Appendix B3

Noise and Vibration CEMP Sub-plan

M6 Stage 1 : Preliminary construction including commencement activities

October 2021

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Contents

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Copy number	Issued to	Version

Glossary/ Abbreviations

Abbreviations	Expanded Text
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.
Attenuation	The reduction in the level of sound or vibration.
CEMP	Construction Environmental Management Plan
CNVG	Construction Noise and Vibration Guideline (Roads and Maritime 2016)
CoA	Condition of Approval
CSSI	Critical State Significant Infrastructure
dBA	Decibels using the A-weighted scale measured according to the frequency of the human ear.
DP&E	NSW Department of Planning and Environment
EIS	Environmental Impact Statement
EMS	Environmental management system
Environmental aspect	Defined by AS/NZS ISO 14001:2015 as an element of an organisation's activities, products or services that can interact with the environment.
Environmental impact	Defined by AS/NZS ISO 14001:2015 as any change to the environment, whether adverse or beneficial, wholly or partially resulting from an organisation's environmental aspects.
EMM	Environmental Management Measure
Environmental objective	Defined by AS/NZS ISO 14001:2015 as an overall environmental goal, consistent with the environmental policy, that an organisation sets itself to achieve.
Environmental target	Defined by AS/NZS ISO 14001:2015 as a detailed performance requirement, applicable to the organisation or parts thereof, that arises from the environmental objectives and that needs to be set and met in order to achieve those objectives.
EPA	NSW Environment Protection Authority
EP&A Act	*Environmental Planning and Assessment Act 1979*
ER	Environmental Representative
ERG	Environmental Review Group

EWMS	Environmental Work Method Statements
Feasible and reasonable	Consideration of best practice taking into account the benefit of proposed measures and their technological and associated operational application in the NSW and Australian context. Feasible relates to engineering considerations and what is practical to build. Reasonable relates to the application of judgement in arriving at a decision, taking into account mitigation benefits and cost of mitigation versus benefits provided, community views and nature and extent of potential improvements..
Highly noise intensive works	Works which are defined as annoying under the ICNG being: a) use of power saws, such as used for cutting timber, rail lines, masonry, road pavement or steel work; b) grinding metal, concrete or masonry; c) rock drilling; d) line drilling; e) vibratory rolling; f) bitumen milling or profiling; g) jackhammering, rock hammering or rock breaking; and h) impact piling.
ICNG	*Interim Construction Noise Guideline (DECC, 2009)*
INP	*NSW Industrial Noise Policy (EPA 2000)*
$L_{Aeq\ (15min)}$	The A-weighted equivalent continuous (energy average) A-weighted sound pressure level of the construction works under consideration over a 15-minute period and excludes other noise sources such as from industry, road, rail and the community.
$L_{A\ (max)}$	the A-weighted maximum noise level only from the construction works under consideration, measured using the fast time weighting on a sound level meter.
NCA	Noise catchment areas
NML	Noise Management Level
NVMP	Noise and Vibration CEMP Sub-plan (this document)
OEH	Office of Environment and Heritage
OOHW	Out-of-hours works
OSR	Other Sensitive Receivers
PIR	Preferred Infrastructure Report
RBL	The Rating Background Level for each period is the medium value of the ABL values for the period over all of the days measured. There is therefore an RBL value for each period (day, evening and night)

Roads and Maritime	Roads and Maritime Services
Sensitive receiver	Includes residences, educational institutions (including preschools, schools, universities, TAFE colleges), health care facilities (including nursing homes, hospitals), religious facilities (including churches), child care centres, passive recreation areas (including outdoor grounds used for teaching), commercial premises (including film and television studios, research facilities, entertainment spaces, temporary accommodation such as caravan parks and camping grounds, restaurants, office premises, and retail spaces), and others as identified by the Planning Secretary.
SWP	Sound Power Level
SPL	Sound Pressure Level
SSI	State Significant Infrastructure
TfNSW	Transport for NSW (formerly Roads and Maritime Services, RMS)

1 Introduction

1.1 Context

This Construction Noise and Vibration CEMP Sub-plan (CNVMP or Plan) forms part of the Construction Environmental Management Plan (CEMP) for preliminary construction including commencement activities of the M6 Stage 1 Project (the Project).

This CNVMP has been prepared to address the requirements of the Minister's Conditions of Approval (CoA) and the environmental management measures listed in the Project's Environmental Impact Statement (EIS), the Response to Submissions on EIS, the response to submissions on PIR and all applicable legislation and Transport for NSW (TfNSW) requirements.

1.2 Background and project description

The Project comprises a new twin motorway tunnel (around four kilometres in length) between the M8 Motorway at Arncliffe and President Avenue at Kogarah with a tunnel portal and entry and exit ramps connecting the tunnels to the surface. Works will include a connection to the M8 Motorway, line marking of additional travel lanes between the St Peters interchange to the M6 Stage 1 tunnels, an intersection with President Avenue (including widening and raising of President Avenue), and intersection improvements at the President Avenue/Princes Highway intersection. Mainline tunnel stubs would be constructed to allow for connections to future stages of the M6 Extension. The EIS assessed noise and vibration impacts on sensitive receivers and structures during construction and operation of the Project, within Chapter 11 and the Noise and Vibration Technical Working Paper (Appendix G of the EIS).

The EIS identified the potential for noise and vibration impacts during construction which are dependent on the types of construction activity in progress and the proximity of works to sensitive receivers. However, it concluded any potential impacts could be managed by tailored mitigation and management measures, including construction noise and vibration monitoring.

Please refer to Section 1.3 of the CEMP for preliminary construction including commencement activities and the activities anticipated during this first construction stage.

The CPB Contractors, Ghella, UGL Engineering (CGU) joint venture was appointed by TfNSW as the construction contractor for the Project.

1.3 Scope of the Sub-Plan

The scope of this CNVMP is to describe how CGU proposes to manage potential noise and vibration impacts during preliminary construction including commencement activities of the Project. This CNVMP:

- Describes how the Project will achieve the environmental performance outcomes identified in the EIS, the Response to Submissions and the CoA;
- Identifies noise and vibration mitigation and management measures that can be applied on-site to avoid or minimise noise and vibration impacts and how these would be implemented;
- Describes how CGU will comply with the relevant terms of the Project Approval; and
- Outlines how issues requiring management during construction (including cumulative impacts), as identified through ongoing environmental risk analysis, will be managed.

This CNVMP applies to the first stage of construction only, which includes preliminary construction and commencement activities at three sites (C1, C2 and C3 including MOC3). Preliminary construction is anticipated to commence in October 2021. A detailed list of preliminary construction

activities is provided in Section 1.4 of the CEMP. An indicative schedule for each site including location / access requirements and applicable works is provided in Appendix A4 of the CEMP.

Operational noise and vibration impacts and operation measures do not fall within the scope of this CNVMP and therefore are not included within the processes contained within this CNVMP.

1.4 Environmental management systems overview

The environmental management system is based on CPB Contractors Environmental Management Systems. The environmental management system overview is described in Section 1.5 of the CEMP for preliminary construction including commencement activities.

2 Purpose and objectives

2.1 Purpose

The purpose of this Plan is to describe how the CGU proposes to manage potential noise and vibration impacts during preliminary construction including commencement activities of the Project.

2.2 Objectives

The key objective of the CNVMP is to ensure all CoA, environmental management measures and licence/permit requirements relevant to noise and vibration are described, scheduled and assigned responsibility as outlined in:

- The Environmental Impact Statement (EIS), the Response to Submissions on EIS, the response to submissions on PIR prepared for M6 Stage 1;
- Conditions of Approval for SSI 8931 granted to the project on 18 December 2019;
- Environmental Management Measures (EMM's), as detailed in the Response to Submissions report;
- Roads and Maritime specifications G36;
- The Project' environment protection licence (EPL) once issued; and
- All relevant legislation and other requirements described in Section 3.1 of this CNVMP.

2.3 Targets and environmental performance outcomes

The following targets have been established for the management of noise and vibration impacts during the delivery of the Project:

- Ensure compliance with the relevant legislative requirements, CoA and EMMs;
- Meet environment protection licence (EPL) requirements;
- Effective management of noise and vibration impacts during construction in accordance with the Roads and Maritime Construction Noise and Vibration Guideline (CNVG);
- Ensure training is provided in the form of inductions to relevant Project personnel relating to noise and vibration issues before they begin work on site;
- Notify affected sensitive receivers of upcoming works and any out-of-hours works;
- Implement reasonably practicable measures to minimise noise and vibration impacts on surrounding residents, commercial and other sensitive receivers during construction;
- No exceedance of predicted noise and vibration impacts during construction of the Project as a result of Project works; and
- Address complaints in a timely and efficient manner.

The following performance outcomes relevant to noise and vibration (as identified in Chapter 24.7 Compilation of performance outcomes of the EIS) are detailed in Table 1 below.

Table 1 Noise and vibration performance outcomes

Desired performance outcome	Target	How addressed
Noise and Vibration – Amenity	• Full compliance with predicted noise levels	• Construction noise and vibration impact

Desired performance outcome	Target	How addressed
Construction noise and vibration (including airborne noise, ground-borne noise and blasting) are effectively managed to minimise adverse impacts on acoustic amenity.	• Implement all reasonable and feasible noise and vibration mitigation measures with the aim of achieving the objectives in Section 5	statements (CNVIS) (see Section 7.2) • Construction compliance reporting (see Section 9.6) • Management reviews (see Section 3.12 CEMP)
Noise and Vibration – Structural Construction noise and vibration (including airborne noise, ground-borne noise and blasting) are effectively managed to minimise adverse impacts on the structural integrity of buildings and items including Aboriginal places and environmental heritage.	• No damage from vibration generated by the Project works to buildings and items including Aboriginal places and environmental heritage	• Construction noise and vibration impact statements (CNVIS) (see Section 7.2) • Construction compliance reporting (see Section 9.6) • Management reviews (see Section 3.12 CEMP)

3 Environmental requirements

3.1 Relevant legislation

3.1.1 Legislation

All legislation relevant to this CNVMP is included in Appendix A1 of the CEMP.

3.1.2 Guidelines

The main guidelines, specifications and policy documents relevant to this Plan include

- Roads and Maritime QA Specification G36 – Environmental Protection (Management System);
- Roads and Maritime Construction Noise and Vibration Guideline (Roads and Maritime 2016);
- NSW Interim Construction Noise Guideline (ICNG), Department of Environment and Climate Change 2009;
- NSW Road Noise Policy, Dept. of Environment, Climate Change and Water 2011;
- NSW Environmental criteria for road traffic noise (Environment Protection Authority 1999);
- NSW Noise Policy for Industry (NPfI), Environment Protection Authority 2017;
- NSW Assessing Vibration – a technical guideline (AVTG), Department of Environment and Conservation 2006;
- Australian Standard AS/NZS 2107:2000 Acoustics - Recommended design sound levels and reverberation times for building interiors;
- Australian Standard 2834-1995 Computer Accommodation, Chapter 2.9 Vibration;
- Australian Standard AS 2187.2 Explosives - Storage and use - Part 2 Use of explosives;
- Australian Standard AS2436-1981 Guide to Noise Control on Construction, Maintenance and Demolition Sites;
- British Standard BS 6472-2008, ‘Evaluation of human exposure to vibration in buildings (1-80Hz);
- British Standard 7385: Part 2-1993 'Evaluation and measurement of vibration in buildings'; and
- German Standard DIN4150-2016 Structural vibration Part 3: Effects of vibration on Structures.

3.2 Minister's Conditions of Approval

The CoA relevant to this Plan are listed in Table 2 below. A cross reference is also included to indicate where the condition is addressed in this Plan or other project management documents.

Table 2 Ministers Conditions of Approval

CoA	Condition Requirements	Document Reference
A5	Where the terms of this approval require a document or monitoring program to be prepared, or a review to be undertaken, in consultation with identified parties, evidence of the consultation undertaken must be submitted to the Planning Secretary with the document. The evidence must include: (a) documentation of the engagement with the party identified in the condition of approval that has occurred before submitting the document for approval; (b) a log of the dates of engagement or attempted engagement with the identified party and a summary of the issues raised by them; (c) documentation of the follow-up with the identified party where engagement has not occurred to confirm that they do not wish to engage or have not attempted to engage after repeated invitations; (d) outline of the issues raised by the identified party and how they have been addressed; and (e) a description of the outstanding issues raised by the identified party and the reasons why they have not been addressed.	Section 3.4.1
A20	Boundary screening must be erected around all ancillary facilities that are adjacent to sensitive receivers for the duration of construction unless otherwise agreed with the relevant council and affected residents, business operators or landowners.	Section 8.1 CEMP Appendix A4 SEMP
A21	Boundary screening required under Condition A20 of this approval must minimise visual, noise and air quality impacts on adjacent sensitive receivers	Section 8 CEMP Appendix A4 SEMP

<table>
<tr><th>CoA</th><th>Condition Requirements</th><th>Document Reference</th></tr>
<tr><td>C4</td><td>CEMP Sub-plans must be prepared in consultation with the relevant government agency(s) and council(s) as identified for each CEMP Sub-plan in Table 4.
Table 4 CEMP Sub-plan and relevant public authorities
<table><tr><th></th><th>Required CEMP Sub-plan</th><th>Relevant government agencies and council(s) to be consulted for each CEMP Sub-plan</th></tr><tr><td>(b)</td><td>Noise and Vibration</td><td>NSW Health, relevant council(s) and Sydney Water (where vibration has the potential to impact on Sydney Water assets)</td></tr></table></td><td>CEMP Section 2
Appendix E of this Plan</td></tr>
<tr><td rowspan="5">C5</td><td colspan="2">The CEMP Sub-plans must state how:</td></tr>
<tr><td>(a) the environmental performance outcomes identified in the documents listed in ConditionA1 as modified by these conditions will be achieved;</td><td>Section 2.3 and Section 5</td></tr>
<tr><td>(b) the mitigation measures identified in the documents listed in Condition A1 as modified by these conditions will be implemented;</td><td>Section 8</td></tr>
<tr><td>(c) the relevant terms of this approval will be complied with; and</td><td>This table and Section 9</td></tr>
<tr><td>(d) issues requiring management during construction (including cumulative impacts), as identified through ongoing environmental risk analysis, will be managed.</td><td>Section 6, Section 7 and Section 8</td></tr>
<tr><td>C10</td><td>The CEMP Sub-plans must be endorsed by the ER and then submitted to the Planning Secretary for approval no later than one (1) month prior to the commencement of the construction activities to which they apply.</td><td>CEMP Section 2</td></tr>
<tr><td>C11</td><td>Any of the CEMP Sub-plans may be submitted to the Planning Secretary along with, or subsequent to, the submission of the CEMP.</td><td>CEMP Section 2</td></tr>
</table>

<table>
<tr><th>CoA</th><th>Condition Requirements</th><th>Document Reference</th></tr>
<tr><td>C12</td><td>Construction must not commence until the CEMP and all relevant CEMP Sub-plans for such construction activities to which they apply have been approved by the Planning Secretary. The CEMP and CEMP Sub-plans, as approved by the Planning Secretary, including any minor amendments approved by the ER, must be implemented for the duration of construction. Where construction is staged, construction of a stage must not commence until the relevant CEMP and CEMP Sub-plans for that stage have been endorsed by the ER and approved by the Planning Secretary.</td><td>CEMP Section 2 and Section 3.13</td></tr>
<tr><td colspan="3">Noise and vibration monitoring program</td></tr>
<tr><td>C13</td><td>The Construction Monitoring Programs set out in Table 5 must be prepared and implemented to enable comparison of the actual construction performance against the predicted performance. The Construction Monitoring Programs must be prepared in consultation with the relevant government agencies and councils as identified for each Construction Monitoring Program.
Table 5: Construction Monitoring and relevant public authorities
<table>
<tr><th></th><th>Required Construction Monitoring Programs</th><th>Relevant government agencies to be consulted for each Construction Monitoring Program</th></tr>
<tr><td>(c)</td><td>Noise and Vibration Monitoring Program</td><td>EPA</td></tr>
</table></td><td>Appendix A</td></tr>
<tr><td rowspan="3">C14</td><td colspan="2">Construction Monitoring Programs must provide:</td></tr>
<tr><td>(a) details of baseline data available;</td><td>Section 4.2 and Appendix B (see also Section 3.1 and 3.2 in Appendix A)</td></tr>
<tr><td>(b) details of baseline data to be obtained and when;</td><td>(see Section 3.1 in Appendix A)</td></tr>
</table>

CoA	Condition Requirements	Document Reference
	(c) details of all monitoring that will be undertaken;	(see Section 3.3, 3.4, 3.5, 4.3 and 4.5 in Appendix A)
	(d) the parameters of the project to be monitored;	(see Section 3.3 and 3.4 in Appendix B)
	(e) the frequency of monitoring;	(see Section 3.3 and 3.4 in Appendix A)
	(f) the location of monitoring;	(see Section 3.3 and 3.4 in Appendix A)
	(g) the reporting of monitoring and analysis results against relevant criteria, including details of the timing and frequency for reporting the results to the Planning Secretary and relevant government agencies;	(see Section 3.3 and 3.4 in Appendix A)
	(h) details of the methods that will be used to analyse the monitoring data;	(see Section 3.1, 3.3 and 3.4 in Appendix A)
	(i) procedures to identify and implement additional mitigation measures where results of monitoring indicate adverse impacts or levels above relevant criteria;	(see Section 4.3 in Appendix A)
	(j) any consultation to be undertaken in relation to the monitoring programs; and	Section 3.4.1 (see also Section 2.3 in Appendix A)
	(k) any specific requirements as required by Conditions C15 to C18, as relevant.	See C16 below

CoA	Condition Requirements	Document Reference
C16	The Noise and Vibration Monitoring Program must include: (a) noise and vibration monitoring at agreed representative sensitive receiver locations adjacent to the construction ancillary facilities in Arncliffe and Rockdale to confirm construction noise and vibration levels; (b) for the purposes of (a), noise monitoring during the day, evening and night-time periods must be undertaken within the first month of operation of the construction ancillary facilities and must cover the range of activities (excluding activities associated with site establishment) being undertaken at the sites; and (c) provision of real time noise and vibration monitoring data. The data must be readily available to the construction team, Proponent, ER and AA. The Department and EPA must be provided with access to the real-time monitoring data, on request.	(see Section 3.3 and 3.4 in Appendix A)
C19	The Construction Monitoring Programs must be developed in consultation with the relevant government agencies as identified in Condition C13 of this approval, and must identify information, including monitoring parameters, requested by a relevant agency to be included in a monitoring program.	Section 3.4.1 (see also Appendix A)
C20	The Construction Monitoring Programs must be endorsed by the ER and then submitted to the Planning Secretary for approval at least one (1) month prior to the commencement of construction.	CEMP Section 2 (see also Appendix A)
C21	Construction, which is required to be monitored under the Construction Monitoring Programs, must not commence until the Planning Secretary has approved all of the required Construction Monitoring Programs and all relevant baseline data for the specific construction activity has been collected.	CEMP Section 2 (see also Appendix A)
C22	The Construction Monitoring Programs, as approved by the Planning Secretary and including any minor amendments approved by the ER, must be implemented for the duration of construction and for any longer period set out in the monitoring program or specified by the Planning Secretary, whichever is the greater.	(see Section 2.1 in Appendix A)

CoA	Condition Requirements	Document Reference
C23	The results of the Construction Monitoring Programs must be made publicly available in the form of a Construction Monitoring Report at the frequency identified in the relevant Construction Monitoring Program. Note: Where a relevant CEMP Sub-plan exists, the relevant Construction Monitoring Program may be incorporated into that CEMP Sub-plan.	(see Section 4.5 in Appendix A)
Construction Noise and vibration management		
E59	Before conducting acoustic treatment at any building listed as a heritage item within the relevant LEP, the advice of a suitably qualified and experienced built heritage expert must be obtained and implemented to ensure any such work does not have an adverse impact on the heritage significance of the item.	Section 8.4
E61	A detailed land use survey must be undertaken to confirm sensitive receivers (including critical working areas such as operating theatres and precision laboratories) potentially exposed to construction noise and vibration, construction ground-borne noise and operational noise. The survey may be undertaken on a progressive basis but must be undertaken in any one area prior to the commencement of works which generate construction or operational noise, vibration or ground-borne noise in that area. The results of the survey must be included in the Noise and Vibration CEMP Sub-plan required by Condition C4.	Appendix B
E62	Works (except for tunnelling (excluding cut and cover tunnelling)) must only be undertaken during the following standard construction hours: (a) 7:00 am to 6:00 pm Mondays to Fridays, inclusive; (b) 8:00 am to 1:00 pm Saturdays; and (c) at no time on Sundays or public holidays.	Section 5.1
E63	Notwithstanding Condition E62, works may be undertaken between 1:00 pm to 6:00 pm on Saturday.	Section 5.1

CoA	Condition Requirements	Document Reference
E64	Notwithstanding Conditions E62 and E63 of this approval, the following activities may be undertaken 24 hours per day, seven days per week: (a) tunnelling (excluding cut and cover tunnelling); (b) delivery of material to support tunnelling; (c) haulage of spoil from the Arncliffe and Rockdale construction ancillary facilities; (d) works within an acoustic shed; and (e) tunnel fit out works. Other surface works associated with tunnelling must be undertaken in accordance with Condition E65 and E66.	Section 5.1
E65	Except as permitted by an EPL, highly noise intensive works that result in an exceedance of the applicable NML at the same receiver must only be undertaken: (a) between the hours of 8:00 am to 6:00 pm Monday to Friday; (b) between the hours of 8:00 am to 1:00 pm Saturday; and (c) in continuous blocks not exceeding three (3) hours each with a minimum respite from those activities or works of not less than one (1) hour. For the purposes of this condition, 'continuous' includes any period during which there is less than a one (1) hour respite period between ceasing and recommencing any of the work.	Section 5.1

CoA	Condition Requirements	Document Reference
E66	Notwithstanding Conditions E62 to E65, works may be undertaken outside the hours specified in the following circumstances: (a) for the delivery of materials required by the NSW Police Force or other authority for safety reasons; or (b) where it is required in an emergency to avoid injury or the loss of life, to avoid damage or loss of property or to prevent environmental harm; or (c) where different construction hours are permitted or required under an EPL in force in respect of the CSSI; or (d) Works which are **not** subject to an EPL that are approved under an Out-of-Hours Work Protocol required by Condition E70; or (e) construction that causes $L_{Aeq(15\ minute)}$ noise levels: i. no more than 5 dB(A) above the rating background level at any residence in accordance with the *Interim Construction Noise Guideline* (DECC, 2009), and ii. no more than the 'Noise affected' noise management levels specified in Table 3 of the *Interim Construction Noise Guideline* (DECC, 2009) at other sensitive land uses, and iii. continuous or impulsive vibration values, measured at the most affected residence are no more than the maximum values for human exposure to vibration, specified in Table 2.2 of *Assessing Vibration: a technical guideline* (DEC, 2006), and iv. intermittent vibration values measured at the most affected residence are no more than the maximum values for human exposure to vibration, specified in Table 2.4 of *Assessing Vibration: a technical guideline* (DEC, 2006). *Note: Section 5.24(1)(e) of the EP&A Act requires that an EPL be substantially consistent with this approval. Out-of-Hours works considered under Conditions E66(c) and (d) must be justified and include an assessment of the potential impacts and effectiveness of the proposed mitigation measures.*	Section 5.1 and Section 7

CoA	Condition Requirements	Document Reference
E67	On becoming aware of the need for emergency works in accordance with Condition E66(b), the Proponent must notify the AA, the ER, the Planning Secretary and the EPA of the reasons for such work. The Proponent must use best endeavours to notify all noise and/or vibration affected sensitive receivers of the likely impact and duration of those works.	Section 8.5
E68	Out-of-hours works that are regulated by an EPL as per Condition E66(c) or through the Out-of-Hours Work Protocol as per Condition E70 include: (a) works which could result in a high risk to construction personnel or public safety, based on a risk assessment carried out in accordance with AS/NZS ISO 31000:2009 "*Risk Management – Principles and Guidelines*"; or (b) where the relevant road network operator has advised the Proponent in writing that carrying out the works and activities could result in a high risk to road network operational performance; or (c) where the relevant utility service operator has advised the Proponent in writing that carrying out the works and activities could result in a high risk to the operation and integrity of the utility network; or (d) where the TfNSW Transport Management Centre (or other road authority) has advised the Proponent in writing that a road occupancy licence is required and will not be issued for the works or activities during the hours specified in Condition E62 and Condition E63. *Note: Other out-of-hours works can be undertaken with the approval of an EPL, or through the project's Out-of-Hours Work Protocol for works not subject to an EPL.*	Section 5.1 and Appendix C

CoA	Condition Requirements	Document Reference
E69	In order to undertake out-of-hours work under **Condition E68**, the Proponent must identify appropriate respite periods for the out-of-hours works in consultation with the community at each affected location on a regular basis. This consultation must include (but not be limited to) providing the community with: (a) a progressive schedule for periods no less than three (3) months, of likely out-of-hours work; (b) the potential works, location and duration; (c) the noise characteristics and likely noise levels of the works; and (d) likely mitigation and management measures which aim to achieve the relevant noise management level (including the circumstances of when a respite or relocation offer will be available and details about how the affected community can access these offers). The outcomes of the community consultation, the identified respite periods and the scheduling of the likely out-of-hour works must be provided to the AA**,** EPA and the Planning Secretary.	Section 8.5.3

CoA	Condition Requirements	Document Reference
E70	An Out-of-Hours Work Protocol must be prepared to identify a process for the consideration, management and approval of works which are outside the hours defined in Conditions E62 and E63 and that are **not** subject to an EPL. The Protocol must be approved by the Planning Secretary prior to commencement of the works. The Protocol must be prepared in consultation with the EPA and AA. The Protocol must identify activities in terms of their risk of adverse impacts on sensitive receivers (low, medium, high) and include: (a) a process for the consideration of out-of-hours works against the relevant noise and vibration criteria, including the determination of low, medium and high-risk activities; (b) a process for selecting and implementing mitigation measures for residual impacts in consultation with the community at each affected location, including respite periods consistent with the requirement of Condition E69. The measures must take into account the predicted noise levels and the likely frequency and duration that sensitive receivers would be exposed to residual impacts, including the number of noise awakening events; (c) procedures to facilitate the coordination with other out-of-hours works, including those approved by an EPL or undertaken by a third party, to ensure appropriate respite is provided; (d) an approval process that considers the risk of works, proposed mitigation and management, and coordination, including where: i. the ER and AA review all proposed out-of-hours activities and confirm their risk levels, ii. low risk activities can be approved by the ER in consultation with the AA, and iii. medium and high risk activities are approved by the Planning Secretary. (e) notification arrangements for affected receivers and the EPA for all approved out-of-hours works and notification to the Planning Secretary of approved low risk out-of-hours works.	Appendix C (Note: evidence of consultation with EPA and AA provided in Section 3.4.1 of this Plan)

CoA	Condition Requirements	Document Reference
E71	All works undertaken for the delivery of the CSSI, including those undertaken by third parties (such as utility relocations), must be coordinated to ensure respite periods are provided**.** The Proponent must: (a) reschedule any works to provide respite to impacted noise sensitive receivers so that the respite is achieved in accordance with **Condition E69**; or (b) consider the provision of alternative respite or mitigation to impacted noise sensitive receivers; and (c) provide documentary evidence to the **AA** in support of any decision made by the Proponent in relation to respite or mitigation.	Section 0 and Section 8.1

CoA	Condition Requirements	Document Reference
E72	Mitigation measures must be implemented with the aim of achieving the following construction noise management levels and vibration criteria: (a) construction 'Noise affected' noise management levels established using the *Interim Construction Noise Guideline* (DECC, 2009); (b) vibration criteria established using the *Assessing vibration: a technical guideline* (DEC, 2006) (for human exposure); (c) Australian Standard AS 2187.2 - 2006 "*Explosives - Storage and Use - Use of Explosives*"; (d) BS 7385 Part 2-1993 "*Evaluation and measurement for vibration in buildings Part 2*" as they are "applicable to Australian conditions"; and (e) the vibration limits set out in the *German Standard DIN 4150-3: Structural Vibration- effects of vibration on structures* (for structural damage). (f) residential ground-borne noise levels of – (g) evening (6:00 pm to 10:00 pm) — internal $L_{Aeq(15\ minute)}$: 40 dB(A), and (h) night (10:00 pm to 7:00 am) — internal $L_{Aeq(15\ minute)}$: 35 dB(A) *Note: The Interim Construction Noise Guideline identifies 'particularly annoying' activities that require the addition of 5 dB(A) to the predicted level prior to comparing to the construction Noise Management Level.*	Section 5, Section 7, Section 8 and Section 9
E73	**Construction Noise and Vibration Impact Statements (CNVIS)** must be prepared for construction ancillary facility(s) before any works that may exceed the noise management levels, vibration criteria and/or ground-borne noise levels specified in **Condition E72** commence. **CNVIS** must include specific mitigation measures identified through consultation with affected sensitive receivers and the mitigation measures must be implemented for the duration of the works.	Section 7.2

CoA	Condition Requirements	Document Reference
E74	Noise generating works near community, religious, educational institutions and noise and vibration-sensitive businesses and critical working areas (such as theatres, laboratories and operating theatres) resulting in noise levels above the NMLs must not be timetabled within sensitive periods, unless other reasonable arrangements with the affected institutions are made at no cost to the affected institution.	Section 3.4 and Section 8.1
E75	Owners and occupiers of properties at risk of exceeding the screening criteria for cosmetic damage must be notified prior to works that generate vibration commences near those properties. If the potential exceedance is to occur more than once over a period of 24 hours, owners and occupiers are to be provided a schedule of potential exceedances on a monthly basis for the duration of the potential exceedances, unless otherwise agreed by the owner and occupier. These properties must be identified and considered in the Noise and Vibration CEMP Sub-plan required by Condition C4 and the Communication Strategy required by Condition B1.	Section 8.30
E76	The Proponent must conduct vibration testing prior to and during vibration generating activities that have the potential to impact on heritage items to identify minimum working distances and/or any changes required to plant and equipment to prevent damage on built heritage items. These measures must be implemented where testing indicates the potential for vibration to damage built heritage items.	Section 9.3.2
E77	All acoustic sheds must be erected as soon as site establishment works at the facilities are completed and before undertaking any works which are required to be conducted within the sheds.	Section 8.1

CoA	Condition Requirements	Document Reference
E78	At-receiver noise mitigation in the form of at-property treatment must be offered to the landowners of the residential properties (including long-term accommodation providers) identified in **Appendix C** for habitable living spaces, unless other mitigation or management measures are agreed to by the landowner. Mitigation must be offered prior to out-of-hours works commencing. The at-property construction noise mitigation treatments must be installed prior to the commencement of any out-of-hours works that may cause sleep disturbance (as described in NSW Road Noise Policy (DECCW, 2011)), unless otherwise approved by the Planning Secretary. The Proponent must prepare a report which details the range of at-property noise mitigation treatments to be offered and the procedures and terms of implementing such treatments. The report must be endorsed by the AA and submitted to the Planning Secretary for approval at least one month prior to making any offers to the landowners of the properties identified in **Appendix C.** This requirement does not apply if the sensitive receiver has been provided with noise mitigation under the TfNSW (RMS) Noise Abatement Program or the *State Environment Planning Policy (Infrastructure) 2007* (clause 102(3)). The adequacy of at-property treatments will be reviewed where previous treatments have been installed as part of other SSI or CSSI projects.	Section 8.4
E79	Landowners whose residential properties are eligible to receive at-property treatment under Condition E78 must be advised of the range of options that can be installed at or in their property and given a choice as to which of these they agree to have installed.	Section 8.4
E80	The offer for at-property treatment in accordance with Condition E78 does not expire until the out-of-hours work affecting that property are completed, even if the landowner initially refuses the offer.	Section 8.4
E81	The implementation of Conditions E78 and E85 does not preclude the application of other noise and vibration mitigation and management measures including temporary alternative accommodation specified under Condition E82.	Section 8.5.4

CoA	Condition Requirements	Document Reference
E82	Temporary alternative accommodation is to be offered/ made available to residents affected by out-of-hours works (including where utility works are being undertaken for the project) where the construction noise levels, between: (a) 10:00 pm and 7:00 am, Monday to Friday; (b) 10:00 pm to 8:00 am, Saturday; and (c) 6:00 pm to 7:00 am, Sunday and public holidays, are predicted to exceed the NML +25 dB(A) or are greater than 75 dBA ($L_{Aeq(15\ min)}$), whichever is the lesser and the impact is planned to occur for more than two (2) nights over a seven (7) day period. The noise level is to be reduced by 5 dB where the noise contains annoying characteristics and increased by 10 dB if the property has been treated or offered at-property noise treatment. The noise levels and duration requirements identified in this condition may be changed through an EPL applying to the CSSI.	Section 8.5.4 and Section 8.6

CoA	Condition Requirements	Document Reference
E84	The Proponent must prepare an **Operational Noise and Vibration Review (ONVR**) to confirm noise and vibration control measures that would be implemented for operation. The **ONVR** must be prepared in consultation with relevant council(s), other relevant stakeholders and the community and must: (a) confirm the appropriate operational noise and vibration objectives and levels for surrounding development, including existing sensitive receivers; (b) confirm the operational noise predictions based on the final design. Confirmation must be based on an appropriately calibrated noise model (which has incorporated noise monitoring, and concurrent traffic counting, where necessary for calibration purposes). The assessment must specifically include verification of noise levels at all fixed facilities, based on noise monitoring undertaken at appropriately identified noise catchment areas surrounding the facilities; (c) confirm the operational noise and vibration impacts at adjoining development based on the final design of the CSSI, including operational daytime $L_{Aeq,15\ hour}$ and night-time $L_{Ae,\ 9\ hour}$ traffic noise contours; (d) review the suitability of the operational noise mitigation measures identified in the documents listed in **Condition A1** and, where necessary, investigate and identify additional noise and vibration mitigation measures required to achieve the noise criteria outlined in the *NSW Road Noise Policy* (DECCW, 2011) and *Noise Policy for Industry* (EPA, 2017); (e) include a consultation strategy to seek feedback from directly affected land owners on the noise and vibration mitigation measures; and (f) procedures for the management of operational noise and vibration complaints. The **ONVR** is to be reviewed and endorsed by the **AA** and submitted to the Planning Secretary for approval. The Proponent must make the **ONVR** publicly available and implement the identified noise and vibration control measures in the **ONVR** prior to commencing operation.	Not applicable to Stage 1 preliminary construction

3.3 Environmental Management Measures

Relevant EMMs are listed in Table 3 below. This includes reference to required outcomes, the timing of when the commitment applies, relevant documents or sections of the environmental assessment influencing the outcome and implementation.

Table 3 Environmental Management Measure relevant to this CNVMP

Ref #	Commitment	Timing	NVMP
NV1	A Construction Noise and Vibration Management Plan (CNVMP) will be prepared. The CNVMP will include processes and responsibilities to assess, monitor, minimise and mitigate noise and vibration impacts during construction. The plan will:	Prior to construction	This Plan
	• Identify relevant performance criteria in relation to noise and vibration		Section 5
	• Identify noise and vibration sensitive receptors and features in the vicinity of the project		Section 4.1
	• Include standard and additional mitigation measures from the Construction Noise and Vibration Guideline (CNVG) (Roads and Maritime 2016) and details about when each will be applied		Section 8.6
	• Describe the process(es) that will be adopted for carrying out location and activity specific noise and vibration impact assessments to assist with the selection of appropriate mitigation measures		Section 7 and Appendix C
	• Consider cumulative construction noise impacts and construction noise fatigue		Section 3.4.3, Section 7.2 Section 7.3, Section 8 and Appendix C
	• Include protocols that will be adopted to manage works required outside standard construction hours, in accordance with relevant guidelines including for management of respite periods		Appendix C

Ref #	Commitment	Timing	NVMP
	• **Include a Blast Management Strategy (where blasting is required)**		Section 7.4
	• Detail monitoring that will be carried out to confirm project performance in relation to noise and vibration performance criteria.		Section 9
	The CNVMP will be implemented for the duration of the construction of the project.		
NV2	Detailed noise assessments will be carried out for all ancillary facilities required for construction of the project. The requirement for temporary noise walls within ancillary facilities and adjacent to construction works, and the requirement for other appropriate noise management measures, is to be assessed and implemented prior to the commencement of activities which have the potential to cause noise or vibration impacts.	Prior to construction	Section 7

Ref #	Commitment	Timing	NVMP
NV3	All residents affected by noise from the construction of the project which are expected to experience an exceedance of the construction noise management levels will be notified about potential noise impacts prior to the commencement of construction works. Roads and Maritime will consult with vulnerable members of the community who are likely to be more susceptible to adverse health effects of noise (especially those who are elderly, who do not speak English, are housebound, or who may be unwell) to accommodate their preferences for noise mitigation, as far as practicable. Consultation will also be undertaken with all schools likely to be affected, and in particular Cairnsfoot Special School, to determine suitable mitigation measures where necessary. The information provided to the residents will include: • General sequencing and locations of construction work • The hours of the project works • Construction noise and vibration impact predictions for the works • Construction noise and vibration mitigation measures likely to be implemented on site. Community consultation regarding construction noise and vibration will be detailed in the Community Communication Strategy for the construction of the project and will include a complaints handling process. The community will be able to provide feedback via a 24 hour, toll-free project information and complaints line, a dedicated email address and postal address for the project. For out of hours works, consultation with affected residents will take place with consideration to Practice note vii of the ENMM and Strategy 2 of the ICNG.	Prior to construction	Section 3.4, Section 7 and Section 8

Ref #	Commitment	Timing	NVMP
NV4	Noisy work (as defined in the EPL) and vibration intensive activities (those activities that exceed the vibration criteria) will be scheduled to be undertaken during standard construction hours as far as possible. Works or activities that cannot be undertaken during standard construction hours will be scheduled as early as possible during the evening and/or night-time periods. Respite measures are to be implemented for noisy work and vibration intensive activities in a manner consistent with EPL and Roads and Maritime guideline requirements.	Construction	Section 7 and Section 8
NV5	Receptors identified as requiring at-property noise mitigation because of an exceedance of operational traffic noise goals be offered treatment prior to construction commencing. The receptors which are predicted to trigger consideration of noise mitigation will be confirmed during future design phases of the project and any additional eligible receptors will be contacted and noise mitigation options discussed with them.	Construction	Section 8.4 and NVMM26
NV6	Construction vehicle movements (on and off site) will be managed to avoid or minimise noise impacts. Where reasonable and feasible, spoil will only be removed from site during the day. Mitigation measures for vehicle movements outside of standard construction hours are to be included in the CNVMP.	Construction	Section 8
NV7	Vibration generating activities will be managed to minimise the potential for impacts on structures and sensitive receptor(s), including maximising safe working distances where practicable, or use of alternate methods to minimise vibration where safe working distances cannot be achieved. Where alternatives cannot be implemented, vibration monitoring is to be undertaken and receptors notified in advance of works. Vibration monitors are to provide real-time notification of exceedances of levels approaching cosmetic damage criteria.	Construction	Section 8.3
SE4	Prepare and implement a Construction Fatigue Protocol as part of the CNVMP to address potential construction fatigue impacts. The Protocol will include consideration of noise attenuation and periods of respite for affected stakeholders, where reasonable and feasible, and restricting out of hours work where practicable.	Prior to construction	Appendix C

Ref #	Commitment	Timing	NVMP
PL4	Prior to the commencement of construction, pre-construction Building Condition Surveys will be offered in writing, to the owners of properties where there is a potential for construction activities to cause cosmetic or structural damage. If accepted, a comprehensive written and photographic condition report would be produced by an appropriate professional prior to relevant works commencing.	Prior to construction	Section 8.3.2 and NVMM10

3.4 Consultation

3.4.1 Relevant government agencies and council(s)

The Noise and Vibration CEMP Sub-plan has been prepared in consultation in accordance with A5, C4(b) and C5. Consultation was carried out with Bayside Council and NSW Health and key matters raised by the stakeholders during this process are featured in Table 4.

Table 4 Key matters raised in consultative process

Relevant Public Authority	Query	Action
Bayside Council	No queries were raised by Bayside Council in regards to the Noise and Vibration Monitoring Program.	Nil
NSW Health	Due to current pandemic conditions, NSW Health was unable to provide resources for consultation at this time.	CGU commits to consulting with NSW Health when resources become available.

The Noise and Vibration Monitoring Program (Appendix A) has been prepared in accordance with C13(c) and consultation was undertaken in accordance with A5 and C13(c). Details on this consultation is featured in Section 2.3 of the Monitoring Program.

The Out of Hours Protocol (Appendix C) has been prepared in accordance with E70 and consultation was undertaken with the AA and EPA. Details on this consultation is featured in Section 1.2 of the Protocol.

3.4.2 Community consultation

Consultation would also be undertaken with the community affected by the out of hours works to coordinate appropriate respite periods, in accordance with CoA E69. Ongoing consultation with the community may be carried out for particular issues pertaining to the Project's noise and vibration impacts, including the identification of appropriate respite periods for out-of-hours works (OOHW).

Furthermore, for works near community, religious, educational institutions and noise and vibration-sensitive businesses and critical working areas (such as theatres, laboratories and operating theatres) consultation would be undertaken where noise and/or vibration generating works are predicted above the criteria identified in Section 5, to satisfy CoA E74 and CoA E75. This would include consultation with vulnerable members of the community who are likely to be more susceptible to adverse health effects as a result of construction noise (especially those who are elderly, who do not speak English, are housebound, or who may be unwell). Noise generating works would not timetabled within sensitive periods, where reasonable and feasible and to preferences for noise mitigation would be accommodated, where practicable.

There are limited out of hours works requirements required for preliminary construction including commencement activities. Community notification and consultation requirements for these works are identified and described in the CNVIS.

Community feedback and complaints relating to noise and vibration will be dealt with in accordance with the Communication Strategy (M6S1-CGU-NWW-CYCG-MPL-000900).

3.4.3 Cumulative noise impact

Ongoing consultation will include regular coordination with State significant developments; infrastructure projects and other construction works being undertaken within 200m of the Project. This consultation will be undertaken with the aim of coordinating works to manage cumulative noise and vibration impacts, in accordance with CoA C5(d) and the EPL.

4 Existing environment

4.1 Sensitive receivers

The Project is located within the Bayside local government area (LGA) and traverses the suburbs of Wolli Creek, Arncliffe, Banksia, Rockdale, Brighton le Sands, Kogarah and Monterey. To comply with CoA E61, a land use survey in areas where works could impact on sensitive receivers is provided Appendix B of this Plan and in Figure 1. The land use survey identified the existing land use and development within and around the Project, which contains a mix of residential, educational, commercial, industrial and open space uses. Aboriginal places and environmental heritage items have also been identified, where relevant.

Physical ground truthing of sensitive receivers impacted by Stage 1 Preliminary Construction has been undertaken. Further ground truthing will be completed prior to Stage 2 Construction.

The land use survey will continue to be updated throughout the delivery of the Project. Where other sensitive receivers are identified (including unexpected Aboriginal places or items of environmental heritage), noise and vibration modelling will then account for them and appropriate mitigation measures will be implemented.

4.1.1 Noise Catchment Areas

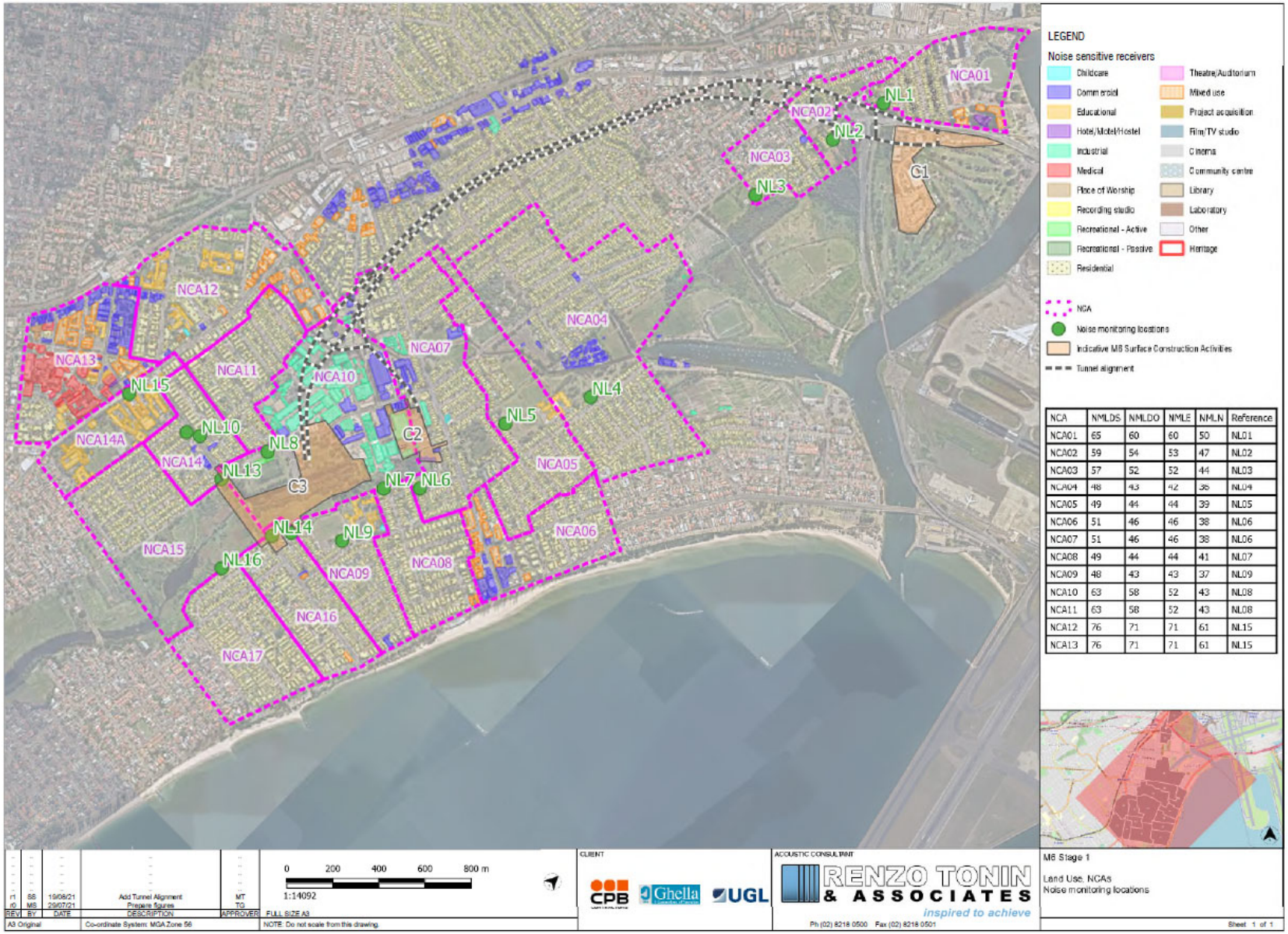
A noise assessment was conducted as part of the development of the EIS and forms Appendix G of the EIS: Technical Working Paper – Noise and Vibration. The EIS noted that key noise sources in the study area include transport infrastructure, including the M5 East Motorway, the arterial road network, Sydney Airport and freight and passenger railway lines.

At the northern end of the Project the noise environment is dominated by road traffic noise from Marsh Street, West Botany Street, the Princes Highway and the M5 East Motorway. The area surrounding the mid-section of the Project is largely suburban. Receivers close to arterial and sub arterial roads including Princes Highway, West Botany Street, Bestic Street and Bay Street are dominated by road traffic noise. Receivers further away from these roads are quieter and suburban sounds and local traffic dominate. At the southern end of the Project, road traffic noise from West Botany Street, President Avenue and the Princes Highway dominates the noise environment. It was noted that residential receivers that back onto the Rockdale Bicentennial Park or the Scarborough and Kings wetlands area would have comparatively lower levels of noise.

To facilitate the assessment of noise impacts from the Project, receivers along the Project alignment have been divided into Noise Catchment Areas (NCAs). NCAs group individual sensitive receivers by common traits such as existing noise environment and location in relation to the Project.

The EIS assessment process identified a total of 17 NCAs along the Project alignment. Review of the EIS NCAs determined that NCA 14 should be subdivided into two NCAs better reflecting the existing acoustic environment of the receiver areas. This would assist with the assessment of impacts to sensitive receivers, in particular with notifications regarding noise from out of hours works associated with the Project.

The NCAs for the Project are presented on the map in Figure 1 with a description of the noise characteristics of each area presented in Table 5. NCAs are also presented in the Land Use Survey (refer to Appendix B).



NCA	NMLDS	NMLDO	NMLE	NMLN	Reference
NCA01	65	60	60	50	NL01
NCA02	59	54	53	47	NL02
NCA03	57	52	52	44	NL03
NCA04	48	43	42	36	NL04
NCA05	49	44	44	39	NL05
NCA06	51	46	46	38	NL06
NCA07	51	46	46	38	NL06
NCA08	49	44	44	41	NL07
NCA09	48	43	43	37	NL09
NCA10	63	58	52	43	NL08
NCA11	63	58	52	43	NL08
NCA12	76	71	71	61	NL15
NCA13	76	71	71	61	NL15

Figure 1 Sensitive receivers - land use survey and Noise Catchment Areas

Table 5 Noise Catchment Areas and Surrounding Land Uses

NCA	Description of receivers	Main sources of background noise
NCA01	This predominantly residential catchment is located to the north west of C1 Arncliffe worksite. Residential receivers are located on Marsh Street which face the worksite and West Botany Street which bounds the NCA to the west. In the northern extent of the catchment there are several apartment buildings and a hotel which overlook the worksite.	Road traffic noise from Marsh Street, West Botany Street and M5 East Motorway.
NCA02	Located to the south west of the C1 Arncliffe worksite and M5 East Motorway. Mostly residential receivers, some of which face West Botany Street. Eve Street wetlands is also located in this NCA.	Road traffic noise from Marsh Street, West Botany Street and M5 East Motorway.
NCA03	This NCA is approx. 250 metres south of the C1 Arncliffe worksite. Mostly residential receivers. Riverine Park is located next to this catchment.	Road traffic noise from West Botany Street, Wickham Street and M5 East Motorway.
NCA04	This NCA is approximately 500 metres north of the C2 Rockdale worksite. Mostly residential receivers with commercial, educational, industrial, places of worship and active recreational receivers also included in the NCA.	Road traffic noise from West Botany Street and Bestic Street.
NCA05	This NCA is approximately 300 metres north of the C2 Rockdale worksite. Mostly residential receivers with educational and active recreational receivers also included in the NCA.	Road traffic noise from West Botany Street and Francis Avenue.
NCA06	This NCA is approximately 300 metres east of the C2 Rockdale worksite. Mostly residential receivers with commercial and mixed use receivers also included in the NCA.	Road traffic noise from Bay Street and The Grand Parade.
NCA07	C2 Rockdale worksite is within NCA07. Mostly residential receivers with commercial, industrial and places of worship also included in the NCA.	Road traffic noise from West Botany Street and Bay Street.
NCA08	This NCA is approximately 150 metres south east of the C2 Rockdale worksite. Mostly residential receivers with places of worship also included in the NCA.	Road traffic noise from Bay Street and The Grand Parade.
NCA09	This NCA is approximately 150 metres east of the C3 Bicentennial Park worksite. Mostly residential receivers with commercial, educational and active recreational receivers also included in the NCA.	Road traffic noise from President Avenue and The Grand Parade.

NCA10	C3 Bicentennial Park and MOC3 worksite are within NCA10. Mostly industrial receivers with commercial and military receivers also included in the NCA.	Road traffic noise from West Botany Street. Industrial noise from industrials receivers within NCA10.
NCA11	This NCA is approximately 50 metres south west of the C3 Bicentennial Park worksite. Only residential receivers within the NCA.	Road traffic noise from West Botany Street and Princes Highway.
NCA14	This NCA is approximately 200 metres south west of the C3 Bicentennial Park worksite. Mostly residential receivers with commercial receivers also included in the NCA.	Road traffic noise from President Avenue and Princes Highway.
NCA14A	This NCA is approximately 500 metres south west of the C3 Bicentennial Park worksite. Mostly educational receivers with residential receivers also included in the NCA.	Road traffic noise from President Avenue and Princes Highway.
NCA15	This NCA is approximately 500 metres south of the C3 Bicentennial Park worksite. Only residential receivers within the NCA. Civic Avenue Reserve is located in this NCA.	Road traffic noise from President Avenue and Princes Highway.
NCA16	This NCA is approximately 200 metres south east of the C3 Bicentennial Park worksite. Mostly residential receives with commercial and mixed use receivers also included in the NCA.	Road traffic noise from President Avenue and The Grand Parade.
NCA17	This NCA is approximately 400 metres south east of the C3 Bicentennial Park worksite. Only residential receivers within the NCA.	Road traffic noise from President Avenue and The Grand Parade.

4.2 Ambient noise

Ambient noise monitoring was completed at 16 monitoring locations are part of the EIS generally within the following three noise monitoring periods:

- June 2015 (as part of the M8 Motorway project);
- November/December 2017; and
- February 2018.

The monitoring locations were representative of receivers that would likely be most affected by the construction and operation of the Project in each NCA. The attended measurements generally found that existing noise levels are typically dominated by transportation noise sources including road, rail and air, depending on location. A review was undertaken on the data from June 2015 (as part of the M8 Motorway project) as the data is more than 5 years old. The data is considered representative of the existing acoustic environment in Arncliffe. Furthermore, monitoring during COVID 19 restrictions in Sydney may result in non-typical background noise levels.

A summary of the unattended noise logging results is provided in Table 6 below, which is sourced from the EIS Appendix G Noise and Vibration Technical Report. This table provides a summary of the ambient noise monitoring results. The noise monitoring locations are shown on the map in

and on the Land Use Survey (refer to Appendix B).

Table 6 Summary of baseline noise monitoring data from EIS

Monitor ID (EIS)	Address	Rating background level RBL			Existing ambient noise L_{Aeq}			Applicable NCA
		Day[1]	Evening[1]	Night[1]	Day[1]	Evening[1]	Night[1]	
NL01	20 Marsh Street, Arncliffe	55	55 (56)[2]	45	61	62	59	NCA01
NL02	6 Eve Street, Arncliffe	49	48	42	54	55	50	NCA02
NL03	25 Firmstone Garden, Arncliffe	47	47 (49)[2]	39	55	54	50	NCA03
NL04	82 Francis Avenue, Brighton-Le-Sands	38	37	31	49	47	44	NCA04
NL05	CA Redmond Field (Rear of 103 Bruce Street, Brighton-Le-Sands)	39	39	34	56	49	45	NCA05
NL06	19 England Street, Brighton-Le-Sands	41	41	33	56	55	53	NCA06 & NCA07
NL07	1B Kings Road, Brighton-Le-Sands	39	39 (40)[2]	36	53	51	46	NCA08
NL08	Ilinden Sports Centre, Rockdale (468 West Botany Street, Rockdale)	53	47	38	64	62	60	NCA10 & NCA11
NL09	53 Crawford Road, Brighton-Le-Sands	38	38	32	52	51	47	NCA09
NL10	48 President Avenue, Kogarah	52	52	38	65	65	63	NCA14[3]
NL11	66 O'Neill Street, Brighton-Le-Sands	42	41	35	53	51	49	-

Monitor ID (EIS)	Address	Rating background level RBL			Existing ambient noise L_{Aeq}			Applicable NCA
		Day[1]	Evening[1]	Night[1]	Day[1]	Evening[1]	Night[1]	
NL13	63 President Avenue, Kogarah	56	53	39	65	63	62	-
NL14	138 President Avenue, Brighton-Le-Sands	57	50	37	71	66	65	NCA16
NL15	TAFE, 750 Princes Highway, Kogarah	66	66	56	72	70	68	NCA12, NCA13 & NCA14A[3]
NL16	Scarborough Park North, Monterey (Rear of 19 Colson Crescent, Monterey)	42	40	32	58	53	44	NCA15 & NCA17

NOTES:

1. DAY is the period from 7am to 6pm (Monday to Saturday) and 8am to 6pm (Sundays and Public Holidays); EVENING is the period from 6pm to 10pm; NIGHT is the period from 10pm to 7am (Monday to Saturday) and 10pm to 8am (Sundays and Public Holidays)
2. Application notes to the NPfI indicate that the community generally expects a greater control of noise during the evening and night as compared to the day time. Therefore the rating background level for the evening is set to no more than that for the daytime and the night-time to no more than the evening. Number in brackets () refers to measured RBL.
3. NCA boundary redefined compared to EIS to better represent acoustic environment on near President Avenue.

5 Noise and vibration criteria for NSW

The documents outlined in Table 7 have been used to establish the Project management levels and goals for assessing construction noise and vibration.

Table 7 Policies and standards used to establish noise and vibration management levels/goals

Environment impact	Relevant documents used to establish noise and vibration management level
Construction hours	Conditions of Approval EPL
Airborne noise	Conditions of Approval Interim Construction Noise Guideline (ICNG)
Sleep disturbance and maximum noise events	No specific guidelines. Guidance taken from the Interim Construction Noise Guideline (ICNG), the Road Noise Policy (RNP) and Roads and Maritime Environmental Noise Management Manual (ENMM) Practice
Ground-borne noise	Conditions of Approval Interim Construction Noise Guideline (ICNG)
Construction-related road traffic noise	No specific guidelines. Guidance taken from the Interim Construction Noise Guideline (ICNG) and the Road Noise Policy (RNP).
Vibration (disturbance to building occupants)	Conditions of Approval NSW DECC's Assessing vibration; a technical guideline, published in February 2006, in line with CoA D16(b), which incorporates British Standard BS 6472-2008, Evaluation of human exposure to vibration in buildings (1-80Hz)
Vibration (structural damage to buildings)	Conditions of Approval British Standard 7385:1993 Evaluation and measurement of vibration in buildings – Part 2 Guide to damage from ground-borne vibration DIN4150-2016 Structural vibration Part 3: Effects of vibration on Structures (for structurally unsound heritage structures)
Vibration (structural damage to buried services)	German Standard DIN 4150:1999 – Part 3 Structural vibration in buildings – Effects on structures
Vibration (sensitive scientific and medical equipment)	ASHRAE Applications Handbook (SI) 2003, Chapter 47 Sound and Vibration Control Gordon GC 28 September 1999 Generic Vibration Criteria for Vibration Sensitive Equipment Australian Standard 2834-1995 Computer Accommodation, Chapter 2.9 Vibration

5.1 Construction hours

Table 8 below consolidates the information provided in the CoA regarding construction working hours for Project.

Table 8 Summary of construction working hours for the Project

CoA	Construction Activity	Monday to Friday	Saturday	Sunday / public holiday
E62 & E63	Standard construction hours Works (except for tunnelling (excluding cut and cover tunnelling))	7:00am to 6:00pm	8:00am to 6:00pm	No work[1]
E64	Tunnelling (excluding cut and cover tunnelling) Delivery of material to support tunnelling Haulage of spoil from the Arncliffe and Rockdale construction ancillary facilities Works within an acoustic shed Tunnel fit out works	24 hours	24 hours	24 hours
E65	Highly noise intensive works that result in an exceedance of the applicable NML[2] at the same receiver	8:00am to 6:00pm (+ respite[3])	8:00am to 1:00pm (+ respite[3])	No work[1]
E66	Work may be undertaken outside standard construction hours: • for the delivery of materials required by the NSW Police Force or other authority for safety reasons; or • where it is required in an emergency to avoid injury or the loss of life, to avoid damage or loss of property or to prevent environmental harm[4]; or • where different construction hours are permitted or required under an EPL in force in respect of the Project[5]; or • Works approved under an Out-of-Hours Work Protocol (see Appendix C), where an EPL does not apply[5]	6:00 pm to 7:00 am	6:00 pm to 8:00 am	8:00 am to 7:00am

CoA	Construction Activity	Monday to Friday	Saturday	Sunday / public holiday
E66 (cont)	• Low impact work, for construction work that causes: ◦ $L_{Aeq(15\ minute)}$ noise levels no more than 5 dB(A) above the RBL at any residence in accordance with the ICNG ◦ $L_{Aeq(15\ minute)}$ noise levels no more than the 'Noise affected' NMLs specified in Table 3 of the ICNG ◦ continuous or impulsive vibration values, measured at the most affected residence are no more than the maximum values for human exposure to vibration, specified in Table 2.2 of the AVTG ◦ intermittent vibration values measured at the most affected residence are no more than the maximum values for human exposure to vibration specified in Table 2.4 of the AVTG	6:00 pm to 7:00 am	6:00 pm to 8:00 am	8:00 am to 7:00am
E91	Blasting[6]	9:00am to 5:00pm	9:00am to 1:00pm	No blasting

Notes: Greyed out rows do not apply to this stage of work (preliminary construction including commencement activities).

1. No work unless permitted and approved
2. Highly noise intensive work restrictions apply to surface works. The applicable NML for residential receivers is the highly noise affected level of 75dB(A)
3. Minimum respite from highly noise intensive works of not less than one (1) hour between each continuous block of works not exceeding three (3)
4. In accordance with CoA E67, on becoming aware of the need for emergency works to avoid the loss of life, damage of property or environmental harm, CGU will notify the AA, the ER, the Planning Secretary, and the EPA of the reasons for such work. In these circumstances, CGU will use best endeavours to notify all noise and/or vibration affected sensitive receivers of the likely impact and duration of the works.
5. Out-of-Hours works must be justified and include an assessment of the potential impacts and effectiveness of the proposed mitigation measures
6. Blasting outside of these hours must be authorised through an EPL.

Construction would be undertaken during the approved standard construction hours wherever possible. Where construction cannot be undertaken during standard construction hours, works or activities that cannot be undertaken during standard construction hours will be scheduled as early as possible during the evening and/or night-time periods. Works will be scheduled with the following hierarchy, in accordance with the Roads and Maritime Construction Noise and Vibration Guideline:

1. 8:00 am to 6:00 pm Sunday (or public holidays) or 6:00 pm to 10:00pm weekdays
2. 10:00 pm to 7:00 am weekday nights
3. 10:00 pm to 8:00 am Saturday night or 6:00 pm to 7:00 am Sunday or public holiday nights.

5.2 Airborne construction noise objectives

The ICNG provides guidelines for the assessment and management of airborne construction noise. The ICNG focuses on applying a range of work practices to minimise construction noise impacts rather than focusing on achieving numeric noise levels.

The main objectives of the ICNG are to:

- Identify and minimise noise from construction works;
- Focus on applying all 'feasible' and 'reasonable' work practices to minimise construction noise impacts;
- Encourage construction during the recommended standard hours only, unless approval is given for works that cannot be undertaken during these hours;
- Reduce time spent dealing with complaints at the project implementation stage; and
- Provide flexibility in selecting site-specific feasible and reasonable work practices to minimise noise impacts.

5.2.1 Residential receivers

Table 9 below, which was sourced from the ICNG, shows how NMLs at residential receivers are determined and how they are to be applied. The rating background level (RBL) is used when determining the noise management level (NML). 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 and methodology to obtain RBLs is described in detail within the Noise Policy for Industry (NPfI)(EPA, 2017).

Table 9 Airborne Noise Management Levels (NMLs) at Residential Receivers

Time of Day	Noise Management Level (NML) L_{Aeq} (15min)	How to Apply
Standard hours: • Monday to Friday 7 am to 6 pm • Saturday 8 am to 6 pm	Noise affected RBL + 10 dB(A)	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 75dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, CGU would carefully consider other ways to reduce noise to below this level. If no quieter work method is feasible or reasonable and the works proceed, the proponent would provide respite periods and communicate with the impacted residents.

Time of Day	Noise Management Level (NML) L_{Aeq} (15min)	How to Apply
Outside recommended standard hours	Noise affected RBL + 5 dB(A)	A strong justification would typically be required for works outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5 dB above the noise affected level, additional noise mitigation measures should be applied in accordance with RMS CNVG.

Sleep disturbance

Where construction works are planned to extend over more than two consecutive nights, the ICNG recommends that an assessment of sleep disturbance impacts be completed. The ICNG refers to the Environmental criteria for road traffic noise (EPA 1999) for assessing the potential impacts, which notes that to limit the level of sleep disturbance the L_{Amax} should not exceed the existing L_{90} noise level by more than 15 dB. In situations where this results in an external screening level of less than 55 dB(A), a minimum screening level of 55 dB(A) is set. Note that this is equivalent to a maximum internal noise level of 45 dB(A) with windows open.

Where there are noise events found to be above the initial screening level, further analysis is made to identify:

- the likely number of events that might occur during the night assessment period; and
- Whether events exceed an 'awakening reaction' level of 55 dB(A) L_{AFmax} (internal) that equates to NML of 65 dB(A) externally (assuming open windows).

Sleep disturbance screening and awakening criteria is provided in Table 10 below.

Adopted Project noise management levels for residential receivers

Table 10 below shows the NMLs for residential receivers for each of the NCAs shown and described in Section 4.1 and shown on NMLs apply at the most noise-affected affected locations within the property boundary 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.

Table 10 Noise Management Levels (NMLs) for residential receivers (external)

Noise catchment area	Monitor ID (EIS)	Noise management level ($L_{Aeq(15\ minute)}$ – dBA)				Sleep disturbance L_{AFmax}	
		Standard hours[1] (RBL + 10 dB)	Out-of-hours[2] (RBL + 5 dB)			Screening (RBL + 15 dB)	Awaken-ing
		Daytime	Daytime	Evening	Night	Night	Night
NCA01	NL01	65	60	60	50	60	65
NCA02	NL02	59	54	53	47	57	65
NCA03	NL03	57	52	52	44	55 (54)	65
NCA04	NL04	48	43	42	36	55 (46)	65
NCA05	NL05	49	44	44	39	55 (49)	65
NCA06	NL06	51	46	46	38	55 (48)	65
NCA07	NL06	51	46	46	38	55 (48)	65
NCA08	NL07	49	44	44	46	55 (51)	65
NCA09	NL09	48	43	43	46	55 (47)	65
NCA10	NL08	63	58	52	43	55 (53)	65
NCA11	NL08	63	58	52	43	55 (53)	65
NCA12	NL15	76	71	71	61	71	65
NCA13	NL15	76	71	71	61	71	65
NCA14	NL10	62	57	57	43	55 (53)	65
NCA14A	NL15	76	71	71	61	71	65
NCA15	NL16	52	47	45	37	55 (47)	65
NCA16	NL14	67	62	55	42	55 (52)	65
NCA17	NL16	52	47	45	37	55 (47)	65

NOTES:

1. Standard construction hours are 7am to 6pm Monday to Friday and 8am to 6pm Saturdays.
2. Daytime out-of-hours are 7am to 8am on Saturday, and 8am to 6pm on Sunday and public holidays; evening out-of-hours are 6pm to 10pm Monday to Sunday; and night-time out-of-hours are 10pm to 7am Monday to Friday, to 8am on Saturday, Sunday and public holidays.

5.2.2 Other sensitive land uses

The ICNG provides noise management levels for commercial and industrial premises and 'other sensitive' land uses (ICNG, Table 3). The management levels for other noise sensitive receivers not listed in the ICNG that are applicable to the Project, such as hotels and libraries, are derived

from *AS/NZS 2107:2016 Acoustics – Recommended design sound levels and reverberation times for building interiors* and the AAAC Guideline for Child Care Centre Acoustic Assessment. The management levels from AS2107 are the upper range levels to account for the variable and short-term nature of construction noise. Noise Management Levels for other sensitive receivers are featured in Table 11.

Table 11 Noise Management Levels (NMLs) for other sensitive receivers (non-residential)

Land Use	NML $L_{Aeq(15min)}$	Where NML applies	Referenced from:	Assumed facade loss (conservative)	External equivalent NML - $L_{Aeq(15min)}$
Studio building (music recording studio)	25 dB(A)	Internal noise level	AS2107 'maximum'	20 dB(A)	45 dB(A)
Studio building (film or television studio)	30 dB(A)	Internal noise level	AS2107 'maximum'	20 dB(A)	50 dB(A)
Cinema space, theatre, auditorium	35 dB(A)	Internal noise level	AS2107 'maximum'	20 dB(A)	55 dB(A)
Hotel (Sleeping areas: Hotels near major roads)	40 dB(A)	Internal noise level	AS2107 'maximum'	20 dB(A)	60 dB(A)
Classrooms at schools and other educational institutions	45 dB(A)	Internal noise level	ICNG	10 dB(A)	55 dB(A)
Childcare centre (sleeping areas)	40 dB(A)	Internal noise level	AAAC - guideline for Child Care Centre Acoustic Assessment	10 dB(A)	50 dB(A)
Hospital wards and operating theatres	45 dB(A)	Internal noise level	ICNG	20 dB(A)	65 dB(A)
Places of worship	45 dB(A)	Internal noise level	ICNG	10 dB(A)	55 dB(A)
Library (reading areas)	45 dB(A)	Internal noise level	AS2107 'maximum'	20 dB(A)	65 dB(A)
Hotel (bars and lounges)	50 dB(A)	Internal noise level	AS2107 'maximum'	20 dB(A)	70 dB(A)
Community centres – Municipal Buildings	50 dB(A)	Internal noise level	AS2107 'maximum'	10 dB(A)	60 dB(A)

Land Use	NML $L_{Aeq(15min)}$	Where NML applies	Referenced from:	Assumed facade loss (conservative)	External equivalent NML - $L_{Aeq(15min)}$
Restaurant, bar (Bars and lounges/ Restaurant)	50 dB(A)	Internal noise level	AS2107 'maximum'	20 dB(A)	70 dB(A)
Passive recreation (e.g. area used for reading, meditation)	60 dB(A)	External noise level	ICNG	-	60 dB(A)
Active recreation (e.g. sports fields)	65 dB(A)	External noise level	ICNG	-	65 dB(A)
Commercial premises (including offices and retail outlets)	70 dB(A)	External noise level	ICNG	-	70 dB(A)
Industrial premises	75 dB(A)	External noise level	ICNG	-	75 dB(A)

In accordance with CoA E74, noise generating works in the vicinity of potentially-affected community, religious, educational institutions and noise and vibration-sensitive businesses and critical working areas (such as theatres, laboratories and operating theatres) resulting in noise levels above the NMLs must not be timetabled within sensitive periods, unless other reasonable arrangements with affected institutions are made at no cost to the affected institution.

Where works cannot be timetabled outside of sensitive periods, consultation with impacted sensitive receivers will be carried out, as per the Communication Strategy (M6S1-CGU-NWW-CYCG-MPL-000900).

5.2.3 Annoying noise

The ICNG identifies 'particularly annoying' activities that require the addition of 5 dB(A) to the predicted level before comparing to the construction Noise Management Level. Annoying activities identified in the ICNG include:

- use of 'beeper' style reversing or movement alarms, particularly at night-time;
- use of power saws, such as used for cutting timber, rail lines, masonry, road pavement or steel work;
- grinding metal, concrete or masonry;
- rock drilling;
- line drilling;
- vibratory rolling;
- rail tamping and regulating;
- bitumen milling or profiling;
- jackhammering, rock hammering or rock breaking; and
- impact piling.

Where monitoring has confirmed that activities described above do not possess annoying characteristics in accordance with the ICNG (i.e. tonality or impulsive etc), the above addition of 5 dB(A) will not apply. Such monitoring will be provided to the AA for endorsement of such activities outside of the EPL, otherwise to the EPA for approval.

5.2.4 National Standard for exposure to noise

In accordance with CoA E83, Project worksites will be managed to ensure that noise generated by construction will not exceed the National Standard for exposure to noise in the occupational environment of an eight-hour equivalent continuous A-weighted sound pressure level of LAeq,8h, of 85dB(A) for any employee working at a location near the Project.

5.3 Ground-borne noise management levels

The ICNG provides guidelines for the assessment and management of ground-borne construction noise. Ground-borne noise management levels for residences are nominated in the ICNG and CoA E72 and indicate when management actions would be implemented. Mitigation measures must be applied when residential ground-borne noise levels are exceeded in accordance with CoA E72. This is typically where noise sensitive receivers are located above tunnelling works or other construction activities (e.g. rock breaking).

Table 12 (taken from the ICNG and CoA E72) sets out the ground-borne noise management levels and how they are to be applied to residential receivers. These levels 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. CGU will inform all potentially impacted receivers of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.

Table 12 Ground-borne Noise Management Levels (NMLs) at Residential Receivers

Assessment period	Time of day	Ground-borne NML $L_{Aeq(15min)}$
Evening	6:00pm to 10:00pm	40 dB(A) internal
Night	10:00pm to 7:00am	35 dB(A) internal

Table 13 Ground-borne Noise Management Levels (NMLs) at other sensitive land users

Assessment period	NML $L_{Aeq(15min)}$	Where NML applies	Referenced from:
Commercial premises (including offices)	50 dB(A)	Internal noise level	ICNG
Commercial premises (including retail outlets)	55 dB(A)	Internal noise level	AS/NZS 2107:2016 (department stores – main floor)
Industrial premises	55-60 dB(A)	Internal noise level	ICNG and AS/NZS 2107:2016 (assembly lines and process and control room)

For other noise sensitive receivers, such as cinema spaces and recording studios, guidance is taken from the recommended 'maximum' internal noise levels in AS/NZS 2107:2000 'Acoustics – For recommended design sound levels and reverberation times for building interiors' to determine suitable noise management levels, refer to Table 13.

5.4 Construction-related road traffic noise

CGU has developed a Heavy Vehicle Driver Code of Conduct to assist with managing driver behaviour both on site and on public roads.

When trucks and other vehicles are operating within the boundary of a construction site, road vehicle noise contributions are included in the overall predicted $L_{Aeq(15minute)}$ construction site noise emissions. When construction-related traffic moves onto the public road network a different noise assessment methodology is appropriate, as vehicle movements would be regarded as 'additional road traffic' rather than as part of the construction site.

The community may associate heavy vehicle movements with the Project works, when vehicles are travelling on roads located immediately adjacent to construction sites. However, once the heavy vehicles move further from construction sites onto major collector or arterial roads, the noise may be perceived as being part of the general road traffic.

The ICNG refers to the NSW Road Noise Policy (RNP) for the assessment of noise from construction traffic on public roads. In line with the RNP and the Construction Noise and Vibration Guideline (Roads and Maritime 2016), the Project will adopt the following approach for assessing and managing construction traffic noise impact:

- Complete an initial screening test to evaluate whether traffic noise levels increase by more than 2 dB(A) as a result of construction traffic within 600m of the Project sites;
- Where increases are 2 dB or less than the corresponding 'without construction traffic' scenario, no further assessment is required;
- Where the road traffic noise levels are predicted to increase by more than 2 dB as a result of construction traffic, consider the total road traffic noise levels (i.e. existing road traffic plus additional construction traffic);
- Review the total road traffic noise levels and whether these levels comply with the following road traffic noise criteria in the RNP:
    - 60 dB $L_{Aeq(15hour)}$ day and 55 dB $L_{Aeq(9hour)}$ night for existing freeway/arterial/sub-arterial roads, and
    - 55 dB $L_{Aeq(1hour)}$ day and 50 dB $L_{Aeq(1hour)}$ night for existing local roads.
- Where total road traffic noise levels are less than or equal to RNP noise criteria, no further assessment is required.

Where total road traffic noise levels are above the RNP noise criteria, feasible and reasonable noise mitigation measures would be applied to reduce the potential noise impacts and preserve acoustic amenity. This may include consideration of alternative truck routes or potential reduction of truck movements.

In addition to the above, where Project trucks and other vehicles are using public roads during the night period, assessment of sleep disturbance is required as outlined in Section 5.2.1.

5.5 Vibration criteria

5.5.1 Disturbance to building occupants

Vibration, with the potential to disturb human occupants of buildings, is managed referencing DECC's Assessing Vibration: a technical guideline (CoA E72(b)). This document provides criteria which are based on the British Standard BS 6472-2008 Evaluation of human exposure to vibration in buildings (1-80Hz).

Intermittent vibration criteria for human comfort, such as from drilling, compacting or other sources which operate intermittently, but which would produce continuous vibration if operated

continuously, is presented in Table 14. This type of vibration is assessed on the basis of vibration dose values (VDV) and is identified as the most likely source of vibration impacts on the Project.

Table 14 Vibration dose value criteria for intermittent vibration

Building type	Assessment period[1]	Vibration dose values ($m/s^{1.75}$)	
		Preferred	Maximum
Critical working areas (eg operating theatres or laboratories)[2]	Daytime or night-time	0.10	0.20
Residential	Daytime	0.20	0.40
	Night-time	0.13	0.26
Offices, schools, educational institutions and places of worship	Daytime or night-time	0.40	0.80
Workshops	Daytime or night-time	0.80	1.60

NOTES:

1. Daytime is 7.00 am to 10.00 pm and night-time is 10.00pm to 7.00 am
2. Examples include hospital operating theatres and precision laboratories where sensitive operations are occurring. There may be cases where sensitive equipment or delicate tasks require more stringent criteria than the human comfort criteria specify above. Source: BS 6472-2008

Continuous vibration from uninterrupted sources assessed on the basis of weighted rms acceleration values presented in Table 15. Project activities are generally not anticipated to result in continuous vibration impacts.

Impulsive vibration can be defined as up to three instances of sudden impact per monitoring period, such as dropping heavy items. Impulsive vibration is assessed on the basis of acceleration values presented in Table 15.

Table 15 Preferred and Maximum Weighted Root Mean Square Values for Continuous and Impulsive Vibration Acceleration (m/ s^2) 1-80Hz

Location	Assessment period[1]	Preferred values		Maximum values	
		Z-axis	X- and Y-axis	Z-axis	X- and Y-axis
Continuous vibration (rms acceleration, m/s^2)					
Critical working areas (eg operating theatres or laboratories)[2]	Daytime or night-time	0.0050	0.036	0.010	0.0072
Residential	Daytime	0.010	0.0071	0.020	0.014
	Night-time	0.007	0.005	0.014	0.010
Offices, schools, educational institutions and places of worship	Daytime or night-time	0.020	0.014	0.040	0.028
Workshops	Daytime or night-time	0.04	0.029	0.080	0.058

Location	Assessment period[1]	Preferred values		Maximum values	
		Z-axis	X- and Y-axis	Z-axis	X- and Y-axis
Impulsive vibration (rms acceleration, m/s^2)					
Critical working areas (eg operating theatres or laboratories)[2]	Daytime or night-time	0.0050	0.0036	0.010	0.0072
Residential	Daytime	0.30	0.21	0.60	0.42
	Night-time	0.10	0.071	0.20	0.14
Offices, schools, educational institutions and places of worship	Daytime or night-time	0.64	0.46	1.28	0.92
Workshops	Daytime or night-time	0.64	0.46	1.28	0.92

NOTES:

1. Daytime is 7.00 am to 10.00 pm and night-time is 10.00pm to 7.00 am
2. Examples include hospital operating theatres and precision laboratories where sensitive operations are occurring. There may be cases where sensitive equipment or delicate tasks require more stringent criteria than the human comfort criteria specify above. Source: BS 6472-2008

5.5.2 Structural damage to buildings

Cosmetic damage vibration limits for buildings and associated minimum working distances are identified in the Construction Noise and Vibration Guideline, British Standard BS7385 Part 2-1993 Evaluation and measurement for vibration in buildings Part 2 and German Standard DIN 4150: Part 3-2016 Structural vibration – Effects of vibration on structures.

The cosmetic damage levels set by BS7385 are considered ‘safe limits’ up to which no damage due to vibration effects has been observed for certain particular building types. Table 16 sets out the recommended vibration limits from BS7385 for transient vibration to ensure minimal risk of cosmetic damage to residential, commercial and industrial buildings and is frequency dependent and specific to particular categories of structure.

Table 16 BS 7385 Transient vibration values for minimal risk of damage

Group	Type of building	Peak Component Particle Velocity in Frequency Range of Predominant Pulse	
		4 Hz to 15 Hz	15Hz and above
1	Reinforced or framed structures. Industrial and heavy commercial buildings.	50 mm/s at 4 Hz and above	
2	Unreinforced or light framed structures. Residential or light commercial type buildings.	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above

5.5.3 Vibration screening criteria

The limits presented in Table 16 above relate predominantly to transient vibration which does not give rise to resonant responses in structures, and to low-rise buildings. Where the dynamic loading caused by continuous vibration is such as to give rise to dynamic magnification due to resonance, then the guide values in Table 16 may need to be reduced by up to 50 percent. This is especially applicable at the lower frequencies where lower guide values apply.

On this basis, consistent a conservative vibration screening criteria per receiver type is given below:

- Reinforced or framed structures (Line 1): 25.0 mm/s
- Unreinforced or light framed structures (Line 2): 7.5 mm/s

At locations where the predicted and/or measured vibration levels are greater than shown above (peak component particle velocity), a more detailed analysis of the building structure, vibration source, dominant frequencies and dynamic characteristics of the structure would be required to determine the applicable safe vibration level. The analysis would take into consideration the transient vibration guide values for minimal risk of cosmetic damage set out in Table 16.

5.5.4 Heritage items and buried pipework

The German standard provides a conservative criterion for vibration limits for different buildings and buried pipework and has been used to identify the vibration criteria for the Project where the British Standard does not apply. The German standard values for peak particle velocity (PPV) (mm/s) measured at the foundation of the building are summarised in Table 17 and short-term vibration on buried pipework is shown in Table 18.

Table 17 DIN 4150-3 guideline values for short-term vibration on structures

Group	Type of structure	Guideline values vibration velocity (mm/s)				
		Foundations, all directions at a frequency of:			Topmost floor, horizontal	Floor slabs, vertical
		1 to 10Hz	10 to 50 Hz	50 to 100 Hz	All frequencies	All frequencies
1	Buildings used for commercial purposes, industrial buildings and buildings of similar design	20	20 to 30	40 to 50	40	20
2	Residential buildings and buildings of similar design and/or occupancy	5	5 to 15	15 to 20	15	20
3	Structures that because of their particular sensitivity to vibration, cannot be classified into Group 1 or 2 and are of great intrinsic value e.g. heritage listed buildings	3	3 to 8	3 to 8	8	20

As noted in BS 7385, heritage buildings and structures should not be assumed to be more sensitive to vibration, unless structurally unsound. A conservative vibration damage screening level (peak component particle velocity) for heritage buildings/structures can be set to 2.5mm/s (the more stringent criterion in the German Standard DIN 4150-2016 Structural Vibration Part 3: Effects of Vibration on Structures). This screening level will allow potentially impacted heritage structures to be identified. If a heritage structure is predicted to be exposed to vibration levels above the conservative vibration screening level of 2.5mm/s, further investigation would be undertaken to determine whether the structure is structurally unsound. Where a heritage building is deemed to be sensitive to vibration impacts, the more stringent DIN 4150-2016 Group 3 guideline values can be applied. Otherwise, structural damage vibration limits based on BS 7385 (Section 5.5.2 and 5.5.3) can be applied.

Table 18 will be used as a guide and further consultation with utility owners and pipeline operators will be undertaken to apply the most appropriate vibration criteria for each utility, in accordance with CoA C5. Where consultation confirms that alternate vibration criteria are required for specific utilities or pipeline operators, a technical memorandum will be completed (as required) for that asset and provided to the asset owner (Note: these technical memorandums will sit outside of this Plan). Where assets have a specific exclusion zone for vibration intensive works, this will also be considered in the technical memorandum.

Table 18 DIN 4150-3 guideline values for short-term vibration on buried pipework

Line	Pipe material	Guideline values for vibration velocity measured on the pipe
1	Steel (including welded pipes)	100 mm/s
2	Clay, concrete, reinforced concrete, pre-stressed concrete, metal (with or without flange)	80 mm/s
3	Masonry, plastic	50 mm/s

5.5.5 Sensitive scientific and medical equipment

Some scientific equipment, such as electron microscopes and microelectronics manufacturing equipment, can require stringent vibration goals than those applicable to human comfort or cosmetic building damage. Where vibration sensitive equipment is potentially affected by construction works, vibration limits for the operation of the equipment should be taken from manufacturer's data or provided by the equipment owner.

Where this is not available the generic Vibration Criterion (VC) curves as published by the Society of Photo-Optical Instrumentation Engineers (Colin G. Gordon - 28 September 1999) may be adopted as vibration goals. These generic VC curves are provided below in Table 19.

Table 19 VC curves for Vibration Sensitive Equipment

Criterion curve	Max level (µm/sec, rms)[1]	Detail size (microns)[2]	Description of Use
VC-A	50	8	Adequate in most instances for optical microscopes to 400X, microbalances, optical balances, proximity and projection aligners, etc.
VC-B	25	3	An appropriate standard for optical microscopes to 1000X, inspection and lithography equipment (including steppers) to 3 micron line widths.

Criterion curve	Max level (µm/sec, rms)[1]	Detail size (microns)[2]	Description of Use
VC-C	12.5	1	A good standard for most lithography and inspection equipment to 1 micron detail size.
VC-D	6	0.3	Suitable in most instances for the most demanding equipment including electron microscopes (TEMs and SEMs) and E-Beam systems, operating to the limits of their capability.
CV-E	3	0.1	A difficult criterion to achieve in most instances. Assumed to be adequate for the most demanding of sensitive systems including long path, laser-based, small target systems and other systems requiring extraordinary dynamic stability.

NOTE:

1. As measured in one-third octave bands of frequency over the frequency range 8 to 100 Hz
2. The detail size refers to the line widths for microelectronics fabrication, the particle (cell) size for medical and pharmaceutical research, etc. The values given consider the observation requirements of many items depend upon the detail size of the process.

5.6 Blast criteria

No blasting is proposed during preliminary construction including commencement activities. This section will be updated prior to the commencement of construction, should blasting be required.

6 Environmental aspects and impacts

6.1 Construction activities

To facilitate delivery of the Project, CGU has elected to stage construction of the Project. A Staging Report (M6S1-CGU-NWW-ENPE-PLN-000401) has been prepared and details the strategy for staging and the compliance requirements for each of the two construction stages. The stages of construction for the Project include:

- Stage 1 - Preliminary Construction.
  - Installation of environmental controls at construction compounds (C1, C2 & C3) such as fencing, hoarding and noise walls;
  - Removal of existing structures where required;
  - Establishment of site facilities such as offices, amenities and storage, including the installation and connection of services such as water, sewer and power;
  - Delivery of Plant and construction equipment;
  - Construction commencement activities such as site levelling, construction of haul roads and hardstands;
  - Installation of construction facilities such as water treatment plants; and
  - The repair, refurbishment and replacement (if required) of the existing M8 construction facilities and services at the C1 site, to facilitate reuse for the M6 Stage 1 Project.
- Stage 2 - Construction.
  - The operation of ancillary facilities;
  - Bulk excavation including: shafts; tunnels; and civil structures;
  - Construction of motorway operations complexes and facilities;
  - Mechanical and electrical fit-out of built structures as required;
  - Permanent power supply works (Earlwood to Rockdale);
  - Reinstatement and rehabilitation of construction areas; and
  - Other works as required to fulfil project objectives.

This CNVMP applies only to preliminary construction (Stage 1) of the Project. Stage 1 of the Project will involve a range of activities incorporating various heavy machinery, plant and equipment that will operate in the vicinity of Arncliffe construction ancillary facility (C1), Rockdale construction ancillary facility (C2) and President Avenue construction ancillary facility (C3).

6.2 Impacts

The potential for noise and vibration impacts on sensitive receivers or structures will depend on a number of factors. Typically these might include:

- The type of equipment in use;
- The number of equipment simultaneously in use;
- Ground condition;
- Topography and other physical barriers;
- Proximity to sensitive receivers;

- The physical condition of sensitive receiver structure;
- Hours/duration of construction works; and
- Existing background noise.

Relevant aspects and the potential for related impacts have been considered in a risk assessment in Section 3.2.1 of the CEMP.

Noise and vibration impacts attributable to the Project are anticipated and are detailed in the Appendix G of the EIS: Technical Working Paper – Noise and Vibration, Chapter 11 of the EIS and the Response to Submissions Report. Section 8 of this Plan provides a suite of mitigation measures that will be implemented to avoid or minimise impacts on the receiving community and/or built environment.

7 Construction noise and vibration assessment

7.1 Method for evaluation and assessment of impacts

The process of assessment of construction noise and vibration impacts is detailed in Figure 2. This process will form the basis of the assessments that will be prepared prior to construction works commence. Where significant new/additional activities and/or significant changes to site layout or construction methodology are proposed, additional assessment as per this section will be undertaken. Site-specific or activity-specific noise assessments will be prepared to assess all construction activities and ancillary facilities for the Project. Noise and vibration monitoring data will be collected throughout the delivery of the Project in accordance with the Construction Noise and Vibration Monitoring Program (refer to Appendix A).

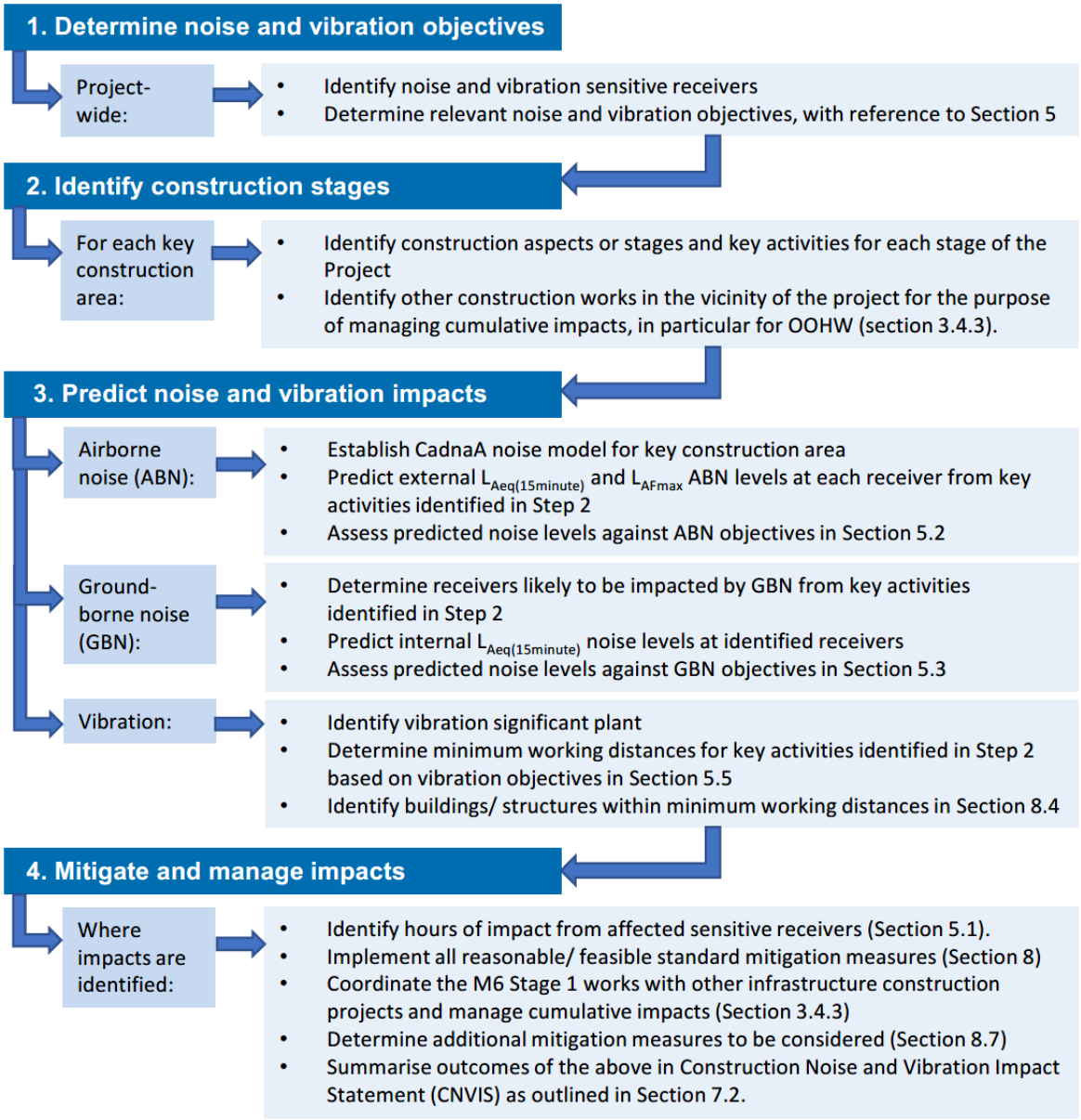


Figure 2 Process for assessing and managing construction noise and vibration

7.2 Construction noise and vibration impact statements

The Construction Noise and Vibration Impact Statements (CNVIS) will be a key site management tool providing clear instructions for managing each construction worksite during Stage 2 construction. Each CNVIS will be prepared before any works that result in noise and vibration impacts commence at the relevant construction worksite. The CNVIS will be progressively prepared for the construction phase to identify noise and vibration impact predictions and applicable management measures. In accordance with CoA E73, any construction work identified in the CNVIS as exceeding the noise management levels and/ or vibration criteria established in Section 5 must be managed in accordance with this CNVMP.

All CNVIS will be prepared by an appropriately qualified and experienced acoustic consultant.

Each CNVIS would set out the mitigation and management measures required for the construction stage, through consultation with affected sensitive receivers. They will address:

- Scope of work covered by CNVIS;
- Justification for OOHW (where required);

- Nearest noise and vibration sensitive receivers, based on the land use survey required by CoA E61;
- Construction noise and vibration objectives (outlined in Section 5);
- Construction noise and vibration impact assessment;
- Mitigation options, preferred management measures and ongoing risk management; and
- Noise and vibration monitoring requirements and auditing process.

Construction noise and vibration impacts associated with a construction worksite would be assessed by identifying the construction activities for each worksite and stage of the Project, including likely plant and equipment. Construction noise and vibration from the activities would be predicted and assessed against the noise and vibration criteria to identify the risk of impact. Where there is a risk of impact, all reasonable and feasible noise and vibration management measures would be recommended to reduce or manage the impacts as much as practicable.

Physical noise mitigation measures such as noise barriers, acoustic sheds and acoustic enclosures around fixed plant will be outlined in the CNVIS. Furthermore, specific management measures such as staging of works, respite periods (CoA E68, E69 and E71) and community notification (CoA B2(b), B2 (d)) will also be summarised, and implemented.

The CNVIS will identify the sensitive receivers that CGU is required to notify regarding upcoming works to ensure ongoing noise and vibration risks are managed throughout the Project. This notification will include the likely noise and vibration impacts during the assessed works, the duration of impact and any additional mitigation (e.g. respite periods) that may be required to manage noise and vibration impacts.

Monitored noise and vibration levels will be verified against the predictions made in the relevant CNVIS. This will allow for ongoing review and where necessary, update of the predictive model and a feedback mechanism to construction planning will ensure ongoing noise and vibration risks are identified and managed appropriately.

The key CNVIS to be prepared under the NVMP are summarised in Table 20. Further to this, the Gatewave noise and vibration management tool will be used to manage ongoing noise and vibration risks (including cumulative impacts) as works progress, as outlined in Section 7.3.

Table 20 Indicative CNVIS prepared under this CNVMP (to be updated for Stage 2)

Construction worksite/ stage	Construction activity
C1 Arncliffe worksite	• Tunnelling Support Establishment • Tunnelling Support Site
C2 Rockdale depot worksite	• Tunnelling Support Establishment (shaft excavation and acoustic shed construction) • Tunnelling and support, spoil handling and tunnel lining
C3 Bicentennial Park North tunnel worksite	• Tunnelling Support Establishment (shaft excavation, jet grouting and acoustic shed construction) • Tunnelling and support, spoil handling and tunnel lining • Civil cut and cover construction • Civil Top-down excavation
C3 MOC 3 worksite	• TBC

A construction noise and vibration assessment of preliminary construction including commencement activities has been completed and is included in Appendix D of this CNVMP. The assessment covers:

- C1 Arncliffe worksite:
  - Amendments and repairs of existing structures
  - Installation of hoarding
  - Utility and services reestablishment
  - Tunnel adit restoration
  - Decline and invert repair
- C2 Rockdale depot worksite:
  - Demolition of existing structures
  - Vegetation clearing
  - Installation of noise walls and hoardings
  - Site levelling, hardstand and site access
  - Utility relocation and services installation (within site)
  - Telegraph pole relocation on West Botany Road
  - Installation of offices, amenities, water treatment plant
- C3 MOC 3 worksite:
  - Demolition of existing structures
  - Utility relocation
  - Installation of fences and crib
- C3 Bicentennial Park North tunnel worksite:
  - Site levelling, hardstand and site access
  - Installation of offices, amenities, water treatment plant, bentonite plant and workshops
  - Utilities investigation, relocation and installation of temporary power supply for worksite
  - Installation of environmental controls
  - Vegetation clearing
  - Installation of noise walls, hoardings and pathways.

The assessment identifies impacts from the activities proposed during the preliminary construction phase and provides mitigation and management measures to reduce impacts, especially during out-of-hours works.

7.3 Gatewave noise and vibration management tool

A 3D construction noise and vibration management tool, Gatewave (www.gatewave.com.au), is being[1] developed for the Project to allow specific work areas and activities to be planned, assessed and managed as construction works progress. It would also allow cumulative noise

[1] Paragraph to be updated once Gatewave prepared

impact from other aspects of the Project or, where relevant, noise from other construction projects, to be assessed and managed in accordance with this CNVMP.

Gatewave incorporates ground elevation contours, building heights, the built environment and atmospheric conditions to predict construction noise in accordance with the International Standard ISO 9613-2:1996 implementing quality standard ISO 17534-1:2015. All sensitive receivers identified by the land use survey (see Section Appendix B) are integrated into the Gatewave tool.

CNVISs prepared for the Project would establish the overall impacts associated with worksites, ancillary facilities and tunnelling excavation. The Project environment team would use Gatewave to manage construction noise and vibration impact by defining specific work areas/activities in the CNVIS as construction progresses and identifying:

- Sensitive receivers where predicted noise levels are above the NMLs so that, where there are residual impacts even after all feasible and reasonable mitigation measures have been adopted, mitigation and management measures can be applied in accordance with this CNVMP; and
- Buildings/structures within minimum working distances established for cosmetic damage and human annoyance so that appropriate mitigation and management measures can be applied in accordance with this CNVMP.

Noise and vibration monitoring data would be collected throughout the delivery of the Project. This feedback loop would ensure the prediction tool is verified and adjusted as required to ensure accuracy across the Project.

7.4 Blasting assessment

No blasting assessment has been undertaken, as blasting is not proposed for the Project preliminary construction including commencement activities. In the event that this circumstance changes, an assessment will be completed.

8 Environmental control measures

8.1 Noise and vibration mitigation and management measures

In accordance with CoA E72, mitigation measures will be implemented with the aim of achieving the construction noise management levels and vibration criteria detailed in Section 5 of this Plan. Specific measures and requirements to address contract specifications, CoA and EMM's in relation to impacts from noise and vibration are outlined in Table 21.

Table 21 Noise and vibration management and mitigation measures

ID	Measure / Requirement	Resource needed	When to implement	Responsibility	Reference	Evidence
	Management Measures					
NVMM1	Project and activity specific mitigation measures will be identified and confirmed in the CNVIS prepared for the Project and implementation as early as practicable, as noted in the CNVIS.	CNVIS or Gatewave report	Prior to identified noise/ vibration generating activity commencement	Environmental and Approvals Manager Construction Project Managers	CoA E73 NV2 CGU Practice	Site inspection records
NVMM2	Implement community consultation or notification measures as detailed in the Communications Strategy and Section 0 and Section 8.6 of this Plan	CNVIS or Gatewave report	Prior to noise generating activities	Environmental and Approvals Manager Stakeholder and Community Relations Manager	CoA E69 CGU practice	Consultation records

ID	Measure / Requirement	Resource needed	When to implement	Responsibility	Reference	Evidence
NVMM3	Where feasible and reasonable, construction would be carried out during the standard construction hours as outlined in Table 8.	CNVMP Induction materials	Construction	Construction Project Managers	CoA E68, CoA E69	Induction records Site inspection records
NVMM4	Work generating high noise and/or vibration levels would be scheduled during less sensitive time periods, in particular works adjacent to theatres, precision laboratories, educational institutions and places of worship. Scheduling particularly noisy activities around HSC exam times, childcare sleep times and other identified sensitive times should be considered, where feasible and reasonable.	CNVIS or Gatewave report	Prior to the commencement of work generating high noise and/or vibration levels at sensitive receivers	Environmental and Approvals Manager Stakeholder and Community Relations Manager	CoA E74, CGU practice	Consultation records
NVMM5	Cumulative construction noise and vibration impacts will be managed through consultation with proponents of other construction works within 300 metres of the Project work area. Undertake reasonable steps to coordinate works to minimise impacts and maximise respite for affected sensitive receivers.	CNVIS or Gatewave report Communications Strategy	Prior to the commencement of works	Environmental and Approvals Manager Stakeholder and Community Relations Manager	CoA C5(d)	OOHW Coordination Meeting

ID	Measure / Requirement	Resource needed	When to implement	Responsibility	Reference	Evidence
NVMM6	Training will be provided to relevant Project personnel, including relevant sub-contractors on noise and vibration requirements from this CNVMP through inductions, toolboxes or targeted training.	Induction materials Toolbox talk	Prior to construction Construction	Construction Manager	CGU Practice	Induction records Toolbox talk record Pre-start records
NVMM7	All employees, contractors & subcontractors are to receive a Project induction prior to commencing work on site. The environmental component, covered in either the induction or toolboxes, must include: • relevant licence & approval conditions; • permissible hours of work; • limitations on high noise activities; • location of nearest sensitive receivers; • construction employee parking areas; • relevant site-specific mitigation measures; • OOHW approval process; and • appropriate behavioural practices.	Induction materials	Prior to construction Construction	Construction Manager	CGU Practice	Induction records Toolbox talk record

ID	Measure / Requirement	Resource needed	When to implement	Responsibility	Reference	Evidence
NVMM8	Noise and vibration verification monitoring is to be undertaken in accordance with this Plan, as identified in the CNVISs and any EPL conditions.	Noise and Vibration Monitoring Program (Appendix A) CNVIS	Construction	Project Manager / Project Engineer Environmental and Approvals Manager	CoA C16 CGU Practice	Monitoring records
NVMM9	Prior to arriving on site, drivers will be advised of designated vehicle routes, parking locations, acceptable delivery hours for the site and other relevant practices (i.e. minimising the use of engine brakes and no extended periods of engine idling). This will be communicated by CGU using notifications under contract provisions and communication with schedulers from companies using heavy vehicles.	Induction materials	Construction	Supervisor / Site Engineer Environmental and Approvals Manager	CGU Practice	Induction records Vehicle Management Plans OOHW records
NVMM10	Building condition surveys will be completed before and after construction works where buildings or structures are within the minimum vibration working distances for cosmetic damage.	Section 8.3.2 CNVIS Communications Strategy	Prior to construction Construction	Construction Project Managers	CoA E75	Condition survey report
At-source controls						

ID	Measure / Requirement	Resource needed	When to implement	Responsibility	Reference	Evidence
NVMM11	All construction plant and equipment used on site will be fitted with properly maintained noise suppression devices in accordance with the manufacturer's specifications.	Plant risk assessment Manufacturer's specifications	Construction	Supervisor	G36	Plant inspection records Spot checking noise monitoring records
NVMM12	All construction plant and equipment used on the site will be operated in a proper and efficient manner.	Plant risk assessment Toolbox talk SWMS	Construction	Supervisor	G36	Site inspection records Safety inspection records SWMS Toolbox talk record

ID	Measure / Requirement	Resource needed	When to implement	Responsibility	Reference	Evidence
NVMM13	All construction plant and equipment used on the site will be maintained in an efficient condition, in accordance with the manufacturers' specification. If a piece of plant or equipment is found to exceed the noise levels included in modelling, the following will occur: • a quieter piece of plant or equipment will be utilised in place of the offending plant / equipment (If available and appropriate); • On-site mitigation (e.g. noise blankets) will be reviewed; and /or • The noise assessment will be repeated with the accurate noise level of the plant / equipment.	Plant risk assessment Manufacturer's specifications CNVIS or noise modelling tool	Construction	Supervisor	G36	Plant inspection records Site inspection records
NVMM14	Non-tonal movement alarms will be used in place of tonal reversing alarms for CGU owned plant and subcontract plant used at night or during the day.	Plant risk assessment Toolbox talk SWMS	Construction	Supervisor	G36	Plant/ site inspection records SWMS Toolbox talk record

ID	Measure / Requirement	Resource needed	When to implement	Responsibility	Reference	Evidence
NVMM15	Manage the use and siting of plant, where practicable by: • Avoiding simultaneous operation of noisy plant within discernible range of a sensitive receiver; • Maximising the offset distance between noisy or vibration significant plant and adjacent sensitive receivers; • Switching off when it is not in use for more than 15 minutes; • Directing noise-emitting plant away from sensitive receivers, particularly during OOHW; and • Using only necessary size, power and number of equipment on site. NOTE: Due to limited land available for construction this may not at times be practical.	Induction materials Toolbox talk SWMS	Construction	Supervisor	CGU Practice	Induction records Site inspection records Pre-start briefing SWMS Noise monitoring records

ID	Measure / Requirement	Resource needed	When to implement	Responsibility	Reference	Evidence
NVMM16	Plan traffic flow, parking & loading/ unloading areas to minimise reversing movements within the site	Plant risk assessment Manufacturer's specifications CNVIS or noise modelling tool	Construction	Supervisor	G36	Plant/ site inspection records Design Report Vehicle Management Plans
NVMM17	Out-of-hours deliveries will be minimised where possible. Where out of hours deliveries are required, due care will be taken to minimise impacts (i.e. no extended periods of engine idling, use of radios instead of shouting, non-tonal reversing beepers where possible, unloading / loading to be undertaken during standard hours).	Induction materials CNVIS	Construction	Supervisor / Site Engineer	CGU Practice	Induction records OOHW records

ID	Measure / Requirement	Resource needed	When to implement	Responsibility	Reference	Evidence
NVMM18	Plant and equipment must have operating Sound Power or Sound Pressure Levels compliant with the levels in Section 8.2 of this Plan, or as specified in the CNVIS. Regular compliance checks on the noise emissions of all plant and machinery used for the Project would indicate whether noise emissions from plant items were higher than predicted. This also identifies defective silencing equipment on the items of plant.	CNVIS or Gatewave report Plant risk assessment Manufacturer's specifications	Construction	Supervisor	CGU practice	Plant/ site inspection records
NVMM19	Additional temporary screening or enclosures will be considered for plant and equipment where additional measures are required to meet relevant NMLs, or where plant and equipment is known to exceed the NMLs	SWMS	Construction	Supervisor / Environmental Advisor	CGU Practice	Site inspection records SWMS Work Packs

ID	Measure / Requirement	Resource needed	When to implement	Responsibility	Reference	Evidence
NVMM20	Stationary noise sources would be enclosed or shielded where reasonable and feasible. This would apply to plant and equipment such as generators, stationary concrete cutters, stationary asphalt corers, stationary vacuum trucks, and stationary jack hammers.	SWMS	Construction	Supervisor	CGU Practice	Site inspection records SWMS Work Packs
Path controls						
NVMM21	All acoustic sheds will be erected as soon as site establishment works at the facilities are complete (following Stage 2 CEMP approval). The acoustic sheds must be completed before undertaking any works which are required to be conducted within the sheds.	This NVMP CNVIS	Construction	Construction Project Managers	CoA E77	Site inspection records
NVMM22	Acoustic sheds will be designed with consideration of the activities that will occur within them and the relevant noise management levels in adjacent areas.	CNVIS Design reports	Construction	Construction Project Managers Environmental and Approvals Manager	NV2	Site inspection records Meeting minutes

ID	Measure / Requirement	Resource needed	When to implement	Responsibility	Reference	Evidence
NVMM23	Noise barriers (such as site hoardings) will be constructed around ancillary facilities as detailed within the CNVIS (Note: this does not include temporary noise blankets, whose location is not specified in the CNVIS).	CNVIS	Prior to construction Construction	Construction Project Managers	CoA A20	Site inspection records
NVMM24	Structures will be used as noise barriers at compounds where appropriate.	CNVIS Site layout drawings	Construction	Construction Project Managers Environmental and Approvals Manager	CGU Practice	Site inspection records Design Reports
NVMM25	Additional temporary screening or enclosures will be considered for plant and equipment where additional measures are required to meet relevant NMLs, or where plant and equipment is known to exceed the NMLs	SWMS	Construction	Supervisor	CGU Practice	Site inspection records SWMS

ID	Measure / Requirement	Resource needed	When to implement	Responsibility	Reference	Evidence
NVMM26	The at-property construction noise mitigation treatments must be installed prior to the commencement of construction activities that may cause the receiver to be construction noise affected and implemented prior to the commencement of any out-of-hours works that may cause sleep disturbance.	At-property Noise Mitigation Report Communications Strategy CNVIS	Prior to construction Construction	Interface Manager Construction Project Managers Environmental and Approvals Manager	CoA E78 CGU Practice	Community notifications Meeting minutes
Consultation and Complaints Management						

ID	Measure / Requirement	Resource needed	When to implement	Responsibility	Reference	Evidence
NVMM27	Sensitive receivers will be notified of construction activities that are likely to affect their noise and vibration amenity in accordance with the Communications Strategy. Information provided will include: • The types of activities to be undertaken, • The timing of activities including expected start and finish, • The location of activities, and • Details of the community information line and how to make an enquiry and / or complaint. If the potential vibration exceedance is to occur more than once or extend over a period of 24 hours, owner and occupiers will be provided a monthly schedule of potential exceedances for the duration of the potential exceedances, unless otherwise agreed by the owner and occupier.	Communications Strategy CNVIS or Gatewave report CEMP	Prior to construction Construction	Community and Stakeholder Manager Construction Project Managers/ Environmental and Approvals Manager	CGU Practice, CNVG	Community notifications OOHW records

ID	Measure / Requirement	Resource needed	When to implement	Responsibility	Reference	Evidence
NVMM28	Temporary alternative accommodation will be offered to residents affected by out-of-hours works where the construction noise levels are predicted to exceed the NML +25 dB(A) or are greater than 75 dBA ($L_{Aeq(15\ min)}$), whichever is the lesser, between: • 10:00 pm and 7:00 am, Monday to Friday; • 10:00 pm to 8:00 am, Saturday; and • 6:00 pm to 7:00 am, Sunday and public holidays	Communications Strategy CNVIS or Gatewave report	Prior to construction Construction	Community and Stakeholder Manager Construction Project Managers/ Environmental and Approvals Manager	CGU Practice, CoA E82	Community notifications OOHW Coordination Meetings OOHW records

8.2 Maximum noise levels for plant and equipment

The Sound Power Level (SWL) represents the total noise output of operating plant and equipment. The SWL is used in computer noise models to predict Sound Pressure Levels (SPLs) at nearby receivers.

When undertaking site compliance measurements, it is normally the SPL that is measured at a specified distance (typically 7m) from the plant or equipment.

All plant and equipment used for the Project should have SWL and SPL which are no higher than the corresponding figures shown in Table 22. Plant and equipment with SWLs or SPLs higher than those on the table would be deemed to be emitting an excessive level of noise and would not be permitted to operate on the Project. Plant and equipment will be subject to regular noise level checks to verify compliance (see Section 9.3), as stated in Table 22.

Table 22 Maximum Allowable Sound Power Levels for Construction Equipment

Equipment	Maximum Allowable Sound Power Level (dB) L_{Amax}	Maximum Allowable Sound Pressure Level (dB) L_{Amax} at 7 m	Not recommended Out of Hours (where practicable)
Air track drill	124	99	✓
Asphalt truck & sprayer	103	78	
Backhoe	111	86	
Bulldozer D9	116	91	
Chainsaw 4-5hp	114	89	✓
Compactor	106	81	
Compressor	109	84	
Concrete pump	109	84	
Concrete saw	118	93	✓
Concrete truck	109	84	
Concrete vibrator	113	88	
Daymakers	98	73	
Dump truck	110	85	
Excavator ≤ 10 tonne	100	75	
Excavator ≤ 20 tonne	105	80	
Excavator ≤ 30 tonne	110	85	
Excavator ≤ 40 tonne	115	90	
Excavator ≤ 40 tonne with hydraulic hammer	122	97	✓
Fixed crane	113	88	
Franna crane 20t	98	73	
Front end loader	112	87	
Grader 35t	113	88	
Light vehicles	88	63	

Equipment	Maximum Allowable Sound Power Level (dB) L_{Amax}	Maximum Allowable Sound Pressure Level (dB) L_{Amax} at 7 m	Not recommended Out of Hours (where practicable)
Light vehicles (eg 4WD)	103	78	
Line marking truck	108	83	
Mobile crane	113	88	
Pavement laying machine	114	89	
Pavement profiler	117	92	✓
Piling rig - bored	112	87	✓
Piling rig – vibratory driven	116	91	✓
Piling rig – impact hammer	126	101	✓
Pneumatic hammer (jackhammer)	115	90	✓
Power generator	103	78	
Road truck	108	83	
Rock crusher	118	93	✓
Roller (large pad foot)	109	84	✓
Scissor lift	98	73	
Scraper 651	110	85	
Smooth drum roller	107	82	
Truck (medium rigid)	103	78	
Truck compressor	75	50	
Tub grinder/ mulcher 40-50hp	116	91	✓
Vacuum truck	109	84	
Vibratory roller	109	84	✓
Water cart	107	82	
Welding equipment	105	80	

Note: Greyed out items would not be used during preliminary construction

8.3 Minimising vibration impacts

The pattern of vibration radiation is very different to the pattern of airborne noise radiation and is very site specific. Final vibration levels are dependent on many factors including the actual plant used, its operation and the intervening geology between the activity and the receiver.

Recommended minimum working distances presented in the following sections provide a conservative screening method for indicating buildings and structures where there is a risk of vibration impact. Vibration monitoring would be carried out to confirm the minimum working distances at specific sites, where vibration significant plant is required to operate within or near the recommended minimum working distances.

8.3.1 Human exposure

Many building occupants assume that building damage is occurring when they feel vibration or observe rattling of loose objects, however the level of vibration at which people perceive vibration or at which loose objects may rattle is far lower than vibration levels that can cause damage to structures. At properties near the construction works, nearby receivers may be able to feel vibration when vibration-generating equipment is being utilised. For this reason it is appropriate identify properties where there is a probability of adverse comment so that impacts can be managed.

Recommended minimum working distances for typical vibration intensive construction equipment for human comfort (response) are shown in Table 23. These recommended distances relate to continuous vibration and are presented as a guide only. For most construction activities, vibration emissions are intermittent in nature and for this reason, higher vibration levels occurring over shorter time periods are allowed (see Section 5.5).

Table 23 Recommended minimum working distances (m) - human comfort (response)

Vibration significant plant item	Critical area	Residence (Day)	Residence (Night)	Office	Workshop
Concrete saw	15	10	10	5	5
Excavator (tracked) ≤ 5t + hydraulic hammer	25	20	20	15	10
Excavator (tracked) ≤ 15t + hydraulic hammer	30	20	25	15	10
Excavator (tracked) ≤ 35t + hydraulic hammer	40	25	30	20	15
Percussive drill (small)	20	10	15	5	5
Piling rig – bored (rock)	20	15	15	10	10
Piling rig – bored (soft ground)	10	10	10	5	5
Piling rig - vibratory driven	305	170	225	100	55
Pneumatic hammer (jackhammer)	25	15	20	10	5
Terrain leveller	30	15	20	5	5
Vibratory roller (11t) padfoot - High vibration	120	70	90	40	25
Vibratory roller (11t) padfoot - Low vibration	110	60	80	35	20
Vibratory roller (13t) smooth drum - High vibration	105	55	75	30	15
Vibratory roller (13t) smooth drum - Low vibration	75	40	55	20	10
Wacker packer	20	10	15	5	5

Note: Greyed out items would not be used during preliminary construction

8.3.2 Buildings and structures

Pre- and post-construction building condition surveys will be conducted on nearby buildings and structures. The inspections will document the existing condition of the property and typically note the location of all visible cracks and/or defects observed by the inspector. The post construction survey will record any changes to the property at construction completion.

Recommended minimum working distances to reduce the risk of cosmetic damage to buildings or structures from typical vibration intensive construction equipment are presented in Table 24 following. These are aimed at reducing the risk of cosmetic damage (as per BS 7385:1993 and DIN 4150-3:2016) and are based on the vibration screening criteria set in Section 5.5.3.

Unlike noise, vibration cannot be readily predicted. The minimum working distances below are indicative and will vary depending on the plant item, building types and foundations and local geotechnical conditions. Vibration monitoring would be carried out to confirm the site specific minimum working distances for this Project.

Table 24 Minimum working distances (m) - cosmetic damage[1]

Vibration significant plant item	Reinforced or frame structures (BS7385)[2]	Unreinforced or light framed structures (BS7385)[2]	Structurally unsound heritage structures (DIN 4150-3)[3]
Concrete/ road saw	5	5	5
Excavator (tracked) ≤ 15t + hydraulic hammer	5	5	10
Excavator (tracked) ≤ 35t + hydraulic hammer	5	10	10
Excavator (tracked) ≤ 50t + hydraulic hammer	5	10	20
Drill Rig	5	5	10
Pneumatic hammer (jackhammer)	5	5	5
Piling rig – bored (rock)	5	5	5
Piling rig – bored (soft ground)	5	5	5
Piling rig - impact hammer (high)	15	30	65
Piling rig - impact hammer (typical)	10	15	35
Piling rig - vibratory driven	10	20	50
Terrain leveller	5	5	5
Vibratory roller ≤ 25t padfoot	5	10	20
Vibratory roller ≤ 13t smooth drum - High vibration	5	5	15
Vibratory roller ≤ 13t smooth drum - Low vibration	5	5	10
Wacker packer	5	5	5

NOTES: Greyed out items would not be used during preliminary construction

1. Minimum working distances are in 5m increments only to account for the intrinsic uncertainty of this screening method

2. Minimum working distance based on vibration screening criterion which reduced the cosmetic damage levels set by BS7385 (see Table 23 **Error! Reference source not found.**) by 50% due to potential dynamic magnification.

3. A building condition inspection should determine whether a heritage item is structurally unsound.

CoA E75 requires owners of properties at risk of exceeding the screening criteria for cosmetic damage to be notified before the commencement of vibration-generating works. Properties at risk of cosmetic damage will be identified through the vibration screening drawings, prepared based on proposed vibration intensive construction activities and presented in the CNVIS prepared for the Project. Structures within the minimum working distance screening limits and potentially at risk of damage from vibration are identified on the drawings.

Pre-construction surveys must be offered to the owners of surface and sub-surface structures and other relevant assets identified at risk of damage from vibration, in accordance with CoA E75 (see Table 22). A comprehensive written and photographic condition report would be produced by an appropriate professional prior to relevant works commencing. Specific properties will be identified in the CNVIS prepared for the Project.

Where properties are identified as within the recommended minimum working distances presented in Table 24, vibration monitoring is recommended to determine site specific minimum working distances that will prevent cosmetic and structural damage. If the monitoring above identifies that vibration is likely to exceed the screening criteria for cosmetic damage, further analysis would be undertaken, including consideration of a different construction method with lower source vibration levels and/or implement additional mitigation measures to prevent damage. This notably applies to heritage items to satisfy CoA E76. Furthermore, if the potential exceedance is likely to occur more than once or extend over a period of 24 hours, owners and occupiers would be provided a schedule of potential exceedances on a monthly basis for the duration of the potential exceedances, unless otherwise agreed by the owner and occupier.

For highly sensitive receivers (e.g. high technology facilities, laboratories, recording studios and theatres), specific assessment is required to ensure satisfactory operation of the facility and determine if any mitigation or management measures are required to minimise the potential impacts. Highly sensitive receivers in the vicinity of the M6 Stage 1 construction work areas are identified in the Land Use Survey in Appendix B and will be further investigated in the relevant CNVIS.

8.4 Early implementation of operational noise mitigation measures

In accordance with CoA E78, mitigation measures for those receivers identified as eligible for consideration of additional mitigation and are likely to experience exceedances of the applicable NML, will be installed as early as possible. The identified mitigation measures will be offered prior to the commencement of construction activities that may cause the receiver to be construction noise affected and implemented prior to the commencement of any out-of-hours works that may cause sleep disturbance.

After the initial offer, landowners of residential properties found to be eligible for at-receiver noise mitigation would be advised of the range of options that can be installed at or in their property and given a choice as to which of these they agree to have installed. Any mitigation measures offered in accordance with Condition E78 would remain valid until the out-of-hours work affecting that property are completed, even if the landowner initially refuses the offer, as per Condition E80.

Sensitive receivers that have been provided with noise mitigation under the TfNSW (RMS) Noise Abatement Program or the *State Environment Planning Policy (Infrastructure) 2007* (clause 102(3)) would not be eligible for additional mitigation. The adequacy of at-property treatments will be reviewed where previous treatments have been installed as part of other SSI or CSSI projects. Receivers who satisfy the eligibility requirements detailed in CoA E78, but have previously received satisfactory at-property treatment, may not require additional mitigation if previous treatments are considered adequate.

Where operational noise mitigation measures would not be implemented in accordance with CoA E78, CGU will prepare a report detailing the justification as to why.

There are no known heritage buildings that will be offered at-property treatment for operational noise and there are no aboriginal places subject to operational noise mitigation. Where properties found to be eligible for at-receiver noise mitigation are also heritage buildings or aboriginal places, the advice of a suitably qualified and experienced built heritage expert will be sought and implemented to ensure any such work does not have an adverse impact on the heritage significance of the item.

8.5 Mitigation and management of out-of-hours Work

8.5.1 Emergency works

Were out-of-hours works are required in an emergency to avoid injury or the loss of life, to avoid damage or loss of property or to prevent environmental harm (CoA E66(b)), CGU will notify the AA, the ER, the Planning Secretary and the EPA of the reasons for emergency works. In addition, CGU will use best endeavours to notify all potentially noise and/or vibration affected sensitive receivers of the likely impact and duration of those works at the earliest opportunity.

8.5.2 Out-of-Hours Works Protocol

An Out-of-Hours Work Protocol (OOHW Protocol) has been prepared in accordance with CoA E70 (Appendix C). The OOHW Protocol provides a process for the consideration, management, and approval of work outside the approved construction hours detailed in Section 5.1, and that is not subject to an EPL.

The aim of the OOHW Protocol is to ensure that OOHW not subject to an EPL follow a rigorous process to identify the associated risk of adverse impacts on sensitive receivers with regards to the OOHW and include:

- Consideration of the OOHW against the relevant NMLs and vibration criteria, and providing a determination of low, medium and high-risk activities;
- Processes for selecting and implementing mitigation measures for residual impacts in consultation with the community;
- Procedures to facilitate the coordination of OOHW with those approved under an EPL or undertaken by a third party, to ensure appropriate respite is provided;
- An approval process for OOHW that considers risks, proposed mitigation, management and coordination, and includes review and approval the ER and AA for low risk activities and Planning Secretary approval for medium and high-risk activities; and
- Details of notification requirements for affected receivers and the EPA for all approved OOHW, including notification to the Planning Secretary for approved low risk OOHW.

The Out of Hours Works and Construction Fatigue Protocol was provided to the Acoustics Advisor on 20 August 2021 with the Noise and Vibration CEMP Sub-plan for preliminary construction including commencement activities.

The Out of Hours Works and Construction Fatigue Protocol was provided to the EPA with the Project's application for an EPL on 6 September 2021 (evidence of submission sighted by the Environmental Representative on 27 September 2021). At a meeting with CGU and the EPA on 9 September 2021, the EPL application was discussed, and the EPA and CGU confirmed that all works associated with the construction of the Project would be subject to an EPL (noting that the Protocol required by CoA E70 only applies to works not subject to an EPL).

8.5.3 Community consultation on respite

To satisfy CoAE69, consultation with the community to determine appropriate respite periods for OOHW would be undertaken where works are:

- undertaken outside standard construction hours; and
- likely to exceed the noise and vibration objectives identified in CoA E72.

The consultation would include, but not be limited to providing the community with:

- a schedule of likely OOHW for a period no less than three (3) months;
- a description of the potential Work, location and duration;
- the noise characteristics and likely noise levels of the Work; and
- likely mitigation and management measures to be implemented.

Note: Respite periods can be any combination of days or hours where OOHW would not be more than 5 dB(A) above the rating background level at any residence.

The standard approach to managing noise and vibration impact from OOHW, including respite periods and temporary alternative accommodation, is outlined in Section 8.6. The Communication Strategy outlines the communication tools CGU will use to consult and engage with affected sensitive receivers and stakeholders. These include (but are not limited to) OOHW community consultation forums and stakeholder and resident one-on-one meetings where attendees can provide feedback on respite periods and offers. Alternative accommodation notifications will be distributed in several ways, including door knocking, letterbox notification, email notifications and phone calls. The outcomes of the community consultation, including the identified respite periods and the scheduling of OOHW would be documented and provided to the AA, EPA and Planning Secretary for information within two (2) weeks of completing the community consultation.

To satisfy CoA E71, all OOHW undertaken on the Project, including works undertaken by third parties (such as utility relocations), would be coordinated to ensure respite periods are provided in accordance with CoA E68 and E69. Where this is unable to be achieved, provision of alternative accommodation or mitigation to impacted noise sensitive receivers would be considered. This would be documented as part of the CNVIS.

8.5.4 Temporary alternative accommodation

Where out out-of-hours works are planned, noise modelling and assessment would be carried out to identify all residential receivers where the construction noise levels are predicted to exceed the NML by 25 dB(A) or are greater than 75 dBA ($L_{Aeq(15\ min)}$), whichever is the lesser, between:

- 10:00 pm and 7:00 am, Monday to Friday;
- 10:00 pm Saturday to 8:00 am Sunday; and
- 6:00 pm Sunday and public holidays to 7:00 am the following day unless that day is Saturday then to 8:00 am.

Where the predicted impact is planned to occur for more than two (2) nights over a seven (7) day rolling period, temporary alternative accommodation would be offered to residents (including those who have accepted at-property treatments), consistent with CoA E82. There may be personal circumstances among the residential receivers where alternative accommodation is not best suited. The Stakeholder and Community Engagement Manager has the authority to amend the offer with due consideration of the personal circumstances that may apply and ensure no less than equivalent mitigation is provided.

The NML must be reduced by 5 dB where the noise contains annoying characteristics and increased by 10 dB if the property has been offered at-property noise treatments which allow the residents to close their windows at night. This would apply to landowners whose residential

properties where at-receiver noise mitigation has been implemented to satisfy Conditions E78 and E85.

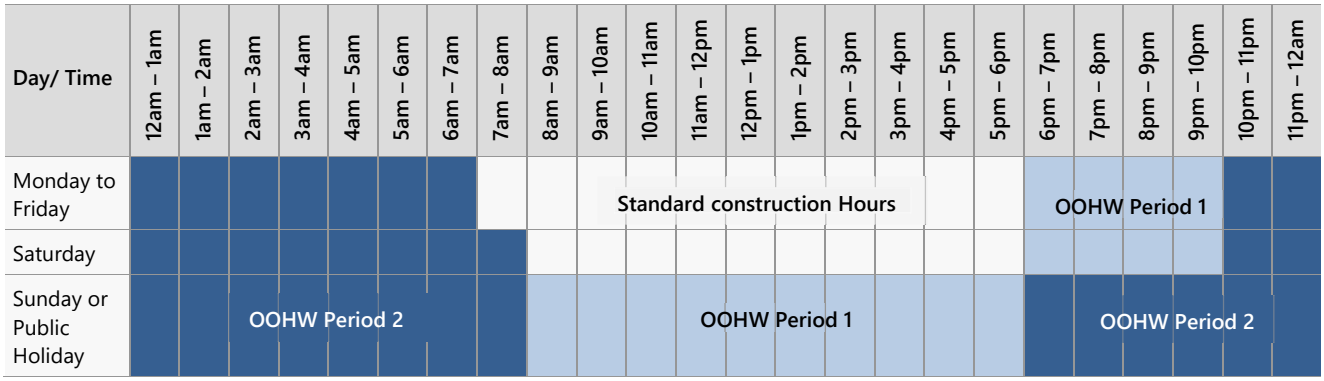
8.6 Additional noise and vibration mitigation measures

In instances where noise levels are still predicted to exceed the NML at receivers, after the application of all reasonable and feasible mitigation and management measures (refer to Section 8.1), the CNVG directs that the Project should consider implementing the additional mitigation measures such as (refer to Appendix C of the CNVG for more detail):

- Notification (letterbox drop or equivalent) detailing work activities, time periods of which these will occur, impacts and mitigation measures;
- Specific notifications, which provide additional information when relevant and informative to more highly affected receivers than covered in general letterbox drops;
- Phone calls, which detail relevant information to identified/affected stakeholders and provide personalised contact, tailored advice and the opportunity to comment on the proposed work;
- Individual briefings, which inform stakeholders about the impacts of high noise activities and mitigation measures, and provide personalised contact, tailored advice and the opportunity to comment on the proposed work;
- Respite offers, to provide residents with respite from an ongoing impact;
- Respite period 1, where out-of-hours construction noise in OOHW Period 1 is generally limited to no more than three consecutive evenings per week;
- Respite period 2, where night-time construction noise in OOHW Period 2 is generally limited to two consecutive nights;
- Duration respite, which is where the work duration, number of evenings or nights is increased so that the Project can be completed more quickly;
- Alternative accommodation;,
- Tailored mitigation measure/s to individual circumstances (where engagement with affected stakeholder/s and/or resident/s has identified the need); and/or
- Verification, including measurement of the background noise level and construction noise.

The standard hours and OOHW periods are depicted in Figure 3. The OOHW periods are further defined as OOHW Period 1 and 2, based on the Roads and Maritime Construction Noise and Vibration Guideline (CNVG).

Figure 3 Construction assessment periods



Figures 4 – 6 detail the additional mitigation measures for airborne noise, ground-borne noise and vibration respectively, as recommended in the CNVG, for standard hours and out-of-hours work (OOHW). Where feasible and reasonable, this approach will be implemented.

Figure 4 Triggers for Additional Mitigation Measures – Airborne Noise

When is the work being undertaken?	How much does the predicted noise level exceed the ANML by?	Receiver perception	Identify additional management measures to be implemented
All Hours	75 dB(A) or greater	-	V, N, PC, RO
Standard Hours M-F 7am to 6pm Sat 8am to 6pm	0 dB(A)	Noticeable	-
	≤ 10 dB(A)	Clearly audible	-
	10 to 20 dB(A)	Moderately intrusive	V, N
	> 20 dB(A)	Highly intrusive	V, N
OOHW Period 1 M-F 6pm to 10pm Sat 6pm to 10pm Sun/ PH 8am to 10pm	< 5 dB(A)	Noticeable	-
	5 to 15 dB(A)	Clearly audible	N, R1, DR
	15 to 25 dB(A)	Moderately intrusive	V, N, R1, DR
	> 25 dB(A)	Highly intrusive	V, N, SN, IB, PC, R1, DR
OOHW Period 2* M-F 10pm to 7am Sat 10pm to 8am Sun/ PH 6pm to 8am	< 5 dB(A)	Noticeable	N
	5 to 15 dB(A)	Clearly audible	V, N, R2, DR
	15 to 25 dB(A)	Moderately intrusive	V, N, SN, IB, PC, R2, DR
	> 25 dB(A)	Highly intrusive	AA, V, N, SN, IB, PC, R2, DR

Notes: Use the abbreviation codes in the table above to confirm management measures required

* Where OOHW occur in the evening/night shoulder period (10pm to 12am) or the night/morning shoulder period (5am to 7am) apply additional airborne mitigation measures from the OOHW Period 2

N = Notification (should be issued a minimum of five working days prior to the start of works)
SN = Specific notifications (issued no later than seven calendar days ahead of construction activities)
IB = Individual briefing
PC = Phone Call
V = Verification of predicted noise levels
AA = Alternative accommodation**
RO = Project specific respite offer
R1 = Respite period 1
DR = Duration respite
R2 = Respite period 2

** Where construction activity impacts receiver for more than two (2) nights over a seven (7) day rolling period (CoA E82).

Figure 5 Triggers for Additional Mitigation Measures – Ground-borne noise

When is the work being undertaken?	How much does the predicted noise level exceed the GNML by?	Receiver perception	Identify additional management measures to be implemented
Standard Hours M-F 7am to 6pm Sat 8am to 6pm	Note: vibration only applicable during standard hours		
	> 10 dB(A) (guidance only)	Noticeable	N
	> 20 dB(A) (guidance only)	Noticeable	V, N
OOHW Period 1 M-F 6pm to 10pm Sat 6pm to 10pm Sun/ PH 8am to 10pm	< 10 dB(A)	Clearly audible	N
	10 to 20 dB(A)	Moderately intrusive	V, N, SN, R1, DR
	> 20 dB(A)	Highly intrusive	V, N, SN, IB, PC, R1, DR
OOHW Period 2* M-F 10pm to 7am Sat 10pm to 8am Sun/ PH 6pm to 8am	< 10 dB(A)	Clearly audible	SN
	10 to 20 dB(A)	Moderately intrusive	V, N, SN, IB, PC, R2, DR, AA
	> 20 dB(A)	Highly intrusive	V, N, SN, IB, PC, R2, DR, AA

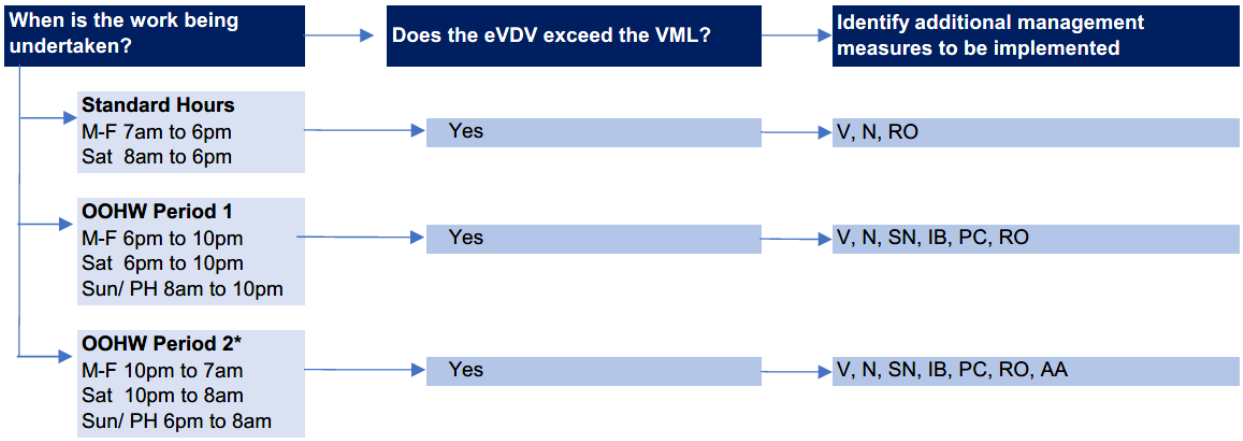
Notes: Use the abbreviation codes in the table above to confirm management measures required

* Where OOHW occur in the evening/night shoulder period (10pm to 12am) or the night/morning shoulder period (5am to 7am) apply additional airborne mitigation measures from the OOHW Period 2

N = Notification (should be issued a minimum of five working days prior to the start of works)
SN = Specific notifications (issued no later than seven calendar days ahead of construction activities)
IB = Individual briefing
PC = Phone Call
V = Verification of predicted noise levels
AA = Alternative accommodation**
RO = Project specific respite offer
R1 = Respite period 1
DR = Duration respite
R2 = Respite period 2

** Where construction activity impacts receiver for more than two (2) nights over a seven (7) day rolling period (CoA E82).

Figure 6 Triggers for Additional Mitigation Measures – Vibration



Notes: Use the abbreviation codes in the table above to confirm management measures required

* Where OOHW occur in the evening/night shoulder period (10pm to 12am) or the night/morning shoulder period (5am to 7am) apply additional airborne mitigation measures from the OOHW Period 2

N = Notification (should be issued a minimum of five working days prior to the start of works)

SN = Specific notifications (issued no later than seven calendar days ahead of construction activities)

IB = Individual briefing	PC = Phone Call	V = Verification of predicted noise levels
AA = Alternative accommodation**	RO = Project specific respite offer	R1 = Respite period 1
	DR = Duration respite	R2 = Respite period 2

** Where construction activity impacts receiver for more than two (2) nights over a seven (7) day rolling period (CoA E82).

9 Compliance management

9.1 Roles and responsibilities

The CGU Project Team's organisational structure and overall roles and responsibilities are outlined in Section 3.4 of the CEMP. Specific responsibilities for the implementation of environmental controls are detailed in Chapter 8 of this Plan.

9.2 Training

All employees, contractors, sub-contractors and utility staff working on site will undergo site induction training that includes construction noise and vibration management issues. The induction training will address elements related to noise and vibration management including:

- Existence and requirements of this sub-plan;
- Relevant legislation;
- Approved construction hours;
- The process for seeking approval for OOHW, including consultation;
- Location of noise sensitive areas;
- Complaints reporting;
- General noise and vibration management measures; and
- Specific responsibilities to minimise impacts on the community and built environment from noise and vibration associated with the works.

Further details regarding staff induction and training are outlined in Section 3.6 of the CEMP.

9.3 Inspection and monitoring

Weekly and other routine inspections by the CGU Environment Team, TfNSW, AA and ER will occur throughout construction. Detail on the nature and frequency of these inspections and activities are documented in Section 3.9 of the CEMP.

Noise and vibration monitoring will also occur routinely for the duration of the Project, in accordance with the Project's Noise and Vibration Monitoring Program, which is detailed in Appendix A of this Plan.

The noise and vibration monitoring program details when monitoring will be undertaken, as well as the representative locations adjacent to the construction works where noise and vibration monitoring will be undertaken.

To satisfy CoA C16, where real time noise and vibration monitoring is undertaken, the data would be readily available to the construction team, Transport for NSW, ER and AA. DPIE and EPA would be provided with access to the real-time monitoring data, on request.

Monitored noise and vibration levels will be analysed against the predictions made in the relevant noise and vibration assessments. Where monitored noise levels are found to be above modelling predictions or vibration goals are exceeded, the following actions will be undertaken:

- Cease the noise and/or vibration generating source which causes the exceeded predictions;

- Confirm the monitored levels are not being impacted by other (non-Project related) noise or vibration sources;
- Confirm if the exceedance is due to an uncharacteristically loud piece of equipment;
- Identify if the equipment can be swapped out for another piece of equipment or alternative equipment or plant, or if additional mitigation can be included in the site design;
- Confirm that the modelling reflects the actual activity being undertaken;
- Implement other feasible and reasonable measures which may include reducing plant size, modifying time of works, changing operational settings (such as turning off the vibratory function of the machine), and utilising alternative construction methodology or a combination of these;
- Review work practices to ensure compliance with the management levels set out in this CNVMP;
- Ensure that the learnings from the above are fed back into the noise modelling assessment process for fine-tuning;
- Continue work where impacts can be reduced; and
- Communicate lessons learnt to relevant personnel.

In accordance with CoA E28, consultation with a heritage specialist will be undertaken prior to the installation of any monitoring equipment, where installation may impact on heritage listed structures.

9.3.1 Noise monitoring

Baseline noise monitoring data

Baseline noise monitoring data was reported in the EIS as noted in Section 4.2.

Parameters to be monitored

Refer to noise monitoring specifications in Appendix A.

Plant and Equipment Noise Audits

A plant induction process will be put in place for the Project. Part of the Plant Induction Process will be to complete periodic noise audits of plant and equipment in use to confirm actual plant noise levels are compliant with the Table 22 maximum noise levels.

The plant and equipment noise monitoring procedure is further detailed in Appendix A

Attended Airborne Noise Monitoring in the Community

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

- At the first opportunity within the first month of starting construction activities as well as throughout the construction period to ensure the range of activities being undertaken at the site are measured to confirm noise predictions, the effectiveness of actions and mitigation measures. This would be undertaken in consultation with the AA;
- Where appropriate in response to a noise related complaint(s) (determined on a case-by-case basis);
- During sensitive periods (i.e. night works); and
- As directed by an authorised officer of the EPA.

Monitoring would be undertaken at the potentially most exposed receivers in proximity to construction activities. Noise monitoring locations will consider factors including:

- The location of previous monitoring sites;

- The proximity of the receiver to a worksite;
- The sensitivity of the receiver to noise;
- Background noise levels;
- Safety; and
- The expected duration of the impact.

Where monitoring indicates that the construction noise levels are above the predicted levels, work practices would be reviewed and further mitigation measures applied where reasonable and feasible.

The attended measurements will need to be carried out by an appropriately trained person in the measurement and assessment of construction noise, who is familiar with the requirements of the relevant standards and procedures.

Ground-Borne Noise Monitoring in the Community

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

- Where appropriate in response to a noise related complaint(s) (determined on a case-by-case basis); and
- As directed by an authorised officer of the EPA.

Monitoring will be undertaken in the most affected room of the residence or other sensitive building and will be conducted in conjunction with vibration measurements whenever practicable (see Section 9.3.2). Note that the room selected for noise monitoring should be well shielded from airborne noise intrusions, such as road traffic noise; to allow the ground-borne noise to dominate over non-construction generated airborne noise.

The attended measurements will need to be carried out by an appropriately trained person in the measurement and assessment of construction noise, who is familiar with the requirements of the relevant standards and procedures.

9.3.2 Vibration monitoring

Attended Vibration Monitoring in the Community

Attended vibration monitoring is to be undertaken as follows:

- At the commencement of construction for each plant or activity on site where the vibration screening criteria is likely to be exceeded, to refine the identified minimum working distances to suit site-specific conditions;
- Where vibration generating activities have the potential to impact on heritage items. In the event that the vibration monitoring shows that the preferred values for vibration are likely to be exceeded, an alternative, lower impact construction methodology would be considered;
- Where it is not feasible to modify construction methodology to reduce vibration intensive construction activities within the minimum working distances for cosmetic damage;
- For short periods of potential risk for cosmetic damage to buildings and structures;
- Where deemed to be relevant to construction works in response to a vibration-related complaint; and
- As otherwise required by the CNVIS (or by an authorised officer of the EPA).

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

Plant and equipment vibration measurement procedures are further detailed in the CNVIS.

Advice of a heritage specialist will be sought regarding methods and locations for installing equipment used for vibration monitoring on heritage-listed structures.

9.4 Complaints

Complaints will be recorded and managed as detailed in Section 3.7.3 of the CEMP and the Communications Strategy.

9.5 Auditing

Audits (both internal and external) will be undertaken to assess the effectiveness of environmental controls, compliance with this sub plan, CoA and other relevant approvals, licenses and guidelines.

Audit requirements are detailed in Section 3.9.3 of the CEMP.

9.6 Reporting

Reporting requirements and responsibilities are documented in Section 3.9 of the CEMP, and are further detailed in the Project's Noise and Vibration Monitoring Program in Appendix A. Specific reports prepared in response to noise and vibration monitoring will include reporting required in accordance with the POEO Act and Regulations, and will capture the following information:

- The locations and descriptions of monitoring carried out;
- A tabulation of results (e.g. for noise including LAmax, LA90 and LAeq noise levels) together with notes identifying the principle sources and operations;
- Summary of any measurements exceeding the nominated criteria, and descriptions of the plant or operations causing these exceedances; and
- Detail of any corrective actions and confirmation of their successful implementation.

10 Review and improvement

10.1 Continual improvement

Monitoring data will be reviewed throughout the construction for continual improvement.

Continual improvement of this Program will be achieved by the ongoing evaluation of environmental management performance against environmental policies, objectives and targets and Project performance outcomes of the EIS for the purpose of identifying opportunities for improvement.

The continual improvement process will be undertaken in accordance with Section 3.2 of the CEMP and the intention of this process is to:

- Identify areas of opportunity for improvement of environmental management and performance;
- Determine the cause or causes of non-conformances and deficiencies;
- Develop and implement a plan of corrective and preventative action to address any non-conformances and deficiencies;
- Verify the effectiveness of the corrective and preventative actions;
- Document any changes in procedures resulting from process improvement; and
- Make comparisons with objectives and targets.

10.2 Update and amendment

The processes described in Chapters 3.9 to 3.13 of the CEMP may result in the need to update or revise this Plan. This will occur as needed, in accordance with the process outlined in Section 3.13 of the CEMP.

A copy of the updated plan and changes will be distributed to all relevant stakeholders in accordance with the approved document control procedure – refer to Section 2 of the CEMP.

Appendix A Construction Noise and Vibration Monitoring Program

Noise and Vibration Monitoring Program

Project Name: M6 Stage 1

Project number:	M6S1
Document number:	M6S1-CGU-NWW-EV-PRG-050000
Revision date:	24/09/2021
Revision:	00

Document approval

Rev	Date	Prepared by	Reviewed by	Recommended	Approved	Remarks
A.01	29/07/2021	[redacted]	[redacted]	[redacted]	[redacted]	Draft issued to TfNSW
Signature:						
A.02	19/08/2021	[redacted]	[redacted]	[redacted]	[redacted]	Issued for consultation
Signature:						
00	24/09/2021	[redacted]	[redacted]	[redacted]	[redacted]	Issued for approval

Table of Contents

Table of Tables

Table of Figures

Table of Appendices

Glossary/ Abbreviations

Term/ Abbreviations	Expanded Text
AA	Acoustic Advisor
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.
Attenuation	The reduction in the level of sound or vibration.
CEMP	Construction Environmental Management Plan
CNVG	Construction Noise and Vibration Guideline (Roads and Maritime 2016)
CNVIS	Construction Noise and Vibration Impact Statement
CoA	Condition of Approval
CSSI	Critical State Significant Infrastructure
dBA	Decibels using the A-weighted scale measured according to the frequency of the human ear.
DPIE	NSW Department of Planning, Industry and Environment
EIS	Environmental Impact Statement
EMS	Environmental management system
Environmental aspect	Defined by AS/NZS ISO 14001:2015 as an element of an organisation's activities, products or services that can interact with the environment.
Environmental impact	Defined by AS/NZS ISO 14001:2015 as any change to the environment, whether adverse or beneficial, wholly or partially resulting from an organisation's environmental aspects.
EMM	Environmental Management Measure
Environmental objective	Defined by AS/NZS ISO 14001:2015 as an overall environmental goal, consistent with the environmental policy, that an organisation sets itself to achieve.
Environmental target	Defined by AS/NZS ISO 14001:2015 as a detailed performance requirement, applicable to the organisation or parts thereof, that arises from the environmental objectives and that needs to be set and met in order to achieve those objectives.
EPA	NSW Environment Protection Authority
EP&A Act	Environmental Planning and Assessment Act 1979
ER	Environmental Representative
ERG	Environmental Review Group
EWMS	Environmental Work Method Statements
Feasible and reasonable	Consideration of best practice taking into account the benefit of proposed measures and their technological and associated operational application in the NSW and Australian context. Feasible relates to engineering considerations and what is practical to build. Reasonable relates to the application of judgement in arriving at a decision, taking into account mitigation benefits and cost of mitigation versus benefits provided, community views and nature and extent of potential improvements.

Term/ Abbreviations	Expanded Text
ICNG	Interim Construction Noise Guideline (DECC, 2009)
INP	NSW Industrial Noise Policy (EPA 2000)
$L_{Aeq(15min)}$	The A-weighted equivalent continuous (energy average) A-weighted sound pressure level of the construction works under consideration over a 15-minute period and excludes other noise sources such as from industry, road, rail and the community.
$L_{A(max)}$	the A-weighted maximum noise level only from the construction works under consideration, measured using the fast time weighting on a sound level meter.
NCA	Noise catchment areas
NML	Noise Management Level
NVMP	Noise and Vibration Management Sub Plan (this document)
OEH	Office of Environment and Heritage
OOHW	Out-of-hours works
RBL	The Rating Background Level for each period is the medium value of the ABL values for the period over all of the days measured. There is therefore an RBL value for each period (day, evening and night)
SWP	Sound Power Level
SSI	State Significant Infrastructure
SPL	Sound Pressure Level
TfNSW	Transport for NSW (formerly Roads and Maritime Services, RMS)
VDV	Vibration Dose Value

1. Introduction

1.1. Context

This Construction Noise and Vibration Monitoring Program (the Program) has been prepared for the Design and Construction of the M6 Stage 1 (the Project). The Program forms Appendix A of the Noise and Vibration Management CEMP Sub-plan (CNVMP) and has been prepared to address the requirements of the Minister's Conditions of Approval (CoA), the Environmental Management Measures (EMMs) listed in the M6 Stage 1 Environmental Impact Statement (EIS) and all applicable legislation.

1.2. Scope

The scope of this Program is to define how the CPB Contractors, Ghella, UGL Engineering (CGU) joint venture intends to monitor potential noise and vibration impacts during construction of the Project. Operational monitoring measures do not fall within the scope of the construction phase and therefore are not included in this Program.

This monitoring Program will apply for the duration of the Project's construction works, unless a longer period is specified by the Secretary of the Department of Planning, Industry and Environment (DPIE).

2. Purpose and objectives

2.1. Purpose

The purpose of the Program is to describe how, where and when CGU will monitor noise and vibration during construction of the Project and supplements the CNVMP, which itself is an Appendix of the Construction Environmental Management Plan (CEMP).

The Program will be implemented to monitor the effectiveness of mitigation measures applied during the construction phase of the Project (refer to Section 9.3 of the CNVMP). Monitoring will be undertaken for modelling verification at sensitive receivers, to assess compliance in response to complaints and for equipment spot checks. For further information refer to Sections 4 and 5.

2.2. Objective

The key objective of this Program is to ensure all CoAs, EMMs, and licence/permit requirements relating to noise and vibration monitoring are described, scheduled, and assigned responsibility as outlined in:

- The Environmental Assessments prepared for the Project;
- Conditions of Approval granted to the project on 18th December 2019;
- RMS specifications G36;
- Environment Protection Licence (EPL); and
- All relevant legislation and other requirements described in Section 3 of the CNVMP.

2.3. Consultation

This Program was prepared in consultation with New South Wales (NSW) Environmental Protection Agency (EPA) in accordance with CoA C13(e). Table 1 outlines the queries raised by stakeholders and the actions CGU undertook to address these matters. Refer to Section 2 of the CEMP for the consultation requirements relating to the CEMP and all sub-plans.

Table 1 Consultation with Stakeholders

Relevant Public Authority	Query	Action
Bayside Council	No queries were raised by Bayside Council in regards to the Noise and Vibration Monitoring Program.	Nil
EPA	The EPA raised a number of issues regarding the level of detail provided in the stand-alone Monitoring Program. The EPA communicated an expectation that the Program must demonstrate that measured noise levels collected in the field, will be assessed against the Noise Management Levels to determine if all reasonable and feasible measures have been implemented to reduce noise levels, as well as Predicted Noise Levels generated through noise modelling. Other matters related to noise monitoring locations, monitoring data collected in the field and monitoring records.	This Monitoring Program was updated in response to EPA comments to provide further clarity of the matters raised. A meeting was held with the EPA on 24/09/2021 to discuss the close out the comments.
NSW Health	Due to current pandemic conditions, NSW Health was unable to provide resources for consultation at this time.	CGU commits to consulting with NSW Health when resources become available.

Community feedback and complaints relating to construction noise and vibration will be managed in accordance with the Communication Strategy and Complaints Management System.

3. Noise and vibration monitoring

3.1. Relevant standards and guidelines

The main guidelines, specifications and policy documents relevant to this noise and vibration monitoring Program include:

- NSW Interim Construction Noise Guideline, Department of Environment and Climate Change 2009;
- NSW Industrial Noise Policy, Environment Protection Authority 2000;
- NSW Noise Policy for Industry, Environment Protection Authority 2017;
- NSW Assessing Vibration – a technical guideline (AVTG), Department of Environment and Conservation 2006;
- Roads and Maritime Construction Noise and Vibration Guideline (Roads and Maritime 2016);
- Australian Standard 1055 Acoustics – Description and Measurement of Environmental Noise;
- Australian Standard AS 2187.2 Explosives - Storage and use - Part 2 Use of explosives;
- Australian Standard AS2436-2010 Guide to noise and vibration control on construction, demolition and maintenance sites Australian Standard 2659.1 – 1998 Guide to the use of sound measuring equipment – portable sound level meters;
- Australian Standard 2659.1 – 1998 Guide to the use of sound measuring equipment – portable sound level meters;
- Australian Standard 2775 Mechanical Mounting of Accelerometers;
- British Standard BS 6472-2008, ‘Evaluation of human exposure to vibration in buildings (1-80Hz);
- British Standard 7385: Part 2-1993 'Evaluation and measurement of vibration in buildings';
- German Standard DIN4150-3:2016 Vibration in buildings – Part 3: Effects on structures;
- International Standard IEC 61672.1 Electroacoustic – Sound Level Meters – Specifications;
- International Standard IEC 60942 'Electroacoustics - Sound calibrators;
- ISO 3744 Acoustics - Determination of sound power levels and sound energy levels of noise sources using sound pressure - Engineering methods for an essentially free field over a reflecting plane;
- ISO 3746 Acoustics - Determination of sound power levels and sound energy levels of noise sources using sound pressure - Survey method using an enveloping measurement surface over a reflecting plane;
- ISO 6393 Earth-moving machinery - Determination of sound power level - Stationary test conditions;
- ISO 6395 Earth-moving machinery - Determination of sound power level - Dynamic test conditions; and
- NATA General Accreditation Guidance - General Equipment - Calibration and Checks, General Equipment Table 2018.

3.2. Existing environment (baseline monitoring)

As part of the EIS process, baseline noise monitoring was conducted within the following three noise monitoring periods:

- June 2015 (as part of the New M5 Motorway project);
- November/December 2017; and
- February 2018.

The monitoring locations were representative of receivers that would likely be most affected by the construction and operation of the Project. The EIS noted that key noise sources in the study area include transport infrastructure, including the M5 East Motorway, the arterial road network, Sydney Airport and freight and passenger railway lines.

For further information regarding baseline noise monitoring refer to Section 4.2 of the CNVMP and Section 3 of the EIS Appendix G Noise and Vibration Technical Report.

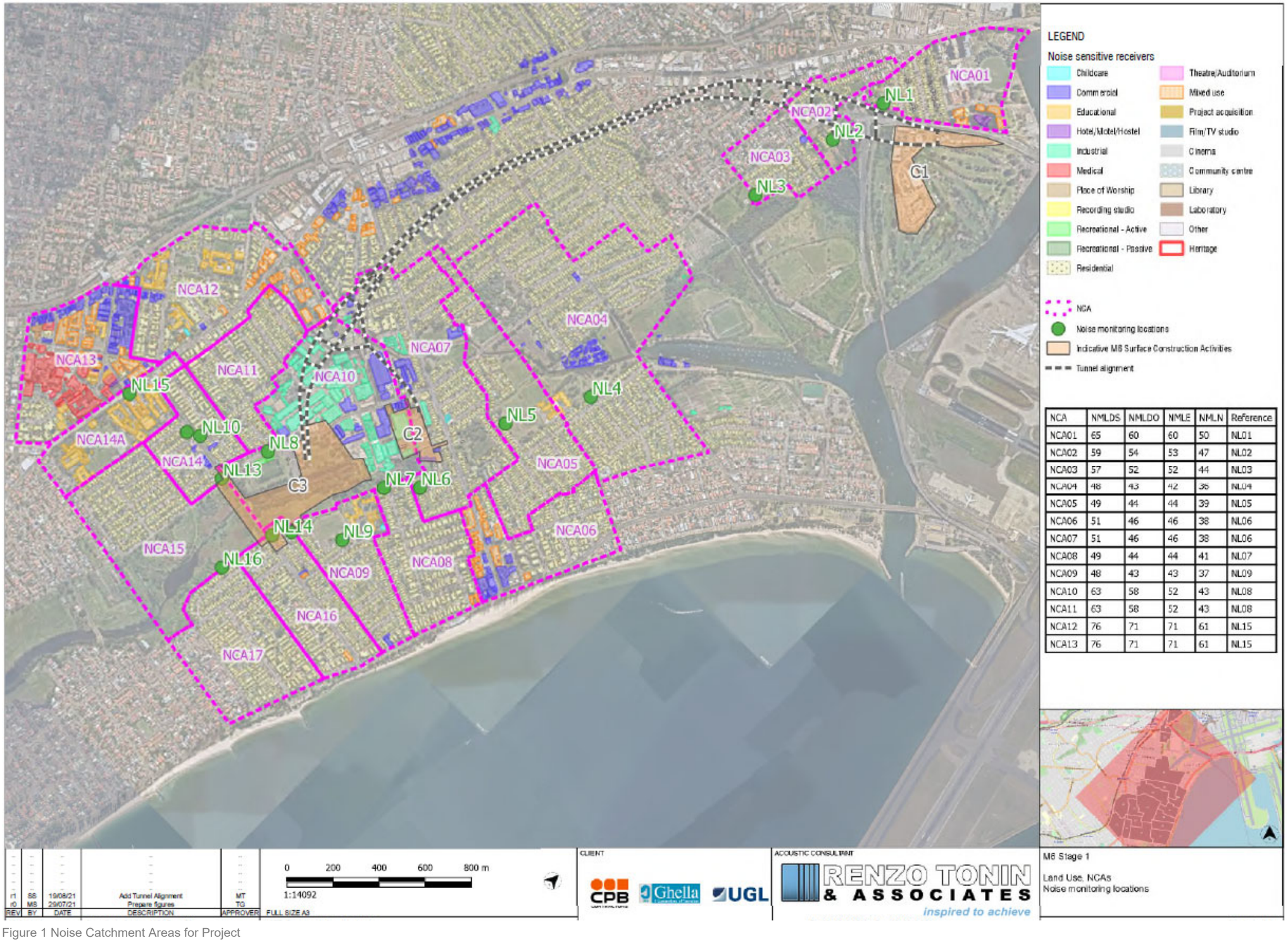
A review was undertaken on the data from June 2015 (as part of the M8 Motorway project) as the data is more than 5 years old. The data is considered representative of the existing acoustic environment in Arncliffe. Furthermore, monitoring during COVID 19 restrictions in Sydney may result in non-typical background noise levels. No additional baseline monitoring is anticipated, however, if required, it will be undertaken in accordance with the relevant guidance and the CNVMP will be updated as necessary and issued to DPIE for approval.

3.3. Sensitive receptors

A land use survey in areas where works could impact on sensitive receivers is included in Appendix B of the CNVMP. The land use survey identified the existing land use and development within and around the Project contains a mix of residential, educational, commercial, industrial and open space uses.

To facilitate the assessment of noise impacts from the Project, receivers along the Project alignment have been divided into Noise Catchment Areas (NCAs). NCAs group individual sensitive receivers by common traits such as existing noise environment and location in relation to the Project. An overview of the NCA's featured in Figure 1 below.

The NCAs and Land Use Survey are described and presented in more detail in Section 4.1 and nine detailed maps are featured in Appendix B of the CNVMP.



NCA	NMLDS	NMLDO	NMLE	NMLN	Reference
NCA01	65	60	60	50	NL01
NCA02	59	54	53	47	NL02
NCA03	57	52	52	44	NL03
NCA04	48	43	42	36	NL04
NCA05	49	44	44	39	NL05
NCA06	51	46	46	38	NL06
NCA07	51	46	46	38	NL06
NCA08	49	44	44	41	NL07
NCA09	48	43	43	37	NL09
NCA10	63	58	52	43	NL08
NCA11	63	58	52	43	NL08
NCA12	76	71	71	61	NL15
NCA13	76	71	71	61	NL15

Figure 1 Noise Catchment Areas for Project

3.4. Noise monitoring

3.4.1. Overview

This Program describes monitoring of noise impacts during construction of the Project. Note that details related to monitoring to be undertaken during Stage 2 Construction activities have been greyed out. These sections will be triggered when consultation on the Noise and Vibration CEMP Sub-plan for Construction begins.

For further information on the staging of the Project, refer to:

- CEMP for Preliminary construction including commencement activities:
  - Section 1.1;
  - Section 3.2.1; and
  - Appendix A2 Aspects and Impacts Register.
- Staging Report.

3.4.2. Monitoring locations during Stage 1 Preliminary Construction

Attended noise monitoring will be carried out during Stage 1 Preliminary Construction in accordance with Table 5.6, Section 5.3.4 of the CNVIA for Preliminary Construction including commencement activities. This document is found in Appendix F of the Noise and Vibration CEMP Sub-plan for Preliminary Construction including commencement activities. An extract of nominated monitoring locations are identified in Table 2 below.

Table 2 Nominated attended noise monitoring locations

Worksite	NCA	Nominated receiver address
C1	NCA01	26 Marsh Street, Wolli Creek 2205
C1	NCA02	6 Eve Street, Arncliffe
C2	NCA07	396 West Botany Street, Rockdale 2216
C2	NCA07	203 Bay Street, Rockdale 2216
C2	NCA07	3 England Street Street, Brighton Le Sands 2216
C2/C3	NCA08	2 Kings Road, Brighton-Le-Sands 2216
C3 (MOC3)	NCA11	79 French Street, Kogarah 2217
C3	NCA09	Brighton Le Sands Public School, 35 Crawford Rd, Brighton-Le-Sands 2216
C3	NCA09	1 Sybill Lane, Brighton Le Sands 2216

3.4.3. Monitoring locations during Stage 2 Construction

The monitoring locations will take into consideration the nature of construction activities being undertaken by the Project. Some activities will occur withing static work sites, like those at C1, C2 and C3. Other construction activities will move progressively over time along roads and other

transport corridors, as in the case for C4, C5 and C6. Therefore, this Program will be tailored to reflect the nature of both static and transient construction works of the Project.

Fixed station (real time) noise monitoring

To provide real time noise monitoring data to assess and confirm whether noise emission from site is within the predicted noise levels identified in the Construction Noise and Vibration Impact Statements (CNVIS), long-term, unattended noise monitoring will occur at fixed locations at construction compounds C1, C2 and C3. A fourth semi-mobile monitoring station will be allocated for construction compounds C4, C5 and C6. This station will be moved along the roads and transport alignment as works progress.

The location of the real-time noise monitoring equipment will be subject to the final work site layouts and availability of mains power and will be selected in consultation with the Acoustic Advisor (AA). Indicative locations of all monitoring stations are found in Appendix A and coordinates are featured in Table 3.

Table 3: Indicative coordinates of fixed real-time noise monitoring stations

Fixed station monitoring location ID	Easting	Northing
Fixed Monitor C1	329552	6243384
Fixed Monitor C2	328799	6240957
Fixed Monitor C3	328786	6240196
Semi-mobile Monitor C4 – C6	To be deployed along road and ATC alignment	

Activities based airborne noise monitoring

Attended noise monitoring locations may vary throughout the life of the Project. Locations would be determined on a case-by-case basis in a CNVIS, via the Project's noise and vibration management tool (Gatewave, see CNVMP Section 7.3) or in response to complaints. The identification of monitoring locations in the CNVIS or via Gatewave will consider the following:

- Most affected noise sensitive receiver location in proximity to the assessed activities,
- Location of previous monitoring sites,
- Proximity of the receiver to a Project worksite,
- Sensitivity of the receiver to noise,
- Background noise levels, and
- Safety of personnel undertaking the measurements,
- Expected duration of the impact.

Noise monitoring should, where practicable, be in positions with unobstructed views of general site activities, whilst shielded as much as possible from non-construction site noise (e.g. road traffic, rail noise and other surrounding noise). In accordance with Australian Standard AS1055, outdoor noise monitoring is to be undertaken at least 3.5m from any reflecting structure other than the ground. The preferred measurement height is 1.2-1.5m above the ground. Where the noise monitors are placed within 3.5 metres of building facades, walls or cliffs, then a reflection correction of up to -2.5dB(A) shall be applied to remove the effect of increased noise due to sound reflections from such structures.

Measurements inside buildings should be at least 1m from the walls or other major reflecting surfaces, 1.2 m to 1.5m above the floor, and about 1.5m from windows.

Plant/ equipment noise checks

Plant/ equipment noise checks are required for noise intensive plant and equipment to ensure compliance with the noise levels for construction equipment assumed in the CNVIS (see Appendix C, Table C1 of the relevant CNVIS) or the levels established in Table F.1 of the CNVG. Spot checks would be carried out as required on a case-by-case basis, such as in response to a plant/equipment specific noise related complaint and during noise and vibration assessment validation monitoring when it is possible to isolate the noise from one piece of plant or equipment.

Ongoing spot checks for noise intensive plant and equipment should typically be carried out at a distance of 7 metres from the plant. The measurements should be undertaken at least 3.5m from any reflecting structure other than the ground. The preferred measurement height is 1.2-1.5m above the ground. Where the noise monitors are placed within 3.5 metres of building facades, walls or cliffs, then a reflection correction of up to -2.5dB(A) shall be applied to remove the effect of increased noise due to sound reflections from such structures.

Further guidance for noise monitoring of specific plant items can be obtained from ISO 3744, ISO 3746, ISO 6393 and ISO 6395, referenced in Section 3.1.

Ground-borne noise monitoring

Ground-borne noise monitoring locations would be determined on a case-by-case basis in a CNVIS, via the Project's noise and vibration management tool (Gatewave, see CNVMP Section 7.3) or in response to complaints. The monitoring will be undertaken in the most affected habitable room of the sensitive receiver building and will be conducted in conjunction with vibration measurements whenever practicable. The room selected for noise monitoring should be well shielded from airborne noise intrusions, such as road traffic noise to allow the ground-borne noise to dominate over non-construction generated airborne noise.

There may be instances where the resident does not allow access to monitor in the most suitable habitable room. In these instances, CGU will endeavour to monitor at the next most suitable available room or location, noting this in the monitoring form.

3.4.4. Monitoring frequency and method

All environmental noise monitoring equipment used must be at least Type 2 instruments as described in AS IEC 61672.1 'Electroacoustic - Sound Level Meters - Specifications'. Noise measurement will be taken with the following meter settings:

- Time Constant: Fast (i.e. 125 milliseconds)
- Frequency Weightings: A-weighting
- The minimum range of noise metrics to be recorded are the following A-weighted noise levels:
  - For attended noise monitoring outlined in Section 3.4.2, L_{90}, L_{eq}, and L_{max}
  - For noise monitoring outlined in Section 3.4.3, L_{90}, L_{eq}, L_{10}, L_1 and L_{max}.

Meteorological conditions such as wind velocity, wind direction and rainfall shall also be either monitored on site or recorded from the nearest weather station to the project site, during the noise monitoring period. Measurements of noise should be disregarded when rain or wind affects the measured noise levels as described in the AS 1055.

Monitoring frequency and methods are outlined in Table 4.

Table 4: Monitoring frequency and method

Type of noise monitoring	Timing/ Frequency	Duration
Stage 1 Preliminary Construction monitoring	▪ At the first opportunity within the first month of Stage 1 preliminary construction activities, as well as throughout the construction period to: ▸ ensure the range of activities being undertaken at the site are measured (see CNVMP Section 9.3.1), ▸ confirm that actual noise levels are consistent with predicted noise impacts and that the management measures that have been implemented are appropriate, ▪ Where a change in methodology, plant or equipment is anticipated to result in a significant increase in construction noise impact than what has been assessed, ▪ In response to a noise related complaint(s) (determined on a case-by-case basis) and in accordance with EPL Conditions, ▪ As directed by an authorised officer of the EPA, ▪ As otherwise required by the CNVIS and/or CNVIA (refer to CNVMP Section 7.2 for information regarding CNVIS). Specific monitoring requirements will be identified in the relevant CNVIS as they are location and task specific, ▪ As required by the Out of Hours Works (OOHW) Protocol (refer Section 4.3) or EPL (refer Section 4.5), ▪ Following the implementation of mitigation measures or noise attenuation as a result of exceedance of predicted noise levels (see Section 4.3)	15-minute
Fixed station monitoring[11]	Continuous	15-minute
Activities based airborne noise monitoring	▪ At the first opportunity within the first month of starting construction activities as well as throughout the construction period to: ▸ ensure the range of activities being undertaken at the site are measured (see CNVMP Section 9.3.1), ▸ confirm that actual noise levels are consistent with predicted noise impacts and that the management measures that have been implemented are appropriate, ▪ Where a change in methodology, plant or equipment is anticipated to result in a significant increase in construction noise impact than what has been assessed, ▪ In response to a noise related complaint(s) (determined on a case-by-case basis) and in accordance with EPL Conditions, ▪ As directed by an authorised officer of the EPA, ▪ As otherwise required by the CNVIS (refer to CNVMP Section 7.2 for information regarding CNVIS). Specific monitoring requirements will be identified in the relevant CNVIS as they are location and task specific, ▪ As required by the Out of Hours Works (OOHW) Protocol (refer Section 4.3) or EPL (refer Section 4.5),	15-minute

Type of noise monitoring	Timing/ Frequency	Duration
	▪ Following the implementation of mitigation measures or noise attenuation as a result of exceedance of predicted noise levels (see Section 4.3)	
Plant/ Equipment checks	▪ At the first opportunity within the first month of starting construction activities as well as throughout the construction period. ▪ Spot checks would be carried out as required on a case-by-case basis, such as in response to a specific noise related complaint and during noise verification monitoring when it is possible to isolate the noise from one piece of plant or equipment.	Static/ constant plant[2]: 1 to 2-minute Dynamic plant[3]: capture a representative activity, such as one truck-and-trailer load cycle
Ground-borne noise monitoring	▪ At the first opportunity following commencement of works if ground-borne noise impacts identified, ▪ Where appropriate in response to ground-borne noise related complaint(s) (determined on a case-by- case basis) and in accordance with the EPL, and ▪ As otherwise required by a CNVIS, OOHW Protocol or EPL.	15-minute

NOTES: 1. Fixed noise monitoring stations will be located at C1, C2 and C3. A semi-mobile monitoring station will be deployed for C4, C5 and C6 as required. This will take place during Stage 2 Construction activities.
2. Constant noise source (e.g. generator, fan)
3. Variable or inconstant noise source (e.g. front-end loader in spoil bin)
Text greyed out will trigger upon Stage 2 construction activities.

3.4.5. Noise goals

The noise monitoring results will be assessed against the noise management levels (NMLs) outlined in Section 5 of the CNVMP. Where, after all reasonable and feasible mitigation measures have been implemented, measured noise levels are above the NMLs, they will be compared to the predicted noise levels in the relevant CNVIS.

If exceedance of the NML is identified, a review of site-specific mitigation measures will be undertaken to confirm that all reasonable and feasible mitigation and management measures have been implemented and confirm if there are any opportunities to further reduce noise levels on site.

If, after all reasonable and feasible mitigation measures have been implemented, an exceedance of the predicted noise levels is identified, a management response will be triggered. Details on this management response is detailed in Section 4.3.

3.5. Vibration monitoring

3.5.1. Overview

This Program describes monitoring of vibration impacts during construction of the Project. Note that details related to monitoring to be undertaken during Stage 2 Construction activities has been greyed out. These sections will be triggered when the Planning Secretary issues the approval of the Noise and Vibration CEMP Sub-plan.

Where human comfort is a concern, vibration monitoring will meet the requirements of the EPA's Assessing Vibration – a technical guideline. Where property damage is a concern, vibration monitoring will meet the requirements of BS7385-2:1993 and DIN 4150-3:2016.

3.5.2. Monitoring locations during Stage 1 Preliminary Construction

Vibration monitoring will be carried out during Stage 1 Preliminary Construction in accordance with Table 6.7, Section 6.3.5 of the CNVIA for Preliminary construction including commencement activities. This document is found in Appendix F of the Noise and Vibration CEMP Sub-plan for Preliminary construction including commencement activities. An extract of nominated monitoring locations are identified in Table 5 below.

Table 5 Nominated vibration monitoring locations

Worksite Plant item Address	Worksite Plant item Address	Worksite Plant item Address	Vibration objectives			
			Reinforced or unreinforced structures	Heritage structures	Cosmetic damage	Human annoyance
C1	Jackhammer Plate compactor 35T excavator with rock hammer attachment Smooth drum roller (13t) – High vibration	43 Innesdale Road, Wolli Creek 2205	✓	-	-	✓
C2	Jackhammer Plate compactor 35T excavator with rock hammer attachment Smooth drum roller (13t) – High vibration	10/380 West Botany Street, Rockdale 2216	✓	-	✓	✓
		396 West Botany Street, Rockdale 2216	✓	-	✓	✓
		406-408 West Botany Street, Rockdale 2216	✓	-	✓	✓
		205 Bay Street, Rockdale 2216	✓	-	✓	✓
		211 Bay Street, Rockdale 2216	✓	-	✓	✓
C3 (MOC3)	Jackhammer Plate compactor 35T excavator with rock hammer attachment Smooth drum	443 West Botany Street, Rockdale 22162	✓	-	✓	✓
		443 West Botany Street,	-	-	✓	✓

Worksite Plant item Address	Worksite Plant item Address	Worksite Plant item Address	Vibration objectives			
			Reinforced or unreinforced structures	Heritage structures	Cosmetic damage	Human annoyance
	roller (13t) – High vibration	Rockdale 22162				
C3	Jackhammer Plate compactor 35T excavator with rock hammer attachment Smooth drum roller (13t) – High vibration	466 West Botany Street, Rockdale 2216	✓	-	-	✓

3.5.3. Monitoring locations during Stage 2 Construction

The monitoring locations will take into consideration the nature of construction activities being undertaken by the Project. Some activities will occur within static work sites, like those at C1, C2 and C3. Other construction activities will move progressively over time along roads and other transport corridors, as in the case for C4, C5 and C6. Therefore, this Program will be tailored to reflect the nature of both static and transient construction works of the Project.

Fixed station (real time) vibration monitoring

To provide real time vibration monitoring data to assess vibration generated by construction activities, long-term, unattended vibration monitoring will occur at fixed locations, where identified in the relevant CNVIS.

The Project will utilise the facilities established for the construction of the M8 Motorway at construction compound C1. Real-time vibration monitoring is not necessary at this site as there are limited vibration intensive works required.

A semi-mobile monitoring station will be allocated for construction compounds C4, C5 and C6. This station will be moved along the roads and transport alignment as works progress.

The final timing, duration and location of the real-time vibration monitoring equipment will be subject to the construction program, availability of mains power, safety requirements and consultation with the Acoustic Advisor (AA). Indicative locations of all monitoring stations are found in Appendix A and coordinates are featured in Table 6.

Table 6: Indicative coordinates of fixed real-time vibration monitoring stations

Fixed station monitoring location ID	Easting	Northing
Fixed Monitor C2	To be confirmed	
Fixed Monitor C3	To be confirmed	
Semi-mobile Monitor C4 – C6	To be deployed along road and ATC alignment	

Building damage vibration monitoring

Attended or unattended vibration monitoring locations may vary throughout the life of the Project. Locations would be determined on a case-by-case basis in a CNVIS, via the Project's predictive noise and vibration management tool (Gatewave, see CNVMP Section 7.3) or in response to complaints. The identification of a suitable vibration monitoring location will consider the following:

- vibration monitoring equipment shall be placed outside at the footings or foundations of the building of interest closest to the vibrating plant;
- the surface should be solid and rigid to best represent the vibration entering the structure of the building under investigation;
- the vibration sensor or transducer shall not be mounted on loose tiles, loose gravel or other resilient surfaces;
- the vibration sensor or transducer shall be directly mounted to the vibrating surface using either adhesive, double sided tape or a magnetic mounting plate onto a steel washer, plate or bracket which shall be either fastened or glued to the surface of interest; and
- where a suitable mounting surface is unavailable, then a metal ground spike shall be driven into solid ground adjacent to the building of interest, and the vibration sensor or transducer shall be mounted on that.

Plant/ equipment vibration monitoring

Attended vibration monitoring to confirm the site specific minimum working distances for vibration intensive plant/ equipment would be determined on a case-by-case basis in a CNVIS, via the Project's noise and vibration management tool (Gatewave, see CNVMP Section 7.3). Items to consider in the identification of a suitable vibration monitoring location are noted above.

Human exposure vibration monitoring

Attended vibration monitoring to confirm human exposure to vibration would be determined on a case-by-case basis in a CNVIS, via the Project's noise and vibration management tool (Gatewave, see CNVMP Section 7.3) or in response to complaints. The monitoring will be undertaken in the most affected habitable room of the sensitive receiver building and will be conducted in conjunction with ground-borne noise measurements where applicable. The room selected for vibration monitoring should be well shielded from extraneous vibration intrusions, such as heavy vehicle road traffic, condenser units or pumps.

There may be instances where the resident does not allow access to monitor in the most suitable habitable room. In these instances, CGU will endeavour to monitor at the next most suitable available room or location, noting this in the monitoring form.

3.5.4. Monitoring frequency and method

The minimum range of vibration metrics to be recorded is the following:

- Root-Mean-Square acceleration (RMS);
- Peak Particle Velocity (PPV) or
- Vibration Dose Values (VDVs) (for human exposure to vibration).

Monitoring frequency and methods are outlined in Table 7.

Table 7: Monitoring frequency and method

Type of noise monitoring	Timing/ Frequency	Duration
Fixed station monitoring[11]	Continuous	15-minute
Building damage vibration monitoring	▪ at the commencement of vibration generating activities that have the potential to impact on heritage items and the vibration sensitive locations are found to fall within the site specific or recommended minimum working distances established for vibration intensive plant	Representative sample of vibration being generated
Plant/ Equipment checks	▪ at the commencement of vibration intensive activities on site that have been identified in a CNVIS (refer to CNVMP Section 7.2 for information regarding CNVIS) or in the noise and vibration management tool (Gatewave) as likely to exceed the vibration screening criteria	Representative sample of vibration being generated
Human exposure vibration monitoring	▪ At the first opportunity following commencement of works, concurrent with ground-borne noise monitoring where applicable, ▪ Where appropriate in response to vibration related complaint(s) (determined on a case-by- case basis) and in accordance with the EPL, and ▪ As otherwise required by a CNVIS, OOHW Protocol or EPL.	15-minute or Representative sample of vibration being generated (as required)

NOTES: 1. Fixed monitoring stations at C2 and C3. A semi-mobile "fixed" monitoring station will be deployed along the Permanent Power Supply and C4, C5 and C6 as required. This will take place during Stage 2 Construction activities.
Text greyed out will trigger upon Stage 2 construction activities.

3.5.5. Vibration management

The vibration monitoring results will be compared to the vibration goals outlined in Section 5.5 of the CNVMP, as required.

If an exceedance is identified, a management response will be triggered. Details on this management response is detailed in Section 4.3.

Building damage vibration monitoring

Vibration monitoring would be undertaken as outlined in Figure 2. Vibration monitoring results will be assessed and reported against the British Standard 7385 and German Standard DIN 4150, as presented in the CNVMP (Section 5.5.2). The approach that will be adopted for the Project to assess and manage potential vibration impact, including on heritage structures is outlined in Section 5.5.4 of the CNVMP.

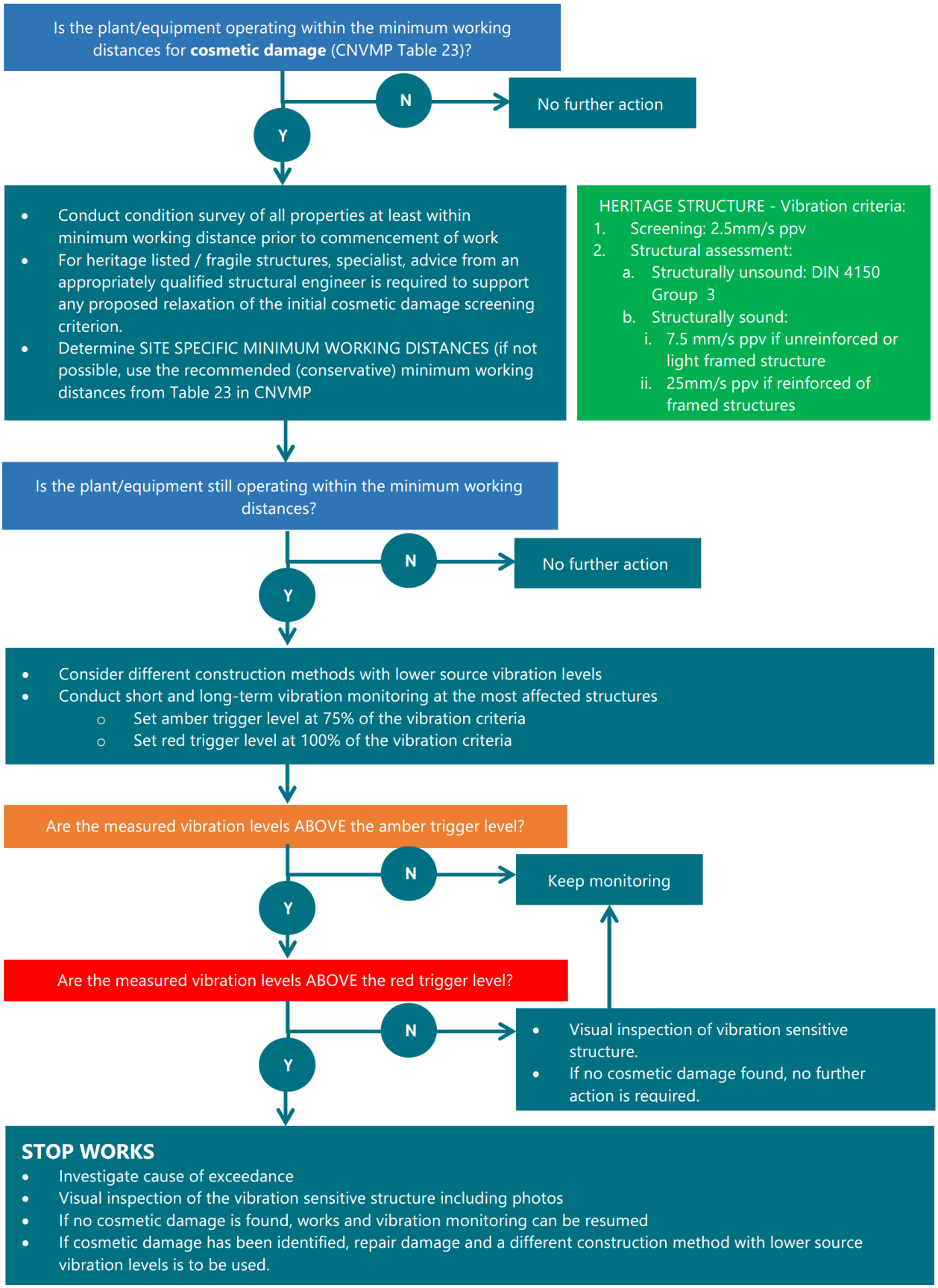


Figure 2: CGU M6 Stage 1 Project vibration monitoring (cosmetic damage to structures) flow chart

Human exposure vibration monitoring

Where human comfort is a concern, vibration monitoring would be undertaken as outlined in Figure 3. Vibration monitoring results would be assessed and reported against the values set out in Tables 2.2 and 2.4 of the EPA's Assessing Vibration – a technical guideline, as presented in the CNVMP (Section 5.5.1).

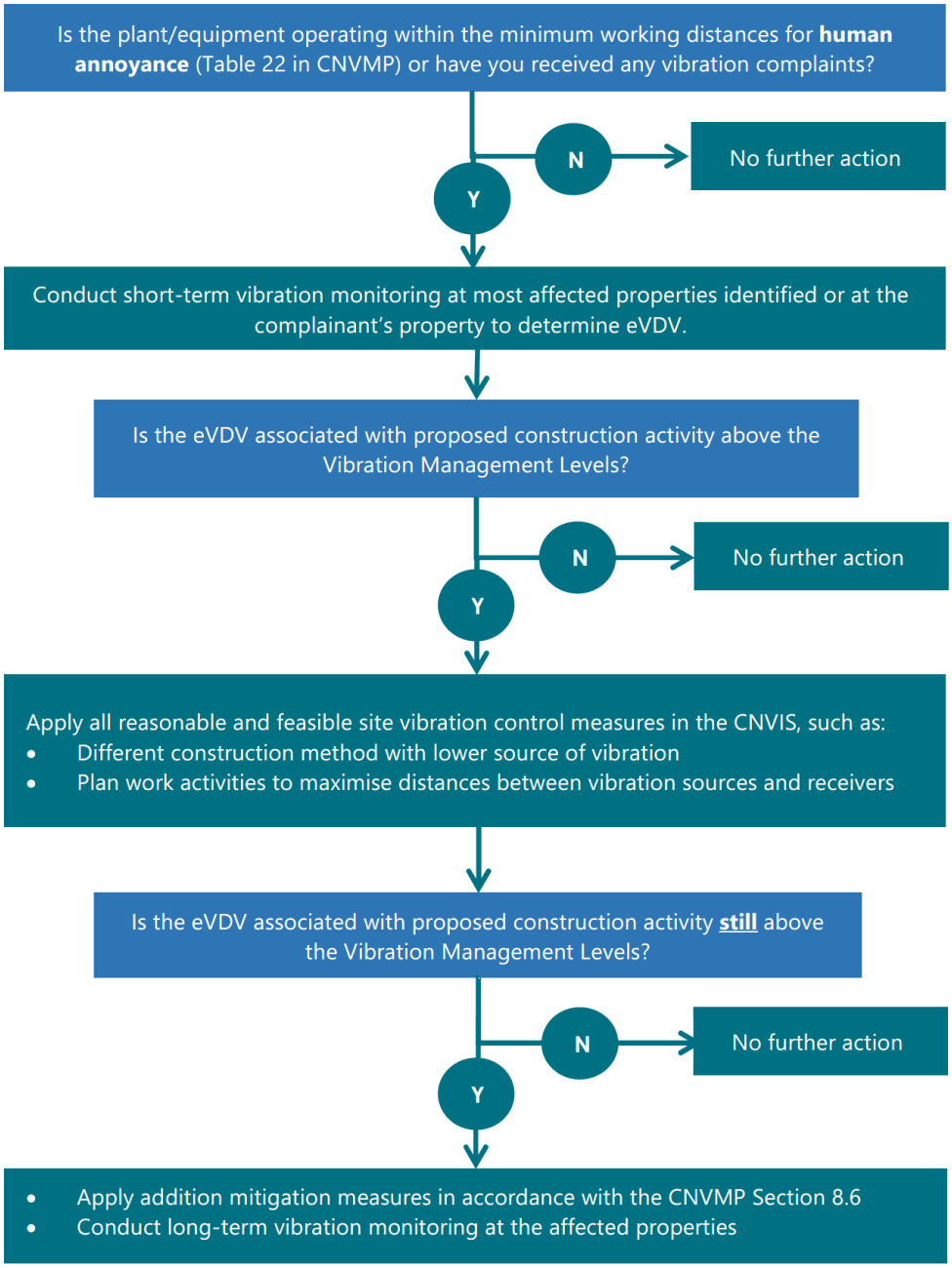


Figure 3: CGU M6 Stage 1 Project vibration monitoring (human exposure) flow chart

3.6. Calibration, quality assurance and documentation

Attended noise monitoring equipment used will be at least Type 2 instruments and calibrated in accordance with manufacturer specifications or relevant Australian Standards. Records of equipment laboratory calibration will be maintained by CGU throughout the delivery of the Project. The calibration of the monitoring equipment will be checked in the field before and after the noise measurement period.

All vibration instruments will be calibrated in accordance with manufacturers specifications or relevant Australian Standards. Records of monitoring equipment calibration will be maintained by CGU throughout the delivery of the Project.

All monitoring records will be retained throughout CGU's delivery of the Project. Monitoring records will record:

- Date and time of measurements;
- Name of person(s) undertaking the measurements;
- Qualifications and/or competency/suitability of the person carrying out the monitoring;
- Weather conditions during measurements;
- Type and model number of monitoring equipment;
- Calibration dates of monitoring equipment;
- Time of day, length of measurement and measurement time intervals;
- Monitoring location details including:
  - a sketched map showing the monitoring location, the location of noise/vibration generating items (construction activities and other environmental noise sources), the location and type of mitigation measures, the location of other acoustically relevant items (e.g. walls/barriers); and
  - photographs clearly identifying the monitoring location;
- Number of measurements at each location;
- Construction activities under investigation, including load conditions of plant; and
- Possible extraneous noise (e.g. road traffic, aircraft, insects) or vibration influences from other sources (e.g. domestic vibrations, other mechanical plant, traffic etc.)
- For noise, the following additional items should be recorded:
  - results of field calibration checks;
  - microphone height;
  - presence (or otherwise) of reflecting surfaces (such as walls), the distance from them in addition to any corrections made for the presence of reflecting surfaces;
  - Measured noise levels including the minimum descriptors required in Section 3.4.4;
  - Estimated noise level from construction activities only;
  - Presence of identified annoying characteristics and if a correction has been made to the measured noise levels;
  - Estimated noise levels from environmental noise sources other than construction; and
  - Mitigation measures in place at the time of the measurement and observations on their potential effectiveness.

4. Compliance management

4.1. Roles, responsibility and training

The CGU Project Team's organisational structure and overall roles and responsibilities are outlined in Section 3.4 of the CEMP. Specific responsibilities for the implementation of environmental controls for construction noise and vibration are detailed in the CNVMP.

All noise and vibration monitoring will be carried out by an appropriately trained and competent person in the measurement and assessment of construction noise and vibration, who is familiar with the requirements of the relevant standards and procedures, detailed in the CNVMP. Training will be undertaken by the Project Noise and Vibration consultant.

All employees, contractors and utility staff working on site will undergo site induction. Further details regarding staff induction and training are outlined in Section 3.6 of the CEMP.

4.2. Monitoring and inspection

This Program details the monitoring requirements for noise and vibration. In accordance with Section 3.4 of the CEMP, CGU Environmental and Sustainability Manager will be responsible for ensuring monitoring activities are undertaken. Additional requirements and responsibilities in relation to inspections are documented in Section 3.9.2 of the CEMP.

4.3. Data analysis and management response

Results obtained as per the construction monitoring Program will be compared against the noise goals listed in Section 3.4.5 and Section 3.5.5. If an exceedance is observed a review will be initiated to determine the significance of the exceedance(s) and possible causes.

The review will assess:

- Activities occurring during the exceedance compared to CNVIS;
- Effectiveness of noise and vibration management and mitigation measures in place (Table 20 of the CNVMP);
- Effectiveness of specific mitigation and management measures identified in the relevant CNVIS; and
- Other aspects that may have influenced the measurement result (e.g. meteorological conditions, extraneous noise/ vibration source).

If the exceedance is determined to be attributable to Project works, the event will be treated as an environmental incident and managed in accordance with the requirements of the CEMP (section 3.8 and Appendix A7). Corrective and preventative actions will be identified and implemented as part of that process.

4.4. Compliance and Auditing

Compliance monitoring and Auditing (both internal and external) will be undertaken to assess the effectiveness of environmental controls, compliance with this Program, CoA, and other relevant approvals, licenses and guidelines. Compliance and auditing requirements are detailed in Section 3.9.3 of the CEMP.

4.5. Reporting

During construction, noise and vibration monitoring data will be collected, tabulated and assessed against the criterion identified in Table 5. A Noise and Vibration Monitoring Report will be submitted to DPIE and EPA within 60 days of the end of the reporting period unless otherwise agreed with DPIE and will be made publicly available.

Reporting requirements associated with the Program for the construction phase of the Project are presented in Table 8.

Table 8: Construction Noise and Vibration Reporting Requirements

Report	Frequency	Content	When	Reporting Authority
Noise and Vibration Monitoring Report	Every 6 months	▪ Data summary tables from monitoring undertaken in reporting period ▪ Exceedances ▪ Management responses to any exceedances which may have occurred during reporting period	Within 60 days of end of reporting period	EPA, DPIE

5. Review and improvement

5.1. Continual improvement

Monitoring data will be reviewed throughout the construction for continual improvement.

Continual improvement of this Program will be achieved by the ongoing evaluation of environmental management performance against environmental policies, objectives and targets and Project performance outcomes of the EIS for the purpose of identifying opportunities for improvement.

The continual improvement process will be undertaken in accordance with Section 3.2 of the CEMP and the intention of this process is to:

- Identify areas of opportunity for improvement of environmental management and performance;
- Determine the cause or causes of non-conformances and deficiencies;
- Develop and implement a Program of corrective and preventative action to address any non-conformances and deficiencies;
- Verify the effectiveness of the corrective and preventative actions;
- Document any changes in procedures resulting from process improvement; and
- Make comparisons with objectives and targets.

6. References

- Roads and Maritime QA Specification G36 – Environmental Protection (Management System).
- Roads and Maritime Construction Noise and Vibration Guidelines (CNVG) (Roads and Maritime 2015)
- NSW Interim Construction Noise Guideline (ICNG), Department of Environment and Climate Change 2009
- NSW Road Noise Policy, Dept. of Environment, Climate Change and Water 2011
- NSW Industrial Noise Policy (INP), Environment Protection Authority 2000
- NSW Noise Policy for Industry (NPfI), Environment Protection Authority 2017
- NSW Assessing Vibration – a technical guideline (AVTG), Department of Environment and Conservation 2006
- Sydney Airport Master Plan 2039 and Environment Strategy 2019-2039
- Australian Standard AS/NZS 1055 Acoustics - Description and Measurement of Environmental Noise
- Australian Standard AS/NZS 2012.1 Acoustics - Measurement of airborne noise emitted by earth-moving machinery and agricultural tractors - Stationary test condition - Determination of compliance with limits for exterior noise
- Australian Standard AS/NZS 2107:2016 Acoustics - Recommended design sound levels and reverberation times for building interiors
- Australian Standard AS 2187.2 Explosives - Storage and use - Part 2 Use of explosives
- Australian Standard AS2436-2010 Guide to Noise Control on Construction, Maintenance and Demolition Sites
- Australian Standard 2775 Mechanical Mounting of Accelerometers
- Australian Standard 2834-1995 Computer Accommodation, Chapter 2.9 Vibration
- British Standard BS 6472-2008, ‘Evaluation of human exposure to vibration in buildings (1-80Hz)
- British Standard 7385: Part 2-1993 'Evaluation and measurement of vibration in buildings'
- German Standard DIN4150- 2016 Structural vibration Part 3: Effects of vibration on Structures
- ISO 3746 Acoustics - Determination of sound power levels and sound energy levels of noise sources using sound pressure - Survey method using an enveloping measurement surface over a reflecting plane

Appendix A Map of Fixed Monitoring Stations

▲ Noise Monitoring Station

N
W E
S

0 50 100 150 200 Metres

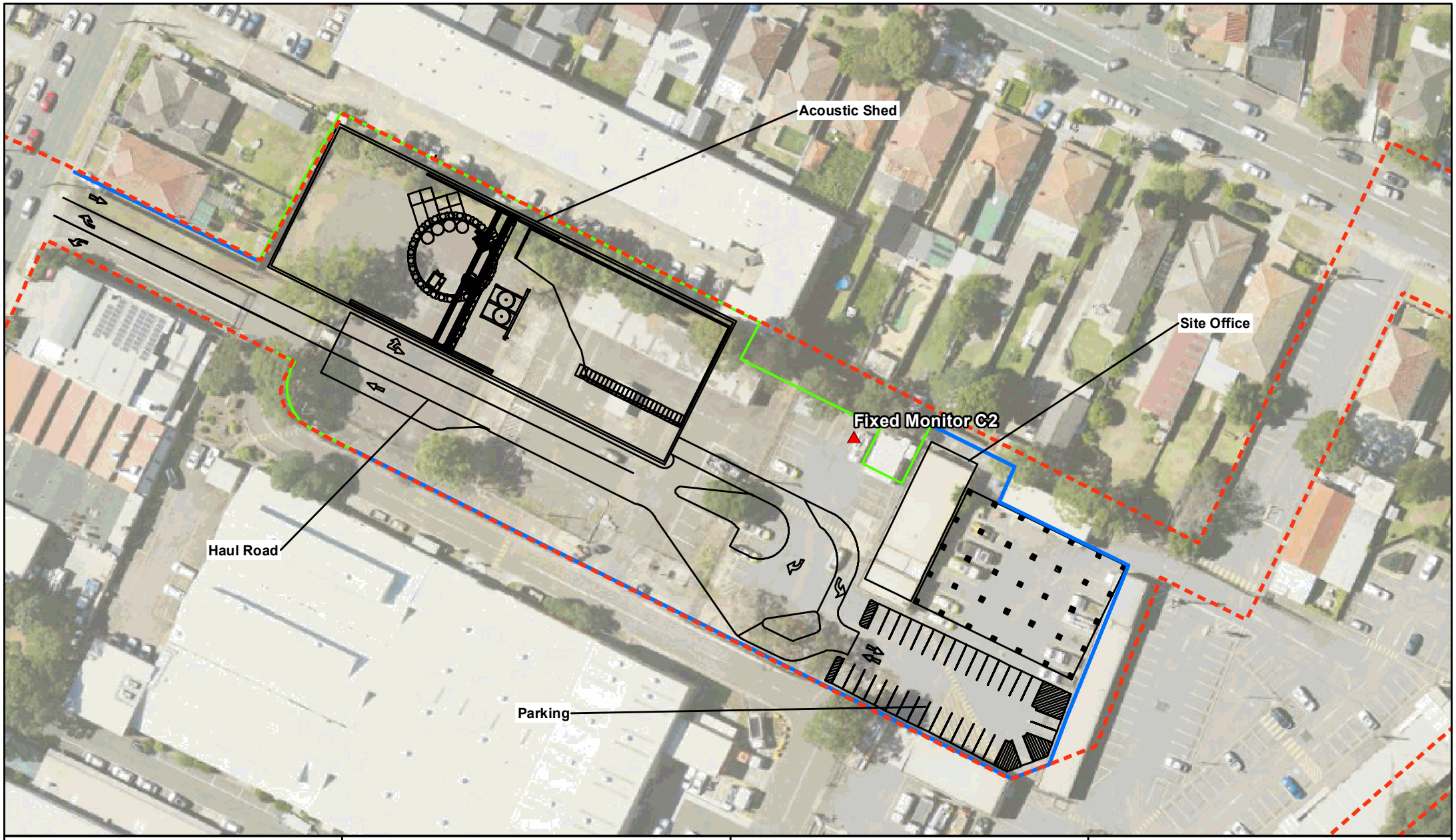
CPB CONTRACTORS | Ghella 3 Generations of Tunnellers | UGL

Original Size	A4	Drawn	GIS
Coordinate System	MGA Zone 56	Designed	MM
Height Datum	AHD	Date Printed	4/082021
Filename	Noise Monitoring - Arncliffe.mxd		

Noise Monitoring Station

Arncliffe

Project Number



▲ Noise Monitoring Station

Construction Boundary

N
W E
S

0 10 20 30 40 50 Metres

CPB CONTRACTORS | Ghella 5 Generations of Tunnellers | UGL

Original Size	A4	Drawn	GIS
Coordinate System	MGA Zone 56	Designed	MM
Height Datum	AHD	Date Printed	6/07/2021
Filename	Noise Monitoring - Rockdale Depot.mxd		

Noise Monitoring

Rockdale Depot

Project Number

ATC Boundary

N
W E
S

0 200 400 600 800 Metres

CPB CONTRACTORS | Ghella 5 Generations of Tunnellers | UGL

Original Size	A4	Drawn	GIS
Coordinate System	MGA Zone 56	Designed	MM
Height Datum	AHD	Date Printed	4/08/2021
Filename	Noise Monitoring - ATC.mxd		

Semi Mobile Noise Monitoring Station

Active Transport Corridor

Project Number

Noise Monitoring Station
Construction Boundary
C&C
Open

N
W
E
S

0 20 40 60 80 100 Metres

CPB CONTRACTORS | Ghella 3 Generations of Tunnellers | UGL

Original Size	A4	Drawn	GIS
Coordinate System	MGA Zone 56	Designed	MM
Height Datum	AHD	Date Printed	4/08/2021
Filename	Noise Monitoring - Bicentennial Park.mxd		

Noise Monitoring

Bicentennial Park

Project Number

Princes Hwy / Presidents Ave / Local Roads Boundary

N
W E
S

0 100 200 300 Metres

CPB CONTRACTORS | Ghella 3 Generations of Tunnellers | UGL

Original Size	A4	Drawn	GIS
Coordinate System	MGA Zone 56	Designed	MM
Height Datum	AHD	Date Printed	04/082021
Filename	Noise Monitoring - Presidents Ave.mxd		

Semi Mobile Noise Monitoring Station

Princes Hwy / Presidents Ave / Local Roads

Project Number

Appendix B Land Use Survey

Land-Use file revision_date: 114_22/07/21

Plot Date: 19/08/21 - 16:26 Layout: TK703 Landuse (r0)

GIS File: R:\Assoc Syd\Projects\TK701-TK750\TK703 TG R6 (M6) Extension Stg 1 D&CS Calcs\01 GIS\TK703 MS (r0).qpz

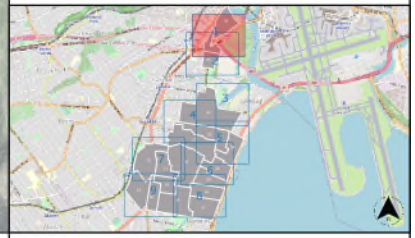
LEGEND

Noise sensitive receivers

- Childcare
- Commercial
- Educational
- Hotel/Motel/Hostel
- Industrial
- Medical
- Place of Worship
- Recording studio
- Recreational - Active
- Recreational - Passive
- Residential
- Theatre/Auditorium
- Mixed use
- Project acquisition
- Film/TV studio
- Cinema
- Community centre
- Library
- Laboratory
- Other
- Heritage

- NCA
- Noise monitoring locations
- Indicative M6 Surface Construction Activities
- Tunnel alignment

NCA	NMLDS	NMLDO	NMLE	NMLN	Reference
NCA01	65	60	60	50	NL01
NCA02	59	54	53	47	NL02
NCA03	57	52	52	44	NL03



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r0	MS	29/07/21	Prepare figures	MT

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1:3500

FULL SIZE A3

A3 Original

Co-ordinate System: MGA Zone 56

NOTE: Do not scale from this drawing.

CLIENT

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M6 Stage 1

Land Use, NCAs
Noise monitoring locations

LEGEND

Noise sensitive receivers

- Childcare
- Commercial
- Educational
- Hotel/Motel/Hostel
- Industrial
- Medical
- Place of Worship
- Recording studio
- Recreational - Active
- Recreational - Passive
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- Heritage

- NCA
- Noise monitoring locations
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- Tunnel alignment

NCA	NMLDS	NMLDO	NMLE	NMLN	Reference
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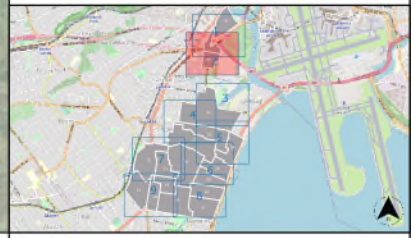

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r0	MS	29/07/21	Prepare figures	MT

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1:3500

FULL SIZE A3
A3 Original
Co-ordinate System: MGA Zone 56
NOTE: Do not scale from this drawing.

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M6 Stage 1

Land Use, NCAs
Noise monitoring locations

Land-Use file revision_date:: r14_22/07/21

Plot Date: 19/08/21 - 16:27 Layout: TK703 Landuse (r0)

GIS File: R:\Assoc Syd\Projects\TK701-TK750\TK703 TG R6 (M6) Extension Stg 1 D&CS Calcs\01 GIS\TK703 MS (r0).qpz

LEGEND

Noise sensitive receivers

- Childcare
- Commercial
- Educational
- Hotel/Motel/Hostel
- Industrial
- Medical
- Place of Worship
- Recording studio
- Recreational - Active
- Recreational - Passive
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- Laboratory
- Other
- Heritage

- NCA
- Noise monitoring locations
- Indicative M6 Surface Construction Activities
- Tunnel alignment

NCA	NMLDS	NMLDO	NMLE	NMLN	Reference
NCA04	48	43	42	36	NL04
NCA05	49	44	44	39	NL05

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r0	MS	29/07/21	Prepare figures	MT

0 70 140 210 m

1:3500

FULL SIZE A3

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M6 Stage 1

Land Use, NCAs
Noise monitoring locations

Land-Use file revision_date: r14_22/07/21

Plot Date: 19/08/21 - 16:27 Layout: TK703 Landuse (r0)

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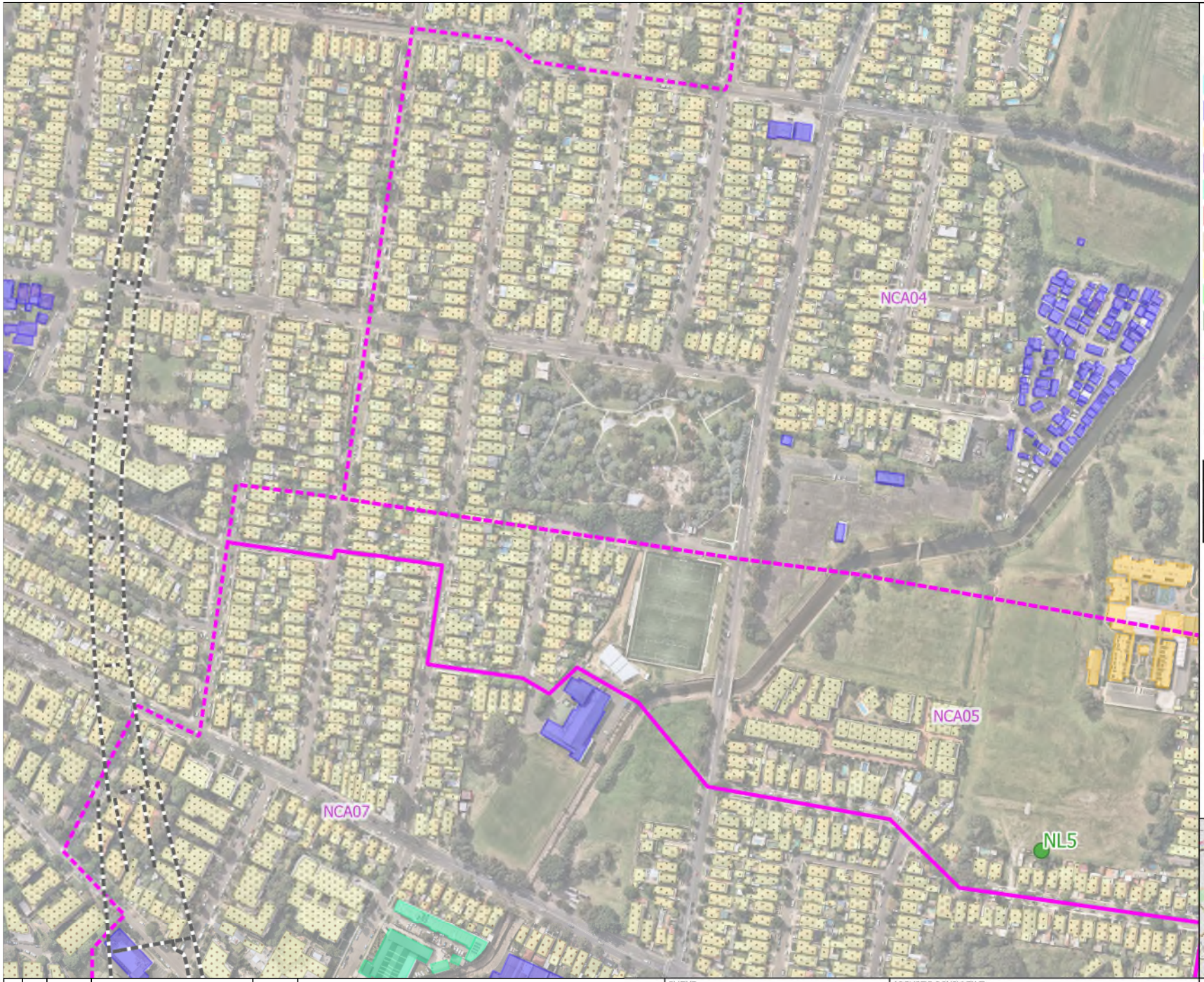

0 50 100 150 200 250 300 350 m

LEGEND

Noise sensitive receivers

- Childcare
- Commercial
- Educational
- Hotel/Motel/Hostel
- Industrial
- Medical
- Place of Worship
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NCA	NMLDS	NMLDO	NMLE	NMLN	Reference
NCA04	48	43	42	36	NL04
NCA05	49	44	44	39	NL05
NCA07	51	46	46	38	NL06

REV	BY	DATE	DESCRIPTION	APPROVER
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0 70 140 210 m

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FULL SIZE A3

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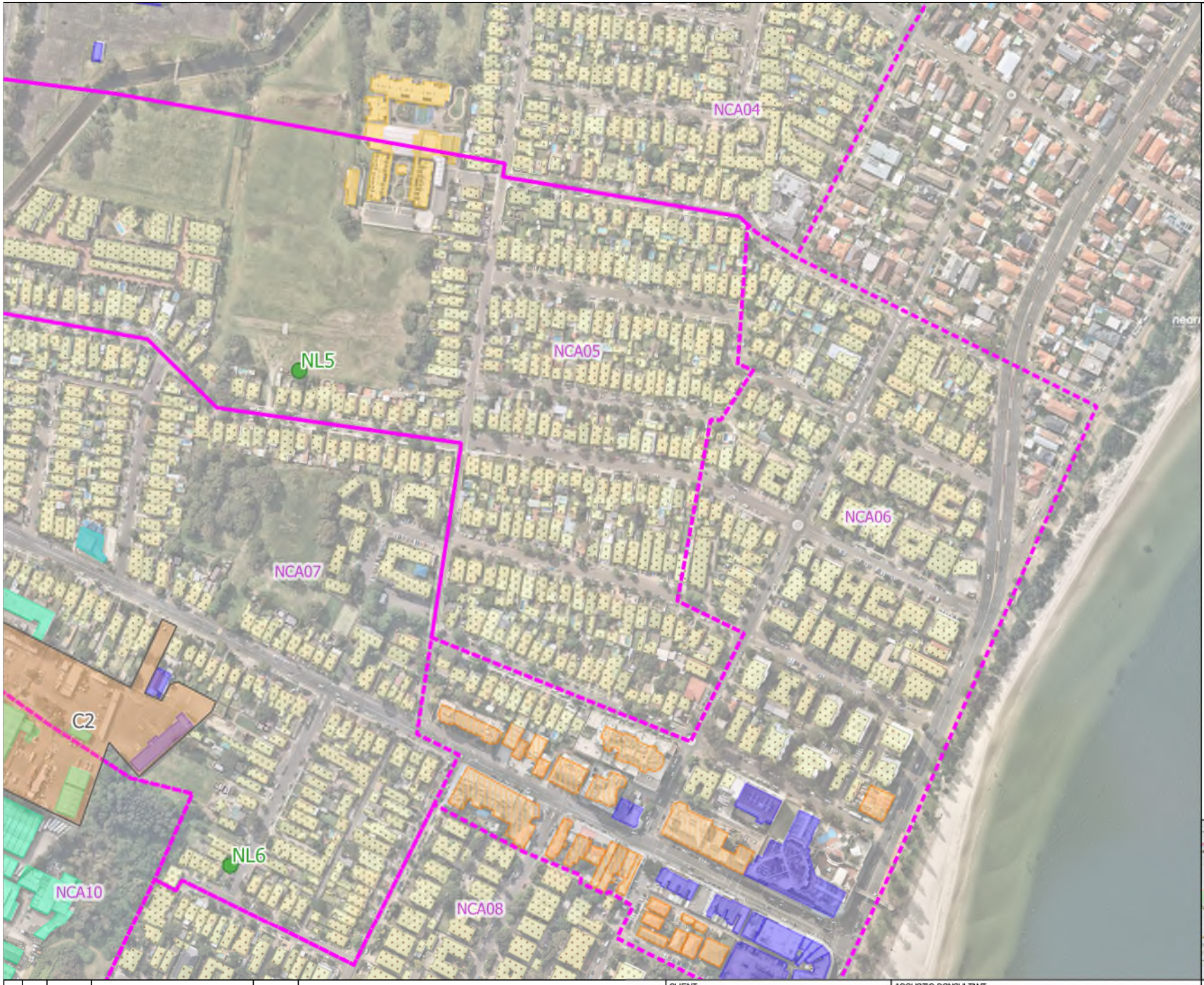
M6 Stage 1

Land Use, NCAs
Noise monitoring locations



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Noise sensitive receivers

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NCA	NMLDS	NMLDO	NMLE	NMLN	Reference
NCA04	48	43	42	36	NL04
NCA05	49	44	44	39	NL05
NCA06	51	46	46	38	NL06
NCA07	51	46	46	38	NL06
NCA08	49	44	44	41	NL07
NCA10	63	58	52	43	NL08

REV	BY	DATE	DESCRIPTION	APPROVER
r1	SS	19/08/21	Add Tunnel Alignment and Surface Worksites	MT
r0	MS	29/07/21	Prepare figures	MT

0 70 140 210 m
1:3500

FULL SIZE A3

A3 Original

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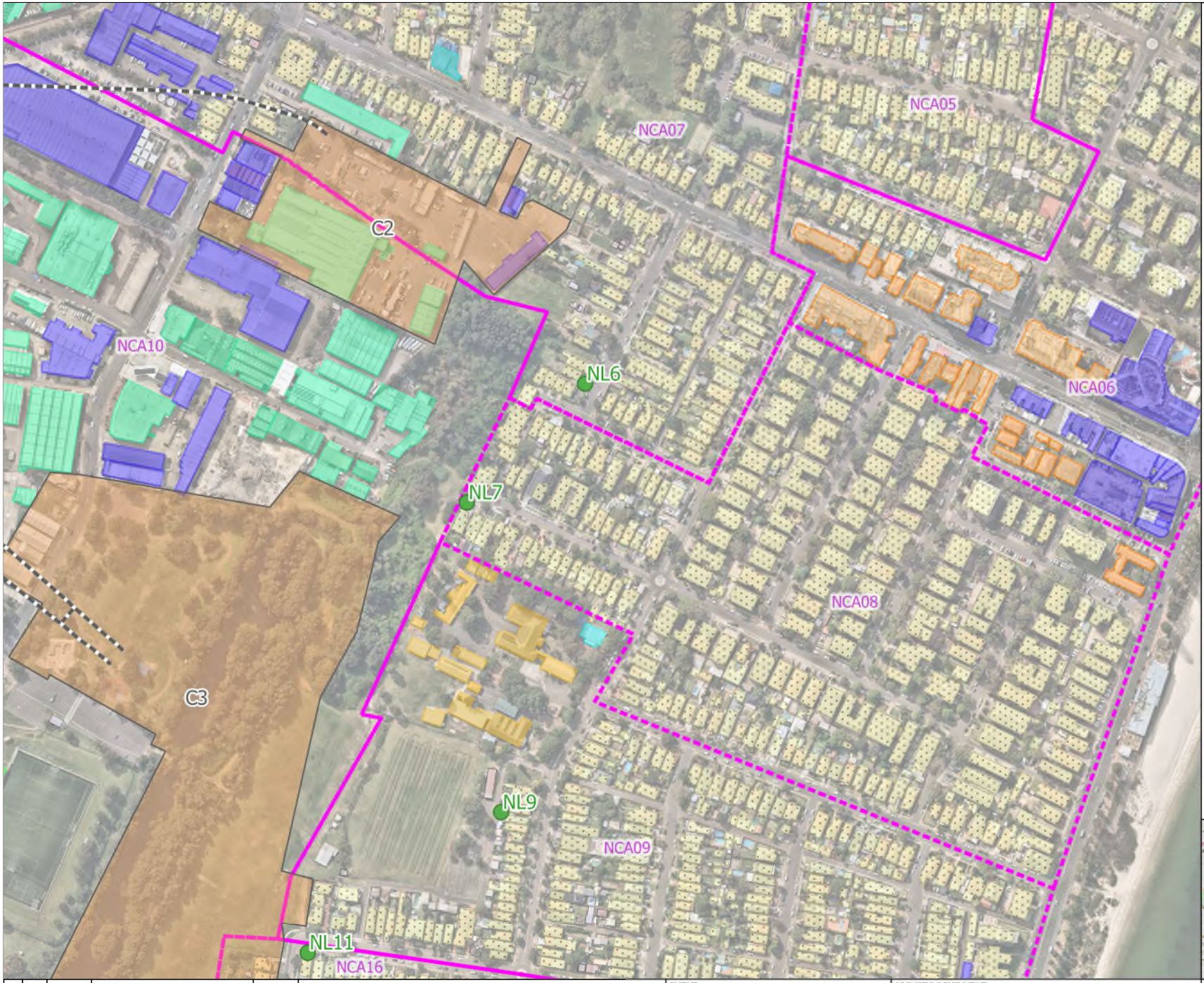
M6 Stage 1

Land Use, NCAs
Noise monitoring locations



LEGEND

Noise sensitive receivers
- Childcare
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NCA	NMLDS	NMLDO	NMLE	NMLN	Reference
NCA05	49	44	44	39	NL05
NCA06	51	46	46	38	NL06
NCA07	51	46	46	38	NL06
NCA08	49	44	44	41	NL07
NCA09	48	43	43	37	NL09
NCA10	63	58	52	43	NL08
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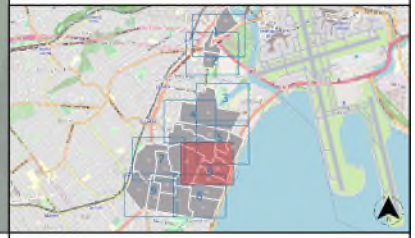

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r0	MS	29/07/21	Prepare figures	MT

A3 Original

Co-ordinate System: MGA Zone 56

0 70 140 210 m

1:3500

FULL SIZE A3

NOTE: Do not scale from this drawing.

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M6 Stage 1

Land Use, NCAs
Noise monitoring locations

Land-Use file revision_date: 114_22/07/21

Plot Date: 19/08/21 - 16:29 Layout: TK703 Landuse (r0)

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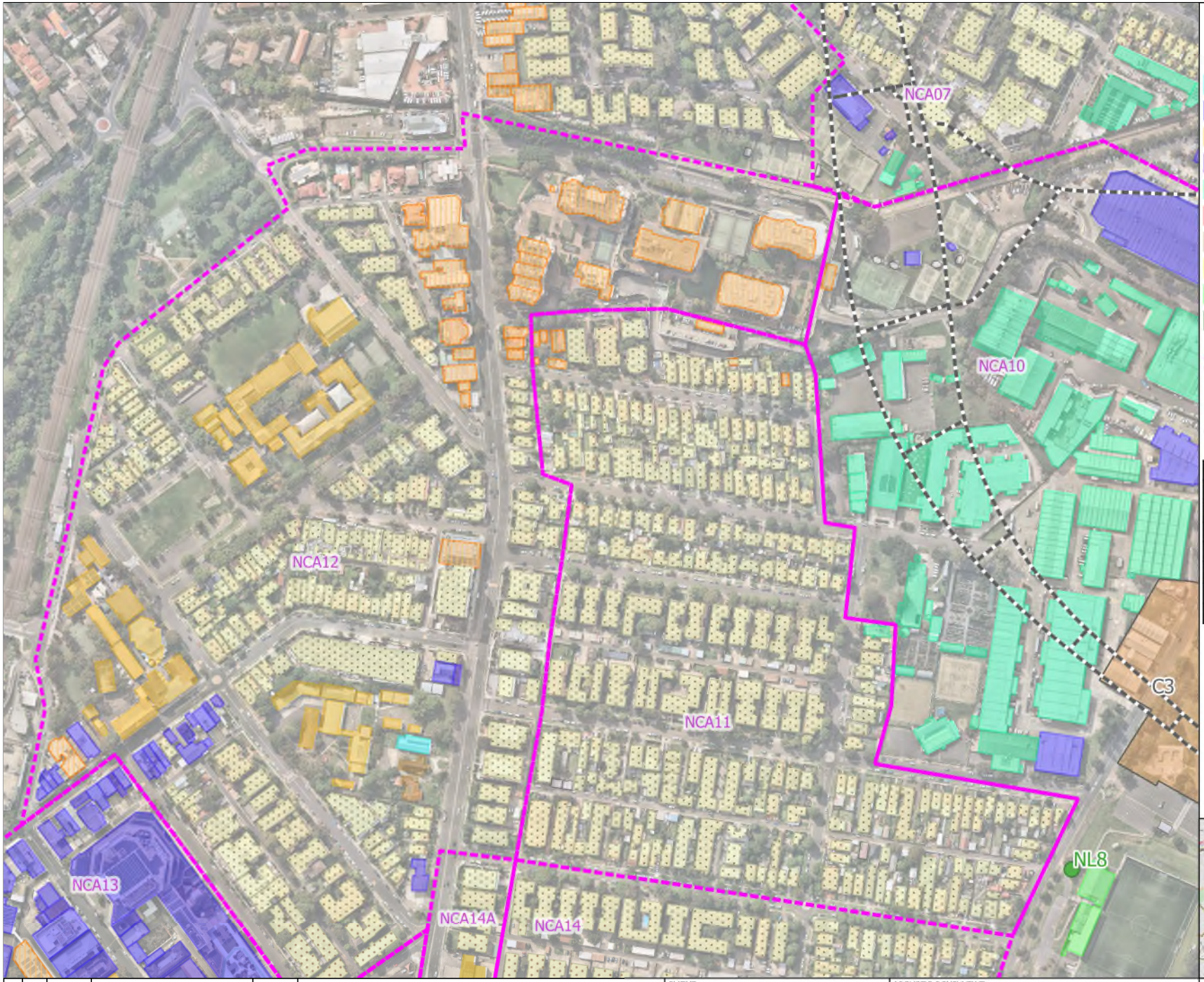

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Noise sensitive receivers

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NCA	NMLDS	NMLDO	NMLE	NMLN	Reference
NCA07	51	46	46	38	NL06
NCA10	63	58	52	43	NL08
NCA11	63	58	52	43	NL08
NCA12	76	71	71	61	NL15
NCA13	76	71	71	61	NL15
NCA14	62	57	57	43	NL10
NCA14A	76	71	71	61	NL15

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r0	MS	29/07/21	Prepare figures	MT

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1:3500

FULL SIZE A3

A3 Original

Co-ordinate System: MGA Zone 56

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M6 Stage 1

Land Use, NCAs
Noise monitoring locations

Sheet 7 of 9

LEGEND

Noise sensitive receivers

- Childcare
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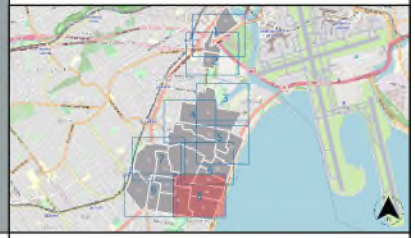
- Noise monitoring locations
- Indicative M6 Surface Construction Activities
- Tunnel alignment

NCA	NMLDS	NMLDO	NMLE	NMLN	Reference
NCA08	49	44	44	41	NL07
NCA09	48	43	43	37	NL09
NCA10	63	58	52	43	NL08
NCA11	63	58	52	43	NL08
NCA14	62	57	57	43	NL10
NCA15	52	47	45	37	NL16
NCA16	67	62	55	42	NL14
NCA17	52	47	45	37	NL16



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FULL SIZE A3
A3 Original
Co-ordinate System: MGA Zone 56
NOTE: Do not scale from this drawing.

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M6 Stage 1

Land Use, NCAs
Noise monitoring locations

Land-Use file revision_date: r14_22/07/21

Plot Date: 19/08/21 - 16:29 Layout: TK703 Landuse (r0)

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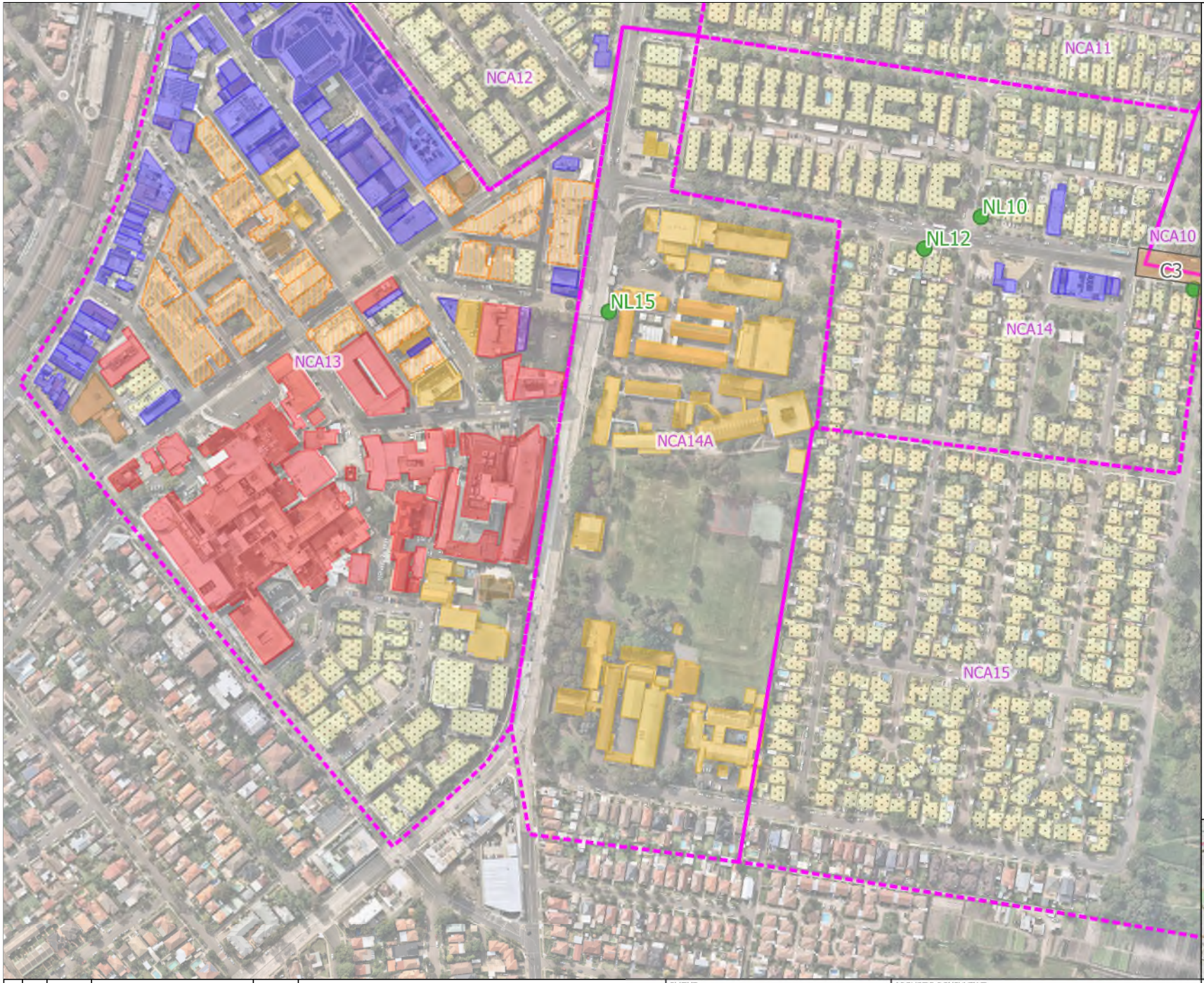

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NCA	NMLDS	NMLDO	NMLE	NMLN	Reference
NCA10	63	58	52	43	NL08
NCA11	63	58	52	43	NL08
NCA12	76	71	71	61	NL15
NCA13	76	71	71	61	NL15
NCA14	62	57	57	43	NL10
NCA14A	76	71	71	61	NL15
NCA15	52	47	45	37	NL16

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r0	MS	29/07/21	Prepare figures	MT

0 70 140 210 m

1:3500

FULL SIZE A3

A3 Original

Co-ordinate System: MGA Zone 56

NOTE: Do not scale from this drawing.

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M6 Stage 1

Land Use, NCAs
Noise monitoring locations

Appendix C Out of Hours Work and Construction Fatigue Protocol

Out of Hours Works and Construction Fatigue Protocol

Project Name: M6 Stage 1

Project number:	M6S1
Revision date:	27/09/2021
Revision:	00

Document approval

Rev	Date	Prepared by	Reviewed by	Recommended	Approved	Remarks
A.01	4/08/2021	[redacted]	[redacted]	[redacted]	[redacted]	
Signature:						
A.02	19/08/2021	[redacted]	[redacted]	[redacted]	[redacted]	
Signature:						
00	27/09/2021	[redacted]	[redacted]	[redacted]	[redacted]	

Table of Contents

Table of Tables

Table of Figures

Table of Appendices

Glossary/ Abbreviations

Term/ Abbreviations	Expanded Text
AA	Acoustic Advisor
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.
Attenuation	The reduction in the level of sound or vibration.
CEMP	Construction Environmental Management Plan
CNVG	Construction Noise and Vibration Guideline (Roads and Maritime 2016)
CNVIS	Construction Noise and Vibration Impact Statement
CoA	Condition of Approval
CSSI	Critical State Significant Infrastructure
dBA	Decibels using the A-weighted scale measured according to the frequency of the human ear.
DPIE	NSW Department of Planning, Industry and Environment
EIS	Environmental Impact Statement
EMS	Environmental management system
Environmental aspect	Defined by AS/NZS ISO 14001:2015 as an element of an organisation's activities, products or services that can interact with the environment.
Environmental impact	Defined by AS/NZS ISO 14001:2015 as any change to the environment, whether adverse or beneficial, wholly or partially resulting from an organisation's environmental aspects.
EMM	Environmental Management Measure
Environmental objective	Defined by AS/NZS ISO 14001:2015 as an overall environmental goal, consistent with the environmental policy, that an organisation sets itself to achieve.
Environmental target	Defined by AS/NZS ISO 14001:2015 as a detailed performance requirement, applicable to the organisation or parts thereof, that arises from the environmental objectives and that needs to be set and met in order to achieve those objectives.
EPA	NSW Environment Protection Authority
EP&A Act	Environmental Planning and Assessment Act 1979
ER	Environmental Representative
ERG	Environmental Review Group
EWMS	Environmental Work Method Statements
Feasible and reasonable	Consideration of best practice taking into account the benefit of proposed measures and their technological and associated operational application in the NSW and Australian context. Feasible relates to engineering considerations and what is practical to build. Reasonable relates to the application of judgement in arriving at a decision, taking into account mitigation benefits and cost of mitigation versus benefits provided, community views and nature and extent of potential improvements.
ICNG	Interim Construction Noise Guideline (DECC, 2009)

Term/ Abbreviations	Expanded Text
INP	NSW Industrial Noise Policy (EPA 2000)
$L_{Aeq(15min)}$	The A-weighted equivalent continuous (energy average) A-weighted sound pressure level of the construction works under consideration over a 15-minute period and excludes other noise sources such as from industry, road, rail and the community.
$L_{A(max)}$	the A-weighted maximum noise level only from the construction works under consideration, measured using the fast time weighting on a sound level meter.
NCA	Noise catchment areas
NML	Noise Management Level
NVMP	Noise and Vibration Management Sub Plan (this document)
OEH	Office of Environment and Heritage
OOHW	Out-of-hours works
RBL	The Rating Background Level for each period is the medium value of the ABL values for the period over all of the days measured. There is therefore an RBL value for each period (day, evening and night)
SWP	Sound Power Level
SSI	State Significant Infrastructure
SPL	Sound Pressure Level
TfNSW	Transport for NSW (formerly Roads and Maritime Services, RMS)
VDV	Vibration Dose Value

1. Introduction

This Out-of-Hours Work (OOHW) and Construction Fatigue Protocol (herein referred to as the Protocol) for the M6 Stage 1 Project has been prepared in accordance with Minister's Condition of Approval (CoA) E70 and Environmental Mitigation Measures (EMM) NV1 and SE4. This Protocol identifies a process for the consideration, management and approval of works which are outside the standard construction hours defined in CoA E62 (out-of-hours work) and that are not subject to an Environment Protection Licence (EPL).

While all works occurring under approval SSI 8931 are intended to ultimately be performed subject to an EPL. Some works will be required to be carried out prior to obtaining an EPL or outside of the project boundary. This protocol allows CPB Contractors, Ghella, UGL Engineering (CGU) joint venture to facilitate the approval of those out of hours works. Once an EPL is in place out of hours works undertaken within the EPL premised area will be undertaken in accordance with the licence conditions.

This Protocol was provided to the Department of Planning, Industry and Environment (DPIE) Planning Secretary on XX/XX/XXXX and subsequently approved on XX/XX/XXXX.

1.1. Minister's Conditions of Approval

The CoA relevant to this Protocol are listed in below. A reference is also included to indicate where the CoA is addressed in this Protocol or other Project documents.

Table 1: Ministers Conditions of Approval

CoA	Condition requirements	Document reference
E62	Works (except for tunnelling (excluding cut and cover tunnelling)) must only be undertaken during the following standard construction hours: (a) 7:00 am to 6:00 pm Mondays to Fridays, inclusive; (b) 8:00 am to 1:00 pm Saturdays; and (c) at no time on Sundays or public holidays.	Section 2
E63	Notwithstanding Condition E62, works may be undertaken between 1:00 pm to 6:00 pm on Saturday.	Section 2
E66	Notwithstanding Conditions E62 to E65, works may be undertaken outside the hours specified in the following circumstances: (a) for the delivery of materials required by the NSW Police Force or other authority for safety reasons; or (b) where it is required in an emergency to avoid injury or the loss of life, to avoid damage or loss of property or to prevent environmental harm; or (c) where different construction hours are permitted or required under an EPL in force in respect of the CSSI; or (d) Works which are not subject to an EPL that are approved under an Out-of-Hours Work Protocol required by Condition E70; or (e) construction that causes $L_{Aeq(15\ minute)}$ noise levels: i. no more than 5 dB(A) above the rating background level at any residence in accordance with the *Interim Construction Noise Guideline* (DECC, 2009), and ii. no more than the 'Noise affected' noise management levels specified in Table 3 of the *Interim Construction Noise Guideline* (DECC, 2009) at other sensitive land uses, and iii. continuous or impulsive vibration values, measured at the most affected residence are no more than the maximum values for human exposure to	Section 2

CoA	Condition requirements	Document reference
	vibration, specified in Table 2.2 of *Assessing Vibration: a technical guideline* (DEC, 2006), and iv. intermittent vibration values measured at the most affected residence are no more than the maximum values for human exposure to vibration, specified in Table 2.4 of *Assessing Vibration: a technical guideline* (DEC, 2006). *Note: Section 5.24(1)(e) of the EP&A Act requires that an EPL be substantially consistent with this approval. Out-of-Hours works considered under Conditions E66(c) and (d) must be justified and include an assessment of the potential impacts and effectiveness of the proposed mitigation measures.*	
E68	Out-of-hours works that are regulated by an EPL as per Condition E66(c) or through the Out-of-Hours Work Protocol as per Condition E70 include: (a) works which could result in a high risk to construction personnel or public safety, based on a risk assessment carried out in accordance with AS/NZS ISO 31000:2009 "*Risk Management – Principles and Guidelines*"; or (b) where the relevant road network operator has advised the Proponent in writing that carrying out the works and activities could result in a high risk to road network operational performance; or (c) where the relevant utility service operator has advised the Proponent in writing that carrying out the works and activities could result in a high risk to the operation and integrity of the utility network; or (d) where the TfNSW Transport Management Centre (or other road authority) has advised the Proponent in writing that a road occupancy licence is required and will not be issued for the works or activities during the hours specified in Condition E62 and Condition E63. *Note: Other out-of-hours works can be undertaken with the approval of an EPL, or through the project's Out-of-Hours Work Protocol for works not subject to an EPL.*	This Protocol
E70	An Out-of-Hours Work Protocol must be prepared to identify a process for the consideration, management and approval of works which are outside the hours defined in Conditions E62 and E63 and that are not subject to an EPL. The Protocol must be approved by the Planning Secretary prior to commencement of the works. The Protocol must be prepared in consultation with the EPA and AA. The Protocol must identify activities in terms of their risk of adverse impacts on sensitive receivers (low, medium, high) and include:	This Protocol and Section 1.2
	(a) a process for the consideration of out-of-hours works against the relevant noise and vibration criteria, including the determination of low, medium and high-risk activities,	Section 3 and 5
	(b) a process for selecting and implementing mitigation measures for residual impacts in consultation with the community at each affected location, including respite periods consistent with the requirement of Condition E69. The measures must take into account the predicted noise levels and the likely frequency and duration that sensitive receivers would be exposed to residual impacts, including the number of noise awakening events,	Section 4
	(c) procedures to facilitate the coordination with other out-of-hours works, including those approved by an EPL or undertaken by a third party, to ensure appropriate respite is provided,	Section 3.4, 3.5 and 6

CoA	Condition requirements	Document reference
	(d) an approval process that considers the risk of works, proposed mitigation and management, and coordination, includingwhere: i. the ER and AA review all proposed out-of-hours activities and confirm their risk levels, ii. low risk activities can be approved by the ER in consultation with the AA, and iii. medium and high risk activities are approved by the Planning Secretary,	Section 2.2, 5 and Appendix A
	(e) notification arrangements for affected receivers and the EPA for all approved out-of-hours works and notification to the Planning Secretary of approved low risk out-of-hours works.	Section 4, 5 and 6

1.1. Updated Environmental Management Measures

Community feedback and complaints relating to construction noise and vibration will be managed in accordance with the Communication Strategy and Complaints Management System.

Table 2 lists the updated EMMs for the Project that are relevant to this Protocol. This includes relevant references to where the commitment has been addressed in this Protocol and/or other Project documents.

Table 2: Environmental management measures relevant to this Protocol

CoA	Condition requirements	Document reference
NV1	A Construction Noise and Vibration Management Plan (CNVMP) will be prepared. The CNVMP will include processes and responsibilities to assess, monitor, minimise and mitigate noise and vibration impacts during construction. The plan will: ▪ Identify relevant performance criteria in relation to noise and vibration ▪ Identify noise and vibration sensitive receptors and features in the vicinity of the project ▪ Include standard and additional mitigation measures from the Construction Noise and Vibration Guideline (CNVG) (Roads and Maritime 2016) and details about when each will be applied ▪ Describe the process(es) that will be adopted for carrying out location and activity specific noise and vibration impact assessments to assist with the selection of appropriate mitigation measures ▪ Consider cumulative construction noise impacts and construction noise fatigue ▪ Include protocols that will be adopted to manage works required outside standard construction hours, in accordance with relevant guidelines including for management of respite periods ▪ Include a Blast Management Strategy (where blasting is required) ▪ Detail monitoring that will be carried out to confirm project performance in relation to noise and vibration performance criteria. ▪ The CNVMP will be implemented for the duration of the construction of the project.	Section 3 and Section 6 This Protocol
SE4	Prepare and implement a Construction Fatigue Protocol as part of the CNVMP to address potential construction fatigue impacts. The Protocol will include consideration of noise attenuation and periods of respite for affected stakeholders, where reasonable and feasible, and restricting out of hours work where practicable.	Section 3 and Section 6

1.2. Consultation

This Protocol was developed in consultation with the Project Acoustic Advisor (AA) and the Environmental Protection Authority (EPA) in accordance with E70. A summary of consultation is found in Table 3 below.

Table 3 Consultation of the Protocol

Stakeholder	Query	Action
AA	The Noise and Vibration CEMP Sub-plan (including this Protocol) was issued to the AA on 20/08/2021. The queries received on this Protocol included recommendations on referencing Sections within the Protocol to provide further clarification for the reader and addition of information in Figure 2.	The close out of these queries were addressed in a meeting held between CGU, TfNSW, the AA and ER on the 10/09/2021 and the Protocol updated to reflect the queries.
EPA	The Noise and Vibration CEMP Sub-plan (including this Protocol) was provided to the EPA with the Project EPL Application on 06/09/2021.	A meeting was held between CGU and the EPA on the 9/09/2021. The EPAs expectation that all out of hour works will be performed under the Project EPL. The ER cited the evidence of submission on the 27/09/2021.

2. Construction Hours

In accordance with CoA E62 and E63, the standard construction working hours for the Project (except for tunnelling (excluding cut and cover tunnelling)) are defined as being:

- 7:00 am to 6:00 pm Mondays to Fridays; inclusive
- 8:00am to 6:00pm Saturdays; and
- at no time on Sundays or public holidays.

CoA E64 allows the following activities 24 hours per day, seven days per week:

- tunnelling (excluding cut and cover tunnelling);
- delivery of material to support tunnelling;
- haulage of spoil from the Arncliffe and Rockdale construction ancillary facilities;
- works within an acoustic shed; and
- tunnel fit out works.

In accordance with CoA E66(d), this Protocol defines the process for the assessment and approval of work that is not subject to an EPL and needs to occur outside of the time periods stipulated above i.e. needs to occur during an OOHW period.

This Protocol will apply to the two OOHW periods depicted in Figure 1. The OOHW periods are further defined as OOHW Period 1 and 2, based on the Roads and Maritime Construction Noise and Vibration Guideline (CNVG).

Figure 1 Construction assessment periods

Day/ Time	12am – 1am	1am – 2am	2am – 3am	3am – 4am	4am – 5am	5am – 6am	6am – 7am	7am – 8am	8am – 9am	9am – 10am	10am – 11am	11am – 12pm	12pm – 1pm	1pm – 2pm	2pm – 3pm	3pm – 4pm	4pm – 5pm	5pm – 6pm	6pm – 7pm	7pm – 8pm	8pm – 9pm	9pm – 10pm	10pm – 11pm	11pm – 12am
Monday to Friday									[Standard construction Hours]										OOHW Period 1					
Saturday		OOHW Period 2																						
Sunday or Public Holiday									OOHW Period 1										OOHW Period 2					

2.1. OOHW Justification

Construction work associated with the Project will be undertaken in accordance with the assessment and management approach outlined in the Interim Construction Noise Guidelines (ICNG). The ICNG outlines the standard construction hours for the Project and requires that work proposed outside of these hours must be appropriately justified. These requirements are reflected in CoA E66 and E68 for the Project. In general, OOHW undertaken on public infrastructure projects, such as on road construction projects where the OOHW is necessary to sustain the operational integrity of roads, is considered justified in the ICNG.

OOHW not subject to an EPL that are regulated through this Protocol are summarised in Table 4.

Table 4: Justification for OOHW regulated through this Protocol

Category	OOHW Justification
A. Safety or emergency work (CoA E66)	▪ for the delivery of materials required by the NSW Police Force or other authority for safety reasons, ▪ where it is required in an emergency to avoid injury or the loss of life, to avoid damage or loss of property or to prevent environmental harm

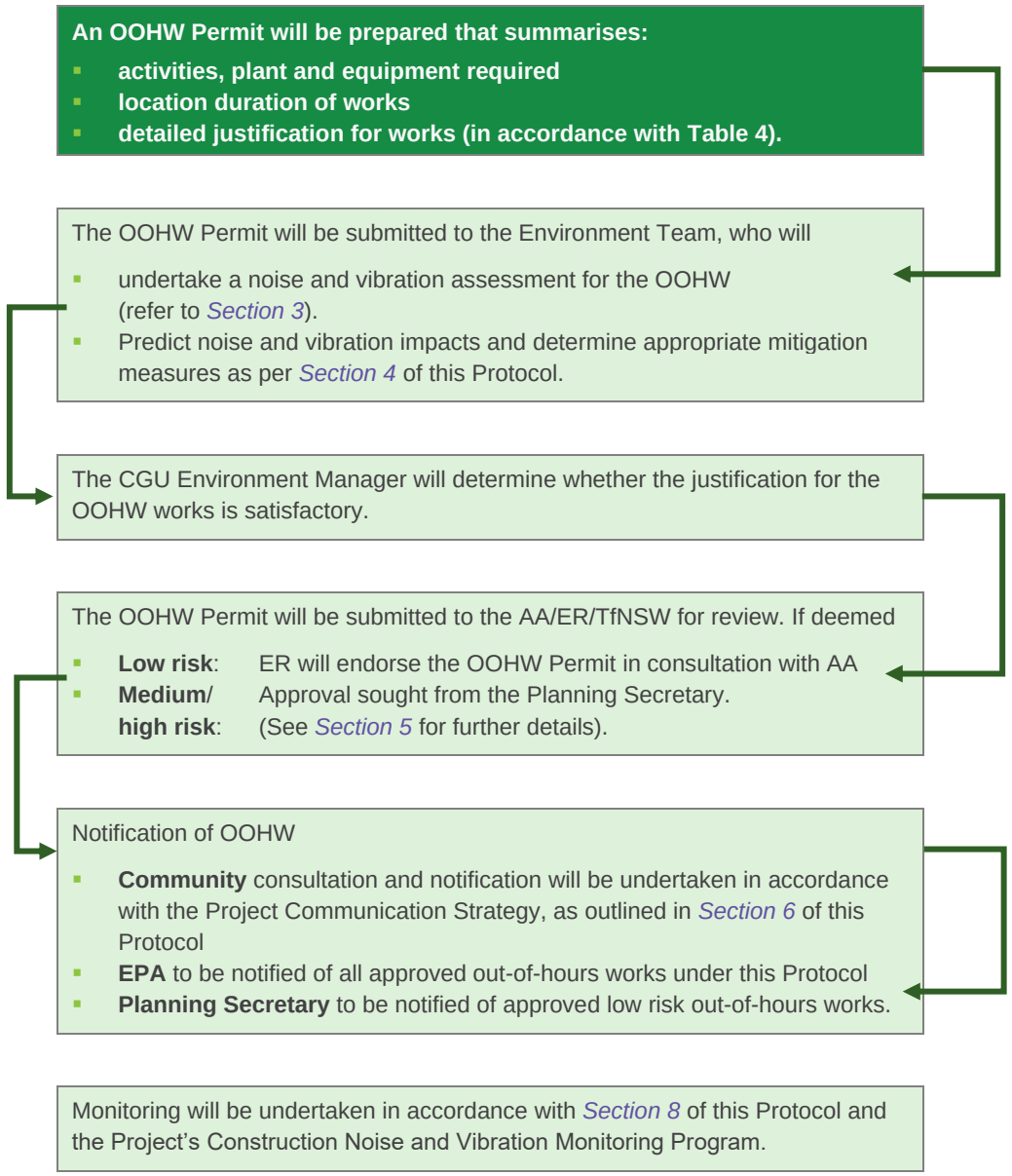
B. Low impact work (CoA E66)	Construction that causes:
	▪ $L_{Aeq(15\ minute)}$ noise levels no more than
	  ▸ 5 dB(A) above the rating background level at any residence in accordance with the Interim Construction Noise Guideline (DECC, 2009), and
	  ▸ the 'Noise affected' noise management levels specified in Table 3 of the Interim Construction Noise Guideline (DECC, 2009) at other sensitive land uses, and
	▪ continuous or impulsive vibration values no more than the preferred values for human exposure to vibration, specified in Table 2.2 of Assessing Vibration: a technical guideline (DEC, 2006) , measured at the most affected residence, and
	▪ intermittent vibration values measured at the most affected residence no more than the preferred values for human exposure to vibration, specified in Table 2.4 of Assessing Vibration: a technical guideline (DEC, 2006)

C. Other out-of-hours works (CoA E68)	▪ works which could result in a high risk to construction personnel or public safety, based on a risk assessment carried out in accordance with AS/NZS ISO 31000:2009 “Risk Management – Principles and Guidelines” ▪ where the relevant road network operator has advised the Proponent in writing that carrying out the works and activities could result in a high risk to road network operational performance ▪ where the relevant utility service operator has advised the Proponent in writing that carrying out the works and activities could result in a high risk to the operation and integrity of the utility network ▪ where the TfNSW Transport Management Centre (or other road authority) has advised the Proponent in writing that a road occupancy licence is required and will not be issued for the works or activities during standard construction hours
D. Negotiated agreement (ICNG)	▪ where negotiated agreements with directly affected residents and sensitive land uses have been reached

2.2. OOHW Permit

Where CGU undertakes Category C or D OOHW, the following process outlined in Figure 2 will be undertaken.

Figure 2 GCU process for obtaining OOHW Permit



3. OOHW Noise & Vibration Assessment

To manage potential impacts from noise and vibration during OOHW, CGU's noise and vibration specialists have developed an online 3D noise and vibration management tool (Gatewave, www.gatewave.com.au) that enables the prediction and assessment of potential noise and vibration impacts resulting from proposed OOHW in specific work areas, including identification of the likely occurrence of noise awakening events as detailed in the CNVMP.

This management tool provides assistance in managing noise and vibration impacts on sensitive receivers, based on works described in an overarching Construction Noise and Vibration Impact Statement (CNVIS) for a worksite. It considered the work area location(s) and the types of construction machinery operating in each specific work area to be used for the proposed OOHW. Gatewave produces a Construction Noise and Vibration Assessment (CNVA) report, summarising the results of the OOHW noise and vibration assessment, including the selection of reasonable and feasible mitigation and management measures from the CNVMP and ICNG considered by the CGU construction team and the Environmental and Sustainability Manager.

3.1. Noise

Gatewave will identify the sensitive receivers likely to be construction noise affected by the OOHW, predict the extent of noise impact and identify any additional mitigation measures required. The assessment will include reasonable and feasible mitigation and management measures from the CNVMP and ICNG considered by the CGU construction team and the Environmental and Sustainability Manager. To minimise cumulative noise impacts, Gatewave will also consider any other OOHW that is planned during the proposed OOHW.

The results of the OOHW noise assessment, including mitigation and management measures will be presented in the CNVA. This will be used to determine the appropriate approval pathway for the OOHW. Ongoing monitoring and validation of predictive outputs will be undertaken as detailed in the CNVMP and the Noise and Vibration Monitoring Program.

3.2. Vibration

Where vibration intensive activities are proposed as OOHW, Gatewave will identify potential impact where sensitive receivers or structures are located within the minimum working distances as defined in relevant CNVISs including:

- Cosmetic structural damage impacts.
- Disturbance to building occupants due to vibration.

Where impacts are found, reasonable and feasible mitigation and management measures will be considered and presented in the CNVA. Ongoing monitoring and validation of predictive outputs will be undertaken as detailed in the CNVMP and the Noise and Vibration Monitoring Program.

3.3. High Noise Intensive Works

In accordance with CoA E65, except as permitted by an EPL or approved under this Protocol, high noise intensive works that result in an exceedance of the applicable NML (i.e. 75dBA at residential receivers) at the same receiver will be undertaken:

- Between the hours of 8:00 am and 6:00 pm Monday to Friday.
- Between the hours of 8:00 am and 1:00 pm Saturday.
- If continuous, then not exceeding 3 hours, with a minimum cessation of work of not less than 1 hour. 'Continuous' includes any period during which there is less than one-hour respite between.

For OOHW subject to this Protocol that involves the use of highly noise intensive equipment, CGU will consider, wherever reasonable and feasible:

- Use of alternative quieter plant and equipment,
- Planning works during less noise sensitive periods (e.g. try and complete highly noise intensive works as early in the night as possible),
- Schedule highly noise intensive equipment prior to 10 pm,
- Where the above cannot be achieved, the equipment will be used prior to midnight.

Note – there may be instances where high noise intensive works will be required after 10pm and/or midnight as outlined above. Examples where this might occur include specific conditions detailed in the Road Occupancy License (ROL), reinstating trafficable areas using whacker packers and asphalting plant at the end of applicable shifts.

In accordance with CoA E70, to identify the appropriate respite periods for work proposed under this Protocol, CGU will consult the community at each affected location. The affected locations will be identified from the Project's noise and vibration management tool (Gatewave) outputs for the proposed OOHW. The outcomes of the consultation and the noise management tool outputs will also be used to identify appropriate mitigation measures to be implemented for the proposed OOHW. The process for stakeholder consultation for OOHW is further detailed in Section 6.

3.4. Coordination of OOHW approved by an EPL

As part of the noise and vibration assessment process, CGU will ensure all OOHW permitted by either an EPL or this protocol are co-ordinated to implement appropriate respite and/or mitigation measures for potentially affected sensitive receivers. OOHW Permits for works under an EPL will be reviewed and approved by CGU's Environmental and Sustainability Manager, Stakeholder and Community Engagement Manager and responsible engineer in accordance with any relevant OOHW conditions detailed in the Projects EPL.

3.5. Coordination of OOHW undertaken by a third party

As part of the noise and vibration assessment process, CGU will ensure all OOHW undertaken for the delivery of the CSSI, including works undertaken by a third party are co-ordinated to implement appropriate respite and/or mitigation measures for potentially affected sensitive receivers. Consultation will be undertaken with the Environmental and Sustainability Manager, Stakeholder and Community Engagement Manager and responsible engineer associated with works by a third party to ensure works can be coordinated to satisfy CoA E69 and E71.

4. OOHW Noise & Vibration Mitigation and Management Measures

Following the noise assessment process as described in Section 3, the most appropriate reasonable and feasible management measures will be determined in accordance with the ICNG. Table 5-1 and Table 5-2 detail the relevant additional mitigation measures from the Roads and Maritime's Construction Noise and Vibration Guideline (RMS CNVG) to be applied during OOHW as required.

As detailed in Section 5, mitigation measures for OOHW will be endorsed by the Environmental Representative (ER) in consultation with the Acoustics Advisor (AA) to ensure that appropriate reasonable and feasible noise and vibration mitigation measures are applied throughout the delivery of the Project.

It should be noted that there may be personal circumstances among the sensitive receivers where the below approach to specific additional mitigation measures is not best suited. The Stakeholder and Community Engagement Manager has the authority to amend the below approach due consideration of the personal circumstances that may apply and ensure no less than equivalent mitigation is provided.

Figure 3 Triggers for Additional Mitigation Measures – Airborne Noise

When is the work being undertaken?	How much does the predicted noise level exceed the ANML by?	Receiver perception	Identify additional management measures to be implemented
All Hours	75 dB(A) or greater	-	V, N, PC, RO
Standard Hours M-F 7am to 6pm Sat 8am to 6pm	0 dB(A)	Noticeable	-
	≤ 10 dB(A)	Clearly audible	-
	10 to 20 dB(A)	Moderately intrusive	V, N
	> 20 dB(A)	Highly intrusive	V, N
OOHW Period 1 M-F 6pm to 10pm Sat 6pm to 10pm Sun/ PH 8am to 10pm	< 5 dB(A)	Noticeable	-
	5 to 15 dB(A)	Clearly audible	N, R1, DR
	15 to 25 dB(A)	Moderately intrusive	V, N, R1, DR
	> 25 dB(A)	Highly intrusive	V, N, SN, IB, PC, R1, DR
OOHW Period 2* M-F 10pm to 7am Sat 10pm to 8am Sun/ PH 6pm to 8am	< 5 dB(A)	Noticeable	N
	5 to 15 dB(A)	Clearly audible	V, N, R2, DR
	15 to 25 dB(A)	Moderately intrusive	V, N, SN, IB, PC, R2, DR
	> 25 dB(A)	Highly intrusive	AA, V, N, SN, IB, PC, R2, DR

Notes: Use the abbreviation codes in the table above to confirm management measures required

* Where OOHW occur in the evening/night shoulder period (10pm to 12am) or the night/morning shoulder period (5am to 7am) apply additional airborne mitigation measures from the OOHW Period 2

N = Notification (should be issued a minimum of five working days prior to the start of works)

SN = Specific notifications (issued no later than seven calendar days ahead of construction activities)

IB = Individual briefing | PC = Phone Call | V = Verification of predicted noise levels

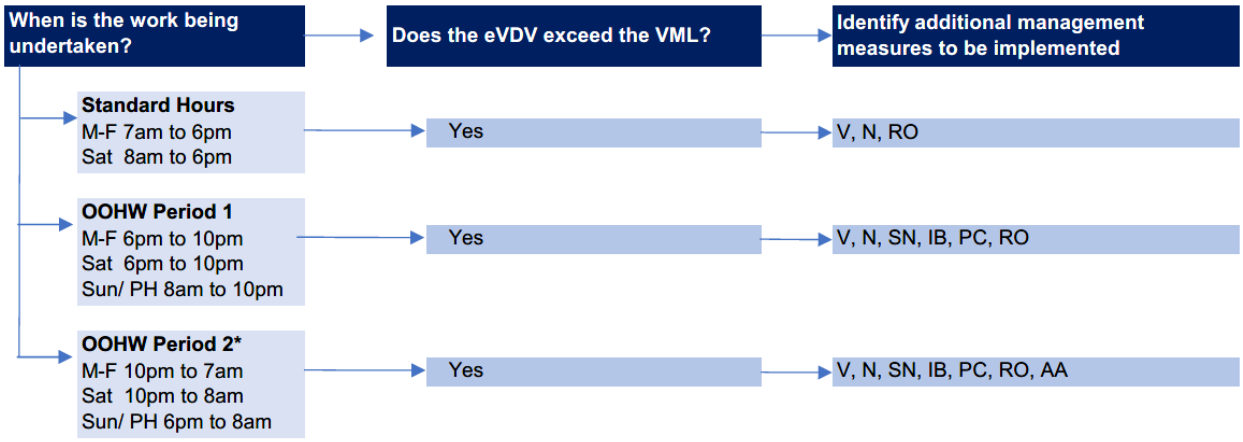
AA = Alternative accommodation** | RO = Project specific respite offer | R1 = Respite period 1

DR = Duration respite | R2 = Respite period 2

** Where construction activity impacts receiver for more than two (2) nights over a seven (7) day rolling period (CoA E82).

As outlined in the CNVMP, an assessment of sleep disturbance impacts would be completed where construction works are planned to extend over more than two consecutive nights. The assessment will identify whether there are noise events above the initial screening level and, where this occurs, whether events are above an 'awakening reaction' level of 55 dB(A) L_{Amax} (internal). Noise events above the awakening reaction level would be classified Clearly Audible or above.

Figure 4 Triggers for Additional Mitigation Measures – Vibration



Notes: Use the abbreviation codes in the table above to confirm management measures required

* Where OOHW occur in the evening/night shoulder period (10pm to 12am) or the night/morning shoulder period (5am to 7am) apply additional airborne mitigation measures from the OOHW Period 2

N = Notification (should be issued a minimum of five working days prior to the start of works)

SN = Specific notifications (issued no later than seven calendar days ahead of construction activities)

IB = Individual briefing	PC = Phone Call	V = Verification of predicted noise levels
AA = Alternative accommodation**	RO = Project specific respite offer	R1 = Respite period 1
	DR = Duration respite	R2 = Respite period 2

** Where construction activity impacts receiver for more than two (2) nights over a seven (7) day rolling period (CoA E82).

5. Approval of OOHW not subject to an EPL

Refer to Annexure A for a flow chart of the approval process for OOHW not subject to an EPL.

When it is identified that OOHW are required and are not subject to an EPL, the engineer responsible for the work will submit an OOHW Permit to the CGU Environment Team. This OOHW Permit will include details of the proposed activity and justification for the need to carry out the work as OOHW.

Following this, the noise and vibration assessment process as described in Section 3 will be undertaken by a member of the CGU Environment Team for the proposed OOHW. The outcomes of the noise and vibration assessment, including relevant management measures, will be forwarded to the CGU Environment and Sustainability Manager and Stakeholder and Community Engagement Manager, who, will review the level of risk associated with the activity, the predicted impacts and the management measures to be implemented.

Once the OOHW Permit has been developed, it will be provided to the ER, AA and TfNSW for review and to confirm the risk level. The proposed OOHW are classified low risk if the noise assessment (including the assessment of sleep disturbance) as described in Section 3 identifies that the works:

- Meet the perception classification (Figure 3) of Noticeable;
- Meet the perception classification (Figure 3) of Clearly Audible and above at any one residential receiver for a maximum of:
  - 2 consecutive evenings and/or nights per calendar week; and
  - 3 evenings and/or nights per calendar week; and
  - 10 evenings and/or nights per calendar month.

The effect of the above facilitates two evening and/or night periods in a row and at least one period off before the third period that week. In accordance with CoA E70 (d)(ii), the ER has the authority to approve low risk OOHW activities. If the duration limitations outlined above cannot be achieved, the proposed OOHW will be classified medium/high risk. In this instance, the assessment of the proposed OOHW and the OOHW Permit will be issued to the Secretary for review and approval.

Following approval by the ER or the Planning Secretary, the approved OOHW Permit will be provided to the relevant construction team by the CGU Environmental and Sustainability Manager. On receipt of the approved OOHW Permit, any standard and additional mitigation measures that relate to the OOHW will be:

- Implemented prior to OOHW (such as specific conditions that relate to the community).
- Communicated to relevant workforce and site personnel before each shift to introduce/reinforce work restrictions, management measures and expected workforce behaviour.
- Implemented during OOHW and monitored by the CGU Environment Team to confirm/validate the noise predictions where required by the permit.

Following the OOHW, CGU will review any lessons learnt and monitoring data to help inform future OOHW activities and mitigation measures and minimise impacts.

Note – Works being conducted under the Environmental Planning and Assessment (COVID-19 Development – Infrastructure Construction Work Days No. 2) Order 2020 (the Order), does not require approval from the ER, TfNSW or Planning Secretary.

6. Consultation and fatigue management

The Community and Stakeholder Team will use a range of communication tools to provide clear, effective, and timely information to the predicted affected sensitive receivers and stakeholders. The method of communication will be chosen based on the nature of works and the potential impacts, as noted in Section 8.6 of the CNVMP.

In accordance with Section 3.7.2.2 of the TfNSW G36 specification, relevant sensitive receivers will be notified of upcoming planned OOHW detailing the location, nature, scope, duration, impacts and likely mitigation measures to be implemented for the proposed works. This will be conducted not less than 5 working days and not more than 14 working days, before commencing OOHW.

In addition to the above, where CGU undertakes Category C or D OOHW (see Table 4 in Section 2.1) respite periods for the OOHW will be identified in consultation with the community at each affected location on a regular basis. This consultation would include:

- a progressive schedule for periods no less than three (3) months, of likely out-of-hours work,
- the potential works, location and duration,
- the noise characteristics and likely noise levels of the works, and
- likely mitigation and management measures which aim to achieve the relevant noise management level (including the circumstances of when a respite or relocation offer will be available and details about how the affected community can access these offers).

The outcomes of the 3 monthly community consultation, the identified respite periods and the scheduling of the likely OOHW will be provided to the EPA, AA and Planning Secretary for information within 2 weeks of undertaking the community consultation.

7. External Approval Authorities for OOHW

7.1. DPIE

In accordance with CoA E70(d)iii), if the proposed OOHW (that is not subject to an EPL) includes medium or high risk activities, approval of the OOHW will be sought from the Secretary.

7.2. Environmental Representative and Acoustics Advisor

In accordance with CoA E70 (d)(ii), if the proposed OOHW (that is not subject to an EPL) only includes low risk activities (refer to Section 0), the OOHW can be approved by the ER, in consultation with the AA.

8. OOHW Monitoring

Noise and vibration monitoring of OOHW will be conducted as determined by the overarching CNVISs or the CNVA reports generated by Gatewave (see Section 0), which will include verification monitoring for any new works being undertaken (in accordance with the CNVIS or CNVIA). Additionally, monitoring will be conducted and documented in accordance with the Project's Construction Noise and Vibration Monitoring Program and serves to validate the predicted levels.

9. OOHW Noise and Vibration Exceedances

9.1. Management Response

Where monitored noise and vibration levels are found to be above modelling predictions or noise/vibration management levels during OOHWs, the following actions will be undertaken:

- Identify whether the exceedance is caused from CGU construction related sources.
- Confirm if the exceedance is due to an uncharacteristically loud/vibratory piece of equipment.
- Confirm that the modelling reflects the actual activity being undertaken.
- If determined to be caused by CGU construction, cease the noise and/or vibration generating source causing the exceedance.
- Identify if the equipment can be swapped out for another piece of equipment or alternative equipment or plant, or if additional mitigation can be included in the site design.
- Implement other feasible and reasonable measures which may include reducing plant size, modifying time of works, changing operational settings (such as turning off the vibratory function of the machine), and utilising alternative construction methodology or a combination of these.
- Continue work where impacts can be reduced or if the exceedance is deemed minor i.e. does not trigger any additional community mitigation measures to be implemented such as Alternative Accommodation.
- Refine the noise modelling assessment process based on the learnings. For example, if noise or vibration predictions are lower/higher than expected, noise modelling would take this into consideration to predict impacts for future works more correctly.
- Communicate lessons learnt to relevant personnel.

Previously recorded non-conformances will be considered prior to the approval of further OOHW permits.

9.2. Reporting

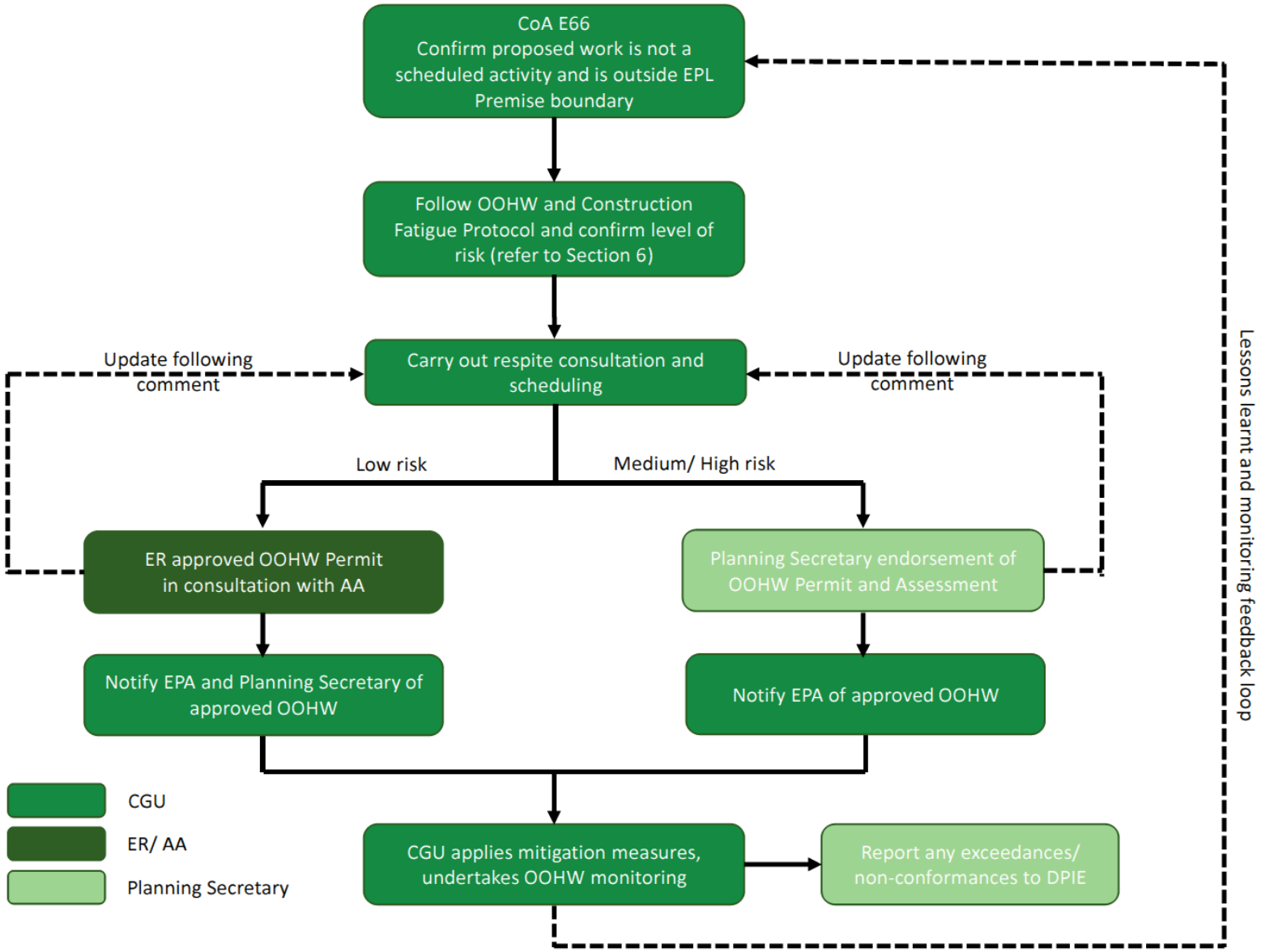
A noise and vibration related non-conformance for OOHW is defined as:

- Where a piece of plant/equipment is being used for OOHW which has not been assessed in noise/vibration modelling and is causing an exceedance of the predicted noise impacts and the Noise Management Levels at relevant sensitive receivers.
- Relevant noise and vibration mitigation measures have not been implemented for OOHW in accordance with the OOHW Permit or CNVMP and monitoring shows exceedance of the noise/vibration goals at relevant sensitive receivers.

All non-conformances will be reported in accordance with Section 3.10 of the CEMP.

Any noise and vibration complaints will be reported in accordance with the Project Communication Strategy.

Appendix A CGU M6 Stage 1 Project OOHW Protocol Approval Flow Chart


CoA E66
Confirm proposed work is not a scheduled activity and is outside EPL Premise boundary
Follow OOHW and Construction Fatigue Protocol and confirm level of risk (refer to Section 6)
Carry out respite consultation and scheduling
Update following comment
Update following comment
Low risk
Medium/ High risk
ER approved OOHW Permit in consultation with AA
Planning Secretary endorsement of OOHW Permit and Assessment
Notify EPA and Planning Secretary of approved OOHW
Notify EPA of approved OOHW
CGU
ER/ AA
Planning Secretary
CGU applies mitigation measures, undertakes OOHW monitoring
Report any exceedances/ non-conformances to DPIE
Lessons learnt and monitoring feedback loop

Appendix B Example Out of Hours Permit Template

Out of Hours Work Approval Permit

SECTION 1: GENERAL DETAILS			
Permit request no:		**Application date:**	
Permit Requestor:			

SECTION 2: JUSTIFICATION FOR OUT OF HOURS WORKS	
Assign one of the below justifications to the work outlined in Section 4: APPROVED WORKS	
A	Where it is required in an emergency to avoid injury or the loss of life, to avoid damage or loss of property or to prevent environmental harm.
	The delivery of oversized plant or structures has been determined by the police or other authorised authorities to require special arrangements to transport along public roads.
B	LAeq (15 minute) noise levels greater than 5dB above the day, evening and/or night RBL as applicable.
	LA1(1 minute) or LAmax noise levels greater than 15dB above the night RBL for night works.
	Continuous or impulsive vibration values greater than those for human exposure to vibration, set out for residences in Table 2.2 in "Environmental Noise Management - Assessing Vibration: a technical guideline" (DEC, 2006).
	Intermittent vibration values greater than those for human exposure to vibration, set out for residences in Table 2.4 in "Environmental Noise Management - Assessing Vibration: a technical guideline" (DEC,2006).
C	Carrying on the work during standard hours would result in a high risk to construction personnel or public safety, based on a risk assessment carried out in accordance with AS/NZS ISO 31000:2009 "Risk Management".
	The road network operator has advised CGU in writing that carrying out the work during standard hours would result in a high risk to road network operational performance.
	Where the relevant utility service operator has advised the Proponent in writing that carrying out the works and activities could result in a high risk to the operation and integrity of the utility network.
	TfNSW Transport Management Centre (or other road authority) has advised the Proponent in writing that a road occupancy licence is required and will not be issued for the works or activities during standard construction hours.
D	Works may be undertaken outside of standard construction hours if agreement between the licensee and a substantial majority of potentially affected sensitive receivers has been reached.
E	EPL Variation: required where no other clause covers the work .

SECTION 3: COMMUNITY	
Community Portal / Notifications	
Contact Number (In the event of contact with the community)	
Contingency Nights	

SECTION 4: SUPERVISORS	
Who from CGU will be supervising the work? (include contact details)	
In the case of any emergency or issue during a night shift. Please contact the specified supervisors to the right for shared use of resources including labour or plant/equipment to deal with the issue.	

SECTION 5: APPROVED WORKS						
Activities	**Location**	**Justification**	**Dates**	**Time**	**CNIA**	**Plant/Equipment (Red = High Impact)**
Arncliffe Compound C1						
Rockdale Depot Compound C2						
Bicentennial Park Compound C3						
President Avenue and Princes Highway						

SECTION 6: NOISE MITIGATION MEASURES	
Assessment	
Proposed mitigation measures:	

SECTION 7: NOISE MONITORING (for Environment Team)								
NCA								

SECTION 8: APPROVALS (Permit must be signed by all parties to be issued)	
Environment Manager **Confirm Mitigations**	Name: Date: …….. Signature: ……..
Stakeholder and Community Relations Manager **Confirm Notifications**	Name: Date: …….. Signature: ……..
Project Manager **Review**	Name: Date: …….. Signature: ……..
Superintendent **Review**	Name: Date: …….. Signature: ……..
Director **Approve**	Name: Date: …….. Signature: ……..

SECTION 8: Permit Acceptance – to be signed by all personnel working out of standard hours			
By signing this permit, I understand; - Plant and equipment used must be as listed in Section 3, including time limitations - Controls in Section 4 and 7 will be implemented before starting noise generating work - I will raise potential changes or issues with my Supervisor - I will only do work detailed in this permit.			
Date:	Name:	Company:	Signature:

Appendix **D Construction Noise and Vibration Impact Assessment for CEMP: Preliminary construction including commencement activities**

RENZO TONIN & ASSOCIATES
inspired to achieve

Acoustics
Vibration
Structural Dynamics

M6 MOTORWAY STAGE 1

CEMP: preliminary construction including commencement activities - Noise and Vibration Assessment

21 September 2021

CPB Contractors Ghella UGL Engineering JV

TK703 1-03F01 M6 NVA Site Estab (r5)

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aaac Association of Australian Acoustical Consultants

Document details

Detail	Reference
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Contents

List of tables

List of figures

1 Introduction

This Preliminary Construction Noise and Vibration Assessment report has been prepared on behalf of CPB Contractors Ghella UGL Engineering (CGU) Joint Venture. CGU have elected to stage construction of the M6 Motorway Stage 1 (the Project) and have prepared a Staging Report (M6S1-CGU-NWW-ENPE-PLN-000401) which details the strategy for staging and the compliance requirements for each of the two stages:

- Stage 1 – Preliminary construction including commencement activities;
- Stage 2 – Construction.

This Noise and Vibration Assessment has been prepared in accordance with the Construction Environmental Management Plan: Preliminary construction including commencement activities (CEMP) (M6S1-CGU-NWW-ENPE-MPL-000400).

1.1 Relevant requirements and purpose of this report

This report provides a noise and vibration assessment of the activities outlined in the CEMP. The report includes:

- Analysis of key risks associated with noise and vibration impacts arising from the CEMP activities,
- Details of how the CEMP activities would be managed to meet the performance outcomes identified in the CEMP and to manage any risks identified above,
- A noise and vibration monitoring program for the monitoring of CEMP activities.

This report summarises the results of an assessment of the noise and vibration impacts from CEMP activities. The works are to be mostly completed during standard construction hours, with Out-Of-Hours (OOH) works occurring for activities detailed in SSI 8931 Infrastructure Condition of Approval (CoA) E66. The construction hours of work for the Project are defined by CoA E62 to E66 as outlined in Section 2.2.

1.2 Structure of this Report

This report is structured as follows:

- **Section 2** - Description of construction works and hours
- **Section 3** - Nearest sensitive receivers
- **Section 4** - Construction noise and vibration objectives
- **Section 5** - Construction noise assessment
- **Section 6** - Construction vibration impacts
- **Section 7** - Conclusion.

1.3 Quality assurance

The work documented in this report was carried out in accordance with the Renzo Tonin & Associates Quality Assurance System, which is based on Australian Standard / NZS ISO 9001. Appendix A contains a glossary of acoustic terms used in this report.

2 Description of construction works and hours

2.1 Summary of works addressed in this report

Preliminary activities including commencement activities is required at construction ancillary facilities C1, C2 and C3. The activities outlined in Figure 2.1 have been considered to ensure a comprehensive assessment and works will be limited to these approved activities until the Stage 2 Construction Environment Management Plan is approved.

Preliminary activities including commencement activities included in this report, may continue after the Stage 2 Construction Environment Management Plan is approved. Once this Plan is approved, preliminary activities including commencement activities will be subject to the controls and mitigations outlined in the Stage 2 Construction Environment Management Plan.

The Preliminary activities including commencement activities for each worksite are summarised below and presented in detail in APPENDIX C.

Figure 2.1: M6 Motorway Stage 1 CEMP activities by worksite

C1 Arncliffe worksite ▪ Amendments and repairs of existing structures ▪ Installation of hoarding ▪ Utility and services reestablishment ▪ Tunnel adit restoration ▪ Decline and invert repair	**C3 MOC 3 worksite** ▪ Demolition of existing structures ▪ Utility relocation ▪ Installation of fences and crib
C2 Rockdale depot worksite ▪ Demolition of existing structures ▪ Vegetation clearing ▪ Installation of noise walls and hoardings ▪ Site levelling, hardstand and site access ▪ Utility relocation and services installation (within site) ▪ Telegraph pole relocation on West Botany Road ▪ Installation of offices, amenities, water treatment plant (WTP)	**C3 Bicentennial Park North tunnel worksite** ▪ Site levelling, hardstand and site access ▪ Installation of offices, amenities, water treatment plant (WTP), bentonite plant and workshops ▪ Utilities investigation, relocation and installation of temporary power supply for worksite ▪ Installation of environmental controls ▪ Vegetation clearing ▪ Installation of noise walls, hoardings and pathways

2.2 Construction Hours

Working hours for the Project are defined by CoA E62 to E66 and E91. Table 2.1 below consolidates the information provided in the Conditions regarding construction working hours for Project.

Table 2.1: Construction works hours

CoA	Construction Activity	Monday to Friday	Saturday	Sunday / public holiday
E62 & E63	Standard construction hours	7:00am to 6:00pm	8:00am to 6:00pm	No work[3]
E64	Tunnelling (excluding cut and cover tunnelling) Delivery of material to support tunnelling Haulage of spoil from the Arncliffe and Rockdale construction ancillary facilities Works within an acoustic shed Tunnel fit out works	24 hours	24 hours	24 hours
E65	Highly noise intensive works[4]	8:00am to 6:00pm (plus respite[1])	8:00am to 1:00pm (plus respite[1])	No work[3]
E91	Blasting[2]	9:00am to 5:00pm	9:00am to 1:00pm	No blasting

Notes:

1. Minimum respite from highly noise intensive works of not less than one (1) hour between each continuous block of works not exceeding three (3)
2. Blasting outside of these hours must be authorised through an EPL
3. No work unless permitted and approved
4. Highly noise intensive work restrictions apply to tunnelling works as well as surface works.

2.2.1 Assessment periods

The standard hours and out of hours work (OOHW) periods are depicted in Table 2.2. The OOHW periods are further defined as OOHW Period 1 and 2, based on the Roads and Maritime Construction Noise and Vibration Guideline (CNVG)[[11]].

Table 2.2: Assessment periods

Day/ Time	12am – 1am	1am – 2am	2am – 3am	3am – 4am	4am – 5am	5am – 6am	6am – 7am	7am – 8am	8am – 9am	9am – 10am	10am – 11am	11am – 12pm	12pm – 1pm	1pm – 2pm	2pm – 3pm	3pm – 4pm	4pm – 5pm	5pm – 6pm	6pm – 7pm	7pm – 8pm	8pm – 9pm	9pm – 10pm	10pm – 11pm	11pm – 12am
Monday to Friday										Standard construction Hours									OOHW Period 1					
Saturday																								
Sunday or Public Holiday	OOHW Period 2											OOHW Period 1							OOHW Period 2					

2.2.2 Justification for OOHW

The relocation of the telegraph pole on West Botany Road, near the C2 worksite and MOC3 worksite (C3) will most likely need a Road Occupancy Licence (ROL) for the closure of one or more lanes on West Botany Road, to allow the works to be completed without high risk to construction personnel or public safety. A ROL is not likely to be issued during the hours specified in the CoA E62 and E63 (Table 2.1). Therefore, works may need to be undertaken outside of standard construction hours, as per CoA E68(a), (b) and (d). These works would be undertaken through an Out of Hours Works Protocol prepared for the project in accordance with CoA E70.

At the C1 worksite in Arncliffe, tunnel adit restoration is required to repair and maintain the existing adit prior to construction commencement. This work would involve rockbolting and shotcreting tunnelling support work and would be undertaken 24 hours per day under CoA E64. Furthermore, the works would be undertaken only where noise and vibration impacts are below the construction noise management levels and vibration criteria established in CoA E72. The OOH works would be managed in accordance with the Out of Hours Works Protocol.

2.3 Construction traffic

When construction related traffic moves on the public road network, a different noise assessment methodology is appropriate as vehicle movements would be regarded as additional road traffic on public roads rather than as part of the construction site's activities.

Construction traffic associated with CEMP activities assessed in this report will be mostly generated during standard construction hours, except for a few OOH deliveries of plant and equipment or concrete during relocation of the telegraph pole on West Botany Road and tunnel adit reinforcement at the C1 Arncliffe worksite. The deliveries would be via arterial roads including Marsh Street, West Botany Road, President Avenue and Princes Highway.

Based on the proposed activities presented in Table C1 in APPENDIX C, the additional vehicle movements would not make a noticeable difference to traffic noise during the day and evening period. At night the total heavy vehicle movements is less than two over the night period for any of the proposed OOHW activities. Construction traffic noise impact from up to two heavy vehicle movements would not add to existing road traffic noise on Marsh Street, West Botany Road, President Avenue and Princes Highway. The impact is assessed as negligible and has not been considered further in this report.

3 Nearest sensitive receivers

3.1 Residential receivers

To assess and manage construction noise and vibration impact, a Land Use Survey was completed to satisfy CoA E61 and included in the Noise and Vibration CEMP Sub-plan (NVMP). The Land Use Survey identified existing land use and development within and around the Project, including a mix of residential, commercial, industrial, educational and open space uses. Further to the Land Use Survey, residential areas surrounding the Project works have been divided into Noise Catchment Areas (NCAs) based on those established in the Environmental Impact Statement (EIS) for the M6 Motorway Stage 1 project [1].

All relevant residential sensitive receivers near the Project worksites are identified on aerial photographs located in APPENDIX B. Receivers more than approximately 300m from the construction area are not anticipated to experience noise and vibration exceeding the adopted noise and vibration management levels described in Section 4 of this report. Therefore, receivers beyond 300m are typically not included in this assessment.

3.2 Other sensitive receivers

Additional to residential receivers, there are 'other' noise and vibration sensitive receivers (e.g. educational institutions, places of worship, recreational areas, etc.) surrounding the construction sites that have been identified as part of the Land Use Survey. The nearest 'other' sensitive properties within approximately 300m of the Project worksites are identified in APPENDIX B.

3.3 Commercial and industrial premises

All commercial and industrial premises within approximately 300m of the Project worksites have been considered in this assessment and are identified in APPENDIX B.

3.4 Heritage receivers

Heritage receivers have also been identified in APPENDIX B. All identified heritage sites have been considered in this assessment.

4 Construction noise and vibration objectives

4.1 Noise management levels

Construction noise management levels have been determined using the NSW Interim Construction Noise Guideline (ICNG) [3], as per CoA E72.

4.1.1 Airborne noise

The Noise Catchment Area (NCAs) and Noise Management Level (NML) figures in APPENDIX B identify the adopted construction noise management levels (NMLs) for the nearest residential receivers to the Project worksites. The NMLs for residential receivers are based on long-term noise logging conducted by on behalf of Transport for New South Wales (TfNSW) to quantify ambient noise levels for the EIS Appendix G: Noise and Vibration Technical Report [2], as outlined in the NVMP.

Residential receivers are considered 'noise affected' where construction noise levels are greater than the noise management levels identified in APPENDIX B. The noise affected level represents the point above which there may be some community reaction to noise. Where predicted and/or measured construction noise levels exceed NMLs, all feasible and reasonable work practices will be applied to meet the NMLs.

During standard construction hours, a highly affected noise objective of $L_{Aeq(15min)}$ 75dB(A) applies at all receivers.

The NMLs for 'other' sensitive receivers are from the ICNG, as reported in Section 5.2.2 of the NVMP.

In addition to the objectives identified in APPENDIX B, where construction activities are tonal or impulsive in nature and are described in the ICNG as being particularly annoying, a +5dB(A) correction must be added to the activity noise.

Any construction related activities that could exceed the NMLs shall be identified and managed in accordance with the NVMP.

4.1.2 Sleep disturbance

Consistent with EIS [2] and as described in Section 5.2 of the NVMP, the likelihood of sleep disturbance is assessed as described in the NSW Road Noise Policy (DECCW)[4]. An initial screening level of $L_{AFmax} \leq L_{A90(15min)}$ + 15 dB(A) is used. In situations where this results in an external screening level of less than 55 dB(A), a minimum screening level of 55 dB(A) is set. Note that this is equivalent to a maximum internal noise level of 45 dB(A) with windows open.

Where noise events are found to exceed the initial screening level, further analysis will be made to identify:

- the likely number of events that might occur during the night assessment period, and

- Whether events exceed an 'awakening reaction' level of 55 dB(A) L_{AFmax} (internal) that equates to NML of 65 dB(A) externally (assuming open windows).

4.1.3 Ground-borne noise

Ground-borne noise management levels for residences are nominated in the ICNG and CoA E72(f). Receivers where predicted ground-borne noise levels are above the management levels are likely to be ground-borne noise affected during the assessed works. Management actions would be implemented to reduce potential impacts. Mitigation measures must be implemented when residential receivers are ground-borne noise affected. This is typically occurs where noise sensitive receivers are located above tunnelling works or other construction activities (e.g. rock breaking).

Table B.2 in APPENDIX B sets out the ground-borne noise management levels and how they are to be applied to residential receivers. These levels are only applicable when ground-borne noise levels are higher than airborne noise levels. The residential 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. CGU JV would inform all potentially ground-borne noise affected receivers of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.

4.2 Vibration management levels

Construction vibration criteria have been determined in accordance with CoA E72 and the Roads and Maritime Construction Noise and Vibration Guideline (CNVG).

4.2.1 Disturbance to building occupants (human annoyance)

The acceptable vibration values to assess the potential for human annoyance from vibration are set out in the NSW 'Environmental Noise Management Assessing Vibration: A Technical Guideline' (Department of Environment and Conservation, 2006) [4], in accordance with CoA E72(b).

To assess the potential for vibration impact on human comfort, an initial (conservative) screening test will be done based on peak velocity units, as this metric is also used for the cosmetic damage vibration assessment. The screening test is based on the continuous vibration velocity (i.e. vibration that continues uninterrupted for a defined period). If the predicted vibration exceeds the initial screening test, the total estimated Vibration Dose Value (i.e. eVDV) will be determined based on the level and duration of the vibration event causing exceedance.

The initial screening test values and VDVs recommended in BS 6472-1992 for which various levels of adverse comment from occupants may be expected are presented in Table 4.1.

Table 4.1: Vibration management levels for disturbance to building occupants

Place and Time	Initial screening test Velocity, PEAK, mm/s (>8Hz)	*Low probability of adverse comment eVDV $m/s^{1.75}$	Adverse comment possible eVDV $m/s^{1.75}$	Adverse comment probable eVDV $m/s^{1.75}$
Critical areas (day or night)**	0.28	0.1 to 0.2	0.2 to 0.4	0.4 to 0.8
Residential buildings 16 hr day	0.56	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Residential buildings 8 hr night	0.40	0.13 to 0.26	0.2 to 0.4	0.4 to 0.8
Offices, schools, educational institutions and places of worship (day or night)	1.10	0.4 to 0.8	0.8 to 1.6	1.6 to 2.4
Workshops (day or night)	2.20	0.8 to 1.6	1.6 to 3.2	3.2 to 6.4

Notes: *These values are consistent with the acceptable vibration dose values for intermittent vibration specified in the "Assessing vibration: a technical guideline (DEC, 2016) and in the NVMP.

**Examples include hospital operating theatres and precision laboratories where sensitive operations are occurring. There may be cases where sensitive equipment or delicate tasks require more stringent criteria than the human comfort criteria specify above.

4.2.2 Structural damage to buildings

The structural damage vibration limits set out in the British Standard BS 7385-2:1993 *Evaluation and measurement for vibration in buildings. Guide to damage levels from ground-borne vibration* [6] have been applied to the Project, as per CoA E72(d). Vibration limits for structural damage to heritage structures as set out in German Standard DIN 4150-3: Structural Vibration – effects of vibration on structures, have been applied to satisfy CoA E72(e). The vibration criteria and approach for managing impacts are established in detail in Section 5.5 of the NVMP.

A conservative vibration damage screening level (peak component particle velocity) per receiver type, as outlined in the NVMP, is given below:

- Reinforced or framed structures: 25.0 mm/s;
- Unreinforced or light framed structures: 7.5 mm/s;
- Heritage structures (structurally unsound): 2.5 mm/s.

Where the predicted and/or measured vibration is greater than shown above, a more detailed analysis of the building structure, vibration source, dominant frequencies and dynamic characteristics of the structure will be completed to determine the applicable vibration limit in accordance the British Standard BS 7385-2:1993.

5 Construction noise assessment

5.1 Noise prediction methodology

Assessment of airborne noise impacts from activities associated with the construction works were determined by modelling the noise sources, receiver locations, topographical features, and possible noise mitigation measures using a Cadna-A computer noise model developed for this project. The model calculates the contribution of each noise source at identified sensitive receiver locations and allows for the prediction of the total noise from a site for the various stages of the construction works.

The noise prediction models consider:

- Location of noise sources varying from 0.5m to 2m above the ground depending on the equipment or plant in use;
- Receiver points at 1.5m above each floor level along all building facades. Predicted noise levels presented in APPENDIX D are the maximum noise levels for each building.
- Height of sources and receivers referenced to one metre digital ground contours for the site area and surrounding area;
- Sound Power Levels (L_w) of plant and equipment likely to be used during the various construction activities are included in Table C1 in APPENDIX C. Table C1 also identifies construction hours plant and equipment will be operating;
- Separation distances between sources and receivers;
- Ground factors between sources and receivers varying from 1 for absorptive surfaces (e.g. park land) to 0 for reflective surfaces (e.g. water, concrete, paving);
- Attenuation from barriers (natural and purpose built).

Key details regarding the construction work locations, the likely plant and equipment, and hours of operation were informed by CGU JV. This information is presented in APPENDIX C and formed the basis for all modelling assumptions used in this assessment. Noise levels were determined by modelling the noise sources, receiver locations, and operating activities, based on the information in APPENDIX C. Modelled activities for each worksite (C1 to C3) are summarised in Table C1. Cumulative impacts have been assessed as indicated in Table C1. Works are estimated to start in October 2021, subject to approval and conclude in April 2022.

The noise predictions in this report represent a realistic worst-case scenario when construction occurs at a works location close to residences and other sensitive receivers. At each receiver, noise levels will vary during the construction period based on:

- the position of equipment within the worksite;
- the distance to the receiver;

- the construction activities being undertaken;
- the noise levels of particular plant items and equipment.

Actual noise levels will often be less than the predicted levels presented in this report.

The key construction activities modelled and assessed, based on the information in APPENDIX C.

5.2 Predicted noise impacts

5.2.1 Airborne noise

Noise impacts during construction works have been predicted and compared to the noise management levels (NMLs). A receiver is considered to be construction noise affected when the predicted construction noise level is above the NML. Table 5-2 and Table 5-3 following present a summary of the number of residential receivers and 'other sensitive receivers (respectively) likely to be noise affected as a result of CEMP activities at each Project worksite. The tables are colour coded to indicate how much the predicted noise level is above the NML and the corresponding perceived noise impact, based on the CNVG, as noted in Table 5-1.

Table 5-1: Key to the predicted construction noise results tables

Assessment	Time of day	Key			
$L_{Aeq(15min)}$	Standard hours[1]	0-10 dB(A) over NML (light blue) Clearly audible	11-20 dB(A) over NML (mid blue) Moderately intrusive	>20 dB(A) above NML (dark blue) Highly intrusive	
	Outside standard hours	1-5 dB(A) above NML (green) Noticeable	6-15 dB(A) above NML (yellow) Clearly audible	16-25 dB(A) above NML (orange) Moderately intrusive	>25 dB(A) above NML (purple) Highly intrusive
Sleep disturbance	Night only	L_{Amax} above sleep disturbance screening criterion (yellow)		L_{Amax} above awakening level (>65 dB(A), purple)	

Notes: 1. Highly noise affected (HNA) which is greater than 75dB(A) is shown with **Bold** text and applies to residential receiver buildings only.

Table 5-2 summarises the number of construction noise affected residential receivers (i.e. receivers where predicted L_{Aeq} noise levels construction works are above the NML) and the likely perceived noise impact. Table 5-3 presents the number of construction noise affected other sensitive receivers. Detailed predicted L_{Aeq} noise levels for all receivers in each NCA are presented in Table D.1 of APPENDIX D. The predictions are representative of noise levels during the works.

Table 5-2: Number of receiver buildings over the noise management level (all NCAs) – residential receivers

Worksite	Construction activity	Assessment reference	Highly noise affected[3] L_{Aeq}	Day (standard hours) L_{Aeq}			Day (outside standard hours) L_{Aeq}				Evening L_{Aeq}				Night L_{Aeq}				Sleep disturbance L_{Amax}	
			> 75 dB(A)	1 – 10 dB(A)	11 – 20 dB(A)	> 20 dB(A)	1 – 5 dB(A)	6 – 15 dB(A)	16 – 25 dB(A)	> 25 dB(A)	1 – 5 dB(A)	6 – 15 dB(A)	16 – 25 dB(A)	> 25 dB(A)	1 – 5 dB(A)	6 – 15 dB(A)	16 – 25 dB(A)	> 25 dB(A)	Screening	Awakening
C1 Arncliffe worksite	A1 Amendments and repairs of existing structures	C1A1-T[4]	0	0	0	0	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]
	A2 Installation of hoarding	C1A2-T[4]	0	0	0	0	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]
	A3 Utility and services reestablishment	C1A3-T[4]	0	0	0	0	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]
		C1A3-H[5]	**1**	32	0	0	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]
	A4 Tunnel adit reinforcement	C1A4-T[4]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	A5 Decline and invert repair	C1A5-T[4]	0	0	0	0	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]
C2 RMS Depot	A1 Demolition of existing structures	C2A1-H[5]	**7**	209	55	2	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]
	A2Vegetation clearing	C2A2-H[5]	**3**	102	16	4	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]
	A3 Installation of noise walls and hoardings	C2A3-T[4]	0	34	7	0	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]
	A4 Site levelling, hardstand and site access	C2A4-T[4]	0	36	9	1	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]
		C2A4-H[5]	**1**	63	13	2	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]
	A5 Utility relocation and services installation (within site)	C2A5-T[4]	0	36	9	1	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]
		C2A5-H[5]	**14**	287	70	5	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]
	A6 Telegraph pole relocation on West Botany Road	C2A6-T[4]	0	5	2	1	-[5]	-[5]	-[5]	-[5]	4	5	2	1	23	8	6	1	5	1
	A7 Installation of offices, amenities, water treatment plant (WTP)	C2A7-T[4]	0	24	6	0	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]
C3 MOC 3 (M3) worksite	Demolition of existing structures	C3M3-T[4]	0	0	0	0	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]
	Utility relocation Installation of fences and crib	C3M3-H[5]	0	230	10	0	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]
	OOH relocation of temporary power supply for worksite	C3M3-T[4]	N/A	N/A	N/A	N/A	-[5]	-[5]	-[5]	-[5]	1	0	0	0	54	2	0	0	0	0
C3 Bicentennial Park (BP) North tunnel worksite	All Bicentennial Park North tunnel worksite activities	C3BP-T[4]	0	3	0	0	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]
		C3BP-H[5]	**2**	188	81	0	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]
	Pedestrian footpath works	C3PFW-T[4]	0	8	3	0	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]
	OOH utilities investigation, relocation and installation of temporary power supply for worksite	OOHC3UI-T[4]	N/A	N/A	N/A	N/A	-[5]	-[5]	-[5]	-[5]	7	4	0	0	51	10	3	0	10	0
	OOH vegetation clearing	OOHC3VC-T[4]	N/A	N/A	N/A	N/A	-[5]	-[5]	-[5]	-[5]	8	2	0	0	45	13	1	0	7	0

Note:

1. No work is proposed outside standard construction hours for this work activity.
2. Construction noise level cells are shaded based upon the predicted worst case NML exceedance of the controlling time period in accordance with the key presented in Table 5-1.
3. Highly noise affected applies, as per the CNVG.
4. Typical activities (T), which will exclude high impact sources (e.g. rock hammer, concrete/road/rail saw, petrol chainsaw, vibratory rollers).
5. High impact activities (H), which will include high impact sources (e.g. rock hammer, concrete/road/rail saw, petrol chainsaw, vibratory rollers).
6. No work is proposed during daytime outside standard hours period.

Table 5-3: Number of other sensitive receivers over the noise management levels (all NCAs)

Stage	Construction activity	Assessment reference	Commercial[1]			Childcare			Educational[2]			Recreational[1]			Places of worship			Hotel/Motel/ Hostel			Other sensitive receivers[1]		
			1 - 10 dB(A)	11 - 20 dB(A)	> 20 dB(A)	1 - 10 dB(A)	11 - 20 dB(A)	> 20 dB(A)	1 - 10 dB(A)	11 - 20 dB(A)	> 20 dB(A)	1 - 10 dB(A)	11 - 20 dB(A)	> 20 dB(A)	1 - 10 dB(A)	11 - 20 dB(A)	> 20 dB(A)	1 - 10 dB(A)	11 - 20 dB(A)	> 20 dB(A)	1 - 10 dB(A)	11 - 20 dB(A)	> 20 dB(A)
C1 Arncliffe worksite	A1 Amendments and repairs of existing structures	C1A1-T[3]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	A2 Installation of hoarding	C1A2-T[3]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	A3 Utility and services reestablishment	C1A3-T[3]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		C1A3-H[4]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	A4 Tunnel adit reinforcement	C1A4-T[3]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	A5 Decline and invert repair	C1A5-T[3]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C2 RMS Depot	A1 Demolition of existing structures	C2A1-H[4]	1	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	2	1	0
	A2 Vegetation clearing	C2A2-H[4]	2	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0
	A3 Installation of noise walls and hoardings	C2A3-T[3]	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	0
	A4 Site levelling, hardstand and site access	C2A4-T[3]	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0
		C2A4-H[4]	3	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0
	A5 Utility relocation and services installation (within site)	C2A5-T[3]	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0
		C2A5-H[4]	4	3	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	2	1
	A6 Telegraph pole relocation on West Botany Road	C2A6-T[3]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	A7 Installation of offices, amenities, water treatment plant (WTP)	C2A7-T[3]	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C3 MOC 3 (M3) worksite	Demolition of existing structures Utility relocation	C3M3-T[3]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0
	Installation of fences and crib	C3M3-H[4]	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	3	1	2
	OOH relocation of power supply for worksite	C3M3-T[3]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1[5]	2[5]	0
C3 Bicentennial Park (BP) North tunnel worksite	All Bicentennial Park North tunnel worksite activities	C3BP-T[3]	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		C3BP-H[4]	3	3	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	7	0	0
	Pedestrian footpath works	C3PFW-T[3]	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0
	OOH utilities investigation, relocation and installation of temporary power supply for worksite	OOHC3UI-T[3]	1[5]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	OOH vegetation clearing	OOHC3VC-T[3]	1[5]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Notes:
1. Commercial, industrial, recreational active and passive and other sensitive receivers have been assessed against the respective NMLs, and exceedances have been presented in the count table.
2. Some educational facilities have multiple building identified within the one facility. All buildings have been included in the counts.
3. Typical activities (T), which will exclude high impact sources (e.g. rock hammer, concrete/road/rail saw, petrol chainsaw, vibratory rollers).
4. High impact activities (H), which will include high impact sources (e.g. rock hammer, concrete/road/rail saw, petrol chainsaw, vibratory rollers).
5. Impacts only applicable where facility is in use

The results summarised in Table 5-2 and Table 5-3 show that at the C1 worksite in Arncliffe, residential receivers are unlikely to be construction noise affected during CEMP activities, with the exception of utility and services reestablishment. During high impact activities (which includes high impact sources such as rock hammer, concrete/road/rail saw, petrol chainsaw and vibratory rollers) associated with the utility and services reestablishment, one residential receiver may be highly noise affected.

At the C2 and C3 worksites, residential receivers nearest to the worksites may at times experience noise levels above 75 dB(A) during high impact activities. During typical activities (activities that exclude high impact sources) residential receivers are unlikely to be highly noise affected although residential receivers near worksites are likely to experience noise levels that are clearly audible to moderately intrusive, depending on the location of the work relative to the receiver and the specific plant in use.

Construction noise impacts for the OOHW period are presented for the tunnel adit reinforcement, the telegraph pole relocation, utilities investigation and the vegetation clearing works. Airborne noise levels for the tunnel adit reinforcement works at the C1 Arncliffe worksite are below NMLs during the OOHW period. These works are therefore considered low risk.

Higher noise impacts are likely for the OOHW telegraph pole relocation, utilities investigation and the vegetation clearing works, with potential for sleep disturbance at the nearest receivers on West Botany Road during the telegraph pole relocation works. It is anticipated that the telegraph pole relocation and the vegetation clearing works would be completed in less than 1 week, including up to 3 nights. The OOH utilities investigation, relocation and installation of temporary power supply works is anticipated to be completed in 6 nights.

Measures for managing construction noise impacts are described in Section 5.3.

5.2.2 Ground-borne noise

GBN levels were determined by modelling the noise source, tunnel adit reinforcement location and receiver locations, based on the information presented in Section 5. Predictions below are representative of a typical worst-case scenario where the drilling work is undertaken at the closest possible location to nearby receivers.

Table 5.4: Summary of the estimated number of potentially GBN affected properties during the tunnel adit reinforcement works at C1 Arncliffe worksite

Work area	Plant item	Receiver Type	GBN					
			35-40	40-45	45-50	50-55	55-60	>60
C1 Tunnel adit	Jumbo Drill	Residential	0	0	0	0	0	0

As noted in Table 5.4 above, there are no residential properties are predicted to be ground-borne noise affected during the tunnel adit reinforcement works. This work is therefore confirmed as low impact.

5.3 Noise mitigation and management

5.3.1 High noise impact activities

CEMP activities assessed in this report will be mostly completed during standard construction hours, except for OOH works to relocate three telegraph poles on West Botany Road; utilities investigation and vegetation clearing works at the C3 worksite; and tunnel adit reinforcement at the C1 Arncliffe worksite. Potential impact from high noise impact activities is unavoidable during the CEMP activities, when there is limited opportunity to install physical noise mitigation measures.

For construction activities which do not require a Road Occupancy License (ROL), respite from activities resulting in high noise impact will be provided by limiting activities as follows to CoA E65:

- Between the hours of 8:00am to 6:00pm Monday to Friday
- Between the hours of 8:00am to 1:00pm Saturday, and
- In continuous blocks not exceeding three hours each with a minimum respite from those activities or works of not less than one hour.

For the purposes of this requirement 'continuous' includes any period during which there is less than one-hour respite between ceasing and recommencing any of the work that is subject to this requirement.

For construction activities which are required to take place outside standard hours under a ROL, the mitigation measures outlined in APPENDIX C Table C2 will be applied to minimise the impact of high noise impact works.

5.3.2 Noise control and management measures

The following noise mitigation and management measures are recommended to reduce potential noise impacts, where reasonable and feasible.

Table 5.5 Site Noise Control Measures

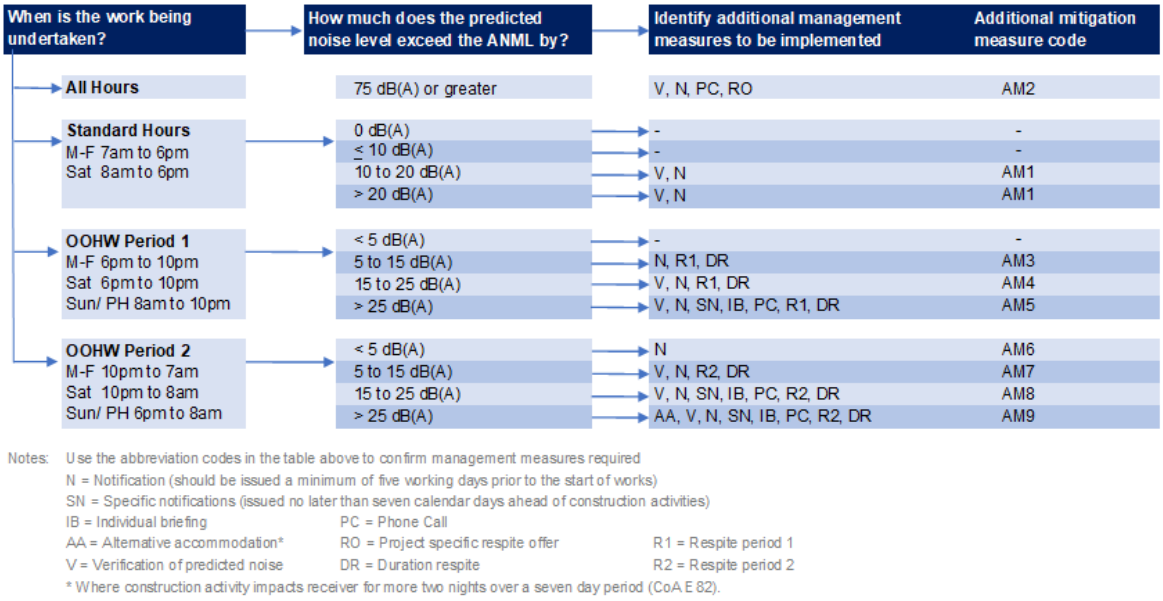
Control Type	Control Measure	Typical Use
At-Source Control Measures	Plant and equipment noise verification monitoring	Attended measurements will be undertaken for items which will be used for more than two months if noisy plant and equipment is identified during inspections and/or attended noise monitoring to confirm actual plant sound power levels are within the limits prescribed in Table C1 (APPENDIX C).

Control Type	Control Measure	Typical Use
	Noise control kits	Plant that is brought to site should meet the sound power limits identified in Table C1. Where plant exceeds limits then the plant may require installation of 'noise control kits' to comply with the noise limits set in Table C1. Such 'noise control kits' comprise: • high performance 'residential-grade' exhaust mufflers, • additional engine cowling / enclosure lined inside with sound absorbent industrial-grade foam, and • air intake and discharge silencers / louvres. • The requirement of fitting 'noise control kits' onto the identified plant, shall be confirmed during monitoring.
	Limit equipment in use	Only the equipment necessary during each stage of the work will be used.
	Timing of equipment in use	Where practicable, limit high noise activities, such as jack hammering and chain sawing, to after 8 am where residential receivers are identified as highly noise affected.
	Limit activity duration	Any equipment not in use for extended periods shall be switched off. For example, heavy vehicles should switch engines off when not in use.
	Use and siting of plant	Avoid/ limit simultaneous operation of noisy plant and equipment within discernible range of a sensitive receiver. Direct noise-emitting plant away from sensitive receivers where practicable. Locate fixed location plant items as far from sensitive receivers as practicable.
	Equipment selection	Use quieter and less noise/ vibration emitting construction methods where feasible and reasonable. Wherever practical, piling activities that affect sensitive receivers shall be undertaken using quieter alternative methods than impact or percussion piling, such as bored piles or vibrated piles.
	Respite periods	Respite periods are to be confirmed following receipt of the EPL and consultation with the surrounding sensitive receivers. In the absence of the EPL, plant and equipment generating noise levels above 75 dB(A) at the nearest residential receiver have been considered as high noise impact. Minimum distances to residential receivers have been determined for these activities to quantify where construction activity will need to adopt respite periods.
	Non-tonal reversing alarms	Alternatives reverse alarm, such as 'quackers' will be installed on all plant and equipment, where practicable.
Noise Management Measures	Site inductions & Toolbox Talks	All employees, contractors and subcontractors are to receive a Project induction. The environmental component may be covered in toolboxes and should include: • location of nearest sensitive receivers • relevant project specific and standard noise and vibration mitigation measures; • permissible hours of work; • OOHW Procedure and Form • construction employee parking areas.
	Community consultation	Consultation will be undertaken in accordance with the Communications Strategy (ref: M6S1-CGU-NWW-CYCG-MPL-000900) to inform community of construction activity, potential impacts and relevant mitigation and management measures.
	Behavioural practices	No swearing or unnecessary shouting or loud stereos/radios on site. No dropping of materials from height, throwing of metal items and slamming of doors.
	Noise monitoring	Noise monitoring is to be carried out as detailed in this report

5.3.3 Additional noise mitigation measures

In accordance with the CNVG [11], where, after application of all reasonable and feasible mitigation measures, the $L_{Aeq(15minute)}$ airborne construction noise levels are still predicted to exceed the NMLs, additional airborne noise management measures can be applied to further limit the risk of annoyance from construction noise. The steps to be carried out to determine the additional management measures to be implemented are identified in Figure 5.1.

Figure 5.1: Additional airborne noise mitigation measures



APPENDIX E presents a summary of the additional noise mitigation measures applicable for construction activities where, after application of all reasonable and feasible mitigation options, construction noise levels still above the NMLs.

Prior to the commencement of CEMP activities, receivers identified in APPENDIX E will be notified to advise that noise from the works may at times be audible. All potentially impacted receivers will be kept informed of the nature of works to be carried out, the expected noise levels and duration, as well as be given appropriate enquiries and complaints contact details (see Section 5.3.5).

5.3.4 Attended noise monitoring

Attended noise monitoring is to be undertaken to verify that noise levels resulting from construction works are in accordance with the levels predicted in this report, subject to obtaining the property owner/occupier's consent to access the property (where required). Noise monitoring will be completed in publicly accessible areas on or near the nominated receivers, typically at ground floor level. Where, following community consultation, specific sensitive receivers are identified for additional monitoring, access to the property will be sought through the Stakeholder and Community Relations team.

Table 5.6: Nominated verification monitoring locations

Worksite	NCA	Nominated receiver address
C1 Arncliffe Worksite	NCA01	26 Marsh Street, Wolli Creek 2205
C2 Rockdale Depot	NCA07	392 West Botany Street, Rockdale 2216
C2 Rockdale Depot	NCA07	396 West Botany Street, Rockdale 2216
C2 Rockdale Depot	NCA07	193 Bay Street, Rockdale 2216
C2 Rockdale Depot	NCA07	207 Bay Street, Rockdale 2216
C3 MOC3 Worksite	NCA11	79 French Street, Kogarah 2217
C3 Bicentennial Park North tunnel worksite	NCA11	75 French Street, Kogarah 2217
C3 Bicentennial Park North tunnel worksite	NCA11	79 French Street, Kogarah 2217

APPENDIX E identifies the activities where monitoring should be carried out for each NCA.

Noise monitoring should follow the procedures outlined in Appendix A of the NVMP. Note that monitoring at all properties may be undertaken from the property boundary to limit any inconvenience to property owners.

5.3.5 Complaints handling

Noise complaints received and responded to will be managed in accordance with the NVMP and Communication Strategy (M6S1-CGU-NWW-CYCG-MPL-000900).

Transport for NSW (TfNSW) operate a 24-hour construction complaints line. Enquiries/ complaints may also be received through the project email mailbox (info@M6Stage1.com.au) or through the complaints hotline (1800 789 297).

6 Construction vibration impacts

6.1 Minimum working distances for vibration intensive plant

From the plant and equipment listed in APPENDIX C, the CEMP activities with dominant vibration generating plant and equipment include:

Table 6.1: CEMP vibration intensive activities/ works

Worksite	Activity	Vibration intensive plant?
C1 Arncliffe worksite	Amendments and repairs of existing structures	Nil[1]
	Installation of hoarding	Nil
	Utility and services reestablishment	Yes
	Tunnel adit restoration	Nil[1]
	Decline and invert repair	Nil[1]
C2 Rockdale depot worksite	Demolition of existing structures	Yes
	Vegetation clearing	Nil
	Installation of noise walls and hoardings	Nil
	Site levelling, hardstand and site access	Yes
	Utility relocation and services installation (within site)	Yes
	Telegraph pole relocation on West Botany Road	Nil
	Installation of offices, amenities, water treatment plant (WTP)	Nil
C3 MOC 3 worksite	Demolition of existing structures	Yes
	Utility relocation	Yes
	Installation of fences and crib	Nil
C3 Bicentennial Park North tunnel worksite	Site levelling, hardstand and site access	Yes
	Installation of offices, amenities, water treatment plant (WTP), bentonite plant and workshops	Nil
	Utilities investigation, relocation and installation of temporary power supply for worksite	Nil
	Installation of environmental controls	Nil
	Vegetation clearing	Nil
	Installation of noise walls and hoardings	Nil

Notes: 1. The proposed vibration intensive plant is to be operated underground. As a result, it is not included in this assessment.

Potential vibration generated to receivers is dependent on separation distances, the intervening soil and rock strata, dominant frequencies of vibration, and the receiver structure. The recommended minimum working distances for vibration intensive plant in Table 6.2 and Table 6.3 are taken from a database of vibration levels measured at various sites or obtained from other sources (e.g. BS5228-2:2009). They are not specific to the Project works as final vibration levels are dependent on many factors including the actual plant used, its operation and the intervening geology between the activity and the receiver.

Site specific minimum working distances for vibration significant plant items must be measured on site where plant and equipment is likely to operate close to or within the recommended minimum working distances for cosmetic damage (Table 6.2).

Table 6.2: Minimum working distances (m) for structural damage (continuous vibration).

Plant item	Minimum working distance (m)		
	Reinforced or frame structures (Line 1)[1]	Screening criteria for non-heritage structures	Screening criteria for heritage structures
		Unreinforced or light framed structures (Line 2)[1]	Structurally unsound heritage structures[2]
Jackhammer	5[3]	5[3]	5[3]
Plate compactor	5	5	5
35T excavator with rock hammer attachment	5	10	10
Smooth drum roller (13t) – High vibration	5	5	15

Note 1: Initial screening test criteria reduced by 50% due to potential dynamic magnification in accordance with BS7385.

Note 2: In accordance with NVMP, a site inspection should determine whether a heritage structure is structurally unsound.

Note 3: Minimum working distances are in 5m increments only to account for the intrinsic uncertainty of this screening method. Jackhammers are likely to have minimum working distances smaller than 5 m.

Table 6.3: Minimum working distances (m) for human annoyance (screening limit).

Plant item	Minimum working distances, m				
	Critical areas[1,4]	Residences		Offices[3,4]	Workshops[4]
		Day[2]	Night[2]		
Jackhammer	25	15	20	10	5
Plate compactor	20	10	15	5	5
35T excavator with rock hammer attachment	40	25	30	20	15
Smooth drum roller (13t) – High vibration	105	55	75	30	15

Notes 1: Examples include hospital operating theatres and precision laboratories where sensitive operations are occurring.

2: Daytime is 7 am to 10 pm; Night-time is 10 pm to 7am.

3: Examples include offices, schools, educational institutions and place of worship.

4: Applicable when in use.

6.2 Vibration assessment

6.2.1 Structural damage

The numbers of buildings which are close to or within the minimum working distances for cosmetic damage are shown in Table 6.4. More detailed results are presented in APPENDIX G. The figures in APPENDIX G identify the minimum working distances for vibration over aerial photographs that also show the work areas and the land uses.

Table 6.4: Number of buildings within minimum working distances for cosmetic damage

Worksite	Plant item	Number of buildings[1]	
		Screening criteria for non-heritage structures	Screening criteria for heritage structures
C1 Arncliffe worksite	Jackhammer Plate compactor	0	0
	35T excavator with rock hammer attachment	0	0
	Smooth drum roller (13t) – High vibration	0	0
C2 RMS depot worksite	Jackhammer Plate compactor	5	0
	35T excavator with rock hammer attachment	5	0
	Smooth drum roller (13t) – High vibration	5	0
C3 MOC3 worksite	Jackhammer Plate compactor	2	0
	35T excavator with rock hammer attachment	2	0
	Smooth drum roller (13t) – High vibration	2	0
C3 Bicentennial Park North tunnel worksite	Jackhammer Plate compactor	0	0
	35T excavator with rock hammer attachment	0	0
	Smooth drum roller (13t) – High vibration	0	0

Note: 1. Site inspection should determine structural conditions of all potentially vibration affected buildings.

The table above shows there is negligible risk of structural damage to heritage listed structures. There are 7 non-heritage buildings located within the minimum working distances established for cosmetic damage during CEMP activities at C1, C2 and C3 work sites. These buildings/structures are identified in Table 6.7 and in APPENDIX G. Owners and occupiers of these properties will be notified prior to works that generate vibration commencing near those properties.

To minimise the risk of vibration impact on structures, condition surveys of all the vibration affected buildings/structures, identified in Table 6.7 below, will be conducted prior to be commencement of construction work that generates vibration. The building condition survey reports will be provided to Renzo Tonin where required to assist in the confirmation of appropriate vibration criteria (e.g. reinforced or unreinforced structures, structurally sound or unsound heritage buildings).

Site specific minimum working distances for vibration significant plant items will be measured on site where plant and equipment is likely to operate close to or within the recommended minimum working distances for cosmetic damage (Table 6.2).

Where plant is required to operate within site specific minimum working distances, vibration monitoring is recommended to verify that vibration levels achieve compliance with the structural damage objectives.

If the monitoring above identifies that vibration is likely to exceed the structural damage objectives, a different construction method with lower source vibration levels should be considered.

6.2.2 Human annoyance

The assessing vibration guideline [4] notes that inside dwellings, adverse comments often arise when occupants can perceive (feel) vibration, particularly when the vibration arises from a source located outside their home (or outside their control), and assume that the vibration has the potential to damage their building or contents.

However, it is noted that vibration levels required to cause minor cosmetic damage are typically 10 x higher than levels that will cause disturbance to building occupants. Many building occupants assume that building damage is occurring when they feel vibration or observe rattling of loose objects, however the level of vibration at which people perceive vibration or at which loose objects may rattle is far lower than vibration levels that can cause damage to structures.

At properties near the worksite, it is likely that the nearest receivers will be able to feel vibration levels when vibration-generating equipment is being utilised. Properties where vibration levels may be above the vibration disturbance goals in Table 6.3 and there is a probability of adverse comment are shown in Table 6.5.

The numbers of buildings where there is potential for adverse comment from or disturbance from vibration are shown in Table 6.5. It is important to note that human comfort levels are much lower than vibration levels likely to result in property damage and people therefore may be disturbed by vibration with no potential to result in property damage. More detailed results are presented in APPENDIX G.

Table 6.5: Number of buildings within minimum working distances for human annoyance

Plant items	Worksite	Critical areas[1,4]	Residences[5]		Offices [3,4]	Workshop[4]
			Day[2]	Night[2]		
Jackhammer	C1 Arncliffe worksite	0	4	-[7]	0	0
Plate compactor	C2 RMS depot worksite	0	23	-[7]	3	3
35T excavator with rock hammer attachment	C3 MOC3 worksite	0	0	-[7]	1	3
Smooth drum roller (13t) – High vibration	C3 Bicentennial Park North tunnel worksite	0	0	-[7]	2	0

Notes:
1. Examples include hospital operating theatres and precision laboratories where sensitive operations are occurring.
2. Daytime is 7 am to 10 pm; Night-time is 10 pm to 7am.
3. Examples include offices, schools, educational institutions and place of worship.
4. Applicable when in use.
5. Hotels and childcare centres are included in the residence category.
6. Most vibration intensive plant (i.e. Smooth drum roller (13T) – High vibration) has been used to estimate the maximum number of buildings within MWD for human annoyance.
7. No vibration intensive activity is proposed during night-time period.

As can be noted from the table above, there are residential properties, offices and workshops that may be exposed to vibration above the screening limit for human annoyance. These receivers are identified in APPENDIX G.

The above assessment is based on vibration-generating equipment being operating at the closest location to nearby receivers. When vibration-generating equipment operates further from the closest point, the predicted vibration levels will reduce along with the probability of adverse comment.

Attended vibration measurements are proposed to be carried out proactively and in response to vibration complaints. If measurement results indicate events above the vibration objectives for human annoyance, vibration control and management measures will be provided to reduce vibration impact (see Section 6.3.3).

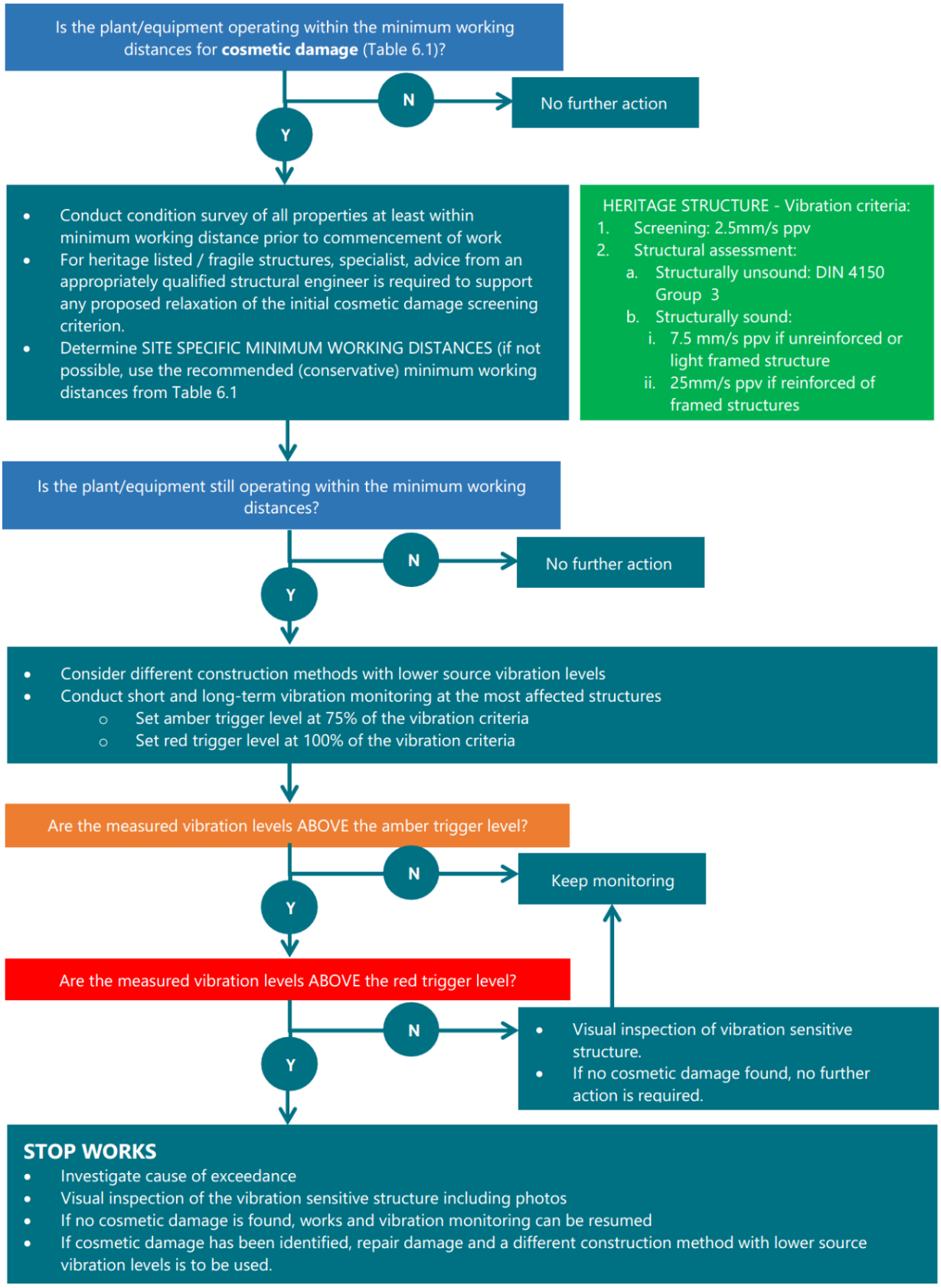
After applying all feasible and reasonable vibration mitigation measures, if vibration monitoring still identifies that measured vibration levels are above the relevant vibration criteria for human annoyance, appropriate additional mitigation measures should be considered (see Section 6.3.4).

6.3 Vibration mitigation measures

6.3.1 Management and mitigation procedure for structural damage

The procedure to manage and minimise potential structural damage impacts is presented in Figure 6.1.

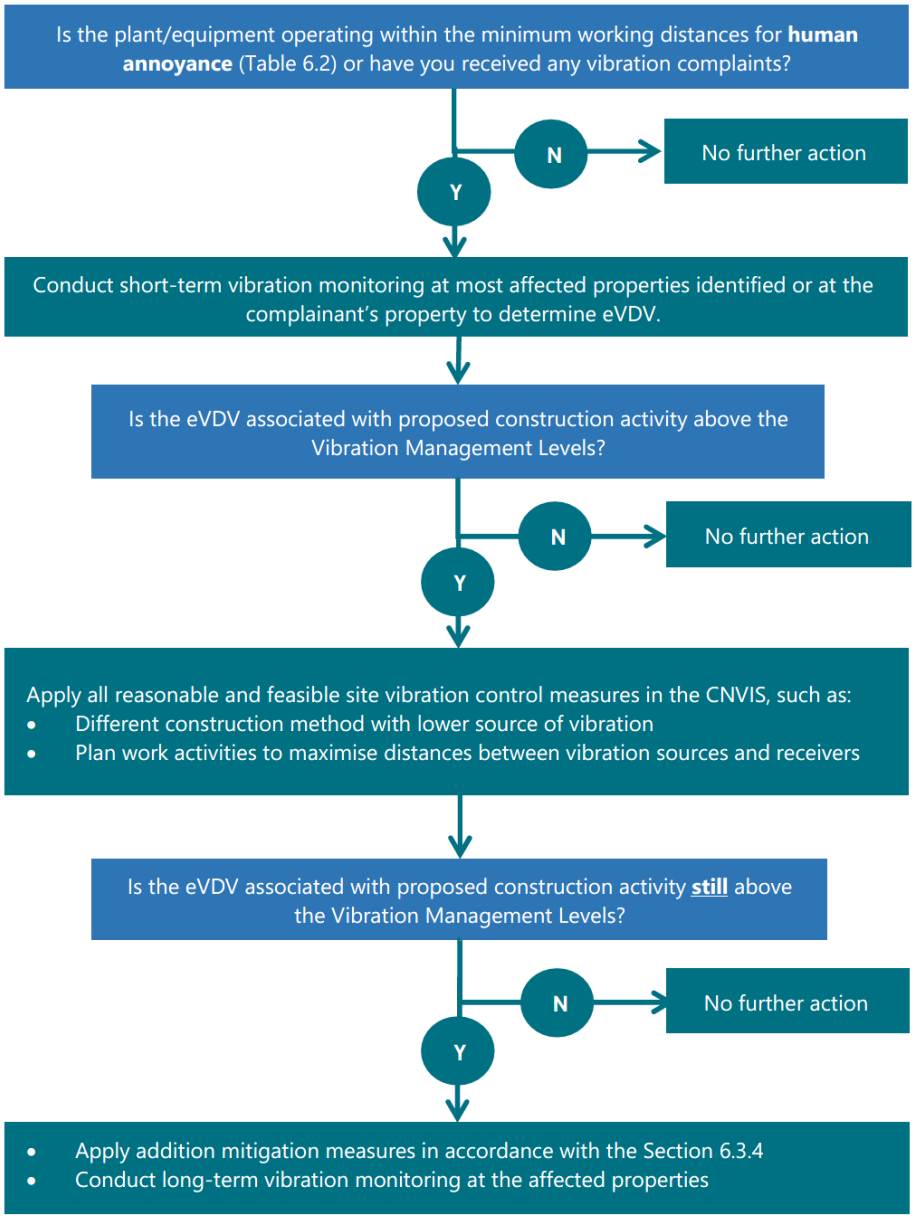
Figure 6.1: Management protocol for structural damage impact



6.3.2 Management and mitigation procedure for human annoyance

The procedure to manage and minimise potential human annoyance vibration impacts is presented in Figure 6.2.

Figure 6.2: Management protocol for human annoyance impact



6.3.3 Vibration control and management measures

The following vibration management measures are provided to minimise vibration impact from construction activities to the nearest affected receivers and to meet the relevant human comfort vibration and structural damage limits.

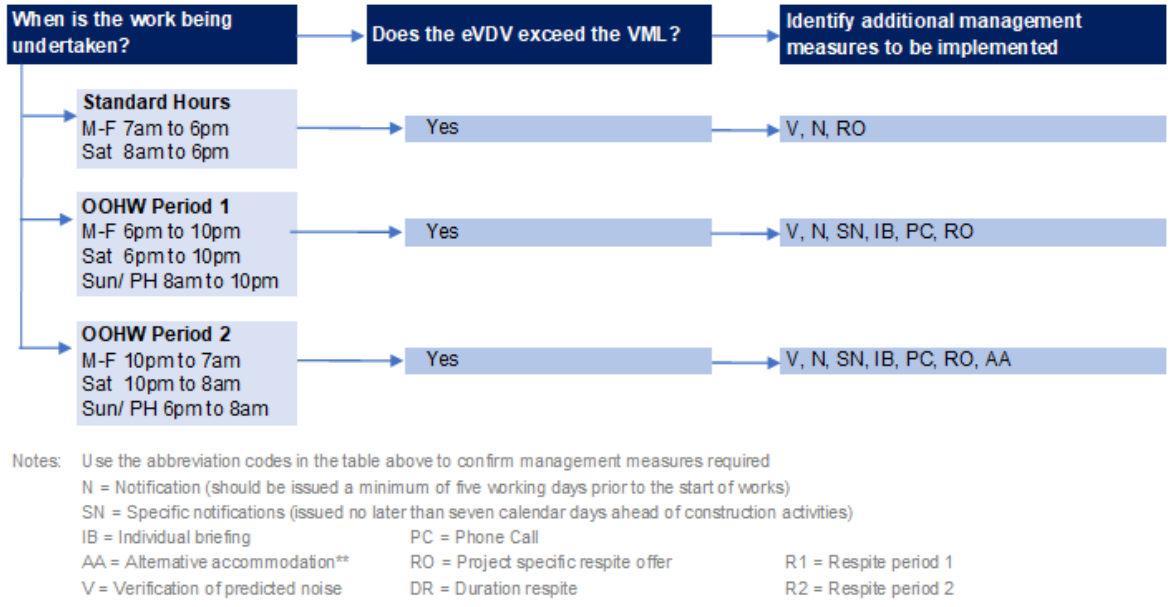
Table 6.6: Site vibration control measures

Control type	Control measure	Typical use
Construction Planning	Building condition surveys	Undertake building dilapidation surveys on all buildings located within the minimum working distances established for cosmetic damage prior to commencement of activities with the potential to cause property damage (see Section 6.1).
	Community consultation	Implement community consultation measures – inform community of construction activity & potential impacts – inform community that the level of vibration at which people perceive it, or at which loose objects may rattle, is far lower than the level at which minor cosmetic damage is expected to occur
	Equipment selection/ construction method	Use less vibration emitting construction methods where feasible & reasonable, for example vibratory rollers can, where practicable, be operated with the vibratory mode switched off to reduce vibration impact.
	Plan work activities to minimise vibration.	Plan traffic flow, parking & loading/unloading areas to maximise distances between truck routes and sensitive receivers.
Complaints Management	Construction Complaints Management System	Complaints will be managed in accordance with the Communication Strategy (M6S1-CGU-NWW-CYCG-MPL-000900) (see Section 6.3.6). Each complaint shall be investigated and where vibration levels are established as exceeding the set limits, appropriate amelioration measures shall be put in place to mitigate future occurrences. Management measures may include modification of construction methods such as using smaller equipment and establishment of minimum working distances as mentioned above.

6.3.4 Additional vibration mitigation measures

After applying all feasible and reasonable mitigation measures identified in Table 6.6, if vibration monitoring at representative locations still exceeds relevant vibration objectives for human annoyance, the appropriate additional vibration mitigations measures, based on the CNVG [11], presented in Figure 6.3, should be provided.

Figure 6.3: Additional vibration mitigation measures



6.3.5 Vibration monitoring

Attended vibration monitoring is to be undertaken to determine and verify site specific minimum working distances for cosmetic damage and human annoyance. As a minimum, it is recommended that attended monitoring is undertaken at the locations in Table 6.7 when vibration significant plant items operate close to or within the minimum working distances. Additional monitoring may also be required in response to vibration complaints.

Table 6.7: Attended vibration monitoring - nominated representative locations

Worksite	Plant item	Address	Vibration objectives			
			Reinforced or unreinforced structures	Heritage structures	Cosmetic damage	Human annoyance[1]
C1 Arncliffe worksite	Jackhammer Plate compactor 35T excavator with rock hammer attachment Smooth drum roller (13t) – High vibration	43 Innesdale Road, Wolli Creek 2205	√	-	-	√
C2 Rockdale depot worksite	Jackhammer Plate compactor 35T excavator with rock hammer attachment Smooth drum roller (13t) – High vibration	10/380 West Botany Street, Rockdale 2216	√	-	√	√
		396 West Botany Street, Rockdale 2216	√	-	√	√
		406-408 West Botany Street, Rockdale 2216	√	-	√	√
		205 Bay Street, Rockdale 2216	√	-	√	√
		211 Bay Street, Rockdale 2216 (Refer to APPENDIX G)	√	-	√	√
C3 MOC 3 worksite	Jackhammer Plate compactor 35T excavator with rock hammer attachment Smooth drum roller (13t) – High vibration	443 West Botany Street, Rockdale 2216[2] (Refer to APPENDIX G)	√	-	√	√
		443 West Botany Street, Rockdale 2216[2] (Refer to APPENDIX G)	√	-	√	√
C3 Bicentennial Park North tunnel worksite	Jackhammer Plate compactor 35T excavator with rock hammer attachment Smooth drum roller (13t) – High vibration	466 West Botany Street, Rockdale 2216	√	-	-	√

Note: 1. Monitoring is required in the event of complaint in relation to vibration

2. Two different buildings within the one property address (Refer to APPENDIX G),

6.3.6 Complaints handling

Vibration complaints received and responded to will be managed in accordance with the NVMP and Communication Strategy (M6S1-CGU-NWW-CYCG-MPL-000900).

Transport for NSW (TfNSW) operate a 24-hour construction complaints line. Enquiries/ complaints may also be received through the project email mailbox (info@M6Stage1.com.au) or through the complaints hotline (1800 789 297).

7 Conclusion

In conclusion, construction works associated with the CEMP have been described in this report to identify potential environmental risks associated with noise and vibration generated by preliminary construction works including commencement activities. Construction noise and vibration objectives have been established consistent with the Conditions of Approval for the Project and the EIS.

The number of sensitive receivers likely to be construction noise affected have been identified in Section 5.2. Detailed predicted construction noise levels at all construction noise affected receivers are provided in APPENDIX D. There will be instances of highly noise affected receivers, however, the same receiver will not be highly noise affected for the duration of the CEMP activities as equipment will shift/relocate as the works progress.

Noise mitigation and management measures, including noise monitoring requirements, have been presented in Section 5.3 to aid in providing additional noise reduction benefits where noise levels are above the NMLs.

Vibration impacts and management measures, including vibration monitoring requirements, have been presented in Section 6.3 to aid in minimising any potential vibration impacts. Figures overlaying the minimum working distances for vibration around each work area over aerial photographs, along the land uses have been presented in APPENDIX G. The figures identify properties at risk of vibration impact from CEMP activities. Mitigation and management measures are described in Section 6.3 to reduce the risk of adverse impact from vibration.

It is also important to note that a key element of the CEMP activities is to ensure all reasonable and feasible noise mitigation is installed in advance of tunnel excavation. As such while CEMP activities do result in some short-term high noise impacts, these works will result in a long-term positive noise reduction in delivering the Project.

References

[1] Roads & Maritime Services 2018 F6 Extension Stage 1 New M5 Motorway at Arncliffe to President Avenue at Kogarah Environmental Impact Statement

[2] Roads & Maritime Services 2018 F6 Extension Stage 1 New M5 Motorway at Arncliffe to President Avenue at Kogarah Environmental Impact Statement Appendix G-Noise and Vibration Technical Report

[3] Department of Environment and Climate Change 2009 NSW Interim Construction Noise Guideline (ICNG)

[4] Department of Environment, Climate Change and Water 2011 NSW Road Noise Policy (RNP)

[5] Department of Environment Conservation NSW 2006 Assessing Vibration; a technical guideline (AVTG)

[6] British Standard BS 6472-2008, Evaluation of human exposure to vibration in buildings (1-80Hz)

[7] German Standard DIN 4150-3: 1999-02, Structural vibration - Effects of vibration on structures, February 1999

[8] ASHRAE Applications Handbook (SI) 2003, Chapter 47 Sound and Vibration Control, pp47.39-47.40

[9] Australian Standard 2834-1995 Computer Accommodation, Chapter 2.9 Vibration, p16

[10] Australian Standard AS/NZS 2107:2000 *Acoustics - Recommended design sound levels and reverberation times for building interiors*

[11] Roads and Maritime Services Construction Noise and Vibration Guideline April 2016

APPENDIX A Glossary of terminology

The following is a brief description of the technical terms used to describe noise to assist in understanding the technical issues presented.

Adverse weather	Weather effects that enhance noise (that is, wind and temperature inversions) that occur at a site for a significant period of time (that is, wind occurring more than 30% of the time in any assessment period in any season and/or temperature inversions occurring more than 30% of the nights in winter).
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.
Assessment period	The period in a day over which assessments are made.
Assessment point	A point at which noise measurements are taken or estimated. A point at which noise measurements are taken or estimated.
Attenuation	The reduction in the level of sound or vibration.
AVTG	Assessing Vibration – a technical guideline (DEC 2006)
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).
CNVG	Construction Noise and Vibration Guideline (Roads and Maritime 2016)
CNVIS	Construction Noise and Vibration Impact Statement
CoA	Condition of Approval
Decibel [dB]	The units that sound is measured in. The following are examples of the decibel readings of every day sounds: 0dB The faintest sound we can hear 30dB A quiet library or in a quiet location in the country 45dB Typical office space. Ambience in the city at night 60dB CBD mall at lunch time 70dB The sound of a car passing on the street 80dB Loud music played at home 90dB The sound of a truck passing on the street 100dB The sound of a rock band 115dB Limit of sound permitted in industry 120dB Deafening
dB(A)	A-weighted decibels. The A- weighting noise filter simulates the response of the human ear at relatively low levels, where the ear is not as effective in hearing low frequency sounds as it is in hearing high frequency sounds. That is, low frequency sounds of the same dB level are not heard as loud as high frequency sounds. The sound level meter replicates the human response of the ear by using an electronic filter which is called the "A" filter. A sound level measured with this filter switched on is denoted as dB(A). Practically all noise is measured using the A filter.
dB(C)	C-weighted decibels. The C-weighting noise filter simulates the response of the human ear at relatively high levels, where the human ear is nearly equally effective at hearing from mid-low frequency (63Hz) to mid-high frequency (4kHz), but is less effective outside these frequencies.
DEC	Department of Environment and Conservation (now EPA)
DECC	Department of Environment and Climate Change (now EPA)
DECCW	Department of Environment, Climate Change and Water (now EPA)

DP&E	NSW Department of Planning and Environment
ECRTN	Environmental Criteria for Road Traffic Noise (EPA 1999)
EIS	Environmental Impacts Statement
EPA	NSW Environment Protection Authority
Feasible and reasonable	Consideration of best practice taking into account the benefit of proposed measures and their technological and associated operational application in the NSW and Australian context. Feasible relates to engineering considerations and what is practical to build. Reasonable relates to the application of judgement in arriving at a decision, taking into account mitigation benefits and cost of mitigation versus benefits provided, community views and nature and extent of potential improvements.
Frequency	Frequency is synonymous to pitch. Sounds have a pitch which is peculiar to the nature of the sound generator. For example, the sound of a tiny bell has a high pitch and the sound of a bass drum has a low pitch. Frequency or pitch can be measured on a scale in units of Hertz or Hz.
GIS	Geographic Information System
ICNG	Interim Construction Noise Guideline (DECC, 2009)
INP	NSW Industrial Noise Policy (EPA, 2000)
Impulsive noise	Having a high peak of short duration or a sequence of such peaks. A sequence of impulses in rapid succession is termed repetitive impulsive noise.
Intermittent noise	The level suddenly drops to that of the background noise several times during the period of observation. The time during which the noise remains at levels different from that of the ambient is one second or more.
L_{Max}	The maximum sound pressure level measured over a given period.
L_{Min}	The minimum sound pressure level measured over a given period.
L_1	The sound pressure level that is exceeded for 1% of the time for which the given sound is measured.
L_{10}	The sound pressure level that is exceeded for 10% of the time for which the given sound is measured.
L_{90}	The level of noise exceeded for 90% of the time. The bottom 10% of the sample is the L90 noise level expressed in units of dB(A).
L_{eq}	The "equivalent noise level" is the summation of noise events and integrated over a selected period of time.
MWD	Minimum Working Distance
NCA	Noise Catchment Areas
NML	Noise management levels
NSR	Noise Sensitive Receivers
OEH	Office of Environment and Heritage
OOHW	Out-of-Hours Works – work completed outside of standard construction hours
PPV	Peak Particle Velocity
RBL	The Rating Background Level for each period is the medium value of the ABL values for the period over all of the days measured. There is therefore an RBL value for each period (day, evening and night)
Reflection	Sound wave changed in direction of propagation due to a solid object obscuring its path.
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. SEL noise measurements are useful as they can be converted to obtain Leq sound levels over any period of time and can be used for predicting noise at various locations.
RNP	NSW Road Noise Policy (DECCW 2011)

Roads and Maritime	Roads and Maritime Services
Sound	A fluctuation of air pressure which is propagated as a wave through air.
Sound absorption	The ability of a material to absorb sound energy through its conversion into thermal energy.
Sound level meter	An instrument consisting of a microphone, amplifier and indicating device, having a declared performance and designed to measure sound pressure levels.
Sound pressure level (SPL)	The level of noise, usually expressed in decibels, as measured by a standard sound level meter with a microphone.
Sound power level (SWP)	Ten times the logarithm to the base 10 of the ratio of the sound power of the source to the reference sound power.
Standard construction hours	Hours during which construction work is permitted by the CoA.
Tonal noise	Containing a prominent frequency and characterised by a definite pitch.

APPENDIX B Sensitive receivers and noise management levels

B.1 NCAs and noise management levels

Table B1: Noise Sensitive Receivers and Construction Noise Management Levels **Site Establishment Works**

NCA	Receiver Type	Reference RBL	Existing Noise Levels, dB(A)						Residential NMLs based on ICNG (external)				Sleep Disturbance		Comments
			RBL Day	RBL Evening	RBL Night	LAeq_D	LAeq_E	LAeq_N	NMLDS	NMLDO	NMLE	NMLN	Screening	Awakening	
NCA01	Predominantly Residential	NL01	55	55	45	61	62	59	65	60	60	50	60	65	
NCA02	Predominantly Residential	NL02	49	48	42	54	55	50	59	54	53	47	57	65	
NCA03	Predominantly Residential	NL03	47	47	39	55	54	50	57	52	52	44	54	65	
NCA04	Predominantly Residential, some commercial	NL04	38	37	31	49	47	44	48	43	42	36	46	65	
NCA05	Predominantly Residential, some educational	NL05	39	39	34	56	49	45	49	44	44	39	49	65	
NCA06	Predominantly Residential, mixed use and some commercial	NL06	41	41	33	56	55	53	51	46	46	38	48	65	
NCA07	Predominantly Residential, some commercial	NL06	41	41	33	56	55	53	51	46	46	38	48	65	
NCA08	Predominantly Residential	NL07	39	39	36	53	51	46	49	44	44	41	51	65	
NCA09	Predominantly Residential, some educational	NL09	38	38	32	52	51	47	48	43	43	37	47	65	
NCA10	Predominantly commercial and industrial	NL08	53	47	38	64	62	60	63	58	52	43	53	65	
NCA11	Predominantly Residential	NL08	53	47	38	64	62	60	63	58	52	43	53	65	
NCA12	Predominantly Residential, mixed use and some commercial	NL15	66	66	56	72	70	68	76	71	71	61	71	-	
NCA13	Hospital precinct with mixed use, commercial and some residential	NL15	66	66	56	72	70	68	76	71	71	61	71	-	
NCA14	Predominantly Residential	NL10	52	52	38	65	65	63	62	57	57	43	53	65	
NCA14A	Educational	NL15	66	66	56	72	70	68	76	71	71	61	71	-	
NCA15	Predominantly Residential	NL16	42	40	32	58	53	44	52	47	45	37	47	65	
NCA16	Predominantly Residential	NL14	57	50	37	71	66	65	67	62	55	42	52	65	
NCA17	Predominantly Residential	NL16	42	40	32	58	53	44	52	47	45	37	47	65	
Other sensitive receivers															
Studio building (music recording studio)									45	45	45	45			Source: AS2107 ‘maximum’, assuming a conservative façade loss of 20 dB(A)
Studio building (film or television studio)									50	50	50	50			Source: AS2107 ‘maximum’, assuming a conservative façade loss of 20 dB(A)
Cinema space, theatre, auditorium									55	55	55	55			Source: AS2107 ‘maximum’, assuming a conservative façade loss of 20 dB(A)
Hotel (Sleeping areas: Hotels near major roads)									60	60	60	60			Source: AS2107 ‘maximum’, assuming a conservative façade loss of 20 dB(A)
Classrooms at schools and other educational institutions									55	55	55	55			Source: ICNG, assuming a conservative façade loss of 10 dB(A)
Chilcare centre (internal play and sleeping areas)									50	50	50	50			Source: AAAC - guideline for Child Care Centre Acoustic Assessment, assuming a conservative façade loss of 10 dB(A)
Hospital wards and operating theatres									65	65	65	65			Source: ICNG, assuming a conservative façade loss of 20 dB(A)
Places of worship									55	55	55	55			Source: ICNG, assuming a conservative façade loss of 10 dB(A)
Library (reading areas)									65	65	65	65			Source: AS2107 ‘maximum’, assuming a conservative façade loss of 20 dB(A)
Hotel (bars and lounges)									70	70	70	70			Source: AS2107 ‘maximum’, assuming a conservative façade loss of 20 dB(A)
Community centres – Municipal Buildings									60	60	60	60			Source: AS2107 ‘maximum’, assuming a conservative façade loss of 10 dB(A)
Restaurant, bar (Bars and lounges/ Restaurant)									70	70	70	70			Source: AS2107 ‘maximum’, assuming a conservative façade loss of 20 dB(A)
Café/ Restaurant/ Bar (outdoors)									60	60	60	60			Source: AS2107 ‘maximum1’
Passive recreation areas (e.g. area used for reading, meditation)									60	60	60	60			Source: ICNG
Active recreation areas (e.g. sports fields)									65	65	65	65			Source: ICNG
Commercial premises (including offices and retail outlets)									70	70	70	70			Source: ICNG
Industrial premises									75	75	75	75			Source: ICNG

Notes: 1 - Levels are estimated assuming an open windows (i.e. 10dBA façade losss)
D(S): standard construction hours from 7 am to 6 pm Monday to Friday and from 8 am to 6 pm Saturday
D(O): out-of-hours day period from 8 am to 6 pm Sunday and Public holidays - OOHW P1
E: evening period from 6 pm to 10 pm Monday to Sunday - OOHW P1
N: night-time period from 10 pm to 7 am Monday to Friday, from 10 pm am to 8 am Saturday, Sunday and Public holidays - OOHW P2

Table B2: Noise Sensitive Receivers and Construction Noise Management Levels (groundborne noise) **Site Establishment Works**

NCA	Receiver Type	Groundborne NMLs based on ICNG (internal)				Comments
		NMLDS	NMLDO	NMLE	NMLN	
Residential receivers						
All	All residential receivers	Human comfort vibration		40	35	Source: ICNG
Other sensitive receivers						
Studio building (music recording studio)		25	25	25	25	Source: AS2107 'maximum'
Studio building (film or television studio)		30	30	30	30	Source: AS2107 'maximum
Cinema space, theatre, auditorium		35	35	35	35	Source: AS2107 'maximum'
Hotel (Sleeping areas: Hotels near major roads)		40	40	40	40	Source: AS2107 'maximum
Classrooms at schools and other educational institutions		45	45	45	45	Source: ICNG
Childcare centre (indoor sleeping areas)		45	45	45	45	Source: AS2107 'maximum
Childcare centre (play areas)		65	65			Source: AS2107 'maximum
Hospital wards and operating theatres		45	45	45	45	Source: ICNG
Places of worship		45	45	45	45	Source: ICNG
Library (reading areas)		45	45	45	45	Source: AS2107 'maximum
Hotel (bars and lounges)		50	50	50	50	Source: AS2107 'maximum
Restaurant, bar (Bars and lounges/ Restaurant)		50	50	50	50	Source: AS2107 'maximum
Commercial premises (including offices and retail outlets)		60	60	60	60	Source: ICNG, assuming a conservative façade loss of 10 dB(A)
Industrial premises		65	65	65	65	Source: ICNG, assuming a conservative façade loss of 10 dB(A)

Notes: D(S): standard construction hours from 7 am to 6 pm Monday to Friday and from 8 am to 6 pm Saturday
D(O): out-of-hours day period from 8 am to 6 pm Sunday and Public holidays - OOHW P1
E: evening period from 6 pm to 10 pm Monday to Sunday - OOHW P1
NS: night shoulder period from 10 pm to 12 am Monday to Sunday - OOHW P1

B.2 Land use map and work areas

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Plot Date: 23/07/21 - 16:10 Layout: WCX M6
GIS File: R:\AssocSydProjects\TK701-TK750\TK703 TG F6 (M6) Extension Stg 1 D&C\5 Calcs\01 GIS\TK703 RZ (r0).qgz

LEGEND

- Residential
- Mixed use
- Commercial
- Industrial
- Hotel/Motel/Hostel
- Medical facility
- Place of Worship
- Community centre
- Recording studio
- Library
- Flight simulator
- Childcare
- Educational
- Theatre/Auditorium
- Cinema
- Laboratory
- Recreational - Passive
- Recreational - Active
- Other
- Heritage
- NCA
- Work Area
- Tunnel adit underground works

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REV	BY	DATE	DESCRIPTION	APPROVER
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A3 Original

Co-ordinate System: MGA Zone 56

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1:2500

FULL SIZE A3

NOTE: Do not scale from this drawing.

CLIENT

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M6 MOTORWAY STAGE 1

SITE ESTABLISHMENT

Land Use, NCAs
Work area: C1 Arncliffe Worksite

Land-Use file revision_date: r14_22/07/21
Plot Date: 23/07/21 - 15:51 Layout: WCX M6
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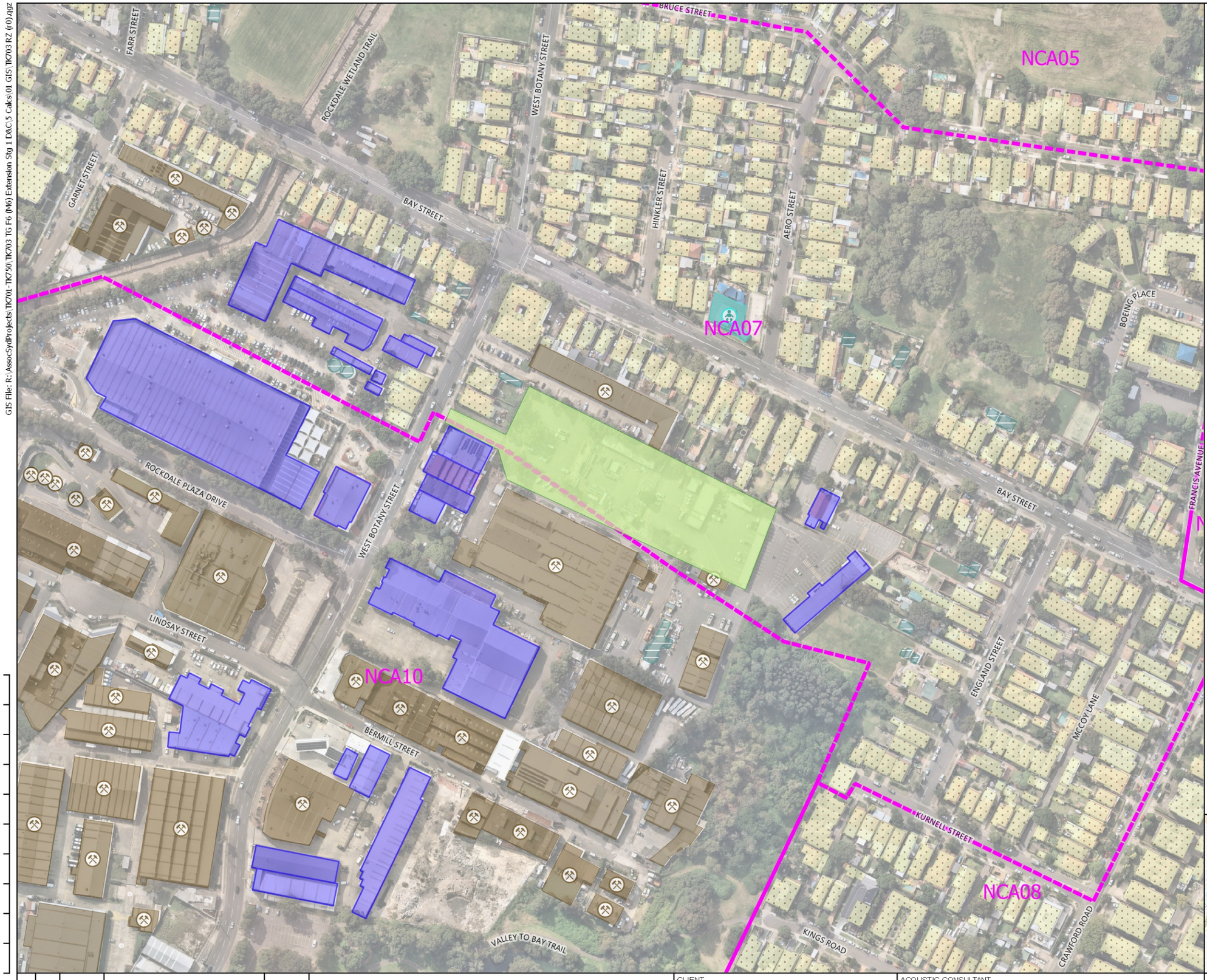
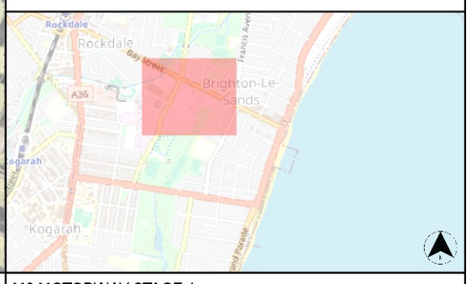


LEGEND

- Residential
- Mixed use
- Commercial
- Industrial
- Hotel/Motel/Hostel
- Medical facility
- Place of Worship
- Community centre
- Recording studio
- Library
- Flight simulator
- Childcare
- Educational
- Theatre/Auditorium
- Cinema
- Laboratory
- Recreational - Passive
- Recreational - Active
- Other
- Heritage
- NCA
- Work Area



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A3 Original

Co-ordinate System: MGA Zone 56

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1:2500

FULL SIZE A3

NOTE: Do not scale from this drawing.

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M6 MOTORWAY STAGE 1

SITE ESTABLISHMENT

Land Use, NCAs
Work area: C2 Rockdale Depot Worksite

Land-Use file revision_date: r14_22/07/21
Plot Date: 23/07/21 - 15:52 Layout: WCX M6
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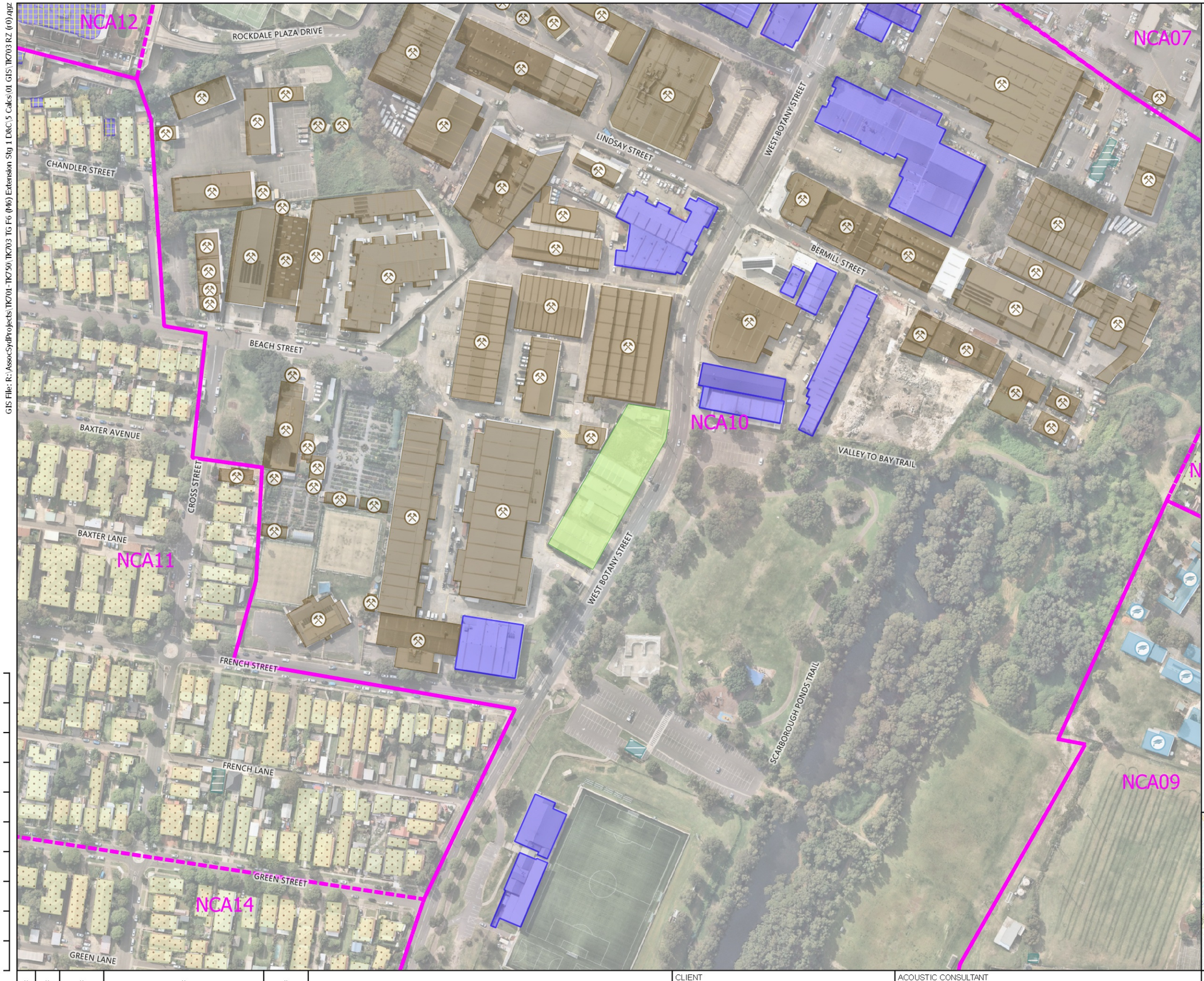
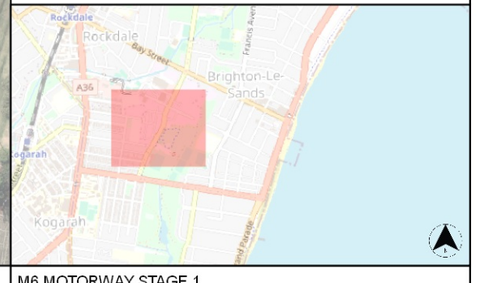


LEGEND

- Residential
- Mixed use
- Commercial
- Industrial
- Hotel/Motel/Hostel
- Medical facility
- Place of Worship
- Community centre
- Recording studio
- Library
- Flight simulator
- Childcare
- Educational
- Theatre/Auditorium
- Cinema
- Laboratory
- Recreational - Passive
- Recreational - Active
- Other
- Heritage
- NCA
- Work Area



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A3 Original | Co-ordinate System: MGA Zone 56 | FULL SIZE A3 | NOTE: Do not scale from this drawing.

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M6 MOTORWAY STAGE 1

SITE ESTABLISHMENT

Land Use, NCAs
Work area: C3 MOC3 Worksite

Land-Use file revision_date: r14_22/07/21

Plot Date: 23/07/21 - 15:52 Layout: WCX M6

GIS File: R:\Assoc\Sydprojects\TK701-TK750\TK703 TG F6 (M6) Extension Stg 1 D&C\5 Calcs\01 GIS\TK703 RZ (r0).qgz

LEGEND

- Residential
- Mixed use
- Commercial
- Industrial
- Hotel/Motel/Hostel
- Medical facility
- Place of Worship
- Community centre
- Recording studio
- Library
- Flight simulator
- Childcare
- Educational
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- Cinema
- Laboratory
- Recreational - Passive
- Recreational - Active
- Other
- Heritage
- NCA
- Work Area

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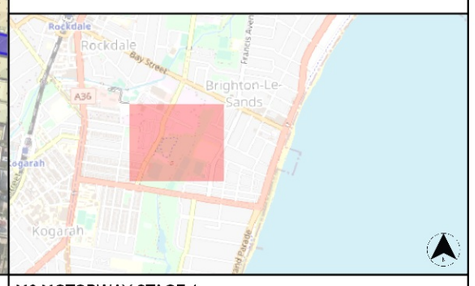

REV	BY	DATE	DESCRIPTION	APPROVER
r0	MS	23/07/21	Prepare figures	RZ

A3 Original

Co-ordinate System: MGA Zone 56

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1:2500

FULL SIZE A3

NOTE: Do not scale from this drawing.

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M6 MOTORWAY STAGE 1

SITE ESTABLISHMENT

Land Use, NCAs

Work area: C3 Bicentennial Park North Tunnel Worksite

APPENDIX C Construction timetable/ activities/ management

C.1 Construction timetable/activities/equipment

Table C1: Construction timetable/ activities/ equipment **Site Establishment Works**

Activity/ Work Area	Aspect	Scenario ID	Plant/ Equipment (as provided by client)	Day	Evening	Night	Timing of Activity (approximate)			Sound Power Level (Lw re: 1pW) in Noise Model, dB(A)			High noise plant	Vibration intensive plant	Notes
				7am - 6pm	6pm - 10pm	10pm - 7am	Start Date	End Date	Duration	L_{Aeq}	Penalty	L_{Amax}			
C1 - Arncliffe															
Ammendments and repairs of existing structures	Facility occupation and ammendments Workshop upgrade and operations Ammendments and RH assembly WTP Acoustic Shed Ventilation fans	C1A1-T	Franna Crane	1	-	-	28/10/2021	22/01/2022	12	98	-	102	-	-	
			EWP	2	-	-	28/10/2021	22/01/2022	12	95	-	98	-	-	
			Concrete Truck	2 per hour	-	-	28/10/2021	22/01/2022	12	108	-	111	-	-	
			Hand Tools	2	-	-	28/10/2021	22/01/2022	12	108	-	118	-	-	
			Power Saw	2	-	-	28/10/2021	22/01/2022	12	108	-	118	-	-	
			Grinders	1	-	-	28/10/2021	22/01/2022	12	108	-	118	-	-	
			Compressor	2	-	-	28/10/2021	22/01/2022	12	102	-	103	-	-	
			Generators	1	-	-	28/10/2021	22/01/2022	12	94	-	95	-	-	
			Water Cart	1	-	-	28/10/2021	22/01/2022	12	107	-	111	-	-	
			Power hand tools	4	-	-	28/10/2021	22/01/2022	12	108	-	118	-	-	
			20-25T excavator with hydraulic hammer	1	-	-	28/10/2021	22/01/2022	12	118	5	126	HN	X	at the bottom of the shaft within the acoustic shed
Installation of hoarding	From shed to Marsh Street	C1A2-T	Excavator with auger	1	-	-	28/10/2021	23/11/2021	4	102	-	106	-	-	
			Hand Tools	1	-	-	28/10/2021	23/11/2021	4	108	-	118	-	-	
			Generators	1	-	-	28/10/2021	23/11/2021	4	94	-	95	-	-	
			Vacuum Truck	2	-	-	28/10/2021	23/11/2021	4	107	-	111	-	-	
			Excavator (<14 tonne)	1	-	-	28/10/2021	23/11/2021	4	103	-	108	-	-	
			Flatbed Truck	2	-	-	28/10/2021	23/11/2021	4	106	-	111	-	-	
			Franna Crane	1	-	-	28/10/2021	23/11/2021	4	98	-	102	-	-	
			EWP	1	-	-	28/10/2021	23/11/2021	4	95	-	98	-	-	
Utility and services reestablishment		C1A3-T, C1A3-H	Jackhammer	1	-	-	28/10/2021	25/01/2022	13	111	5	121	HN	X	Adjacent to WTP/shaft shed over to the workshop area. Potentially minor jackhammering of existing walkways if new site shed required.
			Road Saw	2	-	-	28/10/2021	25/01/2022	13	121	5	129	HN	-	
			Vacuum Truck	1	-	-	28/10/2021	25/01/2022	13	107	-	111	-	-	
			Power hand tools	3	-	-	28/10/2021	25/01/2022	13	108	-	118	-	-	
			Generators	1	-	-	28/10/2021	25/01/2022	13	94	-	95	-	-	
			Excavator with bucket	1	-	-	28/10/2021	25/01/2022	13	101	-	114	-	-	
			Vibratory Roller (7T Smooth Drum)	2	-	-	28/10/2021	25/01/2022	13	112	5	120	HN	X	
			Plate Compactors	1	-	-	28/10/2021	25/01/2022	13	108	-	110	-	X	
			Water Cart	1	-	-	28/10/2021	25/01/2022	13	107	-	111	-	-	
Tunnel adit reinforcement	Rockbolting and shorcreting	C1A4-T	Drilling Jumbo	1	1	1	28/10/2021	25/01/2022	13	115	-	120	-	X	Underground
			Shotcrete rig (Potenza)	2	2	2	28/10/2021	25/01/2022	13	104	-	107	-	-	Underground
			Concrete pump	2	2	2	28/10/2021	25/01/2022	13	103	-	107	-	-	Underground
			Concrete agitator	8 p.h.	2 p.h.	-	28/10/2021	25/01/2022	13	108	-	111	-	-	Delivering to Temporary Shaft acoustic shed and to the decline
Decline and invert repair		C1A5-T	20-25T excavator with hydraulic hammer	2	-	-	28/10/2021	25/01/2022	13	118	5	126	HN	X	Underground
			Excavator with pulveriser	2	-	-	28/10/2021	25/01/2022	13	104	-	108	-	-	Underground
			Jackhammer	1	-	-	28/10/2021	25/01/2022	13	111	5	121	HN	X	Underground
			Demo Saw	1	-	-	28/10/2021	25/01/2022	13	121	5	129	HN	-	Underground
			Excavator with bucket	1	-	-	28/10/2021	25/01/2022	13	101	-	114	-	-	Underground
			Moxie	8 p.h.	-	-	28/10/2021	25/01/2022	13	109	-	119	-	-	To spoil shed
			Concrete pump	2	-	-	28/10/2021	25/01/2022	13	103	-	107	-	-	
			Concrete pump	2	2	2	28/10/2021	25/01/2022	13	103	-	107	-	-	Underground
			Concrete agitator	8 p.h.	2 p.h.	-	28/10/2021	25/01/2022	13	108	-	111	-	-	

Table C1: Construction timetable/ activities/ equipment **Site Establishment Works**

Activity/ Work Area	Aspect	Scenario ID	Plant/ Equipment (as provided by client)	Day	Evening	Night	Timing of Activity (approximate)			Sound Power Level (Lw re: 1pW) in Noise Model, dB(A)			High noise plant	Vibration intensive plant	Notes
				7am - 6pm	6pm - 10pm	10pm - 7am	Start Date	End Date	Duration	L_{Aeq}	Penalty	L_{Amax}			
C2 - Rockdale depot															
Demolition of existing structures	• Removal of hazardous materials • Internal strip out • Structure disassembly and demolition	C2A1-H	10T excavator with hydraulic hammer	1	-	-	28/10/2021	30/11/2021	5	118	5	123	HN	X	See site layout
			Excavator with pulveriser	1	-	-	28/10/2021	30/11/2021	5	104	-	108	-	-	
			Jackhammer	1	-	-	28/10/2021	30/11/2021	5	111	5	121	HN	X	
			Demo Saw	1	-	-	28/10/2021	30/11/2021	5	121	5	129	HN	-	
			Excavator with shears	1	-	-	28/10/2021	30/11/2021	5	104	-	108	-	-	
			EWP	1	-	-	28/10/2021	30/11/2021	5	95	-	98	-	-	
			Bogie Truck	1 ph	-	-	28/10/2021	30/11/2021	5	106	-	111	-	-	
			Power hand Tools	2	-	-	28/10/2021	30/11/2021	5	108	-	118	-	-	
			Grinders	1	-	-	28/10/2021	30/11/2021	5	108	-	118	-	-	
			Compressor	1	-	-	28/10/2021	30/11/2021	5	102	-	103	-	-	
			Generators	1	-	-	28/10/2021	30/11/2021	5	94	-	95	-	-	
			Water Cart	1	-	-	28/10/2021	30/11/2021	5	107	-	111	-	-	
Vegetation Clearing		C2A2-H	EWP	1	-	-	28/10/2021	30/11/2021	5	95	-	98	-	-	
			Mulcher/Chipper	1	-	-	28/10/2021	30/11/2021	5	120	5	124	HN	-	
			Stump grinder	1	-	-	28/10/2021	30/11/2021	5	120	5	124	HN	-	
			Excavator 25T with bucket	1	-	-	28/10/2021	30/11/2021	5	103	-	108	-	-	
			Chainsaw (Petrol)	4	-	-	28/10/2021	30/11/2021	5	116	5	120	HN	-	
			Light vehicles / traffic control utes	1	-	-	28/10/2021	30/11/2021	5	89	-	100	-	-	
			Tipper truck	1	-	-	28/10/2021	30/11/2021	5	103	-	111	-	-	
Installation of noise walls and hoardings		C2A3-T	Excavator with auger	1	-	-	28/10/2021	11/02/2022	15	102	-	106	-	-	Assumed excavator augers for hoarding posts and gate posts
			Hand Tools	1	-	-	28/10/2021	11/02/2022	15	108	-	118	-	-	
			Generators	1	-	-	28/10/2021	11/02/2022	15	94	-	95	-	-	
			Vacuum Truck	2	-	-	28/10/2021	11/02/2022	15	107	-	111	-	-	
			Excavator (<14 tonne)	1	-	-	28/10/2021	11/02/2022	15	103	-	108	-	-	
			Flatbed Truck	2	-	-	28/10/2021	11/02/2022	15	106	-	111	-	-	
			Franna Crane	1	-	-	28/10/2021	11/02/2022	15	98	-	102	-	-	
			EWP	1	-	-	28/10/2021	11/02/2022	15	95	-	98	-	-	
Site levelling, hardstand and site access	• Site levelling, grading and compaction • Temporary stockpiling of materials for site levelling • Formalisation of access and egress points • Sealing of hard stand areas • Internal haul roads installed • Implementing hardstand for car parking • Building of piling pad	C2A4-T, C2A4-H	Excavator with bucket	1	-	-	19/11/2021	8/01/2022	7	101	-	114	-	-	
			Skid Steer	1	-	-	19/11/2021	8/01/2022	7	109	-	113	-	-	
			Vibratory Roller (20T Padfoot)	1	-	-	19/11/2021	8/01/2022	7	108	5	113	HN	X	
			Truck and Dogs	5 p.h.	-	-	19/11/2021	8/01/2022	7	106	-	111	-	-	Delivery of material for pads will be max. 10 trucks per day, at peak 5 per hour (just to account for trucks arriving at similar time).
			Power Tools	3	-	-	19/11/2021	8/01/2022	7	108	-	118	-	-	
			Generators	1	-	-	19/11/2021	8/01/2022	7	94	-	95	-	-	
			Concrete agitator	2 p.h.	-	-	19/11/2021	8/01/2022	7	108	-	111	-	-	
			Concrete pump	1	-	-	19/11/2021	8/01/2022	7	103	-	107	-	-	
			Plate Compactors	2	-	-	19/11/2021	8/01/2022	7	108	-	110	-	X	
			Bored piling rig	1	-	-	19/11/2021	8/01/2022	7	102	-	106	-	-	Might be needed for grout of benonite plant.
			Water cart/ Street Sweeper	1	-	-	19/11/2021	8/01/2022	7	107	-	111	-	-	
Utility relocation and services installation (within site)		C2A5-T, C2A5-H	Jackhammer	1	-	-	28/10/2021	8/01/2022	10	111	5	121	HN	X	
			Road Saw	2	-	-	28/10/2021	8/01/2022	10	121	5	129	HN	-	
			Vacuum Truck	1	-	-	28/10/2021	8/01/2022	10	107	-	111	-	-	
			Power hand tools	3	-	-	28/10/2021	8/01/2022	10	108	-	118	-	-	
			Generators	1	-	-	28/10/2021	8/01/2022	10	94	-	95	-	-	
			Excavator with bucket	1	-	-	28/10/2021	8/01/2022	10	101	-	114	-	-	
			Plate Compactors	1	-	-	28/10/2021	8/01/2022	10	108	-	110	-	X	
			Water Cart	1	-	-	28/10/2021	8/01/2022	10	107	-	111	-	-	
Telegraph pole relocation on West Borany Road		C2A6-T	Powerpole crane truck	1	1	1	28/10/2021	10/03/2022	19	95	-	98	-	-	Potential that works must be undertaken on nightshift Activity duration likely no more than 3 shifts
			EWP	1	1	1	28/10/2021	10/03/2022	19	95	-	98	-	-	
			Excavator with bucket	1	1	1	28/10/2021	10/03/2022	19	101	-	114	-	-	
			Hand tools	1	1	1	28/10/2021	10/03/2022	19	108	-	118	-	-	
Installation of offices, amenities, WTP		C2A7-T	Franna Crane	1	-	-	28/10/2021	11/02/2022	15	98	-	102	-	-	
			EWP	2	-	-	28/10/2021	11/02/2022	15	95	-	98	-	-	
			Hand Tools	2	-	-	28/10/2021	11/02/2022	15	108	-	118	-	-	
			Grinders	2	-	-	28/10/2021	11/02/2022	15	108	-	118	-	-	
			Generators	1	-	-	28/10/2021	11/02/2022	15	94	-	95	-	-	
			Flatbed Truck	1 p.h.	-	-	28/10/2021	11/02/2022	15	106	-	111	-	-	
			Mobile Crane	1	-	-	28/10/2021	11/02/2022	15	104	-	108	-	-	

Table C1: Construction timetable/ activities/ equipment **Site Establishment Works**

Activity/ Work Area	Aspect	Scenario ID	Plant/ Equipment (as provided by client)	Day	Evening	Night	Timing of Activity (approximate)			Sound Power Level (Lw re: 1pW) in Noise Model, dB(A)			High noise plant	Vibration intensive plant	Notes
				7am - 6pm	6pm - 10pm	10pm - 7am	Start Date	End Date	Duration	L_{Aeq}	Penalty	L_{Amax}			
C3 - MOC 3															
Demolition of existing structures	• Removal of hazardous materials • Internal strip out • Structure disassembly and demolition • ABC and or tigertail services on W Botany • Install class B hoarding for demo of front face of brick buildings	C3M3-T, C3M3-H	20T excavator with hydraulic hammer	2	-	-	28/10/2021	11/02/2022	15	118	5	126	HN	X	Note, demo & utilities work unlikely to be continuous through entire activity duration
			Excavator with pulveriser	2	-	-	28/10/2021	11/02/2022	15	104	-	108	-	-	
			Demo Saw	1	-	-	28/10/2021	11/02/2022	15	121	5	129	HN	-	
			Excavator with shears	2	-	-	28/10/2021	11/02/2022	15	104	-	108	-	-	
			EWP	1	-	-	28/10/2021	11/02/2022	15	95	-	98	-	-	
			Bogie Truck	2 p.h.	-	-	28/10/2021	11/02/2022	15	106	-	111	-	-	
			Flatbed Truck	1 p.h.	-	-	28/10/2021	11/02/2022	15	106	-	111	-	-	
			Power hand Tools	2	-	-	28/10/2021	11/02/2022	15	108	-	118	-	-	
			Grinders	1	-	-	28/10/2021	11/02/2022	15	108	-	118	-	-	
			Generators	1	-	-	28/10/2021	11/02/2022	15	94	-	95	-	-	
			Water Cart	1	-	-	28/10/2021	11/02/2022	15	107	-	111	-	-	
			Light vehicles / traffic control utes	1	-	-	28/10/2021	11/02/2022	15	89	-	100	-	-	
			Scaffolding/Class B Hoarding	1	-	-	28/10/2021	11/02/2022	15	-	-	-	-	-	
Utility relocation	Disconnect utilities to buildings Relocate sewer and overhead powerlines adjacent to W Botany St	C3M3-T, C3M3-H	Jackhammer	1	-	-	28/10/2021	11/02/2022	15	111	5	121	HN	X	
			Road Saw	1	-	-	28/10/2021	11/02/2022	15	121	5	129	HN	-	
			Vacuum Truck	1	-	-	28/10/2021	11/02/2022	15	107	-	111	-	-	
			Power hand tools	1	-	-	28/10/2021	11/02/2022	15	108	-	118	-	-	
			Generators	1	-	-	28/10/2021	11/02/2022	15	94	-	95	-	-	
			Vibratory Roller (7T Smooth Drum)	1	-	-	28/10/2021	11/02/2022	15	112	5	120	HN	X	
			Plate Compactors	1	-	-	28/10/2021	11/02/2022	15	108	-	110	-	X	
			Excavator with bucket	1	1	1	28/10/2021	11/02/2022	15	101	-	114	-	-	Powerline relocation may need to occur during evening/night period where ROL is required.
			Powerpole crane truck	1	1	1	28/10/2021	11/02/2022	15	95	-	98	-	-	
			EWP	1	1	1	28/10/2021	11/02/2022	15	95	-	98	-	-	Potential property disconnections from insulated bucket truck at night with lane closure
			Hand tools	1	1	1	28/10/2021	11/02/2022	15	108	-	118	-	-	
			Bogie Truck	1 p.h.	-	-	28/10/2021	11/02/2022	15	106	-	111	-	-	
			Light vehicles / traffic control utes	1	-	-	28/10/2021	11/02/2022	15	89	-	100	-	-	
Installation of fences and crib	Security ATF fencing or similar intially. Hoarding/fencing following behind demo works	C3M3-T, C3M3-H	Franna Crane	1	-	-	28/10/2021	11/02/2022	15	98	-	102	-	-	
			EWP	1	-	-	28/10/2021	11/02/2022	15	95	-	98	-	-	
			Concrete Truck	1	-	-	28/10/2021	11/02/2022	15	108	-	111	-	-	
			Hand Tools	2	-	-	28/10/2021	11/02/2022	15	108	-	118	-	-	
			Power Saw	1	-	-	28/10/2021	11/02/2022	15	108	-	118	-	-	
			Grinders	1	-	-	28/10/2021	11/02/2022	15	108	-	118	-	-	
			Generators	1	-	-	28/10/2021	11/02/2022	15	94	-	95	-	-	
			Flatbed Truck	1	-	-	28/10/2021	11/02/2022	15	106	-	111	-	-	
			Excavator with auger	1	-	-	28/10/2021	11/02/2022	15	102	-	106	-	-	
C3 - Bicentennial Park North - Tunnel Site															
Site levelling, hardstand and site access	• Site levelling, grading and compaction • Temporary stockpiling of materials for site levelling • Formalisation of access and egress points - Implementing hardstand for car parking • Sealing of hard stand areas • Internal haul roads installed (excluding to the east of the creek - Note, TBC with C&C Team) • Building of piling pad	C3BP-T, C3BP-H	Excavator with bucket	2	-	-	28/10/2021	5/04/2022	23	101	-	114	-	-	
			Skid Steer	1	-	-	28/10/2021	5/04/2022	23	109	-	113	-	-	
			Vibratory Roller (20T Padfoot)	1	-	-	28/10/2021	5/04/2022	23	108	5	113	HN	X	
			Grader (140H)	1	-	-	28/10/2021	5/04/2022	23	113	-	121	-	-	
			Truck and Dogs	5 p.h.	-	-	28/10/2021	5/04/2022	23	106	-	111	-	-	35 max per day (up to 5 per hour).
			Power Tools	3	-	-	28/10/2021	5/04/2022	23	108	-	118	-	-	
			Generators	2	-	-	28/10/2021	5/04/2022	23	94	-	95	-	-	
			Concrete agitator	1	-	-	28/10/2021	5/04/2022	23	108	-	111	-	-	
			Concrete pump	1	-	-	28/10/2021	5/04/2022	23	103	-	107	-	-	
			Concrete Truck	4 p.h.	-	-	28/10/2021	5/04/2022	23	108	-	111	-	-	
			Plate Compactors	2	-	-	28/10/2021	5/04/2022	23	108	-	110	-	X	
			Water cart/ Street Sweeper	1	-	-	28/10/2021	5/04/2022	23	107	-	111	-	-	
Installation of offices, amenities, WTP, bentonite plant and workshops	Site preparation for bentonitie plant and WTP Assembly and commissioing of Bentonite Plant and WTP Offices/Amenities/Storage installation Security gate huts and boom gates Installation of piling pad WTP, bentonite plant	C3BP-T, C3BP-H	Franna Crane	1	-	-	28/10/2021	5/04/2022	23	98	-	102	-	-	
			EWP	2	-	-	28/10/2021	5/04/2022	23	95	-	98	-	-	
			Concrete Truck	1	-	-	28/10/2021	5/04/2022	23	108	-	111	-	-	
			Hand Tools	2	-	-	28/10/2021	5/04/2022	23	108	-	118	-	-	
			Power Saw	1	-	-	28/10/2021	5/04/2022	23	108	-	118	-	-	
			Grinders	2	-	-	28/10/2021	5/04/2022	23	108	-	118	-	-	
			Generators	1	-	-	28/10/2021	5/04/2022	23	94	-	95	-	-	
			Water Cart	1	-	-	28/10/2021	5/04/2022	23	107	-	111	-	-	
			Bored piling rig	1	-	-	28/10/2021	5/04/2022	23	102	-	106	-	-	
			Flatbed Truck	4 p.h.	-	-	28/10/2021	5/04/2022	23	106	-	111	-	-	
			Mobile Crane	1			28/10/2021	5/04/2022	23	104	-	108	-	-	
Utilities	Potholing for utilities Water and sewer connections Relocate existing power pole at site exit and site entrance Install temporary power supply (builders pole) Site HV for tunnelling works All of above adjacent to W Botany St Boundary	C3BP-T, C3BP-H. OOHC3UI-T	Excavator (<14 tonne)	1	-	-	28/10/2021	10/03/2022	19	103	-	108	-	-	
			Vacuum Truck	1	-	-	28/10/2021	10/03/2022	19	107	-	111	-	-	
			Hand Tools	2	1	1	28/10/2021	10/03/2022	19	108	-	118	-	-	
			Water cart/ Street Sweeper	1	-	-	28/10/2021	10/03/2022	19	107	-	111	-	-	
			Powerpole crane truck	1	1	1	28/10/2021	10/03/2022	19	95	-	98	-	-	Potential that works must be undertaken on nightshift - activity duration likely no more than 6 shifts
			EWP	1	1	1	28/10/2021	10/03/2022	19	95	-	98	-	-	

Table C1: Construction timetable/ activities/ equipment **Site Establishment Works**

Activity/ Work Area	Aspect	Scenario ID	Plant/ Equipment (as provided by client)	Day	Evening	Night	Timing of Activity (approximate)			Sound Power Level (Lw re: 1pW) in Noise Model, dB(A)			High noise plant	Vibration intensive plant	Notes
				7am - 6pm	6pm - 10pm	10pm - 7am	Start Date	End Date	Duration	L_{Aeq}	Penalty	L_{Amax}			
Environmental controls		C3BP-T, C3BP-H	Vacuum Truck	1	-	-	28/10/2021	30/11/2021	5	107	-	111	-	-	
			Flatbed Truck	1 p.h.	-	-	28/10/2021	30/11/2021	5	106	-	111	-	-	
			Tool Truck	1	-	-	28/10/2021	30/11/2021	5	89	-	100	-	-	
			Hand Tools	2	-	-	28/10/2021	30/11/2021	5	108	-	118	-	-	
Vegetation Clearing		C3BP-T, C3BP-H, OOHC3VC-T	EWP	1	-	-	28/10/2021	17/11/2021	3	95	-	98	-	-	
			Mulcher/Chipper	2	-	-	28/10/2021	17/11/2021	3	120	5	124	HN	-	
			Stump grinder	1	-	-	28/10/2021	17/11/2021	3	120	5	124	HN	-	
			Excavator 25T with bucket	2	-	-	28/10/2021	17/11/2021	3	103	-	108	-	-	
			Chainsaw (Petrol)	6	-	-	28/10/2021	17/11/2021	3	116	5	120	HN	-	Trees along West Botany Street located immediately next to road will require single lane closure (most likely mid-week nightshift ROL). Petrol chainsaws required as late as possible. Likely ~3 nights work. Remaining trees during standard construction hours.
			Chainsaw (Electrical)	-	-	2	28/10/2021	17/11/2021	3	106	-	111	-	-	As necessary on nightshift only
			Light vehicles / traffic control utes	1	-	3	28/10/2021	17/11/2021	3	89	-	100	-	-	Nightshift ROL on W Botany St for tree clearing
			Bogie Truck	1	-	-	28/10/2021	17/11/2021	3	106	-	111	-	-	
			Tipper truck	1	-	-	28/10/2021	17/11/2021	3	103	-	111	-	-	
			Water cart/ Street Sweeper	1	1	1	28/10/2021	17/11/2021	3	107	-	111	-	-	Clean road adjacent to tree clearing
Installation of noise walls and hoardings		C3BP-T, C3BP-H	Excavator with auger	1	-	-	28/10/2021	14/12/2021	7	102	-	106	-	-	NW01 - 4m noise wall away from services. Assume excavator augered... same for gate posts
			Hand Tools	2	-	-	28/10/2021	14/12/2021	7	108	-	118	-	-	
			Generators	1	-	-	28/10/2021	14/12/2021	7	94	-	95	-	-	
			Vacuum Truck	1	-	-	28/10/2021	14/12/2021	7	107	-	111	-	-	
			Franna Crane	1	-	-	28/10/2021	14/12/2021	7	98	-	102	-	-	
			Flatbed Truck	1 p.h.	-	-	28/10/2021	14/12/2021	7	106	-	111	-	-	
			Franna Crane	1	-	-	28/10/2021	14/12/2021	7	98	-	102	-	-	
Construction of pedestrian footpath from West Botany Street to the school			Small remote control roller	1	-	-	28/10/2021	14/12/2021	7	105	5	110	HN	X	
			Plate Compactors	1	-	-	28/10/2021	14/12/2021	7	108	-	110	-	X	
			EWP	2	-	-	28/10/2021	14/12/2021	7	95	-	98	-	-	
			Concrete truck	1 p.h.	-	-	28/10/2021	14/12/2021	7	108	-	111	-	-	

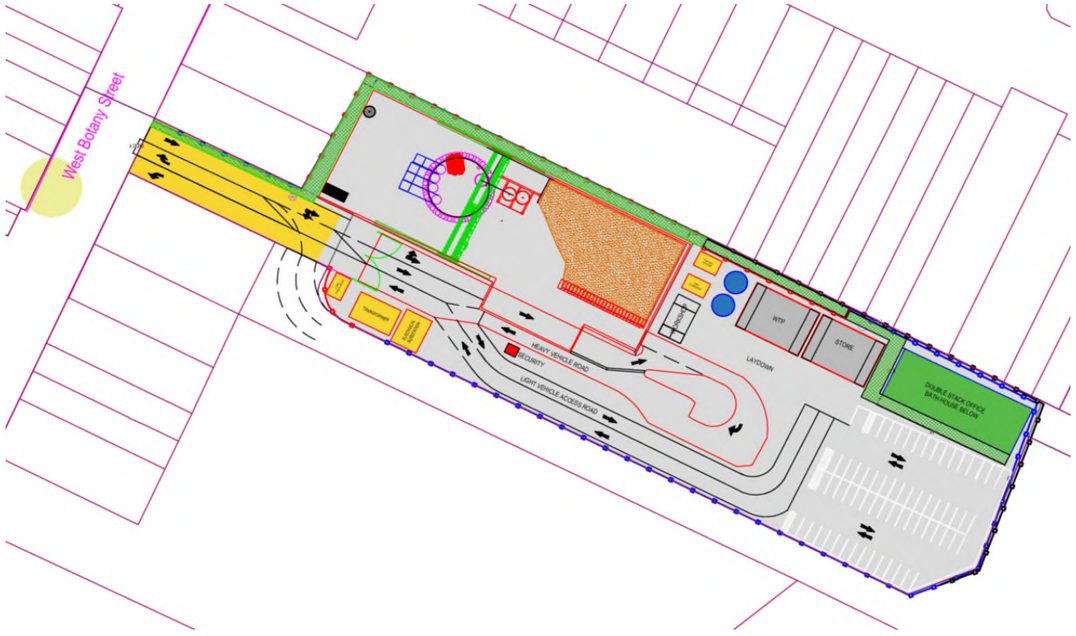
Figure C1: Site Layout

Site Establishment Works

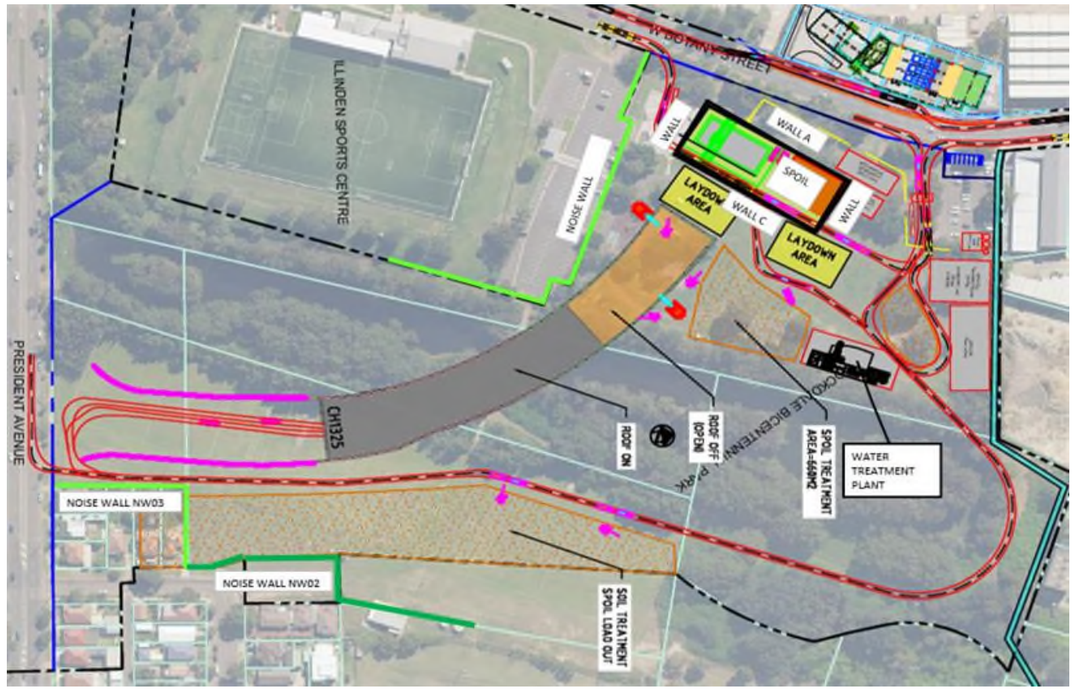
C1 - Arncliffe site

PLEASE INCLUDE UPDATED SITE LAYOUT

C2 - Rockdale depot



C3 - Bicentennial Park



APPENDIX D Detailed predicted noise levels

The detailed predicted levels have provided to CGU JV in a spreadsheet table in order to more adequately mitigate and manage potential noise impacts.

APPENDIX E Additional noise mitigation and consultation

The detailed additional noise and mitigation measures have provided to CGU JV in a spreadsheet table in order to more adequately mitigate and manage potential noise impacts.

APPENDIX F Number of receivers above the NML

This information has been provided to CGU JV in a spreadsheet table along with Appendix D and E.

APPENDIX G Vibration impact

Land-Use file revision_date: rX_dd/mm/yy
Plot Date: 22/07/21 - 15:08 Layout: WCX M6
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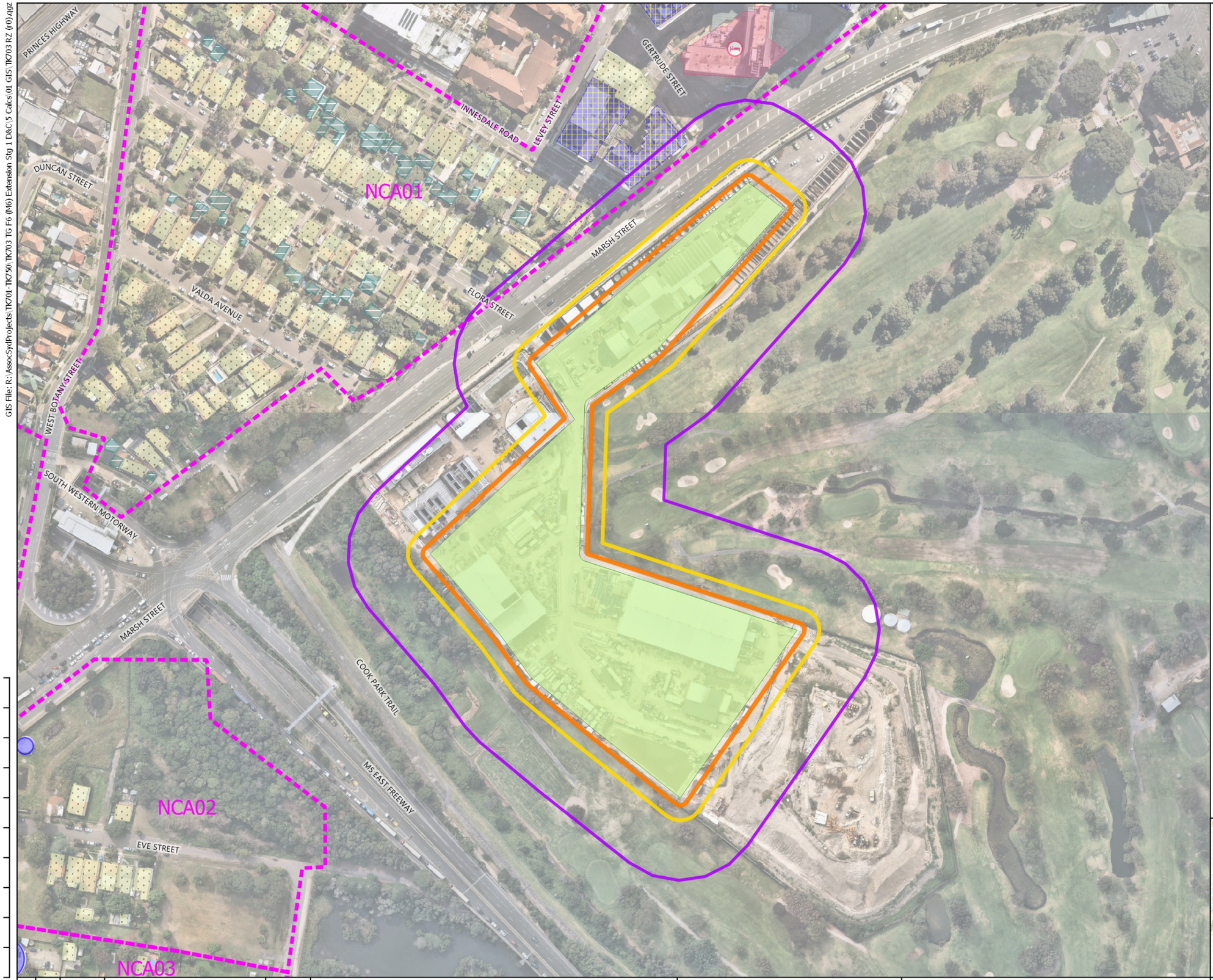

LEGEND

- Residential
- Mixed use
- Commercial
- Industrial
- Hotel/Motel/Hostel
- Medical facility
- Place of Worship
- Community centre
- Recording studio
- Library
- Flight simulator
- Childcare
- Educational
- Theatre/Auditorium
- Cinema
- Laboratory
- Recreational - Passive
- Recreational - Active
- Other
- Heritage

- NCA
- Work Area

MWD for cosmetic damage and human annoyance for 13T smooth drum roller (High vibration)

- Unreinforced structures (7.5mm/s ppv)
- Heritage structures (2.5mm/s ppv)
- Human annoyance - Residential (day)
- Receivers within MWD for cosmetic damage

REV	BY	DATE	DESCRIPTION	APPROVER
r0	MS	22/07/21	Prepare figures	RZ

A3 Original | Co-ordinate System: MGA Zone 56

0 50 100 150 m
1:2500
FULL SIZE A3
NOTE: Do not scale from this drawing.

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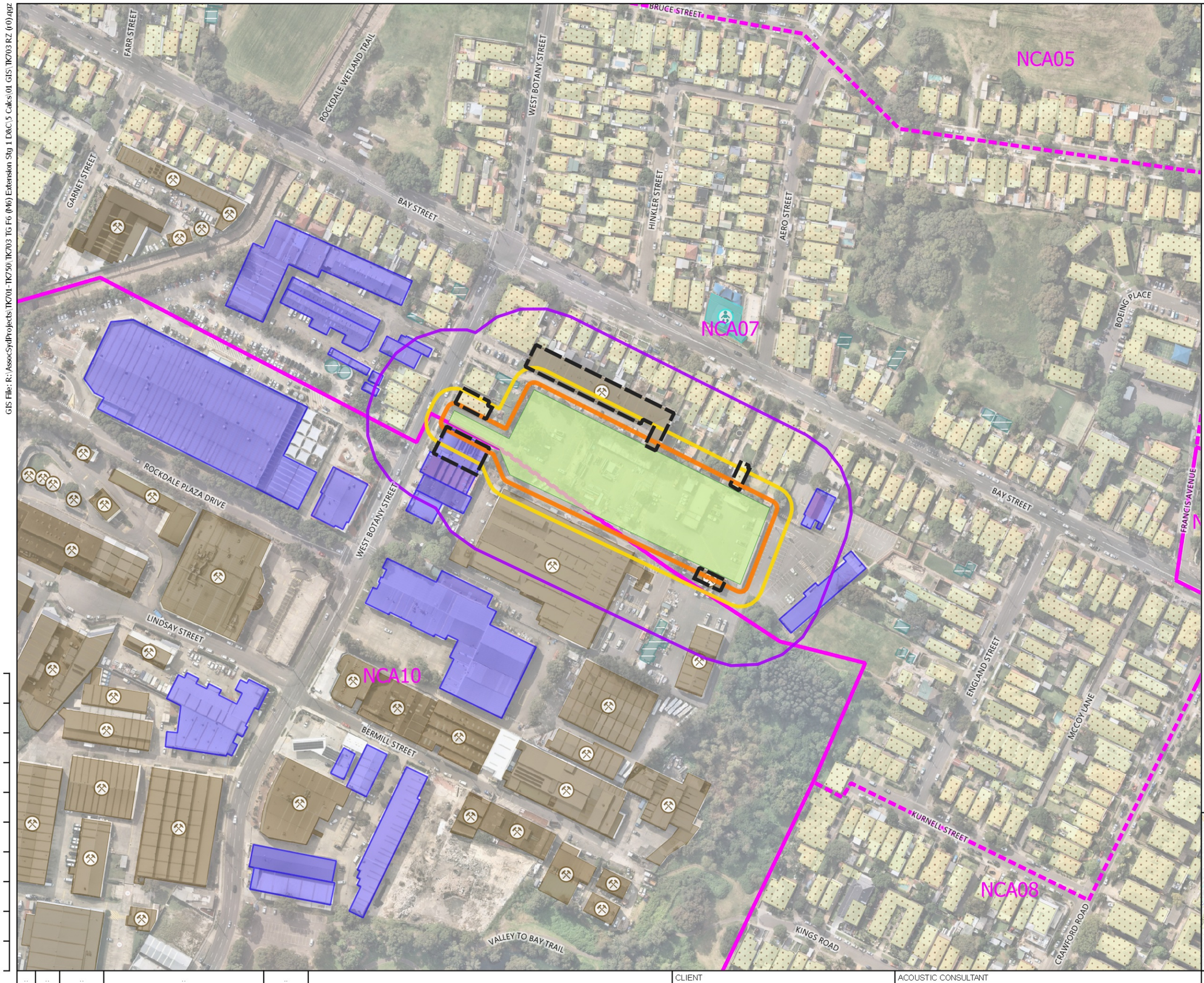
M6 MOTORWAY STAGE 1

SITE ESTABLISHMENT

MWD for cosmetic damage and human annoyance
Work area: C1 Arncliffe Worksite

Land-Use file revision_date: rX_dd/mm/yy
Plot Date: 22/07/21 - 15:08 Layout: WCX M6
GIS File: R:\AssocSydProjects\TK701-TK750\TK703 TG F6 (M6) Extension Stg 1 D&C\5 Calcs\01 GIS\TK703 RZ (r0).qgz



LEGEND

- Residential
- Mixed use
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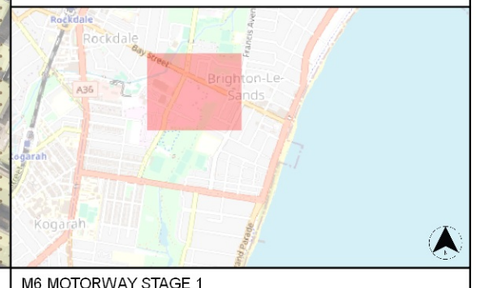
- Industrial
- Hotel/Motel/Hostel
- Medical facility
- Place of Worship
- Community centre
- Recording studio
- Library
- Flight simulator
- Childcare
- Educational
- Theatre/Auditorium
- Cinema
- Laboratory
- Recreational - Passive
- Recreational - Active
- Other
- Heritage

- NCA
- Work Area

MWD for cosmetic damage and human annoyance for 13T smooth drum roller (High vibration)

- Unreinforced structures (7.5mm/s ppv)
- Heritage structures (2.5mm/s ppv)
- Human annoyance - Residential (day)
- Receivers within MWD for cosmetic damage



REV	BY	DATE	DESCRIPTION	APPROVER
r0	MS	22/07/21	Prepare figures	RZ

0 50 100 150 m
1:2500
FULL SIZE A3

A3 Original | Co-ordinate System: MGA Zone 56 | NOTE: Do not scale from this drawing.

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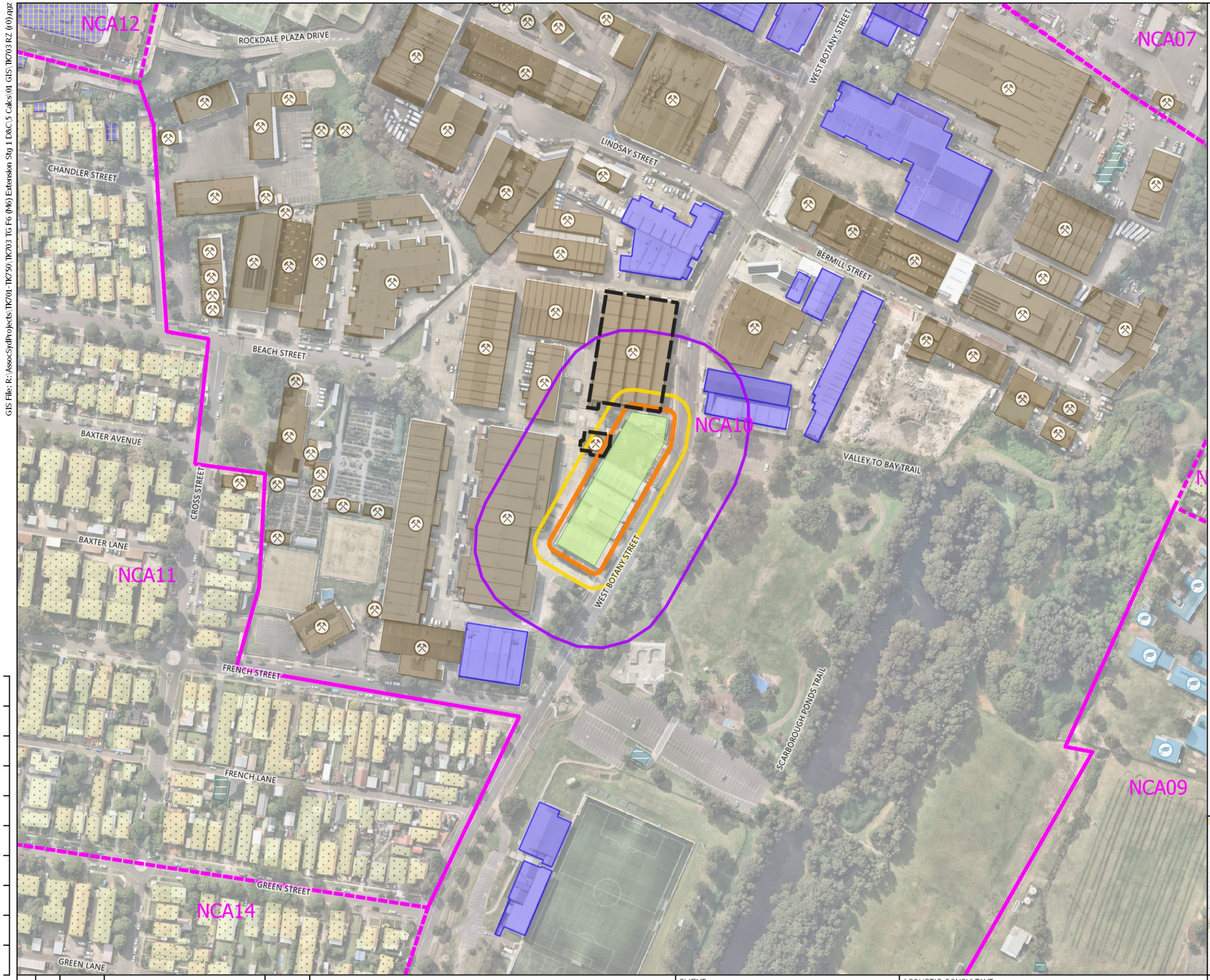
M6 MOTORWAY STAGE 1

SITE ESTABLISHMENT

MWD for cosmetic damage and human annoyance
Work area: C2 Rockdale Depot Worksite

Sheet 2 of 5

Land-Use file revision_date: rX_dd/mm/yy
Plot Date: 22/07/21 - 15:09 Layout: WCX M6
GIS File: R:\AssocSydProjects\TK701-TK750\TK703 TG F6 (M6) Extension Stg 1 D&C\5 Calcs\01 GIS\TK703 RZ (r0).qgz



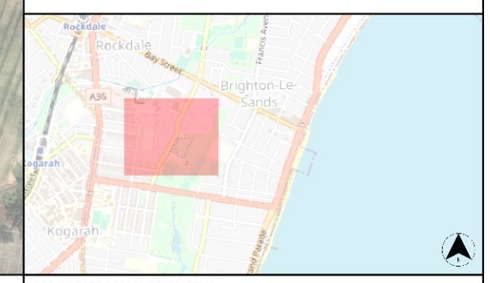
LEGEND

- Residential
- Mixed use
- Commercial
- Industrial
- Hotel/Motel/Hostel
- Medical facility
- Place of Worship
- Community centre
- Recording studio
- Library
- Flight simulator
- Childcare
- Educational
- Theatre/Auditorium
- Cinema
- Laboratory
- Recreational - Passive
- Recreational - Active
- Other
- Heritage

- NCA
- Work Area

MWD for cosmetic damage and human annoyance for 13T smooth drum roller (High vibration)

- Unreinforced structures (7.5mm/s ppv)
- Heritage structures (2.5mm/s ppv)
- Human annoyance - Residential (day)
- Receivers within MWD for cosmetic damage



0 20 40 60 80 100 120 140 160 180 200 m

REV	BY	DATE	DESCRIPTION	APPROVER
r0	MS	22/07/21	Prepare figures	RZ

A3 Original | Co-ordinate System: MGA Zone 56

0 50 100 150 m
1:2500
FULL SIZE A3
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M6 MOTORWAY STAGE 1

SITE ESTABLISHMENT

MWD for cosmetic damage and human annoyance
Work area: C3 MOC3 Worksite

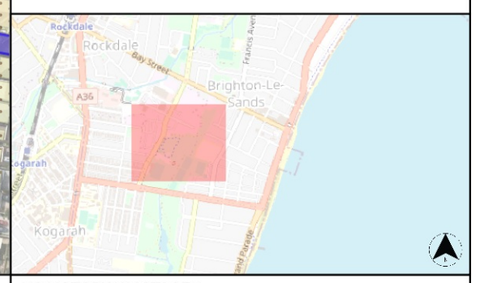
Land-Use file revision_date: rX_dd/mm/yy
Plot Date: 22/07/21 - 15:10 Layout: WCX M6
GIS File: R:\AssocSydProjects\TK701-TK750\TK703 TG F6 (M6) Extension Stg 1 D&C\5 Calcs\01 GIS\TK703 RZ (r0).qgz

LEGEND

- Residential
- Mixed use
- Commercial
- Industrial
- Hotel/Motel/Hostel
- Medical facility
- Place of Worship
- Community centre
- Recording studio
- Library
- Flight simulator
- Childcare
- Educational
- Theatre/Auditorium
- Cinema
- Laboratory
- Recreational - Passive
- Recreational - Active
- Other
- Heritage
- NCA
- Work Area

MWD for cosmetic damage and human annoyance for 13T smooth drum roller (High vibration)

- Unreinforced structures (7.5mm/s ppv)
- Heritage structures (2.5mm/s ppv)
- Human annoyance - Residential (day)
- Receivers within MWD for cosmetic damage



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REV	BY	DATE	DESCRIPTION	APPROVER
r0	MS	22/07/21	Prepare figures	RZ

A3 Original | Co-ordinate System: MGA Zone 56 | FULL SIZE A3 | NOTE: Do not scale from this drawing.

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M6 MOTORWAY STAGE 1

SITE ESTABLISHMENT

MWD for cosmetic damage and human annoyance
Work area: C3 Bicentennial Park North Tunnel Worksite

Land-Use file revision_date: rX_dd/mm/yy
Plot Date: 22/07/21 - 15:13 Layout: WCX M6
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LEGEND

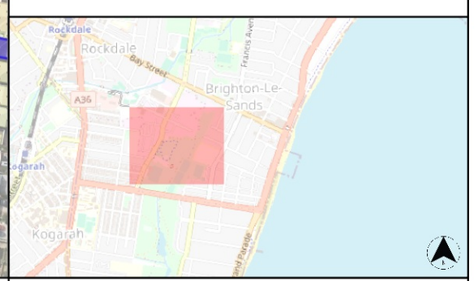
- Residential
- Mixed use
- Commercial
- Industrial
- Hotel/Motel/Hostel
- Medical facility
- Place of Worship
- Community centre
- Recording studio
- Library
- Flight simulator
- Childcare
- Educational
- Theatre/Auditorium
- Cinema
- Laboratory
- Recreational - Passive
- Recreational - Active
- Other
- Heritage

- NCA
- Work Area

MWD for cosmetic damage and human annoyance for Plate compactor

- Unreinforced structures (7.5mm/s ppv)
- Heritage structures (2.5mm/s ppv)
- Human annoyance - Residential (day)

- Receivers within MWD for cosmetic damage



0 20 40 60 80 100 120 140 160 180 200 m

REV	BY	DATE	DESCRIPTION	APPROVER
r0	MS	22/07/21	Prepare figures	RZ

A3 Original | Co-ordinate System: MGA Zone 56

0 50 100 150 m
1:2500
FULL SIZE A3
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M6 MOTORWAY STAGE 1

SITE ESTABLISHMENT
MWD for cosmetic damage and human annoyance
Work area: C3 Bicentennial Park North Pedestrian Footpath Works