

ENDORSEMENT CITY & SOUTHWEST ACOUSTIC ADVISOR

Review of	Construction Noise and Vibration Impact Statement for Line-Wide works Portion 3 – Chatswood	Document reference:	Construction Noise and Vibration Impact Statement Portion 3 – Chatswood Prepared by Renzo Tonin Associates for Systems Connect.
Prepared by:	Larry Clark, Alternate Acoustics Advisor		
Date of issue:	16 April 2021		TK685-03-17F01 CNVIS C2S_P3 CHW (r2) Dated 8 April 2021

As approved Alternate Acoustics Advisor for the Sydney Metro City & Southwest project, I have reviewed and provided comment on the Construction Noise and Vibration Impact Statement (CNVIS) for Line-Wide works Portion 3 – Chatswood, as required under A27 (d) of the project approval conditions (SSI 15-7400).

I reviewed and commented on a previous revision of the CNVIS. Revision 2 has been updated and I am satisfied that my comments have been adequately addressed.

I am satisfied that revision 2 of the CNVIS is technically valid, and includes appropriate noise and vibration mitigation and management. On this basis I endorse revision 2 of the CNVIS for Line-Wide works to be carried out in Portion 3 – Northern Chatswood.



Larry Clark, City & Southwest Alternate Acoustics Advisor

SYDNEY METRO CITY AND SOUTH WEST - LINE-WIDE WORKS

Construction Noise and Vibration Impact Statement Portion 3 - Chatswood

8 April 2021

Systems Connect

TK685-03-17F01 CNVIS C2S_P3 CHW(r2)

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Prepared for:	Systems Connect
Address:	Level 3, 116 Miller Street North Sydney NSW 2060 Australia
Attention:	Mathew Billings

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Important Disclaimer:

The work presented in this document was carried out in accordance with the Renzo Tonin & Associates Quality Assurance System, which is based on Australian Standard / NZS ISO 9001.

This document is issued subject to review and authorisation by the Team Leader noted by the initials printed in the last column above. If no initials appear, this document shall be considered as preliminary or draft only and no reliance shall be placed upon it other than for information to be verified later.

This document is prepared for the particular requirements of our Client referred to above in the 'Document details' which are based on a specific brief with limitations as agreed to with the Client. It is not intended for and should not be relied upon by a third party and no responsibility is undertaken to any third party without prior consent provided by Renzo Tonin & Associates. The information herein should not be reproduced, presented or reviewed except in full. Prior to passing on to a third party, the Client is to fully inform the third party of the specific brief and limitations associated with the commission.

In preparing this report, we have relied upon, and presumed accurate, any information (or confirmation of the absence thereof) provided by the Client and/or from other sources. Except as otherwise stated in the report, we have not attempted to verify the accuracy or completeness of any such information. If the information is subsequently determined to be false, inaccurate or incomplete then it is possible that our observations and conclusions as expressed in this report may change.

We have derived data in this report from information sourced from the Client (if any) and/or available in the public domain at the time or times outlined in this report. The passage of time, manifestation of latent conditions or impacts of future events may require further examination and re-evaluation of the data, findings, observations and conclusions expressed in this report.

We have prepared this report in accordance with the usual care and thoroughness of the consulting profession, for the sole purpose described above and by reference to applicable standards, guidelines, procedures and practices at the date of issue of this report. For the reasons outlined above, however, no other warranty or guarantee, whether expressed or implied, is made as to the data, observations and findings expressed in this report, to the extent permitted by law.

The information contained herein is for the purpose of acoustics only. No claims are made and no liability is accepted in respect of design and construction issues falling outside of the specialist field of acoustics engineering including and not limited to structural integrity, fire rating, architectural buildability and fit-for-purpose, waterproofing and the like.

Supplementary professional advice should be sought in respect of these issues.

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1 Introduction

This Construction Noise and Vibration Impact Statement (CNVIS) has been prepared on behalf of Systems Connect in accordance with the Construction Noise and Vibration Management Plan (CNVMP) [SMCSWLWC-SYC-1NL-PM-PLN-000032] [1], for the Design and Construction of the Line-Wide Works (LWW) of the Sydney Metro City & Southwest Project (the Project).

1.1 Relevant requirements and purpose of this CNVIS

As defined in the CNVMP, the works covered by this CNVIS are part of the Portion 3 – Chatswood to Sydenham LWW delivered under Critical State Significant Infrastructure Approval CSSI 7400. Condition E33 of CSSI-7400 requires that:

Construction Noise and Vibration Impact Statements must be prepared for each construction site before construction noise and vibration impacts commence and include specific mitigation measures identified through consultation with affected sensitive receivers.

This CNVIS applies to Chatswood site, which includes works to be undertaken on the site surface and also includes tunnel fitout works occurring concurrently with the surface works. Works will be completed during standard construction hours as well as works outside of standard construction hours. The construction hours of work are defined by the Project Planning Approval conditions as outlined in the CNVMP.

This CNVIS forms part of the CNVMP for the Project.

1.2 Structure of this CNVIS

This CNVIS 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** - Ground-borne noise assessment
- **Section 8** – Traffic noise assessment
- **Section 9** – Cumulative impacts.

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 CNVIS

2.1.1 Construction activities

This CNVIS provides an assessment of noise and vibration impacts from activities associated with the C2S Chatswood site. These activities include:

- Track construction within the tunnels
 - Concrete works
 - Materials delivery and handling (including delivery of rail)
 - Welding
 - Mechanical and electrical tunnel fitout
- Building construction
 - Dive Services Building
 - Fire Services Building construction
- Surface works
 - Demobilisation of acoustic sheds, water treatment plant, site sheds
 - Hardstand removal
 - Drainage and services
 - Finishing (Fencing and landscaping)

The site location is identified on an aerial photograph located in APPENDIX B.

The proposed works, likely plant and equipment and indicative Project timing is presented in APPENDIX C. Site layout drawings are also presented in APPENDIX C.

2.1.2 Construction traffic

The Chatswood site construction works will generate additional traffic movements in the form of:

- Light vehicle movements generated by construction personnel travelling to and from work,
- Heavy vehicle movements generated by delivery vehicles bringing materials, plant and equipment to the worksite.

Construction traffic on-site (i.e. within the Project footprint) is included as part of the construction noise assessment of the works activities identified in Sections 5 and APPENDIX C. 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's activities. Construction traffic noise is addressed in Section 7.

2.1.3 Cumulative construction impacts

CSSI 7400 Condition of Approval E39 requires Systems Connect to consult with proponents of other construction works in the vicinity of the worksite and take reasonable steps to coordinate works to minimise cumulative impacts of noise and vibration and maximise respite for affected sensitive receivers. Further to this, Condition E40 requires works to be coordinated to provide the required respite periods identified in accordance with the terms of the CSSI 7400 approval.

All concurrent Sydney Metro construction site works have been considered and addressed in Section 9 of this CNVIS. Potentially concurrent construction activities within the vicinity of the Chatswood site have also been considered, as discussed in Section 9.

2.2 Construction hours

The construction hours for the Project are defined by Project Planning Approval (PPA) Conditions E36, E37, E38, E41, E42, E44 and E48. The Environment Protection Licence (EPL 21423) is consistent with these conditions.

2.2.1 Standard construction hours

The standard construction hours of work are defined by the CSSI-7400 Condition E36. The standard construction hours for the Project are summarised in the table below.

Table 2-1: Standard construction hours

Construction Activity	Monday to Friday	Saturday	Sunday/ Public holiday
Above ground activities: construction sites and construction traffic	7:00 am to 6:00 pm	8:00 am to 1:00 pm	No work

2.2.2 Out of hours work periods

CSSI-7400 Condition E44 and E48 allow standard construction hours to be varied under specific conditions (where justified). Condition E48 allows the following activities to be carried out 24 hours per day, 7 days per week:

- Station and tunnel fit out, and
- Haulage and delivery of spoil and materials.

PPA Condition E44 and Condition E46 allow OOHW where it is permitted or required by an EPL or the Out of Hours Work Protocol. Systems Connect will not undertake OOHW until approved by an EPL or through an OOHW Protocol. Oversize deliveries may need to take place outside of standard construction hours in order to comply with RMS requirements for oversize vehicle movements.

The Transport for NSW (TfNSW) Construction Noise and Vibration Strategy (CNVS) [9] provides a hierarchy of Out of Hours (OOH) work periods. The impact of OOH works may be reduced by scheduling work and activities with greater impact during the preferred periods when receivers are likely to be less sensitive to noise and vibration, such as in the day out of hours (OOHD) and evening out of hours (OOHE) periods.

Table 2-2 presents the construction work periods as Standard Hours, Out of Hours Work (OOHW) Period 1 and OOHW Period 2.

Table 2-2: Construction hours

Day	12am	1am	2am	3am	4am	5am	6am	7am	8am	9am	10am	11am	12pm	1pm	2pm	3pm	4pm	5pm	6pm	7pm	8pm	9pm	10pm	11pm
Monday																								
Tuesday																								
Wednesday																								
Thursday																								
Friday																								
Saturday																								
Sunday or Public Holiday																								

- Standard construction hours are defined in CSSI-7400 Condition E36 as: Monday to Friday 7:00am to 6:00pm and Saturdays from 8:00am to 1:00pm.
- Work outside of standard construction hours is defined as Out-of-Hours Work (OOHW) and has been divided by the CNVS into 2 periods of sensitivity:
 - OOHW Period 1** is the least sensitive OOH period and is defined as Monday to Friday 6:00pm to 10:00pm (evenings), Saturday 7:00am to 8:00am and 1:00pm to 10:00pm (day/ OOHD and evening/ OOHE) and Sunday and public holidays 8:00am to 6:00pm (day/ OOHD)
 - OOHW Period 2** is the most sensitive OOH period and is defined as Monday to Saturday 10:00pm to 7:00am (night/ OOHN) and Sundays and public holidays 6:00pm to 8:00am (evening/ OOHE and night/ OOHN).

2.2.3 Justification for OOHW

The track works are an essential component of the Project due to be completed and open to rail traffic in 2024. This completion date has been calculated assuming track work, tunnel systems works and fit out works within the tunnel will be undertaken 24 hours a day, seven days per week. Due to time and space constraints, it will not be possible to lift all materials into the dive structure and tunnel during standard hours, to allow track works to continue 24 hours per day. The process will need to continue during the evening period (6pm to 10 pm) and night period (10 pm and 7am).

OOHW activity on the surface and inside the dive, particularly after 10pm will be managed to minimise impacts on surrounding sensitive receivers. Deliveries during OOHW periods vehicles would be loaded and unloaded from with the existing spoil shed and gantry shed. Concrete deliveries for tunnel works would occur within the gantry shed to minimise impacts to surrounding receivers.

Once demobilisation of the Gantry shed occurs, deliveries during OOHW periods would use the existing spoil shed for loading and unloading. After demobilisation of the spoil shed, heavy vehicle movements during OOHWs would be restricted to ensure minimal impact to surrounding receivers.

Stationary plant will be located at the bottom of the dive structure and inside the acoustic sheds during the night period (10 pm to 7am) to reduce potential noise impact and manage noise from site to within the NMLs.

Allowing track works and tunnel fit out works to occur as OOHW will:

- Ensure key NSW Government program milestones are met.
- Ensure delivery of community and rail commuter user benefits.
- Allow increased project efficiency.
- Reduce the overall duration of the construction phase and in turn reduce the duration of impacts on the surrounding community.

The Project has been identified as Critical State Significant Infrastructure by the NSW Government and will provide an important commuter link connecting the existing Sydney Metro North West with the CBD and South West. There are considerable benefits to the Project, NSW Government and the community from the prompt completion of construction of the Project. For the community particularly, completion of construction works will allow restoration of amenity and, in many respects, an increase in the quality of this amenity.

This, however, will be reviewed once works start and we have a better understanding of the logistics of the work (how efficiently they run and how heavily they are impacted by effects such as supply, traffic impact, etc).

Any work outside standard construction hours must be undertaken in accordance with an EPL or Out of Hours Works Protocol and the CNVMP [1].

2.2.4 COVID-19 extended construction hours

The Environmental Planning and Assessment (COVID-19 Development – Infrastructure Construction Work Days) Order 2020 commenced on 9 April 2020 and will continue until 31 March 2022. The order permits standard construction hours on this project to be extended as follows:

- Saturday from 7am to 8am and from 1pm to 6pm (no high noise work permitted)
- Sundays from 7am to 6pm (no high noise work permitted)
- Public holidays from 7am to 6pm (no high noise work permitted).

High noise work means activities such as rock breaking, rock hammering, sheet piling, pile driving or similar noisy activities, unless an existing consent or approval already allows these works to occur on any of the extended days.

Some of the works that are the subject of this CNVIS are permitted 24 hours per day, 7 days per week under PPA Condition E48 (see Section 4.1.1).

Appropriate noise management levels for the extended hours period (i.e. Sundays/ Public Holidays 8am to 6pm) are as outlined for the Day (D/ D(O)) period in Section 4.1.1.

3 Nearest sensitive receivers

3.1 Residential receivers

To assess and manage construction noise and vibration impacts, the residential areas surrounding the site have been divided into Noise Catchment Areas (NCAs) based on each area's similar acoustic environment prior to the start of construction work. The NCAs are based on those established in the EIS for the Project, with some modifications to allow for site specific characteristics.

All relevant residential sensitive receivers near the worksite are identified on an aerial photograph located in APPENDIX B.

3.2 Other sensitive receivers (PPA Condition E34)

Additional to residential receivers above, 'other' noise and vibration sensitive receivers such as passive recreation areas and places of worship surrounding the construction area have been identified and are summarised on an aerial photograph located in APPENDIX B.

CSSI-7400 Condition E34 states:

Noise generating works in the vicinity of potentially-affected, religious, educational, community institutions and noise and vibration-sensitive businesses and critical working areas (such as theatres, laboratories and operating theatres) must not be timetabled within sensitive periods, unless other reasonable arrangements to the affected institutions are made at no cost to the affected institution or as otherwise approved by the Secretary.

Sydney Metro and Systems Connect have undertaken consultation with identified sensitive receivers to determine sensitive periods. This has been taken into consideration in finalising respite strategies for high noise impacts.

3.3 Commercial and industrial premises

All commercial and industrial premises near the worksite have been considered in this assessment.

3.4 Heritage receivers

Heritage receivers have been identified in the Land Use Survey in ANNEXURE A.2 of the CNVMP. There are five heritage-listed buildings close to the work areas:

Table 3.1: Assessment heritage receivers

Name	Address/Location	Significance
Mowbray House	357 Mowbray Rd	Local
Chatswood Zone Substation No 80	348 Mowbray Rd	Local
Chatswood Reservoirs	366 Mowbray Rd	Local

Name	Address/Location	Significance
Great Northern Hotel	367 Mowbray Rd	Local
Chatswood South Uniting Church and Cemetery	372-374 Mowbray Rd	Local

4 Construction noise and vibration objectives

4.1 Noise goals

4.1.1 Noise management levels (NMLs)

Construction noise management levels (NMLs) have been determined using the Construction Environmental Management Framework (CEMF)[10], CSSI-7400 Conditions, in accordance with the Sydney Metro City & Southwest Construction Noise and Vibration Strategy (SMCSNVS) [8] and as set out in the CNVMP.

For the Chatswood site, external NMLs are derived from the Interim Construction Noise Guideline (ICNG)[3], as identified in Section 5.1.1 of the CNVMP[1] and summarised in Table 4-1 below. Internal NMLs are also applicable at residential receiver locations during the 8 pm to 7 am period per CSSI-7400 Conditions E41 and E42 for works associated with the tunnel fitout, as summarised in Table 4-1 below.

Table 4-1: Application of NMLs at CS2 Chatswood (CSSI 7400 Conditions of Approval)

Time Period	Area	Receiver Type	Reference	Noise management level ³
ICNG				
Day ¹	All	All	CNVS ³ Section 5.3	ICNG (see Table B1 in APPENDIX B)
Day ¹ OOHW Period 1	All	All	CNVS ³ Section 5.3	ICNG (see Table B1 in APPENDIX B)
Evening ¹ OOHW Period 1	All	All	CNVS ³ Section 5.3	ICNG (see Table B1 in APPENDIX B)
Night ¹ OOHW Period 2	All	All	CNVS ³ Section 5.3	ICNG (see Table B1 in APPENDIX B)
CSSI-7400				
Evening ¹ 8pm to 10pm (E2)	Residential zones ²	Residential	CSSI-7400 E42	L _{Aeq(15minute)} 45 dB(A) (internal)
Night ¹ 10pm to 7am (N)				
All	All	All	SSI-7400 E43	L _{Aeq(8hour)} 85 dB(A) (external) near the CCSI

1. Day refers to 7am to 6pm Monday to Friday and 8am to 6pm Saturday, Sunday and Public Holidays; Evening refers to Monday to Sunday 6:00pm to 10:00pm; Night refers to Monday to Friday 10:00pm to 7:00am and Saturdays, Sundays and public holidays 10:00pm to 8:00am.
2. These are identified by the applicable Local Environmental Plan land zoning of the receiver.
3. Sydney Metro City & South West Construction Noise and Vibration Strategy (Sydney Metro 2016)
4. Criteria as described in SSI 7400 Condition E38
5. A 5 dB penalty shall be applied if rock breaking or any other annoying activity likely to result in ground-borne noise or a perceptible level of vibration is planned

ICNG NMLs

For residential receivers, the ICNG NMLs are based on the background noise levels derived from long-term noise logging conducted by SLR on behalf of Transport for NSW (TfNSW) to quantify ambient noise levels for the Environmental Impact Statement (EIS) [2]. Additional pre-construction noise monitoring was carried out prior to the Tunnels and Stations Excavation (TSE) works to establish more representative noise goals. This additional long-term, unattended noise monitoring was carried out in

July 2017 by RT&A following a review of the EIS noise monitoring and has been incorporated into the CNVMP.

The NMLs for 'other' sensitive receivers are from the ICNG, as reported in Section 5.2.3 of the CNVMP. These are applicable when the other sensitive receiver is in use.

Receivers are considered 'noise affected' where construction noise levels are greater than the NMLs 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 are above the NMLs, all feasible and reasonable work practices will be applied to meet the NMLs.

Where construction activities are tonal or impulsive in nature and are described in the ICNG as being particularly annoying, 5 dB(A) must be added to the activity noise. Activities that are defined in the Interim Construction Noise Guideline (ICNG) [3] as particularly annoying include but are not limited to the use of 'beeper' style reversing or movement alarms; power saws; vibratory rolling; jack hammering, rock hammering or rock breaking; impact piling.

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

Internal NMLs (CSSI-7400 Conditions E41 and E42)

CSSI-7400 Conditions E41 and E42 require that residential receivers within non-residential zones or residential zones (respectively) are not above the internal noise levels identified in Table 4-1. In accordance with CSSI-7400 Conditions E41 and E42, if construction works are particularly annoying (as described in *ICNG NMLs* above) or include ground-borne noise or a perceptible level of vibration at the affected receiver, a 5 dB(A) penalty should be added to the predicted construction noise level.

Where the above internal noise levels cannot be achieved, additional mitigation in accordance with the *Sydney Metro City and South West Noise and Vibration Strategy (SMCSNVS)* [8] is to be offered. CSSI-7400 conditions E41 and E42 have been applied to works associated with the tunnel fit out only. All other surface works on site have been assessed to the relevant ICNG noise goals.

Addendum A of the SMCSNVS notes that the applicable Local Environmental Plan land zoning of the receiver be used to identify if residential receivers are located within residential or non-residential zones. An extract from the Willoughby Local Environmental Plan (2012) land zoning map (accessed 26/11/2017) is provided in red and pink areas (R2, R3 and R4) indicate residential zones.

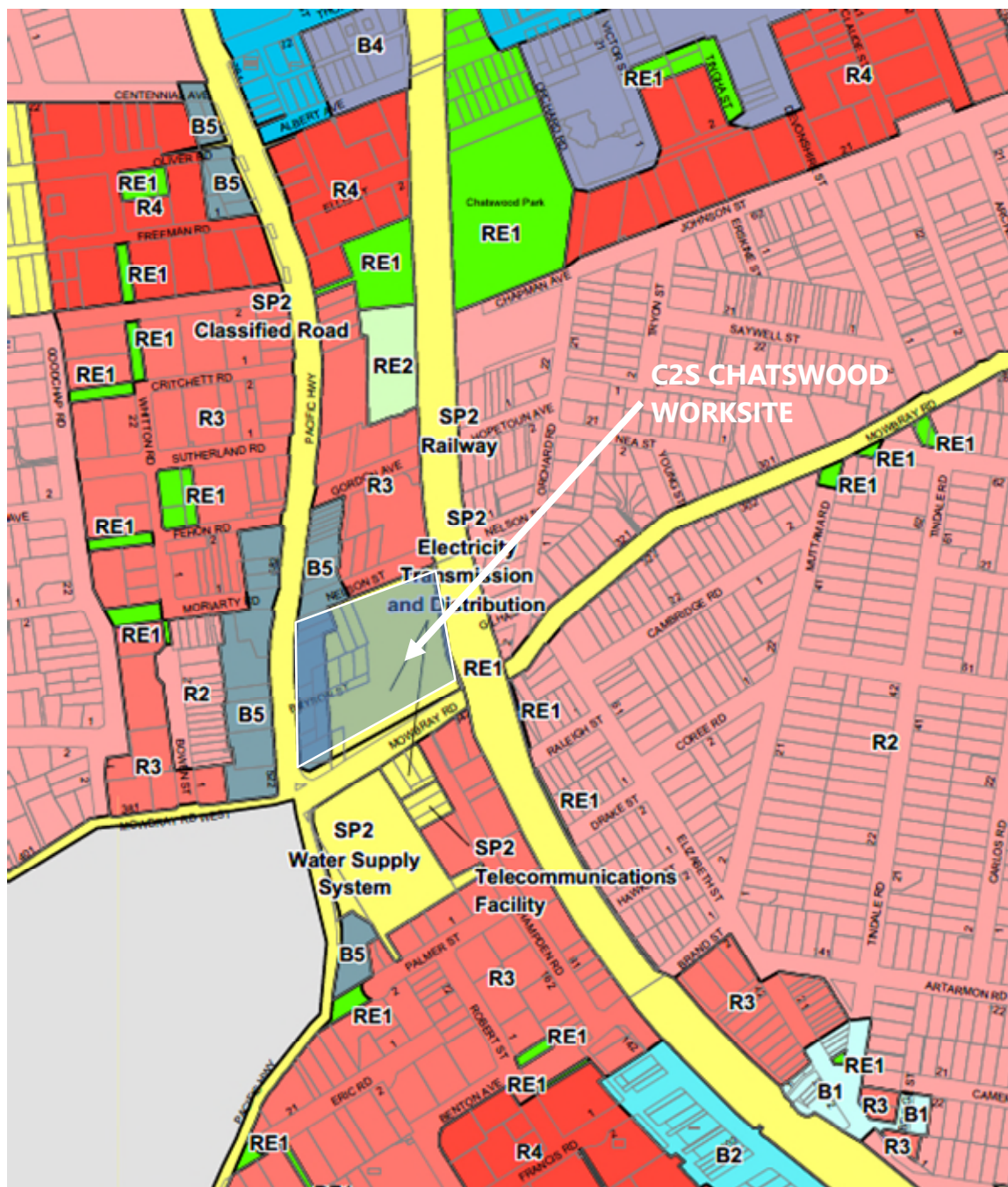
The zoning map indicates that the nearest residential receivers along the rail corridor are in residential areas. The nearest residential receivers on Pacific Highway and north of Albert Avenue are in non-residential areas (B3, B4 and B5 zone in Figure 4-1).

For this assessment, all residential receivers are conservatively assumed to be in residential zones, with a corresponding internal noise threshold level of $L_{Aeq(15minute)}$ 45 dB(A) between 8pm and 7am. Based on a minimum (conservative) external to internal noise difference of 10 dB(A) (assuming windows open), an

equivalent external noise threshold of $L_{Aeq(15\text{minute})}$ 55 dB(A) is applicable between 8pm and 7am for all receivers except for those that are receiving at-property treatments from TfNSW due to the operation of the rail corridor. In this case, a conservative external noise threshold of $L_{Aeq(15\text{minute})}$ 65 dB(A) is considered. Where these external equivalent levels are above the external noise threshold, additional mitigation may be required in accordance with the SMCSNVs.

The assessment presented in Section 5.2 has assessed all receivers against the approach outlined in the SMCSNVs [8] and the CNVMP [1] which achieves the requirements of PPA Conditions E41 and E42, and is consistent with the ICNG [3] and the EIS [2].

Figure 4-1: Extract from the Willoughby Local Environmental Plan (2012) land zoning map



4.1.2 Respite for high noise impact works

The CSSI-7400 Conditions set no specific requirements for respite from high noise impact at the Chatswood site. In accordance with the ICNG, respite will be provided for activities which result in any residential receiver being highly noise affected (affected by noise more than 75 dB(A)).

To coordinate respite periods with other contractors working on the Chatswood site, respite from other high noise impact work will be provided by limiting activities to:

- 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 and works of not less than one hour between each block, except as expressly permitted by the licence.

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.

4.1.3 Sleep disturbance

Consistent with Section 5.1.3 of the CNVMP [1], an initial screening level of $L_{Amax} \leq L_{A90(15min)} + 15 \text{ dB(A)}$ 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 be above the screening level, further analysis is made to identify:

- the likely number of events above 45 dB(A) (internal) that might occur during the night assessment period
- whether events are above an 'awakening reaction' level of 55 dB(A) L_{Amax} (internal) that equates to NML of L_{Amax} 65 dB(A) (assuming open windows).

The ICNG recommends that where construction works are planned to extend over more than two consecutive nights, maximum noise levels and the extent and frequency of maximum noise level events above the RBL should be considered.

During construction works at night, attended noise monitoring will be undertaken at representative residences most impacted by the works during night-time periods (see Section 5). The noise monitoring will follow the procedures outlined in APPENDIX E of the CNVMP [1], which includes measurement of L_{Amax} noise metrics. If maximum noise levels are found to be above the sleep NML of 45 dB(A), the responsible noise source(s) will be identified and further analysis undertaken to quantify the extent and frequency of events above the NML. Additional feasible and reasonable mitigation measures may need to be considered to reduce potential impacts.

4.1.4 National Standard for exposure to noise

In accordance with PPA Condition E43, Systems Connect worksites will be managed to ensure that noise generated by construction will not be above 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 85 dB(A) for any employee working at a location near a Systems Connect worksite.

4.1.5 Construction related road traffic noise objectives

On the roads immediately adjacent to construction sites, the community may associate heavy vehicle movements with the Chatswood site. Construction traffic movements on public roads will aim to limit any increase in existing road traffic noise levels to no more than 2 dB(A). All feasible and reasonable noise mitigation and management measures will be implemented.

4.2 Construction vibration goals

As reported in Section 5.4 and 5.5 of the CNVMP [1], construction vibration goals have been determined using:

- for human exposure, the acceptable vibration values set out in the Environmental Noise Management Assessing Vibration: A Technical Guideline (Department of Environment and Conservation, 2006) [4]
- for structural damage, the 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 [5] and
 - German Standard DIN 4150-3: Structural Vibration - effects of vibration on structures [6].

4.2.1 Disturbance to building occupants (human annoyance)

For disturbance to human occupants of buildings, we refer to 'Assessing Vibration; a technical guideline' [4]. This document provides criteria which are based on the British Standard BS 6472-1992, 'Evaluation of human exposure to vibration in buildings (1-80Hz)' [7].

Intermittent vibration is assessed using vibration dose values (VDVs). For the assessment of potential vibration at the nearest vibration sensitive receivers preferred and maximum VDV goals for the day period (7:00am to 10:00pm) are presented in Table 4-2.

Table 4-2: Construction vibration disturbance goals

Location	Assessment period ¹	Vibration Dose Value (VDV), m/s ^{1.75}	
		Preferred values	Maximum values
Critical areas ²	Day or Night	0.10	0.20
Residences	Day	0.20	0.40

Location	Assessment period ¹	Vibration Dose Value (VDV), m/s ^{1.75}	
		Preferred values	Maximum values
	Night	0.13	0.26
Offices, schools, educational institutions and places of worship	Day or Night	0.40	0.80
Workshops	Day or Night	0.80	1.60

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

2. Examples include hospital operating theatres and precision laboratories where sensitive operations are occurring. These criteria are only indicative, and there may be a need to assess intermittent values against the continuous or impulsive criteria for critical areas. Source: BS 6472-1992

4.2.2 Structural damage to buildings

A conservative vibration damage screening level 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.

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.

4.2.3 Heritage

Section 4.2.3 of the CNVMP [1] outlines the approach to manage potential vibration impacts on heritage items, where identified. The actions to be taken shall be to:

- 1) Identify heritage items where the 2.5 mm/s peak component particle velocity objective may be exceeded during specific construction activities
- 2) Structural engineering report to be undertaken on identified heritage items, to confirm structural integrity of the building and confirm if item is 'structurally sound'
- 3) If item confirmed as 'structurally sound', the screening criteria in Section 4.2.2 shall be adopted, or
- 4) If item confirmed as 'structurally unsound', the more conservative cosmetic damage objectives of 2.5 mm/s peak component particle velocity would be adopted.

4.2.4 Sensitive scientific and medical equipment

No sensitive scientific or medical equipment are known to be located near the assessed works. If they are identified, relevant vibration criteria should be established for each item in line with Section 5.5.3 of the CNVMP [1], and any corresponding management or mitigation measures determined.

4.2.5 Utilities and other vibration sensitive structures

Where utilities or other vibration sensitive structures are identified, relevant vibration criteria will be established for each item per Section 5.5.4 of the CNVMP [1], and any corresponding management or mitigation measures determined.

5 Construction noise assessment

5.1 Noise prediction methodology

Modelling and 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 take into account:

- Location of noise sources and sensitive receiver locations.
- 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 (see Table C1 in APPENDIX C). Table C1 also identifies the plant and equipment that will operate during each assessment period and the likely timing of each activity/aspect.
- Separation distances between sources and receivers.
- Ground type between sources and receivers.
- Attenuation from barriers (natural and purpose built).

Key details regarding the construction site layout, the likely plant and equipment (including truck movements), and hours of operation were informed by the Design and Construction Teams. This information is presented in APPENDIX C and formed the basis for all modelling assumptions used in this assessment.

Table C1 in APPENDIX C provides a list of activities for the tunnel fit out works within the tunnel which have been provided for completeness, however have not been included in the noise assessment as they occur underground and are typically not expected to generate noise impact to receivers. [Some tunnel fit out activities may be audible at receivers. Systems Connect would assess and manage these works on an activity-by-activity basis using Gatewave and attended monitoring to verify the impact and appropriate management measures.](#) Works associated with the tunnel fitout on the surface, such as logistics for deliveries and concrete pours from within the gantry shed have been included in the assessment.

A plan of the likely timing of each activity is presented in Table C.2, based on information of timing of activities provided by the Design and Construction Teams. Table C.2 outlines the key construction noise and vibration management measures included in the predictions.

5.1.1 Detailed design outcomes

During the site design process, Renzo Tonin & Associates played a key role in assisting Systems Connect to determine the noise mitigation measures required to reduce the site's noise impact, incorporating existing mitigation measures from previous stages of the project. The key noise mitigation measures that have been included in the noise modelling results presented in this CNVIS are the following:

- Acoustic spoil shed for deliveries;
- Acoustic gantry shed for deliveries and concrete pours;
- Shipping container noise wall along the northern boundary of it site, adjacent to spoil shed;
- Shed doors must be closed at all times, except the minimum time necessary to allow vehicles to enter or exit.
- 2.1 metre high noise barriers around the site;
- Attenuated pumps, compressors, ventilation fans and other plant/equipment.
- 4m high noise wall along the western side of the rail corridor;
- 3m high noise wall along the eastern side of the rail corridor;
- Heavy vehicle movements restricted to 4 per hour during E2 and night.
- At-property treatments for the most affected noise sensitive receivers.

The above recommendations are all existing measures which have previously been implemented for past construction works. All noise walls, hoardings and acoustic sheds developed for the TSE works will remain on site and will not be altered from the existing configuration.

In addition to the above, TSE works have been completed between the tunnel portal and the gantry shed, which includes completion of the covered solid dive structure which would assist in reducing noise emissions from works being completed underneath the acoustic shed.

5.1.2 Construction activities

Table 5-1 presents a summary of the construction activities and aspects that are proposed to take place during the works. Table C1 in APPENDIX C provides a detailed list of plant and equipment in use during the day, evening and night assessment periods for the construction activities summarised in. Table C-2 presents the indicative program/ timeline for the completion of the works. The indicative program has informed the development of assessment scenarios (V01 to V07 in Table 5-1) representing the different work stages over the duration of the Chatswood site works.

Figure C-1 shows the site layout, including the location of key work areas identified in Table C-1.

Table 5-1: Summary of construction activities

Aspect	Description of Activity	Timing	Daytime 7am to 6pm ICNG 8am to 1pm ICNG OOHW Period 1 7am to 8pm E37/E38							Evening and night-time 6pm to 10pm ICNG OOHW Period 1 ICNG OOHW Period 2 (night-time) 8pm to 7am E41/E42	
			Scenario V01	Scenario V02	Scenario V03	Scenario V04	Scenario V05	Scenario V6	Scenario V7	Scenario V01	Scenario V02-V05
Track construction inside dive and tunnels & surface	Rail and sleeper train consist	Feb 2021 - Mar 2021	X								
	Concrete (on surface in gantry shed)	Jan 2021 – Jun 2021	X								
	Welding	Jun 2021 - Jul 2021	X								
	M&E Tunnel Fitout	April 2021 - Sep 2021	X								
Dive services building	Footings & foundations	April 2021 - Feb 2022	X								
	External Walls, doors, windows, roof and cladding	July 2021 - Oct 2022		X	X						
	Internal finishes and building services										
	External finishes	April 2022 - Oct 2022		X	X						
Fire services building	Footings & foundations	Aug 2022 - Oct 2022		X	X						
	External Walls, doors, windows, roof and cladding	Oct 2022 - Dec 2022				X					
	Internal finishes and building services										
	External finishes	Oct 2022 - Dec 2022					X				
Surface works	Demobilisation of gantry shed	Jun 2022 - Jul 2022		X							
	Hardstand removal (eastern side of site)	Jul 2022 - Aug 2022			X						
	Drainage and services	Aug 2022 - Oct 2022				X					
	Finishing works	Nov 2022 - Mar 2023					X				
	Demobilisation of site (spoil shed, site sheds etc.)	Nov 2022 - Mar 2023						X			
	Hardstand removal (western side of site)	Nov 2022 - Mar 2023							X		
Logistics	Delivery to spoil shed	Mar 2021 - Dec 2022	X	X	X	X	X			X	X
	Between spoil shed and gantry shed & around site	Mar 2021 - Sep 2022	X	X	X	X	X			X	X
	Delivery to gantry shed	Mar 2021 - July 2022	X							X	
	Concrete deliveries to spoil shed	Mar 2021 - May 2022	X							X	

5.2 Predicted noise levels

Predicted L_{Aeq} noise levels from the worksite are assessed against the NMLs and summarised in the following sections, with colour coding to denote the highest level of exceedance of the NML. Detailed results for each receiver are given in APPENDIX D.

The noise predictions presented in this CNVIS represent a realistic worst-case scenario when construction occurs at work locations 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 and the noise levels of particular plant items and equipment. Actual noise levels will often be less than the predicted levels presented in this CNVIS.

5.2.1 ICNG NMLs

The following sections present the predicted worst-case construction noise levels for each of the construction stages identified in Table 5-1 at the most affected residential receiver in each NCA. The results are presented in terms of level above the ICNG NMLs for standard hours and OOH work periods and, where predicted levels are above the NMLs, the perceived impact. Where predicted and/or measured construction noise levels are above the NMLs, all feasible and reasonable work practices will be applied to meet the NMLs.

5.2.1.1 Standard construction hours

Table 5-2 presents the construction noise impacts for **Standard Hours D(S)** as follows:

- Below NML
- < 10dB(A) above NML - construction noise clearly audible
- ◆ > 10dB(A) above NML - construction noise clearly moderately intrusive
- > 75dB(A) - highly noise affected (for residential receivers)

Table 5-2: Summary of construction noise impacts at nearby receivers – standard hours (ICNG)

NCA	Level of compliance with NML						
	V01 D(S)	V02 D(S)	V03 D(S)	V04 D(S)	V05 D(S)	V06 D(S)	V07 D(S)
CDS_01	●	●	○	●	●	○	□
CDS_02	●	●	□	◆	◆	◆	□
CDS_03	●	○	◆	◆	◆	◆	◆
CDS_04	●	○	◆	◆	○	○	◆
CDS_05	●	○	□	◆	◆	◆	□
CDS_06	-	○	○	●	●	●	○

NCA	Level of compliance with NML						
	V01 D(S)	V02 D(S)	V03 D(S)	V04 D(S)	V05 D(S)	V06 D(S)	V07 D(S)
CDS_07	●	●	○	●	●	○	◆
CDS_08	-	●	●	●	●	●	●
CDS_09	-	●	●	●	●	●	○
CDS_10	●	●	◆	○	○	○	◆
OSR	●	●	○	●	●	○	□

Notes:

Standard hours (7am to 6pm Monday to Friday and 8am to 6pm Saturday)

OSR: this includes all commercial, industrial and other sensitive receivers.

Based on the results presented in Table 5-2 above, noise levels are predicted to be above the noise management levels during most activities for nearby surrounding receivers. Noise impacts would be greatest during handstand removal where rock breakers are being used on the surface. Where rock breakers are being used, nearby residences in NCA CDS_02 and NDS_05 for the eastern works, and CDS_01, CDS_02 and CDS_05 for the western side of the site. It is noted that the handstand removal on the western side of the site may not occur.

For works other than the use for rock breakers for handstand removal, noise levels are predicted to be greater than 10dB(A) above the NMLs for nearby receivers.

As noise levels are predicted to be above the ICNG noise goals, proposed measures for managing potential noise impacts are provided in Section 5.3. For more detailed predictions, see APPENDIX D.

5.2.1.2 OOHW period 1

Table 5-3 presents the construction noise impacts for **OOHW period 1 D(O), E1/E2** as follows:

- Below NML
- < 5dB(A) above NML - construction noise noticeable
- ◆ 5 to 15dB(A) above NML - construction noise clearly audible
- > 15 to 25dB(A) above NML - construction noise moderately intrusive
- >25dB(A) above NML - construction noise highly intrusive

Table 5-3: Summary of construction noise impacts at nearby receivers – OOHW period 1 (ICNG)

NCA	Level of compliance with NML													
	V01		V02		V03		V04		V05		V06		V07	
	D(O)	E1/E2	D(O)	E1/E2	D(O)	E1/E2	D(O)	E1/E2	D(O)	E1/E2	D(O)	E1	D(O)	E1
CDS_01	●	●	●	-	●	-	●	-	●	-	●	-	◆	-

NCA	Level of compliance with NML													
	V01		V02		V03		V04		V05		V06		V07	
	D(O)	E1/E2	D(O)	E1/E2	D(O)	E1/E2	D(O)	E1/E2	D(O)	E1/E2	D(O)	E1	D(O)	E1
CDS_02	●	●	●	●	◆	●	○	●	○	●	◆	●	■	-
CDS_03	●	●	◆	●	■	●	■	●	■	●	■	●	□	-
CDS_04	○	○	◆	●	■	●	■	●	■	●	■	●	■	-
CDS_05	●	●	◆	-	■	-	■	-	◆	-	◆	-	■	-
CDS_06	●	○	◆	●	□	●	■	●	■	●	■	●	■	-
CDS_07	-	-	●	-	◆	-	●	-	●	-	○	-	◆	-
CDS_08	●	●	●	●	◆	●	○	●	○	●	◆	●	■	-
CDS_09	-	-	●	-	●	-	●	-	●	-	●	-	●	-
CDS_10	-	-	●	-	○	-	●	-	●	-	●	-	◆	-
OSR	●	●	●	●	◆	●	◆	●	◆	●	◆	●	□	-

Notes:

1. Day D(O): 1pm to 6pm Saturday and 8am to 6pm Sunday and Public Holidays

2. E1: early evening period from 6pm to 8pm.

3. E2: late evening period from 8pm to 10pm. Assessment against ICNG NMLs for this period is used to guide additional mitigation measures (Section 5.3.3). PPA Conditions E41/42 are applicable for this assessment period (see Section 0).

4. OSR: this includes all commercial, industrial and other sensitive receivers.

Based on the results presented in Table 5-2 above, noise levels are predicted to be above the noise management levels during most activities for nearby surrounding receivers. The results above have been presented for completeness, however the surface works occurring in variants V02 to V07 are not likely to occur during the daytime D(O) period.

The logistics and deliveries associated with the tunnel works would occur 24 hours a day and all feasible and reasonable noise mitigation measures would be implemented to minimise impacts. These works activities during the evening E1/E2 period the have been assessed to comply with CSSI-7400 Conditions E41 and E42 internal noise levels, as detailed in Section 5.2.2.

As the ICNG NMLs have not been achieved for all proposed activities on the site, all feasible and reasonable measures would be implemented for these works. This would involve limiting delivery truck to the spoil shed and gantry shed to not occur concurrently, loading and unloading using the spoil shed and gantry shed, and limiting deliveries during OOHW once the spoil shed has been demobilised, except where oversized deliveries are required. Further mitigation measures that would be adopted, where practicable, are identified in Section 5.3. Further, it is necessary to apply Planning Approval Conditions E41 and E42 in order to manage impacts (see Section 5.2.2).

For more detailed predictions, see APPENDIX D.

5.2.1.3 OOHW period 2

Table 5-4 presents the construction noise impacts for **OOHW period 2 (Night)** as follows:

- Below NML
- < 5dB(A) above NML - construction noise noticeable
- ◆ 5 to 15dB(A) above NML - construction noise clearly audible
- > 15 to 25dB(A) above NML - construction noise moderately intrusive
- >25dB(A) above NML - construction noise highly intrusive

Table 5-4: Summary of construction noise impacts at nearby receivers – OOHW period 2 (ICNG)

NCA	Level of compliance with NML				
	V01 N	V02 N	V03 N	V04 N	V05 N
CDS_01	-	-	-	-	-
CDS_02	-	-	-	-	-
CDS_03	●	-	-	-	-
CDS_04	○	○	○	○	○
CDS_05	◆	●	●	●	●
CDS_06	◆	●	●	●	●
CDS_07	○	-	-	-	-
CDS_08	◆	○	○	○	○
CDS_09	-	-	-	-	-
CDS_10	●	●	●	●	●
OSR	-	-	-	-	-

Notes:

N: Night-time period from 10pm to 7am Sunday to Thursday and 10pm to 8am Friday, Saturday and Public Holidays.

Based on the results presented in Table 5-4 above, noise levels are predicted to be above the noise management levels during most activities for at the nearest residential receivers, typically within 5 dB of the ICNG NML once logistics and deliveries associated with track construction are no longer required.

The logistics and deliveries associated with the tunnel works would occur 24 hours a day and all feasible and reasonable noise mitigation measures would be implemented to minimise impacts. These works activities during the night period the have been assessed to comply with CSSI-7400 Conditions E41 and E42 internal noise levels, as detailed in Section 5.2.2 below.

As the ICNG NMLs have not been achieved for all proposed activities on the site, all reasonable and feasible noise mitigation and management measures would be implemented. These mitigation and management measures are discussed in Section 5.1.1 of this report. Further mitigation measures that would be adopted, where practicable, are identified in Section 5.3. Further, it is necessary to apply Planning Approval Conditions E41 and E42 in order to manage impacts (see Section 5.2.2).

For more detailed predictions, see APPENDIX D.

5.2.2 PPA Conditions E41/42

Table 5-5 summarises the predicted noise impacts for each construction stage in each NCA compared with the internal NMLs in CSSI-7400 Conditions E41 and E42. Where predicted levels are above the E41/42 NMLs at residential receivers, additional mitigation measures will be implemented in accordance with the documented procedure in Addendum A of the SMCSNVS.

The impacts presented are as follow:

- Noise levels predicted to be below internal NMLs in PPA Conditions E41 and E42;
- Noise levels predicted to be above internal NMLs in PPA Conditions E41 and E42.

Table 5-5: Noise level summary for PPA Conditions E41/42 (residential only)

NCA	Level of compliance with NML									
	V01		V02		V03		V04		V05	
	E2	N	E2	N	E2	N	E2	N	E2	N
CDS_01	●	●	●	●	●	●	●	●	●	●
CDS_02	●	●	●	●	●	●	●	●	●	●
CDS_03	●	●	●	●	●	●	●	●	●	●
CDS_04	●	●	●	●	●	●	●	●	●	●
CDS_05	●	●	●	●	●	●	●	●	●	●
CDS_06	●	●	●	●	●	●	●	●	●	●
CDS_07	●	●	●	●	●	●	●	●	●	●
CDS_08	●	●	●	●	●	●	●	●	●	●
CDS_09	●	●	●	●	●	●	●	●	●	●
CDS_10	●	●	●	●	●	●	●	●	●	●

Notes:

1. E2: late evening period from 8pm to 10pm.

2. N: Night-time period from 10pm to 7am.

The results in Table 5-5 indicate that construction noise is predicted to comply with the internal noise threshold of PPA Conditions E41/E42 at the nearest residential receivers within all NCAs. The noise predictions are based upon the activities and plant and equipment presented in APPENDIX C. The dominate source of noise is from heavy vehicles moving around on site outside the spoil and gantry sheds.

Proposed measures for managing potential noise impacts are provided in Section 5.3. For more detailed predictions, see APPENDIX D. Based upon results presented in Section 5.2, additional noise mitigation is not required.

5.2.3 Sleep disturbance

Review of the truck access finds that a smooth transition from the road to the site has been provided to minimise noise impacts as heavy vehicles arrive on site. Furthermore, traffic lights have been installed to allow safe egress from the site. This allows maximum noise levels from heavy vehicle in/egress to be more controlled. Toolbox talks will be used to advise all personnel of the need to follow quiet work practices during OOHW periods and of the need to respect the residential receivers surrounding the work site. All heavy vehicle drivers will be instructed of the need to minimise unnecessary acceleration on site and when exiting the site, and to reducing the need for sudden or hard braking or application of the park brake where practicable (as per CNVMP). Other management measures are outlined in Section 5.3 to aid in providing additional noise reduction benefits to assist in meeting the noise objectives.

It is noted that a more detailed analysis of L_{Amax} noise levels along Mowbray Road has been undertaken. For this assessment, the following has been considered:

- Existing truck volume at night along Mowbray Road:
 - Mowbray Road: traffic counts over the week of 7 December 2017 to 13 December 2017 were provided by JHCPBG.
- Number of L_{Amax} noise events above predicted $RBL + 15 \text{ dB(A)}$ [i.e. $L_{Amax} 54 \text{ dB(A)}$] from the existing traffic along Mowbray Road was determined based on the findings of Eric Schreurs et al. [13] in relation to the distribution of noise level maxima for different vehicle types at certain speeds.
- Construction traffic movements from Chatswood construction site at night (see APPENDIX C Table C1): up to 4 concrete / delivery trucks per hour are expected to exit onto Mowbray Road.

The comparison of L_{Amax} noise events from the existing traffic and the project is presented in Table 5-6.

Table 5-6: Sleep disturbance assessment

Site	Road	Existing traffic	Project
		No of L_{max} events above 54 dB(A)	No of truck movements at night
Chatswood	Mowbray Road	174	144

As can be noted from Table 5-6, there are 30 more maximum noise events from existing road traffic passbys along Mowbray Road above the predicted maximum levels of $RBL + 15 \text{ dB(A)}$ when compared to the total number of proposed construction movements along Mowbray Road. This is based traffic volumes presented in APPENDIX C of up to 16 heavy vehicles accessing the site per hour during the night period.

The estimated maximum noise levels from the existing traffic are consistent with measurement data from the nearby noise loggers. Noise monitoring results at 14 Nelson Street (i.e. EIS B.24), close to Mowbray Road, identified L_{Amax} noise levels ranging from 60 dB(A) to 85 dB(A).

Noise monitoring should be undertaken to determine if sleep disturbance is higher than the NML of 65 dB(A) L_{A1} (1 minute) during the night period. If verification monitoring shows noise levels are consistently above the sleep disturbance NML, investigation will be undertaken to understand the cause of the exceedance and additional mitigation and management measures will be implemented in accordance with Sydney Metro City and South West Noise and Vibration Strategy.

5.3 Noise mitigation and management

5.3.1 Consultation with affected receivers (CSSI-7400 Condition E33)

CSSI-7400 Condition E33 requires consultation with affected receivers to assist in determining site-specific mitigation measures to be included in this CNVIS.

Systems Connect will continue consultation with affected sensitive receivers during early investigation works carried out prior to commencement of works.

Systems Connect will continue to consult with potentially affected sensitive receivers, both prior to and following commencement of construction.

Consultation with affected sensitive receivers is informing and will continue to inform the identification of specific mitigation measures for the Chatswood site. These measures may include minimising high noise impact works during night time hours; limiting night time works in individual locations to no more than two consecutive nights; scheduling high noise impact works around sensitive periods where feasible and reasonable; offers of movie or dinner vouchers; alternative accommodation offers.

5.3.2 Site noise control measures

In addition to the noise mitigation measures identified during detailed design (see Section 5.1.1), the following Table 5-7 presents additional noise control measures recommended to reduce and manage potential noise impacts. Table C1 in APPENDIX C notes specific management measures for the key construction stages to reduce noise impacts.

Table 5-7: Site noise control measures

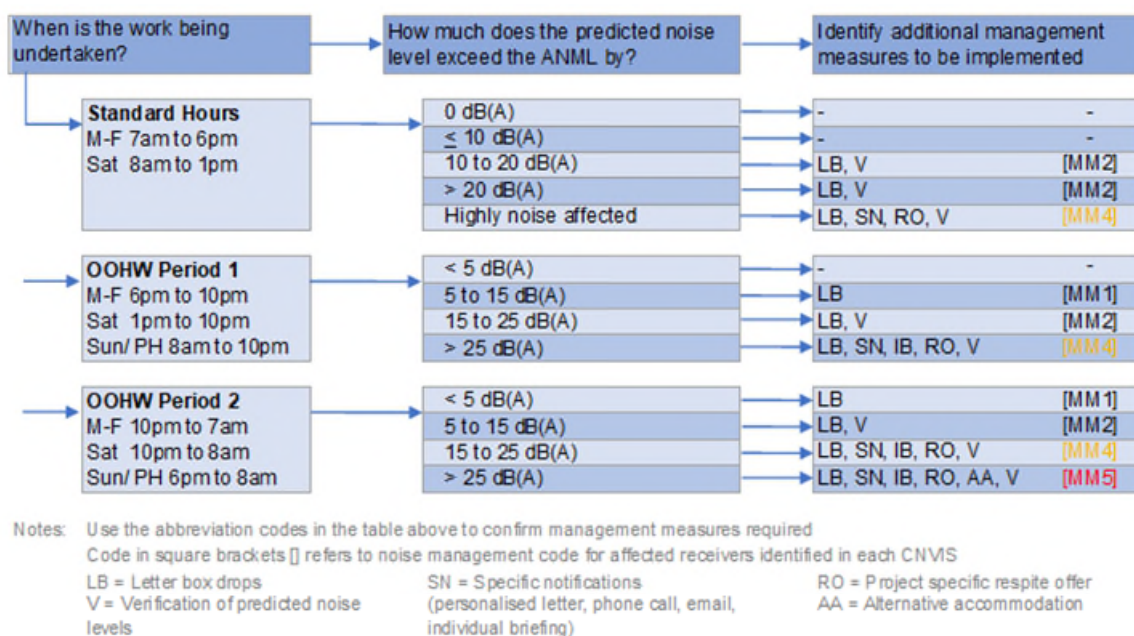
Control type	Control measure	Typical use
At-source control measures	Limit equipment in use	Only the equipment necessary during each stage of the works will be used.
	Timing of equipment in use	Where practicable, activities and plant will be limited as outlined in Table C1 (APPENDIX C).
	Limit activity 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.

Control type	Control measure	Typical use
	Truck movements	Where practicable, avoid the use of park air brakes at night. Air brake silencers are to be correctly installed and fully operational for any heavy vehicles (as per CNVMP). Minimise unnecessary acceleration on site.
	Non-tonal reversing alarms	Alternative reverse alarms, such as 'quackers' will be installed on all vehicles & mobile plant regularly used on site and on all vehicles & mobile plant required for OOHV.
Path mitigation measures	Temporary noise screens	Where practicable, temporary noise screens (e.g. Flexshield, Echo-barrier, or similar) should be used to provide additional noise reduction during works. Temporary noise screens can provide 5 to 10 dB noise reduction, where they can break line of sight.
	Acoustic sheds	All deliveries outside standard hours are to use the spoil shed or gantry shed for loading and unloading. Deliveries to the spoil shed and gantry shed would not occur at the same time.
Noise management measures	Site inductions & Toolbox Talks	All employees, contractors and subcontractors will receive a Project induction. The environmental component may be covered in toolboxes and should include: <ul style="list-style-type: none"> • location of nearest sensitive receivers • relevant project specific and standard noise and vibration mitigation measures; • permitted hours of work; • OOHV Procedure and Form • construction employee parking areas.
	Community consultation	Inform community of construction activity and potential impacts.
	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 Section 5.3.4.

5.3.3 Additional noise mitigation measures

Table 5-8 below should be used to advise the appropriate additional noise mitigation during construction, based on the CNVS [9] and the CNVMP [1].

Table 5-8: Additional airborne noise mitigation measures



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 the project enquiries and complaints 1800 numbers (see Section 5.3.5)

5.3.4 Attended noise monitoring

Real time noise monitoring in accordance with CSSI-7400 Condition C11 is not proposed to be undertaken for the Chatswood site. Attended noise monitoring will be undertaken as required by this CNVIS. Noise monitoring is subject to obtaining the property owner/occupier's consent to access the property (where required). If consent to access property is denied, monitoring will be done on public land on the property boundary, provided it is safe to do so.

Attended noise monitoring will be undertaken during works at one of the representative residential receivers identified in the table below. Nominated attended measurement locations have been selected with the best opportunity to validate the predicted noise levels.

Table 5-9: Nominated verification monitoring locations

NCA	Nominated receiver address	Monitoring location at 1 m from
CDS_03	2 NELSON STREET CHATSWOOD	Western facade
CDS_03	7-11 NELSON STREET CHATSWOOD	Southern facade
CDS_03	6 ORCHARD ROAD CHATSWOOD	Western facade
CDS_06	344 MOWBRAY ROAD ARTARMON	Northern facade

Notes:

Monitoring on private property is subject to owner consent and where relevant, occupier consent. If consent to access property is denied, monitoring will be done on public land on the property boundary, provided it is safe to do so.

Noise monitoring should be undertaken to determine if the construction noise levels are higher than ICNG internal noise goals during standard daytime hours, and the external equivalent NML specified in CSSI-7400 conditions E41/E42. If verification monitoring shows that the external noise levels are consistently above the predicted (or required) noise levels presented in 5.2, investigation will be undertaken to understand the cause of the exceedance and additional mitigation and management measures will be implemented in accordance with Sydney Metro City and South West Noise and Vibration Strategy.

5.3.5 Complaints Handling

Noise complaints received and responded to will be managed in accordance with the CNVMP and the Community Consultation Strategy.

Transport for NSW operate a 24-hour construction complaints line (1800 171 386).

Enquiries/ complaints may also be received through the Sydney Metro project email (LinewideMetro@transport.nsw.gov.au).

6 Construction vibration impacts

6.1 Minimum working distances for vibration intensive plant

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

- Compactor / roller (14 tonnes)
- Excavator with hammer (35-45T)

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 are presented in Table 6-1 and Table 6-2. These distances are conservatively based on excavation of hard rock. Site specific minimum working distances for vibration intensive plant items must be measured on site where plant and equipment are likely to operate close to or within the minimum working distances for cosmetic damage (Table 6-1).

Unlike noise, vibration cannot be readily predicted. There are many variables from site to site, such as soil type and conditions, sub surface rock, building types and foundations, and actual plant on site.

The data relied upon in this assessment (tabulated below) is taken from a database of vibration levels measured at various sites or obtained from other sources (such as BS5228-2:2009). They are not specific to this project 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.

Table 6-1: Minimum working distances (m) for cosmetic damage (continuous vibration)

Plant item	Minimum working distance (m)		
	Reinforced or framed structures (e.g. commercial buildings) ¹	Unreinforced or light framed structures (e.g. residential buildings) ¹	Sensitive structures (e.g. heritage structures) ²
Compactor / roller (4-14t) - high vibration	5	5	15
Compactor / roller (4-14t) - low vibration	5	5	10
Excavator with hammer (35-45T)	5	10	10

Notes

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

2) In accordance with Section 5.8.1 of CNVMP, a site inspection should determine whether a heritage structure is structurally unsound.

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

Table 6-2: Minimum working distances (m) for human annoyance (continuous vibration)

Plant item	Minimum working distances, m				
	Critical areas ^{1,4}	Residences Day ²	Night ²	Offices ^{3,4}	Workshops ⁴
Compactor / roller (4-14t) - high vibration	105	55	75	30	15
Compactor / roller (4-14t) - low vibration	75	40	55	20	10
Excavator with hammer (35-45T)	40	25	30	20	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 6-3.

Table 6-3: Number of buildings within minimum working distances for cosmetic damage

Plant item	Number of buildings	
	Screening criteria for non-heritage structures	Screening criteria for heritage structures
Compactor / roller (4-14t) - high vibration	0	1
Compactor / roller (4-14t) - low vibration	0	1
Excavator 35t with hydraulic hammer attachment	0	1

The roller would be used within the eastern side of the existing Chatswood site for drainage and services and finishing works. The excavator with rock breaker attachment would be used for breaking out the hard stands on the eastern side of the site, and potentially the western side if required. It is more than 15 metres from site to the nearest receivers across the rail line, Mowbray Road, Pacific Highway and Nelson Street. There are no buildings outside the worksite within the minimum working distances established for cosmetic damage during use of the vibratory roller.

Mowbray House, located within the site, is a heritage listed building. For works using the roller or excavator with rock breaker attached within the minimum working distances, continuous vibration measurements are recommended to ensure vibration is below the relevant limits.

A structural report should be prepared for Mowbray House to determine if the building is structurally sound. Depending on the outcomes of the assessment, the vibration limit would be set to either 2.5mm/s if it is found to be structurally unsound, or 25.0 mm/s for a reinforced/ framed structure.

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.

Properties where vibration levels may be above the vibration disturbance goals in Table 4-2 and there is a probability of adverse comment are shown in Table 6-4.

Table 6-4: Number of buildings within minimum working distances for human annoyance

Plant item	Critical areas ^{1,4}	Residences ⁵		Offices ^{3,4}	Workshops ⁴
		Day ²	Night ²		
Compactor / roller (4-14t) - high vibration	0	6	0	0	0
Compactor / roller (4-14t) - low vibration	0	6	0	0	0
Excavator 35t with hydraulic hammer attachment	0	0	0	0	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.

There are six receivers predicted to experience vibration which can cause adverse comment when the roller is being used on high vibration within the minimum working distance of 55 meters (or low vibration within the minimum working distance of 40 metres). This may occur near the northern and southern extents of the site. The receivers are located to the north of the site on Nelson and to the south on Mowbray Road. The potentially affected receivers are listed below:

- 7-11 Nelson Street Chatswood
- 15 Nelson Street Chatswood
- 17 Nelson Street Chatswood
- 19 Nelson Street Chatswood
- 342 Mowbray Road Artarmon

- 344 Mowbray Road Artarmon

Where practicable, the vibratory roller should be limited to 'low-vibration' mode to reduce the likelihood of disturbance to residential receivers. It is noted that the minimum working distance for human disturbance conservatively assumes that the vibratory roller would be used continuously over the construction day period.

Attended vibration measurements are proposed to be carried out proactively and in response to vibration complaints. If measurement results indicate exceedances of the vibration objectives for human annoyance at these locations, vibration control and management measures will be provided to reduce vibration impact (see Section 6.3.1).

6.3 Vibration mitigation measures

6.3.1 Vibration control and management measures

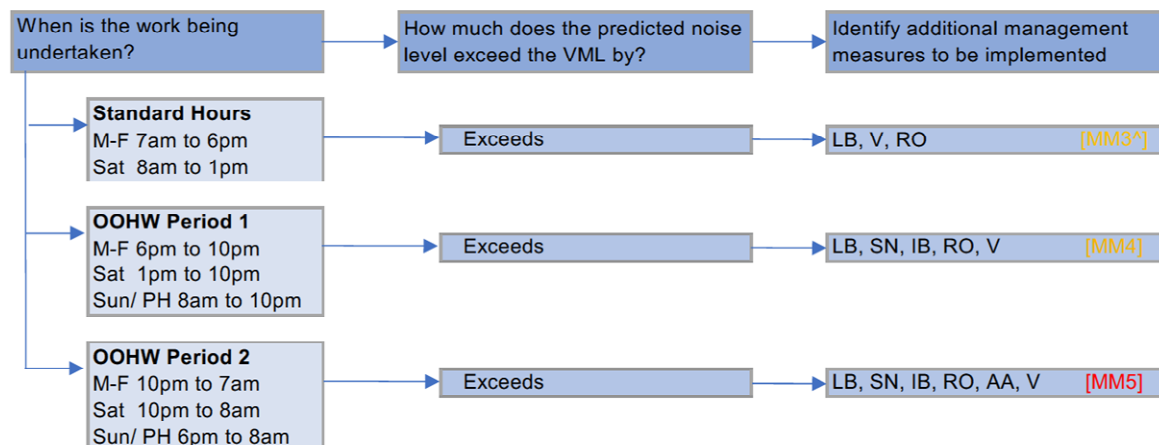
In addition to the vibration control measures presented in the CNVMP, the following vibration management measures are provided to minimise vibration impact from construction activities to the nearest affected receivers and to meet the relevant human comfort vibration and structural damage limits identified in Section 4.2.

Table 6-5: Site vibration control measures

Control type	Control measure	Typical use
Construction planning	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 Construction Complaints Management System (see Section 6.3.4). 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.

6.3.2 Additional vibration mitigation measures

After applying all feasible and reasonable mitigation measures identified in Table 6-5, if vibration monitoring at representative locations are still above relevant vibration objectives for human annoyance, the appropriate additional vibration mitigations measures, as outlined in Section 8.2 of the CNVMP.

Table 6-6: Additional vibration mitigation measures

Notes: Use the abbreviation codes in the table above to confirm management measures required
Code in square brackets [] refers to noise management code for affected receivers identified in each CNVIS

LB = Letter box drops

SN = Specific notifications

RO = Project specific respite offer

V = Verification monitoring

IB = individual briefing

AA = Alternative accommodation

6.3.3 Vibration monitoring

Vibration monitoring may be required in response to vibration complaints. Real-time vibration monitoring in accordance with PPA Condition C11 is not proposed for this site.

6.3.4 Management of complaints

Vibration complaints received and responded to will be managed in accordance with the CNVMP and the Community Consultation Strategy.

Transport for NSW operate a 24-hour construction complaints line (1800 171 386).

Enquiries/ complaints may also be received through the Sydney Metro project email (LinewideMetro@transport.nsw.gov.au).

7 Ground-borne noise assessment

Due to the nature of the Chatswood station, which are surface works, airborne noise is expected to be much higher than ground-borne noise levels at the nearest sensitive receivers.

The risk of annoyance due to ground-borne noise is therefore considered low and has not been addressed further in this CNVIS.

8 Traffic noise assessment

8.1 Traffic sources

All heavy vehicles will access the C2S Chatswood worksite via Mowbray Road and Pacific Highway which are arterial roads with significant daytime and night-time flows, and exit the construction site as follows:

- During day and evening periods, all heavy trucks will exit on to Mowbray Road and turn right to merge on to Pacific Highway. However, RMS has requested heavy vehicles to turn left into Mowbray Road during morning and afternoon peak times to minimise impact to already congested traffic on this road.

Details of projected heavy vehicle movements associated with the construction works were provided by Systems Connect and described in APPENDIX C Table C1. Light vehicle movements associated with construction were not considered to be significant.

To predict road traffic noise levels on the existing road network, the most recent available traffic count data for each road forming part of the site access route was obtained by reviewing the following reference source:

- RMS Traffic volume viewer (last access 19/12/2017) – location: 80m south of Mowbray Road, station id 33014;
- Traffic counts for Mowbray Road over the week of 7 December 2017 to 13 December 2017 were provided by JHCPBG.

Traffic volumes are detailed in Table 8-1.

Table 8-1: Traffic noise modelling data - existing road network

Site	Road	Road category (RNP)	15-hour day period (7am-10pm)				9-hour night period (10pm-7am)			
			Existing		Project		Existing		Project	
			TOTAL	HV	TOTAL	HV	TOTAL	HV	TOTAL	HV
Chatswood	Pacific Highway	Arterial	51155	3237	840	600	10201	1003	432	288
Chatswood	Mowbray Road	Arterial	24668	730	840	600	2477	174	432	288

8.2 Predicted construction traffic noise

The potential impact of construction road traffic noise to nearby residential receivers has been estimated using the United Kingdom Department of Environment's 'Calculation of Road Traffic Noise' (1988) method.

Table 8-2 below summarises the predicted increase in traffic noise levels during day and night periods due to construction related road traffic noise.

Table 8-2: Predicted traffic noise levels (with/ without construction)

Site	Road	Road category (RNP)	Increase, dB(A)	
			Day $L_{Aeq(15h)}$	Night $L_{Aeq(9h)}$
Chatswood	Pacific Highway	Arterial	0.3	0.6
Chatswood	Mowbray Road	Arterial	0.5	1.6

Notes:

* Predicted increases are based on the most impacted receiver

The predicted road traffic noise levels indicate a less than 2dB(A) increase in overall day $L_{Aeq(15h)}$ and night $L_{Aeq(9h)}$ noise on nearby main roads and so construction traffic is predicted to have minimal impact on this road used to access/exit the site.

Predicted noise levels therefore comply with the traffic NMLs identified in Section 4.1.4.

8.3 Traffic noise mitigation and management

The Heavy Vehicle Code of Conduct includes several measures, including limiting of compression braking, which will ensure that noise impacts of heavy vehicle traffic on surrounding streets are minimised.

9 Cumulative impacts

The impacts addressed in this assessment have not considered the additional works that are proposed to occur for the Northern Connection works. These impacts have been considered in the C2B Northern Connection CNVIS [ref:TK685-03-02F01 CNVIS C2B_P3 Northern Connection (r5)]. The impacts predicted in the Northern cConnection CNVIS are considerably higher than those presented in this CNVIS for works occurring during possessions outside standard hours. This is due to the requirement for high noise generating plant and equipment to be operating within the rail corridor adjacent to surrounding residences. As a result, any increase in noise from the Chatswood works would not be significant, therefore the cumulative impacts from all works are addressed in the Northern Connection CNVIS.

Works occurring during standard hours would on the surface would be the dominate source of noise for most construction activities. Based on this, the additional mitigation measures provided during standard hours are appropriate and additional noise from other surrounding works is not considered to be significant.

Systems Connect are aware of other ongoing, potentially concurrent construction activities within the vicinity of the Chatswood worksite. These works, summarised in Table 9-1, may have the potential to generate cumulative noise impacts on receivers. These works have been considered but it has been determined that, due to the nature of the other unrelated construction works, no additional physical mitigation measures are deemed reasonable. Nevertheless, Systems Connect will endeavour to take all reasonable steps to collaborate with other Projects to minimise cumulative noise and vibration impact where Systems Connect are above management levels and coordinate respite for affected sensitive receivers, whenever practicable.

Table 9-1: Other construction works close to Chatswood worksite

Construction company	Project	Timing of activities	Hours of works	Works location	Activity types	General plant types
Systems Connect Northern Connection	Sydney Metro - Main North and North Shore Corridor Works	September 2018 to 2021	Standard construction hours, outside construction hours and rail possession works. Intermittent out of hours works between Chatswood and Artarmon train stations on the eastern extent	Between Chatswood and Artarmon train stations on the eastern extent	Rail and signalling modification works	Utility relocation, minor earthworks, signal and rail modification.
Sydney Trains	Sydney Train maintenance works	Based on Sydney Trains trackwork schedule	Based on Sydney Trains trackwork schedule	Any point along the railway corridor. Immediately adjacent to LWW worksite	Rail and signalling maintenance works	Utility relocation, minor earthworks, signal and rail modification.
JHCPBG JV	Sydney Metro TSE Works	May 2020 to October 2020	Standard construction hours, outside construction hours and rail possession works.	Northern portal Zone 4 and Zone 5		Stage 3 - Post piling

10 Conclusion

Works associated with the C2S Chatswood site surface works and tunnel fitout works have been identified and described in this report. Potentially affected noise and vibration sensitive receivers and relevant construction noise and vibration objectives have been identified and discussed to allow the assessment of potential construction impacts.

Expected construction noise levels have been predicted and presented in Section 5.2 and APPENDIX D. The expected duration of construction activities is outlined in Table C1 of APPENDIX C.

For works associated with the tunnel fitout, construction noise is predicted to comply with the ICNG noise goals during the daytime period and are compliant with Conditions E41 and E42 at all assessed residential receivers.

For surface works other than deliveries and logistics for the tunnel fitout, construction activities would only occur during the standard daytime period. Noise is predicted to be above the ICNG noise goals for most activities during the standard daytime hours.

Noise mitigation and management measures have been presented in Section 5.3 to aid in providing additional noise reduction benefits where exceedance of the objective occurs.

Vibration impacts and management measures have been presented in Section 6 to aid in minimising any potential vibration impacts.

The potential impact of ground-borne noise from construction activities is expected to be negligible due to the expectation that airborne noise (potentially from sources other than construction, such as road and rail traffic) will be much higher than ground-borne noise levels at the nearest sensitive receivers.

Construction traffic noise on the local road network associated with the works is predicted to have minimal impact on receivers in proximity to public roads.

References

- [1] Sydney Metro City & Southwest – Line Wide Works Contract Construction Noise and Vibration Management Plan (SMCSWLWC-SYC-1NL-PM-PLN-000032-A-CNVMP-C2B)
- [2] SLR Consulting Australia Pty Ltd 2016 Sydney Metro Chatswood to Sydenham - Technical Paper 2: Noise and Vibration Report Number 610.14718R1 – 28 April 2016
- [3] Department of Environment and Climate Change 2009 NSW Interim Construction Noise Guideline
- [4] Department of Environment Conservation NSW 2006 Assessing Vibration; a technical guideline
- [5] British Standard BS 7385 Part 2 1993, Evaluation and measurement for vibration in buildings. Guide to damage levels from groundborne vibration
- [6] German Standard DIN 4150-3:2016-12 Vibration in buildings – Part 3: Effects on structures
- [7] British Standard BS 6472-2008, Evaluation of human exposure to vibration in buildings (1-80Hz)
- [8] Transport for NSW Sydney Metro City & Southwest Construction Noise Strategy (ref: 610.14213-R3) 08 August 2016
- [9] Transport for NSW Construction Noise and Vibration Strategy (ref: 7TP-ST-157/4.0) May 2018
- [10] Transport for NSW Sydney Metro Construction Environmental Management Framework August 2016
- [11] Department of Environment, Climate Change and Water 2011 NSW Road Noise Policy
- [12] NSW Department of Planning – Development near rail corridors and busy road – interim guideline 2008
- [13] Eric Schreurs, Lex Browns and Deanna Tomerini – Maximum pass-by noise levels from vehicles in real road traffic streams: comparison to modelled levels and measurement protocol issues. Internoise 2011, Osaka Japan, September 4-7

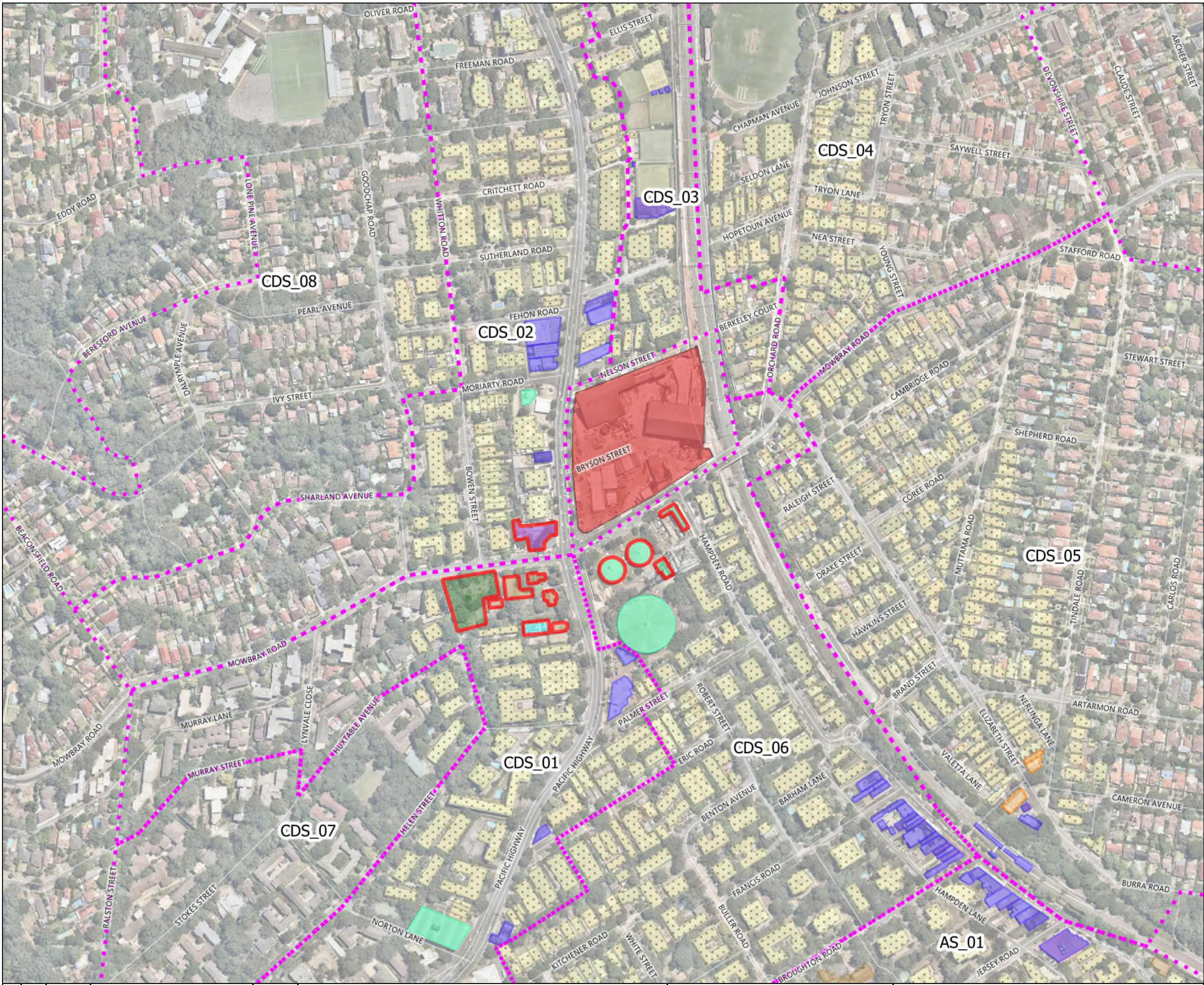
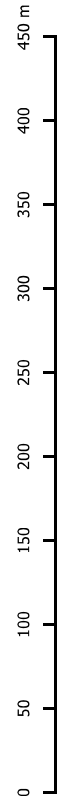
APPENDIX A Glossary of terminology

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.
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).
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.
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.
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 L ₉₀ 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.
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 L _{eq} sound levels over any period of time and can be used for predicting noise at various locations.
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	The level of noise, usually expressed in decibels, as measured by a standard sound level meter with a microphone.
Sound power level	Ten times the logarithm to the base 10 of the ratio of the sound power of the source to the reference sound power.
Tonal noise	Containing a prominent frequency and characterised by a definite pitch.

APPENDIX B **Nearest sensitive receivers and noise management levels**



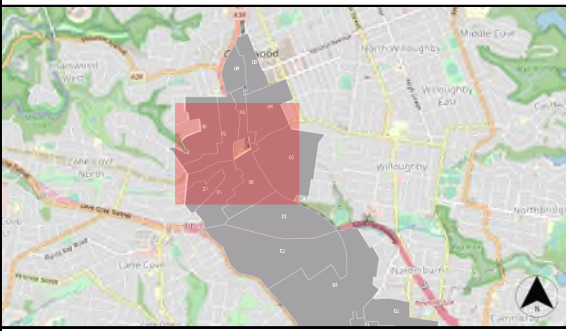
LEGEND

Noise sensitive receivers

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

NCA

Chatswood work area



REV	BY	DATE	DESCRIPTION	APPROVER
0	RP	24/04/20	Prepare figures	RP
A3 Original				

0	50	100	150	200 m
1:4500				
FULL SIZE A3				
NOTE: Do not scale from this drawing.				

CLIENT

Systems Connect

ACOUSTIC CONSULTANT

RENZO TONIN & ASSOCIATES
inspired to achieve

Ph (02) 8218 0500 Fax (02) 8218 0501

SYDNEY METRO - CHATSWOOD TO SYDENHAM

LINE WIDE WORKS
Land Use, NCAs
Work area: Chatswood

Sheet 0 of 2

Table B1: Noise sensitive receivers and construction noise management levels

CHATSWOOD SMTF

NCA	Nearest construction work area	Receiver Type	Reference RBL	Existing Noise Levels $L_{A90(15min)}$, dB(A)			Residential NMLs based on ICNG (external), $L_{Aeq(15min)}$				Sleep Dist. L_{Amax}		Comments
				RBL Day	RBL Evening	RBL Night	NML DS	NML DO	NML E	NML N	Screening ¹	Max ¹	
Portion 2 & 3	Chatswood to Sydenham (C2S)												
CDS_01	Chatswood Dive	Residential buildings on Pacific Hwy and along Mowbray Road, south of Mowbray Rd. Traffic noise affected.	RTA TH511-L02 516 Pacific Hwy, Chatswood	55	54	42	65	60	59	47	57	65	
CDS_02	Chatswood Dive	Residential apartments on Pacific Highway opposite site and along Mowbray Road, north of Mowbray Rd. Traffic noise affected.	RTA TH511-L02 516 Pacific Hwy, Chatswood	55	54	42	65	60	59	47	57	65	
CDS_03	Chatswood Dive	Residential apartments north of Nelson St and west of rail line	C2S EIS B.24	50	47	39	60	55	52	44	55	65	
CDS_04	Chatswood Dive	Residential buildings north of Mowbray Rd, east of railway line (behind rail barrier)	C2S EIS B.25	41	40	35	51	46	45	40	55	65	
CDS_05	Chatswood Dive	Residential buildings south of Mowbray Rd, east of railway line (behind rail barrier)	C2S EIS B.22	42	41	34	52	47	46	39	55	65	
CDS_06	Chatswood Dive	Residential apartments south of Mowbray Rd and west of rail line	C2S EIS B.24	50	47	39	60	55	52	44	55	65	
CDS_07	Chatswood Dive	Residential buildings west of Pacific Hwy and south of Mowbray Road, shielded by CDS_01	C2S EIS B.22	42	41	34	52	47	46	39	55	65	
CDS_08	Chatswood Dive	Residential buildings west of Pacific Hwy and north of Mowbray Road, shielded by CDS_02	C2S EIS B.25	41	40	35	51	46	45	40	55	65	
AS_01	Artarmon Substation	Residential apartments north of Gore Hill Freeway, west of Reserve Rd, south of Butchers Ln	C2S EIS B.21	49	46	41	59	54	51	46	56	65	
Other sensitive receivers							Sensitive Receiver NMLs based on ICNG (see comments for details), $L_{Aeq(15min)}$						
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)		
Office building (general office 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)		
Railway platform and concourse areas							75	75	75	75	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 loss)
DS: standard construction hours from 7 am to 6 pm Monday to Friday and from 8 am to 6 pm Saturday
DO: 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

APPENDIX C

Construction details

C.1 Construction timetable/ activities/ management

Table C1: Construction Activities/ Equipment

Work activity	Details	Indicative timing/ duration	Modelling ID	Plant/ Equipment (as provided by client)	Day	Evening	Night	Sound Power Level (Lw re: 1pW) in Noise Model, dB(A)			High noise plant (EPL E1)	Vibration intensive plant	Notes					
					7am - 6pm	6pm - 10pm	10pm - 7am	L _{Aeq}	Penalty	L _{Amax}								
TRACK CONSTRUCTION - inside dive and tunnels																		
Rail and sleeper train consist		Feb 2021 - Mar 2021		Hiab	Rail set (train consist)	1	1	1	98	-	102	-	-					
				Excavator w bucket (25t)	Excavator 20t - Rubber tyre	2	2	2	103	-	108	-	-					
				Front end loader	Front end loader	1	1	1	110	-	115	-	-					
				-	Rail trolley	1	1	1	-	-	-	-	-					
Concrete	Dive Concrete Placement:	Jan 2021 - Mar 2021		Concrete pump	Concrete pump (line)	1			103	-	107	-	-	Concrete FRP in dive covered by existinq CNVIS				
				Concrete Aqi	Concrete Aqi	4 p.h.			108	-	111	-	-	Truck drive down ramp to pump				
					Concrete vibrator	Concrete vibrator	5	5	5	97	-	100	-	-	IN DIVE/TUNNEL			
					Hand tools (Power)	Hammer drill/ power saw	2	2	2	107	-	118	-	-	IN DIVE/TUNNEL			
					Concrete Aqi	Concrete Remixer	1	1	1	108	-	111	-	-	Concrete deliveries will be managed with other deliveries coming to site			
					Concrete Pump (Putzmeister BSC 1409 D)	Concrete Pump (Putz 1409)	1	1	1	116	-	118	-	-				
					Pressure washer (70Mpa and Nozzel 0.5mm)	Pressure Washer - Diesel	1	1	1	109	-	115	-	-				
					Concrete Aqi	Concrete Aqi	up to 4 p.h.	up to 4 p.h.	up to 4 p.h.	108	-	111	-	-	Typically 2 on site at a time, Discharge into surface			
					Compressor	Air compressor - Diesel	1	1	1	102	-	103	-	-	remixer, pumped via pipe to shuttle at track level			
					Excavator w bucket (25t)	Excavator 20t - Rubber tyre	1	1	1	103	-	108	-	-	Excavator to handle skip bins, tow trailer pump			
					Excavator w bucket (25t)	Excavator 20t Hi-rail	1	1	1	103	-	108	-	-				
					Tipper	Rail Waqon	1	1	1	103	-	111	-	-				
					Concrete Aqi	Concrete remixer	1	1	1	108	-	111	-	-				
					Concrete Pump (Putzmeister BSC 1409 D)	Concrete Pump (Putz 1409)	1	1	1	116	-	118	-	-				
					Concrete Aqi	Concrete remixer	1	1	1	108	-	111	-	-	Starts in Northern Dive before moving into tunnel			
					Compressor	Air compressor - Diesel	1	1	1	102	-	103	-	-				
					Pressure washer (70Mpa and Nozzel 0.5mm)	Pressure Washer - Diesel	1	1	1	109	-	115	-	-	Surface			
					Pressure washer (70Mpa and Nozzel 0.5mm)	Pressure Washer - Diesel	1	1	1	109	-	115	-	-	Dive			
					Pressure washer (70Mpa and Nozzel 0.5mm)	Pressure Washer - Diesel	1	-	-	109	-	115	-	-	Tunnel			
					Concrete / road / rail saw	Demolition saw	1	-	-	121	5	129	HN	X				
					Excavators with hammers (10-15T)	Excavator 13t w hammer	1	-	-	115	5	120	HN	X				
					Tipper	Tipper Truck - Hi-rail	various	-	-	103	-	111	-	-				
	Welding		Jun 2021 - Jul 2021		Welding tools /oxy	Aluminotherrmic welding set-up	1	1	1	102	-	105	-	-	Will be done sometime in 2021 for the dive, pending NC works			
					Handtool - grinder	Grinder	2	2	2	107	-	118	HN	-				
M&E Tunnel Fitout incl. walkways		April 2021 - September 2021		Light vehicles / traffic control utes	Light vehicle	4 p.h.	1 p.h.	1 p.h.	89	-	100	-	-					
				Handtool - rattle qun	Rattle qun	2	2	2	107	-	118	-	-	Fixing brackets etc to tunnel/dive wall.				
				Handtool - grinder	Grinder	2	2	2	107	-	118	HN	-					
				Welding tools /oxy	Welder - Diesel	1	1	1	102	-	105	-	-					
				Generator	Generator - Diesel	1	1	1	94	-	95	-	-					
				EWP	EWP - Hi-rail	2	2	2	95	-	98	-	-					
				Tipper	Trucks 12t rigid - Hi-rail	2	2	2	103	-	111	-	-					
				Forklift	Fork Lift / material handler	2	2	2	99	-	103	-	-					
BUILDINGS - dive services building, fire services building																		
Dive Services Building																		
Footings & Foundations	Reinforced concrete works and blockwork	April 2021 - Feb 2022		Delivery truck	Flatbed truck	2 p.h.	-	-	102	-	111	-	-					
Insitu Concrete slab				Light vehicles / traffic control utes	Ute	4 p.h.	-	-	89	-	100	-	-					
Blockwork	Installation of columns, mullions, girts, purlins, etc...			Water cart	Water Cart	1	-	-	104	-	107	-	-					
Structural Steel Installation				Crane (Grove GMK5130)	Crane (Grove GMK5130)	2	-	-	105	-	103	-	-					
				EWP	EWP	2	-	-	95	-	98	-	-					
				Hand tools	Hand tools	various	-	-	105	-	111	-	-					
				Hand tools (Power)	Power tools	various	-	-	107	-	118	-	-					
				Handtool - rattle qun	Rattle qun	2	-	-	107	-	118	-	-					
				Concrete vibrator	Vibrator	2	-	-	97	-	100	-	-					
				Hiab	Hiab	1	-	-	98	-	102	-	-					
				Telehandler / Franna crane (20t)	Telehandler	1	-	-	99	-	103	-	-					
				Hand tools	Hand tools	various	-	-	105	-	111	-	-					
				Hand tools (Power)	Power tools	various	-	-	107	-	118	-	-					
				EWP	EWP	2	-	-	95	-	98	-	-					
				Handtool - rattle gun	Rattle qun	2	-	-	107	-	118	-	-					
				Buildings Services	HVAC, electrical, hydraulics, fire, security, comms, gas suppression, etc...			Telehandler / Franna crane (20t)	Telehandler	1	-	-	99	-	103	-	-	
Delivery truck	Delivery truck	2 p.h.	-					-	102	-	111	-	-					
External finishes		April 2022 - October 2022		Hand tools	Hand tools	various	-	-	105	-	111	-	-					
				Hand tools (Power)	Power tools	various	-	-	107	-	118	-	-					
				Asphalt Paver	Paver	1	-	-	105	-	112	-	-					
				Delivery truck	Shuttle buqqies	1	-	-	102	-	111	-	-					
				Vibratory Roller - smooth drum (up to 14T)	Roller (smooth drum) 14t	5	-	-	112	-	118	HN	X					
				Delivery truck	Delivery truck	4 p.h.	-	-	102	-	111	-	-					
				Water cart	Watercart	2 p.h.	-	-	104	-	107	-	-					
				Hand tools	Hand tools	various	-	-	105	-	111	-	-					
				Bobcat	Bobcat	2	-	-	104	-	107	-	-					
				Road Planer	Profiler	1	-	-	110	5	124	HN	-					
				Water cart	Road sweeper	1	-	-	104	-	107	-	-					
				Fire services Building														
				Footinqs & Foundations	Reinforced concrete works and blockwork	Jun 2022 - Aug 2022		Delivery truck	Flatbed truck	2 p.h.	-	-	102	-	111	-	-	
				Blockwork				Water cart	Water Cart	1	-	-	104	-	107	-	-	
Structural Steel Installation	Installation of columns, mullions, girts, purlins, etc...			Crane (Grove GMK5130)	Crane (Grove GMK5130)	1	-	-	105	-	103	-	-					
				EWP	EWP	2	-	-	95	-	98	-	-					
				Hand tools	Hand tools	various	-	-	105	-	111	-	-					
				Hand tools (Power)	Power tools	various	-	-	107	-	118	-	-					
				Handtool - rattle gun	Rattle qun	2	-	-	107	-	118	-	-					
				Concrete vibrator	Vibrator	2	-	-	97	-	100	-	-					
				Hiab	Hiab	1	-	-	98	-	102	-	-					
				Telehandler / Franna crane (20t)	Telehandler	1	-	-	99	-	103	-	-					
				Hand tools	Hand tools	various	-	-	105	-	111	-	-					
				Hand tools (Power)	Power tools	various	-	-	107	-	118	-	-					
				EWP	EWP	2	-	-	95	-	98	-	-					
				Handtool - rattle gun	Rattle qun	2	-	-	107	-	118	-	-					
				Buildings Services	HVAC, electrical, hydraulics, fire, security, comms, gas suppression, etc...			Telehandler / Franna crane (20t)	Telehandler	1	-	-	99	-	103	-	-	
Delivery truck	Delivery truck	2 p.h.	-					-	102	-	111	-	-					
External finishes		Oct 2022 - Dec 2022		Asphalt Paver	Paver	1	-	-	105	-	112	-	-					
				Delivery truck	Shuttle buqqies	1	-	-	102	-	111	-	-					
				Vibratory Roller - smooth drum (up to 14T)	Roller (smooth drum) 14t	1	-	-	112	-	118	HN	X					
				Delivery truck	Delivery truck	2 p.h.	-	-	102	-	111	-	-					

Table C1: Construction Activities/ Equipment

Work activity	Details	Indicative timing/ duration	Modelling ID	Plant/ Equipment (as provided by client)	Day	Evening	Night	Sound Power Level (Lw re: 1pW) in Noise Model, dB(A)			High noise plant (EPL E1)	Vibration intensive plant	Notes	
					7am - 6pm	6pm - 10pm	10pm - 7am	L _{Aeq}	Penalty	L _{Amax}				
				Water cart	Watercart	2 p.h.	-	-	104	-	107	-	-	
				Hand tools	Hand tools	various	-	-	105	-	111	-	-	
				Bobcat	Bobcat	2	-	-	104	-	107	-	-	
				Road Planer	Profiler	1	-	-	110	5	124	HN	-	
				Water cart	Road sweeper	1	-	-	104	-	107	-	-	
SURFACE WORKS														
Demobilisation of gantry shed	Removal of: Gantry crane Gantry shed	Jun 2022 - Jul 2022		Delivery truck	Delivery truck	2 p.h.			102	-	111	-	-	
				Hand tools	Hand tools	various			105	-	111	-	-	
				Hand tools (Power)	Power tools	various			107	-	118	-	-	
				EWP	EWP	2			95	-	98	-	-	
				Handtool - rattle gun	Rattle gun	2			107	-	118	-	-	
				EWP	Scissor lift	2			95	-	98	-	-	
				Telehandler / Franna crane (20t)	Telehandler	1			99	-	103	-	-	
				Mobile crane (20t-250t)	Mobile Crane 100t	1			104	-	108	-	-	
Hardstand removal	Eastern side of site	Jul 2022 - Aug 2022		Excavators with hammers (35-45T)	Excavator 30t with hammer	1			118	5	123	HN	X	
				Truck and Doq	Truck & doq	2 p.h.			106	-	111	-	-	
				Bobcat	Bobcat	1			104	-	107	-	-	
				Vibratory Roller - smooth drum (up to 14T)	Roller (smooth drum) 14t	1			112	-	118	HN	X	
				Water cart	Road sweeper	1			104	-	107	-	-	
				Excavator w bucket (25t)	Excavator 20t	1			103	-	108	-	-	
				Excavator w bucket (25t)	Excavator 30t	2			103	-	108	-	-	
Drainage and services (and sed basin construction)		Aug 2022 - Oct 2022		Truck and Dog	Truck & dog	2 p.h.			106	-	111	-	-	
				Bobcat	Bobcat	1			104	-	107	-	-	
				Vibratory Roller - smooth drum (up to 14T)	Roller (smooth drum) 14t	1			112	-	118	HN	X	
				Water cart	Road sweeper	1			104	-	107	-	-	
				Mobile crane (20t-250t)	Mobile crane 100t	1			104	-	108	-	-	
				Excavator w bucket (25t)	Excavator 30t	2			103	-	108	-	-	
				Truck and Dog	Truck & dog	2 p.h.			106	-	111	-	-	
Finishing works	Fencinq; landscaping...	Nov 2022 - Mar 2023		Bobcat	Bobcat	1			104	-	107	-	-	
				Vibratory Roller - smooth drum (up to 14T)	Roller (smooth drum) 14t	1			112	-	118	HN	X	
				Water cart	Road sweeper	1			104	-	107	-	-	
				Hand tools	Hand tools	various			105	-	111	-	-	
				Delivery truck	Delivery truck	2 p.h.			102	-	111	-	-	
				Hand tools	Hand tools	various			105	-	111	-	-	
				Hand tools (Power)	Power tools	various			107	-	118	-	-	
				EWP	EWP	2			95	-	98	-	-	
Demobilisation of site	Removal of: Spoil shed Workshop; Water treatment plant Site sheds and hoardings	Nov 2022 - Mar 2023		Handtool - rattle gun	Rattle gun	2			107	-	118	-	-	
				EWP	Scissor lift	2			95	-	98	-	-	
				Telehandler / Franna crane (20t)	Telehandler	1			99	-	103	-	-	
				Mobile crane (20t-250t)	Mobile Crane 100t	1			104	-	108	-	-	
				Excavators with hammers (35-45T)	Excavator 30t with hammer	1			118	5	123	HN	X	
				Truck and Doq	Truck & doq	2 p.h.			106	-	111	-	-	
				Bobcat	Bobcat	1			104	-	107	-	-	
				Vibratory Roller - smooth drum (up to 14T)	Roller (smooth drum) 14t	1			112	-	118	HN	X	
Hardstand removal	Western side of site	Nov 2022 - Mar 2023		Water cart	Road sweeper	1			104	-	107	-	-	
				Excavator w bucket (25t)	Excavator 20t	1			103	-	108	-	-	
LOGISTICS														
Deliveries	Delivery to spoil shed	March 2021 - December 2022		Delivery truck	Delivery truck	4 p.h.	4 p.h.	4 p.h.	102	-	111	-	-	Deliveries to spoil shed and deliveries to gantry shed will be managed so as not to occur concurrently.
				Telehandler / Franna crane (20t)	Telehandler/forklift/franna	2	1	1	99	-	103	-	-	
				Mobile crane (20t-250t)	Mobile crane 100t	1	1	1	104	-	108	-	-	
Deliveries	Delivery to gantry shed	March 2021 - July 2022		Delivery truck	Delivery truck	4 p.h.	4 p.h.	4 p.h.	102	-	111	-	-	Deliveries once sheds removed during standard hours only, except for OSDs
				Telehandler / Franna crane (20t)	Telehandler/forklift/franna	2	1	1	99	-	103	-	-	
				Gantry crane 40T (MDS)	Gantry crane 40t	2	2	2	100	-	106	-	-	
Concrete deliveries		March 2021 - May 2022		Concrete pump	Concrete pump (line)	1	1	1	103	-	107	-	-	OOH inside gantry shed - not concurrent with other deliveries
				Concrete Aqi	Concrete Aqi	4 p.h.	4 p.h.	4 p.h.	108	-	111	-	-	
Material movement	Between spoil shed and gantry shed Around whole site	March 2021 - September 2022		Delivery truck	Flat bed truck/hiab	2	1	1	102	-	111	-	-	
				Telehandler / Franna crane (20t)	Telehandler/forklift/franna	2	1	1	99	-	103	-	-	

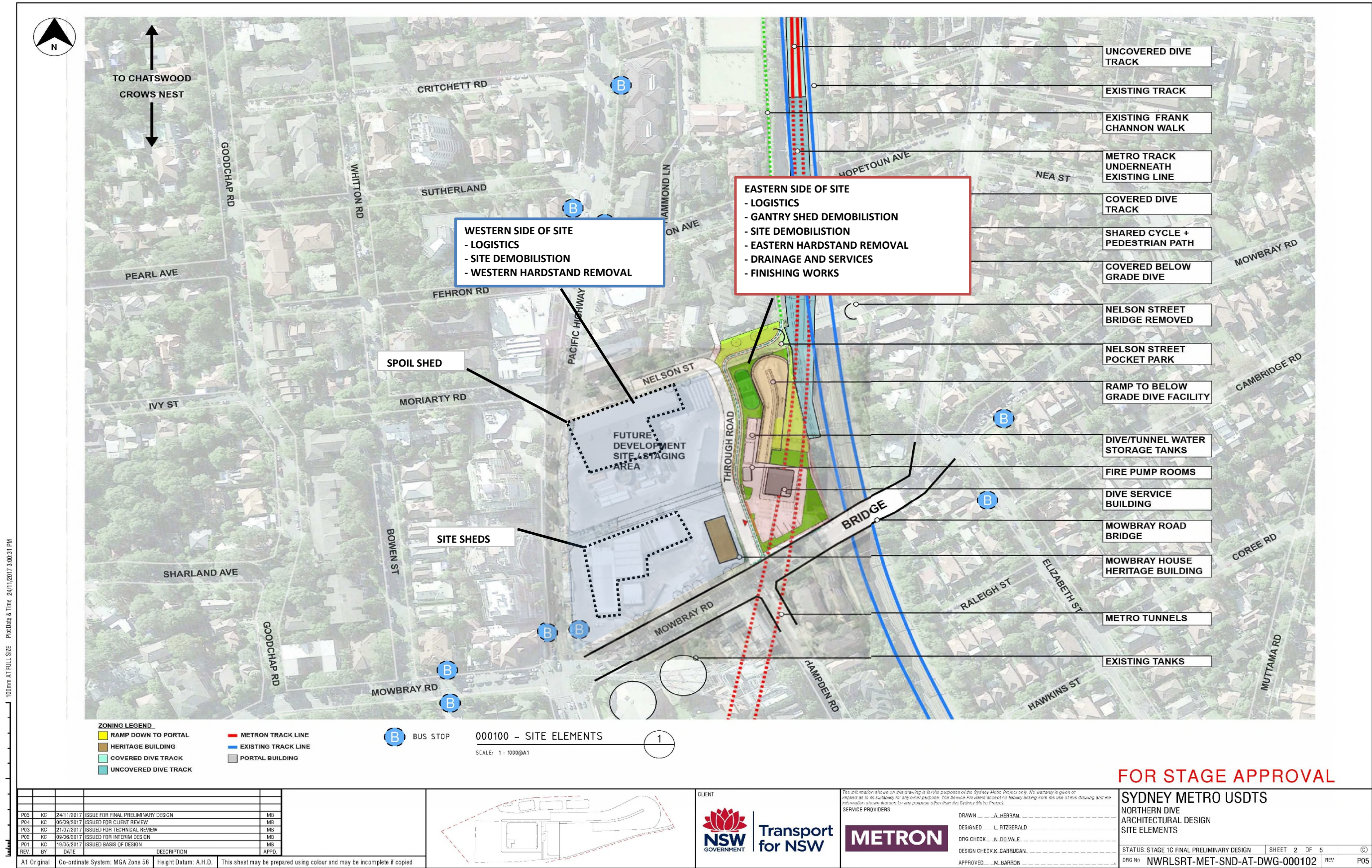
Table C2: Construction Timetable

Work Activity	Description of Activity	Jan-21	Feb-21	Mar-21	Apr-21	May-21	Jun-21	Jul-21	Aug-21	Sep-21	Oct-21	Nov-21	Dec-21	Jan-22	Feb-22	Mar-22	Apr-22	May-22	Jun-22	Jul-22	Aug-22	Sep-22	Oct-22	Nov-22	Dec-22	Jan-23	Feb-23	Mar-23
Track construction	Rail and sleeper consist																											
	Concrete																											
	Welding																											
	M&E Fitout																											
Dive Service Building	Footings & Foundations & Structural steel																											
	External finishes, internal finishes and fitout																											
	External																											
	External																											
Fire Services Building	Footings & Foundations & Structural steel																											
	External finishes, internal finishes and fitout																											
	External																											
	External																											
Surface works	Demobilisation of gantry shed																											
	Hardstand removal (eastern side of site)																											
	Drainage and services																											
	Finishing (Fencing and landscaping)																											
Logistics	Demobilisation - spoil shed, water treatment plant, site sheds																											
	Hardstand removal (western side of site)																											
	Delivery to spoil shed																											
	Delivery to gantry shed																											
	Concrete deliveries																											
	Material movement																											

C.2 Construction site layout

Figure C1: Construction Site Layout

CHATSWOOD SMTF



APPENDIX D Detailed predicted noise levels

The impacts presented in the following table are identified by colour coding of the text.

For Standard Hours:

- XX Complies with NML
- **XX** < 10dB(A) above NML - construction noise clearly audible
- **XX** > 10dB(A) above NML - construction noise moderately intrusive
- **XX** > 75dB(A) - highly noise affected

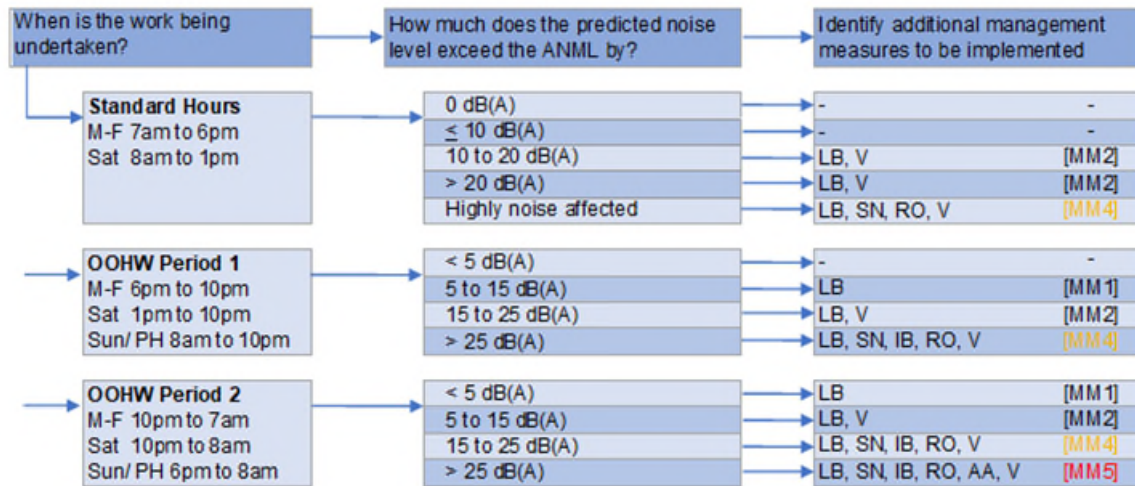
For OOHW

- XX Complies with NML
- **XX** < 5 dB(A) above NML - construction noise noticeable
- **XX** 5 to 15 dB(A) above NML - construction noise clearly audible
- **XX** > 15 to 25 dB(A) above NML - construction noise moderately intrusive
- **XX** > 25 dB(A) above NML - construction noise highly intrusive

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

APPENDIX E Additional noise mitigation

The table below is replicated from Table 5-8, and identifies the additional mitigation measures to be applied at construction noise affected receivers.



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

Code in square brackets [] refers to noise management code for affected receivers identified in each CNVIS

LB = Letter box drops

V = Verification of predicted noise levels

SN = Specific notifications

(personalised letter, phone call, email, individual briefing)

RO = Project specific respite offer

AA = Alternative accommodation