CROSSRIVERRAIL

Environmental Impact Statement

Request for Project Change

February 2017

Volume 1

Queensland Government

CROSSRIVERRAIL

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1. Introduction

This request for changes to the Cross River Rail (CRR) project is made by the State of Queensland, represented by the Department of Transport and Main Roads (TMR), pursuant to Part 4, Division 3A of the *State Development and Public Works Organisation Act 1971* (SDPWO Act). The State is the proponent for the project.

In March 2010, the CRR project was declared a significant project (now a coordinated project) for which an environmental impact statement (EIS) was required. The EIS relating to the CRR project was evaluated by the Coordinator-General in a report dated 20 December 2012. The Coordinator-General recommended that the project could proceed, subject to conditions for the minimisation and management of the environmental impacts of the project in its delivery and implementation.

The proposed changes to the CRR project relate to:

- project design and implementation
- project delivery
- certain conditions of the Coordinator-General's evaluation report.

The reasons for the changes to the project are:

- enhanced project affordability and functionality
- opportunity to reduce impacts on sensitive receivers
- design refinements arising from further technical investigations, updated freight and passenger demand forecasts and from community input.

1.1 Process for Evaluation of Project Changes

The process by which the changes to the CRR project are to be addressed and assessed are established in Part 4, Division 3A of the SDPWO Act.

The proposed Project changes since the Coordinator-General's evaluation report trigger the requirement for the Proponent to request that the Coordinator-General assess:

- changes to the project
- changes to the conditions of the Project.

The existing imposed conditions and Stated Conditions that apply to the Project require revision to reflect:

(a) physical changes to the Project, including:
  (i) the locations of construction worksites
  (ii) spoil haulage routes and placement locations
  (iii) the Project alignment
(b) changed environmental impacts as a result of the physical changes to the Project, reflected in updated technical assessments
(c) changed mitigation measures and a changed Draft Outline Environmental Management Plan (EMP) as a result of the changes
(d) regulatory changes since the Coordinator-General's evaluation report.

It is requested that the Coordinator-General's conditions be changed to align with the approach in the updated Draft Outline EMP contained at Volume 2 of this Request for Project Change.

The effects of the changes to the existing conditions for the Reference Project have been assessed throughout the chapters of Volume 1 (this document) and the updated Draft Outline EMP contained at Volume 2 of this Request for Project Change.

1.2 Consultation Requirements

Comprehensive consultation processes have been conducted across the study corridor in respect of the Reference Project, and the Bus and Train Project (including the revised reference design). These processes included a range of consultation activities designed to extend information about each project and its likely effects in both delivery and operation upon communities along the study corridor.

In addition to any statutory consultation requirement under the SDPWO Act, the Proponent has published a newsletter about the Changed Project and has written to individual property owners who would have a surface or volumetric land requirement for the Changed Project. Land requirements would be dealt with separately through Queensland Government land acquisition processes.

More information on project consultation activities is available at www.crossriverrail.qld.gov.au.

1.3 Relationship with Other Projects

1.3.1 Possible cumulative effects

The Reference Project identified a number of significant projects across the study corridor that had the potential to be undergoing construction at the same time. The Draft Outline EMP for the Reference Project proposed a range of mitigation measures to minimise and manage the potential cumulative impacts on community amenity and the transport network. The Draft Outline EMP for the Changed Project would carry these forward.

The Changed Project would be delivered at a later time to the Reference Project with the potential for impacts with other projects under construction at the same time. The likely cumulative impacts, particularly in the inner city would be no different to those anticipated for the Reference Project, although the anticipated projects would be different, for example, the Queen's Wharf Brisbane project. With the removal of works south of Dutton Park Station, the predicted cumulative impacts including at the Yeerongpilly transit-oriented development (TOD) site are no longer relevant.

Consequently, the approach to the management of cumulative impacts remains the same.

1.3.2 Supporting network enhancements

As part of normal operations, a number of enhancements would be delivered across the wider railway network during the operational life of the Changed Project. To support the current indicative rail service plans for the Changed Project, a range of network enhancements are required. These works would generally be within the existing rail corridor and delivered by other entities such as Queensland Rail (QR), generally as part of ongoing operational works programs. These network enhancements do not form part of the Changed Project.

Network enhancements that may be delivered include:

Station upgrades

- Upgrades to existing surface railway stations at Salisbury, Rocklea, Moorooka, Yeerongpilly, Yeronga and Fairfield. These upgrades include new platforms or platform extensions to allow passenger trains using the existing dual-gauge freight line to stop at the stations. Under the indicative rail service plan, CRR services would run express between Boggo Road Station and Salisbury Station.
- Upgrades to existing railway stations at Wooloowin and Northgate including new platforms. While these upgrades are not expected to be required before 2036, they would allow an increase in train services on the northern lines that feed into CRR.

Train stabling

- QR is already increasing its stabling facilities to accommodate new passenger trains through the QR Stabling Program. A new stabling facility at Clapham Yard and works in the existing facility at

Mayne Yard would support CRR and broader network operations across the regional rail network.

Signalling

- Signalling upgrades to provide bi-directional[1] conventional signalling from Salisbury Station to Dutton Park Station would allow bi-directional running of trains, which supports the indicative rail service plan.
- New inner-city signalling through the European Train Control System (ETCS) – Inner City Project. The ETCS Project would deliver a complete overhaul of the inner-city rail signalling and communications system and includes the area of the rail network between Milton and Northgate stations. CRR incorporates ETCS throughout the tunnels, as part of the new ETCS system.

The approvals required for these projects would be influenced by the scope of works and the potential environmental impacts. These supporting network enhancements are consistent with works undertaken by Queensland Rail in its role as rail infrastructure manager[2]. Appropriate approvals would be sought by the responsible entities as these projects are developed.

1.4 Structure of the Request for Project Change

The Request for Project Change comprises the following:

- *Volume 1* – Request for Project Change (this report)

  Volume 1 describes the proposed changes, the reasons for the proposed changes and the effects of the changes on the project.

- *Volume 2* – Draft Outline Environmental Management Plan (EMP)

  Volume 2 provides the proposed environmental design requirements and environmental management measures that must be incorporated in the environmental management plans for the construction and commissioning of CRR. This replaces, in full, the Draft Outline EMP in the CRR 2011 EIS (Chapter 24).

- *Volume 3* – Cross River Rail Design Drawings

  Volume 3 presents the Changed Project design drawings including general arrangement drawings, longitudinal and cross sections, construction site layout plans, property impact plans and station design drawings.

- *Volume 4* – Technical Reports

  Volume 4 provides technical information supporting the request for project change including transport, air quality, non-indigenous cultural heritage, noise and vibration, settlement, land use and tenure, landscape and visual, groundwater and cumulative impacts.

[1] Bi-directional signalling allows trains to run in both directions on a single track.
[2] Rail infrastructure manager is defined in the *Transport (Rail Safety) Act 2010*

2. Reference Project

2.1 Cross River Rail (Reference Project)

The CRR project described in the Coordinator-General's evaluation report is defined in this Request for Project Change as the Reference Project. The Reference Project is the project to which the proposed changes relate.

A complete description of the CRR Reference Project is provided in the EIS (Volume 1, Part A, Chapter 4) dated July 2011, and is summarised below.

2.2 Reference Project Design

The Reference Project design proposed an 18km rail line comprising:

- new tracks in each of twin tunnels, 10km in length, extending from Yeerongpilly under the Brisbane River to Victoria Park at Spring Hill
- four new underground stations at Dutton Park (Boggo Road Urban Village), Woolloongabba, and in the Brisbane CBD at Albert Street and Roma Street
- two new stations on the surface at Yeerongpilly and Bowen Hills (RNA Showgrounds);
- upgraded stations (existing) at Moorooka and Rocklea
- new surface tracks between Salisbury and Yeerongpilly and between Bowen Hills (RNA Showgrounds) passing through Mayne Yard to connect with the North Coast Line at Breakfast/ Enoggera Creek
- stabling facilities at Clapham Yard
- a ventilation and emergency access building at Fairfield
- traction feeder stations at Yeerongpilly, RNA Showgrounds and Mayne Yard
- southern roadworks.

The main tunnels were designed to be constructed by tunnel boring machines (TBM) and reinforced with interlocking concrete segments, resulting in an undrained, or waterproof lining. The bored tunnels would have an internal diameter of 6.0m to accommodate the design rolling stock. The bored tunnels would transition to 'cut-and-cover' structures and then to open troughs as the tracks came to the surface to join with the existing rail network. These transition structures were designed to be drained, allowing groundwater to enter and be collected for subsequent treatment and discharge.

The main tunnels would pass deep in rock beneath the Brisbane River. Any groundwater entering these tunnels would be collected in a sump at the low point beneath the river, just south of the Brisbane Botanic Gardens, and treated prior to discharge. Cross-passages connecting the parallel tunnels would be provided for emergency access and evacuation. The cross passages would be provided at 240m intervals.

The underground stations were designed to be constructed in a combination of top-down excavations and mined caverns, with design elements minimising the inflow of groundwater. The stations would be situated at various depths below the surface, determined by local topography in combination with the design requirement for maximum rail gradients of 3%.

The stations would be equipped with platform screen doors for passenger safety, loading efficiency and for climate control. The public concourse and platforms would be ventilated to maintain passenger comfort. Vertical transport between the platforms and the surface would be provided by escalators and by elevators for people with mobility constraints.

The upgrades to the existing surface stations would provide disabled access, straightened platforms and the installation of new surface tracks necessary to facilitate the 'sectorisation' of the urban rail network to deliver scheduling and service benefits across the South East Queensland commuter rail network.

The new surface tracks would include two passenger lines for CRR from south of Rocklea to the Southern Portal at Yeerongpilly and a dual gauge freight track from Acacia Ridge to just south of Tennyson junction.

The southern roadworks would involve:

- the reconfiguration of Muriel Avenue – Fairfield Road and the south-bound ramp onto the Ipswich Motorway to accommodate the new surface tracks
- changes to local roads at Unwin Road and Evesham Road, Station Street and the intersection of Railway Parade, Railway Terrace and Fairlie Terrace
- Realignment of the Beaudesert Road service road, Heaton Street and Dollis Street to accommodate new surface tracks
- Changes to Tramore Street and signalising the intersection of Tramore and Lillian Street.

2.3 Reference Project Operations

The railway infrastructure manager would operate the Reference Project and would hold all necessary approvals for operational safety, management, signalling and fleet management. Scheduling of services would be managed by the railway manager in consultation with TMR, under current governance arrangements.

The Reference Project would allow the sectorisation, or separation of different rail operations (i.e. express services and all-stops services) as well as separating freight services from the commuter services. Ultimately, the CRR Reference Project would accommodate up to 48 additional trains per hour (two-way) through the Brisbane CBD, creating a combined total throughput of 132 trains per hour. The Reference Project would lead to an increase in train paths. This increased capacity would relieve constraints in the network, such as the Merivale Bridge, and would enable additional passenger and freight services.

The Reference Project would accommodate Gold Coast, Beenleigh, Caboolture, Redcliffe and Sunshine Coast services, stopping at the new underground stations. This would allow all-stop passenger services and freight services to continue on the relieved surface tracks.

2.4 Reference Project Delivery

For the Reference Project, construction was anticipated to commence in 2015 and have a construction period of approximately five years.

2.4.1 Preliminary Works

The delivery of the Reference Project would require a range of preliminary activities including:

- community awareness and consultation about the project works, their duration and their scale
- relocation of existing services in areas likely to be affected by the project works
- detailed design – which would be ongoing to meet project requirements
- land acquisition for both surface and sub-surface land requirements
- the establishment of project worksites
- taking possession of sections of the surface rail network to establish and facilitate worksites and project works.

2.4.2 Worksites

The Reference Project would be a large and complex construction undertaking. Necessarily, works would progress across multiple worksites to achieve the program and cost efficiencies.

Worksites would be established in a number of locations across the inner city including:

- Mayne Yard – for surface works and track integration work
- RNA Showgrounds and O'Connell Terrace – for station upgrades and local road works
- Victoria Park – for the northern portal and track integration works

- Roma Street (several sites including parkland in Roma Street and vacant land in the Roma Street Parklands) – for the underground station
- Albert Street – for the underground station
- Woolloongabba (the Go Print site situated between Stanley Street and Vulture Street) for the underground station and for major tunnelling works
- Boggo Road (several sites in the Urban Village precinct) – for the underground station
- Fairfield for the ventilation and emergency access facility off Fairfield Road
- Yeerongpilly (several sites including Wilkie Street - for surface works, and a major site off Station Road for track integration works and major tunnelling works)
- Clapham Yard – for stabling works
- Moorooka – for station upgrades and track work
- Rocklea – for station upgrades and track work
- Salisbury – for station upgrades, local road works and track work.

2.4.3 Underground Works

Much of the tunnelling works would be undertaken by TBMs with a cutting diameter of 7.0m. This would accommodate the reinforced concrete segmented lining and leave a clear operational diameter of 6.0m.

There would also be short sections of tunnel on the approaches to the underground stations and the portals which would be constructed by a range of methods such as road-header, mining (drilling and blasting) and cut-and-cover. Underground works would progress on a 24hr/7 day basis, providing environmental management objectives could be achieved.

2.4.4 Construction Spoil

The underground works, as well as surface works, would generate a large quantity of construction spoil. The EIS for the Reference Project estimated a total spoil volume of approximately 1.4 million cubic metres[3] (in-situ). The bulk of the construction spoil would be generated by the bored tunnelling works, resulting in approximately 375,000m^3 to be removed via the Yeerongpilly worksite and approximately 437,000m^3 to be removed via the Woolloongabba worksite. Both worksites would be serviced by 214 heavy vehicle movements per day to meet the spoil removal requirement.

Lesser but still substantial volumes would be removed from the underground stations at Roma Street, Albert Street and Boggo Road. Of these, Boggo Road would generate the highest spoil transport need at 89 loads per day (peak generation).

2.4.5 General Construction

Construction of the Reference Project would generate a peak labour force requirement of 2,200 workers and generate approximately 1,600 full-time equivalent jobs.

Construction would proceed in shifts on a 24hr/7 day basis for underground work and spoil haulage. Surface works would generally be on a 12hr/6 day basis with extended work hours for particular circumstances including works within the railway corridor, delivery of oversized equipment and works that require continuous activity (e.g. concrete pours).

[3] 1.4M m^3 spoil (in-situ) is equivalent to approximately 3.4M tonnes.

3. Changes to the CRR Reference Project

3.1 Changes to the CRR Reference Project Design

There are a number of changes to the Reference Project that are the subject of this Request for Project Change. These changes are referred to as the Changed Project and are illustrated in Figure 3-1. The Reference Project is illustrated in Figure 3-2, while a comparison of the two project alignments is shown in Figure 3-3.

3.1.1 Changes to the Alignment

The alignment has been shortened significantly, so that the Changed Project now connects with the surface rail network near the existing station at Dutton Park in the south and with the existing surface rail network (Exhibition Line) near the Brisbane Girls Grammar School (BGGS) in the north. There would be new and realigned surface track through Mayne Yard to connect the Changed Project with the North Coast Line between Breakfast/Enoggera Creek and Albion Station.

There would be a change in the horizontal alignment of the route between Dutton Park and Woolloongabba to accommodate both the changed southern connection and maintain rail track grade requirements (maximum gradient of 3%). The route also changes between Woolloongabba and Albert Street to accommodate the track grade requirements and allow the tunnels to pass beneath the Brisbane River in the same location as the Reference Project in stable rock conditions.

North of the relocated Albert Street Station, the route changes to accommodate a new location for the Roma Street Station under the existing Brisbane Transit Centre (BTC) site. The route then moves further west before heading north beneath Countess Street and Hardgrave Park to connect with the surface rail network on the Exhibition Line. A single new track would be provided along the Exhibition Line from the northern portal into Mayne Yard. Two new tracks would pass through Mayne Yard to provide connections with the North Coast Line.

Figure 3-1 - Changed Project

Figure 3-2 - Reference Project (2011)

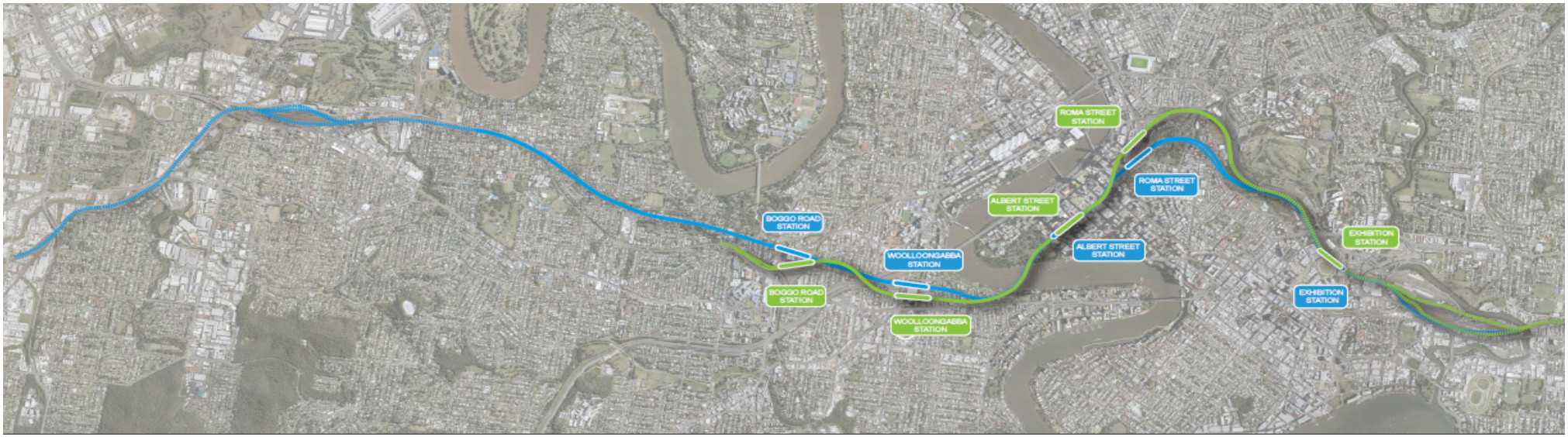

Figure 3-3 - Alignment Comparison - Reference Project (2011) shown as blue and Changed Project shown as green

3.1.2 The Stations

Stations south of Dutton Park

The proposed station at Yeerongpilly in the Reference Project is not proposed as part of the Changed Project, nor are upgrades to the Rocklea, Moorooka and Salisbury stations.

Boggo Road Station

The proposed station at Boggo Road would be relocated to land to the east of Joe Baker Street, partly within the existing rail corridor, to accommodate the changed connections and alignment at the southern portal. This station would serve as an interchange between the Gold Coast/Beenleigh Line and the Cleveland Line at Park Road Station. The Eastern Busway also interconnects with the rail network at Park Road Station and the changed Boggo Road Station. A new pedestrian connection from the proposed Boggo Road Station to the Princess Alexandra (PA) Hospital would be provided as part of the Changed Project. A conceptual illustration of the Boggo Road Station entry for the Changed Project is provided at Figure 3-4.

Woolloongabba Station

The proposed station at Woolloongabba would remain within the 'GoPrint' site albeit further to the east, and closer to the existing Landcentre building. A conceptual illustration of the Woolloongabba Station entry for the Changed Project is provided at Figure 3-5.

Albert Street Station

The proposed station at Albert Street would remain in Albert Street albeit further to the north-west to a location beneath Albert Street between Margaret Street and Elizabeth Street. The changed location of the Albert Street Station and the proposal to pedestrianise parts of Albert Street, in line with Brisbane City Council's (BCC) City Centre Master Plan 2014, would benefit from alternate arrangements for the southern exit of the Myer Centre car park. The exit would be removed and, if required, relocated to Charlotte Street between Albert Street and George Street. A conceptual illustration of the Albert Street Station entry for the Changed Project is provided at Figure 3-6.

Roma Street Station

The proposed station at Roma Street would be relocated to the site of the current BTC (West) building. The changed Roma Street Station would be at a similar depth to the Reference Project. The Transit Centre (West) building would be demolished to accommodate the changed Roma Street Station. A conceptual illustration of the Roma Street Station entry for the Changed Project is provided at Figure 3-7.

Exhibition Station

The location of the proposed Exhibition Station in the Changed Project is similar to the Reference Project. The station has a different configuration, however it would offer the same high levels of connectivity with the RNA Showgrounds, Bowen Hills and the Royal Brisbane and Women's Hospital as the Reference Project.

Dutton Park Station

Dutton Park Station would be upgraded for the Changed Project to include a third platform face to provide access to suburban train services. Under the indicative rail service plan, which is subject to change, CRR trains would run express to and from the new Boggo Road Station.

Figure 3-4 - Conceptual illustration of Boggo Road Station entry

Figure 3-5 - Conceptual illustration of Woolloongabba Station entry

Figure 3-6 - Conceptual illustration of Albert Street Station entry

Figure 3-7 - Conceptual illustration of Roma Street Station entry

3.1.3 Surface Works

The Changed Project would not provide additional tracks south of Dutton Park Station as was proposed in the Reference Project. Consequently, the surface roadworks previously required at Yeerongpilly, Rocklea and Salisbury to accommodate the new track and station upgrades would not be required for the Changed Project.

The Changed Project would require the reconfiguration of surface tracks between Mayne Yard and just north of Breakfast/Enoggera Creek. This work would occur within the existing rail corridor and would cross Breakfast/ Enoggera Creek via the existing rail bridge.

3.1.4 Portals

The Southern Portal would be relocated from Yeerongpilly in the Reference Project to Dutton Park in the Changed Project. The configuration of the Southern Portal for the Changed Project would involve two separate transitions, situated within the rail corridor between Railway Terrace and Kent Street. Both the northbound portal and the southbound portal would be situated to the east of Rawnsley Street.

In the Reference Project, the Northern Portal would be located in Victoria Park adjacent to the land bridge over the Inner City Bypass. In the Changed Project, the Northern Portal would be situated within the rail corridor (Exhibition Line), adjacent to the BGGS. The portal would combine both the northbound and southbound tracks and transition structures.

3.1.5 Feeder Stations

While the Reference Project would have three new feeder stations, the Changed Project would provide one new feeder station and an electrical sub-station.

The southern feeder station would be relocated from a site off Station Road, Yeerongpilly to a site on railway land between the freight overpass, the Beenleigh Line and Cleveland Line. It would be reconfigured to a smaller scale electrical sub-station.

The intermediate feeder station would be relocated from a site in Victoria Park for the Reference Project to land between the BCC temporary staging facility (Victoria Park) and the Exhibition Line. The land requirement on Victoria Park is reduced as a consequence of the change.

The northern feeder station required for the Reference Project, north of Lanham Street, is no longer required for the Changed Project.

3.1.6 Systems

The main rail systems for the Changed Project are the same as those proposed for the Reference Project. They comprise signalling, communications and train control.

European Train Control Systems (ETCS) Level 2 signalling would be provided in the Changed Project and include transitions between conventional and ETCS signalling where required. Upgrades to signalling at the southern and northern connections of the Changed Project would be provided to facilitate integrated train operations.

The ETCS – Inner City Project, to be procured separately, will deliver ETCS Level 2 technology within the existing inner city network between Milton and Northgate. The Changed Project would integrate the design development of ETCS in the tunnels with the ETCS – Inner City Project.

3.2 Changes to Delivery of the Project

Delivery, or construction, of the Changed Project would require approximately 5 years, as would the Reference Project. Delivery is assumed to be completed by 2023.

There are few changes in delivery methods between the Reference Project and the Changed Project.

3.2.1 Tunnelling changes

The key tunnelling construction changes between the Reference Project and the Changed Project are summarised as follows:

- the length of the twin tunnels has reduced, from approximately 10km to 5.9km
- the tunnels between Woolloongabba Station and Boggo Road Station would be mined instead of bored tunnels and would be on a different alignment
- the number of TBMs required for construction is reduced from four to two
- tunnelling operations for the main tunnels would commence from the Woolloongabba worksite resulting in the bulk of spoil material reporting back to that site, and the bulk of tunnel construction materials being delivered to that site.

In the context of this request for project change, bored tunnel construction involves the use of one or more TBMs. The TBMs proposed for both the Reference Project and the Changed Project would have a cutting diameter of 7 metres. Mined tunnel construction could involve the use of roadheader machines to construct different tunnel and cavern cross-sections and may involve drill and blast techniques. Cut-and-cover construction typically involves the excavation of material from an area supported by piling or other support structures, in preparation for the installation of a temporary or permanent cover. Further excavation could continue after installation of the cover, or 'lid' on the excavated area.

3.2.2 Changes to Portals and Worksites

Southern Portal

For the Changed Project, the Southern Portal would be north of Dutton Park Station, rather than at Yeerongpilly. Both portal structures for the southern connection would be situated across live rail tracks and would require temporary possessions of the corridor for their construction. Both would be constructed by a combination of excavation and drill and blast methods.

The worksite would be established on land between Kent Street and the rail corridor, extending around to Ipswich Road. Primary access to this worksite would be from Ipswich Road, opposite the intersection with O'Keefe Street and adjacent to the Eastern Busway viaduct. A secondary access, for light vehicles and workers vehicles, would be off Annerley Road via Kent Street.

Northern Portal

For the Changed Project, the Northern Portal would be located entirely within the Exhibition Line rail corridor adjacent to the BGGS to minimise direct impacts to Victoria Park. The Northern Portal would be an open construction employing a combination of excavation and drill and blast methods.

Construction works for the Northern Portal would be supported by a worksite occupying the Exhibition Line rail corridor and a small area in Victoria Park adjacent to and including the BCC temporary staging facility. Access to this worksite would be consistent with the Reference Project and would be via the rail corridor and from a two-way entry point off Bowen Bridge Road. A secondary access road from Gregory Terrace would also be provided, consistent with the Reference Project.

3.2.3 Changes to Stations and Worksites

There would be some changes in the method of constructing some underground stations, which would have the potential for different environmental effects on adjacent properties.

Boggo Road Station and Worksites

Apart from the changed location of the Boggo Road Station, the method of construction would remain a cut-and-cover method extending to include tunnels for rail connections to the surface network and a pedestrian tunnel connecting the station with the PA Hospital campus. These cut-and-cover tunnel sections would require temporary possessions of the live rail corridor.

The area involved in cut-and-cover works would be slightly larger than that required for the Reference Project.

The worksite configuration would change to be situated on Lot 2 on Joe Baker Street.

A small worksite with worker parking would be established adjacent to the Park Road Railway Station on land situated between Quarry Street and Merton Road.

Woolloongabba Station and Worksite

Apart from the changed location and configuration of the Woolloongabba Station, there would be no change to the proposed cut-and-cover method of construction for the station box. Parts of the station would also be mined as was proposed for the Reference Project.

Construction planning for the changed station anticipates the demolition of the Landcentre building, GoPrint and the Dental Hospital. This would open up the entire area bounded by Stanley Street, Leopard Street, Vulture Street and Main Street to construction worksite activities. Access would include left-in, left-out arrangements to Ipswich Road, egress to Leopard Street, and a combination of ingress and egress arrangements with the South East Freeway ramp and Vulture Street. These access arrangements to Vulture Street are similar to those for the Reference Project.

The TBMs would be launched from this worksite, within an acoustic shed, to progress to the north. The location of the workshed would be slightly to the east of that proposed for the Reference Project. Mining operations would also be launched from within the acoustic shed on the Woolloongabba worksite for the tunnels to the south to Boggo Road Station.

Albert Street Station and Worksite

The Albert Street Station for the Reference Project was proposed to be constructed mostly through mined cavern work deep beneath the street, supported by cut-and-cover shafts on adjoining land on Alice Street and on Mary Street.

The Albert Street Station for the Changed Project would be constructed from a central shaft established by cut-and-cover methods. Mined caverns would be constructed between Margaret Street and Mary Street and between the central shaft near Mary Street and Elizabeth Street. For the Changed Project, the cut-and-cover work would be adjacent to properties between Elizabeth Street and Mary Street. Works for the Changed Project would require the closure of part of Albert Street.

The worksite for the changed station in Albert Street would require occupation of Albert Street near its intersection with Mary Street, as well as property either side of the street. There would be an acoustic shed erected over the shaft at the southern end of the cut-and-cover construction. Access to the worksite would be from Albert Street, at the intersection with Mary Street.

Roma Street Station and Worksites

For the Reference Project, the Roma Street Station was proposed to be constructed mostly as a mined cavern supported from three deep shafts constructed by cut-and-cover methods. For the Changed Project, the station would be a large central cut-and-cover construction with mined caverns extending to the south-east and north-west along the changed alignment.

Construction of the Roma Street Station for the Changed Project would also require the demolition of the BTC (West Tower).

The changed worksite would be provided with an acoustic shed over the cut-and-cover shaft supporting the mined cavern construction and station works. The worksite for the Changed Project would include a section of the Inner Northern Busway and Roma Street busway station.

Worksite access would be provided from Roma Street via a two-way point adjacent to the Inner Northern Busway entry (near Countess Street), as well as a left-in, left-out arrangement further east (opposite Makerston Street).

Similar to the Reference Project, a secondary worksite would be established off Parkland Boulevard primarily for workforce car parking with access off College Road.

A further worksite for laydown and storage purposes would also be established at the platform 10 car park, off Parkland Boulevard. This site was identified as a major construction worksite for the Reference Project.

Exhibition Station and Worksite

The worksite for the Exhibition Station would be in a similar location but of a reduced scale compared to the Reference Project. There would be a changed approach to the construction of the rail track beneath O'Connell Terrace so that the realignment and raising of O'Connell Terrace would no longer be required (as proposed for the Reference Project).

Other Worksites

The Changed Project would require a worksite within the northern part of the Mayne Yard complex. This worksite is similar to, but slightly larger than that proposed for the Reference Project. There would be no requirement for a worksite for track connection works on or beyond the Breakfast/ Enoggera Creek rail bridge.

The proposed construction site plans are illustrated in the Reference Design Drawings (Volume 3).

3.2.4 Changes to Spoil Handling and Placement

In response to a requirement of the Commonwealth Department of the Environment, the Reference Project proposed to collect construction spoil and transport it by road to a placement site at Swanbank, approximately 36km to the south west. This would require a round trip of approximately 72km from most of the Reference Project worksites.

The quantity of spoil generated by the Changed Project (0.97 million m^3 in-situ) would be less than anticipated for the Reference Project (1.4 million m^3 in-situ) due to the shortened tunnel length (refer to Table 3-1).

Table 3-1: Estimated Spoil Quantities

Worksite Location	Reference Project spoil quantity (volume m^3)	Changed Project Spoil quantity (volume m^3)[4]
Southern Portal	Yeerongpilly 375,000 Ventilation shaft/building 11,500	Near Dutton Park Station 39,000
Boggo Road Station	155,000	119,000
Woolloongabba Station	437,000	470,000
Albert Street Station	190,000	135,000
Roma Street Station	161,000	112,000
Northern Portal	96,000 (Victoria Park)	65,000 (Exhibition Line corridor)
Mayne Yard	-	36,000
Total	**1,400,000**	**976,000**
Estimated Trucks (Loads)[5]	**112,000**	**77,600**

While the Reference Project proposed that all construction spoil be placed at Swanbank, the Changed Project proposes that construction spoil be placed at one or more of five sites, including:

- *Brisbane Airport* - landside development site identified in the Brisbane Airport Masterplan for general industry uses
- *Swanbank*, Swanbank Road - an area of long-term land reclamation of exhausted open cut coal mines
- *Pine Mountain,* Pine Mountain Road - former quarry intended to be rehabilitated
- *Larapinta*, Paradise Road - sites previously used for sand extraction from the floodplain for Oxley Creek which feeds into the Brisbane River. The sand pits are currently open and if used, could be rehabilitated
- *Port of Brisbane*, Port Drive - site identified for future expansion and currently subject to ongoing reclamation works under an approved management plan.

These five spoil placement sites are based on general availability, size of the land, retention of environmental values, haul route length and proximity to sensitive receivers.

Although these five sites are now proposed, not all sites would be used for spoil placement, with contingency provided to cater for commercial or environmental drivers at the relevant time. Following detailed design, the contractor will have firmer details as to the quantity of spoil, its rate of excavation or production, and how it will be placed at any of the nominated spoil placement sites.

The approval to use spoil sites, including any Commonwealth approvals for placement of spoil, will not be sought as part of the current State environmental assessment. If required, approvals would be sought by the relevant entity prior to placement.

Spoil and material would be transported from the work sites on pre-determined, designated haulage routes. The objective of these routes is to facilitate construction in a manner that is efficient and with a minimum of disruption and inconvenience to the public. Short routes on arterial roads have been selected in the attempt to avoid residential areas. The proposed spoil haulage routes are:

- Brisbane Airport site - the proposed spoil truck routes vary depending on the origin worksite but would generally make use of CLEM7, Airport Link, East-West Arterial Road, Airport Drive, Lomandra Drive and Sugarmill Road.
- Swanbank site - spoil haulage from the worksites would be primarily via Ipswich Road and Ipswich Motorway for worksites south of the Brisbane River or via ICB, Milton Road/Legacy Way, Western Freeway and Centenary Highway for worksites north. Both routes would continue on to Ipswich Motorway, Cunningham Highway and Swanbank Road.

[4] The same assumptions identified in the Reference Project EIS have been adopted here with reference to a 1.5 bulk factor.
[5] Assumed truck load of 30 tonnes, with a load factor of 2.4 tones / m^3 in-situ material.

- Pine Mountain site - spoil haulage would follow:
  - Southern Portal, Boggo Road and Woolloongabba worksites: via Ipswich Road, O'Keefe Street, Old Cleveland Road, Creek Road and Pine Mountain Road;
  - North of the Brisbane River worksites: via ICB, Hale St, Riverside Expressway, Vulture Street, Ipswich Road, O'Keefe St, Old Cleveland Road, Creek Road and Pine Mountain Road.
- Larapinta site - spoil haulage would follow:
  - ICB, Legacy Way, Western Freeway, Centenary Highway, and Logan Motorway; and
  - Pacific Motorway, Logan Road, Gateway Motorway and Logan Motorway.
- Port of Brisbane - spoil haulage would follow:
  - Ipswich Road, O'Keefe Street, Old Cleveland Road, Gateway Motorway and Port of Brisbane Motorway; and
  - Riverside Expressway, Vulture Street, Wellington Road, Wynnum Road, Lytton Road and Port of Brisbane Motorway.

3.3 Commissioning

As part of the completion of the Changed Project, a program of testing would be undertaken over a commissioning phase. The commissioning phase would test the project elements individually, as coordinated systems and as an overall project wide system. Commissioning would test the functionality, operation and integration with the existing systems and procedures of key stakeholders including QR and the Queensland Fire and Emergency Services.

As the Changed Project is a new part of an existing railway network there is considerable new infrastructure, mechanical and electrical equipment, fire and life safety systems and rail systems that would need to be integrated into the existing network and tested for functionality. These requirements are consistent with the Reference Project with the exception of the integration of the new ETCS and associated systems and signalling as discussed in Section 3.1.6.

3.4 Environmental Management Framework

The environmental management framework for the Reference Project is proposed to be updated to reflect the Changed Project.

The Changed Project would be designed and implemented in accordance with the changed approach to environmental management. This approach entails:

- environmental design requirements
- environmental management requirements in project delivery
- application of existing environmental protocols and procedures for the operating rail network.

The environmental management framework for the Changed Project is set out in the updated Draft Outline EMP (Volume 2). The Draft Outline EMP would inform the development of changed conditions on the Changed Project, should the Coordinator-General recommend it proceed.

3.4.1 Environmental Design Requirements

The environmental design requirements for the Changed Project are set out in the Draft Outline EMP. These requirements are intended to achieve environmental outcomes for the Changed Project in its operational mode, by avoiding where possible and otherwise minimising and managing environmental impacts. The environmental design requirements address potential operating effects of the Changed Project on the receiving environment including the local transport network, groundwater, ground settlement, noise and vibration, air quality, cultural heritage, landscape and visual amenity, land use, social, climate change and sustainability.

Since the development of the Reference Project, CRR has registered with the Infrastructure Sustainability Council of Australia (ISCA) and it is proposed that the Changed Project seek an Infrastructure Sustainability Rating (Design).

3.4.2 Environmental Management Requirements

The environmental management requirements for delivery of the Changed Project adopt a performance-based approach intended to minimise and manage the effects of construction on the receiving environment while facilitating the timely and efficient delivery of the Project.

Due to the highly urbanised setting of some of the Changed Project worksites, the project works in some locations would occur in closer proximity to sensitive receivers than anticipated for the Reference Project. Consequently, without a flexible and responsive approach to construction planning and environmental management, there would be an increased potential for intrusive construction effects on those receivers.

In combination with the environmental design requirements, the environmental management requirements for delivery of the Changed Project are intended to support the continuation of daily activity adjacent to worksites while construction proceeds as efficiently as possible. The environmental management requirements for the Project are provided in the Draft Outline EMP.

3.4.3 Existing Environmental Procedures

In its operational mode the Changed Project would be governed by the environmental, workplace health and safety, and other systems requirements of the rail network rail infrastructure manager. These systems and requirements would be subject to periodic review by the rail infrastructure manager.

The environmental design requirements set out in the Draft Outline EMP are intended to achieve the environmental requirements of the rail infrastructure manager.

4. Reasons for the Proposed Changes

4.1 Technical Investigations

Technical investigations undertaken since the Reference Project, including for the Bus and Train (BaT) Project, identified opportunities to achieve a more affordable solution that meets demand forecasts and responds to community feedback. Notable changes resulting from this work include:

- Reducing the length of tunnel to achieve better affordability, to meet new demand forecasts and to reduce community impacts (e.g. property requirements and construction impacts).
- Retaining the southern CBD station in Albert Street, further to the north, to enable a simpler station layout and construction as well as support Brisbane City Council's vision for Albert Street.
- Retaining and simplifying the northern surface connection to provide additional capacity in support of strong growth in demand from the north, by incorporating an underpass (trough structure) and an at-grade solution in Mayne Yard for easier construction and reduced impacts on operating rail lines.
- Relocating the Boggo Road Station and refining track integration to accommodate recent and proximate urban development, to strengthen the station's role as a multimodal interchange, to provide for a dedicated pedestrian connection to the PA Hospital, and to reduce the potential impacts on the Boggo Road Gaol and the Ecosciences precinct.

4.2 Changes in Transport Demand

Since investigations for CRR commenced in 2008, the trend growth in rail patronage temporarily slowed due to factors such as fare policy, slower inner-city employment growth and ongoing investments in road and busway projects.

Since 2013, rail patronage has increased and demand to 2026 is expected to be more reflective of pre-2009 rates as population and employment growth continues, patronage grows on the new Redcliffe Peninsula Line, New Generation Rollingstock (trains) comes online, and the Gold Coast Light Rail Stage 2 project is completed.

With revised fares and travel zones for South East Queensland (SEQ) commencing in January 2017, further increases in public transport patronage growth are expected. Transport modelling undertaken for the Changed Project shows that rail demand across the region is predicted to grow as follows:

- 2015: 177,200 average daily rail users
- 2026: 368,800 average daily rail users
- 2036: 511,700 average daily rail users.

Based on these demand forecasts, the existing capacity of some parts of the inner-city rail network will be exceeded by 2021 and progressively worsen. Without additional infrastructure through the inner-city, it would not be possible to service growth in demand, nor could the rail network expand into new growth areas. As passenger demand increases toward the limit of available network capacity, service reliability would be affected and trains would operate in increasingly overcrowded conditions.

Table 4-1 shows the predicted impact on two key areas in the network – capacity across the Brisbane River from the south, and in the northern corridor. By 2036, forecast peak-hour demand will exceed existing capacity by 71% to the south and 130% to the north.

Table 4-1: Forecast peak-hour demand and capacity (trains inbound per hour)

Location	Peak hour capacity without CRR[7]	2021 peak hour demand	2026 peak hour demand	2036 peak hour demand
Southern lines[8]	24	26	29	41
Northern lines[9] (north of Albion)	20	22	32	46

4.3 Reduce Impacts on Sensitive Receivers

The consultation processes accompanying the Reference Project EIS and the BaT project EIS (2014) identified a range of community concerns regarding valued places and amenities. For the Reference Project, the issues raised in submissions and during subsequent consultation related to:

- property impacts (land requirements in Yeerongpilly, Boggo Road Urban Village and Victoria Park)
- impacts on heritage places (Victoria Park, Roma Street Station, Emma Miller Place and Boggo Road Gaol)
- impacts on land use and amenity (Yeerongpilly residential and industrial, Dutton Park residential and Boggo Road urban village, Roma Street parklands apartments, recreational values of Victoria Park, Centenary Aquatic Centre and the RNA Showgrounds)
- construction impacts – general construction (hours of work), air quality; noise and vibration; construction traffic; groundwater drawdown and possible settlement; workforce car parking; changes to accessibility and connectivity for the PA Hospital, Roma Street, Albert Street, and Victoria Park
- operational impacts – noise from surface rail freight operations, car parking (Yeerongpilly station), and pedestrian traffic near CBD stations.

For the BaT (2014) project, community concerns were raised in relation to:

- impacts on Victoria Park (land requirements, landscape and recreation opportunities, heritage – historic and cultural, environmental – air quality from bus emissions, noise, vegetation loss)
- impacts on community infrastructure (PA Hospital, Centenary Aquatic Centre, Brisbane Girls Grammar School, Dutton Park State School)
- impacts on near neighbours (residential buildings – Gregory Terrace, George Street, Mary Street, Rawnsley Street and Railway Terrace; special purpose buildings – Leukaemia Foundation at Peter Doherty Street, St Nicholas Russian Orthodox Cathedral on Vulture Street; commercial and government offices – George Street, Stanley Street and Vulture Street
- impacts on heritage values (George Street historic precinct, Victoria Park)
- impacts on the use and amenity of land adjacent to the Southern Portal (construction impacts – noise, air quality, construction traffic, disruptions to connectivity, loss of amenity, public safety particularly adjacent to the PA Hospital and Dutton Park State School; operational impacts – air quality, noise and vibration, loss of Dutton Park Station – since resolved).

The Changed Project would address and resolve many of these issues. In particular, the reduction in length and change in alignment of the Changed Project would avoid the major impacts on:

- sensitive places and receivers south of Dutton Park including those in Yeerongpilly
- heritage places at Boggo Road, Roma Street and Victoria Park
- residential and industrial properties at Yeerongpilly and residential properties at Roma Street parklands
- the recreation values of Victoria Park as well as the Centenary Aquatic Centre.

[7] Excludes capacity provided by the proposed ETCS - Inner City Project for the northern line
[8] Gold Coast, Beenleigh, and Cleveland Lines
[9] Sunshine Coast and Redcliffe Peninsula Line – main lines

The effects on properties adjacent to the stations and portals are addressed in section 5 of this request for project change.

4.4 Changes to Freight

Passenger and freight trains currently share the same tracks on parts of Brisbane's metropolitan rail network, including between Dutton Park and Salisbury stations. This restricts rail freight operations during passenger peak hours and limits opportunities to increase off-peak passenger service frequencies.

The Reference Project proposed to provide passenger rail services in tunnels north of Yeerongpilly and provided additional surface tracks from Yeerongpilly south to Salisbury, freeing up track capacity for freight trains to operate at all times of the day. This provided additional capacity for the rail freight network to meet higher freight volumes through the corridor.

The need for a dedicated freight track in this corridor is driven by forecast freight demand. Rail freight demand forecasts for the Reference Project anticipated strong growth in the corridor. These forecasts have now been revised downward. Investigations undertaken for the Changed Project demonstrate that forecast freight demand can be accommodated within the existing rail network. Existing demand for freight through the Yeerongpilly section is around 50% of available capacity (train paths). Consequently, the number of rail freight movements could double before additional capacity is required.

The Changed Project would retain the existing combination of surface tracks for passenger and freight services south of Dutton Park Station. Reflecting current operations, freight trains would be constrained in operating in the corridor during peak passenger periods and the corridor generally sustains the existing capacity for freight trains that exist without the Project.

4.5 Economic Benefits

The key strategic benefits of the Changed Project are consistent with those of the Reference Project, and include:

- an additional rail crossing under the Brisbane River near the Brisbane CBD
- more railway capacity to significantly increase rail services across the SEQ network and expand the rail network into new areas
- less-congested roadways
- city-building opportunities at Woolloongabba, the Brisbane CBD and Bowen Hills.

The economic opportunities which have changed for the Changed Project primarily relate to the overall construction task being smaller due to the exclusion of works south of Dutton Park Station, reducing the cost, resources and labour required.

4.5.1 Changes to Cost Benefit Analysis

The key assumptions used for the cost-benefit analysis (CBA) for the Reference Project and the Changed Project are presented in Table 4-2.

Table 4-2: Economic appraisal assumptions

	Reference Project	Changed Project
Discount rate (based on Infrastructure Australia)	A central rate of 7% (real) Sensitivities at 4% and 10 %	A central rate of 7% (real) Sensitivities at 4% and 10 %
Price year	2010	2015
Evaluation period	30 years of benefits post construction	30 years of benefits post construction

A comparison of the CBA for the Reference Project and the Changed Project is provided in Table 4-3.

Table 4-3: Comparison of CBA (Reference Project and Changed Project)

	Reference Project	**Changed Project**
Estimated cost of delivery	$8.9b (2010)	$5.4b (2015)
Benefit Cost Ratio (BCR)	1.42	1.41
Net Present Value (NPV)	$2,345m	$1,877m
Estimated no. of jobs per annum	Construction - 1,600 Full-time equivalents (FTEs) Post-construction - 230 FTEs[10]	Construction - 1,547 FTEs Post-construction - 576 FTEs
Wider Economic Benefits	$1,176m	$1,209m

Like the Reference Project, the Changed Project would enhance connectivity between major residential growth areas (e.g. Ipswich, Gold Coast, Sunshine Coast and Logan) and key employment hubs, particularly Brisbane's inner city. It would position Brisbane and the broader region for a more sustainable and competitive future through supporting a more compact urban form, vibrant inner-city centre and connected region. The Project remains an important step in managing SEQ's population growth, driving economic prosperity, and catalysing urban renewal around new station precincts.

The increased rail network capacity provided by the Project has the potential to benefit the entire region, not just within the transport corridor. In line with the Reference Project, economic benefits, including wider economic benefits, are forecast for SEQ and more broadly the Queensland and Australian economies.

Overall, the Changed Project would continue to provide positive project economic benefits, support construction and operational employment and provide wider economic benefits including productivity gains. The Changed Project is also delivered at a significantly reduced cost compared to the Reference Project.

[10] Excludes indirect jobs.

5. Effects of the Proposed Changes on the Reference Project – Design

5.1 Property

At the time of its EIS assessment, the Reference Project identified a total of 412 properties that would have been impacted by a whole or partial acquisition. Of these, 108 properties were required for surface works and 304 were for volumetric acquisition for underground tunnels and stations.

There is a substantial reduction of property acquisitions required for the Changed Project, with a total of 224 properties, comprising 29 properties required for surface works and 195 required for volumetric acquisition for underground tunnel and station works.

Surface acquisitions of commercial/industrial sites have reduced from 60 to 15, surface acquisition of residential sites have reduced from 39 to zero and volumetric acquisitions for residential sites have reduced by 94.

A breakdown of surface and volumetric property requirements by land use type is provided in Table 5-1. Overall, this indicates that there are less properties (both at surface and below) that require acquisition for the Changed Project compared to the Reference Project, mainly due to the reduced tunnel length.

Table 5-1: Number of properties[11] required by land use type

Property Acquisition – Land Use Type	Reference Project (2011)*	Reference Project (2017)**	Changed Project
Surface Acquisition – number of properties			
Residential	39	44	0
Commercial/industrial	60	60	15
Other (park, showground, and so on)	9	12	14
Total properties requiring surface acquisition	108	116	29
Volumetric Acquisition – number of properties			
Residential	235	244	141
Commercial/industrial	50	43	38
Other (park, showground, and so on)	19	19	16
Total properties requiring volumetric acquisition	304	306	195
Total properties requiring acquisition	**412**	**422**	**224**

* - Property numbers based on ownership, development and uses of properties as at July 2011

** - Property numbers based on ownership, development and uses of properties as at February 2017

5.2 Transport Network

Since assessment of the Reference Project, the transport models have been updated to reflect changes in demography, transport planning and network changes, and new electronic ticketing data. The transport models have also been calibrated to reflect revised commencement years and revised planning horizons.

For the purposes of this assessment, the revised transport model has been applied to the Reference Project infrastructure and the Changed Project infrastructure. This enables a direct comparison of the

[11] Property numbers exclude existing roads, busways and railway properties.

effects of the changes to the Reference Project in relation to transport patronage and other network considerations. The revised transport model incorporates new demographic forecasts and the new fares and travel zones. For the Changed Project, it also takes account of the ETCS – Inner City Project.

The indicative service plans (as included in the transport model) for the Reference Project and the Changed Project are provided as Figure 5-1 and Figure 5-2.

For the Reference Project in 2021, 102 trains would pass through the CBD with 47 services approaching the CBD from the north, 19 from the west and 36 services from the south and east. Of the 36 trains from the south and east, 17 would travel via the CRR tunnel.

For the Changed Project in 2026, 104 trains would pass through the CBD with 50 services approaching the CBD from the north, 20 from the west and 34 services from the south and east. Of the 34 trains from the south and east, 18 would travel via the CRR tunnel.

Overall, there would be a similar number of peak hour train services through the CBD at opening year with the Changed Project, compared with the Reference Project. There would be a small redistribution of services on other lines in response to changes in demography and demand.

Compared with the Reference Project, the Changed Project would see an increase in the number of passenger trains running at surface in the section between Yeerongpilly Station and Dutton Park Station since this would no longer be running in tunnel. The increase in passenger trains on the surface would be within the capacity of the existing surface infrastructure.

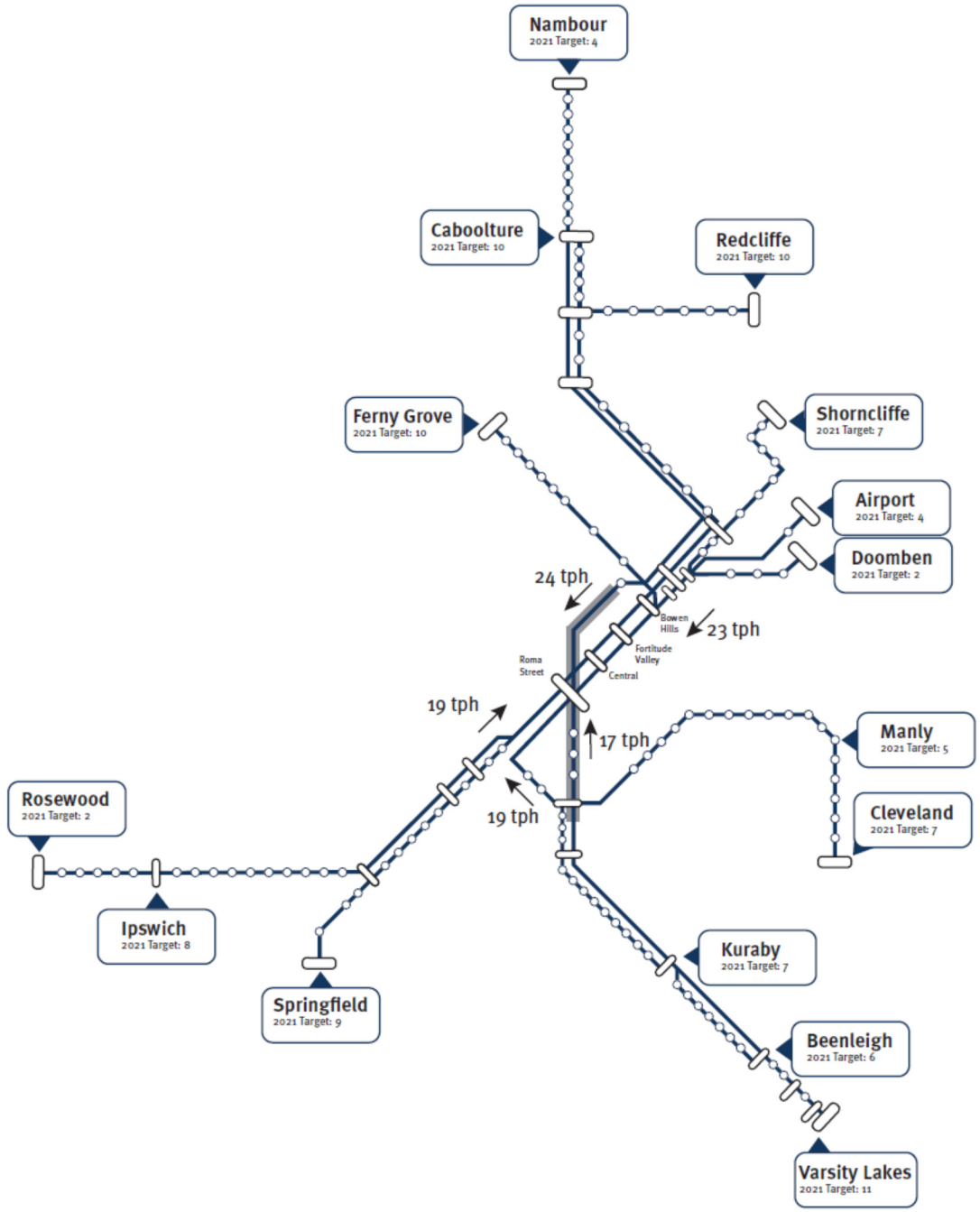

Figure 5-1 - Reference Project indicative rail service plan (2021 AM peak 1hr)

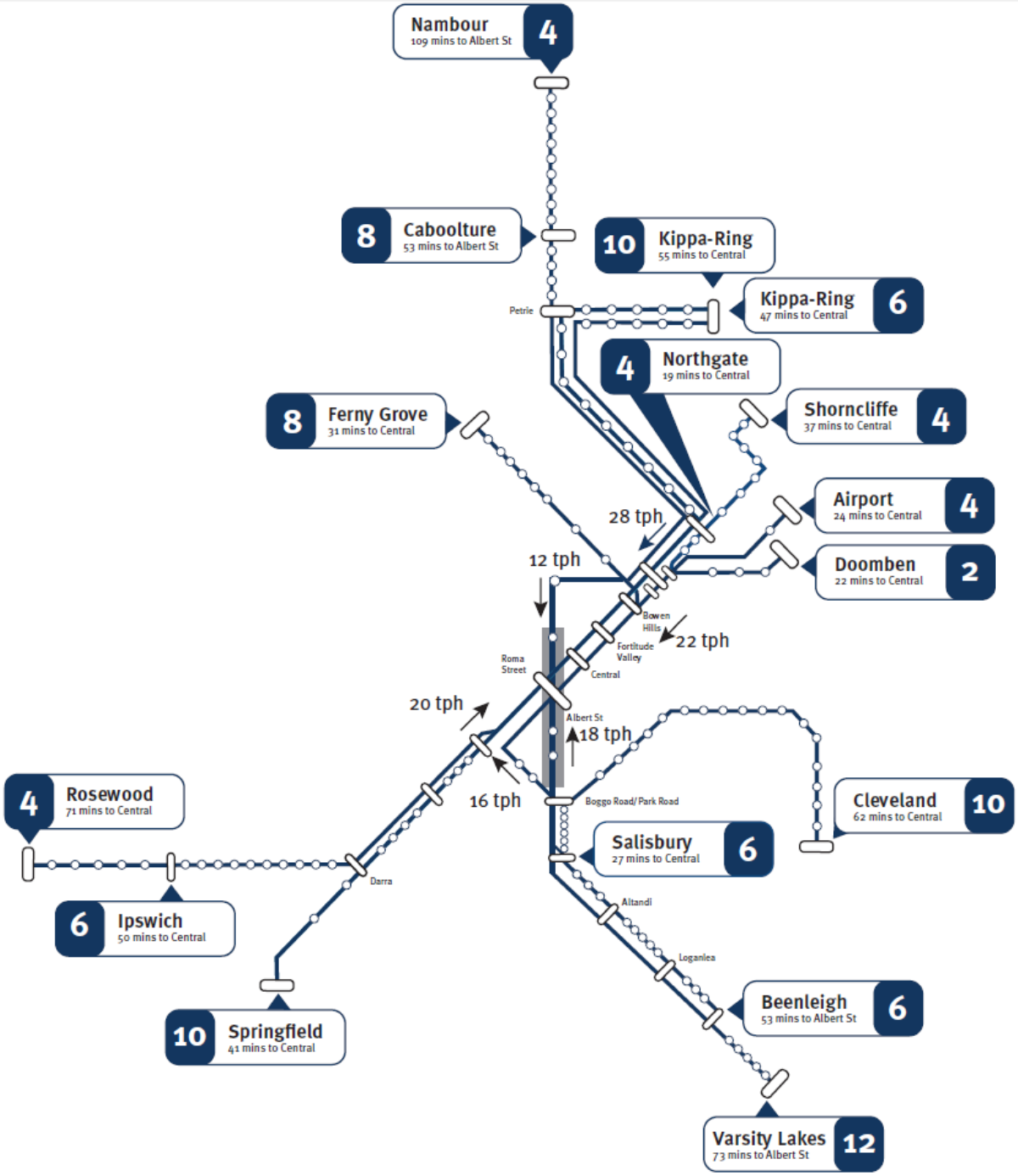

Figure 5-2 - Changed Project indicative rail service plan (2026 AM peak 1 hr)

5.2.1 Effects on Passenger Rail Patronage

The change in forecast passenger rail patronage in the AM peak period across the Brisbane metropolitan area, due to the Changed Project, is summarised in Table 5-2.

Table 5-2: Rail patronage (AM Peak) without and with Reference Project and Changed Project

2026 AM peak period	Without CRR	With Reference Project	With Changed Project	Difference Changed Project to Reference Project
Total rail patronage	104,000	109,400	110,100	0.6%
Change in patronage		5.2%	5.9%	

With the implementation of CRR, there will be a substantial improvement in the role of public transport as a preferred mode, particularly for journeys to work, across the Brisbane metropolitan area. With the Changed Project, there would be substantially the same forecast rail patronage as with the Reference Project.

The anticipated distribution of weekday trips across the transport network is presented in Table 5-3.

Table 5-3: Average weekday trip changes with and without the Reference Project and the Changed Project

Parameter	2015	2026			Difference Reference Project to Changed Project
		Without CRR	With Reference Project	With Changed Project	
Total person trips by car	6,354,000	7,210,000	7,207,000	7,203,000	-0.1%
Public transport trips	514,000	875,000	881,000	884,000	0.3%
Public transport mode share	6.8%	9.8%	9.8%	9.9%	1%
Total rail patronage	177,000	369,000	386,000	387,000	0.3%

The AM peak movement of passengers through the new CRR stations is illustrated in Table 5-4. The forecast throughputs at the Changed Project stations are similar to those for the Reference Project with the exception of Albert Street and Roma Street. This variation relates to revised rail service planning assumptions which distribute rail services differently through the CBD rail stations; higher patronage is seen at Central Station in the Changed Project. There is potential for increased service levels (e.g. beyond 2026) through the Changed Project infrastructure, which would more closely reflect the Reference Project's passenger throughputs, with future iterations to rail service plans.

Table 5-4: CRR station AM peak passenger throughput - 2026

CRR station	Reference Project	Changed Project
Boggo Road	5,900	5,400
Woolloongabba	4,300	3,500
Albert Street	23,200	17,700
Roma Street	16,800	10,500
Exhibition	3,200	2,800

5.2.2 Effects on Bus Patronage

Transport modelling indicates a growth in passenger rail trips at a faster rate than passenger bus trips across the Brisbane metropolitan area between 2015 and 2026, without the implementation of CRR. This growth trend, particularly with regards passenger rail trips, is forecast to continue to 2036.

Table 5-5: Forecast rail and bus trips 2015 to 2026 - Brisbane metropolitan area

Average weekday (24 hours)	2015	2026	Growth
Total rail trips	177,200	368,800	108%
Total bus trips	321,600	509,800	59%

Changes in anticipated bus patronage across the Brisbane metropolitan area for the Changed Project compared with the Reference Project would be minimal and are summarised in Table 5-6.

Table 5-6: Bus patronage 2026

Average weekday (24 hours)	Without CRR	With Reference Project	With Changed Project	Difference Changed Project to Reference Project
Total bus trips	509,800	509,800	508,400	-0.3%

The transport modelling for the Changed Project assumes only minor modifications would be made to the bus network in the 'with Changed Project' scenario. These changes are less extensive than those adopted in the assessment (2011) of the Reference Project for bus/rail interchange opportunities across the public transport network.

The Changed Project offers a significant opportunity to progressively reorient targeted bus corridors, where there is a customer benefit, to more effectively feed buses to the rail network at key locations. This opportunity will be investigated further as the Project progresses.

5.2.3 Effects on the Road Network

The likely effects of the Changed Project on the road network have been compared with those forecast for the Reference Project, on a with- and without-project basis. The findings of this comparison are presented in Table 5-7 and are considered insignificant.

The pattern of forecast changes in traffic volumes with the Changed Project is similar to those forecast with the Reference Project.

Table 5-7: Total vehicle trips (average weekday) 2026

Average weekday	2026 Without CRR	2026 With Reference Project	2026 With Changed Project	Change
Total vehicle trips	5,285,000	5,282,000	5,279,000	0.1%

At a regional level, the Changed Project would not lead to a significant reduction in traffic volumes across the road network. There would be likely reductions in vehicle volumes and consequently, kilometres travelled, fuel used and emission produced, on some key road links. This outcome would be consistent with the effects of the Reference Project.

5.2.4 Changes to Rail Freight Operations

Forecast growth in freight demand, during the first 10 years of operation of the Changed Project, would not be as strong as indicated in the scenarios modelled for the Reference Project. Previous modelling for the Reference Project anticipated the number of freight movements on the North Coast

Line at opening year was expected to reach 264 movements a week compared to 114 freight movements a week for the revised scenario for the Changed Project. Table 5-8 provides a comparison of the freight demand forecasts for the Reference Project and the Changed Project.

Table 5-8: Forecast freight demand

Location	Freight Rail Demand (average per week, both directions)		
	2015	Reference Project 2021	Changed Project 2026
North Coast (Total)	**90**	**264**	**114**
Including Salisbury – Tennyson (Intermodal)	40	172	48
Tennyson to Port (Total)	**154**	**275**	**223**
Tennyson – Port (Intermodal)	16	78	19
Tennyson – Port (Coal)	138	197	204

The decrease in freight movements reflects the changing demand, particularly a reduction in intermodal trains on the North Coast Line. This may change in the future with the development of Inland Rail.

Rail freight demand is variable due to the influence of a range of external factors. A number of alternatives to meet increasing rail freight demand have been considered. The Australian Rail Track Corporation (ARTC) has identified possible upgrades to the existing rail corridor extending to the Port of Brisbane that could progressively improve freight capacity. Long-term planning by others has identified a possible rail freight connection in a new corridor to the Port of Brisbane. This would provide for rail freight demand well into the future and free up existing track to meet growth in forecast passenger demand.

5.2.5 Effects of Changes on Local Transport Network

Changes to local traffic, pedestrian and cycle impacts

The reduced scale of the Changed Project would cause an overall reduction in impacts on local traffic, pedestrian and cycle movements compared to the Reference Project. Local road reconfigurations and impacts south of Dutton Park Station would no longer be required, resulting in reduced overall operational transport impacts in this area. In other areas, the likely impacts are generally consistent with, or lower than those anticipated for the Reference Project, although in some different locations.

The assessment of changes to local traffic, pedestrian and cycle networks is based on changes to the Reference Project design and the forecast patronage at the new stations (at year of opening), as illustrated in Table 5-9.

Table 5-9: Forecast AM peak passenger movements and mode of access

	Reference Project[12]			Changed Project		
	Car / Walk / Cycle	Transfer (Bus & Rail)	Total	Car / Walk / Cycle	Transfer (Bus & Rail)	Total
Boggo Road Station	900	5,000	5,900	700	4,700	5,400
Woolloongabba Station	1,900	2,400	4,300	1,700	1,800	3,500
Albert Street Station	22,900	300	23,200	17,500	200	17,700
Roma Street Station	5,100	11,700	16,800	3,600	6,900	10,500
Exhibition Station	2,500	700	3,200	2,300	500	2,800

Stations south of Dutton Park Station

With the Changed Project not extending south of Dutton Park Station, local road reconfigurations and impacts between Salisbury and Dutton Park would no longer be required. There would be an overall consequential reduction in operational transport impacts at these locations. In particular, impacts identified for the Reference Project on Wilkie Street and other local roads around the proposed Yeerongpilly Station and Southern Portal would no longer occur.

While no works are proposed as part of the Changed Project, further detail on supporting projects south of Dutton Park Station is provided in Chapter 1 (Introduction).

Dutton Park Station

To accommodate the upgrade of Dutton Park Station, there would be no changes to existing pedestrian access at the station or surrounding road networks.

Boggo Road Station

For the Reference Project, the Boggo Road Station was proposed to be located between Boggo Road Gaol and the Ecosciences building. In the Changed Project, the Boggo Road Station would be relocated to a site to the east of Joe Baker Street in order to integrate with the existing Park Road Station and Eastern Busway.

The key local transport effects of the new station location include:

- replacing existing on-street parking to provide taxi bays and passenger loading bays on Joe Baker Street
- connecting the proposed station with the Park Road Station and Boggo Road Busway Station
- connecting the proposed station with the Boggo Road Urban Village via a new pedestrian crossing of Joe Baker Street
- providing pedestrian access from the station to the PA Hospital.

Woolloongabba Station

The location of the Woolloongabba Station for the Changed Project would move from the western end of the GoPrint site to its eastern end, adjacent to the existing Woolloongabba Busway Station, the Landcentre and the Dental Hospital.

The changed station location does not require changes to the local road network. The changed location adjacent to the busway station improves transport interchange opportunities between the new rail station and busway system.

The Changed Project station design would accommodate pedestrian traffic after events at the nearby Brisbane Cricket Ground (Gabba Stadium).

[12] Based on Reference Project scheme run in the Changed Project transport model (Refer Section 5.2)

The local traffic, pedestrian and cycle connectivity initiatives proposed in the Woolloongabba Priority Development Area (PDA) would also accommodate the changed location of the Woolloongabba Station. Future planning for the PDA would need to incorporate the changed location of the proposed station.

Albert Street Station

The Albert Street Station for the Changed Project would be situated one block north-west along Albert Street compared with the Reference Project. This change creates a future opportunity for creating a priority pedestrian environment in Albert Street between Mary Street and Charlotte Street, and between Charlotte Street and Elizabeth Street.

As part of the opportunity to 'pedestrianise' parts of Albert Street, the Myer Centre car park exit to Albert Street would be removed. The Myer Centre car park has an existing exit onto Elizabeth Street, however if necessary the Albert Street exit may also be relocated to Charlotte Street between Albert Street and George Street.

While the Reference Project did not propose closing parts of Albert Street permanently, there was to be some lane capacity reductions associated with footpath widening to cater for pedestrian traffic demands. The Reference Project also required closure of the left lane in Alice Street on the corner of Alice Street and Albert Street. That action would reduce parking capacity. The Changed Project would not directly affect Alice Street.

The opportunity presented by the Changed Project to close sections of Albert Street permanently to through-vehicle traffic will result in a local redistribution of traffic to other parts of the CBD network. Traffic redistribution would be confined to local traffic accessing CBD establishments and would not impact the Riverside Expressway. As there are no bus services operating on this section of Albert Street, there would be no impacts on bus routes.

An assessment was undertaken of the potential traffic impacts of the partial closure of Albert Street. As part of the assessment, assumptions were made about the current routes of potentially impacted traffic and the redistribution of traffic after the road closure. Traffic counts were also carried out during peak periods on 27 April, 2016 and form the basis of the analysis. Traffic growth rates in the CBD were derived from the Changed Project transport model, which indicate a compounding growth rate of 0.64% between 2016 and 2023, and 0.38% between 2016 and 2033. These growth rates have been applied to estimate the traffic volumes at the opening year of 2023 and 10 years after opening in 2033.

Key intersections in the vicinity of the Albert Street closure were analysed for the AM and PM peak periods to assess possible traffic impacts in 2023 (year of opening) and 2033. The assessment indicated that impacts on the operation of the intersections would be minor. Most intersections are forecast to operate well within acceptable levels for both peak periods. Only the intersection of George Street and Elizabeth Street was forecast to exceed capacity limits in both AM and PM peak periods as a result of traffic rerouting from Albert Street to George Street. The anticipated impact would arise from greater demand for the right-turn movement from George Street into Elizabeth Street causing queuing and delays for this movement.

The proposed mitigation measure for the intersection of George Street and Elizabeth Street would be to convert the centre lane into a shared through and right turn from George Street into Elizabeth Street. This would increase the available right-turn capacity in the AM and PM peak periods, allowing the intersection to function at an acceptable level of service. There would be minimal change in delay on the through movement on George Street as result of the mitigation measure.

The results of the intersection assessment are summarised in Table 5-10 and Table 5-11 and documented in the Technical Reports (Volume 4). Note that the proposed mitigation measure for the intersection of George Street and Elizabeth Street is included in these results.

Table 5-10: AM Peak Degree of Saturation (DOS[13]) and Level of Service (LOS[14]) at key CBD intersections with and without Albert Street closure.

Intersection	2016 Existing[15]		2023 No Closure		2023 With Closure		2033 No Closure		2033 With Closure	
	DOS	LOS	DOS	LOS	DOS	LOS	DOS	LOS	DOS	LOS
George St-Elizabeth Street[18]	0.71	C	0.75	C	0.85	C	0.77	C	0.87	C
George St-Charlotte Street	0.38	A	0.42	A	0.49	A	0.43	A	0.52	A
George St-Mary Street	0.48	A	0.52	A	0.73	C	0.54	A	0.75	C
George St-Margaret Street	0.52	A	0.56	A	0.56	A	0.57	A	0.57	A
George St-Alice Street	0.65	B	0.68	B	0.71	C	0.69	B	0.73	C
Albert St-Elizabeth Street	0.64	B	0.69	B	0.61	B	0.71	C	0.62	B
Albert St-Charlotte Street	0.59	A	0.72	C	0.35	A	0.73	C	0.37	A
Albert St-Mary Street	0.53	A	0.56	A	0.55	A	0.59	A	0.56	A
Albert St-Margaret Street	0.45	A	0.50	A	0.49	A	0.51	A	0.50	A
Albert St-Alice Street	0.29	A	0.31	A	0.27	A	0.32	A	0.28	A

[13] DOS is the ratio of Volume to Capacity.
[14] Level of service (using SIDRA Method) values are based on highest (worst movement/lane) degree of saturation for the intersection: DoS ≤ 0.60 – A; 0.60 < DoS ≤ 0.70 – B; 0.70 < DoS ≤ 0.90 – C; 0.90 < DoS ≤ 0.95 – D; 0.95 < DoS ≤ 1.00 – E; and DoS > 1.00 – F.
[15] Based on signal timings derived from www.data.brisbane.qld.gov.au (accessed July 2016) and traffic survey undertaken 27 April 2016.
[18] Includes reconfiguration of George Street – Elizabeth Street intersection.

Table 5-11 PM peak DOS and LOS at key CBD intersections with and without Albert Street closure.

Intersection	2016 Existing		2023 No Closure		2023 With Closure		2033 No Closure		2033 With Closure	
	DOS	LOS	DOS	LOS	DOS	LOS	DOS	LOS	DOS	LOS
George St-Elizabeth Street[19]	0.59	A	0.65	B	0.75	C	0.67	B	0.79	C
George St-Charlotte Street	0.39	A	0.43	A	0.82	C	0.46	A	0.86	C
George St-Mary Street	0.49	A	0.53	A	0.66	B	0.55	A	0.69	B
George St-Margaret Street	0.45	A	0.48	A	0.58	A	0.49	A	0.59	A
George St-Alice Street	0.77	C	0.81	C	0.86	C	0.82	C	0.88	C
Albert St-Elizabeth Street	0.56	A	0.62	B	0.68	B	0.65	B	0.70	B
Albert St-Charlotte Street	0.53	A	0.61	B	0.49	A	0.65	B	0.44	A
Albert St – Mary Street	0.39	A	0.43	A	0.42	A	0.44	A	0.43	A
Albert St – Margaret Street	0.33	A	0.37	A	0.22	A	0.38	A	0.23	A
Albert St – Alice Street	0.67	B	0.70	C	0.48	A	0.72	C	0.50	A

Roma Street Station

In the Changed Project, the Roma Street Station would be relocated to the site of the existing BTC (West Tower). This would necessitate the closure and relocation of the long distance coach terminal and the demolition of the BTC car park with the loss of approximately 600 car parking spaces.

The BTC car park is used principally by tenants of the transit centre office buildings as well as some paid car parking for CBD commuters. With the demolition of the office buildings, there would be a reduced car parking demand. Alternative commercial car parking is available locally.

The existing long distance coach terminal would need to be relocated prior to demolition. Further investigation would be undertaken by the Proponent, in consultation with the operators, to find a suitable site for the coach terminal.

In terms of pedestrian access, passengers would be able to access the new station from two entrances facing Roma Street and one on the eastern side facing the Transit Centre. The eastern entrance would provide a convenient route for passengers transferring to/from bus and surface rail platforms and for passengers walking to destinations in the CBD. The dominant movement from the station is expected to be alighting passengers heading south-east across Roma Street towards George Street from the existing station entrance.

In the 2026 AM peak, there are forecast to be around 12,000 passengers walking to and from the Roma Street Station complex (comprising the new CRR station, existing surface rail station, and busway station). To accommodate these movements, improvements will be required to local pedestrian facilities.

Figure 5-3 illustrates a possible conceptual layout for the Roma Street area to improve the pedestrian environment.

[19] Includes reconfiguration of George Street – Elizabeth Street intersection.

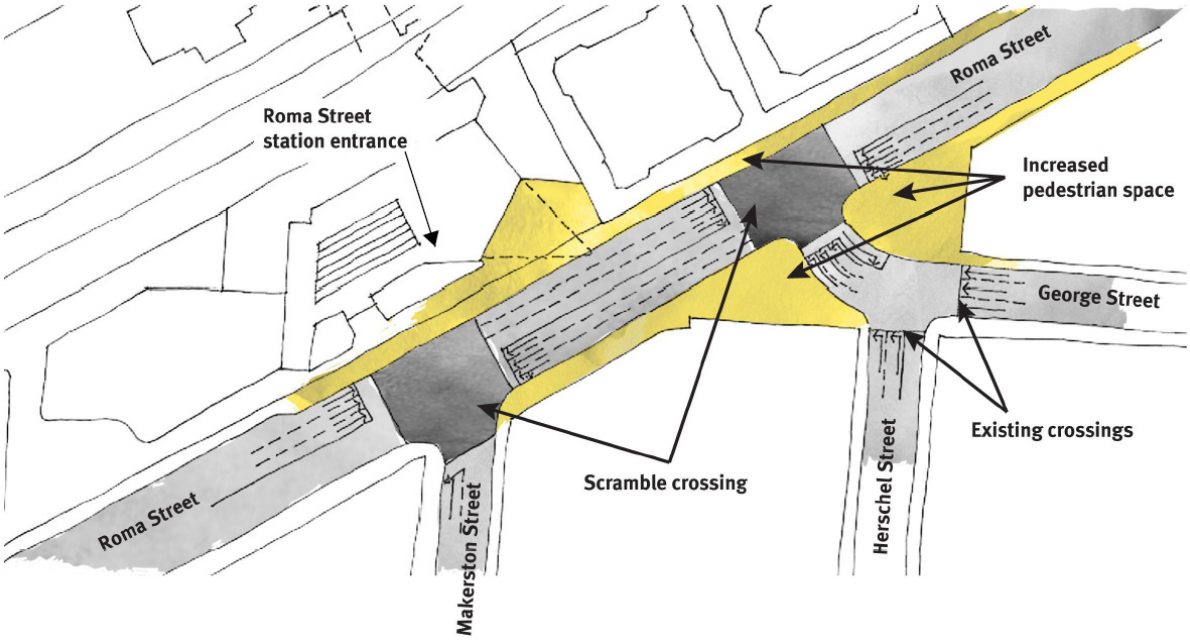

Figure 5-3 - Roma Street Station – concept layout for pedestrian footpath treatments and crossing facilities

The conceptual layout includes the creation of a signalised T-intersection of George Street and Roma Street that would include a scramble pedestrian crossing. The T-intersection would be created through the re-alignment of George Street at Roma Street and the removal of the short section of Herschel Street between George Street and Roma Street. The layout has the following key features:

- maintains two lanes on Roma Street in the eastbound direction from Makerston Street
- maintains three lanes on Roma Street from Parklands Boulevard through to Countess Street
- allows a left turn from Roma Street to George Street to access Herschel Street
- removes eastbound movements from Herschel Street to Roma Street
- retains the bus-only right turn from Roma Street to George Street
- retains the driveway access to the car park and hotel situated at the eastern end of the Transit Centre
- retains the cycle lanes on George Street and Roma Street
- provides pedestrian scramble crossings at new intersection of Roma Street with George Street and of Roma Street with Makerston Street.

The proposed changes to the road network and pedestrian facilities at Roma Street would result in localised changes to traffic operations. It is noted that the concept has previously been subject to a traffic assessment[20], however the layout would require further consultation with BCC.

Exhibition Station

The location of the Exhibition Station in the Changed Project is similar to the Reference Project and would have similar effects on local transport. There would be improved pedestrian connectivity between the station and both Bowen Bridge Road and O'Connell Terrace with the implementation of pedestrian connections in the Changed Project.

5.3 Southern Portal and Boggo Road Station

The primary effects of the changes to the Southern Portal and to Boggo Road Station are to achieve the strategic transport functions required of the project while reducing cost and minimising the environmental effects on the surface network between Dutton Park and Yeerongpilly. The change in alignment at Boggo Road Station is illustrated in Figure 5-4.

[20] As part of the Bus and Train project EIS

Figure 5-4 - Alignment changes at the Boggo Road Station and the Southern Portal

Table 5-12 presents a summary of the likely effects of the changes in the operational phase of CRR.

Table 5-12: Effects of changes in the operations phase (Southern Portal and Boggo Road)

EIS aspect	Likely changed environmental effect
Transport	Refer to Section 5.2
Climate Change and Sustainability	No changed effect
Topography, Geology, Geomorphology and Soils	No changed effect
Land Contamination	Refer below
Land Use and Tenure	Refer below
Visual Amenity and Lighting	Refer below
Nature Conservation	No changed effect
Groundwater	Refer below
Surface Water Quality	Refer below
Flood Management	Refer below
Air Quality	Refer below
Noise and Vibration	Refer below
Waste Management	No changed effect
Indigenous Cultural Heritage	No changed effect
Non-Indigenous Cultural Heritage	Refer below
Social	Refer below
Hazard and Risk	No changed effect
Cumulative Impacts	Refer below

5.3.1 Land Contamination

The reduced scale of the Changed Project would result in land south of Dutton Park Station and included on either the environmental management register (EMR) and the contaminated land register (CLR) no longer being disturbed by project works.

Land in the rail corridor at Dutton Park is likely to contain hazardous contaminants which could be intercepted by project works associated with either the Southern Portal works or the Boggo Road Station works. While not directly affected, the PA Hospital land is shown on the EMR to include petroleum product and oil storage. Detailed site investigations would be required prior to the commencement of the project works to determine the extent of contamination in areas subject to disturbance.

The Draft Outline EMP (Volume 2) provides for the safe management of contaminated materials intercepted during project delivery.

5.3.2 Land Use and Tenure

The reduced scale of the Changed Project would avoid the impacts on land use and tenure that would have arisen with the Reference Project south of Dutton Park. The changes in land use associated with the Reference Project in the residential and industrial areas adjacent to the Yeerongpilly Station would not occur with the Changed Project.

The Changed Project would support the continued and planned development of the Boggo Road Urban Village by connecting the proposed Boggo Road Station with the Ecosciences Precinct, and with the PA Hospital campus and the Translational Research Institute, via new pedestrian infrastructure. The Changed Project would also support the strengthening of land use relationships with the Woolloongabba area and the University of Queensland via pedestrian connections with the Park Road Station and Boggo Road Busway Station.

The Changed Project would impact on the future use of parts of Lot 2 on Joe Baker Street through limitations on basement depths for development that might be proposed above the new station.

With the Changed Project, Outlook Park would transition to a public plaza adjacent to the station entry. The locality is well serviced by formal and informal open space at Gair Park and Dutton Park as well as park reserve fronting Peter Doherty Street. The Dutton Park State School playing fields are also used heavily by local community groups participating in active recreation.

5.3.3 Visual Amenity

The Changed Project would avoid the predicted impacts of the Reference Project on visual amenity in the corridor to the south of Yeerongpilly. The surface infrastructure in the rail corridor necessary for the Reference Project would not be required for the Changed Project (e.g. Clapham Yard, noise barriers adjacent to the Southern Portal).

The portal structures for the Changed Project at Dutton Park would require surface structures, including noise barriers which would be visible from vantage points along Railway Terrace (portals) and Joe Baker Street (pedestrian connections to Park Road Station and the new electrical sub-station). The surface infrastructure would be consistent with structures in the rail corridor and would not impact adversely on the visual amenity of the surrounding locality.

5.3.4 Groundwater

The reduced length of tunnel south of Dutton Park in the Changed Project would reduce the effects on groundwater resources. In the other parts of the study corridor, the effects of the Changed Project on groundwater resources would be substantially the same as for the Reference Project.

5.3.5 Surface Water

The Reference Project works proposed to intercept surface waters at Yeerongpilly (Moolabin Creek), Rocklea (Rocky Waterholes Creek) and Salisbury (Stable Swamp Creek). The works would have created the potential for changed surface water flows and changed water quality, particularly due to sedimentation if worksites were not managed according to the environmental management plan and conventional site management practices.

The Changed Project would not impact on the catchments of any of these streams. Surface water flows and surface water quality considerations for the Changed Project at Boggo Road are substantially the same as for the Reference Project, with the exception that the worksite for the Changed Project may be more susceptible to impacts from stormwater drainage than the station worksite for the Reference Project.

5.3.6 Flood Management

The EIS for the Reference Project identified the potential for minor changes in peak flood levels in Moolabin Creek (increase of 0.04m for 1 in 20 year AEP event; 0.09m for 1 in 100 year AEP event). The Reference Project predicted an increase to the possible peak flood levels in Rocky Waterholes Creek calculated at Muriel Avenue (0.015m in 1 in 5 year AEP event; 0.02m in 1 in 20 year AEP event; 0.04m in 1 in 100 year AEP event). For Stable Swamp Creek, the Reference Project forecast increase peak flood levels.

As the Changed Project would not extend into the catchments of any of the streams, none of the minor impacts anticipated for the Reference Project would occur.

5.3.7 Air Quality

The impacts to air quality anticipated for operation of the Reference Project between Yeerongpilly and Salisbury would be avoided with the Changed Project. The operation of the Boggo Road Station, in the changed location, would have the potential to cause air quality impacts substantially similar to those anticipated for the Reference Project. The Boggo Road station ventilation outlet for the Changed Project would be in the general vicinity of that proposed for the Reference Project, leading to similar impacts on air quality.

5.3.8 Noise and Vibration

The airborne noise, ground-borne noise and vibration assessment criteria for the Project are consistent between the Reference Project and the Changed Project assessments. The planning levels for airborne noise from operational railway activities (train movements) are retained as 65 dB [$LA_{eq\ (24hour)}$] and Single Event Maximum 87 dB[21].

The predicted difference in railway noise emission levels between the Reference Project and the Changed Project arising from rail traffic movements are presented in Table 5-13.

Based on the change in daily train movements and fleet composition at the Southern Portal, it has been determined that total rail noise levels would vary by -6 to +1 dBA between the Reference Project and the Changed Project. An increase in daily $LA_{eq(24hour)}$ noise of 1 dBA would not be a perceptible change from the Reference Project impacts.

With regards to the increase in passenger train movements between Yeerongpilly and Park Road, the 4 dBA change in passenger train $LA_{eq(24hour)}$ noise level would be offset to a degree by the reduction in freight train noise with the net effect being a negligible change in $LA_{eq(24hour)}$ rail noise between Yeerongpilly and Park Road.

[21] Queensland Rail, Safety and Environmental Management Systems, formerly the Code of Practice for the Management of Railway Noise

Table 5-13: Predicted incremental change in rail noise emission for surface rail during operation

Section	Change in noise level (dBA $LA_{eq(24hour)}$ – Changed Project compared to Reference Project[22]							
	Year of opening				Ten years after opening			
	Freight	Passenger	Total*	Change	Freight	Passenger	Total*	Change
Salisbury – Y'pilly	-4.9	0.5	1.2	no change	-4.0	-3.5	-3.5	no change
Y'pilly - Park Rd	-2.3	4.1	0.8	no change	-3.0	4.4	0.3	no change
Park Rd - Roma St	-48.4	1.9	1.0	no change	-11.0	2.0	1.2	no change

* The total change in noise level is the change in the logarithmic sum of the combined freight and passenger noise levels, not the linear sum of the individual changes for freight and passenger noise levels.

Noise modelling was completed for the Changed Project (Southern Portal) between Annerley Road, Burke Street and Ipswich Road. The predicted noise levels include contributions from all surface rail traffic in the vicinity of the portal, including noise emissions from the portal itself. These predicted operational rail noise levels have been assessed against the adopted planning levels.

The predicted noise levels for the Changed Project are displayed as noise contours in the Technical Reports (Volume 4).

In 2026, operational rail traffic noise levels of up to 69 dBA $LA_{eq(24hour)}$ and 92 dBA LA_{max} are predicted at receivers within the modelled area. Noise levels of up to 70 dBA $LA_{eq(24hour)}$ and 92 dBA LA_{max} are predicted for 2036. The future increase in rail traffic results in a negligible 1 dB increase in railway noise between 2026 and 2036. Twelve residences, including the ESA Village (Leukaemia Foundation) and residences on Rawnsley Street and Railway Terrace are predicted to exceed one or more of the planning levels in both years by up to 5 dBA.

A comparison between the Reference Project and the Changed Project of the highest predicted railway noise levels and the number of residences predicted to exceed the Planning Levels is provided in Table 5-14. This comparison is for the Changed Project without mitigation measures installed (i.e. no new or upgraded railway noise barriers).

With the changed location of the Southern Portal, there would be 25 fewer residential properties subject to rail traffic noise in excess of the planning levels in proximity to the portal location. While there would be fewer residential properties affected by rail traffic noise, they would be different properties to those affected by the Reference Project.

[22] For example at Salisbury to Yeerongpilly, at year of opening, freight generated noise is forecast to be 4.9 dBA lower for the Changed Project compared to the forecast noise level for the Reference Project.

Table 5-14: Comparison – Southern Portal rail noise levels (without mitigation)

Southern Portal design	**Rail noise levels**		**Number of residences above planning levels**	**Difference**
	$LA_{eq(24hour)}$	SEM[23]		
Reference Project (2031)	75	92	37	The daily rail noise levels are up to 5 dB lower with the Changed Project. An approximate reduction of 67% in the number of residences above the Planning Levels has been achieved with the Changed Project.
Changed Project (2036)	70	92	12	

Rail traffic noise emanating from the Southern Portal area for the Changed Project would affect 12 sensitive receivers of which 11 are residential properties in Rawnsley Street and Railway Terrace. The remaining property would be the ESA Village (Leukaemia Foundation) in Peter Doherty Street. By increasing the height of the existing noise barriers to 6 metres, there would be only seven properties in Railway Terrace predicted to be affected by rail traffic noise in excess of the planning levels. Mitigation of the exceedances of the planning noise levels for these seven properties would need to be addressed during detailed design in consultation with the affected parties.

Feeder Station

The southern feeder station would be relocated from Yeerongpilly to a site on railway land between the freight overpass, the Beenleigh Line and Cleveland Line. It would also be reconfigured to a small scale electrical sub-station. As with the Reference Project, all components would be enclosed in buildings. A noise reduction through the sub-station building facades of approximately 20 dBA can be expected.

The notable change between the Reference Project and the Changed Project is the change in proximity of the nearest sensitive receivers. The potential airborne noise impacts for the southern electrical sub-station are provided in Table 5-15. The assessment demonstrates that there would no exceedance of the criteria for any sensitive receiver.

Table 5-15: Assessment of noise emissions from southern electrical sub-station

	Distance to nearest sensitive receiver (m)		**Predicted noise level** LA_{90} (dBA)		**Change in impact**
	Reference Project	Changed Project	Reference Project	Changed Project	
Noise goal			40	40	
Southern electrical sub-station	160	70	<30	<35	Complies

[23] SEM = Single Event Maximum

Station Ancillary Facilities

There would be no discernible change in sound power levels emitted by station mechanical plant and ventilation noise sources for the Boggo Road Station in the Changed Project compared with the Reference Project (refer Table 5-16).

Table 5-16: Assessment of noise emissions from station ancillary facilities

	Distance to nearest sensitive receiver (m)		**Noise goal** L_{A90} (dBA)	**Maximum SWL[24] noise** (dBA)		**Change in impact**
	Reference Project	Changed Project		Reference Project	Changed Project	
Boggo Road	90	100	37	84	85	No predicted impact, similar design requirement.

5.3.9 Non-Indigenous Cultural Heritage

The Reference Project proposed the Boggo Road Station to be constructed beside the Boggo Road Gaol. The gaol is listed on the Queensland Heritage Register as a place of heritage significance. The main rail tunnels in the Reference Project also proposed to pass deep beneath the eastern corner of the South Brisbane Cemetery which is also included in the Queensland Heritage Register.

With the Changed Project, there would no longer be any potential to impact on either the State-listed Boggo Road Gaol or the South Brisbane Cemetery.

5.3.10 Social Impacts

The relocation of the Southern Portal from Yeerongpilly to Dutton Park would give rise to a number of social effects stemming from project implementation, including:

- avoiding the occupation of residential, commercial and industrial land at Yeerongpilly for the surface infrastructure
- providing more effective and direct pedestrian access to the changed Boggo Road Station and a direct pedestrian connection from the changed station to the PA Hospital campus.

As with the Reference Project, the Changed Project would provide long-term benefits to communities in the study corridor and beyond through improved access to major centres and employment areas. A range of impacts on communities to the south of Dutton Park would be avoided with the Changed Project.

5.3.11 Cumulative Impacts

The Changed Project would not interact directly with the Yeerongpilly TOD in the way anticipated for the Reference Design.

The Changed Project would interact with ongoing development of the Boggo Road Urban Village (BRUV) through partial limitations to basement depths available over part of Lot 2 on Joe Baker Street (Lot 2 on SP217441). The proposed station structures would result in a public plaza adjacent to the station entry coinciding with the present location of Outlook Park (Lot 902 on SP217441).

The enhanced transport accessibility provided by the Changed Project would deliver long-term benefits for the future development and utility of facilities within and nearby the BRUV.

[24] SWL = Sound Power Level (source noise emission level).

5.4 Boggo Road to Woolloongabba Tunnels

The Changed Project alignment would pass to the west of the alignment for the Reference Project before returning to a similar alignment, albeit further to the east, at Woolloongabba Station. A summary of the likely effects of the Changed Project is presented in Table 5-17.

Table 5-17: Effects of changes, Operations phase (Boggo Road – Woolloongabba Tunnels)

EIS aspect	Likely changed environmental effect
Transport	Refer to 5.2
Climate Change and Sustainability	No changed effect
Topography, Geology, Geomorphology and Soils	No changed effect
Land Contamination	No changed effect
Land Use and Tenure	Refer below
Visual Amenity and Lighting	No changed effect
Nature Conservation	No changed effect
Groundwater	Refer below
Surface Water Quality	No changed effect
Flood Management	No changed effect
Air Quality	No changed effect
Noise and Vibration	Refer below
Waste Management	No changed effect
Indigenous Cultural Heritage	No changed effect
Non-Indigenous Cultural Heritage	Refer below
Social	Refer below
Hazard and Risk	No changed effect
Cumulative Impacts	No changed effect

5.4.1 Land Use and Tenure

With the change in alignment of the main tunnels between Boggo Road to Woolloongabba, the Changed Project would change the number and location of properties affected by volumetric acquisitions. While the alignment of the Reference Project between Boggo Road Station and Woolloongabba Station would be a relatively direct route, the alignment of the Changed Project would be more curvilinear and would pass beneath Park Road, Woolloongabba. The alignment of the Changed Project would pass beneath Park Road at a similar depth to the Reference Project.

As with the Reference Project, the Changed Project would not impact on existing land use on the surface, and would be unlikely to constrain future land use potential south of Stanley Street.

5.4.2 Groundwater

As with the Reference Project, the Changed Project would be a lined, waterproof construction with limited inflow of groundwater post construction. In the operational phase, the Changed Project would not influence groundwater resources or the groundwater table between Boggo Road and Woolloongabba.

5.4.3 Noise and Vibration

There is no potential for airborne noise affecting sensitive receivers between Boggo Road and Woolloongabba.

To reduce the potential for ground-borne noise impacts at sensitive receivers above the changed alignment between Boggo Road and Woolloongabba without impacting operations via speed reductions, mitigation measures would address the vibration isolation characteristics of the track. Track fastening systems include:

- direct fixation track fasteners
- resilient track fasteners
- highly resilient track fasteners

As with the Reference Project, the Changed Project would adopt track fastening systems to achieve the goals for ground-borne noise and vibration in sensitive receivers above the changed alignment.

Table 5-18: Operational Ground-borne Noise, Boggo Road to Woolloongabba (with compliance trackform)

Rail Section	Building Type	Goal (dBA)	Predicted Ground-borne Noise (dBA)		Mitigation
			Reference Project	Changed Project	
Boggo Rd - Woolloongabba	Residential	35 (night)	<10 – 34	<10 – 34	Resilient rail fasteners and highly resilient rail fasteners
	Commercial	40	<10 – 29	<10 – 28	
	Educational	40	<10	<10	
	Worship	40	<10 – 15	<10	
	Medical	40		13	
	Hotel	35 (night)	20	<10	

To achieve the criteria for ground-borne noise the extent of the Highly Resilient Rail Fasteners for underground track north of Boggo Road Station is slightly extended in the Changed Project compared with the Reference Project. The comparative requirements are illustrated in Figure 5-5.

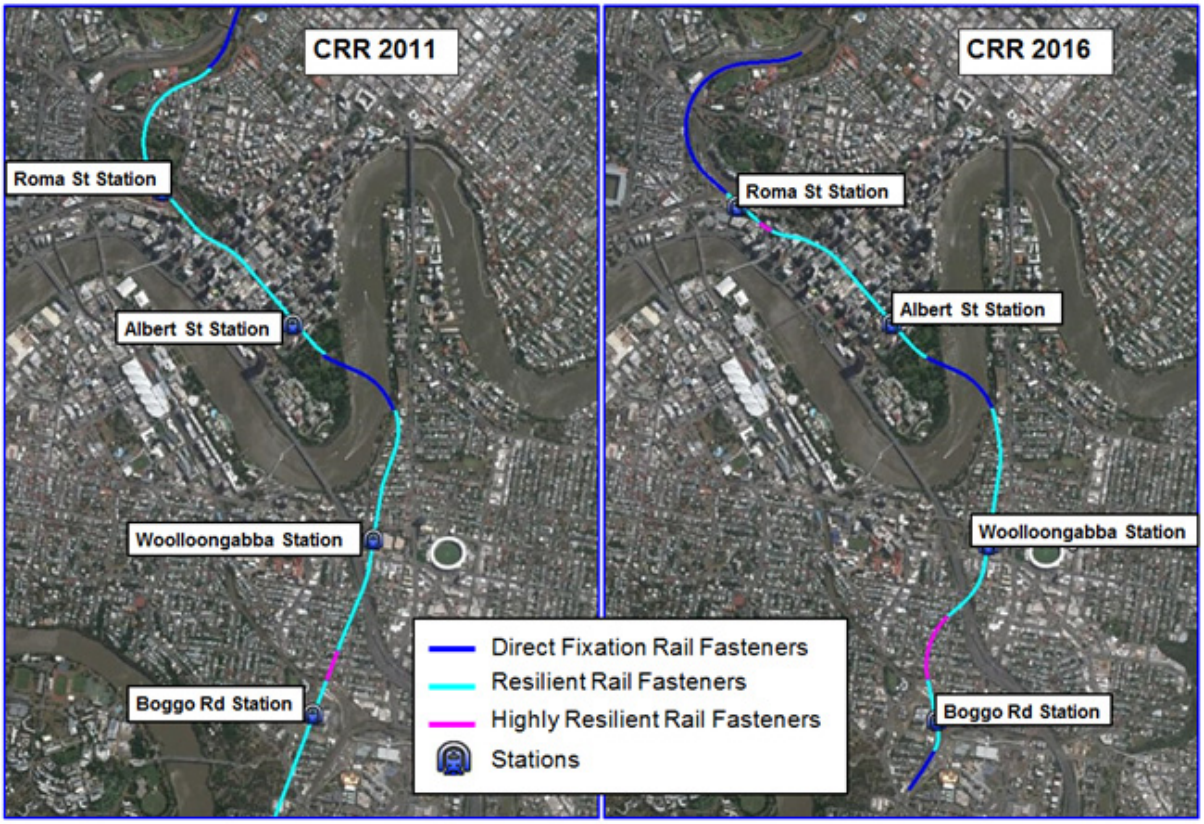

Figure 5-5 - Compliance trackform requirements, Reference Project and Changed Project

With the installation of track fastening systems necessary to achieve the goals for ground-borne noise, the sensitive receivers above the changed alignment between Boggo Road and Woolloongabba are predicted to achieve the vibration criteria.

Table 5-19: Operational Ground-borne Vibration, Boggo Road to Woolloongabba (with compliance trackform)

Rail Section	**Building Type**	**Night-time Goal** (mm/sec)	**Predicted Ground-borne Vibration** (mm/sec, PPV)		**Mitigation**
			Reference Project	Changed Project	
Boggo Rd - Woolloongabba	Residential	0.2	0.002 – 0.032	0.002 – 0.043	Resilient rail fasteners and highly resilient rail fasteners
	Commercial		0.003 – 0.031	0.001 – 0.024	
	Educational		0.003 – 0.005	0.002 – 0.003	
	Worship		0.005 – 0.010	0.002 – 0.003	
	Medical			0.008	
	Hotel		0.014	0.004	

5.4.4 Non-indigenous Cultural Heritage

There are no places on the Queensland Heritage Register which would be affected by the change in the project alignment between Boggo Road and Woolloongabba. It is noted that the changed alignment would pass beneath the Old Woolloongabba Post and Telegraph Office, which is included on the Queensland Heritage Register (QHR 600357). There would be no impacts due to settlement (range 10 – 25mm) or ground-borne vibration (0.004mm/sec PPV) which would be likely to affect either the structural fabric of this building or its State heritage value.

5.4.5 Social

The changed alignment of the tunnels for the Changed Project between Boggo Road and Woolloongabba would change the properties affected by volumetric property acquisition.

5.5 Woolloongabba Station

While remaining in the locality, the proposed Woolloongabba Station for the Changed Project would be slightly to the east of the station for the Reference Project. The changed location would require demolition of the Landcentre, GoPrint and the Dental Hospital. The change in alignment at Woolloongabba Station is illustrated in Figure 5-6.

Figure 5-6 - Alignment changes at Woolloongabba Station

The construction effects and operational effects of the proposed change would be substantially similar to those predicted for the Reference Project. A summary of the likely effects of the Changed Project is presented in Table 5-20.

Table 5-20: Effects of changes, Operations phase (Woolloongabba Station)

EIS aspect	Likely changed environmental effect
Transport	Refer to 5.2
Climate Change and Sustainability	No changed effect
Topography, Geology, Geomorphology and Soils	No changed effect
Land Contamination	No changed effect
Land Use and Tenure	Refer below
Visual Amenity and Lighting	No changed effect
Nature Conservation	No changed effect
Groundwater	No changed effect
Surface Water Quality	No changed effect
Flood Management	No changed effect
Air Quality	No changed effect
Noise and Vibration	Refer below
Waste Management	No changed effect
Indigenous Cultural Heritage	No changed effect
Non-Indigenous Cultural Heritage	No changed effect
Social	Refer below

Hazard and Risk	No changed effect
Cumulative Impacts	No changed effect

5.5.1 Land Use and Tenure

The demolition of the Landcentre, GoPrint and the Dental Hospital represent notable changes in land use in Woolloongabba, in comparison with the Reference Project. Post construction, those sites together with the remainder of the Woolloongabba worksite would become available for development in accordance with planning guidelines in place at the time.

5.5.2 Noise and Vibration

There would be no change in operational airborne noise effects at Woolloongabba as a consequence of the Changed Project.

With the installation of the track fastening systems referred to in section 5.4.3, there would be no exceedance of the goals for ground-borne noise and vibration in the sensitive receivers above the changed alignment to the north of the changed station location at Woolloongabba. Table 5-21 and Table 5-22 refer.

Table 5-21: Operational Ground-borne Noise, Woolloongabba – Albert Street (with compliance trackform)

Rail Section	**Building Type**	**Goal (dBA)**	**Predicted Ground-borne Noise (dBA)**		**Mitigation**
			Reference Project	Changed Project	
Woolloongabba – Albert Street	Residential	35 (night)	<10 – 26	<10 – 27	Resilient rail fasteners and highly resilient rail fasteners
	Commercial	40	<10 – 25	<10 – 27	
	Educational	40	<10 – 23	<10 – 23	
	Worship	40	<10	<10 – 25	
	Medical	40	<10	<10	
	Hotel	35 (night)	<10 – 27	<10 – 27	

Table 5-22: Operational Ground-borne Vibration, Woolloongabba – Albert Street (with compliance trackform)

Rail Section	**Building Type**	**Night-time Goal** (mm/sec)	**Predicted Ground-borne Vibration** (mm/sec, PPV)		**Mitigation**
			Reference Project	Changed Project	
Woolloongabba – Albert Street	Residential	0.2	0.001 to 0.025	0.001 - 0.027	Resilient rail fasteners and highly resilient rail fasteners
	Commercial		0.002 to 0.023	0.001 - 0.028	
	Educational		0.002 - 0.016	0.001 - 0.018	
	Worship		0.001 - 0.008	0.002 – 0.005	
	Medical		0.002	0.001	
	Hotel		0.001 - 0.023	0.001 - 0.026	

5.5.3 Social

The South Brisbane Dental Hospital would be demolished to allow construction of the Changed Project. This facility currently extends general and specialist oral health services including assessment and preventative treatments for adults. The services are an important element of wider health services delivered by the Metro South region of Queensland Health.

The relocation of dental services from Woolloongabba would be addressed by Queensland Government prior to project construction. Queensland Health, and the Department of Public Works and Housing, would be consulted about the program for project works.

5.6 Albert Street Station

The Changed Project would relocate Albert Street Station further to the north-west along Albert Street between Margaret Street and Elizabeth Street. The alignment of the Changed Project is the same as the Reference Project. The change in location of Albert Street Station is illustrated in Figure 5-7.

Figure 5-7 - Changed location of Albert Street Station

The effects of the Changed Project at Albert Street Station would be substantially similar for those anticipated for the Reference Project with the exceptions indicated in Table 5-23 below.

Table 5-23: Effects of changes, Operations phase (Albert Street Station)

EIS aspect	Likely changed environmental effect
Transport	Refer to 5.2
Climate Change and Sustainability	No changed effect
Topography, Geology, Geomorphology and Soils	No changed effect
Land Contamination	No changed effect
Land Use and Tenure	Refer below
Visual Amenity and Lighting	No changed effect
Nature Conservation	No changed effect
Groundwater	No changed effect
Surface Water Quality	No changed effect
Flood Management	Refer below
Air Quality	No changed effect
Noise and Vibration	Refer below

Waste Management	No changed effect
Indigenous Cultural Heritage	No changed effect
Non-Indigenous Cultural Heritage	No changed effect
Social	Refer below
Hazard and Risk	No changed effect
Cumulative Impacts	No changed effect

5.6.1 Land Use and Tenure

There would be opportunities for redevelopment with the demolition of buildings on the corner of Mary and Albert Street required for the construction of the Changed Project. Any redevelopment would be subject to separate planning and approval processes.

The proposed partial pedestrianisation of Albert Street between Mary Street and Elizabeth Street would also lead to rejuvenation of land uses at the street level in the operational phase of the Changed Project. This opportunity is consistent with BCC's City Centre Master Plan 2014 vision for Albert Street.

5.6.2 Flood Management

As with the Reference Project the Changed Project would be designed to achieve flood immunity in a 1 in 10,000 year flood event (i.e. Q10,000 design flood level) at all underground rail stations.

The relocation of Albert Street Station in the Changed Project would have a similar flood risk to the Reference Project. At this new location, the changed station would have an entrance level of approximately 4.3m AHD.

In the Changed Project, Albert Street Station would be designed with smaller entrance structures to enable discrete flood protection measures that can be easily and quickly deployed. There would be three levels of flood protection for a range of flood events. These measures would be deployed sequentially during design flood events and offer a more flexible approach to flood mitigation than the Reference Project.

1 in 100 year flood event

For a 1 in 100 year flood event, the raised station entrances would be designed to avoid surface water in-flows entering the station. The proposed design measures would still comply with the *Disability Discrimination Act 1992*.

1 in 800 year flood event

For a 1 in 800 year flood event, the Albert Street Station would be closed, but other Changed Project stations could remain operational. For such flood events, a vertical flood barrier, approximately 1m high, would be activated at each station entry as required.

1 in 10,000 year flood event

For a 1 in 10,000 flood event, the ultimate level of flood protection would be activated. Small structures with gaskets and seals to provide water cut off would be placed horizontally above the intermediate flood protection measures. These structures would be designed for the required hydrostatic water pressure from a Q10,000 flood event.

During detailed design, alternative measures would be considered, such as flood gates at concourse level or platform level to protect critical assets.

5.6.3 Noise and Vibration

The effects of the Changed Project with regards airborne noise in the operational phase at Albert Street would be negligible and no different to those anticipated for the Reference Project.

With the implementation of compliance track fastening systems the predicted levels of ground-borne vibration at sensitive receivers between the changed station at Albert Street and Roma Street would be very low and unlikely to be detected. The predicted levels are set out in Table 5-24 and Table 5-25 respectively.

Table 5-24: Operational Ground-borne Noise, Albert Street - Roma Street (with compliance trackform)

Rail Section	**Building Type**	**Goal (dBA)**	**Predicted Ground-borne Noise (dBA)**		**Mitigation**
			Reference Project	Changed Project	
Albert Street - Roma Street	Residential	35 (night)	NA	<10 - 27	Resilient rail fasteners
	Commercial	40	<10 - 36	<10 - 35	
	Educational	40	13 - 23	<10 - 18	
	Heritage		21 - 34	18 - 29	
	Worship	40	16 - 30	13 - 21	
	Medical	40	13 - 35	<10 - 27	
	Hotel	35 (night)	<10 - 33	<10 - 31	

Table 5-25: Operational Ground-borne Vibration, Albert Street - Roma Street (with compliance trackform)

Rail Section	**Building Type**	**Night-time Goal** (mm/sec)	**Predicted Ground-borne Vibration** (mm/sec, PPV)		**Mitigation**
			Reference Project	Changed Project	
Albert Street - Roma Street	Residential	0.2	NA	0.001 - 0.034	Resilient rail fasteners and highly resilient rail fasteners
	Commercial		0.004 - 0.059	0.001 - 0.048	
	Educational		0.009 - 0.025	0.001 - 0.015	
	Heritage		0.023 - 0.056	0.016 - 0.036	
	Worship		0.015 - 0.029	0.011 - 0.019	
	Medical		0.012 - 0.058	0.006 - 0.027	
	Hotel		0.006 - 0.044	0.004 - 0.040	

5.6.4 Social

The proposal to pedestrianise Albert Street between Mary Street and Charlotte Street, and between Charlotte Street and Elizabeth Street would enhance accessibility from the Changed Project to the city centre including important community infrastructure such as QUT Gardens Point campus and the Brisbane Botanic Gardens. The pedestrian-only zone between Charlotte Street and Elizabeth Street would retain local vehicular access from Elizabeth Street. The proposed enhancement of the Albert Street pedestrian environment would improve the general amenity of this part of the city centre.

5.6.5 Non-indigenous Cultural Heritage

The relocation of Albert Street Station in the Changed Project would relieve the potential for impacts the Reference Project would have had on heritage values of the Brisbane Botanic Gardens (QHR 600067).

The Changed Project in its operational mode would have no effect due to ground borne vibration or settlement on the Royal Albert Apartments (QHR 600103) on the corner of Elizabeth and Albert Streets.

The changed alignment between Albert Street and Roma Street would bring the Changed Project closer to a number of places on the Queensland Heritage Register including:

- The McDonnell and East & Co Building (414 George Street, QHR 600120)
- Transcontinental Hotel (462 - 468 George Street, QHR 600122)

The estimated maximum settlement for the Changed Project between Turbot Street and Makerston Street would be in the range of 0 - 10mm over a trough width ranging from 100 - 150m. While this potential settlement would be unlikely to affect either of these places of State heritage significance, monitoring of settlement during construction would manage the risk. Similarly, the predicted ground-borne vibration for the Changed Project along this section of the route would be well below the criterion for building damage to heritage places.

5.7 Roma Street Station

The Changed Project involves a realignment of the tunnels between Turbot Street and Roma Street, and a consequential change to the location of the underground Roma Street Station. The change in location of Roma Street Station is illustrated in Figure 5-8.

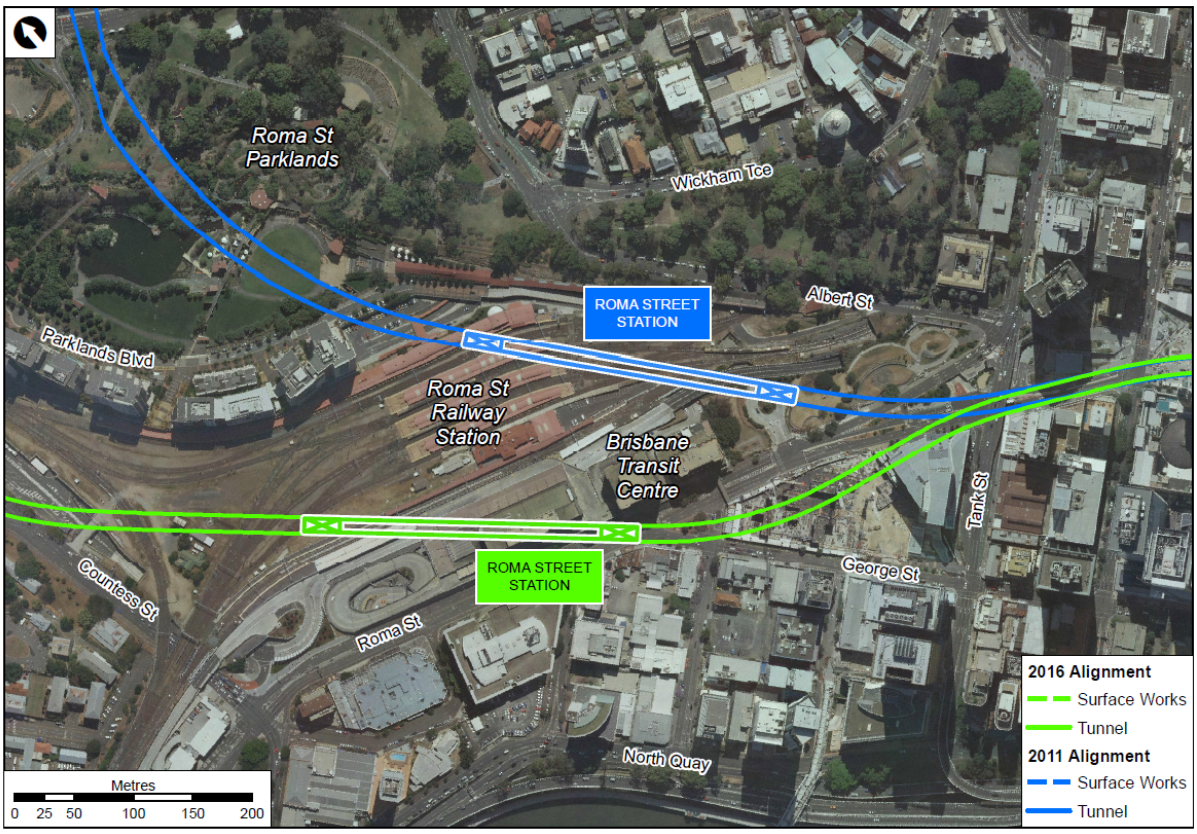

Figure 5-8 – Changed location of Roma Street Station

In its operational phase the Changed Project at Roma Street would have similar effects as the Reference Project on the receiving environment, with the exceptions noted in Table 5-26.

Table 5-26: Effects of changes, Operations phase (Roma Street Station)

EIS aspect	Likely changed environmental effect
Transport	Refer to 5.2
Climate Change and Sustainability	No changed effect
Topography, Geology, Geomorphology and Soils	No changed effect
Land Contamination	No changed effect
Land Use and Tenure	Refer below
Visual Amenity and Lighting	Refer below
Nature Conservation	No changed effect
Groundwater	No changed effect
Surface Water Quality	No changed effect
Flood Management	No changed effect
Air Quality	No changed effect
Noise and Vibration	Refer below
Waste Management	No changed effect
Indigenous Cultural Heritage	No changed effect
Non-Indigenous Cultural Heritage	Refer below
Social	Refer below
Hazard and Risk	No changed effect
Cumulative Impacts	No changed effect

5.7.1 Land Use and Tenure

The Changed Project requires the demolition of the BTC (West Tower) and relocation of the long distance coach terminal. This would open up a key site for redevelopment and renewal on Roma Street. The Changed Project would influence the form of development above the proposed underground station due to structural considerations (basement). Any redevelopment would be subject to separate planning and approval processes.

The relocation of the long distance coach terminal would be determined prior to the delivery of the Changed Project, in consultation with the coach operators.

5.7.2 Visual Amenity and Lighting

The demolition of the BTC (West Tower) would open up vistas along George Street to St Brigid's Church, Red Hill (QHR 601078). This might be a temporary benefit of the Changed Project depending on the scale of any redevelopment of the site.

With its changed location, the Changed Project does not propose new above-ground station entry structures to connect with upper Albert Street and Spring Hill. The existing connections between Roma Street Station, Roma Street Parklands and Spring Hill would be retained.

5.7.3 Noise and Vibration

The relocation of the changed station would relieve operational ground-borne noise and vibration on the apartments on Parklands Boulevard that had the potential to arise with the Reference Project.

With the implementation of compliance track fastening systems, ground-borne noise and vibration at sensitive receivers along Roma Street adjacent to the changed station would be well below the planning levels for rail operations.

5.7.4 Non-Indigenous Cultural Heritage

The relocation of the changed station would reduce the potential for operational impacts on the Roma Street Railway Station (QHR 601208) due to settlement and ground-borne vibration. Predicted settlement would be in the range of 10 - 25mm within 25m of the changed station wall, which would be within the manageable range for building damage for heritage places.

The predicted ground-borne vibration with compliance track fastening systems would be 0.02 - 0.04mm/sec PPV (rounded), well below the criterion for damage to heritage places of 2.0mm/sec.

5.7.5 Social

The Changed Project at Roma Street Station would not provide the same level of direct pedestrian connectivity with the Roma Street Parklands and Spring Hill as would be achieved with the Reference Project. The Changed Project would rely on the existing connections with both the parklands and Spring Hill available via the platform 10 concourse and path.

5.8 Roma Street - Northern Portal

The Changed Project involves the mainline tunnels passing deep beneath Countess Street and Hardgrave Park, west of the alignment for the Reference Project. The changed alignment allows the Project to connect with the Exhibition Line via a portal within the rail corridor rather than via a portal and transition structure in Victoria Park required for the Reference Project. The change in alignment between Roma Street Station and the Northern Portal is illustrated in Figure 5-9.

Figure 5-9 - Alignment change between Roma Street Station and the Northern Portal

While this change would avoid the potential for operational impacts on sensitive receivers in Spring Hill, it would introduce the potential for impacts on sensitive receivers on parts of Petrie Terrace. The potential effects of the changes are summarised in Table 5-27.

Table 5-27: Effects of changes, Operations phase (Roma Street - Northern Portal)

EIS aspect	Likely changed environmental effect
Transport	Refer to 5.2
Climate Change and Sustainability	No changed effect
Topography, Geology, Geomorphology and Soils	No changed effect
Land Contamination	No changed effect
Land Use and Tenure	No changed effect
Visual Amenity and Lighting	Refer below
Nature Conservation	Refer below
Groundwater	No changed effect
Surface Water Quality	No changed effect
Flood Management	No changed effect
Air Quality	No changed effect
Noise and Vibration	Refer below
Waste Management	No changed effect
Indigenous Cultural Heritage	Refer below
Non-Indigenous Cultural Heritage	Refer below
Social	Refer below
Hazard and Risk	No changed effect
Cumulative Impacts	No changed effect

5.8.1 Visual Amenity and Lighting

The relocation of the Northern Portal from Victoria Park to the rail corridor (Exhibition Line) would avoid the potential impacts of the Reference Project on the visual amenity and landscape values of the park. The portal structure would be consistent with the visual context of the rail corridor. Similarly, the relocation of the feeder stations from Victoria Park to a position north of the BCC temporary staging facility would reduce the visual impact of the above-ground infrastructure required for operation of the Changed Project.

5.8.2 Nature Conservation

The relocation of the Northern Portal from Victoria Park to the rail corridor (Exhibition Line) would avoid the loss of mature vegetation within Victoria Park required for the delivery and operation of the Reference Project. While such vegetation had limited habitat value it contributes to high community value of the parkland.

5.8.3 Noise and Vibration

Airborne Noise

The predicted airborne noise for the Changed Project includes contributions from all surface rail traffic in the vicinity of the changed Northern Portal, including noise emissions from the portal itself.

Without mitigation, in 2026, operational rail noise of up to 60 dBA $LA_{eq(24hour)}$ and 86 dBA LA_{max} are predicted between Bowen Bridge Road and BGGS. In 2036 predicted noise levels in this area would be 62 dBA $LA_{eq(24hour)}$ and 86 dBA LA_{max}. No rail noise is predicted to exceed either the average or the maximum planning levels in either year at sensitive receivers in the modelling area. There would be no requirement for rail noise mitigation in this area.

The changed location of the Northern Portal would introduce a new source of rail noise for BGGS. Predicted rail noise levels for the Changed Project at the BGGS Sports Centre building (i.e. closest to

the Northern Portal) indicates that freight rail noise would dominate both the $L_{Aeq(24hour)}$ and L_{Amax} assessment parameters. BGGS is currently exposed to freight rail noise. The forecast daily freight train movements would decrease from 38 in 2021 for the Reference Project to 18 in 2026 for the Changed Project.

The predicted airborne noise displayed in Table 5-28 below.

Table 5-28: Operational Airborne Noise, Northern Portal

Building Type	**2026**		**2036**	
	$L_{Aeq(24\ hour)}$	L_{Amax}	$L_{Aeq(24\ hour)}$	L_{Amax}
Goal	65dBA	87dBA	65dBA	87dBA
BGGS Building A	59	84	60	84
BGGS Building E2 (Science)	56	77	57	77
BGGS Building G	55	78	56	78
BGGS Building MC (Sports Centre)	60	86	62	86

Ground-borne Noise

Despite the changed alignment the predicted operational ground-borne noise and vibration for the Changed Project would not exceed the criteria for properties above at any location, providing the recommended mitigation methods for rail track fastening were implemented. The predicted levels of ground-borne noise and vibration are presented in Table 5-29 and Table 5-30 below.

Table 5-29: Operational Ground-borne Noise, Roma Street - Northern Portal (with compliance trackform)

Rail Section	**Building Type**	**Goal (dBA)**	**Predicted Ground-borne Noise (dBA)**		**Mitigation**
			Reference Project	Changed Project	
Roma Street - Northern Portal	Residential	35 (night)	<10 - 25	<10 - 34	Resilient rail fasteners, direct fixation rail fasteners
	Commercial	40	<10 - 21	<10 - 34	
	Educational	40	<10 - 24	<10 - 30	
	Worship	40	NA	11	
	Medical	40	<10	NA	
	Hotel	35 (night)	<10 - 20	<10	

Table 5-30: Operational Ground-borne Vibration, Roma Street - Northern Portal (with compliance trackform)

Rail Section	**Building Type**	**Night-time Goal** (mm/sec)	**Predicted Ground-borne Vibration** (mm/sec, PPV)		**Mitigation**
			Reference Project	Changed Project	
Roma Street - Northern Portal	Residential	0.2	0.002 to 0.023	0.02 - 0.017	Resilient rail fasteners and direct fixation rail fasteners
	Commercial		0.003 to 0.018	0.001 - 0.017	
	Educational		0.003 - 0.021	0.001 - 0.027	
	Worship		NA	0.005	
	Medical		0.003	NA	
	Hotel		0.005 - 0.017	0.003 - 0.004	

5.8.4 Indigenous Cultural Heritage

The relocation of the Northern Portal from Victoria Park to the rail corridor (Exhibition Line) would avoid adverse effects on indigenous cultural heritage values attaching to the park that would potentially be affected by the Reference Project.

5.8.5 Non-Indigenous Cultural Heritage

The changed alignment would be closer to Victoria Barracks (Commonwealth Heritage Register 105226) and Brisbane Grammar School (QHR 600124). The Commonwealth listing for Victoria Barracks relates to the whole property while the changed alignment would pass close by the north-east corner of the property.

A preliminary settlement analysis for the Changed Project for that section of the alignment closest to Victoria Barracks indicates a maximum settlement of 7mm. While subsequent more detailed analysis would be conducted to inform detailed design, settlement of this magnitude would likely have a negligible effect on the buildings within Victoria Barracks.[25]

Operational ground-borne vibration from the Changed Project in the vicinity of Victoria Barracks would range from 0.001-0.03mm/sec PPV, which is well below the criterion for building damage to heritage places of 2.0mm/sec.

Similar ground-borne vibration would potentially manifest at Brisbane Grammar School with little or no potential for impact or damage to heritage structures. Settlement adjacent to Brisbane Grammar School is predicted to range between 25-30mm over a trough width of 50-70m. Monitoring would inform construction management to mitigate any risk of damage to heritage buildings.

5.8.6 Social

The changed location of the Northern Portal and the feeder station in the operational phase of the project would avoid the potential impacts on the recreation and community values attaching to Victoria Park.

While the Northern Portal would be closer to the BGGS, modelling indicates that the operational noise from the Changed Project would be within the planning criteria for the Exhibition Line rail corridor. Similarly ground-borne noise and vibration predicted for the Changed Project in its operational phase would be below the criteria for the commercial and entertainment premises along Petrie Terrace.

Connectivity through and beyond Victoria Park to key social infrastructure would be maintained with the Changed Project as it would with the Reference Project.

5.9 Exhibition Station

While the configuration of the changed station at Exhibition is different to the station for the Reference Project, the operational effects of both would be substantially similar in this location.

The changed station would offer the same high levels of connectivity with the RNA Showgrounds, Bowen Hills and the Royal Brisbane and Women's Hospital as offered by the Reference Project.

There would be some reduced impacts to vegetation (fig trees) and heritage buildings within the RNA Showgrounds, compared to the Reference Project.

There would be a slight improvement through the reduction of airborne noise in the operation of the Changed Project compared with the Reference Project. This improvement would arise from the reduction in forecast rail freight traffic on the Exhibition Line (not attributable to the Project). There would be no exceedance of the single event maximum noise planning level due to rail freight movement and the increase in rail passenger movement would not result in a noticeable increase in background noise levels ($LA_{eq(24\ hour)}$).

[25] Technical Reports (Volume 4)

There would no longer be a requirement for a feeder station north of Lanham Street as proposed in the Reference Project, and therefore no airborne noise impacts at sensitive receivers in the Bowen Hills area associated with this facility.

5.10 **Mayne Yard**

The Changed Project would have a similar, although slightly larger, footprint in Mayne Yard compared with the Reference Project. The Changed Project would allow greater flexibility in the use and operation of Mayne Yard and would avoid the potential operational conflicts that might arise with the Reference Project. This benefit is achieved by separating the CRR tracks from the northern line tracks by way of an underpass (trough structure) just north of the Ferny Grove viaduct. The change in alignment through Mayne Yard is illustrated in Figure 5-10.

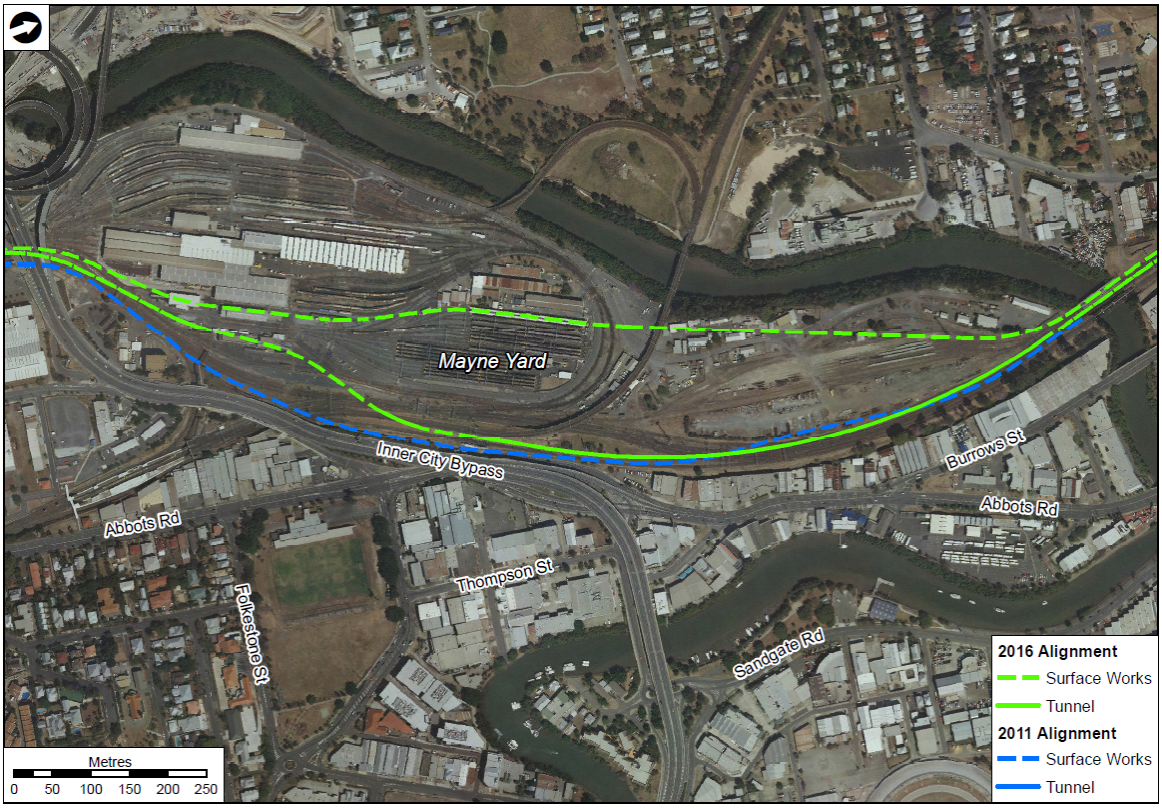

Figure 5-10 - Alignment changes at Mayne Yard

The overall change in effects of the Changed Project at Mayne Yard are summarised in Table 5-31.

Table 5-31: Effects of changes, Operations phase (Mayne Yard)

EIS aspect	Likely changed environmental effect
Transport	Refer to 5.2
Climate Change and Sustainability	No changed effect
Topography, Geology, Geomorphology and Soils	No changed effect
Land Contamination	No changed effect
Land Use and Tenure	No changed effect
Visual Amenity and Lighting	Refer below
Nature Conservation	Refer below
Groundwater	No changed effect
Surface Water Quality	No changed effect

Flood Management	Refer below
Air Quality	No changed effect
Noise and Vibration	Refer below
Waste Management	No changed effect
Indigenous Cultural Heritage	No changed effect
Non-Indigenous Cultural Heritage	No changed effect
Social	No changed effect
Hazard and Risk	No changed effect
Cumulative Impacts	No changed effect

5.10.1 Visual Amenity and Lighting

The viaduct proposed in the Reference Project to convey the CRR tracks to tie in with the existing northern line would not be required in the Changed Project. This would remove an elevated structure, approximately 9m high, from the urban landscape adjacent to the inner-city bypass viaduct. This would provide some relief from the intense infrastructure development characteristic of this area of Bowen Hills.

5.10.2 Nature Conservation

While remaining well within the confines of Mayne Yard, the Changed Project (north-bound track) would pass closer to the Breakfast/ Enoggera Creek bank, with its riparian vegetation, than the Reference Project. The riparian vegetation along Breakfast/Enoggera Creek adjacent to Mayne Yard has supported colonies of Black flying-fox (*Pteropus Alecto*). Since May 2014 the roost site for Black flying-fox has been used sporadically with greatly reduced numbers recorded. During a flying-fox assessment in July 2016 only three Black flying-fox were recorded. This species is protected under the *Nature Conservation Act 1992* (Qld). There are no records of the site being used by the Grey-headed flying-fox.

The Changed Project would have no greater direct effect on the riparian vegetation of Breakfast/ Enoggera Creek than the Reference Project.

5.10.3 Flood Management

Mayne Yard is affected by flooding in Breakfast/Enoggera Creek. The Changed Project underpass (trough structure) has the potential to be effected by flooding in that waterway when it impacts on Mayne Yard. Detailed flood modelling would be required to inform detailed design to ensure the Changed Project is not adversely affected in its operational phase by flooding.

5.10.4 Noise and Vibration

There would be no change in the effects of the Changed Project compared with the Reference Project with regards to airborne rail noise on sensitive receivers.

6. Effects of the Proposed Changes on the Reference Project - Delivery

6.1 Construction Methods

The key changes to the construction method for the Changed Project would be:

- a combination of cut-and-cover and mined tunnelling instead of bored tunnelling between the Southern Portal and Woolloongabba
- greater use of cut-and-cover construction for Albert Street Station
- demolition of the BTC (West Tower) and more extensive use of cut-and-cover construction at Roma Street.

Other changes reflect changes in project alignment and not changes in construction method (e.g. the Northern Portal). Some surface works in the rail corridor are works which would be conducted as part of general rail network improvements (e.g. trackworks, additional platform and other improvements at Dutton Park Station).

Construction of the Changed Project would impact on existing traffic conditions through additional construction vehicles using the road network, in much the same way anticipated for the Reference Project. Construction traffic would be generated by the removal and haulage of spoil from excavation sites and the TBM operations, as well as the delivery of construction materials including oversized loads for concrete segments for tunnel lining, prefabricated components and large machinery plant and equipment.

6.2 Spoil and Materials Haulage

As discussed in 3.2.4, the Changed Project would rely on one or more of five potential spoil placement sites to receive construction spoil. The haulage routes from the project works to the spoil placement sites would be designated for that purpose in construction traffic management plans.

Peak daily spoil and delivery vehicle movements are compared in Table 6-1. Due to the reduced scale of the Changed Project, there would be a significant reduction in the peak daily construction trips at each worksite and across the project corridor.

Table 6-1 Construction peak daily traffic (one way movements)

Construction Worksites	**Peak Spoil Movements** (Loads / Day)		**Peak Delivery Movements** (Loads / Day)	
	Reference Project	**Changed Project**	**Reference Project**	**Changed Project***
Tunnelling works				
Southern Portal	214	12	57	20
Ventilation Facility (Fairfield)	29	n/a	8	n/a
Boggo Road	89	46	24	24
Woolloongabba	214	142	57	57
Albert Street	80	32	21	21
Roma Street	103	39	27	27
Northern Portal	75	31	20	20
Surface works				
Clapham Yard	-	-	143	-
Mayne Yard	-	20	143	100
Exhibition	-	-	60	60
Totals	**804**	**322**	**560**	**329**

Note: The estimated peak daily construction traffic does not include traffic associated with demolition activities.
* Determined to be similar to Reference Project, except Mayne Yard, which was reduced due to a change in design (construction of an underpass/trough structure in place of a viaduct).

For both the Reference Project and the Changed Project, demolition and site establishment would be expected to be for less than six months. The frequency of truck movements is expected to not exceed that of the excavation stage. The peak hourly construction traffic for both the Reference Project and the Changed Project is presented in Table 6-2.

Table 6-2: Peak hourly construction traffic (one way movements)

Construction Worksites	**Peak Traffic Movements** (Loads / Hour)	
	Reference Project	**Changed Project**
Southern Portal	15	3
Ventilation Facility (Fairfield)	3	n/a
Boggo Road	9	6
Woolloongabba	14	11
Albert Street	8	5
Roma Street	10	6
Northern Portal	8	5
Clapham Yard	9	n/a
Mayne Yard	9	8
Exhibition	4	4

It is evident that the Changed Project would generate a much lower construction traffic load on the local road network than the Reference Project. The hourly peak traffic flow from the Woolloongabba worksite would require management to avoid conflicts with peak traffic flows on the arterial roads in the locality.

6.2.1 Intersection Analysis

For the Reference Project, the 'worst-case' scenario assumed existing peak hour traffic plus the peak rate of haulage movements with all worksites operating at full capacity concurrently accessing the Swanbank spoil placement site. An intersection analysis was undertaken for all intersections along the haul route to determine critical intersections. Twelve intersections were identified and detailed SIDRA analysis completed. Mitigation measures were proposed where the average intersection delay increase was greater than 5 seconds.

For the Changed Project, the assessment was based on previous technical investigation for the BaT project, which adopted these same five spoil placement sites. The assessment analysed the haul routes of three spoil placement sites (Brisbane Airport, Swanbank and Pine Mountain) using cumulative volumes to test whether all of the spoil could be delivered to any one site. Considering that the total peak hourly trip generation for the Changed Project is lower than both the Reference Project and the BaT project, construction traffic impacts would also be reduced.

6.3 Construction Worksites

6.3.1 Southern Portal and Boggo Road

The Southern Portal would be constructed through surface excavation works leading to cut-and-cover works for the connections to the Boggo Road Station cavern. The station would be constructed by cut-and-cover methods. The Changed Project worksite for the Southern Portal is shown in Figure 6-1. The Reference Project and Changed Project worksites for Boggo Road Station are shown in Figure 6-2 and Figure 6-3, respectively.

Construction Traffic - Southern Portal

The Southern Portal construction worksites would be located within the existing rail corridor bounded by Dutton Park Station, Kent Street and the Eastern Busway. Access to the worksite primarily would be off Ipswich Road with a secondary access for light vehicles off Kent Street. There would be a temporary bridge over the Eastern Busway provided within this worksite, adjacent to the rail overpass. This bridge would be used by construction vehicles to access the worksite and would connect to Ipswich Road via O'Keefe Street, reducing the impact on the PA Hospital and Cornwall Street.

A secondary access for light vehicles only to the Southern Portal worksite for the Changed Project would be via Cornwall Street onto Kent Street. This secondary access would be used by workers' vehicles coming off Annerley Road. Additional traffic from workers arriving on site would contribute to inbound morning traffic but would generally be arriving on site before the AM peak period.

In the Changed Project, workforce parking for up to 115 cars would be provided within the Southern Portal worksites. Parking demand for the Changed Project would be lower than for the Reference Project (464 parking spaces – Southern Portal).

While the existing 'live tracks' would be retained much of the existing offline rail infrastructure and buildings on the Southern Portal worksite would be demolished for the Changed Project. The low number of truck movements during demolition would have minimal impact on existing traffic. Spoil haulage access routes for the site would be via the temporary bridge to O'Keefe Street, connecting to major arterial roads and ultimately to the placement sites.

Heavy vehicle movements to and from this worksite are forecast to peak at around three trucks per hour at peak spoil haulage times. This is less than the peak haulage movements forecast for the Reference Project, for which impacts on the surrounding road network would be minor and would not require mitigation. With primary access from Ipswich Road and the small number of truck movements, construction traffic for the Changed Project would have no discernible impacts on surrounding traffic conditions. Impacts on the local road network would be reduced as access would be provided off two major arterial roads (Annerley and Ipswich Roads).

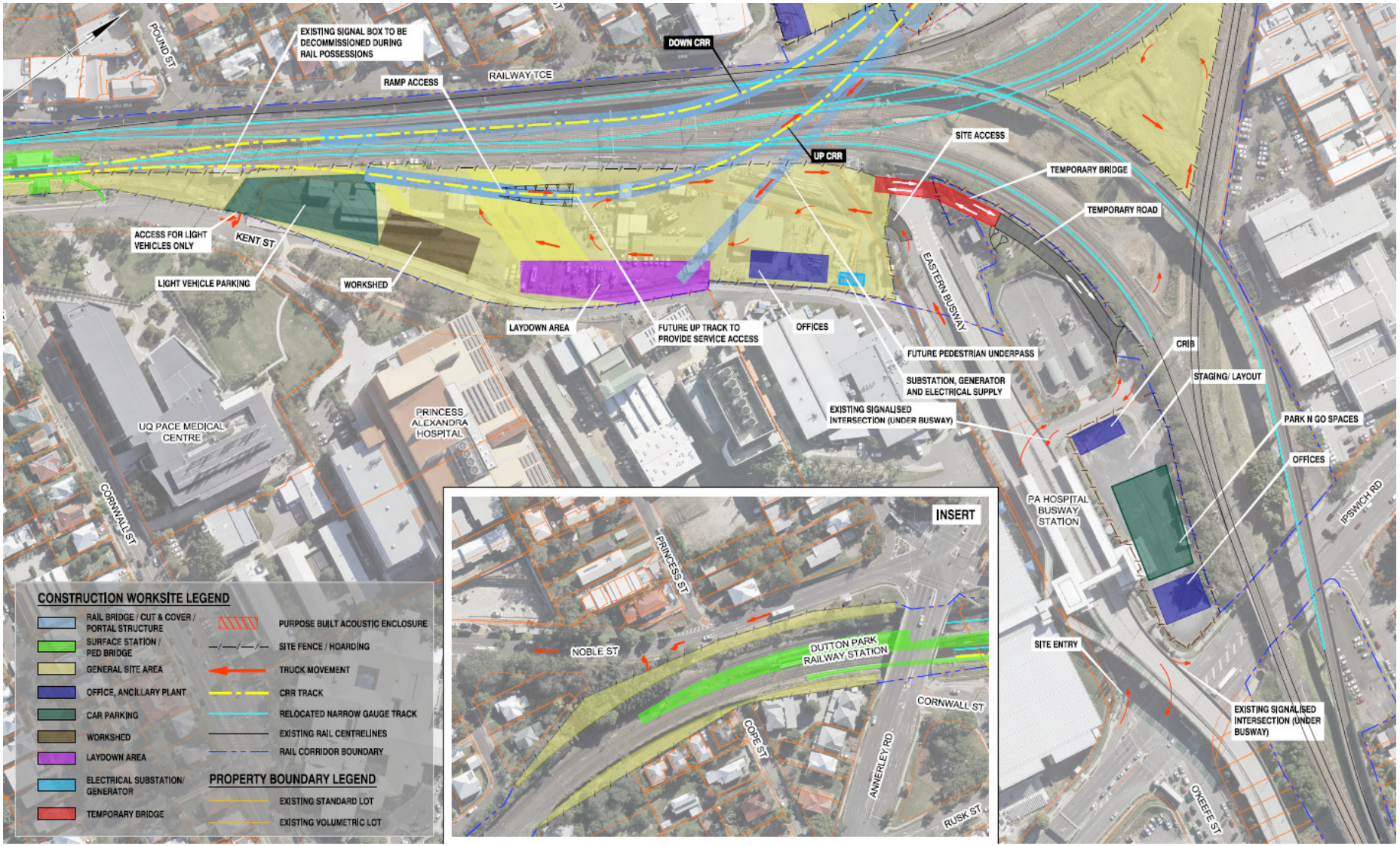

Figure 6-1 - Changed Project Southern Portal worksite

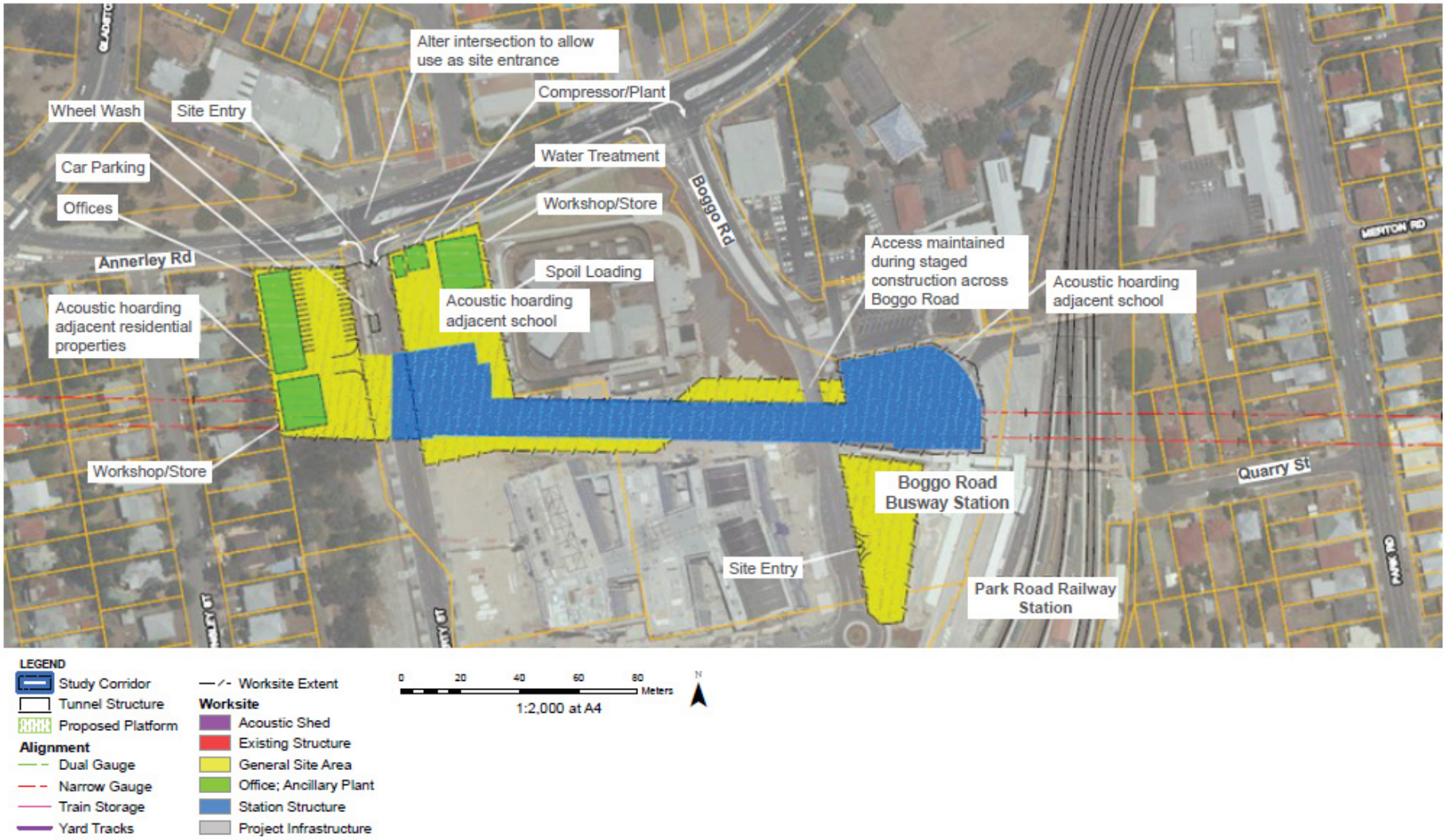

Figure 6-2 - Reference Project Boggo Road Station worksite

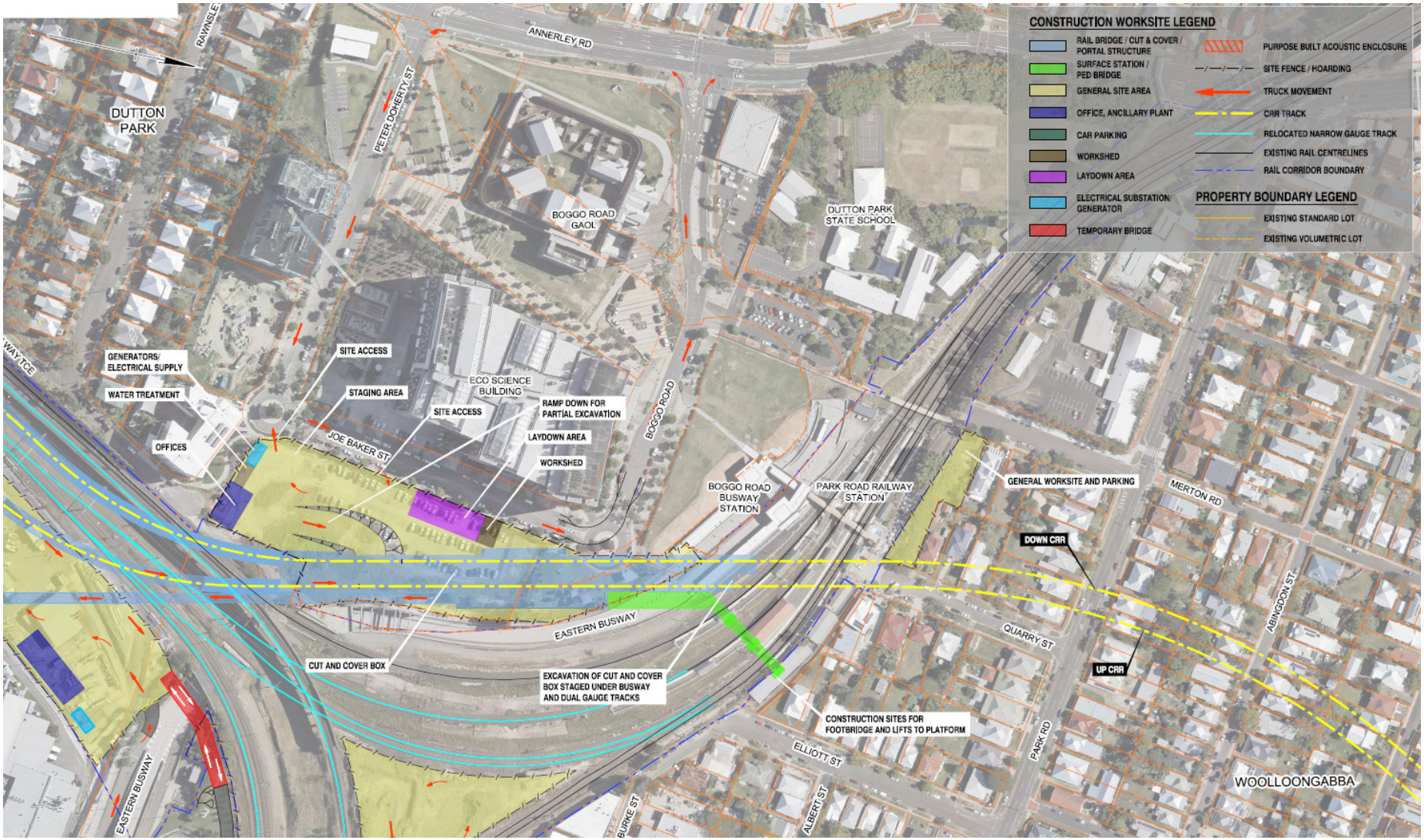

Figure 6-3 - Changed Project Boggo Road Station worksite

Construction Traffic - Boggo Road

The proposed Boggo Road worksite for the Changed Project would be located within the Boggo Road Urban Village (Lot 2 Joe Baker Street) with a smaller, auxiliary site located adjacent Park Road Railway Station between Quarry Street and Merton Road. The worksite at Joe Baker Street is currently being used for car parking.

Where possible, the main worksite would be accessed via Cornwall Street and Annerley Road with a one-way circulation into Peter Doherty Street, Joe Baker Street and exit out of Boggo Road. The right-turn access to this worksite from Annerley Road into Peter Doherty Street would require a short right-turn bay to be provided at this intersection. This one-way circulation system provides for controlled management of truck movements through the precinct.

Spoil haulage access to Ipswich Road would be via Annerley Road and Cornwall Street and through to Ipswich Road, connecting to spoil placement sites.

The auxiliary worksite (between Quarry Street and Merton Road) would provide up to 45 car park spaces, compared with 30 spaces proposed in the Reference Project. Pedestrian access to the changed worksite would be via the footbridge over the rail corridor west of the existing Park Road Station. Workers accessing the car park from Annerley Road onto Park Road would contribute to inbound morning movements but would generally be arriving on site before the AM peak period.

In relation to impacts on Boggo Road Busway Station, there may be short-term temporary closures required of the busway during construction. Where possible, closures would occur during off-peak periods including weekends.

Heavy vehicle movements to and from the Boggo Road changed worksite are forecast to peak at around six trucks per hour at peak spoil haulage times. This is less than the peak haulage movements forecast for the Reference Project.

The predicted impacts of heavy vehicle movements on the surrounding road network for the Changed Project would be minor and less than that for the Reference Project. The Boggo Road worksite would affect local traffic within the Boggo Road Urban Village with minimal impacts on Annerley Road and Cornwall Street.

Land Contamination

The project works for the Southern Portal and the Boggo Road Station would be situated within and adjacent to the rail corridor at Dutton Park. The EMR indicates the notifiable activity over this land is hazardous contaminants arising from railway operations. The Kent Street worksite is adjacent to the PA Hospital which is listed on the EMR for petroleum and oil product storage.

Detailed site assessments would be required prior to the commencement of the works to enable the scope and scale of the environmental hazard to be assessed. The management procedures for handling and disposing of contaminated soil from railway land are established under the provisions of the *Environmental Protection Act 1994* and remain unchanged from the requirements for the Reference Project.

Groundwater

The cut-and-cover section of Boggo Road Station would be undrained (above rock) and the base would be drained. In this location the rock is fractured near the surface with evidence of groundwater flow through iron-staining of joints.

Construction of the changed Boggo Road Station would encounter contact zones between Brisbane Tuff and Aspley Formation. This carries the risk of increased permeability and inflows of groundwater at these contacts. Groundwater inflows would be manageable with probing and grouting.

The mined tunnel component between Boggo Road Station and Woolloongabba Station would be likely to intersect mixed ground, low rockhead and higher permeability soil and rock. There is a potential for major transmissive features such as the Normanby Fault to be encountered and potential for increased permeability and groundwater inflows. The potential risk would be managed by:

- design measures in sections of undrained, mined tunnels
- tunnel construction and temporary support structures to limit groundwater inflow potential and support of potentially problematic ground conditions.

A comparison between the Reference Project and the Changed Project in relation to groundwater drainage is provided in Table 6-3.

Table 6-3: Groundwater drainage measures

Location	Reference Project	Changed Project
Boggo Road Station	Drained.	Cut and cover undrained above rock, base of cut and cover to be drained.
Boggo Road to Woolloongabba	Undrained – segmental linings with gaskets and undrained cross passages.	Undrained mined tunnels.
Woolloongabba Station	Undrained section for cut and cover elements protruding bedrock into weathered rock and alluvium. Drained construction for the base of the station and cavern elements.	Cut and cover works to be undrained above bedrock with a drained base structure. Northern mined cavern to have a drained base and undrained arch. Southern mined cavern to have a drained cavern and base.

Air Quality

The Boggo Road construction worksite for the Changed Project would be relocated to the eastern side of the Ecosciences building. The Southern Portal construction worksite would be relocated to the northwest of the PA Hospital.

The predicted concentrations of TSP, PM_{10}, $PM_{2.5}$ and dust deposition from the Boggo Road and Southern Portal construction worksites would be lower than those predicted for Boggo Road in the Reference Project (refer to Table 6-4), due to the addition of a ventilated enclosure to control dust emissions. There would be no health or nuisance-based exceedances for the modelled pollutants at any surrounding sensitive receiver locations with this mitigation measure in place.

It should be noted that impacts on air quality for fine particles measured as $PM_{2.5}$ were not included in the EIS for the Reference Project. There was no adopted guideline for that parameter at that time.

The predicted concentrations would also be lower than those predicted for the Yeerongpilly Station and Southern Portal construction worksite in the Reference Project.

Table 6-4: Air quality impacts, Southern Portal and Boggo Road Station, Changed Project

Site	TSP ($\mu g/m^3$)		PM_{10} ($\mu g/m^3$)		$PM_{2.5}$ ($\mu g/m^3$)		Dust (Max Month) ($mg/m^2/day$)
	24hr Nuisance	Annual Health	24hr Nuisance	Annual Health	24hr Nuisance	Annual Health	Nuisance
Guideline	80	90	50	25	25	8	120
Ecosciences Building	26.9	24.2	17.5	14.6	8.4	6.5	60.6
PA Hospital – general services	29.7	24.8	18.6	14.9	8.6	6.6	65.0
Rawnsley St - residential	27.4	24.4	17.7	14.7	8.4	6.5	61.9
Annerley Rd – residential	26.3	24.1	17.2	14.5	8.3	6.5	60.1
Dutton Park State School	26.5	24.1	17.3	14.5	8.3	6.5	60.0
Leukaemia Foundation	28.0	24.5	18.0	14.7	8.5	6.5	62.9

The actual construction sequencing for the Southern Portal would be influenced by the number and frequency of rail possessions. It is possible that construction activities would be staged differently with measured concentrations of air quality parameters lower than this analysis. The provision of a ventilated enclosure of the staged works would be determined by predictive modelling of the air pollutant discharges. Where predictive modelling indicated a likely exceedance of the criteria set out in Table 6-4, mitigation measures including the likely provision of a ventilated enclosure of the work area would be required.

Noise and Vibration

The Changed Project would result in construction works being conducted to the east of the Ecosciences building and within the rail corridor. This change would bring construction activity closer to some sensitive receivers (e.g. ESA Leukaemia Foundation) and further away from others (e.g. Dutton Park State School).

Consistent with the assessment of the Reference Project, construction scenarios for the Changed Project were developed for Southern Portal and Boggo Road Station construction works. Those scenarios would be representative of activities having potentially the greatest (i.e. 'worst-case') noise impact on the surrounding receivers operating simultaneously. For the purposes of assessment, none of the works scenarios included noise mitigation measures.

Airborne construction noise impacts predicted for the Changed Project would be similar to those predicted for the BaT Project.[27] In particular, the predicted airborne noise impacts for Ecosciences and ESA Village (Leukaemia Centre) would be similar to those notified during the public consultation and notification for the BaT Project EIS in August 2014.

Airborne construction noise impacts would be introduced for the PA Hospital, Railway Terrace and Merton Road (to Elliott Street) residential areas.

Airborne construction noise for the Reference Project was assessed against the criteria set out in the CRR EIS (August 2011, Chapter 16), which were derived from Australian Standard 1055.2. The goals remain the same as for the Reference Project in respect of construction airborne noise at nominated sensitive receivers for the Changed Project, and are presented in Table 6-5.

[27] BaT Project EIS August 2014, Chapter 11

Table 6-5: Construction airborne noise goals - Southern Portal and Boggo Road Station

Receiver Location / Type	Monday to Saturday 6:30 am to 6:30 pm		Monday to Saturday 6:30 pm to 6:30 am, Sundays and Public Holidays	
	Steady State (dBA $LA_{eq,adj,15min}$)*	Non-Steady State (dBA $LA_{10,adj,15min}$)*	Continuous (dBA $LA_{eq,adj(15min))}$*	Intermittent (dBA LA_{max})*
Railway Terrace Commercial	67	77	-	-
Railway Terrace Residential	47	57	42	49
ESA Village (Leukaemia Centre)	62	72	57	64
Ecosciences Building	67	77	-	-
Police Station & Gaol	62**	72**	-	-
Dutton Park Primary School	52	62	-	-
Merton Rd to Elliott St Residential	47	57	42	49
PA Hospital	62***	72***	57	64
Cornwall St Residential	47	57	42	49

* Noise goal has been adjusted to represent external free-field levels.
** Noise goal relevant at all times.
*** Based on AS2107 category “wards” for medical buildings.

Adopting a ‘worst-case’ position for each of the construction scenarios, the proposed changes in the southern worksite locations have the potential to result in predicted exceedances of the daytime construction noise goals (LA_{10} or average maximum) for:

- Railway Terrace residential receivers (up to 19 dBA)
- the ESA Village Leukaemia Centre (up to 12 dBA)
- the PA Hospital (up to 9 dBA).

The evening and night-time construction noise criteria would also be exceeded at these receiver locations if these works scenarios were to be undertaken during these time periods. It is noted that not all properties in the locations presented in Table 6-5 are predicted to be affected at the average maximum noise level.

Potential exceedances (up to 13 dBA) of the daytime construction noise criteria would also affect residential receivers north of Park Road Railway Station.

Table 6-6 presents the 'worst-case' construction airborne noise (without mitigation) at the Southern Portal and Boggo Road Street Station.

Table 6-6: Predicted 'worst-case' construction airborne noise (non-steady state) - Southern Portal and Boggo Road Station

Receiver Location / Type	External Construction Noise Criteria $LA_{10,adj,15min}$				
	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
Railway Terrace Commercial	64	58	67	61	49
Railway Terrace Residential	71	66	74	76	56
ESA Village Leukaemia Centre	75	75	76	84	69
Ecosciences Building Commercial	80	81	82	70	65
Dutton Park Primary School	51	57	56	40	32
Merton Rd to Elliott St Residential	65	69	70	61	51
PA Hospital	80	73	81	73	65
Kent St & Cornwall St Residential	51	55	56	51	36

The predicted effects of construction of the Changed Project for airborne noise give rise to a need for effective mitigation based upon predictive modelling, monitoring and consultation with directly affected parties. Detailed investigations for the BaT project[28] indicate there are a range of construction and mitigation techniques which would be effective in addressing the predicted impacts.

The ground-borne noise impacts during construction of Boggo Road Station have been predicted for the Changed Project, adopting a 'worst-case' construction scenario without mitigation.

Without mitigation measures, exceedances of the internal ground-borne noise criteria are predicted during excavation of the tunnel portal and underground station for:

- the ESA Village Leukaemia Centre (up to 4 dBA)
- residential receivers north of Park Road Railway Station (up to 17 dBA).

Table 6-7 presents the 'worst-case' construction ground-borne noise at the Southern Portal and Boggo Road Street Station. A detailed analysis of the predicted noise levels for each construction scenario is presented in the Technical Reports (Volume 4). Mitigation measures of the construction works would be required to achieve the environmental objectives at all sensitive receivers.

Table 6-7 - Predicted 'worst-case' construction ground-borne noise and vibration - Southern Portal and Boggo Road Station

Receiver Area	Period	Ground-borne Noise and Vibration Goals			Predicted Ground-borne Vibration Level PPV (mm/s)	Predicted Ground-borne Noise Level (dBA)*	
		Vibration PPV (mm/s)	Internal Ground-borne Noise (dBA)			Rock-breaker	Road-header
			Continuous	Intermittent			
Railway Terrace (Pound St to Rawnsley St)	Day	10	40 LAeq,adj	50 LA10,adj	0.12	33 LA10	35 LAeq
	Night	0.5	35 LAeq,adj	42 LAmax	0.12	37 LAmax	35 LAeq
ESA Village	Day	25	40 LAeq,adj	50 LA10,adj	0.19	39 LA10	39 LAeq
	Night	0.5	35 LAeq,adj	42 LAmax	0.19	**43** LAmax	**39** LAeq
Ecosciences Building	Day	25	45 LAeq,adj	55 LA10,adj	0.44	53 LA10	26 LAeq
Ecosciences Building (TEM)	24/7	0.013 RMS mm/s**	N/A	N/A	0.01 RMS mm/s**	N/A	N/A
Dutton Park Primary School	Day	10	45 LAeq,adj	55 LA10,adj	0.03	33 LA10	19 LAeq
Merton Rd to Elliott St	Day	10	40 LAeq,adj	50 LA10,adj	2.0	47 LA10	**52** LAeq
	Night	0.5	35 LAeq,adj	42 LAmax	2.0	**51** LAmax	**52** LAeq
PA Hospital	Day	25	40 LAeq,adj	50 LA10,adj	0.03	26 LA10	20 LAeq
	Night	0.5	35 LAeq,adj	42 LAmax	0.03	30 LAmax	20 LAeq

* Exceedances shown in bold.

** The TEM criterion is specified in root mean square (RMS) vibration velocity. The vibration predictions assume a crest factor (i.e. difference between PPV and RMS) of 4.

Mitigation measures for construction works giving rise to ground-borne noise and vibration effects greater than the nominated goals would be required and would be informed by predictive modelling, monitoring and consultation with directly affected parties.

Ground-borne vibration from construction of the Boggo Road Station in the Reference Project had the potential to impact on the operation of a transmission electron microscope (TEM) housed in the Ecosciences building. The relocation of the Boggo Road Station in the Changed Project would increase the separation distance between the works and the TEM and reduce the potential for

[28] Bus and Train Project EIS August 2014 Chapter 11

impacts to an unlikely level of occurrence. Prudent construction management would still involve consultation with the TEM operators and monitoring of vibration levels caused by the project works.

Non-indigenous Cultural Heritage

The construction of the Southern Portal and Boggo Road Station in the Changed Project would not impact on the cultural heritage values of the Boggo Road Gaol, nor would the works impact on the gaol building due to the increased separation distance.

6.3.2 Boggo Road to Woolloongabba (mined tunnel)

The tunnels between Boggo Road Station and Woolloongabba Station in the Changed Project would be constructed as mined tunnels, rather than as bored, segmentally-lined tunnels for the Reference Project.

Groundwater

There would be a temporary drawdown of groundwater during the excavation phase of construction. Progressive installation of a permanent tunnel lining would arrest the inflow of groundwater, allowing the water-table to return to its preconstruction levels.

Settlement

There would be an increased potential for settlement associated with tunnel works for the Changed Project in the vicinity of Park Road Station and Quarry Street, compared with the Reference Project. Settlement of the surface for the Reference Project was estimated to be in the range of 10 – 25mm over a trough width ranging from 75 – 125m for this section of the route. For the Changed Project, the mined tunnel section would contribute to settlement ranging from 15 – 35mm over a trough width ranging from 40 – 80m. Most buildings in this section are Queenslander style housing well suited to accommodate Brisbane's expansive soils. A preliminary building damage assessment of the change in settlement risk for masonry buildings (i.e. 'worst-case') indicates a slight risk of damage. These buildings would require specific monitoring of settlement during construction.

Building condition surveys prior to the commencement of the works, supported by ground monitoring, would enable the works to proceed while effectively managing the risk to property owners and occupants.

Noise and Vibration

The change in construction methodology to mined tunnelling excavation would involve roadheader and possibly drill and blast tunnelling. This construction methodology would progress at a slower rate than a TBM, but would generate significantly lower ground-borne noise and vibration to receivers above the tunnels.

The assessment of vibration levels determined there would be no exceedances of the cosmetic damage vibration goals for residential property or the stricter cosmetic damage goal for heritage buildings.

Between Boggo Road Station and Woolloongabba Station, the indicative maximum vibration levels and ground-borne noise levels would be lower for the Changed Project than for TBM tunnelling for the Reference Project. Ground-borne noise during roadheading would potentially impact residential receivers located in Quarry Street, Park Road, Elliott Street, Lockhart Street, Abingdon Street, Longwood Street, Ross Street, Fleurs Street, Peterson Street, Wilton Street and Hubert Street.

To relieve the potential impacts of roadheading work, drill and blast construction methods may be used as an alternative for sections of tunnel between Boggo Road Station and Woolloongabba Station. The design of a blast can be controlled to ensure that vibration levels remain within specified bounds and within designated and notified periods.

Non-indigenous Cultural Heritage

The realignment of the tunnels and the adoption of mined tunnelling construction methods reduces the potential to impact on places of cultural heritage significance further. While there are places of local heritage interest in the study corridor between Boggo Road and Woolloongabba, none would be affected by construction of the Changed Project.

Social

Construction of the changed alignment of the tunnels between Boggo Road and Woolloongabba for the Changed Project would not lead to impacts on social or community infrastructure.

6.3.3 Woolloongabba Station

In the Changed Project, the station box would be situated further to the east but within the same general worksite for Woolloongabba Station as proposed for the Reference Project. As a consequence, the effects of construction would also be moved further east. This would also be the case for the tunnels running to the north between Woolloongabba and Albert Street.

The construction method of the Woolloongabba Station for the Changed Project would be similar to that proposed for the Reference Design. The station would be constructed by a combination of cut-and-cover works for the upper levels of the underground station and mining for the deep caverns. As with the Reference Project, the upper levels of the Changed Project station would be undrained to minimise groundwater inflow. The base of the station would be drained.

There would be an acoustic work shed erected over the main access shaft in the worksite, principally to support TBM tunnelling works, including the handling of tunnel segments.

The TBMs would be launched from Woolloongabba, as was proposed for the Reference Project.

The construction worksites for Woolloongabba Station for the Reference Project and Changed Project are shown in Figure 6-4 and Figure 6-5, respectively.

Construction Traffic

Overall, the access arrangements for the Changed Project would be improved compared with the Reference Project with additional access proposed to and from Leopard Street.

Heavy vehicle movements to and from the Woolloongabba worksite for the Changed Project would peak at about 11 trucks per hour at peak spoil haulage times compared with about 14 trucks per hour with the Reference Project (refer to Table 6-2). With the reduction in peak haulage traffic, impacts on the surrounding road network would be minor.

Spoil from the Changed Project (Woolloongabba) would follow the spoil routes described in section 3.2.4 to transport spoil to placements sites.

While the Reference Project did not have a direct effect on busway operations, the Changed Project would lead to temporary impacts on busway operations to allow for construction of the pedestrian footbridge from Stanley Street at the western end of the busway station. This may involve piling and placing of deck structures which would require some busway closures or traffic management. Busway interruptions would be for short periods (typically days) and where possible, would occur during off-peak periods to minimise disruption to services.

There may also be some minor delays to buses traveling along Main Street and Vulture Street with construction vehicles entering and exiting the worksite.

Other traffic impacts such as pedestrian and cyclist access, local parking, local access, emergency vehicle access and special events would be consistent with those anticipated for the Reference Project.

The Changed Project would provide construction workforce parking for up to 300 cars compared with 72 cars for the Reference Project. This is due to Woolloongabba now being the main spoil removal

location for tunnelling works. Additional workforce traffic would contribute to greater inbound morning traffic movements but these would generally be arriving on site before the AM peak period.

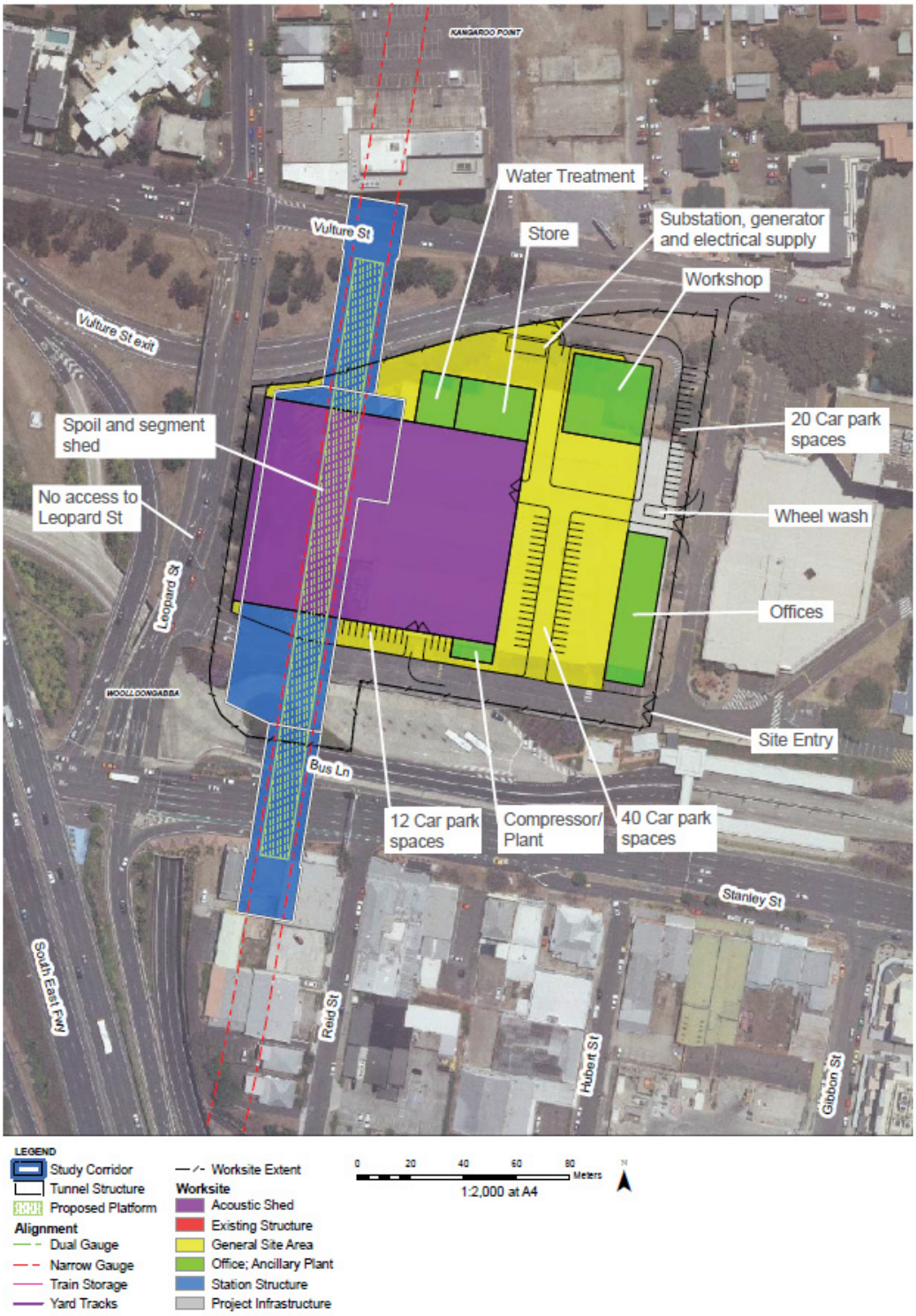

Figure 6-4 - Reference Project Woolloongabba Station worksite

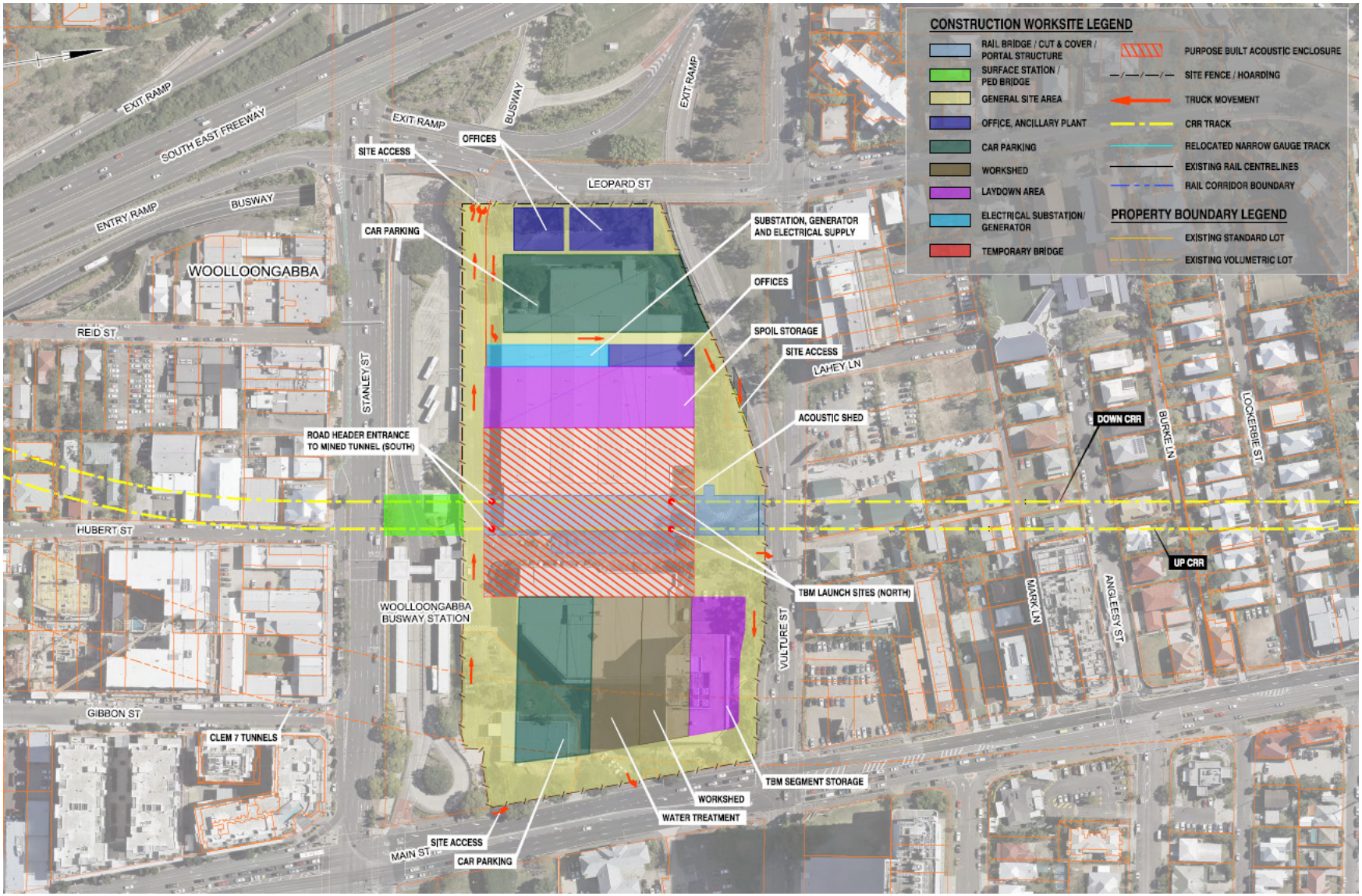

Figure 6-5 - Changed Project Woolloongabba Station worksite

Air Quality

The potential impacts on air quality arising from construction of the Changed Project at Woolloongabba are similar to those anticipated for the Reference Project. It should be noted that impacts on air quality for fine particles measured as $PM_{2.5}$ were not included in the EIS for the Reference Project. There was no adopted guideline for that parameter at that time.

There would be no exceedances of health-based ambient air quality criteria for the modelled pollutants at any surrounding residential receiver locations. Some exceedances of the health-based, 24-hour and annual average PM_{10} and annual average $PM_{2.5}$ criteria are predicted at the indicator site in Main Street. It is noted that the building on this site is to be demolished.

Adopting a 'worst-case' approach to modelling, there would be exceedances of:

- the nuisance-based criterion for 24-hour average for total suspended particulates (TSP) for receivers in Vulture Street (residential) and in Vulture Street at St Nicholas Russian Orthodox Cathedral
- the annual average dust deposition rate nuisance criterion at all modelled receivers except for St Joseph's Primary School.

The predicted impacts of the Changed Project on air quality at surrounding sensitive receivers would be less compared to those anticipated for the Reference Project. This is due to the inclusion of additional mitigation measures (paving/sealing of haul roads) to minimise wheel-generated dust emissions from the Changed Project.

Noise and Vibration

Noise and vibration impacts generated by construction works in the Changed Project worksite at Woolloongabba would be substantially similar to those anticipated for the Reference Project.

Non-indigenous Cultural Heritage

There are three places on the Queensland Heritage Register which have the potential to be affected by works at the Woolloongabba worksite and in the caverns and tunnel sections adjacent to it. They are:

- the old Woolloongabba Post and Telegraph Office (QHR 600357) at 765 Stanley Street
- the old Woolloongabba Police Station (QHR 601382) at 842 – 848 Main Street
- St Nicholas Russian Orthodox Cathedral (QHR 600358) at 330 – 334B Vulture Street.

The realigned tunnels between Boggo Road and Woolloongabba would pass deep beneath the old post office. There would be at least 23m[29] of cover above the crown of the tunnels. With careful construction management, the potential for impacts caused by vibration and settlement would be low. A construction management plan would address the specific requirements to manage any potential construction risks for this building.

There would be no risk to the heritage values of the old police station as a consequence of changes to the Reference Project.

The mined cavern (northern) for the changed station at Woolloongabba would lie beneath St Nicholas Russian Orthodox Cathedral. There would be approximately 10m[30] of cover between the cathedral (ground-level) and the top of the station cavern. Construction of the mined cavern would require careful design and management to avoid damage to the cathedral arising from either vibration or settlement. Settlement is estimated to be in the range of 10 – 25mm.

A construction management plan supported by vibration and settlement monitoring would assist in managing this risk.

[29] Refer to Technical Drawings, Long Sections (Down Track) (Sheet 2) – level difference at chainage 2600 is approximately 29.88m surface to rail track, including approximately 6.0m for track to crown.
[30] Refer to Technical Drawings, Woolloongabba Station Sections, Section A

6.3.4 Albert Street

Apart from the relocation of Albert Street further to the north-west along Albert Street, the Changed Project proposes the station be constructed by a combination of cut-and-cover and mining methods. Whereas the Reference Project proposed mostly a mined cavern supported by two deep shafts off the street, the Changed Project proposes a staged approach to establishing a shaft by cut-and-cover method within the road reserve, from which the caverns would be mined in either direction.

There would be an acoustic work shed erected over the main shaft from which cut-and-cover works and subsequent cavern mining works would be serviced.

The Albert Street Station worksite for the Reference Project and the Changed Project are shown in Figure 6-6 and Figure 6-7, respectively.

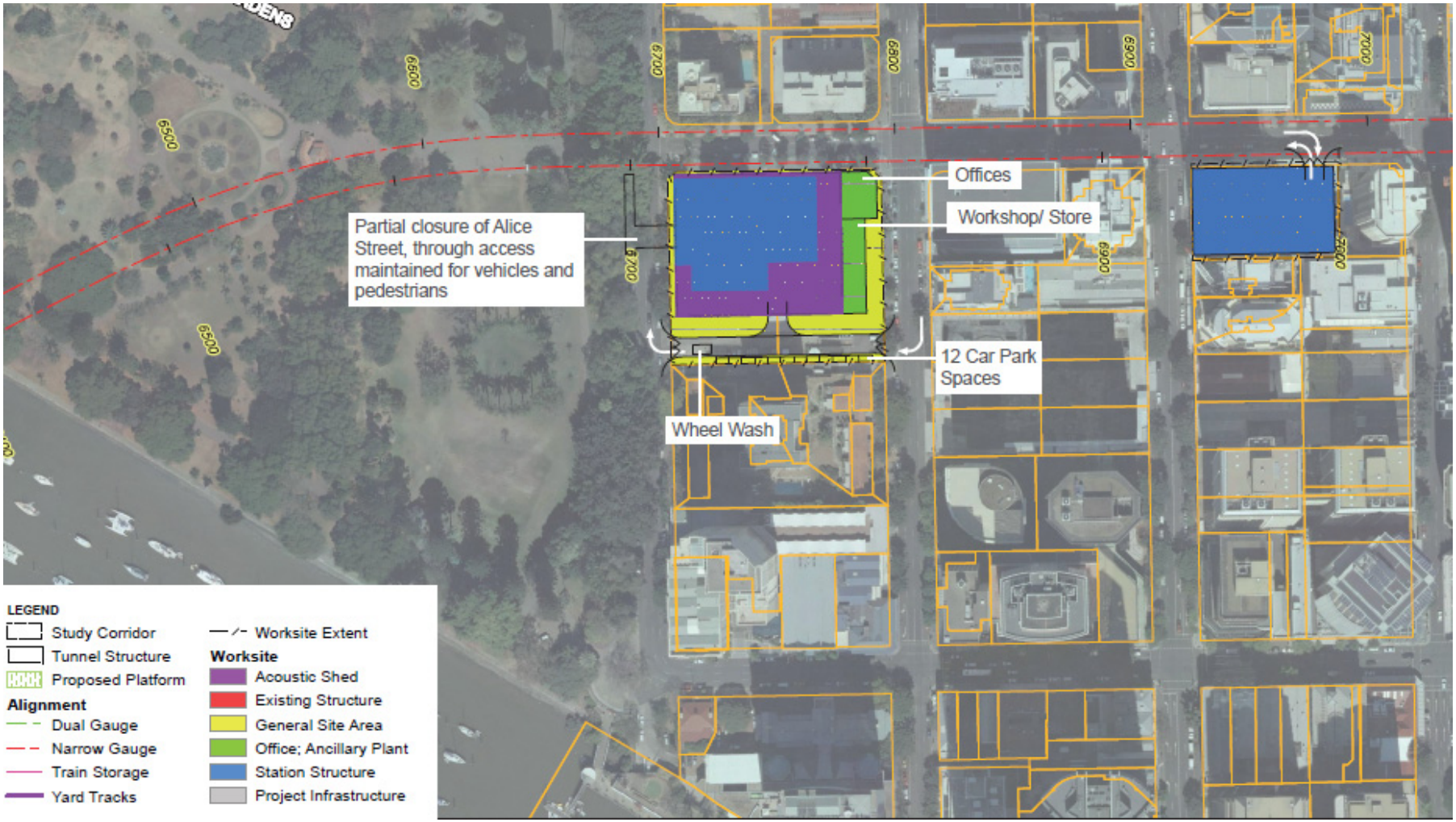

Figure 6-6 - Reference Project Albert Street Station worksite

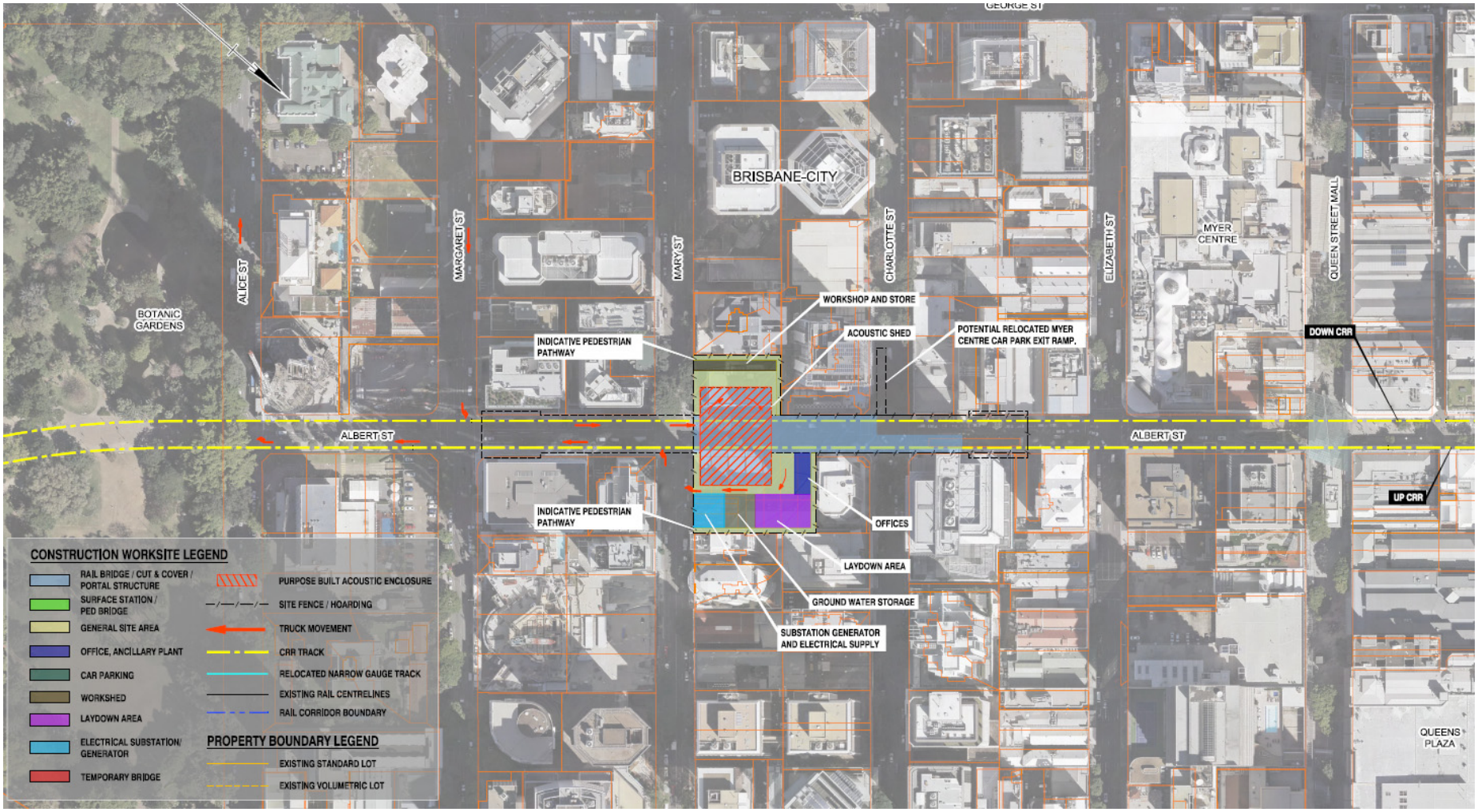

Figure 6-7 - Changed Project Albert Street Station worksite

Construction Traffic

Unlike the Reference Project which proposed a mined station cavern serviced by 'off street' worksites, the Changed Project would involve the partial closure of Albert Street between Mary Street and Charlotte Street to construct the Albert Street Station in its changed location.

The sequencing of the station excavation and construction would maintain pedestrian access through Albert Street. The potential for conflicts between pedestrians and construction traffic would be managed in accordance with a construction traffic management plan.

Establishment of the worksite would allow pedestrian traffic to be maintained along footpaths, with some disruption. Pedestrian flows would be interrupted by construction vehicles crossing footpaths to access work sites, as occurs with any construction site in the central city. Construction vehicles would need to cross the Mary Street footpath to enter and leave the changed worksite.

Heavy vehicle traffic from this worksite would peak at around five trucks per hour in peak spoil production times, compared with eight movements per hour for the Reference Project. Analysis for the Reference Project indicated impacts on the surrounding road network to be minor. A SIDRA analysis undertaken for the Changed Project also indicates that the intersection of Albert Street and Mary Street would be able to accommodate additional traffic with the partial closure.

The partial closure of Albert Street for the Changed Project would likely lead to a redistribution of traffic to other parts of the CBD network. Section 5.2.5 confirms that the CBD road network would continue to function with similar levels of service at key intersections with the partial closure of Albert Street.

As with the Reference Project, there would be no on-site car parking provided for the workforce during construction of the changed Albert Street Station. The changed worksite is accessible to the construction workforce through the existing public transport system. Abundant commercial car parking is also available nearby.

Buses do not use the section of Albert Street proposed to be closed. Bus routes would therefore not be affected by the Changed Project.

The CityCycle station near the corner of Albert Street and Mary Street would need to be relocated in coordination with BCC. Most cycle parking and other street furniture on Albert Street between Mary Street and Elizabeth Street would be temporarily removed during construction.

If required, the potential relocation of the Myer Centre exit ramp to Charlotte Street between Albert Street and George Street would result in temporary lane closures within the vicinity of the intersection of Albert Street and Charlotte Street. The relocation of the ramp would be implemented in construction stages. As a result, various lane closures and vehicle access conditions and diversions would be required for each stage of construction. Not all the construction stages would directly impact intersection traffic as some stages would be underground.

The traffic impacts associated with each stage of the relocation would be addressed in a comprehensive Construction Traffic Management Plan (CTMP), including temporary removal of on-street car parking on Charlotte Street.

Results from SIDRA intersection assessment indicates that potential traffic impacts are within the capacity of the existing intersection of Albert Street and Charlotte Street. During some stages of construction, local traffic flows would improve as a result of reduced intersection movements brought about by the closure of parts of Albert Street.

Groundwater

As with the Reference Project, there is potential for groundwater to enter the station void during its construction. The management of these potential impacts are addressed in the Draft Outline EMP.

The impacts of the Changed Project upon the groundwater resources of the locality would be substantially the same as those anticipated for the Reference Project. Groundwater inflows would be managed according to the objectives provided in the Draft Outline EMP.

Flood Management

As with the Reference Project, a suitable level of flood protection would be required for the changed Albert Street Station worksite.

Air Quality

The proposal to construct the changed Albert Street Station from within an acoustic shed would address the key concerns regarding potential impacts to air quality (namely dust deposition, motor emissions from fixed plant and equipment).

Noise and Vibration

Airborne construction noise generated by construction works at Albert Street Station would be at a similar level to those anticipated for the Reference Project.

The worksite for the changed station would be located closer to different sensitive receivers than would the Reference Project. The works involve demolition of commercial buildings in Albert Street between Charlotte Street and Mary Street.

In the 'worst-case' scenario, the predicted construction airborne noise for the Changed Project in Albert Street would exceed the criteria and would be similar in magnitude to the Reference Project. The 'worst-case' scenario relates to demolition works and piling works that must precede the erection of the acoustic shed. Exceedances were estimated to range from 13 – 27dBA ($L_{A10\ adj}$) for common receivers for the Reference Design[31]. Similar impacts would be expected for the new sensitive receivers along Albert Street towards Elizabeth Street.

The proposal to conduct the works from within an acoustic shed also would be effective in mitigating the potential airborne construction noise. Specific, performance-based construction management measures would be required and are provided in the Draft Outline EMP.

Similar exceedances of the 'worst-case' ground-borne noise for the Reference Project would likely be experienced by new sensitive receivers for the Changed Project in Albert Street towards Elizabeth Street. The 'worst-case' scenario would involve rock-breaking at night in the shaft, at least until a slant distance of 20m has been achieved.

Site-specific construction mitigation measures for these new sensitive receivers would be required to allow the project works to proceed without unreasonable disruption to the use of adjacent properties.

Non-indigenous Cultural Heritage

The relocation of the Albert Street Station in the Changed Project would relieve and avoid the construction-related impacts on the cultural heritage values of the Brisbane Botanic Gardens and the historic values of the lower end of Albert Street.

Construction of the Changed Project at Albert Street has the potential to impact on the Royal Albert Apartments building (QHR 600103) on the corner of Albert Street and Elizabeth Street. Potential impacts that could affect the building including settlement and vibration associated with the excavation of the station structures and also the bored tunnel for the 'up track' (i.e. southbound track). The separation distances are likely to provide some flexibility in management of the construction effects.

Social

As with the Reference Project, construction of the changed Albert Street Station would impact on pedestrian access from the city centre to the Brisbane Botanic Gardens and the QUT (Gardens Point) Campus. While pedestrian access along Albert Street would be maintained at all times during construction, alternative access routes to both community facilities would be available via George Street and Edward Street.

[31] Cross River Rail EIS, Volume 1, Part C, Chapter 16, Table 16-32

6.3.5 Roma Street

Apart from the relocation of the Changed Station from a position adjacent to platform 10 at Roma Street Station, the Changed Project would involve the demolition of the BTC (West Tower). Following demolition, construction of the changed station would involve cut-and-cover methods to establish a central shaft and the main station box from which the station caverns would be mined in either direction along the alignment. Once the surface cut and supports have been established, the cut-and-cover work would be conducted within an acoustic shed.

Temporary support and management measures would be required to maintain operations on the Inner Northern Busway during construction.

The Roma Street Station worksite for the Reference Project and the Changed Project are shown in Figure 6-8 and Figure 6-9, respectively.

Demolition

The Changed Project would require the demolition of the BTC (West Tower) and the long-distance coach ramps. There is potential for the demolition works to intercept hazardous materials such as asbestos and possibly hydrocarbons. Consistent with the requirements of the Draft Outline EMP, detailed site investigations will be required to be conducted prior to the commencement of demolition to scope a safe approach to demolition.

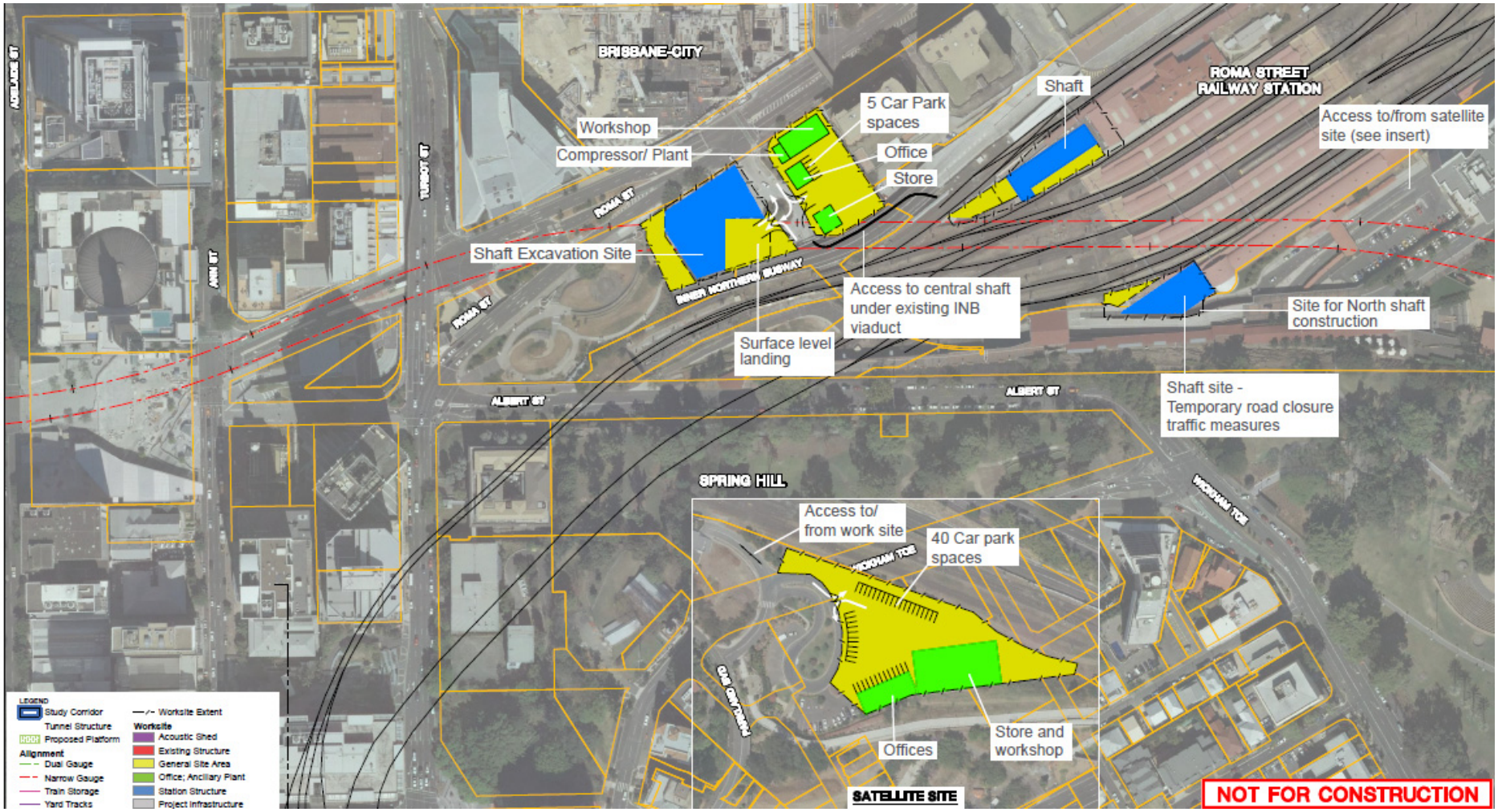

Figure 6-8 - Reference Project Roma Street Station worksite

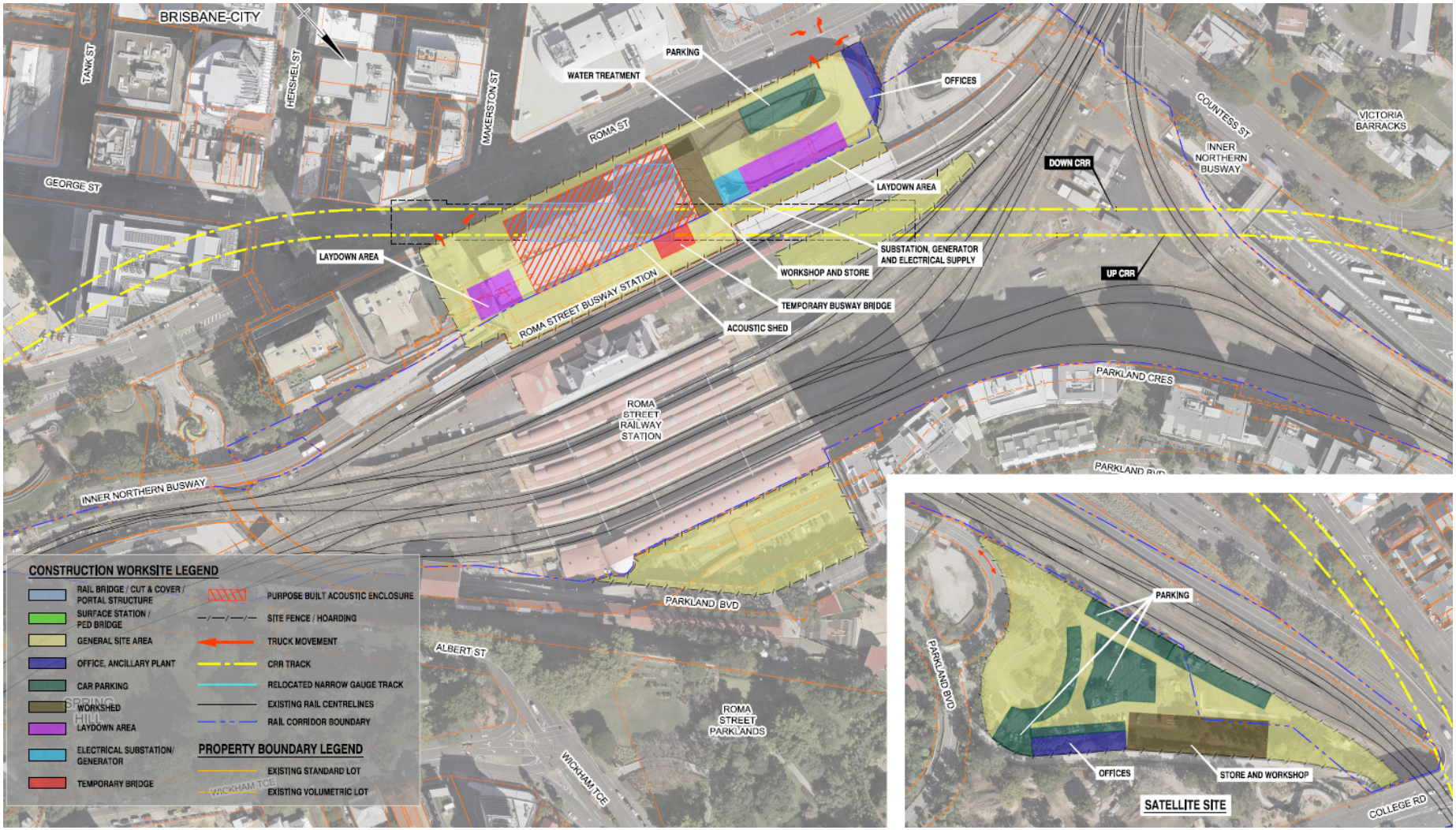

Figure 6-9 - Changed Project Roma Street Station worksite

Construction Traffic

The Reference Project proposed a major worksite off Parkland Boulevard adjacent to platform 10 at Roma Street Station. The Changed Project involves a major worksite at the existing BTC (West Tower), with access directly from Roma Street.

There would be two access points from Roma Street to the changed major worksite, one in the west and one in the eastern section of the worksite. Some delays to pedestrian and cycle movements along Roma Street would arise due to vehicles crossing footpaths to access the worksite. This would be no worse than the Reference Project.

Demolition of the BTC West Tower and ramps would occur within the confines of the worksite. Establishment of the worksite for demolition would allow pedestrian and cyclist access to be maintained along the Roma Street frontage.

Demolition works would include the long distance coach terminal. Alternative arrangements would need to be determined for the relocation of the long distance coach terminal prior to the commencement of demolition.

The inbound bus stop at Roma Street adjacent to the changed worksite would need to be relocated in coordination with TMR prior to the demolition phase. This could include moving the bus stop further east along Roma Street in front of the BTC (East Tower) for buses continuing along Roma Street. Services travelling via Herschel Street may be unable to stop at Roma Street for short periods. The CityCycle station in front of the BTC (West Tower) would need to be relocated in coordination with BCC.

Establishment of the construction worksite may result in temporary disruption to the Inner Northern Busway adjacent to Roma Street Station. This would need to be managed in consultation with TMR and BCC.

Heavy vehicle movements from this worksite would peak at about six trucks per hour at peak spoil production times, compared with 10 truck movements per hour in the peak for the Reference Project. The traffic impacts on the surrounding road network would be minor.

Groundwater

There would be no change in the impacts to groundwater resources and groundwater levels as a consequence of construction of the Changed Project.

Settlement

Predicted settlement associated with station works for the Changed Project would be in the range of 10 – 25mm, consistent with that predicted for the Reference Project albeit in a different location.

Air Quality

Potential impacts to air quality due to the Changed Project at Roma Street would be similar to those anticipated for the Reference Project. The changed location would reduce the potential for dust nuisance for the residential apartments in Roma Street Parklands (Parkland Boulevard), but would increase the potential for dust nuisance for commercial accommodation (Jen Hotel, Abbey Apartments) in Roma Street.

Demolition works would need to be managed to avoid or manage dust effects for vehicular and pedestrian traffic on Roma Street.

Noise and Vibration

Consistent with the Reference Project assessments, a number of ‘worst-case’ construction scenarios have been adopted and tested to determine the effects of construction of the Changed Project on the acoustic environment. The goals for the assessment of the Changed Project are consistent with those of the Reference Project and are presented in Table 6-8.

Table 6-8 - Construction airborne noise goals - Roma Street Station

Receiver Location/Type	Monday to Saturday 6:30 am to 6:30 pm		Monday to Saturday 6:30 pm to 6:30 am, Sundays and Public Holidays	
	Steady State (dBA $L_{Aeq,adj,15min}$)*	Non-Steady State (dBA $L_{A10,adj,15min}$)*	Continuous (dBA $L_{Aeq,adj,15min}$)*	Intermittent (dBA L_{Amax})*
Parkland Boulevard Residential	67	77	57	64
Parkland Boulevard Commercial	67	77	-	-
Magistrates Court	57	67	-	-
Supreme and District Courts	57	67	-	-
Roma St Station Hotel (Hotel Jen)	67	77	57	64
BTC (East Tower)	67	77	-	-
George Street Commercial	67	77	-	-
Roma Street Commercial	67	77	-	-
George Street Residential (backpackers)	67	77	57	64
Roma Street Residential (Abbey)	67	77		
Police Headquarters & Watch House	67	77	57	64

* Noise goal has been adjusted to represent external free-field levels.
** Monday to Saturday 6:30 am to 6:30 pm goals relevant at all times.
*** Based on AS2107 category “wards” for medical buildings.

As with the Reference Project, construction works for the Changed Project station at Roma Street would lead to exceedances of the goals for both airborne noise and ground-borne noise. Without mitigation in the ‘worst-case’ scenario, these exceedances would be greatest for demolition (airborne noise) and night time works (ground-borne noise - rockbreaker).

Typical of intensive demolition and construction works in the central city, there would be exceedances of the goals for airborne noise at a number of receivers adjacent to the changed station works. The Abbey Apartments and the Queensland Police Headquarters buildings would be the most affected by airborne construction noise without mitigation.

Night works, particularly involving demolition and initial site excavation without mitigation, would lead to significant exceedances of the night time goals (Abbey Apartments). Demolition and initial site excavation works during standard daytime working hours would lead to exceedances of the airborne noise goals at the Queensland Police Headquarters, the Abbey Apartments and the BTC (East Tower). Once work has progressed to the point where the acoustic shed can be installed, impacts due to airborne noise would be managed within the goals. Table 6-9 presents the 'worst-case' construction airborne noise (without mitigation) at Roma Street Station.

Table 6-9 - Predicted 'worst-case' construction airborne noise (non-steady state) - Roma Street Station

Receiver	Predicted External Construction Noise Levels $L_{A10,adj,15min}$		
	Scenario 1	Scenario 2	Scenario 3
Parkland Boulevard Residential	77	67	72
Parkland Boulevard Commercial	61	55	60
Magistrates Court	62	56	61
Supreme and District Courts	70	64	72
Roma Street Station Hotel (Hotel Jen)	58	51	56

Receiver	Predicted External Construction Noise Levels $LA_{10,adj,15min}$		
	Scenario 1	Scenario 2	Scenario 3
BTC (East Tower)	85	74	82
George Street Commercial	65	62	64
Roma Street Commercial	75	70	76
George Street Residential (backpackers)	60	62	63
Roma Street Residential (Abbey)	80	76	84
Police Headquarters and Watch House	84	76	84

Construction works of the station shaft (rockbreakers) and mining the station caverns (roadheaders) would generate ground-borne noise and vibration that would exceed both day time and night time goals. Without mitigation, these predicted exceedances would be experienced at the BTC (East Tower), Transcontinental Hotel, and the Abbey Apartments. Detailed investigations conducted for similar circumstances for the Bus and Train project[32] indicate there are a range of construction and mitigation techniques which would be effective in addressing the predicted impacts. The predicted ground-borne noise and vibration for the Changed Project in the 'worst-case' construction scenario is presented in Table 6-10.

Table 6-10 - Ground-borne Noise and Vibration - Roma Street Station

Receiver Area		Ground-borne Noise and Vibration Goals			Predicted Ground-borne Vibration Level PPV (mm/s)	Predicted Ground-borne Noise Level (dBA)*	
		Vibration PPV (mm/s)	Internal Ground-borne Noise (dBA)			Rock-breaker	Road-header
			Continuous	Intermittent			
Parkland Boulevard Residential	Day	25	40 $L_{Aeq,adj}$	50 $L_{A10,adj}$	0.04	32 $L_{A10,adj}$	24 $L_{Aeq,adj}$
	Night	0.5	35 $L_{Aeq,adj}$	42 L_{Amax}	0.04	36 L_{Amax}	24 $L_{Aeq,adj}$
Parkland Boulevard Commercial	Day	25	45 $L_{Aeq,adj}$	55 $L_{A10,adj}$	0.03	27 $L_{A10,adj}$	20 $L_{Aeq,adj}$
Magistrates Court	Day	25	35 $L_{Aeq,adj}$	45 $L_{A10,adj}$	0.01	24 $L_{A10,adj}$	13 $L_{Aeq,adj}$
Supreme and District Courts	Day	25	35 $L_{Aeq,adj}$	45 $L_{A10,adj}$	0.04	31 $L_{A10,adj}$	25 $L_{Aeq,adj}$
Roma Street Station Hotel (Hotel Jen)	Day	25	45 $L_{Aeq,adj}$	55 $L_{A10,adj}$	0.09	35 $L_{A10,adj}$	33 $L_{Aeq,adj}$
	Night	0.5	35 $L_{Aeq,adj}$	42 L_{Amax}	0.09	39 L_{Amax}	33 $L_{Aeq,adj}$
BTC (East Tower)	Day	25	45 $L_{Aeq,adj}$	55 $L_{A10,adj}$	0.36	45 $L_{A10,adj}$	**47** $L_{Aeq,adj}$
George Street Commercial	Day	2	45 $L_{Aeq,adj}$	55 $L_{A10,adj}$	0.44	39 $L_{A10,adj}$	45 $L_{Aeq,adj}$
Roma Street Commercial	Day	2	45 $L_{Aeq,adj}$	55 $L_{A10,adj}$	0.58	45 $L_{A10,adj}$	**46** $L_{Aeq,adj}$

[32] Bus and Train Project EIS August 2014 Chapter 11

Receiver Area		Ground-borne Noise and Vibration Goals			Predicted Ground-borne Vibration Level PPV (mm/s)	Predicted Ground-borne Noise Level (dBA)*	
		Vibration PPV (mm/s)	Internal Ground-borne Noise (dBA)			Rock-breaker	Road-header
			Continuous	Intermittent			
George Street Residential (backpackers)	Day	25	45 $L_{Aeq,adj}$	55 $L_{A10,adj}$	0.11	35 $L_{A10,adj}$	34 $L_{Aeq,adj}$
	Night	0.5	35 $L_{Aeq,adj}$	42 L_{Amax}	0.11	39 L_{Amax}	34 $L_{Aeq,adj}$
Roma Street Residential (Abbey)	Day	25	45 $L_{Aeq,adj}$	55 $L_{A10,adj}$	0.25	48 $L_{A10,adj}$	41 $L_{Aeq,adj}$
	Night	0.5	35 $L_{Aeq,adj}$	42 L_{Amax}	0.25	**52** L_{Amax}	**41** $L_{Aeq,adj}$
Police Headquarters & Watch House	Day	25	45 $L_{Aeq,adj}$	55 $L_{A10,adj}$	0.34	51 $L_{A10,adj}$	36 $L_{Aeq,adj}$
Roma Street Station (heritage)	24/7	2	N/A	N/A	0.22	N/A	N/A
* Exceedances shown in bold.							

Mitigation measures for construction works giving rise to ground-borne noise and vibration effects greater than the nominated goals would be required and would be informed by predictive modelling, monitoring and consultation with directly affected parties.

Non-indigenous Cultural Heritage

Construction of the tunnels for the Changed Project along the same alignment as for the Reference Project, past the Brisbane City Hall (QHR 600065), would have the same effects as the Reference Project.

By relocating the station further to the north-west, the Changed Project would not impact directly the heritage-listed Roma Street Station (QHR 601208) and associated historic infrastructure (Roma Street Platform Shelter).

The demolition of the BTC (West Tower) would re-open views to St Brigid's Church, Red Hill (QHR 600284) at least for the period until the site was re-developed. Re-development would be conducted as a separate planning and assessment process.

The Victoria Barracks (Commonwealth Heritage Register 105226) is located approximately 250 metres to the west of the changed Roma Street Station. The construction of the Changed Project along this section of the alignment would involve TBM works. Ground-borne vibration predicted for these works would be in the range of 0.1 to 0.3 mm/sec PPV. This would be well below the criterion for heritage places of 2.0 mm/sec. The potential for ground settlement due to TBM pass-by in this location is very low and unlikely to impact on the fabric of any building within this place. Prudent construction management would involve predictive modelling of both vibration and settlement, combined with real time monitoring.

Hazard (asbestos)

If asbestos is detected in the BTC (West Tower), it would need to be removed in accordance with the requirements of the *Work Place Health and Safety Act 2011* and Regulation, and associated code of practice. The handling, transport and safe disposal of any asbestos would be conducted in accordance with the requirements of the *Environmental Protection Act 1994*. There would need to be a specific site management plan prepared for the removal and disposal of asbestos.

6.3.6 Northern Portal

With the relocation of the Northern Portal from Victoria Park to the rail corridor (Exhibition Line), the construction impacts of the Reference Project on the locality would be greatly reduced and for some attributes, avoided.

The proposal to retrieve the TBMs at the Northern Portal is consistent with the Reference Project.

The Northern Portal construction worksite for the Reference Project and the Changed Project are shown in Figure 6-10 and Figure 6-11, respectively.

Construction Traffic

The Changed Project involves use of the BCC temporary staging facility (which would require relocation) in Victoria Park as a temporary staging facility. It would be more than 1km from the changed location for the Northern Portal. For construction efficiencies, a temporary construction area in the rail corridor would be accessed from the ICB for materials handling and logistics.

Consequently, local traffic impacts on Gregory Terrace would be reduced with car parking and construction laydown traffic diverted to other roads such as the Inner City Bypass Herston off-ramp, Herston Road and Bowen Bridge Road.

Truck access and egress to this changed worksite would be via Bowen Bridge Road immediately south of the Northern Busway. Access to the BCC temporary staging facility would remain unchanged from the Reference Project, via Gregory Terrace.

Heavy vehicle movements to and from this worksite would peak at about five trucks per hour at peak spoil production times, compared with eight trucks per hour for the Reference Project.

The Changed Project would use land in Victoria Park off Gilchrist Avenue for temporary car parking and construction laydown areas. This site has been used for similar purposes to support construction of Legacy Way. Parking would be provided for approximately 154 vehicles compared to 80 for the Reference Project.

Other construction worksite impacts would be consistent with the Reference Project, including the temporary diversion of the bikeway along the southern area of the worksite in Victoria Park.

Landscape and Visual

The Changed Project would avoid the landscape and visual impacts associated with construction of the Northern Portal for the Reference Project within Victoria Park. There would be a requirement for a worksite adjacent to the BCC temporary staging facility at the eastern end of the park, with access being provided off both Gregory Terrace and Bowen Bridge Road consistent with the Reference Project.

The visual effects of construction of the Northern Portal for the Changed Project would be contained within the rail corridor, and would be consistent with the previous works in this locality associated with the construction of the Legacy Way portals to the Inner City Bypass.

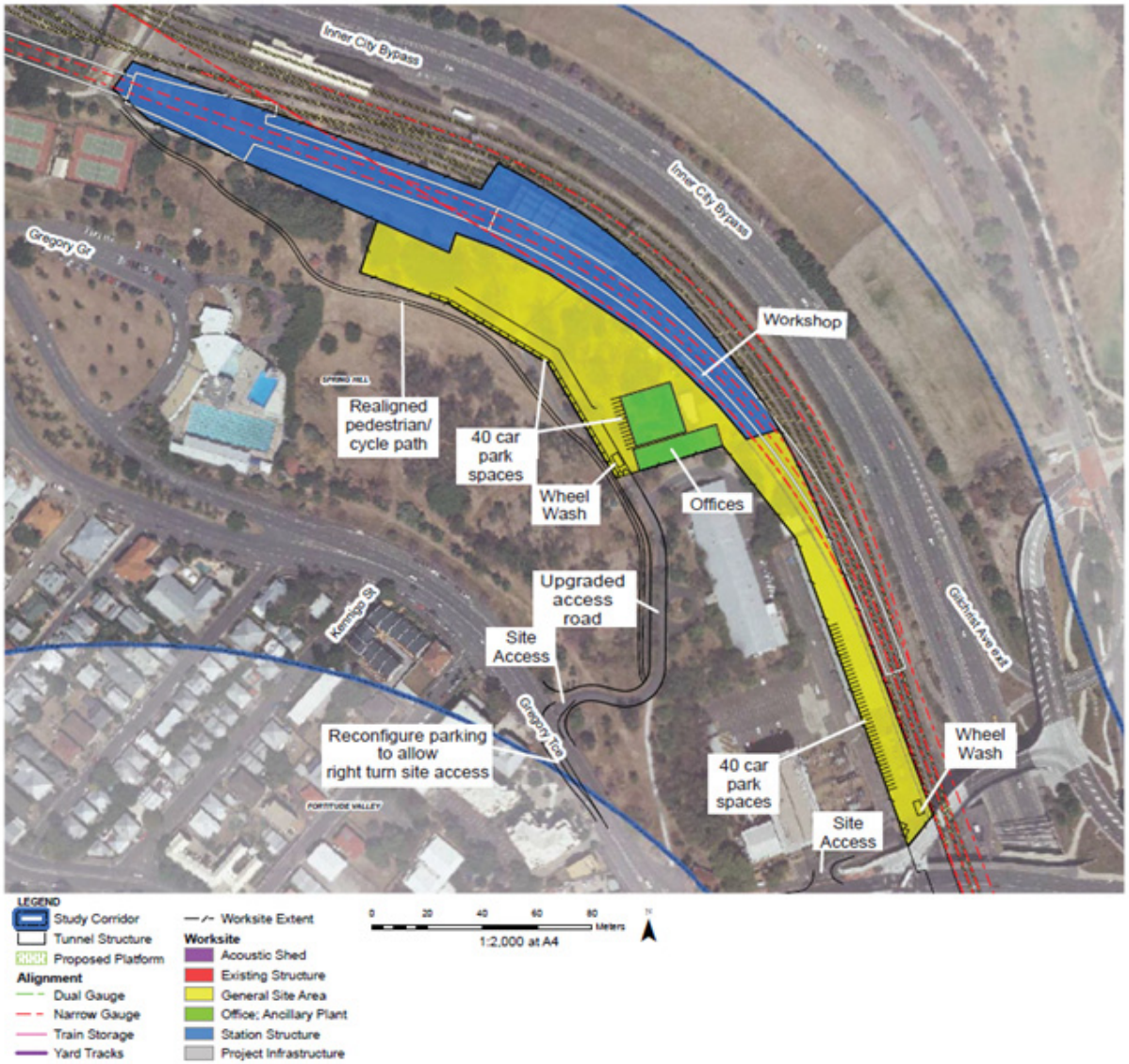

Figure 6-10 - Reference Project Northern Portal worksite

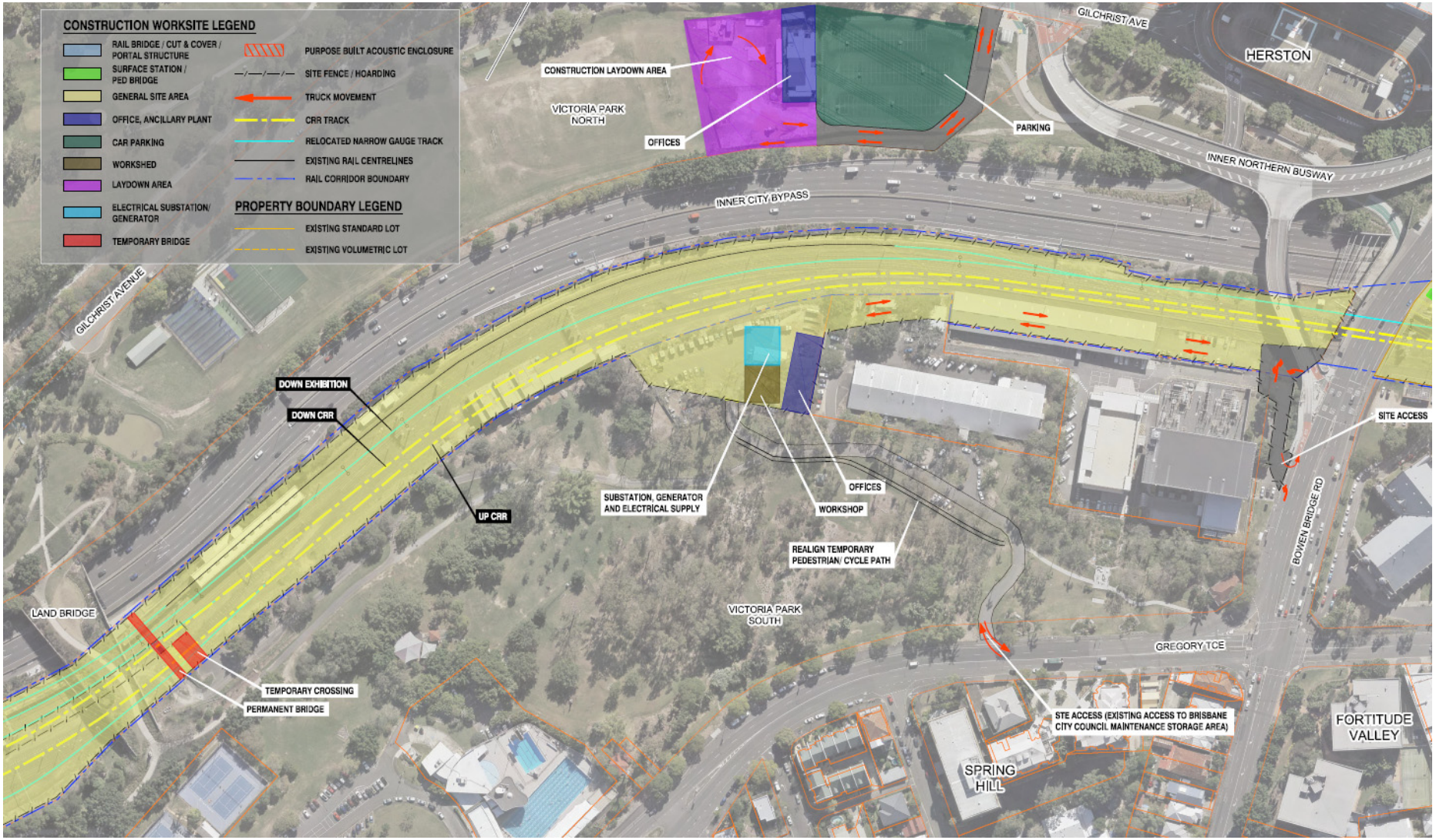

Figure 6-11 - Changed Project Northern Portal worksite

Nature Conservation

In line with the landscape and visual assessment, the changed location of the Northern Portal would avoid the loss of a number of mature and maturing trees standing in Victoria Park.

Groundwater

The potential for groundwater drawdown between Roma Street Station and the Northern Portal would be minimal due to this section being constructed as lined (undrained) bored tunnel with a short length of drained trough structure as the project transitions to the surface. The extent to which groundwater would be impacted by the changed location of the Northern Portal would also be consistent with the impacts predicted for the Reference Project which also proposed a lined, bored tunnel construction in this section.

Flood Management

The Changed Project would involve construction of the Northern Portal on land identified in BCC's Flood Awareness Mapping as being situated in an area affected by overland flooding. Overland flowpaths originate in Victoria Park Golf Course and Kelvin Grove Road. Suitable design of the on-site stormwater network would be required during detailed design to ensure overland flows are not impacted by construction works, and conversely, do not impact on those works.

Air Quality

The generation of airborne pollutants, particularly dust, for the Changed Project would be substantially similar to the Reference Project. The effect of the changed location of the Northern Portal would be to different sensitive receivers (see Table 6-11). The works would be closer to BGGS but further removed from residential receivers.

There would be no predicted exceedances of the health-based dust criterion within the BGGS campus. There would be exceedances predicted for the nuisance-based dust criterion along the boundary of the BGGS campus. With mitigation measures implemented at the Northern Portal worksite, nuisance dust impacts would be reduced and managed.

Table 6-11: Predicted air quality, construction – Northern Portal

Receivers	**TSP** (µg/m^3)		**PM_{10}** (µg/m^3)		**$PM_{2.5}$** (µg/m^3)		**Dust** (Max Month) (mg/m^2/day)
	24hr Nuisance	Annual Health	24hr Nuisance	Annual Health	24hr Nuisance	Annual Health	Nuisance
Guideline	80	90	50	25	25	8	133
Brisbane Girls Grammar School	38.8	27	23.8	16	9.1	7	95.3
Gregory Terrace - residential	35.0	26	21.7	15	8.9	7	66.9
Gregory Terrace - commercial	56.1	32	32.2	19	10.2	7	108.2
St Joseph's College	38.1	26	23.3	16	9.1	7	70.0
Centenary Aquatic Centre	40.1	26	25.2	16	9.4	7	75.5

Considering the proximity of BGGS to the worksite for the Northern Portal, worksite management would need to be both proactive and responsive to minimise the dust nuisance likely to be experienced along the common boundary.

Noise and Vibration

Changing the location of the Northern Portal would change the effects of construction works for different sensitive receivers. For example, the exceedances of the airborne noise construction criteria for the residential areas along Gregory Terrace predicted for the Reference Project would be avoided.

Construction works close to BGGS would require careful site management based on effective consultation with the school. Analysis of likely airborne construction noise in the 'worst-case'

scenarios (site establishment and piling; trough excavation; cut-and-cover works) indicates a potential for exceedances should the works proceed without mitigation. Table 6-12 demonstrates how the airborne noise would reduce as works proceed below ground level (i.e. range in predicted noise levels).

Table 6-12: Predicted 'worst-case' airborne noise, construction – Northern Portal*

Sensitive Receivers	**Period**	**Noise Goal** (dBA)	**Predicted Noise** (dBA)		
		LA_{10adj}	Site Establishment	Trough Excavation	Cut-and-cover
Brisbane Grammar	Day	62	55 – **64**	47 – 60	51 – 61
Brisbane Girls Grammar	Day	62	55 – **69**	40 – **65**	47 – **65**
Gregory Terrace - residential	Day	62	59 – 61	51 – 56	49 – 51
St Joseph's College	Day	62	47 – 55	36 – 51	40 – 49
Centenary Aquatic Centre	Day	77	47 – 53	41 – 47	43 – 49
Normanby Tce - residential	Day	62	41 – 50	32 – 44	35 – 46

* Predicted noise levels taken from assessment of BaT Revised Reference Design which proposed a rail portal in the same location as the Changed Project Northern Portal.

No impacts due to ground-borne noise or vibration associated with construction of the changed Northern Portal are anticipated at any sensitive receiver.

Indigenous Cultural Heritage

While there are indigenous cultural heritage values underlying the study corridor for CRR, the changed location of the Northern Portal from Victoria Park into the rail corridor (Exhibition Line) would reduce the degree of impact that was predicted with the Reference Project portal in Victoria Park.

Non-indigenous Cultural Heritage

The relocation of the Northern Portal into the rail corridor would also reduce the impacts to cultural heritage that may have arisen with the Reference Project portal in Victoria Park. It is noted that the rail and road transport corridor comprising the Exhibition Line and the Inner City Bypass has already had a significant impact on land within the original declaration of Victoria Park. Greater use of the rail corridor would not add to or exacerbate the existing level of intervention.

Land contamination

As with all works within a rail corridor, there is potential for the works to intercept contaminated material. The Exhibition Line corridor is listed on the EMR as containing hazardous contaminants. The Northern Portal works for the Changed Project would generate less spoil material (65,000m^3 in-situ) in total than the Reference Project (96,000m^3 in-situ). That spoil material would be likely to contain more contaminated material to be disposed of in accordance with an accepted management plan.

6.3.7 Exhibition Station

Construction works for the Exhibition Station for the Changed Project would be less complex than for the Reference Project. The key differences in construction lie in the proposal to construct a new track on structure (at existing track level) to the north of the existing tracks, and the lengthening of the existing passenger platforms. There would also be pedestrian connections provided between the station and O'Connell Terrace and Bowen Bridge Road.

The worksite for the changed Exhibition Station would be similar to but slightly smaller than the Reference Project.

Compared with the Reference Project, the proposed Exhibition Station, including the construction of a new rail track (for non-operational passenger trains and freight trains), would involve fewer and less intense construction effects.

The Exhibition Station worksite for the Reference Project and the Changed Project are shown in Figure 6-12 and Figure 6-13, respectively.

Construction Traffic

In the Changed Project, access to the Exhibition worksite would be via O'Connell Terrace and Bowen Bridge Road. This would provide greater flexibility with traffic access compared to the Reference Project, which provided site access from O'Connell Terrace only (left-in, left-out).

Access for workforce parking would be off Lanham Street. Car parking for the Changed Project is generally consistent with the Reference Project.

Non-indigenous Cultural Heritage

While the construction effects of the Changed Project would be substantially similar to the Reference Project, it is likely that there would be a reduced impact on the fig trees adjacent to the Number 2 Ring and Exhibition Station.

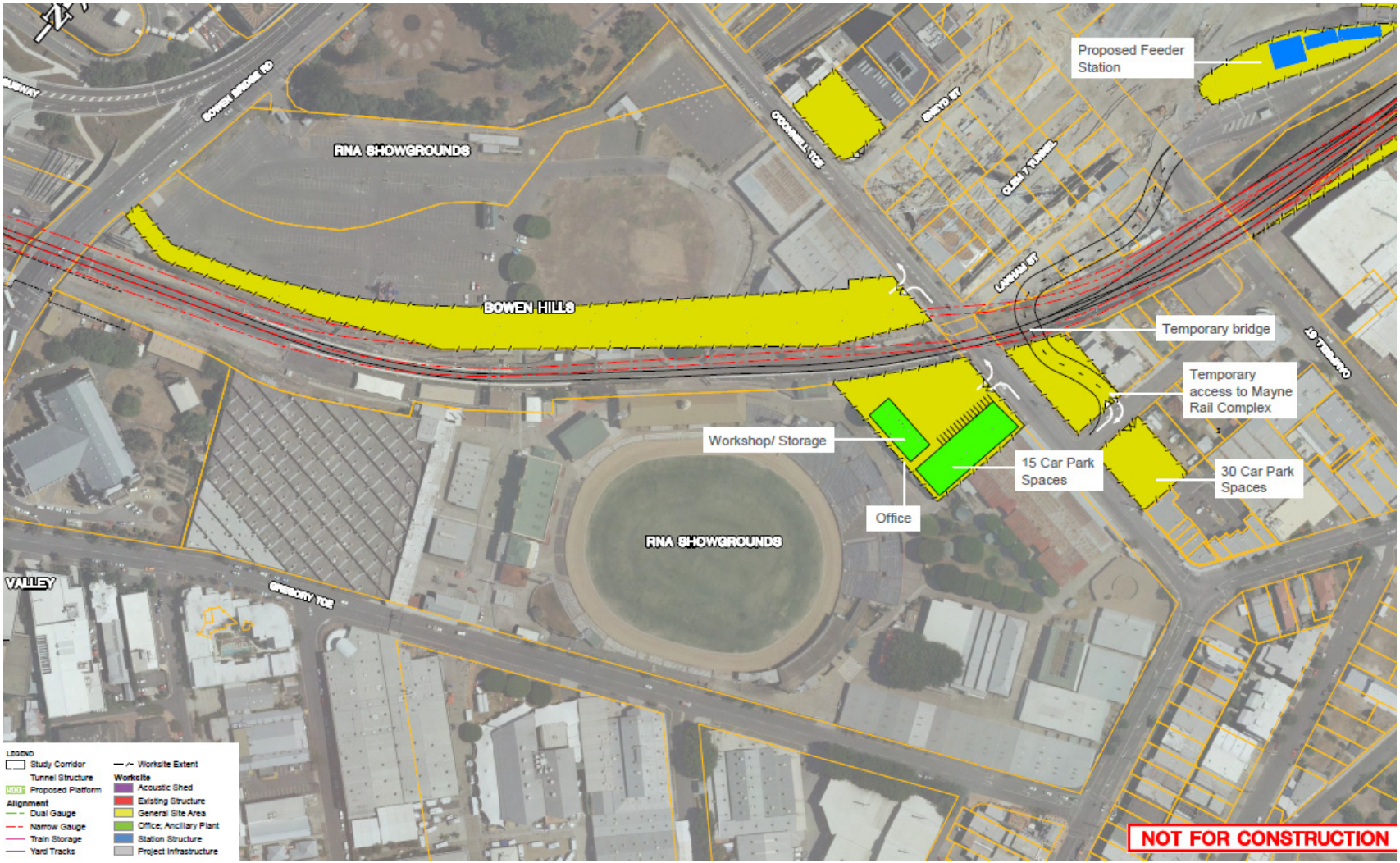

Figure 6-12 - Reference Project Exhibition Station worksite

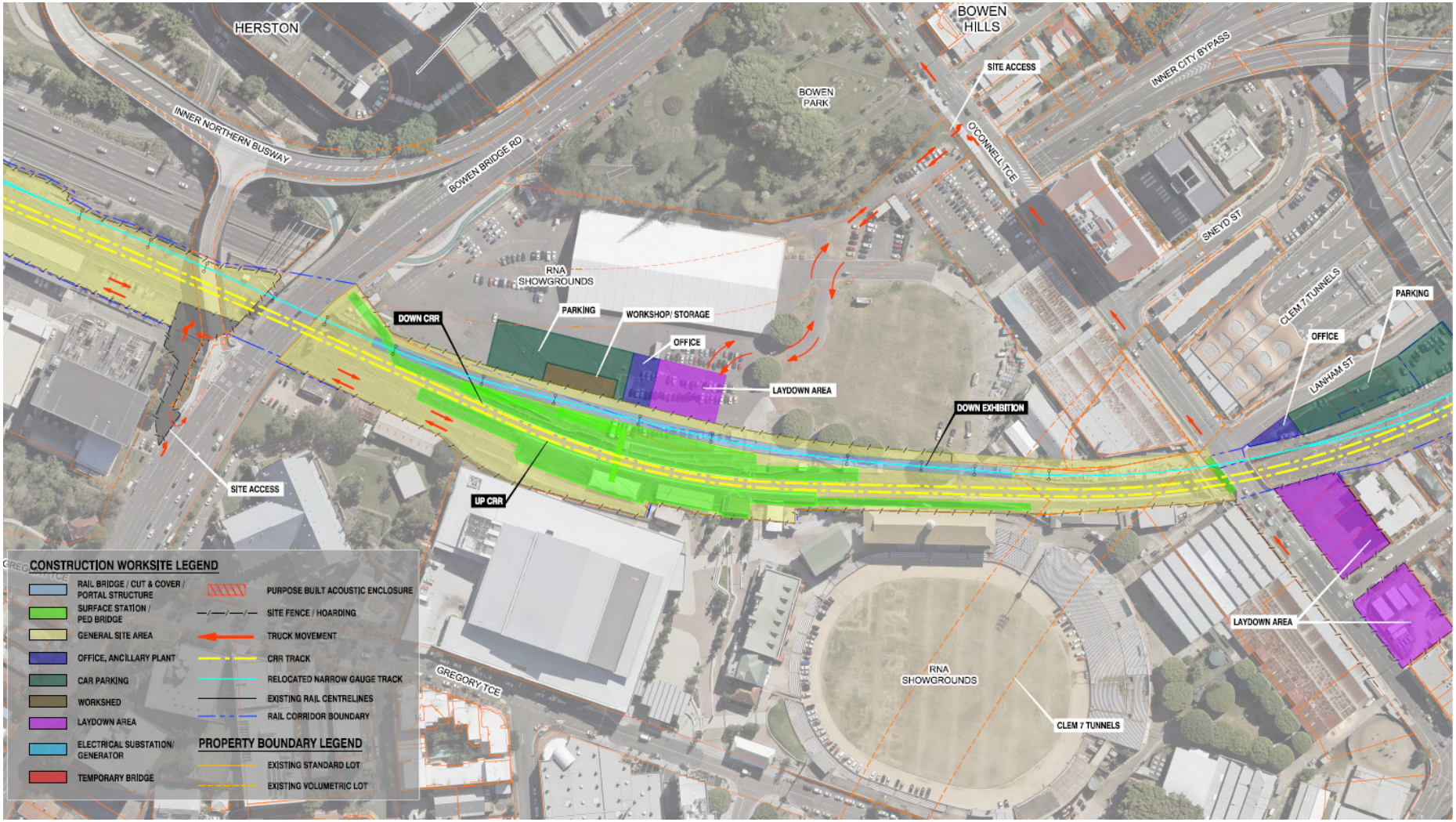

Figure 6-13 - Changed Project Exhibition Station worksite

6.3.8 Mayne Yard

Works within Mayne Yard for the Changed Project occupy a similar area to that required for the Reference Project. The key construction difference is the proposal to construct an underpass (trough structure) for the CRR southbound track allowing the main Northern Line (northbound track) to remain at the surface.

Construction works on railway land are managed in accordance with the code of practice[33] and the general environmental duty established under the *Environmental Protection Act 1994*.

The Mayne Yard construction worksite for the Changed Project is shown in Figure 6-14.

Construction Traffic

Access arrangements and construction traffic flows from the Mayne Yard worksite (Changed Project) would be substantially similar to the Reference Project.

Flood Management

Mayne Yard has a history of flooding. As with the Reference Project, the proposed surface works for the Changed Project would not impact the floodplain or flood behaviour of Breakfast/ Enoggera Creek. Detailed flood modelling would be required during the detailed design phase to ensure that the design of the Project appropriately responds to any potential impacts due to flooding.

Groundwater

The Changed Project would not impact on groundwater resources owing to the probability of a hydrogeological connection with Breakfast/Enoggera Creek. The rail underpass (trough structure) would be undrained.

Nature Conservation

The works for the Changed Project in Mayne Yard would not intercept or directly disturb any flora or fauna species of conservation value.

Air Quality

The results presented in Table 6-13 show no health or nuisance-based exceedances for the modelled pollutants at any surrounding residential receiver locations.

The works for the Changed Project in Mayne Yard are predicted to lead to exceedances of the nuisance-based criterion for 24-hour average TSP at Burrows Street (commercial properties). Exceedances of the annual average dust deposition rate are predicted at commercial properties in Burrows Street.

As with other worksites, construction management methods for the Changed Project would be engaged to reduce dust emissions.

[33] Transport Noise Management Code of Practice: Volume 2 - Construction Noise and Vibration

Table 6-13: Predicted air quality, construction – Mayne Yard

Site	**TSP** (µg/m^3)		**PM$_{10}$** (µg/m^3)		**PM$_{2.5}$** (µg/m^3)		**Dust** (Max Month) (mg/m^2/day)
	24hr Nuisance	Annual Health	24hr Nuisance	Annual Health	24hr Nuisance	Annual Health	Nuisance
Guideline	80	90	50	25	25	8	133
Burrows Street - commercial	**83.8**	37.0	20.1	18.9	14.4	7.9	**238.5**
Burrows Street - commercial	64.5	33.9	14.8	17.9	13.2	7.5	**182.8**
Burrows Street - commercial	55.3	27.8	7.1	15.7	11.7	7.0	115.1
Grantson Street - residential	32.6	25.1	2.7	15.0	9.4	6.7	77.4

Noise and Vibration

While the Changed Project would involve more intensive construction works for the rail underpass (trough structure) than anticipated for the Reference Project, construction noise levels are predicted to be within the goals at the nearest sensitive receivers (i.e. at least 200m from the worksite).

Contaminated Land

As with all works within a rail corridor, there is potential for the works to intercept contaminated material. The notifiable activity for Mayne Yard listed on the EMR includes rail yard, petroleum and oil storage and engine reconditioning.

The surface connection works for the Changed Project would generate spoil material (36,000m^3 in-situ) that would be likely to contain contaminated material to be disposed of in accordance with an accepted management plan.

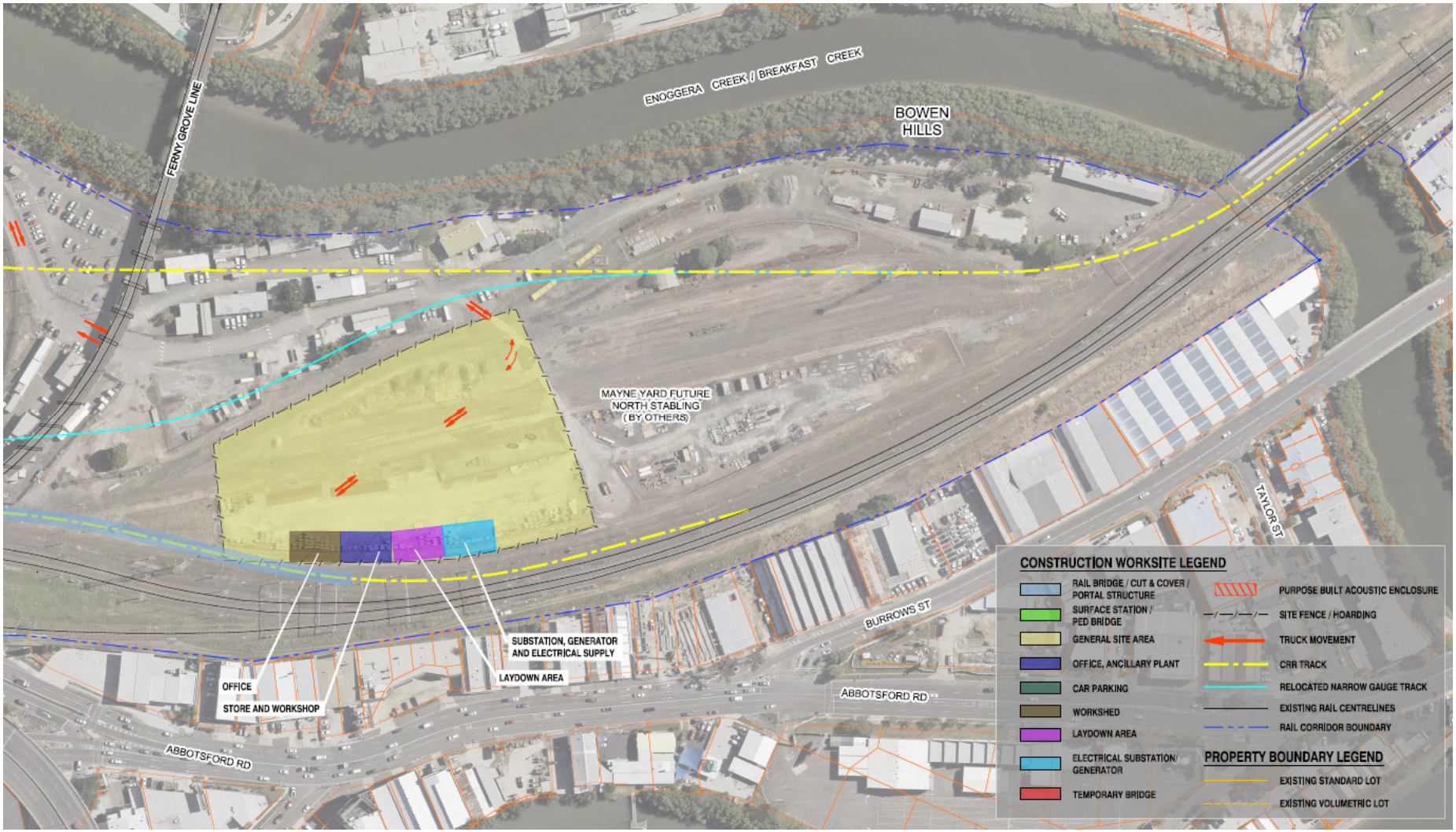

Figure 6-14 - Changed Project Mayne Yard worksite

7. Conclusions and Recommendations

In his evaluation report dated December 2012, the Coordinator-General recommended that the Reference Project proceed subject to further approvals and conditions. The Coordinator-General found that any substantial future changes to the reference design upon which the evaluation report was based, could be assessed under the 'change report' process in accordance with Part 4, Division 3A of the *State Development and Public Works Organisation Act 1971*.

The Changed Project is consistent with the objectives of the Reference Project, and would deliver significant economic and city-building benefits to Brisbane, by improving rail network capacity, service frequency and reliability.

It is recommended that the Changed Project proceed, subject to the conditions of the Coordinator-General's Report on the Environmental Impact Statement dated December 2012 (CG Evaluation Report), and in accordance with the variations set out below.

7.1 Changes to the Project and the Effects of the Changes

The most significant changes between the Reference Project and the Changed Project are the shorter tunnel, revision to sections of the alignment, and the location of stations. The Changed Project has increased affordability, due primarily to the reduced infrastructure requirements.

This Report has analysed the effects of the changes to the Reference Project. Overall the impacts of the Changed Project remain the same as, or would be reduced, compared to the Reference Project due to the reduced tunnel length, some changes in alignment and reduced construction footprint. The potential adverse environmental impacts of the construction and commissioning of the Changed Project can be avoided, or minimised and managed, in accordance with the processes in the Draft Outline EMP.

7.2 Reasons for the Changes

The Changed Project provides a more cost effective response to the constraints on the inner city rail network that has less community impacts and an alignment that responds to anticipate transport needs. It reflects up-to-date population, employment and transport demand projections, which underpin the need for the Project. It also responds to community feedback received since 2011 and incorporates a range of design improvements from more recent assessment and technical investigations.

The key drivers for the project changes are:

- improved project affordability in both delivery and operation
- changes to forecast passenger and freight rail demand and other network capacity improvements
- opportunities for design and construction improvements arising from ongoing technical investigations
- community input received in relation to the EIS for the Reference Project and other transport proposals in the study corridor.

7.3 Changes to Conditions and the Reasons for the Changes

The existing Imposed Conditions and Stated Conditions in the Coordinator-General's evaluation report for the Reference Project require revision to reflect:

(a) changes to the Project, including:

  (i) the locations of construction worksites

  (ii) spoil haulage routes and placement locations

(iii) station locations

(iv) the Project alignment.

(b) changed environmental effects as a result of changes to the Project

(c) a change in the approach to environmental management in response to the project changes and community feedback received since the Reference Project EIS

(d) consequential changes to the Draft Outline EMP

(e) regulatory changes since the Coordinator-General's evaluation report.

It is requested that the existing conditions be changed as set out below.

7.4 Changes to the Coordinator-General's imposed conditions

As a result of changes to the design and delivery of the Reference Project, it is requested that the Coordinator-General's imposed conditions be reviewed and changed to reflect the Changed Project.

This Request for Project Change incorporates a replacement Draft Outline EMP that presents a flexible and performance based approach to environmental management. That revised approach has been adopted to respond to the predicted impacts of an intensive construction project within a highly urbanised setting. The approach has been designed to achieve a balance that allows construction of the project to proceed in a timely and efficient way, while maintaining a reasonable amenity for nearby sensitive receivers. Key features of the revised approach include:

- engagement of an independent environmental monitor to provide environmental oversight for the construction and commissioning phases of the project
- engagement of an independent community relations monitor who will act as an independent interface between the community, individual affected persons and the project delivery team
- flexibility in the design of mitigation measures and corrective actions that would be developed in consultation with affected persons and with the oversight of the community relations monitor and the environmental monitor
- reporting on compliance with the Coordinator-General's conditions and the environmental management framework that has been established through the Draft Outline EMP.

Specific imposed conditions that require amendment for the Changed Project are set out in Table 7-1. Minor, or consequential changes, may be required to other imposed conditions.

Table 7-1: Requested changes to imposed conditions

Imposed condition	Requested change	Reasons for the change
Condition 1 - General Conditions	Condition 1 be updated to refer to the Changed Project.	To reflect the design changes to the Reference Project.
Condition 3 - Environmental monitoring reporting and verification	Change the condition to reflect the monitoring and reporting approach as set out in section 1.5.3 of the Draft Outline EMP.	Reflect the updated environmental management approach as set out in the Draft Outline EMP.
Condition 4 - Interface agreements for transport matters	Remove the condition.	The condition is not required as it is provided for in relevant legislation.

Imposed condition	Requested change	Reasons for the change
Condition 5 - Construction hours of work	Change the condition to reflect Table 1.6 of the Draft Outline EMP.	Reflect the updated environmental management approach and construction requirements as set out in the Draft Outline EMP.
Condition 6 - Conduct of construction work	Change the condition to reflect Table 1.6 of the Draft Outline EMP.	Reflect the updated environmental management approach and construction requirements as set out in the Draft Outline EMP.
Condition 7 - Noise	Change the condition to reflect Table 1.15 of the Draft Outline EMP.	Reflect the updated environmental management approach and construction requirements as set out in the Draft Outline EMP.
Condition 9 - Vibration	Change the condition to reflect Table 1.15 of the Draft Outline EMP.	Reflect the updated environmental management approach and construction requirements as set out in the Draft Outline EMP.
Condition 10 - Spoil handling and placement	Change the condition to reflect the proposed new spoil placement sites and haulage routes as set out in Table 1.7 of the Draft Outline EMP.	Reflect the updated environmental management approach and construction requirements as set out in the Draft Outline EMP.
Condition 11 - Transport and access	Change the condition to reflect the environmental design requirements approach set out in Table 1.5 of the Draft Outline EMP.	Reflect the updated environmental management approach and construction requirements as set out in the Draft Outline EMP.
Condition 12 - Pedestrian and cycle connectivity	Change the condition to reflect Table 1.7 of the Draft Outline EMP and changes to the project design in Albert Street.	Reflect the updated environmental management approach and changes to project design.
Condition 13 - Construction traffic and construction vehicles management	Change to reflect Table 1.7 of the Draft Outline EMP.	Reflect the updated environmental management approach and construction requirements as set out in the Draft Outline EMP.
Condition 14 - Construction parking	Change to reflect Table 1.7 of the Draft Outline EMP.	Reflect the updated environmental management approach and construction requirements as set out in the Draft Outline EMP.
Construction 15 - Future Transport Planning	(a) No longer required because of design changes to the Project. (b) No longer required as this is addressed in the environmental design requirements.	
Condition 16 - Construction air quality	Change to reflect Table 1.14 of the Draft Outline EMP.	Reflect the updated environmental management approach and construction requirements as set out in the Draft Outline EMP.
Condition 17 - Pre-procurement geology and geotechnical survey program	Remove the condition.	The requirements of the condition are addressed in Table 1.8 of the Draft Outline EMP.

Imposed condition	Requested change	Reasons for the change
Condition 18 - Potential ground settlement	Remove the condition.	The requirements of the condition are addressed in Table 1.8 of the Draft Outline EMP.
Condition 19 - Erosion and sediment control	Minor changes to reflect the new Draft Outline EMP.	Reflect the updated environmental management approach and construction requirements as set out in the Draft Outline EMP.
Condition 20 - Acid sulphate soils	Change to reflect Table 1.8 of the Draft Outline EMP, and changes in statutory instruments.	Reflect the updated environmental management approach and construction requirements asset out in the Draft Outline EMP.
Condition 22 - Visual amenity and lighting	Minor changes to reflect the changes to the project design.	
Condition 23 - Flora and fauna	Change to reflect Table 1.11 of the Draft Outline EMP.	Reflect the updated environmental management approach and construction requirements as set out in the Draft Outline EMP.
Condition 27 - Groundwater quality	Change to reflect Table 1.12 of the Draft Outline EMP.	Reflect the updated environmental management approach and construction requirements as set out in the Draft Outline EMP.
Condition 28 - Groundwater monitoring	Change to reflect Table 1.12 of the Draft Outline EMP.	Reflect the updated environmental management approach and construction requirements as set out in the Draft Outline EMP.
Condition 33 - Flood Commission of Inquiry (QFCI) recommendations	Remove this condition.	The recommendations of the QFCI have been incorporated into the environmental design requirements in the Draft Outline EMP and Table 1.13 of the Draft Outline EMP for construction.
Condition 34 - Flood management	Remove this condition.	The requirements of the condition have been incorporated into the environmental design requirements in the Draft Outline EMP.
Condition 36 - Construction environmental management plan (CEMP)	Change to reflect section 1.9 of the Draft Outline EMP	Reflect the updated environmental management approach and construction requirements as set out in the Draft Outline EMP.
Condition 37 - Operations environmental management plan	Remove this condition. Operational impacts will be managed through the environmental design requirements set out in the Draft Outline EMP.	Replaced with the environmental design requirements set out in the Draft Outline EMP.
Conditions 38-41 - Operation	Remove these conditions. Operational impacts will be managed through the environmental design requirements set out in the Draft Outline EMP.	Replaced with the environmental design requirements set out in the Draft Outline EMP.

Imposed condition	Requested change	Reasons for the change
Additional imposed conditions	The existing recommendation 14 of the Coordinator-General's evaluation report should be incorporated into the imposed conditions, with necessary changes.	Address statutory requirements of the *Aboriginal Cultural Heritage Act 2003*.

7.5 Changes to the Coordinator-General's stated conditions

Since the Coordinator-General's Evaluation Report, changes in the project design and delivery, as well as legislative amendments have resulted in the Stated Conditions no longer being required for the Changed Project. It is recommended that all of the Stated Conditions in Appendix 3 of the Evaluation Report be removed in the Coordinator-General's Change Report for the following reasons:

(a) **Condition 1 - Constructing or Raising a Waterway Barrier** is no longer required as the waterway crossings that were required for the Reference Project are removed with the Changed Project.
(b) **Condition 2 - Material Change of Use of premises if all or part of the land is on the EMR or CLR** is no longer required due to legislative changes.
(c) **Condition 3 - Development on a state heritage place** is not required as the Project will follow the statutory process for development by the State under the *Queensland Heritage Act 1992*.
(d) **Condition 4 - Development on a local heritage place** is not required as the Project is exempt from local heritage requirements by virtue of the exemption in Schedule 4, Table 5, Item 10C of the Sustainable Planning Regulation 2009.
(e) **Condition 5 - Rehabilitation of Moolabin Creek** is no longer required as the Changed Project does not propose any works for road or rail crossings of Moolabin Creek.

7.6 Conclusions

The Changed Project alignment is shorter and avoids approximately 5km of surface works and station upgrades south of Yeerongpilly and 3.2km of tunnel between Yeerongpilly and Dutton Park. The Changed Project also alters the alignment and reduces the tunnel length between Roma Street Station and the Northern Portal. The underground stations at Boggo Road, Woolloongabba, Albert Street and Roma Street also have revised alignments.

The Changed Project remains within the study corridor for the Reference Project, and achieves the same strategic transport objectives. The Project has been refined in response to affordability considerations, engineering design, community feedback and other technical assessments.

Overall the impacts of the Changed Project would be similar to, or would be reduced, compared to the Reference Project. The Draft Outline EMP has been revised and replaced for the Changed Project to ensure that the potential adverse environmental impacts of the Project can be avoided, or minimised, and managed in accordance with a performance-based environmental management framework.

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