AW EDWARDS

669 Hastings PCYC

Construction Noise & Vibration Management Plan

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1 INTRODUCTION

1.1 DESCRIPTION OF THE WORKS

A W Edwards are the Principal Contractor for the construction of the Hastings PCYC Project.

The project is located at 16 Owen Street Port Macquarie with a scope:

The construction of a new Multi-sports centre conceived in three parts. Courts, a circulation spine and supporting facilities. Works include external site improvements and on-grade car parking

A drawing of the project identifying key environmental controls and location of environmental sensitive areas will be posted on the Site Noticeboard.

The site office, worker facilities and compound will be located within the construction footprint.
In accordance with the State Significant Development (SSD 11920082), unless for an emergency as describe by the SSD or where written approval has been provided, the site construction work hours are restricted to the following:

Monday – Friday	7:00am – 6:00pm
Saturday	7:00am – 6:00pm
Sunday/Public Holidays	No construction work permitted

1.2 PURPOSE OF THIS PLAN

This Construction Noise and Vibration Management Plan (CNVMP) has been prepared in response to a request for tender for the Project. This Plan is one of a number of Plans developed to manage our obligations as part of the project delivery.

This Noise and Vibration Management plan is written with the purpose of communicating to NSW Department of Education, School Infrastructure our objectives, strategies, methodologies and actions for the management of Noise and Vibration whilst executing the works under the Contract.

This CNVMP should be read in conjunction with the Construction Management Plan and other management plans.

As part of the Tender and Post-Tender process, AWE will provide further detailing or revision of this Plan to meet the Client and stakeholder requirements. After contract award, this Plan will be developed, reviewed and updated on a regular basis to reflect design development, and our developing construction methodology.

This Plan is to ensure all members of the A W Edwards team and other project stakeholders understand the objectives and the procedures and processes in place as necessary for the successful execution of works under the contract.

1.3 OBJECTIVES

The primary objective of this plan is to comply with the noise and vibration requirements of the Contract. A W Edwards is committed to ensuring that no works significantly impact on local background noise and vibration levels at the Hastings PCYC Project.

The objective of the Construction Noise & Vibration Management Plan (CNVMP) can be summarised as follows:

- Ensure that construction works do not significantly impact background noise levels around the site, and that applicable guidelines and regulations are met;
- Identification and management of critical locations for noise and vibration levels in neighbouring properties
- Ensure all equipment operates within the applicable noise levels;
- Ensure that construction works do not cause sufficient vibration to damage surrounding buildings, and comply with the applicable guidelines and regulations.
- Cooperative and responsive management principles

1.4 IMPACTS

Excessive noise and vibration levels can result in a serious nuisance and loss of amenity for site and surrounding occupants including surrounding residents, site workers and any sensitive fauna populations.

Work health risks to the site workforce include:

- Noise induced hearing loss, tinnitus, etc.
- Communication problems including safety instructions
- Stress

Vibration may also cause damage to the site and surrounding buildings and infrastructure.

1.5 REFERENCE DOCUMENTS

- Construction Vibration Management Requirements
- AWE Management System
- Environmental Management Plan
- Construction Management Plan
- Inspection and Test Plans

1.6 PRECEDENCE

Where ambiguity is detected between the procedures and requirements in this plan and the A W Edwards Management System, then the procedures nominated in this plan will take precedence.

1.7 INTERFACE WITH OTHER PROJECT PLANS AND PROCEDURES

The Environmental Management Plan forms part of an integrated set of Project Management Plans and should be read in conjunction with the Management Plans described in Project Management Plan.

1.8 GLOSSARY OF CONSTRUCTION NOISE TERMS

Acoustic Term	**Description**
Ambient Noise	The all-encompassing noise associated within a given environment at a given time, usually composed of sound from all sources near and far.
Background Noise	Background noise is the term used to describe the underlying level of noise present in the ambient noise, measured in the absence of the noise under investigation, when extraneous noise is removed. It is described as the average of the minimum noise levels measured on a sound level meter and is measured statistically as the A-weighted noise level exceeded for ninety percent of a sample period. This is represented as the L90 noise level (see below).
Decibels [dB]	Abbreviation for 'decibel', which is the standard unit of measurement of sound pressure level 0dB The faintest sound we can hear 20dB Quiet bedroom at night or recording studio 30dB Quiet library or quiet location in the country 40dB Living room 50dB Typical office space or ambience in the city at night

Acoustic Term	Description
	60dB Normal conversational speech 70dB A car passing by 80dB Kerbside of a busy road 90dB Truck passing by 100dB Nightclub 110dB Rock band or 2m from a jackhammer 120dB 70m from a jet aircraft 130dB Threshold of pain 140dB 25m from a jet aircraft
dB[A]	The "A" donates that the sound pressure level has been "A-weighted" so that the scale approximates the response of the human ear.
$L_{A10(15min)}$	Noise level in dB (A) of the "Average maximum noise level" during construction activities. This is the main parameter used to assess the construction noise impacts and is measured over a 15 minute period;
L_{A90}	Noise level in dB (A) in the absence of construction activities. This parameter represents the average minimum noise level during the daytime, evening and night-time periods respectively. The $L_{A10(15min)}$ construction noise objectives are based on an allowance margin above the L_{A90} background noise levels.
L_{Aeq}	Average noise level during a measurement period.
OEH	Office of Environment and Heritage (formerly DECCW)
SEL	Sound Exposure Level (SEL) is the constant sound level which, if maintained for a period of 1 second would have the same acoustic energy as the measured noise event.
Structure-borne noise	Vibration propagating through solid structures in the form of compressional or bending waves, heard as sound.

2 APPROVALS

2.1 LICENCES AND PERMITS

No licences or permits are required as part of these work

2.2 HOURS OF WORK

As per the Condition of Consent 4, the standard construction hours are:

Working Day	Working Hours
Monday to Friday	0700 to 1800
Saturday	0700 to 1800
Sunday and Public Holidays	Not permitted

Approved construction hours for rock breaking, rock hammering, piling.
Note: rock breaking is not expected throughout this construction. If required AWE will process through the 'unexpected finds' procedures.

Working Day	Working Hours
Monday to Friday	09:00 -12:00 & 14:00 - 17:00
Saturday	09:00 – 12:00
Sunday and Public Holidays	Not permitted

2.3 CONDITIONS OF APPROVAL

The conditions of approval related to noise and vibration management have been tabled in the Self verification Checklist in Appendix A. The checklist will reference where in the CNVMP the conditions have been addressed.

3 REGULATIONS AND LEGISLATIVE REQUIREMENTS

3.1.1 LEGISLATION

Key environmental legislation relating to noise and vibration management includes:

- Protection of the Environment Operations Act (1997)
- Environment Planning and Assessment Act (1979)
- Local Government Act (1993)
- Protection of the Environment Operations (Noise Control) Regulation 1999 NSW EPA Environmental Noise Control Manual

3.1.2 GUIDELINES AND STANDARDS

The key references relevant to noise and vibration management of project include:

- DIN 1999, DIN 4150: Part 3 – 1999 Effects of vibration on structures, DIN, Germany
- EPA Interim Construction Noise Guideline
- DEC 2006, Assessing vibration – a technical guideline, Department of Environment and Conservation, Sydney NSW
- DECC 2009, Interim Construction Noise Guideline, NSW Department of Environment and Climate Change, Sydney NSW
- RTA 2001, Environmental Noise Measurement Manual, Roads and Traffic Authority, Sydney NSW
- NSW Industrial Noise Policy
- AS 1055 Parts 1 to 3 Acoustics: Description and management of environmental noise;
- AS 2659 Sound level metres;
- AS 2659.1 Guide to the use of sound measuring equipment;
- AS 2072 Acoustics: Methods for measurement of traffic noise;

4 COMMUNICATION

Following the completion and implementation of an approved Noise and Vibration Management Plan, there are several key measures, which will be undertaken by A W Edwards's site team to ensure effective and positive communication with all affected parties.

4.1 ONGOING COOPERATIVE MANAGEMENT

A W Edwards apply a pro-active approach to all aspects of the project to ensure a high level of control is exercised and any potential problems can be identified (and responded to) as early as possible.

Our project team pro-actively manage the project by focusing closely on planning, programming, forecasting and monitoring activities. This focus minimises the potential for problems to occur. We continue to develop contingency plans to address the possibility of problems actually arising. This approach is fundamental to the successful delivery of the project.

Despite the best endeavours of all stakeholders, problems or unforeseen circumstances may arise. We will actively resolve or help to resolve such problems in the most expedient and efficient way possible. Project staff with the experience and skills needed to solve complex problems in projects of this nature will remain committed to this project. In the event that unforseen problems are encountered, the team will immediately initiate and implement a problem resolution plan to minimise any impacts.

We will encourage and promote a co-operative and harmonious project environment. This applies to relationships between clients, employees, consultants, suppliers, subcontractors, unions and other stakeholders. Our objective will be to eliminate conflict wherever possible and at all levels, as this can be a major impediment to progress and meeting project objectives.

4.2 COMMUNITY CONSULTATION

A community consultation forum was held at Hastings Secondary School. The forum included all with stakeholders including the School Principal
No material issues were identified and stakeholders were keen to see the school upgrade undertaken. The consultation included:

- Overview and timeline of 3 stage construction process
- Construction hours
- key personnel and contacts
- Buildings/zones affected
- Construction zones boundaries
- Changes and impacts to access & egress for public
- 3D presentation of final campus design
- Q & A

4.3 COMMUNITY COMPLAINTS

Community complaints shall be recorded on a 'A W Edwards Complaints Register' form SE7013.
Community complaint must be immediately referred to the Principal's Project Manager (Currie & Brown)
Remedial action must be taken within the timeframe agreed with the Principal's Project Manager.
The Principles Project Manager shall ensure closure and sign off with all relevant parties
Any action taken shall be recorded on the form.

4.4 FORECASTING AND NOTIFICATION

A key communication tool is the provision of ongoing forecasting and early notification of activities to affected parties. Our success on recent projects can be attributed to the provision of adequate forecasting of construction activities to affected parties. This provides early warning of the stages of the

projects, provides an opportunity for review and comment by affected parties and helps outside parties generally understand the construction process and why certain activities occur.

Through our recent projects and experience in sensitive projects, we have developed a Noise and Vibration Control Plan, which is used to provide detailed forecasting of construction activities.

By providing this open form of communication we have found that affected parties have a higher level of understanding of our works and it encourages feedback into other party's activities, which may affect our works or change for whatever reason. i.e. a particularly sensitive experiment could be underway which has a stricter noise and vibration limits than our contractual requirements. Through early warning we can assist in re-programming works to suit the requirements of the affected party without affecting the overall construction programme. Early warning and notifications both ways is necessary for the ongoing success of the project.

4.5 CONTRACTOR MANAGEMENT

A W Edwards will ensure the noise and vibration management plan will be a contract document for our contractors, notably civil works, and will be further developed and amended in conjunction with our leading contractors. We will listen to their concerns and innovations in accordance the requirements of the contract to ensure an effective balance of community management, environmental management and onsite production.

We will ensure that the noise and vibration requirements and plans are;

- Contract documents for all contractors
- An integral part of individual project site inductions
- Monitored daily through site environmental hazard sheets
- Adequate site management resources throughout all project phases
- An assessment criteria for the selection of contractors
- Are continually updated throughout the course of the works as required

The transfer of knowledge and requirements, while maintaining overall project responsibility, will be integral to ensuring effective site management. We recognise this communication link with site contractors is important to maintaining effective overall management of the project to the satisfaction of all affected parties.

5 RISK ASSESSMENT

The risk assessment process, as detailed in the Environmental Management Plan, has been applied to this Project, in order to determine the sources and risks associated with noise and vibration. Details of this risk assessment, including mitigation measures, have been included in Environmental Management Plan.

The risk assessment process will be reviewed at the following times:

- Every six months during a site audit, and including comments from personnel and sub-contractors on site
- Following high monitoring results
- Following a complaint
- If new work processes that have not been previously addressed start on site
- Should new requirements for the project or new legislation take effect

5.1 SENSITIVE RECEIVERS

The nearest potentially affected receivers of construction noise and vibration are as follows:

- Hastings PCYC Project (within 50m)
- Residential receiver surrounding the project site (approximately 250m);
- Multiple Residential & Business receivers to the east of the Project Site (approximately 300m);

5.2 POTENTIAL CONTOLS

Predicted worst case noise levels at various potentially affected receivers are presented above. Residential premises surrounding the site will receive noise levels marginally exceeding the noise
management level.
Operations ought to generally comply with the noise affected management levels at all times at the residential receivers surrounding the site.

Specific treatments to items of plant will be developed in conjunction with the engaged contractor in an ongoing acoustic review of construction methodology. These reviews will be undertaken regularly and when more detailed planning regarding including possible actual plant locations, actual plant being used, etc are known.

Where practicable, positioning major mobile temporary plant such as concrete crushers, concrete pumps, concrete trucks and the like as far as possible from sensitive receptors. The strategic positioning of these items can result in construction noise levels not exceeding the NAML around the site.

The noise and vibration assessment indicate that exceedances of the noise and vibration management goals would primarily be caused by vibratory rollers and ad hoc jack hammering. Hence these activities should be managed as follows:

- Vibrating compaction rollers should only be undertaken where static rolling is not feasible or reasonable.
- Where vibrating compaction/jack hammering is undertaken it will be performed after assessment of work, and consultation.

Demolition and excavation activities are typically the loudest construction activities on site.

6 NOISE AND VIBRATION SOURCES

6.1 NOISE SOURCES

Typical noise levels from construction plant equipment most likely to be used during the construction works are provided in Table 1.

Equipment/Process	Sound Power Level bD(A)**
Excavator	114
Skid/Steer	105
Pneumatic Hammer	115*
Concrete Pump	105
Concrete Truck	110
Truck	108
Angle Grinders	118*
Electric Saw	116*
Driling	94
Site Crane	105
Impact Drill	115
Concrete Float/Vibrators	105

Table 1- Sound Power Levels.

* Includes 5dB(A) addition for characteristics of noise surrounds
**The noise levels presented in the above table are derived from on-site measurements, Table A1 of AS 2436-2010, and date held by Acoustic Logic and from other similar studies

6.2 VIBRATION SOURCES

Typical vibration levels from construction plant equipment most likely to cause significant vibration are presented inTable 2.

Plant	Typical ground vibration
Bulldozers / Excavator	Typical ground vibration levels from bulldozers/ excavators are similar to those from jackhammers. They range from 1 mm/s to 2 mm/s at distances of approximately 5 m and at distances greater than 20m, vibration levels are usually below 0.2 mm/s.
Jack Hammers	Typical ground vibrations from jack hammers are generally greater than 5mm/s at distances of 1m and no more than 2mm/s for distances of 5m or more.
Vibratory rollers	Ground vibration caused by vibratory rollers can range up to 1.5mm/s at distances of 25m. The highest levels of vibration usually occur as the roller is brought to rest and the frequency of the centrifugal forces passes through resonance with the natural frequency of the roller/ground/structure. Machinery should therefore not be brought to rest when in the vicinity of susceptible buildings, especially dwellings. Higher levels could occur at closer distances, however, no damage would be expected for any building at distances greater than approximately 12m (for a medium to heavy roller).
Truck traffic	Typical vibration from heavy trucks passing over normal (smooth) road surfaces generate relatively low vibration levels in the range of 0.01 - 0.2mm/s at the footings of buildings located 10 - 20m from a roadway. Very large surface irregularities can cause levels up to five to ten times higher. In general, ground vibration from trucks is usually imperceptible in nearby buildings. The rattling of windows and other loose fittings that is sometimes reported is more likely to be caused by airborne acoustic excitation from very low frequency (infrasonic) noise radiated by truck exhausts and truck bodies. While this may cause concern to the occupants, the phenomenon is no different from the rattling caused by wind or people walking or jumping on the floor and fears of structural damage or even accelerated ageing are usually unfounded.

Table 2- Typical vibration sources

7 NOISE AND VIBRATION CRITERIA

7.1 NOISE CRITERIA

Noise impacts including impacts from mechanical plant and equipment and operations have been adequately mitigated to not exceed the following noise limits measured at the most effective noise sensitive receiver of 16 Owen Street Port Macquarie.

Noise Descriptor	LAeq (15 min)	LAeq (period)	LA (1 minute)
Daytime	47 dB(A)	45 Db(A)	

7.1.1 AIR BORNE NOISE

The *Interim Construction Noise Guideline* produced by OEH setouts out the management levels for noise at residences and how they are to be applied. The noise at residences quantitative assessment in presented in Table 3.

In Table 3 the rating background level (RBL) is used when determining the management level. The RBL is the overall single-figure background noise level measured in each relevant assessment period (during or outside the recommended standard hours). The term RBL is described in detail in the *NSW Industrial Noise Policy (EPA 2000).*

As a guide, the difference between the internal noise level and the external noise level is typically 10 dB with windows open for adequate ventilation.

Time of day	**Management level** L_{Aeq}(15 min) *	**How to apply**
Recommended standard hours: Monday to Friday 7 am to 6 pm Saturday 7 am to 6pm No work on Sundays or public holidays	Noise affected RBL + 10 dB	The noise affected level represents the point above which there may be some community reaction to noise. • Where the predicted or measured L_{Aeq}(15 min) is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. • The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75 dB(A)	The highly noise affected level represents the point above which there may be strong community reaction of noise. • Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: 1. 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 2. If the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise affected RBL + 5 dB	• A strong justification would typically be required for works outside the recommended standard hours. • The proponent should apply all feasible and reasonable work practices to meet the noise affected level.

Time of day	Management level L_{Aeq} (15 min) *	How to apply
		• 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.

Table 3 - Noise at residences using quantitative assessment

* 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.

Other sensitive land uses, such as schools, typically consider noise from construction to be disruptive when the properties are being used (such as during school times). Table 4 presents management levels for noise at other sensitive land uses based on the principle that the characteristic activities for each of these land uses should not be unduly disturbed.

Land use	Management level, L_{Aeq} (15 min) (applies when properties are being used)
Classrooms at schools and other educational institutions	Internal noise level 45 dB(A)
Hospital wards and operating theatres	Internal noise level 45 dB(A)
Places of worship	Internal noise level 45 dB(A)
Active recreation areas (characterised by sporting activities and activities which generate their own noise or focus for participants, making them less sensitive to external noise intrusion)	External noise level 65 dB(A)
Passive recreation areas (characterised by contemplative activities that generate little noise and where benefits are compromised by external noise intrusion, for example, reading, meditation)	External noise level 60 dB(A)
Community centres	Depends on the intended use of the centre.

Table 4 - Noise at sensitive land uses (other than residences) using quantitative assessment

7.1.2 GROUND-BORNE NOISE AT RESIDENCES

Ground-borne noise is noise generated by vibration transmitted through the ground into a structure. Ground-borne noise caused, for example, by underground works such as tunnelling can be more noticeable than airborne noise. The following ground-borne noise levels for residences indicate when management actions should be implemented. These levels recognise the temporary nature of construction and are only applicable when ground-borne noise levels are higher than airborne noise levels. The ground-borne noise levels are for evening and night-time periods only, as the objectives are to protect the amenity and sleep of people when they are at home.

Evening (6 pm to 10 pm)
Internal: L_{Aeq} (15 min) 40 dB(A)
Night-time (10 pm to 7 am)
Internal: L_{Aeq} (15 min) 35 dB(A)

7.1.3 TYPES OF VIBRATION

Vibration in buildings can be caused by many different external sources, including industrial, construction and transportation activities. The vibration may be continuous (with magnitudes varying or remaining constant with time), impulsive (such as in shocks) or intermittent (with the magnitude of each event being either constant or varying with time). Examples of typical types of vibration and their sources are shown in Table 5.

Vibration in buildings may also occur from internal sources (within a building structure), such as a road development forming part of the building structure, or mechanical vibration sources in buildings.

Vibration and its associated effects are usually classified as continuous, impulsive or intermittent as follows:

- **Continuous vibration** continues uninterrupted for a defined period (usually throughout daytime and/or night-time). This type of vibration is assessed on the basis of weighted rms acceleration values presented in Table 6.

- **Impulsive vibration** is a rapid build-up to a peak followed by a damped decay that may or may not involve several cycles of vibration (depending on frequency and damping). It can also consist of a sudden application of several cycles at approximately the same amplitude, providing that the duration is short, typically less than 2 seconds. Impulsive vibration (no more than three occurrences in an assessment period) is assessed on the basis of acceleration values presented in Table 8.
- **Intermittent vibration** can be defined as interrupted periods of continuous (e.g. a drill) or repeated periods of impulsive vibration (e.g. a pile driver), or continuous vibration that varies significantly in magnitude. It may originate from impulse sources (e.g. pile drivers and forging presses) or repetitive sources (e.g. pavement breakers), or sources which operate intermittently, but which would produce continuous vibration if operated continuously (for example, intermittent machinery, railway trains and traffic passing by). This type of vibration is assessed on the basis of vibration dose values in Table 8.

Continuous vibration	Impulsive vibration	Intermittent vibration
Machinery, steady road traffic, continuous construction activity (such as tunnel boring machinery).	Infrequent: Activities that create up to 3 distinct vibration events in an assessment period, e.g. occasional dropping of heavy equipment, occasional loading and unloading. Blasting is assessed using ANZECC (1990).	Trains, nearby intermittent construction activity, passing heavy vehicles, forging machines, impact pile driving, jack hammers. Where the number of vibration events in an assessment period is three or fewer these would be assessed against impulsive vibration criteria.

Table 5 - Examples of types of vibration

The criteria for exposure to continuous vibration are set out in the OEH guideline document Assessing Vibration: A Technical Guideline (2006), as presented in Table 6.

Place	Time	Peak Particle Velocity (mm/s)	
		Preferred	Maximum
Critical working areas (e.g. hospitals, precision laboratories)	Day or night time	0.14	0.28
Residences	Day time	0.28	0.56
	Night time	0.20	0.40
Offices	Day or night time	0.56	1.1
Workshops	Day or night time	1.1	2.2

Table 6 - OEH Criteria for exposure to continuous vibration

The criteria for exposure to impulsive vibration are set out in the OEH guideline document Assessing Vibration: A Technical Guideline (2006), as presented in Table 7.

Place	Time	Peak Particle Velocity (mm/s)	
		Preferred	Maximum
Critical working areas (e.g. hospitals, precision laboratories)	Day or night time	0.14	0.28
Residences	Day time	8.6	17.0
	Night time	2.8	5.6
Offices	Day or night time	18.0	36.0
Workshops	Day or night time	18.0	36.0

Table 7 – OEH criteria for exposure to impulsive vibration

The criteria for exposure to intermittent vibration are set out in the OEH guideline document Assessing Vibration: A Technical Guideline (2006), as presented in presented in Table 8.

Location	Daytime		Night-time	
	Preferred Value	Maximum Value	Preferred Value	Maximum Value
Critical areas	0.10	0.20	0.10	0.20
Residences	0.20	0.40	0.13	0.26
Office, schools, educational institutions and places of worship	0.40	0.80	0.40	0.80
Workshops	0.80	`1.60	0.80	1.60

Table 8 - Acceptable vibration dose values for intermittent vibration (m/s$^{1.75}$)

7.1.4 STRUCTURAL VIBRATION

The effects of ground vibration on buildings near construction sites may be broadly defined by the following three categories:

1. Disturbance to building occupants - Vibration in which the occupants or users of the building are inconvenienced or possibly disturbed
2. Effects on building contents - Vibration where the building contents may be affected
3. Effects on building structures - Vibration in which the integrity of the building or structure itself may be prejudiced.

There is no specific Australian Standard referring to structural vibration in buildings, therefore British Standard BS7385: Evaluation and measurement of vibration in buildings is used to assess the possibility of building damage from vibration from construction activities. BS 7385 uses peak particle velocity to assess vibration, and specifies damage criteria for frequencies from 4Hz to 250Hz, in the range of significance for construction related damage. The levels from the standard are presented in Table 9

Type of Structure	Peak Component Particle Velocity, mm/s		
	4Hz to 15Hz	15Hz to 40Hz	40Hz & above
Reinforced or framed structures, industrial and heavy commercial buildings	50	50	50
Un-reinforced or light framed structures, residential or light commercial type buildings	15 to 20	20 to 50	50

Table 9 - BS 7385 structural vibration criteria

German Standard DIN 4150: Structural Vibration in Buildings - Effects on Structures provides recommended maximum vibration levels that reduce the likelihood of building damage caused by vibration.

These levels are 'safe limits', up to which no damage due to vibration effects have been observed. 'Damage' is defined by DIN 4150 to include even minor non-structural effects such as superficial cracking in cement render, the enlargement of cracks already present, and the separation of partitions or intermediate walls from load bearing walls. DIN 4150 also states that when vibrations higher than the 'safe limits' are present, it does not necessarily follow that damage will occur. DIN 4150 values are presented in

Type of Structure	Peak Component Particle Velocity, mm/s		
	<10Hz	10Hz to 50Hz	50Hz & above
Buildings used for commercial purposes, industrial buildings, and buildings of similar design	20	20 to 40	40 to 50
Dwellings and buildings of similar design and/or use	5	5 to 15	15 to 20

Structures that because of their particular sensitivity to vibration, do not correspond to those listed above, and have intrinsic value (e.g. heritage buildings)	3	3 to 8	8 to 10

Table 10 - DIN4150 structural vibration criteria

8 MITIGATION MEASURES

The following noise mitigation measures will be adopted to ensure noise and vibration impacts comply with the Project objectives.

Action Required	Applies to	Details
Management Measures		
Working Hours	Airborne Noise Ground –borne noise & vibration	Ensure strict compliance with construction hours. This requirement to be communicated to all staff through inductions and toolbox meetings.
Out of Hours Works	Airborne Noise Ground –borne noise & vibration	Where work is required to be conducted outside normal construction hours, the out-of-hours works protocol shall be followed to minimise the impact
Site Induction	Airborne Noise Ground –borne noise & vibration	All employee, contractors and subcontractors are to receive an environmental induction. The induction must at least include: • All relevant project specific and standard noise and vibration mitigation measures • Relevant licence and approval conditions • Permissible hours of work • Any limitations on high noise generating activities • Location of nearest sensitive receivers • Construction employee parking areas • Designated loading/unloading areas and procedures • Site opening/closing times • Environmental incident procedures
Behavioral Practices	Airborne Noise	No swearing or unnecessary shouting or loud radios on site. No dropping of materials from height, throwing of metal items and slamming of doors
Education	Airborne Noise Ground –borne noise & vibration	Provide education of supervisors, operators and sub-contractors on the need to minimise noise through Toolbox meetings and on-site coaching
Noise Monitoring	Airborne Noise Ground –borne noise & vibration	A noise monitoring program is implemented in accordance with this plan any approval and licence conditions
Vibration Monitoring	Vibration	A vibration monitoring program may be implemented where required in accordance with this plan any approval and licence conditions
Consultation	Airborne Noise Ground –borne noise & vibration	Provide information to neighbours before and during construction to advise of expected noisy works, the duration of the works and what is being done to minimise the noise.
Noise & vibration complaints	Airborne Noise Ground –borne noise & vibration	A protocol will be developed for handling noise and vibration complaints that includes recording, reporting and acting on complaints.
Planning		
Dilapidation Survey	Vibration	Prior to commencement of works, undertake a dilapidation survey to detail the current structural condition of the site and adjoining areas, including all existing fences, adjoining buildings, infrastructure, roads, crossovers etc.
Construction hours and scheduling	Airborne Noise Ground –borne noise & vibration	Where feasible and reasonable, construction should be carried out during the standard daytime working hours. Work generating high noise and/or vibration levels should be scheduled during less sensitive time periods
Maximise Shielding	Airborne Noise	Select hoarding material suitable for noise shielding. Use temporary site buildings and materials stockpiles as noise barriers Where possible, schedule construction of permanent walls so they can be used as early as possible
Equipment selection	Airborne Noise Ground –borne noise & vibration	Use quieter and less vibration emitting construction methods where feasible. Ensure all fixed plant at the work sites is appropriately selected, and where necessary, fitted with silencers, acoustical enclosures and other noise attenuation measures.

Action Required	Applies to	Details
Equipment Placement	Airborne Noise Ground –borne noise & vibration	Position noisy plant and equipment as far apart as is practicable from each other and consider whether orientation and location of the plant can reduce noise impacts at sensitive receivers.
Vehicle Movements	Airborne Noise Ground –borne noise & vibration	Arrange work sites to avoid or minimise truck movements, and ensure vehicles enter and exit work sites in a forward direction.
Reversing Alarms	Airborne Noise	Avoid the use of reversing alarms by designing the site layout to avoid reversing. Where possible, install non-tonal and / or automatically adjusting reversing alarms on site equipment
Maximum noise levels	Airborne Noise	The noise levels of plant and equipment must have operating Sound Power or Sound Pressure levels complaint with the criteria set in OEH guidelines.
Construction		
Rock Breaking ***Note: Not expected* on this project**	Airborne Noise Ground –borne noise & vibration	Reduce the use of rock-hammering where feasible and use alternative measures such as rock-saws and rippers where possible.
Equipment selection	Airborne Noise Ground –borne noise & vibration	Select appropriate sized equipment for the task, such as vibratory compactors and rock excavation equipment.
Equipment Maintenance	Airborne Noise Ground –borne noise & vibration	Regular maintenance and testing of all plant and equipment onsite to ensure they continue to meet the noise and vibration criteria
Equipment Operation	Airborne Noise Ground –borne noise & vibration	Ensure equipment is operated in the correct manner and adequately maintained - including replacement of engine covers, repair of defective silencing equipment, tightening of rattling components, repair of leakages in air lines and shutting down equipment not in use
Work Methods	Airborne Noise Ground –borne noise & vibration	Careful selection of all work methods to be used on the project to ensure they meet the noise and vibration criteria.
Site Entrances	Airborne Noise Ground –borne noise & vibration	The site entry and egress points will be set as far from receivers as practical and will be designed to distribute the movements rather than directing all movements through a single gate.
Relief Periods	Airborne Noise Ground –borne noise & vibration	Provide periods of relief when practical during noise intensive activities such as rock breaking.
Noisy fabrication works	Airborne Noise	Carry out noisy fabrication work at another site (for example, within enclosed factory premises) and then transport to site.
Generators/ compressors	Airborne Noise	Use only silenced generators and compressors
Vehicle queuing	Airborne Noise Ground –borne noise & vibration	Prevent vehicles and plant queuing and idling outside the site, particularly prior to the construction start time.
Vehicle maintenance	Airborne Noise	Ensure that equipment is operated in the correct manner including repair of defective mufflers, tightening/correction of rattling parts and components and repair of leakages in compressed airlines.
Auditing and Monitoring		
Noise Monitoring	Airborne Noise Ground –borne noise & vibration	Where identified, undertake regular monitoring of overall noise levels at sensitive receivers to check for compliance
Vibration Monitoring	Vibration	Undertake vibration monitoring during works at sensitive receivers to check for compliance.
Community Consultation	Airborne Noise Ground –borne noise & vibration	Undertake community consultation and respond to complaints in accordance with project procedures

9 SITE SPECIFIC MANAGEMENT AND MITIGATION MEASURES

Through our experience and understanding of the contract documents, we propose the following specific mitigation measures:

9.1 MANAGEMENT MEASURES

Management of Noise and Vibration issues rest in the first instance with the Project Manager. Working closely with the Site Manager and his team the Project Manager will ensure resources and support is available to allow the Site Manager to effectively management of all aspects of this Noise and Vibration Plan and its resulting requirements.

9.2 PLANNING

Planning for control of Noise and Vibration is the key to successful outcomes. With proper planning in place many potential problems resulting in complaints can be averted thus maintaining confidence with stakeholders that all possible measures are in place.

Where potential problems are anticipated following the planning and risk review process we will communicate outcomes and potential problems to the stakeholders concerned to avoid surprises.

Examples of planning measures are as follows:

- Careful selection of all work methods to be used on the project to ensure they meet the noise and vibration criteria.
- Where practicable, increase the use of offsite manufactured elements in the design to eliminate site manufacturing.
- Create dedicated truck routes for heavy vehicles. It will be important to establish and agree early in the project approved truck routes, not just for close neighbours, but for the community as a whole. Our strategy is to choose a route that minimises disruption to neighbours and the community and enforce it throughout the works.

9.3 PLANT AND EQUIPMENT

- Careful selection of all plant and equipment to be used on the project to ensure they meet the noise and vibration criteria.
- Regular maintenance and testing of all plant and equipment onsite to ensure they continue to meet the noise and vibration criteria.
- Where identified, set up anti vibration pads for any vibrating plant and other temporary plant and equipment.

9.4 SITE ESTABLISHMENT

Site establishment being the first site impact is particularly important in terms of establishing trust with the stakeholders that Noise and Vibration issues will be well managed. A W Edwards are well aware of this and being experienced in the management of such issues over an extensive period have the skilled teams ready to implement mitigation strategies from day 1. Particularly whilst setting up the site.

9.5 MANAGEMENT

In addition to noise and vibration mitigation, we propose to establish and emergency contact point for any complaints, should there be an immediate issue, which requires immediate action.

This will enable school managers and the public to make a direct phone call to the site manager to stop a work area or address a problem should the need arise.

10 SUCCESSFUL MANAGEMENT OF NOISE AND VIBRATION

In summary the overall process to be implemented by A W Edwards includes;

- Understand the project and contract requirements
- Identify the specific project risks and sensitive locations and provide a detailed risk assessment for each location in specific relation to noise and vibration requirements
- Set clear criteria and guidelines prior to works commencing
- Further develop the Noise and Vibration Management Plan in conjunction with affected parties throughout the course of the works
- Management the implementation of the plan through the allocation of appropriate resources and ensuring the requirements of the plan are transferred to all contractors and site workers
- Provide ongoing cooperative management throughout all phases of the project. Understand that it is our obligation, regardless of contractual requirements, to act in a cooperative manner at all times with all affected parties and stakeholders
- Provide adequate response management for any issue.
- Provide adequate contractor management to ensure common guidelines and restrictions with the managing contractor requirements. Actively monitor the contractors on the project in a detailed and regular fashion through site and contractual management
- Allocate sufficient overall site management resources in all facets of the project to ensure issues are understood, allow correct forecasting and planning, allow adequate consultation and communication, comprehensive daily management and adequate response management
- Implement project monitoring and provide constant feedback to monitoring data as required
- Implement comprehensive physical mitigation measures in plant and equipment used and construction techniques
- Draw on our extensive experience on noise and vibration sensitive sites, and our recent experience and methods used in similar confined sites with nearby sensitive receivers.
- Understand our clear obligations to be cooperative, responsive and constantly adjust our processes to suit affected parties, stakeholders and the greater community

MONITORING PLAN

Vibration

Texcel ETM vibration construction monitors will be established for an initial period of 7 days during excavation works to baseline vibration reading of the project. During the initial 7 days, vibration results are monitored and reviewed by geotechnical engineer, if exceedance has occurred further monitoring and mitigation measures as detailed in section 8 of the report are implemented. Extended vibration monitoring may be implemented where required in accordance with this plan and licence conditions. The monitor sensor is to be located and coupled with plsastibond to concrete at ground level immediately adjacent to the potentially affected structure. Exact location of vibration monitoring is at the most sensitive receiver location and has been detailed in the trailing figure.

Noise.

Noise monitor readings to be established at sensitive receiver with initial baseline results to be captured. Airbourne noise monitors should be undertaken where construction activities have potential to exceed performance exceedance levels detailed in section 7.1.1 of this report. If exceedance has occurred further monitoring and mitigation measures as detailed in section 8 of the report are to be implemented. Exact location of Noise monitoring is at the most sensitive receiver location and has been detailed in the trailing figure.

Figure 1.0 Vibration and noise monitor location.

Vibration Monitor Location

Noise Monitor Location

11 TRAINING

In addition to other A W Edwards training requirements discussed in the Environmental Management Plan, inductions are required and are to address:

- Sensitivity of the site and proximity to the school and other sensitive receivers
- Awareness of noise and vibration created during construction and the requirement to operate equipment is in the quietest possible manner in consideration of surrounding residents / land uses
- Strict adherence to the approved hours of operation
- Delivery hours and locations
- Notification of the AWE project Manager/Site Supervisor of any works likely to cause significantly high vibration / noise emissions

Toolbox talks to be conducted on:

- Working hours allowed, and required procedure for approval of any out of hour's works.
- Results of noise and vibration monitoring

12 OUT OF HOURS PROCEDURE

In accordance with the project conditions, approval will be sought from the SINSW to complete any out of hour's works – if required.

13 SPECIALIST ADVICE

A W Edwards with specialist seek support where required. Support will include assistance with:

- Project risk assessment (aspects and impacts);
- Environmental documentation;
- Training;

- Construction documentation, construction monitoring and issues management;
- Auditing;
- Reporting; and
- Re-assessment.

14 AUDITING

The collaborative audit process established for the Works will be followed when planning audits of the Noise and Vibration Management Plan. Refer to the A W Edwards Management System for details of the audit plans and processes.

The A W Edwards Noise and Vibration Management Plan and A W Edwards' related obligations and actions arising from it are to be audited every 12 months.

15 APPENDICES

APPENDIX A – SELF VERIFICATION CHECKLIST

Self Verification Checklist

Contract Document Requirement	Brief Description of Requirement	Location in Plan
Contract Document		
SSD Requirements	Condition B16 – Construction Noise and Vibration Management Plan	Refer to appendix B

APPENDIX B – RAPT CONSULTING REVIEW

18&19 / 10 Kenrick Street
The Junction, NSW 2291
December 14, 2022

Craig Mcilveen
AW Edwards Pty Ltd
7 / 35 Merrigal Road
Port Macquarie NSW

Port Macquarie PCYC – Construction Noise and Vibration Management Plan Requirements

Dear Craig,

Thank you for contacting me regarding assistance in reviewing and endorse the Port Macquarie PCYC Construction Noise and Vibration Management Plan (CNVMP).

I can confirm I am a Member of The Australian Acoustics Society and have over 28 years' experience in a wide range of Acoustics and Air Quality projects. I have previously been the Air and Noise Technical Service line leader and The Global Environmental Technical Sector Leader for international professional service firms and have the appropriate experience to undertake this review of your plan.

Consent Conditions regarding the CNVMP include:

B16. The Construction Noise and Vibration Management Sub-Plan must address, but not be limited to, the following:

A. be prepared by a suitably qualified and experienced noise expert
    - As outlined above I possess the qualifications and experience to undertake this review
B. describe procedures for achieving the noise management levels in EPA's *Interim Construction Noise Guideline* (DECC, 2009)
    - Section 8 – 10 satisfy this requirement
C. describe the measures to be implemented to manage high noise generating works such as piling, in close proximity to sensitive receivers
    - Section 8 and 11 discuss management of high noise generating activities
D. include strategies that have been developed with the community for managing high noise generating works
    - Section 4.2, 4.3, 4.5, 8, 9.2, discuss consultation and strategies
E. describe the community consultation undertaken to develop the strategies in condition B15(c)(d)
    - Section 4.2, 4.3, 4.5, 8, 9.2, discuss consultation and strategies

F. include a complaints management system that would be implemented for the duration of the construction
    - Section 4.3, 8, 9.5 discuss complaints and management of.
G. include a program to monitor and report on the impacts and environmental performance of the development and the effectiveness of the management measures in accordance with Condition B13.
    - Section 4.5, 8, 10, 11 monitoring and reporting on environmental performance

I can confirm I have reviewed the CNVMP for the Port Macquarie PCYC and it satisfies the requirements for the CNVMP outlined above.

Should you have any further questions, please do not hesitate to contact Greg Collins on 0488512224 or greg@raptconsulting.com.au.

Thank you,

Greg Collins - MAAS

Director – RAPT Consulting