

**APPROVAL**  
**CITY & SOUTHWEST ACOUSTICS ADVISOR**

<b>Review of:</b>	Sydney Metro City and South West Line Wide Works - CNVIS Addendum Report – TSOM works at Sydenham Station	<b>Document reference:</b>	TK685-03-16F02 CNVIS_ADD C2B_P3 SMTF-2 (r4)
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<b>Date of issue:</b>	20 September 2022		14 September 2022

As approved Alternate Acoustics Advisor for the Sydney Metro City & Southwest project, and as required under A27 (d) of the project approval conditions (SSI 15-7400), I have reviewed and provided comment on the Construction Noise and Vibration Impact Statement (CNVIS) Addendum Report for the TSOM works at Sydenham Station.

I am satisfied that the CNVIS Addendum Report is technically valid and includes appropriate noise and vibration mitigation and management. On this basis, I endorse the CNVIS Addendum Report referenced herein.



Carl Fokkema, City & Southwest Alternate Acoustics Advisor

14 September 2022

TK685-03-16F02 CNVIS\_ADD C2S\_P3 SMTF-2 (r4)

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## Sydney Metro City and Southwest Line Wide Works - CNVIS Addendum Report - TSOM works at Sydenham Station

### 1 Introduction

#### 1.1 Overview of works

This technical memorandum is an addendum to the report *Construction Noise and Vibration Impact Statement: Portion 3 – SMTF-S and southern dive* (SMTF-S and southern dive CNVIS<sup>1</sup>) and has been prepared for Systems Connect (on behalf of TSOM) in accordance with the Construction Noise and Vibration Management Plan (CNVMP) [SMCSWLWC-SYC-1NL-PM-PLN-000032] for the Design and Construction of the Line-Wide Works (LWW) of the Sydney Metro City & Southwest Project (the Project). The works addressed in this addendum will be wholly undertaken by TSOM, within the Systems Connect Principal Contractor (PC) Area.

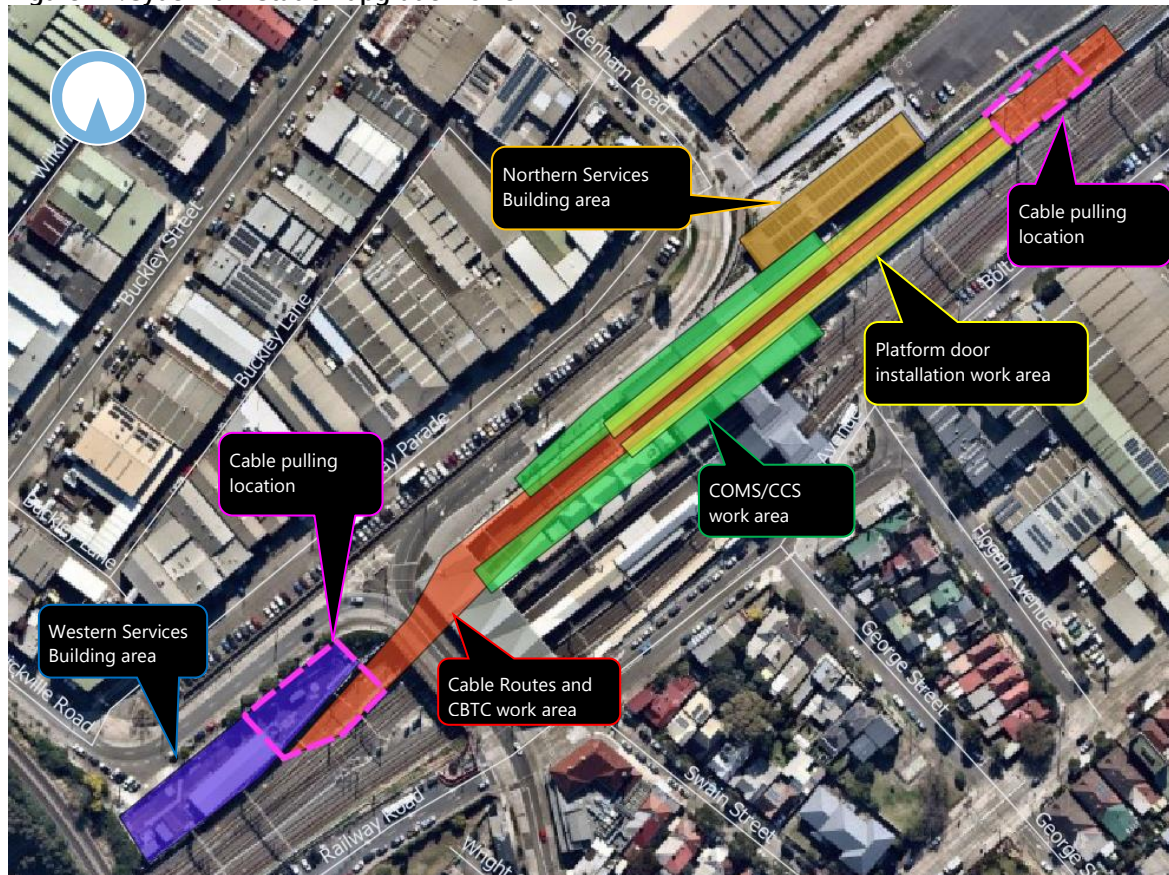
Sydney Metro have requested TSOM undertake station upgrade works at the Sydenham Station worksite. The works are outside the work area assessed in the SMTF-S and southern dive CNVIS, but within the PC Area nominated in the Systems Connect Environment Protection Licence No 21423 (EPL). The station upgrade works will be conducted within Sydenham station in the rail corridor and station platforms as well as surrounding and within the Western Services building. Most of the works will be conducted with the use of powered and non-powered hand tools and pallet jacks and a winch will be used for cable pulling. The key area nominated for the works are shown in Figure 1-1.

The works are anticipated to commence August 2022 and conclude in June 2023 and will occur during standard construction hours over this timeframe.

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<sup>1</sup> *Sydney Metro City & Southwest – Line Wide Works, Construction Noise and Vibration Impact Statement: Portion 3 – SMTF-S and southern dive, reference: TK685-03-16F01 CNVIS C2S\_P3 SMTF-S, revision 4, dated 9 June 2021*

Figure 1-1: Sydenham Station upgrade works



This memorandum has been prepared to address the potential construction noise impacts from the station upgrade works at Sydenham station.

## 1.2 Justification for OOH construction works

All works are planned to be completed during standard construction hours. As contingency, out-of-hours works (OOHW) have been assessed should the works require completion under Rail Possession, where existing rail traffic would impose major risks to rail users and construction workers due to the extremely close proximity between all parties involved. Conducting works during rail shutdown or possessions would minimise the risks of rail traffic and work site interaction. Works would need to be conducted 24 hours per day during the rail shutdown or possession periods to allow the planned works to be completed within the shutdown period.

The construction hours for the Project are defined by Project Planning Approval (PPA) Conditions E36, E37, E38, E41, E42, E44 and E48. CSSI-7400 Condition E44 allows standard construction hours to be varied under an EPL. EPL 21423 Condition L4.13 allows Possession Works to occur outside standard construction hours under specific conditions.

Any work outside standard construction hours must be undertaken in accordance with the Out of Hours Works Procedure and the CNVMP.

## 2 Construction noise assessment

### 2.1 Construction activities

Key details regarding the location and layout of the noise generating plant that will operate during these works were informed by the Construction and Environmental Teams. Table 2.1 presents the list of plant proposed to be used for these works and their assumed sound power levels.

**Table 2.1 Construction activities and equipment sound power levels using in noise modelling**

Activity	Activity ID	Plant/ Equipment	No. items		Sound Power Level (Lw re: 1pW), dB(A)		High noise plant?	Vibration intensive plant?
			Standard hours	Out of hours	L <sub>Aeq</sub>	L <sub>Amax</sub>		
Cable pulling	CP	Winch	1	1	96	101	No	No
		Hi rail truck	1	1	98	102	No	No
		Powered hand tools	various	0	107	118	No	No
		Non-powered hand tools (excluding hammer)	various	various	100	111	No	No
		Handheld hammer	various	various	105	118	No	No
		Light vehicle	1	0	89	100	No	No
		Delivery truck	2 per week	0	102	111	No	No
CBTC scope	CBTC	Hi rail truck	1	1	98	102	No	No
		Powered hand tools	various	0	107	118	No	No
		Non-powered hand tools (excluding hammer)	various	various	100	111	No	No
		Handheld hammer	various	various	105	118	No	No
		Light vehicle	1	0	89	100	No	No
		Delivery truck	1 per week	0	102	111	No	No
		Platform screen door installation	PSD-T <sup>1</sup>	Powered hand tools	various	0	107	118
PSD-H <sup>2</sup>	Non-powered hand tools (excluding hammer)		various	various	100	111	No	No
	Handheld hammer		various	various	105	118	No	No
	Pallet jack, glass lifter		1	0	99	103	No	No
	Non-powered hydraulic crane		1	0	106	110	No	No
	Light vehicle		1	0	89	100	No	No
	Delivery truck		1 per week	0	102	111	No	No
	Jackhammer		1	0	115	120	Yes	Yes
COMS/CC S scope	COMS	Powered hand tools	various	0	107	118	No	No
		Non-powered hand tools (excluding hammer)	various	various	100	111	No	No
		Handheld hammer	various	various	105	118	No	No

Activity	Activity ID	Plant/ Equipment	No. items		Sound Power Level (Lw re: 1pW), dB(A)		High noise plant?	Vibration intensive plant?
			Standard hours	Out of hours	L <sub>Aeq</sub>	L <sub>Amax</sub>		
Radio scope	RS	Pallet jack	1	0	99	103	No	No
		Scissor lift	2	0	95	98	No	No
		Light vehicle	2	0	89	100	No	No
		Delivery truck	1 per week	0	102	111	No	No
		Powered hand tools	various		107	118	No	No
		Non-powered hand tools (excluding hammer)	various	various	100	111	No	No
		Handheld hammer	various	various	105	118	No	No
		Light vehicle	1 per week	0	102	111	No	No

Note: 1. 'T' denotes 'typical' activities, which excludes the high noise plant identified in the table  
 2. 'H' denotes High impact activities, which includes the high noise plant identified in the table

## 2.2 Predicted construction noise levels

Predicted construction noise levels at the closest noise sensitive receivers are compared against the Noise Management Levels (NMLs) established in the SMTF-S and southern dive CNVIS. Table 2.2 compares the predicted noise levels with the Interim Construction Noise Guideline NMLs (see Section 4.1 and Appendix B of the SMTF-S and southern dive CNVIS). Table 2.3 compares the predicted noise levels to the PPA Conditions E37/E38 and E42 noise goals, as outlined in Section 4.1 of the SMTF-S and southern dive CNVIS.

Note that for OOHW two cases have been assessed, works with handheld hammering and works excluding handheld hammering. Detailed noise predictions are also compared to ICNG NMLs and presented in APPENDIX B.

Predicted noise levels typically works comply with the ICNG NMLs and PPA Condition E37/E38 noise goal during standard construction hours. The high noise impact scenario for the platform screen door installation (i.e. with jackhammering occurring) is predicted to exceed the ICNG NMLs and PPA Condition E37/E38 noise goal by up to 6 dB. Noise mitigation measures will be required to reduce the noise level below the noise goal as outlined in Section 2.3.1, otherwise respite periods will be required during jackhammering works in accordance with E37/38.

Table 2.2: Comparison of predicted OOHW noise levels at the closest noise sensitive receivers with ICNG NMLs

NCA	Address	Type of receiver	Day NML <sup>1</sup> L <sub>Aeq,15min</sub>	Predicted levels L <sub>Aeq,15min</sub> , dB(A)						Evening/ Night NML <sup>2</sup> L <sub>Aeq,15min</sub> , dB(A)	Predicted levels L <sub>Aeq,15min</sub> , dB(A)				
				CP	CBTC	PSD-T	PSD-H	COMS	RS		CP	CBTC	PSD	COMS	RS
MDS_04	30 Hogan Avenue, Sydenham	Residential	69	55	62	62	<b>75</b>	63	52	58/ 46	<b>48 (53)</b>	<b>55</b>	<b>55 (60)</b>	<b>56 (61)</b>	45 ( <b>50</b> )
MDS_04	28 Hogan Avenue, Sydenham	Residential	69	54	60	60	<b>73</b>	61	54	58/ 46	<b>47 (52)</b>	<b>55</b>	<b>53 (58)</b>	<b>54 (59)</b>	<b>47 (52)</b>
MDS_04	134 George Street, Sydenham	Residential	69	52	61	61	<b>74</b>	63	48	58/ 46	45 ( <b>50</b> )	<b>55</b>	<b>54 (59)</b>	<b>56 (61)</b>	41 (46)
MDS_04	11 Swain Street, Sydenham	Residential	69	57	61	61	<b>73</b>	62	57	58/ 46	<b>50 (55)</b>	<b>55</b>	<b>54 (59)</b>	<b>55 (60)</b>	<b>50 (55)</b>
MDS_05	115 Railway Road, Sydenham	Residential	69	62	62	50	63	57	62	58/ 46	<b>55 (60)</b>	<b>55</b>	43 ( <b>48</b> )	<b>50 (55)</b>	<b>55 (60)</b>
MDS_05	108 Railway Road, Sydenham	Residential	69	62	62	51	64	52	67	58/ 46	<b>55 (60)</b>	<b>55</b>	44 ( <b>49</b> )	45 ( <b>50</b> )	<b>60 (65)</b>
MDS_05	106 Railway Road, Sydenham	Residential	69	60	60	49	62	52	66	58/ 46	<b>53 (58)</b>	<b>55</b>	<b>42 (47)</b>	45 ( <b>50</b> )	<b>59 (64)</b>

Notes:

- Day refers to 7am to 6pm Monday to Friday and 8am to 6pm Saturday, Sunday and Public Holidays;
  - Evening refers to Monday to Sunday 6:00pm to 10:00pm; Night refers to Monday to Friday 10:00pm to 7:00am and Saturdays, Sundays, and public holidays 10:00pm to 8:00am
- Values in brackets are noise levels with handheld hammering included
- Bold** text indicates exceedance of the Day or Night ICNG NML; **Bold** shaded indicates exceedance of the Evening and night ICNG NML

Table 2.3: Predicted OOHW noise levels at the closest noise sensitive receivers (PPA Conditions E37/E38/ E42)

NCA	Address	Type of receiver	NML 7am - 8pm <sup>1</sup> L <sub>Aeq,15min</sub>	Predicted levels L <sub>Aeq,15min</sub> , dB(A)						NML 8pm – 7am <sup>2</sup> L <sub>Aeq,15min</sub> , dB(A)	Predicted levels L <sub>Aeq,15min</sub> , dB(A)				
				CP	CBTC	PSD-T	PSD-H	COMS	RS		CP	CBTC	PSD	COMS	RS
MDS_04	30 Hogan Avenue, Sydenham	Residential	70	55	62	62	<b>75</b>	63	52	55	48 (53)	55	55 ( <b>60</b> )	<b>56 (61)</b>	45 (50)
MDS_04	28 Hogan Avenue, Sydenham	Residential	70	54	60	60	<b>73</b>	61	54	55	47 (52)	55	53 ( <b>58</b> )	54 ( <b>59</b> )	47 (52)
MDS_04	134 George Street, Sydenham	Residential	70	52	61	61	<b>74</b>	63	48	55	45 (50)	55	54 ( <b>59</b> )	<b>56 (61)</b>	41 (46)
MDS_04	11 Swain Street, Sydenham	Residential	70	57	61	61	<b>73</b>	62	57	55	50 (55)	55	54 ( <b>59</b> )	55 ( <b>60</b> )	50 (55)
MDS_05	115 Railway Road, Sydenham	Residential	70	62	62	50	63	57	62	55	55 ( <b>60</b> )	55	43 (48)	50 (55)	55 ( <b>60</b> )
MDS_05	108 Railway Road, Sydenham	Residential	70	62	62	51	64	52	67	55	55 ( <b>60</b> )	55	44 (49)	45 (50)	<b>60 (65)</b>
MDS_05	106 Railway Road, Sydenham	Residential	70	60	60	49	62	52	66	55	53 ( <b>58</b> )	55	42 ( <b>47</b> )	45 (50)	<b>59 (64)</b>

Notes:

- External equivalent NML, Condition E37/E38
  - External equivalent NML, Condition E42
- Values in brackets are noise levels with handheld hammering included
- Bold** text indicates exceedance of the PPA Condition E37/ E38 or E42 noise goal



Predicted noise levels for works outside standard construction hours likely to exceed the ICNG NMLs during the evening and night period at the closest noise sensitive receivers, should out of hours works be required. Predicted noise levels for works without handheld hammering are typically below the PPA Condition E41/E42 noise goal. The COMS/CCS works are predicted to exceed by 1 dB and the radio scope works are predicted to exceed by 5 dB at the nearest receivers. Verification monitoring will be required to determine if external noise levels exceed noise goal and if so, noise mitigation measures will be required to reduce the noise level below the noise goal.

Predicted noise levels for works with handheld hammering exceed the PPA Condition E41/E42 noise goal for all scenarios. Verification monitoring will be required to determine if external noise levels exceed noise goal and if so, noise mitigation measures will be required to reduce the noise level below the noise goal, as outlined in Section 2.3.1.

In accordance with Planning Project Approval (PPA) Condition E32 and APPENDIX A2 of the *Sydney Metro City and Southwest Construction noise and Vibration Strategy (SMCSNVS)*<sup>2</sup>, additional mitigation measures must be considered. Recommended mitigation measures are presented in Section 2.3.

## 2.3 Noise mitigation and management

### 2.3.1 Site noise control measures

In addition to the noise mitigation measures identified in the CNVIS (see Section 5.4.2), the following Table 2.4 presents additional noise control measures recommended to reduce and manage potential noise impacts.

**Table 2.4: Site noise control measures**

Control type	Control measure	Typical use
Path mitigation measures	Temporary or Mobile noise screens	Where practicable, a temporary noise screen would be used to reduce noise from the station upgrade works. Temporary screens utilise temporary construction fencing, with acoustic blanket/ quilt (e.g. Echo-barrier, FlexShield or similar) attached to one side. The temporary noise barrier should be installed to break line of site between the plant/ equipment generating noise and the nearest receiver/s. Temporary noise screens can provide 5 to 10 dB noise reduction. Temporary noise screens are recommended if extended use of handheld hammers is required during OOHW.
Noise management measures	Respite coordination	During works that generate noise exceeding the E37/E38 noise goal, respite periods will be required in accordance with E37/E38. Respite timing will be coordinated with community agreement.
	Limit clangs and bangs at night	Identify potential of loose items or plant/equipment that could generate metal-on-metal bangs and manage accordingly.

<sup>2</sup> Transport for NSW Sydney Metro City & Southwest Construction Noise Strategy (ref: 610.14213-R3) 08 August 2016

Control type	Control measure	Typical use
	Site inductions & Toolbox Talks	All employees, contractors and subcontractors will receive a Project induction. The environmental component may be covered in toolboxes and should include: <ul style="list-style-type: none"> <li>• location of nearest sensitive receivers</li> <li>• relevant project specific and standard noise and vibration mitigation measures;</li> <li>• permitted hours of work;</li> <li>• OOHW Procedure and Form</li> </ul> construction employee parking areas.
	Community consultation	Inform community of construction activity and potential impacts.
	Behavioural practices	No swearing or unnecessary shouting or loud stereos/radios on site. No dropping of materials from height, throwing of metal items and slamming of doors. Reduce banging and clanging from hammering during OOH periods.
	Noise monitoring	Noise monitoring is to be carried out as detailed in Section 2.3.4.

### 2.3.2 Consultation with affected receivers (PPA Condition E33)

As outlined in Section 5.3.1 of the *SMTF-S and southern dive CNVIS*, consistent with requirements in PPA Conditions E33, Systems Connect will consult with potentially affected stakeholders including business and residential receivers regarding specific mitigation measures applicable to the construction works.

### 2.3.3 Additional mitigation measures

Figure 2-1 will be used to advise the appropriate additional mitigation during construction.

Figure 2-1: Additional airborne noise mitigation measures

When is the work being undertaken?	Predicted $L_{Aeq,15min}$ noise level above		Identify additional management measures to be implemented	
	Background (RBL)	Noise Management Level (NML)		
<b>Standard Hours</b> M-F 7am to 6pm Sat 8am to 1pm	0 to 10 dB(A)	-	-	-
	> 10 to 20 dB(A)	≤ 10 dB(A)	-	-
	> 20 to 30 dB(A)	> 10 to 20 dB(A)	LB, M	[MM2]
	> 30 dB(A)	> 20 dB(A)	LB, M	[MM2]
<b>OOHW Period 1</b> M-F 6pm to 10pm Sat 1pm to 10pm Sun/ PH 8am to 10pm	0 to 10 dB(A)	≤ 5 dB(A)	-	-
	> 10 to 20 dB(A)	> 5 to 15 dB(A)	LB	[MM1]
	> 20 to 30 dB(A)	> 15 to 25 dB(A)	LB, M	[MM2]
	> 30 dB(A)	> 25 dB(A)	LB, M, IB, PC, RO, SN	[MM4]
<b>OOHW Period 2</b> M-F 10pm to 7am Sat 10pm to 8am Sun/ PH 6pm to 8am	0 to 10 dB(A)	≤ 5 dB(A)	-	-
	> 10 to 20 dB(A)	> 5 to 15 dB(A)	LB, M	[MM2]
	> 20 to 30 dB(A)	> 15 to 25 dB(A)	LB, M, IB, PC, RO, SN	[MM4]
	> 30 dB(A)	> 25 dB(A)	LB, M, IB, PC, RO, SN, AA	[MM5]

Notes: Use the abbreviation codes in the table above to confirm management measures required  
 Code in square brackets [] refers to noise management code for affected receivers identified in each CNVIS  
 LB = Letter box drops  
 M = Monitoring  
 IB = Individual briefings  
 SN = Specific notifications  
 PC = Phone calls and emails  
 RO = Project specific respite offer  
 AA = Alternative accommodation

APPENDIX C 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 relevant NMLs.



### 2.3.4 Noise monitoring

Attended noise monitoring will be undertaken to verify that the construction activities are consistent with the assessed noise modelling scenarios and that noise levels resulting from construction works are not higher than the levels predicted in this CNVIS. Attended monitoring on private property is subject to obtaining the property owner/occupier's consent (where required).

Attended noise monitoring will be undertaken in the NCAs most impacted by the works. The nominated monitoring locations are identified in Table 2.5, and have been selected as they present the best opportunity to validate the predicted noise levels, depending on the location of the plant.

If verification monitoring shows that the external noise levels from the construction works are above the predicted levels, investigation will be undertaken to understand the cause of the exceedance and relevant reasonable and feasible mitigation measures will be implemented.

**Table 2.5: Nominated verification monitoring locations**

NCA	Nominated receiver address	Monitoring location at 1 m from
WS_02	30 Hogan Avenue, Sydenham 134 George Street, Sydenham	Northern façade Eastern façade
WS_03	115 Railway Road, Sydenham 108 Railway Road, Sydenham	Northern façade Eastern façade

Note: Monitoring on private property is subject to owner consent and where relevant, occupier consent. If property access is denied, monitoring will still be carried out outside property boundaries.

## 2.4 Construction vibration impact

From the plant and equipment listed in Table 2.1, the dominant vibration generating plant and equipment include a jackhammer.

The recommended minimum working distances for vibration intensive plant are presented in Table 2-6 and Table 2-7. Site specific minimum working distances for vibration intensive plant items must be measured on site where plant and equipment are likely to operate close to or within the minimum working distances for cosmetic damage (Table 2-6).

**Table 2-6: Minimum working distances (m) for cosmetic damage (continuous vibration)**

Plant item	Minimum working distance (m)		
	Reinforced or framed structures (e.g. commercial buildings) <sup>1</sup>	Unreinforced or light framed structures (e.g. residential buildings) <sup>1</sup>	Sensitive structures (e.g. heritage structures) <sup>2</sup>
Jackhammer	5	5	5

Notes

- 1) Initial screening test criteria reduced by 50% due to potential dynamic magnification in accordance with BS7385.
- 2) In accordance with Section 5.8.1 of CNVMP, a site inspection should determine whether a heritage structure is structurally unsound.
- 3) Minimum working distances are in 5m increments only to account for the intrinsic uncertainty of this screening method.

**Table 2-7: Minimum working distances (m) for human annoyance (continuous vibration)**

Plant item	Minimum working distances, m				
	Critical areas <sup>1,4</sup>	Residences Day <sup>2</sup>	Night <sup>2</sup>	Offices <sup>3,4</sup>	Workshops <sup>4</sup>
Jackhammer	25	15	20	10	5

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.

## 2.5 Vibration assessment

### 2.5.1 Structural damage

The numbers of buildings which are close to or within the minimum working distances for cosmetic damage are shown in Table 2-8.

**Table 2-8: Number of buildings within minimum working distances for cosmetic damage**

Plant item	Number of buildings	
	Screening criteria for non-heritage structures	Screening criteria for heritage structures
Jackhammer	0	2

Two station buildings have been identified to be within the minimum working distance for cosmetic damage during the jackhammering works. Vibration monitoring will be required where jackhammering works are required within this minimum working distance.

### 2.5.2 Human annoyance

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 2-7 and there is a probability of adverse comment are shown in Table 2.9. 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.

**Table 2.9: Number of buildings within minimum working distances for human annoyance**

Plant items	Critical areas <sup>1,4</sup>	Residences <sup>5</sup>		Offices <sup>3,4</sup>	Workshop <sup>4</sup>
		Day <sup>2</sup>	Night <sup>2</sup>		
Jackhammer	0	0	0	0	0

- Notes:
1. Examples include hospital operating theatres and precision laboratories where sensitive operations are occurring.
  2. Daytime is 7 am to 10 pm; Night-time is 10 pm to 7am.
  3. Examples include offices, schools, educational institutions and place of worship.
  4. Applicable when in use.
  5. Hotels and childcare centres are included in the residence category.
  6. Most vibration intensive plant (i.e. Excavator (<35T) with rock hammer attachment) has been used to estimate the maximum number of buildings within MWD for human annoyance.

As can be noted from the table above, there are no properties that may be exposed to vibration above the screening limit for human annoyance. The above assessment is based on vibration-generating equipment being operating at the closest location to nearby receivers. When vibration-generating equipment operates further from the closest point, the predicted vibration levels will reduce along with the probability of adverse comment.

### 3 Conclusion

This technical memorandum is an addendum to the report *SMTF-S and southern dive CNVIS* to review the potential noise impacts for the proposed TSOM station upgrade works at the Sydenham Station worksite. The works are anticipated to be completed during standard hours, however reduced works will be required OOH.

During standard construction hours, predicted noise levels from the proposed works are below the ICNG NML and the PPA Conditions E37/E38 noise goals at the nearest noise sensitive receiver except during jackhammering works. Noise mitigation measures outlined in Section 2.3 are recommended when conducting jackhammering works.

During out-of-hours works noise levels are predicted to exceed the ICNG NMLs during the evening and night periods, except for low noise activities. Without handheld hammering the predicted noise levels from the proposed works are below the PPA Conditions E41/E42 noise goals at the nearest noise sensitive receiver except for the COMS/CCS and radio scope works. During out-of-hours works with handheld hammering the predicted noise levels from the proposed works exceed the PPA Conditions E41/E42 noise goals at the nearest noise sensitive receiver. Noise mitigation is required as outlined in Section 2.3 for all station upgrade works if conducted during OOH periods.

Assessment found the only vibration intensive activity proposed is jackhammering works. Two station buildings are identified within the minimum working distances for structural damage during jackhammering. Vibration monitoring will be required when jackhammering works are within the minimum working distance. There are no receivers predicted to be within the minimum working distances for human annoyance.

## Document control

Date	Revision history	Non-issued revision	Issued revision	Prepared	Instructed	Reviewed / Authorised
12.08.2022	Initial issue	0	1	D. Auld	-	T. Gowen
18.08.2022	Minor edits	-	2	-	-	T. Gowen
30.08.2022	Address TSOM comments	-	3	D. Auld	T. Gowen	T. Gowen
14.09.2022	Address AA comments	-	4	T. Gowen	-	M. Tabacchi

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### 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.

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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.

## APPENDIX A Glossary of terminology

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

Adverse weather	Weather effects that enhance noise (that is, wind and temperature inversions) that occur at a site for a significant period of time (that is, wind occurring more than 30% of the time in any assessment period in any season and/or temperature inversions occurring more than 30% of the nights in winter).
Ambient noise	The all-encompassing noise associated within a given environment at a given time, usually composed of sound from all sources near and far.
Assessment period	The period in a day over which assessments are made.
Assessment point	A point at which noise measurements are taken or estimated. A point at which noise measurements are taken or estimated.
Background noise	Background noise is the term used to describe the underlying level of noise present in the ambient noise, measured in the absence of the noise under investigation, when extraneous noise is removed. It is described as the average of the minimum noise levels measured on a sound level meter and is measured statistically as the A-weighted noise level exceeded for ninety percent of a sample period. This is represented as the L90 noise level (see below).
Decibel [dB]	<p>The units that sound is measured in. The following are examples of the decibel readings of every day sounds:</p> <p>0dB The faintest sound we can hear</p> <p>30dB A quiet library or in a quiet location in the country</p> <p>45dB Typical office space. Ambience in the city at night</p> <p>60dB CBD mall at lunch time</p> <p>70dB The sound of a car passing on the street</p> <p>80dB Loud music played at home</p> <p>90dB The sound of a truck passing on the street</p> <p>100dB The sound of a rock band</p> <p>115dB Limit of sound permitted in industry</p> <p>120dB Deafening</p>
dB(A)	A-weighted decibels. The A-weighting noise filter simulates the response of the human ear at relatively low levels, where the ear is not as effective in hearing low frequency sounds as it is in hearing high frequency sounds. That is, low frequency sounds of the same dB level are not heard as loud as high frequency sounds. The sound level meter replicates the human response of the ear by using an electronic filter which is called the "A" filter. A sound level measured with this filter switched on is denoted as dB(A). Practically all noise is measured using the A filter.
dB(C)	C-weighted decibels. The C-weighting noise filter simulates the response of the human ear at relatively high levels, where the human ear is nearly equally effective at hearing from mid-low frequency (63Hz) to mid-high frequency (4kHz), but is less effective outside these frequencies.
Frequency	Frequency is synonymous to pitch. Sounds have a pitch which is peculiar to the nature of the sound generator. For example, the sound of a tiny bell has a high pitch and the sound of a bass drum has a low pitch. Frequency or pitch can be measured on a scale in units of Hertz or Hz.
Impulsive noise	Having a high peak of short duration or a sequence of such peaks. A sequence of impulses in rapid succession is termed repetitive impulsive noise.
Intermittent noise	The level suddenly drops to that of the background noise several times during the period of observation. The time during which the noise remains at levels different from that of the ambient is one second or more.
L <sub>Max</sub>	The maximum sound pressure level measured over a given period.

L <sub>Min</sub>	The minimum sound pressure level measured over a given period.
L <sub>1</sub>	The sound pressure level that is exceeded for 1% of the time for which the given sound is measured.
L <sub>10</sub>	The sound pressure level that is exceeded for 10% of the time for which the given sound is measured.
L <sub>90</sub>	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 <sub>eq</sub>	The "equivalent noise level" is the summation of noise events and integrated over a selected period of time.
Reflection	Sound wave changed in direction of propagation due to a solid object obscuring its path.
SEL	Sound Exposure Level (SEL) is the constant sound level which, if maintained for a period of 1 second would have the same acoustic energy as the measured noise event. SEL noise measurements are useful as they can be converted to obtain L <sub>eq</sub> sound levels over any period of time and can be used for predicting noise at various locations.
Sound	A fluctuation of air pressure which is propagated as a wave through air.
Sound absorption	The ability of a material to absorb sound energy through its conversion into thermal energy.
Sound level meter	An instrument consisting of a microphone, amplifier and indicating device, having a declared performance and designed to measure sound pressure levels.
Sound pressure level	The level of noise, usually expressed in decibels, as measured by a standard sound level meter with a microphone.
Sound power level	Ten times the logarithm to the base 10 of the ratio of the sound power of the source to the reference sound power.
Tonal noise	Containing a prominent frequency and characterised by a definite pitch.



## APPENDIX B Detailed predicted construction noise levels

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

## APPENDIX C      Additional noise mitigation

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