

ENDORSEMENT CITY & SOUTHWEST ACOUSTIC ADVISOR

Review of	Construction Noise and Vibration Impact Statement Addendum: Pitt Street Additional works	Document reference:	SYDNEY METRO CHATSWOOD TO SYDENHAM TSE Works – Pitt Street – Additional works - CNVIS Addendum
Prepared by:	Larry Clark Alternate Acoustic Advisor		<i>TH511-02 01.08.05 F03 PS Addendum CNVIS – Concrete pours (r7)</i>
Date of issue:	3 August 2020		<i>Dated 31 July 2020</i>

As approved Acoustic Advisor for the Sydney Metro City & Southwest project, I have reviewed revision 7 of the Construction Noise and Vibration Impact Statement (CNVIS) Addendum for Pitt Street Additional works, as required under A27 (d) of the project approval conditions.

The CNVIS addendum is for the following additional works:

- two 18-hour long concrete pours in August 2020 to complete the tunnel crown for the Pitt Street Station tunnel adits. One pour will be completed at Pitt Street North (PSN) worksite and the other pour at Pitt Street South (PSS) worksite.
- up to 14 tunnel lining support pours from PSS are required prior to the end of the project (i.e. approximately September 2020). The majority of these pours are planned to start during the day and finish by midnight however the larger pours may extend further into the night.
- plant demobilisation: the retrieval of excavators and cranes is required to be carried out from the Metrodeck at PSS worksite and would require two night-shifts.

I reviewed and commented on the CNVIS addendum. I am satisfied that the CNVIS is technically valid and that it includes appropriate noise and vibration mitigation and management. On this basis I endorse revision 7 of the CNVIS Addendum.



Larry Clark, City & Southwest Alternate Acoustic Advisor

31 July 2020

TH511-02 01.08.05 F03 PS Addendum CNVIS - Concrete pours (r7)

John Holland CPB Ghella JV
Level 3, 140 Sussex Street,
Sydney, NSW, 2000

Sydney Metro Chatswood to Sydenham – TSE Works - Pitt Street - Additional works - CNVIS Addendum

1 Introduction

1.1 Overview of works

This technical memorandum is an addendum to the report Construction Noise and Vibration Impact Statement: Pitt Street Constructions sites¹ (*Pitt Street CNVIS*). It has been prepared on behalf of John Holland CPB Ghella Joint Venture (JHCPBG) in accordance with the Construction Noise and Vibration Management Plan (*CNVMP*)² for the Design and Construction of the Tunnel and Station Excavation (TSE) Works of the Sydney Metro City & Southwest Project (the Project).

JHCPBG is proposing to carry out the following additional works:

- two 18-hour long concrete pours in August 2020 to complete the tunnel crown for the Pitt Street Station tunnel adits. One pour will be completed at Pitt Street North (PSN) worksite and the other pour at Pitt Street South (PSS) worksite.
- up to 14 tunnel lining support pours from PSS are required prior to the end of the project (i.e. approximately September 2020). The majority of these pours are planned to start during the day and finish by midnight however the larger pours may extend further into the night.
- plant demobilisation: the retrieval of excavators and cranes is required to be carried out from the Metrodeck at PSS worksite and would require two night-shifts.

This memorandum has been prepared to address the potential construction noise and vibration impacts from the proposed construction activities. The works have been assessed in conjunction with all concurrent activities. Construction details are summarised in Section 2.1 below.

¹ TH511-02 01.08.05 F01 PS CNVIS, dated 3 May 2018, revision 4

² Sydney Metro City & Southwest – TSE Works Construction Noise and Vibration Management Plan (SMCSTSE-JCG-TPW-EN-PLN-002012)

1.2 Justification for out of hours construction works

Due to constructability and design requirements to ensure structural integrity, tunnel crown pours are required to be completed in a single pour. This results in extremely large pours which are unable to be broken up into smaller sub pours. These pours are planned to last between 10 and 18 hours, depending on which section is being poured, and will therefore have a portion of the works occurring outside of standard constructions hours regardless of when each pour is commenced. The majority of each pour will be planned to occur during standard hours while considering site safety and impact on other critical path works which can only occur during the day.

Tunnelling ancillary surface support works, including activities such as the delivery and transfer of concrete, are required to be carried out at PSS outside of standard hours to support these upcoming tunnel lining pours. Previously concrete for tunnel works was delivered via the decline at Martin Place Bligh St or the acoustic shed which was previously located at PSN worksite. However, from early August the decline will be closed to traffic due to tunnel support works being carried out at Bligh St worksite. Therefore, concrete can only be delivered from the Metrodeck at PSS and transported within the tunnel via site concrete agitators.

In addition, the retrieval of excavators and cranes is required to be carried out from PSS worksite and would require two nights. The lifting of the plant, including both the cranes and excavators, would require a Road Occupancy Licence (ROL) to be taken out on Pitt St as the trucks are unable to park on the Metrodeck at PSS worksite. This ROL would only be issued outside of standard hours between 10:00pm and 05:00am to minimise impacts on traffic, necessitating works be carried out overnight. As the acoustic shed and crane at PSN worksite has been removed, there is no alternative to lifting the plant out at PSS worksite.

JHCPBG is seeking to vary the Environment Protection Licence to permit the works set out in this report.

2 Construction noise assessment

2.1 Construction activities

For the tunnel crown pours, the concrete trucks would access the site at PSS worksite and pour concrete into the drop pipe over the edge of the Metro deck. Concrete agitators operating within the PSS shaft would then transport the concrete from the drop pipe to the concrete pumps located at the tunnel adit entrances for the PSS and PSN worksites (Figure 2.1 and Figure 2.2) to allow the tunnel adit crown to be poured. An external concrete vibrator would also be located inside the tunnel adit and would be used to consolidate the concrete to achieve the uniformity, durability and strength required. Concrete pumps may also be located on the Metro deck depending on space constraints. Temporary noise barriers would close the portal to the tunnel adits during the operation of the external concrete vibrators.

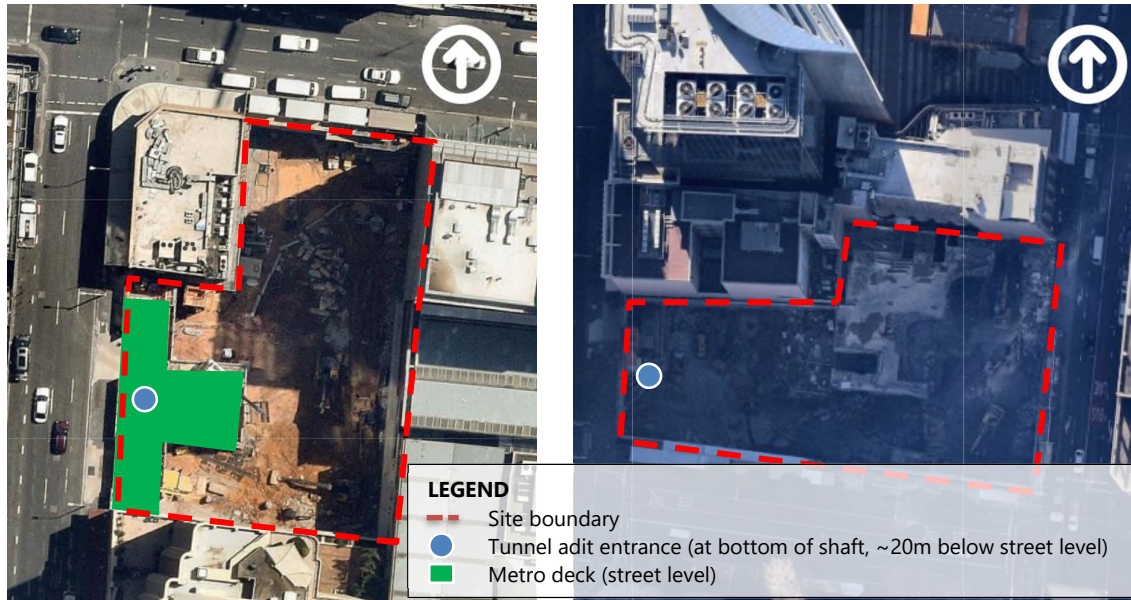
For the tunnel lining support pours, the concrete trucks would access the site at PSS worksite and pour concrete into the drop pipe over the edge of the Metro deck. Concrete agitators operating within the

PSS shaft would then transport the concrete inside the tunnel. An external concrete vibrator would not be required for these pours.

For the plant demobilisation, a mobile crane located on the Metrodeck at PSS worksite would lift plant and load them on trucks parked on Pitt St.

Figure 2.1 – Concrete pours at PSS

Figure 2.2 – Concrete pours at PSN



These large concrete pours may last up to 18 hours and would therefore have a portion of the pour occurring outside of standard construction hours. During standard construction hours, the concrete pours would be carried concurrently with the Shaft excavation / widening works at PSS and PSN worksites. Outside standard construction hours, to minimise the total number of nights the local receivers are exposed to OOH works, the plant demobilisation would be planned to be carried out on the same night as the concrete pours, whenever practicable. Due to space constraints on the metrodeck the plant demobilisation and concrete pours would not occur concurrently when the concrete pour is completed the plant demobilisation would then proceed after road closures are in place.

Table 2.1 presents the list of plant and equipment that are proposed to be used during these works and the associated sound power levels.

Table 2.1: Construction activities and associated sound power levels

Construction Work Area	Key plant and equipment	Assessment periods			Sound power level, dB(A)	
		Day (7am – 6pm)	Evening (6pm-10pm)	Night (10pm-7am)	L _{Aeq}	L _{A1}
PSS Concrete Pours – Tunnel crown						
Metro Deck	Concrete truck	4 p.h.	4 p.h.	4 p.h.	108	111
Metro Deck	Concrete pumps	2	2	2	103	106
In the shaft	Concrete agitators	2	2	2	108	111

Construction Work Area	Key plant and equipment	Assessment periods			Sound power level, dB(A)	
		Day (7am – 6pm)	Evening (6pm-10pm)	Night (10pm-7am)	L _{Aeq}	L _{A1}
Inside PSS tunnel adit (temporary barriers to close the tunnel portal)	External concrete vibrators	2	2	2	121	125
PSN concrete pours – Tunnel crown						
Inside PSN tunnel adit (temporary barriers to close the tunnel portal)	External concrete vibrators	2	2	2	121	125
Metro Deck	Concrete truck	4 p.h.	4 p.h.	4 p.h.	108	111
Transferring concreter from PSS to PSN (inside the tunnel)	Concrete agitators	2	2	2	108	111
PSS Concrete Pours – Tunnel lining support						
Metro Deck	Concrete truck	4 p.h.	4 p.h.	4 p.h.	108	111
Metro Deck	Concrete pumps	2	2	2	103	106
In the shaft	Concrete agitators	2	2	2	108	111
Plant demobilisation						
Metro Deck	100t mobile crane	-	-	1	104	107
Pitt St	Flatbed trucks	-	-	4 p.h.	106	111
Shaft excavation / widening works at PSS – concurrent with PSS concrete pours during standard construction hours						
PSS shaft	Power hand tools	1	-	-	107	111
PSS shaft	Excavator with bucket attachment	1	-	-	103	108
PSS shaft	Shotcrete rigs	2	-	-	104	107
PSS shaft	Compressors	2	-	-	102	103
Shaft excavation / widening works at PSN– concurrent with PSN concrete pours during standard construction hours						
PSN shaft	Power hand tools	1	-	-	107	111
PSN shaft	Caterpillar 966H wheeled loader	1	-	-	106	110
PSN shaft	Excavator with bucket attachment	2	-	-	103	108
PSN shaft	Excavators with hammers (35-45T)	2	-	-	118 + 5	123
PSN shaft	Drilling machine	2	-	-	106	116
PSN shaft	Shotcrete rig	2	-	-	104	107
PSN shaft	Compressor	2	-	-	102	103

2.2 Predicted noise levels

Noise results are summarised in Table 2.2, Table 2.3 and Table 2.4 below.

Table 2.2: Predicted construction noise levels at the closest noise sensitive receivers during day-time period

NCA	Address	Type of receiver	ICNG NMLs (reference only)	Assumed façade loss, dB(A)	External equivalent NML, PPA Condition E37 LAeq 15 minute	External equivalent NML, PPA Condition E41 LAeq 15 minute	Predicted level LAeq 15 minute					
							Concrete pours at PSS (Tunnel crown)		Concrete pours at PSN (Tunnel crown)		Concrete pours at PSS (Tunnel lining)	
							Cumulative impacts	Concrete pour in isolation	Cumulative impacts	Concrete pour in isolation	Cumulative impacts	Concrete pour in isolation
PS_05	308 PITT STREET	Residential	69	20	80	-	74	74	71	71	71	71
PS_05	209 CASTLEREAGH STREET	Residential	69	20	80	-	64	64	58	57	61	61
PS_05	137-139 BATHURST STREET	Residential	69	20	80	-	74	74	69	69	69	69
PS_02	199 CASTLEREAGH STREET	Residential	69	20	80	-	58	58	71	62	55	55
PS_02	197 CASTLEREAGH STREET	Residential	69	20	80	-	61	61	69	61	58	58
PS_02	27 PARK STREET	Residential	69	20	80	-	53	53	76	62	50	50
OSR	50-52 PARK STREET	Commercial	70	20	80	-	36	35	80	64	34	32
OSR	248A-250 PITT STREET	Commercial	70	20	80	-	45	45	83	71	42	42
OSR	211-217 CASTLEREAGH STREET	Fire Brigade	60	20	80	-	80	80	76	76	77	77
OSR	189-195 ELIZABETH STREET	Commercial	70	20	80	-	35	34	80	64	33	31
OSR	169-173 CASTLEREAGH STREET	Hotel/Motel/Hostel	60	20	80	-	37	36	88	64	35	33
OSR	163 CASTLEREAGH STREET	Commercial	70	20	80	-	50	50	81	64	47	47
OSR	258-260 PITT STREET	Hotel/Motel/Hostel	60	20	80	-	44	44	64	52	41	41
OSR	5-7 PARK STREET	Hotel/Motel/Hostel	60	20	80	-	38	37	59	44	36	34
OSR	2 PARK STREET	Commercial	70	20	80	-	53	52	76	55	51	49
OSR	294-294B PITT STREET	Commercial	70	20	80	-	72	72	72	72	69	69

The results in Table above indicate that cumulative noise levels (including shaft excavation/widening works and concrete pours) are predicted to be above the internal NMLs in PPA Condition E37 at 3 receivers (highlighted in bold in the Table above) at PSN worksite. These receivers had already been identified in the Pitt St CNVIS and consultation to determine appropriate hours of respite in accordance with PPA Conditions E37 and E38 was conducted. During these agreed respite periods, rockhammer excavation works would stop at PSN worksite. Noise levels from concrete pours (tunnel crown and tunnel lining) only are predicted to be below the internal NMLs in PPA Condition E37, therefore no consultation is required.

Table 2.3: Predicted construction noise levels at the closest noise sensitive receivers during evening period

NCA	Address	Type of receiver	ICNG NMLs (reference only)	Assumed façade loss, dB(A)	External equivalent NML, PPA Condition E37 L _{Aeq} 15 minute	External equivalent NML, PPA Condition E41 L _{Aeq} 15 minute	Predicted level L _{Aeq} 15 minute			
							Concrete pours at PSS (Tunnel crown)	Concrete pours at PSN (Tunnel crown)	Concrete pours at PSS (Tunnel lining)	Plant demobilisation
PS_05	308 PITT STREET	Residential	62	20	80	65	74	71	71	67
PS_05	209 CASTLEREAGH STREET	Residential	62	20	80	65	64	57	61	57
PS_05	137-139 BATHURST STREET	Residential	62	20	80	65	74	69	69	65
PS_02	199 CASTLEREAGH STREET	Residential	62	20	80	65	58	62	55	51
PS_02	197 CASTLEREAGH STREET	Residential	62	20	80	65	61	61	58	54
PS_02	27 PARK STREET	Residential	62	20	80	65	53	62	50	46
OSR	50-52 PARK STREET	Commercial	70	20	80	-	35	64	32	28
OSR	248A-250 PITT STREET	Commercial	70	20	80	-	45	71	42	38
OSR	211-217 CASTLEREAGH STREET	Fire Brigade	60	20	80	-	80	76	77	73
OSR	189-195 ELIZABETH STREET	Commercial	70	20	80	-	34	64	31	27
OSR	169-173 CASTLEREAGH STREET	Hotel/Motel/Hostel	60	20	80	-	36	64	33	29
OSR	163 CASTLEREAGH STREET	Commercial	70	20	80	-	50	64	47	43
OSR	258-260 PITT STREET	Hotel/Motel/Hostel	60	20	80	-	44	52	41	37
OSR	5-7 PARK STREET	Hotel/Motel/Hostel	60	20	80	-	37	44	34	30
OSR	2 PARK STREET	Commercial	70	20	80	-	52	55	49	45
OSR	294-294B PITT STREET	Commercial	70	20	80	-	72	72	69	65

Notes: Residential receivers predicted to be above the external equivalent NML of PPA condition E41 are highlighted in **bold**

Table 2.4: Predicted construction noise levels at the closest noise sensitive receivers during night-time period

NCA	Address	Type of receiver	ICNG NMLs (reference only)	Assumed façade loss, dB(A)	External equivalent NML, PPA Condition E37 L _{Aeq} 15 minute	External equivalent NML, PPA Condition E41 L _{Aeq} 15 minute	Predicted level L _{Aeq} 15 minute			
							Concrete pours at PSS (Tunnel crown)	Concrete pours at PSN (Tunnel crown)	Concrete pours at PSS (Tunnel lining)	Plant demobilisation
PS_05	308 PITT STREET	Residential	58	20	-	65	74	71	71	67
PS_05	209 CASTLEREAGH STREET	Residential	58	20	-	65	64	57	61	57
PS_05	137-139 BATHURST STREET	Residential	58	20	-	65	74	69	69	65
PS_02	199 CASTLEREAGH STREET	Residential	58	20	-	65	58	62	55	51
PS_02	197 CASTLEREAGH STREET	Residential	58	20	-	65	61	61	58	54
PS_02	27 PARK STREET	Residential	58	20	-	65	53	62	50	46
OSR	50-52 PARK STREET	Commercial	70	20	-	-	35	64	32	28
OSR	248A-250 PITT STREET	Commercial	70	20	-	-	45	71	42	38
OSR	211-217 CASTLEREAGH STREET	Fire Brigade	60	20	-	-	80	76	77	73
OSR	189-195 ELIZABETH STREET	Commercial	70	20	-	-	34	64	31	27
OSR	169-173 CASTLEREAGH STREET	Hotel/Motel/Hostel	60	20	-	-	36	64	33	29
OSR	163 CASTLEREAGH STREET	Commercial	70	20	-	-	50	64	47	43
OSR	258-260 PITT STREET	Hotel/Motel/Hostel	60	20	-	-	44	52	41	37
OSR	5-7 PARK STREET	Hotel/Motel/Hostel	60	20	-	-	37	44	34	30
OSR	2 PARK STREET	Commercial	70	20	-	-	52	55	49	45
OSR	294-294B PITT STREET	Commercial	70	20	-	-	72	72	69	65

Notes: Residential receivers predicted to be above the external equivalent NML of PPA condition E41 are highlighted in **bold**

The results in Table 2.3 and Table 2.4 above indicate that noise levels are predicted to be above the external equivalent NMLs in PPA Condition E41 at following receivers:

- 308 PITT STREET SYDNEY
- 137-139 BATHURST STREET SYDNEY

Measures to minimise and manage noise impacts are outlined in Section 2.3

2.2.1 Sleep disturbance

The predicted L_{Amax} noise levels associated with these works are expected to be above the sleep awakening reaction level at the nearest residential receivers. It is noted that there would be only two 18-hour long concrete pours.

Potential sleep disturbance impacts will be managed as outlined in Section 2.3. Toolbox talks will be used to advise all personnel of the need to follow quiet work practices during OOHW periods and of the need to respect the residential receivers surrounding the work site.

2.3 Noise management and mitigation measures

2.3.1 Noise control measures

The following standard noise control measures are recommended to reduce potential noise impacts.

Table 2.5: Site noise control measures

Control type	Control measure	Typical use
At-Source Control Measures	Limit equipment in use	Only the equipment necessary during each stage of the OOHW will be used.
	Timing of equipment in use	Where practicable, activities and plant will be limited as outlined in Table 2.1
	Limit activity duration	Any equipment not in use for extended periods shall be switched off. For example, heavy vehicles should switch engines off when not in use.
	Use and siting of plant	Avoid/ limit simultaneous operation of noisy plant and equipment within discernible range of a sensitive receiver. Direct noise-emitting plant away from sensitive receivers where practicable. Locate fixed location plant items as far from sensitive receivers as practicable.
	Equipment selection	Use quieter and less noise/ vibration emitting construction methods where feasible and reasonable.
	Non-tonal reversing alarms	Alternative reverse alarms, such as 'quackers' will be installed on all plant and equipment, where practicable.

Table 2.7: Additional airborne noise mitigation measures during concrete pours

NCA	Address	Concrete pours at PSS (Tunnel crown)	Concrete pours at PSN (Tunnel crown)	Concrete pours at PSS (Tunnel lining)	Plant demobilisation
PS_05	308 PITT STREET SYDNEY	MM4	MM2	MM2	MM2
PS_05	137-139 BATHURST STREET SYDNEY	MM4	MM2	MM2	MM2

Prior to the commencement of works, residential receivers around the site, identified in Table 2.7 above 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, expected noise levels and duration, as well as given appropriate enquiries and complaints contact details (see Section 2.3.5).

2.3.3 Consultation with affected receivers (PPA Condition E33)

As outlined in Section 5.4.1 of the *Pitt Street CNVIS*, consistent with requirements in PPA Conditions E33, JHCPBG has commenced and will continue to consult with potentially affected stakeholders including business and residential receivers regarding specific mitigation measures applicable to the construction works at the Pitt St site.

Site specific mitigation measures will include:

- Installation of temporary noise barriers to close the portal to the tunnel adits during the operation of the external concrete vibrators, which are the loudest noise sources on site.
- To minimise the total number of nights the local receivers are exposed to OOH works, the plant demobilisation would be planned to be carried out on the same night as the concrete pours, whenever practicable. Due to space constraints on the metrodeck, the plant demobilisation and concrete pours would not occur concurrently. When the concrete pour is completed the plant demobilisation would then proceed after road closures are in place.

2.3.4 Attended noise monitoring

Attended noise monitoring will be undertaken to verify that noise levels resulting from construction works are not higher than the levels predicted in this report, subject to obtaining the property owner/occupier's consent to access the property (where required).

Attended noise monitoring will be undertaken during works at monitoring location shown in Table 2.8. Nominated attended measurement location has been selected with the best opportunity to verify the predicted noise levels.

Table 2.8: Nominated verification monitoring locations

NCA	Nominated receiver address	Activity
PS_05	308 PITT STREET SYDNEY	Works at PSS
PS_02	27 PARK STREET SYDNEY	Works at PSN

NCA	Nominated receiver address	Activity
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.	

If verification monitoring shows that the external noise levels from the construction works are consistently above the predicted levels (i.e. for 2 or more consecutive monitoring events/ occasions that find the works to be the primary contributor to noise above the E37/E38 and E41/E42 NML), investigation will be undertaken to understand the cause of the exceedance and relevant reasonable and feasible mitigation measures will be implemented.

All noise monitoring will follow the procedures outlined in Appendix D of the CNVMP.

2.3.5 Complaints handling

Noise complaints received and responded to will be managed in accordance with the CNVMP and TSE Community Communication Strategy (SMCSWTSE-JCG-TPW-SH-PLN-002040).

Transport for NSW operate a 24-hour construction complaints line (1800 171 386). Enquiries/ complaints may also be received through the Sydney Metro project email (sydneymetro@transport.nsw.gov.au).

3 Other assessments

3.1 Cumulative impacts

All concurrent work activities have been assessed in this report.

3.2 Construction related road traffic assessment

The maximum combined number of heavy and light vehicles will not be greater than what has been already assessed in the *Pitt St CNVIS*. Therefore, consistent with the conclusions of the *Pitt St CNVIS*, construction traffic due to the proposed works is expected to have minor noise impact on surrounding public roads.

3.3 Vibration and ground-borne noise assessment

The proposed concrete works are not vibration intensive and so construction vibration or ground-borne noise impacts have not been considered further in this addendum assessment. It is noted that the external concrete vibrators are fitted to the formwork and operated within the tunnel more than 20m away from the closest receivers. The risk of vibration impact is considered negligible.

4 Conclusion

This technical memorandum is an addendum to the report *Pitt St CNVIS* to review the potential noise and vibration impacts for the additional works at PSS and PSN worksites.

As the predicted cumulative noise levels are expected to be above the PPA Conditions E37 and E41 external equivalent NMLs, additional noise mitigation and management measures will be implemented during the works.

JHCPBG is seeking to vary the Environment Protection Licence to permit the works set out in this report.

Document control

Date	Revision history	Non-issued revision	Issued revision	Prepared	Instructed	Reviewed / Authorised
29.06.2020	Initial issue	0	1	M. Tabacchi	-	T. Gowen
01.07.2020	Minor edit	-	2	M. Tabacchi	-	T. Gowen
07.07.2020	Inclusion of temporary noise barriers at tunnel adits	-	3	M. Tabacchi	-	T. Gowen
07.07.2020	Minor edit	-	4	M. Tabacchi	-	T. Gowen
21.07.2020	Inclusion of addition work scenarios	-	5	M. Tabacchi	-	T. Gowen
22.07.2020	Minor edit	-	6	M. Tabacchi	-	T. Gowen
31.07.2020	Addition of section 2.3.3	-	7	M. Tabacchi	-	T. Gowen

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.

APPENDIX A Glossary of terminology

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

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

L ₁	The sound pressure level that is exceeded for 1% of the time for which the given sound is measured.
L ₁₀	The sound pressure level that is exceeded for 10% of the time for which the given sound is measured.
L ₉₀	The level of noise exceeded for 90% of the time. The bottom 10% of the sample is the 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.
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.
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.