Integrated Management System

Planning Approval Consistency Assessment Form

SM ES-FT-414

Sydney Metro Integrated Management System (IMS)

Assessment Name:	Relocation of a crossover cavern to Pyrmont and tunnel alignment optimisation
Prepared by:	Sydney Metro
Prepared for:	Sydney Metro and John Holland CPB Contractors 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:	Stage 2 – 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 2023)

Sydney Metro West Environmental Impact Statement – Rail infrastructure, stations, precincts and operations (SSI-22765520) *(*Sydney Metro, March 2022)

All proposed work identified in the assessment would be carried out in accordance with the mitigation measures identified in the *Sydney Metro West Environmental Impact Statement – Major civil construction between The Bays and Sydney CBD (*EIS Stage 2*)*, 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 (the Concept)

Sydney Metro West (the Concept) involves the construction and operation of a metro rail line around 24 kilometres long between Westmead and Hunter Street in the Sydney central business district (CBD). The key components for the Approved Concept include:

- Construction and operation of new passenger rail infrastructure between Westmead and the CBD of Sydney, including:
    - Tunnels, stations (including surrounding areas) and associated rail facilities

- Stabling and maintenance facilities (including associated underground and overground connections to tunnels)
- Modification of existing rail infrastructure (including stations and surrounding areas)
- Ancillary development.

The indicative alignment and proposed station locations are shown on Figure 6-1 of the Environmental Impact Statement for Sydney Metro West Concept and Stage 1 (major civil construction between Westmead and The Bays). The Approved Concept identified that tunnel excavation would be mainly carried out using tunnel boring machines, with roadheaders used for caverns, stub tunnels and connection tunnels from the stabling and maintenance facility to the mainline tunnels via the Rosehill dive structure.

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 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 includes:

- 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

Tunnel alignment for the Approved Project

Section 5 of the EIS for the Approved Project described the tunnel excavation works and identified the indicative location of the tunnel alignment (Figure 5-1 to Figure 5-3 of the EIS). The total tunnel length between The Bays and Sydney CBD is about 3.5 kilometres. The sections of the indicative tunnel alignment relevant to this Consistency Assessment are shown in Figure 4 of this Consistency Assessment.

Tunnelling by tunnel boring machines

Around 2.3 kilometres of the tunnel alignment will be excavated by tunnel boring machines. The two bored tunnels would have a circular cross-section with an internal lined diameter of about six metres and an excavated diameter of about seven metres. The centre lines of the two tracks would typically be about 14 metres apart, however this would depend on specific geological constraints and the need to avoid building basements. The tunnels would be lined with precast concrete segments to ensure the long term life of the asset and minimise groundwater inflow into the tunnel. The depth of the tunnels would vary from about 15 to 50 metres deep due to changes in topography.

Tunnelling by means other than tunnel boring machines (non-TBM tunnelling)

As specified in Table 5-5 of the EIS, the following tunnel features will be excavated using roadheaders and rock hammers:

- Crossover cavern east of The Bays tunnel launch and support 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.

Crossover cavern for the Approved Project

The *Sydney Metro West Environmental Impact Statement – Sydney Metro West – The Bays to Sydney CBD* identified and assessed a crossover cavern to be located to the east of The Bays Station. The crossover cavern at The Bays Station was identified in section 5.4.3 of the EIS. The crossover cavern will provide a crossover point between The Bays Station and Pyrmont Station, to enable a train to cross between two parallel tracks for use in degraded operations due to maintenance, breakdowns or other emergencies. Crossovers are provided at various points along the alignment and are needed to provide service reliability and safety.

Construction period for the tunnelling works associated with the Approved Project

Sydney Metro West Environmental Impact Statement – Sydney Metro West – The Bays to Sydney CBD

The EIS for the Approved Project identified that tunnelling is proposed to occur from early 2024 to early 2025. The crossover cavern excavation was anticipated to be carried out alongside site setup and enabling work at The Bays Station to prepare for the launch of the tunnel boring machines.

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.

Condition D23 identifies variations to the construction hours identified in Condition D21 and 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 West Stage 2 – Modification Request (Mod 1 Request)

Sydney Metro has 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 is expected to be 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.

Sydney Metro West - Rail infrastructure, stations, precincts and operations (Stage 3)

The EIS for Sydney Metro West - Rail infrastructure, stations, precincts and operations was on public exhibition from 23 March to 4 May 2022. Assessment by the Department of Planning and Environment is currently underway. The proposal includes tunnel fit-out, construction of stations, ancillary facilities and station precincts, and operation and maintenance of the Sydney Metro West line. Operational impacts associated with the proposed change will be assessed separately following

approval of Stage 3 (SSI-22765520). An assessment of the crossover cavern and tunnel alignment at a conceptual level has been undertaken in this Consistency Assessment.

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

The purpose of this Consistency Assessment is to assess the following proposed change to the Approved Project:

- Relocation of the crossover cavern from The Bays Station (east of The Bays Station box) to the western end of Pyrmont Station (refer Figure 6)
- Minor realignment of the tunnels to:
    - Achieve a crossover in-line and at grade with the future station platforms
    - Minimise horizontal curves along the tunnel alignment to improve operational efficiencies.

Tunnel realignment

The construction methodology of the revised tunnel alignment by tunnel boring machine would remain unchanged. This Consistency Assessment relates to the tunnel alignment sections between The Bays and the western Hunter Street Station site. A separate Consistency Assessment was approved in September 2022 (SMW05) which changed the tunnel alignment between the eastern Hunter Street station site and the turnback stubs (under The Domain). This consistency assessment does not change nor impact the revised tunnel alignment for the area approved in SMW05.

Pyrmont crossover

The construction methodology of the crossover cavern (including construction plant and equipment) would remain generally unchanged in its revised location.

The construction of the crossover cavern at Pyrmont would initially be carried out by continuing the station cavern heading excavation westwards following the completion of the station cavern heading. The crossover cavern works at Pyrmont would be supported by both the Pyrmont Station western and eastern construction sites, to facilitate the parallel construction of both the station cavern excavation and the crossover excavation works without impacting the construction program.

The proposal provides a net reduction in crossover cavern length compared to the location identified in the Approved Project at The Bays, resulting from the revised horizontal alignment and vertical alignment of the tunnels at Pyrmont. This would result in a reduction in the amount of excavation required and timeframe for non-TBM tunnelling works for the project as a whole.

However, whilst there is a decrease in excavation by non-TBM tunnelling required for the project as a whole, there would be an increase at Pyrmont. Reducing the crossover cavern length helps improve safety in design outcomes by flattening the grade that the cavern is constructed on and straightening the rail alignment.

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

Relevant elements of the Approved Project	Proposed change
Tunnel alignment Section 5 of the EIS for the Approved Project identified the indicative location of the tunnel alignment (Figure 5-1 to Figure 5-3 of the EIS). The total tunnel length between The Bays and Sydney CBD is about 3.5 kilometres, of which about 2.3 kilometres will be excavated by tunnel boring machines. The sections of the indicative tunnel alignment relevant to this Consistency Assessment are shown in Figure 5.	This Consistency Assessment includes minor tunnel realignments between The Bays and Hunter Street Stations. The relevant sections of the approved tunnel alignment, and the proposed revised tunnel alignment is shown in Figure 4 and 5. The proposed change in tunnel alignment is located entirely underground (with a maximum realignment of around 16 metres) and the depths of the realigned tunnels would be similar to the relevant sections of the approved tunnel alignment (refer Figure 5)
Tunnel features The location and scope of works required for the crossover cavern has been identified in Chapter 5 (Project description) of the EIS. It notes that The Bays tunnel launch and support site would be used to mine a crossover cavern to the east of The Bays Station excavation box. Roadheaders at the bottom of The Bays Station excavation box would mine a crossover cavern about 200 metres long, east of the station excavation box. The crossover cavern excavation would be carried out alongside site setup and enabling work to prepare for the launch of the tunnel boring machines. Refer to Figure 4 below for the indicative alignment plan showing the crossover cavern location at The Bays Station site as assessed in the EIS for the Approved Project.	The crossover cavern would be relocated from The Bays Station to the western end of Pyrmont Station. The excavation of the crossover cavern relocation would be supported by the Pyrmont Station construction sites. The proposed location of the crossover cavern is shown below in Figure 2. The construction of the crossover cavern at Pyrmont would be carried out by continuing the station cavern heading excavation westwards after the station cavern heading is complete. Roadheaders will be used to mine the crossover cavern, which would be approximately 123 metres long. There would be an overall reduction in non-TBM tunnelling required for the Approved Project by approximately 77 metres due to the relocation (noting this would instead be excavated by TBM).
Spoil generation Indicative spoil generation of the Approved Project is outlined in Section 5.4.3 of the EIS. The EIS identified that about 306,000 m^3 of spoil would be removed from The Bays tunnel launch and support site, including about 43,700m^3 from the crossover cavern excavation.	The total spoil generation amount for the crossover cavern at Pyrmont would be approximately 40,000m^3. The proposal would provide a reduction in construction waste (spoil generation) within a shorter crossover cavern and permanent materials use such as concrete for permanent works would be reduced by over 5,000m^3 (subject to final design) compared to the crossover cavern at The Bays in the Approved Project.

Heavy vehicles

To address discrepancies in the construction vehicle movements presented in the EIS, a re-assessment was undertaken during the preparation of the Response to Submissions Report. The outcomes of the assessment were detailed in a Traffic Update memo which was prepared by Jacobs on 4 May 2022 with the summary of the assessment findings included in the Response to Submissions Report for the Approved Project.

The heavy vehicle movement volumes assessed in the Response to Submissions Report for the Pyrmont construction sites are shown in Figure 1 and Figure 2.

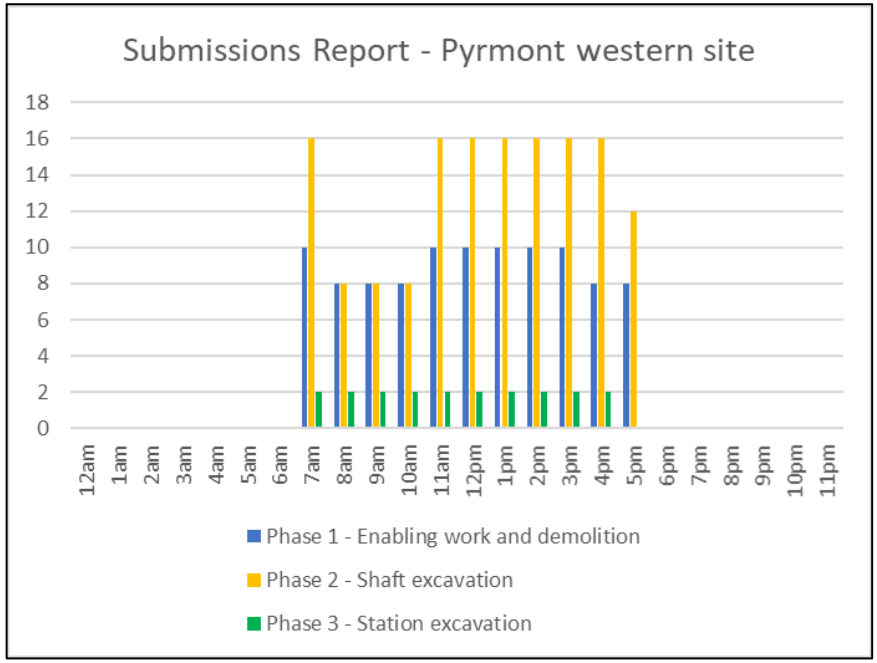

Figure 1 Pyrmont western site heavy vehicle movements as assessed in the Response to Submissions Report

The proposed crossover cavern works would result in:

- No changes to the hourly or daily maximum heavy vehicle movements from the eastern construction site
- A maximum of 16 heavy vehicle movements per hour would be required during the daytime for Phase 3 works to/from the western construction site, which would include crossover cavern excavation. There would also be fewer heavy vehicle movements in the morning road network peak period, consistent with the Phase 1 and Phase 2 works. The maximum heavy vehicle movements required for each hour would be consistent with the Phase 2 works (western site) as assessed in the Response to Submissions Report/Traffic Update memo for the Approved Project
- Reduced total number of construction vehicles required at The Bays.

In summary, whilst there is an increase in the daily and hourly vehicle movements at the Pyrmont Station western construction site during the Phase 3 works, the numbers are consistent with the daily and hourly maximum vehicles assessed within the Response to Submissions Report for the Approved Project. The revised required numbers for the western site are shown in Figure 3 below.

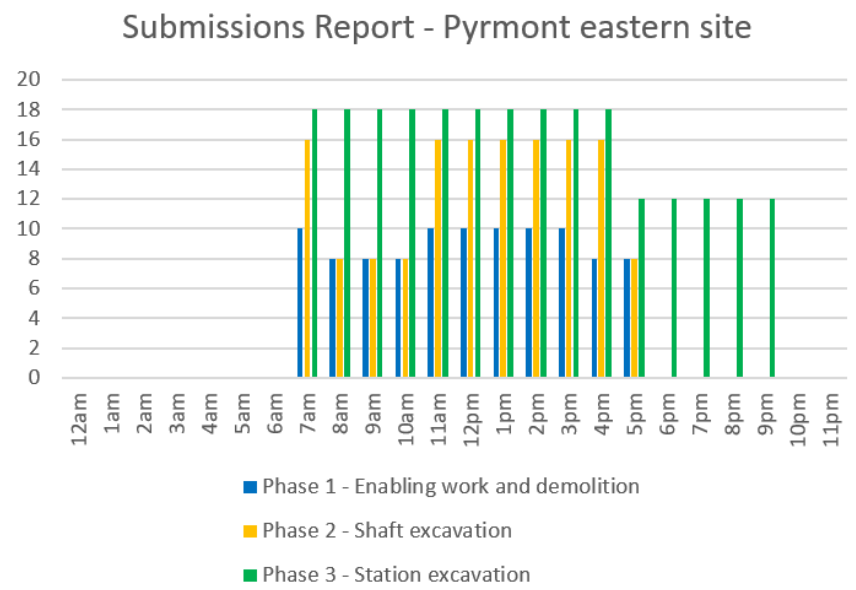

Figure 2 Pyrmont eastern site heavy vehicle movements as assessed in the Response to Submissions Report

Note: The bar chart estimates refer to truck movements. A movement means a one-way therefore, a truck entering then leaving the work site represents two movements.

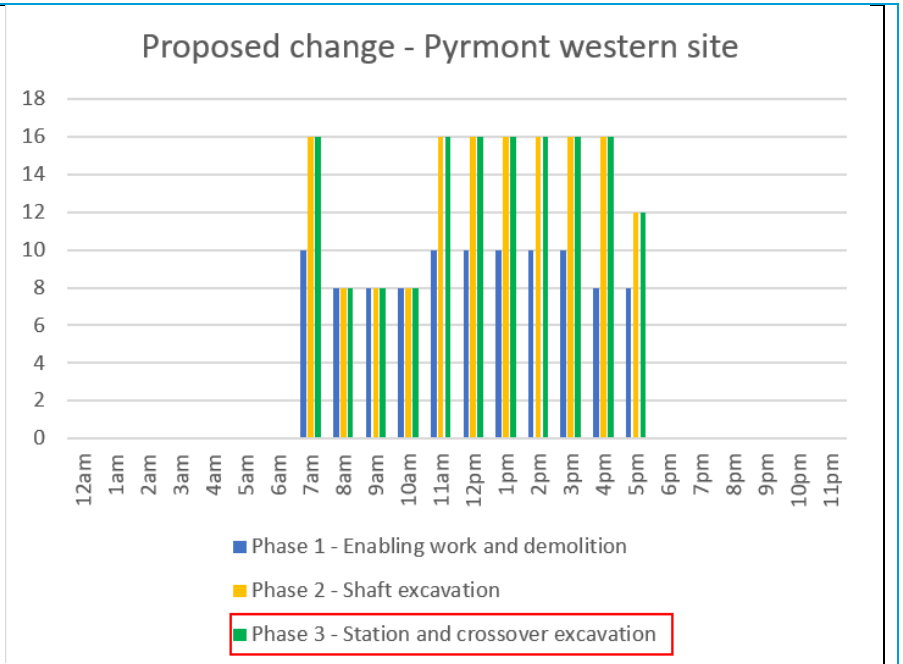

Figure 3 Proposed change - Pyrmont western site heavy vehicle movements

Note: The bar chart estimates refer to truck movements. A movement means a one-way, therefore a truck entering then leaving the work site represents two movements.

Timing The EIS for the Approved Project identified that the crossover cavern excavation at The Bays would be carried out alongside site setup and enabling work to prepare for the launch of the tunnel boring machines. Tunnelling is proposed to occur from early 2024 to early 2025. Some construction work, including crossover cavern concrete lining work, may take place within The Bays tunnel launch and support site until late 2025.	The proposal would not result in any changes to the indicative construction program as shown in Figure 5-6 of the EIS for the Approved Project. The crossover cavern excavation would commence Q1 2024 and construction of the crossover cavern is predicted to be completed by the end of Q3 2025. This is consistent with the indicative construction program for the Approved Project.

Hours of work 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 has 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 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 should the Modification Request be determined to allow non-TBM tunnelling 24 hours a day, seven days a week.

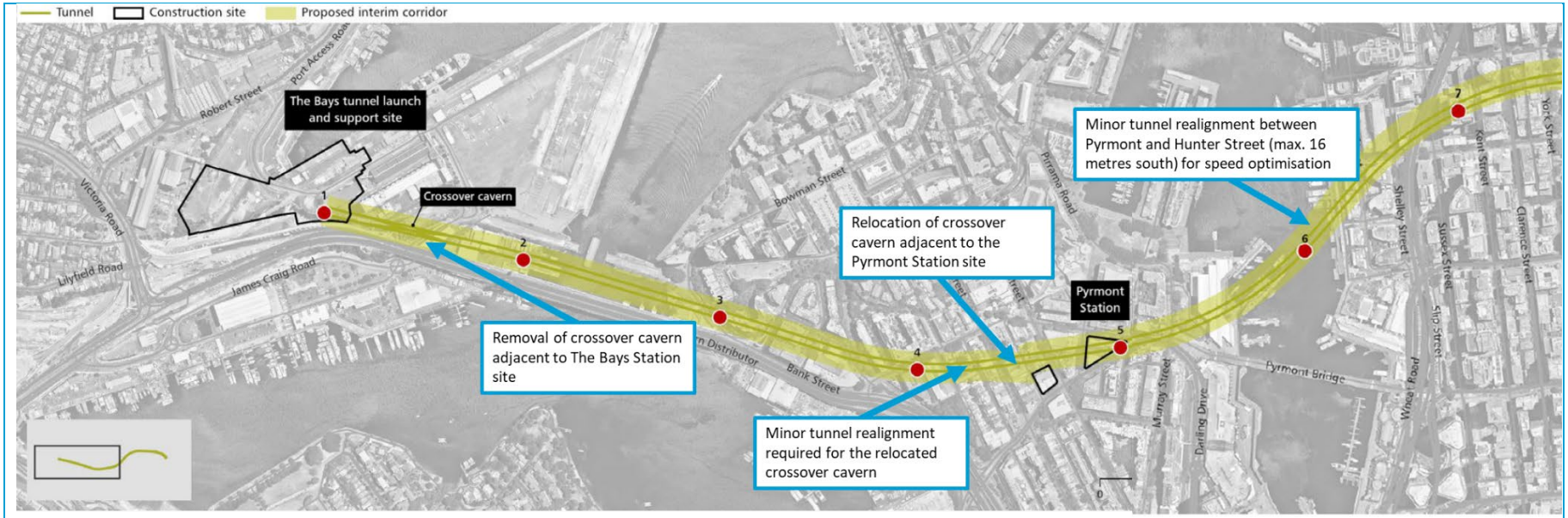

Figure 4 EIS indicative alignment plan and proposed changes

Figure 5 Amended Sydney Metro West tunnel alignment

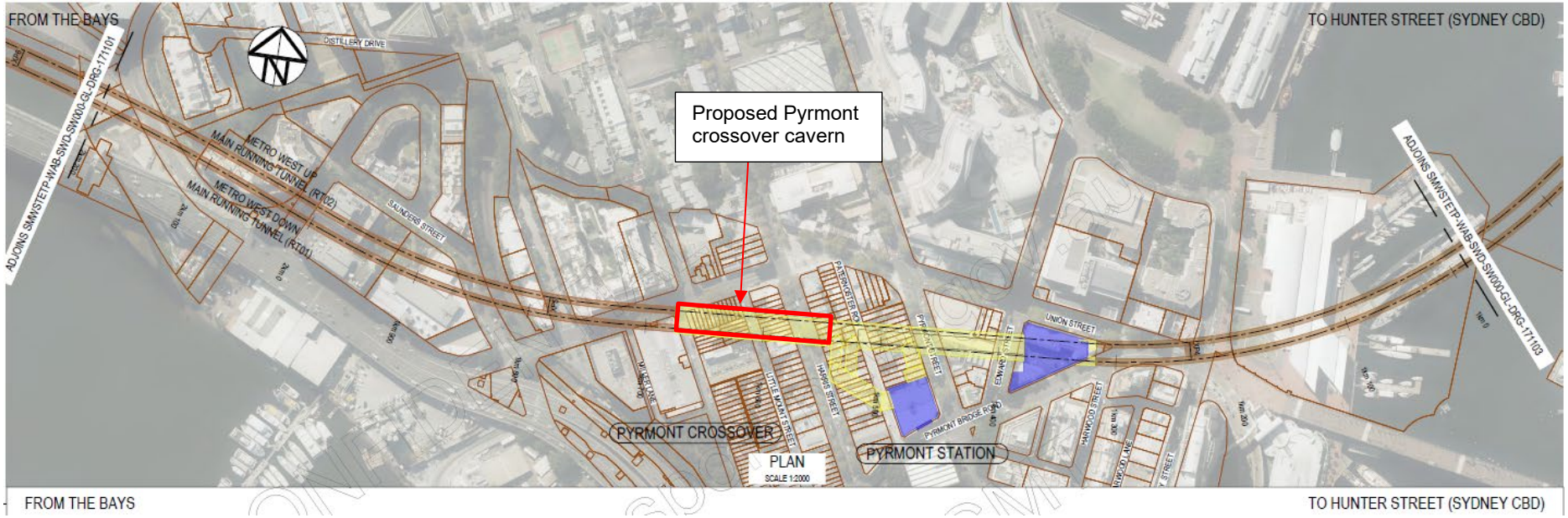

Figure 6 Location and design of the proposed Pyrmont crossover cavern

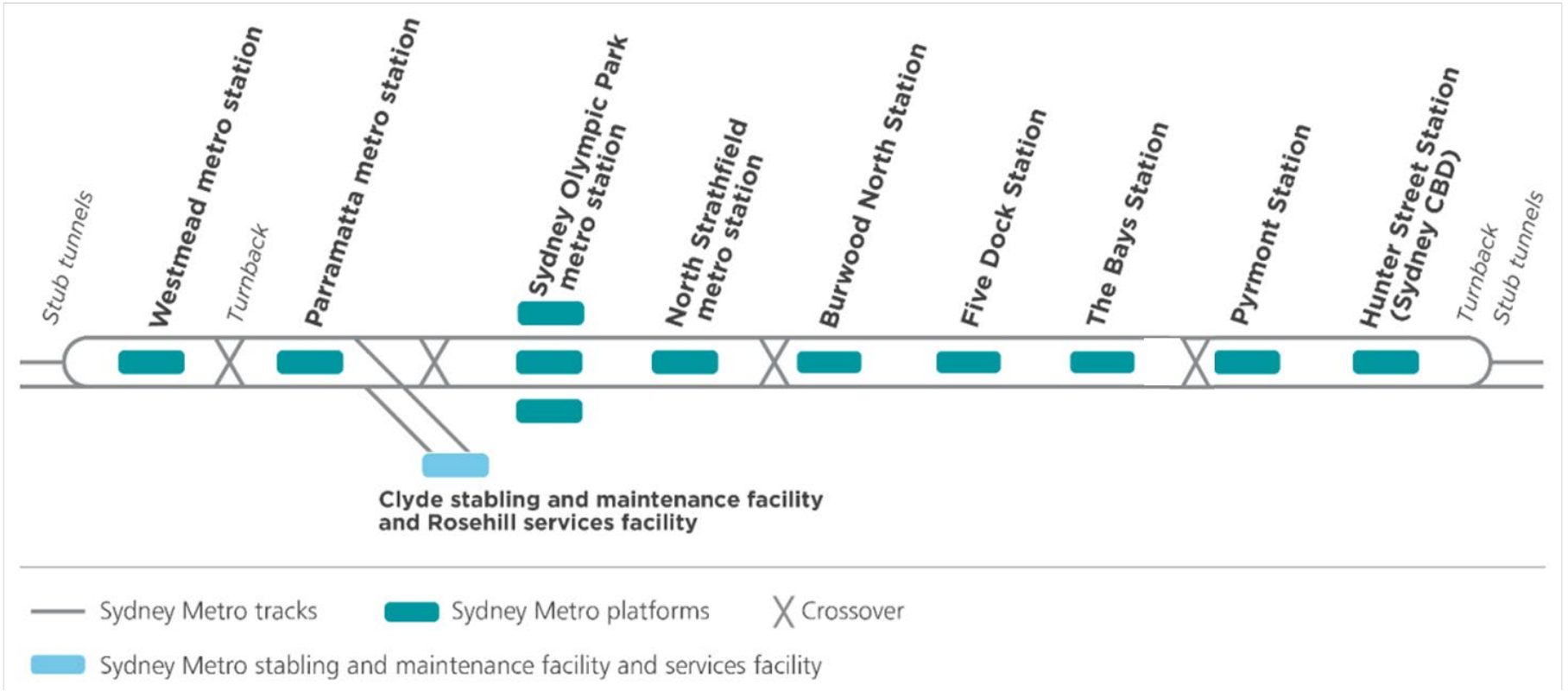

Figure 7 Revised indicative track configuration for Sydney Metro West

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 change subject to this Consistency Assessment would not result in any changes to the Approved Project delivery timeframe and indicative construction program, with construction commencing around Q1 2023.

4. Site description

Crossover cavern

The proposal includes a revised construction location for the crossover cavern (from The Bays to Pyrmont). The proposed changes would be limited to substratum tunnelling and below ground spaces.

The proposed work would be located at the Pyrmont Station constructions sites which are located on Pyrmont Bridge Road near the centre of the Pyrmont Peninsula:

- The Pyrmont Station western construction site (Lot 10/-/DP1028280) – covers about 1,250 square metres and is located between Paternoster Row and Pyrmont Street, immediately north of Pyrmont Bridge Road.
- The Pyrmont Station eastern construction site (Lot 1/-/DP620352 and 1/-/DP657429) – covers about 2,600 square metres and is located between Edward Street, Union Street and Pyrmont Bridge Road.

Section 5.4.4 of the EIS provides a detailed description of the Pyrmont Station construction sites which both have frontage to Pyrmont Bridge Road. The properties on these construction sites have been acquired by Sydney Metro and would be demolished as a part of the Approved Project as described in Chapter 5 (Project Description) of the EIS. The proposed changes associated with this Consistency Assessment would be substratum only and the surface level footprint of the approved Pyrmont Station construction sites 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 and Figure 5-3 of the EIS. As a result of the change in location for the crossover cavern which would require a slightly wider tunnel, there would be minor additional substratum acquisition in Pyrmont required.

Tunnel realignment

Refer to Figure 4 for the indicative tunnel alignment as assessed in the EIS for the Approved Project. The revised tunnel alignment is shown in Figure 5 which shows minor realignments required around Pyrmont and Darling Harbour. The proposed change in tunnel alignment would be substratum only (entirely underground) and the surface level footprint of the approved Pyrmont Station construction sites would not change.

5. Site Environmental Characteristics

The Pyrmont Station construction sites are located within a dense urban area with low and medium-rise character terrace buildings, modern commercial and residential buildings, medium and high-density apartments and former warehouse buildings and local hotels at prominent corner sites.

There are areas of local and regional visual sensitivity with the western construction site being within a heritage conservation area and the eastern construction site being visible from the State listed heritage item Pyrmont Bridge. The crossover cavern would be located beneath the heritage conservation area.

There are no known Aboriginal heritage sites (AHIMS registered sites) within 200 metres of the Pyrmont Station construction sites. The closest registered AHIMS site to the construction site is approximately 270 metres west of the western construction site within the former foreshore of Blackwattle Bay.

6. Justification for the proposed change

The EIS for the Approved Project included an indicative design of the tunnel that was subject to design development and construction planning. A review of the tunnel alignment including the crossover cavern location was undertaken to optimise the design.

As a result of the review, a revised location of the crossover cavern was identified at Pyrmont which would provide the following benefits:

- The Pyrmont location would provide a more suitable disembarkment location for customers in the event of degraded mode operations or an emergency evacuation, as the site is more connected to other transport modes including bus and light rail services and closer to the Sydney CBD
- Avoid any potential construction impacts to the Anzac Bridge foundations at The Bays as a result of construction of the crossover cavern, by relocating the underground cavern excavation closer toward Pyrmont Station
- Removal of the crossover from The Bays would enable more efficient tunnel boring machine assembly activities at the Bays and reduce program risk at this location
- A reduction in non-TBM tunnelling to the project as a whole, due to the reduced size of the cavern required at the Pyrmont location, which reduces construction waste (spoil generation)
- Positive sustainability and cost savings through the net reduction in construction materials and waste.

The detailed design process has also identified an optimised tunnel alignment which includes minor tunnel realignments required for the Pyrmont crossover and between Pyrmont Station and Hunter Street Station (around Darling Harbour) to improve operational efficiency of the alignment. These realignments have been identified to reduce the length and curvature of the tunnel alignment. During operations, this would result in operational efficiency by improving speed potential. During construction, this results in a more efficient construction process and cost savings.

7. Environmental Benefit

The relocation of the crossover to Pyrmont would provide community benefits during operations as it would be a more suitable disembarkment location in the event of an emergency or degraded services (being closer to the Sydney CBD and more connected to other transport modes including bus and light rail services). The overall reduction of excavation required by relocating the crossover cavern to Pyrmont from The Bays would deliver positive sustainability outcomes through the net reduction in construction materials and waste, and would also reduce the timeframe of non-TBM tunnelling required.

8. Control Measures

Will a project and site specific EMP be prepared?	☒ Yes	**Are appropriate control measures already identified in an existing EMP?** A project and site specific EMP would 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		☒ No

9. Conditions of approval

Will the proposal be consistent with the conditions of approval?	☒ Yes. The proposal would be consistent with the conditions of approval. The proposal would also be consistent with the proposed Modification Request (Mod 1) which is subject to determination by the NSW Department of Planning and Environment.
	☐ No

10. 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	As the proposed changes would be located underground and the surface level approved Pyrmont Station construction sites would not change, the proposed changes would not result in any additional impacts to flora and fauna.	No additional measures required.	Y	Y	

Water	**Surface water and flooding** As the proposed changes including the crossover and the tunnel realignment would be located underground and the surface level approved Pyrmont Station construction sites would not change, the proposed changes would not result in any changes to the flooding or surface water quality impacts described in the EIS for the Approved Project. **Groundwater - Tunnel alignment** The areas of realignment of the tunnel would be excavated by tunnel boring machines which would not result in any changes to the groundwater impacts described in the EIS for the Approved Project as tunnels would be tanked (restricting groundwater inflow) almost immediately following tunnelling by tunnel boring machine. **Groundwater – Pyrmont crossover** The addition of the crossover cavern at Pyrmont has the potential to result in surrounding groundwater in the Hawkesbury Sandstone to flow towards the excavation in this location, until it is tanked (concrete lined). The inflow of groundwater into the cavern is expected to be minimal and would meet the allowable inflow criteria, as sealing of the cavern would occur progressively restricting the open area allowing inflows. The crossover cavern in this location also reduces the potential intersection with the Great Sydney Dyke in proximity to previous location to the east of The Bays Station. Section 14.6.9 of the EIS for the Approved Project outlines that interactions between surface water and groundwater due to tunnelling activities are not expected to occur at Pyrmont due to the depth of tunnels and absence of natural surface streams. Therefore, there are no anticipated changes from the Approved Project. Any potential impacts would be managed in accordance with the mitigation measures identified in the EIS for the Approved Project and Condition of Approval D101 which requires the preparation of a Groundwater Modelling Report before bulk excavation.	No additional measures required.	Y	Y	

Soils and contamination	Assessment of potential acid sulfate soils, saline soils and contamination was carried out in the EIS for the approved footprint and surrounding areas. **Tunnel alignment** Potential impacts from contamination for the tunnel alignment were assessed as low or very low and given the minor realignment changes, this proposal is expected to have no additional impacts to soils and contamination associated with the tunnel alignment changes. **Pyrmont crossover** Groundwater beneath and around the Pyrmont Station construction sites was assigned a moderate potential impact associated with the industrial land use and general historical activities carried out in the surrounding area. The closest area of environmental interest with moderate (or greater) contamination risk potential is located in proximity to the eastern construction site. There is also potential risk of acid sulfate soils in this area near the eastern construction site. The proposed crossover cavern location is not expected to encounter significantly different conditions or result in significantly different impacts to those already identified (and managed as required) for the Approved Project.	No additional measures required.	Y	Y	
Air quality	Given that the proposed changes would be located underground and that there would be no substantial changes to plant and equipment, there would be no substantial changes to the air quality impacts of the proposed changes compared with that for the Approved Project.	No additional measures required.	Y	Y	

Aboriginal heritage	As the proposed changes would be located underground and the surface level approved construction sites would not change, the proposed changes would not result in any Aboriginal heritage impacts not described for the Approved Project. The proposed crossover cavern would be at a depth where no Aboriginal heritage objects or sites would be encountered.	No additional measures required.	Y	Y	
Non-Aboriginal heritage	**Tunnel alignment** The potential impacts of the Approved Project to heritage items located within the 25m buffer of the tunnel alignment were provided in Chapter 8 Non-Aboriginal Heritage of the EIS and Technical Paper 3 Non-Aboriginal Heritage. It was identified that the tunnel sections between stations would generally be too deep to affect heritage items or archaeological deposits. As the proposal does not involve a substantial change to the depth (or location) of the tunnels, the potential non-Aboriginal heritage impacts associated with the proposal are consistent with the Approved Project. **Pyrmont crossover** The Pyrmont crossover would be located underneath the Pyrmont Heritage Conservation Area – SLEP 2012 Item no. C52 and in proximity to a number of other local heritage listed items as outlined in Technical Paper 3 Non-Aboriginal Heritage of the EIS. As the works would be located underground and the surface level approved Pyrmont Station construction sites would not change, the proposed changes would not result in any visual (and indirect) heritage impacts. The detailed noise and vibration technical assessment did not identify any exceedances of the 7.5 mm/s Peak Particle Velocity cosmetic damage screening criteria at any properties or heritage buildings in the vicinity of the crossover at Pyrmont. The risk of structural damage is considered low during the Pyrmont crossover cavern excavation, which is consistent with the predicted vibration impacts assessed in the EIS.	No additional measures required.	Y	Y	

	It has therefore been assessed that there would be no additional adverse direct or indirect impacts to the significant heritage items within the 25m buffer zone around the Pyrmont crossover cavern location and above the tunnel alignment. There would be no increase in cumulative impacts as a result of the proposed change in scope. The mitigation measures outlined in the Technical Paper 3 – Non-Aboriginal heritage would remain applicable for the works proposed in this Consistency Assessment.				
Noise and vibration	**Tunnel alignment – noise and vibration impacts** Construction noise and vibration impacts from tunnelling activities were assessed in Chapter 7 and Technical Paper 2 of the EIS. Given the minor tunnel realignment required (as the maximum realignment is of about 16 metres) the extent of potential noise and vibration impacts is not expected to materially change from the Approved Project. The tunnel boring machines are expected to progress at a rate of between 20 to 50 metres per day. This means that the worst-case ground-borne noise and vibration impacts from tunnelling at a receiver would likely only be apparent for a few days for each tunnel boring machine as the tunnelling works pass beneath. **Pyrmont crossover cavern: ground-borne noise impacts** A detailed noise and vibration technical assessment has been prepared by the construction contractor to assess the noise and vibration impacts using the preferred construction methodology for the excavation of the crossover cavern at Pyrmont. This detailed noise and vibration technical assessment therefore contains a more refined assessment of the predicted vibration levels when compared to the more conservative assumptions in the EIS (refer to Attachment A for the assessment). The assessment provided in Appendix A concludes:	No additional Measures required. Mitigation and management measures to minimise noise and vibration impacts from the Approved Project are identified in Technical Paper 2 (Noise and vibration) of the EIS.	Y	Y	

	• that worst-case ground-borne noise levels during the construction of the Pyrmont crossover are predicted to comply with the relevant NML at receivers for daytime standard hours • the crossover cavern at this location to be excavated by non-TBM tunnelling would impact fewer receivers and have a lower noise impact than those expected to be experienced by TBM tunnelling in the same location. However, the duration of construction by non-TBM tunnelling would mean the noise impacts would likely be experienced for a longer duration when compared to tunnelling by TBM. • noise impacts associated with excavation of the crossover cavern would be consistent with those outlined in the EIS and would be effectively managed in accordance with the CNVS. • the noise and vibration assessment in the EIS for the approved project assessed TBM tunnelling as worst-case construction method in terms of potential ground-borne noise and vibration impact. The potential noise impact of tunnelling by TBM in the crossover location in the EIS (at The Bays) would therefore be consistent with the noise and vibration assessment for the Approved Project, which did not identify any impacted receivers in The Bays study area. *Out of hours works* As discussed in Section 1 and Section 2 of this Consistency Assessment, Sydney Metro have 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 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 detailed noise and vibration technical assessment for the Pyrmont crossover cavern (Attachment A) assessed the potential noise impacts for out of hours works. The assessment identified the potential worst-case ground-borne noise impacts would result in 1-10 dB exceedances of the NMLs for the daytime period outside of standard hours (i.e. between 8am and 6pm on Sundays and on public holidays), evening and night time periods for: • up to 16 receivers during day time outside of standard hours (note: this represents a reduction in the number of impacted receivers compared to the TBM tunnelling in this area assessed in the EIS. TBM tunnelling is this area was predicted to result in potential 1-10dB NML exceedances at up to 56 receivers during this period) • up to 16 receivers during the evening period (note: this represents a reduction in the number of				

	impacted receivers compared to the TBM tunnelling in this area assessed in the EIS. TBM tunnelling is this area was predicted to result in potential 1-10dB NML exceedances at up to 56 receivers during this period) • up to 50 receivers during night time period (note: this represents a reduction in the number of impacted receivers compared to the TBM tunnelling in this area assessed in the EIS. TBM tunnelling is this area was predicted to result in potential 1-10dB NML exceedances at up to 91 receivers and potential 11-20dB exceedances at up to seven receivers during this period). The crossover cavern at this location to be excavated by non-TBM tunnelling would therefore impact fewer receivers and have a lower noise level than those expected to be experienced by TBM tunnelling in the same location. Should the Modification Request be approved by the Department of Planning and Environment, Sydney Metro would undertake the excavation of the Pyrmont crossover cavern outside of standard construction hours to realise the safety and program benefits outlined above. *Cumulative impacts* The worst-case potential noise impacts to any receiver above the cavern are expected to last for around six to 12 weeks, assuming the works would be undertaken outside of standard construction hours. Some receivers in proximity to the Pyrmont crossover cavern adjacent to the station cavern may experience impacts for a longer duration as a result of additional non-TBM tunnelling, however the impacts are similarly expected to remain for around six to 12 weeks. These worst-case potential noise impacts could occur to any receiver for up to nine months if works were restricted to standard construction hours only. These potential impacts would be mitigated and managed through the measures and processes outlined in the CVNS.				

	Pyrmont crossover cavern: vibration impacts The detailed noise and vibration technical assessment in Appendix A has been prepared by the construction contractor to assess the vibration impacts using the preferred construction methodology for this proposed change. This technical assessment therefore contains a more refined assessment of the predicted vibration levels when compared to the more conservative assumptions in the EIS. The detailed noise and vibration technical assessment confirms that vibration levels from the excavation of the crossover cavern are predicted to be below the human comfort criteria and the cosmetic damage screening level at receivers in the vicinity of the crossover cavern. It has therefore been assessed that there would be no additional vibration impacts to receivers around the Pyrmont crossover cavern location and above the tunnel alignment than those identified in the EIS for the Approved Project. The vibration assessment in the EIS for the approved project assessed TBM tunnelling as worst-case construction method in terms of potential ground-borne vibration impact. The potential vibration impact of tunnelling by TBM in the crossover location in the EIS (at The Bays) would therefore be consistent with the vibration assessment for the Approved Project, which did not identify any impacted receivers with an exceedance of the vibration criteria in The Bays study area.				

Community and socio-economic	Consistent with the construction of the station cavern at Pyrmont, the worst-case potential noise impacts to any receiver above the Pyrmont crossover cavern are expected to last for around six to 12 weeks, assuming the works would be undertaken outside of standard construction hours (consistent with the assessment in the EIS for the Approved Project). These worst-case potential noise impacts could occur to any receiver for up to nine months if works were restricted to standard construction hours only. Potential noise impacts would be managed in accordance with the CNVS. As described above, the crossover cavern at this location to be excavated by non-TBM tunnelling would impact fewer receivers and have a lower noise level than those expected to be experienced by TBM tunnelling in the same location. The overall impact associated with the proposed changes on receivers would be minimal, and consistent with the impacts outlined in the EIS for the Approved Project. 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. 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.	Y	Y	

Traffic and transport	The proposed crossover cavern works at Pyrmont Station construction sites would result in: • No changes to the maximum heavy vehicle movements from the eastern construction site than those assessed in the Response to Submissions Report for the Approved Project • A maximum of 16 heavy vehicle movements per hour would be required during the daytime for Phase 3 works from the western construction site, which would include crossover cavern excavation. There would also be fewer heavy vehicle movements in the morning peak, consistent with the Phase 1 and Phase 2 works. The maximum heavy vehicle movements required for each hour would be consistent with the Phase 2 works (western site) as assessed in the Response to Submissions Report for the Approved Project • Reduced total number of construction vehicles required at The Bays. In summary, whilst there is an increase in vehicle movements at the Pyrmont Station western construction site during the Phase 3 works, the numbers are consistent with the daily and hourly maximum vehicles assessed within the Response to Submissions Report for the Approved Project. As a result, there would be no substantial changes to the traffic impacts of the proposed changes compared with that for the Approved Project.	No additional Measures required.	Y	Y	

Waste and resource management	The total spoil generation amount for the crossover cavern at Pyrmont would be approximately 40,000m^3. Due to the shorter crossover cavern, the proposal would provide a reduction in construction waste (spoil generation) by around 15,000m^3 and permanent materials use such as concrete for permanent works by over 5,000m^3 (subject to final design) compared to the crossover cavern at The Bays in the Approved Project. The reduction has a direct benefit in reducing the carbon footprint that would be generated through resource consumption and spoil transport movement, which is a positive outcome for the project.	No additional Measures required.			
Visual	As the proposed changes would be located underground and the surface level approved Pyrmont Station construction sites would not change, the proposed changes would not result in any visual impacts.	No additional Measures required.	Y	Y	
Land use and property	As the proposed changes would be located underground and the surface level approved Pyrmont Station construction sites would not change, the proposed changes would not result in any additional land use impacts. Minor changes to substratum property acquisitions may be required as a result of the proposed changes as a result of the crossover cavern location and the minor tunnel realignment, however the amount of substratum to be required is expected to be consistent with that identified in the EIS for the Approved Project. The process of substratum acquisition for the proposed changes would be consistent with that for the Approved Project as described	No additional Measures required.	Y	Y	
Hazard and risk	Given that the proposed changes would be located underground and that there would be no substantial changes to traffic volumes and plant and equipment, there would be no substantial changes to the hazard and risk impacts of the proposed changes compared with that for the Approved Project.	No additional Measures required.	Y	Y	

Sustainability	The proposed change provides sustainability benefits through a net reduction in crossover cavern length by approximately 77 metres, which would achieve a reduction in excavation quantity and a reduction in permanent materials use such as concrete, by virtue of being deconstructed on a flatter grade with improved rail alignment in its relocated position. Sydney Metro West would continue to be managed in accordance with the Sydney Metro West Sustainability Plan.	No additional Measures required.	Y	Y	
Business impacts	As described above, there would be no substantial changes to traffic, noise, land use and property, landscape and visual amenity and air quality as a result of the proposed changes. As a result, there would be no substantial impacts to businesses from reduced amenity. Given that the proposed changes would be located underground and that there would be no additional businesses impacted, there would be no substantial changes to the business impacts of the proposed changes compared with that for the Approved Project.	No additional Measures required.	Y	Y	

11. Impact Assessment – Operation

Stage 2 of the planning application for Sydney Metro West (subject of this Consistency Assessment) is for major civil construction work for Sydney Metro West between The Bays and Sydney CBD. At this stage, measures to avoid or minimise impacts have been developed only for major civil construction work for Sydney Metro West between The Bays and Sydney CBD – which involves construction only. Impacts applicable to the operational aspects of Sydney Metro West including operation stage environmental mitigation measures are subject to the Sydney Metro West - Rail infrastructure, stations, precincts and operations (Stage 3) planning application which is currently under assessment by the Department of Planning and Environment. Operational impacts associated with the proposed change will be assessed separately following approval of Stage 3 (SSI-22765520). An assessment of the crossover cavern and tunnel realignment at a conceptual level has been undertaken in this assessment.

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	The Approved Project covers the major civil construction between The Bays and Sydney CBD and this Consistency Assessment relates to the potential construction impacts of these proposed changes. Given the changes are located underground, and groundwater drawdown would be negligible during operation as the tunnels would be fully lined, it is anticipated that there would be no changes to the impacts to flora and fauna (including groundwater dependent ecosystems).	Where relevant, proposed control measures would be identified through a separate assessment of consistency following approval of SSI-22765520.	N/A	Y	

Water	The Approved Project covers the major civil construction between The Bays and Sydney CBD and this Consistency Assessment relates to the potential construction impacts of these proposed changes. Given the changes are located underground, no impacts to surface water or flooding are anticipated during operations. Groundwater drawdown would be negligible during operation as the tunnels would be lined to minimise groundwater inflow, reducing potential groundwater impacts.	Where relevant, proposed control measures would be identified through a separate assessment of consistency following approval of SSI-22765520.	N/A	Y	
Soils and contamination	The Approved Project covers the major civil construction between The Bays and Sydney CBD and this Consistency Assessment relates to the potential construction impacts of these proposed changes. Given the changes are located underground, no impacts to soils and contamination are anticipated during operations.	Where relevant, proposed control measures would be identified through a separate assessment of consistency following approval of SSI-22765520.	N/A	Y	
Air quality	The Approved Project covers the major civil construction between The Bays and Sydney CBD and this Consistency Assessment relates to the potential construction impacts of these proposed changes. Given the changes are located underground, no impacts to air quality are anticipated during operations.	Where relevant, proposed control measures would be identified through a separate assessment of consistency following approval of SSI-22765520.	N/A	Y	

Noise and vibration	The Approved Project covers the major civil construction between The Bays and Sydney CBD and this Consistency Assessment relates to the potential construction impacts of these proposed changes. Given the minor tunnel realignment required (as the maximum realignment is of about 16 metres) the extent of potential noise and vibration impacts is not expected to materially change from the Approved Project. The location of the Pyrmont crossover cavern is at a similar depth to the tunnel alignment assessed as part of the EIS for the Approved Project. Therefore, it is anticipated that operational noise impacts associated with the crossover and the tunnel realignments can be appropriately managed to achieve compliance with the applicable guidelines.	Where relevant, proposed control measures would be identified through a separate assessment of consistency following approval of SSI-22765520.	N/A	Y	
Aboriginal heritage	The Approved Project covers the major civil construction between The Bays and Sydney CBD and this Consistency Assessment relates to the potential construction impacts of these proposed changes. Given the changes are located underground, no impacts to Aboriginal heritage are anticipated during operations.	Where relevant, proposed control measures would be identified through a separate assessment of consistency following approval of SSI-22765520.	N/A	Y	
Non-Aboriginal heritage	The Approved Project covers the major civil construction between The Bays and Sydney CBD and this Consistency Assessment relates to the potential construction impacts of these proposed changes. Given the changes are located underground, no impacts to heritage are anticipated during operations.	Where relevant, proposed control measures would be identified through a separate assessment of consistency following approval of SSI-22765520.	N/A	Y	

Community and socio-economic	The Approved Project covers the major civil construction between The Bays and Sydney CBD and this Consistency Assessment relates to the potential construction impacts of these proposed changes. The relocation of the crossover to Pyrmont would provide a more suitable disembarkment location for customers in the event of degraded mode operations or an emergency evacuation, as the site is more connected to other transport modes including bus and light rail services and closer to the Sydney CBD. No additional impacts to nearby residents or businesses are anticipated.	Where relevant, proposed control measures would be identified through a separate assessment of consistency following approval of SSI-22765520.	N/A	Y	
Traffic and transport	The Approved Project covers the major civil construction between The Bays and Sydney CBD and this Consistency Assessment relates to the potential construction impacts of these proposed changes. The relocation of the crossover to Pyrmont would provide a more suitable disembarkment location for customers in the event of degraded mode operations or an emergency evacuation, as the site is more connected to other transport modes including bus and light rail services and closer to the Sydney CBD. No additional impacts on the local road, active transport or public transport networks are anticipated.	Where relevant, proposed control measures would be identified through a separate assessment of consistency following approval of SSI-22765520.	N/A	Y	
Waste and resource management	The Approved Project covers the major civil construction between The Bays and Sydney CBD and this Consistency Assessment relates to the potential construction impacts of these proposed changes. Given the changes are located underground, no impacts to waste and resource management are anticipated during operations.	Where relevant, proposed control measures would be identified through a separate assessment of consistency following approval of SSI-22765520.	N/A	Y	

Visual and urban design	The Approved Project covers the major civil construction between The Bays and Sydney CBD and this Consistency Assessment relates to the potential construction impacts of these proposed changes. Given the changes are located underground, no impacts to landscape and visual amenity are anticipated during operations. Given the changes are located underground, no impacts to landscape and visual amenity are anticipated during operations.	Where relevant, proposed control measures would be identified through a separate assessment of consistency following approval of SSI-22765520.	N/A	Y	
Land use and property	The Approved Project covers the major civil construction between The Bays and Sydney CBD and this Consistency Assessment relates to the potential construction impacts of these proposed changes. Given the changes are located underground, no impacts to land use and property are anticipated during operations.	Where relevant, proposed control measures would be identified through a separate assessment of consistency following approval of SSI-22765520.	N/A	Y	
Hazard and risk	The Approved Project covers the major civil construction between The Bays and Sydney CBD and this Consistency Assessment relates to the potential construction impacts of these proposed changes. The relocation of the crossover to Pyrmont has been identified as the preferred location along the alignment for the Approved Project as it would provide a more suitable disembarkment location for customers in the event of degraded mode operations or an emergency evacuation.	Where relevant, proposed control measures would be identified through a separate assessment of consistency following approval of SSI-22765520.	N/A	Y	
Other	The Approved Project covers the major civil construction between The Bays and Sydney CBD and this Consistency Assessment relates to the potential construction impacts of these proposed changes. Subject to separate assessment of consistency, no major impacts to other environmental elements assessed in the Concept EIS are anticipated.	Where relevant, proposed control measures would be identified through a separate assessment of consistency following approval of SSI-22765520.	N/A	Y	

12. Consistency with the Approved Project

Question	Response
Is the project (including the proposed changes) consistent with the conditions of approval?	Yes. The proposed works would be consistent with the conditions of approval. As discussed in Section 1 and Section 2 of this Consistency Assessment, Sydney Metro has 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 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. This would ensure the stability of the excavation, minimise potential ground movement and settlement and make the excavation safe for construction workers. It would also minimise potential program delays to Sydney Metro West, including to the opening of the line to passenger services. The detailed noise and vibration technical assessment for the crossover cavern at this location to be excavated by non-TBM tunnelling would impact fewer receivers and have a lower noise level than those expected to be experienced by TBM tunnelling in the same location. Should the Modification Request be approved by the Department of Planning and Environment, Sydney Metro would undertake the excavation of the Pyrmont crossover cavern outside of standard construction hours to realise the safety and program benefits outlined above. Impacts associated with out of hours non-TBM tunnelling for the Pyrmont crossover cavern would be consistent with those assessed in the EIS for the Approved Project.
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 elements of the Approved Project. The purpose of the proposed revised alignment and the relocated crossover is to improve future operational ability of the Sydney Metro West line, and is considered consistent with the objectives and functions of the Approved Project.
Are the environmental impacts of the proposed change consistent with the impacts of the Approved Project?	Yes. The revised tunnel alignment and relocation of the crossover cavern to Pyrmont would result in some minor changes to the impacts as assessed in the EIS and Submissions Report for the Approved Project, however the level of impact would remain consistent. Potential impacts to receivers would be adequately addressed through the application of the mitigation measures provided in the Environmental Impact Statement, Submissions Report, and the Instrument of Approval.
Is the change within the envelope of what has been approved?	Yes. The proposed changes would be located underground, and the surface level approved Pyrmont construction sites would not change. The proposed crossover cavern would be located within tunnel alignment required for the Approved Project, which has undergone a minor design review to improve construction and operational efficiencies. This cavern would be an extension of the cavern required for Pyrmont Station and would remain as a permanent excavation required to support operation of the station. The proposed revised tunnel alignment is shown in Figure 5. The length and depth of the revised tunnels would be generally consistent with the Approved Project. The proposed realignment would be generally within the Approved Project corridor. Chapter 5 of the EIS notes that the tunnel alignment is indicative and subject to design development and construction planning. The proposed changes are therefore considered to be consistent with the Approved Project.

Question	Response
Are there any new environmental impacts as a result of the proposed works/project changes?	The proposed works would not result in any new environmental impacts beyond those considered in the Approved Project. The proposed changes would have negligible or minor environmental impacts relative to the impact of the Approved Project. All impacts identified for the proposed change would be adequately mitigated through the application of the mitigation measures provided in the EIS, Submissions Report and conditions of approval.
Are the impacts of the proposed activity/works known and understood?	Yes. The impacts of the proposed works are understood and will be managed by implementing the control measures within this document, and relevant plans.
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 so as to avoid an adverse impact.
Is the proposed change/s consistent with the approval (having regard to the above assessment)?	☒ Yes ☐ No

13. 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 Sydney Metro West Environmental Impact Statement – Major civil construction between The Bays and Sydney CBD (Sydney Metro, November 2021), Submissions Report (April 2022), and 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:	Isabella Caruso and Jessie Strange	Signature:	Jessie Strange
Title:	Planning Officer / Planning Manager		
Company:	Sydney Metro	Date:	25/01/23

Assessment Supporting Signature

Application supported and submitted by			
Name:	Yvette Buchli	Date:	25/01/2023
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:	27 January 2023
Title:	Director Sydney Metro West, Environment, Sustainability and Planning	Comments:	
Signature:			

Appendix A – Detailed noise and vibration technical assessment: Pyrmont crossover cavern

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 - Pyrmont Crossover Cavern

16 January 2023

John Holland CPB Contractors Ghella JV

TM372-02-1-07F01 SMW-ETP_NVCA-Pyrmont (r2)

40 YEARS 1982-2022 ACOUSTIC ENGINEERING EXCELLENCE

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16.01.2023	Update to include JCG comments	-	2	T. Gowen	-	M. Tabacchi

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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

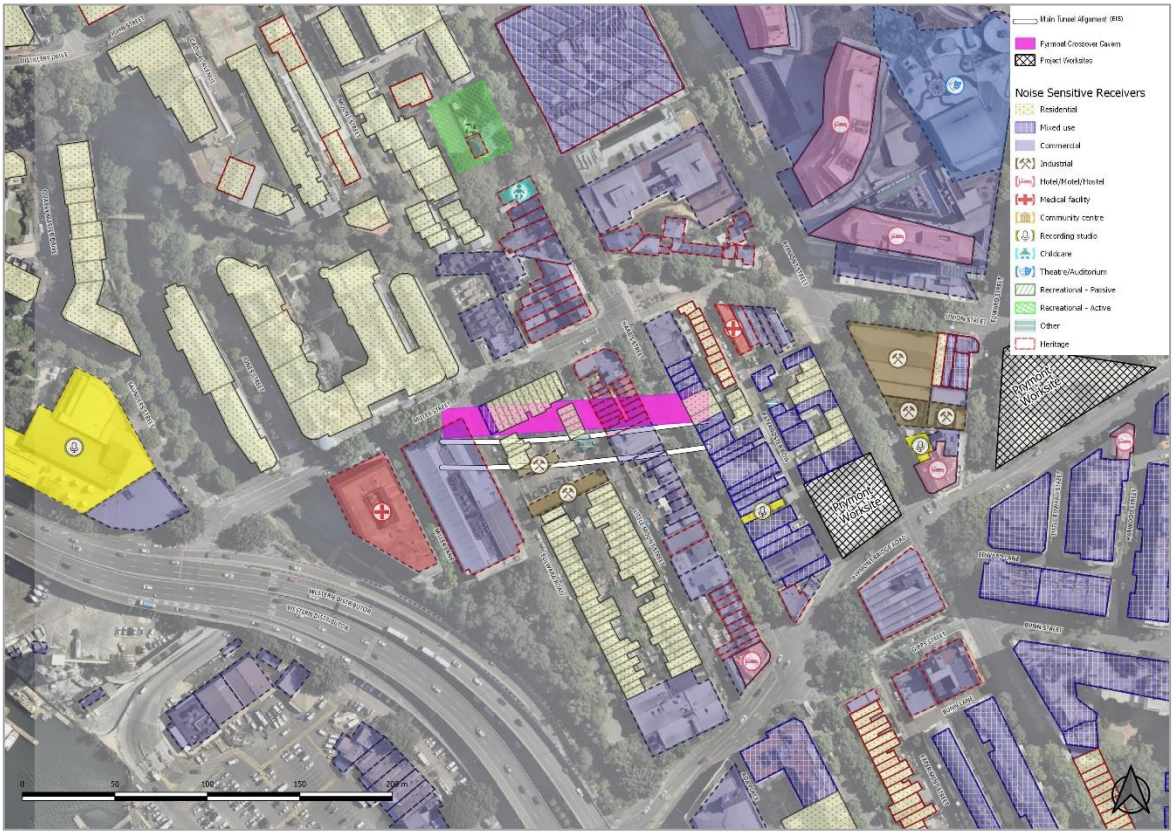
The proposed change involves the relocation of the crossover cavern from The Bays construction and TBM launch site (eastern end of the station) to Pyrmont Station construction site (western end of the station).

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 Pyrmont Station cavern.

This memorandum provides a technical review of the potential ground-borne noise and vibration impacts associated with the proposed change to the crossover cavern location. The location of the revised crossover cavern is shown in Figure 1.

Figure 1: Revised crossover cavern location, western end of Pyrmont Station



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

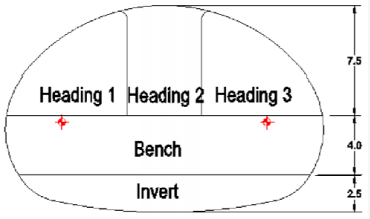
Assessment of ground-borne noise and vibration impacts from the construction works were determined by predicting noise levels using a 3-dimensional model of the cross-over cavern and surrounding noise and vibration sensitive receivers developed for the Project. This was compared to the predicted ground-borne noise and vibration impacts from TBM excavation of the corresponding section of the EIS mainline tunnel (see Figure 1). 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.

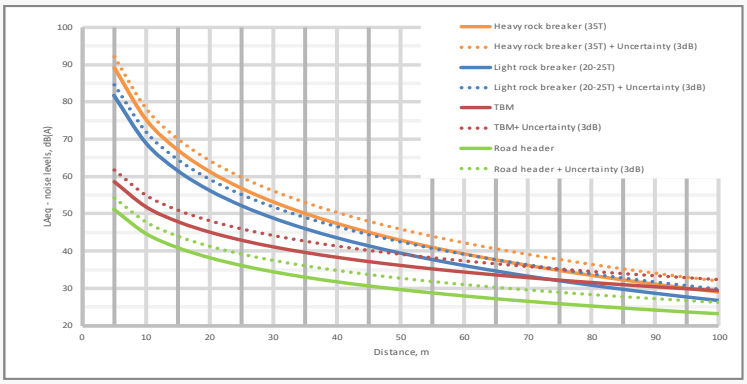
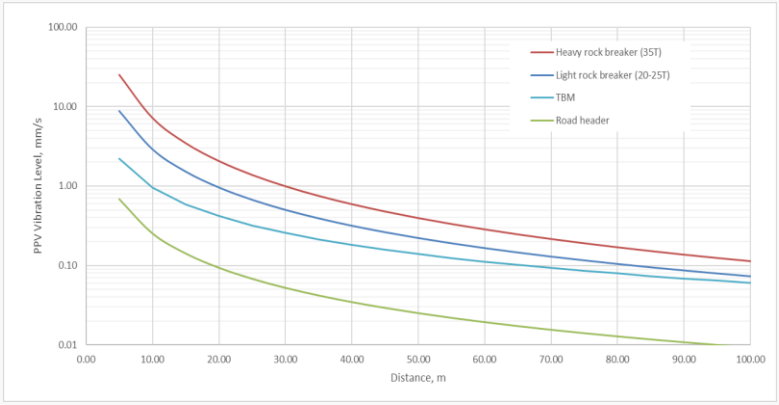
Key details regarding the construction work methodology, the likely plant and equipment, and hours of operation were informed by the JCG Design and Construction Teams. The ground-borne noise and vibration predictions in this report represent a realistic worst-case scenario when excavation occurs at the 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 3 and Figure 4. 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 crossover cavern 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 tunnel/ duct/ adit information was provided by JCG based on SMWSTETP-WPS-SCB-ST100-TU-SKE-357110) with offset to the tunnel crown.
Excavation methodology	The Pyrmont crossover cavern and station cavern are mostly in hard ground/ rock (i.e. Hawksbury sandstone). These caverns would be excavated using up to 3 roadheaders at once and installation of ground support, including rock bolting and shotcrete, as described below and in Figure 2: - Top heading (average advance rate 20 metres per week) - Bench, about 150 metres behind the heading (average advance rate 5 metres per week) **Figure 2: Cross section of Pyrmont crossover cavern**  Ground-borne noise and vibration of the TBM excavation of the EIS tunnel alignment was based on the assumptions used in the EIS (Section 4.2 of Technical Paper 2: Noise and Vibration [4].

Parameters	Inputs
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 3.
Ground-borne noise sources:	**Figure 3: 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 4: 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 during crossover cavern 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 crossover cavern section of the tunnel alignment, are also presented to compare with GBN impacts from the roadheader excavation of the relocated crossover cavern 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.

Figures showing ground-borne noise impacts during crossover cavern excavation and TBM excavation are provided in APPENDIX C.

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) and the likely perceived noise impact. Table 4.3 presents the number of construction noise affected other sensitive receivers. Detailed predicted noise levels for nearby receivers are presented 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)
Crossover cavern top heading	0	0	0	16	0	0	16	0	0	50	0	0
TBM excavation of main alignment (EIS)	7	0	0	56	0	0	56	0	0	91	7	0

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)
Crossover cavern heading (roadheader)	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	1	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 ground-borne noise NML 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 ground-borne noise levels resulting from the excavation of the relocated crossover cavern at Pyrmont are typically below the daytime ground-borne noise NML for all receivers. This is consistent with the EIS impacts from the TBM excavation of the mainline tunnel section that corresponds to the Pyrmont crossover.

The predicted GBN impacts from the revised location of the crossover cavern are consistent with the EIS.

4.1.2 Out of hours work

The results summarised in Table 4.2 show that nearby residential receivers are predicted to be ground-borne noise affected by the road header excavation of the Pyrmont crossover caverns outside standard construction hours. Predicted ground-borne noise levels are up to 10dB above the ground-borne NML. Predicted ground-borne noise levels from the TBM excavation of the mainline tunnel in the EIS are up to 10dB above the ground-borne NML at residential and other sensitive receivers (if in use) during the evening period, with and up to 20 dB(A) above the ground-borne NML at residential receivers at night.

The predicted GBN impacts from the revised location of the crossover cavern 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	
	Crossover cavern top heading (roadheader)	TBM main alignment (EIS)
Structural damage to buildings		
Reinforced or frame structures (Line 1)[1]	0	0
Screening criteria - non-heritage structures[1, 2]	0	0
Screening criteria - heritage structures[1, 2]	0	0
Disturbance to building occupants		
Critical areas[2,7]	0	0
Residences - Day	0	0
Residences - Night	0	0
Offices[4,7]	0	0
mat	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.

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 Pyrmont crossover cavern excavation. This is consistent with the predicted vibration impacts from the TBM excavation of the main tunnel alignment assessed in the EIS.

4.2.2 Heritage structures at Pyrmont

No heritage structures are expected to be above the vibration screening limit for cosmetic damage during the Pyrmont crossover cavern excavation. This is consistent with the predicted vibration impacts on heritage structures from the TBM excavation of the main tunnel alignment assessed in the EIS.

4.2.3 Human annoyance

As can be noted from Table 4.4, vibration levels predicted 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 Pyrmont crossover cavern excavation. This is consistent with the predicted vibration impacts from the TBM excavation of the main tunnel alignment assessed in 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.	See Table 5.2. Engagement and consultation details, where applicable, will be presented in DNVIS 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.	Respite periods, where applicable, will be outlined in DNVIS for tunnelling.
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.	See Table 5.2

No.	Requirement	Reference
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 acoustic sheds for the station cavern excavation would also be utilised for the crossover cavern
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
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

No.	Requirement	Reference
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 – 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 – 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

JCG will commence consultation with potentially affected stakeholders including business and residential receivers as soon as possible, following contract award. The consultation will include specific mitigation and management measures applicable to the tunnelling works at Pyrmont. A summary 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 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		Yes	Yes	Project team shall proactively contact nearby sensitive receivers, particularly those which may have special requirements (e.g. recording studios, hotels).
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 crossover cavern 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 tunnelling 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

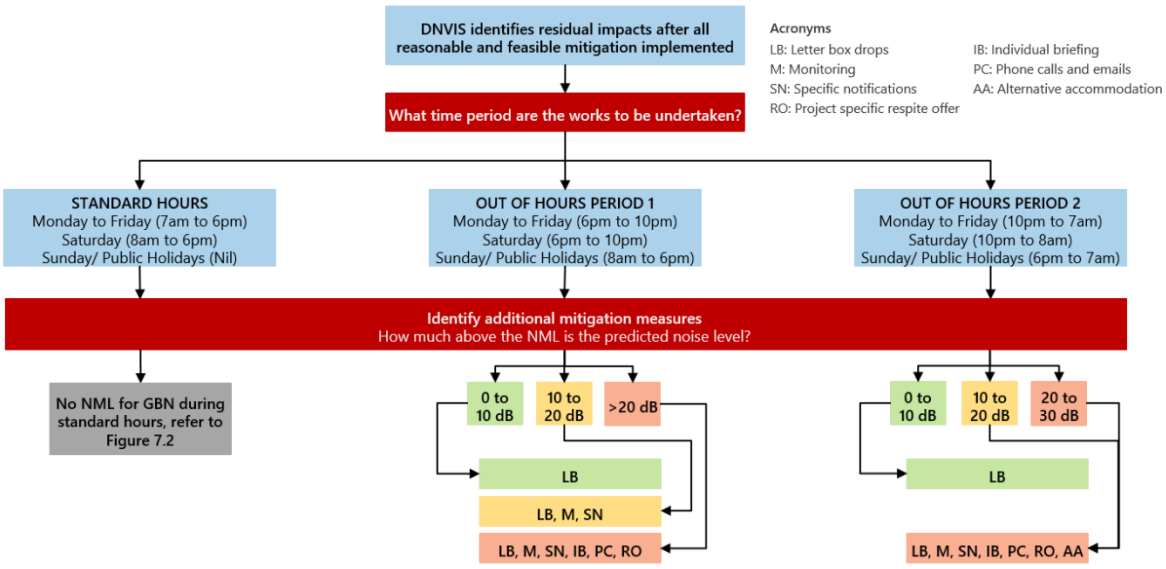


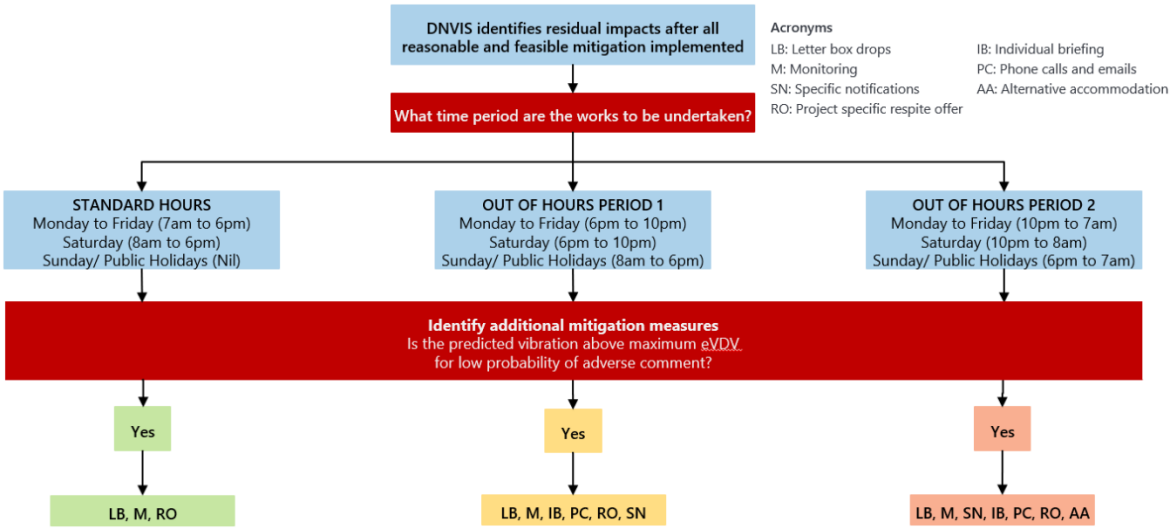
Figure 5.1 presents a summary of the additional management measures applicable for construction activities where, after application of all reasonable and feasible mitigation options, ground-borne noise levels are still above the NMLs.

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 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 tunnelling 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 relocation of the crossover cavern from The Bays construction and TBM launch site (eastern end of the station) to Pyrmont Station construction site (western end of the station) 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 Pyrmont crossover cavern excavation with road headers is predicted to have lower ground-borne noise impacts on residential and other noise sensitive receivers during standard and outside standard construction hours, compared with the TBM excavation of the EIS mainline alignment section overlapping the crossover cavern. The ground-borne noise impacts predicted from the proposed relocation of the crossover cavern from The Bays to Pyrmont are consistent with the ground-borne noise impacts predicted in the EIS.

Recommendations have been provided to manage impacts 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 ground-borne vibration levels from tunnelling excavation at Pyrmont with road headers for the relocated crossover cavern, and with TBM for the EIS mainline tunnel are below the screening criteria for human annoyance and structural damage. The risk of structural damage from tunnelling excavation at Pyrmont is considered low during the Pyrmont crossover cavern excavation. Furthermore, the probability of adverse comment caused by tunnelling induced vibration is also low during the Pyrmont crossover cavern excavation. The predicted vibration impacts from the proposed relocation of the crossover cavern from The Bays to Pyrmont are consistent with the ground-borne vibration impacts assessed in the EIS.

Recommendations have been provided to manage impacts 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

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
NCA04	60	55	52	50
NCA05	62	57	54	51
NCA06	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
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

A3 Original | Co-ordinate System: MGA Zone 56

0 50 100 150 200 m

1:3,000 At A3

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

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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) **CONSISTENCY ASSESSMENT - PYRMONT CROSSOVER CAVERN**

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

Plot Date: 12/01/23 - 14:22 Layout: TM372 GBN&V Cavern Template

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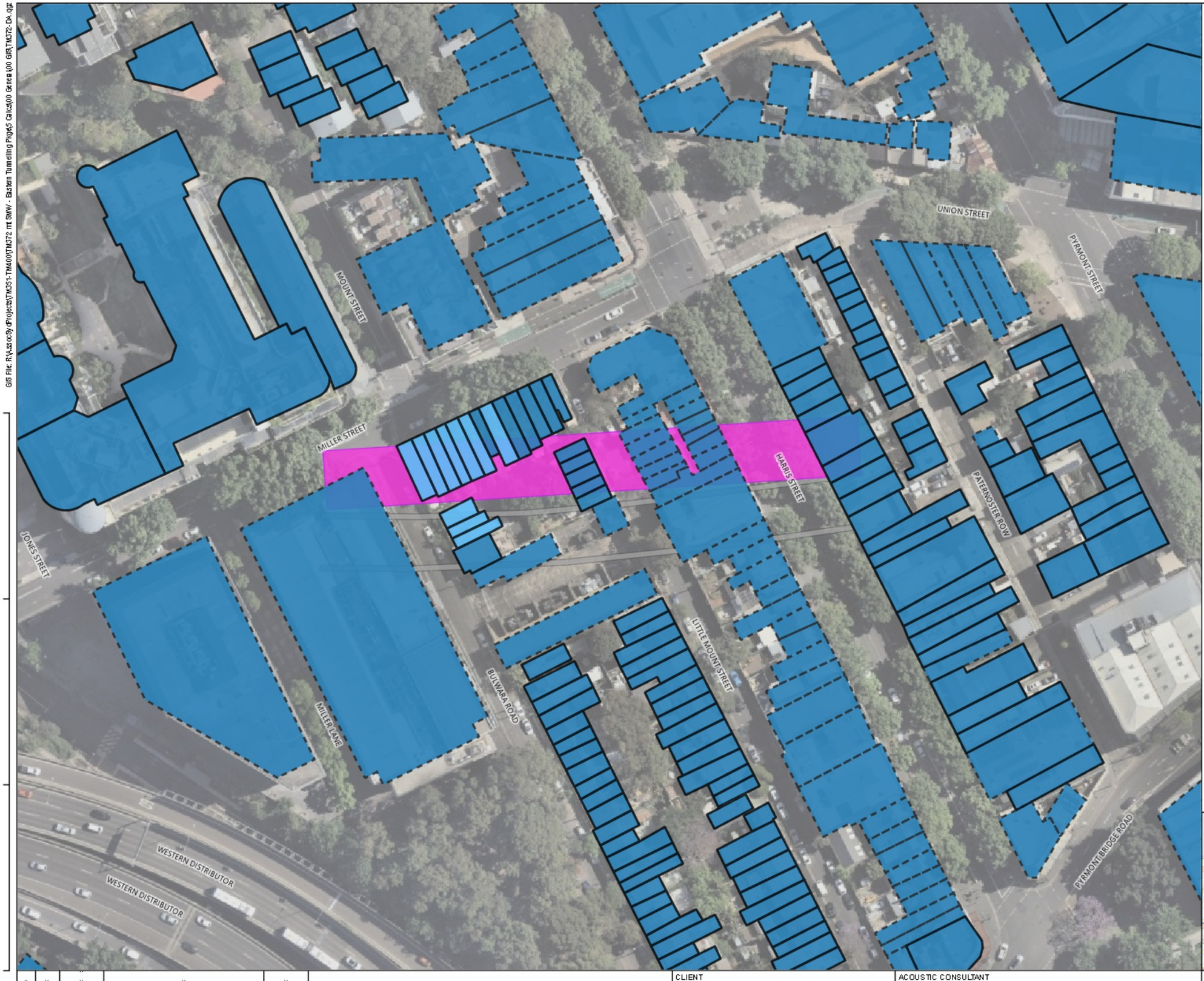

LEGEND

- Residential and Hotels
- Non-Residential

Pyrmont Tunnel Alignment

- EIS Mainline Alignment
- Pyrmont Crossover Cavern

Predicted Exceedance of Ground-borne NML dB(A) (Evening Period)

- Compliant
- 0-2 dB(A) above GNML (Partial Compliance)
- 2-10 dB(A) above GNML
- 10-20 dB(A) above GNML
- 20-30 dB(A) above GNML

Notes :

- Predicted levels represent the typical maximum Ground Borne Noise (GBN) level that the receivers may experience for a limited time when the excavation plant is in the closest section of the tunnel and will reduce as the underground works move further away.

- The predicted GBN levels are calculated at the ground floor level.

REV	BY	DATE	DESCRIPTION	APPROVER
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N

FULL SIZE A3, REDUCED TO A4

A3 Original

Co-ordinate System: MGA Zone 56

NOTE: Do not scale from this drawing.

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SYDNEY METRO WEST
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Predicted Maximum GBN impacts during
Pyrmont Crossover Cavern excavation (Top Heading)
Excavation method: Roadheader
Assessment period: Evening

Plot Date: 12/01/23 - 14:22 Layout: TM372 GBN&V Cavern Template

GIS File: R:\Assets\By dProjects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkg\45 Calcs\00 General\00 GIS\TM372-DA.qgz

LEGEND

- Residential and Hotels
- Non-Residential

Pyrmont Tunnel Alignment

- EIS Mainline Alignment
- Pyrmont Crossover Cavern

Predicted Exceedance of Ground-borne NML dB(A) (Evening Period)

- Compliant
- 0-2 dB(A) above GNML (Partial Compliance)
- 2-10 dB(A) above GNML
- 10-20 dB(A) above GNML
- 20-30 dB(A) above GNML

Notes :

- Predicted levels represent the typical maximum Ground Borne Noise (GBN) level that the receivers may experience for a limited time when the excavation plant is in the closest section of the tunnel and will reduce as the underground works move further away.

- The predicted GBN levels are calculated at the ground floor level.

REV	BY	DATE	DESCRIPTION	APPROVER
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A3 Original | Co-ordinate System: MGA Zone 56

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FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

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SYDNEY METRO WEST
Eastern Tunneling Package
Predicted Maximum GBN impacts during EIS Mainline Alignment excavation
Excavation method: TBM
Assessment period: Evening

Plot Date: 12/01/23 - 14:22 Layout: TM372 GBNMV Cavern Template

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LEGEND

- Residential and Hotels
- Non-Residential

Pyrmont Tunnel Alignment

- EIS Mainline Alignment
- Pyrmont Crossover Cavern

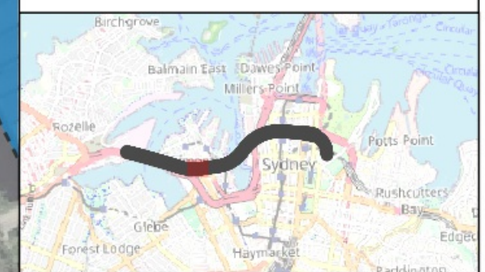
Predicted Exceedance of Ground-borne NML dB(A) (Night Period)

- Compliant
- 0-2 dB(A) above GNML (Partial Compliance)
- 2-10 dB(A) above GNML
- 10-20 dB(A) above GNML
- 20-30 dB(A) above GNML

Notes :

- Predicted levels represent the typical maximum Ground Borne Noise (GBN) level that the receivers may experience for a limited time when the excavation plant is in the closest section of the tunnel and will reduce as the underground works move further away.

- The predicted GBN levels are calculated at the ground floor level.



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NOTE: Do not scale from this drawing.

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Predicted Maximum GBN impacts during
Pyrmont Crossover Cavern excavation (Top Heading)
Excavation method: Roadheader
Assessment period: Night

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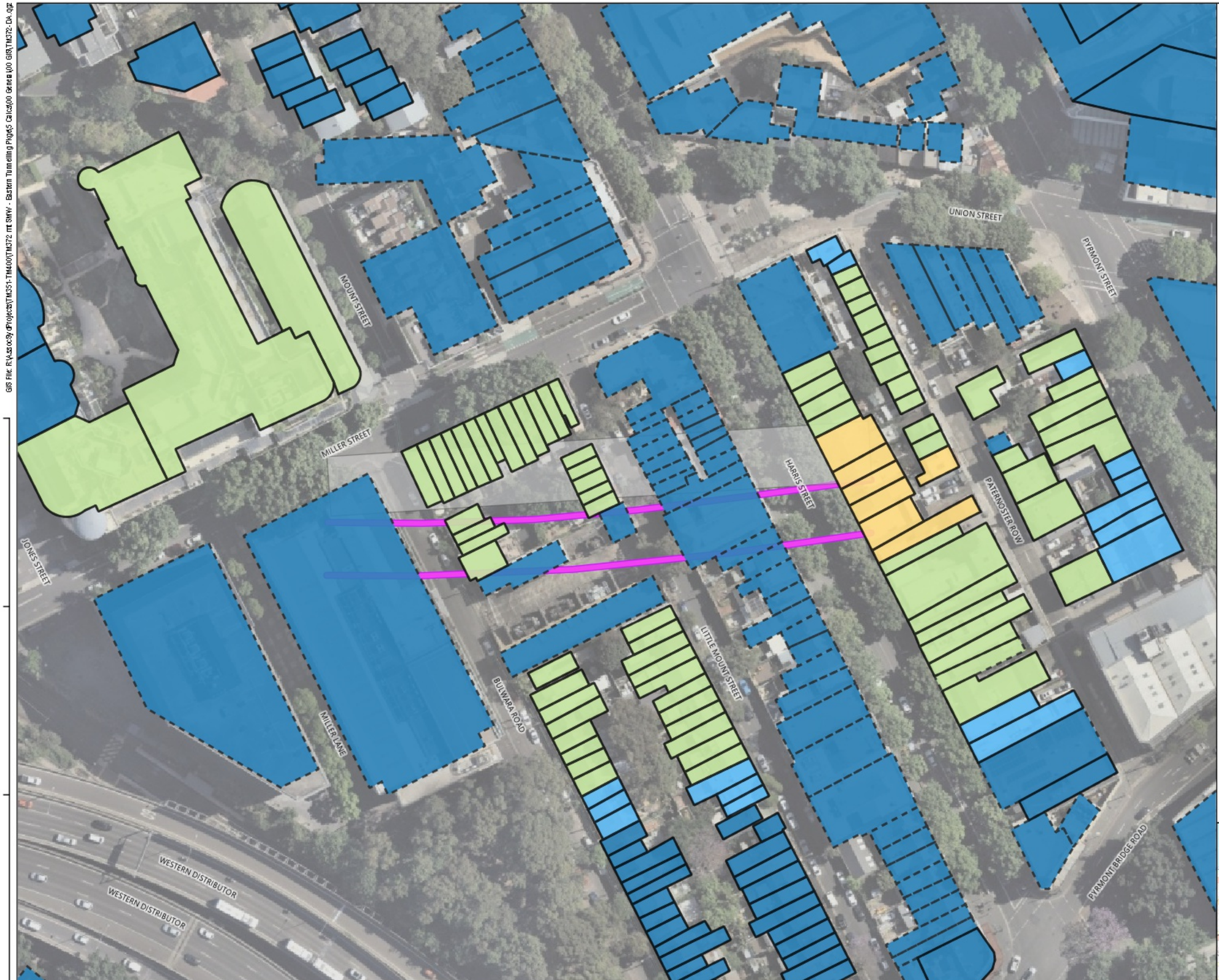


LEGEND

- Residential and Hotels
- Non-Residential

Pyrmont Tunnel Alignment

- EIS Mainline Alignment
- Pyrmont Crossover Cavern

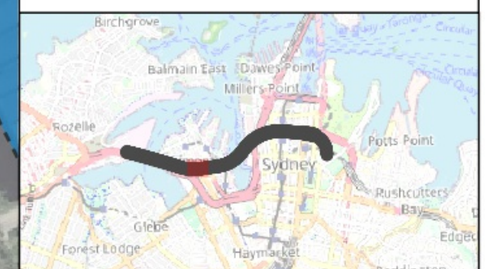
Predicted Exceedance of Ground-borne NML dB(A) (Night Period)

- Compliant
- 0-2 dB(A) above GNML (Partial Compliance)
- 2-10 dB(A) above GNML
- 10-20 dB(A) above GNML
- 20-30 dB(A) above GNML

Notes :

- Predicted levels represent the typical maximum Ground Borne Noise (GBN) level that the receivers may experience for a limited time when the excavation plant is in the closest section of the tunnel and will reduce as the underground works move further away.

- The predicted GBN levels are calculated at the ground floor level.



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A3 Original | Co-ordinate System: MGA Zone 56

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FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

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SYDNEY METRO WEST
Eastern Tunneling Package
Predicted Maximum GBN impacts during EIS Mainline Alignment excavation
Excavation method: TBM
Assessment period: Night

APPENDIX D Construction ground-borne vibration impacts

Plot Date: 12/01/23 - 14:38 Layout: TM372 GBNV Cavern Template

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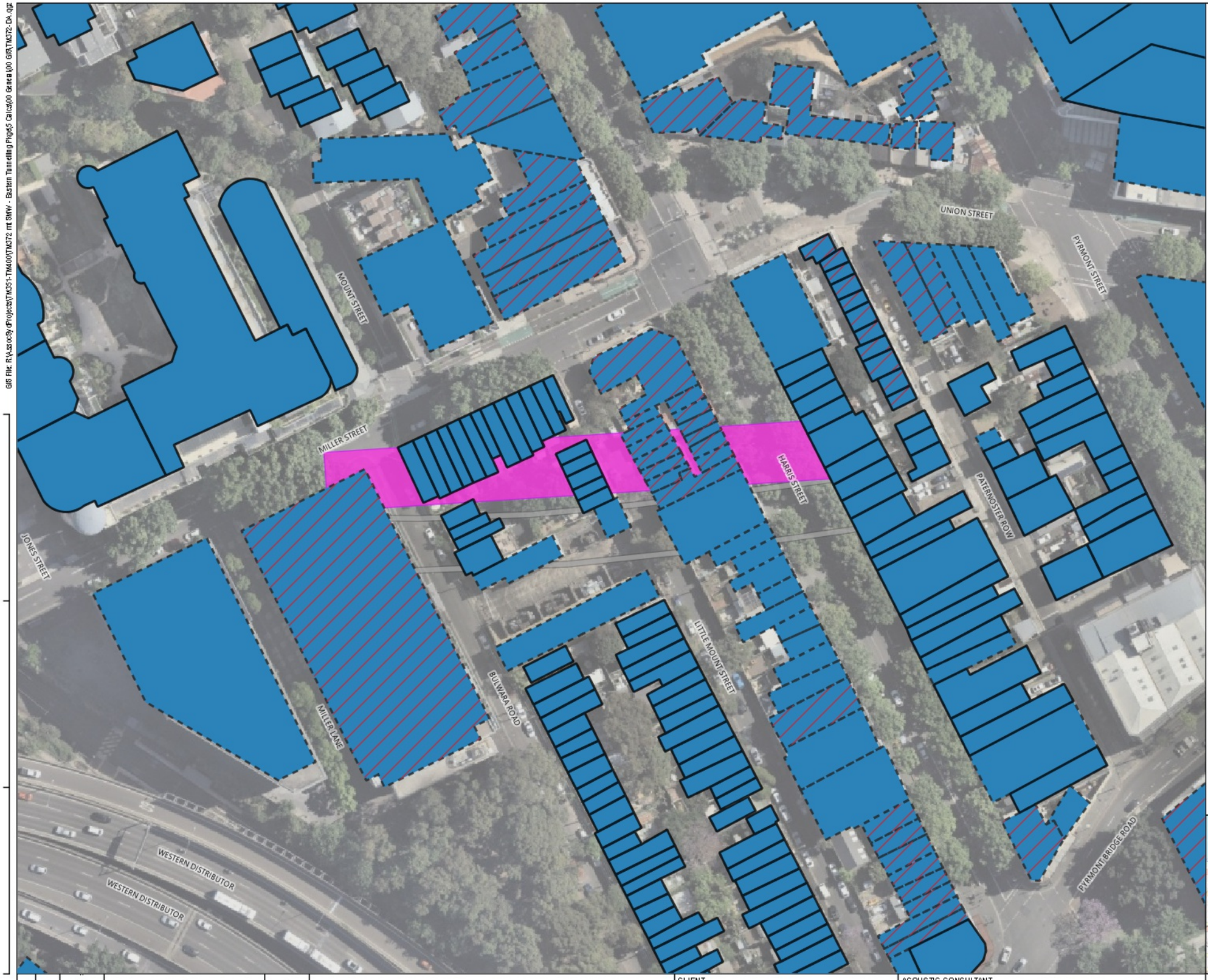

LEGEND

- Residential and Hotels
- Non-Residential
- Heritage

Pyrmont Tunnel Alignment

- EIS Mainline Alignment
- Pyrmont Crossover Cavern

Predicted Maximum Ground-borne Vibration PPV (mm/s) (Day Period)

- < 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)

Notes:

- This assessment is based on the underground excavation works being undertaken at the closest location to the nearby receivers.

- The maximum vibration levels are based on the initial screening approach which assumes continuous vibration levels.

- Building occupants often assume that building damage is occuring when they feel vvibration or observe rattling of loose objects. However the level of vibration which people perceive is far lower than the vibration levels that could cause damage to structures.

REV	BY	DATE	DESCRIPTION	APPROVER
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A3 Original | Co-ordinate System: MGA Zone 56

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FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

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SYDNEY METRO WEST
Eastern Tunneling Package
Predicted Maximum GBV impacts during
Pyrmont Crossover Cavern excavation (Top Heading)
Excavation method: Roadheader
Assessment period: Day

Plot Date: 12/01/23 - 14:38 Layout: TM372 GBNWV Cavern Template

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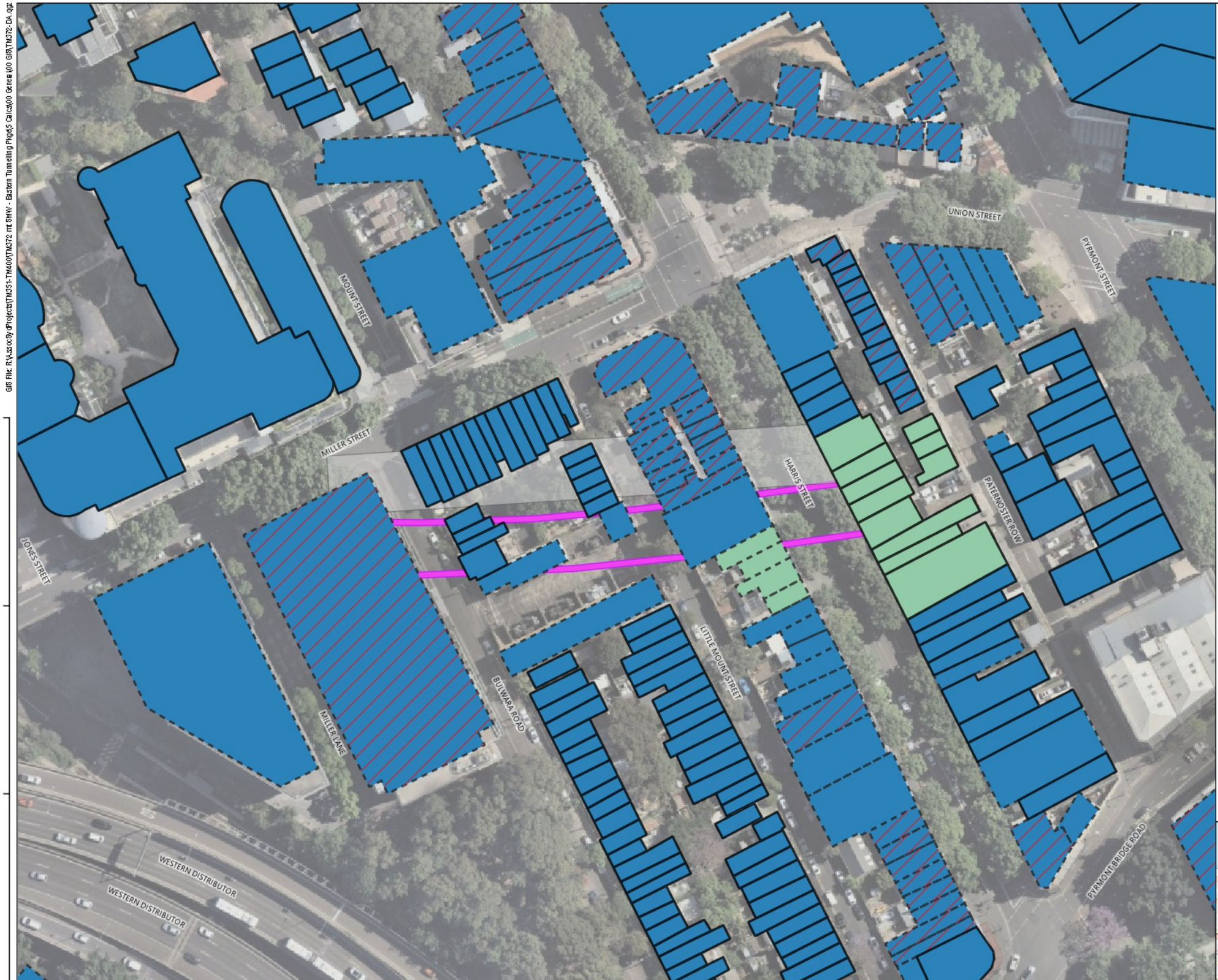

LEGEND

- Residential and Hotels
- Non-Residential
- Heritage

Pyrmont Tunnel Alignment

- EIS Mainline Alignment
- Pyrmont Crossover Cavern

Predicted Maximum Ground-borne Vibration PPV (mm/s) (Day Period)

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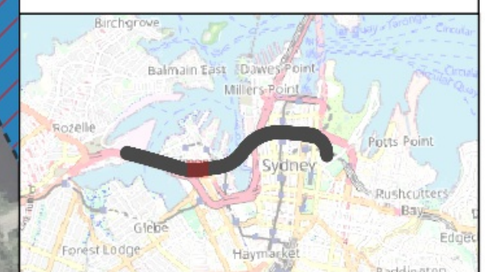

REV	BY	DATE	DESCRIPTION	APPROVER
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FULL SIZE A3, REDUCED TO A4

A3 Original | Co-ordinate System: MGA Zone 56 | NOTE: Do not scale from this drawing.

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SYDNEY METRO WEST
Eastern Tunneling Package
Predicted Maximum GBV impacts during EIS Mainline Alignment excavation
Excavation method: TBM
Assessment period: Day

Plot Date: 12/01/23 - 14:38 Layout: TM372 GBNV Cavern Template

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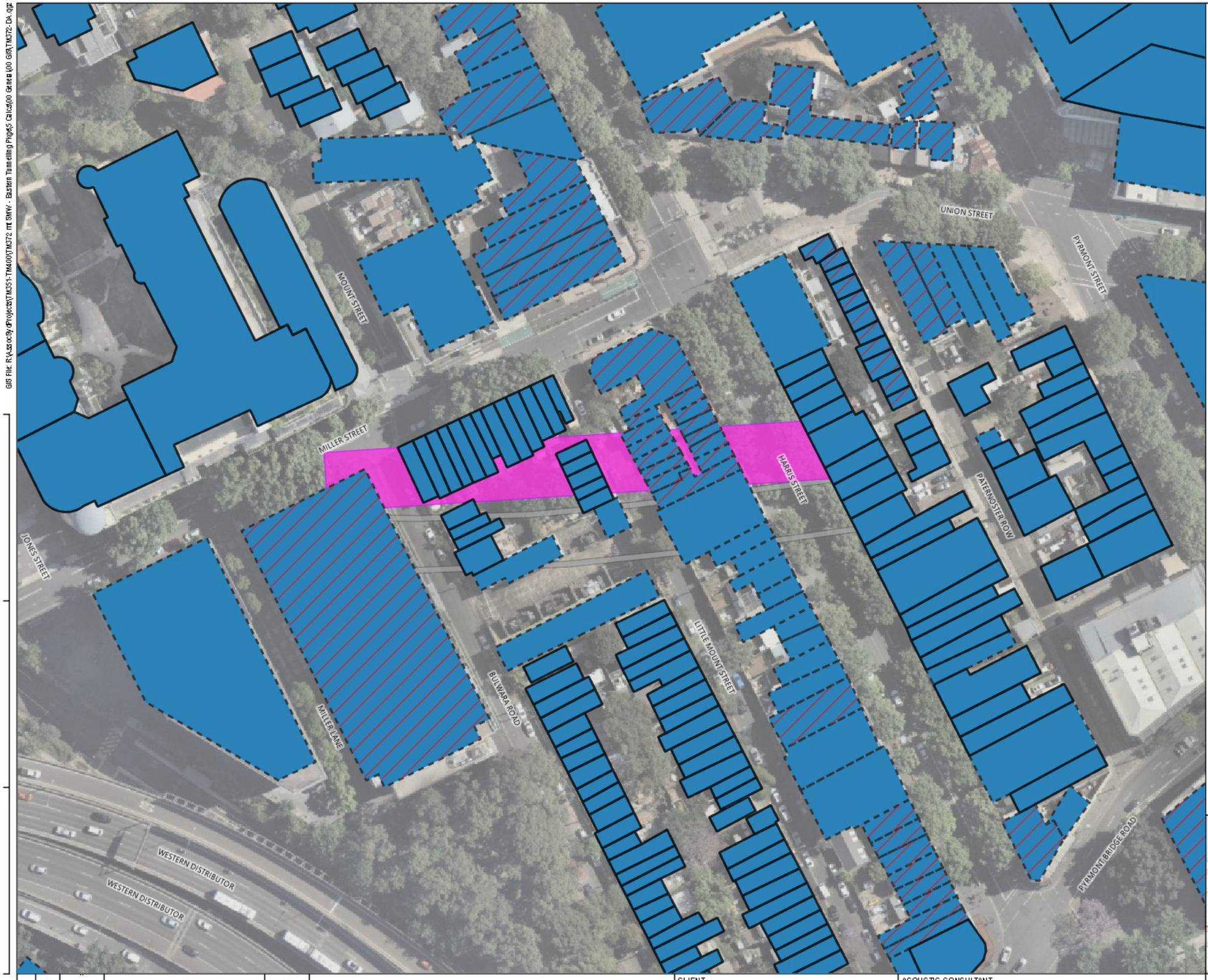

LEGEND

- Residential and Hotels
- Non-Residential
- Heritage

Pyrmont Tunnel Alignment

- EIS Mainline Alignment
- Pyrmont Crossover Cavern

Predicted Maximum Ground-borne Vibration PPV (mm/s) (Night Period)

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REV	BY	DATE	DESCRIPTION	APPROVER
r0	DA	12/01/23	Prepare figures	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 10 20 30 40 50 m

1:1,000

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

N

CLIENT

SYDNEY METRO WEST

JOHN HOLLAND CPB Ghella

ACOUSTIC CONSULTANT

RENZO TONIN & ASSOCIATES

inspired to achieve

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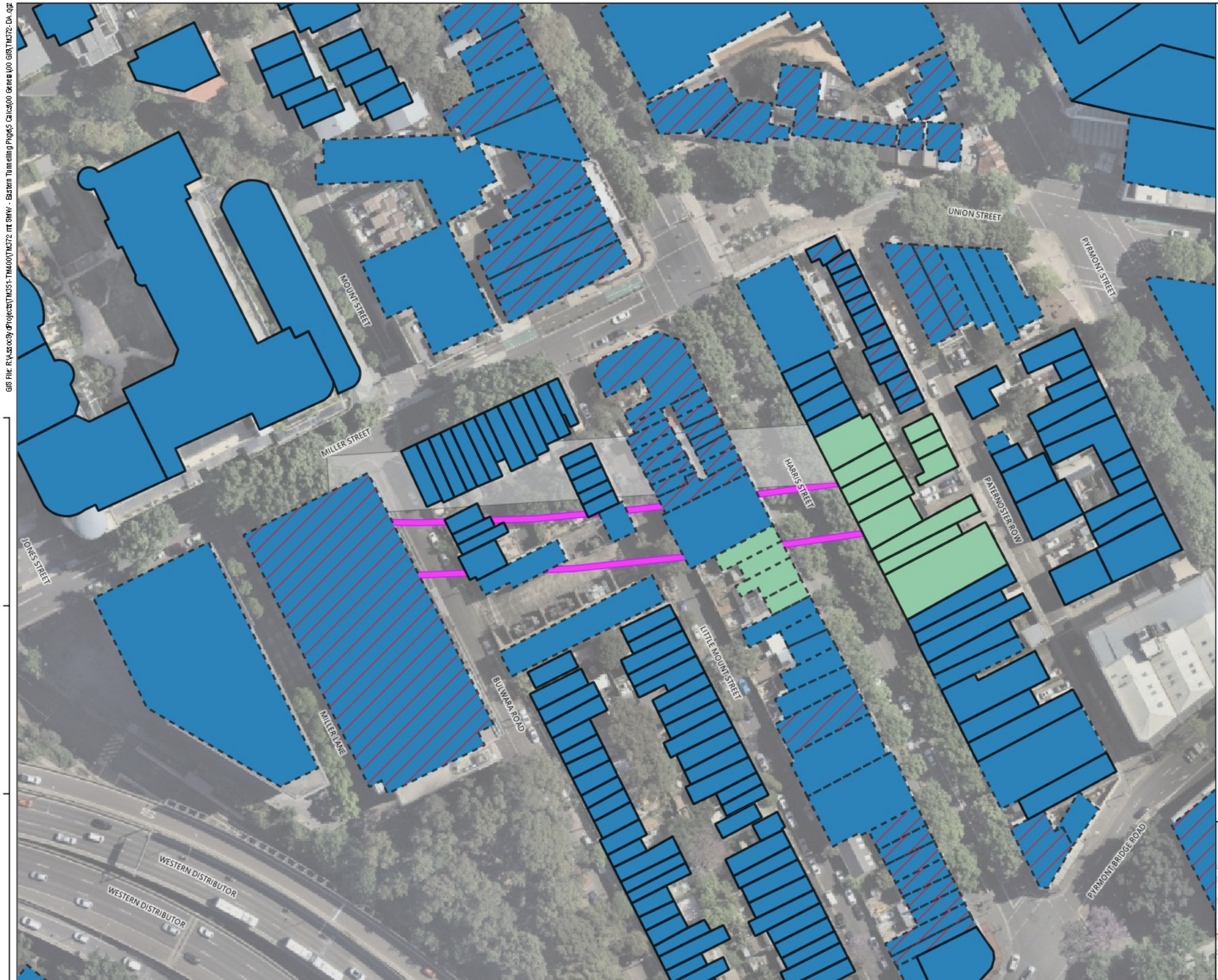
SYDNEY METRO WEST
Eastern Tunneling Package
Predicted Maximum GBV impacts during
Pyrmont Crossover Cavern excavation (Top Heading)
Excavation method: Roadheader
Assessment period: Night

Plot Date: 12/01/23 - 14:38 Layout: TM372 GBNMV Cavern Template

GIS File: R:\Assets\ByDProjects\TM351-TM400\TM372 mt SMW - Eastern Tunnelling Pkg\45 Calcs\00 General\00 GIS\TM372-DA.qgz



LEGEND

- Residential and Hotels
- Non-Residential
- Heritage

Pyrmont Tunnel Alignment

- EIS Mainline Alignment
- Pyrmont Crossover Cavern

Predicted Maximum Ground-borne Vibration PPV (mm/s) (Night Period)

- < 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)

Notes:

- This assessment is based on the underground excavation works being undertaken at the closest location to the nearby receivers.

- The maximum vibration levels are based on the initial screening approach which assumes continuous vibration levels.

- Building occupants often assume that building damage is occuring when they feel vvibration or observe rattling of loose objects. However the level of vibration which people perceive is far lower than the vibration levels that could cause damage to structures.

REV	BY	DATE	DESCRIPTION	APPROVER
r0	DA	12/01/23	Prepare figures	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 10 20 30 40 50 m

1:1,000

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

N

CLIENT

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SYDNEY METRO WEST
Eastern Tunneling Package
Predicted Maximum GBV impacts during EIS Mainline Alignment excavation
Excavation method: TBM
Assessment period: Night