Planning Approval Consistency Assessment Form

SM-17-00000111

Metro Body of Knowledge (MBoK)

Assessment name:	Sydney Metro West – Revised Westmead metro station box
Prepared by:	Sydney Metro
Prepared for:	Sydney Metro and Western Tunnelling Package contractor
Assessment number:	SMW04
Status:	Final (16 February 2022)
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The Planning Approval Consistency Assessment Form should be completed in accordance with SM-17-00000103 Planning Approval Consistency Assessment Procedure.

1. Approved project

Planning approval reference details (Application/Document No. (including modifications)):

- SSI-10038 Sydney Metro West – Concept and major civil construction work for Sydney Metro West between Westmead and The Bays (Stage 1 of the planning approval process for Sydney Metro West)
- SSI-10038-Mod-1 The Sydney Metro West Westmead to The Bays and Sydney CBD - Modification 1 (Administrative Modification)

Date of determination:

- SSI 10038: 11 March 2021
- SSI-10038-Mod-1: 28 July 2021

Type of planning approval: Critical SSI (Division 5.2)

Approved project

The approved project includes the Concept and major civil construction work between Westmead and The Bays (Stage 1 of the planning approval process). This Consistency Assessment relates to Stage 1 works, as described below.

Approved major civil construction work for Sydney Metro West between Westmead and The Bays

Approved major civil construction work for Sydney Metro West between Westmead and The Bays (Stage 1 of the planning approval process) includes (refer to Section 9 of the Environmental Impact Statement):

- Enabling works, such as demolition, utility supply to construction sites, utility adjustments and modifications to the existing transport network
- Tunnel excavation including tunnel support activities between Westmead and The Bays
- Station excavation for new metro stations at Westmead, Parramatta, Sydney Olympic Park, North Strathfield, Burwood North, Five Dock and The Bays
- Shaft excavation for services facilities
- Civil work for the stabling and maintenance facility at Clyde.

Westmead metro station construction site

The Westmead metro station construction site would cover about 15,750 square metres within the block bound by the T1 Western Line rail corridor, Hawkesbury Road, Bailey Street and Hassall Street. The site currently contains residential and commercial buildings.

The construction site would be used to:

- Carry out the excavation of Westmead metro station and turnback cavern
- Retrieve two tunnel boring machines that would be driven west from Clyde stabling and maintenance facility construction site (and collected by retrieval gantries).

The approved metro station excavation area is located to the south of the existing Westmead Station, in an east-west direction, and predominantly underneath Alexandra Avenue. This station would be constructed using a cut-and-cover technique and the turnback cavern would be constructed using a mined technique and require the removal of about 245,000 cubic metres of spoil. Access to and egress from the Westmead metro station construction site would be left-in from Bailey Street via Hawkesbury Road and left-out via Hawkesbury Road. The location and indicative layout of the Westmead metro station construction site, including vehicle access and egress, are illustrated in Figure 1. As part of the approved project, Alexandra Avenue would be closed between Hassall Street and Hawkesbury Road during construction. Traffic would be temporarily diverted via Hassall Street and Bailey Street, with new and altered traffic signals provided where required.

At the end of construction works at the Westmead metro station construction site, Alexandra Avenue would be permanently realigned between Hassall Street and Hawkesbury Avenue, including a new signalised intersection at Alexandra Avenue, Hawkesbury Road and Grand Avenue (refer to Figure 2).

It is noted that following approval of the Stage 1 works, elements shown on Figure 1 have changed and determined to be consistent with the approved project (refer to Consistency Assessment SMW01, endorsed 13 September 2021). These changes include removal of the following construction activities at the Westmead metro station construction site:

- Tunnel boring machine launch and support services
- Installation of precast lining elements
- Removal of 675,000 cubic metres of spoil from tunnelling works.

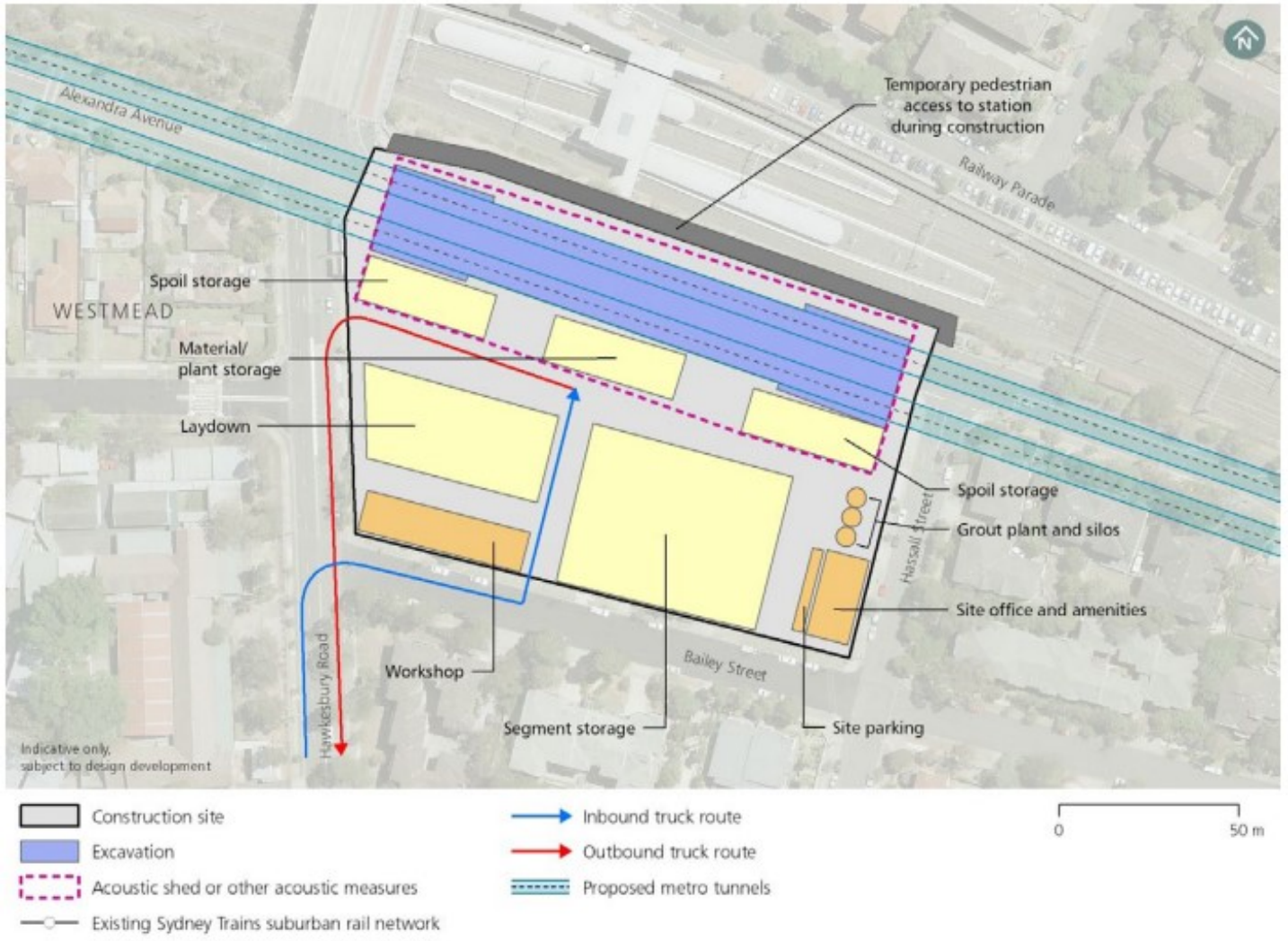


Figure 1 Westmead metro station indicative construction site layout (as per the Environmental Impact Statement)

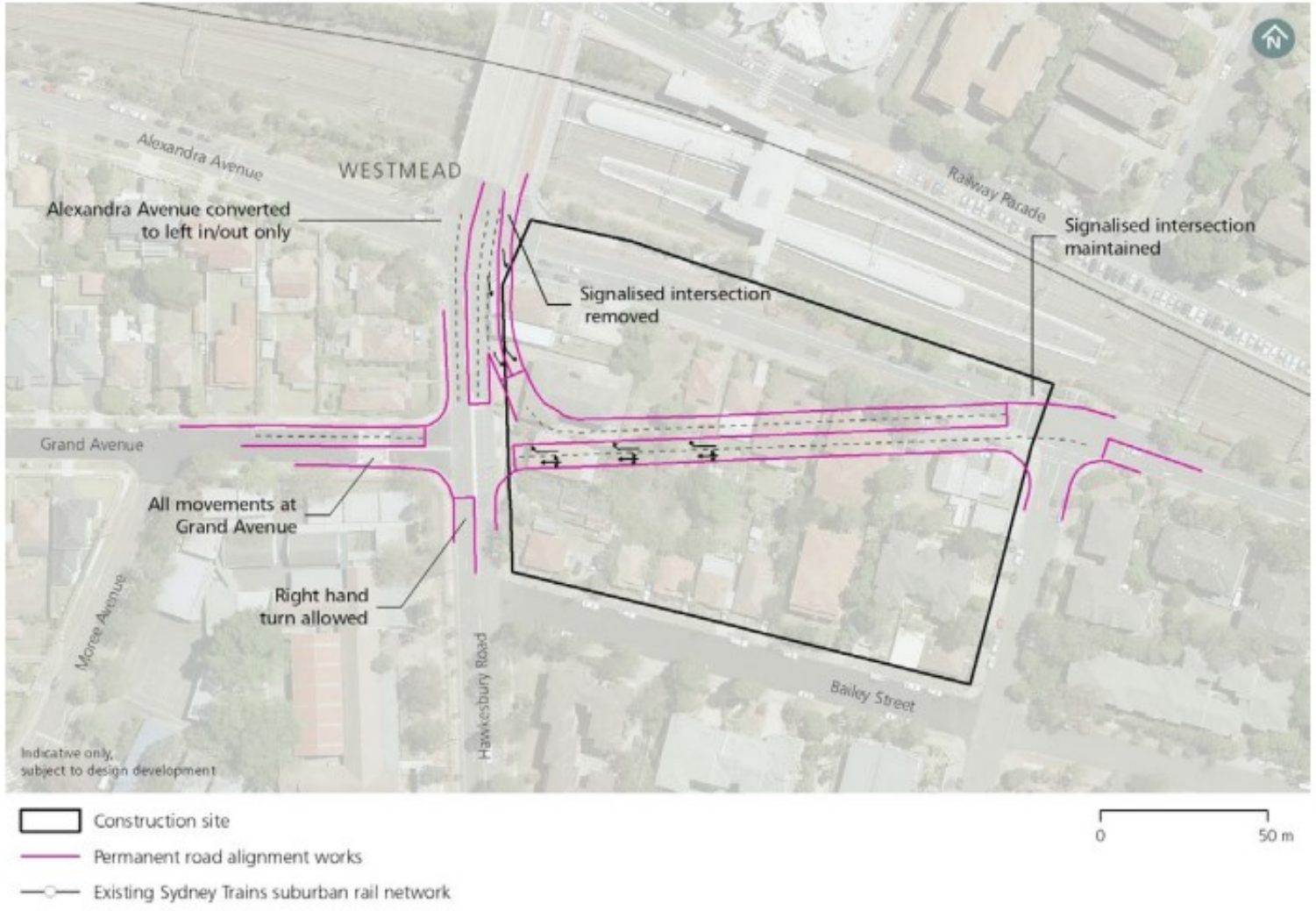


Figure 2 Westmead road alignment works (as per the Environmental Impact Statement)

Relevant background information (including EA, REF, Submissions Report, Director General's Report, MCoA):
This consistency assessment has been undertaken for the Sydney Metro West Concept and major civil construction work for Sydney Metro West between Westmead and The Bays (Stage 1 of the planning approval process). This includes the following planning approval documentation:

- Sydney Metro West - Westmead to The Bays and Sydney CBD (Concept and Stage 1) Environmental Impact Statement (15 April 2020)
- Sydney Metro West - Westmead to The Bays and Sydney CBD (Concept and Stage 1) Submissions Report (20 November 2020)
- Sydney Metro West - Westmead to The Bays and Sydney CBD (Concept and Stage 1) Amendment Report (20 November 2020)
- Sydney Metro West - Westmead to The Bays and Sydney CBD (Concept and Stage 1) Modification 1 - Administrative Modification (July 2021)
- Consolidated Instrument of Approval (28 July 2021).

All documentation has been published on the Department of Planning, Industry and Environment Major Projects website located here (Major Project Number: SSI-10038): https://www.planningportal.nsw.gov.au/major-projects/project/25631

Other relevant documentation prepared as part of design development and construction planning include:

- Consistency Assessment SMW01: Sydney Metro West – Tunnel boring machine drive strategy and future Rosehill crossover (endorsed 13 September 2021).

All proposed works identified in this assessment would be undertaken in accordance with the mitigation measures identified in the Environmental Impact Statement, Submissions Report and Amendment Report and the conditions of approval.

2. Description of proposal

Summary of proposal

Since project approval, further construction planning has been undertaken by Sydney Metro to identify improvements for the construction site through relocation of the station box and to minimise associated impacts. The purpose of this consistency assessment is to assess the revised Westmead metro station construction site, relocated station box excavation area, and the revised tunnel alignment to support the new station location.

Description of proposal

The proposal includes a Westmead metro station construction site that (refer to Figure 5 & Figure 6):

- Relocates the excavation and construction of the station box south-east of the location identified in the Environmental Impact Statement (about 12 metres south and 25 metres east), with cut and cover to remain as the main method for excavation of the station box and the area of station box beneath Hawkesbury Road and Hassall Street to remain as being mined
- Reduces the total area and revises the northern boundary of the construction site to south of Alexandra Avenue. This removes the need to close Alexandra Avenue during construction and permanently realign it between Hassall Street and Hawkesbury Avenue during operation
- Revises the alignment of main tunnels, about 20 metres south-east, to accommodate the revised Westmead metro station box location and stub tunnels (that have been reduced about 155 metres less in length, to the west of the construction site, compared to the Environmental Impact Statement).

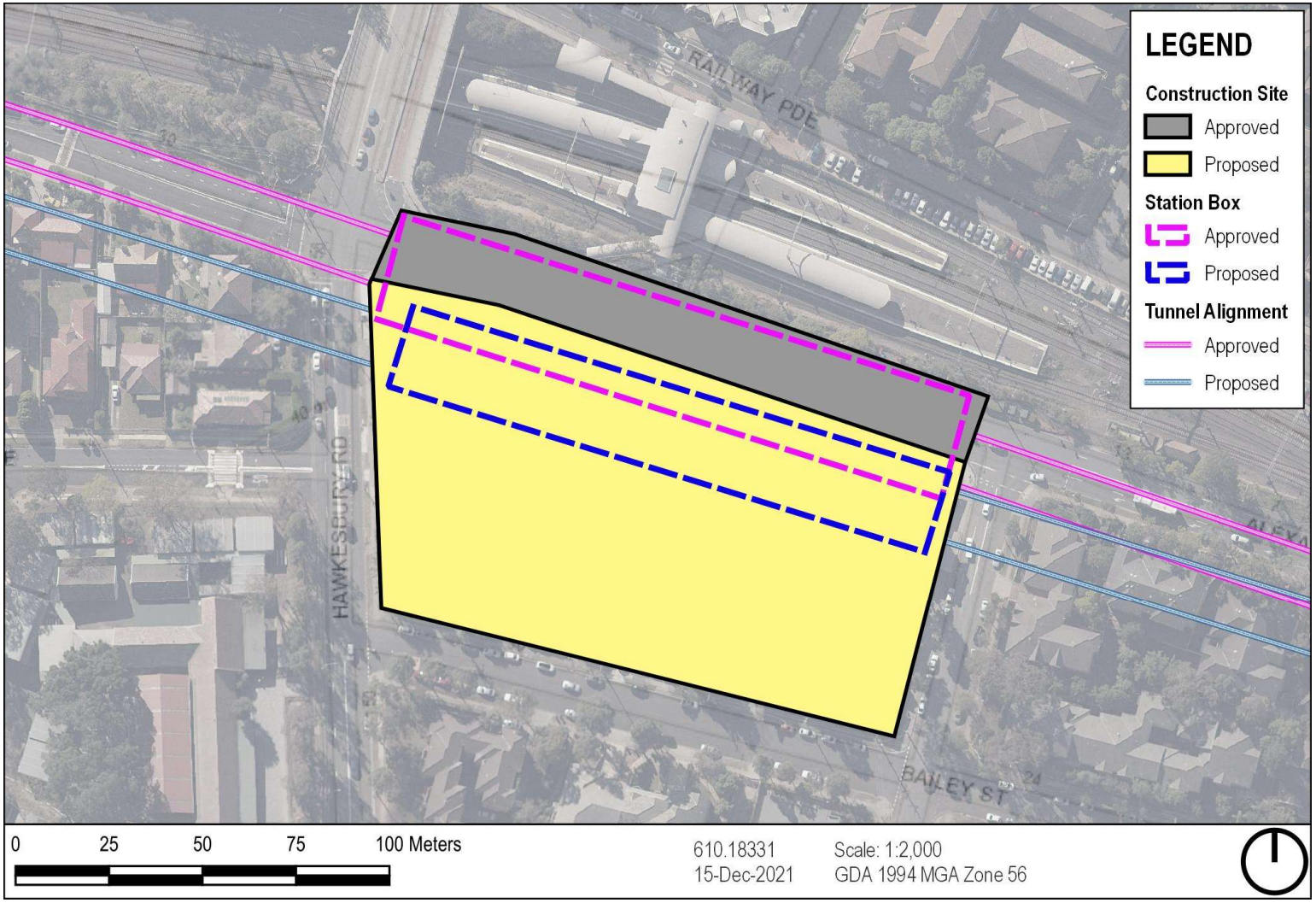


Figure 3 Approved project and proposal for Westmead metro station construction site

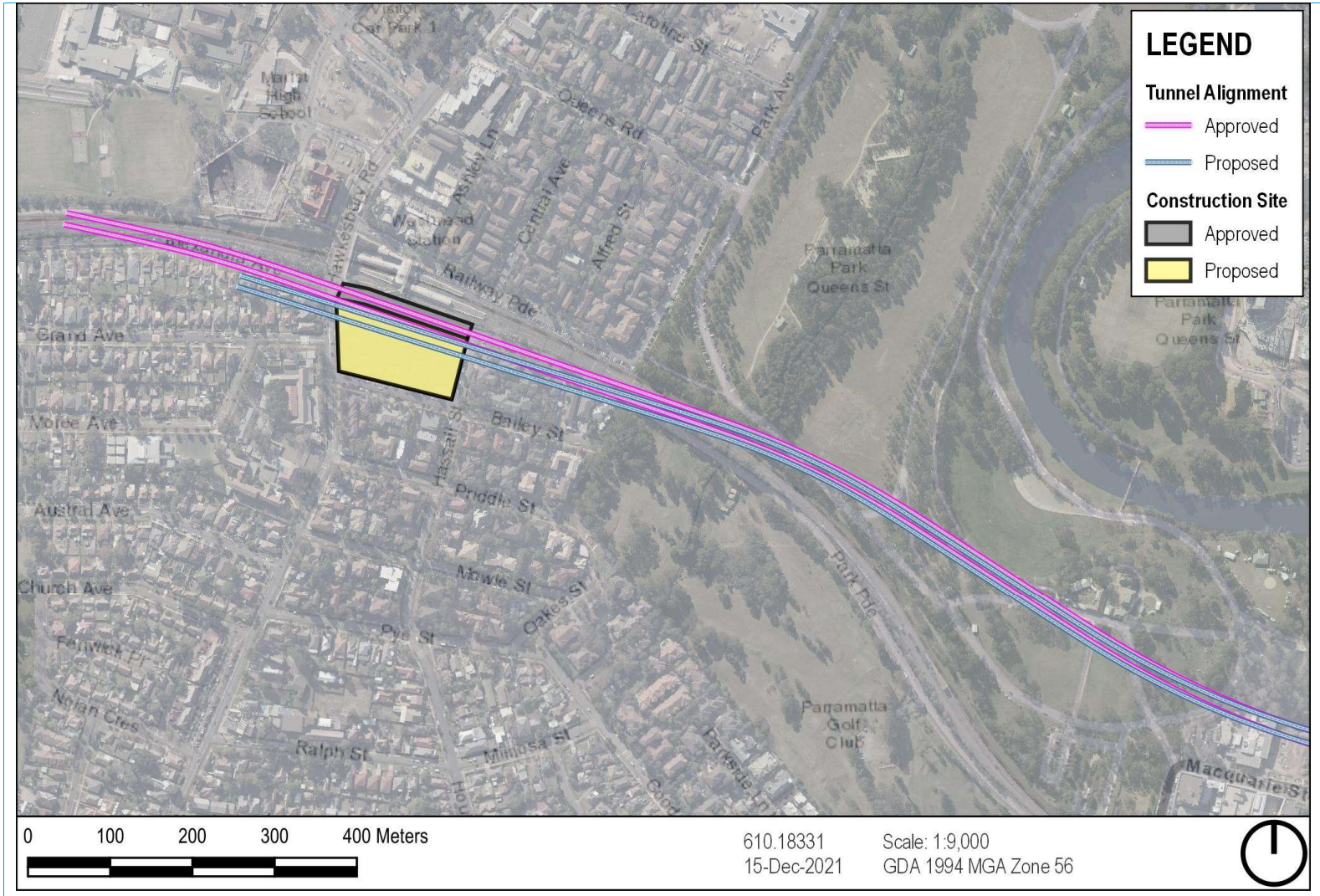


Figure 4 Approved project and proposal for Westmead metro station construction site station box and tunnel alignment

Westmead metro station construction site

The revised construction site would cover about 12,380 square metres and be bound by Hawkesbury Road, Bailey Street, Hassall Street, and Alexandra Avenue. The temporary closure of Alexandra Avenue would still be considered to support the construction activities proposed as part of future planning applications (Stage 3 of the planning approval process).

The construction site would be used to:

- Carry out the excavation of Westmead metro station (including station cavern), crossover cavern, nozzle enlargements and stub tunnels.
- Retrieve two tunnel boring machines that would be driven west from Clyde stabling and maintenance facility construction site in Rosehill (and collected by retrieval gantries or other suitable means).

The majority of the station box excavation would be constructed using a cut-and-cover technique, with the station cavern section (west), crossover cavern (east), nozzle enlargements and stub tunnels being constructed using a mined technique, and require the removal of about 200,000 cubic metres of spoil. Access to and egress from the Westmead metro station construction site would be as per the approved project being left-in from Bailey Street via Hawkesbury Road and left-out via Hawkesbury Road. Access to Westmead metro station during construction would continue to be considered as part of design development and construction planning.

The tunnel would be realigned up to approximately 20 metres south-east of the tunnel corridor compared with the indicative alignment in the Environmental Impact Statement. The environmental characteristics of the proposed tunnel realignment would be generally similar to the environmental characteristics of the indicative tunnel corridor in the Environmental Impact Statement.

3. Timeframe

The approved standard working hours for the approved project are as follows:

- 07:00 – 18:00 Monday to Friday
- 08:00 – 18:00 Saturdays
- No works Sundays or Public holidays.

The approved project also permits the following activities to be carried our 24 hours per day, seven days per week:

- Tunnelling (excluding cut and cover tunnelling and surface works)
- Haulage of spoil except between the hours of 10:00pm and 7:00am to / from the Westmead construction site

Other out of hours works which may be required would be undertaken in accordance with the conditions of approval, and the applicable contractor's Environmental Protection Licence. The construction hours for the proposed change are consistent with the approved project.

The indicative construction program, as set in Section 9.3 of the Environmental Impact Statement, would be revised to improve the construction interfaces with other construction activities along the alignment, however the overall construction program timeframes for the approved project would remain consistent. Major civil construction work for Westmead metro station would commence in early 2022 and end by mid-2025 (around three years), as part of this proposal.

4. Site description

Westmead metro station construction site

The revised construction site would cover about 12,380 square metres (reduced from the site proposed in the Environmental Impact Statement) and still be bound by Hawkesbury Road, Bailey Street and Hassall Street to the west, south and east respectively. The northern boundary of the site would now be bound by Alexandra Avenue rather than the T1 Western Line rail corridor. The site currently contains residential and commercial buildings, which have been approved for demolition.

5. Site environmental characteristics

A summary of the site environmental characteristics for Westmead metro station includes:

- The area of the revised construction site historically has had low density residential land uses since at least 1955 with scattered trees and vegetation and has remained largely unchanged with extensions and subdivisions to properties and the widening of Alexandra Avenue in the 1960s
- Land use surrounding the Westmead metro station construction site include:
  - North of the existing Westmead Station is the Westmead town centre and the health and education precinct including Westmead Hospital. Westmead town centre includes a range of businesses providing commercial and retail services, many which are focussed on medical services such as medical centres, consulting rooms, specialist health services, and health offices and interspersed with retail such as cafes
  - North-east of the site, beyond the existing rail corridor, is a medium density residential area with apartments of three to four storeys. North-west of the site is Western Sydney University's Westmead Campus, a tertiary education area which is currently under development
  - East of the site predominantly includes medium density residential apartments, with Parramatta Park beyond the residential area
  - South of the site is a largely residential area, which includes mostly medium density residential buildings
  - West of the site is lower density housing, with the Westmead Public School immediately to the south-west of the site.
- The nearest watercourse is Domain Creek about 500 metres to the east, and Toongabbie Creek about one kilometre to the north that both flow to Parramatta River which is about a kilometre to the east from the revised construction site
- There are limited areas within the revised construction site of naturally occurring native vegetation present as most of the vegetation is exotic. Street trees and residential garden plantings include some native species found in NSW.
- The revised site has a moderate contamination risk with historical construction waste (building materials and demolition wastes) and leaks and spills (from a former fuel station on the corner of Alexandra Avenue and Hassel Street). There are no sites listed on the NSW Environment Protection Authority Contaminated Sites Register within 500 metres and NSW EPA Protection of the Environment Operations Act public register that have current environment protection licences
- Existing noise levels are generally controlled by the surrounding road network and existing rail line. The following two Noise Catchment Areas are located to the north and south of the existing Westmead Station:
  - NCA01 is north of the existing rail corridor in Westmead and is mostly residential receivers (with other sensitive receivers such as commercial, educational, medical facilities in the area)

- NCA02 is south of the existing rail corridor in Westmead and is mostly residential (with other sensitive receivers including educational, childcare and places of worship facilities in the area)

- There are no heritage items or conservation areas within the revised construction site, however Westmead Public School, that is locally listed is adjacent south-west of the construction site.
- The archaeological potential of the Westmead metro station construction site is low. The site has been subjected to substantial levels of surface disturbance, due to the construction of commercial and residential buildings and infrastructure.

6. Justification for the proposed works

Justification for each aspect of the proposal is as follows:

- **Revised station box location**: further design development and construction planning has identified that the construction site layout can be organised without requiring the space that Alexandra Avenue currently occupies. This was enabled as a result of the construction site no longer requiring the tunnelling support services (refer to Consistency Assessment SMW01, endorsed 13 September 2021), hence the construction site area could be reduced, and construction site layout reconfigured. This allows for Alexandra Avenue to remain open during construction of the Stage 1 works and avoid the need to permanently realign Alexandra Avenue between Hassall Street and Hawkesbury Avenue, resulting in a reduction in traffic and transport impacts compared to the approved project. Future Sydney Metro West planning applications would separately consider whether any temporary closures of Alexandra Avenue would be required to support future construction activities
- **Tunnel realignment:** the indicative tunnel alignment in the Environmental Impact Statement has been realigned further southeast to accommodate the revised location for the Westmead metro station box. The design of the tunnel realignment has considered the impacts on the tunnelling program, spoil volumes and existing land uses to ensure these elements are consistent with the approved project. This includes train storage no longer being required, allowing the stub tunnel length to the west of the construction site to be reduced.

7. Environmental benefit

Benefits of the proposal

The proposal would include the following environmental benefits:

- **Traffic and transport:** Alexandra Avenue would remain open during construction of the Stage 1 works and no longer require permanent realignment between Hassall Street and Hawkesbury Avenue. Retaining Alexandra Avenue in its current configuration would result in a reduction of transport and traffic impacts when compared to the approved project and include:
    - Traffic would no longer be required to be diverted via Hassall Street and Bailey Street during construction of Stage 1 works, generally minimising impacts to traffic and bus travel times
    - Pedestrians and cyclists would no longer be required to seek alternative routes to Alexandra Avenue during construction of Stage 1 works, maintaining pedestrian and cycling connectivity
    - Public transport connectivity would be retained, with bus stops no longer needing to be relocated further away from the southern entrance of the existing Westmead Station.
- **Noise and vibration:** the revised construction site, station box relocation and revised tunnel alignment would include:
    - Airborne noise from outdoor construction is predicted to impact fewer total receivers due to the reduced construction site area
    - Ground-borne noise from the tunnelling of the revised alignment is predicted to impact fewer total receivers due to the shortened stub tunnels to the west of the construction site
    - Road traffic noise impacts from the diversion of public traffic are expected to reduce due to the proposal no longer permanently realigning Alexandra Avenue between Hawkesbury Road and Hassall Street (this includes buses and other traffic no longer diverted in both directions past Westmead Public School).

Cumulative environmental benefits

The revised Westmead metro station construction site layout together with the changes at Westmead metro station construction site as a result of no longer requiring tunnel boring machine support services (refer to Consistency Assessment SMW01, endorsed 13 September 2021) would provide environmental benefits such as significant reduction in construction traffic movement in the area and removal of these noisy activities. This would provide positive socio-economic impacts to the community.

8. Control Measures

The Sydney Metro Construction Environmental Management Framework, Construction Noise and Vibration Standard and Construction Traffic Management Framework set out the overall approach to environmental management. The proposal would also be undertaken in accordance with the mitigation measures and the conditions of approval for the approved project.

The proposal would be managed in accordance with the relevant Construction Environmental Management Plans, which must be produced in accordance with the conditions of approval for the approved project.

9. Climate Change Impacts

No change in climate change risk as identified in the Environmental Impact Statement as a result of this change.

10. Impact Assessment – Construction

Aspect	Nature and extent of impacts (negative and positive) during construction (if control measures implemented) of the proposed/activity, relative to the Approved Project	Proposed Control Measures in addition to project COA and REMMs	Minimal Impact Y/N	Endorsed	
				Y/N	Comments
Flora and fauna	**Flora and fauna** No additional impacts from the approved project. There would be positive impacts to flora and fauna with the revised construction site area requiring less street trees and other vegetation to be removed. **Groundwater dependent ecosystems** No additional impacts from the approved project. There would be similar impacts to groundwater dependent ecosystems to the approved project.	No additional measures required.	Y	Y	
Surface water	No additional impacts from the approved project. There would be minor surface water benefits with the revised construction site area that would allow for less wastewater to accumulate and impact surrounding water bodies.	No additional measures required.	Y	Y	
Groundwater	No additional impacts from the approved project. The revised station box location and tunnel realignment groundwater impacts would not significantly change from the approved project.	No additional measures required.	Y	Y	
Air quality	No additional impacts from the approved project. The proposal would reduce air quality impacts through reducing the size of the construction site therefore the area for dust generating activities.	No additional measures required.	Y	Y	
Noise and vibration	A construction Noise and Vibration Impact Assessment memorandum (SLR, 2021) was prepared to review the potential noise and vibration impacts associated with the changes to the Westmead metro station construction site as a result of the proposal (refer to Appendix A). The assessment summarised the following in comparison to the approved project: • Airborne noise from outdoor construction is predicted to have reduced impact at up to around 10 total receivers due to the reduced construction site area • Airborne noise from shaft excavation is predicted to cause higher impacts at some receivers due to the relocated station box moving closer to the	No additional measures required. Noise impacts would also continue to be managed in accordance with the Sydney Metro Construction Noise and Vibration Standard.	Y	Y	

Aspect	Nature and extent of impacts (negative and positive) during construction (if control measures implemented) of the proposed/activity, relative to the Approved Project	Proposed Control Measures in addition to project COA and REMMs	Minimal Impact Y/N	Endorsed	
				Y/N	Comments
	residential receivers in NCA02 (south of the site). During the night-time when excavation is within the acoustic shed and the doors are closed, increased impacts are predicted at up to around 51 total receivers. • Highly noise affected impacts are predicted to be generally consistent with the approved project, with two fewer receivers predicted to be impacted. • The ground-borne noise and vibration impacts from vibration intensive shaft excavation are predicted to be generally consistent with the approved project. Two of the closest receivers are predicted to have a decrease impact category and one receiver is predicted to have an increased impact due to the relocation of the station box • Ground-borne noise from the tunnelling of the revised alignment is predicted to impact fewer total receivers due to the shortened stub tunnels to the west of the site. Some receivers are, however, predicted to have increased ground-borne noise impacts due to the tunnel alignment being relocated to the south of Alexandra Avenue, which is closer to certain receivers. During the daytime, decreased ground-borne noise impacts are predicted at five receivers and increased impacts are predicted at two receivers. During the night-time, decreased ground-borne noise impacts are predicted at 19 receivers and increased impacts are predicted at five receivers. • Vibration from the tunnelling of the revised alignment is predicted to potentially exceed the human comfort criteria up to six additional receivers during the daytime and up to two additional receivers during the night-time. This means perceptible levels of vibration may occur when tunnelling work is at the closest point below these receivers. This is due to the tunnel alignment being relocated south, which is closer to certain receivers on Alexandra Avenue. • Road traffic noise impacts from the diversion of public traffic are expected to reduce due to the proposal no longer permanently realigning Alexandra Avenue between Hawkesbury Road and Hassall Street (this includes buses and other traffic no longer diverted in both directions past Westmead Public School). As such, the Noise and Vibration Impact Assessment (SLR, 2021) concluded that the assessed noise and vibration impacts from works specific to the proposal are,				

Aspect	Nature and extent of impacts (negative and positive) during construction (if control measures implemented) of the proposed/activity, relative to the Approved Project	Proposed Control Measures in addition to project COA and REMMs	Minimal Impact Y/N	Endorsed	
				Y/N	Comments
	in general, consistent with the range and magnitude of impacts predicted for the approved project. While work associated with the proposal is predicted to impact some additional receivers during certain activities, there are other receivers no longer receiving impacts, Therefore, the proposal would not require any changes to, or additional, noise and vibration mitigation measures than those provided for the approved project and impacts at additionally affected receivers would be managed using the relevant measures specified for the approved project				
Aboriginal heritage	No change from the approved project.	No additional measures required.	Y	Y	
Non-Aboriginal heritage	No additional impacts from the approved project. No heritage items or conservation areas are within the revised construction site. Westmead Public School, that is locally listed, is adjacent south-west of the construction site may be indirectly impacted through the construction site changing the surrounding setting and context of the item, however views and vistas are not considered integral in the items heritage significance. This impact would be the consistent to the approved project.	No additional measures required.	Y	Y	
Stakeholders including the community	The proposal would generally provide beneficial outcomes to some stakeholders minimising noise and vibration and traffic and transport impacts. It is anticipated some receivers would receive additional impacts, however those receivers would be managed using the relevant measures specified for the approved project. Consultation would continue with stakeholders including the community and updates provided through communication streams through the approved project.	No additional measures required.	Y	Y	
Traffic and transport	The proposal would provide beneficial traffic and transport outcomes through Alexandra Avenue remaining open during construction of Stage 1 works and avoiding the need to permanently realign Alexandra Avenue between Hassall Street and Hawkesbury Avenue. A summary of the benefits associated with the proposal is provided below:	No additional measures required.	Y	Y	

Aspect	Nature and extent of impacts (negative and positive) during construction (if control measures implemented) of the proposed/activity, relative to the Approved Project	Proposed Control Measures in addition to project COA and REMMs	Minimal Impact Y/N	Endorsed	
				Y/N	Comments
	• Traffic would no longer be required to be diverted via Hassall Street and Bailey Street during construction generally minimising impacts to traffic and bus travel times • Pedestrians and cyclists would no longer be required to seek alternative routes to Alexandra Avenue maintaining pedestrian and cycling connectivity • Public transport connectivity would be retained, with bus stops no longer needing to be relocated further away from the southern entrance of existing Westmead Station Other aspects of traffic and transport such as construction traffic (light and heavy vehicles), construction haulage routes, parking and property access would be consistent with the approved project.				
Waste	No additional impacts from the approved project. The revised station box location and tunnel alignment would have positive impacts due to the reduced amount of spoil compared to the approved project. This is due to the reduced length of the stub tunnels, about 155 metres less, at Westmead metro station than in the Environmental Impact Statement. The total amount of spoil at Westmead metro station construction site would be reduced from about 245,000 cubic metres to about 200,000 to cubic metres.	No additional measures required.	Y	Y	
Social	No additional impacts from the approved project. The proposal would have positive socio-economic impact on the surrounding community through greater connectivity for traffic and transport network and access to the public transport with Alexandra Avenue remaining open during construction of Stage 1 works.	No additional measures required.	Y	Y	
Economic	No change from the approved project.	No additional measures required.	Y	Y	
Visual	No additional impacts from the approved project. There would be improved visual amenity due to the reduced construction site and allowing Alexandra Avenue to remain open during construction of Stage 1 works.	No additional measures required.	Y	Y	

Aspect	Nature and extent of impacts (negative and positive) during construction (if control measures implemented) of the proposed/activity, relative to the Approved Project	Proposed Control Measures in addition to project COA and REMMs	Minimal Impact Y/N	Endorsed	
				Y/N	Comments
Urban design	No change from the approved project.	No additional measures required.	Y	Y	
Geotechnical	No change from the approved project. The geotechnical characteristics around the revised tunnel alignment are generally similar to the indicative tunnel corridor identified in the Environmental Impact Statement.	No additional measures required.	Y	Y	
Land use	No change from the approved project.	No additional measures required.	Y	Y	
Contamination	No additional impacts from the approved project. There would be similar contamination risks as the approved project.	No additional measures required.	Y	Y	
Property	The following changes to property are required as a result of the proposal: - Surface: part of Alexandra Avenue was identified for acquisition as part of the approved project, however it is no longer required as a result of the proposal - Substratum: seven properties no longer required for acquisition, with an additional six required (overall one less substratum property required for acquisition).	No additional measures required.	Y	Y	
Climate change adaptation	No change from the approved project.	No additional measures required.	Y	Y	
Hazard & risk	No change from the approved project.	No additional measures required.	Y	Y	
Other	No change from the approved project.	No additional measures required.	Y	Y	

Aspect	Nature and extent of impacts (negative and positive) during construction (if control measures implemented) of the proposed/activity, relative to the Approved Project	Proposed Control Measures in addition to project COA and REMMs	Minimal Impact Y/N	Endorsed	
				Y/N	Comments
Management and mitigation measures	No change from the approved project.	No additional measures required.	Y	Y	

11. Impact Assessment – Operation

Stage 1 of the planning application for Sydney Metro West (subject of this Consistency Assessment) is for major civil construction work for Sydney Metro West between Westmead and The Bays. At this stage, measures to avoid or minimise impacts have been developed only for major civil construction work for Sydney Metro West between Westmead and The Bays – which involves construction only. Impacts applicable to the operational aspects of Sydney Metro West including operation stage environmental mitigation measures would be developed when planning approval applications are made for future stages. This includes the scope of this Consistency Assessment with details of the associated operational impacts and appropriate mitigation to be provided as part of the relevant future planning approval staged application.

As such, operational impacts of the proposal are not applicable, and therefore there are no changes from the approved project are anticipated.

Aspect	Nature and extent of impacts (negative and positive) during operation (if control measures implemented) of the proposed activity/works, relative to the Approved Project	Proposed Control Measures in addition to project COA and REMMs	Minimal Impact Y/N	Endorsed	
				Y/N	Comments
Flora and fauna	No change from the approved project.	No additional measures required.	Y	Y	
Water	No change from the approved project.	No additional measures required.	Y	Y	
Air quality	No change from the approved project.	No additional measures required.	Y	Y	
Noise and vibration	No change from the approved project.	No additional measures required.	Y	Y	
Aboriginal heritage	No change from the approved project.	No additional measures required.	Y	Y	
Non-Aboriginal heritage	No change from the approved project.	No additional measures required.	Y	Y	
Community and stakeholder	No change from the approved project.	No additional measures required.	Y	Y	
Traffic	No longer requiring the realignment of Alexandra Avenue during operation. Stage 3 of the planning approval process would assess traffic during operation of the project.	No additional measures required.	Y	Y	

Aspect	Nature and extent of impacts (negative and positive) during operation (if control measures implemented) of the proposed activity/works, relative to the Approved Project	Proposed Control Measures in addition to project COA and REMMs	Minimal Impact Y/N	Endorsed	
				Y/N	Comments
Waste	No change from the approved project.	No additional measures required.	Y	Y	
Social	No change from the approved project.	No additional measures required.	Y	Y	
Economic	No change from the approved project.	No additional measures required.	Y	Y	
Visual	No change from the approved project.	No additional measures required.	Y	Y	
Urban design	No change from the approved project.	No additional measures required.	Y	Y	
Geotechnical	No change from the approved project.	No additional measures required.	Y	Y	
Land use	No change from the approved project.	No additional measures required.	Y	Y	
Climate change adaptation	No change from the approved project.	No additional measures required.	Y	Y	
Risk	No change from the approved project.	No additional measures required.	Y	Y	
Other	No change from the approved project.	No additional measures required.	Y	Y	
Management and mitigation measures	No change from the approved project.	No additional measures required.	Y	Y	

12. Consistency with the Approved Project

Based on a review and understanding of the existing Approved Project and the proposed modifications, is there is a transformation of the Project?	No. The proposal would not transform the project. The project would continue to provide major civil works between Westmead and The Bays as part of the approved project.
Is the project as modified consistent with the objectives and functions of the Approved Project as a whole?	Yes. The proposal would be consistent with the objectives and functions of the approved project.
Is the project as modified consistent with the objectives and functions of elements of the Approved Project?	Yes. The proposal would be consistent with the objectives and functions of the approved works for the project. The activities proposed to be undertaken are generally consistent with the activities identified for the approved project.
Are there any new environmental impacts as a result of the proposed works/modifications?	No. There would be no new environmental risks as a result of the proposal. All risks identified for the approved project and the proposal would be adequately addressed through the application of the mitigation measures provided in the Environmental Impact Statement, Submissions Report, Amendment Report and the Instrument of Approval.
Is the project as modified consistent with the conditions of approval?	Yes. The proposal would be consistent with the conditions of approval.
Are the impacts of the proposed activity/works known and understood?	Yes. The impacts of the proposal are understood and will be accounted for by implementing the existing mitigation measures provided in the Environmental Impact Statement, Submissions Report, Amendment Report and the Instrument of Approval for the approved project. These would be implemented through the Sydney Metro Construction Environment Management Framework, Construction Traffic Management Framework and Construction Noise and Vibration Standard.
Are the impacts of the proposed activity/works able to be managed so as not to have an adverse impact?	Yes. The impacts of the proposal can be managed so as to avoid an adverse impact.

13. Other Environmental Approvals

Identify all other approvals required for the project:	N/A

Author certification

To be completed by person preparing checklist.

I certify that to the best of my knowledge this Consistency Checklist:

- Examines and takes into account the fullest extent possible all matters affecting or likely to affect the environment as a result of activities associated with the Proposed Revision; and
- Examines the consistency of the Proposed Revision with the Approved Project; is accurate in all material respects and does not omit any material information.

Name:	Ari Stypel	Signature:	
Title:	Planning Approvals Manager		
Company:	Sydney Metro	Date:	16 February 2022

This section is for Sydney Metro only.

Application supported and submitted by			
Name:	Yvette Buchli	Date:	16 February 2022
Title:	Associate Director Planning Approvals	Comments:	
Signature:	YvetteBuchli		

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

Yes	The proposed activity/works are consistent and no further assessment is required.
No	The proposed works/activity is not consistent with the Approved Project. A modification or a new activity approval/ consent is required. Advise Project Manager of appropriate alternative planning approvals pathway to be undertaken.

Endorsed by			
Name:	Carolyn Riley	Date:	16 February 2022
Title:	Director Environment, Sustainability and Planning	Comments:	
Signature:			

Appendix A - Noise and Vibration Impact Assessment

Memorandum

To:	Ari Stypel	**At:**	Sydney Metro
From:	Jordan McMahon	**At:**	SLR Consulting Australia Pty Ltd
Date:		**Ref:**	SMW_WestmeadCA_AppA_NVIA_Rev5
Subject:			
	Noise and Vibration		

1 Introduction

1.1 Overview

Sydney Metro is Australia's biggest public transport program. The Sydney Metro West project is part of the broader Sydney Metro and includes a new 24-kilometre metro line that will connect Greater Parramatta with the Sydney CBD. Stations include Westmead, Parramatta, Sydney Olympic Park, North Strathfield, Burwood North, Five Dock, The Bays, Pyrmont and Hunter Street (Sydney CBD). This infrastructure investment will double the rail capacity of the Greater Parramatta to Sydney CBD corridor with a travel time target between the two centres of about 20 minutes.

The planning approval process for Sydney Metro West is being completed as a staged infrastructure application under section 5.20 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

1.2 The Approved Project

Planning approval for the Sydney Metro West Concept, from Westmead to the Sydney CBD, as well as station excavation and tunnelling between Westmead and The Bays (the approved project) was granted by the Minister for Planning and Public Spaces on 11 March 2020 (SSI-10038) and is described in the following documents:

- The Sydney Metro West Environmental Impact Statement – Westmead to The Bays and Sydney CBD (Sydney Metro, 2020a)
- The Sydney Metro West Westmead to The Bays and Sydney CBD Submissions Report (Concept and Stage 1) (Sydney Metro, 2020b)
- The Sydney Metro West Westmead to The Bays and Sydney CBD Amendment Report (Concept and Stage 1) (Sydney Metro, 2020c)
- Conditions of Approval for Sydney Metro West – Concept and Stage 1 Construction (SSI 10038) (Department of Planning and Environment, 2021).

1.3 The Proposal

The proposal includes the Westmead metro station construction site that relocates:

- Excavation and construction of the station box south-east of the existing location (about 12 metres south and 25 metres east, with cut and cover to remain as the method for construction of the station box and tunnelling beneath Hawkesbury Road and Hassall Street to remain as mining)

- The northern boundary, and reducing the area, of the construction site to south of Alexandra Avenue (removing the need to close Alexandra Avenue during construction and permanently realigned between Hassall Street and Hawkesbury Avenue during operation)
- The main tunnels to accommodate the revised Westmead metro station box location move about 20 metres south east.

This memorandum provides a technical review of the potential noise and vibration impacts associated with the proposal. These are shown in **Figure 1** and **Figure 2**.

Figure 1 Approved and Revised Westmead Metro Station Construction Site

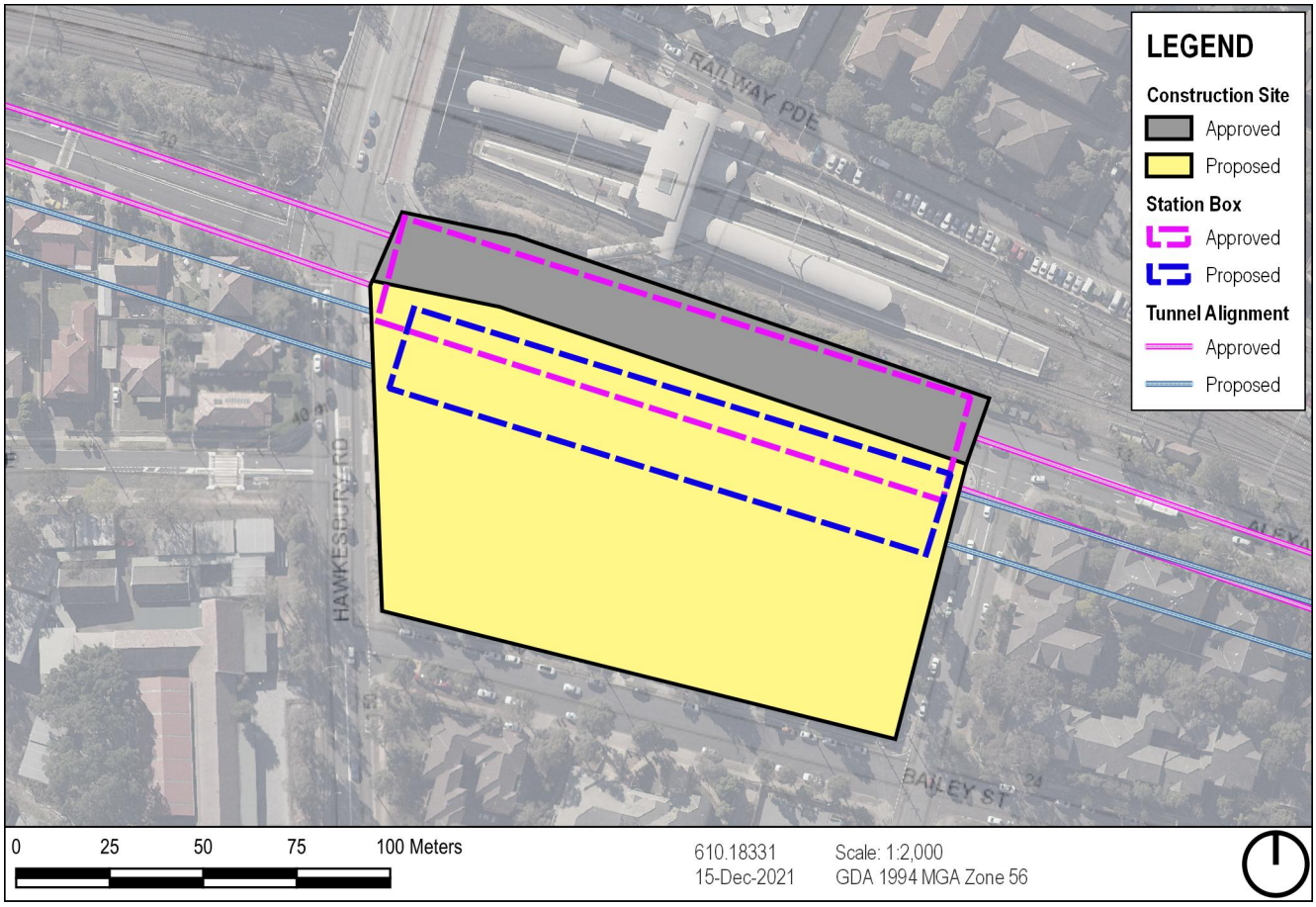
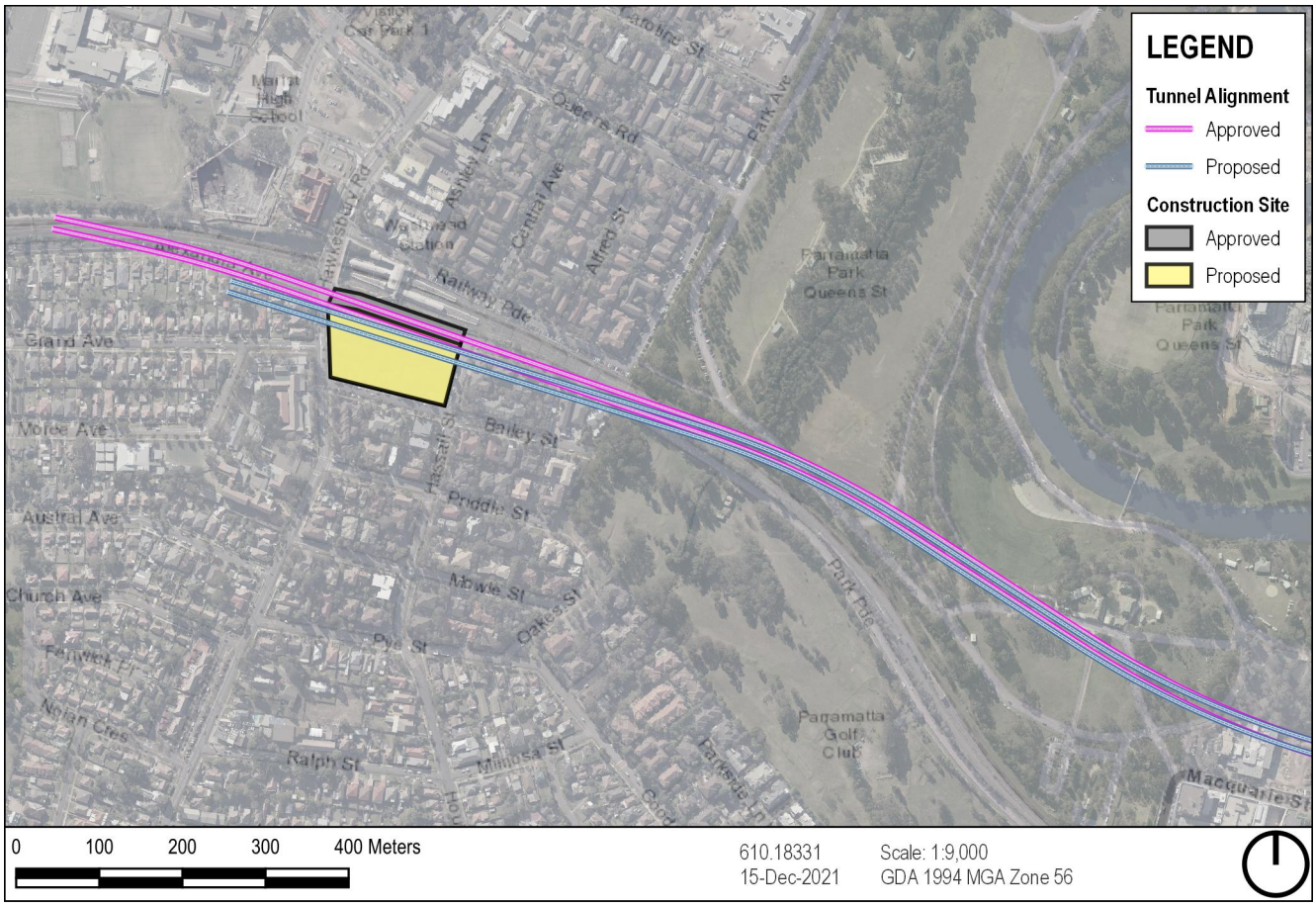


Figure 2 Approved and Revised Tunnel Alignment



2 Existing Environment

2.1 Study Area

The study area for this assessment is centred on the Westmead metro station construction site. This study area contains two Noise Catchments Areas (NCA01 and NCA02) which are to the north and south of the existing Westmead Station, and were defined in the Technical Paper 2 (Noise and vibration) of the Sydney Metro West Environmental Impact Statement – Westmead to The Bays and Sydney CBD (Sydney Metro, 2020a).

The revised construction site is located to the south of the existing Westmead Station and is bound by Alexandra Avenue to the north, Hawkesbury Road to the west, Hassall Street to the east and Baily Street to the south.

Existing noise levels in this study area are generally controlled by transportation noise from the surrounding road network and existing rail line. The area surrounding the construction site is generally suburban and the nearest receivers are residential.

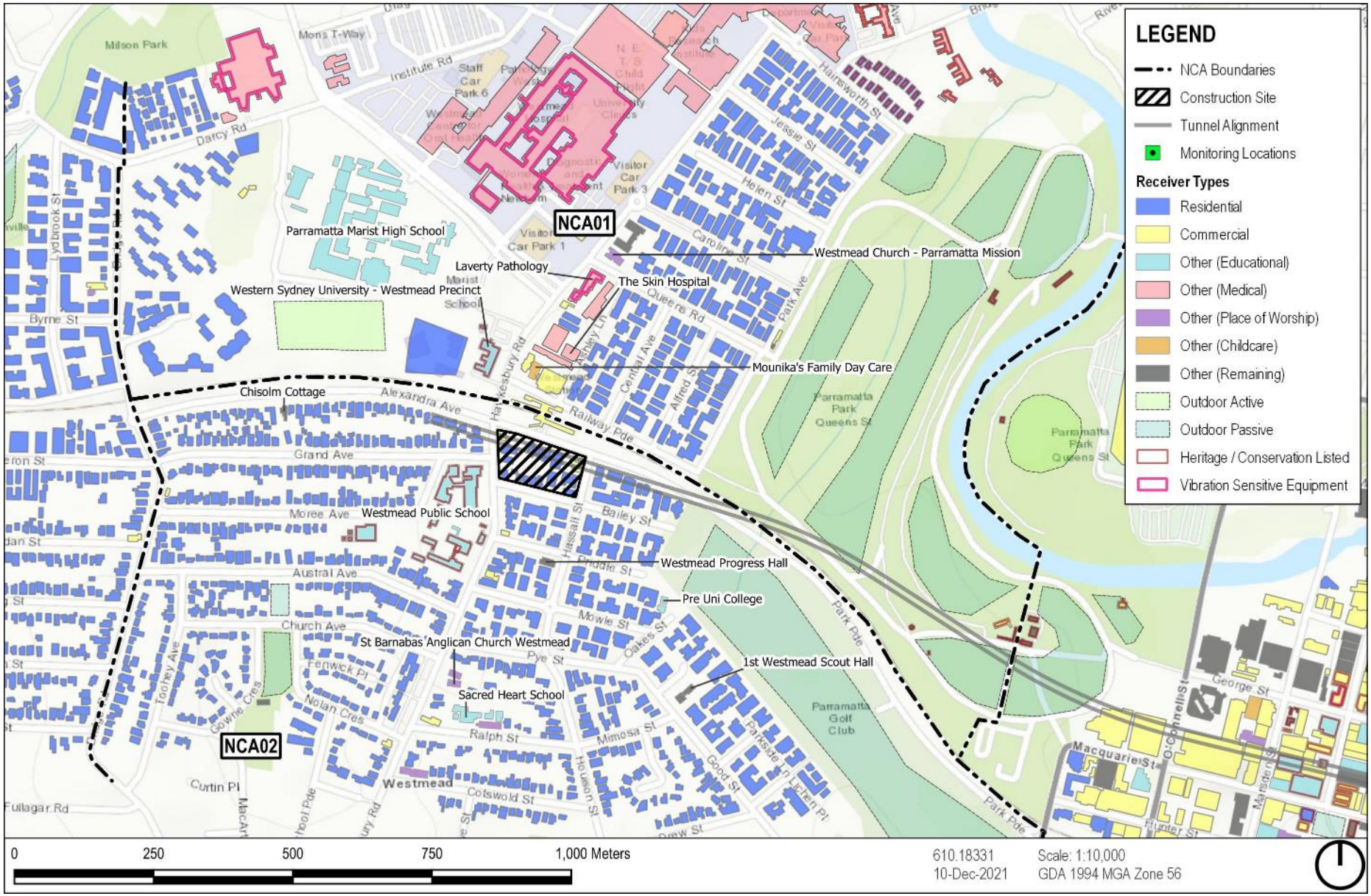
The NCAs in the study area are described in **Table 1** and shown in **Figure 3.**

Table 1 Noise Catchment Areas and Surrounding Land Uses

NCA	Minimum distance (metres)[1]	Description
NCA01	80	North of the existing rail corridor in Westmead and mainly residential. 'Other sensitive' receivers include Westmead Hospital, Western Sydney University – Westmead, and Parramatta Marist High School. A child care centre and a number of medical facilities are to the north of the existing Westmead Station.
NCA02	25	South of the existing rail corridor and mainly residential. Westmead Primary School is in the north of the catchment on Hawksbury Road.

Note 1: Approximate minimum horizontal distance from the proposed Westmead metro station construction site to nearest sensitive receivers.

Figure 3 Construction Site, Tunnelling Alignment and Sensitive Receivers Map



2.2 Noise Survey and Monitoring Locations

Ambient noise monitoring was completed in the Westmead study area between March and July 2019 at two representative monitoring locations, as shown in **Figure 3**. The measured noise levels have been used to determine the existing noise environment and to set criteria to assess the potential impacts. The monitoring results are summarised in **Table 2**.

Table 2 Summary of Unattended Noise Monitoring Results

Location ID	Address	Noise Level (dBA)[1]					
		Background Noise (RBL)			Average Noise Level (LAeq)		
		Day[2]	Evening[2]	Night[2]	Day	Evening	Night
B.01	8-12 Alexandra Avenue, Westmead[3]	49	47	37	67	67	62
B.02	14A Central Avenue, Westmead	48	46	41	58	53	51

Note 1: The RBL and L_{Aeq} noise levels have been determined with reference to the procedures in the *Noise Policy for Industry* (NPfI).

Note 2: Daytime is 7.00 am to 6.00 pm, evening is 6.00 pm to 10.00 pm and night-time is 10.00 pm to 7.00 am.

3 Construction Guidelines

3.1 Construction Airborne Noise Guidelines

The NSW *Interim Construction Noise Guideline* (ICNG) has been used for assessing and managing impacts from construction noise, as per the assessment of the approved project.

The ICNG contains procedures for determining project specific Noise Management Levels (NMLs) for sensitive receivers. The realistic 'worst-case' noise levels from construction of a project are predicted and then compared to the NMLs in a 15-minute assessment period to determine the likely impacts.

The NMLs are not mandatory limits, however, where construction noise levels are predicted or measured to be above the NMLs, feasible and reasonable work practices to minimise noise emissions are to be investigated.

All NMLs applied in the following assessment are consistent with those presented in the Technical Paper 2 (Noise and vibration) of the Sydney Metro West Environmental Impact Statement – Westmead to The Bays and Sydney CBD (Sydney Metro, 2020a).

3.1.1 Residential Receivers

The residential NMLs have been determined using the results from the unattended ambient noise monitoring and are shown in **Table 3**.

Table 3 Residential Receiver Construction NMLs

Study area	NCA	Representative Background Monitoring Location	NML ($L_{Aeq(15minute)}$ – dBA)				Sleep Disturbance Screening Criteria (52 dBA or RBL +15 dB whichever is higher)
			Standard Construction (RBL +10 dB)	Out of Hours (RBL +5 dB)			
			Daytime	Daytime[1]	Evening	Night-time	
Westmead	NCA01	B.02	58	53	51	46	56
	NCA02	B.01	59	54	52	42	52

Note 1: Daytime out of hours is 7 am to 8 am and 1 pm to 6 pm on Saturday, and 8 am to 6 pm on Sunday and public holidays.

The ICNG Standard Construction Hours are proposed to be extended to include work during the Saturday out of hours work period, from 1pm to 6pm, consistent with the approved project. All work scenarios have, therefore, been assessed as occurring during this period.

3.1.2 Other Sensitive Land Uses and Commercial Receivers

Non-residential land uses are the same as for the approved project and are shown in **Figure 3**. These include 'other sensitive' land uses such as educational institutes, medical facilities, outdoor recreational areas and commercial properties. The ICNG NMLs for 'other sensitive' receivers are shown in **Table 4**.

Table 4 ICNG NMLs for 'Other Sensitive' Receivers

Land Use	Noise Management Level $L_{Aeq(15minute)}$ (dBA) (Applied when the property is in use)	
	Internal	External
Classrooms at schools and other educational institutions	45	55[1]
Hospital wards and operating theatres	45	65[1]
Places of worship	45	55[1]
Active recreation areas (characterised by sporting activities and activities which generate noise)	-	65
Passive recreation areas (characterised by contemplative activities that generate little noise)	-	60
Commercial	-	70
Industrial	-	75

Note 1: Criteria specified as an internal noise level for this receiver category. As the noise model predicts external noise levels, it has been conservatively assumed that all schools and places of worship have openable windows and external noise levels are 10 dB higher than the corresponding internal level, which is representative of windows being partially open to provide ventilation. Hospitals are assumed to have fixed windows with 20 dB higher external levels.

The ICNG references *AS2107:2016 Acoustics – Recommended design sound levels and reverberation times for building interiors* for criteria for 'other sensitive' receivers which are not listed in the guideline. Neither the ICNG nor AS2107 provide criteria for child care centres so the Association of Australian Acoustical Consultants *Guideline for Child Care Centre Acoustic Assessment* (GCCCAA) has been referenced. The NMLs for 'other sensitive' receivers are shown in **Table 5**.

Table 5 NMLs for 'Other Sensitive' Receivers

Use	Period	NML Derived From	Noise Management Level $L_{Aeq(15minute)}$ (dBA)	
			Internal	External
Hotel	Daytime & evening	AS2107: Bars and lounges	50	70[1]
	Night-time	AS2107: Sleeping areas, Hotels near major roads	40	60[1]
Child care centres	Daytime	GCCCAA: Outdoor play areas	-	55
		GCCCAA: Sleeping areas	40	50[2]
Public building	When in use	AS2107: Public space	50	60[2]

Note 1: Receiver conservatively assumed to have openable windows and a 10 dB outside to inside facade performance.

3.2 Construction Traffic Noise Guidelines

The potential impacts from construction traffic travelling on public roads are assessed under the NSW *Road Noise Policy* (RNP).

An initial screening test is first applied to evaluate if existing road traffic noise levels are expected to increase by more than 2.0 dB due to construction traffic. Where this is considered likely, further assessment is required using the RNP base criteria shown in **Table 6**.

Table 6 RNP Criteria for Assessing Construction Traffic on Public Roads

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)

3.3 Construction Vibration Guidelines

3.3.1 Human Comfort Vibration

People can sometimes perceive vibration impacts when vibration generating construction work are located close to occupied buildings.

Vibration from construction work tends to be intermittent in nature and the EPA's *Assessing Vibration: a technical guideline* (2006) provides criteria for intermittent vibration based on the Vibration Dose Value (VDV). The 'preferred' and 'maximum' VDVs for human comfort impacts are shown in **Table 7**.

Table 7 Vibration Dose Values for Intermittent Vibration

Building Type	Assessment Period	Vibration Dose Value[1] ($m/s^{1.75}$)	
		Preferred	Maximum
Critical Working Areas (e.g. operating theatres or laboratories)	Day or night-time	0.10	0.20
Residential	Daytime	0.20	0.40
	Night-time	0.13	0.26
Offices, schools, educational institutions and places of worship	Day or night-time	0.40	0.80
Workshops	Day or night-time	0.80	1.60

Note 1: The VDV accumulates vibration energy over the daytime and night-time assessment periods, and is dependent on the level of vibration as well as the duration.

3.3.2 Cosmetic Damage Vibration

The Sydney Metro Construction Noise and Vibration Standard (Sydney Metro, 2020d) recommends the following conservative cosmetic damage screening limits shown in **Table 8**.

Table 8 Transient Vibration Values for Minimal Risk of Cosmetic Damage

Type of Building	Peak Particle Velocity[1]
Reinforced or framed structures. Industrial and heavy commercial buildings	25 mm/s
Unreinforced or light framed structures. Residential or light commercial type buildings	7.5 mm/s

Note 1: Cosmetic damage vibration limits are reduced by 50 percent to account for dynamic loading caused by continuous vibration dynamic magnification due to resonance.

4 Methodology

The assessment of the potential noise and vibration impacts from the revised Westmead metro station construction site includes:

- Computer noise modelling to predict airborne noise levels from the amended construction sites and activities to the surrounding receivers. The model uses ISO 9613 algorithms in SoundPLAN software to predict noise levels at external building facades and outdoor recreation areas. Local terrain, receiver buildings and structures were digitised in the noise model to develop a three-dimensional representation of the construction sites and surrounding areas.
- Calculation of ground-borne noise and vibration which includes the shaft locations/tunnel alignment and elevation data for receivers above the proposed tunnelling work or near to station excavation work.

This assessment follows the same methodology as the approved project. The methodology is detailed in Technical Paper 2 (Noise and Vibration) of the Sydney Metro West Environmental Impact Statement – Westmead to The Bays and Sydney CBD, which should be referenced where further information is required.

4.1 Construction Work Descriptions

The work involved in the revised Westmead metro station construction site are listed and described in **Table 9**. The construction scenarios are the same as for the approved project, however, most scenarios are now required in a reduced construction site area compared to the approved project (see **Figure 1**).

Table 9 Construction Scenario Descriptions – Construction Site Activities

Scenario	Description
Enabling and site establishment work	This work is required to demolish existing buildings and structures, clear or protect trees, establish access points and erect hoarding. Relocation of services or third party assets may also be required. This work may include provision of high voltage power supplies for excavation equipment. The assessed scenarios are: - 'Typical' work generally includes operation of supporting equipment such as generators, cranes, compressors, etc, and loading of heavy vehicles with equipment such as excavators. - 'Peak' work includes the use of noise intensive equipment such as rockbreakers and concrete saws at times, especially during demolition of existing structures. The number of construction faces would double during 'Peak' work.
Piling	Piling is required at all construction sites for the foundations of future structures and to support linings for the stations and shafts. The assessed scenarios are: - 'Typical' work would include operation of supporting equipment such as excavators and cranes, as well as concreting equipment such as concrete mixer heavy vehicles and concrete pumps. - 'Peak' work would use all supporting equipment plus a piling rig. The number of piling faces would double during 'Peak' work with up to four piling faces where there is sufficient space. Bored piling would be used as opposed to impact piling, where possible. Bored piling is significantly less noisy.
Surface construction	Following site establishment and piling, civil work and surface structures such as abutments, roads, hardstand areas, and facilities such as water treatment equipment and site offices would be constructed. An acoustic shed (or other acoustic measures) would be constructed over excavation and spoil handling areas as early as possible The assessed scenarios are: - 'Typical' work would include the use of general construction equipment such as cranes, generators and hand tools. - 'Peak' work would use all supporting equipment plus noise intensive equipment such as grinders. The number of construction faces would double during 'Peak' work.
Excavation	Excavation would begin after the piling work. The excavation would be separated into two phases – 'initial excavation' and 'main excavation'. Definitions of these phases are provided below. **Initial excavation** Initial excavation involves removal of the upper layers of soil and rock to a depth suitable for the construction of an acoustic shed (or other acoustic measures) or acoustic panels (which are covers placed over the top of the excavation pit to minimise noise emissions). Initial excavation would take around two months to complete and would be performed during the daytime. Initial excavation of soil and soft rock can be undertaken using 'ripping' where the earth is separated using a manual pick attachment on an excavator. Initial excavation of hard rock would require rockbreaking, which is noise intensive. The time required for ripping versus rockbreaking would vary depending on the depth of rock. The assessed scenarios are: - 'Typical' initial excavation work would include the use of support equipment for spoil handling and a process called 'mucking out' which is described below. - 'Peak' work would involve the concurrent use of support equipment and either ripping through soft soil/rock or noise intensive rockbreaking through hard rock. The number of construction faces would double during 'Peak' work.

Scenario	Description
	Main excavation Main excavation (referred to as 'excavation' hereon) involves excavation to a depth where blasting can be performed, if it is suitable for that site. Excavation would be completed within an acoustic shed or below acoustic panels (or other acoustic measures) The assessed scenarios are: - 'Typical' excavation work would include the use of supporting equipment for spoil handling and a process called 'mucking out' which is described below. - 'Peak' work would involve the concurrent operation of supporting work and rockbreakers. The number of construction faces would double during 'Peak' work. Construction equipment outside the acoustic sheds would include heavy vehicles and fixed ancillary equipment such as ventilation systems and water treatment facilities.
Mucking out	At times during excavation, work would pause so the loose spoil can be removed using excavators and transferred to heavy vehicles. This is referred to as 'mucking out'. - Mucking out is part of the 'Typical' work activity for the initial excavation and excavation scenarios.

4.2 Tunnelling, Ancillary, and Alternative Construction Activities

The tunnelling and ancillary activities, outside of the surface construction sites, that are affected by the proposed changes are listed and described in **Table 10**. The proposed construction methodology is generally consistent with the approved project, but the tunnelling alignment has been relocated about 20 metres to the south-east to accommodate the revised Westmead metro station box location.

Table 10 Construction Scenario Descriptions – Tunnelling and Ancillary Activities

Scenario	Description
Tunnelling – excavation and construction	The tunnelling works would occur 24/7. Depending on the rate of progress, noise and vibration impacts from tunnelling would likely only be apparent for relatively short periods at most locations. At this stage, TBMs are proposed to be used for the majority of the alignment with roadheaders and rockbreakers used at stations, stub tunnels, cross passages and crossover and turnback caverns. Roadheaders would also be used to excavate the tunnels that connect the stabling and maintenance facility to the main alignment.
Tunnelling – work trains	Consistent with the tunnelling methodology used on previous Sydney Metro projects, work trains would be used to supply materials, such as precast tunnel lining segments, and workers to the workface. Spoil would be removed via conveyor. Work trains are anticipated to operate on a temporary narrow gauge rail with resilient mounts and/or rubber wheels. The work trains would be loaded at the TBM launch site and unloaded at the TBM. The operating speed of work trains is around 10 km/h and they would be required 24/7 to support tunnelling. On the basis of the above, work trains are not expected to result in any significant noise and vibration impacts.

5 Noise and Vibration Impacts from Construction Site

The assessment uses 'realistic worst-case' scenarios to determine the potential airborne noise impacts from the noisiest 15-minute period for each work scenario, as required by the ICNG. The impacts represent construction noise levels with project specific base-case mitigation applied, as detailed in **Table 11**.

Table 11 Project Specific Base-case Mitigation Measures

Included Mitigation Measures	Description
Bored piling	The construction activities assume that bored piling would be used as opposed to impact piling, wherever possible. Bored piling is significantly less noisy than impact piling.
Acoustic perimeter hoardings	For construction concentrated in a single area, such as at station and services facility construction sites, temporary acoustic hoardings around the site perimeter would be used where receivers are potentially affected and where feasible and reasonable. On this basis, three metre high acoustic hoarding of solid construction (as opposed to standard wire mesh fence) has been included in the assessment and is shown on the study area figures in **Section 5.3**. However, in practice the same noise outcome at the receivers could be achieved through a range of mitigation measures and potentially different barrier heights.
Acoustic sheds (or other acoustic measures)	Acoustic sheds have been assumed to be used for Westmead metro station construction site where station excavation would occur on a 24/7 basis in close proximity to sensitive receivers. At this stage, detailed designs have not been developed and a typical shed construction based on previous stages of Sydney Metro have been used with indicative shed dimensions provided by the project team. Shed ventilation would be required to be designed to maintain the integrity of the shed's acoustic performance, which indicatively would require attenuators for supply and return air ducting. When the main doors of the acoustic sheds are opened to allow heavy vehicle access, noise emissions would potentially increase. The assessment presents predicted noise levels for doors open and doors closed. Where opening the shed doors during the night-time is predicted to result in NML exceedances, a two-stage 'airlock' door may be required to provide additional mitigation. The specific noise mitigation measures would be determined during detailed construction planning taking into account construction program, construction working hours and construction traffic management in accordance with the Sydney Metro CNVS and may include mitigation measures other than acoustic sheds.
Acoustic panels	Where acoustic sheds are constructed over part of a cut and cover station, the remainder of the excavated pit would be covered by acoustic panels to minimise noise emissions. This assessment assumes that the panels would be consistent with those used in previous stages of Sydney Metro and would not allow a significant transfer of construction noise through the system.

Scenarios have been categorised into peak and typical work which have been used to define the likely range of potential noise impacts:

- **Peak** work represents the noisiest stages and can require noise intensive equipment, such as rockbreakers or concrete saws. While peak work would be required at times in most locations, the noisiest work would not occur for the full duration of the work.
- **Typical** work represents typical noise emissions when noise intensive equipment is not in use. The typical work generally includes most items of equipment for a given activity except for the loudest item. These items generally support the peak work activity and are referred to as 'supporting equipment'.

The assessment shows the predicted impacts based on the exceedance of the management levels, as per the categories in **Table 12**.

Table 12 Exceedance Bands and Impact Colouring

Exceedance of Management Level	Subjective Classification[1]	Impact Colouring
No exceedance	Negligible	
1 to 10 dB	Low impact	
11 dB to 20 dB	Moderate impact	
>20 dB	High impact	

Note 1: This subjective classification is indicative and follows the approach outlined in the Sydney Metro CNVS for reporting of construction impacts in Detailed Noise and Vibration Impact Statements. The subjective response would vary and depends on the period in which the impacts occur (i.e. people are generally more sensitive to impacts during the evening and night-time).

5.1 Construction Site Activities

The construction scenarios required in the Westmead study area and proposed working hours are shown in **Table 13**. The estimated duration of each activity is also provided, noting that most activities would be intermittent during this period and would not be expected to be undertaken on a continual basis during every day of the scheduled activity.

Construction work at the Westmead metro station construction site is anticipated to commence in 2022 and have a total duration of around three years.

Table 13 Surface construction Activities and Period of Work

Scenario	Activity		Total Indicative Duration (Weeks)[3]	Maximum Number of Working Faces	Hours of Works[1,2]			
					Std. Day	Out-of-Hours Works		
						Day OOH	Eve	Night
Enabling work	Typical	Supporting and loading	13	1	✓	✓	-	-
	Peak	Demolition using a rockbreaker	13	2	✓	✓	-	-
Piling	Typical	Supporting work	9	2	✓	✓	-	-
	Peak	Bored piling with support plant	**9**	4	✓	✓	-	-
Surface construction	Typical	General work	7	1	✓	✓	-	-
	Peak	Noise intensive works	7	2	✓	✓	-	-
Initial excavation	Typical	Mucking out	25	1	✓	✓	-	-
	Peak	Through soft soil/rock	15	2	✓	✓	-	-
		Through rock using rockbreaker	10	2	✓	✓	-	-
Excavation with shed	Typical	Mucking out	46	1	✓	✓	✓	-
	Peak	Through rock using rockbreaker	46	2	✓	✓	✓	✓

Note 1: Noise intensive works outside of Standard Construction Hours would only be undertaken within the acoustic shed.

Note 2: OOH = Out of hours. During the daytime, this refers to the period on Saturday between 7am – 8am, and 1pm – 10pm.

Note 3: Durations should be regarded as indicative and represent the total estimated duration of works at a typical worksite over the entire construction period.

5.2 Change from Approved Project

The predicted change in impacts compared to the assessment of the approved project are shown in brackets, where applicable, throughout the following assessment.

For example, a result of **10 (5)** indicates that ten receiver buildings are predicted to be impacted and five of these receivers are additional to what was predicted for the approved project. Similarly, a result of **10 (-5)** indicates that five fewer receivers are predicted to be impacted than for the approved project.

5.3 Airborne Noise Impacts

5.3.1 Number of NML Exceedances

The predicted airborne noise impacts from the revised construction work in the Westmead study area are summarised in **Table 14**, **Table 15** and **Table 16** for all receiver types, residential receivers, and commercial 'other sensitive' receivers, respectively. The predictions are representative of the highest noise levels that would likely be experienced at the surrounding receivers when the work is at their nearest. The number of receivers predicted to experience exceedances of the NMLs are summarised in bands of 10 dB and are separated into day, evening and night-time periods, as appropriate.

Table 14 Overview of NML Exceedances – All Receiver Types

Scenario	Activity		No. Weeks[1]	Number of Receivers																
				Total	HNA[2]	With NML Exceedance[3, 4]														
						Standard Construction Hours – Daytime			Out-of-Hours Works[5]											
									Daytime OOH			Evening			Night-time			Sleep Disturbance		
						1-10 dB	11-20 dB	>20 dB	1-10 dB	11-20 dB	>20 dB	1-10 dB	11-20 dB	>20 dB	1-10 dB	11-20 dB	>20 dB	1-10 dB	11-20 dB	>20 dB
Enabling work	Typical	Supporting and loading	13	941	0 (0)	12 (-2)	- (0)	- (0)	19	4	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Peak	Demolition using a rockbreaker	13	941	11 (-1)	136 (-5)	30 (-1)	9 (-1)	293	68	12	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Piling	Typical	Supporting work	9	941	0 (0)	12 (0)	- (0)	- (0)	30	1	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Peak	Bored piling with support plant	9	941	0 (0)	24 (-2)	2 (1)	- (0)	54	9	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Surface construction	Typical	General work	7	941	0 (0)	2 (0)	- (0)	- (0)	7	-	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Peak	Noise intensive works	7	941	0 (0)	13 (-3)	- (0)	- (0)	26	3	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Initial excavation	Typical	Mucking out	25	941	0 (0)	17 (-2)	- (0)	- (0)	42	3	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Peak	Through soft soil/rock	15	941	0 (0)	31 (-3)	4 (1)	- (0)	67	13	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Through rock using rockbreaker	10	941	10 (0)	145 (-6)	31 (-3)	4 (1)	277	67	13	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Excavation with shed	Typical	Mucking out (doors closed)	46	941	0 (0)	3 (3)	- (0)	- (0)	8 (8)	- (0)	- (0)	10 (9)	- (0)	- (0)	n/a	n/a	n/a	n/a	n/a	n/a
	Peak	Through rock using rockbreaker (doors closed)	46	941	0 (0)	4 (4)	- (0)	- (0)	12 (10)	1 (1)	- (0)	13 (10)	2 (2)	- (0)	48 (26)	13 (10)	2 (2)	51 (13)	4 (-6)	2 (0)
		Through rock using rockbreaker (doors open)	46	941	0 (0)	12 (4)	- (0)	- (0)	14 (0)	5 (4)	- (0)	15 (-1)	6 (5)	- (0)	59 (-4)	15 (-1)	6 (5)	48 (9)	10 (0)	2 (0)

Note 1: Durations should be regarded as indicative and represent a typical worksite. The duration of these impacts is less than the overall duration, and depends on the rate of progress in the work areas.

Note 2: Highly Noise Affected (HNA), based on ICNG definition (i.e. predicted $L_{Aeq(15minute)}$ noise at residential receiver is 75 dBA or greater).

Note 3: Based on worst-case predicted noise levels.

Note 4: Results that have changed are shown in brackets with increases as positive values and decreases as negative values, relative to the assessment of the approved project.

Note 5: OOH = Out of hours. During the daytime, this refers to the period on Saturday between 7am – 8am, and 1pm – 10pm.

Table 15 Overview of NML Exceedances – Residential Receivers

Scenario	Activity		No. Weeks[1]	Number of Receivers																
				Total	HNA[2]	With NML Exceedance[3, 4]														
						Standard Construction Hours – Daytime			Out-of-Hours Works[5]											
									Daytime OOH			Evening			Night-time			Sleep Disturbance		
						1-10 dB	11-20 dB	>20 dB	1-10 dB	11-20 dB	>20 dB	1-10 dB	11-20 dB	>20 dB	1-10 dB	11-20 dB	>20 dB	1-10 dB	11-20 dB	>20 dB
Enabling work	Typical	Supporting and loading	13	854	- (0)	9 (-1)	- (0)	- (0)	16	4	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Peak	Demolition using a rockbreaker	13	854	11 (-1)	129 (-1)	25 (-2)	8 (0)	286	63	11	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Piling	Typical	Supporting work	9	854	- (0)	9 (0)	- (0)	- (0)	27	1	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Peak	Bored piling with support plant	9	854	- (0)	20 (-2)	1 (1)	- (0)	50	8	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Surface construction	Typical	General work	7	854	- (0)	1 (0)	- (0)	- (0)	6	-	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Peak	Noise intensive works	7	854	- (0)	9 (-2)	- (0)	- (0)	22	3	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Initial excavation	Typical	Mucking out	25	854	- (0)	12 (-2)	- (0)	- (0)	37	3	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Peak	Through soft soil/rock	15	854	- (0)	27 (-3)	2 (1)	- (0)	63	11	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
		Through rock using rockbreaker	10	854	10 (0)	134 (-2)	27 (-3)	2 (1)	266	63	11	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Excavation with shed	Typical	Mucking out (doors closed)	46	854	- (0)	2 (2)	- (0)	- (0)	7 (7)	- (0)	- (0)	10 (9)	- (0)	- (0)	n/a	n/a	n/a	n/a	n/a	n/a
	Peak	Through rock using rockbreaker (doors closed)	46	854	- (0)	3 (3)	- (0)	- (0)	11 (9)	1 (1)	- (0)	13 (10)	2 (2)	- (0)	48 (26)	13 (10)	2 (2)	51 (13)	4 (-6)	2 (0)
		Through rock using rockbreaker (doors open)	46	854	- (0)	10 (3)	- (0)	- (0)	12 (-1)	5 (4)	- (0)	15 (-1)	6 (5)	- (0)	59 (-4)	15 (-1)	6 (5)	48 (9)	10 (0)	2 (0)

Note 1: Durations should be regarded as indicative and represent a typical worksite. The duration of these impacts is less than the overall duration, and depends on the rate of progress in the work areas.

Note 2: Highly Noise Affected (HNA), based on ICNG definition (i.e. predicted $L_{Aeq(15minute)}$ noise at residential receiver is 75 dBA or greater).

Note 3: Based on worst-case predicted noise levels.

Note 4: Results that have changed are shown in brackets with increases as positive values and decreases as negative values, relative to the assessment of the approved project.

Note 5: OOH = Out of hours. During the daytime, this refers to the period on Saturday between 7am – 8am, and 1pm – 10pm.

Table 16 Overview of Commercial and 'Other Sensitive' Receiver NML Exceedances

Scenario	Activity		No. Weeks[1]	Number of Receivers[2]																				
				Commercial			Child Care			Educational			Public Building			Place of Worship			Passive Recreation			Medical		
				1-10 dB	11-20 dB	>20 dB	1-10 dB	11-20 dB	>20 dB	1-10 dB	1-10 dB	1-10 dB	1-10 dB	11-20 dB	>20 dB	1-10 dB	11-20 dB	>20 dB	1-10 dB	11-20 dB	>20 dB	1-10 dB	11-20 dB	>20 dB
Enabling work	Typical	Supporting and loading	13	- (0)	- (0)	- (0)	1 (0)	- (0)	- (0)	2 (-1)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)
	Peak	Demolition using a rockbreaker	13	- (-1)	- (0)	- (0)	- (0)	1 (1)	- (-1)	1 (-2)	4 (0)	1 (0)	1 (0)	- (0)	- (0)	2 (0)	- (0)	- (0)	- (-1)	- (0)	- (0)	3 (0)	- (0)	- (0)
Piling	Typical	Supporting work	9	- (0)	- (0)	- (0)	1 (0)	- (0)	- (0)	2(0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)
	Peak	Bored piling with support plant	9	- (0)	- (0)	- (0)	1 (1)	- (-1)	- (0)	3 (-1)	1 (1)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)
Surface construction	Typical	General work	7	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	1 (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)
	Peak	Noise intensive works	7	- (0)	- (0)	- (0)	1 (0)	- (0)	- (0)	3 (-1)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)
Initial excavation	Typical	Mucking out	25	- (0)	- (0)	- (0)	1 (0)	- (0)	- (0)	4 (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)
	Peak	Through soft soil/rock	15	- (0)	- (0)	- (0)	- (0)	1 (0)	- (0)	4 (0)	1 (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)
		Through rock using rockbreaker	10	1 (0)	- (0)	- (0)	- (0)	- (0)	1 (0)	4 (-2)	4 (0)	1 (0)	1 (-1)	- (0)	- (0)	2 (0)	- (0)	- (0)	- (-1)	- (0)	- (0)	3 (0)	- (0)	- (0)
Excavation with shed	Typical	Mucking out (Doors Closed)	46	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	1 (1)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)
	Peak	Through rock using rockbreaker (Doors Closed)	46	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	1 (1)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)
		Through rock using rockbreaker (Doors Open)	46	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	2 (1)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)	- (0)

Note 1: Durations should be regarded as indicative and represent a typical worksite. The duration of these impacts is less than the overall duration and depends on the rate of progress in the work areas.

Note 2: The numbers represent the count of individual receiver buildings with predicted exceedances of the NMLs. Several buildings can have exceedances at the same receiver (i.e. child care facilities, educational facilities, stables, etc).

Note 3: Results that have changed are shown in brackets with increases as positive values and decreases as negative values, relative to the assessment of the approved project.

5.3.2 Daytime Scenarios

The worst-case impacts during the daytime are predicted when noise intensive work within the Westmead metro station construction site occurs before construction of the acoustic shed during *Enabling work* and *Initial Excavation*.

The predicted worst-case daytime impacts with the greatest change from the approved project are shown in the following figures and are compared to the equivalent impacts presented in Technical Paper 2 (Noise and vibration) of the Sydney Metro West Environmental Impact Statement – Westmead to The Bays and Sydney CBD (Sydney Metro, 2020a):

- **Figure 4** – *Enabling work – Demolition using a rockbreaker* (peak)
- **Figure 5** – *Enabling work – Supporting and loading* (typical)

Peak and typical scenarios are presented to show the range of potential impacts during work across the entire site.

The highest impact works are expected to last for:

- *Enabling works – Demolition using a rockbreaker* – 10 days (actual rockbreaker use)
- *Initial excavation – Through rock using rockbreaker* – 10 weeks

Figure 4 Worst-case Daytime Airborne Noise Impacts – *Enabling work – Demolition using a rockbreaker* (peak)

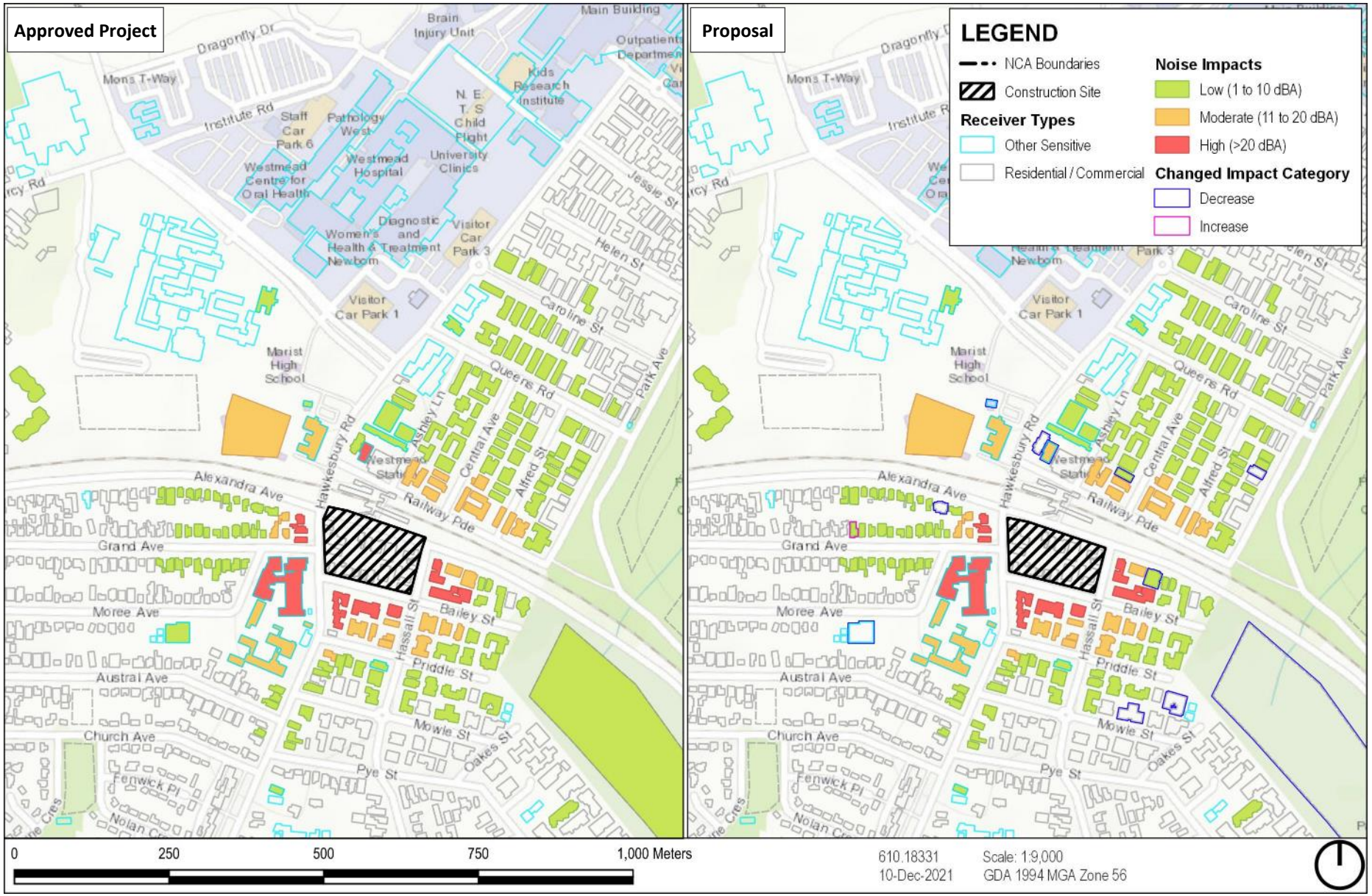
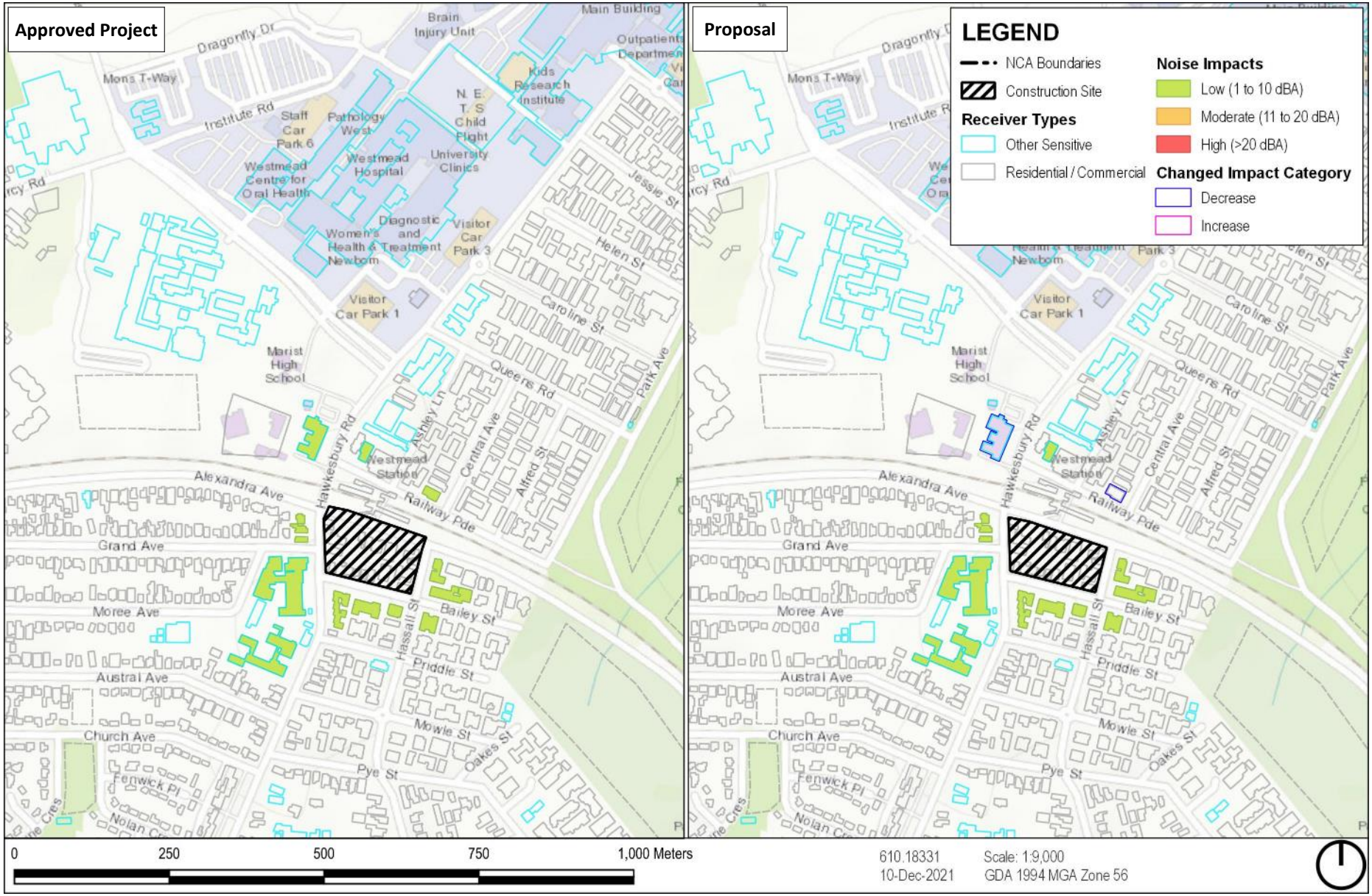


Figure 5 Worst-case Daytime Airborne Noise Impacts – *Enabling work – Supporting and loading* (typical)



The assessment during the worst-case daytime impacts shows the following:

- Construction work is predicted to result in 'high' worst-case noise impacts at the nearest receivers during higher noise generating activities. The nearest receivers to the site are generally residential and educational buildings. Some of the worst-case impacts are predicted during *Enabling work* and *Initial excavation* which would occur before the acoustic shed is constructed. This is consistent with the approved project.
- Outdoor work within the Westmead metro station construction site, including *Enabling work, Piling, Surface Construction*, is generally predicted to result in slightly fewer impacted receivers compared to the approved project. This is due to the reduced construction site area.
- The worst-case impacts at 'other sensitive' receivers are predicted to be consistent with the approved project. 'High' or 'moderate' impacts are predicted at:
    - Westmead Public School, Western Sydney University – Westmead Precinct and Mounika's Family Day Care ('high')
    - Westmead Progress Hall ('moderate')

  The highest impacts at these receivers are predicted when rockbreakers are being used outdoors as part of *Enabling work* or *Initial Excavation*. Outdoor demolition and excavation are expected to require rockbreakers for a total of around 23 weeks across the three year construction program. The impacts are predicted to be much lower when less noisy equipment is being used.

The impacts presented above are based on all equipment working simultaneously in each assessed scenario. There would be periods when construction noise levels would be much lower than the worst-case levels predicted and there would be times when no equipment would be in use and no impacts occur.

5.3.3 Night-time Scenarios

Noise intensive work during the night-time would only be completed inside the acoustic shed. *Mucking out* and the associated heavy vehicle haulage, which was assessed during the night-time for the approved project, is no longer proposed. The worst-case night-time impacts are predicted during *Excavation with shed* when rockbreakers are in use.

The predicted worst-case night-time impacts with the greatest change from the approved project are shown in the following figures and are compared to the equivalent impacts presented in Technical Paper 2 (Noise and vibration) of the Sydney Metro West Environmental Impact Statement – Westmead to The Bays and Sydney CBD (Sydney Metro, 2020a).

- **Figure 6** – *Excavation with shed – Through rock using rockbreaker (doors open)* (peak)
- **Figure 7** – *Excavation with shed – Through rock using rockbreaker (doors closed)* (peak).

The highest impact works are expected to last for:

- *Excavation with shed – Through rock using rockbreaker* – 23 weeks

Figure 6 Worst-case Night-time Airborne Noise Impacts – *Excavation with shed – Through rock using rockbreaker (doors open)* (peak)

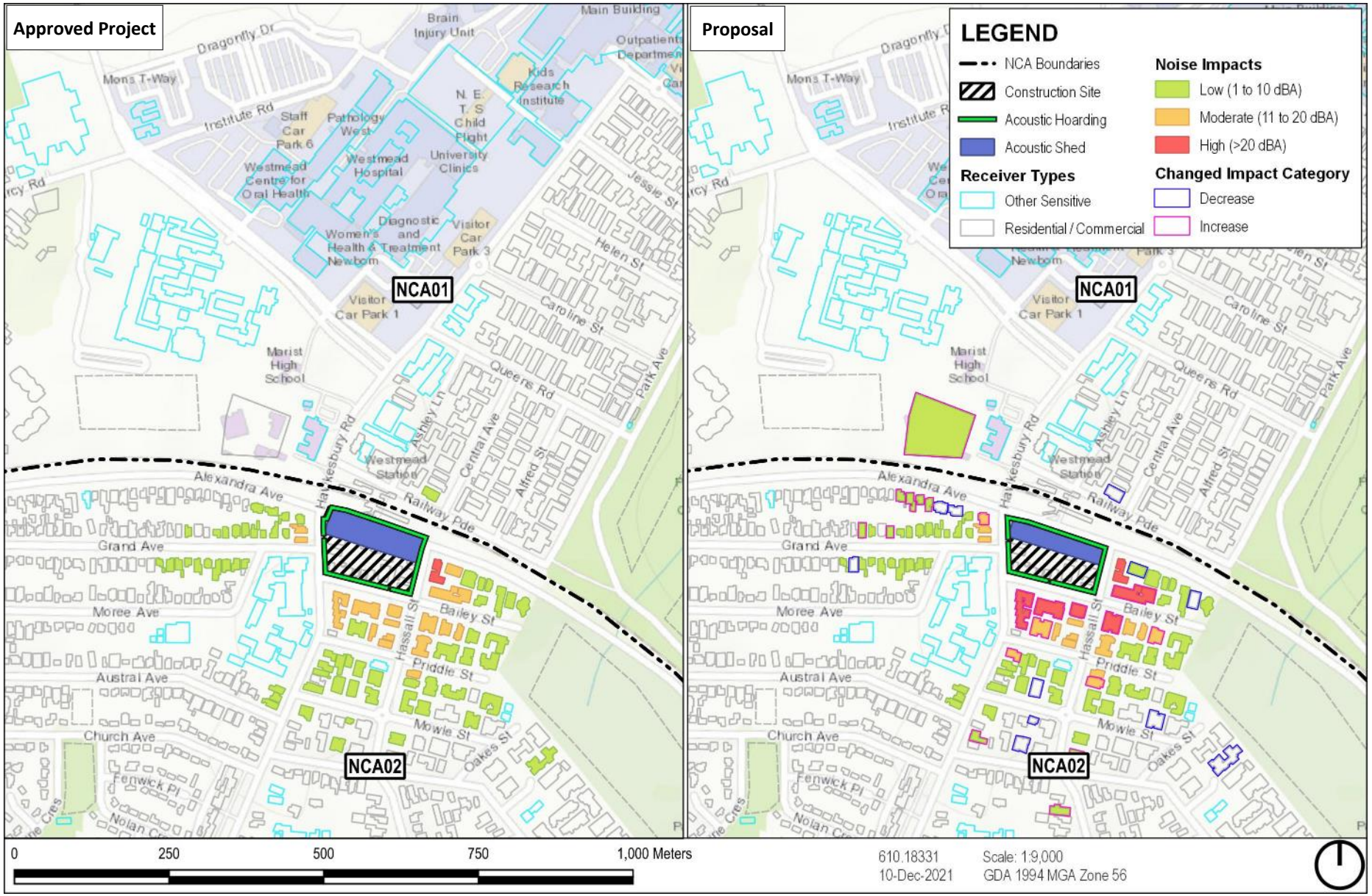
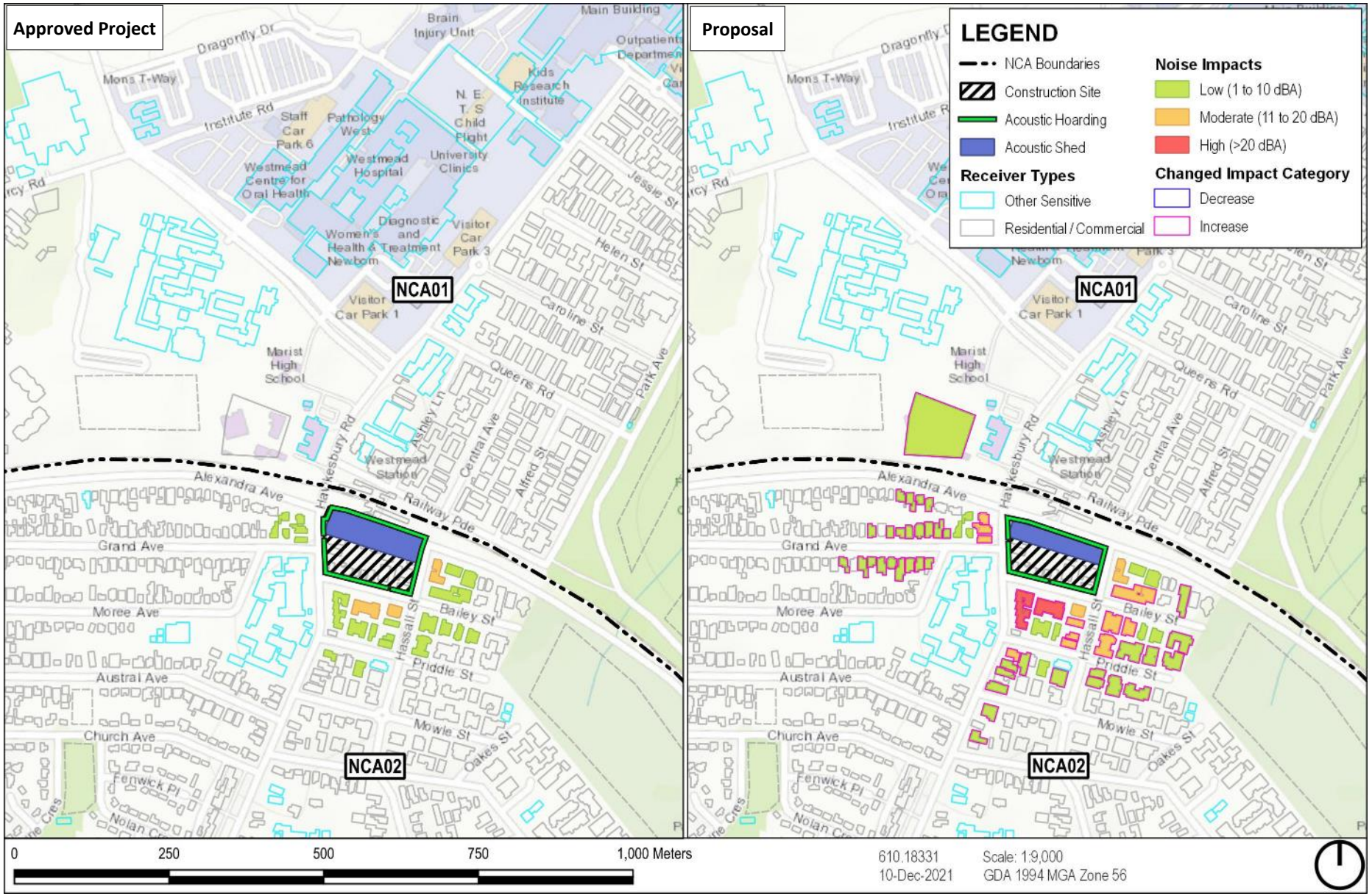


Figure 7 Worst-case Night-time Airborne Noise Impacts – *Excavation with shed – Through rock using rockbreaker (doors closed)* (peak)



The assessment during the worst-case night-time impacts shows the following:

- Peak night-time work is predicted to result in 'high' worst-case impacts at up to six of the nearest residential receivers. 'Moderate' impacts are predicted for the other receivers which are near to the site, with 'low' impacts at more distant receivers.
- Compared to the approved project, *Excavation* inside the acoustic shed is predicted to result in more impacted receivers due to the relocated station box moving closer to the residential receivers in NCA02.
- *Excavation* work within the acoustic shed are expected to last a total of around 46 weeks and 34 weeks respectively, across the three year construction program.

The impacts presented above are based on all equipment working simultaneously in each assessed scenario. There would be periods when noise levels are much lower than the worst-case levels predicted and there would be times when no equipment is in use and no impacts occur.

5.3.4 Sleep Disturbance

A sleep disturbance screening assessment has been completed and is summarised in **Table 14.** 'High' sleep disturbance impacts are predicted at the nearest residential receivers during *Excavation*.

Sleep disturbance impacts from within the construction site are generally controlled by heavy vehicle movements in the outdoor areas of the site. The potential awakenings from heavy vehicles would be influenced by the number of trucks accessing the site during the night-time and the way in which the vehicles are operated.

Compared to the approved project, there are slightly more 'low' sleep disturbance impacts predicted, generally on Grand Avenue to the west of the site, due to the night-time excavation work moving closer to these residential receivers.

5.3.5 Highly Noise Affected Residential Receivers

The receivers predicted to be highly noise affected during the worst-case impacts are summarised in **Table 17** and shown in **Figure 8**. The table shows the number of residential receivers separated by work activity and NCA.

Table 17 Predicted Number of Highly Noise Affected Residential Receivers by Work

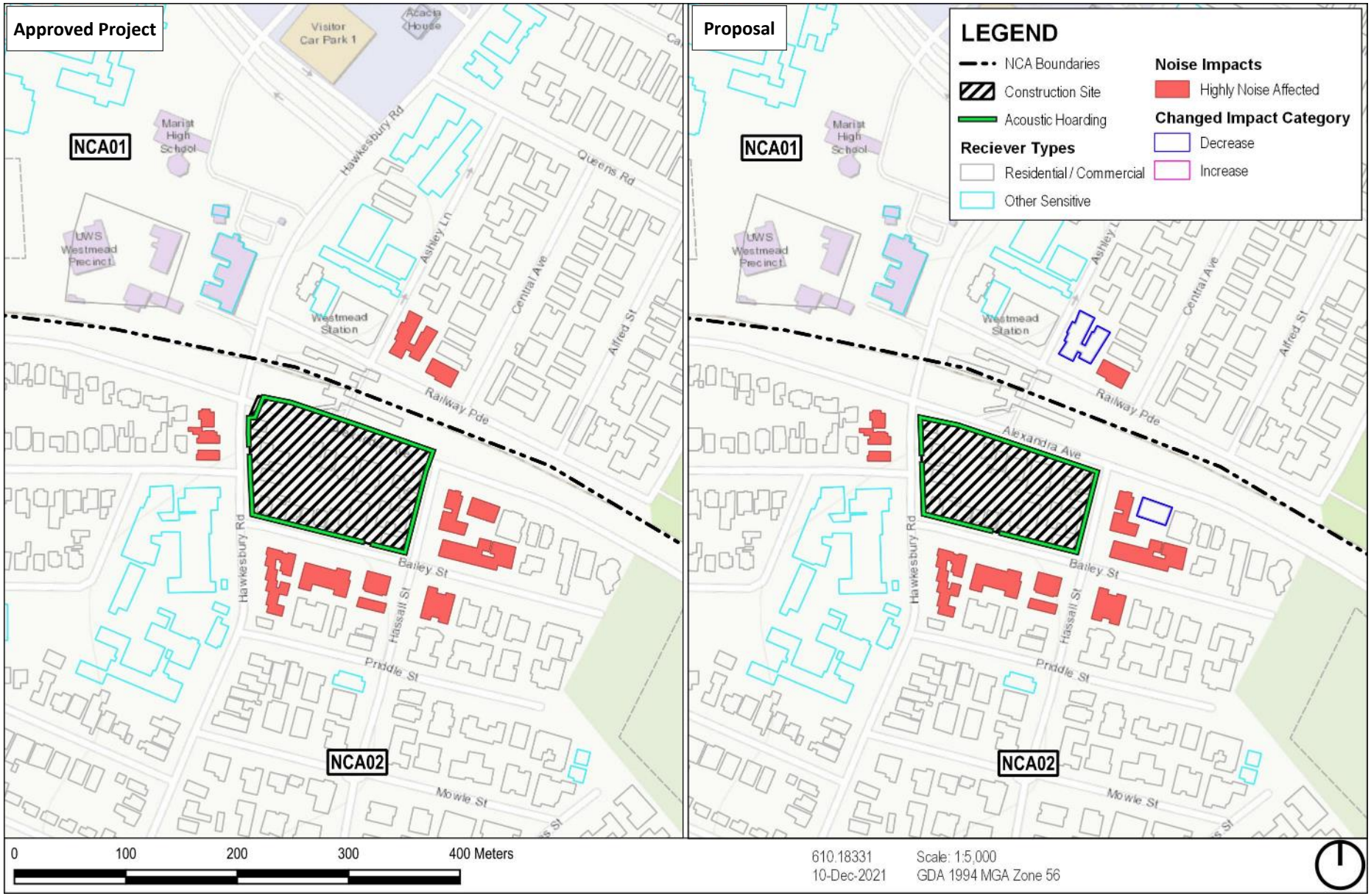
Scenario	Activity		NCA01			NCA02		
			Day	Eve	Night	Day	Eve	Night
Enabling works	Typical	Supporting and loading	- (-)	n/a	n/a	- (-)	n/a	n/a
	Peak	Demolition using a rockbreaker with supporting plant	1 (-)	n/a	n/a	10 (-1)	n/a	n/a
Piling	Typical	Supporting works	- (-)	n/a	n/a	- (-)	n/a	n/a
	Peak	Bored piling with support plant	- (-)	n/a	n/a	- (-)	n/a	n/a
Surface construction	Typical	General works	- (-)	n/a	n/a	- (-)	n/a	n/a
	Peak	Noise intensive works	- (-)	n/a	n/a	- (-)	n/a	n/a
Initial excavation	Typical	Mucking out	- (-)	n/a	n/a	- (-)	n/a	n/a
	Peak	Through soft soil/rock	- (-)	n/a	n/a	- (-)	n/a	n/a
		Through rock using rockbreaker	2 (-)	n/a	n/a	9 (1)	n/a	n/a
Excavation with shed	Typical	Mucking out (Doors Closed)	- (-)	- (-)	n/a	- (-)	- (-)	n/a
	Peak	Through rock using rockbreaker (Doors Closed)	- (-)	- (-)	- (-)	- (-)	- (-)	- (-)
		Through rock using rockbreaker (Doors Open)	- (-)	- (-)	- (-)	- (-)	- (-)	- (-)

Note 1: 'n/a' represents where work would not be performed during the evening or night-time periods.

Note 2: Results that have changed are shown in brackets with increases as positive values and decreases as negative values, relative to the assessment of the approved project.

The assessment shows that the predicted impacts are generally consistent with the approved project, with the nearest receivers to the site predicted to be highly noise affected during daytime work involving rockbreakers before the acoustic shed is constructed. Work undertaken in the shed is not predicted to result in any highly noise affected impacts. Across all work scenarios, two fewer receivers are predicted to be highly noise affected compared to the approved project.

Figure 8 Highly Noise Affected Residential Receivers (During Any Work)



5.4 Ground-borne Noise and Vibration Impacts

The predicted ground-borne impacts from vibration intensive station shaft excavation works inside the acoustic shed (or other comparable acoustic measures) are summarised in **Table 18**. The results are shown in **Figure 9** and **Figure 10** for the daytime and night-time, respectively. The predictions are representative of the highest ground-borne noise levels that would likely be experienced by the nearest receivers when excavation works are at their closest.

Table 18 Overview of Ground-borne NML Exceedances

NCA	Receiver Classification	Number of Receivers									
		Total	With NML Exceedance[1]								
			Daytime			Out-of-Hours Works					
						Evening			Night-time		
			1-10 dB	11-20 dB	>20 dB	1-10 dB	11-20 dB	>20 dB	1-10 dB	11-20 dB	>20 dB
NCA01	Residential	261	-	-	-	-	-	-	-	-	-
	Commercial	9	- (-1)	-	-	-	-	-	-	-	-
	Other Sensitive	62	-	-	-	-	-	-	-	-	-
NCA02	Residential	655	1 (-1)	-	-	3 (-1)	-	-	5 (2)	1 (-1)	-
	Commercial	9	-	-	-	-	-	-	-	-	-
	Other Sensitive	26	-	-	-	-	-	-	-	-	-

Note 1: Based on worst-case predicted noise levels.

Note 2: Results that have changed are shown in brackets with increases as positive values and decreases as negative values, relative to the assessment of the approved project.

The predicted vibration impacts during vibration intensive works within the Westmead metro station construction site are shown in **Table 19** and **Figure 11**. The predictions are representative of the highest vibration levels that would likely be experienced by the nearest receivers when work is at its closest.

The worst-case predicted impacts from vibration intensive surface work are consistent with the approved project.

Table 19 Overview of Vibration Exceedances

NCA	Number of Receivers				
	Total	With Vibration Criteria Exceedance[1]			
		All Vibration Intensive Works (with rockbreaker)			
		Cosmetic Damage	Human Comfort		Sensitive Equipment
		Day / Night	Day	Night	Day / Night
NCA01	340	-	-	-	-
NCA02	806	-	1	1	-

Note 1: Based on worst-case predicted vibration levels.

Figure 9 Ground-borne Noise Impacts – Daytime

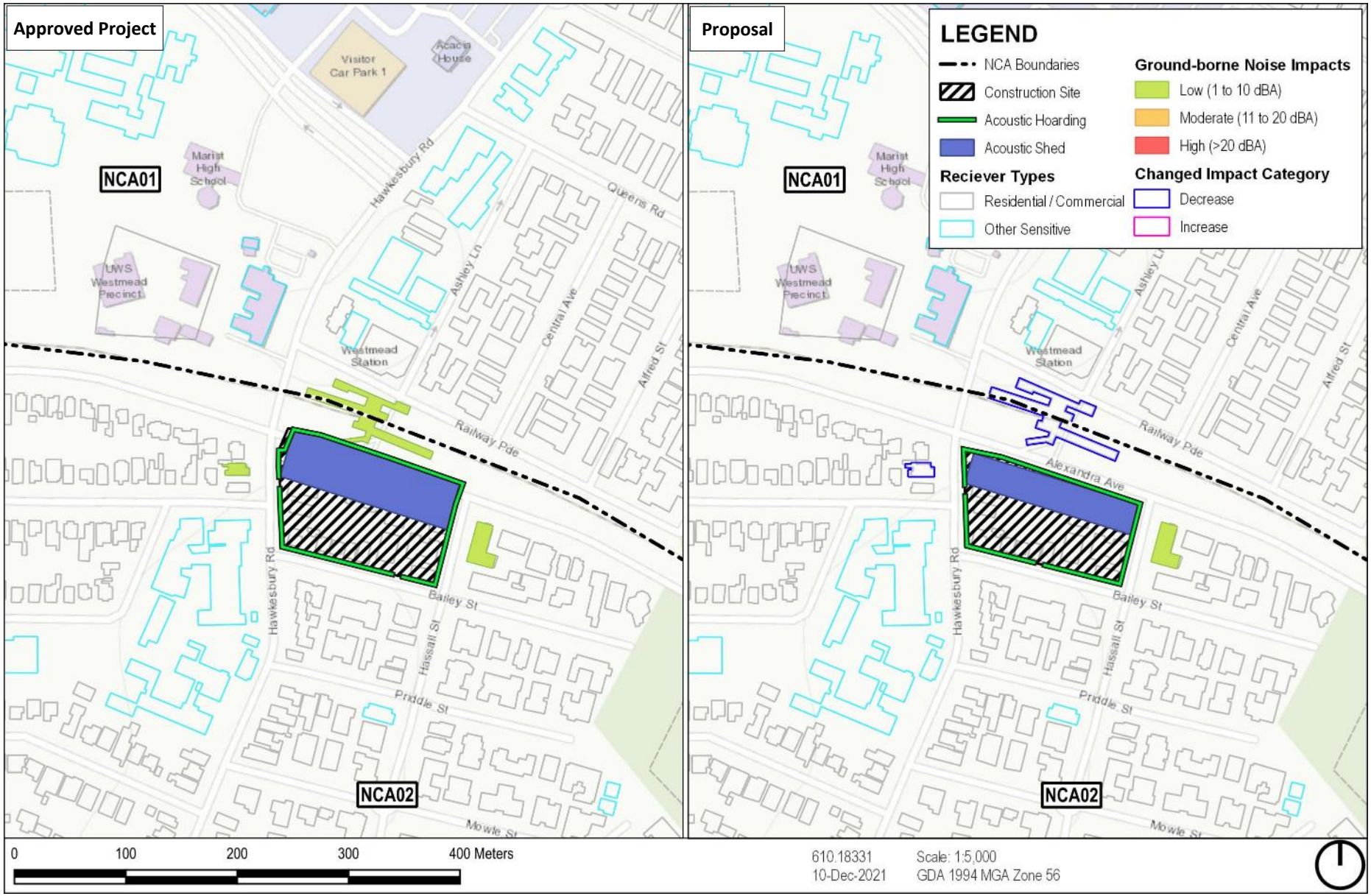


Figure 10 Ground-borne Noise Impacts – Night-time

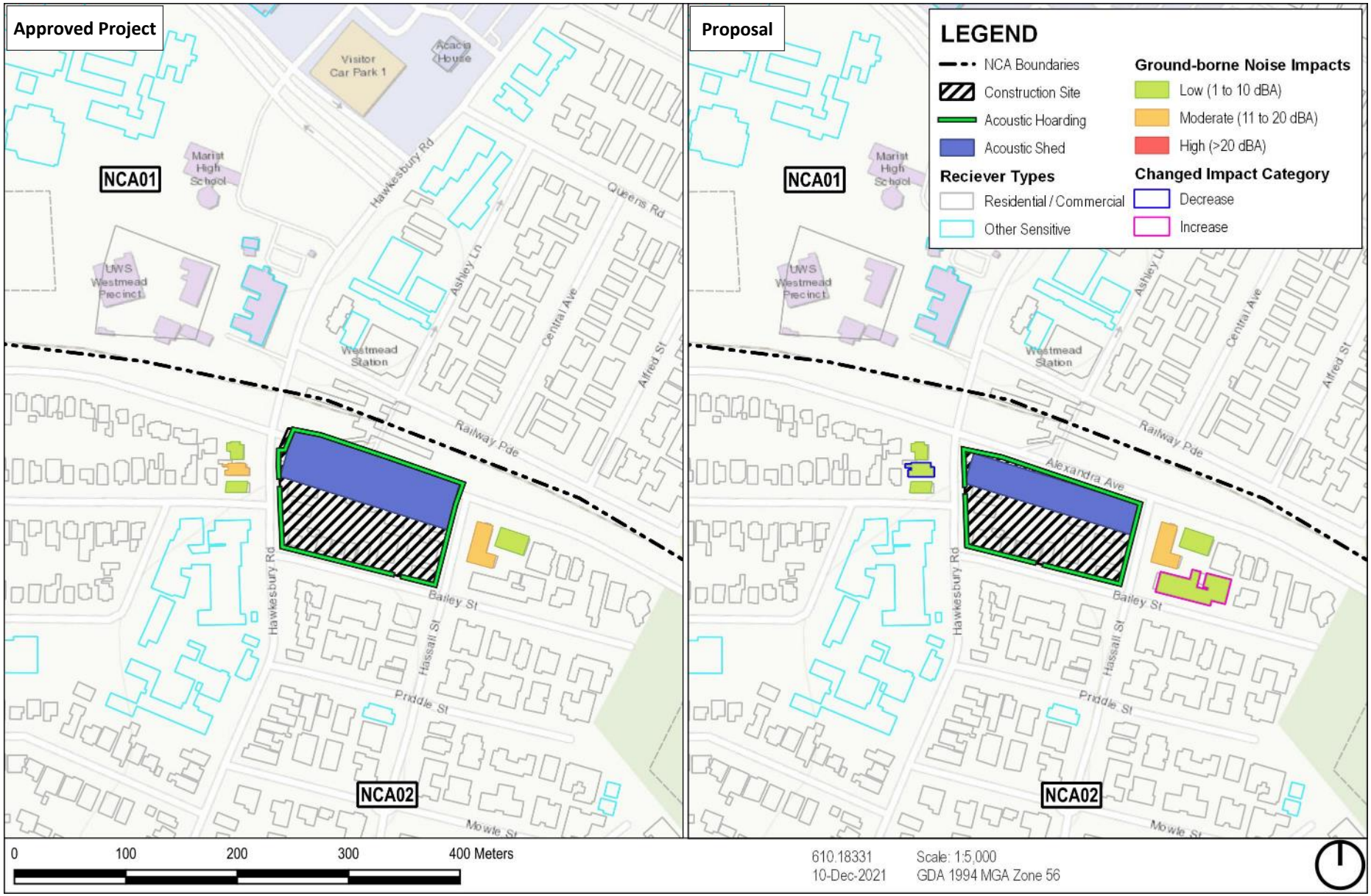
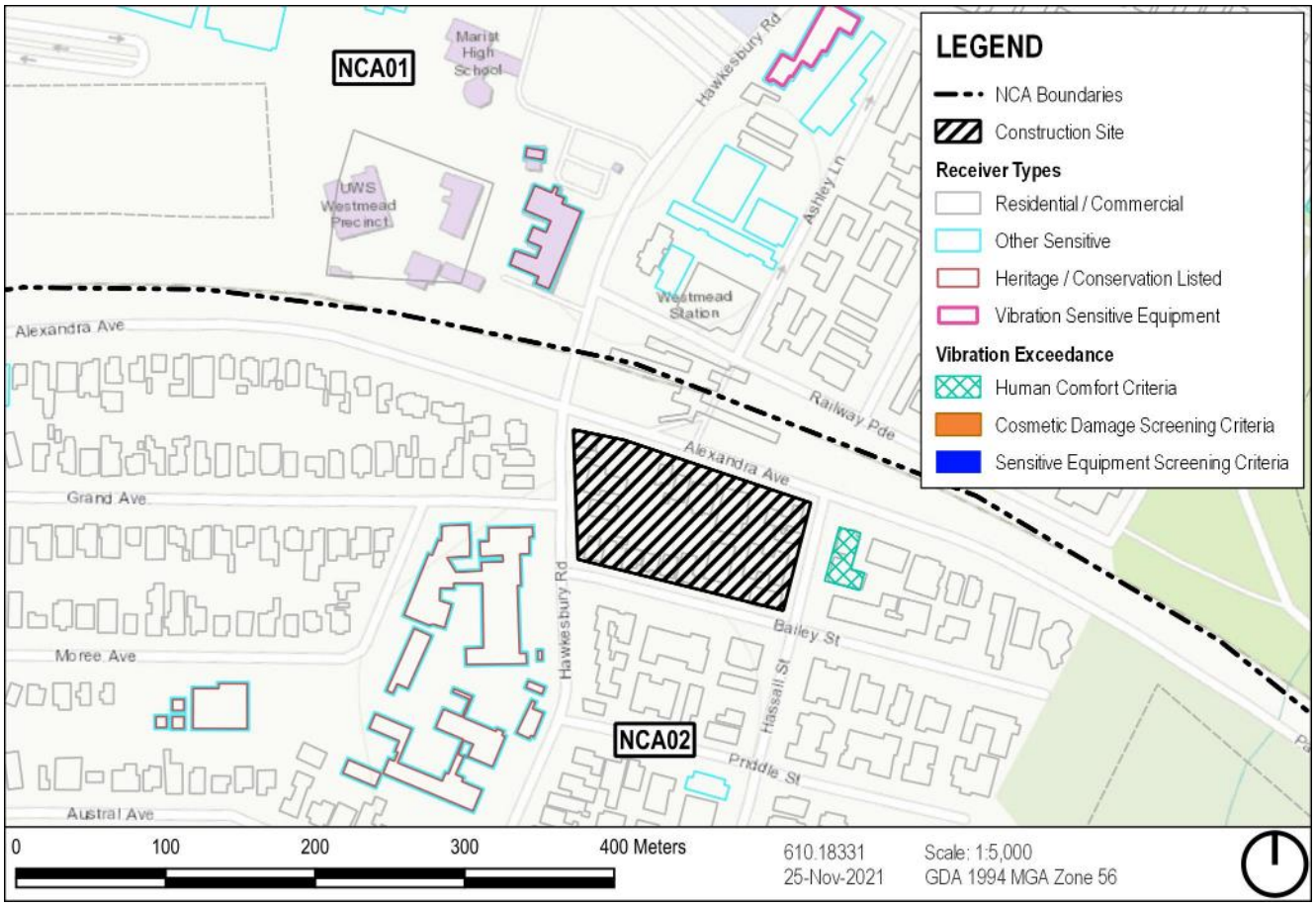


Figure 11 Worst-case Vibration Impacts



The above assessment during the worst-case impacts shows the following:

- Vibration intensive works are predicted to result in 'low' worst-case ground-borne noise impacts at the one of the nearest residential receivers during the daytime. During the night-time, 'moderate' worst-case impacts are predicted at the closest residential receiver and 'low' impacts are predicted at five other nearby receivers.
- Ground-borne noise impacts from vibration intensive work are predicted to be generally consistent with the approved project. There are minor changes to the impacted receivers due to the relocation of the station box. During the daytime, two fewer receivers are predicted to be impacted when compared to the approved project. During the night-time, one receiver is predicted to have a reduced impact category and one receiver is predicted to have an increased impact category compared to the approved project.
- Vibration intensive shaft excavation work inside the acoustic shed is anticipated to occur for 46 weeks. The predictions represent the worst-case scenario when excavation work is at surface level and at the closest point to the affected buildings. As the works progress deeper, the impacts are expected to reduce. This is consistent with the methodology and presentation of impacts for the approved project, however, the anticipated duration of vibration intensive excavation inside the acoustic shed has increased from 23 weeks.
- The human comfort criteria are predicted to be exceeded at one of the nearest commercial buildings located to the east of the site, meaning occupants of affected buildings may be able to perceive vibration impacts at times when vibration intensive equipment is in use nearby. This is consistent with the predicted vibration impacts from the approved project.

- There are no predicted exceedances of the cosmetic damage screening criteria or the sensitive equipment screening criteria. This is consistent with the predicted vibration impacts from the approved project.

6 Tunnelling

The following sections present an assessment of the predicted ground-borne noise and vibration impacts from the revised tunnelling work in the Westmead study area.

6.1 Ground-borne Noise Impacts from Tunnelling

The ground-borne noise assessment is based on the worst-case predicted internal ground-borne noise levels for sensitive receivers above the proposed tunnel alignment. The predictions represent the likely highest noise levels when the tunnelling work is directly below each receiver.

A summary of the predicted ground-borne noise levels from work in each NCA is shown in. The results are shown in **Figure 12** and **Figure 13** for the daytime and night-time, respectively. The predicted change from the approved project due to the alternate alignment is shown in brackets.

Table 20 Overview of Tunnelling Ground-borne NML Exceedances – All Receiver Types

NCA	Number of Receivers									
	Total	With NML Exceedance [1, 2]								
		Daytime			Evening			Night-time		
		1-10 dB	11-20 dB	>20 dB	1-10 dB	11-20 dB	>20 dB	1-10 dB	11-20 dB	>20 dB
NCA01	340	-	-	-	-	-	-	- (-2)	-	-
NCA02	806	12 (-3)	-	-	15 (-9)	8 (5)	-	14 (-9)	12 (-3)	-

Note 1: Based on worst-case predicted noise levels in each NCA.

Note 2: Results that have changed are shown in brackets with increases as positive values and decreases as negative values, relative to the assessment of the approved project.

Figure 12 Ground-borne Noise Impacts from Tunnelling Daytime

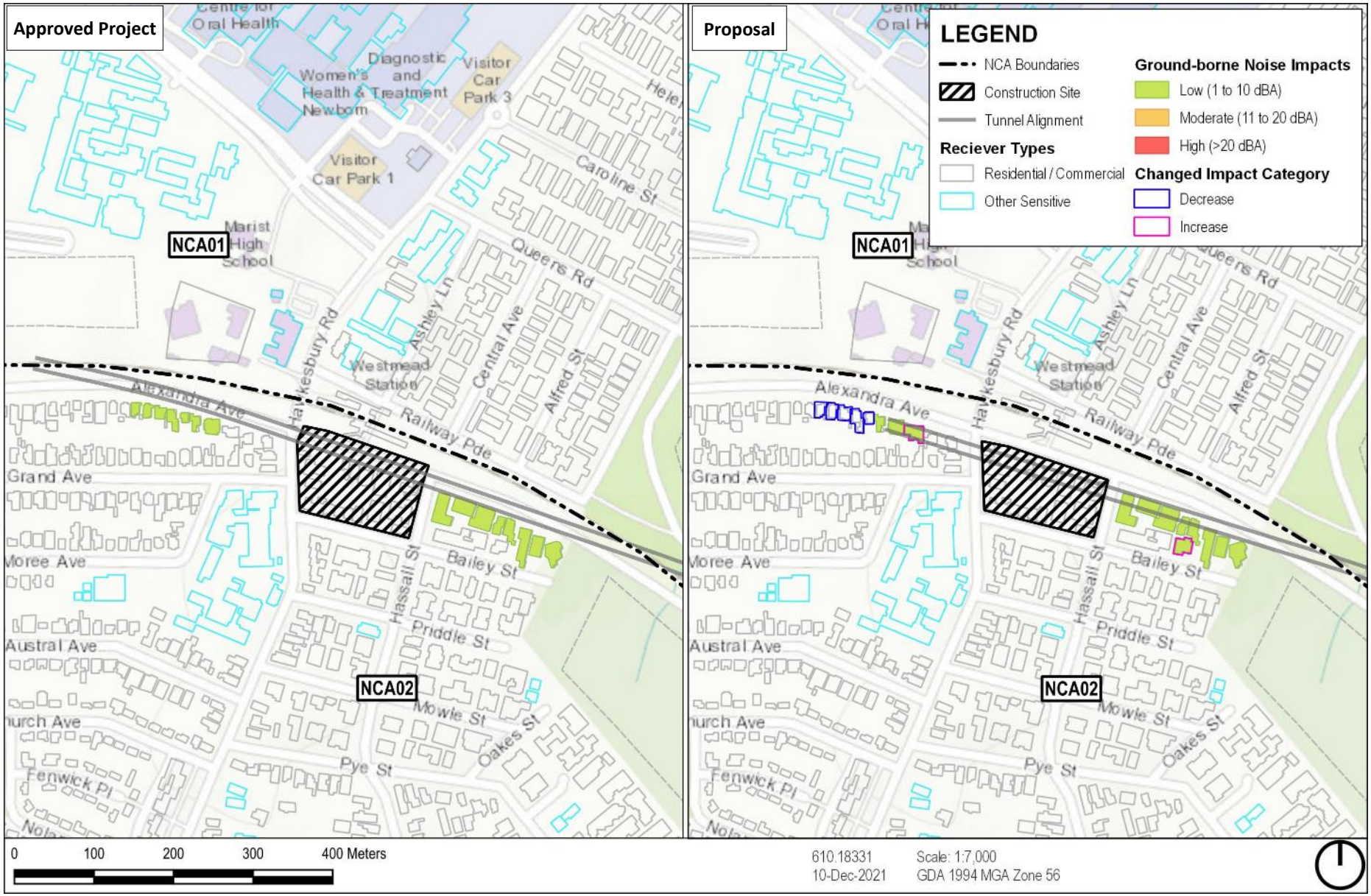
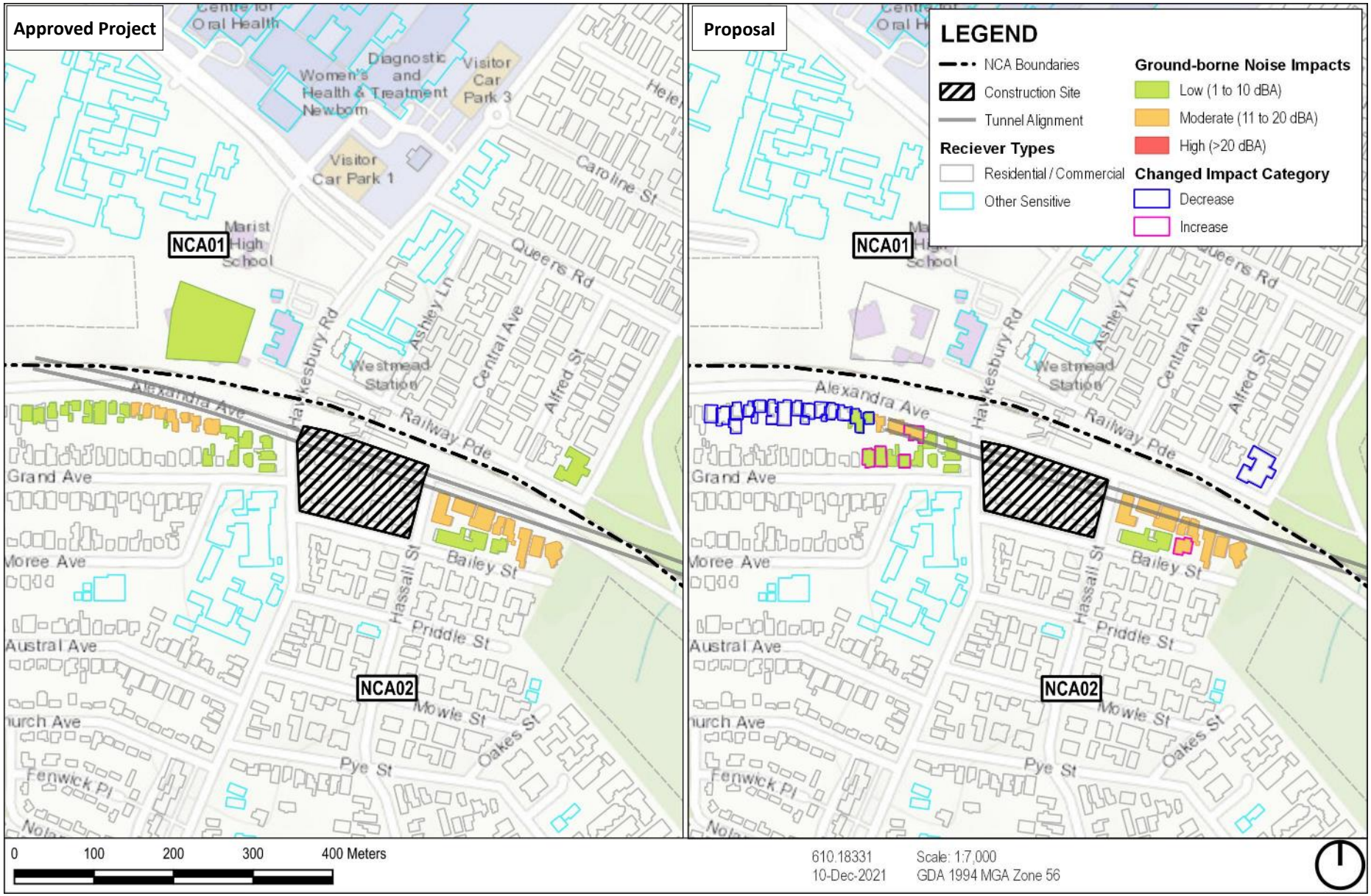


Figure 13 Ground-borne Noise Impacts from Tunnelling Night-time



The above assessment during the worst-case impacts shows that:

- Ground-borne noise from tunnelling during the daytime is predicted to result in 'low' worst-case impacts, with three fewer receivers predicted to be impacted compared to the approved project. This is due to the shortened stub tunnels to the west of Westmead metro station construction site.
- During the night-time worst-case impacts are predicted to be 'moderate', with three fewer 'moderate' impacts and nine fewer 'low' impacts are predicted due to the revised (shorter) tunnel alignment compared to the approved project.

The ground-borne noise predictions are based on the nearest receivers within each building at ground floor. The impacts would reduce for sensitive receivers which are further away from the alignment or for receivers on high floors in multistorey buildings.

6.2 Vibration Impacts from Tunnelling

The ground-borne vibration assessment is based on the worst-case predicted ground-borne vibration level for sensitive receivers above the proposed tunnel alignment. The predictions represent the likely highest vibration level when the tunnelling work are directly below each receiver.

A summary of the predicted ground-borne vibration levels from work in each NCA is shown in **Table 21**. The results are shown in **Figure 14** and **Figure 15** for the daytime and night-time, respectively. The predicted change from approved project due to the alternate alignment is shown in brackets.

Table 21 Overview of Vibration Criteria Exceedances – All Receiver Types

NCA	Number of Receivers				
	Total	With Vibration Criteria Exceedance[1]			
		Cosmetic Damage	Human Comfort		Sensitive Equipment
		Day / Night	Day	Night	Day / Night
NCA01	340	-	-	-	-
NCA02	806	-	8 (6)	10 (2)	-

Note 1: Based on worst-case predicted vibration levels.

Note 2: Results that have changed are shown in brackets with increases as positive values and decreases as negative values, relative to the assessment of the approved project.

Figure 14 Worst-case Vibration Impacts from Tunnelling Daytime

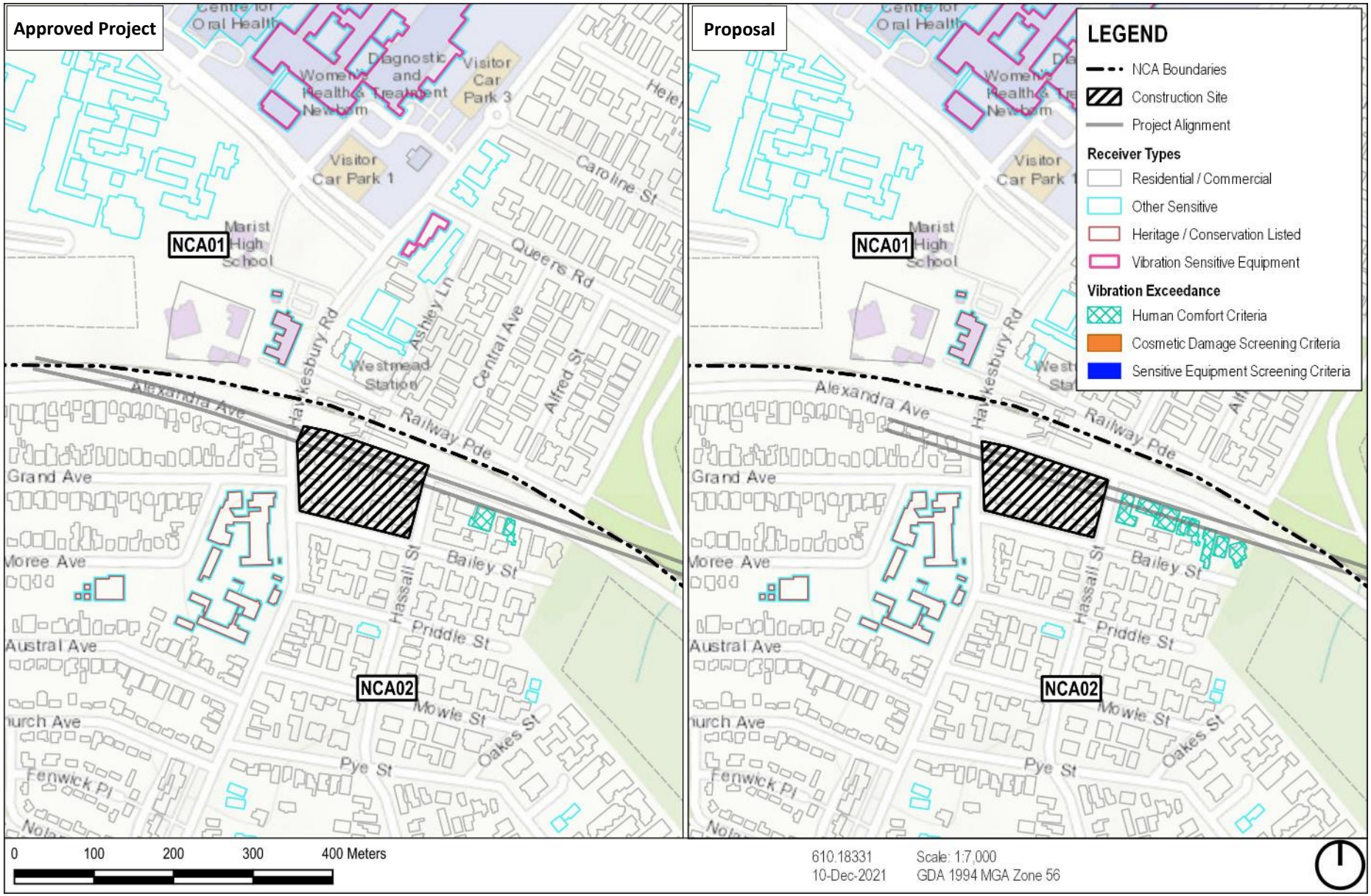
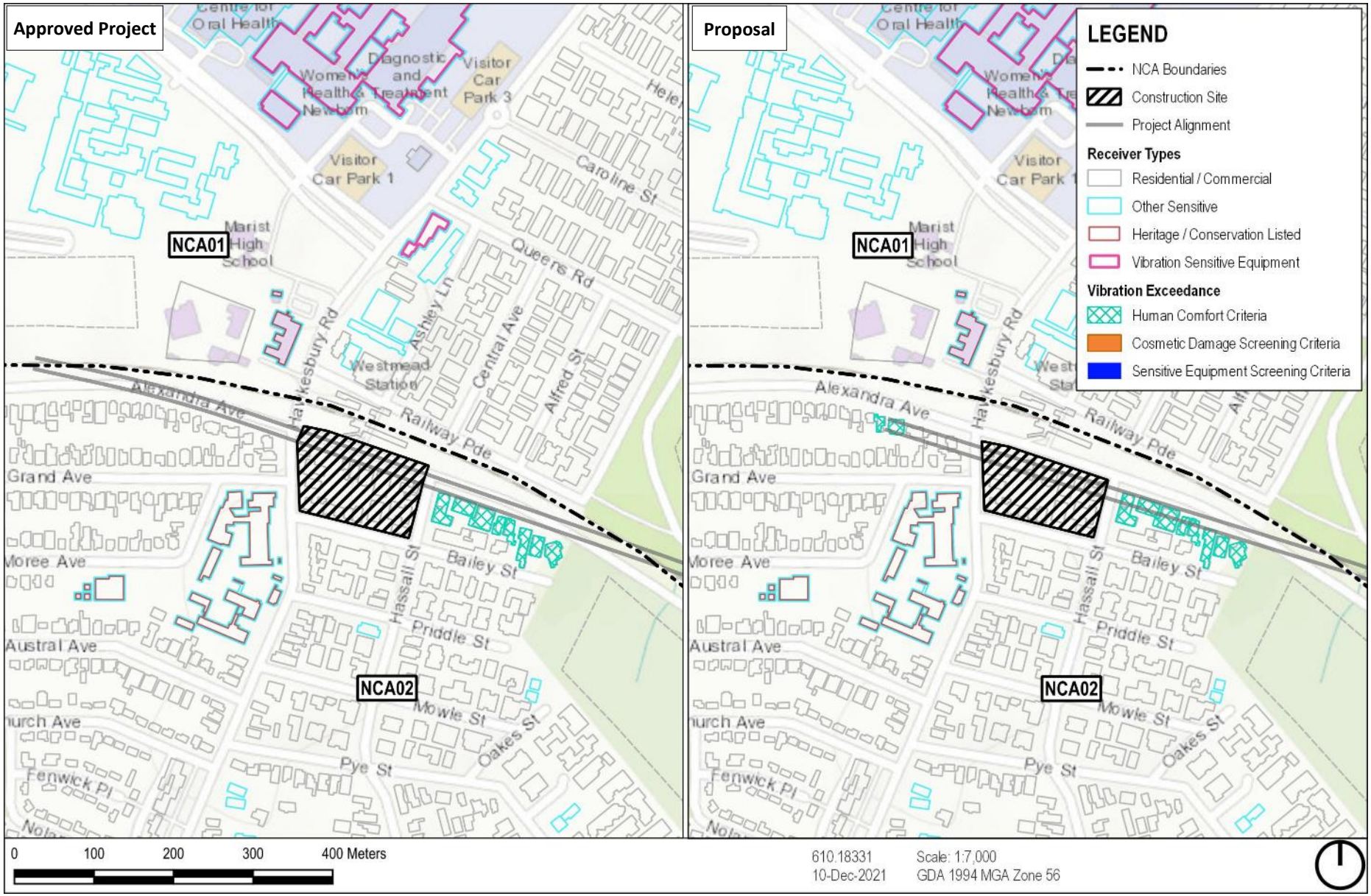


Figure 15 Worst-case Vibration Impacts from Tunnelling Night-time



The above assessment during the worst-case impacts shows that:

- No receivers are predicted to be subject to vibration levels which exceed the cosmetic damage or sensitive equipment screening criteria during tunnelling. This is consistent with the approved project
- Potential exceedances of the human comfort criteria are likely at the nearest receivers, meaning perceptible levels of vibration may occur when tunnelling work are below these areas. These impacts are typically at receivers which surround the construction site, as this is where the tunnel depth is shallowest.
- Six additional receivers east of the site on Alexandra Avenue are predicted to have potential exceedances of the human comfort criteria during the daytime, compared to the approved project. This is due to the realignment of the tunnels to the south, which is closer to these receivers.
- Two additional receivers above the western extent of the revised tunnel alignment are predicted to have potential exceedances of the human comfort criteria during the night-time, compared to the approved project. This is due to the realignment of the tunnels to the south.

7 Road Traffic Noise

The approved project involved the closure of Alexandra Avenue between Hawkesbury Road and Hassall Street during construction at the Westmead metro station construction site. This closure of an arterial road required the rerouting of existing traffic, including bus routes, through the surrounding road network. The revised construction strategy allows Alexandra Avenue to remain open due to the relocated station box and reduced construction site area.

By retaining Alexandra Avenue, the proposal is expected to reduce the potential road traffic noise impacts on the surrounding roads from the redistribution of traffic (including buses). A potentially noticeable increase in road traffic noise (ie a greater than 2.0 dB increase above the existing noise level) is only expected on roads used as construction haulage routes. This will be determined at a later stage in the project during detailed construction planning.

8 Management of Impacts

Mitigation and management measures which would be applied to minimise impacts associated with the proposed change are identified in Section 8 of Technical Paper 2 (Noise and vibration) of the Sydney Metro West Environmental Impact Statement – Westmead to The Bays and Sydney CBD (Sydney 2020a). Noise impacts from any noisy work undertaken during out of hours work periods would be managed in accordance with the requirements of the Sydney Metro *Construction Noise and Vibration Standard*.

Mitigation and management measures which would be applied to minimise increased impacts associated with the proposed change are provided in Section 8 of Technical Paper 2 (Noise and vibration) of the Sydney Metro West Environmental Impact Statement – Westmead to The Bays and Sydney CBD. Noise impacts from any noisy works undertaken during out of hours would be managed in accordance with the requirements of the Sydney Metro Construction Noise and Vibration Standard.

While work associated with the revised site layout is predicted to impact additional receivers during certain activities, the proposed revisions would not require any changes to, or additional, noise and vibration mitigation measures than those provided for the approved project. Impacts at additionally affected receivers would be managed using the measures specified for the approved project.

9 Summary

The potential noise and vibration impacts from the proposed revised site layout for Westmead metro station constructions site have been assessed. The revised layout includes relocating the station box and associated excavation south to allow Alexandra Avenue to remain open for the duration of the Stage 1 work. The tunnel alignment to either side of the proposed Westmead metro station is also proposed to be realigned to accommodate the relocated station box. The location of the road work has also been altered based on revised site access requirements.

The potential noise and vibration impact from the Westmead metro station construction site and associated tunnelling have been assessed and found the following in comparison to the approved project:

- Airborne noise from outdoor construction is predicted to have reduced impacts at up to around 10 total receivers, depending on the work scenario, due to the reduced construction site area.
- Airborne noise from shaft excavation is predicted to cause higher impacts at some receivers due to the relocated station box moving closer to the residential receivers in NCA02 (south of the site). During the night-time when excavation is within the acoustic shed and the doors are closed, increased impacts are predicted at up to around 51 total receivers.
- Highly noise affected impacts are predicted to be generally consistent with the approved project, with two fewer receivers predicted to be impacted.
- The ground-borne noise and vibration impacts from vibration intensive shaft excavation are predicted to be generally consistent with the approved project. Two of the closest receivers are predicted to have a decreased impact category and one receiver is predicted to have an increased impact category due to the relocation of the station box.
- Ground-borne noise from the tunnelling of the revised alignment is predicted to impact fewer total receivers due to the shortened stub tunnels to the west of the site. Some receivers are, however, predicted to have increased ground-borne noise impacts due to the tunnel alignment being relocated to the south of Alexandra Avenue, which is closer to certain receivers. During the daytime, decreased ground-borne noise impacts are predicted at five receivers and increased impacts are predicted at two receivers. During the night-time, decreased ground-borne noise impacts are predicted at 19 receivers and increased impacts are predicted at five receivers.
- Vibration from the tunnelling of the revised alignment is predicted to potentially exceed the human comfort criteria at up to six additional receivers during the daytime and up to two additional receivers during the night-time. This means perceptible levels of vibration may occur when tunnelling work is at the closest point below these receivers. The change is due to the tunnel alignment being relocated south, which is closer to certain receivers on Alexandra Avenue.
- Road traffic noise impacts from the diversion of public traffic are expected to reduce due to the proposal no longer permanently realigning Alexandra Avenue between Hawkesbury Road and Hassall Street.
- The proposal would not require any changes to, or additional, noise and vibration mitigation measures than those provided for the approved project.

While the relocated work locations do result in a relatively small change to the number of receivers being impacted during certain stages of the work, the potential noise and vibration impacts associated with the proposed alternate site layout are generally considered comparable to the impacts predicted for the approved project.

Checked/
Authorised by: AW