Acoustic Assessment DRAFT

Residential Aged Care Facility

7 Martin Close & 42 Stronach Avenue, East Maitland

Prepared for Fresh Hope Care
Report Reference: 20SYA0021 R01_B DRAFT

About TTM

For 30 years, we've been at the centre of the Australian development and infrastructure industry. Our unique combination of acoustics, data, traffic and waste services is fundamental to the success of any architectural or development project.

We have over 50 staff, with an unrivalled depth of experience. Our industry knowledge, technical expertise and commercial insight allow us to deliver an exceptional and reliable service.

T: (02) 9418 3033
F: (02) 9418 3112
E: ttmnsw@ttmgroup.com.au

Revision Record

No.	Author	Reviewed/Approved	Description	Date
A	K Dhayam	-	Draft A – Issued for Review	14/05/2020
B	K Dhayam	-	Draft B – Issued for Review	12/06/2020

Level 5, Suite 501, 174 Pacific Highway, Greenwich NSW 2065

Executive Summary

TTM Consulting undertook an acoustic assessment of the proposed redevelopment of the Residential Aged Care Facility (RACF) at 7 Martin Close and 42 Stronach Avenue, East Maitland NSW 2323 for ICON Project Management on behalf of Fresh Care Hope.

Noise monitoring of existing ambient noise levels was conducted in the area to understand the existing acoustic environment at the site, for the purpose of derivation of noise compliance criteria.

Noise impact levels of the proposed redevelopment onto the local community were assessed for mechanical plant noise, vehicle movement noise, noise from community areas and noise from additional generated road traffic. The impact of construction noise and vibration of the redevelopment onto existing sensitive receivers was also assessed.

The development is predicted to comply with Maitland Development Control Plan (DCP) 2011 and relevant standards and guidelines with the inclusion of management measures to the use of the community areas and a detailed acoustic assessment of mechanical plant during detailed design stage.

A management response in the form of a Construction Noise and Vibration Management Plan is also recommended to address any community concerns during construction.

Overall, this report demonstrates that the proposed development is feasible and reasonable, whilst keeping an appropriate acoustic amenity and controlled noise impact to the local community.

Contents

Table Index

Figure Index

1 Introduction

TTM was engaged by ICON Project Management on behalf of Fresh Care Hope to undertake an acoustic assessment of the proposed redevelopment of the Residential Aged Care Facility (RACF) at 7 Martin Close and 42 Stronach Avenue, East Maitland NSW 2323. The assessment addresses the noise impact of the redevelopment on the local community. This report will form part of the development application for consideration by Maitland City Council.

The assessment is based on the following:

- Maitland Local Environmental Plan (LEP) 2011
- Maitland Development Control Plan (DCP) 2011
- State Environmental Planning Policy (Housing for Seniors or People with a Disability) 2004
- NSW Noise Policy for Industry 2017[1]
- NSW SEPP Infrastructure[2]
- Architectural plans by Calderflower Architecture, dated 10/06/2020, as presented in Appendix A.

[1] NSW Environment Protection Authority (2017), Noise Policy for Industry

[2] NSW Department of Planning, State Environmental Planning Policy (SEPP) (Infrastructure) 2007

2 Site Description

The subject site is located within the Maitland City Council Local Government Area (LGA), at 7 Martin Close and 42 Stronach Avenue, East Maitland NSW 2323 in R1 General Residential zone under Maitland LEP 2011. There is currently an existing aged care facility, Green Hills Residential Aged Care Facility, operated by Fresh Hope Care, which has reached the end of its operational life and is subject to a redevelopment.

The site is bounded by existing residential dwellings to the north-east, east and south. To the North of site, is a riparian corridor known as Two Mile Creek.

An aerial image of the site locality is shown in Figure 1.

Figure 1: Site Locality

3 Proposed Development

The new development is proposed to be a two to four storey building with a lower ground/basement level. The proposed facility comprises of the following:

- 160 Residential Aged Care (16-Bed per Household Wing),
- 8 Overnight Respite Care Units, Day Respite with capacity for 20 guests and a Family Room,
- Community and lounge areas, multi-function areas, ancillary facilities, office areas and outdoor areas,
- Café and kitchen areas at the lower ground level,
- Wellness area on the lower ground level,
- Approximately 24 car parking spaces in the basement and on-grade, and
- Driveway and loading dock to the south of the site.

The café and the wellness areas are expected to be used by future residents of the facility and are expected to operate from 7am to 6pm. Background music is also proposed in those areas which will be strictly indoors. The noise impact of the operations of the café and wellness areas to external areas is expected to be insignificant.

Outdoor community areas are also expected to be used by future residents of the facility for light exercise and small gathering. Outdoor amplified music or speech may be expected in the outdoor areas and will be assessed. The community areas are generally expected to be in use from 7am to 6pm.

The proposed number of staff for the facility is estimated to be 48 for the day shifts, 16 for the afternoon shifts and 4 for night shifts.

The lower ground layout of the proposed development is presented in Figure 2 for reference.

3.1 Noise Sources

Based on the proposed new facility, the following new noise generating activities/sources have been identified and will be subject to this operational noise assessment:

- Mechanical plant noise from:
  - Kitchen exhaust,
  - Rooftop condensers, and
  - Energy Recovery Ventilators (ERVs).
- Vehicle movement noise from:
  - Car parking,

- Driveway noise,
- Loading dock, and
- Maintenance driveway along Riparian corridor.

- Amplified music and speech from outdoor community areas, and
- Noise from additional road traffic generated by the development.

3.2 Noise Sensitive Receivers

The closest existing noise sensitive receivers (NSRs) to the proposed development have been identified and are as follows, as shown in Figure 2:

- R1 – North-east of site: Residential properties at 44 Stronach Avenue
- R2 – East of site: Residential property at 6 Martin Close
- R3 – South of site: Residential properties at 3-7 Erin Close

Noise prediction to the identified NSRs will be assessed at the closest window of the NSR to the noise source.

Noise mitigation and management measures implemented to achieve compliance at the identified NSRs ensure that impact at properties located further away will also achieve compliance.

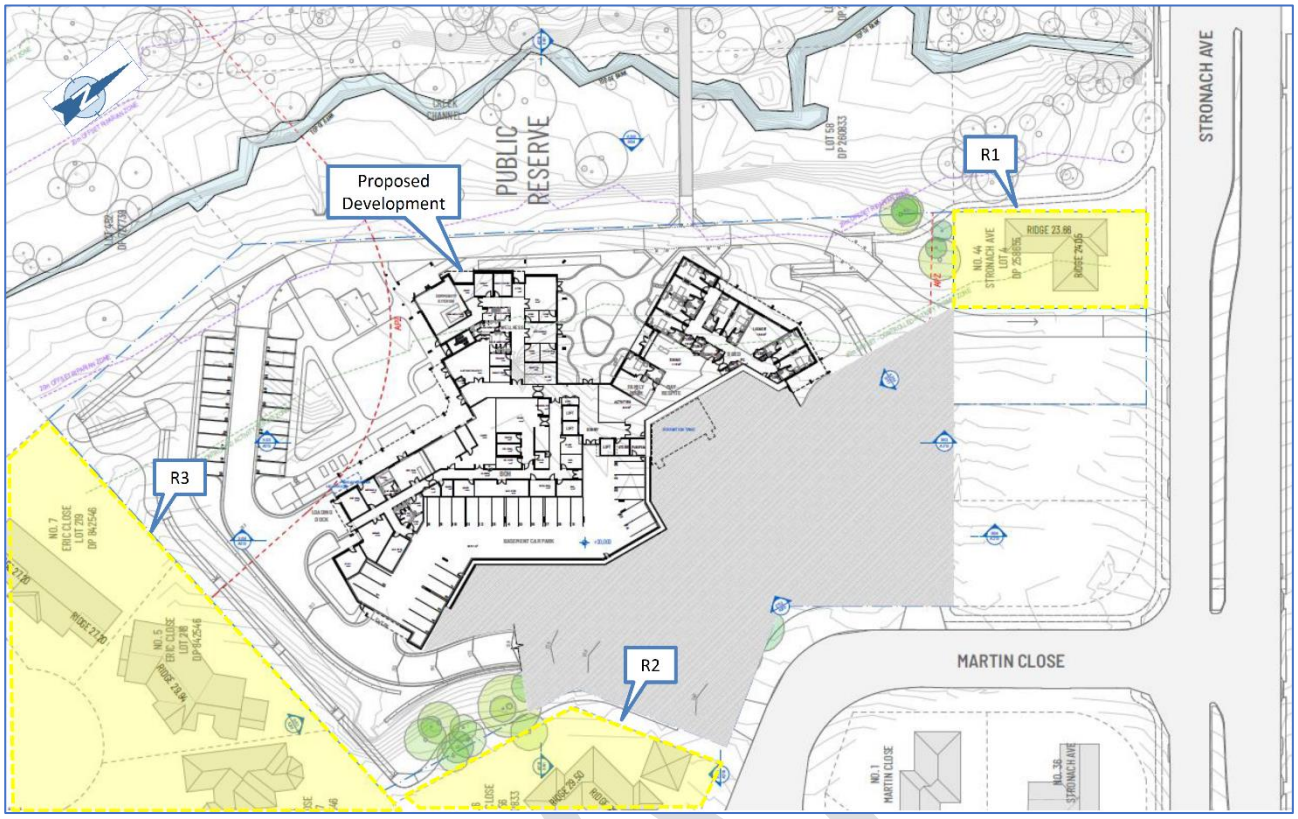


Figure 2: Proposed Development and Noise Sensitive Receivers

4 Noise Survey

TTM conducted a site inspection on the 3rd April 2020 to ascertain the site characteristics and its immediate surroundings. During the site inspection, existing environmental noise sources and noise sensitive receivers were identified.

The area was observed to be typical of a residential suburban area with an acoustical environment dominated by local traffic with characteristically intermittent traffic flows.

Unattended ambient noise monitoring was conducted between the 3rd and 10th April 2020 to capture representative ambient noise levels at the site to be used for the derivation of relevant noise assessment criteria. Noise levels were captured generally in accordance with the recommendations of Australian Standard AS 1055[3].

The noise monitoring location is shown in Figure 3.

Figure 3: Noise Monitoring Location

[3] AS 1055:2018 Acoustics - Description and measurement of environmental noise

4.1 Equipment and Observations

The equipment used to measure existing ambient noise levels at the site are presented in Table 1. All measurements were recorded in average, maximum and statistical noise parameters at 15-minute intervals using fast response.

Table 1: Measurement Equipment and Observations

Type of Measurement	Equipment Model, Type and Serial Number	Observations
Unattended – Long term ambient noise	Brüel & Kjær Model 2250 Light Noise Logger (S/N 3006261)	To ensure the security of noise logger and considering access restrictions, the logger was installed at the location shown in Figure 3 at a height of 1.5 metres above ground level. Noise environment was dominated by local intermittent road traffic activity with very low heavy vehicle percentage observed. The noise logger was used to capture long-term existing ambient noise levels representative of the site area.
Calibration – Check equipment	Brüel & Kjær Model 4231 Sound Calibrator (S/N 3009809)	Noise logger and sound level meter were both calibrated on-site before and after measurements/monitoring and no significant drift was observed.

4.2 Weather Conditions

During the noise monitoring period, weather conditions were monitored via the Bureau of Meteorology[4] website (Ref: Newcastle). Weather conditions during the entire noise monitoring period were considered suitable.

4.3 Monitoring Results

Table 2 presents the statistical noise levels measured by the unattended noise logger installed on site. The daily noise monitoring results are represented graphically in Appendix B. The monitoring results are used to derive the environmental noise targets applicable to the proposed development.

Table 2: Noise Monitoring Results – Ambient Noise Descriptors

Period	Existing Noise Levels in dB(A)			
	Rating Background Noise Levels, RBL L_{90}	L_{eq}	L_{10}	L_1
Day	42	55	61	70
Evening	37	57	63	71
Night	32	48	46	67

Note:
- Day-time period is from 0700 to 1800 (Monday to Saturday) and 0800 to 1800 (Sundays and Public Holidays)
- Evening period is from 1800 to 2200
- Night-time period is from 2200 to 0700 (Monday to Saturday) and 2200 to 0800 (Sundays and Public Holidays)

[4] http://www.bom.gov.au/nsw/observations/sydney.shtml

4.3.1 Road Traffic Noise Monitoring Results

The unattended noise monitoring results have also been summarised in terms of the NSW Road Traffic Noise descriptors and the CoRTN Method descriptor (*Calculation of Road Traffic Noise, Department of Transport, Welsh Office*, UK 1988) in Table 3.

Table 3: Road Traffic Noise Monitoring Results

Period (T)	Existing Noise Level in dB(A)		
	NSW Road Noise Policy descriptor		CoRTN $L_{10,18h}$ (6am to 12am)
	$L_{eq,T}$	$L_{eq,1h}$ (Average maximum 1 hour)	
Day (7am - 10pm)	55	59	54
Night (10pm - 7am)	51	44	

5 Noise Criteria

The main guidelines, standards and other policy documents relevant to the assessment contained in this acoustic report include:

- Maitland Development Control Plan (DCP) 2011
- State Environmental Planning Policy (SEPP) (Housing for Seniors or People with a Disability) 2004
- NSW Noise Policy for Industry 2017
- NSW SEPP Infrastructure.

5.1 Maitland DCP 2011

The Maitland DCP 2011 provides general recommendations and guidelines to ensure the acoustic amenity of the local community is preserved from new development. Recommendations are generally related to the design of residential development and are as follows:

- Where no design techniques and screening (e.g. fences or walls) are proposed, openings of adjacent dwellings shall be separated by a distance of at least three metres.
- Site layout shall separate active recreational areas, shared parking areas and driveways, and service equipment areas away from bedroom areas of dwellings.
- Mechanical plant or equipment (e.g. Air conditioning units) shall be designed and located to minimise noise nuisance.
- Shared walls and floors between dwellings shall be constructed to reduce noise transmission in accordance with the Building Code of Australia.

The NSW Noise Policy for Industry 2017 provides a comprehensive method for the derivation of noise criteria and will be referred to assess potential noise impact from the proposed development.

5.2 SEPP (Housing for Seniors or People with a Disability) 2004

The SEPP also provides general design recommendations for consideration for new proposed development to ensure the visual and acoustic privacy of neighbours in the vicinity and residents are preserved. The design recommendations to be considered are as follows:

- appropriate site planning, the location and design of windows and balconies, the use of screening devices and landscaping, and
- ensuring acceptable noise levels in bedrooms of new dwellings by locating them away from driveways, parking areas and paths.

Acceptable noise levels for this development are defined by the Australian and New Zealand Standard entitled *AS/NZS 2107–2000, Acoustics—Recommended design sound levels and reverberation times for building interiors*.

5.3 NSW Noise Policy for Industry 2017

For the noise impact assessment, reference has been made to the NSW Noise Policy for Industry 2017. The policy sets out the procedure to determine the project noise trigger levels relevant to assess noise from mechanical plant and equipment, and other industrial noise sources. The project noise trigger level applies to existing noise-sensitive receivers.

The project noise trigger level provides a benchmark or objective for assessing a proposal or site. It is not intended for use as a mandatory requirement. The project noise trigger level is a level that, if exceeded, would indicate a potential noise impact on the community, and so 'trigger' a management response, for example, further investigation of mitigation measures.

The project noise trigger level is the lower (that is, the more stringent) value of the project intrusiveness noise level and project amenity noise level as specified in Sections 2.3 and 2.4 of the policy.

5.3.1 Project Intrusiveness Noise Level

The Noise Policy for Industry states:

> *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 background noise level by more than 5 dB when beyond a minimum threshold. This intrusiveness noise level seeks to limit the degree of change a new noise source introduces to an existing environment.*

The intrusiveness noise level is determined as follows:

$$L_{Aeq,\ 15min} \leq \text{Rating Background Noise Level} + 5\ \text{dB}$$

5.3.2 Amenity Noise Levels and Project Amenity Noise Levels

To limit continuing increases in noise levels from application of the intrusiveness level alone, the ambient noise level within an area from all industrial noise sources combined should remain below the recommended amenity noise levels specified in Table 2.2 of the Noise Policy for Industry where feasible and reasonable. The recommended amenity noise levels will protect against noise impacts such as speech interference, community annoyance and some sleep disturbance. The noise amenity area is defined as suburban residential. The relevant noise amenity levels are given in Table 4.

Table 4: Amenity Noise Levels

Noise Amenity Area of Receiver	Assessment Period	Recommended Amenity Noise Level, L_{eq} dB(A)
Residential Suburban	Day	55
	Evening	45
	Night	40

Note:
- Day-time period is from 0700 to 1800 (Monday to Saturday) and 0800 to 1800 (Sundays and Public Holidays)
- Evening period is from 1800 to 2200
- Night-time period is from 2200 to 0700 (Monday to Saturday) and 2200 to 0800h (Sundays and Public Holidays)

The recommended amenity noise levels represent the objective for total industrial noise at a receiver location, whereas the project amenity noise level represents the objective for noise from a single industrial development at a receiver location.

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 minus 5 dB(A)

For this project, the following exception to the above method to derive the project amenity noise level apply:

- 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.

For the subject area, based on the existing land uses and surrounding noise sources, it is unlikely that existing industrial noise levels will decrease in the future. The project amenity noise levels are derived in Table 5 based on the above exception.

Table 5: Derivation of Project Amenity Noise Level

Assessment Period	Resultant Project Amenity Noise Level L_{eq} dB(A)	Existing Industrial Noise Level (Difference with Resultant Project Amenity Noise Level) L_{eq} dB(A)	Existing Industrial Noise Level minus 10 dB(A) L_{eq} dB(A)	Project Amenity Noise Level L_{eq} dB(A)
Day	50	55 (+5 dB)	45	**50**
Evening	40	57 (+17 dB)	47	**47**
Night	35	48 (+18 dB)	38	**38**

Note:
- Day-time period is from 0700 to 1800 (Monday to Saturday) and 0800 to 1800 (Sundays and Public Holidays)
- Evening period is from 1800 to 2200
- Night-time period is from 2200 to 0700 (Monday to Saturday) and 2200 to 0800h (Sundays and Public Holidays)

5.3.3 Project Noise Trigger Level

The project noise trigger level (PNTL) has been determined in Table 6.

Table 6: NSW Noise Policy for Industry Evaluated Criteria

Assessment Period	Project Intrusiveness Noise Level $L_{eq,15min}$ dB(A)	Project Amenity Noise Level $L_{eq,15min}$ dB(A)	Project Noise Trigger Level $L_{eq,15min}$ dB(A)
Day	47	50	**47**
Evening	42	47	**42**
Night	37	38	**37**

Note:
- Day-time period is from 0700 to 1800 (Monday to Saturday) and 0800 to 1800 (Sundays and Public Holidays)
- Evening period is from 1800 to 2200
- Night-time period is from 2200 to 0700 (Monday to Saturday) and 2200 to 0800h (Sundays and Public Holidays)

Table 6 shows that the project intrusiveness noise level is more stringent than the project intrusiveness noise level for all assessment time periods, and therefore make the PNTLs for this assessment.

5.3.4 Maximum Noise Level Event Assessment – Sleep Disturbance

The potential for sleep disturbance from maximum noise level events from the development during the night-time period needs to be considered. Sleep disturbance is considered to be both awakenings and disturbance to sleep stages.

A detailed maximum noise level event assessment should be undertaken where the subject development night-time noise levels at a residential location exceed:

- $L_{Aeq,15min}$ 40 dB(A) or the prevailing RBL plus 5 dB whichever is the greater = **$L_{Aeq,15min}$ 40 dB(A)**, and/or
- L_{AFmax} 52 dB(A) or the prevailing RBL plus 15 dB whichever is the greater = **L_{AFmax} 52 dB(A)**,

The detailed assessment should cover the maximum noise level, the extent to which the maximum noise level exceeds the rating background noise level, and the number of times this happens during the night-time period.

Other factors that may be important in assessing the extent of impacts on sleep include:

- how often high noise events will occur,
- the distribution of likely events across the night-time period and the existing ambient maximum events in the absence of the subject development,
- whether there are times of day when there is a clear change in the noise environment (such as during early-morning shoulder periods), and
- current scientific literature available at the time of the assessment regarding the impact of maximum noise level events at night.

5.4 NSW SEPP Infrastructure

The SEPP has been referred to investigate the impact of road traffic noise on the proposed development.

The relevant criteria for road traffic noise impact are contained in Division 17 *Roads and traffic,* Subdivision 2 *Development in or adjacent to road corridors and road reservations,* Paragraph 102 *Impact of road noise or vibration on non-road development*.

Relevant noise criteria contained in The NSW Department of Planning, *Development near Rail Corridors and Busy Roads – Interim Guideline* also refers to the NSW SEPP Infrastructure.

The criteria are summarised as follows:

- For the development that is on land in or adjacent to the road corridor with an annual average daily traffic (AADT) volume of more than 40,000 vehicles, the development is likely to be adversely affected by road noise or vibration
- Appropriate measures are required to be taken to ensure that the following L_{Aeq} noise levels are not exceeded for road traffic noise impact:
  - in any bedroom in the building—35 dB(A) at any time between 10 pm and 7am, and
  - anywhere else in the building (other than a garage, kitchen, bathroom or hallway)—40 dB(A) at any time.

5.4.1 Road Traffic Noise Impact Assessment

The site is located at approximately 200-300 metres from the main road noise source, Stronach Avenue. Stronach Avenue is classified as a sub-arterial road for the local traffic only and is expected to carry up to 10,000 AADT.

In accordance with The NSW Department of Planning, *Development near Rail Corridors and Busy Roads – Interim Guideline*, the screening test concludes that residential properties located more than 200 metres from roads with AADT of 10,000 or less do not require additional acoustic treatment to the development façade. Therefore, the future development is not expected to be adversely impacted by road traffic noise from the surrounding road network. No further assessment is required.

6 Operational Noise Assessment

This section of the report assesses the noise impact from the development to the local community, including:

- Mechanical plant noise from:
  - Kitchen exhaust,
  - Rooftop condensers and,
  - Energy Recovery Ventilators (ERVs).
- Vehicle movement noise from:
  - Car parking,
  - Driveway noise,
  - Loading dock, and
  - Maintenance driveway along Riparian corridor.
- Amplified music and speech from outdoor community areas, and
- Noise from additional road traffic generated by the development.

6.1 Mechanical Plant Noise

Mechanical plant and equipment are proposed on the rooftop of the development. Future mechanical plant may have an adverse effect onto nearby noise sensitive receivers, and are required to meet the NSW Noise Policy for Industry PNTL derived in this report. The most stringent PNTL for residential noise sensitive receivers is during the night-time assessment period at **37 dB(A) L_{eq}** (Refer to Table 6).

The specifications of the proposed condensers, ERVs and acoustic screening are summarised in Table 7.

Table 7: Mechanical Plant Design Specifications

Item	Model No./Reference	Sound Data Specifications
Condenser	REYQ10TAY1	57 dB(A) L_P measured at 1 metre
ERV	ERV1500-ECP	Inlet/Outlet: 75/81 L_W
Acoustic Screening	Height: 1.8 metres high screen. Material: Constructed of a material with a surface mass greater than 12kg/m^2. Position: The screen is to be positioned in such a way that direct line of sight of the top of plant and the perimeter of the roof is blocked.	Noise attenuation of 6-12 dB is predicted to NSRs located at ground level.

In consultation with the mechanical engineers and the design team, the proposed final locations of the rooftop mechanical plant and acoustic screening are shown in Figure 4.

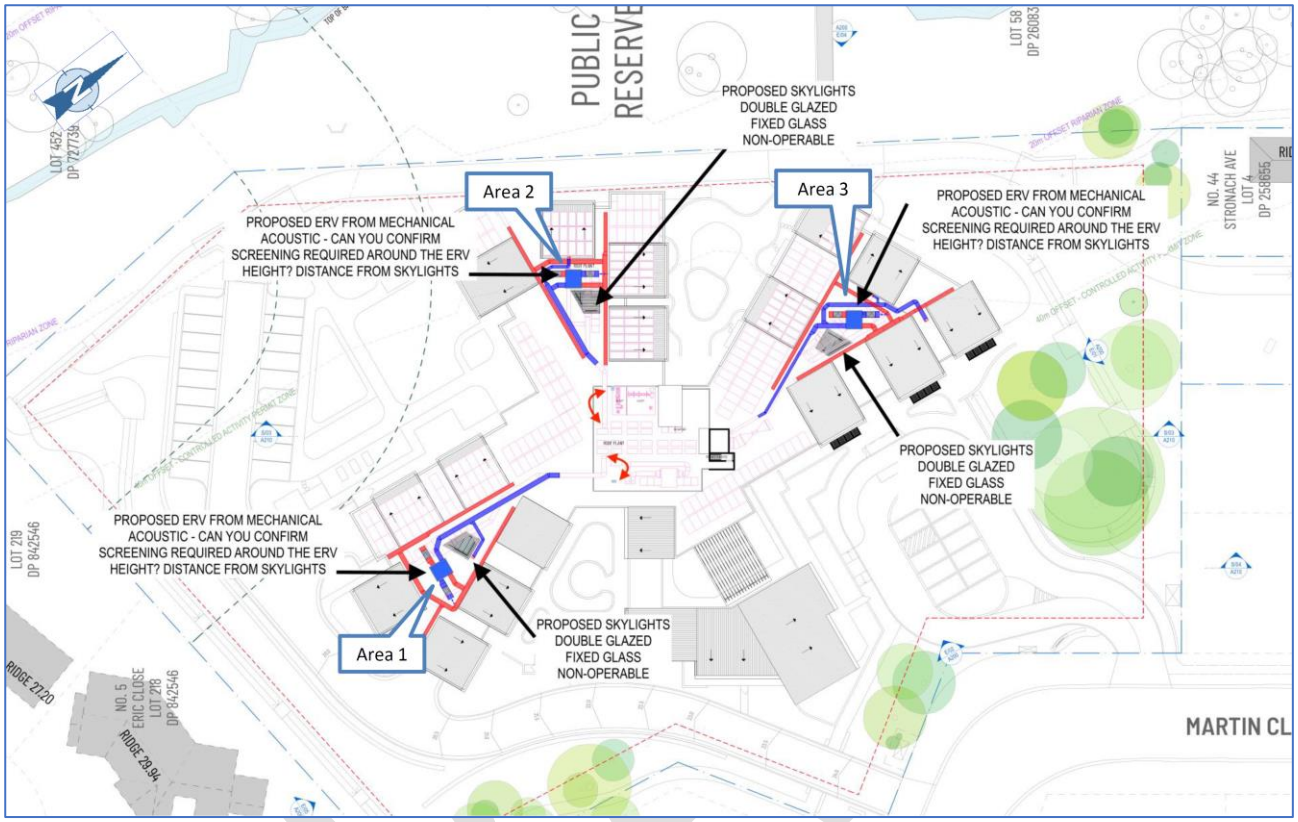


Figure 4: Proposed final locations for rooftop mechanical plant

Based on the design specifications of the rooftop mechanical plant, the noise impact onto the identified NSRs have been predicted and are summarised in Table 8.

Table 8: Predicted Noise Impact of Mechanical Plant Noise

NSR (Refer to Figure 2)	Predicted Noise Impact Levels, L_{eq} in dB(A)			
	Source: Area 1	Source: Area 2	Source: Area 3	Cumulative Impact
R1	23	26	31	**32**
R2	33	25	25	**34**
R3	35	26	25	**36**

The predicted plant noise levels in the mechanical plant noise assessment show that compliance with the noise limit of **37 dB(A) L_{eq}** is achieved by 1-5dB at the identified closest noise sensitive receivers. No additional noise mitigation measures are required.

6.2 Vehicle Movement Noise

The proposed development will give rise to vehicle movement noise from the outdoor car parking areas, driveways, drop-off zones and loading dock. The use of those areas is summarised as follows:

1. Outdoor car parking areas:
   - To be used mainly by staff.
   - Peak vehicle movement is expected during start and end of shifts.
2. Driveways:
   - Similar to the car parking areas, peak vehicle movement is expected during start and end of shifts.
   - Maintenance driveway will be used by maintenance vehicles only during the day-time.
3. Entry car park – Drop-off zones:
   - Low volume use of the drop-off zones is expected, with an average of ten vehicles per hour during the day-time.
   - Night-time use is expected to be minimal to none.
4. Loading dock:
   - To be used by delivery vehicles in the day-time only.

Noise from vehicle movements inside the lower ground basement area will be contained inside the building facilities. No further assessment is required.

The noise sources applicable to this assessment, representing similar situations previously measured by TTM, are presented in Table 9. The levels have been adjusted to one metre and corrected for tonality and impulsiveness characteristics in accordance with AS 1055[5].

Table 9: Noise Source Levels

Noise Source Description	Source Reference Location (Refer to Figure 5)	Adjusted Noise Level to one metre, corrected for tonality and impulsiveness characteristics	
		SEL[6] in dB(A)	L_{Fmax} in dB(A)
Vehicle door slam	1 to 5	78	85
Car bypass @ 5km/h in parking areas	1, 2, 4	77	75
Car engine start	1, 4	77	74
Truck Manoeuvring/Pass by	3, 5	93	86
Waste Collection	5	109	83
Refrigerated Deliveries	5	103	83
Note: *Sound power levels are based on a 15-minute noise source.			

The reference locations of the noise sources are shown in Figure 5.

[5] AS 1055.1:1997. Acoustics - Description and measurement of environmental noise - General procedures

[6] Sound Exposure Level (SEL) is the constant sound level that has the same amount of energy in one second as the original noise event.

Figure 5: Vehicle Movement Noise Sources

6.2.1 Noise Impact Predictions

The noise impact from each noise source location have been predicted to the identified noise sensitive receivers (NSRs) using a spreadsheet model based on the following assumptions:

- Distance noise propagation loss from noise source to the closest noise sensitive receiver (NSR).
- Assumed number of vehicles entering/leaving the noise source area in a 15-minute interval to represent a realistic average scenario.
- One vehicle produces on average two door slam noise events, one ignition noise event and one engine pass-by noise event while parking.
- Noise source location is positioned at the closest point to each receiver.
- Noise sensitive receiver taken as the closest window of the façade to the noise source.
- Shielding from surrounding buildings or barriers calculated in accordance with ISO 9613, where appropriate.

The noise impact prediction results are presented in Table 10.

Table 10: Noise Impact Prediction Results

Noise Source Location and Description (Refer to Figure 5)	Assessment Period	Assumed Max. No. of vehicles entering/leaving area in a 15-minute interval	Predicted Noise Levels at Receivers, in dB(A)					
			R1		R2		R3	
			L_{eq}	L_{AFmax}	L_{eq}	L_{AFmax}	L_{eq}	L_{AFmax}
1 Outdoor Car Parking Areas	Day	8	< 20	N/A	< 20	N/A	35	N/A
	Evening	4	< 20	N/A	< 20	N/A	29	N/A
	Night	2	< 20	< 20	< 20	30	23	51
2 Car Park Driveway	Day	12	< 20	N/A	44	N/A	44	N/A
	Evening	6	< 20	N/A	42	N/A	42	N/A
	Night	2	< 20	< 20	30	51	30	51
3 Maintenance Driveway	Day	1	42	N/A	< 20	N/A	< 20	N/A
	Evening	-	-	-	-	-	-	-
	Night	-	-	-	-	-	-	-
4 Drop-off Zones	Day	4	38	N/A	< 20	N/A	< 20	N/A
	Evening	2	34	N/A	< 20	N/A	< 20	N/A
	Night	1	26	35	< 20	< 20	< 20	35
5 Loading Dock (Engine off when loading/unloading)	Day	1	< 20	N/A	41	N/A	45	N/A
	Evening	-	-	-	-	-	-	-
	Night	-	-	-	-	-	-	-

The results show that the predicted impact levels using a conservative prediction method comply with the PNTL of 47 dB(A), 42 dB(A) and 37 dB(A) in the day, evening and night-time assessment periods respectively.

Compliance is predicted at all the identified closest noise sensitive receivers; no additional mitigation measures are required.

6.2.2 Sleep Disturbance Assessment and Discussion

The maximum impact levels from vehicle movement noise is predicted to be 51 dB(A) from the use of the driveway at receivers R2 and R3. Maximum vehicle movement noise of 35 dB(A) is also predicted at receiver R1. Therefore, the predicted impact complies with the sleep disturbance criteria of L_{AFmax} 52 dB(A).

In the night-time period, the use of the driveways and car parking areas are expected to be minimal, being used mostly before and after the night shift by staff only. The maintenance driveway, drop-off zones and loading zones are not expected to be in use in the night-time.

Based on the maximum impact level prediction and the minimal use of the car parking areas and driveway, sleep disturbance is not expected to occur from the proposed development at the identified closest noise sensitive receivers.

6.3 Noise from Outdoor Community Areas and Discussion

Outdoor noise in community areas may cause an adverse effect on the acoustic amenity of the local community. Outdoor community areas are expected to be used during the day-time assessment period only from 7am to 6pm. Potential outdoor community areas are located at the northern and southern parts of the development. Outdoor community areas are expected to be used by residents for light exercise and for social activities. Background music played through speakers is also expected to be used in those areas.

The northern outdoor community area is approximately 30 metres from R1. Based on a noise level of 60 dB(A) L_{eq}[7] for normal, raised voice during one conversation, it is predicted that a maximum number of **50** people may engage into verbal communication simultaneously to achieve compliance with the day-time PNTL of **47 dB L_{Aeq}** at the residential receiver, R1.

For the southern outdoor community area, it is predicted that a maximum of **80** people may engage into verbal communication simultaneously to achieve compliance with the daytime PNTL of **47 dB L_{Aeq}** at the residential receivers, R2 and R3.

It is an unlikely event that 50-80 people will engage in verbal communication in the outdoor community areas. The noise impact from social use of the community areas is therefore predicted to be insignificant.

To comply with the day-time PNTL of **47 dB L_{Aeq}** at the closest residential receivers, background music may emit up to 76 dB(A) L_{eq} measured at 1 metre from the speakers. Background music typically achieves less than 70 dB(A) in a social environment. Therefore, background music played within the outdoor community areas is not expected to adversely the acoustic amenity of the local community.

6.4 Road Traffic Generated by Development

Additional traffic generated from the development on Stronach Avenue is expected to be insignificant during peak hour. As such, the impact of additional traffic from the development on the existing residential properties in the local area is predicted to be insignificant.

[7] Lazarus, H. (1986). Prediction of verbal communication in noise – A review: Part 1. Applied Acoustics, vol. 19, pp. 439-464

7 Construction Noise Assessment

This section of the report addresses the noise impact of construction noise at the site onto noise sensitive receivers. The impact is assessed in accordance with NSW Interim Construction Noise Guideline (ICNG).

7.1 Interim Construction Noise Guideline (ICNG)

The ICNG describes how a noise impact assessment can be undertaken for construction sites, how sites can be managed to minimise noise, and how compliance with approved conditions can be determined.

The development is considered a major construction project, therefore the quantitative assessment method has been adopted for the construction noise impact assessment in accordance with the guideline.

7.1.1 ICNG Noise Management Levels

The ICNG recommends the following standard hours for construction activities where noise is audible at residential premises:

- Monday to Friday: 7am to 6pm
- Saturday: 8am to 1pm
- Sundays or public holidays: No Construction Work

Time restrictions on construction works are the primary management tool of the ICNG.

The guideline also provides noise management levels for residential premises for both the recommended and outside standard hours of construction. The recommended noise management levels have been extracted from the ICNG and are shown in Table 11.

Table 11: ICNG Noise Management Levels

Time of day	Management level, $L_{Aeq\ (15\ min)}$*	How to apply
Recommended standard hours: Monday to Friday 7am to 6pm Saturday 8am to 1pm No work on Sundays or public holidays	**Residential:** Noise affected RBL + 10 dB **= 52 dB(A)**	The noise affected level represents the point above which there may be some community reaction to noise. • Where the predicted or measured $L_{Aeq\ (15\ min)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. • The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75 dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise. • Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: – times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences – if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours **(Unlikely to occur)**	Noise affected RBL + 5 dB	• A strong justification would typically be required for works outside the recommended standard hours. • The proponent should apply all feasible and reasonable work practices to meet the noise affected level. • Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community. • For guidance on negotiating agreements see section 7.2.2 of the ICNG.
Note: * Noise levels apply at the property boundary that is most exposed to construction noise, and at a height of 1.5m above ground level. If the property boundary is more than 30m from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30m of the residence. Noise levels may be higher at upper floors of the noise affected residence.		

7.2 General Construction Schedule

The expected construction schedule below outlines the basic steps involved in the construction program:

1. Demolition & Preparation Works
2. Excavation
3. Construction – Structure
4. Construction – Finishes
5. Testing, Commissioning & Handover (No Construction Noise Impact).

7.3 Plant and Equipment Noise Source Levels

The expected plant and machinery information for each step of the construction schedule are summarised in Table 12. The information has been used to predict construction noise levels to the identified NSRs.

The percentage use per day during a typical working day was estimated based on previous experience. The approximate percentage use is to account for the transient and changing nature of the construction activities, which are dependent upon site's conditions, timelines, delays and other unexpected occurrences.

The sound power level for each equipment has been obtained from available literature as referenced in the table below.

Table 12: Plant and Equipment Source Noise Level (L_W) and % Use per day

Construction Phase	Plant and equipment	% Use per day	L_W dB(A)	Reference
Demolition & Preparation Works	Chainsaw	40	107	https://webgate.ec.europa.eu/growth-portal/noise/reports/EN/EN_EQUIPMENT28.PDF
	Chipper	40	115	https://webgate.ec.europa.eu/growth-portal/noise/reports/EN/EN_EQUIPMENT58.PDF
	Excavator	80	97	AS 2436[8]
	Hand-held pneumatic breaker	70	111	BS 5228
	Lump hammer	40	97	BS 5228
	8t Loader	70	113	AS 2436
	10t Truck	50	107	AS 2436
	Diesel generator	100	99	AS 2436
	TOTAL L_W including % on-times	-	**116**	-
Excavation	Excavator	50	97	AS 2436
	8t Loader	50	113	AS 2436
	10t Truck	50	107	AS 2436
	Hand-held pneumatic breaker	80	116	AS 2436
	Vibratory roller	80	108	AS 2436
	Diesel generator	100	99	AS 2436
	TOTAL L_W including % on-times	-	**117**	-
Construction – Structure	Tower crane	70	105	AS 2436
	Material delivery truck	30	106	AS 2436
	Truck mixer	40	107	BS 5228
	Concrete boom pump	40	108	AS 2436
	Concrete vibrator	40	103	AS 2436
	Diesel generator	100	99	AS 2436
	Brick saw	40	117	AS 2436
	Air compressor (Silenced)	50	101	AS 2436

[8] AS 2436:2010. Guide to noise and vibration control on construction, demolition and maintenance sites

Construction Phase	Plant and equipment	% Use per day	L_W dB(A)	Reference
	Power tools	50	102	AS 2436
	TOTAL L_W including % on-times	-	**115**	-
Construction – Finishes	Concrete/ring saw	40	117	AS 2436
	Scissor lift	70	105	AS 2436
	Material delivery truck	40	106	AS 2436
	Diesel generator	100	99	AS 2436
	Power tools	70	102	AS 2436
	TOTAL L_W including % on-times	-	**114**	-

7.4 Predicted Construction Noise Impact

The construction noise impact level for each construction phase has been predicted based on the following:

- Construction schedule, plant and equipment source sound level, and % use per day given in Table 12
- Average position of plant and equipment in the middle of the construction site
- Receiver prediction point to be taken as the closest window of the NSR
- Noise propagation loss.

Construction noise has been predicted to the identified NSRs and the results are presented in Table 13.

Table 13: Predicted Construction Noise Levels

Construction Phase	Predicted Construction Noise Levels at NSRs, L_{eq} in dB(A)		
	R1	R2	R3
Demolition & Preparation Works	64	67	67
Excavation	65	68	68
Construction – Structure	63	66	66
Construction – Finishes	62	65	65

As expected, the predicted results show that the identified NSRs will exceed the ICNG Noise Management Level of 52 dB(A). However, none of the NSRs are predicted to be 'highly noise affected' (noise levels greater than 75 dB(A)) by the construction activities during all the construction phases.

As such, a noise management response is recommended to address community responses.

7.5 Discussion and Recommendations

The predicted construction noise impact shows that all the NSRs will exceed the ICNG Noise Management Level of 52 dB(A) during all the construction phases. This is typically due to the densely populated area surrounding the construction site where structures are very close to each other.

Although construction noise is expected to be audible and there is likely to be some degree of adverse impact, as is typical with construction projects in close proximity to people, by incorporating noise control measures, the noise impact to residents and other noise sensitive receivers surrounding the site can be managed.

Community reaction is expected as the result of the construction noise. Temporary noise control measures, such as mobile acoustic barriers, are recommended to provide temporary relief to high noise impact. A construction noise management plan (CNMP) is required to facilitate community engagement and to set a reliable means of communication. The CNMP will also help identify times when the community is less sensitive to noise, such as, when residents are away for work, and therefore minimise complaints.

8 Construction Vibration Assessment

This section of the report investigates the risk of vibration caused by the construction works onto nearby buildings.

8.1 Vibration Criteria – Building Damage

The likelihood of structural or even cosmetic damage to buildings located around the site is considered highly unlikely given the machinery and equipment proposed to be used during the construction activities. However, due to the close proximity of the neighbouring structures, a building damage criterion has been set to prevent cosmetic damage. Moreover, the state of the adjacent structures is currently unknown, and it is recommended that this be ascertained by a structural engineer through a dilapidation survey.

There is little reliable data on the threshold of vibration-induced damage in buildings. Although vibrations induced in buildings by ground-borne excitation are often noticeable, there is little evidence that cosmetic damage[9] are actually produced. The lack of data is one of the reasons that there is variation between International Standards.

Vibration will be felt by the occupants of a building at levels far lower than those at which damage is likely to occur. Therefore, for the purposes of the project, it is recommended to set a building damage vibration criterion that is conservative. In doing so, in the unlikely event that the criterion is exceeded, the works can be stopped, and any vibration damage can be established. If no damage is observed and the occupants' fears have been allayed, the construction works can resume.

Construction vibration levels are to be measured on or close to the foundations of the closest building to where the vibration causing work is taking place. A recommended conservative vibration criterion for building damage is provided in Table 14.

Table 14: Recommended Conservative Vibration Criterion – Building Damage

Criteria	Vibration Limit, Peak Particle Velocity (PPV), mm/s	Comments
Structural/Cosmetic Damage	5	Set as an initial limit, to be monitored during construction for excavation, use of hydraulic hammers and compaction plant.

8.2 Vibration Criteria – Human comfort

Vibration criteria for human comfort are given by the Office of Environment and Heritage (OEH) "Assessing Vibration" guideline[10]. The criteria are for guidance and represent non-mandatory goals for new developments.

[9] Building Research Establishment (1995), 'Damage to Structures from Ground-borne Vibration', BRE Digest

[10] NSW Department of Environment and Conservation (2006) – *Assessing Vibration: a technical guideline*

The human comfort vibration criterion is significantly below the building damage vibration criterion, and therefore achieving the human comfort condition generally results in the building damage condition being met.

For intermittent vibration sources, such as from the hydraulic hammer and other construction plant, the concept of a "vibration dose value" (VDV) has been adopted. For residences, the acceptable VDV range is as follows:

- Preferred value: 0.2 $m/s^{1.75}$, and
- Maximum value: 0.4 $m/s^{1.75}$.

The OEH's vibration guidance is generally based on British Standard *BS 6472*[11]. *BS 6472* and its Australian equivalent, Australian Standard *AS 2670.2*[12] give a series of rating curves to assess human exposure to vibration and provide further guidance on acceptable vibration levels.

Table 2 of *AS 2670.2* recommends day-time continuous or intermittent human comfort vibration limits for residential receivers that should not be exceeded. The human comfort vibration limits for the day-time period are summarised in Table 15.

Table 15: Human Comfort Vibration Levels equivalent to Curve 4 given in *AS 2670.2*

Criteria (Day-time period)	Vibration Limit, rms in mm/s		Comments
	Continuous or intermittent	Transient vibration with several occurrences per day	
Human comfort in residences	0.2 – 0.4	3 – 9*	To be monitored and reported should a complaint be received.
Note: *AS2670 suggests that for transient vibration people may not elicit an adverse reaction to vibration levels 30 to 90 times to the threshold of perception (0.1 mm/s).			

8.3 Discussion and Recommendations

Due to the close proximity of adjacent buildings to the construction works, vibration monitoring is recommended on the northern, southern and eastern boundaries of the construction site. It is recommended to set a conservative building damage vibration criterion so that in the unlikely event that the criterion is exceeded, the construction works can be stopped and the vibration damage established. If no damage is observed and after the occupants' fears have been allayed, the works can resume. The recommended vibration criterion for building damage is set at 5 mm/s PPV.

The greatest risk of vibration causing an adverse impact to the residents is by causing discomfort or fear of damage to their premises.

[11] British Standard BS6472.2 (1992) Guide to evaluation of human exposure to vibration in buildings (1 to 80 Hz)

[12] Australian Standard AS2670.2 (1990) – Evaluation of human exposure to whole-body vibration. Part 2: Continuous and shock-induced vibration in buildings (1 to 80 Hz)

For reference, the safe working distances for vibration causing plant which may be used during the construction activities have been taken from the *Transport Infrastructure Development Corporation Construction Noise Strategy (Rail Projects) 2007* and are summarised in Table 16.

Table 16: Recommended Safe Working Distances

Plant Item	Rating/Description	Safe Working Distance, in metres	
		Cosmetic Damage (BS 7385[13])	Human Response (AS 2670)
Vibratory Roller	<50kN (1-2t)	5	15 to 20
Vibratory Roller	<100kN (2-4t)	6	20
Vibratory Roller	<200kN (4-6t)	12	40
Vibratory Roller	<300kN (7-13t)	15	100
Small Hydraulic Hammer	300kg – 5 to 12t excavator	2	7
Medium Hydraulic Hammer	900kg – 12 to 18t excavator	7	23

The safe working distances should be included in the Construction Vibration Management Plan.

8.4 Potential Exceedance

Due to the works being conducted close to occupied buildings, exceedances of the human comfort criterion from proposed plant and activities may be expected. The largest vibration generating activities are expected during excavation when hydraulic hammers and vibratory/foot rollers are expected to be used.

Referring to the safe working distances given in Table 16, by selecting smaller plant when conducting construction work, the risk of cosmetic building damage or human comfort vibration impact, and complaints of vibration from the residents are expected to be low.

[13] BS 7385 -2: 1993 Guide to damage levels from ground borne vibration

9 TTM Recommendations

Based on the noise assessment, recommendations have been made to ensure compliance with the relevant noise criteria is achieved.

9.1 Acoustic Screening

A 1.8-metre high acoustic screen is recommended on the rooftop to block line of sight from the top of all mechanical plant to the perimeter edge of the roof. All acoustic screens require the following minimum characteristics for construction:

- All screens shall be constructed to the designated height above the respective finished rooftop level.
- The height of the screen has been modelled based on the finished rooftop level, the height of the mechanical plant and the adjacent noise sensitive properties located at ground floor level. The height must be reviewed should the assumed levels differ by more than 300mm.
- The screens must be constructed of a material with a surface mass greater than 12kg/m^2. Suitable materials may include 25mm thick lapped timber (minimum 40% overlap), 25mm thick plywood, masonry, 12mm thick fibre cement, 11mm perspex, 6mm thick compressed fibre cement sheet, 7mm thick aluminium or 2.5mm thick steel, 5mm glazing, earth mound or combination of the above.
- No gaps or holes of any kind in the screen construction particularly at the base and along main vertical support posts.

The final design of the acoustic barrier is recommended to be reviewed by a suitably qualified acoustic consultant prior to issuing a construction certificate.

9.2 Mechanical Plant Noise

The predicted plant noise levels in the mechanical plant noise assessment is predicted to be achieved based on the specifications of the mechanical plant arrangement on the rooftop, including all acoustic screens. However, a detailed mechanical plant noise assessment should be conducted by a suitably qualified acoustic consultant once final plant selections are made to confirm the noise emission levels.

The detailed noise assessment should include noise source levels of plant, location, adjustments for mechanical plant noise characteristics and application of practical and effective noise control to verify compliance with the relevant noise criteria derived in this report. It is, however, expected that no additional onerous noise mitigation measures will be required.

9.3 Outdoor Community Areas

The outdoor areas are expected to be used for light exercise and social outdoor gatherings generally in the day-time only. The following general recommendations have been made to manage the use of the outdoor areas:

- Restrict use of areas to the day-time periods only, which is from 7am to 6pm.
- Position outdoor speakers strategically away from noise sensitive receivers.

9.4 Construction Noise Control Measures

The opportunities for practical physical noise control are few given the transient and constantly moving nature of the construction work. However, it is recommended to use mobile noise barriers/enclosures during certain construction work, such as around stationary work activities and plant.

9.4.1 Construction Noise Management Plan

In addition to physical noise control or in situations where physical noise control measures are not practical, management measures should be employed to minimise the construction noise impact onto the noise sensitive receivers. These should include all feasible and reasonable measures employed by the builder as part of a Construction Noise Management Plan and should include the following:

- Informing and consulting residents and interested parties, as far as practicable, regarding impending or current events that may cause high levels of noise and how long they are expected to take. This may take the form of letter drops, or community notices.
- Provide a complaints telephone number and contact name prominently displayed at the construction site and on any letter-drops or community notices.
- Respite hours agreed with residents when noisy works will not take place if necessary.
- Investigate complaints when received to establish the cause, and where possible implement a corrective action such as, provide a respite period or other practical measure.
- Minimising the operating noise of machinery brought on to the site.
- Where appropriate, obtaining acoustic test certificates for machinery brought on to the site.
- If there is excessive noise from any process, that process will be stopped and if possible that noise attenuated to acceptable levels. Where there is no alternative the process will be rescheduled to non-sensitive hours.
- Where it is not practical to sufficiently mitigate the noise impact of a particular activity, substitute methods of construction should be considered for example, using a rock saw or stitch drilling to excavate rock instead of a rock breaker, which uses impact as its operating energy.
- Ensuring that plant is not left idling when not in use.
- Ensuring that plant is well maintained and in good working order and not causing unnecessary noise, such as damaged mufflers on plant.
- All access hatches for plant to be kept closed.

- Provision of a toolbox talk to personnel on-site so that everyone understands the importance of controlling noise and vibration.

To provide a framework for construction noise management on-site, it is recommended that a Construction Noise Management Plan (CNMP) is produced by the contractor. This should include all pertinent information regarding the control and management of noise and would be used as a working document on-site by contractors and sub-contractors so that everyone is aware of their responsibilities.

9.5 Vibration Monitoring

It is recommended to conduct vibration monitoring with an alarm system at vibration sensitive areas (Northern, southern and eastern boundaries of the site) when construction work is being undertaken inside or close to the safe working distances, in order to quantity the extent of vibration impact. The alarm system should be set to the cosmetic damage criterion.

An adverse vibration impact is not a high risk for the construction of the development in terms of damage to buildings or human comfort for the majority of construction activities and machinery/equipment being used. However, there may be some activities, such as the use of hydraulic hammers and vibratory/foot rollers during the excavation stage that may exceed the human comfort criteria at properties located at up to 40 metres from the construction site.

Vibration monitoring at the specified locations should be included in the Construction Vibration Management Plan.

10 Conclusion

Following a noise assessment conducted for ICON Project Management on behalf of Fresh Care Hope for the Residential Aged Care Facility (RACF) at 7 Martin Close and 42 Stronach Avenue, East Maitland NSW, TTM concludes the following:

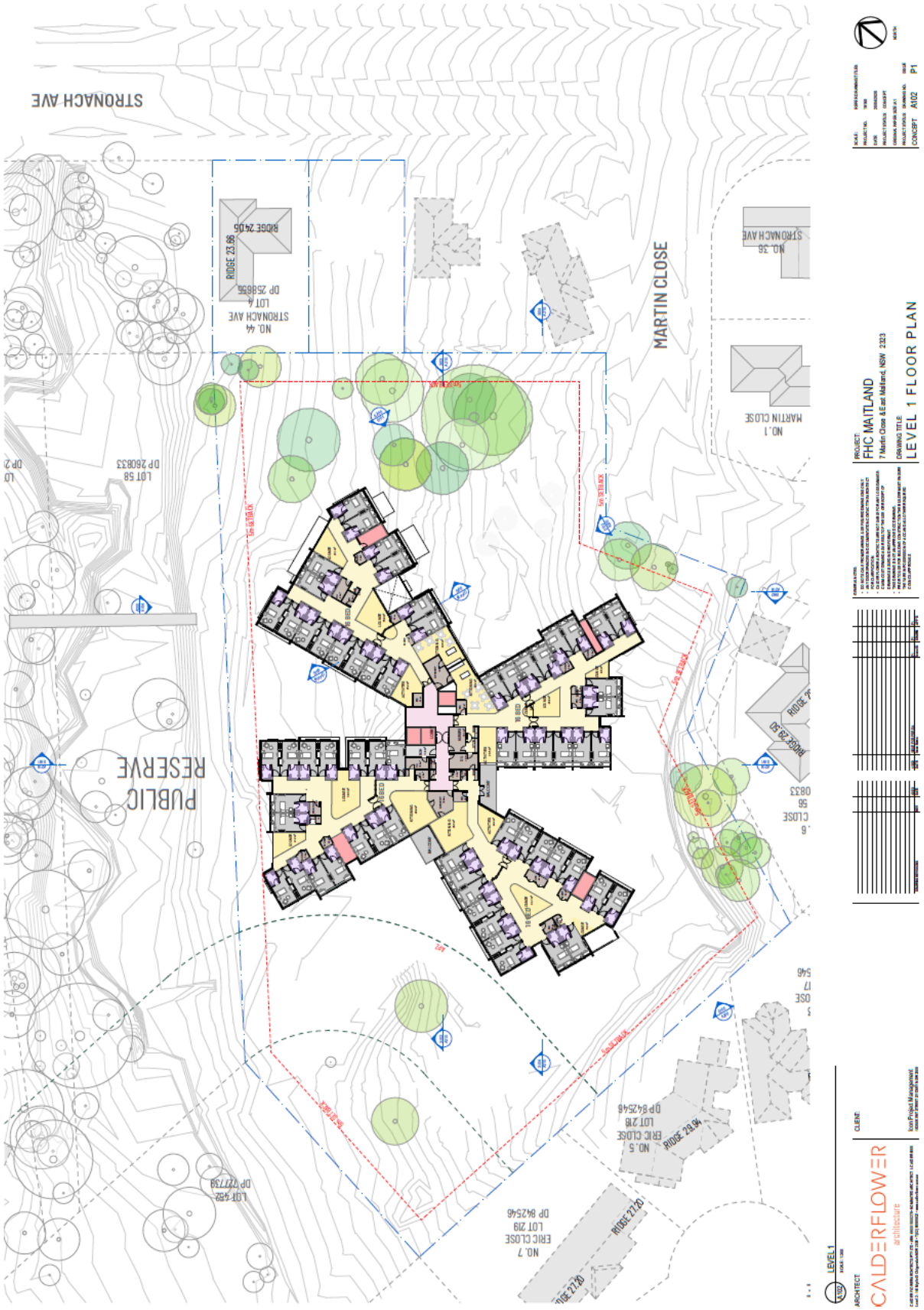
- A detailed noise assessment of the mechanical plant during the detailed design stage is recommended to ensure the acoustic screening and the proposed mechanical plant as specified in this report are adhered to. The noise assessment should include noise source levels of plant, location, adjustments for plant noise characteristics, the cumulative noise effect of all plant noise, and practical effective noise control where required to verify compliance with the criteria.
- Practical noise management measures have been recommended for the outdoor community areas, such as restricting use of the areas during day-time only and the positioning of speakers.
- Construction noise control measures are required to be implemented in the form of a Construction Noise Management Plan during construction.
- Vibration monitoring is required for all construction works occurring within the safe working distances as specified in this report.

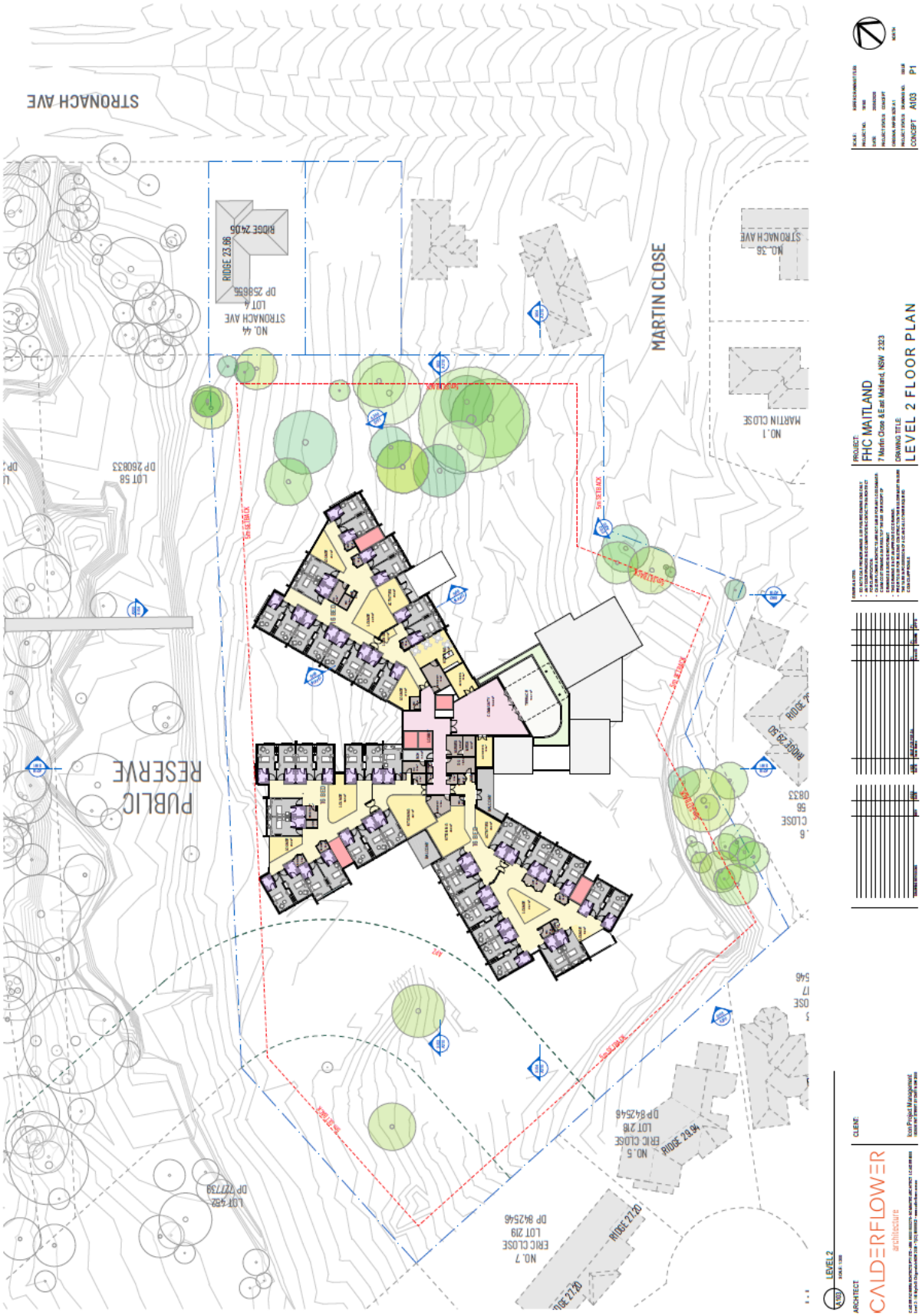
The assessment and recommendations contained in this report demonstrate the development is feasible and reasonable, whilst keeping an appropriate acoustic amenity and controlled noise impact to the local community

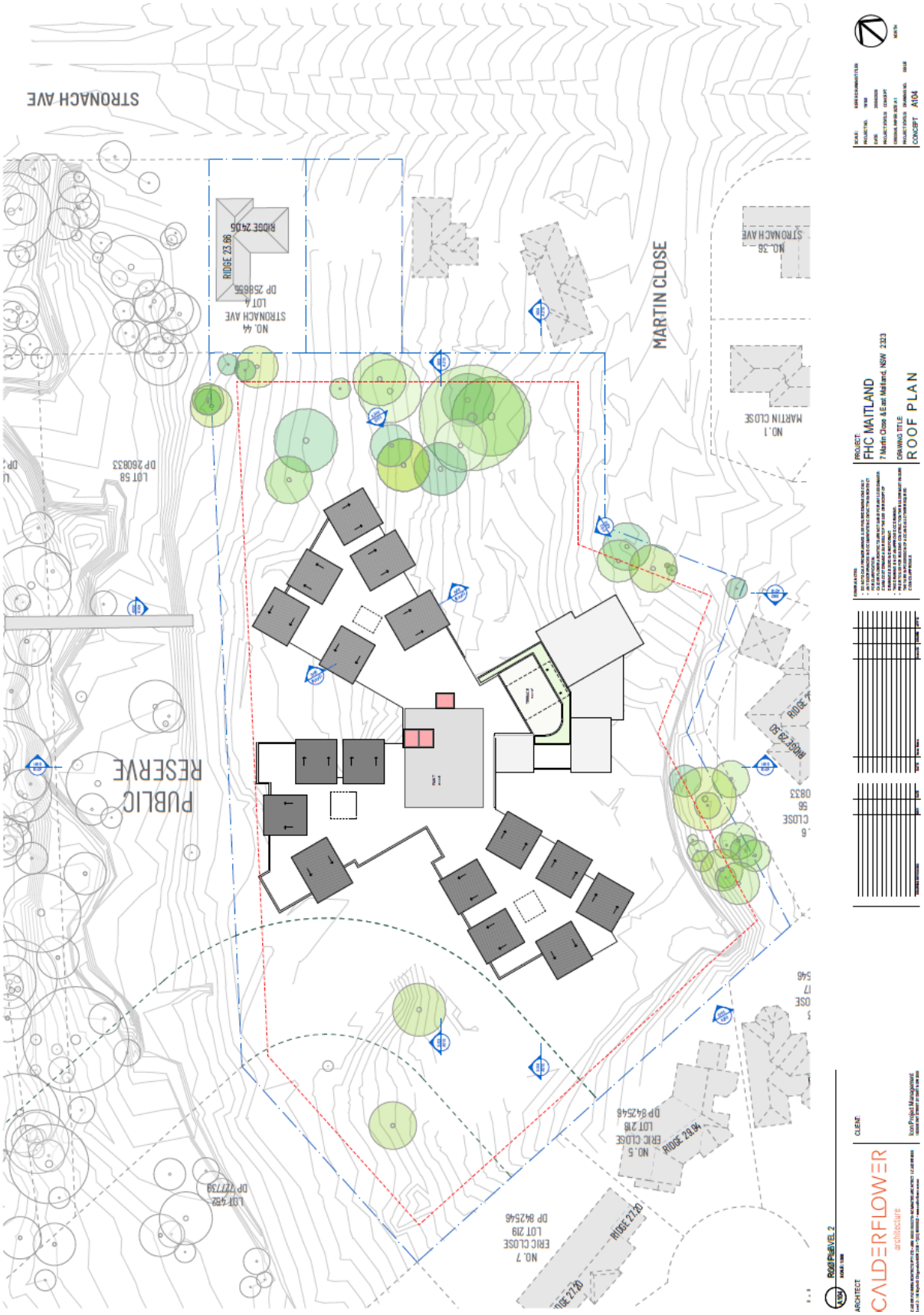
Appendix A Relevant Development Plans


STRONACH AVE
MARTIN CLOSE
PUBLIC RESERVE
LOWER GROUND FLOOR
PROJECT
FHC MAITLAND
7 Martin Close & East Maitland, NSW 2323
DRAWING TITLE
LOWER GROUND FLOOR PLAN
CONCEPT
A100
P1
CALDERFLOWER
architecture

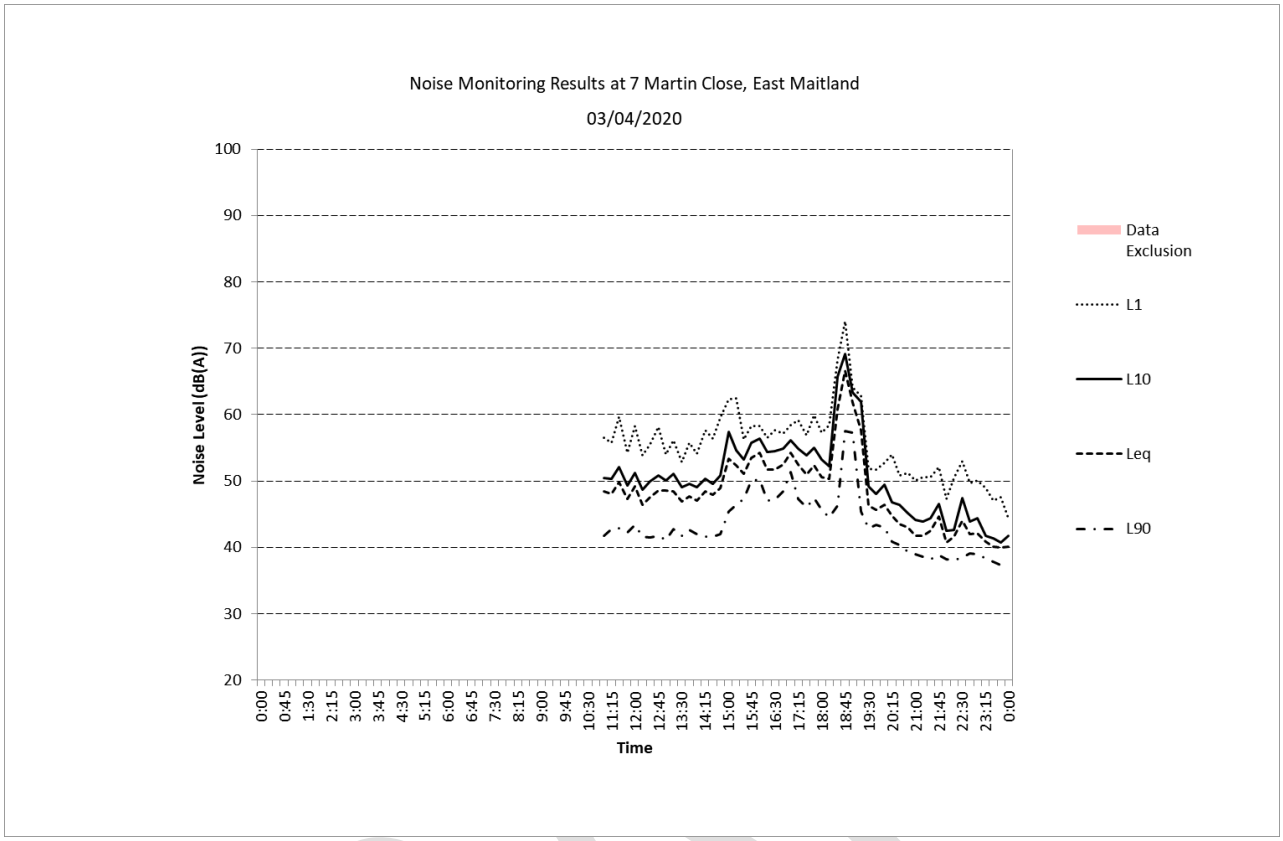

STRONACH AVE
MARTIN CLOSE
PUBLIC RESERVE
NO. 44 STRONACH AVE LOT A DP 258856
NO. 36 STRONACH AVE
NO. 1 MARTIN CLOSE
NO. 5 ERIC CLOSE LOT 218 DP 842546
NO. 7 ERIC CLOSE LOT 219 DP 842546
LOT 58 DP 260833
LOT 432 DP 727738
PROJECT:
FHC MAITLAND
7 Martin Close &5 East Maitland, NSW 2323
DRAWING TITLE:
GROUND FLOOR PLAN
GROUND FLOOR
CONCEPT
A101
P1
ARCHITECT:
CALDERFLOWER
architecture
CLIENT:

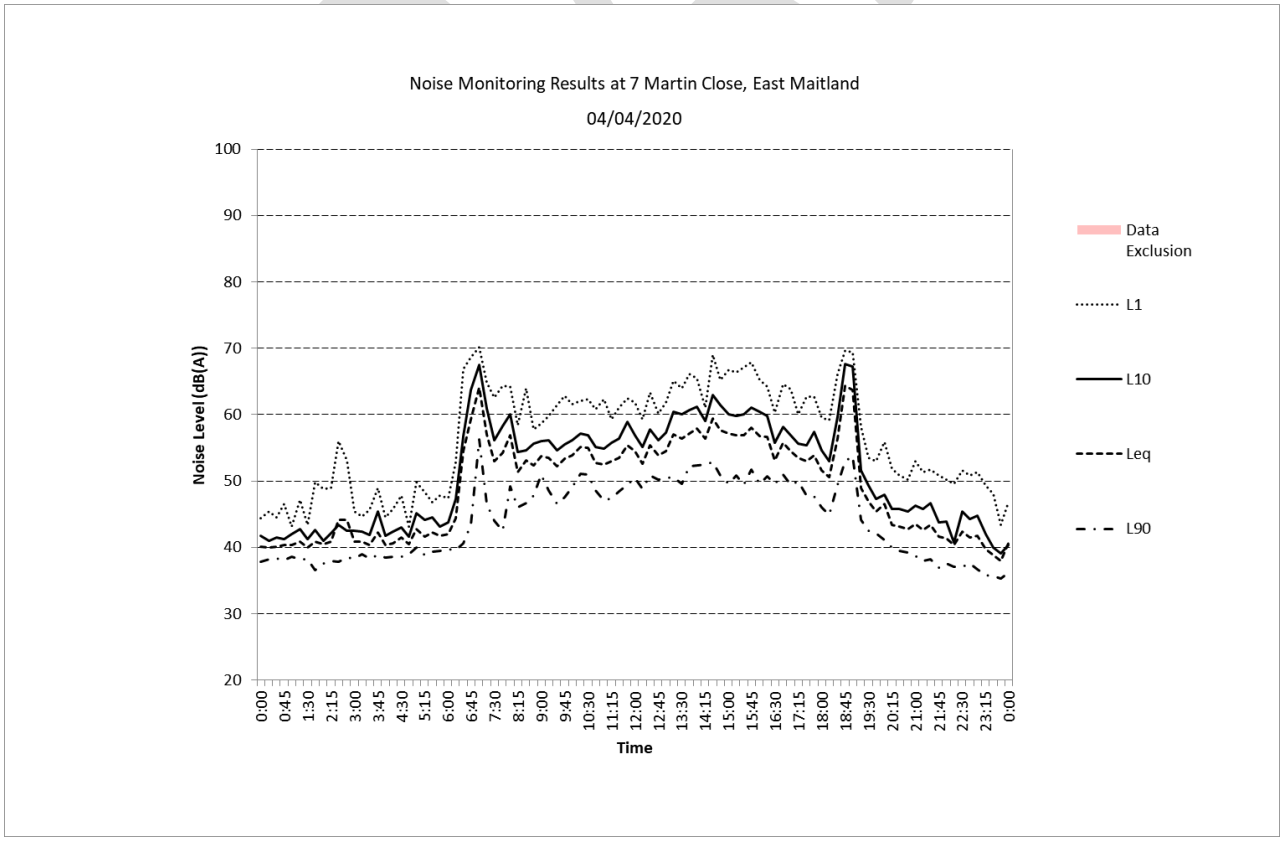

STRONACH AVE
MARTIN CLOSE
PUBLIC RESERVE
PROJECT:
FHC MAITLAND
7 Martin Close & East Maitland, NSW 2323
DRAWING TITLE:
LEVEL 1 FLOOR PLAN
CALDERFLOWER
architecture
LEVEL 1

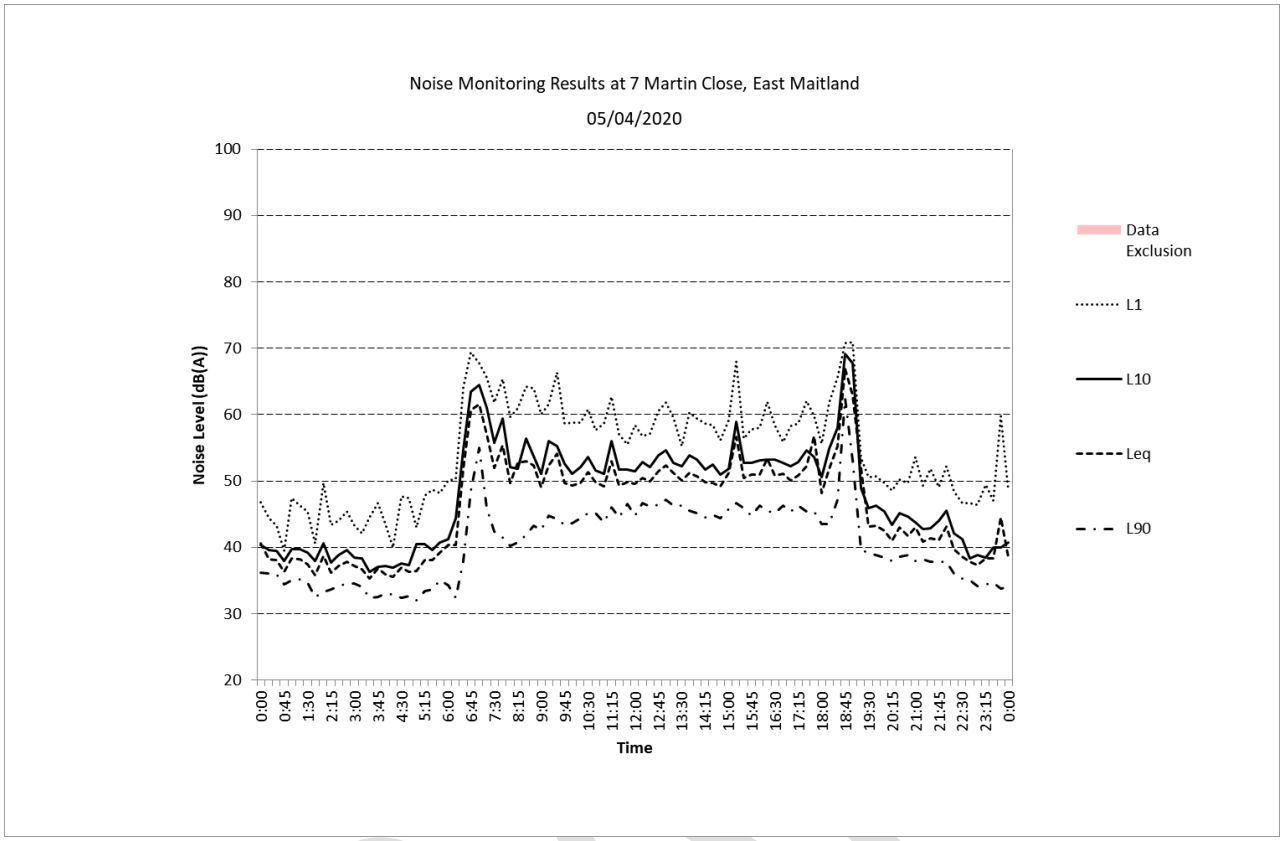

STRONACH AVE
MARTIN CLOSE
PUBLIC RESERVE
PROJECT:
FHC MAITLAND
7 Martin Close & East Maitland, NSW 2323
DRAWING TITLE:
LEVEL 2 FLOOR PLAN
CONCEPT A103 P1
CLIENT:
ARCHITECT
CALDERFLOWER
architecture
LEVEL 2

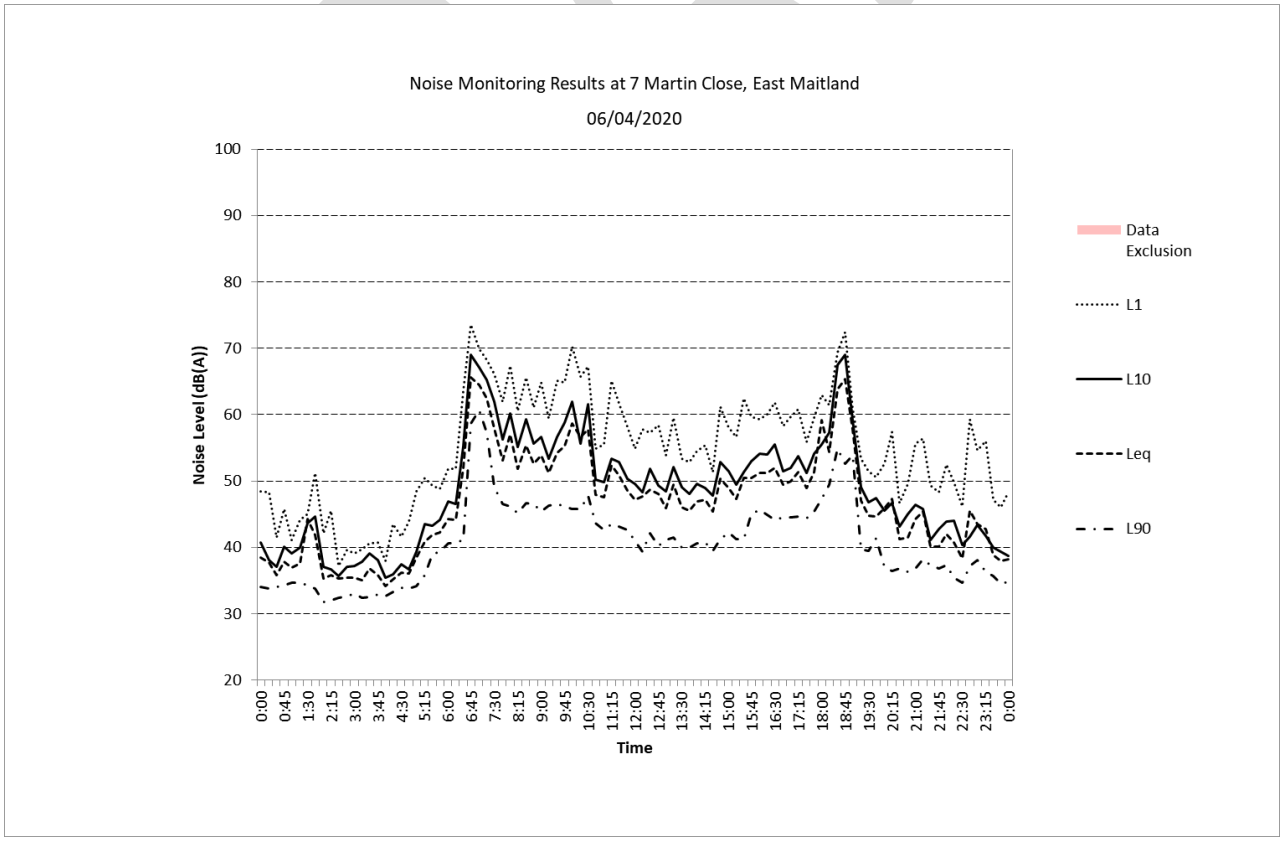

STRONACH AVE
MARTIN CLOSE
PUBLIC RESERVE
PROJECT
FHC MAITLAND
7 Martin Close East Maitland, NSW 2323
DRAWING TITLE
ROOF PLAN
CONCEPT A104
ARCHITECT
CALDERFLOWER
architecture
CLIENT

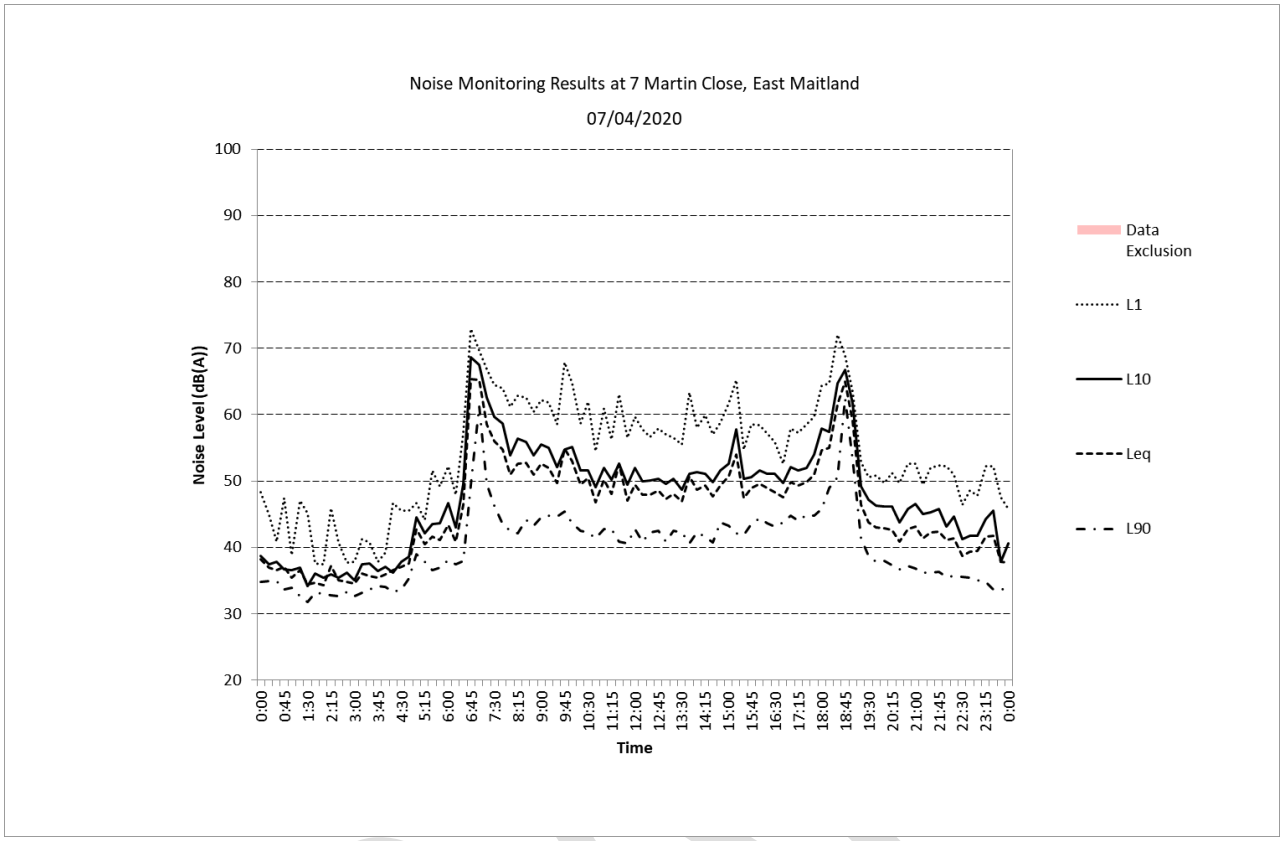
Appendix B Noise Monitoring Graphs

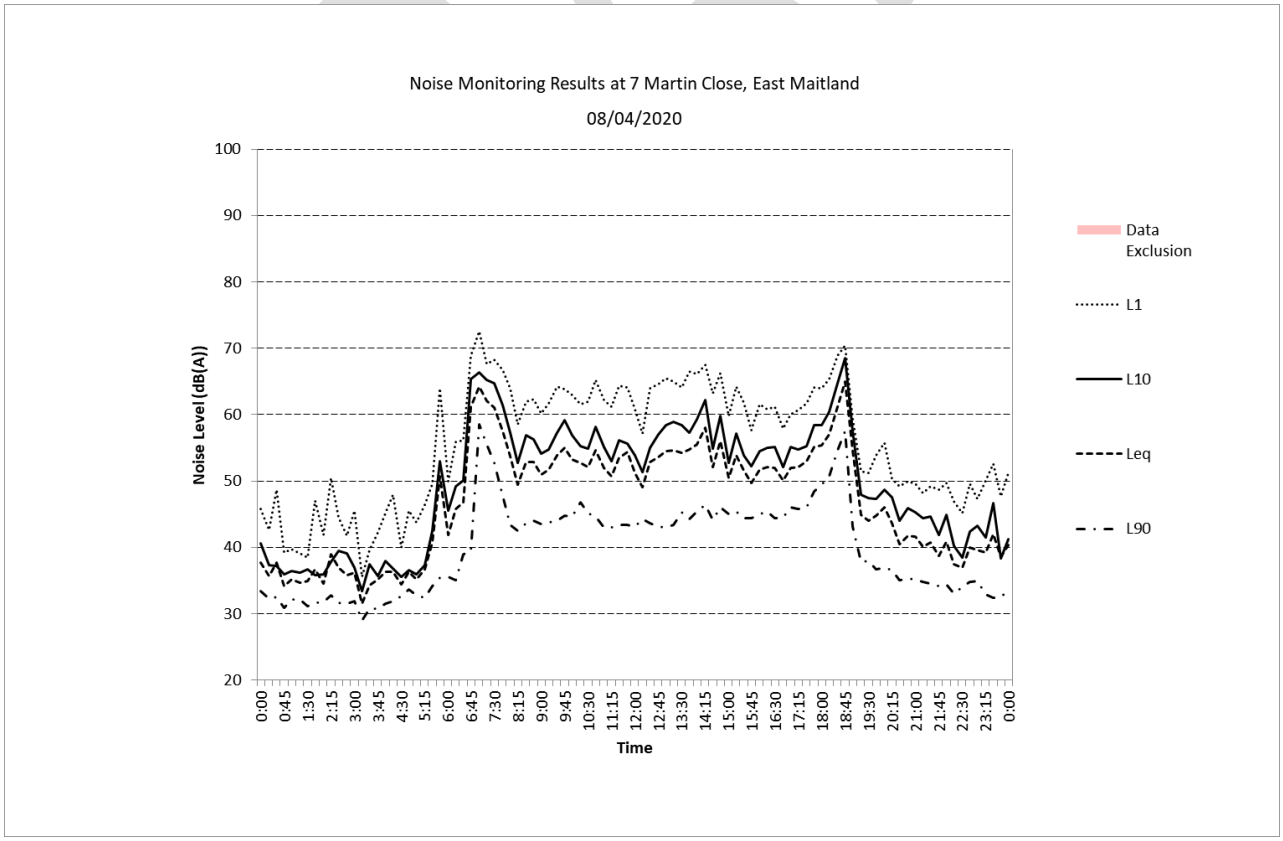

Noise Monitoring Results at 7 Martin Close, East Maitland
03/04/2020
Noise Level (dB(A))
100
90
80
70
60
50
40
30
20
0:00
0:45
1:30
2:15
3:00
3:45
4:30
5:15
6:00
6:45
7:30
8:15
9:00
9:45
10:30
11:15
12:00
12:45
13:30
14:15
15:00
15:45
16:30
17:15
18:00
18:45
19:30
20:15
21:00
21:45
22:30
23:15
0:00
Time
Data Exclusion
L1
L10
Leq
L90

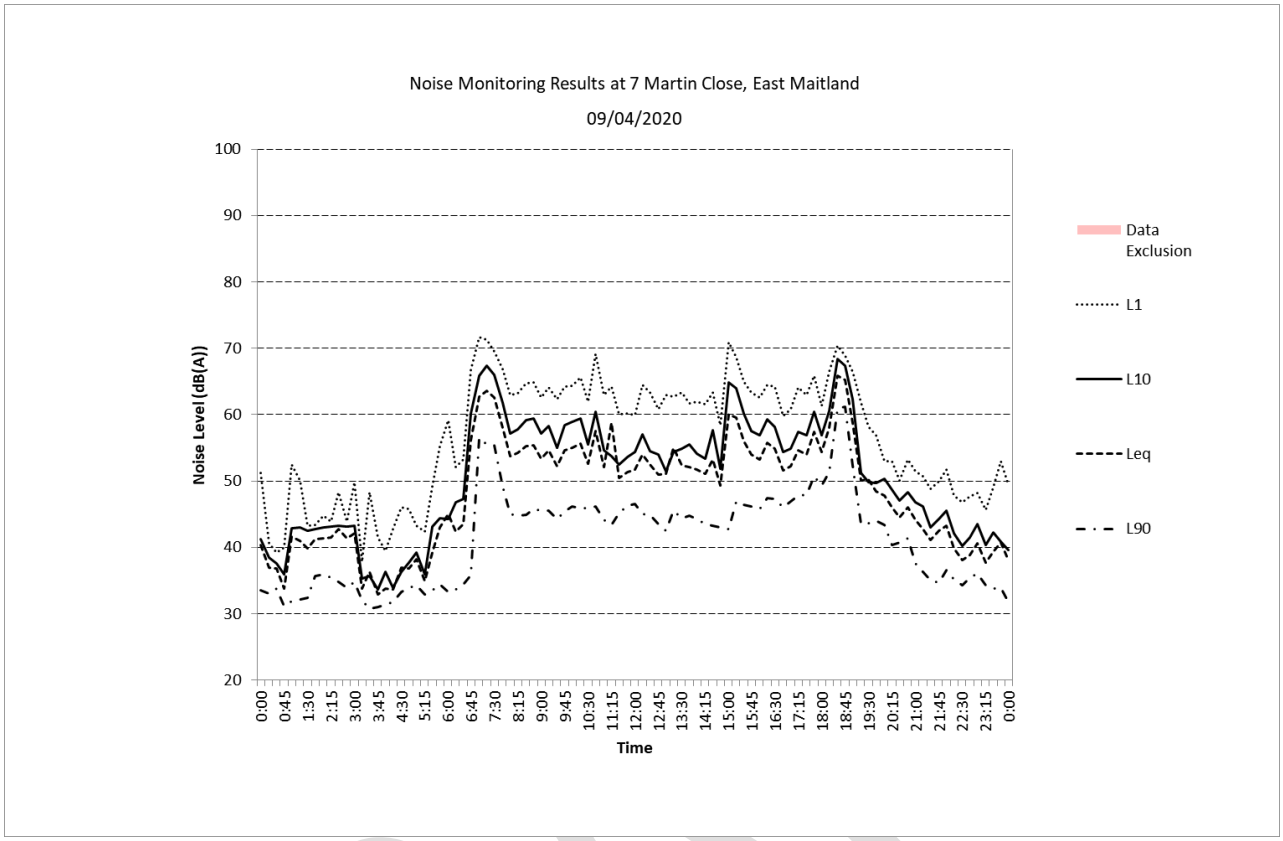

Noise Monitoring Results at 7 Martin Close, East Maitland
04/04/2020
Noise Level (dB(A))
100
90
80
70
60
50
40
30
20
0:00
0:45
1:30
2:15
3:00
3:45
4:30
5:15
6:00
6:45
7:30
8:15
9:00
9:45
10:30
11:15
12:00
12:45
13:30
14:15
15:00
15:45
16:30
17:15
18:00
18:45
19:30
20:15
21:00
21:45
22:30
23:15
0:00
Time
Data Exclusion
L1
L10
Leq
L90

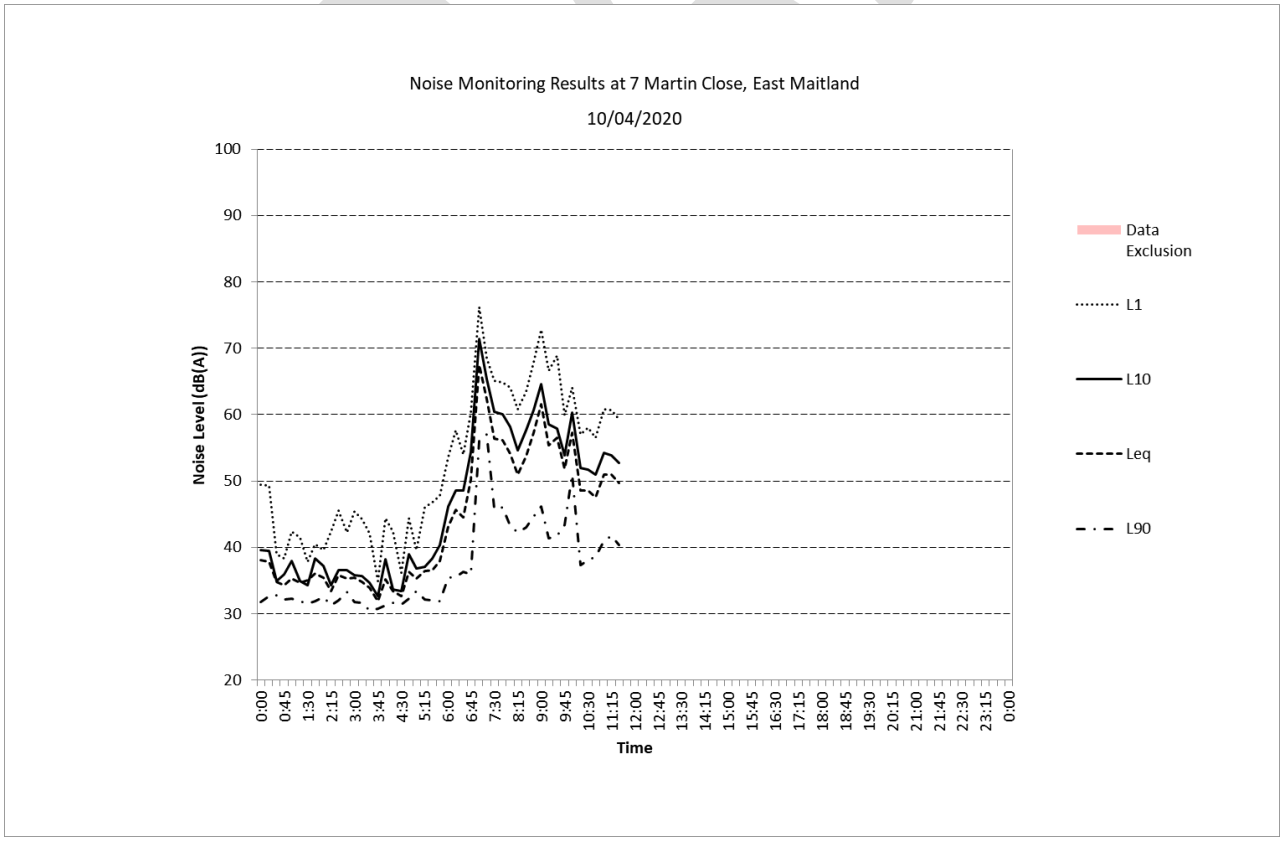

Noise Monitoring Results at 7 Martin Close, East Maitland
05/04/2020
Noise Level (dB(A))
100
90
80
70
60
50
40
30
20
0:00
0:45
1:30
2:15
3:00
3:45
4:30
5:15
6:00
6:45
7:30
8:15
9:00
9:45
10:30
11:15
12:00
12:45
13:30
14:15
15:00
15:45
16:30
17:15
18:00
18:45
19:30
20:15
21:00
21:45
22:30
23:15
0:00
Time
Data Exclusion
L1
L10
Leq
L90


Noise Monitoring Results at 7 Martin Close, East Maitland
06/04/2020
Noise Level (dB(A))
100
90
80
70
60
50
40
30
20
0:00
0:45
1:30
2:15
3:00
3:45
4:30
5:15
6:00
6:45
7:30
8:15
9:00
9:45
10:30
11:15
12:00
12:45
13:30
14:15
15:00
15:45
16:30
17:15
18:00
18:45
19:30
20:15
21:00
21:45
22:30
23:15
0:00
Time
Data Exclusion
L1
L10
Leq
L90


Noise Monitoring Results at 7 Martin Close, East Maitland
07/04/2020
Noise Level (dB(A))
100
90
80
70
60
50
40
30
20
0:00
0:45
1:30
2:15
3:00
3:45
4:30
5:15
6:00
6:45
7:30
8:15
9:00
9:45
10:30
11:15
12:00
12:45
13:30
14:15
15:00
15:45
16:30
17:15
18:00
18:45
19:30
20:15
21:00
21:45
22:30
23:15
0:00
Time
Data Exclusion
L1
L10
Leq
L90


Noise Monitoring Results at 7 Martin Close, East Maitland
08/04/2020
Noise Level (dB(A))
100
90
80
70
60
50
40
30
20
0:00
0:45
1:30
2:15
3:00
3:45
4:30
5:15
6:00
6:45
7:30
8:15
9:00
9:45
10:30
11:15
12:00
12:45
13:30
14:15
15:00
15:45
16:30
17:15
18:00
18:45
19:30
20:15
21:00
21:45
22:30
23:15
0:00
Time
Data Exclusion
L1
L10
Leq
L90


Noise Monitoring Results at 7 Martin Close, East Maitland
09/04/2020
Noise Level (dB(A))
100
90
80
70
60
50
40
30
20
0:00
0:45
1:30
2:15
3:00
3:45
4:30
5:15
6:00
6:45
7:30
8:15
9:00
9:45
10:30
11:15
12:00
12:45
13:30
14:15
15:00
15:45
16:30
17:15
18:00
18:45
19:30
20:15
21:00
21:45
22:30
23:15
0:00
Time
Data Exclusion
L1
L10
Leq
L90


Noise Monitoring Results at 7 Martin Close, East Maitland
10/04/2020
Noise Level (dB(A))
100
90
80
70
60
50
40
30
20
0:00
0:45
1:30
2:15
3:00
3:45
4:30
5:15
6:00
6:45
7:30
8:15
9:00
9:45
10:30
11:15
12:00
12:45
13:30
14:15
15:00
15:45
16:30
17:15
18:00
18:45
19:30
20:15
21:00
21:45
22:30
23:15
0:00
Time
Data Exclusion
L1
L10
Leq
L90

Appendix C Glossary

In this acoustic report unless the context of the subject matter otherwise indicates or requires, a term has the following meaning:

TERM	DEFINITION
ABL	The Assessment Background Level is the single figure background level representing each assessment period (daytime, evening and night-time (for each day). It is determined by calculating the 10th percentile (lowest 10th percent) background level (L_{A90}) for each period.
Adverse Weather	Weather effects that increases noise (i.e. wind and temperature inversion) that occurs at a site for a significant period of time (i.e. wind occurring more than 30% of the time in any assessment period in any season and / or temperature inversion occurring more than 30% of the nights in winter).
Ambient Noise	The all-encompassing noise associated within a given environment. It is the composite of sounds from many sources both near and far.
Assessment Period	The period in a day over which assessments are made: day (0700 to 1800h), evening (1800 to 2200h) or night (2200 to 0700h) or actual operating period if only a part of a period(s).
A – Weighting Filter	A-weighting is the most commonly used of a family of curves defined in the International standard IEC 61672:2003 and various national standards relating to the measurement of sound pressure level. A-weighting is applied to instrument-measured sound levels in effort to account for the relative loudness perceived by the human ear, as the ear is less sensitive to low audio frequencies.
Background Noise	The underlying level of noise present in the ambient noise, excluding the noise source under investigation, when extraneous noise is excluded. Usually described using the L90 measurement parameter.
C – Weighting Filter	The C-weighting approximates the sensitivity of human hearing at industrial noise levels (above about 85 dB(A)). The C-weighted sound level (i.e., measured with the C-weighting) is more sensitive to sounds at low frequencies than the A-weighted sound level and is sometimes used to assess the low-frequency content of complex sound environments and entertainment noise.
Decibel	The ratio of sound pressures which we can hear is a ratio of 106 (one million:one). For convenience, therefore, a logarithmic measurement scale is used. The resulting parameter is called the 'sound pressure level' (Lp) and the associated measurement unit is the decibel (dB). As the decibel is a logarithmic ratio, the laws of logarithmic addition and subtraction apply.
dB(A)	The unit generally used for measuring environmental, traffic or industrial noise is the A-weighted sound pressure level in decibels, denoted dB(A). An A-weighting network can be built into a sound level measuring instrument such that sound levels in dB(A) can be read directly from a sound level meter. The weighting is based on the frequency response of the human ear and has been found to correlate well with human subjective reactions to various sounds. It is worth noting that an increase or decrease of approximately 10 dB corresponds to a subjective doubling or halving of the loudness of a noise, and a change of 2 to 3 dB is subjectively barely perceptible.
Equivalent Continuous Sound Level (L_{eq})	Another index for assessment for overall noise exposure is the equivalent continuous sound level, L_{eq}. This is a notional steady level which would, over a given period of time, deliver the

TERM	DEFINITION
	same sound energy as the actual time-varying sound over the same period, similar to the average. Hence fluctuating levels can be described in terms of a single figure level.
Extraneous Noise	Noise resulting from activities that are not typical of the area. Atypical activities may include construction, and traffic generated during holiday periods and during special events such as concert or sporting events.
Fast Time Weighting	125 ms integration time while the signal level is increasing and decreasing.
Frequency	The rate of repetition of a sound wave. The subjective equivalent in music is pitch. The unit of frequency is the Hertz (Hz), which is identical to cycles per second. A thousand hertz is often denoted kHz, e.g. 2 kHz = 2000 Hz. Human hearing ranges approximately from 20 Hz to 20 kHz. For design purposes, the octave bands between 63 Hz to 8 kHz are generally used. The most commonly used frequency bands are octave bands, in which the mid frequency of each band is twice that of the band below it. For more detailed analysis, each octave band may be split into three one-third octave bands or in some cases, narrow frequency bands.
L_{Aeq}	See equivalent continuous sound level definition above. This is the A-weighted energy average of the varying noise over the sample period and is equivalent to the level of a constant noise which contains the same energy as the varying noise environmental. This measure is also a common measure of environmental noise and road traffic noise.
$L_{Aieq,T}$	Equivalent continuous A-weighted sound pressure level over the measurement period T with impulse time weighting.
$L_{Ceq,T}$	The equivalent continuous C-weighted sound pressure level (integrated level) that, over the measurement period T, has the same mean square sound pressure (referenced to 20 µPa) as the fluctuating sound(s) under consideration.
$L_{C, Peak}$	The C-weighted Peak sound pressure level during a designated time interval or a noise event.
Maximum Noise Levels L_{max}	The maximum noise level over a sample period is the maximum level, measured on fast response, during the sample period.
Minimum Noise Levels L_{min}	The minimum noise level over a sample period is the minimum level, measured on fast response, during the sample period.
Noise Sensitive Receiver (NSR)	A noise sensitive receiver is any person or building or outside space in which they reside or occupy that has the potential to be adversely impacted by noise from an outside source, or noise not generated by the noise sensitive receiver.
Octave Bands	Octave bands are frequency ranges in which the upper limit of each band is twice the lower limit. Octave bands are identified by their geometric mean frequency, or centre frequency.
One-Third Octave Bands	One-Third Octave Bands are frequency ranges where each octave is divided into one-third octaves with the upper frequency limit being 1.26 times the lower frequency. They are identified by the geometric mean frequency of each band, or centre frequency.

TERM	DEFINITION
Project-Specific Noise Levels	They are target noise levels for a particular noise generating facility. They are based on the most stringent of the intrusive or amenity criteria derived from the NSW Industrial Noise Policy.
RBL	The Rating Background Level for each period is the median value of the ABL values for the period over all the days measured. There is a therefore an RBL value for each period – daytime, evening and night-time.
Shoulder Periods	Where early morning (5 am to 7 am) operations are proposed, it may be unduly stringent to expect such operations to be assessed against the night-time criteria (especially if existing background noise levels are steadily rising in these early morning hours). In these situations, appropriate noise level targets may be negotiated with the regulatory/consent authority on a case-by-case basis.
Sound Level Difference (D)	The sound insulation required between two spaces may be determined by the sound level difference needed between them. A single figure descriptor, the weighted sound level difference, D_w, is sometimes used (see BS EN ISO 717-1).
Sound Power	The sound power level (L_w) of a source is a measure of the total acoustic power radiated by a source. The sound pressure level varies as a function of distance from a source. However, the sound power level is an intrinsic characteristic of a source (analogous to its volume or mass), which is not affected by the environment within which the source is located.
Statistical Noise Levels	For levels of noise that vary widely with time, for example road traffic noise, it is necessary to employ an index which allows for this variation. The L_{10}, the level exceeded for ten per cent of the time period under consideration, has been adopted in this country for the assessment of road traffic noise. The L_{90}, the level exceeded for ninety per cent of the time, has been adopted to represent the background noise level. The L_1, the level exceeded for one per cent of the time, is representative of the maximum levels recorded during the sample period. A-weighted statistical noise levels are denoted L_{A10}, dBL_{A90} etc. The reference time period (T) is normally included, e.g. $dBL_{A10, 5min}$ or $dBL_{A90, 8hr}$.
L_{A1}	The L_{A1} level is the A-weighted noise level which is exceeded for 15 of the sample period. During the sample period, the noise level is below the L_{A1} level for 99% of the time.
L_{A10}	The L_{A10} level is the A-weighted noise level which is exceeded for 10% of the sample period. During the sample period, the noise level is below the L_{A10} level for 90% of the time. The L_{A10} is a common noise descriptor for environmental noise and road traffic noise.
L_{A50}	The L_{A50} level is the A-weighted noise level which is exceeded for 50% of the sample period.
L_{A90}	The LA90 level is the noise level which is exceeded for 90% of the sample period. During the sample period, the noise level is below the LA90 level for 10% of the time. This measure is a commonly referred to as the background noise level.
Tonality	Noise containing a prominent frequency and characterised by a definite pitch.