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Noise & Vibration Management Plan during the Demolition, Excavation and Construction and Increased Traffic Noise

No. 23-29 Harvey Ave, Moorebank

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1.0 INTRODUCTION

Acoustic, Vibration & Noise P/L was commissioned to assess, and where required make recommendations to reduce and manage the noise impact at the nearest potentially affected receiver/s resulting from the demolition, excavation and construction of the proposed development No. 23-29 Harvey Ave, Moorebank as per Liverpool City Council Conditions/Requirements. This assessment is also to study increased traffic noise on Harvey Ave, and adjacent residential receivers.

The site is located on Harvey Ave, in the suburb of Moorebank (Figure 1 – Site Location). The architectural plans by Pagano Architect dated the 25th July, 2018 are for the proposed construction of a six (6) storey residential building.

This report presents the relevant noise emission criteria, noise prediction calculations, an impact assessment and recommendations for mitigation and management measures to be implemented, to minimise the potential for adverse acoustic impact at the nearest potentially affected receivers, resulting from demolition, excavation, construction works and traffic increase.

This report will comply with Liverpool City Council Conditions/ Requirements and the following the relevant industry and professional standards and guidelines:

- Section 80A of the Environmental Planning & Assessment Act, 1979
- Protection of the Environment Operations Act 1997 (NSW)
- Protection of the Environment Operations (Noise Control) Regulation 2008 (NSW)
- Interim Construction Noise Guideline, Department of Environment & Climate Change July 2009
- Australian Standard 2436 – 1981 Guide to Noise control on Construction, maintenance and demolition sites
- NSW Industrial Noise Policy, January 2000; (Noise Policy for Industry 2017 does not apply. Exclusion ; item 4, section 1.5 of the policy exclusions)
- Assessing Vibration: A Technical Guideline, Department of Environment & Climate Change 2006
- Assessing Vibration: A Technical Guideline (DEC 2006)
- Australian Standard AS2436-1981 *Guide to Noise Control on Construction, Maintenance and Demolition Sites*
- NSW Road Noise Policy
- Noise Guide for Local Government.

Acoustic readings will be measured in accordance with AS 1055:1.2.1997.

2.0 ACOUSTIC DESCRIPTORS

Maximum Noise Level (L_{Amax}) – The maximum noise level over a sample period is the

maximum level, measured on fast response, during the sample period.

L_{A1} – The L_{A1} level is the noise level which is exceeded for 1% 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 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_{Aeq} – The equivalent continuous sound level (L_{Aeq}) is the 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 environment. This measure is also a common measure of environmental noise and road traffic noise.

L_{A50} – The L_{A50} level is the noise level which is exceeded for 50% of the sample period. During the sample period, the noise level is below the L_{A50} level for 50% of the time.

L_{A90} – The L_{A90} level is the noise level which is exceeded for 90% of the sample period. During the sample period, the noise level is below the L_{A90} level for 10% of the time. This measure is commonly referred to as the background noise level.

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.

RBL – The Rating Background Level for each period is the median value of the ABL values for the period over all of the days measured. There is therefore an RBL value for each period **–** daytime, evening and night time.

3.0 DESCRIPTION OF OPERATIONS AND ENVIRONS

The demolition, excavation and construction works will be undertaken on site at No. 23-29 Harvey Ave, Moorebank. The background noise in the local area is dominated by traffic noise from the surrounding streets, environmental noise as well as residential activities in the close vicinity of the site (Figure 2 – Surrounding Environment).

The development site boundaries are shared with residential properties located east of the site at No. 31 Harvey Street, west of the site at No. 21 Harvey Street and south of the site at Nos. 28 to 34 Mckay Ave.
The demolition, excavation and construction works are proposed over several months, during the daytime hours only. Works are generally undertaken between the following hours only.

Building Activities (including demolition) :

- Monday to Friday 7.00am to 6.00pm
- Saturday 8.00am to 1.00pm
- Sundays and Public Holidays - No work permitted

A site location map and aerial photo are included within the Appendix (Figures 1 & 3), showing the location of the site and nearest potentially affected receivers.

4.0 IMPACTS OF EXCESSIVE VIBRATION DOSES

Vibration caused by the project works can be classified as intermittent vibration under the DECCW's *"Assessing Vibration: a technical guideline"*. The human comfort goals for intermittent vibration from this guideline applicable for the project are shown in the table below.

Table 1 - Preferred and maximum vibration dose values for human comfort

Building Type	Intermittent Vibration ($m/s^{1.75}$)	
	Preferred	Maximum
Critical working areas (e.g. hospital operating theatres, laboratories)	0.10	0.20
Residential daytime (7:00am to 10:00pm)	0.20	0.40
Residential night time (10:00pm to 7:00am)	0.13	0.26
Offices, educational institutions. Places of worship	0.40	0.80
Workshops	0.80	1.60

The 'human annoyance' criteria for intermittent vibration are cumulative dose values, rather than instantaneous particle velocities or acceleration. Determining dose values depends not only on vibration levels but the length of time over which they affect a receiver. Vibration generating equipment is not often used constantly, making accurate predictions of dose values for intermittent vibration difficult in practice. Determining vibration dose values and compliance with the criteria relies on field measurements during the activity.

To give an indication of potential situations where the criteria for intermittent vibration might be exceeded, the information presented in Table 2 has been used to determine the time it would take before the vibration dose values are exceeded for various items of plant. These are presented in Table 3. In these calculations it is assumed that the equipment would be in continuous use for the full duration of the specified time. The times outlined are therefore considered to be conservative.

Table 2 - Intermittent Vibration

Equipment	Approximate Time to Reach a VDV of 0.4 (hours) at given distance					
Vibratory Roller	<1	<1	<1	1.3	8	15
Heavy rock hammer	<1	0.6	46	>1000	>1000	>1000
Rock saw Rock drill (estimate)	<1	<1	0.7	3	8	14
Bored piling	<1 1.3	3 30	46 >1000	193 >1000	741 >1000	>1000 >1000
Light rock hammer	113	>1000	>1000	>1000	>1000	>1000

The vibration criteria in relation to surface structures are adopted from the German Standard *DIN 4150 Part 3-1999 Structural Vibration in Buildings – Effects on Structures.* These are shown below.

Table 3 - Vibration velocity guide values – short term vibration on structures (mm/s)

Building Type	Vibration at the foundation at a frequency of			Vibration at horizontal plane of highest floor at all 1Hz to frequencies
	1Hz to 10Hz	10Hz to 50Hz	50Hz to 100Hz	
Buildings used for commercial purposes, industrial buildings and buildings of a similar design	20	20 to 40	40 to 50	40
Dwellings and buildings of similar design and/or occupancy	5	5 to 15	15 to 20	15
Structures that, because of their particular sensitivity to vibration, cannot be classified under lines 1 and 2 and are of great intrinsic value	3	3 to 8	8 to 10	8

Prior to the commencement of construction of each part of the project that may impact on surrounding properties the following shall occur:

• identify properties at risk from impact / damage based on the criteria in Table 3 above;
•for the properties identified at risk from damage, a risk assessment will be undertaken by appropriately qualified and experienced geotechnical and construction engineering experts. Inspections of those properties at risk will be undertaken prior to construction, and a Dilapidation report to be produced in accordance with *AS 4349.1 'Inspection of Buildings'*;
• the owners of all properties on which inspections are to be conducted will be contacted at least two weeks before the inspection, or as otherwise agreed by the affected property owners.
• a copy of the property inspection report will be provided to the owner of each property inspected at least one week prior to construction commencing; and
• a register will be maintained of all properties inspected, indicating whether the owner accepted or refused the property inspection offer.

Any property damage caused directly or indirectly as a result of construction works will be rectified at no cost to the property owner. Alternatively, property owners will be offered compensation for any damage. The major sources of vibration caused by the project will include the use of excavators with rock breakers (or grinding heads attached), bulldozers, vibratory rollers and rock anchoring.

Typical ground vibration from bulldozers range from 1 mm/s to 2 mm/s at a distance of approximately 5m. At distances of 20m or greater, vibration levels are generally below 0.2 mm/s. Table 4 details the typical ground vibration from a range of plant and equipment.

Table 4 - Typical Vibration Levels

Operation	Frequency of vibration (Hz)	Peak Vibration Level (mm/s) at Given Distance					
		5m	10m	20m	30m	40m	50m
Light rock hammer	30-60	0.2	0.06	0.02	0.01	0.01	0.01
Heavy rock hammer	30-60	5	1.5	0.5	0.2	0.15	0.1
Vibratory Roller	~30 Hz	7	3	1.05	0.55	0.35	0.3
Rock saw	45-90	0.75	0.5	0.3	0.2	0.16	0.14
Bored piling	30-60	0.4	0.2	0.1	0.07	0.05	0.04
Rock drill (estimate)	18-60	1.1	0.5	0.2	0.1	0.05	0.04

Ground vibration caused by vibratory rollers can be up to 1.05mm/s at 20m. Table 5 shows the safe working distances for the use of vibratory rollers close to buildings.

Table 5 - Safe Working Distances from Vibratory Rollers

Roller Class	Weight Range (tonnes)	Centrifugal Force (kN)	Distance from Building (m)	
			A	B
I – Very Light	Less than 1.25	10-20	3	No effect
II – Light	1 to 2	20-50	5	No effect
III – Medium	2 to 4	50-100	6	12
IV – Medium Heavy	4 to 6	100-200	12	24
V – Heavy	7 to 11	200-300	25	50
VI – Very Heavy	12 and over	Over 300	25	50

Note: Source of data: ARRB Special Report No.11, *"Ground Vibrations: Damaging Effects to Buildings"*.
A: Values suggested to prevent damage to buildings and structures
B: Values suggested to minimise strongly adverse comment from residents

Based on this table, roller class "I – Very Light" (if required) or lighter should be utilised when working within 5m from the neighbouring buildings or structures. Generally, vibration caused by the project is predicted to be less than structural damage criteria.
Where vibration causing works are being undertaken in close proximity to the neighbouring buildings or structures, careful selection of plant will be necessary as outlined above from rock hammers and vibratory rollers.

Plant and machinery selection undertaken by the relevant builder(s)/engineers is to be in in accordance with this CNVMP during construction planning and during the development of Construction Method Statements.

5.0 PROJECT SPECIFIC NOISE CRITERIA

The following sections outline the relevant construction noise, vibration & dust emission criteria and conditions applicable to the works.

5.1 DECCW Construction Noise Criteria

In this section, the relevant construction noise emission criteria and conditions applicable to the works are outlined, based on the NSW Department of Environment, Climate Change's and Water's (DECCW) Interim Construction Noise Guideline (ICNG).
The ICNG is the appropriate guideline for use in construction noise assessments and is to be used when establishing specific construction noise management levels for a particular project.

The NSW DECCW's ICNG is developed to manage noise from construction works. The ICNG advises that a qualitative methodology for assessment of construction noise emission may be undertaken for short-term works (less than 3 weeks). However, for larger construction projects, a quantitative assessment of construction noise should be undertaken.

Section 4 of the ICNG classifies noise criteria into the following categories:
- Airborne noise;
- Ground-borne noise;
- Sleep disturbance at residences;
- Blasting and vibration; and
- Predicting noise levels – quantitative assessment.

The ICNG also goes on to state that when developing noise mitigation strategies for reducing construction noise emission focus should be given to *"applying all 'feasible' and 'reasonable' work practices to minimise construction noise impacts".*

The CNG provides management levels (criteria) for construction noise emission at residential receivers, and other various sensitive receivers. The management noise levels at residential receivers are dependent upon the relevant Rated Background Level (RBL) at the residential receiver, and the time of day that the construction noise is to be generated. Acoustic Vibration& Noise has determined the daytime ambient background noise environment of the nearest residential receivers at No.21 ,31 Harvey Ave and No. 28-34 McKay Ave, Moorebank.

5.1.1 Airborne Noise

Criteria for residential receivers are set using the information in the table below.

Table 6 - Measured Ambient Noise Environment

Time of day	**Management Level $L_{Aeq, (15min)}$**	**How to apply**
Recommended standard hours: <u>For all Building Activities (including Demolition):</u> Monday to Friday 7.00am to 6.00pm Saturday 8.00am to 1.00pm Sundays and 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 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	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 (ICNG)

6.0 <u>PROCEDURES AND INSTRUMENTATION</u>

Acoustic Vibration& Noise P/L sound pressure measurements and monitoring were conducted in general accordance with the Australian Standard*, "Acoustics - Description and*

Measurement of Environmental Noise. Part 1: General Procedures" and were carried out using precision sound level meters conforming to the requirements of AS1259 *"Sound Level Meters".*

6.1 Noise Survey Instrumentation

The existing noise readings presented here are carried with Svantek 957 Noise and vibration level meter which has the following features:

- Type 1 sound level measurements meeting IEC 61672:2002
- General vibration measurements (acceleration, velocity and displacement) and HVM meeting ISO 8041:2005 standard
- Three parallel independent profiles
- 1/1 and 1/3 octave real time analysis
- Acoustic dose meter function
- FFT real time analysis (1920 lines in up to 22.4 kHz band)
- Reverberation Time measurements (RT 60)
- Advanced Data Logger including spectra logging
- USB Memory Stick providing almost unlimited logging capacity
- Time domain signal recording
- Advanced trigger and alarm functions
- USB 1.1 Host & Client interfaces (real time PC "front end" application supported)
- RS 232 and IrDA interfaces
- Modbus protocol

The readings referred to in this report were carried out on the 27th of August, 2018 by our office. Readings were carried out at the western boundary of the site adjacent to the nearest receiver at No.31 Harvey Ave, (Figure 4) to represent a conservative sample of the acoustic environment at the boundaries of the potential residential receivers.

Table 7 provides a summary of the noise levels for the daytime, evening and night time periods as defined in the NSW Department of Environment Climate Change & Water (DECCW) Construction Noise Guideline (CNG).

Table 7- Measured Ambient Noise Environment

Location	**Period**	**Measured Noise Levels [dB(A)]**		
		LA_{eq}	**LA_{90}**	**RBL**
Nearest Residential Receivers – No. 21/31 Harvey Ave	Day Time Front Day Time Back	49	43	40
	Evening and Night Time	N/A	N/A	N/A

Note: 1) Measured noise levels are ambient, and do not include any subject works or associated activities.

2) Works at the site are not expected to take place outside the hours of:

Building Activities (including demolition):

- **Monday to Friday 7:00am to 6:00pm.**
- **Saturday 8:00am to 1:00pm.**
- **Sunday & Public Holidays: No Work Permitted**

Based on the measured background noise environment, Table 8 presents the construction noise emission management levels/criteria, as detailed in the DECCW's ICNG, for the nearest residential receivers.

Table 8 - Site Specific Construction Noise Criteria at Residential Receiver

Receiver	**Time of Day**	**DECCW Management Level** [1] **($L_{Aeq\ (15\ min)}$)**	**Site Specific Construction Noise Emission Criteria ($L_{Aeq(15\ min)}$)**
Boundary of Nearest Residential Receiver – No. 21 Harvey Ave	**Recommended Standard Hours** [2]**:** For all Building Activities (including Demolition): Monday to Friday 7.00am to 6.00pm Saturday 8.00am to 4.00pm Sundays and Public Holidays	RBL + 10 dB	50dB(A)
	Outside Recommended Standard Hours	RBL + 5dB	45dB(A)

Note:
[1] Noise levels apply at the property boundary that is most exposed to construction noise, and at a height of 1.5 m above ground level. If the property boundary is more than 30 m from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30 m of the residence. Noise levels may be higher at upper floors of the noise affected residence
[2] Recommended standard hours are as stated in DECCW's Interim CNG

Further to the criteria at residential receiver locations, Table 8 reproduces the construction noise emission management levels as detailed in the DECCW's Interim CNG for the various other relevant receivers:

7.0 METHODOLOGY FOR EMISSION PREDICTION AND ASSESSMENT

Acoustic Vibration& Noise understands that the following items of noise emitting equipment and machinery are likely to be used during the demolition, excavation and construction works on site:

Demolition (Around 2 weeks duration)
• Hammers;
• Saws;
• Grinders;
• Other hand-held tools;
• Excavator; and
• Trucks (for removal of materials).

Piers & Footings (Around 2 weeks duration)
• Excavator; and
• Trucks (for removal of materials).

Construction (Around 52 weeks duration)
• Concrete Trucks;
• Trades (Brick Layers, Concreters, Renderers, Roofers, Carpenters, Plumbers etc.);
• Concrete Pumps; and
• Trucks (for removal of materials).

Accordingly, assessment of the operation of above items requires calculation of their noise emission levels to nearby potentially affected receiver locations.

Acoustic Vibration& Noise has conducted operator-attended noise monitoring of similar equipment/activities at many other sites on numerous occasions. Based on previous operator-attended surveys of similar activities and equipment, prediction calculations have been undertaken to predict the noise impact at adjacent receiver locations, resulting from the proposed works.

In our noise prediction calculations and modelling, the noise emission contribution from the above items of equipment has been incorporated into the prediction calculations and modelling along with various loss factors, including:

- Losses due to distance and ground topography;
- Airborne noise losses;
- Losses due to direction;
- Weather conditions; and
- Acoustic shielding.

8.0 NOISE EMISSION PREDICTION AND ASSESSMENT

Acoustic Vibration& Noise P/L advises that the project is likely to be undertaken in three main stages:

- Demolition;
- Excavation; and
- Construction.

Acoustic Vibration& Noise understands demolition works will be undertaken over a 2 weeks period. It is likely that earthworks and excavation works would be undertaken over a period of 2 weeks. Construction works would then be undertaken and may last for a period between 40 to 52 weeks.

The demolition, excavation and construction stages typically produce the highest levels of noise emission during a project such as this.

8.1 Noise Emission Prediction Calculations

Acoustic Vibration& Noise has performed prediction calculations and determined maximum LAeq noise emission levels at adjacent receiver locations, resulting from proposed demolition, excavation and construction activities, including use of the tools and equipment listed in Section 4.

For the purpose of noise assessment, the likely maximum *"at source"* noise levels (sound pressure levels at 1 metre) have been used as detailed below.

Demolition (Around 4 weeks duration)
• Hammers (similar to criteria for impact wrenches) — 85 dB (A);
• Saws—80 dB (A);
• Grinders — 80 dB (A);
• Other hand-held and electric tools — 80 dB (A);
• Excavator (5 tonne) — 83 dB (A); and
• Trucks (for removal of materials) — 85 dB (A).

Piers & Basement Excavation (Around 5 weeks duration)
• Excavator (5 tonne) — 83 dB (A); and
• Trucks (for removal of materials) — 85 dB (A).

Construction (Around 52 weeks duration)
• Concrete Mixers — 90 dB (A);
• Concrete Pumps — 100 dB (A);
• Bricklayers, Roofers, Carpenters 55 -65 dB (A); and
• Trucks (for removal of materials) — 85 dB (A).

All plant and machinery noise emissions are to comply with the criteria set out in the table below:

Table 9 - Maximum Demolition, Excavation, and Construction Noise Emission at Boundaries*

Location of Residential Receiver Boundary	**Time of the Day**	**Maximum Predicted L_{Aeq} Level dB(A) from Building Works**	**Site specific construction noise emission criteria ($L_{Aeq(15\ min)}$)- Table 8**	**Criteria Compliance**
No. 21/29 Harvey Ave	For all Building Activities (including Demolition): Monday to Friday 7.00am to 6.00pm Saturday 8.00am to 1:00pm Sundays and Public Holidays	49	50	Less than 50 -Complies-

*Assuming all Recommendations in section 9 are adhered to.

Note should be made that the predicted noise levels above, are the maximum predicted LAeq noise levels from an activity at the nearest boundaries of the listed properties, resulting from proposed demolition, excavation and building works at the centre of the subject site. Typically, received LA_{eq} noise emission levels would be expected to be lower than these during the majority of the demolition, excavation and construction works. Significantly lower noise levels than those presented would also be expected within (inside) the nearest potential residential receivers residences.

Due to the fact that highest noise emitting items are unlikely to be used for a long duration then it is unlikely to lead to complaints.

8.2 Noise Assessment

Noise emission resulting from demolition, excavation and construction has been considered and is likely to cause higher noise emission levels than during the majority of the construction phase of the project, when much of the noise emission can be significantly contained within the new building envelope.

The predicted noise emission levels presented in Table 9 above indicate LAeq noise emission associated with the proposed demolition, excavation and building works will exceed the relevant construction noise criterion at certain times.

Acoustic Vibration& Noise advises that lower noise levels, which are likely to be acceptable, would be received inside these nearby/adjacent dwellings, when the external windows are closed.

To ensure that construction noise emission levels from the proposed works are kept to a minimum, Acoustic Vibration& Noise P/L provides recommendations for feasible and reasonable noise mitigation and management, which should be incorporated into the noise management plan for the proposed demolition, excavation and construction.

9.0 DISCUSSION AND RECOMMENDATIONS

Further to the predicted noise emission levels presented in Section 9, Acoustic Vibration& Noise advises that measures are required to minimise and manage noise emission and impact from the proposed demolition, excavation and construction works at the site.

We understand that proposed works at No. 23-29 Harvey Ave, Moorebank will only be carried out during daytime hours only:

Building Activities (including demolition):

- Monday to Friday 7.00am to 6.00pm
- Saturday 8.00am to 1.00pm
- Sundays and Public Holidays - No work permitted

We recommend the following measures be implemented to minimise and manage noise emission from the subject demolition, excavation and construction:

9.1 Noise induction of all site staff

We recommend that all site staff be inducted, ensuring each person is aware of the noise management and mitigation procedures applicable to the site and site works.

All site managers should be made aware of noise and vibration limits, applicable control measures and methods. They should ensure that all agreed noise and vibration measures are carried out by employees and sub-contractors.

When a builder/contractor has made noise reduction commitments all staff needs to be made aware of them. Workers and sub-contractors need to be trained to follow noise management practices (a toolbox meeting may be an effective way to do this).

Embedding requirements to manage noise in tenders, employment contracts or sub-contractor agreements can be an effective tool for pro-active noise management. This ensures that responsibility for noise rests with all people involved.

9.2 Implementation of an appropriate community liaison procedure

Acoustic Vibration& Noise recommends implementation of an appropriate community liaison procedure, including a noise management and compliant procedure, and continual liaison with the nearby potentially affected receivers.

Community Liaison

Community consultation is an essential part of managing noise from a construction project. Builders/contractors should aim to:

- establish good working relationships with community stakeholders;
- give and receive feedback on construction activity and performance during a project; and
- discuss the community's concerns and be proactive in complaint resolution.

As part of a community consultation strategy, neighbouring premises should be given written notification of the project. The information should outline the type and duration of works, likely noise impacts, and provide contact details for feedback and/or complaints. The minimum notification period is 48 hours before noisy work is scheduled.

Methods of notification for noisy works and ongoing communication about a project's progress can include:

- letterbox drops;
- meetings;
- individual contact;
- a website (for larger projects); or
- a regular newsletter with site news, project planning etc.

In some areas, provision of multi-lingual notification may be required.

Complaint Resolution

A person may have experienced noise disturbance for some time before they approach the builder/contractor or the Council and may have become tense and angry. This is particularly important to acknowledge when the complaint refers to disturbed sleep and/or noise that is

tonal (beeping, metal-on- metal), impulsive (hammering, pile driving) or low frequency (truck engine, heavy machinery).

The builder/contractor should respond respectfully to a complaint and implement all feasible and reasonable measures to address the issue. High impact projects should have a readily accessible contact point such as a 24-hour toll-free information and complaints line. The builder/contractor should call back as soon as possible, and then maintain communication about how the issue is to be resolved.

The complaint management process should be well documented, with details about the following:

- the noise/s, vibration or dust issue in question;
- the time of the complaint and the person making it;
- the person dealing with the complaint and how they plan to do so;
- how resolution of the complaint is to be communicated to the person who made the complaint, the community and the Council;
- who should be contacted if the complaint cannot be resolved; and
- the time taken for responses.

9.3 Implementation of monitoring and reporting programmes

Noise & vibration monitoring and reporting that is to be undertaken during the main stages of work and is to be the course of action to be taken following receipt of a complaint concerning noise and vibration from the proposed works should they arise.

In response to requests by the builder or owner Acoustic Vibration& Noise P/L will attend site and carry out operator-attended noise and vibration measurements and monitoring of site equipment and operations.

9.3.1 Noise monitoring and reporting methodology

Upon request of the builder or owner, Acoustic Vibration& Noise would carry out additional noise monitoring at the boundary of the nearest potential receiver or at any other location where there is a complaint, in a similar method as discussed in Section 7.0 of this report.

9.3.2 Vibration monitoring and reporting methodology

All excavation proposed on site for footings/piers and basement, are expected to be carried out in clay/shale. Therefore, vibration monitoring may be carried out where predicted vibration levels approach or exceed structural damage criteria, in response to complaints or for the purpose of refining construction methods or techniques to minimise vibrations. Monitoring will be carried out in accordance with:

• for structural damage vibration – *German Standard DIN 4150 and BS 7385: Part 2 – 1993*;

• for human exposure to vibration – the evaluation criteria presented in the *Environmental Noise Management Assessing Vibration: A Technical Guideline* (DECC 2006).

9.4 Noise Mitigation Measures

The following Noise Mitigation Producers are to be carried out during construction:

- Excessive noisy plant or earth moving equipment are not allowed to operate on site.
- Provide alternative less noisy equipment when possible.
- No radio or music to be audible in areas outside the construction site.
- Use acoustic barriers, Nosie shields where feasible and possible.
- Avoid simultaneous noise activities.
- Operating noisy hand-held equipment are to be used inside and away from any window/opening.
- Ensure all machines and equipment are well maintained and don't produce excessive noise due to malfunctioning.
- Avoid drooping material from high levels. Provide rubber matting on ground when material to be dropped from high levels.
- All site staffs and employees to use appropriate protective equipment when operating or in the vicinity of a noise generating equipment.

9.5 Training & Communications with affected Neighbours

All site staffs, employees and subcontractors are to be induct into the CNVMP. This induction will clearly explain the sensitive receivers, the work hours in relation to noise generation, and employees and subcontractors obligation to ensure that the site complies with the noise criteria outlined in this report.

Builder also to contact the owners/residents of the neighbouring potentially affected sites, including but not limited to No. 21 Harvey Ave, No. 31 Harvey Ave and No. 28-34 McKay Ave, Moorebank. A letter to be dropped in the mail explaining what noise controls are established. Letter also to identify the person and telephone number to contact when issues are raised concerning loud noise or vibration generated from the site.

10.0 TRAFFIC NOISE GENERATION & COMPLIANCE

The operation of the proposed development also needs to comply with the criteria of the NSW Road Noise Policy due to potential impact of additional traffic that may be generated by the development, on nearby residential developments.

Table 3 in Section 2.3.1 of the NSW Road Noise Policy sets out traffic noise assessment criteria measured at 1.0m from the façade as follows:

Table 10 – NSW Road Noise Policy Traffic Noise Criteria

Road Category	**Type of Project/Land Use**	**Assessment Criteria – dB(A)**	
		Day (7am – 10pm)	**Night (10pm – 7am)**
Local Roads	Existing Residences affected by additional traffic on existing local roads general by land use developments	$L_{Aeq\ (1\ hour)}$ 55 (external)	$L_{Aeq\ (1\ hour)}$ 50 (external)

The maximum number of additional vehicle trips per hour generated by the proposal is 13 cars as per Loka Consulting Engineer Traffic report. Below is calculation table showing compliance during the day and evening with a maximum of thirteen (13) cars per hour.

Table 11 – Predicted Traffic Generation Noise Levels

Sound Power level of a car dB(A)	85.00
Max. Number of cars in 1 hour	13.00
L Aeq, 1 hour - all cars (power)	69
Leq, 1 hr @ 1 m from facade(pressure)= 50 dB(A)	50 < 55; 50<=50 -Complies-

11.0 NOISE EMISSION FROM CARS ENTERING & EXITING CARPARK

Section 2.2.1 of the Noise Guide for Local Government states that a noise source is generally considered to be intrusive if the noise from the source when measured over a 15-minute period exceeds the background noise by more than 5 dB(A).

The noise from the source is measured as $L_{Aeq,15\ min}$ at the most affected point within the residential property boundary and ideally should be measured at the point where the impact occurs.

The Table below provides specific sound power levels for different car activities and noise measurements carried out at similar sites. These are given in terms of maximum sound power levels in decibels.

Table 12 – SPL Levels for Different Car Activities

Noise Source	Typical Maximum Sound Power Level Lw (dBA)
Vehicle Accelerating	90
Vehicle Starting	90 (N/A)*
Vehicle Door Closing	95 (N/A)*
Vehicle Drive of at 10km/h	86

*Activity taking place inside enclosed basement.

Below is calculation table showing compliance of cars entering/exiting the driveway during the day with a maximum of 17 vehicles/ hour; 5 vehicles per 15mins (As per Loka Consulting Engineer Traffic Report).

Table 13 – Predicted Noise Levels from driveway

L pressure=L power-10 log d2/d1[line] - 11 +D; [D=0 (free), D = 3 (floor); D=6 (1 floor & wall), D=9 (Room Corner)]	
N noise sources with Noise level P each then Ptotal=P+10log(N)	dB(A)
Sound Power level of a car - 85 dB (A)	85.00
Sound Power level of a Van- 90 dB(A)	88.00
Sound Power level of a truck- 110 dB(A)	97.00
Number of cars in 15 minutes	5.00
L Aeq, 15 minutes - all cars (power)	70.90
Number of Vans in 15 minutes	0.00
L Aeq, 15 minutes - all Vans (power)	0.00
Number of Trucks in 15 minutes	0.00
L Aeq, 15 minutes - all Trucks	0.00
Total Sound power [Cars + Vans + Trucks]	70.90
Leq 15 minutes @ receiver (29 Harvey St).= (pressure)	48.5 Exceeds 48.0 (L90 + 5) by .5 dB at peak. OK*

*Change in sound levels perceivability

± 1dB	Not perceptible
± 2dB	Hardly perceptible

Similarly, calculations during the night complies.

12.0 CONCLUSION

Acoustic Vibration& Noise P/L has undertaken a quantitative assessment of the noise impact at the nearest potentially affected receivers resulting from the demolition, excavation and associated activities, for the proposed development at 23-29 Harvey Ave, Moorebank in accordance with Liverpool City Council Conditions/ Requirements and the NSW DECCW's Interim Construction Noise Guideline.

The calculated noise emission associated with the proposed demolition of existing residence,

excavation and construction of proposed development is unlikely to generate "offensive noise", as described in the POEC Act *1997,* at the surrounding residential receiver locations.

Acoustic Vibration& Noise P/L advises that implementation of the recommendations contained in Section 9 of this report will assist with the mitigation and management of noise emission from demolition, excavation and construction of the subject development site.

This report addresses the requirements Liverpool City Council Conditions / Requirements and Section 80A of the Environmental Planning & Assessment Act 1979.

Acoustic Vibration & Noise P/L also checked increased traffic noise levels and found to be in compliance with 2.3.1 of the NSW Road Noise Policy and Section 2.2.1 of the Noise Guide for Local Government.

We hope this report meets your requirements. Should you require further explanations, please do not hesitate to contact us.

Yours sincerely,

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M.S. Eng'g Sci. (UNSW).
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13.0 APPENDIX

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Figure 1 - Site Location

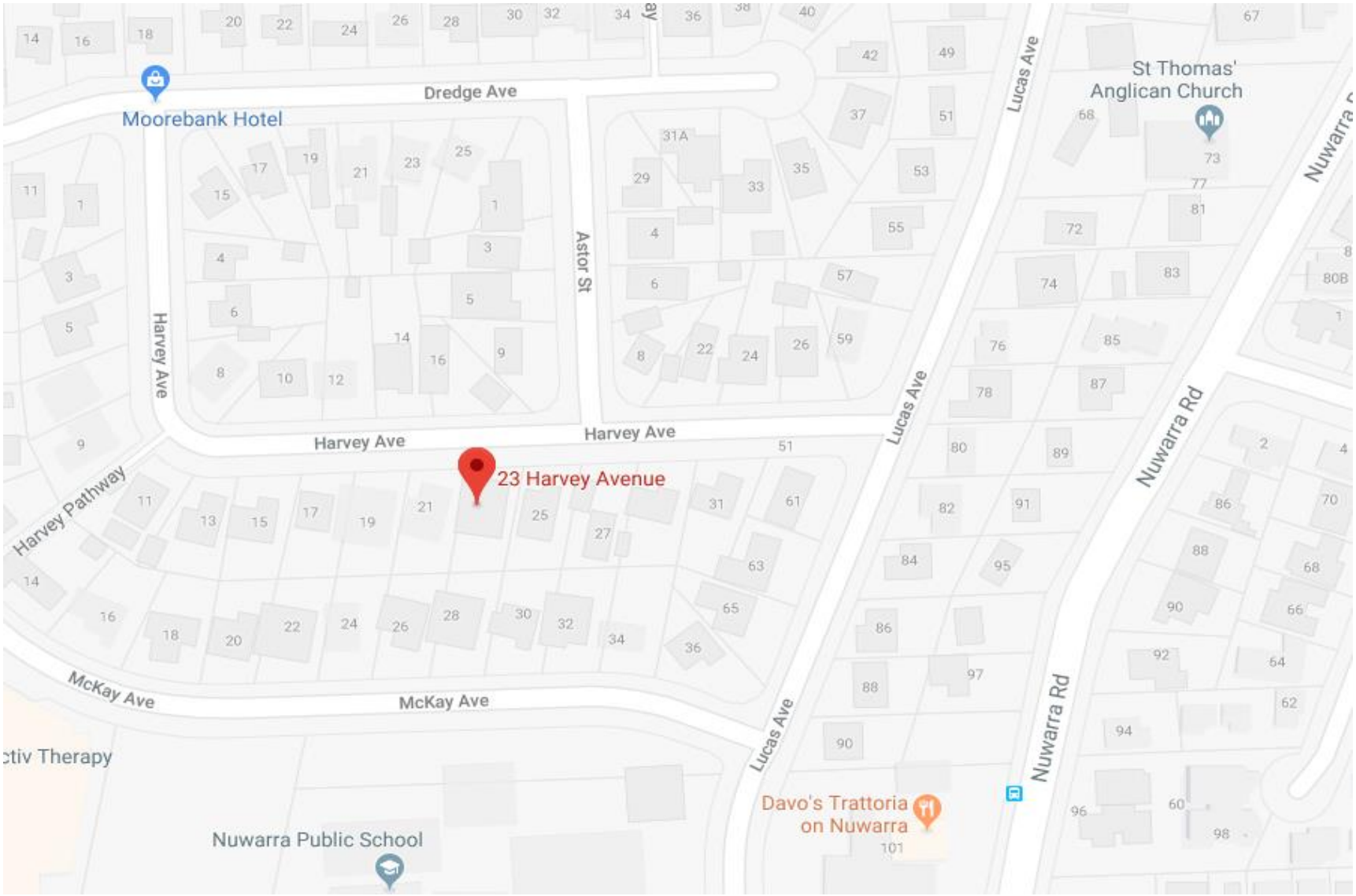

Figure 2 - Surrounding Environment

Figure 3 - Nearest Residential Receivers

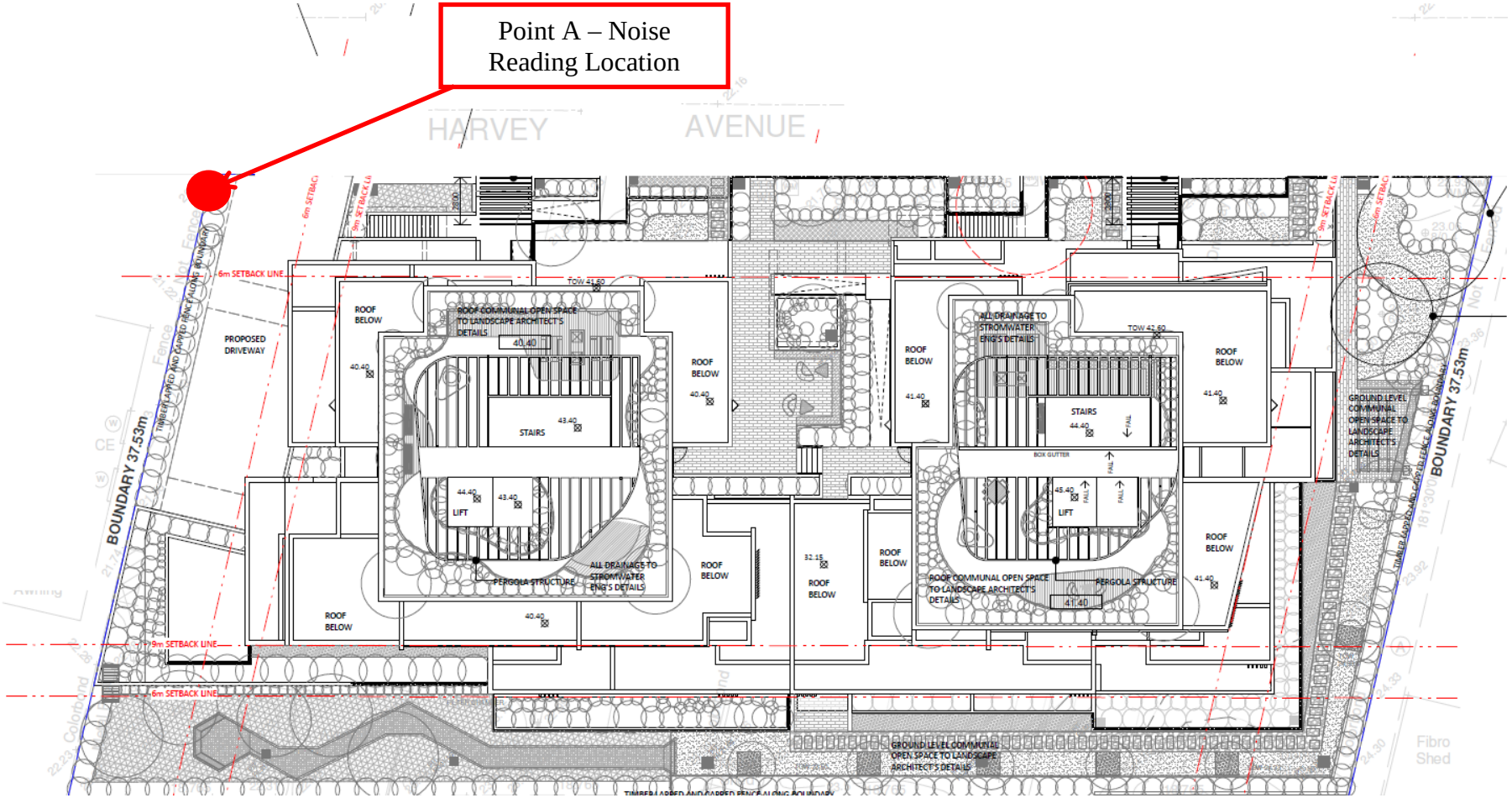

Figure 4 - Noise Reading Locations

TABLE 1

CATEGORIES OF WORKING HOURS, AND NOISE CRITERIA

DAY	TIME ZONE	CATEGORY	NOISE CRITERIA (which must not be exceeded)
Monday to Friday	00.00 - 07.00	4	Background + 0 dBA
	07.00 - 08.00	1	Background + 5 dBA
	08.00 - 19.00	1	Background + 5 dBA + 5 dBA to be determined on a site basis
	19.00 - 23.00	2	Background + 3 dBA
	23.00 - 24.00	4	Background + 0 dBA
Saturday	00.00 - 07.00	4	Background + 0 dBA
	07.00 - 08.00	1	Background + 5 dBA
	08.00 - 17.00	1	Background + 5 dBA + 5 dBA to be determined on a site basis
	17.00 - 23.00	2	Background + 3 dBA
	23.00 - 24.00	4	Background + 0 dBA
Sundays and Public Holidays	00.00 - 07.00	4	Background + 0 dBA
	07.00 - 17.00	3	Background + 3 dBA
	17.00 - 24.00	4	Background + 0 dBA

NOTE: 00.00 or 24.00 means 12.00 midnight.

1. All noise levels to be $L_{A\ av\ max}$ (15 minute) measured at the nearest Nominated Occupancy.

2. The permissible noise level is to be complied with during each fifteen (15) minute period during the relevant Category of Hours.

3. The guidelines for control of construction noise as outlined in AS2436 shall be applied, where appropriate.

4. Background is "Background Noise Level" as defined in para 18.j (page 5).

Figure 5 - Categories of Working Hours and Noise Criteria

SCHEDULE 1

LISTED APPLIANCES AND ALLOWABLE NOISE LEVELS

GROUP A (see Note 2)	GROUP B 90dBA	GROUP C 85dBA	GROUP D 80dBA	GROUP E 75dBA	GROUP F 70Dba
Pile drivers Hydraulic hammers Machine mounted rock breakers Sand blasters Steam cleaners Mole borers	Earthmoving equipment of engine capacity above 200kW NEP Warning sirens* Reversing alarms+ Trucks	Impulsive tools - air, electric or hydraulic Earthmoving equipment of engine capacity between 100kW and 200kW NEP Explosive power tools Impact wrenches Refuse chutes* Scabblers Chain saws Rock drills	Concrete agitators Concrete pumps Concrete saws Cranes (fixed) Cranes (mobile) Earthmoving equipment up to and including engine capacities of 100kW NEP Concrete vibrators Portable hand tools Vibratory compacters	Air compressors above 170 L/s capacity Construction dumpers over 1m^3 capacity Public address system* Internal combustion or electrically driven equipment (unless grouped elsewhere) over 14kW NEP	Air compressors up to 170 L/s capacity Fluid pumps Internal combustion or electrically driven equipment (unless grouped elsewhere) up to 14kW NEP

* To be measured at the site boundary closest to the affected area.
\+ Reversing alarms must be controlled so that noise levels produced do not exceed the background sound level by more than 10dBA.

Notes

1. Where any appliance is unable to comply with the allowable noise level, para 43 applies.

2. A Certificate of Acoustic Performance (see Form D) shall be provided for each appliance listed in Group A.

3. All noise levels are to be $L_{A\ av\ max}$ (1 minute) measured at 7 m from the point nearest to an Appliance.

4 "NEP" means the Net Engine Power and shall be determined in accordance with Australian Design Rule No.28/00 External Noise of Motor Vehicles, Other Than L-Group Vehicles dated March 1989;

Figure 6 - Listed Appliances and Allowable Noise Levels