WestConnex M4-M5 Link

Mainline Tunnel

Modification report

Appendix C

Noise and vibration report

WESTCONNEX M4-M5 LINK

Mainline Tunnel – Modification report

Appendix C Noise and vibration report

SEPTEMBER 2018

This document cover is to be replaced with a Roads and Maritime Services approved document cover. Refer to Roads and Maritime Services Visual Identity Manual.

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Roads and Maritime Services

WestConnex M4-M5 Link

Mainline Tunnel – Modification report

Appendix C Noise and vibration report

September 2018

Prepared for

Roads and Maritime Services

Prepared by

SLR Consulting Australia

Contents

Glossary of terms and abbreviations

Term	Definition
AS	Australian Standard
BS	British Standard
CEMP	Construction Environmental Management Plan
CNVMP	Construction Noise and Vibration Management Sub-Plan
CORTN	Calculation of Road Traffic Noise
CSSI	Critical State Significant Infrastructure
dB	Decibels
dBA	A-weighted decibels
dBL	Linear weighted decibels
DECC	Department of Environment and Climate Change NSW
DECCW	Department of Environment, Climate Change and Water NSW
DGA	Dense Graded Asphalt
DIN	Deutsches Institut für Normung
DP&E	(NSW) Department of Planning and Environment
ECRTN	Environmental Criteria for Road Traffic Noise (replaced by the RNP)
EIS	Environmental Impact Statement
ENMM	Environmental Noise Management Manual
EPA	(NSW) Environment Protection Authority
EPL	Environment Protection Licence
ICNG	Interim Construction Noise Guideline
$L_{A1(1minute)}$	The "typical maximum noise level" for an event, used in the assessment of potential sleep disturbance during night-time periods. Alternatively, assessment may be conducted using the L_{Amax} or maximum noise level
L_{A90}	The "background noise level" in the absence of construction activities. This parameter represents the average minimum noise level during the daytime, evening and night-time periods respectively. The $L_{Aeq(15minute)}$ construction Noise Management Levels (NMLs) are based on the L_{A90} background noise levels.
$L_{Aeq(1hour)}$	The 'energy average noise level' evaluated for a specific one-hour period.
$L_{Aeq(9hour)}$	The 'energy average noise level' evaluated over the night-time period (10.00 pm to 7.00 am).
$L_{Aeq(15hour)}$	The 'energy average noise level' evaluated over the daytime period (7.00 am to 10.00 pm). The L_{Aeq} can be likened to the average of all the noise events occurring in the relevant time period.
$L_{Aeq(15minute)}$	The "energy average noise level" evaluated over a 15-minute period. This parameter is used to assess the potential construction noise impacts
L_{AFmax}	The maximum fast time weighted noise level from road traffic noise occurring at a particular location.
LPI	NSW Land and Property Information
MIC	Maximum Instantaneous Charge
NATA	National Association of Testing Authorities
NCA	Noise Catchment Area
NCG	Noise Criteria Guideline
NMG	Noise Mitigation Guideline
NML	Noise Management Level.
OEH	Office of Environment and Heritage
OGA	Open Graded Asphalt
OOHW	Out of Hours Work
RIC	Relative Increase Criteria as described in the NMG
RBL	Rating Background Level
RMS	Root Mean Square
Roads and Maritime	(NSW) Roads and Maritime Services

Term	Definition
RTA	(NSW) Roads and Traffic Authority (now Roads and Maritime)
SEARs	Secretary's Environmental Assessment Requirements
SLR	SLR Consulting Australia
SPL	Sound Pressure Level
SWL	Sound Power Level
VDV	Vibration Dose Value

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Executive summary

Introduction

SLR Consulting Australia (SLR) has been engaged by NSW Roads and Maritime Services (Roads and Maritime) to assess the potential noise and vibration impacts associated with modifications to Stage 1 of the WestConnex M4-M5 Link project (the project). This report has been prepared to inform the modification report.

Overview of the modification

The proposed modification relates to Stage 1 of the approved project. The following points provide an overview of the proposed modification:

- The Northcote Street civil site (C3a) would become a civil and tunnel site. This would result in 24 hours, seven days a week tunnelling works being carried out from this location within an existing acoustic shed. The Northcote Street site is being used for tunnelling as part of the M4 East project. A construction access tunnel is to be provided from the Northcote Street site that utilises part of the existing access tunnel for the M4 East project. Proposed spoil haulage routes to and from this site are identified in this traffic and transport assessment. Relevant conditions of the project approval would apply to the use of this site for tunnelling and civil works to ensure potential impacts are managed consistently with the project approval
- The Parramatta Road West and Parramatta Road East civil sites (C1b and C3b) would be used as civil sites in accordance with condition of approval C19 and other conditions of the project approval. The sites would be used for site offices, light and heavy vehicle car parking, shuttle bus services, workshop and storage of equipment, materials and construction machinery. Both sites would operate 24 hours a day, 7 days a week in accordance with the conditions of the project approval. No tunnelling, tunnel spoil handling or tunnel spoil stockpiling and haulage would occur at these sites
- A temporary pedestrian walkway would be constructed above Parramatta Road to connect the Parramatta Road East and Parramatta Road West civil sites. The pedestrian walkway would only be available for use by project staff during the construction phase of the project and would not be available for public use. The pedestrian walkway would be demobilised upon completion of the construction phase of the project
- Removal of the Darley Road civil and tunnel site (C4) from the project. No construction activities or permanent operational infrastructure would be provided at this location. The M4-M5 Link Environmental Impact Statement (EIS) provided for construction spoil to be removed from the Darley Road site. This spoil would now be removed from other tunnelling sites
- The relocation of the operational water treatment plant from the Darley Road motorway operations complex (as described in the EIS) to the Campbell Road motorway operations complex at the St Peters interchange.

Relevant guidelines

Construction noise has been assessed in accordance with the *Construction Noise and Vibration Guideline* (CNVG) (Roads and Maritime, 2016) and the *Interim Construction Noise Guideline* (ICNG) (DECC, 2009) which references *Assessing Vibration: A Technical Guideline* (EPA, 2006) for human comfort vibration guidance. Guidance for assessing potential structural damage from vibration is taken from Australian Standard AS 2187: Part 2-2006 *Explosives - Storage and Use – Part 2: Use of Explosives* (Standards Australia, 2006), BS 7385 Part 2-1993 *Evaluation and measurement for vibration in buildings* Part 2 (British Standards Institution (BSI), 1993), and DIN 4150: Part 3-1999 *Structural vibration - Effects of vibration on structures* (Deutsches Institut für Normung (DIN), 1999).

Noise from operation of proposed fixed operational facilities is assessed with guidance from the *NSW Industrial Noise Policy* (INP) (EPA 1999).

Noise and vibration assessment

The assessment of potential changes to noise and vibration impacts followed the same approach as was carried out for the approved project and involved:

- A quantitative assessment of construction noise (including ground borne noise), vibration and road traffic noise impacts associated with the use of the Northcote Street civil and tunnel site and the construction of the G-loop
- Qualitative discussion of the impacts relating to the use of the Parramatta Road East and West civil sites by comparison to that assessed in the EIS.
- A quantitative assessment of construction noise and vibration assessment of the temporary overhead pedestrian overpass which connects the Parramatta Road East and Parramatta Road West sites
- An assessment of the operational noise associated with the proposed water treatment plant to be located at the Campbell Road motorway operations complex (MOC5) at St Peters interchange.

Northcote Street civil and tunnel site

The Northcote Street site at Haberfield is located between Wattle Street and Wolseley Street at Haberfield and was assessed in the EIS as a civil site. The modification proposes the use of this site as a civil and tunnel site incorporating tunnelling activities 24 hours, seven days a week, which is consistent with the current use of the site as part of the M4 East project.

Airborne noise impacts

Minor noise impacts (less than 10 dBA) are predicted during site establishment and decommissioning of the site. Impacts are limited to five receivers who are located in close proximity to the site. These works are proposed to be conducted during standard daytime hours only and would be relatively short in duration.

Tunnelling activities are predicted to result in minor impacts (less than 10 dBA) at surrounding receivers with the exception of one receiver which is predicted to be moderately impacted (greater than 10 dBA) during the night-time period. Airborne noise impacts are generally as a result of spoil trucks entering and exiting the site along with concrete trucks pumping concrete. Predicted noise levels represent a worst-case noise level with all activities working simultaneously within the site. Mitigation of these exceedances could include investigation of localised barriers or enclosures around static noise sources (pumps etc) and limiting the amount that the roller doors are open during the night time period.

Minor noise impacts (less than 10 dBA) are predicted during site establishment and decommissioning of the G-loop. Impacts are limited to six receivers which are located in close proximity to the site. As some of the works may require road occupancy, there will be the requirement for some works to be undertaken outside of standard construction hours, in which case moderate impacts (greater than 10 dBA) are predicted at nearby receivers. Out of hours works (OOHWs) are expected to be limited in duration as the extent of the modification required is minor and as such would be managed via the implementation of the mitigation and management measures outlined in the EIS to be incorporated in the Construction Noise and Vibration Management Sub-Plan.

Construction traffic noise

Two spoil haulage routes for the Northcote Street civil and tunnel site have been assessed against relevant noise criterion. Predicted noise from construction traffic on public roads is below the Roads and Maritime assessment criterion for both spoil haulage routes options. It should be noted that while the predicted increase is below the 2 dB increase threshold, both Ramsay Street and Great North Road currently have relatively low volumes of heavy vehicles during the night time period. The project should consider the potential impact from maximum noise levels that heavy vehicles may have on surrounding receivers along Ramsay Street, Fairlight Street and Great North Road when finalising the routes for construction traffic during the night time period.

Ground-borne noise

Ground-borne noise from tunnelling works associated with the excavation of the access tunnel is predicted to be compliant with the night-time criterion at all sensitive receivers when road headers are being used. During rock-breaker tunnelling works, the worst case ground-borne noise levels are predicted to exceed the 35 dBA $L_{Aeq(15minute)}$ night-time criterion at up to 38 sensitive receivers in NCA01, NCA02 and NCA06. While most tunnelling works would be anticipated to progress at a consistent rate, there may be discreet locations which require a longer duration of tunnelling works due to site conditions.

Parramatta Road West and Parramatta Road East civil sites

The EIS described the Parramatta Road West site as a civil and tunnel site and the Parramatta Road East site as a civil site. The modification proposes that these sites would be used as civil sites in accordance with condition of approval C19 (ie they would be used for parking and other works that do not exceed the 'Noise affected' Noise Management Levels as identified in the ICNG).

A qualitative consistency assessment was undertaken to identify activities associated with the proposed modification that may result in a greater impact or otherwise be considered inconsistent with activities identified in the EIS. The assessment indicated that the proposed use of the Parramatta Road West and Parramatta Road East civil sites is considered to be consistent with the assessment undertaken in the M4-M5 Link EIS and SPIR and would not result in a change to the mitigation proposed for the equivalent activities. The proposed modification would remove tunnelling activities from the site and is therefore expected to result in a reduction in the impact on nearby receivers previously predicted in association with tunnelling related activities. There would be no change to the project footprint as assessed in the EIS and SPIR.

Consistent with recommendations in the EIS and SPIR, a CNVIS will be prepared based on the finalised construction methodology and will include consideration of the indicative revised layout and use of the site, including the location of specific items of plant. The CNVIS will include details of how the noise emissions from the sites will be managed to achieve compliance with the applicable noise management levels as required by condition of approval C19. Where non-compliances are predicted within the CNVIS, the contractor will explore a range of at source noise mitigation options.

A temporary overhead pedestrian walkway for construction workers only connecting the Parramatta Road West and East civil sites is proposed. This walkway would span Parramatta Road and would be in place from around late 2018 to early 2023.

Minor noise impacts (less than 10 dBA) are predicted during the construction of the gantry during standard construction hours. Impacts are limited to 14 receivers which are located in close proximity to the site. As the works involving lifting of the bridge span may require road occupancy, there will be a requirement for these works to be undertaken outside of standard construction hours, in which case moderate impacts (greater than 10 dBA) are predicted at nearby receivers. Out of hours works (OOHWs) are expected to be limited in duration and as such would be managed via the implementation of the mitigation and management measures outlined in the EIS to be incorporated in the Construction Noise and Vibration Management Sub-Plan. The use of the pedestrian walkway by workers during the construction period is expected to result in negligible noise impacts.

Campbell Road motorway operations complex

The operational water treatment plant (WTP) is to be relocated to the Campbell Road motorway operations complex at St Peters interchange. The relocation of the operational WTP would result in the operational footprint of the motorway operations complex at St Peters being increased.

The water treatment plant at the Campbell Road motorway operations complex (MOC5) has been modelled at a sound power level (SWL) of 90 dBA. This is the maximum SWL that results in compliance with the criteria at all residential receivers and is considered to be reasonably representative of similar plant. Other fixed plant at this location has been modelled as per the EIS inputs.

The selected mechanical equipment should be reviewed and assessed for compliance with the established criteria at the detailed design stage of the project when specific plant selection is finalised

and appropriate noise control measures can be determined. Note that the cumulative noise emissions from all fixed facility noise sources should be considered when determining the appropriate mitigation options.

1 Introduction

Approval for the construction and operation of the project was granted on 17 April 2018 by the NSW Minster for Planning (application number SSI 7485).

Construction design and planning has progressed since the assessment contained in the EIS and the M4-M5 Link Submissions and Preferred Infrastructure Report (SPIR) and a review of the concept design for the approved project has occurred. As a result, the proponent has further optimised the construction site arrangements assessed in the EIS and SPIR to reduce community impacts and to decrease the overall number of construction sites required for Stage 1 of the project. The main changes include the removal of the Darley Road civil and tunnel site for the project and changes to some of the construction ancillary facilities as summarised in **Table 1-1**.

Table 1-1 Change to construction ancillary facilities at Haberfield, Ashfield and Leichhardt

EIS and SPIR	Proposed modification
Wattle Street civil and tunnel site (C1a)	No change
Haberfield civil site (C2a/C2b)[1]	No change
Northcote Street civil site (C3a)	Northcote Street civil and tunnel site. Includes tunnelling, spoil handling and spoil haulage from this site
Parramatta Road West civil and tunnel site (C1b)	Parramatta Road West civil site[2] Inclusion of a temporary pedestrian walkway above Parramatta Road to link to the Parramatta Road East civil site.
Parramatta Road East civil site (C3b)	Parramatta Road East civil site[2] Inclusion of a temporary pedestrian walkway above Parramatta Road to link to the Parramatta Road West civil site.
Darley Road civil and tunnel site (C4)	Removal of site

Notes

1. The use and footprint of this site was amended in sections B11.6.8 and C6.1.3 of the SPIR to be as per the arrangement for the Haberfield civil site (C2b).
2. Condition C19 allowed use of the site for parking and other works that do not exceed the 'noise affected' Noise Management Levels as identified in the ICNG.

1.1 Overview of M4-M5 Link project

The EIS describes construction and operation of the M4-M5 Link in two stages:

Stage 1[1], as described in the EIS included:

- Construction of the mainline tunnels between the M4 East Motorway at Haberfield and the New M5 Motorway at St Peters, stub tunnels to the Rozelle interchange (at the Inner West subsurface interchange) and ancillary infrastructure at the Darley Road motorway operations complex (MOC1) and Campbell Road motorway operations complex (MOC5)
- These works are anticipated to commence in 2018 with the mainline tunnel opening to traffic in 2022.

Stage 2[2] as described in the EIS, included:

- Construction of the Rozelle interchange and Iron Cove Link including connection to the stub tunnels at the Inner West subsurface interchange, connection to the surface road network at Lilyfield and Rozelle, and construction of tunnels, ramps and associated infrastructure as part of the Rozelle interchange to provide connections to the proposed future Western Harbour Tunnel and Beaches Link project. Ancillary infrastructure will be provided at Rozelle West motorway operations complex (MOC2), Rozelle East motorway operations complex (MOC3) and Iron Cove Link motorway operations complex (MOC4)
- Stage 2 works are expected to commence in 2019 with these components of the project opening to traffic in 2023.

The M4-M5 Link project is part of the WestConnex program of works that, together with the proposed future Sydney Gateway, would facilitate improved connections between western Sydney, Sydney Airport and Port Botany and south and south-west Sydney, as well as better connectivity between the important economic centres along Sydney's Global Economic Corridor and through local communities.

A more comprehensive overview of the M4-M5 Link project, as well as other aspects of the WestConnex program of works, is provided within the EIS and the SPIR.

[1] M4-M5 Link Stage 1 (the mainline tunnels) is also commonly referred to as Stage 3A of the WestConnex program of works

[2] M4-M5 Link Stage 2 (the Rozelle interchange and Iron Cove Link) is also commonly referred to as Stage 3B of the WestConnex program of works

1.2 Overview of modification

The proposed modification relates to Stage 1 of the approved project. The following points provide an overview of the proposed modification:

- The Northcote Street civil site (C3a) would become a civil and tunnel site. This would result in 24 hours, seven days a week tunnelling works being carried out from this location within an existing acoustic shed. The Northcote Street site is being used for tunnelling as part of the M4 East project. A construction access tunnel is to be provided from the Northcote Street site that utilises part of the existing access tunnel for the M4 East project. Proposed spoil haulage routes to and from this site are identified in this modification report. Relevant conditions of the project approval would apply to the use of this site for tunnelling and civil works to ensure potential impacts are managed consistently with the project approval
- The Parramatta Road West and Parramatta Road East civil sites (C1b and C3b) would be used as civil sites in accordance with condition of approval C19 and other conditions of the project approval. The sites would be used for site offices, light and heavy vehicle car parking, shuttle bus services, workshop and storage of equipment, materials and construction machinery. Both sites would operate 24 hours a day, 7 days a week in accordance with the conditions of the project approval. No tunnelling, tunnel spoil handling or tunnel spoil stockpiling and haulage would occur at these sites
- A temporary pedestrian walkway would be constructed above Parramatta Road to connect the Parramatta Road East and Parramatta Road West civil sites. The pedestrian walkway would only be available for use by project staff during the construction phase of the project and would not be available for public use. The pedestrian walkway would be demobilised upon completion of the construction phase of the project
- Removal of the Darley Road civil and tunnel site (C4) from the project. No construction activities or permanent operational infrastructure would be provided at this location. The EIS provided for construction spoil to be removed from the Darley Road site. This spoil would now be removed from other tunnelling sites
- The relocation of the operational water treatment plant from the Darley Road motorway operations complex (as described in the EIS) to the Campbell Road motorway operations complex at the St Peters interchange.

Key aspects of the proposed modification relevant to the assessment of potential noise and vibration impacts are described in further detail in **Chapter 2.** Chapter 4 (Proposed modification) of the modification report provides a detailed description of the proposed modification.

The proposed modification would require changes to the conditions of the project approval. Proposed changes to the project approval are detailed in Chapter 7 (Conditions of approval) of the modification report.

Site establishment works (in accordance with an approved Site Establishment Management Plan) and/or construction works (in accordance with an approved Construction Environmental Management Plan) are proposed at a number of the project construction sites and will be carried out in accordance with the existing conditions of approval for the project.

1.3 Purpose of this report

The purpose of the noise and vibration assessment is to support the environmental assessment for the project modification by assessing and reporting changes to that assessed for the project approval. Specifically, the assessment will include the following:

- Construction noise (including ground borne noise), vibration and road traffic noise impacts associated with the use of the Northcote Street civil and tunnel site
- Construction noise and vibration assessment of the temporary overhead pedestrian overpass which links the Parramatta Road East and Parramatta Road West civil sites
- Fixed facility operational noise assessment of the proposed water treatment plant to be located at the Campbell Road motorway operations complex (MOC5) at the St Peters interchange.

This report is to be read in conjunction with Appendix J (Technical working paper: Noise and vibration) of the EIS which contains detailed descriptions and explanations of the assessment guidelines and methodologies used.

1.4 Structure of this report

This report has been structured as follows:

- **Chapter 2** presents an overview of the modification to the approved project
- **Chapter 3** presents ambient noise surveys to determine the existing noise environment within the study area
- **Chapter 4** details assessment guidelines and methodology
- **Chapter 5** provides an assessment of predicted noise and vibration impacts during construction and consideration of potential mitigation and management measures associated with the propose modification
- **Chapter 6** provides an assessment of predicted noise impacts due to the operation of the project and consideration of potential mitigation measures.

1.5 Terminology

The technical terminology used in this report is explained in Appendix J (Technical working paper: Noise and vibration) of the M4-M5 Link EIS.

2 Key aspects of the proposed modification relevant to this assessment

2.1 Change of use at the Northcote Street civil and tunnel site

The Northcote Street site is located between Wattle Street and Wolseley Street at Haberfield. The site is currently being used as a tunnelling site for the M4 East project and was approved for use as a civil site during construction of the M4-M5 Link project.

The Northcote Street site is proposed to be used as a civil and tunnel site for the project. Once construction works for the M4 East project are completed at this site, the site would be altered to make it suitable for use by the M4-M5 Link project. Existing construction infrastructure that is currently being used for the M4 East project would, where required, be retained and used for the project. This includes hoarding, offices, access gates, noise walls, the acoustic shed structure and part of the construction access tunnel.

2.1.1 Site layout

The proposed indicative site layout is provided in **Figure 2-1**. Key elements that would be consistent with the existing layout for the M4 East project include the vehicle entry and exit locations, the acoustic shed and the entry to the temporary access tunnel. Infrastructure not required for construction of the M4-M5 Link project would be removed from the site. The final layout for this site would be confirmed during detailed design and detailed in the approved Site Establishment Management Plan (SEMP) and/ or approved Construction Environmental Management Plan (CEMP).

The existing acoustic shed is located in the middle of the site with tunnelling activities being undertaken inside the shed. The acoustic shed would be used to enclose most noise-generating and dust-generating activities associated with tunnelling works. Within the acoustic shed, the main construction activities proposed are spoil handling, stockpiling of spoil material along with the loading of spoil material onto haulage vehicles for transportation to designated landfill or reuse sites.

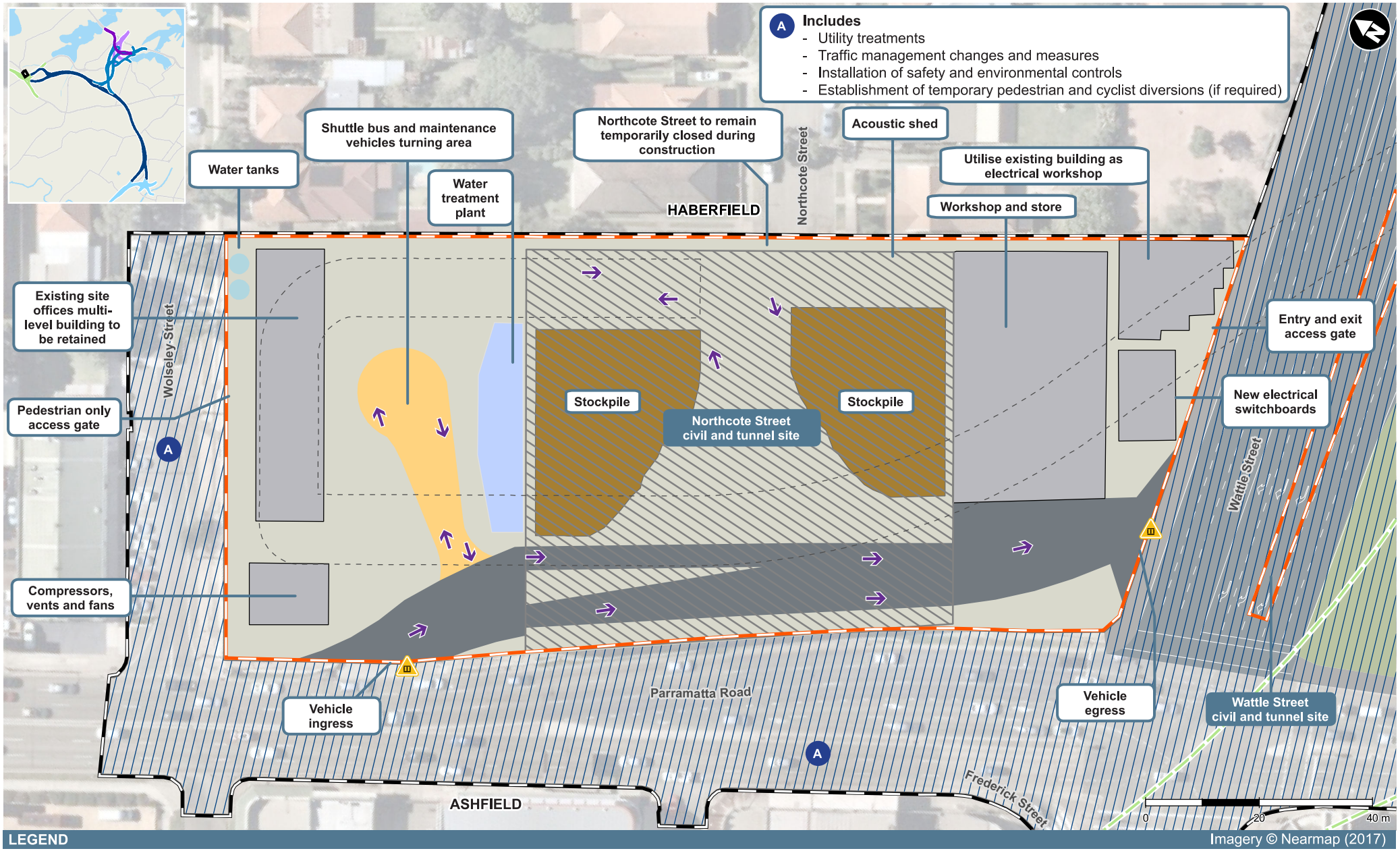


Figure 2-1 Indicative Northcote Street civil and tunnel site layout

2.1.2 Operating hours

Construction activities would operate 24 hours a day, seven days a week at the Northcote Street civil and tunnel site. Activities would predominately include tunnelling, spoil handling and spoil haulage and the delivery of shotcrete and concrete and general construction vehicles. The proposed hours of operation would be consistent with the operating hours used by the M4 East project at this site.

2.1.3 Construction access tunnel

The existing construction access tunnel located at the northern end of the site would be altered to meet the needs of the M4-M5 Link project. At present the access tunnel heads west under Parramatta Road to join the M4 East mainline tunnel. On completion of the M4 East project, demobilisation will occur, with some elements being retained for the M4-M5 Link project. Part of the existing M4 East access tunnel will be retained and blocked off adjacent to the eastern side of Parramatta Road. This will enable construction of the M4-M5 Link access tunnel.

For the M4-M5 Link project, the new construction access tunnel would head generally in a south eastern direction beneath Wattle Street, to the north of the Haberfield civil site and beneath a small number of residential properties (less than 10 properties) in Walker Avenue and Alt Street to connect with the M4-M5 Link mainline tunnels. This route has been selected as it would provide the most direct route from the access tunnel to the M4-M5 Link mainline tunnels. The route avoids the M4 East Motorway tunnels and Parramatta Road ventilation facility and ventilation tunnels.

Figure 2-2 presents the proposed alignment of the construction access tunnel. **Figure 2-3** presents an indicative cross section of the construction access tunnel.

The construction access tunnel would have an average grade of around 14 per cent with a maximum depth of around 50 metres and would be around 430 metres in length. The access tunnel would connect to the mainline tunnels around 30 metres below ground. The average width of the construction access tunnel would be 12 metres to allow two heavy construction vehicles to comfortably travel side by side.

For the construction of the access tunnel, roadheaders would be used to cut the top heading with a roadheader, and surface miner or excavators with breakers would be used to excavate the bench. To support the access tunnel, steel rock bolts, mesh and shotcrete would be used. Spoil would be removed by off road articulated trucks to the surface where it would be stockpiled in the acoustic shed until transported to a disposal or reuse site. Construction of the access tunnel would take around nine months. Once construction works are complete, the construction access tunnel would be backfilled.

Figure 2-2 Indicative alignment of construction access tunnel

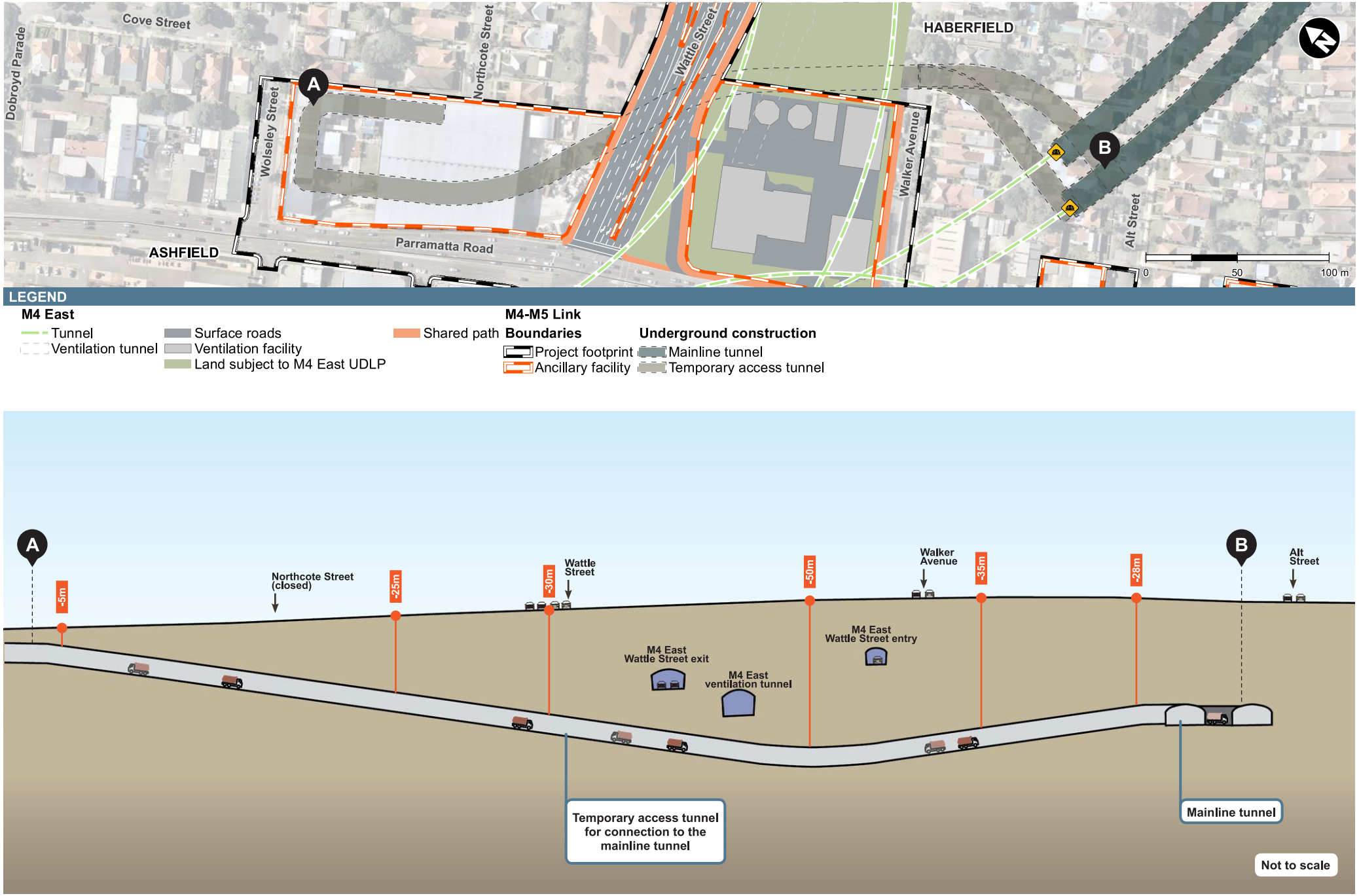


Figure 2-3 Indicative cross section of construction access tunnel

2.1.4 Spoil volumes and spoil haulage route

Two spoil haulage routes are proposed to be used in association with the Northcote Street civil and tunnel site. **Table 2-1** describes each proposed route for spoil haulage. **Figure 2-4** shows the proposed spoil haulage routes.

Table 2-1 Indicative spoil haulage routes for Northcote Street civil and tunnel site

Route	Indicative spoil haulage route
Route A	Entry: via Parramatta Road city bound and then left turn into the site
	Exit: via left turn from site onto Wattle Street, then left turn into Ramsay Street/ Road, then left turn into Fairlight Street, then left turn into Great North Road, then right turn into Parramatta Road
Route B	Entry: via Parramatta Road city bound and then left turn into the site
	Exit: via left turn from site onto Wattle Street, then left turn onto the dedicated temporary construction vehicle turning lane (known as the G-loop) at the intersection of Dobroyd Parade and Waratah Street within part of Reg Coady Reserve. Right turn onto Wattle Street from truck turning facility toward M4 East tunnels or Parramatta Road. The G-loop has been used during the construction of the M4 East project.

Traffic signals are provided at intersections where vehicle turning is required for both Route A and Route B. All of the roads included in the proposed haulage routes are state roads managed by Roads and Maritime. Generally, all roads along the proposed routes have two traffic lanes in each direction with some on street parking and are heavily trafficked.

The G-loop at the intersection of Dobroyd Parade and Waratah Street was established in the M4 East project and would be utilised for the proposed Route B. M4 East construction traffic and public motorists are able to use the G-loop during construction of the M4 East project. The access to the G-loop for public motorists was provided because the construction of the M4 East project removed the ability to turn right into Waratah Street when travelling eastbound on Dobroyd Parade.

Minor changes would be required to the proposed intersection design at Dobroyd Parade and Waratah Street (after completion of the M4 East project at the end of Q1 2019) to allow Route B to be used, including:

- Adjustments to the kerb and channel, including protection of new drainage infrastructure, along the north side of Dobroyd Parade at the entry and exit to the G-loop
- A short section of the median designed to separate the eastbound traffic on Dobroyd Parade from the eastbound traffic using the M4 East tunnel exit ramp would be removed to allow heavy vehicles to exit the G-loop and turn right onto Dobroyd Parade westbound
- A section of the pedestrian path along the north side of Dobroyd Parade would be realigned around the perimeter of the G-loop to avoid potential conflict between heavy vehicles and pedestrians
- Upgrade the traffic light phasing at this intersection to accommodate the G-loop traffic
- Signage and line marking associated with the above.

Use of the G-loop for the proposed modification would be restricted to M4-M5 Link construction vehicles. This restriction would be communicated through appropriate signage and line marking. Public motorists would not be able to use the G-loop. However, the completed M4 East project will provide a right turn lane from the M4 East eastbound lanes into Waratah Street at this location and a right turn lane from the Wattle Street eastbound lanes into Ramsay Street.

On completion of construction of the M4-M5 Link project, the G-loop infrastructure would be removed and that part of Reg Coady Reserve would be rehabilitated in accordance with the M4 East Residual Land Management Plan.

Once the G-loop is in operation, Route B would be the preferred spoil haulage route and would be available for use 24 hours a day and 7 days a week in accordance with condition of approval E70.

Route A would also be used as a spoil haulage route. However, in response to feedback received from stakeholders during the consultation process, it is proposed that Route A would generally only be used between 7am and 6pm Monday to Friday and 8am to 6pm on Saturdays except in the following circumstances and in accordance with the relevant conditions of the project approval:

- During the early stages of construction until such time as the works to facilitate operation of the G-loop were completed and the G-loop was functional
- In the event of heavy traffic congestion, an incident or maintenance works on the arterial road and/or motorway network which has the potential to detrimentally impact on the efficient use of the G-loop and result in delays for spoil haulage vehicles.

A spoil haulage protocol would be developed by the contractor in consultation with Roads and Maritime and the Transport for NSW Traffic Management Centre to manage spoil haulage movements on Routes A and B. The protocol would be documented in the Construction Traffic Transport and Access Management Sub-Plan.

2.1.5 Car parking

Limited car parking would be provided at the Northcote Street civil and tunnel site due to space constraints. Car parking for the construction workforce would primarily be provided at the Parramatta Road West and Parramatta Road East civil sites with around a total of 200 spaces being provided at these two sites.

A shuttle bus would be provided to transport the majority of construction workforce to and from designated parking areas, which are anticipated to be predominantly at the Parramatta Road East and Parramatta Road West civil sites and the Northcote Street civil and tunnel site. Where possible, the workforce will be encouraged to walk between the Northcote Street, Parramatta Road and Wattle Street sites.

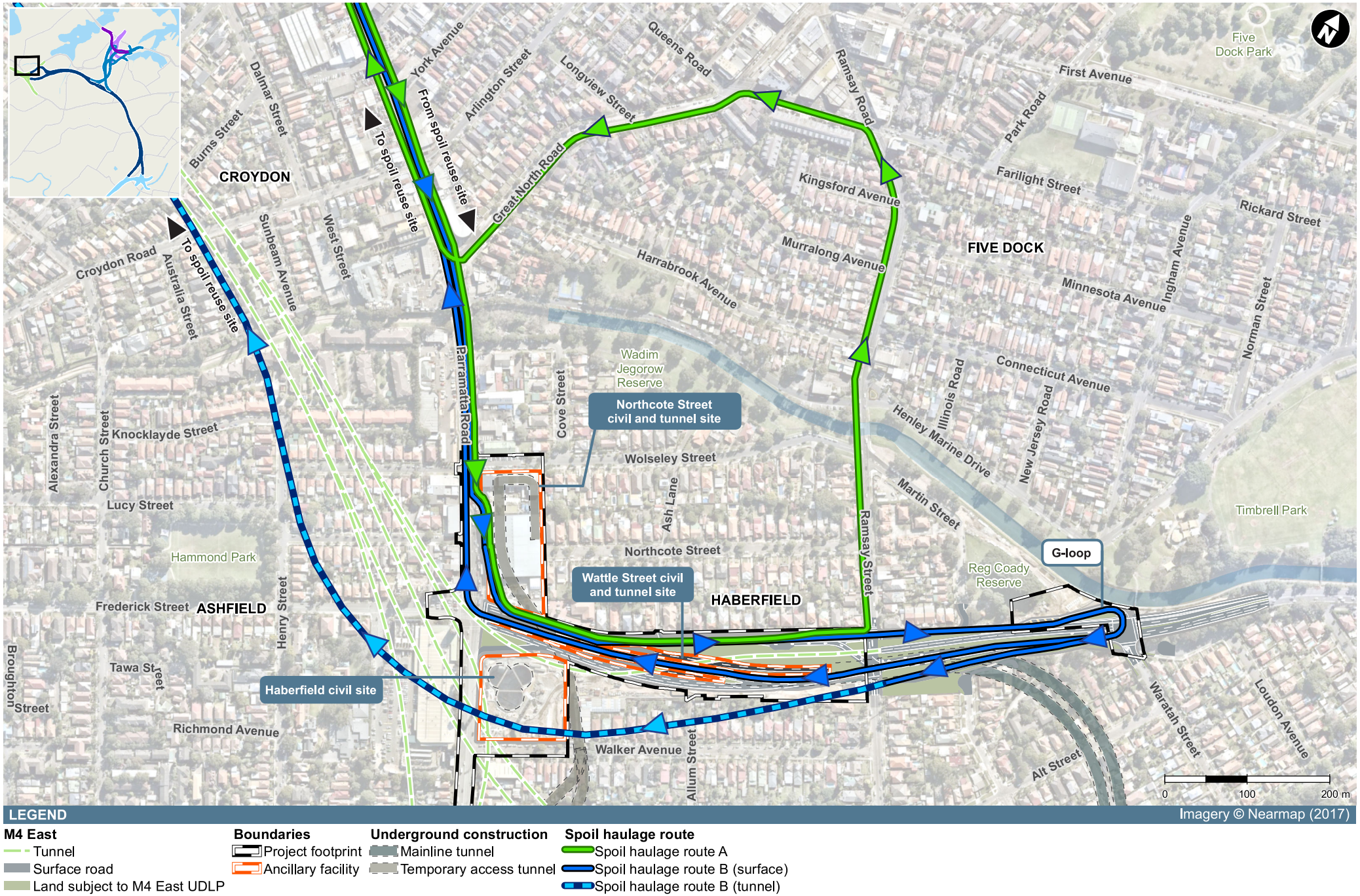


Figure 2-4 Northcote Street civil and tunnel site proposed spoil haulage routes

2.1.6 Program

An indicative program of works for the Northcote Street civil and tunnel site is shown in **Table 2-2**. The program shows that the construction activity at the Northcote Street site commences in Q2 2019, and continues through to end of Q1 2023. Once construction works are complete, construction facilities would be demobilised and the site would be rehabilitated in accordance with the M4 East Residual Land Management Plan. It is expected that Northcote Street would be reinstated, as provided for under the M4 East project approval.

Table 2-2 Indicative program of works - Northcote Street civil and tunnel site

Construction Activity	Indicative construction timeframe																							
	2018				2019				2020				2021				2022				2023			
Refurbishment and traffic management						■	■																	
Site establishment						■	■																	
Construct temporary access tunnel							■	■	■															
Tunnelling										■	■	■	■	■	■	■	■							
Civil and mechanical fitout											■	■	■	■	■	■	■	■						
Testing and commissioning																■	■	■	■	■				
Site demobilisation and rehabilitation																	■	■	■	■	■			

2.1.7 Construction activities

Four scenarios have been developed to assess potential noise and vibration impacts associated with construction works at the Northcote Street civil and tunnel site. **Table 2-3** outlines the construction scenarios and corresponding activities, as well as the assessed periods of operation. The estimated durations of activities are also summarised, noting that the activities are intermittent during this period and would not be expected to be undertaken every day during the scheduled activity.

For the G-loop, site establishment works to facilitate operation of the G-loop are limited and are expected to occur over a period of around two weeks. At the completion of construction G-loop decommissioning works are expected to occur over a period of up to eight weeks (up to 10 weeks in total).

Table 2-3 Indicative construction activity (works) scenarios

Scenario	Works ID	Indicative duration (weeks)[1]	Period of works[2]			
			Day	Day OOH	Eve	Night
Northcote Street civil and tunnel site						
Site establishment	NST-01	24	✓			
Tunnelling activities	NST-02	116	✓	✓	✓	✓
Tunnelling support activities	NST-03	116	✓	✓	✓	✓
Decommissioning	NST-04	52	✓			
G-loop						
Site establishment and decommissioning	NST-05	10	✓	✓	✓	✓

Notes:

1. The duration refers to the overall period during which the work activities would be undertaken. In reality the work activities are likely to be undertaken intermittently (not continuously) and the impacts would be localised to areas adjacent to where the works activity is being undertaken. The overall duration of work activities would be confirmed during detail design
2. Works periods are defined as:

   Day 7:00 am to 6:00 pm Monday to Friday, 8:00 am to 6:00 pm Saturday

   Day out of hours (OOH) Sunday and public holidays 8:00 am to 6:00 pm

   Evening (Eve) 6:00 pm to 10:00 pm Monday to Sunday

   Night 10:00 pm to 7:00 am Monday to Friday and 10:00 pm to 8:00 am Saturday, Sunday and public holidays

2.2 Parramatta Road West and Parramatta Road East civil sites

The Parramatta Road West and Parramatta Road East civil sites are located on the western and eastern sides of Parramatta Road between around Alt Street and Bland Street at Ashfield and Haberfield.

The Parramatta Road West and Parramatta Road East civil sites would be used in accordance with condition of approval C19 and other conditions of the project approval. The sites would be used for parking and other works that do not exceed the 'noise affected' Noise Management Levels (NMLs) as identified in the ICNG.

The sites would be used for site offices, light and heavy vehicle car parking, shuttle bus services, workshop and storage of equipment, materials and construction vehicles. Both sites would operate 24 hours a day, 7 days a week in accordance with the conditions of the project approval.

The sites would be used to support civil and tunnelling construction activities at other project construction sites, primarily within the Haberfield and Ashfield area. No tunnelling, tunnel spoil stockpiling and handling or tunnel spoil haulage would occur at these sites.

2.2.1 Site layout

The proposed indicative site layout for Parramatta Road West and Parramatta Road East civil sites is provided in **Figure 2-5**. The layout for the sites would be confirmed during detailed design and in the approved Site Establishment Management Plan (SEMP) and/or approved Construction Environmental Management Plan (CEMP).

Site establishment works would be carried out which would include demolition of buildings and structures, vegetation clearing and removal, establishment of vehicle entry and exit points, establishment of temporary noise attenuation measures and utility works. These site establishment works were assessed in the EIS.

Vehicle access points are provided for Parramatta Road West civil site from Parramatta Road, Bland Street and Alt Street. The entry along Parramatta Road would only be accessible for west-bound traffic with a left turn into the site. Exit onto Parramatta Road would be left turn out to travel west-bound. Entry and exit points are also proposed onto Bland Street and Alt Street to allow traffic to access between the sites or onto Parramatta Road.

Light and heavy vehicle access points for the Parramatta Road East civil site would be from Parramatta Road and Alt Street. Entry would be left turn in, only available for east-bound traffic. Exit would be left turn out to travel east bound along Parramatta Road. Vehicle access points would not be provided from Bland Street for this site.

Table 2-4 provides indicative heavy and light vehicle numbers for the Parramatta Road West and Parramatta Road East civil sites.

Table 2-4 Indicative construction vehicle numbers

Parramatta Road West and Parramatta Road East civil sites										
Site	**Daily Vehicles**		**AM peak hour**				**PM peak hour**			
	(one way)		**(7.30-8.30am)**				**(4.15-5.15pm)**			
	Heavy	**Light**	**Heavy vehicles**		**Light vehicles**		**Heavy vehicles**		**Light vehicles**	
			Arrive	**Depart**	**Arrive**	**Depart**	**Arrive**	**Depart**	**Arrive**	**Depart**
West	25	306	7	7	18	5	7	7	5	31
East	25	210	1	1	12	4	1	1	4	20

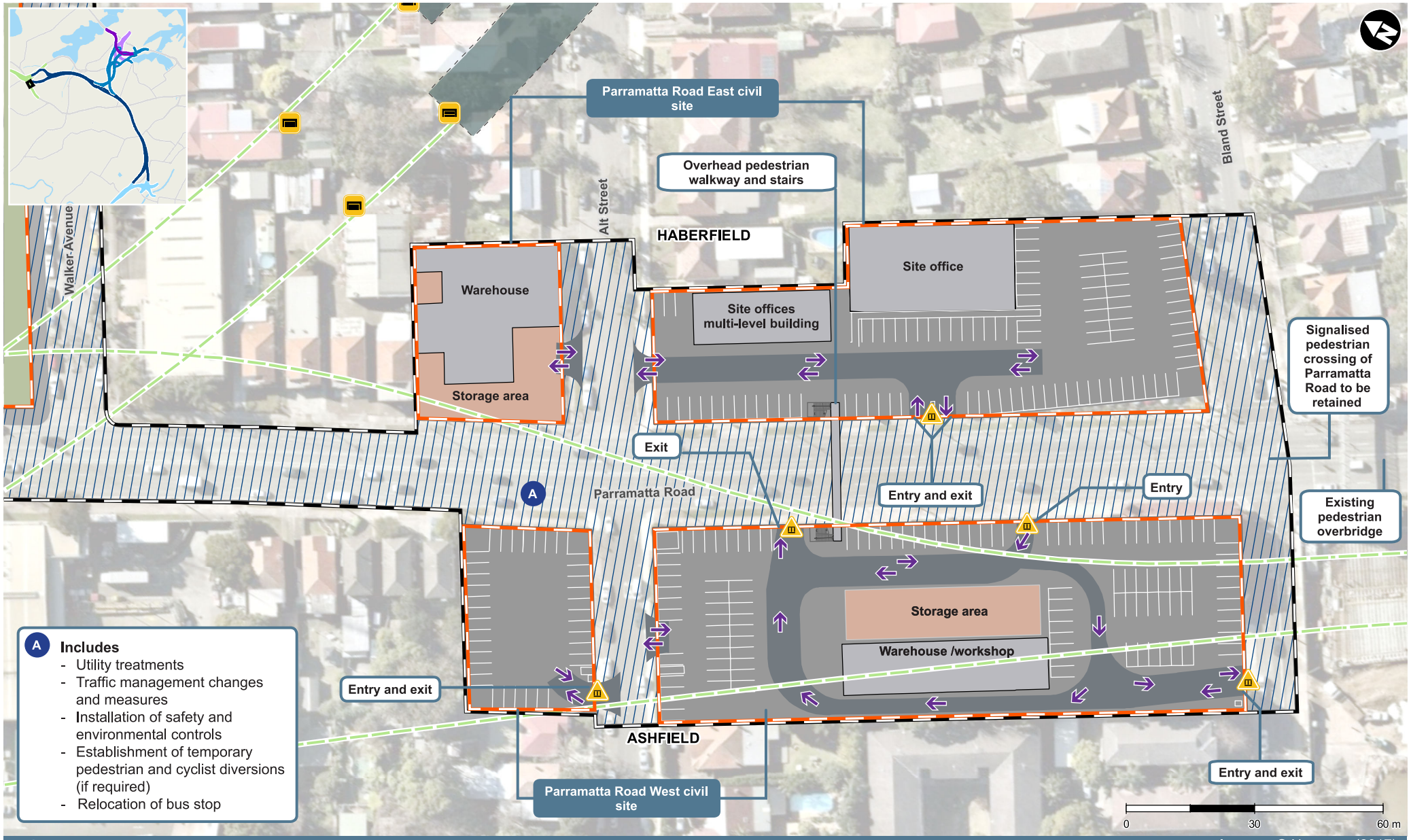


Figure 2-5 Indicative Parramatta Road West and Parramatta Road East site layouts

2.2.2 Operating hours

The Parramatta Road West and Parramatta Road East civil sites would be used 24 hours a day, seven days a week to support civil and tunnelling construction activities at other project construction sites, primarily within the Haberfield and Ashfield area. No tunnelling, tunnel spoil stockpiling and handling or tunnel spoil haulage would occur at these sites.

Site establishment works would generally occur during standard construction hours of 7.00 am to 6.00 pm Monday to Friday and 8.00 am to 6.00 pm on Saturdays (as permitted by conditions E68 and E69 of the project approval)or as provided for in other conditions of approval and the project Environment Protection Licence (EPL).

2.2.3 Car parking

A total of around 200 car parking spaces would to be provided at the Parramatta Road West and Parramatta Road East civil sites for the construction workforce. The parking spaces would be used by construction workforce staff working at other project construction sites and for some heavy vehicle parking. A shuttle bus service would be provided to transport the majority of the construction workforce to and from construction sites. Where possible the workforce would be encouraged to walk between sites. As required by condition of approval E54, a Construction Parking and Access Strategy would be prepared by the contractor to assist with managing parking demand for the project.

The site would also be used for heavy vehicle parking. The type of heavy vehicles likely to use the sites for parking would include rigid and articulated trucks dropping off or picking up materials or equipment from laydown areas, vehicles or equipment to be serviced at the workshop and short term layover of trucks across working shifts. No tunnel spoil trucks would use these sites.

2.2.4 Program

An indicative program of works for Parramatta Road West and Parramatta Road East civil sites is provided in **Table 2-5**. The construction program shows construction activities commencing in Q3 2018 and continuing through to the end of Q1 2023. Once construction activities are complete, construction facilities would be removed and the site would be rehabilitated in accordance with the Residual Land Management Plan for the project.

Table 2-5 Indicative program of works - Parramatta Road West and East civil sites

Construction Activity	Indicative construction timeframe																							
	2018				2019				2020				2021				2022				2023			
Site establishment and utility works			■	■	■	■																		
Site operations – offices, warehouse/storage, workshop and parking				■	■	■	■	■	■	■	■	■	■	■	■	■	■	■						
Site demobilisation and rehabilitation																		■	■	■	■			

2.3 Parramatta Road West and East civil sites – pedestrian walkway

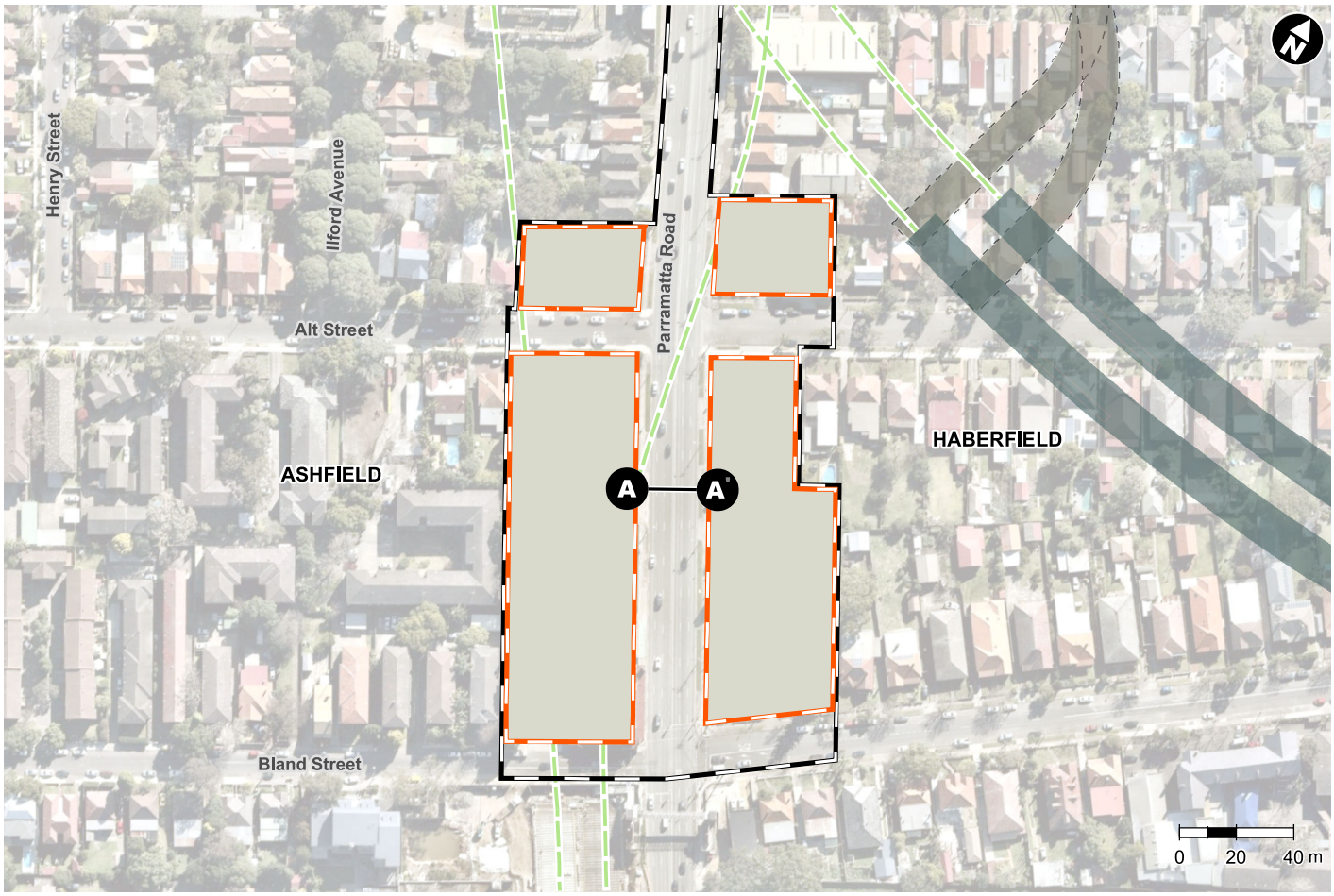
This modification proposes to link the Parramatta Road West and Parramatta Road East civil sites with a temporary overhead pedestrian walkway above Parramatta Road which would only be used by the construction workforce and would not be available for public use. Access to the walkway would be via stairs at either end located within the work sites. The pedestrian walkway is provided to allow the construction workforce to easily move between the two sites without the need to use the existing at-grade pedestrian crossing on Parramatta Road at the traffic signals.

The structure would provide sufficient clearance for vehicles travelling along Parramatta Road with the base of the walkway being around six metres above Parramatta Road. The overall height of the walkway structure would extend to around 10 metres above Parramatta Road. Both the walkway and access towers would be enclosed to provide weather protection for users and enable use 24 hours a

day, seven days a week. Lighting would be provided to allow the walkway to be used after daylight hours.

The bridge structure would be fabricated offsite in sections that are of suitable size for transportation to the site. The sections would be welded or bolted together at the Parramatta Road sites. The supporting steel towers would be assembled on site and mounted on concrete foundations to support the pedestrian walkway. The bridge would be a single span and would be lifted into position by a crane. Installation of the span would be carried out at night with full road closure of Parramatta Road and traffic detours provided. A Road Occupancy Licence from the Transport for NSW Traffic Management Centre would be required for the installation of the pedestrian walkway, allowing for the temporary closure of Parramatta Road. Once the walkway span is in place the roof and deck would be installed.

The pedestrian walkway is expected to be in place from around late 2018 to end of Q1 2023. Once construction works are complete, the pedestrian walkway would be removed following a similar process to that described above, but in reverse. An indicative site layout showing the location of the walkway and an elevation plan of the pedestrian walkway are provided in **Figure 2-6**.



Imagery © Nearmap (2017)

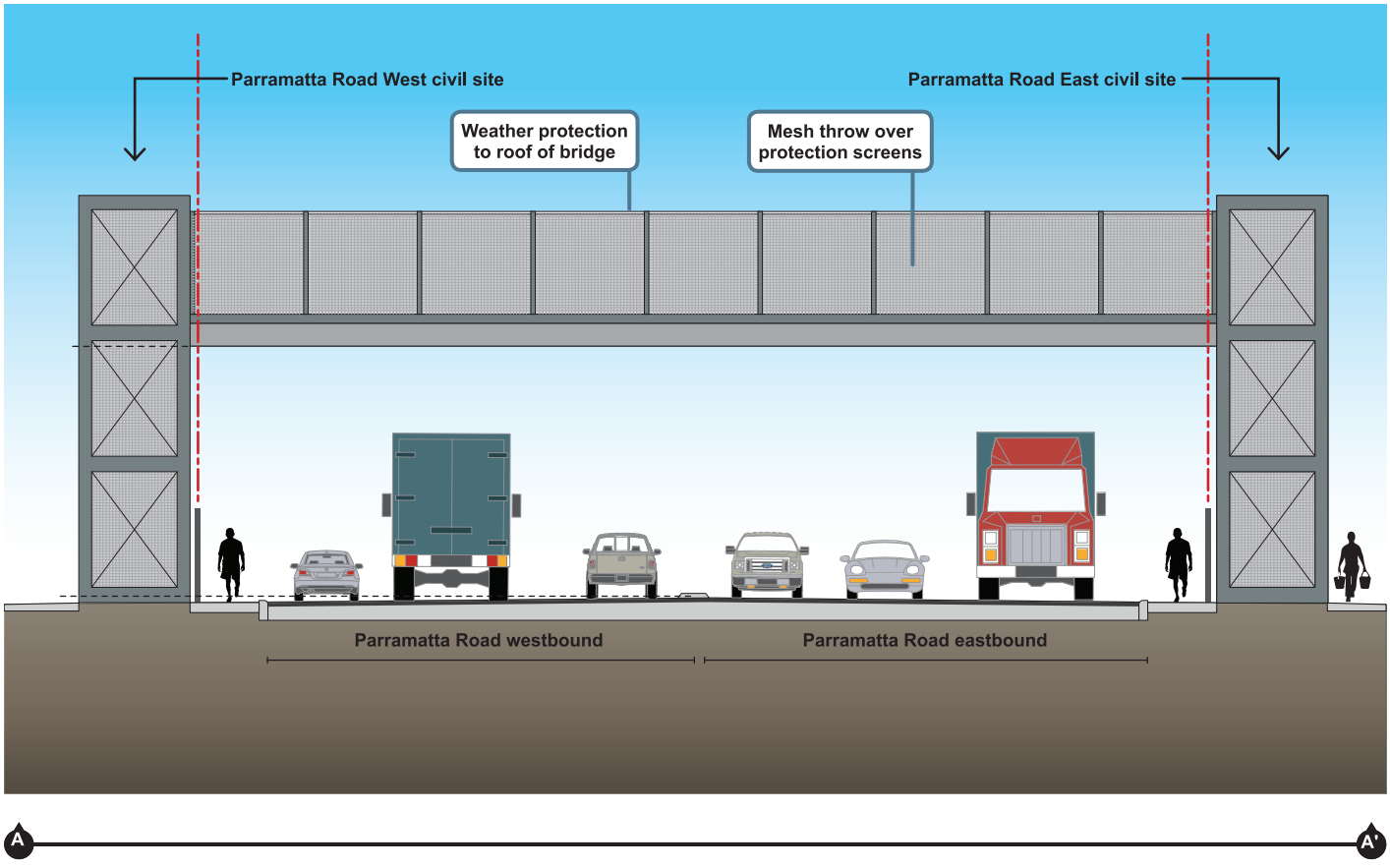


Figure 2-6 Indiactive location and design of Parramatta Road West and Parramatta Road East overhead pedestrian walkway

2.3.1 Operating hours

It is proposed to undertake activities associated with the construction of the footings and supporting structures for the overhead pedestrian walkway during standard construction hours. The bridge span would be craned into position during which temporary occupation of Parramatta Road would be required. This would occur during the non-peak (out-of-hours) period.

2.3.2 Construction activities

Three scenarios have been developed to assess potential impacts associated with the construction of the pedestrian overpass. **Table 2-6** outlines the construction scenarios and corresponding activities, as well as the assessed periods of operation. The estimated durations of activities are also summarised, noting that the activities are intermittent during this period and would not be expected to be undertaken every day during the scheduled activity.

While the bridge assembly and span lift is expected to occur over a duration of up to 8 weeks, the work associated with assembly of the bridge would be undertaken during the daytime hours and the span lift would be undertaken during night time but over a limited period of a few nights.

Table 2-6 Indicative program of works

Scenario	Works ID	Indicative duration (Weeks)[1]	Period of works[2,]			
			Day	Day OOH	Eve	Night
Footing constructions include concrete saws	MPO-01	1	✓			
Boarded piling	MPO-02	3	✓			
Bridge assembly and span lift	MPO-03	8	✓	✓	✓	✓

Notes:

1. The duration refers to the overall period during which the work activities would be undertaken. In reality the work activities are likely to be undertaken intermittently (not continuously) and the impacts would be localised in areas adjacent to where the works activity is being undertaken. The overall duration of work activities would be confirmed during detail design
2. Works periods are defined as:

   Day 7:00 am to 6:00 pm Monday to Friday, 8:00 am to 6:00 pm Saturday

   Day out of hours Sunday and Public holidays 8:00 am to 6:00 pm

   Evening (Eve) 6:00 pm to 10:00 pm Monday to Sunday

   Night 10:00 pm to 7:00 am Monday to Friday and 10:00 pm to 8:00 am Saturday, Sunday and Public holidays.

2.4 Removal of Darley Road site from project

The EIS identified the site as the Darley Road civil and tunnel site (C4) for the construction of the project and as the Darley Road motorway operations complex (MOC1) for the operation of the project.

Ongoing construction design and planning has determined that the Darley Road site is no longer required to support the construction and operation of the project.

2.4.1 Relocation of construction activities

Construction activities would not be carried out at the Darley Road civil and tunnel site. The construction activities proposed for Darley Road civil and tunnel site as described in the EIS would be accommodated at other project construction sites.

The approved project involved the removal and transportation of around 550,300 cubic metres of tunnel spoil from the Darley Road civil and tunnel site as described in section 23.3.2 of the EIS. Given that the length of the mainline tunnel would not change for the proposed modification, this spoil volume would be required to be removed from other tunnelling sites.

The overall intensity (rate) of spoil removal at approved tunnelling sites is not expected to change, however the additional spoil to be removed would require the extension of the tunnelling component of the overall construction program by around six months.

2.4.2 Relocation of operational ancillary infrastructure

The EIS described that an operational water treatment plant and substation would be located at the Darley Road motorway operations complex. The removal of the Darley Road site from the project would result in the relocation of the operational water treatment plant to the Campbell Road motorway operations complex at St Peters interchange. The relocation of the operational water treatment plant is described in **section 2.5**.

The permanent substation proposed at the Darley Road site in the EIS is no longer required. As described in the EIS, permanent power for Stage 1 of the M4-M5 link project will be supplied via the intake substation at the Campbell Road motorway operations complex at the St Peters interchange. Section 5.10.1 of the EIS and section 4.2.4 of Appendix F (Utilities Management Strategy) of the EIS provides further details on the proposed arrangements to provide electricity to the project.

The removal of the motorway operation complex from Darley Road would result in no permanent infrastructure for the project being located at this location.

2.5 Relocation of operational water treatment plant to St Peters

The proposed relocation of the operational water treatment plant to the Campbell Road motorway operations complex would result in the operational footprint of the motorway operations complex at St Peters being increased.

Figure 2-7 provides an indicative site layout for the Campbell Road motorway operations complex at St Peters interchange which includes an indicative location for the operational water treatment plant. The motorway operation complex is located on the cut and cover structure above the M4-M5 Link ramps at the St Peters interchange which is being constructed by the New M5 project and on land to the immediate east. The motorway operations complex as described in the EIS includes ventilation facilities and a substation. Additional land adjacent to, and to the immediate south east of the motorway operations complex would be required to accommodate the operational water treatment plant.

The increase in footprint of the motorway operations complex would have only a minimal impact on the total area of proposed open space on the southern side of Campbell Road at the St Peters interchange that is being delivered as part of the New M5 project. The increase in footprint will also have some impact on the proposed landscaping area for the St Peters interchange to be provided in this location.

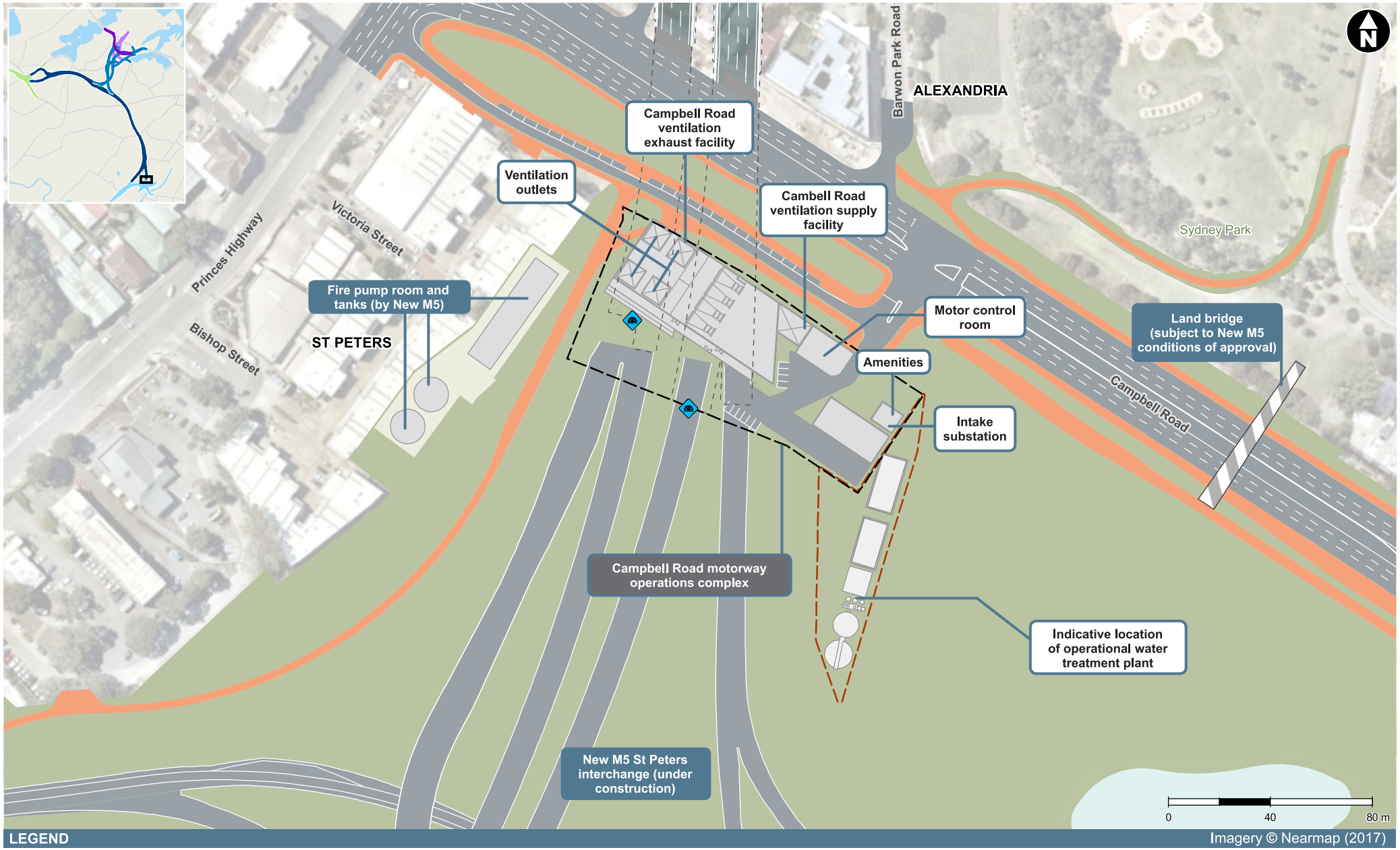


Figure 2-7 Indicative layout of the Campbell Road motorway operations complex

3 Existing environment

The existing ambient noise environment was described in Appendix J (Technical working paper: Noise and vibration) of the EIS. This section provides details of the existing ambient noise environment specifically relating to the proposed modification.

3.1 Noise catchment areas

For assessment purposes, the study area for the modification has been divided into multiple Noise Catchment Areas (NCAs). These NCAs include a variety of land uses within and surrounding the project and assist in the identification of impacts upon groups of receivers likely to be affected by the same works. The NCAs are consistent with the NCAs described in the EIS.

A description of each NCA relevant to the modification is provided in **Table 3-1** and depicted in **Figure 3-1**, **Figure 3-2** and **Figure 3-3.**

Table 3-1 Noise catchment areas and surrounding land uses

NCA description		
Reference	**Min. distance (m)[1]**	**Description**
Haberfield and Ashfield		
NCA00	40	West of Parramatta Road between Bland Street and Orpington Street. Land use consists of residential receivers.
NCA01	<5	West of Parramatta Road between Iron Cove Creek and Bland Street. Land use comprises of a mix of residential receivers, special use facilities, active and passive recreation areas and commercial receivers fronting Parramatta Road.
NCA02	<5	East of Parramatta Road between Henley Marine Drive and Walker Avenue. Land use comprises of a mix of residential and commercial receivers, a place of worship and a childcare centre.
NCA03	20	Catchment adjoins either side of Wattle Street between Ash Lane and Ramsay Street. Land use consists of residential receivers.
NCA04	30	Catchment area adjoins Ramsay Street and the northern side of Wattle Street. Land use consists of residential receivers, isolated commercial receivers and a passive recreational area
NCA05	n/a[2]	South of Dobroyd Parade between Hawthorne Parade and Martin Street. Land use consists of residential receivers with isolated commercial receivers and educational facilities
NCA06	<5	East of Parramatta Road between Walker Avenue and Alt Street residences. Land use consists of residential and commercial receivers and an educational facility on Ramsay Street
NCA07	<5	East of Parramatta Road between Dalhousie Street and Bland Street residences. Land use comprises of a mix of residential and commercial facilities, an educational facility on Bland Street and active and passive recreation areas.
St Peters		
NCA46	750	North of Sydney Park Road between Concord Street, Coulson Street and Maddox Street. Land use comprises of a mix of residential receivers and isolated commercial receivers.
NCA47	150	East of Euston Road, between Maddox Street and Campbell Road. Land use consists of commercial receivers.

NCA description		
Reference	**Min. distance (m)[1]**	**Description**
NCA48	50	South of Sydney Park Road between Barwon Park Road, Campbell Road and Euston Road. Land use comprises of a passive recreation area and isolated commercial receivers.
NCA49	75	Catchment area adjoins either side of Barwon Park Road, between Campbell Road and Crown Street. Land use comprises of a mix of residential and commercial receivers.
NCA50	<5	Catchment area adjoins either side of Princes Highway, between Mary Street, Church Street/Applebee Street and May Street. Land use comprises of a mix of residential and commercial receivers, an educational facility and an active recreation area.
NCA51	225	North of Campbell Street between Applebee Street and the Illawarra Rail Line/St Peters Rail Station. Land use comprises of a mix of residential and commercial receivers and active and passive recreation areas.
NCA52	225	South of the Illawarra Rail Line between Campbell Street, Sutherland Street and Princes Highway premises. Land use comprises of a mix of residential and commercial receivers, an educational facility and active and passive recreation areas.
NCA53	n/a[2]	West of Princes Highway, south of Sutherland Street. Land use comprises of a mix of residential and commercial receivers.
NCA54	n/a[2]	East of Princes Highway between Canal Street and Alexandra Canal. Land use comprises of a mix of residential and commercial receivers.
NCA55	190	East of Burrows Road. Land use comprises of a mix of residential and commercial receivers.

Notes:

1. Approximate minimum horizontal offset distance from the nearest receiver building facade (receiver of any type) to the nearest point that construction works are occurring
2. No surface works are proposed in this NCA. Receivers in this catchment would therefore only be potentially affected by impacts from tunnelling works during construction

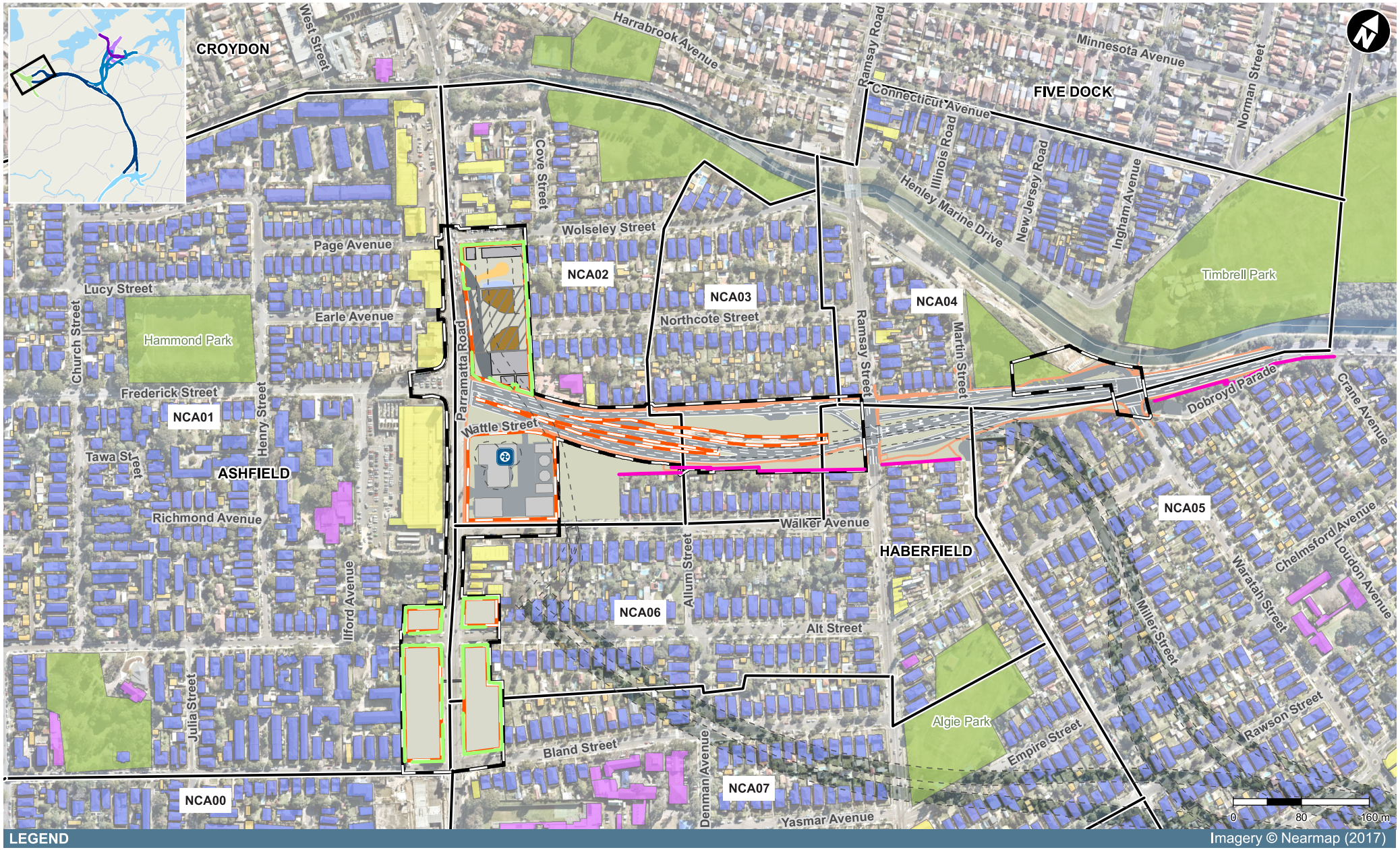


Figure 3-1 NCA boundary map around the Northcote Street civil and tunnel site and G-loop

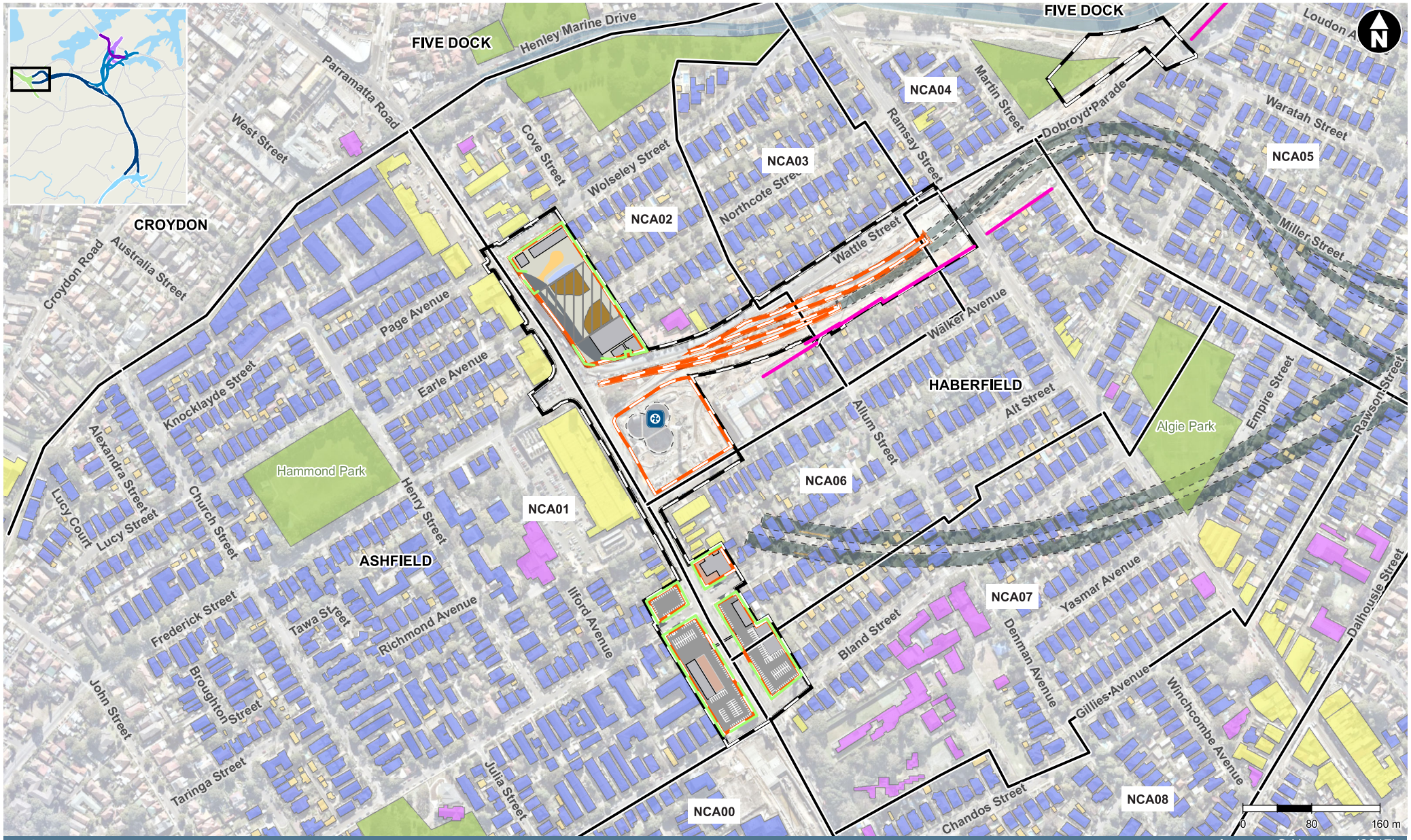


Figure 3-2 NCA boundary map around the Parramatta Road West and Parramatta Road East civil sites

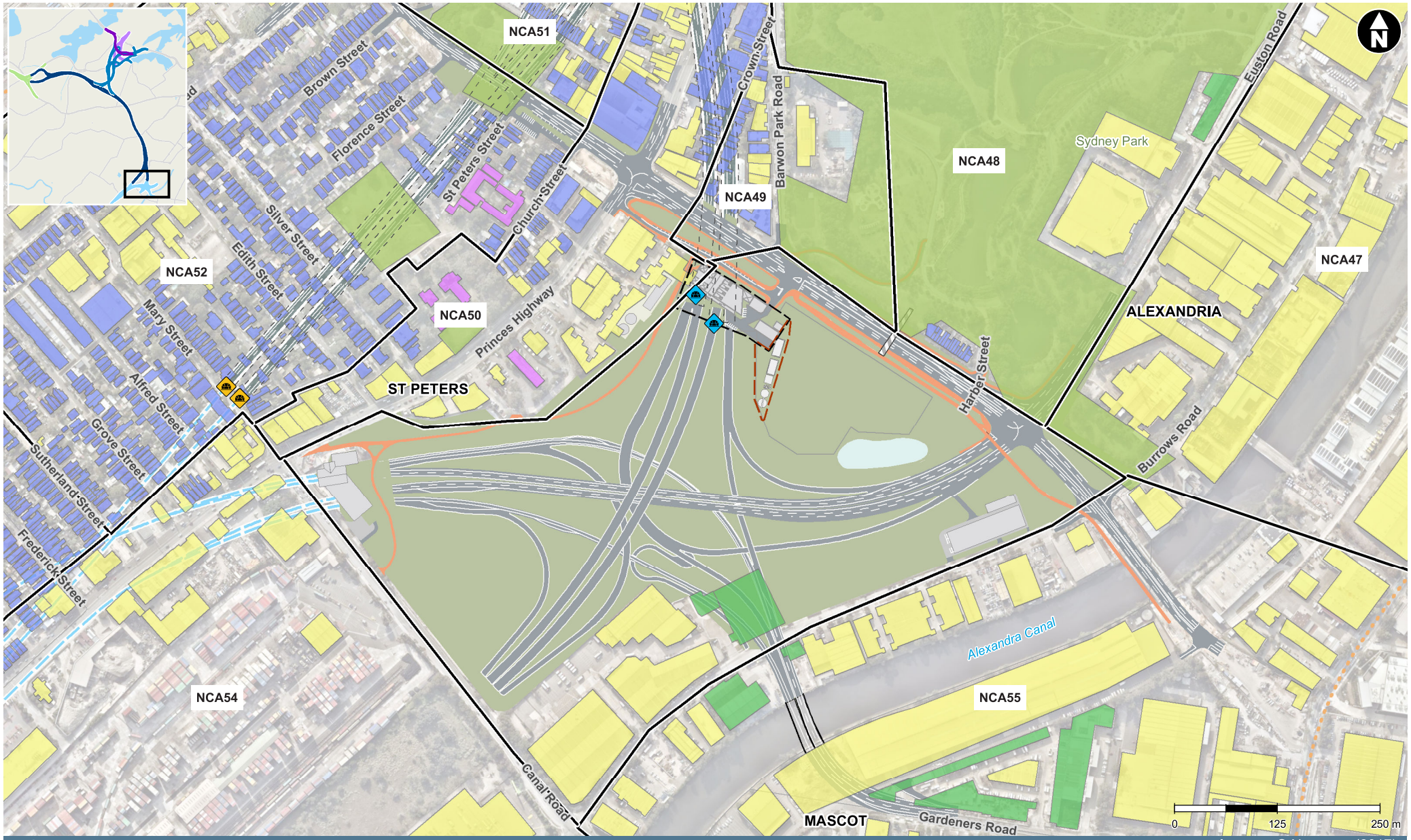


Figure 3-3 NCA boundary map arounnd the Campbell Road motorway operations complex (MOC5)

3.2 Ambient noise levels at Haberfield and Ashfield

The existing ambient noise environment across the study area around Haberfield and Ashfield varies; however, road noise is generally the primary contributor to background noise levels, largely due to the presence of major roads such as Parramatta Road, Wattle Street and the M4 East entry and exit ramps (when operational). The broader road network also contributes to background noise levels, albeit to a lesser degree than major roads. The noise environment is also influenced by the construction works for the M4 East project, which are occurring in the area until Q1 2019.

The measured ambient noise levels applicable to the Northcote Street civil and tunnel site, Parramatta Road West and Parramatta Road East civil sites and the G-loop at Haberfield and Ashfield are outlined in **Table 3-2.** No additional monitoring at representative locations was required for the assessment of potential noise impacts as a result of the proposed modification. Monitoring was undertaken prior to the construction of the M4 East project and is therefore representative of the ambient noise environment without M4 East construction noise. .

Table 3-2 Residential NMLs for the project around Haberfield and Ashfield

ID	Representative monitoring location	Rating Background Level (RBL) dBA ICNG defined time periods1		
		Daytime period RBL	Evening period RBL	Night period RBL
H.01	1A Wattle St, Haberfield	58	58	52
H.02	141 Alt St, Haberfield	46	46	43
H.03	119 Alt St, Ashfield	46	46	38
H.04	35 Wattle St, Haberfield	58	55	44
H.06	259 Ramsay St, Haberfield	56	53	43
L.02	99 Charles St, Lilyfield	51	49	42

Notes:

1. ICNG Governing Periods – Day: 7.00 am to 6.00 pm Monday to Saturday, 8.00 am to 6.00 pm Sunday; Evening: 6.00 pm to 10.00 pm; Night: 10.00 pm to 7.00 am Monday to Saturday, 10.00 pm to 8.00 am Sunday

3.3 Ambient noise levels – Campbell Road motorway operations complex (MOC5)

The existing ambient noise environment across the study area around the Campbell Road motorway operations complex (MOC5) also varies. However, as with Haberfield and Ashfield, road noise is generally the primary contributor to background noise levels. The noise environment is also influenced by the construction works for the New M5 project, which are occurring in the area until Q1 2020.

The measured ambient noise levels for the Campbell Road motorway operations complex (MOC5) are outlined in **Table 3-3.** No additional monitoring at representative locations was required for the assessment of potential noise impacts as a result of the proposed modification.

Table 3-3 Residential NMLs for the project around the Campbell Road motorway operations complex (MOC5)

ID	Representative monitoring location	Rating Background Level (RBL) dBA ICNG defined time periods1		
		Daytime period RBL	Evening period RBL	Night period RBL
S.01	400 Sydney Park Rd, Alexandria	57	51	40
S.02	108 Campbell St, St Peters	50	46	39
S.03	18 Campbell St, St Peters	54	45	40
S.04	187-211 Princes Hwy, St Peters	52	50	44
S.05	608 Princes Hwy, Tempe	58	56	49

4 Assessment methodology

The assessment of potential construction noise and vibration impacts from the proposed modification followed the same approach as was carried out for the approved project and involved:

- Identifying and classifying sensitive receivers
- Characterising the existing noise environment based on attended and unattended noise measurements at nearby receiver locations
- Determining noise and vibration management levels in accordance with relevant guidelines
- Modelling to quantify the potential construction noise and vibration impacts from the construction activities for the proposed modification
- Identifying the potential changes to the impacts from the approved project and assessing the significance of potential impacts identified
- Preparing and documenting any changes to the mitigation measures identified for the approved project that would be implemented during construction.

The only exception to this is the methodology used to assess the noise and vibration impacts associated with the Parramatta Road West and Parramatta Road East civil sites. As required by the environmental assessment requirements, a qualitative assessment was used to assess these sites, which included identification of differences in noise and/or vibration impact between the equivalent work activities for each of the proposed activities as assessed in the EIS and/or SPIR and those of the proposed modification. The assessment also considered whether the proposed uses at these sites would be consistent with requirements of condition of approval C19.

4.1 Relevant guidelines and policies

The Roads and Maritime *Construction Noise and Vibration Guideline,* August 2016 (CNVG) outlines Roads and Maritime's approach to assessing and mitigating construction noise. This guideline should be read in conjunction with other relevant policy and guidelines discussed in this section. Guidelines referenced in this noise and vibration assessment are listed in **Table 4-1**.

Table 4-1 Construction noise and vibration guidelines and policies

Noise and vibration guidelines and policies	
Construction noise and vibration	
Guideline/policy name	**When guideline is used**
Construction Noise and Vibration Guideline (Roads and Maritime 2016)	Assessment of airborne noise, ground-borne noise and vibration impacts on sensitive receivers
Interim Construction Noise Guideline (DECC 2009)	Assessment of airborne noise and ground-borne noise impacts on sensitive receivers
Assessing Vibration: a technical guideline (DECC 2006)	Assessment of vibration impacts on sensitive receivers
BS 7385 Part 2-1993 *Evaluation and measurement for vibration in buildings* Part 2, BSI, 1993	Assessment of vibration impacts on non-heritage sensitive structures (damage)
DIN 4150:Part 3-1999 *Structural vibration - Effects of vibration on structures*, Deutsches Institut für Normung, 1999	Screening assessment of vibration impacts on heritage sensitive structures (damage)
Australian Standard AS 2187: Part 2-2006 *Explosives - Storage and Use - Part 2: Use of Explosives*	Assessment of blasting impacts on sensitive receivers

4.1.1 Airborne noise

The *Interim Construction Noise Guideline* (ICNG) (DECC 2009) sets out ways to assess and manage the impacts of demolition and construction noise on residences and other sensitive land uses. It does this by presenting assessment approaches that are tailored to the scale of the proposed works.

The ICNG requires project specific NMLs to be established for noise affected receivers. In the event that construction noise levels are predicted to be above the NMLs, feasible and reasonable work practices are investigated to minimise noise emissions.

The project specific $L_{Aeq(15minute)}$ NMLs are provided in **Table 4-2**.

Table 4-2 NMLs for other sensitive receivers

Land use	NML $L_{Aeq(15minute)}$ (Applied when the property is in use)
Residential	Standard construction hours[1] measured RBL[2] + 10 Outside standard construction hours RBL + 5 Highly Noise affected > 75 dBA NMLs for residential receivers are presented in the assessment section.
Commercial / Industrial	Commercial 70 dBA Industrial 75 dBA
Child cares	External NML 65 dBA for play areas External NML 50 dBA for sleeping areas
Classrooms at schools and other education institutions	Internal noise level 45 dBA
Hospital wards and operating theatres	Internal noise level 45 dBA
Places of worship	Internal noise level 45 dBA
Active recreation areas (characterised by sporting activities and activities which generate their own noise or focus for participants, making them less sensitive to external noise intrusion)	External noise level 65 dBA
Passive recreation areas (characterised by contemplative activities that generate little noise and where benefits are compromised by external noise intrusion, e.g. reading, meditation)	External noise level 60 dBA
Community centres	Depends on the intended use of the centre. Refer to the recommended 'maximum' internal levels in AS 2107 for specific uses.

Notes:

1. ICNG Governing Periods – Day: 7.00 am to 6.00 pm Monday to Saturday, 8.00 am to 6.00 pm Sunday; Evening: 6.00 pm to 10.00 pm; Night: 10.00 pm to 7.00 am Monday to Saturday, 10.00 pm to 8.00 am Sunday
2. Measured Rating Back Ground Level (RBL)

For sensitive receivers such as schools and places of worship, the NMLs presented in **Table 4-2** are based on internal noise levels. For the purpose of this assessment, it is conservatively assumed that all schools and places of worship have windows that can open. On the basis that external noise levels are typically 10 dBA higher than internal noise levels when windows are open sufficiently for ventilation, an external NML of 55 dBA LAeq(15 minute) has been adopted.

Other noise-sensitive receivers require separate project specific noise goals and, as per the guidance in the ICNG, NMLs for these receivers have been derived from the internal levels presented in AS 2107.

4.1.2 Sleep disturbance

The assessment of sleep disturbance impacts followed the same approach as was carried out for the approved project. This included a night-time sleep disturbance 'screening criterion' noise goal of RBL +15 dBA. The term 'screening criterion' indicates a noise level that is intended as a guide to identify the likelihood of sleep disturbance. It is not a limit to be met, however where the criterion is met sleep disturbance is considered to be unlikely. Rather, when the screening criterion is not met, this triggers the requirement for a more detailed analysis to determine if an impact is likely.

With regard to reaction to potential sleep disturbance awakening events, the *Road Noise Policy* (RNP) gives the following guidance:

> *From the research on sleep disturbance to date it can be concluded that:*
>
> - *maximum internal noise levels below 50–55 dBA are unlikely to awaken people from sleep*
> - *one or two noise events per night, with maximum internal noise levels of 65–70 dBA, are not likely to affect health and wellbeing significantly.*

4.1.3 Construction road traffic

When construction related traffic moves onto the public road network a different noise assessment methodology is appropriate, as vehicle movements are regarded as 'additional road traffic' rather than as part of the on-site construction works and as such would be assessed under the Roads and Maritime *Noise Criteria Guideline* (NCG) (2015). The NCG documents Roads and Maritime's approach to implementing the Road Noise Policy (DECCW 2011) (RNP).

The NCG requires that an initial screening test should be applied by evaluating whether noise levels would increase by more than 2 dBA (an increase in the number of vehicles of around 60 percent) due to construction traffic or a temporary reroute due to a road closure. Where increases are predicted to be 2 dBA or less then no further assessment is required as noise level changes would most likely not be discernible to most people.

Where noise levels increase by more than 2 dBA (ie 2.1 dBA or greater) further assessment is required using criteria presented in the NCG (see **Table 4-3**).

Table 4-3 NCG criteria for assessing construction vehicles on public roads

NCG criteria			
Road category	**Type of project/land use**	**Assessment criteria (dBA)**	
		Daytime (7 am - 10 pm)	**Night-time (10 pm - 7 am)**
Freeway/ arterial/ sub-arterial roads	Existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments	$L_{Aeq(15hour)}$ 60 (external)	$L_{Aeq(9hour)}$ 55 (external)
Local roads	Existing residences affected by additional traffic on existing local roads generated by land use developments	$L_{Aeq(1hour)}$ 55 (external)	$L_{Aeq(1hour)}$ 50 (external)

4.1.4 Ground borne noise

The CNVG provides residential NMLs for ground-borne noise, which are applicable when ground-borne noise levels are higher than the corresponding airborne construction noise levels. The CNVG provides ground-borne noise levels at residences for evening and night-time periods only, as the objectives aim to protect amenity and minimise potential sleep disturbance. The following ground-borne noise levels are applicable for residences:

- Evening 40 dBA $L_{Aeq(15minute)}$
- Night-time 35 dBA $L_{Aeq(15minute)}$.

For commercial receivers such as offices and retail areas, the CNVG does not provide guidance in relation to acceptable ground-borne noise levels. For the purpose of this assessment, an internal NML of 60 dBA $L_{Aeq(15minute)}$ has been adopted in order to assist in identifying potential impacts. This is consistent with the internal NMLs adopted for commercial receivers on similar large infrastructure projects and has taken guidance from Australian Standard 2107.

These NMLs are applicable to residences and commercial receivers located above tunnelling works, and could also apply to other construction activities such as rock-breaking in an adjoining building where ground-borne noise levels may be higher than airborne noise levels. This situation may occur at construction ancillary facilities where airborne noise impacts are shielded by noise barriers or other structures, or noise sensitive areas within residential or commercial buildings which are not directly affected by the airborne noise component of nearby construction works.

4.1.5 Vibration

The assessment of vibration impacts followed the same approach as was carried out for the approved project. The recommended minimum working distances for construction plant in **Table 4-4** are referenced from the CNVG and DIN 4150.

Consistent with BS 7385 and the Assessing Vibration guideline, the recommendations are for the practical management of potential vibration to minimise the likelihood of cosmetic damage to buildings and disturbance or annoyance in humans. The human comfort (response) minimum working distances are conservative, developed with reference to the more stringent objectives for continuous vibration for typical residential building constructions.

Table 4-4 Recommended minimum working distances for vibration intensive plant

Plant item	Rating/description	Minimum working distance			
		Cosmetic damage			Human response[1]
		Residential and light commercial[1]	Group 2 (typical)[2]	Group 3 (structurally unsound)[2]	
Vibratory roller	< 50 kn (Typically 1-2t	5 m	7 m	11 m	15 m to 20 m
	< 100 kn (Typically 2-4t)	6 m	8 m	13 m	20 m
	< 200 kn (Typically 4-6t)	12 m	16 m	15 m	40 m
	< 300 kn (Typically 7-13t)	15 m	20 m	31 m	100 m
	> 300 kn (Typically 13-18t)	20 m	26 m	40 m	100 m
	> 300 kn (Typically > 18t)	25 m	33 m	50 m	100 m
Small hydraulic hammer	300 kg - 5 to 12t excavator	2 m	3 m	5 m	7 m
Medium hydraulic hammer	900 kg - 12 to 18t excavator	7 m	10 m	15 m	23 m
Large hydraulic hammer	1600 kg - 18 to 34t excavator	22 m	29 m	44 m	73 m
Vibratory pile driver	Sheet piles	2 m to 20 m	3 m to 26 m[4]	5 m to 40 m[4]	20 m to 100 m[4]
Pile boring	≤ 800 mm	2 m (nominal)	3 m	5 m	4 m
Jackhammer	Hand held	1 m (nominal)	2 m	3 m	2 m
Road-header[3]	Tunnelling	2 m	3 m	5 m	7 m

Notes:

1. Criteria referenced from Roads and Maritime CNVG
2. Criteria referenced from DIN 4150
3. Measurement from SLR Database
4. Corresponds to the higher guideline range

4.1.6 Fixed facilities noise criteria

The *NSW Industrial Noise Policy* (INP) (EPA, 1999) sets two separate noise criteria to meet environmental noise objectives: one to account for intrusive noise and the other to protect the amenity of particular land uses. These criteria are to be met at the most-affected boundary of the receiver property. The more stringent of these two criteria usually defines the proposal specific noise levels. For both amenity and intrusiveness, night-time criteria are typically more stringent than daytime or evening criteria.

Operational noise goals for the fixed facilities were determined in Appendix J (Technical working paper: Noise and vibration) of the EIS. A summary of the operational noise goals is provided in **Table 4-5**. Assuming continuous operation of industrial noise sources, the more stringent of the intrusiveness or the amenity criteria sets the noise goals, as highlighted in the table.

Table 4-5 Summary of operational noise goals for fixed facilities

Area	NCAs	Applicable noise logger (ANL)	Receiver type	Existing night time noise levels (dBA)		Operational noise goals (dBA)		
				RBL	LAeq	$L_{Aeq(15minute)}$ Intrusive[1]	$L_{Aeq(period)}$ Amenity[1,2,3]	$L_{A1(60second)}$ Sleep dist. screening level
St Peters	NCA46	S.01	Residential	40	62	45	45	55
	NCA48	S.03	Residential	40	61	45	45	55
	NCA49	S.03	Residential	40	61	45	45	55
	NCA50	S.04	Residential	42	63	47	45	57
	NCA51	S.02	Residential	39	63	44	45	54

Notes:

1. A grey highlight indicates the controlling design criteria (ie the lower of the intrusiveness and amenity criteria)
2. Criteria are identified as controlling as noise source is continuous throughout the period
3. No existing industrial noise sources were present therefore amenity criteria has been set as ANL for urban areas

4.2 Conditions of approval for the project

The conditions of approval that address the control and management of noise relevant to this modification are listed below in **Table 4-6**. A cross reference and/or comment is also included to indicate where the condition applies within this modification. It is important to note that these conditions of approval apply to all works associated with the construction of the project. The included cross reference to a particular works activity is only to highlight that an activity includes works which relate directly to a particular condition of approval.

Table 4-6 Relevant noise management conditions from the M4-M5 Link project approval

CoA	Condition Requirements	Document reference/ comment
C 19	Only one of the two ancillary facility options (A or B) presented in Chapter 6 of the EIS can be implemented at Haberfield, except if one site is used for parking and other works that do not exceed the 'Noise affected' Noise Management Levels as identified in the ICNG.	Applies to the operation of the Parramatta Road East and Parramatta Road West civil sites
E 68	Works must be undertaken during the following hours: a. 7:00 am to 6:00 pm Mondays to Fridays, inclusive; b. 8:00 am to 1:00 pm Saturdays; and c. at no time on Sundays or public holidays.	Applies to all construction works included within this modification
E 69	Notwithstanding Condition E68, works may be undertaken between 1:00 pm to 6:00 pm on Saturday.	
E 70	Notwithstanding Conditions E68 and E69 the following works are permitted to be undertaken 24 hours a day, seven days a week: a. tunnelling activities excluding cut and cover tunnelling; b. haulage of spoil and delivery of material; c. works within an acoustic shed; and d. tunnel fit out works. Other surface works associated with tunnelling must only be undertaken in accordance with the requirements of Condition E73.	Section 5.1 – Northcote Street tunnel and civil site
E 72	Except as permitted by an EPL, highly noise intensive works that result in an exceedance of the applicable NML at the same receiver must only be undertaken: a. between the hours of 8:00 am to 6:00 pm Monday to Friday; b. between the hours of 8:00 am to 1:00 pm Saturday; and c. in continuous blocks not exceeding three (3) hours each with a minimum respite from those activities and works of not less than one (1) hour between each block. d. For the purposes of this condition, 'continuous' includes any period during which there is less than a one (1) hour respite between ceasing and recommencing any of the work that are the subject of this condition.	Applies to all construction works included within this modification

CoA	Condition Requirements	Document reference/ comment
E 73	Notwithstanding Conditions E68 to E72 works may be undertaken outside the hours specified under those conditions in the following circumstances: a. for the delivery of materials required by the NSW Police Force or other authority for safety reasons; or b. where it is required in an emergency to avoid injury or the loss of life, to avoid damage or loss of property or to prevent environmental harm; or c. where different construction hours are permitted or required under an EPL in force in respect of the CSSI; or d. works approved under an Out-of-Hours Work Protocol for works not subject to an EPL as required by Condition E77; or e. construction that causes LAeq (15 minute) noise levels: i. no more than 5 dB(A) above the rating background level at any residence in accordance with the Interim Construction Noise Guideline (DECC, 2009), and ii. no more than the 'Noise affected' noise management levels specified in Table 3 of the Interim Construction Noise Guideline (DECC, 2009) at other sensitive land uses, and iii. continuous or impulsive vibration values, measured at the most affected residence are no more than the maximum values for human exposure to vibration, specified in Table 2.2 of Assessing Vibration: a technical guideline (DEC, 2006), and iv. intermittent vibration values measured at the most affected residence are no more than the maximum values for human exposure to vibration, specified in Table 2.4 of Assessing Vibration: a technical guideline (DEC, 2006). Note: Section 5.24(1)(e) of the EP&A Act requires that an EPL be substantially consistent with this approval. For example, an EPL cannot authorise spoil movements at the Darley Road construction ancillary facility outside of the hours specified in Conditions E68 and E69. Out of Hours Works considered under Conditions E73(c) and (d) must be justified and include an assessment of mitigation measures.	

CoA	Condition Requirements	Document reference/ comment
E 75	Out-of-hours works that are regulated by an EPL as per Condition E73(c) or through the Out-of-Hours Work Protocol as per Condition E77 include: a. works which could result in a high risk to construction personnel or public safety, based on a risk assessment carried out in accordance with AS/NZS ISO 31000:2009 “Risk Management – Principles and Guidelines”; or b. where the relevant road network operator has advised the Proponent in writing that carrying out the works and activities could result in a high risk to road network operational performance; or c. where the relevant utility service operator has advised the Proponent in writing that carrying out the works and activities could result in a high risk to the operation and integrity of the utility network; or d. (d) where the TfNSW Transport Management Centre (or other road authority) has advised the Proponent in writing that a road occupancy licence is required and will not be issued for the works or activities during the hours specified in Condition E68 and Condition E69; or e. where Sydney Trains (or other rail authority) has advised the Proponent in writing that a Rail Possession is required. Note: Other out-of-hours works can be undertaken with the approval of an EPL, or through the project’s Out-of-Hours Work Protocol for works not subject to a EPL.	Section 5.15 – Construction of the G-Loop Section 5.2 – Construction of the Parramatta Road pedestrian overpass bridge Both works may require road occupancy (item b of E75) during construction.
E 76	In order to undertake out-of-hours work described in Condition E75, the Proponent must identify appropriate respite periods for the out-of-hours works in consultation with the community at each affected location. This consultation must include (but not be limited to) providing the community with: a. a schedule of likely out-of-hours work for a period no less than three (3) months; b. the potential works, location and duration; c. the noise characteristics and likely noise levels of the works; and d. likely mitigation and management measures. The outcomes of the community consultation, the identified respite periods and the scheduling of the likely out-of-hour works must be provided to the AA, EPA and the Secretary.	
E 78	All works undertaken for the delivery of the CSSI, including those undertaken by third parties, must be coordinated to ensure respite periods are provided. The Proponent must: a. reschedule any works to provide respite to impacted noise sensitive receivers so that the respite is achieved in accordance with Condition E76; or b. consider the provision of alternative respite or mitigation to impacted noise sensitive receivers; and provide documentary evidence to the AA in support of any decision made by the Proponent in relation to respite or mitigation.	Applies to all construction works included within this modification

CoA	Condition Requirements	Document reference/ comment
E 79	Construction Noise and Vibration Impact Statements must be prepared for construction ancillary facility(s) before any works that result in noise and vibration impacts commence, and include specific mitigation measures identified through consultation with affected sensitive receivers. The Statements must supplement the Construction Noise and Vibration Management Sub-plan or Site Establishment Management Plan(s) and are to be implemented for the duration of the works. The Construction Noise and Vibration Impact Statement for the White Bay Civil Site (C11) must be prepared in consultation with the Port Authority of NSW and NSW Heritage Council.	
E 80	Noise generating works in the vicinity of potentially-affected community, religious, educational institutions and noise and vibration-sensitive businesses and critical working areas (such as theatres, laboratories and operating theatres) resulting in noise levels above the NMLs must not be timetabled within sensitive periods, unless other reasonable arrangements with the affected institutions are made at no cost to the affected institution.	
E 81	Mitigation measures must be implemented with the aim of achieving the following construction noise management levels and vibration criteria: a. construction 'Noise affected' noise management levels established using the Interim Construction Noise Guideline (DECC, 2009); b. vibration criteria established using the Assessing vibration: a technical guideline (DEC, 2006) (for human exposure); c. Australian Standard AS 2187.2 - 2006 "Explosives - Storage and Use - Use of Explosives"; d. BS 7385 Part 2-1993 "Evaluation and measurement for vibration in buildings Part 2" as they are "applicable to Australian conditions"; and e. the vibration limits set out in the German Standard DIN 4150-3: Structural Vibration- effects of vibration on structures (for structural damage). Any works identified as exceeding the noise management levels and/or vibration criteria must be managed in accordance with the Construction Noise and Vibration Management Sub-plan. Note: The Interim Construction Noise Guideline identifies 'particularly annoying' activities that require the addition of 5 dB(A) to the predicted level before comparing to the construction Noise Management Level.	
E 82	Mitigation measures must be applied when the following residential ground-borne noise levels are exceeded: a. evening (6:00 pm to 10:00 pm) — internal LAeq (15 minute): 40 dB(A); and b. night (10:00 pm to 7:00 am) — internal LAeq (15 minute): 35 dB(A). c. The mitigation measures must be outlined in the Construction Noise and Vibration Management Sub-plan, including in any Out-of-Hours Work Protocol, required by Condition E77.	Section 5.1.10 – Ground borne noise associated with the construction of the access tunnels

CoA	Condition Requirements	Document reference/ comment
E 83	Owners and occupiers of properties at risk of exceeding the screening criteria for cosmetic damage must be notified before works that generate vibration commences in the vicinity of those properties. If the potential exceedance is to occur more than once or extend over a period of 24 hours, owner and occupiers are to be provided a schedule of potential exceedances on a monthly basis for the duration of the potential exceedances, unless otherwise agreed by the owner and occupier. These properties must be identified and considered in the Construction Noise and Vibration Management Sub-plan.	Applies to all construction works included within this modification
E 84	The Proponent must conduct vibration testing before and during vibration generating activities that have the potential to impact on heritage items to identify minimum working distances to prevent cosmetic damage. In the event that the vibration testing and monitoring shows that the preferred values for vibration are likely to be exceeded, the Proponent must review the construction methodology and, if necessary, implement additional mitigation measures.	
E 85	The Proponent must seek the advice of a heritage specialist on methods and locations for installing equipment used for vibration, movement and noise monitoring at heritage-listed structures.	
E 86	All acoustic sheds must be erected as soon as site establishment works at the facilities are completed and before undertaking any works which are required to be conducted within the sheds.	Section 5.1 – Northcote Street tunnel and civil site
E 88	At receiver noise mitigation in the form of at-property treatment must be offered to the land owner for habitable living spaces, or other mitigation or management measures as agreed by the occupier, to residential properties identified in Appendix E. Mitigation must be offered prior to works commencing. This requirement does not apply if the sensitive receiver has been provided with noise mitigation under the RMS Noise Abatement Program or the State Environment Planning Policy (Infrastructure) 2007 (clause 102(3)). The adequacy of at-property treatments will be reviewed where previous treatments have been installed as part of other SSI or CSSI projects. Note: This condition does not preclude the application of other noise and vibration mitigation and management measures.	Applies to properties in Haberfield which are defined by Appendix E of the CoA
E 90	Receivers which are eligible for receiving treatment under the Noise Insulation Program required under Condition E89 must have treatment implemented within six (6) months following the commencement of construction which would affect the receiver. The implementation of the Noise Insulation Program must be prioritised based on the degree and duration of exceedance with high priority exceedances undertaken within three (3) months of the commencement of construction.	

CoA	Condition Requirements	Document reference/ comment
E 92	The Proponent must prepare an Operational Noise and Vibration Review (ONVR) to confirm noise and vibration control measures that would be implemented for the operation of the CSSI. The ONVR must be prepared in consultation with the Department, relevant council(s), other relevant stakeholders and the community and must: a. confirm the appropriate operational noise and vibration objectives and levels for adjoining development, including existing sensitive receivers; b. confirm the operational noise predictions based on the final design. Confirmation must be based on an appropriately calibrated noise model (which has incorporated noise monitoring, and concurrent traffic counting, where necessary for calibration purposes). The assessment must specifically include verification of noise levels at all fixed facilities, based on noise monitoring undertaken at appropriately identified noise catchment areas surrounding the facilities; c. confirm the operational noise and vibration impacts at adjoining development based on the final design of the CSSI, including operational daytime LAeq,15 hour and night-time LAe, 9 hour traffic noise contours; d. review the suitability of the operational noise mitigation measures identified in the EIS and SPIR and, where necessary, investigate and identify additional noise and vibration mitigation measures required to achieve the noise criteria outlined in the NSW Road Noise Policy (DECCW, 2011) and NSW Industrial Noise Policy (EPA, 2000), including the timing of implementation; e. include a consultation strategy to seek feedback from directly affected landowners on the noise and vibration mitigation measures; and f. procedures for the management of operational noise and vibration complaints. The ONVR is to be verified by a suitably qualified and experienced noise and vibration expert. The ONVR is to be undertaken at the Proponent's expense and submitted to the Secretary for approval prior to the implementation of mitigation measures. The Proponent must implement the identified noise and vibration control measures and make the ONVR publicly available.	Section 6.1 – Water treatment plant
E 105	The Proponent must offer pre-dilapidation surveys and must undertake and prepare pre-dilapidation reports where the offer is accepted, on the current condition of surface and sub-surface structures identified as at risk from settlement or vibration by the geotechnical model described in Condition E101. The pre-dilapidation surveys and reports must be prepared by a suitably qualified and experienced person(s) and must be provided to the owners of the surface and sub-surface structures for review prior to the commencement of potentially impacting works.	Section 5.1.10 – Ground borne noise associated with the construction of the access tunnels

5 Potential impacts - construction

5.1 Northcote Street civil and tunnel site (including the G-loop)

5.1.1 Noise management summary

The NMLs derived for the NCAs around the Northcote Street civil and tunnel site and G-loop are outlined in **Table 5-1.** Additional information on the representative monitoring locations and derived NCAs is provided in Appendix J (Technical working paper: Noise and vibration) of the EIS. No additional monitoring at representative locations was required for the assessment of potential noise impacts as a result of the proposed modification at the Northcote Street site.

Table 5-1 Residential NMLs for the project

NCA	Representative monitoring location	Receiver type	Standard construction NMLs (RBL+10dBA)	Out of hours NMLs (RBL+5dBA)[1]			Sleep disturbance screening (RBL+15dBA)
			Daytime period	Daytime period	Evening period	Night period	
NCA00	H.03	Residential	56	51	51	43	53
NCA01	H.03	Residential	56	51	51	43	53
NCA02	H.01	Residential	68	63	63	57	67
NCA03	H.04	Residential	68	63	60	49	59
NCA04	H.06	Residential	66	61	58	48	58
NCA05	L.02	Residential	61	56	54	47	57
NCA06	H.02	Residential	56	51	51	48	58
NCA07	H.02	Residential	56	51	51	48	58

Notes:

1. Out of Hours construction hours – Evening hours are 6.00 pm to 10.00 pm. Night-time hours are 10.00 pm to 7.00 am Sunday to Saturday and 10.00 pm Saturday to 8.00 am Sunday

5.1.2 Activity source noise levels

Sound power levels for the typical operation of construction equipment applied in the modelling are listed in **Table 5-2**. The activities are representative of works which have the potential to impact nearby sensitive receivers. Potential ground-borne noise impacts from works within the tunnel are assessed in **Section 5.1.10**.

Table 5-2 Sound power levels for construction equipment

Scenario name	Works ID	Equipment (realistic worst case)	Worst case items in same location	Sound power level (dBA)		
				LWA		LWAmax
				Item	Activity[2]	Activity
Site establishment – Northcote Street civil and tunnel site	NST-01	Flatbed truck	1	100	106	112
		Franna crane	1	99		
		Mobile crane	1	101		
		Semi-trailer	2	106		
		Hand tools	1	96		
Tunnelling works – Northcote Street civil and tunnel site	NST-02	Front end loader	2	112	117	119
		Underground trucks	2	113		
		Surface Haulage Trucks	4	110		
		Water treatment plant[1]	1	87		
		Ventilation fans[1]	1	89		
Tunnelling support activities – Northcote Street civil and tunnel site	NST-03	Concrete truck / agitator	2	106	106	112
		Hand tools	1	96		
		Franna crane	1	99		
		Bus	1	98		
		Forklift	1	101		
		Concrete pump	1	106		
Site decommissioning – Northcote Street civil and tunnel site	NST-04	Excavator	1	104	112	123
		Mobile crane	1	101		
		Semi trailer	1	106		
		Elevated working platform	1	97		
		Truck	1	97		
		Concrete saw	1	115		
Site establishment and decommissioning G-loop	NST-05	Concrete truck / agitator	1	103	112	123
		Mobile crane	1	101		
		Semi trailer	1	106		
		Elevated working platform	1	97		
		Truck	1	97		
		Concrete saw	1	115		

Notes:

1. Equipment sound power levels are referenced from the M4-East Northcote Street tunnel site Construction Noise and Vibration Impact Statement and are indicative only. Sound power levels of the finalised equipment may differ and are subject to detailed design
2. Activity sound power levels account for the amount of time an item of plant is anticipated to operate within each 15 minute period

Specific details on construction of the ventilation and water treatment plant including the enclosure and silencer design will be confirmed by the M4-M5 Link contractor in the Construction Noise and Vibration Impact Statement (CNVIS) for this site.

5.1.3 In-situ noise mitigation – Northcote Street civil and tunnel site

It is proposed to use the existing M4 East tunnelling site arrangement (with minor modifications). This would include retention of the existing hoarding and acoustic shed. As these features form part of the proposed works, these are included in the assessment prior to the consideration of additional mitigation.

The height of hoarding and transmission loss of the acoustic shed elements has been referenced from the WestConnex M4 East CNVIS for the Northcote Tunnel Support Site (Renzo Tonin 2016). **Table 5-3** details the acoustic shed composition considered within this assessment and **Figure 5-1** depicts the indicative height and location of site hoarding. The assumptions relating to the height of hoarding and transmission loss of the acoustic shed at the Northcote Street civil and tunnel site would be validated as part of the CNVIS that will be prepared for this site.

Table 5-3 Northcote Street civil and tunnel site acoustic shed composition

Acoustic shed element	Octave band transmission loss (dB)[1]						
	63	125	250	500	1000	2000	4000
Walls facing north east	20	24	29	33	38	41	46
All other walls including roof	16	20	24	29	33	35	41

Notes:

1. It is assumed that octave band transmission loss (dB) and hoarding height is consistent with that referenced in the WestConnex M4 East CNVIS for the Northcote Tunnel Support Site (Renzo Tonin 2016).

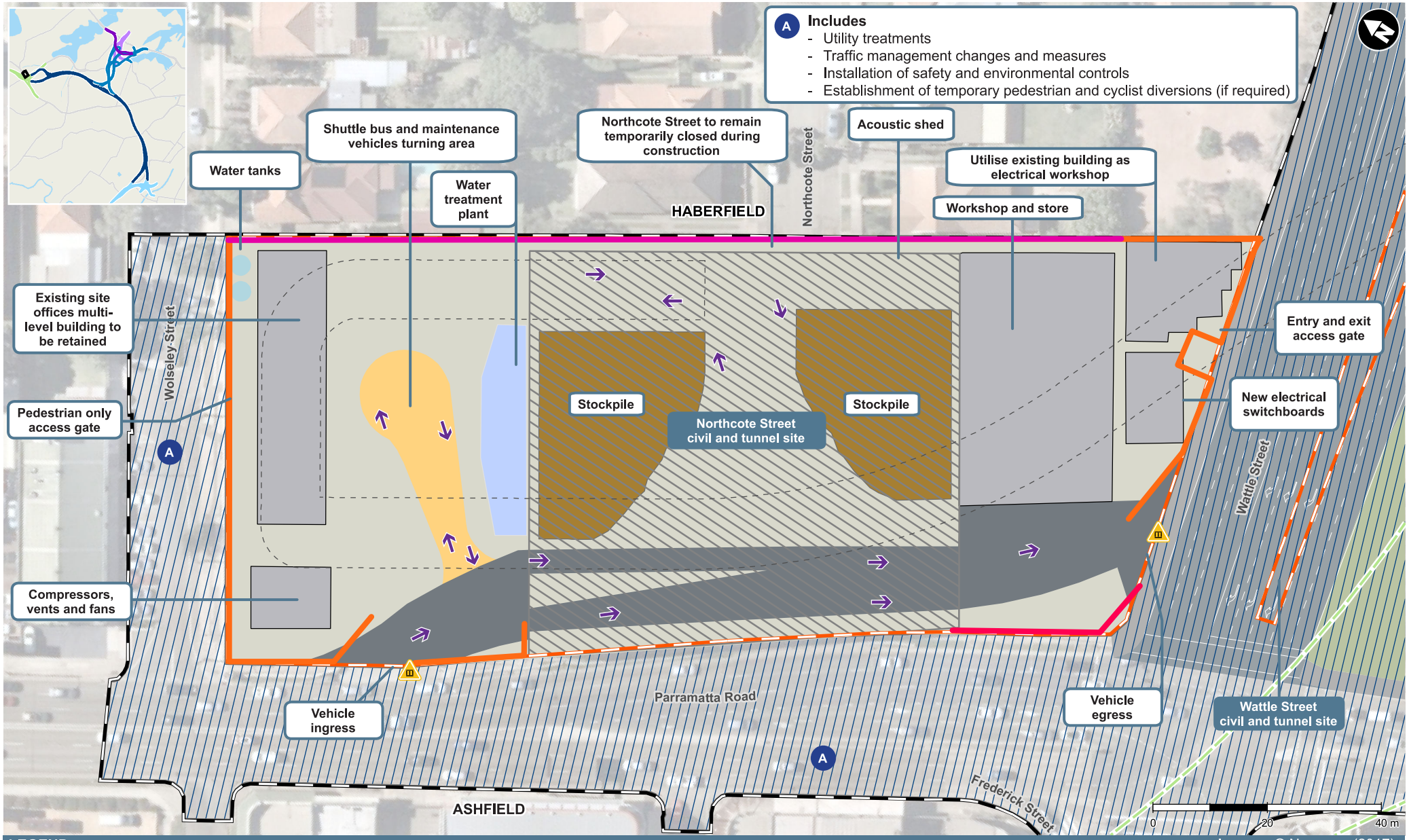


Figure 5-1 Indicative Northcote Street civil and tunnel site hoarding height

Predicted noise levels

A summary of the predicted noise levels (without additional mitigation) in each of the NCAs for the various work activities is presented in **Table 5-4** for residential, commercial and other sensitive receivers. The noise levels are representative of impacts where works are closest to each NCA and are intended to give an overview of the noise from the proposed works.

Shading in the following tables denotes the predicted noise levels based on the exceedance of the NML during that period and for that receiver type. A qualitative description of the NML exceedance bands is given below, noting that the impact of these potential exceedances would depend on the period in which they were to occur (ie the night-time period is typically more sensitive to changes in noise levels than the daytime or evening for most people):

- Noise levels 1 dBA to 10 dBA above NMLs – impacts would typically be marginal to minor
- Noise levels 11 dBA to 20 dBA above NMLs – impacts would typically be moderate
- Noise levels >20 dBA above NMLs – impacts would typically be high

For most construction activities, it is expected that the actual construction noise level would generally be lower than the worst-case prediction made at the most-exposed receiver. This is because noise level varies with the position of plant items and the distance to noise sensitive receivers as well as across different stages of construction.

The predicted NML exceedances in this area are summarised in **Table 5-5**. The assessment presented in this table takes into consideration the assessed construction scenarios in this area. The number of receivers predicted to experience exceedances of the NMLs is shown in bands and are separated into day, evening and night-time periods, as appropriate.

Table 5-4 Predicted worst case noise levels – Northcote Street civil and tunnel site

NCA	NML	Predicted LAeq(15minute) Noise Level (dBA)[1]				
		NST-01 Site establishment	NST-02 Tunnelling activities	NST-03 Tunnelling support activities	NST-04 Site decommissioning	NST-05 G-loop establishment and decommissioning
Residential - Standard Daytime						
NCA00	56	40	37	37	46	40
NCA01	56	52	53	54	58	41
NCA02	68	66	57	59	72	48
NCA03	68	43	42	44	49	51
NCA04	66	38	36	38	44	60
NCA05	61	32	31	33	38	65
NCA06	56	47	43	43	53	55
NCA07	56	41	38	36	47	46
Residential – Evening						
NCA00	51	-	37	37	-	40
NCA01	51	-	53	54	-	41
NCA02	63	-	57	59	-	48
NCA03	60	-	42	44	-	51
NCA04	58	-	36	38	-	60
NCA05	54	-	31	33	-	65
NCA06	51	-	43	43	-	55
NCA07	51	-	38	36	-	46
Residential - Night-time						
NCA00	43	-	37	37	-	40
NCA01	43	-	53	54	-	41
NCA02	57	-	57	59	-	48
NCA03	49	-	42	44	-	51
NCA04	48	-	36	38	-	60
NCA05	47	-	31	33	-	65
NCA06	48	-	43	43	-	55
NCA07	48	-	38	36	-	46

NCA	NML	Predicted LAeq(15minute) Noise Level (dBA)[1]				
		NST-01 Site establishment	NST-02 Tunnelling activities	NST-03 Tunnelling support activities	NST-04 Site decommissioning	NST-05 G-loop establishment and decommissioning
Commercial						
NCA01	70	58	61	56	64	43
NCA02	70	61	56	60	67	40
NCA03	70	-	-	-	-	-
NCA04	70	36	37	37	43	54
NCA05	70	-	-	-	-	-
NCA06	70	47	43	38	53	50
NCA07	70	40	35	35	46	46
Other Sensitive						
NCA00	- Refer to note 2 - - - - - - - -	<30	<30	<30	<30	<30
NCA01		42	39	44	49	37
NCA02		50	47	48	56	46
NCA03		-	-	-	-	-
NCA04		30	30	31	36	83
NCA05		<30	<30	<30	35	50
NCA06		<30	<30	<30	32	38
NCA07		41	38	37	47	46

Notes:

1. Colouring indicates the range of predicted worst case NML exceedances without any additional mitigation based on nearest receiver (red >20 dBA, orange 11-20 dBA, yellow 1-10 dBA) based on the controlling time period
2. The NML is dependent on the classification of a given sensitive receiver. As the table represents the highest predicted noise level for a particular activity, the most affected “other sensitive” receiver may change between each activity depending on the location of the works. No NMLs can be provided in this table for “other sensitive receivers as result of the various types of “other sensitive” receivers within each NCA which may be affected by different activities

Table 5-5 Overview of NML exceedances – Northcote Street civil and tunnel site

Activity ID	Activity	Weeks[1]	Activity duration within overall project program[2]				Number of receivers																
							Total	Highly noise affected[4]	NML exceedance receiver count[3]														
									Daytime			Daytime (out of hours)			Evening			Night-time			Sleep disturbance		
			25	50	75	100			1-10 dBA	11-20 dBA	>20 dBA	1-10 dBA	11-20 dBA	>20 dBA	1-10 dBA	11-20 dBA	>20 dBA	1-10 dBA	11-20 dBA	>20 dBA	1-10 dBA	11-20 dBA	>20 dBA
NST-01	Site establishment	24					1747	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NST-02	Tunnelling	116					1747	-	-	-	-	1	-	-	1	-	-	41	-	-	162	8	-
NST-03	Tunnelling support activities	116					1747	-	-	-	-	2	-	-	2	-	-	71	1	-	35	-	
NST-04	Site decommissioning	52					1747	-	5	-	-	-	-	-	-	-	-	-	-	-			
NST-05	G-loop establishment and decommissioning	10					1747	-	6	-	-	31	-	-	43	2	-	196	22	-	225	31	-

Notes

1. Approximate overall duration of the activity in all areas of the site. The duration of these impacts is less than the overall duration, and depends on the rate of progress in the works areas
2. Approximate percentage (to nearest 13 per cent) of activity duration within overall proposal program. Where percentage is less than 13 per cent, 13 per cent is shown for illustrative purposes
3. Based on worst case noise works area (closest to receivers)
4. Based on ICNG definition (ie predicted LAeq(15minute) noise at residential receiver is 75 dBA or greater).

5.1.4 NML exceedances

Site establishment (NST-01) and decommissioning (NST-04)

No exceedances of the daytime NMLs are predicted during site establishment (NST-01). This is primarily due to the planned use of the existing acoustic shed and upper parts of the existing decline tunnel, with no major surface earthworks therefore required during site establishment.

During decommissioning (scenario NST-04), minor exceedances (up to 10 dBA) at five sensitive receivers are predicted during standard construction hours within NCA01 and NCA02. Exceedances would be expected to be attributed to the use of excavators and concrete saws during the decommissioning of the site.

Tunnelling activities (NST-02)

During tunnelling activities (scenario NST-02) worst case predicted exceedances of the night-time airborne NMLs are predicted at residential receivers located to the west of the site (NCA01), with a maximum exceedance of 10 dBA predicted. These exceedances are due to the openings in both the site hoarding and the acoustic shed to allow truck access and egress from the site.

Figure 5-2 indicates the distribution of exceedances for tunnelling activities during the night time period and shows that the majority of the receivers are predicted to be subject to no or minor exceedances (one to five dBA exceedances) of the night time NMLs, with worst-case impacts of up to 10 dBA limited to only three receivers within NCA01. **Figure 5-3** shows a grid noise map of the works scenario NST-02, which illustrates how noise emissions propagate from the site.

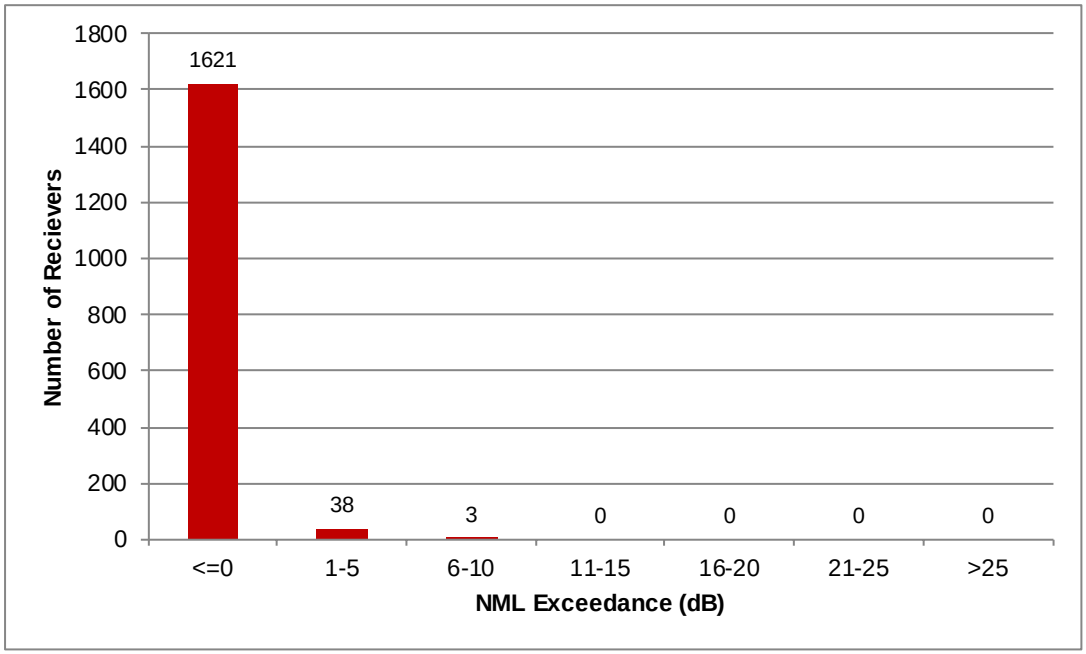


Figure 5-2 Activity NST-02 noise level exceedance, Night time

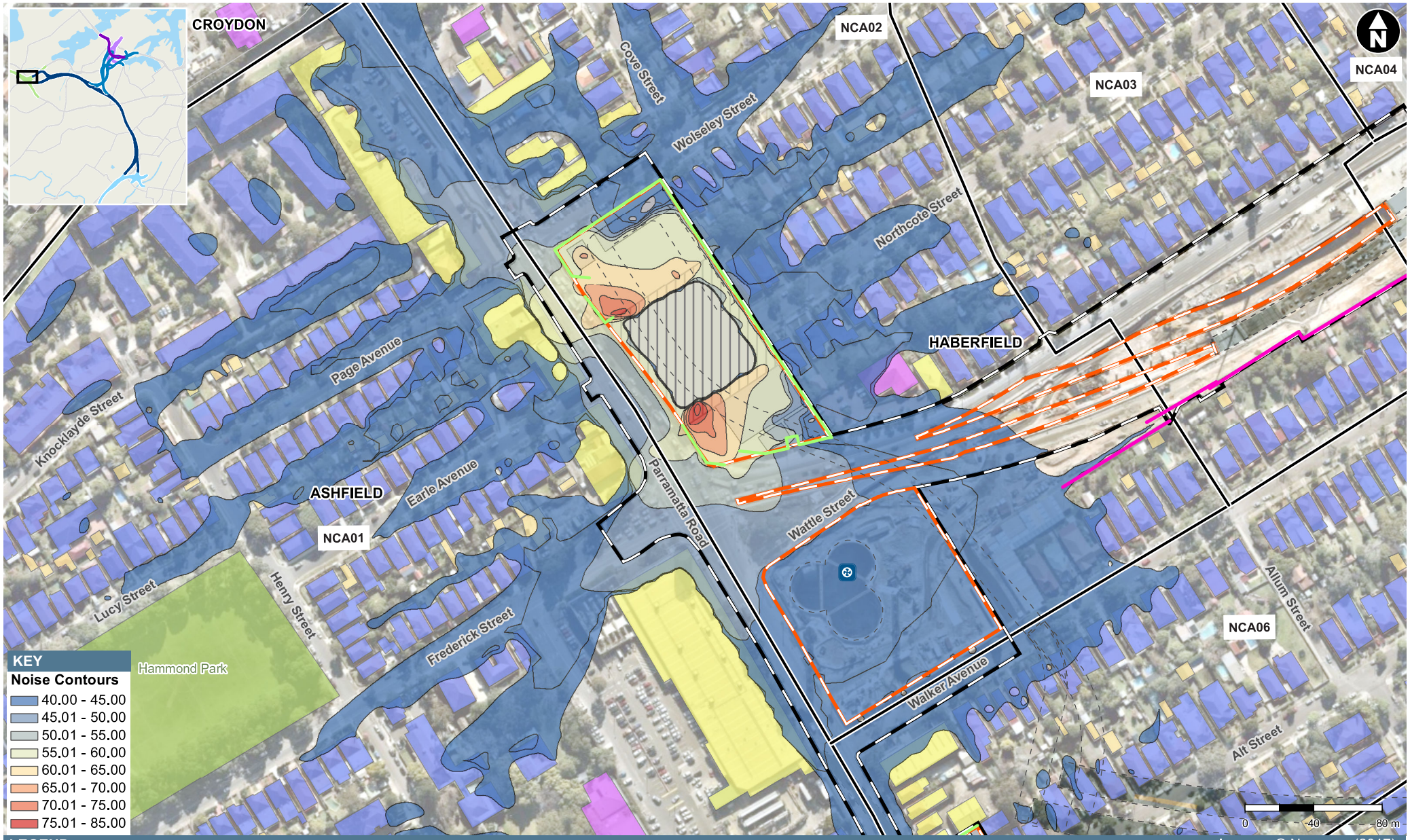


Figure 5-3 Grid Noise Map for tunneling activities (NST-02)

Tunnelling support activities (NST-03)

NML exceedances of up to 15 dBA (during the night period) are predicted during tunnelling support activities (NST-03) in NCA01 and NCA02. **Figure 5-4** indicates the distribution of exceedances for tunnelling support activities (NST-03) (night) prior to the application of any additional mitigation. **Figure 5-5** shows a grid noise map of the works scenario NST-02, which illustrates how noise emissions propagate from the site.

While the worst case impacts may result in up to 15 dBA exceedance of NMLs during the night time period, this is limited to one receiver within NCA01 with the majority of the receivers in this area being subject to considerably lower impacts. Exceedances are generally expected due to the use of concrete pumps associated with concrete deliveries. Mitigation of these exceedances could include investigation of source mitigation such as localised barriers or enclosures around the source control noise emissions.

As per all construction works associated with the M4-M5 link project, the Northcote Street civil and tunnel site will operate in accordance with the project conditions of approval. Conditions which relate directly to the site have been identified in **Section 4.2.** These include both E73 which requires the site to operate within NMLs during construction works outside of standard hours and E72 which defines the time periods as to when highly noise intensive works can be conducted on the site.

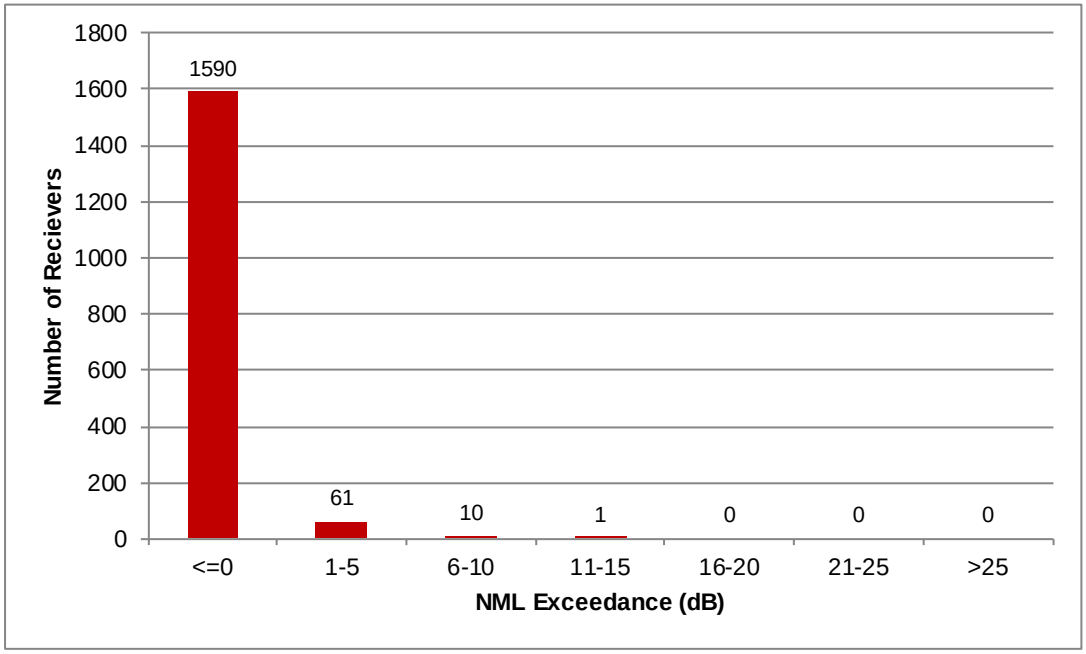


Figure 5-4 Activity NST-03 noise level exceedance, night-time

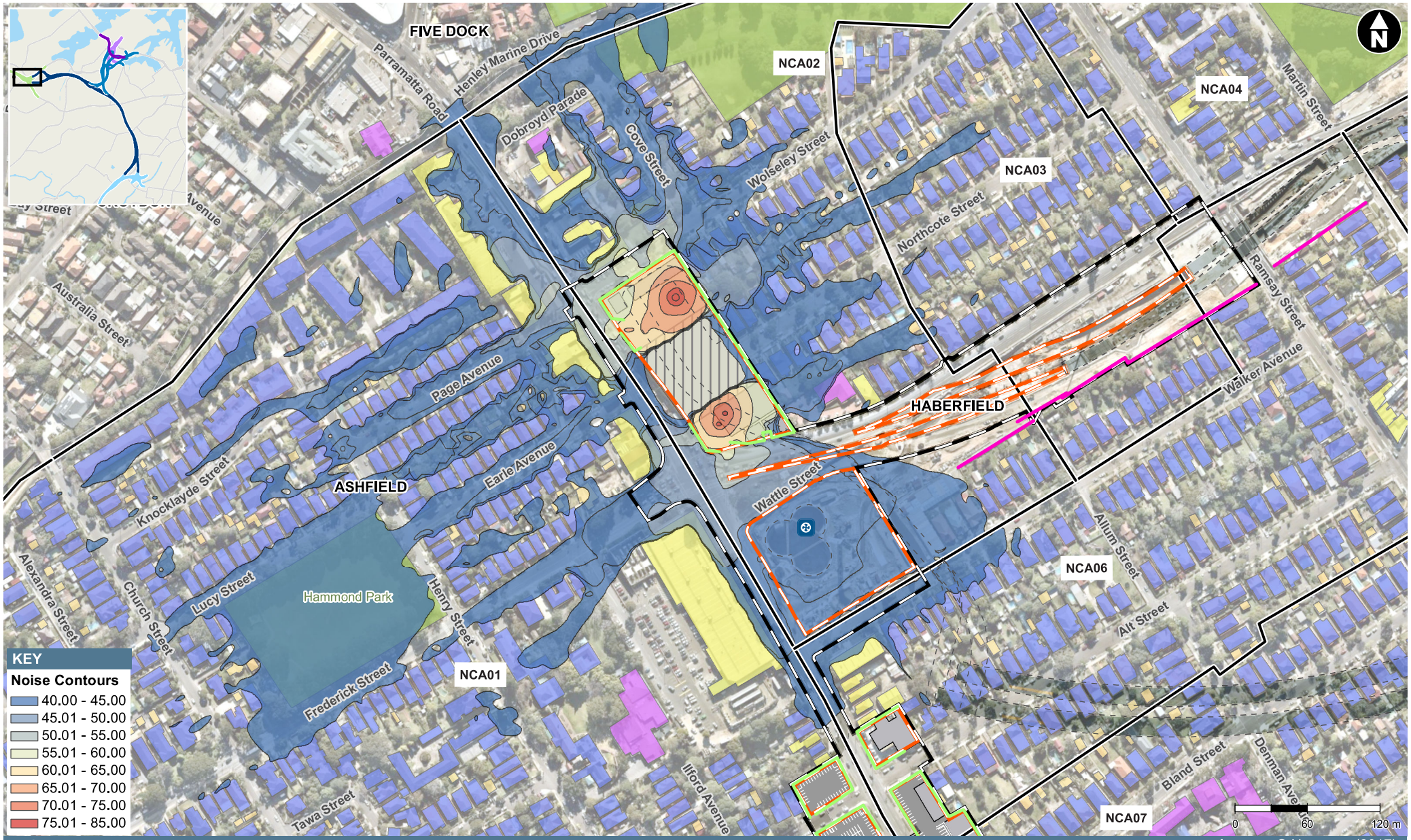


Figure 5-5 Grid Noise Map for tunneling support activities (NST-03)

5.1.5 Construction of the G-loop (NST-05)

Works activity NST-5 is representative of establishment works for the reinstatement of the G-loop. These works may be conducted outside of standard construction hours to avoid impacts on the road network during the busier periods. Moderate NML exceedances of up to 20 dBA are predicted when the concrete saw is operating. Noise impacts are generally limited to receivers that are situated near to the G-loop within NCA04, NCA05 and NCA06.

Commissioning of the G-loop is expected to take up to two weeks, with the majority of works undertaken during standard construction hours. Some limited night works will be required to construct tie-ins with the operational road network to minimise disruptions to traffic. Decommissioning of the G-loop is expected to take up to eight weeks, with the majority of works also to be undertaken during standard construction hours. As with commissioning, some limited night works would be required where works have the potential to impact on the operational road network. The construction of the G-loop would be managed via the implementation of the mitigation and management measures outlined in the EIS and the conditions of approval for the project.

The operation and location of the dominant item typically controls the level of noise emissions. For the construction of the G-loop (activity NST-05) the operation of the concrete saw dominates the noise predictions and as such mitigation and management measures should focus on the operation of this item particularly during OOHWs. It is estimated that when the concrete saw is not in operation, NML exceedances would generally reduce by up to 4 dBA and up to 10 dB noise reduction could be achieved with the use of localised hoarding around the concrete saw.

As per all construction works associated with the M4-M5 link project, the construction of the G-loop will be undertaken in accordance with the project Conditions of approval. Conditions which relate directly to these works have been identified in **Section 4.2**. These include both E76 which requires appropriate respite periods to be identified and the community consulted with prior to any out of hours works which may require road occupancy or other works noted in E75 and, E72 which defines the time periods as to when highly noise intensive works can be conducted on the site.

Figure 5-6 indicates the distribution of exceedances for activity NST-05 (at night) for receivers within the Haberfield study area.

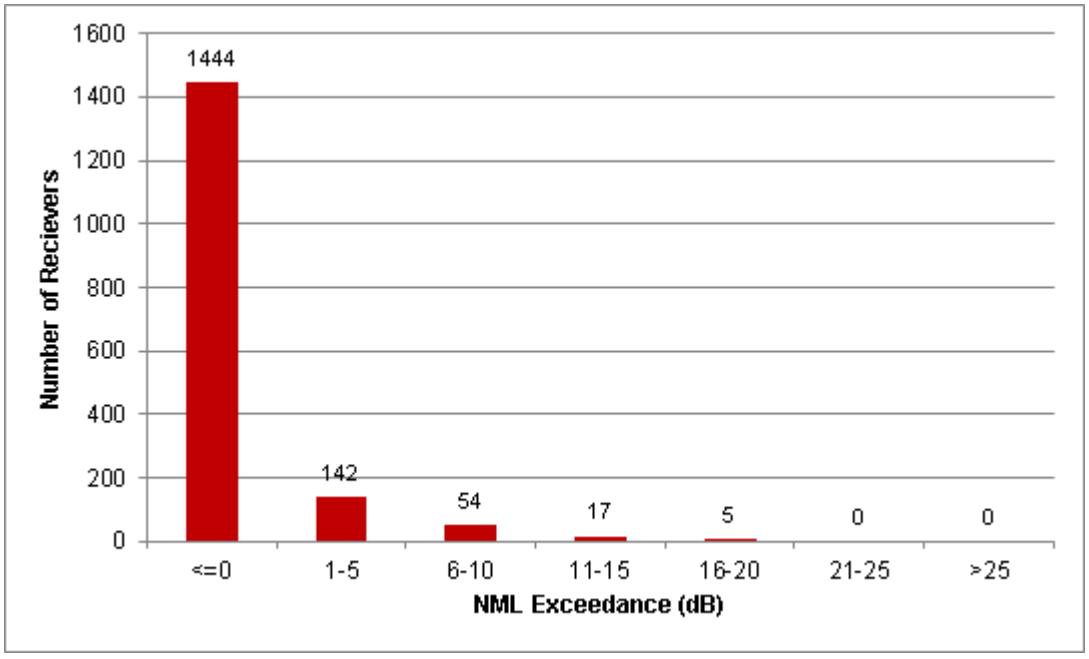


Figure 5-6 Activity NST-05 noise level exceedance, night-time

5.1.6 Sleep disturbance

A review of the predicted $L_{A1(1minute)}$ exceedances at the nearest noise sensitive receivers provided in **Table 5-5** indicates that the sleep disturbance screening criterion is likely to be exceeded when night works associated with tunnelling (NST-02), tunnelling support activities (NST-03) and the construction of the G-loop (NST-05) are occurring adjacent to residential receivers.

The assessment has included predictions of maximum noise impacts for assessment of potential sleep disturbance, however, it is noted that the ICNG only requires the project to consider maximum noise levels where construction works are planned to extend over more than two consecutive nights.

The project wide Construction Noise and Vibration Management Sub-Plan (CNVMP) will set parameters around how works outside standard daytime construction hours will be carried out, including timing and frequency, and the mitigation measures that will be implemented based on predicted impacts identified through location and activity specific assessments.

5.1.7 Construction mitigation and management measures

Particular effort should be directed towards the implementation of all feasible and reasonable noise mitigation and management strategies as per the standard mitigation measures detailed in the ICNG and CNVG. Where feasible and reasonable, mitigating impacts via means of source and or path control are preferred.

Based on the noise impact assessment of the proposed works, the following mitigation measures summarised in **Table 5-6** should be further investigated in addition to the standard suite of measures in the ICNG and CNVG.

Table 5-6 Recommended site specific noise mitigation measures to be considered

Activity	Mitigation description	Reason
NST-02, NST 05	Use of structures such as site sheds to shield residential receivers from construction activities.	Exceedances have been identified for works conducted within the Northcote Street civil and tunnel site.
	Non-tonal reversing beepers (or an equivalent) must be fitted and used on all construction vehicles and mobile plant regularly used onsite.	
	Plan traffic flow, parking and loading/ unloading areas to minimise truck reversing movements within the site.	
	Partially close the roller door during out of hours periods to the minimum height required to allow trucks to access the shed.	
	Access to the site to be sealed to limit noise impacts by trucks accessing and egressing the site.	

5.1.8 Consecutive construction impacts

The CNVG recognises that mitigation measures aimed at short term works may be less effective where longer term impacts are apparent and requires additional consideration of reasonable and feasible management measures to minimise impacts on the community.

When evaluating the extent of noise impacts within the Haberfield area, it is noted that this area would likely be subject to potential construction impacts from works associated with other infrastructure projects, including the approved M4 East project currently under construction.

The indicative construction program for M4-East and M4-M5 Link associated with the Northcote Street site are shown below in **Table 5-7**.

Table 5-7 Indicative construction program for Northcote Street civil and tunnel site – M4 East and M4-M5 Link projects

Project use of Northcote Street site	2016				2017				2018				2019				2020				2021				2022				2023			
	Q				Q				Q				Q				Q				Q				Q				Q			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
M4 East																																
M4-M5 Link																																

The noise and vibration impacts discussed in this report consider the duration of the M4-M5 Link project use of the Northcote Street civil and tunnel site in isolation, whereas the potential impacts from the identified consecutive projects may be longer for receivers near this site. While the majority of the highly noise intrusive works associated with the Northcote Street civil and tunnel site have occurred as part of the M4 East project (predominantly building demolition, bulk earthworks, construction of the acoustic shed and other construction activities that occurred outside of the acoustic shed), the M4-M5 Link project use of this site is predicted to result in impacts (of a lesser degree) for similar receivers in the area.

Receivers which front Parramatta Road between Page Avenue and Frederick Street at Haberfield within NCA01, and in NCA02 at receivers adjoining the Northcote Street site, are predicted to experience up to 10 dBA exceedances of the project NMLs (in the night-time period) during tunnelling operations (NST-02). While the magnitude of the predicted exceedance is relatively low, these impacts are predicted at receivers which would likely have been exposed to noise impacts during construction of the M4 East project.

The Construction Noise and Vibration Management Sub-Plan that will be prepared for the project will consider where longer term impacts are apparent and provide consideration of reasonable and feasible management measures to minimise impacts on the community. These will be consistent with the management and mitigation measures set out in the EIS, SPIR and the conditions of approval for the project, including condition E88.

Condition E88 identifies that at receiver noise mitigation in the form of at-property treatment must be offered to the land owner for habitable living spaces, or other mitigation or management measures as agreed by the occupier, to residential properties identified in Appendix E of the conditions of approval. Mitigation must be offered prior to works commencing. This requirement does not apply if the sensitive receiver has been provided with noise mitigation under the Roads and Maritime Noise Abatement Program or the State Environment Planning Policy (Infrastructure) 2007 (clause 102(3)). The adequacy of at-property treatments will be reviewed where previous treatments have been installed as part of other projects.

The proposed modification does not result in a change to the properties identified within Appendix E of the conditions of approval as the footprint assessed in the EIS has not been modified. As a result there will be no additional receivers impacted as a result of the modification.

Receivers in NCA05 and NCA05 east of Wattle Street / Dobroyd Parade have been subject to noise impacts during the construction of the M4 East project, including impacts resulting from the reconfiguration of Wattle Street, the construction of the Wattle Street entry and exit ramps and the use of the G-loop by construction vehicles. These receivers would be subject to potential ongoing noise impacts during construction of the project, particularly as a result of the proposed ongoing use of the G-loop. As described in **section 5.1.9**, two properties (83 and 85 Dobroyd Parade) have been provided at-property treatment as part of the M4 East project as a result of the use of the G-loop (refer to WestConnex M4 East CNVIS for the Northcote Tunnel Support Site (Renzo Tonin 2016)).

Likely noise impacts from the proposed use of the G-loop for the construction of the M4-M5 Link project would be consistent with or less than noise impacts from the M4 East project due to a forecast reduction in the number of heavy vehicles using the G-loop. In addition, the noise barrier being provided as part of M4 East project along the east side of Wattle Street / Dobroyd Parade would assist in ameliorating potential noise impacts from the G-loop on some receivers in NCA05 and NCA06.

Receivers in NCA05 and NCA06 are predicted to experience exceedances of the NML of less than 10 dBA during the evening and night-time periods during G-Loop establishment and decommissioning only, which would be a short-term activity. No exceedances of the NMLs are predicted within these NCAs as a result of tunnelling or tunnelling support activities, which are the activities that would occur over longer durations during the M4-M5 Link construction period.

5.1.9 Construction road traffic noise assessment

As described in **section 2.1.4** two spoil haulage routes have been assessed for the Northcote Street civil and tunnel site. **Table 5-8** describes each route proposed for spoil haulage. **Figure 2-4** shows the proposed spoil haulage routes.

Table 5-8 Indicative spoil haulage routes for Northcote Street civil and tunnel site

Route	Indicative spoil haulage route
Route A	Entry: via Parramatta Road city bound and left turn into the site
	Exit: via left turn from site onto Wattle Street, then left turn into Ramsay Street/ Road, then left turn into Fairlight Street, then left turn into Great North Road, then right turn into Parramatta Road
Route B	Entry: via Parramatta Road city bound and left turn into the site
	Exit: via left turn from site onto Wattle Street, then left turn onto the dedicated temporary construction vehicle turning lane (known as the G-loop) at the intersection of Dobroyd Parade and Waratah Street within part of Reg Coady Reserve. Right turn onto Wattle Street from truck turning facility toward M4 East tunnels or Parramatta Road. The G-loop has been used during the construction of the M4 East project.

All of the roads included in the proposed haulage routes are managed by Roads and Maritime. The roads all have two traffic lanes, some with provision for car parking in each direction, and are not divided carriageways (except for the section of Wattle Street around the M4 East entry and exit ramps). The speed limit on roads along the routes is 60 kilometres per hour.

Construction road traffic noise assessment

The forecast maximum daily heavy and light vehicles volumes predicted to use the Northcote Street civil and tunnel site are presented in **Table 5-9**. These volumes are based on the information available at the time of preparing this assessment and are subject to detailed construction planning and detailed design. Maximum forecast daily volumes have been used to provide a conservative assessment.

Table 5-9 Construction traffic forecast – Haberfield and Ashfield civil and tunnel sites

Road	Daytime 15hr 0700 2200[1,2]		Night time 9hr 2200 0700[1,2]	
	Heavy vehicles	Light vehicles	Heavy vehicles	Light vehicles
Northcote Street civil and tunnel site	90	15	54	9

Notes:

1. One direction flows. The assessment assumes all movements require an additional return trip
2. 15-hour and 9-hour flows have been estimated assuming that the daily volumes are distributed evenly throughout the period

Pre-construction (2012) daily numbers of vehicle movements on the local road network are shown in **Table 5-10** for the daytime and night time periods. 2012 has been selected as the base year to reflect the road network around this site before construction of the M4 East commenced.

Table 5-10 Existing (pre-construction 2012) traffic volumes on modelled roads around the Haberfield and Ashfield civil and tunnel sites

Road	Daytime 15hr 0700 2200		Night time 9hr 2200 0700	
	Heavy vehicles	Light vehicles	Heavy vehicles	Light vehicles
Parramatta Road	6,732	69,404	886	11,112
Wattle Street	3,809	37,321	502	5,980
Ramsay Street[1]	122	12,711	16	2,006
Great North Road	891	18,378	117	2,919

Notes:

1. No (pre-construction 2012) volumes are available for Fairlight Street. The assessment has used volumes for Ramsay Street as a proxy for the purposes of this assessment.

The proposed haulage routes for the Northcote Street civil and tunnel site are presented in **Table 5-11** along with the assessment of predicted increase in noise impacts along the modelled roads. Forecast construction traffic volumes (heavy and light vehicles) as presented in **Table 5-9** have been added to the existing (pre-construction) vehicle movements presented in **Table 5-10** to derive the predicted change in construction traffic noise levels on the modelled roads along the spoil haulage routes.

Table 5-11 Construction road traffic noise assessment – Northcote civil and tunnel site

Site	Vehicle type	Road	Predicted traffic noise increase (dBA)[1]	
			Daytime	Night-time
Northcote Street civil and tunnel site	Light & heavy	Parramatta Rd	<0.5	<0.5
		Wattle St	<0.5	<0.5
		Ramsay St / Rd	<0.5	1.6
		Fairlight St	<0.5	1.7
		Great North Rd	<0.5	1.5

Notes:

1. Existing traffic noise levels based on traffic modelling undertaken by RMS and/or AADTs where available.

The results of the construction road traffic noise assessment presented in **Table 5-11** shows that construction traffic is below the assessment criterion (2 dB) which reflects only marginal forecast change in LAeq noise levels at receivers along the proposed routes. The predicted change in noise level is less than 2 dB along all roads during the daytime and night-time period.

Route A

When Route A is in use Ramsay Street, Fairlight Street and Great North Road are predicted to experience the greatest change in noise levels, with increases of up to 1.7 dBA forecast during the night-time period. While this predicted increase is below the 2 dB criterion, Ramsay Street and Great North Road have relatively low volumes of heavy vehicles during the night time period (see **Table 5-10**). Additionally, the size and type of heavy vehicle used to haul spoil (truck and dog) is not common on Ramsay Street during the night time period.

Individual pass-by maximum noise levels of project related spoil haulage trucks are therefore likely to be higher than traffic noise levels without construction during the night-time period. The project should consider the potential impact from maximum noise levels that heavy vehicles may have on surrounding receivers along Ramsay Street, Fairlight Street and Great North Road when considering the routes for construction traffic during the night time period.

Route B (G-loop)

When Route B is in use, construction traffic would use Wattle Street / Dobroyd Parade to access and egress the G–loop. The construction road traffic noise assessment in **Table 5-11** indicates that construction traffic is unlikely to result in a noticeable increase in LAeq noise levels at receivers along Wattle Street / Dobroyd Parade (noise levels are predicted to increase by less than 0.5 dB during the daytime and night time periods).

In addition to an assessment of potential impacts on receivers along Wattle Street / Dobroyd Parade against the RNP, the G-loop is considered a construction site road for use by construction vehicles only and as such noise emissions associated with its use would be assessed against construction NMLs. An assessment of the use of the 'G-loop' was conducted as part of the WestConnex M4 East CNVIS for the Northcote Tunnel Support Site (Renzo Tonin 2016) and, as a result, two properties (83 and 85 Dobroyd Parade) have been provided at-property treatment.

The M4 East project assessed a maximum 20 heavy vehicles per hour egressing from the Northcote Street site (refer to section 6.6.5 of the M4 East EIS (Roads and Maritime, 2015)).Eight vehicles per hour are forecast to egress from the Northcote Street civil and tunnel site during construction of the M4-M5 Link project. As such, it is considered that the likely noise impacts from the proposed use of the G-loop would be consistent with or less than that from the M4 East project. As the identified impacted receivers have been offered mitigation (at-property treatment) as part of the M4 East project, and the use of the 'G-loop would be consistent with the use of this route by M4 East construction traffic, no further assessment of noise impacts for the G-loop is required.

With regard to potential night-time maximum noise events, construction traffic on Wattle Street and Parramatta Road are unlikely to significantly increase the number of maximum noise events due to the relatively high existing traffic volumes on these road, including heavy vehicles.

The Construction Traffic Transport and Access Management Sub-Plan that will be prepared for the project will include instructions for operation of vehicles entering and leaving the sites to assist in minimising construction traffic noise.

Mitigation and management measures – Construction road traffic noise

The following measures are recommended, and should be confirmed during detailed design:

- Appropriate training should be provided to contractors in order to minimise noise when entering and leaving the sites and the use of compression brakes on local roads.

5.1.10 Ground-borne noise assessment

Tunnelling works associated with the Northcote Street civil and tunnel site decline access tunnel to the mainline tunnel alignment have the potential to result in ground-borne noise impacts at the nearest sensitive receivers.

The ground-borne noise assessment is based on the worst case predicted LAeq internal ground-borne noise level when the tunnelling works are at their closest point below each sensitive receiver.

In addition to ground-borne noise criteria, human comfort vibration levels are applicable at all receivers during all time periods (day, evening and night). Based on the proposed depth of the access tunnel, no sensitive receivers are located within the minimum working distances (refer to **Table 4-4**) and are not further considered for road-header operation during tunnelling works.

While the proposed construction methodology utilises road headers to construct the access tunnel, ground borne noise impacts have been included for a large rock breaker to provide an assessment of impacts if these were to be used.

Table 5-12 summarises the maximum ground-borne noise levels from both road header and rock-breaker tunnelling works associated with the temporary access tunnel at the Northcote Street civil and tunnel site. Ground-borne noise contours are provided in **Figure 5-7** and **Figure 5-8**. The exceedances listed in **Table 5-12** assume that the tunnelling works will occur 24 hours a day, and therefore consider potential exceedances of the more stringent night-time ground-borne levels.

Table 5-12 Worst case predicted ground-borne noise levels during tunnelling – Northcote decline access tunnel

NCA	Worst case ground borne noise level at a residential receiver (dBA $L_{Aeq(15minute)}$)	Number of residential receivers where criteria are exceeded	Number of other sensitive receivers where criteria are exceeded	Number of commercial receivers where criteria are exceeded
Road-header tunnelling works				
NCA01	27	-	-	-
NCA02	33	-	-	-
NCA03	21	-	-	-
NCA06	32	-	-	-
NCA07	22	-	-	-
Rock-breaker tunnelling works				
NCA01	37	1	-	-
NCA02	49	8	1	-
NCA03	23	-	-	-
NCA06	47	28	-	-
NCA07	26	-	-	-

During road-heading tunnelling works, the worst case ground-borne noise levels are predicted to be compliant with the more stringent 35 dBA $L_{Aeq(15minute)}$ night-time criterion at all sensitive receivers which are potentially affected by ground-borne noise from road-header tunnelling works.

During rock-breaker tunnelling works, the worst case ground-borne noise levels are predicted to exceed the 35 dBA $L_{Aeq(15minute)}$ night-time criterion at up to 38 sensitive receivers in NCA01, NCA02 and NCA06. Additionally, there is potential for human comfort vibration levels to be exceeded where rock breakers are used within the tunnel for extended periods of time. The human comfort vibration criteria is significantly lower than the criteria for cosmetic damage and takes into account both intensity and duration of the works. This should be assessed in greater detail in the preparation of the tunnelling CNVIS when more detailed construction methodology information is available.

The ground-borne noise predictions are based on the nearest sensitive receivers above or adjacent to the proposed tunnel alignment. The ground-borne noise impacts would reduce for sensitive receivers offset horizontally from the access tunnel due to the increased slant distance. In addition, it is

expected that a combination of road headers and rock-breakers would be used during construction. The exceedances under the rock-breaker tunnelling works scenario are therefore conservative and impacts would be expected to be less than those predicted under this scenario.

Figure 5-7 Ground borne noise - road header

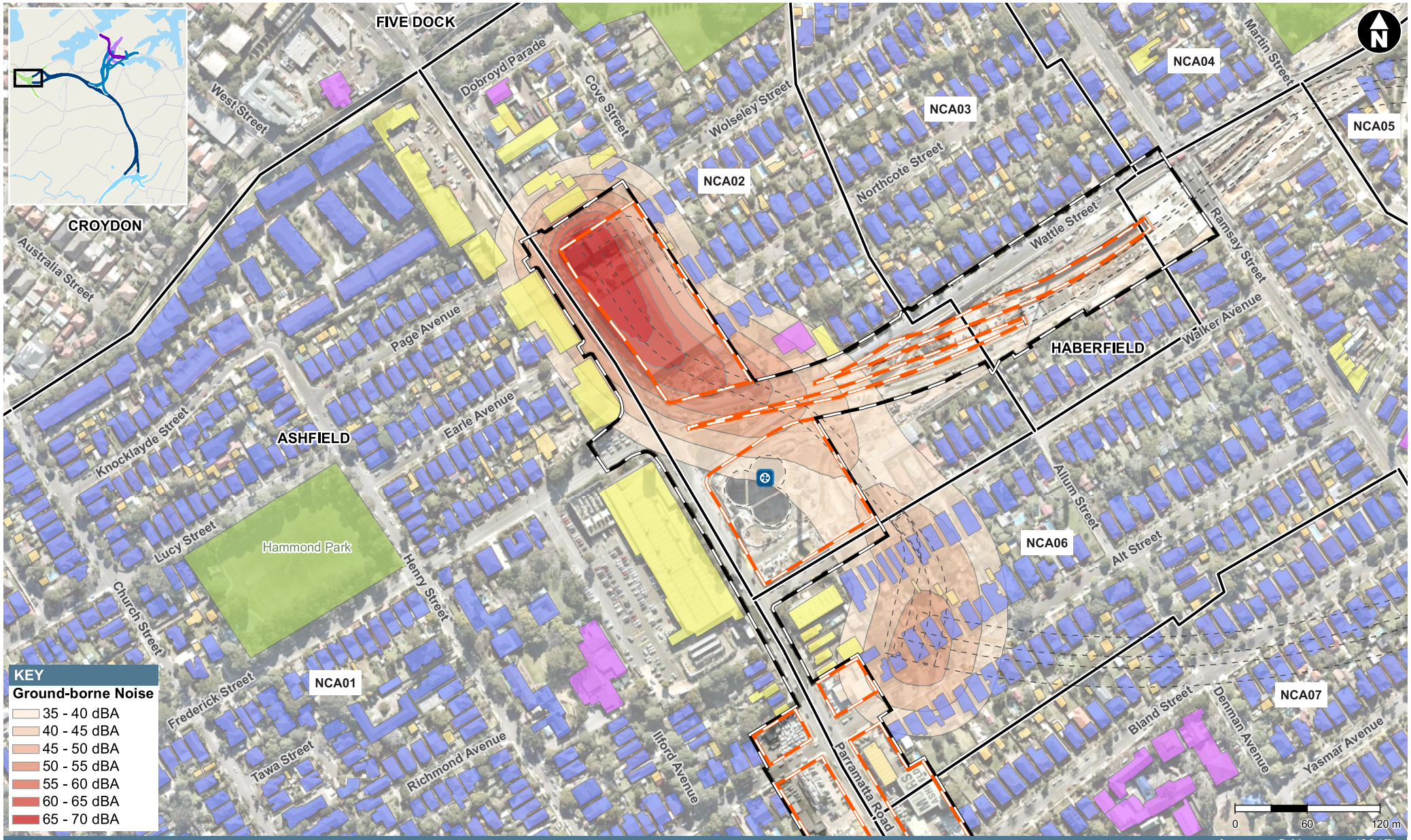


Figure 5-8 Ground borne noise - rock-breaker

Mitigation and management measures – Ground-borne noise impacts

Table 5-12 indicates that there are 37 residential receivers and one other sensitive receiver where ground-borne noise levels are predicted to exceed the night-time ground-borne noise level by up to 14 dBA.

With reference to the CNVG ground-borne noise mitigation measures, the following mitigation measures should be considered where feasible and reasonable:

- Validation of predicted ground-borne noise levels through the use of monitoring
- Notification letterbox drops to receivers in the area around the works location, detailing work activities, time periods over which these will occur, impacts and mitigation measures
- Specific notifications provided to receivers where the ground-borne noise levels are predicted to exceed the night-time ground-borne noise management level, providing additional information when relevant and more specific information than covered in general letterbox drops
- Individual briefings to inform the residents about the impacts of the works and mitigation measures that will be implemented. Where the resident cannot be met with individually then an alternative form of engagement should be used.
- Respite offers may be offered to the affected residents during works where noise levels are predicted to exceed the ground-borne noise management level by 10 dBA or more
- Alternative accommodation options may be offered to the affected residents for the periods where noise levels are predicted to exceed the ground-borne noise management level by 10 dBA or more.

As per all construction works associated with the M4-M5 link project, the access tunnel would be required to be constructed in accordance with the project conditions of approval. Conditions which relate directly to the works have been identified in **section 4.2**. These include E82 which defines when mitigation measures must be applied for ground borne noise impacts, E83 which outlines the notification process where cosmetic damage vibration screen criteria is expected to be exceeded and E105 which requires pre-dilapidation surveys to be offered where surface structures are at risk of settlement or vibration.

5.2 Parramatta Road West and Parramatta Road East civil sites

5.2.1 Qualitative assessment

The Parramatta Road West and Parramatta Road East civil sites would be used generally in accordance with condition C19 and other conditions of the project approval. The sites would be used for parking and other works that do not exceed the 'noise affected' NMLs as identified in the ICNG.

Table 5-13 provides a qualitative assessment of the use of the Parramatta Road West and Parramatta Road East civil sites generally in accordance with condition C19 and includes identified differences in noise and/or vibration impact between the equivalent work activities for each of the proposed activities as described in the EIS and SPIR, and those of the proposed modification.

Table 5-13 Qualitative assessment of the use of the Parramatta Road West and Parramatta Road East civil sites generally in accordance with condition C19

Proposed Activity Scenario	Description	Equivalent activity assessed in the EIS (EIS Activity Ref)	Proposed period of work	EIS/SPIR assessed period of work	Are predicted impacts likely to be different than that assessed in the EIS (reduced / consistent / higher) (Qualitative discussion)	Recommended additional mitigation methods that can be considered to manage impacts where they are likely to be higher than that assessed in the EIS/SPIR
Site establishment	Demolition of buildings and structures such as the workshops, awnings and stores	Yes (OPTB-01)	Standard daytime hours	Standard daytime hours	**Consistent –** The extent of the site footprint was assessed in the EIS. Several buildings located within the site may be retained for use during construction. These would be demolished at the end of construction.	Recommended mitigation methods outlined in the EIS, SPIR and CoA are considered appropriate.
	Vegetation clearing and removal	Yes (OPTB - 05) (OPTB - 03)	Standard daytime hours	Standard daytime hours	**Consistent –** No material change to the amount of vegetation clearing described and assessed in the EIS.	
	Establishment of temporary noise attenuation measures	Yes (OPTB - 03)	Standard daytime hours	Standard daytime hours	**Consistent –** The extent of the site footprint was assessed in the EIS.	
	Utility works including protection and/or adjustment of existing utilities	Yes (OPTB-02) (OPTB-04)	All periods	Standard daytime hours – (OPTB-02) All time periods – (OPTB-04)	**Consistent –** EIS scenario OPTB-02 (utility works) assessed utility works required within the compound. As there is no requirement for the site to provide power to support tunnelling, the extent of utility works would be less than that assessed in the EIS. EIS scenario OPTB-04 addressed pavement and infrastructure works required where the site adjoins Parramatta Road and was assessed against all time periods (day, evening and night).	

Proposed Activity Scenario	Description	Equivalent activity assessed in the EIS (EIS Activity Ref)	Proposed period of work	EIS/SPIR assessed period of work	Are predicted impacts likely to be different than that assessed in the EIS (reduced / consistent / higher) (Qualitative discussion)	Recommended additional mitigation methods that can be considered to manage impacts where they are likely to be higher than that assessed in the EIS/SPIR
	Contamination remedial work	Yes (OPTB - 05)	Standard daytime hours	Standard daytime hours	**Consistent –** The extent of the site footprint was assessed in the EIS.	
	Construction of a pedestrian walkway over Parramatta Road	No	All periods	All periods	An assessment of potential noise and vibration impacts associated with the construction of the pedestrian walkway is included in **Section 5.3.**	
	Establishment of site offices, amenities and temporary infrastructure	Yes (OPTB - 05)	Standard daytime hours	Standard daytime hours	**Consistent –** The extent of the site footprint was assessed in the EIS. The proposed layout of the site would also provide a greater level of shielding than that assessed in the EIS as some existing buildings may be retained through the operation of the site.	

Proposed Activity Scenario	Description	Equivalent activity assessed in the EIS (EIS Activity Ref)	Proposed period of work	EIS/SPIR assessed period of work	Are predicted impacts likely to be different than that assessed in the EIS (reduced / consistent / higher) (Qualitative discussion)	Recommended additional mitigation methods that can be considered to manage impacts where they are likely to be higher than that assessed in the EIS/SPIR
Site operations	Laydown and storage of materials Plant and equipment assembly Heavy vehicle, equipment and plant storage Delivery of materials, plant and equipment	Yes (OPTB-07)	All periods	All periods	**Consistent -** The EIS assessed general laydown operations within select areas of the site footprint. Although the proposed use of the site is to include laydown operations over a larger area of the footprint, it is expected that the predicted absolute level of noise would be comparable to that presented in the EIS at the closest receiver due to similar items of plant being used. As such, mitigation measures identified in the EIS, SPIR and CoAs are considered appropriate. The proposed layout of the site would also provide a greater level of shielding than that assessed in the EIS as some existing buildings may be kept in place through the operation of the site. The proposed site footprint is consistent with that assessed in the EIS.	A Construction Noise and Vibration Impact Statement (CNVIS) will be prepared based on the revised layout of the site and will detail noise mitigation and management measures in line with the contractor's finalised construction methodology.
	Construction traffic access	Yes	All periods	All periods	**Reduced -** The site is to be used for civil activities, with no spoil storage or haulage proposed from the site. The EIS assessed spoil haulage from the Parramatta Road West site as it was a tunnelling compound. This would result in reduced number of heavy vehicles (spoil haulage truck and dogs) accessing the site	-

Proposed Activity Scenario	Description	Equivalent activity assessed in the EIS (EIS Activity Ref)	Proposed period of work	EIS/SPIR assessed period of work	Are predicted impacts likely to be different than that assessed in the EIS (reduced / consistent / higher) (Qualitative discussion)	Recommended additional mitigation methods that can be considered to manage impacts where they are likely to be higher than that assessed in the EIS/SPIR
Site rehabilitation and landscaping	Demobilisation including works to prepare the site for a future use in accordance with the M4-M5 Link Residual Land Management Plan	Yes (OPTB - 11)	Standard daytime hours	Standard daytime hours	**Consistent –** The extent of the site footprint was assessed in the EIS.	Recommended mitigation methods outlined in the EIS, SPIR and CoA are considered appropriate.

5.2.2 Discussion

Review of the assessment outlined in **Table 5-13** indicates that the proposed use of the Parramatta Road West and Parramatta Road East civil sites is considered to be consistent with the assessment undertaken in the M4-M5 Link EIS and SPIR and would not result in a change to the mitigation proposed for the equivalent activities. The proposed modification would remove tunnelling activities from the site and is therefore expected to result in a reduction in the impact on nearby receivers previously predicted in association with tunnelling related activities. There would be no change to the project footprint as assessed in the EIS and SPIR.

Consistent with recommendations in the EIS and SPIR, a CNVIS will be prepared based on the finalised construction methodology and will include consideration of the indicative revised layout and use of the site, including the location of specific items of plant. The CNVIS will include details of how the noise emissions from the sites will be managed to achieve compliance with the applicable noise management levels as required by condition of approval C19. Where non-compliances are predicted within the CNVIS, the contractor will explore at source noise mitigation options that may include, but are not limited to:

- Site perimeter hoarding
- Localised enclosures around noise sources
- Judicious selection of fixed plant and equipment
- Optimisation of site layout to maximise localised shielding by on-site buildings
- Positioning driveways away from sensitive receivers
- If necessary, limiting noise intensive activities during sensitive periods.

Noise and vibration impacts on receivers in the vicinity of the Parramatta Road West and Parramatta Road East civil sites, assessed in accordance with the ICNG and CNVG, were identified in the EIS. Condition of approval (E88) requires mitigation in the form of “at-property treatment” to be offered to habitable spaces identified within the Appendix E of the conditions of approval.

Sensitive receivers adjoining the Parramatta Road East and Parramatta Road West civil sites were identified in Appendix E of the conditions of approval due to their proximity to the works associated with the construction of the M4-M5 Link project and the impacts associated with the consecutive and long-term nature of construction of the wider WestConnex project. While the modification proposes the use of these sites as civil sites (with the use to be generally in accordance with condition C19), the assessed EIS construction activities other than tunnelling would still occur within the site footprint and as such, noise impacts are expected to be consistent with those identified in the EIS and would not change the boundaries defined in Appendix E of the conditions of approval.

As per all construction works associated with the project, the Parramatta Road East and Parramatta Road West civil sites will operate in accordance with the project conditions of approval. Conditions that relate directly to the site have been identified in **section 4.2.** These include C19 and E73 that require the site to operate within NMLs and E72 which defines the time periods as to when highly noise intensive works can be conducted on the site.

5.3 Parramatta Road West and East civil sites – pedestrian walkway

5.3.1 Noise management summary

The NMLs derived for the NCAs around the Parramatta Road West and Parramatta Road East civil sites are outlined in **Table 5-14.** Additional information on the representative monitoring locations and derived NCAs is provided in Appendix J (Technical working paper: Noise and vibration) of the EIS. No additional monitoring at representative locations was required for the assessment of potential noise impacts as a result of the proposed modification at the Northcote Street site.

Table 5-14 Residential NMLs for the project

NCA	Representative monitoring location	Receiver type	Standard construction NMLs (RBL+10dBA)	Out of hours NMLs (RBL+5dBA)[1]			Sleep disturbance screening (RBL+15dBA)
			Daytime period	Daytime period	Evening period	Night period	
NCA00	H.03	Residential	56	51	51	43	53
NCA01	H.03	Residential	56	51	51	43	53
NCA02	H.01	Residential	68	63	63	57	67
NCA03	H.04	Residential	68	63	60	49	59
NCA04	H.06	Residential	66	61	58	48	58
NCA05	L.02	Residential	61	56	54	47	57
NCA06	H.02	Residential	56	51	51	48	58
NCA07	H.02	Residential	56	51	51	48	58

Notes:

1. Out of Hours construction hours – Evening hours are 6.00 pm to 10.00 pm. Night-time hours are 10.00 pm to 7.00 am Sunday to Saturday and 10.00 pm Saturday to 8.00 am Sunday

5.3.2 Activity source noise levels

Sound power levels for the typical operation of construction equipment applied in the modelling re listed in **Table 5-15**. The activities are representative of works which have the potential to impact nearby sensitive receivers.

Table 5-15 Sound power levels for construction equipment – Haberfield

Scenario name	Works ID	Equipment (realistic worst case)	Worst case items in same location	Sound power level (dBA)[1,2]		
				L_{WA}		L_{WAmax}
				Item	Activity[4]	Activity
Footing constructions include concrete saws	MPO-01	Concrete saw	1	115	110	123
		Excavator (small)	1	98		
		Truck	1	98		
Boarded piling	MPO-02	Piling rig (bored)	1	108	108	118
		Mobile crane	1	100		
		Concrete truck	1	106		
Bridge assembly and span lift	MPO-03	Mobile crane(large)	1	104	107	112
		Semi-trailer	2	106		
		Lighting tower	2	99		

Notes:

1. In accordance with the EPA ICNG for activities identified as particularly annoying (such as jackhammering, rock-breaking and power saw operation), a 5 dBA 'penalty' is added to predicted noise levels when using the quantitative method
2. Activity sound power levels account for the amount of time an item of plant is anticipated to operate within each 15 minute period

5.3.3 Early opportunities for noise mitigation

The proposed works include a number of opportunities to achieve a noise benefit from judicious use and design of the following standard construction features:

- **Site hoarding** – For construction concentrated in a single area, such as at the ancillary facilities, temporary acoustic hoarding/barriers around the site perimeter should be considered where feasible and reasonable to mitigate off-site noise levels. Hoarding surrounding the construction ancillary facility of solid lapped and capped construction (as opposed to standard wire mesh fence) has been included where practicable.

5.3.4 Predicted noise levels

A summary of the predicted noise levels (without additional mitigation) in each of the NCAs for the various work activities is presented in **Table 5-16** for residential, commercial and other sensitive receivers. The noise levels are representative of impacts where works are closest to each NCA and are intended to give an overview of the noise from the proposed works.

Shading in the following tables denotes predicted noise levels based on the exceedance of the NML during that period and for that receiver type. A qualitative description of the NML exceedance bands is given below, noting that the impact of these potential exceedances would depend on the period in which they were to occur (ie changes in noise levels during the night-time period are typically more sensitive than the daytime or evening for most people):

- Noise levels 1 to 10 dBA above NMLs – impacts would typically be marginal to minor
- Noise levels 11 dBA to 20 dBA above NMLs – impacts would typically be moderate
- Noise levels >20 dBA above NMLs – impacts would typically be high

For most construction activities, it is expected that the actual construction noise level would generally be lower than the worst-case prediction made at the most-exposed receiver. This is because noise level varies with the position of plant items or noise sensitive receivers as well as across different stages of construction.

The predicted NML exceedances in this area are summarised in **Table 5-17**. The assessment presented in this table takes into consideration the assessed construction scenarios associated with

the construction of the temporary overhead pedestrian bridge. The number of receivers predicted to experience exceedances of the NMLs is shown in bands and separated into day, evening and night-time periods, as appropriate.

Noise impacts associated with construction workers using the pedestrian overpass are expected to be predominantly as a result of footsteps and voices and would be negligible during all time periods (day, evening and night) given the high background noise levels from traffic on Parramatta Road.

Table 5-16 Predicted worst case noise levels

NCA	NML	Predicted LAeq(15minute) Noise Level (dBA)[1]		
		MPO-01 Footing constructions include concrete saws	MPO-02 - Boarded piling	MPO -03 Bridge span lift
Residential - Standard Daytime				
NCA00	56	54	52	51
NCA01	56	65	63	62
NCA02	68	45	43	42
NCA03	68	42	40	39
NCA04	66	37	35	34
NCA05	61	37	35	34
NCA06	56	59	57	56
NCA07	56	56	54	53
Residential – Evening				
NCA00	51	-	-	51
NCA01	51	-	-	62
NCA02	63	-	-	42
NCA03	60	-	-	39
NCA04	58	-	-	34
NCA05	54	-	-	34
NCA06	51	-	-	56
NCA07	51	-	-	53
Residential - Night-time				
NCA00	43	-	-	51
NCA01	43	-	-	62
NCA02	57	-	-	42
NCA03	49	-	-	39
NCA04	48	-	-	34
NCA05	47	-	-	34
NCA06	48	-	-	56
NCA07	48	-	-	53
Commercial				
NCA01	70	-	-	-
NCA02	70	57	55	54
NCA03	70	42	40	39
NCA04	70	-	-	-
NCA05	70	38	36	35
NCA06	70	-	-	-
NCA07	70	57	55	54
Other Sensitive				
NCA00	- Refer to note 2	<30	<30	<30
NCA01		50	48	47
NCA02	-	46	44	43
NCA03	-	-	-	-
NCA04	-	<30	<30	<30
NCA05	-	30	<30	<30
NCA06	-	<30	<30	<30
NCA07	-	53	51	50

Notes

1. Colouring indicates the range of predicted worst case NML exceedances without any additional mitigation based on nearest receiver (red >20 dBA, orange 11-20 dBA, yellow 1-10 dBA) based on the controlling time period
2. The NML is dependent on the classification of a given sensitive receiver. As the table represents the highest predicted noise level for a particular activity, the most affected “other sensitive” receiver may change between each activity depending on the location of the works. No NMLs can be provided in this table for “other sensitive receivers as result of the various types of “other sensitive” receivers within each NCA which may be affected by different activities

Table 5-17 Overview of NML exceedances

Activity ID	Activity	Weeks[1]	Activity duration within overall project program[2]				Number of receivers																	
							Total	Highly noise affected[4]	NML exceedance receiver count[3]															
									Daytime			Daytime (out of hours)			Evening			Night-time			Sleep disturbance		
			25	50	75	100			1-10 dBA	11-20 dBA	>20 dBA	1-10 dBA	11-20 dBA	>20 dBA	1-10 dBA	11-20 dBA	>20 dBA	1-10 dBA	11-20 dBA	>20 dBA	1-10 dBA	11-20 dBA	>20 dBA
MPO-01	Footing constructions include concrete saws	1					1747	-	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MPO-02	Boarded piling	3					1747	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MPO-03	Bridge assembly and span lift	8					1747	-	3	-	-	21	1	-	21	1	-	88	8	-	22	1	-

Notes;

1. Approximate overall duration of the activity in all areas of the Site. The duration of these impacts is less than the overall duration, and depends on the rate of progress in the works areas
2. Approximate percentage (to nearest 13%) of activity duration within overall proposal program. Where percentage is less than 13%, 13% is shown for illustrative purposes
3. Based on worst case noise works area (closest to receivers)
4. Based on ICNG definition (ie predicted LAeq(15minute) noise at residential receiver is 75 dBA or greater)

5.3.5 NML exceedances

Works activity MPO-01 and MPO-02 cover construction activities required for the preparation of the footings and structure and are limited to standard daytime hours only. Worst case predicted exceedances of the daytime NMLs are predicted at 14 receivers within NCA01 and NCA06, with a maximum exceedance of nine dBA predicted. These exceedances are due to the use of a concrete saw during the demolition of the existing hardstand (MPO-01). Exceedances would significantly decrease when the concrete saw is not in use, and it would be expected that these works would be short in duration.

Works activity MPO-03 is representative of the bridge assembly and span lift which is expected to occur over a duration of up to eight weeks. However, the work associated with assembly of the bridge would be undertaken during the daytime hours and the span lift may be conducted outside of standard construction hours to avoid impacts on the road network during the peak periods. Moderate NML exceedances of up to 19 dBA are predicted when the crane for the span lift is operating. Noise impacts are generally limited to receivers that are situated near to the Parramatta Road facilities within NCA00, NCA01, NCA06 and NCA07. These works are expected to be completed over a few nights and would be managed via the implementation of the mitigation and management measures outlined in the EIS.

Figure 5-9 shows a grid noise map of the works scenario MPO-03, which illustrates how noise emissions propagate from the site.

As per all construction works associated with the project, the Parramatta Road East and West civil sites will operate in accordance with the project conditions of approval. Conditions which relate directly to these works have been identified in **Section 4.2**. These include both E76 which requires appropriate respite periods to be identified and the community consulted with prior to any out of hours works which may require road occupancy or other works noted in E75 and, E72 which defines the time periods as to when highly noise intensive works can be conducted on the site.

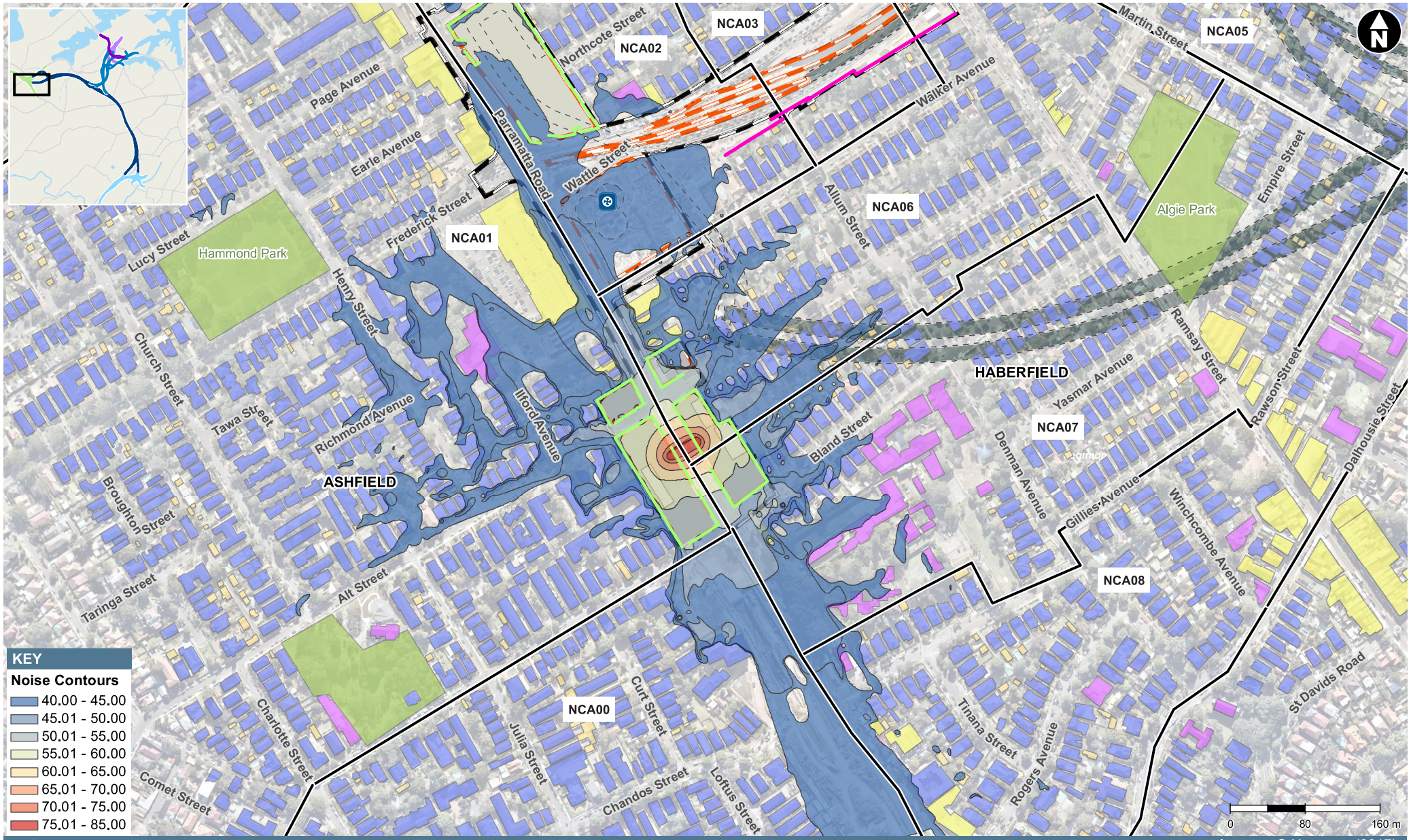


Figure 5-9 Grid Noise Map bridge assembly and span lift (MPO-03)

5.3.6 Sleep disturbance

A review of the predicted $L_{A1(1minute)}$ exceedances at the nearest noise sensitive receivers provided in **Table 5-17** indicates that the sleep disturbance screening criterion is likely to be exceeded when night works are occurring adjacent to residential receivers.

At this early stage in the project, the assessment has included predictions of maximum noise impacts for assessment of potential sleep disturbance, however, it is noted that the ICNG only requires the project to consider maximum noise levels where construction works are planned to extend over more than two consecutive nights.

An OOHW protocol will be developed as part of the project wide CNVMP to set parameters around how works outside standard daytime construction hours will be carried out, including timing and frequency, and the mitigation measures that will be implemented based on predicted impacts identified through location and activity specific assessments. The OOHW protocol will be developed in consultation with the NSW EPA.

5.3.7 Construction mitigation and management measures

Particular effort should be directed towards the implementation of all feasible and reasonable noise mitigation and management strategies as per the standard mitigation measures detailed in the ICNG and CNVG. Where feasible and reasonable, mitigating impacts via means of source and or path control are preferred.

Based on the noise impact assessment of the proposed works, the following mitigation measures summarised in **Table 5-18** should be further investigated in addition to the standard suite of measures in the ICNG and CNVG.

Table 5-18 Recommended site specific noise mitigation measures to be considered

Activity	Mitigation description	Reason
All	Use structures such as site sheds and or hoarding to shield residential receivers from works activities.	Exceedances have been identified for works associated with the establishment of the temporary pedestrian overpass.
	Non-tonal reversing beepers (or an equivalent) must be fitted and used on all construction vehicles and mobile plant regularly used onsite.	
	Plan traffic flow, parking and loading/ unloading areas to minimise reversing movements within the site.	

5.3.8 Vibration from construction activities

Piling works associated with construction of the pedestrian overbridge have the potential to result in vibration impacts at the nearest sensitive receivers. The EIS details the vibration criteria applicable to the project. The criteria are based on recommended minimum working distances for construction plant, which are outlined in **Table 5-19**.

Table 5-19 Recommended minimum working distances for vibration intensive plant

Plant item	Rating/description	Minimum working distance			
		Cosmetic damage			Human response[1]
		Residential and light commercial[1]	Group 2 (typical)[2]	Group 3 (structurally unsound)[2]	
Pile boring	≤ 800 mm	2 m (nominal)	3 m	5 m	4 m

Notes:

1. Criteria referenced from Roads and Maritime CNVG
2. Criteria referenced from DIN 4150 (Structural vibration – Effects of vibration on structures)

The locations of the proposed works (refer to **Section 2.2)** are approximately 30 metres from the nearest sensitive receiver buildings. No sensitive receiver buildings are located within the minimum working distances for piling works. As such, cosmetic damage and human response vibration impacts from piling works associated with construction of the pedestrian overbridge are considered unlikely to occur.

5.4 Removal of Darley Road site from project

The EIS identified the site as the Darley Road civil and tunnel site (C4) for the construction of the project and as the Darley Road motorway operations complex (MOC1) for the operation of the project. Detailed construction planning of the approved project has determined that the Darley Road site is no longer required to support the construction and operation of the project.

Construction activities would not be carried out at the Darley Road civil and tunnel site for the proposed modification. The construction activities proposed for Darley Road civil and tunnel site in as described in the EIS would be accommodated at other project construction sites. The overall intensity (rate) of spoil removal at the other approved tunnelling sites is not expected to change, however the additional spoil to be removed would require the extension of the overall tunnelling program by around six months.

The removal of Darley Road civil and tunnel site (C4) from the project would remove the assessed construction noise and vibration impacts on nearby receivers around this site as set out in the EIS and SPIR. The extension of the overall tunnelling program by around six months at the other Stage 1 construction ancillary facilities where tunnelling would be carried out would prolong the assessed noise and vibration impacts on receivers around these sites, but as the intensity (rate) of tunnelling would not change, these noise and vibration impacts would remain consistent in their intensity.

The removal of the Darley Road motorway operations complex (MOC1) from Darley Road would result in no permanent infrastructure for the project being located at this location. This would remove the potential operational noise impacts on nearby receivers around the previously proposed Darley Road motorway operation complex (MOC1) as assessed in the EIS and SPIR.

5.5 Cumulative noise and vibration impacts

Concurrent noise impacts can occur where more than one works activity occurs at the same time and in the same location such that an individual receiver is potentially impacted by noise from more than one element of works. A scenario where construction equipment operates concurrently has been modelled for the Northcote Street civil and tunnel site (**section 5.1**) and for the Parramatta Road pedestrian walkway (**section 5.3**).

Cumulative noise impacts associated with the operation of multiple construction ancillary facilities in proximity to each other such as the Northcote Street and Wattle Street civil and tunnel sites or the Parramatta Road West and East civil sites are considered unlikely to occur given the following:

- The noise impacts at each site would be localised to receivers in close proximity to each construction site
- The separation distances and noise attenuation between the sites
- The location of the sites adjacent to heavily trafficked major roads such as Wattle Street and Parramatta Road which dominate the ambient noise environment
- The conditions of approval for the project which require each construction ancillary facility to operate within applicable noise management levels particularly during the more sensitive out of hours periods.

As per all construction works associated with the project, the construction ancillary facilities around Haberfield and Ashfield will operate in accordance with the project conditions of approval.

6 Potential impacts - operation

6.1 Campbell Road motorway operations complex – operational water treatment plant

The results in **Table 6-1** indicate that the assessed fixed facilities are predicted to comply with the relevant criteria during the more stringent night-time period in all NCAs in the vicinity of the operational water treatment plant.

6.1.1 Construction of operational water treatment plant

Construction noise and vibration impacts on receivers in the vicinity of the Campbell Road motorway operations complex were assessed in the EIS. The relocation of the operational water treatment plant to the Campbell Road motorway operations complex (MOC5) is proposed to be located in a similar but slightly larger footprint as that assessed in the EIS, and would be around 200 metres from the nearest sensitive receiver.

The construction scenarios assessed within the EIS would be considered to be representative and consistent with the construction of the operational water treatment plant at the Campbell Road motorway operations complex (MOC5). The two scenarios assessed within the EIS which are considered to be representative of impacts associated with the construction of the operational water treatment plant at this location are the ventilation building installation (SPI-09) and the site rehabilitation and landscape (SPI-12) both of which did not identify any noise impacts at nearby receivers. Construction of the operational water treatment plant would be undertaken during standard construction hours only.

As is required for the construction of the Campbell Road motorway operations complex (MOC5), the operational water treatment plant would be constructed in accordance with the project conditions of approval.

6.1.2 Operational noise assessment

Noise impacts from the operation of the fixed facilities associated with the project located at Campbell Road motorway operations complex (MOC5) have been predicted for the NCAs nearest to the facilities. These predicted noise levels are summarised in **Table 6-1** and shown in **Figure 6-1**.

Table 6-1 Predicted noise levels – fixed facilities

Area	NCAs	Noise level (dBA L_{Aeq})		
		Criteria	Predicted	Exceedance
St Peters	NCA46	45	<30	-
	NCA48	45	34	-
	NCA49	45	42	-
	NCA50	45	35	-
	NCA51	44	<30	-

Figure 6-1 St Peters interchange fixed facilities operational noise levels

The operational water treatment plant at the Campbell Road motorway operations complex (MOC5) has been modelled at a SWL of 90 dBA. This is the maximum SWL that results in compliance with the criteria at all residential receivers. Other fixed plant at this location has been included in the model as per the EIS inputs to ensure that the cumulative noise from all operational plant is assessed.

The selected mechanical equipment for the facility would be reviewed and assessed against the relevant operational noise criteria at the detailed design stage of the project. Specific plant would be selected and designed to achieve compliance with the relevant criteria. The cumulative noise emissions from all fixed facility noise sources should be considered when determining the appropriate mitigation options.

6.1.3 Modifying factors

Where a noise source contains certain characteristics, such as tonality, impulsiveness, intermittency, irregularity or dominant low-frequency content, the INP describes modifying factors to be applied when assessing amenity and intrusiveness.

The indicative source levels have not been found to trigger the requirement to correct the predicted noise level due to low frequency or tonal components. Notwithstanding, tonal and/or low frequency noise is often observed from fans and the predictions would be revisited during detailed design based on the actual specifications of the final selection of equipment. Based on the assessment presented in this report, receivers in NCA49 have been identified as most likely to exceed the criteria specified in **Table 6-1** should application of a +5 dBA modifying factor be triggered on the basis of the noise characteristics of the finalised equipment.

6.1.4 Operational management and mitigation measures

It is noted that the equipment and sound power levels modelled are indicative only and may be subject to change during the detailed design phase of the project. It is envisaged that the mechanical plant noise sources associated with the fixed facilities will be controllable by common engineering methods that may consist of:

- Judicious location selection
- Noise barriers
- Silencers
- Acoustically lined ductwork
- Acoustic louvres.

The selected mechanical equipment should be reviewed and assessed for conformance with the established criteria at the detailed design stage of the project when specific plant selection is finalised and appropriate noise control measures can be determined. Note that the cumulative noise emissions from all fixed facility noise sources should be considered when determining the appropriate mitigation options.