

SYDNEY METRO - WESTERN SYDNEY AIRPORT STATION BOXES AND TUNNELLING WORKS

Detailed Noise and Vibration Impact Statement - Orchard Hills Tunnel Support Worksite

Sydney Metro Western Sydney Airport Station Boxes and Tunnelling Works

Project number	WSA-200-SBT
Document number	SMWSASBT-CPG-OHE-SN150-EN-RPT-293013
Revision date	May 2023
Revision	E

Document approval

Rev	Date	Prepared by	Reviewed by	Approved by
Α	Jul 2022			
В	Dec 2022			
С	Apr 2023			
D	May 2023			
E	Jul 2023			
Signature:				

|Page 1



SYDNEY METRO - WESTERN SYDNEY AIRPORT STATION BOXES AND TUNNELLING WORKS

Details of Revision Amendments

Document Control

The Project Director is responsible for ensuring that this Report is reviewed and approved. The Environment Manager is responsible for updating this Report to reflect construction, legal and other requirements changes.

Amendments

Any revisions or amendments must be prepared by the Specialist Acoustic Consultant in consultation with the Construction Team and the Environment Team before being distributed/implemented.

Revision Details

Revision	Details
А	Initial Development
В	Update to include fan details, noise barrier updates and respond to Auditor comments
С	Update to include OOHW TBM Assembly and minor edits
D	Update to address ER comments
E	Update to address Auditor comments





Acoustics Vibration Structural Dynamics

SYDNEY METRO - WESTERN SYDNEY AIRPORT - STATION BOXES AND TUNNELLING WORKS

Detailed Noise and Vibration Impact Statement -Orchard Hills Tunnel Support Worksite

11 July 2023

CPB Ghella

TM008-03-01F01 SMWSA-SBT_DNVIS-OHE (r8)





Document details

Detail	Reference
Doc reference:	TM008-03-01F01 SMWSA-SBT_DNVIS-OHE (r8)
Prepared for:	CPB Ghella
Address:	Level 3, 116 Miller Street North Sydney, NSW 2060
Attention:	

Document control

Date	Revision history	Non-issued revision	Issued revision	Prepared	Instructed	Reviewed / Authorised
3.07.2022	Initial issue	0	1			
20.07.2022	Include CPBG comments	-	2			
15.12.2022	Update to include fan details, noise barrier updates and respond to Auditor comments	-	3		I	
21.02.2023	Updated for revised TBM assembly	-	4			
06.03.2023	Minor edits	-	5			
13.04.2023	Minor edits	-	6			
01.05.2023	Update to address ER comments	-	7			
11.07.2023	Update to address Auditor comments	-	8			

File Path: R:\AssocSydProjects\TM001-TM050\TM008 mt Sydney Metro WSA SBT\1 Docs\03 ORCHARD HILLS\TM008-03-01F01 SMWSA-SBT_DNVIS-OHE (r8).docx

Important Disclaimers:

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

This document is issued subject to review and authorisation by the suitably qualified and experienced person named in the last column above. If no name appears, 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.

External cladding disclaimer: No claims are made and no liability is accepted in respect of any external wall and/or roof systems (eg facade / cladding materials, insulation etc) that are: (a) not compliant with or do not conform to any relevant non-acoustic legislation, regulation, standard, instructions or Building Codes; or (b) installed, applied, specified or utilised in such a manner that is not compliant with or does not conform to any relevant non-acoustic legislation, regulation, standard, instructions or Building Codes; or (b) installed, applied, specified or utilised in Such a manner that is not compliant with or does not conform to any relevant non-acoustic legislation, regulation, standard, instructions or Building Codes.

Compliance

No.	Requirement	Reference
SSI 100	51 Planning Approval	
E37	A detailed land use survey must be undertaken to confirm sensitive land use(s) (including critical working areas such as operating theatres and precision laboratories) potentially exposed to construction noise and vibration and construction ground-borne noise. The survey may be undertaken on a progressive basis but must be undertaken in any one area before the commencement of work which generate construction noise, vibration or ground-borne noise in that area. The results of the survey must be included in the Detailed Noise and Vibration Impact Statements required under Condition E47.	Section 3.1 and APPENDIX B
E38	Work must only be undertaken during the following hours: (a) 7:00am to 6:00pm Mondays to Fridays, inclusive; (b) 8:00am to 1:00pm Saturdays; and (c) at no time on Sundays or public holidays.	Section 2.2
E39	Except as permitted by an EPL or approved in accordance with the Out of Hours Works Protocol required by Condition E42, highly noise intensive work that result in an exceedance of the applicable NML at the same receiver must only be undertaken: (a) between the hours of 8:00 am to 6:00 pm Monday to Friday; (b) between the hours of 8:00 am to 1:00 pm Saturday; and (c) if continuously, then not exceeding three (3) hours, with a minimum cessation of work of not less than one (1) hour. For the purposes of this condition, 'continuously' includes any period during which there is less than one (1) hour between ceasing and recommencing any of the work.	Section 2.2
E40	This approval does not permit blasting.	Noted, blasting not proposed.
E41	Notwithstanding Conditions E38 and E39 work may be undertaken outside the hours specified in the following circumstances:	Section 2.2
	(a) Safety and Emergencies, including:	Table 2.2
	 (i) for the delivery of materials required by the NSW Police Force or other authority for safety reasons; or (ii) where it is required in an emergency to avoid injury or the loss of life, to avoid damage or loss of property or to prevent environmental harm; or 	
	 (b) Low impact, including: (i) construction that causes L_{Aeq(15 minute)} noise levels: no more than 5 dB(A) above the rating background level at any residence in accordance with the ICNG, and no more than the 'Noise affected' NMLs specified in Table 3 of the ICNG at other sensitive land user(s); and (ii) construction that causes: continuous or impulsive vibration values, measured at the most affected residence are no more than the preferred values for human exposure to vibration, specified in Table 2.2 of Assessing Vibration: a technical guideline (DEC, 2006), or intermittent vibration values measured at the most affected residence are no more than the preferred values for human exposure to vibration, specified in Table 2.4 of Assessing Vibration: a technical guideline (DEC, 2006). 	Table 2.2
	 (c) By Approval, including: (i) where different construction hours are permitted or required under an EPL in force in respect of the CSSI; or (ii) works which are not subject to an EPL that are approved under an Out-of-Hours Work Protocol as required by Condition E42; or (iii) negotiated agreements with directly affected residents and sensitive land user(s). 	Table 2.2

No.	Requirement	Reference
	(d) By Prescribed Activity, including:	Table 2.2
	 (i) tunnelling and ancillary support activities (excluding cut and cover tunnelling and surface works not directly supporting tunnelling) are permitted 24 hours a day, seven days a week; or 	
	(ii) grout batching at the Orchard Hills ancillary facility is permitted 24 hours a day, seven days a week; or	
	 (iii) delivery of material that is required to be delivered outside of standard construction hours in Condition E38 to directly support tunnelling activities, except between the hours 10:00 pm and 7:00 am to / from the Orchard Hills ancillary facility; or (iv) haulage of spoil except between the hours of 10:00 pm and 7:00 am to / from Orchard 	
	Hills ancillary facility; or (v) work within an acoustic enclosure are permitted 24 hours a day, seven days a week where there is no exceedance of noise levels or intermittent vibration levels under Low impact	
	circumstances identified in Condition E41(b), unless otherwise agreed with the Planning Secretary; or	
	days per week.	
	On becoming aware of the need for emergency work in accordance with (a)(ii) above, the ER, the Planning Secretary and the EPA must be notified of the reasons for such work. The	Table 2.2
	Proponent must use best endeavours to notify as soon as practicable all noise and/or vibration affected sensitive land user(s) of the likely impact and duration of those work. Notes:	
	 Tunnelling does not include station box excavation. Tunnelling ancillary support activities includes logistics support and material handling and delivery 	
E42	An Out-of-Hours Work Protocol must be prepared	N/A to this DNVIS
E43	Mitigation measures must be implemented with the aim of achieving the following construction noise management levels and vibration criteria:	Section 4
	(a) construction 'Noise affected' noise management levels established using the Interim Construction Noise Guideline (DECC, 2009);	
	(b) preferred vibration criteria established using the Assessing vibration: a technical guideline (DEC, 2006) (for human exposure);	
	(c) Australian Standard AS 2187.2 - 2006 "Explosives - Storage and Use - Use of Explosives" (for human exposure);	
	(d) BS 7385 Part 2-1993 "Evaluation and measurement for vibration in buildings Part 2" as they are "applicable to Australian conditions"; and	
	(e) the vibration limits set out in the German Standard DIN 4150-3: Structural Vibration- effects of vibration on structures (for structural damage).	
	Any work identified as exceeding the noise management levels and / or vibration criteria must be managed in accordance with the Noise and Vibration CEMP Sub-plan.	
	Note: The ICNG identifies 'particularly annoying' activities that require the addition of 5 dB(A) to the predicted level before comparing to the construction Noise Management Level.	
E44	All reasonable and feasible mitigation measures must be applied when the following residential ground-borne noise levels are exceeded:	N/A to this DNVIS
	(a) evening (6:00 pm to 10:00 pm) — internal LAeq(15 minute): 40 dB(A); and (b) night (10:00 pm to 7:00 am) — internal LAeq(15 minute): 35 dB(A). The mitigation measures must be outlined in the Noise and Vibration CEMP Sub-plan, including in any Out-of-Hours Work Protocol, required by Condition E42.	
E45	Noise generating work in the vicinity of potentially-affected community, religious, educational institutions and noise and vibration-sensitive businesses and critical working areas (such as theatres, laboratories and operating theatres) resulting in noise levels above the NMLs must not be timetabled within sensitive periods, unless other reasonable arrangements with the affected institutions are made at no cost to the affected institution.	N/A to this DNVIS

No.	Requirement	Reference
E47	Detailed Noise and Vibration Impact Statements (DNVIS) must be prepared for any work that may exceed the NMLs, vibration criteria and / or ground-borne noise levels specified in Conditions E43 and E44 at any residence outside construction hours identified in Condition E38, or where receivers will be highly noise affected or subject to vibration levels above those otherwise determined as appropriate by a suitably qualified structural engineer under Condition E87. The DNVIS must include specific mitigation measures identified through	This document Section 5.3
	consultation with affected sensitive land user(s) and the mitigation measures must be implemented for the duration of the works. A copy of the DNVIS must be provided to the ER before the commencement of the associated works. The Planning Secretary and the EPA may request a copy (ies) of the DNVIS.	
E48	Owners and occupiers of properties at risk of exceeding the screening criteria for cosmetic damage must be notified before works that generate vibration commences in the vicinity of those properties. If the potential exceedance is to occur more than once or extend over a period of 24 hours, owners and occupiers are to be provided a schedule of potential exceedances on a monthly basis for the duration of the potential exceedances, unless otherwise agreed by the owner and occupier. These properties must be identified and considered in the Noise and Vibration CEMP Sub-plan.	Section 6.2
E49	Where sensitive land use(s) are identified in Appendix B as exceeding the highly noise affected criteria during typical case construction, mitigation measures must be implemented with the objective of reducing typical case construction noise below the highly noise affected criteria at each relevant sensitive landuse(s). Activities that would exceed highly noise affected criteria during typical case construction must not commerce until the measures identified in this condition have been implemented, unless otherwise agreed with the Planning Secretary.	Section 5.2.1 and Section 5.3.1
	Note: Mitigation measures may include path barrier controls such as acoustic sheds and/or noise walls, at-property treatment, or a combination of path and at-property treatment.	
E50	For all construction sites where acoustic sheds are installed, the sheds must be designed, constructed and operated to minimise noise emissions. This would include the following considerations:	Table C.2 in APPENDIX C
	(a) all significant noise producing equipment that would be used during the night-time would be inside the sheds, where feasible and reasonable;	
	(b) noise generating ventilation systems such as compressors, scrubbers, etc, would be located inside the sheds and external air intake/discharge ports would be appropriately acoustically treated; and	
	(c) the doors of acoustic sheds would be kept closed during the night-time period. Where night-time vehicle access is required at sites with nearby residences, the shed entrances would be designed and constructed to minimise noise breakout.	
E51	Where Condition E49 determines that at-property treatment (temporary or permanent) is the appropriate measure to reduce noise impacts, this at-property treatment must be offered to landowners of residential properties for habitable living spaces, unless other mitigation or management measures are agreed to by the landowner.	Section 5.3.1
	Landowners must be advised of the range of options that can be installed at or in their property and given a choice as to which of these they agree to have installed.	
	A copy of all guidelines and procedures that will be used to determine at-property treatment at their residence must be provided to the landowner.	
E52	Any offer for at-property treatment or the application of other noise mitigation measures in accordance with Condition E51 does not expire until the noise impacts specified in Condition E49 affecting that property are completed, even if the landowner initially refuses the offer.	CNVMP
	Note: If an offer has been made but is not accepted, this does not preclude the commencement of construction under Condition E49.	
E53	The implementation of at-property treatment does not preclude the application of other noise and vibration mitigation and management measures including temporary and long term accommodation.	CNVMP

No.	Requirement	Reference
E54	Vibration testing must be conducted during vibration generating activities that have the potential to impact on Heritage items to verify minimum working distances to prevent cosmetic damage. In the event that the vibration testing and attended monitoring shows that the preferred values for vibration are likely to be exceeded, the Proponent must review the construction methodology and, if necessary, implement additional mitigation measures. Such measures must include, but not be limited to, review or modification of excavation techniques.	Section 6.3
E55	The Proponent must seek the advice of a heritage specialist on methods and locations for installing equipment used for vibration, movement and noise monitoring at Heritage items.	CNVMP
E56	All work undertaken for the delivery of the CSSI, including those undertaken by third parties (such as utility relocations), must be coordinated to ensure respite periods are provided. The Proponent must:	Section 5.3.5
	(a) reschedule any work to provide respite to impacted noise sensitive land use(s) so that the respite is achieved in accordance with Condition E57; or	
	(b) consider the provision of alternative respite or mitigation to impacted noise sensitive land use(s); and	
	(c) provide documentary evidence to the ER in support of any decision made by the Proponent in relation to respite or mitigation.	
	The consideration of respite must also include all other approved Critical SSI, SSI and SSD projects which may cause cumulative and / or consecutive impacts at receivers affected by the delivery of the CSSI.	
E57	In order to undertake out-of-hours work outside the work hours specified under Condition E38, appropriate respite periods for the out-of-hours work must be identified in consultation with the community at each affected location on a regular basis. This consultation must include (but not be limited to) providing the community with:	Section 5.3.2 This DNVIS and the
	(a) a progressive schedule for periods no less than three (3) months, of likely out-of-hours work;	Communication Strategy (CCS)
	(b) a description of the potential work, location and duration of the out-of-hours work;	57 ()
	(c) the noise characteristics and likely noise levels of the work; and	
	(d) likely mitigation and management measures which aim to achieve the relevant NMLs under Condition E43 (including the circumstances of when respite or relocation offers will be available and details about how the affected community can access these offers).	
	The outcomes of the community consultation, the identified respite periods and the scheduling of the likely out-of-hour work must be provided to the ER, EPA and the Planning Secretary prior to the out-of-hours work commencing.	
	Note: Respite periods can be any combination of days or hours where out-of-hours work would not be more than 5 dB(A) above the RBL at any residence.	
Revised	Environmental Performance Outcomes	
1	Construction noise and vibration impacts on local communities (including airborne noise and ground-borne noise and vibration) are managed in accordance with the Construction Noise and Vibration Standard, the Interim Construction Noise Guideline, and the Airports (Environment Protection) Regulations 1997	Section 4
2	Structural damage to buildings, heritage items and public utilities and infrastructure, including the Warragamba to Prospect Water Supply Pipelines, from construction vibration to be avoided	Section 6.3
Revised	Environmental Mitigation Measures	
NV1	Where acoustic sheds are installed, the internal lining and type of material used in the construction of the sheds would be considered during design development and construction planning to ensure appropriate attenuation is provided	Table C.2 in APPENDIX C
Constru		
5.1 (a)	Working Hours	Section 2.2
	Standard working hours are between 7am – 6pm on weekdays and 8am – 1pm on Saturdays	

No.	Requir	rement	Reference
5.1 (b)	Works approv	which can be undertaken outside of standard construction hours without any further val include:	Table 2.2
	i. Thos examp Wester	e which have been described and assessed in the environmental assessments. For le, tunnelling and underground excavations and supporting activities or works within rn Sydney International	
	ii. Wor sensiti	ks which are determined to comply with the relevant Noise Management Level at ve receivers;	
	iii. The author	delivery of materials outside of approved hours as required by the Police or other ities(including Transport for NSW) for safety reasons;	
	iv. Wh harm i	ere it is required to avoid the loss of lives, property and / or to prevent environmental n an emergency; and	
	v. Whe	ere written agreement is reached with all affected receivers	
5.1 (c)	Where Princip workin	e off-airport works are being undertaken under an Environmental Protection Licence, oal Contractors may apply for EPA approval to undertake works outside of normal ng hours	Section 2
8.1 a	Constr	ruction Noise and Vibration Management Objectives	Section 4
	The fo	llowing noise and vibration management objectives will apply to construction:	
	i.	Minimise unreasonable noise and vibration impacts on residents and businesses;	
	ii.	Avoid structural damage to buildings or heritage items as a result of construction vibration;	
	iii.	Undertake active community consultation;	
	iv.	Maintain positive, cooperative relationships with schools, childcare centres, local residents and building owners; and	
8.2 a	Constr	ruction Noise and Vibration Management Implementation	Construction Noise
	On-air of the impler consist Climat	port management of noise and vibration will be achieved through the implementation SMWSA Noise and Vibration CEMP and Principal Contractors will develop and ment a Construction Noise and Vibration Management Plan for all off-airport works tent with the Interim Construction Noise Guidelines (Department of Environment and the Change, 2009). Both plans will include as a minimum:	and Vibration Management Plan (CNVMP)
	i.	Identification of work areas, site compounds and access points;	
	ii.	Identification of sensitive receivers and relevant construction noise and vibration goals;	
	iii.	Be consistent with, and include the requirements of the noise and vibration mitigation measures as detailed in the planning approval documentation and the Sydney Metro Construction Noise and Vibration Standard (CNVS), including the provision of respite;	
	iv.	Details of construction activities and an indicative schedule for construction works, including the identification of key noise and/or vibration generating construction activities (based on representative construction scenarios) that have the potential to generate noise or vibration impacts on surrounding sensitive receivers, in particular residential areas;	
	v.	Identification of feasible and reasonable procedures and mitigation measures to ensure relevant vibrations and blasting criteria are achieved, including a suitable blast program;	
	vi.	The requirements of any applicable licence or approval (for example EPL);	
	vii.	Additional requirements in relation to activities undertaken 24 hours of the day, 7 days per week;	
	viii.	Pre-construction compliance requirements and hold points;	
	viii. ix.	Pre-construction compliance requirements and hold points; The responsibilities of key project personnel with respect to the implementation of the plan;	
	viii. ix. x.	Pre-construction compliance requirements and hold points; The responsibilities of key project personnel with respect to the implementation of the plan; Noise monitoring requirements;	
	viii. ix. x. xi.	Pre-construction compliance requirements and hold points; The responsibilities of key project personnel with respect to the implementation of the plan; Noise monitoring requirements; Compliance record generation and management; and	

No.	Require	ement	Reference	
8.2 (b)	Detailed intensiv vibratio Stateme constru include	Detailed Construction Noise and Vibration Impact Statements will be prepared for noise- ntensive construction sites and or activities to ensure the adequacy of the noise and vibration mitigation measures. Specifically, Construction Noise and Vibration Impact Statements will be prepared for works proposed to be undertaken outside of standard construction hours and to support applications to undertake out of hours works (this ncludes variations of EPLs and applications to relevant agencies).		
8.2 (c)	Noise a CNVS.	nd vibration monitoring would be undertaken for construction as specified in the	Section 5.3.6 and Section 6.3.2	
8.2 (d)	The foll	owing compliance records would be kept by Principal Contractors:	CEMP	
	i.	Records of noise and vibration monitoring results against appropriate NMLs		
	ii.	Records of community enquiries and complaints, and the Contractor's response		
8.3 (a)	Constru	ction Noise and Vibration Mitigation	Section 5.3	
	All feas the CN Manage as relev	ible and reasonable mitigation measures would be implemented in accordance with VS. The on-airport Noise and Vibration CEMP and the off-airport Noise and Vibration ement Plan will include the following noise and vibration mitigation measures as well ant Conditions:		
	i.	Construction hours will be in accordance with the working hours specified in Section 5.1;	Section 2.2	
	ii.	Hoarding and enclosures will be implemented where required to minimise airborne noise impacts; and	Section 5.3.2 and Table C.2 in APPENDIX C	
	iii.	The layout of construction sites will aim to minimise airborne noise impacts to surrounding receivers	Section 5.3.2	
	iv.	Provision of respite periods	Section 5.3.1	

Contents

Com	plian	ce	iv		
Cont	tents		х		
1	Intro	Introduction			
	1.1	Purpose	1		
	1.2	Relevant requirements and application of this DNVIS	1		
	1.3	Quality assurance	2		
2	Desc	cription of construction works and hours	3		
	2.1	Summary of works addressed in this DNVIS	3		
	2.2	Construction Hours	4		
		2.2.1 Justification for OOHW	5		
		2.2.2 Assessment periods	5		
	2.3	Construction traffic	6		
	2.4	Ground-borne noise	6		
3	Nea	rest sensitive receivers	7		
	3.1	Land use survey	7		
	3.2	Residential receivers	7		
	3.3	Other sensitive receivers	7		
	3.4	Commercial and industrial premises	7		
	3.5	Heritage receivers	7		
4	Con	struction noise and vibration objectives	8		
5	Con	struction noise assessment	10		
	5.1	Noise prediction methodology	10		
		5.1.1 General modelling assumptions	10		
		5.1.2 Specific modelling assumptions	11		
	5.2	Predicted noise levels	11		
		5.2.1 Standard construction hours	14		
		5.2.2 Out of hours work	14		
		5.2.3 Sleep disturbance	15		
	5.3	Noise mitigation and management	16		
		5.3.1 High noise impact activities	16		
		5.3.2 Consultation with affected receivers	16		
		5.3.3 Noise control and management measures	18		
		5.3.4 Additional noise mitigation measures	24		
		5.3.5 Managing site specific activities and cumulative noise impacts (Gatewave)	25		
		5.3.6 Real-time and attended noise monitoring	26		

		5.3.7	Complaints handling	27
6	Con	struct	ion vibration impacts	28
	6.1	Mini	mum working distances for vibration intensive plant	28
	6.2	Vibra	ation assessment	29
		6.2.1	Structural damage	29
			6.2.1.1 Heritage structures at OHE	30
		6.2.2	Human annoyance	30
	6.3	Vibra	ation mitigation measures	31
		6.3.1	Management and mitigation procedures	31
		6.3.2	Consultation with affected receivers	32
		6.3.3	Vibration control and management measures	33
		6.3.4	Additional vibration mitigation measures	36
		6.3.5	Vibration monitoring	36
		6.3.6	Complaints handling	36
7	Con	struct	ion traffic noise assessment	37
	7.1	Traff	ic sources	37
	7.2	Traff	ic noise mitigation and management	38
	7.3	Com	plaints handling	39
8	Impa	act cla	essification	41
9	Con	clusio	n	43
Refe	erence	S		44
APP	ENDI	(A	Glossary of terminology	45
APP	ENDI>	КΒ	Sensitive receivers and noise management levels	48
	B.1	NCA	s and sensitive receiver identification	49
	B.2	NCA	s and noise management levels	50
APP	ENDI>	(C	Construction timetable/ activities/ management	51
	C.1	Cons	truction timetable/activities/equipment	52
	C.2	Spec	ific mitigation measures (temporary noise barriers)	53
APP	ENDI>	(D	Construction noise impacts	54
	D.1	Pred	icted noise levels	55
	D.2	Num	ber of receivers above NMLs	56
	D.3	Addi	tional mitigation measures	57
APP	ENDI	Ε	Construction vibration impacts	58
	E.1	Mini	mum working distances – Vibration	59

List of tables

Table 2.1: Summary of construction works under this DNVIS

4

Table 2.2: Working hours for construction worksites		4
Table 2.3: Assessment periods		6
Table 4.1: Construction noise and vibration objectives for Orchard Hills		8
Table 5.1: Summary of construction activities		11
Table 5.2: Key to the predicted construction noise results tables		12
Table 5.3: Number of receiver buildings over the noise management level (all	NCAs) – residential receivers	13
Table 5.4: Number of other sensitive receivers over the noise management le	evels (all NCAs)	13
Table 5.5 Site noise mitigation and management measures		19
Table 5.6: Nominated verification monitoring locations		26
Table 6.1: Summary of vibration intensive activities/ works		28
Table 6.2: Minimum working distances (m) for continuous vibration		29
Table 6.3: Number of buildings within minimum working distances for cosm	netic damage	29
Table 6.4: Number of buildings within minimum working distances for hum	an annoyance	31
Table 6.5: Site vibration mitigation and management measures		34
Table 7.1: Summary of construction generated traffic based on Table C.1 in	APPENDIX C	37
Table 7.2:Summary of traffic volumes – base (2023/2024) traffic volumes ar construction traffic	nd base traffic volumes with	40
Table 7.3: Predicted construction traffic noise impacts – base (2023/2024) trvolumes with construction traffic	affic volumes and base traffic	40
Table 8.1: Impact classification for bulk excavation and TBM support works – worksite (OHE)	Orchard Hills tunnel support	41

List of figures

Figure 2-1: Orchard Hills station, dive and tunnel support worksite location	3
Figure 5-1: Additional airborne noise mitigation measures	25
Figure 6-1: Management protocol for human annoyance impact	32
Figure 6-2: Additional vibration mitigation measures	36

1 Introduction

1.1 Purpose

This Detailed Noise and Vibration Impact Statement (DNVIS) has been prepared on behalf of CPB Ghella Joint Venture (CPBG) in accordance with the Sydney Metro Construction Noise and Vibration Standard (CNVS)[1] for the construction of the Sydney Metro: Western Sydney Airport Project – Station Boxes and Tunnelling (SBT) Works.

1.2 Relevant requirements and application of this DNVIS

SSI 10051 Infrastructure Condition of Approval (CoA) E47 requires that:

Detailed Noise and Vibration Impact Statements (DNVIS) must be prepared for any work that may exceed the NMLs, vibration criteria and / or ground-borne noise levels specified in Conditions E43 and E44 at any residence outside construction hours identified in Condition E38, or where receivers will be highly noise affected or subject to vibration levels above those otherwise determined as appropriate by a suitably qualified structural engineer under Condition E87. The DNVIS must include specific mitigation measures identified through consultation with affected sensitive land user(s) and the mitigation measures must be implemented for the duration of the works. A copy of the DNVIS must be provided to the ER before the commencement of the associated works. The Planning Secretary and the EPA may request a copy (ies) of the DNVIS.

SBT Works will be delivered through the following sub-stages for NSW (off-airport) worksites:

- Preparatory Works: including demolition, site access and other local area works, site levelling/grading, utility and temporary services work, erection of demountable buildings and noise barriers, tunnelling preparatory works and use of ancillary facilities including onsite parking which has already been addressed in the Preparatory Construction Environmental Management Plan (CEMP) and in the DNVISs (ref: TM008-02-10F01 SMWSA-SBT_DNVIS-SE) and local area and utility works (ref: TM008-02-11F01 SMWSA-LAUW DNVIS; TM008-02-11F02 SMWSA-LAUW STH DNVIS).
- Bulk Excavation and Tunnelling Works: including the Preparatory Works scope (not completed prior to Final CEMP approval) including bulk excavation and tunnelling works (this DNVIS).

This DNVIS provides a noise and vibration assessment of the bulk excavation and tunnelling (including tunnelling support) works which will be undertaken at the Orchard Hills SBT worksite.

The aim of this assessment is to minimise the impact of construction noise and vibration on sensitive receivers and demonstrate compliance with relevant SSI-10051 Conditions of Approval (CoA) and Environment Protection Licence (EPL) No. 21672.

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 DNVIS

The Orchard Hills SBT (OHE) worksite is located between the Western Motorway and Lansdowne Road, along Kent Road, as shown on Figure 2-1 and Figure B1 in APPENDIX B. The worksite is made up of three work areas:

- Northern portion tunnel support worksite
- Central portion station civil worksite
- Southern portion Dive civil worksite.





The works are proposed to be undertaken during standard construction hours. The water treatment plant and the TBM tunnelling and ancillary support activities, including grout batching delivery of material that is required to be delivered outside of standard construction hours, and haulage of spoil generated through tunnelling are proposed to be undertaken during standard construction hours and outside of standard construction hours. The out of hours works (OOHW) are justified (see Section 2.2.1). The works are summarised in Table 2.1.

Activity	Aspect	Construction hours	Timing of activity
Compound	General worksite and car park	Standard hours (D)	Jul-22 to Apr-24
Station box and	Piling	Standard hours (D)	Sep-22 to Feb-23
dive excavation	Capping Beam and Upstand	Standard hours (D)	Sep-22 to Feb-23
	Excavation	Standard hours (D)	Oct-22 to May-23
	Blinding Works	Standard hours (D)	Feb-23 to Jul-23
	Clearing and earthworks	Standard hours (D)	Feb-23 to Jul-23
Lansdowne Bridge	Bridge FRP works	Standard hours (D)	Sep-22 to Oct-23
works	Backfilling behind abutments	Standard hours (D)	Feb-23 to Feb-23
	Bridge precast plank installation and deck topping	Standard hours (D)	Mar-23 to Mar-23
	Bridge finishing works	Standard hours (D)	Feb-23 to Mar-23
Portal FRP works	Piling	Standard hours (D)	Sep-22 to Nov 22
	Waterproofing	Standard hours (D)	Jan-24 to Feb-24
	Portal FRP	Standard hours (D)	Feb-24 to Apr-24
Dive FRP works	Drainage	Standard hours (D)	Jan-24 to Feb-24
	Invert slab	Standard hours (D)	Feb-24 to Mar-24
TBM tunnelling	Construction of site structures	Standard hours	Sep-22 to Feb-23
and ancillary support activities	TBM delivery to site and assembly	Standard hours + OOHW (D/E/N)	Jan-23 to Mar-23
	TBM support and spoil handling	Standard hours + OOHW (D/E/N)	Mar-23 to Jan-24

Table 2.1: Summary of construction works under this DNVIS

Notes: 'OOHW' means Out of Hours works, or work outside the standard construction hours (see Section 2.2) 'OOHW(D)' is the OOH 'Day' period, 1pm to 6pm Saturday; 8am to 6pm Sunday 'OOHW(E)' is the 'Evening' period, 6pm to 10pm Monday to Sunday 'OOHW(N) is the OOH 'Night' period, 10pm to 7am Sunday/Monday to Thursday/ Friday; 10pm to 8am Friday/Saturday and Saturday/Sunday

A detailed summary of the construction activities assessed in this report is presented in Section 5.1 and in Table C.1 of APPENDIX C.

2.2 Construction Hours

Construction hours for the Project are defined by SSI 10051 CoA E38 and E39. Table 2.2 below consolidates the information provided in these Conditions regarding construction working hours for the Project.

Table 2.	2: Workina	hours for	construction	worksites
10010 -	E. HOHANG	nours for	construction	

CoA	Construction Activity	Monday to Friday	Saturday	Sunday / public holiday
E38	Standard construction	7:00am to 6:00pm	8:00am to 1:00pm	No work ¹
E39	Highly noise intensive works ²	8:00am to 6:00pm (plus respite ²)	8:00am to 1:00pm (plus respite ²)	No work ¹
E41(a)	Safety and emergency work ²	6:00pm to 7:00am	6:00pm to 8:00am	8:00 am to 7:00am

CoA	Construction Activity	Monday to Friday	Saturday	Sunday / public holiday
E41(b)	Low impact work ³	6:00pm to 7:00am	6:00pm to 8:00am	8:00am to 7:00am
E41(c)	Works approved under and EPL or Out-of-Hours Work Protocol	6:00pm to 7:00am	6:00pm to 8:00am	8:00am to 7:00am
E41(d)	 Prescribed activity: Tunnelling and ancillary support activities⁴ Grout batching at the Orchard Hills ancillary facility Delivery of material to directly support tunnelling activities⁵ Haulage of spoil⁵ Work within an acoustic shed Tunnel and underground station box fit out works. 	24 hours	24 hours	24 hours

Notes:

1. No work unless permitted and approved.

2. Minimum respite from highly noise intensive works of not less than one (1) hour between each continuous block of works not exceeding three (3) hours.

3. Construction that causes L_{Aeq(15 minute)} noise levels no more than 5dB(A) above the Rating Background Level (RBL) at any residence; and/or no more than the 'noise affected' NMLs specified in Table 3 of the ICNG at other sensitive land user(s). Construction that causes continuous/impulsive/intermittent vibration values at the most affected residence, no more than the preferred values for human exposure to vibration, specified in Table 2.2 and Table 2.4 of the AVTG.

4. Tunnelling does not include station box excavation. Tunnelling ancillary support activities includes logistics support and material handling and delivery

5. Except between the hours 10:00pm and 7:00amto/from the Orchard Hills ancillary facility.

2.2.1 Justification for OOHW

TBM tunnelling will be supported from the OHE worksite. Tunnelling and tunnel support works (including TBM assembly and TBM support as outlined in Section 8.3.3 of the EIS) are prescribed activities permitted 24 hours a day under CoA E41(d). All reasonable and feasible mitigation and management measures will be implemented to reduce noise from the TBM tunnelling and tunnel support works to within NMLs.

Concrete works associated with shaft and station construction, including concrete pouring, finishing and cleaning will mostly be completed during standard construction hours, with some out-of-hours work required to achieve compliance with overarching project technical requirements. These works would be undertaken through the Sydney Metro Western Sydney Airport Out of Hours Works Protocol [3] (OOHW Protocol) prepared for the project in accordance with CoA E42 or under the Environment Protection Licence (EPL) No 21672 for works subject to an EPL.

2.2.2 Assessment periods

The standard hours and out of hours work (OOHW) periods are depicted in Table 2.3. The OOHW periods are further defined as OOHW Period 1 and 2, based on the CNVS[1].

Day/ Time	12am – 1am	1am – 2am	2am – 3am	3am – 4am	4am – 5am	5am – 6am	6am – 7am	7am – 8am	8am – 9am	9am – 10am	10am – 11am	11am – 12pm	12pm – 1pm	1pm – 2pm	2pm – 3pm	3pm – 4pm	4pm – 5pm	5pm – 6pm	6pm – 7pm	7pm – 8pm	8pm – 9pm	9pm – 10pm	10pm – 11pm	11pm – 12am
Monday to Friday											Stan	dard	cons	struc	tion	Hour	s		00	н	Perio	d 1		
Saturday																								
Sunday or Public Holiday		C	ЮН\	V Pe	riod 2	2						00	HW	Perio	d 1					00	нw	Perio	d 2	

Table 2.3: Assessment periods

2.3 Construction traffic

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

Construction traffic associated with OHE worksite will access the site via Kent Road, having arrived via the Great Western Highway. Heavy vehicles will depart via Kent Road then onto the Great Western Highway. Kent Road is a sub-arterial road with typically moderate traffic volume, including heavy vehicles. Great Western Highway is an arterial road with typically moderate to high traffic volume, including heavy vehicles. The worksite 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 raw materials, plant, and equipment to the site (typically standard hours, except for oversized deliveries)
 - Concrete trucks bringing concrete to the site (typically standard hours, with OOHW deliveries prior to 10:00 pm)
 - Spoil trucks removing spoil from the site (typically standard hours)

Construction traffic noise, related to the public road network, is addressed in Section 7.

2.4 Ground-borne noise

During the bulk excavation and TBM tunnelling and ancillary support activities at the OHE worksite, airborne noise is expected to be much higher than any ground-borne noise levels at the nearest sensitive receivers. On this basis, the potential impact of ground-borne noise is expected to be negligible and has not been addressed further in this DNVIS.

Ground-borne noise and vibration impacts from TBM tunnelling excavation is addressed in a separate DNVIS (TM008-02-07F01).

3 Nearest sensitive receivers

3.1 Land use survey

To assess and manage construction noise and vibration impact, a Land Use Survey has been undertaken to satisfy SSI 10051 CoA E37 and included in the Noise and Vibration CEMP Sub-plan (CNVMP). The Land Use Survey identifies existing land use and development within and around the OHE worksites, including a mix of residential, commercial, industrial and open space uses.

The Land Use Survey relevant to the OHE worksite are identified on an aerial photograph in APPENDIX B and was used in the preparation of this DNVIS. The land use revision date is shown in the top left corner of the drawing.

3.2 Residential receivers

Further to the Land Use Survey, residential areas have been divided into Noise Catchment Areas (NCAs) based on those established in the Environmental Impact Statement (EIS) [4] for the project. All relevant residential sensitive receivers near the project are identified in APPENDIX B.

3.3 Other sensitive receivers

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

3.4 Commercial and industrial premises

All nearby commercial and industrial premises have been considered in this assessment and are identified in APPENDIX B.

3.5 Heritage receivers

Heritage receivers have been identified in EIS [3] and in the land use survey (Section 3.1) and have been considered in this assessment. There are no heritage receivers identified within 200 metres of the worksite (refer to Land Use Survey in APPENDIX B).

4 **Construction noise and vibration objectives**

Construction noise and vibration objectives are detailed in the CNVMP Section 6. A summary of the objectives as applicable to the Orchard Hills tunnel support worksite is provided in Table 4.1.

Table 4 1. C				a la la attiva a	£		11:11-
Table 4.1: C	onstruction	noise and	vibration	objectives	TOR	Orchard	HIIIS

Impact	Relevant guideline	Construction noise/ vibration objective
Airborne noise	NSW Interim Construction Noise Guideline (ICNG) [6] CNVS [1]	Construction noise management levels (NMLs) for residential receivers are based on long-term noise logging conducted on behalf of Sydney Metro to quantify ambient noise levels for the EIS [3]. During standard construction hours, a highly affected noise objective of $L_{Aeq(15min)}$ 75dB(A) applies at all residential receivers. The NMLs for 'other' sensitive receivers are from the ICNG, as reported in Section 2.2 of the CNVS.
		Receivers are considered 'noise affected' where construction noise levels are greater than the noise management levels identified in Table B.1 of APPENDIX B.
		Where construction activities are tonal or impulsive in nature and are described in the ICNG as being particularly annoying, a $+5dB(A)$ correction must be added to the activity noise.
		construction related activities that could exceed the NMLs shall be identified and managed in accordance with the noise and mitigation and management measures set out in Section 5.3.
Sleep	Noise Policy for	Initial screening level:
disturbance	Industry (EPA 2017) [7]	- $L_{Aeq,15min}$ 40 dB(A) or the prevailing RBL plus 5 dB, whichever is the greater, and/or the
	CNVS [1]	+ L_{AFmax} 52 dB(A) or the prevailing RBL plus 15 dB, whichever is the greater,
		Where noise events are found to exceed the initial screening level, further analysis will be made to identify:
		 the likely number of events that might occur during the night assessment period, and
		• Whether events exceed an 'awakening reaction' level of 55 dB(A) L _{AFmax} (internal) that equates to NML of 65 dB(A) externally (assuming open windows).
Ground-borne noise	NSW Interim Construction Noise Guideline (ICNG) [6] CNVS [1]	Receivers are considered 'ground-borne noise affected' where construction noise levels are greater than the noise management levels identified in Table B.2 of APPENDIX B.
Construction	ICNG refers to the	Construction traffic impact initial screening test:
traffic	NSW Road Noise	• Traffic noise levels increase \leq 2 dB(A) because of construction traffic
		Where traffic noise levels increase by more than 2 dB(A):
		+ Freeway/arterial/sub-arterial road - 60 dB $L_{Aeq(15hour)}$ day/ 55 dB $L_{Aeq(9hour)}$ night
		Existing local road - 5 dB LAeq(1hour) day/ 50 dB LAeq(1hour) night
Vibration – disturbance to building occupants	NSW 'Environmental Noise Management Assessing Vibration: A Technical Guideline' (AVTG) [8] CNVS [1]	 To assess the potential for vibration impact on human comfort, an initial screening test will be done based on peak velocity units, as this metric is also used for the cosmetic damage vibration assessment. The initial screening test values are: Critical areas - 0.28 mm/s (day or night) Residential buildings - 0.56 mm/s (16h day); 0.40 mm/s (8h night) Offices eshaple educational institutions and places of working - 1.10 mm/s
		(day or night)
		• Workshops - 2.20 mm/s (day or night).
		If the predicted vibration exceeds the initial screening test, the total estimated Vibration Dose Value (i.e. eVDV) will be determined based on the level and duration of the vibration event causing exceedance as detailed in Section 6.4.6.1 of the CNVMP and Section 2.4 of the AVTG.

Impact	Relevant guideline	Construction noise/ vibration objective
Vibration – structural damage to buildings	British Standard BS 7385-2:1993 'Evaluation and measurement for vibration in buildings'[11] German Standard DIN 4150-3: 2016-12	 A conservative vibration damage screening level (peak component particle velocity) per receiver type is detailed in Section 2.4 of the CNVS and outlined below: Reinforced or framed structures: 25.0 mm/s Unreinforced or light framed structures: 7.5 mm/s. Heritage buildings and structures found to be structurally unsound (following inspection) would adopt a more conservative vibration damage screening level (peak component particle velocity):
	Effects of vibration on structures [12] CNVS [1]	• Heritage structures (structurally unsound): 2.5 mm/s. Where the predicted and/or measured vibration is greater than shown above, a more detailed analysis of the building structure, vibration source, dominant frequencies and dynamic characteristics of the structure will be completed to determine the applicable vibration limit.

5 Construction noise assessment

5.1 Noise prediction methodology

5.1.1 General modelling assumptions

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

The noise prediction models consider:

- Location of noise sources varying from 0.5m to 2m above the ground depending on the equipment or plant in use;
- Receiver points at 1.5m above each floor level along all building facades. Predicted noise levels presented in APPENDIX D are the maximum noise levels for each building.
- Height of sources and receivers referenced to one metre digital ground contours for the site area and surrounding area;
- Sound Power Levels (L_w) of plant and equipment likely to be used during the various construction activities are included in Table C1 in APPENDIX C. L_{Aeq} sound power levels are identified for assessment against the construction NMLs. L_{A1} (or L_{Amax}) sound power levels are identified for sleep disturbance assessment.
- Activity timing, number of plant and hours of operation are included in Table C1 in APPENDIX C
- Separation distances between sources and receivers;
- Ground factors between sources and receivers varying from 1 for absorptive surfaces (e.g. park land) to 0 for reflective surfaces (e.g. water, concrete, paving);
- Attenuation from barriers (natural and purpose built), including temporary noise barriers/ construction hoarding identified in APPENDIX C.2.

Key details regarding the construction work locations, the likely plant and equipment, 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. Noise levels were determined by modelling the noise sources, receiver locations, and operating activities, based on the information presented in APPENDIX C.

5.1.2 Specific modelling assumptions

The following sections present a summary of the predicted noise impacts at each work area in terms of compliance with the NMLs. The colours in the table indicate whether receivers in the NCA comply with the NML and, where exceedance of the NML occurs, the perceived impact of the exceedance.

The construction activities included in this DNVIS are summarised in Table 5.1.

Table 5.1: Summary of construction activities

Work Activity (APPENDIX C)	Work area (APPENDIX B)	Scenario reference code (APPENDIX D)
General worksite and car parking + station box and dive excavation: piling + capping beam and upstand	Orchard Hills station box and dive excavation work area	SBDE-PC
General worksite and car parking + station box and dive excavation: excavation and blinding works	Orchard Hills station box and dive excavation work area	SBDE-EB
General worksite and car parking + station box and dive excavation: clearing and earthworks	Orchard Hills SE portion of station worksite, east of station box, north of Lansdowne Rd	SBDE-CE
Lansdowne Bridge works	Orchard Hills Lansdowne Bridge work area	LBW
Portal FRP works	Orchard Hills portal work area	P-FRP
Dive FRP works	Orchard Hills dive work area	D-FRP
TBM Delivery to Site + Assembly on the surface TBM Assembly in the station box	Orchard Hills tunnel support work area	TBM-A TBM-B
TBM tunnelling and ancillary support works	Orchard Hills tunnel support work area	TBM-S

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

- the position of equipment within the worksite;
- the distance to the receiver;
- the construction activities being undertaken;
- the noise levels of plant items and equipment
- acoustic noise barriers identified in APPENDIX C.2.

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

5.2 Predicted noise levels

Noise impacts during construction works have been predicted and compared to the noise management levels (NMLs) in APPENDIX B Table B1. A receiver is considered construction noise affected when the predicted construction noise level is above the NML. Table 5.3 and Table 5.4 present a summary of the number of residential receivers and 'other sensitive receivers (respectively) likely to be noise affected by the proposed activities. The tables are colour coded to indicate how much the predicted noise level is

above the NML and the corresponding perceived noise impact, based on the CNVS, as noted in Table 5.2.

Assessment	Time of day	Key							
L _{Aeq(15min)}	Standard hours ¹ or Outside standard hours	0-10 dB(A) above NML (green)	11-20 dB(A) above NML (yellow)	21-30 dB(A) above NML (orange)	>30 dB(A) above NML (purple)				
Sleep disturbance	Night only	L _{Aeq,15min} above 40 dB whichever is the grea	(A) or RBL plus 5 dB, iter (yellow)	L _{Amax} above 52 dB(A) of whichever is the great	_{ax} above 52 dB(A) or RBL plus 15 dB, ichever is the greater (purple)				

Table 5.2: Key to the predicted construction noise results tables

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

Table 5.3 summarises the number of construction noise affected residential receivers (i.e. receivers where predicted L_{Aeq} noise levels construction works are above the NML) and the likely perceived noise impact. Table 5.4 presents the number of construction noise affected other sensitive receivers. Detailed predicted L_{Aeq} noise levels for all receivers in each NCA are presented in Table D.1 of APPENDIX D.

Table 5.3: Number of receiver buildings over the noise management level (all NCAs) – residential receivers

			Highly noise affected ³	e Day (standard hours)				Day (outside standard hours) L _{Aeq}				Evening					Ni	Sleep disturband			
		Accorement	L _{Aeq}													LAeq				L _{Aeq}	L _{Amax}
Worksite	Construction activity	reference	> 75 dB(A)	1 – 10 dB(A)	11 – 20 dB(A)	21-30 dB(A)	> 30 dB(A)	1 – 10 dB(A)	11 – 20 dB(A)	21-30 dB(A)	> 30 dB(A)	1 – 10 dB(A)	11 – 20 dB(A)	21-30 dB(A)	> 30 dB(A)	1 – 10 dB(A)	11 – 20 dB(A)	21-30 dB(A)	> 30 dB(A)	> 40 or RBL+5 dB(A)	> 52 or RBL+15 dB(A)
Orchard Hills tunnel support	General worksite and car parking + station box and dive excavation: piling + capping beam and upstand	SBDE-PC	0	11	0	0	0	_1	_1	_1	_1	_1	_1	_1	_1	_1	_1	_1	_1	_1	_1
worksite (OHE)	General worksite and car parking + station box and dive excavation: excavation and blinding works	SBDE-EB	0	3	0	0	0	_1	_1	_1	_1	_1	_1	_1	_1	_1	_1	_1	_1	_1	_1
	General worksite and car parking + station box and dive excavation: clearing and earthworks (SE site portion east of station box)	SBDE-CE	0	49	5	0	0	_1	_1	_1	_1	_1	_1	_1	_1	_1	_1	_1	_1	_1	_1
	Lansdowne Bridge works	LBW	0	3	0	0	0	_1	_1	_1	_1	_1	_1	_1	_1	_1	_1	_1	_1	_1	_1
	Portal FRP works	P-FRP	0	2	0	0	0	_1	_1	_1	_1	_1	_1	_1	_1	_1	_1	_1	_1	_1	_1
	Dive FRP works	D-FRP	0	37	1	0	0	_1	_1	_1	_1	_1	_1	_1	_1	_1	_1	_1	_1	_1	_1
	TBM Delivery to Site & Assembly on the surface	TBM-A	0	8	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0
	TBM Delivery to Site & Assembly in the station box	TBM-B	0	8	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0
	TBM tunnelling and ancillary support works	TBM-S	0	4	0	0	0	5	0	0	0	5	0	0	0	4	0	0	0	4	0
Note: 1.	No work is proposed outside standard construction hours for this work activity.																				-

1. No work is proposed outside standard construction hours for this work activity.

2. Construction noise level cells are shaded based upon the predicted worst case NML exceedance in accordance with the key presented in Table 5.2.

3. Highly noise affected applies to residential receivers, as per the ICNG.

Table 5.4: Number of other sensitive receivers over the noise management levels (all NCAs)

				Commercial			Childcare			Educational			Recreational				Places of worship			,	Hotel/Motel/ Hostel			tel	Industrial					
Stage	Construction activity	Assessment reference	1 – 10 dB(A)	11 – 20 dB(A)	21-30 dB(A)	> 30 dB(A)	1 – 10 dB(A)	11 – 20 dB(A)	21-30 dB(A)	> 30 dB(A)	1 - 10 dB(A)	11 – 20 dB(A)	21-30 dB(A)	> 30 dB(A)	1 – 10 dB(A)	11 – 20 dB(A)	21-30 dB(A)	> 30 dB(A)	1 - 10 dB(A)	11 – 20 dB(A)	21-30 dB(A)	> 30 dB(A)	1 - 10 dB(A)	11 – 20 dB(A)	21-30 dB(A)	> 30 dB(A)	1 - 10 dB(A)	11 – 20 dB(A)	21-30 dB(A)	> 30 dB(A)
Orchard Hills tunnel support	General worksite and car parking + station box and dive excavation: piling + capping beam and upstand	SBDE-PC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
worksite (OHE)	General worksite and car parking + station box and dive excavation: excavation and blinding works	SBDE-EB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	General worksite and car parking + station box and dive excavation: clearing and earthworks (SE site portion east of station box)	SBDE-CE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Lansdowne Bridge works	LBW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Portal FRP works	P-FRP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Dive FRP works	D-FRP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	TBM Delivery to Site & Assembly on the surface	TBM-A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	TBM Delivery to Site & Assembly in the station box	TBM-B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	TBM tunnelling and ancillary support works	TBM-S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Note:

1. Commercial, industrial, recreational and other sensitive receivers have been assessed against the respective NMLs, and exceed ances have been presented in the count table.

2. Impacts only applicable when facility is in use.

3. Highly noise affected does not apply to OSRs, as per the ICNG.

5.2.1 Standard construction hours

The results summarised in Table 5.3 and Table 5.4 show that nearby residential receivers are likely to be construction noise affected by the bulk excavation and TBM tunnelling support works during standard construction hours. Note that predictions are based on the worst-case scenario during the peak construction period. Actual noise levels are likely to be lower than the predicted noise levels.

The highest impacts are likely to occur during the station box and dive excavation: clearing and earthworks. Predicted impacts are typically within 10 dB of the NML, except for 5 receivers close to the clearing and earthworks in the southeast portion of the site. Predicted noise levels at these receivers are within 15 dB of the standard hours NML and are below the highly noise affected level of L_{Aeq(15min)} 75 dB(A).

A number of receivers are predicted as construction noise affected during the TBM delivery and assembly phase, which includes construction of the conveyors and spoil handling area, although predicted impacts at all receivers are within 10 dB of the NML. Noise barriers along the western boundary of the site reduce noise emission from the worksite to the nearest receivers on Kent Road.

The TBM support site has been designed to minimise noise from the 24 hour TBM tunnelling and ancillary support activities, with the aim of achieving the NMLs 24 hours per day. Noise mitigation measures have been included in the noise model, for example noise barriers, partial enclosures, and restrictions on out of hours activities such as spoil handling at night. The result is that there are minimal receivers noise affected by TBM tunnelling and ancillary support works during standard construction hours.

There are no noise affected other sensitive receivers (e.g. schools, childcare, etc.) in the vicinity of the proposed works, that is predicted construction noise levels at other sensitive receivers are below the corresponding NMLs during standard hours.

All works associated with the bulk excavation and TBM tunnelling and ancillary support works are predicted to be below the highly noise affected level of L_{Aeq(15min)} 75 dB(A) at all residential receivers. The predicted noise levels are below the noise level predictions in the EIS because more detail regarding the site layout, site buildings and construction methodologies are known at this stage of the design.

5.2.2 Out of hours work

Bulk excavation works (including piling and shaft excavation) assessed in this DNVIS are not scheduled to occur outside standard construction hours.

TBM delivery and assembly is a prescribed activity and will extend into the OOH day, evening and night periods (i.e. Saturday afternoon, Sunday, and weekday evenings and nights) under Condition E41(d) (see Section 2.2.1). Site specific mitigation measures including noise barriers and limiting of work activities during the evening and night period will be implemented as noted in Table C.1 and Table C.2 in APPENDIX C. The resulting predicted noise levels are below the NMLs at all but 1 residential receiver,

where noise levels are within 3 dB of the NML. As noted above, the predictions are based on the typical worst-case scenario during the peak of the construction activity. Actual noise levels are likely to be lower than the predicted noise levels.

TBM tunnelling and ancillary support works would occur outside standard construction hours, provided all reasonable and feasible mitigation measures have been implemented to reduce noise levels with the aim of achieving the NML. The results summarised in Table 5.3 show that up to 5 residential receivers are predicted to be construction noise affected by out-of-hours TBM tunnelling and ancillary support works. Predicted noise levels at three receivers are within 2 dB of the NML, and within 5 dB of the NML at the remaining two receivers.

The OOH TBM assembly works and TBM support works would be subject to verification monitoring to confirm all reasonable and feasible mitigation measures have been implemented and that actual noise levels are consistent with or below predictions.

Noise mitigation and management measures to reduce noise impacts from the TBM assembly and the TBM support works are outlined in Section 5.3 and in APPENDIX C. Mitigation to reduce residual impacts is specifically addressed in Table 5.5.

5.2.3 Sleep disturbance

Bulk excavation is generally not scheduled during the night period. For the TBM assembly and TBM support works, the works during the night period have been limited to reduce the likelihood of a sleep disturbance event occurring, for example no hammering steel would occur at night during TBM assembly and no spoil handling during tunnelling and TBM Support would occur at night. Noise mitigation and management measures have been implemented to reduce noise levels with the aim of achieving the NML.

The main contributor to potential sleep disturbance impacts are the arrival and departure of oversized delivery (OSD) trucks on site as part of the TBM delivery and assembly works. There may be up to 2 OSD trucks required over the night period. Truck entry and exit from the worksite will be managed to reduce the likelihood of generating short-term, high impact noise that may cause awakening. Measurements on previous worksites with managed exits for heavy vehicles found that there are minimal high noise events as the truck departs site. Predicted impacts are therefore likely to be much higher than actual maximum noise levels generated on site. As noted above, verification monitoring to confirm actual noise levels from the OOHW would be used to identify whether any additional mitigation or management measures need to be incorporated into the worksite.

As noted in the previous section, the water treatment plant will be acoustically treated to ensure noise emission from its operation at night would be below the NMLs for sleep disturbance.

5.3 Noise mitigation and management

5.3.1 High noise impact activities

Bulk excavation and TBM tunnelling and ancillary support works at the Orchard Hills tunnel support worksite have been assessed in this DNVIS. Works during standard construction hours will be managed to reduce noise impacts to nearby receivers. Potential impact from high noise impact activities has been minimised through the implementation of noise mitigation measures, including construction hoarding and noise barriers. The predicted noise levels presented in Table 5.3 indicate that there are no highly noise affected residential receivers for the proposed works.

High Noise Impact Activities are defined in the EPL 21672 as jack hammering, rock breaking or hammering, pile driving, vibratory rolling, cutting of pavement, concrete or steel or other work occurring on the surface that generates noise with impulsive, intermittent, tonal or low frequency characteristics that exceeds the applicable NML (i.e. 75 dB(A) at the nearest residential). Activities during surface excavation works have predicted noise levels below the highly noise affected level of 75 dB(A) at the nearest residential, as defined in the Conditions of Approval and in Table 4.1.

If verification monitoring finds high noise impact activity exceed the applicable NML, respite will be provided by limiting the activities as follows to satisfy CoA E39 and EPL Condition L5.2:

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

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

5.3.2 Consultation with affected receivers

CPBG has commenced works and will continue to consult with potentially affected stakeholders including business and residential receivers regarding specific mitigation and management measures applicable to the bulk excavation and tunnelling works at Orchard Hills. A summary of the consultation program is provided below:

- A project-wide community newsletter was distributed on 1 October 2022 updating the community on upcoming bulk excavation and tunnelling activities. A newsletter will be distributed every six months for the duration of the project.
- Community information sessions have been held by Sydney Metro and CPBG JV to discuss site establishment, utility and tunnelling works. These sessions will continue for the project duration.

- A full page advertisement was published in the Western Weekender on 2 December 2022, notifying of upcoming tunnelling works
- Consultation with noise affected receivers identified in APPENDIX D (Table D.3) to ensure additional mitigation measures are provided (if required, refer to Section 5.3.4).
- Consultation with receivers impacted by OOHW in relation to property treatment, including installation of acoustic blinds.
- Residents and businesses within the 50m of the tunnel alignment have received a Property Condition Survey fact sheet and survey offer. Where survey offers have been accepted, Property Condition Surveys have been carried out and copies provided to property owners. Residents and businesses who have accepted a Pre-construction Property Survey will be offered a Postconstruction Property Survey.
- Engagement with residents within 60 metres of tunnel alignment to keep them informed of tunnelling progress.
- Meetings with stakeholders upon request.
- Proactive noise monitoring and in response to complaints.

The Community will be regularly updated on the progress of the project as described in the CPBG SBT Community Communication Strategy (SMWSASBT-CPG-1NL-NL000-CY-PLN-000002). Prior to the commencement of site establishment activities, receivers identified in APPENDIX D.3 will be notified to advise that noise from the works may at times be audible. All potentially impacted receivers will be kept informed of the nature of works to be carried out, the expected noise levels and duration, as well as be given appropriate enquiries and complaints contact details (see Section 5.3.7). The community construction update will also include a schedule of likely OOHW for a period of no less than three (3) months.

In addition to the above, no out-of-hours work where sensitive land user(s) may be noise affected will be permitted unless an OOHW notification has been issued to potentially affected receivers at least seven (7) days prior. This notification will detail the following to satisfy the requirements of Conditions E47 and E57:

- A description of the potential work, location and duration of the OOHW;
- The noise characteristics and likely noise levels of the work; and
- Likely mitigation and management measures which aim to achieve the relevant NMLs under condition E43
- Contact details for the relevant CPBG representative to be contacted to provide feedback on appropriate respite periods or mitigation measures they may require for their specific circumstances.

Respite periods would be any combination of days or hours where out-of-hours work would not be more than 5 dB(A) above the RBL at any residence.

The outcomes of any community consultation undertaken in accordance with Condition E57 (i.e., regarding respite periods), the identified respite periods and the scheduling of the likely OOHW will be documented in a register and provided to Sydney Metro prior to commencing any relevant OOHW. Sydney Metro will be responsible for submitting this information to the ER, EPA and Planning Secretary.

Any specific mitigations measures identified during consultation will be documented within this DNVIS where required.

5.3.3 Noise control and management measures

Noise mitigation and management measures to reduce potential noise impacts will be implemented during the bulk excavation and TBM tunnelling and ancillary support works, where reasonable and feasible. In accordance with the ICNG and consistent with the CNVS, feasible noise mitigation measures are those work practices or measures to reduce noise that are capable of being put into practice or of being engineered and are practical to build given project constraints such as safety and maintenance requirements. Reasonable noise mitigation measures are those feasible noise mitigation measures that are considered reasonable in the circumstances, based on a judgement that the overall noise benefits outweigh the overall adverse social economic and environmental effects, including the cost of implementing the measure. To make such a judgement, consideration is to be given to noise level impacts, noise mitigation benefits, cost effectiveness of noise mitigation and community views.

Table 5.5 outlines site noise control measures that would be implemented on site during the station box and dive excavation, Lansdowne Bridge works, Portal and Dive FRP works, TBM Delivery and Assembly, and TBM tunnelling and ancillary support works, where feasible and reasonable.

Table 5.5 Site noise mitigation and management measures

Control measure	Description of the mitigation measure	Feasible mitigation test	Deemed feasible?	Reasonable mitigation test	Deemed reasonable?	Adopted?	Justification and commentary
At source contro	l measures						
Site planning and layout	Locate noise-generating activities away from sensitive receivers. Plan traffic flow, parking, loading/unloading, and other vehicle movements to keep vehicles away from sensitive receivers where possible and to minimise reversing movements.	This measure could be feasibly implemented.	Yes	Sufficient noise reduction could be achieved at enough receivers. Deemed to be cost effective. Outweighs the identified social, economic and environmental effects.	Yes	Yes	Works will be undertaken in the station box and tunnels to limit noise impacts.
Noise control kits	 Plant that is brought to site for works should meet the sound power limits identified in this assessment. Where plant are above limits then the plant may require installation of 'noise control kits' to comply with the noise limits in this assessment. Such 'noise control kits' comprise: high performance 'residential-grade' exhaust mufflers, additional engine cowling / enclosure lined inside with sound absorbent industrial-grade foam, and air intake and discharge silencers / louvres. 	This measure could be feasibly implemented. Subject to availability for each equipment item.	Yes	Equipment will be assessed on a case-by-case basis	Yes	Yes	The need to fit 'noise control kits' onto the identified plant, will be confirmed once each plant item is tested prior to its regular use on site
Limit equipment in use	Only the equipment necessary during each stage of the works will be used.	This measure could be feasibly implemented.	Yes	Sufficient noise reduction could be achieved at enough receivers. Outweighs the identified social, economic and environmental effects. Cost effectiveness to be determined on a case-by-case basis.	Yes	Yes	Excess equipment will be avoided where it is not needed for the works and where it is reasonable to do without it. OOHW will be limited with the aim of achieving NMLs.
Timing of equipment in use	Where practicable, activities and plant will be scheduled/limited as outlined in this assessment	This measure could be feasibly implemented.	Yes	Sufficient noise reduction could be achieved at enough receivers. Deemed to be cost effective. Outweighs the identified social, economic and environmental effects. Verification monitoring to confirm OOH impacts	Yes	Yes	OOHW will be managed to ensure construction noise levels are within NMLs, where feasible and reasonable
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.	This measure could be feasibly implemented.	Yes	Sufficient noise reduction could be achieved at enough receivers. Deemed to be cost effective. Outweighs the identified social, economic and environmental effects.	Yes	Yes	Equipment that is not directly needed for works at a given time will be switched off.
Equipment selection	Use quieter and less noise/vibration emitting construction methods where feasible and reasonable.	This measure could be feasibly implemented. To be determined on a case-by-case basis	Yes	Routine task for project team.	Yes	Yes	Project team shall review plant and equipment on a case-by-case basis and find opportunities to use items with lower noise/vibration impacts.

11 JULY 2023

Control measure	Description of the mitigation measure	Feasible mitigation test	Deemed feasible?	Reasonable mitigation test	Deemed reasonable?	Adopted?	? Justification and commentary		
Truck movements	Where practicable, avoid the use of park air brakes at night. Set up relevant traffic management measures to minimise the use of air brakes when leaving site. Air brake silencers are to be correctly installed and fully operational for any heavy vehicles (as per	This measure could be feasibly implemented.	Yes	Sufficient noise reduction could be achieved at enough receivers. Deemed to be cost effective. Outweighs the identified social, economic and environmental effects.	Yes	Yes	OOH truck movements on site will be limited. Drivers will be reminded to drive responsibly on-site.		
	CNVMP). Minimise unnecessary acceleration on site and avoid vigorous slamming of truck doors.								
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 OOHW.	This measure could be feasibly implemented.	Yes	Sufficient noise reduction could be achieved at enough receivers. Deemed to be cost effective. Outweighs the identified social, economic and environmental effects.	Yes	Yes	Project team will prioritise use of non-tonal reversing alarms on equipment.		
Path mitigation r	neasures								
Noise barriers or temporary noise screens	Erection of noise barriers in strategic locations to shield sensitive receivers from noisy activities, e.g, temporary barriers to shield TBM assembly (See Appendix C). Barriers may be permanent or temporary, depending on the duration and location of noisy works.	Potential benefit of 5-10 dB(A). This measure could be feasibly implemented.	Yes	Sufficient noise reduction could be achieved at enough receivers. Deemed to be cost effective. Outweighs the identified social, economic and environmental effects.	Yes	Yes	Noise barriers and construction hoarding to be installed along the construction boundary as detailed in Table C3 and Figure C1 in APPENDIX C of the DNVIS.		
Enclosures	Construction of an enclosure to contain key noise- generating activities and/or items. Sound insulation and absorption performance shall be specified by a suitably qualified person (acoustic engineer).	Potential benefit of 10-20 dB(A). This measure could be feasibly implemented.	Yes	Sufficient noise reduction could be achieved at enough receivers. Deemed to be cost effective. Outweighs the identified social, economic and environmental effects. Acoustic enclosures required to allow OOHW to meet NMLs.	Yes	Yes	Acoustic enclosures as detailed in Table C4 and Figure C1 in APPENDIX C of the DNVIS.		

20

RENZO TONIN & ASSOCIATES

At-receiver (residual impacts) At-property treatment to mitigate residual impacts Design and installation of architectural treatments to sensitive receiver buildings to reduce internal noise impacts This measure could be feasibly implemented. At Yes Sufficient noise reduction could be achieved at enough receivers. No Yes The predicted levels in Table achieved at enough receivers. Predicted noise levels within 5 dB(A) of the OOH NML based on typical worst-case scenario during peak TBM support works. At-property treatment would involve the installation of mechanical ventilation to allow windows facing the workite to be closed reduce noise intrusion, whilst maintaining fresh air ventilation within the property. This measure could be feasibly implemented. At to verification monitoring Yes Sufficient noise reduction could be achieved at enough receivers. No Yes The predicted levels in Table achieved at enough receivers. Windows facing the workite to be closed reduce noise intrusion, whilst maintaining fresh air ventilation within the property. This measure could be feasibly inplemented. At to verification monitoring OOHW residual impacts are marginal (<2 dB) of the OOH NML two treatment to s to dB(A) of the OOH NML two the risk of exceedance occurring is considered low. The predicted table 5.3 indic to verification monitoring to worst-case scenario during peak to residered low. At-property tr the NML durin considered low. Where external noise levels are less than 5dB(A) above the NML, internal noise goals can be achieved by closing windows. It is noted that key reasonable, su and still obtain adequate
At-property treatment to mitigate residual impacts Design and installation of architectural treatments to sensitive receiver buildings to reduce internal noise impacts This measure could be feasibly implemented. At property Yes Sufficient noise reduction could be achieved at enough receivers. No Yes The predicted levels in Table are no highly implemented. At property Predicted noise levels within 5 dB(A) of the OOH NUL hosed on typical worst-case scenario during peak TBM support works. At-property treatment would involve the installation of mechanical ventilation allow windows facing the worksite to be closed to reduce noise intrusion, whilst maintaining fresh air ventilation within the property. OOHW residual impacts are marginal (<2 dB) of the OOH NML)
Given that the magnitude of the treatment (cost, time, disruption, contractual arrangements with owners etc) is greater than the magnitude of the impact it would address (low risk of exceedance, relatively short duration of impact) and that the option to close windows on a short term basis is available without mechanical ventilation, at property treatment is deemed not reasonable, provided OOHW residual impacts are as predicted. Predicted OOHW noise levels will be confirmed by verification monitoring.

Control measure	Description of the mitigation measure	Feasible mitigation test	Deemed feasible?	Reasonable mitigation test	Deemed reasonable?	Adopted?	Justification and commentary
Property acquisition to mitigate residual impacts	Purchase of sensitive receiver buildings by the project.	Not relevant to this worksite.	No	Insufficient noise reduction achieved at an acceptable number of receivers. Not cost effective. Does not outweigh potential adverse effects - excessive cost to the project, unnecessary adverse impact associated with permanently relocating residents	No	No	Property acquisition is not a feasible or reasonable mitigation measure for these works.
Noise manageme	ent 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 (but is not limited to): • location of nearest sensitive receivers • relevant project specific and standard noise and vibration mitigation measures; • permitted hours of work; • OOHW Procedure and Form • construction employee parking areas.	This measure could be feasibly implemented.	Yes	Routine task for project team.	Yes	Yes	Inductions and toolbox talks will continue to be conducted for the project.
Community consultation - disseminating information	Provide information to community of construction activity and potential impacts.	This measure could be feasibly implemented.	Yes	Routine task for project team.	Yes	Yes	Updates will be distributed regularly for the duration of the project.
Community consultation - active communication with nearby sensitive receivers	Seek feedback from community to identify more sensitive times of the day, or particularly sensitive days. An example is identifying when student exams (such as Higher School Certificate exams, end of semester exams) will take place.	This measure could be feasibly implemented.	Yes	Routine task for project team.	Yes	Yes	Project team shall proactively contact nearby sensitive receivers, particularly those which may have special requirements (e.g. recording studios).
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.	This measure could be feasibly implemented.	Yes	Routine task for project team.	Yes	Yes	Project team shall monitor site behaviour and advise supervisors if issues arise or additional behavioural practices are needed.
Noise monitoring	Noise monitoring to be conducted at key locations to quantify noise impacts at sensitive receivers.	This measure could be feasibly implemented.	Yes	Deemed to be cost effective. Outweighs the identified social, economic and environmental effects.	Yes	Yes	Noise monitoring shall be carried out as detailed in this assessment, in accordance with the CNVMP.
Update Construction Environmental Management Plans	Regular updates of the CEMP to account for changes in noise and vibration management strategies.	This measure could be feasibly implemented.	Yes	Can be reasonably undertaken by project team where required.	Yes	Yes	Updates to the CEMP will be carried out where required and will be reviewed regularly.

RENZO TONIN & ASSOCIATES
	Control measure	Description of the mitigation measure	Feasible mitigation test	Deemed feasible?	Reasonable mitigation test	Deemed reasonable?	Adopted?	Justification and commentary
- >	Respite coordination	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 (e.g. aligning respite evenings).	This measure could be feasibly implemented.	Yes	Sufficient noise reduction could be achieved at enough receivers. Deemed to be cost effective. Outweighs the identified social, economic and environmental effects.	Yes	Yes	Respite coordination shall be conducted with neighbouring projects.
	Implement additional mitigation measures	Identify and implement additional mitigation measures outlined in this assessment.	This measure could be feasibly implemented.	Yes	Consistency with CNVS and CNVMP	Yes	Yes	Additional mitigation measures to be identified on a case-by-case basis and with consideration of the standard mitigation and management measures outlined in this report.

RENZO TONIN & ASSOCIATES

5.3.4 Additional noise mitigation measures

Section 5 of the CNVS directs that in instances where, after the application of all reasonable and feasible mitigation and management measures (refer to Section 5.3.2), the $L_{Aeq(15minute)}$ airborne construction noise levels are still predicted to exceed the NMLs, additional airborne noise management measures can be applied to further limit the risk of annoyance from construction noise. The CNVS suggests the Project should consider implementing additional mitigation measures such as:

- Alternative accommodation (AA) options may be provided for residents living close to construction works that are likely to incur unreasonably high impacts over an extended period of time (more than 2 consecutive days). Alternative accommodation will be determined on a case-by-case basis.
- **Monitoring** (**M**) of noise or vibration may be conducted at the affected receiver(s) or a nominated representative location where it has been identified that specific construction activities are likely to exceed the relevant noise or vibration objectives. Monitoring can be in the form of either unattended logging or operator attended surveys. The purpose of monitoring is to inform the relevant personnel when the noise or vibration goal has been exceeded so that additional management measures may be implemented.
- Individual briefings (IB) are used to inform stakeholders about the impacts of high noise activities and mitigation measures that will be implemented. Communications representatives from the contractor would visit identified stakeholders at least 48 hours ahead of potentially disturbing construction activities. Individual briefings provide affected stakeholders with personalised contact and tailored advice, with the opportunity to comment on the project.
- Letter box drops (LB) in the form of a newsletter produced and distributed to the local community via letterbox drop or email via the project mailing list. The newsletter will provide an overview of current and upcoming works across the project and other topics of interest. The objective is to engage, inform and provide project-specific messages. Advanced warning of potential disruptions (e.g. traffic changes or noisy works) can assist in reducing the impact on the community.
- **Project specific respite offers (RO)** provide residents subjected to lengthy periods of noise or vibration respite from an ongoing impact.
- Phone calls and emails (PC) detailing relevant information about construction works would be made to identified noise or vibration affected stakeholders within 7 days of proposed work to provide tailored advice and the opportunity for stakeholders to provide comments on the proposed work and specific needs etc.
- **Specific notifications** (**SN**) would be letterbox dropped or hand distributed to identified stakeholders no later than 7 days ahead of construction activities that are likely to exceed the noise objectives. This form of communication is used to support periodic notifications, or to advertise unscheduled works.

The steps to be carried out to determine the additional management measures to be implemented are identified in Figure 5-1.



Figure 5-1: Additional airborne noise mitigation measures

Figure 5-1 presents a summary of the additional noise mitigation measures applicable for construction activities where, after application of all reasonable and feasible mitigation options, construction noise levels are still above the NMLs.

It is noted that no receivers are predicted to be highly noise affected, therefore at-property treatment requirements as per Conditions E49 and E51 are not triggered.

5.3.5 Managing site specific activities and cumulative noise impacts (Gatewave)

This DNVIS has established the overall impacts associated with the proposed works. A 3D construction noise and vibration management tool (Gatewave, <u>www.gatewave.com.au</u>) has been developed specifically for the SBT Works to allow specific work areas and activities to be assessed as construction works progress. It also allows cumulative noise impact from other aspects of the Project or, where relevant noise from other construction projects, to be assessed and managed in accordance with relevant CoA.

Gatewave will be used regularly to plan, assess and manage works progressively.

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

5.3.6 Real-time and attended noise monitoring

To provide real time noise monitoring data to assess and confirm whether noise emission from site is within the predicted noise levels identified in this DNVIS and to satisfy CoA C15(d), long-term, unattended noise monitoring will occur at a fixed location at the OHE worksite.

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

Type of monitoring	NCA	Nominated receiver address
Fixed, real-time	OHE-N, On worksite	E 291777; N 6259430
Fixed, real-time	OHE-S, On worksite	E 291927; N 6258930
Attended	NCA08	16 Lansdowne Road, Orchard Hills NSW 2748
Attended	NCA08	40 Lansdowne Road, Orchard Hills NSW 2748
Attended	NCA08	40A-40B Lansdowne Road, Orchard Hills NSW 2748
Attended	NCA08	77-81 Kent Road, Orchard Hills NSW 2748
Attended	NCA08	95 Kent Road, Orchard Hills NSW 2748
Attended	NCA08	71B Samuel Marsden Road, Orchard Hills NSW 2748

Table 5.6: Nominated verification monitoring locations

APPENDIX D.3 identifies the activities where monitoring should be carried out for each NCA.

Noise monitoring should follow the procedures outlined in Noise and Vibration Monitoring Program (refer to Annexure A of the CNVMP). Note that monitoring at all properties may be undertaken from the property boundary to limit any inconvenience to property owners. Monitoring should be undertaken at a minimum of two of the most affected locations nominated in Table 5.6.

5.3.7 Complaints handling

Noise complaints received and responded to will be managed in accordance with the CPBG SBT Community Communication Strategy (SMWSASBT-CPG-1NL-NL000-CY-PLN-000002).

Sydney Metro operate a 24-hour construction complaints line. Enquiries/ complaints may also be received through the project email mailbox (<u>sydneymetrowsa@transport.nsw.gov.au</u>) or through the complaints hotline (1800 717 703).

6 Construction vibration impacts

6.1 Minimum working distances for vibration intensive plant

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

Activity	Aspect	Vibration intensive plant?
Station box and dive excavation	Piling	Yes
	Capping beam and upstand	Yes
	Excavation	Yes
	Blinding works	Nil
	Clearing and earthworks (east of station box and north of Landsdown Road)	Yes
Lansdowne Bridge works	Bridge FRP works	Nil
	Backfilling behind abutments	Yes
	Bridge super – T installation and deck topping	Nil
	Bridge finishing works	Yes
Portal FRP works	Piling	Yes
	Waterproofing	Nil
	Portal FRP	Nil
Dive FRP works	Drainage	Yes
	Invert slab	Nil
TBM support works	TBM delivery and assembly, spoil conveyer installation	Nil
	Tunnelling support, spoil handling and tunnel lining	Nil

Table 6.1: Summary of vibration intensive activities/ works

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

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

Vibration sensitive receiver	tive receiver Minimum working distances for vibration intensive plant, m								
	Pneumatic Hammer (jackhammer)	Ground Anchor Drill Rig/ Boltec Rig	Piling Rig – Bored	Excavator <35T w rock hammer attachment	Plate compactor	Excavator <35T w rocksaw attachment	Padfoot roller (≤16T) – High vibration	Smooth drum roller (≤16T) – High vibration	
Structural damage to buildings									
Reinforced or frame structures (Line 1) ¹	5 ³	5	5	5	5 ³	5	5	5	
Screening criteria - non-heritage structures ^{1, 2}	5³	5	5	5	5 ³	5	10	5	
Screening criteria - heritage structures ^{1, 2}	5 ³	5	5	10	5 ³	10	20	15	
Disturbance to building occupants									
Critical areas ^{4,7}	25	20	20	40	20	40	120	105	
Residences - Day	15	10	15	25	10	25	70	55	
Residences - Night	20	15	15	30	15	30	90	75	
Offices ^{6,7}	10	5	10	20	5	20	40	30	
Workshops ⁷	5	5	10	15	5	15	25	15	

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

2. In accordance with NVMP, 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. Jackhammers/ plate compactors are likely to have minimum working distances smaller than 5 m.

4. Examples include hospital operating theatres and precision laboratories where sensitive operations are occurring.

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

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

7. 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. More detailed results are presented in APPENDIX E. The figures in APPENDIX E identify the minimum working distances for vibration over aerial photographs that also show the work areas and the land uses.

Table 6.3:	Number	of buildinas	within	minimum	working	distances [•]	for co	smetic	damage
10010 0.0.	TTOLINCI Y		****		WOINING.	anstances		June tie	aanage

		Number of buildings ¹		
Worksite	Plant item	Screening criteria for non-heritage structures	Screening criteria for heritage structures	
OHE	Jackhammer	0	0	
	Plate compactor	0	0	

		Number of buildings ¹						
Worksite	Plant item	Screening criteria for non-heritage structures	Screening criteria for heritage structures					
	Ground Anchor Drill Rig/ Boltec Rig	0	0					
	Piling Rig (Bauer BG36)	0	0					
	Excavator (<35T) with rock hammer attachment	0	0					
	Excavator (<35T) with rocksaw attachment	0	0					
	Smooth drum roller (≤16T) – High vibration	0	0					
	Padfoot roller (≤16T) – High vibration	0	0					

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

No sensitive structures are expected to be within the MWD for cosmetic damage during the vibration intensive works during bulk excavation and TBM support works at OHE worksite. As a result, the risk of structural damage is considered negligible for the proposed works.

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

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

6.2.1.1 Heritage structures at OHE

There are no potentially impacted heritage structures by the bulk excavation and TBM support works at OHE.

6.2.2 Human annoyance

The assessing vibration guideline [7] notes that inside dwellings, adverse comments often arise when occupants can perceive (feel) vibration, particularly when the vibration arises from a source located outside their home (or outside their control) and assume that the vibration has the potential to damage their building or contents.

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

At properties near the worksite, it is possible that the nearest receivers will be able to feel vibration levels when vibration-generating equipment is being utilised. Properties where vibration levels may be above the vibration disturbance goals in Table 4.1 and there is a probability of adverse comment are shown in Table 6.4. It is important to note that human comfort levels are much lower than vibration

levels likely to result in property damage and people therefore may be disturbed by vibration with no potential to result in property damage. More detailed results are presented in APPENDIX E.

Diant items	Maduaita	Critical	Residences⁵		Offices	Workshop ⁴	
Plant items	Worksite areas ^{1,4}		Day ² Night ²		3,4	workshop	
Jackhammer	OHE	0	1	_7	0	0	
Plate compactor							
Ground Anchor Drill Rig/ Boltec Rig							
Piling Rig (Bauer BG36)							
Excavator (<35T) with rock hammer attachment							
Excavator (<35T) with rocksaw attachment							
Smooth drum roller (≤16T) – High vibration							
Padfoot roller (\leq 16T) – High vibration							

Table 6.4:	Number of	of buildings	within	minimum	working	distances	for	human a	annoyance
									,

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

As can be noted from the table above, there is one residential property; 40 Lansdowne Road, Orchard Hills that may be exposed to vibration above the screening limit for human annoyance during the operation of a vibration roller when undertaking Lansdowne Bridge works. The above assessment is based on vibration-generating equipment operating at the closest location to nearby receivers. When vibration-generating equipment operates further from the closest point, the predicted vibration levels will reduce along with the probability of adverse comment.

Attended vibration measurements are proposed to be carried out proactively and in response to vibration complaints. If measurement results indicate events above the vibration objectives for human annoyance, vibration control and management measures will be provided to reduce vibration impact (see Section 6.3).

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

6.3 Vibration mitigation measures

6.3.1 Management and mitigation procedures

The procedure to manage and minimise potential structural damage impacts is presented in the Vibration Management Procedure.

The procedure to manage and minimise potential human annoyance vibration impacts is presented in Figure 6-1.





6.3.2 Consultation with affected receivers

CPBG has commenced works and will continue consultation with potentially affected stakeholders including business and residential receivers regarding specific mitigation and management measures applicable to the bulk excavation and tunnelling works at Orchard Hills. In addition to the consultation measures outlined in Section 5.3.2, the following consultation measures will be undertaken:

• Residents and businesses within the 50m of the tunnel alignment have received a Property Condition Survey fact sheet and survey offer

- Where survey offers have been accepted, Property Condition Surveys have been carried out and copies provided to property owners
- Residents and businesses who have accepted a Pre-construction Property Survey will be offered a Post-construction Property Survey
- Meetings with stakeholders upon request.
- Proactive vibration monitoring and in response to complaints.

Community will be regularly updated on the progress of the project as described in the CPBG SBT Community Communication Strategy (SMWSASBT-CPG-1NL-NL000-CY-PLN-000002).

6.3.3 Vibration control and management measures

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

Table 6.5: Site vibration mitigation and management measures

Control measure	Description of the mitigation measure	Feasible mitigation test	Deemed feasible?	Reasonable mitigation test	Deemed reasonable?	Adopted?	Justification and commentary
Construction Plan	ning						
Building condition surveys	Undertake building dilapidation surveys on all buildings located at least within the minimum working distances established for cosmetic damage prior to commencement of activities with the potential to cause property damage (see Section 6.1).	This measure could be feasibly implemented. It is noted that no buildings within cosmetic damage MWDs have been identified.	Yes	Not required based on current design.	No	No	No buildings have been identified within the MWD for cosmetic damage. As the MWDs in this assessment are conservative, the risk of cosmetic damage is considered negligible. Therefore, it is not considered reasonable to conduct building condition surveys.
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	This measure could be feasibly implemented.	Yes	Routine task for project team.	Yes	Yes	Updates will be distributed regularly for the duration of the project.
Construction hours and scheduling	Where feasible and reasonable, construction would be carried out during the standard daytime working hours. Work generating high noise and/or vibration levels would be scheduled during less sensitive time periods.	This measure could be feasibly implemented. It is noted that only one receiver is within human annoyance MWD. No vibration intensive plant are scheduled for use during the night period.	Yes	Not cost effective due to low risk.	No	No	1 residential receiver has been identified within the MWD for human annoyance. As the MWDs in this assessment are conservative, exceeding the human annoyance criteria is considered low. Therefore, it is not considered reasonable to change construction scheduling, except in response to vibration complaints (subject to monitoring).
Equipment selection/ construction method	Use less vibration emitting construction methods where feasible & reasonable, for example: - Conduct impact piling at typical setting rather than high setting where possible	This measure could be feasibly implemented. It is noted that only one receiver is within human annoyance MWD.	Yes	Not cost effective due to low risk.	No	No	1 residential receiver has been identified within the MWD for human annoyance. As the MWDs in this assessment are conservative, exceeding the human annoyance criteria is considered low. Therefore, it is not considered reasonable to change vibration intensive construction methods, except in response to vibration complaints (subject to verification monitoring).
Construction respite period	High vibration generating activities may only be carried out in continuous blocks, not exceeding 3 hours each, with a minimum respite period of one hour between each block, as per high noise impact activities.	This measure could be feasibly implemented. It is noted that only 1 receiver is within human annoyance MWD.	Yes	Not cost effective due to low risk. Does not outweigh potential adverse effects - economic cost not justified	No	No	1 residential receiver has been identified within the MWD for human annoyance. As the MWDs in this assessment are conservative, exceeding the human annoyance criteria is considered low. Therefore, it is not reasonable to implement respite periods for vibration intensive plant in this DNVIS, except in response to vibration complaints (subject to verification monitoring).

Control measure	Description of the mitigation measure	Feasible mitigation test	Deemed feasible?	Reasonable mitigation test	Deemed reasonable?	Adopted?	Justification and commentary
Plan work activities to minimise vibration.	Plan traffic flow, parking & loading/unloading areas to maximise distances between truck routes and sensitive receivers.	This measure could be feasibly implemented.	Yes	Sufficient vibration reduction could be achieved at enough receivers.	Yes	Yes	Implemented as part of the project.
Complaints Manag	gement						
Construction Complaints Management System	Complaints would be managed in accordance with the Community Communication Strategy. 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.	This measure could be feasibly implemented.	Yes	Routine task for project team.	Yes	Yes	Implemented as part of the project.

6.3.4 Additional vibration mitigation measures

After applying all feasible and reasonable mitigation measures identified in Table 6.5, if vibration monitoring at representative locations still exceeds relevant vibration objectives for human annoyance, the appropriate additional vibration mitigations measures, based on the CNVS [1], presented in Figure 6-2, should be provided.





6.3.5 Vibration monitoring

Attended vibration monitoring is to be undertaken to determine and verify site specific minimum working distances for cosmetic damage and human annoyance. Additional monitoring may be required in response to vibration complaints.

6.3.6 Complaints handling

Noise complaints received and responded to will be managed in accordance with the CPBG SBT Community Communication Strategy (SMWSASBT-CPG-1NL-NL000-CY-PLN-000002).

Sydney Metro operate a 24-hour construction complaints line. Enquiries/ complaints may also be received through the project email mailbox (<u>sydneymetrowsa@transport.nsw.gov.au</u>) or through the complaints hotline (1800 717 703).

7 Construction traffic noise assessment

7.1 Traffic sources

All heavy vehicles will access the OHE worksite via Kent Road, having arrived via the M4 Western Motorway. Heavy vehicles will depart via Kent Road then onto M4 Western Motorway.

Traffic noise impacts have been calculated along Kent Road as there are residential receivers along the heavy vehicle route. Note that there only limited proposed construction traffic during the night-time period. The impact of construction traffic on traffic noise levels from the M4 Western Motorway, a major road transport corridor, is considered negligible and has not been assessed in this report.

Details of projected heavy vehicle movements associated with the construction works were provided by CPBG (See Table C.1 in APPENDIX C).

		Construction traffic movements – Total (per hour)				
Activity/ Aspect	venicie type	Day (7am to 10pm)	Night (10pm to 7am)			
Compound (Staff and deliveries)	Light vehicles	Peak: 60 (30 per hour)	-			
		Off-peak: 24 (12 per hour)				
	Delivery trucks	10 (5 per hour)	-			
Station box and dive excavation:	Concrete trucks	8 (4 per hour)	-			
piling, capping beam and upstand	Delivery trucks	8 (4 per hour)	-			
Station box and dive excavation:	Concrete trucks	6 (3 per hour)	-			
excavation and blinding works	Delivery trucks	30 (15 per hour)	-			
Lansdowne Bridge works	Concrete trucks	10 (5 per hour)	-			
	Delivery trucks	20 (10 per hour)	-			
Portal FRP works	Concrete trucks	12 (6 per hour)	-			
	Delivery trucks	6 (3 per hour)	-			
Dive FRP works	Concrete trucks	12 (6 per hour)	-			
	Delivery trucks	6 (3 per hour)	-			
TBM tunnel support works	Delivery trucks	60 (30 per hour)	≤2 movements; 1 per hour (OSD only)			
Peak construction	Light vehicles	60 (30 per hour)	-			
	Heavy vehicles	60 (30 per hour)	≤2 movements; 1 per hour (OSD only)			
Off-Peak construction	Light vehicles	24 (12 per hour)	-			
	Heavy vehicles	16 (8 per hour)	≤2 movements; 1 per hour (OSD only)			

NOTES: OSD = Oversized deliveries that are restricted by the road authority from travelling on public roads during standard hours.

To predict road traffic noise levels on the existing road network, the most recent available traffic data for each road forming part of the site access route was obtained by reviewing the EIS Technical Paper 2:

Noise and vibration [4]. Base traffic volumes based on the EIS are detailed in Table 7.1. 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. The method uses the average 1-hour traffic volume for the 'assessment period' (i.e. day or night) to predict the $L_{10, 1hour}$ noise levels. A correction of -3dB(A) is applied to obtain the $L_{eq, 1 hour}$ noise levels which equate to the L_{Aeq} noise levels for the 'assessment period'.

For this assessment, the model has considered:

- traffic volume and heavy vehicle forecasts;
- vehicle speed;
- road gradient;
- ground reference levels of the road and receivers;
- separation distances of the road to receivers;
- ground type between the road and receivers; and
- angles of view of the road from the receiver's position.

Table 7.2 and Table 7.3 below summarises the predicted construction traffic noise levels during day and night periods.

The predicted road traffic noise levels indicate less than 2dB(A) increase in L_{Aeq(15h)} day and L_{Aeq(9h)} night on Kent Road during the peak and off-peak construction day and night periods. Note that predictions are based on the worst-case scenario during the peak construction period. Actual noise levels are likely to be lower than the predicted noise levels. Therefore, the risk of construction traffic impacting the existing traffic noise at receivers on Kent Road during the day and night period is low.

7.2 Traffic noise mitigation and management

None required when on public roads, provided traffic movements associated with construction are consistent with the assumptions outlined above.

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

7.3 Complaints handling

Construction traffic noise complaints received and responded to will be managed in accordance with the CPBG SBT Community Communication Strategy (SMWSASBT-CPG-1NL-NL000-CY-PLN-000002) and Overarching Community Communications Strategy.

Sydney Metro operate a 24-hour construction complaints line. Enquiries/ complaints may also be received through the project email mailbox (<u>sydneymetrowsa@transport.nsw.gov.au</u>) or through the complaints hotline (1800 717 703).

Table 7.2: Summary of traffic volumes – base (2023/2024) traffic volumes and base traffic volumes with construction traffic

		Distance to pearest		2023/2024 Ba		2023/2024 Base + Construction traffic					
Road	RNP Classification	representative	Posted speed limit	Day (7am to 10pm)		Night (10pm to 7am)		Day (7am to 10pm)		Night (10pm to 7am)	
	classification	residential receiver	sheer with	Total vehicles	HV%	Total vehicles	HV%	Total vehicles	HV%	Total vehicles	HV%
Peak construction											
Kent Road (south of the M4)	Sub-arterial	30 m	50 km/h	7421	4%	1310	3%	7541	5%	1311	3%
Off-Peak construction											
Kent Road (south of the M4)	Sub-arterial	30 m	50 km/h	7421	4%	1310	3%	7461	4%	1311	3%

Table 7.3: Predicted construction traffic noise impacts – base (2023/2024) traffic volumes and base traffic volumes with construction traffic

Deed	RNP	Day (7am to 10	om)		Night (10pm to 7am)			
Koad	Classification	Metric	2023/2024 Base	Base + Construction	Metric	2023/2024 Base	Base + Construction	
Peak construction								
Kent Road (south of the M4)	Sub-arterial	L _{Aeq(15 hour)}	57.1 dB(A)	57.5 dB(A)	L _{Aeq(9 hour)}	51.5 dB(A)	51.5 dB(A)	
Off-peak construction								
Kent Road (south of the M4)	Sub-arterial	L _{Aeq(15 hour)}	57.1 dB(A)	57.5 dB(A)	L _{Aeq(9 hour)}	51.5 dB(A)	51.5 dB(A)	

CPB GHELLA TM008-03-01F01 SMWSA-SBT_DNVIS-OHE (R8)

Impact classification

The CNVS requires that on completion of a DNVIS, the subjective classification of the noise (and vibration) impact is to be evaluated and documented as:

Low Impact

Moderate Impact

High Impact.

The classifications are to be determined on a case-by-case basis with consideration of the items addressed in the table below and the requirements of SSI 10051 Condition E41 (b) which defines Low impact.

Table 8.1: Impact classification for bulk excavation and TBM support works – Orchard Hills tunnel support worksite (OHE)

No.	Impact item description	Analysis	Classification
1	The location of the works in relation to NSRs with consideration of noise attenuation features such as noise barriers including topographical features (earth-mounds), buildings, dividing fences etc (distance of works from sensitive receiver(s)).	NSRs are typically not directly adjoining worksite. Noise barriers identified in Appendix C.2 to be installed to reduce potential construction noise impacts to nearby NSRs. Temporary noise barriers screens to be installed (where practicable) when high noise works are occurring near NSRs.	Low
2	The type and sensitivity of the NSRs: - Low Impact: e.g. Commercial buildings/ Scattered Residential (low density) - Moderate Impact: e.g. Standard residential (typical density) - High Impact: e.g. Residential home for the elderly/high density unit blocks/ persistent complainers/ residents deemed to have "construction noise fatigue".	Scattered residential (typically 1 to 2 storeys high)	Low
3	Land use zoning and planning amenity objectives for the area.	Rural/ residential land use surrounding worksite.	Moderate to low
4	Construction and architectural design of impacted building, particularly the presence of any existing noise mitigation including that provided under a Noise Abatement Program or required by the ISEPP, Council DCP or other planning instrument.	It is assumed most buildings are standard construction with no existing additional mitigation. Newer buildings may include noise mitigation under ISEPP or Australian Standard AS 2021:2015 Acoustics - Aircraft Noise Intrusion - Building Siting and Construction (to be confirmed)	Low
5	Existing ambient levels.	Moderate existing ambient noise levels during daytime (L _{Aeq(15min)} 55 dB(A)); evening (L _{Aeq(15min)} 53 dB(A)); and night (L _{Aeq(15min)} 50 dB(A)).	Low
6	The extent of noise exceedance above Noise Management Level.	No residential receivers are expected to experience noise levels above 75 dB(A) during the bulk excavation works. The level of impact is limited due to large distances between the main construction works area and the nearest residential receivers, in addition to mitigation measures such as noise barriers and partial enclosures reduce noise emission from the site.	Low

8

No.	Impact item description	Analysis	Classification
7	The likelihood for potential sleep disturbance (as described in the NPfl).	Small risk during concrete truck entry/ egress from worksite as part of the TBM support works. Worst case would be up to 2 OSD trucks per night during TBM delivery and assembly. Noise levels are likely to be lower than predicted levels. Verification monitoring during the construction stage would confirm the likelihood of sleep disturbance occurring	Low
8	The type of and intensity of noise emitted from works (i.e. tonal or impulsive): - Lower Impact: No high noise and/or vibration intensive activities - Moderate Impact: Short/intermittent high noise and/or vibration intensive activities - High Impact: Prolonged high noise and/or vibration intensive activities.	Due to distances between the construction work areas and receivers, combined with mitigation measures such as noise barriers and partial acoustic enclosures (see Table C.1 and Table C.2 in APPENDIX C) there are no receivers are predicted to be highly noise affected by the works. All reasonable and feasible measures will be applied to minimise noise impacts, as outlined in Section 5.3.2. Respite periods will be provided as outlined in Section 5.3.1	Low to Moderate
9	The duration of any OOHW required.	Up to sixteen months during TBM assembly and TBM support works, with noise impacts limited at night through effective site management.	Low
10	The time frames for any OOHW: - Lower Impact: 6.00 pm till 10.00 pm weekdays 1.00 pm till 10.00pm Saturdays 8.00 am till 6.00 pm Sundays or Public Holidays. - Moderate Impact: 10.00 pm to 7.00 am Weekday Nights 10.00 pm to 8.00 am Saturdays. - High Impact: 6.00 pm to 7.00 am Sundays and Public Holidays.	The site will be managed to meet the NMLs by limiting activities after 6pm, and further limiting activities after 10pm. There may be minor impacts (<5 dB(A)) above the NML at up to seven (7) receivers during the OOHW period, to be confirmed by verification noise monitoring.	Low
11	As a result of noise classification and/or the noise level exceedances at sensitive receivers provided by the DNVIS reports, appropriate reasonable and feasible noise mitigation is to be adopted and implemented. For sites where works are predicted to significantly exceed noise goals and impact on receivers for a significant period of time, additional reasonable and feasible noise mitigation measures such as those outlined in Section 5 would be considered if practical to reduce the noise levels and impact on sensitive receivers.	Mitigation measures outlined in Section 5.3 will be implemented to manage and reduce impacts from site establishment works.	Low

Review of the overall noise impact of bulk excavation and TBM works at the OHE worksite is considered **low**. Whilst there are some instances of moderate impact from high noise impact activity, this impact is short term in nature and will be managed through the mitigation and management measures outlined in Section 5.3, including suitable community notification regarding potential impacts from the works. Notably, the works assessed in this DNVIS will mostly be completed during standard construction hours. Mitigation and management measures will be implemented to reduce noise levels with the aim of achieving the NMLs.

At OHE, properties at risk of vibration impact have been identified through the conservative screening process set out in the CNVS [1]. Vibration impact from the bulk excavation and TBM support works are assessed as low. Vibration significant works will be managed in accordance with Section 6.3. The overall vibration impact of bulk excavation and TBM support works at OHE worksite is considered **low**.

RENZO TONIN & ASSOCIATES

9 Conclusion

In conclusion, construction works associated with the bulk excavation and TBM support works at the Orchard Hills tunnel support worksite have been described in this DNVIS to identify potential environmental risks associated with construction noise and vibration. Construction noise and vibration objectives have been established consistent with the Conditions of Approval for the Project and the EIS.

Construction noise

The predicted noise levels indicate there are no highly noise affected receivers over the duration of the bulk excavation and TBM support works.

TBM support works would occur outside standard construction hours, provided all reasonable and feasible mitigation measures have been implemented to reduce noise levels with the aim of achieving the NML.

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

Construction vibration

There are no buildings/structures within minimum working distances for cosmetic damage. There is one residential receiver identified to be within the minimum working distances for human annoyance.

Construction traffic

The predicted noise impacts are assessed as low and within the minimum requirements in the CNVS.

Impact classification

The overall noise and vibration impact of site establishment works project-wide is considered **low**.

References

- [1] Sydney Metro Construction Noise and Vibration Standard Version 4.3 (SM-20-00098866) 4 November 2020
- [2] Transport for NSW Construction Noise and Vibration Strategy (ref: ST-157/4.1) April 2019
- [3] Sydney Metro Western Sydney Airport Out-of-hours Work Protocol Version 2.0 (SM-21-00306108) –
 8 November 2021
- [4] M2A Joint Venture 2020 Sydney Metro Western Sydney Airport Technical Paper 2: Noise and Vibration October 2020
- [5] M2A Joint Venture 2020 Sydney Metro Western Sydney Airport Submissions Report
- [6] Department of Environment and Climate Change 2009 NSW Interim Construction Noise Guideline (ICNG)
- [7] Environment Protection Authority 2017 NSW Noise Policy for Industry (NPfl)
- [8] Department of Environment Conservation NSW 2006 Assessing Vibration; a technical guideline
- [9] British Standard BS 6472-2008, Evaluation of human exposure to vibration in buildings (1-80Hz)
- [10] Australian Standard AS 2187.2-2006 Explosives Storage and Use Use of Explosives
- [11] British Standard BS 7385 Part2-1993, Evaluation and measurements for vibration in buildings Part 2
- [12] German Standard DIN 4150-3: 2016-12, Structural vibration Effects of vibration on structures, December 2016
- [13] ASHRAE Applications Handbook (SI) 2003, Chapter 47 Sound and Vibration Control, pp47.39-47.40
- [14] Australian Standard 2834-1995 Computer Accommodation, Chapter 2.9 Vibration, p16
- [15] Australian Standard AS/NZS 2107:2000 Acoustics Recommended design sound levels and reverberation times for building interiors
- [16] Department of Environment, Climate Change and Water 2011 NSW Road Noise Policy (RNP)

APPENDIX A Glossary of terminology

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

Adverse weather	Weather effects that enhance noise (that is, wind and temperature inversions) that occur at a site for a significant period of time (that is, wind occurring more than 30% of the time in any assessment period in any season and/or temperature inversions occurring more than 30% of the nights in winter).
Ambient noise	The all-encompassing noise associated within a given environment at a given time, usually composed of sound from all sources near and far.
Assessment period	The period in a day over which assessments are made.
Assessment point	A point at which noise measurements are taken or estimated. A point at which noise measurements are taken or estimated.
Attenuation	The reduction in the level of sound or vibration.
AVTG	Assessing Vibration – a technical guideline (DEC 2006)
Background noise	Background noise is the term used to describe the underlying level of noise present in the ambient noise, measured in the absence of the noise under investigation, when extraneous noise is removed. It is described as the average of the minimum noise levels measured on a sound level meter and is measured statistically as the A-weighted noise level exceeded for ninety percent of a sample period. This is represented as the L90 noise level (see below).
CNVS	Construction Noise and Vibration Standard (Sydney Metro 2021)
СоА	Condition of Approval
Decibel [dB]	The units that sound is measured in. The following are examples of the decibel readings of every day sounds: OdB 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 100dBThe sound of a rock band 115dBLimit of sound permitted in industry 120dBDeafening
dB(A)	A-weighted decibels. The A- weighting noise filter simulates the response of the human ear at relatively low levels, where the ear is not as effective in hearing low frequency sounds as it is in hearing high frequency sounds. That is, low frequency sounds of the same dB level are not heard as loud as high frequency sounds. The sound level meter replicates the human response of the ear by using an electronic filter which is called the "A" filter. A sound level measured with this filter switched on is denoted as dB(A). Practically all noise is measured using the A filter.
dB(C)	C-weighted decibels. The C-weighting noise filter simulates the response of the human ear at relatively high levels, where the human ear is nearly equally effective at hearing from mid-low frequency (63Hz) to mid-high frequency (4kHz), but is less effective outside these frequencies.
DEC	Department of Environment and Conservation (now EPA)
DECC	Department of Environment and Climate Change (now EPA)
DECCW	Department of Environment, Climate Change and Water (now EPA)
DNVIS	Detailed Noise and Vibration Impact Statement

DP&E	NSW Department of Planning and Environment
ECRTN	Environmental Criteria for Road Traffic Noise (EPA 1999)
EIS	Environmental Impacts Statement
EPA	NSW Environment Protection Authority
Feasible and reasonable	Consideration of best practice taking into account the benefit of proposed measures and their technological and associated operational application in the NSW and Australian context. Feasible relates to engineering considerations and what is practical to build. Reasonable relates to the application of judgement in arriving at a decision, taking into account mitigation benefits and cost of mitigation versus benefits provided, community views and nature and extent of potential improvements.
Frequency	Frequency is synonymous to pitch. Sounds have a pitch which is peculiar to the nature of the sound generator. For example, the sound of a tiny bell has a high pitch and the sound of a bass drum has a low pitch. Frequency or pitch can be measured on a scale in units of Hertz or Hz.
GIS	Geographic Information System
ICNG	Interim Construction Noise Guideline (DECC, 2009)
INP	NSW Industrial Noise Policy (EPA, 2000)
Impulsive noise	Having a high peak of short duration or a sequence of such peaks. A sequence of impulses in rapid succession is termed repetitive impulsive noise.
Intermittent noise	The level suddenly drops to that of the background noise several times during the period of observation. The time during which the noise remains at levels different from that of the ambient is one second or more.
L _{Max}	The maximum sound pressure level measured over a given period.
L _{Min}	The minimum sound pressure level measured over a given period.
L1	The sound pressure level that is exceeded for 1% of the time for which the given sound is measured.
L ₁₀	The sound pressure level that is exceeded for 10% of the time for which the given sound is measured.
L ₉₀	The level of noise exceeded for 90% of the time. The bottom 10% of the sample is the L90 noise level expressed in units of dB(A).
L _{eq}	The "equivalent noise level" is the summation of noise events and integrated over a selected period of time.
MWD	Minimum Working Distance
NCA	Noise Catchment Areas
NML	Noise management levels
NSR	Noise Sensitive Receivers
OEH	Office of Environment and Heritage
OOHW	Out-of-Hours Works – work completed outside of standard construction hours
PPV	Peak Particle Velocity
RBL	The Rating Background Level for each period is the medium value of the ABL values for the period over all of the days measured. There is therefore an RBL value for each period (day, evening and night)
Reflection	Sound wave changed in direction of propagation due to a solid object obscuring its path.
SEL	Sound Exposure Level (SEL) is the constant sound level which, if maintained for a period of 1 second would have the same acoustic energy as the measured noise event. SEL noise measurements are useful as they can be converted to obtain Leq sound levels over any period of time and can be used for predicting noise at various locations.
RNP	NSW Road Noise Policy (DECCW 2011)

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

B.1 NCAs and sensitive receiver identification

B.2 NCAs and noise management levels

APPENDIX C Construction timetable/ activities/ management

C.1 Construction timetable/activities/equipment

Table B1: Noise Sensitive Receivers and Construction Noise Management Levels (airborne noise)

			Existing Noise Levels, dB(A)					Airborne N	Airborne NMLs based on ICNG (external)				Amax	Commonte	
NCA	Receiver Type	Reference RBL	RBL Day	RBL Evening	RBL Night	LAeq_D	LAeq_E	LAeq_N	NMLDS	NMLDO	NMLE	NMLN	L _{Aeq(15min)}	L _{AFmax}	Comments
Residential r	eceivers				-										
NCA06	Predominantly Residential	NM07	37	37	36	48	49	45	47	42	42	41	41	52	
NCA07	Predominantly Residential	NM16	47	42	30	59	56	54	57	52	47	35	40	52	
NCA08	Predominantly Residential	NM15	44	44	41	55	53	50	54	49	49	46	46	56	
Other sensit	ive receivers														
Studio buildi	ng (music recording studio)								45	45	45	45	-	-	Source: CNVS
Studio buildi	ng (film or television studio)								50	50	50	50	-	-	Source: AS21
Theatre/ Aud	ditorium (Drama Theatre)								50	50	50	50	-	-	Source: CNVS
Cinema spac	e, theatre, auditorium								55	55	55	55	-	-	Source: AS21
Classrooms a	t schools and other educational institution	ons							55	55	55	55	-	-	Source: ICNG
Childcare cer	ntre (indoor sleeping areas)								55	55	55	55	-	-	Source: CNVS
Childcare cer	ntre (play areas)								65	65	65	65	-	-	Source: CNVS
Hospital war	ds and operating theatres								65	65	65	65	-	-	Source: ICNG
Places of wo	rship								55	55	55	55	-	-	Source: ICNG
Library (read	ing areas)								65	65	65	65	-	-	Source: CNVS
Hotel (Sleepi	ng areas: Hotels near major roads)								60	60	60	60	-	-	Source: CNVS
Hotel (bars a	nd lounges)								70	70	70	70	-	-	Source: CNVS
Community	centres – Municipal Buildings								60	60	60	60	-	-	Source: AS21
Bar/ Restaur	ant (Bars and lounges/ Restaurant)								60	60	60	60	-	-	Source: CNVS
Café/ Coffee	bar								60	60	60	60	-	-	Source: CNVS
Railway platf	orm and concourse areas								75	75	75	75	-	-	Source: AS21
Passive recre	ation areas (e.g. area used for reading	g, meditation)							60	60	60	60	-	-	Source: ICNG
Active recrea	ation areas (e.g. sports fields)								65	65	65	65	-	-	Source: ICNG
Commercial	premises (including offices and retail out	lets)							70	70	70	70	-	-	Source: ICNG
Industrial pre	emises								75	75	75	75	-	-	Source: ICNG
Neteci		C	d franc 0 and ba (Caterralau											

Notes: D(S): standard construction hours from 7 am to 6 pm Monday to Friday and from 8 am to 6 pm Saturday

D(O): out-of-hours day period from 8 am to 6 pm Sunday and Public holidays - OOHW P1

E: evening period from 6 pm to 10 pm Monday to Sunday - OOHW P1

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

Orchard Hills Tunnel Support, Station and Dive Worksites

Section 2.2.1 & AS2107 'maximum', assuming 20 dB(A) facade loss
07 'maximum', assuming 20 dB(A) facade loss
Section 2.2.1 & AS2107 'maximum', assuming 20 dB(A) facade loss
07 'maximum', assuming a conservative façade loss of 20 dB(A)
, assuming a conservative façade loss of 10 dB(A)
Section 2.2.1, assuming a conservative façade loss of 10 dB(A)
Section 2.2.1
, assuming a conservative façade loss of 20 dB(A)
, assuming a conservative façade loss of 10 dB(A)
Section 2.2.1 & AS2107 'maximum', assuming 20 dB(A) facade loss
Section 2.2.1 & AS2107 'maximum', assuming 20 dB(A) facade loss
Section 2.2.1 & AS2107 'maximum', assuming 20 dB(A) facade loss
07 'maximum', assuming a conservative façade loss of 10 dB(A)
Section 2.2.1 & AS2107 'maximum', assuming 10 dB(A) facade loss
Section 2.2.1 & AS2107 'maximum', assuming 10 dB(A) facade loss
07 'maximum', assuming a conservative façade loss of 20 dB(A)

Table B2: Noise Sensitive Receivers and Construction Noise Management Levels (groundborne noise)

		Groundborne	NMLs based o	n ICNG (interna	I)	Comments
NCA Rec	eiver Type	NMLDS	NMLDO	NMLE	NMLN	
Residential receivers						
All All	residential receivers	Human comfo	ort vibration	40	35	Source: ICNG
Other sensitive recei	vers					
Studio building (musi	ic recording studio)	25	25	25	25	Source: CNVS Section 2.2.1 & AS2107 'maximum
Studio building (film	or television studio)	30	30	30	30	Source: AS2107 'maximum
Theatre/ Auditorium	(Drama Theatre)	30	30	30	30	Source: CNVS Section 2.2.1 & AS2107 'maximum
Cinema space, theatr	e, auditorium	35	35	35	35	Source: AS2107 'maximum'
Classrooms at school	s and other educational institutions	45	45	45	45	Source: ICNG
Childcare centre (ind	oor sleeping areas)	45	45	45	45	Source: CNVS Section 2.2.1
Childcare centre (pla	y areas)	65	65	65	65	Source: CNVS Section 2.2.1
Hospital wards and o	perating theatres	45	45	45	45	Source: ICNG
Places of worship		45	45	45	45	Source: ICNG
Library (reading area	s)	45	45	45	45	Source: CNVS Section 2.2.1 & AS2107 'maximum
Hotel (Sleeping areas	: Hotels near major roads)	40	40	40	40	Source: CNVS Section 2.2.1 & AS2107 'maximum
Hotel (bars and loung	ges)	50	50	50	50	Source: CNVS Section 2.2.1 & AS2107 'maximum
Community centres -	- Municipal Buildings	40	40	40	40	Source: AS2107 'maximum'
Bar/ Restaurant (Bar	s and lounges/ Restaurant)	50	50	50	50	Source: CNVS Section 2.2.1 & AS2107 'maximum
Café/ Coffee bar		50	50	50	50	Source: CNVS Section 2.2.1 & AS2107 'maximum
Railway platform and	l concourse areas	55	55	55	55	Source: AS2107 'maximum'

 Notes:
 D(S): standard construction hours from 7 am to 6 pm Monday to Friday and from 8 am to 6 pm Saturday

 D(O): out-of-hours day period from 8 am to 6 pm Sunday and Public holidays - OOHW P1

 E: evening period from 6 pm to 10 pm Monday to Sunday - OOHW P1

NS: night shoulder period from 10 pm to 12 am Monday to Sunday - OOHW P1 $\,$

Orchard Hills Tunnel Support, Station and Dive Worksites

C.2 Specific mitigation measures (temporary noise barriers)

Table C1: Construction timetable/ activities/ equipment

Activity/ Work Area	Aspect	Scenario ID	Plant/ Equipment (as provided by client)	Day	Evening	Night 10pm - 7am	Timing of Activity		Sound Power Level (Lw re: 1pW) in Nois Model, dB(A)			High noise	Vibration intensive	Notes
				7am - 6pm	6pm - 10pm		Start Date	End Date	L _{Aeq}	Penalty	L _{Amax}	plant	plant	
CIVIL SITE														
Compound and	General worksite and Car parking	SBDE-PC	Light vehicle	30	-	-	Sep-22	Aug-23	89	-	100	-	-	
Carpark		2RDF-FR	Road Truck (Deliveries to site)	5 p.n	-	-	Aug-23	Nov-24	106	-	111	-	-	
Cite Fatablisher est			Water Cart	1	-	-		C	107	-	101	-	-	Dission of D
Site Establishment	Clearing, demo and haul roads		Dozer	1	-	-	Jun-22	Sep-22	116	-	121	-	-	Ripping or Pi
			Chainsaw	2	-	-			110	5	120	HN	-	Tree clearing
			Mulcher	1	-	-			120	5	124	HIN	-	Tree clearing
			Excavator w bucket	2	-	-			103	-	108	-	-	Demolition
			Hand tools	2	-	-			105	-	118	-	-	Demolition
			Padfoot Roller 161	1	-	-			108.1001224	5	112.7062554	HN	X	
WORKS	COMPLETED.		Smooth Drum Roller 161	1	-	-			107	5	111	HN	X	
			Bobcat	2	-	-			102	-	107	-	-	
			Water cart	1	-	-			107	-	111	-	-	
			Iruck & Irailer	1	-	-			106	-	111	-	-	
			Excavator w bucket	2	-	-			103	-	108	-	-	
			Wacker Plate and plate compactor	1	-	-			108	-	110	-	X	
			Delivery Trucks	4 per day	-	-			106	-	111	-	-	
	Internal hard stands and footings		Concrete pump	1	-	-	Jun-22	Sep-22	103	-	107	-	-	
			Concrete Agi	5 every 2nd da	ay -	-			108	-	111	-	-	
			Pneumatic Vibrator	3	-	-			97	-	100	-	-	
			Compressor	1	-	-			102	-	103	-	-	
			Generator	1	-	-			94	-	95	-	-	
			Franna	1	-	-			98	-	102	-	-	
			Telehandler 10t	2	-	-			98	-	102	-	-	
			Hand tools	5	-	-			105	-	118	-	-	
Station Box and	Piling	SBDE-PC	Piling Rig - bored	2	-	-	Sep-22	Apr-23	107	-	116	-	х	
Dive Excavation			Concrete Agi	9 per day	-	-			108	-	111	-	-	
			Concrete pump	1	-	-			103	-	107	-	-	
			Crawler crane 120T	1	-	-			104	-	108	-	-	
			Excavator 35T w bucket	1	-	-	_	_	103	-	108	-	-	
			Moxy 30T	1	-	-			109	-	119	-	-	
			Delivery Trucks	4 per day	-	-		_	106	-	111	-	-	
	Capping Beam and Upstand	SBDE-PC	Concrete pump	1	-	-	Sep-22	May-23	103	-	107	-	-	
	Stephen Stephe		Concrete Agi	5 every 2nd da	av -	-			108	-	111	-	-	
			Pneumatic Vibrator	3	-	-		_	97	-	100	-	-	
			Pneumatic hammer	1			_	_	111	5	121	HN	x	
			Compressor	1		-	_	_	102	-	103		-	
			Generator	1	-	-	_		94	-	95	-	-	
			Franna	1	-	-	_		98	-	102	-	-	
			Tolohandlor 10t	2				_	08		102			
			Hand tools	5				_	105	-	112			
	Execution		Evenuator yr Bucket	1	-	-	Oct 22	lup 22	103	-	100	-	-	
		SDDL-LD	Dezer	1	-		000-22	5011-2.5	115	-	121		-	Dipping or D
			Dozer	[-	-			100	-	121	-	-	Ripping or Pt
			Delivery trucks	5 p.n	-	-			106	-	101	-	-	
			Pheumatic Hammer	1	-	-			102	5	121	HIN	X	
			Excavator w bucket	4	-	-			103	-	108	-	-	
			Articulated Dump Truck	4	-	-			109	-	119	-	-	
			FE Loader	1	-	-			105	-	115	-	-	
			Shotcrete Rig (Diesel)	2	-	-			104	-	107	-	-	
			Shotcrete Agi	5 per day	-	-			108	-	111	-	-	
			Ground Anchor Drill Rig (Diesel)	2	-	-			114	-	118	HN	Х	
			Boom Pump	1	-	-			103	-	107	-	-	
			Truck & Dog (spoil haulage)	10 per hour	-	-			106	-	111	-	-	
			Shaft ventilation fans	2	-	-			107	-	110	-	-	Air supply for
	Blinding Works	SBDE-EB	Boom Pump	1	-	-	Feb-23	Jul-23	103	-	107	-	-	
			Concrete Agi	3 p.h	-	-			108	-	111	-	-	Every 3rd day
			Excavator 25T w bucket	1	-	-			103	-	108	-	-	
			Compressor	2	-	-			102	-	103	-	-	
			Blowpiping	3	-	-			96	-	107	-	-	
			Pneumatic vibrator	3	-	-			97	-	100	-	-	

Orchard Hills Tunnel Support, Station and Dive Worksites

shing	
	1
abba a	
sning	
	-
	-
	-
	-
	-
	j
	1
	1
station box excavation	1
	Í

RENZO TONIN ASSOCIATES

Table C1: Construction timetable/ activities/ equipment

Activity/ Work Area	Aspect	Scenario ID	Plant/ Equipment Day Evening Night Tir		Timing of Activity		Sound Power Level (Lw re: 1pW) in Noise Model, dB(A)			High noise	Vibration intensive	Notes		
·····,			(as provided by client)	7am - 6pm	6pm - 10pm	10pm - 7am	Start Date	End Date	L _{Aeq}	Penalty	L Amax	plant	plant	notes
	Clearing and earthworks	SBDE-CE	Excavator w Bucket	2	-	-	Feb-23	Jul-23	103	-	108	-	-	
	- Area east of station box and north		Dozer	1	-	-			116	-	121	-	-	Ripping or Pu
	of Landsdowne Road		Delivery trucks	5 p.h	-	-			106	-	111	-	-	
			Chainsaw	2	-	-			116	5	120	HN	-	
			Mulcher	1	-	-			120	5	124	HN	-	
			Bobcat	2	-	-			102	-	107	-	-	
			Vibratory Compactor 16T (Padfoot)	1	-	-			108.1001224	5	112.7062554	HN	Х	
			Vibratory Compactor 16T (Smoothdrum)	1	-	-			107	5	111	HN	Х	
			Truck & Dog (spoil haulage)	4 per hour	-	-			106	-	111	-	-	
Lansdowne Bridge	Bridge FRP Works	LBW	Delivery trucks	5	-	-	Sep-22	Mar-23	106	-	111	-	-	
Works			Boom pump	2	-	-			103	-	107	-	-	
			Concrete Agi	40 per day	-	-			108	-	111	-	-	Assume 4 No
			Pneumatic vibrator	3	-	-			97	-	100	-	-	
			Compressor	2	-	-			102	-	103	-	-	
			Generator	2	-	-			94	-	95	-	-	
			Pneumatic vibrator	3	-	-			97	-	100	-	-	
			Franna	1	-	-			98	-	102	-	-	
			Telehandler	2	-	-			98	-	102	-	-	
			Forklift	1	-	-			99	-	103	-	-	
			Hand tools	5	-	-			105	-	118	-	-	
	Backfilling Behind Abutments	LBW	Vibratory Compactor 13T (Sheepsfoot)	1	-	-	Feb-23	Mar-23	108	5	113	HN	Х	
			Vibratory Compactor 13T (Smoothdrum)	1	-	-			107	5	111	HN	Х	
			Bobcat	1	-	-			102	-	107	-	-	
			Water cart	1	-	-			107	-	111	-	-	
			Truck & Trailer	1	-	-			106	-	111	-	-	
			Excavator w bucket	1	-	-			103	-	108	-	-	
			Delivery Truck	4 per day	-	-			106	-	111	-	-	
			Wacker Plate and plate compactor	3	-	-			108	-	110	-	Х	
	Bridge Precast Plank Installation	LBW	Mobile Crane 300t	1	-	-	Mar-23	Mar-23	106	-	110	-	-	Only for 5 day
	& Deck Topping		Franna	1	-	-			98	-	102	-	-	
			Oversize Delivery Truck	10	-	-			106	-	111	-	-	Super T Deliv
			Boom Pump	1	-	-			103	-	107	-	-	
			Pneumatic vibrator	3	-	-			97	-	100	-	-	
	WORKS COMPLET	ED.	Compressor	2	-	-			102	-	103	-	-	
			Generator	2	-	-			94	-	95	-	-	
			Concrete Agi	5 Per day	-	-			108	-	111	-	-	Assume 6 Pou
			Hand Tools	5	-	-			105	-	118	-	-	
			EWP	2	-	-			95	-	98	-	-	
	Bridge Finishing Works	LBW	Delivery truck	5 per day	-	-	Feb-23	Mar-23	106	-	111	-	-	
			Concrete Agi	5 Per day	-	-			108	-	111	-	-	Assume 10 po
			Pneumatic vibrator	3	-	-			97	-	100	-	-	
			Compressor	2	-	-			102	-	103	-	-	
			Generator	2	-	-			94	-	95	-	-	
			Hand Tools	5	-	-			105	-	118	-	-	
			Franna	1	-	-			98	-	102	-	-	
			Boom Pump	1	-	-			103	-	107	-	-	
			Asphalt Paver	1	-	-			105	-	112	-	-	Pavement Ins
			Road Asphalt truck	4 p.h	-	-			106	-	111	-	-	Pavement Ins
			Bobcat	1	-	-			102	-	107	-	-	Pavement Ins
			Asphalt truck & sprayer	1	-	-			105	-	112	-	-	
			Vibratory Roller	1	-	-			107	5	111	HN	Х	
			Water cart	1	-	-			107	-	111	-	-	
			Line marking truck	1	-	-			87	-	92	-	-	

Orchard Hills Tunnel Support, Station and Dive Worksites

shing	
Pours	
5	
Dave	
siy - 2 Days	
rrs	
purs.	
tall 5 days only	
tall 5 days only	
tall 5 days only	

RENZO TONIN ASSOCIATES

Table C1: Construction timetable/ activities/ equipment

Activity/ Work Area	Aspect	Scenario ID	Plant/ Equipment	Day	Evening Night T			Timing of Activity		Sound Power Level (Lw re: 1pW) in Noise Model, dB(A)			Vibration intensive	Notes
			(as provided by client)	7am - 6pm	6pm - 10pm	10pm - 7am	Start Date	End Date	L _{Aeq}	Penalty	L _{Amax}	plant	plant	Notes
Portal FRP Works	Piling	P-FRP	Piling Rig - bored	1	-	-	Sep-22	Nov-22	107	-	116	-	Х	
			Concrete Agi	9 per day	-	-			108	-	111	-	-	
	WORKS COMPLETED).	Concrete pump	1	-	-			103	-	107	-	-	
			Delivery Trucks	4 per day	-	-			106	-	111	-	-	
	Waterproofing	P-FRP	EWP	5	-	-	Jan-24	Feb-24	95	-	98	-	-	
			Delivery Trucks	4 per day	-	-			106	-	111	-	-	
			Hand Tools	5	-	-			105	-	118	-	-	
			Crawler Crane 50t	1	-	-			104	-	108	-	-	
			Telehandler	2	-	-			98	-	102	-	-	
	Portal FRP	P-FRP	Delivery trucks	8 per day	-	-	Feb-24	Apr-24	106	-	111	-	-	
			Franna	1	-	-			98	-	102	-	-	
			Crawler Crane 50t	1	-	-			104	-	108	-	-	
			Telehandler	3	-	-			98	-	102	-	-	
			EWP	4	-	-			95	-	98	-	-	
			Forklift	1	-	-			99	-	103	-	-	
			Hand tools	5	-	-			105	-	118	-	-	
			Boom Pump	1	-	-			103	-	107	-	-	
			Compressor	1	-	-			102	-	103	-	-	
			Pneumatic vibrator	6	-	-			97	-	100	-	-	
			Concrete Agi	6 p.h	-	-			108	-	111	-	-	Pour every 2
Dive FRP Works	DRAINAGE	D-FRP	Excavator 25T with saw attachment	2	-	-	Jan-24	Jul-23	121	5	129	HN	Х	
			Excavator 25T w Hammer	2	-	-			118	5	126	HN	Х	
			Vacuum Truck	1	-	-			107	-	111	-	-	
			Delivery Trucks	6 per day	-	-			106	-	111	-	-	
			Concrete Agi	4 per day	-	-			108	-	111	-	-	Pour every 3
			Crawler Crane 50t	1	-	-			104	-	108	-	-	
	INVERT SLAB D-	D-FRP	Delivery trucks	8 per day	-	-	Feb-24	Jul-23	106	-	111	-	-	
			Franna	1	-	-			98	-	102	-	-	
			Crawler Crane 50t	1	-	-			104	-	108	-	-	
			Telehandler	3	-	-			98	-	102	-	-	
			Forklift	1	-	-			99	-	103	-	-	
			Hand tools	5	-	-			105	-	118	-	-	
			Boom Pump	1	-	-			103	-	107	-	-	
			Compressor	1	-	-			102	-	103	-	-	
			Pneumatic vibrator	6	-	-		_	97	-	100	-	-	
			Concrete Agi	6 p.h	-	-			108	-	111	-	-	Pour every 2
TBM SUPPORT SITE				- p										
Site structures	Construction of site structures	TBM-A	Mobile Crane 300t	2	-	-	Sep-22	Apr-23	106	-	110	-	-	
		& -B	Telebandler	1	_	_			98	-	102	-	-	
		a b	Delivery truck	2 n h	_	_			106	-	111	-	-	
			Power tool - table saw	2	_	_			115	5	120	HN	-	
			Power tool - rotany drill	2		-		_	106	-	118	-	-	
			Power tool - 5" grinder	2					100		110			
			France Grane 25t	1	-	-			00	-	102	-	-	
				1	-	-			90	-	102	-	-	
			Excavator w hammer	1	-	-	5 1 00		118	5	126	HN	X	
TBM Delivery to Site & Assembly	IBM Delivery to Site, unloading	IBM-A	Road truck (deliveries to site)	8 per hour	8 per hour	OSD only*	Feb-23	Mar-23	106	-	111	-	-	* Oversized o
	and lifting into portal	& -B	Tower Crane Favco M2480	1	1	1			114	5	119	HN	-	This operate
	TBM assembly (on surface) TBM-A - Subject to noise verification monitoring (see Table C2)	IBM-A	Grinder	1	1	1	Feb-23	Apr-23	108	-	118	-	-	** OOH: Beh
		g	EWP	1	1	1			95	-	98	-	-	** OOH: Beh
			Mobile Crane GMK6400	1	-	-			106	-	110	-	-	This operate
			Hammering Steel	1 location	-	-			116	-	118	-	-	** OOH: Beh
			Air/ hydraulic hand tools	1	-	-			105	-	118	-	-	** OOH: Beh
			Welding Machines 400 amp	2	2	2			96	-	107	-	-	** OOH: Beh
			Compressor	1	1	1			102	-	103	-	-	** OOH: Beh
			Site Forklift	1	1	1			99	-	103	-	-	** OOH: Beh

|--|

2nd day
,
3rd day
· ·
2nd day
•
delivery vehicles only
es in isolation (i.e. no other TBM assembly tools concurrent)
hind noise barrier (see Table C2 and C3) only
hind noise barrier (see Table C2 and C3) only
es in isolation (i.e. no other TBM assembly tools concurrent)
hind noise barrier (see Table C2 and C3) only
hind noise barrier (see Table C2 and C3) only
hind noise barrier (see Table C2 and C3) only
hind noise barrier (see Table C2 and C3) only
hind noise barrier (see Table C2 and C3) only
Table C1: Construction timetable/ activities/ equipment

Activity/ Work Area Aspect		Scenario ID	Plant/ Equipment	Day Evening Ni		Night	Timing of Activity		Sound Power Level (Lw re: 1pW) in Noise Model, dB(A)			High noise	Vibration intensive	Notes
			(as provided by client)	7am - 6pm	6pm - 10pm	10pm - 7am	Start Date	End Date	L _{Aeq}	Penalty	L _{Amax}	plant	plant	
	TBM assembly (in the station box)	TBM-B	Grinder	1	-	-	Apr-23	May-23	108	-	118	-	-	** OOH: In sta
	- Subject to noise verification monitoring	9	EWP	1	1	1			95	-	98	-	-	** OOH: In sta
	(see Table C2)		Hammering Steel	1 location	-	-			116	-	118	-	-	** OOH: In sta
			Air/ hydraulic hand tools	1	-	-			105	-	118	-	-	** OOH: In sta
			Hydraulic Power Pack	1	1	1			94	-	95	-	-	This operates
			Welding Machines 400 amp	2	2	2			96	-	107	-	-	** OOH: In sta
			Compressor	1	1	1			102	-	103	-	-	** OOH: In sta
			Site Forklift	1	1	1			99	-	103	-	-	** OOH: In sta
	Spoil conveyor installation	TBM-A	Crawler crane 350T	1	-	-	Mar-23	May-23	104	-	108	-	-	
		& -B	Mobile franna crane	1	-	-			98	-	102	-	-	
			EWP	2	-	-			95	-	98	-	-	
			Forklift	1	-	-			99	-	103	-	-	
			Delivery trucks	2 p.h.	-	-			106	-	111	-	-	
			Generator	1	-	-			94	-	95	-	-	
			No powered handtools (spanners, podgy bars)	1	-	-			105	-	118	-	-	
			Workshop Hand Tools	2	-	-			107	-	111	-	-	
			Grinder	2	-	-			108	-	118	-	-	
			rattle guns	2	-	-			107	-	118	-	-	
			Gantry Crane (electric)	1	-	-			106	-	110	-	-	
			Electric welder	2	-	-			96	-	107	-	-	
			Handheld electric core drill (e.g. Husqvarna DM 22	20) 1	-	-			106	-	118	-	-	
	Early segment delivery	TBM-A	Semi trailer segment delivery	4 per hour	4 per hour	-	Mar-23	May-23	106	-	111	-	-	Delivered to s
		& -B	Forklift	2	2	-			96	-	100	-	-	In segment ya
TBM Support and	Tunnelling & Support	TBM-S	Grout plant	1	1	1	Mar-23	Jan-24	89	-	92	-	-	Plant design s
Spoil Handling			TBM compressors	2	2	2			93	-	94	-	-	At bottom of
			EVAPCO LPT-539 [TBM Cooling Towers]	4	4	4			90	#N/A	93	#N/A	#N/A	On surface, cl
			Ventilation fan	2	2	2			102	-	105	-	-	Fans on surfa
			Water treatment plant	1	1	1		_	91	-	94	-	-	On surface, cl
			Cross conveyor drive unit	2	2	2			92	-	95	-	-	At bottom of
			Conveyor Drive Unit	2	2	2		_	92	-	95	-	-	At bottom of
			Conveyor Drive Unit (enclosed)	1	1	1		_	85	-	88	-	-	On surface, n
			Conveyor	2	2	2			80/m	-	103	-	-	Bottom of sta
			Conveyor	1	1	1			80/m	-	103	-	-	Surface - Stat
			Tripper Conveyor	1	1	1			80/m	-	103	-	-	Surface - In si
	Spoil Handling	TBM-S	Truck & Dog (spoil haulage)	30 per hour	16* per hour	-	Mar-23	Jan-24	102	-	107	-	-	No trucks afte
			Spail falling from tripper conveyor	1	1	1			106		108			*Limit trucks
			EE Loader in speil bin	2	1*	-			100		115		-	Under 'all che
				2	1	-			105	-	115	-	-	*Swap to ever
			Wheel Wash unit	1	1	-		_	89	-	91	-	-	Not in use at
	Tunnel Lining	TBM-S	Forklift	1	1	1	Mar-23	Apr-24	99	-	103	-	-	Surface - In se
			Forklift	1	1	1			103	-	108	-	-	At bottom of
			Truck Movement (MSVs)	4	4	4			103	-	108	-	-	At bottom of
			Gantry Crane (electric)	1	1	1			96	-	100	-	-	
			Concrete trucks for cross passage	4 per hour	4 per hour	-			105	-	108	-	-	OOH concret
			Small truck	4 per hour	-	-			106	-	111	-	-	
	Segment Yard	TBM-S	Semi trailer segment delivery	8 per hour	4 per hour	-			106	-	111	-	-	
			Forklift	2	1	-			99	-	103	-	-	Delivering see

ation box or behind noise barrier (see Table C2 and C3) only
ation box or behind noise barrier (see Table C2 and C3) only
ation box or behind noise barrier (see Table C2 and C3) only
ation box or behind noise barrier (see Table C2 and C3) only
in isolation (i.e. no other TBM assembly tools concurrent)
ation box or behind noise barrier (see Table C2 and C3) only
ation box or behind noise barrier (see Table C2 and C3) only
ation box or behind noise barrier (see Table C2 and C3) only
segment vard
ard
specification - see Table C5
station box
ose to noise barrier on western boundary (see Table C5)
ce, with intake directed north. See Table C2.
ose to noise barrier on western boundary
station box
station box
orthern end of conveyor. Plant design specification - Table C5
tion box - TBM to surface convevor.
ion box to spoil area (covered - see Table C4)
poil area. Behind noise barrier OOH (see Table C2)
er 10:00 pm.
to 8 per hour, where practicable (see Table C2).
ding on spoil type. Subject to verification monitoring.
lter', see Table C4
avator for evening, subject to verification monitoring (see Table C2).
night
egment area (loading gantry)
station box
station box
e discharge must be behind segment shelter, see Table C2
aments No NIGHT delivery from segment storage

Figure C1: Site Layout and Hoardings



LEGEND	
×	- CONSTRUCTION SITE BOUNDARY
	- CADASTRAL BOUNDARY
1+400	
<	
\	RAIL ALIGNMENT (BT OTHERS)
17+400	
×	ORCHARD HILLS LOCAL AREA WORKS (LAW)
	PACKAGE OHE-SN150 0324
~	ORCHARD HILLS METRO STATION BOX
	E KENT ROAD (AEW PACKAGE 4.3)
	HARDSTAND
5	
	2 m NOISE WALL
\`	3 m NOISE WALL
λ	3.7 m NOISE WALL
	5 m NOISE WALL
	PARTIAL ENCLSOURE
3	
Ч	
~	
\sim	
~	
L	
Т	
<u>[</u>	
L -	
- T	
1	
L	
7	
L	
1	
E	
FOR	REVIEW AND COMMENT
DNEY METRO - WESTERN SY	DNEY AIRPORT - STATION BOXES AND TUNNELLING WORKS
OBILISATION AND SITE EST	TABLISHMENT
/ERALL GENERAL ARRANG	SEMENT PLAN
E No: SMWSASBT-CPG-O	HE-SN150-MB-M3D-031801 SHEET: 1 OF 1 ©
R No: SMWSASBT-CPG	-OHE-SN150-MB-DRG-031810 REV VER
	A

Table C2: Construction Noise Management Schedule

Area to be Managed		Specific Mitigation/ Management Measure	Typical Details
Tunnelling & Supporting Works			
1 Orchard Hills worksite			
1.1 Work during Standard Construction Hours	DAY:	Standard hours activities	see Table C1 for details
1.2 Work outside Standard Construction Hours	D(O)/EVE/ NGT:	- Station Box Excavation and Dive excavation works -	No OOHW scheduled
		- Lansdowne Bridge works - no OOHW scheduled	No OOHW scheduled
		- Portal FRP and Dive FRP works - no OOHW scheduled	No OOHW scheduled
		- TBM Support site structures installation works - no OOHW scheduled	No OOHW scheduled
		- TBM delivery to site and assembly - limited OOHW in station box	see Table C1 for details
		- TBM Support and spoil handling - OOHW permitted 24/7. Some activities limited with the aim of achieving NMLs.	see Table C1 for details
2 Noise Barriers	NW01	5 m noise wall to be constructed as early as practicable.	see Table C3 for details
	NW02	3 m noise wall to be constructed as early as practicable.	see Table C3 for details
	NW03	3 m noise wall to be constructed as early as practicable.	see Table C3 for details
	NW04	2 m noise wall to be constructed as early as practicable.	see Table C3 for details
3 Station Box excavation			
3.1 Work during Standard Construction Hours	DAY:	Standard hours activities.	see Table C1 for details
	Highly noise affected	Respite periods apply to high noise impact works, e.g. pile trimming and rock hammering, to meet EPL requirements. Physical noise mitigation: construction noise barriers (see Table C3) to be installed around works prior to piling commencement, where reasonable and feasible, to limit	See Table C3 for details
		'typical case' noise levels below highly noise affected level (L _{Aeq(15min)} 75 dB(A)).	
3.2 Work outside Standard Construction Hours	D(O)/EVE/ NGT:	If water pumps need to operate OOH, silencers, enclosures or other acoustic treatments may be required.	see Table C1 and C5 for details
4 TBM assembly 4.1 Work during Standard Construction Hours	DAY:	Standard hours activities	see Table C1 for details
4.2 Work outside Standard Construction Hours	D(O)/EVE/ NGT:	- Plant and equipment limited as per Table C1	see Table C1 for details
	-(-,,,	- Crawler crane limited to 4 lifts per hour during OOHW evening and not operating concurrently	see Table C1 for details
		Contru crope lifts limited to 4 ner hour during COLIW and not operating concurrently with other plant	see Table C1 for details
		- Gality crane mits minited to 4 per nour during Conw and not operating concurrently with other plant	
		- No forking movements at same time as crane during night. All other activities within station box.	
4.3 TBM shield assembly on surface (24/7)		Prior to completion of station box, OOH TBM assembly may occur on the surface provided:	Subject to noise verification monitoring
		- Plant and equipment limited as per Table CI	see Table C1 for details
		- Temporary noise screens (e.g. Flexsnield, ecobarrier or similar products) fixed onto the scattoldings around the TBM shields with no gaps/penetrations.	assembly works on C&SW TSE.
		- TBM shield assembly may extend to 10 pm and potentially 24/7.	Subject to noise verification monitoring
4 TBM Operations			
4.1 Work during Standard Construction Hours	DAV	Standard hours activities	see Table C1 for datails
4.2 Work outside Standard Construction Hours	DAT. D(O)/EVE/ NGT:	OOHW activities limited as noted below and in Table C1	see Table C1 for details
4.3 Acoustic enclosures/ sheds	-(-,,,		
Spoil handling area	D(O)/EVE/ NGT:	1 Front End Loader (FEL) with residential grade muffler inside spoil shelter only (eastern side). Day use only, subject to verification monitoring.	see Table C1 for details
		Swap to excavator with bucket to load trucks during day (OOH) and evening period.	see Table C1 for details
		1 Front End Loader (FEL) with residential grade muffler inside spoil shelter only (eastern side). Day use only, subject to verification monitoring.	see Table C1 for details
4.4 Truck restrictions during the OOHW period		Swap to excavator with bucket to load trucks during day (UOH) and evening period. Avoid the use of park air brakes at night. Set up relevant traffic management measures to minimise the use of air brakes when leaving the site	see Table C1 for details
		Air brake silencers are to be correctly installed and fully operational for any heavy vehicles (as per CNVMP). Minimise unnecessary acceleration on site	
SEGMENT trucks on site	D(O)/EVE:	4 per hour	see Table C1 for details
	NIGHT:		
SPOIL trucks on site	D(O)/EVE NIGHT:	≤ 16 per hour. If practicable, limit spoil trucks to ≤ 8 per hour	
MSV trucks	D(O)/EVE	≤ 4 per hour	
	NGT:	≤ 4 per hour	
Concrete delivery	D(O)/EVE	≤ 4 per hour. Drop point located adjacent to station box, shielded by segment shelter to west.	
	NIGHT:		
4.5 Ventilation Fan	EVE/NGI:	ventilation rans with silencer + additional attenuation (duct lining/ inlet attenuator). Intake to be orientated away from receivers	see Table C5 for performance requirements
		Noise harrier may be required to shield receivers to east or west, subject to verification monitoring on site	see Table C3 for details
		these same, may be required to smella receivers to east or weat, subject to vermed for information monitoring on site.	

Table C2: Construction Noise Management Schedule

A	rea to be Managed		Specific Mitigation/ Management Measure
_	4.6 TBM Grout plant		Acoustic specification
	4.7 Conveyor drive units		Acoustic specification
	4.8 Conveyors		Covered conveyor
	4.9 Wheel wash unit		mitigation measures TBC depending on location
	4.9 FEL with residential muffler (inside partial enclosure)		fitted with residential grade muffler
	4.10 Water treatment plant		Additional enclosure subject to compliance testing
	4.11 TBM Cooling Towers		Additional enclosure subject to compliance testing
	4.12 Electrical substation		Additional enclosure subject to compliance testing
5	Lansdowne Bridge works		
	5.1 Work during Standard Construction Hours	DAY:	Standard hours activities
	5.2 Work outside Standard Construction Hours	D(O)/EVE/ NGT:	No OOHW scheduled for Lansdowne Bridge works.
6	Portal FRP works		
	6.1 Work during Standard Construction Hours	DAY:	Standard hours activities
	6.2 Work outside Standard Construction Hours	D(O)/EVE/ NGT:	No OOHW scheduled for Portal FRP works.
7	Dive FRP works		
	7.1 Work during Standard Construction Hours	DAY:	Standard hours activities. Rocksawing and rockhammering activity should be undertaken concurrently where practicable. Rocksawing and rockhammering operation respite periods and consultation may be required.
	7.2 Work outside Standard Construction Hours	D(O)/EVE/ NGT:	No OOHW scheduled for Dive FRP works.

Orchard Hills Tunnel Support, Station and Dive Worksites **Typical Details**

see Table C5 for performance requirements see Table C5 for performance requirements see Table C4 for enclsoure design and Table C5 see Table C5 for performance requirements see Table C5 for performance requirements see Table C5 for performance requirements see Table C4b for performance requirements see Table C5 for performance requirements

with

Table C3: Noise Wall / Hoarding Design Specifications

Orchard Hills Tunnel Support, Station and Dive Worksites

Noise wall reference		Location	Noise wall/ hoarding height	Length of barrier	Proposed Construction	Acoustic Rating of Construction*
NW01		Western site boundary, parallel to Kent Road (as shown in Figure C1)	5 m	355 m and 50 m	17 mm plywood hoarding	Rw 20
NW02		Western site boundary, south of Lansdowne Road (as shown in Figure C1)	3 m	100 m	17 mm plywood hoarding	Rw 20
NW03		Eastern site boundary, south of Lansdowne Road (as shown in Figure C1)	3 m	153 m	17 mm plywood hoarding	Rw 20
NW04		Western site boundary adjacent to site compound, parallel to Kent Road (as shown in Figure C1)	2 m	130 m	17 mm plywood hoarding	Rw 20
Temporary barriers - assembly	TBM	Temporary noise screens fixed onto the scaffolding around the TBM shields with no gaps/penetrations.	At least 2 m above and below work platform	-	Flexshield Sonic Curtain 4kg	Rw 27
Noise barrier/ screen - ventilation fans	Tunne	Either side of tunnel ventilation fans, suject to verification monitoring. Directivitiy of fan may be sufficient as to not warrant noise barrier. Barrier to be installed if verification monitoring confirms fan noise is above predicted levels.	3.7 m	2 x 8 m	17 mm plywood hoarding Mounted on F-type barrier/ jersey kerb	Rw 20

Notes:

Noise barrier performance: Low - Rw 10-15; Medium - Rw 15-20; Medium-High - Rw 20-25; High - Rw 25; Very High - Rw 30

* estimated by calculations and/or reference to other similar barrier type data

GENERAL

• The specified 'required rating' must be achieved by the product selected.

• By way of explanation, the Sound Insulation Rating Rw is a measure of the noise reduction property of the assembly, a higher rating implying a higher sound reduction performance.

• Note that the Rw rating of systems measured as built on site (R'w Field Test) may be up to 5 points lower than the laboratory result.

• The sealing of all gaps is critical in a sound rated construction. Use only sealer approved by the acoustic consultant.

• Check design of all junction details with acoustic consultant prior to construction.

• Check the necessity for HOLD POINTS with the acoustic consultant to ensure that all building details have been correctly interpreted and constructed.

• The information provided in this table is subject to modification and review without notice.

• The advice provided here is in respect of acoustics only. Supplementary professional advice may need to be sought in respect of fire ratings, structural design, buildability, fitness for purpose and the like.

RENZO TONIN ASSOCIATES

Table C4: Noise Shed / Enclosure Design Specifications

Area to be Mitigated	Construction component	Reference ID	Indicative element construction		
-					
Spoil shelter	Walls (east and west sides)		Steel framed structure approx. 20 m high, 30 m wide and 65 m long with High-Density Polyethelene (HDPE) fabric cover		
	Walls (north and south		Open		
	Roof		High Strength Polyethylene Fabric Cover		
	Doors		Eastern side only, open		
Conveyor cover	Walls and roof	F002	Enclosed to achieve a sound power level per metre of 80 dB/m. See Table C5		
(surface conveyor)					

Notes:

1. The final level of noise reduction required from an acoustic shed / enclosure is dependent on a number of factors, however one important factor is whether or not there are noisy plant on site which cannot be acoustic shed / enclosure. Depending on the number and noise emissions of such plant, it may be necessary to apply greater acoustic treatment to the acoustic shed / enclosure in order to keep its noise contributions down so that the total noise emissions from site meet the set environmental noise limits at neighbouring receptors.

LEGEND * estimated by calculations and/or reference to other similar wall type data. The client is advised not to commit to materials which have not been tested in an approved laboratory or for which an opinion only is available. Testing materials is a component of the quality control of the design process and should be viewed as a priority because there is no guarantee the forecast results will be achieved thereby necessitating the use of an alternative which an approved laboratory or for which an opinion only is available. Testing materials is a component of the quality control of the design process and should be viewed as a priority because there is no guarantee the forecast results will be achieved thereby necessitating the use of an alternative which an approved laboratory or for which an opinion only is available. Testing materials is a component of the quality control of the design process and should be viewed as a priority because there is no guarantee the forecast results will be achieved thereby necessitating the use of an alternative which an approved laboratory or for which an opinion only is available. Testing materials is a component of the quality control of the design process and should be viewed as a priority because there is no guarantee the forecast results will be achieved thereby necessitating the use of an alternative which an approved laboratory or for which an opinion only is available. Testing materials be achieved thereby necessitating the use of or reliance upon untested materials, estimates or opinions.

GENERAL

· The underside of the roof and (where possible) internal walls should be lined with acoustic insulation to reduce the build-up of sound inside the shed

- · The specified performances must be achieved by the product selected.
- The sealing of all gaps is critical in a sound rated construction. Use only sealer approved by the acoustic consultant.
- · Check design of all junction details with acoustic consultant prior to construction.
- · Check the necessity for HOLD POINTS with the acoustic consultant to ensure that all building details have been correctly interpreted and constructed.
- · The information provided in this table is subject to modification and review without notice.
- The advice provided here is in respect of acoustics only. Supplementary professional advice may need to be sought in respect of fire ratings, structural design, buildability, fitness for purpose and the like.
- Only the buildings elements noted in Table C4 and Table C4a have been assessed. It is assumed that all other items will not impact the acoustic properties, or can be sufficiently acoustically treated.

Table C4a: Specification for acoustic elements of noise sheds/ acoustic

Orchard Hills Tunnel Support, Station and Dive Worksites

Reference	Sound	transmis	sion loss	per octa	ave spect	rum dB		Indicative ched element construction
ID	63	125	250	500	1000	2000	4000	indicative shed element construction
F002	7	9	13	18	22	19	20	1x 0.48mm BMT corrugated steel
F043	21	24	29	31	26	33	42	2 x 25mm plywood
F055		16	19	27	39	45	50	FlexShield Sonic Panel V50

LEGEND * estimated by calculations and/or reference to other similar wall type data. The client is advised not to commit to materials which have not been tested in an approved laboratory or for which an opinion only is available. Testing materials is a component of the quality control of the design process and should be viewed as a priority because there is no guarantee the forecast results will be achieved thereby necessitating the use of an alternative which may affect the cost and timing of the project. No responsibility is taken for use of or reliance upon untested materials, estimates or opinions.

Table C4b: Fan & Silencer Design Specifications

Site	Madal	Soun	d Power I	Level - O	ctave Ba	nd dB				Overall		Neter	
Site	Model		125	250	0 500	1000	2000	4000	8000	dB	dB(A)	Notes	
FANS													
1 - Shaft ventilation fan	Shaft FAN (ZITRONZVN 1-14-45/4) no SIL	91	106	109	105	101	96	96	93	112	107	In use during standard construction hours only	
2 - Shaft ventilation fan													
1 - Tunnel Inlet & Outlet	Tunnel FAN (ZITRON ZVN 1-14-132/4)+4.8m SIL w	99	110	108	94	84	82	90	94	112	102	24/7 operation to support tunnelling works. Intake directed	
2 - Tunnel Inlet & Outlet	pod											Additional screening to be confirmed, subject to verification	
TBM Cooling Towers	EVAPCO LPT-539 (22p125143 - 46 (HFA)) 11.00 kW	92	91	88	86	84	83	82	80	98	90	24/7 operation to support tunnelling works (see Table C2).	

Orchard Hills Tunnel Support, Station and Dive Worksites

north.

monitoring (see Table C3).

Table C5: Plant noise level schedule

Building/ Area to be Mitigated	Item	Acoustic Requirement	Lw dB(A)
Plant item	FEL with residential muffler (inside spoil shelter)	residential grade muffler to achieve	105
Station Box ventilation	Tunnel vent fan	Acoustic silencing (see Table C4b) to achieve	107
Tunnel ventilation	Tunnel vent fan	Acoustic silencing (see Table C4b) to achieve	102
Plant item (TBM support)	All conveyor drive units above surface	Drive unit designed to achieve	85
Plant item (TBM support)	Conveyor on surface	Additional enclosure (see Table C4) to achieve	75/m
Plant item (TBM support)	Conveyor in the dive	Additional enclosure subject to compliance testing	80/m
Plant item (TBM support)	Water treatment plant (total plant noise)	Additional partial or full enclosure subject to compliance testing	91
Plant item (TBM support)	Grout plant	Acoustic enclosure to achieve	89
Plant item (TBM support)	TBM Cooling Towers (EVAPCO LPT-539)	Additional partial or full enclosure subject to compliance testing (see Table C4b)	90
Plant item	Electrical substation	Additional partial or full enclosure subject to compliance testing	90
Plant item	Workshop Franna Crane 20 t	Plant sound power level	99
Plant item	Workshop handtools	Plant sound power level	107
Plant item	Truck & Dog (spoil haulage)	Plant sound power level (on site measurments conducted on 17 April 2020)	102
Plant item	Concrete / shotcrete truck	Plant sound power level (on site measurments conducted on 17 April 2020)	105

Notes:

LEGEND * estimated by calculations and/or reference to other similar plant type data. The client is advised not to commit to fans which have not been tested in an approved laboratory. Testing plant is a component of the quality control of the design process and should be viewed as a priority because there is no guarantee the forecast results will be achieved thereby necessitating the use of an alternative which may affect the cost and timing of the project. No responsibility is taken for use of or reliance upon untested materials, estimates or opinions. The advice provided here is in respect of acoustics only.

GENERAL

· Sound power level of plant assumed based on sound power level of similar plant type, incorporating attenuation (acoustic attenuator/ muffler/ duct lining as required)

- · The specified performances must be achieved by the product selected.
- · Check the necessity for HOLD POINTS with the acoustic consultant to ensure that all building details have been correctly interpreted and constructed.
- · The information provided in this table is subject to modification and review without notice.
- The advice provided here is in respect of acoustics only. Supplementary professional advice may need to be sought in respect of fire ratings, structural design, buildability, fitness for purpose and the like.

Table C6: Managing Residual Impacts during 'out of standard hours' work

ID Noise Mitigation/ Management Measure

1 At some receiver locations noise levels may exceed the NMLs after all reasonable and feasible mitigation measures have been incorporated into the design.

2 Further mitigation measures may include changing operational procedures at night in order to reduce noise impacts, e.g. reduce the number of trucks on site during the night period (10 pm to 7am).

3 The following at-property treatment measures are recommended:

Treatment package 0 (TP0)	
< 2 dB(A) reduction	Given the predictions are based on a worst-case scenario with everything operating at maximum capacity at the same time, it is likely that noise levels are lower than what has been predicted.
Treatment package 1 (TP1)	
3-5 dB(A) reduction	Where external noise levels are less than 5dB(A) above the NML, the internal noise goals can be achieved by simply closing windows. If the internal noise goals can only be achieved with windows closed, then mechanical ventilation (e.g. 240v Aeropac systems) would be considered to ensure fresh airflow inside the dwelling s
	It is important to ensure that mechanical ventilation does not provide a new noise leakage path into the habitable room and does not create a noise nuisance to neighbouring residential pren
Treatment package 2 (TP2)	
5-10 dB(A) reduction	Where external noise levels are less than 10dB(A) above the NML, the internal noise goals can be achieved with windows closed and wall vents sealed. Special acoustic grade seals may also ne the internal noise goals to be achieved with windows and doors shut. If the internal noise goals can only be achieved with windows closed, then mechanical ventilation (e.g. 240v Aeropac syste the ventilation requirements of the NCC.
Treatment package 3 (TP3)	
10-12 dB(A) reduction	Where external noise levels are only slightly greater than 10dB(A) above the NML, then in addition to installing mechanical ventilation and sealing of wall vents (TP2), special acoustic grade sea noise to enable the internal noise criteria to be achieved with windows and doors shut.
Treatment package 4 (TP4)	
> 12 dB(A) reduction	Where the predicted external noise level exceeds the NML by significantly more than 10dB(A), then upgraded windows and glazing and the provision of solid core doors would be required on sealing of wall vents and acoustic seals for windows and doors described in TP1, TP2 and TP3, respectively. Note that these upgrades are only suitable for masonry type buildings. It is unlikely structures should there be no acoustic insulation in the walls.

4 The following at-property treatment may be required to reduce noise impact from the site:

Treatment Type								
Level of exceedance	Treatment	Indicative No. Properties*						
1-2 dB(A) exceedance	Treatment package 0	3						
3-5 dB(A) exceedance	Treatment package 1	2						
5-10 dB(A) exceedance	Treatment package 2	0						
10-12 dB(A) exceedance	Treatment package 3	0						
>12 dB(A) exceedance	Treatment package 4	0						

*Number of Properties to be finalised following verification monitoring

4.1 Properties identified as eligible for at-property treatment based on design**.

NCA	Address	Exceedance
NCA08	71B SAMUEL MARSDEN ROAD, ORCHARD HILLS,	0-2 dB(A)
NCA08	83-87 KENT ROAD, ORCHARD HILLS, NSW	0-2 dB(A)
NCA08	51-55 KENT ROAD, ORCHARD HILLS, NSW	0-2 dB(A)
NCA08	63-67 KENT ROAD, ORCHARD HILLS, NSW	2-5 dB(A)
NCA08	95 KENT ROAD, ORCHARD HILLS, NSW	2-5 dB(A)

**Number of Properties to be finalised following verification monitoring

Reasonableness of at-property mitigation should be considered. Exceedance is based on typical worst for the evening period, that would occur during peak operations. Properties may be able to achieve sufficient ventilation from windows/ doors facing away from Kent Road, with windows facing Kent Road closed.

Maximum exceedance at night <= 3dB(A)

Orchard Hills Tunnel Support, Station and Dive Worksites

. It is recommended that no immediate action is undertaken for these properties.

so to meet the ventilation requirements of the NCC. nises.

eed to be installed on windows and perimeter doors exposed to noise to enable tems) would be considered to ensure fresh airflow inside the dwelling so to meet

eals should be installed on windows and perimeter doors exposed to road traffic

n the facades exposed to the works, in addition to the mechanical ventilation, ly that this degree of upgrade would provide significant benefits to light framed

APPENDIX D Construction noise impacts

D.1 Predicted noise levels

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

D.2 Number of receivers above NMLs

The number of exceedances has been provided to CPBG in a spreadsheet table.

D.3 Additional mitigation measures

The additional mitigation measures have been provided to CPBG in a spreadsheet table to more adequately mitigate and manage potential noise impacts.

APPENDIX E Construction vibration impacts

E.1 Minimum working distances – Vibration







LEGEND

loise Sensitive Receivers		٢	Childcare		
	Residential	1	Educational		
	Mixed use	۲	Theatre/Auditorium		
	Commercial		Cinema		
8	Industrial	0	Laboratory		
Θ	Hotel/Motel/Hostel	۲	Flight simulator		
Ð	Medical facility	۲	Horse Stable		
•	Place of Worship		Recreational - Passive		
	Community centre		Recreational - Active		
?	Recording studio		Other		
۲	Library/Museum		Heritage		



NCAs

Site boundary

- Receivers within MWD for cosmetic damage
 - Station box and dive excavation

MWD for cosmetic damage and human annoyance for Bored piling rig

Unreinforced structures (7.5mm/s ppv)

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



SYDNEY METRO WESTERN SYDNEY AIRPORT SBT WORKS: ORCHARD HILLS TUNNEL SUPPORT SITE

MWD for Cosmetic Damage and Human Annoyance Work Activity: Bored piling rig Work Area: Station box and dive excavation





LEGEND Noise Sensitive Receivers 🚯 Childcare Residential Educational Mixed use ③ Theatre/Auditorium Commercial 回 Cinema 🛞 Industrial Laboratory 🕞 Hotel/Motel/Hostel Flight simulator Hedical facility ۲ Horse Stable Place of Worship Recreational - Passive Community centre **X**X Recreational - Active ⑦ Recording studio Other S Library/Museum Heritage



NCAs

- Receivers within MWD for cosmetic damage
 - Lansdowne Bridge works

MWD for cosmetic damage and human annoyance for Smooth drum roller (13T) - High Vibration

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



SYDNEY METRO WESTERN SYDNEY AIRPORT SBT WORKS: ORCHARD HILLS TUNNEL SUPPORT SITE

MWD for Cosmetic Damage and Human Annoyance Work Activity: Smooth drum roller (13T) - High Vibration Work Area: Lansdowne Bridge works

Sheet 2 of 5





Commercial 🛞 Industrial \odot Hotel/Motel/Hostel

LEGEND

Hedical facility

Noise Sensitive Receivers

Residential

Mixed use

Childcare

回 Cinema

Laboratory

Other

Heritage

۲

۲

Educational

Theatre/Auditorium

Flight simulator

Recreational - Passive

Recreational - Active

Horse Stable

- Place of Worship
- Community centre
- ⑦ Recording studio
- S Library/Museum

				í	
•					
٢					1
l					
r	-	-	-	-	
Ξ.					

NCAs

- Site boundary
- Receivers within MWD for cosmetic damage
- Portal FRP works

MWD for cosmetic damage and human annoyance for Bored piling rig

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

SYDNEY METRO WESTERN SYDNEY AIRPORT SBT WORKS: ORCHARD HILLS TUNNEL SUPPORT SITE

MWD for Cosmetic Damage and Human Annoyance Work Activity: Bored piling rig Work Area: Portal FRP works





GEND						
GLND						
ise Sensitive Receivers 🚯			Childcare			
	Residential	(7)	Educational			
	Mixed use	۲	Theatre/Auditorium			
	Commercial		Cinema			
8	Industrial	0	Laboratory			
Э	Hotel/Motel/Hostel	۲	Flight simulator			
Ð	Medical facility	۲	Horse Stable			
D	Place of Worship	(///)	Recreational - Passive			
	Community centre		Recreational - Active			
2	Recording studio		Other			
١	Library/Museum	[]]	Heritage			

NCAs

Site boundary

- Receivers within MWD for cosmetic damage
 - Dive FRP works

MWD for cosmetic damage and human annoyance for Excavator (<35T) with rockhammer attachment

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

SYDNEY METRO WESTERN SYDNEY AIRPORT SBT WORKS: ORCHARD HILLS TUNNEL SUPPORT SITE

MWD for Cosmetic Damage and Human Annoyance Work Activity: Excavator (<35T) with rockhammer attachment Work Area: Dive FRP works





LEGEND Noise Sensitive Receivers Childcare Residential Educational Mixed use Theatre/Auditorium Commercial 回 Cinema 🛞 Industrial Laboratory 🕞 Hotel/Motel/Hostel **Flight simulator** Hedical facility ۲ Horse Stable Place of Worship Recreational - Passive Community centre Recreational - Active Recording studio Other S Library/Museum Heritage NCAs Site boundary Receivers within MWD for cosmetic damage Laydown area

MWD for cosmetic damage and human annoyance for Smooth drum roller (13T) - High Vibration

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

SYDNEY METRO WESTERN SYDNEY AIRPORT SBT WORKS: ORCHARD HILLS TUNNEL SUPPORT SITE

MWD for Cosmetic Damage and Human Annoyance Work Activity: Smooth drum roller (13T) - High Vibration Work Area: Laydown area