CONSTRUCTION NOISE & VIBRATION MANAGEMENT PLAN

182-186 Gertrude Street, North Gosford

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Prepared For:
Shan Lin

C/- Andy Wu, Texco Design
Suite 801C Rhodes Waterside, 1 Rider Boulevard,
Rhodes NSW 2138

Email: andy@texcodesign.com.au

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Author: Sri Harsha Eati

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Prepared By:
PJ Knowland Pty. Ltd.
t/a PKA Acoustic Consulting

PO Box 345, Lane Cove NSW 1595

ABN 87 256 407 546, ACN 621 896 204

T (02) 9460 6824 · **E** admin@pka.com.au

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1.0 INTRODUCTION

PKA Acoustic Consulting have been commissioned by Shan Lin to prepare a Construction Noise & Vibration Management Plan to assess the potential noise and vibration impact from the proposed construction work for the residential development located at 182 – 186 Gertrude Street, North Gosford upon the surrounding environment.

To analyse and minimise construction noise and vibration impact the EPA's *Interim Construction Noise Guideline* were applied. References were also be made to AS 2436 Guide to noise and vibration control on construction, demolition, and maintenance sites.

The goal of this assessment is to:

- Present the noise criteria for the construction stages of the development.
- Undertake a general noise and vibration analysis of the impacts to the affected receivers.
- Provide best practice recommendations to reduce identified exceedances.

2.0 SUMMARY

An assessment was conducted in accordance with the EPA's *Interim Guidelines Construction Noise Guideline and the relevant Construction Vibration Guidelines.* Indicative plant and machinery noise emissions using published sound power levels were used to assess the noise levels at the nearest and most affected receivers and to determine compliance with the nominated noise criteria. It was found that for some processes the sensitive receivers will be exposed to noise levels below or equal to the EPA "*Noise Affected Level*" and "*Highly Noise Affected Level*" and in some cases, exceed the limits. Details on noise impact mitigation strategies have been presented.

Induced ground vibrations from typical construction machinery have been estimated at the nearest and most affected receivers to determine compliance with the nominated vibration criteria. The assessment results are presented in the report. To reduce the noise and vibration impacts, a series of best practice mitigation measure are recommended in Section 8.0 of this report.

3.0 SITE DESCRIPTION

The proposed development is located at 182-186 Gertrude Street, North Gosford. The site is bound by Gertrude Street to the east, and other residential developments on the remaining boundaries (which are also the nearest sensitive receivers to the noise and vibration generated from the construction activities).

The site location is shown in the figure below.

Figure 3-1 Site Location

4.0 NOISE CRITERIA

4.1 NSW Department of Planning and Environment – Request for Information

The NSW Department of Planning and Environment requested the following information in their letter ref. DA23/3021 dated 19th July 2023.

"Provide a Construction Noise and Vibration Management Plan which considers construction noise and vibration impacts on surrounding sensitive receivers and which outlines proposed management and mitigation measures that would be implemented."

4.2 EPA NSW Interim Construction Noise Guidelines (ICNG)

Based on the above, the *NSW EPA Interim Construction Noise Guideline* (ICNG) is being used in performing this assessment. The document aims at managing noise from construction works regulated by the EPA. Details of noise limits are presented in the following Table 4-1.

Table 4-1 Noise Levels Residential Receivers (Extract from EPA ICNG)

Time of day	Management level $L_{Aeq\ (15\ min)}$	Application
Recommended standard hours: Monday to Friday 7 am to 6 pm Saturday 8 am to 1 pm 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 $L_{Aeq\ (15\ min)}$ 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	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 above the noise affected level, the proponent should negotiate with the community.

4.3 NSW EPA Road Noise Policy

To assess the vehicular noise impact of the construction activities upon the surrounding environment, we refer to the criterion defined by the *NSW Road Noise Policy* (RNP).

Table 4-2 presents the noise assessment criteria by the RNP for land use developments with potential to create additional traffic on existing roads.

Table 4-2 Road Traffic Criteria for Residential Land Use

Road category	Type of project/land use	Assessment criteria, dB(A)	
		Day: 7am-10 pm	Night: 10pm – 7 am
Local roads	Existing residences affected by additional traffic on existing local roads generated by land use development	$L_{eq\ (1\ hr)}$ 55 (external)	$L_{eq\ (1\ hr)}$ 50 (external)

In cases noise exceeds the above criteria:

- The RNP recommends that "where feasible, existing noise levels should be mitigated to meet the noise criteria. In this regard, the RNP states that for existing roads there is limited potential for noise control as the development is not linked to road improvements. It does however advise that applicable strategies include appropriate location of private access roads, regulating times of use, using clustering, using quiet vehicles, and using barriers and acoustic treatments".

- For existing residences and other sensitive land uses affected by additional traffic on existing roads generated by land use development, any increase in total traffic noise level should be limited to 2 dB above that of the corresponding 'no build option'.

4.4 General Vibration Criteria

During demolition and excavation, there is the potential for vibration impact on the neighbouring buildings' amenity and on structures. The EPA ICNG states that human comfort (amenity) vibration is to be measured and assessed in accordance with *Assessing Vibration – a technical guideline* (DECC 2006).

In general, structural damage due to vibration can be of concern when hammering, blasting, vibration rolling, crushing, piling and other vibration inducing construction works are carried out.

The EPA ICNG does not have specific structural vibration damage criteria however the RTA *Environmental Noise Management Manual* (2001) recommends the use of the following Standards:

- British Standard BS 7385: Part 2: *Evaluation and Measurement for Vibrations in Buildings – Part 2 Guide to Damage Levels from Ground-Borne Vibration*
- AS 2187.2 *Explosives-Storage, transport and use, Part 2: Use of Explosives*
- German Standard DIN 4150, Part 3: *Structural Vibration in Buildings: Effects on Structures*

4.4.1 Project Amenity Vibration Criteria

The vibration amenity criteria are adopted from *Assessing Vibration – a technical guideline* (DECC 2006) and are presented in Table 4-3. Vibration is normally perceived via floor vibration so typically the vertical vibrations are assessed for construction induced vibrations. The preferred assessment method is the Vibration Dose Value (VDV). However, there are other descriptors that may be used in lieu as shown in the next sections of this report.

Table 4-3 Human Comfort Vibration Criteria (vertical axis)

Receiver Type	Vibration Type	VDV $m/s^{1.75}$		RMS Acceleration m/s^2		RMS Velocity mm/s		Peak Velocity mm/s	
		Pref'd	Max	Pref'd	Max	Pref'd	Max	Pref'd	Max
Residential	Continuous	0.2	0.4	0.01	0.02	0.2	0.4	0.28	0.56
	Impulsive			0.3	0.6	6	12	8.6	17
Offices	Continuous	0.4	0.8	0.02	0.04	0.4	0.8	0.56	1.1
	Impulsive			0.64	1.28	13	26	18	36

Continuous vibration relates to vibration that continues uninterrupted for a defined period (usually throughout the daytime or night-time), e.g. continuous construction or maintenance activity. (DECC, 2006). Impulsive vibration relates to vibration that builds up rapidly to a peak followed by a damped decay and that may or may not involve several cycles of vibration (depending on frequency and damping), with up to three occurrences in an assessment period, e.g. occasional loading and unloading, or dropping of heavy equipment. (DECC, 2006).

4.4.2 Structural Damage Vibration Criteria

Guidance for the vibration structural damage is adopted from the German Standard *DIN 4150, Part 3: Structural Vibration in Buildings: Effects on Structures.* The main criteria are based on the absolute value or magnitude of the peak body (X, Y or Z) component velocity at the foundation or on the planar axes (X, Y) for the top floor and are presented in Table 4-4. All tabulated vibration levels for structural considerations are given in terms of the Peak Particle Velocity (PPV).

Table 4-4 DIN 4150-3 Vibration Criteria

Building Type		Vibration at Foundation Level (PPV)				Top Floor Horizontal Vibration
		<10 Hz	10-50 Hz	50-100 Hz	>100 Hz	All Freq
1	Buildings used in commercial purposes, industrial buildings and buildings of similar design	20 mm/s	20-40 mm/s	40-50 mm/s	50 mm/s	40 mm/s

Building Type		Vibration at Foundation Level (PPV)				Top Floor Horizontal Vibration
		<10 Hz	10-50 Hz	50-100 Hz	>100 Hz	All Freq
2	Dwellings and buildings of similar design and/or use	5 mm/s	5-15 mm/s	15-20 mm/s	20 mm/s	15 mm/s
3	Structures that because of their sensitivity to vibration, do not correspond to those listed in Lines 1 or 2 and have intrinsic value (e.g. buildings that are under a preservation order)	3 mm/s	3-8 mm/s	8-10 mm/s	10 mm/s	8 mm/s

Table 4-5 presents the vibration criteria for pipelines in "good" condition which are buried and restrained from vibrating freely by the surrounding back fill.

Table 4-5 DIN 4150-3 Short Term Peak Component Buried Pipe Vibration Criteria

Pipe Material Type	PPV Vibration on Pipe
Steel	100 mm/s
Clay, Cement or Metal	80 mm/s
Masonry or Plastic	50 mm/s

Although not specified in the EPA ICNG, guidance will be sought from BS 5228-2:2009 Code of practice for noise and vibration control on construction and open sites for items not covered by the recommended standards. The following tables present relevant criteria for items that are in "good" condition. For underground services, the item is restrained from vibrating freely by the surrounding backfill.

Table 4-6 BS 5228-2 Peak Component Retaining Wall PPV Vibration Criteria

Wall Material and Type	Vibration Type	Vibration on toe of Wall	Vibration on crest of Wall (horizontal)
Masonry	Transient	10 mm/s	40 mm/s
Propped, Tied, Mass Gravity	Transient	15-20 mm/s	60-80 mm/s
Well supported Steel Pile, Reinforced Concrete	Transient	15-20 mm/s	60-80 mm/s
Masonry	Continuous	4-6 mm/s	16-26 mm/s
Propped, Tied, Mass Gravity	Continuous	6-13 mm/s	24-53 mm/s
Well supported Steel Pile, Reinforced Concrete	Continuous	6-13 mm/s	24-53 mm/s

Table 4-7 BS 5228-2 Peak Component Underground Services PPV Vibration Criteria

Wall Material	Vibration Type	Vibration on wall
Reinforced concrete	Intermittent/Transient	30 mm/s
Reinforced concrete	Continuous	15 mm/s

4.4.3 Project Vibration Criteria

In the absence of any other site-specific criteria, the following generic vibration criteria is recommended for guidance in setting construction vibration limits. Vibration level criteria from the nominated standards has been presented in this section.

The target vibration levels of the Amenity criteria are typically not achieved on the ground and lower floors in buildings near works such as hammering and other construction processes such as piling and compaction. The possible disturbance from the works is temporary and typically the effect is removed once the process is complete, thus it is unlikely to have a permanent effect, so these criteria are considered as ideal target levels but not as mandatory limits.

The structural damage criteria relevant to this project have also been presented in the previous section and are considered as mandatory vibration limits. Generic criteria are presented for structures in “good” condition and compliance with the listed levels will minimise the likelihood of structural damage. For structures in diminished or poor condition the vibration level limits should be appropriately reduced. Note the standards presented do not cover structural damage due to subsidence, compaction/settling, soil liquefaction, etc. resulting from vibration. Vibration criteria to cover these and other vibration related effects are typically documented in the geotechnical and structural engineer’s reports for the site and adjacent buildings. Vibration level requirements from these two specialists shall precede any generic criteria presented in the standards.

Although the specified vibration levels given for buildings are frequency dependent, for vibration monitoring, the criteria levels for buildings may be set to the lowest limit being the level for frequencies less than 10 Hz for each respective building type. Alternatively, each vibration source or process can be site measured and the respective criteria level selected based on the dominant frequency of the excitation. Typically, this will relax vibration limit levels to permit a higher level of vibration.

5.0 NOISE SURVEY & GOALS

As part of the preparation of the DA Acoustic Report, PKA conducted a noise survey to measure the existing background and ambient noise levels as detailed in report ref.12382 R01v1 dated 11th October 2022. Based on this, Table 5-1 below presents the results of the measured background noise levels and the noise affected level (criterion). The following is assuming that the project management intends to do the construction during normal daytime working hours.

Table 5-1 Construction Site-Specific Noise Goals – Residential Receivers

Location	Period	Background RBL	Noise affected Level Criteria	Highly Noise Affected Criteria
At residential boundary	Day (7am to 6pm)	42 dB(A)	52 dB(A)	75dB(A)

6.0 CONSTRUCTION NOISE ASSESSMENT

The proposed construction work is expected to consist of demolition of the existing, earthworks / excavation and construction of a multi-level residential house development. The following are the assumed hours of operation for construction based on typical activity within the provision of generally approved guidelines.

Table 6-1 Construction Operating Hours

Days	Hours
Monday to Friday	7am to 5pm
Saturday	8am to 12pm
Sundays & Public Holidays	No works

As a detailed construction time schedule and information of proposed demolition, excavation and construction methodologies or plant selections are not known. PKA reviewed the provided "Construction Traffic Management Plan" prepared by Motion Traffic Engineers Pty Ltd, ref. N233149N (Version 1a) dated September 2023. The works during the various stages are expected to comprise of the following:

1. Demolition: Expected duration of 6 weeks. The existing buildings will be demolished.
2. Earthworks/Excavation: Expected duration of 10 weeks. The excavation work may get as close as 4 m to the boundaries. Bore holes, retaining structures (walls) levelling off the ground are expected to be part of the earthworks.
3. Construction: Expected duration of 52 weeks. The construction phase is expected to comprise of levelling, concrete slab works, walls and roofing, internal fit-outs, landscaping, and carpark.

For the purposes of this assessment general equipment were considered as follows:

- For demolition: Small excavator, bobcat, sledge or jack hammer, saw, loader & trucks.
- For excavation: Small excavator, jack hammer, saw cutting, bored piling, loader, trucks.
- For construction: Concrete pump and pouring, tools such as drills, grinders, riveting or welding.

Noise impacts due to the construction process will be mostly during the external works. Once the proposed building shells are completed, the noise sources will be mainly inside the building hence noise emissions will be reduced during the later stages.

At this stage, detailed information regarding proposed excavation and construction methodologies or specific plant or equipment selections is not available. Therefore, for the purpose of this assessment, the following general equipment was considered based on the loudest typical activities.

The source sound levels of the various equipment were considered based on the published information in Appendix A, Table A1 of the AS 2436-2010 "*guide to noise and vibration control on construction, demolition and maintenance sites*" as presented below.

Table 6-2 Construction Noise Sources

Plant Description	A-weighted sound power levels L_{wA} dB ref: 10^{-12} W		A-weighted sound pressure levels L_{pA} (mid-point) dB at 10 m
	Typical or Range	Typical (midpoint)	
Asphalt paver	103-112	108	80
Asphalt rotomill	111	111	83
Backhoe	100-108	104	76
Backhoe with auger	100-111	106	78
Bulldozer	102-114	108	80
Cherry picker	105	105	77
Compactor	110-115	113	85
Compressor (silenced)	93-110	101	73
Concrete agitator truck	107-111	109	76
Concrete pencil vibrator	101-105	103	75
Concrete pump truck	103- 113	108	80
Concrete vibratory screed	115	115	87
Crane (mobile)	95-113	104	76
Crane (tower)	105	105	77
Excavator	97-117	107	79
Filtration unit (40 000 cfm)	109	109	81
Forklift	106	106	78
Front end loader	110-115	113	85
Generator (diesel)	84-113	99	71
Grader	105-115	110	82
Hand tools (electric)	95-110	102	74
Hand tools (pneumatic)	114-117	116	88

Plant Description	A-weighted sound power levels L_{wA} dB ref: 10^{-12} W		A-weighted sound pressure levels L_{pA} (mid-point) dB at 10 m
	Typical or Range	Typical (midpoint)	
Loader (wheeled)	99-111	105	77
Piling (bored)	111	111	83
Spreader	95	95	67
Truck (>20 tonne)	107	107	79
Truck (dump)	117	117	89
Truck (water cart)	106-108	107	79
Vehicle (light commercial e.g. 4WD)	100-111	106	78
Welder	100-110	105	77

6.1 Predicted Noise Levels

Noise levels from demolition excavation and construction equipment have been calculated at the nearest noise receivers by using the midpoint sound power levels for each machinery item from Australian standard AS2436 (midpoint values) and by distance attenuation.

Depending on the work schedule and nature of each task, different equipment may or may not work simultaneously. For example, during demolition, the saw cutting may be used when the hammer is not in operation. Equipment such as the excavator and the hammer will not be working simultaneously. The loader and the truck, however, may work in combination with any other equipment or combination.

Calculations consider a combination for the noisiest equipment in action. Noise levels and noise attenuations at the receivers were calculated based on average distance and directivity. A summary of results is presented in Table 6-3.

Table 6-3 Predicted Noise Levels at Receivers- Based on Loudest Equipment Nominated

Location	Equipment distance to boundary	Noise Levels, $L_{eq\ 15minute}$ dB(A)		
		Demolition phase	Excavation phase	Construction phase
Residential Receiver	7m	82 dB(A)	82 dB(A)	80 dB(A) for external works
				68 dB(A) for internal works

The resultant noise levels in the above table are based on equipment operating continuously for the entire 15-minute period of assessment. Where equipment is used more intermittently or periodically (shorter than 15 minutes at a time), the above value will drop accordingly.

Noise levels in the summary table above present the highest combined noise levels in each phase. The duration of the highest noise levels above will vary from few minutes to few hours each day depending on the work schedule and work details. The above noise levels will be the maximum levels occurring at any time during each phase of construction. At other times, the noise levels will be lower depending on the type and amount of equipment in operation.

6.2 Assessment of equipment noise

The noise levels from the proposed machinery have been assessed against the acceptable noise level criteria for adjoining residential receivers and a summary is presented in Table 6-4.

Table 6-4 Noise Compliance Summary Status for Residential Receivers

Location	Comparison to Noise Affected Level, 52 dB(A)	Comparison to Highly Noise Affected Level, 75 dB(A)?
Adjacent Affected Residential Receivers	No, for demolition. No, for excavation. No, for construction.	No, for excavation. No, for external construction. Yes, for internal works.

Our comments are as follows:

- The most affected residential buildings will be the adjacent neighbours. Due to the proximity, the adjacent receivers will have a noise impact from most operations, hence mitigation measures will be required. It is recommended that installation of hoardings to the appropriate height on the periphery of the site. The height of the hoarding should be such that there is no line of site between the equipment and the receiver. We recommend installation of hoardings to a minimum height of 3m. They will provide 5- 10 dB(A) attenuation to the ground level of the adjacent buildings. The hoardings should be constructed of solid acoustic material such as FC sheeting or particleboard or plywood. The hoardings should be properly overlapped and be free from any gaps and openings.
- Although some individual plant item noise may comply with noise limits, the accumulated noise from simultaneous operation of the equipment including the loader and truck will generally exceed the noise criteria. The exceedance would however be reasonably typical for most construction sites.
- During construction phase, once the buildings are erected, most noise sources such as drilling or welding will be inside the building, therefore the perceived noise levels will be lower due to shielding.

Typically, construction activities are noisy and are carried out in the open. Australian Standard AS2436 identifies this difficult issue and suggests some leeway in noise criteria by the following:

> *Some construction and demolition activities are by their very nature noisy. The authorities responsible for setting noise level criteria for essential works will take note of the constraints imposed by such activities, especially when they are of short duration.*

6.3 Truck Noise Assessment

The "Construction Traffic Management Plan" prepared by Motion Traffic Engineers Pty Ltd, ref. N233149N (Version 1a) dated September 2023 provides the following truck movement numbers.

Table 6-5 Expected Truck Activity

Construction Phase	Truckloads per day
Demolition	4 per day

Construction Phase	Truckloads per day
Excavation	10 per day
Construction (& Crossover)	4 per day

For those trucks arriving on site and getting into loading position, the stationary truck noise emissions has been included in our calculations in Section 6.1 and is part of the noise impact assessment.

The RNP daytime criteria for local roads is $L_{eq1\ hr}$ 55 dB(A) as shown in Table 6-6. In any case, the noise level increase due to such activities should be limited to 2 dB(A).

The noise effect of the additional traffic was calculated against the criteria. The following Table 6-6 presents a summary of the results. PKA was not provided the existing traffic volume count and therefore assumptions for the Vehicles per hour (vph) have been made based on previous Construction Noise and Vibration Management plans PKA has prepared for similar localities. The below consider an unlikely scenario where the concentration of the trucks is high within the hour.

Table 6-6 Noise from traffic movements during construction

Period	Existing volume (vph)	Truck generation volume (vph)	Increase in noise level over period	Increase in noise limit permitted (criteria)	Complies (Yes/No)
AM peak hour	20	1 to 2	<1 dB(A)	2dB(A)	Yes
PM peak hour	20	1 to 2	<1 dB(A)	2dB(A)	Yes

The 2 dB(A) permitted noise level corresponds to an increase of traffic volume of 60%. The generated traffic volume is within 60 % of the existing volume hence noise increase will be within 2 dB(A) limit. Although the truck noise is higher than passenger vehicle noise, the proportion increase in volume is so small that the total increase will be well within the criteria.

7.0 CONSTRUCTION VIBRATION ASSESSMENT

A preliminary review of typical construction vibration levels was conducted using published formulae, historical and measured data for major plant equipment expected to be used during the excavation stages. Actual site vibration levels may vary from those shown in Table 7-1 as there is a dependence on the ground/soil type on site.

Table 7-1 Ground Vibrations vs. Distance for Plant Items

Activity / Plant	Peak Particle Velocity (PPV) mm/s									
	Distance (m)									
	5	10	15	20	25	30	35	40	45	50
Loaded Trucks	3.6	1.3	0.7	0.5	0.3	0.2	0.2	0.2	0.1	0.1
Small excavator (less than)	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Activity / Plant	Peak Particle Velocity (PPV) mm/s									
	Distance (m)									
	5	10	15	20	25	30	35	40	45	50
Jack Hammer (less than)	1.7	0.6	0.3	0.2	0.1	0.1	0.1	0.1	0.1	0.0
Rock Hammer (1500 Kg)	4.5	3	-	1.5	-	0.4	-	0.3	-	0.3

Based on the vibration levels given in Table 7-1, the predicted vibration levels at the nearest and most affected buildings are presented in Table 7-2. The activities which have the highest vibration levels will be the use of excavator and rock hammer which all show compliance.

It is assumed that the truck loading will be at the driveway crossing, close to the street. Therefore, the corresponding distance for trucks to receivers was taken as 10m.

Table 7-2 Assessment of Predicted Vibration Levels at Residential Receiver

Plant Item	Distance (m)	Vibration level PPV (mm/s)	Amenity Criterion (mm/s)	Structural Criterion (mm/s)	Complies?
Loaded Trucks	10	<1.3	<0.28 -0.56	<5	Yes
Small excavator	10	<0.1	<0.28- 0.56	<5	Yes
Jack Hammer	10	<1.1 (extrapolated)	<0.28 -0.56	<5	Yes

When on site (or close to the site), the loaded trucks will be moving at a very low speed therefore the actual vibration levels will be much lower than those of a loaded truck shown above. The predicted levels are only a guide, and it is noted that:

- The dominant frequencies of the vibration producing processes have not been considered.
- The hardness of the ground may be harder than assumed.
- The building foundation/ground coupling properties can also reduce the foundation vibration level.
- The predicted vibrations are for the ground level. Vibration levels on the upper floors of buildings can be different due to structural attenuation losses.

We note that our predictions are based on theoretical assessments rather than measurements on site. As such, actual vibration levels may vary from these predictions. Based on our vibration assessment, no residential buildings are likely to be impacted by vibration works.

8.0 MITIGATION STRATEGIES – RECOMMENDATIONS

8.1 Noise Mitigation Measures

Detailed construction timelines and methodologies are not available at this stage. Typically, detailed construction plans are only prepared once relevant contractors have been appointed and specific details of work for the next stage of works are finalised. Our analysis however indicates at the nearest residences, noise from some activities such as the use of excavator, concrete saw or concrete pouring will exceed the EPA “Noise Affected Level” and “Highly Noise Affected Level”

criteria. While this may vary based on the actual selected plant, the following comprises a specific and general guide and list of our recommendations for control of such noise and reduction of the noise impact. All feasible and reasonable work practices should be applied to meet the noise affected level. Where feasible, these include:

- Installation of localised hoardings around loud equipment. The hoarding should be constructed of solid panels such as 9 mm plywood or fc sheets. The hoarding panels should have proper overlap, to be free of any gaps or openings.
- The height of the hoarding should be such that there is no line of site between the equipment and the receiver. To have an effective hoarding the height should be in minimum of 3m. However, erection of such tall hoarding may prove impractical. If that is the case, management measures such as the use of “all feasible and reasonable solutions” should be fully considered.
- where possible, demolishing structures and excavations, should use jaw crushers and saws as an alternative to using rock breakers or dozers. At close distances, hammering should be replaced by ripping.
- using a low noise and vibration generating form of piling, such as bored piling or auger for retaining walls (impact piling not to be used).
- limiting noisy activities such as piling and demolishing, to when community is less sensitive to noise to provide respite to surrounding residences (avoiding early morning or late afternoon hours).
- selecting low noise equipment, e.g. the engines to have proper exhaust or silencers, or the noise radiating surfaces to be damped.
- the stationary noisy equipment such as generators should be kept as far possible to the residential end. Such equipment to be fitted with a purpose-built semi-enclosure.
- liaising with all the affected residences and informing them when noisy work will occur and what is being done to minimize the noise.
- using less annoying alternatives (such as broadband “quacker” units) to audible movement alarms that provide a safe system of work, or configuring the site to maximize forward movements of mobile plant.
- A proper system for community liaison and consultation to be placed (see below for details)
- All truck movements, loading/unloading should take place with minimum amount of noise emission to the neighbours. The trucks should be selected to have minimal noise and a proper exhaust system. All drivers should be trained to keep the noise to a minimum. To eliminate the reversing beep, the route must be planned to minimize the reversing distance. Trucks should be switched off as soon as they arrive into position.

The *EPA Interim Construction Noise Guideline* provides the operational suggestions to reduce noise impact. The following general procedures, based on those in the EPA Guideline can be adopted for this site.

- Community consultation and notification should be carried out. Keep affected receivers informed of upcoming works and construction times.
- A complaint handling procedure should be established. This should include a readily accessible contact point for residents to contact the site staff in charge of noise management, a clear complaint (and reporting) process and establishment of a complaints register.
- Use quiet work methods and lower noise plant and equipment.

- Use quiet equipment where possible. Specified noise levels can be taken into account when selecting individual plant items.
- Operate plant in a quiet and efficient manner. For example, reduce throttle setting and turn off equipment when not being used.
- Maintain equipment to ensure manufacturers design noise levels are achieved.
- Locate noisy plant away from sensitive receivers where possible. This may include locating construction vehicle entrances away from the residential area.
- Maximise noise shielding on site. This may include using site sheds, materials stockpiles, or natural landforms to provide acoustic shielding.
- Schedule activities to minimise noise impacts. Consultation should be undertaken with affected neighbours to minimise impacts.
- Organise deliveries and access to minimise noise impacts. This may include nomination of off-site truck parking areas away from residents, provision of on-site parking for trucks and staff and amalgamation of loads to minimise truck movement numbers.

8.2 Vibration mitigation measures

Based on the proximity of the north & south boundary neighbours, the vibration levels predicted above and the ground geology, we recommend the following:

- The equipment especially for excavation should be carefully chosen to have the minimum vibration levels. For example, the work should be limited to using the excavator and saw cutting (avoid using hammer or rock breaker near the west, east & south boundaries).
- Vibration due to piling should be kept to a minimum. Auger method is preferred to compact or other methods.
- Vibration monitoring during construction may be considered but this is to be investigated following the availably of a construction schedule which is typically prepared at later stages of the development.

8.3 Community Consultation and Complaints Handling

The following community consultation and complaints handling procedures should be adopted for the site:

- Contact potentially noise affected neighbours at the earliest possible time before any site work begins.
- Inform potentially noise affected neighbours about the nature of the construction stages and the duration of noisier activities.
- Keep potentially noise affected neighbours up to date on progress.
- Provide contact details (including phone number) on a site board at the front of the site and maintain a complaint register suited to the scale of works.
- Once a complaint is received it should be followed up promptly, acted upon and then the complainant contacted (if amenable) to inform them of progress and check that the solution is satisfactory.
- Ask about any concerns that potentially noise affected neighbours may have and discuss possible solutions.

As part of the complaint management process, the following steps must be considered.

- A complaint hotline must be maintained with the contact details for this line/email clearly published on the development website or other relevant documents.
- A log must be kept detailing the contact person who made the complaint, the description of the complaint and the date and time.
- Discussion within the relevant panel to potentially minimise the noise where feasible. This must be done in co-ordination with the contact who made the complaint, and a log must be maintained detailing the progress of addressing the complaint.
- Where it is found that the issue cannot be solved internally, hire an acoustic consultant to review if the noise generated is within the noise goals allowed for the premises and provide mitigation measures where necessary.
- Create a database of the above details that can be reproduced when requested/required by the local community and authorities.
- In addition, to ensure that the system is working, create a system for receiving feedback from the community. This could be in the form of regular meetings with affected residents, or a newsletter etc.
- The following contact details must be made available to the public.
    - Address for correspondence:
    - Phone No:
    - Fax No (if applicable):
    - Email:

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PKA ACOUSTIC CONSULTING

PO Box 345, Lane Cove 1595

+612 9460 6824 — admin@pka.com.au