

CONSTRUCTION NOISE & VIBRATION MANAGEMENT PLAN

AE-JHG-PLN-MAN-0025

Airport East Precinct, Mascot

Rev	Date	Prepared by Name & Signature	Reviewed by Name & Signature	Approved by Name & Signature	Remarks
A	22.12.2016	A.Harrington	J.Braham	A.Thompson	Draft for Initial Review
B	03.01.2017	S.Orchard	J.Braham	A.Thompson	Inrternal comments

Copy Holder Details		
Name	Position	Copy No
		1
		2
		3
		4
		5

Table of Contents

1	REVISIONS AND DISTRIBUTION.....	4
1.1	Revisions	4
1.2	Distribution List	4
2	DEFINITIONS AND ABBREVIATIONS	5
2.1	Definitions and Abbreviations Table.....	5
3	INTRODUCTION.....	9
3.1	Purpose and Application	9
3.2	Scope	9
3.2.1	Hours of Operation	12
4	SENSITIVE RECEIVERS.....	14
5	NOISE ASSESSMENT	16
5.1	Background Noise Levels & Noise Management Levels	16
5.1.1	Establishment of Recommended Background Levels (RBLs)	16
5.1.2	Assessment/Confirmation of RBL's.....	16
5.1.3	Construction Noise Management Levels.....	16
5.2	Construction Activities and Equipment.....	17
6	VIBRATION ASSESSMENT	18
6.1	Criteria.....	18
6.2	Minimum Working Distances from Sensitive Receivers.....	19
7	CONSTRUCTION NOISE MANAGEMENT	21
7.1	Noise Modelling	21
7.2	Determine & Implement Required Additional Noise Mitigation Measures.....	21
8	CONSTRUCTION VIBRATION MANAGEMENT.....	24
9	MONITORING, AUDITING AND REPORTING.....	25
9.1	Noise Monitoring.....	25
9.1.1	Plant and Equipment Noise Monitoring	25
9.1.2	Noise Monitoring in the Community	25
9.2	Vibration Monitoring.....	25
9.3	Reporting.....	26
9.4	Non-conformance and Corrective Action.....	26
10	ENQUIRIES AND COMPLAINTS MANAGEMENT	26
11	OUT OF HOURS WORKS (OOHW) PROTOCOL.....	27
11.1	OOHW Justification	27

11.2	OOHW Noise and Vibration Assessment.....	27
11.3	OOHW Documentation	28
11.4	OOHW Community Notifications.....	29
11.5	RMS Approval of OOHW and Implementation of OOHW EPL Conditions.....	29
11.6	OOHW Enquiries / Complaints Management	29
11.7	OOHW Monitoring	29
12	REFERENCES.....	30
13	APPENDICES.....	31
	APPENDIX 1 – RECEIVERS’ ADDRESSES.....	32
	APPENDIX 2 – CONSTRUCTION EQUIPMENT SOUND PRESSURE LEVELS	34
	APPENDIX 3 – RMS STANDARD MITIGATION MEASURES	35
	APPENDIX 4 – TABLE 9.1, WILKINSON MURRAY REPORT (November 2014)	40
	APPENDIX 5 – OOHW APPLICATION FORM.....	41
	APPENDIX 6 – OOHW PROTOCOL.....	44

1 REVISIONS AND DISTRIBUTION

1.1 Revisions

Draft issues of this document shall be identified as Revision A, B, C etc. Upon initial issue (generally Contract Award) this shall be changed to a sequential number commencing at Revision 0. Revision numbers shall continue at Rev. 1, 2 etc.

1.2 Distribution List

Client	NSW Roads & Maritime Services
Project Director	Andy Thompson
HSEQ Manager	Tony Sheppard
Operations Environment Manager (OEM)	James Braham
Project Environmental Representative	Simon Orchard
Community Liaison Manager	Sharon Clague

The controlled master version of this document is available for distribution as appropriate and maintained on the Project Pack of Incite. All circulated hard copies of this document are deemed to be uncontrolled.

2 DEFINITIONS AND ABBREVIATIONS

2.1 Definitions and Abbreviations Table

Definitions and abbreviations to be applied to Airport East Precinct, Mascot project are listed below.

Table 1: Definitions and Abbreviations

Term/Abbreviation	Definition
a_{rms}	"Root mean squared weighted acceleration", a vibration parameter used to assess human response to continuous or intermittent vibration
Affected distance	Distance up to which noise levels are expected to exceed the Noise Management Level (NML) as defined by the EPA's ICNG.
All-receiver treatments	Includes building treatments and courtyard walls. Building treatments may include but are not limited to ventilation, glazing, window and door seals, sealing of vents and underfloor areas.
AS/NZS	Australian Standard/New Zealand Standard
CEMP	Construction Environmental Management Plan
Client	NSW Roads & Maritime Services (RMS)
Client's Representative	The person appointed by the Client to perform the duties of the "Superintendent" as defined in the contract
CNVMP	Construction Noise & Vibration Management Plan (this document)
Consultant	The party engaged to perform the design, preparation of detailed 'For Construction' documentation and necessary certification to meet contractual requirements.
DECC(W)	Department of Environment and Climate Change (and Water)
EM	Environment Manager
EMS	John Holland's Environmental Management System
Environment	The Project's surroundings, including air, water, land, flora, fauna, humans and their interaction
Environmental Aspect	An element of the Project that has potential to cause environmental impacts
Environmental Impact	A change to the environment, positive or negative, caused by environmental aspects
NSW EPA	NSW Environment Protection Authority
EPBC Act	Environmental Protection and Biodiversity Conservation Act (Commonwealth) - legislation to protect and manage matters of national environmental significance
EPL	Environment Protection Licence
Equitable	Receivers and communities exposed to road project noise receive consistent outcomes.
ESD	Ecologically Sustainable Development

Term/Abbreviation	Definition
eVDV	"Estimated Vibration Dose Value", the overall vibration exposure assessed over the daytime or night-time period to assess human response to intermittent vibration and calculated as described in AS 2670.
Feasibility	Relates to engineering considerations (what can be practically built). These engineering considerations may include: <ul style="list-style-type: none"> • The inherent limitations of different techniques to reduce noise emissions from road traffic noise sources • Safety issues such as restrictions on road vision • Road corridor site constraints such as space limitations • Floodway and stormwater flow obstruction • Access requirements • Maintenance requirements • The suitability of building conditions for at receiver treatments.
Few receivers	Where the project resources are sufficient to meet with affected receivers then the number of receivers is considered to be few. Note in some instances it may not be possible to meet with all receivers due to circumstances associated with a particular receiver.
Hardship case	Residents hampered, to a significant degree, by illness or other exceptional cause, causing the resident to experience sleep disturbance from construction noise levels between 15dBA – 30dBA above applicable RBL during periods: Monday to Friday: 10pm – 7am Saturday: 10pm – 8am Sunday / Public Holidays: 6pm – 7am
Highly sensitive receiver	Receiver where standard annoyance and human comfort criteria do not provide sufficient guidance on the impact. Some examples include buildings with sensitive equipment, recording studios and cinemas.
IMS	Integrated Management System
ICNG	Interim Construction Noise Guideline
ITP	Inspection and Test Plan – defines the steps to be taken to check and verify an activity or product
JH	John Holland
L_{Amax}	The "Maximum Noise Level" for an event, used in the assessment of potential sleep disturbance during night- time periods. The subscript "A" indicates that the noise levels are filtered to match normal human hearing characteristics (i.e. A-weighted). "Fast" time constant is used for this measurement.
$L_{Aeq(15\text{ minute})}$	The "Energy Average Noise Level" during construction activities, evaluated over a measurement period of 15 minutes. This is the main parameter used to assess the construction noise impacts.
L_{A90}	The "Background Noise Level" in the absence of construction activities. This parameter represents the average minimum noise level during the daytime, evening and night-time periods respectively. The $L_{Aeq(15\text{ minute})}$ construction noise objectives are based on an allowance margin above the L_{A90} background noise levels.

Term/Abbreviation	Definition
Many receivers	Where the project resources are unable to meet with all affected receivers then the number of receivers is considered to be many. Project resources should be sufficient to meet with the worst affected receivers. Where letter box drops are necessary to communicate with the community then this would be considered to be many receivers.
NML	Noise Management Level
Number of affected receivers	The number of receivers that may be considered to be few or many will depend on the project resources and the number of receivers.
OEHS	NSW Office of Environment & Heritage
OEM	Operations Environment Manager
OLS	Obstacle Limitation Surface
OOHW	Out of Hours Work
WH&S	Workplace Health and Safety
PM	Project Manager
PP	Process Procedure – A work instruction, which details the technical/engineering/safety/quality/environmental methodology for a particular activity
PPV	“Peak Particle Velocity”, the peak vector vibration velocity used to assess the risk of damage to structures from ground borne vibration. This is generally evaluated at the building footings.
Reasonable	<p>Selecting reasonable measures from those that are feasible involves judging whether the overall noise benefits provide significant social, economic or environmental benefits. The factors to be considered are:</p> <ul style="list-style-type: none"> • The noise reduction provided and the overall number of people that benefit from the mitigation. • Existing and future noise levels, including changes in noise levels in the build and design year and the extent of any exceedance of the noise criteria. • Potential for a mitigation measure to reduce noise during construction as well as from road traffic after the project is complete. • The cost of mitigation, including the cost of noise mitigation measures as a percentage of the total project cost and the ongoing maintenance and operational costs. • Community views and preferences (typically gathered during the community consultation process following the noise assessment). • Visual impacts for the community surrounding the road project and for road users. These are typically identified in the Environmental Assessment. • The wider community benefits arising from noise mitigation of the proposed road or road redevelopment. • Relative weighting of treatments with respect to protection of outdoor areas or only internal living spaces.
SQE	Safety, Quality and Environment
Subcontractor	Any company, body or person who is contracted to John Holland for the purpose of supplying plant and/or services

Term/Abbreviation	Definition
System Element	The administrative activities that need to be implemented and controlled to ensure that the product or service meets environmental requirements
The Project	Airport East Precinct, Mascot
TfNSW	Transport for NSW
Velocity	A vector quantity that specifies the time rate of change of displacement of a system, [m/s] [mm/s] or [μ m/s].
Vibration	Oscillation of a parameter (a displacement, a velocity or an acceleration) that defines the motion of a system.

3 INTRODUCTION

3.1 Purpose and Application

This Construction Noise & Vibration Management Plan (CNVMP) for the Airport East Precinct, Mascot project satisfies the requirement to prepare and implement a CNVMP as part of the CEMP, specified in section 4.6 and 4.7 of the RMS QA General Specification G26: *Environmental Protection*. This CNVMP will be implemented by John Holland (JH) and its subcontractors for the duration of the Project.

This CNVMP describes the John Holland approach for managing and minimising the noise and vibratory impacts of its activities, meeting its legislative and contractual obligations and providing a means of continually improving environmental performance. It includes proposed environmental control measures for all significant noise and vibration generating activities.

The EMP has been developed in accordance with, and having consideration of, the following:

- Environmental Protection Licence (EPL) 20851
- RMS QA Specification G35: *Environmental Protection*, Addendum 11 (post-tender), 25 October 2016.
- *RMS Construction Noise and Vibration Guide Manual*, April 2016.
- *Construction Noise and Vibration Guideline*, Roads and Maritime Services (RMS), August 2016.
- *Construction Noise Strategy*, Transport for New South Wales (TfNSW), 1 April 2012
- *Interim Construction Noise Guideline*, NSW Department of Environment and Climate Change (DECC), now NSW Environment Protection Authority (EPA), July 2009.
- *NSW Industrial Noise Policy*, Environment Protection Authority of New South Wales (EPA), January 2000.
- *Assessing Vibration: a technical guideline*, Department of Environment and Conservation, now Environment Protection Authority (EPA), February 2006.
- DIN 4150-3 *Structural vibration - Effects of vibration on structures*, German Standard, February 1999.
- WestConnex Enabling Works - Airport East Precinct - Review of Environmental Factors - Volume 1 Main Report - Appendix A-E, Jacobs, February 2015.
- WestConnex Enabling Works - Airport East Precinct - Review of Environmental Factors - Volume 2 - Appendix F-I, Jacobs, February 2015.
- WestConnex Enabling Works - Airport East Precinct - Review of Environmental Factors - Volume 2 - Appendix H: Construction Noise and Vibration Impact Statement - Report No 14174 Version B, Wilkinson Murray, November 2014.
- Airport East: General Holmes Drive Project - *Detailed Design Operational and Construction Noise and Vibration Assessment* - Job ID 20857, Pacific Environment Limited, 1 June 2016.

This EMP will be revised on an as needs basis to incorporate all relevant contractual information and obligations, including in response to complaints where necessary.

3.2 Scope

Roads and Maritime Services (RMS) propose to upgrade a number of roads east of Sydney Kingsford Smith Airport (herein referred to as Sydney Airport) to improve traffic flow and access to Sydney Airport, Port Botany and the future WestConnex Motorway. John Holland has been awarded the contract to construct these improvements and will be delivering them through execution of the Airport East Precinct, Mascot Project.

The main features of The Project, and therefore the scope of this CNVMP, include:

- Separate the road network from the Port Botany Freight Rail Line. This would involve:
 - Extending Wentworth Avenue beneath the Port Botany Freight Rail Line to link with General Holmes Drive. The Wentworth Avenue underpass would have nine lanes, with five lanes eastbound and four lanes westbound, and a minimum 4.7 metres clearance;
 - Building two rail bridges over the Wentworth Avenue underpass; and
 - Removing the General Holmes Drive rail level crossing of the Port Botany Freight Rail Line, improving safety and enabling increased speed for freight trains.
- Adjust, protect and locally relocate utilities.
- Provide a bridge over the stormwater channel which runs parallel to General Holmes Drive and a protection slab over sewer and gas utilities on the extension of Wentworth Avenue.
- Provide a new intersection at General Holmes Drive and the extension of Wentworth Avenue.
- Upgrade or adjust the intersections at:
 - Wentworth Avenue and Botany Road;
 - General Holmes Drive and Mill Pond Road;
 - Botany Road and Mill Pond Road;
 - General Holmes Drive, Joyce Drive and Ross Smith Avenue; and
 - General Holmes Drive and Botany Road.
- Widen Joyce Drive and General Holmes Drive between about 100 metres east of O’Riordan Street and 175 metres south of Mill Pond Road to three lanes in each direction.
- Adjust and locally relocate drainage infrastructure including:
 - Replacing the grassed swale along Joyce Drive with a pipe and pit system; and
 - Installing a permanent pump at the low point of the Wentworth Avenue underpass.
- Landscape and replant generally on road verges and in the area of land between General Holmes Drive and the Port Botany Freight Rail Line.
- Provide new facilities - and relocate existing facilities - for pedestrians, cyclists and public transport, including:
 - A new shared-use path linking to the existing cycleway at Todd Reserve on Wentworth Avenue;
 - A new shared path on Botany Road from the Botany Road and Wentworth Avenue intersection to Baxter Road;
 - Removing the pedestrian path on the northern side of Joyce Drive, which would be replaced with a new shared path along Baxter Road as part of a separate project in the WestConnex Enabling Works program; and
 - Relocating the northbound bus stop on Botany Road about 70 metres to the south of its current location.
- Provide temporary construction ancillary facilities, including construction compounds, stockpile sites and erosion and sedimentation control measures.
- The construction works are expected to commence in early-2017, and construction is expected to take a minimum of 2 years to complete (including preliminary works).

Figure 1 below displays the extent of the Airport East Precinct, Mascot Project.



Figure 1 Extent of the Airport East Precinct, Mascot Project

With consideration of the above Project scope, the key components covered in this CNVMP include:

- The identification of all properties potentially affected by construction noise;
- The identification of background noise levels and OEH construction noise goals;
- Indication of vibration safe working distances for the Project;

- The evaluation and assessment of noise and vibration impacts from construction activities associated with the Project;
- The implementation of all feasible and reasonable noise and vibration mitigation and management measures;
- Monitoring of noise and vibration impacts from construction activities against the noise and vibration management levels;
- Rectifying any noise and vibration related exceedances or non-compliances;
- The Out of Hours Works (OOHW) Protocol, which details the approval process and permit / licencing requirements for out of hours works associated with the Project; and
- The implementation of additional noise and vibration mitigation and management measures as a result of Project construction activities.

3.2.1 Hours of Operation

3.2.1.1 Standard Construction Hours

As per condition L3.1 of EPL 20851, unless otherwise specified by any other condition of this licence, construction work is:

- a) Restricted to between the hours of 7:00am and 6:00pm Monday to Friday; and
- b) Restricted to between the hours of 8:00am and 1:00pm Saturday; and
- c) Not to be undertaken on Sundays or Public Holidays.

3.2.1.2 High Noise Impact Works

As per condition L3.2 of EPL 20851, any high noise impact works must only be undertaken:

- a) Between the hours of 8:00am and 6:00pm Monday to Friday; and
- b) Between the hours of 8:00am and 1:00pm Saturday; and
- c) In continuous blocks of no more than 3 hours, with at least 1-hour respite between each block of work generating high noise impact, where the location of work is likely to impact the same receivers; except as expressly permitted by another condition of this licence.

Note: for the purpose of this condition, 'continuous' includes any period during which there is less than a 1-hour respite between ceasing and recommencing any of the work that is subject of this condition.

3.2.1.3 Works Outside of Standard Construction Hours

As per condition L3.3 of EPL 20851, the licensee may undertake works outside of standard construction hours if:

- a) The delivery of oversized plant or structures has been determined by police or other authorities to require special arrangements to transport along public roads; or
- b) Emergency work is required to avoid the loss of life or property; or
- c) To prevent environmental harm.

3.2.1.4 Approved Works Outside of Standard Construction Hours

As per condition L3.4 of EPL 20851, the licensee may undertake construction works out of hours if the work does not cause:

- a) LAeq (15minute) noise levels no more than 5db(A) above rating background level at any residence in accordance with the Interim Construction Noise Guideline (ICNG) (DECC, 2009); and
- b) LAeq (15 minute) noise levels no more than the noise management levels specified in Table 3 of the ICNG at other sensitive receivers; and
- c) Continuous or impulsive vibration values, measured at the most affected residence, greater than those for human exposure to vibration as set out in Table 2.2 of the technical guideline 'Environmental Noise Management Assessment Vibration' published by the Department of Environment and Conservation, February 2006; and
- d) Intermittent vibration values, measures at the most affected residence, greater than those for human exposure to vibration, set out for residences in Table 2.4 to the technical guideline 'Environmental Noise Management Assessing Vibration' published by the Department of Environment and Conservation. February 2006.

3.2.1.5 Exceptions to Standard Construction Hours

As per condition L3.5 of EPL 20851, Activities and works may be undertaken outside the requirements of EPL 20851 licence condition L3.1 and L3.2, but only if one or more of the following applies:

- a) Carrying out those works and activities during the hours specified in condition L3.1 would cause an unacceptable risk to one or more of the following;
 - i. Construction personnel safety;
 - ii. Road user and public safety;
 - iii. Road network operational performance as may be notified from time to time by RMS; and/or
 - iv. Essential utility services.
- b) The TfNSW Transport Management Centre (or other road authority) refuse to issue a road occupancy licence for the works or activities during the hours specified in condition L3.1; or
- c) ARTC require a rail possession (involving week night and/or weekend rail shutdown) for the works or activities to be performed; or
- d) The equipment required to undertake the works or activities would penetrate the Sydney Airport Obstacle Limitation Surface (OLS).

3.2.1.6 Additional Works Approved Outside of Standard Construction Hours

As per condition L3.7 of EPL 20851, if a Sydney Airport runway shutdown period is obtained, activities or works may be undertaken 24 hours a day for the duration of any runway shutdown, up to a maximum of fourteen days. Where these activities and works result in high noise impact outside of standard construction hours, conditions L3.6 (b) (c) and (d) of EPL 20851, will apply.

3.2.1.7 Approved Works Outside of Standard Construction Hours – Community Agreement

As per condition L3.8 of EPL 20851, the licensee may undertake works outside of standard construction hours (not including works undertaken in accordance with conditions L3.3, L3.4 and L3.5 of EPL 20851) if agreement between the licensee and a substantial majority of potentially affected receivers has been reached.

4 SENSITIVE RECEIVERS

The project is located in an urban area of dense residential land use, with some multi-storey apartment complexes. Commercial premises are located along Botany Road, Wentworth Street, Joyce Drive and General Holmes Drive. Receivers are presented graphically in Figure 2, with address details provided in Appendix 1.



Figure 2 Project receivers (Source: Pacific Environment Limited, June 2016)

5 NOISE ASSESSMENT

5.1 Background Noise Levels & Noise Management Levels

5.1.1 Establishment of Recommended Background Levels (RBLs)

RBLs have been established for the Project and are detailed in the Airport East: General Holmes Drive Project - Detailed Design Operational and Construction Noise and Vibration Assessment, Pacific Environment Limited, 1 June 2016. A summary of the RBLs is provided in the Table below.

Table 1 RBLs

Land Use	Background Location (Representative)	RBL dB(A)		
		Day (7am – 6pm)	Evening (6pm – 10pm)	Night (10pm – 7am)
Residential (R1 – 32)	R13 (36 Baxter Rd)	56	56	43
Residential (R33 – 115)	R38 (3 Wentworth Ave)	55	51	41
Residential (R116 – 121)	R117 (59 McBurney Ave)	53	54	46
Commercial Premises (C1 – C31, Hotel and Airport)		L _{Aeq(15 minute)} 70dB(A) (External)		

5.1.2 Assessment/Confirmation of RBL's

The RBL's for the project were established sometime in 2014. Due to this they will be assessed and re-evaluated if required. If new values are required monitoring shall be established after the end of the school holiday period and during a time when works are not occurring. If/when such values are determined this plan shall be revised to include the new values and the noise modelling software shall be update to provide more accurate levels.

5.1.3 Construction Noise Management Levels

With consideration of the above RBLs, the following Construction Noise Management Levels have been established taking into consideration the guidelines provided in the NSW Interim Construction Noise Guideline (DECCW, 2009).

Table 2 Project Specific Construction Noise Management Levels, dB(A)

Land Use	Background Location (Representative)	Standard Hours		Outside of Standard Hours			Sleep Disturbance Criteria (L _{max})
		Day	Highly Noise Affected Level dB(a)	Day	Evening	Night	
Residential (R1 – 32)	R13 (36 Baxter Rd)	66	75	61	61	48	58
Residential (R33 – 34)	R38 (3 Wentworth Ave)	65	75	60	56	46	56
Residential (R35 – 115)	R38 (3 Wentworth Ave)	65	75	60	56	46	58
Residential (R116 – 121)	R117 (59 McBurney Ave)	63	75	58	59	51	61
Commercial Premises (C1 – C31, Hotel and Airport)		70 (when in use)					n/a

5.2 Construction Activities and Equipment

Construction is expected to occur in a number of stages and upgrade work is expected to be progressive along the length of the alignment. As the construction work progresses, receivers may be impacted when works are nearby. Piling activities are anticipated as part of the construction of the Wentworth Street intersection and bridge construction, and boring activities will be required at a number of locations during utility relocation works.

Construction activities are generally associated with the project include relocation of utilities, deviation of railway line, provision of construction access, drainage construction, bridge construction activities, reconstruction of rail, road works and structure works including earthworks, piling, concreting and road surface construction.

A summary of the equipment and sound power levels is presented in Appendix 2.

6 VIBRATION ASSESSMENT

6.1 Criteria

Impacts from vibration can be considered both in terms of effects on building occupants (human comfort) and the effects on the building structure (building/cosmetic damage). Of these considerations, the human comfort limits are the most stringent. Therefore, for occupied buildings, if compliance with human comfort limits is achieved, it will follow that compliance will be achieved with the building.

With regards to human comfort criteria the EPA administered guideline entitled *Assessing Vibration: A technical guideline* (DEC, 2004) provides acceptable values for continuous and impulsive vibration and intermittent vibration, in the range of 1 – 80Hz, sourced from BS 6472 – 1992: *Guide to human exposure to vibration in buildings*.

Construction sources of vibration are generally thought to be intermittent in nature and therefore Table 3 can be referenced for acceptable vibration dose value for intermittent sources.

Table 3 Acceptable Vibration Dose Values for Intermittent Vibration (m/s 1.75)

Location	Daytime (7am - 10pm)		Night Time (10pm – 7am)	
	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
Offices, schools, educational institutions and places of worship	0.40	0.80	0.40	0.80
Workshops	0.8	1.60	0.80	1.60

With regard to building / cosmetic damage, German Standard DIN 4150-3-1999 “Structural Vibration – Part 3 Effects of vibration on structures” provides methods for evaluating the effects of vibration on structures. The recommended limits (guide values) from DIN 4150 for transient vibration to ensure minimal risk of cosmetic damage to residential and industrial buildings are presented numerically in Table 4 below.

Table 4 Guideline Vibration Values for Short Term Vibration on Structures (mm/s)

Type of Building	Guideline values for velocity (mm/s)			
	1 – 10 Hz	10 – 50 Hz	50 – 100 Hz	Vibration at horizontal plane of highest floor at all frequencies
Commercial and industrial building	20	20 – 40	40 – 50	40
Dwellings and buildings of similar occupancy or design	5	5 – 15	15 – 20	15
Structures that, because of their particular sensitivity to vibration cannot be classified under the above two lines and are of great intrinsic value	3	3 – 8	8 – 10	8

6.2 Minimum Working Distances from Sensitive Receivers

Minimum working distances are indicative and will vary depending on the particular item of plant and local geotechnical conditions. Vibration monitoring is a common recommendation to confirm the minimum working distances are adequate and meet the above guidelines, at specific site locations.

From comparisons made between the criteria discussed in section 6.1 above and those receivers listed in Appendix 1, we understand that equipment causing significant ground vibration on the Project will operate at an acceptable distance so as not to cause ground vibration which exceeds acceptable limits.

Occasionally, equipment causing significant ground vibration on the Project will operate at less than *minimum working distance* from Beckenham Memorial Church (1293-1295 Botany Road), which is a heritage listed building. Beckenham Memorial Church, will not undergo any damages, if the total ground vibration (velocity) near the foundations of this church will not exceed **3 mm/s** (3000 µm/s).

For reference during construction planning and works, Table 5 below.

Table 5 Recommended Site Working Distances for Vibration Intensive Plant

Plant Item	Rating / Description	Minimum Working Distance	
		Building Damage (DIN 4150-3-1999)	Human Response (NSW OEH Guideline and BS 6472 – 1992)
Vibratory Roller	< 50 kN (Typically 1-2 tonnes)	5 m	15 m to 20 m
	< 100 kN (Typically 2-4 tonnes)	6 m	20 m
	< 200 kN (Typically 4-6 tonnes)	12 m	40 m
	< 300 kN (Typically 7-13 tonnes)	15 m	100 m
	> 300 kN (Typically 13-18 tonnes)	20 m	100 m
	> 300 kN (> 18 tonnes)	25 m	100 m
Small Hydraulic Hammer	(300 kg - 5 to 12-tonne excavator)	2 m	7 m
Medium Hydraulic Hammer	(900 kg - 12 to 18-tonne excavator)	7 m	23 m
Large Hydraulic Hammer	(1600 kg - 18 to 34-tonne excavator)	22 m	73 m
Vibratory Pile Driver	Sheet piles	2 m to 20 m	20 m
Pile Boring	≤ 800 mm	2 m (nominal)	4 m
Jackhammer	Hand held	1 m (nominal)	2 m

7 CONSTRUCTION NOISE MANAGEMENT

The management of construction noise emanating from the Project should be carried out in the following steps:

7.1 Noise Modelling

All assessments of noise emanating from construction activities will be based on modelling of dispersion of the A-weighted, equivalent, fifteen-minute sound pressure level (LAeq, 15min); and the A-weighted, one-percentile, one-minute sound pressure level (LA1, 1min) emanating from the Project, using acoustic modelling software Brüel and Kjær (B&K) type: 7810 Predictor-LimA Plus, version 11.20 (current version) or later.

For each operational scenario, the modelling should determine the LAeq, 15min and the LA1, 1min at receivers identified in Appendix 1. The modelling will assume that the sound power level (SPL) of the construction equipment to be operated on the Project will be as per Appendix 2.

Where the results noise dispersion modelling show that the LAeq, 15min emanating from the Project is below the applicable NML from section 5.1.2, no further actions in the management of construction noise are required.

Where the results of noise dispersion modelling show that the LAeq, 15min emanating from the Project is above the applicable NML identified in section 5.1.2, the Project team will determine sources of noise causing the exceedance and apply 'all feasible and reasonable work practices' (listed in Appendices 3 and 4) to reduce the LAeq, 15min. These 'feasible and reasonable work practices' are provided for in the RMS *Construction Noise and Vibration Guideline*, identifying standard actions and mitigation measures that should be implemented on all construction projects.

7.2 Determine & Implement Required Additional Noise Mitigation Measures

In certain instances, all feasible and reasonable work practices applied to sources of noise (causing excessive noise) will be unlikely to reduce the LAeq, 15min at the residential receivers below the applicable NML from section 5.1.2. Where this occurs, results of noise dispersion modelling will be specially programmed by Pollution Control Consultancy and Design (PCCD) Microsoft Excel spreadsheets to identify the additional noise mitigation measures required to be implemented to satisfy affected receivers.

The additional noise mitigation measures should be implemented before commencement of construction works and are detailed below:

- **Notification (letterbox drop or equivalent)**
 - Advanced warning of works and potential disruptions can assist in reducing the impact on the community. The notification may consist of a letterbox drop (or equivalent) detailing work activities, time periods over which these will occur, impacts and mitigation measures. Notification should be a minimum of 5 working days prior to the start of works. The approval conditions for projects may also specify requirements for notification to the community about works that may impact on them.

- **Specific notifications (SN)**

- Specific notifications are letterbox dropped (or equivalent) to identified stakeholders no later than seven calendar days ahead of construction activities that are likely to exceed the noise objectives. The specific notification provides additional information when relevant and informative to more highly affected receivers than covered in general letterbox drops.
- The exact conditions under which specific notifications would proceed are defined in the relevant Additional Mitigation Measures (Tables C1 to C3 of [1]). This form of communication is used to support periodic notifications, or to advertise unscheduled works.
- **Phone calls (PC)**
 - Phone calls detailing relevant information made to identified/affected stakeholders within seven calendar days of proposed work. Phone calls provide affected stakeholders with personalised contact and tailored advice, with the opportunity to provide comments on the proposed work and specific needs. Where the resident cannot be telephoned, an alternative form of engagement should be used.
- **Individual briefings (IB)**
 - Individual briefings are used to inform stakeholders about the impacts of high noise activities and mitigation measures that will be implemented. Project representatives would visit identified stakeholders at least 48 hours ahead of potentially disturbing construction activities. Individual briefings provide affected stakeholders with personalised contact and tailored advice, with the opportunity to comment on the project. Where the resident cannot be met individually then an alternative form of engagement should be used.
- **Respite Offers (RO)**
 - Respite Offers should be considered made where there are high noise and vibration generating activities near receivers. As a guide, work should be carried out in continuous blocks that do not exceed three hours each, with a minimum respite period of one hour between each block. The actual duration of each block of work and respite should be flexible to accommodate the usage of and amenity at nearby receivers.
 - The purpose of such an offer is to provide residents with respite from an ongoing impact. This measure is evaluated on a project-by-project basis, and may not be applicable to all projects.
- **Respite Period 1 (R1)**
 - Out of hours construction noise in out of hours works (OOHW) period 1 shall be limited to no more than three consecutive evenings per week except where there is a Duration Respite. For night work these periods of work should be separated by not less than one week and no more than six evenings per month.
- **Respite Period 2 (R2)**
 - Night time construction noise in OOHW period 2 shall be limited to two consecutive nights except for where there is a Duration Respite. For night work these periods of work should be separated by not less than one week and six nights per month. Where possible, high noise generating works shall be completed before 11 pm.
- **Duration Respite (DR)**

- Respite offers and respite periods 1 and 2 may be counterproductive in reducing the impact on the community for longer duration projects. In this instance and where it can be strongly justified it may be beneficial to increase the work duration, number of evenings or nights worked through Duration Respite so that the project can be completed more quickly.
 - The project team should engage with the community where noise levels are expected to exceed the NML to demonstrate support for Duration Respite. Where there are few receivers above the NML each of these receivers should be visited to discuss the project to gain support for Duration Respite.
- **Alternative Accommodation (AA)**
 - Alternative accommodation options may be offered to residents living in close proximity to construction works that are likely to experience highly intrusive noise levels, as defined in Table 1 below. The specifics of the offer will be identified on an activity-by-activity basis. Additional aspects for consideration shall include Hardship cases (as defined above).
 - **Verification (V)**
 - The verification should include measurement of the *Background Noise* level and construction noise. Appendix F of [1] provides details about verification of noise and vibration levels as part of routine checks of noise levels or following reasonable complaints.

The above 10 additional mitigation measures are to be implemented as detailed in Table 6 below. Based on the results from noise dispersion modelling, noise measurements at the most affected residential receivers will be undertaken to check whether the applied additional noise mitigation measures from discussed above and in Table 6 are adequate. If these measures appear to be inadequate, construction staff will be notified to implement further noise control measures, where practicable.

Table 6 Implementation of Additional Mitigation Measures

		Additional Mitigation Measures				
		0 – 10 dB(A) (Noticeable)	10 – 20 dB(A) (Clearly Audible)	20 – 30 dB(A) (Moderately Intrusive)	>30 dB(A) (Highly Intrusive)	15 – 30 dB(A) (Hardship Cases)
Standard	7am – 6pm (Mon to Fri)					
	8am – 1pm (Sat)	-	-	N, V	N, V	N, V
	No Work (Sun / PH)					
OOHW Period 1	6pm – 10pm (Mon to Fri)					
	7am – 8am (Sat)	-	N, RI, DR	N, V, RI, DR	V, IB, N, RI, DR, PC, SN	N, V, RI, DR
	8am – 6pm (Sun / PH)					
OOHW Period 2	10pm – 7am (Mon to Fri)					
	10pm – 8am (Sat)	N	N, V, R2, DR	N, V, IB, PC, SN, R2, DR	AA, V, IB, N, PC, SN, R2, DR	N, V, IB, PC, SN, R2, DR, AA
	6pm – 7am (Sun / PH)					

8 CONSTRUCTION VIBRATION MANAGEMENT

The management of construction vibration emanating from the Project will be carried out at any time in accordance with the following:

- Where vibration-intensive plant is planned to operate closer than the minimum working distance (Table 5) from Beckenham Memorial Church in 1293-1295 Botany Road, carry out ground vibration measurements in front of the church;
- Stop the vibration-intensive plant immediately if ground vibration exceeds 3 mm/s and modify operation of the plant.

9 MONITORING, AUDITING AND REPORTING

9.1 Noise Monitoring

9.1.1 Plant and Equipment Noise Monitoring

Attended measurements of plant and equipment noise will be undertaken as soon as practicable after equipment arriving on site for the long term (more than two months) to confirm actual plant noise levels indicated in Appendix 2. Noise emissions from individual plant items are not anticipated to vary significantly over a period of less than six months. Plant and equipment operating on the site for more than six months will be re-tested to confirm that noise levels from individual plant items are still within the acceptable noise range, or where it is clearly evident that either plant or equipment may be exceeding the maximum levels identified in Appendix 2.

9.1.2 Noise Monitoring in the Community

Attended monitoring of construction noise levels will be undertaken as follows:

- As soon as practicable from the commencement of a construction activity to confirm the effectiveness of actions and management and mitigation measures determined in the CNVMP are sufficient;
- Where appropriate in response to a noise related complaint(s) (determined on a case-by-case basis); and
- As otherwise required by the Project EPL.

Monitoring would be undertaken at representative sensitive receivers in proximity to construction activities. Noise monitoring locations should be consistent with the distances / locations identified in the Activity Specific Construction Noise and Vibration Assessments and will take into consideration factors including:

- The location of previous monitoring sites;
- The proximity of the receiver to the work area or a compound;
- The sensitivity of the receiver to noise;
- Background noise levels; and
- The expected duration of the impact.

9.2 Vibration Monitoring

Attended vibration monitoring is to be undertaken as follows:

- At the commencement of operation for each plant or activity on site, which has the potential to generate significant vibration levels, so as to refine the indicative safe working distances set out in Table 5 and provide a site-specific table of safe working distances;
- Where it is not feasible to modify construction methodology to reduce vibration intensive construction activities within the safe working distances for cosmetic damage;
- For short periods time where there is potential risk for cosmetic damage to buildings and structures; and
- Where deemed to be relevant to construction works in response to a vibration related complaint.

Where attended vibration monitoring is not feasible, due to extended periods of vibration intensive works, a permanent vibration monitoring system is to be installed to warn plant operators (via flashing light, audible alarm, etc.) that there is potential risk for cosmetic damage to buildings and structures.

9.3 Reporting

The results of noise and vibration monitoring will be documented and provided to the EPA in accordance with the Project EPL.

9.4 Non-conformance and Corrective Action

Procedures for Auditing, Non Conformance and Corrective Action Notification are addressed in the Construction Environmental Management Plan AE-JHG-PLN-EMP-0002.

10 ENQUIRIES AND COMPLAINTS MANAGEMENT

John Holland will manage enquiries and complaints in a responsive manner. Throughout the works, the Project team will be making contact with multiple and varied internal and external stakeholders. The Community Liaison Plan (AE-JHG-PLN-MAN-0012) details procedures to ensure that the process of dealing with Project enquires and complaints by the Project team is consistent and in line with the Project's enquiry and complaints handling management policies.

The Project will operate a 24-hour construction complaints and enquires line and Project email during construction.

24-hour Construction Complaints & Enquiries Line – 1300 862 844

Project Emil - airporeast@jhg.com.au

Where noise or vibration monitoring / investigation is required, a Preliminary Investigation Report will be provided to RMS and EPA the next working day in accordance with the timeframe specified in the EPL following any noise or vibration monitoring undertaken. A Follow-up Investigation Report will be provided within five working days of any noise or vibration monitoring, to satisfy the EPL. When required, this CNVMP will be reviewed following complaints and issued to RMS for approval.

11 OUT OF HOURS WORKS (OOHW) PROTOCOL

This out of hours works (OOHW) Protocol applies to all works to be undertaken outside the standard construction hours or respite periods under the EPL. An OOHW protocol decision flowchart has been established relevant to the time and circumstances under which OOHW is required to be undertaken. These include:

- Work outside of standard construction hours (as specified in EPL license condition L3.3)
- Approved works outside of standard construction hours (as specified in EPL license condition L3.4)
- Exceptions to standard construction hours (as specified in EPL license condition L3.5)

The Project specific OOHW decision flowchart is provided in Appendix 6.

11.1 OOHW Justification

All proposed OOHW require a full justification as why the works are required to be undertaken outside standard construction hours. Where it is considered possible (safe and reasonable) for works to be undertaken during standard hours, OOHW proposals will not be further actioned by the Environment Manager (EM). There are a number of reasons why works can only be undertaken out of hours and these include, but are not limited to:

- Ensuring the safety of construction personnel;
- Ensuring the safety of rail passengers and railway personnel;
- Ensuring road user and public safety;
- Minimising disruption to road network users/ pedestrians;
- Minimising disruption to operating rail line;
- Minimising disruption to essential utility services;
- The TfNSW Transport Management Centre (or other road authority) refuse to issue a road occupancy licence for the works or activities during the hours specified in EPL condition L3.1;
- ARTC require a Rail Possession (involving week night and/or weekend rail shutdown) for the works or activities to be performed; and
- The equipment required to undertake the works or activities would penetrate the Sydney Airport Obstacle Limitation Surface.

11.2 OOHW Noise and Vibration Assessment

Activity Specific Construction Noise and Vibration Assessments will be prepared as required by the Project to assess the extent of noise and/or vibration impact construction activities will have upon the community. The level of assessment will be determined by the Project EPL requirements (condition L3). The Activity Specific Construction Noise and Vibration Assessments will be prepared in accordance with the relevant guidelines, as specified in section 1 of this CNVMP.

As part of the assessment process:

- Any exceedance of the construction noise / vibration objectives will be identified;
- The level of noise / vibration impact will be evaluated and classified, following the steps in sections 7 and 8 of this CNVMP;
- Appropriate noise/ vibration management and mitigation measures will be determined as detailed in Section 7 and 8; and
- An appropriate noise / vibration monitoring program will be developed to satisfy the EPL.

11.3 OOHW Documentation

OOHW documentation will be prepared according to the type of OOHW that will be undertaken, as determined in the OOHW PROTOCOL displayed in Appendix 6.

John Holland will submit the completed OOHW documentation, in the formal OOHW application form a sample of which is provided in Appendix 5, to RMS for review and approval. When used, the OOHW application form will be provided along with all required detail about the OOHW including the Activity Specific Construction Noise and Vibration Assessment, as detailed above in section 11.2.

11.4 OOHW Community Notifications

Notification to relevant impacted receivers will be provided between 5 and 14 days prior to OOHW as required by the Project EPL. Any additional notification requirements set by RMS in the issuing of an EPL variation will be undertaken.

Any additional management measures identified for the works that require community notification are to be undertaken as detailed in the Community Liaison Plan AE JHG-PLN-MAN-0012, and may include, but is not limited to:

- Letterbox drop and/ or email;
- Phone calls;
- Individual briefings; and
- The offering of alternate accommodation or other measures of respite.

11.5 RMS Approval of OOHW and Implementation of OOHW EPL Conditions

Where relevant OOHW have been approved by, any specific conditions that relate to the OOHW are to be:

- Actioned for implementation (such as any additional notification to the community);
- Tool-boxed to relevant workforce and site personnel before each shift to introduce / reinforce works restrictions, management measures and expected workforce behaviour. These will include any EPL conditions; and
- Implemented during works and monitored by John Holland.

11.6 OOHW Enquiries / Complaints Management

All complaints are to be managed by the Project Community Liaison Team in accordance with the Community Liaison Plan (AE-JHG-PLN-MAN-0012) and described in section 10.

11.7 OOHW Monitoring

Attended noise and vibration monitoring is to be undertaken, at representative stages of the activity or work, to verify that noise levels resulting from OOHW are in accordance with the levels predicted in the Activity Specific Construction Noise and Vibration Assessments and the relevant EPL conditions. Noise and vibration monitoring should follow the procedures outlined in sections 9.1 and 9.2 of this CNVMP.

12 REFERENCES

1. Construction Noise and Vibration Guideline, Roads and Maritime Services (RMS), August 2016.
2. Construction Noise Strategy, Transport for New South Wales (TfNSW), 1 April 2012
3. Interim Construction Noise Guideline, NSW Department of Environment and Climate Change (DECC), now NSW Environment Protection Authority (EPA), July 2009.
4. New South Wales Industrial Noise Policy, Environment Protection Authority of New South Wales (EPA), January 2000.
5. *Assessing Vibration: a technical guideline*, Department of Environment and Conservation, now Environment Protection Authority (EPA), February 2006.
6. DIN 4150-3 *Structural vibration - Effects of vibration on structures*, German Standard, February 1999.
7. WestConnex Enabling Works - Airport East Precinct - Review of Environmental Factors - Volume 1 Main Report - Appendix A-E, Jacobs, February 2015.
8. WestConnex Enabling Works - Airport East Precinct - Review of Environmental Factors - Volume 2 - Appendix F-I, Jacobs, February 2015.
9. WestConnex Enabling Works - Airport East Precinct - Review of Environmental Factors - Volume 2 - Appendix H: Construction Noise and Vibration Impact Statement - Report No 14174 Version B, Wilkinson Murray, November 2014.
10. Airport East: General Holmes Drive Project - Detailed Design Operational and Construction Noise and Vibration Assessment - Job ID 20857, Pacific Environment Limited, 1 June 2016.
11. HELP of Brüel and Kjær (B&K) type 7810 Predictor-LimA Plus version 11.20 - acoustic modelling software.
12. ISO 9613-1 and ISO 9613-2 Acoustics - Attenuation of sound during propagation outdoors - Part 1: Calculation of absorption of sound by the atmosphere and Part 2: General method of calculation.
13. Keith Attenborough, Kai Ming Li and Kirill Horoshenkov - *Predicting Outdoor Sound* - Taylor & Francis - 2007
14. Malcolm Crocker - *Handbook of Noise and Vibration Control* - John Wiley & Sons, Inc. - 2007.

13 APPENDICES

APPENDIX 1 – RECEIVERS’ ADDRESSES

ID	Address	ID	Address	ID	Address	ID	Address	ID	Address	ID	Address
R1	2 Baxter Rd	R26	25 Baxter Rd	R51	50 Hardie St	R76	67 Johnson St	R101	62 Wentworth Ave	C2	37 Baxter Rd
R2	4 Baxter Rd	R27	29 Baxter Rd	R52	52 Hardie St	R77	65 Johnson St	R102	60 Wentworth Ave	C3	79 Baxter Rd
R3	6-8 Baxter Rd	R28	31 Baxter Rd	R53	54 Hardie St	R78	63 Johnson St	R103	56 Wentworth Ave	C4	81-85 Baxter Rd
R4	10-12 Baxter Rd	R29	33 Baxter Rd	R54	56 Hardie St	R79	61 Johnson St	R104	54 Wentworth Ave	C5	95-97 Baxter Rd
R5	14-16 Baxter Rd	R30	93 Baxter Rd	R55	58 Hardie St	R80	78 Alfred St	R105	52 Wentworth Ave	C6	101 Baxter Rd
R6	18-20 Baxter Rd	R31	105 Baxter Rd	R56	60 Hardie St	R81	74 Alfred St	R106	50 Wentworth Ave	C7	113-121 Baxter Rd
R7	22-24 Baxter Rd	R32	133 Baxter Rd	R57	62 Hardie St	R82	70 Alfred St	R107	48 Wentworth Ave	C8	127 Baxter Rd
R8	26 Baxter Rd	R33	1247 Botany Rd	R58	64 Hardie St	R83	75A Alfred St	R108	46 Wentworth Ave	C9	1209 Botany Rd
R9	28 Baxter Rd	R34	1273 Botany Rd	R59	66 Hardie St	R84	75 Alfred St	R109	44 Wentworth Ave	C10	1225 Botany Rd
R10	30 Baxter Rd	R35	1275 Botany Rd	R60	68 Hardie St	R85	73 Alfred St	R110	42 Wentworth Ave	C11	1237 Botany Rd
R11	32 Baxter Rd	R36	1277 Botany Rd	R61	70 Hardie St	R86	71 Alfred St	R111	40 Wentworth Ave	C12	1245 Botany Rd
R12	34 Baxter Rd	R37	1285 Botany Rd	R62	72 Hardie St	R87	69 Frogmore St	R112	38 Wentworth Ave	C13	1263 Botany Rd
R13	36 Baxter Rd	R38	86 Hardie St	R63	74 Hardie St	R88	67 Frogmore St	R113	36 Wentworth Ave	C14	1265 Botany Rd
R14	1 Baxter Rd	R39	87 Hardie St	R64	76 Hardie St	R89	65 Frogmore St	R114	44B Wentworth Ave	C15	1269 Botany Rd
R15	3 Baxter Rd	R40	90 Johnson St	R65	80 Hardie St	R90	63 Frogmore St	R115	1 McBurney Ave	C16	1297 Botany Rd
R16	5 Baxter Rd	R41	69 Johnson St	R66	82 Hardie St	R91	64 Frogmore St	R116	57 McBurney Ave	C17	1303 Botany Rd
R17	7 Baxter Rd	R42	5 Johnson Ln	R67	84 Hardie St	R92	62 Frogmore St	R117	59 McBurney Ave	C18	1307 Botany Rd
R18	9 Baxter Rd	R43	80 Alfred St	R68	85 Hardie St	R93	60 Frogmore St	R118	61 McBurney Ave	C19	1309 Botany Rd
R19	11 Baxter Rd	R44	77 Alfred St	R69	85 Hardie St	R94	58 Frogmore St	R119	63 McBurney Ave	C20	1305 Botany Rd
R20	13 Baxter Rd	R45	71 Frogmore St	R70	83 Hardie St	R95	182 Sutherland St	R120	40 McBurney Ave	C21	1305 Botany Rd
R21	15 Baxter Rd	R46	66 Frogmore St	R71	81 Hardie St	R96	180 Sutherland St	R121	42 McBurney Ave	C22	1309 Botany Rd
R22	17 Baxter Rd	R47	184 Sutherland St	R72	88 Johnson St	R97	178 Sutherland St			C23	22 Merchant St
R23	19 Baxter Rd	R48	44 Hardie St	R73	86 Johnson St	R98	68 Wentworth Ave	Church	1293-1295 Botany Rd	C24	6 Merchant St
R24	21 Baxter Rd	R49	46 Hardie St	R74	84 Johnson St	R99	66 Wentworth Ave			C25	14 Wentworth Ave
R25	23 Baxter Rd	R50	48 Hardie St	R75	82 Johnson St	R100	64 Wentworth Ave	C1	35 Baxter Rd	C26	14 Wentworth Ave

Note: The addresses identified have been interpreted from review of Googlemaps aerial imagery and Googlemaps Streetview and have not been confirmed by ground-truthing. The identified addresses should be considered approximate only.

1 Also, vibration-sensitive receiver

(Source: Pacific Environment Limited, 2016)

APPENDIX 2 – CONSTRUCTION EQUIPMENT SOUND PRESSURE LEVELS

Plant	Sound Power Level (SPL) dB(A)
Tracked Excavator 22-tonne	106
Large Concrete Mixer 26-tonne	104
Vacuum Sucker Truck	107
Road Planer	110
Wheeled Backhoe Loader 9-tonne	95
Grader 25-tonne	115
Vibratory Roller 12-tonne	112
Concrete Pump + Concrete Mixer Truck (Idling) 6-tonne	103
Diesel Generator	93
Hydraulic Hammer Rig	117
Road Sweeper	104
Asphalt Paver (+ Tipper Truck) 18-tonne	112
Tipper Truck / Truck and Dog	107
Vibratory Piling Rig 52-tonne	116
Hydraulic Vibratory Compactor (Tracked Excavator)	106
Continuous Flight Auger - Crawler Mounted Rig 33-tonne	108
Tracked Excavator (Inserting Cylindrical Metal Cage) 20-tonne	102
Concrete Pump 2.8-tonne	106
Mobile Telescopic Crane 55-tonne	109
Angle Grinder (Grinding Steel)	109
Piling 2800 kN 10-tonne / 13 m length / 900 mm width / soil	96
Power Pack 147 6-tonne	98
Lorry with Lifting Boom 6-tonne	105
Telehandler	99
Generator	113
Flood lights	90
Lighting tower	80
Concrete Vibrator	106
Tree Mulcher	115
Pump	110
Tracked Hydraulic Drilling Rig (boring machine)	114
Water pump	106
Compressor for Mini Piling 1-tonne	103
Skidsteer Loaders (approx. 1-tonne) ¹	110
Hi-Rail Dumper ²	103
Rail Tamper ²	118
Ballast Regulator ²	110
Skid Steer Crane ²	110
Rail Saw ²	113

(Source: Pacific Environment Limited, 2016)

APPENDIX 3 – RMS STANDARD MITIGATION MEASURES

Action required	Applies to	Details
Management measures		
Implementation of any project specific mitigation measures required.	Airborne noise	Implementation of any project specific mitigation measures required.
Implement community consultation or notification measures (refer to Appendix C for further details of each measure).	Airborne noise. Ground-borne noise & vibration.	<p>Notification detailing work activities, dates and hours, impacts and mitigation measures, indication of work schedule over the night time period, any operational noise benefits from the works (where applicable) and contact telephone number.</p> <p>Notification should be a minimum of 7 calendar days prior to the start of works. For projects other than maintenance works more advanced consultation or notification may be required. Please contact Roads and Maritime Communication and Stakeholder Engagement for guidance.</p> <p>Website (If required)</p> <p>Contact telephone number for community</p> <p>Email distribution list (if required)</p> <p>Community drop in session (if required by approval conditions).</p>
Site inductions	Airborne noise. Ground-borne noise & vibration	<p>All employees, contractors and subcontractors are to receive an environmental induction. The induction must at least include:</p> <ul style="list-style-type: none"> • all project specific and relevant 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 (including deliveries) • environmental incident procedures.
Behavioural practices	Airborne noise	<p>No swearing or unnecessary shouting or loud stereos/radios on site.</p> <p>No dropping of materials from height, throwing of metal items and slamming of doors.</p>

Action required	Applies to	Details
Verification	Airborne noise Ground-borne noise & vibration	Where specified under Appendix C a noise verification program is to be carried out for the duration of the works in accordance with the Construction Noise and Vibration Management Plan and any approval and licence conditions.
Attended vibration measurements	Ground-borne vibration	Where required attended vibration measurements should be undertaken at the commencement of vibration generating activities to confirm that vibration levels are within the acceptable range to prevent cosmetic building damage.
Update Construction Environmental Management Plans	Airborne noise. Ground-borne noise & vibration.	The CEMP must be regularly updated to account for changes in noise and vibration management issues and strategies.
Building condition surveys	Vibration Blasting	Undertake building dilapidation surveys on all buildings located within the buffer zone prior to commencement of activities with the potential to cause property damage
Source controls		
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.
Construction respite period during normal hours and out-of-hours work	Ground-borne noise & vibration. Airborne noise.	Please refer to Appendix C for more details on the following respite measures: <ul style="list-style-type: none"> • Respite Offers (RO) • Respite Period 1 (R1) • Respite Period 2 (R2) • Duration Respite (DR)
Equipment selection.	Airborne noise. Ground-borne noise & vibration	Use quieter and less vibration emitting construction methods where feasible and reasonable. For example, when piling is required, bored piles rather than impact-driven piles will minimise noise and vibration impacts. Similarly, diaphragm wall construction techniques, in lieu of sheet piling, will have significant noise and vibration benefits. Ensure plant including the silencer is well maintained.

Action required	Applies to	Details
Plant noise levels.	Airborne-noise.	<p>The noise levels of plant and equipment must have operating Sound Power or Sound Pressure Levels compliant with the criteria in Appendix H.</p> <p>Implement a noise monitoring audit program to ensure equipment remains within the more stringent of the manufacturers specifications or Appendix H.</p>
Rental plant and equipment.	Airborne-noise.	<p>The noise levels of plant and equipment items are to be considered in rental decisions and in any case cannot be used on site unless compliant with the criteria in Table 2.</p>
Use and siting of plant.	Airborne-noise.	<p>The offset distance between noisy plant and adjacent sensitive receivers is to be maximised.</p> <p>Plant used intermittently to be throttled down or shut down.</p> <p>Noise-emitting plant to be directed away from sensitive receivers.</p> <p>Only have necessary equipment on site.</p>
Plan worksites and activities to minimise noise and vibration.	Airborne noise. Ground-borne vibration.	<p>Locate compounds away from sensitive receivers and discourage access from local roads.</p> <p>Plan traffic flow, parking and loading/unloading areas to minimise reversing movements within the site.</p> <p>Where additional activities or plant may only result in a marginal noise increase and speed up works, consider limiting duration of impact by concentrating noisy activities at one location and move to another as quickly as possible.</p> <p>Very noise activities should be scheduled for normal working hours. If the work can not be undertaken during the day, it should be completed before 11:00pm.</p> <p>Where practicable, work should be scheduled to avoid major student examination periods when students are studying for examinations such as before or during Higher School Certificate and at the end of higher education semesters.</p> <p>If programmed night work is postponed the work should be re-programmed and the approaches in this guideline apply again.</p>
Reduced equipment power	Airborne noise. Ground-borne vibration.	<p>Use only the necessary size and power</p>

Action required	Applies to	Details
Non-tonal and ambient sensitive reversing alarms	Airborne noise	<p>Non-tonal reversing beepers (or an equivalent mechanism) must be fitted and used on all construction vehicles and mobile plant regularly used on site and for any out of hours work.</p> <p>Consider the use of ambient sensitive alarms that adjust output relative to the ambient noise level.</p>
Minimise disturbance arising from delivery of goods to construction sites.	Airborne noise	<p>Loading and unloading of materials/deliveries is to occur as far as possible from sensitive receivers.</p> <p>Select site access points and roads as far as possible away from sensitive receivers.</p> <p>Dedicated loading/unloading areas to be shielded if close to sensitive receivers.</p> <p>Delivery vehicles to be fitted with straps rather than chains for unloading, wherever possible.</p> <p>Avoid or minimise these out of hours movements where possible.</p>
Blasting regime	Airborne noise. Ground-borne vibration.	<p>The noise and vibration impacts of blasting operations can be minimised by:</p> <ul style="list-style-type: none"> ▪ Choosing the appropriate blast charge configurations ▪ Ensuring appropriate blast-hole preparation ▪ Optimising blast design, location, orientation and spacing ▪ Selecting appropriate blast times, and ▪ Utilising knowledge of prevailing meteorological conditions. ▪ AS 2187.2 Explosives-Storage, transport and use, Part 2: Use of Explosives provides more detailed advice on ground vibration and airstart overpressure impact minimisation options.
Engine compression brakes	Construction vehicles	<p>Limit the use of engine compression brakes at night and in residential areas.</p> <p>Ensure vehicles are fitted with a maintained Original Equipment Manufacturer exhaust silencer or a silencer that complies with the National Transport Commission's 'in-service test procedure' and standard.</p>
Path controls		

Action required	Applies to	Details
Shield stationary noise sources such as pumps, compressors, fans etc.	Airborne noise.	Stationary noise sources should be enclosed or shielded where feasible and reasonable whilst ensuring that the occupational health and safety of workers is maintained. Appendix D of AS 2436:2010 lists materials suitable for shielding.
Shield sensitive receivers from noisy activities.	Airborne noise.	Use structures to shield residential receivers from noise such as site shed placement; earth bunds; fencing; erection of operational stage noise barriers (where practicable) and consideration of site topography when siting plant.
Receptor controls		
Structural surveys and vibration monitoring	Ground-borne vibration.	Pre-construction surveys of the structural integrity of vibration sensitive buildings may be warranted. At locations where there are high-risk receptors, vibration monitoring should be conducted during the activities causing vibration.
See Appendix C for additional measures	Airborne noise. Ground-borne vibration.	In some instances additional mitigation measures may be required.

APPENDIX 4 – TABLE 9.1, WILKINSON MURRAY REPORT (November 2014)

Table 9-1 Noise Mitigation Measures

Management Measure	Anticipated Noise Reduction, dBA
Administrative Controls	
Operate during approved hours	N/A
Undertake regular noise monitoring to determine the impact of operating plant on sensitive receivers	N/A
Appropriate training of onsite staff	N/A
Undertake community consultation and respond to complaints in accordance with established project procedures	N/A
Turning off machinery when not in use	0-5
Respite periods for pile drivers and rock breakers	N/A
Engineering Controls	
Portable temporary screens	5-10
Screen or enclosure for stationary equipment	10-15
Maximising the offset distance between noisy plant items and sensitive receivers	3-6
Avoiding using noisy plant simultaneously and/or close together, adjacent to sensitive receivers	2-3
Orienting equipment away from sensitive receivers	3-5
Carrying out loading and unloading away from sensitive receivers	3-5
Using dampened tips on rock breakers	3-6
Using noise source controls, such as the use of residential class mufflers, to reduce noise from all plant and equipment including bulldozers, cranes, graders, excavators and trucks	5-10
Selecting site access points and roads as far as reasonably practicable away from sensitive receivers	3-6
Using spotters, closed circuit television monitors, "smart" reversing alarms, or "squawker" type reversing alarms in place of traditional reversing alarms	2-5
Employ non noise-generating structures such as site offices, storage sheds, stockpiles and tanks as noise barriers	5-10

APPENDIX 5 – OOHW APPLICATION FORM

Out-Of-Hours Work Application Form

(Environment Protection Licence Variation **NOT** Required)

No:				
APPLICATION AND ALL SUPPORTING INFORMATION ARE TO BE SUBMITTED TO THE APPROVING AUTHORITY AT LEAST 10 BUSINESS DAYS BEFORE THE PLANNED DATES OF OUT-OF-HOURS WORK				
Application Date:		Contractor: John Holland		Project: Airport East Precinct, Mascot
A. Contact details				
	Name	Mobile number	Email	
Contractor's Representative				
Contractor's 24 hour contact person				
Transport Projects Project Manager				
Transport Projects Environment & Planning Manager				
Transport Projects Public Affairs Manager/Officer				
B. Justification for OOHW				
List any environmental / community benefits of OOHW (if any)				
Attach additional details if required.				
C. Details of work				
Location				
Description of works				
Proposed dates				
<input type="checkbox"/> Map attached (showing location / work extent / nearest sensitive receivers / landscape)				
Proposed timings				
IMPACT ASSESSMENT Reference table				
D. Timings				
i. Identify time period when each item of plant is to be used, from reference table on right.		Standard hours	Period 1 (low risk period)	Period 2 (medium/high risk period)
ii. Tick which plant to be used in Section E. below and record whether to be used in Period 1 or Period 2, or both.		No OOHW application required	1800-2200	2200-0700 overnight
Acoustic assessment of OOHW required if Period 2 used.			1300-2200	2200-0800 overnight
		Sundays and public holidays	0800-1800	1800-0700 overnight
E. Plant required & level of risk				
e.g. Generator to be used between 2300 and 0200 on a weekday is Period 2 and acoustic assessment is required				
<input type="checkbox"/> Rock breaker (97dB)	Period	<input type="checkbox"/> Mechanical broom (83dB)	Period	
<input type="checkbox"/> Dump truck (96dB)		<input type="checkbox"/> Tip truck (83dB)		
<input type="checkbox"/> Front end loader (90dB)		<input type="checkbox"/> Construction truck (80dB)		
<input type="checkbox"/> Excavator (89 dB)		<input type="checkbox"/> Cherry picker (80dB)		
<input type="checkbox"/> Vibratory roller (89dB)		<input type="checkbox"/> Concrete saw/corer (80dB)		
<input type="checkbox"/> Water cart (88dB)		<input type="checkbox"/> Concrete vibrator (80dB)		

No:			
<input type="checkbox"/> Jackhammer (89dB)		<input type="checkbox"/> Generator (79dB)	
<input type="checkbox"/> Bulldozer (88dB)		<input type="checkbox"/> Compressor (75dB)	
<input type="checkbox"/> Crane (87dB)		<input type="checkbox"/> Backhoe (75dB)	
<input type="checkbox"/> Semi trailer (87dB)		<input type="checkbox"/> Mobile lighting tower (71dB)	
<input type="checkbox"/> Concrete truck (87dB)		<input type="checkbox"/> Bobcat	
<input type="checkbox"/> Piling rig (85 dB)		<input type="checkbox"/> Power tool	
<input type="checkbox"/> Compactor (85dB)		<input type="checkbox"/> Others – impact wrenches etc	
<input type="checkbox"/> Air drill (85dB)			
<input type="checkbox"/> Welder (85dB)			
<input type="checkbox"/> Concrete pump (84dB)			
F. Distance to nearest sensitive noise receiver(s)	<i>Refer to ECM / Noise Sub Plan</i>		
G. Nature of landscape / nature of any barriers or shielding between source & sensitive receiver	<i>e.g. brick wall 2m high; open grassland; embankments at 30m</i>		
H. Details of alternatives & how investigated. Details of any consultation carried out.			
I. Noise Assessment of activities and work covered in this form	<input type="checkbox"/> Activities and works cause noise emissions that are not audible at any noise sensitive receiver. <input type="checkbox"/> Approval and notification not required		
	<input type="checkbox"/> Activities and works cause noise emissions that are <5dBA above background noise level <input type="checkbox"/> Approval not required <input type="checkbox"/> Community notification required		
	<input type="checkbox"/> Activities and works cause noise emissions that are >5dBA above background noise level <input type="checkbox"/> Approval and community notification required.		
	Consultants' acoustic assessment attached? <input type="checkbox"/> Yes <input type="checkbox"/> No		
J. Contractor's community notification strategy <small>Contractor must provide minimum 7 days notice of works</small>			

No:		
K. Associated impacts of proposed OOHW	<input type="checkbox"/> Dust e.g. heavy trucks; soil clearance <input type="checkbox"/> Traffic e.g. deliveries, lane closures <input type="checkbox"/> Pedestrian access e.g. pavements closed <input type="checkbox"/> Vibration e.g. rollers, damage to heritage properties <input type="checkbox"/> Adjacent construction works	<input type="checkbox"/> Public transport e.g. schedule changes <input type="checkbox"/> Lighting e.g. floodlit residential areas <input type="checkbox"/> Parking e.g. closure of spaces <input type="checkbox"/> Property access <input type="checkbox"/> Others (specify)
	L. Mitigation measures <i>E.g. noisy works moved to standard hours or 'low risk' hours; silencing; consultation. Refer to CEMP.</i>	
Contractor signature		Date
M. Transport Projects Communications Team	Comments on application (include comment on community)	
	<input type="checkbox"/> Community notification required by Contractor? <input type="checkbox"/> Application on Register?	
N. Environmental Management Representative <i>For OOHW with high risk factors, make recommendation for approval by DoP or DE as applicable</i>	<input type="checkbox"/> OOHW approved / endorsed (delete as appropriate) <input type="checkbox"/> OOHW approved with conditions (see below) <input type="checkbox"/> OOHW rejected	
	EMR conditions of approval for OOHW / comments <i>Attach additional letter/comments if required</i>	
O. Approval to conduct OOHW <i>For OOHW with low and medium risk factors, Approval may be granted by the EMR; For OOHW with high risk factors approval by DoP or DE is required (EPM to arrange approval by DoP)</i>	Assessment of Risk Factors: <input type="checkbox"/> Low <input type="checkbox"/> Medium <input type="checkbox"/> High	
	Approved by (strike out as applicable): DE EMR EPM (for DoP) Signature _____ Date _____	



APPENDIX 6 – OOHV PROTOCOL



NOTE 1 -
 EPL Condition L3.4 - The works to be undertaken fall under one of the following items, and **WILL NOT CAUSE**:

a) LAeq(15minute) noise levels no more than 5 dB(A) above rating background level at any residence in accordance with the Interim Construction Noise Guideline (Department of Environment and Climate Change, 2009); and b) LAeq(15minute) noise levels no more than the noise management levels specified in Table 3 of the Interim Construction Noise Guideline (Department of Environment and Climate Change, 2009) at other sensitive receivers; and c) continuous or impulsive vibration values, measured at the most affected residence, greater than those for human exposure to vibration as set out in Table 2.2 to the technical guideline 'Environmental Noise Management Assessing Vibration' published by the Department of Environment and Conservation in February 2006; and d) intermittent vibration values, measured at the most affected residence, greater than those for human exposure to vibration, set out for residences in Table 2.4 to the technical guideline 'Environmental Noise Management Assessing Vibration' published by the Department of Environment and Conservation in February 2006.

NOTE 2 -
 EPL Condition L3.5 - Activities and works may be undertaken outside the requirements of Conditions L3.1 and L3.2, but only if one or more of the following applies:

a) Carrying on those works and activities during the hours specified in condition L3.1 would cause unacceptable risks to one or more of the following: (i) Construction personnel safety; (ii) Road user and public safety; (iii) Road network operational performance as may be notified from time to time by the Roads and Maritime Services; and/or (iv) Essential utility services. b) The TfNSW Transport Management Centre (or other road authority) refuse to issue a road occupancy licence for the works or activities during the hours specified in condition L3.1; or c) ARTC require a Rail Possession (involving week night and/or weekend rail shutdown) for the works or activities to be performed; or d) The equipment required to undertake the works or activities would penetrate the Sydney Airport Obstacle Limitation Surface.