name

WEST ELEVATION

Drawing Number

DA-13

Amendment **A**

ACOUSTICAL – Pertaining to the science of sound, including the generation, propagation, effects and control of both noise and vibration.

AMBIENT NOISE – The ambient noise level at a particular location is the overall environmental noise level caused by all noise sources in the area, both near and far, including road traffic, factories, wind in the trees, birds, insects, animals, etc.

AUDIBLE – means that a sound can be heard. However, there are a wide range of audibility grades, varying from "barely audible" to "just audible", "clearly audible" and "prominent". Chapter 83 of the NSW Environment Protection Authority – Environmental Noise Control Manual (1985) states:
"noise from a particular source might be offensive if it is clearly audible, distinct from the prevailing background noise and of a volume or character that a reasonable person would be conscious of the intrusion and find it annoying or disruptive".

It follows that the word "audible" in an environmental noise context means "clearly audible".

BACKGROUND NOISE LEVEL – Silence does not exist in the natural or the built-environment, only varying degrees of noise. The Background Noise Level is the average minimum dBA level of noise measured in the absence of the noise under investigation and any other short-term noises such as those caused by cicadas, lawnmowers, etc. It is quantified by the L_{A90} or the dBA noise level that is exceeded for 90 % of the measurement period (usually 15 minutes).

- **Assessment Background Level (ABL)** is the single figure background level representing each assessment period – day, evening and night (ie three assessment background levels are determined for each 24hr period of the monitoring period). Determination of the assessment background level is by calculating the tenth percentile (the lowest tenth percent value) of the background levels (L_{A90}) for each period (refer: NSW Industrial Noise Policy, 2000).
- **Rating Background Level (RBL)** as specified by the Environment Protection Authority is the overall single figure (L_{A90}) background noise level representing an assessment period (day, evening or night) over a monitoring period of (normally) three to seven days.

  The RBL for an assessment period is the median of the daily lowest tenth percentile of L_{90} background noise levels.

  If the measured background noise level is less than 30 dBA, then the Rating Background Level (RBL) is considered to be 30 dBA.

DECIBEL – The human ear has a vast sound-sensitivity range of over a thousand billion to one. The decibel is a logarithmic unit that allows this same range to be compressed into a somewhat more comprehensible range of 0 to 120 dB. The decibel is ten times the logarithm of the ratio of a sound level to a reference sound level. See also Sound Pressure Level and Sound Power Level.

Decibel noise levels cannot be added arithmetically since they are logarithmic numbers. If one machine is generating a noise level of 50 dBA, and another similar machine is placed beside it, the level will increase to 53 dBA, not 100 dBA. Ten similar machines placed side by side increase the sound level by 10 dBA, and one hundred machines increase the sound level by 20 dBA.

dBA – The human ear is less sensitive to low frequency sound than high frequency sound. We are most sensitive to high frequency sounds, such as a child's scream. Sound level meters have an inbuilt weighting network, termed the dBA scale, that approximates the human loudness response at quiet sound levels (roughly approximates the 40 phon equal loudness contour).

However, the dBA sound level provides a poor indication of loudness for sounds that are dominated by low frequency components (below 250 Hz). If the difference between the "C" weighted and the "A" weighted sound level is 15 dB or more, then the NSW Industrial Noise Policy recommends a 5 dBA penalty be applied to the measured dBA level.

dBC – The dBC scale of a sound level meter is similar to the dBA scale defined above, except that at high sound intensity levels, the human ear frequency response is more linear. The dBC scale approximates the 100 phon equal loudness contour.

EQUIVALENT CONTINUOUS NOISE LEVEL, L_{Aeq} – Many noises, such as road traffic or construction noise, vary continually in level over a period of time. More sophisticated sound level meters have an integrating electronic device inbuilt, which average the A weighted sound pressure levels over a period of time and then display the energy average or L_{Aeq} sound level. Because the decibel scale is a logarithmic ratio the higher noise levels have far more sound energy, and therefore the L_{Aeq} level tends to indicate an average which is strongly influenced by short term, high level noise events. Many studies show that human reaction to level-varying sounds tends to relate closely to the L_{Aeq} noise level.

FREE FIELD – This is a sound field not subject to significant reflection of acoustical energy. A free field over a reflecting plane is usually outdoors with the noise source resting on hard flat ground, and not closer than 6 metres to any large flat object such as a fence or wall; or inside an anechoic chamber.

FREQUENCY – The number of oscillations or cycles of a wave motion per unit time, the SI unit being the Hertz, or one cycle per second.

IMPACT ISOLATION CLASS (IIC) – The American Society for Testing and Materials (ASTM) has specified that the IIC of a floor/ceiling system shall be determined by operating an ISO 140 Standard Tapping Machine on the floor and measuring the noise generated in the room below. The IIC is a number found by fitting a reference curve to the measured octave band levels and then deducting the sound pressure level at 500 Hz from 110 decibels. Thus the higher the IIC, the better the impact sound isolation.

IMPACT SOUND INSULATION ($L_{nT,w}$) – Australian Standard AS ISO 717.2 – 2004 has specified that the Impact Sound Insulation of a floor/ceiling system be quantified by operating an ISO 140 Standard Tapping Machine on the floor and measuring the noise generated in the room below. The Weighted Standardised Impact Sound Pressure Level ($L_{nT,w}$) is the sound pressure level at 500 Hz for a reference curve fitted to the measured octave band levels. Thus the lower $L_{nT,w}$ the better the impact sound insulation.

IMPULSE NOISE – An impulse noise is typified by a sudden rise time and a rapid sound decay, such as a hammer blow, rifle shot or balloon burst.

INTRUSIVE NOISE LEVEL, L_{Aeq} – The level of noise from a factory, place of entertainment, etc. in NSW is assessed on the basis of the average maximum noise level, or the $L_{Aeq\ (15\ min)}$. This is the energy average A weighted noise level measured over any 15 minute period.

LOUDNESS – The degree to which a sound is audible to a listener is termed the loudness. The human ear perceives a 10 dBA noise level increase as a doubling of loudness and a 20 dBA noise increase as a quadrupling of the loudness.

MAXIMUM NOISE LEVEL, L_{Amax} – The rms maximum sound pressure level measured on the "A" scale of a sound level meter during a noise survey is the L_{Amax} noise level. It may be measured using either the Fast or Slow response time of the meter. This should be stated.

NOISE RATING NUMBERS – A set of empirically developed equal loudness curves has been adopted as Australian Standard AS1469-1983. These curves allow the loudness of a noise to be described with a single NR number. The Noise Rating number is that curve which touches the highest level on the measured spectrum of the subject noise. For broadband noise such as fans and engines, the NR number often equals the dBA level minus five.

NOISE – Noise is unwanted sound. Sound is wave motion within matter, be it gaseous, liquid or solid. "Noise includes sound and vibration".

NOISE REDUCTION COEFFICIENT – See: "Sound Absorption Coefficient".

OFFENSIVE NOISE - (Reference: Dictionary of the Protection of the Environment Operations Act 1997). *"Offensive Noise means noise:*

(a) that, by reason of its level, nature, character or quality, or the time at which it is made, or any other circumstances:

(i) is harmful to (or likely to be harmful to) a person who is outside the premise from which it is emitted, or

(ii) interferes unreasonably with (or is likely to interfere unreasonably with) the comfort or repose of a person who is outside the premises from which it is emitted, or

(b) that is of a level, nature, character or quality prescribed by the regulations or that is made at a time, or in other circumstances prescribed by the regulations."

PINK NOISE – Pink noise is a broadband noise with an equal amount of energy in each octave or third octave band width. Because of this, Pink Noise has more energy at the lower frequencies than White Noise and is used widely for Sound Transmission Loss testing.

REVERBERATION TIME, T_{60} – The time in seconds, after a sound signal has ceased, for the sound level inside a room to decay by 60 dB. The first 5 dB decay is often ignored, because of fluctuations that occur while reverberant sound conditions are being established in the room. The decay time for the next 30 dB is measured and the result doubled to determine the T_{60}. The Early Decay Time (EDT) is the slope of the decay curve in the first 10 dB normalised to 60 dB.

SOUND ABSORPTION COEFFICIENT, α – α Sound is absorbed in porous materials by the viscous conversion of sound energy to heat energy as the sound waves pass through it. Sound is similarly absorbed by the flexural bending of internally damped panels. The fraction of incident energy that is absorbed is termed the Sound Absorption Coefficient, α. An absorption coefficient of 0.9 indicates that 90 % of the incident sound energy is absorbed. The average α from 250 to 2000 Hz is termed the Noise Reduction Coefficient (NRC).

SOUND ATTENUATION – If an enclosure is placed around a machine, or a silencer is fitted to a duct, the noise emission is reduced or attenuated. An enclosure that attenuates the noise level by 30 dBA, reduces the sound energy by one thousand times.

SOUND EXPOSURE LEVEL (SEL) – The total sound energy of a single noise event condensed into a one second duration or in other words it is an L_{eq} (1 sec).

SOUND PRESSURE LEVEL, L_p – The level of sound measured on a sound level meter and expressed in decibels, dB, dBA, dBC, etc. $L_p = 20 \times \log (P/P_o)$ ... dB

where P is the rms sound pressure in Pascal and P_o is a reference sound pressure of 20 µPa. L_p varies with distance from a noise source.

SOUND POWER LEVEL, L_w – The Sound Power Level of a noise source is an absolute that does not vary with distance or with a different acoustic environment.

$L_w = L_p + 10 \log A$ ... dB, re: 1pW,
where A is the measurement noise-emission area in square metres in a free field.

SOUND TRANSMISSION CLASS (STC) – An internationally standardised method of rating the sound transmission loss of partition walls to indicate the decibels of noise reduction of a human voice from one side to the other. (Refer: Australian Standard AS1276 – 1979)

SOUND TRANSMISSION LOSS – The amount in decibels by which a random sound is reduced as it passes through a sound barrier. A method for the measurement of airborne Sound Transmission Loss of a building partition is given in Australian Standard AS1191 - 2002.

STATISTICAL EXCEEDENCE SOUND LEVELS, L_{A90}, L_{A10}, L_{A1}, etc – Noise which varies in level over a specific period of time (usually 15 minutes) may be quantified in terms of various statistical descriptors:

The L_{A90} is the dBA level exceeded for 90 % of the time. In NSW the L_{A90} is measured over periods of 15 minutes, and is used to describe the average minimum or background noise level.

The L_{A10} is the dBA level that is exceeded for 10 % of the time. In NSW the L_{A10} measured over a period of 10 to 15 minutes. It was until recently used to describe the average maximum noise level, but has largely been replaced by the L_{Aeq} for describing level-varying noise.

The L_{A1} is the dBA level that is exceeded for 1 % of the time. In NSW the L_{A1} may be used for describing short-term noise levels such as could cause sleep arousal during the night.

STEADY NOISE – Noise, which varies in level by 6 dBA or less, over the period of interest with the time-weighting set to "Fast", is considered to be "steady". (Refer AS 1055.1 1997)

WEIGHTED SOUND REDUCTION INDEX, R_w – This is a single number rating of the airborne sound insulation of a wall, partition or ceiling. The sound reduction is normally measured over a frequency range of 100 to 3,150 Hertz and averaged in accordance with ISO standard weighting curves (Refer AS/NZS 1276.1:1999).

Internal partition wall $R_w + C$ ratings are frequency weighted to simulate insulation from human voice noise. The $R_w + C$ is always similar in value to the STC rating value. External walls, doors and windows may be $R_w + C_{tr}$ rated to simulate insulation from road traffic noise. This is normally a lower number than the STC rating value.

WHITE NOISE – White noise is broadband random noise whose spectral density is constant across its entire frequency range. The sound power is the same for equal bandwidths from low to high frequencies. Because the higher frequency octave bands cover a wider spectrum, white noise has more energy at the higher frequencies and sounds like a hiss.

Table C.1 Modifying factor corrections
(See definitions in Section C2)

Factor	Assessment/ Measurement	When to apply	Correction[1]	Comments
Tonal noise	One-third octave band analysis using the objective method for assessing the audibility of tones in noise – simplified method (*ISO1996.2-2007 – Annex D*).	Level of one-third octave band exceeds the level of the adjacent bands on both sides by: • 5 dB or more if the centre frequency of the band containing the tone is in the range 500–10,000 Hz • 8 dB or more if the centre frequency of the band containing the tone is in the range 160–400 Hz • 15 dB or more if the centre frequency of the band containing the tone is in the range 25–125 Hz.	5 dB [2, 3]	Third octave measurements should be undertaken using unweighted or Z-weighted measurements. **Note:** Narrow-band analysis using the reference method in *ISO1996-2:2007, Annex C* may be required by the consent/regulatory authority where it appears that a tone is not being adequately identified, e.g. where it appears that the tonal energy is at or close to the third octave band limits of contiguous bands.
Low frequency noise	Measurement of source contribution C-weighted and A-weighted level and one-third octave measurements in the range 10–160 Hz	Measure/assess source contribution C- and A-weighted Leq,T levels over same time period. Correction to be applied where the C minus A level is 15 dB or more and: • where any of the one-third octave noise levels in Table C2 are exceeded by up to and including 5 dB and cannot be mitigated, a 2 dB(A) positive adjustment to measured/predicted A-weighted levels applies for the evening/night period • where any of the one-third octave noise levels in Table C2 are exceeded by more than 5 dB and cannot be mitigated, a 5-dB(A) positive adjustment to measured/predicted A-weighted levels applies for the evening/night period and a 2dB(A) positive adjustment applies for the daytime period.	2 or 5 dB[2]	A difference of 15 dB or more between C- and A-weighted measurements identifies the potential for an unbalance spectrum and potential increased annoyance. The values in Table C2 are derived from Moorhouse (2011) for DEFRA fluctuating low-frequency noise criteria with corrections to reflect external assessment locations.

Table C.1 Modifying factor corrections – continued

Factor	Assessment/ Measurement	When to apply	Correction[1]	Comments
Intermittent noise	Subjectively assessed but should be assisted with measurement to gauge the extent of change in noise level.	The source noise heard at the receiver varies by more than 5 dB(A) and the intermittent nature of the noise is clearly audible.	5 dB	Adjustment to be applied for **night-time only**
Duration	Single-event noise duration may range from 1.5 min to 2.5 h.	One event in any assessment period.	0 to 20 dB(A)	The project noise trigger level may be increased by an adjustment depending on duration of noise (see Table C3).
Maximum Adjustment	Refer to individual modifying factors.	Where two or more modifying factors are indicated.	Maximum correction of 10 dB(A)[2] (excluding duration correction).	

Notes:

1. *Corrections to be added to the measured or predicted levels, except in the case of duration where the adjustment is to be made to the criterion.*
2. *Where a source emits tonal and low-frequency noise, only one 5-dB correction should be applied if the tone is in the low-frequency range, that is, at or below 160 Hz.*
3. *Where narrow-band analysis using the reference method is required, as outlined in column 5, the correction will be determined by the ISO1996-2:2007 standard.*