Appendix C
Noise and vibration assessment

Memorandum

To:	Ari Stypel	**At:**	Sydney Metro
From:	Jordan McMahon	**At:**	SLR Consulting Australia Pty Ltd
Date:	19 November 2021	**Ref:**	SMW_ClydeMod_AppC_NVIA_Rev6.docx
Subject:	Sydney Metro West Clyde stabling and maintenance facility modification Noise and vibration impact assessment		

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 Sydney Metro West Project 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 Proposed Modification

The proposed modification relates to the major civil construction work at the Clyde stabling and maintenance facility and would include:

- Rosehill dive structure relocation and extension
- Kay Street and Unwin Street realignment.

These changes to the design for the approved project would require:

- Additional land required for future planning applications brought forward
- Additional impact to heritage not assessed as part of the approved project
- Additional impact to biodiversity not assessed as part of the approved project.

There would be no changes proposed to the Concept as described in Chapter 6 (Concept description) of the Environmental Impact Statement.

1.4 Project Description

1.4.1 Rosehill dive structure

The Rosehill dive structure is required to provide for a future connection from the Clyde stabling and maintenance facility to the mainline tunnels. The proposed modification includes:

- Relocation east and extension of the Rosehill dive structure further north-east within the former T6 Carlingford Line
- Additional construction area, previously identified in the Environmental Impact Statement as required for future use, to allow for:
    - Enabling works as outlined in Section 9.4.1 of the Environmental Impact Statement
    - Removal of the Rosehill Railway Station Footbridge which is of local heritage significance, listed under the RailCorp Heritage and Conservation Register under Section 170 of the *Heritage Act 1977* (NSW), and provision for an alternative crossing of the former T6 Carlingford Line prior to removal of the footbridge
    - Removal of the platforms and station furniture at the former Rosehill Railway Station
- Minor realignment of the tunnel portal connecting the mainline tunnels to the revised Rosehill dive structure location.

The revised Rosehill dive structure is presented in **Figure 1**. Further investigation into temporary facilities to support additional access to the tunnels would be considered as part of detailed construction planning.

Figure 1 Clyde stabling and maintenance facility indicative construction site (proposed modification)

1.4.2 Kay Street and Unwin Street Realignment

The realignment of Kay Street and Unwin Street is required to provide general traffic and B-double access around the Clyde stabling and maintenance facility construction site. The proposed modification includes the following changes to the Kay Street and Unwin Street realignment:

- A road bridge as opposed to an underpass to cross the future metro rail tracks
- Elevation of the Kay Street and Unwin Street realignment for about 250 metres
- Minor realignment of the Kay Street and Unwin Street route
- A shared path to accommodate pedestrians and cyclists on one side.

The revised Kay Street and Unwin Street realignment is presented in **Figure 2**.

The proposed modification does not include any changes to the culverts located at A'Becketts Creek and Duck Creek assessed as part of the approved project. These structures and the changes to A'Becketts Creek and Duck Creek as part of the approved project are subjective to ongoing design development to ensure project outcomes are met.

Figure 2 Kay Street and Unwin Street route realignment (proposed modification)

1.5 Purpose of this Memo

This memo provides a technical review of the noise and vibration impacts from the proposed modification. It compares the impacts as a result of the proposed modification with the approved project.

2 Existing Environment

2.1 Clyde Study Area

The Clyde study area is centred on the Clyde stabling and maintenance facility construction site. This study area contains four Noise Catchments Areas, NCA04 to NCA07 as defined 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).

Existing noise levels in this study area are generally controlled by road traffic noise on the surrounding road network, particularly in the areas adjacent to James Ruse Drive and the M4 Motorway where the existing noise levels are mostly dominated by continuous road traffic noise. The area surrounding the construction site is generally suburban residential to the west and commercial/industrial to the east.

The NCAs in the Clyde 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
NCA04	60	South of the Parramatta River and west of James Ruse Drive. The catchment is mainly residential with small areas of commercial receivers.
NCA05	60	North of the M4 Motorway and west of James Ruse Drive. The catchment is mainly residential. 'Other sensitive' receivers include Rosehill Public School and a number of hotels and child care centres.
NCA06	200	South of the M4 Motorway in Granville. The catchment is mostly residential adjacent to the motorway, with some commercial use in the south-east.
NCA07	200	East of James Ruse Drive, this catchment is mostly commercial and covers Rosehill Gardens Racecourse, the Clyde commercial/industrial area, and Silverwater and Newington. Residential receivers and Newington Public School are in the south-east.

Note 1: Approximate minimum horizontal distance from the proposed Clyde stabling and maintenance facility construction site to nearest sensitive receivers.

Unattended ambient noise monitoring was completed in the Clyde study area between March and July 2019, at a total of four representative monitoring locations, as shown in **Figure 3**. The monitoring results are summarised in **Table 2.**

Table 2 Summary of Noise Monitoring Results

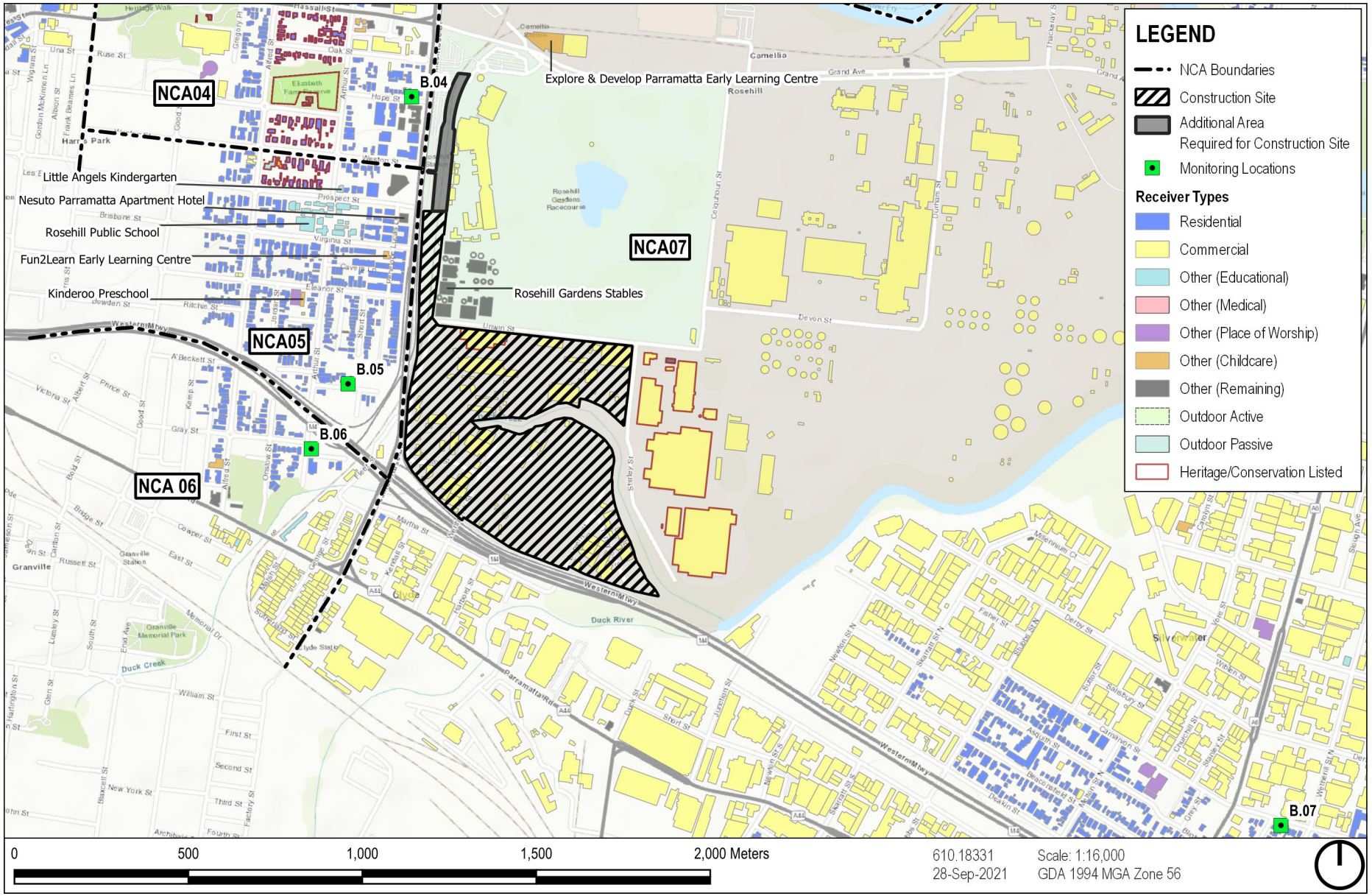
NCA	Location ID	Address	Noise Level (dBA)[1]					
			Background Noise (RBL)			Average Noise Level (LAeq)		
			Day[2]	Evening[2]	Night[2]	Day	Evening	Night
NCA04	B.04	5 Hope Street, Rosehill[3]	51	48	41	61	58	57
NCA05	B.05	9 A'Beckett Street, Granville[3]	50	49	45	56	54	52
NCA06	B.06	4B Gray Street, Granville[3]	52	51	44	58	57	55
NCA07	B.07	10 Carnarvon Street, Silverwater	46	44	41	60	57	55

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.

Note 3: Data referenced from M4 Widening and Parramatta light rail projects, Refer to Appendix B of Technical Paper 2 (Noise and Vibration) of the Sydney Metro West Environmental Impact Statement – Westmead to The Bays and Sydney CBD for details.

Figure 3 Site Map, Work and Sensitive Receivers



2.2 Summary of NMLs

2.2.1 Residential receivers

The residential NMLs for the Clyde study area are shown in **Table 3**.

Table 3 Residential Receiver Construction NMLs

Study area	NCA	Representative Background Monitoring Location	NML (LAeq(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	
Clyde	NCA04	B.04	61	56	53	46	56
	NCA05	B.05	60	55	54	50	60
	NCA06	B.06	62	57	56	49	59
	NCA07	B.07	56	51	49	46	56

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.

2.2.2 'Other Sensitive' land uses and commercial receivers

Non-residential land uses have been identified in the study area. These include 'other sensitive' land uses such as child care centres, places of worship outdoor recreation areas and commercial receivers. Stables for Rosehill Gardens Racecourse are also located close the eastern boundary of the site. The NMLs for 'other sensitive' receivers are shown in **Table 4**.

Table 4 NMLs for 'Other Sensitive' Receivers

Land Use	Noise management level $L_{Aeq(15minute)}$ (dBA) (applied when the property is in use)	
	Internal	External
ICNG 'other sensitive' receivers		
Classrooms at schools and other educational institutions	45	55[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

Land Use	Noise management level $L_{Aeq(15minute)}$ (dBA) (applied when the property is in use)	
	Internal	External
Non-ICNG 'other sensitive' receivers		
Hotel – daytime & evening[3]	50	70[2]
Hotel – night-time[3]	40	60[2]
Child care centres – sleeping areas[4]	40	50[1]
Public building[3] (when in use)	50	60[1]
Stables[5] (when in use)	-	60

Note 1: It is assumed that these receivers have windows partially open for ventilation which results in internal noise levels being around 10 dB lower than the external noise level.

Note 2: It is assumed that these receivers have fixed windows which conservatively results in internal noise levels being around 20 dB lower than the external noise level.

Note 3: Taken from AS2107.

Note 4: Taken from Association of Australian Acoustical Consultants *Guideline for Child Care Centre Acoustic Assessment*.

Note 5: Taken from ICNG for passive recreation areas.

3 Methodology

This noise and vibration assessment follows the same methodology as detailed 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) which should be referenced where further information is required.

3.1 Rosehill Dive Structure

The modified construction methodology and additional construction site area has the potential to alter construction impacts at the nearest receivers.

The assessment of the potential construction impacts uses ISO 9613 algorithms in SoundPLAN 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 study area.

3.1.1 Assessment Approach and Construction Work Descriptions

Representative scenarios have been developed to assess the likely impacts from the various construction activities required. The work scenarios are described in **Table 5** and consist of:

- An additional construction scenario for the removal of structures at the former Rosehill Railway Station. This work would take place in the additional area at the north of the construction site for the approved project. This scenario was not assessed for the approved project.
- Several changed construction scenarios regarding the revised dive structure. This work would take place primarily within the approved construction site, with the northern extent of the dive structure extending into the additional area at the north of the construction site for the approved project. Construction of the dive structure was previously assessed for the approved project and these scenarios represent the potential impacts of the modification only.

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.

Table 5 Construction Scenario Descriptions – Construction Site Activities

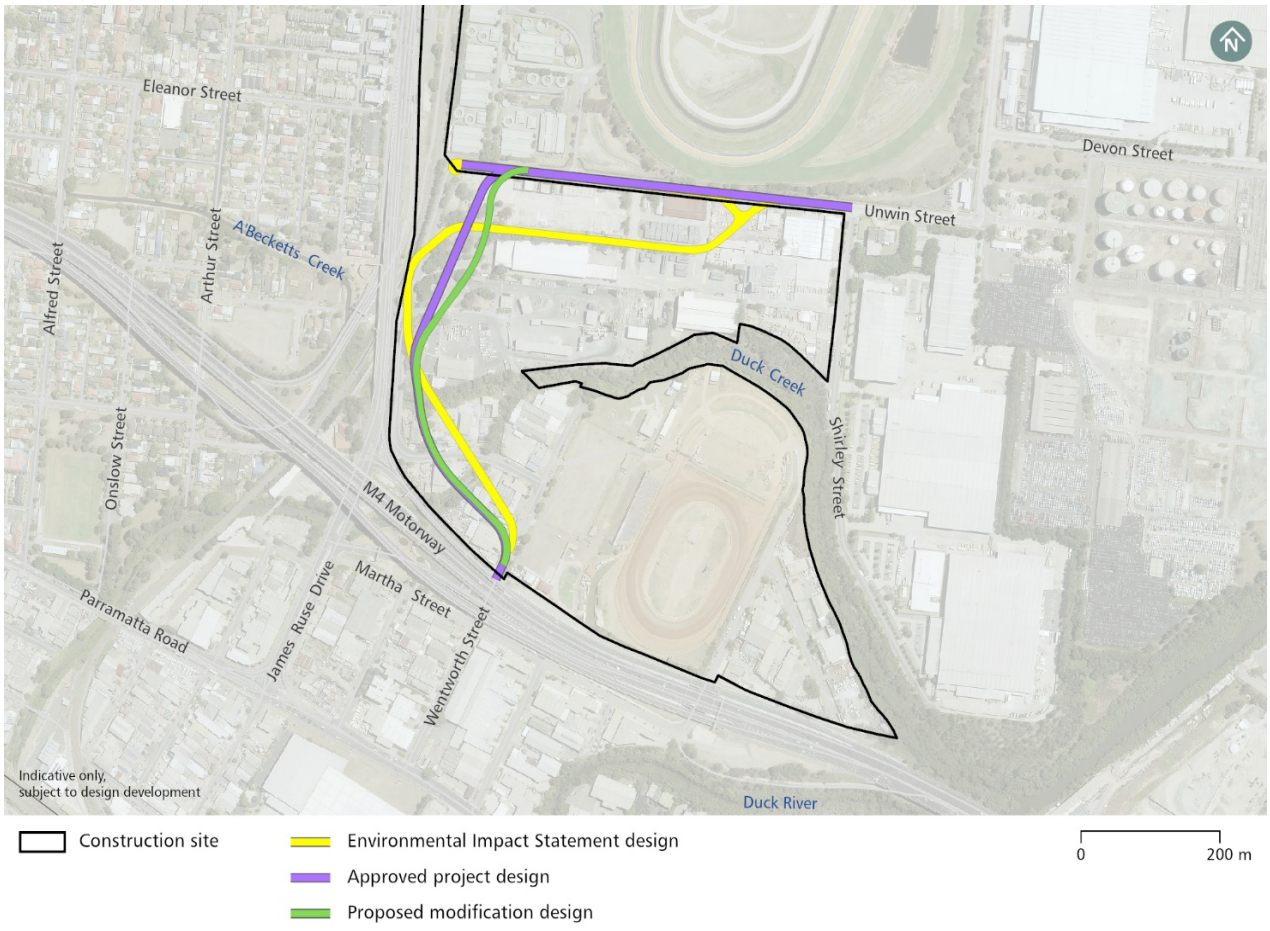
Scenario	Description
Additional construction	
Removal of structures	This work is required to remove the former Rosehill Railway Station platforms, footbridge and station furniture. It would be required at the former Rosehill Railway Station within the additional area required for construction. Elevated work would also be required to remove the Rosehill Railway Station Footbridge. 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. The number of construction faces would double during 'Peak' work.
Changed construction	
Enabling work	Minimal enabling work would be required as the former T6 Carlingford Line has been previously removed (as part of Parramatta Light Rail Stage 1). Enabling work would involve the delivery of equipment and establishment of site facilities. This work would be required across the Rosehill dive structure area and the additional site area, including at the former Rosehill Railway Station. The assessed scenarios are: - 'Typical' works would generally involve delivery of equipment and facilities to the site. - 'Peak' works include the assembly of site facilities including perimeter hoarding and amenities buildings.
Construction of piling pad	The piling pad is a working platform for piling rigs and other associated equipment. This work would be required across the Rosehill dive structure area. The assessed scenarios are: - 'Typical' work would include operation of supporting equipment such as excavators and cranes used for importing materials and light soil compacting - 'Peak' work would use all supporting equipment plus a vibratory roller. The number of construction faces would double during 'Peak' work.
Piling	Piling is required for the foundations of the dive structure. This work would be required across the Rosehill dive structure area. 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.

Scenario	Description
Excavation	Excavation involves removal of the upper layers of soil and rock to a depth suitable for the construction of the capping beam. Surface chiselling of the pile tops with a jackhammer would also be required before the construction of the capping beam. Typical excavation methods involving 'ripping' and spoil handling would be performed to a depth where rock is encountered. Excavation would then occur which includes the concurrent operation of supporting work and rockbreakers. This work would be required across the Rosehill dive structure. The assessed scenarios are: - 'Typical' work would include the use of support equipment for spoil handling at times during excavation when work would pause so the loose spoil can be removed using excavators and transferred to heavy vehicles - 'Peak 1' work would involve the concurrent use of support equipment and ripping through soft soil/rock. This work is also representative of breaking back the piles during the early stages of excavation - 'Peak 2' work would involve the concurrent use of support equipment and rockbreaking through hard rock, where encountered. The number of construction faces would double during all 'Peak' work. Excavation would occur within the dive site at varying depths depending on the stage of the construction and where rock faces are encountered. This assessment assumes that the work is near to surface level, which represents the 'worst-case' situation.
Roadheader launch and support	Roadheaders would be launched from the Rosehill dive structure towards the mainline tunnels. This work would include preparation, launch and extraction and may occur 24/7. This would be required at the tunnel portal at the northern end of the Rosehill dive structure. Once the roadheaders are operational, spoil handling and removal would occur at the Rosehill dive structure. The work requires heavy vehicles, spoil conveyors, loading activities, tunnel ventilation fans, dust collectors, materials and equipment deliveries and onsite stockpiling. The assessed scenarios are: - 'Typical' work would include spoil handling and removal. The work requires heavy vehicles, spoil conveyors, loading activities, tunnel ventilation fans, dust collectors, materials and equipment deliveries and onsite stockpiling - 'Peak' work would include the concurrent use of some supporting equipment and roadheader launch or retrieval activities.

3.2 Kay Street and Unwin Street Realignment

The Clyde B-double access road is proposed to be altered from an underpass to a road bridge. The horizontal alignment of the access road is generally similar to the previous alignment, as shown in **Figure 4**, with the northern end of the route being realigned to east to join Unwin Road earlier.

Figure 4 Kay Street and Unwin Street Realignment



3.2.1 Construction Impacts

The approved project assessed the potential impacts from construction of the access road using the following scenarios:

- Piling
- Earthwork and civil work.

The nearest sensitive receivers to the access road are residential receivers to the west across James Ruse Drive. Piling for the modified alignment and bridge would be required in a location that is further away from the nearest receivers than the previous alignment, meaning noise levels from this activity would be the same or less than the approved project. Earthwork and civil work were assessed across the full Clyde stabling and maintenance facility construction site for the approved project, meaning impacts from this work would not change due to the modified access road.

Construction impacts from the revised alignment of the access road are not expected to be higher than predicted for the approved project and no further assessment has been completed.

3.2.2 Operational Road Traffic Impacts

The potential road traffic noise impacts from the modified alignment for the access road have been qualitatively compared to the impacts predicted for the approved project.

4 Rosehill Dive Structure – Construction Impact Assessment

The revised construction scenarios and proposed working hours are described in **Table 6**. 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.

The work within this study area is expected to occur between June 2022 and July 2025.

Table 6 Surface Construction Activities and Period of Work

Scenario	Activity		Total Indicative Duration (Weeks)[2]	Maximum Number of Working Faces	Hours of Work[1]			
					Std. Day	Out-of-Hours Work		
						Day OOH	Eve	Night
Additional construction								
Removal of structures	Typical	Supporting and loading	6	1	✓	✓		
	Peak	Demolition using a rockbreaker	6	2	✓	✓		
Changed construction								
Enabling work	Typical	Delivery of equipment	7	1	✓	✓	-	-
	Peak	Assembly of site facilities	7	2	✓	✓	-	-
Construction of piling pad	Typical	Supporting work	2	1	✓	✓	-	-
	Peak	Noise intensive work	2	2	✓	✓	-	-
Piling	Typical	Supporting work	1	1	✓	✓	-	-
	Peak	Bored piling with support plant	22	4	✓	✓	-	-
Excavation	Typical	Mucking out	33	1	✓	✓	-	-
	Peak 1	Through soft soil/rock	9	2	✓	✓	-	-
	Peak 2	Through rock using rockbreaker	24	2	✓	✓		
Roadheader launch and support	Typical	Support and spoil removal	88	1	✓	✓	✓	✓
	Peak	Assembly and launch	2	1	✓	✓	✓	✓

Note 1: OOH = Out of hours. During the daytime, this refers to the period on Saturday between 7am – 8am, and 1pm – 6pm.

Note 2: Durations should be regarded as indicative and represent the total estimated duration of work at a typical worksite over the entire construction period.

4.1 Airborne Noise Impacts

4.1.1 Change from Approved Project

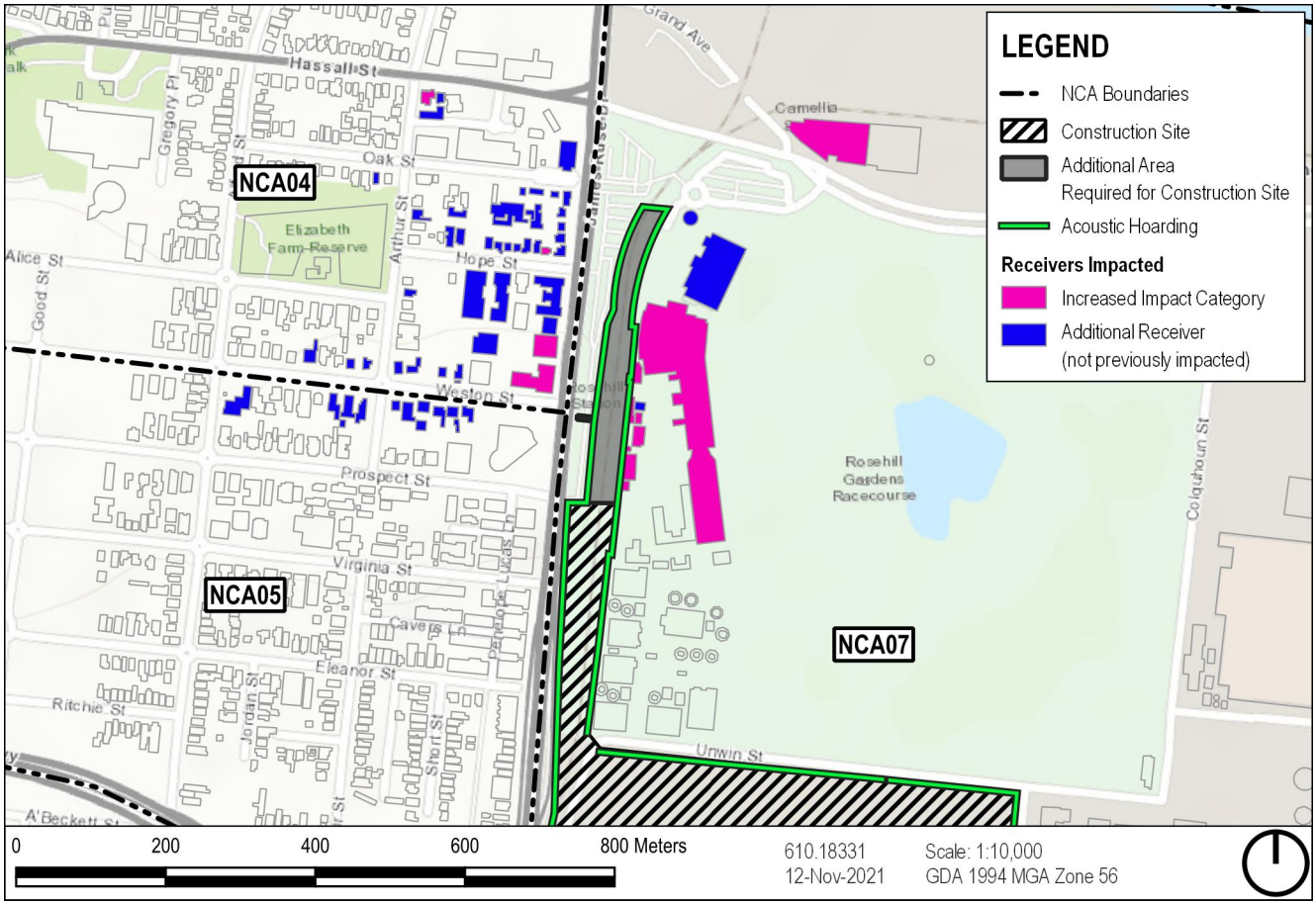
Additional receivers that are predicted to be impacted and receivers that are predicted to have increased impacts from the proposed work, in comparison to what was identified for the approved project (i.e. receivers that are predicted to have an NML exceedance where they previously didn't or experience an increase in NML exceedance category), are shown in **Table 7** and **Figure 5**.

The worst-case impacts from both the additional and changed construction are compared to the worst-case impacts from all scenarios assessed for the approved project (including sitewide demolition that would occur early in the program). This comparison identifies all receivers with an increase to worst-case (i.e. maximum) constriction noise impacts predicted from all construction actives at the Clyde stabling and maintenance facility construction site.

Table 7 Increased Exceedances from Approved Project

Number of Receivers					
With Increased Worst-case Noise Level			With Additional or Increased NML Exceedance		
1-10 dB	11-20 dB	>20 dB	1-10 dB	11-20 dB	>20 dB
22	47	2	58	11	2

Figure 5 Receivers with increased or additional worst-case daytime airborne noise impacts from additional and changed construction



The assessment shows the following:

Additional construction

- Additional impacts are predicted at receivers (additional receivers and receivers with increased impact) on both sides of James Ruse Drive adjacent to the additional area required for construction. These additional impacts result from *Removal of structures* during demolition of the station platforms, footbridge and station furniture at the former Rosehill Railway Station, which occur in the area further north than what was assessed for the approved project. This work would be relatively short term with a total duration of four to six weeks and would be completed during daytime hours.

- The receivers identified to have additional impacts generally have increased noise levels in the range of 5-20 dB when compared to the approved project. These receivers are generally predicted to have 'low' worst-case impacts, which corresponds with a 1-10 dB exceedance of the noise management levels.

Changed construction

- Impacts from the revised location and extent of the Rosehill dive structure are generally consistent with the impacts predicted for the approved project. No receivers are predicted to be additionally impacted from the excavation of the dive structure compared with the worst-case impacts from all scenarios assessed for the approved project.
- It is noted that as part of design development and construction planning, other elements of the site have changed (including removal of segment production facility, segment storage, parking and changed Rosehill services shaft location) and as such a direct comparison of the predicted impacts from the excavation of the modified and previous dive structure is not possible. However, it is expected that some receivers more distant from the dive structure would experience marginally increased impacts during excavation work due to the larger area of the modified dive structure.
- The total duration of excavation is unchanged by the modification and the work would be completed during daytime hours.

4.1.2 Number of NML Exceedances

The predicted airborne noise impacts from construction work are summarised in **Table 8**, **Table 9** and **Table 10** for all receiver types, residential receivers, and commercial and '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 its 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 8 Overview of NML Exceedances – All Receiver Types

Scenario	Activity		No. Weeks[1]	Number of Receivers																
				Total	HNA[2]	With NML Exceedance[3]														
						Standard Construction Hours – Daytime			Out-of-Hours Work[4]											
									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
Additional construction																				
Removal of structures	Typical	Supporting and loading	6	2764	-	4	-	-	5	-	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Peak	Demolition using a rockbreaker	6	2764	1	131	22	2	240	48	3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Changed construction																				
Enabling work	Typical	Delivery of equipment	7	2764	-	2	-	-	7	-	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Peak	Assembly of site facilities	7	2764	7	22	-	-	35	-	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Construction of piling pad	Typical	Supporting work	2	2764	-	11	-	-	17	1	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Peak	Noise intensive work	2	2764	-	49	10	-	95	15	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Piling	Typical	Supporting work	1	2764	-	11	-	-	17	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	22	2764	-	23	-	-	36	5	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Excavation	Typical	Mucking out	33	2764	-	5	-	-	9	-	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Peak 1	Through soft soil/rock	9	2764	-	22	-	-	35	5	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Peak 2	Through rock using rockbreaker	24	2764	6	122	23	-	208	36	6	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Roadheader launch and support	Typical	Support and spoil removal	88	2764	-	-	-	-	4	-	-	5	-	-	7	-	-	13	1	-
	Peak	Assembly and launch	2	2764	-	2	-	-	6	-	-	6	-	-	18	1	-	13	1	-

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, 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: OOH = Out of hours. During the daytime, this refers to the period on Saturday between 7am – 8am, and 1pm – 6pm.

Table 9 Overview of NML Exceedances – Residential Receivers

Scenario	Activity		No. Weeks[1]	Number of Receivers																
				Total	HNA[2]	With NML Exceedance[3]														
						Standard Construction Hours – Daytime			Out-of-Hours Work[4]											
									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
Additional construction																				
Removal of structures	Typical	Supporting and loading	6	1574	-	1	-	-	2	-	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Peak	Demolition using a rockbreaker	6	1574	1	74	8	-	183	34	1	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Changed construction																				
Enabling work	Typical	Delivery of equipment	7	1574	-	-	-	-	5	-	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Peak	Assembly of site facilities	7	1574	7	6	-	-	19	-	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Construction of piling pad	Typical	Supporting work	2	1574	-	5	-	-	11	1	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Peak	Noise intensive work	2	1574	-	23	5	-	69	10	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Piling	Typical	Supporting work	1	1574	-	5	-	-	11	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	22	1574	-	10	-	-	23	5	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Excavation	Typical	Mucking out	33	1574	-	4	-	-	8	-	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Peak 1	Through soft soil/rock	9	1574	-	10	-	-	23	5	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Peak 2	Through rock using rockbreaker	24	1574	6	79	11	-	165	24	6	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Roadheader launch and support	Typical	Support and spoil removal	88	1574	-	-	-	-	4	-	-	5	-	-	7	-	-	13	1	-
	Peak	Assembly and launch	2	1574	-	1	-	-	5	-	-	6	-	-	17	1	-	13	1	-

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, 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: OOH = Out of hours. During the daytime, this refers to the period on Saturday between 7am – 8am, and 1pm – 6pm.

Table 10 Overview of Commercial and 'Other Sensitive' Receiver NML Exceedances

Scenario	Activity		No. Weeks[1]	Number of Receivers with NML Exceedances[2]																	
				Commercial			Child Care			Educational			Hotel (Daytime)			Hotel (Night-time)			Stables		
				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	1-10 dB	11-20 dB	>20 dB
Additional construction																					
Removal of structures	Typical	Supporting and loading	6	3	-	-	-	-	-	-	-	-	-	-	-	n/a	n/a	n/a	-	-	-
	Peak	Demolition using a rockbreaker	6	5	6	2	7	3	-	18	1	-	4	-	-	n/a	n/a	n/a	21	4	-
Changed construction																					
Enabling work	Typical	Delivery of equipment	7	-	-	-	-	-	-	-	-	-	-	-	-	n/a	n/a	n/a	2	-	-
	Peak	Assembly of site facilities	7	5	-	-	2	-	-	-	-	-	-	-	-	n/a	n/a	n/a	9	-	-
Construction of piling pad	Typical	Supporting work	2	1	-	-	1	-	-	-	-	-	-	-	-	n/a	n/a	n/a	4	-	-
	Peak	Noise intensive work	2	3	1	-	1	1	-	7	-	-	2	-	-	n/a	n/a	n/a	13	3	-
Piling	Typical	Supporting work	1	1	-	-	1	-	-	-	-	-	-	-	-	n/a	n/a	n/a	4	-	-
	Peak	Bored piling with support plant	22	1	-	-	2	-	-	-	-	-	-	-	-	n/a	n/a	n/a	10	-	-
Excavation	Typical	Mucking out	33	-	-	-	-	-	-	-	-	-	-	-	-	n/a	n/a	n/a	1	-	-
	Peak 1	Through soft soil/rock	9	1	-	-	1	-	-	-	-	-	-	-	-	n/a	n/a	n/a	10	-	-
	Peak 2	Through rock using rockbreaker	24	8	1	-	5	1	-	11	-	-	2	-	-	n/a	n/a	n/a	16	10	-
Roadheader launch and support	Typical	Support and spoil removal	88	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Peak	Assembly and launch	2	1	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-

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).

4.1.3 Daytime Scenarios

The highest daytime construction noise impacts are predicted when noise intensive work occurs during *Removal of structures* at the former Rosehill Railway Station and during *Excavation* at the Rosehill dive structure.

The daytime construction noise predictions for these scenarios are shown in the following figures with peak and typical impacts presented for *Excavation to* show the range of potential impacts during the work:

- **Figure 6** – *Removal of structures – Demolition using a rockbreaker (peak)*
- **Figure 7** – *Excavation – Through rock using a rockbreaker (peak 2)*
- **Figure 8** – *Excavation – Mucking out (typical).*

The highest impact work is expected to last for:

- *Removal of structures – demolition using a rockbreaker* – 4-6 weeks
- *Excavation – Through rock using a rockbreaker* – 24 weeks.

Figure 6 Worst-case Daytime Airborne Noise Impacts – *Removal of structures – Demolition using a rockbreaker (peak)*

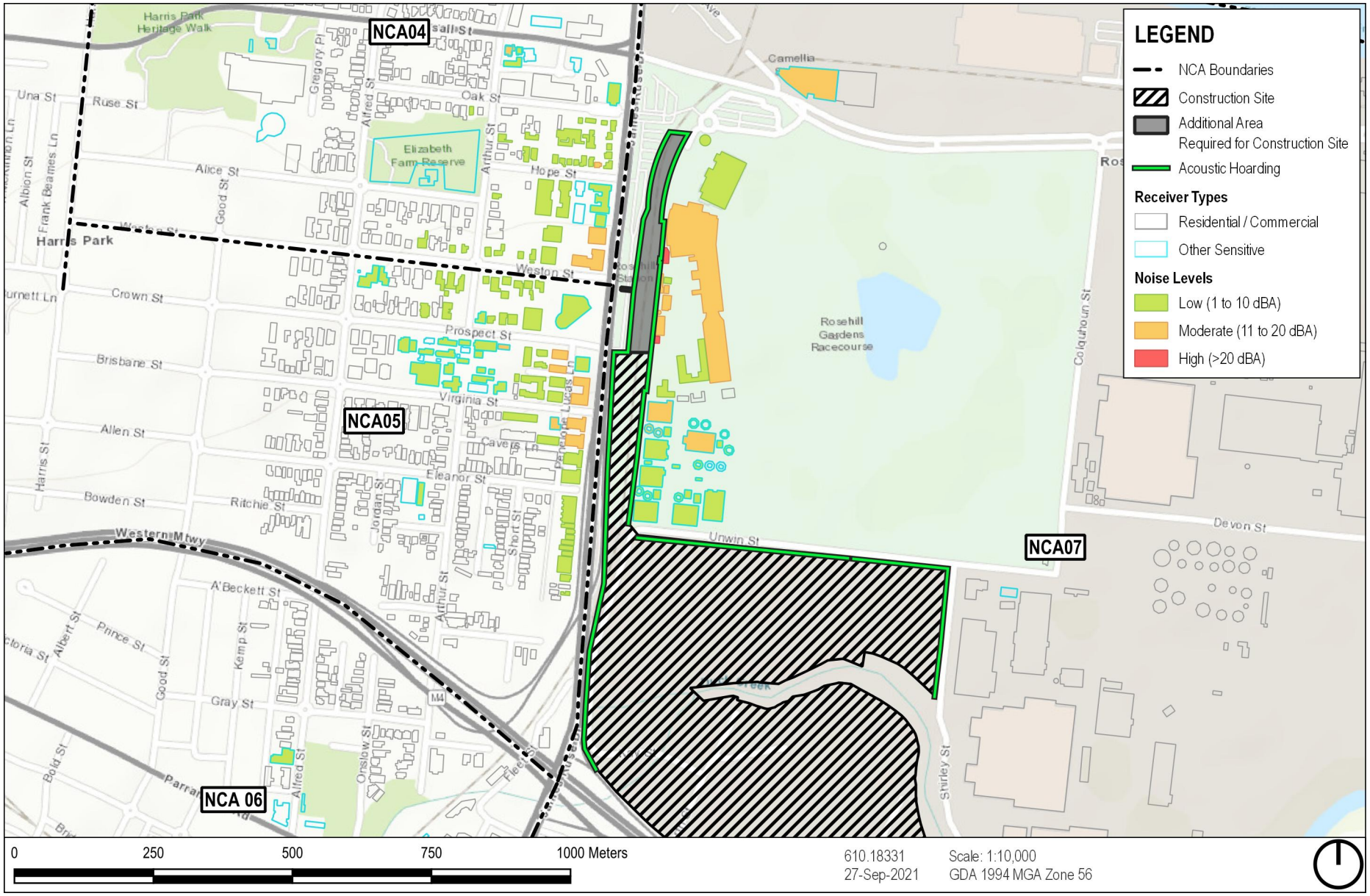
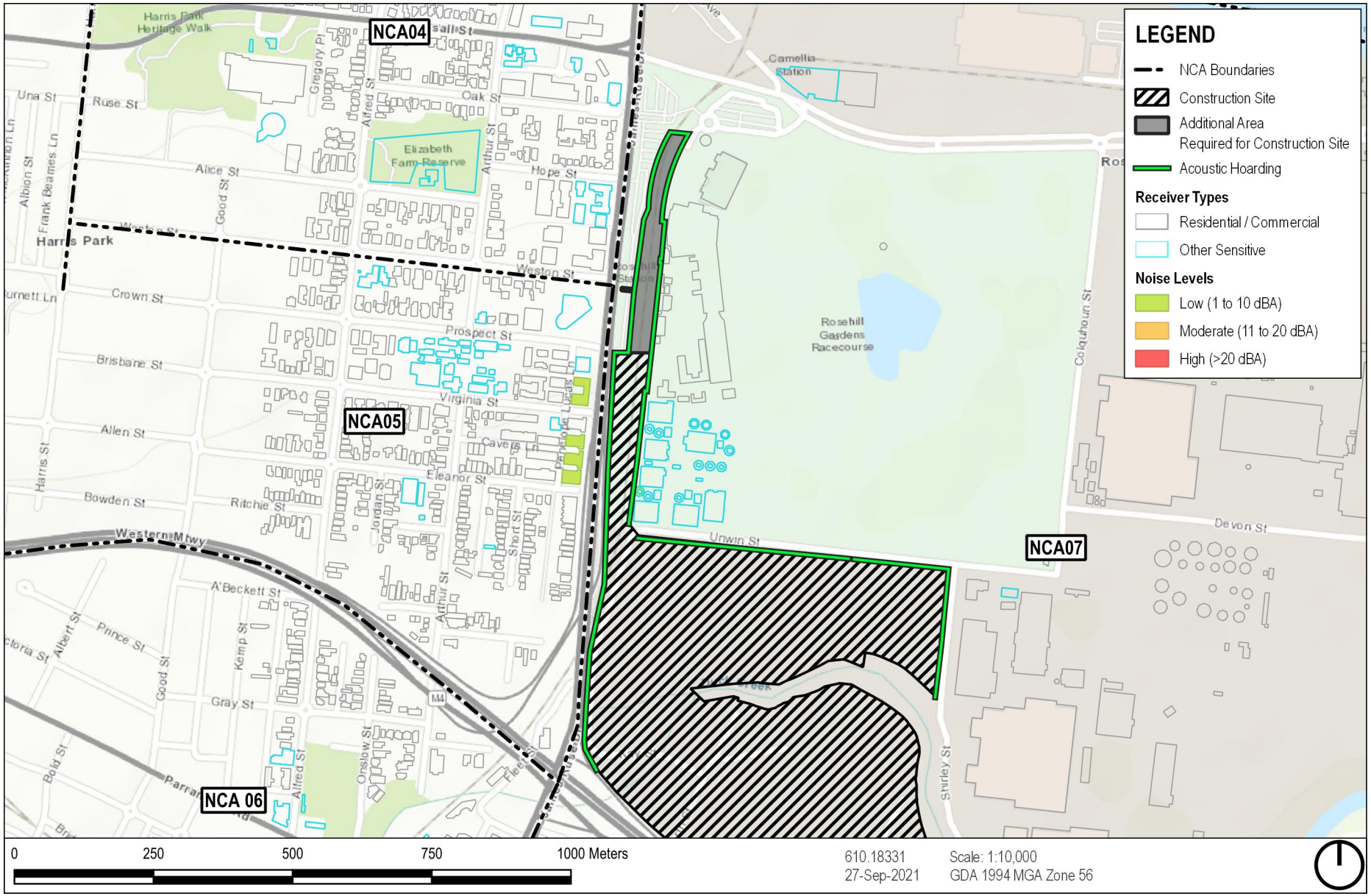


Figure 7 Worst-case Daytime Airborne Noise Impacts – *Excavation – Through rock using a rockbreaker (peak 2)*

Figure 8 Worst-case Daytime Airborne Noise Impacts – *Excavation – Mucking out (typical)*



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

- The proposed work at the Rosehill dive structure and former Rosehill Railway Station would involve noise intensive surface work. This work would only be completed during the daytime. The nearest receivers to the site are generally residential to the west of James Ruse Drive, and commercial and 'other sensitive' stables receivers at the Rosehill Gardens Racecourse.
- Receivers are located close to the modified construction site and impacts are predicted to be 'high' or 'moderate' at the nearest receivers during noisy outdoor surface work, particularly when rockbreakers are being used as part of *Removal of structures* and *Excavation*. Outdoor rockbreaker use is expected to occur over four to six weeks for the additional construction and 24 weeks for the changed construction (reduced by six weeks from the approved project). When less noise intensive work is occurring the daytime impacts substantially reduce, with 'low' impacts predicted at a small number of the nearest receivers.
- It is noted that receivers with direct exposure to James Ruse Drive experience high existing road traffic noise levels during the daytime period. This existing noise would likely mask construction noise emissions to a certain degree, particularly for scenarios with 'low' predicted impacts.
- The 'peak' scenarios generate more noise and result in more exceedances than the 'typical' scenarios, which results from the 'peak' scenarios using noise intensive equipment.
- The nearest commercial and 'other sensitive' receivers are predicted to be impacted during some of the noisier activities. 'High' or 'moderate' worst-case impacts are predicted at:
    - Some stables at Rosehill Gardens ('high')
    - Fun2Learn Early Learning Centre and at Explore & Develop Parramatta Early Learning Centre ('moderate')
    - Rosehill Public School ('moderate')

  The highest impacts at these receivers are predicted when rockbreakers are being used outdoors as part of *Removal of structures* or *Excavation*. 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 are much lower than the worst-case levels predicted and there would be times when no equipment is in use and no impacts occur.

4.1.4 Night-time Scenarios

Roadheader launch and support is the only work proposed during the night-time at the Rosehill dive structure.

The worst-case night-time construction noise impacts are shown in **Figure 9**.

The work is expected to last for:

- *Roadheader launch and support – Assembly and launch (peak)* – 2 weeks
- *Roadheader launch and support – Support and spoil removal (typical)* – 88 weeks

Figure 9 Worst-case Night-time Airborne Noise Impacts – *Roadheader launch and support – Assembly and launch (peak)*

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

- The night-time work is predicted to result in 'moderate' to 'low' impacts at the nearest residential receivers.
- When noise intensive equipment is not in use the noise levels are predicted to result in 'low' impacts at a small number of the nearest residential receivers. Receivers which are more distant are predicted to comply with the management levels.
- The nearest 'other sensitive' receivers are predicted to comply with the management levels except for a 'low' impact exceedance at the Rydges Hotel, which is directly west of the Rosehill dive structure portal.
- No night-time impacts are predicted at the Rosehill Gardens Racecourse stables.

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.

4.1.5 Sleep Disturbance

A sleep disturbance screening assessment has been completed and is summarised in **Table 8.**

'Moderate' sleep disturbance impacts are predicted at the one residential receiver and 'low' impacts are predicted at other nearby receivers during *Roadheader launch and support*. Sleep disturbance impacts from the Rosehill dive structure 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. The number of heavy vehicles at the construction site during the night-time is expected to be around 22 heavy vehicles per hour.

4.1.6 Highly Noise Effected Residential Receivers

No additional receivers are predicted to be highly noise effected from the proposed work in comparison to those identified for the approved project.

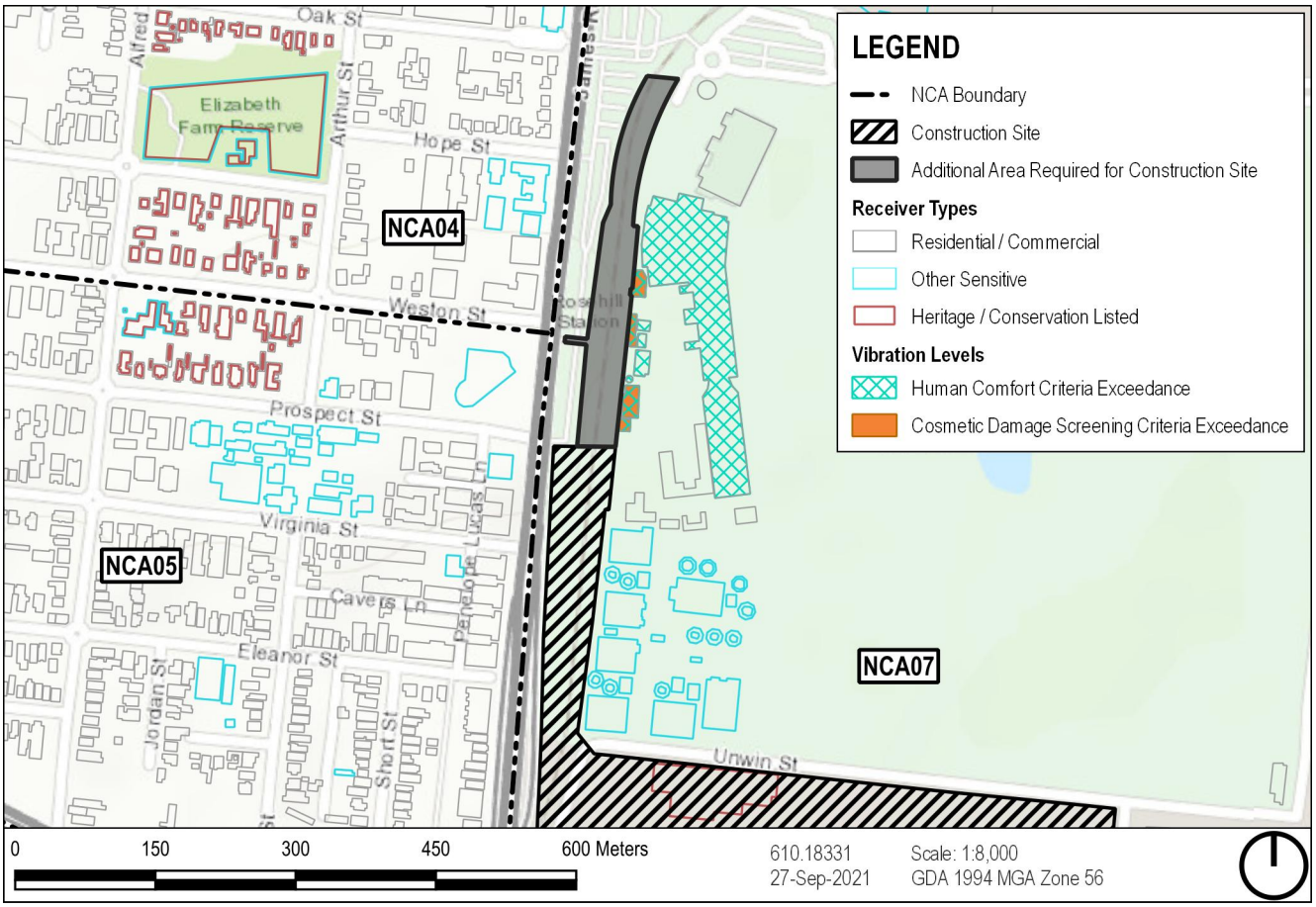
4.2 Ground-borne Noise Impacts

Vibration intensive work during excavation would be completed outdoors meaning airborne noise levels at the nearest receivers would likely be higher than the corresponding internal ground-borne noise levels. Where airborne noise levels are higher than ground-borne noise levels it is not necessary to evaluate potential ground-borne noise impacts and they have not been considered further.

4.3 Vibration Impacts

The predicted impacts during vibration intensive work from the modification are shown in **Figure 10**. The predictions are representative of the highest vibration levels that would likely be experienced by the nearest receivers when work is at its closest.

Figure 10 Worst-case Vibration Impacts



The above shows the following:

- Vibration impacts are predicted at the receivers nearest to the additional site area where vibration intensive work is required to remove structures at the former Rosehill Railway Station. These receivers were not previously identified in the assessment of the approved project due to their distance from the approved project site boundary.
- The cosmetic damage screening criteria are predicted to be exceeded at four commercial buildings at Rosehill Gardens Racecourse, located east of the existing Rosehill Railway Station platform.
- The human comfort criteria are also predicted to be exceeded at several of the nearest commercial buildings at the Rosehill Gardens Racecourse 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.
- The predictions represent work at its closest point to each receiver. In reality, smaller equipment or alternative methodologies would likely be used as the work gets near to adjacent structures which would control the potential impacts. Impacts would also be reduced when work is more distant or further underground.

5 Kay Street and Unwin Street Realignment

5.1 Construction Noise

As outlined in **Section 3.2.1**, construction of the access road would require work equivalent to or further from the nearest sensitive receivers when compared to the assessment of the approved project. As such, construction noise impacts from the revised alignment are not expected to be higher than predicted for the approved project.

5.2 Operational Noise

The assessment of the approved project concluded that the potential impacts from the B-double access road were unlikely to alter existing road traffic noise levels at the adjacent receivers. This was due to existing and future road traffic noise levels in the area being predicted to be controlled by traffic on James Ruse Drive, which is closer to the nearest receivers to the west and has substantially higher volumes of traffic.

The modified B-double access route generally follows a similar alignment to that of the approved project, with the northern end of the route being realigned slightly to the east. The route is also modified to a road bridge, rather than an underpass, to cross the future rail tracks within the Clyde stabling and maintenance facility.

This has moved the northern end of the alignment to be horizontally further away from the nearest residential receivers to the west. The modified alignment is not expected to significantly change noise levels at the closest residential receivers compared to the alignment from the approved project.

Notwithstanding, existing and future noise levels at these receivers would be controlled by noise from the much higher traffic on James Ruse Drive and the modified alignment is not predicted to result in any additional impacts from those predicted for the approved project.

6 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) and provided in **Table 11**. 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*.

In addition to the mitigation measures identified as part of the approved project, additional mitigation measures were developed to manage the potential noise and vibration impacts at the Rosehill Gardens stables. New mitigation measures are shown in bold text with measures not applicable shown with a strikethrough.

Table 11 Stage 1 Specific Construction Noise and Vibration Mitigation Measures

ID	Impact	Mitigation measure	Applicable Location[1]
Approved mitigation measures			
NV01	Community preference	Further engagement and consultation would be carried out with: The affected communities to understand their preferences for mitigation and management measures Other sensitive' receivers such as schools, medical facilities or places of worship would be consulted to understand periods in which they are more sensitive to impacts. Based on this consultation, appropriate feasible and reasonable mitigation and management options would be considered and implemented where feasible and reasonable to minimise the impacts.	All
NV02	Alternative construction methodologies	Alternative construction methodologies and measures minimise the impacts during noise intensive works would be investigated and implemented where feasible and reasonable. This would include consideration of alternative techniques that have been effective on previous similar projects such as: The use of hydraulic concrete shears in lieu of rockbreakers Sequencing works to shield noise sensitive receivers by retaining building wall elements Locating demolition load out areas away from nearby noise sensitive receivers Providing respite periods for noise intensive works Minimising structure-borne noise to adjacent buildings by separating the structural connection prior to demolition using less vibration intensive means such as saw-cutting and propping, using hand splitters and pulverisers or hand demolition Installing of acoustic screening on areas of scaffolding facing noise sensitive receivers Using portable noise barriers around particularly noisy equipment such as concrete saws Modifying demolition works sequencing / hours to minimise impacts during peak pedestrian times and / or adjoining neighbour outdoor activity periods.	All
NV03	Respite and duration of construction noise exceedances	Appropriate respite would be provided to affected receivers in accordance with the CNVS. This would include consideration of impacts from Stage 1 utility and power supply works when determining appropriate respite periods for affected receivers When determining appropriate respite, the need to efficiently undertake construction would be balanced against the communities' preferred noise and vibration management approach.	All
NV04	Out of hours construction noise exceedances	The use of noise intensive equipment at construction sites with 'moderate' or 'high' out of hours noise management level exceedances would be scheduled for Standard Construction Hours, where feasible and reasonable. Where this is not feasible and reasonable, the works would be undertaken as early as possible in the work shift.	All
NV05	Heavy vehicle pneumatic release noise	Air brake silencers would be used on heavy vehicles that access the construction sites multiple times per night or over multiple nights.	All

ID	Impact	Mitigation measure	Applicable Location[1]
NV06	Sleep disturbance impacts from heavy vehicles	Perimeter site hoarding would be designed with consideration of on-site heavy vehicle movements with the aim of minimising sleep disturbance impacts.	All
NV07	Long-term stationary equipment	Long-term stationary construction site support equipment and machinery would be specified to be low noise emitting and suitable for use in residential areas, where feasible and reasonable. Examples include: Low noise water pumps in water treatment facilities Low noise generators and compressors Low noise air conditioner units for use of amenities buildings.	All
NV08	Acoustic sheds	For all sites where acoustic sheds are determined to be suitable, the sheds would be sufficiently designed and constructed to minimise noise emissions. This would include the following considerations: All significant noise producing equipment that would be used during the night-time would be inside the sheds, where feasible and reasonable Noise generating ventilation systems such as compressors, scrubbers, etc, would be located inside the sheds and external air intake/discharge ports would be appropriately acoustically treated The doors of acoustic sheds would be kept closed during the night-time period, where feasible and reasonable. Where night-time vehicle access is required at sites with nearby residences, the shed entrances would be designed and constructed to minimise noise breakout.	WMS, SOPMS, BNS, FDS, TBS
NV09	Construction ground-borne noise at construction sites	Feasible and reasonable measures would be used to minimise ground-borne noise where exceedances are predicted. This could include measures such as using alternative less ground-borne noise and vibration intensive construction methodologies.	All
~~NV10~~	~~Ground-borne noise – cross passages~~	~~The proximity of cross passages to nearby receivers and the corresponding construction ground-borne noise and vibration impacts during the excavation works would be considered when determining locations. Relocation of cross passages to be further away from sensitive receivers to mitigate potential construction impacts would be considered, where feasible and reasonable.~~	n/a
NV11	Ground-borne noise – underground rockbreaking	An activity specific Construction Noise and Vibration Impact Statement (in accordance with the requirements of the CNVS) would be developed for rockbreaking in the tunnel and at cross passages, specifically addressing the activity between 10:00 pm and 7:00 am.	Metro rail tunnels
~~NV12~~	~~Blast Management~~	~~Blasting would be planned during hours that would cause the least disruption and disturbance to the nearest receivers. Notification protocols prior to blasting for the nearest sensitive receivers would be established.~~	n/a
~~NV13~~	~~Blast monitoring~~	~~Attended vibration and overpressure measurements would be completed at the start of any blasting activities to confirm that vibration levels are within the blasting criteria.~~	n/a

ID	Impact	Mitigation measure	Applicable Location[1]
NV14	Construction traffic noise	Further assessment of construction traffic would be completed during detailed design, including consideration of the potential for exceedances of the RNP base criteria (where >2.0 dB increases are predicted). The potential impacts would be managed using the following approaches, where feasible and reasonable: On-site spoil storage capacity would be maximised to reduce the need for truck movements during sensitive times Vehicle movements would be redirected away from sensitive receiver areas and scheduled during less sensitive times The speed of vehicles would be limited and the use of engine compression brakes would be avoided Heavy vehicles would be restricted from idling near to sensitive receivers.	All
NV15	Rosehill Gardens Racecourse stables	Consultation with the owners and operators of the horse stables near the Clyde stabling and maintenance facility construction site would be carried out so that potential impacts to horses are appropriately managed.	CSMF
NV16	Construction vibration at construction sites	Where vibration levels are predicted to exceed the screening criteria, a more detailed assessment of the structure (in consultation with a structural engineer) and attended vibration monitoring would be carried out to ensure vibration levels remain below appropriate limits for that structure. For heritage items, the more detailed assessment would specifically consider the heritage values of the structure in consultation with a heritage specialist to ensure sensitive heritage fabric is adequately monitored and managed.	All
NV17	Building condition surveys	Condition surveys of buildings and structures near to the tunnel and excavations would be undertaken before and after the works, where appropriate. For heritage buildings and structures the surveys would consider the heritage values of the structure in consultation with a heritage specialist.	All
NV18	Cumulative construction impacts	The likelihood of cumulative construction noise impacts would be reviewed during detailed design when detailed construction schedules are available. Co-ordination would occur between potentially interacting projects to minimise concurrent or consecutive works in the same areas, where possible. Specific mitigation strategies would be developed to manage impacts. Depending on the nature of the impact, this could involve adjustments to construction program or activities of Sydney Metro West or of other construction projects.	All
NV19	Operational road traffic noise impacts	Further assessment of operational road traffic noise mitigation would be undertaken for receivers identified as being eligible for consideration of treatment. The mitigation would likely include at-property treatment. Receivers that are identified as requiring at-receiver noise mitigation would be identified and, where possible, offered treatment prior to the start of construction works which have the potential to affect them.	WMS

ID	Impact	Mitigation measure	Applicable Location[1]
Additional mitigation measures (proposed)			
NV20	**Noise impacts to horses at the Rosehill Racecourse stables (consultation)**	**Undertake consultation with the Rosehill Gardens Racecourse and an equine veterinary expert to inform construction noise and vibration objectives for this sensitive receiver.** **Achievement of objectives are to be demonstrated in accordance with Noise and Vibration Construction Monitoring Program required by Conditions C15 and C16 and would include reference to equine behavioural responses where feasible.**	**Clyde modification**
NV21	**Noise impacts to horses at the Rosehill Racecourse stables (additional mitigation)**	**Consider the use of additional noise mitigation measures such as noise barriers where feasible and reasonable.**	**Clyde modification**

Note 1: Key: WMS: Westmead metro station; PMS: Parramatta metro station; CSMF: Clyde stabling and maintenance facility; SSF: Silverwater services facility; SOPMS: Sydney Olympic Park metro station; NSMS: North Strathfield metro station; BNS: Burwood North Station; FDS: Five Dock Station; TBS: The Bays Station; Metro rail tunnels: Metro rail tunnels not related to other sites (e.g. tunnel boring machine works); PSR: Power supply routes.

7 Conclusion

The potential noise and vibration impacts from the modified Clyde stabling and maintenance facility construction site have been assessed. The predicted impacts from the Rosehill dive construction are generally consistent with those predicted for the approved project, however, additional receivers to the north are predicted to impacted due to the extended construction area. All predicted impacts are consistent in nature to the approved project, meaning worst-case impacts are of a similar magnitude and are only expected to occur intermittently when the nosiest construction activities take place close to each receiver. No receivers are predicted to be highly noise affected from the assessed additional and changed construction scenarios.

The potential impacts from the modified alignment of the B-double access road have also been evaluated. The assessment concluded the modified design is not expected to result in any additional construction or operational impacts from those predicted for the approved project.

Checked/
Authorised by: AW