

CrossRiver*Rail*

Reference Design Overview



1	Background to the project
7	Project overview
13	Stations
43	Engineering design
57	Construction
69	Operations



CrossRiver*Rail*



Background to the project

Introduction

What is Cross River Rail?

The Queensland Government is planning to transform South East Queensland's rail network, with the Cross River Rail Project as the first step.

The Cross River Rail Project (Cross River Rail) is a north-south rail line in Brisbane's inner city which features a tunnelled railway under Brisbane's CBD and river, and four new underground inner-city train stations at Roma Street, Albert Street, Woolloongabba and Boggo Road.

On the surface there are major upgrades to existing stations at Exhibition and Yeerongpilly, and minor upgrades at Moorooka and Rocklea. It also incorporates substantial modifications to the rail infrastructure on the Exhibition loop, Mayne Yard, Clapham Yard (new stabling facility) and from Salisbury to Moorooka.

The planned underground stations will provide better access to:

- Key existing and future employment destinations including the CBD, South Brisbane, Woolloongabba and Bowen Hills.
- Major events facilities including the 'Gabba', the redeveloped River Stage in the Botanic Gardens, the RNA Showgrounds and Suncorp Stadium via Roma Street.
- Significant hospitals and health infrastructure at the Mater Public and Private Hospitals, the new Queensland Children's Hospital, Princess Alexandra Hospital (PAH) and Royal Brisbane and Women's Hospital (RBWH).
- Major tertiary education institutions including the Queensland University of Technology (QUT) at Gardens Point, and improved access to the University of Queensland.

Upon completion, Cross River Rail will deliver significant additional capacity into central Brisbane through the provision of up to 24 nine car trains per hour in each direction.

This capacity has been designed to accommodate the forecasted demands of Monday to Friday business, special cultural and sporting events, and increased liveability requirements over the weekends.

Cross River Rail will allow the current number of train services from the suburbs to the city to double, greatly improving access from the northern and southern population growth corridors. This increased rail capacity is an essential requirement for future network enhancements on the Sunshine Coast, Kippa- Ring and the Gold Coast.

As with all large infrastructure projects, there will be challenges with the building of Cross River Rail. However, careful attention has been paid to ensure that solutions adopted for the project reflect intelligent design, are environmentally sensitive, minimise land take, are part of a strong business case and can be constructed with sensitive programming and construction methodology.

Cross River Rail provides the solution to issues associated with the forecasted growth demand and leaves a lasting and manageable public transportation legacy.

“Most of our main cities are now at the size where it is simply impossible to rely solely on private motor vehicles for commuting journeys... comprehensive public transport networks are essential for the long term success of Australia's cities.”

Infrastructure Australia





South East Queensland's growth in perspective

South East Queensland is one of Australia's fastest growing metropolitan regions. From 2006 to 2031, its population is expected to almost double, growing from 2.8 million to 4.4 million people.

Employment projections for Brisbane in the period 2010-2031 (sourced from the National Institute of Economic and Industrial Research), reveal significant employment growth in higher value knowledge intensive tertiary services including health, education and professional services such as law, finance and architecture.

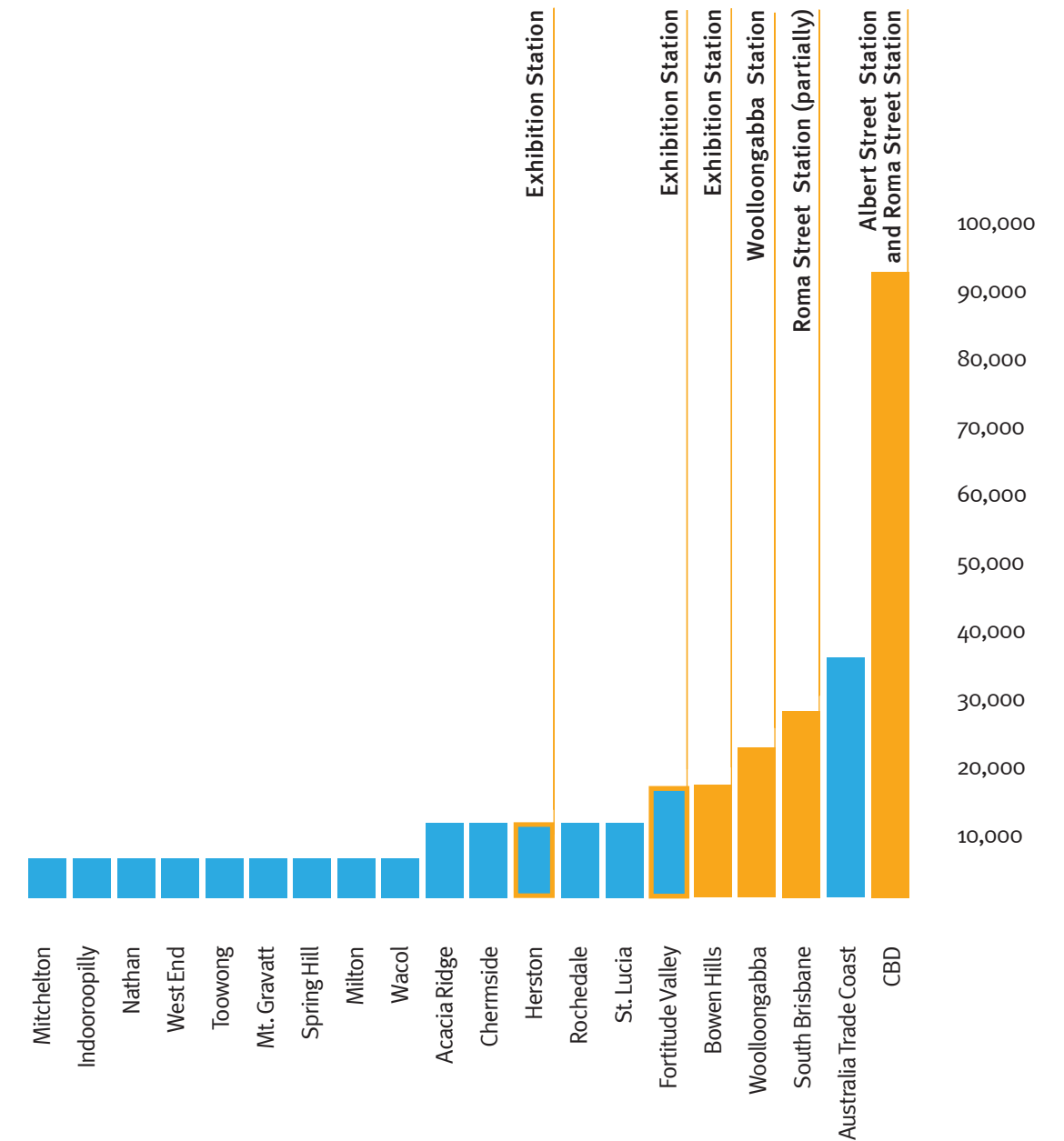
This growth is expected to concentrate in the key inner city Cross River Rail catchments, including:

- the CBD (an increase of 90,000 jobs by 2031)
- Woolloongabba (an increase of 20,000 jobs by 2031)
- Boggo Road health and knowledge precinct (an increase of 9,500 jobs by 2031)
- Bowen Hills (an increase of 15,000 jobs by 2031)

Destinations such as the Royal Brisbane and Women's Hospital (Herston) and Fortitude Valley are also anticipated to undergo growth in employment, generating 10,000-15,000 jobs respectively.

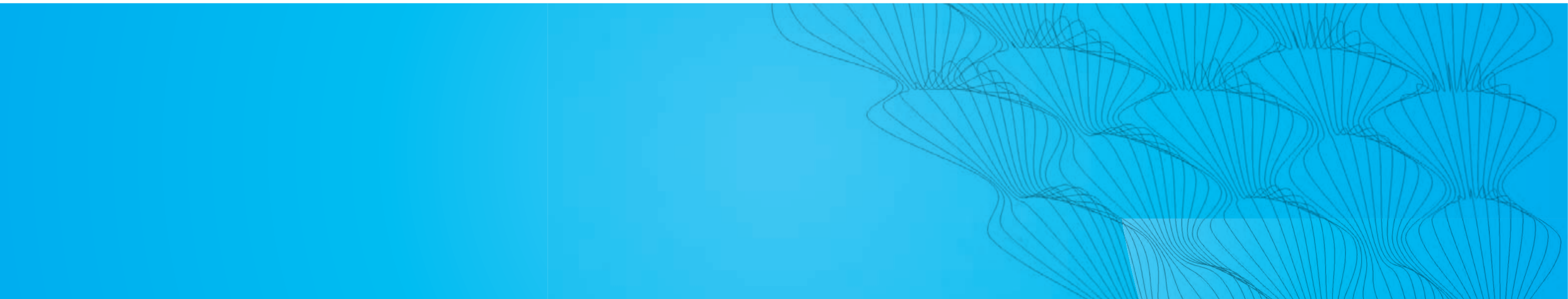
How this growth is managed, and what transport systems are established to support it, will determine whether Brisbane and South East Queensland will emerge as a sustainable, competitive and attractive place to live, work and play.

With such significant growth over a short period of time, a critical choice is required to define the strategic direction for the transport network and urban form of the future. While involving a significant early investment, passenger rail is recognised as the most efficient, sustainable and high capacity mode of transport available for a city or region.



Brisbane employment growth by local area 2010-2031

(derived from the National Institute of Economic and Industrial Research)



CrossRiver*Rail*

Project overview

Overview of the Cross River Rail project

The Cross River Rail reference design has been developed to meet project requirements using current design standards and engineering principles supplemented by feedback obtained through consultation with the community and engagement with key stakeholders and industry.

This report gives an overview of the following key items of the Cross River Rail reference design:

- Project overview
- Station design
- Engineering design
- Construction
- Operations

“Metropolitan rail networks provide impetus for urban revitalisation and growth. Targeted investment in these networks will help transform our cities by providing real support for sustainable urban development along major transport corridors as our cities continue to grow.”

Commonwealth Government (National Infrastructure Priorities)

Cross River Rail is a proposed 18 kilometre long north-south rail line that extends from the existing rail line at Salisbury Station in the south through to the existing north coast line at Breakfast Creek in the north.

The underground section of the project is 9.8 kilometres in length, from just north of Yeerongpilly Station through to the Exhibition line in Victoria Park.

Eight stations are included in the Cross River Rail corridor comprising four new underground stations, two existing surface stations with major upgrades and two existing surface stations with minor upgrades.

The new underground stations are located at Roma Street, Albert Street, Woolloongabba and Boggo Road, with platform depths ranging from 25 to 32 metres below ground level. The two existing surface stations with major upgrades are located at Exhibition and Yeerongpilly and the two existing surface stations with minor upgrades are located at Moorooka and Rocklea.

The underground system consists of two single track tunnels each of seven metre diameter running under the city with connecting cross passages at regular intervals to satisfy fire and life safety requirements. Particular allowance has been made for potential airspace developments directly above the stations at Albert Street and Woolloongabba and adjacent to Roma Street and Boggo Road.

A new signalling system for the underground section will allow 24 trains an hour to operate in the peak period on each new line. The new signalling system will interlock with the existing system, enabling automatic train operations to synchronise with the platform screen doors in underground stations.

A separate ventilation and emergency shaft at Fairfield ensures compliance with the egress and fire and life safety requirements in the underground operating environment.

The new system will be based on the ability to operate electric trains that run on the existing QR 25Kv electrified network.

Station Locations

The key station sites associated with Cross River Rail are:

- Roma Street (northern CBD)
- Albert Street (southern CBD)
- Woolloongabba
- Boggo Road
- Yeerongpilly
- Exhibition
- Moorooka
- Rocklea.

Following preliminary technical investigations and in consultation with stakeholders through the Planning Advisory Group (PAG), a framework of critical drivers was identified to clarify transport integration, operational and catchment objectives for the project and to explore the best alignments and station locations.

The underground stations have been positioned according to the vertical and horizontal rail alignment and the urban design and precinct planning requirements. The rail alignment has been calibrated to minimise disruption to existing and future development, and to facilitate the desired station location amongst a broader range of engineering constraints.

The station entry locations with their associated deep shafts and vertical transport for the public, take into account the preferred precinct planning objectives including the required proximity to existing bus and rail infrastructure in balance with the local site, cost and engineering constraints.

The new Albert Street station supports the ongoing development of Brisbane’s CBD and a vibrant mixed-use residential, employment and retail precinct adjoining the Botanic Gardens. It also provides direct access to the financial district, the government precinct at lower George Street, the retail precinct around Queens Street Mall as well as the education precinct at QUT.

New Cross River Rail platforms at Roma Street will create South East Queensland’s primary transport interchange hub and support the continued development of commercial and mixed-use activities in the north quarter of the CBD and preserve long term city expansion opportunities associated with the Transit Centre and Roma Street railway yards. They will also provide direct access over the Kurilpa Bridge to the planned CBD expansion areas at the northern extent of the West End peninsula.

The new full service station at Exhibition station supports the regeneration of the Bowen Hills Urban Development Area core and the planned RNA redevelopment, as well as the ongoing renewal of the Fortitude Valley urban core and employment growth at Herston associated with the Royal Brisbane and Women’s Hospital.

The new station at Woolloongabba supports the planned renewal of Woolloongabba Central, Kangaroo Point south and the Woolloongabba Urban Development Area.

New platforms at Boggo Road combined with a new southern Cross River Rail entry, support the redevelopment of the Boggo Road Urban Village, ongoing growth of the UQ campus and the Princess Alexandra Hospital and associated health, medical and eco-science activities.



In building a functional and attractive public transport system, the streets, footpaths and public spaces around stations are as important as the essential track infrastructure and rolling stock. It is critical for passengers to be able to reach a station safely and in comfort.

The working life of the city

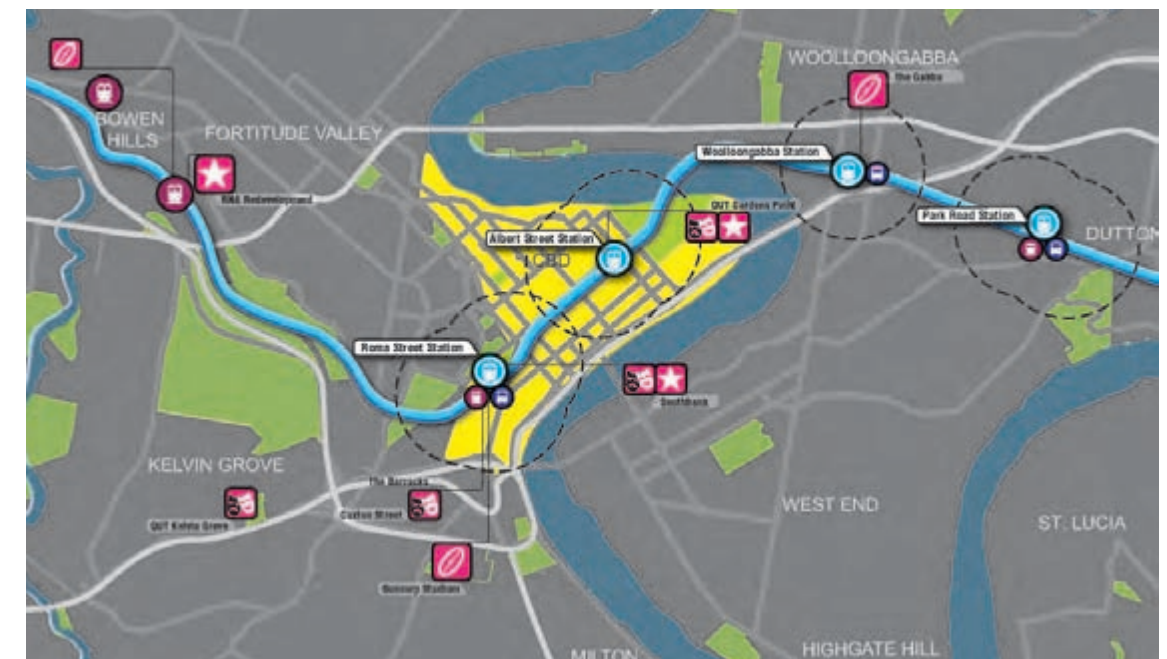
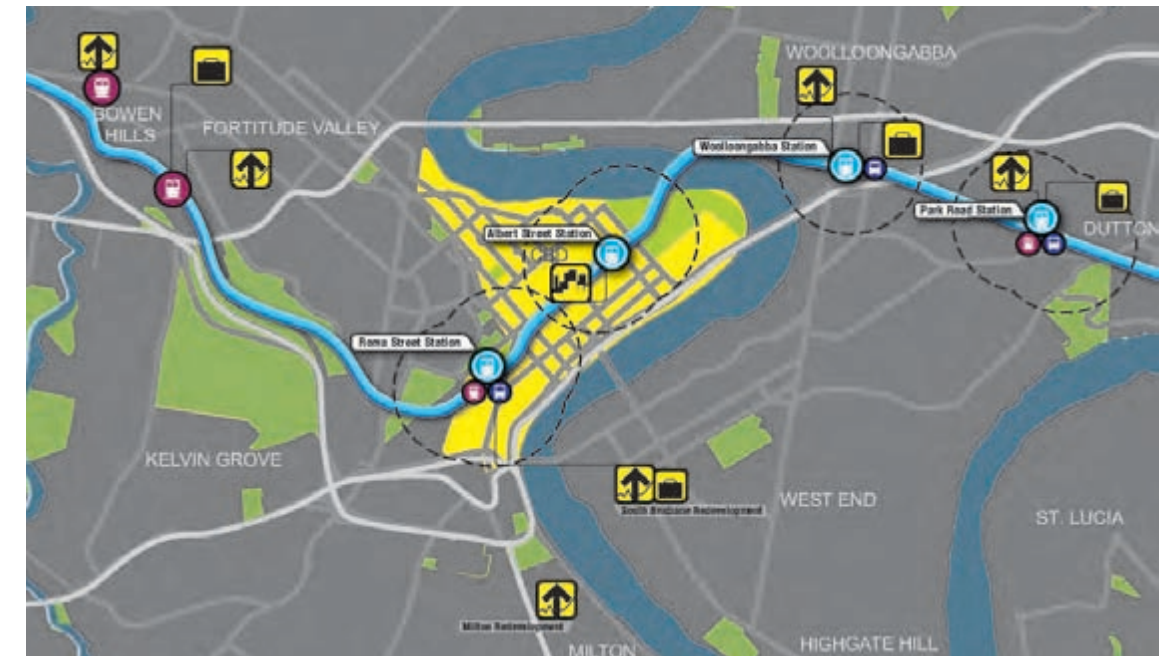
Cross River Rail will significantly improve access to four out of five of the highest growth employment areas in the city and link major planned renewal precincts:

- Brisbane CBD and north quarter
- South Brisbane commercial district
- Bowen Hills, RNA and Fortitude Valley commercial activities
- Woolloongabba central commercial district and the Mater Hospital
- Boggo Road health and knowledge cluster
- Major education and health facilities.

Major events access

Cross River Rail will provide significantly greater public transport capacity to the city's premier sporting and events facilities including:

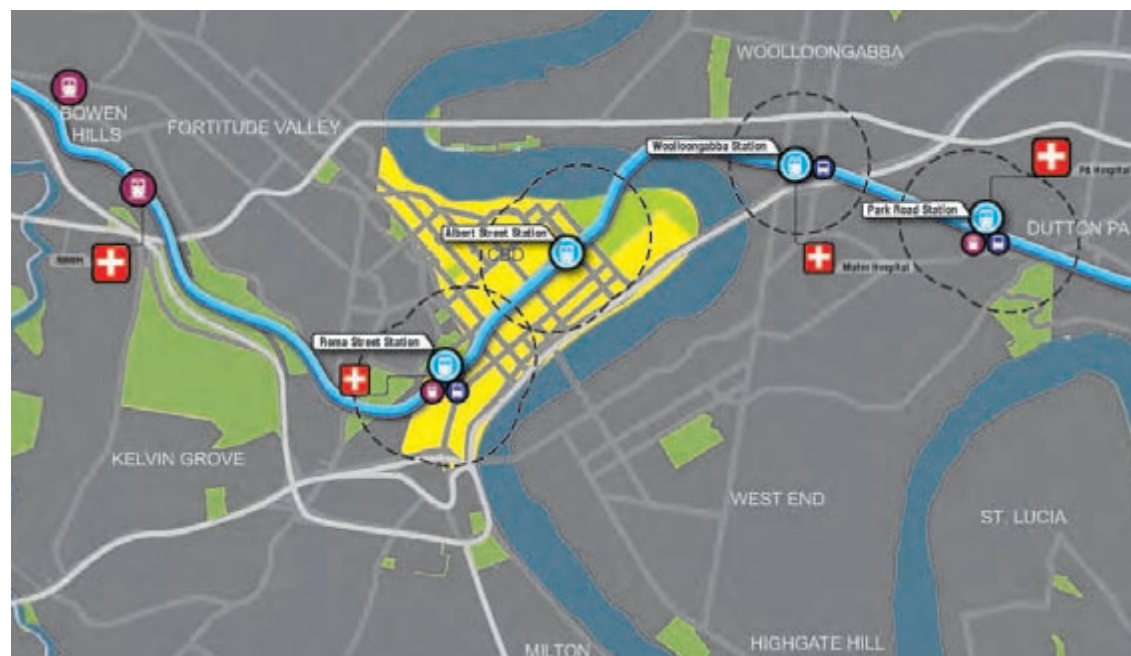
- Suncorp Stadium (52,000)
- The Gabba (42,000)
- Planned expansion of the River Stage (32,000)
- The Ekka (50,000-70,000 daily)
- Queensland Tennis Centre (5,500)
- Riverfire (600,000 along river front)
- The Southbank precinct via the Kurilpa and Goodwill pedestrian bridges.



Health and wellbeing

Cross River Rail provides direct access to each of the major public and private health facilities in the inner city including:

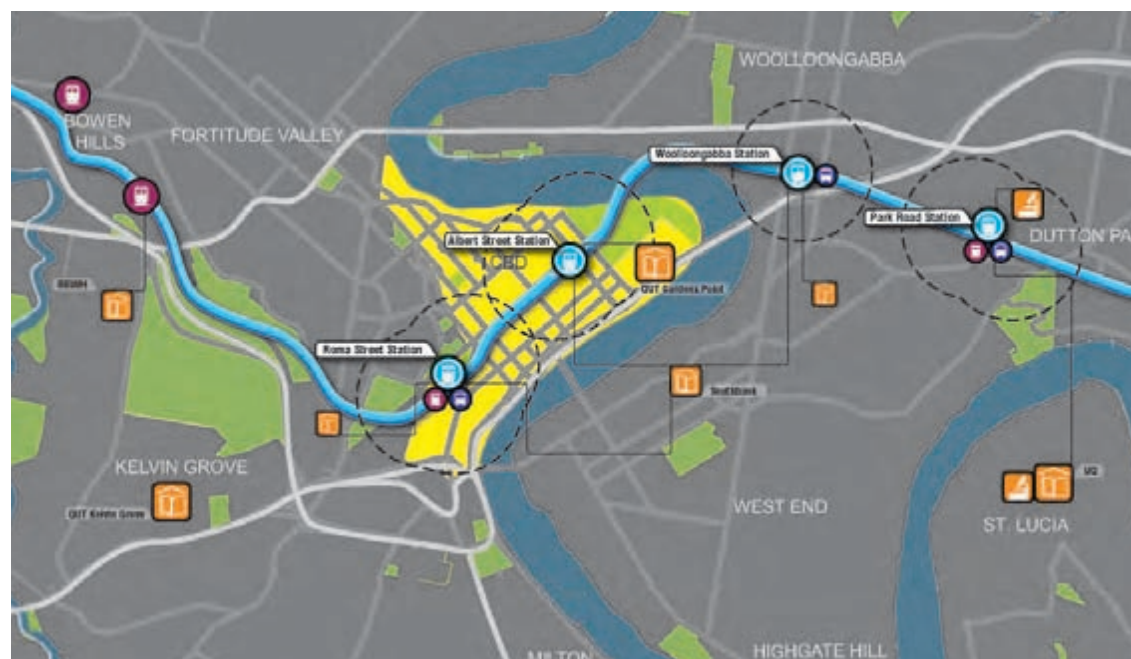
- The Princess Alexandra (PA) public tertiary hospital
- The Royal Brisbane and Women's Hospital (RBWH) public tertiary hospital
- The Mater public and private hospitals
- The Spring Hill medical precinct
- The Holy Spirit private hospital
- Woolloongabba Dental Hospital.

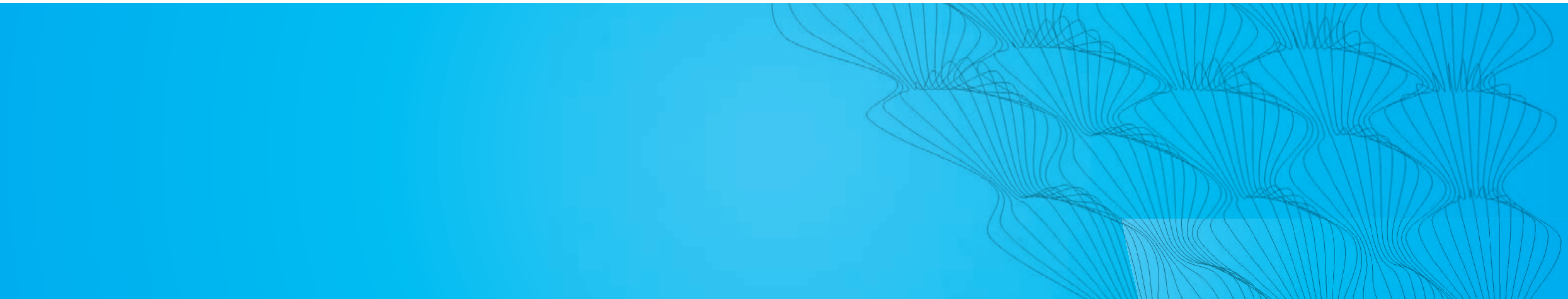


Learning, education and research

Cross River Rail improves access to many of the major inner city education, research and learning institutions including:

- University of Queensland St Lucia Campus via the Eleanor Schonell Bridge
- Queensland University of Technology Campus
- Southbank Institute of Technology via the Goodwill Bridge
- Brisbane Grammar Schools (boys and girls)
- St Joseph's, Gregory Terrace
- PA Hospital, Mater Hospital and the RBWH health and knowledge precincts
- Boggo Road Eco-sciences Precinct.





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Stations

Station design

All stations referenced in this project have been designed to comply with the following control documents:

- Disability Discrimination Act (DDA)
- Building Code of Australia
- Disability Standards for Accessible Public Transport (DSAPT)
- QR Station Design Guide
- QR Accessibility Signage Manual
- TransLink Station Signage Manual.

Visual design concept

Cross River Rail is a movement network under and across Brisbane's city centre.

It carves out a passage through the rock, and like the river above, connects with key communities along its journey. The design concept reflects the movements of the river. The underlying geometry of the 'braid' is an abstraction of moving water, developed into a visual element which is used in public spaces, entrance shafts and platform canopies.

The braid is a linear, intertwined element. It transforms as it moves from the platform cavern to the surface, articulates a sense of space underground and becomes a celebration of shade and light at the surface.

Underground, the braid gives direction to the path of travel, emphasises volume and allows natural light to be directed down from the surface.

At station entry points it becomes an extension of the riverside gum trees, constructed of renewable Queensland timber and creating a sensory experience for travellers that is uniquely 'Brisbane'.

The design provides a consistent station experience and creates a unique visual identity for the Cross River Rail network.

Entrance design

The station entries provide simple, functional access to the Cross River Rail network, and serve as the line identity and public face as well as enhancing the immediate built environment.

Station entries are designed to respond to the warm Brisbane climate with a combination of adjustable panels, louvers and generous shading devices providing an environment like that of a great verandah. The entrance covering can be progressively closed and secured in severe conditions.

In the underground stations the entrance shaft is a vertical connection between surface and the platform. The entrance shaft is integrated with the entry canopies and where possible it reads as a continuous volume, linking the surface to the ticketing concourse.

Natural light from the entry structures will penetrate the shaft and reflect down to lower levels. Light levels are progressively filtered from the surface to the platform to provide a comfortable transition, avoiding light glare, discomfort, and impact on signage legibility.

Station capacities

Stations have been designed to meet projected passenger loading at each station in 2031 based on two hour peak travel periods in both the morning and evening.

Vertical transportation

The vertical transport options include escalators, lifts and stairs to public areas. Emergency egress fire isolated stairs are provided from the platform ends to street level. These stairs pass through the service zones at each end of the station and provide service access during normal operational hours. Escalator quantities are designed to meet the forecasted station patronage.

Key design assumptions include:

- escalators in lieu of stairs where the vertical rise is greater than 5.4m
- stairs in public areas where patronage levels are lower and the rise is less than 6m
- a minimum of three escalators where no alternative route is available to allow for the maintenance of one escalator
- accessible lifts to all public areas - sized to carry 21 people and rated to carry cleaning and maintenance equipment between levels.

There is no redundancy for the lifts in the event of failure, with the alternative exit point being the alternative/second station entry.



Above: Example of station entrance



Left: Braid

Station caverns

There are two generic types of underground station in the Cross River Rail reference design:

- mined single span cavern with centre platform
- top down excavated box with centre platform.

Caverns are double height spaces with a mezzanine access from the concourse level. The mezzanine distributes passengers to the platform via stairs and escalators, while allowing exiting passengers to leave the platforms efficiently. The cavern incorporates a ten metre wide platform between platform screen doors. The cavern cross sectional area has been optimised to reduce construction cost.

Station caverns are approximately 250m long (catering for nine car trains and service areas at each end), 21m wide (with a 10m clear platform width between platform screen doors) and 12m high (allowing for a mezzanine level above the platform).

The cavern is structurally lined. A suspended three dimensional ceiling element is perforated and articulated to assist in reducing acoustic reverberation.

Structures within this defined cavern are treated as minimal insertions with transparent balustrades and platform screen doors. Services have been contained in the zone above the platform screen doors which reduces the effective visual space of the cavern, however this increases the efficiency of space usage and facilitates cleaning of any non-vertical surface above the rail line.

Mechanical and electrical services

The services infrastructure occupies a significant area at each station. The locations were chosen to minimise excavation, distance from the cavern and to avoid major underground constraints. Generally, they are located at either end of the mined caverns and within the excavated zone of the box caverns.

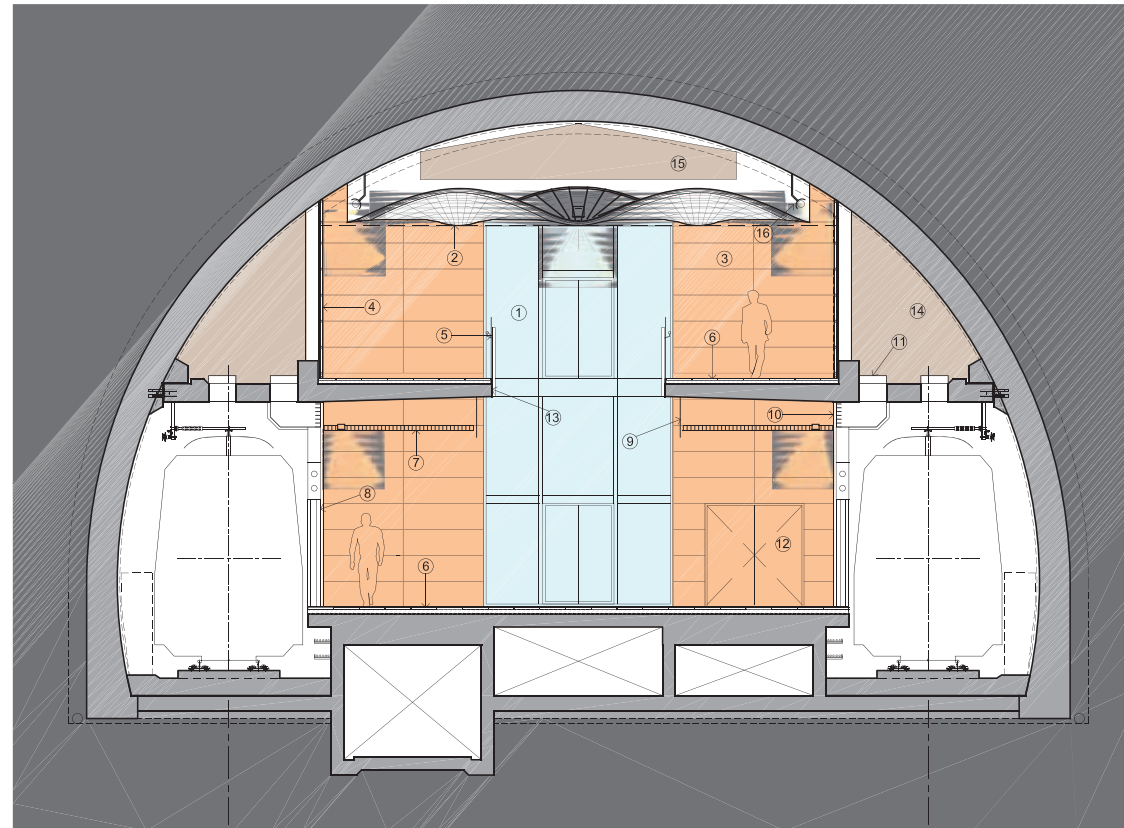
The electrical power system for the station is separate from the bulk supply power points feeding the operational line. Each end of each station contains a single ring main unit and transformers which provide 100% redundancy.

Lighting is provided to all public and back of house areas and is an integral component of the passenger experience. Where possible, lighting is indirect and directional to maximise comfort levels.

The underground stations include mechanical cooling to the platform level to improve passenger amenity during the hotter months. This is achieved through mechanical plant located at each end of the station and a sub-floor displacement system along the length of the centre platform.

This system delivers the conditioned air to its point of immediate need and avoids energy wastage through the open vertical transport shafts. The return air is extracted at high level in the mezzanine area just below the cavern ceiling using the smoke exhaust duct connected to the tunnel ventilation over track exhaust. The return air is recirculated back to the inlet of the supply air handling unit to maximise energy recovery.

It has been designed to maintain temperatures of 26 deg C at the platform level in the vicinity of the platform screen doors during the hotter months. It is expected however that when the platform screen doors are open, the inflow and outflow of air to and from the running tunnels will impact on the platform temperature which will fluctuate accordingly.



Typical Cavern Section

1. 21 Person Lift
2. Custom Feature Suspended Ceiling
3. GRFC (Glass Reinforced Fibre Cement) Feature Panels
4. GRFC Standard Wall Panel - Neutral Colour
5. 1200mm High Toughened Glass Stainless Steel Balustrade
6. Reconstituted Stone Epoxy Floor Tile on Screed
7. Aluminium Blade Ceiling System with Integrated Linear Slot Diffusers
8. Aluminium Framed Platform Screen Door
9. 800mm Glazed Smoke Baffle
10. Stainless Steel Smoke Grill Exhaust
11. Automated Dampers
12. Fire Escape Door
13. Class 1 Steel Form Concrete Finish Sealed
14. Over Track Exhaust
15. Smoke Duct
16. Continues Indirect Light



Acoustics noise and vibration

There are acoustically absorptive surfaces on the platform ceiling and walls where they are double storey height. This limits the reverberation time and allows the public address system to be clearly comprehensible.

Mechanical ventilation systems are placed where they will have minimal impact on background noise levels. Train noise in stations is controlled via the platform screen doors. Vibration resilient fastenings or vibration isolated tracks are used to control train vibration.

Information systems and signage

The information systems used in the stations include:

- electronic passenger information display screens
- public address system
- help points for passenger communication with customer care/station staff for emergency and information use
- emergency information and evacuation systems
- staffed help point located at platform level and permanently manned by a Queensland Rail staff member.

Station fire and life safety

The fire and life safety systems for Cross River Rail are designed to meet international standards for underground systems. The underground tunnel and station spaces are designed with electrical and mechanical systems that detect fire and activate ventilation systems to maintain conditions during evacuation.

The basic design relies on major ventilation extract points at the ends of stations to cater for both tunnel and station extraction. The station and tunnel ventilation systems are designed as independent systems. The design has avoided the need for jet fans within the running tunnels, through the use of large ventilation systems within the stations.

Platform screen doors

The underground stations have platforms equipped with platform screen doors. These doors are full height, separating the platform space and tracks which allows better climate control, reduced noise and dust on the platforms and a higher degree of safety for passengers.

Safety and security

The primary focus of the design is to apply crime prevention through environmental design (CPTED) principles to the stations, comprising:

- Closed Circuit Television (CCTV) monitoring of concourse, entry shafts and platforms
- intrusion detection and monitoring
- platform screen doors (to avoid likelihood of accidental access to rail line)
- ability to close entries to stations during non-operational hours
- integration of security bollards where vehicular access/approach to the station is available
- clear sight lines on approach to station
- location of entry points to the station and to staff entries in areas activated by other uses such as retail or within sight lines of adjoining residential or commercial tenancies
- good levels of lighting in and about the station entry points
- easily located help points
- minimal dead spaces behind columns or other barriers
- public toilets within the paid concourse entrance, visible from staff positions, well lit and monitored
- central platform to avoid isolation of passengers across dividing rail line
- full time staff member located on platforms during operational hours.

Top left: Platform screen doors and escalators

Left: Station entrance with information systems, signage and security

Emergency services requirements comprise:

- access to all parts of the station
- provision of fire control room near station entry at ground level
- provision of fire isolated access routes to platform and track level
- provision of fire fighting lobbies to fire isolated stairs
- automatic fire detection and occupant warning system
- fire fighting facilities including hydrants, tanks, boosters, gas suppression to communications rooms
- pressurised fire isolated exit stairs
- tunnel egress refuges at platform ends
- sprinkler protection
- CCTV
- storage area for emergency trolleys for tunnel incident access.

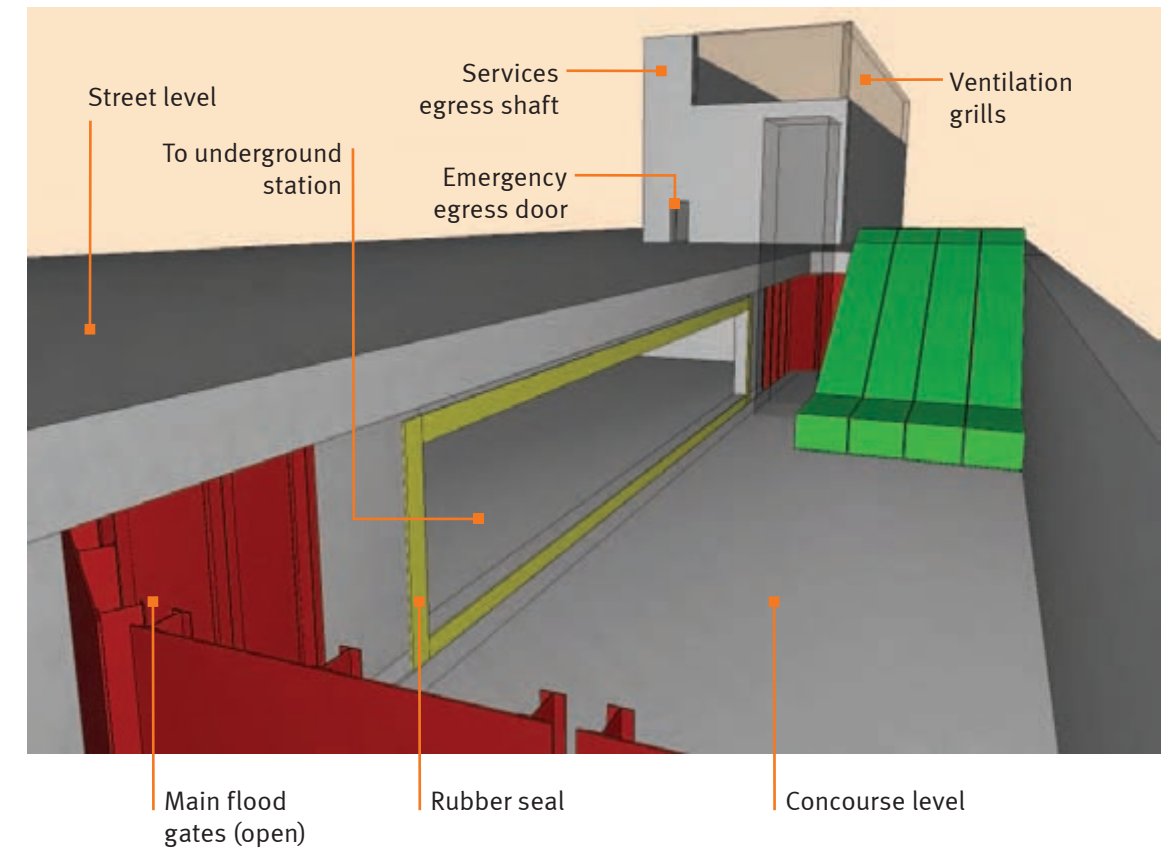
Sustainability

Cross River Rail will incorporate key sustainability initiatives including:

- low energy, long life usage
- promotes natural ventilation, daylight
- capture and store stormwater
- treat any emissions and by products
- use of recycled material and low embodied energy
- long design life with high quality and robust material
- utilise locally made product
- use of timber as a key renewable resource
- minimise disruption and impact on surrounding communities
- maximise densification opportunities and quality of community outcomes.

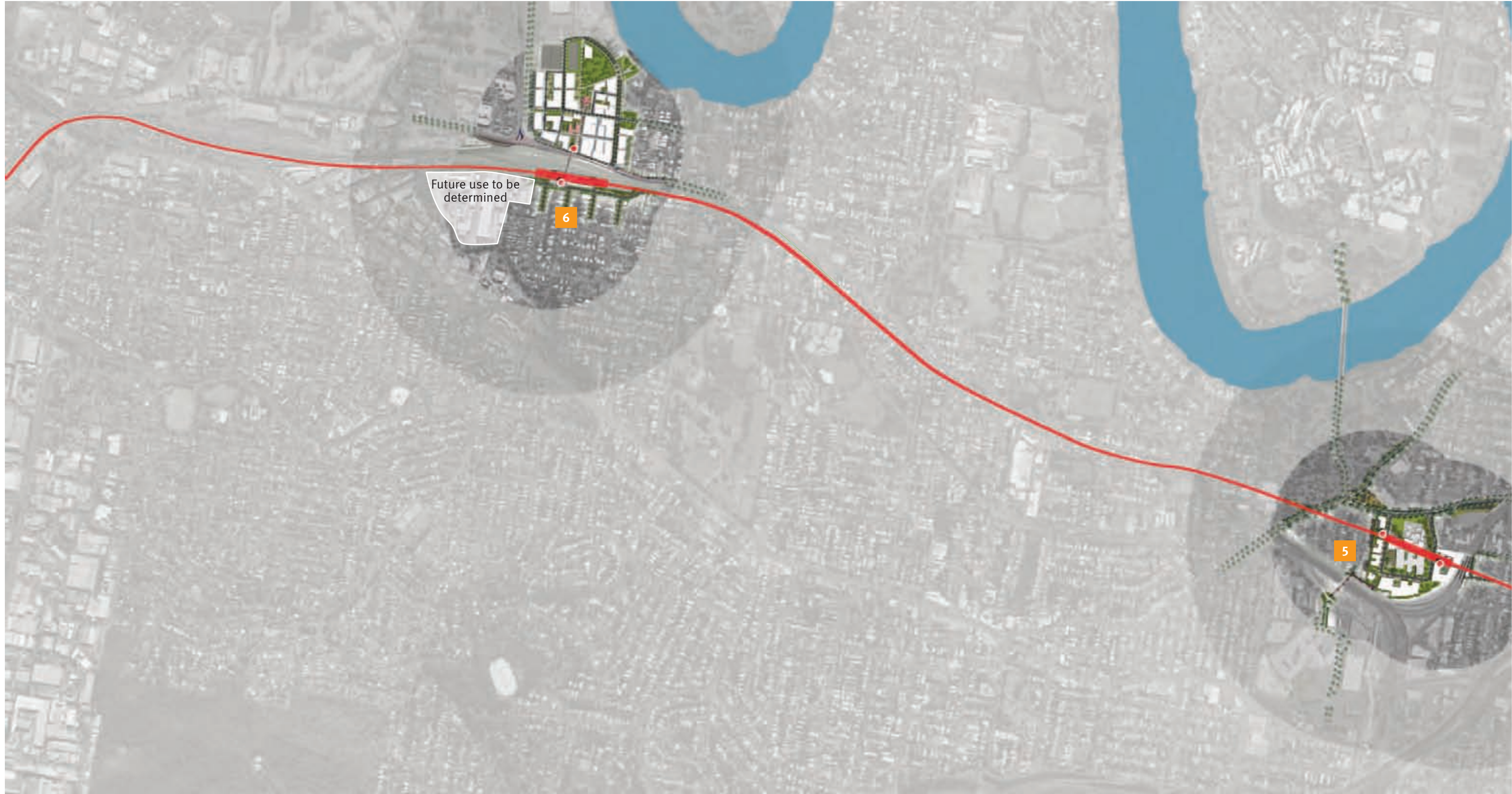
Flood protection

Flood protection measures include raised underground station entry points to protect against local flooding, a stop block protection system for intermediate flood events for low lying stations and finally dedicated automatic flood gates for protection of Albert Street Station and the southern portal against the extreme 1 in 10,000 year flood event.



Flood mitigation systems during normal conditions (no flood)

Transforming the face of the city





Exhibition station

Vision

Realise Exhibition station as a fully operational station and catalyse the planned regeneration of Bowen Hills and RNA Showgrounds.

City building outcomes

- Catalyse redevelopment of RNA Showgrounds and broader Bowen Hills UDA.
- Preserve planned intent for all passenger lines to pass through the Bowen Hills area.
- Facilitate ongoing growth and development of major health and knowledge precinct focused on the Royal Brisbane and Women's Hospital.
- Reinforce role and function of O'Connell Terrace as an important people street and inner city east/west connection.
- Provide critical missing link in northern cycle network.
- Reinforce major public pedestrian route through the RNA from Fortitude Valley.

A new Exhibition station will improve public transport access to the broader Bowen Hills urban development area (UDA) and help to catalyse development within the RNA site. The station would improve access to the Royal Brisbane and Women's Hospital and preserve the level of access to the Bowen Hills UDA core by all services on the passenger rail network.

A fully operational station would promote more rapid market absorption of development and support greater commercial yields subject to future planning outcomes, particularly within the RNA site.

Station entry locations

The new Cross River Rail station at Exhibition has two entries to optimise the station's walk up catchment and provide direct access to the range of destinations in the locality.

Entry one is on the O'Connell Terrace frontage of the RNA site and will provide a strong public presence and address for the station on the local road network. This entry provides convenient access to the UDA core to the north east, planned development on O'Connell Terrace and the Royal Brisbane and Women's Hospital precinct to the west. An entry in this location also provides opportunity for interchange with local bus services and kiss and ride facilities.

Entry two is positioned to intergrate with the north-south pedestrian spine through the RNA redevelopment. This entry will provide access to the Royal Brisbane and Women's Hospital to the north, commercial intensification planned for the northern areas of Fortitude Valley and the commercial development and convention centre proposed as part of the RNA plans. This entry will also be used to manage access during events such as the Ekka.



Note: Precinct plan shows development opportunities and is indicative only

Station design

Exhibition station is a surface station that will consist of a new raised island platform constructed between O'Connell Terrace and Ekka Plaza. The station is designed to operate in normal commuter mode as well as being able to meet the loadings associated with RNA events.

The existing station comprises low level curved platforms approximately 155m in length. The new station comprises high level straight platforms, 220m in length and 12m wide, designed for nine car trains. The new upgraded station will replace the existing Exhibition station. The platforms are 100% covered for passenger weather protection to cater for full platform loading.

The elevation of the station varies along the length. The new track and station is raised approximately five to six metres above the ground near the existing subway entry to O'Connell Terrace resulting in the western end of the station being on viaduct. Opportunities may exist for the spaces under the viaduct to be used in the future by the RNA.

The existing subway entry to the Exhibition grounds will be widened and heightened to facilitate greater passenger flows during events, whilst at the other end of the station a new elevated main entry level will be provided at O'Connell Terrace.

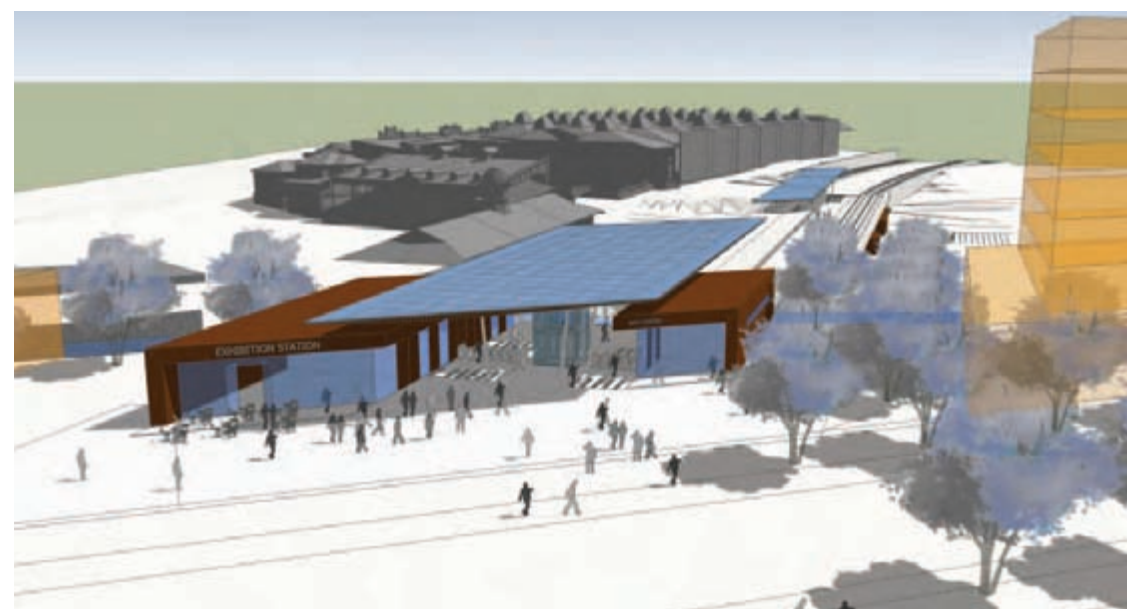
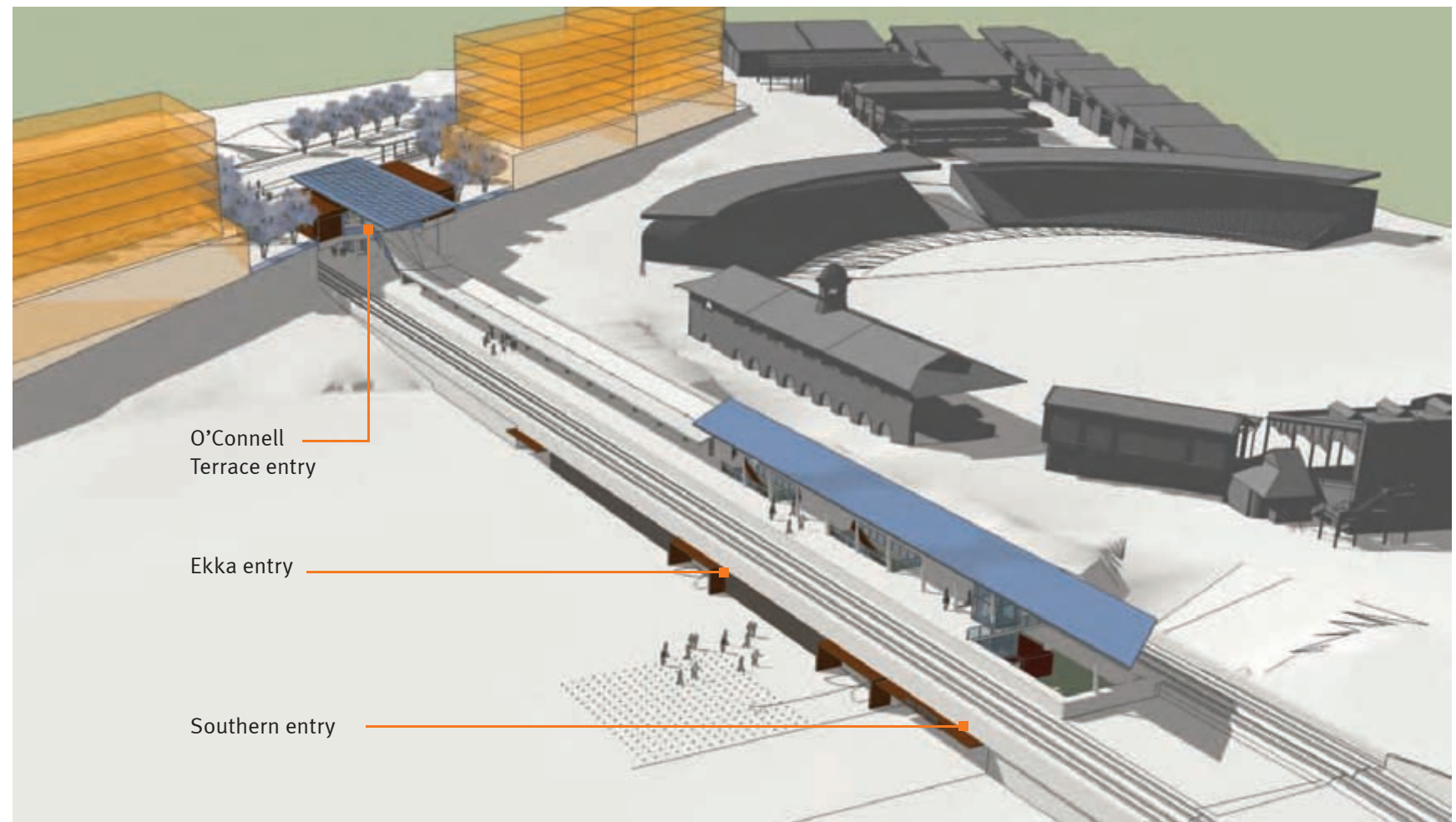
Many adjoining buildings, landscape features and spaces have historic, social or cultural significance and the proposed work will require ongoing coordination to ensure compliance with relevant legislation.

Ticketing gates are located at each end of the station. Ticket offices and staff facilities are located at the northern end of the station on O'Connell Terrace. Provision has been made to include a secondary staff facility and ticket office, at the southern end adjacent to Ekka Plaza, to allow day to day access as the RNA precinct develops.

Essential works

The essential precinct and streetscape works identified to support the new Cross River Rail infrastructure at Exhibition station include:

- the reconfiguration of the O'Connell Terrace rail bridge and associated re-grading of O'Connell Terrace to accommodate rail corridor widening
- the provision of a new southern station concourse and re-grading of rail underpass to interface with the RNA site
- the development of a plaza forecourt for the station on O'Connell Terrace
- the provision of signalised pedestrian crossing over O'Connell Terrace and to local bus stops
- the provision of cycle parking facilities in public area outside the station.



Above: Aerial view

Left: View from O'Connell Terrace

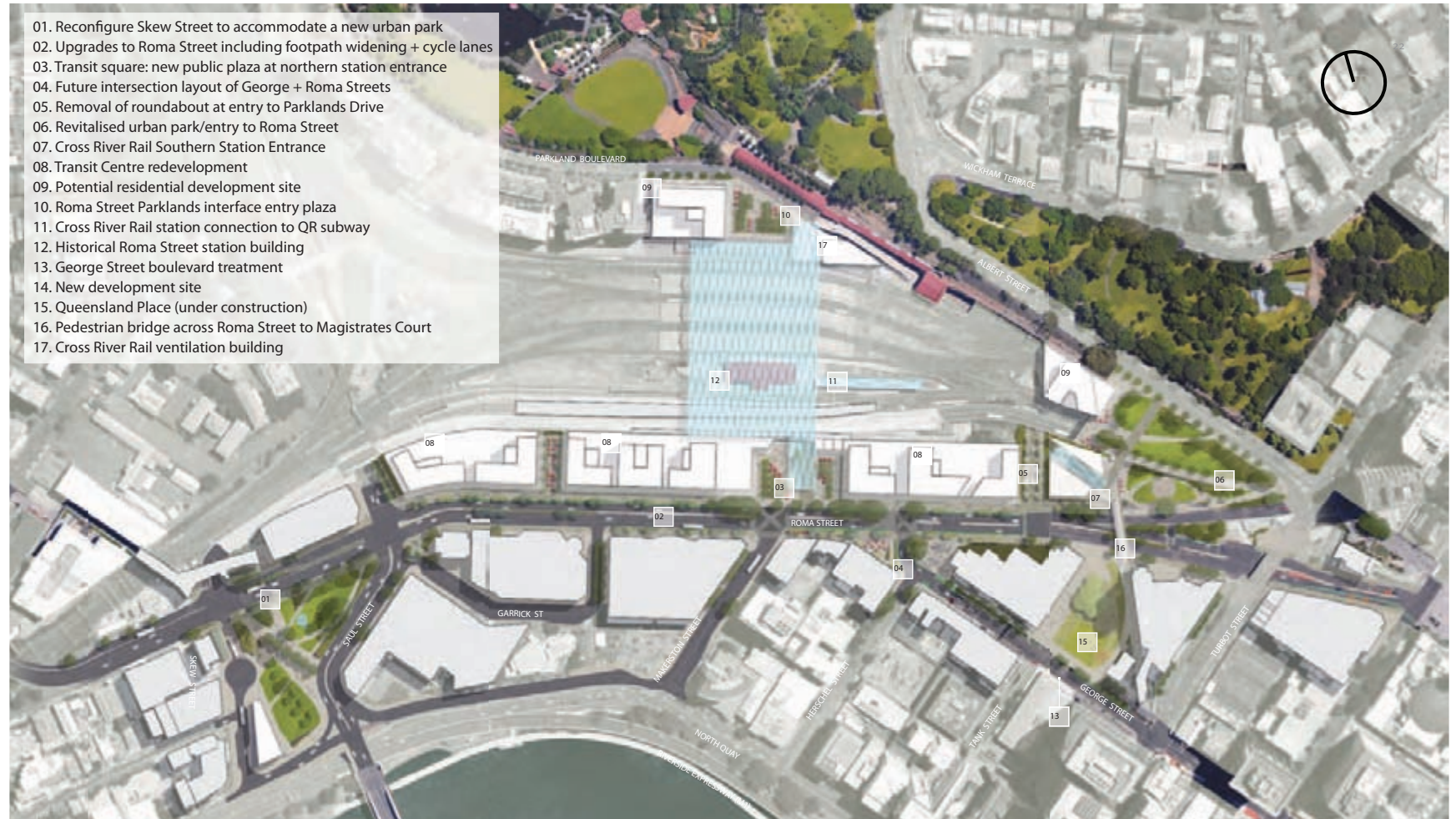
Roma Street station

Vision

South East Queensland's primary transport interchange. The Brisbane CBD's western gateway and future expansion zone connecting the hillside to the river and the city's great people streets.

City building outcomes

- Establish a regional transport interchange for all local, city wide, regional and interstate public transport.
- Reinforce the Albert Street green spine between the Botanic Gardens and Roma Street Parklands.
- Reinforce the western gateway to the CBD and improve urban quality.
- Reconnect the river to Spring Hill and the Tower Mill.
- Protect long term renewal and CBD expansion opportunities associated with the Roma Street rail yard and the Transit Centre.

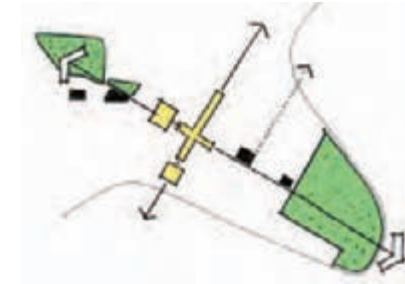


Note: Precinct plan shows development opportunities and is indicative only

Key vision elements



Albert Street green spine and access to the Parklands



Western gateway and north quarter growth and long term renewal opportunities



South East Queensland's regional transport hub – all modes pass through it

Key destinations and activity areas

Short term backpacker accommodation is prominent towards the north-west end of Roma Street. Roma Street also serves as a focal point for legal and judicial activity, with the presence of the supreme, district (under construction) and magistrate's courts, and the Queensland Police headquarters.

The northern perimeter of the Roma Street area is bordered by several important entertainment precincts, including 'The Barracks', Caxton Street and the Normanby Hotel. 'The Barracks' and Caxton Street also serve as important destinations both before and after events held at nearby Suncorp Stadium.

Cross River Rail would reinforce the transport amenity of the area and underpin further renewal opportunities including the immediate station surrounds, the transit centre and longer term opportunities associated with the rail yards.

Station location drivers

Key drivers for selecting the Roma Street location include:

- the need to integrate Cross River Rail with a CBD railway station for network integration and legibility
- the need for Cross River Rail to integrate with CBD busway station to facilitate intermodal transfer and an integrated transport network for the city and region
- the desire for Cross River Rail to integrate with the regional rail and bus network which is currently accessed at Roma Street Station
- Roma Street station has more additional capacity than Central station.

Key destinations and activities along Roma Street can be considered to be employment based, with high density commercial and residential buildings dominating land use. These have a variety of service and amenity retail at street level.

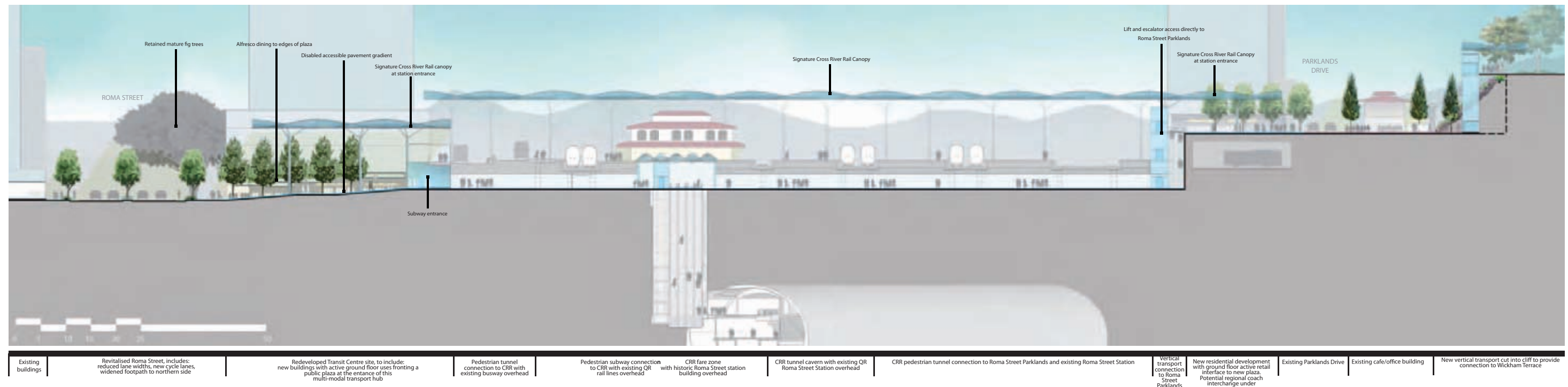
Station entry locations

Roma Street station has two entry points to the Cross River Rail platforms.

Entry one integrates directly with the existing underground concourse to connect with existing surface rail and busway networks, and interchange with regional and interstate bus and rail platforms. The underground concourse also provides access to Roma Street Parklands, including a nearby stairwell that connects to upper Albert Street and the Spring Hill catchment, and will help to unlock the long-term development potential over the existing Roma Street Parkland car park.

Entry two is positioned to the immediate north west of Emma Miller Place and provides a new point of entry from Albert Street and Roma Street. This entry would also link with the proposed pedestrian bridge from George Street near the Brisbane Magistrates court which in turn links with the Kurilpa Bridge Link to South Brisbane and South Bank.

Below: Section through existing Roma Street station concourse



Existing buildings	Revitalised Roma Street, includes: reduced lane widths, new cycle lanes, widened footpath to northern side	Redeveloped Transit Centre site, to include: new buildings with active ground floor uses fronting a public plaza at the entrance of this multi-modal transport hub	Pedestrian tunnel connection to CRR with existing busway overhead	Pedestrian subway connection to CRR with existing QR rail lines overhead	CRR fare zone with historic Roma Street station building overhead	CRR tunnel cavern with existing QR Roma Street Station overhead	CRR pedestrian tunnel connection to Roma Street Parklands and existing Roma Street Station	Vertical transport connection to Roma Street Parklands	New residential development with ground floor active retail interface to new plaza. Potential regional coach interchange under	Existing Parklands Drive	Existing cafe/office building	New vertical transport cut into cliff to provide connection to Wickham Terrace
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Station design

Roma Street station is a single span cavern incorporating a central island platform. The cavern is approximately 25m deep from surface to platform level and oriented to avoid sub-surface obstructions and allow the running tunnels to achieve suitable operational radii.

The alignment of Roma Street station has been dictated by the requirement to link with the Albert Street station. This results in a skewed station orientation in relation to the existing Roma Street platforms. The new underground station will effectively become platforms 11 and 12 of the integrated Roma Street Station.

The station has a major entry facing Roma Street to service the city, a secondary entry from the existing Roma Street subway that connects to all the existing operational Roma Street surface platforms, the Inner Northern Busway Station at Roma Street and the Roma Street Parklands.

The circulation elements for the station comprise escalators, lifts and stairs to a mezzanine level approximately 20 metres below ground. This mezzanine level acts as a longitudinal passenger circulation level for passengers entering from Roma Street or transferring from the existing surface public transport platforms.

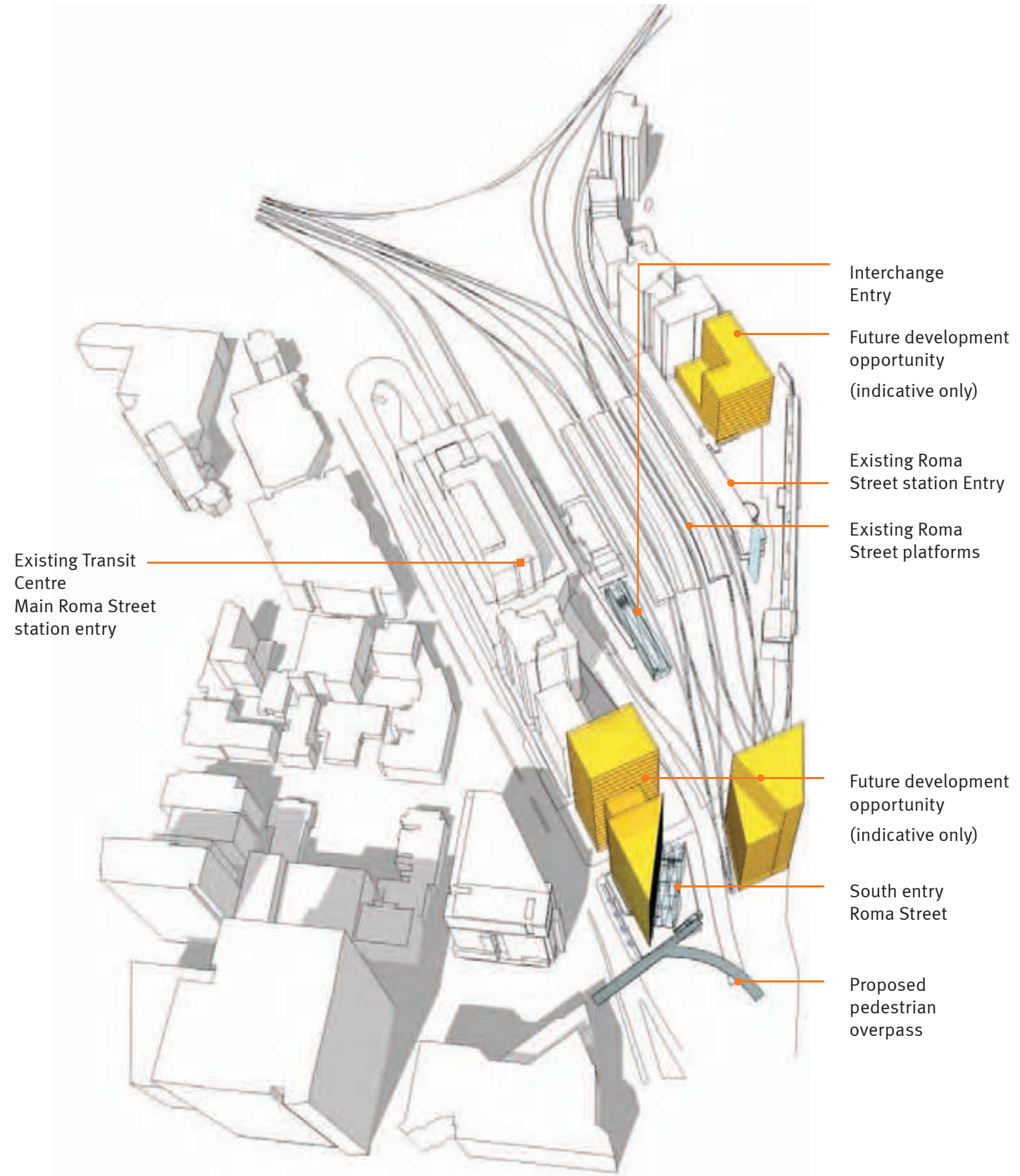
The station mezzanine is continuous between the southern Roma Street entrance and the centrally located interchange entry to facilitate passenger movement from Roma Street to the existing concourse without travelling via the platform.

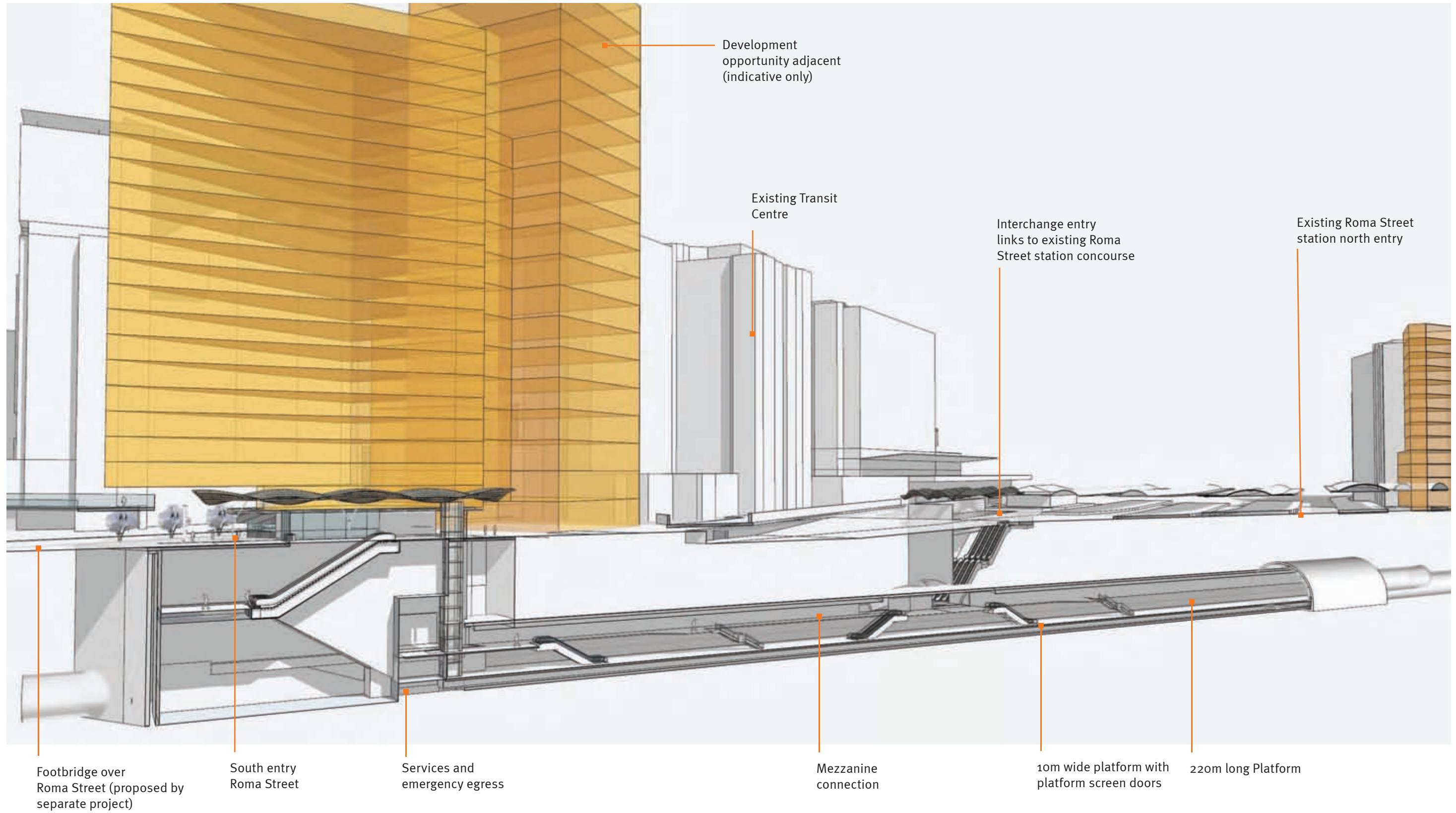
Emergency egress from the station is at the ends of the platforms up to surface. Emergency services access is also at these locations.

Essential works

The essential precinct and streetscape works identified to support the new Cross River Rail infrastructure in this location include:

- improving and potentially widening footpaths on the northern side of Roma Street
- improving street crossing opportunities from the CBD across Roma Street to address pedestrian safety risks
- reconfiguring the Roma Street and George Street intersection to provide enhanced pedestrian capacity and to improve pedestrian safety
- reconfiguring of Parkland Boulevard to enable the delivery of the southern Cross River Rail entry and public plaza.





Albert Street station

Vision

A truly central station and forecourt providing a focus and identity for the southern CBD as an active, mixed-use quarter on the park.

Albert Street station is considered the most important new station delivered by Cross River Rail, delivering additional passengers to the city centre.

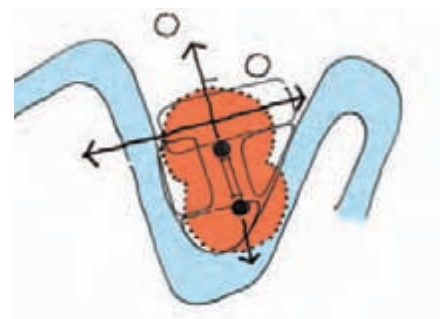
City building outcomes

- Establish a truly central station that addresses the public transport shortage in the southern CBD.
- Promote Albert Street as a principle people street and green link between the Roma Street Parklands and the Botanic Gardens.
- Create a new public space at the heart of CBD south.
- Promote a more legible structure for the CBD with improved connections.
- Facilitate the ongoing renewal and intensification of the CBD and opportunity sites.



Note: Precinct plan shows development opportunities and is indicative only

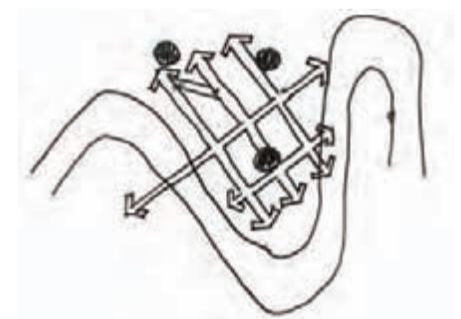
Key vision elements



A truly "central" station addressing known shortfalls and future development



Albert Street as a key green "people" street



A more connected and legible structure for the CBD to disperse loadings

Key destinations and activity areas

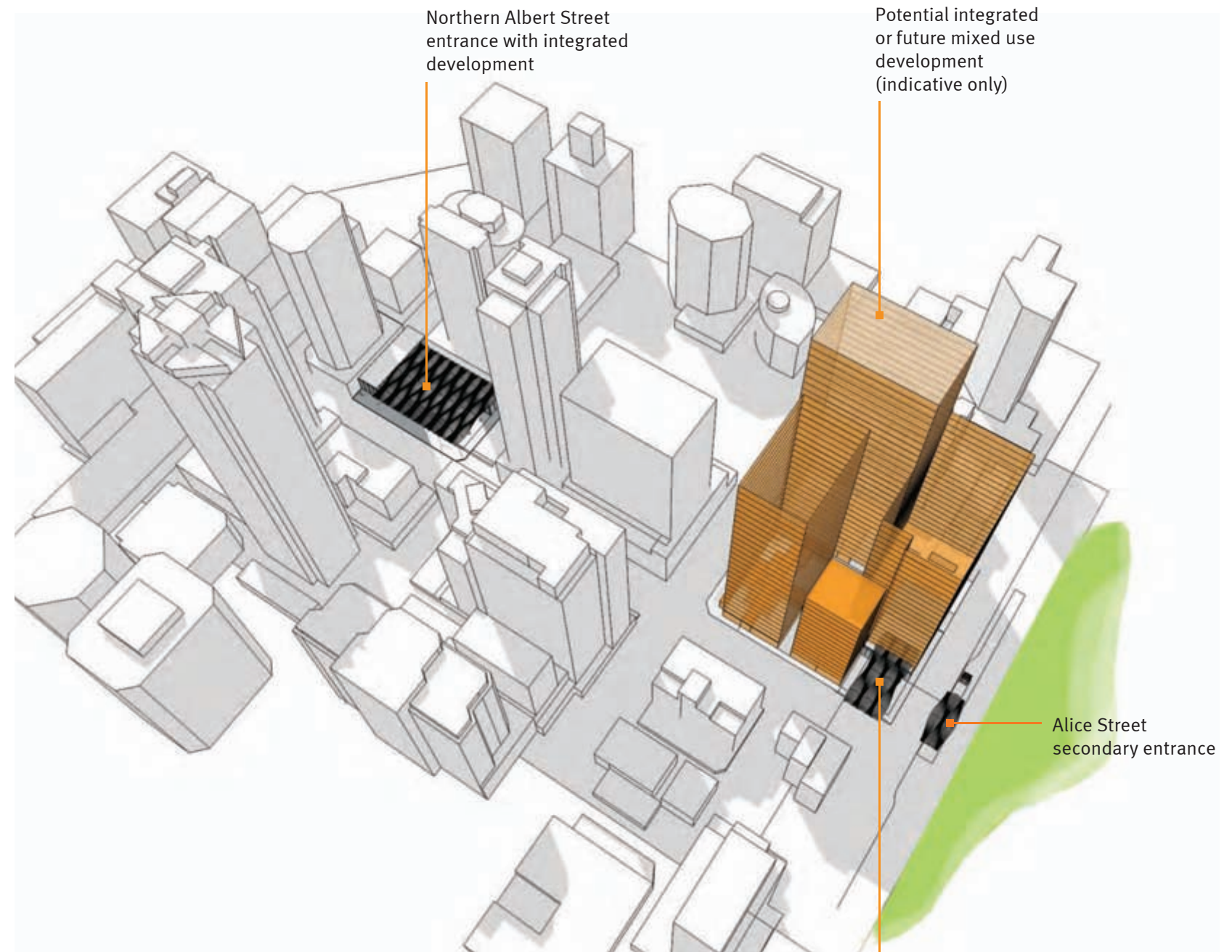
Southern Albert Street has close proximity to a diverse mix of key CBD destinations and activity areas, including the Queen Street Mall retail precinct, employment destinations including the Eagle Street commercial zone, or 'Golden Triangle', and tertiary education destinations, most notably the QUT Gardens Point Campus.

In addition, government and administrative uses are concentrated at lower George Street, lying parallel to lower Albert Street. The northern portion of Albert Street can be considered to have a higher concentration of destinations and uses, and therefore activity, while the southern extremities of Albert Street are adjoined by predominantly high density residential uses, and therefore suffer from a lack of street level activity.

Station location drivers

The key drivers for Albert Street:

- locations in the vicinity of Central Station could provide inadequate public transport accessibility to the southern CBD area, Government Precinct and QUT
- the need to provide two CBD Cross River Rail stations to cater for future passenger volumes
- truly central location providing good access to QUT and the retail, government and financial precincts
- significant renewal and regeneration opportunities exist in the Albert Street and lower George Street areas.



Aerial view of Albert Street station context with indicative development and new public space and main entry

Southern Alice Street entrance with indicative development

Albert Street

Station entry points

There are two entry points for the new Cross River Rail station at lower Albert Street.

Entry one is near the junction of Mary Street and Albert Street and provides the primary access to the station, supporting the highest volume of passenger trips.

The station entry is positioned centrally in the lower CBD, providing convenient walking trips from the Eagle Street business district, the Government Precinct on Lower George Street and the Queen Street Mall retail precinct.

Entry two is positioned at the southern extent of Albert Street near Alice Street with a potential underground pedestrian access from a subsidiary entry positioned near the edge of the Botanic Gardens.

This entry provides direct access to QUT and also supports convenient access to the proposed River Stage upgrade. It also provides access to the riverside pedestrian and cycle links and any future bridge crossings from Edward Street to Kangaroo Point.



Albert Street Station – north entry at corner of Mary and Albert Streets

Station design

Albert Street Station is a single span cavern with central platform. The cavern is located below Albert Street (largely within the street width) to minimise impact on adjacent property development and existing buildings. It is approximately 31 metres deep from surface to platform level.

The cavern extends from the intersection of Albert Street and Mary Street through to the intersection of Albert Street and Alice Street, incorporating a 220 metre long platform. The method of construction of the main cavern will be wholly underground with no disruption to the surface streets.

There are two primary entries into the station. The most significant of these is at the intersection of Mary and Albert Streets in the heart of the CBD. To facilitate entry into the station at this point a station forecourt has been created that will greatly aid passenger movement in and out of the station. At this location four main escalators service the entry point with escalator operation always favouring the peak movements.

At the secondary Alice Street entry, which caters for the southern part of the CBD and QUT Campus, there is a smaller station forecourt area. Three main escalators and a slightly widened footpath service the entry feeder point. The position of this station entry relieves congestion at the intersection and facilitates passenger movements from the city financial district.

A particular engineering requirement for Albert Street station is the provision of floodgates at each of the major entry points to protect against a 1 in 10,000 year flood event.

The floodgates are positioned at the first level down within the station. This protects the vast majority of the station from inundation.

Temporary flooding of the very top entry levels of the station would result in minimising any station downtime. This is considered a very prudent level of protection commensurate with the frequency and consequences of such an event.

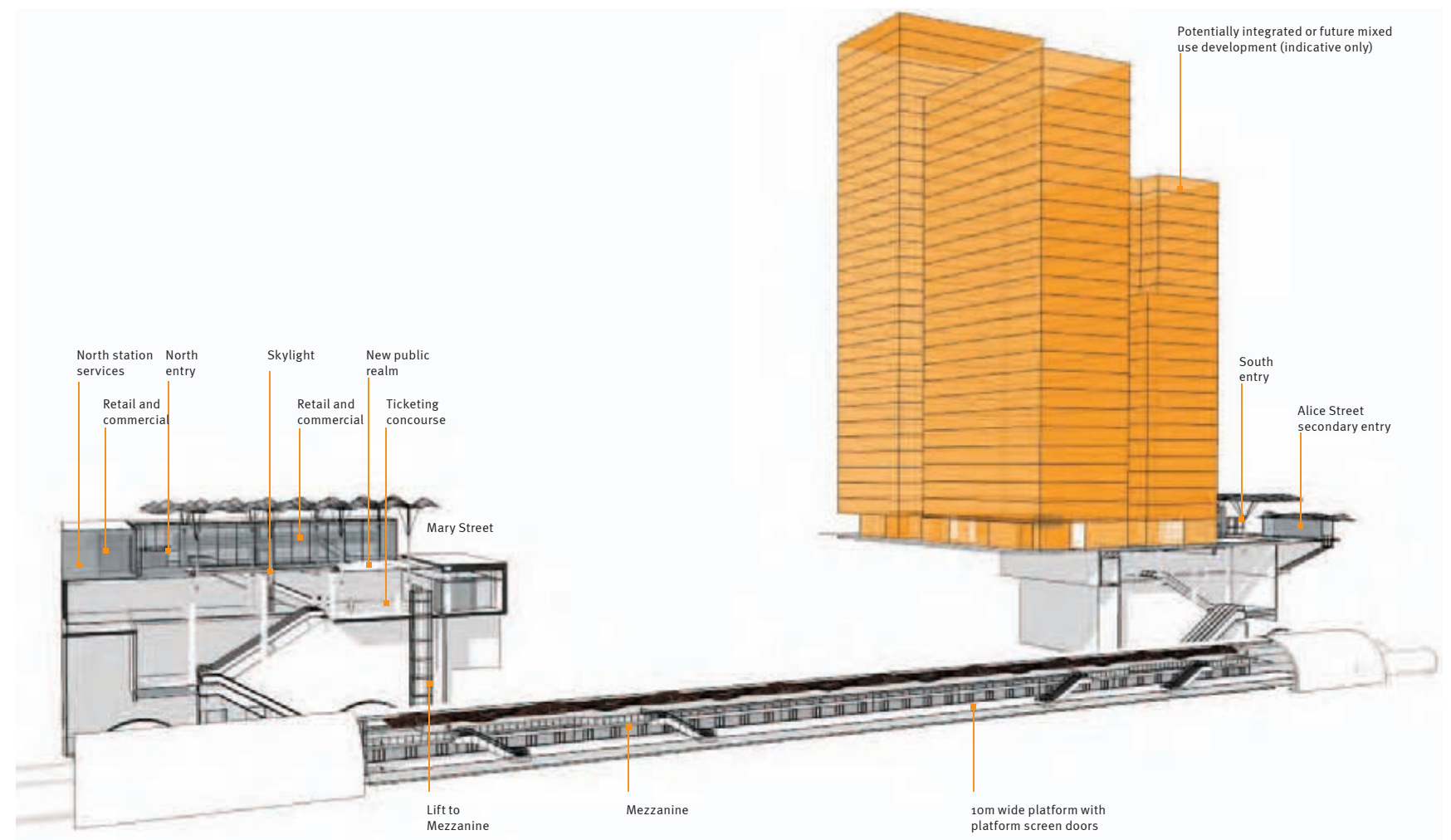
In terms of the overall station configuration Albert Street has four subterranean levels – concourse, a “mid-level”, mezzanine and platform. Opportunities exist for retail businesses at the first concourse level at the Alice Street end of the station.

There is also allowance for development at the southern end of the station. A high rise development of up to eighty storeys could be accommodated with loading directly onto the main walls of the station box. The potential development footprint available at this location is extensive and offers great opportunity to integrate with the new station.

Essential works

The essential precinct and streetscape works identified to support the new Cross River Rail infrastructure in this location include:

- reconfiguring Albert Street between Charlotte and Alice Streets to enable footpath widening
- reconfiguring Albert Street between Charlotte and Elizabeth Streets to enable more efficient use of space for pedestrians and address existing pinch point
- partially reconfiguring Mary Street lanes to enable footpath widening on western side
- a generous covered forecourt and public space at entry with associated retail
- targeted footpath widening on all Albert Street crossings to increase pedestrian waiting capacity at signals during peak periods
- signal adjustments to support scramble crossings at Albert / Mary and Albert / Charlotte junctions
- reallocating kerb space to provide for new taxi ranks, drop off, bus stop relocation and reconfiguration of loading bays.



Woolloongabba station

Vision

A mixed-use heart for Woolloongabba that supports a new inner city community and a vibrant public realm that enhances The Gabba 'game day' experience.

City building outcomes

- Catalyse redevelopment of Woolloongabba UDA, Woolloongabba Central and Kangaroo Point South
- Establish Woolloongabba as a key southern intermodal interchange
- Support a vibrant sports and events precinct
- Enable improved pedestrian access and walkability
- Reinforce role and function of Stanley Street as an important people street and major connection from the southern suburbs to the CBD.

Key destinations and activity areas

The two major attractions to Woolloongabba that generate activity in the area are the Brisbane Cricket Ground 'the Gabba' and the Mater Hospital.

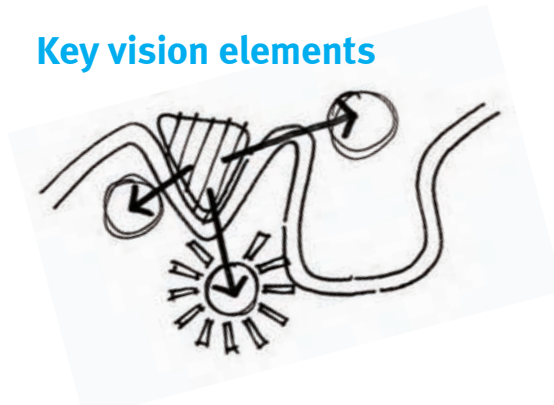
The Gabba is a major sports stadium hosting predominantly football and cricket matches, with a maximum spectator capacity of 42,000 people. The Gabba is conveniently located a short walking distance from the busway station which is utilised by spectators on match days.

The Mater Hospital precinct is a cluster of six hospitals, with approximately 6,000 staff providing care for up to 500,000 people per year. This number is expected to increase with the new Queensland Children's Hospital which is currently under construction on the Mater site. This hospital precinct is serviced by the Mater Hill Busway Station.

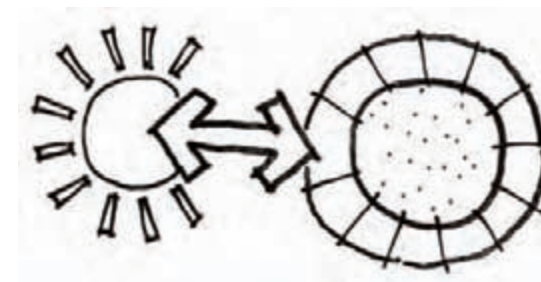


Note: Precinct plan shows development opportunities and is indicative only

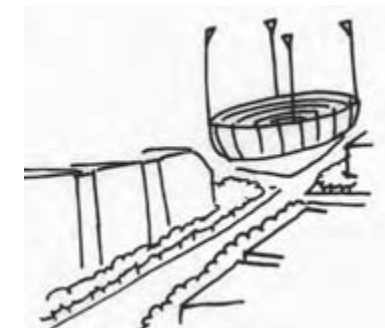
Key vision elements



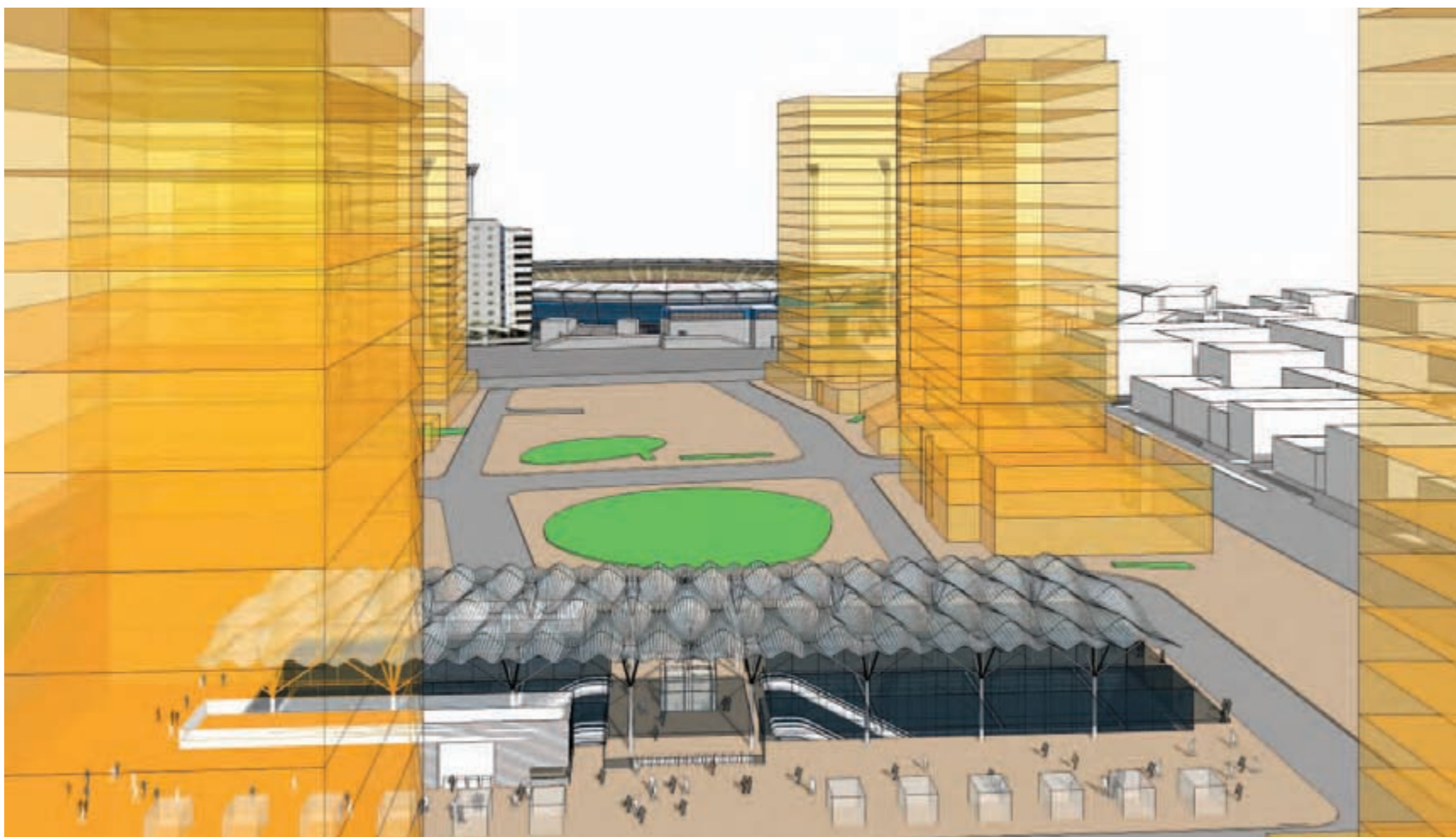
CBD long term expansion



A recognised events precinct



Intensive renewal and residential growth and Stanley Street as a key urban connector



View towards the Gabba

Station location drivers

Key drivers for the station at Woolloongabba include:

- the critical need for Cross River Rail to support daily access for future residents, workers and recreational uses
- catering for demand driven by events at 'the Gabba'
- the requirement to preserve flexibility for future planning decisions to accommodate residential and employment growth
- the need to minimise the land take for transport infrastructure in order to deliver market ready surplus land for redevelopment
- integration with the existing and future busway station
- opportunities to reconfigure the existing road network for public benefit must be preserved.

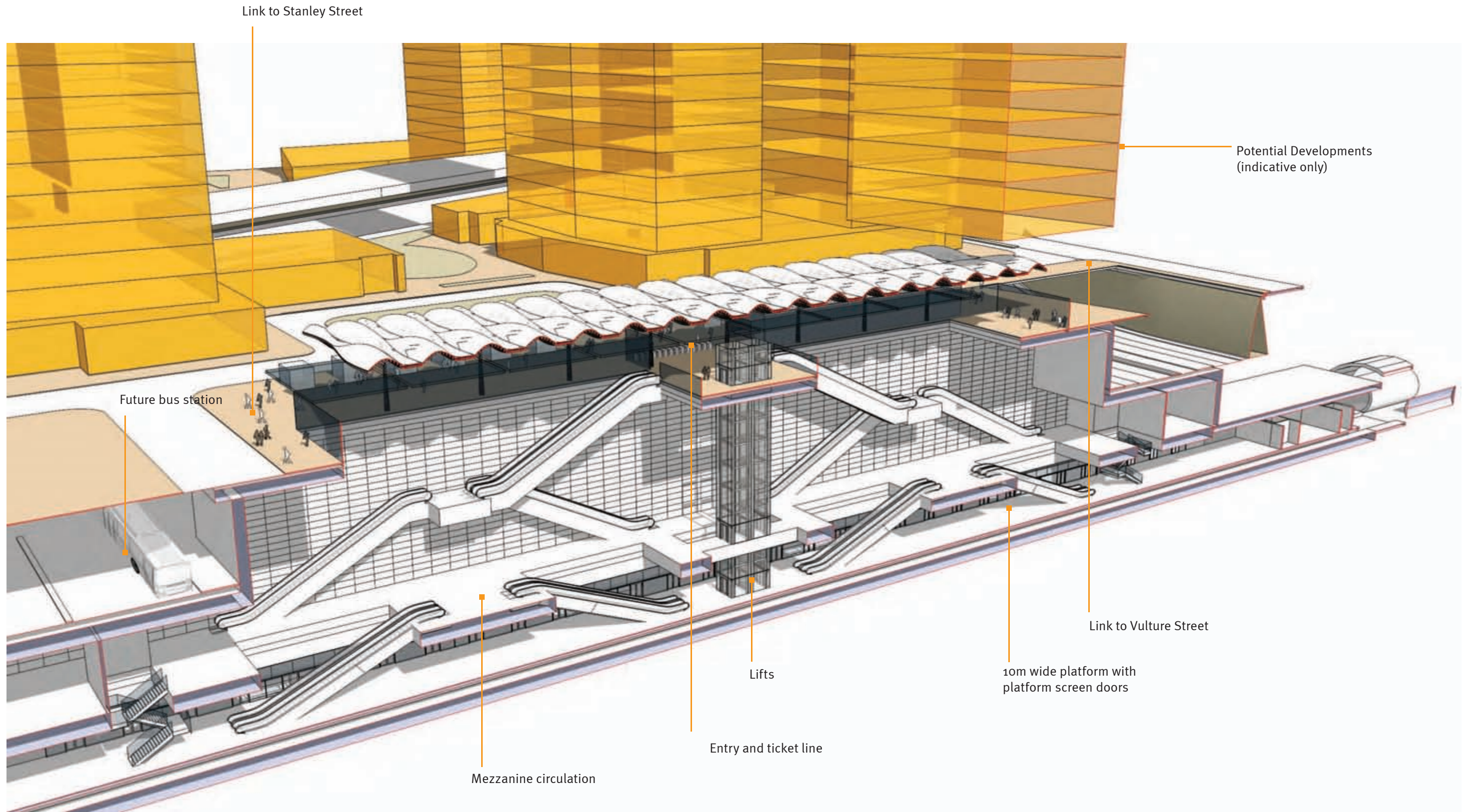
Station entry locations

There is one entry point for the new Cross River Rail station at Woolloongabba to enable effective crowd management for major sporting events and effectively serve the local catchment.

The entry is positioned to the immediate east of Leopard Street at the western extent of the GoPrint site. The entry will be highly visible from Stanley Street and the structure planning for the urban development area will preserve direct line of sight between the station and the stadium to ensure ease of navigation.

The position of the station several hundred metres away from the Gabba, will ensure effective dispersal of crowds during events and provide better station access.

Woolloongabba



Station design

Woolloongabba Station has multiple roles in the Cross River Rail network. It provides daily commuter access to the new Woolloongabba precinct, provides a major interchange function with the existing and future busway station and is a major event station serving “The Gabba” stadium.

The design allows for high-rise development to occur over the northern half of the station. This development will need to be coordinated with the Urban Land Development Authority (ULDA) and Department of Transport and Main Roads (DTMR) due to the need to relocate and expand the existing bus station. The relocation and expansion of the existing bus station is not part of the Cross River Rail project, however, provision has been made for future bus loading within the station structure.

Woolloongabba station is a combination of cut and cover box and single span cavern with a central island platform. The cut and cover box is located in the western part of the new UDA precinct, allowing sufficient separation from the “Gabba” stadium and efficient connection to the busway. The cavern sections are short extensions of the main station box running beneath Stanley and Vulture Streets.

The station platforms are approximately 28 metres below surface level.

The ticketing and staff facilities are at ground level. The vertical transport is arranged into two groups, each comprising four escalators which commence at a paid area. The vertical transport then splits at a mid-landing level and again at a mezzanine level to evenly distribute passengers down onto the platform.

The central box section of the station is open to natural light and ventilation. This is a particularly desirable feature of the station aiding in an overall sense of space and ease of way-finding.

The Woolloongabba station will have special event crowds that may be unfamiliar with the station (as opposed to regular commuters) and this key spatial feature of the station is seen as a significant advantage for new users. The central part of the station is covered with a full length canopy which is easily identified and recognisable within the new Woolloongabba precinct.

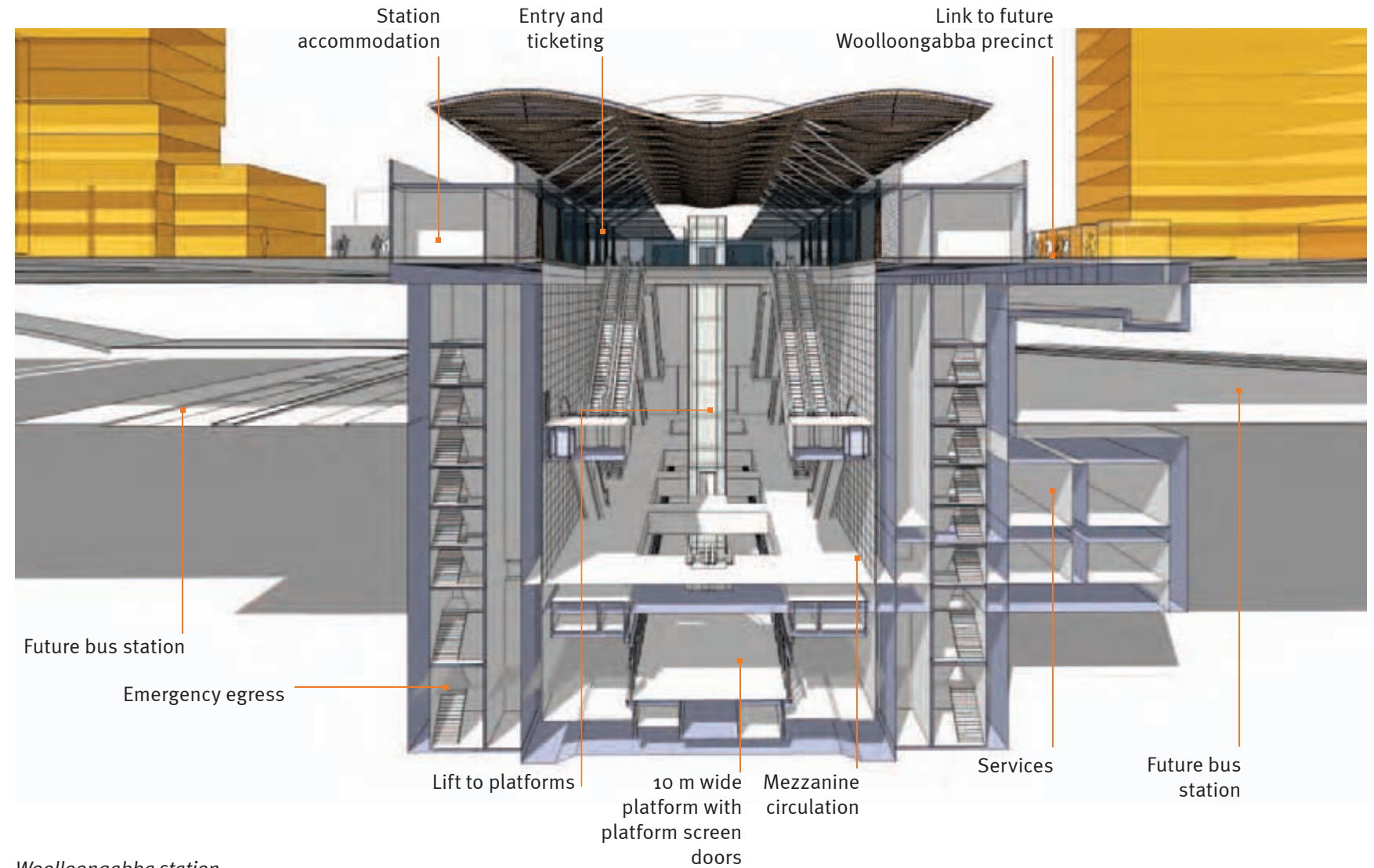
Particular features of the station also include a very symmetrical arrangement of escalators running through all station levels. This particularly aids flows in event loading.

A significant component of the UDA site is required for construction of the cut and cover box and running tunnels.

Essential works

Given existing conditions prior to the redevelopment of the Woolloongabba UDA, the essential precinct and streetscape works required to support Cross River Rail infrastructure in this area include:

- the provision of a station forecourt / plaza or access bridge over the existing busway cutting, to the station entry and the creation of surface pedestrian connections to the existing busway station
- allowance for clear pedestrian through movement to accommodate game day crowd movements from the Gabba to the station entry
- the creation of cycle parking facilities in public area outside station.



Woolloongabba station

Boggo Road station

Vision

A world class health, science and knowledge cluster and mixed-use TOD connecting Boggo Road Urban Village, the University of Queensland and Princess Alexandra Hospital.

City building outcomes

- Facilitate development of a major health, science and knowledge precinct
- Create new connections between communities and activities currently separated by rail and road infrastructure
- Promote convenient and rapid rail/rail and rail/bus interchange
- Encourage intensification of land uses in close proximity to station to take advantage of city and river views.



Note: Precinct plan shows development opportunities and is indicative only

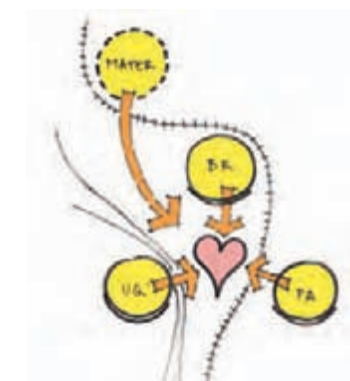
Key vision elements



World class jobs for a world class city



Brisbane south's primary transport interchange



Connecting communities

Key destinations and activity areas

The Boggo Road / Dutton Park rail precincts include a number of key activity generators, which should be considered in the positioning of any new stations.

The area is the focus of a number of established and emerging drivers of significant employment activity. The majority of this employment is generally focused around the Princess Alexandra Hospital and its associated ancillary health care services and uses. This focus establishes a nucleus of health related activity and research.

In addition to employment there are a number of established residential neighbourhoods; Dutton Park to the south, Boggo Road to the north and Buranda further east. The residential density of these communities is relatively low, with individual dwellings on generous lots typical of the predominant residential character. This may, however, change with significant planned land use diversification and residential intensification, particularly around the Buranda precinct to the east.

Station location drivers

Key drivers for the station at Boggo Road include:

- the critical need for Cross River Rail to integrate with the existing Park Road rail station for network integration and legibility
- the need to integrate with Boggo Road Busway station to facilitate intermodal transfer and an integrated transport network for the region
- the need for safe and convenient access to public transport for employees and residents in the health employment hub and also in existing residential neighbourhoods
- the opportunity to deliver improved connections between existing and emerging communities
- ability to spread passenger loading and improve the potential extent of the walk-up catchments.

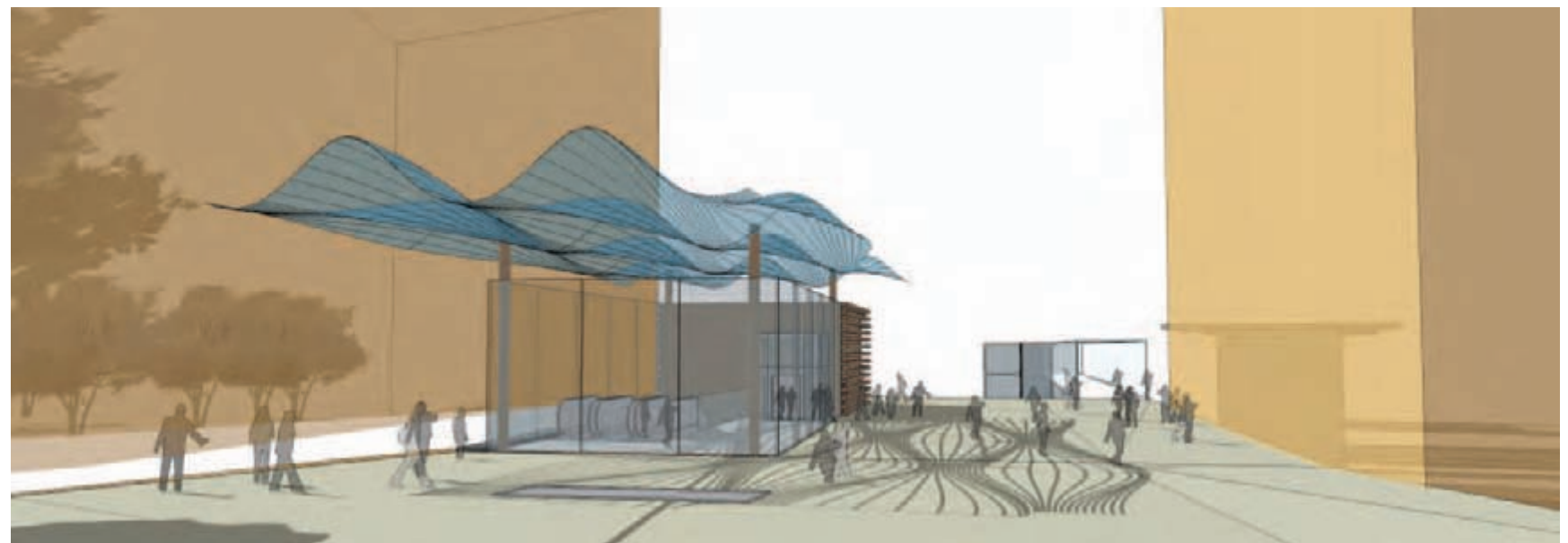
Station entry locations

There are two entry points for the new Cross River Rail platforms at Boggo Road to optimise the stations walk up catchment and to enable effective interchange with bus and rail facilities.

Entry one is positioned immediately adjacent to the existing Park Road surface station and Boggo Road busway station and is intended to facilitate rapid and convenient inter-modal transport interchange. This entry is positioned to the south of the existing railway station in order to preserve future opportunities for the upgrade of the surface station.

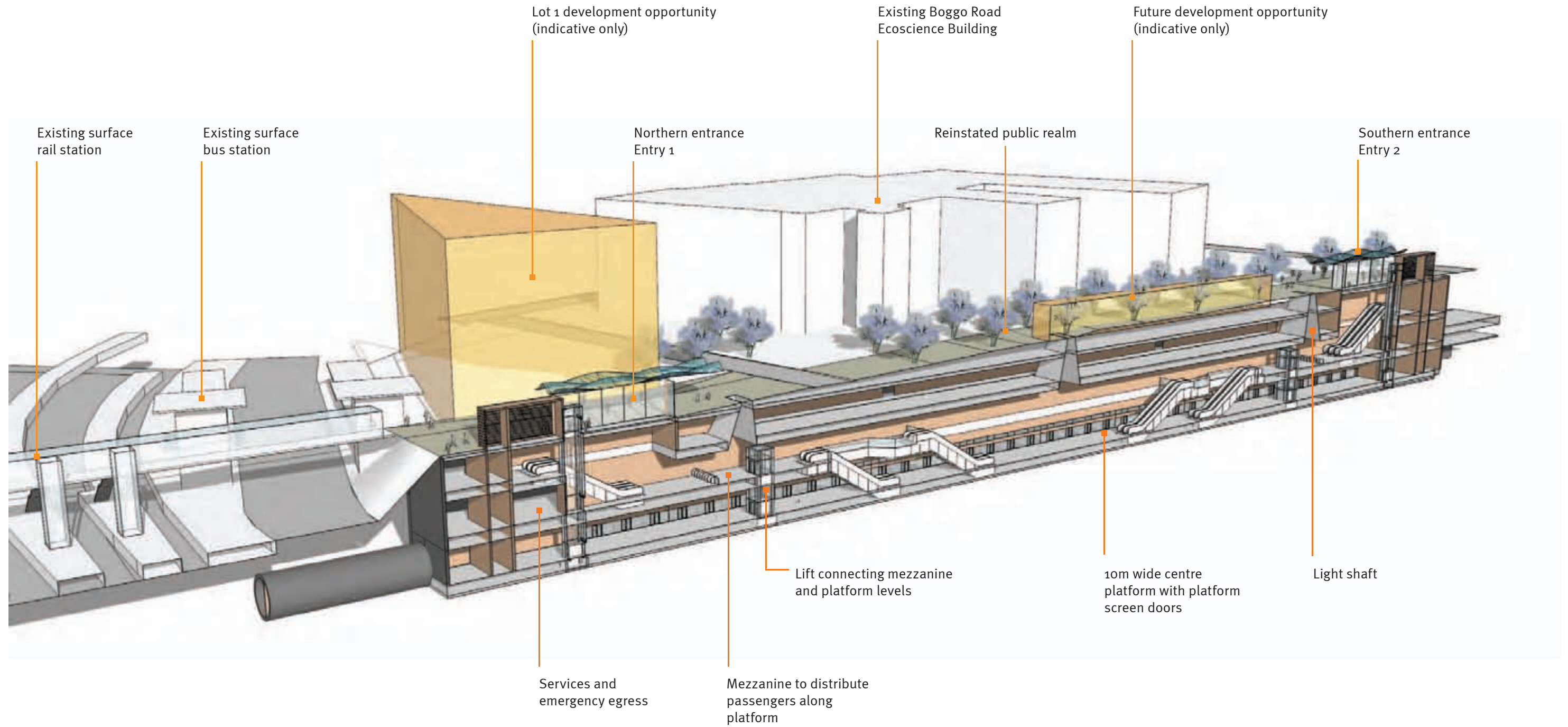
Entry two is positioned on the Boggo Road Urban Village pedestrian spine to the immediate south east of the heritage listed gaol and will be integrated with the Urban Village development. This location will be visible from the surrounding road network improving the presence of the station and promoting navigation.

The southern location of the entry supports much improved access to key destinations including the Princess Alexandra Hospital and the University of Queensland via the Eleanor Schonell Bridge.



Boggo Road station entry

Boggo Road



Section of Boggo Road station

Station design

Boggo Road station is an important interchange between Cross River Rail, the current rail system and Eastern Busway. It will be a significant catalyst for the development of this knowledge precinct.

Boggo Road station is a cut and cover box station with a central island platform. The station is located below a narrow pedestrian street located between the newly constructed Knowledge Based Research and Business building and the heritage listed Boggo Road Gaol.

It will be constructed mainly using the top down excavation method to reduce the length and severity of impacts on this precinct and pedestrian street during the construction period. The box will be excavated and closed in an early works phase to allow the surface works to be completed and pedestrian access restored as quickly as practicable.

The station is approximately 25m deep from surface to platform level. It lies between the existing entry to the bus station in the north, adjacent to Lot 1, and Peter Doherty Street to the south.

The station consists of three subterranean levels: a service level; a mezzanine level; and a platform level. The service level provides for mechanical ventilation plant and equipment and acts as a landing level only for vertical circulation.

The station is largely symmetrical in configuration in terms of entry structures and the internal station spatial arrangements. At the northern end there is a new pedestrian footbridge to link the new Cross River Rail entry, the existing busway and the surface rail.

The entry arrangements at each end allow for three escalators, stairs and lifts.

All mechanical ventilation and plant within the station are housed in two dedicated service buildings that rise approximately eight metres above surface level with provision for ventilation and heat release in the top four metres. The buildings are located at each end of the box station.

Essential works

The essential precinct and streetscape works identified to support the new Cross River Rail infrastructure at Boggo Road include:

- improving and potential widening of footpaths on western side of Annerley Road in Gair Park
- improving street crossing opportunities from the Boggo Road Urban Village west towards UQ
- the reallocation of kerb space to provide drop-off facilities and turning facility at Quarry Street
- creating kiss and ride facilities and local surface bus stops to integrate with northern and southern station entry
- the provision of cycle parking facilities in public realm outside station.



Boggo Road station platform

Yeerongpilly station

Vision

Revitalise Yeerongpilly station providing improved transport amenity to underpin the development of a leading transit orientated development, that straddles the rail line and Fairfield Road.

City building outcomes

- Catalyse the development of a significant Transit Oriented Development hub
- Supporting a tunnel portal location which preserves the urban fabric of the inner city
- Providing convenient and direct access to Queensland’s premier tennis precinct
- Creating a stronger, mixed use focus for the community.

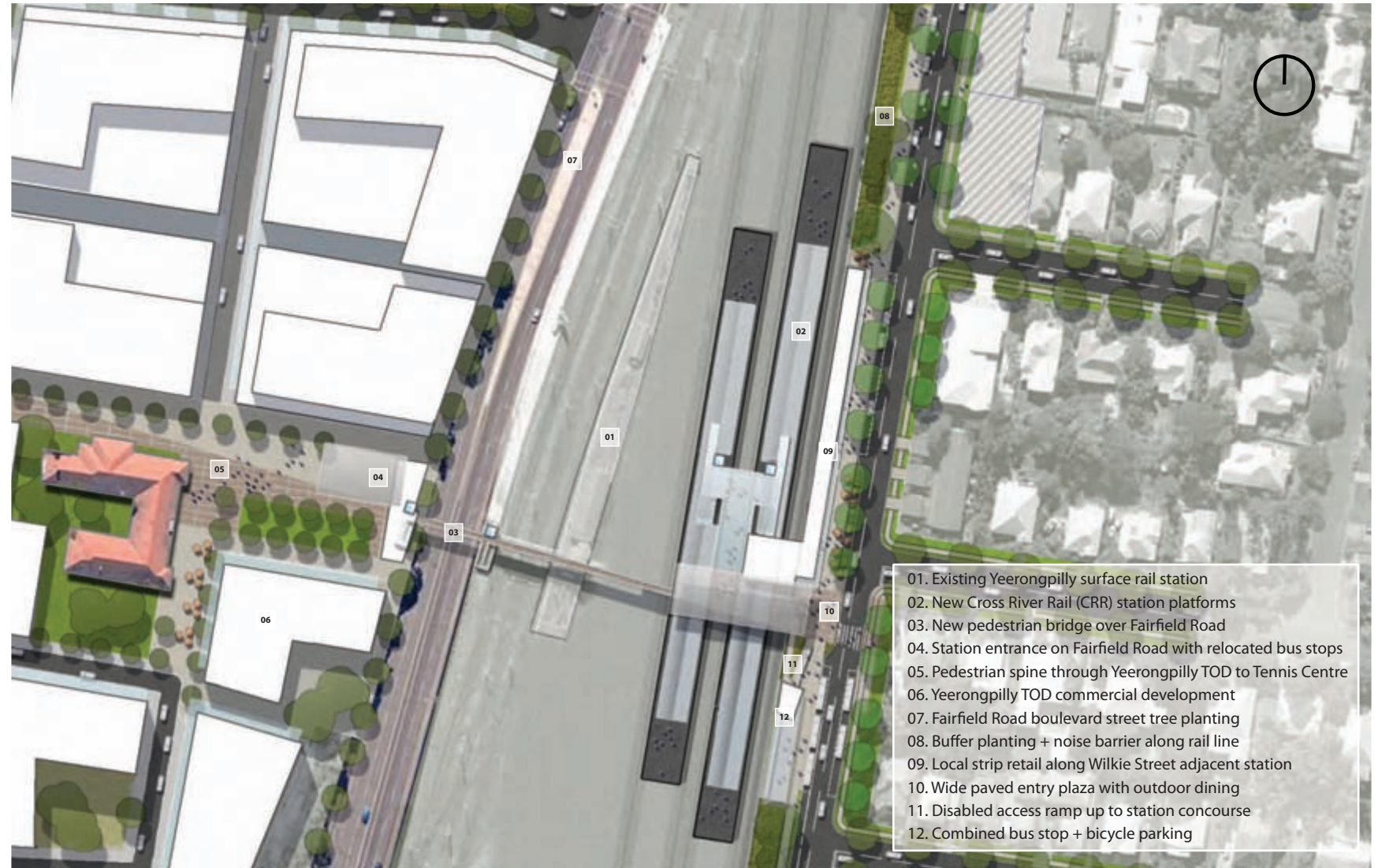
Key destinations and activity areas

The area to the east of the rail corridor at Yeerongpilly station is mostly residential area with a mix of houses and medium height units. There is an industrial area further to the south on both sides of Moolabin Creek.

To the west of the rail corridor is the Queensland Tennis Centre, a medium rise residential development along the river, the planned Yeerongpilly transit oriented development and an existing residential area north of Ortive Street.

Station entry locations

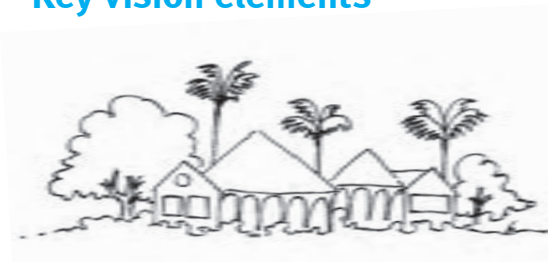
Access to the new station from the east is via the re-aligned Wilkie Street and from the west (Queensland Tennis Centre and the Yeerongpilly transit oriented development) via a covered, over track pedestrian bridge, accessible from both sides of Fairfield Road. The Wilkie Street entry connects to a new bus set down and kiss and ride facility.



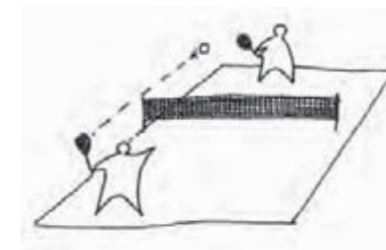
- 01. Existing Yeerongpilly surface rail station
- 02. New Cross River Rail (CRR) station platforms
- 03. New pedestrian bridge over Fairfield Road
- 04. Station entrance on Fairfield Road with relocated bus stops
- 05. Pedestrian spine through Yeerongpilly TOD to Tennis Centre
- 06. Yeerongpilly TOD commercial development
- 07. Fairfield Road boulevard street tree planting
- 08. Buffer planting + noise barrier along rail line
- 09. Local strip retail along Wilkie Street adjacent station
- 10. Wide paved entry plaza with outdoor dining
- 11. Disabled access ramp up to station concourse
- 12. Combined bus stop + bicycle parking

Note: Precinct plan shows development opportunities and is indicative only

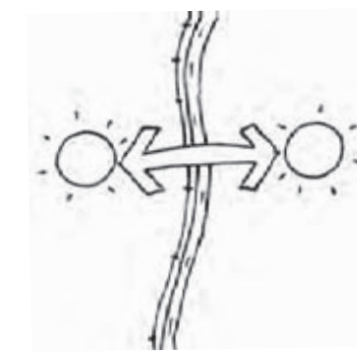
Key vision elements



Responsive to existing character residential areas



Sport and recreation focus



Re-stitching severed communities

Station design

The new station at Yeerongpilly is a surface station that comprises two island platforms linked by an over-track concourse and pedestrian overpass.

Ticketing and QR staff facilities are located on the concourse and include a small retail concession. The concourse is located centrally over the platforms and is connected by stairs and lifts.

Access to the new station from the east is via the re-aligned Wilkie Street and from the west (Queensland Tennis Centre and the Yeerongpilly Transit oriented Development) via a covered over-track pedestrian bridge, accessible from both sides of Fairfield Road. The Wilkie Street entry connects to a new bus set down and kiss and ride facility.

Due to the natural topography, the Wilkie Street entry has the concourse level practically at street level with the platforms five metres lower. This facilitates comfortable and safe access and provides a natural barrier which will reduce visual and noise impacts on the immediate neighbourhood.

The western island platform is configured for six car sets with future provision for longer trains. This platform will replace the existing station platform.

The eastern platform is configured to meet the future requirements of Cross River Rail operations, being 220m long to allow for nine car sets.

The platforms are 12m wide and include covered canopies for pedestrian protection over 70% of their length.

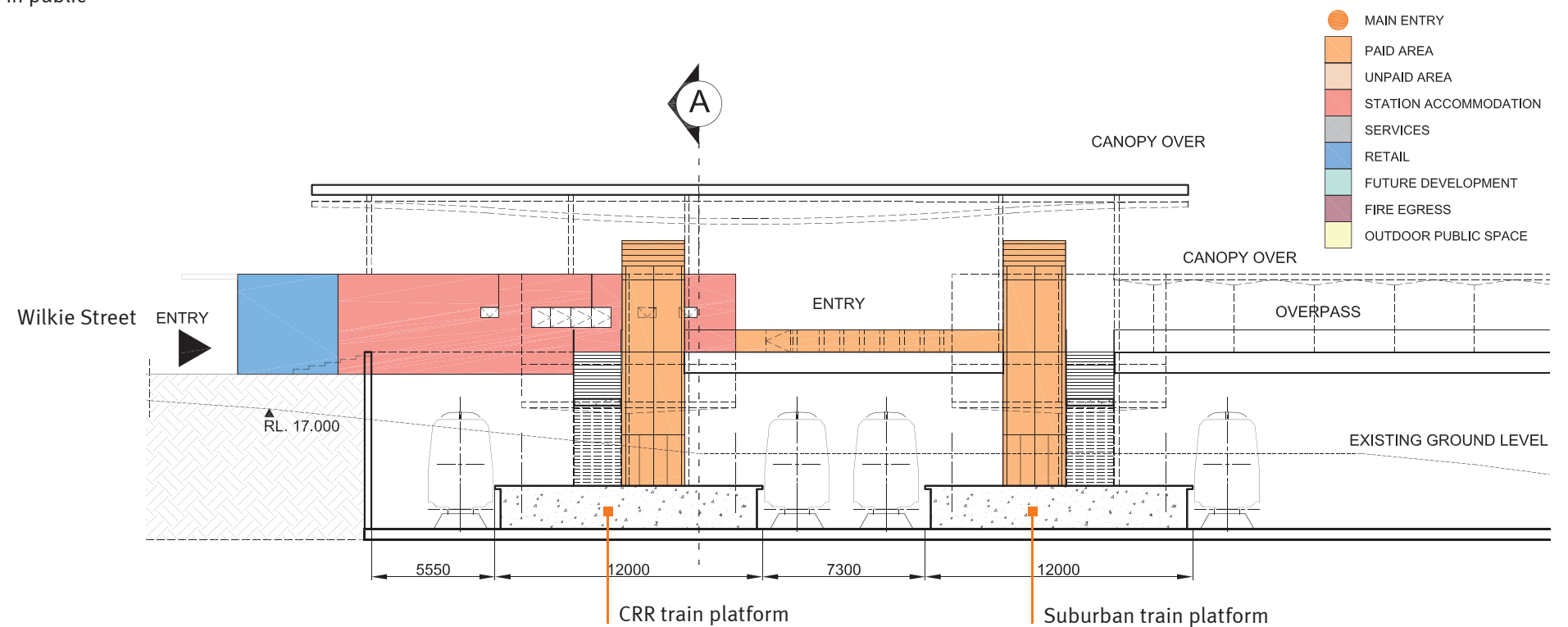
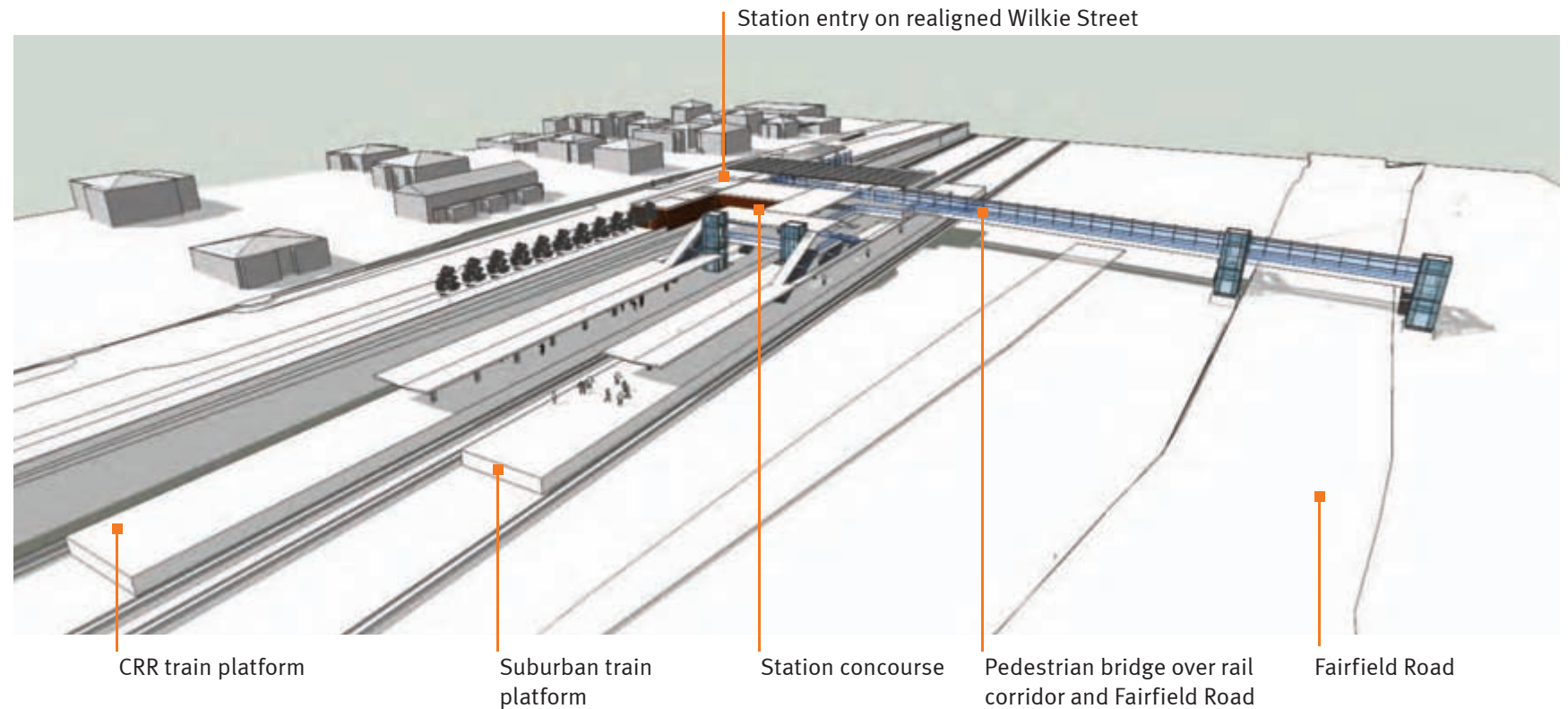
The station will be easily accessed and is located centrally within an expanding catchment area. Park and Ride has been excluded to maximise the kiss and ride capability and encourage 'walk-up' patronage.

The new platform arrangements also enable freight trains to bypass the new passenger platforms minimising conflicts between passenger and freight traffic and providing greater passenger amenity.

Essential works

The essential precinct and streetscape works identified to support the new Cross River Rail infrastructure at Yeerongpilly include:

- reconfiguring Wilkie Street from rail overpass bridge (Cardross Street) and integration with improved road and pedestrian connection to future renewal precinct and Ipswich Road
- providing kiss and ride and bus stop facilities on Wilkie Street to integrate with station entry
- widening and improving the pedestrian bridge over the rail corridor and Fairfield Road to Queensland Tennis Centre and the Yeerongpilly transit oriented development initiative
- providing kiss and ride facilities and relocation of local surface bus stop on Fairfield Road to integrate with station entry and pedestrian bridge link
- providing visual screening and noise attenuation to residential areas east of corridor
- providing cycle parking facilities in public realm outside station.

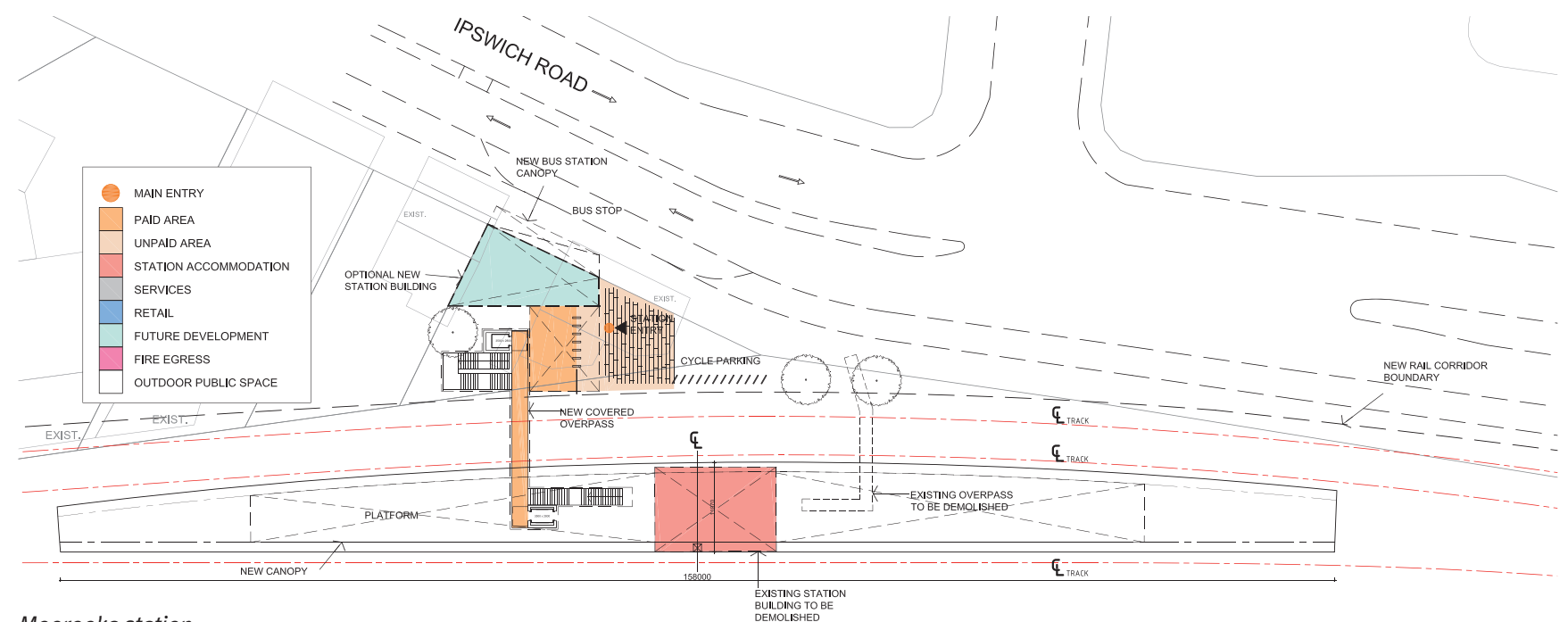


Moorooka and Rocklea stations

The works at these two surface stations comprise construction of a new footbridge and station upgrades to meet the Disability Discrimination Act (DDA) requirements. Upgraded or repositioned DDA car parking has also been allowed for as well as DDA compliance to achieve effective bus-rail interchange.

Station upgrades at both stations include:

- new covered pedestrian overpass
- new pedestrian weather protection canopy to 70% of platform
- new lifts at each entry point and platform, 21 pax capacity and designed to allow stretched access
- upgraded disabled passenger path of travel from lift entry point on platform to nominated boarding point at centre of 160m long platform
- new six metre wide minimum disabled passenger boarding point approximately 77m from each end of station (based on six car trains)
- allowance for platform at one end to be extended to suit future seven car trains
- existing low level platforms (approx. 865mm) to be upgraded to high level platforms (approx. 1050mm), regrade platform to fall to centre of station including upgraded stormwater system
- upgrade coping and tactile for raised platform
- upgrade directional tactile at disabled passenger zone
- upgrade existing station building to include new disabled toilet, new ticket window and counter, and upgrade staff areas to be compliant with AS 1428.2
- upgrade general signage to be compliant with TransLink Signage Manual
- general repainting of existing surfaces and replacement of damaged materials
- general replacement of damaged services including lighting, A/V and passenger information display screens.



Moorooka station

Moorooka

The existing Moorooka station will be refurbished to meet Disability Discrimination Act (DDA) requirements.

Essential works

The essential precinct and streetscape works identified to support the new Cross River Rail infrastructure and comply with DDA requirements include:

- reconfiguring Ipswich Road between Chaucer Street and Hamilton Road to accommodate the adjacent improvements to the railway
- a cul-de-sac at Unwin Road to accommodate the adjacent improvements to the railway
- a cul-de-sac at Evesham Road to accommodate the adjacent improvements to the railway
- upgrading park and ride disabled parking bays and access pathways to the station entry point
- upgrading all pedestrian paths from bus set down to station entry point to be DDA compliant
- a new pedestrian protection canopy, nine metres long and 2.5 metres wide adjacent to the bus set down area.

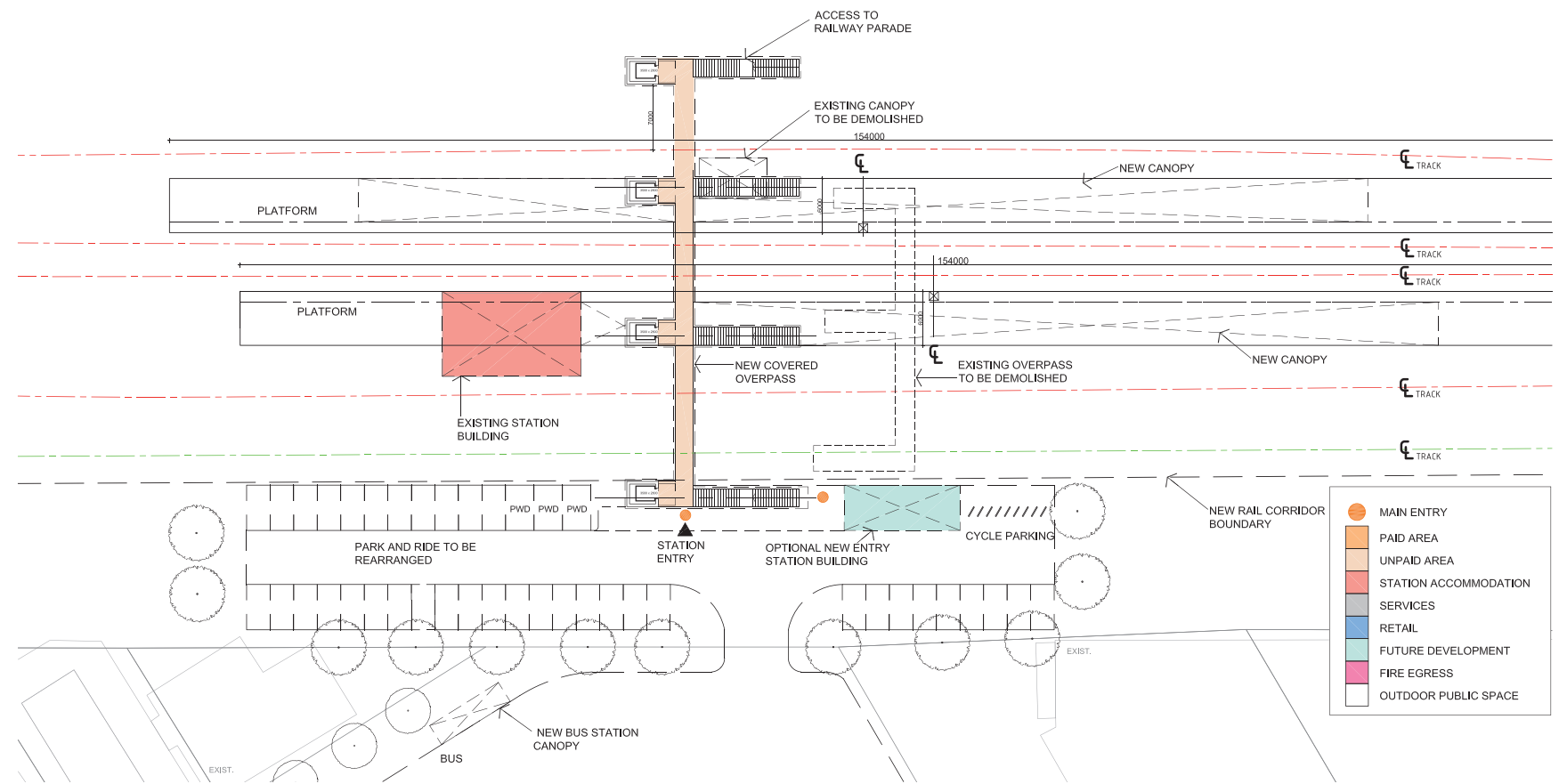
Rocklea

The existing Rocklea station will be refurbished to meet Disability Discrimination Act (DDA) requirements.

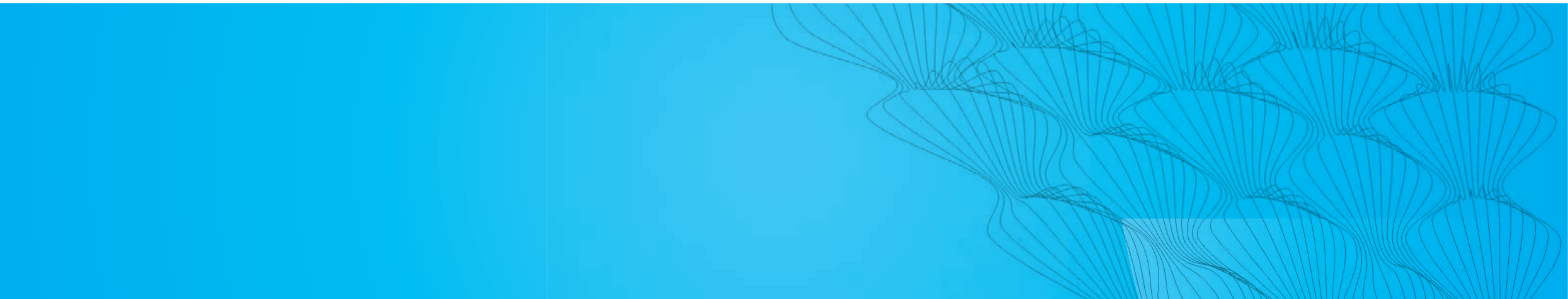
Essential works

The essential precinct and streetscape works identified to support the new Cross River Rail infrastructure and meet DDA requirements at Rocklea include:

- reconfiguring the Sherwood Road to Fairfield Road southbound slip lane to accommodate a new rail over road bridge adjacent and to the west of the existing bridge
- reconstructing the southbound ramp on to Ipswich Road, to pass under new span under Ipswich road
- reconfiguring the Station Street link under existing span to accommodate the adjacent rail line
- upgrading the park and ride disabled parking bays and access pathways to the station entry point.
- upgrading all pedestrian paths from bus set down to station entry point to be DDA compliant
- the creation of a new pedestrian protection canopy, nine metres long and 2.5 metres wide adjacent to the bus set down
- the creation of a new covered pedestrian overpass
- closing the Beaudesert Road Service Road level crossing
- removing the Heaton Street/Beaudesert Road Service Road intersection and replacement with a smooth alignment
- reconfiguring the Railway Parade/Railway Terrace/Fairlie Terrace intersection, Fairlie Terrace alignment and intersection in the vicinity of the existing Fairlie Terrace/Beaudesert Road Service Road intersection
- realigning Dollis Street to accommodate the adjacent rail line
- a cul-de-sac at Norbury Street and Dollis Street each side of the Ravena Road overpass to accommodate adjacent rail line.



Rocklea station



CrossRiver*Rail*



Engineering design

Overview of the design

The Cross River Rail engineering requirements are significant, comprising substantial underground and surface works including stations, tunnels, bridges, viaducts, new and modified track, rail systems and associated services. The infrastructure has been designed to reflect requirements of construction methodology, logistics, environment and operational issues while minimising impacts.

Cross River Rail is essentially an extension of the existing Queensland Rail network which provides an additional link between southern and northern sections of the passenger network. Some particular requirements, which are unique to the underground infrastructure include:

- enhanced fire and life safety and ventilation requirements
- impacts on surrounding built infrastructure
- allowance for future development
- focus on construction technique
- inter-operability with the existing Queensland Rail network and systems.

The rail systems design incorporates the existing Queensland Rail 25kV traction and overhead electrification system and allows for integration with the existing signalling and communication system.

A new signalling and train control system based on the European Train Control System has been incorporated for the underground sections of the Project. This system enables the new trains to operate efficiently at close headways and to interface with the automated platform screen doors at all underground stations.

The additional power requirements for the new Cross River Rail line necessitates new traction feeder stations at each end of the tunnel system and a third new feeder station to replace the existing traction feeder station at Mayne Yard.

Fire and life safety is a key focus of the Cross River Rail design. Fire and life safety takes on additional importance because of the significant amount of new rail infrastructure that is underground. Extensive ventilation systems are required to ventilate the underground stations and tunnels and to control and extract smoke during emergency fire scenarios.

Ventilation equipment is typically located at each end of the underground stations and for the longest tunnel section, between the southern portal and Boggo Road station, there is an additional ventilation and emergency access shaft.

Geological mapping is important for any major underground system. A 3-D geological model has been developed based on existing data and targeted site-specific ground investigation which has allowed for a reasonable degree of certainty with respect to the design and construction techniques for stations and tunnels.

The depth of the stations and tunnels is largely driven by geotechnical conditions and, in particular, the river crossing, which influenced the general vertical alignment of the railway as well as the actual station locations.

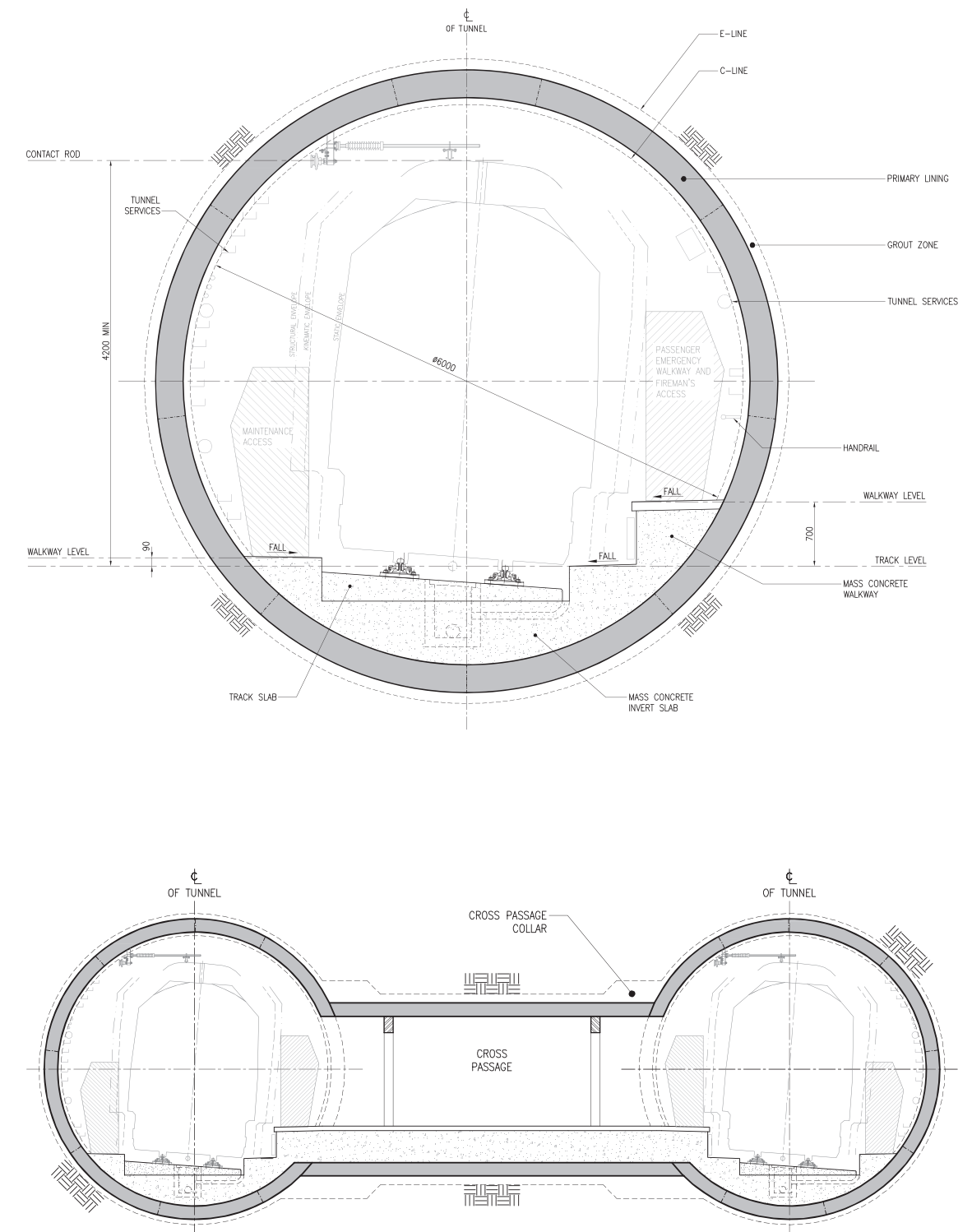
The tunnel design has been defined by operational, engineering, construction and cost effectiveness requirements. The decision to design twin single track running tunnels associated with island platform underground stations was made early in the detailed feasibility stage based on operational, design, risk, constructability and whole of life cost criteria.

The underground stations are the dominant engineering structures in the project and have required significant consideration. The depths were determined by the vertical rail alignment capabilities, the river crossing, existing sub-surface infrastructure and the geology at each location.

The length of the stations is mainly determined by the need to service nine car trains in the future, which require 220m long platforms. Additional length at the end of each station for plant and equipment means the underground stations are typically 250m long.

The depth, geology and local conditions at Boggo Road and Wooloongabba Stations allow box stations to be used in the design, which improve the visual connection to the platforms and allow more natural light and air to penetrate the underground spaces.

Significant surface structures include two major station upgrades at Yeerongpilly and Exhibition Stations, rail over rail viaducts at the north and south ends of the tunnel system, an intermediate ventilation and emergency access shaft at Fairfield and a flood gate building near the southern portal at Yeerongpilly.



Top: Typical TBM section

Above: Twin TBM tunnels connected by cross-passage

Geology and tunnelling

At this stage, geotechnical site investigations have been carried out at the following general locations:

- seismic survey in the Brisbane River
- drilling and testing in the vicinity of each station and on the river bank at the proposed river crossing
- drilling and testing for the running tunnels south of Boggo Road Station.

The remainder of the geological information has been obtained from a variety of existing records and together has been used to form a 3-D geological model of the Cross River Rail corridor.

The Cross River Rail alignment has been designed to maintain the majority of the running tunnels in rock. The standard tunnel configuration consists of two single track tunnels separated by a central rock pillar and connected at regular intervals by mined cross-passages for emergency evacuation. The cross-passages between the tunnels are supported by a permanent concrete lining connected to both running tunnels.

The tunnels have a bored diameter of seven metres and a finished internal diameter of approximately six metres. The track separation for the two running tunnels generally matches the track centres through the stations (13.7m).

The tunnels will be constructed primarily by tunnel boring machine (TBM), with pre-cast concrete segmental linings erected directly behind a mechanised shield. The design recommends four tunnel boring machines are used for construction of the Cross River Rail Project.

A particular challenge with the tunnel construction is passing beneath the Brisbane River. The depth of the river crossing has been based on a desk-top analysis, seismic river survey and limited river bank borehole information, and will suit conventional tunnel boring machine operation. Approximately one tunnel diameter of rock cover can be achieved with the current vertical alignment.



Above left: Geotechnical investigations
Top: Roadheader construction
Left: Tunnel boring machine (TBM)

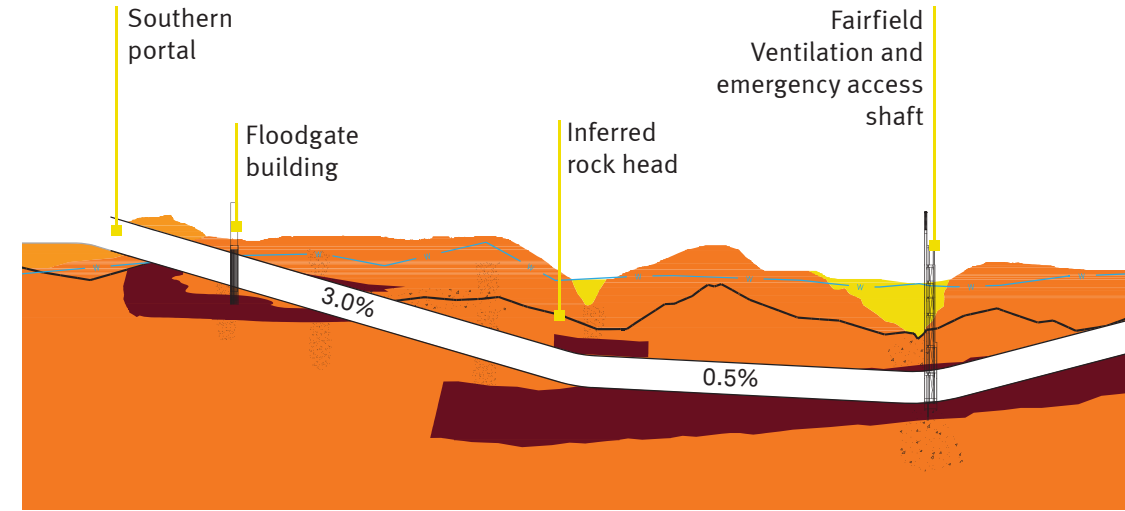
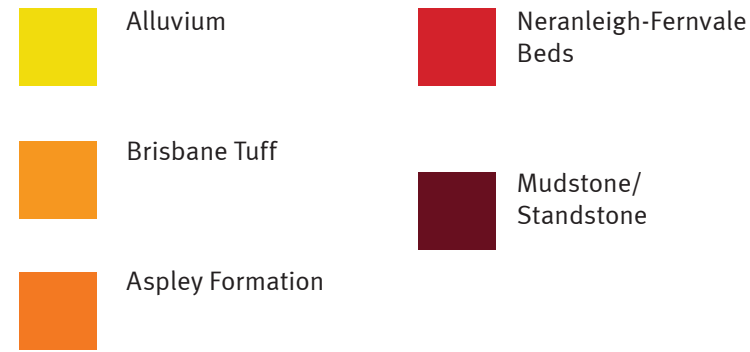
Tunnelling strategy

A number of options have been considered for constructing the running tunnels. The option shown right, with two TBMs launched from near the southern portal and two launched from the Woolloongabba Station site, has been adopted as the basis for the reference design scheme.

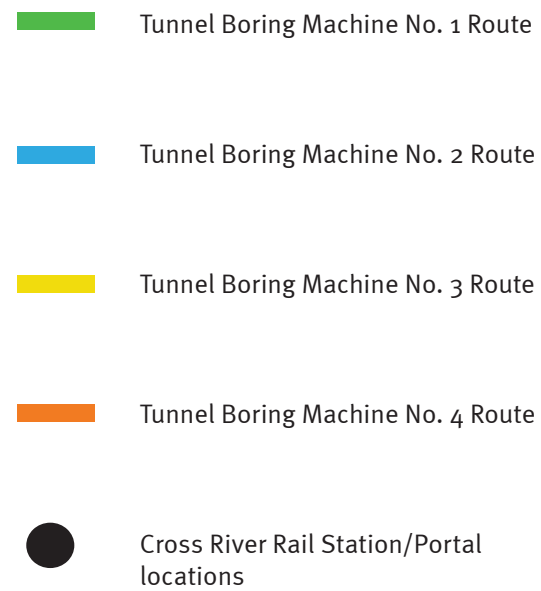
This decision was made based on various criteria including:

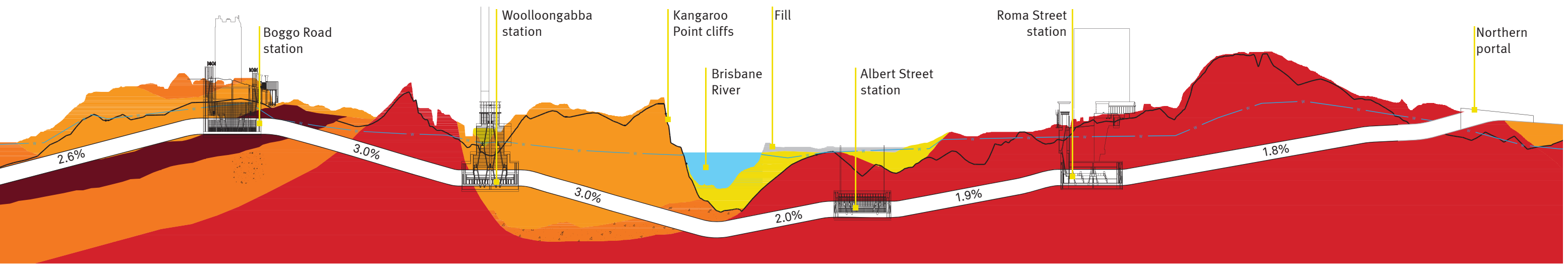
- program
- interface with station construction
- availability of sites to support the tunnel construction
- impacts on the community
- cost.

Vertical tunnel alignment showing geological formation



Preferred tunnel boring machine routes





Volumetric and development allowances

Cross River Rail involves the construction of underground stations and tunnels in cut and cover, caverns, mined excavations and machine-driven tunnels. The Cross River Rail corridor, and the eventual operating railway, will be protected via volumetric resumptions around tunnels and caverns; and alongside cut and cover shafts.

The reference design has allowance for loads associated with:

- existing buildings, structures and utilities in the vicinity of the railway
- proposed developments at Woolloongabba Station and Albert Street Station
- aspirations for future development alongside, and above the corridor.

These allowances will continue to form part of the framework for further development of the design.

Volumetric resumptions

Tunnels and caverns rely on a pillar or arch of rock for support because the tunnel linings are attached to the surrounding natural materials.

The ground surrounding the tunnel openings will be protected by volumetric resumption from development activity affecting the integrity of Cross River Rail.

The running tunnels require a volumetric resumption of seven metres, which equates to approximately one tunnel diameter, to ensure an adequate rock pillar between the tunnels and any future structure. This is standard practice at this stage of project development.

For station caverns, a volumetric resumption of ten metres around the outer curve of the arch is required, which is approximately half the diameter of the cavern. This makes allowance for the required dimension of the rock arch supporting the ground above.

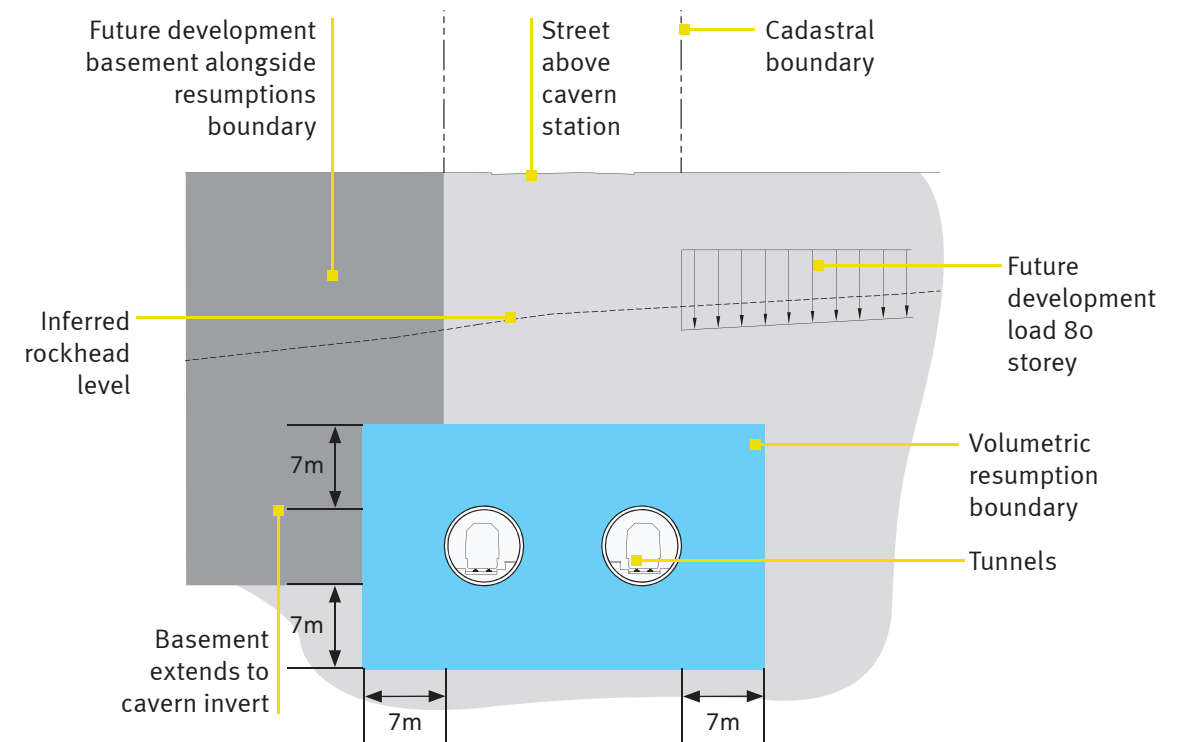
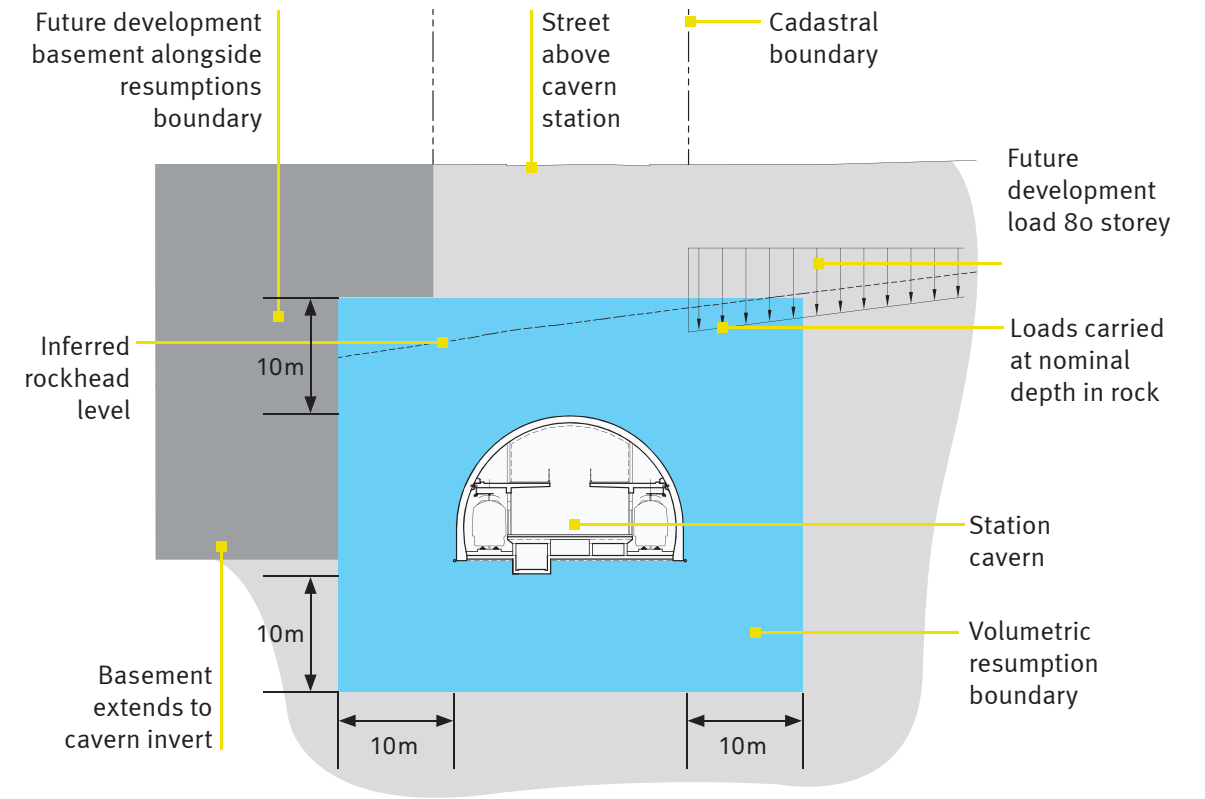
The resumptions around the proposed cut and cover shafts are required to secure rights to

install permanent anchors at Roma Street, under the Queensland Rail corridor; and under the Eco-sciences Building at Boggo Road Station.

Some temporary anchors are also required. These blocks of underground strata could be handed back to the effected properties post-construction.

Recognising the potential for the project to generate city-forming developments around sections of Cross River Rail, the reference design incorporates the following allowances for future developments alongside or over Albert Street Station, and near Woolloongabba Station:

- loads associated with nominal 80-storey buildings, founded into rock up to current cadastral boundaries
- basement excavations to the same depth as the adjacent Cross River Rail works down to, and alongside, the proposed resumption boundaries.



Volumetric resumption principles

Structural design

Aside from the stations themselves, the Cross River Rail project includes numerous other major structures.

Roads and bridges

- Ipswich Motorway on-ramp bridge and tunnel
- a rail bridge over Muriel Avenue
- a rail bridge over Moolabin Creek
- a road over rail bridge at O'Connell Terrace.

Rail structures

- a traction feeder station to the south of Yeerongpilly station
- a traction feeder station near the northern portal in Victoria Park
- a traction feeder station just south of Mayne Yard
- an elevated structure for grade separation and connection with Clapham Yard for stabling
- an elevated structure along the eastern edge of Mayne Yard with connection to the existing North Coast Line just before Breakfast Creek
- northbound and southbound tracks in a ten kilometre tunnel from Yeerongpilly to the Exhibition line.

Tunnel structures

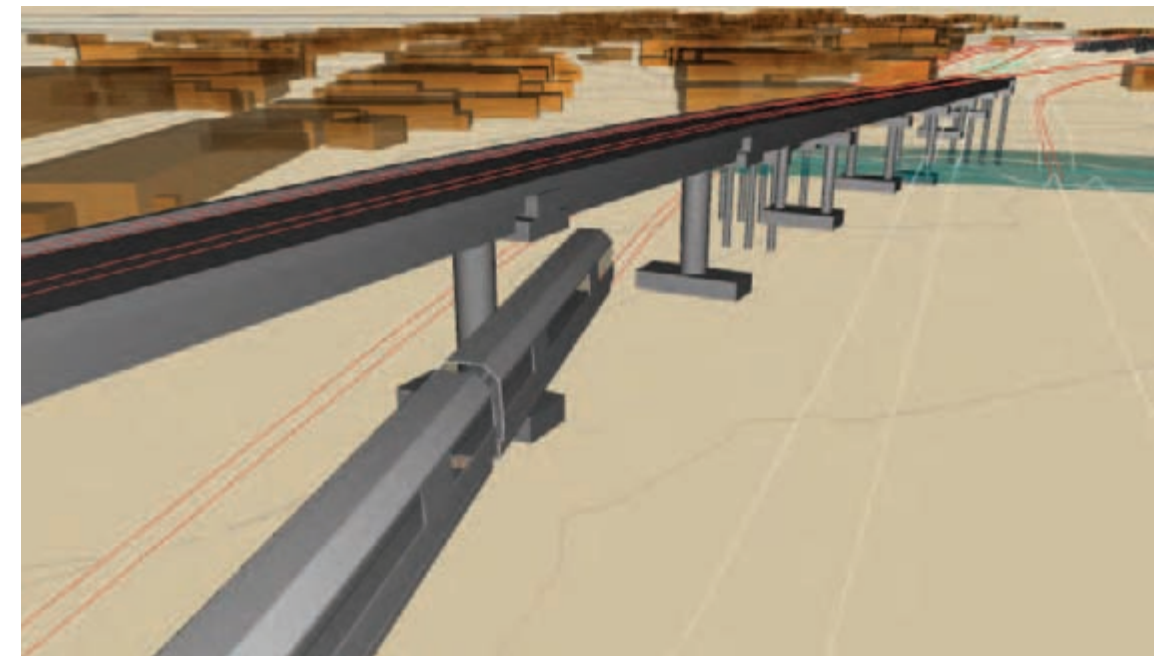
- a southern portal and dive structure
- a northern portal and dive structure
- a southern floodgate shaft just north of Yeerongpilly station
- intermediate ventilation shaft between Yeerongpilly and Boggo Road stations
- provision for a ventilation shaft near the north portal and provision for a future connection to a North West rail corridor.

Each of the underground stations has entrance shafts with a surface footprint and some have separate plant and equipment buildings at surface.

Minimising costs was one of the main drivers in determining the most appropriate structural solutions for the project. Principles used to minimise cost include:

- optimising alignment to favour more economical structural and civil arrangements
- maximising off-line works to reduce dependency on rail possession works
- using industry standard construction methods
- simple staging, supporting higher production rates
- providing adequate construction work areas to maximise production rates
- minimising land resumption
- using readily available building materials
- incorporating temporary shoring into permanent works where possible

Descriptions of the main structural elements are given on the following pages.



Southern elevated structure at Moolabin Creek

Underground stations

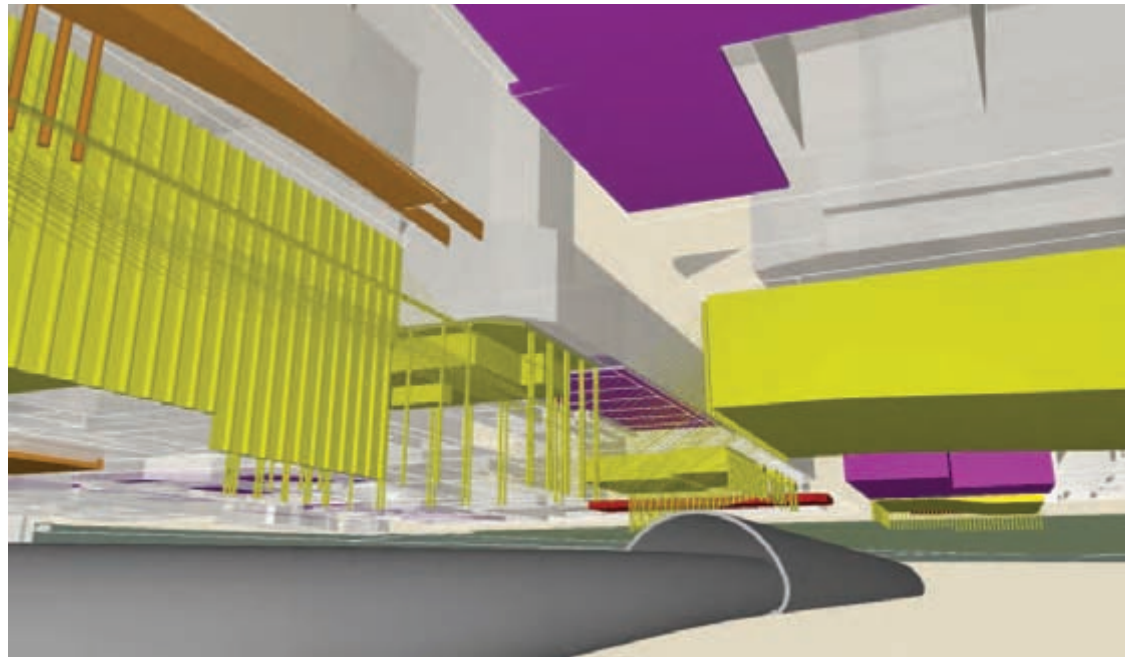
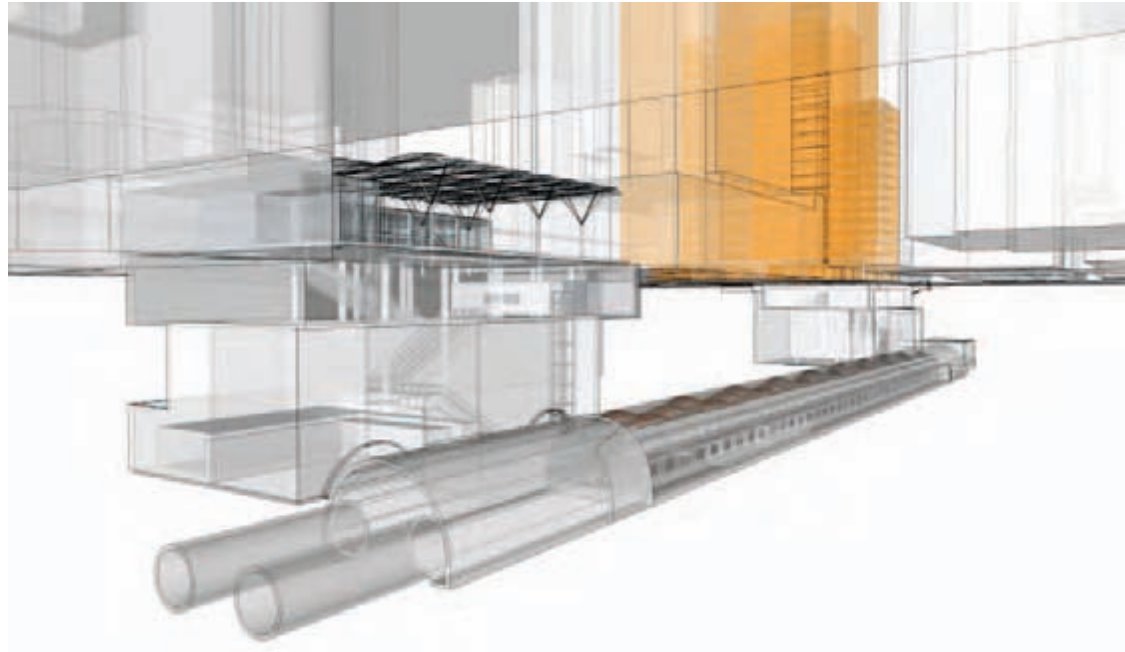
Two main underground station types are being used in Cross River Rail; mined caverns and cut and cover box stations.

Mined caverns have been used for both Albert Street and Roma Street stations where the rail alignment is deep and there is sufficient good quality rock above the track level to form a rock arch. The surface impacts from an open excavation in these areas are considered to be unacceptable.

Cut and cover box stations are used for Boggo Road and Woolloongabba stations because there is limited good quality rock at critical depths. This also allows the stations to be partially open from top to bottom which means more natural light and air can reach the station platform.

All underground stations have been designed as drained structures with the exception of the shaft or box walls in soft ground which must resist full hydrostatic water pressures.

Internal slabs in the cut and cover box stations and station entrance shafts have been used as permanent struts for the walls wherever possible.



Top: Albert Street station cavern and entrance shafts

Above: Tunnels and existing foundations in Albert Street

Surface stations

Exhibition Station is to be largely constructed off-line, immediately to the west of the existing station. It is slightly higher than the existing station to allow for an improved connection under the station and a new station concourse with ticketing and other station facilities under the new elevated station structure.

Most of the elevated section of the station will be constructed with prefabricated concrete elements. The most northern section of the station will be in a rock cut and founded directly on the ground.

The existing Yeerongpilly station will be replaced by a new station that accommodates both Cross River Rail and suburban trains, which provides an easy and convenient interchange.

The new station is located immediately to the east of the existing station and, due to the local topography, will be in a rock cut at a level below the realigned Wilkie Street. This allows direct street level access to the concourse station facilities and also reduces the visual and noise impacts on the adjacent residential community.

Southern elevated structure

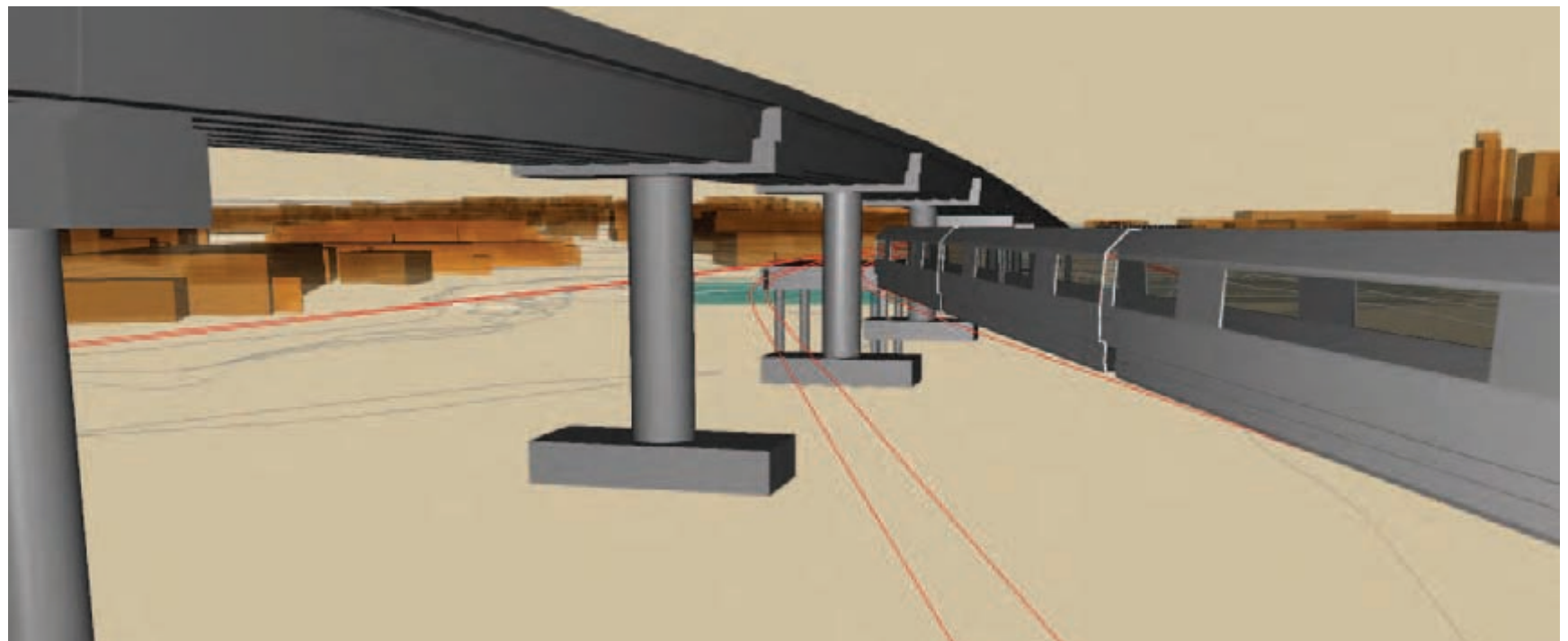
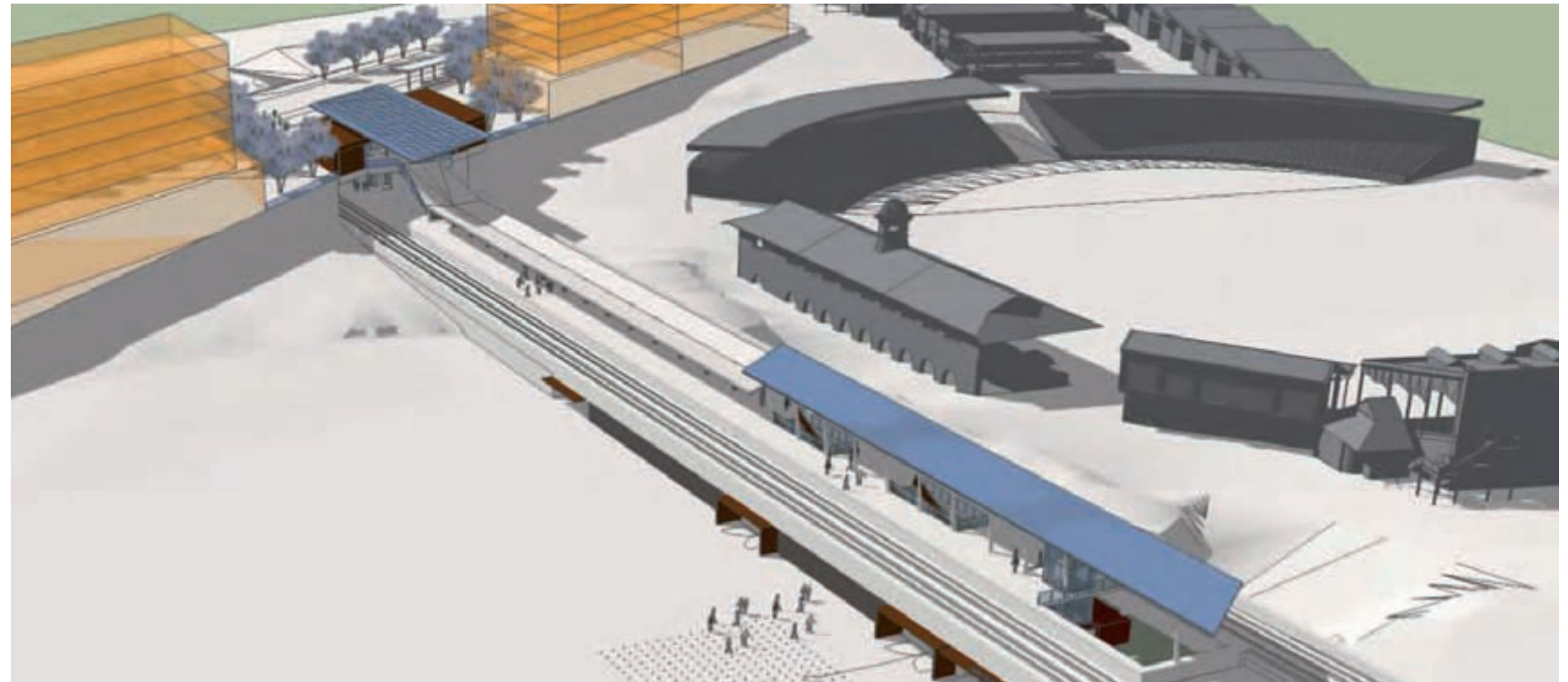
The Cross River Rail tunnel emerges at the portal at Yeerongpilly with a new station located just south of the dive structure. From this location, grade separation is required to access the Clapham stabling yard and to get the northbound Cross River Rail track to the west of the suburban tracks.

This is achieved with an elevated structure with a 3% grade south of Moolabin Creek and 2.5% grade north of the creek. The structure is similar to the twin track Airtrain viaduct and consists of architectural insitu concrete columns and headstocks, prefabricated, prestressed concrete beams (typically 30m spans), an insitu top slab and steel cantilever walkways.

Northern elevated structure

The Cross River Rail tunnels surface onto the Exhibition line in the vicinity of Bowen Bridge Road continuing north in a widened corridor to Mayne Yard. From this location, they follow an elevated structure along the eastern edge of Mayne Yard to achieve a grade separation with the existing North Coast line, and to fly over the Ferny Grove line.

This elevated structure is similar to the southern elevated structure but with 3% grades at both ends.



Top: Exhibition station

Above: Southern elevated structure at Moolabin Creek

Northern portal and dive structure

The northern portal is located along the northern edge of Victoria Park, between the Inner City Bypass land bridge and Bowen Bridge Road. Both southbound and northbound tracks will use the one portal and dive structure.

The underground portal structure makes allowance for a possible future North West rail corridor connection. The portal comprises a cutting for the dive structure.

The surrounding landscaping is reinstated to fit with the existing park setting at completion.

Southern portal and dive structure

The southern portal is located on the eastern side of the existing rail corridor at Yeerongpilly between Cardross and Crichton Streets.

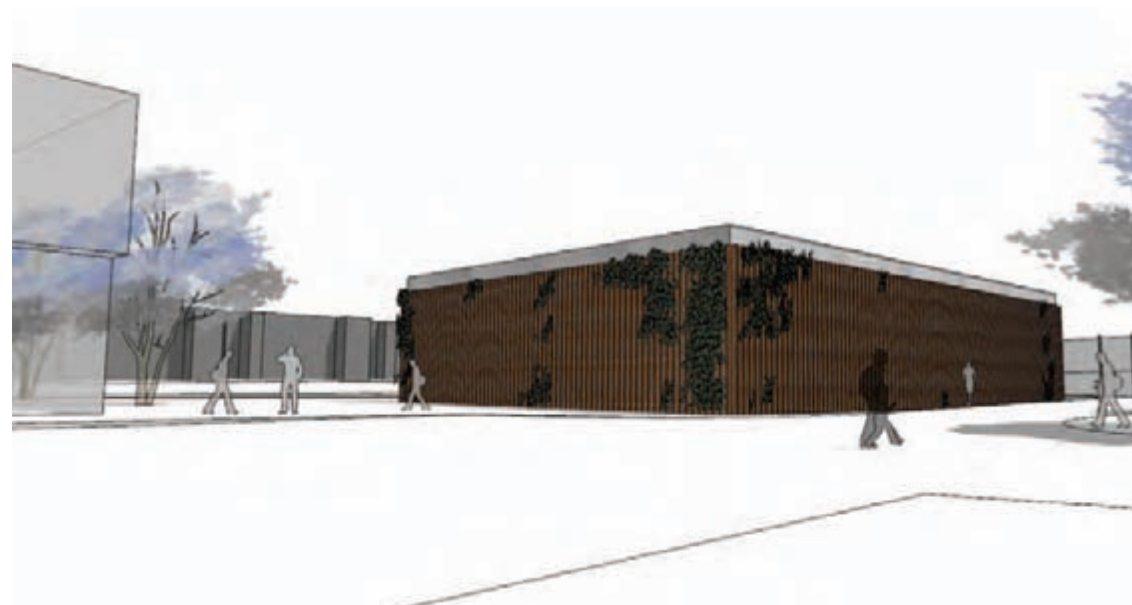
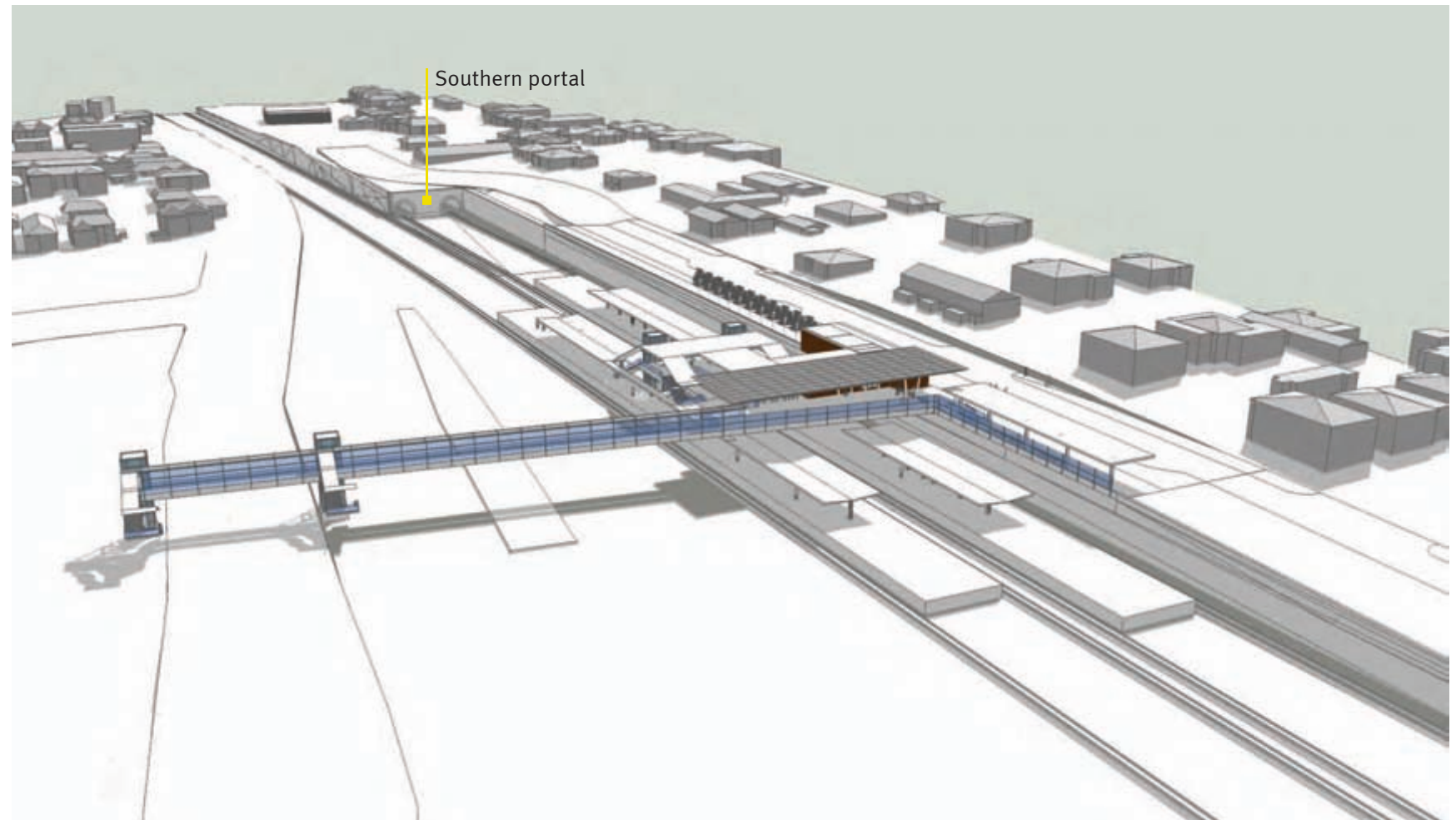
The dive structure starts as an open cut containing both tracks, with batter stabilisation such as soil nailing and shotcrete. It continues into separate cut and cover boxes for each track and finally into mined tunnel utilising techniques such as canopy tubes and grout injected ground improvement for tunnelling at shallow depths in soft ground.

The open portal structure is lined by angled pre-cast noise walls and a safety barrier.

Southern floodgate building

A floodgate and associated building has been located at the end of School Road near the southern tunnel portal to protect the tunnel infrastructure from up to a one in 10,000 year flood event.

This building will be visible from the surrounding community and from vehicles passing along Fairfield Road. The building is approximately 10m x 15m and six metres high, with maintenance vehicle access from School Road. The building has been designed to minimise the visual impact by providing a simple, unarticulated form.



Above: View of the Southern portal and Yeerongpilly station

Left: Southern floodgate building

Southern ventilation and emergency access building

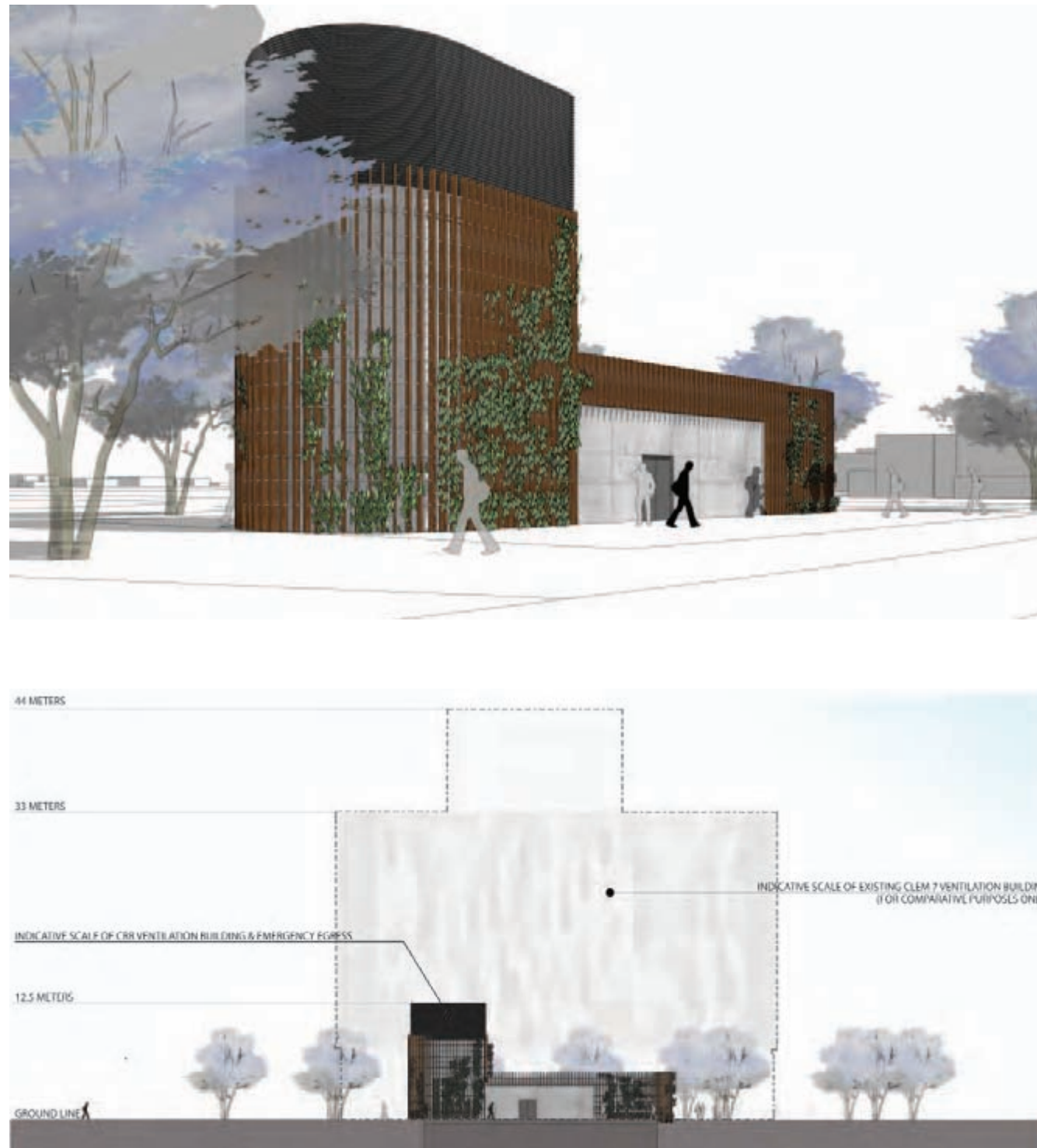
Due to the length of the tunnels between the southern portal at Yeerongpilly and Boggo Road station, a ventilation and emergency access shaft and building is required to ensure the safety of trains and passengers in the event of an emergency.

This southern ventilation shaft and building is located in the traffic median between Fairfield Road and Brougham Street, opposite Fairfield Gardens Shopping Centre.

The structure includes ventilation equipment for the tunnels, pumps to remove water and stairs to the surface for emergency egress and maintenance and emergency services access.

The ventilation building has a modest footprint of approximately 24m x 7m x 5m with a 12.5m high raised structure to protect the ventilation ducts against floods.

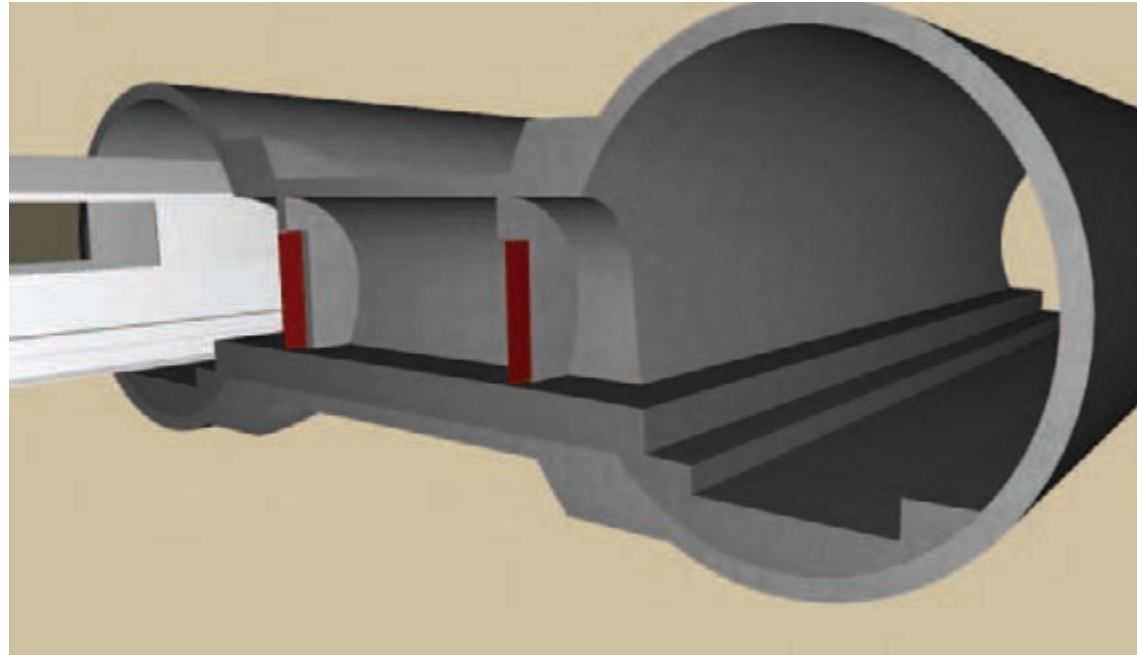
The electrified rail system has no exhaust emissions as a road tunnel would. The ventilation equipment is designed for emergency use and may occasionally be used to remove any excess heat from the tunnels.



Top: Southern ventilation and emergency access building

Above: Ventilation building size compared with Clem7

Fire and life safety



Top: Cross passage between tunnels

Above: Station and tunnel ventilation equipment

Emergency management plans for the Cross River Rail system will integrate the responses of the owners and operators of the rail infrastructure, rollingstock, rail track and passenger services, with those of the station managers and local emergency response agencies.

The fundamental aims of the fire and life safety strategy are to:

- provide life safety for the public, rail staff and emergency services in accordance with community expectations by making the risks as low as reasonably practicable
- provide a reasonable level of protection of property and assets while maximising continuity of operations
- minimise impact on the immediate environment.

The provision for fire and life safety includes a tunnel and ventilation system that allows for normal operations as well as emergency fire conditions. The system has been designed to cope with a train fire of 20 MW based on benchmarking other regional and world systems.

The tunnel and station ventilation is serviced from major ventilation plant contained in or adjacent to all stations as well as in a southern intermediate ventilation shaft located part way along the southern tunnel section. The design has managed to avoid the need for ventilation jet fans within the tunnel system.

Cross passages between the running tunnels have been placed approximately every 240 metres to aid emergency egress and access for emergency services. Emergency service access points to the stations have been discussed with the emergency service authorities and allowed for at stations and other surface structures.

For the purposes of design, fires are classified by location and /or fuel types:

- station - fire in a back of house area, an escalator or elevator pit, on a platform, on a concourse, under a vehicle, on top of a vehicle, in a vehicle
- tunnel – fire under a vehicle, on top of a vehicle, in a vehicle, equipment room / niche fire, trackway debris fire.

The fire and life safety design of the system requires consideration of design incidents and the following scenarios have been considered:

- 20MW fully involved train fire (at a station platform and in a tunnel) – assuming a mix of new and modern existing rollingstock
- 5MW undercar fire (at a station and in a tunnel)
- 1MW trackway fire
- 350kW platform or concourse fire.

The largest fuel loads and most likely ignition sites are the trains. Consequently, rollingstock design is fundamental to the fire safety risk of the entire running rail network because it impacts the ability for passengers and crew to escape safely and emergency responders to access any incident site.

The project design team consulted with Queensland Rail to ensure acceptable fire and life safety considerations for future rollingstock specifications.

Rail systems



Railway systems infrastructure

Rail systems cover three main areas:

- traction power distribution
- overhead line electrification
- signalling and telecommunications.

The introduction of Cross River Rail will require significant changes within the surface infrastructure and the management and control of the network. These changes will need to be carefully sequenced and implemented to ensure minimum disruption to the overall network and passenger services.

Construction and commissioning testing plans are critical to the strategy for implementation of this project and will be developed further as the design progresses.

A new signalling and train control system based on the European Train Control System has been incorporated for the underground sections of the Project. This system enables the new trains to operate efficiently at close headways and to interface with the automated platform screen doors at all underground stations. Upgrades are required within the existing Mayne Yard control centre.

With the additional train traffic and movements, the demand on the traction power increases and additional feeder stations and track section cabins are required to bolster the delivery of power to the suburban network and tunnels.

Traction power distribution

Three new 25 kV feeder stations are located as follows:

- near the northern portal in Victoria Park
- at Mayne Yard (to replace an existing feeder facility)
- south of Yeerongpilly station.

These feeder stations provide the additional power required for the Cross River Rail traction power system and are connected to adjacent Energex main supply points. The new traction power supply feeds through the tunnel system and has an independent supply in the event of a localised power failure.

Overhead line electrification

The surface overhead wiring system consists of two components – surface works and tunnel works.

Surface works are from Salisbury through to the southern portal and from the northern portal through to the North Coast line at Breakfast Creek. This is a conventional 25kV, AC, Mk3B system with overhead masts and catenary support system similar to the existing Queensland Rail system. All surface passenger tracks are electrified however surface tracks that only carry freight are not.

In the tunnel section, the overhead wiring system consists of a solid conductor (supported by special fixings to the tunnel roof) as this provides advantages for operations and maintenance, with reduced outages on the network.

Signalling and telecommunications

The signalling infrastructure consists of new line-side signalling works to suit the new surface track arrangements between Salisbury and the southern portal (near Yeerongpilly), and between the northern portal (near Exhibition) and the North Coast line track works at Breakfast Creek.

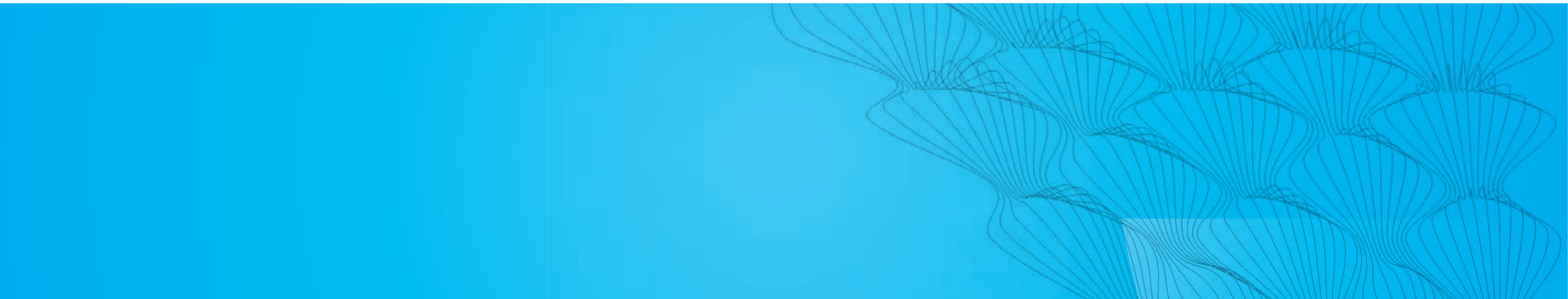
The second element of the signalling network is within the tunnels, where a new automatic train protection system forms part of the scope of work, incorporating the latest advances in signalling applications being applied in Europe.

The construction, testing and commissioning strategies will be developed further during the detailed design to ensure effective continuation of existing operations during implementation of the project.

A train communication system has been allowed for throughout the tunnel, station and above ground network to facilitate train operations under all conditions.

Train control

Modifications will be required to the existing QR Train Control Centre to accommodate this substantial network upgrade. This may involve a new enlarged control facility.



CrossRiver*Rail*

Construction

Overview of construction works

The Cross River Rail reference design includes both major surface and underground works.

The surface rail infrastructure works represent approximately 50 per cent of the overall project length. Much of the Cross River Rail surface works border the existing Queensland Rail operational network which means there will be extensive sections of complex urban brown-field rail construction.

As with all detailed brown-field works, detailed planning will be required to enable Queensland Rail to appropriately program in many of the extended shutdowns for the project. They will need to occur over designated weekends or public holiday periods such as long weekends, Easter and Christmas.

Queensland Rail have a possessions program for the entire South East Queensland rail network and the Cross River Rail project is expected to utilise much of this possession requirement during the peak years of construction.

Surface works include:

- acquiring land
- demolishing / removal of existing buildings and industrial infrastructure
- widening existing rail corridor boundaries
- altering road, pedestrian and public utility plants
- structuring new road and rail bridges
- upgrading existing stations
- constructing new stations
- introducing new rail infrastructure
- significantly altering existing rail infrastructure.

To minimise the impact on the existing and future network's operational capacity, delivery of surface works will be staged into manageable, safe and reliable increments that are acceptable to the rail manager and subject to the rail manager's corridor safety requirements. Consequently, construction durations for the surface works will be comparable to the tunnelling works.

The underground sections of the project, from the Yeerongpilly southern portal to the Victoria Park northern portal, are complex and many different structural forms have been proposed. These are based on:

- inferred geological profiles
- preferred horizontal and vertical rail alignment
- depth at each station location
- specific local constraints
- proposed construction methodology.

All running tunnels and station caverns have been arranged to lie below the inferred rock-head levels, making initial excavations self-supporting. This means the spaces required can be formed economically using a combination of tunnel boring machine (TBM) and mined solutions.

Station caverns and mined tunnels can be drained structures and TBM tunnels undrained.

Some stations, station entries, and plant space require shafts and cut-and-cover elements which have been arranged as reinforced concrete structures, predominantly cast insitu, but with specific pre-cast elements.

Perimeter walls will extend to rock, with excavations continuing below as vertical rock cuts to depth. The majority of piled walls will be drained, soldier piles, with shotcrete lagging.

Full groundwater cut-off to rock has been provided at specific locations to deal with anticipated groundwater risks.

To provide sufficient space for construction activities, major tunnel construction sites have been planned for Yeerongpilly, Woolloongabba and the north portal in Victoria Park.

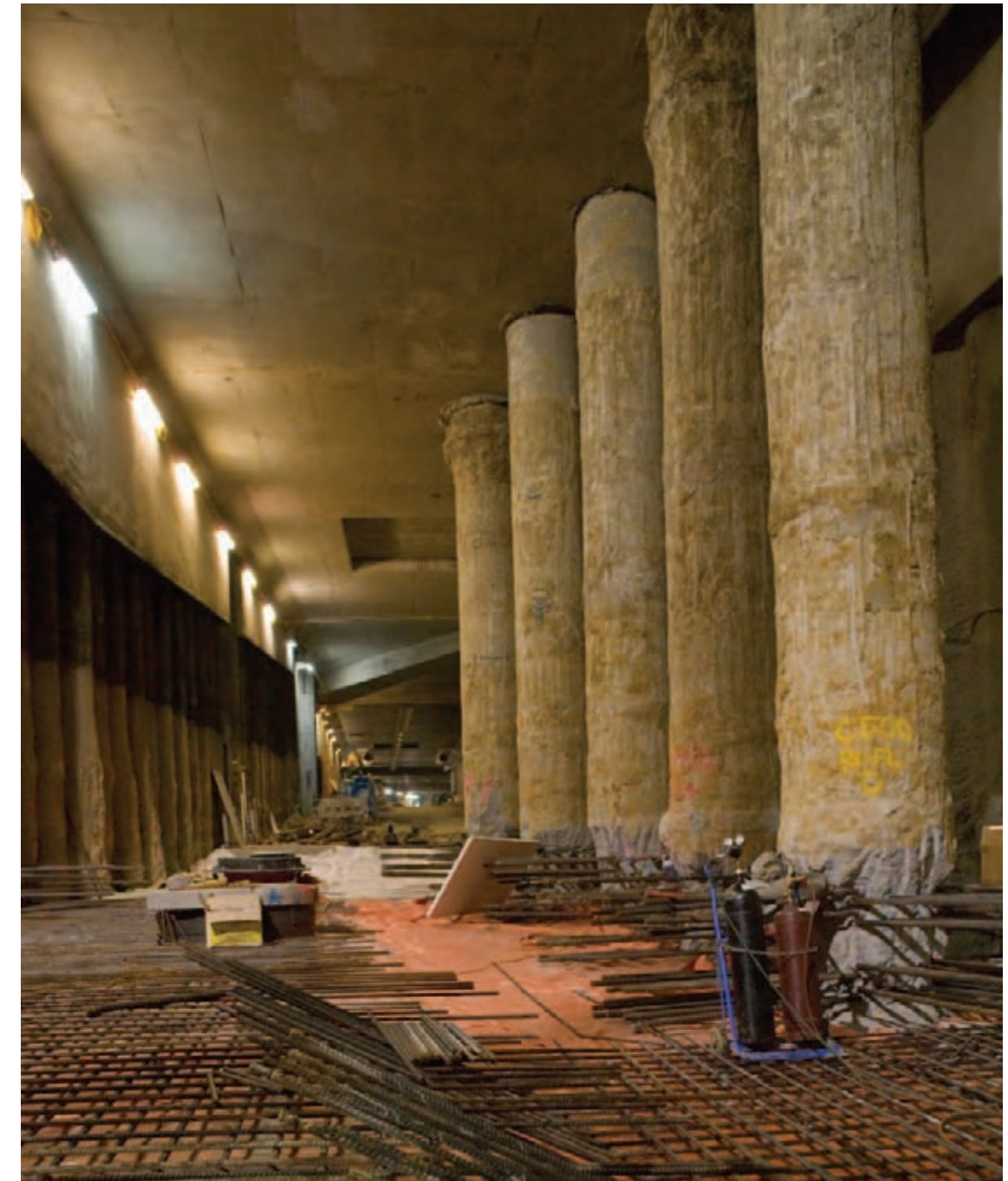
The stations are projects in their own right, and a significant footprint will be required for these in their final state as well as during construction.

A number of factors have driven the strategy for the tunnel and station construction, including:

- delivering the reference scheme in a cost effective manner
- shortening the construction program where possible, but not where it may adversely affect the overall costs
- minimising land-take
- minimising disruption to existing road and rail traffic, or businesses
- minimising construction risks, particularly those associated with potential third-party impacts
- minimising environmental impacts
- making reasonable allowance for future developments above and along the corridor.



Above: Cut and cover construction



Major underground infrastructure works elements

Element	Form	Proposed Construction Technique(s)
Yeerongpilly south portal and dive structure	<ul style="list-style-type: none"> Dive structure immediately to east of existing rail corridor. Short length of driven tunnel followed by shallow driven tunnels to north. 	<ul style="list-style-type: none"> Reinforced concrete retaining wall. Soldier pile wall at immediate portal retaining re-aligned Wilkie Street. Elsewhere reinforced (i.e. soil nails) or un-reinforced cuttings. Shallow driven tunnels – canopy tubes, multiple headings. Lattice arch girders (LGS) and shotcrete from the portal north to the Floodgate shaft. Short length of cut & cover tunnel.
Floodgate building shaft	<ul style="list-style-type: none"> Reinforced concrete box cast insitu (possibly with pre-cast elements) with cross-passage at track level. Floodgates and associated mechanisms at upper levels. Surface footprint providing access to floodgate mechanism. 	<ul style="list-style-type: none"> Soldier pile walls with shotcrete lagging panels. Temporary anchors providing lateral support. It is anticipated that the shaft may be used for TBM-launch northwards, with the TBM train assembled in the driven tunnels between the shaft and the portal.
Yeerongpilly - Boggo Road tunnels	<ul style="list-style-type: none"> Two single track running tunnels with cross-passages at approximately 240m centres. 	<ul style="list-style-type: none"> TBM tunnels in rock, mined cross passages. Pre-cast concrete segmental TBM tunnel linings, cast insitu concrete or shotcrete cross passage linings.
Southern ventilation and emergency access shaft	<ul style="list-style-type: none"> Tunnel supply and exhaust, emergency egress stairs, tunnel sump. Surface structure includes ventilation tower to take ventilation openings above flood levels. 	<ul style="list-style-type: none"> Secant pile walls with cast reinforced concrete skin. Cast insitu reinforced concrete internal structure.
Boggo Road station	<ul style="list-style-type: none"> Cut and cover station box, entrances and tunnel ventilation at each end of the station. 	<ul style="list-style-type: none"> Soldier pile wall or similar retaining structures. Capping beam on piles at top-slab level. Pre-cast beams and cast insitu top slab. Conventional reinforced concrete slabs and skin-wall at depth. Top-down construction to minimize surface impacts.
Boggo Road - Woolloongabba station tunnels	<ul style="list-style-type: none"> Two single track running tunnels with cross-passages at approximately 240m centres. 	<ul style="list-style-type: none"> TBM tunnels in rock, mined cross passages. Pre-cast concrete segmental TBM tunnel linings, cast insitu concrete or shotcrete cross passage linings.
Woolloongabba station	<ul style="list-style-type: none"> Cut and cover station box in central section of site from busway in the south to Vulture Street in the north. Cavern profiles at each end. Tunnel ventilation reticulated back into box from station ends. 	<ul style="list-style-type: none"> Secant pile walls with cast reinforced concrete skin. Numbers of piles taken to depth to carry future development loads.

Element	Form	Proposed Construction Technique(s)
Woolloongabba - Albert Street station tunnels	<ul style="list-style-type: none"> Two single track running tunnels with cross-passages at approximately 240m centres. Tunnel sump at low point in alignment. 	<ul style="list-style-type: none"> TBM tunnels in rock, mined cross passages. Pre-cast concrete segmental TBM tunnel linings, cast insitu concrete or shotcrete cross passage linings.
Albert Street station	<ul style="list-style-type: none"> Station cavern approximately 250m long - entrances and tunnel ventilation in off-line shafts at each end. Two shaft-cavern connecting adits at each end - one passenger, one ventilation/services/egress. 	<ul style="list-style-type: none"> Mined station cavern - minimum two top-headings, potentially full-width bench. Shaft at southern end - shallow rock anticipated - temporary walls retaining soil near-surface, cast insitu walls. Secant pile wall for northern shaft (deeper rock).
Albert St - Roma Street tunnels	<ul style="list-style-type: none"> Two single track running tunnels with cross-passages at approximately 240m centres. 	<ul style="list-style-type: none"> TBM tunnels in rock, mined cross passages. Pre-cast concrete segmental TBM tunnel linings, cast insitu concrete or shotcrete cross passage linings.
Roma Street Station	<ul style="list-style-type: none"> Station cavern approx. 250m long - entrance and tunnel ventilation in on-line shaft at south end. Entrance in shaft providing connection to existing subway towards centre of station. Ventilation and egress shaft beyond northern end of station. 	<ul style="list-style-type: none"> Mined station cavern - possibly two top-headings, potentially full-width bench. Shafts - shallow rock anticipated - temporary walls retaining soil near-surface, cast insitu walls.
Roma Street - North portal tunnels	<ul style="list-style-type: none"> Two single track running tunnels with cross-passages at approximately 240m centres. Transition to single twin-track tunnel and central dividing wall. 	<ul style="list-style-type: none"> TBM tunnels in rock; mined cross passages. Pre-cast concrete segmental TBM tunnel linings, cast insitu concrete or shotcrete cross passage linings.
North portal and dive structure	<ul style="list-style-type: none"> Shallow tunnels transition to cut and cover and then trough structures for north-bound and south-bound tracks. Provision for the future North West Transport Corridor line (tunnel stubs, provision for future ventilation facility). 	<ul style="list-style-type: none"> Temporary walls retaining soil near-surface, cast insitu walls.

Construction sites



Rock bolt installation



TBM breakthrough



Bottom up construction

The following constraints and issues have been considered to determine the suitability of possible construction sites.

- Green-field sites, or sites with either low-rise or industrial development only, where possible.
- Each of the proposed underground stations is a major construction site, approximately 250m long and up to 30m deep. Sites should be around 5,000 to 6,000sqm to provide width for cranes, storage and logistical support adjacent to any shaft excavation.
- The construction activities anticipated at surface are similar to those associated with any large building site (e.g. the recent Vision building development site).
- Sites with straightforward access to major trunk roads are preferable to sites associated with construction traffic along suburban streets.
- Sites in support of significant tunnel drives should be as large as practical, with a minimum area of 20,000sqm.
- Spoil disposal via rail is an option being considered. Such a strategy would lend itself to the sites at the north portal and south of Yeerongpilly where there is some scope for sidings to be dedicated to Cross River Rail construction requirements.

A schedule of the proposed sites (concentrating on the underground section of the project from Yeerongpilly-Exhibition line) is presented opposite.

Major Construction Site	Description	Purpose
Victoria Park	Adjacent to the Exhibition line, north of Centenary Pool.	<ul style="list-style-type: none"> Construction of the north portal dive structures and cut and cover section. Retrieval of tunnel boring machines.
Woolloongabba station	Go-print site in Woolloongabba UDA.	<ul style="list-style-type: none"> Construction of the central cut and cover box, and station caverns. Launch site for running tunnel construction to the north TBM launch site for tunnels to the north TBM retrieval for running tunnels from the south.
Yeerongpilly – south portal	Area alongside Wilkie Street and east of the Queensland Rail corridor; and commercial properties to the south along Lucy Street.	<ul style="list-style-type: none"> Construction of the southern portal. Extended footbridge to the existing Yeerongpilly railway station. Construction of the new at-grade railway station. Construction of re-aligned local streets. TBM launch site. Potential for access to nearby sidings to facilitate spoil removal via rail.
Minor Construction Site	Description	Purpose
Roma Street station – north shaft	Luggage handling building adjacent to Platform 10.	<ul style="list-style-type: none"> Construction of the northern plant building for Roma Street station. Re-located toilet facilities.
Roma Street station – central shaft	Queensland Rail car park adjacent to the heritage-listed station building on Platform 3.	<ul style="list-style-type: none"> Construction of the central shaft for escalators and lift shaft access to mezzanine level. Will require breaking into the existing Roma Street Station subway. Re-location of the toilets alongside the subway
Roma Street station – south shaft	Between Roma Street and the busway corridor, adjacent to the Roma Street Parklands entrance on Roma Street.	<ul style="list-style-type: none"> Construction of the shaft to accommodate the southern entrance to the station and associated plant. Main on-site support for construction of the station cavern.
Roma Street Parklands – car park	In the car park adjacent to the Roma Street Parklands, north of Roma Street station.	<ul style="list-style-type: none"> Satellite site for carpark, truck staging, site offices, workshops, store and general support for the construction of Roma Street station.
Albert Street station - north shaft	Eastern side of Albert Street, on the north east corner of the junction of Mary Street and Albert Street.	<ul style="list-style-type: none"> Construction of the shaft accommodating the northern station entrance and associated plant.
Albert Street station – south shaft	Eastern side of Albert Street on the corner of Alice Street.	<ul style="list-style-type: none"> Site for the construction of Albert Street station. Construction of the shaft accommodating the southern station entrance and associated plant. Construction of the subway and entrance under Alice Street.
Boggo Road station	Between Boggo Road Gaol and Ecosciences Building extending to the south of Boggo Road Urban Village.	<ul style="list-style-type: none"> Construction of the cut and cover station box, entrance shafts and plant adits.
Southern ventilation and emergency access shaft	Traffic island and adjacent parkland on Fairfield Road, west of Fairfield Shopping Centre.	<ul style="list-style-type: none"> Construction of the southern ventilation shaft –some staged construction on roads anticipated.
Southern floodgate building	End of School Road adjacent to the Queensland Rail corridor.	<ul style="list-style-type: none"> Construction of the shaft for the floodgate building. Support of the launch of the tunnel drives to the north.

Spoil removal

An outline scheme for spoil removal from the construction sites has been developed using the following criteria:

- sites where construction traffic can flow directly on and off freeways and major trunk roads are favoured
- minimal spoil quantities extracted from other sites
- consideration of access to sidings for rail transport as a means of spoil removal.

The majority of spoil will be generated from the TBM running tunnel sites at Woolloongabba and south of Yeerongpilly, however the north portal and station location will also generate significant volumes. The major spoil removal facilities will be located inside acoustic sheds to minimise noise and dust impacts. The intended disposal routes from the main tunnelling sites are via Ipswich Road to the South West.

The total estimated volume from the works, portal to portal, is approximately 1.4 million cubic metres insitu or approximately 2.1 million cubic metres of excavated spoil to dispose of off-site.



Acoustic shed interior



Acoustic shed exterior

Infrastructure works

Surface rail infrastructure works

For both the southern and northern surface works significant detailed construction planning will be required.

Whilst the underground works are underway, surface works are progressively actioned within, and adjacent to, the existing rail corridor.

Much of the new corridor works in the southern surface section are off-line and can be carried out independently of main line rail operations. However, some property acquisition and enabling works such as public utility and road alterations are likely to be required.

Despite the proportion of off-line work there is still significant work within the existing Queensland Rail corridor which will mean relocating the existing rail services prior to the new Cross River Rail works.

Works inside the corridor include track slews, new bridge support structures, station upgrades and rail system interface works associated with track, traction power, overhead electrification, signalling and communication systems.

The works will require detailed possession planning in procurement phases of the project. Possessions are likely to be associated with rail services relocation works, rail grade separation works within the corridor, road and pedestrian bridge works and station works.

These may range from extended overnight closures, weekend closures and extended major shutdowns of several days at a time such as over the Christmas and Easter periods or long weekends.

The Cross River Rail Project requirements will need to be planned in Queensland Rail's forward possession planning for the overall South East Queensland network.



Surface works

Track and rail systems

Track and rail systems are project-wide and therefore will generally be constructed as end to end installations. The activities will be planned to avoid construction conflicts with other station sites.

The assumed sequence of track and rail systems is as follows:

- construction and installation of the track formation and tunnel track slabs
- sleeper and rail installation as required
- installation of overhead masts
- overhead electrical assemblies
- traction power supply and connection
- line-side signalling system installation and communications.

At this stage the track and rail systems works in the tunnels are envisaged to be carried out from three separate locations – the southern portal, the Woolloongabba construction site and the northern portal – to reduce tunnel fit-out time to a minimum.

The timing of track installation works at the southern and northern surface sections will rely on the availability of track possessions.

It is important to leave sufficient space between the rail system installation contracts to enable appropriate sequential access along the corridor especially within the tunnel sections.

Station fit-out

The fit-out of the underground stations is complex, and therefore needs to be commenced as soon as the station structural shells are complete and the ongoing tunnel boring operations will allow.

Significant mechanical and electrical, control and ventilation systems will be required in addition to the normal station facility fit-out and finishes. The platform screen doors will be a late installation activity that needs to be synchronised with the new signalling and train control system.

The fit-out of surface stations is expected to be substantially shorter in duration once the new station platforms and facilities have been structurally completed. Surface stations will not include platform screen doors or significant electrical and mechanical services.

All Cross River Rail stations will include automatic gated ticket lines that will need testing and commissioning.



Underground station concourse

Program overview

The construction of a project of this scale and complexity requires careful detailed planning and consideration. An outline construction methodology has been developed.

The methodology focuses heavily on the underground construction with additional sections for the surface works.

Based on the current tunnelling strategy and other major assumptions, the overall main construction timeframe is more than 4 years.

However there are many key activities that will have to be undertaken prior to the start of major project works.

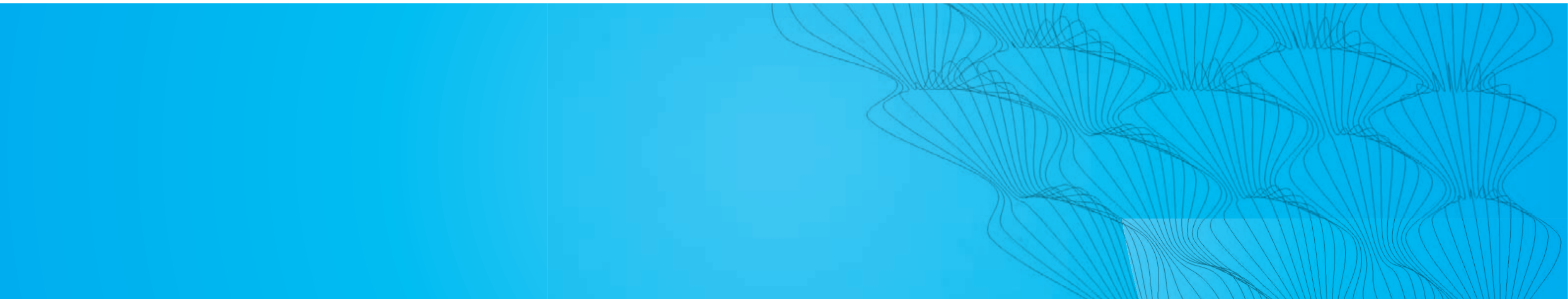
These may vary depending on the final procurement model and scope of works but are likely to include:

- finalising environmental impact statement
- more design development and field investigation to address either high cost or high risk components of the project
- further engagement with the rail operator to confirm staging methodologies and final project scope
- property acquisition
- more detailed service authority negotiations.

Effective progress on the above activities would allow the project to start early, and therefore end early.



Commissioned tunnel infrastructure



CrossRiver*Rail*

Operations

Commissioning and testing

The works described here cover some of the key commissioning activities associated with the new underground system. The extent and detail of commissioning activities described is to inform the reference design and EIS phase of the Cross River Rail Project.

Further detail will be developed in line with the design as it progresses.

Extensive underground and project commissioning plans will need to be developed for all underground built infrastructure and systems and associated surface works.

This will include plans and documents that highlight the various control systems to be operated as part of the project and which will be further developed in subsequent phases of the Cross River Rail project.

Underground station commissioning

An important part of the commissioning of the overall Cross River Rail will be the commissioning of the underground rail stations. Underground stations require significantly more infrastructure than surface stations, therefore the commissioning process is longer and more involved. These will include testing and training in relation to station fire and life safety systems, day to day operations, and general passenger and train control.

In terms of fire and life systems staff must be fully conversant with the Fire and Life Safety Protocols for the new underground station and tunnel system. A comprehensive Emergency Procedures Manual (EPM) will form part of the key hand-over documentation for the project.

The EPM will outline roles and responsibilities of all Queensland Rail operations staff – station staff, train drivers, control centre staff and senior management in relation to specific emergency procedures for the Cross River Rail project. The EPM will also indicate the interaction with emergency services agencies and personnel, including the various responsibilities of all parties.

Particular commissioning activities are expected to include mock emergency evacuations, which will potentially include rescue, fire and life safety system operation including ventilation system activation and control.

Station training activities are expected to include station capacity management strategies for station staff. Station capacity overload may occur due to circumstances such as service disruption or major events such as a match at the Woolloongabba stadium.

An important differentiator to the existing Queensland Rail system will be the platform screen doors. The operation of the platform screen doors is linked to train operation through an automatic train operation system. Reliability testing of all platform screen doors is required for all the underground stations, as well as station staff training in relation to any disruption to the platform screen door system.

A unique aspect of the underground environment is the need for specific anti-terrorist training which would largely revolve around surveillance activities in and around the stations. Specific training of station staff, control centre staff and liaison with emergency services personnel are required under this circumstance.

The appropriate location and functionality of the CCTV system will be an important consideration with respect to passenger safety and security.

There are extensive electrical and mechanical services including lifts, escalators and all passenger interface equipment such as electronic passenger information devices, electronic ticket gates, PA systems and CCTV cameras. Progressive commissioning of these items will occur during the course of completion of the stations.

A period of three to six months is anticipated for the appropriate training of station staff after completion of essential works.



Tunnel system commissioning

The fire and life system training will extend to the tunnel system. Ventilation system operation and smoke testing will be undertaken in the months prior to commissioning to ensure adequate operation of all ventilation in all tunnel systems.

A mock evacuation of a train in a mid-tunnel section may form part of the emergency procedures check prior to final project commissioning.

Flood protection systems at various sites will require operational testing and commissioning as a key system that protects the infrastructure.

Driver training

Driver training is always an essential part of commissioning activities. In the case of Cross River Rail extra training will be required due to the substantially different nature of driver environment compared with the existing Queensland Rail suburban network which is predominantly a surface network.

Drivers will need to be trained in underground operation, the new route and the particular station interfaces.

Emergency procedures protocols will take on greater emphasis as indicated above.

Surface works commissioning

The Cross River Rail Project consists of two large sections of surface works either side of the underground environment. The surface works interface with the existing operating railway.

As a result, interim stages and commissioning of new rail works are required prior to final commissioning.

Each of the surface stations is expected to have an individual commissioning plan to ensure full functionality at day one of operations. As indicated above, the commissioning of the surface stations will be relatively simpler than the commissioning of the major underground stations.

Rail systems commissioning

The commissioning of the majority of the rail systems cannot be completed until the end to end project has been fitted out progressively with trackwork, power supply, overhead electrification, signalling and communications. Each rail system will have its own individual commissioning plan.

Timing of the final commissioning

Due to the complex integration required for the new Cross River Rail railway it is recommended that the final rail systems and rail infrastructure commissioning take place over the major shut-down period at Christmas.

This provides a commissioning contingency for a major major shut-down window to be available three to four months later at Easter.

Each of the surface stations is expected to have an **individual commissioning plan to ensure full functionality at day one of operations.**

Rail operations

The Cross River Rail project ideally **minimises interaction between services** using the Cross River Rail sector and services operating through the inner city using the existing network.

Cross River Rail will deliver twin track tunnels from Yeerongpilly in the south to the Exhibition line in the north. It will provide new nine car platforms for the Cross River Rail tracks at Yeerongpilly, Boggo Road, Woollongabba, Albert Street, Roma Street and Exhibition stations.

The introduction of Cross River Rail is based on breaking the current network into sectors as follows:

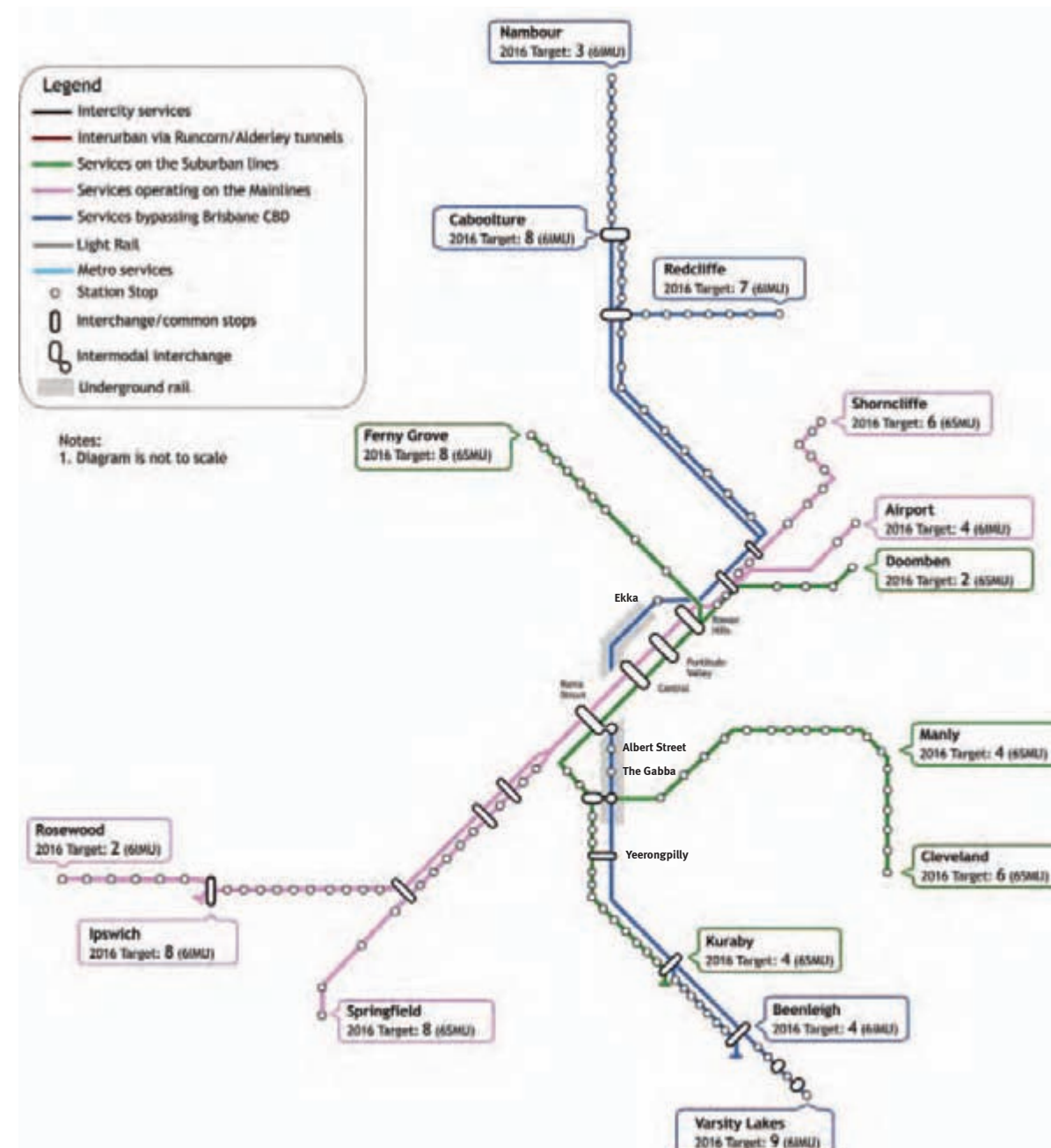
- North-south Cross River Rail sector - connects the Beenleigh and Gold Coast to Caboolture and Sunshine Coast lines and allows the transition to nine car sets on these high growth lines.
- East-west sector - connects the Springfield and Rosewood/Ipswich to Airport and Shorncliffe lines, which have similar rolling stock type and off peak service numbers.
- Brisbane suburban sector - connects the Ferny Grove and Doomben to Kuraby and Cleveland/Manly lines, which service the current Southbank and South Brisbane stations and utilises the Ferny Grove flyover and the suburban platforms in the inner city.

For operations, Cross River Rail Project can be reviewed in three separate sections: the northern approach, the tunnel, and the southern approach. Each of these sections has been designed to minimise interaction between services using the Cross River Rail network and services operating through the inner city using the existing network.

Queensland Rail is currently undergoing a process to procure additional rolling stock to meet growing passenger demand. This new rolling stock will need to be stabled across the entirety of the Brisbane metropolitan network, and ideally would be stabled in locations that minimise dead running, either at the beginning or end of services, or at maintenance facilities.

With this in mind, access to stabling and maintenance has been considered important in design development of the northern and southern approaches, to enable access to Mayne and Clapham yards.

Freight is an important part of operations on the Brisbane metropolitan network. While freight services will not be utilising the Cross River Rail tunnel, infrastructure layouts on the northern and southern approaches have the ability to minimise passenger service impact on freight, and in some cases enhance freight capacity.



Year 1 sectorisation plan
(AM peak 1 Hour)

Northern Approach: Breakfast Creek to the Northern Portal

The northern track layout between the Northern Portal and Breakfast Creek is shown on the right.

This location allows the development of the new Exhibition Station, and provides access to Mayne yard for Cross River Rail sector trains. However it poses challenges due to the complexity of operations in this area of the network, as well as space constraints.

A new pair of tracks is required on the Exhibition loop to connect to the existing corridor north of the Ferny Grove flyover, creating three corridors south of the Ferny Grove flyover.

Mayne Yard is the primary daytime stabling location for many of the existing Queensland Rail Citytrain rolling stock fleet. The ability to operate independently of the main line operations is important, and it is desirable to separate maintenance and stabling within the Yard from main operations. This allows staff to be rostered accordingly, as internal yard drivers require different qualifications to main line drivers.

The segregation of yard and mainline operations is shown on the right.

While access to Mayne Yard is desirable for daytime stabling, the new pair of tracks does not impact on the existing Mayne Yard operations. Due to space constraints and potential flat junction conflicts, a grade separated alignment has been determined as the best solution.

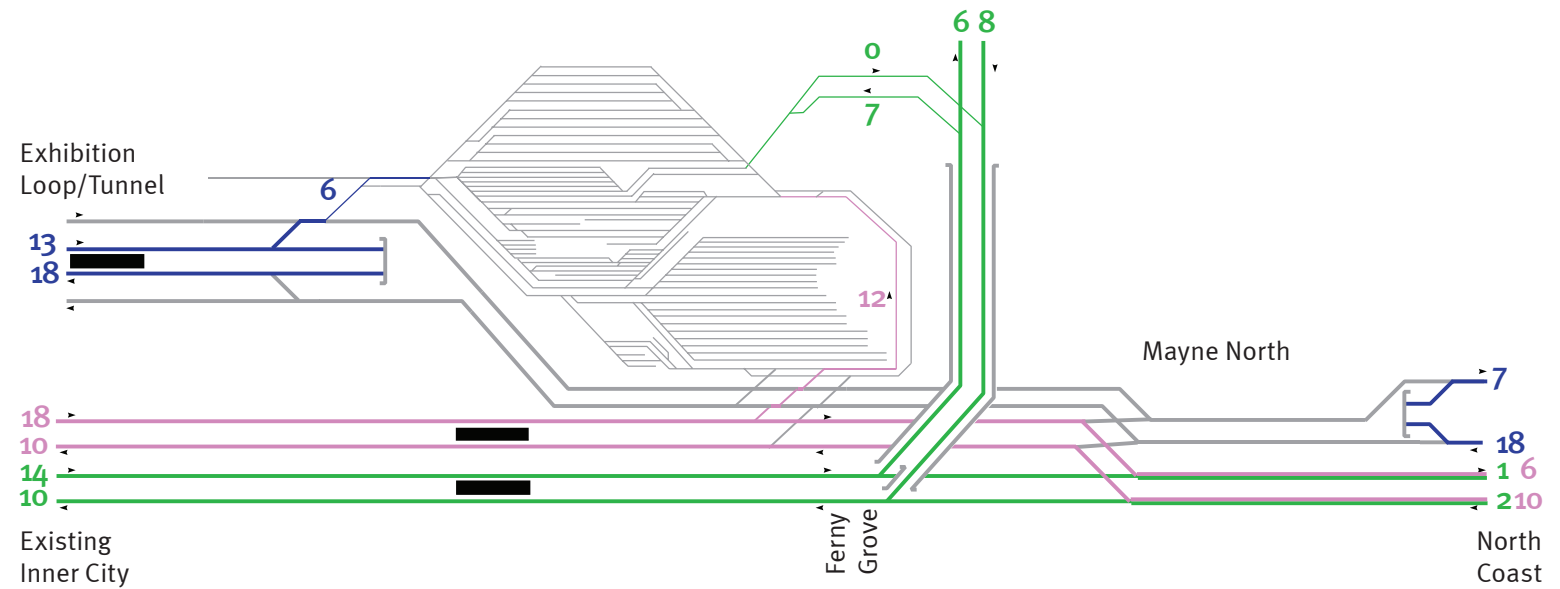
With the new pair of tracks around Exhibition line placed in the centre of the new quad track corridor, the access to Mayne Yard is maintained as it is today, as well as conflict-free access between passenger services.

The station arrangement at the new Exhibition station allows for an island platform with two passenger tracks, and two freight tracks are provided on the outside of the two passenger tracks. The Cross River Rail passenger tracks rejoin the existing North Coast line quad track at Breakfast Creek, south of Albion Station.

AM peak operations are shown on the top right.

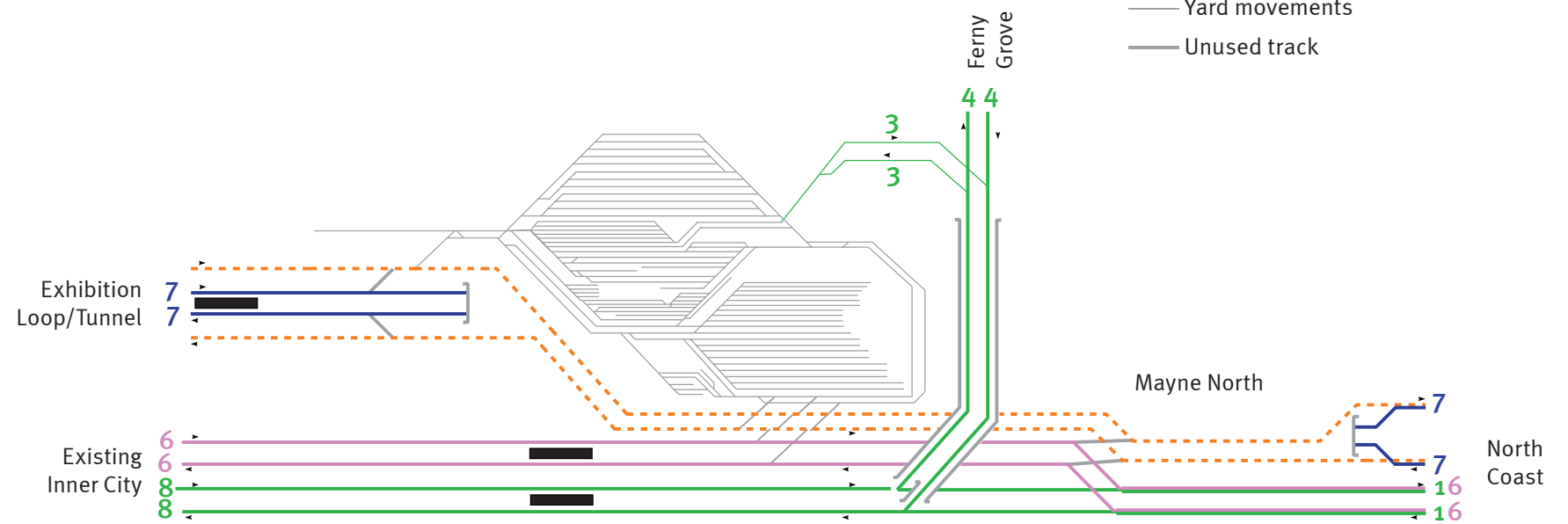
A new pair of tracks from the Exhibition loop to the Breakfast Creek has been provided to ensure that intermodal freight from the North Coast is only required to operate with the one sector to the north of the inner city.

Freight operations are shown on the bottom right.



Key paths - Citytrain Services
(Year 1 - AM peak 1 Hour)

- Sunshine Coast/Caboolture
- Ferny Grove/Doomben
- Airport/Shorncliffe
- - - Freight
- Yard movements
- Unused track



Key paths - Citytrain Off-Peak
(Year 1 - 1 hour - including main freight paths)

Southern Approach: Southern Portal to Salisbury

The southern approach to the Cross River Rail tunnel is shown on the right.

The southern surface track infrastructure required as part of the Cross River Rail Project comprises the tracks from the Southern Portal through to Beaudesert Road, a dedicated freight track from Clapham Yard through to the interstate line just south of Salisbury, and adjustments to the existing suburban tracks between Yeerongpilly and Salisbury to accommodate the new Cross River Rail tracks. Additional crossovers are provided where required by operations.

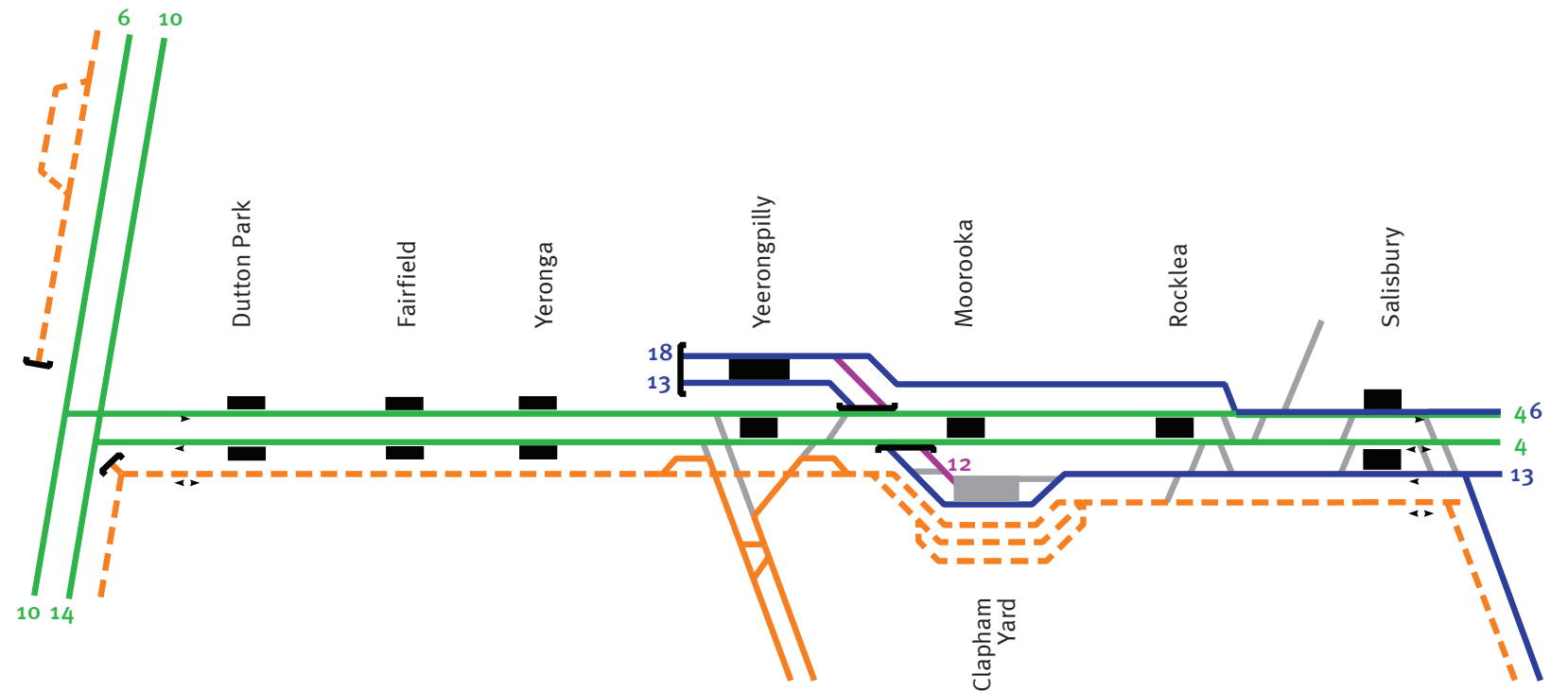
This solution provides access to Clapham Yard, which is important because forecasts require up to 22 six car trains to be stabled in the daytime in the first year of operations.

In addition to this, the new “next generation” rolling stock fleet could be maintained at Clapham Yard because this location is close to the Cross River Rail tunnel portal, and would require minimal empty running for terminating services.

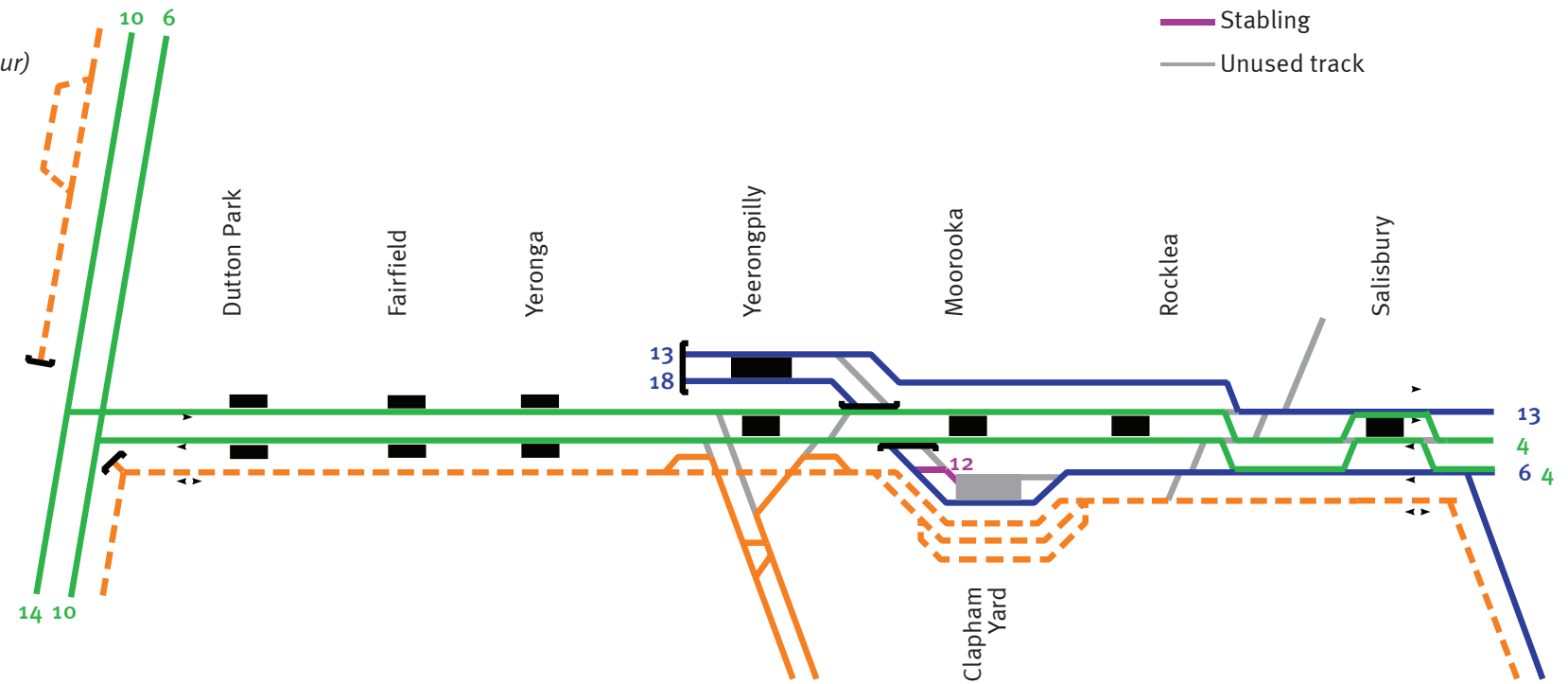
The Yeerongpilly to Beaudesert Road quad track is augmented by a dedicated freight track from Salisbury to Clapham Yard, allowing freight operations to continue all day without peak curfews between Salisbury and the Port of Brisbane. This operation is shown on the right.

The ability to operate outside of peak curfews will allow time sensitive intermodal freight to arrive at the Port of Brisbane or Acacia Ridge more easily, and provides approximately 20-30 additional hours a week of relatively unrestricted freight operations to occur between Salisbury and the Port of Brisbane.

Fairfield to Salisbury
Year 1 Project Case Layout (AM Peak 1 Hour)



Fairfield to Salisbury
Year 1 Project Case Layout (PM Peak 1 Hour)



- Gold Coast/Beenleigh
- Kuraby/Cleveland
- - - Freight
- Stabling
- Unused track

Station operations

Stations will be operational 18 hours a day and seven days a week for the public. The stations will be accessed 24 hours a day, seven days a week for operational and maintenance staff.

Station Maintenance

Cross River Rail services will be operated by Queensland Rail and new operational procedures will be developed to manage the underground stations.

Maintenance will be carried out on an ongoing basis and specific design requirements have been incorporated, including:

- provision for cleaning and maintenance of finishes in public areas
- access to equipment and service facilities for maintenance and replacement
- station staff facilities are located adjacent to the ticket gates to allow staff access to both paid and unpaid areas
- public toilets are provided within the paid concourse
- cleaning equipment, refuse and maintenance stores are located at plant level (separate lift access is to be determined)
- the width of each area allows access to all materials and finishes for cleaning and maintenance and replacement using conventional access equipment such as

scissor lifts, wall mounted access rails, and cleaning cradles

- lifts are sized and load rated to accommodate cleaning and maintenance access equipment
- plant areas can be accessed from ground level via the emergency access stairs (in cut and cover stations plant rooms can also be accessed from the concourse level)
- plant rooms are provided with access hatches (3m x 3m) at each end of the station to permit the removal of large plant items by cranes located at ground level.

Parking facilities are not provided for short term access of maintenance vehicles within the Cross River Rail station precinct and it is envisioned this will be provided in designated maintenance areas in consultation and agreement with Brisbane City Council.



Gate line and ticket office

