Detailed Noise and Vibration Impact Statement - Tunnelling

Sydney Metro Western Sydney Airport Station Boxes and Tunnelling Works

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Details of Revision Amendments

Document Control

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

Amendments

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

Revision Details

Revision	Details
A	Initial Development
B	For Infomation

RENZO TONIN & ASSOCIATES
inspired to achieve

Acoustics
Vibration
Structural Dynamics

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

Detailed Noise and Vibration Impact Statement - Tunnelling

29 August 2023

CPB Ghella

TM008-07-01F01 SMWSA-SBT_DNVIS-TUN (r6)

40 YEARS 1982-2022 ACOUSTIC ENGINEERING EXCELLENCE

Sydney Melbourne Brisbane Gold Coast Kuwait Singapore
Renzo Tonin & Associates ABN 29 117 462 861
Level 1/418A Elizabeth St SURRY HILLS NSW 2010 | PO Box 877 STRAWBERRY HILLS NSW 2012
P (02) 8218 0500 F (02) 8218 0501 sydney@renzotonin.com.au www.renzotonin.com.au

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1 Introduction

1.1 Purpose

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

1.2 Relevant requirements and application of this DNVIS

This DNVIS provides a noise and vibration assessment of the tunnel boring machine (TBM) tunnelling, including cross passage excavation and TBM breakthrough, traverse and re-launch. Noise and vibration from other SBT work sites have been addressed separately through DNVISs for each site.

1.2.1 Off-Airport (NSW) land

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

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

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

- Preparatory Works: including demolition, site access and other local area works, site levelling/grading, utility and temporary services work, erection of demountable buildings and noise barriers, tunnelling preparatory works and use of ancillary facilities including onsite parking which has already been addressed in the Preparatory Construction Environmental Management Plan (CEMP) and in the DNVISs (ref: TM008-02-10F01 SMWSA-SBT_DNVIS-SE) and local area and utility works (ref: TM008-02-11F01 SMWSA-LAUW DNVIS; TM008-02-11F02 SMWSA-LAUW STH DNVIS).
- Bulk Excavation and Tunnelling Works: including the Preparatory Works scope including bulk excavation, acoustic shed/enclosure installation, tunnelling and cross passage installation (refer to Section 2.3 for DNVIS references).

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

1.2.2 On-Airport (Commonwealth) land

Sydney Metro Western Sydney Airport Noise and Vibration Construction Environmental Management Plan applicable to Airport Rail Development (NV CEMP) [2] requires:

A Detailed Noise and Vibration Impact Statement (DNVIS) is a document developed by Contractors which clarifies assumptions made in the EIS. A DNVIS:

- *allows the Contractor to provide more detailed quantitative assessments of the EIS due to their better understanding of the exact equipment list and construction methodology they will be using to complete the scope of works*
- *are typically written with a focus on specific activities or locations and consider works carried out inside and outside of standard work hours. Working outside of standard construction hours*

The aim of this assessment is to minimise the impact of construction noise and vibration on sensitive receivers and demonstrate compliance with the requirements of the Western Sydney Airport Plan.

1.3 Quality assurance

The work documented in this report was carried out in accordance with the Renzo Tonin & Associates Quality Assurance System, which is based on Australian Standard / NZS ISO 9001. Appendix A contains a glossary of acoustic terms used in this report.

2 Description of construction works and hours

2.1 Summary of works addressed in this DNVIS

The TBM tunnelling for this project comprises of two twin tunnels, one at the northern end of the Project between Orchard Hills (OHE) and St Marys (STM) and one at the southern end of the Project, between Western Sydney Airport Business Park (ABP) and Aerotropolis (AEC), as shown on Figure 1 and Figure 2 and furthered detailed in Figure B1 in APPENDIX B. The Sydney Metro – Western Sydney Airport, Surface and Civil Alignment Works is a surface works project that connects the northern and southern tunnels. This project is assessed separately.

Figure 1: Twin tunnels between Orchard Hills (OHE) and St Marys (STM)

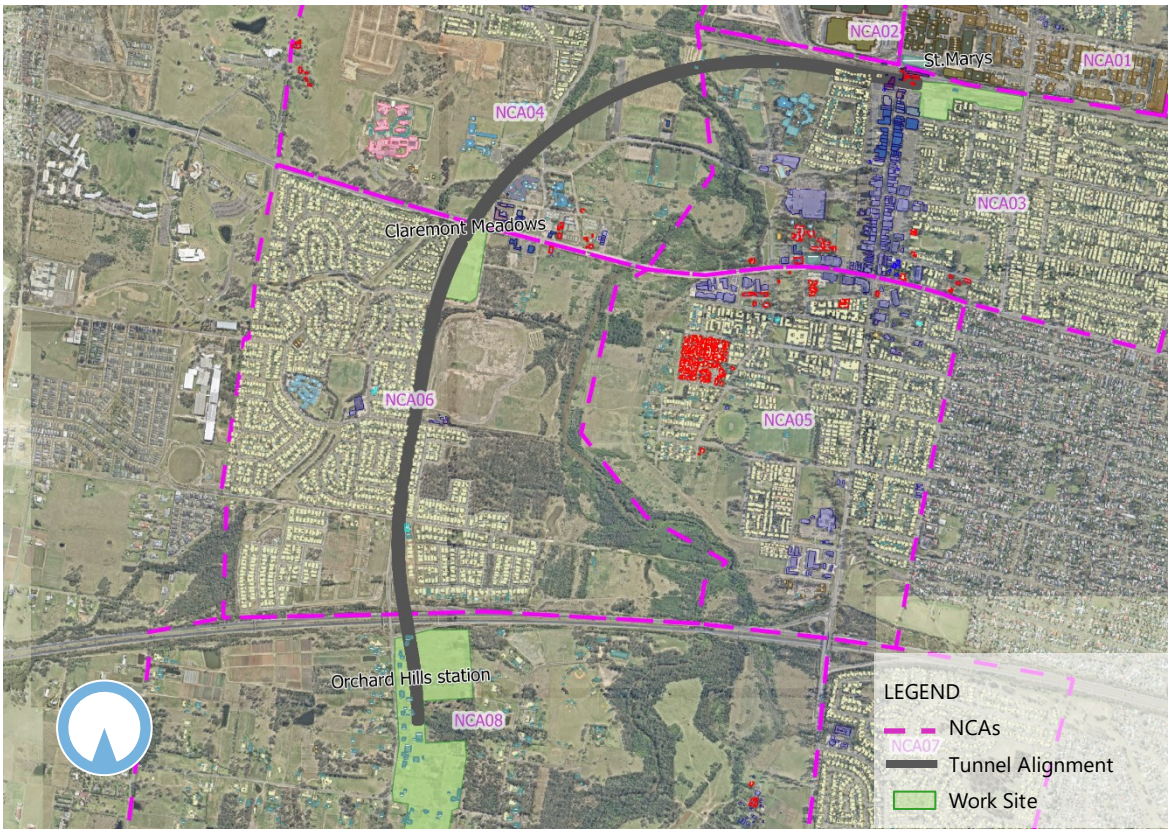
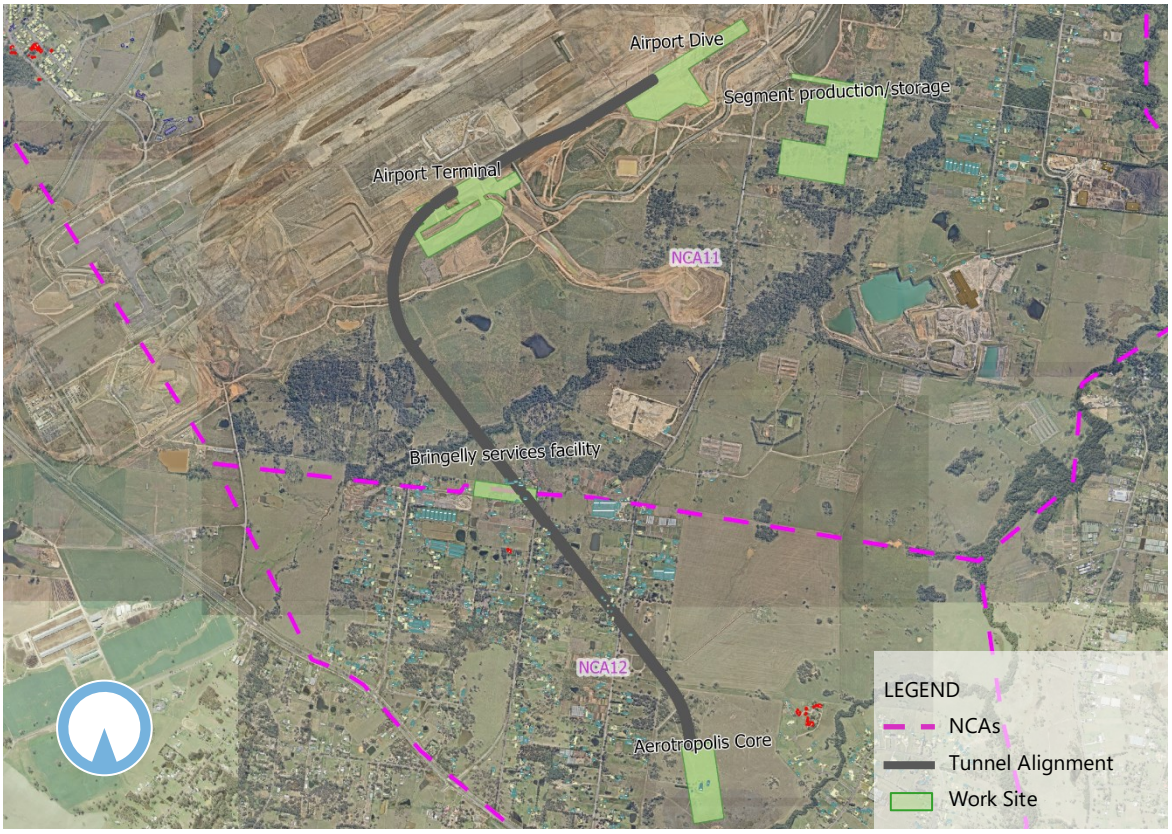


Figure 2: Twin tunnels between Airport Business Park dive (ABP) and Aerotropolis (AEC)



This DNVIS provides an assessment of ground-borne noise and vibration impacts from activities associated with tunnelling works, including:

- TBM tunnelling - four hard rock TBMs to excavate the two rail tunnels, as follows:
  - two hard rock TBMs starting from Orchard Hills Station site and tunnelling approximately 4.3 kilometres to St Marys Station;
  - two hard rock TBMs starting from Airport Business Park dive site and tunnelling to Aerotropolis Station (approximately 3.3 kilometres within Western Sydney International and 3 kilometres between Western Sydney International and AEC).
- Rock hammer tunnelling:
  - rock hammers excavating cross passages in multiple locations.

All tunnelling works will occur 24 hours per day. The out of hours works (OOHW) are justified (see Section 2.2.2).

The works are summarised in Table 2.1.

Table 2.1: Summary of construction works under this DNVIS

Activity	Aspect	Construction hours	Timing of activity
TBM tunnelling	North – OHE to STM	Standard hours + OOHW (D/E/N)	Oct 24 to completion
	South – ABP to AEC	Standard hours + OOHW (D/E/N)	Jun-23 to Feb-24
Cross passage excavation	North – OHE to STM	Standard hours + OOHW (D/E/N)	Oct 24 to completion
	South – ABP to AEC	Standard hours + OOHW (D/E/N)	Jun-23 to Feb-24
Cross passages Lining	North – OHE to STM	Standard hours + OOHW (D/E/N)	Oct 24 to completion
	South – ABP to AEC	Standard hours + OOHW (D/E/N)	Jun-23 to May-24

Notes: 'OOHW' means Out of Hours works, or work outside the standard construction hours (see Section0)

'OOHW(D)' is the OOH 'Day' period, 1pm to 6pm Saturday; 8am to 6pm Sunday

'OOHW(E)' is the 'Evening' period, 6pm to 10pm Monday to Sunday

'OOHW(N) is the OOH 'Night' period, 10pm to 7am Sunday/Monday to Thursday/ Friday; 10pm to 8am Friday/Saturday and Saturday/Sunday

A detailed summary of the construction activities assessed in this report is presented in Section 5.

2.2 Construction Hours

2.2.1 Off-Airport (NSW) land

Construction hours for the Project are defined by SSI 10051 CoA E38, E39 and E41. Table 2.2 below consolidates the information provided in these Conditions regarding construction working hours for the Project.

Table 2.2: Working hours for construction worksites on NSW land

CoA	Construction Activity	Monday to Friday	Saturday	Sunday / public holiday
E38	Standard construction	7:00am to 6:00pm	8:00am to 1:00pm	No work[1]
E39	Highly noise intensive works[2]	8:00am to 6:00pm (plus respite[2])	8:00am to 1:00pm (plus respite[2])	No work[1]
E41(a)	Safety and emergency work[2]	6:00pm to 7:00am	6:00pm to 8:00am	8:00 am to 7:00am
E41(b)	Low impact work[3]	6:00pm to 7:00am	6:00pm to 8:00am	8:00am to 7:00am
E41(c)	Works approved under and EPL or Out-of-Hours Work Protocol	6:00pm to 7:00am	6:00pm to 8:00am	8:00am to 7:00am
E41(d)	Prescribed activity: • Tunnelling and ancillary support activities • Grout batching at the Orchard Hills ancillary facility • Delivery of material to directly support tunnelling activities[4] • Haulage of spoil[4] • Work within an acoustic shed • Tunnel and underground station box fit out works.	24 hours	24 hours	24 hours

CoA	Construction Activity	Monday to Friday	Saturday	Sunday / public holiday

Notes:

1. No work unless permitted and approved.
2. Minimum respite from highly noise intensive works of not less than one (1) hour between each continuous block of works not exceeding three (3) hours.
3. Construction that causes $L_{Aeq(15\ minute)}$ noise levels no more than 5dB(A) above the Rating Background Level (RBL) at any residence; and/or no more than the 'noise affected' NMLs specified in Table 3 of the ICNG at other sensitive land user(s). Construction that causes continuous/impulsive/intermittent vibration values at the most affected residence, no more than the preferred values for human exposure to vibration, specified in Table 2.2 and Table 2.4 of the AVTG.
4. Except between the hours 10:00pm and 7:00amto/from the Orchard Hills ancillary facility.

2.2.2 On-Airport (Commonwealth) land

Construction hours for the Project are defined in Section 9.2 and 9.3 of the NV CEMP. Table 2.2 below consolidates the information provided in these Sections regarding construction working hours for the Project.

Table 2.3: Working hours for construction worksites

NV CEMP	Construction Activity	Monday to Friday	Saturday	Sunday / public holiday
9.2	Standard construction	7:00am to 6:00pm	8:00am to 1:00pm	No work[1]
9.3	Project related out-of-hour works (OOHW)[1]:			
	- Deliveries of oversized plant or structures	6:00pm to 7:00am	6:00pm to 8:00am	8:00 am to 7:00am
	- Responsive activities to protect people, property, and the environment in the event of an emergency such as a fire or structural failure	6:00pm to 7:00am	6:00pm to 8:00am	8:00am to 7:00am
	- Other activities undertaken in accordance with relevant noise and vibration guidelines, or which have no material noise or other impacts on residences	6:00pm to 7:00am	6:00pm to 8:00am	8:00am to 7:00am
	- Work that relies on third party authorisation	6:00pm to 7:00am	6:00pm to 8:00am	8:00 am to 7:00am
	- Work that would otherwise be a safety risk to project employees or the general public	6:00pm to 7:00am	6:00pm to 8:00am	8:00am to 7:00am
	- Delivery of material that is required to be delivered outside of standard construction hours to directly support tunnelling activities	6:00pm to 10:00pm	1:00pm to 10:00pm	8:00am to 10:00pm
	- Haulage of spoil generated through tunnelling	6:00pm to 10:00pm	1:00pm to 10:00pm	8:00am to 10:00pm
	- Works within an acoustic enclosure where it is assessed as 'Low impact work'[2]	24 hours	24 hours	24 hours
	- Tunnel and underground station box fit out works	24 hours	24 hours	24 hours

Notes:

1. No work unless permitted and approved through the out of hours process.
2. Construction that, as defined by Condition E41(b) of the CSSi MCoA, causes $L_{Aeq(15\ minute)}$ noise levels no more than 5dB(A) above the Rating Background Level (RBL) at any residence; and/or no more than the 'noise affected' NMLs specified in Table 3 of the ICNG at other sensitive land user(s). Construction that causes continuous/impulsive/intermittent vibration values at the most affected residence, no more than the preferred values for human exposure to vibration, specified in Table 2.2 and Table 2.4 of the AVTG.

2.2.3 Justification for OOHW

The Environmental Impact Statement (EIS) for the Sydney Metro: Western Sydney Airport project [4] states that tunnelling and support operations will be undertaken 24-hours per day, seven days per week. The justification for OOH tunnelling and support operations includes:

- The need to install ground support systems immediately following excavation;
- Reducing the overall duration of construction;
- Reducing peak demand on the electricity network.

It was noted that the OOH tunnelling works are not expected to cause noise impacts to any given receiver over extended time periods.

Tunnelling is a prescribed activity under Condition of Approval E41(d) and is permitted 24 hours per day. All reasonable and feasible mitigation measures will be implemented to reduce noise emission from the fans to below the NMLs.

2.2.4 Assessment periods

The standard hours and out of hours work (OOHW) periods are depicted in Table 2.4. The OOHW periods are further defined as OOHW Period 1 and 2, based on the CNVS[1].

Table 2.4: Assessment periods

Day/ Time	12am – 1am	1am – 2am	2am – 3am	3am – 4am	4am – 5am	5am – 6am	6am – 7am	7am – 8am	8am – 9am	9am – 10am	10am – 11am	11am – 12pm	12pm – 1pm	1pm – 2pm	2pm – 3pm	3pm – 4pm	4pm – 5pm	5pm – 6pm	6pm – 7pm	7pm – 8pm	8pm – 9pm	9pm – 10pm	10pm – 11pm	11pm – 12am
Monday to Friday										Standard construction Hours									OOHW Period 1					
Saturday																								
Sunday or Public Holiday	OOHW Period 2											OOHW Period 1							OOHW Period 2					

2.3 Interface with other DNVIS

Airborne and ground-borne noise and vibration impact from surface works to support the tunnelling, including spoil haulage, materials delivery and ventilation at the tunnel support sites and construction traffic on public roads has been assessed in separate DNVISs for each site.

TBM breakthrough, traverse across station boxes and re-launch are an essential part of the TBM tunnelling and will occur 24 hours per day. These works will be prioritised over other construction activities so that the TBM can continue operating as soon as practicable. No concurrent excavation works are likely to occur during these activities, except for potential roadheading works at St Marys and Aerotropolis Stations. During the TBM traverse, construction activities will include the installation of the push truss and rails. This is considered the most noise-generating activity. Breakthroughs generally occur during the standard construction hours. These activities have been assessed in DNVISs prepared for each worksite.

The DNVISs for each off-Airport (NSW land) site include:

- DNVIS: St Marys Station site (ref: TM008-02-01F01 SMWSA-SBT_DNVIS-STM);
- DNVIS: Claremont Meadows Ventilation Facility (ref: TM008-02-02F01 SMWSA-SBT_DNVIS-CMF);
- DNVIS: Orchard Hills Station site (ref: TM008-03-01F01 SMWSA-SBT_DNVIS-OHE)
- DNVIS: Bringelly Service Facility (ref: TM008-02-04F01 SMWSA-SBT_DNVIS-BSF)
- DNVIS: Aerotropolis Station site (ref: TM0008-05-01F01 SMWSA-SBT_DNVIS-AEC).

The DNVISs for on-Airport (Commonwealth land) sites includes:

- DNVIS: Airport Business Park, Airport Terminal and Spoil Site (FS01) Worksites (ref: M008-02-08F01 SMWSA-SBT_DNVIS-AIRPORT).

3 Nearest sensitive receivers

3.1 Land use survey

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

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

3.2 Residential receivers

Further to the Land Use Survey, residential areas have been divided into Noise Catchment Areas (NCAs) based on those established in the Environmental Impact Statement (EIS) [[3]] for the project [3]. All relevant residential sensitive receivers near the project are identified in APPENDIX B.

3.3 Other sensitive receivers

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

3.4 Commercial and industrial premises

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

3.5 Heritage receivers

Heritage receivers have been identified in EIS [3] and in the land use survey (Section 3.1) and have been considered in this assessment.

4 Construction noise and vibration objectives

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

Table 4.1: Construction ground-borne 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.2 of APPENDIX B. The ground-borne noise management levels are given below: • Evening (6.00 pm to 10.00 pm) Internal Residential: 40 dB $L_{Aeq(15minute)}$ • Night-time (10.00 pm to 7.00 am) Internal Residential: 35 dB $L_{Aeq(15minute)}$ EIS Daytime ground-borne NML 45 dB(A) also considered for consistency.
Vibration – disturbance to building occupants	NSW 'Environmental Noise Management Assessing Vibration: A Technical Guideline' (AVTG) [8] CNVS [1]	To assess the potential for vibration impact on human comfort, an initial screening test will be done based on peak velocity units, as this metric is also used for the cosmetic damage vibration assessment. The initial screening test values are: • Critical areas - 0.28 mm/s (day or night) • Residential buildings - 0.56 mm/s (16h day); 0.40 mm/s (8h night) • Offices, 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 6.4.6.1 of the CNVMP 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'[12] German Standard DIN 4150-3: 2016-12, Structural vibration - Effects of vibration on structures [13] 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.

5 Construction noise and vibration prediction methodology

5.1 Construction modelling input

The predicted ground-borne noise (GBN) and vibration levels are based on the noise modelling inputs and assumptions outlined below. Blasting methodology is not assessed in this tunnelling DNVIS as CPBG has indicated that blasting is not anticipated for the proposed tunnelling works.

5.1.1 TBM tunnelling methodology

Two Tunnel Boring Machines (TBMs) will be launched from the Orchard Hills Station site in the north and will tunnel towards St Marys Station from approximately February 2023.

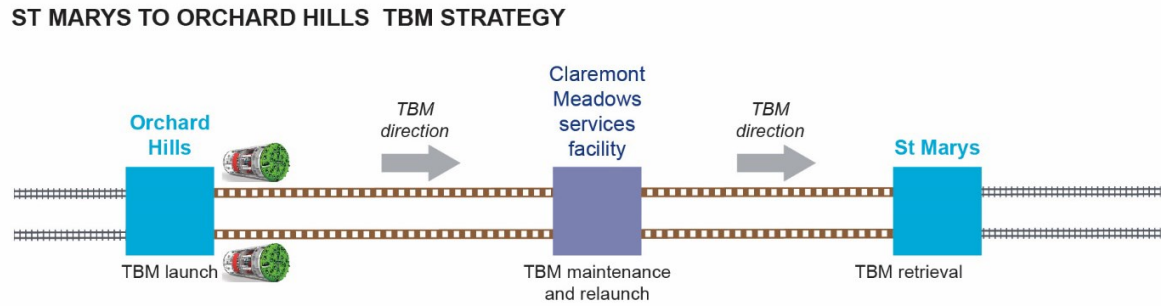


Figure 3: TBM tunnelling Orchard Hills to St Marys

In the south, two TBMs will be launched from the Airport Business Park Dive site (within the Western Sydney Airport land) and will tunnel towards Aerotropolis Station from February 2023.

Tunnelling activities will be supported from Airport Business Park until handover to the follow-on contractor SSTOM in December 23. After this date, the tunnelling activities will be supported from Airport Terminal Temporary Shaft until completion of tunnelling.

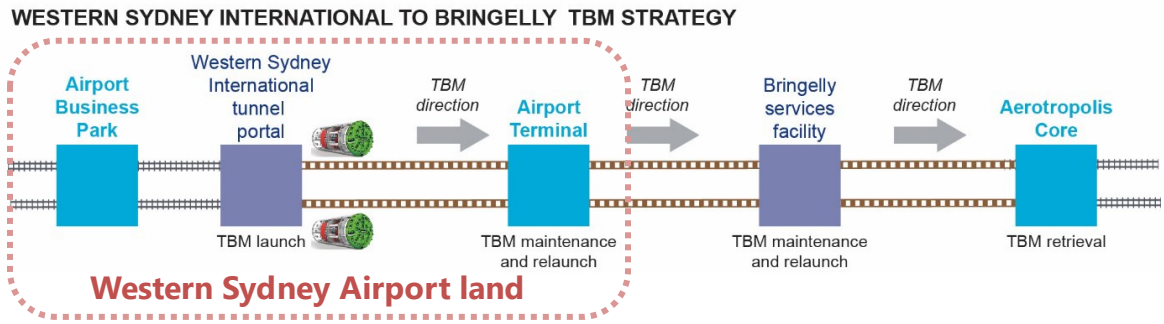


Figure 4: TBM tunnelling Airport Business Park Dive site to Aerotropolis Station site

The TBM tunnelling will advance at an assumed typical progress rate of 20 to 40 metres per day. It is also assumed that the TBM launch is staggered (i.e. approximate separation of two weeks between TBM launch.

5.1.2 Cross passage excavation

There are 44 cross-passages between the twin tunnel alignments, located at varying distances along tunnel alignment. There are 21 cross passages located in the north tunnel alignment and 23 cross passages located in the south tunnel.

- Approximately every 250 m along tunnel alignment using one small size (~ 5 to 15 tonne) Rock breaker (Brokk type); or alternatively, where reasonable and feasible using
  - one small excavator with twinheader / drum cutter attachment; or
  - one small excavator with ripper (non-percussive).
- Approximate duration is typically 6 days for standard cross passages (based on 1m per day).

The excavation methodology used will depend on the ground type and timing of the works.

5.2 Modelling assumptions

To assist in predicting ground-borne noise (GBN) levels along the tunnel alignment, a 3-dimensional model of the tunnels and cross passages was developed. The model included the following assumptions:

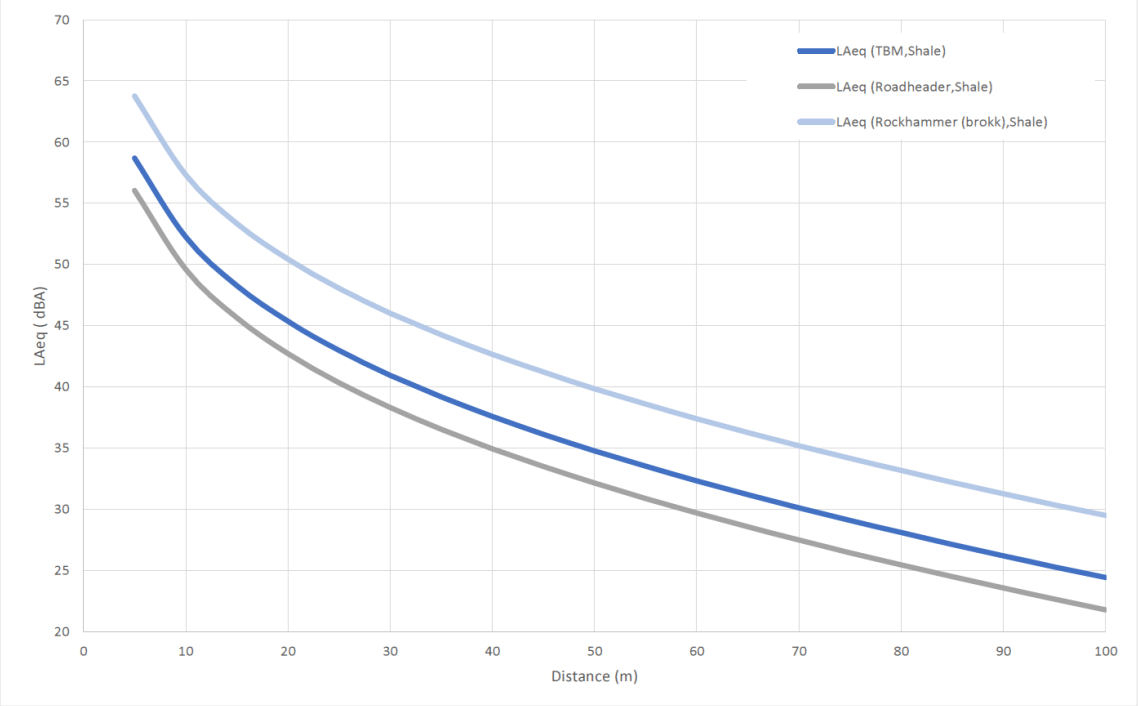
- Three-dimensional tunnel information was provided by CPBG on 10/10/2022 (reference: SMWSASBT-CPG-SWD-TU000-TU-M3D-010110, SMWSASBT-CPG-SWD-TU000-TU-M3D-010111, SMWSASBT-CPG-SWD-TU000-TU-M3D-010160 and SMWSASBT-CPG-SWD-TU000-TU-M3D-010161) including all mainline tunnels, adits, cross passages.
- Surface topography was obtained from ELVIS. Land contours presented in 1m intervals;
- The ground-height of each building was determined based on the ground surface height;
- Distances between the tunnel excavation works and nearby buildings is based on the 3-dimensional slant distance from the tunnel crown (TBM or top-heading excavation) or from the cross passage crown to the closest edge of the buildings;
- Rock type:
  - Shale rock along the tunnel alignment from Orchard Hills to St Marys;
  - Shale rock along the tunnel alignment from Airport Business Park Dive to Aerotropolis.
- Ground-borne noise levels versus distance prediction curves for each plant item, ground-borne noise levels are calculated on the ground floor level of within each building.
- A 3 dB(A) engineering margin has been applied to all GBN level predictions to account for multiple roadheaders/rockhammers operating concurrently within the same chainage, to be conservative.

- A 5 dB(A) penalty has been applied for rockhammer excavation works due to the annoying characteristic of noise generated by this source, consistent with SSI 10051 CoA E43.

5.3 Ground-borne noise and vibration sources

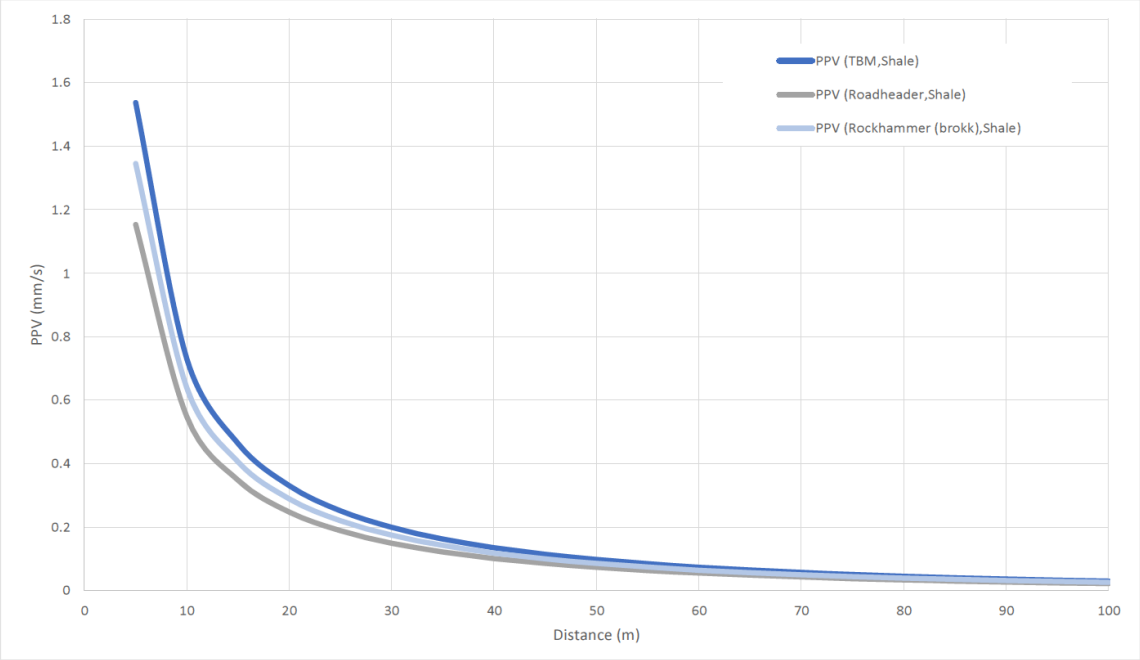
Based on the ground-borne noise and vibration levels versus distance prediction curves for each plant item, ground-borne noise and vibration levels are calculated on the ground floor level of each building. The algorithms used in the modelling (Figure 5 and Figure 6) have been developed from measurement data obtained from various Sydney projects, including the Sydney Metro City & South West (SM-TSE), Sydney Metro North West (NWRL), WestConnex M4-M5 Rozelle Interchange (WCX3B), WestConnex New M5 (WCX2), WestConnex M4 (WCX1B), Lane Cove Tunnel (LCT), Epping to Chatswood Rail Link (ECRL) and Cross City Tunnel (CCT).

Figure 5 Indicative ground-borne noise levels from tunnelling



Source: GBN taken from recent Sydney tunnel projects, including SM-TSE, NWRL, WCX3B, WCX2, WCX1B, LCT, ECRL and CCT.
Light rock hammer algorithms shown include a 5dB penalty

Figure 6 Indicative ground-borne vibration levels from tunnelling



Source: GBN taken from recent Sydney tunnel projects, including SM-TSE, NWRL, WCX3B, WCX2, WCX1B, LCT, ECRL and CCT.

The geology of the tunnel alignment is predominantly shale. The predictions and subsequent assessment is based on this assumption. 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 and vibration levels may vary significantly to what has been predicted herein, therefore verification measurements shall be undertaken along the full extent of the tunnel alignment to check and verify the models (refer to Section 6.3.4 and Section 7.2.4 for detail).

6 Construction noise impacts

6.1 Predicted ground-borne noise levels

GBN levels were determined by modelling the noise source, excavation location and receiver locations, based on the information presented in Section 5. Predictions below are representative of a typical worst-case scenario where the excavation is undertaken at the closest possible location to nearby receivers. They represent the typical maximum ground-borne noise levels that receivers may experience for a limited amount of time and will reduce as the underground works move further away.

Ground-borne noise impacts during construction works have been predicted and compared to the noise management levels (NMLs). A receiver is considered construction noise affected when the predicted noise level is above the ground-borne NML (GNML). Table 6.2 and Table 6.3 present a summary of the number of residential receivers and 'other sensitive receivers likely to be noise affected by TBM tunnel excavation and cross passage excavation (respectively). The tables are colour coded to indicate how much the predicted noise level is above the GNML, based on the CNVS, as noted in Table 6.1.

Table 6.1: Key to the predicted construction 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)	21-30 dB(A) above NML (orange)	>30 dB(A) above NML (purple)

GBN prediction maps are provided in APPENDIX C for the following tunnelling activities:

- APPENDIX C.1 - TBM tunnel excavation
- APPENDIX C.2 – Cross-passage excavation.

The predicted ground-borne noise impacts would be updated if additional representative noise (and vibration) measurements demonstrate actual noise levels vary from the predictions.

6.1.1 TBM tunnel excavation

Table 6.2 summarises the number of sensitive receivers where ground-borne noise from TBM tunnel excavation may be perceptible. The impacts are presented based on the colour coding in Table 6.1 where predicted ground-borne L_{Aeq} noise levels from tunnelling are above the ground-borne NML for:

- Residential receivers during the night period or,
- Other sensitive receivers when in use.

Table 6.2: Summary of the estimated number of properties (ground floor) that may perceive GBN during TBM tunnel excavation

Receiver Type	GBN							
	<35	35-40	40-45	45-50	50-55	55-60	60-65	>65
North TBM tunnel (OHE to STM)								
Residential	694	79	99	12	14	0	0	0
Childcare	-	-	1	0	0	0	0	0
Hotel/Motel/Hostel	-	0	0	0	0	0	0	0
Medical	-	-	-	-	0	0	0	0
Educational	-	-	-	1	0	0	0	0
Place of Worship	-	-	-	-	0	0	0	0
Commercial	-	-	9	1	6	0	0	0
Industrial	-	-	-	-	-	-	0	0
South TBM tunnel (ABP to AEC)								
Residential	25	3	2	4	0	0	0	0
Childcare	-	-	0	0	0	0	0	0
Hotel/Motel/Hostel	-	0	0	0	0	0	0	0
Medical	-	-	-	-	0	0	0	0
Educational	-	-	-	-	0	0	0	0
Place of Worship	-	-	-	-	0	0	0	0
Commercial	-	-	-	-	0	0	0	0
Industrial	-	-	-	-	-	-	0	0

Notes: Shaded region represents GBN levels that are above the GNMLs

The predicted GBN levels in APPENDIX C and the table above identify that during TBM tunnelling GBN may be perceptible within residential and other sensitive receiver properties.

6.1.1.1 Off-Airport (NSW) land

Review of predicted GBN levels from TBM excavation to receivers outside the Airport boundary, on NSW land found that:

- During the North tunnel (OHE to STM) excavation with TBM:
  - 79 residential properties are expected to experience maximum GBN levels above 35 dB(A) but less than 40 dB(A);
  - 99 residential properties are expected to experience maximum GBN levels above 40 dB(A);
  - 26 residential properties are exposed to GBN levels above 45 dB(A);
  - 1 childcare receiver is expected to experience maximum GBN levels above 40 dB(A) but less than 45 dB(A);

- 1 educational receiver is expected to experience maximum GBN levels above 45 dB(A) but less than 50 dB(A);
- 6 commercial receivers are expected to experience maximum GBN levels above 50 dB(A) but less than 55 dB(A).

- During the South tunnel (ABP to AEC) excavation with TBM:
  - 3 residential properties are expected to experience maximum GBN levels above 35 dB(A) but less than 40 dB(A);
  - 2 residential properties are expected to experience maximum GBN levels above 40 dB(A);
  - 4 residential properties are exposed to GBN levels above 45 dB(A).

Sensitive receiver properties identified in the shaded cells in Table 6.2 that are predicted to experience maximum GBN levels above the GNML would be recommended to receive a letterbox notification to advise that tunnelling works would be occurring and that noise levels may be audible at times.

Additional management measures such as respite offers are described in Section 6.3.3.

6.1.1.2 On-Airport (Commonwealth) land

Review of predicted GBN levels from TBM excavation to receivers within the Airport boundary found that there were no GBN affected receivers on Commonwealth land.

6.1.2 Cross-passage excavation

Table 6.3 summarises the number of sensitive receivers where ground-borne noise from cross passage excavation may be perceptible. The impacts are presented based on the colour coding in Table 6.1 where predicted ground-borne L_{Aeq} noise levels from cross passage excavation are above the ground-borne NML.

Table 6.3: Summary of the estimated number of properties (ground floor) that may perceive GBN during cross passage excavation

Receiver Type	GBN							
	<35	35-40	40-45	45-50	50-55	55-60	60-65	>65
North cross passages (OHE to STM)								
Residential	651	73	40	24	16	2	3	0
Childcare	-	-	0	0	1	0	0	0
Hotel/Motel/Hostel	-	-	0	0	0	0	0	0
Medical	-	-	0	0	0	0	0	0
Educational	-	-	-	1	0	0	0	0
Place of Worship	-	-	-	0	0	0	0	0

Receiver Type	GBN							
	<35	35-40	40-45	45-50	50-55	55-60	60-65	>65
Commercial	-	-	6	4	0	0	0	0
Industrial	-	-	-	-	-	-	0	0
South cross passages (ABP to AEC)								
Residential	25	3	0	0	1	1	0	0
Childcare	-	-	0	0	0	0	0	0
Hotel/Motel/Hostel	-	-	0	0	0	0	0	0
Medical	-	-	0	0	0	0	0	0
Educational	-	-	-	0	0	0	0	0
Place of Worship	-	-	-	0	0	0	0	0
Commercial	-	-	-	-	0	0	0	0
Industrial	-	-	-	-	-	-	0	0

Notes: Shaded region represents GBN levels that are above the GNMLs

The predicted GBN levels in APPENDIX C and the table above identify that during cross passage excavation GBN may be perceptible within residential and other sensitive receiver properties. GBN impact from cross passage excavation using the alterative excavation methods (excavator with twinheader / drum cutter or ripper attachment) will be less than the impacts presented above.

6.1.2.1 Off-Airport (NSW) land

Review of predicted GBN levels from cross passage excavation outside the Airport boundary, on NSW land found that:

- During the North cross passage (OHE to STM) excavation with TBM:
  - 73 residential properties are expected to experience maximum GBN levels above 35 dB(A) but less than 40 dB(A);
  - 40 residential properties are expected to experience maximum GBN levels above 40 dB(A);
  - 45 residential properties are exposed to GBN levels above 45 dB(A);
  - 1 childcare receiver is expected to experience maximum GBN levels above 50 dB(A) but less than 55 dB(A) during the excavation of XP-N18;
  - 1 educational receiver is expected to experience maximum GBN levels above 45 dB(A) but less than 50 dB(A) during the excavation of XP-N10.
- During the South cross passage (ABP to AEC) excavation with TBM:
  - 3 residential properties are expected to experience maximum GBN levels above 40 dB(A);

- 2 residential properties are exposed to GBN levels above 45 dB(A).

To ensure GBN levels are below the GBNMLs, excavation or trimming of cross-passage using a light rockhammer would be limited to the allowable periods outlined in the Table 6.4.

In addition to the standard approach for cross passage excavation, alternative excavation methods were considered (i.e. excavator with twinheader / drum cutter or ripper attachment). We do not have sufficient data to model impacts from this excavation method. The nearest representative available data is for roadheader excavation (see Figure 5). Allowable periods that ensure GBN levels from roadheader excavation of the cross passages are below GBNMLs are summarised in Table 6.4.

It is likely that GBN impact from the excavator with twinheader / drum cutter or ripper attachment will be lower than the predicted impacts from roadheader excavation. Verification monitoring at the earliest opportunity (see Section 6.3.4) would be used to confirm GBN impacts from alternative excavation methods and may provide opportunity to extend excavation hours.

Table 6.4: Allowable periods for each cross-passage excavation to ensure GBN levels are GBNMLs

Cross-passage ID	Allowable period		Cross-passage ID	Allowable period	
	Rockhammer (brokk)	Roadheader		Rockhammer (brokk)	Roadheader
XP-N02	Day	Day	XP-S02	Day, Evening, Night	Day, Evening, Night
XP-N03	Day	Day, Evening, Night	XP-S03	Day, Evening, Night	Day, Evening, Night
XP-N04	Day, Evening, Night	Day, Evening, Night	XP-S04	Day, Evening, Night	Day, Evening, Night
XP-N05	Day, Evening, Night	Day, Evening, Night	XP-S05	Day, Evening, Night	Day, Evening, Night
XP-N06	Day, Evening, Night	Day, Evening, Night	XP-S06	Day, Evening, Night	Day, Evening, Night
XP-N07	Day, Evening, Night	Day, Evening, Night	XP-S08	Day, Evening, Night	Day, Evening, Night
XP-N08	Day, Evening, Night	Day, Evening, Night	XP-S09	Day, Evening, Night	Day, Evening, Night
XP-N09	Day, Evening, Night	Day, Evening, Night	XP-S10	Day, Evening, Night	Day, Evening, Night
XP-N10	Day, Evening, Night	Day, Evening, Night	XP-S11	Day, Evening, Night	Day, Evening, Night
XP-N11	Day, Evening, Night	Day, Evening, Night	XP-S12	Day, Evening, Night	Day, Evening, Night
XP-N13	Day	Day	XP-S13	Day, Evening, Night	Day, Evening, Night
XP-N14	Day	Day	XP-S14	Day, Evening, Night	Day, Evening, Night
XP-N15	Day	Day	XP-S15	Day, Evening, Night	Day, Evening, Night
XP-N16	Day	Day	XP-S17	Day	Day
XP-N17	Day	Day	XP-S18	Day, Evening, Night	Day, Evening, Night
XP-N18	Day	Day, Evening	XP-S19	Day, Evening, Night	Day, Evening, Night
XP-N19	Day	Day	XP-S20	Day	Day
XP-N20	Day, Evening, Night	Day, Evening, Night	XP-S21	Day, Evening, Night	Day, Evening, Night
XP-N21	Day, Evening, Night	Day, Evening, Night	XP-S22	Day, Evening, Night	Day, Evening, Night
			XP-S23	Day, Evening, Night	Day, Evening, Night

Note: XP-N01, XP-N12, XP-N22, XP-S01, XP-S07, XP-S16 and XP-S24 are within the station boxes and have not been assessed for ground-borne noise as airborne noise will be dominant.

Greyed cross passages are within the Western Sydney Airport on Commonwealth land. Sensitive receiver properties identified in the shaded cells in Table 6.3 that are predicted to experience maximum GBN levels above the GNML would be recommended to receive a letterbox notification to advise that tunnelling works would be occurring and that noise levels may be audible at times.

Additional management measures such as respite offers are described in Section 6.3.3.

6.1.2.2 On-Airport (Commonwealth) land

Review of predicted GBN levels from TBM excavation to receivers within the Airport boundary found that there were no GBN affected receivers on Commonwealth land.

6.2 Duration of GBN impacts

6.2.1 TBM Tunnel excavation

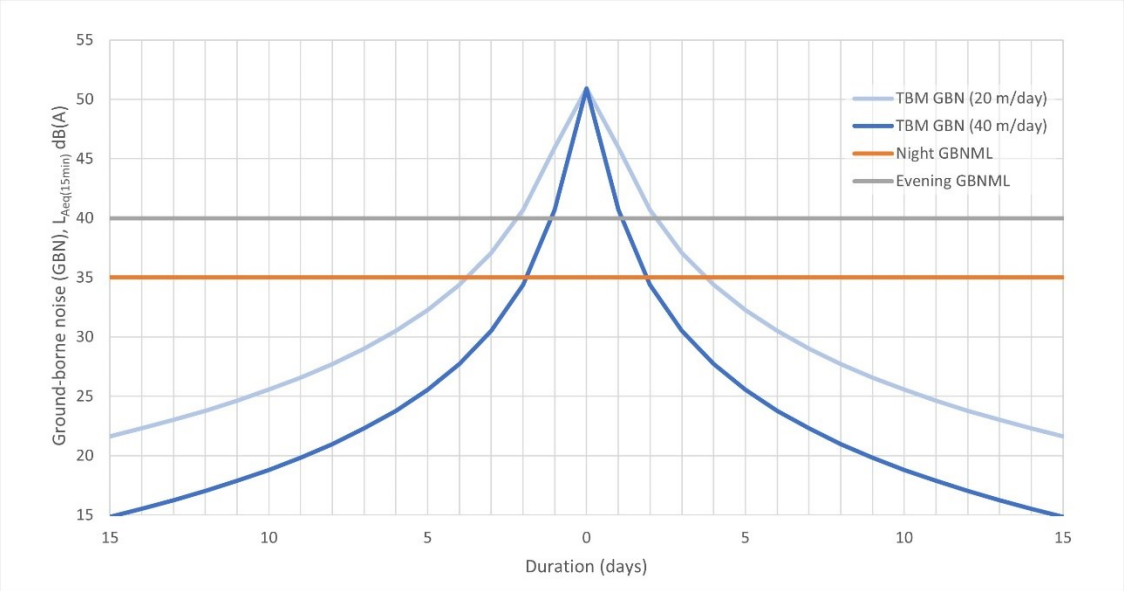
The extent of mitigation and management required to limit potential GBN impacts to receivers is determined by looking not only at the level of noise impact, but also the duration that receivers are likely to be exposed to noise levels above the relevant GNMLs.

The 'Number of consecutive days affected' where GBN levels are above relevant GNMLs has been determined by applying the operational assumptions outlined in Section 5 regarding the tunnel excavation methodology and the predicted GBN levels discussed in Section 6.1.

The duration of potential GBN impacts depends on the TBM advance rate. JCG JV has advised that the TBM will advance at a rate of 20 to 40 metres per day. Figure 7 below shows the indicative duration of potential GBN impacts for a TBM advancing at a rate of 20 metres per day and at 40 metres per day, with a minimum tunnel depth of approximately 15 metres (i.e. shallowest depth).

It can be seen from Figure 7 that the indicative duration of GBN levels above 35 dB(A) during the TBM excavation of the mainline tunnel at the shallowest depth is approximately 5 to 7 days where the TBM is advancing at a rate of 20 to 40 metres per day. The indicative duration of GBN levels above 40 dB(A) during the TBM excavation of the mainline tunnel at the shallowest depth is approximately 3 to 4 days.

Figure 7 Indicative duration of impacts during TBM excavation of mainline tunnel (worst-case scenario)



The estimated number of maximum consecutive days that properties may experience noise levels above the relevant GNMLs during TBM tunnelling are summarised in the below table.

Table 6.5: Summary of the estimated number of properties (ground floor) that may perceive GBN during TBM tunnel excavation

Receiver Type	Maximum number of consecutive days	GBN exposure, dB(A)					
		35-40	40-45	45-50	50-55	55-60	60-65
Residential	1-2 days	31	101	16	14	0	0
	2 or more days	51	0	0	0	0	0
Childcare	1-2 day	-	1	0	0	0	0
Educational	1-2 day	-	-	1	0	0	0
Commercial	1-2 day	-	-	-	6	0	0
Industrial	1-2 day	-	-	-	-	-	0

The table above indicates that many residential properties will experience GBN levels greater than the GNML of 35 dB(A) for 2 nights or more. GBN is likely to be audible inside those premises at night. No residential properties are however predicted to experience GBN levels of 10 dB(A) or more above the GNML of 35 dB(A) over 2 or more consecutive nights.

Other sensitive receivers may be impacted for up to 1 day when the premise is in use.

Measures for managing exceedance of the GNMLs are identified in Section 6.3.

6.2.2 Cross passages excavation

Due to the constrained extent and depth of the cross passages and the slow advance rate of the excavation (approximately 1m per day), the predicted GBN levels are not expected to vary significantly.

The maximum predicted GBN levels have been analysed and assessed to determine the extent of potential impacts and accordingly the appropriate management measures for these activities. The summary of all proposed management measures for each cross passage is presented in C.4.

6.3 Noise mitigation and management

6.3.1 Consultation

CPBG JV has commenced and will continue to consult with potentially affected stakeholders including business and residential receivers regarding specific mitigation and management measures applicable to the tunnelling excavation works for this project. A summary is provided below:

- A project-wide community newsletter was distributed on 1 October 2022 date updating the community on upcoming tunnelling activities. A newsletter will be distributed every six months for the duration of the project.
- Four construction updates have been distributed, notifying of upcoming tunnelling works.
- Community information sessions have been held by Sydney Metro and CPBG JV to discuss site establishment, utility and early tunnelling works. These sessions will continue for the duration of the project.
- A full page advertisement was published in the Western Weekender on 2 December 2022, notifying of upcoming tunnelling works.
- Residents and businesses within the 50m of the tunnel alignment have received a Property Condition Survey fact sheet and survey offer
- Where survey offers have been accepted, Property Condition Surveys have been carried out and copies provided to property owners
- Residents and businesses who have accepted a Pre-construction Property Survey will be offered a Post-construction Property Survey
- Consultation and management of impacts as outlined in Appendix C.3 and C.4.

Residents and businesses within the 60m of the tunnel alignment will receive the following:

- Notification of the online Tunnel Tool available through the Project website,
- Community updates as tunnel excavation activities approach properties and the expected noise and vibration impacts
- One week notification of tunnelling approaching specific properties
- Meetings with stakeholders upon request
- Proactive noise and vibration monitoring and in response to complaints.

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

6.3.2 Noise control and management measures

The following noise mitigation and management measures are recommended to reduce potential noise impacts, where reasonable and feasible.

Table 6.6: Site Noise Control Measures

Control Type	Control Measure	Typical Use
At-Source Control Measures	Limit equipment in use	Only the equipment necessary during each stage of the tunnelling will be used.
	Cross passage excavation	• Less vibration generating plant such as small rockbreakers or roadheaders (for long cross passages with sufficient space) will be used for cross passage excavation works to reduce potential impacts • Due to its annoying characteristics, rockhammer excavation should comply with the evening and night-time ground-borne noise management levels to minimise the risk of noise complaints. Allowable construction hours are presented in Table 6.4
Noise Management Measures	TBM excavation	• If predicted/measured GBN levels from TBMs are above the relevant GBNMLs outside standard construction hours, apply additional mitigation measures as described in Section 6.3.3 and Appendix C.3.
	Alternative accommodation	• Alternative accommodation will be determined on determined on a case-by-case basis in accordance with the CNVS. Alternative accommodation will be considered where predicted/measured GBN levels are more than 45dB(A) (i.e. more than 10 dB(A) above the night-time GBNML of 35dB(A)) (see Figure 8), typically for more than two consecutive nights. Other negotiated respite offers may be more suitable for the resident than alternative accommodation where the duration of impact is two days or less.
	Community consultation	Inform community of construction activity and potential impacts.
	Noise monitoring	Noise monitoring is to be carried out as detailed in Section 6.3.4.
	Site inductions & Toolbox Talks	All relevant employees, contractors and subcontractors are to receive an induction/tool box addressing ground borne noise. This should include: - location of nearest sensitive receivers - relevant project specific and standard noise and vibration mitigation measures; - permissible hours of work; - relevant permits.

6.3.3 Additional noise mitigation measures

Section 5 of the CNVS directs that in instances where, after the application of all reasonable and feasible mitigation and management measures (refer to Section 6.3.1), the $L_{Aeq(15minute)}$ ground-borne construction noise levels are still predicted to exceed the NMLs, additional ground-borne noise management measures can be applied to further limit the risk of annoyance from construction noise. The CNVS suggests the Project should consider implementing additional mitigation measures such as:

- **Alternative accommodation** (**AA**) options may be provided for residents living close to construction works that are likely to incur unreasonably high impacts over an extended period of time (more than 2 consecutive days). Alternative accommodation will be determined on a case-by-case basis.

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

The steps to be carried out to determine the additional management measures to be implemented are identified in Figure 8.

Figure 8: Additional ground-borne noise mitigation measures

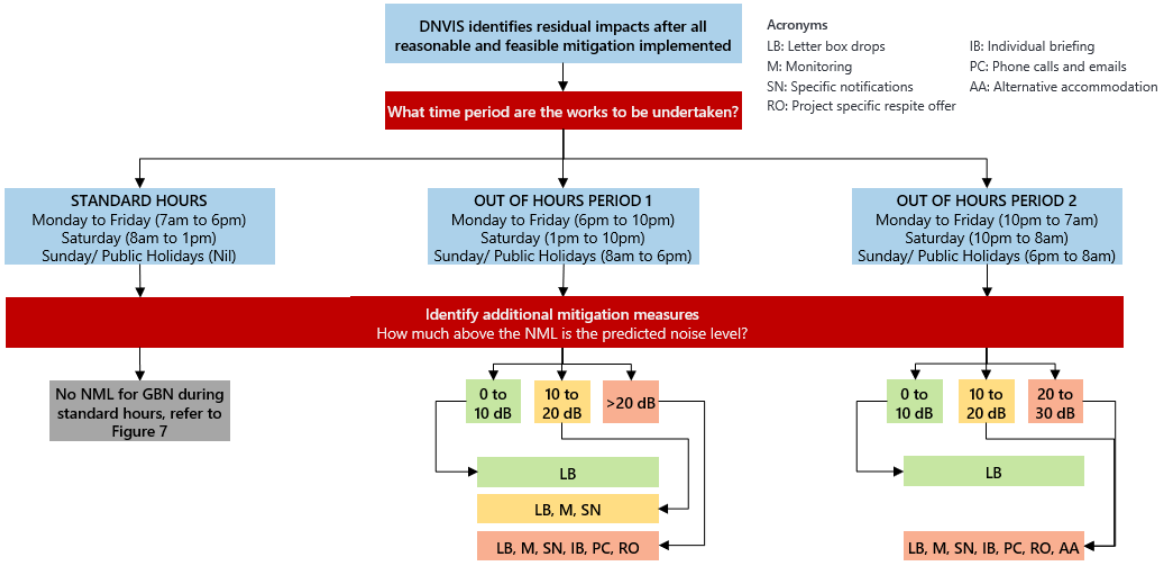


Figure 8 presents a summary of the additional noise mitigation measures applicable for construction activities where, after application of all reasonable and feasible mitigation options, construction noise levels still above the GNMLs.

Prior to the commencement of tunnelling, receivers identified in APPENDIX C.3 and C.4 will be notified to advise that noise from the works may at times be audible. All potentially impacted receivers will be kept informed of the nature of works to be carried out, the expected noise levels and duration, as well as be given appropriate enquiries and complaints contact details (see Section 6.3.4.2).

6.3.4 Ground-borne noise monitoring

6.3.4.1 Off-Airport (NSW) land

Ground-borne noise monitoring is to be undertaken to validate the GBN model and to verify that GBN resulting from excavation works are in accordance with the levels predicted in this DNVIS and any EPL Condition, subject to obtaining the property owner/occupier's consent to access the property.

Attended or unattended noise monitoring will be undertaken at the first available locations identified in Table 6.7. These monitoring locations are considered the most suitable locations along tunnel alignment to collect a representative sample of measurements required to validate the noise model. Monitoring is not required at every one of the locations and for all potential excavation activities listed in the table below. Once a representative sample of measurements has been completed and the model has been validated, no further monitoring is required for model validation. However, additional monitoring would be conducted in response to noise complaints or community consultation. Where, following community consultation, specific sensitive receivers are identified for additional monitoring, access to the property will be sought through the Stakeholder and Community Relations team.

Table 6.7: Attended GBN monitoring - nominated representative locations

Work Location	Nominated Receiver Address	Monitoring Location	Monitoring requirement/ status	
			XP excavation	TBM tunnelling
XP-N02 or CMF to STM	[redacted]	Internal, within ground floor rooms situated away from the main road	To be monitored	To be monitored
XP-N16 or OHE to CMF	[redacted]	Internal, within ground floor rooms situated away from the main road	To be monitored	To be monitored
XP-N17 or OHE to CMF	[redacted]	Internal, within ground floor rooms situated away from the main road	To be monitored	To be monitored
XP-N19 or OHE to CMF	[redacted]	Internal, within ground floor rooms situated away from the main road	To be monitored	To be monitored
OHE to CMF	[redacted]	Internal, within ground floor rooms situated away from the main road	Not required	To be monitored
XP-S17 or BSF to AEC	[redacted]	Internal, within ground floor rooms situated away from the main road	Not required	To be monitored
XP-S20 or BSF to AEC	[redacted]	Internal, within ground floor rooms situated away from the main road	To be monitored	To be monitored

Notes: 1) Monitoring on private property is subject to owner consent and where relevant, occupier consent.
2) If the above properties are not suitable or the occupiers deny access, nearby properties can also be considered.

Subject to obtaining the property owner/occupier's consent to access the property, noise measurements would be undertaken in rooms that are the most shielded from existing ambient noise to allow a higher signal to noise ratio to be obtained. Consideration of the method of indirect ground-borne noise measurement, via ground-borne vibration monitoring will be given where access to properties is not possible.

In addition, vibration monitoring at the receivers identified in the table above should be considered to provide assurance to the residents that vibration levels are not potentially causing any cosmetic damages to the buildings.

Noise monitoring should follow the procedures outlined in the Noise and Vibration Monitoring Program (refer to Annexure A of the CNVMP).

6.3.4.2 On-Airport (Commonwealth) land

Ground-borne noise monitoring is not required when the TBM excavation is within the Airport boundary found as there were no identified GBN affected receivers on Commonwealth land.

6.3.5 Complaints handling

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

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

7 Construction vibration impacts

7.1 Predicted ground-borne vibration levels

Ground-borne vibration from tunnelling excavation was determined by modelling the vibration source, tunnel excavation location and receiver locations, based on the information presented in Section 5. Predictions below are representative of a typical worst-case scenario where the excavation is undertaken at the closest possible location to nearby receivers. They represent the typical maximum vibration that receivers may experience for a limited amount of time and will reduce as the underground works move further away.

Vibration predictions for tunnelling works are presented in APPENDIX D of this report:

- Appendix D.1 presents the vibration predictions from the main line TBM tunnelling works;
- Appendix D.2 presents the vibration predictions from the rock breaking excavation works for the cross passages.

The vibration predictions have been compared to the vibration criteria for disturbance to building occupants and for damage to buildings, as outlined in Table 4.1.

7.1.1 Disturbance to building occupants

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

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

Receivers along the tunnel alignment may perceive vibration levels when tunnel excavation works are underneath the property. The number of properties where vibration levels may be above the vibration disturbance goals during tunnelling works are summarised in Table 7.1. **Bold text** indicates the properties are above the relevant vibration management goal. These properties are also identified in APPENDIX D.

Table 7.1: Number of buildings within minimum working distances for human annoyance

Receiver Type	PPV mm/s (screening vibration levels – see Table 4.1					
	<0.28	0.28-0.4	0.4-0.56	0.56-1.1	1.1-.2.2	>2.2
North TBM tunnel (OHE to STM)						
Residential	858	25	**1**	**14**	0	0
Childcare	3	0	0	0	0	0
Educational	25	1	0	0	0	0
Commercial	70	1	1	6	0	0
Industrial	42	0	0	0	0	0
South TBM tunnel (ABP to AEC)						
Residential	30	3	**1**	0	0	0
Childcare	0	0	0	0	0	0
Educational	0	0	0	0	0	0
Commercial	0	0	0	0	0	0
Industrial	0	0	0	0	0	0
North Cross passages (OHE to STM)						
Residential	785	15	**8**	**4**	0	0
Childcare	2	0	**1**	0	0	0
Educational	31	0	0	0	0	0
Commercial	71	0	0	0	0	0
Industrial	18	0	0	0	0	0
South Cross passages (ABP to AEC)						
Residential	28	1	0	**1**	0	0
Childcare	0	0	0	0	0	0
Educational	0	0	0	0	0	0
Commercial	0	0	0	0	0	0
Industrial	0	0	0	0	0	0

7.1.1.1 Off-Airport (NSW) land

As can be noted from Table 7.1, there are vibration levels from the TBM and rockhammer excavation works that are predicted to exceed the screening vibration levels. This assessment is based on tunnelling works being underneath the receivers. When excavation works are further away from the closest point, the predicted vibration levels would reduce along with the probability of adverse comments. Therefore, considering the amount of time the underground excavation works would be at the closest point to the properties, the probability of adverse comments due to vibration is considered medium to low.

Vibration impact from cross passage excavation using the alterative excavation methods (excavator with twinheader / drum cutter or ripper attachment) will be less than the impacts presented above.

Attended vibration measurements are proposed to be carried out proactively and in response to vibration complaints. If measurement results indicate events above the vibration objectives for human

annoyance, vibration control and management measures would be provided to reduce vibration impact (see Section 7.2.2).

After applying all feasible and reasonable vibration mitigation measures, if vibration monitoring still identifies that measured vibration levels are above the relevant vibration criteria for human annoyance, appropriate additional mitigation measures should be considered (see Section 7.2).

7.1.1.2 On-Airport (Commonwealth) land

Review of predicted vibration levels from the TBM and rockhammer excavation to receivers within the Airport boundary found that there were no receivers on Commonwealth land predicted to exceed the screening vibration levels.

7.1.2 Damage to buildings

The numbers of buildings which are close to or within the minimum working distances for cosmetic damage are shown in Table 7.2. There are no heritage properties where vibration from tunnelling exceeded the building damage goals (Table 4.1).

Table 7.2: Number of potentially affected structures for cosmetic damage

Tunnelling excavation	Number of structures	
	Screening criteria for non-heritage structures	Screening criteria for heritage structures
North TBM tunnel (OHE to STM)	0	0
South TBM tunnel (ABP to AEC)	0	0
North Cross passages (OHE to STM)	0	0
South Cross passages (ABP to AEC)	0	0
Total	**0**	**0**

Table 7.2 above shows there are no building structures being triggered above the screening criteria for cosmetic damage. As a result, there is negligible risk of structural damage to non-heritage and heritage listed structures during the proposed tunnelling excavation works.

7.1.3 Vibration sensitive equipment and operations

No sensitive scientific or medical equipment are known along the proposed tunnel alignment. Should such items be identified by CPBG JV, then relevant vibration criteria would be established for each item and any associated management or mitigation measures determined.

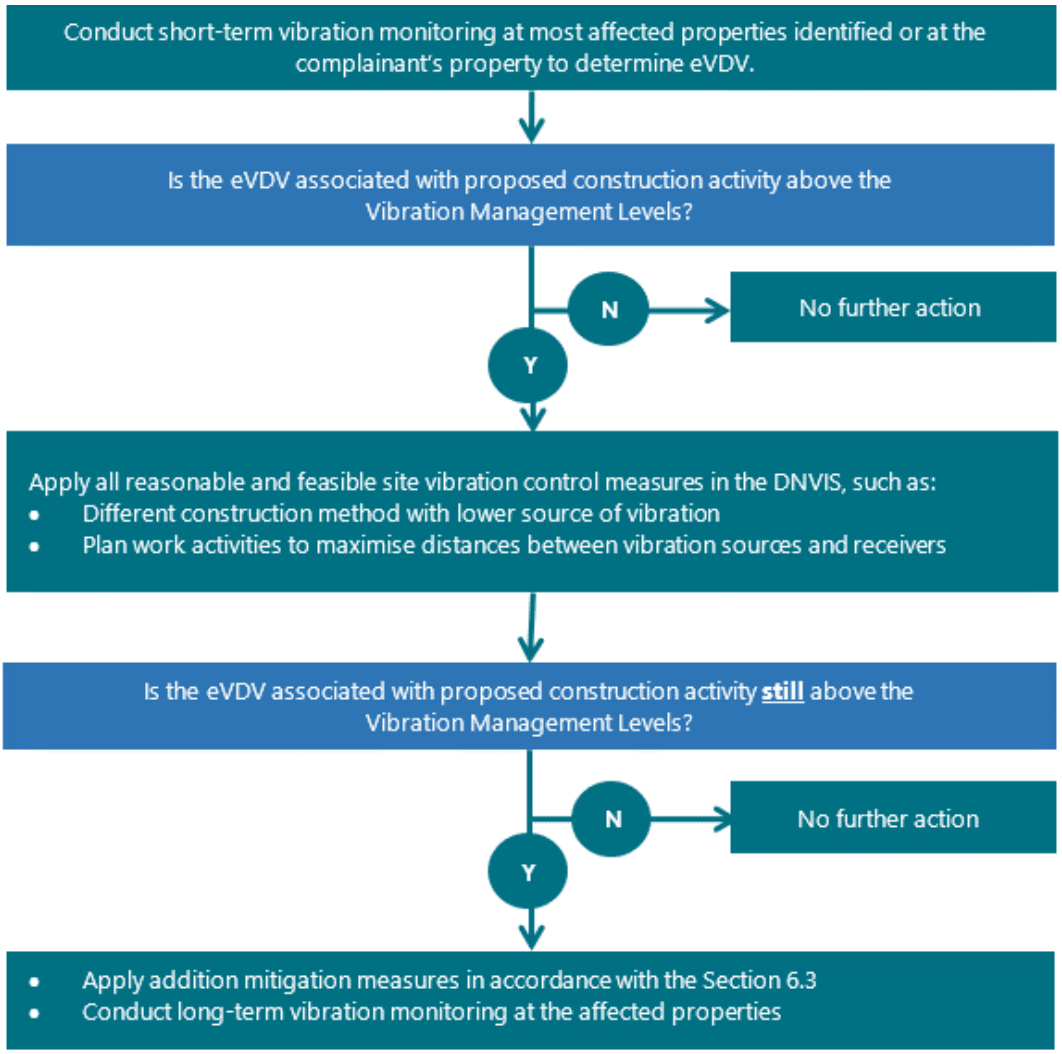
Other sensitive vibration equipment may be inspected in response to community consultation or complaints.

7.2 Vibration mitigation measures

7.2.1 Management and mitigation procedures

The procedure to manage and minimise potential human annoyance vibration impacts is presented in Figure 9.

Figure 9: Management protocol for human annoyance impact



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

7.2.2 Vibration control and management measures

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

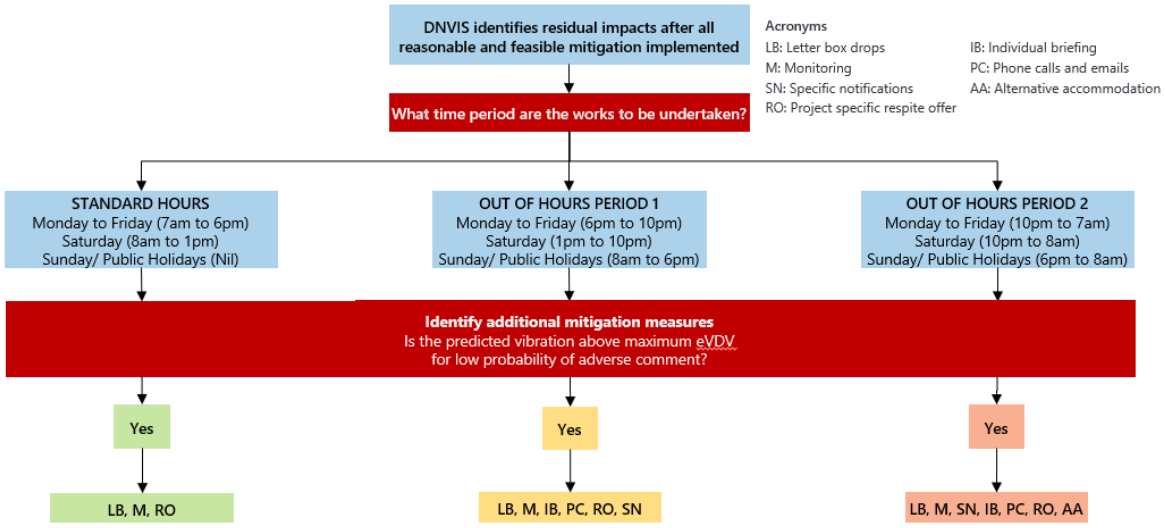
Table 7.3: Site vibration control measures

Control type	Control measure	Typical use
Construction Planning	Building condition surveys	Undertake building dilapidation surveys on all buildings identified in Table 7.2 prior to commencement of activities with the potential to cause property damage (see Section 7.1).
	Community consultation	Implement community consultation measures – inform community of construction activity & potential impacts – inform community that the level of vibration at which people perceive it, or at which loose objects may rattle, is far lower than the level at which minor cosmetic damage is expected to occur
	Equipment selection/ construction method	Use less vibration emitting construction methods where feasible & reasonable Where there is capacity, use roadheaders to excavate cross passages in place of rock hammers.
	Respite offer	Where vibration is found to be above the vibration management levels, respite would be offered (Section 7.2.3).
Complaints Management	Construction Complaints Management System	Complaints would be managed in accordance with the CPBG SBT Community Communication Strategy (SMWSASBT-CPG-1NL-NL000-CY-PLN-000002)(see Section 7.2.4.2). Each complaint shall be investigated and where vibration levels are established as exceeding the set limits, appropriate amelioration measures shall be put in place to mitigate future occurrences. Management measures may include modification of construction methods where practicable.
Monitoring	Unattended and attended vibration measurements	Representative vibration measurements are required at the commencement of vibration generating activities to confirm that vibration is within the acceptable range to prevent damage to buildings and sensitive equipment (Section 7.2.4).

7.2.3 Additional vibration mitigation measures

After applying all feasible and reasonable mitigation measures identified in Table 7.3, if vibration monitoring at representative locations still exceeds relevant vibration objectives for human annoyance, the appropriate additional vibration mitigations measures, based on the CNVS [1], presented in Figure 10, should be provided.

Figure 10: Additional vibration mitigation measures



7.2.4 Vibration monitoring

7.2.4.1 Off-Airport (NSW) land

Attended vibration monitoring is to be undertaken to validate the vibration model and to verify that vibration resulting from tunnelling works are consistent (or below) with vibration predicted in this DNVIS and any EPL Condition, or in response to vibration complaints.

Table 7.4 shows the representative vibration monitoring locations as does Table 6.7 which shows the attended GBN monitoring locations. Both GBN and vibration measurements would be conducted concurrently, subject to obtaining the property owner/occupier's consent to access the property (where required).

Noise monitoring should follow the procedures outlined in the Noise and Vibration Monitoring Program (refer to Annexure A of the CNVMP).

Table 7.4: Attended vibration monitoring - nominated representative locations

Work Location	Nominated Receiver Address[1,2]	Plant	Nominated receiver location
XP-N02 or CMF to STM	[redacted]	TBM and small rockhammer (Brokk)	Internal, within ground floor rooms when the TBM is closest to the receiver or when the Brokk is closest at XP-N02
XP-N16 or OHE to CMF	[redacted]	TBM and small rockhammer (Brokk)	Internal, within ground floor rooms when the TBM is closest to the receiver or when the Brokk is closest at XP-N16
XP-N17 or OHE to CMF	[redacted]	TBM and small rockhammer (Brokk)	Internal, within ground floor rooms when the TBM is closest to the receiver or when the Brokk is closest at XP-N17
OHE to CMF	[redacted]	TBM	Internal, within ground floor rooms when the TBM is closest to the receiver
XP-S17 or BSF to AEC	[redacted]	TBM and small rockhammer (Brokk)	Internal, within ground floor rooms when the TBM is closest to the receiver or when the Brokk is closest at XP-S17
XP-S20 or BSF to AEC	[redacted]	TBM and small rockhammer (Brokk)	Internal, within ground floor rooms when the TBM is closest to the receiver or when the Brokk is closest at XP-S20

Notes: 1) Monitoring on private property is subject to owner consent and where relevant, occupier consent.

2) Further consultation and investigation will be undertaken to confirm the presence of potentially vibration sensitive structures and determine the relevant vibration criteria.

7.2.4.2 On-Airport (Commonwealth) land

Vibration monitoring is not required for tunnelling work within the Airport boundary found as there were no identified vibration affected receivers on Commonwealth land.

7.2.5 Complaints handling

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

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

8 Impact classification

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

- Low Impact
- Moderate Impact
- High Impact.

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

Table 8.1: Impact classification for tunnelling works

No.	Impact item description	Analysis	Classification
1	The location of the works in relation to NSRs with consideration of noise attenuation features such as noise barriers including topographical features (earth-mounds), buildings, dividing fences etc (distance of works from sensitive receiver(s)).	NSRs are typically only near the tunnel alignment expect at St Marys and Claremont Meadows.	Moderate to low
2	The type and sensitivity of the NSRs: - Low Impact: e.g. Commercial buildings/ Scattered Residential (low density) - Moderate Impact: e.g. Standard residential (typical density) - High Impact: e.g. Residential home for the elderly/high density unit blocks/ persistent complainers/ residents deemed to have "construction noise fatigue".	Standard residential (typically 1 to 2 storeys high) at St Marys and Claremont Meadows. Scattered residential (typically 1 to 2 storeys high) at all other locations.	Low
3	Land use zoning and planning amenity objectives for the area.	Rural/ residential land use surrounding worksite.	Moderate to low
4	Construction and architectural design of impacted building, particularly the presence of any existing noise mitigation including that provided under a Noise Abatement Program or required by the ISEPP, Council DCP or other planning instrument.	It is assumed most buildings are standard construction with no existing additional mitigation. Newer buildings may include noise mitigation under ISEPP or Australian Standard AS 2021:2015 Acoustics - Aircraft Noise Intrusion - Building Siting and Construction (to be confirmed)	Moderate
5	Existing ambient levels.	Low to moderate existing ambient noise levels.	Low
6	The extent of noise exceedance above Noise Management Level.	Predicted levels indicate that residential receives are expected to experience noise greater than the evening and NML. However, it is expected that the maximum duration of the exceedance of the night NML is 5 days and the evening NML is 3 days.	Moderate to Low
7	The likelihood for potential sleep disturbance (as described in the NPfI).	The likelihood of sleep disturbance from tunnelling works is considered low as • GBN impacts from TBM tunnelling will be managed as outlined in Section 6.3 • cross passage excavation will be managed during the OOHW night period where predicted GBN levels are above the GBNMLs.	Low

No.	Impact item description	Analysis	Classification
8	The type of and intensity of noise emitted from works (i.e. tonal or impulsive): - Lower Impact: No high noise and/or vibration intensive activities - Moderate Impact: Short/intermittent high noise and/or vibration intensive activities - High Impact: Prolonged high noise and/or vibration intensive activities.	Tunnelling excavation works will have so0me instances of 'moderate impact'. The ground-borne noise and vibration impacts presented in this report represent the typical maximum levels that receivers may experience for a limited amount of time and will reduce as the underground works move further away. The impacts would typically be short term in nature and will be managed through the mitigation and management measures outlined in Section 6.3 and Section 7.2.	Low
9	The duration of any OOHW required.	TBM tunnel excavation will be conducted for several months, however the TBM ground-borne noise will affect a specific receiver for up to 5 days.	Low
10	The time frames for any OOHW: - Lower Impact: 6.00 pm till 10.00 pm weekdays 1.00 pm till 10.00pm Saturdays 8.00 am till 6.00 pm Sundays or Public Holidays. - Moderate Impact: 10.00 pm to 7.00 am Weekday Nights 10.00 pm to 8.00 am Saturdays. - High Impact: 6.00 pm to 7.00 am Sundays and Public Holidays.	TBM excavation will operate for 24 hours. Light rockhammer excavation will be conducted at all hours except at cross passages where exceedances occur during the OOH period as identified in Table 6.4 and Appendix C.4.	Low to moderate
11	As a result of noise classification and/or the noise level exceedances at sensitive receivers provided by the DNVIS reports, appropriate reasonable and feasible noise mitigation is to be adopted and implemented. For sites where works are predicted to significantly exceed noise goals and impact on receivers for a significant period of time, additional reasonable and feasible noise mitigation measures such as those outlined in Section 5 would be considered if practical to reduce the noise levels and impact on sensitive receivers.	Mitigation measures outlined in Section 6.2 will be implemented to manage and reduce impacts from tunnelling works.	Low

Review of the overall noise impact of TBM and cross passage tunnelling excavation works is considered **low**. Whilst there are some instances of moderate impact, this impact is short term in nature and will be managed through the mitigation and management measures outlined in Section 6.3, including suitable community notification regarding potential impacts from the works. Mitigation and management measures will be implemented to reduce noise levels with the aim of achieving the NMLs.

Properties at risk of vibration impact from TBM and cross passage tunnelling excavation works have been identified through the conservative screening process set out in the CNVS [1]. Vibration impacts presented in this report represent the typical maximum vibration that receivers may experience for a limited amount of time and will reduce as the underground works move further away. There are no instances of vibration from tunnelling causing structural damage to buildings above the tunnel alignment. Whilst there may be some instances of vibration induced disturbance to building occupants, this impact would be short term in nature and will be managed through the mitigation and management measures outlined in Section 7.2, including suitable community notification regarding potential impacts from the works. The overall vibration impact of TBM and cross passage tunnelling excavation works is considered **low**.

9 Conclusion

In conclusion, the TBM and cross passage tunnelling excavation works have been described in this DNVIS to identify potential environmental risks associated with construction noise and vibration. Construction noise and vibration objectives have been established consistent with the Conditions of Approval for the Project and the EIS.

Construction ground-borne noise

TBM excavation of the mainline tunnel are predicted to generate GBN levels up to 55 dB(A) and light rockhammer excavation of cross passages are predicted to generate GBN levels up to 60 dB(A) at the closest residential receivers outside the Airport boundary on NSW land. The OOH exceedances of the NMLs are expected to have a duration up to 5 days at the closest residential receiver.

There were no GBN affected receivers on Commonwealth land because of tunnel excavation (TBM and cross passages) within the Airport boundary.

Noise mitigation and management measures, including noise monitoring requirements, have been presented in Section 6.2 to aid in providing additional noise reduction benefits where noise levels are above the NMLs.

Construction ground-borne vibration

The risk of structural damage as a result of the proposed tunnelling works is assessed to be negligible.

The predicted vibration levels from the TBM and light rockhammer excavation are above the screening criteria at residential receivers for human annoyance. These predictions are based on tunnelling works being underneath the receivers. When excavation works are further away from the closest point, the predicted level vibration levels would decrease as well as the probability of adverse comments. Therefore, considering the amount of time the underground excavation works would be at the closest point to the properties, the probability of adverse comments due to vibration is considered moderate to low.

There were no receivers on Commonwealth land predicted to exceed the screening vibration levels TBM and rockhammer tunnel excavation within the Airport boundary.

Impact classification

The overall noise and vibration impact of TBM and cross passage tunnelling excavation project-wide is considered **low**.

References

[1] Sydney Metro Construction Noise and Vibration Standard Version 4.3 (SM-20-00098866) – 4 November 2020

[2] Transport for NSW Construction Noise and Vibration Strategy (ref: ST-157/4.1) April 2019

[3] Sydney Metro Western Sydney Airport Out-of-hours Work Protocol Version 2.0 (SM-21-00306108) – 8 November 2021

[4] M2A Joint Venture 2020 Sydney Metro - Western Sydney Airport - Technical Paper 2: Noise and Vibration October 2020

[5] M2A Joint Venture 2020 Sydney Metro - Western Sydney Airport – Submissions Report

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

[7] Environment Protection Authority 2017 NSW Noise Policy for Industry (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] British Standard BS 6472-2008, Evaluation of human exposure to vibration in buildings (1-80Hz)

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

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

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

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

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

[16] 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.
Attenuation	The reduction in the level of sound or vibration.
AVTG	Assessing Vibration – a technical guideline (DEC 2006)
Background noise	Background noise is the term used to describe the underlying level of noise present in the ambient noise, measured in the absence of the noise under investigation, when extraneous noise is removed. It is described as the average of the minimum noise levels measured on a sound level meter and is measured statistically as the A-weighted noise level exceeded for ninety percent of a sample period. This is represented as the L90 noise level (see below).
CNVS	Construction Noise and Vibration Standard (Sydney Metro 2021)
CoA	Condition of Approval
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.
DEC	Department of Environment and Conservation (now EPA)
DECC	Department of Environment and Climate Change (now EPA)
DECCW	Department of Environment, Climate Change and Water (now EPA)
DNVIS	Detailed Noise and Vibration Impact Statement

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

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

APPENDIX B Sensitive receivers and noise management levels

B.1 NCAs and sensitive receiver identification

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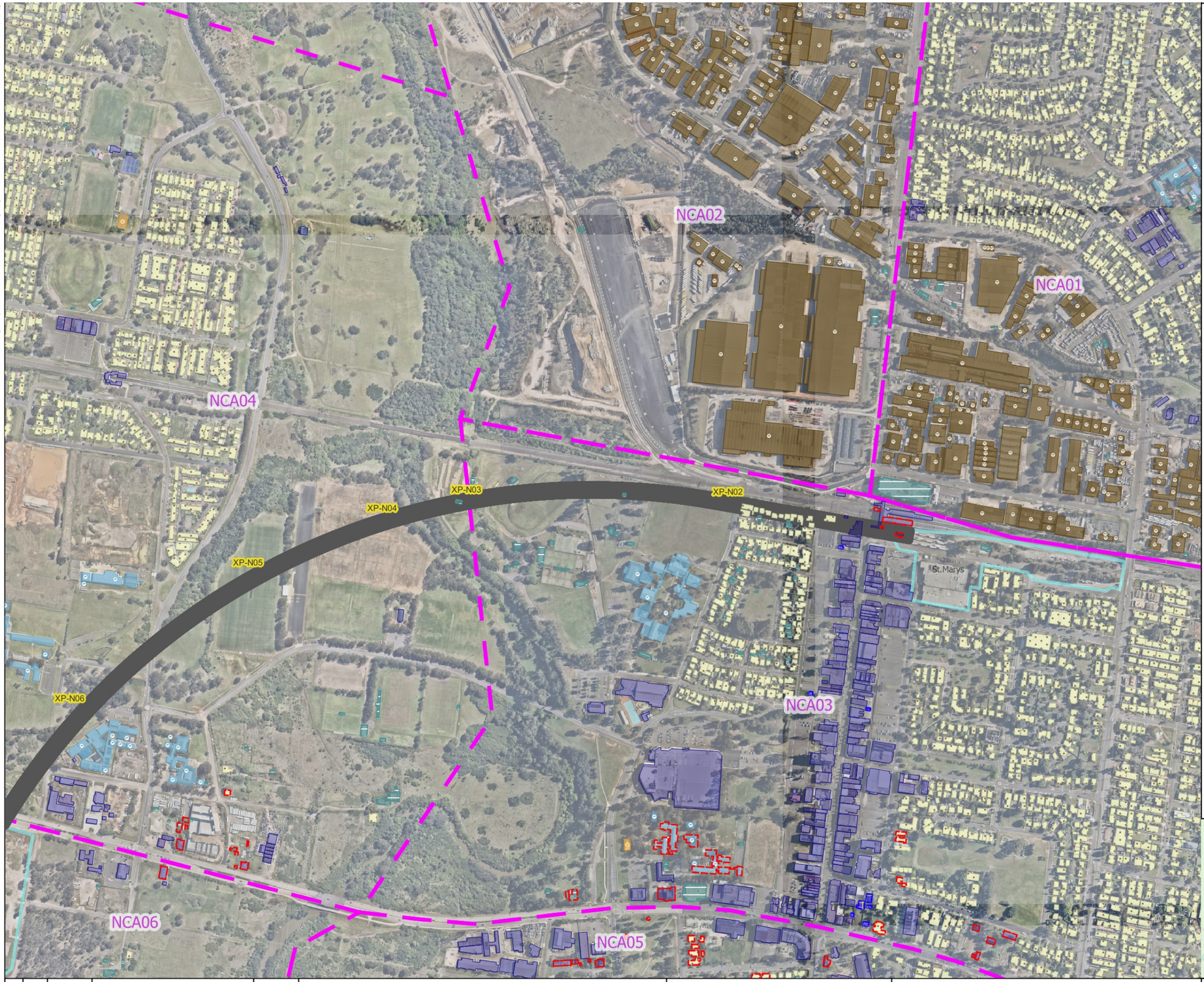

LEGEND

Noise Sensitive Receive

- 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
- Horse Stable
- Recreational - Passive
- Recreational - Active
- Other
- Heritage

NCAs

Construction Footprint

Tunnel Alignment

REV	BY	DATE	DESCRIPTION	APPROVER
r0	DA	02/11/22	Prepare figures	TG

A3 Original

Co-ordinate System: MGA Zone 56

0 170 340 510 m

1:8,000

FULL SIZE A3

NOTE: Do not scale from this drawing.

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Rock Cruching Addendum
Land Use, Compounds and NCAs

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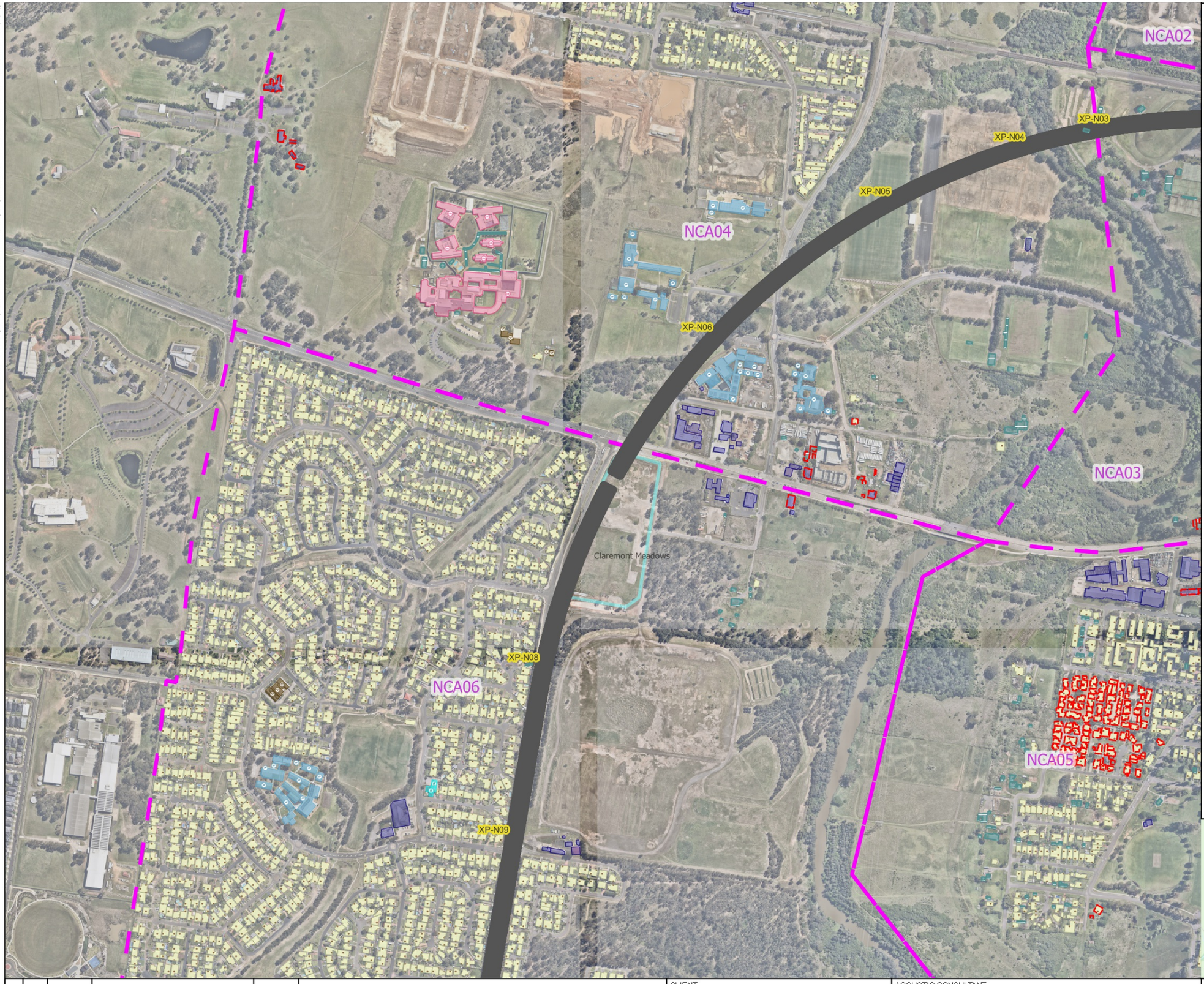

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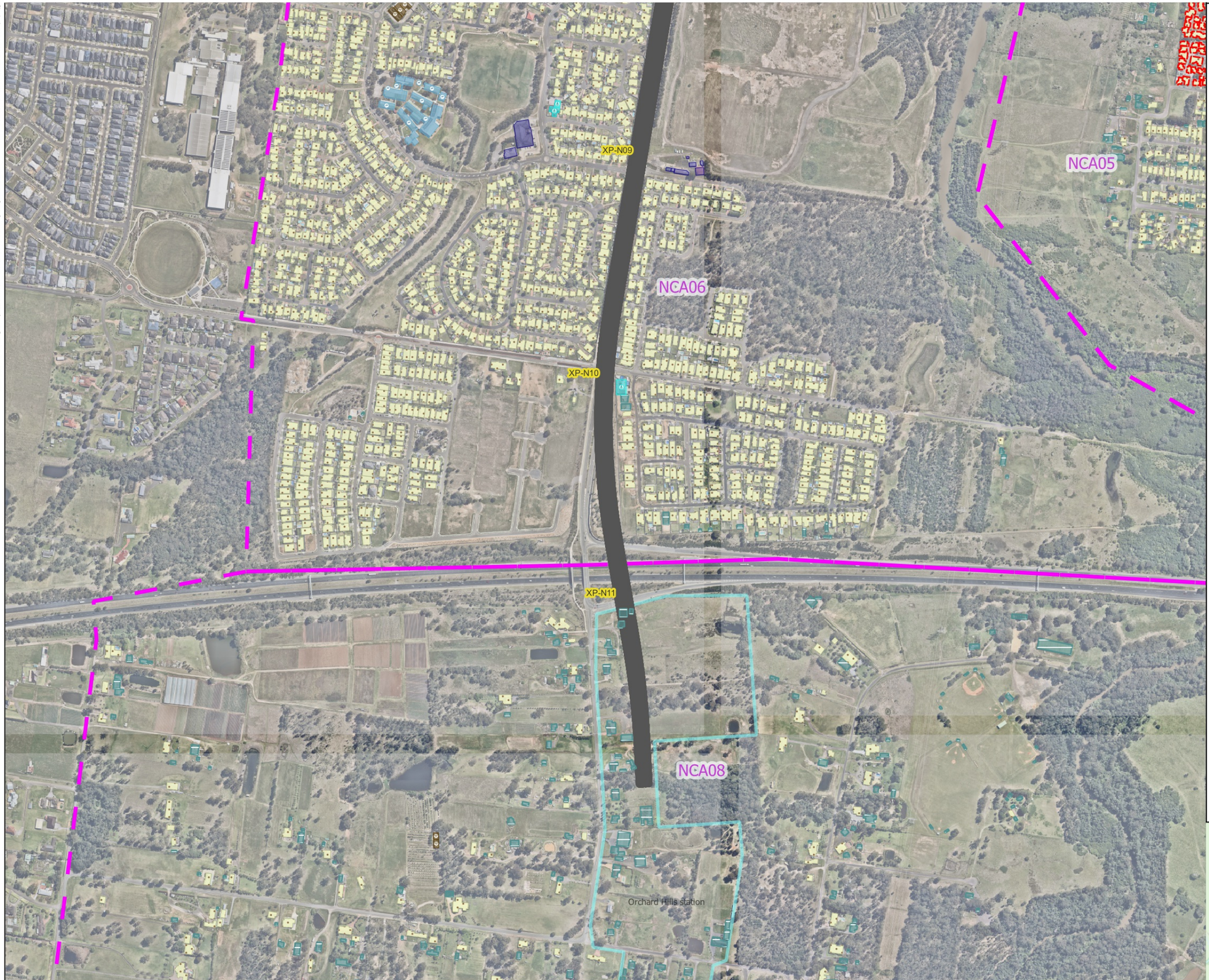

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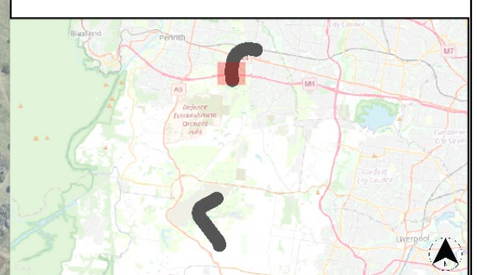

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FULL SIZE A3

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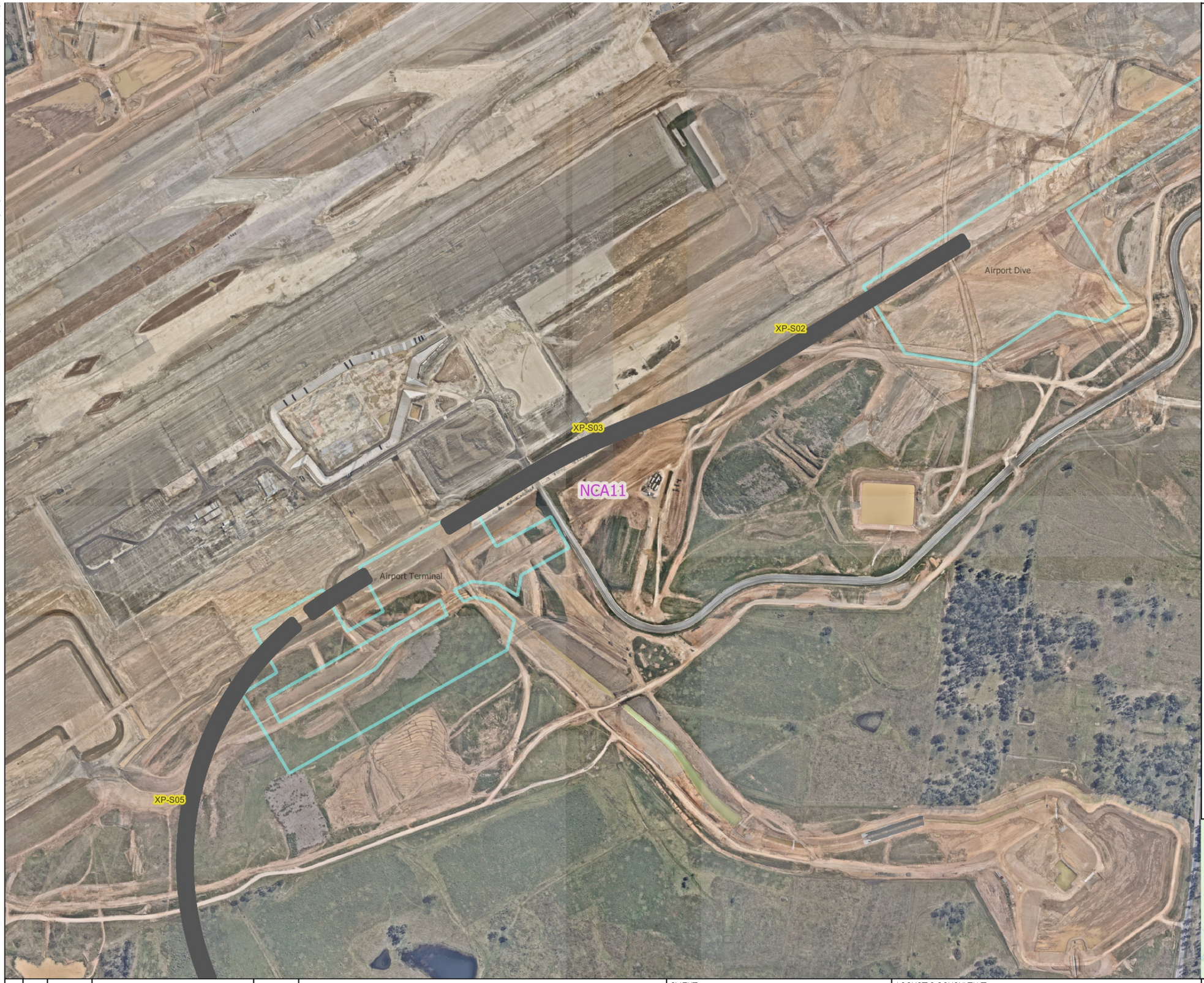

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Co-ordinate System: MGA Zone 56

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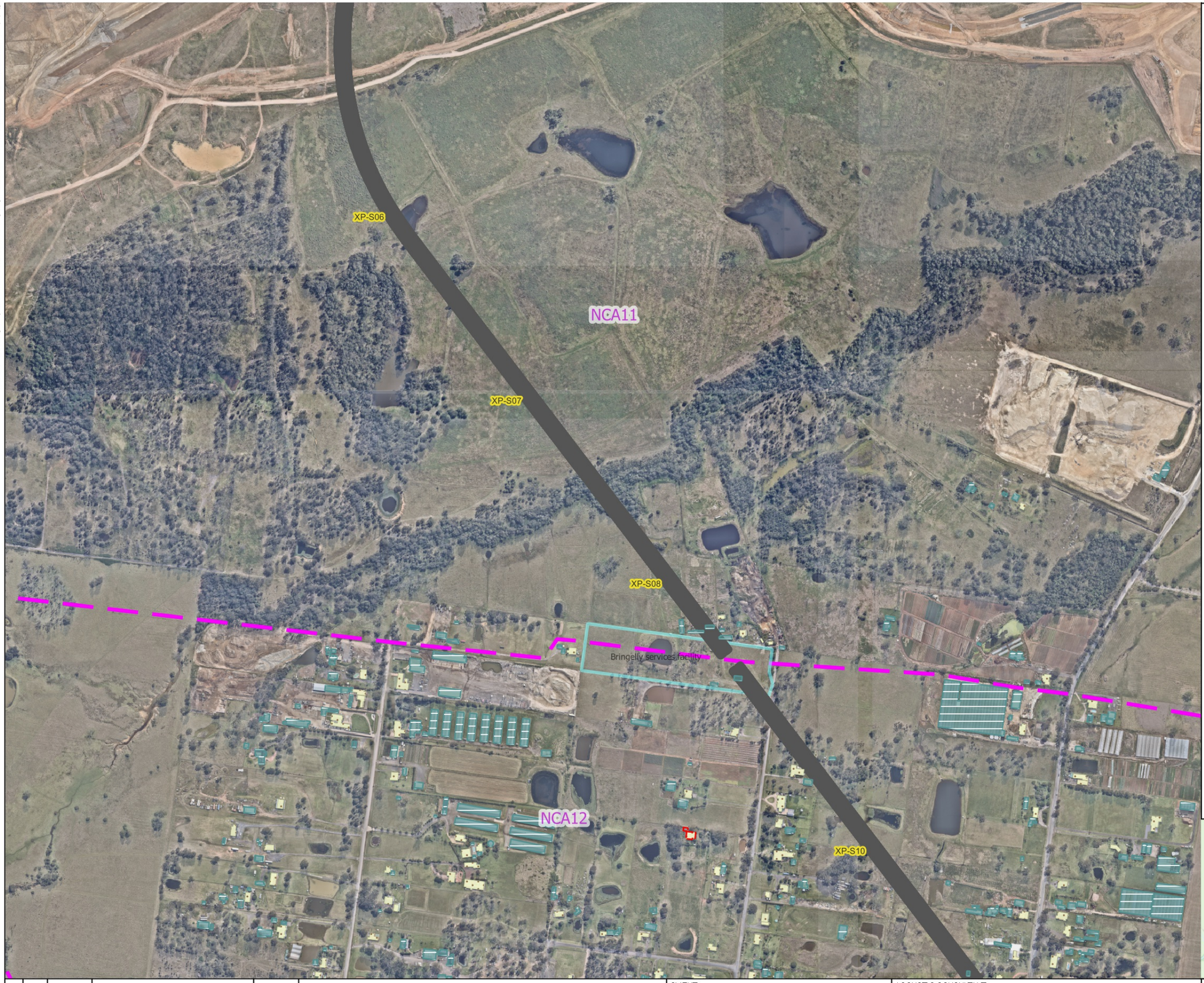

LEGEND

Noise Sensitive Receive

- 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
- Horse Stable
- Recreational - Passive
- Recreational - Active
- Other
- Heritage

NCAs

Construction Footprint

Tunnel Alignment

REV	BY	DATE	DESCRIPTION	APPROVER
r0	DA	02/11/22	Prepare figures	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 170 340 510 m

1:8,000

FULL SIZE A3

NOTE: Do not scale from this drawing.

CLIENT

CPB CONTRACTORS | Ghella 5 Generations of Tunnelers

ACOUSTIC CONSULTANT

RENZO TONIN & ASSOCIATES
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SYDNEY METRO WSA
Tunnelling Works

Rock Cruching Addendum
Land Use, Compounds and NCAs

Land-Use title revision_date: r7_ 12/07/21

Plot Date: 02/11/22 - 09:30 Layout: TM008 APPB&E (r0)

GIS File: R:\Assoc\SydProjects\TM001-TM050\TM008 mt Sydney Metro WSA SBT\5 Calcs\00 GENERAL\Q1 GIS\TM008-DA (r0).qgz

LEGEND

Noise Sensitive Receive

- Residential
- Mixed use
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- Industrial
- Hotel/Motel/Hostel
- Medical facility
- Place of Worship
- Community centre
- Recording studio
- Library/Museum
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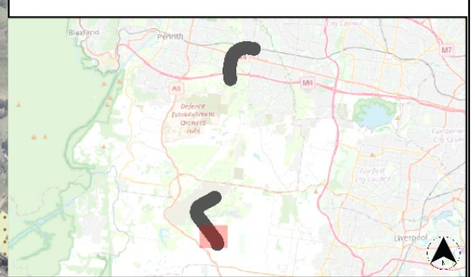
- Educational
- Theatre/Auditorium
- Cinema
- Laboratory
- Flight simulator
- Horse Stable
- Recreational - Passive
- Recreational - Active
- Other
- Heritage

- NCAs
- Construction Footprint
- Tunnel Alignment

0 70 140 210 280 350 420 490 560 630 700 m



REV	BY	DATE	DESCRIPTION	APPROVER
r0	DA	02/11/22	Prepare figures	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 170 340 510 m

1:8,000

FULL SIZE A3

NOTE: Do not scale from this drawing.

CLIENT

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SYDNEY METRO WSA
Tunnelling Works

Rock Cruching Addendum
Land Use, Compounds and NCAs

B.2 NCAs and noise management levels

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

NCA	Receiver Type	Groundborne NMLs based on ICNG (internal) NMLDS	NMLDO	NMLE	NMLN	Comments
Residential receivers						
All	All residential receivers	(50)*	(50)*	40	35	Source: ICNG, CNVS (NMLE and NMLN only)
		Daytime ground-borne noise NMLs are not specified in the ICNG or Sydney Metro CNVS. Human comfort vibration limit applies during the day. 50 dB(A) used as screening guideline as this correlates to human comfort vibration limit. EIS Daytime ground-borne NML 45 dB(A) also considered for consistency.				
ICNG 'Other sensitive' receivers (NML applicable when in use)						
Classrooms at schools and other educational institutions		45	45	45	45	Source: ICNG
Hospital wards and operating theatres		45	45	45	45	Source: ICNG
Places of worship		45	45	45	45	Source: ICNG
Commercial premises (including offices and retail outlets)		50	50	50	50	Source: ICNG, assuming a conservative façade loss of 20 dB(A)
Industrial premises		55	55	55	55	Source: ICNG, assuming a conservative façade loss of 20 dB(A)
Other sensitive receivers						
Studio building (music recording studio)		25	25	25	25	Source: CNVS Section 2.2.1 & AS2107 'maximum
Studio building (film or television studio)		30	30	30	30	Source: AS2107 'maximum
Theatre/ Auditorium (Drama Theatre)		30	30	30	30	Source: CNVS Section 2.2.1 & AS2107 'maximum
Cinema space, theatre, auditorium		35	35	35	35	Source: AS2107 'maximum'
Childcare centre (indoor sleeping areas)		45	45	45	45	Source: CNVS Section 2.2.1
Childcare centre (play areas)		65	65	65	65	Source: CNVS Section 2.2.1
Library (reading areas)		45	45	45	45	Source: CNVS Section 2.2.1 & AS2107 'maximum
Hotel (Sleeping areas: Hotels near major roads)		40	40	40	40	Source: CNVS Section 2.2.1 & AS2107 'maximum
Hotel (bars and lounges)		50	50	50	50	Source: CNVS Section 2.2.1 & AS2107 'maximum
Community centres – Municipal Buildings		40	40	40	40	Source: AS2107 'maximum'
Bar/ Restaurant (Bars and lounges/ Restaurant)		50	50	50	50	Source: CNVS Section 2.2.1 & AS2107 'maximum
Café/ Coffee bar		50	50	50	50	Source: CNVS Section 2.2.1 & AS2107 'maximum

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

APPENDIX C Ground-Borne Noise (GBN)

C.1 TBM tunnel excavation – maximum GBN levels

Land-Use file revision_date: r7_07/07/21

Plot Date: 22/06/23 - 14:25 Layout: TM008 GBN&V (r0)

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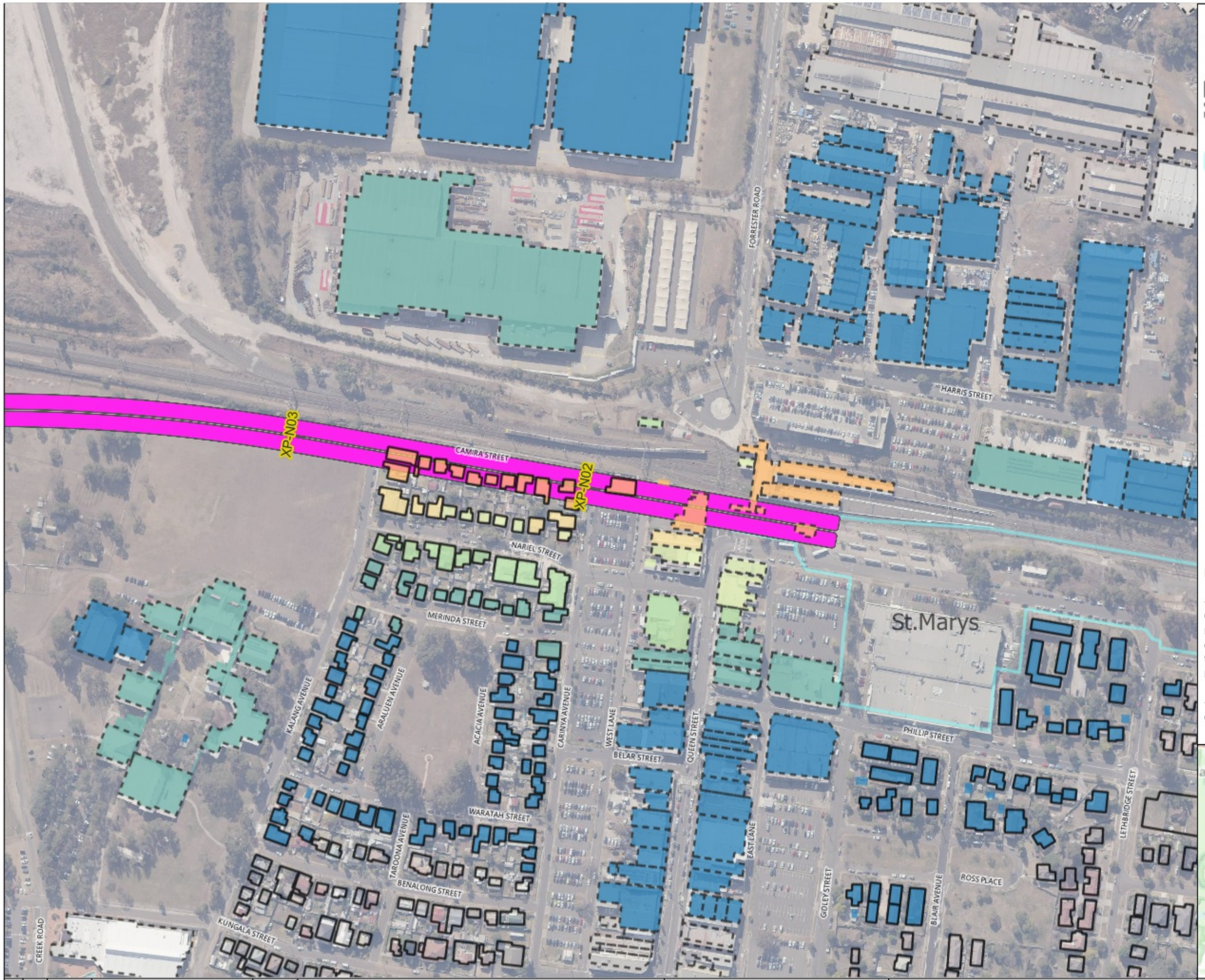


0 39 78 117 156 195 234 273 312 351 m

LEGEND

Noise sensitive receivers

- Residential and Hotels
- Non-Residential

- Construction Footprint
- Mainline Tunnel Alignment
- St Marys to Claremont Meadows Tunnel

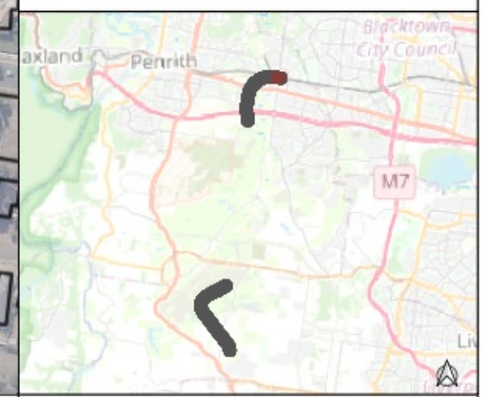
Maximum GBN levels dB(A) during TBM excavation

- <30
- 30.0 - 35.0
- 35.0 - 40.0
- 40.0 - 45.0
- 45.0 - 50.0
- 50.0 - 55.0
- 55.0 - 60.0
- >60

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
r0	DA	01/11/22	Prepare figures	TG
r1	DA	22/06/23	Updated cross passages	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 40 80 120 160 m

1:3,000

FULL SIZE A3

NOTE: Do not scale from this drawing.

N

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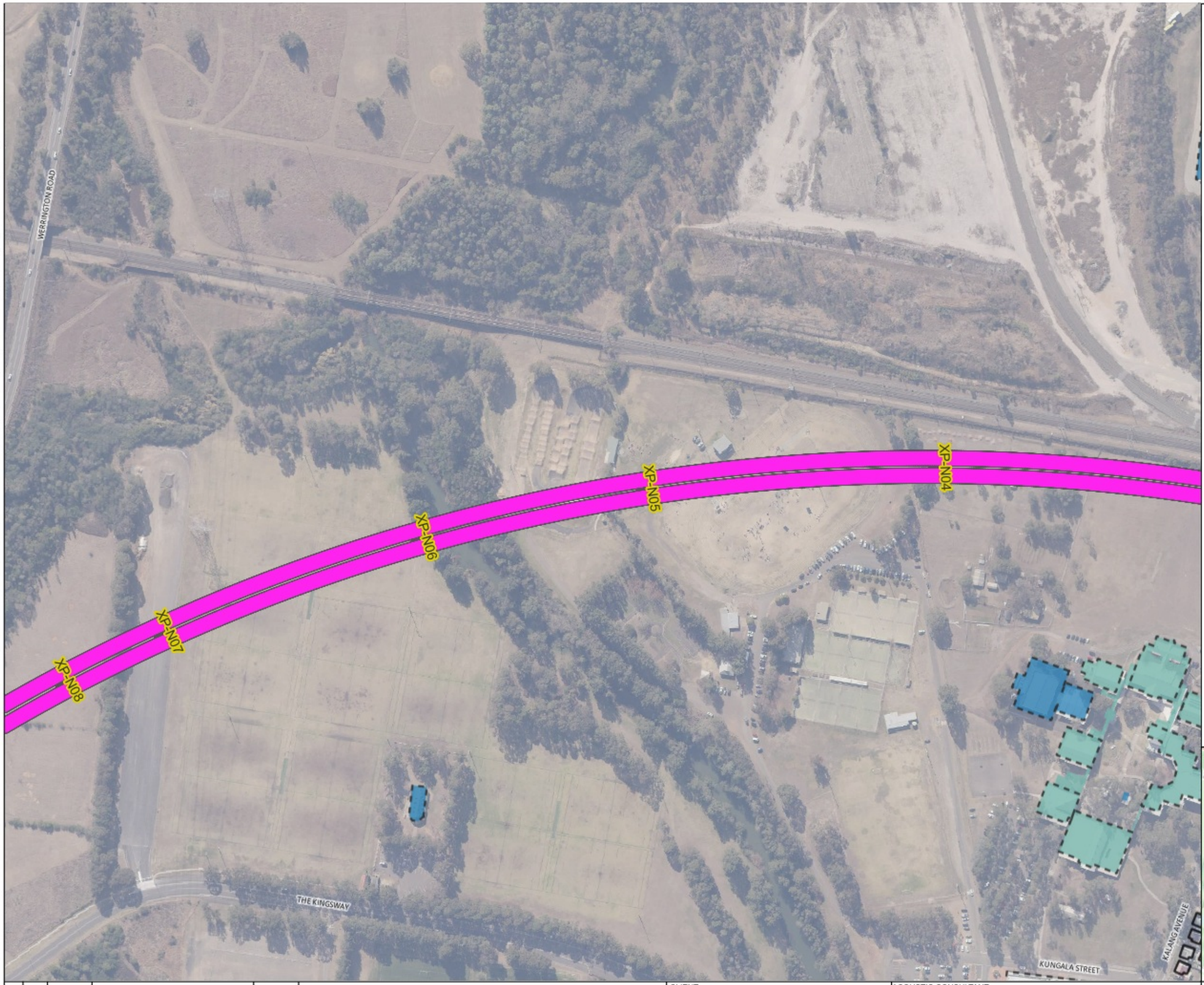
SYDNEY METRO WEST WESTERN SYDNEY AIRPORT TUNNELLING

Predicted Maximum GBN level during St Marys to Claremont Meadows excavation (TBM)

Land-Use file revision_date: r7_07/07/21

Plot Date: 22/06/23 - 14:25 Layout: TM008 GBN&V (r0)

GIS File: R:\AssocSydProjects\TM001-TM050\TM008 mt Sydney Metro WSA SBT\5 Calcs\00 GENERAL\01 GIS\TM008-DA (r0).qgz



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r1	DA	22/06/23	Updated cross passages	TG

A3 Original

Co-ordinate System: MGA Zone 56

0 40 80 120 160 m

1:3,000

FULL SIZE A3

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N

CLIENT

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SYDNEY METRO WEST WESTERN SYDNEY AIRPORT TUNNELLING

Predicted Maximum GBN level during St Marys to Claremont Meadows excavation (TBM)

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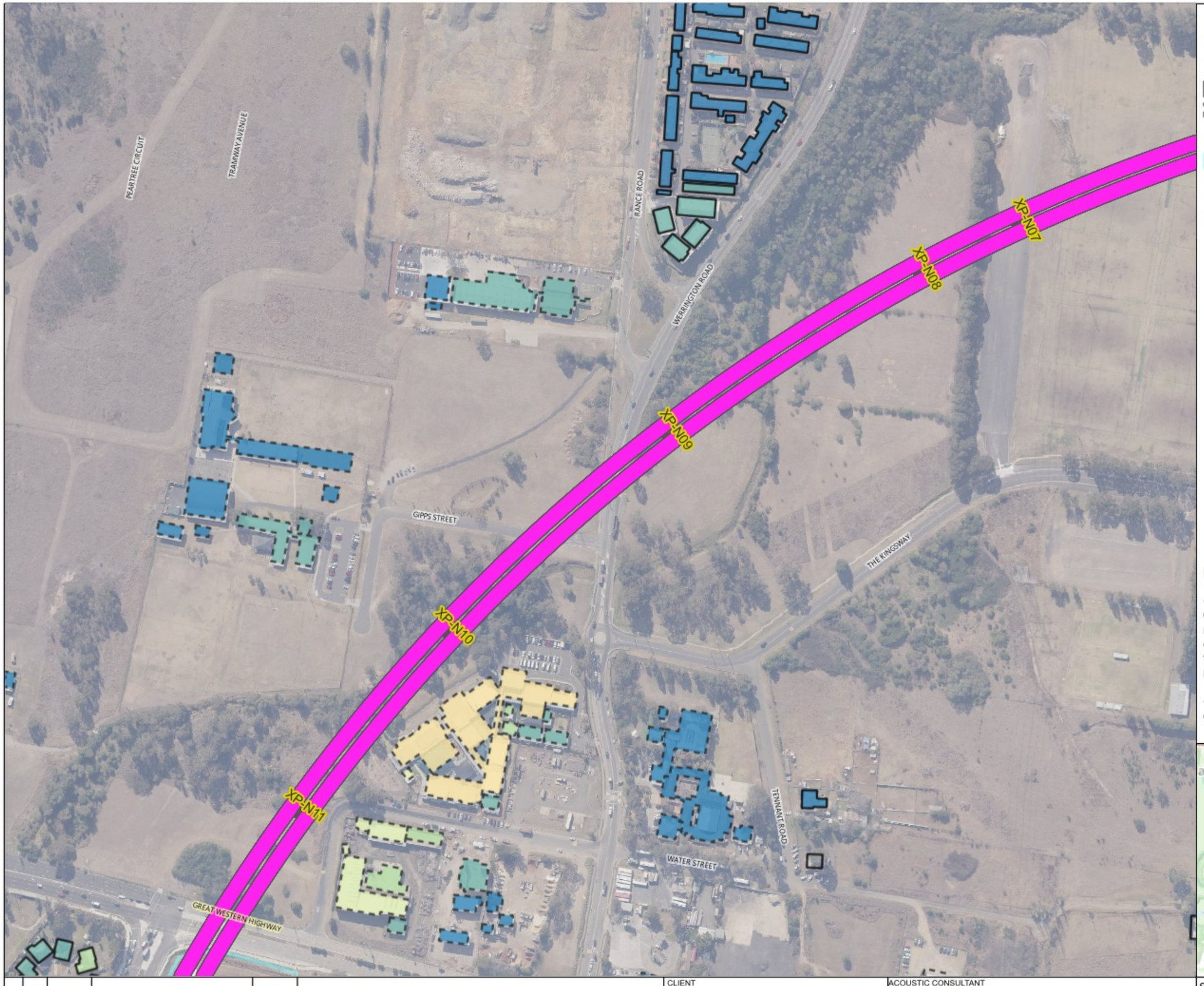
Plot Date: 22/06/23 - 14:25 Layout: TM008 GBN&V (r0)

GIS File: R:\AssocSydProjects\TM001-TM050\TM008 mt Sydney Metro WSA SBT\5 Calcs\00 GENERAL\01 GIS\TM008-DA (r0).qgz



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LEGEND

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r1	DA	22/06/23	Updated cross passages	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 40 80 120 160 m

1:3,000

FULL SIZE A3

NOTE: Do not scale from this drawing.

CLIENT

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SYDNEY METRO WEST WESTERN SYDNEY AIRPORT TUNNELLING

Predicted Maximum GBN level during St Marys to Claremont Meadows excavation (TBM)

Land-Use file revision_date: r7_07/07/21

Plot Date: 22/06/23 - 14:25 Layout: TM008 GBN&V (r0)

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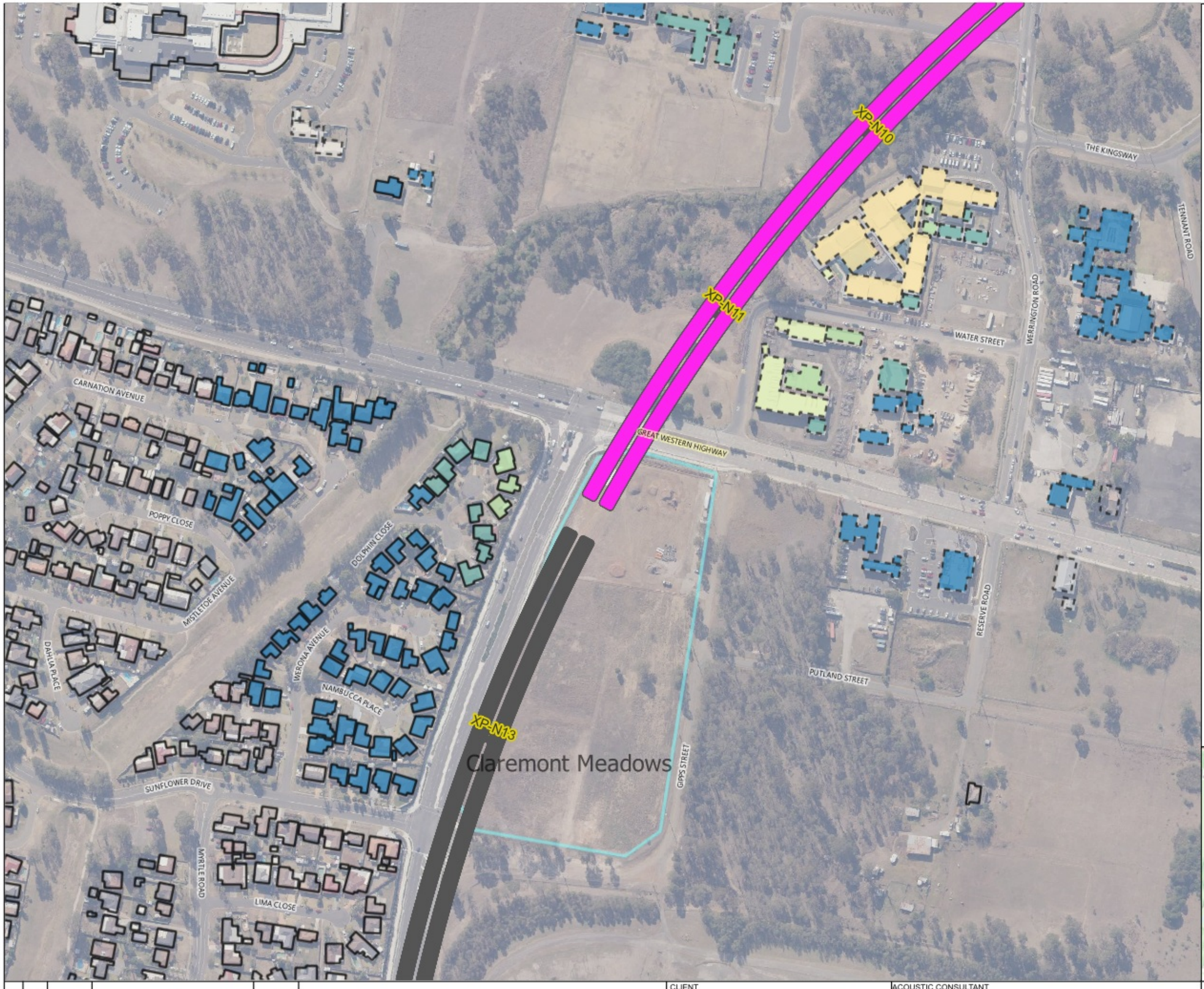

LEGEND

Noise sensitive receivers

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- Non-Residential

- Construction Footprint
- Mainline Tunnel Alignment
- St Marys to Claremont Meadows Tunnel

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A3 Original

Co-ordinate System: MGA Zone 56

0 40 80 120 160 m

1:3,000

FULL SIZE A3

NOTE: Do not scale from this drawing.

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SYDNEY METRO WEST WESTERN SYDNEY AIRPORT TUNNELLING

Predicted Maximum GBN level during St Marys to Claremont Meadows excavation (TBM)

Land-Use file revision_date: r7_07/07/21

Plot Date: 22/06/23 - 14:26 Layout: TM008 GBN&V (r0)

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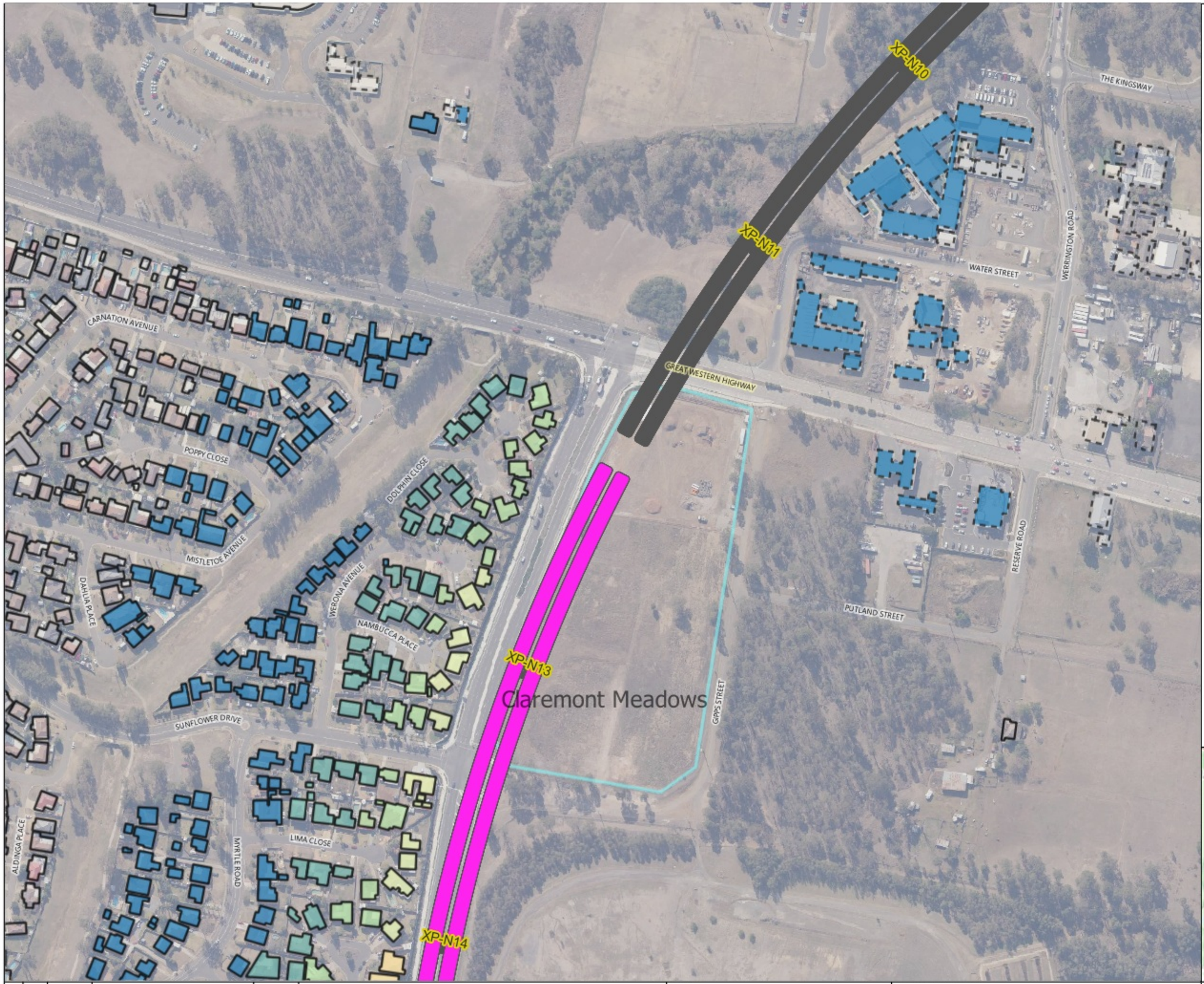

351 m
312
273
234
195
156
117
78
39
0

LEGEND

Noise sensitive receivers

- Residential and Hotels
- Non-Residential

- Construction Footprint
- Mainline Tunnel Alignment
- Claremont Meadows to Orchard Hills Tunnel

Maximum GBN levels dB(A) during TBM excavation

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A3 Original | Co-ordinate System: MGA Zone 56

0 40 80 120 160 m

1:3,000

FULL SIZE A3

NOTE: Do not scale from this drawing.

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SYDNEY METRO WEST WESTERN SYDNEY AIRPORT TUNNELLING

Predicted Maximum GBN level during Claremont Meadows to Orchard Hills excavation (TBM)

Land-Use file revision_date: r7_07/07/21
Plot Date: 22/06/23 - 14:26 Layout: TM008 GBN&V (r0)
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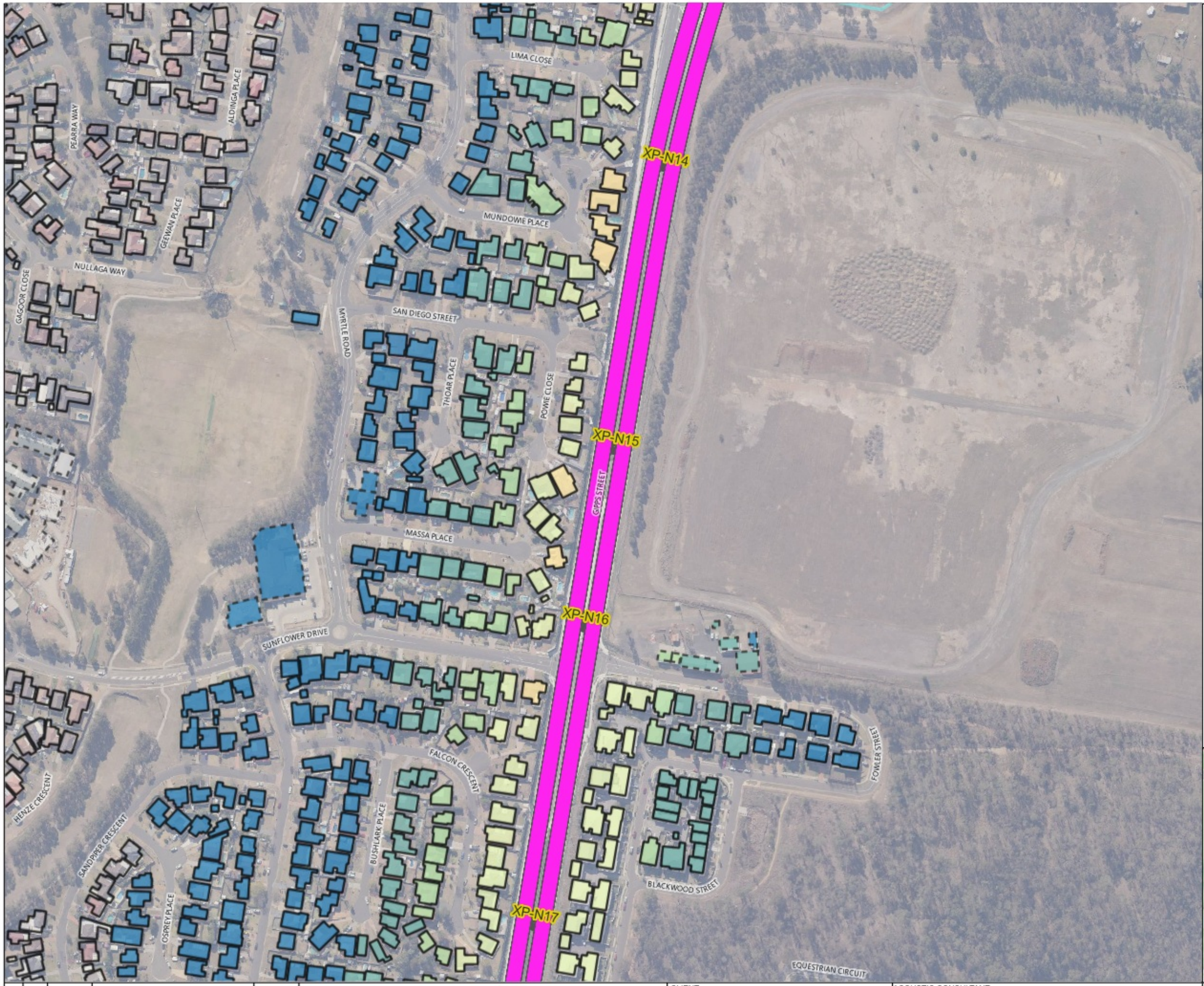

LEGEND

Noise sensitive receivers

- Residential and Hotels
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- Construction Footprint
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r1	DA	22/06/23	Updated cross passages	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 40 80 120 160 m
1:3,000
FULL SIZE A3
NOTE: Do not scale from this drawing.

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SYDNEY METRO WEST WESTERN SYDNEY AIRPORT TUNNELLING

Predicted Maximum GBN level during Claremont Meadows to Orchard Hills excavation (TBM)

Land-Use file revision_date: r7_07/07/21

Plot Date: 22/06/23 - 14:26 Layout: TM008 GBN&V (r0)

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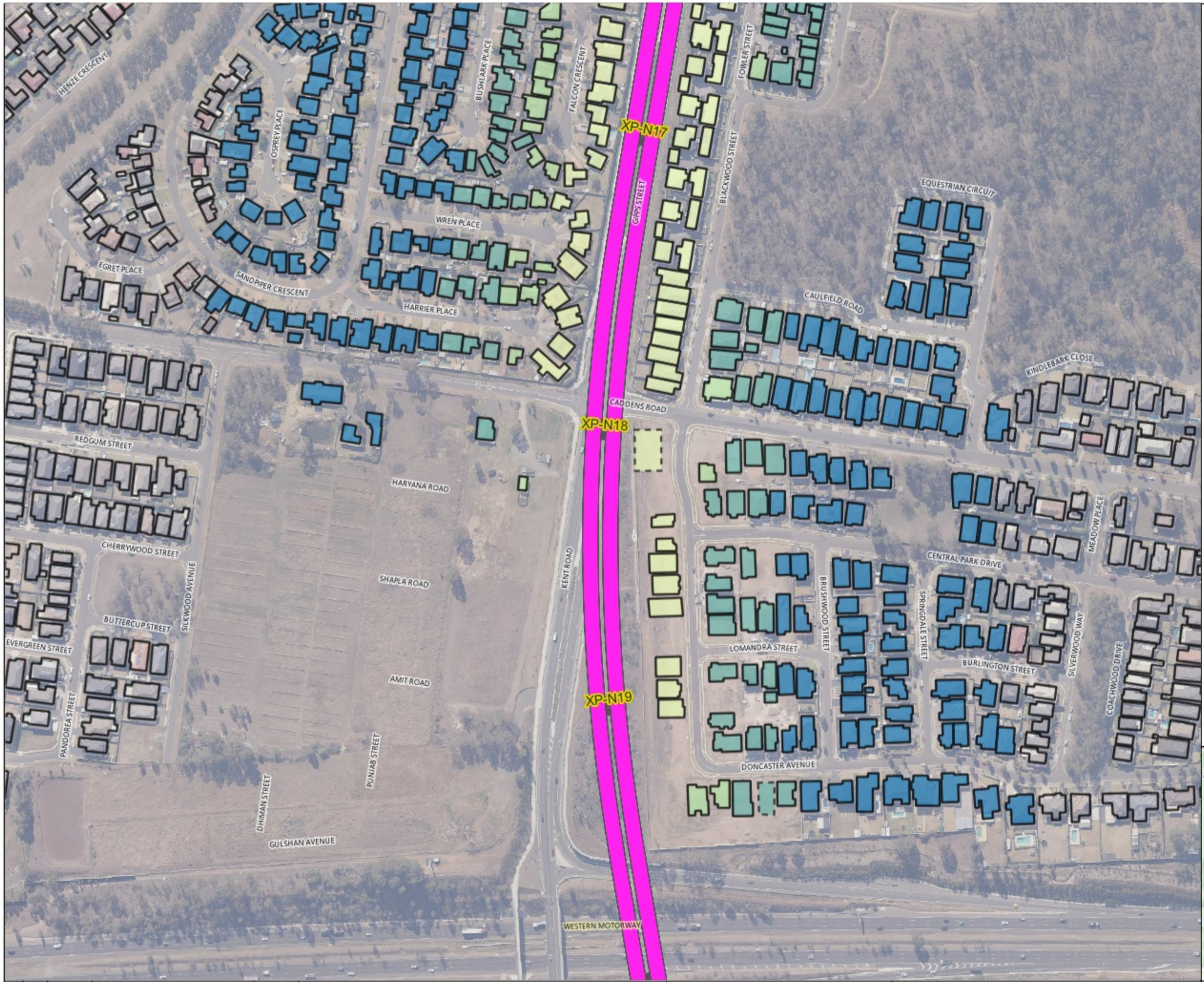

LEGEND

Noise sensitive receivers

- Residential and Hotels
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- Mainline Tunnel Alignment
- Claremont Meadows to Orchard Hills Tunnel

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A3 Original

Co-ordinate System: MGA Zone 56

0 40 80 120 160 m

1:3,000

FULL SIZE A3

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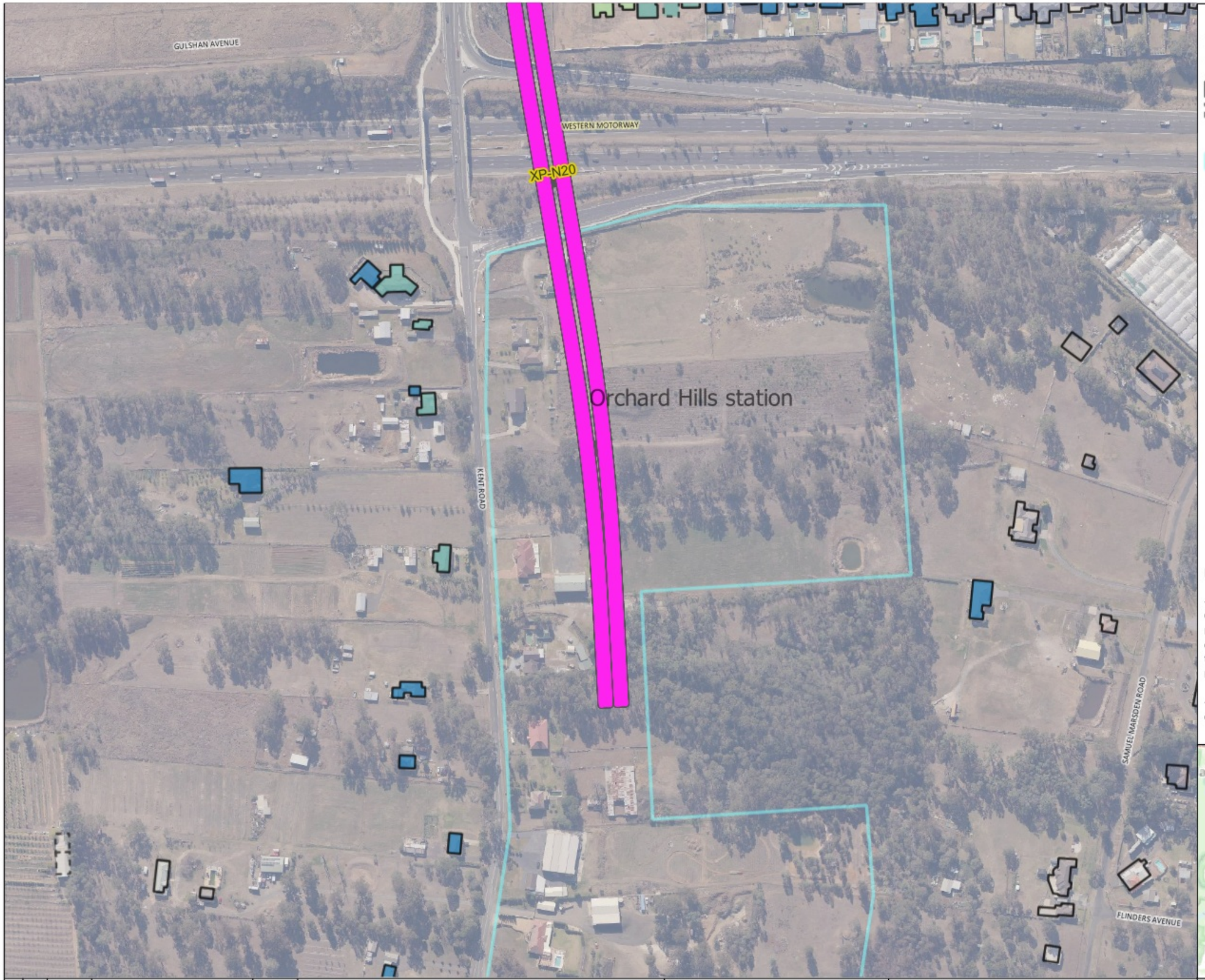
SYDNEY METRO WEST WESTERN SYDNEY AIRPORT TUNNELLING

Predicted Maximum GBN level during Claremont Meadows to Orchard Hills excavation (TBM)

Land-Use file revision_date: r7_07/07/21
Plot Date: 22/06/23 - 14:26 Layout: TM008 GBN&V (r0)
GIS File: R:\AssocSydProjects\TM001-TM050\TM008 mt Sydney Metro WSA SBTJ\5 Calcs\00 GENERAL\01 GIS\TM008-DA (r0).qgz



0 39 78 117 156 195 234 273 312 351 m

LEGEND

Noise sensitive receivers
- Residential and Hotels
- Non-Residential

- Construction Footprint
- Mainline Tunnel Alignment
- Claremont Meadows to Orchard Hills Tunnel

Maximum GBN levels dB(A) during TBM excavation
- <30
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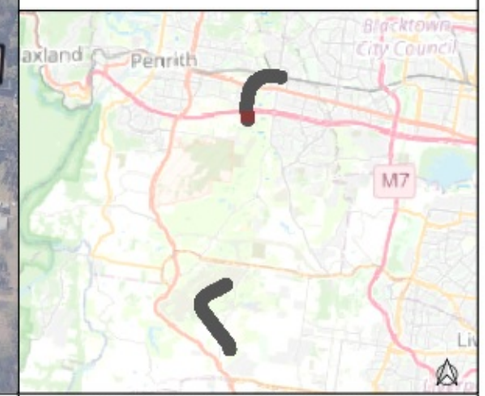

REV	BY	DATE	DESCRIPTION	APPROVER
r0	DA	01/11/22	Prepare figures	TG
r1	DA	22/06/23	Updated cross passages	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 40 80 120 160 m
1:3,000
FULL SIZE A3
NOTE: Do not scale from this drawing.

CLIENT
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SYDNEY METRO WEST WESTERN SYDNEY AIRPORT TUNNELLING

Predicted Maximum GBN level during Claremont Meadows to Orchard Hills excavation (TBM)

Land-Use file revision_date: r7_07/07/21

Plot Date: 22/06/23 - 14:27 Layout: TM008 GBN&V (r0)

GIS File: R:\AssocSydProjects\TM001-TM050\TM008 mt Sydney Metro WSA SBT\5 Calcs\00 GENERAL\01 GIS\TM008-DA (r0).qgz

LEGEND

Noise sensitive receivers

- Residential and Hotels
- Non-Residential

- Construction Footprint
- Mainline Tunnel Alignment
- Airport Dive to Airport Terminal Tunnel

Maximum GBN levels dB(A) during TBM excavation

- <30
- 30.0 - 35.0
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r1	DA	22/06/23	Updated cross passages	TG

A3 Original

Co-ordinate System: MGA Zone 56

0 50 100 150 200 m

1:4,000

FULL SIZE A3

NOTE: Do not scale from this drawing.

CLIENT

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SYDNEY METRO WEST WESTERN SYDNEY AIRPORT TUNNELLING

Predicted Maximum GBN level during Airport Dive to Airport Terminal excavation (TBM)

Land-Use file revision_date: r7_07/07/21

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GIS File: R:\AssocSydProjects\TM001-TM050\TM008 mt Sydney Metro WSA SBT\5 Calcs\00 GENERAL\01 GIS\TM008-DA (r0).qgz

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- 40.0 - 45.0
- 45.0 - 50.0
- 50.0 - 55.0
- 55.0 - 60.0
- >60

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
r0	DA	01/11/22	Prepare figures	TG
r1	DA	22/06/23	Updated cross passages	TG

A3 Original

Co-ordinate System: MGA Zone 56

0 50 100 150 200 m

1:4,000

FULL SIZE A3

NOTE: Do not scale from this drawing.

CLIENT

CPB CONTRACTORS Ghella

ACOUSTIC CONSULTANT

RENZO TONIN & ASSOCIATES
inspired to achieve
Ph (02) 8218 0500 Fax (02) 8218 0501

SYDNEY METRO WEST WESTERN SYDNEY AIRPORT TUNNELLING

Predicted Maximum GBN level during Airport Terminal to Bringelly excavation (TBM)

Land-Use file revision_date: r7_07/07/21

Plot Date: 22/06/23 - 14:27 Layout: TM008 GBN&V (r0)

GIS File: R:\AssocSydProjects\TM001-TM050\TM008 mt Sydney Metro WSA SBT\5 Calcs\00 GENERAL\01 GIS\TM008-DA (r0).qgz

450 m

0 50 100 150 200 m

1:4,000

N

LEGEND

Noise sensitive receivers

- Residential and Hotels
- Non-Residential

- Construction Footprint
- Mainline Tunnel Alignment
- Airport Terminal to Bringelly Tunnel

Maximum GBN levels dB(A) during TBM excavation

- <30
- 30.0 - 35.0
- 35.0 - 40.0
- 40.0 - 45.0
- 45.0 - 50.0
- 50.0 - 55.0
- 55.0 - 60.0
- >60

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
r0	DA	01/11/22	Prepare figures	TG
r1	DA	22/06/23	Updated cross passages	TG

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

CLIENT

CPB CONTRACTORS | Ghella

ACOUSTIC CONSULTANT

RENZO TONIN & ASSOCIATES
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Ph (02) 8218 0500 Fax (02) 8218 0501

SYDNEY METRO WEST WESTERN SYDNEY AIRPORT TUNNELLING

Predicted Maximum GBN level during Airport Terminal to Bringelly excavation (TBM)

Land-Use file revision_date: r7_07/07/21

Plot Date: 22/06/23 - 14:27 Layout: TM008 GBN&V (r0)

GIS File: R:\AssocSydProjects\TM001-TM050\TM008 mt Sydney Metro WSA SBTJ\5 Calcs\00 GENERAL\01 GIS\TM008-DA (r0).qgz

450 m

0 50 100 150 200 m

1:4,000

N

LEGEND

Noise sensitive receivers

- Residential and Hotels
- Non-Residential

- Construction Footprint
- Mainline Tunnel Alignment
- Bringelly to Aerotropolis Tunnel

Maximum GBN levels dB(A) during TBM excavation

- <30
- 30.0 - 35.0
- 35.0 - 40.0
- 40.0 - 45.0
- 45.0 - 50.0
- 50.0 - 55.0
- 55.0 - 60.0
- >60

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
r0	DA	01/11/22	Prepare figures	TG
r1	DA	22/06/23	Updated cross passages	TG

FULL SIZE A3

A3 Original

Co-ordinate System: MGA Zone 56

NOTE: Do not scale from this drawing.

CLIENT

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Ph (02) 8218 0500 Fax (02) 8218 0501

SYDNEY METRO WEST WESTERN SYDNEY AIRPORT TUNNELLING

Predicted Maximum GBN level during Bringelly to Aerotropolis excavation (TBM)

Land-Use file revision_date: r7_07/07/21

Plot Date: 22/06/23 - 14:28 Layout: TM008 GBN&V (r0)

GIS File: R:\AssocSydProjects\TM001-TM050\TM008 mt Sydney Metro WSA SBT\5 Calcs\00 GENERAL\01 GIS\TM008-DA (r0).qgz

450 m

400 350 300 250 200 150 100 50 0

LEGEND

Noise sensitive receivers

- Residential and Hotels
- Non-Residential

- Construction Footprint
- Mainline Tunnel Alignment
- Bringelly to Aerotropolis Tunnel

Maximum GBN levels dB(A) during TBM excavation

- <30
- 30.0 - 35.0
- 35.0 - 40.0
- 40.0 - 45.0
- 45.0 - 50.0
- 50.0 - 55.0
- 55.0 - 60.0
- >60

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
..	..	..	..	..
..	..	..	..	..
..	..	..	..	..
..	..	..	..	..
..	..	..	..	..
r0	DA	01/11/22	Prepare figures	TG
r1	DA	22/06/23	Updated cross passages	TG

A3 Original

Co-ordinate System: MGA Zone 56

0 50 100 150 200 m

1:4,000

FULL SIZE A3

NOTE: Do not scale from this drawing.

CLIENT

CPB CONTRACTORS Ghella

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SYDNEY METRO WEST WESTERN SYDNEY AIRPORT TUNNELLING

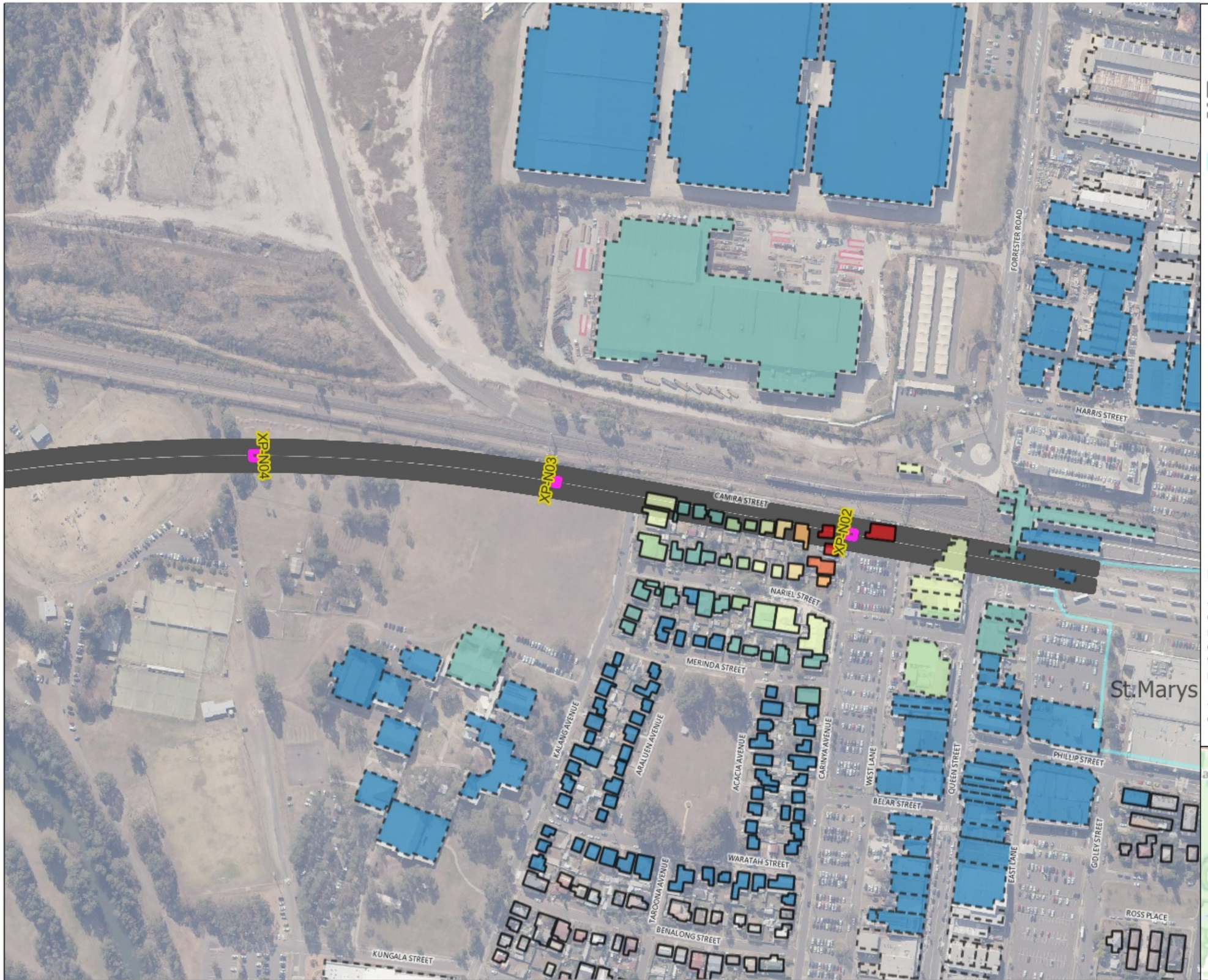
Predicted Maximum GBN level during Bringelly to Aerotropolis excavation (TBM)

C.2 Cross-passage excavation – maximum GBN levels

Land-Use file revision_date: r7_07/07/21

Plot Date: 22/06/23 - 14:28 Layout: TM008 GBN&V (r0)

GIS File: R:\AssocSydProjects\TM001-TM050\TM008 mt Sydney Metro WSA SBT\5 Calcs\00 GENERAL\01 GIS\TM008-DA (r0).qgz



LEGEND

Noise sensitive receivers

- Residential and Hotels
- Non-Residential

- Construction Footprint
- Mainline Tunnel Alignment
- Cross Passages

Maximum GBN levels dB(A) during Light Rockhammer excavation

- <30
- 30.0 - 35.0
- 35.0 - 40.0
- 40.0 - 45.0
- 45.0 - 50.0
- 50.0 - 55.0
- 55.0 - 60.0
- >60

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.

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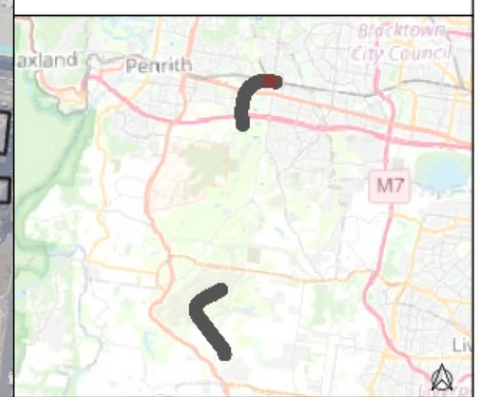

REV	BY	DATE	DESCRIPTION	APPROVER
r0	DA	01/11/22	Prepare figures	TG
r1	DA	22/06/23	Updated cross passages	TG

A3 Original

Co-ordinate System: MGA Zone 56

0 40 80 120 160 m

1:3,000

FULL SIZE A3

NOTE: Do not scale from this drawing.

CLIENT

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Ph (02) 8218 0500 Fax (02) 8218 0501

SYDNEY METRO WEST WESTERN SYDNEY AIRPORT TUNNELLING

Predicted Maximum GBN level during Northern Section excavation (Light Rockhammer)

Land-Use file revision_date: r7_07/07/21

Plot Date: 22/06/23 - 14:28 Layout: TM008 GBN&V (r0)

GIS File: R:\AssocSydProjects\TM001-TM050\TM008 mt Sydney Metro WSA SBT\5 Calcs\00 GENERAL\01 GIS\TM008-DA (r0).qgz

0 39 78 117 156 195 234 273 312 351 m

LEGEND

Noise sensitive receivers

- Residential and Hotels
- Non-Residential

- Mainline Tunnel Alignment
- Cross Passages

Maximum GBN levels dB(A) during Light Rockhammer excavation

- <30
- 30.0 - 35.0
- 35.0 - 40.0
- 40.0 - 45.0
- 45.0 - 50.0
- 50.0 - 55.0
- 55.0 - 60.0
- >60

Notes:

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REV	BY	DATE	DESCRIPTION	APPROVER
r0	DA	01/11/22	Prepare figures	TG
r1	DA	22/06/23	Updated cross passages	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 40 80 120 160 m

1:3,000 FULL SIZE A3

NOTE: Do not scale from this drawing.

CLIENT

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SYDNEY METRO WEST WESTERN SYDNEY AIRPORT TUNNELLING

Predicted Maximum GBN level during Northern Section excavation (Light Rockhammer)

Land-Use file revision_date: r7_07/07/21

Plot Date: 22/06/23 - 14:28 Layout: TM008 GBN&V (r0)

GIS File: R:\AssocSydProjects\TM001-TM050\TM008 mt Sydney Metro WSA SBT\5 Calcs\00 GENERAL\01 GIS\TM008-DA (r0).qgz

LEGEND

Noise sensitive receivers

- Residential and Hotels
- Non-Residential

- Mainline Tunnel Alignment
- Cross Passages

Maximum GBN levels dB(A) during Light Rockhammer excavation

- <30
- 30.0 - 35.0
- 35.0 - 40.0
- 40.0 - 45.0
- 45.0 - 50.0
- 50.0 - 55.0
- 55.0 - 60.0
- >60

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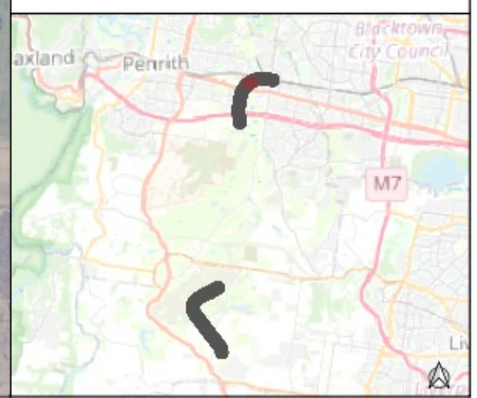

REV	BY	DATE	DESCRIPTION	APPROVER
r0	DA	01/11/22	Prepare figures	TG
r1	DA	22/06/23	Updated cross passages	TG

A3 Original

Co-ordinate System: MGA Zone 56

0 40 80 120 160 m

1:3,000

FULL SIZE A3

NOTE: Do not scale from this drawing.

CLIENT

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SYDNEY METRO WEST WESTERN SYDNEY AIRPORT TUNNELLING

Predicted Maximum GBN level during Northern Section excavation (Light Rockhammer)

Land-Use file revision_date: r7_07/07/21

Plot Date: 22/06/23 - 14:28 Layout: TM008 GBN&V (r0)

GIS File: R:\AssocSydProjects\TM001-TM050\TM008 mt Sydney Metro WSA SBT\5 Calcs\00 GENERAL\01 GIS\TM008-DA (r0).qgz

LEGEND

Noise sensitive receivers

- Residential and Hotels
- Non-Residential

- Construction Footprint
- Mainline Tunnel Alignment
- Cross Passages

Maximum GBN levels dB(A) during Light Rockhammer excavation

- <30
- 30.0 - 35.0
- 35.0 - 40.0
- 40.0 - 45.0
- 45.0 - 50.0
- 50.0 - 55.0
- 55.0 - 60.0
- >60

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REV	BY	DATE	DESCRIPTION	APPROVER
r0	DA	01/11/22	Prepare figures	TG
r1	DA	22/06/23	Updated cross passages	TG

A3 Original

Co-ordinate System: MGA Zone 56

0 40 80 120 160 m

1:3,000

FULL SIZE A3

NOTE: Do not scale from this drawing.

CLIENT

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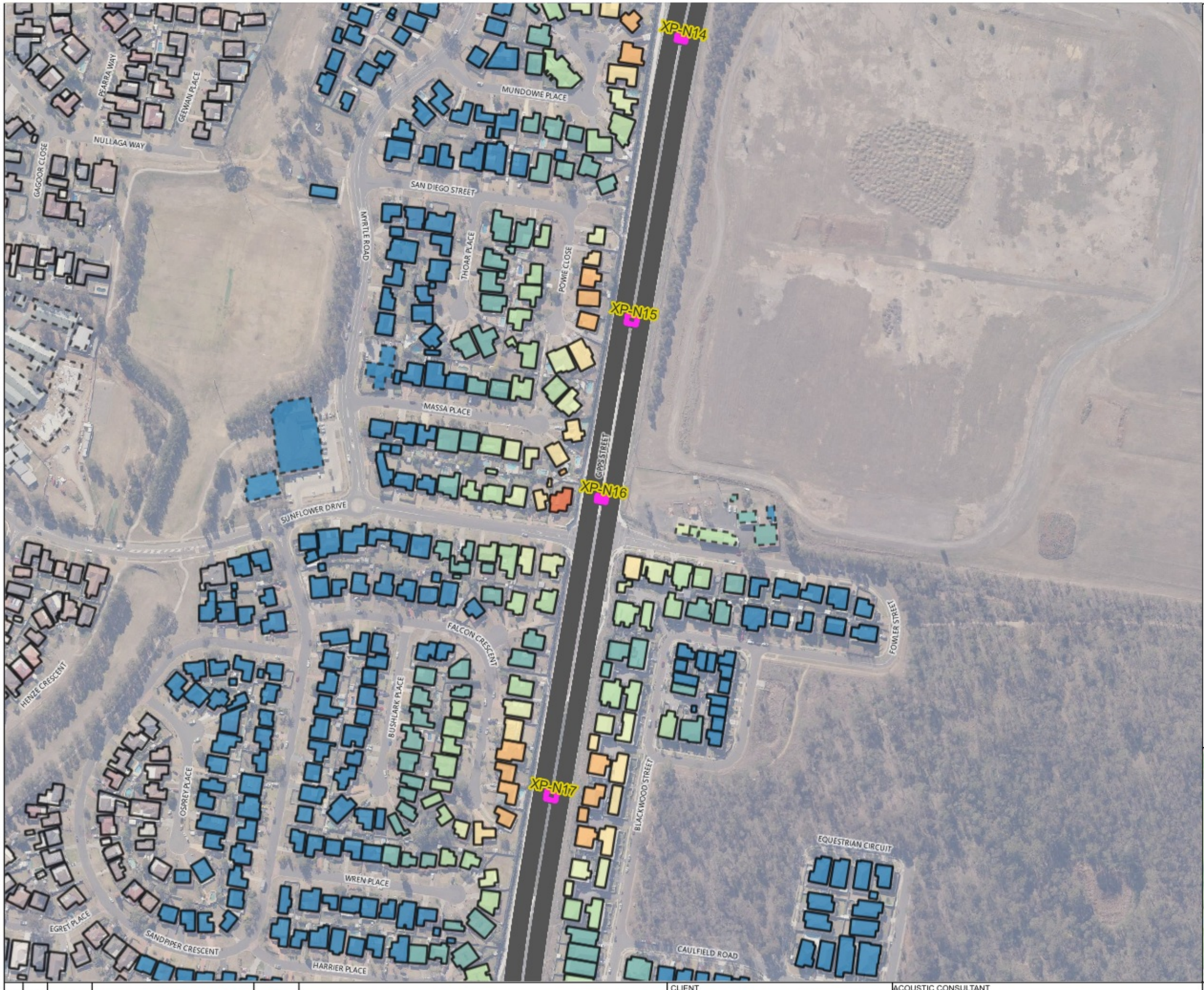
SYDNEY METRO WEST WESTERN SYDNEY AIRPORT TUNNELLING

Predicted Maximum GBN level during Northern Section excavation (Light Rockhammer)

Land-Use file revision_date: r7_07/07/21

Plot Date: 22/06/23 - 14:29 Layout: TM008 GBN&V (r0)

GIS File: R:\AssocSydProjects\TM001-TM050\TM008 mt Sydney Metro WSA SBT\5 Calcs\00 GENERAL\01 GIS\TM008-DA (r0).qgz



LEGEND

Noise sensitive receivers

- Residential and Hotels
- Non-Residential

- Mainline Tunnel Alignment
- Cross Passages

Maximum GBN levels dB(A) during Light Rockhammer excavation

- <30
- 30.0 - 35.0
- 35.0 - 40.0
- 40.0 - 45.0
- 45.0 - 50.0
- 50.0 - 55.0
- 55.0 - 60.0
- >60

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REV	BY	DATE	DESCRIPTION	APPROVER
r0	DA	01/11/22	Prepare figures	TG
r1	DA	22/06/23	Updated cross passages	TG

A3 Original

Co-ordinate System: MGA Zone 56

0 40 80 120 160 m

1:3,000

FULL SIZE A3

NOTE: Do not scale from this drawing.

CLIENT

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Ph (02) 8218 0500 Fax (02) 8218 0501

SYDNEY METRO WEST WESTERN SYDNEY AIRPORT TUNNELLING

Predicted Maximum GBN level during Northern Section excavation (Light Rockhammer)

Land-Use file revision_date: r7_07/07/21
Plot Date: 22/06/23 - 14:29
Layout: TM008 GBN&V (r0)
GIS File: R:\AssocSydProjects\TM001-TM050\TM008 mt Sydney Metro WSA SBT\5 Calcs\00 GENERAL\01 GIS\TM008-DA (r0).qgz

EGRET PLACE
SANDPIPER CRESCENT
HARRIER PLACE
REDGUM STREET
HARYANA ROAD
CHERRYWOOD STREET
SILKWOOD AVENUE
SHAPLA ROAD
BUTTERCUP STREET
AMIT ROAD
PANDOREA STREET
PUNJAB STREET
DHIMAN STREET
GULSHAN AVENUE
GIPPS STREET
CADDENS ROAD
XP-N18
XP-N19
XP-N20
BLACKWOOD STREET
CAULFIELD ROAD
EQUESTRIAN CIRCUIT
KINDLEBARK CLOSE
MEADOW PLACE
CENTRAL PARK DRIVE
BRUSHWOOD STREET
SPRINGDALE STREET
SILVERWOOD WAY
COACHWOOD DRIVE
LOMANDRA STREET
BURLINGTON STREET
DONCASTER AVENUE
WESTERN MOTORWAY
KENT ROAD
Orchard Hills station

351 m
312
273
234
195
156
117
78
39
0

LEGEND

Noise sensitive receivers
- Residential and Hotels
- Non-Residential

- Construction Footprint
- Mainline Tunnel Alignment
- Cross Passages

Maximum GBN levels dB(A) during Light Rockhammer excavation
- <30
- 30.0 - 35.0
- 35.0 - 40.0
- 40.0 - 45.0
- 45.0 - 50.0
- 50.0 - 55.0
- 55.0 - 60.0
- >60

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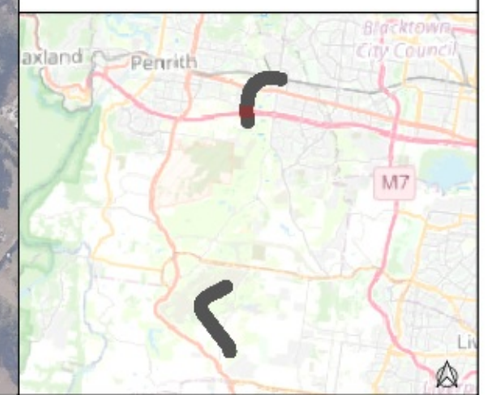

REV	BY	DATE	DESCRIPTION	APPROVER
r0	DA	01/11/22	Prepare figures	TG
r1	DA	22/06/23	Updated cross passages	TG

A3 Original
Co-ordinate System: MGA Zone 56

0 40 80 120 160 m
1:3,000
FULL SIZE A3
NOTE: Do not scale from this drawing.

CLIENT
CPB CONTRACTORS
Ghella

ACOUSTIC CONSULTANT
RENZO TONIN & ASSOCIATES
inspired to achieve
Ph (02) 8218 0500 Fax (02) 8218 0501

SYDNEY METRO WEST WESTERN SYDNEY AIRPORT TUNNELLING

Predicted Maximum GBN level during Northern Section excavation (Light Rockhammer)

Land-Use file revision_date: r7_07/07/21

Plot Date: 22/06/23 - 14:29 Layout: TM008 GBN&V (r0)

GIS File: R:\AssocSydProjects\TM001-TM050\TM008 mt Sydney Metro WSA SBT\5 Calcs\00 GENERAL\01 GIS\TM008-DA (r0).qgz

LEGEND

Noise sensitive receivers

- Residential and Hotels
- Non-Residential

- Construction Footprint
- Mainline Tunnel Alignment
- Cross Passages

Maximum GBN levels dB(A) during Light Rockhammer excavation

- <30
- 30.0 - 35.0
- 35.0 - 40.0
- 40.0 - 45.0
- 45.0 - 50.0
- 50.0 - 55.0
- 55.0 - 60.0
- >60

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REV	BY	DATE	DESCRIPTION	APPROVER
r0	DA	01/11/22	Prepare figures	TG
r1	DA	22/06/23	Updated cross passages	TG

A3 Original

Co-ordinate System: MGA Zone 56

0 50 100 150 200 m

1:4,000

FULL SIZE A3

NOTE: Do not scale from this drawing.

CLIENT

CPB CONTRACTORS Ghella

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Ph (02) 8218 0500 Fax (02) 8218 0501

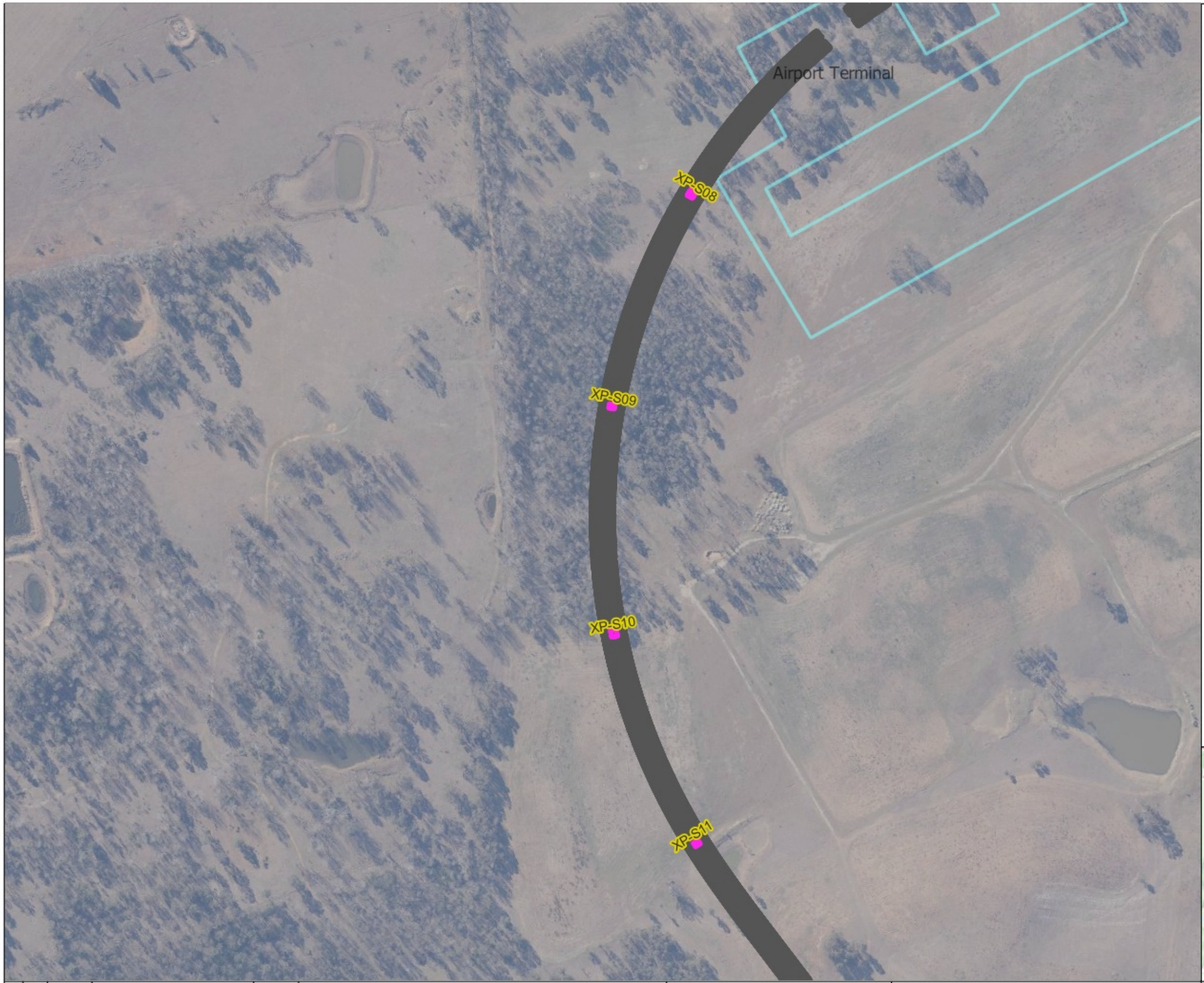
SYDNEY METRO WEST WESTERN SYDNEY AIRPORT TUNNELLING

Predicted Maximum GBN level during Southern Section excavation (Light Rockhammer)

Land-Use file revision_date: r7_07/07/21

Plot Date: 22/06/23 - 14:30 Layout: TM008 GBN&V (r0)

GIS File: R:\AssocSydProjects\TM001-TM050\TM008 mt Sydney Metro WSA SBT\5 Calcs\00 GENERAL\01 GIS\TM008-DA (r0).qgz



LEGEND

Noise sensitive receivers

- Residential and Hotels
- Non-Residential

- Construction Footprint
- Mainline Tunnel Alignment
- Cross Passages

Maximum GBN levels dB(A) during Light Rockhammer excavation

- <30
- 30.0 - 35.0
- 35.0 - 40.0
- 40.0 - 45.0
- 45.0 - 50.0
- 50.0 - 55.0
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- >60

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A3 Original

Co-ordinate System: MGA Zone 56

0 50 100 150 200 m

1:4,000

FULL SIZE A3

NOTE: Do not scale from this drawing.

CLIENT

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SYDNEY METRO WEST WESTERN SYDNEY AIRPORT TUNNELLING

Predicted Maximum GBN level during Southern Section excavation (Light Rockhammer)

Land-Use file revision_date: r7_07/07/21

Plot Date: 22/06/23 - 14:30 Layout: TM008 GBN&V (r0)

GIS File: R:\AssocSydProjects\TM001-TM050\TM008 mt Sydney Metro WSA SBT\5 Calcs\00 GENERAL\01 GIS\TM008-DA (r0).qgz

LEGEND

Noise sensitive receivers

- Residential and Hotels
- Non-Residential

- Construction Footprint
- Mainline Tunnel Alignment
- Cross Passages

Maximum GBN levels dB(A) during Light Rockhammer excavation

- <30
- 30.0 - 35.0
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- 40.0 - 45.0
- 45.0 - 50.0
- 50.0 - 55.0
- 55.0 - 60.0
- >60

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r1	DA	22/06/23	Updated cross passages	TG

A3 Original

Co-ordinate System: MGA Zone 56

0 50 100 150 200 m

1:4,000

FULL SIZE A3

NOTE: Do not scale from this drawing.

CLIENT

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SYDNEY METRO WEST WESTERN SYDNEY AIRPORT TUNNELLING

Predicted Maximum GBN level during Southern Section excavation (Light Rockhammer)

Land-Use file revision_date: r7_07/07/21

Plot Date: 22/06/23 - 14:30 Layout: TM008 GBN&V (r0)

GIS File: R:\AssocSydProjects\TM001-TM050\TM008 mt Sydney Metro WSA SBTJ\5 Calcs\00 GENERAL\01 GIS\TM008-DA (r0).qgz

LEGEND

Noise sensitive receivers

- Residential and Hotels
- Non-Residential

- Construction Footprint
- Mainline Tunnel Alignment
- Cross Passages

Maximum GBN levels dB(A) during Light Rockhammer excavation

- <30
- 30.0 - 35.0
- 35.0 - 40.0
- 40.0 - 45.0
- 45.0 - 50.0
- 50.0 - 55.0
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r0	DA	01/11/22	Prepare figures	TG
r1	DA	22/06/23	Updated cross passages	TG

A3 Original

Co-ordinate System: MGA Zone 56

0 50 100 150 200 m

1:4,000

FULL SIZE A3

NOTE: Do not scale from this drawing.

CLIENT

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SYDNEY METRO WEST WESTERN SYDNEY AIRPORT TUNNELLING

Predicted Maximum GBN level during Southern Section excavation (Light Rockhammer)

Land-Use file revision_date: r7_07/07/21

Plot Date: 22/06/23 - 14:30 Layout: TM008 GBN&V (r0)

GIS File: R:\AssocSydProjects\TM001-TM050\TM008 mt Sydney Metro WSA SBT\5 Calcs\00 GENERAL\01 GIS\TM008-DA (r0).qgz

450 m
400
350
300
250
200
150
100
50
0

LEGEND

Noise sensitive receivers

Residential and Hotels

Non-Residential

Construction Footprint

Mainline Tunnel Alignment

Cross Passages

Maximum GBN levels dB(A) during Light Rockhammer excavation

- <30
- 30.0 - 35.0
- 35.0 - 40.0
- 40.0 - 45.0
- 45.0 - 50.0
- 50.0 - 55.0
- 55.0 - 60.0
- >60

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
r0	DA	01/11/22	Prepare figures	TG
r1	DA	22/06/23	Updated cross passages	TG

A3 Original

Co-ordinate System: MGA Zone 56

0 50 100 150 200 m

1:4,000

FULL SIZE A3

NOTE: Do not scale from this drawing.

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SYDNEY METRO WEST WESTERN SYDNEY AIRPORT TUNNELLING

Predicted Maximum GBN level during Southern Section excavation (Light Rockhammer)

C.3 TBM tunnel excavation – mitigation measures

Receiver		Night (OOHW)	
NCA	Address	TBM Additional Mitigation	Duration exceeding 45 dB(A)[2]
NCA03	[redacted]	LB	No Exceedance
NCA03		LB	No Exceedance
NCA03		LB	No Exceedance
NCA03		LB, M, SN, IB, PC, RO, AA	< 1 Day
NCA03		LB, M, SN, IB, PC, RO, AA	< 2 Days
NCA03		LB	No Exceedance
NCA03		LB	No Exceedance
NCA03		LB	No Exceedance
NCA03		LB	No Exceedance
NCA03		LB, M, SN, IB, PC, RO, AA	< 2 Days
NCA03		LB	No Exceedance
NCA03		LB, M, SN, IB, PC, RO, AA	< 2 Days
NCA03		LB	No Exceedance
NCA03		LB	No Exceedance
NCA03		LB, M, SN, IB, PC, RO, AA	< 2 Days
NCA03		LB	No Exceedance
NCA03		LB, M, SN, IB, PC, RO, AA	< 1 Day
NCA03		LB, M, SN, IB, PC, RO, AA	< 2 Days
NCA03		LB, M, SN, IB, PC, RO, AA	< 2 Days
NCA03		LB	No Exceedance
NCA03		LB, M, SN, IB, PC, RO, AA	< 2 Days
NCA03		LB, M, SN, IB, PC, RO, AA	< 2 Days
NCA03		LB, M, SN, IB, PC, RO, AA	< 2 Days
NCA03		LB, M, SN, IB, PC, RO, AA	< 2 Days
NCA03		LB, M, SN, IB, PC, RO, AA	< 1 Day
NCA03		LB, M, SN, IB, PC, RO, AA	< 1 Day
NCA03		LB, M, SN, IB, PC, RO, AA	< 1 Day
NCA03		LB	No Exceedance
NCA03		LB	No Exceedance
NCA03		LB	No Exceedance
NCA03		LB	No Exceedance
NCA03		LB, M, SN, IB, PC, RO, AA	< 2 Days
NCA03		LB, M, SN, IB, PC, RO, AA	< 2 Days
NCA03		LB, M, SN, IB, PC, RO, AA	< 2 Days
NCA03		LB, M, SN, IB, PC, RO, AA	< 2 Days
NCA03		LB	No Exceedance
NCA03		LB	No Exceedance
NCA06		LB	No Exceedance
NCA06		LB	No Exceedance
NCA06		LB	No Exceedance
NCA06		LB	< 1 Day

Receiver		Night (OOHW)	
NCA	Address	TBM Additional Mitigation	Duration exceeding 45 dB(A)[2]
NCA06	[redacted]	LB	No Exceedance
NCA06		LB	No Exceedance
NCA06		LB	No Exceedance
NCA06		LB	No Exceedance
NCA06		LB	No Exceedance
NCA06		LB	No Exceedance
NCA06		LB	No Exceedance
NCA06		LB	No Exceedance
NCA06		LB	No Exceedance
NCA06		LB	No Exceedance
NCA06		LB	No Exceedance
NCA06		LB	No Exceedance
NCA06		LB	No Exceedance
NCA06		LB	< 1 Day
NCA06		LB	No Exceedance
NCA06		LB	No Exceedance
NCA06		LB	< 1 Day
NCA06		LB	No Exceedance
NCA06		LB, M, SN, IB, PC, RO, AA	< 1 Day
NCA06		LB	No Exceedance
NCA06		LB	No Exceedance
NCA06		AM1	No Exceedance
NCA06		AM1	No Exceedance
NCA06		AM1	No Exceedance
NCA06		AM1	No Exceedance
NCA06		AM1	No Exceedance
NCA06		AM1	No Exceedance
NCA06		AM1	No Exceedance
NCA06		AM1LB	No Exceedance
NCA06		LB	No Exceedance
NCA06		LB	No Exceedance
NCA06		LB	No Exceedance
NCA06		LB	No Exceedance
NCA06		LB	No Exceedance
NCA06		LB	No Exceedance
NCA06		LB	< 1 Day
NCA06		LB	No Exceedance
NCA06		LB	No Exceedance
NCA06		LB	No Exceedance
NCA06		LB	No Exceedance
NCA06		LB	No Exceedance
NCA06		LB	No Exceedance

Receiver		Night (OOHW)	
NCA	Address	TBM Additional Mitigation	Duration exceeding 45 dB(A)[2]
NCA06	[redacted]	LB	No Exceedance
NCA06		LB	No Exceedance
NCA06		LB	No Exceedance
NCA06		LB	< 1 Day
NCA06		LB	No Exceedance
NCA06		LB	No Exceedance
NCA06		LB, M, SN, IB, PC, RO, AA	< 1 Day
NCA06		LB, M, SN, IB, PC, RO, AA	< 1 Day
NCA06		LB	No Exceedance
NCA06		LB	No Exceedance
NCA06		LB	No Exceedance
NCA06		LB	No Exceedance
NCA06		LB	No Exceedance
NCA06		LB	No Exceedance
NCA06		LB	No Exceedance
NCA06		LB	No Exceedance
NCA06		LB	No Exceedance
NCA06		LB	No Exceedance
NCA06		LB	No Exceedance
NCA06		LB	No Exceedance
NCA06		LB	No Exceedance
NCA06		LB	No Exceedance
NCA06		LB	No Exceedance
NCA06		LB	No Exceedance
NCA06		LB	No Exceedance
NCA06		LB	No Exceedance
NCA06		LB, M, SN, IB, PC, RO, AA	< 1 Day
NCA06		LB	No Exceedance
NCA06		LB	No Exceedance
NCA06		LB	No Exceedance
NCA06		LB, M, SN, IB, PC, RO, AA	< 1 Day
NCA06		LB	No Exceedance
NCA06		LB	No Exceedance
NCA06		LB	No Exceedance
NCA06		LB	No Exceedance
NCA06		LB	No Exceedance
NCA06		LB	No Exceedance
NCA06		LB	No Exceedance
NCA06		LB	No Exceedance
NCA06		LB	No Exceedance
NCA06		LB	No Exceedance
NCA06		LB	No Exceedance

Receiver		Night (OOHW)	
NCA	Address	TBM Additional Mitigation	Duration exceeding 45 dB(A)[2]
NCA06	[redacted]	LB	No Exceedance
NCA06		LB	No Exceedance
NCA06		LB	No Exceedance
NCA06		LB	No Exceedance
NCA06		LB	< 1 Day
NCA06		LB	No Exceedance
NCA06		LB	No Exceedance
NCA06		LB	No Exceedance
NCA06		LB	No Exceedance
NCA06		LB	No Exceedance
NCA06		LB	No Exceedance
NCA06		LB	< 1 Day
NCA06		LB	No Exceedance
NCA06		LB	No Exceedance
NCA06		LB	No Exceedance
NCA06		LB	No Exceedance
NCA06		LB	No Exceedance
NCA06		LB	No Exceedance
NCA06		LB	No Exceedance
NCA06		LB	No Exceedance
NCA06		LB	No Exceedance
NCA06		LB	No Exceedance
NCA06		LB	No Exceedance
NCA06		LB	< 1 Day
NCA06		LB	No Exceedance
NCA06		LB	No Exceedance
NCA06		LB	No Exceedance
NCA06		LB	No Exceedance
NCA06		LB	No Exceedance
NCA06		LB	No Exceedance
NCA06		LB	No Exceedance
NCA06		LB	No Exceedance
NCA06		LB	No Exceedance
NCA06		LB	No Exceedance
NCA06		LB	No Exceedance
NCA06		LB	No Exceedance
NCA06		LB	No Exceedance
NCA06		LB	No Exceedance
NCA06		LB	No Exceedance
NCA06		LB	No Exceedance

Receiver		Night (OOHW)	
NCA	Address	TBM Additional Mitigation	Duration exceeding 45 dB(A)[2]
NCA06	[redacted]	LB	No Exceedance
NCA06	[redacted]	LB	No Exceedance
NCA06	[redacted]	LB	No Exceedance
NCA06	[redacted]	LB	No Exceedance
NCA06	[redacted]	LB	No Exceedance
NCA06	[redacted]	LB	No Exceedance
NCA06	[redacted]	LB	No Exceedance
NCA06	[redacted]	LB	No Exceedance
NCA06	[redacted]	LB	No Exceedance
NCA06	[redacted]	LB, M, SN, IB, PC, RO, AA	< 1 Day
NCA06	[redacted]	LB	No Exceedance
NCA06	[redacted]	LB	No Exceedance
NCA06	[redacted]	LB	No Exceedance
NCA06	[redacted]	LB	No Exceedance
NCA06	[redacted]	LB	No Exceedance
NCA06	[redacted]	LB	No Exceedance
NCA06	[redacted]	LB	No Exceedance
NCA06	[redacted]	LB	No Exceedance
NCA06	[redacted]	LB	No Exceedance
NCA06	[redacted]	LB	No Exceedance
NCA06	[redacted]	LB	No Exceedance
NCA06	[redacted]	LB	No Exceedance
NCA06	[redacted]	LB	No Exceedance
NCA06	[redacted]	LB	No Exceedance
NCA06	[redacted]	LB	No Exceedance
NCA06	[redacted]	LB	No Exceedance
NCA06	[redacted]	LB	No Exceedance
NCA06	[redacted]	LB	No Exceedance
NCA06	[redacted]	LB	< 1 Day
NCA06	[redacted]	LB	No Exceedance
NCA06	[redacted]	LB	No Exceedance
NCA06	[redacted]	LB	No Exceedance
NCA06	[redacted]	LB	No Exceedance
NCA06	[redacted]	LB	No Exceedance
NCA06	[redacted]	LB	No Exceedance
NCA06	[redacted]	LB	No Exceedance
NCA06	[redacted]	LB, M, SN, IB, PC, RO, AA	< 1 Day
NCA11	[redacted]	LB	No Exceedance
NCA11	[redacted]	LB	No Exceedance
NCA11	[redacted]	LB	No Exceedance
NCA12	[redacted]	LB, M, SN, IB, PC, RO, AA	< 1 Day
NCA12	[redacted]	LB	No Exceedance

Receiver		Night (OOHW)	
NCA	Address	TBM Additional Mitigation	Duration exceeding 45 dB(A)[2]
NCA12	[redacted]	LB	No Exceedance
NCA12		LB, M, SN, IB, PC, RO, AA	< 1 Day
NCA12		LB, M, SN, IB, PC, RO, AA	< 1 Day
NCA12		LB, M, SN, IB, PC, RO, AA	< 1 Day
OSR_CHC		LB	No Exceedance
OSR_COM		LB	No Exceedance
OSR_COM		LB	No Exceedance
OSR_COM		LB	No Exceedance
OSR_COM		LB	No Exceedance
OSR_COM		LB	No Exceedance
OSR_COM		LB	No Exceedance
OSR_COM		LB	No Exceedance
OSR_COM		LB	No Exceedance
OSR_COM		LB	No Exceedance
OSR_COM		LB, M, SN, IB, PC, RO, AA	< 2 Days
OSR_COM		LB	No Exceedance
OSR_COM		LB, M, SN, IB, PC, RO, AA	< 2 Days
OSR_COM		LB	< 1 Day
OSR_COM		LB	No Exceedance
OSR_COM		LB, M, SN, IB, PC, RO, AA	< 2 Days
OSR_COM		LB	No Exceedance
OSR_COM		LB, M, SN, IB, PC, RO, AA	< 2 Days
OSR_COM		LB, M, SN, IB, PC, RO, AA	< 2 Days
OSR_COM		LB	No Exceedance
OSR_COM		LB, M, SN, IB, PC, RO, AA	< 2 Days
OSR_COM		LB	No Exceedance
OSR_COM		LB, M, SN, IB, PC, RO, AA	< 2 Days
OSR_COM		LB	No Exceedance
OSR_EDU		LB	No Exceedance
OSR_EDU		LB, M, SN, IB, PC, RO, AA	< 1 Day
OSR_EDU		LB	No Exceedance
OSR_OTH		LB	No Exceedance
OSR_OTH		LB	No Exceedance
OSR_OTH		LB, M, SN, IB, PC, RO, AA	< 2 Days
OSR_OTH		LB	No Exceedance
OSR_OTH		LB, M, SN, IB, PC, RO, AA	< 1 Day
OSR_OTH		LB, M, SN, IB, PC, RO, AA	< 1 Day
OSR_OTH		LB, M, SN, IB, PC, RO, AA	< 1 Day
OSR_OTH		LB	No Exceedance
OSR_OTH		LB, M, SN, IB, PC, RO, AA	< 1 Day
OSR_OTH		LB, M, SN, IB, PC, RO, AA	< 1 Day
OSR_OTH		LB	No Exceedance

Receiver		Night (OOHW)	
NCA	Address	TBM Additional Mitigation	Duration exceeding 45 dB(A)[2]
OSR_OTH	[redacted]	LB, M, SN, IB, PC, RO, AA	< 1 Day
OSR_OTH		LB	No Exceedance
OSR_OTH		LB, M, SN, IB, PC, RO, AA	< 1 Day
OSR_OTH		LB	No Exceedance
OSR_OTH		LB, M, SN, IB, PC, RO, AA	< 2 Days
OSR_OTH		LB	No Exceedance
OSR_OTH		LB, M, SN, IB, PC, RO, AA	< 1 Day
OSR_OTH		LB, M, SN, IB, PC, RO, AA	< 2 Days
OSR_OTH		LB, M, SN, IB, PC, RO, AA	< 2 Days
OSR_OTH		LB	No Exceedance
OSR_OTH		LB, M, SN, IB, PC, RO, AA	< 2 Days
OSR_OTH		LB	No Exceedance
OSR_OTH		LB	No Exceedance
OSR_OTH		LB	No Exceedance
OSR_OTH		LB, M, SN, IB, PC, RO, AA	< 2 Days
OSR_OTH		LB	No Exceedance
OSR_OTH		LB	No Exceedance
OSR_OTH		LB	No Exceedance
OSR_OTH		LB	No Exceedance
OSR_OTH		LB	No Exceedance
OSR_OTH		LB, M, SN, IB, PC, RO, AA	< 1 Day
OSR_OTH		LB, M, SN, IB, PC, RO, AA	< 2 Days
OSR_OTH		LB, M, SN, IB, PC, RO, AA	< 1 Day
OSR_OTH		LB	No Exceedance
OSR_OTH		LB	No Exceedance
OSR_OTH		LB	No Exceedance
OSR_OTH		LB, M, SN, IB, PC, RO, AA	< 2 Days
OSR_OTH		LB	No Exceedance
OSR_OTH		LB, M, SN, IB, PC, RO, AA	< 1 Day
OSR_OTH		LB, M, SN, IB, PC, RO, AA	< 1 Day
OSR_OTH		LB, M, SN, IB, PC, RO, AA	< 2 Days
OSR_OTH		LB, M, SN, IB, PC, RO, AA	< 1 Day
OSR_OTH		LB, M, SN, IB, PC, RO, AA	< 1 Day
OSR_OTH		LB, M, SN, IB, PC, RO, AA	< 1 Day
OSR_OTH		LB, M, SN, IB, PC, RO, AA	< 2 Days
OSR_OTH		LB	< 1 Day
OSR_OTH		LB, M, SN, IB, PC, RO, AA	< 1 Day
OSR_OTH		LB, M, SN, IB, PC, RO, AA	< 1 Day
OSR_OTH		LB, M, SN, IB, PC, RO, AA	< 1 Day
OSR_OTH		LB	No Exceedance
OSR_OTH		LB, M, SN, IB, PC, RO, AA	< 1 Day

Receiver		Night (OOHW)	
NCA	**Address**	**TBM Additional Mitigation**	**Duration exceeding 45 dB(A)[2]**

Notes 1. Alternative accommodation will be determined on determined on a case-by-case basis in accordance with the CNVS. Typically, residential receivers experiencing GBN levels greater than 10 dB(A) of the night NML (i.e. 45 dB(A)) for less than 2 days would not be offered alternate accommodation.

2. LB: Letterbox drops; M: Monitoring; SN: Specific Notification; IB: Individual Briefing; PC: Phone Call; RO: Respite Offer; AA: Alternative Accommodation (refer to Section 6.3.3 for details)

C.4 Cross-passage excavation – mitigation measures

Table C.3.1: Cross-passage light rockhammer excavation – summary of mitigation measures

Cross passage ID number[1]	Receiver Types in Vicinity of Subject Area	Maximum Ground-borne Noise levels, dB(A)	Respite periods to be provided[2]			Recommend 24 hours tunnelling?
			Day (7am – 6pm)	Evening (6pm – 10pm)	Night (10pm – 7am)	
XP-N02	Residential	50-65	No	Yes	Yes	No
XP-N03	Residential	40-45	No	Yes	Yes	No
XP-N04	Educational	<35	No	No	No	Yes
XP-N05	No receivers	No impacts	No	No	No	Yes
XP-N06	No receivers	No impacts	No	No	No	Yes
XP-N07	No receivers	No impacts	No	No	No	Yes
XP-N08	Residential	<35	No	No	No	Yes
XP-N09	Educational	<35	No	No	No	Yes
XP-N10	Educational	40-50	Yes	No	No	No
XP-N11	Commercial	40-50	No	No	No	Yes
XP-N13	Residential	40-50	No	Yes	Yes	No
XP-N14	Residential	40-55	No	Yes	Yes	No
XP-N15	Residential	40-55	No	Yes	Yes	No
XP-N16	Residential	40-60	No	Yes	Yes	No
XP-N17	Residential	40-55	No	Yes	Yes	No
XP-N18	Residential and childcare	40-55	Yes	Yes	Yes	No
XP-N19	Residential	40-50	No	Yes	Yes	No
XP-N20	Residential	<35	No	No	No	Yes
XP-N21	Residential	<35	No	No	No	Yes
XP-S02	No receivers	No impacts	No	No	No	Yes
XP-S03	No receivers	No impacts	No	No	No	Yes
XP-S04	No receivers	No impacts	No	No	No	Yes
XP-S05	No receivers	No impacts	No	No	No	Yes
XP-S06	No receivers	No impacts	No	No	No	Yes
XP-S08	No receivers	No impacts	No	No	No	Yes
XP-S09	No receivers	No impacts	No	No	No	Yes
XP-S10	No receivers	No impacts	No	No	No	Yes
XP-S11	No receivers	No impacts	No	No	No	Yes
XP-S12	No receivers	No impacts	No	No	No	Yes
XP-S13	No receivers	No impacts	No	No	No	Yes
XP-S14	No receivers	No impacts	No	No	No	Yes
XP-S15	Residential	<35	No	No	No	Yes
XP-S17	Residential	35-55	No	Yes	Yes	No
XP-S18	Residential	<35	No	No	No	Yes

Cross passage ID number[1]	Receiver Types in Vicinity of Subject Area	Maximum Ground-borne Noise levels, dB(A)	Respite periods to be provided[2]			Recommend 24 hours tunnelling?
			Day (7am – 6pm)	Evening (6pm – 10pm)	Night (10pm – 7am)	
XP-S19	Residential	<35	No	No	No	Yes
XP-S20	Residential	35-60	No	Yes	Yes	No
XP-S21	Residential	<35	No	No	No	Yes
XP-S22	Residential	<35	No	No	No	Yes
XP-S23	No receivers	No impacts	No	No	No	Yes

Note: 1. XP-N01, XP-N12, XP-N22, XP-S01, XP-S07, XP-S16 and XP-S24 are within the station boxes and have not been assessed for ground-borne noise as airborne noise will be dominant.

2. Day respite periods will be in the form of 3-1-3. Evening and night respites periods will be no works during these periods

Greyed cross passages are within Commonwealth land.

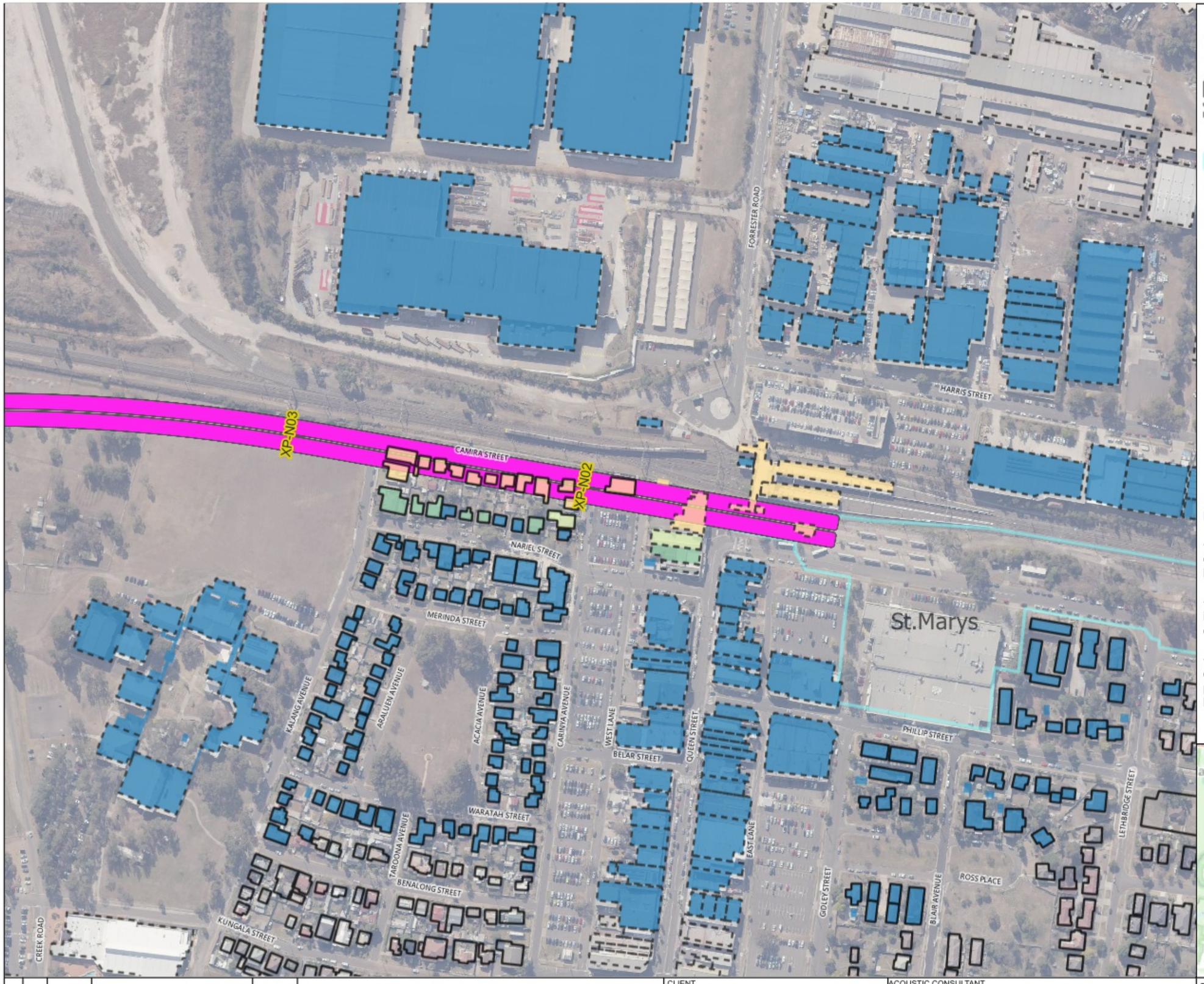
APPENDIX D Maximum Ground-Borne Vibration (GBV) levels

D.1 TBM excavation

Land-Use file revision_date: r7_07/07/21

Plot Date: 22/06/23 - 14:45 Layout: TM008 GBN&V (r0)

GIS File: R:\AssocSydProjects\TM001-TM050\TM008 mt Sydney Metro WSA SBTJ\5 Calcs\00 GENERAL\01 GIS\TM008-DA (r0).qgz



LEGEND

Noise sensitive receivers

- Residential and Hotels
- Non-Residential

- Construction Footprint
- Mainline Tunnel Alignment
- St Marys to Claremont Meadows Tunnel

Maximum GBV levels PPV(mm/s) during TBM excavation

- <0.28
- 0.28 - 0.40
- 0.40 - 0.56
- 0.56 - 1.1
- 1.1 - 2.2
- >2.2

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 buidling damage is occuring when they feel vibration which people perceive is far lower than the vibration levels that could cause damage to structures.

REV	BY	DATE	DESCRIPTION	APPROVER
r0	DA	01/11/22	Prepare figures	TG
r1	DA	22/06/23	Updated cross passages	TG

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

0 40 80 120 160 m

1:3,000

N

CLIENT

CPB CONTRACTORS | Ghella

ACOUSTIC CONSULTANT

RENZO TONIN & ASSOCIATES

inspired to achieve

Ph (02) 8218 0500 Fax (02) 8218 0501

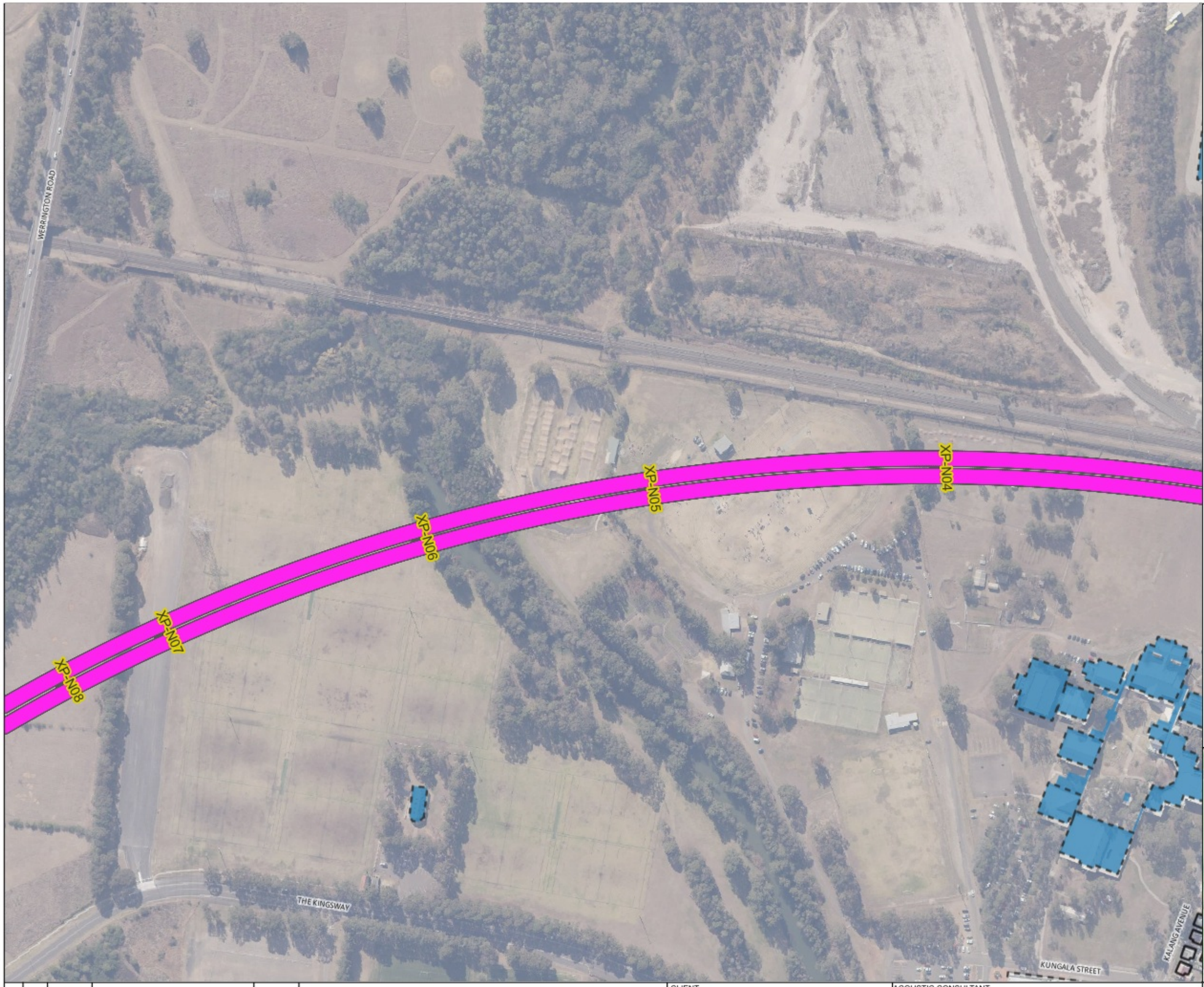
SYDNEY METRO WEST WESTERN SYDNEY AIRPORT TUNNELLING

Predicted Maximum GBV level during St Marys to Claremont Meadows excavation (TBM)

Land-Use file revision_date: r7_07/07/21

Plot Date: 22/06/23 - 14:45 Layout: TM008 GBN&V (r0)

GIS File: R:\AssocSydProjects\TM001-TM050\TM008 mt Sydney Metro WSA SBT\5 Calcs\00 GENERAL\01 GIS\TM008-DA (r0).qgz



351 m
312
273
234
195
156
117
78
39
0

LEGEND

Noise sensitive receivers

- Residential and Hotels
- Non-Residential

- Mainline Tunnel Alignment
- St Marys to Claremont Meadows Tunnel

Maximum GBV levels PPV(mm/s) during TBM excavation

- <0.28
- 0.28 - 0.40
- 0.40 - 0.56
- 0.56 - 1.1
- 1.1 - 2.2
- >2.2

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 buidling damage is occuring when they feel vibration which people perceive is far lower than the vibration levels that could cause damage to structures.

REV	BY	DATE	DESCRIPTION	APPROVER
r0	DA	01/11/22	Prepare figures	TG
r1	DA	22/06/23	Updated cross passages	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 40 80 120 160 m

1:3,000

FULL SIZE A3

NOTE: Do not scale from this drawing.

CLIENT

CPB CONTRACTORS | Ghella

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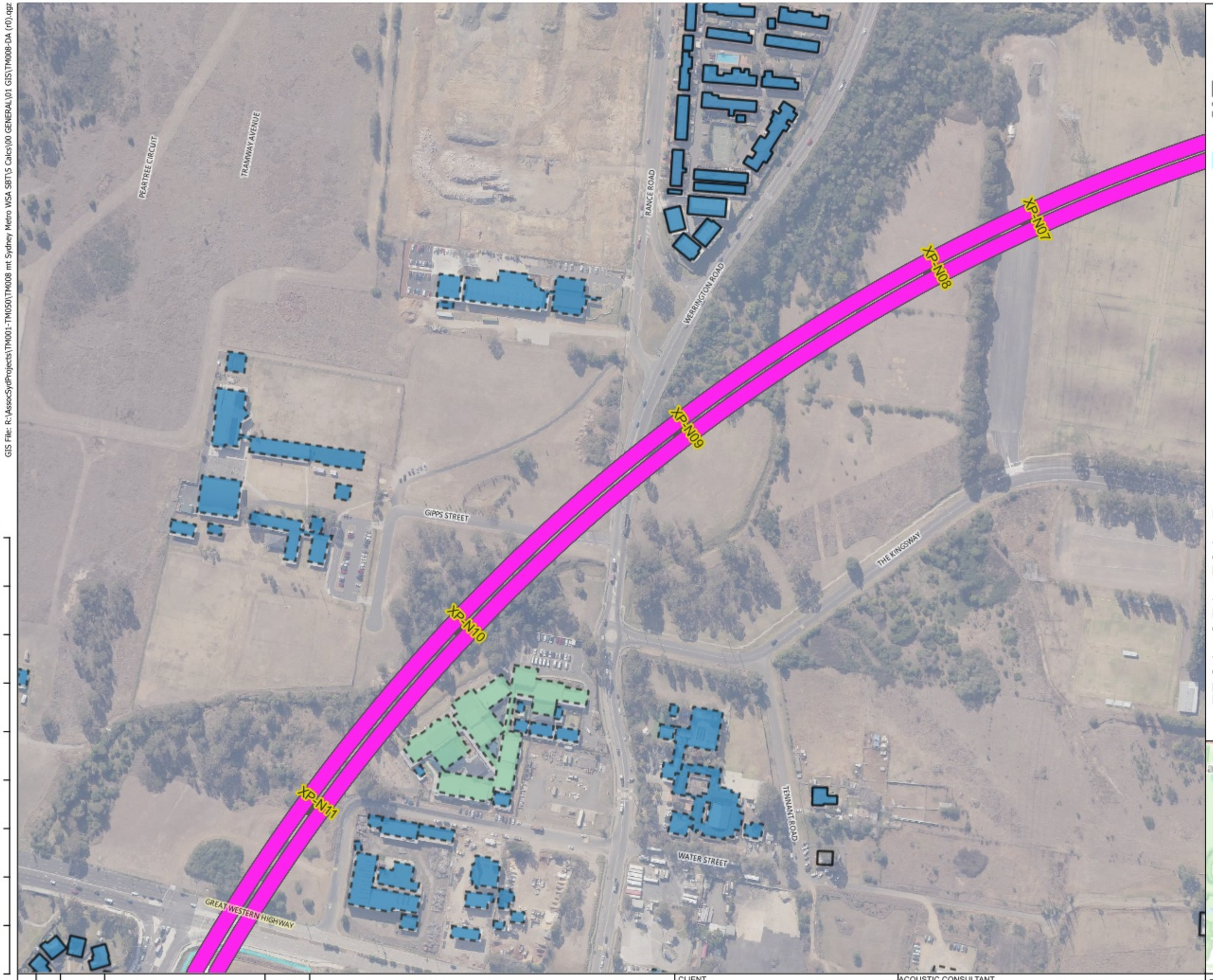
SYDNEY METRO WEST WESTERN SYDNEY AIRPORT TUNNELLING

Predicted Maximum GBV level during St Marys to Claremont Meadows excavation (TBM)

Land-Use file revision_date: r7_07/07/21

Plot Date: 22/06/23 - 14:45 Layout: TM008 GBN&V (r0)

GIS File: R:\AssocSydProjects\TM001-TM050\TM008 mt Sydney Metro WSA SBT\5 Calcs\00 GENERAL\01 GIS\TM008-DA (r0).qgz



351 m
312
273
234
195
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LEGEND

Noise sensitive receivers

- Residential and Hotels
- Non-Residential

- Construction Footprint
- Mainline Tunnel Alignment
- St Marys to Claremont Meadows Tunnel

Maximum GBV levels PPV(mm/s) during TBM excavation

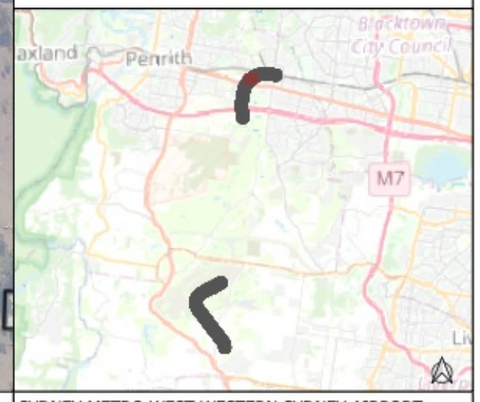
- <0.28
- 0.28 - 0.40
- 0.40 - 0.56
- 0.56 - 1.1
- 1.1 - 2.2
- >2.2

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 buidling damage is occuring when they feel vibration which people perceive is far lower than the vibration levels that could cause damage to structures.



REV	BY	DATE	DESCRIPTION	APPROVER
r0	DA	01/11/22	Prepare figures	TG
r1	DA	22/06/23	Updated cross passages	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 40 80 120 160 m

1:3,000

FULL SIZE A3

NOTE: Do not scale from this drawing.

CLIENT

CPB CONTRACTORS | Ghella

ACOUSTIC CONSULTANT

RENZO TONIN & ASSOCIATES

inspired to achieve

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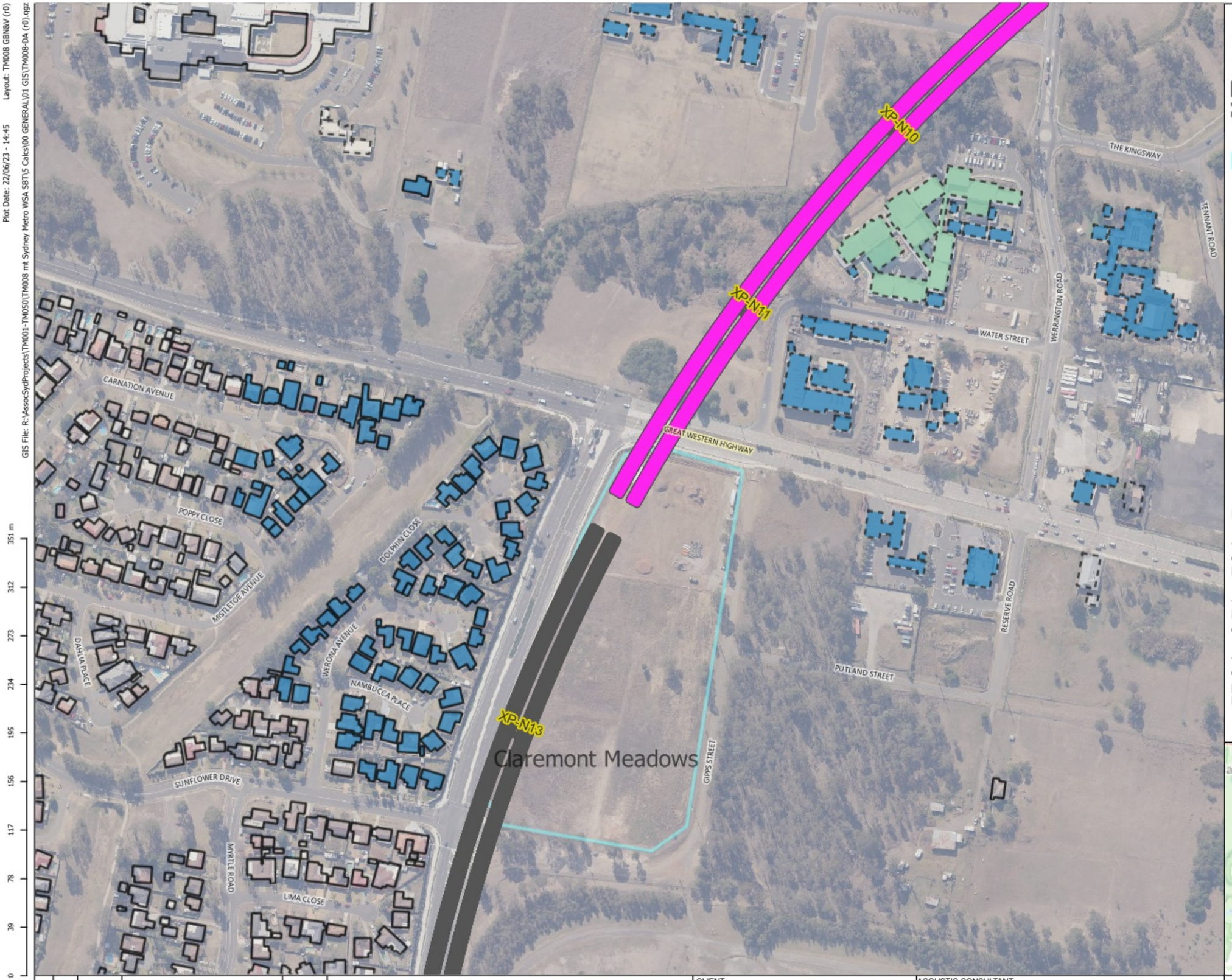
SYDNEY METRO WEST WESTERN SYDNEY AIRPORT TUNNELLING

Predicted Maximum GBV level during St Marys to Claremont Meadows excavation (TBM)

Land-Use file revision_date: r7_07/07/21

Plot Date: 22/06/23 - 14:45 Layout: TM008 GBN&V (r0)

GIS File: R:\AssocSydProjects\TM001-TM050\TM008 mt Sydney Metro WSA SBT\5 Calcs\00 GENERAL\01 GIS\TM008-DA (r0).qgz



351 m
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LEGEND

Noise sensitive receivers

- Residential and Hotels
- Non-Residential

- Construction Footprint
- Mainline Tunnel Alignment
- St Marys to Claremont Meadows Tunnel

Maximum GBV levels PPV(mm/s) during TBM excavation

- <0.28
- 0.28 - 0.40
- 0.40 - 0.56
- 0.56 - 1.1
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- >2.2

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 buidling damage is occuring when they feel vibration which people perceive is far lower than the vibration levels that could cause damage to structures.

REV	BY	DATE	DESCRIPTION	APPROVER
r0	DA	01/11/22	Prepare figures	TG
r1	DA	22/06/23	Updated cross passages	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 40 80 120 160 m

1:3,000

FULL SIZE A3

NOTE: Do not scale from this drawing.

CLIENT

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SYDNEY METRO WEST WESTERN SYDNEY AIRPORT TUNNELLING

Predicted Maximum GBV level during St Marys to Claremont Meadows excavation (TBM)

Land-Use file revision_date: r7_07/07/21

Plot Date: 22/06/23 - 14:46 Layout: TM008 GBN&V (r0)

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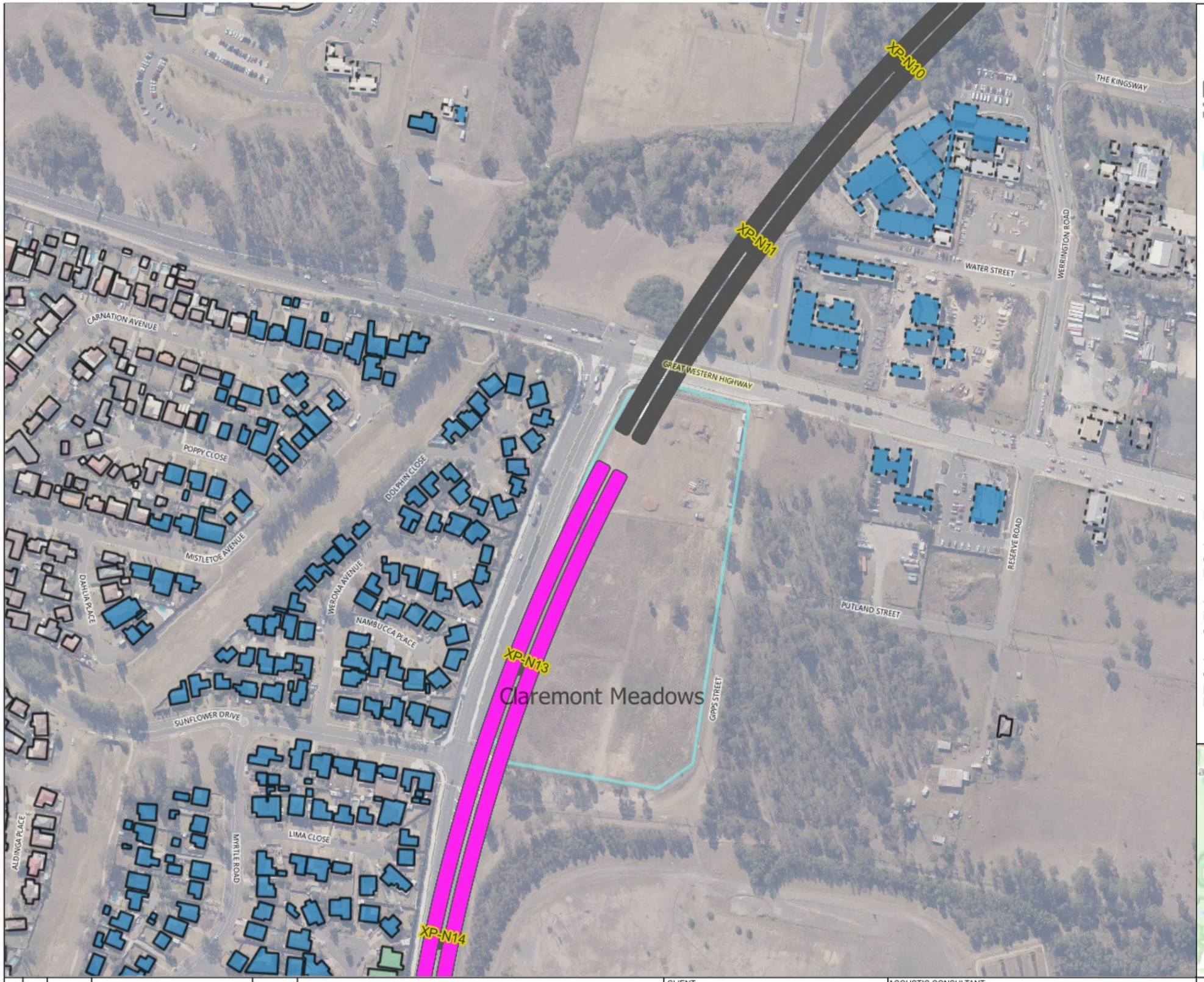

351 m
312
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195
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LEGEND

Noise sensitive receivers

- Residential and Hotels
- Non-Residential

- Construction Footprint
- Mainline Tunnel Alignment
- Claremont Meadows to Orchard Hills Tunnel

Maximum GBV levels PPV(mm/s) during TBM excavation

- <0.28
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- 0.56 - 1.1
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- >2.2

Notes:

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REV	BY	DATE	DESCRIPTION	APPROVED
r0	DA	01/11/22	Prepare figures	TG
r1	DA	22/06/23	Updated cross passages	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 40 80 120 160 m

1:3,000

FULL SIZE A3

NOTE: Do not scale from this drawing.

CLIENT

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SYDNEY METRO WEST WESTERN SYDNEY AIRPORT TUNNELLING

Predicted Maximum GBV level during Claremont Meadows to Orchard Hills excavation (TBM)

Land-Use file revision_date: r7_07/07/21

Plot Date: 22/06/23 - 14:46 Layout: TM008 GBN&V (r0)

GIS File: R:\AssocSydProjects\TM001-TM050\TM008 mt Sydney Metro WSA SBT\5 Calcs\00 GENERAL\01 GIS\TM008-DA (r0).qgz

LEGEND

Noise sensitive receivers

- Residential and Hotels
- Non-Residential

- Construction Footprint
- Mainline Tunnel Alignment
- Claremont Meadows to Orchard Hills Tunnel

Maximum GBV levels PPV(mm/s) during TBM excavation

- <0.28
- 0.28 - 0.40
- 0.40 - 0.56
- 0.56 - 1.1
- 1.1 - 2.2
- >2.2

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REV	BY	DATE	DESCRIPTION	APPROVER
r0	DA	01/11/22	Prepare figures	TG
r1	DA	22/06/23	Updated cross passages	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 40 80 120 160 m

1:3,000

FULL SIZE A3

NOTE: Do not scale from this drawing.

CLIENT

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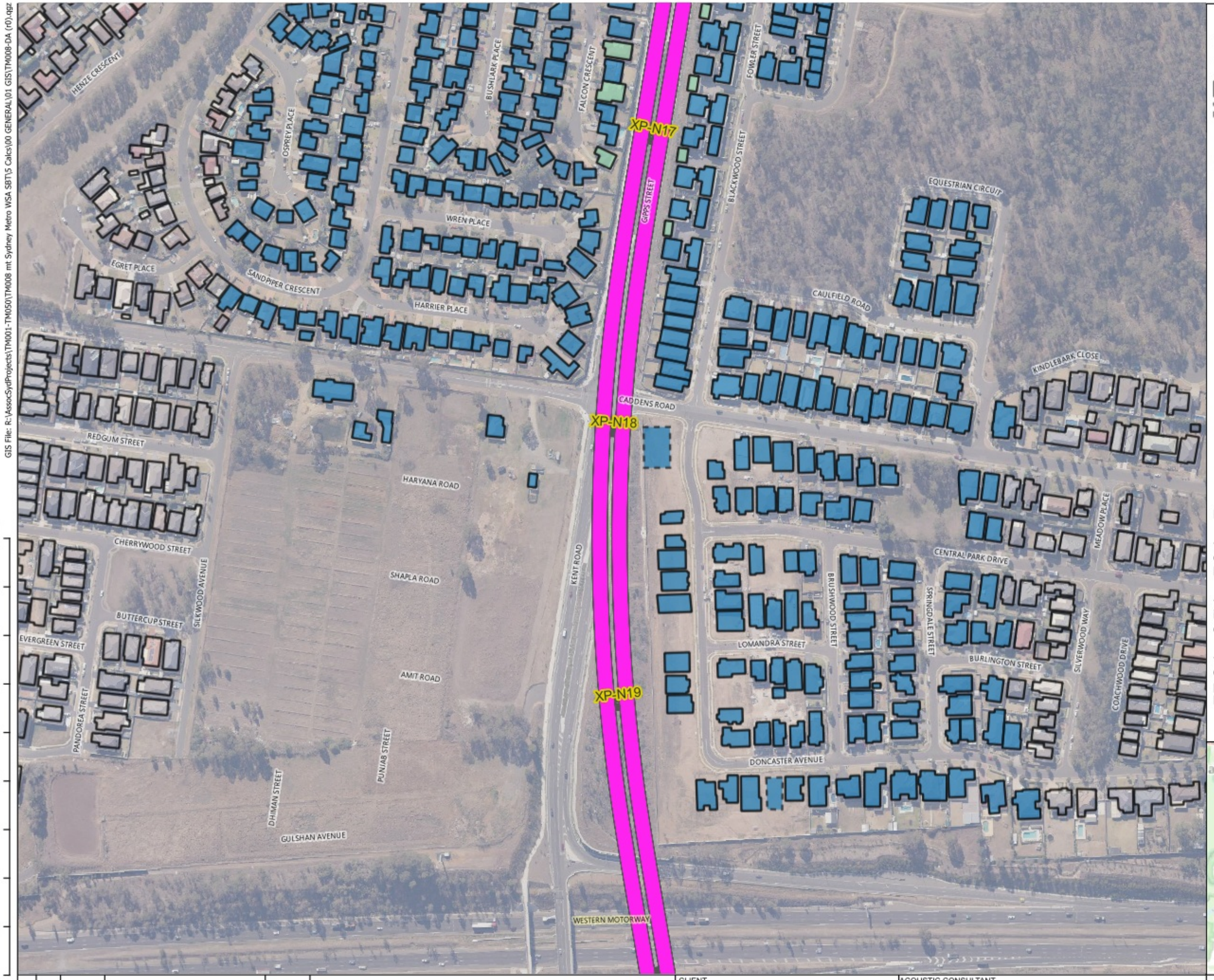
SYDNEY METRO WEST WESTERN SYDNEY AIRPORT TUNNELLING

Predicted Maximum GBV level during Claremont Meadows to Orchard Hills excavation (TBM)

Land-Use file revision_date: r7_07/07/21

Plot Date: 22/06/23 - 14:46 Layout: TM008 GBN&V (r0)

GIS File: R:\AssocSydProjects\TM001-TM050\TM008 mt Sydney Metro WSA SBT\5 Calcs\00 GENERAL\01 GIS\TM008-DA (r0).qgz



LEGEND

Noise sensitive receivers

- Residential and Hotels
- Non-Residential

- Mainline Tunnel Alignment
- Claremont Meadows to Orchard Hills Tunnel

Maximum GBV levels PPV(mm/s) during TBM excavation

- <0.28
- 0.28 - 0.40
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REV	BY	DATE	DESCRIPTION	APPROVED
r0	DA	01/11/22	Prepare figures	TG
r1	DA	22/06/23	Updated cross passages	TG

A3 Original

Co-ordinate System: MGA Zone 56

0 40 80 120 160 m

1:3,000

FULL SIZE A3

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CLIENT

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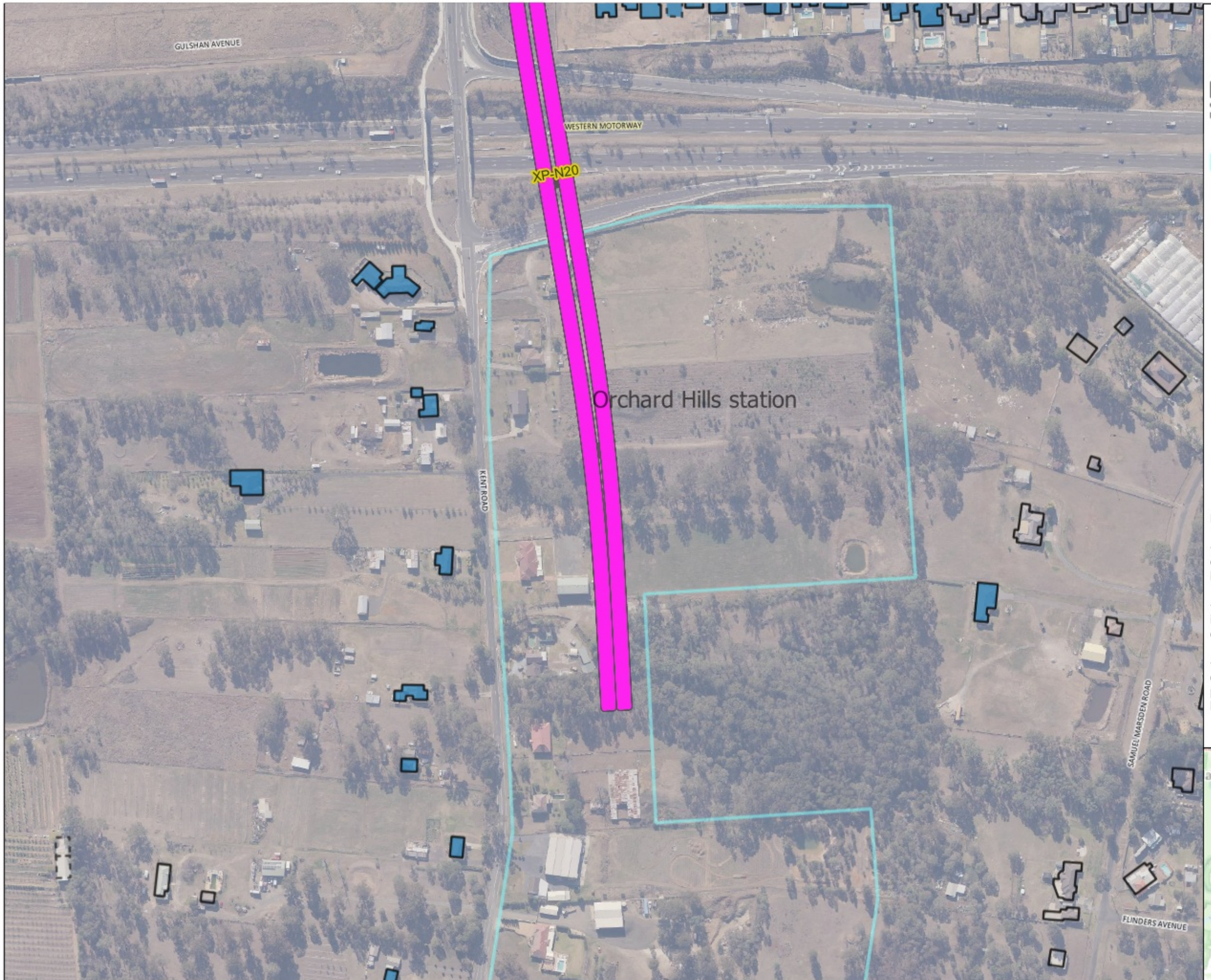
SYDNEY METRO WEST WESTERN SYDNEY AIRPORT TUNNELLING

Predicted Maximum GBV level during Claremont Meadows to Orchard Hills excavation (TBM)

Land-Use file revision_date: r7_07/07/21

Plot Date: 22/06/23 - 14:46 Layout: TM008 GBN&V (r0)

GIS File: R:\AssocSydProjects\TM001-TM050\TM008 mt Sydney Metro WSA SBTJ\5 Calcs\00 GENERAL\01 GIS\TM008-DA (r0).qgz



351 m
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LEGEND

Noise sensitive receivers

- Residential and Hotels
- Non-Residential

- Construction Footprint
- Mainline Tunnel Alignment
- Claremont Meadows to Orchard Hills Tunnel

Maximum GBV levels PPV(mm/s) during TBM excavation

- <0.28
- 0.28 - 0.40
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Notes:

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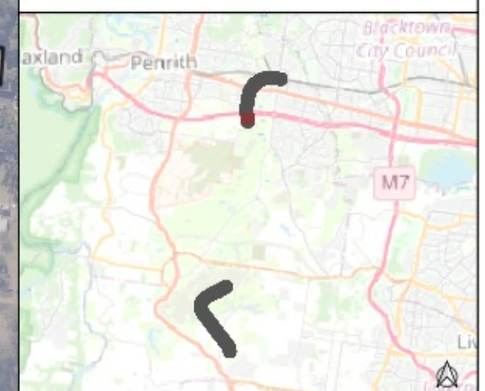

REV	BY	DATE	DESCRIPTION	APPROVER
r0	DA	01/11/22	Prepare figures	TG
r1	DA	22/06/23	Updated cross passages	TG

A3 Original

Co-ordinate System: MGA Zone 56

0 40 80 120 160 m

1:3,000

FULL SIZE A3

NOTE: Do not scale from this drawing.

CLIENT

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SYDNEY METRO WEST WESTERN SYDNEY AIRPORT TUNNELLING

Predicted Maximum GBV level during Claremont Meadows to Orchard Hills excavation (TBM)

Land-Use file revision_date: r7_07/07/21

Plot Date: 22/06/23 - 14:47 Layout: TM008 GBN&V (r0)

GIS File: R:\AssocSydProjects\TM001-TM050\TM008 mt Sydney Metro WSA SBT\5 Calcs\00 GENERAL\01 GIS\TM008-DA (r0).qgz

LEGEND

Noise sensitive receivers

- Residential and Hotels
- Non-Residential

- Construction Footprint
- Mainline Tunnel Alignment
- Airport Dive to Airport Terminal Tunnel

Maximum GBV levels PPV(mm/s) during TBM excavation

- <0.28
- 0.28 - 0.40
- 0.40 - 0.56
- 0.56 - 1.1
- 1.1 - 2.2
- >2.2

Notes:

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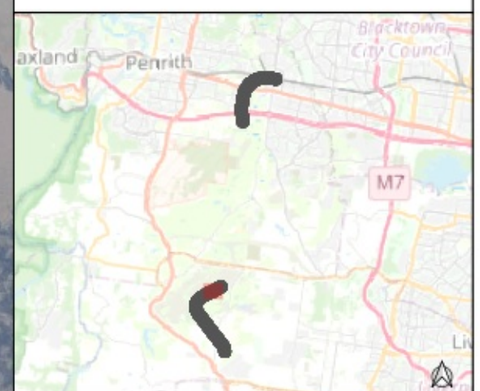

REV	BY	DATE	DESCRIPTION	APPROVER
r0	DA	01/11/22	Prepare figures	TG
r1	DA	22/06/23	Updated cross passages	TG

A3 Original

Co-ordinate System: MGA Zone 56

0 50 100 150 200 m

1:4,000

FULL SIZE A3

NOTE: Do not scale from this drawing.

CLIENT

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SYDNEY METRO WEST WESTERN SYDNEY AIRPORT TUNNELLING

Predicted Maximum GBV level during Airport Dive to Airport Terminal excavation (TBM)

Land-Use file revision_date: r7_07/07/21

Plot Date: 22/06/23 - 14:47 Layout: TM008 GBN&V (r0)

GIS File: R:\AssocSydProjects\TM001-TM050\TM008 mt Sydney Metro WSA SBT\5 Calcs\00 GENERAL\01 GIS\TM008-DA (r0).qgz

LEGEND

Noise sensitive receivers

- Residential and Hotels
- Non-Residential

- Construction Footprint
- Mainline Tunnel Alignment
- Airport Terminal to Bringelly Tunnel

Maximum GBV levels PPV(mm/s) during TBM excavation

- <0.28
- 0.28 - 0.40
- 0.40 - 0.56
- 0.56 - 1.1
- 1.1 - 2.2
- >2.2

Notes:

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

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REV	BY	DATE	DESCRIPTION	APPROVER
r0	DA	01/11/22	Prepare figures	TG
r1	DA	22/06/23	Updated cross passages	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 50 100 150 200 m

1:4,000

FULL SIZE A3

NOTE: Do not scale from this drawing.

CLIENT

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SYDNEY METRO WEST WESTERN SYDNEY AIRPORT TUNNELLING

Predicted Maximum GBV level during Airport Terminal to Bringelly excavation (TBM)

Land-Use file revision_date: r7_07/07/21

Plot Date: 22/06/23 - 14:47 Layout: TM008 GBN&V (r0)

GIS File: R:\AssocSydProjects\TM001-TM050\TM008 mt Sydney Metro WSA SBT\5 Calcs\00 GENERAL\01 GIS\TM008-DA (r0).qgz

LEGEND

Noise sensitive receivers

- Residential and Hotels
- Non-Residential

- Construction Footprint
- Mainline Tunnel Alignment
- Airport Terminal to Bringelly Tunnel

Maximum GBV levels PPV(mm/s) during TBM excavation

- <0.28
- 0.28 - 0.40
- 0.40 - 0.56
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REV	BY	DATE	DESCRIPTION	APPROVED
r0	DA	01/11/22	Prepare figures	TG
r1	DA	22/06/23	Updated cross passages	TG

A3 Original

Co-ordinate System: MGA Zone 56

0 50 100 150 200 m

1:4,000

FULL SIZE A3

NOTE: Do not scale from this drawing.

CLIENT

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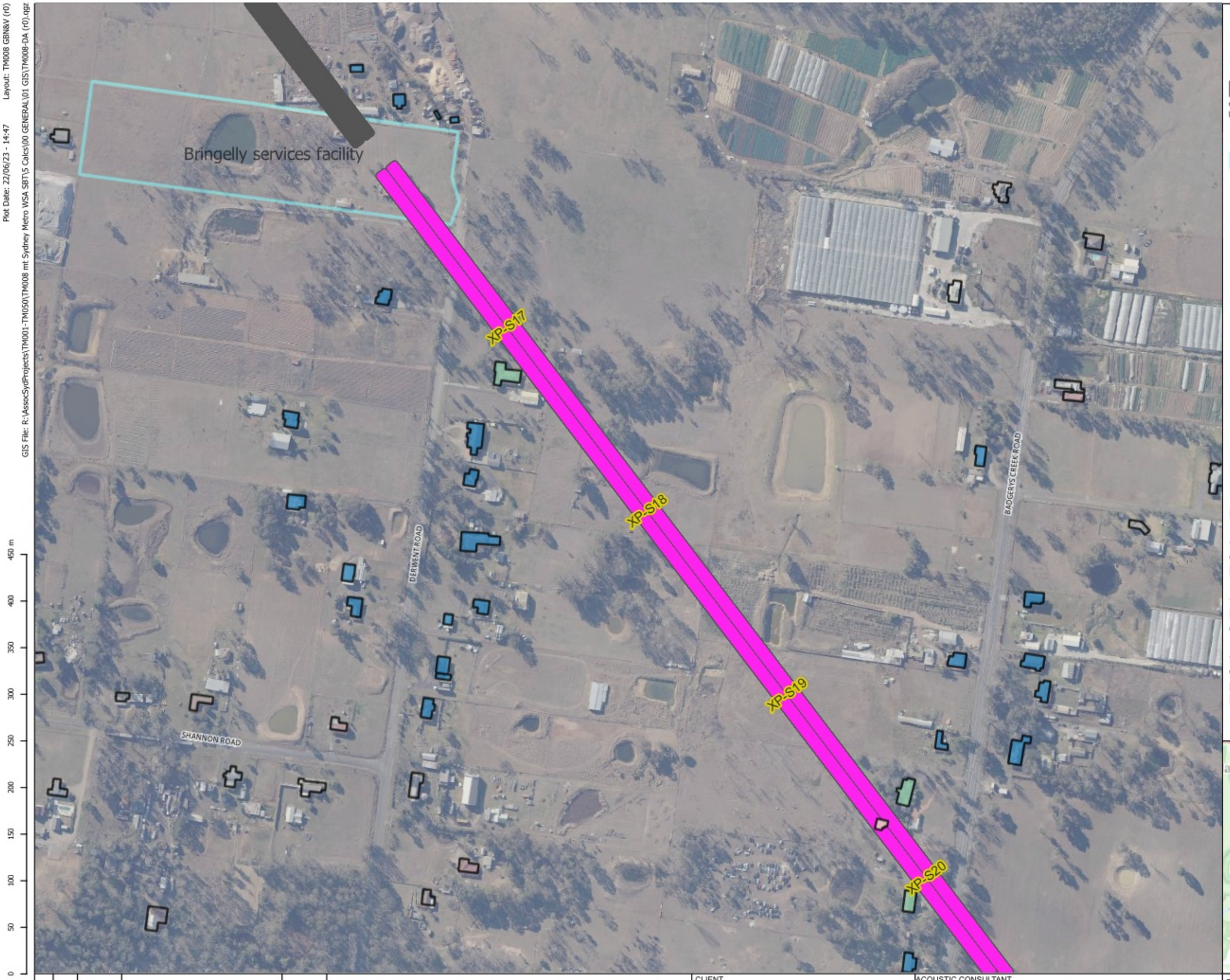
SYDNEY METRO WEST WESTERN SYDNEY AIRPORT TUNNELLING

Predicted Maximum GBV level during Airport Terminal to Bringelly excavation (TBM)

Land-Use file revision_date: r7_07/07/21

Plot Date: 22/06/23 - 14:47 Layout: TM008 GBN&V (r0)

GIS File: R:\AssocSydProjects\TM001-TM050\TM008 mt Sydney Metro WSA SBT\5 Calcs\00 GENERAL\01 GIS\TM008-DA (r0).qgz



LEGEND

Noise sensitive receivers

- Residential and Hotels
- Non-Residential

- Construction Footprint
- Mainline Tunnel Alignment
- Bringelly to Aerotropolis Tunnel

Maximum GBV levels PPV(mm/s) during TBM excavation

- <0.28
- 0.28 - 0.40
- 0.40 - 0.56
- 0.56 - 1.1
- 1.1 - 2.2
- >2.2

Notes:

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

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REV	BY	DATE	DESCRIPTION	APPROVED
r0	DA	01/11/22	Prepare figures	TG
r1	DA	22/06/23	Updated cross passages	TG

A3 Original

Co-ordinate System: MGA Zone 56

0 50 100 150 200 m

1:4,000

FULL SIZE A3

NOTE: Do not scale from this drawing.

CLIENT

CPB CONTRACTORS Ghella

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SYDNEY METRO WEST WESTERN SYDNEY AIRPORT TUNNELLING

Predicted Maximum GBV level during Bringelly to Aerotropolis excavation (TBM)

Land-Use file revision_date: r7_07/07/21

Plot Date: 22/06/23 - 14:47 Layout: TM008 GBN&V (r0)

GIS File: R:\AssocSydProjects\TM001-TM050\TM008 mt Sydney Metro WSA SBT\5 Calcs\00 GENERAL\01 GIS\TM008-DA (r0).qgz

LEGEND

Noise sensitive receivers

- Residential and Hotels
- Non-Residential

- Construction Footprint
- Mainline Tunnel Alignment
- Bringelly to Aerotropolis Tunnel

Maximum GBV levels PPV(mm/s) during TBM excavation

- <0.28
- 0.28 - 0.40
- 0.40 - 0.56
- 0.56 - 1.1
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Notes:

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

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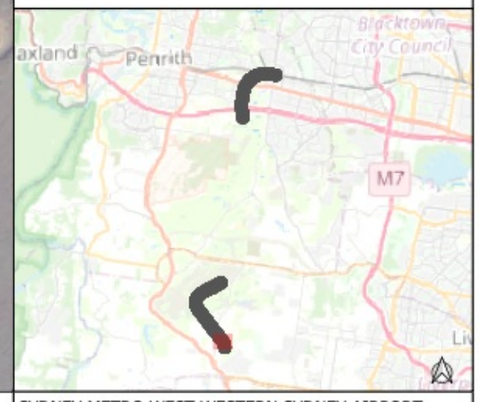

REV	BY	DATE	DESCRIPTION	APPROVER
r0	DA	01/11/22	Prepare figures	TG
r1	DA	22/06/23	Updated cross passages	TG

A3 Original

Co-ordinate System: MGA Zone 56

0 50 100 150 200 m

1:4,000

FULL SIZE A3

NOTE: Do not scale from this drawing.

CLIENT

CPB CONTRACTORS Ghella

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SYDNEY METRO WEST WESTERN SYDNEY AIRPORT TUNNELLING

Predicted Maximum GBV level during Bringelly to Aerotropolis excavation (TBM)

D.2 Cross-passage excavation

Land-Use file revision_date: r7_07/07/21

Plot Date: 22/06/23 - 14:48 Layout: TM008 GBN&V (r0)

GIS File: R:\AssocSydProjects\TM001-TM050\TM008 mt Sydney Metro WSA SBT\5 Calcs\00 GENERAL\01 GIS\TM008-DA (r0).qgz

LEGEND

Noise sensitive receivers

- Residential and Hotels
- Non-Residential

- Construction Footprint
- Mainline Tunnel Alignment
- Cross Passages

Maximum GBV levels PPV(mm/s) during Light Rockhammer excavation

- <0.28
- 0.28 - 0.40
- 0.40 - 0.56
- 0.56 - 1.1
- 1.1 - 2.2
- >2.2

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 buidling damage is occuring when they feel vibration which people perceive is far lower than the vibration levels that could cause damage to structures.

0 39 78 117 156 195 234 273 312 351 m

REV	BY	DATE	DESCRIPTION	APPROVER
r0	DA	01/11/22	Prepare figures	TG
r1	DA	22/06/23	Updated cross passages	TG

A3 Original

Co-ordinate System: MGA Zone 56

0 40 80 120 160 m

1:3,000

FULL SIZE A3

NOTE: Do not scale from this drawing.

CLIENT

CPB CONTRACTORS Ghella

ACOUSTIC CONSULTANT

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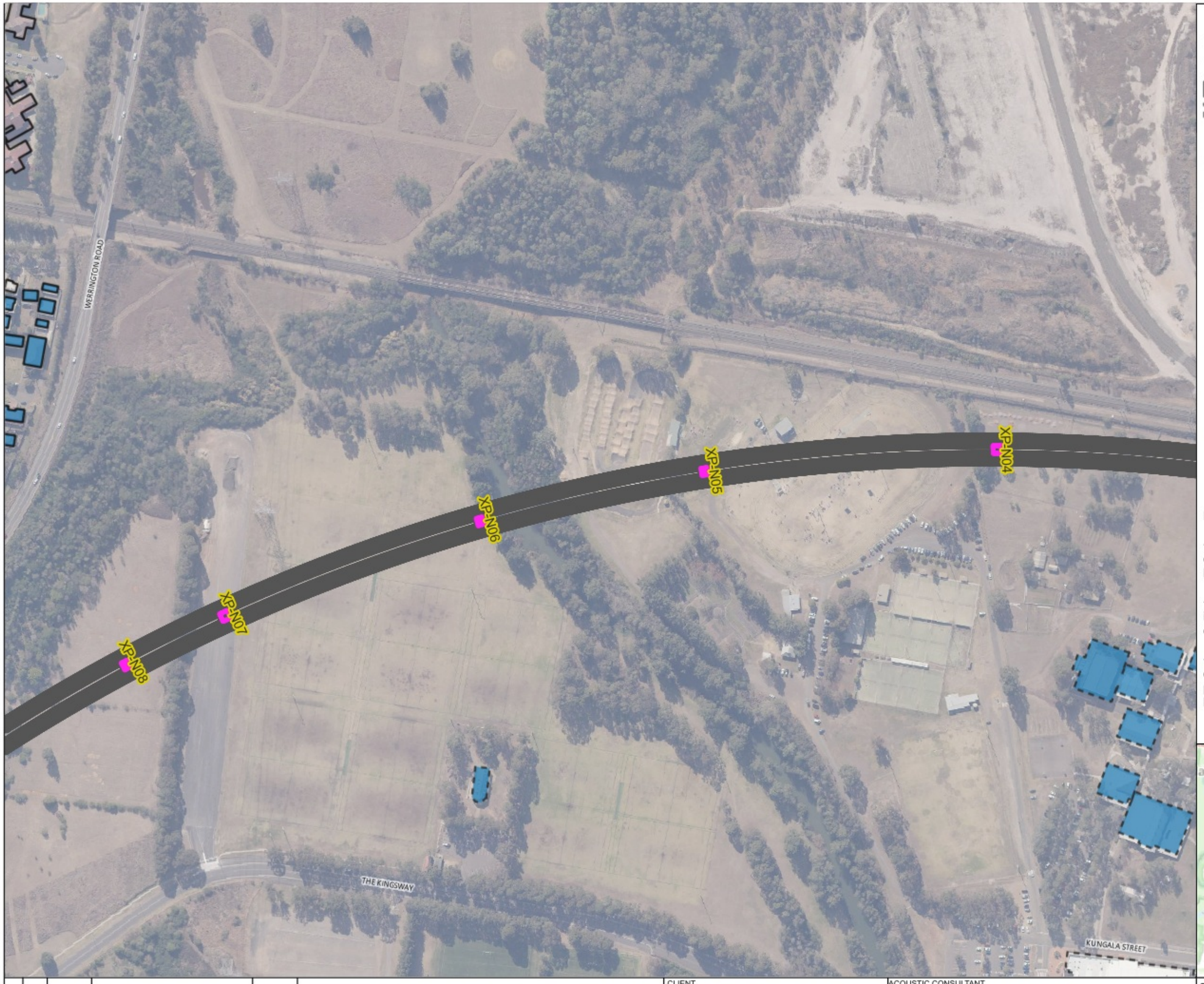
SYDNEY METRO WEST WESTERN SYDNEY AIRPORT TUNNELLING

Predicted Maximum GBV level during Northern Section excavation (Light Rockhammer)

Land-Use file revision_date: r7_07/07/21

Plot Date: 22/06/23 - 14:48 Layout: TM008 GBN&V (r0)

GIS File: R:\AssocSydProjects\TM001-TM050\TM008 mt Sydney Metro WSA SBT\5 Calcs\00 GENERAL\01 GIS\TM008-DA (r0).qgz



351 m
312
273
234
195
156
117
78
39
0

LEGEND

Noise sensitive receivers

- Residential and Hotels
- Non-Residential

- Mainline Tunnel Alignment
- Cross Passages

Maximum GBV levels PPV(mm/s) during Light Rockhammer excavation

- <0.28
- 0.28 - 0.40
- 0.40 - 0.56
- 0.56 - 1.1
- 1.1 - 2.2
- >2.2

Notes:

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

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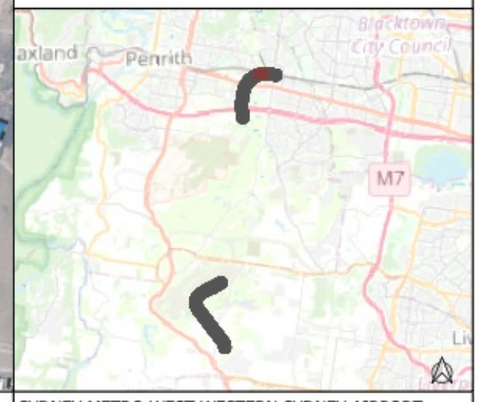

REV	BY	DATE	DESCRIPTION	APPROVER
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..	..	..	..	..
r0	DA	01/11/22	Prepare figures	TG
r1	DA	22/06/23	Updated cross passages	TG

A3 Original | Co-ordinate System: MGA Zone 56

0 40 80 120 160 m

1:3,000

FULL SIZE A3

NOTE: Do not scale from this drawing.

CLIENT

CPB CONTRACTORS | Ghella

ACOUSTIC CONSULTANT

RENZO TONIN & ASSOCIATES
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Ph (02) 8218 0500 Fax (02) 8218 0501

SYDNEY METRO WEST WESTERN SYDNEY AIRPORT TUNNELLING

Predicted Maximum GBV level during Northern Section excavation (Light Rockhammer)

Land-Use file revision_date: r7_07/07/21

Plot Date: 22/06/23 - 14:48 Layout: TM008 GBN&V (r0)

GIS File: R:\AssocSydProjects\TM001-TM050\TM008 mt Sydney Metro WSA SBT\5 Calcs\00 GENERAL\01 GIS\TM008-DA (r0).qgz

LEGEND

Noise sensitive receivers

- Residential and Hotels
- Non-Residential

- Mainline Tunnel Alignment
- Cross Passages

Maximum GBV levels PPV(mm/s) during Light Rockhammer excavation

- <0.28
- 0.28 - 0.40
- 0.40 - 0.56
- 0.56 - 1.1
- 1.1 - 2.2
- >2.2

Notes:

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

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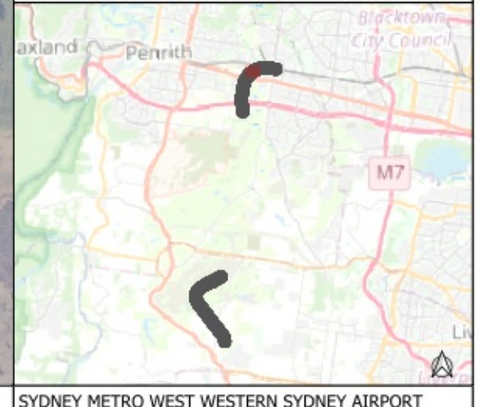
- Building occupants often assume that buidling damage is occuring when they feel vibration which people perceive is far lower than the vibration levels that could cause damage to structures.



REV	BY	DATE	DESCRIPTION	APPROVED
r0	DA	01/11/22	Prepare figures	TG
r1	DA	22/06/23	Updated cross passages	TG

A3 Original

Co-ordinate System: MGA Zone 56

0 40 80 120 160 m

1:3,000

FULL SIZE A3

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SYDNEY METRO WEST WESTERN SYDNEY AIRPORT TUNNELLING

Predicted Maximum GBV level during Northern Section excavation (Light Rockhammer)

Land-Use file revision_date: r7_07/07/21

Plot Date: 22/06/23 - 14:48 Layout: TM008 GBN&V (r0)

GIS File: R:\AssocSydProjects\TM001-TM050\TM008 mt Sydney Metro WSA SBT\5 Calcs\00 GENERAL\01 GIS\TM008-DA (r0).qgz

LEGEND

Noise sensitive receivers

- Residential and Hotels
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- Construction Footprint
- Mainline Tunnel Alignment
- Cross Passages

Maximum GBV levels PPV(mm/s) during Light Rockhammer excavation

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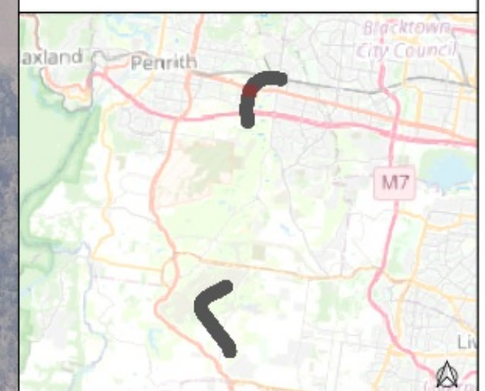

REV	BY	DATE	DESCRIPTION	APPROVER
r0	DA	01/11/22	Prepare figures	TG
r1	DA	22/06/23	Updated cross passages	TG

A3 Original

Co-ordinate System: MGA Zone 56

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SYDNEY METRO WEST WESTERN SYDNEY AIRPORT TUNNELLING

Predicted Maximum GBV level during Northern Section excavation (Light Rockhammer)

Land-Use file revision_date: r7_07/07/21

Plot Date: 22/06/23 - 14:49 Layout: TM008 GBN&V (r0)

GIS File: R:\AssocSydProjects\TM001-TM050\TM008 mt Sydney Metro WSA SBT\5 Calcs\00 GENERAL\01 GIS\TM008-DA (r0).qgz

351 m
312
273
234
195
156
117
78
39
0

LEGEND

Noise sensitive receivers

- Residential and Hotels
- Non-Residential

- Mainline Tunnel Alignment
- Cross Passages

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SYDNEY METRO WEST WESTERN SYDNEY AIRPORT TUNNELLING

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Land-Use file revision_date: r7_07/07/21

Plot Date: 22/06/23 - 14:49 Layout: TM008 GBN&V (r0)

GIS File: R:\AssocSydProjects\TM001-TM050\TM008 mt Sydney Metro WSA SBT\5 Calcs\00 GENERAL\01 GIS\TM008-DA (r0).qgz

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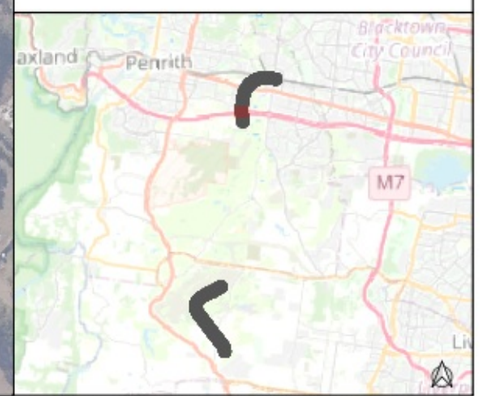

0 39 78 117 156 195 234 273 312 351 m

REV	BY	DATE	DESCRIPTION	APPROVED
r0	DA	01/11/22	Prepare figures	TG
r1	DA	22/06/23	Updated cross passages	TG

A3 Original

Co-ordinate System: MGA Zone 56

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1:3,000

FULL SIZE A3

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CLIENT

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SYDNEY METRO WEST WESTERN SYDNEY AIRPORT TUNNELLING

Predicted Maximum GBV level during Northern Section excavation (Light Rockhammer)

Land-Use file revision_date: r7_07/07/21

Plot Date: 22/06/23 - 14:49 Layout: TM008 GBN&V (r0)

GIS File: R:\AssocSydProjects\TM001-TM050\TM008 mt Sydney Metro WSA SBT\5 Calcs\00 GENERAL\01 GIS\TM008-DA (r0).qgz

LEGEND

Noise sensitive receivers

- Residential and Hotels
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- Cross Passages

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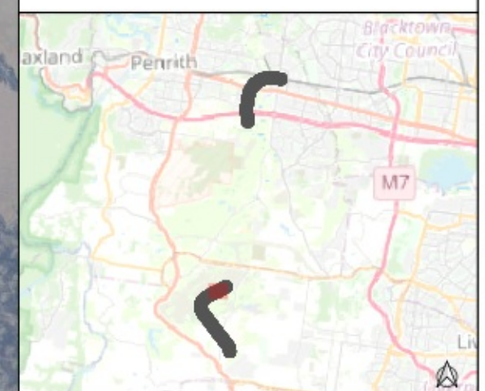

REV	BY	DATE	DESCRIPTION	APPROVER
r0	DA	01/11/22	Prepare figures	TG
r1	DA	22/06/23	Updated cross passages	TG

A3 Original

Co-ordinate System: MGA Zone 56

0 50 100 150 200 m

1:4,000

FULL SIZE A3

NOTE: Do not scale from this drawing.

CLIENT

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Ph (02) 8218 0500 Fax (02) 8218 0501

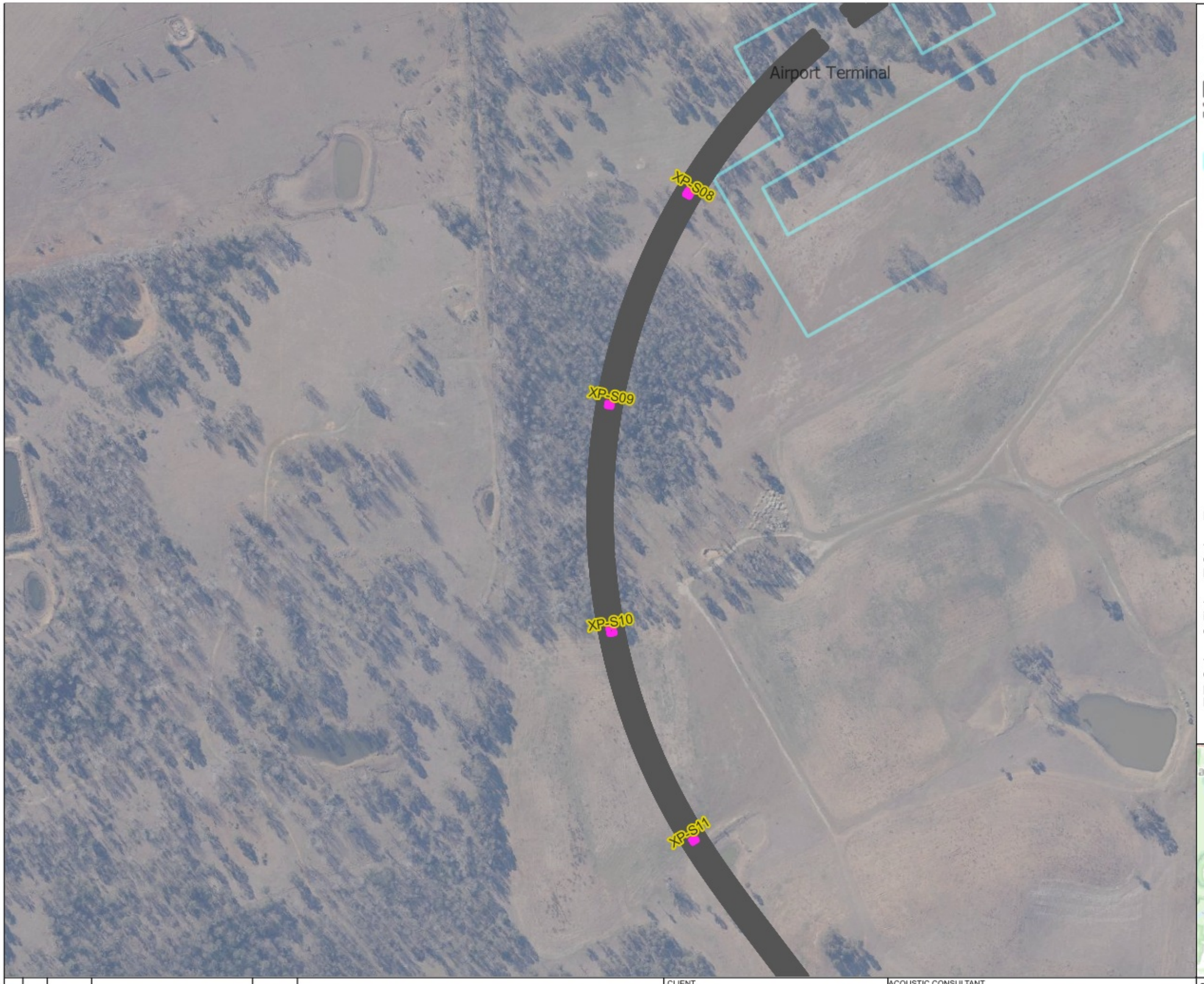
SYDNEY METRO WEST WESTERN SYDNEY AIRPORT TUNNELLING

Predicted Maximum GBV level during Southern Section excavation (Light Rockhammer)

Land-Use file revision_date: r7_07/07/21

Plot Date: 22/06/23 - 14:49 Layout: TM008 GBN&V (r0)

GIS File: R:\AssocSydProjects\TM001-TM050\TM008 mt Sydney Metro WSA SBT\5 Calcs\00 GENERAL\01 GIS\TM008-DA (r0).qgz



LEGEND

Noise sensitive receivers

- Residential and Hotels
- Non-Residential

- Construction Footprint
- Mainline Tunnel Alignment
- Cross Passages

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REV	BY	DATE	DESCRIPTION	APPROVER
r0	DA	01/11/22	Prepare figures	TG
r1	DA	22/06/23	Updated cross passages	TG

A3 Original

Co-ordinate System: MGA Zone 56

0 50 100 150 200 m

1:4,000

FULL SIZE A3

NOTE: Do not scale from this drawing.

CLIENT

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SYDNEY METRO WEST WESTERN SYDNEY AIRPORT TUNNELLING

Predicted Maximum GBV level during Southern Section excavation (Light Rockhammer)

Land-Use file revision_date: r7_07/07/21

Plot Date: 22/06/23 - 14:50 Layout: TM008 GBN&V (r0)

GIS File: R:\AssocSydProjects\TM001-TM050\TM008 mt Sydney Metro WSA SBT\5 Calcs\00 GENERAL\01 GIS\TM008-DA (r0).qgz

LEGEND

Noise sensitive receivers

- Residential and Hotels
- Non-Residential

- Construction Footprint
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Maximum GBV levels PPV(mm/s) during Light Rockhammer excavation

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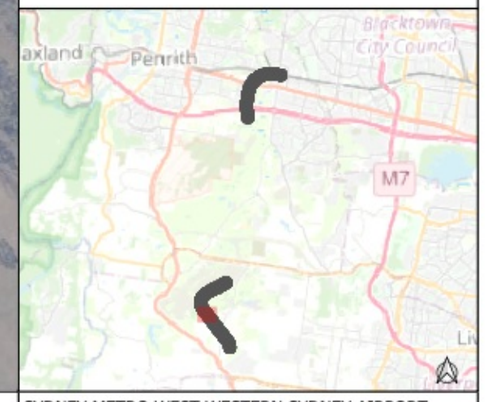

REV	BY	DATE	DESCRIPTION	APPROVED
r0	DA	01/11/22	Prepare figures	TG
r1	DA	22/06/23	Updated cross passages	TG

A3 Original

Co-ordinate System: MGA Zone 56

0 50 100 150 200 m

1:4,000

FULL SIZE A3

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CLIENT

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SYDNEY METRO WEST WESTERN SYDNEY AIRPORT TUNNELLING

Predicted Maximum GBV level during Southern Section excavation (Light Rockhammer)

Land-Use file revision_date: r7_07/07/21

Plot Date: 22/06/23 - 14:50 Layout: TM008 GBN&V (r0)

GIS File: R:\AssocSydProjects\TM001-TM050\TM008 mt Sydney Metro WSA SBT\5 Calcs\00 GENERAL\01 GIS\TM008-DA (r0).qgz

LEGEND

Noise sensitive receivers

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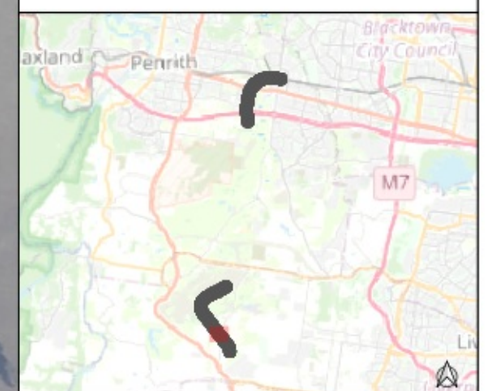

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SYDNEY METRO WEST WESTERN SYDNEY AIRPORT TUNNELLING

Predicted Maximum GBV level during Southern Section excavation (Light Rockhammer)

Land-Use file revision_date: r7_07/07/21

Plot Date: 22/06/23 - 14:50 Layout: TM008 GBN&V (r0)

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LEGEND

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