Integrated Management System

Planning Approval Consistency Assessment Form

SM ES-FT-414

Sydney Metro Integrated Management System (IMS)

Assessment Name:	Hunter Street Station East temporary decline
Prepared by:	Sydney Metro West
Prepared for:	Sydney Metro and John Holland CBP Contactors Ghella Joint Venture (JCG)
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1. Existing Approved Project

Planning approval reference details (Application/Document No. (including modifications)):			
SSI-19238057: Sydney Metro West – Major civil construction between The Bays to Sydney CBD (Stage 2 of the planning approval process for Sydney Metro West)			
Date of determination:	24 August 2022	Type of planning approval:	Critical State Significant Infrastructure (CSSI) (Division 5.2)
Relevant background information (including EA, REF, Submissions Report, Director General's Report, MCoA):			
Sydney Metro West Environmental Impact Statement – Concept and Stage 1 (major civil construction between Westmead and The Bays) (Sydney Metro, April 2020) (EIS 1) *Sydney Metro West – Concept and Stage 1 Conditions of Approval (SSI 10038)* (11 March 2021) *Sydney Metro West Environmental Impact Statement – Major civil construction between The Bays and Sydney CBD* (Sydney Metro, November 2021) (referred to throughout this document as 'the EIS') *Sydney Metro West Submissions Report – Major civil construction work between The Bays and Sydney CBD* (Sydney Metro, April 2022) *Sydney Metro West Stage 2 - Assessment Report (SSI 19238057)* (24 August 2022) *Sydney Metro West Stage 2 – Instrument of Approval - Conditions of approval (CoA)* (24 August 2022) *Sydney Metro West Stage 2 – Modification Request (Mod 1 Request)* - (February 2022) All proposed work identified in the assessment would be carried out in accordance with the mitigation measures identified in the Environmental Impact Statement (EIS), Submissions Report and the Conditions of Approval (CoA). The Sydney Metro West Stage 2 – Modification Request (Mod 1 Request) is subject to determination from the Department of Planning and Environment.			
Description of existing Approved Project you are assessing for consistency:			
Sydney Metro West - all major civil construction work between Westmead and The Bays (Stage 1) Sydney Metro West – Concept and Stage 1 (major civil construction between Westmead and The Bays), including station excavation and tunnelling, was determined on 11 March 2021. It is noted that this consistency assessment does not relate to any aspects of the Concept and Stage 1. **Sydney Metro West - all major civil construction work and tunnelling between The Bays and Sydney CBD (Stage 2, the Approved Project)** The major civil construction work between The Bays and Sydney CBD was determined on 24 August 2022. The scope of the Approved Project is described in Chapter 5 of the EIS and would include:			

- Enabling work such as demolition, utility supply to construction sites, utility adjustments, and modifications to the existing transport network
- Tunnel excavation including tunnel support activities
- Station excavation for new metro stations at Pyrmont and at Hunter Street, in the Sydney CBD

Construction methodology for the Approved Project

The work for the Approved Project was described in the *Sydney Metro West Environmental Impact Statement – Sydney Metro West – The Bays to Sydney CBD* (Sydney Metro, 2021) (Stage 2 of the planning approvals process).

The EIS presented the depth of the tunnels (to rail level) to vary from the ground surface to rail level from about 27 to 52 metres due to changes in topography, with depths to the top of the tunnel typically measuring about seven metres less than this. The shallower tunnel sections would generally be near the stations, with the deeper sections generally under the major water bodies of Johnstons Bay and Cockle Bay.

The following tunnel features would be excavated using road headers and rock hammers:

- Crossover cavern at the Pyrmont station site
- Cross passages between the two tunnels to allow for emergency access
- Tunnel turnback at the end of the line, east of the eastern Hunter Street Station (Sydney CBD) construction site, to allow for the future operational ability to turn trains around for services travelling from the Hunter Street Station (Sydney CBD) west towards Westmead
- Stub tunnels to safeguard a potential future extension to the Metro network.

Condition D23 identifies variations to the construction hours identified in Condition D21 and allows for tunnelling by tunnel boring machine (TBM) (excluding cut and cover tunnelling and surface works) to be undertaken 24 hours a day, seven days a week.

Sydney Metro West Stage 2 – Modification Request (Mod 1 Request)

Sydney Metro submitted a Modification Request to the Department of Planning and Environment to enable tunnelling by other means including rockbreaker and roadheader (i.e. non-TBM tunnelling) to also be undertaken 24 hours a day, seven days a week. This would align with the assessment provided in the EIS for the Approved Project and is consistent with the construction of all recent tunnel projects in Sydney including Sydney Metro West - Major civil construction between Westmead and The Bays.

The Modification Request was placed on public exhibition in February 2023 and would then be subject to assessment and determination by the Department of Planning and Environment. This Consistency Assessment considers both the Approved Project and the project as proposed as part of the Modification Request.

2. Description of proposed change which is the subject of this assessment

The purpose of this consistency assessment is to assess the construction of a temporary decline (excavation) at the Hunter Street Station (Sydney CBD) eastern construction site (referred to as 'the site' throughout) in order to facilitate vehicular access into the site including the station cavern and turnback tunnels. The proposed change involves replacing the temporary access shaft and mined adit at the Hunter Street eastern site with a mined temporary decline tunnel under Bligh Street and

Hunter Street. Once constructed, vehicles would access the temporary decline tunnel through the existing Bligh St adit that connects to the Sydney Metro City & Southwest line (located within the Hunter Street Station (Sydney CBD) eastern construction site acoustic shed), where they would descend into the Hunter Street cavern and the turnback tunnels. The temporary decline location and footprint is shown in Attachment A of this consistency assessment.

This temporary decline would be excavated by use of a roadheader (consistent with the same construction method as described in Section 5.5.3 of the EIS). The temporary decline would only be required during the construction of the Approved Project and would be backfilled upon completion of construction.

Construction of the temporary decline would commence in Q2 2023 during the commencement of demolition works on the south side of the Hunter Street eastern site footprint. Use of the adit would be required for the construction of the station excavation works. The proposed temporary decline would be located partially outside of the Approved Project corridor, under the Hunter Street and Bligh Street road reserves.

Relevant elements of the Approved Project	Proposed change
Project description Section 5.4 of the EIS notes that wherever possible, construction sites would be contained within the future operational station footprints for Hunter Street Station (Sydney CBD). Section 5.4.5 of the EIS provides a detailed description of the Hunter Street Station (Sydney CBD) eastern construction site bounded by O'Connell Street, Hunter Street and Bligh Street.	The proposed temporary decline would extend marginally outside the approved Hunter Street Station (Sydney CBD) eastern construction site. The proposed change would be substratum and the surface level footprint of the approved construction site would not change. This decline adit would be a temporary excavation required to support the construction of the station but it would not be required during the future planned operation of the station and would therefore be backfilled upon completion of the Approved Project.
Station depth Figure 5-3 of the EIS demonstrates that the Hunter Street Station sites would be constructed about 27 metres below ground surface level.	The construction of the temporary decline would not be at a depth greater than what was assessed in the EIS for the Approved Project. The decline adit would be constructed from a depth (to top of the decline adit crown) of around 10 metres and would descend into the station cavern and adit, terminating around 17 metres below ground level.
Construction traffic Information relating to haulage routes, the daily profile of construction traffic movements for each site, construction traffic impacts and mitigation is provided in Chapter 6 (Transport and traffic) and Technical Paper 1 (Transport and traffic) of the EIS.	Heavy vehicle movements for the Hunter Street Eastern construction site were amended in SMWER04. There would be no material change to the estimated construction vehicle movements or traffic volumes as a result of the proposed changes, compared with that for the Approved Project.
Construction site Sections 5.4 of the EIS describes the construction sites for the Approved Project. Section 5.4.5 of the EIS provides a detailed description of the Hunter Street Station (Sydney CBD) eastern construction site bounded by O'Connell Street, Hunter Street and Bligh Street.	The proposed temporary decline would extend marginally outside the approved Hunter Street Station (Sydney CBD) eastern construction site. The proposed change would be substratum and the surface level footprint of the approved construction site would not change.
Noise and vibration Chapter 7 of the EIS assesses noise and vibration impacts associated with the Approved Project.	The proposed change would not result in any changes to noise and vibration impacts at receivers in the vicinity of the Hunter Street (Sydney CBD) eastern

	construction site. This is further discussed in Section 9 – Impact Assessment of this Consistency Assessment.
Spoil Indicative spoil generation of the Approved Project is outlined in Section 5.6.1 of the EIS. Further detail on the impacts associated with spoil generation and management is provided in the relevant chapters of the EIS, including Chapter 6 (Transport and traffic), Chapter 19 (Air quality) and Chapter 20 (Spoil, waste management and resource use).	There would be no substantial change to the estimated volume of spoil generated by the proposed changes compared with that for the Approved Project. Additional spoil volumes are expected to result in about a 3% increase in total spoil volumes compared with the volume identified for the Approved Project for the Hunter Street (Sydney CBD) eastern construction site.
Property and land use Sections 5.4 of the EIS describes the construction sites for the Approved Project. Section 5.4.5 of the EIS provides a detailed description of the Hunter Street Station (Sydney CBD) eastern construction site bounded by O'Connell Street, Hunter Street and Bligh Street. The need for and approach to substratum acquisition is discussed in in Section 10.5.1 of the EIS.	The temporary decline would extend marginally outside the approved Hunter Street Station (Sydney CBD) eastern construction site (near the corner of Hunter Street and Bligh Street). As the proposed changes would be located underground and the surface level footprint of the approved Hunter Street Station (Sydney CBD) construction site would not change, the proposed changes would not result in any changed land use and surface property impacts not described for the Approved Project. There would be no additional private property acquisitions as a result of the proposed changes, as the decline adit would be located beneath a roadway. The process of substratum acquisition for the proposed changes would be consistent with that for the Approved Project as described in the EIS.
Construction Hours The project description in the EIS for the Approved Project indicates that tunnelling (including associated excavation such as crossover cavern excavation) would occur 24 hours per day, seven days per week. The construction hours identified in Condition of Approval D21 for the Approved Project are: (a) 7:00am to 6:00pm Mondays to Fridays, inclusive; (b) 8:00am to 6:00pm Saturdays; and (c) at no time on Sundays or public holidays. Condition of Approval D23 however allows for tunnelling by tunnel boring machine (excluding cut and cover tunnelling and surface works) to be undertaken 24 hours a day, seven days a week.	Sydney Metro would seek to undertake the proposed works both during standard construction hours and outside of the standard construction hours as Low Noise Impact Work in accordance with Condition D23(b) of the Approved Project. Alternatively, Sydney Metro has also submitted a Modification Request to the Department of Planning and Environment to enable tunnelling by means other than TBM including rockbreaker and roadheader (i.e. non-TBM tunnelling) to also be permitted 24 hours a day, seven days a week. This would align with the assessment provided in the EIS for the Approved Project and is consistent with the construction of all recent tunnel projects in Sydney including Sydney Metro West - Major civil construction between Westmead and The Bays. Should this Modification Request be determined, Sydney Metro would undertake tunnelling by both tunnel boring machine and non-TBM tunnelling 24 hours per day, seven days a week. Restricting non-TBM tunnelling works to daytime would result in a substantial program delay to Sydney Metro West, including to the opening of the line to passenger services. This would have flow on impacts including prolonged construction impacts and disruption for receivers across the whole Sydney Metro

	West alignment and the later realisation of the substantial operational benefits of Sydney Metro West. This assessment has also included the potential impacts of out of hours works to allow non-TBM tunnelling 24 hours a day, seven days a week.

Table 1 - Comparison of the proposal with relevant elements of the Approved Project

3. Timeframe

An indicative construction program for the major civil construction work between The Bays and Sydney CBD is shown in Figure 5-6 of the EIS. Section 5.3 of the EIS notes that the actual program and commencement of the civil work at each construction site may vary and is subject to ongoing design development and construction planning to be agreed with the successful contractor for each work package.

The proposed changes would fit within the indicative construction program for the Hunter Street (Sydney CBD) eastern construction site described in Figure 5-12 of the EIS for the Approved Project and would not require any change to the Approved Project's indicative construction program. Construction of the decline adit would commence during 'Phase 2 – Shaft excavation' in Q2 2023 and would be in full use during the 'Phase 3 – Station excavation' in 2024. The temporary decline would likely be decommissioned during Q4 2024.

4. Site description

The Hunter Street (Sydney CBD) eastern construction site is comprised of:

- 20-26 O'Connell Street Sydney 2000 (DP626651)
- 28-34 O'Connell Street Sydney 2000 (DP1107981, DP217112, DP536538)
- 44-48 Hunter Street Sydney 2000 (DP59871, DP217112)
- 50-58 Hunter Street Sydney 2000 (SP87437).

These properties have been acquired by Sydney Metro and will be demolished as part of the work in the Approved Project as described in Chapter 5 (Project Description) of the EIS. Section 5.4.5 of the EIS provides a detailed description of the Hunter Street Station (Sydney CBD) eastern construction site bounded by O'Connell Street, Hunter Street and Bligh Street. The proposed changes subject to this consistency assessment are substratum and fall within and outside of the Approved Project boundary (shown in Figure 1). The proposed changes would be substratum and the surface level footprint of the approved Hunter Street Station (Sydney CBD) eastern construction site would not change.

As described in Section 10.5.1 of the EIS, it would be necessary to acquire land below the surface of properties for the construction of the tunnels, adits, cross passages and caverns (substratum acquisition). Figure 10-1 of the EIS shows an indicative example of the extent of the substratum to be acquired around the tunnels. The indicative depth of the tunnel alignment is shown in Figure 5-2 of the EIS. There would be no additional substratum acquisition under private properties required as a result of the proposed changes as the decline adit would be located within a road reserve. The process of substratum acquisition for the proposed changes would be consistent with that for the Approved Project as described in the EIS.

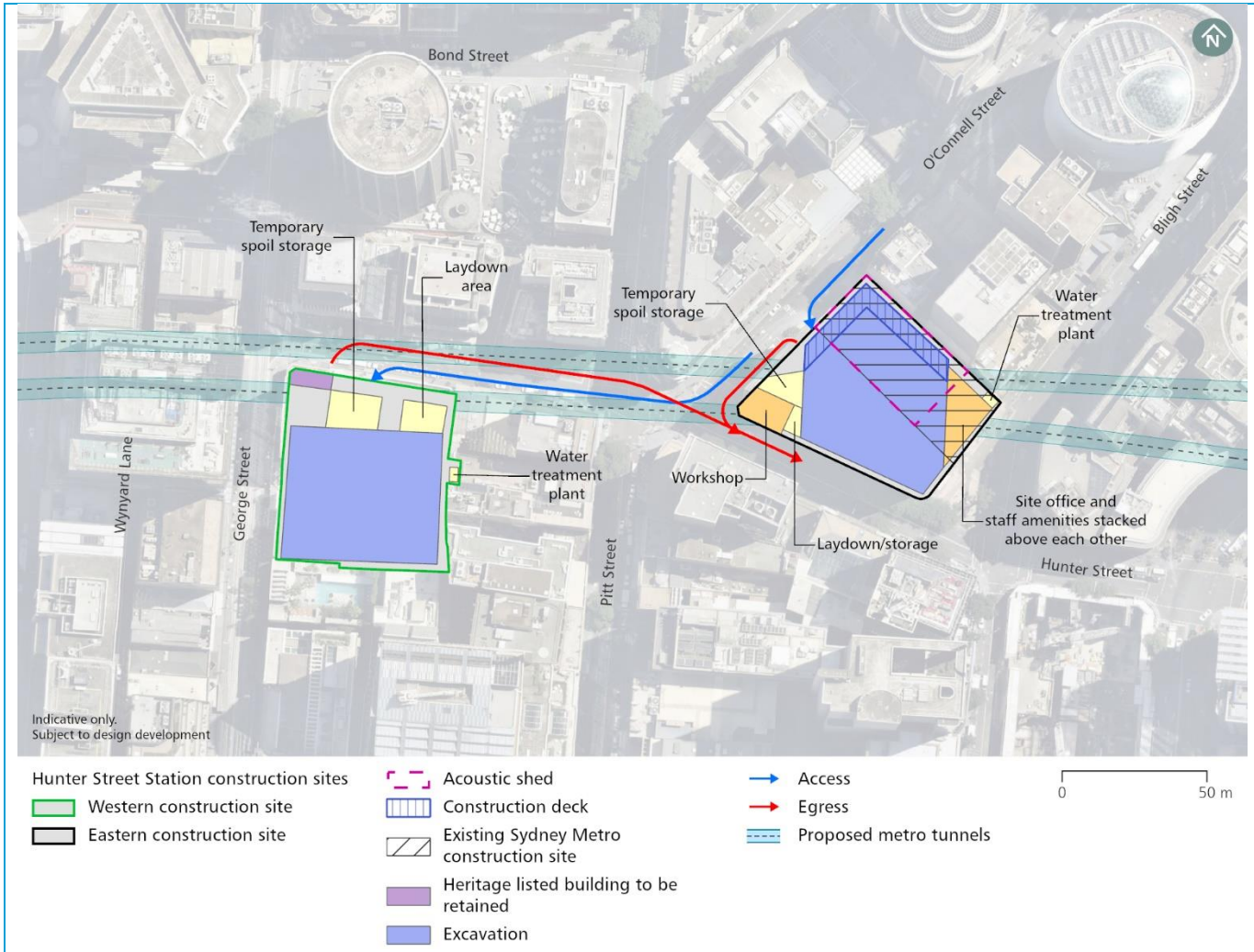


Figure 1. Hunter Street Station construction sites – indicative construction site layout

5. Site Environmental Characteristics

The Hunter Street (Sydney CBD) eastern construction site is in a dense, highly developed urban area within Sydney CBD. There is no threatened vegetation or protected species proximal to the site, or that would be affected by the change proposed in this consistency assessment. Surrounding land uses are predominantly commercial, with neighbouring properties comprising of office and retail buildings. The site is bound by O'Connell Street, Hunter Street and Bligh Street.

The proposed changes would be substratum and would not have any effect at ground surface level. The proposed decline adit would be excavated in geology that is consistent with the adjoining areas of the Approved Project (Hawkesbury Sandstone).

6. Justification for the proposed change

The proposed changes are the result of further construction planning that has occurred since the exhibition of the EIS. The construction of the temporary decline would provide construction efficiencies by enabling loading of heavy vehicles to occur within the acoustic shed at the Hunter Street (Sydney CBD) eastern construction site. Vehicles would be able to use the decline adit to drive down to tunnel level without the need for vertical crainage which provides longer-term cost benefits and would assist in minimising adverse impacts to stakeholders in the vicinity of the site, and the surrounding road network.

7. Environmental Benefit

The environmental benefits of the proposed changes are anticipated to be consistent with the environmental benefits of the Approved Project.

8. Control Measures

Will a project and site specific EMP be prepared?	☒ Yes ☐ No	Are appropriate control measures already identified in an existing EMP? A project and site specific EMP will be prepared by John Holland CPB Contractors Ghella Joint Venture (JCG). The EMP will be prepared in accordance with the relevant conditions of approval and project mitigation measures and include the appropriate control measures for the activities described within this consistency assessment. All work will be undertaken in accordance with the control measures outline in the project and site specific EMP.	☐ Yes ☒ No

9. Conditions of approval

Will the proposal be consistent with the conditions of approval?	☒ Yes ☐ No

9. Impact Assessment – Construction

Aspect	Nature and extent of impacts (negative and positive) during construction (if control measures implemented) of the proposed change, relative to the relevant impact in the Approved Project	Proposed Control Measures in addition to project CoA and REMMs	Minimal Impact Y/N	Endorsed	
				Y/N	Comments
Flora and fauna	No change from Approved Project.	No additional measures required.	Y	Y	
Water	As the proposed changes would be located underground and the surface level of the approved Hunter Street Station (Sydney CBD) construction site would not change, the proposed changes would not result in any changes to the flooding or surface water quality impacts compared to the Approved Project. Section 14.9 of the EIS for the Approved Project assessed that interactions between surface water and groundwater due to tunnelling activities are not expected to occur due to the depth of tunnels and absence of natural surface streams. There are no surface freshwater bodies or waterways within the area of potential drawdown associated the Hunter Street Station (Sydney CBD) construction sites. Due to the existing groundwater drawdown in the area associated with building basements it would be unlikely that the construction of the temporary decline would result in the inflow of groundwater into the structure or adjoining station cavern and shaft.	No additional measures required.	Y	Y	

Soils and contamination	The proposed works are not within an area of known contamination. Table 5-7 of the EIS estimated that about 396,200 cubic metres of spoil would be generated by the Hunter Street eastern construction site. It is expected that the construction of the temporary decline would result in a minor generation of about 8,300 tonnes of spoil in addition to what was assessed in the Approved Project. This would not constitute as a significant change from the volumes and associated impacts assessed for the Approved Project. Spoil would be classified in accordance with the NSW Environment Protection Agencies *Waste Classification Guidelines* (2014) and would be managed under the existing environmental mitigation measures including WR5, and the Construction Environmental Management Framework.	No additional measures required.	Y	Y	
Air quality	No change from Approved Project.	No additional measures required.	Y	Y	
Noise and vibration	A detailed noise and vibration technical assessment has been prepared by Renzo Tonin & Associates and is included as Attachment B. Ground-borne noise and vibration impacts were assessed as a worst-case scenario, with modelling incorporating measurement data from various infrastructure projects in Sydney. The technical assessment in Attachment B therefore contains more detailed information when compared to the more conservative assumptions for predicted ground-borne noise and vibration levels in the EIS of the Approved Project. The assessment in Attachment B makes the following conclusions:	Impacts would continue to be managed in accordance with the Construction Noise and Vibration Standard (CNVS), as well as the following mitigation measures from the Approved Project: • NV02 – alternative construction methodologies • NV09 – ground-borne noise • NV04 – Construction noise – out of hours work • NV05 – Night-time noise impacts • NV06 – Night-time noise impacts • NV08 – Acoustic sheds	Y	Y	

	• Ground-borne noise impacts generated by the proposed works would be consistent with the impacts assessed in the EIS of the Approved Project for TBM excavation at Hunter Street • Vibration impacts are below the vibration criteria for structural damage and would not result in cosmetic or structural damage to neighbouring properties (including heritage structures) • Noise and vibration impacts are below the tolerable thresholds for human disturbance and would not result in adverse impacts to the community and nearby receivers. **Out of hours works** Sydney Metro would seek to undertake the proposed change subject to this consistency assessment in accordance with the requirements for Low Noise Impact Work detailed in Condition D23(b). These impacts are discussed below and in Attachment C of this Consistency Assessment. In conclusion, works would meet the criteria outlined in Condition D23(b) allowing the works to be undertaken outside standard construction hours, to minimise safety, ground movement and program risks. As discussed in Section 1 and Section 2 of this Consistency Assessment, Sydney Metro have also submitted a Modification Request to the Department of Planning and Environment to enable non-TBM tunnelling to be permitted 24 hours a day, seven days a week. This would align with the assessment provided in the EIS	• NV15 – Cumulative construction noise impacts			

	for the Approved Project and is consistent with the construction of all recent tunnel projects in Sydney including Sydney Metro West - Major civil construction between Westmead and The Bays. The benefits of undertaking tunnelling outside of standard construction hours would: • ensure the stability of the excavation, minimise potential ground movement and settlement and make the excavation safe for construction workers • non-TBM tunnelling works being restricted to daytime would result in a substantial program delay to Sydney Metro West, including to the opening of the line to passenger services. This would have flow on impacts including prolonged construction impacts and disruption for receivers across the whole Sydney Metro West alignment and the later realisation of the substantial operational benefits of Sydney Metro West • the detailed noise and vibration assessments being undertaken along the Sydney Metro West alignment have confirmed that non-TBM tunnelling would result in lower worst-case ground-borne noise levels than those produced by TBMs • non-TBM tunnelling out of standard hours can be effectively managed through application of the Sydney Metro CNVS. The EIS for the Approved Project assessed noise and vibration impacts on receivers for excavation activities including tunnel boring and rockbreaking as a 24 hour scenario.				

	Ground-borne noise Ground-borne noise impacts from the proposed decline excavation were compared against the respective ground-borne noise management levels (GNMLs), as well as the ground-borne noise (GBN) levels associated with tunnel boring activities in the Approved Project. Modelling found that the predicted GBN levels resulting from the decline excavation using roadheaders for excavation are below the daytime, evening and night-time ground-borne NML for all receivers. This results in no receivers being impacted by ground-borne noise from the proposed works during any time periods. The proposed use of a roadheader to excavate the decline tunnel would see no additional generation of ground-borne noise impacts beyond what was assessed in the Approved Project and the activity. **Air-borne noise** The proposed construction methods required for the proposed changes, including plant and equipment and construction hours, is principally unchanged compared with that for the Approved Project. The use of an acoustic shed at the Hunter Street (Sydney CBD) eastern construction site would mitigate additional airborne noise generated by construction activities and would reduce the impact of noise on receivers. Given that all changes would be substratum, there would be no substantial change to predicted air-borne noise impacts from those assessed in the Approved Project. There would be no substantial change to the indicative construction traffic volumes as a				

	result of the proposed changes, given that the volume of spoil and construction methodology would be consistent with that described in the EIS. As a result, there would be no substantial change to predicted construction traffic noise. **Vibration** The assessment in Attachment B confirms that vibration levels from the use of roadheaders during excavation of the decline are predicted to be below the human comfort criteria and the cosmetic damage screening level at receivers in the vicinity of the Hunter Street eastern construction site. Attachment B outlines that no additional impacts are predicted at nearby receivers due to the proposed changes, and therefore the proposed change would not result in any properties being at risk of exceeding the screening criteria for cosmetic damage as a result of the proposed works. The vibration assessment in the EIS for the Approved Project assessed TBM tunnelling and rockbreaking activities as worst-case construction method in terms of potential ground-borne vibration impact. The vibration impacts as described in Attachment B are well below the tolerable thresholds for structural damage to buildings and for human disturbance. As a result, the proposed changes are not predicted to result in any additional ground-borne noise or vibration impacts to the surrounding receivers. **Cumulative Impacts** As the impacts from the proposed works are found to be well below the noise and vibration impacts associated with the Approved Project, it is considered highly unlikely that receivers				

	would experience adverse cumulative impacts. The proposed change would be mitigated and managed through the measures and processes outlined in the CVNS.				
Aboriginal heritage	No change from Approved Project.	No additional measures required.	Y	Y	
Non-Aboriginal heritage	An assessment of the potential heritage impacts associated with the proposed change has been undertaken and included at Attachment B of this consistency assessment. **Ground-borne vibration** The assessment found that the predicted worst-case vibration levels would be below the vibration criteria for structural damage. The risk of structural damage being caused to neighbouring structures is considered to be low during excavation works, which is consistent with the impacts of the Approved Project. No neighbouring properties at the Hunter Street Station eastern construction site would exceed the cosmetic damage screening vibration criteria during tunnelling. This is consistent with the impacts of the Approved Project. **Ground movement and Settlement** Preliminary settlement contours were developed for the Approved Project to identify the expected zone of influence and magnitude of induced settlement from construction, as described in Section 14.6.1 of the EIS. The identified buildings, infrastructure and utilities currently fall within risk category 1 or 2 where the damage is negligible or slight. As a result of the proposed temporary decline being at comparable depths as the station cavern for the Approved Project, maximum estimated ground	No additional measures required. Impacts to non-Aboriginal heritage items would continue to be managed in accordance with the existing mitigation measures: • NAH8 - Ground movement and settlement assessment • NAH9 - Monitoring	Y	Y	

	movement is anticipated to be substantially unchanged. Overall, there would be no substantial change to the impacts to the non-Aboriginal heritage items.				
Community and socio-economic	Noting the outcomes of noise and vibration assessment at Attachment B, there is not expected to be any additional impacts to the community as a result of the proposed works. Noise and vibration impacts are expected to be low and would be able to be adequately mitigated under the existing mitigation measures for the Approved Project. As most of the identified receivers are situated in commercial buildings within a busy urban centre, it remains that the overall impact associated with the proposed changes on receivers would be minimal. There would also be no substantial changes to traffic, land use and property, landscape and visual amenity and air quality as a result of the proposed changes which are substratum and would be located within a road reserve. As a result, there would be no substantial changes to the community and socio-economic impacts of the proposed changes compared with that for the Approved Project.	No additional measures required. Impacts would continue to be managed in accordance with the Construction Noise and Vibration Standard (CNVS), Overarching Community Communications Strategy (OCCS) as well as the Approved Project's existing mitigation measures.	Y	Y	

Traffic and transport	The proposed change would result in a minor additional generation of spoil beyond what was assessed in the Approved Project. This minor increase in spoil generation would not result in a material change to the estimated construction vehicle traffic volumes for the Approved Project. As described in Section 5.6.1 of the EIS, spoil would be removed from the site using heavy vehicles. Construction traffic would continue to be managed in accordance with the Construction Traffic Management Framework. Construction traffic management plans for each site would be submitted to the relevant roads authority for review before work starts, as such there would be no change to traffic and transport impacts beyond what was assessed in the Approved Project. As there are no proposed changes to the layout of the approved Hunter Street (Sydney CBD) construction site, there would be no changes to the active transport, public transport, parking and property access impacts of the Approved Project.	No additional measures required.	Y	Y	
Waste and resource management	No change from Approved Project.	No additional measures required.	Y	Y	
Visual	As the proposed change would be substratum and managed within the constraints of the Hunter Street Eastern construction site acoustic shed, there would be no change to the visual impacts from Approved Project.	No additional measures required.	Y	Y	

Land use and property	As the proposed changes would be located underground and the surface level approved Hunter Street Station (Sydney CBD) eastern construction site would not change, the proposed changes would not result in any changed land use and surface property impacts not described for the Approved Project. There would be no additional private property acquisitions as a result of the proposed changes, as the temporary decline would be located beneath a roadway. The process of substratum acquisition for the proposed changes would be consistent with that for the Approved Project as described in the EIS.	No additional control measures proposed.	Y	Y	
Hazard and risk	No change from Approved Project.	No additional measures required.	Y	Y	

10. Impact Assessment – Operation

The Approved Project covers the major civil construction between The Bays and Sydney CBD (SSI-19238057). The proposed works in this consistency assessment are for the purpose of construction efficiencies and would be backfilled upon completion of the Approved Project. Operations of the Sydney Metro West project are assessed in SSI-22765520. Any impacts associated with the proposed works would not carry into the operational stage of the Sydney Metro West project.

Aspect	Nature and extent of impacts (negative and positive) during operation (if control measures implemented) of the proposed change, relative to the relevant impact in the Approved Project	Proposed Control Measures in addition to project COA and REMMs	Minimal Impact Y/N	Endorsed	
				Y/N	Comments
Flora and fauna	No change from Approved Project.	No additional measures required.	N/A	Y	
Water	No change from Approved Project.	No additional measures required.	N/A	Y	
Soils and contamination	No change from Approved Project.	No additional measures required.	N/A	Y	
Air quality	No change from Approved Project.	No additional measures required.	N/A	Y	
Noise and vibration	No change from Approved Project.	No additional measures required.	N/A	Y	
Aboriginal heritage	No change from Approved Project.	No additional measures required.	N/A	Y	
Non-Aboriginal heritage	No change from Approved Project.	No additional measures required.	N/A	Y	
Community and socio-economic	No change from Approved Project.	No additional measures required.	N/A	Y	
Traffic and transport	No change from Approved Project.	No additional measures required.	N/A	Y	

Aspect	Nature and extent of impacts (negative and positive) during operation (if control measures implemented) of the proposed change, relative to the relevant impact in the Approved Project	Proposed Control Measures in addition to project COA and REMMs	Minimal Impact Y/N	Endorsed	
				Y/N	Comments
Waste and resource management	No change from Approved Project.	No additional measures required.	N/A	Y	
Visual and urban design	No change from Approved Project.	No additional measures required.	N/A	Y	
Land use and property	No change from Approved Project.	No additional measures required.	N/A	Y	
Hazard and risk	No change from Approved Project.	No additional measures required.	N/A	Y	

11. Consistency with the Approved Project

Question	Consider the following:
Is the project as modified consistent with the conditions of approval?	Yes. The proposed changes are consistent with the Conditions of Approval.
Is the project (including the proposed changes) consistent with the objectives and functions of elements of the Approved Project?	Yes. The changes identified in this assessment are consistent with the objectives and functions of the relevant elements of the Approved Project. The purpose of the proposed temporary decline is to better facilitate vehicular access into the site including the station cavern, tunnels and the adit connecting to the Sydney Metro City & Southwest line to complete the construction works required for the Approved Project. Once constructed, vehicles would access the temporary decline through the existing temporary access shaft (located within the Hunter Street Station (Sydney CBD) eastern construction site acoustic shed), where they would descend into the excavated eastern station access shaft.
Are the environmental impacts of the proposed change consistent with the impacts of the Approved Project?	Yes. The environmental impacts of the proposed change are consistent with the environmental impacts as assessed for the Approved Project.
Is the change within the envelope of what has been approved?	The proposed changes would be located underground, and the surface level approved Hunter Street Station (Sydney CBD) eastern construction site would not change. The proposed temporary decline would be substratum and would be constructed partially outside of the approved Hunter Street Station (Sydney CBD) construction site within a road reserve. The temporary decline would fall slightly outside of the approved interim corridor from the EIS.
Are there any new environmental impacts as a result of the proposed works/project changes?	All risks would be adequately addressed through the application of the mitigation measures in the above tables. There would be no new environmental risks as a result of the proposed works.
Are the impacts of the proposed activity/works known and understood?	Yes. The impacts of the proposed works are understood and will be accounted for by implementing the control measures within this document and the existing mitigation measures established under the Approved Project.
Are the impacts of the proposed activity/works able to be managed so as not to have an adverse impact?	Yes. The impacts of the proposed works can be managed under the existing environmental mitigation measures so as to avoid an adverse impact
Is the proposed change/s consistent with the approval (having regard to the above assessment)?	☒ Yes ☐ No

12. Other Environmental Approvals

Identify all other approvals required for the proposed works:	N/A

14. Recommendation

Based on the above impact assessment, and with reference to the environmental impact assessment documents, including the conditions of approval, it is recommended that:

	Tick relevant box
The proposed change has negligible or more than negligible impacts on the environment or community however is consistent with the Approval, including the conditions of approval. The proposed impacts are consistent with those assessed for the Approved Project (i.e., does not trigger a change to the conditions of approval).	☒
The proposed change is not consistent with the Approved Project including the conditions of approval and would be subject to a separate modification application.	
The proposed change is not substantially the same as the Approved Project and is considered a radical transformation. A new planning pathway should be considered.	

Author certification

I certify that to the best of my knowledge this Consistency Checklist: • Examines and takes into account the fullest extent possible all matters affecting or likely to affect the environment as a result of activities associated with the proposed change; and • Examines the consistency of the proposed change with the Approved Project; is accurate in all material respects and does not omit any material information.				
Name:	Charlotte Brogan	Signature:	Charlotte Brogan	
Title:	Planning Approvals Officer			
Company:	Sydney Metro	Date:	20/02/2023	

Assessment Supporting Signature

Application supported and submitted by			
Name:	Yvette Buchli	Date:	20/02/2023
Title:	Associate Director Planning Approvals	Comments:	
Signature:	YvetteBuchli		

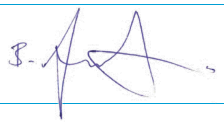
Assessment Endorsement

Based on the above assessment, are the impacts and scope of the proposed change consistent with the existing Approved Project?

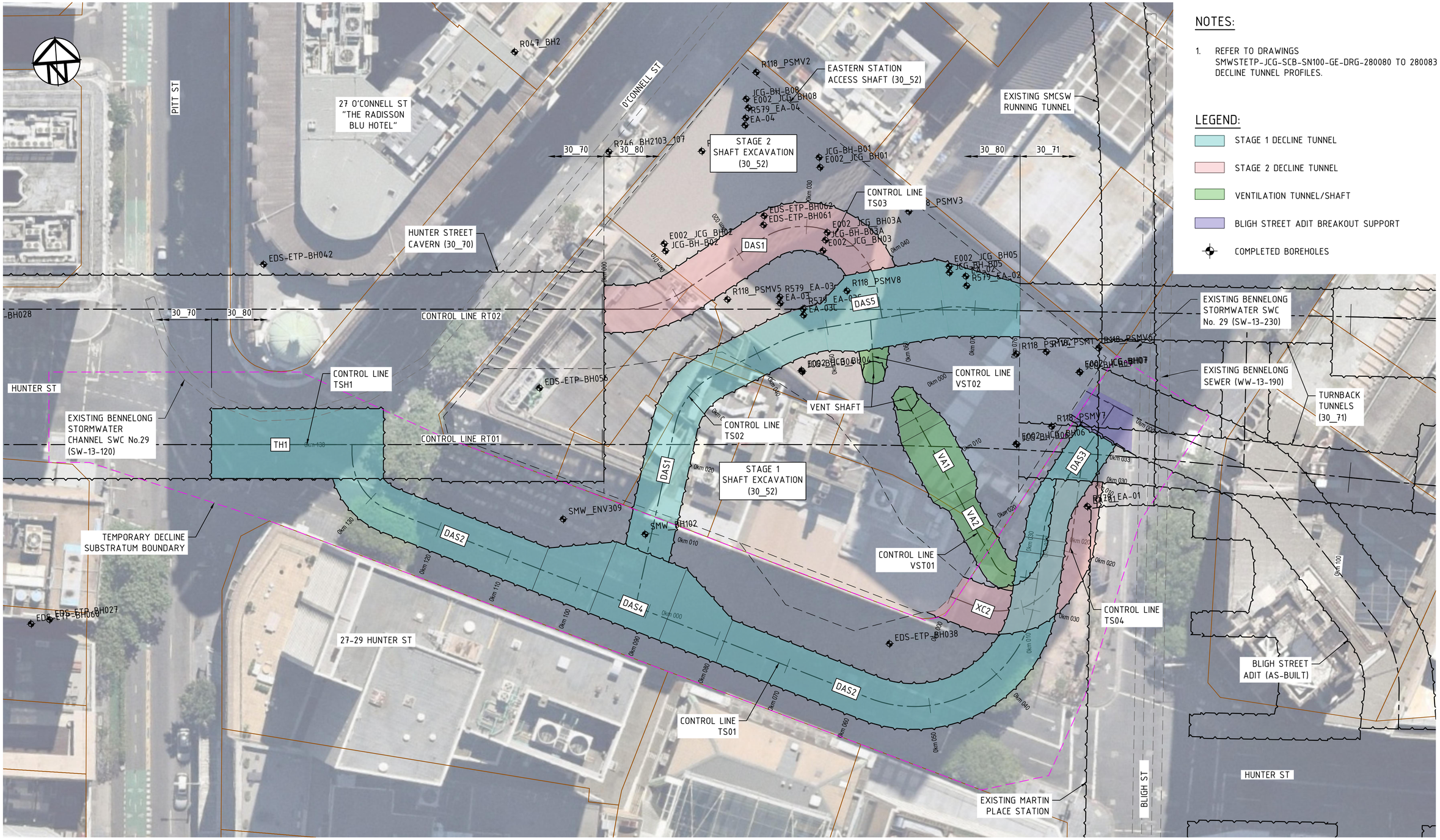
Yes ☒ The proposed change is consistent with the Approved Project and no further assessment is required.

No ☐ The proposed change is not consistent with the Approved Project.

A modification or a new activity approval/ consent is required. Advise Senior Project Manager of appropriate alternative planning approvals pathway to be undertaken.

Endorsed by			
Name:	Ben Armstrong	Date:	23/02/2023
Title:	Director Sydney Metro West, Environment, Sustainability and Planning	Comments:	
Signature:			

Attachment A – Hunter Street cavern & adits general arrangement plan



PLAN
SCALE 1:250

NOT FOR CONSTRUCTION

REV.	BY	DATE	DESCRIPTION	APPD.
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C	E.N.	31/01/23	ISSUED FOR STAGE APPROVAL - STAGE 3	A.M.

SCALES
0 2.5 5.0 7.5 10 12.5 15m
SCALE 1:250 AT A1 SIZE

A1 Original | Co-ordinate System: GDA 2020 | Height Datum: A.H.D. | This sheet may be prepared using colour and may be incomplete if copied | NOTE: Do not scale from this drawing. | ALT. DRG No. .

CLIENT
NSW GOVERNMENT | sydney METRO

SERVICE PROVIDERS
JOHN HOLLAND | CPB CONTRACTORS | Ghella

DRAWN	E.NOCKOLDS	
DESIGNED	D.TRAN	
DRG CHECK	D.TRAN	
DESIGN CHECK	S.CLARKE	
APPROVED	A.MERRITT	31/01/23

SYDNEY METRO WEST - EASTERN TUNNELLING PACKAGE
HUNTER STREET (SYDNEY CBD)
30_80 EXCAVATION AND PRIMARY SUPPORT
TEMPORARY DECLINE
GENERAL ARRANGEMENT - PLAN

STATUS: WORK IN PROGRESS | SHEET 1 OF 1 | ©

DRG No. SMWSTETP-JCG-SCB-SN100-GE-DRG-280050 | REV. C

Attachment B – Detailed Noise and Vibration Technical Assessment

RENZO TONIN & ASSOCIATES
inspired to achieve

Acoustics
Vibration
Structural Dynamics

SYDNEY METRO WEST STAGE 2 (THE BAYS TO SYDNEY CBD)

Noise and Vibration Consistency Assessment - Hunter Street Decline

27 February 2023

John Holland CPB Contractors Ghella JV

TM372-02-1-07F02 SMW-ETP_NVCA-Hunter (r2)

40 YEARS 1982-2022 ACOUSTIC ENGINEERING EXCELLENCE

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Document details

Detail	Reference
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Prepared for:	John Holland CPB Contractors Ghella JV
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Attention:	Sally Reynolds

Document control

Date	Revision history	Non-issued revision	Issued revision	Prepared	Instructed	Reviewed / Authorised
19.01.2023	Initial issue	0	1	T. Gowen	-	M. Tabacchi
20.01.2023	Minor edits (JCG review)	-	2	T. Gowen	-	M. Tabacchi
22.02.2023	Update for WCAG	-	3	T. Gowen	-	M. Tabacchi

File Path: R:\AssocSydProjects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkge\1 Docs\07 CONSISTENCY\TM372-02-1-07F02 SMW-ETP_NVCA-Hunter (r2).docx

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1 Introduction

1.1 Overview

The proposed major civil construction work between The Bays and Sydney CBD (the approved project) was determined on 24 August 2022. The scope of the approved project is described in Chapter 5 of Sydney Metro West Environmental Impact Statement – Major civil construction between The Bays and Sydney CBD (the EIS) and would include the following:

- Enabling work such as demolition, utility supply to construction sites, utility adjustments, and modifications to the existing transport network
- Tunnel excavation including tunnel support activities
- Station excavation for new metro stations at Pyrmont and at Hunter Street, in the Sydney CBD.

The potential noise and vibration impacts from the approved project were assessed in Technical Paper 2 (Noise and Vibration) of the Sydney Metro West Stage 2 Environmental Impact Statement –Major civil construction between The Bays and Sydney CBD.

1.2 The proposed change

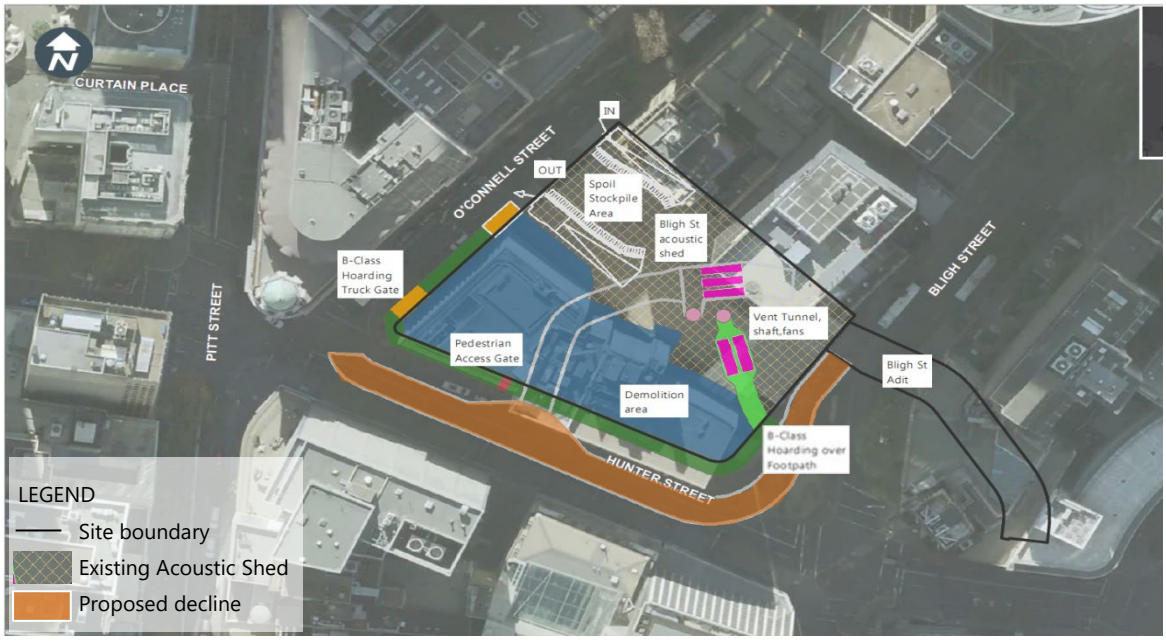
The proposed change involves replacing the temporary access shaft and mined adit at the Hunter Street East site with a mined temporary decline tunnel under Bligh Street and Hunter Street. The proposed decline would commence from the existing decline tunnel constructed between the Hunter Street East site and Martin Place North as part of the Sydney Metro City and South West tunnelling project, travel underneath Bligh Street and Hunter Street, providing access to the cavern from the southern side. The location of the proposed decline tunnel is shown in Figure 1.

All tunnel excavation works would the supported from within the existing acoustic shed at Hunter Street East, consistent with the tunnel excavation works for the Hunter Street Station cavern, turnback caverns and stub tunnels. The following aspects are generally unchanged from the approved project and are not expected to change the predicted noise and vibration impacts from the approved project:

- Peak hourly and daily truck numbers.
- The construction methodology (including construction plant and equipment, working hours and duration of work)
- Surface tunnelling support activity, which will be consistent with the activities undertaken for the Hunter Street Station cavern.

This memorandum provides a technical review of the potential ground-borne noise and vibration impacts associated with the proposed change to excavate a decline tunnel to access the Hunter Street cavern.

Figure 1: Hunter Street East worksite



2 Construction guidelines

This assessment applies the same guidelines and criteria as the assessment of the approved project. The guidelines are detailed in Technical Paper 2 (Noise and Vibration) of the Sydney Metro West Stage 2 Environmental Impact Statement –Major civil construction between The Bays and Sydney CBD [4], and are summarised in Table 2.1.

Table 2.1: Summary of construction noise and vibration objectives

Impact	Relevant guideline	Construction noise/ vibration objective
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.1 of APPENDIX B. For residential receivers: • *Daytime $L_{Aeq(15minute)}$ 45 dB(A)** • Evening $L_{Aeq(15minute)}$ 40 dB(A) • Night-time $L_{Aeq(15minute)}$ 35 dB(A) Note: * Human comfort vibration limit applies during the day. NML used as screening guideline.
Vibration – disturbance to building occupants	NSW 'Environmental Noise Management Assessing Vibration: A Technical Guideline' (AVTG) [9] 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, schools, educational institutions and places of worship - 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 2.3.1 of the CNVS and Section 2.4 of the AVTG.
Vibration – structural damage to buildings	British Standard BS 7385-2:1993 'Evaluation and measurement for vibration in buildings'[13] German Standard DIN 4150-3: 2016-12, Structural vibration - Effects of vibration on structures [14] CNVS [1]	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): • 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.

3 Methodology

Assessment of ground-borne noise and vibration impacts from the construction works were determined by predicting noise levels using a 3-dimensional model of the temporary decline tunnel and surrounding noise and vibration sensitive receivers developed for the Project. The model incorporates the ground-borne noise levels versus distance prediction curve algorithms for each plant item, developed from measurement data obtained from various Sydney projects. This was compared to the predicted ground-borne noise and vibration impacts from the EIS excavation of the shafts, caverns, turnback tunnels and mainline tunnel.

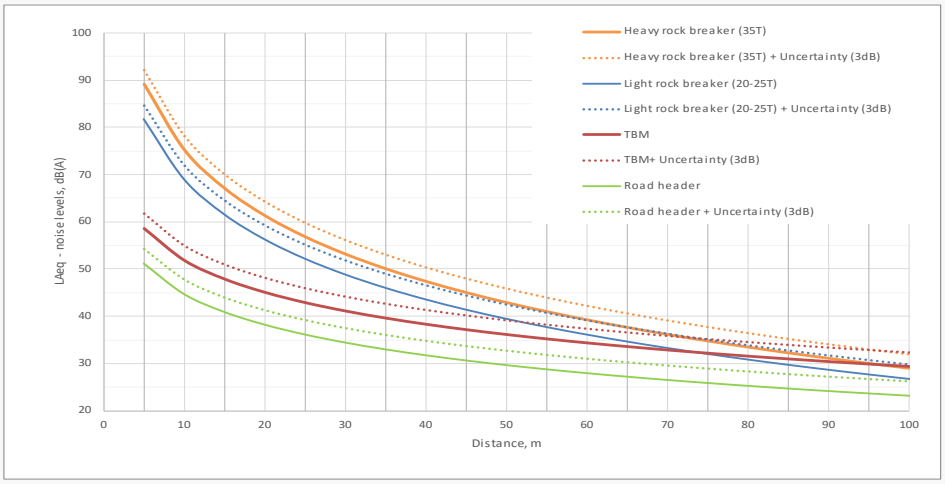
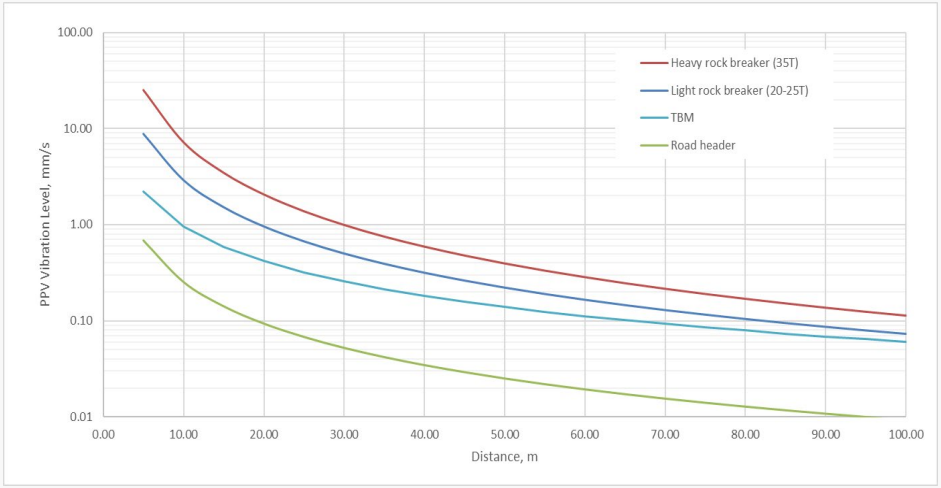
Key details regarding the construction work methodology, the likely plant and equipment, and hours of operation were informed by the JCG Design and Construction Teams. The ground-borne noise and vibration predictions in this report represent a realistic worst-case scenario when excavation occurs at the closest location to residences and other sensitive receivers. At each receiver, ground-borne noise and vibration will vary during the construction period based on:

- the position of equipment within the crossover cavern/ tunnel alignment and distance to the receiver;
- construction methodology/ plant items and equipment in use.

A summary of the noise and vibration model input parameters is detailed in Table 3.1.

Table 3.1: Summary of noise and vibration modelling parameters

Parameters	Inputs
Calculation method	Empirical model using ground-borne noise levels versus distance prediction curve algorithms (Figure 2 and Figure 3). Distances between the excavation works and nearby buildings was calculated as the 3-dimensional slant distance from the closest edge of the buildings to the tunnel crown. The decline tunnel excavation area is clearly identified in Figure 1 and on the drawings in APPENDIX C and APPENDIX D.
Location of ground-borne noise sources	3D decline tunnel information was provided by JCG based on SMWSTETP-WPS-SCB-ST100-TU-SKE-357110 drawing with offset to the tunnel crown.
Excavation methodology	The Hunter Street decline is mostly in hard ground/ rock (i.e. Hawksbury sandstone) and would be excavated using 1 roadheaders at once and installation of ground support, including rock bolting and shotcrete Ground-borne noise and vibration of the TBM excavation of the EIS tunnel alignment and the Hunter Street east shaft excavation by rockhammer was based on the assumptions used in the EIS (Section 4.2 of Technical Paper 2: Noise and Vibration [4]).
Height of receivers	Ground-borne noise levels are calculated on the ground floor level within each building. Assumed 2 dB loss for every additional floor assessed.
Ground topography	1m digital ground contours
Ground-borne noise sources:	Algorithms based on measurement data obtained from Sydney Metro City & South-West (TSE), Sydney Metro North-West (NWRL), WestConnex Rozelle Interchange (WCX3B), WestConnex M8 (M5N), WestConnex M4East (M4E), Cross City Tunnel (CCT), Lane Cove Tunnel (LCT), Epping to Chatswood Rail Link (ECRL). See Figure 2.

Parameters	Inputs
Ground-borne noise sources:	**Figure 2: Indicative Ground-borne Noise Levels from Tunnelling**  Source: GBN from Sydney tunnel projects, including TSE, WCX3B, M5N, M4E, CCT, LCT, ECRL, and NWRL Extensive ground-borne noise and vibration verification monitoring on Sydney tunnelling projects has found that ground-borne noise from rock anchor drilling is typically below the ground-borne noise level for roadheading. Therefore, the roadheader curve above covers all roadheader tunnelling stages (i.e. including installation of support).
Engineering margin	The ground-borne noise predictions are based on typical geology for the area, comprising Sydney sandstone with a varying depth of shale above. However due to localised geological anomalies, foundation-to-footing interaction and the large range and variety of structures that exist (e.g. construction type, dimensions, materials, quality of construction, footing conditions etc) actual GBN levels may vary significantly to what has been predicted herein. A 3 dB(A) engineering margin has been applied to all GBN level predictions. Verification measurements shall be undertaken at the first opportunity to verify the models.
Ground-borne vibration sources:	**Figure 3: Indicative Ground-borne Vibration Levels from Tunnelling**  Source: GBV from Sydney tunnel projects, including TSE, WCX3B, M5N, M4E, CCT, LCT, ECRL, and NWRL

Predicted ground-borne noise and vibration levels presented in Section 10 are the maximum levels for each building. Actual levels will often be less than the predicted levels presented in this report.

4 Ground-borne noise and vibration impacts

4.1 Ground-borne noise impacts

Ground-borne noise impacts from the proposed decline excavation by roadheader have been predicted and compared to the ground-borne noise management levels (GNMLs). A receiver is considered construction noise affected when the predicted construction noise level is above the NML. Predicted impacts from the EIS design, based on the TBM excavation of the tunnel alignment and the Hunter Street shaft excavation by rockhammer are also presented to compare with GBN impacts from the decline excavation for the purpose of assessing consistency with the EIS.

Table 4.2 and Table 4.3 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 GBNML and the corresponding perceived noise impact, based on the CNVS, as noted in Table 4.1.

Table 4.1: Key to the predicted construction ground-noise results tables

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)	>20 dB(A) above NML (orange)

Table 4.2 summarises the number of construction noise affected residential receivers (i.e. receivers where predicted L_{Aeq} noise levels construction works are above the GBNML). Table 4.3 presents the number of construction noise affected other sensitive receivers. Figures showing ground-borne noise impacts are provided in APPENDIX C.

Table 4.2: Number of residential receiver buildings over the GBN management level (all NCAs)

Construction activity	Day (standard hours)			Day (outside standard hours)			Evening			Night		
	L_{Aeq}			L_{Aeq}			L_{Aeq}			L_{Aeq}		
	1 – 10 dB(A)	11 – 20 dB(A)	21-30 dB(A)	1 – 10 dB(A)	11 – 20 dB(A)	21-30 dB(A)	1 – 10 dB(A)	11 – 20 dB(A)	21-30 dB(A)	1 – 10 dB(A)	11 – 20 dB(A)	21-30 dB(A)
Roadheader excavation of decline tunnel (Proposed change)	0	0	0	0	0	0	0	0	0	0	0	0
TBM excavation of main alignment (EIS)	0	0	0	0	0	0	0	0	0	0	0	0
Rockhammer excavation of Hunter Street East shaft (EIS)	0	0	1	0	0	1	0	0	1	0	0	1

Notes: Day (Standard) 7 am to 6 pm Monday to Friday and 8 am to 6 pm Saturday; Day (outside standard hours) Sunday 8 am to 6 pm Sunday and Public holidays - OOHW P1; Evening 6 pm to 10 pm Monday to Sunday - OOHW P1; Night 10 pm to 7 am Monday to Friday, and 10 pm am to 8 am Saturday, Sunday and Public holidays - OOHW P2.

Table 4.3: Number of other sensitive receivers over the GBN management levels (all NCAs)

Construction activity	Commercial			Hotel/Motel/ Hostel			Childcare			Other		
	L_{Aeq}			L_{Aeq}			L_{Aeq}			L_{Aeq}		
	1 – 10 dB(A)	11 – 20 dB(A)	21-30 dB(A)	1 – 10 dB(A)	11 – 20 dB(A)	21-30 dB(A)	1 – 10 dB(A)	11 – 20 dB(A)	21-30 dB(A)	1 – 10 dB(A)	11 – 20 dB(A)	21-30 dB(A)
Roadheader excavation of decline tunnel (Proposed change)	0	0	0	0	0	0	0	0	0	0	0	0
TBM excavation of main alignment (EIS)	1	0	0	1	0	0	0	0	0	0	0	0
Rockhammer excavation of Hunter Street East shaft (EIS)	6	1	2	1	0	0	0	0	0	0	0	0

Note: 1. Commercial, industrial and other sensitive receivers have been assessed against the respective GBNMLs, and exceedances have been presented in the count table. In the table above 'other' includes educational facilities, places of worship etc as identified in the land use survey and sensitive receiver types in Figure B.1 in APPENDIX B

2. Impacts only applicable when facility is in use.

4.1.1 Standard construction hours

Daytime ground-borne NMLs do not apply during the day period as the objectives are to protect the amenity and sleep of people when they are at home. A daytime GB NML of 45dB(A) was applied as a screening level in the EIS, taken from preceding Sydney Metro planning applications for consistency.

The results summarised in Table 4.2 and Table 4.3 show that predicted GBN levels resulting from the decline excavation are below the daytime GB NML for all receivers. The predicted impacts are consistent with the EIS impacts from the TBM excavation of the mainline tunnel section at Hunter Street East and below the predicted GBN impacts from the Hunter Street East shaft excavation by rockhammer.

The predicted standard hours GBN impacts from the proposed Hunter Street East decline tunnel are consistent with the EIS.

4.1.2 Out of hours work

The results summarised in Table 4.2 and Table 4.3 show that predicted GBN levels resulting from the decline excavation are below the evening and night time GB NML for all receivers. The predicted impacts are consistent with the EIS impacts from the TBM excavation of the mainline tunnel section at Hunter Street East and below the predicted GBN impacts from the Hunter Street East shaft excavation by rockhammer.

The predicted out of hours GBN impacts from the proposed Hunter Street East decline tunnel are consistent with the EIS.

4.2 Vibration impacts

The numbers of buildings which are likely to be vibration impacted are shown in Table 4.4. More detailed results are provided in APPENDIX D, which presents the vibration impact for nearby receivers over aerial photographs that also show the work areas and the land uses.

Table 4.4: Number of buildings within minimum working distances for vibration impact

	Number of buildings above vibration impact screening level		
	Decline tunnel (roadheader) – Proposed change	**EIS main alignment (TBM)**	**EIS Hunter Street East shaft (rockhammer)**
Structural damage to buildings			
Reinforced or frame structures (Line 1)[1]	0	0	2
Screening criteria - non-heritage structures[1, 2]	0	0	0
Screening criteria - heritage structures[1, 2]	0	0	0
Disturbance to building occupants			
Critical areas[2]	0	0	0
Residences - Day	0	1[6]	1[6]
Residences - Night	0	1[6]	1[6]
Offices[4]	0	0	2
Workshops	0	0	0

Notes: 1. Site inspection should determine structural conditions of all potentially vibration affected buildings
2. Examples include hospital operating theatres and precision laboratories where sensitive operations are occurring.
3. Daytime is 7 am to 10 pm; Night-time is 10 pm to 7am.
4. Examples include offices, schools, educational institutions, and place of worship.
5. Applicable when in use.
6. Residential initial screening test values applied to Hotel

4.2.1 Structural damage

The predicted vibration levels for nearby sensitive receivers are expected to be below the corresponding vibration criteria for structural damage. As a result, the risk of structural damage is considered low during the decline tunnel excavation. This is consistent with the predicted vibration impacts from the TBM excavation of the main tunnel alignment assessed in the EIS and below the predicted vibration impacts from the Hunter Street East shaft excavation by rockhammer.

The predicted structural damage impacts from the proposed Hunter Street East decline tunnel are consistent with the EIS.

4.2.2 Heritage structures at Hunter Street East

No heritage structures are expected to be above the vibration screening limit for cosmetic damage during the Hunter Street East decline tunnel. This is consistent with the predicted vibration impacts on heritage structures from the TBM excavation of the main tunnel alignment and the Hunter Street East shaft excavation by rockhammer assessed in the EIS.

4.2.3 Human annoyance

As can be noted from Table 4.4, predicted vibration levels for the decline tunnel excavation to all nearby properties are below the screening limit for human annoyance. As a result, the probability of adverse comment caused by tunnelling induced vibration is considered low during the Hunter Street East decline tunnel. This is consistent with the predicted vibration impacts from the TBM excavation of the main tunnel alignment assessed in the EIS and below the predicted vibration impacts from the Hunter Street East shaft excavation by rockhammer.

The predicted human annoyance impacts from the proposed Hunter Street East decline tunnel are consistent with the EIS.

5 Management of impacts

5.1 Revised Environmental Mitigation Measures

The EIS, Technical Paper 2 [4] and Submissions Report established project specific construction noise and vibration mitigation measures to reduce noise and vibration impact from the project. These are summarised in Table 5.1, including reference to how the measure applies to the proposed change assessed in this report.

Table 5.1: Revised Environmental Mitigation Measures

No.	Requirement	Reference
NV01	Community preference for noise mitigation and management Where justified by the application of the Construction Noise and Vibration Standard, further engagement and consultation would be carried out in accordance with the Sydney Metro Overarching Community Communications Strategy with: • The affected communities to understand their preferences for mitigation and management measures. • 'Other sensitive' receivers such as schools, medical facilities, theatres, or places of worship to understand periods in which they are more sensitive to impacts. Based on this consultation, appropriate mitigation and management options would be considered and implemented where feasible and reasonable to minimise the impacts.	Not required for decline excavation (see Section 4.1 and Section 4.2). Engagement and consultation details, where applicable, will be presented in DNVISs for Hunter Street and for tunnelling prepared during design phase.
NV02	Alternative construction methodologies Alternative construction methodologies and measures that minimise noise and vibration levels during noise intensive work would be investigated and implemented where feasible and reasonable. This would include consideration of: • The use of hydraulic concrete shears in lieu of hammers/rock breakers • Sequencing work to shield noise sensitive receivers by retaining building wall elements • Locating demolition load out areas away from the nearby noise sensitive receivers • Providing respite periods to minimise impacts from prolonged periods of noise intensive work • Minimising structural-borne noise to adjacent buildings including separating the structural connection prior to demolition through saw-cutting and propping, using hand held splitters and pulverisers or hand demolition • Installing sound barrier screening to scaffolding facing noise sensitive neighbours • Using portable noise barriers around particularly noisy equipment, such as concrete saws • Modifying demolition work sequencing/hours to minimise impacts during peak pedestrian times and/or adjoining neighbour outdoor activity periods.	See Table 5.2.
NV03	Construction noise – respite periods Appropriate respite would be provided to affected receivers in accordance with the Sydney Metro Construction Noise and Vibration Standard. This would include consideration of impacts from utility and power supply work when determining appropriate respite periods for affected receivers. When determining appropriate respite, the need to efficiently undertake construction would be balanced against the communities' preferred noise and vibration management approach.	Not required for decline excavation. Respite periods, where applicable, will be outlined in DNVISs for Hunter Street and for tunnelling.

No.	Requirement	Reference
NV04	Construction noise – out of hours work The use of noise intensive equipment at construction sites with 'moderate' and 'high' out of hours noise management level exceedances would be scheduled for standard construction hours, where feasible and reasonable. Where this is not feasible and reasonable, the work would be undertaken as early as possible in each work shift.	N/A to decline excavation. See Table 5.2
NV05	Night-time noise impacts Where practicable, air brake silencers would be used on heavy vehicles that access construction sites multiple times per night or over multiple nights.	N/A
NV06	Night-time noise impacts Perimeter site hoarding would be designed with consideration of on-site heavy vehicle movements with the aim of minimising sleep disturbance impacts.	N/A
NV07	Noise emissions from equipment Long term construction site support equipment and machinery would be low noise emitting and suitable for use in residential areas, where feasible and reasonable. Examples include: Low noise water pumps for use in water treatment facilities Low noise generators and compressors Low noise air conditioner units for use of amenities buildings.	N/A
NV08	Acoustic sheds Where acoustic sheds are installed, the internal lining and construction materials would be determined during later design stages to ensure appropriate attenuation is provided. This design of sheds would likely include the following considerations: All significant noise producing equipment that would be used during the night-time would be inside the shed, where feasible and reasonable Noise generating ventilation systems such as compressors, scrubbers, etc, would also be inside the shed and external air intake/discharge ports would be appropriately acoustically treated Acoustic shed doors would be kept closed during the night-time period, where feasible and reasonable. Where night-time vehicle access is required, the doors would be designed and constructed to minimise noise breakout.	N/A Note that the existing acoustic shed would be utilised for the decline excavation (consistent with EIS)
NV09	Ground-borne noise Feasible and reasonable measures would be implemented to minimise ground-borne noise where exceedances are predicted. This may require implementation of less ground-borne noise and less vibration intensive alternative construction methodologies.	See Table 5.2
NV10	Ground-borne noise – cross passages The proximity of cross passages to nearby receivers and the corresponding construction ground-borne noise and vibration impacts during the excavation work would be considered when determining locations. Relocation of cross passages to be further away from sensitive receivers to mitigate potential construction impacts would be considered, where feasible and reasonable.	N/A
NV11	Ground-borne noise – underground rockbreaking Activity specific Detailed and/or General Noise and Vibration Impact Statement (in accordance with the requirements of the Construction Noise and Vibration Standard) would be developed for rockbreaking in the tunnel and at cross passages, specifically addressing the activity where it is required between 22:00 - 07:00.	N/A

No.	Requirement	Reference
NV12	Construction traffic noise Further assessment of construction traffic would be completed during detailed design, including consideration of the potential for exceedances of the NSW Road Noise Policy base criteria (where greater than two dB increases are predicted). The potential impacts would be managed using the following approaches, where feasible and reasonable: • On-site spoil storage capacity would be maximised to reduce the need for truck movements during sensitive times • Vehicle movements would be redirected away from sensitive receiver areas and scheduled during less sensitive times • The speed of vehicles would be limited, and the use of engine compression brakes would be avoided • Heavy vehicles would not be permitted to idle near sensitive receivers.	N/A
NV13	Construction vibration Where vibration levels are predicted to exceed the screening criteria, a more detailed assessment of the structure (in consultation with a structural engineer) and vibration monitoring would be carried out to ensure vibration levels remain below appropriate limits for that structure. For heritage items, the more detailed assessment would specifically consider the heritage values of the structure in consultation with a heritage specialist to ensure sensitive heritage fabric is adequately monitored and managed.	No vibration impact predicted for decline excavation – see Section 4.2
NV14	Building condition surveys – construction vibration Condition surveys of buildings and structures near to the tunnel and excavations would be undertaken prior to the commencement of excavation at each site, where appropriate. For heritage buildings and structures the surveys would consider the heritage values of the structure in consultation with a heritage specialist.	No vibration impact predicted for decline excavation – see Section 4.2
NV15	Cumulative construction noise impacts The likelihood of cumulative construction noise impacts would be reviewed during detailed design when detailed construction schedules are available. Co-ordination would occur between potentially interacting projects to minimise concurrent or consecutive work in the same areas, where possible. Specific mitigation strategies would be developed to manage impacts. Depending on the nature of the impact, this could involve adjustments to construction program or activities of Sydney Metro West or of other construction projects.	Cumulative construction noise impacts with be addressed in the DNVIS.

5.2 Consultation with affected receivers

Sydney Metro and JCG have commenced consultation with potentially affected stakeholders including business and residential receivers. The consultation will include specific mitigation and management measures applicable to the tunnelling works at Hunter Street. A summary of the consultation program is provided below:

- Project-wide consultation with relevant community members to discuss site establishment, utility and early tunnelling works, including ground-borne noise and vibration impacts. These sessions will continue as the Project progresses.
- Consultation with noise and vibration affected receivers identified in APPENDIX C and APPENDIX D to ensure additional mitigation measures are provided (if required, receivers will be identified in the DNVIS).
- Engagement with residents within 50 metres of tunnel alignment or worksites to discuss design process, shaft depths, tunnel alignment, settlement, groundwater movement, construction

methods and timeline, noise and vibration, monitoring requirements, site layout, haulage routes, property damage and air quality.

Following community consultation, JCG will endeavour to provide one month's notice for any 24-hour tunnel excavation. JCG is committed to undertake noise and vibration monitoring proactively and in response to complaints.

5.3 Noise and vibration control and management measures

Mitigation and management measures to reduce potential ground-borne noise and vibration impacts will be implemented during tunnelling works, where reasonable and feasible. In accordance with the ICNG and consistent with the CNVS, feasible 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 mitigation measures are those feasible mitigation measures that are considered reasonable, based on a judgement that the overall benefits outweigh the overall adverse social economic and environmental effects. To make such a judgement, consideration is to be given to the level of impact, mitigation benefits, cost effectiveness of mitigation and community views.

Table 5.2 outlines site noise and vibration control measures that would be implemented on site during the preliminary works, where feasible and reasonable.

Table 5.2: Ground-borne noise and vibration control measures

Control measure	Description of the control measure	Feasible mitigation test	Deemed feasible?	Reasonable mitigation test	Deemed reasonable?	Adopted?	Justification and commentary
Construction Planning							
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		Yes	Yes	Updates to the CEMP will be carried out where required and will be reviewed regularly.
Community consultation	Disseminate information to community of construction activity and potential impacts. Inform community that - GBN may be audible at times and will be managed to meet the CNVS - The level at which people perceive vibration, or at which loose objects may rattle, is far lower than the level at which minor cosmetic damage is likely 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.
Building condition surveys	Undertake building dilapidation surveys on all buildings identified as above the screening limit for cosmetic damage (see APPENDIX D) prior to commencement of tunnel excavation.	Yes	Yes	Deemed to be cost effective. Outweighs the identified social, economic and environmental effects.	Yes	Yes	No buildings are identified as above the screening limit for cosmetic damage.
At source control measures							
Timing of equipment in use	Where practicable, activities and plant will be scheduled/limited.	This measure could be feasibly implemented. Timing and location of cavern excavation works planned to manage the potential impacts to the nearest receivers.	Yes	- Sufficient noise reduction could be achieved at enough receivers. - Deemed to be cost effective. - Outweighs the identified social, economic and environmental effects. - Noise benefit varies depending on excavation location within cavern	Yes	Yes	24-hour tunnel excavation would be managed to reduce noise levels towards the GNML, where feasible and reasonable.
Equipment selection	Use quieter and less noise/vibration emitting construction methods where feasible and reasonable. Roadheading (instead of rockhammer excavation) will be adopted for crossover cavern heading and bench excavation to reduce ground-borne noise levels to sensitive receivers.	This measure could be feasibly implemented.	Yes	- Potential benefit of 10-20 dB(A). - 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 shall review plant and equipment on a case-by-case basis and find opportunities to use items with lower noise/vibration impacts.

Control measure	Description of the control measure	Feasible mitigation test	Deemed feasible?	Reasonable mitigation test	Deemed reasonable?	Adopted?	Justification and commentary
Noise management measures							
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. hotels, childcare centres).
Alternative construction methodology	Alternative construction methodologies and measures that minimise noise and vibration levels during noise intensive work would be investigated and implemented where feasible and reasonable. This would include consideration of: • Use of roadheader (instead of rockhammer) to excavate crossover cavern to reduce ground-borne noise and vibration.	This measure could be feasibly implemented.	Yes	- Potential benefit of >5-10 dB(A). - Sufficient noise reduction could be achieved at enough receivers.	Yes	Yes	Roadheader to be adopted for excavation of decline in lieu of rockhammer to reduce ground-borne noise and vibration impact to sensitive receivers to within requirements in Table 2.1.
Noise/ vibration monitoring	Noise and/or vibration monitoring to be conducted at key locations to quantify impacts at sensitive receivers to verify predicted noise and vibration levels and ensure impacts are adequately managed.	This measure could be feasibly implemented.	Yes		Yes	Yes	Noise and vibration monitoring shall be carried out as detailed in the DNVIS prepared for the works and the Noise and Vibration Monitoring Program.
Implement additional mitigation measures	Identify and implement additional mitigation measures outlined in this assessment.	This measure could be feasibly implemented.	Yes		Yes	Yes	Additional mitigation measures to be identified on a case-by-case basis as outlined in Section 5.4.

5.4 Additional management 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), the ground-borne noise and/ or vibration levels are still predicted to exceed the limits established in Table 2.1, additional management measures can be applied to further limit the risk of annoyance from construction noise and vibration. The CNVS suggests the Project should consider implementing additional management 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.

5.4.1 Additional ground-borne noise management measures

The steps to be carried out to determine the additional ground-borne management measures to be Implemented are identified in Figure 5.1.

Figure 5.1: Additional ground-borne noise management measures

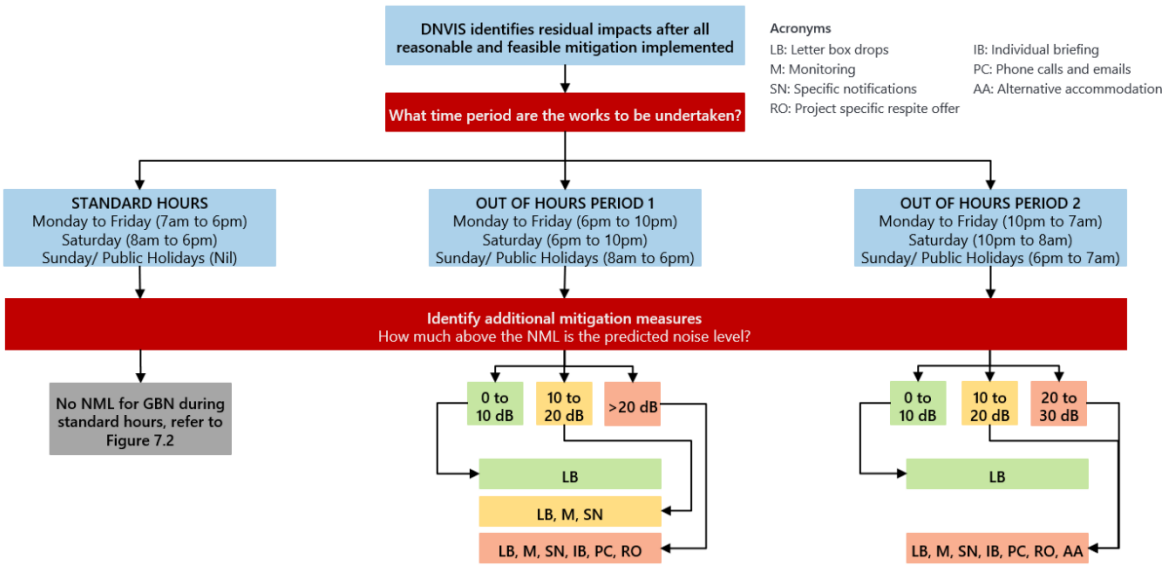


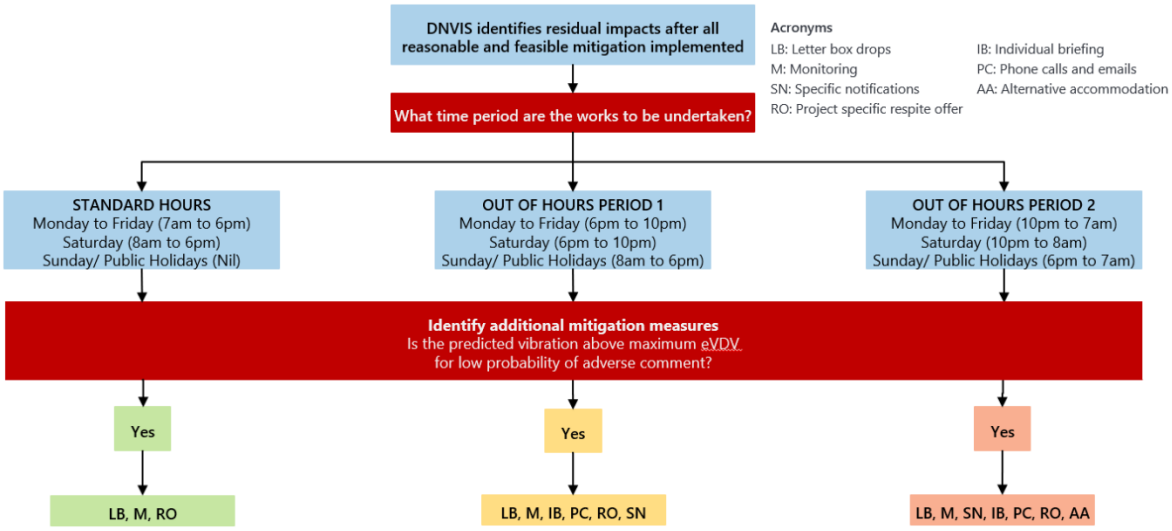
Figure 5.1 presents a summary of the additional management measures applicable for construction activities where, after application of all reasonable and feasible mitigation options, ground-borne noise levels are still above the NMLs.

Receivers will be identified in the DNVIS. 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 5.5.1).

5.4.2 Additional vibration mitigation measures

After applying all feasible and reasonable mitigation measures identified in Table 5.2, if vibration monitoring at representative locations still exceeds relevant vibration objectives for human annoyance, the appropriate additional management measures, based on the CNVS [1], presented in Figure 5.2, should be provided.

Figure 5.2: Additional vibration mitigation measures



5.5 Attended or unattended noise and vibration monitoring

Noise and vibration monitoring would be conducted during tunnelling excavation works at the first available locations, subject to landowner and tenant consent. The monitoring locations would be identified in the DNVIS prepared for the works, based on the most suitable locations near the tunnel alignment to collect a representative sample of measurements required to validate the models.

Monitoring would be undertaken by trained personnel, familiar with the relevant standards and should follow the procedures outlined in the Noise and Vibration Monitoring Program required by Condition of Approval C14 and the CNVS.

5.5.1 Complaints handling

Noise and/or vibration complaints received and responded to will be managed in accordance with the JCG Community Communication Strategy prepared under Condition D52 and the Overarching Community Communications Strategy.

Sydney Metro operate a 24-hour construction complaints line. Enquiries/ complaints may also be received through the project email mailbox (sydneymetrowest@transport.nsw.gov.au) or through the complaints hotline (1800 612 173).

6 Conclusion

In conclusion, the proposed replacement of the temporary access shaft and mined adit at the Hunter Street East site with mined a temporary decline tunnel under Bligh Street and Hunter Street has been reviewed and assessed against the construction noise and vibration objectives established in the EIS and compared to the impacts presented in the EIS.

Construction ground-borne noise

The predicted impacts from the Hunter Street East decline tunnel excavation with road headers are consistent with the EIS impacts from the TBM excavation of the mainline tunnel section at Hunter Street East and below the predicted GBN impacts from the Hunter Street East shaft excavation by rockhammer.

Recommendations provided to manage impacts are consistent with the EIS, the Revised Environmental Management Measures identified in the Submissions Report and the Conditions of Approval.

Construction ground-borne vibration

The predicted vibration impacts from the proposed mined decline tunnel at Hunter Street East are below the corresponding vibration criteria for structural damage. Furthermore, no heritage structures are predicted to be above the vibration screening limit for cosmetic damage during the Hunter Street East decline tunnel. As a result, the risk of structural damage is considered low during the decline tunnel excavation. This is consistent with the predicted vibration impacts from the TBM excavation of the main tunnel alignment assessed in the EIS and below the predicted vibration impacts from the Hunter Street East shaft excavation by rockhammer.

The predicted vibration levels for the decline tunnel excavation to all nearby properties are below the screening limit for human annoyance. As a result, the probability of adverse comment caused by tunnelling induced vibration is considered low during the Hunter Street East decline tunnel. This is consistent with the predicted vibration impacts from the TBM excavation of the main tunnel alignment assessed in the EIS and below the predicted vibration impacts from the Hunter Street East shaft excavation by rockhammer.

Recommendations provided to manage impacts are consistent with the EIS, the Revised Environmental Management Measures identified in the Submissions Report and the Conditions of Approval.

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 West Out-of-hours Work Protocol (in progress)

[4] SLR Consulting Australia Pty Ltd 2021 Sydney Metro West - Major civil construction between The Bays and Sydney CBD - Technical Paper 2: Noise and Vibration October 2020

[5] Sydney Metro 2022 Sydney Metro West – Submissions Report - Major civil construction between The Bays and Sydney CBD

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

[7] Environment Protection Authority 2017 NSW Noise Policy for Industry (NPfI)

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

[9] Department of Environment Conservation NSW 2006 Assessing Vibration; a technical guideline

[10] Environment Protection Authority 2000 NSW Industrial Noise Policy (INP)

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

[12] Australian Standard AS 2187.2-2006 Explosives - Storage and Use - Use of Explosives

[13] British Standard BS 7385 Part2-1993, Evaluation and measurements for vibration in buildings Part 2

[14] German Standard DIN 4150-3: 2016-12, Structural vibration - Effects of vibration on structures, December 2016

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

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

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

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.

APPENDIX B Sensitive receivers and noise management levels

B.1 NCAs and sensitive receiver identification

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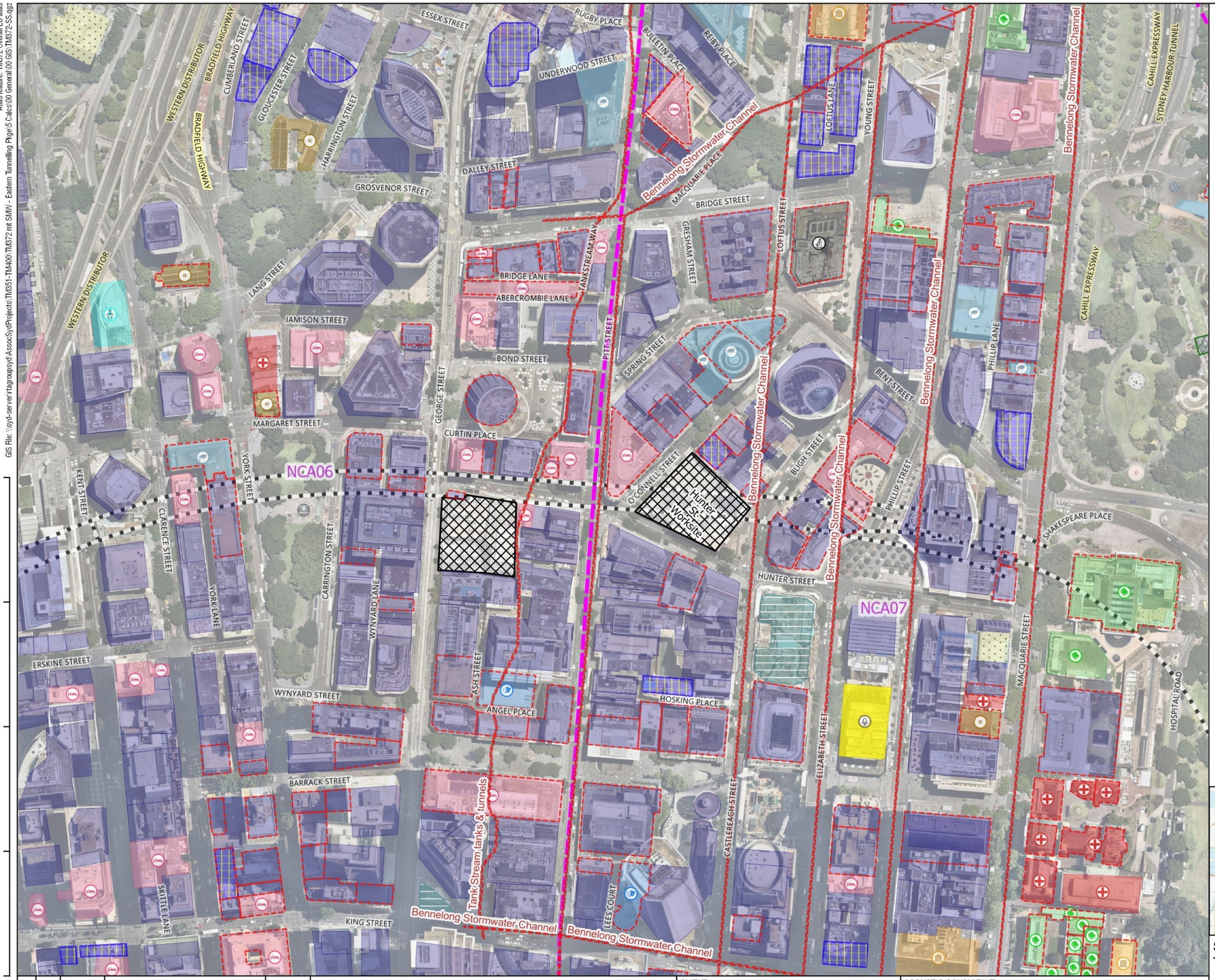

LEGEND

Noise Sensitive Receiver

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

NCA	NML DS	NML DO	NML E	NML N
NCA06	71	66	61	57
NCA07	71	66	61	57

NCA: Noise Catchment Area
NML: Noise Management Level
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

REV	BY	DATE	DESCRIPTION	APPROVER
r4	SS	19/01/23	Updated Landuse	TG
r3	SS	12/12/22	Labeling specific Heritage	TG
r2	SS	23/11/22	OSR Corrections	TG
r1	SS	16/11/22	Update Landuse	TG
r0	SS	23/06/22	Prepare figures	TG

FULL SIZE A3, REDUCED TO A4

0 50 100 150 200 m

1:3,000 At A3

N

CLIENT

JOHN HOLLAND CPB CONTRACTORS Ghella 5 Generations of Tunnellers

ACOUSTIC CONSULTANT

RENZO TONIN & ASSOCIATES
inspired to achieve

SYDNEY METRO WEST – EASTERN TUNNELLING PACKAGE

Landuse, Worksites and NCAs

B.2 NCAs and noise management levels

Table B1: Noise Sensitive Receivers and Construction Noise Management Levels (ground-borne noise)

NCA	Receiver Type	Groundborne NMLs based on ICNG (internal) NMLDS	NMLDO	NMLE	NMLN	MS			Comments
Residential receivers									
All	All residential receivers	(45)*	(45)*	40	35				Source: ICNG
		**Human comfort vibration limit applies during the day. NML used as screening guideline.*							
ICNG 'Other sensitive' receivers (NML applicable when in use)									
Classrooms at schools and other educational institutions		45	45	45	45	45	-	-	Source: ICNG
Hospital wards and operating theatres		45	45	45	45	45	-	-	Source: ICNG
Places of worship		45	45	45	45	45	-	-	Source: ICNG
Commercial premises (including offices and retail outlets)		50	50	50	50	50	-	-	Source: ICNG, assuming a conservative façade loss of 20 dB(A)
Industrial premises		55	55	55	55	55	-	-	Source: ICNG, assuming a conservative façade loss of 20 dB(A)
Non-ICNG 'Other sensitive' receivers (GBNML applicable when in use)									
Hotel - daytime and evening		50	50	50	50	50	-	-	Source: CNVS Section 2.2.1 & AS2107 'maximum'
Hotel - night-time		40	40	40	40	40	-	-	Source: CNVS Section 2.2.1 & AS2107 'maximum'
Café/ Bar/ Restaurant		50	50	50	50	50	-	-	Source: CNVS Section 2.2.1 & AS2107 'maximum'
Childcare centre (indoor sleeping areas)		45	45	45	45	45	-	-	Source: CNVS Section 2.2.1 & AS2107 'maximum'
Childcare centre (play areas)		55	55	55	55	55	-	-	Source: CNVS Section 2.2.1, assuming a conservative façade loss of 10 dB(A)
Public Building		50	50	50	50	50	-	-	Source: CNVS Section 2.2.1 & AS2107 'maximum'
Studio building (music recording studio)		25	25	25	25	25	-	-	Source: CNVS Section 2.2.1 & AS2107 'maximum'
Studio building (film or television studio)		30	30	30	30	30	-	-	Source: CNVS Section 2.2.1 & AS2107 'maximum'
Theatre/ Auditorium		30	30	30	30	30	-	-	Source: CNVS Section 2.2.1 & 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
N: night period from 22:00 to 07:00 Monday to Friday, and from 22:00 to 08:00 Saturday, Sunday and Public holidays - OOHW P2
MS: Morning shoulder from 05:00 to 07:00 Monday to Friday, and from 06:00 to 08:00 Saturday, Sunday and Public holidays - OOHW P2

APPENDIX C Construction ground-borne noise impacts

C.1 Ground-borne noise impacts from roadheader excavation of decline tunnel (Proposed change)

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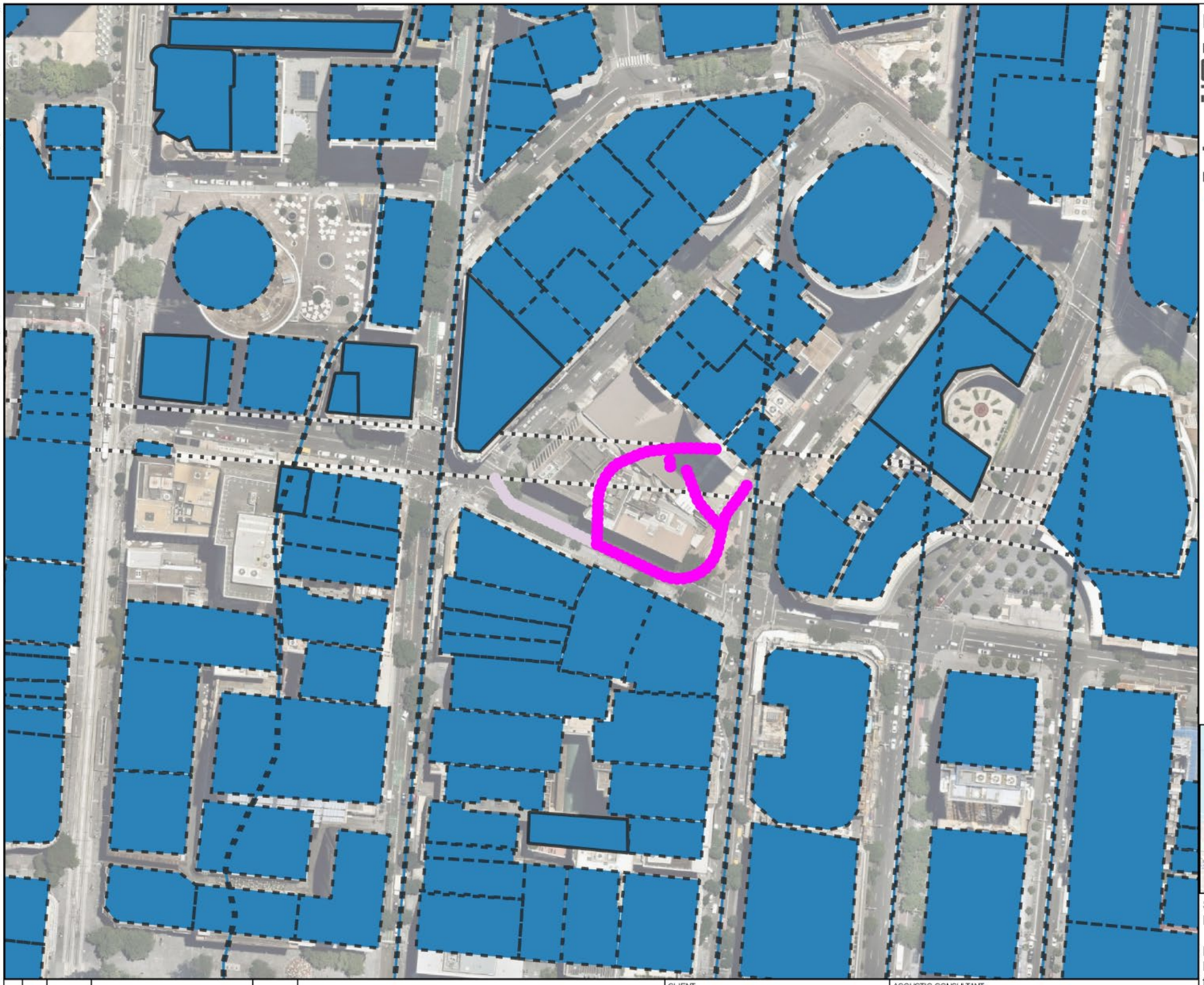


LEGEND

Noise Sensitive Receivers

- Residential / Hotels
- Non-Residential and Non-Hotel

Mainline Tunnel Alignment

Hunter Street East Decline and Ventilation Adits

- Tunnel Section being Assesed (Section excavated with Roadheader)
- Decline and Ventilation Adits

Maximum GBN levels dB(A) during Excavation of Temporary Decline using Roadheader

- < 30
- 30 - 35
- 35 - 40
- 40 - 45
- > 45

REV	BY	DATE	DESCRIPTION	APPROVER
r1	SS	01/12/22	Modify Tunnel Alignment	RZ
r0	SS	22/11/22	Prepare figures	TG/RZ

0 20 40 60 80 100 m

1:1,500 At A3

FULL SIZE A3, REDUCED TO A4

N

CLIENT

JOHN HOLLAND CPB CONTRACTORS Ghella 5 Generations of Tunnellers

ACOUSTIC CONSULTANT

RENZO TONIN & ASSOCIATES

inspired to achieve

SYDNEY METRO WEST
Eastern Tunneling Package

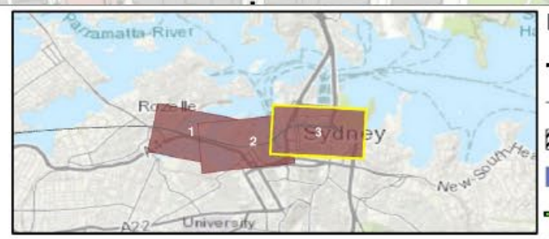
Predicted maximum GBN levels during Preliminary Works at Hunter Street East (within the acoustic shed)

Roadheader excavation of temporary decline and ventilation adit

C.2 Ground-borne noise impacts from TBM excavation of main alignment (EIS)

SLR
2 LINCOLN STREET
LANE COVE
NEW SOUTH WALES 2066
AUSTRALIA
T: 61 2 9427 8100
F: 61 2 9427 8200
www.slrconsulting.com

Project No.:	610.18331
Date:	27-Aug-2021
Drawn by:	ML
Scale:	1:5,000
Sheet Size:	A4
Projection:	GDA2020 MGA Zone 56



Sydney Metro Authority

Sydney Metro West
Stage 2

Worst-case Ground-borne Noise Impacts from TBM Tunnelling All Periods

61018331 GBN Appendix 20210730_P03

C.3 Ground-borne noise impacts from rockhammer excavation of Hunter Street East shaft (EIS)

Figure 28 Predicted Ground-borne Noise Impacts – Daytime

Source: SLR Consulting Australia Pty Ltd 2021 Sydney Metro West - Major civil construction between The Bays and Sydney CBD - Technical Paper 2: Noise and Vibration October 2020

Figure 29 Predicted Ground-borne Noise Impacts – Night-time

Source: SLR Consulting Australia Pty Ltd 2021 Sydney Metro West - Major civil construction between The Bays and Sydney CBD - Technical Paper 2: Noise and Vibration October 2020

APPENDIX D Construction ground-borne vibration impacts

D.1 Vibration impacts from roadheader excavation of decline tunnel (Proposed change)

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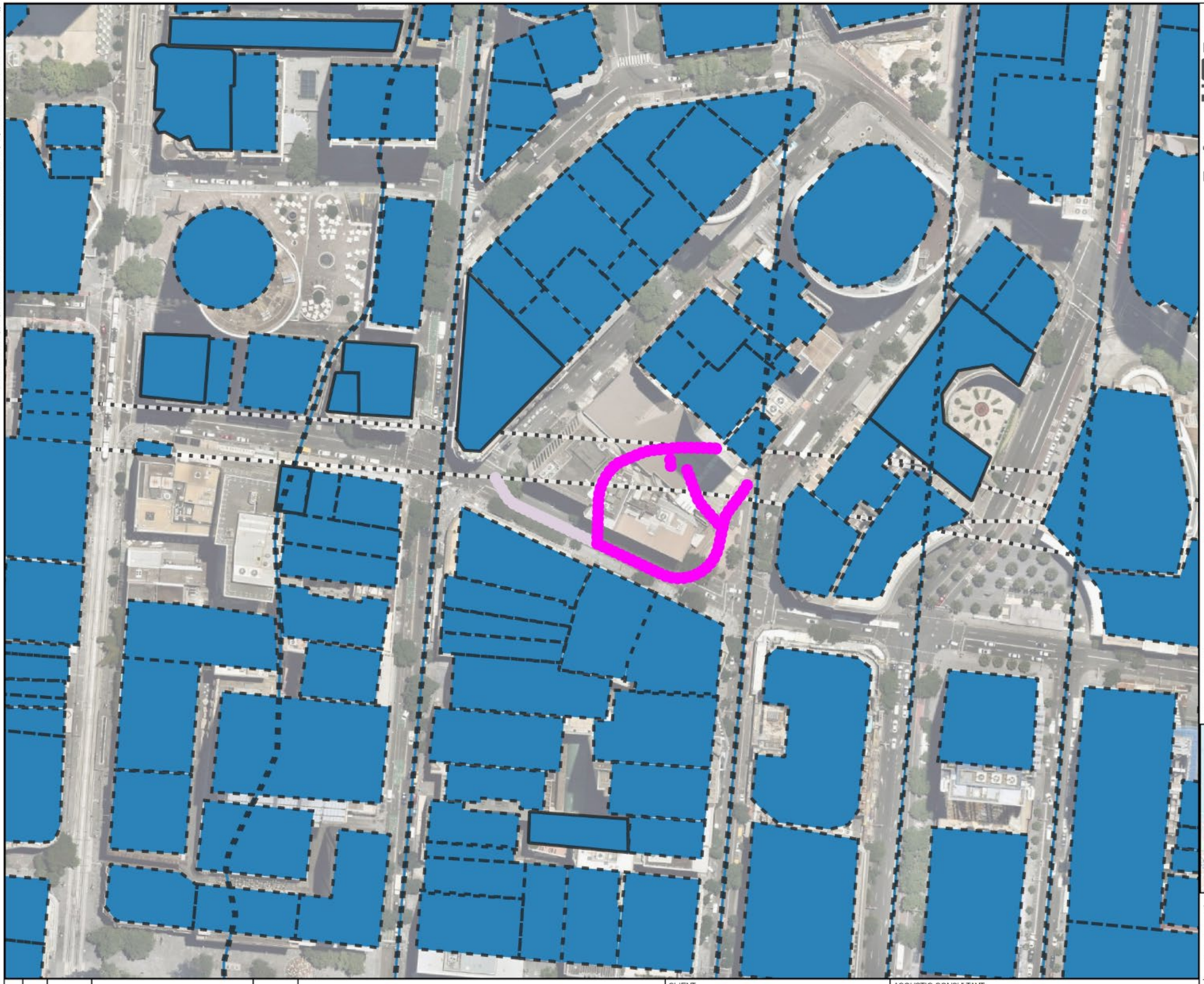


LEGEND

Noise Sensitive Receivers

- Residential / Hotels
- Non-Residential and Non-Hotel
- Mainline Tunnel Alignment

Hunter Street East Decline and Ventilation Adits

- Tunnel Section being Assesed (Section excavated with Roadheader)
- Decline and Ventilation Adits

Maximum GBV levels PPV (mm/s) during Excavation of Temporary Decline using Roadheader

- < 0.28
- 0.28 - 0.4 Critical Working areas (in use)
- 0.4 - 0.56 Residential - Night
- 0.56 - 1.1 Residential - Day
- 1.1 - 2.2 Commercial (in use)
- > 2.2 Industrial (in use)

REV	BY	DATE	DESCRIPTION	APPROVER
r1	SS	01/12/22	Modify Tunnel Alignment	RZ
r0	SS	22/11/22	Prepare figures	TG/RZ

0 20 40 60 80 100 m

1:1,500 At A3

FULL SIZE A3, REDUCED TO A4

CLIENT

JOHN HOLLAND CPB CONTRACTORS Ghella 5 Generations of Tunnelers

ACOUSTIC CONSULTANT

RENZO TONIN & ASSOCIATES

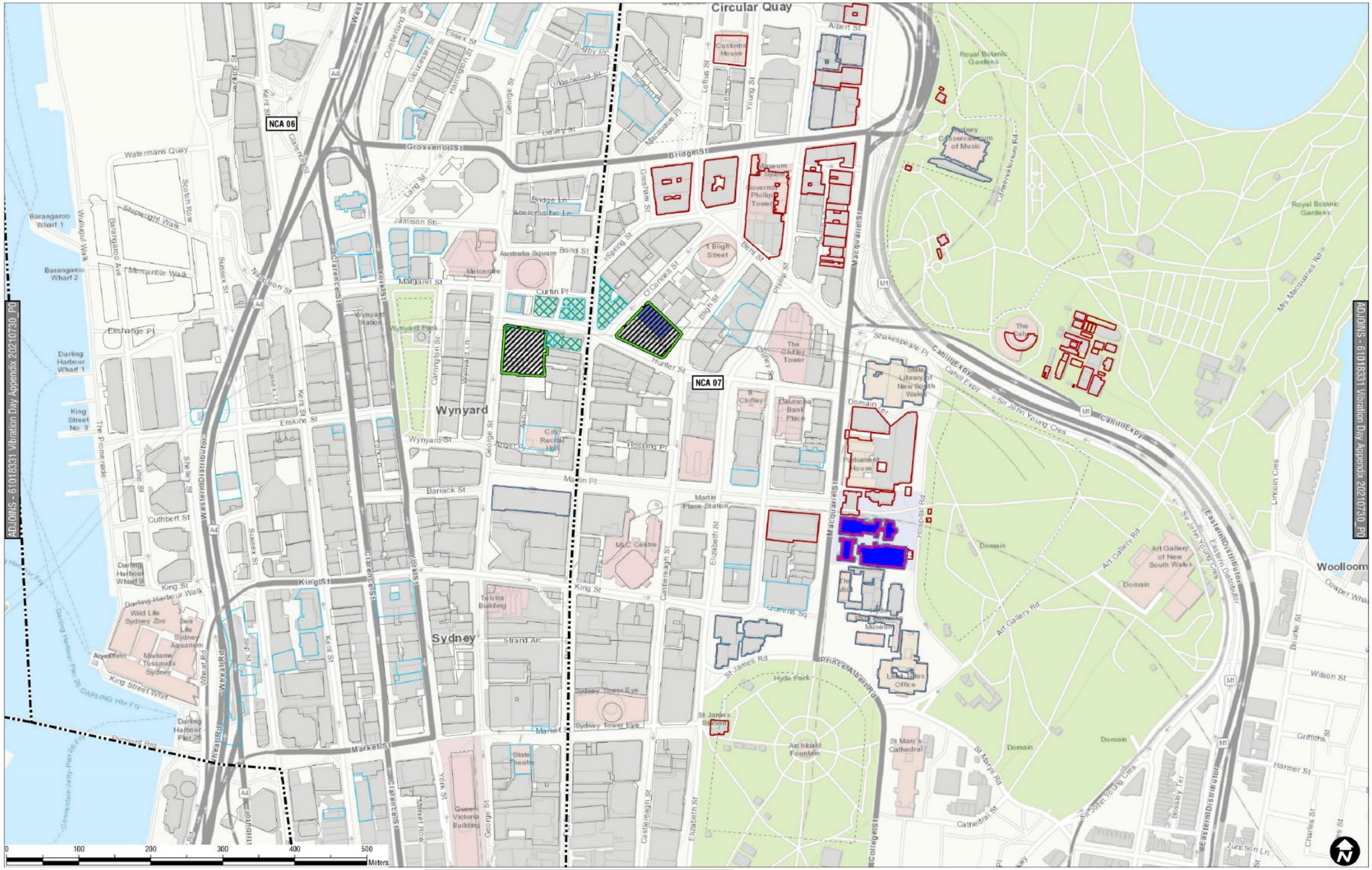
inspired to achieve

SYDNEY METRO WEST
Eastern Tunneling Package

Predicted maximum GBV levels during Preliminary Works at Hunter Street East (within the acoustic shed)

Roadheader excavation of temporary decline and ventilation adit

D.2 Vibration impacts from TBM excavation of main alignment (EIS)



ADJOINS - 61018331 Vibration Day Appendix 20210730_P0

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Project No.:	610.18331
Date:	27-Aug-2021
Drawn by:	ML
Scale:	1:5,000
Sheet Size:	A4
Projection:	GDA2020 MGA Zone 56

- NCA Boundary
- Project Alignment
- Construction Sites
- Acoustic Sheds
- Acoustic Hoarding
- Tunnel Launch and Support Site
- Heritage/Conservation Listed
- Vibration Sensitive Heritage
- Vibration Sensitive Equipment
- Human Comfort Criteria Exceedance
- Cosmetic Damage Screening Criteria Exceedance
- Sensitive Equipment Screening Criteria Exceedance

Sydney Metro Authority

Sydney Metro West
Stage 2

Worst-case Vibration Impacts from TBM Tunnelling Day Time

61018331 Vibration Day Appendix 20210730_P03

D.3 Vibration impacts from rockhammer excavation of Hunter Street East shaft (EIS)

Figure 30 Predicted Vibration Impacts

Source: SLR Consulting Australia Pty Ltd 2021 Sydney Metro West - Major civil construction between The Bays and Sydney CBD - Technical Paper 2: Noise and Vibration October 2020