Document 27

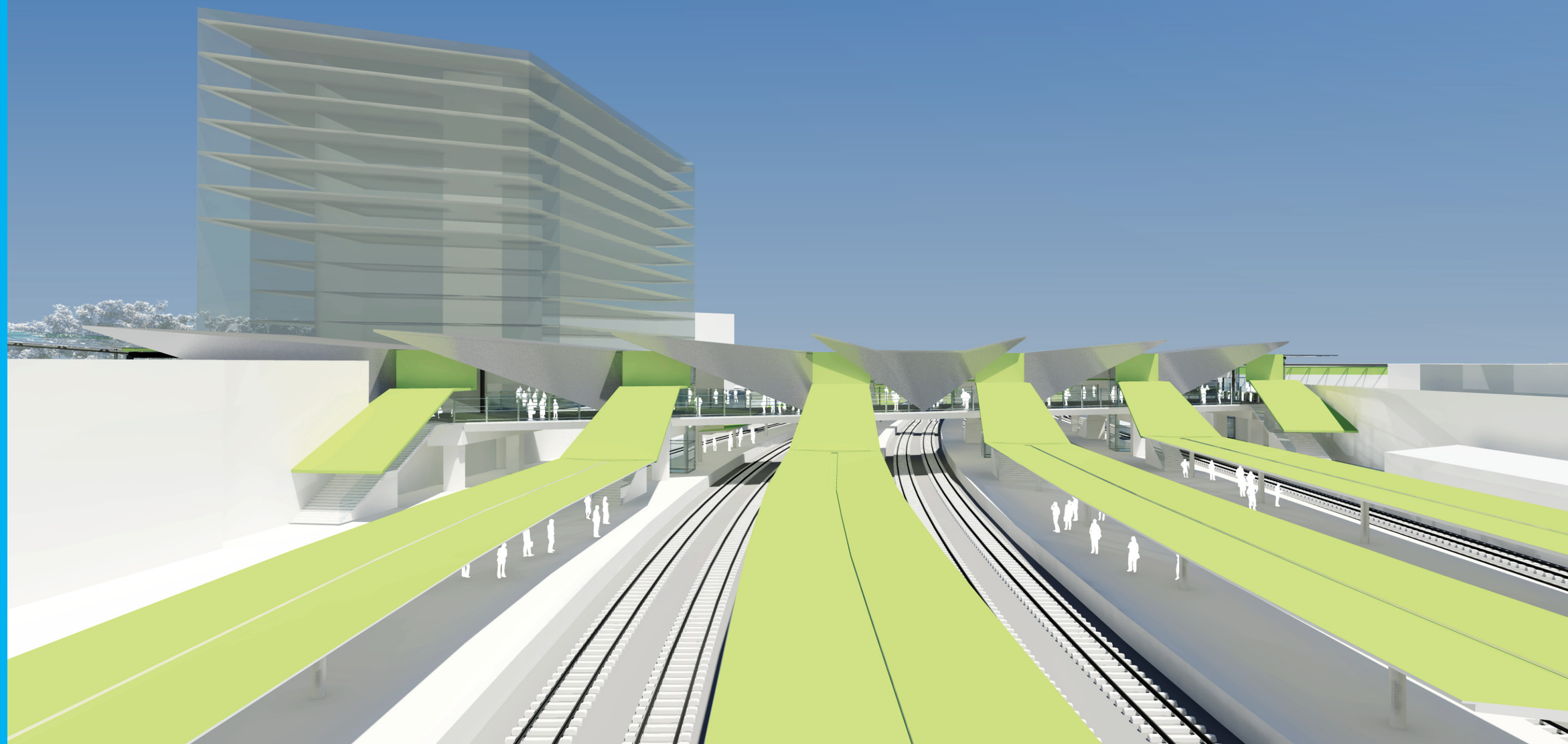
# Redfern Station
# Revised Concept Design report

**Section A** Architectural Design

**Section B** Structural Design

**Section C** Cost and Constructability

**Appendices**



COX

ARUP

Bovis
Lend Lease

# Section A
# Architectural Design

# Contents

# 01 Introduction

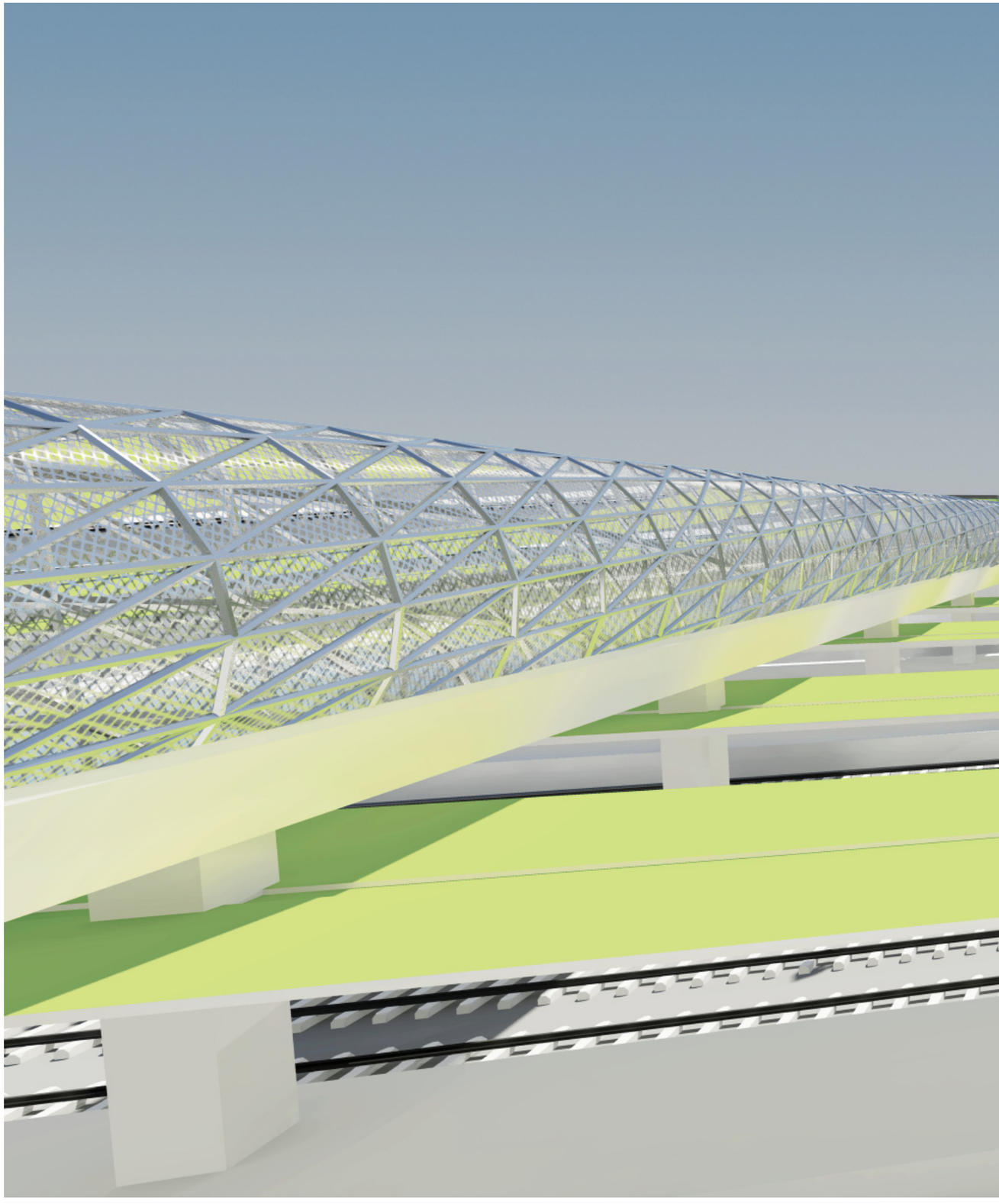
The redevelopment of Redfern Station represents an opportunity to radically reshape an important and well used component of Sydney's public transport network.

The existing station is deficient in terms of accessibility, safety and customer experience. High levels of existing and projected future patronage mean that prudent investment in Redfern Station will provide tangible benefit to large numbers of commuters.

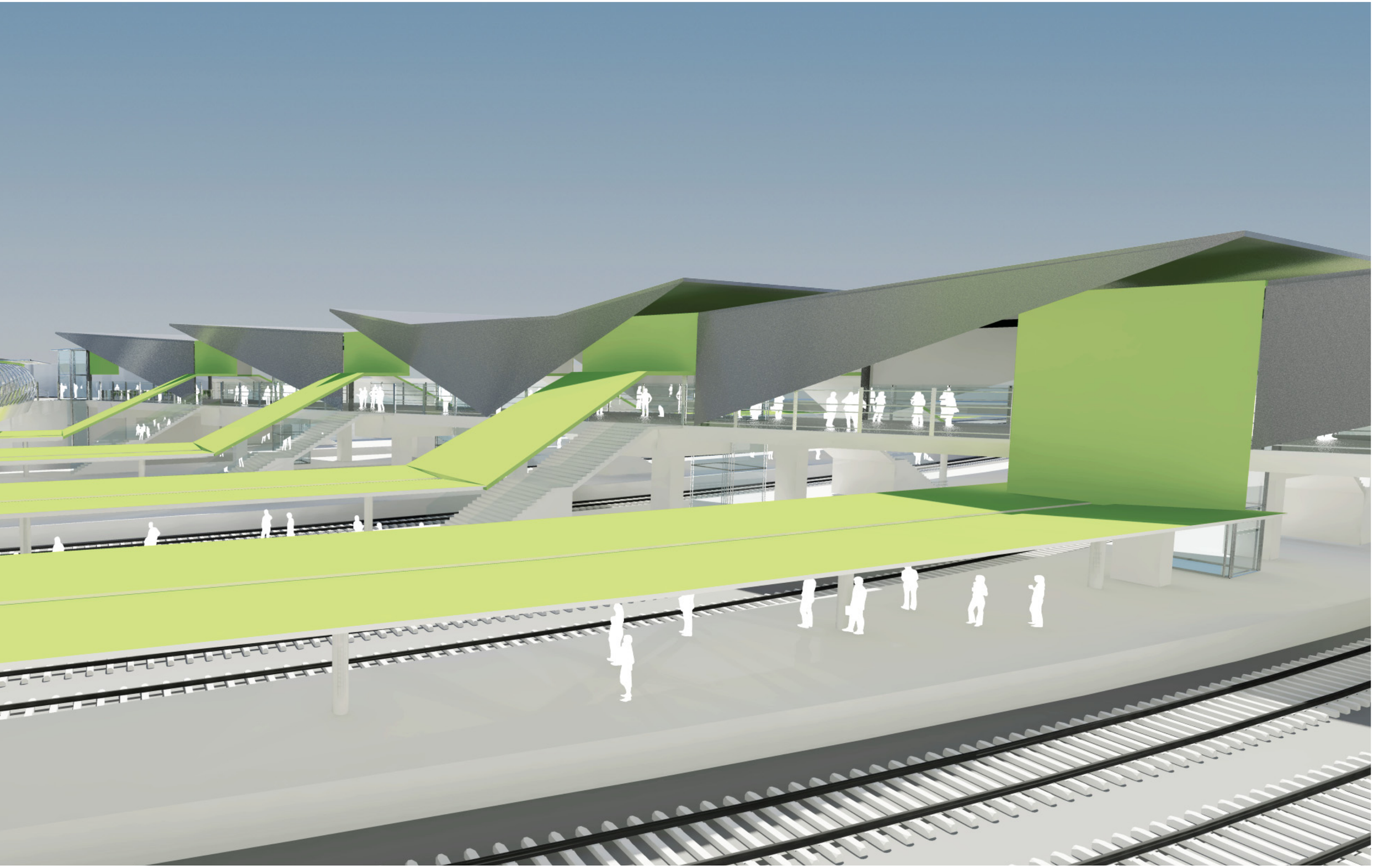
It is also vital for Sydney as a city to accommodate growth in office space, accommodation, research and education, and the areas serviced by Redfern Station include significant government and private lands with the potential to accommodate these uses at much higher densities. These areas can be viewed as the southern extension of the CBD, and the redevelopment of Redfern Station can be seen as a catalyst for unlocking this growth potential and for broader enhancement of the public realm.

This report follows from studies by previous design teams, and a more recent Peer Review of those designs. The intent of this report is to outline an optimised design solution that resolves the issues of all stakeholders, maximises the benefit from the investment of public funds, provides value for money and provides a commuter experience appropriate for the 21st century.

This report summarises the Peer Review and Value Engineering outcomes, and establishes a framework to advance the project based on benchmarking and desired project outcomes. It describes the optimised design proposal in terms of it's main components and also by discipline. It provides an assessment against the Peer Review recommendations and a discussion of buildability and costplan implications. The report concludes with recommendations on appropriate next steps.



VIEW OF UNPAID BRIDGE CONCOURSE AND STATION FROM MARION STREET



# 02 Scope of Work

Previous concept design proposals were prepared in 2007for RailCorp by Jackson Teece and Connell Wagner, and these design options are referred to as Options C, D and E. Option C was the preferred outcome.

We understand that the costs of these options at that time were assessed at [redacted] respectively (refer UDR 2007 pages 21, 29, & 31) and that none of these previous options satisfy all objectives of all stakeholders.

A Peer Review exercise undertaken by COX and ARUP in March this year explored the advantages and disadvantages of the three previous options in the context of: functionality; station operations; customer experience and broader public benefit. The review concurred that Option C was the preferable outcome over both options D and E. A range of issues and opportunities for improvement that would enhance the outcome were identified.

These opportunities have been developed and value engineered. This report outlines the revised preliminary concept design for the redevelopment of Redfern Station

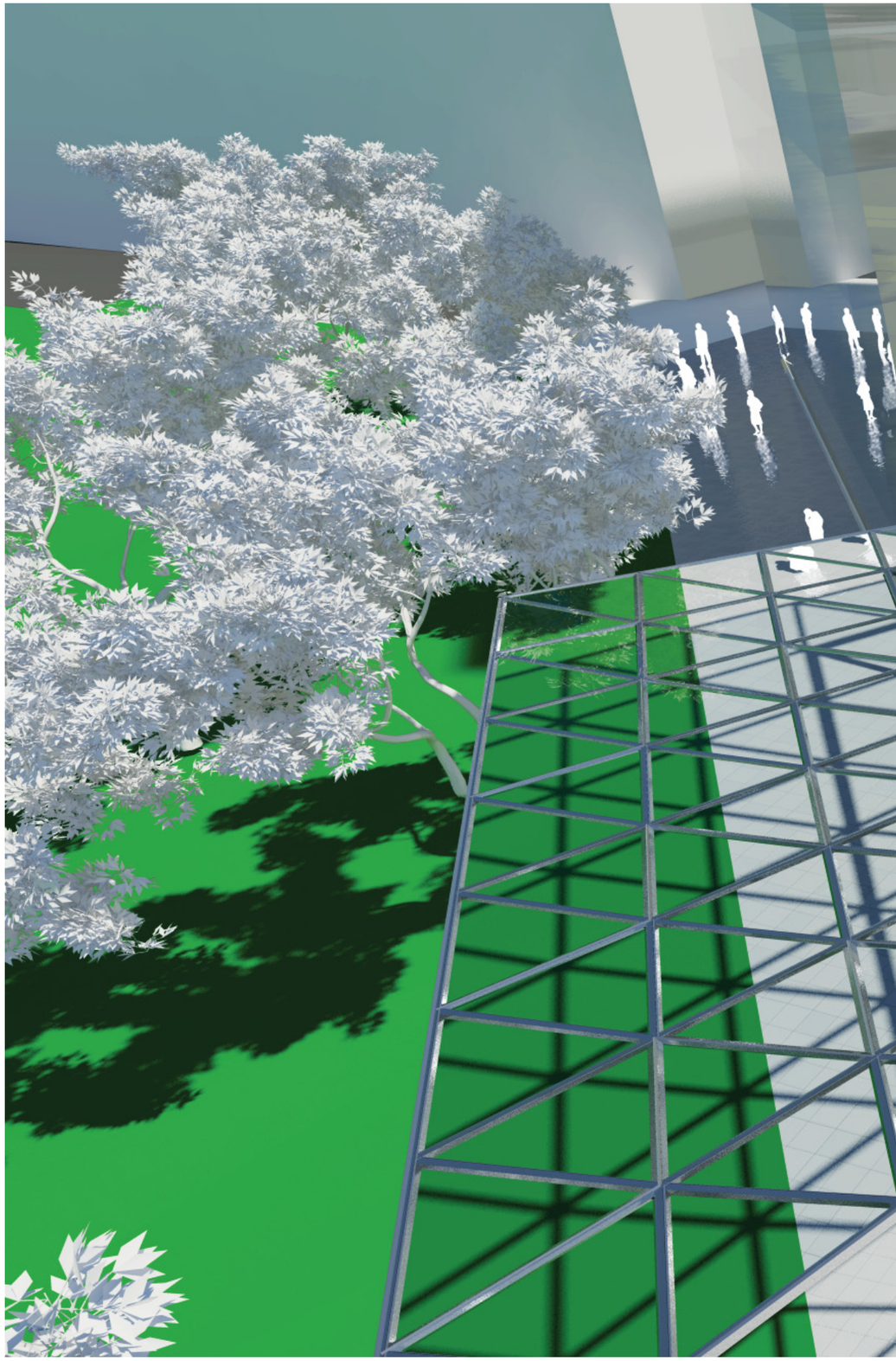
The design team for this study comprised:

- Project Management, Buildability and Cost Planning: Bovis Lend Lease Consulting
- Architecture and Urban Design: Cox Richardson Architects
- Structural Engineering, Rail Services Engineering and Crowd Modelling: Arup

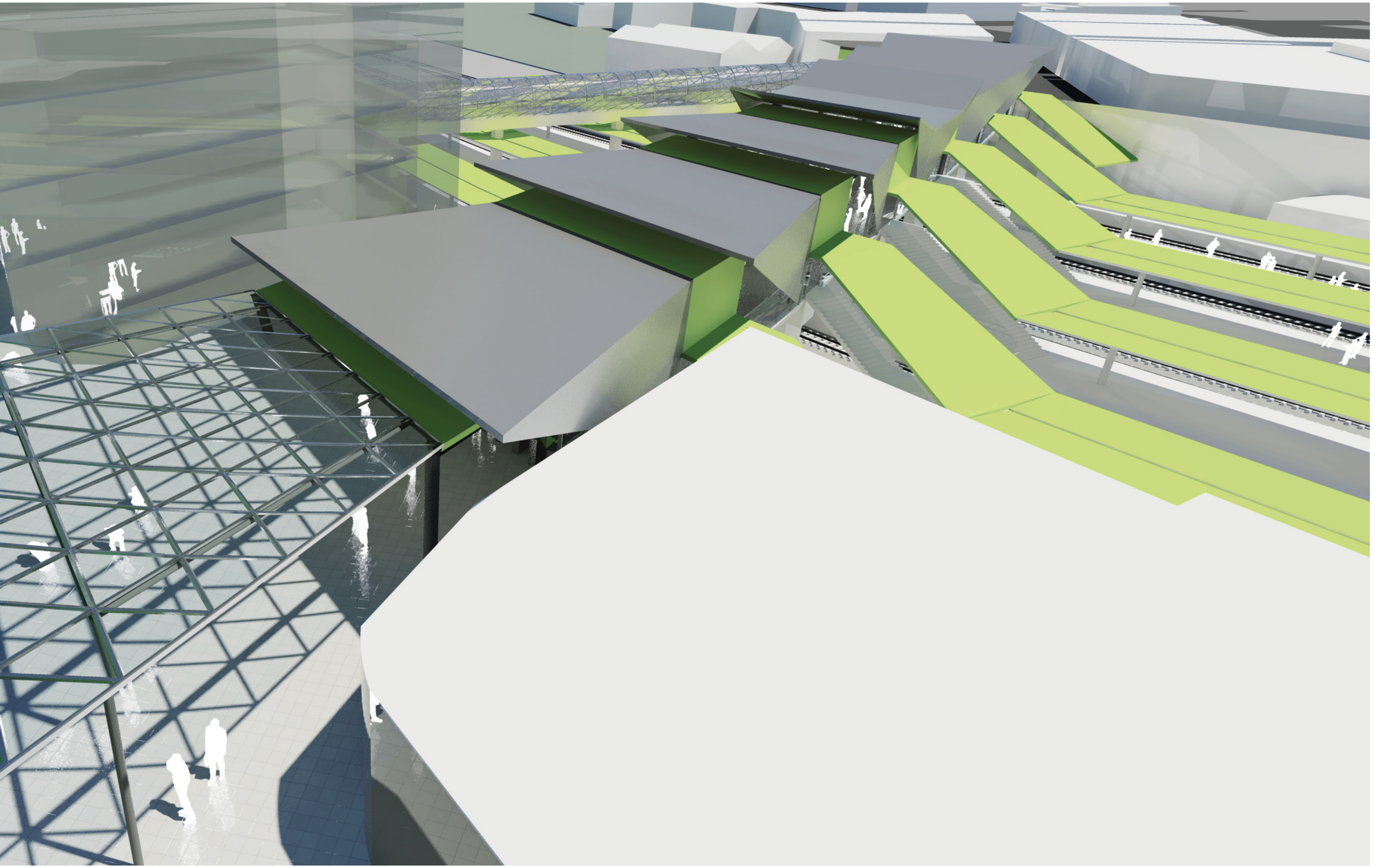
Relevant documents referred to in this report include the following:

- **Redfern Station Upgrade** – Concept Design Study - Part A - Urban Design Report April 2007 prepared by Jackson Teece and Connell Wagner (UDR 2007).
- **Redfern Station Upgrade** – Concept Design study - Part B - Engineering Report April 2007 prepared by Jackson Teece and Connell Wagner (ER 2007).
- **Redfern Waterloo Built Environment Plan** (Stage One) August 2006 prepared by the Redfern Waterloo Authority (BEP 2006).
- **North Eveleigh Concept Plan** March 2008 prepared by Urbis (NECP 2008).
- **Redfern Station Redevelopment** – Peer review of previous options C, D + E, Revision 1 – 3 March 2009, prepared By Cox Richardson Architects (PR COX 2009)
- **Redfern Station Upgrade** – (Engineering) Concept Design Peer Review Report, prepared By Arup (PR ARUP 2009)
- **Redfern Railway Station Access Review**, prepared by Morris Godding & Associates March 2009

* (excluding development costs)



VIEW OF MAIN STATION ENTRANCE ADJACENT GIBBONS STREET PARK



# 03 Background

## 03.1 The existing station & need for redevelopment

Redfern Station is one of the oldest and most integrated in the Sydney rail network. Raising levels of equitable access, fire egress, station operations and commuter experience will provide public transport infrastructure appropriate for the 21st century

Redevelopment of Redfern Station can be seen as a catalyst for urban renewal in the local area, for unlocking the growth potential of surrounding development precincts and for broader enhancement of the public realm.


## 03.2 Integration with other development projects in the area

The Redfern Waterloo Built Environment Plan (BEP 2006) outlines the Redfern Waterloo Authority vision for areas surrounding the station and how these may become better integrated.

Three key areas for future urban growth include

- Transport orientated development immediately adjacent to the station on Gibbons and Regent Streets
- The completion of the Australian Technology Park precinct
- The future North Eveleigh precinct

The existing rail corridor is the obvious major impediment to pedestrian, cycle and traffic connections. The location of future station entrances and the adjacent unpaid public bridge link are important factors in improved connection.

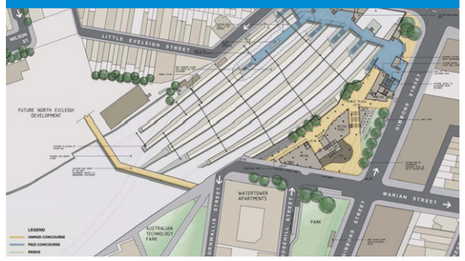
OPTION C

OPTION D

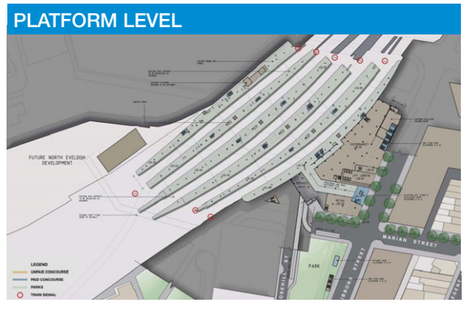
OPTION E

CONCOURSE LEVEL

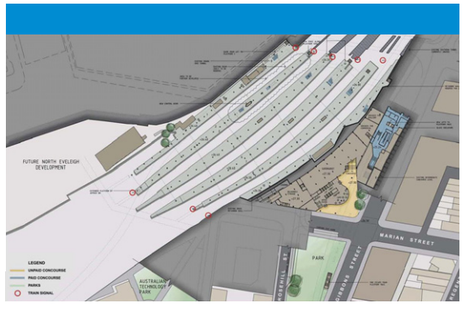





PLATFORM LEVEL








## 03.3 Summary of previous proposals by Jackson Teece

The three previous schemes prepared by Jackson Teece and Connell Wagner are referred to as Options C, D and E. They can be summarised as follows:

### OPTION C

- Option C incorporates a diagonal concourse alignment parallel to Lawson Street. A separate unpaid link runs along side this.
- Two gatelines are provided, one off the unpaid link and one within an extensive retail mall development at the eastern end of the concourse.
- This unpaid retail mall link then connects to the south and to the north and the existing station entrance on Lawson Street.
- The connection from the bridge into North Eveleigh is not indicated, however this would either need to involve demolition of the existing heritage listed Telecommunications Equipment Centre in order to make a direct connection, or incorporate a significant extent of elevated walkway around the building.
- Lifts are provided to all platforms.
- The new plaza space on Gibbons Street responds to the Built Environment Plan (BEP 2006 page 69) creating an open space at the termination of Redfern Street.
- The design assumes closure of Marion St/Cornwallis St corner.
- Only the booking office on Lawson Street station building and ventilation stacks on Platform 1 are retained. Other structures on Platform 1 that are on the State Register are removed. Platform buildings on the other platforms that are the local heritage register are removed.
- A supermarket is shown below ground.
- A triangular shaped tower floor plate is located above the retail mall and station entrance.

### OPTION D

- The existing paid concourse at the north end of the station is essentially retained with minor modification above Platforms 8/9 to provide lift access.
- An additional walkway above Platforms 2/3 positions the access stairs more centrally and with increased side clearances and other stairways are retained in similar positions but modified to varying degrees.
- Lifts are provided to all platforms but are located at the extreme northern end of the platforms
- The entrance down to the Eastern Suburbs Line platform is retained in its current position
- This option does not provide any new public unpaid east/west connection.
- The existing station entrances at Lawson Street and Gibbons Street are retained.
- There are no significant changes to the public domain
- All the heritage items within the station are retained.
- No additional commercial space is proposed

### OPTION E

- The paid concourse at the northern end of the station is retained in position and expanded in width and is consequently more generous than Option D.
- In addition there are minor modifications above Platforms 8/9 to provide lift access.
- An additional walkway above Platforms 2/3 positions the access stairs more centrally and with increased side clearances and other stairways are retained in similar positions but modified to varying degrees.
- Lifts are provided to all platforms but are located at the extreme northern end of the platforms
- The entrance down to the Eastern Suburbs Line platform is retained in its current remote position.
- Signaling is effected and requires reconfiguration.
- A separate new public pedestrian/cycle connection between the east and west sides of the rail lines is shown located further south.
- The station entrance at Gibbons St is retained in its general position and modified to slightly increase external forecourt space. This entrance also then connects to an adjacent retail mall and commercial development.
- There is a minor increase in the size of the forecourt at the Gibbons St entrance.
- There is no change to Lawson Street Bridge
- The booking office on Lawson Street and all State Heritage Register elements on Platform 1 are retained. The buildings on the other platforms that are on the local heritage register are removed.
- A supermarket is shown below ground.
- A triangular shaped tower floor plate is located above the retail mall and station entrance.

# 04 Summary of Peer Review of Previous Options

## 04.1 Process

The previous Architecture and Urban Design Peer Review and Engineering Peer Review discuss in detail the advantages and disadvantages of each of the three options. In summary the review concurred with previous assessments that in principle Option C is a preferable outcome over both options D and E.

Issues and opportunities related to Options D and E are not summarised here, but were identified and discussed in the Peer Reviews.

The following is a brief summary of some of the key issues raised in the Peer review as regards Option C. Refer to the original Peer Review Reports for more detail.

## 04.2 Architecture & Urban Design

The Architecture and Urban Design Peer Review identified areas where Option C could be improved, including the issue of costs where it is understood that the construction cost is viewed as too expensive in its current form.

Opportunities for improvement to Option C may not only reduce cost and improve value for RailCorp and rail users, but also provide a superior outcome in terms of urban design, station address, legibility, heritage impact, the unpaid east/west linkage and the quality and viability of the commercial development on Gibbons Street.

The following table compares Options C, D and E in terms of selected criteria. The references noted under each issue relate to text sections in the Peer Review report.

The key issues and potential areas of improvement for option C can be summarised:

### OPTION C
### Key Issues

- The diagonal concourse configuration results in a large amount of OHW gantry amendments.
- Longer than a concourse perpendicular to the tracks.
- In effect 2 separate bridges - paid and unpaid, hence expensive and disruptive.
- Poor urban design at eastern entry to concourse and bridge, poor legibility & way finding.
- Unresolved at western connection to Little Eveleigh Street.
- No resolution of fire egress at end of platforms.
- Cost of removing most heritage structures.

### Potential improvements

- Explore concourse perpendicular to tracks.
- Explore combining paid concourse and unpaid bridge in one structure.
- Improve Gibbons Street development urban design.
- Explore means of retaining Lawson Street and stairs for fire egress.
- Improve connectivity at western end to Little Eveleigh Street and a station entrance on this western side.

| Review Criteria | Option C | Option D | Option E |
|---|---|---|---|
| **Urban Design** (Refer 2.1.3, 2.2.3 & 2.3.3) | Average | Poor | Poor |
| **Visible Station Entrance** (Refer 2.1.2, 2.2.2 & 2.3.2) | Poor | Average | Average |
| **Clarity of Station Planning** (Refer2.1.1, 2.2.1 & 2.3.1) | Good | Poor | Poor |
| **Sight Lines / legibility** (Refer 2.1.1, 2.2.1 & 2.3.1) | Average | Poor | Poor |
| **Equitable Acess** (Refer appended Accessibility Report) | Good | Unacceptable | Unacceptable |
| **Passenger Amenity – Comfort – Security** (Refer 2.1.3, 2.2.3 & 2.3.3) | Good | Poor | Poor |
| **Travel Distance from Key Destination** (Refer 2.1.2, 2.2.2 & 2.3.2) | Good | Average | Average |
| **Heritage Impact** (Refer 2.1.4, 2.2.4 & 2.3.4) | Poor | Good | Good |
| **Provisional Unpaid Link Across Tracks** (Refer 2.1.3, 2.2.3 & 2.3.3) | Average | Unacceptable | Poor |
| **Quality Development Around Station** (Refer 2.1.5, 2.2.5 & 2.3.5) | Poor | Unacceptable | Poor |
| **Value for Money** (Extrapolated from above) | Average | Poor | Poor |

References noted above are sections from COX Peer Review 2009

## 04.3 Accessibility

The Morris Godding Accessibility review concluded that Option C was the preferred outcome in terms of DDA compliance. Options D or E were viewed as exposing Railcorp to risk under DDA.

## 04.4 Engineering

### Civil/Structural Engineering

Arup conclude that the proposed Option C structural solution generally provides an effective solution to constructability, durability and fire resistance issues. Key comments and issues include:

- The general approach of a precast concrete concourse structure over in situ platform support structures is appropriate and valid.
- The separation of the paid and unpaid concourses in Option C increases the scope of construction work and maintenance over the live railway corridor.
- A more perpendicular concourse alignment would reduce spans and hence member size and lift weight,
- The butterfly awnings steel framing and support and concourse roof and side wall framing appear reasonable
- The restriction on construction of piled foundations to beyond 2.6m of the platform edge is not considered valid.
- In terms of the two options provided for the support of the commercial building development over the Illawarra Relief, Option A is preferred due to its reduced impact on the rail corridor beneath
- The temporary construction access bridge costing should allow for design to the ESC320 and AS5100 - assuming that a waiver could not be obtained for a footbridge on this scale.

### Fire Engineering

- The location of the required two new emergency stairs from Platforms 11 and 12 does not appear to have been co-ordinated in Option C.
- The calculation of passenger numbers, waiting to board a train prior to an emergency is not clear.
- The methodology for estimating the time to clear the platform appears to be incorrect
- The provision of evacuation plans on platforms is considered to be ineffective
- The STEPS simulation carried out for Option C may not adequately model the occupant scenarios.
- Option C provides the better option for evacuation from above ground platforms, because it has extra stair width.
- The two 2 m wide stairs from each of the platforms above ground may not achieve the egress times stated.
- It is recommended that the existing stairs be retained, in addition to providing the new stairs, to provide the maximum practicable exit width capacity from the platforms.

### Rail Systems Engineering

- The recommendation that new station substations are required appears reasonable, although the maximum demand and required kVA of the substations needs to be verified.
- OHW in Option C is not supported by the new concourse. Arup recommend exploring a bridge deck design specifically designed for constructability and maintainability, while supporting the OHW.
- Of the three options for achieving visibility of Signal SY455 by southbound trains on platform 1, obstructed by the concourse (in Option C), relocation of signal SY approximately 20m towards Central (Option 1) or redesign of the profile of the signal to reduce the overall elevation (Option 2) are both considered practical. Relocation of the signal onto a post-mounted structure on platform 1 (Option 3) is considered impractical.
- Extension of platform 9 towards Central is considered impractical because Signal SY466 cannot be moved more than 1m towards Central

### Summary of key issues and potential areas of improvement

The Engineering Peer Review concluded that the key issues that should be addressed in the revised concept design are as follows:

- Pursuit of reduction in extent and area of concourse structure built over the rail corridor
- Investigation of design to reduce the effects on existing OHWS, and minimise the replacement works that result
- Removal of BOH and toilets, and resulting services, over the live rail corridor
- Clarify requirements to provide level access on platforms within the scope of this project (consideration of network track works that are currently planned)
- Review of evacuation egress capacity for the station, including platforms 11 and 12
- Clarification of compliance with FLS standards
- Clarification of maximum demand calculations
- Relocated position of signal SY455

# 04 Summary of Peer Review of Previous Options

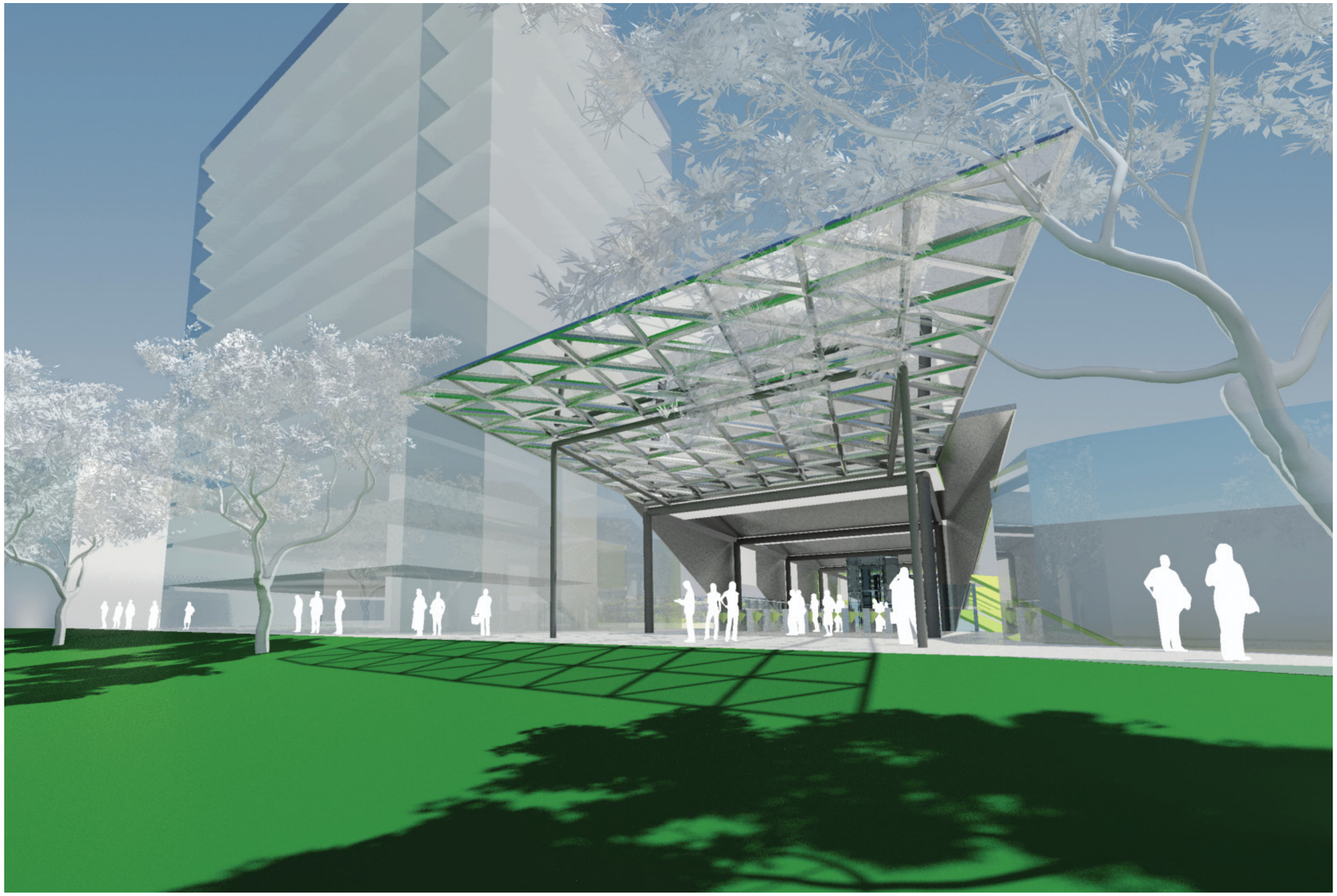
## 04.5 Crowd Modelling

Arup reviewed the approach adopted to analyse Options C, D and E, and the performance of the proposed options. Following this process, Arup revised the modelling assumptions with respect to VT flow rates, and conducted a revised analysis of the options. This exercise focussed on the vertical transportation requirements to meet a 90 seconds platform clearance time, a criteria stipulated by RailCorp.

The analysis of the VT provision performance proposed within Option C identified that the platform clearances times for P1, P2/P3 and P10 (for travel to P11/P12) were above the 90 seconds maximum criteria.

However, understanding the constraints in platform space, especially for Platform 2/3, Arup recommended further investigation into design modifications that seek to create a more efficient balance of VT provision, as follows:

- Maintaining the existing stairs at the northern end to manage interchange flows and to minimise platform clearances and bi-directional conflicts on stairs
- A mixture of stairs and escalators where possible, to assist in efficiently managing the flows, whilst maintaining the appropriate spatial clearances form platform edge to any obstruction
- Additional VT on P10, or preferably via an alternative passage for P11/P12 passengers given the potential for P10 to be an operational platform in the future
- Any VT provision needs to be balanced with the station as a whole. P1 would benefit from more VT but with adverse affects to other platforms (primarily P2/P3). Therefore VT needs to be driven by weakest link.
- Except P1 clearances above 90 seconds given train frequency. Look to maximise clearances off P2/P3 by maximising stair width (requiring a concession if necessary).



VIEW OF STATION ENTRANCE FROM GIBBONS PARK

# 05 Value Engineering of Previous Option

In order to create the best value for the Redfern Station Redevelopment, initial value engineering study and associated workshops were undertaken.

In summary the review of relevant documentation and new work undertaken including value engineering workshops held by BLLC with the design team resulted in 22 value engineering items that were reviewed and investigated. These items generated alternative design solutions which are considered to be in accordance with RailCorp's user requirements.

These 22 items had the potential to achieve cost reductions, shorten construction durations, enhance building value, enhance customer experience, increase safety of construction and maintenance works and increase value to the customer. The proposed possession timetable has the highest impact on the construction method, the concourse alignment has the highest impact on the design and the car park, retail buildings and enabling works have the highest impact on procurement strategy or staging.

The table provides an overview of the value engineering items and their rankings. The items are fully described in the Value Engineering report - Draft version 2, 20090306. (refer appendix 5)

| Value engineering item | | Cost | Construction Duration | Safety | Project risk |
|---|---|---|---|---|---|
| **Construction items** | | | | | |
| 1 | Possession timetable | H | H | H | H |
| 2 | Temporary crash deck | H | H | H | M |
| 3 | Temporary construction bridge | M | M | M | L |
| 4 | Temporary control rooms on platforms | H | H | L | L |
| 5 | Type of concourse construction | H | H | M | L |
| 6 | Use of unused southern rail tunnel | L | L | N/A | L |
| 7 | Effect of Metro West exclusion zone | M | L | L | L |
| 8 | Extent of strengthening works on existing platform 11/12 | M | M | H | M |
| 9 | Stair construction | M | M | M | L |
| **Design items** | | | | | |
| 10 | Impact on OHW (structures) / Concourse alignment | H | H | H | H |
| 11 | New control rooms on platforms | H | H | L | L |
| 12 | Platform level raising | H | H | H | H |
| 13 | New canopy structures | M | H | M | L |
| 14 | Extent of demolition works | L | L | L | L |
| 15 | Location of main offices | M | M | L | L |
| 16 | Concourse supports on platforms | M | M | L | L |
| 17 | Extent of supports on platforms | L | M | L | L |
| 18 | Unpaid pedestrian link over train lines | L | M | L | L |
| **Procurement strategy items** | | | | | |
| 19 | Station ticket gates | H | N/A | N/A | N/A |
| 20 | New substations | H | N/A | N/A | N/A |
| 21 | Extent of commercial development works required by RailCorp | H | M | L | L |
| 22 | Carpark and retail buildings | M | M | M | L |

# 06 Principles of Modern Railway Stations

## 06.1 Introduction

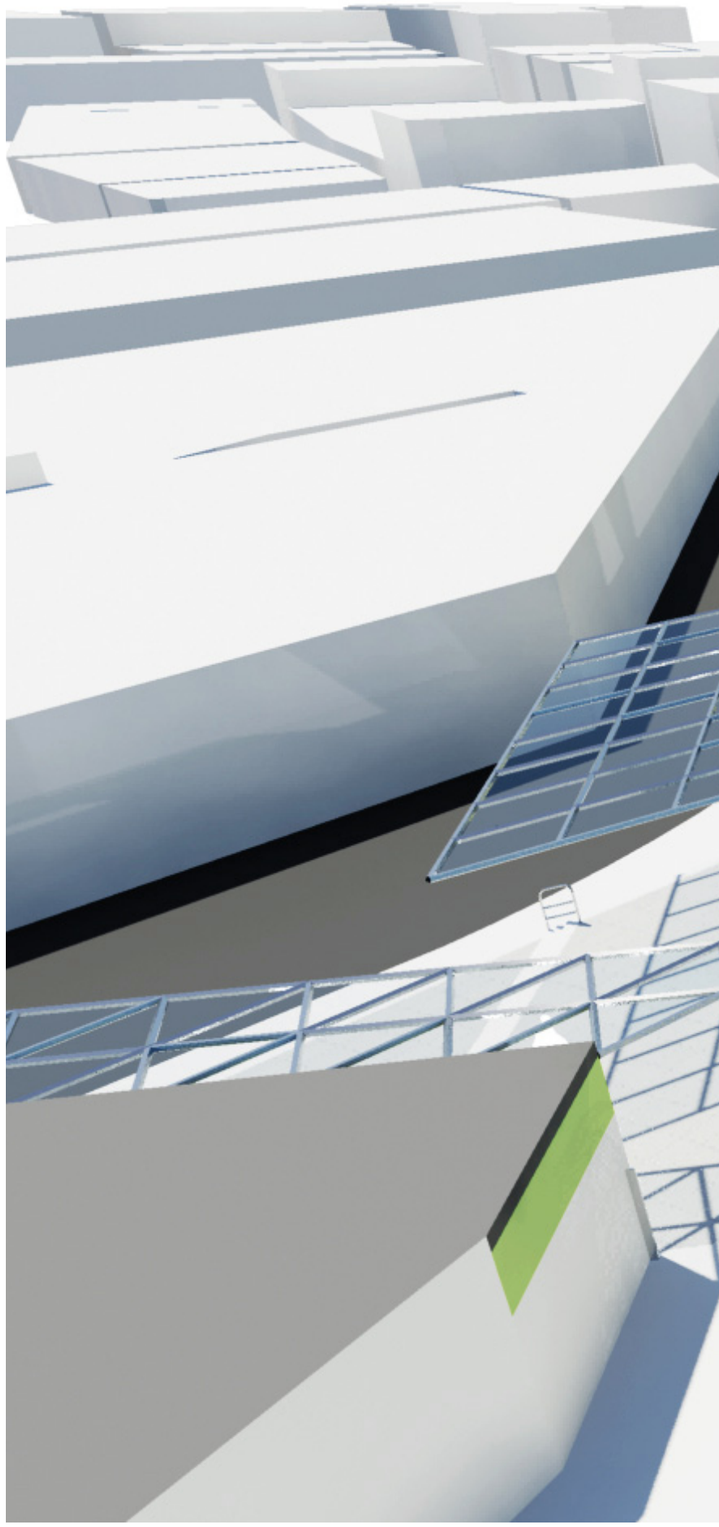
In establishing a brief for redevelopment of Redfern Railway Station it is useful to review this in the context of a generic framework of design objectives that typically apply to contemporary station infrastructure. The following objectives are proposed by the design team as benchmark aspirations:

## 06.2 Urban Design Objectives

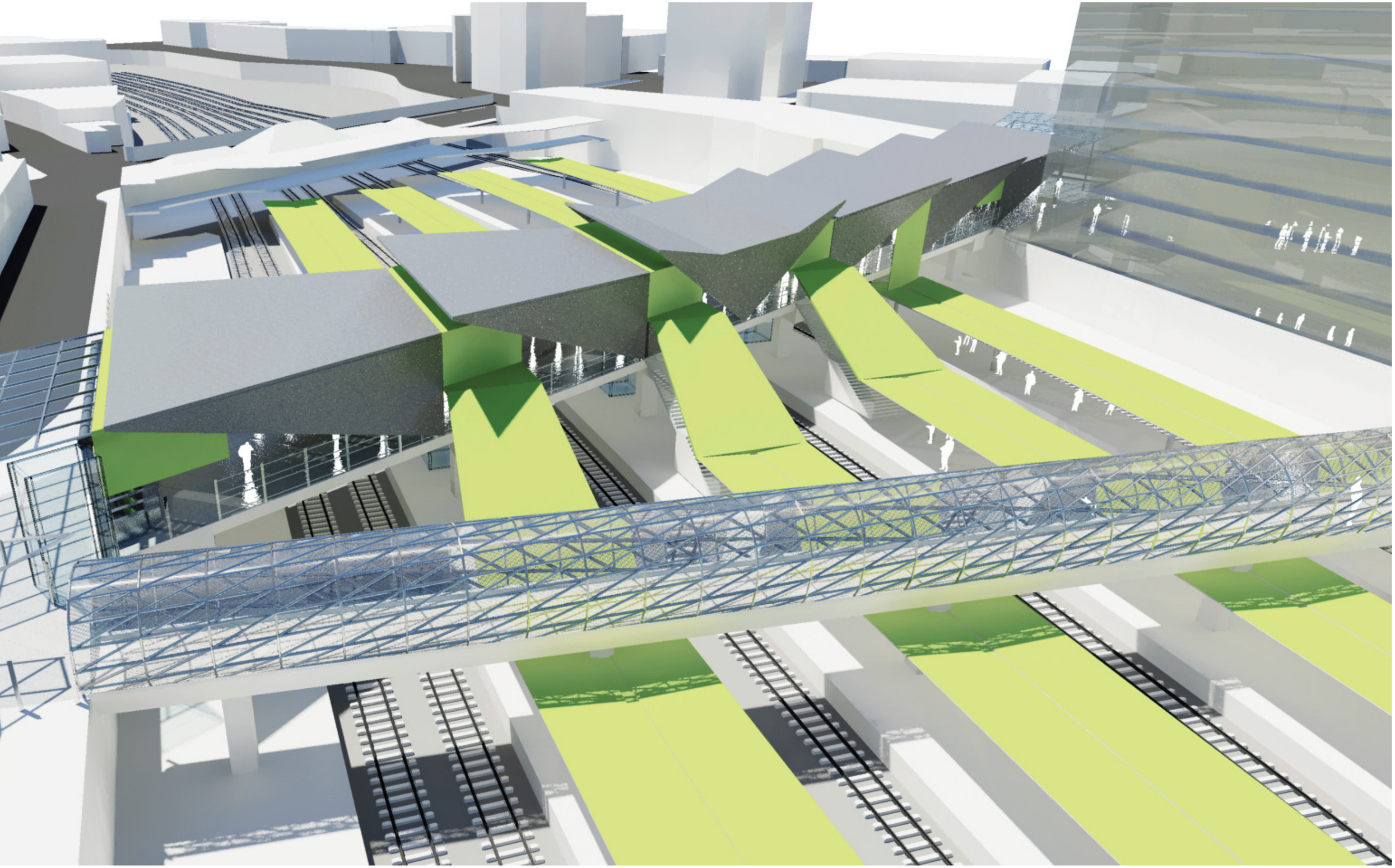
- Integrate the design of station facilities with the current and future urban context
- Create a high quality, positive addition to the public domain
- Integrate with the existing bus network
- Encourage walking, cycling and bus usage by creating good access to all customers, through the urban design of the station precinct and careful integration of the station precinct within the local area
- Create a gateway to the station and a memorable sense of place for the local community which is attractive, contemporary and welcoming
- Create appropriate opportunities for transit-oriented development, including the intensification of centres for employment and housing consistent with the NSW Government Metropolitan Strategy for Sydney
- Take due consideration of the urban design strategies and development controls of local government including BEP 2006
- Achieve a good fit of the station precinct with the surrounding land uses and circulation networks (both current and future) in a manner that will minimize adverse environmental and social impacts
- Incorporate in the urban design strategies to bring “life” to the station precinct and to provide a viable link to the surrounding local community
- Consider the process of transition as the urban context around stations evolves from the existing state to a future configuration
- Incorporate flexibility and adaptability in the station precinct design to accommodate future changes in patronage levels and land use types and densities

## 06.3 Architectural Objectives

- Deliver design excellence achieved through elegant, uplifting, and memorable architecture
- Maintain consistency and elegant simplicity in the architectural planning and detailing
- Wherever possible ensure compliance with functional and operational requirements
- Produce an architecture of civic presence, as befits the role of Redfern Station as a community focal point
- Infuse a sense of light and permeability in the architecture
- Respond sensitively to the current and likely future built environment of the station
- Design all elements with an appropriate human scale
- Encourage innovation
- Generate an architectural expression of a world-class transport system that is streamlined, comfortable, efficient, and contemporary
- Express the sense of place
- Provide a high level of environmental comfort conditions for all customers
- Balance core operational and customer needs
- Facilitate a customer journey that is seamless and intuitive from trip origin to destination
- Provide equity of access for all types of customers
- Adopt relevant design initiatives to achieve a sustainable design for the whole of life for the facility
- Design in a manner that is constructible, maintainable, safe, and provides the necessary operational flexibility
- Optimize in the architectural design “whole of life” cost benefits
- Enable delivery of the project within budget and program



VIEW OF STATION ENTRANCE ON LITTLE EVELEIGH STREET



## 06.4 Selected case studies exemplar projects (local/overseas)

Case studies of benchmark projects both within Australia and overseas can serve to illustrate the qualities of contemporary world class transport systems. Observations and lessons learnt from benchmark case studies can provide useful parameters for assessment and comparison of the proposed design.

A separate benchmark study was not part of the project scope and the following shortlist of projects is not intended to be exhaustive. However the selection provides a degree of context and serves to illustrate relevant issues and opportunities.

At this early stage of the design for Redfern Station, key issues for consideration include:

- Spatial organisation allowing safe, efficient and comfortable movement
- Simplicity with clearly defined paths allowing intuitive wayfinding
- Customer amenity that enhances the station experience
- Urban design creating a landmark that integrates with and enhances with the broader urban environment
- Commercial opportunities appropriate to station context

The selected project address the following relevant issues:

### 06.4.1 Epping

- Recent local pavilion style building elevated over main north line tracks
- Links east and west Epping across a major roadway

### 06.4.2 Parramatta

- Recent local major interchange station redevelopment

### 06.4.3 Chatswood

Recent local major interchange station redevelopment

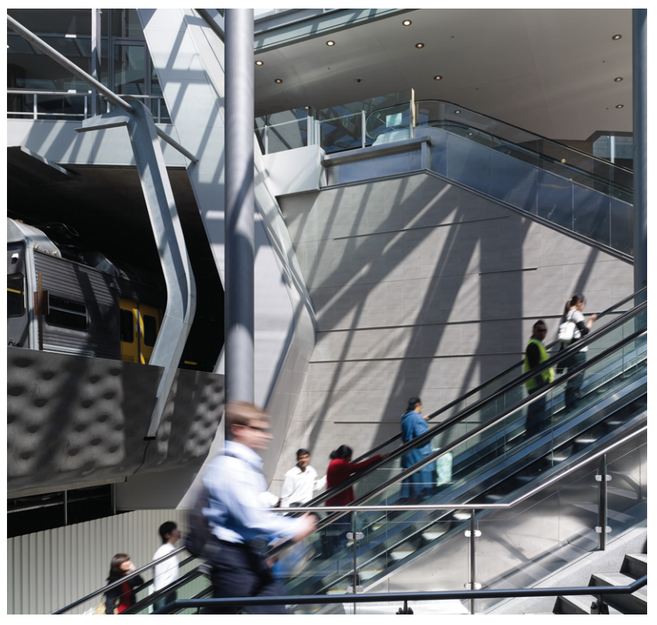
- Strongly reconnects east and west Chatswood
- Integration with retail and transport orientated development

### 06.4.4 Joondalup

An open station connected to the broader environment

- Prominent roof structure allows sheltered natural ventilation



### 06.4.5 Southern Cross

Recent major station redevelopment that resolved pedestrian access issues

- Iconic roof treatment

### 06.4.6 Subiaco

Pavilion style station with multiple entry points

- Successful urban regeneration catalyst
- An integrated civic development

### 06.4.7 Bochum Metro / Rathaus Sud station

Recent overseas example incorporating skylights to below ground station

- Contemporary architectural treatment

### 06.4.8 Munich U-Bahn / Oberwienenfield Station

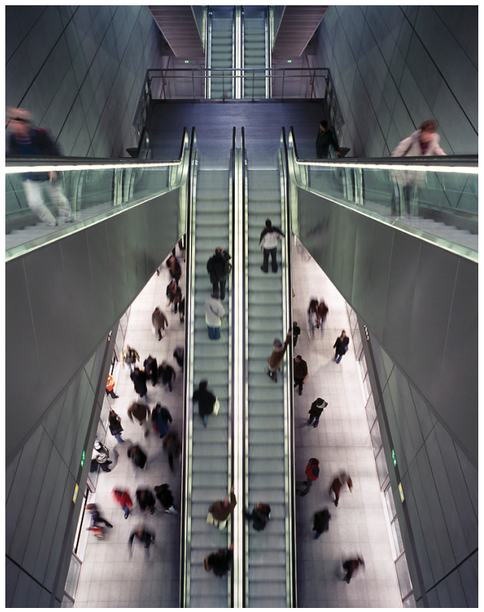
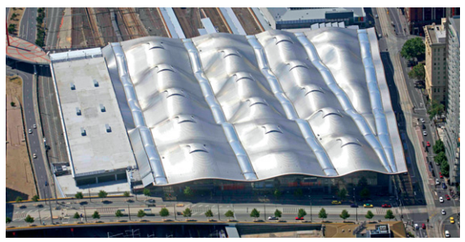
Recent overseas example incorporating skylights to below ground station

### 06.4.9 Copenhagen / Christianshavn Station

Recent overseas example incorporating skylights to below ground station





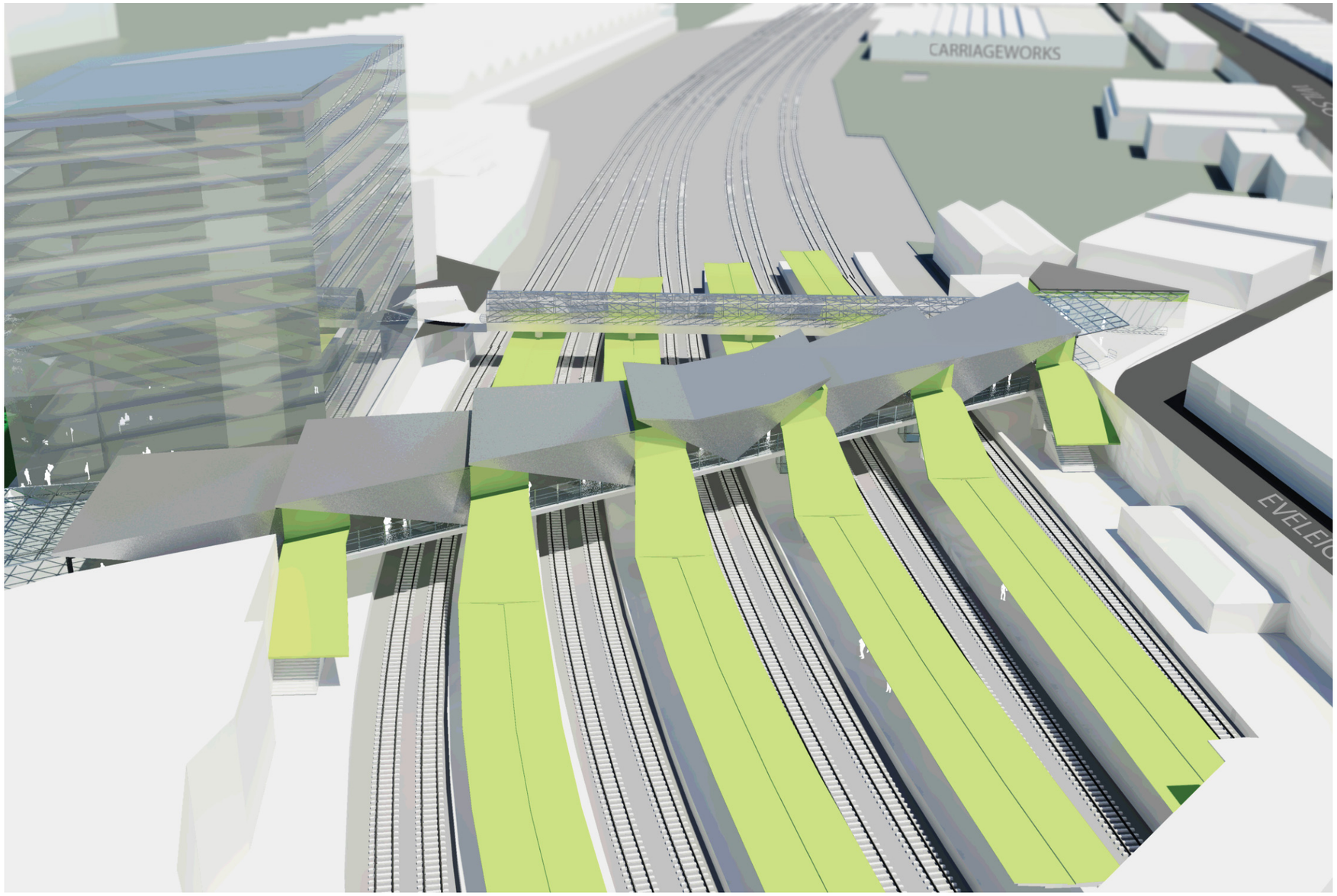




# 07 Decision Making Framework for Design Options

The intent of this report is to provide Railcorp with the sufficient information on the design proposals viability, implications and anticipated benefit. Criteria by which the proposal may be assessed include the following:

- Compliance with Railcorp and other standards
- Functional response
- Public benefit
- Cost
- Time




AERIAL VIEW OF STATION LOOKING SOUTH

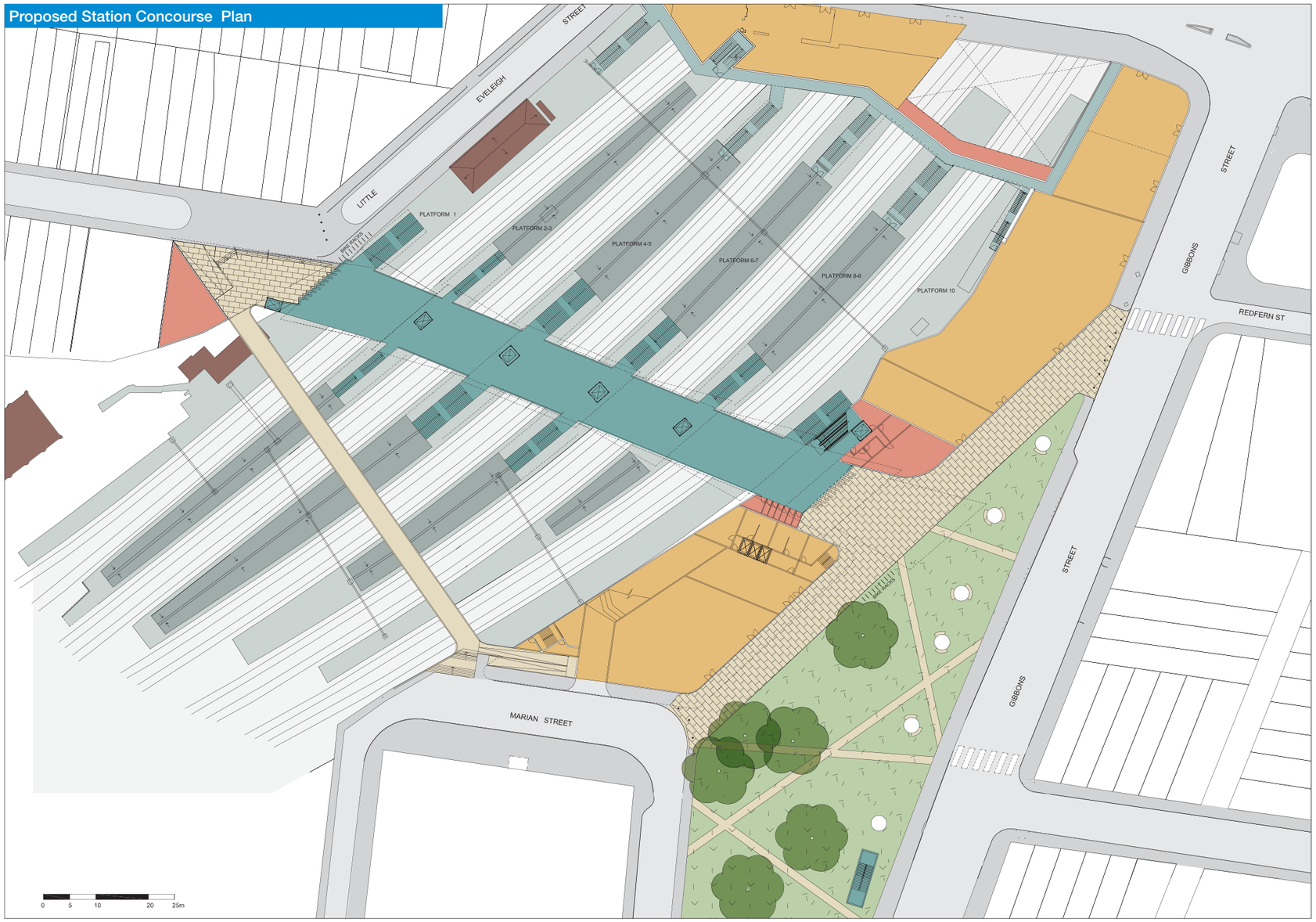
# 08 Proposed Revised Concept Design

## 08.1 Overall station vision to 2061

As one of the busiest stations in the Sydney region, the proposed long term vision for redevelopment of Redfern Station is for:

- A high quality, efficient, well organised and contemporary, example of public transport infrastructure
- a building that is easy and enjoyable to use, that will encourage growth is in public transport usage and cater to anticipated patronage up to 2061 and beyond
- generation of a fresh perception of Redfern Station
- a building that is responsive to and expressive of its physical, historical, environmental and social context
- station entrances that are clearly legible in the urban context
- a development that enhances the public domain around it, including the provision of new pedestrian connections
- a catalyst to encourage transport oriented development in the surrounding precincts and urban renewal in the broader context.
- a project that represents a sound long term investment and value for money for the people of NSW

**Proposed Station Concourse Plan**



## 08.2.2 Urban Design

### 08.2.2.1 Address

Customer experience and customer convenience are factors that have influenced the overall station design and in particular the proposed location of station entrances.

Studies by Arup have determined the existing and projected customer destinations points around the station. Dominant destinations include the ATP precinct to the south-east and University/North Eveleigh precinct to the west of the station. Demand levels to the east and north of the station are currently, and will continue to be, less significant.

### 08.2.2.2 Lawson Street

The existing Lawson Street Station entrance is very constrained due to the narrowness of the road and footpath. The immediate streetscape is inactive and has limited opportunity to improve due to heritage constraints, traffic requirements, and the requirement for safety barriers at the kerb line. (Refer Diagram 1)

### 08.2.2.3 Propoesed Entrances

The revised concept incorporates **two entrances** to the station. One on the south-eastern side addressing Gibbons Street and one the north western side addressing Little Eveleigh Street. These provide **direct access** to the dominant destination points without constraint on access to the broader area. They also provide the opportunity to improve amenity and re-define perceptions regarding the character of the station. (Refer Diagram 2)

### 08.2.2.4 Gibbons Street

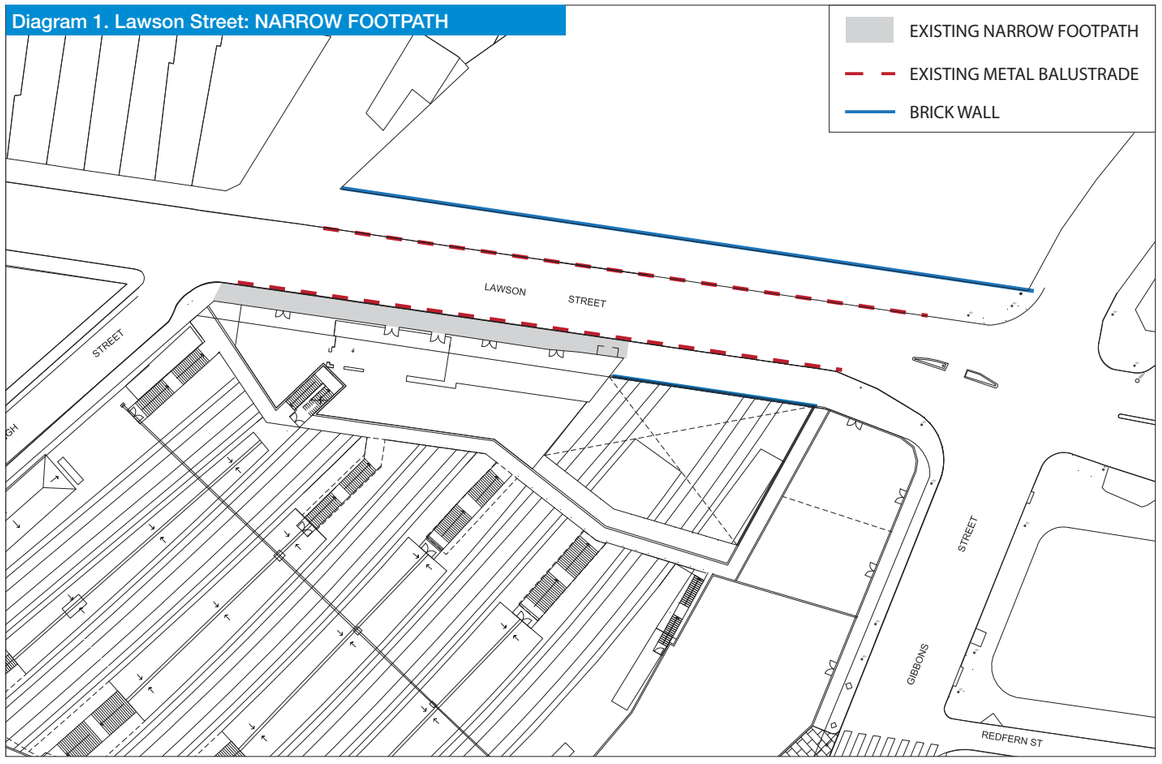
The Gibbons Street address is linked to the proposed northern extension of the existing parkland, providing the opportunity to create a more formal “Civic” address. Being relatively sheltered from the heavy winds that effect the Lawson Street ridgeline, this public space will provide increased public amenity and benefit from the activity generated by the station. The intent is that the Station entrance is distinct and strongly expressed in the Gibbons Street streetscape. A pedestrian connection to Redfern Street is provided along the edge of the park. (Refer Diagram 3)

### 08.2.2.5 Little Eveleigh Street

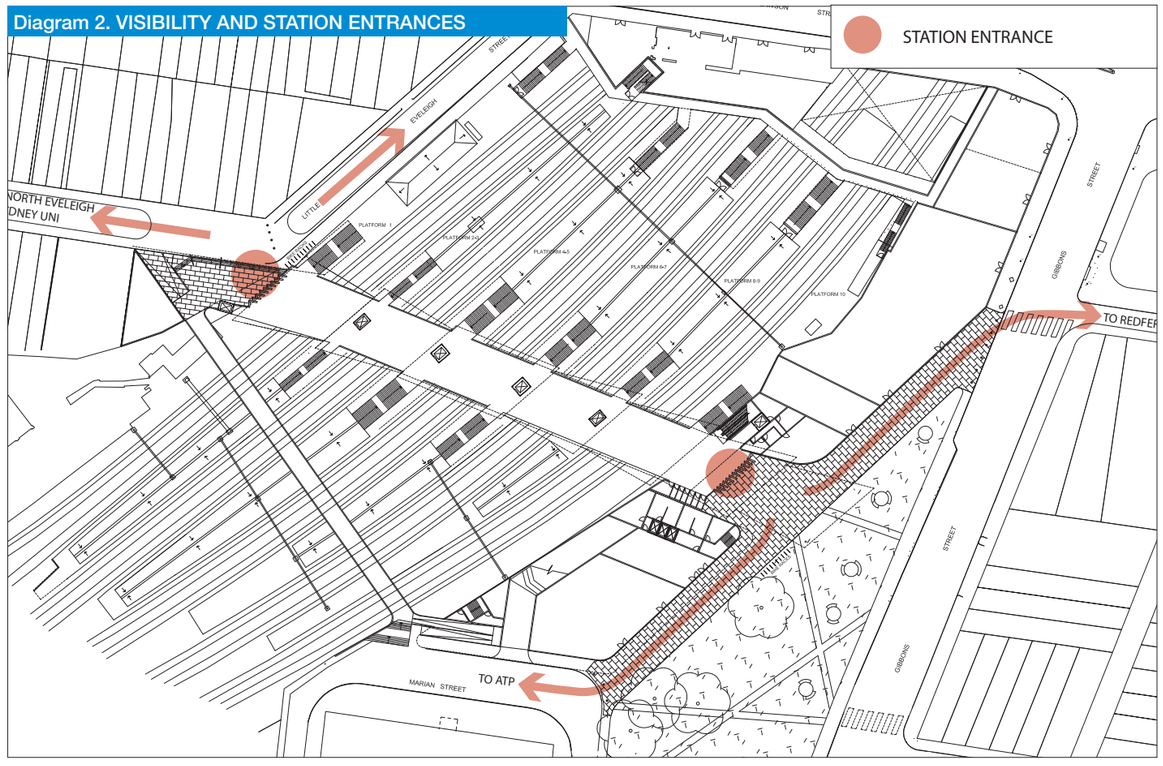
The Little Eveleigh Street address provides direct connection through to both Wilson Street to the south-west and Lawson Street to the north-west, thereby serving both existing and future customer patronage. Little Eveleigh Street would become as a minimum a “traffic calmed shareway”, and could potentially be fully pedestrianised. It has the potential to develop as a vibrant street and increased pedestrian movement will improve passive surveillance and safety in the area. (Refer Diagram 3)

At this stage it is assumed that both entrances would incorporate ticket vending machines and ticket counters.

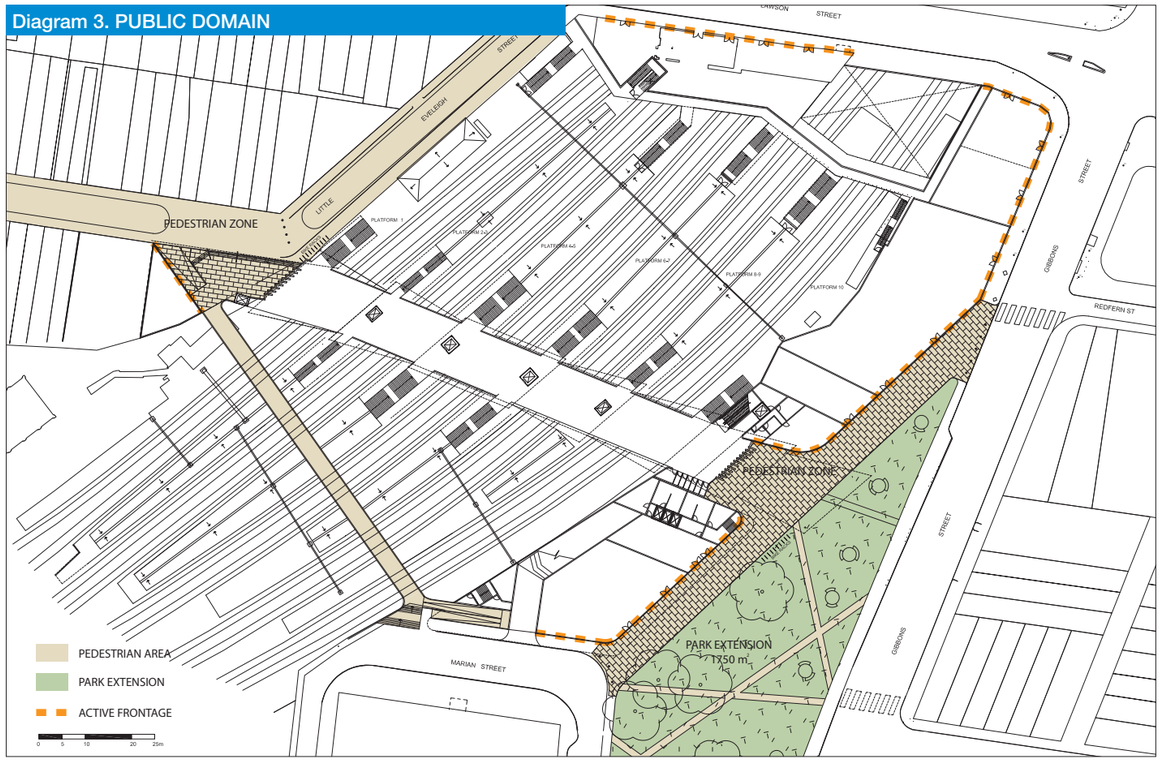
**Diagram 1. Lawson Street: NARROW FOOTPATH**



## Diagram 2. VISIBILITY AND STATION ENTRANCES




## Diagram 3. PUBLIC DOMAIN



## 08.2.3 New Paid Concourse

### 08.2.3.1 Alignment

The proposed new paid concourse provides more centralised access to all platforms thereby increasing the efficiency of passenger movements and station operations.

The new proposed alignment of the concourse has been optimised within existing constraints resulting in a slightly reduced built area and permitting an improved address outcome on Gibbons Street. (Refer Diagram 4)

### 08.2.3.2 OHW

The alignment also reduces the impact on existing Overhead Wiring & Signalling (OWS) with assumed advantages in buildability and construction cost. (Refer Diagram 6)

### 08.2.3.3 Platform 1-10 Access

Due to the constrained existing platform widths, access down to platforms 1-10 is via stair and lift. Stair widths vary based on achieving a minimum 2700mm clearance to platform edge.

### 08.2.3.4 Lift Access

Lift shafts on platforms 2+3 and platforms 8+9 are the most constrained but preliminary lift supplier advice is that a DDA compliant lift could be provided within a total overall external width of 2100mm. These more compact lifts are therefore assumed to have a 13 person capacity in comparison to the more standard 24 person lifts proposed on other platforms. Rectangular fully glazed lifts are assumed consistent with recent major station developments at Chatswood and Parramatta. (Refer Diagram 5)

### 08.2.3.5 Platform 11+12 Access

Access down to Illawarra relief platforms 11+12 is via escalators and lifts down to the existing Mezzanine Concourse and platform 10 level, and then dropping down more central on the platform than the existing arrangement.

The Mezzanine Concourse level could potentially be extended underneath Gibbons Street to a future retail development of the eastern side. This would be a “paid” link requiring a separate station entrance and gateline on the other side of the road.

### 08.2.3.6 Concourse Building Form

The main concourse is proposed as a sheltered naturally ventilated space using overlapping roof forms to create clear-storey spaces to take advantage of fresh air and daylight. The roof forms open away from the centre of the concourse toward the entrances at each end. Fixed glazed screens on the concourse edge allow views down to platform level.

### 08.2.3.7 Concourse Width

Subject to more detailed crowd modelling studies in future stages, Arup have advised a concourse width of 12metres will accommodate projected capacities with appropriate run off clearances for stairs and lifts. (refer to section 08.3.1). (Refer Diagram 7)

Finishes are proposed to be high quality durable that provide long term value for money. Internal wall and ceiling finishes include insulated metal panelling with the potential for acoustic insulation.

The concourse is close to existing ground levels requiring only minor 1:20 ramps at each end.

**Diagram 4. PAID CONCOURSE ALIGNMENT**

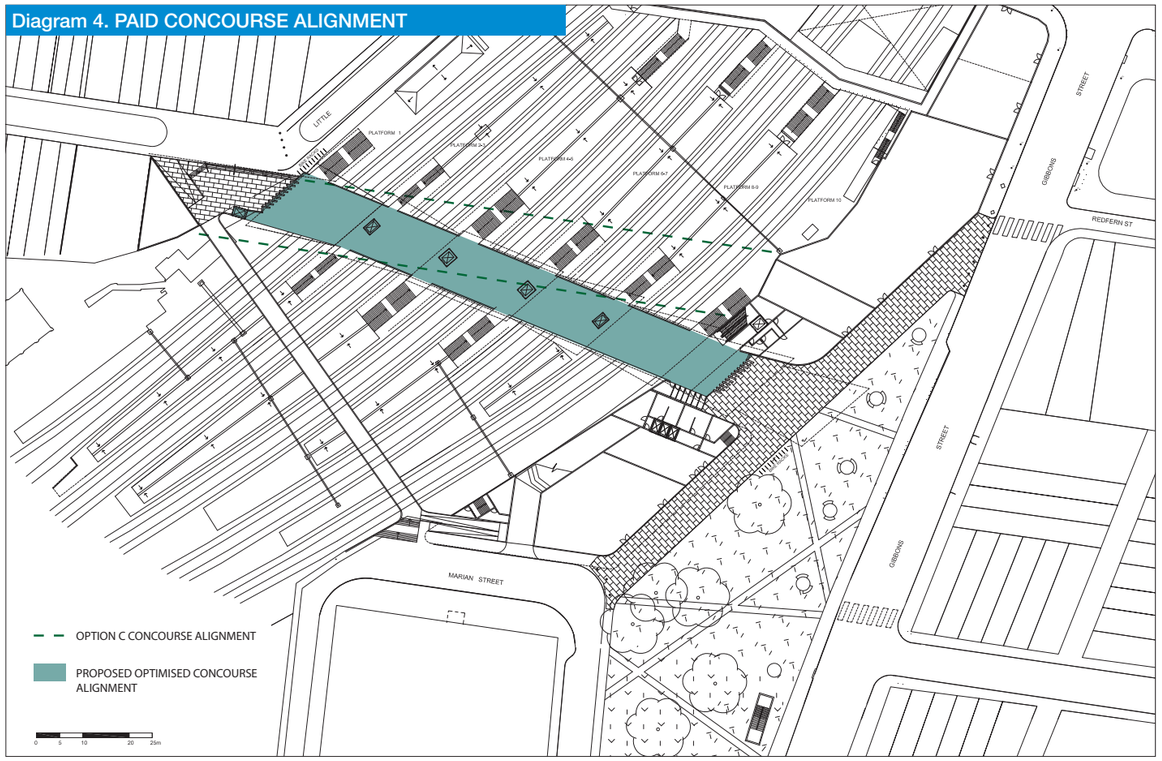
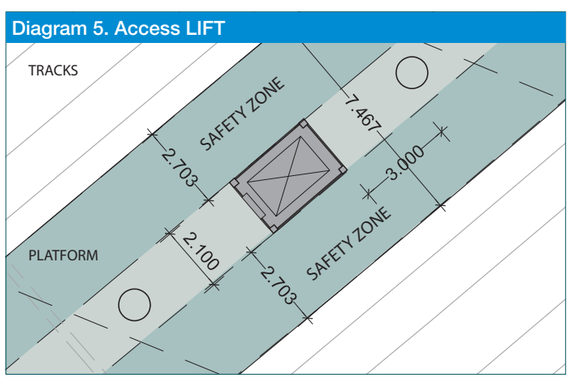
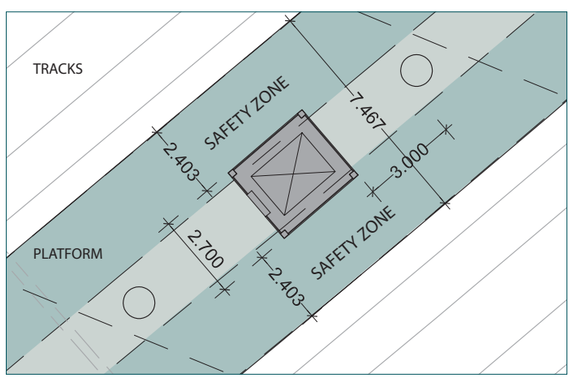



**Diagram 5. Access LIFT**

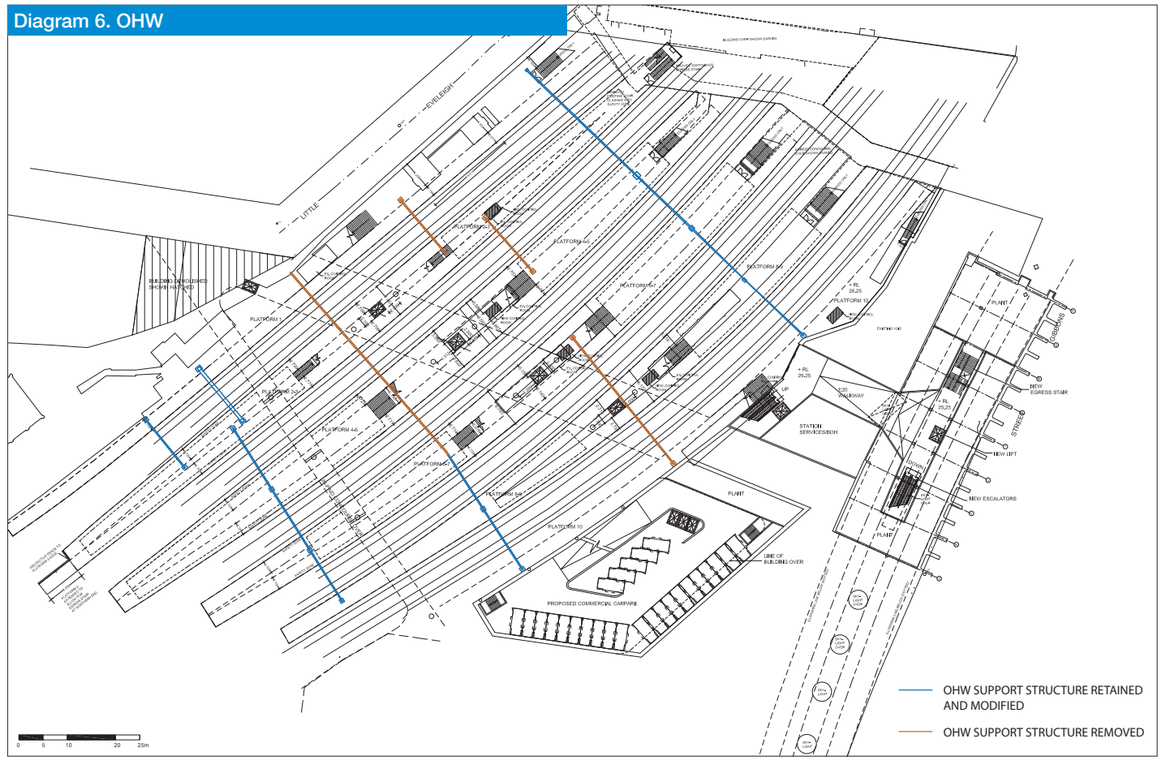



NARROW LIFT OPTION 2.7m SAFETY ZONE CLEARANCE

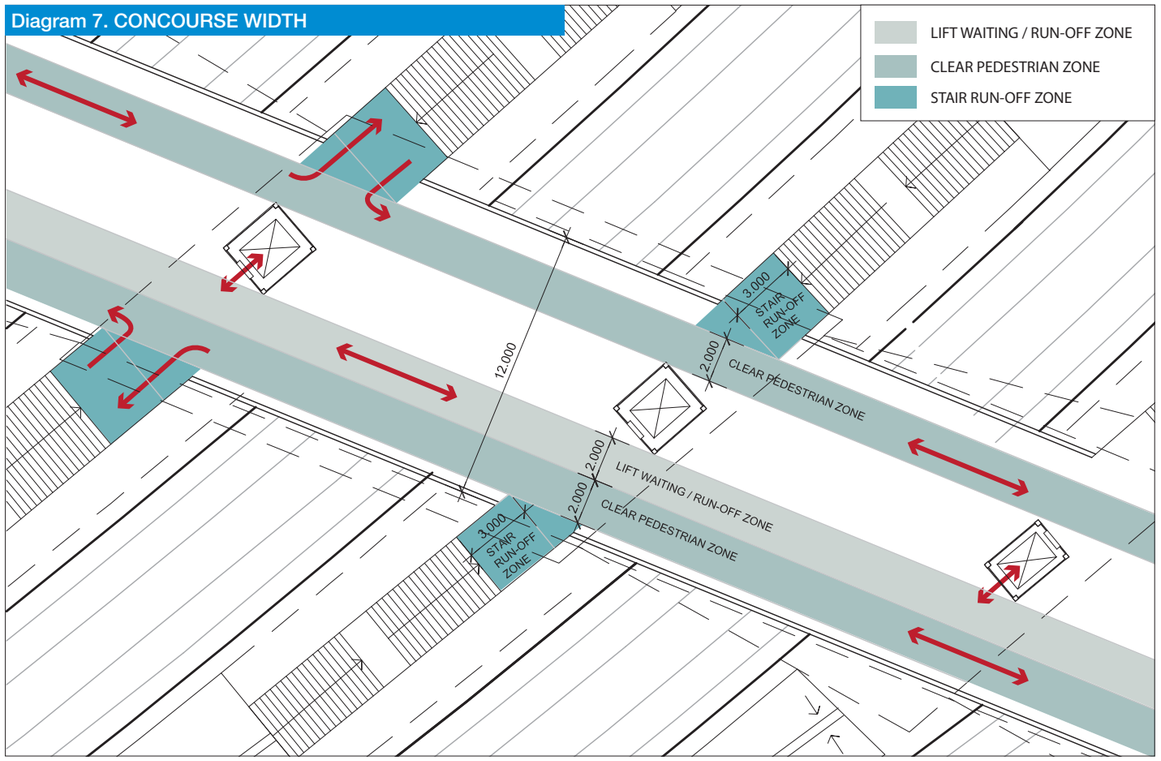



STANDARD LIFT OPTION 2.4m SAFETY ZONE CLEARANCE

## Diagram 6. OHW




## Diagram 7. CONCOURSE WIDTH



## 08.2.4 Platforms 1 - 10

Due to stair requirements and platform width constraints the existing local heritage listed buildings on platforms 4 to 10 are proposed to be removed. All state heritage listed buildings on Platform 1 and Lawson Street are retained. (Refer Diagram 8)

### 08.2.4.2 Canopies

Platform canopies are assumed to be replaced across the extent of platforms 2+3, 4+5, 6+7 and 8+9. This will ensure a consistent contemporary expression, allowing centralised structural support outside of clearance zones and incorporate new platform indicator displays and lighting. (Refer Diagram 9 + 10)

Due to heritage constraints on platform 1 only limited canopies at stairways are assumed. Canopies are not required on Platform 10 as trains do not stop.

Diagram 9. CANOPY SECTION

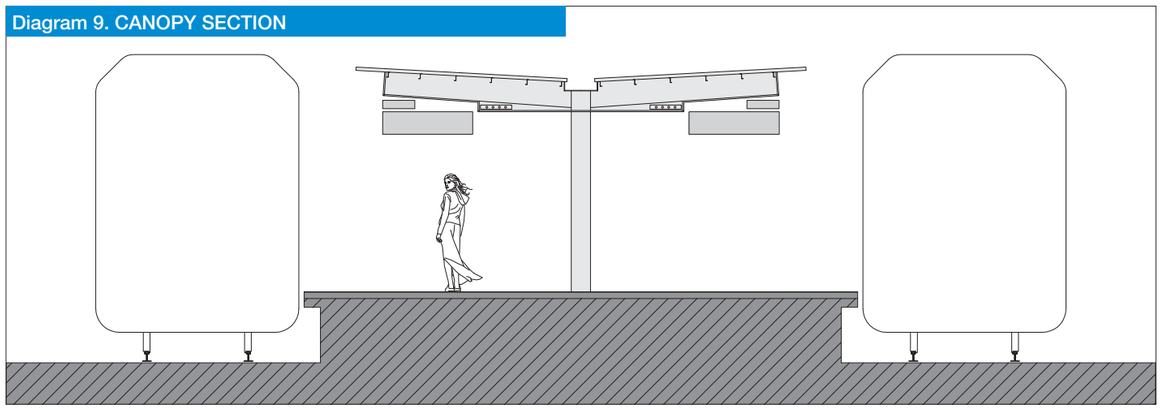


Diagram 8. HERITAGE

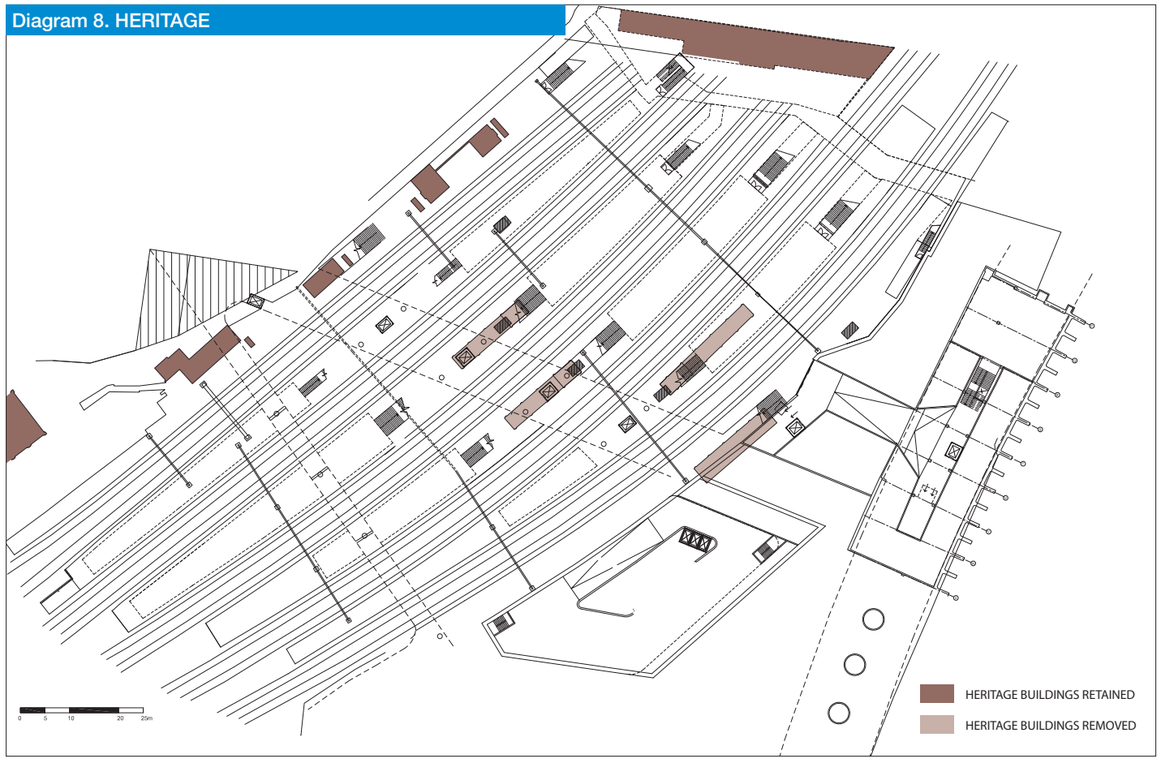
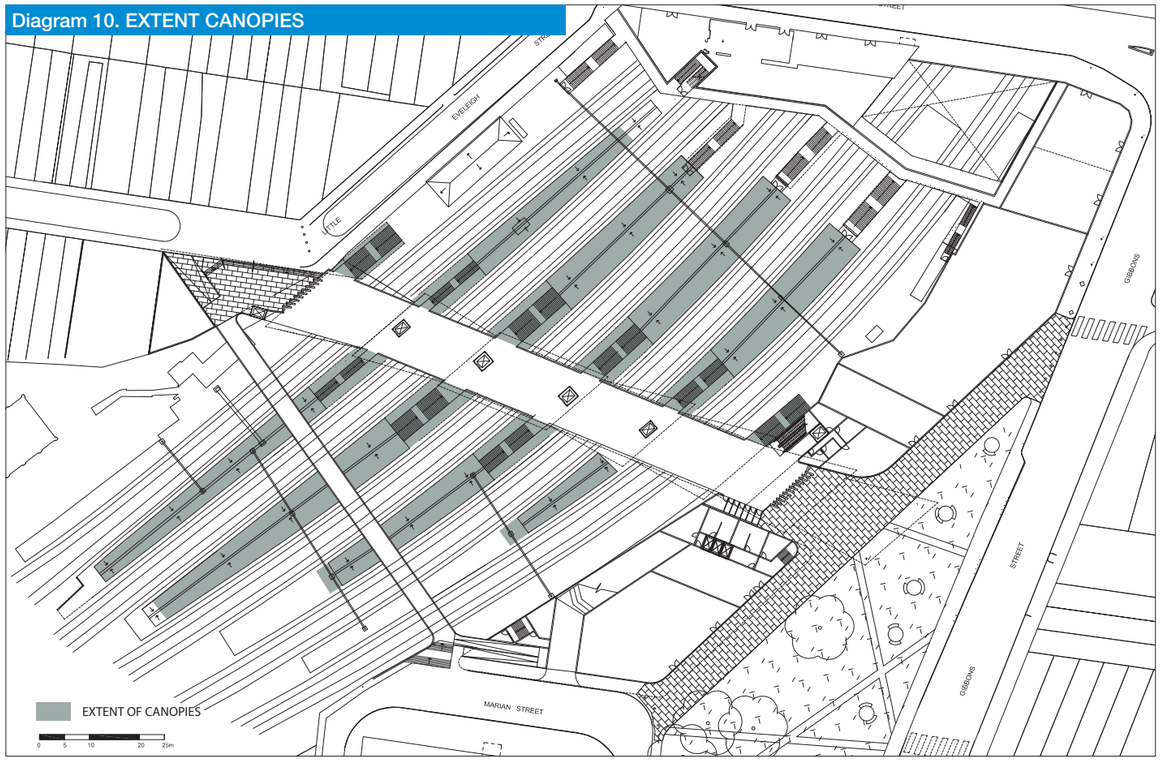



Diagram 10. EXTENT CANOPIES



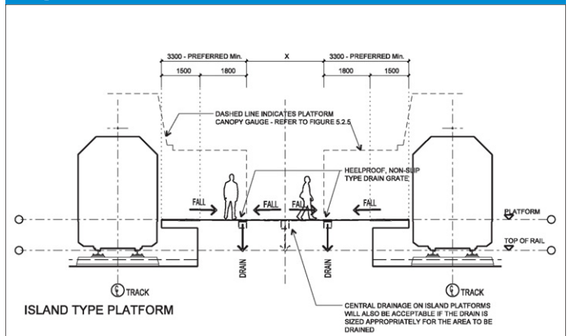
### 08.2.4.3 Control Rooms

New Control Rooms consistent with Railcorp Design Guidelines have been located as close as possible to existing services to minimise re-cabling works. (Refer Diagram 12)

### 08.2.4.4 Platform Profile

The existing gradient from platform centre to edge would be adjusted to reduce the risk of strollers etc rolling onto the tracks. Similar to recent work at North Sydney Station, the central half of the platform would remain unaffected and the edge “quarters” adjusted to slope away from the edge, creating a W cross section. (Refer Diagram 11)

**Diagram 11. PLATFORM CROSS SECTION**




ISLAND TYPE PLATFORM

**Diagram 12. CONTROL ROOMS**

## 08.2.5 Platform 11 and 12

### 08.2.5.1 Access

A new escalator is proposed in the general location of the existing stairway close to the centre of the platforms. This stair is moved north to the location of the existing escalator. Both open stair and escalator, together with a new lift connect up to the existing mezzanine concourse and then main concourse above that. (Refer Diagrams 13, 14 + 15)

### 08.2.5.2 Egress

A second new egress stair is proposed toward the southern end of the platforms that would rise up in the park above at the edge of the Gibbons Street footpath.

**Diagram 13. PLATFORM 11 ACCESS Concourse level**

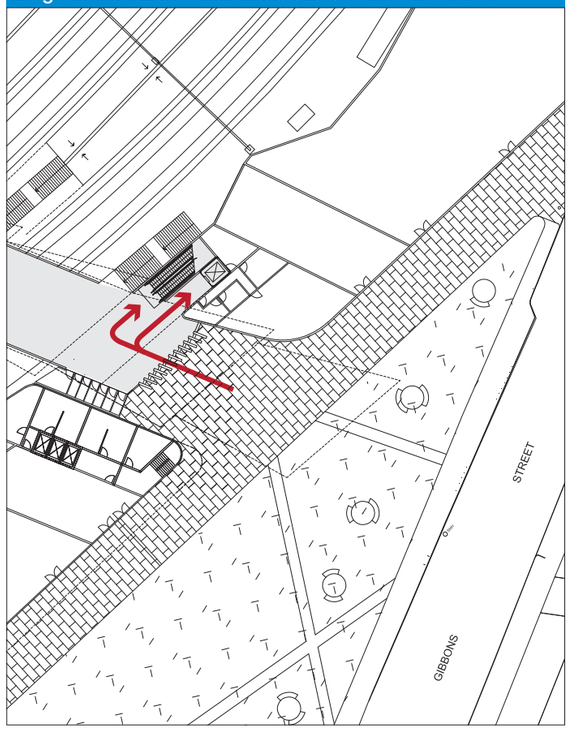



**Diagram 14. PLATFORM 11 ACCESS Main Platform level**

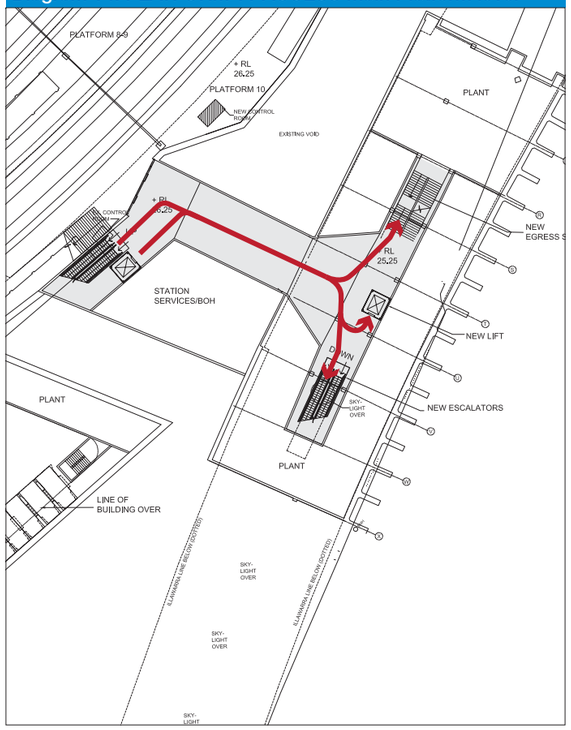
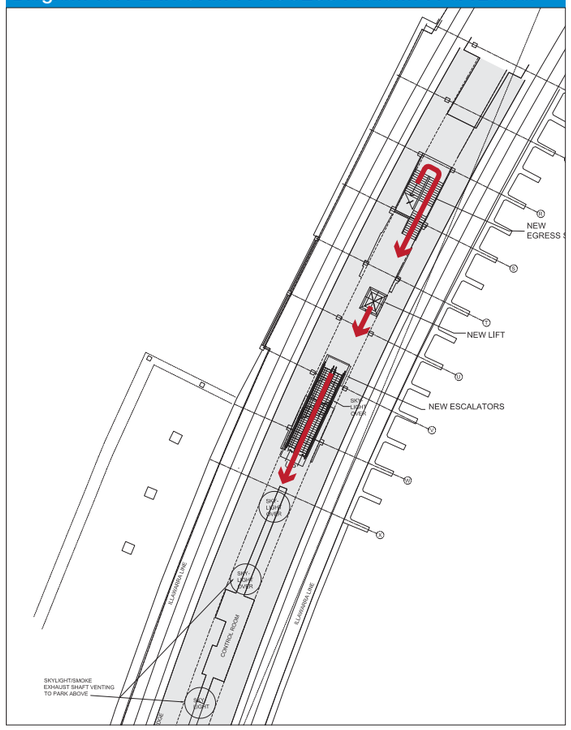



**Diagram 15. PLATFORM 11 ACCESS Platform 11 & 12 level**



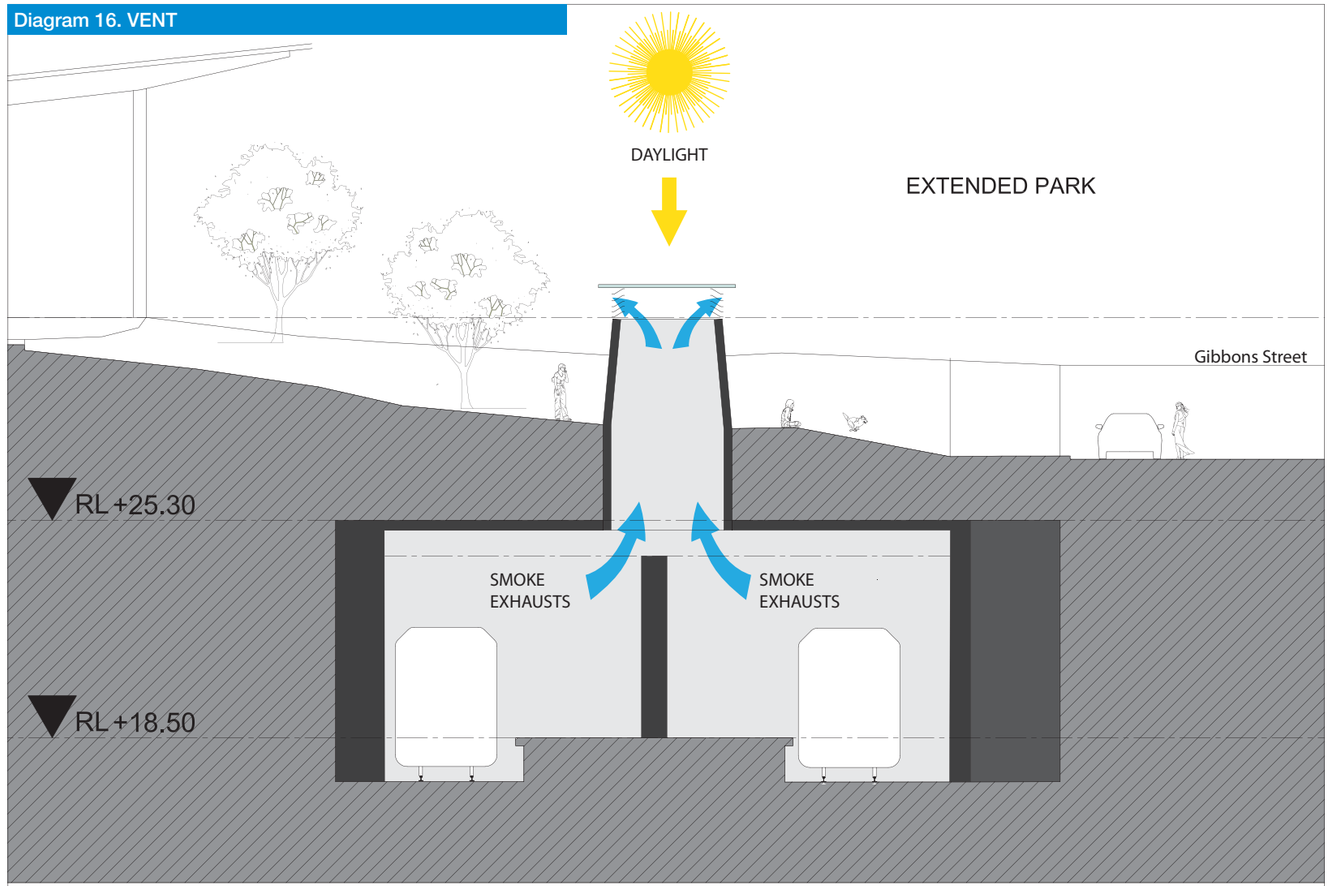
### 08.2.5.3 Daylight & Natural Ventillation

A series of combined skylight/ventilation shafts are proposed to improve amenity at platform level while improving smoke exhaust in fire mode. (Refer Diagram 16)

### 08.2.5.4 Platform Profile

The existing gradient from platform centre to edge would be adjusted to reduce the risk of strollers etc rolling onto the tracks. Similar to recent work at North Sydney Station, the central half of the platform would remain unaffected and the edge “quarters” adjusted to slope away from the edge, creating a W cross section.

**Diagram 16. VENT**



## 08.2.5 Unpaid link

Three options are proposed for an unpaid link across the tracks.

### 08.2.5.1 Preferred Option

**Option 1** comprises a separate bridge structure running perpendicular to the tracks and meeting the concourse at the north-west end. This bridge would be at the same height as the main concourse and could support OWS. A ramp and stair transition is required at the south eastern end of the bridge. Columns would generally support the bridge at the centre of platforms below. A larger span across platform 8+9 would be required due to the narrowness of the platform.

This option provides a simple and direct link convenient to pedestrians and cyclists. Construction could only take place in stages consistent with track possessions. Users on the bridge would be visible from the platforms and concourse providing a degree of passive surveillance and safety. (Refer Diagram 17)

### 08.2.5.2 Option 2

**Option 2** comprises a grade separated bridge above the main paid concourse. It is assumed that the bridge would be approximately 3 metres above concourse level. Stairs and lifts are provided at each end integrated with the station entrances.

The advantage of this option is that it can potentially be constructed independent of track possessions, once the main concourse structure below it is in place. This option is possibly less attractive to cyclists due to the requirement to use lifts up to bridge level. Bridge users would be highly visible to rail patrons on the main concourse providing a degree of passive surveillance and safety. (Refer Diagram 18)

Diagram 17. OPTION 1 ADJACENT UNPAID LINK AT CONCOURSE LEVEL

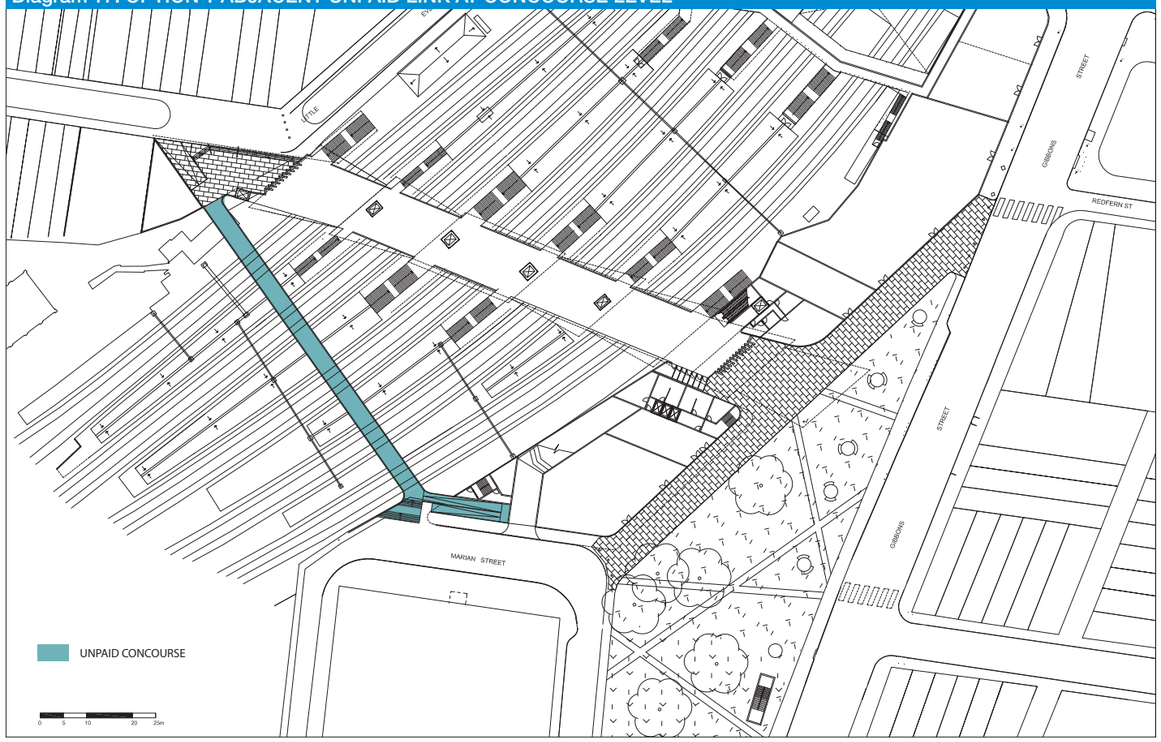
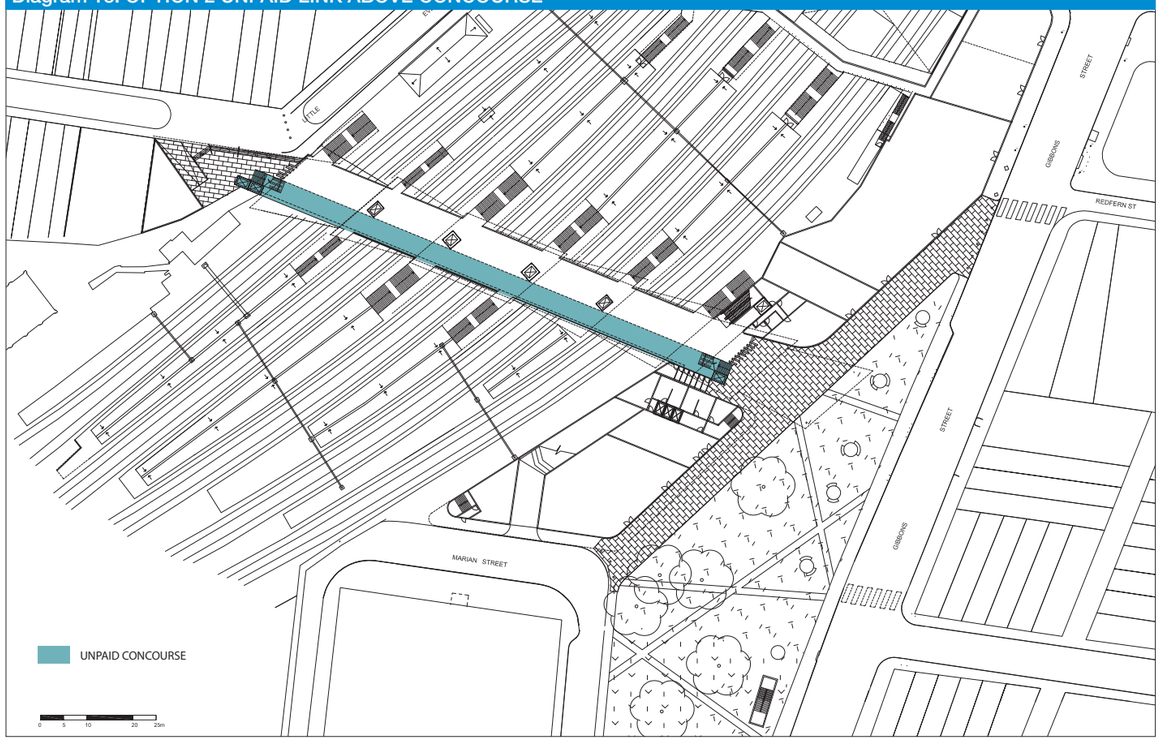



Diagram 18. OPTION 2 UNPAID LINK ABOVE CONCOURSE

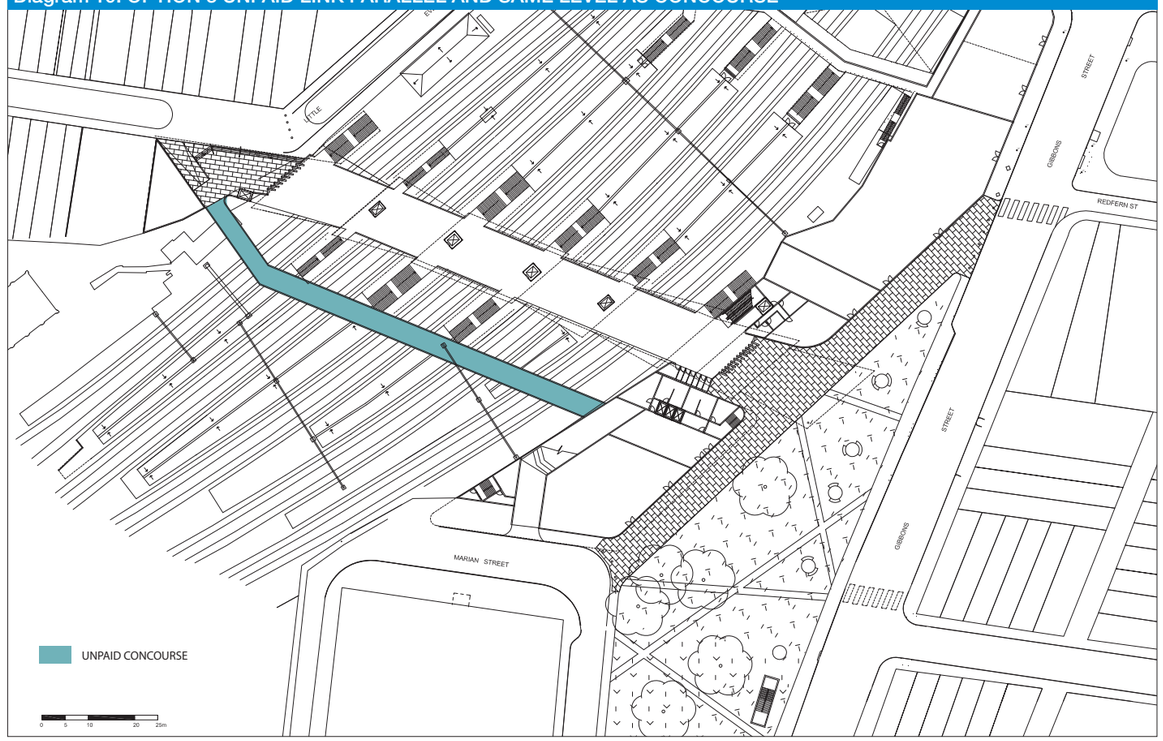


### 08.2.5.3 Option 3

A hybrid of Option 1 which provides a separate bridge structure parallel to the paid concourse. This follows a similar alignment to the Jackson Teece design and has been deemed unsatisfactory for the following reasons:

- Limits ground plan for tower redevelopment
- Increase bridge length and cost
- Diminishes ability to create strong urban link to ATP
- Complicates structural interfaces into platform canopies and stairs
- Impacts more OHW
- Column supports at platform would block pedestrian flows to stairs (Refer Diagram 19)

Diagram 19. OPTION 3 UNPAID LINK PARALLEL AND SAME LEVEL AS CONCOURSE




## 08.2.6 Lawson Street Concourse

### 08.2.6.1 Platform Transfers

An option that retained the Lawson Street concourse for use in platform transfers was explored and rejected for the following reasons:

- Requirement of an additional 6 passenger lifts to meet DPA intent - potential need to extend platform lengths for lift provision
- Concourse not requried for adequate transfer times
- Increased station area for management and surveillance
- Security risks increased
- Crowd modelling by Arup has determined that, with the exception of platform 2+3, transfer times of less than 90 seconds could be expected using only the new central concourse up to the year 2061. For platform 2+3 transfer times would be less than 90 seconds up to year 2053.

### 08.2.6.2 Platform Egress

An option of retaining the Lawson Street concourse for use in fire egress has also been explored. This would require:

- Re-building the stair on platforms 2+3 further toward the end of the platform and extension of the platform at the southern end to achieve minimum platform edge clearances or remove exisitng stairs and provide narrow width stairs to preserve platform edge safety compliance. This would not comply with BCA + FCS.
- Adjustment to the width of stairs to platforms 4+5 and 6+7 to achieve minimum platform edge clearances.
- Reconfiguration at Lawson street level to provide egress points.

While this improves egress times from the platforms in fire mode it increases the operational area of the station requiring observation and control.

## 08.2.7 Heritage

Due to stair requirements and platform width constraints the existing local heritage listed buildings on platforms 4 to 10 are proposed to be removed. The state heritage listed buildings on Platform 1 and Lawson Street are retained - (Refer Diagram 8).

Platform canopies are proposed to be minimised on platform 1 to maximise visibility of the heritage structures on this platform.

### 08.2.7.2 Platform 1

The new concourse sits above one heritage building on platform 1. This building has a parapet expression with roofing concealed from view and it is suggested that the concourse will not substantially impact on the visibility and integrity of the building.

### 08.2.7.3 Lawson Street

It is recommended that Railcorp consider new uses for the heritage buildings on Lawson Street that are no longer required for rail functions. These could potentially be adapted to a number of uses including cafes, art gallery, community and retail spaces that will activate this important streetscape. A review by a Heritage Consultant and opportunities for Heritage Interpretation should be explored in future stages.

## 08.2.8 Potential Development

Commercial development around the station has the potential to activate the public domain, provide amenity to rail patrons, and provide a commercial return that helps fund the project.

The proposal permits staged delivery of retail and office space, potentially separate to the delivery of the station. This recognises that:

- Market cycles and the commitment of retail and office tenants may not coincide with the desired station timeline;
- Commercial demand in Redfern can be expected to increase only once the existing station is redeveloped;
- While the site has the advantage of proximity to the station, there are easier sites nearby that are likely to be developed first.

Rather than focussing on maximising the quantity of commercial development, the design attempts to maximise quality.

### 08.2.8.1 Retail

Retail spaces are proposed at ground level only with highly visible frontages addressing the public domain. This improves attractiveness to potential tenants and avoids secondary spaces. It also ensures that the station entrance is clearly legible. (Refer Diagram 20)

Retail areas are proposed in the following areas:

- beneath the office building
- on the Gibbons Street frontage north of the station entrance;
- within the existing station buildings and parts of the existing concourse on Lawson Street.

Approximately 2600m$^2$ of retail space is incorporated, potentially accommodating cafes, a small supermarket and other smaller retail uses convenient to rail users and the public.

### 08.2.8.2 Retail Opportunity

A further 580m$^2$ of retail space could be added by the infill of the void space above the tracks at the eastern end of Lawson Street. This would replace the existing blank full height brick wall on the bridge with active streetscape and thereby improve passive surveillance in the area.

### 08.2.8.3 Retail Loading

Loading access is assumed to be after hours from the footpath between the station and the extended Gibbons Street Park. Bollards would restrict this area to pedestrian movement only at other times.

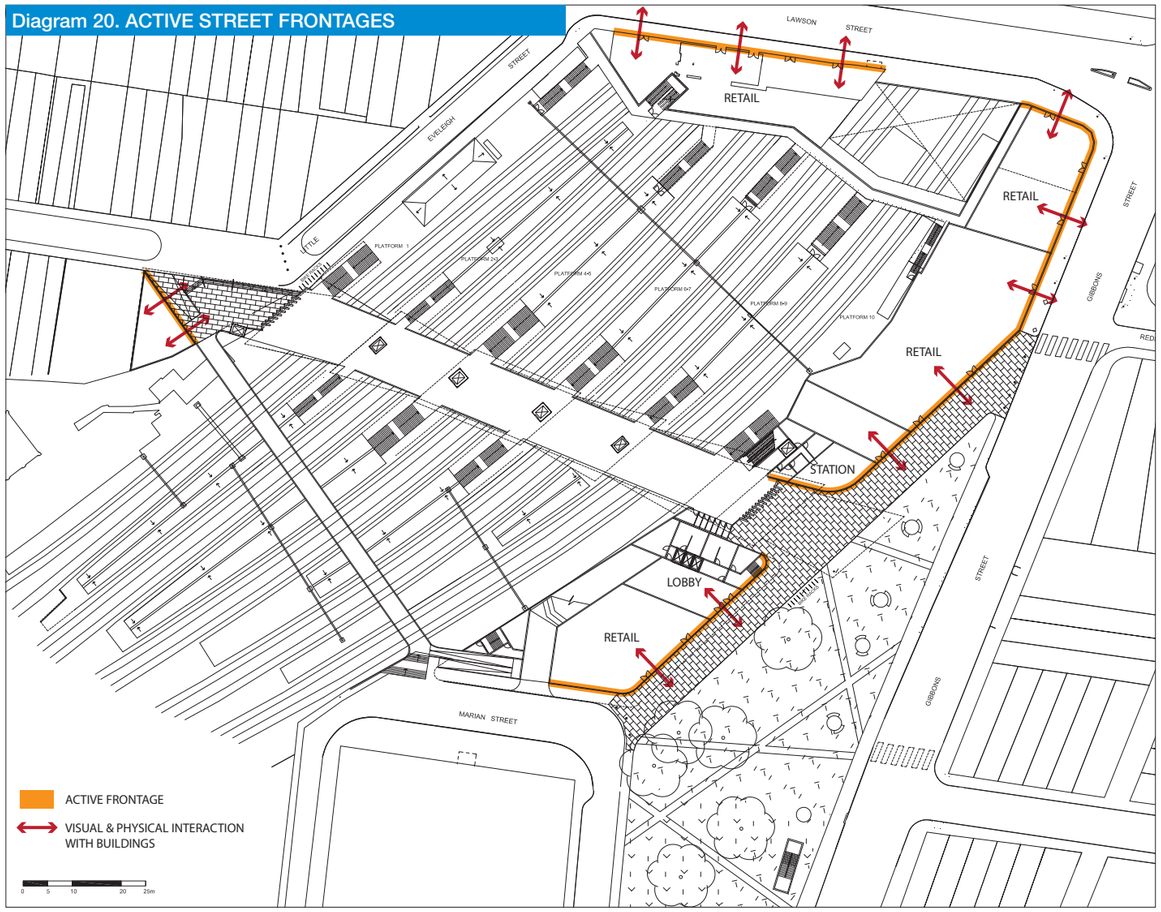
### 08.2.8.4 Commercial

The typical office floorplate as shown in Option 1 is more rectangular than previous designs with excellent access to daylight and outlook from the whole plate. The office foyer addresses Gibbons Street and the park. At this time is assumed that the previous 14 level height would apply. Assuming the ground level is retail and included in the previous retail areas, this delivers 15,600m$^2$ GFA or approximately 13,260m$^2$ NLA of office space. The urban design implications of a taller tower could potentially be explored. A preferred total area would be 20,000m$^2$ (20 storeys) which could accommodate a reasonable size occupant with additional smaller occupants to spread risks of single occupancy.

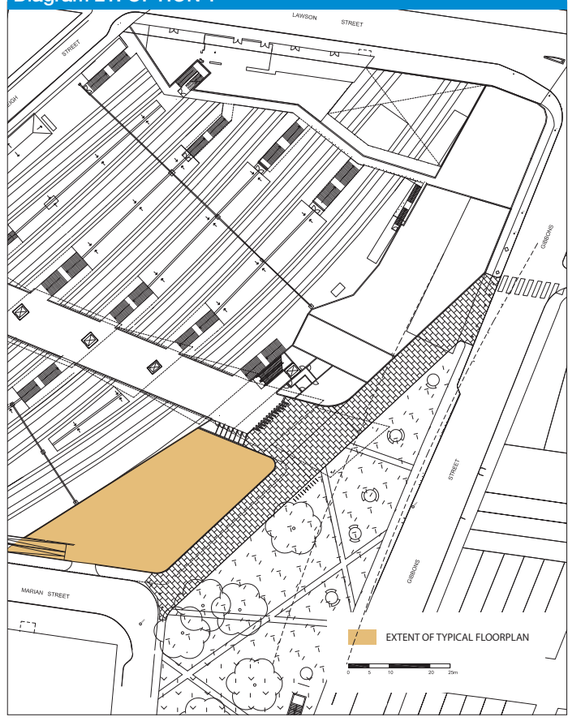
The four options provided show options with a variety of advantages and disadvantages. Option 1 permits the simplest staging but all proposed development options can be built without impacting the rail. Option 4 would require structural transfers to avoid impact on the Illawarra line below ground.

A three level basement carpark is assumed underneath the office tower accommodating approximately 78 cars in total with 25 carspaces assumed for Railcorp and related uses.

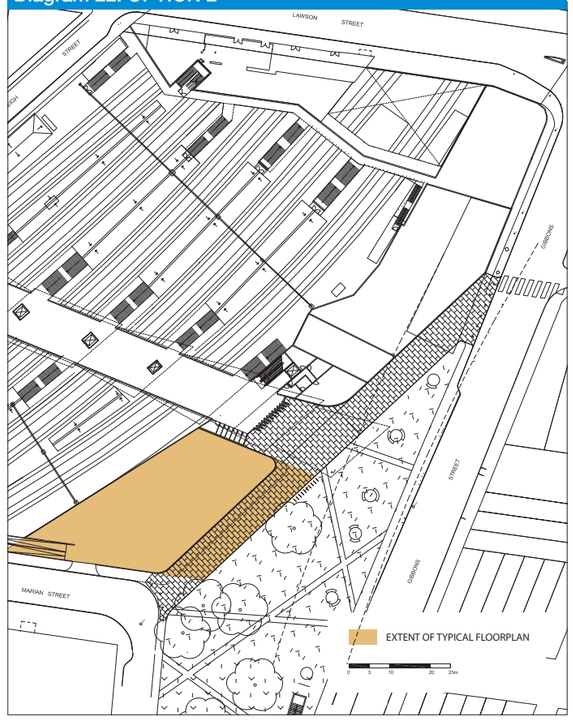
Diagram 20. ACTIVE STREET FRONTAGES



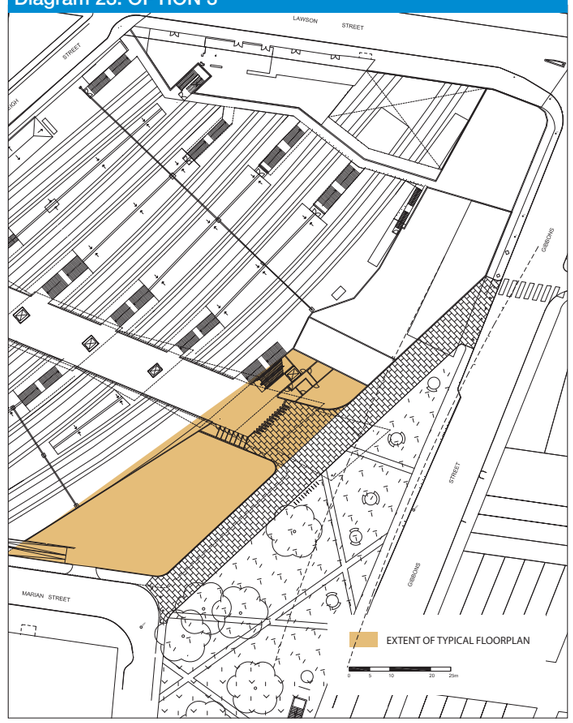
## Diagram 21. OPTION 1



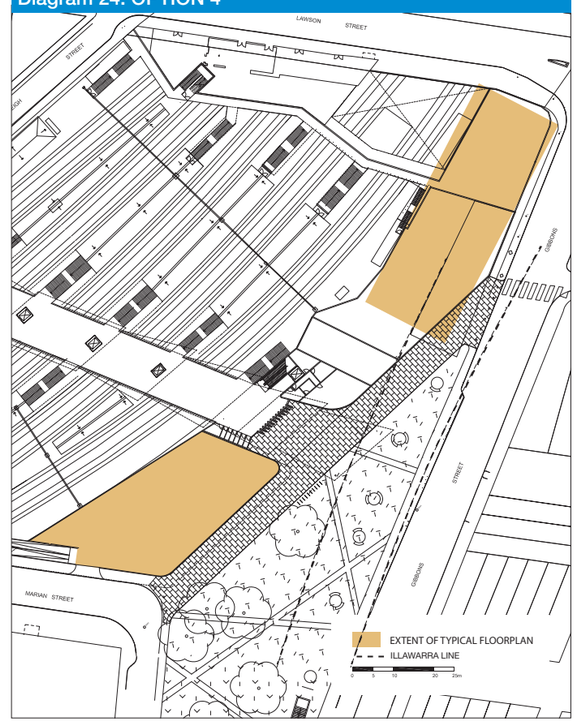

## Diagram 22. OPTION 2




## Diagram 23. OPTION 3




## Diagram 24. OPTION 4



## 08.3.1 Urban Design

### 08.3.1.1 Integration

- The proposal presents the opportunity to integrate the station address and egress with the existing park on Gibbons Street
- The scale of the station is sensitive to the existing low scale residential/mixed use areas to the north-west. The height of the commercial tower should be assessed in terms of its close proximity to public transport, context, and general height of existing buildings, shadow impact etc.

### 08.3.1.2 Connectivity

- The design includes three options for a separate unpaid pedestrian and cycle bridge link across the tracks.
- Station entrances are located with key destinations taken into account. The north-west entrance connects via Little Eveleigh Street to the North Eveleigh and University precincts. The south-east entry connects to Australia Technology Park and Redfern Street.
- The potential for a future sub-grade connection under Gibbons Street is allowed for.
- Interchange to bus is facilitated with simple direct on grade connection to Gibbons and Regent Street bus stops.
- A further link to North Eveleigh via an elevated walkway has been proposed by RWA - while this may reduce distance travelled it has significant disadvantages including possible impact on an existing heritage building, need for a long and elevated ramp overlooking existing residential property, high pedestrian security risk due to lack of passive surveillance and need for additional lift for DDA compliance

### 08.3.1.3 Activation

- Frontages to the public domain are generally activated by retail, office or rail activity.
- The adaption of station buildings on Lawson Street for retail use may, depending on the type of retail, increase activation along this frontage.

### 08.3.1.4 Public Domain

- The design includes the extension to the north of the park on Gibbons street by approximately 1750m$^2$

## 08.3.2 Architecture

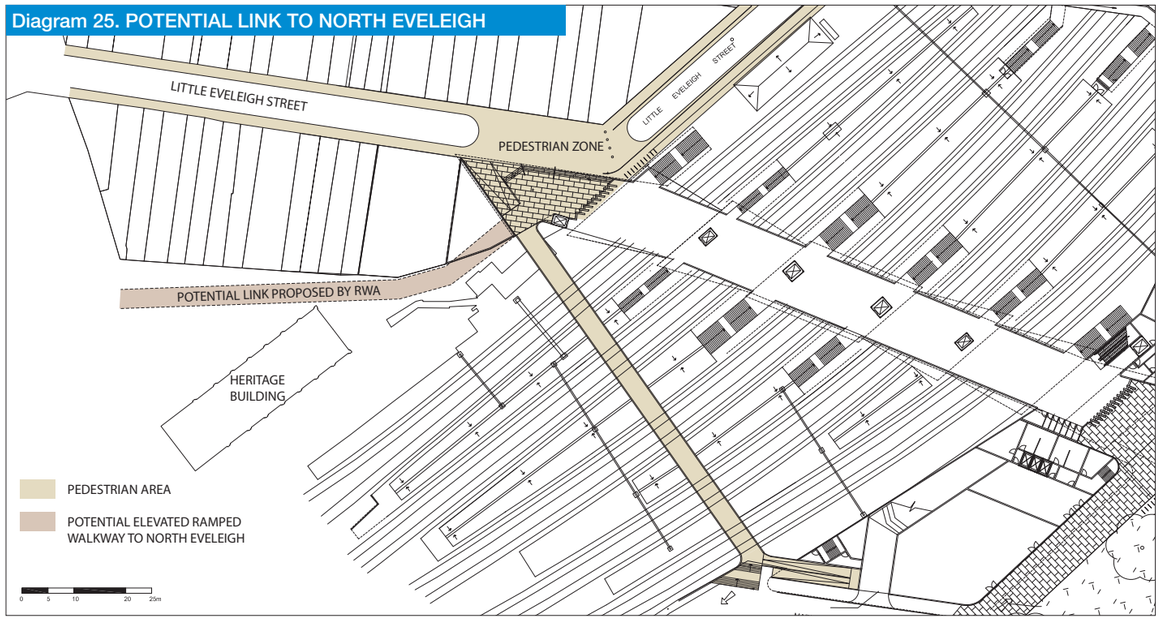
### 08.3.2.1 Civic presence

- The engagement of the Gibbons Street station entrance with the extended park creates the opportunity for a strong civic presence for the station.
- The architectural treatment of the entrance and the station in general is clearly important. The preliminary proposed language of overlapping open shell roofs, expresses the entrances at opposite sides of the concourse and creates an iconic expression using a simple formal portal framework. This arrangement achieves a naturally ventilated and day-lit concourse that is protected from rainfall in most situations.

### 08.3.2.2 Clarity of station planning

- The organising structure of the station is a single open ended linear concourse.
- All above ground platforms are visible from the concourse and directly accessed from it.
- The below ground Illawarra Relief platforms 11+12 are also accessed from the main concourse with a transition at mezzanine concourse level.
- Intuitive wayfinding is maximised by the simplicity and directness of the station planning.

Diagram 25. POTENTIAL LINK TO NORTH EVELEIGH




### 08.3.2.3 Entrance visibility

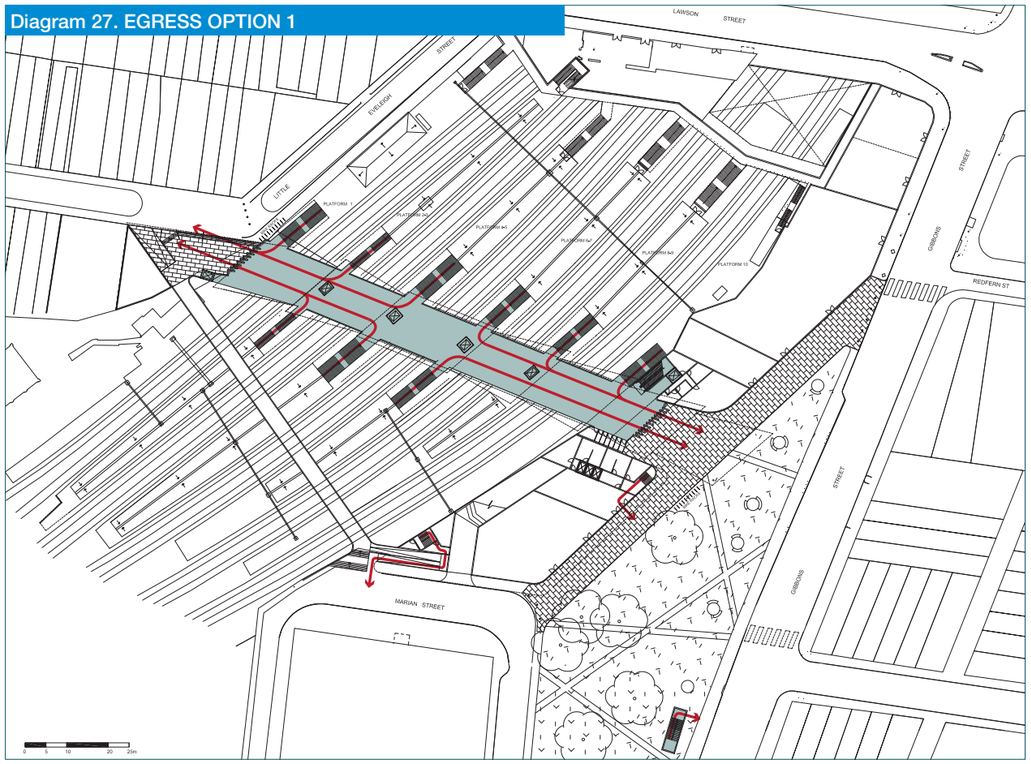
- Both station entrances are clearly visible from the public domain. Gibbons Street is a major arterial road and Little Eveleigh Street is a minor roadway, so it is anticipated that The Gibbons Street entrance will be perceived as the formal address.

### 08.3.2.4 Functionality and operational efficiency

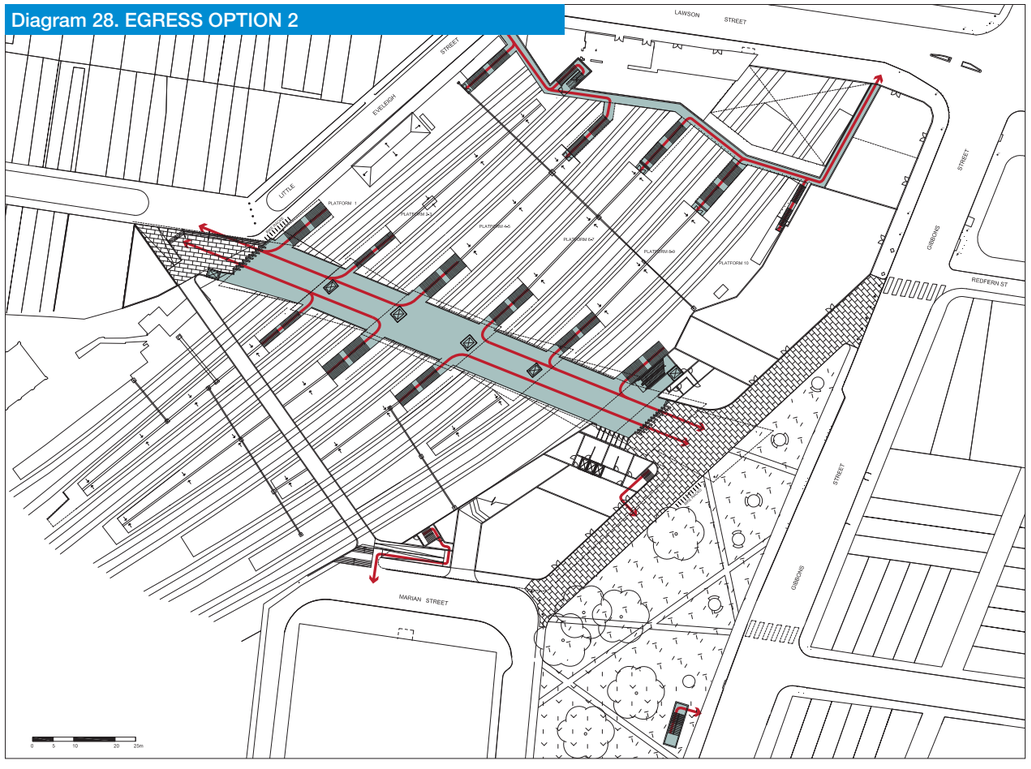
- While the width of existing platforms is not ideal, transfer times achieved between platforms are acceptable as outlined in the following section on crowd modelling.
- Station facilities at each end of the concourse result in good sightlines onto the two gatelines.
- The compact nature of the station planning minimises the areas requiring surveillance.
- The existing northern concourse is currently assumed to be retained and modified as an egress path. Complete removal of this concourse would remove a potential safety risk and simplify station operations, however this requires review against its benefit as an alternative egress path.
- The addition of a second fire stair and smoke exhaust system to platforms 11+12 increases safety in the event of a fire.
- Redevelopment of station control rooms and staff facilities presents the opportunity to bring these up to contemporary standards.

## Diagram 26. EXISTING PARK


## Diagram 27. EGRESS OPTION 1




## Diagram 28. EGRESS OPTION 2



### 08.3.2.5 Passenger amenity, comfort and security

- The centralisation of platform access dramatically improves the efficiency of the station from a customer viewpoint
- The increase in platform shelter will improve amenity in inclement conditions
- The general upgrade of facilities such as signage, seating and finishes etc will enhance the customer experience and encourage increased use of the station
- Improvements in disabled access will significantly improve passenger equity
- The addition of skylights on platforms 11+12 increases amenity at platform level

## 08.3.3 Heritage

### 08.3.3.1 Heritage impact

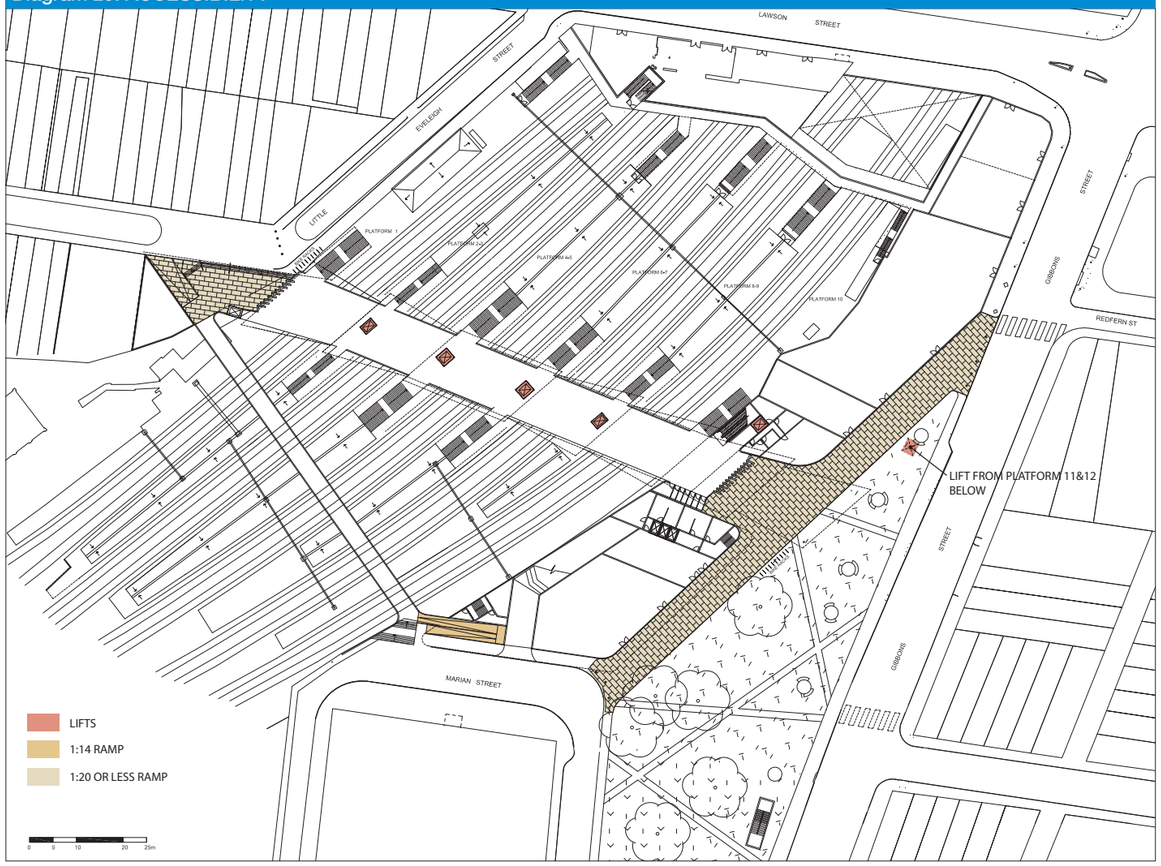
- Local heritage listed buildings on platforms 4 to 10, as indicated on page 26, are proposed to be removed.
- The state heritage listed buildings on Platform 1 and Lawson Street are retained.
- Platform canopies are proposed to be minimised on platform 1 to maximise visibility of the heritage structures on this platform.
- The new concourse sits above one heritage building on platform 1. This building has a parapet expression with roofing concealed from view and it is suggested that the concourse will not substantially impact on the visibility and integrity of the building.
- It is recommended that Railcorp consider new uses for the heritage buildings on Lawson Street that are no longer required for rail functions. These could potentially be adapted as retail, cafe, art gallery and community space that will activate this important streetscape.
- A review by a Heritage Consultant and opportunities for Heritage Interpretation should be explored in future stages.

## 08.3.4 Access

### 08.3.4.1Accessibility

- Lifts are provided to all platforms 1 to 10 in a location adjacent to the stairways and close to the centre of platforms to maximise equitable access.
- Lifts are provided to all platforms 11 and 12 adjacent to the escalator and stairways and in a location close to the centre of platforms to maximise equitable access
- The main station entrances are approached via gradients equal or less than a 1:20 slope.
- The unpaid bridge link options involve either 1;14 ramps or stairs and lifts grouped together to maximise equitable access

**Diagram 29. ACCESSIBILITY**



## 08.3.5 Crowd modelling

The Concept Design has been assessed from a passenger experience perspective. The analysis of this design assumes:

- The existing northern concourse and stairs are not maintained for normal operations (only for emergency egress).
- Therefore, all interchange movements and all entry/exit movements use the new centrally located concourse.
- A new link to P11/P12 from the centrally concourse is proposed, via 2 escalators and a walkway ramp to the concourse level, and then via a 4m stair and 2 escalators to P11/12 platform level.
- A new 3.6m wide unpaid link is proposed, and will connect from western station plaza to Marian Street at the southeast.

The Concept Design provides improved passenger amenity with respect to east-west links and VT provision. Pedestrian analysis of the design has identified the following recommendations:

- The volume of alighting passengers from Platform 1 (approx. 550 in 2061) will clear in approximately 150 seconds. Although additional VT capacity would achieve an improved P1 clearance time, the P1 VT capacity will need to be balanced with the downward capacity of the VT to the destination platform. Given the relatively low service frequency of trains on P1, consideration should also be given to tolerating a clearance time of >90 seconds.
- Further VT width is required to serve Platform 2/3 in order to meet the target 90 seconds platform clearance time. However, given the spatial constraints (the P2/3 platform width), it is noted that there is limited opportunity to increase the VT capacity to P2/3.

### Vertical Transportation

The pedestrian planning performance of the VT provision is summarised as follows:

- The stair flow rates adopted within the VT analysis are extracted from the Connell Wagner VT assessment report; 35 ppm for bi-directional movement, 50ppm for uni-directional movement.
- The single 4m wide stairs provided on Platform 1 offers insufficient capacity to cater for the peak 2061 alighting load of 550 passengers, and will take approximately 150 seconds to clear. An additional 1.8 metres is required to achieve the target of 90 seconds. A second stair connecting to the south side of the concourse would increase the overall capacity, but clearly needs to be considered alongside other station design drivers. Furthermore, although the additional VT capacity would achieve an improved P1 clearance time, the P1 VT capacity will need to be balanced with the downward capacity of the interchange platforms (P2/3, P4/5, P6/7, P11/12). The service frequency of P1 is expected to be 7tph in 2061, which implies an average headway of 8 to 9 minutes. A platform clearance time of >90 seconds may therefore be tolerated on P1, although the overall journey times for P1 interchange passengers would be significant (estimated to be approaching 4 minutes inclusive of the 150 seconds queue time).
- P2/P3 is assumed to be at a width of 3.8m, requiring an additional 0.6m to meet the target of 90 seconds platform clearance time. The queue population at this time is estimated to reach a maximum of 80 people. However, understanding the spatial limitations inherent with the narrowness of P2/3, there are limited opportunities to increase the VT capacity without significant re-design, or maintenance of the existing northern concourse.
- All other platforms cater for the anticipated 2061 demand levels within the 90 seconds clearance time criteria.
- Although the VT serving the alighting loads on P11/12 can meet 90 seconds clearance time target, the VT provision from the transfer concourse to the concourse bridge (1 escalator UP) will be a bottleneck. A queue of up to 100 persons is estimated to form at the base of the escalator, with up to a minute of queueing likely.

### Spatial Review

The Concept Design provides between 12m and 13m of concourse width, and is therefore in accordance with the pedestrian movement requirements. Given the complex mix of bi-directional flows are waiting/ queueing behaviours predicted within this space, a dynamic simulation of the concourse would be required to fully understand and finalise

## 08.3.6 Structure

### 08.3.6.1 Ground Conditions

The draft geotechnical report associated with the Eveleigh Heritage Walk was made available to this study. It is noted that this information relates to ground conditions at least 60m away. It may therefore not necessarily be representative of the ground conditions under the proposed new foundations.

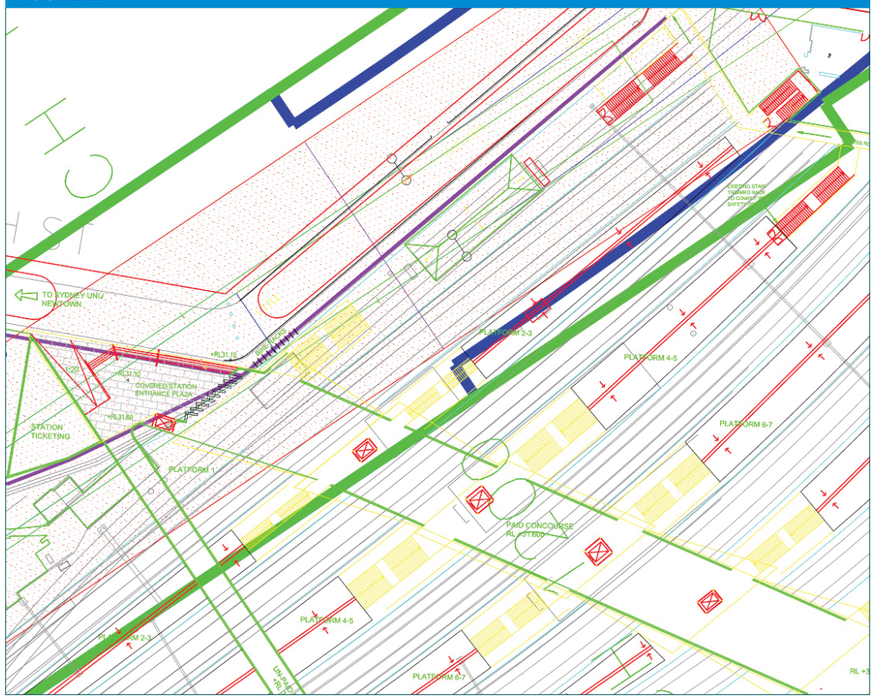
Assumed ground conditions based on the Eveleigh Heritage Walk geotechnical report are:

- Fill and/or low to medium density Silty Sand or hard Silty Clay
- Medium density sand or very stiff Silty Clay at RL23mAHD - with an allowable bearing pressure of 200kPa
- Extremely to very low strength Shale (Class V) at RL 20mAHD - with an allowable end bearing pressure 700kPa and shaft adhesion of 70kPa
- Medium strength Shale (Class IV) at RL 12m with an average allowable end bearing pressure of 1000kPa and shaft adhesion of 100kPa.
- In Option C the 650mm dia bored piles with 1100kN load capacity were assumed to be founded on rock with an allowable end bearing pressure of 3500kPa at RL18mAHD. On the basis of the above assumed ground conditions, 650mm dia bored piles are required to extend to approx. RL14mAHD to achieve 1100kN load capacity. Less heavily loaded piles supporting the canopies and stairs can be founded in the Class V shale at RL18-19mAHD.

### 08.3.6.2 ACDEP Engine Dive

- Foundations will need to be located in Little Eveleigh Street (outside the railway boundary) on the west side of the retaining wall. Alternatively, it may be feasible to install a strip foundation to spread the load onto the west brick side wall of the ACDEP engine dive.

**FIGURE 2**




- The ACDEP engine dive lies within the west metro dive protection zone and is likely to represent a more significant impediment to construction of the west metro dive than foundations to the new concourse.
- The Little Eveleigh Street retaining wall is presumed to crank 120° to follow Little Eveleigh Street along the boundary of Nos 125-127 Little Eveleigh Street. South of the crank in the retaining wall, it should be possible to install a strip foundation beside the west brick side wall to the ACDEP engine dive

**FIGURE 3**

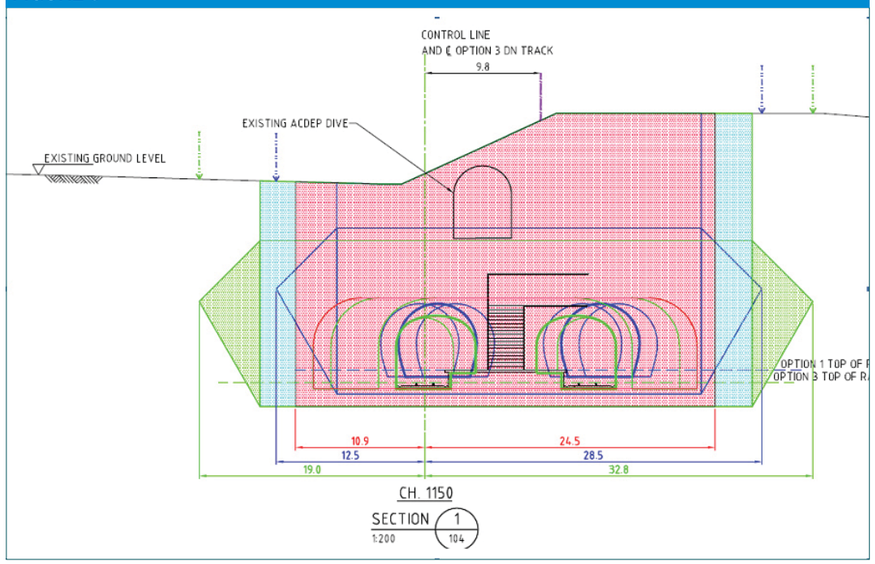
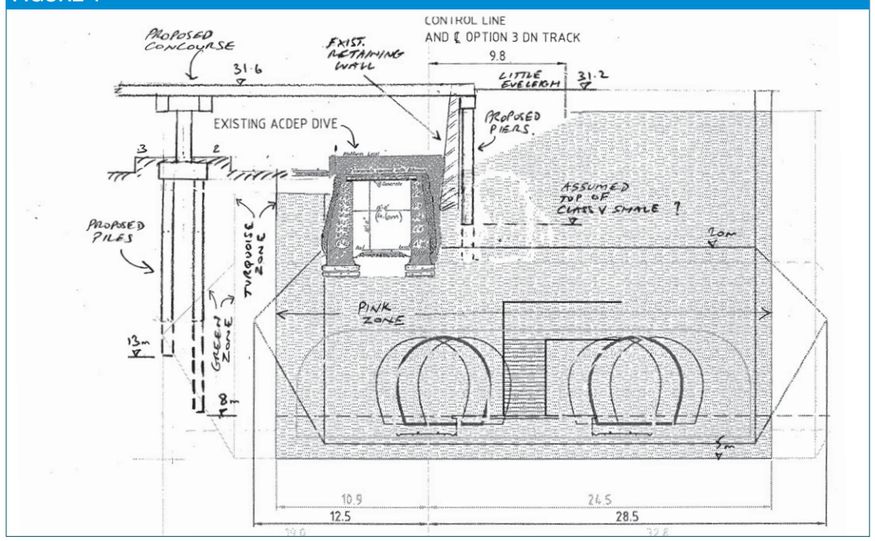
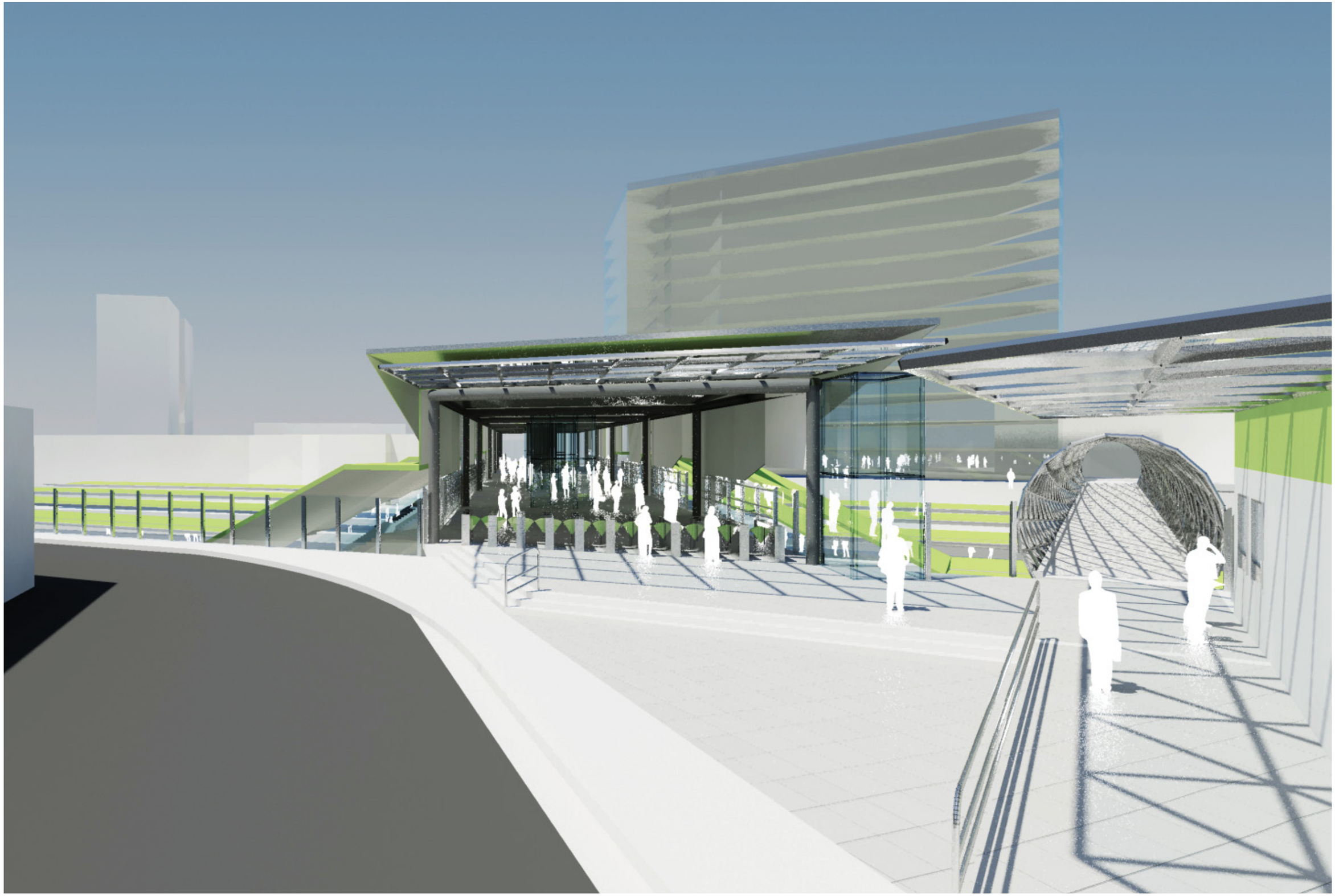



**FIGURE 4**





VIEW OF LITTLE EVELEIGH STREET STATION ENTRANCE

### 08.3.6.3 Metro West Dive Protection Zone

- RailCorp have provided concept design drawings for the North Eveleigh dive and tunnel alignment corridor protection (‘draft’ issue 2 October 2007).
- Refer to Figs 2 and 3 for extracts from these drawings indicating the extent of the protection zone affecting Redfern Station. Foundations are allowed above the green zone. Piles may pass through the turquoise or green zones. No foundations are allowed on, in or through the pink zone.

**Fig.2** Protection zone overlayed on Redfern Station Redevelopment to be updated

**Fig.3** Section through the protection zone at CH 1150 (from SK130) towards the north end of Redfern Station.

- The support structures to the paid concourse and unpaid bridge on Platforms 1 and Nos 125-127 Little Eveleigh Street and also Platforms 2/3 fall within the protection zone for the proposed metro west dive.
- However the foundations for the paid concourse and unpaid bridge on platforms 2/3 are over the green zone, which restricts the toe level of piles to above or below the restricted zone.
- For those foundations required in the pink full protection zone, the proposed design solution assumes shallow foundations ‘on rock’ rather than piles.
- The metro west exclusion zone potentially creates a significant constraint to the Redfern station upgrade project.

**Fig 4** Section through northern support to the concourse showing relationship to ACDEP dive and Metro West dive protection zone at the north side of the concourse

### 08.3.6.4 Paid Concourse Platforms 1 to 10

- The paid concourse floor structure between Platforms 1 and 10 consists of approximately 5 equal spans across each pair of tracks.
- The concourse is supported on reinforced concrete headstocks at each platform, with two 1100mm diameter RC columns at platform level. Structure below the platform comprises 3-pile pile caps, one at each side of the concourse.
- The deck consists of 600mm x 600mm prestressed precast concrete planks, laid side by side, spanning approx. 15metres. A 150mm thick in situ reinforced concrete topping ties the planks together.
- The concourse enclosure consists of a series of steel portal frames, one portal on each side of the platform stairs/lifts. This provides stability across the width of the concourse. Each pair of portals is also portalised over the stairs to provide stability along the length of the concourse. The roof structure consists of cold formed Z section purlins over raking steel beams supported on the portal frames.

**Fig 5** Structural model of concourse

FIGURE 5

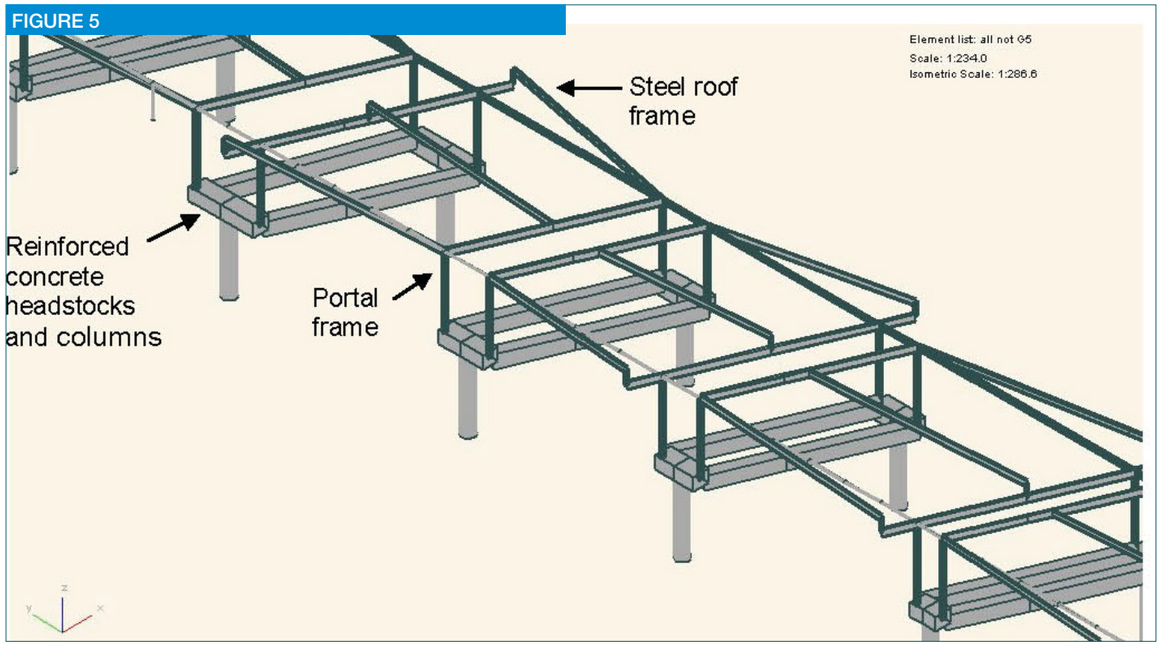
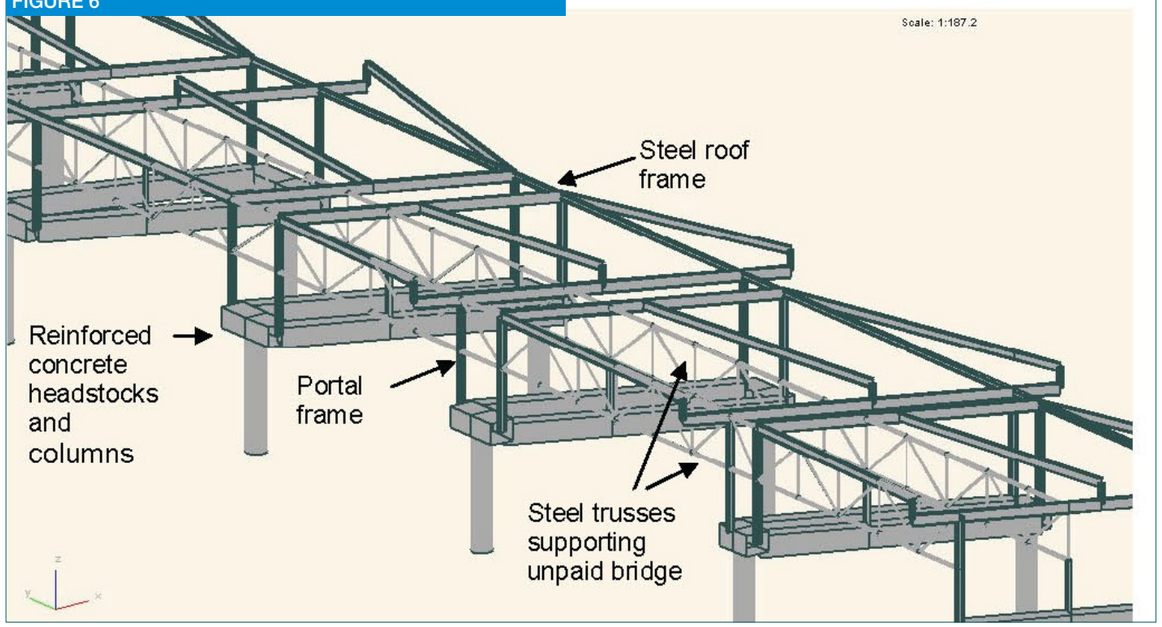



FIGURE 6



### 08.3.6.5 Option of Paid Concourse With Unpaid Bridge

- Consists of a pair of steel trusses with precast concrete planks or panel flooring between the bottom chords. This maximises the headroom underneath.
- The unpaid bridge aligns with the south side of the concourse so that on the south side the steel trusses span between the portal frame posts.
- On the north side of the unpaid bridge the steel trusses span 3-4m further, between steel columns supported on the headstock beams, adjacent to the SE corner of the lifts.

**Fig 6** Structural model of concourse incorporating unpaid bridge link

- Apart from the additional structure required for the unpaid bridge the headstock beams, RC column and foundations and southern steel portal frame posts and southern prestressed precast concrete plank are required to have increased load capacity.

### 08.3.6.6 Concourse Floor Structure – Platforms 1 to 125-127 Little Eveleigh Street

- The brick and timber buildings at 125-127 Little Eveleigh Street will be demolished down to basement level which is at approx. platform level.
- The retaining wall along the Little Eveleigh Street boundary is assumed to be located outside the property boundary and does not rely on the basement structure for support.
- It is proposed that the new concourse structure will be steel framed with reinforced concrete deck on permanent metal formwork and pad foundations, to minimise the load on the foundations (and the North Eveleigh dive protection zone). The distributed weight of the new concourse structure should be significantly less than the existing buildings.

### 08.3.6.7 Paid Concourse and Mezzanine Floor Structure - Platforms 10 to 11/12

- To minimise cost, the concept re-uses the existing steel beams in the excavation void as support structure for station manager's office and ticketing at concourse level and below this, back of house station services and pedestrian link between platform 10 and Illawarra intermediate concourse.
- A thorough assessment of the extent of corrosion of the existing steelwork will be required. However the steel section sizes are much larger than required to support the proposed new loads and some loss of section could be tolerated.
- Provision should be made for welding /replacement of bolts or alternative seating arrangement, grit blasting to remove excessive corrosion products, wrapping with FGW41 and then concrete encasement to prevent further corrosion and provide fire rating.
- The existing car parking area south of the excavation void is partially supported on the existing southern rail tunnel and partially on natural ground or backfill. The concourse in this area is assumed to consist of 150thick ground slab on compacted road base.

### 08.3.6.8 Stairs and Canopies

- In the concept design the stairs are shown as precast concrete treads on steel stringers, but could be precast in one piece as in the previous concept design study. The stairs will be supported on new piled foundations, similar to the previous concept design study.
- New steel framed butterfly canopies are provided along the platforms similar to the previous concept design study, with central steel support columns bolted to the top of single 600dia piles.

### 08.3.6.9 Lifts

- In the concept design the new lifts are independent of the concourse structure to enable the use of lightweight steel frame and glazing.
- The lift on platform 1 is located outside the west brick side walls to the ACDEP dive. The reinforced concrete lift pit is constructed on mass concrete over Class V Shale.

### 08.3.6.10 Stand alone unpaid bridge link option

- The stand alone unpaid bridge is of similar construction to the paid concourse, except that supports on each island platform require only a single 900mm diameter RC column on a 3-pile pile cap supporting a 900mm x 900mm deep in situ reinforced concrete crosshead.
- The deck consists of 600mm x 600mm prestressed precast concrete planks with 150mm thick in situ reinforced concrete topping, laid side by side, spanning approx. 15m across tracks 3/4 and 5/6 on to the headstock beam.
- The width of platform 8/9 is too narrow to allow support structure. Hence, the bridge is required to span approximately 25m across tracks 7/8 and 9/10. This proposed solution is a steel truss structure with precast concrete planks, which fits comfortably within the 750mm O/A structural depth.
- The first span across tracks 1/2 is at least 20m, since the foundation has to be located on the west side of the ACDEP dive and the heritage building on platform 1. A truss solution matching the south eastern end is assumed.

### 08.3.6.11 Modifications to Lawson Street Concourse for New Stair to Platform 2/3

- Structural modifications are required to the Lawson Street concourse to create a void to accommodate the new stair.
- The steel beams that currently support the southern edge of the concourse are supported on two steel columns at the end of Platforms 2/3. It is proposed to replace both existing columns with a new steel column or RC blade wall on new foundations and to extend/ strengthen the existing steel beams along the southern edge of the concourse for the new support condition. However, if strengthening is not feasible, it may be necessary to install new (upstand) trimmer beams along the southern edge of the concourse (on the south side of the new stair) spanning between supports on platforms 1 and platform 4/5.
  The existing steel beams within the new stair void will be removed along with the RC slab. The parts of the existing steel beams that are to be retained would require new connections to the new steel trimmer beams.

### 08.3.6.12 Structural Modifications to Illawarra Line Station Box

- Openings will be created in the Illawarra Line Station Box concrete capping slab for the skylights / smoke exhaust shaft venting. The steel beams supporting the capping slab will need to be retained and circular reinforced concrete walls will be used to trim the openings and retain the backfill.
- Installation of a new egress stair to street level at the south end of the platforms. Some steel beams supporting the capping slab will need to be removed and the opening trimmed with reinforced concrete beams. Retaining walls will be required around the opening to retain the backfill.
- Installation of a new reinforced concrete egress stair

between platform and intermediate concourse / mezzanine level within the existing escalator void
- A lightweight steel glazed lift is installed within the existing escalator pit servicing between platform and intermediate concourse / mezzanine level. The original drawings suggest that the existing pit may be deep enough for the new lift. An opening for the lift shaft will need to be cut in the intermediate concourse. This will require cutting of the reinforced concrete slab and one or two steel beams and trimming of the opening with new steel beams.
- A new escalator is provided in the location of the existing stair. This will require excavation to construct a new pit below platform level and extension of the intermediate concourse into the existing stair void to support the new escalator and form the escalator landing. This would require new steel beams and reinforced concrete slab.

#### 08.3.6.13 Commercial Development Enabling Works

- The commercial office development site has been located clear of the Illawarra line structures to remove the requirement for extensive enabling works to be carried out to the Illawarra line structures.
- Retail development at concourse level is located to the north of the station manager's office and ticketing would require infill structure within the existing excavation void. The southern rail tunnels to the north of the void are likely to have adequate load capacity to support single storey retail.

#### 08.3.6.14 Summary of Issues and Risks

The structural issues and risks are as follows:

- Concourse and platform structures on 125-127 Little Eveleigh Street, Platform 1 and some parts of Platform 2/3 are located over the proposed North Eveleigh Dive / Metro West protection zone. Foundations are required that do not comply with the protection zone conditions.
- Geotechnical site investigation is required in the vicinity of the proposed foundations. This information is crucial in order to determine the cost and practicality of the foundation options and progress the design.
- A detailed services survey for the existing services within the Redfern Station boundary was not available. A Dial-Before-You-Dig enquiry was undertaken, but this was insufficient to identify services that are in close proximity to the proposed foundations.
- Topographical survey is required to locate the ACDEP engine dive plan position and levels.
- Structural survey is required to verify that the structure of the ACDEP engine dive is consistent with the available documentation.
- Structural survey is required of the Illawarra line structures in the areas subject to structural modification to determine the existing structure and/or verify existing documentation.
- Structural survey is required to assess the structural condition and determine the remaining load capacity of the existing exposed rusted steelwork in the excavation void (to determine whether it is cost effective to retain).
- Structural survey is required of the existing southern rail tunnels and associated suspended structures to assess the structural condition and determine the load capacity.

## 08.3.7 Fire and life safety (Fire engineering)

#### 08.3.7.1 Existing Station

The existing station has the following key fire safety issues:

1. Long single direction of escape from Platform 11 and 12 (Eastern Suburbs Line).
2. No smoke control from the Platform 11 and 12.
3. Non-fire rated beams above sections of Platform 11 and 12.
4. Long single direction of escape from the platforms and inadequate exit width from Platforms 1 to 9.

#### 08.3.7.2 Station Redevelopment

The new concourse will improve safety in relation to Item 4, by reducing the travel distances on Platforms 1 to 9 and increasing the exit width capacity; however, there will still be a long single direction of travel and on some platforms inadequate width.

#### 08.3.7.2 Codes and Regulations

Platforms 11 and 12 can be addressed by the Building Code of Australia and the RailCorp standard for underground stations. Codes and regulations in NSW do not adequately address above ground rail stations (Platforms 1 to 10 and the concourse); however interpretations of their requirements can be made.

As an existing station, there is a limit to what can implemented at the station to improve fire safety. This is recognised in legislation. The key principle is that fire safety should be improved as much as practicable.

#### 08.3.7.3 Fire Safety Upgrade

The following fire safety measures should be implemented, in addition to the construction of the new concourse and underground station entrance:

1. New fire isolated stair to be built at the southern end of Platforms 11 and 12 (Eastern Suburbs Line).
2. Provide smoke control from the Platforms 11 and 12. The preliminary proposal has adopted natural ventilation.

The proposals will be subject to further design development. In addition to these measures,
the following active system are required throughout the station as per the BCA, Australian Standards and RailCorp Standards:

- Occupant warning and public address system to all areas;
- Smoke detection at Platform 11 and 12 and in enclosed areas;
- Sprinklers to back of house areas in the ESL underground station section, and to risk areas, such as escalator pits;
- Emergency lighting and exit signage; and
- Fire fighting systems (hydrants, hose reels and extinguishers) per code.

The following can be subject to further review to determine the effectiveness of adopting these measures, as follows:

#### 08.3.7.4 Fire rate all the beams above Platforms 11 and 12

Undertake fire engineering assessment to determine the risk associated with having non-fire protected beams.

#### 08.3.7.5 Retain the northern stair to Platforms 1 to 9

RailCorp should carry out a risk review by to compare the overall risk associated with retaining or removing the existing northern stairs. The risk assessment will need to address emergency evacuation, slips trips and falls, and operational management in an emergency.

## 08.3.8 Rail systems engineering

### 08.3.8.1 Overhead Wiring Proposal

**Down & Up Main**

- Provide alternate anchor for crossover wire on No.1 Platform.
- Support the OHW from the signal gantry at ~SW1+337 and Sydney face beam of new concourse. The span to Signal gantry will be approximately 38m and from the new concourse to SW1+233 will be approximately 55m.

**Down & Up Suburban proposal**

- Disconnect Down & Up Suburbans OHW from SW1+304 and attach to the country face of the new concourse. There is some curvature of the track but it seems likely that the geometry will work. The span from the country face of the new concourse to SW1+340 would be approximately 35m.
- Disconnect Down & Up Suburbans OHW from SW1+267 and attach to the Sydney face of the new concourse. There is some curvature of the track but it seems likely that the geometry will work. The span from the Sydney face of the new concourse to SW1+233 would be approximately 47m.
- If the geometry will not work it will be necessary to provide a new portal over the Down & Up Suburbans between Sydney face of the new concourse and SW1+233 clear of the platform 4 / 5 Sydney side stair. Alternately, on a cost / benefit basis it may be acceptable to provide hand-rails around the leg of SW1+267 and leave it just at the foot of the stair - the stair is quite wide - architects to confirm if this is an acceptable option.

**Down & Up Local**

- Disconnect Down & Up Locals OHW from SW1+267 and attach to the Sydney face of the new concourse. There is some curvature of the track but it seems likely that the geometry will work. The span from the Sydney face of the new concourse to SW1+233 would be approximately 40m.
- Replace the span of SW1+304 over the down & up Locals with a cantilevered boom and double drop vertical nose. Assumes that the foundation and leg on platform 6 / 7 is suitable for the greater loads and that the structure can reasonably be modified. Also assumes that the clearance from the foot of the country side stair on platform 6 / 7 to the existing leg is acceptable.

**Down & Up Illawarra Local**

- Disconnect OHW from SW1+267 and attach to the Sydney face of the new concourse. There is some curvature of the track but it seems likely that the geometry will work. The span from the Sydney face of the new concourse to SW1+233 would be approximately 33m.

**Down & Up Illawarra**

- Disconnect OHW from SW1+267 and attach to the new concourse. The spans would be essentially unchanged.

**Summary of Issues and Risks**

- The supports of the OHW from the new concourse must be insulated from the concrete with secondary insulation. The design of the secondary insulation system requires care and attention to detail to ensure the long term integrity of the insulation.
- A full OHW design will be required to assess vertical clearances and pantograph security / stagger.
- OHW field resources are scarce and it will be essential to ensure that a stage is not attempted with inadequate resources on site if time overruns are to be avoided.
- Careful survey and measurement will be essential to ensure that as much pre-assembly as possible can be done successfully.

### 08.3.8.2 Signalling Proposal

- The preferred solution is to leave the signal at its present location and lower the signal head to restore the sighting distance. To this end a detailed survey should be made to establish the relative positions of the kinematic envelopes for the Down and Up main lines to the signal gantry and the underside of the proposed concourse.
- It is recommended that a search be undertaken to identify technology that allows the signal heads to be raised to gantry level rather than accessed from within a cage as this should allow a narrower assembly that could be positioned lower (closer to the kinematic envelopes) to achieve better sighting under the concourse. Such an arrangement would also eliminate the longstanding personnel safety issues with accessing the signal via the cage arrangement.
- Provided that the signal head was well constrained on a track, the lateral electrical clearance required to the OHW and pantograph would be quite modest (~200mm). Provided that the new arrangement mounted a standard signalling head the type approval issues may not be too onerous. Once the minimum practical height for the signal head between the Down and Up Main lines has been determined a long section should be developed to determine the likely sighting distance.
- Should the first option not prove feasible then moving the signal to the Sydney side of the proposed concourse will be necessary. Given the constraints of the heritage building on platform 1 and the new stair on platforms 2 / 3 it seems likely that the signal would have to be supported from the Sydney face of the new concourse, potentially with maintenance access from the concourse.
- It may be possible to reduce construction time by having the signal pre-mounted on the edge plank before the plank is lifted into position. However, maintenance access to the signal would be required throughout the period while the concourse is under construction.

**Summary of Issues and Risks**

- Signalling resources (design, construction and commissioning) are heavily constrained – non availability of the required resources is a risk.
- Type approval for any slide-down signal arrangement will be non-trivial. However, RailCorp are likely to have other uses for such a configuration and would likely welcome a catalyst to trigger its adoption.
- If the two level combined concourse and un-paid link makes the first option practical then the cost and resource issues associated with relocating the signal may be the deciding factor in relation to the configuration of the un-paid link.

# 09 Construction Methodology

## 09.1 Introduction

The construction methodology has been prepared by Bovis Lend Lease Consulting (BLLC). Initially BLLC reviewed the available existing documentation on the Redfern station, both the peripheral documents and the documents associated with the previous concept design done by Jackson Teece. In addition BLLC used their knowledge and experience on other stations, including proposed concept designs, completed station upgrades as well as reviewing existing stations to assist in developing a robust construction methodology.

The construction methodology has been developed based on a number of assumptions that BLLC consider reasonable but are subject to further consideration by RailCorp prior to or during the detailed design phase.

The most efficient and safest method to undertake construction works in the rail environment is during track possessions when train services are suspended and power to the OHW is isolated. However, the limited number and relatively short duration of track possessions, can lead to prolonged project durations and intensive work schedules increasing the risk of delayed hand back and train operation disruption. Therefore, the construction methodology has been developed to not only rely on works being undertaken during possessions but also undertake works during normal working hours, so as to achieve the most efficient construction methodology whilst reducing risks of disruptions to train.

In order to be able to undertake works during normal working hours in a rail environment, the works need to be separated from passengers, station staff and railway systems (e.g. OHW) through staging and protective hoardings.

## 09.2 Staging

One of the key criteria for the revised concept design was to make sure the station redevelopment works could be constructed separately from any potential commercial development works. The revised concept design allows construction of the new centrally located concourse and the upgrade of the Illawarra reliefs, whilst not inhibiting the commercial development proposed in the revised concept design.

Staging of the actual construction works for the station is therefore only needed to keep the station accessable and in operation during construction.

The existing concourse and station facilities at the city end of the station will remain operational during the construction works on and above the platforms. After the new concourse has been commissioned the existing concourse will be decommissioned.

For the Illawarra Relief, staging is critical to maintaining adequate access and egress to and from the platforms. The Illawarra Relief staging is outlined below:

### Stage 1

- Construct new egress stairs (southern side of platforms 11 and 12) which will be used as temporary access during construction until new station is commissioned.
- Demolish existing stairs.
- Install new escalators to mezzanine concourse (access via platform 10 and “new walkway”)

### Stage 2

- New escalators operational
- Remove existing escalators
- Construct new stairs and lift
- Fill “voids” in slab

### Stage 3

- New stairs and lift operational
- Demolish existing building above escalator machine room floor level
- Waterproof slab.

## 09.3 Surface Construction Sequence

The construction sequence for the new concourse and unpaid pedestrian and cycle bridge in option 1 of the revised concept design are very similar and are outlined in the indicative programme. The main difference is that the narrower platform width at the proposed location of the unpaid pedestrian and cycle bridge prevents some of the substructure works being undertaken during normal working hours. It has been assumed that these works can only be undertaken during possessions; however, working in these areas at night could be explored further by the construction contractor.

The construction sequence on platforms would be as follows:

- Relocate services and station operation equipment such as SPIs, Emergency Help Points, Precise Clocks (possession);
- Construct control rooms (these could be modular units built offsite and delivered to site during a possession);
- Migration to control rooms (possession or normal weekend);
- Demolish existing buildings and awnings (possession);
- Erect hoardings(dayworks);
- Construct piles, pile caps, stair landings, awning foundations control room foundations, columns and headstocks (dayworks except for unpaid footbridge where narrow platforms do not permit) –;
- Due to the risk of platform subsidence, the excavation of lifts pits have scheduled during possessions;
- Erect platform awnings (possession);
- Re-profile platform surface for Level Access (possession).

## 09.4 Illawarra Relief and Void between Platforms 10 and 11

Platforms 11 & 12 are serviced by the Up and Down Illawarra Relief lines which form part of the Eastern Suburbs Railway (ESR) and are located to the east of Platform 10. The reduced level of Platform 11 & 12 is approximately 6m below the surface platforms. There is an intermediate concourse level in between the ground level and platform level. In between Platforms 10 and 11 is the corridor for proposed Southern Suburbs Railway which was never progressed. Although tunnels were constructed at the Northern end of Redfern Station and some structural steel was erected for the station building, essentially a void has been left in this area.

It is envisaged that the existing steel grillage erected for the Southern Suburbs Railway will be utilised for the link between the new concourse and Platforms 11 & 12 as well as extending the covered area on grade with the concourse. This will ensure that the station upgrade works will not significantly inhibit any future development with the void bounded by the retaining wall along Platform 10, the Southern Suburbs tunnels, the ESR and the existing steel grillage remaining unimproved until such commercial or retail development is undertaken.

The existing steel shows signs of corrosion and requires closer inspection by a structural engineer as to its integrity. It is assumed that it can be remediated to a condition suitable for supporting the link between Platforms 10 &11 as well as extending the covered area on grade with the concourse.

In addition to the link between Platforms 10 & 11, there are substantial works to be undertaken in the ESR station building. In order to maintain station operations, the works in the ESR need to be staged. The staging has been included in the indicative programme and is outlined as follows:

- Erect hoardings and construct new emergency egress route at southern end of platforms (Dayworks with access from above ESR);
- Construct smoke exhaust vents (Dayworks with access from above ESR);
- Hoard off existing stairs and demolish (Dayworks and Nightworks);
- Build new escalators in void left from demolished stairs (possession);
- Close and remove existing escalators (possession) – Note that substantial time savings may be gained if this activity is not dependent on the opening of the new concourse and passengers access/egress the new escalators via Platform 10;
- Construct new city end stair and lift in void left by escalators (Dayworks and Nightworks),
- Resurface platforms to provide Level Access (Possession);
- Fill stair and escalator voids in ground level slab (Dayworks and Nightworks);
- Demolish exiting roof structure to ground level (Dayworks);
- Waterproof ground level slab (Dayworks);
- Landscaping (Dayworks).

The existing beams supporting the roof of the ESR are exposed and some are displaying signs of advanced corrosion. Further investigation is required to determine the extent of the corrosion and to develop remediation requirements. Until further investigations are undertaken, no allowance has been made for remedial works. In addition to remedial works, the beams will require fire-rating to comply with fire and life safety requirements. As the beams extend across the tracks and OHW, the remedial and fire-rating work will need to be carried out during (weekend) possessions. Bovis Lend Lease consider any remedial works to the beams to be independent of the station redevelopment works and although the works will need to be carried out during the project, any costs associated with remedial works should be independent of the project funding.

## 09.4 Constraints on Buildability

- The programme for the proposed revised option C is possession driven (approximately 36 months, please refer to programme) ie the duration is directly linked to available possessions.
- The revised design does not require any construction interface between the station with development works by others.
- Minimal impact to the existing concourse until it is decommissioned.
- Although the extent has been reduced in the revised design OHW works are still required due to the new concourse and pedestrian and cycle bridge.
- The Signal SY455 will need to be relocated.
- The extent of construction which can be undertaken during normal train operations is limited due to the allowable limits on the impact to passengers on surface platforms (eg temporarily no weather protection during awning demolition and reduced platform widths due to construction hoardings)
- The extent of construction which can be undertaken during normal train operations is limited due to the allowable limits on the impact on passengers using Illawarra Relief and staff due to temporary access

There are several opportunities to potentially reduce the time frame through alternative possessions. Bovis Lend Lease Consulting has discussed the following possessions with RailCorp and achieved an in principal agreement to their possibility:

- Five day closedowns over Christmas (2x)
- No stopping of trains on platforms 1 and 10 for a period of 26 weeks (not simultaneously)
- No stopping of trains on platforms during substructure works (one island platform at a time for approximately 1 month and 3 months for the ESR)

The proposed possessions will reduce time, costs and improve safety. In addition, a shorter timeframe will result in the project risks to RailCorp also to be reduced.

These possessions should be reviewed and endorsed by RailCorp prior to commencement of the detailed design.

# 10 Costplan

The cost estimation is based on the revised option C which has three options for the unpaid pedestrian and cycle bridge: option 1 unpaid bridge at southern end of platforms, on grade to concourse, option 2 unpaid bridge suspended above new concourse and option 3 a separate unpaid bridge parallel to the paid concourse which will be in line with option 1 in relation to costs. In summary the scope is:

- Increase station capacity to 2061 patronage;
- Provide Easy access
- Provide Fire & Life Safety compliance;
- New RailCorp Staff Facilities;
- New centrally located concourse for surface platforms with lift access to all platforms plus new access to ESR mezzanine level;
- Modification of ESR with centralised access and new fire egress stairs including fire rating of beams;
- Resurfacing of to all platforms;
- New canopies to platforms 2-9;
- Decommissioning existing station building on Lawson street;
- Create fire egress route on existing concourse (using existing stairs);
- Landscaping.

A summary of the cost estimation for the two options is shown below:

| Preliminary Concept Design - Revised Option C – Standard Possessions | | |
|---|---|---|
| | Option 1 (34months) | Option 2 (35months) |
| Total Project Costs At 2009 | [redacted] | |

| Preliminary Concept Design - Revised Option C – Alternative preferred Possessions | | |
|---|---|---|
| | Option 1 (29months) | Option 2 (30months) |
| Total Project Costs At 2009 | [redacted] | |

# 11 Assessment

## 11.1 Performance against Peer Review recommendations Architecture and Urban Design

The revised design proposal achieves enhancement of the previous Option C in the majority of areas indentified in the Architecture and Urban design Peer review as potential improvements:

- The main concourse is more perpendicular to the tracks thereby minimising its built area (within the constraints of platform widths and clearance guideline)
- The proposal includes an option for an unpaid link sitting above the main concourse
- The extension of the Park on Gibbons street and clear articulation of the station entrance improves the urban environment east of the station
- The proposal includes options for retention of the Lawson Street concourse for as fire egress only
- Connection of both an entrance into the station and the unpaid bridge link onto Little Eveleigh Street enhance the ability of the station to service areas to the northwest.

| Review Criteria | Previous Option C | Optimised Design Proposal |
|---|---|---|
| Urban design | Average | Good |
| Visible Station entrance | Poor | Good |
| Clarity of Station planning | Good | Good |
| Sight Lines / Legibility | Average | Good |
| Equitable Access | Good | Good |
| Passenger Amenity - Comfort - Security | Good | Good |
| Travel Distances to key destinations | Good | Good |
| Heritage Impact | Poor | Poor |
| Unpaid Link across tracks | Average | Good |
| Quality Development around Station | Poor | Good |
| Value for Money | Average | Good |

**Key improvements include:**

- An increase in the quantity and quality of public open space
- Clearly legible station entrances including a new entrance to the north-west
- A strong civic presentation to the station
- Clear sight lines into the station concourse and unpaid link from the public domain
- Enhanced legibility & way finding.
- A safe and active unpaid connection to the North Eveleigh/University precinct that integrates with a new station entrance on the north/west side of the tracks
- Simplification of retail areas so that they flank, rather than obscure, the south-eastern station entrance.
- Deletion of low value retail areas hidden within a retail mall
- Rationalisation of the commercial office floorplate with improved access to daylighting and outlook.
- Re-distribution of station and commercial functions to allow these to be staged according to demand
- Adjustment of the main concourse alignment to reduce it's length and area
- A reduction in impact on OHWS

## 11.2 Crowd modelling

### 11.2.1 Concept Design Features

Overall the Concept Design provides improved passenger amenity with respect to east-west links and vertical provision, significantly improving platform clearance times and quality of journey experience. From a pedestrian movement perspective, the primary design impacts are as follows:

a. The existing northern concourse and stairs are not maintained for normal operations (only for emergency egress). Therefore, all interchange movements and all entry/exit movements use the new centrally located concourse.
b. A new link to P11/P12 from the centrally concourse is proposed, via 2 escalators and a walkway ramp to the concourse level, and then via a 4m stair and 2 escalators to P11/12 platform level.
c. A new 3.6m wide unpaid link is proposed, and will connect from western station plaza to Marian Street at the southeast.

### 11.2.2 Vertical Transportation (VT)

The performance of the proposed Concept Design VT provision has been considered with respect to achieving a 90 seconds platform clearance time, and is summarised on the following tables:

**Concept Design Platform Clearance Time Performance, 2061**

| Platform | Demand (pax in peak min) | | Stair Width (metres) | Max Queue (per stair) | Platform Clearance Time (secs) |
|---|---|---|---|---|---|
| | Alighting | Boarding | | | |
| 1 | 551 | 7 | 4.0 | 340 | 150 |
| 2 / 3 | 0 / 233 | 0 / 180 | 3.8 | 80 | 105 |
| 4 / 5 | 63 / 169 | 108 / 98 | 8.2 | 31 | 45 |
| 6 / 7 | 23 / 266 | 91 / 102 | 6.6 | 74 | 75 |
| 10 (to 11/12) | - | - | 4.0 | - | - |
| 11 / 12 | 312 / 25 | 79 / 58 | 4.0 & 2 Escs | 44 | 45 |

**Concept Design Vertical Transportation Requirements**

| Platform | Concept Design Stair Width (m) | Required Stair Width (m) | Required Width Increase (m) |
|---|---|---|---|
| 1 | 4.0 | 5.8 | 1.8 |
| 2 / 3 | 3.8 | 4.4 | 0.6 |
| 4 / 5 | 8.2 | 4.6 | - |
| 6 / 7 | 6.6 | 6.5 | - |
| 10 (to 11/12) | 4.0 | - | - |
| 11 / 12 | 4.0 & 2 Escs | 3.0 & 2 Escs | - |

The key performance issues of the proposed VT provision are as follows:

d. The service frequency of P1 is expected to be 7tph in 2061, which implies an average headway of 8 to 9 minutes. The volume of alighting passengers from Platform 1 will clear in approximately 150 seconds, and an additional 1.8m is required to meet the 90 seconds criteria. However, the relatively low service frequency of trains on P1 suggests that consideration should be given to tolerating a clearance time of >90 seconds.
e. Further VT width is required to serve Platform 2/3 in order to meet the target 90 seconds platform clearance time. However, given the spatial constraints (the P2/3 platform width), it is noted that there is limited opportunity to increase the VT capacity to P2/3 and that the platform is estimated to meet targets up to 2053.
f. Although the VT serving the alighting loads on P11/12 can meet 90 seconds clearance time target, the VT provision from the transfer concourse to the concourse bridge (1 escalator UP) will be a bottleneck. A queue of up to 100 persons is estimated to form at the base of the escalator, with up to a minute of queueing likely.
g. All other platforms cater for the anticipated 2061 demand levels within the 90 seconds clearance time criteria.
h. The existing northern concourse is proposed to be used only for emergency egress, but also provides an opportunity to act as an interchange route. This would provide additional overall VT capacity and reduce platform clearance times on all platforms, and would separate the primary flows therefore alleviating demand to the new central concourse VT. However, this option has been rejected based on other constraints (e.g. requirement of additional lifts).

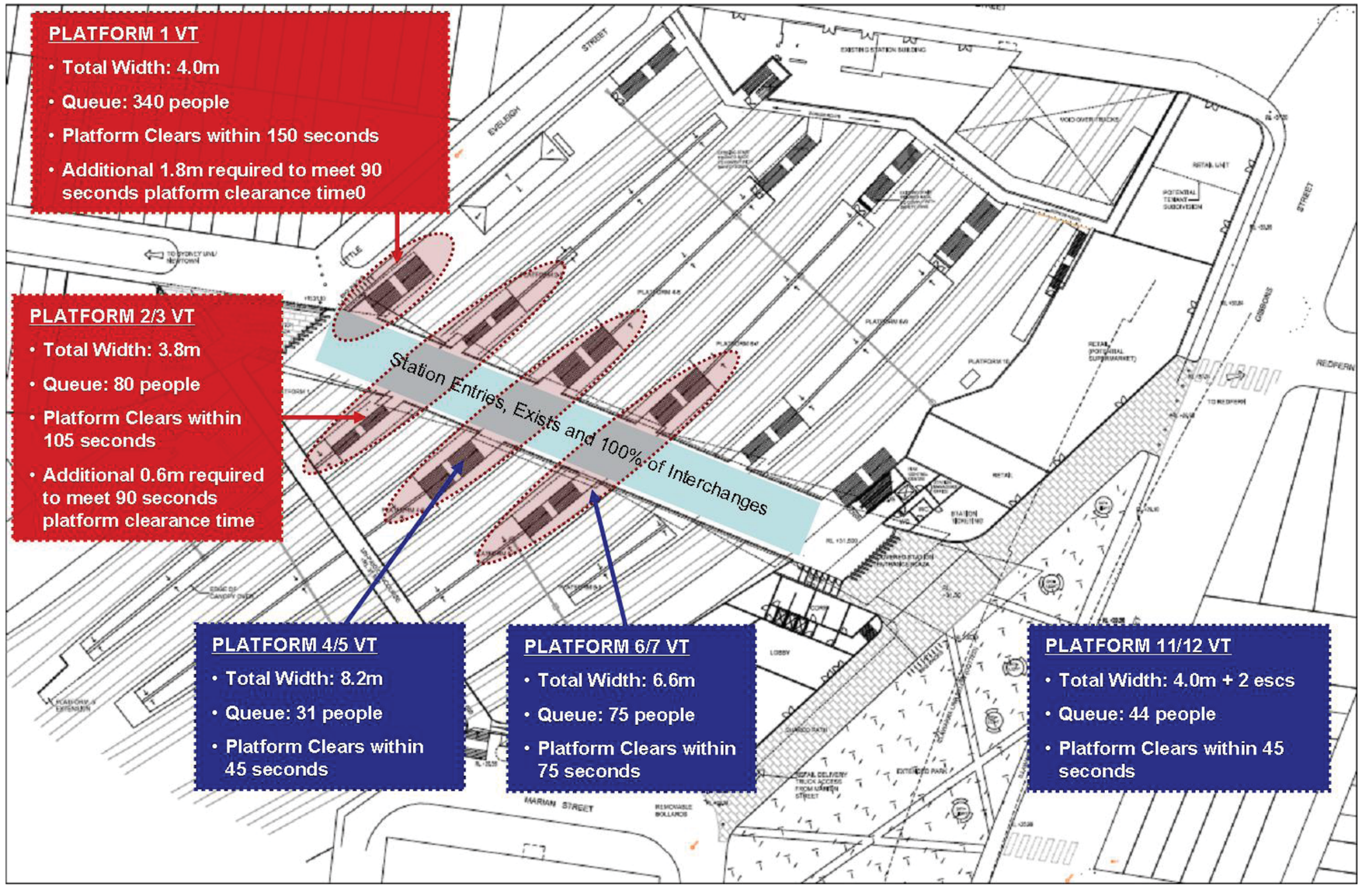
### 11.2.3 Proposed Concourse

a. The Concept Design provides between 12m and 13m of concourse width, and is therefore in accordance with the pedestrian movement requirements (12m minimum). However, given that the concourse is not positioned perpendicular to the VT, the layout is not fully efficient with the available width. Given the complex mix of bi-directional flows are waiting/queueing behaviours predicted within this space, a dynamic simulation of the concourse would be required to fully understand and finalise the concourse width requirements and performance.

b. The gateline provision recommended is based on 2061 demand levels, and can be introduced in stages as to reflect the annual gateline requirements. For example, in 2031, it is estimated that a total of 17 will be required across both the east and west gatelines.

A comparison of the required gateline provision against the Concept Design provision is provided below.

| Station Entrance | Recommended Number of Gates (inc DDA) | Concept Design Provisions |
|---|---|---|
| East | 13 | 12 |
| West | 9 | 9 |



## 11.3 Engineering

Although subject to further design development, key Improvements in the revised concept design engineering are as follows:

### Civil, Structural and Railway Systems

- Avoids construction of the commercial building development over the Illawarra Relief, considerably reducing the impact on the rail corridor beneath and the associated enabling works
- The option with the unpaid concourse over the paid concourse considerably reduces the scope of construction work and maintenance over the live railway corridor
- BOH and toilets and resulting services have been removed from over the live rail corridor
- The restrictions of the Metro West protection zone have been identified and addressed in the concept design
- The restriction on piled foundations to beyond 2.6m from the platform edge has been relaxed
- The preferred approach of a precast concrete concourse structure and insitu platform support structures has been maintained, but a narrower and slightly more perpendicular concourse alignment has been achieved
- The existing substation transformers are assessed not to require upgrade for the additional demand from the station redevelopment
- OHWS works have been minimised by minimising the width, and fine tuning the position of the new concourse and attaching the OHW to the new concourse
- A proposed construction sequence for OHWS works has been established
- Retention of signal SY455 at its present location is considered possible (for the option positioning the unpaid concourse over the paid concourse) with the signal head lowered closer to the kinematic envelopes to restore the sighting distance (possibly with height adjustability to allow a narrower assembly that could be positioned lower and that would eliminate the longstanding personnel safety issues with accessing the signal via the cage).

### Fire Life Safety

The following fire safety measures are incorporated in the revised concept design, in addition to the new concourse and stairs and link to Platforms 11 and 12:

- The northern stairs to Platforms 1, 4 to 9 are retained for emergency egress
- Platform 3 is extended and new switchback emergency egress stair is provided at the northern end of Platforms 2 and 3, improving platform circulation
- New fire isolated emergency egress stairs are provided at the southern end of Platforms 11 and 12 (Eastern Suburbs Line)
- Smoke control is provided from Platforms 11 /12
- Steel beams above Platforms 11/12 are to be fire protected

The following active systems are required throughout the station as per the BCA, Australian Standards and RailCorp Standards:

- Occupant warning and public address system to all areas;
- Smoke detection at Platform 11 /12 and in enclosed areas;
- Sprinklers to back of house areas in the ESL underground station section, and to risk areas, such as escalator pits;
- Emergency lighting and exit signage; and
- Fire fighting systems (hydrants, hose reels and extinguishers) per code.

# 12 Next Steps

## 12.1 Introduction

Assuming Business Case and Treasury approval of the proposed revised concept design, the next major step will be to develop the design and document this for tender in accordance with the Railcorp selected procurement methodology. A number of issues have been identified requiring RailCorp action (as noted in item 12.2) in order to provide clarification, define boundaries and determine scope. We believe prioritised action in these areas will contribute to a smooth transition into the next phase and efficient delivery of the project.

## 12.2 Design interfaces

Several design interfaces have been identified where RailCorp needs to direct the project what should be considered in scope and out scope. The interfaces which could have a major impact on the design development, but are not exhaustive, are:

- The proposed Metro West dive (North Eveleigh) - Railcorp direction required as to whether or not the redevelopment of Redfern Station should attempt to allow for integration of a potential future station box.
- The revised concept design proposes a change in the character of Little Eveleigh Street that may be related to this project or broader RWA urban design strategies. - RailCorp to determine project boundaries.
- The proposed revised concept design proposes the extension of the Park along Gibbons Street that may be related to this project or broader RWA urban design strategies. - RailCorp to determine project exact scope/ site boundaries.

## 12.3 Design decisions

The revised concept design has been influenced by recommendations derived from the peer review and the value engineering processes, and several options are outlined in the proposal. Clarification of Railcorp preferences will be required for the design to progress.

- **Unpaid pedestrian & cycle bridge**
  Three options are outlined in the proposal: option 1 and 3 contains the unpaid bridge on grade to the south of the paid concourse and option 2 contains the unpaid bridge above the paid concourse within a shared roof structure. Both options have their advantages and disadvantages as described in the report. - Railcorp to determine preference.

- **Northern end concourse**
  The revised concept design follows the advice of ARUP's fire engineer to retain the existing stairs from the platforms 1-10 to the existing concourse. The stair from platform 2/3 has been relocated to the far north of the platform to comply with required clearance guidelines to platform edge. - It is recommended that RailCorp carry out a risk assessment to compare the overall risks associated with retaining or removing the existing northern stairs. The risk assessment will need to address emergency evacuation, slips trips and falls, and operational management in an emergency.

- **Smoke control on Illawarra Relief**
  The revised concept design has adopted natural ventilation through skylight ducts to address smoke control from platforms 11/12. Other options are outlined in the Fire Life Safety sections of the report. - It is recommended that further study of the detailed options is required prior to finalisation but that Railcorp provide feedback on any design preferences at this stage.

- **Staging of development**

The revised concept design proposes commercial development opportunities adjacent to the station facilities. These have been designed to permit construction separate to the station works and with minimal impact on station. However construction of some parts of the commercial development works with the initial station project would assist is activation of the station precinct and provide passive surveillance contributing to greater public and commuter safety. - RailCorp to determine project boundaries.

### Required information

The proposed concept design is based on the quantity and quality of information available at the time. Survey and As-Built information was not comprehensive and in some cases was inconsistent with observations on site. - It is recommended that selected investigations and surveys are carried as soon as possible to reduce design risk. These include:

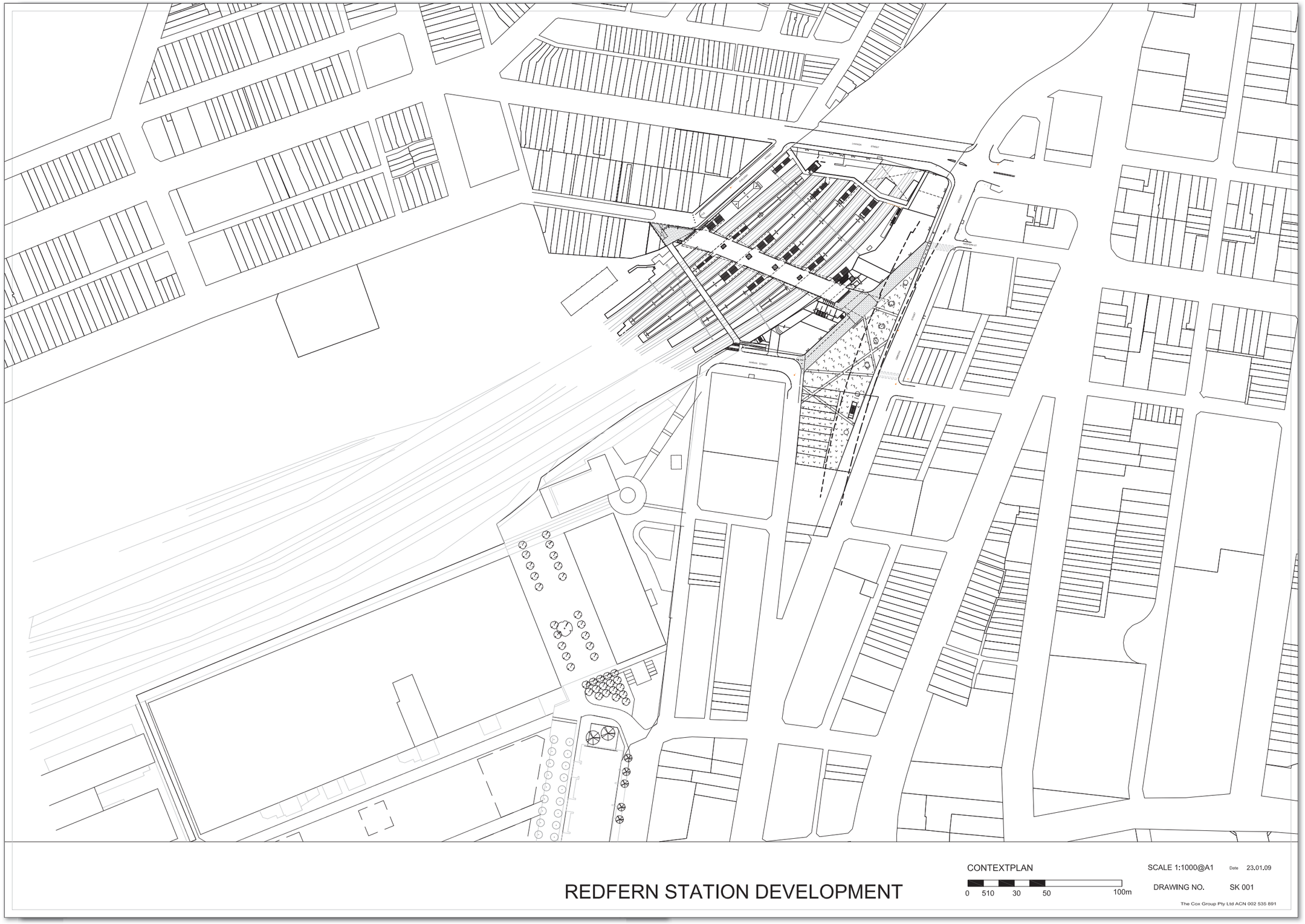
- Geotechnical investigations (particularly in area of Metro West Dive)
- Boundary survey
- Services search
- Survey existing building (verify as built information)
- Structural integrity
- Hazardous material survey

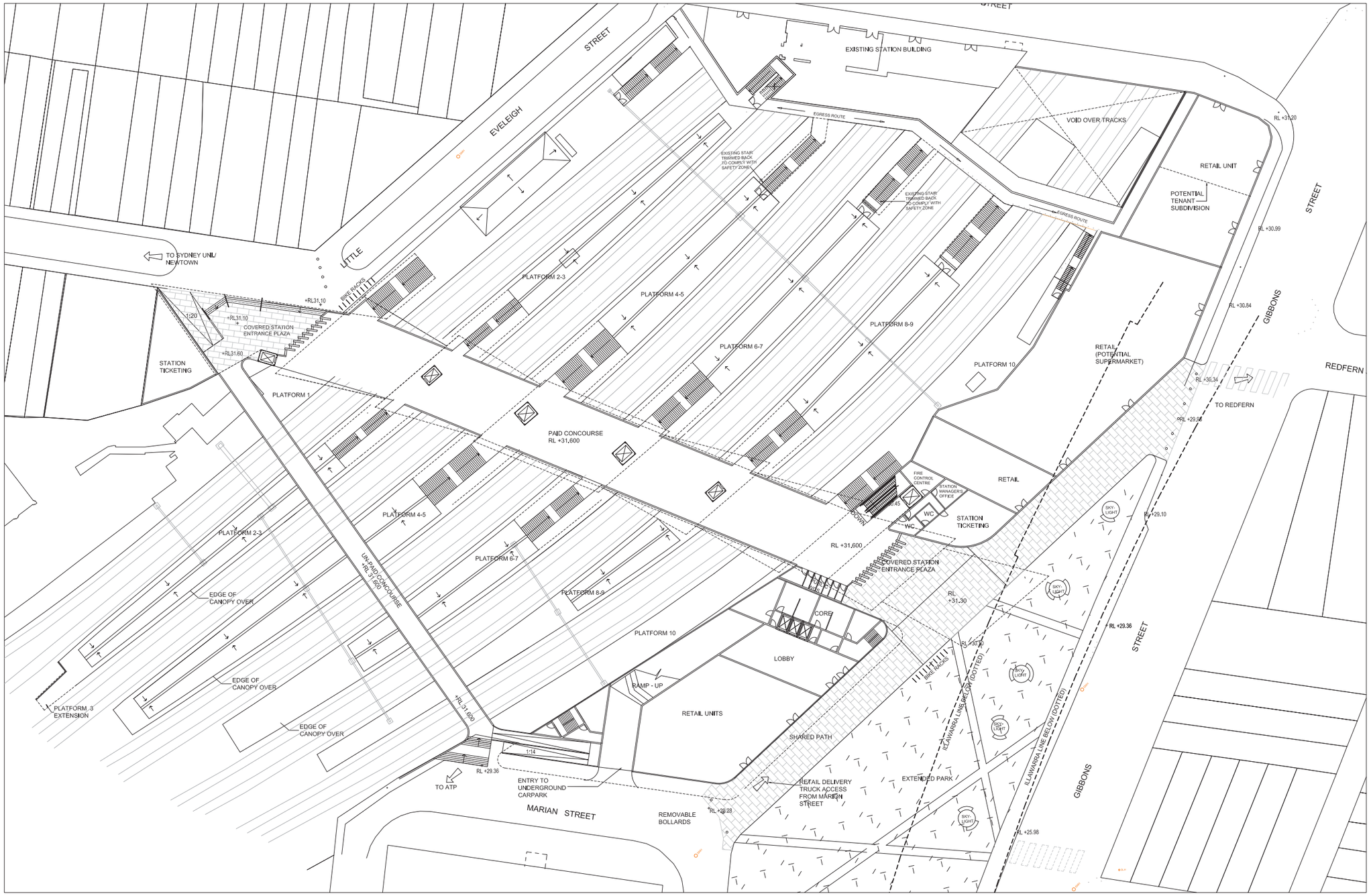
### Further recommendations

It is assumed that the next phase of design work will include input from the following specialist disciplines:

- Heritage Architecture
- Building Services Engineering
- Traffic Engineering
- Acoustic Engineering

Appendix Revised Concept Design Drawings






**Cox Richardson**
Level 2, 204 Clarence Street, Sydney 2000 Australia
Tel : 612 9267 9599 Fax : 612 9264 5844
Email : sydney@cox.com.au
Architecture Planning Urban design Interior design Health facility design

# REDFERN STATION DEVELOPMENT

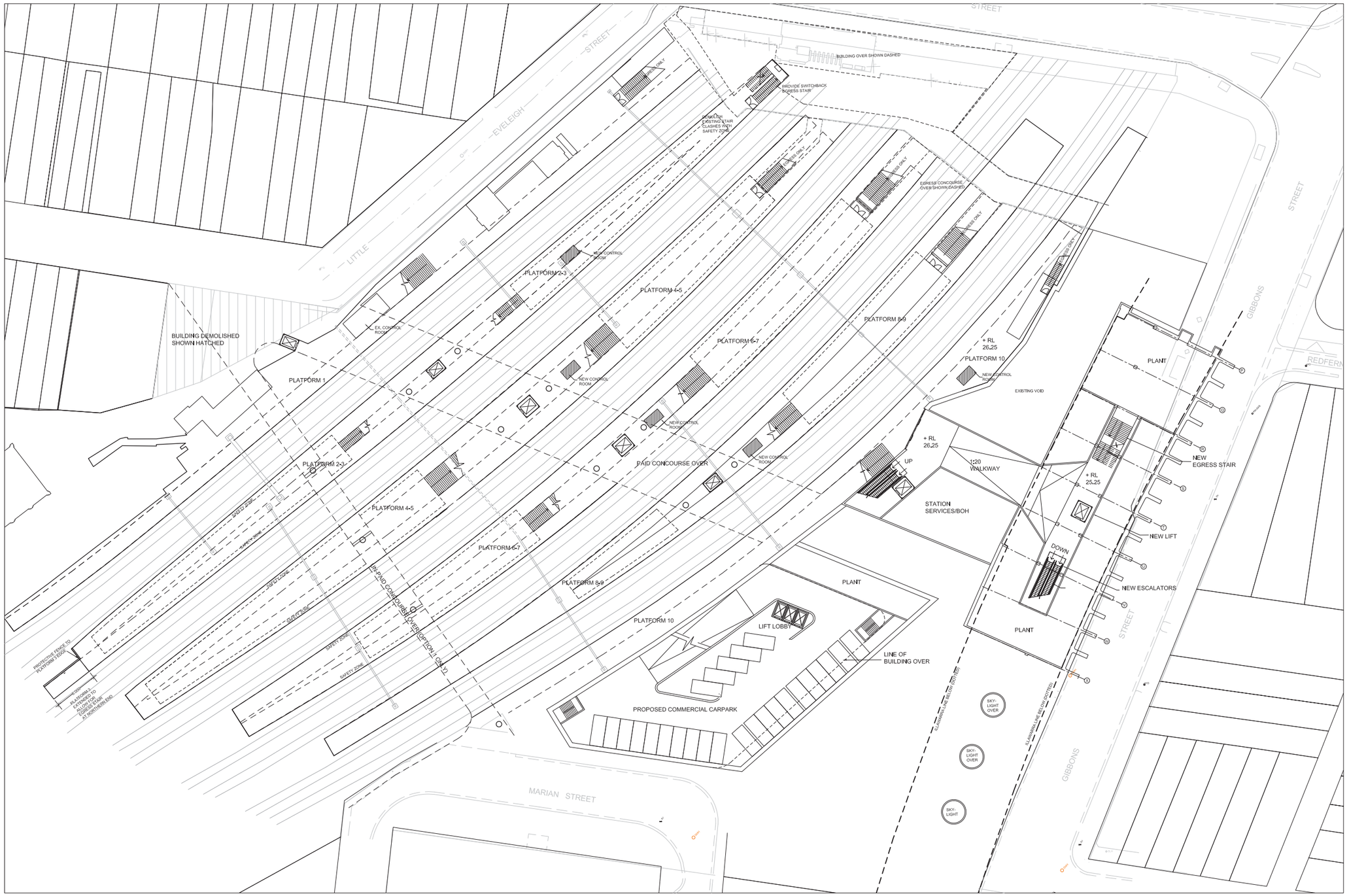
CONCOURSE PLAN - OPTION 1

SCALE 1:250@B1 Date 23.01.09

DRAWING NO. SK 001

0 5 10 20 25m

Appendix Revised Concept design drawings





**Cox Richardson**
Level 2, 204 Clarence Street, Sydney 2000 Australia
Tel : 612 9267 9599 Fax : 612 9264 5844
Email : sydney@cox.com.au


Architecture Planning Urban design Interior design Health facility design

COX

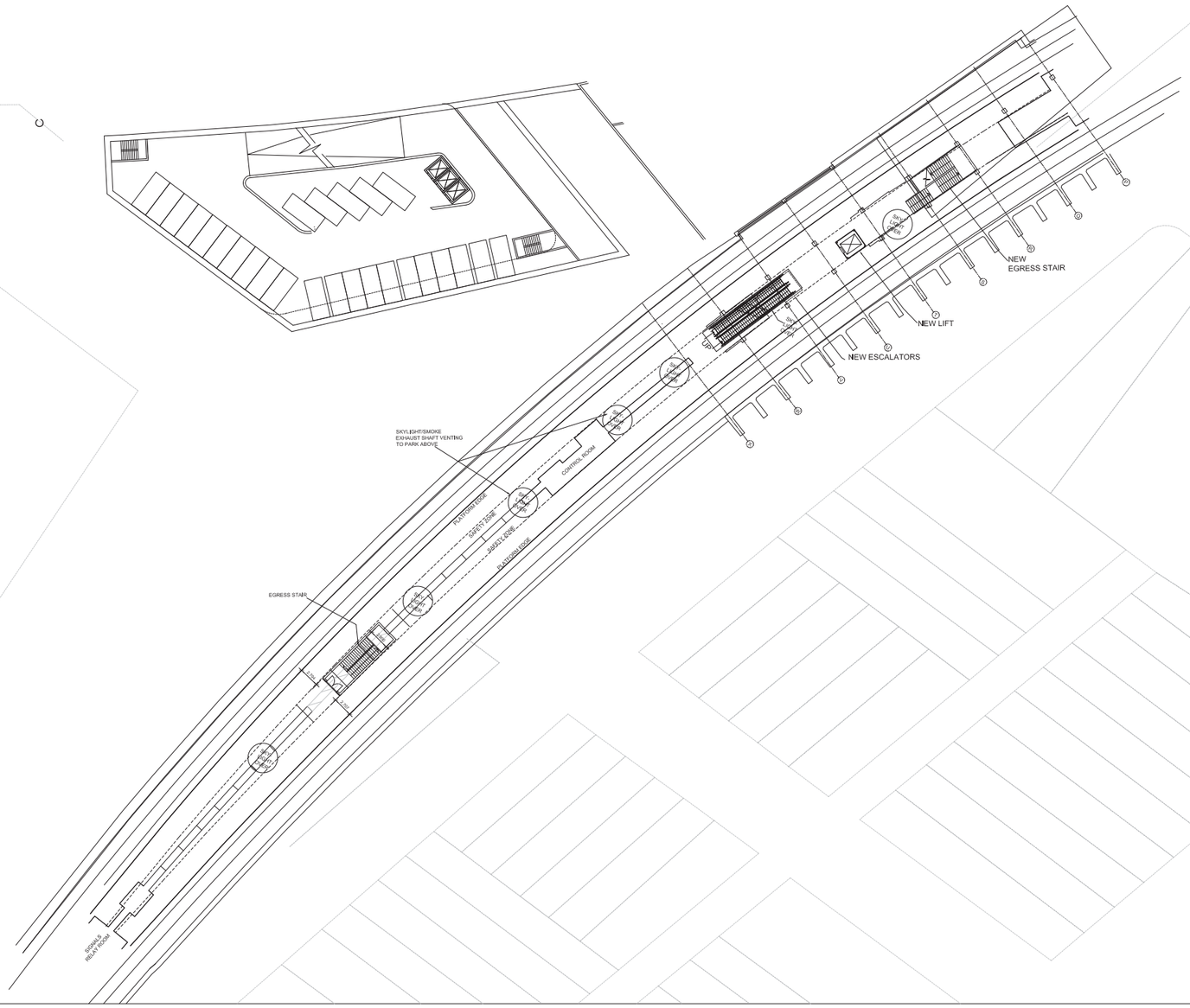
# REDFERN STATION DEVELOPMENT

PLATFORM LEVEL PLAN

0 5 10 20 25m

SCALE 1:250@B1 Date 23.01.09

DRAWING NO. SK 002




**Cox Richardson**
Level 2, 204 Clarence Street, Sydney 2000 Australia
Tel : 612 9267 9599 Fax : 612 9264 5844
Email : sydney@cox.com.au
Architecture Planning Urban design Interior design Health facility design

# REDFERN STATION DEVELOPMENT

PLATFORM 11 AND 12 PLAN

SCALE 1:250@B1 Date 23.01.09

DRAWING NO. SK 003

0 5 10 20 25m


**Cox Richardson**
Level 2, 204 Clarence Street, Sydney 2000 Australia
Tel : 612 9267 9599 · Fax : 612 9264 5844
Email : sydney@cox.com.au
Architecture Planning Urban design Interior design Health facility design

COX

Bovis Lend Lease

# REDFERN STATION DEVELOPMENT

ROOF PLAN & TYPICAL COMMERCIAL FLOOR PLAN- OPTION 1

0 5 10 20 25m

SCALE 1:250@ B1 Date 23.01.09

DRAWING NO. SK 004


# REDFERN STATION DEVELOPMENT

ROOF PLAN & TYPICAL COMMERCIAL FLOOR PLAN- OPTION 1

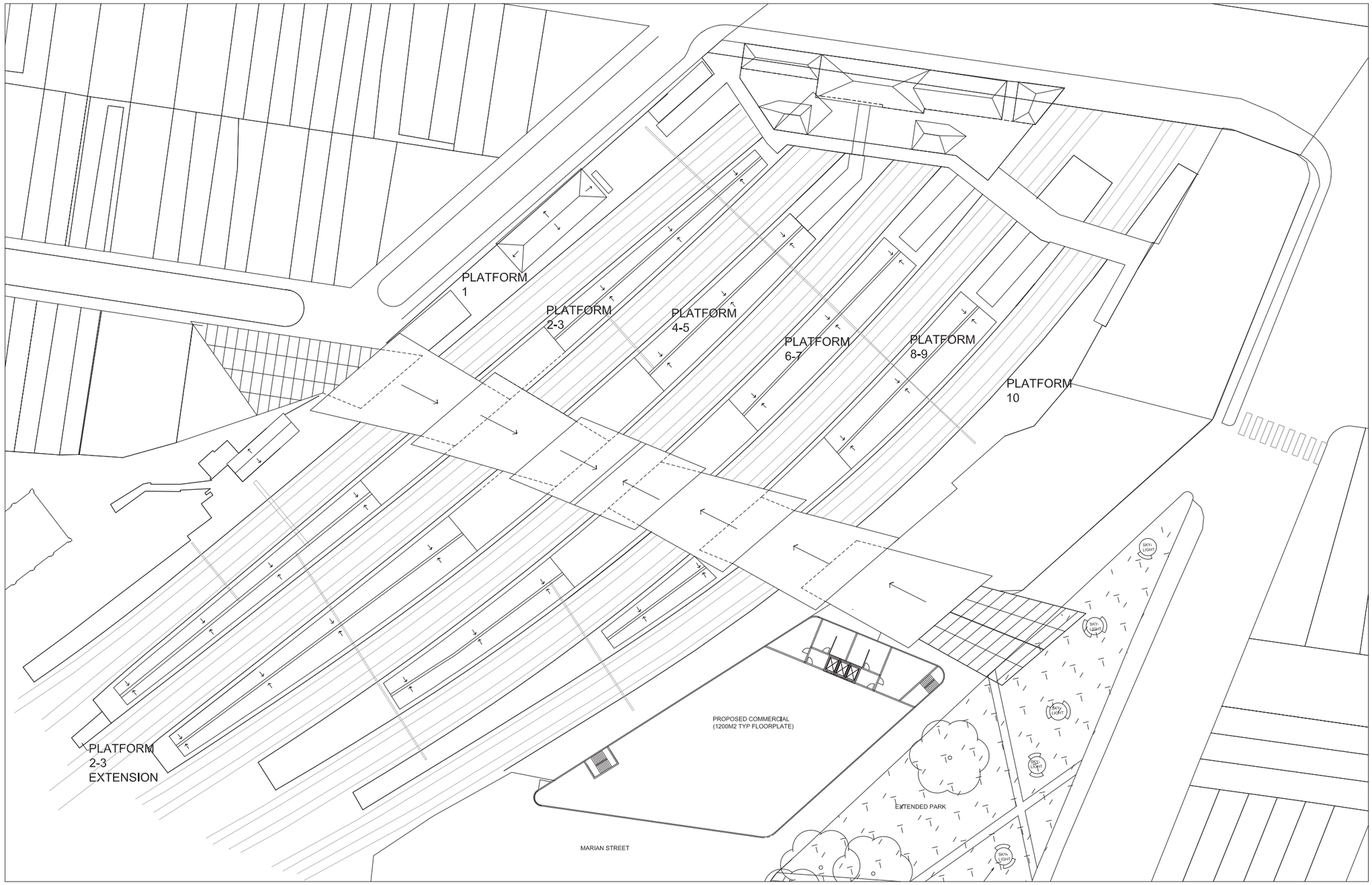
SCALE 1:250@ B1 Date 23.01.09

DRAWING NO. SK 004

0 5 10 20 25m

**Cox Richardson**
Level 2, 204 Clarence Street, Sydney 2000 Australia
Tel : 612 9267 9599 Fax : 612 9264 5844
Email : sydney@cox.com.au
Architecture Planning Urban design Interior design Health facility design
COX
Bovis Lend Lease

Appendix R Revised Concept design drawings




REDFERN STATION DEVELOPMENT

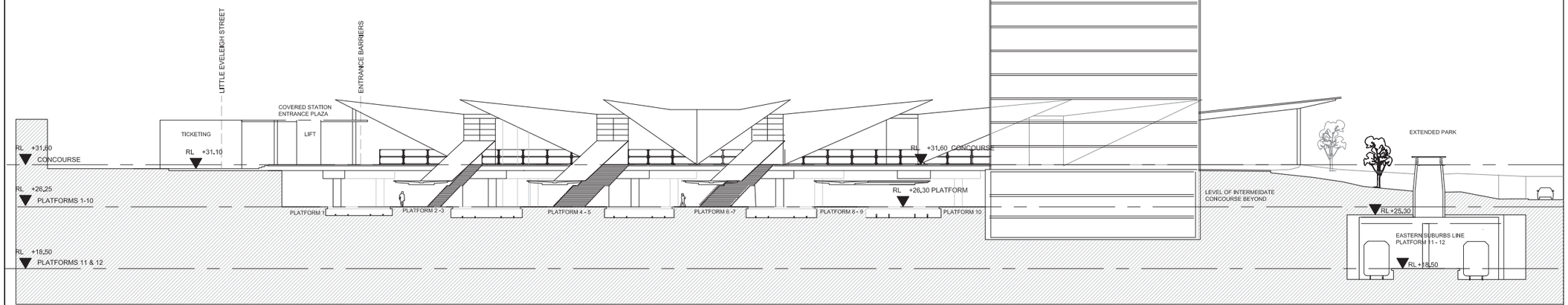
ROOF PLAN & TYPICAL COMMERCIAL FLOOR PLAN- OPTION 2

SCALE 1:250@ B1 Date 23.01.09

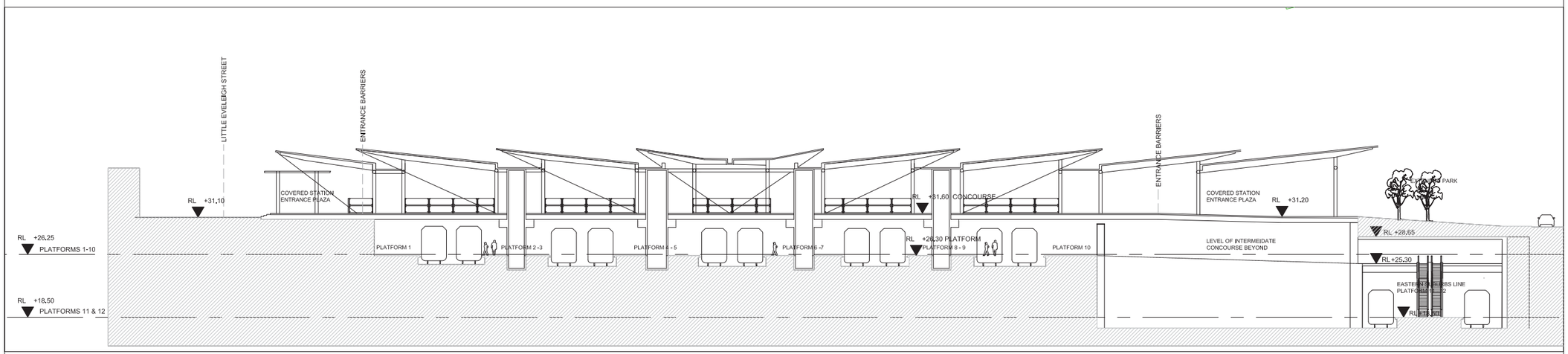
0 5 10 20 25m

DRAWING NO. SK 006

**Cox Richardson**
Level 2, 204 Clarence Street, Sydney 2000 Australia
Tel : 612 9267 9599 Fax : 612 9264 5844
Email : sydney@cox.com.au
Architecture Planning Urban design Interior design Health facility design
COX




SOUTH ELEVATION OF CONCOURSE 1:200




LONG SECTION THROUGH CONCOURSE OPTION 1 1:200

**Cox Richardson**
Level 2, 204 Clarence Street, Sydney 2000 Australia
Tel : 612 9267 9599 Fax : 612 9264 5844
Email : sydney@cox.com.au
Architecture Planning Urban design Interior design Health facility design

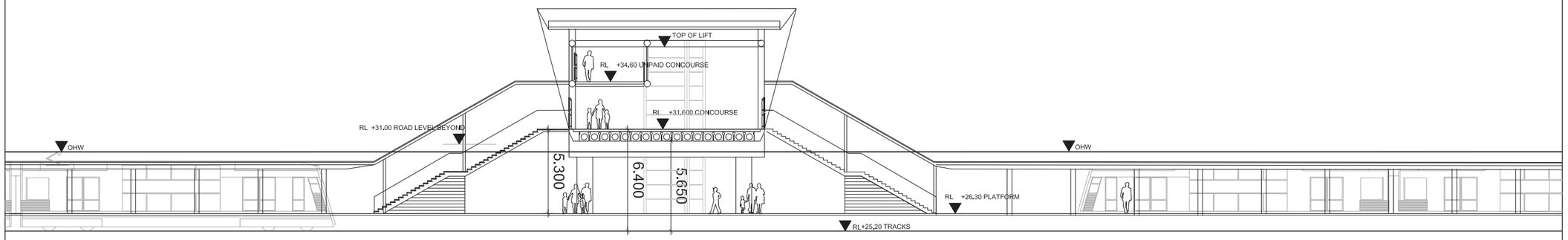
# REDFERN STATION DEVELOPMENT

CONCOURSE LONG SECTION
AND SOUTH ELEVATION

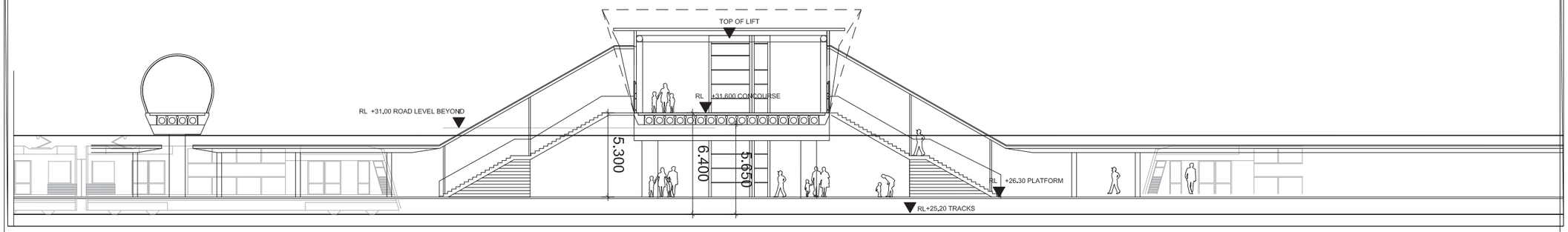
SCALE 1:200 @ B1 Date 23.01.09

DRAWING NO. SK 007

0M 2M 6M 10M 20M




SHORT SECTION THROUGH CONCOURSE OPTION 2 1:100




SHORT SECTION THROUGH CONCOURSE OPTION 1 1:100

**Cox Richardson**
Level 2, 204 Clarence Street, Sydney 2000 Australia
Tel : 612 9267 9599 Fax : 612 9264 5844
Email : sydney@cox.com.au
Architecture Planning Urban design Interior design Health facility design

REDFERN STATION DEVELOPMENT

CONCOURSE CROSS SECTIONS
OPTIONS A AND B

SCALE 1:100 @ B1 Date 23.01.09

DRAWING NO. SK 008

0M 1M 2M 3M 4M 5M 10M