TAFE Kingswood Centre of Excellence

Construction Noise and Vibration Sub-Plan

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E-LAB Consulting

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Document QA and Revisions

ISSUE	DATE	COMMENTS	ENGINEER	REVIEWER
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3				
4				

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Acoustics & Vibration

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1 INTRODUCTION

This Construction Noise and Vibration Sub-Plan has been prepared for the construction of the proposed Centre of Excellence located at TAFE Kingswood (the site).

Components involved with the works are expected to be:

- Excavation and groundworks of current grass field;
- Foundation works;
- Construction of a 3-storey high building (Centre of Excellence); and
- Landscaping.

This Construction Noise and Vibration Sub-Plan provides:

- Criteria for the noise and vibration generated during the main works
- A quantitative assessment of the airborne and ground-borne noise generated by the work for the proposed development and its impact on nearby receivers
- Strategies to mitigate the noise and vibration generated during the construction works phases
- Complaints handling and community liaison procedures

This assessment discusses the predicted impact of the construction noise and vibration generated by the construction equipment on the nearest most-affected receivers.

This report has been prepared with the following references:

- Interim Construction Noise Guideline (ICNG), NSW DECC, 2009;
- Construction Noise Strategy, Transport for NSW, 2013;
- Noise Policy for Industry (NPI), NSW EPA, 2017;
- Assessing Vibration: A Technical Guideline, NSW DEC, 2006;
- AS 2436:2010 *Guide to Noise and Vibration Control on Construction, Demolition and Maintenance Sites*;
- British Standard BS 5228: Part 1:1997 *Noise and Vibration Control on Construction and Open Sites*;
- British Standard BS 7358:1993 *Evaluation and Measurement for Vibration in Buildings – Part 2: Guide to Damage Levels from Ground-borne Vibration*; and
- German Standard DIN 4150-Part 3 *Structural vibration in buildings – Effects on structures*.

The predicted noise levels are based on the proposed construction program and equipment lists provided in this report.

Additionally, this document has been specifically prepared to address Condition B12 of the Development Consent. A summary of the Condition B12 and where all components of this condition are addressed within this report is provided in Table 1.

Table 1: Condition B12 – Location where parts of condition are addressed

CONDITION B12, PART	SECTION IN THIS REPORT
(a) be prepared by a suitably qualified and experienced noise expert	M.AAS (Member of Australian Acoustical Society)
(b) describe procedures for achieving the noise management levels in EPA's Interim Construction Noise Guideline	Section 6
(c) describe the measures to be implemented to manage high noise generating works such as piling, in close proximity	Section 6.1.1, 6.2.1 and 6.3
(d) include a complaints management system that would be implemented for the duration of the construction; and	Section 6.2.3
(e) include a program to monitor and report on the impacts and environmental performance of the development and the effectiveness of the implemented management measures in accordance with the requirements of condition B13	Section 6.3.4

2 PROJECT DESCRIPTION

2.1 SITE DESCRIPTION AND NOISE & VIBRATION SENSITIVE RECEIVERS

For the purposes of this Construction Noise and Vibration Sub-Plan, the site location, measurement positions (conducted by Norman Disney & Young in report *Acoustics Services – Noise and Vibration Impact* Assessment, dated 10 March 2021) and surrounding noise and vibration sensitive receivers are shown in Figure 1 and .

Figure 1: Overview of the site and surrounding sensitive receivers (source: Google Maps)

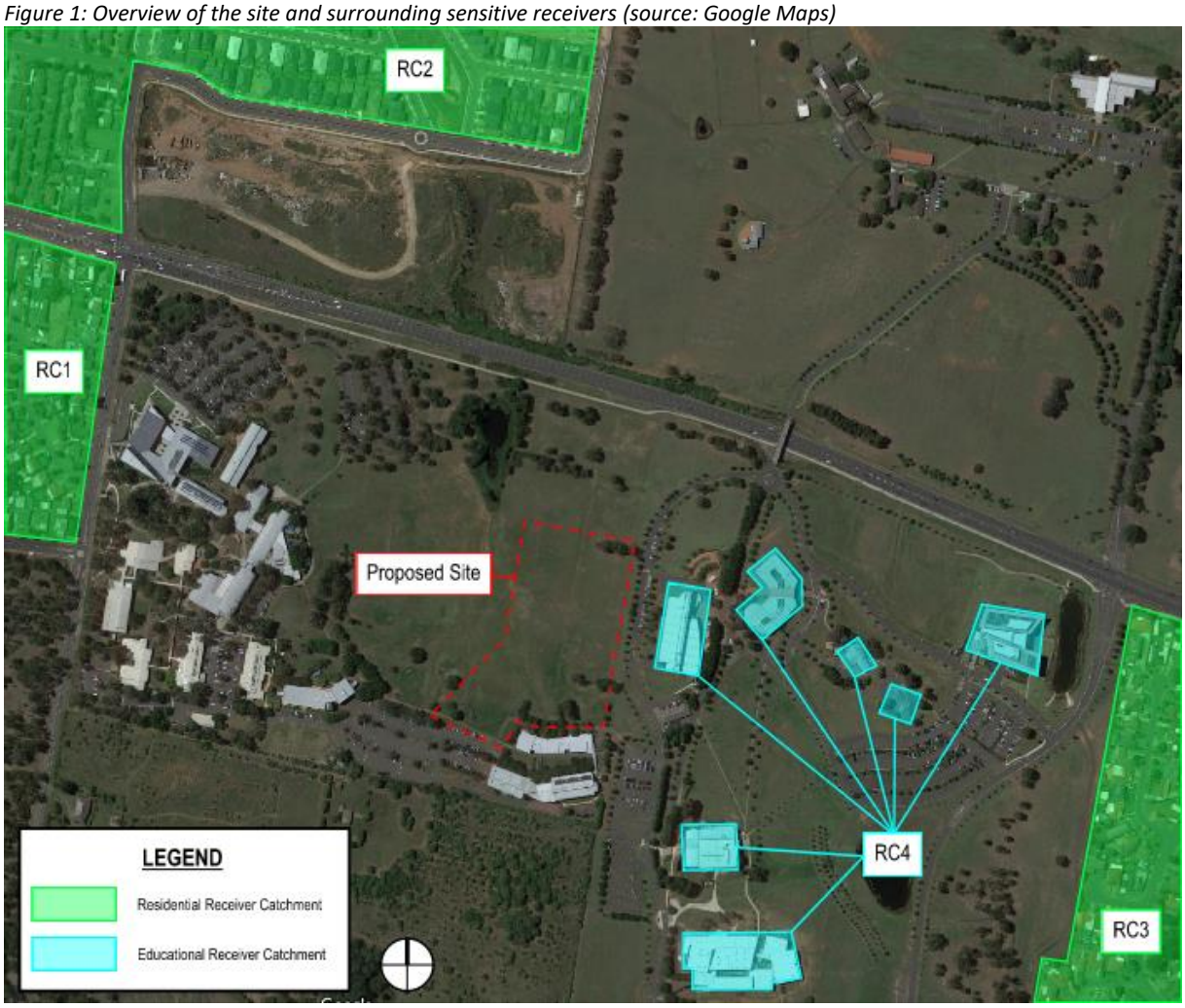


Figure 2: Monitoring locations conducted by Norman Disney & Young (source: report Acoustics Services – Noise and Vibration Impact Assessment, dated 10 March 2021)

3 BACKGROUND AND AMBIENT NOISE MONITORING

Long-term noise monitoring was conducted by Norman Disney & Young in report *Acoustics Services – Noise and Vibration Impact* Assessment, dated 10 March 2021 (locations presented in Figure 2). Background noise levels and subsequent Rating Background Noise Level (RBL) have been extracted from this report, which have been established in accordance with the Noise Policy for Industry 2017.

The description of time of day is outlined within the Noise Policy for Industry and described as follows:

- Day – the period from 7am to 6pm Monday to Saturday or 8am to 6pm on Sundays and public holidays
- Evening – the period from 6pm to 10pm
- Night – the remaining periods

Table 2: Unattended noise monitoring results (conducted by Norman Disney & Young)

LOCATION	MEASURED RATING BACKGROUND NOISE LEVELS (RBL) - dB(A)		
	DAY	EVENING	NIGHT
Logger 1	41	41	35
Logger 2	41	41	38
Logger 3	43	41	39
Logger 4	39	41	35
Logger 5	44	41	35

4 PROJECT NOISE AND VIBRATION CRITERIA

4.1 CONSTRUCTION NOISE CRITERIA

Airborne Noise – Residential Receivers

The airborne noise criteria for surrounding residential receivers have been extracted from Table 2 in the ICNG and is presented in Table 3 below.

Table 3: NSW ICNG construction noise criteria for surrounding residential receivers

TIME OF DAY	MANAGEMENT LEVEL $L_{Aeq,15min}$[1]	HOW TO APPLY
Recommended Standard Hours: Monday – Friday 7am – 6pm Saturday 8am – 1pm No work on Sundays or public holidays	Noise Affected RBL + 10dB	The noise-affected level represents the point above which there may be some community reaction to noise. ▪ Where the predicted or measured **$L_{Aeq,15min}$** 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 residences 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 in, 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 + 5dB	▪ The proponent should apply all feasible and reasonable work practices to meet the noise affected level. ▪ Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community. ▪ For guidance on negotiating agreements see section 7.2.2.

Note 1: Noise levels apply at the property boundary that is most exposed to construction noise, and at a height of 1.5 m above ground level. If the property boundary is more than 30 m from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30m of the residence. Noise levels may be higher at upper floors of the noise affected residence.

Airborne Noise – Educational Receivers

Table 4 below (extracted from Section 4.1.2 of the ICNG) sets out the noise management levels for other land uses, including educational institutions. Internal noise levels are to be assessed at the centre of the occupied room. External noise levels are to be assessed at the most affected point within 50m of the area boundary. Where internal noise levels cannot be measured, external noise levels may be used. A conservative estimate of the difference between internal and external noise levels is 10 dB for buildings other than residences.

Table 4: NSW ICNG construction noise criteria for surrounding educational receivers

RECEIVER TYPE	MANAGEMENT LEVEL (APPLIES WHEN PROPERTIES ARE BEING USED) $L_{Aeq,15min}$, dB(A)
Educational Institutes	45 (internal) 55 (external)

Based on the criteria in the tables above, the following noise management levels in Table 5 should be applied to the surrounding residential and educational receivers when appropriate. Construction during standard hours has been assumed.

Table 5: Project specific construction noise management levels (external noise level)

LAND USE	RECEIVER	NOISE MANAGEMENT LEVEL, $L_{Aeq,15min}$	HIGHLY NOISE AFFECTED LEVEL $L_{Aeq,15min}$
Residential	RC1	41 dB(A) + 10 dB = 51 dB(A)	75 dB(A)
	RC2	44 dB(A) + 10 dB = 54 dB(A)	
	RC3	39 dB(A) + 10 dB = 49 dB(A)	
Educational	RC4	55 dB(A)	N/A

4.2 CONSTRUCTION VIBRATION CRITERIA

4.2.1 Human Comfort

The office of Environment and Heritage (OEH) developed a document, "Assessing vibration: A technical guideline" in February 2006 to assist in preventing people from exposure to excessive vibration levels from construction and operation of a development within buildings. The guideline does not however address vibration induced damage to structures or structure-borne noise effects. Vibration and its associated effects are usually classified as continuous, impulsive or intermittent.

Continuous and Impulsive Vibration

Structural vibration in buildings can be detected by occupants and can affect them in many ways including reducing their quality of life and also their working efficiency. Complaint levels from occupants of buildings subject to vibration depend upon their use of the building and the time of the day.

Maximum allowable magnitudes of building vibration with respect to human response are shown in Table 6. It should be noted that the human comfort for vibration is more stringent than the building damage criteria.

Table 6: Preferred and maximum weighted RMS values for continuous and impulsive vibration acceleration (m/s^2) 1-80 Hz

LOCATION	ASSESSMENT PERIOD[1]	PREFERRED VALUES		MAXIMUM VALUES	
		z-axis	x- and y-axes	z-axis	x- and y-axes
Continuous vibration					
Residences	Daytime	0.010	0.0071	0.020	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
Impulsive vibration					
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

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

Intermittent Vibration Criteria

Disturbance caused by vibration will depend on its duration and its magnitude. This methodology of assessing intermittent vibration levels involves the calculation of a parameter called the Vibration Dose Value (VDV) which is used to evaluate the cumulative effects of intermittent vibration. Various studies support the fact that VDV assessment methods are far more accurate in assessing the level of disturbance than methods which is only based on the vibration magnitude.

Table 7: Acceptable vibration dose values for intermittent vibration ($m/s^{1.75}$)

LOCATION	DAYTIME[1]		NIGHT-TIME[1]	
	PREFERRED VALUE	MAXIMUM VALUE	PREFERRED VALUE	MAXIMUM VALUE
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

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

4.2.2 Cosmetic Damage

Structural vibration thresholds are set to minimize the risk of cosmetic surface cracks and lie below the levels that have the potential to cause damage to the main structure. Table 8 presents guide values for building vibration, based on the vibration thresholds above which cosmetic damage has been demonstrated outlined within BS7385-Part 2:1993. These values are evaluated to give a minimum risk of vibration-induced damage, where minimal risk for a named effect is usually taken as 95% probability of no effect.

Table 8: Transient vibration guide values for cosmetic damage – BS 7385-2:1993

TYPE OF BUILDING	PEAK PARTICLE VELOCITY IN FREQUENCY RANGE OF PREDOMINANT PULSE (PPV)	
	4 Hz TO 15 Hz	15 Hz AND ABOVE
Reinforced or framed structures Industrial or light commercial type buildings	50mm/s	N/A
Unreinforced or light framed structures Residential or light commercial type buildings	15mm/s	20mm/s (50mm/s at 40Hz and above)

4.2.3 Structural Damage

Ground vibration criteria is defined in terms of the levels of vibration emission from the construction activities which will avoid the risk of damaging surrounding buildings or structures. It should be noted that human comfort criteria are normally expressed in terms of acceleration whereas structural damage criteria are normally expressed in terms of velocity.

Most specified structural vibration levels are defined to minimize the risk of cosmetic surface cracks and are set below the levels that have the potential to cause damage to the main structure. Structural damage criteria are presented in German Standard DIN4150-Part 3 "Structural vibration in buildings – Effects on structures" and British Standard BS7385-Part 2: 1993 "Evaluation and Measurement for Vibration in Buildings". Table 9 indicates the vibration limits presented in DIN4150-Part 3 to ensure structural damage doesn't occur.

Table 9: Guideline value of vibration velocity, vi, for evaluating the effects of short-term vibration – DIN4150-3

LINE	TYPE OF STRUCTURE	VIBRATION VELOCITY, V_i, IN mm/s			
		FOUNDATION			PLANE OF FLOOR OF UPPERMOST FULL STOREY
		AT A FREQUENCY OF			
		LESS THAN 10HZ	10 TO 50HZ	50 TO 100HZ*	ALL FREQUENCIES
1	Buildings used for commercial purposes, industrial buildings and buildings of similar design	20	20 to 40	40 to 50	40
2	Dwellings and buildings of similar design and/or use	5	5 to 15	15 to 20	15
3	Structures that, because of their particular sensitivity to vibration, do not correspond to those listed in lines 1 and 2 and are of great intrinsic value (e.g. buildings that are under a preservation order)	3	3 to 8	8 to 10	8
*For frequencies above 100Hz, at least the values specified in this column shall be applied					

5 CONSTRUCTION NOISE ASSESSMENT

5.1 PROPOSED CONSTRUCTION ACTIVITIES

In this assessment, the noise impact from the main works are considered, which are expected to consist of the following stages:

- Excavation and ground works; and
- Building foundation and construction above ground.

The hours of work are expected to occur during standard daytime hours, as follows:

- Monday to Friday: 7am to 6pm
- Saturday: 8am to 1pm
- Sunday and public holidays: no work

5.2 EXPECTED CONSTRUCTION EQUIPMENT

The noise sources likely to be associated with the works listed in the previous section of this report are presented in Table 10. The equipment noise levels have been extracted from AS2436:2010 “Guide to Noise and Vibration Control on Construction, Demolition and Maintenance Sites” and the “Construction Noise Strategy, Transport for NSW, 2013”. These equipment noise levels are provided as sound power levels (in-line with the documents referenced above) and are the estimated sound power emitted by the equipment, which differs to the sound pressure level rated for equipment at a particular distance.

Table 10: Construction equipment noise levels

STAGES	EQUIPMENT	QUANTITY	SOUND POWER LEVEL – dB(A)	ACOUSTICAL USAGE FACTOR (%)	USAGE IN 15-MINUTE PERIOD (MINUTES)	TIME CORRECTED SOUND POWER LEVEL– dB(A) $L_{Aeq,15min}$
Excavation and ground works	Powered hand tool	4	102	50	7.5	99
	Excavator 30 tonne	1	110	40	6	106
	Excavator breaker	1	115	40	6	111
	Bobcat	1	107	70	10.5	105
	Dump truck	2	108	40	6	104
Building foundation and construction above ground	Powered hand tool	10	102	50	7.5	99
	Concrete pump	1	109	50	7.5	106
	Concrete Truck	1	108	50	7.5	105
	Generator	1	104	20	3	97
	General Truck	2	104	40	6	100
	Mobile Crane	1	110	16	2.4	102

5.3 NOISE MODELLING AND ASSUMPTIONS

In order to assess the noise impact from the site during the various construction stages, a noise model was prepared using commercial software SoundPLAN v8.2, which is a comprehensive software package for conducting three-dimensional complex noise propagation modelling. Using the software, a 3D model of the site and its surroundings was constructed including the nearby buildings, and the construction plant and equipment were positioned as noise sources. Within the model, the effects of the environment (built and natural) on propagation of sound were considered to reliably estimate the resulting noise effects on the surrounding noise sensitive receivers.

The noise model represents the 'reasonable' worst case periods of construction activities, meaning that all the equipment of each stage is operating simultaneously during a 15-minute observation period.

The assumptions that were made within the assessment include the following:

- The predicted noise levels represent the worst-case scenario for each receiver;
- The predicted noise levels at the receivers have been assessed at a height of 1.5m above ground level in accordance with the assessment procedures of the ICNG.
- The mitigation measures outlined in Section 6 are implemented; and
- Neutral weather conditions;

5.4 PREDICTED NOISE LEVELS

The predicted noise levels have been presented in Table 11 and Table 12 have been assessed to the construction noise criteria established in Section 4.1.

Table 11: Predicted noise levels – excavation and ground works

ID	RECEIVER TYPE	PREDICTED NOISE LEVEL RANGE $L_{Aeq,15min}$ dB(A)	NOISE MANAGEMENT LEVEL $L_{Aeq,15min}$ dB(A)	NOISE MANAGEMENT LEVEL EXCEEDANCE dB	EXCEEDS HIGHLY NOISE AFFECTED LEVEL (YES/NO)
RC1	Residential	< 49	51	0	No
RC2	Residential	< 49	54	0	No
RC3	Residential	< 49	49	0	No
RC4	Educational	58 – 61	55	3 – 6	N/A

Table 12: Predicted noise levels – building foundation and construction above ground

ID	RECEIVER TYPE	PREDICTED NOISE LEVEL RANGE $L_{Aeq,15min}$ dB(A)	NOISE MANAGEMENT LEVEL $L_{Aeq,15min}$ dB(A)	NOISE MANAGEMENT LEVEL EXCEEDANCE dB	EXCEEDS HIGHLY NOISE AFFECTED LEVEL (YES/NO)
RC1	Residential	< 49	51	0	No
RC2	Residential	< 49	54	0	No
RC3	Residential	< 49	49	0	No
RC4	Educational	58 – 61	55	3 – 6	N/A

6 CONSTRUCTION NOISE & VIBRATION MITIGATION MEASURES

6.1 PROJECT SPECIFIC RECOMMENDATIONS

Project specific recommendations and required mitigation methods have been listed below within Section 6.1. For general noise and vibration mitigation and management measures, refer to Section 6.2 of this report.

6.1.1 Noise

The receivers which can be considered as most affected are the educational buildings (RC4) due to their close proximity to the site.

It is recommended a respite period of minimum one hour, for example between 12:00pm – 1:00pm (or other period to coincide with construction workers lunch time(s)), should be offered per day during the most intensive periods of hammering and rock breaking. Frequent and proactive communication with the educational institute (Western Sydney University) is also encouraged, that being receiver RC4. This will allow occupiers of the educational facility to tune their schedules to accommodate possible noise sensitive meetings or classes. More details regarding communication with the community can be found in Section 6.2.3.

6.1.2 Vibration

The highest vibration inducing activities are predicted to be rock breaking (if required). The most-affected receiver is expected to be RC4, being the closest receivers to the project site. Vibration levels at RC4 aren't expected to exceed structural damage criteria (Section 4.2.3) as there is a reasonable distance from the closest façade of the receiver to the proposed structure (approx. min. 50m distance).

If vibration intensive activities (such as rock breaking) are to occur along the eastern boundary, attended vibration measurements should be conducted to determine if there is an exceedance of the vibration limits set out in Section 4.2.

Upon any exceedances in vibration levels, reasonable and feasible measures should be considered to lessen the impact, such as alternative methods or equipment for rock breaking to achieve the vibration levels required.

To further diminish the vibration impact, the one-hour respite period, for example between 12:00pm – 1:00pm (or other period to coincide with construction workers lunch time(s)), recommended for noise mitigation shall also apply for vibration mitigation.

6.2 GENERAL ACOUSTIC RECOMMENDATIONS FOR CONSTRUCTION

According to AS 2436 – 2010 “Guide to noise and vibration control on construction, demolition and maintenance sites” the following techniques could be applied to minimize the spread of noise and vibrations to the potential receivers.

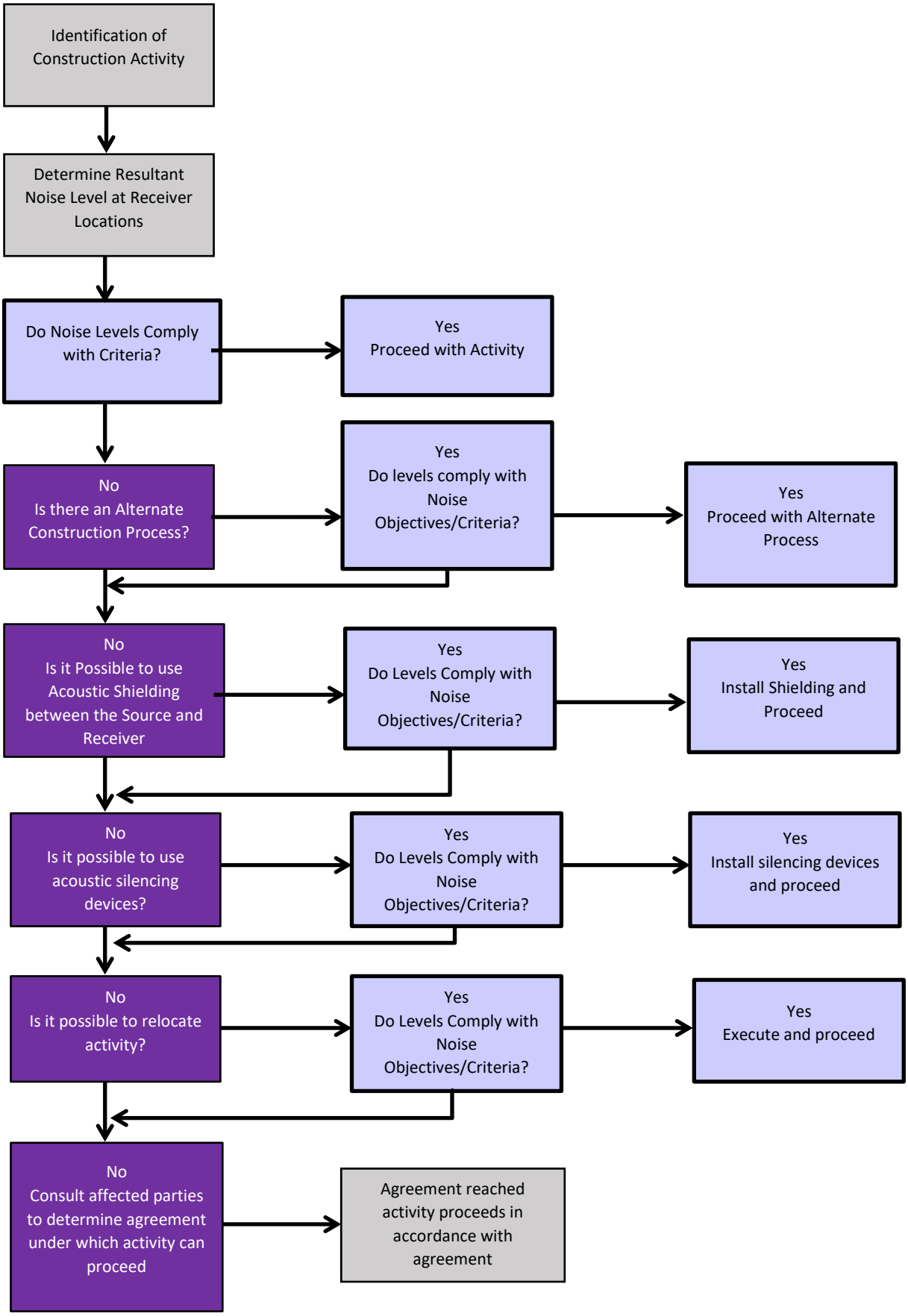
6.2.1 Noise

Figure 3 demonstrates the preferred order of actions taken to mitigate excessive construction noise emissions. If a process that generates significant noise levels cannot be avoided, the amount of noise reaching the receiver should be minimized. Two ways of achieving this are to either increase the distance between the noise source and the receiver or to introduce noise reduction measures such as screens. Practices that will reduce noise from the site include:

- Increasing the distance between noise sources and sensitive receivers.
- Reducing the line-of-sight noise transmission to residences or other sensitive land uses using temporary barriers (stockpiles, shipping containers and site office transportables can be effective barriers).
- Constructing barriers that are part of the project design early in the project to introduce the mitigation of site noise.
- Installing purpose-built noise barriers, acoustic sheds and enclosures.

Physical methods to reduce the transmission of noise between the site works and residences, or other sensitive land uses, are generally suited to works where there is longer-term exposure to the noise. A few of these methods have been introduced below.

Figure 3: Noise mitigation management flow chart



Screening

On sites where distance is limited, screening of noise may be beneficial or even the only way to reduce construction noise impacts on the nearby receivers. Below, screening options for various situations have been introduced. Constructing and utilising these screening methods should be taken into account already during the planning stages.

Temporary buildings: One option to introduce screening is to position structures such as stores, storage piles, site offices and other temporary buildings between the noisiest part of the site and the nearest dwellings. Due to shielding provided by these buildings, some of the noise emission from the site can be reduced. If the buildings are occupied, however, sound insulation measures may be necessary to protect site workers inside the buildings.

Hoarding: Another way of implementing screening is to build hoarding that includes a site office on an elevated structure. This option offers superior noise reduction when compared with a standard, simple hoarding. The acoustic performance is further enhanced when the hoarding is a continuous barrier.

Equipment operating 24h: When it comes to water pumps, fans and other plant equipment that operate on a 24-hour basis, they may not be an irritating source of noise during the day but can be problematic at night. They should therefore be effectively screened by either situating them behind a noise barrier or by being positioned in a trench or a hollow in the ground. Again, generated reverberant noise must be minimised and adequate ventilation should be ensured.

General remarks: In many cases, it is not practical to screen earthmoving operations effectively, but it may be possible to partially shield a construction plant at the early stages of the project with protective features required to screen traffic noise.

The usefulness of a noise barrier will depend upon its length, its height, its position relative to the source and the receiver, and the material of which it is made. A barrier designed to reduce noise from a moving source should extend beyond the last property to be protected by at least ten times the shortest distance from the said property to the barrier. A barrier designed to reduce noise from a stationary source should, where possible, extend beyond the direct line of sight between the noise source and the receiver by a distance equal to ten times the effective barrier height, which is the height above the direct line between source and receiver.

If the works are already predominantly located within nominally closed structures, careful consideration should be given to reducing noise breakout at any openings.

Cranes

For the early works construction phases, any cranage will be limited to mobile cranes where the engines are typically enclosed in an acoustically treated housing.

Reversing and warning alarms

Community complaints often involve the intrusive noise of alarms commonly used to provide a safe system of work for vehicles operating on a site. Beeper reversing alarm noise is generally tonal and may cause annoyance at significant distances from the work site.

There are alternative warning alarms capable of providing a safe system of work that are equal to or better than the traditional “beeper”, while also reducing environmental noise impacts. The following alternatives should be considered for use on construction sites as appropriate:

- Broadband audible alarms incorporating a wide range of sound frequencies (as opposed to the tonal-frequency ‘beep’) are less intrusive when heard in the neighbourhood.
- Variable-level alarms reduce the emitted noise levels by detecting the background noise level and adjusting the alarm level accordingly.
- Proximity alarms that use sensors to determine the distance from objects, such as people or structures, and generate an audible alarm in cabin for the driver.
- Spotters or observers.

The above methods should be combined, where appropriate.

6.2.2 Vibration

Vibration can be more difficult to control than noise, and there are few generalizations that can be made about its control. It should be kept in mind that vibration may cause disturbance by causing structures to vibrate and radiate noise in addition to perceptible movement. Impulsive vibration can, in some cases, provide a trigger mechanism that could result in the failure of building components that had previously been in a stable state.

During the excavation works and the erection of new structures, some vibrations (transmitted through the structure from the demolition sites) are expected, being more of a concern for the surrounding sensitive receivers. Vibrations can also trigger annoyance, which might get elevated into action by occupants of exposed buildings and should therefore be included in the planning of communication with impacted communities.

It should be remembered that failures, sometimes catastrophic, can occur as a result of conditions not directly connected with the transmission of vibrations, e.g. the removal of supports from retaining structures to facilitate site access. BS 7385-2 provides more information on managing ground-borne vibration and its potential effects on buildings. Where site activities may affect existing structures, a thorough engineering appraisal should be made at the planning stage.

General principles of seeking minimal vibration at receiving structures should be followed in the first instance. Predictions of vibration levels likely to occur at sensitive receivers are recommended when they are relatively close, depending on the magnitude of the source of the vibration or the distance associated. Relatively simple prediction methods are available in textbooks, codes of practice and standards, however, it is preferable to assess site transmission and propagation characteristics between source and receiver locations through measurements.

Guidance for measures available for the mitigation of vibration transmitted can be sought in more detailed standards, such as BS 5228-2 or policy documents, such as the NSW DEC *Assessing Vibration: A technical guideline*. Identifying the strategy best suited to the control of vibration follows a similar approach to that of noise: avoidance, control at the source, control along the propagation path, control at the receiver, or a combination of these. It is noted that vibration sources can include stationary plants (pumps and compressors), portable plants (jackhammers and pavement vibrators), mobile plants, pile-drivers, tunnelling machines and activities, and blasting, amongst others. Unusual ground conditions, such as a high water-table, can also cause a difference to expected or predicted results, especially when considering the noise propagated from piling.

6.2.3 Complaint Handling Procedures and Community Liaison

It is recommended that the builder directly contact adjacent noise sensitive receivers and provide them with the following information:

- The contact details for a nominated representative in order to make noise / vibration complaints.
- Explain the timeframe for the construction works and the proposed activities, i.e. the proposed start / stop dates of work and a description of the noise producing equipment that will be used.
- Notify the noise sensitive receivers and Penrith City Council in a timely manner should there be any need for an extension to the proposed arrangements.
- Provide them with a copy of this report as approved by the Penrith City Council.
- Penrith City Council should be notified of the nature and details of complaints received (time, complainant etc.) and what remedial action has taken place, if any.
- Where noise is demonstrated as being compliant with criteria, this should not limit the proponent in undertaking further additional reasonable and feasible steps to reduce noise emissions.

To assist in the management of noise and vibration complaints various procedures are to be followed. These include:

- Clearly visible signage identifying any key personnel along with their contact details to be erected along the perimeter of the building site including a 24-hour contact name, phone number and email address provided for the resident to address any complaint. The signage will declare; “For any enquiry, complaint or emergency relating to this site at any time please contact…”
- Give complaints a fair hearing.
- Have a documented complaints process, including an escalation procedure so that if a complaint is not satisfied there is a clear path to follow.
- Call back as soon as possible to keep people informed of action to be taken to address noise problems. Call back at night time only if requested by the complainant to avoid further disturbance.
- Implement all feasible and reasonable measures to address the source of the complaint.
- A register is to be kept by the contractor to keep a record of complaints and detail any information associated with them. The contents of the register will include:
    - The name and the address of the complainant
    - Time and date of the complaint
    - The nature of the complaint (Noise/Vibration)
    - Subsequent details
    - Remedial action undertaken

The contents of the register will be maintained and updated with any new complaint without delay. The complaints will be reported to both Penrith City Council and the Contractor. The investigation of the complaint and any remedial actions will be performed by the builder and/or client representative.

In the event of noisy works scheduled, the builder will notify residents 5 business days in advance.

6.3 NOISE & VIBRATION MONITORING STRATEGY

6.3.1 General Methodology

Noise and vibration levels should be monitored from time to time to ensure that noise generated as a result of remediation and construction activities does not disturb local businesses and residents.

Monitoring may be in the form of regular checks by the builder or indirectly by an acoustic consultant engaged by the builder and in response to any noise or vibration complaints. Where noise and vibration criteria are being exceeded or in response to valid complaints, noise and / or vibration monitoring should be undertaken. This would be performed inside the premises of the affected property and on site adjacent to the affected receivers.

Monitoring is to be undertaken by an experienced noise and vibration monitoring professional or an acoustic consultant. The results of any noise or vibration monitoring are to be provided to the relevant party or person in a timely manner allowing the builder to address the issue and respond to the complaints.

Noise and vibration monitoring can take two forms:

- Short-term monitoring
- Long-term monitoring

Both of these approaches are elaborated below.

6.3.2 Short-term Monitoring

Short-term monitoring consists of attended monitoring when critical stages of the construction are occurring. This normally provides real-time assistance and guidance to the subcontractor on site, telling them when the noise and vibration criteria are exceeded. Thus, the selection of alternative method on construction or equipment selection is allowed in order to minimise noise and vibration impacts.

6.3.3 Long-term Monitoring

Similarly, to short-term monitoring, long-term monitoring provides real-time alerts to the builder / site manager when the noise and vibration criteria are exceeded. Instead of someone being on site measuring, noise and vibration loggers are used.

Typically, the noise and vibration loggers stay on site for a period of several months for the critical construction stages of the project, such as the demolition and excavation phases.

Both methodologies are complementary and normally used simultaneously providing a significant amount of data via the long-term monitoring, but also providing information on the sources of noise and vibration generating exceedances via the short-term or attended monitoring.

6.3.4 Noise & Vibration Monitoring Program

A monitoring program for the main work is proposed in Table 13. The monitoring program is to be carried out during the most intrusive activities (such as rock breaking) as agreed with the Acoustic engineer and Contractor.

Table 13: Noise and vibration monitoring program

RECEIVER LOCATION	PROPOSED MONITORING TYPE AND PHASE
RC4	Noise – Excavation Works
	Vibration – Excavation Works

7 CONCLUSION

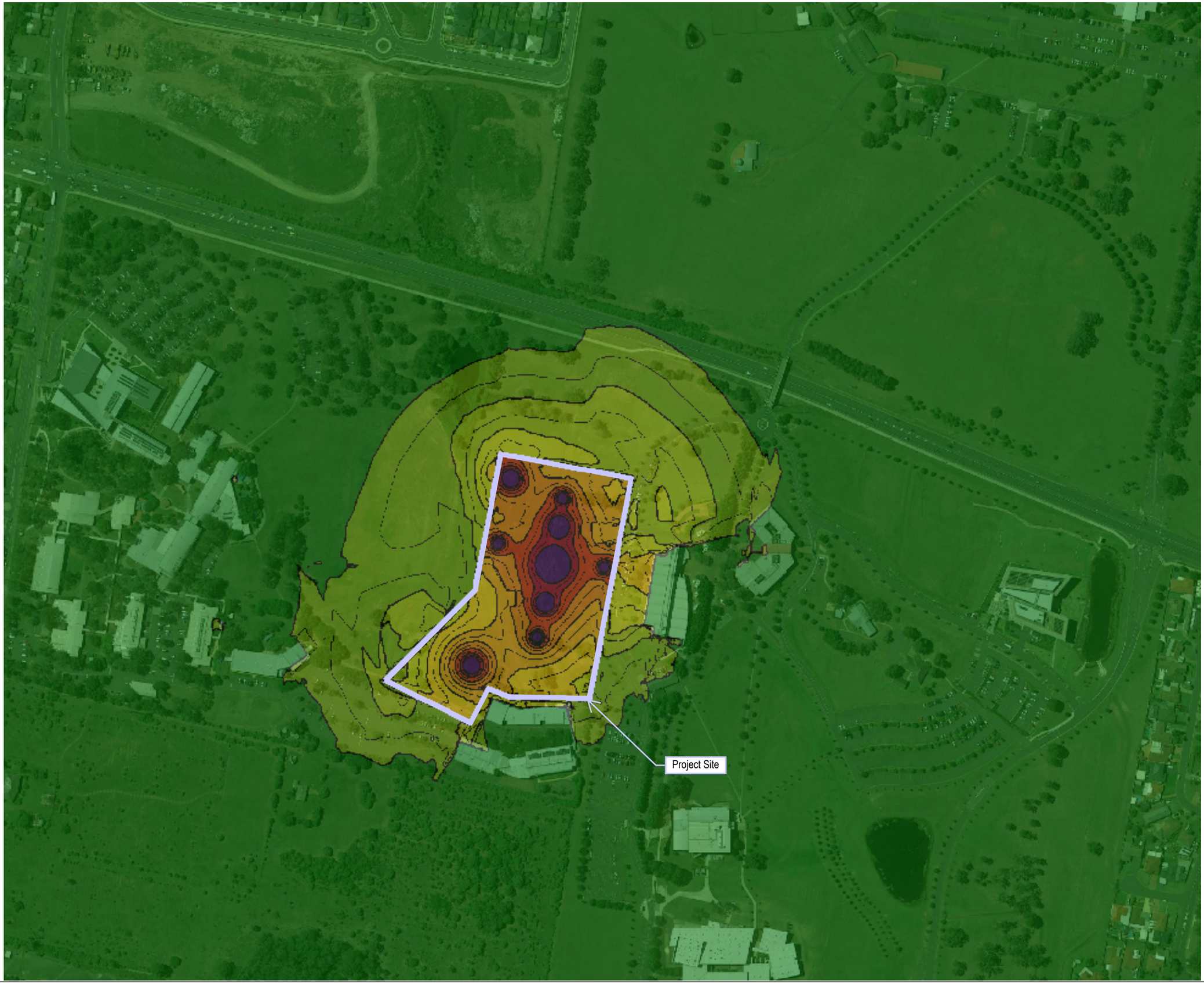
A Construction Noise and Vibration Sub-Plan has been provided for the construction of the proposed Centre of Excellence located at TAFE Kingswood.

The details of the noise and vibration modelling and assessment undertaken to predict the impacts on sensitive receivers have been presented in Sections 5.

To reduce the noise and vibration impacts on the sensitive receivers, noise and vibration management strategies have been proposed in Section 6.

The information presented in this report shall be reviewed if any modifications to the features of the development specified in this report occur, including and not restricted to selection of equipment/machinery and modifications to the construction program.

Appendix A **Construction Noise Emissions Modelling**



E-LAB CONSULTING

ISSUE	DATE	STATUS
1	14/12/2021	For Coordination
2	21/02/2022	For Coordination

LEGEND

Noise Level - $L_{Aeq,15min}$ dB(A)

- < 49
- 49 - 52
- 52 - 55
- 55 - 58
- 58 - 61
- 61 - 64
- 64 - 67
- 67 - 70
- 70 - 73
- ≥ 73

NOTES

PROJECT
TAFE KINGSWOOD - CENTRE OF EXCELLENCE

PROJECT NO.
P00139

ARCHITECT
GRAY PUKSAND

CLIENT
ADCO

SCALE
NTS

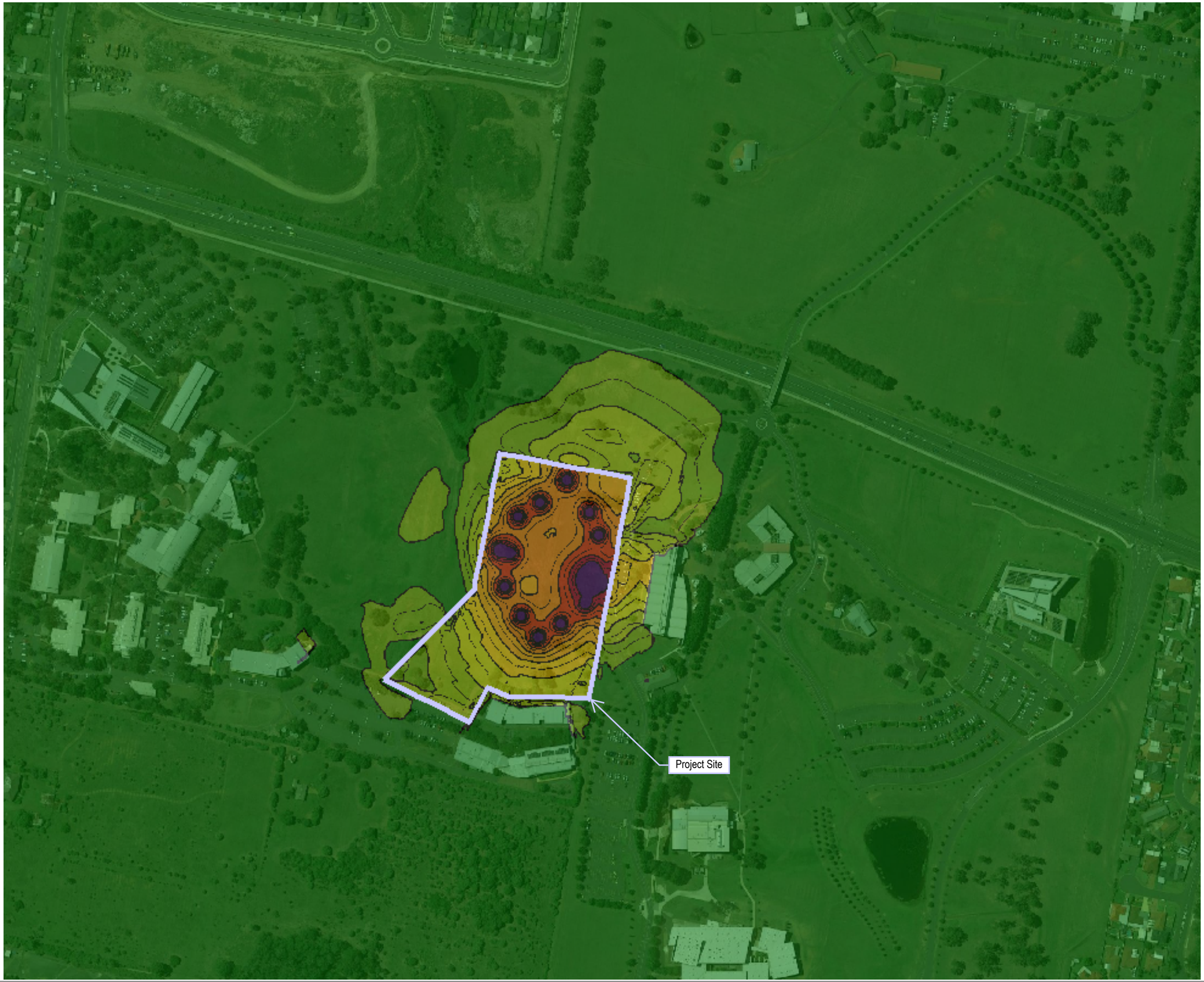
STATUS
FOR COORDINATION

DRAWING
NOISE EMISSIONS CONTOUR MAP

EXCAVATION AND GROUND WORKS

DISCIPLINE
ACOUSTICS AND VIBRATION

DRAWING NUMBER	REVISION
AC-DWG-100-02-02	002



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