

PREFERRED INFRASTRUCTURE REPORT

CHAPTER NINE



9 Preferred infrastructure report

This chapter provides a description and assessment of following proposed changes to the project:

- Changes to the construction methodology for the northern surface track works
- Changes to the timing for alterations to the Pacific Highway and Mowbray Road intersection
- Changes to Martin Place Station to accommodate the platform-to-platform connection to the Martin Place metro station
- Changes to Central Station, including removal of the temporary pedestrian bridge
- Removal of the stub tunnels from the project
- Removal of rock breaking outside of standard construction hours for cut-and-cover stations and station shafts (except at Central Station).

9.1 Northern surface track works – changes to construction methodology

Section 7.8 of the Environmental Impact Statement outlines the construction activities for the northern surface track works between Chatswood Station and the Chatswood dive structure. This would involve adjustments to the T1 North Shore Line between the southern end of Chatswood Station and Brand Street, Artarmon.

Section 7.11.7 of the Environmental Impact Statement identifies that there would be impacts on pedestrian and cyclist facilities to enable construction of this section of the project. The impacts include the temporary closure of the Frank Channon Walk (a shared path that provides a link between Chatswood Station and Nelson Street, Chatswood). It also identifies that construction access would be from Hopetoun Avenue, Drake Street and Brand Street from the eastern side of the rail corridor.

Since the exhibition of the Environmental Impact Statement, ongoing construction planning for this section has identified the need for a longer, staged closure of the Frank Channon Walk between Albert Street and Nelson Street, Chatswood. It has also identified a need for access to the western side of the rail corridor from Gordon Avenue. This has led to a need to change the construction methodology for this section of track.

9.1.1 Change in retaining wall construction method

A review of construction methodology indicated that there would be a need to construct the retaining wall from the Frank Channon Walk. The location of the northern surface track works in relation to the Frank Channon Walk is shown in Figure 9-1. Construction would include:

- Vegetation clearance
- Site establishment works, including, protecting and / or relocating utilities, establishing site hoardings, noise barriers and / or site fencing around the site perimeter, establishing work areas and establishing access and egress points.
- Construction of the retaining wall, including earthworks and piling
- Reinstatement of the Frank Channon Walk (including pavement) and installing permanent noise barriers.



Figure 9-1 Northern surface track works in relation to the Frank Channon Walk

This work (with the exception of site establishment and closure), would not involve construction activities additional to those described in the Environmental Impact Statement.

The adjustments to the T1 North Shore Line, as identified in the Environmental Impact Statement, would involve piling and heavy earthworks, the operation of plant and equipment, and installation of noise barriers and retaining walls. Further construction planning has identified the need for this work to be carried out directly from the Frank Channon Walk given the complexity of construction and the narrowness of the rail corridor at this location.

Occasional construction vehicles as well as the delivery of plant and machinery would be required to access sections of the Frank Channon Walk, primarily during site establishment and closure. This would occur via Ellis Street, Gordon Avenue and / or Nelson Street as the work progresses.

Construction activities would occur during standard construction hours, but would also occur outside these hours coinciding with rail possessions.

Based on current construction planning, the Frank Channon Walk would be closed for around nine months in two stages as shown in Figure 9-2 and Figure 9-3, and as described below:

- Stage 1: The Frank Channon Walk would be closed between Albert Street, Chatswood to the Chatswood Oval pedestrian underpass for a period of about three months. Where feasible and reasonable:
 - ◆ this would occur prior to the removal of Nelson Street bridge in late 2018
 - ◆ the section of shared path between Ellis Street and the pedestrian underpass, and the pedestrian underpass itself, would be re-opened as early as possible, to reinstate the link between the Pacific Highway and Orchard Road
- Stage 2: The Frank Channon Walk would be closed between the Chatswood Oval pedestrian underpass to Nelson Street, Chatswood for a period of about six months. Where feasible and reasonable, this would occur once Nelson Street bridge is removed.

At the completion of work in this area, the Frank Channon Walk would be reinstated in consultation with Willoughby City Council.

The Frank Channon Walk would also be extended as part of the project from Nelson Street to Mowbray Road on the western side of the railway line. This would benefit pedestrians and cyclists as it would provide continued access between Chatswood Station and residential areas to the south. Further detail on this change is provided in Section 2.1 of this report.

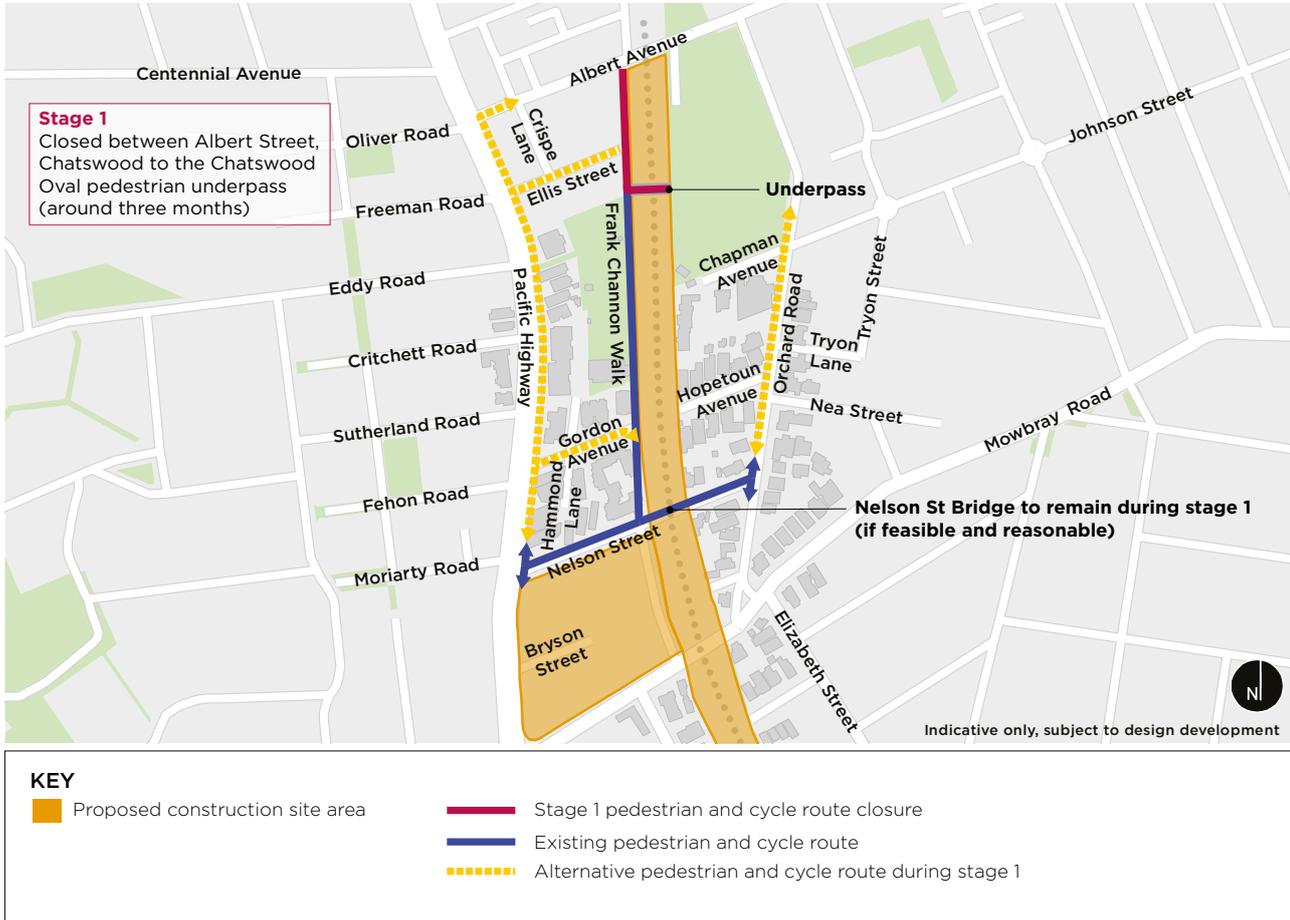


Figure 9-2 Staging strategy for the Frank Channon Walk - Stage 1

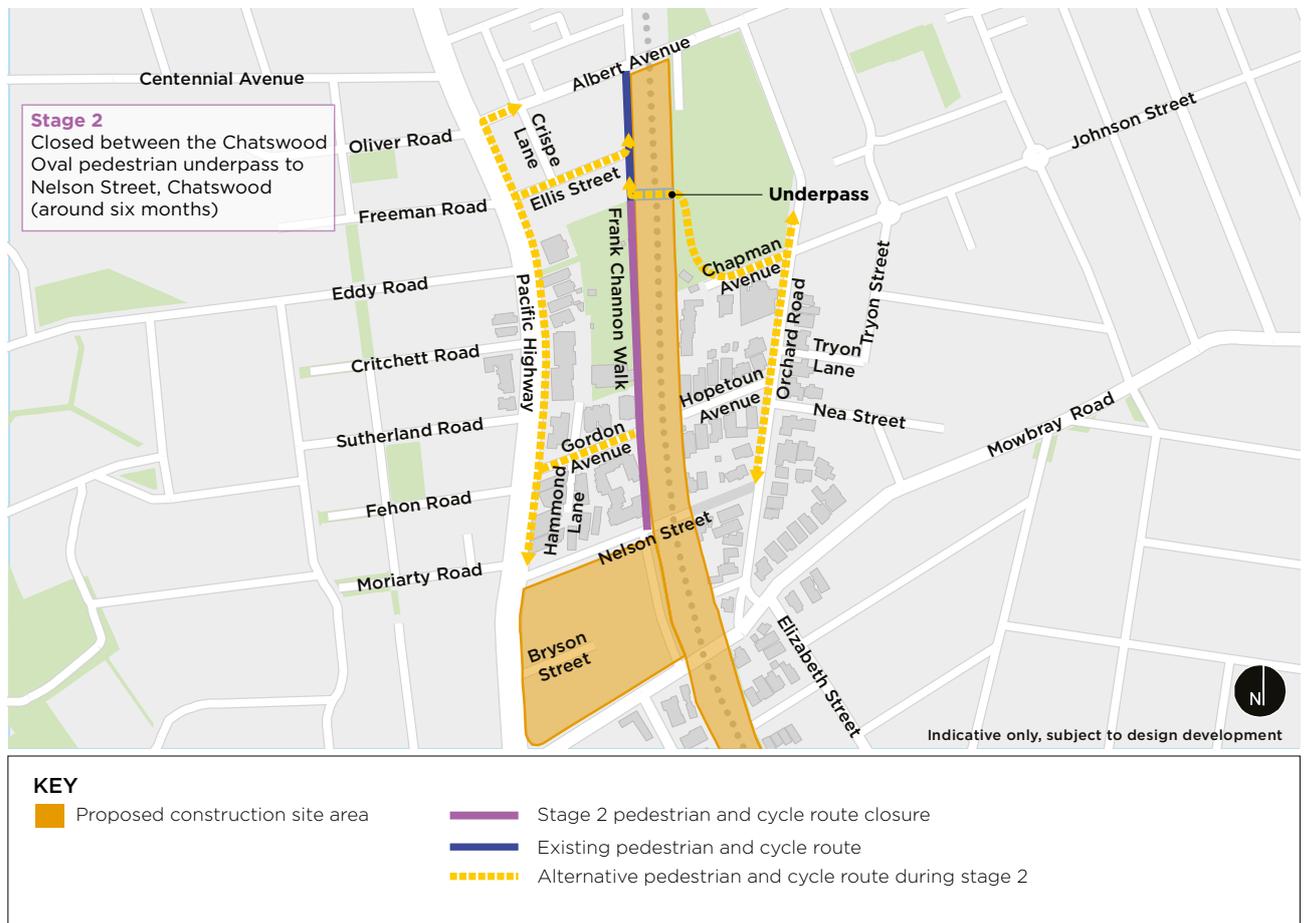


Figure 9-3 Staging strategy for the Frank Channon Walk – Stage 2

9.1.2 Gordon Avenue temporary construction site access

A temporary ramp is now required to construct the northern surface track works to allow vehicles to access from Gordon Avenue to the western side of the rail corridor. The location of the proposed Gordon Avenue access is shown on Figure 9-4. Site establishment work for the access would involve:

- Clearing landscaped vegetation, where required
- Protecting and / or relocating utilities, including street lighting
- Establishing the new access / egress point and ramp, and constructing the temporary diversion of the Frank Channon Walk, a new heavy vehicle footpath crossing and relocated kerb line
- Establishing site hoardings around the perimeter of the site.

Construction work for the northern surface track works between Chatswood and Brand Street, Artarmon would occur from mid-2017 to mid-2022 (refer to Section 7.8 of the Environmental Impact Statement). Based on current planning, the Gordon Avenue access would take about four months to construct and would be used for around three years (estimated at this stage from mid-2017 to mid-2020).

During this period, it is anticipated there would be around 39 heavy vehicle round trips (that is, 78 movements) and 37 light vehicle round trips (that is, 74 movements) to and from the Gordon Avenue access every day, with a maximum construction peak of eight vehicle trips per hour.

The use of the Gordon Avenue access would generally be restricted to the standard daytime construction hours. However, vehicles would also use this access to support work during track possessions.

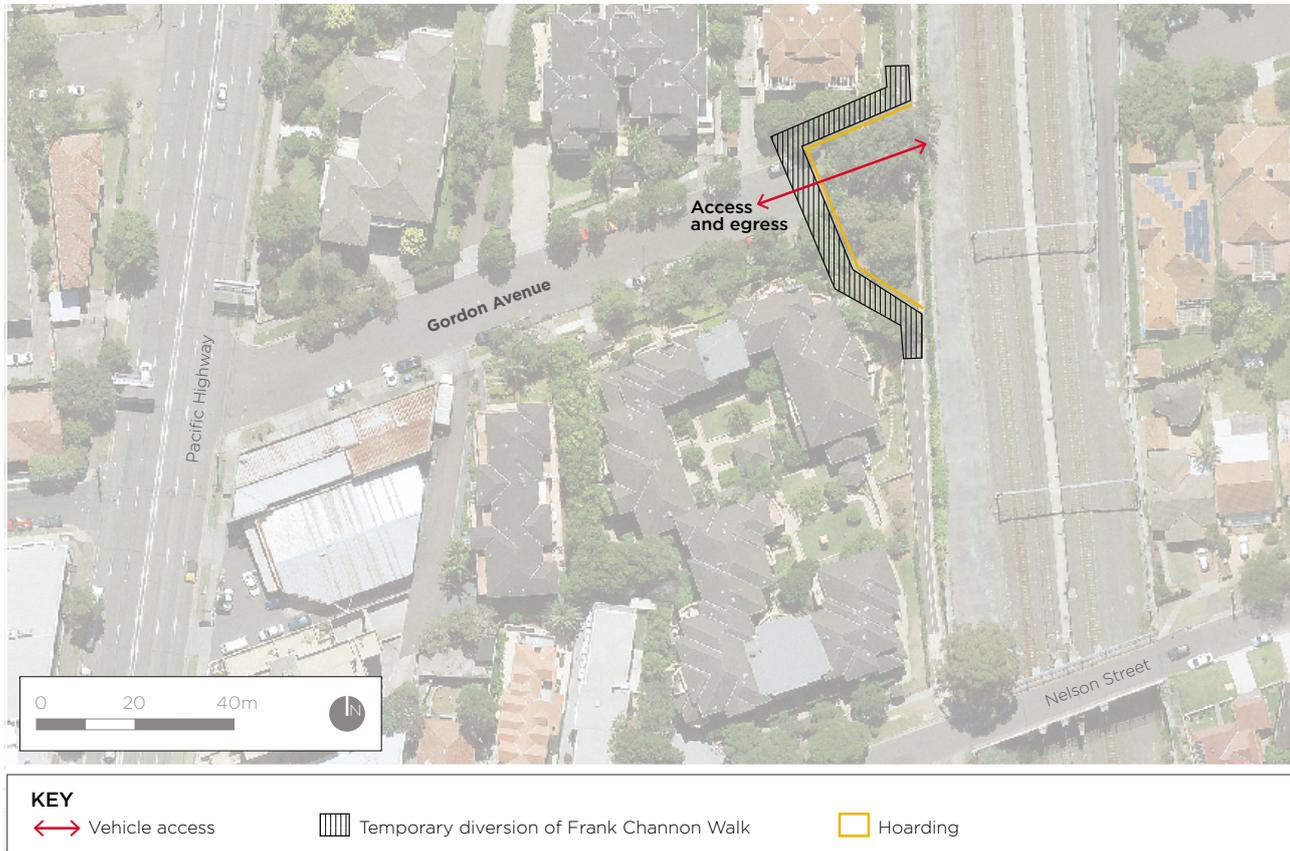


Figure 9-4 Gordon Avenue temporary construction site access

The Frank Channon Walk would be diverted and relocated to the west around the perimeter of the access point. The diversion at Gordon Avenue would enable the walk to remain open while the construction site access is being used. However, sections of the Frank Channon Walk would be closed (including sections of the shared path near Gordon Avenue) to support the construction of the northern surface works.

A small park at the eastern end of Gordon Avenue would be occupied for the full three-year period. The use of the park would require the removal of vegetation at the eastern end of Gordon Avenue, primarily within the park (around 12 to 15 trees), and some street trees (around four trees). This would be in addition to the vegetation that would be removed to construct the northern surface track works. The park would be reinstated and landscaped in consultation with Willoughby City Council once the temporary construction access is no longer required.

9.1.3 Environmental screening assessment

To understand the potential change in environmental impacts, a screening level assessment was conducted and is presented in Table 9-1. This assessment considers potential environmental aspects that may require further impact assessment to understand likely environmental impacts, and identify any relevant mitigation measures that may be required. An assessment of these potential changes in impacts compared to the assessment in the Environmental Impact Statement is provided after the table.

Table 9-1 Chatswood dive site (northern) and northern surface track works – environmental screening assessment

Aspect	Potential change in impacts	Description
Construction traffic and transport	Yes	<p>Construction vehicles and road network impacts</p> <p>The change in construction methodology may require vehicular access to the Frank Channon Walk from Ellis Street and/or Nelson Street as work progresses. However, this would be occasional and largely associated with site establishment. No further assessment is required.</p> <p>However, the construction access at Gordon Avenue would introduce construction traffic movements to a new location. Further assessment is provided in Section 9.1.4.</p> <p>Active transport (walking and cycling)</p> <p>The potential for disruption and alternative routes for pedestrians and cyclists is identified in the Environmental Impact Statement. However, the impacts would now be for a longer duration. Further, alternative routes identified in the Environmental Impact Statement to mitigate the removal of Nelson Street bridge would now be occasionally unavailable.</p> <p>Further assessment is provided in Section 9.1.4</p>
Operational traffic and transport	No	<p>The change in construction methodology would not result in any changes to the operation of the project as assessed in the Environmental Impact Statement.</p> <p>The Frank Channon Walk would be reinstated following completion of the work. Further, the project would also provide a permanent connection between Albert Street and Mowbray Road, which would enhance connectivity for pedestrians and cyclists.</p> <p>No further assessment is required.</p>
Construction noise and vibration	Yes	<p>The construction site access at Gordon Avenue would introduce construction traffic noise impacts.</p> <p>Construction activities that were to be undertaken from within the rail corridor, such as piling, would now occur from the Frank Channon Walk, immediately adjacent to sensitive receivers.</p> <p>Further assessment is provided in Section 9.1.5.</p>
Operational noise and vibration	No	<p>The change in construction methodology would not result in any changes to the operation of the project as assessed in the Environmental Impact Statement.</p> <p>No further assessment is considered necessary.</p>
Land use and property	No	<p>The changes in construction methodology would require the temporary occupation of the Frank Channon Walk for a longer duration than originally identified in the Environmental Impact Statement. However, once the construction activities within the shared path have been completed, the Frank Channon Walk would be reinstated to a similar standard, and in consultation with the local council. Further, following the completion of construction in the area, the shared path would be extended to Mowbray Road, which would benefit pedestrians and cyclists.</p> <p>For the Gordon Avenue construction site access, a small portion of land currently used as open space would be required for the construction period, and a temporary diversion for the shared path provided. This would be reinstated after completion of construction.</p> <p>The changes in impact are considered to be minor and the mitigation measures in the Environmental Impact Statement would manage any increase in impacts.</p> <p>No further assessment is considered necessary.</p>

Aspect	Potential change in impacts	Description
Business impacts	No	<p>There would be no additional direct impacts on business as a result of the changes in construction methodology. Pedestrians and cyclists would continue to have access to the Chatswood central business district and businesses located alongside the rail corridor via alternative routes.</p> <p>Changes in noise impacts may further reduce amenity at the closest business; however, noise impacts would be mitigated where feasible and reasonable in accordance with the mitigation measures in Chapter 11 (Revised environmental mitigation measures and environmental performance outcomes) and the Sydney Metro Construction Noise and Vibration Strategy. The change in impact is considered to be minor and the mitigation measures in the Environmental Impact Statement would manage any increase in impacts.</p> <p>No further assessment is considered necessary.</p>
Non-Aboriginal heritage	No	<p>No heritage items or conservation areas would be directly impacted by the changes in construction methodology. Further, the footprint of earthworks and more extensive construction activities would not differ from those assessed in the Environmental Impact Statement.</p> <p>No further assessment is considered necessary.</p>
Aboriginal heritage	No	<p>The northern surface track works area has a low probability for Aboriginal heritage. Further, the footprint of earthworks and more extensive construction activities would not differ from those assessed in the Environmental Impact Statement.</p> <p>No further assessment is considered necessary.</p>
Landscape character and visual amenity	Yes	<p>The changes in construction methodology would result in construction areas being closer to sensitive receivers, as well as impacts on users of the Frank Channon Walk. The construction site access at Gordon Avenue would also result in the clearing of vegetation from the end of Gordon Avenue. This would result in a change to the landscape character and introduce additional visual impacts.</p> <p>Further assessment is provided in Section 9.1.6.</p>
Groundwater and geology	No	<p>The change in construction methodology would not result in any additional groundwater and geology impacts as the extent of excavation has not changed from that assessed in the Environmental Impact Statement.</p> <p>No further assessment is considered necessary.</p>
Soils, contamination and water quality	No	<p>The changes in construction methodology would not significantly change the potential impacts on soils, contamination or water quality as assessed in the Environmental Impact Statement. The mitigation measures in the Environmental Impact Statement would be implemented to manage this construction area.</p> <p>No further assessment is considered necessary.</p>
Social impacts and community infrastructure	Yes	<p>The temporary, but staged, closure of the Frank Channon Walk would have impacts on pedestrians and cyclists that use this facility. The construction site access at Gordon Avenue would also require the temporary use of a small portion of land currently used as open space, and require the temporary diversion of the Frank Channon Walk.</p> <p>Further assessment is provided in Section 9.1.7.</p>

Aspect	Potential change in impacts	Description
Biodiversity	Yes	The changes in construction methodology would require clearing of vegetation from the end of Gordon Avenue. Vegetation to be cleared elsewhere along the Frank Channon Walk is assessed in the Environmental Impact Statement. Further assessment is provided in Section 9.1.8.
Flooding and hydrology	No	The work would not be located in flood-prone land and would not alter existing stormwater systems. No further assessment is considered necessary.
Air quality	No	The changes in construction methodology would not result in any additional air quality impacts. However, some plant and equipment may be closer to sensitive receivers. The change in impact would be minor and the mitigation measures in the Environmental Impact Statement would manage any increase in impacts. No further assessment is considered necessary.
Hazard and risk	No	The changes in construction methodology would not involve the storage and use of any hazardous substances and dangerous goods in areas closer. No further assessment is considered necessary.
Waste management	No	The changes in construction methodology would not result in the generation of any different and increased volumes of waste materials. No further assessment is considered necessary.
Sustainability	No	The changes in construction methodology would not change the climate risk profile of the project, and would not result in a substantial change to the generation of greenhouse gases or the use of resources. No further assessment is considered necessary.
Cumulative impacts	No	The changes in construction methodology would not result in any additional cumulative impacts. No further assessment is considered necessary.

9.1.4 Traffic and transport

The Frank Channon Walk is a shared pedestrian and cyclist path on the western side of the rail corridor between Nelson Street and Albert Avenue, Chatswood. An underpass is located adjacent to Chatswood Oval, which provides a connection to the Frank Channon Walk for pedestrians and cyclists travelling to / from areas east of the rail corridor.

Gordon Avenue is a local, no through road with low traffic volumes. It has a connection to Hammond Lane, which provides access to residential, commercial and recreational properties, such as the Chatswood Bowling Club and rear lane access for businesses along the Pacific Highway. Footpaths are located on both sides of Gordon Avenue, and connect to the Frank Channon Walk.

The intersection of Gordon Avenue with the Pacific Highway does not have traffic signals, and is restricted to left-in, left-out movements. Unrestricted, on-street parking is allowed within signposted areas.

Vehicle trip forecasts and routes

The proposed haul routes are shown in Figure 9-5. Access to and egress from the site would be left-in from Gordon Avenue and left-out via Gordon Avenue. Construction access would occur during standard daytime construction hours (7am to 6pm Monday to Friday, and 8am to 1pm Saturday). However, vehicles would also use this access on occasion to support work carried out during track possessions.

The anticipated vehicle numbers (heavy and light vehicles) using the Gordon Avenue site access over a typical day is provided in Figure 9-6. This graph shows that the peak for heavy vehicle trips would be the AM peak period (7am to 10am), with four heavy vehicle trips and four light vehicle trips per hour (a total of 16 movements, with every vehicle entering the site departing within the same hour).

The haul routes presented in the Environmental Impact Statement would not directly impact Gordon Avenue. However, the haul routes described above would be in addition to those presented in the Environmental Impact Statement, with Gordon Avenue becoming the primary access/egress point for work within the rail corridor between mid-2017 and mid-2020.

The use of Gordon Avenue access would not result in an increase in total construction vehicles associated with the northern corridor and Chatswood dive (northern) construction site compared with that discussed in the Environmental Impact Statement. However, it would result in additional vehicles on the road network in any one hour.

Active transport network

The Frank Channon Walk is a shared path that provides pedestrian and cyclist access along the western side of the rail corridor between Nelson Street, Chatswood and Albert Avenue, Chatswood. As identified in the Environmental Impact Statement, it would be temporarily closed to safely carry out construction work along the northern corridor.

Change in retaining wall construction method

While the potential for disruption and alternative routes for pedestrians and cyclists is identified in the Environmental Impact Statement, these impacts would now be for a longer duration. Further, alternative routes identified in the Environmental Impact Statement (Chapter 8 – Construction traffic and transport) to mitigate the removal of Nelson Street bridge would now be occasionally unavailable.

The staged closure of the Frank Channon Walk would aim to minimise these impacts, and maintain, where feasible and reasonable, key alternative east-west routes, being the Nelson Street bridge or the rial underpass. If these alternative east-west routes are not available, pedestrians and cyclists travelling between Albert Avenue and Nelson Street would need to travel an additional 250 to 300 metres via Pacific Highway or via Orchard Road.

The proposed staged closure of the Frank Channon Walk would result in a longer disruption to pedestrians and cyclists that use this shared path than assessed in the Environmental Impact Statement. However, alternative routes would remain available and the option of reopening the section between Ellis Street and the underpass during Stage 1 would be explored further during detailed construction planning to minimise disruption to east-west connectivity, and travel distances for pedestrians and cyclists. Mitigation measures in the Environmental Impact Statement (T2, T3, T6 and T7) would provide further mitigation, including advanced notification, road safety audits and directional signage.

The proposed change in construction methodology for the northern surface track works would result in additional impacts on the Frank Channon Walk. While the nature and scale of the impacts would be similar to those assessed in the Environmental Impact Statement, the impacts would occur for a longer duration. Given the availability of temporary alternatives and the proposed staging of closures of certain sections, the impact would be generally consistent with the impacts assessed in the Environmental Impact Statement. The mitigation measures in the Environmental Impact Statement would effectively manage any increased impact.

Gordon Avenue temporary construction site access

A temporary diversion of the Frank Channon Walk in the immediate vicinity of the proposed access/egress point at Gordon Avenue would be provided where there are direct impacts on the path. The path would be closed while the temporary diversion is established, which would be in addition to closure of the path as required to facilitate the construction of the retaining wall (as detailed above).

The closure of the shared path at this location would occur during Stage 1 of the broader staged closure of the Frank Channon Walk and would result in additional impacts on access and connectivity for users of the path. However, access to and from Chatswood Station for pedestrians and cyclists from the south would be maintained via the Pacific Highway, or Orchard Road. This would create an additional travel distance of up to around 300 metres while the underpass is closed.

Overall, the proposed changes to impacts on the Frank Channon Walk compared to those assessed in the Environmental Impact Statement would be minor.

Public transport services

There would be no additional impacts on public transport services as a result of the additional construction site access on Gordon Avenue.

Parking and taxis

There is potential for about four on-street parking spaces to be removed to cater for the additional site access at Gordon Avenue. This is unlikely to significantly impact the surrounding community given that the nearby residential, recreational and commercial properties have available off-street parking. Opportunities to limit the number of on-street parking spaces impacted would be explored during detailed design.

Road network performance

Chapter 10 (Construction traffic and transport) of the Environmental Impact Statement presents the impacts on pedestrians, cyclists and motorists as a result of construction activities in the vicinity of the Chatswood dive site (northern). The assessment found that a number of intersections currently experience long delays and a poor level of service due to the high through traffic volumes and conflicting right-turn movements. The Environmental Impact Statement concludes that:

- The construction traffic from the project would cause minor increases in the degree of saturation and the average delay at some intersections, but generally no change to the level of service in the peak periods
- The construction traffic would not have a major impact on the surrounding road network.

The Gordon Avenue site access would generate a maximum of eight additional construction vehicle trips per hour during the peak construction period (10am to 3pm), reducing to five trips per hour during the AM and PM peak. Given this low volume relative to existing traffic flows on key construction haulage routes and the volume of total construction traffic generated by the project at this location, the impacts on the road network as a result of this additional access would be negligible.

The Pacific Highway / Gordon Avenue intersection is a priority controlled intersection. During use of this site access, a maximum of four light vehicles and four heavy vehicles per hour are anticipated to turn into and out of Gordon Avenue to access the site during the peak construction period. These low volumes would have a minimal impact on the performance of the intersection. Breaks in traffic flow on the Pacific Highway may also occur due to heavy vehicles requiring a large turning circle and longer lead times to enter traffic. However, since the maximum construction vehicle volumes are expected outside of the network peak period, these breaks in traffic flow are likely to be short in duration and have minor impacts to southbound vehicles on the Pacific Highway immediately upstream of the intersection.

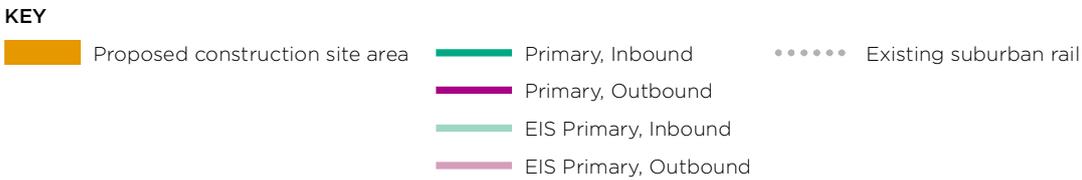
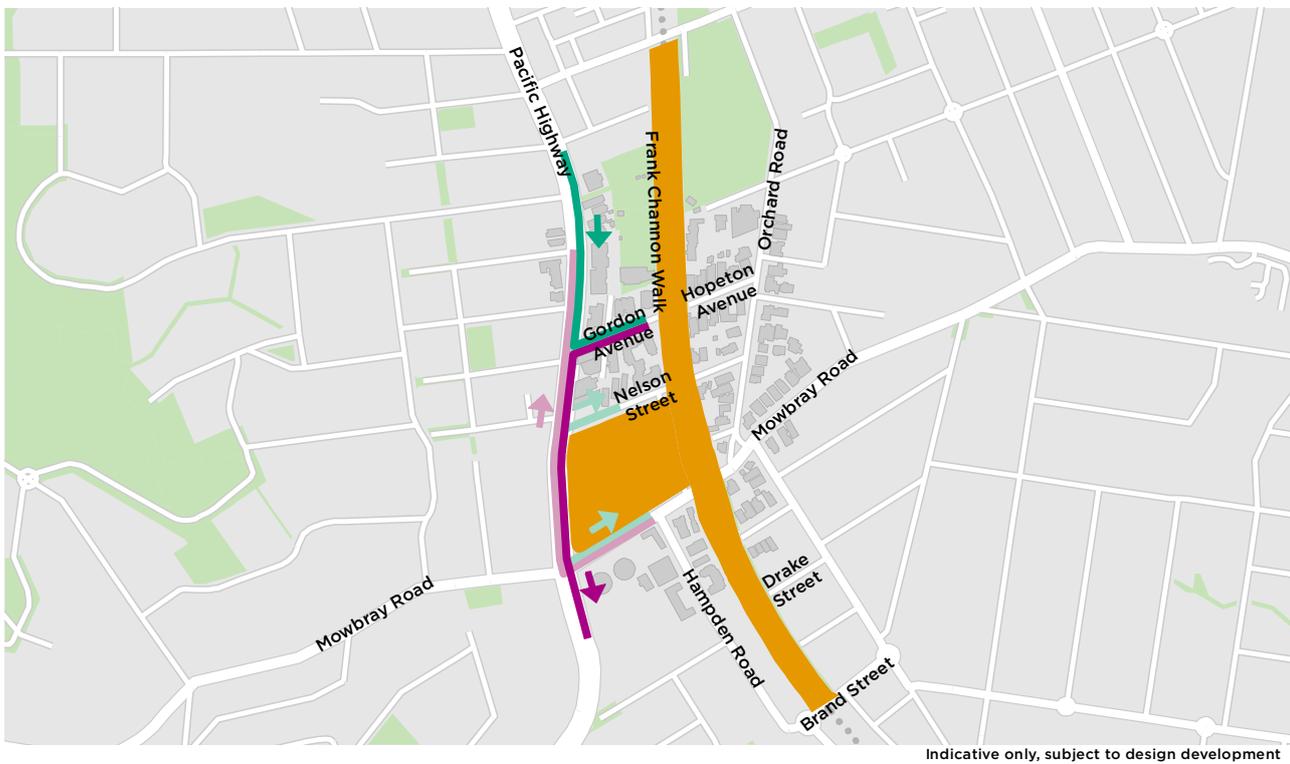
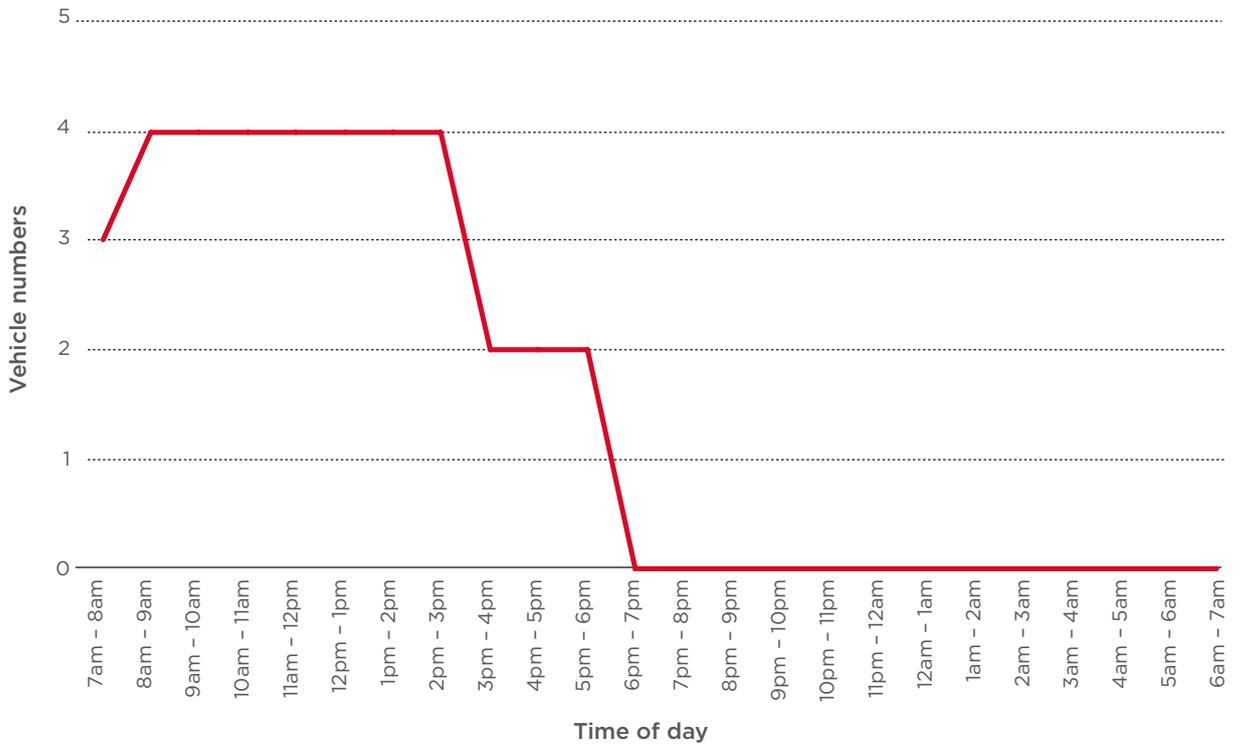


Figure 9-5 Proposed Gordon Avenue temporary construction site access route

Light vehicles



Heavy vehicles

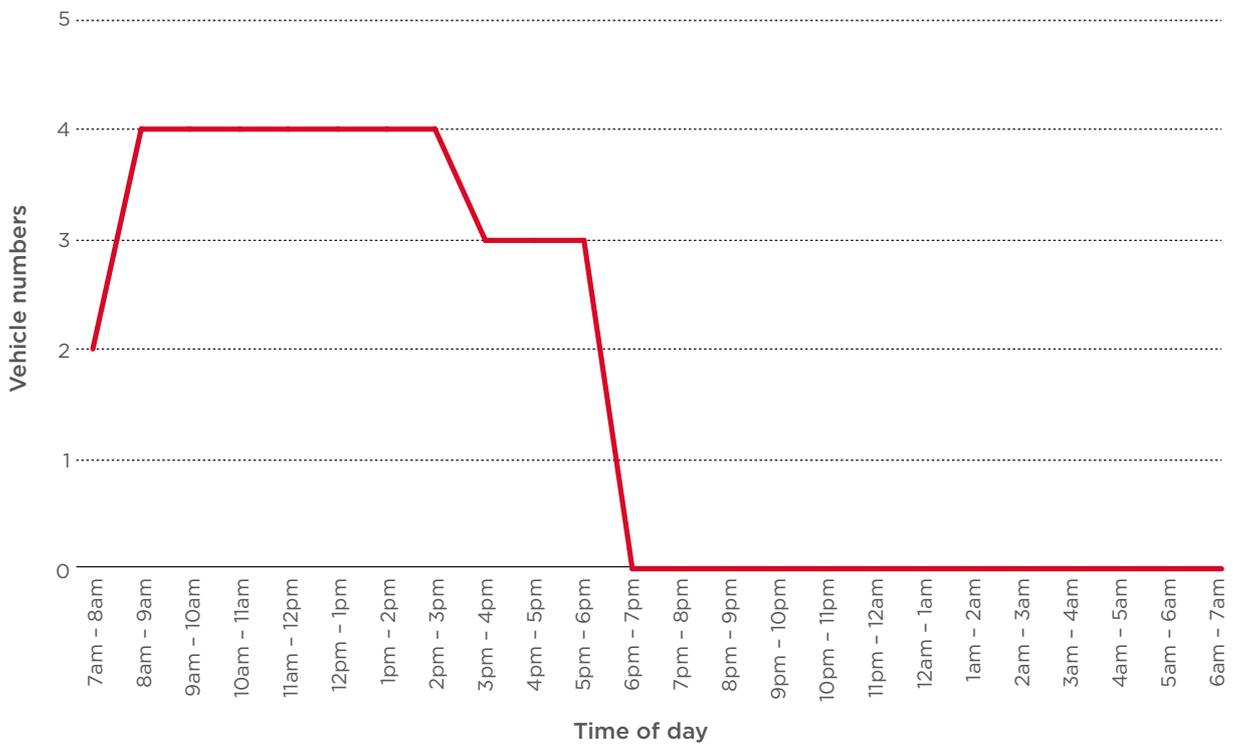


Figure 9-6 Gordon Avenue temporary construction site access – construction traffic numbers (arrival only)

9.1.5 Noise and vibration

Land uses in the vicinity of the Frank Channon Walk are predominately residential and commercial, with an educational receiver south of Ellis Street. There are active recreational receivers to the northwest and northeast of the railway line.

Gordon Avenue is a local, no through road with low daytime traffic flows. Land uses along Gordon Avenue are predominately medium density residential. Limited commercial and light industrial uses (auto mechanics) have frontage to the Pacific Highway, south of the intersection of Gordon Avenue.

Construction airborne noise

Section 10.4.1 of the Environmental Impact Statement provides an assessment of the potential construction noise impacts on nearby sensitive receivers during construction of the northern surface works. Appendix E of the Technical Noise Paper 2 Noise and Vibration presents the predicted construction noise levels at the most affected façade for each receiver, including the sensitive receivers along Gordon Avenue and in the vicinity of the Frank Channon Walk.

Change in retaining wall construction method

Activities that were to be undertaken from within the rail corridor, such as piling, would now occur from the Frank Channon Walk. As a result, construction activities would now occur immediately adjacent to sensitive receivers that adjoin the Frank Channon Walk. This could result in additional airborne noise and vibration. Sensitive receivers adjacent to the Frank Channon Walk include residential, commercial, educational and active recreation.

To assess the change in impact, the additional activities have been incorporated into the earthwork scenario as presented in the Environmental Impact Statement. As a consequence of this change, exceedances of noise management levels at the nearest receiver during this scenario have increased, and would now be similar or greater than the exceedances predicted for the surface track works scenario in the Environmental Impact Statement.

Specifically, the assessment found that receivers to the west of the Frank Channon Walk (Area C) would experience an increase in noise levels, as follows:

- Commercial and active recreational receivers in Area C: The Environmental Impact Statement predicts exceedances of the noise management levels between 10 dB and 20 dB during surface track works. These receivers would now experience exceedances of greater than 20 dB
- Residential and educational receivers in Area C: The Environmental Impact Statement predicts exceedances of noise management levels of over 20 dB during surface track works. The reduction in setback distances to the active construction area would further increase these noise levels.

Consistent with the commitments in the Environmental Impact Statement, any exceedance would be managed in accordance with the mitigation measures in Chapter 11 (Revised environmental mitigation measures and environmental performance outcomes) and the Sydney Metro Construction Noise and Vibration Strategy as provided in Appendix C of this report.

Construction equipment that is now proposed to be placed within the Frank Channon Walk would be at an elevation that would provide a direct line of sight for some receivers located to the east of the rail corridor (in Area D). Where this occurs, receivers could experience an increase in noise levels. The Environmental Impact Statement predicts that these receivers would experience an increase of over 20 dB (for residential receivers) and between 10 to 20 dB (for active recreational receivers).

Consistent with the commitments in the Environmental Impact Statement, any additional exceedance would be managed in accordance with the mitigation measures in Chapter 11 (Revised environmental mitigation measures and environmental performance outcomes) and the Sydney Metro Construction Noise and Vibration Strategy as provided in Appendix C of this report. The applicable mitigation measures are detailed further in Section 9.1.9 of this report.

Gordon Avenue temporary construction site access

The Gordon Avenue site access would reduce the setback distances to the two apartment buildings immediately adjacent to the rail corridor. Noise levels at the most impacted façade are unlikely to increase as a result of this access, but the number of façades impacted would be expected to increase. For example, noise levels would increase on the northern or southern façades of the residential apartment buildings that front onto Gordon Avenue. However, the level of exceedance would be similar to that predicted in the Environmental Impact Statement and the mitigation measures as presented in Chapter 11 (Revised environmental mitigation measures and environmental performance outcomes) and the Sydney Metro Construction Noise and Vibration Strategy would continue to apply.

At receivers further along Gordon Avenue, there would be minor increases of about 2 dB to 3 dB in the predicted maximum noise levels. Mitigation measures would be implemented in accordance with Chapter 11 (Revised environmental mitigation measures and environmental performance outcomes) and the Sydney Metro Construction Noise and Vibration Strategy. The applicable mitigation measures are detailed further in Section 9.1.9 of this report.

Construction traffic noise

Gordon Avenue temporary construction site access

Construction vehicles would use the proposed site access on Gordon Avenue during standard daytime construction hours (7am to 6pm Monday to Friday, and 8am to 1pm Saturday).

Construction vehicles would also use this access to support work carried out during track possessions, but out-of-hours work would be short term and subject to approval under an Environment Protection Licence for the project. As such, this assessment only considers the potential impacts against the Environment Protection Authority's NSW *Road Noise Policy* (DECCW, 2011) baseline criteria for the daytime period.

The assessment presented in Table 9-2 shows that construction traffic noise levels from the additional access on Gordon Avenue would comply with the baseline criteria at all residences.

Table 9-2 Gordon Avenue construction site access – predicted traffic noise

Access road	Base criteria daytime $L_{Aeq}(1hr)$	Predicted daytime road traffic noise $L_{Aeq}(1hr)$
Gordon Avenue	55	52

Note 1: Existing traffic flows are not available for Gordon Avenue.

9.1.6 Landscape character and visual amenity

Currently, trees within the park and vegetation along the western embankment of the rail corridor filter views of the transparent noise barriers along the rail corridor from elevated windows and balconies in residential areas to the west of the Frank Channon Walk.

Gordon Avenue is a local residential street consisting of medium density residential apartment buildings around three to six storeys high, and is lined by an avenue of mature street trees. Commercial and light industrial uses (mechanics and retail outlets) are located at the corner of Gordon Avenue and the Pacific Highway, and associated vehicles use Gordon Avenue for rear lane access.

The eastern end of Gordon Avenue terminates at a small pocket park, which includes mature trees and a lawn area. This park provides a small area of neighbourhood open space and pedestrian access to the local footpath network via the Frank Channon Walk.

Views to the Pacific Highway are more urban in character to the western end of Gordon Avenue. The highway also creates a barrier to pedestrian movement, with no east-west crossings located nearby.

An assessment of the landscape character and visual impacts has been completed consistent with the methodology and rating systems in Chapter 16 (Landscape character and visual amenity) of the Environmental Impact Statement.

Landscape character impacts

Change in retaining wall construction method

Landscape impacts anticipated during construction and operation are summarised in Table 9-3.

During construction, there would be a considerable reduction in landscape quality as a result of the change in construction methodology, primarily due to the direct impact and temporary closure of the Frank Channon Walk. This would result in a moderate adverse landscape impact.

The change in construction methodology would further contribute to a considerable reduction in landscape quality. However, the impact rating would not differ from that presented in the Environmental Impact Statement, as construction activities were already proposed to be undertaken along the interface of the shared path and the rail corridor.

As the Frank Channon Walk would be reinstated following the completion of construction, there is no change in the operational impact presented in the Environmental Impact Statement.

A new mitigation measure has been included in Chapter 11 (Revised environmental mitigation measures and environmental performance outcomes) concerning the reinstatement of the Frank Channon Walk in consultation with the Willoughby City Council. This includes consultation with Willoughby City Council concerning the identification of opportunities to mitigate impacts to Frank Channon Walk (along with impacts to Gordon Avenue and Nelson Street), through landscape and public domain treatments for areas affected by construction.

Further, mitigation measures (LV12 and LV13) have committed that, where feasible and reasonable, vegetation would be provided to screen and visually integrate sites with the surrounding area. In addition, appropriate landscape treatments for Frank Channon Walk are to be identified and implemented

Gordon Avenue temporary construction site access

Landscape impacts anticipated during construction and operation are summarised in Table 9-3.

During construction, there would be:

- A further but minor contribution to the reduction in landscape quality as a result of the impact on the Frank Channon Walk, primarily due to the direct impact on the path and temporary closure
- A further but minor adverse landscape impact on Gordon Avenue due to the removal of mature trees and temporary removal of local open space, which would temporarily alter the character of the street.

During operation, there would be:

- A further but minor contribution to the reduction in landscape quality due to the removal of mature trees, until new plantings mature. The overall impact, however, would remain unchanged from the impact identified in the Environmental Impact Statement
- A negligible landscape impact on Gordon Avenue. Reinstatement of the park would provide an opportunity for new planting, lawn and footpaths, though this may take a number of years to provide the same level of shade and general amenity.

A new mitigation measure has been included in Chapter 11 (Revised environmental mitigation measures and environmental performance outcomes) concerning the reinstatement of the small park and the Frank Channon Walk in consultation with Willoughby City Council.

Table 9-3 Chatswood dive site (northern) and northern surface track works – landscape impacts

Location	Sensitivity rating	Construction		Operation	
		Modification rating	Impact rating	Modification rating	Impact rating
Gordon Avenue and park	Neighbourhood	Considerable reduction	Minor adverse	Noticeable reduction	Negligible
Frank Channon Walk	Local	Considerable reduction	Moderate adverse	Noticeable reduction	Minor adverse

Daytime visual amenity impacts

The anticipated daytime visual impacts from representative viewpoints during construction and operation are shown in Figure 9-7 and summarised in Table 9-4.

For all assessed viewpoints, a level of impact would occur irrespective of the changes in construction methodology given work would occur along the rail corridor, and would involve the removal of vegetation along the Frank Channon Walk.

Change in retaining wall construction method

For the change in construction method for the retaining wall, the following viewpoints were assessed:

- Viewpoint 1: View south along the Frank Channon Walk
- Views from residential areas to the west of the Frank Channon Walk

The change in construction method would result in additional localised visual impacts during construction over and above those identified in the Environmental Impact Statement due to the temporary closure and occupation of the Frank Channon Walk. Construction equipment would be operated within the path, and noise barriers and / or fencing provided around the perimeter of the construction site.

For viewpoint 1, this would result in a moderate adverse visual impact during construction. However, this level of impact remains unchanged from that assessed in the Environmental Impact Statement. For views from residential areas to the west of the Frank Channon Walk, construction work areas would now be closer to residential areas and adjacent to recreational areas, such as the Chatswood Bowling Club. This would considerably impact views from these areas.

Therefore, the project, with the proposed change in methodology, would result in a minor adverse impact during construction. However, this level of impact would remain unchanged from that assessed in the Environmental Impact Statement.

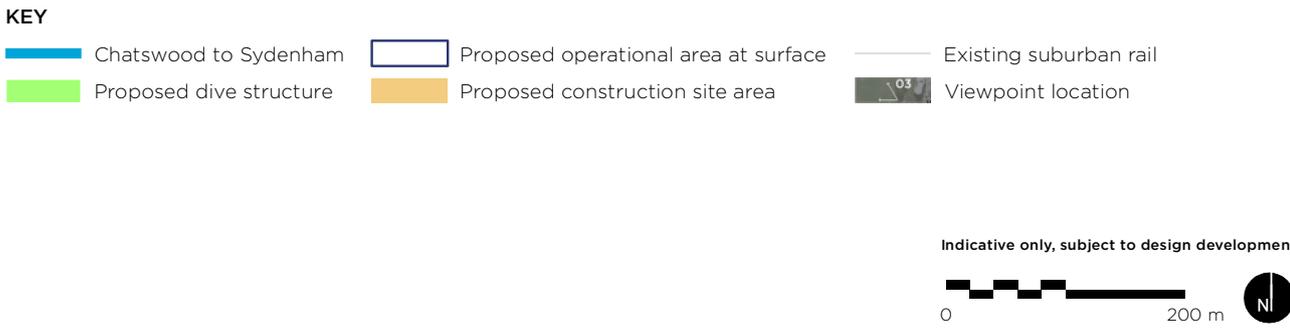


Figure 9-7 Chatswood dive site (northern) and northern surface track works – representative viewpoints

During operation, this work would have a minor adverse impact on views. This impact remains unchanged from the Environmental Impact Statement as there are no proposed changes to the project at this site.

Gordon Avenue temporary construction site access

The following viewpoints were assessed for the provision of a temporary construction site access from Gordon Avenue:

- Views from residential areas to the west of the Frank Channon Walk
- Viewpoint 12: View south along the Frank Channon Walk
- Viewpoint 13: View east along Gordon Avenue, which is an additional viewpoint to that assessed in the Environmental Impact Statement.

For all assessed viewpoints, the Gordon Avenue access would have additional localised visual impacts over and above those identified in the Environmental Impact Statement during construction and operation due to:

- The removal of mature vegetation within the park and along a short section of road, which currently filters views of the rail corridor
- The temporary occupation of the small park
- The introduction of additional construction elements within the landscape (such as hoarding and construction vehicles).

During construction, the Gordon Avenue access would have minor to moderate adverse impacts. In the case of impacts to views from residential areas to the west of the Frank Channon Walk, the introduction of the Gordon Avenue access would not differ from that presented in the Environmental Impact Statement. This is because the impacts of other construction activities in the area contribute to a considerable reduction in visual amenity.

During operation, the Gordon Avenue access would have negligible to minor adverse impacts on views. Following the reinstatement of the park and landscaping, views to the rail corridor and metro infrastructure would be filtered, with this effect increasing as the vegetation matures. However, there would be a noticeable reduction in amenity until the vegetation matures.

Table 9-4 Chatswood dive site (northern) and northern surface track works – daytime visual impacts

Location	Sensitivity rating	Construction impact		Operation impact	
		Modification rating	Impact rating	Modification rating	Impact rating
Viewpoint 1: View south along Frank Channon Walk	Local	Considerable reduction	Moderate adverse	Noticeable reduction	Minor adverse
Residential areas to the west of Frank Channon Walk	Neighbourhood	Considerable reduction	Minor adverse	Considerable reduction	Minor adverse
Viewpoint 12 View south along Frank Channon Walk, adjacent to the Chatswood Bowling Club	Local	Considerable reduction	Moderate adverse	Noticeable reduction	Minor adverse
Viewpoint 13 View northeast along Gordon Avenue	Neighbourhood	Considerable reduction	Minor adverse	Noticeable reduction	Negligible

Night-time visual amenity impacts

Change in retaining wall construction method

The northern surface track works would require night-time work during rail possessions. During construction, it is expected that the project would result in a high adverse visual impact during evening hours due to the effect of light spill. The magnitude of change be greater than that assessed in the Environmental Impact Statement due to the expansion of the construction site towards residential areas to the west of the Frank Channon Walk. There is also potential for some direct light spill onto the adjacent property. The lighting would create a considerable reduction in amenity of views from surrounding streets and adjacent residential properties. To mitigate this impact, lighting of the construction area would be orientated to minimise glare and light spill on adjacent receivers (mitigation measure LV3).

During operation, lighting would be consistent with existing lighting on the Frank Channon Walk. As such, the impact remains unchanged from that presented in the Environmental Impact Statement.

Gordon Avenue temporary construction site access

The Chatswood dive site (northern) and northern surface works would require night-time work during rail possessions. This would involve traffic movements at night to and from the Gordon Avenue site access. This would cause a minor additional adverse impact during construction and a negligible visual impact during operation. The magnitude of light levels from the site would be the same as that assessed in the Environmental Impact Statement.

Although there would generally be no out-of-hours vehicle access along Gordon Avenue, it may be used during rail possessions, which would occur over a weekend, including at night. Overall, the site would be more brightly lit than the existing setting; however, it is expected that there would be no direct light intrusion onto adjacent private properties.

During operation, lighting would be consistent with the adjacent railway and the Frank Channon Walk. As such, the impact would be the same as that assessed in the Environmental Impact Statement.

9.1.7 Social impacts and community infrastructure

The Frank Channon Walk would be subject to a temporary staged closure to enable construction associated with the northern surface track works. A temporary diversion would be in place where direct impacts to the path would occur at Gordon Avenue.

Change in retaining wall construction method

The temporary closure of the Frank Channon Walk would have impacts to access and connectivity for users of the path. However, as detailed in the Environmental Impact Statement (Chapter 19 – Social impacts and community infrastructure), access to and from Chatswood Station for pedestrians and cyclists would be maintained via the Pacific Highway or Orchard Road. Nearby community infrastructure (such as Chatswood Oval) would remain accessible for pedestrians via local streets. The closure of the Frank Channon Walk would be staged to minimise the duration of disruption to users and to maintain connections where possible. This includes, if feasible and reasonable, maintaining Nelson Street bridge during Stage 1 of the planned closure to minimise the degree of disruption.

To further manage impacts on pedestrians and cyclists, the mitigation measures in Section 9.1.4 would also be implemented and the affected community would be consulted and informed about the project and construction activities (including timing, likely impacts and mitigation measures) (refer to mitigation measure S02 in the Environmental Impact Statement). Transport for NSW would consult with Willoughby City Council to identify in opportunities to mitigate the impacts to Frank Channon Walk through landscape and public domain treatments for areas affected by construction.

Gordon Avenue temporary construction site access

The Gordon Avenue construction site access would require the temporary closure of the Frank Channon Walk while the temporary diversion is being constructed. If this were to occur during Stage 1 of the staged closure of the Frank Channon Walk, there would be a short term cumulative impact to users of the shared path. However, if feasible and reasonable, the Nelson Street bridge would remain and would maintain an east–west connection across the corridor during Stage 1.

The increase in the construction footprint at Gordon Avenue would have a direct temporary impact on a small area of open space, which currently serves the surrounding residential community. The loss of open space would result in a temporary reduction in amenity for these residents as well as users of the Frank Channon Walk. For residences immediately adjacent to the site access, the impacts would include loss of green outlook, reduction in privacy and increased proximity to the construction site (with the associated potential visual, noise and dust related impacts).

The use of Gordon Avenue by a small number of construction vehicles is also expected to have temporary impacts on amenity for nearby residents due to minor increases in noise, dust and traffic. However, construction vehicles would only use the road during standard construction hours (excluding rail possessions) and only for a small proportion of the full period of construction. Therefore, this impact would be low.

The use of this local road may also impact on community perceptions of road safety due to the introduction of construction vehicles, or may impact on perceptions of safety due to changes to the shared path through reduced sight lines and changes in levels of activity. Mitigation measures to manage potential safety risks associated with construction traffic and pedestrian / cyclist safety are provided in the Environmental Impact Statement and would continue to apply. This would include the application of Crime Prevention through Environmental Design principles, which take into account the relationship between the physical environment and users of that environment, promoting maximum usability and safety.

In addition, the affected community would be consulted and informed about the project and construction activities (including timing, likely impacts and mitigation measures) (refer to mitigation measure S02 in Chapter 11).

9.1.8 Biodiversity

To allow for the construction of the Gordon Avenue site access, a number of trees and shrubs would be removed, including some street trees. The vegetation has not been mapped by the Office of Environment and Heritage (2013).

Based on an inspection of the site, the trees and shrubs appear to be landscape plantings, and consist of a mix of native and exotic species (such as *Casuarina cunninghamiana* (River Oak), *Acacia implexa* (Hickory Wattle), *Pittosporum undulatum* (Sweet Pittosporum), *Jacaranda mimosifolia* (Jacaranda), *Harpullia pendula* (Tulipwood) and *Callistemon* spp). The groundcover is also managed, and dominated by exotic grasses and/or woodchips. No endangered ecological communities, threatened species or their habitat listed under the *Threatened Species Conservation Act 1995* (TSC Act) or *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) were identified. Some trees may provide foraging resources for native birds or bats. However, none of the species recorded are identified as feed trees for the Grey-headed Flying Fox (*Pteropus poliocephalus*) (Eby and Law, 2008), a listed vulnerable species under the TSC Act and EPBC Act.

Construction of the Gordon Avenue access would not generate significant impacts on biodiversity, with impacts limited to a very small area of planted and landscaped vegetation within a previously disturbed area. Any potential impacts on fauna would be minor and generally restricted to common fauna species that inhabit urban environments. Risk of fauna injury or death would be similar to the risks identified in the Environmental Impact Statement, and would be limited to the construction phase of the project and managed through mitigation measure B3 in Chapter 11.

As no endangered ecological communities, threatened species or their habitat were identified in the site inspection, and the impacts would be limited to planted or highly modified native vegetation, an update to the assessment of significance under the EPBC Act, and the assessment according to the Framework for Biodiversity Assessment (including any consideration of offsets) as presented in the Environmental Impact Statement is not required.

9.1.9 Mitigation measures

As discussed in Section 9.1.6, a new mitigation measure (LV10) is proposed to require the rehabilitation of the Frank Channon Walk and the small park at Gordon Avenue in consultation with Willoughby City Council following the completion of construction work in those spaces.

Additional mitigation measures as identified in the Environmental Impact Statement and detailed in Chapter 11 (Revised environmental management measures and environmental performance outcomes) would also address the potential impacts of the proposed changes. These measures include:

- Mitigation measure T2 – Road Safety Audits would be carried out at each construction site. Audits would address vehicular access and egress, and pedestrian, cyclist and public transport safety
- Mitigation measure T3 – Directional signage and line marking would be used to direct and guide drivers and pedestrians past construction sites and on the surrounding network. This would be supplemented by Variable Message Signs to advise drivers of potential delays, traffic diversions, speed restrictions, or alternate routes
- Mitigation measure T5 – The community would be notified in advance of proposed road and pedestrian network changes through media channels and other appropriate forms of community liaison
- Mitigation measure T6 – Vehicle access to and from construction sites would be managed to ensure pedestrian, cyclist and motorist safety. Depending on the location, this may require manual supervision, physical barriers, temporary traffic signals and modifications to existing signals or, on occasions, police presence
- Mitigation measure T7 – Additional enhancements for pedestrian, cyclist and motorist safety in the vicinity of the construction sites would be implemented during construction. This would include measures such as:
 - ◆ Use of speed awareness signs in conjunction with variable message signs near construction sites to provide alerts to drivers
 - ◆ Community educational events that allow pedestrians, cyclists or motorists to sit in trucks and understand the visibility restrictions of truck drivers, and for truck drivers to understand the visibility from a bicycle; and a campaign to engage with local schools to educate children about road safety and to encourage visual contact with drivers to ensure they are aware of the presence of children

- ◆ Specific construction driver training to understand route constraints, expectations, safety issues, human error and its relationship with fitness for work and chain of responsibility duties, and to limit the use of compression braking
- ◆ Use of IVMS (telematics) to monitor vehicle location and driver behaviour
- ◆ Safety devices on construction vehicles that warn drivers of the presence of a vulnerable road user located in the vehicles' blind spots and warn the vulnerable road user that a vehicle is about to turn
- Mitigation measure T13 – Construction site traffic would be managed to minimise movements in the AM and PM peak periods
- Mitigation measure NV1 – The Construction Noise and Vibration Strategy would be implemented with the aim of achieving the noise management levels where feasible and reasonable. This would include the following example mitigation measures where feasible and reasonable:
 - ◆ Provision of noise barriers around each construction site
 - ◆ The coincidence of noisy plant working simultaneously close together would be avoided
 - ◆ Offset distances between noisy plant and sensitive receivers would be increased
 - ◆ Residential grade mufflers would be fitted to all mobile plant
 - ◆ Dampened rock hammers would be used
 - ◆ Non-tonal reversing alarms would be fitted to all permanent mobile plant
 - ◆ High noise generating activities would be scheduled for less sensitive period considering the nearby receivers
 - ◆ The layout of construction sites would consider opportunities to shield receivers from noise
- Mitigation measure LV3 – Lighting of construction sites would be oriented to minimise glare and light spill impact on adjacent receivers
- Mitigation measure LV5 – Opportunities for the retention and protection of existing street trees would be identified during detailed construction planning
- Mitigation measure LV6 – The design and maintenance of construction site hoardings would aim to minimise visual amenity and landscape character impacts, including the prompt removal of graffiti. Public art opportunities would be considered
- Mitigation measure LV12 – Where feasible and reasonable, vegetation would be provided to screen and visually integrate sites with the surrounding area.
- Mitigation measure LV13 – Identify and implement appropriate landscape treatments for Frank Channon Walk.
- Mitigation measure S02 – Specific consultation would be carried out with sensitive community facilities (including aged care, childcare centres, educational institutions and places of worship) potentially impacted during construction. Consultation would aim to identify and develop measures to manage the specific construction impacts for individual sensitive community facilities
- Mitigation measure B3 – The local WIRES group and / or veterinarian would be contacted if any fauna are injured on site or require capture and / or relocation.

In accordance with the Construction Noise and Vibration Strategy (Appendix C of this report), Construction Noise Impact Statements would be developed for construction activities associated with the northern corridor works. This would be informed by more detailed construction planning and would include typical standard mitigation strategies (such as at source mitigation, temporary noise barriers and works scheduling).

If the Construction Noise Impact Statement identifies significant exceedances of noise management levels and impacts on receivers for a significant period of time, despite the implementation of standard mitigation measures, additional reasonable and feasible mitigation measures would be considered if practical to reduce noise levels and impacts on sensitive receivers. These are primarily aimed at pro-active engagement with affected sensitive receivers, but includes site specific respite periods. Further detail can be found in the Construction Noise and Vibration Strategy (refer to Appendix C of this report).

Place Managers would also continue to play a vital role in maintaining close and ongoing contact with local communities and stakeholders during the design and delivery of Sydney Metro. Place Managers would provide a direct point of contact between affected members of the community and the project team.

9.2 Chatswood dive site (northern) – Pacific Highway and Mowbray Road intersection

As detailed in Chapter 7 (Project description – construction) of the Environmental Impact Statement, track and associated rail corridor work would require the permanent removal of the Nelson Street bridge. The bridge serves local traffic movements to and from Nelson Street and regional traffic, particularly vehicles completing the following G-turn:

- Traffic travelling on Pacific Highway southbound to Mowbray Road westbound (regional route A)
- Traffic travelling on Mowbray Road eastbound to Pacific Highway southbound (regional route B).

To maintain this movement, an all vehicle right-turn movement from the Pacific Highway (southbound) to Mowbray Road westbound is proposed in the Environmental Impact Statement. Additional details are provided in Section 9.4.3 of the Environmental Impact Statement.

Since the exhibition of the Environmental Impact Statement, concerns have been raised by stakeholders (including Roads and Maritime Services) regarding the proposed changes to the intersection of the Pacific Highway and Mowbray Road with respect to the provision of right-turn lanes. Roads and Maritime would prefer a solution taking into account broader road network requirements. It has also been identified that it would be more desirable for upgrades of this intersection to be carried out at the one time to avoid multiple traffic disruptions.

As a result, Transport for NSW is currently working with Roads and Maritime Services and other stakeholders to carry out a broader review of the traffic and transport needs in this precinct. This may include alternative solutions for improving the intersection of the Pacific Highway and Mowbray Road to the addition of right-turn lanes as proposed as part of this project. A decision on the preferred solution for this intersection may not occur prior to the proposed closure of the Nelson Street bridge.

This section provides an assessment of the closure of the Nelson Street bridge without a proposed solution for the Pacific Highway / Mowbray Road intersection. It also includes an assessment of the proposed Gordon Avenue site access as described in Section 9.1 of this report.

9.2.1 Description

The removal of the Nelson Street bridge, without the provision of right-turn lanes, would result in a re-distribution of local and regional traffic on the surrounding road network. As shown on Figure 9-8, traffic that currently uses regional route A would likely use the following alternative route:

- Southbound on Pacific Highway
- Left turn into Albert Avenue
- Right turn into Orchard Road
- Right turn at Mowbray Road
- Continue westbound on Mowbray Road.

For traffic that currently uses regional route B, there would be two alternatives (as shown in Figure 9-9). Alternative route 1 would be:

- Eastbound on Mowbray Road
- Right turn into Hampden Road
- Right turn at the roundabout located at the intersection of Hampden Road and Brand Street
- Southbound on Hampden Road
- Right turn into Broughton Road
- Right turn into Rimmington Street
- Left turn into Pacific Highway.

Alternative route 2 would be:

- Eastbound on Mowbray Road
- Right turn into Hampden Road
- U-turn at the roundabout located at the intersection of Hampden Road and Brand Street
- Northbound on Hampden Road
- Left turn into Mowbray Road
- Left turn at Pacific Highway
- Continue southbound on Pacific Highway.

The removal of the right-turn lanes would not result in changes to construction haulage routes to and from the Chatswood dive site (northern), nor the volumes of construction vehicles generated by the project as presented in the Environmental Impact Statement, other than the Gordon Avenue site access (as described in Section 9.1 of this report).



Figure 9-8 Pacific Highway southbound to Mowbray Road westbound – alternative route for regional route A

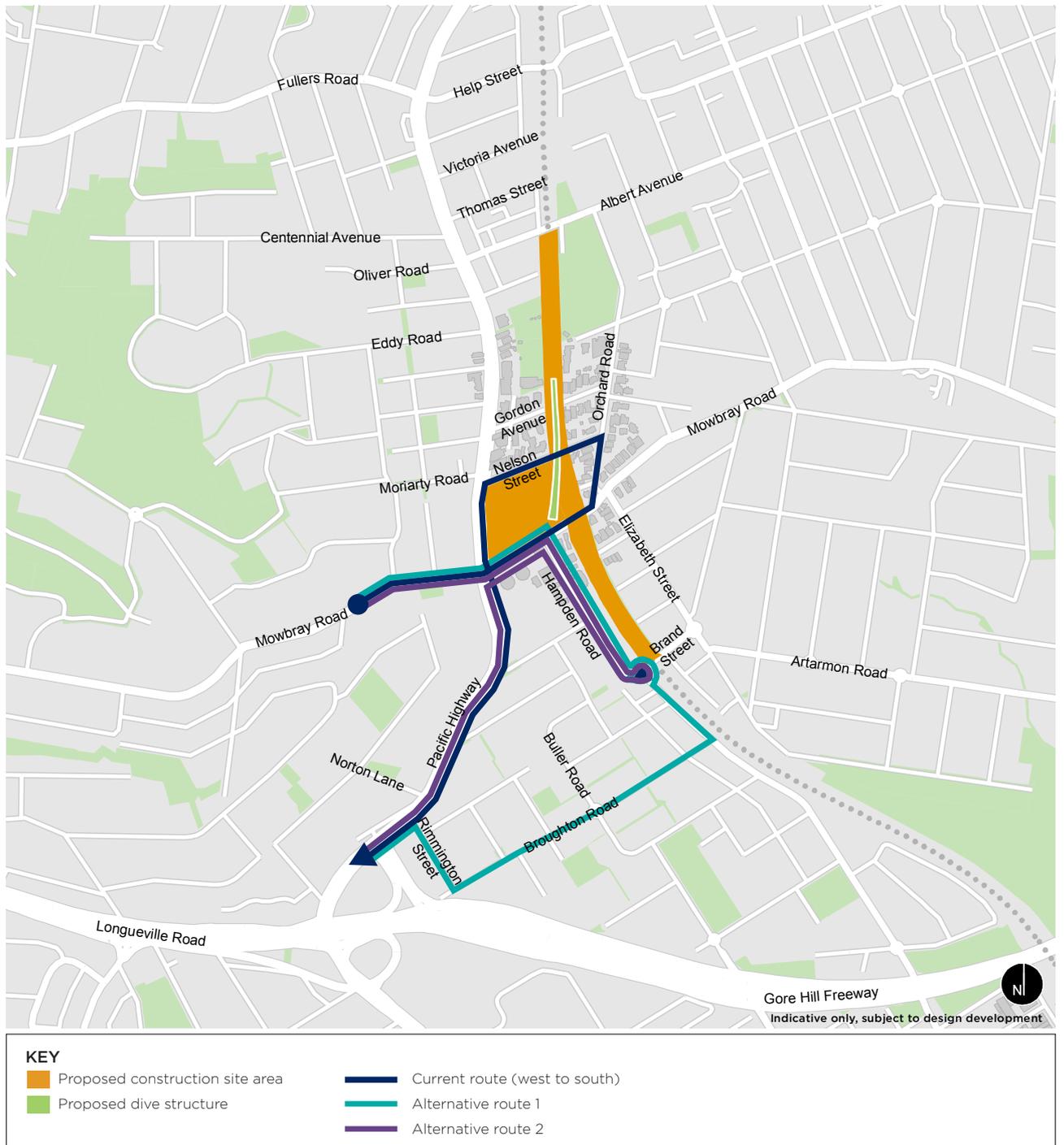


Figure 9-9 Mowbray Road eastbound to Pacific Highway southbound – alternative routes for regional route B

9.2.2 Environmental screening assessment

To understand the potential change in environmental impacts compared to those assessed in the Environmental Impact Statement, a screening assessment was conducted and is presented in Table 9-5. This assessment considers potential environmental aspects that may require further impact assessment to understand likely environmental impacts, and identify any relevant mitigation measures that may be required.

Table 9-5 Chatswood dive site (northern) – Pacific Highway and Mowbray Road intersection – environmental screening assessment

Aspect	Potential change in impacts	Description
Construction traffic and transport	Yes	The changed traffic conditions would alter the distribution of local and regional traffic on the surrounding road network. It would not alter the volume or distribution of construction vehicles. An assessment is provided in Section 9.2.3.
Operational traffic and transport	Yes	A final solution for the Pacific Highway / Mowbray Road intersection would be determined in consultation with Roads and Maritime Services and other stakeholders. It is expected to be implemented before completion of construction. No further assessment is considered necessary.
Construction noise and vibration	Yes	The changed traffic conditions may introduce changes to road traffic noise on the alternative routes due to re-distributed traffic. An assessment is provided in Section 9.2.4.
Operational noise and vibration	Yes	A final solution for the Pacific Highway / Mowbray Road intersection would be determined in consultation with Roads and Maritime Services and other stakeholders. It is expected to be implemented before the completion of construction. No further assessment is considered necessary.
Land use and property	No	There would be no additional impacts on land use and property as a result of the changed traffic conditions. An assessment is not considered necessary.
Business impacts	No	Before a solution is implemented at the Pacific Highway / Mowbray Road intersection, customers accessing businesses along the Pacific Highway would experience minor increases in travel times due to the alternative routes. However, this would not result in significant additional business impacts. An assessment is not considered necessary.
Non-Aboriginal heritage	No	The changed traffic conditions would not alter the impact on non-Aboriginal heritage. An assessment is not considered necessary.
Aboriginal heritage	No	The changed traffic conditions would not alter the impact on Aboriginal heritage. An assessment is not considered necessary.

Aspect	Potential change in impacts	Description
Landscape character and visual amenity	No	The changed traffic conditions would not increase the impact on landscape character and visual amenity. An assessment is not considered necessary.
Groundwater and geology	No	The changed traffic conditions would not result in any additional groundwater and geology impacts, as excavation is not proposed. An assessment is not considered necessary.
Soils, contamination and water quality	No	The changed traffic conditions would not change the potential soils, contamination or water quality impacts. An assessment is not considered necessary.
Social impacts and community infrastructure	No	The re-distribution of traffic would not have a noticeable impact on social or community infrastructure located along the alternative routes. An assessment is not considered necessary.
Biodiversity	No	The changed traffic conditions would not result in any additional biodiversity impacts. An assessment is not considered necessary.
Flooding and hydrology	No	The changed traffic conditions would not occur on flood-prone land and would not alter existing stormwater systems. An assessment is not considered necessary.
Air quality	No	The changed traffic conditions would not result in any additional air quality impacts. An assessment is not considered necessary.
Hazard and risk	No	The changed traffic conditions would not involve the storage and use of any hazardous substances and dangerous goods, or be located within a bushfire prone area. An assessment is not considered necessary.
Waste management	No	The changed traffic conditions would not result in the generation of any different and increased volumes of waste materials. An assessment is not considered necessary.
Sustainability	No	The changed traffic conditions would not change the climate risk profile of the project, and would not result in a substantial change to the generation of greenhouse gases or the use of resources. An assessment is not considered necessary.
Cumulative impacts	No	The changed traffic conditions would not result in any additional cumulative impacts. An assessment is not considered necessary.

9.2.3 Construction traffic and transport

Approach

Nelson Street bridge serves local traffic movements to and from Nelson Street as well as regional traffic, in particular vehicles completing the following G-turn:

- Traffic travelling on Pacific Highway southbound to Mowbray Road westbound (regional route A)
- Traffic travelling on Mowbray Road eastbound to Pacific Highway southbound (regional route B).

Intersection counts and origin-destination surveys have been undertaken to determine the proportion of local and regional traffic movements on Nelson Street. The following peak hour volumes were recorded using Nelson Street as a G-turn facility:

- AM peak hour:
 - ◆ Regional route A – 41 vehicles
 - ◆ Regional route B – 12 vehicles
- PM peak hour:
 - ◆ Regional route A – 56 vehicles
 - ◆ Regional route B – 18 vehicles.

As identified in Section 9.2.1, this assessment considers the impact on intersections along alternative routes with construction underway, with site access points at Gordon Avenue, Nelson Street and Mowbray Road, but with no changes to the Pacific Highway / Mowbray Road intersection. The introduction of traffic signals ('signalisation') of Mowbray Road / Hampden Road and the construction access point at the northern leg of this intersection are included in the analysis.

The assessment considers each southbound alternative route (regional route B) with the westbound alternative route (regional route A). Alternative route 1 and 2 for regional route B has been assessed separately, with all vehicles assumed to undertake one route for each assessment.

This approach provides a worst case scenario, as it assesses the additional vehicles on the road network during the AM and PM peak hours due to construction activity alongside traffic using the alternative routes.

Figure 9-10 provides an overview of intersection locations included in the assessment.

Results

Table 9-6 summarises the average delay per vehicle, level of service and degree of saturation at each intersection comparing the existing network layout (without the signalisation of Mowbray Road / Hampden Road), and with the project (with the signalisation of the Mowbray Road / Hampden Road intersection).

The signalisation of Mowbray Road / Hampden Road during construction would improve the performance of the intersection from level of service F to level of service C during the AM peak hour. During the PM peak hour the intersection would still operate with spare capacity at LoS A or B. The operational performance of the intersection would remain the same irrespective of the alternative route undertaken for regional route B. However, the level of service would reduce when compared to the results presented in the Environmental Impact Statement, reducing from level of service B to level of service C in the AM peak. This is attributed to the additional vehicles now using this intersection in the absence of the right-turn lanes.

The performance of the Hampden Road / Brand Street roundabout would deteriorate from level of service A to level of service B during the AM peak hour, with increases in peak period delays at the roundabout. This is primarily due to the additional vehicles that would now use the roundabout in order to travel southbound on the Pacific Highway. However, the intersection would continue to operate with spare capacity.

Impacts on all other intersections would be minimal, with similar average delays except at the Pacific Highway / Mowbray Road intersection where the average delay increases by eight seconds during the AM peak hour. However, the level of service would remain the same.

Each alternative route for regional route B would adequately accommodate the additional traffic generated due to the closure of Nelson Street bridge. However, alternative route 2, which involves vehicles performing a U-turn at the Hampden Road / Brand Street roundabout, would be preferred as it does not require the use of local roads and the shopping precinct around Artarmon Station, unlike alternative route 1.

The assessment identifies an improvement in the performance of the Mowbray Road / Orchard Street / Elizabeth Street intersection during the AM peak hour due to the lower number of vehicles using this intersection. This lower volume is attributable to vehicles travelling via the alternative regional routes. Improvements observed at all other intersections are a result of the marginal change in approach volumes and the reallocation of green time (that is, the length of time the traffic light stays on green) within the model.

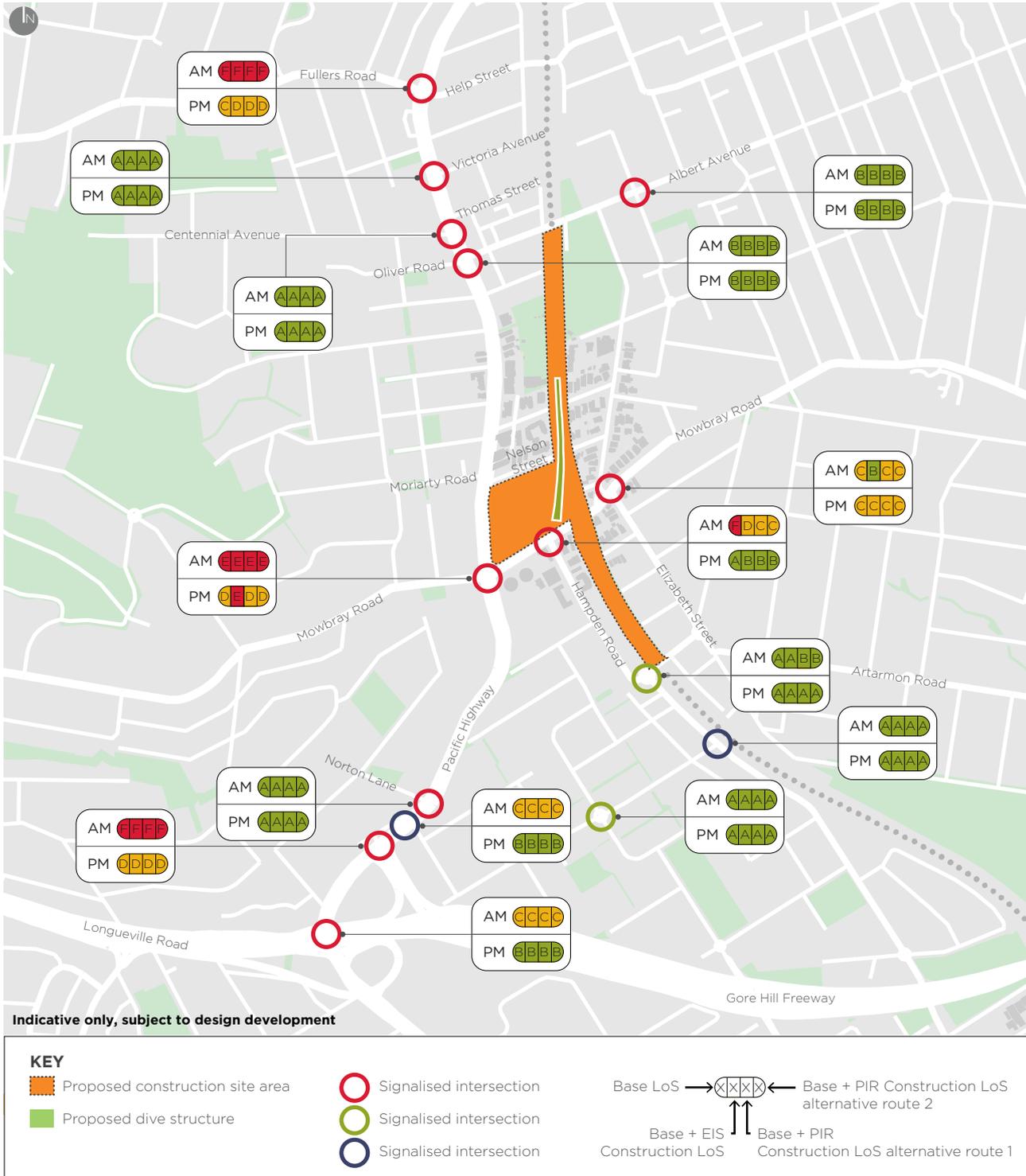


Figure 9-10 Chatswood dive site (northern) and northern surface track works - assessed intersection locations

*Note: Mowbray Road / Hampden Road is a priority controlled intersection in the existing network layout.

Table 9-6 Chatswood dive site (northern) and northern surface track works – assessment of intersection performance (AM and PM peak hour)

Intersection / peak period	Existing		With project (EIS) (without Gordon Avenue access)		With project (Preferred Infrastructure Report) – southbound alternative route 1		With project (Preferred Infrastructure Report) – southbound alternative route 2	
	Level of service	Degree of saturation	Level of service	Degree of saturation	Level of service	Degree of saturation	Level of service	Degree of saturation
Pacific Highway / Fullers Road / Help Street (signalised)								
AM peak	F	1.28	F	1.16	F	1.28	F	1.28
PM peak	C	0.92	D	0.94	D	0.94	D	0.94
Pacific Highway / Victoria Avenue (signalised)								
AM peak	A	0.82	A	0.85	A	0.85	A	0.85
PM peak	A	0.73	A	0.73	A	0.73	A	0.73
Pacific Highway / Centennial Avenue (signalised)								
AM peak	A	0.67	A	0.69	A	0.70	A	0.70
PM peak	A	0.72	A	0.72	A	0.73	A	0.73
Pacific Highway / Albert Avenue / Oliver Road (signalised)								
AM peak	B	0.77	B	0.95	B	0.77	B	0.77
PM peak	B	0.96	B	0.96	B	0.96	B	0.96
Pacific Highway / Mowbray Road (signalised)								
AM peak	E	1.05	E	1.03	E	1.10	E	1.10
PM peak	D	0.97	E	1.01	D	0.97	D	0.97
Pacific Highway / Howarth Road / Norton Lane (signalised)								
AM peak	A	0.61	A	0.60	A	0.62	A	0.62
PM peak	A	0.75	A	0.75	A	0.75	A	0.75
Pacific Highway / Gore Hill Freeway ramps (signalised)								
AM peak	F	1.07	F	1.12	F	1.04	F	1.04
PM peak	D	1.04	D	1.04	D	1.04	D	1.04
Pacific Highway / Longueville Road (signalised)								
AM peak	C	0.83	B	0.83	B	0.79	B	0.78
PM peak	B	0.79	B	0.79	B	0.77	B	0.79
Mowbray Road / Orchard Road / Elizabeth Street (signalised)								
AM peak	C	0.71	B	0.72	C	0.68	C	0.68
PM peak	C	0.74	C	0.68	C	0.74	C	0.74

Intersection / peak period	Existing		With project (EIS) (without Gordon Avenue access)		With project (Preferred Infrastructure Report) – southbound alternative route 1		With project (Preferred Infrastructure Report) – southbound alternative route 2	
	Level of service	Degree of saturation	Level of service	Degree of saturation	Level of service	Degree of saturation	Level of service	Degree of saturation
Mowbray Road / Hampden Road (existing – priority controlled, with project – signalised)								
AM peak	F	1.04	D	0.97	C	0.89	C	0.89
PM peak	A	0.38	B	0.69	B	0.65	B	0.64
Orchard Road / Albert Avenue (signalised)								
AM peak	B	0.39	B	0.38	B	0.44	B	0.40
PM peak	B	0.37	B	0.45	B	0.51	B	0.51
Hampden Road / Brand Street (roundabout)								
AM peak	A	0.82	A	0.82	B	0.83	B	0.83
PM peak	A	0.60	A	0.60	A	0.60	A	0.60
Hampden Road / Broughton Road (priority controlled)								
AM peak	A	0.38	A	0.38	A	0.40	A	0.38
PM peak	A	0.38	A	0.38	A	0.38	A	0.38
Broughton Road / Buller Road (roundabout)								
AM peak	A	0.18	A	0.18	A	0.18	A	0.18
PM peak	A	0.22	A	0.22	A	0.22	A	0.22
Pacific Highway / Rimmington Street (priority controlled)								
AM peak	C	0.57	C	0.61	C	0.62	C	0.58
PM peak	B	0.44	B	0.43	B	0.49	B	0.44

Note: Level of Service reported for signalised intersections is for the overall intersection, and for roundabouts and priority controlled intersections is the worst performing approach.

Note: Existing and 'with project' results are based on 2016 traffic counts

Note: Outputs from LinSig Version 3.2

9.2.4 Road traffic noise

The re-distribution of traffic that would occur prior to the implementation of a solution for the Pacific Highway / Mowbray Road intersection could result in a change in road traffic noise compared to that assessed in the Environmental Impact Statement.

To assess the potential impacts on sensitive receivers located along these routes, an assessment of road traffic noise has been completed with consideration to the applicable criteria specified in the Environment Protection Authority's *NSW Road Noise Policy*. While there are two possible alternative routes for southbound traffic, the assessment has assumed all traffic uses one route (ie does not split) to represent a worst case scenario.

The results of the assessment are presented in Table 9-7. Where an exceedance of the criterion has been identified, the predicted increase in noise as a result of the diverted traffic has been identified.

Table 9-7 Chatswood dive site (northern) and northern surface track works – Road traffic noise on local roads

Road	Road Noise Policy criteria (dB)		Predicted road traffic noise (dB), including diverted traffic		Predicted increase (dB), where criteria is exceeded	
	Day	Night	Day	Night	Day	Night
Albert Avenue, Chatswood ¹	60	55	69	62	0.3	0.4
Orchard Road, Chatswood ¹	60	55	62	55	0.9	1.3
Mowbray Road, Chatswood ¹	60	55	69	61	0.1	0.1
Hampden Road, Artarmon ¹	60	55	63	55	0.9	N/A
Broughton Road, Artarmon ²	55	50	56	43	0.9	N/A
Rimington Street, Artarmon ²	55	50	52	43	N/A	N/A

Notes:

1 – The Road Noise Policy criteria for arterial and sub-arterial roads is daytime LAeq(15hr) and night-time LAeq(9hr)

2 – The Road Noise Policy criteria for local roads is daytime LAeq(1hr) and night-time LAeq(1hr). For local roads, the most impacted year is presented.

Table 9-7 indicates that the increase in road traffic noise as a result of the diverted traffic would be within the applicable criterion or would represent an increase of less than 2dB. An increase of 2dB represents a minor impact that is considered to be barely perceptible

9.3 Changes at Martin Place Station to facilitate platform-to-platform pedestrian connections

Section 6.6.4 of the Environmental Impact Statement described a new underground pedestrian link between the existing Suburban and Intercity Martin Place Station platforms and the metro station platforms. Ongoing design work has identified the need for additional work within the heritage listed Martin Place Station to construct and operate the new connection. Martin Place Station is a State heritage item. These changes are assessed below.

9.3.1 Description

As assessed in the Environmental Impact Statement, the underground pedestrian link to the Martin Place metro station would have a direct impact to the western end of the Suburban and Intercity platforms at Martin Place Station. Ongoing design work has identified the need for additional construction works within the existing Martin Place Station to provide the pedestrian link, including:

- Removal of three banks of station seating on the platform to provide adequate customer circulation to and from the metro station
- Relocation of utilities located at the western end of the platform to accommodate the new connection, including provision of new storage units for fire-fighting equipment.
- Works within the ceiling space in proximity to the underground connection, including temporary removal of the false ceiling. This would be reinstated, subject to fire rating requirements.
- Strengthening works to Martin Place Station structures that would be directly adjacent to the new connection, including platform walls and the Eastern Suburbs Line tunnel. These would typically be undertaken from within the excavated void created for the underground connection.
- An area in the immediate vicinity of the new connection would be temporarily occupied during construction to support the works.

The key adverse impact of the change would be on non-Aboriginal heritage, as it would have a direct impact on original fabric that contributes to the significance of the heritage listing. This is discussed further in Section 9.3.2.

Clarifications on the curtilage of the item and other construction impacts of the project are also provided in Section 9.3.2.

Other issues would be very similar to those assessed in the Environmental Impact Statement and do not require additional assessment.

9.3.2 Non-Aboriginal heritage

Martin Place Railway Station is of State heritage significance, and is listed on the State Heritage Register, the Sydney Trains Section 170 Heritage and Conservation Register and *Sydney Local Environment Plan 2012*.

The curtilage of the heritage item, as described on the State Heritage Register, is as follows:

The listing boundary is the whole of the underground station area from the main public and pedestrian concourse where ticket vending machines and ticket windows are located (to the entrance of the western pedestrian subway as defined by the line of the newsagent and shops). Within the paid concourse the boundary extends up to the open ceiling above the concourse, while in the station area the boundary should be considered to be a 5 metre radius from the tunnel ceiling and platform ends. (Does not include modern retail areas).

Direct impacts to the curtilage would be associated with the construction of the underground connection at the western end of the platform. As discussed in Section 14.5.7 of the Environmental Impact Statement, this would result in a direct physical impact on the aesthetic significance of the heritage item due to the removal of original fabric (including red ceramic tiling). Overall, the heritage impact assessment within the Environmental Impact Statement concluded that the project would have moderate impact on the heritage item.

The curtilage for the heritage item (MP10) has been updated and provided on Figure 9-11.



KEY

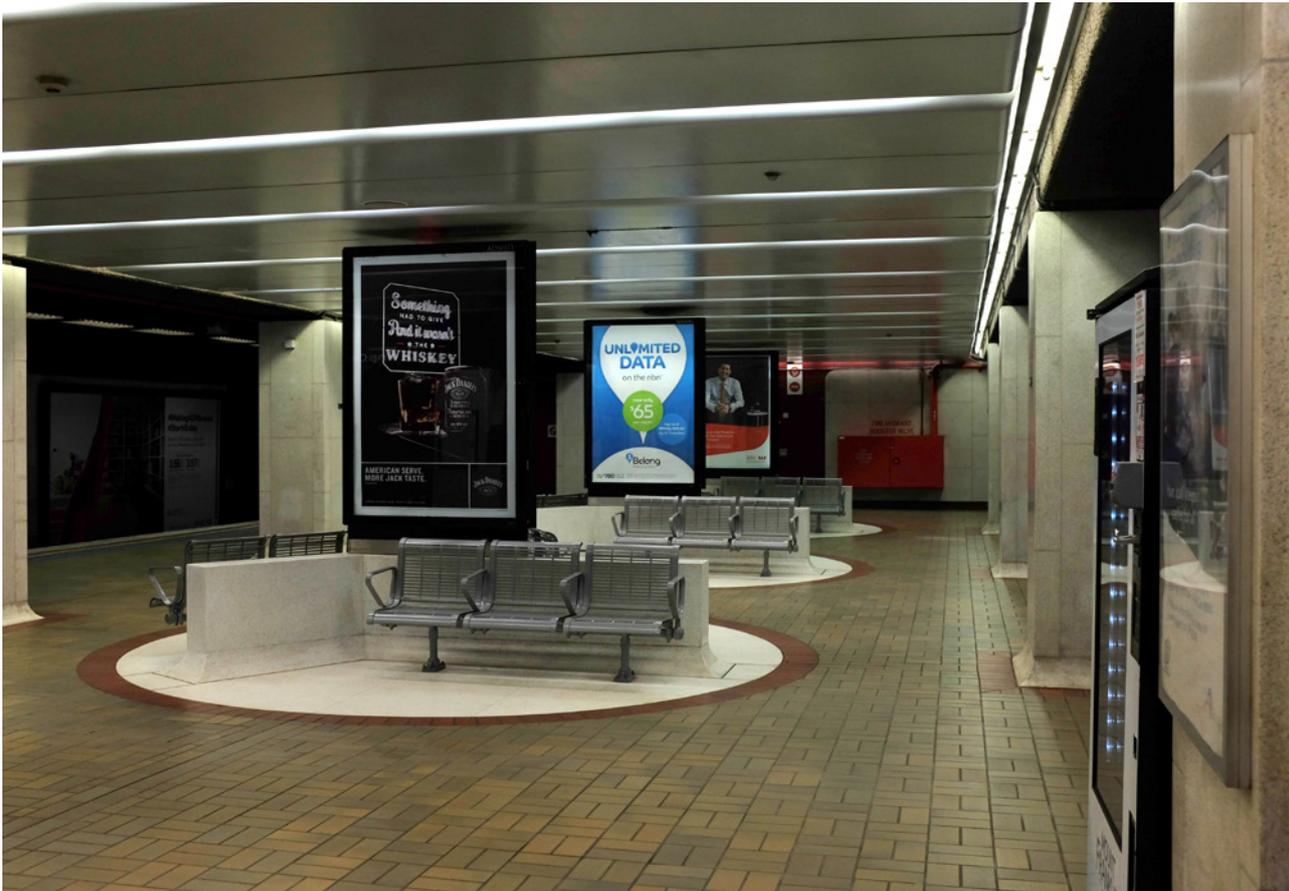
- Chatswood to Sydenham
 - Proposed construction site area at surface
 - 25 m buffer around proposed construction site area at surface
 - Proposed operational area at surface
 - State Heritage Register item
 - LEP Heritage item
 - Section 170 heritage item
- Indicative only, subject to design development*
- 0 100 m

Figure 9-11 Martin Place Station – impacts to heritage items – updated curtilage

The additional works identified in Section 9.3.1 would have the following additional impacts to the heritage item:

- The platform seating frames and the associated floor tiles are original significant fabric (the seats are a modern addition). The removal of the seating frames and impacts to the floor tiling would have a major direct impact on the element, and a moderate direct impact on the heritage significance of Martin Place Railway Station.
- The removal of the existing utilities space and relocation of utilities elsewhere on the platform would have a minor direct impact to original fabric (including the terrazzo panel tiling). It would also have a negligible to minor indirect impact (views and vistas) due to the location of utilities (including fire fighting equipment) on the platform, depending on the design and size of the storage units.
- The removal of a small portion and possible reinstatement of roofing would have a minor impact on the heritage significance of Martin Place Station.
- Other works would have a neutral heritage impact as it would not impact original fabric.

Figure 9-12 provides an example of the circular seating and tiling on the station platforms.



Source: Artefact 2016

Figure 9-12 An example of circular seating, red tiles and terrazzo panel tiles at Martin Place Station

Since the exhibition of the Environmental Impact Statement, other impacts to the heritage item, including works within the curtilage have been clarified:

- Impacts to the curtilage as a result of the permanent closure of underground connections and staircases in Martin Place.
- Indirect impacts due to construction vibration associated with tunnelling.

The curtilage of the heritage item extends to the end of the pedestrian concourse and ticketing area to the entrance of the existing underground connection which connects to the surface at Martin Place. Sections of the existing underground connection would be closed as part of the project, including the stairs to / from Martin Place, to the west of Elizabeth Street (refer to Figure 8-36 of the Environmental Impact Statement). The stairs to the underground connection are outside the State heritage curtilage. Parts of the underground connection are within the heritage curtilage but would not be physically impacted.

The metro tunnels would be excavated under the Eastern Suburbs Line in the vicinity of the heritage curtilage. Tunnelling activities would result in vibration below the 7.5 m/s screening level for cosmetic damage. Other construction activities would be below the 7.5 m/s screening level for cosmetic damage.

The above impacts would be in addition to the impacts as assessed in the Environmental Impact Statement, and are assessed as having a moderate impact on the heritage values of Martin Place. However, this would not impact the heritage significance of the item and Martin Place Railway Station would retain its State significance under all criteria.

Mitigation measures

The Environmental Impact Statement included a number of mitigation measures that would still be applicable. These are:

- Archival recording of the item prior to works commencing (NAH1)
- Fabric salvage, including consideration of reuse opportunities for salvaged fabric considered (NAH5). This would include the salvage and reuse of any significant red tiles and terrazzo panels impacted during works.
- The project design would be sympathetic to heritage items and, where reasonable and feasible, minimise impacts to the setting of heritage items. The detailed design for Martin Place Station would be developed with input from a heritage architect (NAH7).
- Appropriate heritage interpretation would be incorporated into the design for the project in accordance with the NSW Heritage Manual, the NSW Heritage Office's *Interpreting Heritage Places and Items: Guidelines* (August 2005), and the NSW *Heritage Council's Heritage Interpretation Policy* (NAH8)

While these mitigation measures provide for minimising heritage impacts, including the salvage and reuse of removed heritage fabric, additional mitigation measures have been identified to address impacts on any significant fabric of the heritage item:

- The final design and location of the new connection and opening at Martin Place Railway Station would minimise removal of the significant red ceramic tiling where feasible and reasonable (NAH14).
- Opportunities for the reuse of any tiles at Martin Place Railway Station that are removed would be investigated (NAH15).
- Opportunities for the reuse of the circular seating within Martin Place Station would be investigated (NAH16).

9.4 Changes at Central Station

Ongoing design work and construction planning have identified a need for the following changes at Central Station:

- The removal of the Central Station temporary pedestrian bridge
- An additional temporary construction site to support the construction of the Sydney Yard Access Bridge.
- Changes to the northern concourse and Intercity platforms, including the relocation of the northern services building from Eddy Avenue forecourt to the northern concourse.

These changes are described in Section 9.4.1.

9.4.1 Description

Removal of the temporary pedestrian bridge

Ongoing construction planning has identified that the proposed temporary pedestrian bridge at Central Station (described in Chapter 7 of the Environmental Impact Statement) is no longer required.

It is now proposed to manage pedestrian movements during the construction of the metro platforms at Central Station using existing and new underground connections. As shown on Figure 9-13 this would include:

- Construction of the new underground pedestrian connection at the southern end between platforms 12 and 16. During this work, the existing underground pedestrian connections would remain open, except for a potential two week full closure of the existing pedestrian connections. This two-week period would be timed to avoid periods of peak pedestrian demand (ie any major events) and would not be concurrent with the temporary two week full closure of the Devonshire Street tunnel
- Construction of new temporary stairs to platform 20 to 23
- Opening of the new permanent underground pedestrian connection
- Closure of existing underground pedestrian connections.

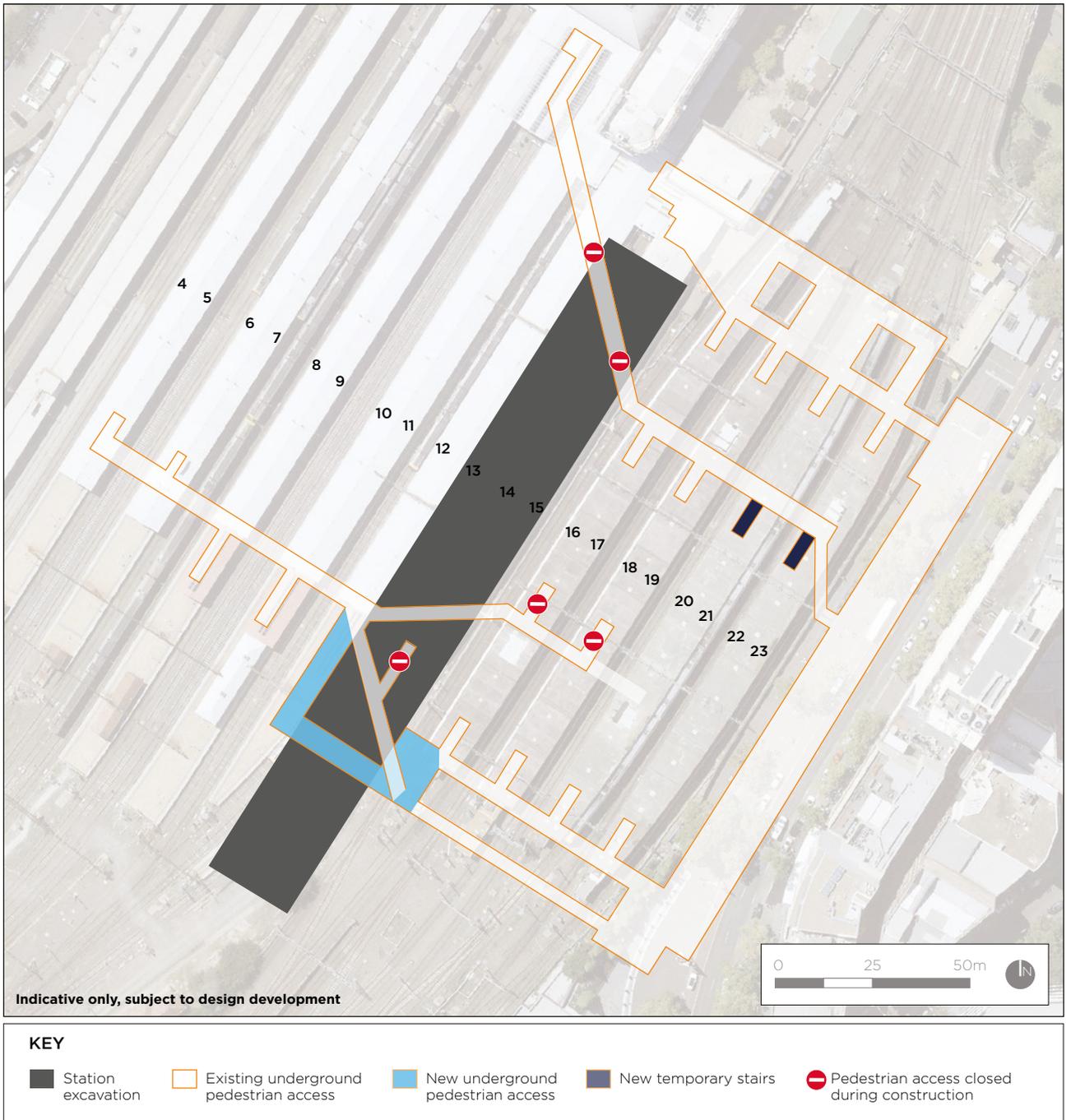


Figure 9-13 Central Station – staged closure of the existing and realigned southern pedestrian connection, and additional suburban platform stairs

Northern concourse and Intercity platform changes

Ongoing design development has identified the following changes at the northern concourse and the Intercity platforms:

- The need for additional space at the northern concourse to accommodate the vertical transport from the metro platforms. This would require the shortening of platforms 9 to 14 at the northern end, and a corresponding lengthening at the southern end.
- Demolition and reinstatement of platform 12. The Environmental Impact Statement had proposed partial demolition of platform 12/13, with platform 12 remaining.

Due to structural stability, platform 12 would be demolished and re-built/re-constructed. Operational adjustments may be made elsewhere within Central Station to ensure the operational functionality of the station during construction.

- Platforms 13 to 15 would be demolished to accommodate the construction of the metro station. The Environmental Impact Statement identified that platform 15 could be reinstated and converted to a suburban platform following construction of the new Sydney Metro platforms at Central Station. It is now proposed that platform 15 would not be reinstated. This was based on further investigation and consultation with Sydney Trains and NSW Trains that determined that existing and planned services at Central Station can be accommodated without the need for platform 15.
- Relocation of the northern services building from the Eddy Avenue Forecourt onto the northern end of platform 14 (refer to Figure 9-14). This building contains the emergency egress stairs for the metro platforms below the concourse. The building would be a similar height to the northern concourse canopy, and would be designed in accordance with the Chatswood to Sydneyham Design Guidelines for the project (refer to Appendix A). There would be no change to the southern services building. Following completion of construction, areas of the Eddy Avenue forecourt that were previously permanently impacted by the northern services building, would now be reinstated as part of the existing forecourt.

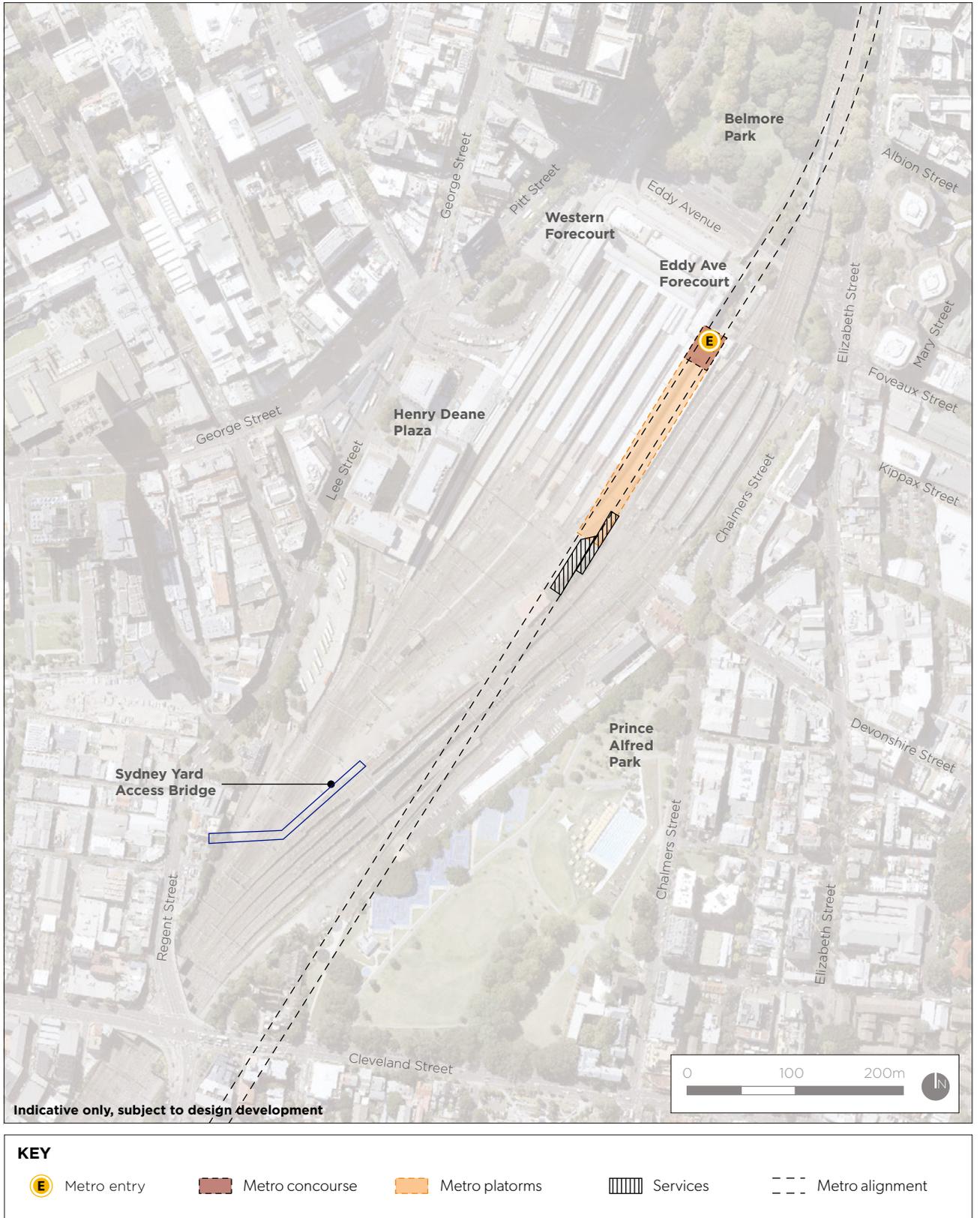


Figure 9-14 Central Station – indicative layout

Sydney Yard Access Bridge temporary construction site

Ongoing construction planning and design development has identified the need for an additional site to support the construction of the Sydney Yard Access Bridge. Activities at the temporary construction site would include:

- Construction of a large hardstand area, including crane pads, to support the activities
- Delivery and storage of pre-cast bridge segments on hardstand
- Assembly of pre-cast bridge segments. This would be supported by two cranes and other equipment.
- Positioning of the assembled segments into place, using a large crane (750 tonnes) to lift assembled segments into place.

Access to the site would be via Lee Street using an existing Sydney Trains maintenance access way provided through the Sydney Buses depot. An additional temporary access track across the rail tracks would be constructed to connect the temporary site with the Central Station construction site.

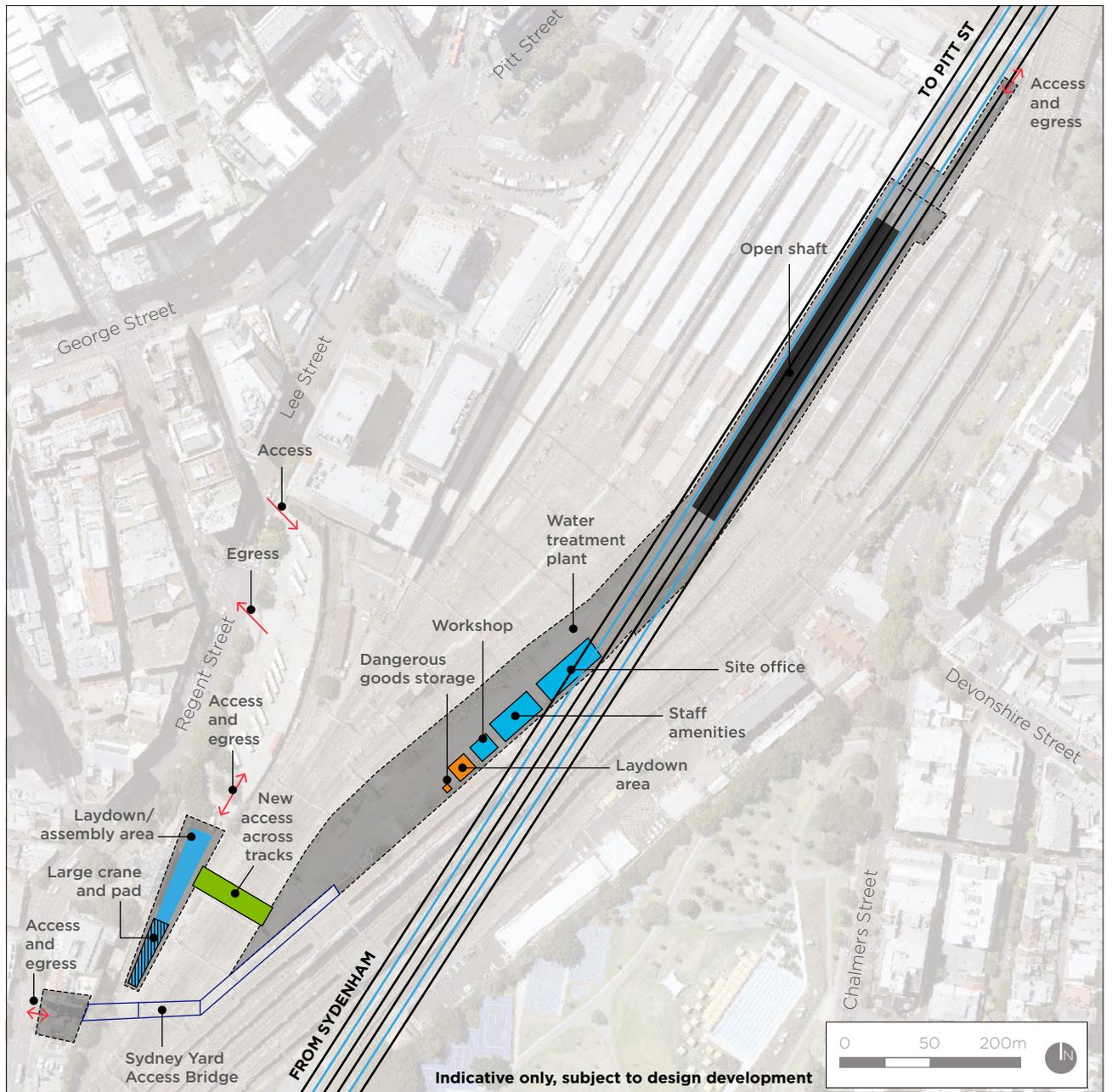
The temporary construction site would be used for around seven months, commencing in the first quarter of 2017.

The site would generally be restricted to the standard daytime construction hours. However, the site would support bridge construction works which would only be undertaken during track possessions (refer to Section 7.10.9 of the Environmental Impact Statement). Any out of hours works associated with work carried out during rail possessions would be short term and subject to approval under an Environment Protection Licence for the project.

The location of the Sydney Yard Access Bridge construction site, including vehicle access and egress, are illustrated in Figure 9-15.

The area is currently used as a maintenance area by Sydney Trains. Site preparation works would be required and would involve:

- Establishing site hoardings around the perimeter of the site.
- Levelling of the construction site and formation of hardstand
- Construction of the crane pads, including minor excavation.



KEY	
	Proposed metro tracks
	Construction area

Figure 9-15 Sydney Yard Access Bridge and Central Station construction sites

9.4.2 Environmental screening assessment

To understand the potential change in environmental impacts, a screening level assessment was conducted and is presented in Table 9-1. This assessment considers potential environmental aspects that may require further impact assessment to understand likely environmental impacts, and identify any relevant mitigation measures that may be required. An assessment of these potential changes in impacts compared to the assessment in the Environmental Impact Statement is provided after the table.

Table 9-8 Central Station – environmental screening assessment

Aspect	Potential change in impacts	Description
Construction traffic and transport	Yes	<p>Construction vehicles and road network impacts</p> <p>The additional construction site would result in an additional site access / egress point onto Lee Street. This is an existing maintenance access for Sydney Trains and passes through the Sydney Buses depot. The construction vehicles that would use this access point once the site is established would be redistributed from the access point provided off Regent Street. However, there would be additional construction vehicles generated during the establishment of the construction site and the delivery of the cranes.</p> <p>Impacts to customers</p> <p>The proposed alternative to the temporary pedestrian bridge would alter customer circulation while construction is underway. Works associated with the northern concourse and Intercity platforms would have impacts consistent with those described and assessed in the Environmental Impact Statement. Further assessment is provided in Section 9.4.3.</p>
Operational traffic and transport	No	<p>The changes at Central Station would not result in changes to the operation of the project as assessed in the Environmental Impact Statement, noting that some changes are proposed to improve circulation in the northern concourse. No further assessment is required.</p>
Construction noise and vibration	Yes	<p>The additional construction site and works within Central Station would introduce additional works. Further assessment is provided in Section 9.4.4.</p>
Operational noise and vibration	No	<p>The change in construction methodology would not result in any changes to the operation of the project as assessed in the Environmental Impact Statement. No further assessment is considered necessary.</p>
Land use and property	No	<p>The changes at Central Station would be contained within operational areas of Central Station and would not have direct impacts to private property. No further assessment is considered necessary.</p>
Business impacts	No	<p>There would be no additional direct impacts on business as a result of the changes at Central Station.</p> <p>Changes in noise impacts may further reduce amenity at the closest business; however, noise impacts would be mitigated where feasible and reasonable in accordance with the mitigation measures in Chapter 11 (Revised environmental mitigation measures and environmental performance outcomes) and the Sydney Metro Construction Noise and Vibration Strategy. The change in impact is considered to be minor and the mitigation measures in the Environmental Impact Statement would manage any increase in impacts. No further assessment is considered necessary.</p>

Aspect	Potential change in impacts	Description
Non-Aboriginal heritage	Yes	The changes at Central Station would be located directly adjacent to Mortuary Station and within the curtilage of Central Station. Both are State heritage listed items. Further assessment is provided in Section 9.4.5.
Aboriginal heritage	No	No identified Aboriginal sites would be impacted by the changes at Central Station. Across the Central Station site there is potential for Aboriginal objects to occur in sub-surface contexts where natural soil contexts remain. The mitigation measures in the Environmental Impact Statement would be implemented to manage activities associated with the changes at Central Station and near Mortuary Station. No further assessment is considered necessary.
Landscape character and visual amenity	Yes	The changes at Central Station would alter the landscape character and visual impacts. Further assessment is provided in Section 9.4.6.
Groundwater and geology	No	The changes at Central Station would not result in any additional groundwater and geology impacts. Minor excavation works are required at the temporary construction site however this is expected to comprise of residual soils. The change in impact is considered to be minor and the mitigation measures in the Environmental Impact Statement would manage any increase in impacts. No further assessment is considered necessary.
Soils, contamination and water quality	No	The changes at Central Station would not significantly change the potential impacts on soils, contamination or water quality as assessed in the Environmental Impact Statement. The mitigation measures in the Environmental Impact Statement would be implemented to manage these changes. No further assessment is considered necessary.
Social impacts and community infrastructure	No	There would be no additional direct impacts on community infrastructure as a result of the changes at Central Station. Changes in noise impacts may further reduce amenity at the closest residences and businesses; however, noise impacts would be mitigated where feasible and reasonable in accordance with the mitigation measures in Chapter 11 (Revised environmental mitigation measures and environmental performance outcomes) and the Sydney Metro Construction Noise and Vibration Strategy. The change in impact is considered to be minor and the mitigation measures in the Environmental Impact Statement would manage any increase in impacts. No further assessment is considered necessary.
Biodiversity	No	The changes at Central Station would not impact landscaped areas. No further assessment is considered necessary.
Flooding and hydrology	No	There would be minor changes to hydrology and drainage as a result of the changes at Central Station. The area is not identified as being flood prone. No further assessment is considered necessary.

Aspect	Potential change in impacts	Description
Air quality	No	The changes at Central Station would not result in any additional air quality impacts. However, some activities, plant and equipment may be closer to sensitive receivers. The change in impact would be minor and the mitigation measures in the Environmental Impact Statement would manage any increase in impacts. No further assessment is considered necessary.
Hazard and risk	No	The changes would not involve the storage and use of any hazardous substances and dangerous goods in areas closer. No further assessment is considered necessary.
Waste management	No	The changes would not result in the generation of any different and increased volumes of waste materials. No further assessment is considered necessary.
Sustainability	No	The changes at Central Station would not change the climate risk profile of the project, and would not result in a substantial change to the generation of greenhouse gases or the use of resources. No further assessment is considered necessary.
Cumulative impacts	No	The changes in construction methodology would not result in any additional cumulative impacts. No further assessment is considered necessary.

9.4.3 Traffic and transport

Removal of the temporary pedestrian bridge

The southern underground pedestrian connections under platforms 12, 13, 14 and 15 currently enable customer interchange from platforms 4 through to 23 and the Eastern Suburbs Line.

Beneath platforms 12 and 13, the connection splits at a Y-junction. As shown on Figure 9-13, the southern arm provides connections through to all platforms from 14 to 23 and the Eastern Suburbs Line, and the northern arm provides connections through to platforms 16 to 19 only. The northern arm is used less frequently than the southern arm given it only provides connections to platforms 16 to 19 through to the InterCity platforms. There is an additional pedestrian connection to suburban platforms only, which runs parallel to the southern arm of the Y-junction. This is also accessed via the southern end of these platforms through an additional set of stairs.

The southern pedestrian connection between the InterCity and Suburban platform are busiest during the AM peak period. This is associated with the arrival of InterCity trains with customers interchanging to Suburban trains or exiting the station to Chalmers Street. However, the frequency of InterCity train arrivals during the AM peak (around 12 per hour) are relatively low. Observations of the underground connection indicate that the sections impacted by this change generally operate at a level of service B or C.

The southern pedestrian connections that would be impacted by this change (located beneath platforms 12 to 15) would already be affected by the metro platform work. (That is, the Environmental Impact Statement identifies that the sections that provide links between the InterCity and Suburban platforms would be directly impacted during construction of the station).

The removal of the temporary construction bridge without the provision of replacement connections to the subterranean pedestrian links during construction would significantly impact pedestrian flows around the station to the extent that the station would cease to operate effectively. The provision of temporary underground connections is essential to maintaining acceptable levels of service for pedestrians. As such, a new permanent underground pedestrian connection would be constructed prior to removal of the existing southern arm. The proposed connection would be built with similar dimensions to the existing connection and would therefore operate at a similar level of service. It would also allow for the two southernmost stairs to directly connect to the InterCity platform pedestrian link. Stairs would also be constructed on platforms 20 to 23. These elements would allow for a more even distribution of demand and to help reduce congestion during construction.

There would be no impacts on the connectivity between suburban platforms, where the majority of interchange at Central Station occurs, as the functionality would remain. The exception would be prior to the opening of the new underground connection, which would require a two week temporary closure of the underground connections, and works on platforms 20 to 23. The two-week closure would be timed to avoid periods of peak pedestrian demand and would not be concurrent with the temporary two week full closure of the Devonshire Street tunnel. The construction of the additional stairs on platforms 20 to 23 would be undertaken during rail possessions.

Northern concourse and Intercity platform changes

As identified in Section 9.4.16 of the Environmental Impact Statement, works at Central Station are likely to result in limited alterations to the Sydney Trains and NSW Trains timetable due to the closure of platforms 13, 14 and 15. Transport for NSW would liaise with Sydney Trains and NSW Trains in relation to the necessary timetable alterations. Customers would be advised of any timetable changes. The demolition and reinstatement of platform 12, and minor adjustments to platforms 9 to 11 (which would be of shorter duration) would be considered in any required timetable alterations. However, the works would be undertaken during rail possessions and wherever possible, within the scheduled Sydney Trains track possessions. Alternative bus services would be provided during possession works.

Sydney Yard Access Bridge temporary construction site

The construction site would be accessed via the Sydney Buses depot, which has direct access onto Lee Street and an egress at the intersection of Regent Street and Lee Street. This access is currently used by Sydney Trains maintenance vehicles.

The addition of the Sydney Yard Access Bridge construction site would not increase the volume of construction traffic as presented in the Environmental Impact Statement. However, until the construction of the Sydney Yard Access Bridge is completed, construction traffic that would have used the Regent Street access / egress point would use the additional access / egress points on Lee Street. As the egress point does not allow left turn movements, it would also require outbound vehicles to use Lee Street and George Street. George Street was identified as a secondary outbound route in the Environmental Impact Statement.

As identified in the Environmental Impact Statement, the initial stages of construction activity would generate around six heavy vehicle trips per hour and a maximum of 10 light vehicle trips per hour in the AM and PM peak. The assessment presented in the Environmental Impact Statement identified that:

- The Lee Street and Regent Street intersection, which also serves the egress point for the Sydney Buses depot, operates at a level of service B with and without the project
- The George Street, Lee Street, Pitt Street and Quay Street intersection operates at a level of service F during the AM peak, and a level of service C during the PM peak, with and without the project.

The temporary change in distribution of construction traffic as a result of this change would not change the level of service for the intersections as presented in the Environmental Impact Statement. Furthermore, the volume of traffic generated by the project during the peak periods would be low, and would occur for a short duration (ie seven months).

Transport for NSW would liaise with Sydney Buses to minimise disruption to depot operations, particularly during peak periods of construction activity, including the delivery of the cranes and oversized equipment. Mitigation measures T1, T2 and T3, which relate to consultation and road safety audits, would effectively manage the additional access / egress points, and potential conflicts with Sydney Buses, as well as motorists, cyclists and pedestrians along Regent Street and Lee Street.

9.4.4 Construction noise and vibration

This section provides an assessment of the Sydney Yard Access Bridge construction site, incorporating adjustments to some receiver type classification in the vicinity of the station.

Receiver type classifications

Near the Central Station construction site, receivers in Areas B and D were identified in the Environmental Impact Statement as commercial receivers. These have since been confirmed as residential receivers. The receiver classification changes do not require further assessment as these receivers would not be the closest residential receivers to the construction sites.

In addition, in Area E, the Environmental Impact Statement (Figure 10-10) identified:

- One receiver as a residential receiver, but this was correctly categorised and assessed as a commercial receiver with the results presented in Table 10-30 of the Environmental Impact Statement (that is, it was only an error within the figure). Therefore, no further assessment for this receiver is required
- One receiver as a commercial receiver, but this has since been confirmed as a residential receiver. Further assessment has been undertaken for this receiver.
- Mortuary Station, which was correctly assessed as a commercial receiver but the results were not presented in the summary table.

The correct receiver types in Area E are shown in Figure 9-16.

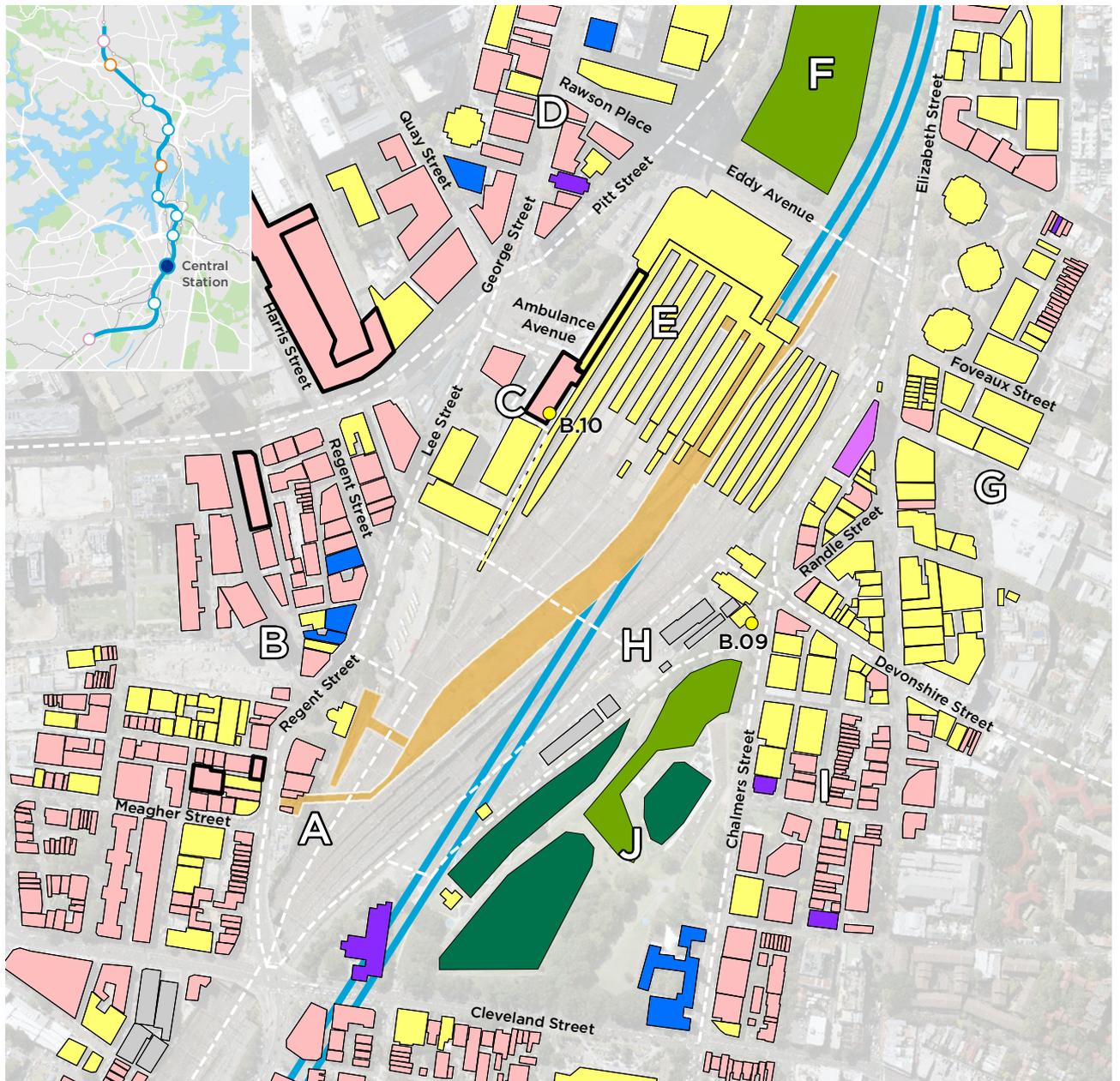
Construction airborne noise

The Sydney Yard Access Bridge construction site would be located adjacent to residential and commercial receivers located along Regent Street, and would introduce additional construction activities closer to the rear façade of these buildings.

The findings of the revised construction noise impact assessment, including clarified receiver types, are presented in Table 9-9 and discussed below. Noise level exceedances are shown on brackets where they have changed from those presented in the Environmental Impact Statement.

The approximate period for each phase of construction at Central Station would be:

- Enabling work (18 months)
- Earthworks (two months)
- Excavation (three and a half years)
- Station construction (12 months).



KEY

- Chatswood to Sydenham
 - Proposed construction site area
 - Receiver area boundary
 - Monitoring location
- Receiver types
- | | | | |
|--|--|---|---|
| Residential | Other (Medical) | Active Recreation | Updated receiver type |
| Commercial | Other (Worship) | Passive Recreation | |
| Industrial | Other (Education) | | |
- Indicative only, subject to design development
- 0 200 m

Figure 9-16 Revised classification of noise receivers at Central Station

For activities associated with the Sydney Yard Access Bridge construction site, the additional activities have been considered under the enabling works and earthworks scenarios. The addition of the construction site would not change the level of exceedance of the noise management levels at the closest affected residential receiver, as this receiver was already predicted to exceed noise management levels by more than 20 dB during other enabling works and earthwork activities (for example, the demolition of adjoining buildings, and piling activities associated with the construction of the Sydney Yard Access Bridge). However, the residential receiver located adjacent to Mortuary Station would also now experience an increase in noise when compared to the Environmental Impact Statement as the construction site is now closer.

For Mortuary Station, it would now exceed noise management levels by up to 10 dB during enabling works and earthwork activities as a result of the additional construction activities. As identified in the Environmental Impact Statement, feasible and reasonable noise mitigation measures would be implemented in accordance with Chapter 11 (Revised environmental mitigation measures and environmental performance outcomes) and the Sydney Metro Construction Noise and Vibration Strategy (refer to Appendix C of this report) to minimise airborne construction noise where exceedances are predicted. Examples of standard mitigation measures that could be implemented, where feasible and reasonable, include avoiding the coincidence of noisy plant operating simultaneously close together, use of dampened rock hammers, scheduling of noisy activities during less sensitive periods, and considering opportunities in site layouts to provide shielding from noise for receivers.

Construction noise impacts for the residential receiver in Area E (east of Lee Street and west of Central Station) would:

- Comply with the noise management levels during enabling, earthworks and station construction phases
- Exceed the noise management levels by up to 10 dB for night-time work during the excavation phase, but would comply with the noise management levels for the excavation phase during the day, daytime out of hours (DOOH) and evening periods. Again, these exceedances would be managed through the mitigation measures in Chapter 11 (Revised environmental mitigation measures and environmental performance outcomes) and the Sydney Metro Construction Noise and Vibration Strategy.

Construction ground-borne noise and human comfort vibration

The addition of the Sydney Yard Access Bridge construction site would not alter the ground-borne noise or vibration impacts as presented at the closest residential receivers.

Operational ground-borne noise

The ground-borne noise levels would comply with the relevant criterion at the receiver during operation of the project.

Table 9-9 Central Station – revised assessment

Receiver area	Scenario							
	Enabling works	Earthworks	Excavation	Construction				
	Day	Day	Day	DOOH	Evening	Night	Sleep	Day
A Residential receivers to the west, east of Regent Street	●	●	●	●	●	●	●	●
<i>A Commercial receiver to the west, east of Regent Street</i>	●	●	●	●	●	●	●	●
B Residential receivers to the east, west of Regent Street	●	●	●	●	●	●	●	●
B Commercial receivers to the west, east of Lee Street	●	●	●	●	●	●	●	●
C Residential receivers to the west, east of Regent Street	●	●	●	●	●	●	●	●
C Commercial receivers to the west, east of Regent Street	●	●	●	●	●	●	●	●
D Residential receivers to the west, west of Pitt Street	●	●	●	●	●	●	●	●
D Church to the west, west of Pitt Street	●	●	●	●	●	●	●	●
<i>E Residential receivers to the west, east of Lee Street</i>	●	●	●	●	●	●	●	●
E Commercial receivers surrounding at Central Station	●	●	●	●	●	●	●	●
F Belmore Park to the north	●	●	●	●	●	●	●	●
G Residential receivers to the east, east of Chalmers Street	●	●	●	●	●	●	●	●
G Sydney Dental Hospital to the east, east of Chalmers Street	●	●	●	●	●	●	●	●
H Commercial receivers to the east, west of Prince Alfred Park	●	●	●	●	●	●	●	●
I Residential receivers to the east, south of Devonshire Street	●	●	●	●	●	●	●	●
I Commercial receivers to the east, south of Devonshire Street	●	●	●	●	●	●	●	●
J Prince Alfred Park	●	●	●	●	●	●	●	●

Legend

- NML compliance
- NML exceedance of less than 10 dB
- NML exceedance between 10 dB and 20 dB
- NML exceedance of more than 20 dB

Note 1: The results presented in the Environmental Impact Statement are shown in brackets ()

Note 2: DOOH = Daytime out of hours (i.e Saturdays 1pm to 6pm and Sundays 7am to 6pm)

Note 3: Additional or clarified receiver types are shown in italics.

9.4.5 Non-Aboriginal heritage

Central Station (Sydney Terminal and Central Railway Station Group) and Mortuary Station are State heritage items, and the changes to the project at Central Station would have additional impacts on these items. The changes to the project would also have additional impacts on three local heritage items and one heritage conservation area.

Central Station

The changes to Central Station would have the following heritage impacts to the Sydney Terminal and Central Railway Station Group:

- The removal of the temporary pedestrian bridge would result in a reduction in impact at this location, which was previously expected to have a major visual impact and direct impact to significant fabric.
- The southern underground pedestrian connection would be impacted by the construction of the metro station box, and additional minor excavation works would not have a greater impact to the heritage values of this item.
- The suburban platforms (referred to as the Central Electric Station) are of high significance as a heritage group. The construction of additional stairs on platforms 20 to 23 would have a localised major direct impact on the fabric of the platforms (paving and asphalt), which are elements of moderate significance. However, the impacts would be minor in the context of the Central Electric Station group, and the heritage values of the item as a whole.
- The relocation of the northern services building from Eddy Avenue Forecourt to platform 15 would have a minor indirect impact (visual) to the heritage item. As it would be built within the footprint of the new platform, it would not have an additional impact on the existing heritage fabric. It would also be located in a similar location to an existing services building, which is a modern addition and an intrusive element. The design of the northern services building would be an element of high quality design consistent with the Chatswood to Sydenham Design Guidelines (Appendix A) and would be viewed as part of the visual context of the new metro infrastructure. The replacement of the existing structure with the northern services building would be a positive heritage outcome.
- The changes to platform 15 would result in minor impacts on the significance of the InterCity platforms as a heritage group as the symmetry would be effected along with the historical use of the platform, change in platform structure and change in views. However, the impacts would be minor in the context of the heritage values of the item as a whole
- The demolition and reinstatement of platform 12 would have a major direct impact on the original fabric, but the impacts to the item as a whole would be consistent with that as assessed for platforms 13 to 15.
- The shortening and lengthening of the Intercity platforms at platforms 9 to 12 would have a negligible direct and indirect impacts to the heritage value of these item. The platforms would be visually similar on completion of the works, and would not impact significant view corridors within or towards the station. Furthermore platforms 9 to 15 were extended southwards in preparation of the Sydney Olympics, and the proposed extensions to platform 9 to 11 would not be fixed to heritage fabric.

- The temporary Sydney Yard Access Bridge construction site would have a temporary minor visual impact to the heritage item, as the cranes would be visually distant from the main station site. The setting of Sydney Yard would not be visually compromised as it is a working rail corridor and a work site would be in keeping with its use. The additional access track would have negligible impacts on the heritage item as it would not impact original fabric and requires minimal construction works.
- There are no overhead wiring structures within the portion of the Sydney Yard that would be used for the Sydney Yard Access Bridge construction site. All overhead wiring structures within the southern portion of Sydney Yard constructed after the mid twentieth century.

Overall the level of heritage impacts to the Sydney Terminal and Central Railway Station Group would be the same as assessed in the Environmental Impact Statement, which concluded that the project would have:

- A moderate to major direct physical impact on the heritage item due to the works associated with the construction of the metro station, adjustments elsewhere within the item to accommodate the metro platforms as well as temporary structures and sites.
- A minor direct impact to the item due to construction vibration.
- A moderate to major indirect impact to the item due to visual impacts associated with temporary infrastructure, with negligible to minor visual impacts upon completion of the works.

The project, as amended, would not impact the State significance of the item against all assessment criteria.

The Environmental Impact Statement included a number of mitigation measures that would still be applicable, including (but not limited to):

- Archival recording of the item prior to works commencing (NAH1)
- The design and detailed construction planning of work at Central Station would consider the requirements of the *Central Station Conservation Management Plan* (Rappoport and Government Architects Office, 2013) and include consideration of opportunities for the retention, conservation and / or reuse of original and significant heritage fabric. Consultation would be carried out with Sydney Trains and the Heritage Council of NSW during design development (NAH13).
- Inclusion of an appropriately qualified and experienced heritage architect in the Sydney Metro Design Review Panel, who would provide independent review periodically throughout detailed design (NAH6)
- The project design would be sympathetic to heritage items and, where reasonable and feasible, minimise impacts to the setting of heritage items. The detailed design for Central Station would be developed with input from a heritage architect (NAH7).
- A Central Station heritage interpretation plan would be developed and implemented. It would be consistent with the *Central Station Conservation Management Plan* (Rappoport and Government Architects Office, 2013) and in accordance with the guidelines identified in NAH8 (being NSW Heritage Manual, the NSW Heritage Office's *Interpreting Heritage Places and Items: Guidelines* (August 2005), and the NSW *Heritage Council's Heritage Interpretation Policy*).

An additional mitigation measure has also been incorporated into Chapter 11 (Revised environmental mitigation measures and environmental performance outcomes), which requires works at Central Station to be carried out with the oversight of heritage specialists (NAH18). No further mitigation measures are considered necessary.

Mortuary Station

The temporary Sydney Yard Access Bridge construction site would not be located within the curtilage of Mortuary Station, but would be directly adjacent to the heritage item. Site establishment and general construction activities would have the following additional temporary heritage impacts:

- The site activities, including large cranes would limit views to the east and south east. While this is in keeping with the character of a working rail corridor, it would result in a moderate to major temporary visual impact.
- The construction of an access route across the rail tracks to the Central Station construction site would have negligible direct heritage impacts as significant fabric would not be affected.
- Minor direct impacts due to construction vibration.
- Subsurface impacts as a result of the excavation works required for the construction site (including crane pads) are unlikely to impact archaeological remains. The evidence of previous structural remains in this location consists of a number of mid-19th century wooden structures associated with the first railway station. Archaeological remains associated with these structures are likely to have been impacted or removed by later construction works.

Overall, the project, as amended, would not significantly change the impact to the item (as assessed in the Environmental Impact Statement), nor would it impact the State significance of the item against all assessment criteria.

The Environmental Impact Statement included a number of mitigation measures that would still be applicable, including (but not limited to):

- Archival recording of the item prior to works commencing (NAH1)
- A Central Station heritage interpretation plan would be developed and implemented. It would be consistent with the *Central Station Conservation Management Plan* (Rappoport and Government Architects Office, 2013) and in accordance with the guidelines identified in NAH8 (NAH9).
- Where vibration levels are predicted to exceed the screening criteria, a more detailed assessment of the structure and attended vibration monitoring would be carried out to ensure vibration levels remain below appropriate limits for that structure. This would include specific consideration of the heritage values of the structure in consultation with a heritage specialist to ensure sensitive heritage fabric is adequately monitored and managed (NV3).

No further mitigation measures are considered required, noting that the Archaeological Research Design (provided in Appendix H) (revised mitigation measure NAH2) would apply to this additional construction site.

Other items

The following local heritage items or conservation areas (listed in the *Sydney Local Environmental Plan 2012*) are located within the vicinity of the Sydney Yard Access Bridge temporary construction site:

- Terrace group including interior (99-105 Regent Street). The Environmental Impact Statement identified that the project would have a moderate visual impact on the item.
- Former Crown Hotel including interior. The Environmental Impact Statement identified that the project would have a moderate visual impact on the item.
- Co-Masonic Temple including interior. The Environmental Impact Statement identified that the project would have a moderate visual impact on the item.
- The Chippendale conservation area. The Environmental Impact Statement identified that the project would have a moderate visual impact on the item.

The additional construction activity, including the presence of large cranes, would have additional temporary visual impacts on the items or conservation area. However, the change in impact as a result of the additional construction site would not increase from that as presented in the Environmental Impact Statement.

9.4.6 Landscape character and visual impacts

An assessment of the landscape character and visual impacts has been completed consistent with the methodology and rating systems in Chapter 16 (Landscape character and visual amenity) of the Environmental Impact Statement.

Landscape character impacts

The Environmental Impact Statement identified the northern concourse as representative of the landscape character of Central Station. The proposed changes to Central Station would not alter the impacts to the northern concourse.

Daytime visual amenity impacts

The anticipated daytime visual impacts from representative viewpoints during construction and operation are shown in Figure 9-17 and summarised in Table 9-10.

For the Central Station changes, the following viewpoints were assessed:

- Viewpoint 1: View south from Eddy Avenue to the northern concourse
- Viewpoint 2: View south from platform 16
- Viewpoint 3: View west from Chalmers and Devonshire Streets
- Views from the rail corridor
- Viewpoint 6: View northeast from Meagher Street
- Viewpoint 7: View southeast from Regent Street
- Viewpoint 8: View east from Regent Street to Mortuary Station

Three additional viewpoints have also been considered to assess the proposed changes at Central Station:

- Viewpoint 9: View north from platform 16
- Views from residential properties on Regent Street
- Viewpoint 10: View south from platforms 20/21

During construction, the changes to Central Station would have the following key additional impacts to visual amenity:

- The removal of the temporary pedestrian bridge would reduce visual impacts during construction as assessed in the Environmental Impact Statement
- Additional construction activities, storage of equipment and hoarding on platforms within Central Station would be visible from approaching trains and/or while at platforms.
- Construction activities on the Intercity platforms, including the construction of the metro box, would have a moderate adverse impact during construction, due to temporary obstruction of views from within the station.
- Additional construction activities at the Sydney Yard Access Bridge construction site would be visually prominent from viewed from passing trains. However the additional activities would be seen within the context of existing infrastructure (including bridges)
- Views of the temporary cranes would be possible from viewpoints on surrounding roads in the vicinity of the construction site. Along with other construction activity, this would have a considerable though temporary reduction in the amenity of the views when considered in conjunction with other construction activity. For views east from Regent Street to Mortuary Station, this would result in an increase the visual impact from moderate to high. Similarly these impacts would be temporary.
- Residential properties on Regent Street would have views of the temporary construction sites within Sydney Yard. The construction site and large cranes are located in close proximity to these properties, which would have obstructed views of the cranes. This would have a considerable though temporary reduction in the amenity of these views.

Overall the level of impact would remain unchanged from that assessed in the Environmental Impact Statement.



KEY

- Chatswood to Sydenham
- Proposed operational area at surface
- Proposed construction site area
- 03
 Viewpoint location
- 08
 Artists impression
- Existing suburban rail

Indicative only, subject to design development



Figure 9-17 Central Station – representative viewpoints

Table 9-10 Central Station – daytime visual impacts

Location	Sensitivity rating	Construction impact		Operation impact	
		Modification rating	Impact rating	Modification rating	Impact rating
View 1: View southwest from Eddy Avenue to the northern concourse	Local	Noticeable reduction	Minor adverse	No perceived change	Negligible
View 2: View north from platform 16	Regional	Noticeable reduction	Moderate adverse	No perceived change	Negligible
View 3: View northwest from the corner of Devonshire and Chalmers Streets	Local	No perceived reduction (Noticeable reduction)	Negligible (Minor adverse)	No perceived change	Negligible
Views from the rail corridor	Regional	Noticeable reduction	Moderate adverse	Noticeable reduction	Moderate adverse
View 5: View west from Prince Alfred Park	Regional	No perceived change	Negligible	No perceived change	Negligible
View 6: View southeast along Regent Street	Local	Considerable reduction	Moderate adverse	Considerable reduction	Moderate adverse
View 7: View northeast from Meagher Street	Local	Considerable reduction	Moderate adverse	Considerable reduction	Moderate adverse
View 8: View east across Regent Street to Mortuary Station	Regional	Considerable reduction (Noticeable reduction)	High adverse (Moderate adverse)	Noticeable reduction	Moderate adverse
New – View 9: View north from platform 16	Regional	Noticeable reduction	Moderate adverse	No perceived change	Negligible
New – Views from residential properties on Regent Street	Neighbourhood	Considerable reduction	Minor adverse	Considerable reduction	Minor adverse
New – View 10: View north from platform 20/21	Regional	Noticeable reduction	Moderate adverse	No perceived change	Negligible

Note: The ratings as presented in the Environmental Impact Statement are shown in brackets where different

During operation, there would be negligible visual impacts on the majority of the assessed viewpoints within Central Station as much of the site would be reinstated. While there would be additional permanent features, these would not significantly obstruct views of station buildings and/or the skyline, or change the character of the existing views. It is noted expected that the northern services building would further obstruct views to station buildings (being generally in the same location as an existing modern structure), and that visibility through to the adjacent platforms would be relatively unchanged. As such, the changes within Central Station would not alter the level of impact as concluded in the Environmental Impact Statement. As the proposed changes at Central Station do not include permanent infrastructure in Sydney Yards, the assessment as presented in the Environmental Impact Statement has not changed.

Night-time visual amenity impacts

The Sydney Yard Access Bridge temporary construction site, in conjunction with other construction activities in the Sydney Yard, would have a minor adverse visual impact during evening hours. This is an increase in predicted impact, as presented in the Environmental Impact Statement, due to proximity of the additional construction activities to residential properties along Regent Street. During all other times, and from most locations, there would be no change in impact as presented in the Environmental Impact Statement.

During operation, the impact would be the same as that assessed in the Environmental Impact Statement.

9.5 Removal of stub tunnels

Chapter 6 of the Environmental Impact Statement identifies the need to provide stub tunnels to the north of Victoria Cross Station and between Waterloo Station and the Marrickville dive structure.

Stub tunnels were proposed as one method to provide for potential extensions to the network should this be decided in the future. However, given the complexity of designing for this long term potential, stub tunnels are no longer proposed.

An alternative approach is to establish a more flexible tunnel design and track alignment with the ability to build extensions in the future. In future, the Sydney Metro network could be extended by:

- Direct connections to the tunnels proposed as part of this project. This approach could result in disruption to the metro network during construction, and would need to be considered at the time of any proposed extension. This approach would, however, provide flexibility in determining how and where the network should be extended
- Separate independent metro alignments that provide connectivity through strategic interchange points.

The removal of the stub tunnels from the project would:

- Reduce the potential impacts described in the Environmental Impact Statement. In particular, there would be a reduction in construction ground-borne noise impacts associated with the roadheader excavation of the stub tunnels, and a reduction in the volume of spoil generated by the project
- Reduce construction complexity and provide a more efficient construction methodology, and therefore reduce the potential for construction delays.

9.6 Removal of rock breaking at night

Since the exhibition of the Environmental Impact Statement, and in response to issues raised by the community and the Environment Protection Authority, construction planning has identified that rock breaking is no longer essential for construction of cut-and-cover stations and station shafts (with the exception of Central Station) outside of standard construction hours. Other station excavation activities would still occur up to 24 hours per day and seven days per week.

This change would substantially reduce the potential impacts associated with airborne and ground-borne noise in periods outside standard daytime construction hours. Ongoing construction planning and further geotechnical investigations has also identified efficiencies in excavation methods, which has reduced the duration of time when rock breakers would be in use.

A revised assessment of the potential noise impacts is provided in this section for the following sites:

- Crows Nest Station
- Victoria Cross Station
- Pitt Street Station
- Waterloo Station.

As outlined in Section 2.6 of this report, some receiver type classifications in proximity to these sites have also been clarified since the exhibition of the Environmental Impact Statement and have been incorporated in the revised assessment.

Revised assessments for Barangaroo Station (refer to Section 3.2) and Martin Place Station (refer Section 3.3) have been considered elsewhere in this report.

The removal of rock breaking outside of standard daytime construction hours would not change the potential impacts for any other environmental aspect.

9.6.1 Crows Nest Station

This section provides an assessment of the elimination of rock breaking outside of standard construction hours, incorporating adjustments to some receiver type classification in the vicinity of the station.

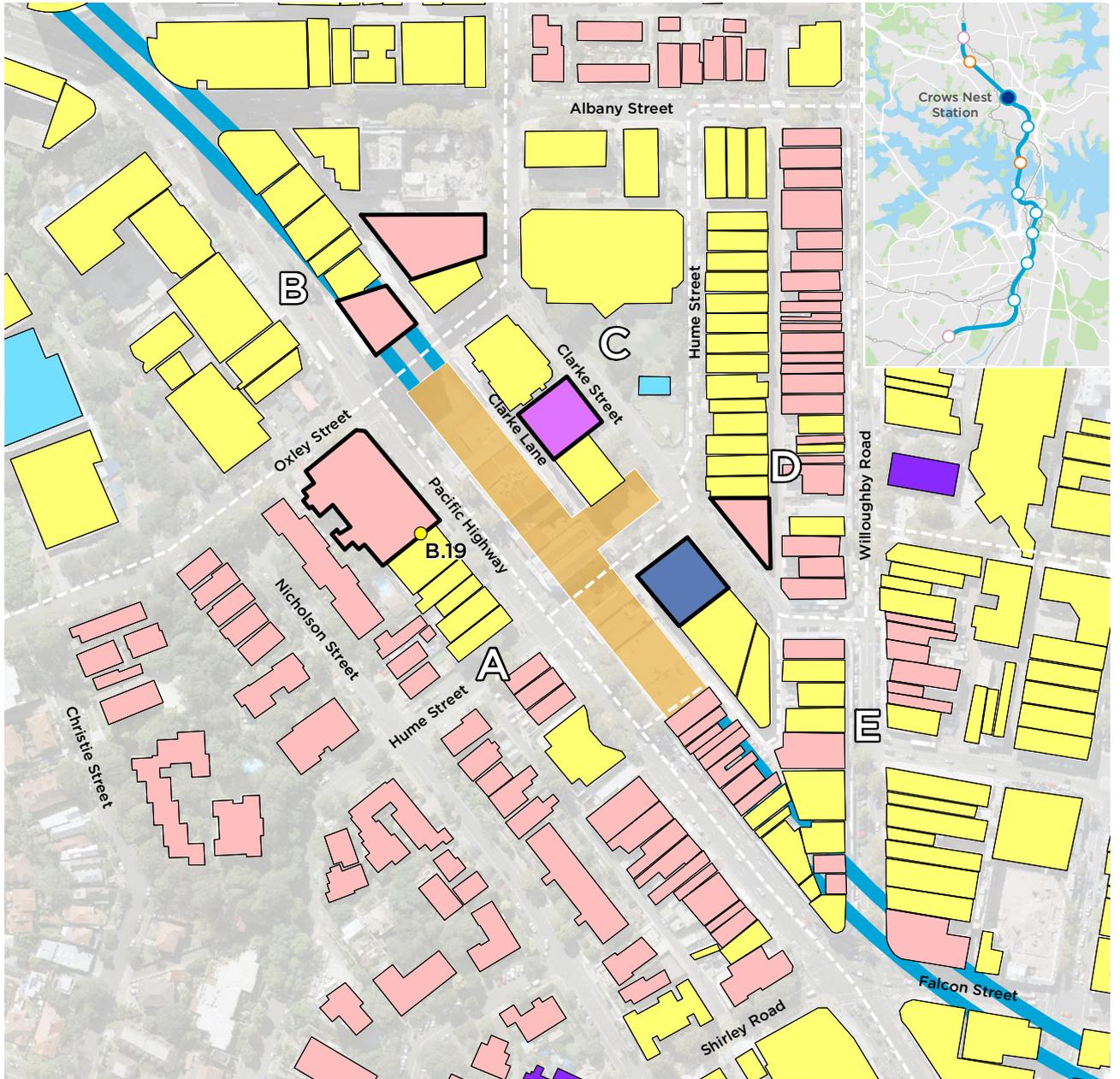
Receiver type classifications

In the vicinity of the Crows Nest Station construction site, the Environmental Impact Statement identified:

- Receivers in Area A, B and D as commercial, but have since been confirmed as being residential.
- One receiver was identified as a commercial receiver, and has since been confirmed as being a theatre (video production and duplication)
- One receiver was identified as a commercial receiver, and has since been confirmed as a medical centre.

These receivers are shown in Figure 9-18.

These receiver types have more stringent criteria (and therefore stricter noise management levels) for construction noise and vibration compared with the criteria assessed in the Environmental Impact Statement. While the level of predicted noise and vibration has not changed, the level of potential exceedances may have increased.



KEY

- Chatswood to Sydenham
- Proposed construction site area
- Receiver area boundary
- Residential
- Commercial
- Other (Worship)
- Other (Child Care)
- Other (Medical)
- Other (Theatre)
- Updated receiver type
- Monitoring location

Indicative only, subject to design development



Figure 9-18 Revised classification of noise receivers at Crows Nest Station

Construction airborne noise

The findings of the revised construction noise impact assessment, including clarified receiver types, are presented in Table 9-11 and discussed below. Noise level exceedances are shown on brackets where they have changed from those presented in the Environmental Impact Statement.

Table 9-11 Predicted airborne noise level exceedances at Crows Nest Station – revised assessment

Receiver area	Scenario								
	Enabling Works	Earthworks	Acoustic shed construction	Excavation with shed				Construction	
	Day	Day	Day	Day	DOOH	Evening	Night	Sleep	Day
A Residential receivers to the west on the Pacific Highway	●	●	●	●	●	●	●	●	●
A Commercial receivers to the west on the Pacific Highway	●	●	●	●	●	●	●	●	●
B Commercial receivers to the north of Oxley Street	●	●	●	●	●	●	●	●	●
B North Side Community Church to the north on Oxley Street	●	●	●	●	●	●	●	●	●
B Residential north of Oxley Street	●	●	●	●	●	●	●	●	●
C Residential receivers to the north east on Clarke Street	●	●	●	●	●	●	●	●	●
C Medical identified in the ground floor of the residential identified in the row above	●	●	●	●	●	●	●	●	●
C Commercial receivers to the north, between Pitt Street and Castlereagh Street	●	●	●	●	●	●	●	●	●
C Active recreation receiver to north on Hume Street	●	●	●	●	●	●	●	●	●
D Residential receivers to the south east on Clarke Street	●	●	●	●	●	●	●	●	●
D Commercial receivers to the north east on Clarke Street	●	●	●	●	●	●	●	●	●
D Commercial (video production and duplication)	●	●	●	●	●	●	●	●	●
E Residential receivers to the south on the Pacific Highway	●	●	●	●	●	●	●	●	●
E Commercial receivers to the south on the Pacific Highway	●	●	●	●	●	●	●	●	●

Legend

- NML compliance
- NML exceedance of less than 10 dB
- NML exceedance between 10 dB and 20 dB
- NML exceedance of more than 20 dB

Note 1: The results presented in the Environmental Impact Statement are shown in brackets ()

Note 2: DOOH = Daytime out of hours (i.e Saturdays 1pm to 6pm and Sundays 7am to 6pm)

Note 3: Additional or clarified receiver types are shown in italics.

The approximate period for each phase of construction at the Crows Nest Station site would be as follows:

- Enabling works including mobilisation and demolition activities (12 months)
- Earthworks (two months), noting that rock breaking during excavation would now only occur during standard construction hours
- Acoustic shed construction (one month)
- Excavation with acoustic shed (three years)
- Station construction (18 months).

The findings of the construction noise impact assessment indicate:

- The restriction of rock breaking activities to standard construction hours during the excavation scenario has lowered, or in some instances removed the predicted exceedances of noise management levels at some receivers in Areas A, B and C during the daytime (outside standard hours), evening and/or night time periods.
- For clarified residential receiver types in Area A and B, moderate exceedance of the noise management levels of between 10 dB and 20 dB are predicted during enabling works and minor exceedances of up to 10 dB during construction works. At the residential receiver in Area A, this would be an increase in the level of exceedance as presented in the Environmental Impact Statement for earthworks only, as the receiver is closer to the construction site.
- For clarified residential receiver type in Area D, minor exceedances of up to 10 dB are predicted during enabling works and earthworks.
- For the medical centre in Area C, exceedances of greater than 20 dB of the noise management levels are predicted during enabling works, earthworks, acoustic shed construction works and construction works. Moderate exceedance of the noise management levels of between 10 dB and 20 dB are predicted during excavation works (standard construction hours), and minor exceedances of up to 10 dB during excavation works (daytime out of hours, evening and night time).
- For the theatre (video production and duplication) in Area D, exceedances of greater than 20 dB of the noise management levels are predicted during enabling works, earthworks, acoustic shed construction works and construction works. Moderate exceedance of the noise management levels of between 10 dB and 20 dB are predicted during excavation (standard construction hours) and minor exceedances of up to 10 dB during excavation works (daytime out of hours).
- As result of clarified receiver types in Area B, the closest commercial receiver is now further away from the construction site, which has reduced the predicted noise levels at these receivers. For the earthworks scenarios, this has lowered the category of the predicted exceedance at the receiver.

As identified in the Environmental Impact Statement, feasible and reasonable noise mitigation measures would be implemented in accordance with Chapter 11 (Revised environmental mitigation measures and environmental performance outcomes) and the Sydney Metro Construction Noise and Vibration Strategy (refer to Appendix C of this report) to minimise airborne construction noise where exceedances are predicted. Examples of standard mitigation measures that could be implemented, where feasible and reasonable, include avoiding the coincidence of noisy plant operating simultaneously close together, use of dampened rock hammers, scheduling of noisy activities during less sensitive periods, and considering opportunities in site layouts to provide shielding from noise for receivers.

Construction ground-borne noise and human comfort vibration

Changes to the potential ground-borne noise impacts due to vibration intensive construction activities (rock breaking) have been re-assessed, alongside the updated receiver types.

The Environmental Impact Statement (Section 10.2.3), indicates that ground-borne noise does not usually create a significant disturbance to building occupants during the day due to high ambient levels which mask the audibility of ground-borne noise emissions. The Environmental Impact Statement also identifies that where ground-borne noise exceedances are identified, then exceedances of human comfort vibration levels may also occur.

The restriction of rock breaking during standard construction hours during excavation works has eliminated ground-borne noise exceedances of the noise management levels at residential receivers during the daytime (outside standard construction hours) evening and night time.

The revised receiver classifications would not result in changes in assessed ground-borne noise impacts at the commercial (video production and duplication) receiver where the ground-borne noise levels are potentially higher than 75dBA.

The medical receiver in area C has been classified as a residential receiver for the purposes of night time work as this would be the most sensitive use within this building with respect to ground-borne noise and human comfort. The night time ground-borne noise levels would be below the ground-borne noise management level. This medical receiver has been classified as a commercial receiver for the purposes of daytime ground-borne noise assessment. Daytime ground-borne noise levels would be potentially higher than 75 dBA.

Where exceedances of ground-borne noise levels are predicted, mitigation measures would be implemented in accordance with the mitigation measures in Chapter 11 (Revised environmental mitigation measures and environmental performance outcomes) and the Sydney Metro Construction Noise and Vibration Strategy (refer to Appendix C of this report). This would include a more detailed site specific ground-borne noise investigation being carried out where day-time internal noise levels are predicted to be greater than 75 dBA. This would include consideration of the acoustic properties and the structural response of the building.

Blasting

Consistent with the approach taken in the Environmental Impact Statement, blasting has been considered due to the level and duration of ground-borne noise exceedances associated with rock breaking. As rock breaking would now only be undertaken during standard construction hours, only the daytime period has been further considered.

Table 9-12 compares the number of daytime periods times when the noise management levels would be exceeded with and without blasting. The table shows that the adoption of blasting as an excavation technique would reduce impacts to receivers, with around a 60 per cent reduction in the number of periods in which noise management levels would be exceeded during the daytime period.

Table 9-12 Crows Nest blasting scenarios

Scenario	Number of daytime periods above Noise Management Levels			
	Residential		Commercial	
	No blasting	Blasting plus large rock breaker	No blasting	Blasting plus large rock breaker
Crows Nest	25	10	21	8

Further detailed construction planning, through the development of Construction Noise Impact Statements (as required by the Sydney Metro Construction Noise and Vibration Strategy in Appendix C of this report) would determine detailed construction activities with the aim of reducing ground-borne noise impacts to receivers. With careful planning and positioning of equipment it may be possible to avoid consecutive periods of noise management levels exceedances to any one receiver, effectively providing respite periods. For any residual exceedances of the noise management levels, additional mitigation measures would be implemented in accordance with Chapter 11 (Revised environmental mitigation measures and environmental performance outcomes) and the Sydney Metro Construction Noise and Vibration Strategy (refer to Appendix C of this report).

Operational ground-borne noise

The ground-borne noise levels would comply with the relevant criterion at the receiver during operation of the project.

9.6.2 Victoria Cross Station

This section provides an assessment of the elimination of rock breaking outside of standard construction hours, incorporating adjustments to some receiver type classification in the vicinity of the station.

Receiver type classifications

In the vicinity of the Victoria Cross Station construction site, the Environmental Impact Statement identified the Monte Sant' Angelo Mercy College as an educational receiver. However, it has been confirmed since the exhibition of the Environmental Impact Statement that:

- The building immediately to the south of the services building with the school grounds contains a theatre
- The building immediate to the west of the services building within the school grounds contains residential premises.

These receivers are shown in Figure 9-19.

The residential building within the school grounds had been assessed in the Environmental Impact Statement as a residential receiver with the results presented in Table 10-15 of the Environmental Impact Statement (as *B – Residential to the west on McLaren Street*). However, it had been depicted incorrectly within the corresponding Figure 10-4 of the Environmental Impact Statement as an educational receiver.

For the theatre within the school grounds, this receiver type would have more stringent criteria (and therefore noise management levels) for construction noise and vibration compared with that assessed in the Environmental Impact Statement. While the level of predicted noise and vibration has not changed, the level of potential exceedances may have increased.

In addition to this clarification, a receiver to the east on Walker Street was identified and assessed in the Environmental Impact Statement as a child care centre. However this receiver was not identified in the summary table for airborne noise as being the nearest receiver of that type. This has now been included in the summary table for completeness.

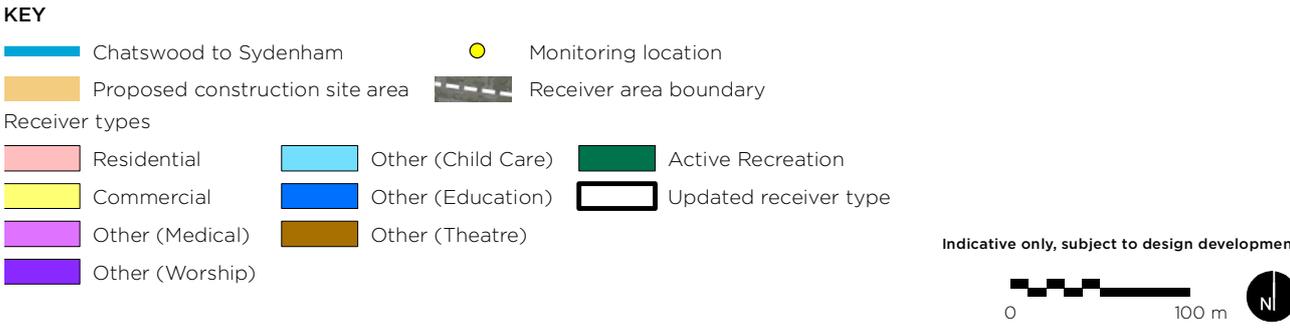
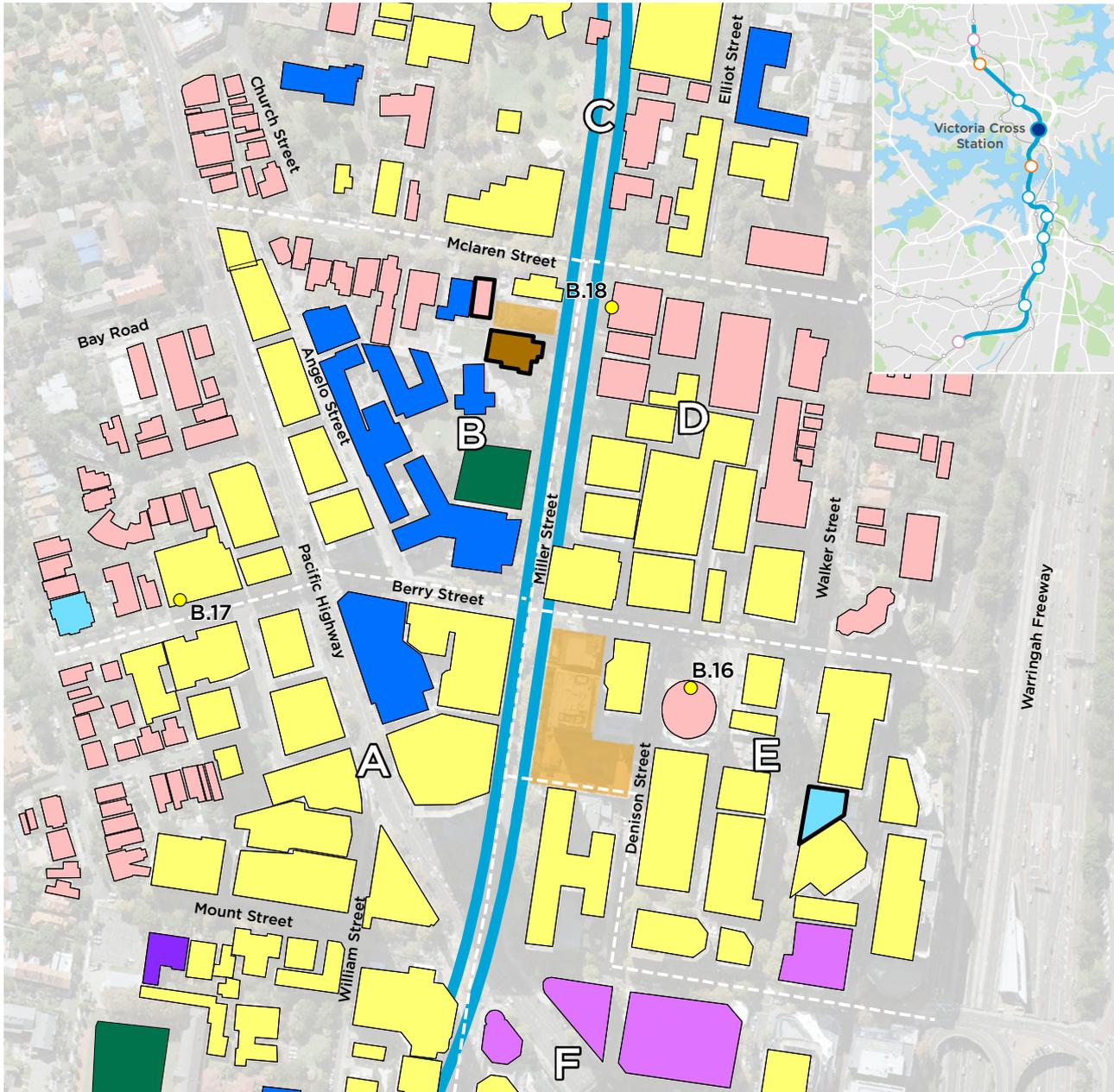


Figure 9-19 Revised classification of noise receivers at Victoria Cross Station

Construction airborne noise

The findings of the revised construction noise impact assessment, including clarified receiver types, are presented in Table 9-13 and discussed below. Noise level exceedances are shown on brackets where they have changed from those presented in the Environmental Impact Statement.

Table 9-13 Predicted airborne noise level exceedances at Victoria Cross Station – revised assessment

Receiver area	Scenario								
	Enabling Works	Earthworks	Acoustic shed construction	Excavation with shed				Construction	
	Day	Day	Day	Day	DOOH	Evening	Night	Sleep	Day
A Commercial receivers to the west on Miller Street	●	●	●	●	●	●	●	●	●
A Educational receivers to the west on the Pacific Highway	●	●	●	●	●	●	●	●	●
B Commercial receivers to the west on Miller Street	●	●	●	●	●	●	●	●	●
B Residential receivers to the west on McLaren Street	●	●	●	●	●	● (●)	● (●)	● (●)	●
B Educational receivers to the west on Miller Street	●	●	● (●)	● (●)	● (●)	●	●	●	● (●)
B <i>Theatre (school theatre)</i>	●	●	●	●	●	●	●	●	●
C Residential receivers to the north on McLaren Street	●	●	●	●	●	●	●	●	●
C Commercial receivers to the north on McLaren Street	●	●	●	●	●	●	●	●	●
D Residential receivers to the east on Miller Street	●	●	●	●	●	●	● (●)	●	●
D Commercial receivers to the east on Miller Street	●	●	●	●	●	●	●	●	●
E Residential receivers to the east on Miller Street	●	●	●	●	●	●	●	●	●
E Commercial receivers to the east on Miller Street	●	●	●	●	●	●	●	●	●
E <i>Childcare receiver to the east on Walker Street</i>	●	●	●	●	●	●	●	●	●
F Commercial receivers adjacent to the south	●	●	●	●	●	●	●	●	●

Legend

- NML compliance
- NML exceedance of less than 10 dB
- NML exceedance between 10 dB and 20 dB
- NML exceedance of more than 20 dB

Note 1: The results presented in the Environmental Impact Statement are shown in brackets ()

Note 2: DOOH = Daytime out of hours (i.e Saturdays 1pm to 6pm and Sundays 7am to 6pm)

Note 3: Additional or clarified receiver types are shown in italics.

The approximate period for each phase of construction at the Victoria Cross Station site as follows:

- Enabling works including mobilisation and demolition activities (12 months)
- Earthworks (two months), noting that rock breaking during excavation would now only occur during standard construction hours
- Acoustic shed construction (one month)
- Excavation with acoustic shed (three years)
- Station and services building construction (18 months).

The findings of the construction noise impact assessment indicate:

- The restriction of rock breaking activities to standard construction hours during the excavation scenario has lowered, or in some instances removed, the predicted exceedances of noise management levels at some receivers in Areas B and D during the evening and night time periods. This includes the residential premises within the grounds of the Monte Sant' Angelo Mercy College.
- For the theatre within Monte Sant' Angelo Mercy College, exceedances of greater than 20 dB of the noise management levels are predicted during the daytime for enabling works, earthworks, acoustic shed construction works, excavation works and construction works. There would be no exceedance of noise management levels for excavation works undertaken during daytime (outside standard hours), evening and night time.
- The re-classification of the theatre has increased the setback of the closest education building from the services building construction site. As a consequence of this change, the level of exceedance has reduced from some activities.
- For the child care receiver, moderate exceedance of the noise management levels of between 10 dB and 20 dB are predicted during enabling works and earthworks, and minor exceedances of up to 10 dB during construction works.

As identified in the Environmental Impact Statement, feasible and reasonable noise mitigation measures would be implemented in accordance with the Chapter 11 (Revised environmental mitigation measures and environmental performance outcomes) and the Sydney Metro Construction Noise and Vibration Strategy (refer to Appendix C of this report) to minimise airborne construction noise where exceedances are predicted. Examples of standard mitigation measures that could be implemented, where feasible and reasonable, include avoiding the coincidence of noisy plant operating simultaneously close together, use of dampened rock hammers, scheduling of noisy activities during less sensitive periods, and considering opportunities in site layouts to provide shielding from noise for receivers.

Construction ground-borne noise and human comfort vibration

Changes to the potential ground-borne noise impacts due to vibration intensive construction activities (rock breaking) have been re-assessed, alongside the updated receiver types.

The Environmental Impact Statement (Section 10.2.3), indicates that ground-borne noise would not usually create a significant disturbance to building occupants during the day due to high ambient levels which mask the audibility of ground-borne noise emissions. The Environmental Impact Statement also identified that where there are likely to be exceedances of ground-borne noise criteria then exceedances of human comfort vibration levels may also occur.

The elimination of rock breaking outside of standard construction hours has eliminated ground-borne noise exceedances of the noise management levels at residential receivers outside of standard construction hours.

At the theatre within Monte Sant' Angelo Mercy College, internal ground-borne noise levels would be potentially greater than 75dBA during the day-time. During the evening and night time period, noise levels would typically be 35 dBA to 50 dBA, depending on the location of the excavation activity relative to the theatre.

Where exceedances of ground-borne noise levels are predicted, mitigation measures would be implemented in accordance with Chapter 11 (Revised environmental mitigation measures and environmental performance outcomes) and the Sydney Metro Construction Noise and Vibration Strategy (refer to Appendix C of this report). This would include a more detailed site specific ground-borne noise investigation, which would include consideration of the acoustic properties and the structure response of the building.

Blasting

Consistent with the approach taken in the Environmental Impact Statement, blasting has been considered due to the level and duration of ground-borne noise exceedances associated with rock breaking. As rock breaking would now only be undertaken during standard construction hours, only the daytime period has been further considered.

Table 9-14 compares the number of daytime periods times when the noise management levels would be exceeded with and without blasting. The table shows that the adoption of blasting as an excavation technique would reduce impacts to receivers, with up to a 55 per cent reduction in the number of periods in which noise management levels would be exceeded during the daytime period.

Table 9-14 Victoria Cross Station blasting scenarios

Scenario	Number of daytime periods above Noise Management Levels			
	Residential		Commercial	
	No blasting	Blasting plus large rock breaker	No blasting	Blasting plus large rock breaker
Victoria Cross North	57	29	260	120
Victoria Cross South	0	0	21	13

Further detailed construction planning, through the development of Construction Noise Impact Statements (as required by the Sydney Metro Construction Noise and Vibration Strategy in Appendix C of this report) would determine detailed construction activities with the aim of reducing ground-borne noise impacts to receivers. With careful planning and positioning of equipment it may be possible to avoid consecutive periods of noise management levels exceedances to any one receiver, effectively providing respite periods. For any residual exceedances of the noise management levels, additional mitigation measures would be implemented in accordance with Chapter 11 (Revised environmental mitigation measures and environmental performance outcomes) and the Sydney Metro Construction Noise and Vibration Strategy (refer to Appendix C of this report).

Operational ground-borne noise

The ground-borne noise levels would comply with the relevant criterion at the theatre during operation of the project, with ground-borne noise levels predicted to be 24 dBA, which is below the criterion for drama theatres. During the night time period, ground borne vibration levels would be below the residential criterion. As the child care receiver is not in proximity to the rail tunnels, it has not been re-assessed.

9.6.3 Pitt Street Station

This section provides an assessment of the elimination of rock breaking outside of standard construction hours, incorporating adjustments to some receiver type classification in the vicinity of the station.

Receiver type classifications

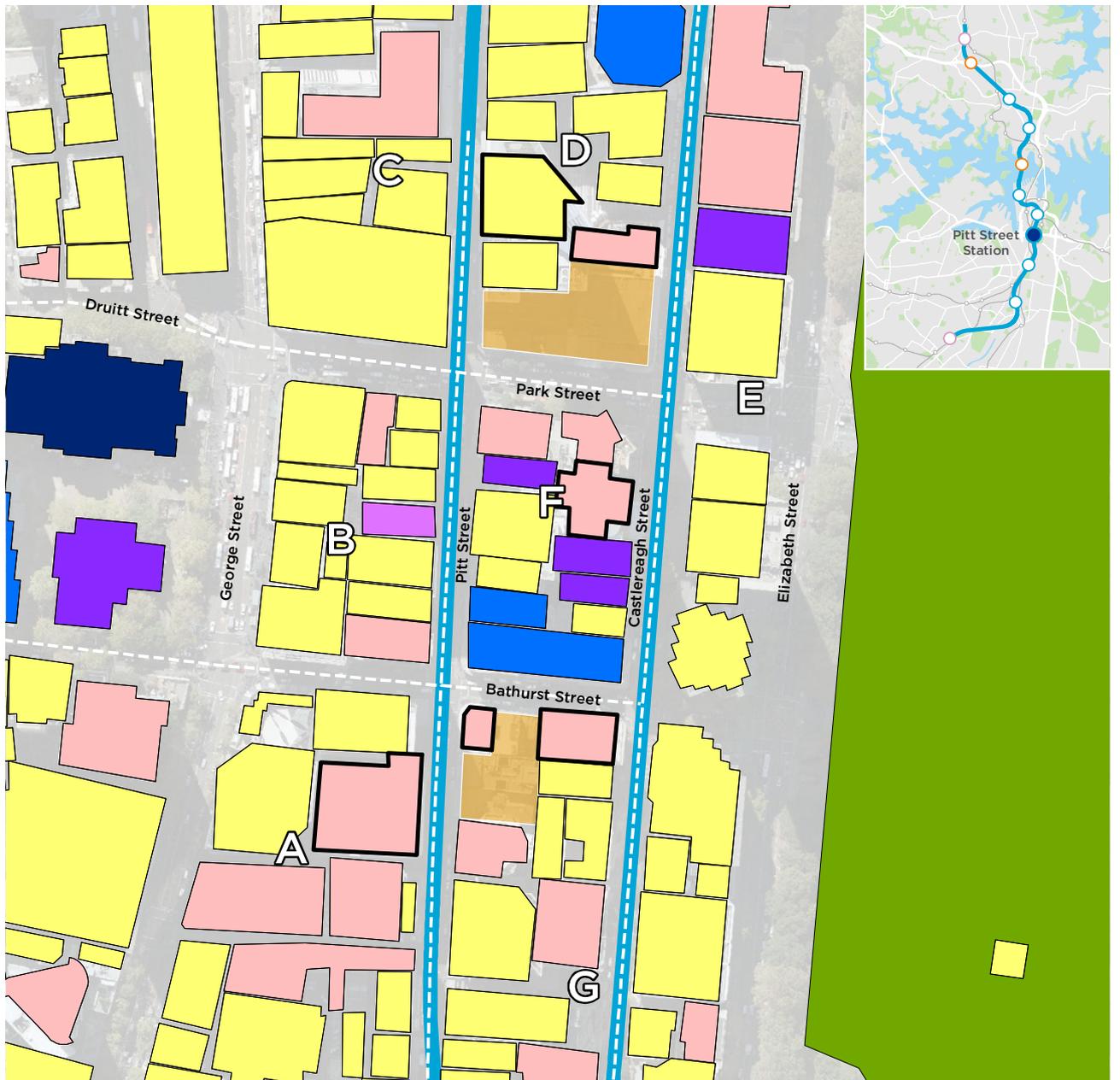
In the vicinity of the Pitt Street Station construction site, the Environmental Impact Statement identified:

- Receivers in Areas A, F and G as commercial, but have since been confirmed as being residential receivers
- One receiver in Area D immediately adjacent to the Pitt Street Station (north) construction site was identified as a commercial receiver, and has since been confirmed as being a hotel. This receiver has now been now classified as a residential receiver
- One receiver in Area D was identified as a residential, and has since been confirmed as being a commercial receiver

These receivers are shown in Figure 9-20.

As a result of these clarifications, the closest residential receivers in Area A and D have changed and an assessment of the potential impacts for these receivers in presented in Table 9-15 along with the revised assessment for rock breaking.

The clarifications in receiver types elsewhere have not resulted in changes to the closest receiver type, and therefore do not require further assessment.



KEY

- Chatswood to Sydenham
 - Proposed construction site area
 - Receiver area boundary
 - Monitoring location
- Receiver types
- Residential
 - Other (Medical)
 - Other (Education)
 - Updated receiver type
 - Commercial
 - Other (Worship)
 - Other (Theatre)
 - Passive Recreation

Indicative only, subject to design development



Figure 9-20 Revised classification of noise receivers at Pitt Street Station

Construction airborne noise

The findings of the revised construction noise impact assessment, including reclassified receiver types, are presented in Table 9-15 and discussed below. Noise level exceedances are shown on brackets where they have changed from those presented in the Environmental Impact Statement.

The approximate period for each phase of construction at the Pitt Street Station site would be as follows:

- Enabling works including mobilisation and demolition activities (12 months)
- Earthworks (two months), noting that rock breaking during excavation would now only occur during standard construction hours
- Acoustic shed construction (one month)
- Excavation with acoustic shed (three years)
- Station and services building construction (18 months).

The findings of the construction noise impact assessment indicate:

- The restriction of rock breaking activities to standard construction hours during the excavation of the shafts has removed the predicted exceedances of noise management levels at residential receiver in Area G during the night time period.
- For the residential receiver in Area A, minor exceedances of up to 10 dB are predicted during enabling works, earthworks and construction works.
- For the hotel in Area D, moderate exceedance of the noise management levels of between 10 dB and 20 dB are predicted during enabling works and earthworks, and minor exceedances of up to 10 dB during construction works.

As identified in the Environmental Impact Statement, feasible and reasonable noise mitigation measures would be implemented in accordance with Chapter 11 (Revised environmental mitigation measures and environmental performance outcomes) and the Sydney Metro Construction Noise and Vibration Strategy (refer to Appendix C of this report) to minimise airborne construction noise where exceedances are predicted. Examples of standard mitigation measures that could be implemented, where feasible and reasonable, include avoiding the coincidence of noisy plant operating simultaneously close together, use of dampened rock hammers, scheduling of noisy activities during less sensitive periods, and considering opportunities in site layouts to provide shielding from noise for receivers.

Table 9-15 Predicted airborne noise level exceedances for re-classified receivers at Pitt Street Station

Receiver area	Scenario								
	Enabling Works	Earthworks	Acoustic shed construction	Excavation with shed				Construction	
	Day	Day	Day	Day	DOOH	Evening	Night	Sleep	Day
<i>A Residential receivers to the west, west of Pitt Street and south of Bathurst Street</i>	●	●	●	●	●	●	●	●	●
<i>A Commercial receivers to the west, west of Pitt Street and south of Bathurst Street</i>	●	●	●	●	●	●	●	●	●
<i>B Residential receivers to the west, west of Pitt Street and north of Bathurst Street</i>	●	●	●	●	●	●	●	●	●
<i>B Commercial receivers to the west, west of Pitt Street and north of Bathurst Street</i>	●	●	●	●	●	●	●	●	●
<i>C Residential receivers to the west, west of Pitt Street and north of Park Street</i>	●	●	●	●	●	●	●	●	●
<i>C Commercial receivers to the west, west of Pitt Street and north of Park Street</i>	●	●	●	●	●	●	●	●	●
<i>D Hotel receiver to the north on Castlereagh Street</i>	●	●	●	●	●	●	●	●	●
<i>D Commercial receivers to the north, between Pitt Street and Castlereagh Street</i>	●	●	●	●	●	●	●	●	●
<i>E Residential receivers to the east</i>	●	●	●	●	●	●	●	●	●
<i>E Commercial receivers to the east</i>	●	●	●	●	●	●	●	●	●
<i>F Residential receivers between Park Street and Bathurst Street</i>	●	●	●	●	●	●	●	●	●
<i>F Commercial receivers between Park Street and Bathurst Street</i>	●	●	●	●	●	●	●	●	●
<i>F Educational receivers between Park Street and Bathurst Street</i>	●	●	●	●	●	●	●	●	●
<i>G Residential receivers to the south, between Pitt Street and Castlereagh Street</i>	●	●	●	●	●	●	●	●	●
<i>G Commercial receivers to the south, between Pitt Street and Castlereagh Street</i>	●	●	●	●	●	●	●	●	●

Legend

- NML compliance
- NML exceedance of less than 10 dB
- NML exceedance between 10 dB and 20 dB
- NML exceedance of more than 20 dB

Note 1: The results presented in the Environmental Impact Statement are shown in brackets ()

Note 2: DOOH = Daytime out of hours (i.e Saturdays 1pm to 6pm and Sundays 7am to 6pm)

Note 3: Additional or clarified receiver types are shown in italics.

Construction ground-borne noise and human comfort vibration

Changes to the potential ground-borne noise impacts due to vibration intensive construction activities (rock breaking) have been re-assessed, alongside the reclassified receiver types.

The Environmental Impact Statement (Section 10.2.3), indicates that ground-borne noise would not usually create a significant disturbance to building occupants during the day due to high ambient levels which mask the audibility of ground-borne noise emissions. The Environmental Impact Statement also identified that where there are likely to be ground-borne noise exceedances, then exceedances of human comfort vibration levels may also occur.

The elimination of rock breaking outside of standard construction hours has eliminated ground-borne noise exceedances of the noise management levels at residential receivers outside of standard construction hours. However, internal ground-borne noise levels would be potentially greater than 75dBA during the daytime on several floors of the re-classified residential building in Area A and at the hotel in Area D.

Where exceedances of ground-borne noise levels are predicted, mitigation measures would be implemented in accordance with Chapter 11 (Revised environmental mitigation measures and environmental performance outcomes) and the Sydney Metro Construction Noise and Vibration Strategy (refer to Appendix C of this report). This would include a more detailed site specific ground-borne noise investigation, which would include consideration of the acoustic properties and the structure response of the building.

Blasting

Consistent with the approach taken in the Environmental Impact Statement, blasting has been considered due to the level and duration of ground-borne noise exceedances associated with rock breaking. As rock breaking would now only be undertaken during standard construction hours, only the daytime period has been further considered.

Table 9-16 compares the number of daytime periods times when the noise management levels would be exceeded with and without blasting. The table shows that the adoption of blasting as an excavation technique would reduce impacts to receivers, with around a 50 per cent reduction in the number of periods in which noise management levels would be exceeded during the daytime period.

Table 9-16 Pitt Street Station blasting scenarios

Scenario	Number of daytime periods above Noise Management Levels			
	Residential		Commercial	
	No blasting	Blasting plus large rock breaker	No blasting	Blasting plus large rock breaker
Pitt Street North	24	13	20	11
Pitt Street South	41	18	63	32

Further detailed construction planning, through the development of Construction Noise Impact Statements (as required by the Sydney Metro Construction Noise and Vibration Strategy in Appendix C of this report) would determine detailed construction activities with the aim of reducing ground-borne noise impacts to receivers. For example, this could involve the consideration of different sized rock breakers at different periods, and the positioning of rock breakers within the site during different periods.

With careful planning and positioning of the rock breakers it may be possible to avoid consecutive periods of noise management levels exceedances to any one receiver, effectively providing respite periods. For any residual exceedances of the noise management levels, additional mitigation measures would be implemented in accordance with Chapter 11 (Revised environmental mitigation measures and environmental performance outcomes) and the Sydney Metro Construction Noise and Vibration Strategy (refer to Appendix C of this report).

Operational ground-borne noise

The ground-borne noise levels would comply with the relevant criterion at the clarified receiver types during operation of the project.

9.6.4 Waterloo Station

At the Waterloo Station construction site, earthworks would occur for around two months. Rock breaking during excavation would now only occur during standard construction hours. As there are no changes to the receiver classifications within the vicinity of the construction site, this section only presents the change in impacts resulting from the change in construction methodology.

The findings of the revised construction noise impact assessment during excavation are presented in Table 9-17 and discussed below. Noise level exceedances are shown in brackets where they have changed from those presented in the Environmental Impact Statement.

Table 9-17 Predicted airborne noise level exceedances at Waterloo Station construction site – revised assessment (restriction of rock breaking)

Receiver area	Scenario				
	Day	DOOH	Evening	Night	Sleep
A Residential receivers north of Raglan Street	●	● (●)	● (●)	● (●)	● (●)
B Residential receivers east of Cope Street	●	● (●)	● (●)	● (●)	● (●)
C Residential receivers south of Buckland Street	●	●	● (●)	● (●)	● (●)
C Commercial receivers south of Buckland Street	●	●	●	●	●
D Residential receivers west of Botany Road	●	● (●)	●	● (●)	●
D Place of worship receivers east of Botany Road	●	● (●)	●	●	●
C Commercial receivers east of Botany Road	●	●	●	●	●

Legend

- NML compliance
- NML exceedance of less than 10 dB
- NML exceedance between 10 dB and 20 dB
- NML exceedance of more than 20 dB

Note 1: The results presented in the Environmental Impact Statement are shown in brackets ()

Note 2: DOOH = Daytime out of hours (i.e Saturdays 1pm to 6pm and Sundays 7am to 6pm)

Note 3: Additional or clarified receiver types are shown in italics.

The restriction of rock breaking activities to standard construction hours during the excavation scenario has lowered, or in some instances removed, the predicted exceedances of noise management levels at all receivers in Areas A, B, C and D during the evening and night time periods.

As identified in the Environmental Impact Statement, feasible and reasonable noise mitigation measures would be implemented in accordance with Chapter 11 (Revised environmental mitigation measures and environmental performance outcomes) and the Sydney Metro Construction Noise and Vibration Strategy (refer to Appendix C of this report) to minimise airborne construction noise where exceedances are predicted. Examples of standard mitigation measures that could be implemented, where feasible and reasonable, include avoiding the coincidence of noisy plant operating simultaneously close together, use of dampened rock hammers, scheduling of noisy activities during less sensitive periods, and considering opportunities in site layouts to provide shielding from noise for receivers.

Construction ground-borne noise and human comfort vibration

Changes to the potential ground-borne noise impacts due to vibration intensive construction activities (rock breaking) have been re-assessed, alongside the updated receiver types.

The Environmental Impact Statement (Section 10.2.3), indicates that ground-borne noise would not usually create a significant disturbance to building occupants during the day due to high ambient levels which mask the audibility of ground-borne noise emissions. The Environmental Impact Statement also identified that where there are likely to be exceedances of ground-borne noise levels, then exceedances of human comfort vibration levels may also occur.

The restriction of rock breaking during standard construction hours during excavation works has eliminated ground-borne noise exceedances of the noise management levels at residential receivers outside of standard construction hours.

Blasting

Consistent with the approach taken in the Environmental Impact Statement, blasting has been considered due to the level and duration of ground-borne noise exceedances associated with rock breaking. As rock breaking would now only be undertaken during standard construction hours, only the daytime period has been further considered.

Table 9-18 shows the number of daytime periods times when the noise management levels would be exceeded while excavation works are underway. The table shows that the adoption of blasting as an excavation technique would reduce impacts to receivers, with around a 50 per cent reduction in the number of periods in which noise management levels are exceeded during the daytime period.

Table 9-18 Waterloo Station blasting scenarios

Scenario	Number of daytime periods above Noise Management Levels			
	Residential		Commercial	
	No blasting	Blasting plus large rock breaker	No blasting	Blasting plus large rock breaker
Waterloo Station	76	42	4	2

Further detailed construction planning, through the development of Construction Noise Impact Statements (as required by the Sydney Metro Construction Noise and Vibration Strategy in Appendix C of this report) would determine detailed construction activities with the aim of reducing ground-borne noise impacts to receivers. For example, this could involve the consideration of different sized rock breakers at different periods, and the positioning of rock breakers within the site during different periods.

With careful planning and positioning of the rock breakers it may be possible to avoid consecutive periods of noise management levels exceedances to any one receiver, effectively providing respite periods. For any residual exceedances of the noise management levels, additional mitigation measures would be implemented in accordance with Chapter 11 (Revised environmental mitigation measures and environmental performance outcomes) and the Sydney Metro Construction Noise and Vibration Strategy (refer to Appendix C of this report).

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