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Project Bowerbird, 15 Gow Street, Padstow

Construction Noise & Vibration Management Plan

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1 INTRODUCTION

The following Construction Noise and Vibration Management Plan ("**CNVMP**" or the "**Plan** has been prepared to review potential noise and vibration generated by construction activities associated with the proposed industrial development at 15 Gow Street, Padstow.

The Plan:

- Identifies sensitive receivers that are likely to be potentially impacted by the proposed works.
- Develops project specific noise and vibration management levels. These will be used to indicate whether additional impact mitigation, beyond normal "good practice", is indicated.
- Identifies the major noise and vibration sources that will be present on the construction site, and additional construction-related traffic generated by the development.
- Predicts the likely noise and vibration levels during the phases of construction and assesses these against the established management levels. Where the predicted impacts exceed the management levels, the Plan identifies and assesses potential measures to minimise these impacts.
- Provides specific and general recommendations for the ongoing monitoring, assessment and management of noise and vibration emissions as the works progress in response to additional information and site conditions, and the updating of the Plan to reflect additional information obtained during the construction period.

Where the term "construction" is used in this Plan, it includes demolition, excavation and any other site activity related to the construction of the development being assessed.

This Plan has been prepared for the sole purpose as stated above and should not be used or relied on for any other purpose.

2 PROPOSED WORKS

2.1 PURPOSE OF WORKS

The existing Selley's manufacturing facility located at 15 Gow Street is proposed to be upgraded to modernise manufacturing capabilities, provide sustainability improvements and improve safety. In order to facilitate the works the following is proposed:

- Demolition of the existing warehouse and maintenance buildings,
- Strip-out and refurbishment of existing warehouse space, to be converted into a state-of-the-art manufacturing facility.
- Construction of a new warehouse and ancillary building, alongside external tank storage and tanker unloading areas.

2.2 DEMOLITION & CONSTRUCTION ACTIVITIES

Construction works are to include the following phases:

- Demolition of existing structures, as indicated in Figure 2. Structures to be demolished include:
  - Docks to existing warehouse facilities
  - Existing warehouse
  - Canteen
  - Pump shed
  - Ancillary buildings.
- Excavation and levelling of site, as indicated in the cut and fill plan in Figure 4.
  - Subsoil conditions indicate clay/sand to a depth of approximately 2m, and shale below.
  - Excavation activities are generally limited to levelling works and minor alterations to existing ground heights – hammering or similar high noise generating works are not expected during this phase.
- Structure works will include installation of foundation piles to the technical centre building.
  - Auger type piling is proposed (refer Figure 3)
  - Concrete pumps will be retained within the boundary of the site, primarily around the perimeter f the existing warehouse and proposed warehouse to be constructed under these works.
- Mobile cranes are proposed where required, primarily during the structure and fitout stages of work.

The anticipated construction schedule is detailed below.

- Demolition – 5 months
- Excavation – 1 month
- Piling – 15 days
- Construction – 12 months from the conclusion of demolition activities.

Plans detailing the general site layout and key construction activities are provided in the following pages of this report.

2.3 SENSITIVE RECEIVERS

A summary of noise sensitive receivers is provided in the approved acoustic report submitted with the SSD application (*Project Bowerbird – Noise and Vibration Impact Assessment*, GHD, project number 12606520, dated 24/10/2024).

The closest residential receivers are located approximately 400m from the site (east), with land uses immediately surrounding the site consisting of other industrial uses. Commercial receivers are located further to the north. Potentially noise affected receivers in close proximity to the works are summarised below.

Table 1 – Noise Sensitive Receivers

Receiver Type	Address / Location	Distance from Site
Industrial	40 Fairford Road, Padstow	100m
	48 Fairford Road, Padstow	15m
	54 Fairford Road, Padstow	
	56 Fairford Road, Padstow	
	60 Fairford Road, Padstow	
	26 Gow Street, Padstow	80m
	30 Gow Street, Padstow	90m
	31 Gow Street, Padstow	15m
	33 Gow Street, Padstow	30m
	35 Gow Street, Padstow	45m
	37 Gow Street, Padstow	60m
	39 Gow Street, Padstow	75m
	41 Gow Street, Padstow	90m
Commercial	1618 Canterbury Road, Punchbowl	380m
Residential	Residents east of Moxon Road, Punchbowl	400m
	Residents South of Wiggs Road, Riverwood	650m

A summary of noise sensitive receivers is presented in Figure 5

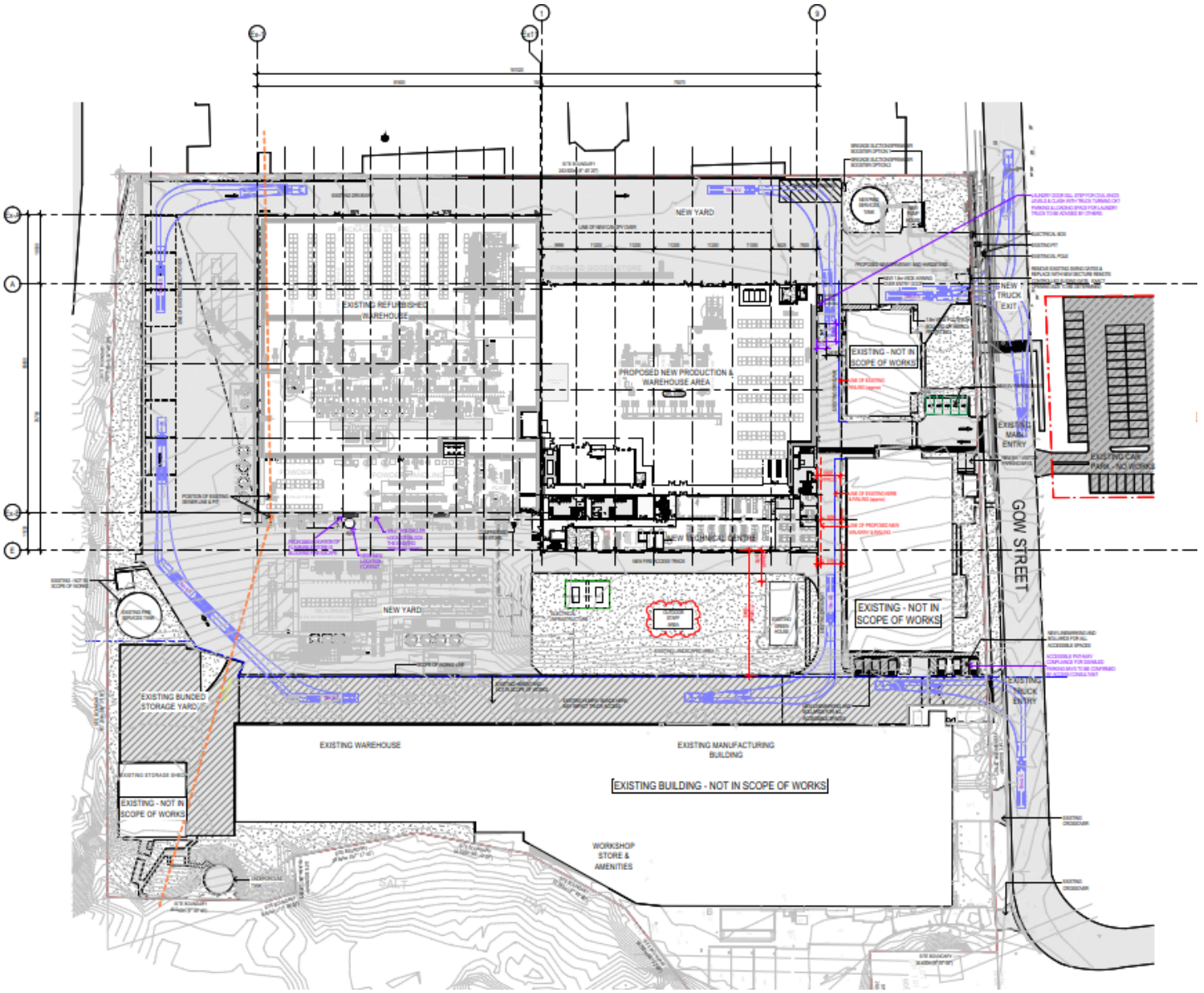


Figure 1 – Overall Site Plan

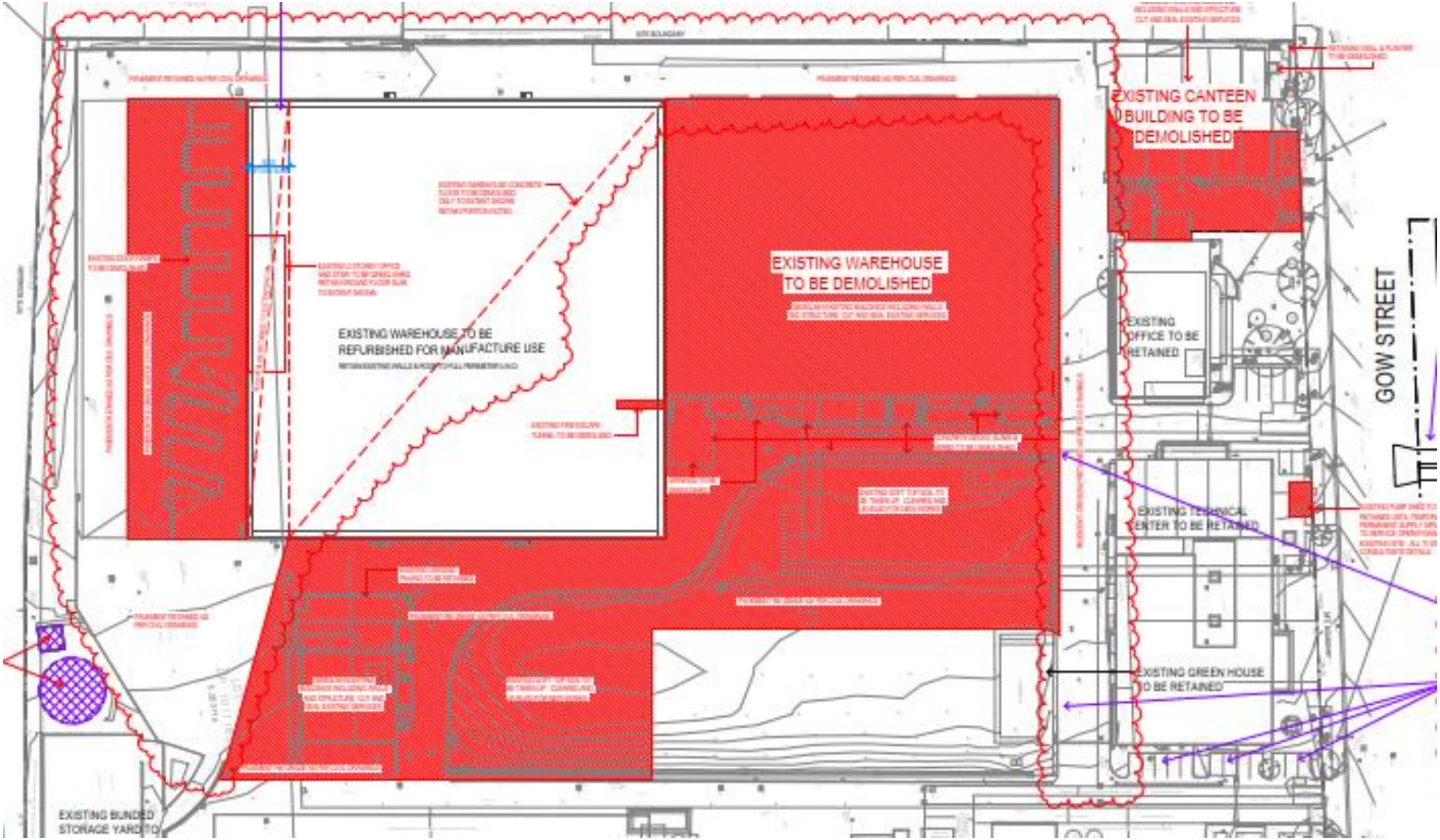


Figure 2 – Demolition Plan Indicating Structures to be Removed

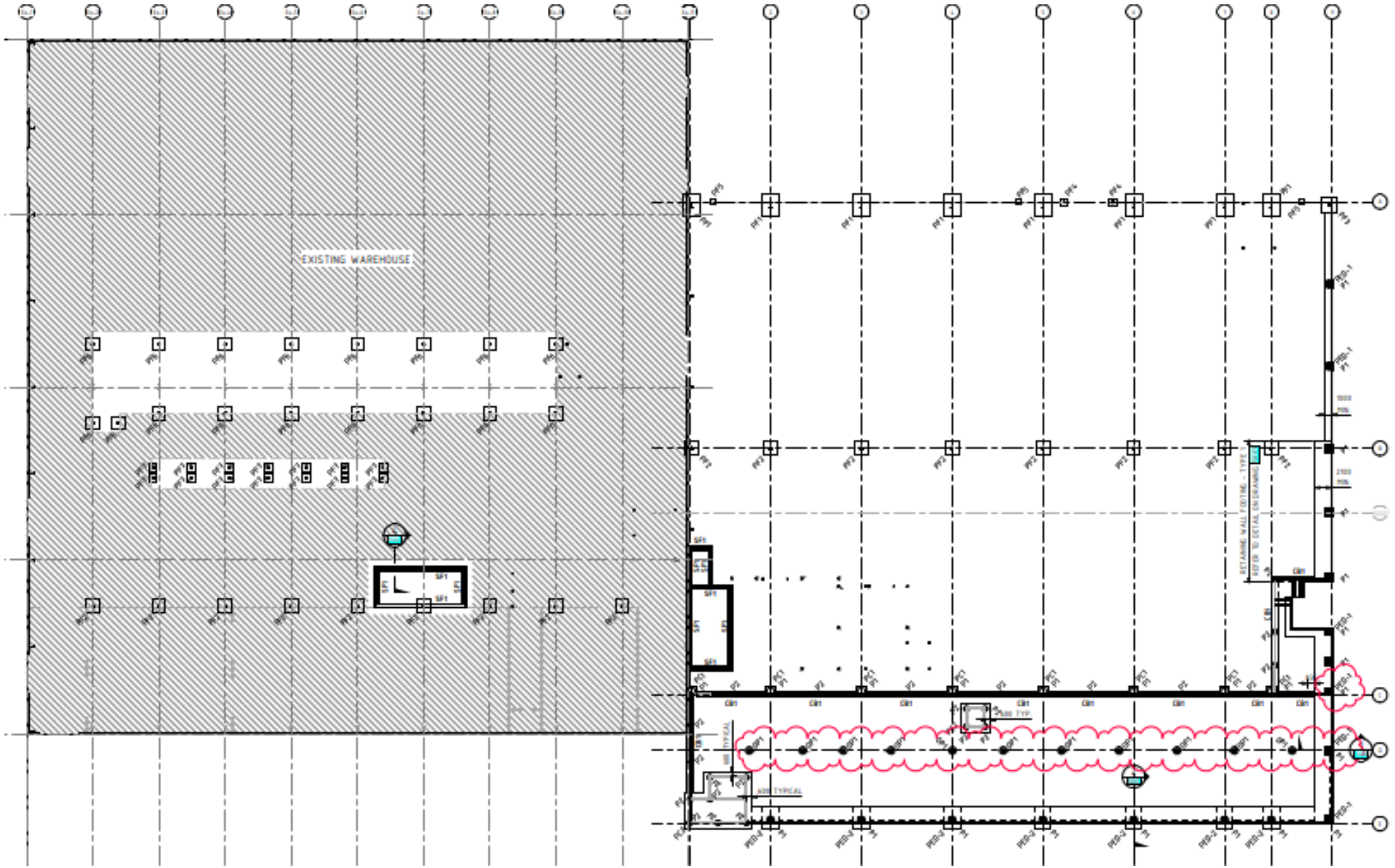


Figure 3 – Warehouse Footing Plan, Indicating Extent of Piling Works Required

Figure 4 – Cut and Fill Plan Indicating Extent of Excavation

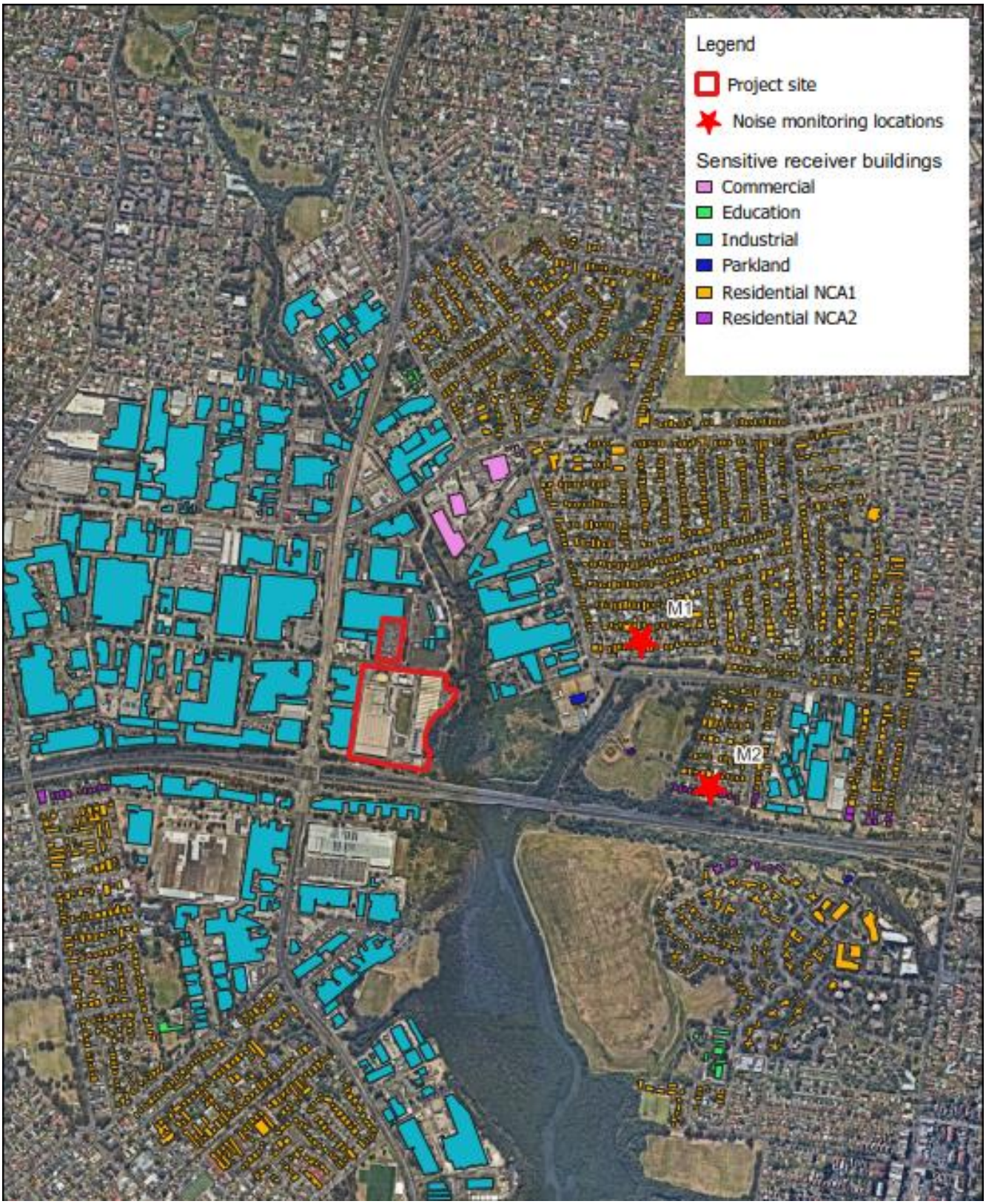


Figure 5 – Noise Sensitive Receivers (GHD SSDA Acoustic Report)

3 DEVELOPMENT CONSENT SSD-71052213 (DRAFT)

Hours of Work

B6. *The applicant must comply with the hours detailed in Table 2 below.*

Table 2 *Hours of Work*

Activity	***Day***	***Time***
Construction	*Monday – Friday*	*7am to 6pm*
	Saturday	*8am to 1pm*

B7. *Work outside of the hours identified in condition B8 may be undertaken in the following circumstances:*

(a) works that are inaudible at the nearest sensitive receivers

(b) works agreed to in writing by the Planning Secretary;

(c) for the delivery of materials required outside these hours by the NSW Police Force or other authorities for safety reasons; or

(d) where it is required in an emergency to avoid the loss of lives, property or to prevent environmental harm.

Construction Noise Limits

B8. *The development must be constructed to achieve the construction noise management levels detailed in the Interim Construction Noise Guidelines (as may be updated or replaced from time to time). All feasible and reasonable noise mitigation measures must be implemented and any activities that could exceed the construction noise management levels must be identified and managed in accordance with the Construction Noise and Vibration Management Plan required under condition B13.*

Vibration Criteria

B9. *Vibration caused by construction at any residence or structure outside the site must be limited to:*

(a) for structural damage, the latest version of DIN 4150-3 (2016-12) Vibration in Buildings – Part 3: Effects on Structures (German Institute for Standardisation, 2016); and

(b) for human exposure, the acceptable vibration values set out in the Environmental Noise Management Assessing Vibration: a technical guideline (DEC, 2006) (as may be updated or replaced from time to time).

B10. *The limits in condition B9 apply unless otherwise outlined in the development's Construction Noise and Vibration Management Plan (see condition B13).*

Construction Noise and Vibration Management Plan

B13. *Prior to the commencement of construction, the Applicant must prepare a Construction Noise and Vibration Management Plan (CNVMP) for the development to the satisfaction of the Planning Secretary. A copy of the CNVMP must be included in the development's CEMP (see condition C2) and must:*

(a) be prepared by a suitably qualified and experienced noise expert(s);

(b) describe procedures for achieving the noise management levels detailed in the Interim Construction Noise Guidelines (as may be updated or replaced from time to time) and the vibration criteria in condition B9;

(c) describe the measures to be implemented to manage high noise generating works such as piling, in close proximity to sensitive receivers;

(d) include strategies that have been developed with the community for managing high noise generating works (such as the provision of respite periods);

(e) include strategies that have been developed in consultation with the directly adjoining properties for managing vibration (such as any alternative construction methods with lower source vibration levels and provision for respite periods);

(f) describe the community consultation undertaken to develop the strategies in condition B13(d) and B13(e); and

(g) include a complaints management system that would be implemented for the duration of construction of the development.

B14. *The Applicant must:*

(a) not commence construction until the CNVMP required by condition B13 is approved by the Planning Secretary; and

(b) implement the most recent version of the CNVMP approved by the Planning Secretary for the duration of construction.

CONSTRUCTION ENVIRONMENTAL MANAGEMENT PLAN

C3. *As part of the CEMP required under condition C2 of this consent, the Applicant must include the following:*

…

(b) Construction Noise and Vibration Management Plan (see condition B13)

Appendix 2 – APPLICANT'S MANAGEMENT AND MITIGATION MEASURES

A6. *Construction Environment Management Plan*

Prior to the commencement of construction, Selleys would prepare a Construction Environment Management Plan (CEMP) that addresses the following:

…

(b) Noise and Vibration;

NV1. Noise and vibration management and monitoring will form part of the CEMP, to be prepared for the project, as outlined in A6.

3.1 CONSTRUCTION NOISE & VIBRATION MANAGEMENT PLAN REQUIREMENTS

A summary of the requirements for the Construction Noise & Vibration Management Plan detailed in condition B13 and the locations within this report where they are addressed are summarised below.

Table 2 – Condition B13 Requirements

Condition Number	Requirement	Report Reference	Additional Comments
B13	Prior to the commencement of construction, the Applicant must prepare a Construction Noise and Vibration Management Plan (CNVMP) for the development to the satisfaction of the Planning Secretary	All	This reports presents the Construction Noise & Vibration Management Plan for the project.
B13(a)	Be prepared by a suitably qualified and experienced noise expert(s)	Appendix A	Refer attached CV
B13(b)	Describe procedures for achieving the noise management levels detailed in the Interim Construction Noise Guidelines (as may be updated or replaced from time to time) and the vibration criteria in condition B11	45.25.3	Noise management levels and vibration criteria has been developed with reference to the ICNG, and noise levels expected from construction quantified to surrounding receivers.
B13(c)	Describe the measures to be implemented to manage high noise generating works such as piling, in close proximity to sensitive receivers	5.5, 5.6, 6.4	Management controls have been developed based on predicted noise levels to mitigate noise impacts to surrounding receivers.
B13(d)	Include strategies that have been developed with the community for managing high noise generating works (such as the provision of respite periods);	7	Community engagement of surrounding noise receivers in close proximity to the project site has been undertaken. Significant feedback from community and surrounding businesses has not been received, however management and mitigation strategies have been implemented to mitigate any noise and vibration impacts generated by construction activities.
B13(e)	Include strategies that have been developed in consultation with the directly adjoining properties for managing vibration (such as any alternative construction methods with lower source vibration levels and provision for respite periods)	7	
B13(f)	Describe the community consultation undertaken to develop the strategies in condition B13(d) and B13(e)	7	
B13(g)	Include a complaints management system that would be implemented for the duration of construction of the development	6.3, 7, 8	Complaints management procedures have been outlined in the event of noise or vibration complaint.

4 REFERENCED DOCUMENTS

4.1 BACKGROUND INFORMATION USED

The assessment is based on the following information and documentation:

- SSD-71052213 (Draft)
- SSDA Acoustic report prepared by GHD - *Project Bowerbird – Noise and Vibration Impact Assessment* (project number 12606520, dated 24/10/2024
- Construction documentation (drawings, schedules, etc.) provided by Vaughans Construction.

4.2 GUIDELINES

The primary guideline that will be used to formulate the Plan is the NSW EPA – 'Interim Construction Noise Guideline' ("ICNG") July 2009.

The ICNG recognises that development occurs close to sensitive receivers and the nature of construction means that it is not possible to prevent noise impacts. The ICNG is focused "on applying a range of work practices most suited to minimise construction noise impacts, rather than focusing only on achieving numeric noise levels. While some noise from construction sites is inevitable, the aim of the Guideline is to protect the majority of residences and other sensitive land uses from noise pollution most of the time."

The ICNG requires the identification of activities likely to exceed the noise/vibration management levels, and the implementation of feasible and reasonable mitigation strategies to minimise emissions. Strategies include physical and management controls, liaising with the public and stakeholders, monitoring, etc. The ICNG recognises that each site will have a particular set of circumstances to be addressed, and that it is typically not possible to fully mitigate impacts. The guideline is intended as a pathway to determining a realistic compromise between construction sites and the surrounding receivers.

The following additional planning instruments and guidelines have also been used in the assessment:

- *DIN 4150-3 (2016-12) Vibration in Buildings – Part 3: Effects on Structures (German Institute for Standardisation, 2016)*
- NSW Department of Environment and Conservation Assessing Vibration: A Technical Guideline" (Feb, 2006)

5 CONSTRUCTION NOISE AND VIBRATION ASSESSMENT

5.1 GENERAL

A quantitative evaluation of the proposed works has been undertaken to identify those activities that have the potential to adversely impact nearby properties. The outcomes of the assessment have been used to develop a management plan to minimise adverse noise and vibration impacts.

The assessment uses site specific noise and vibration management levels developed using the EPA ICNG. The predicted, receiver noise and vibration levels will be compared to the management levels to identify those activities that are likely to require additional management, above what is considered to be normal good practice.

5.2 CONSTRUCTION NOISE MANAGEMENT LEVELS

5.2.1 Residential Receivers

Residential noise management levels are based on the "rating background noise level" ("**RBL**") applicable to the receivers. RBL's are typically determined by measuring the ambient noise environment using the methodology in the EPA NPfI. The measurements, analysis and RBL's determined for this project are summarised in Appendix A.

The ICNG construction noise management levels are summarised in the following table, along with how they should be used to manage impacts.

Table 3 – Construction Noise Management Levels

Management Level $L_{Aeq,(15min)}$*	**How to Apply**
Noise affected Management Level ("**NML**") RBL + 10dB	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.

*** 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.**

The project specific NML's for closest residents and surrounding buildings are summarised in the following table based on noise measurements detailed in the GHD acoustic report.

Table 4 – Noise Management Levels for Surrounding Receivers

Location/Receiver	RBL dB(A) L_{90}	NML dB(A) L_{eq}	HANML dB(A) L_{eq}
Residents within NCA1	46	56	75
Residents within NCA2	49	59	75
Commercial Receivers	-	70	-
Industrial Receivers	-	75	-

5.3 CONSTRUCTION VIBRATION MANAGEMENT LEVELS

5.3.1 Amenity Management

Vibration goals for the amenity of nearby land users are those recommended by the EPA document *Assessing Vibration: A technical guideline*. These levels (extracted from Tables 2.2 and 2.4 of the guideline) are presented in the following table for various types of vibration:

Table 5 -(Table 2.2 Assessing Vibration: A Technical Guideline) – Preferred and Maximum Weighted RMS Values for Continuous and Impulsive Vibration Acceleration (m/s2) 1-80Hz

Location	Assessment Period [1]	Preferred values		Maximum Values	
		z-axis	x- and y-axes	z-axis	x- and y-axes
Continuous Vibration					
Critical areas[2]	Day or night-time	0.0050	0.0036	0.010	0.0072
Residences	Daytime	0.010	0.0071	0.02	0.014
	Night-time	0.007	0.005	0.014	0.010
Offices, schools, educational institutions and places of worship	Day or night-time	0.020	0.014	0.040	0.028
Workshops	Day or night-time	0.04	0.029	0.080	0.058
Impulsive Vibration					
Critical areas[2]	Day or night-time	0.0050	0.0036	0.010	0.0072
Residences	Daytime	0.30	0.21	0.60	0.42
	Night-time	0.10	0.071	0.20	0.14
Offices, schools, educational institutions and places of worship	Day or night-time	0.64	0.46	1.28	0.92
Workshops	Day or night-time	0.64	0.46	1.28	0.92

1 Daytime is 7:00am to 10:00pm and night-time is 10:00pm to 7:00am.

2 Examples include hospital operating theatres and precision laboratories where sensitive operations are occurring. There may be cases where sensitive equipment or delicate task require more stringent criteria than the human comfort criteria specified above. Stipulation of such criteria is outside the scope of this policy, and other guidance documents (e.g. relevant standards) should be referred to. Source: BS6472-1992.

Table 6 -(Table 2.4 Assessing Vibration: A technical guideline) – Acceptable Vibration Dose Values for Intermittent Vibration (m/s1.75)

Location	Daytime[1]		Night-time[1]	
	Preferred value	Maximum Value	Preferred value	Maximum Value
Critical areas[2]	0.10	0.20	0.10	0.20
Residences	0.20	0.40	0.13	0.26
Offices, schools, educational institutions and places of worship	0.40	0.80	0.40	0.80
Workshops	0.80	1.60	0.80	1.60

1 Daytime is 7:00am to 10:00pm and night-time is 10:00pm to 7:00am.
2 Examples include hospital operating theatres and precision laboratories where sensitive operations are occurring. These criteria are only indicative, and there may be a need to assess intermittent values against the continuous or impulsive criteria for critical areas. Source: BS6472-1992.

5.3.2 Structure Damage Risk Criteria

5.3.2.1 Generally

German Standard DIN 4150-3 (2016) provides a guideline for acceptable levels of vibration velocity in building foundations, to assess the effects of vibration on structures. The table give guidance on the maximum accepted values of velocity at the foundation and in the plane of the highest floor of various types of buildings, to prevent any structural damage.

The table following lists the peak particle velocity, which is the maximum absolute value of the velocity signals for the three orthogonal components. This is measured as a maximum value of any of the three orthogonal component particle velocities when measured at the foundation, and the maximum levels measured in the x- and y-horizontal directions in the plane of the floor of the uppermost storey.

It is noted that if measured vibration levels do not exceed the guidelines listed in the following table, damage that will reduce the serviceability of the building will not occur, and if damage to the building does occur, it is assumed that the damage is related to other causes. Furthermore, the DIN4150-3 guideline states the following regarding the limits presented in Table 1 of the standard:

"Exceeding the guideline values does not necessarily lead to damage. Should they be exceeded, however, further investigations may be necessary, such as determining and evaluating the stresses as detailed in 4.3 and 4.4.".

Table 7 -(Table 1 – DIN 4150-3 (2016)) – Guideline Values for Vibration Velocity, $v_{i,max}$, for Evaluating the Effects of Short-Term Vibration on Structures

	TYPE OF STRUCTURE	Guideline values for $v_{i,max}$ in mm/s				
		Foundation, all directions, i = x, y, z, at a frequency of			Topmost floor, horizontal direction, i = x, y	Floor slabs, vertical direction, i = z
		1Hz to 10Hz	10Hz to 50Hz	50Hz to 100Hz [a]	All Frequencies	All Frequencies
L/C	1	2	3	4	5	6
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 lines 1 and 2 **and** are of great intrinsic value (e.g. listed buildings) buildings that are under a preservation order)	3	3 to 8	8 to 10	8	20[b]

NOTE Even if guideline values as in line 1, columns 2 to 5, are complied with, minor damage cannot be excluded.

a At frequencies above 100 Hz, the guideline values for 100 Hz can be applied as minimum values.

b It may be necessary to lower the guideline value markedly to prevent minor damage

5.4 NOISE AND VIBRATION SOURCES

The likely main noise and vibration sources relevant to each phase of the works have been identified, and are summarised in the following section.

Table 8 – Construction Plant Sound Power Levels (SWL)

Equipment/Process	Sound Power Level (SWL) dB(A)
Demolition – 5 Months	
Hammering	121
Bulldozer	116
Excavator with Bucket Attachment	114
Skid Steer/Bobcat	110
Truck	103
Hand Tools (Electric)	102
Excavation/Piling – 1-2 Months	
Excavator with Bucket Attachment	114
Auger Pile	111
Truck	103
Hand Tools (electric)	102
Construction – 12 Months	
Mobile Crane	110
Cement Mixing Truck	109
Manitou/Forklift	106
Cherry Picker	105
Truck	103
Hand Tools (Electric)	102

The noise levels presented in the above table are derived from the following sources (details in Appendix B):

- On-site measurements.
- Table D2 of Australian Standard 2436-1981 & Table A1 of Australian Standard 2436-2010.
- Data held by this office from other similar studies.

5.5 CONSTRUCTION NOISE ASSESSMENT

5.5.1 Predictions

Construction noise emissions to nearby development depend on the activities being undertaken at the time, and where on the site the activities occur. Construction noise levels at the surrounding receivers have been predicted based on the following inputs.

- The plant sound power levels indicated in Section 5.4.
- Corrections for source to receiver distance attenuation
- Barrier or directivity attenuation where present.
- Source heights – 1.5m above the ground/building level of the noise source location, unless noted otherwise.
- Receiver heights - 1.5m above the ground/building level of the receiver location, unless noted otherwise.

The predicted noise levels for each construction phase are summarised in the following tables below.

Table 9 – Predicted Construction Noise Impacts (Demolition)

Location/Receiver	Maximum Predicted Noise Level dB(A) L_{eq}	NML dB(A) L_{eq}	HANML dB(A) L_{eq}	Requires Assessment of Additional Management
Residential Receivers NCA1	53	56	75	No, within NAML for all proposed construction activities
Residential Receivers NCA2	50	59		
Commercial Receivers	60	70	-	
Industrial Receivers	90	75	-	Yes, for industrial receivers immediately adjoining site to the west.

Table 10 – Predicted Construction Noise Impacts (Excavation/Piling)

Location/Receiver	Maximum Predicted Noise Level dB(A) L_{eq}	NML dB(A) L_{eq}	HANML dB(A) L_{eq}	Requires Assessment of Additional Management
Residential Receivers NCA1	48	56	75	No, within NAML for all proposed construction activities
Residential Receivers NCA2	45	59		
Commercial Receivers	53	70	-	
Industrial Receivers	83	75	-	Yes, for industrial receivers immediately adjoining site to the west.

Table 11 – Predicted Construction Noise Impacts (Construction)

Location/Receiver	Maximum Predicted Noise Level dB(A) L_{eq}	NML dB(A) L_{eq}	HANML dB(A) L_{eq}	Requires Assessment of Additional Management
Residential Receivers NCA1	45	56	75	No, within NAML for all proposed construction activities
Residential Receivers NCA2	42	59		
Commercial Receivers	49	70	-	
Industrial Receivers	78	75	-	Yes, marginal exceedance for industrial receivers immediately adjoining site to the west.

5.5.2 Analysis and Discussion – Noise

During demolition, excavation and piling phases, the analysis indicates that:

- All residential and commercial premises will be below the noise affected management level at all stages during construction.
- Surrounding industrial receivers have the potential to exceed noise management levels. Specifically, industrial receivers immediately to the west may be exposed to noise levels which exceed 75dB(A) $L_{eq(15min)}$, depending on the type of activity and location on site. A markup of these receivers is presented below, noting that industrial sites outside of this area are anticipated to be below 75 dB(A) during all phases of construction.
    - Noise is expected to progressively reduce as construction progresses, with the largest impacts being during the demolition phase.
    - Piling works close to the western boundary present the highest levels of noise exceedance during this phase, noting that only a limited number of piles are required at these locations.
    - For structural works, the impact will largely be dependant on the location of concrete pumping trucks – where these are close to the western boundary exceedances are expected.
    - For general construction works, only marginal (3dB(A)) exceedances are expected where mobile cranes and concrete trucks are required close to the boundary. Other general construction works are anticipated to be below the 75dB(A) NAML.

Figure 6 – Noise Affected Industrial Receivers

To assess whether mitigation of these exceedances is feasible or reasonable, the ICNG indicates the following should be considered:

- The levels of impact including noise levels and the number of people affected.
- The benefits of noise mitigation and the number of people protected.
- Cost effectiveness of mitigation.
- Community views.

For the nearest residential receivers, the assessment indicates that feasible and reasonable noise mitigation would need to be investigated to by the contractor to minimise noise impacts, based on the procedures and methods in Section 6 and the ICNG.

Effective mitigation strategies to be considered for each phase should include the below:

- The location of demolition activities are fixed by the location of existing buildings. Consideration may be given to use of alternative construction processes or sizing of hammering equipment.
- Similarly for excavation and piling, works close to the boundary are unavoidable. In this case, the existing ground conditions (generally sandy clay) do not require high noise generating construction techniques. Similarly, the quietest piling technique (auger piling) is adopted.
- During structure and construction activities, the location and operation of mobile plant (concrete pumps, mobile crane) should be considered and generally located away from the western boundary where feasible, noting that in some instances access arrangements will require plant items to be located adjacent to the boundary.

5.6 CONSTRUCTION VIBRATION

5.6.1 Vibration Sources

The following preliminary sources have been identified as potentially producing ground vibration:

- Piling rig (depending on shale strength)
- Hammering

The remaining activities are not expected to produce significant ground vibration and/or are sufficiently separated from sensitive receivers. Vibration from these activities are expected to be significantly below amenity or damage risk management levels at all receivers.

5.6.2 Assessment of Vibration

It is impractical to predict the vibrations induced by the excavation/construction operations on site at potentially affected receivers. This is because vibration level is principally proportional to the energy impact which is unknown nature of terrain in the area (type if soil), drop weight, height etc.

In general, site vibration levels from machinery and processes should be verified on a case-by-case basis given site soil conditions may be different may vary from one location the next.

The assessment of building and soil settlement or the liquefaction of soils under induced vibration is outside the scope of typical vibration standards such as DIN 4150-3 and expert advice is to be sought from a Geotechnical Engineer.

There is not expected to be any vibration impacts to residential or commercial premises given the distance separation from the site. Industrial receivers immediately bounding the site may be exposed to higher levels of vibration during demolition close to the boundary.

In these cases, sample vibration testing should be carried out at the beginning of demolition and piling works. This shall be assessed on a case-by-case basis to determine mitigation measures, safe working distances, and monitoring methodology. Where excessive vibration is identified, alternative methods shall be considered.

6 NOISE AND VIBRATION MANAGEMENT AND CONTROL

6.1 NOISE AND VIBRATION CONTROL METHODS

The ICNG recommends "feasible and reasonable" mitigation measures to be implemented where works generate noise levels above the out of normal hours NML but does not specify what mitigation measures or to what extent these measures should be applied.

6.1.1 General Noise Control Methods

The determination of appropriate additional noise control measures will be dependent on the particular activities and the construction equipment and plant identified as requiring future acoustic treatments to those already identified in this report. This section provides an outline of available methods which have previously been used on similar construction sites and may be possible on this site.

6.1.1.1 Selection of Alternate Appliance or Process

Where a particular activity or plant and equipment is found to generate noise levels that exceed the management levels, it may be possible to select an alternative approach or plant and equipment. For example; the use of excavator mounted hydraulic hammers of the site may potentially generate high levels of noise. By carrying this activity by using concrete saws or smaller plant here practical, construction noise levels and/or length of exposure to construction noise levels may be reduced.

6.1.1.2 Acoustic Barriers

The placement of barriers at the source is generally only effective for static plant. Placing barriers at the source cannot effectively attenuate equipment which is on the move or working in rough or undulating terrain.

The degree of noise reduction provided by barriers is dependent on the amount by which the line of sight can be blocked by the barrier. If the receiver is totally shielded from the noise source reductions of up to 15 dB(A) can be effected. Where only partial obstruction of line of sight occurs, noise reductions of 5 to 8 dB(A) may be achieved. Where the barrier does not obstruct line of sight, generally no noise reduction will occur.

Barriers are used to provide shielding and do not act as an enclosure. The material they are constructed from should have a noise reduction performance which is approximately 10dB(A) greater than the maximum reduction provided by the barrier screening. In this case, the use of a material such as 15mm plywood (or equivalent material) would be acceptable for the barriers.

6.1.1.3 Silencing Devices

Where construction methodologies or plant and equipment permit, investigate the use of silencing devices. These may take the form of engine shrouding, or special industrial silencers fitted to exhausts, for example.

6.1.1.4 Establishment of Site Practices

This involves the formulation of work practices to reduce noise generation. This includes, for example, investigating the possibility of locating fixed plant items as far as possible from residents, rotating plant and activities to provide respite to receivers, scheduling activities after the construction of buildings that will screen receivers, avoiding noise sensitive periods for receivers, identify "safe" working distances, etc.

6.1.2 Vibration Management

The following principles should be considered to manage adverse vibration impacts identified:

- Obtaining separate structural or specialist advice for critical or fragile structures as to the level of damage risk.
- Selection of processes that minimise structure and ground vibration – generally avoiding percussive methods.
- Use smallest plant that is able to efficiently undertake the work activity.
- Lay vibration absorbing mats to cushion impacts from falling debris.
- Application of vibration dampening pads to metal surfaces subject to impacts.
- When demolishing, cut control joints in structures to form vibration "breaks", or work away from sensitive receiver locations to form natural vibration breaks in propagation path.
- Monitoring of structures using attended and/or unattended monitors with alarms.
- Time scheduling works to minimise amenity impacts.
- Communicating with affected receivers.
- Identify "safe" working distances to sensitive receivers/structures for various activities by conducting site simulation tests, and limiting activities within those distances to those that are not likely to exceed vibration goals. Vary locations/equipment/techniques used as determined by the simulation testing. The following table provides an initial guide to working distances that should be confirmed by site measurement.

6.1.3 Notification

Notification of affected receivers of the progress of works, particularly when short-term activities likely to create higher noise levels occur, can in many cases minimise community reaction.

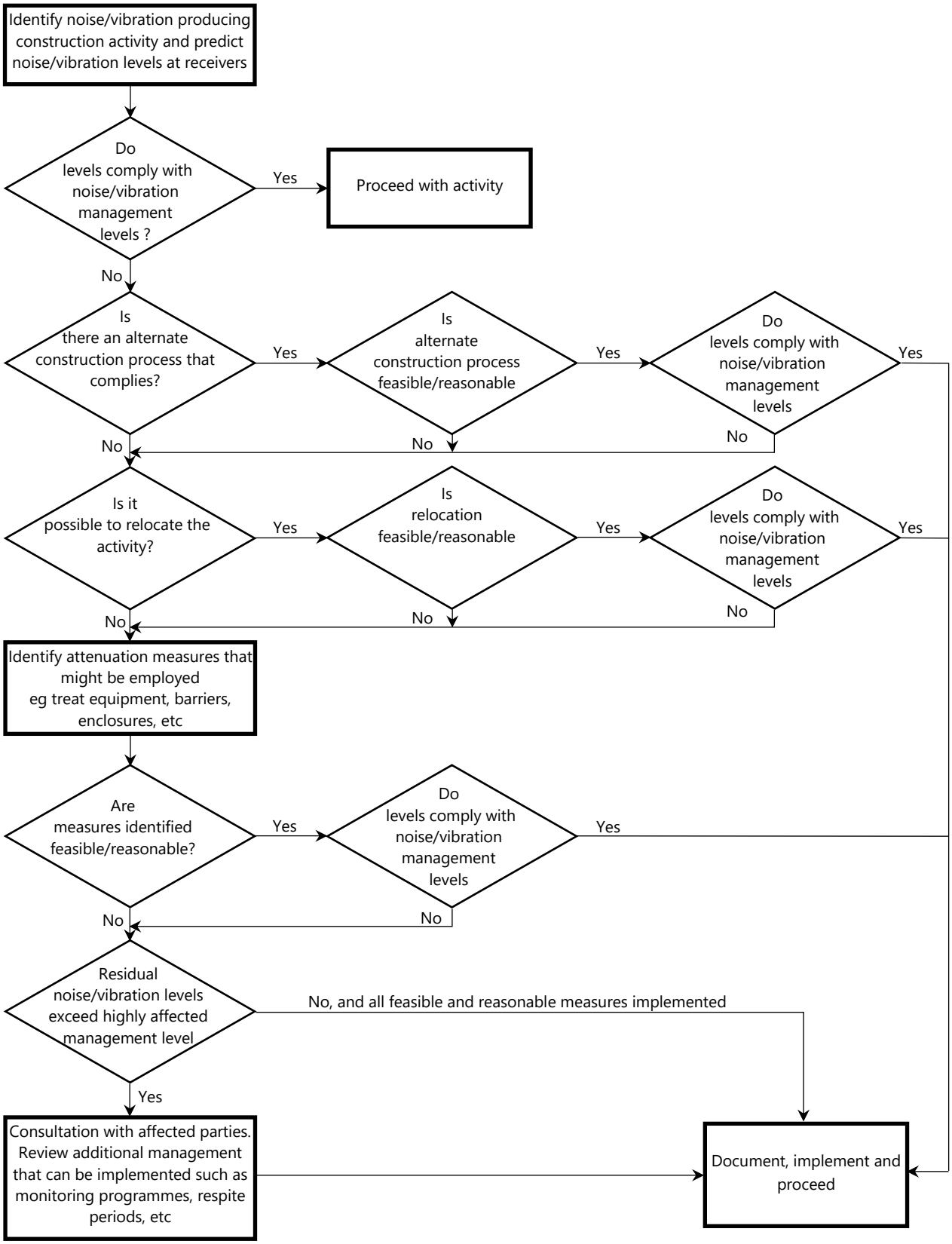
6.2 NOISE MONITORING TECHNIQUES

Where any noise monitoring is undertaken (either by attended short term measurements or long-term unattended noise monitoring), it should be conducted at a practical location representative of the impact to nearby noise sensitive receivers. Where this is not possible, noise measurements of construction processes should be taken such that noise levels can be accurately predicted to receivers. Any reporting of noise measurement results may include the following information:

- The date and time that the measurements were undertaken.
- The location of measurements, noise receivers and construction processes. A site map should be included for clarity.
- A description of the construction processes being undertaken during the measurement period.
- The measured noise construction noise levels, and the noise level at the façade of nearby receivers (if noise levels are predicted).
- A comparison to the NSW EPA Interim Construction Noise Guideline noise management levels.

6.3 CONTROL OF CONSTRUCTION NOISE AND VIBRATION – PROCEDURAL STEPS

The flow chart that follows illustrates the processes followed to assess construction activities prior to the start of work on site, and for the ongoing investigation of noise and vibration impacts during the construction period.



Noise and Vibration Management Flow Chart

6.4 SUMMARY OF MITIGATION

The project specific mitigation and management to be adopted is summarised in the following sections. Relevant contractors and suitably qualified acoustic consultants for the project shall ensure that the following mitigation and management is adopted during the construction process.

6.4.1 Management Controls

- Quiet work methods/technologies – use of auger piling is adopted.
- Materials handling/vehicles:
    - Trucks and forklifts in general use on site are to use a non-tonal reversing beacon where possible (subject to OH&S requirements) to minimise potential disturbance of surrounding receivers;
    - Avoid careless dropping of construction materials into empty trucks.
    - Trucks, trailers and delivery vehicles are to turn off engines when idling or when queuing outside of the site to reduce noise impacts (unless required for concrete pumping or similar).
- Concrete pump trucks and mobile cranes should generally be located within the bounds of the site, should be away from the western boundary as much as possible.
- Community consultation is recommended be undertaken throughout the construction process. In this regard regular letterbox drops detailing site progress and scheduled works is proposed. In particular, these should detail the extent and times of piling works, and hydraulic hammering, jackhammering, concrete sawing, and the use of pneumatic tools where planned to be undertaken. Details of community consultation and future engagement are provided in Section 7.
- Complaints handling:
    - An after-hours contact number shall be displayed outside of the building site, so that in the event that surrounding development believes that a noise breach is occurring, they may contact the site.
    - In the event of complaint, the procedures outlined in Sections 6.3, 7 & 8 are adopted.
- Site Induction:
    - A copy of the Plan is to be available to contractors. The location of the Plan should be advised during any site induction.
    - Site induction should also detail the site contact to be notified in the event of noise complaint.

6.4.2 Construction Monitoring

It is recommended that sample attended vibration measurements be conducted along the western boundary at the beginning of demolition and piling activities, being indicative of the vibration inducing works most likely to affect the adjacent receivers to ensure and safeguard amenity and structural integrity of nearby receivers. Based on these results, it may be determined whether long term vibration monitoring for these receivers is required during each construction phase.

In the case of noise complaints, monitoring (either sample attended or continuous unattended) should be considered during the demolition, excavation and piling stages along the boundary and at surrounding residents to ensure vibration levels at these receivers are satisfactory.

The noise and vibration impact from equipment and plant, alongside any potential monitoring techniques/locations should be developed in conjunction with the advice of structural, civil and geotechnical experts.

7 COMPLAINTS AND COMMUNITY ENGAGEMENT

7.1 DEALING WITH OFFENSIVE NOISE LEVELS

Should ongoing complaints of excessive noise occur, immediate measures shall be undertaken to investigate the complaint, the cause of noise exceedances and identify the required changes to work practices.

The effectiveness of any changes shall be verified before continuing. Documentation and training of site staff shall occur to ensure the practices that produced the exceedances are not repeated.

All complaints or offensive noise received should be fully investigated and reported to management. The complainant should also be notified of the results and actions arising from the investigation.

The investigation of offensive noise shall involve where applicable:

- Noise measurements at the affected receiver.
- An investigation of the activities occurring at the time of the incident.
- Inspection of the activity to determine whether any undue noise is being emitted by equipment.
- Whether work practices were being carried out either within established guidelines or outside these guidelines.

Where an item of plant is found to be emitting excessive noise, the cause is to be rectified as soon as possible. Where work practices within established guidelines are found to result in excessive noise being generated then the guidelines should be modified to reduce noise emissions to acceptable levels. Where guidelines are not being followed, the additional training and counselling of employees should be carried out.

Measurement or other methods shall validate the results of any corrective actions arising from a complaint where applicable.

7.2 ESTABLISHMENT OF DIRECT COMMUNICATION WITH AFFECTED PARTIES

In order for any construction noise management programme to work effectively, continuous communication may be required between all parties, which may be potentially impacted upon, the builder and the regulatory authority. This establishes a dynamic response process which allows for the adjustment of control methods and criteria for the benefit of all parties.

The objective in undertaking a consultation process is to:

- Inform and educate the groups about the project and the noise controls being implemented.
- Increase understanding of all acoustic issues related to the project and options available.
- Identify group concerns generated by the project, so that they can be addressed.
- Ensure that concerned individuals or groups are aware of and have access to a Constructions Complaints Register which will be used to address any construction noise related problems should they arise.

7.3 ENGAGEMENT UNDERTAKEN TO DATE

A newsletter and online survey has been distributed to surrounding Tier One local communities and businesses, i.e. those in closest proximity to the proposed site. The purpose of the newsletter was to introduce the project to surrounding businesses and provide contact information to enable stakeholder engagement. An engagement portal was also establishes to provide an opportunity for feedback or concerns raised for the project.

Of this one stakeholder provided feedback on the project, with noise impacts being raised as a potential concern. This report has been prepared with reference to relevant guidelines for noise, with the aim to reduce and mitigate potential noise impacts during the construction phase of the project.

7.4 DEALING WITH COMPLAINTS

Should ongoing complaints of excessive noise or vibration criteria occur immediate measures shall be undertaken to investigate the complaint, the cause of the exceedances and identify the required changes to work practices. In the case of exceedances of the vibration limits all work potentially producing vibration shall cease until the exceedance is investigated.

The effectiveness of any changes shall be verified before continuing. Documentation and training of site staff shall occur to ensure the practices that produced the exceedances are not repeated. If a noise complaint is received the complaint should be recorded on a Noise Complaint Form. The complaint form should list:

- The name and address of the complainant (if provided).
- The time and date the complaint was received.
- The nature of the complaint and the time and date the noise was heard.
- The name of the employee who received the complaint.
- Actions taken to investigate the complaint, and a summary of the results of the investigation.
- Required remedial action, if required.
- Validation of the remedial action.
- Summary of feedback to the complainant.

A permanent register of complaints should be held. All complaints received should be fully investigated and reported to management. The complainant should also be notified of the results and actions arising from the investigation.

Where an item of plant is found to be emitting excessive noise, the cause is to be rectified as soon as possible. Where work practices within established guidelines are found to result in excessive noise being generated then the guidelines should be modified as to reduce noise emissions to acceptable levels. Where guidelines are not being followed, the additional training and counselling of employees should be carried out.

Measurement or other methods shall validate the results of any corrective actions arising from a complaint where applicable.

7.5 REPORTING REQUIREMENTS

The following shall be kept on site:

- A register of complaints received/communication with the local community shall be maintained and kept on site with information as detailed in this report.
- Where noise/vibration complaints require noise/vibration monitoring, results from monitoring shall be retained on site at all times.
- Any noise exceedances occurring including, the actions taken and results of follow up monitoring.
- A report detailing complaints received and actions taken shall be presented to the construction liaison committee.

8 CONTINGENCY PLANS

Where non-compliances or noise complaints are raised the following methodology will be implemented.

- Determine the offending plant/equipment/process.
- Locate the plant/equipment/process further away from the affected receiver(s) if possible.
- Implement additional acoustic treatment in the form of localised barriers, silencers etc where practical.
- Selecting alternative equipment/processes where practical.
- If necessary, setup noise/vibration and dust monitoring devices at locations representing the nearest noise/vibration and dust affected receivers and provide data for each complain time period. Analysis is required to determine suitable mitigation measures.

Complaints associated with noise/vibration generated by site activities shall be recorded on a Complaint Form. The person(s) responsible for complaint handling and contact details for receiving of complaints shall be established on site prior to construction works commencing. A sign shall be displayed at the site indicating the Site Manager to the general public and their contact telephone number.

9 CONCLUSION

This report assesses potential noise and vibration impacts from the construction of the industrial development located at 15 Gow Street, Padstow with reference to the requirements of Condition B13. The assessment uses the methodology contained in the EPA ICNG to:

- determine appropriate noise and vibration management levels
- identify those activities that are likely to impact nearby receivers.
- indicate the measures that are likely to be required to minimise impacts to the extent that is recommended in the ICNG.

The assessment indicates that:

- All residential and commercial receivers are expected to be below the Noise Affected Management Level at all times.
- Industrial receivers immediately west of the site may experience noise levels above the management levels, particularly during demolition and structural works. Mitigation measures have been identified for these receivers.

It is concluded that with the implementation of the mitigation and ongoing assessment recommended in Sections 6.3, 7 & 8, construction noise and vibration emissions from the proposed development will be minimised in accordance with the ICNG.

Please contact us should you have any further queries.

Yours faithfully,

Acoustic Logic Pty Ltd
Alex Washer

APPENDIX A AUTHOR CV

Qualifications & Experience

Bachelor of Engineering (Mechanical) – 2018

2022 – current	Senior Engineer
2020 – 2022	Senior Project Engineer, Acoustic Logic
2017 - 2020	Project Engineer, Acoustic Logic
2007 – 2017	Foreman/Project Manager

Outline of Experience

Beginning at ALC in 2017, Alex has developed experience in a variety of areas of noise and vibration measurement and assessment. Having worked in the building and construction industry for over 10 years, Alex has extensive experience with construction practices and projects.

Since working at Acoustic Logic, Alex has been involved in building certification/compliance, detailed assessment of acoustic impacts from building/operational use, application of statutory codes and requirements & acoustic design of buildings and mechanical systems. A summary of relevant experience includes:

- Building acoustics and noise control
- Room acoustics
- Building services noise control, including acoustic design of mechanical systems.
- Environmental noise modelling and assessment, including ventilation design.
- Industrial noise control
- Construction noise and vibration, including to vibration sensitive equipment (medical treatment/imaging).
- NSW Liquor and Gaming acoustic assessment.
- Expert witness evidence as part of Land and Environment Court proceedings.

Project Experience

A sample of projects Alex has been or is currently involved with include the following:

Concord Hospital – Public Hospital Expansion

Macksville Hospital – New Public Hospital

The Ribbon Hotel – IMAX, Commercial & Hotel Development

77 Market Street, Sydney – Mixed Use Development

Rouse Hill Town Centre – Residential/Retail Town Centre Expansion

11 Gibbons Street, Redfern – Social Housing

Newmarket, Randwick – Residential Development

York & George – Residential Development

University of Wollongong – Western Building – Specialty Performance Spaces

Waitara Public School – School Expansion

Marsden Park Public School – New School Development (Planning, Design & Construction)

APPENDIX B - CONSTRUCTION NOISE AND VIBRATION EMISSION LEVELS

This section provides the noise and vibration emission levels adopted for the plant in the assessment, presenting the equipment list and their respective sound power levels in octave bands used in our noise modelling to predict site noise emissions.

The total dB(A) sound power levels for the equipment items have been obtained from the Transport for NSW Construction Noise and Vibration Strategy (April 2018). We note that equipment having sound power levels greater than those specified should not be permitted to work on site as they are excessively noisy.

Our noise analyses are typically frequency based so model inputs such as sound power levels, surface absorptions, barrier effects are in octave bands. It is noted that the sound power levels are presented in terms of the L_{Aeq} descriptor which indicates the equivalent energy noise level over a period, and it assumes the machinery operates continuously within that time or 100% duty, which may not always be the case. For example, excavators may load trucks intermittently for 5 minutes in every 15-minute assessment period so their duty would be reduced to 33% and correspondingly in the noise modelling the effective sound power will be reduced by the same amount.

The equipment sound power spectra are based on the UK Defra database. Missing item's spectra were filled with similar machinery spectra and by measured spectra taken by this office. Items identified in the document as having special audible characteristics have been penalised by an additional 5dB across all octave bands, and these items have been highlighted in the following table. This equates to 5dB added to the Transport for NSW's maximum permissible machinery sound power level.

For impact piling the sound power levels have been given in both L_{Aeq} and L_{Amax} descriptors as the City of Sydney uses the $L_{Amax,\ avg}$ to assess impact piling noise.

Additional values were gathered from Table D2 of Australian Standard 2436-1981 & Table A1 of Australian Standard 2436-2010.

B.1 NOISE

The adopted emission levels take into account:

- A time correction for expected proportion of a 15-minute interval that the equipment is expected to emit noise, for non-continuously operating plant.
- Penalties for impulsive and tonal noise characteristics.

Table B-1 – Construction, Demolition and Civil works Machinery Effective Sound Power Levels based on Continuous operation (100% duty)

Equipment	Approx. Size/ Weight/Model	Highest Permissible Sound Power Level (dBA) (inc Penalties)	Duty	Unweighted Octave Band Sound Power Levels, dB (includes Applicable Penalties)							
				63	125	250	500	1000	2000	4000	8000
Asphalt - Truck & Sprayer		106	100%	112	110	104	102	99	97	100	92
Backhoe		111	100%	113	107	103	111	104	103	98	94
Chainsaw – petrol*	4-5hp	114	100%	92	106	103	111	113	114	112	109
Compactor		106	100%	99	101	97	100	100	100	96	93
Compressor		109	100%	127	116	107	102	100	98	101	90
Crane - Fixed		113	100%	120	115	116	112	106	99	93	87
Crane - Franna	20 tonnes	98	100%	108	104	99	91	92	91	84	78
Crane - Mobile		113	100%	115	114	108	109	108	108	99	90
Crane - Truck mounted	20 to 60 tonnes	108	100%	112	109	107	105	103	100	95	87
Crusher – Rock*		118	100%	135	128	121	123	117	113	108	101
Dozer	CAT D9	116	100%	112	116	114	114	111	108	102	94
Dozer	CAT D10	121	100%	130	131	122	114	115	111	109	105
Elevated work platform - scissor lift		98	100%	100	97	94	94	94	91	85	83
Elevated work platform		97	100%	108	106	92	93	90	89	88	79
Excavator - tracked	3 tonnes	90	100%	101	91	88	88	85	83	78	72
Excavator - tracked	6 tonnes	95	100%	102	104	95	89	89	87	82	77
As above + hydraulic hammer*		115	100%	110	113	110	114	117	113	111	106
Excavator - tracked	10 tonnes	100	100%	104	100	99	97	95	92	86	81
As above + hydraulic hammer*		118	100%	124	124	121	116	118	116	114	109
Excavator - tracked	20 tonnes	105	100%	107	114	106	101	98	97	93	90
Excavator - tracked	30 tonnes	110	100%	113	113	107	107	105	102	97	91
As above + hydraulic hammer*		122	100%	125	123	119	123	121	121	118	114
Excavator - tracked	40 tonnes	115	100%	111	114	113	110	110	109	104	97

Grader		113	100%	114	113	109	105	110	104	100	91
Generator - diesel/petrol	6kW	103	100%	115	110	102	98	97	95	92	80
Generator - attenuated	30kW	92	100%	95	95	93	86	85	86	82	79
Grinder*		105	100%	86	80	81	89	99	106	102	102
Jackhammer		113	100%	108	97	93	96	96	101	109	110
Lighting Tower		80	100%	73	73	73	73	73	73	73	73
Lighting - Daymakers		98	100%	110	105	97	93	92	90	87	75
Light Vehicle - 4WD		103	100%	96	96	96	96	96	96	96	96
Line Marking Truck		108	100%	114	112	106	104	101	99	102	94
Loader - Front-end (wheeled)	23 tonnes	112	100%	118	118	107	109	105	103	102	94
Loader - Skidsteer	1/2 tonne	107	100%	112	115	104	106	101	98	92	92
Loaders - Skidsteer	1 tonne	110	100%	113	104	108	108	104	103	97	91
Loader - Tracked	0 to 50 kW	115	100%	108	108	108	108	108	108	108	108
Loaders- Tracked	200 to 300 kW	121	100%	114	114	114	114	114	114	114	114
Pavement Laying Machine		114	100%	117	114	111	110	109	106	104	95
Pavement Profiler		117	100%	116	122	114	112	112	109	105	102
Pile Driver – Vibratory*		121	100%	121	120	117	120	122	120	115	105
Piling Rig - Bored		112	100%	112	120	109	108	106	104	96	89
Piling Rig LMAX – Impact*		151		137	138	143	152	152	148	143	138
Piling Rig LEQ- Impact*		134	100%	124	125	128	135	135	132	127	121
Pump - Concrete		109	100%	115	107	101	102	104	104	97	89
Rattle gun (handheld)		104	100%	82	81	81	87	96	98	98	98
Roller - smooth drum		107	100%	114	112	102	100	102	100	96	90
Roller - large pad foot		109	100%	120	111	103	107	105	98	95	89
Roller – Vibratory*	10 tonnes	109	100%	125	116	108	112	110	103	100	94
Saw – Concrete*		118	100%	120	122	114	114	113	114	118	116
Scraper/Grader		113	100%	120	122	113	107	107	105	100	95
Truck - Concrete		109	100%	112	103	95	98	99	107	89	84
Truck - Dump	15 tonnes	110	100%	114	111	111	107	104	103	97	90
Truck - Medium rigid	20 tonnes	103	100%	109	107	101	99	96	94	97	89

Truck - road truck/ truck and dog	30 tonnes	108	100%	123	109	101	100	104	99	98	91
Truck - Vacuum (NDD or non-destructive digger)		109	100%	111	112	97	102	101	104	103	96
Tub Grinder/Mulcher	40-50hp	116	100%	105	106	110	110	112	111	105	96
Vibrator – Concrete*		113	100%	122	120	120	113	109	112	110	105
Water Cart		107	100%	106	107	101	105	99	100	96	91
Welding equipment		110	100%	104	105	106	105	106	103	98	93
Wrench - Impact		111	100%	81	84	89	91	95	101	107	107

TABLE A1

TYPICAL SOUND LEVELS OF CONSTRUCTION PLANT AND EQUIPMENT*

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 (mid-point)	
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 saw	112-122	117	89
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
Gritblaster (grit & nozzle air noise)	129	129	101
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 (mid-point)	
Jack hammers	121	121	93
Loader (wheeled)	99-111	105	77
Machine mounted hydraulic drill	110-115	113	85
Machine mounted percussive drill	116	116	88
Machine mounted pneumatic drill	110-121	116	88
Piling (bored)	111	111	83
Piling (impact sheet) (L_{max})	126-147	137	109
Piling (vibratory)	116-133	125	97
Rock breaker	118	118	90
Roller (vibratory)	103-112	108	80
Scraper	116	116	88
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

* Information in Table A1 has been derived from a combination of the following sources and further information can be obtained from them:

(a) AS 2436—1981 *Guide to noise control on construction, maintenance and demolition sites.*

(b) BS 5228-1, *Code of practice for noise and vibration control on construction and open sites. Noise.*

(c) DEFRA—Department for Environment Food and Rural Affairs (United Kingdom), Update of noise database for prediction of noise on construction and open sites-Phase 3: Noise measurement data for construction plant used on quarries, July 2006.

NOTE: The sound power data within the column marked 'Typical (mid-point)' can be used to calculate typical noise levels at the nominated assessment locations.