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CONSTRUCTION MANAGEMENT PLAN

For

AFFORDABLE + BUILD TO RENT HOUSING DEVELOPMENT
2a Gregory Place Harris Park,

STATE SIGNIFICANT DEVELOPMENT APPROVAL

CONTENTS

Revision of this CMP

A	26/3/2025	Issued for amendment
Revision	*Date*	*Description of Change*

Approvals and Modifications included in this CMP

Approval/ Modification No.	*Description*

1.0 GENERAL

This Construction Management Plan has been prepared draft format to identify for the consent authority how the management of the site during the "construction" stage of this project may proceed.

This plan is a live document and shall be updated with each subsequent application for construction, to ensure it remains pertinent to the current design and construction methodology and sequencing.

The majority of the works are confined to the site area, inclusive of all accommodation, storage, loading and unloading, environmental controls and materials handling.

No activities are currently proposed to be carried out off-site. There is potential fo some infrastructure upgrade works in collaboration with Parramatta Council and Sydney Water. If these are to proceed they will need to progress through a (Voluntary Planning Agreement) VPA or similar agreement.

2.0 SITE STAGING

The project is not currently assumed to be delivered in stages.

3.0 SITE ESTABLISHMENT

The site consists of a series of existing factory buildings, hard stand and overgrown open space. The entire site will be secured with the required amenities provided in accordance with construction sequencing.

4.0 EROSION & SEDIMENT CONTROL

All sediment and erosion control measures will be installed and maintained in accordance with the relevant plans.

Sediment and erosion control measured will be inspected every 48 hours and after each downpour.

5.0 VEHICULAR ACCESS/EGRESS

The site currently provides two vehicular access/egress points to Gregory Place. It is proposed that during the works these will be utilised to ensure vehicles enter and exit in a forward direction.
Work includes the construction of the internal road including the two new vehicular entry/egress points. Upon their completion, all vehicular movements will occur via these new driveways.

Contractor parking will be proved onsite, with an emphasis during site inductions to promote car pooling and the utilisation of public transport.

Refer to the construction traffic management plan for further details.

6.0 MATERIAL HANDLING

All waste and materials will be handled onsite.

Waste generated through the construction works will be removed by the engaged subcontractor.

Surplus excavated material will be removed by the engaged subcontractor.

A waste minimisation and recycling strategy will be employed onsite with the engaged waste bin supplier.

Telehandlers will be deployed for horizontal materials movement, and materials hoists and tower cranes deployed for vertical materials movement. The location, type and nature of these will be determined with the subsequent detailed design stages.

7.0 DUST MANAGEMENT

In order to mitigate the risk of air-borne dust the following procedures may need to be implemented for the following items:

Excavation
Water down all working surfaces as required and install wash out pit for trucks during initial excavation stages.

Site Perimeter
Install solid or shade cloth panels to fence.

Material Stockpiles
Avoid stockpiles wherever possible, however, water down if required.

Scaffold
To be fitted with mesh and dust/shade cloth (if necessary).

Trucks
Cover loose loads prior to leaving site.

Site
Ensure access points are kept clean and free of spoil at all times.

Plant and Equipment
Contractors to service machinery regularly and ensure qualified operators minimise excessive emissions.

Garbage Chutes
May be used during construction and at the base of these chutes a bulk bin will be used to collect the waste. The chutes may be fitted with devices that hose down the garbage as it is dropped in to the chutes.

Power Tools
Whenever possible, wet processes will be used during cutting, drilling and grinding to limit dust emissions.

8.0 NOISE & VIBRATION MANAGEMENT

A Construction Noise and Vibration Management Plan will be specifically prepared for this site. The lodged Acoustic Report by Renzo Tonin & Associates identifies a high level review with proposed recommendations.

Generally, all plant and equipment will be properly maintained to reduce excessive noise and vibration.

Propose the use of electric cranes and bored piling to reduce excessive noise and vibration where feasible.

Strategically position plant on site to reduce the emission of noise to the surrounding neighbourhood and to site personnel.

Any equipment not in use for extended periods during construction work must be switched off.

The offset distance between noisy plant and adjacent sensitive receivers is to be maximised where practicable.

Plant used intermittently to be throttled down or shut down when not in use where practicable.

9.0 COMMUNITY ENGAGEMENT

A community hotline will be established for complaints.

A management procedure will be put in place to deal with complaints that may arise from construction activities.

Each complaint will need to be investigated and appropriate amelioration measures put in place to mitigate further occurrences.

The person selected to liaise with the community must be adequately trained and experienced in such matters.

10.0 CONTAMINATION MANAGEMENT

It is understood the existing site buildings and structures contain hazardous materials that could include non-friable and friable forms of asbestos containing building products.

It is a requirement under the Work Health and Safety Act 2011 (NSW) and the Work Health and Safety Regulation 2017 (NSW) that hazardous building materials including asbestos must be removed and managed appropriately before any demolition of buildings or structures occurs.

Contamination of ground surfaces and soil caused by inappropriate demolition practices would not occur under existing controls and legislation of managing hazardous asbestos building materials.

APPENDIX A – [NOT USED]

APPENDIX B – SEDIMENT & EROSION CONTROL

(to be prepared at detailed design stage)

APPENDIX C – CONSTRUCTION TRAFFIC MANAGEMENT PLAN

Technical Advisory Note

Project	2A Gregory Place	**Project Number**	SCT_00631
Client	2A Gregory Place Pty Ltd		
Document Name	Preliminary Construction Traffic Management Plan		
Version	2.0	**Date**	26 May 2025
Author	Sorathun Maitrawatthana	Consultant	
Reviewer	Andy Yung	Director	
Authoriser	Andy Yung	Director	

1.0 Introduction

SCT Consulting has been engaged by 2A Gregory Place Pty Ltd (the proponent) to prepare a transport and accessibility impact assessment (TAIA) to support an updated state significant development application (SSDA) for a proposed affordable housing build-to-rent (BTR) residential development at 2A Gregory Place, Harris Park, in the City of Parramatta local government area.

As part of the TAIA and requested by the Secretary's Environmental Assessment Requirements (SEARs), a preliminary Construction Traffic Management Plan (CTMP) is required to accompany the assessment to provide estimated construction vehicle movements and how their impacts would be managed and mitigated.

Given the project design is in its early stages, a preliminary CTMP is deemed adequate to provide a high-level appraisal of construction traffic management. Contractors responsible for the construction of the development will prepare a detailed CTMP, which may need to be approved by relevant authorities before the construction commences. A detailed CTMP usually includes Temporary Traffic Management Plans (TTMPs) and a Driver's Code of Conduct.

2.0 Site context

The development site is located at Gregory Place, south of Hassall Street and around 1km east of the Parramatta CBD. The area around the site is characterised as a predominantly low-density residential neighbourhood and open space, with a church and school south of Clay Cliff Creek. The existing context around the site is shown in **Figure 2-1**.

Key roads in the proximity of the site include:

– **James Ruse Drive** is a State road starting from the Cumberland Highway in the north and ending at the Great Western Highway in the south. It provides access for North Parramatta residents to the M4 Motorway towards the Sydney CBD and western suburbs. The road is asymmetrical with four lanes as it enters the intersection with Hassall Street and three lanes as it exits the intersection.

– **Hassall Street** is a regional road connecting the site to James Ruse Drive in the east and the Parramatta CBD in the west. The road has two lanes in each direction. Footpaths are provided along both sides of the road, separated from the road by street trees. Pedestrian crossings are provided at the intersection with Alfred Street.

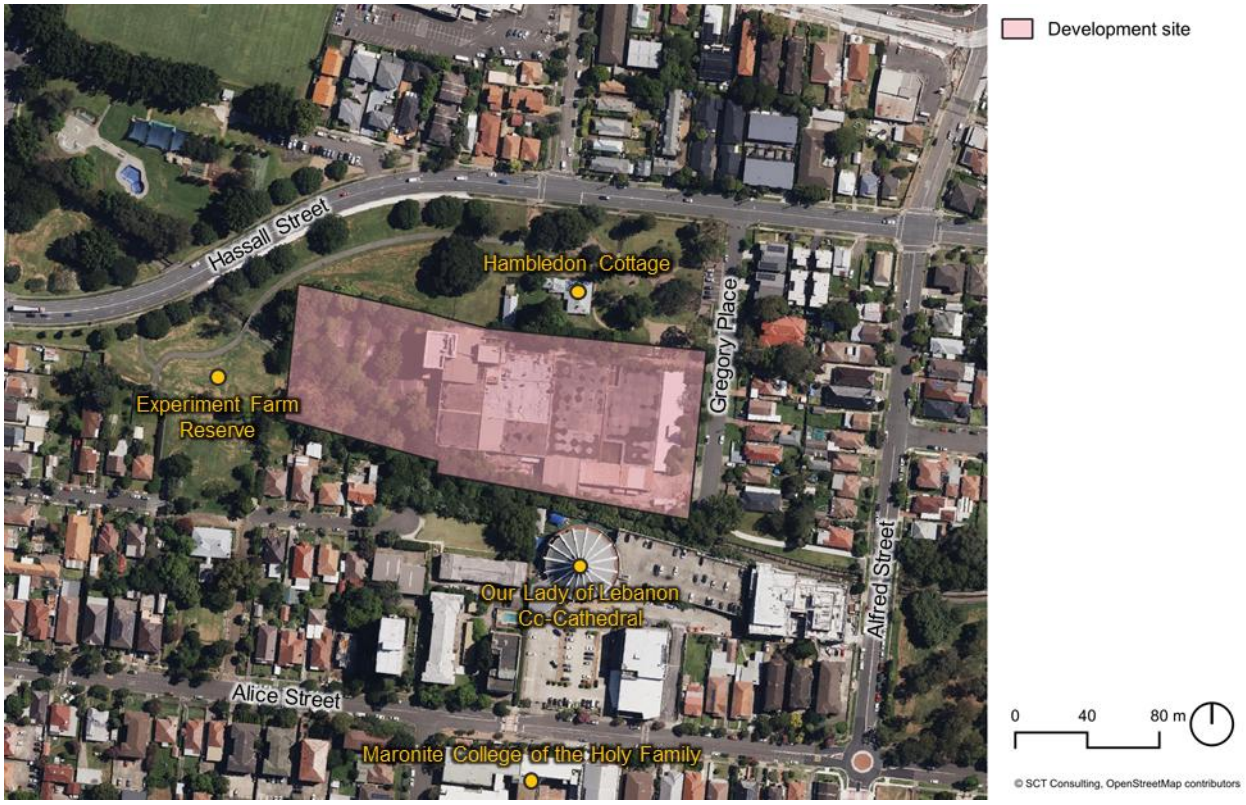
– **Parkes Street** is a regional road continuing from Hassall Street at the intersection with Harris Street in the east towards the Great Western Highway in the west. The road has two lanes in each direction with footpaths on both sides of the road. Tall buildings along the northern side provide shade for road users on the ground. On-street parking is prohibited throughout its length.

– **Harris Street** runs in the north-south direction. It provides links to the wider road network via Hassall Street, Parkes Street, and Macarthur Street. The road has four lanes north of Parkes Street and two lanes southwards. Footpaths, nature strips, and occasional street trees are provided on both sides of the road.

– **Gregory Place** is a local cul-de-sac that provides the only access to the site. The road is 10.2m wide and can accommodate two-way traffic and on-street parking. Footpaths are provided only on the western side.

– **Alfred Street** is a local road to the east of the site. To the north, the road provides a link between the site and the Tramway Avenue Light Rail Stop. The road generally has one lane per direction with footpaths, on-street parking, and nature strips along both sides.

Figure 2-1 Existing context around the site



Source: SIX Maps (2024) / Annotated by SCT Consulting

3.0 Construction activities

The construction activities have not been finalised at this stage and will be confirmed later once all contractors have been appointed. Notwithstanding, main construction activities may include, but not limited to, the following:

– Demolition of existing structures

– Excavation and disposal of discarded construction materials and soil

– Construction of structure and sub-structure

– Fit out and finishes

– Landscaping

4.0 Working hours

This preliminary CTMP proposes that the construction working hours for the proposed development be between the hours of 7am and 6pm on weekdays, in accordance with the Draft Construction Noise Guideline (EPA, 2020)'s recommendations, with an additional working hours between 7am and 6pm on Saturdays, noting that the nearby development at Novus 39-43 Hassell Street (SSD-34919690) is approved for Saturday working hours of 8am–5pm.

5.0 Site access

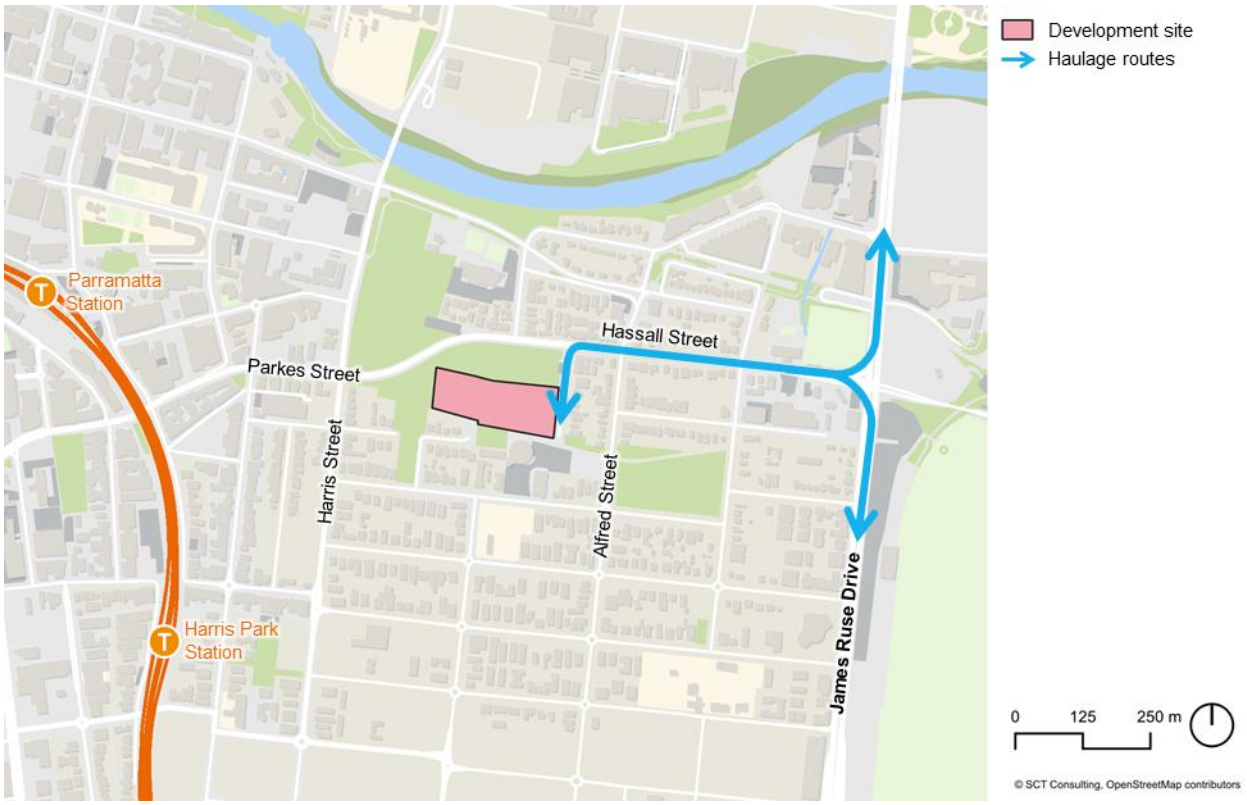
Most construction vehicles are anticipated to access the site via James Ruse Drive < > Hassall Street < > Gregory Place, as shown in **Figure 5-1**.

Based on the desktop analysis, heavy vehicles (including B-double trucks) are anticipated to be able to access the site following the preliminary proposed haulage route. Nevertheless, the following should be noted:

– Removals and deliveries carried out by vehicles of B-double size and larger should be restricted to take place outside of the road network peak hours to mitigate the potential impacts on other road users.

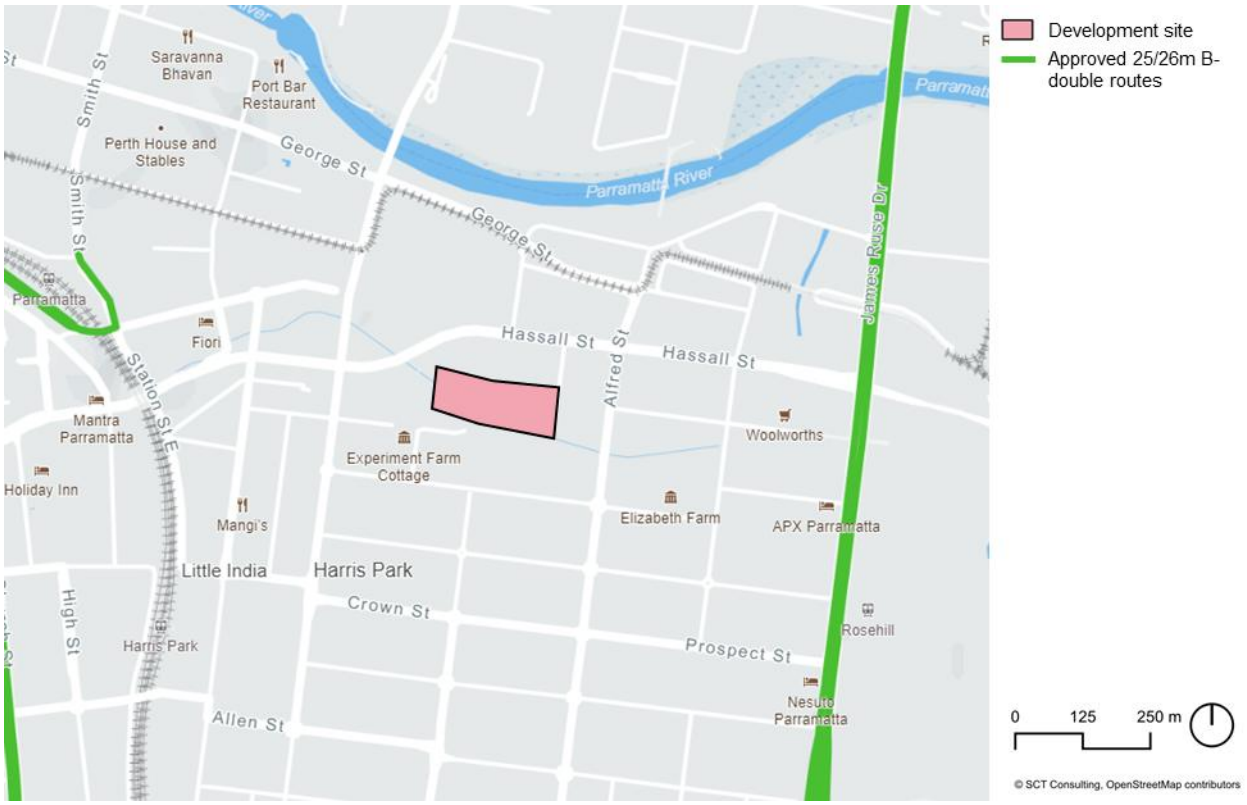
– Vehicle swept path analyses may be required at key pinch points, particularly the Hassall Street | Gregory Place intersection and the site entrance, once contractors have been appointed. This will be prepared by the contractors when they confirm the preferred heavy vehicle access route.

Figure 5-1 Construction haulage routes



The New South Wales Restricted Access Vehicle (RAV) map shows that James Ruse Drive is a designated 25/26m B-double route. It is integrated to the wider road network via the M4 Western Motorway, Parramatta Road, and Victoria Road. **Figure 5-2** depicts approved 19m B-double routes around the site.

Figure 5-2 Approved 25/26m B-double routes around the site



Source: National Heavy Vehicle Register (2024)

6.0 Construction traffic volume

The volume of construction traffic required to deliver this proposal has not yet been determined and will be required to be assessed in a detailed CTMP provided by the principal contractor, typically post-DA approval.

7.0 Impacts on parking

Removal and delivery activities will be managed and occur within the site boundary. When needed, heavy vehicles will be parked within the site.

Given the site location close to the Parramatta CBD and various public transport options, most construction workers are expected to travel to the site by public transport while only a small proportion would drive. Considering the site land area, it is satisfied that the workers' parking demand will be sufficiently accommodated within the site and there will be no impact on the availability of the on-street parking in the area.

Specific parking requirements based on construction staging will need to be further considered by the principal contractor under the detailed CTMP. The following measures could be implemented to encourage staff to utilise public transport:

– Provision of a secure tool storage facility on-site to allow tradespeople to safely store tools required for the project allowing them to use public transport to travel to and from the site on a daily basis.

– During the site induction phase and regular management meetings, staff would be instructed to use public transport when travelling to the site and public transport timetables. Workers would also be informed of restricted parking conditions on-site and the surrounding road network.

8.0 Impacts on walking and cycling

Pedestrian and cyclist access and safety need to be prioritised, and alternative routes should be provided where needed.

Signage will be provided to give information on the construction works. All signs should be visible and noticeable.

Where construction works have an impact on the footpath on Gregory Place, consideration will be given to the requirements of pedestrians and cyclists, especially those with specific requirements, e.g., seniors, people with prams, and people with mobility aides.

Movements of heavy vehicles and large construction equipment should be controlled and coordinated by qualified personnel to manage potential conflicts between these larger vehicles and pedestrians and cyclists.

All vehicles are required to enter and exit the site in a forward movement unless in special circumstances. This is to ensure that both pedestrians and drivers have clear sight distances and can easily gauge and mitigate any potential safety risks.

9.0 General mitigations

The following mitigations are proposed to reduce the potential impacts of construction traffic on the surrounding area:

- Truckloads are to be covered during transportation.
- Neighbouring properties are to be notified of construction works and timing. Any comments would be recorded and taken into consideration when planning construction activities.
- All activities, including materials delivery, are to be conducted fully within the sites and, therefore, would not impede traffic flow along local roads.
- Materials are to be delivered and spoil removed during standard construction hours.
- Avoidance of idling trucks alongside sensitive receivers
- Deliveries are planned to ensure a consistent and minimal number of trucks arriving at the site at any time.
- Additionally, to manage driver conduct the following measures are to be implemented:
    - All truck movements will be scheduled.
    - Vehicles are to enter and exit the site in a forward direction along the travel path shown on delivery maps.
    - Drivers are to always give way to pedestrians and construction equipment.

10.0 Detailed CTMP requirements

The principal contractor will develop a detailed CTMP and include/formalise the following information:

- Description of construction activities, duration and work hours
- Detailed assessment of construction traffic impacts, including any cumulative impacts from surrounding developments
- Details regarding one-off activities such as crane installation and other equipment
- Swept path analysis of heavy vehicle access to the site
- Detailed assessment of on-street parking impacts
- Detailed strategy for pedestrian diversion
- Emergency vehicle access
- Traffic Guidance Schemes
- Contact details of key project personnel.

APPENDIX D – NOISE & VIBRATION MANAGEMENT

RENZO TONIN & ASSOCIATES
inspired to achieve

Acoustics
Vibration
Structural Dynamics

2A GREGORY PLACE, HARRIS PARK

Updated Construction Noise and Vibration Assessment

31 July 2025

2A Gregory Place P/L

TM724-03F02 Updated CNVMP for SSDA - 2024 Scheme (r1)

Document details

Detail	Reference
Doc reference:	TM724-03F02 Updated CNVMP for SSDA - 2024 Scheme (r1)
Prepared for:	2A Gregory Place P/L
Attention:	Raymond Raad

Document control

Date	Revision history	Non-issued revision	Issued revision	Prepared	Instructed	Reviewed / Authorised
28.7.2025	Prepare report		0	T. Taylor	T. Taylor	Y.Kalkunte
31.7.2025	Prepare report		1	T. Taylor	T. Taylor	Y.Kalkunte

File Path: R:\AssocSydProjects\TM701-TM750\TM724 yk 2A Gregory Place, Harris Park\1 Docs\TM724-03F02 Updated CNVMP for SSDA - 2024 Scheme (r1).docx

Contents

1 Introduction

Renzo Tonin & Associates was engaged to prepare a site-specific Construction Noise and Vibration Management Plan (CNVMP) in relation to the basement excavation works and construction for the proposed development at 2 Gregory Place, Harris Park.

The purpose of this CNVMP is to form part of the SSDA response to submissions package.

This assessment identifies potentially noisy activities, their impacts on surrounding receivers and outlines management strategies to control the impacts of noise and vibration during the demolition, excavation and construction works.

The work documented in this report was carried out in accordance with the Renzo Tonin & Associates Quality Assurance System, which is based on Australian Standard / NZS ISO 9001. Appendix A contains a glossary of acoustic terms used in this report.

Appendix A contains a glossary of acoustic terms used in this report.

2 Project Description

The SSDA seeks consent for a concept proposal for affordable housing and build-to-rent development.

The site is bounded as follows:

- To the north and West by parkland (Hambledon Cottage Reserve and Experiment Farm Reserve respectively). Further to the north and west lies Hassall St, a collector/semi-arterial road (which changes its name to Park Street).
- To the south by Clay Cliff Creek. Further to the south lies residential development (Ruse St residences at the western end of the southern boundary) and church/learning centre/car park (at the eastern end of the southern boundary).
- To the east by Gregory Place (a local road). Further to the east lies residential development (Gregory Place residences).

While the site is not highly impacted by external noise, the primary external noise source at the site is road traffic from Hassell Street.

The nearest noise sensitive development to the site is as follows:

- Ruse St Residences.
- Gregory Place residences.
- Our Lady of Lebanon Church/early learning centre.
- Hambledon Cottage Reserve.
- Experiment Farm Reserve.

Aerial photo below shows the site location showing noise/vibration measurement locations and the surrounding environment.


Hassall Street Residences
Attended Measurement A2
Logger 1 (L1)
Attended Measurement (A1)
SITE
Gregory Place Residences
Attended Measurement A3
Ruse Street Residences
Logger 2 (L2)
Our Lady of Lebanon Church and Young Academics Early Learning

3 Existing Noise Environment

The noise environment of an area varies over time. The NSW Environmental Protection Authority's (EPA) Noise Policy for Industry (NPfI) outlines standard time periods over which the background and ambient noise levels are to be determined, which is as follows:

- Day: 07:00-18:00 Monday to Saturday and 08:00-18:00 Sundays & Public Holidays
- Evening: 18:00-22:00 Monday to Sunday & Public Holidays
- Night: 22:00-07:00 Monday to Saturday and 22:00-08:00 Sundays & Public Holidays

As such, the existing background and ambient noise levels on the site will be summarised in accordance with the NPfI.

3.1 Long term noise survey details

An unattended noise survey was carried out to quantify the existing noise environment. Two unattended long-term noise monitors were installed within the site to measure the ambient and background noise levels:

- Monitor 1 was used to measure noise levels from road traffic impacting the site.
- Monitor 2 was used to measure noise from operations at the Our Lady of Lebanon Church and Young Academics Earl Learning Centre. This logging was conducted on three occasions in order to capture a number of religious celebrations.

Table 1: Noise monitoring locations

Location ID	Description
Long-term noise monitoring	
L1	28 April to 10 May 2022, installed in the north-western corner of the site, microphone 2.5m above ground in order to obtain unobstructed view to road traffic). Logging location selected to determine road traffic noise impacts on the site. It is also representative of ambient noise levels for residences facing Hassell Street.
L2	9 August to 21 August 2024 Installed externally on the roof near the south-east corner of the site (clear line of site to Our Lady of Lebanon Church/car park). Logging conducted to capture noise from Feast of the Assumption Celebration at Our Lady of Lebanon Church (14-15 August)

The noise monitors record noise levels on a continuous basis and stores data every fifteen minutes. The noise logger was calibrated before and after measurements and no significant deviation in calibration was noted. The noise monitoring equipment used complies with Australian Standard 1259.2-1990 "Acoustics - Sound Level Meters" and is designated as Type 2 instruments suitable for field use.

3.2 Long term noise survey results

The results from the noise survey are summarised below.

Table 2: Measured background and ambient noise levels

Monitoring Duration	Noise Descriptor	Representative Noise Levels		
		Day[1]	Evening[2]	Night[3]
Monitoring location L1. Representative of: -Road noise impact from Hassell Street (L_{eq} noise levels). -Background Noise Levels at Hassell Street Residences (L_{90} noise levels)				
28/4/2022 to 10/5/2022	L_{90} Background Noise Levels	50	48	40
	L_{Aeq} Ambient Noise Levels	60	59	56
Monitoring location L2. Representative of: -Noise generation from Our Lady of Lebanon Church/Car Park. Industrial Development (L_{eq} noise levels). -Background Noise Levels at Ruse Street and Gregory Place Residences (L_{90} noise levels)				
9/10/2024 to 21/9/2024	L_{90} Background Noise Levels	45	45	40
	L_{Aeq} Ambient Noise Levels	54	60	49

Notes: The following time periods are in accordance with the NPfI:

1. Day: 07:00-18:00 Monday to Saturday and 08:00-18:00 Sundays & Public Holidays
2. Evening: 18:00-22:00 Monday to Sunday & Public Holidays
3. Night: 22:00-07:00 Monday to Saturday and 22:00-08:00 Sundays & Public Holidays

4 Construction Noise and Vibration Criteria

4.1 Noise management levels (NMLs)

The NSW Interim Construction Noise Guideline (ICNG, 2009) provides guidelines for assessing noise generated during the construction phase of developments.

The key components of the guideline that are incorporated into this assessment include:

- Use of L_{Aeq} as the descriptor for measuring and assessing construction noise.
- Application of reasonable and feasible noise mitigation measures.
- As stated in the ICNG, a noise mitigation measure is feasible if it is capable of being put into practice and is practical to build given the project constraints.
- Selecting reasonable mitigation measures from those that are feasible involves making a judgement to determine whether the overall noise benefit outweighs the overall social, economic and environmental effects.

The ICNG provides two methods described for the assessment of construction noise, being either a quantitative or a qualitative assessment. A quantitative assessment is recommended for major construction projects of significant duration and involves the measurement and prediction of noise levels and assessment against set criteria. A qualitative assessment is recommended for small projects with duration of less than three weeks and focuses on minimising noise disturbance through the implementation of reasonable and feasible work practices, and community notification. Given the scale and duration of the construction works proposed, a quantitative assessment is carried out herein, consistent with the ICNG requirements.

The table below reproduced from the ICNG, sets out the airborne noise management levels and how they are to be applied for residential receivers.

Table 3: Noise management levels at residential receivers

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	Noise affected RBL + 10 dB	The noise affected level represents the point above which there may be some community reaction to noise. • Where the predicted or measured LAeq (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/ 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	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 5dB(A) above the noise affected level, the proponent should negotiate with the community. • For guidance on negotiating agreements see ICNG section 7.2.2.

* Noise levels apply at the property boundary that is most exposed to construction noise, and at a height of 1.5 metres above ground level. If the property boundary is more than 30 metres from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30 metres of the residence. Noise levels may be higher at upper floors of the noise affected residence.

Table 4 sets out the ICNG noise management levels for other noise sensitive receiver locations.

Table 4: Noise management levels at other noise sensitive land uses

Land use	Time of day	Where objective applies	Management level $L_{Aeq\ (15\ min)}$
Industrial premises	When in use	Outdoor noise level	75

4.2 Summary of construction noise management levels

A summary of construction Noise Management Levels is presented below. In the event these Noise Management Levels are exceeded, reasonable and feasible construction noise mitigation is required.

Table 5: Construction noise management levels (Standard Hours)

Location description	Noise management level $L_{Aeq(15min)}$[1]
	Monday to Fridays (7:00am to 6:00pm) **Saturdays (8:00am to 1:00pm)**
Nearby residences (Hassall Street)	50 + 10 = 60
Nearby residences (Ruse Street, Gregory Place)	45 + 10 = 55
Our Lady of Lebanon Church	45 (internal noise level)
Hambledon Cottage Reserve	60

Notes:
1. 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.
2. Noise management levels apply when receiver areas are in use only.
3. Day time background noise levels for residential receivers are presented in **Error! Reference source not found.**.

4.3 Construction vibration objectives

Construction vibration is associated with three main types of impact:

- disturbance to building occupants
- potential damage to buildings, and
- potential damage to sensitive equipment in a building.

Generally, if disturbance to building occupants is controlled, there is limited potential for structural damage to buildings.

Vibration amplitude may be measured as displacement, velocity, or acceleration.

- Displacement (x) measurement is the distance or amplitude displaced from a resting position. The International System of Units (SI unit) for distance is the metre (m), although common industrial standards include mm.
- Velocity ($v=\Delta x/\Delta t$) is the rate of change of displacement with respect to change in time. The SI unit for velocity is metres per second (m/s), although common industrial standards include mm/s. The Peak Particle Velocity (PPV) is the greatest instantaneous particle velocity during a given time interval. If measurements are made in 3-axis (x, y, and z) then the resultant PPV is the vector sum (i.e. the square root of the summed squares of the maximum velocities) regardless of when in the time history those occur.

- Acceleration (a=Δv/Δt) is the rate of change of velocity with respect to change in time. The SI unit for acceleration is metres per second squared (m/s2). Construction vibration goals are summarised below.

Construction vibration goals are summarised below.

4.3.1 Disturbance to buildings occupants

The acceptable vibration values to assess the potential for human annoyance from vibration are set out in the NSW 'Environmental Noise Management *Assessing Vibration: A Technical Guideline*' (AVTG).

To assess the potential for vibration impact on human comfort, an initial screening test will be done based on peak velocity units, as this metric is also used for the cosmetic damage vibration assessment. The screening test is based on the continuous vibration velocity (i.e. vibration that continues uninterrupted for a defined period). If the predicted vibration exceeds the initial screening test, the total estimated Vibration Dose Value (i.e. eVDV) will be determined based on the level and duration of the vibration event causing exceedance.

The initial screening test values and VDVs recommended in BS 6472-1992 for which various levels of adverse comment from occupants may be expected, are presented in Table 5 4. The 'Low probability of adverse comment eVDV' represent the preferred and maximum value presented in the AVTG.

Table 6: Vibration management levels for disturbance to building occupants

Place and Time	Initial screening test Velocity, PEAK, mm/s (>8Hz)	Low probability of adverse comment eVDV $m/s^{1.75}$	Adverse comment possible eVDV $m/s^{1.75}$	Adverse comment probable eVDV $m/s^{1.75}$
Residential buildings 16 hr day2	0.56	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Residential buildings 8 hr night2	0.40	0.1 to 0.2	0.2 to 0.4	0.4 to 0.8
Offices, schools, educational institutions and places of worship (day or night)	1.10	0.4 to 0.8	0.8 to 1.6	1.6 to 2.4

Notes: 1. Examples include hospital operating theatres and precision laboratories where sensitive operations are occurring. There may be cases where sensitive equipment or delicate tasks require more stringent criteria than the human comfort criteria specify above

2. Daytime is 7am to 10pm and night-time is 10pm to 7am

4.3.2 Building damage

Potential structural damage of buildings as a result of vibration is typically managed by ensuring vibration induced into the structure does not exceed certain limits and standards, such as British Standard 7385 Part 2 and German Standard DIN4150-3. Currently there is no existing Australian Standard for assessment of structural building damage caused by vibration energy.

It is noted that vibration levels required to cause minor cosmetic damage are typically 10 times higher than levels that will cause disturbance to building occupants. Many building occupants assume that building damage is occurring when they feel vibration or observe rattling of loose objects, however the

level of vibration at which people perceive vibration or at which loose objects may rattle is far lower than vibration levels that can cause damage to structures.

Within British Standard 7385 Part 1, different levels of structural damage are defined:

- *Cosmetic - The formation of hairline cracks on drywall surfaces, or the growth of existing cracks in plaster or drywall surfaces; in addition the formation of hairline cracks in mortar joints of brick/concrete block construction.*
- *Minor - The formation of large cracks or loosening of plaster or drywall surfaces, or cracks through bricks/concrete blocks.*
- *Major - Damage to structural elements of the building, cracks in supporting columns, loosening of joints, splaying of masonry cracks, etc.*

The vibration limits in Table 1 of British Standard 7385 Part 2 are for the protection against cosmetic damage, however guidance on limits for minor and major damage is provided in Section 7.4.2 of the Standard:

7.4.2 Guide values for transient vibration relating to cosmetic damage

Limits for transient vibration, above which cosmetic damage could occur are given numerically in Table 1 and graphically in Figure 1. In the lower frequency region where strains associated with a given vibration velocity magnitude are higher, the guide values for the building types corresponding to line 2 are reduced. Below a frequency of 4 Hz, where a high displacement is associated with a relatively low peak component particle velocity value a maximum displacement of 0.6 mm (zero to peak) should be used.

Minor damage is possible at vibration magnitudes which are greater than twice those given in Table 1, and major damage to a building structure may occur at values greater than four times the tabulated values.

Within DIN4150-3, damage is defined as "any permanent consequence of an action that reduces the serviceability of a structure or one of its components" (p.4). The Standard also outlines:

"For buildings as in lines 2 and 3 of Tables 1, 4 or B.1, the serviceability is considered to have been reduced if, for example

- cracks form in plastered or rendered surfaces of walls;

- existing cracks in a structure are enlarged;

- partitions become detached from load-bearing walls or floor slabs.

These effects are deemed 'minor damage. " (DIN4150.3:2016, p.6)

While the DIN Standard defines the above damage as 'minor', based on the definitions provided in BS7385, the DIN standard is considered to deal with cosmetic issues rather than major structural failures.

4.3.2.1 British Standard

British Standard 7385: Part 2 'Evaluation and measurement of vibration in buildings', can be used as a guide to assess the likelihood of building damage from ground vibration. BS7385 suggests levels at which 'cosmetic', 'minor' and 'major' categories of damage might occur.

The cosmetic damage levels set by BS 7385 are considered 'safe limits' up to which no damage due to vibration effects has been observed for certain particular building types. Damage comprises minor non-structural effects such as hairline cracks on drywall surfaces, hairline cracks in mortar joints and cement render, enlargement of existing cracks and separation of partitions or intermediate walls from load bearing walls. 'Minor' damage is considered possible at vibration magnitudes which are twice those given and 'major' damage to a building structure may occur at levels greater than four times those values.

BS7385 is based on peak particle velocity and specifies damage criteria for frequencies within the range 4Hz to 250Hz, being the range usually encountered in buildings. At frequencies below 4Hz, a maximum displacement value is recommended. The values set in the Standard relate to transient vibrations and to low-rise buildings. Continuous vibration can give rise to dynamic magnifications due to resonances and may need to be reduced by up to 50%. Table 7 sets out the BS7385 criteria for cosmetic, minor and major damage.

Regarding heritage buildings, British Standard 7385 Part 2 (1993) notes that "a building of historical value should not (unless it is structurally unsound) be assumed to be more sensitive" (p.5).

Table 7: BS 7385 structural damage criteria

Group	Type of structure	Damage level	Peak component particle velocity, mm/s		
			4Hz to 15Hz	15Hz to 40Hz	40Hz and above
1	Reinforced or framed structures Industrial and heavy commercial buildings	Cosmetic	50		
		Minor*	100		
		Major*	200		
2	Un-reinforced or light framed structures Residential or light commercial type buildings	Cosmetic	15 to 20	20 to 50	50
		Minor*	30 to 40	40 to 100	100
		Major*	60 to 80	80 to 200	200

Notes: Peak Component Particle Velocity is the maximum Peak particle velocity in any one direction (x, y, z) as measured by a tri-axial vibration transducer.

* Minor and major damage criteria established based on British Standard 7385 Part 2 (1993) Section 7.4.2

4.3.2.2 German Standard

German Standard DIN 4150 - Part 3 (2016) 'Vibration in buildings - Effects on Structures' (DIN 4150-3:2016), also provides recommended maximum levels of vibration that reduce the likelihood of building damage caused by vibration and are generally recognised to be conservative.

DIN 4150-3:2016 presents the recommended maximum limits over a range of frequencies (Hz), measured at the foundations, in the plane of the uppermost floor of a building or structure or vertically on floor slabs. The vibration limits at the foundations increase as the frequency content of the vibration increases. The criteria are presented in Table 8.

Table 8: DIN 4150-3:2016 structural damage criteria

Group	Type of structure	Vibration velocity, mm/s				
		At foundation in all directions at frequency of			Plane of floor uppermost storey in horizontal direction	Floor slabs, vertical direction
		1Hz to 10Hz	10Hz to 50Hz	50Hz to 100Hz	All frequencies	All frequencies
1	Buildings used for commercial purposes, industrial buildings and buildings of similar design	20	20 to 40	40 to 50	40	20
2	Residential buildings and buildings of similar design and/or occupancy	5	5 to 15	15 to 20	15	20
3	Structures that because of their particular sensitivity to vibration, cannot be classified under Groups 1 and 2 and are of great intrinsic value (eg listed buildings) – **Hambledon Cottage**	3	3 to 8	8 to 10	8	20

4.3.3 Damage to buried services

Section 5.3 of DIN 4150-3:2016 also sets out guideline values for vibration velocity to be used when evaluating the effects of vibration on buried pipework. These values, which apply at the wall of the pipe, are reproduced and presented in Table 5 7 below.

Table 9: DIN 4150-3:1999 Guideline values for vibration velocity to be used when evaluating the effects of short-term vibration on buried pipework

Line	Pipe Material	Guideline values for vibration velocity measured on the pipe, mm/s
1	Steel (including welded pipes)	100
2	Vitrified clay, concrete, reinforced concrete, prestressed concrete, metal (with or without flange)	80
3	Masonry, plastics	50

For long-term vibration the guideline levels presented in Table 9 should be halved.

Recommended vibration goals for electrical cables and telecommunication services such as fibre optic cables range from between 50 mm/s and 100 mm/s. It is noted however that although the cables may sustain these vibration levels, the services they are connected to, such as transformers and switch blocks, may not. It is recommended that should such equipment be encountered during the construction process an individual vibration assessment should be carried out. This may include a specific vibration impact statement addressing impact on the utility and consultation with the utility provider to confirm specific vibration requirements.

5 Construction Noise and Vibration Assessment

5.1 Construction noise sources

A list of the loudest typical construction items is presented in the table below.

Table 10: Typical construction equipment & sound power levels, dB(A) re 1pW

Plant item	Plant description	Sound power levels LAeq(15min)
1	Excavator (with hydraulic hammer, stop/start use)	117 (inclusive of 5dB(A) penalty for irritating characteristics, and assuming 50% use in 15 minute period)
2	Excavator (no hydraulic hammer)	105
3	Tower crane (electric)	100
4	Concrete pump	105
5	Piling (augured)	105

The sound power levels for the majority of construction plant and equipment presented in the above table are based on maximum noise levels given in Table A1 of Australian Standard 2436 - 2010 'Guide to Noise Control on Construction, Demolition and Maintenance Sites', the Interim Construction Noise Guideline (ICNG), information from past projects and/or information held in our library files.

5.2 Predicted noise levels

The table below presents noise levels likely to be experienced at the nearby affected receivers based on the construction activities and plant and equipment associated with the proposed site. The noise level range presented represents the plant item operating at a location furthest from the receiver and a location closest to the receiver.

Table 11: Predicted noise levels for typical construction works

Plant Item	Plant description	Predicted dB(A)$L_{eq(15min)}$ construction noise levels			
		Location 1 (Gregory Place/Ruse Street residences)	Location 2 (Hassell Street residences)	Location 3 (Church - internal)	Location 4 (Hambledon Cottage Reserve)
Noise management level (external) – Standard construction hours					
1	Excavator (with hydraulic hammer)	60-80	60-72	40-60	60-85
2	Excavator (no hydraulic hammer)	55-75	55-65	35-55	55-80
3	Tower crane (electric)	50-60	50-60	30-40	50-60
4	Piling (augured)	50-73	50-60	35-55	50-75

The predicted noise levels presented above indicate that the noise levels during the excavation and construction stages are likely exceed the NML at nearby residential receivers when working near the eastern and southern property boundaries of the site.

5.3 Noise management measures

The following general noise management measures are recommended for all receiver locations:

- When using hydraulic hammers near the southern or eastern boundaries of the site, there is a risk of residential receivers on Gregory Place or Ruse Street being highly noise affected (i.e., exposed to noise levels greater than 75 dB(A)$L_{eq(15min)}$) if working close to the property boundary.
- Given the projected exceedance of 75dB(A) at Gregory Place and Ruse Street when working near the eastern and southern boundaries respectively, respite periods should be considered (indicatively, no use of hydraulic hammers prior to 8am).
- Detailed respite periods or other mitigation should be developed at CC stage, once a construction project is development (and the extent of excavation in rock is determined).
- Use of electric cranes (as opposed to diesel) and bored piling (as opposed to vibrated) whenever feasible.
- Strategically position plant on site to reduce the emission of noise to the surrounding neighbourhood and to site personnel (locate crane centrally within site)
- Any equipment not in use for extended periods during construction work must be switched off.
- The offset distance between noisy plant and adjacent sensitive receivers is to be maximised where practicable.
- Plant used intermittently to be throttled down or shut down when not in use where practicable.
- The person selected to liaise with the community must be adequately trained and experienced in such matters.

In addition to the noise mitigation measures outlined above, a management procedure will need to be put in place to deal with noise complaints that may arise from construction activities. Each complaint will need to be investigated and appropriate noise amelioration measures put in place to mitigate future occurrences, where the noise in question is in excess of allowable limits.

5.4 Vibration assessment

5.4.1 Minimum working distances

The recommended minimum working distances for vibration intensive plant are presented below

Table 12: Recommended minimum working distances for vibration intensive equipment

Plant item	Minimum working distance, m					
	Cosmetic damage			Human disturbance		
	Commercial and industrial buildings1	Dwellings and similar structures1	Sensitive structures (e.g. heritage)1	Residences Day2	Offices	Workshops
5 Tonne Excavator w/Hydraulic Breaker, Vibratory Compactor	5	5	10	20	15	10

Notes: 1. Vibration limits referenced from DIN 4150 Structural Damage - Safe Limits for Short-term Building Vibration.
2. Daytime is 7 am to 10 pm;

Site specific buffer distances for vibration significant plant items must be measured on site where plant and equipment is likely to operate close to or within the minimum working distances for cosmetic damage.

With respect to vibration impact on the rail corridor - acceptable vibration impact on rail infrastructure would typically be indicated by Sydney Trains as approval stage. This is commonly approximately 15mm/s PPV, however must be confirmed. This is necessary to determine whether safe working distances or vibration monitoring would be required.

5.4.2 Vibration mitigation measures

Assuming that the basement excavation will require excavation in rock, the following vibration management measures are provided to minimise vibration impact from construction activities to the nearest affected receivers and to meet the relevant human comfort and building damage vibration limits:

- Dilapidation surveys should be conducted at Hambledon of the site. This will inform if any of the adjacent industrial development should be subject to vibration criteria different to those identified in Section 6.2.2.2
- At a minimum, vibration measurement during commencement of rock excavation should be made at Hambleton Cottage (heritage item) to determine if there needs to be an adjustment of safe working distances for this item (or use of different excavation methods when in close proximity to the Cottage).
- Notification by letterbox drop would be carried out for all occupied buildings within 100m of the construction site. These measures are to address potential community concerns that perceived vibration may cause damage to property.

- Where construction activity occurs in close proximity to sensitive receivers (Gunya Street Industrial development), vibration testing of actual equipment on site would be carried out prior to their commencement of site operation to determine acceptable buffer distances to the nearest affected receiver locations.
- A management procedure should be implemented to deal with vibration complaints. Each complaint should be investigated and where vibration levels are established as exceeding the set limits, appropriate amelioration measures should be put in place to mitigate future occurrences.
- Where vibration is found to be excessive, management measures should be implemented to ensure vibration compliance is achieved. Management measures may include modification of construction methods such as using smaller equipment, establishment of safe buffer zones as mentioned above, and if necessary, time restrictions for the most excessive vibration activities. Time restrictions are to be negotiated with affected receivers.

5.4.3 Complaints management

The construction contractor will be responsible for ensuring that all reasonable measures are implemented such as the provision of a Noise and Vibration Complaints Program, to minimise the generation of excessive noise and/or vibration levels from the site to nearby sensitive areas.

Site management contact information to be clearly displayed on site.

Owners and occupants of nearby affected properties are to be informed of a direct telephone line and contact person where any noise and/or vibration complaints related to the operation of the construction activities are to be reported.

See complaint management procedure in Appendix C.

6 Conclusion

This Construction Noise and Vibration Management Plan has been prepared by Renzo Tonin & Associates for the proposed road works and excavation work within the development.

The expected construction noise levels have been predicted in Section 5.2. Noise mitigation and management measures have been presented in Section 5.3to aid in providing additional noise reduction benefits where exceedance of the objectives occur.

Vibration impacts and management measures have been presented in Section 5.4.2 to aid in minimising any potential vibration impacts.

APPENDIX A Glossary of terminology

The following is a brief description of the technical terms used to describe noise to assist in understanding the technical issues presented.

Adverse weather	Weather effects that enhance noise (that is, wind and temperature inversions) that occur at a site for a significant period of time (that is, wind occurring more than 30% of the time in any assessment period in any season and/or temperature inversions occurring more than 30% of the nights in winter).
Ambient noise	The all-encompassing noise associated within a given environment at a given time, usually composed of sound from all sources near and far.
Assessment period	The period in a day over which assessments are made.
Assessment point	A point at which noise measurements are taken or estimated. A point at which noise measurements are taken or estimated.
Background noise	Background noise is the term used to describe the underlying level of noise present in the ambient noise, measured in the absence of the noise under investigation, when extraneous noise is removed. It is described as the average of the minimum noise levels measured on a sound level meter and is measured statistically as the A-weighted noise level exceeded for ninety percent of a sample period. This is represented as the L90 noise level (see below).
Decibel [dB]	The units that sound is measured in. The following are examples of the decibel readings of everyday sounds: 0dB The faintest sound we can hear 30dB A quiet library or in a quiet location in the country 45dB Typical office space. Ambience in the city at night 60dB CBD mall at lunch time 70dB The sound of a car passing on the street 80dB Loud music played at home 90dB The sound of a truck passing on the street 100dB The sound of a rock band 115dB Limit of sound permitted in industry 120dB Deafening
dB(A)	A-weighted decibels. The A- weighting noise filter simulates the response of the human ear at relatively low levels, where the ear is not as effective in hearing low frequency sounds as it is in hearing high frequency sounds. That is, low frequency sounds of the same dB level are not heard as loud as high frequency sounds. The sound level meter replicates the human response of the ear by using an electronic filter which is called the "A" filter. A sound level measured with this filter switched on is denoted as dB(A). Practically all noise is measured using the A filter.
dB(C)	C-weighted decibels. The C-weighting noise filter simulates the response of the human ear at relatively high levels, where the human ear is nearly equally effective at hearing from mid-low frequency (63Hz) to mid-high frequency (4kHz) but is less effective outside these frequencies.
Frequency	Frequency is synonymous to pitch. Sounds have a pitch which is peculiar to the nature of the sound generator. For example, the sound of a tiny bell has a high pitch, and the sound of a bass drum has a low pitch. Frequency or pitch can be measured on a scale in units of Hertz or Hz.
Impulsive noise	Having a high peak of short duration or a sequence of such peaks. A sequence of impulses in rapid succession is termed repetitive impulsive noise.
Intermittent noise	The level suddenly drops to that of the background noise several times during the period of observation. The time during which the noise remains at levels different from that of the ambient is one second or more.
L_{Max}	The maximum sound pressure level measured over a given period.
L_{Min}	The minimum sound pressure level measured over a given period.

L_1	The sound pressure level that is exceeded for 1% of the time for which the given sound is measured.
L_{10}	The sound pressure level that is exceeded for 10% of the time for which the given sound is measured.
L_{90}	The level of noise exceeded for 90% of the time. The bottom 10% of the sample is the L90 noise level expressed in units of dB(A).
L_{eq}	The "equivalent noise level" is the summation of noise events and integrated over a selected period of time.
Reflection	Sound wave changed in direction of propagation due to a solid object obscuring its path.
SEL	Sound Exposure Level (SEL) is the constant sound level which, if maintained for a period of 1 second would have the same acoustic energy as the measured noise event. SEL noise measurements are useful as they can be converted to obtain Leq sound levels over any period of time and can be used for predicting noise at various locations.
Sound	A fluctuation of air pressure which is propagated as a wave through air.
Sound absorption	The ability of a material to absorb sound energy through its conversion into thermal energy.
Sound level meter	An instrument consisting of a microphone, amplifier and indicating device, having a declared performance and designed to measure sound pressure levels.
Sound pressure level	The level of noise, usually expressed in decibels, as measured by a standard sound level meter with a microphone.
Sound power level	Ten times the logarithm to the base 10 of the ratio of the sound power of the source to the reference sound power.
Tonal noise	Containing a prominent frequency and characterised by a definite pitch.

APPENDIX B Specification for Construction Vibration Monitoring

B.1 Scope

This document specifies methods for undertaking vibration monitoring during the construction phase of the project, where it may be deemed to be required. The vibration monitoring shall be conducted in accordance with DIN 4150.3 Structural Vibration in Buildings – Effects on Structures.

B.2 Referenced Standards and Guidelines

- AS 2775 Mechanical Mounting of Accelerometers
- AS 2670.2 Part 2: Evaluation of human exposure to whole body vibration
- DECC NSW Assessing Vibration: A Technical Guideline
- DIN 4150.3 Structural Vibration in Buildings – Effects on Structures
- BS 7385:1 Evaluation and Measurement for Vibration in Buildings – Part 1: Guide for measurement of vibrations and evaluation of their effects on buildings
- BS 7385:2 Evaluation and Measurement for Vibration in Buildings – Part 2: Guide to Damage Levels from Ground borne Vibration
- ISO 4866 Mechanical Vibration & Shock – Vibration of Buildings – Guidelines for the Management of the Vibrations and Evaluation of their Effects on Buildings

B.3 Testing Procedures

The following procedures are to be followed by personnel suitably qualified and experienced in undertaking vibration measurements.

All vibration monitoring equipment used must be calibrated at least once every two years to standards that are traceable to Australian Physical Standards held by the National Measurement Laboratory (CSIRO Division of Applied Physics). The monitoring system should also have a measurement frequency range down to 1Hz.

B.4 Monitoring Procedure

Vibration monitoring shall be undertaken at vibration sensitive locations determined to fall within the 'minimum working distances' established for each item of plant during the commencement of use of each plant on site.

Vibration monitoring shall be undertaken over the following period(s):

- continuously whilst the vibrating plant is operational within the pre-determined 'minimum working distance' from the potentially affected building.

Vibration monitoring equipment shall be placed outside at the footings or foundations of the building of interest, closest to the vibrating plant.

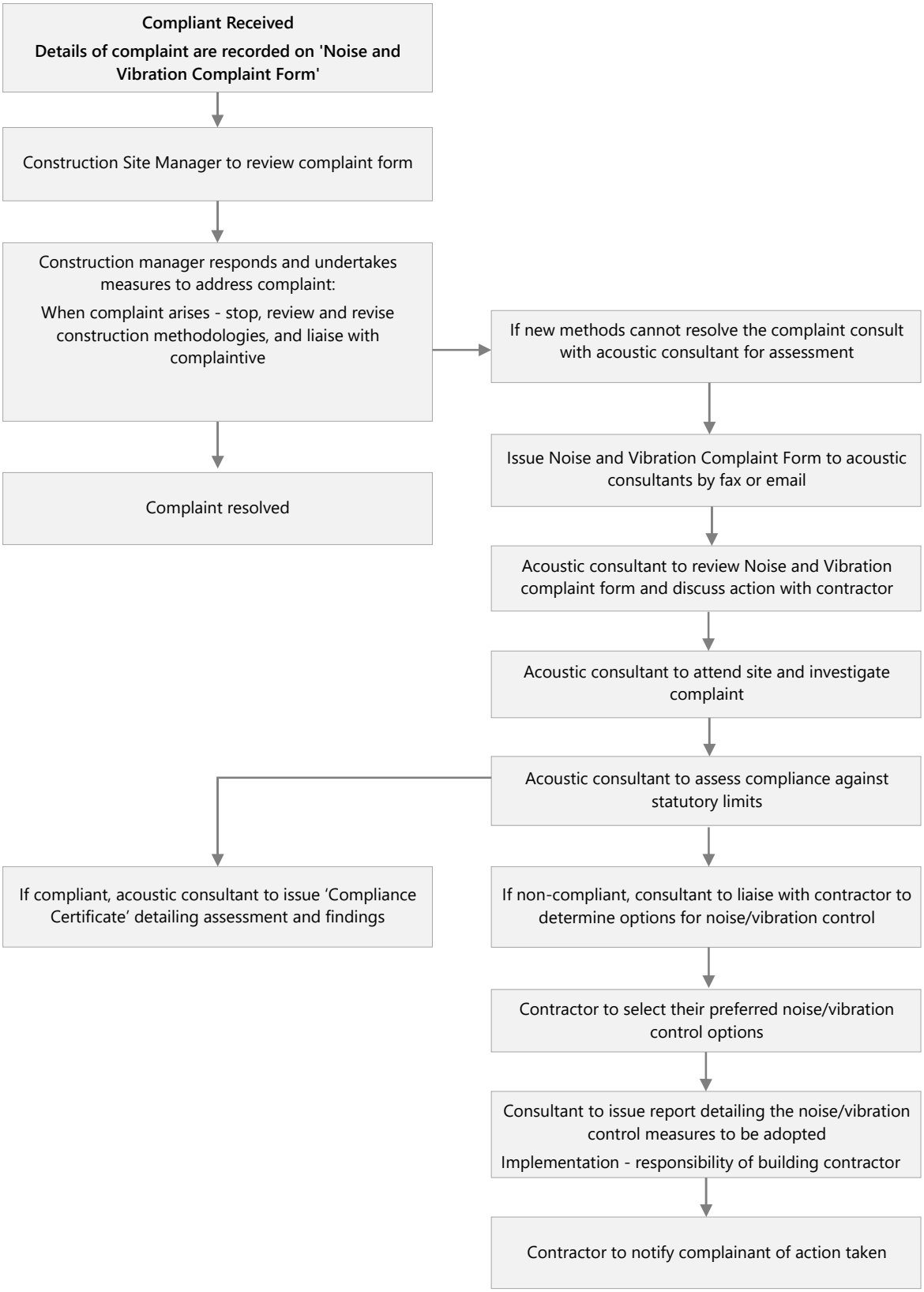
Vibration is to be recorded at a minimum rate of 10 samples per second. The data is to be processed statistically and stored in memory. The minimum range of vibration metrics to be stored in memory for later retrieval is the following:

- Vibration Dose Values (VDVs)
- vector-sum root-mean-square (rms) – maximums and statistical metrics; and
- vector-sum peak-particle velocity (ppv) – maximums and statistical metrics.

Vibration monitoring shall be undertaken in accordance with the vibration measurement requirements stipulated in the reference Standards and documents listed above. The following notes of importance are included here:

- vibration monitoring equipment shall be placed outside at the footings or foundations of the building of interest, closest to the vibrating plant;
- the surface should be solid and rigid in order to best represent the vibration entering the structure of the building under investigation;
- the vibration sensor or transducer shall not be mounted on loose tiles, loose gravel or other resilient surfaces;
- the vibration sensor or transducer shall be directly mounted to the vibrating surface using bees wax or a magnetic mounting plate onto a steel plate or bracket either fastened or glued to the surface of interest;
- where a suitable mounting surface is unavailable, then a metal stake of at least 300mm in length shall be driven into solid ground adjacent to the building of interest, and the vibration sensor or transducer shall be mounted on that; and
- a flashing light alarm should be attached in a visible position from the construction work area. When vibration exceeds the set threshold, the light will flash notifying the operator that works in that area should cease immediately.

APPENDIX C Complaint Management Procedure



NOISE/ VIBRATION COMPLAINT FORM

Project title: _____ **Date:** _____

Site contractor: _____ **Phone:** _____

Site contact: _____ **Email:** _____

Complaint details

Received by (circle): Phone / Email / In person / Other: _____

Name: _____ H Ph: _____

Address: _____ W Ph _____

Email: _____ M Ph _____

Describe when the problem occurred (date and time), what equipment caused the complaint (if known) and where person was standing when he/she experienced the noise/vibration:

Investigation

Question foreman responsible on site and obtain information on what equipment or processes would most likely have caused the complaint:

Following approval from the Project Manager, email/fax this form to Renzo Tonin & Associates