APPENDIX

A

ALTERNATIVE SCHEMES OPTIONS REPORT

Sydney Light Rail Extension Stage 1 - Inner West Extension: Alternative Schemes Options Report

December 2010

Transport NSW

Revision	Details	Date	Amended By
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Glossary

CBD	Central Business District
CPTED	Crime Prevention Through Environmental Design
EA	Environmental Assessment
EP&A Act	*Environmental Planning and Assessment Act 1979*
HV	High voltage
LRVs	Light rail vehicles
m^3	Cubic metres
MCA	Multi criteria analysis
NSW	New South Wales
RTA	Roads and Traffic Authority
SLRE	Sydney Light Rail Extension
SLRE Stage 1	An Inner West extension of 5.6 kilometres along the disused Rozelle goods line corridor from Lilyfield to Dulwich Hill.
SLRE Stage 2	A CBD western corridor extension from Haymarket to Circular Quay via Barangaroo with consideration of a future light rail option from Circular Quay to Central via George Street.
The Project	SLRE Stage 1 (Inner West Extension) including the GreenWay shared path and bushcare elements.
Transport NSW	Lead public transport agency of the NSW Government, with primary responsibility for transport policy, planning and coordination functions as well as oversight of infrastructure delivery and asset management. Transport NSW is the governing body responsible for the development and delivery of the project and the proponent for the purposes of the EP&A Act.
Underbridge	A bridge carrying the railway and allowing a roadway to pass under the railway

1. Introduction

1.1 Project background

In February 2010, the New South Wales (NSW) Government announced, as part of the *Metropolitan Transport Plan*, a $500 million commitment to extend the Sydney light rail system in the Inner West along the disused Rozelle goods line corridor. This extension would comprise two stages:

- Stage 1 — an Inner West extension of 5.6 kilometres along the disused Rozelle goods line corridor from Lilyfield to Dulwich Hill.
- Stage 2 — a CBD western corridor extension from Haymarket to Circular Quay via Barangaroo with consideration of a future light rail option from Circular Quay to Central via George Street.

Collectively, these two stages are known as the Sydney Light Rail Extensions (SLRE).

In finalising the scope of work for the SLRE Stage 1, the NSW Government also took into account suggestions received from the community during initial consultation regarding the project. The community strongly favoured the inclusion of a walking and cycling shared path with the rail corridor, along with a number of bushcare sites — termed the 'GreenWay' — from the Cooks River to Iron Cove. On 19 July 2010, the NSW Government announced that the GreenWay would be included as part of the development and construction of the SLRE Stage 1 (Inner West Extension).

The construction and operation of the SLRE Stage 1 (Inner West Extension) and GreenWay form the scope of the project. An Environmental Assessment (EA) was prepared to assess the impacts of the project. The EA was exhibited between 13 October and 15 November 2010 in accordance with Part 3A of the *Environmental Planning & Assessment Act 1979*.

1.2 Project overview

The project would involve the construction and operation of a 5.6 kilometre extension of the light rail between the existing Lilyfield light rail stop and the proposed Dulwich Hill Interchange stop. The extension would be located within the disused Rozelle goods line corridor. The project would also include the provision of the GreenWay, a pedestrian and cycle shared path and biodiversity corridor from Iron Cove at Dobroyd Point to the northern bank of the Cooks River.

The project design has considered a number of different alternatives including stop locations, stop configurations, track alignment and GreenWay shared path route options. Consideration of alternatives has included consideration of engineering, environmental, community, safety, operations and cost factors. The key features of the project include:

- nine new light rail stops — Leichhardt North, Hawthorne, Marion, Taverners Hill, Lewisham West, Waratah Mills, Arlington, Dulwich Grove and Dulwich Hill Interchange

- minor modifications to the existing Lilyfield stop and surrounding track to tie-in new track and overhead wiring infrastructure with the existing light rail
- provision of the GreenWay shared path, a pedestrian and cycle path, from Iron Cove at Dobroyd Point to the northern bank of the Cooks River
- as part of the GreenWay, sites for bushcare and vegetation remediation to provide for and increase existing local habitat for fauna
- modifications to the existing space that is used for car parking in Bedford Crescent to accommodate the Dulwich Hill Interchange stop
- raising of the existing bridge over Parramatta Road, which would carry the light rail
- provision of pedestrian linkages (access pathways) to surrounding neighbourhoods to enable access to the GreenWay shared path and light rail stops
- modification of the existing road bridge structures to accommodate the GreenWay shared path — namely at Hercules Street, Old Canterbury Road, Constitution Road, Davis Street and Longport Street
- a new pedestrian/cycle bridge at Parramatta Road adjacent to the Parramatta Road underbridge
- a new pedestrian/cycle bridge across Hawthorne Canal near Hawthorne stop
- new infrastructure to ensure accessibility and connectivity between the GreenWay shared path, local streets and light rail stops
- safety fencing or separation of the GreenWay shared path and light rail operations and the light rail operations and the heavy rail operations on the Bankstown Line, near Dulwich Hill Railway Station
- provision of overhead wiring, substation and utilities infrastructure
- minor modifications to the existing light rail stabling and maintenance facility located at Pyrmont.

Figures 1.1a to 1.1f shows the key features of the project including the proposed light rail extension and GreenWay shared path.

The construction program for Stage 1 is expected to commence in the first quarter of 2011 (subject to obtaining project approval) and would take approximately 12 months to complete.

Early track maintenance works comprising laying of ballast, track sleepers and track work was approved in mid-2010 under a separate approval (subject to Part 5 of the *Environmental Planning and Assessment Act* 1979 (EP&A Act)), and is currently underway, with completion of this work expected in late 2010.

1.3 Project objectives

In line with the NSW Government's overarching strategic objectives for metropolitan transport, the key objectives of the project are to:

- improve public transport access and connections between where people live, work and visit
- improve the integration of public transport networks by linking existing radial corridors
- enhance liveability by improving local accessibility and amenity along the corridor
- encourage sustainable and healthier travel options with greater use of active transport
- make best use of a disused government asset
- deliver a safe and reliable project in a sustainable and environmentally friendly way
- deliver the project in an economically efficient and timely manner, in a close and cooperative manner with the local community, State and local government, contractors and other key stakeholders.

1.4 Alternatives schemes background

Transport NSW undertook a program of community and stakeholder consultation during the preparation of the EA. During this consultation concerns were raised about certain components of the project. The concerns related to three particular elements of the project:

- the location of the Dulwich Hill Interchange stop
- the signalised pedestrian crossing at Marion Street
- the Weston Street on street cycle pathway (on street section of the GreenWay).

As a result of these concerns Transport NSW devised alternative schemes for these three elements of the project. Figure 1.2 shows the location of these three project elements.

As identified in the EA these alternative schemes did not represent Transport NSW's preferred position at the time and were therefore not assessed in the EA. In the EA these alternative schemes were identified as requiring further investigation into the viability and feasibility of these schemes. This options assessment report presents the findings of the further investigations which have been undertaken since the preparation of the EA.

1.5 Purpose of this report

The purpose of this alternative schemes options report is to:

- describe each of the three elements of the project which caused concerns to be raised – referred to as the base case elements – see Chapter 2
- detail each of the alternative schemes devised – see Chapter 2
- summarise the key issues/constraints/benefits associated with each of the base case elements – see Chapter 3
- provide an overview of the key issues/constraints/benefits associated with each alternative schemes – see Chapter 3
- detail the options assessment and selection process undertaken – the multi criteria analysis – see Chapter 4
- outline the selected and preferred schemes which are to be progressed by TNSW as part of the project – see Chapter 4
- outline the further investigations following the multi criteria analysis on the GreenWay in the vicinity of Weston Street – see Chapter 5
- provide an overview of the next steps in the process – see Chapter 6.

Joins Figure 1.1b

Light rail alignment
City West Link rail corridor tunnel
Local government area boundary
Existing light rail stop
Proposed light rail stops
Potential substation location

Figure 1.1a Key features of the project

Note: Indicative only, subject to detail design.

Figure 1.1b Key features of the project

Note: Indicative only, subject to detail design.

Light rail alignment
Proposed light rail stops
Local government area boundary
Watercourse
Existing GreenWay shared path (upgraded)
New GreenWay shared path (at-grade)
New GreenWay shared path (elevated)
Existing bushcare site
Potential bushcare/landscaping
Potential substation location
Potential service vehicle access point

Figure 1.1c Key features of the project

Note: Indicative only, subject to detail design.

Figure 1.1d Key features of the project

Note: Indicative only, subject to detail design.

Figure 1.1e Key features of the project

Note: Indicative only, subject to detail design.

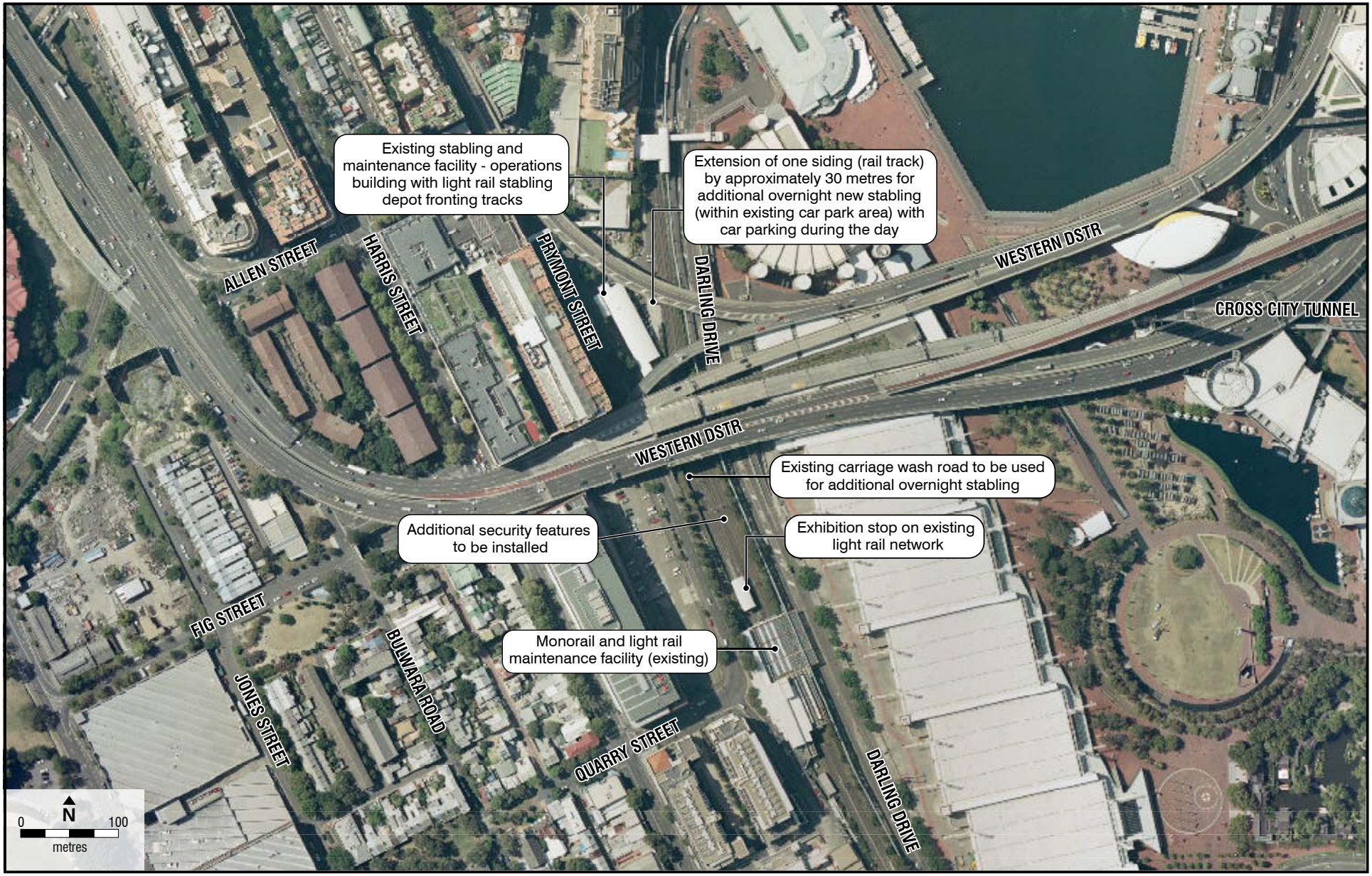
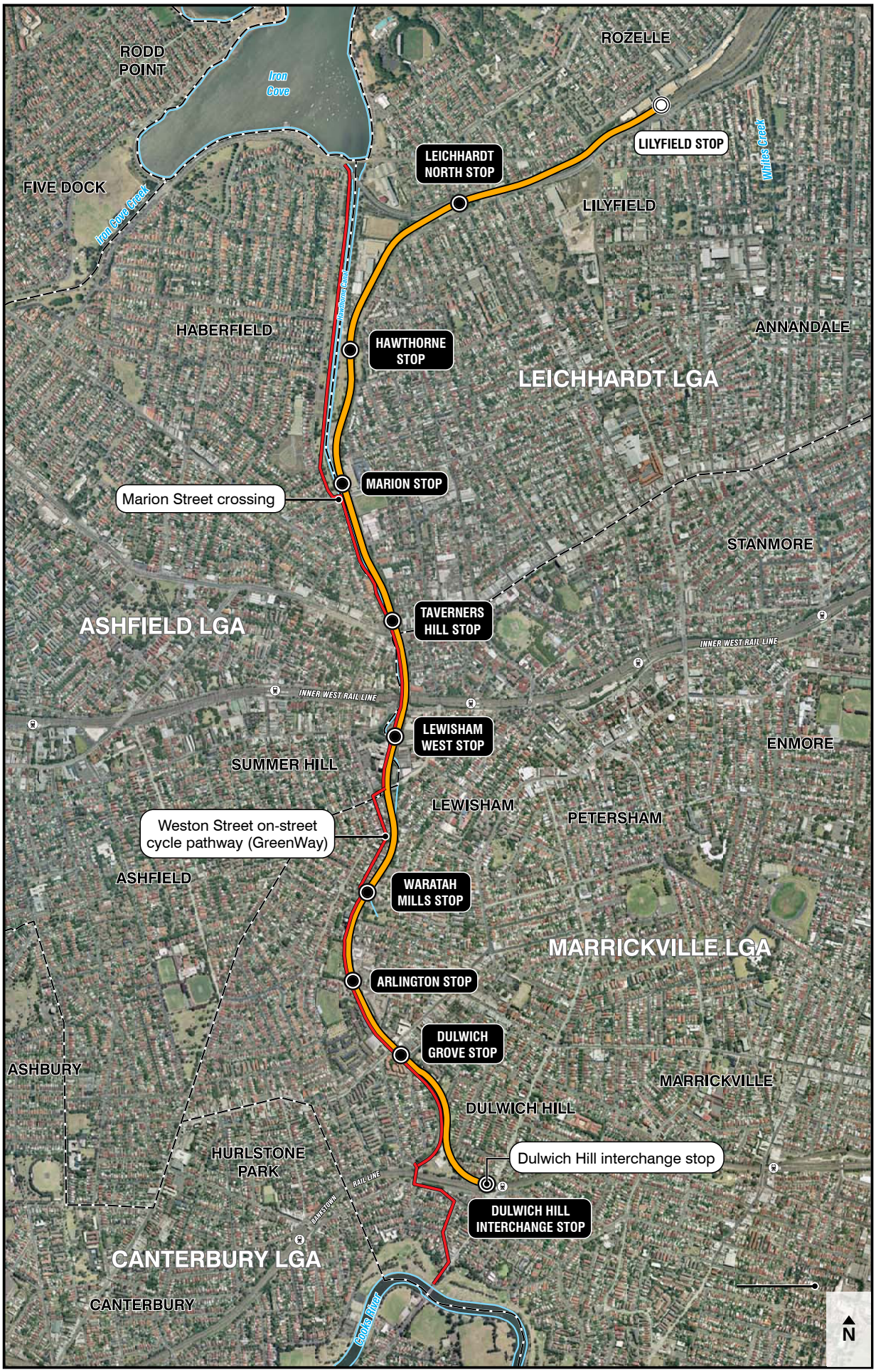


Figure 1.1f Key features of the project - existing stabling and maintenance facility, Pyrmont

Note: Indicative only, subject to detail design.



Light rail alignment
Proposed GreenWay shared path
Local government area boundary
Watercourse
Existing light rail stop
Proposed light rail stops
Existing heavy rail stop

Figure 1.2 Location of alternative scheme elements

Note: Indicative only, subject to detail design.

2. The base case elements and the alternative schemes

This chapter outlines the three base case elements of the project that have raised concerns with some members of the community and other stakeholders:

- the location of the Dulwich Hill Interchange stop
- the signalised pedestrian crossing at Marion Street
- the Weston Street on street cycle pathway (on street section of the GreenWay).

The chapter also provides descriptions of each of the alternative schemes that have been devised for each of these base case elements.

2.1 Dulwich Hill Interchange stop location

2.1.1 Base case

The base case was presented and assessed in the EA. The Dulwich Hill Interchange stop would be the terminus of the proposed light rail line extension and would be located adjacent to and below Bedford Crescent and Wardell Road. The stop would be adjacent to the Dulwich Hill Railway Station.

The Dulwich Hill Interchange stop would be located in a cutting and have a central platform at a level similar to the current rail tracks. This would require excavation of the existing escarpment at Bedford Crescent and would impact on existing on-street car parking. New landscaping with parallel car parks would be located along the southern edge of Bedford Crescent. The configuration of the proposed parking along Bedford Crescent would be subject to detailed development once the extent of required excavation of the existing embankment has been determined. An indicative arrangement of the Dulwich Hill Interchange stop base case is shown on Figure 2.1.

Pedestrian access to the Dulwich Hill Interchange stop would be provided via a lift and stair linking to a small landing at the intersection of Bedford Crescent and Wardell Road. At this point, pedestrian access would be available via the Wardell Road overpass to the Dulwich Hill Railway Station. The proposed configuration of the staircase and linkage to Dulwich Hill Railway Station is shown in Figure 2.2.

A security fence would be installed between the proposed light rail corridor and the existing heavy rail corridor. This fence would also extend to the north along the light rail corridor around the eastern edge of Jack Shannon Park.

There would also be a fence at the edge of the escarpment on Bedford Crescent.

The Dulwich Hill Interchange stop would generally serve the southern part of Dulwich Hill and provide a transport modal interchange with existing CityRail passenger services on the Bankstown Line at Dulwich Hill Railway Station and with bus route 412 on Wardell Road.

2.1.2 Alternative scheme 1

Alternative scheme 1 would locate the Dulwich Hill Interchange stop at the western end of Bedford Crescent between the existing residential properties to the east and Jack Shanahan Park to the west. An indicative arrangement of the Dulwich Hill Interchange stop alternative scheme 1 is shown on Figure 2.3.

The Dulwich Hill Interchange stop would include a single, four metre wide, platform which would allow for light rail vehicles (LRVs) to load and unload passengers on its western side.

A stair and lift from Bedford Crescent down to a new path would provide access to the stop platform and to Jack Shanahan Park. Upgraded footpaths would be provided on Bedford Crescent. A new pedestrian crossing and extended footpath blisters would be provided on Bedford Crescent at its intersection with Wardell Street.

A new small pocket park with tree plantings would be installed at the far western end of Bedford Crescent. This would require the removal of a small section of the road and some car parking spaces.

The existing 90 degree commuter parking on the southern side of Bedford Crescent would remain, with the exception of a few spaces on the eastern end of the street which would be removed to accommodate a kiss and ride drop off area. Line markings would be provided to formalise the 90 degree commuter parking. An area for car turning would be provided at the western end of the street.

As with the base case this alternative scheme would include a security fence between the proposed light rail corridor and the existing heavy rail corridor. This fence would also extend to the north along the light rail corridor around the eastern edge of Jack Shannon Park. There would also be a fence at the edge of the escarpment on Bedford Crescent.

Totem signage would be installed at the junction of Bedford Crescent and the Wardell Road bridge, at the stop entrance and in Jack Shanahan Park.

2.1.3 Alternative scheme 2

Alternative scheme 2 would locate the Dulwich Hill Interchange stop slightly to the north of the alternative scheme 1.

The location of this alternative would be south of Macarthur Parade between the intersection of Macarthur Parade and Keith Lane on the east and Jack Shanahan Park on the west. An indicative arrangement of the Dulwich Hill Interchange stop alternative scheme 2 is shown on Figure 2.4.

The Dulwich Hill Interchange stop would include a single, four metre wide, platform which would allow for light rail vehicles (LRVs) to load and unload passengers on its western side.

A stair and ramp from the existing pedestrian path off Macarthur Parade and Keith lane would provide access to the stop platform and to a new path which would provide access to Jack Shanahan Park. A kiss and ride drop off area would be provided on Macarthur Parade.

As with the base case this alternative scheme would include a security fence between the end of proposed light rail corridor and the existing heavy rail corridor. This fence would also extend to the north along the light rail corridor around the eastern edge of Jack Shannon Park. There would also be a fence at the edge of the escarpment on Bedford Crescent.

Totem signage would be installed at the junction of Macarthur Parade and Keith Lane, on the stop entrance on the pedestrian path and in Jack Shanahan Park.

This alternative scheme would not require changes to Bedford Crescent.

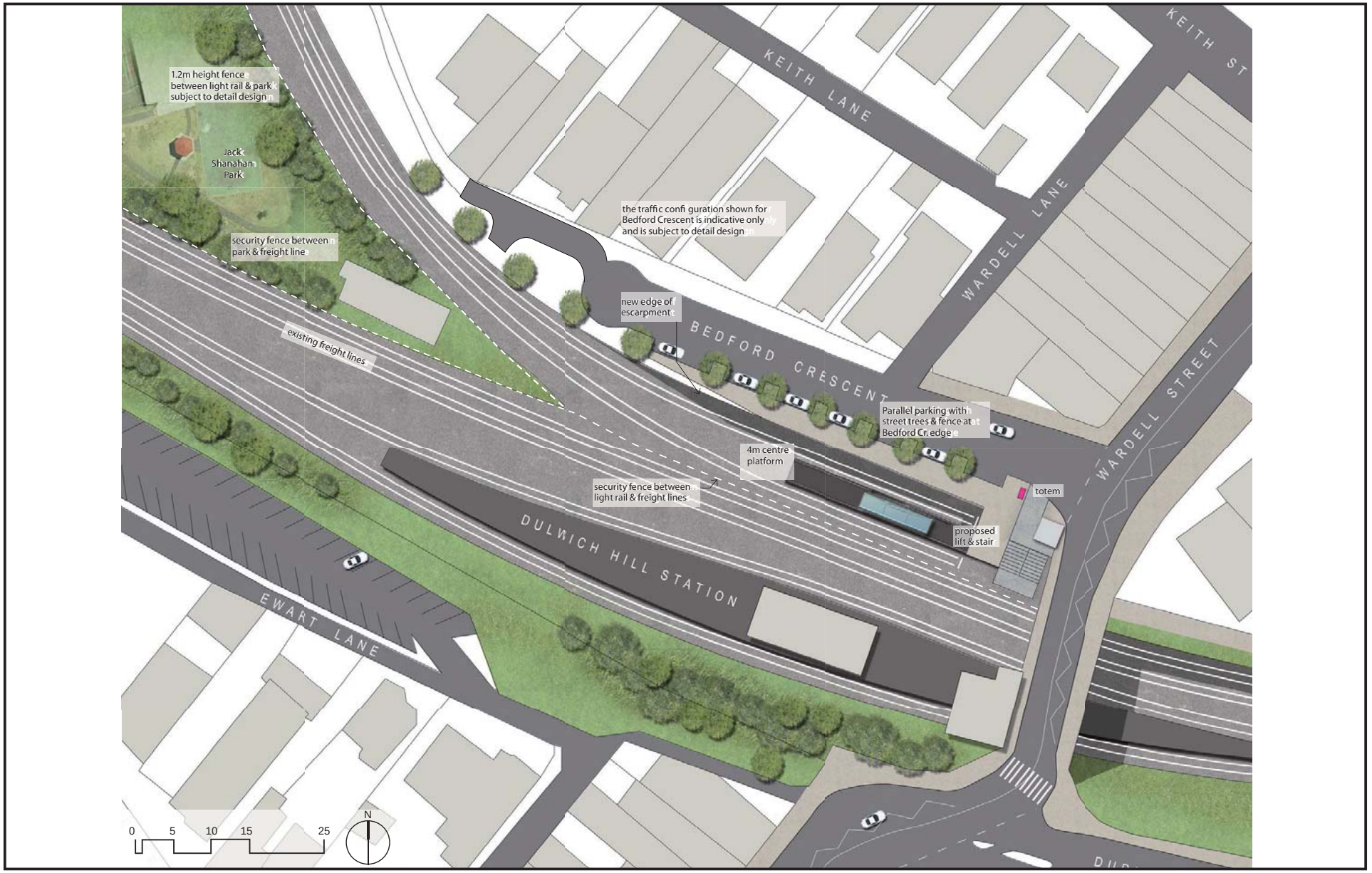


Figure 2.1 Indicative stop – Dulwich Hill Interchange
Note: Indicative only, subject to detail design.

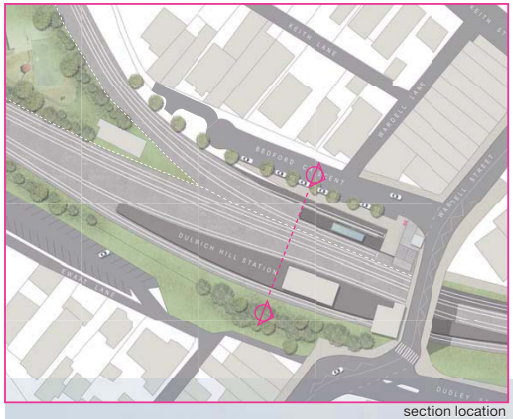


Figure 2.2 Indicative section – Dulwich Hill Interchange
Note: Indicative only, subject to detail design.

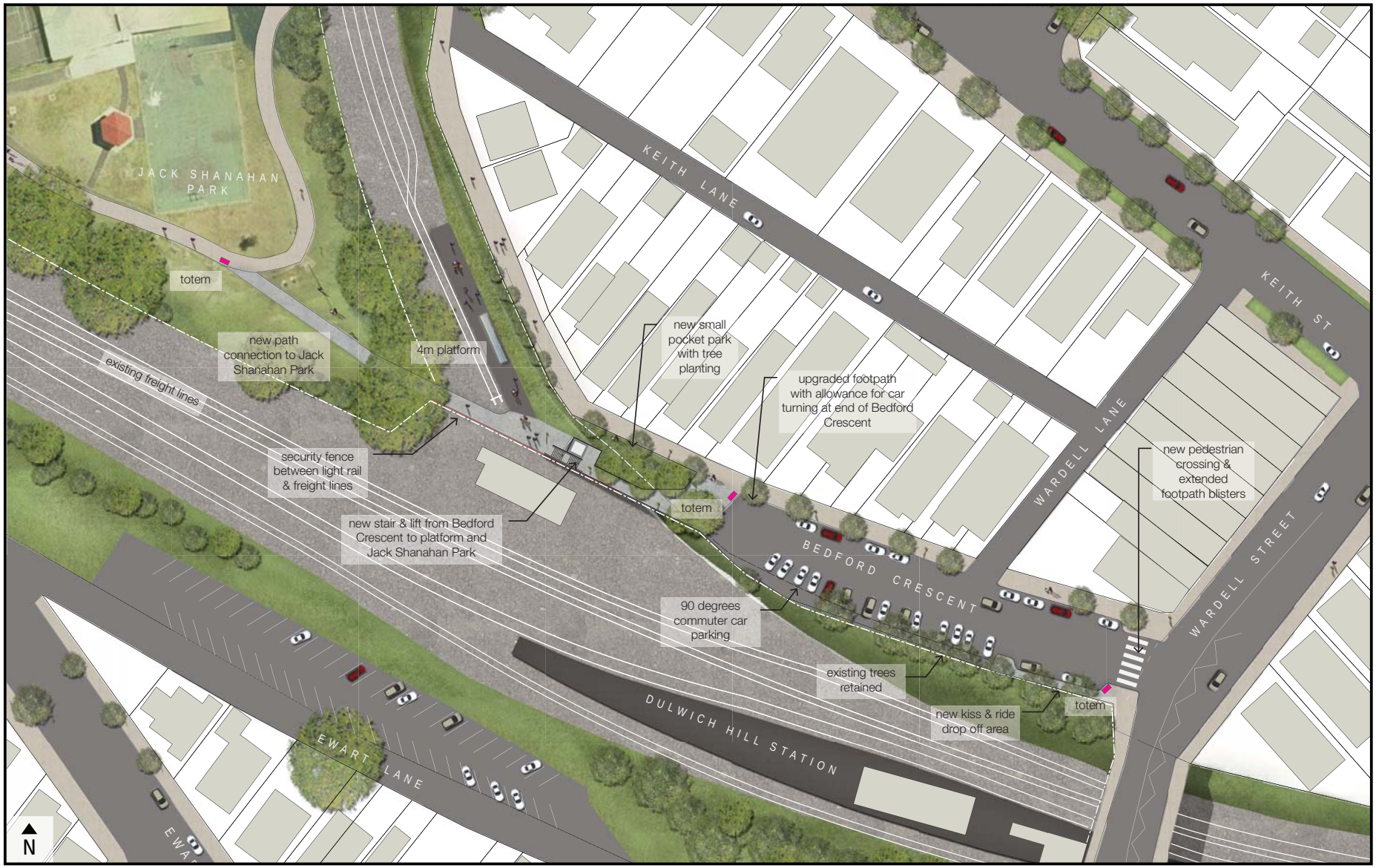


Figure 2.3 Indicative arrangement of the Dulwich Hill Interchange stop (alternative scheme 1)

Note: Indicative only, subject to detail design.

Figure 2.4 Indicative arrangement of the Dulwich Hill Interchange stop (alternative scheme 2)

Note: Indicative only, subject to detail design.

2.2 Crossing of Marion Street for pedestrians and cyclists

2.2.1 Base case

The base case was presented and assessed in the EA. The GreenWay shared path would be located on the western side of the light rail corridor and would predominantly be within the disused Rozelle goods line corridor, extending outside the corridor and into adjacent streets and parklands where opportunities for local connections arise or where continuation within the corridor is highly constrained. The crossing of Marion Street is one of the areas where the GreenWay shared path extends outside of the corridor. The base case for the crossing of Marion Street comprised a new signalised crossing with traffic lights immediately west of the rail bridge to facilitate safe access across Marion Street.

An indicative arrangement of the signalised crossing at Marion Street is shown on Figure 2.5.

2.2.2 Alternative scheme

The alternative scheme would provide for a new GreenWay pedestrian and cycle bridge over Marion Street. The bridge would comprise an elevated ramp approximately 200 metres long over Marion Street adjacent to the western side of the existing underbridge.

The northern side of ramp would join upgraded shared path in Richard Murden Reserve and cross above Hawthorne Canal.

On the southern side of Marion Street the ramp would gradually decrease in height and join the GreenWay shared path alongside the rail corridor as proposed in the EA.

On the northern side of Marion Street the bridge would provide access to Marion stop via a new ramp. Lifts would be provided on both sides of Marion Street to provide easy access to the bridge and the Marion stop platform.

No signalised crossing or changes to Marion Street road infrastructure would take place as part of the alternative scheme.

The indicative arrangements of the alternative scheme are shown in Figure 2.6 and Figure 2.7.

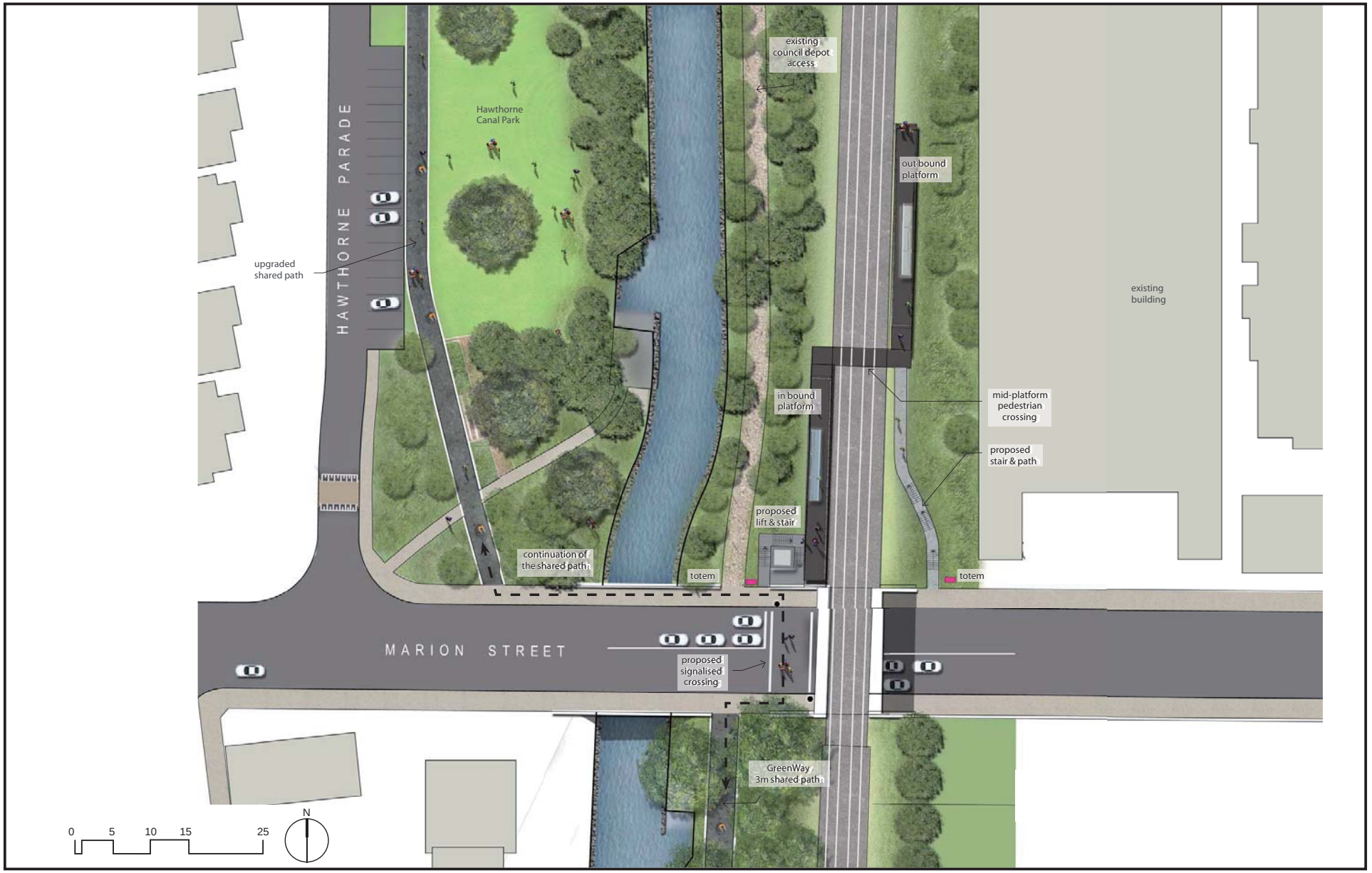


Figure 2.5 Indicative stop – Marion
Note: Indicative only, subject to detail design.

Figure 2.6 Indicative stop – Marion (alternative scheme)
Note: Indicative only, subject to detail design.

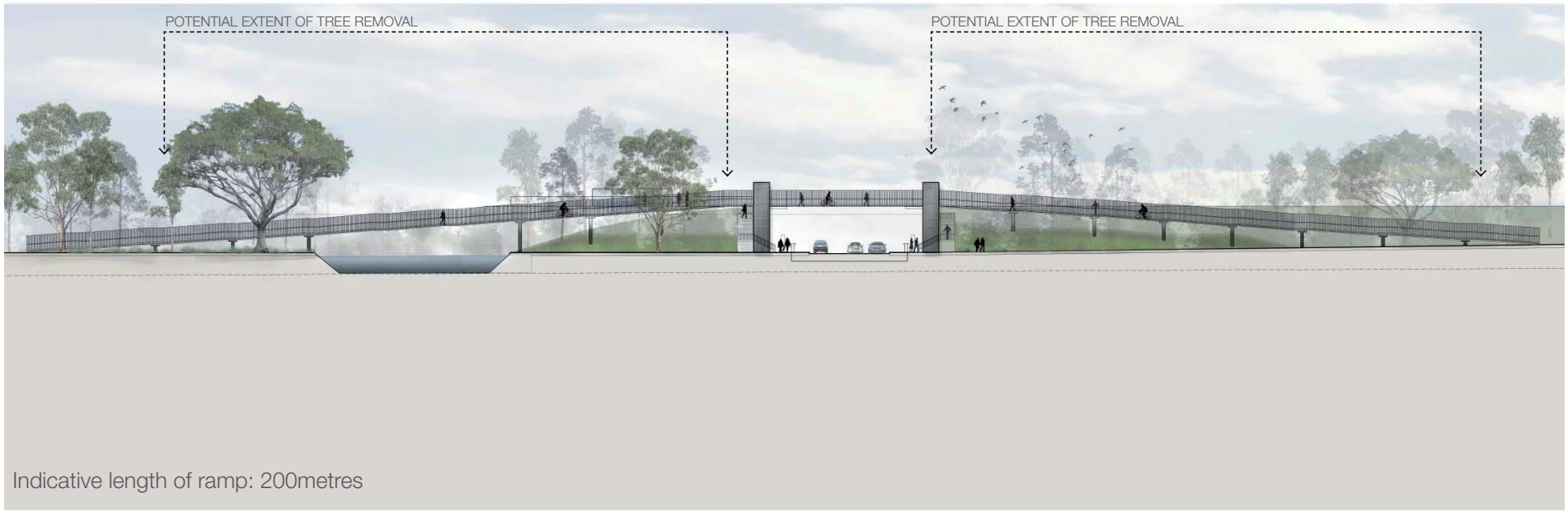


Figure 2.7 Indicative Marion Street crossing – pedestrian cyclist overpass (alternative scheme)

Note: Indicative only, subject to detail design.

2.3 GreenWay between Davis Street and Old Canterbury Road (Weston Street)

2.3.1 Base case

The base case was presented and assessed in the EA. The GreenWay shared path heading south from Old Canterbury Road would separate from the corridor, via a laneway connection between the light rail corridor and Weston Street, and continue as a shared traffic zone along Weston Street, Dulwich Hill. Signage and markings would be installed on the street to advise users of the shared traffic conditions.

Pedestrians would be directed to travel along existing pedestrian paths on Weston Street whilst cyclists would travel along the street on Weston Street. An indicative cross-section of the arrangement is provided in Figure 2.8.This on-street deviation for the GreenWay shared path would be required due to existing land use and corridor constraints at this section of the route.

At the southern end of Weston Street the GreenWay shared path would reconnect with the light rail corridor and meet the Waratah Mills stop.

Figure 2-8 Indicative cross-section of the proposed GreenWay on Weston Street near the Waratah Mills stop

Two arrangements for cyclists are proposed as part of the base case along Weston Street to accommodate differing street widths to the south (9 metre street width) and to the north (12 metre street width) of the street.

2.3.2 Alternative scheme 1

Alternative scheme 1 would include the GreenWay shared path within the rail corridor at the rear of properties on Weston Street. The pedestrian and cycle paths would not enter onto Weston Street.

Alternative scheme 1 would position the GreenWay shared path directly above Hawthorne Canal as suspended walkway structure. There would be a 3.5 metre safety clearance from centre line of light rail track to the GreenWay shared path.

Privacy screening would be provided between the GreenWay shared path and the property boundaries. A schematic of the scheme is provided in Figure 2.9.

2.3.3 Alternative scheme 2

Alternative scheme 2 would also include the GreenWay shared path within the rail corridor at the rear of properties on Weston Street. The pedestrian and cycle paths would not enter onto Weston Street.

Alternative scheme 1 would position the GreenWay shared path adjacent to Hawthorne Canal as an elevated structure supported by columns. As with alternative scheme 1, there would be a 3.5 metre safety clearance from centre line of light rail track to the GreenWay shared path and privacy screening would be provided between the GreenWay shared path and the property boundaries. A schematic of the scheme is provided in Figure 2.10.

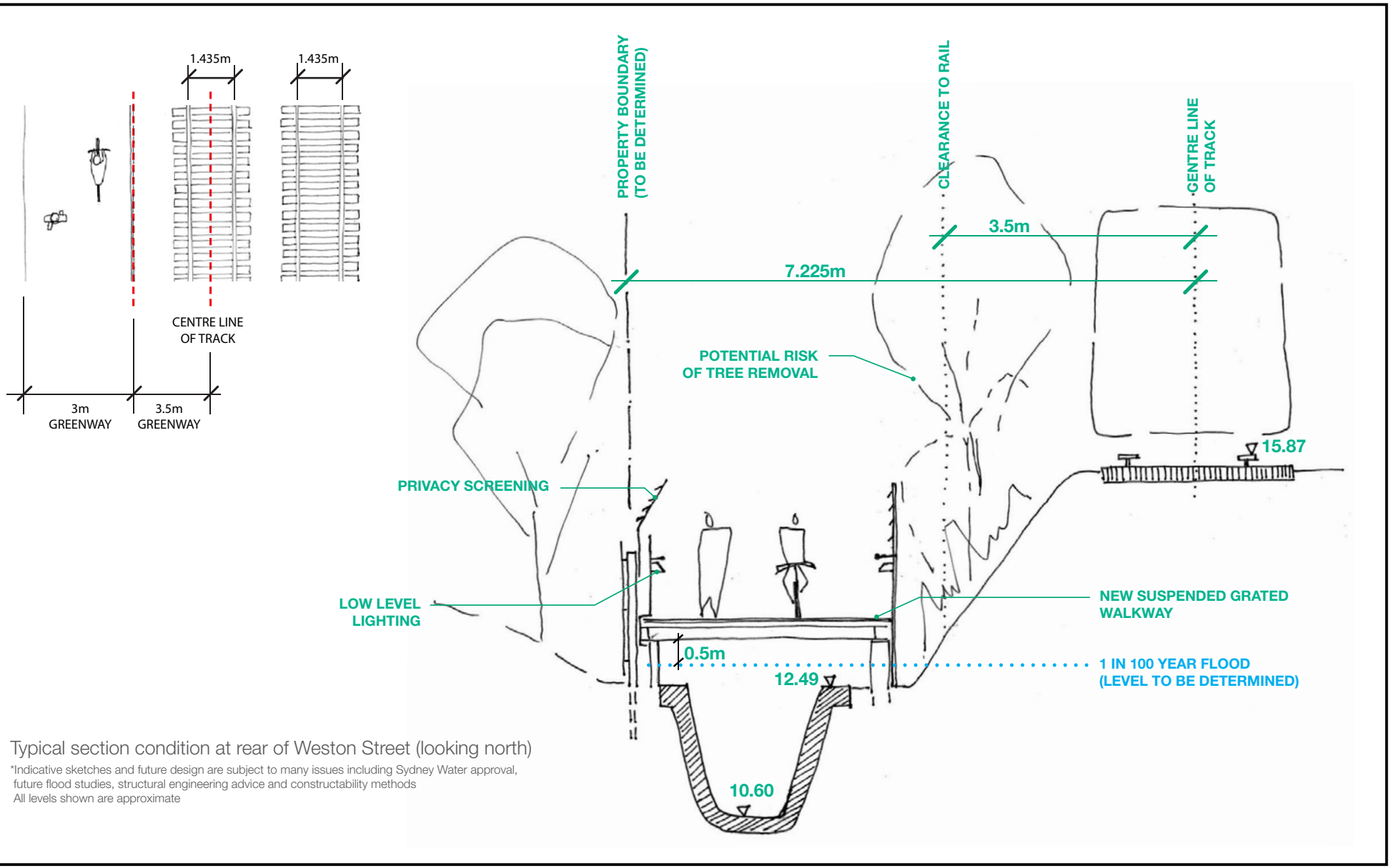


Figure 2.9 Indicative section of the GreenWay shared path at rear of Weston Street – alternative scheme 1

Note: Indicative only, subject to detail design.

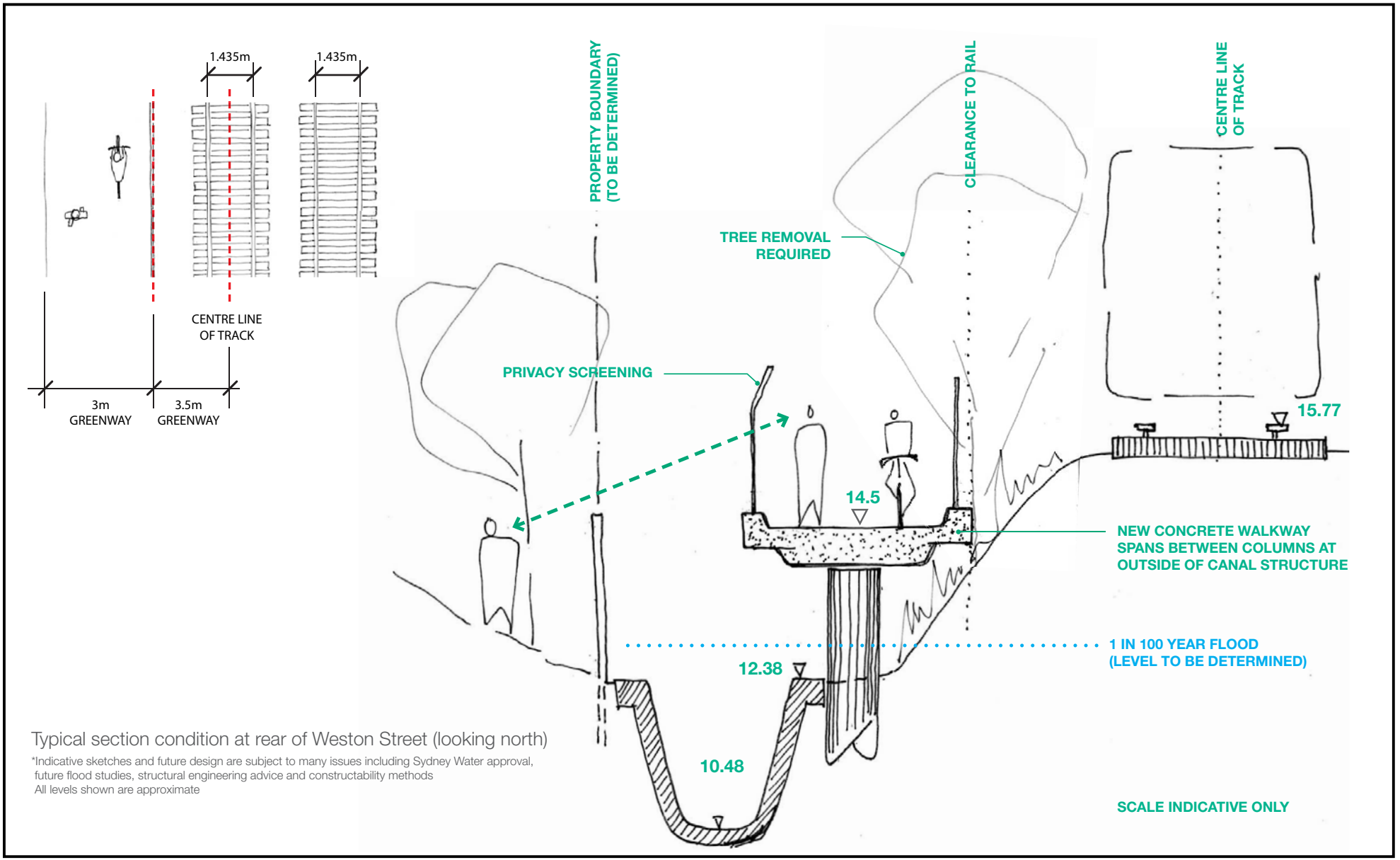


Figure 2.10 Indicative section of the GreenWay shared path at rear of Weston Street – alternative scheme 2

Note: Indicative only, subject to detail design.

3. Issues identification

This chapter outlines the key issue categories which have been investigated for each of the base cases and the alternative schemes and which are used to undertake a comparison of the options (for comparison of options see Chapter 4).

A brief overview of the base case against each of the identified issue categories is detailed to provide context. Further detail on each of the base cases are provided in the EA.

Descriptions of the alternative scheme against the issue categories are provided in Section 3.2 – 3.4.

3.1 Key issue categories

Table 3-1 identifies the key issue categories that have been investigated for each of the base cases and the alternative schemes and which are used to undertake a comparison of the options (for comparison of options see Chapter 4).

Table 3-1 Key issue categories

Issue category title	Description
User experience	Review of the product to ensure it meets customer expectations and operating requirements, such as travel times, functionality of GreenWay and improvements to accessibility. Also includes urban design components.
Stakeholder views	Preferred positions or advice from key stakeholders, including regulatory agencies and asset owners.
Community feedback	Discussion on the feedback received from community noting the key areas of concern raised or benefits of schemes identified. Feedback has generally been in the form of emails, forms, phone calls, site visits, verbally during information sessions and from submissions lodged.
Constructability	A review of construction issues and constraints. Including construction risk.
Cost	Indicative cost for construction of each of the schemes.
Environment	Identification of potential environmental impacts, constraints or benefits associated with each scheme, particularly those associated with: ▪ ecology i.e. vegetation clearing ▪ heritage ▪ flooding and climate change ▪ parking and traffic access ▪ noise and vibration ▪ amenity and property impacts – including connectivity between communities and to other community infrastructure facilities.
Environmental sustainability	Sustainability of design with respect to carbon footprint and resource efficiency.

Issue category title	Description
Safety and security	Safety on GreenWay shared path and light rail. Security of users and neighbours. Potential pedestrian conflicts. Includes where relevant identification of proximity to light rail 'safety envelope'.

3.2 Dulwich Hill Interchange stop location

3.2.1 User experience

Base case

Key user experience features of the base case would include:

- Easy interchange with heavy rail via Dulwich Hill Railway Station (approximate distance of 55 metres) – approximate time to walk to interchange at Dulwich Hill Railway Station is one minute.
- The interchange with Dulwich Hill Railway Station would be obvious to transport user at it is clearly visible from the light rail stop.
- Easy interchange with bus routes along Wardell Road - approximate time to walk to Wardell Road is less than one minute.
- No direct link to GreenWay shared path is provided in the design from the eastern side of the light rail line near Bedford Crescent.

Alternative scheme 1

Key user experience features of alternative scheme 1 would include:

- Interchange distance to Dulwich Hill Railway Station of 190 metres and an approximate time to walk of 3 minutes 20 seconds.
- Dulwich Hill Railway Station and Wardell Road area visible from light rail stop encourage interchange with heavy rail and bus routes.
- Would provide shorter and more direct access route for residents on the western side of the rail corridor (i.e. Hercules Street) to access the stop –directly across Jack Shanahan Park.
- A new access to GreenWay shared path across Jack Shanahan Park would be created. This would provide access to the stop from these facilities.
- Commuting distance to stop location would be increased slightly for community members located south of the Dulwich Hill Railway Station.
- This would include a single track end of line which would potentially reduced operational flexibility of the light rail.

Alternative scheme 2

Key user experience features of alternative scheme 2 would include:

- Interchange distance to Dulwich Hill Railway Station of approximately 230 metres – requiring approximately 3 minutes 50 seconds to walk.
- The alternative would provide relatively poor access for pedestrians along Keith Lane to reach the stop.
- The location would not provide clear view of the Dulwich Hill Railway Station or Wardell Road and is not easily seen from the heavy rail stop therefore not promoting interchanges.
- A new access to Jack Shanahan Park and the GreenWay shared path would be created to the light rail stop.
- The location would provide shorter access route for residents on the western side of the rail corridor (i.e. Hercules Street) to access the stop through Jack Shanahan Park.
- The topographical level change is reduced in this area and a lift is not considered necessary to access the stop.
- Commuting distance to stop location would be increased for community south of the Dulwich Hill Railway Station.
- This would include a single track end of line which would potentially reduced operational flexibility of the light rail.

3.2.2 Stakeholder views

Base case

Stakeholder views which have been advised to Transport NSW include:

- Marrickville Steering Committee supports the base case citing transport connectivity as the primary concern.
- EcoTransit support the base case due to maximise the benefit of an interchange between light rail, heavy rail and bus network.
- Physical Disability Council of NSW stated that the base case should not be supported if it jeopardised future plans for providing easy access to Dulwich Hill Railway Station.

Alternative scheme 1

The stakeholder view which has been advised to Transport NSW includes:

- EcoTransit are strongly opposed to this scheme.

Alternative scheme 2

The stakeholder view which has been advised to Transport NSW includes:

- EcoTransit are strongly opposed to this scheme.

3.2.3 Community feedback

Base case

Community feedback which has been advised to Transport NSW includes:

- Bedford Crescent residents are opposed to the base case due to significant loss of parking and traffic management issues, increased noise and vibration, intrusive excavation of sandstone cliff face, loss of native tree planting and loss of local fauna, increased light pollution and visual impact from light rail and associated infrastructure.
- Other community stakeholders provided strong support for the base case due to connectivity with heavy rail.

Alternative scheme 1

Community feedback which has been advised to Transport NSW includes:

- Some members of community support Alternative scheme 1 as it allows for easy access to Dulwich Hill Railway Station from the light rail stop and provides community access between the east and west sides of the line, shops and bus and rail routes.

Alternative scheme 2

Community feedback which has been advised to Transport NSW includes:

- Some members of community support Alternative scheme 2 as it allows for easy access to Dulwich Hill Railway Station from the light rail stop and provides community access between the east and west sides of the line, shops and bus and rail routes
- Some residents from Keith Lane are opposed this option as it could have traffic management issues, particularly increased flow in Keith Lane.

3.2.4 Constructability

Base case

The Dulwich Hill Interchange stop base case would require cutting into the Bedford Crescent rockface in the vicinity of the intersection with Wardell Road, and adjacent to the Dulwich Hill Railway Station.

As identified in the EA the construction would involve the use of excavation plant and equipment including a large excavator, a dozer with ripper attachments, hydraulic rockbreakers, and rock saws for excavation of approximately 2000m^3 of rock material.

Constructability constraints that have been identified in relation to this stop configuration since the preparation of the EA include:

- The location of a number of live rail utilities, services and infrastructure that would need to be relocated or diverted clear of the worksite prior to any excavation works. Services that have been identified include a signal location hut that houses live signalling equipment; signal feeder cables including an under track crossing to the adjacent signalling building; track bonding cables; above ground cable troughing that contains signalling and communications cabling; overhead wiring structures that span the adjacent freight line tracks; high voltage (HV) aerial feeder system on poles; an open stormwater drainage line; and sewer lines.
- The relocation of live rail infrastructure is complex and has the potential to impact on the adjacent live rail operations and safety of rail passengers. To complete these interface works, track possessions and power closedowns (for 'cutting over' of live infrastructure) would be required. The relocation works would potentially have significant program implications due to the constraints associated with interfacing with the live rail infrastructure and operations.
- Position for the relocation of the live HV aerial feeder system and associated poles would require careful consideration of construction activities that would be required for the stop, including clearance requirements which may constrain work methods and construction plant.
- The excavation and construction methods would be constrained due to the vicinity of the adjacent live rail lines and certain activities would require suitable worksite protection measures that could include requirement for track possessions with power in the adjacent overhead wiring turned off. This is primarily due to clearance requirements for safe working in the live rail corridor, and potential to impact on live infrastructure.
- Existing trees and vegetation along the Bedford Crescent boundary with the rail corridor would need to be cleared in order to establish the worksite and to allow excavation works to proceed. A proportion of Bedford Crescent would be taken up for construction of the works for this stop location.
- Construction access for removal of spoil material (in the order of 2000m^3 rock) would be undertaken via Bedford Crescent and Wardell Road or via Jack Shanahan Park temporary construction access point.
- Depending on the ground conditions and the nature of the exposed rock face, the excavation into Bedford Crescent may require support as the excavation progresses (such as use of rock anchors and/or sprayed concrete).
- New landscaping and treatment including fencing along the new edge of Bedford Crescent with the light rail stop below would be required.

Alternative scheme 1

The stop for Dulwich Hill Interchange alternative scheme 1 is positioned such that the access to the stop is provided at the termination of Bedford Crescent with the rail corridor.

This scheme has a number of constructability benefits when compared to the base scheme including:

- Minimal relocation of live rail infrastructure is anticipated. There are no current identified services or infrastructure that would need to be diverted or relocated.
- The scope and major construction activities for the stop would be well removed from the adjacent 'live' rail corridor and construction could proceed unhindered.
- Only minimal removal of existing trees and vegetation would be required at the termination of Bedford Crescent and the rail corridor to create the access way.
- The extent and duration of the worksite within Bedford Crescent would be minimal.
- This scheme does not involve excavation works hence there would be minimal access and truck movements for removal of spoil material.

There are no major constructability constraints associated with this scheme with sufficient clearance from the live infrastructure provided. The key construction access point would be provided via the temporary access utilising Jack Shanahan Park.

Alternative scheme 2

The stop location for Dulwich Hill Interchange alternative scheme 2 is in the corridor adjacent to corner of Macarthur Parade and Keith Lane. The stop and associated construction activities are located further away from the adjacent 'live' rail corridor than alternative scheme 1. All of the constructability benefits identified for alternative scheme 1 above would also apply to this scheme, although clearance of vegetation at the termination of Bedford Crescent and the rail corridor would not be required.

As the grade separation of the rail corridor and the road surface level of Macarthur Parade is minimal, an alternative construction access for the stop would also be available via Macarthur Parade, as well as the temporary access utilising Jack Shanahan Park.

3.2.5 Cost

Indicative cost differences for the base case and alternative schemes include:

- The base case would potentially require substantial earthworks and excavations at Bedford Crescent. The alternative schemes would not have this requirement and would therefore present a cost saving compared to base case.
- The base case and alternative scheme 1 both include lifts to facilitate easy access to the stops. Alternative scheme 2 would not require a lift at the stop and would result in a construction and operational (maintenance) cost reduction.

3.2.6 Environment

Base case

Ecology

During construction the main impact of the base case in this location would be the clearing of street plantings along Bedford Crescent. This would remove some foraging opportunities in this area and would contribute towards the overall loss of vegetation and habitats as a result of the project.

During operation no impacts in this location relating to ecology would be expected.

Heritage

Although the stop is to be located within the curtilage of the Dulwich Hill Railway Station, the proposed construction and operation works would not adversely affect the Dulwich Hill Railway Station, or any other listed heritage items.

No Aboriginal sites, places or objects were identified in the project area including this specific location. There would be no impact to known Aboriginal heritage.

Flooding and climate change

During construction and operation phases no impacts are anticipated with respect to flooding and climate change.

Parking and traffic access

Construction phase issues relating to parking and traffic access would include:

- Relatively high volume of construction traffic to transport excavated spoil material from the rock face cutting along Bedford Crescent.
- Impacts to parking along Bedford Crescent during construction works.

Operation phase issues relating to parking and traffic access would include:

- Changes to parking on Bedford Crescent with a loss of approximately 10 parking spaces.

Noise and vibration

For construction of the base case the excavation of the rock face along Bedford Crescent would result in relatively high noise and vibration impacts for the duration of the works. There would also be construction traffic noise impacts due to the need to remove the spoil from the site. Construction noise and vibration would be restricted to daytime hours only.

The operational running noise from the light rail is largely proportional to the speed. The location of the stop determines when the light rail vehicles (LRVs) will need to begin to slow, so the stop location that is further from the previous stop (i.e. the base case) means the LRVs would be able to run at their top speed over a greater distance, and noise levels along the alignment between stops would be correspondingly higher.

The baseline stop location in a cutting would provide some shielding of dwellings on Bedford Crescent from any noise from the stop itself. However this is not expected to be a significant noise issue, on the basis that warning bells during the evening and night-time would only be sounded at the drivers' discretion.

Amenity and property

The base case would include some visual amenity impacts for residents on Bedford Crescent as a result of the removal of street planting vegetation which currently screens views of the heavy rail line and station.

The base case does not provide a direct connection between communities on either side of rail corridor or direct access to Jack Shanahan Park and GreenWay shared path from eastern side of rail corridor.

No changes to private property boundaries or public land uses would be required as part of the base case.

Alternative scheme 1

Ecology

Current street plantings along Bedford Crescent would be retained in this alternative scheme and a small pocket park would be created to the west of the proposed car park.
This alternative would however have little change in the level of ecological impact.

No operational impacts would be expected relating to ecology from this scheme.

Heritage

The stop would be located outside of the curtilage of the Dulwich Hill Railway Station, and the proposed works would not adversely affect the Dulwich Hill Railway Station, or any other listed heritage items.

No Aboriginal sites, places or objects were identified in the project area including this specific location. There would be no impact to known Aboriginal heritage.

Flooding and climate change

No impacts anticipated during construction or operation from this alternative related to flooding or climate.

Parking and traffic access

The number of construction traffic movements would likely be reduced compared to the base case as a result of the reduced excavation and spoil movement activities.

During the operational phase parking and traffic features of the alternative scheme 1 would include:

- the removal of fewer parking spaces on Bedford Crescent, a reduction in the number of parking spaces that would need to be removed for the base case
- provision of a dedicated kiss and ride facility that would benefit both the Dulwich Hill Interchange stop and railway station

- improved turning facility at the end of Bedford Crescent.

Noise and vibration

Alternative scheme 1 would result in a shift in the construction noise impacts to different receivers. However, the construction noise and vibration levels would be expected to be lower as there is no requirement to excavate rock or to remove the spoil from along Bedford Crescent. The construction noise and vibration impacts of this alternative are therefore likely to be less than in the base case.

A small reduction in noise levels would be expected at some receivers due to the LRVs slowing earlier on approach to the alternative stop location.

Amenity and property

Connectivity between communities would be improved with this alternative as a result of direct access between communities on the east and west of the rail corridor being provided.

This alternative would also provide improved access to community infrastructure. Access between the eastern side of rail corridor and Jack Shanahan Park and the GreenWay shared path would be created.

No changes to private property boundaries or public land uses would be required.

Visual amenity impacts would occur for residents adjacent to the new stop location. The scheme would result in a reduction in the visual amenity impacts for residents on Bedford Crescent as street plantings would be retained and a pocket park introduced on the street. Some visual amenity impacts would however be introduced from having the kiss and ride located on the street.

There would be no works in the vicinity of Dulwich Hill Railway Station and therefore no visual amenity impacts to commuters on Dulwich Hill Railway Station platform.

Alternative scheme 2

Ecology

During construction current street plantings along Bedford Crescent would be retained. This alternative would however create little change in the level of ecological impact.

There are no operational impacts from this alternative relating to ecology.

Heritage

The stop would be located outside of the curtilage of the Dulwich Hill Railway Station, and the proposed works would not adversely affect the Dulwich Hill Railway Station, or any other listed heritage items.

No Aboriginal sites, places or objects were identified in the project area including this specific location. There would be no impact to known Aboriginal heritage.

Flooding and climate change

During construction this alternative may require some minor modification or diversion of existing urban drainage to accommodate the new access ways on Bedford Crescent. This would result in a minor impact.

No impacts are anticipated during operation.

Parking and traffic access

The number of construction traffic movements would likely be reduced compared to the base case as a result of the reduced excavation and spoil movement activities.

Operational impacts of this alternative would include:

- parking spaces would all be retained on Bedford Crescent which would reduce parking impacts on this street.
- some loss of parking in Keith Lane in order to accommodate the dedicated kiss and ride facility
- traffic access impacts on Keith Lane as the street is relatively narrow and would accommodate a kiss and ride facility.

Noise and vibration

During the construction phase alternative scheme 2 would result in a shift in the construction noise impacts to different receivers. However, the construction noise and vibration levels would be expected to be lower as there is no requirement to excavate rock or to remove the spoil. The construction noise and vibration impacts of this alternative are therefore likely to be less than in the base case.

During operation a small reduction in noise levels would be expected for alternative scheme 2 at some receivers due to the LRVs slowing earlier on approach to the alternative stop location.

Amenity and property

Amenity and property features of this alternative would be the very similar to alternative scheme 1.

Connectivity between communities would be improved with this alternative as a result of direct access between communities on the east and west of the rail corridor being provided.

This alternative would also provide improved access to community infrastructure. Access between the eastern side of rail corridor and Jack Shanahan Park and the GreenWay shared path would be created.

No changes to private property boundaries or public land uses would be required.

Visual amenity impacts would occur for residents adjacent to the new stop location and kiss and ride facility. Additional lighting for safety and security would potentially impact on visual amenity on Keith lane.

The scheme would result in a reduction in the visual amenity impacts for residents on Bedford Crescent as street plantings would be retained.

There would be no works in the vicinity of Dulwich Hill Railway Station and therefore no visual amenity impacts to commuters on Dulwich Hill Railway Station platform.

3.2.7 Environmental sustainability

Base case

Compared to the alternative options, greenhouse gas emissions associated with the construction of the base case are likely to be higher, mainly due to fuel consumed in the excavation and transportation of spoil, vegetation clearing, and embodied carbon in materials needed for the new lift and replacement of services and signalling infrastructure.

Greenhouse gas emissions would be mostly associated with energy consumed for the operation of the lift and lighting for the interchange.

Alternative scheme 1

Greenhouse gas emissions for the construction of alternative scheme 1 would be less than that for the base case, as there would be no need for mass excavation and haulage, minimal clearing of vegetation, and less hardstand area (so less embodied emissions associated with materials). Emissions would be slightly offset by the provision of the new pocket park.

Greenhouse gas emissions would be mostly associated with energy consumed in operating the lift and lighting for the interchange. Compared to the base case, the stop is further from Dulwich Hill Railway Station, so more light fixtures would be required for community safety, and more greenhouse gas emissions would be associated with energy consumed in lighting.

Alternative scheme 2

Greenhouse gas emissions for the construction of alternative scheme 2 would be less than that for the base case, as there would be no need for mass excavation and haulage, minimal clearing of vegetation, no lift installation and less hardstand area (so less embodied emissions associated with materials).

During operation greenhouse gas emissions would be mostly associated with energy consumed in operating lighting for the interchange. As this alternative has the stop located furthest from Dulwich Hill Railway Station, greenhouse gas emissions associated with lighting would be the highest of any option. However, there is no lift associated with this option, which would reduce greenhouse gas emissions.

3.2.8 Safety and security

Base case

The base case locates the interchange stop adjacent to the heavy rail line which creates potential for operational safety risks. Detailed design would however address these safety risks to maximise patron and driver safety.

The base case locates the interchange stop in close proximity to other transport mode facilities allowing for easy and safe interchange for patrons.

Alternative scheme 1

This alternative locates the interchange stop away from the heavy rail line reducing potential operational interface risks.

This alternative scheme moves the light rail stop away from Dulwich Hill Railway Station and Wardell Road area, and locates it to the west, below the level of Bedford Crescent within the residential area. The location is relatively isolated and there would be limited passive surveillance of the stop and access paths. Lighting and safety would need to be considered at detailed design through crime prevention through environmental design (CPTED) assessment to maximise commuter security.

Alternative scheme 2

This alternative locates the interchange stop further away from the heavy rail line minimising potential operational interface risks.

Alternative scheme 2 locates the light rail stop further into the residential area adjacent to Keith Lane and Macarthur Parade, a greater distance from Dulwich Hill Railway Station. The location is isolated and at the rear of a small number of residential properties posing potential safety and surveillance concerns with no mitigation measures implemented. CPTED assessment would need to be undertaken during detailed design to maximise commuter security.

3.3 Marion Street crossing

3.3.1 User experience

Base case

Key user experience features of the base case would include:

- Safe crossing for pedestrians and cyclists at the signalised crossing.
- Relatively level gradient to travel along – easy access for all pedestrians and cyclists including less mobile users.
- Requirement to stop and wait for light signal to cross the road for cyclists and pedestrians. This can create a disruption of flow in the journey.
- For road traffic there would be an occasional requirement to stop at the signalised crossing to allow pedestrians and cyclists to cross the road. This would create a slight delay in travel.

Alternative scheme

Key user experience features of the alternative scheme would include:

- Bridge facility for pedestrians and cyclist to cross over Marion Street. No requirement for cyclists and pedestrians to stop to cross the road which would facilitate a more fluid movement through area.

- The gradient of the paths on either side of the bridge facility may be viewed as a slight negative for user experience for less mobile pedestrians i.e. pedestrians with prams, elderly or people with disabilities and for some recreational cyclists.
- No impact on flow of traffic on road as no signalised crossing on Marion Street.
- The alternative design would require the Marion Stop location to move slightly north to accommodate the bridge. This would increase the distance to reach the stop for commuters by a small amount (less than approximately 20 metres).

3.3.2 Stakeholder views

Base Case

Stakeholder views which have been advised to Transport NSW include:

- RTA is not opposed to an at grade signalised crossing. RTA propose, however that it be moved to the intersection of Marion Street and Hawthorn Parade, subject to Ashfield Council's concurrence.
- Ashfield Council supports signalised crossing on Marion Street, however, proposes that a pedestrian/cycle bridge also be placed on the east side of the light rail.
- Leichhardt Council does not support the base case due to increased delays in traffic as a consequence of the signalised crossing and that it may inhibit access to Council's Depot.

Alternative Scheme

Stakeholder views which have been advised to Transport NSW include:

- RTA expressed support for this scheme.
- Leichhardt Council supports this scheme
- Bicycle NSW, Bikes Sydney, and Leichhardt Bicycle User Group support this scheme
- Friends of the Greenway and Greenway Steering Committee support this scheme.

3.3.3 Community feedback

Base case

Community feedback which has been advised to Transport NSW includes:

- Residents along Hawthorne Parade are supportive of the base case.
- Some community concerns have been raised about the impact from the signalised crossing on traffic along Marion Street however the traffic assessment undertaken as part of the EA has not supported this concern.

Alternative scheme

Community feedback which has been advised to Transport NSW includes:

- Some residents on Hawthorne Parade (south of Marion Street) are opposed to the overpass (tree clearing, reduction in privacy and visual impacts).
- Some residents on Hawthorne Parade (north of Marion Street) are opposed to bridge structure commencing in Richard Murden Reserve and crossing Hawthorne Canal.
- Broader community have supported not having a signalised intersection and would prefer a pedestrian/cycle bridge.
- Some community members would prefer signalised crossing to control crossing of crowds after sporting events at nearby Lambert Park.

3.3.4 Constructability

Base Case

The construction of the signalised crossing of Marion Street would be relatively low impact work as it would not involve any significant construction plant and equipment and with activities of only minimal durations. Activities would include installation of traffic signals, detector loops, line marking, installation of holding rails and signage. Subject to the detailed design for the crossing, some minor road works may be involved to modify the traffic arrangements such as a raised crossing, kerb ramps, centre refuge and traffic medians to converge lanes to one lane each direction.

The work would be staged and would involve partial lane closures on Marion Street – adequate traffic flows would need to be maintained.

Alternative Scheme

Constructability constraints that have been identified in relation to this alternative scheme include the following:

- In order to provide access and establish a worksite to facilitate the construction of the southern bridge ramp, trees and vegetation would need to be cleared in the vicinity of the structure for a length of approximately 80 metres. Some trees and vegetation on the western side of the canal (i.e. within Richard Murden Reserve) would also need to be removed for the northern bridge ramp and landing.
- In order to achieve the required grades on the bridge approach ramps, the total length of the structure would be in the order of 200 metres. This structure would require piled foundations and would include precast bridge girders for the crossing of Marion Street (approximately 25 metres clear span) and the Hawthorne Canal (from 25 to 40 metres clear span depending on alignment over the canal). Installation of the bridge girders would involve the use of large mobile cranes.

- Pile capping beams, bridge columns, headstocks and other elevated sections of the ramps would be constructed using cast in-situ reinforced concrete. The bridge deck and ramps would be constructed with precast planks or panels, or with cast in situ concrete. These works, particularly on the southern side of Marion Street would be constrained by the worksite size and location, with the canal along one side and the rail embankment along the other.

- Due to the vicinity of the Hawthorne Canal and depending on the ground conditions and permeability of the rock, dewatering would likely to be required for the construction of the pile foundations.

- The majority of the work is in the vicinity of Hawthorne Canal and would need to be undertaken carefully so as not to damage the canal structure (vibration and/or loading). Suitable erosion and sedimentation control measures would be required to mitigate potential water quality impacts.

3.3.5 Cost

There would be a substantial cost difference between the base case and alternative scheme with the alternative scheme likely to be significantly more expensive. Increased costs for the alternative scheme would result from the bridge materials, construction costs, additional lift installation and ongoing maintenance costs.

3.3.6 Environment

Base case

Ecology

Minimal vegetation clearing would be required during construction to accommodate the GreenWay shared path on either side of signalised crossing.

No operational impacts are expected from the base case relating to ecology.

Heritage

No impacts from the base case.

Flooding and climate change

No impacts from the base case.

Parking and traffic access

Minimal impacts anticipated during the installation of the signalised crossing in the construction phase.

Operation phase impacts would likely include:

- Signalised crossing would change traffic conditions on Marion Street. However the EA identified that this would not be a significant impact to the Level of Service (LoS) on Marion Street.

- Access to the council depot would remain unchanged.

Noise and vibration

No impacts from the base case.

Amenity and property

No amenity impacts from the base case or changes to private property boundaries or public land uses.

Alternative scheme

Ecology

There would be increased vegetation clearing at this location to accommodate the bridge (and possibly construction compounds and work areas). This would include vegetation from bushcare sites within the Richard Murden Reserve to the north of Marion Street as well as vegetation areas to the south of Marion Street adjacent to Hawthorne Canal. This would incrementally add to the overall extent of vegetation clearing from the project. This would further create a wider barrier within the Greenway, although Marion Street presents a significant barrier at this location in the current arrangement.

Heritage

There is potential for direct and indirect impacts to the Hawthorne Canal. Construction of a new bridge would potentially result in a loss of the original fabric of the canal and has the potential to expose sub-surface canal fabric or relics associated with its construction. The bridge design would need to be undertaken in consultation with Sydney Water and would need to sensitively reflect the local heritage environment.

Construction of a new pedestrian/cycle bridge over Marion Street may have an impact on the aesthetic and visual amenity of the Haberfield Conservation Area.

Construction of a new pedestrian/cycle bridge over Marion Street would be within the curtilage of the Marion Street underbridge, and has the potential to impact the underbridge. The bridge would need to be restricted to the western elevation of the underbridge and not attached to the fabric of the underbridge to ensure that heritage integrity is retained.

No Aboriginal sites, places or objects were identified in the project area including this specific location. There would be no impact to known Aboriginal heritage.

Flooding and climate change

The alternative scheme involves the construction of new ramps adjacent to Hawthorne Canal and also potentially works within the canal if piers for the crossing ramp are required. The alternative scheme would therefore introduce the following additional environmental risks during construction and operation:

- Construction phase – potential for water quality impacts on the canal due to mobilisation of sediment during the works.
- Construction phase – potential for increased flooding to adjacent land if a flood event occurred while temporary works were present that caused obstruction to the channel.

- Operation phase – potential for increased flooding to adjacent land due to loss of overbank flood conveyance and/or storage south of Marion Street if existing levels are to be raised to accommodate the ramp in this location.

Parking and traffic access

During the construction phase impacts could include:

- lane closures of Marion Street to construct the bridge
- increased construction vehicle movements for material delivery.

During the operational phase impacts could include:

- reduced delays for vehicle traffic that would have been experienced at a signalised midblock crossing
- impacts to access for council depot. The bridge would need to be designed with an appropriate clearance height for council vehicles in order to ensure this access would remain operational.

Noise and vibration

The alternative would have greater construction noise impacts due to the need to construct a bridge, associated piling work and possibly night works to allow closure of Marion Street during construction. However, residential receivers are set back some distance from the Marion Street crossing so construction noise and vibration impacts would be manageable.

Amenity and property

Visual amenity and intrusion impacts would be associated with the alternative scheme for residents along Hawthorne Parade.

No changes to private property boundaries would be required.

Some changes to public land uses would occur through bridge construction and positioning in the Richard Murden Reserve.

3.3.7 Environmental sustainability

Base case

Greenhouse gas emissions associated with the construction of the base case would be relatively minor, when compared to the alternative.

Greenhouse gas emissions would be mostly associated with fuel consumed by vehicles idling at the signalised crossing and energy consumed in operating the signals, lift and lighting.

Alternative scheme

Greenhouse gas emissions associated with the construction of the alternative would be much higher than the base case, as a result of:

- fuel consumed in construction equipment
- embodied emissions in the substantial additional concrete and steel and the additional lift
- emissions associated with vegetation clearing.

Greenhouse gas emissions would be mostly associated with energy consumed in operating the lifts and lighting. Although an additional lift is proposed, it is likely that operational emissions would be less than the base case.

3.3.8 Safety and security

Base case

The proposed signalised crossing provides a safer crossing of Marion Street than the existing situation where pedestrians and cyclists cross at this location via a traffic island.

Potential conflict between pedestrians and cyclists on the footpath on Marion Street would exist without design mitigation.

Alternative scheme

The bridge would create a safer pedestrian and cycle alternative with the removal of the potential for traffic conflicts. This scheme would however leave the existing pedestrian paths, creating the possibility that cyclists and pedestrians would choose to continue to cross Marion Street at grade with no signalised crossing, instead of the elevated ramp and bridge structure.

The potential conflict between pedestrians and cyclists on the footpath on Marion Street would be removed.

3.4 Location of GreenWay shared path in vicinity of Weston Street

3.4.1 User experience

Base case

Key user experience features of the base case would include:

- The requirement for cyclists and pedestrians travelling along the GreenWay to travel out onto Weston Street before rejoining the shared path facility within the rail corridor. This would potentially reduce the continuity of the travel experience.

- The potential for cyclists to conflict with vehicles on the road and for collision with car doors opening from parked vehicles.

Alternative scheme 1

Key user experience features of alternative scheme 1 would include:

- Continuous travel along GreenWay without travel out onto road. This would allow for increased continuity of journey.
- A more direct route of travel.
- There is the potential for users to experience a tunnel effect due to the likely requirements for privacy and safety screens on both sides of the GreenWay.

Alternative scheme 2

The user experience for alternative scheme 2 would be the same as for alternative scheme 1.

3.4.2 Stakeholder views

Base case

Stakeholder views which have been advised to Transport NSW include:

- EcoTransit supports the base case.
- The GreenWay Steering Committee support the base case.
- Friends of the GreenWay expressed concern on the impact of biodiversity if alternatives are pursued.
- Bicycle NSW supports the base case recommending that the northern end of Weston Street be closed off.
- Marrickville Council does not support the base case.

Alternative scheme 1 and alternative scheme 2

Stakeholder views which have been advised to Transport NSW include:

- Marrickville Council supports placing the Greenway within the light rail corridor and recognises the impact of issues such the narrow corridor width, flooding, privacy impact, construction feasibility, construction cost associated with these schemes.

3.4.3 Community feedback

Base case

Community feedback which has been advised to Transport NSW includes:

- Community stakeholders, including some residents of Weston Street, support the base case.
- Community stakeholders, including a number of residents of Weston Street, do not support the base case.

Alternative scheme 1 and alternative scheme 2

Community feedback which has been advised to Transport NSW includes:

- A number of Weston Street residents lodged repeated submissions or endorsed the lodgement of a group submission supporting an in corridor GreenWay.
- Other community stakeholders have expressed support for an in corridor GreenWay.

3.4.4 Constructability

Base case

The base case would include minimal construction impact from on street cycleway – limited to elements such as some sign installation and painting of street markings.

Alternative scheme 1 and alternative scheme 2

Key elements associated with the construction of the alternatives are very similar and identified as follows:

- constrained area with difficult terrain for construction equipment access – likely to require some impact to properties / access through properties
- unknown impacts to Hawthorne Canal infrastructure – structural integrity of canal not currently known. Construction of GreenWay structure immediately on top of the existing canal structure is not supported by Sydney Water
- working on embankment would potentially impact the structural integrity of embankment
- unknown geology to support piles e.g. depth to bedrock and potential fill/contamination issues
- requirement for piling to occur – this would contribute to construction noise and vibration impacts
- requirement for the removal of residential fences and potential encroachment across property boundaries
- piles or piers would need to minimise impacts to flooding extents

- significant privacy impacts for Weston Street properties which back onto rail corridor.

3.4.5 Cost

There would be a substantial cost difference between the base case and alternative schemes with the alternative schemes likely to be significantly more expensive. Increased costs for the alternative scheme would result from the additional materials and construction costs and ongoing maintenance costs.

3.4.6 Environment

Base Case

Ecology

The base case involves no vegetation clearing or loss of habitat.

Heritage

No impact to Hawthorne Canal or Pressure Tunnel from on street cycleway.

Flooding and climate change

No flooding or climate change impacts associated with the base case.

Traffic, access and parking

Construction phase would involve some painting of templates on the road way and some signage erection. This would result in minimal traffic disruption expected.

During the operation phase there would be potential for conflict between cyclists and cars. No parking impacts would be expected.

Noise and vibration

The base case option would have minimal construction noise and vibration impacts. Operational noise impacts from the base case are expected to be negligible.

Amenity and property

On street cycleway would put more pedestrian and cyclist traffic on the local road. Increased usage of the road area and footpath would potentially result in some amenity change on Weston Street.

No changes to private property or acquisition requirements.

Alternative scheme 1

Ecology

Alternative schemes 1 would require clearing of vegetation along Hawthorne Canal.

Although largely weed growth and planting, this would add to the incremental loss of vegetation and habitat as a result of the project. It would also reduce the width of the green corridor that runs though this section.

Heritage

There would be direct and indirect impacts to the Hawthorne Canal. Construction of the GreenWay shared path over the canal would likely undermine its integrity and result in a loss of the original fabric of the Hawthorne Canal. The scheme has the potential to expose sub-surface canal fabric or relics associated with its construction. This would be a serious impact to its historic and technical significance of the item, which should be avoided. Consultation with Sydney Water would need to be undertaken during the design stage to impacts to the canal are minimised.

Although there is unlikely to be a direct impact on the building housing the vertical maintenance shafts of the Pressure Tunnel, there may be a direct impact on the Pressure Tunnel itself from this scheme.

No Aboriginal sites, places or objects were identified in the project area including this specific location. There would be no impact to known Aboriginal heritage.

Flooding and climate change

Alternative scheme 1 involves the construction of a suspended grated walkway directly above the concrete lined channel of Hawthorne Canal over a distance of approximately 300 metres adjacent to Weston Street. This alternative scheme would therefore introduce the following additional environmental risks during construction and operation:

- Construction – potential for water quality impacts on the canal due to mobilisation of sediment during the works.
- Construction – potential for increased flooding to adjacent land if a flood event occurred while temporary works were present that caused obstruction to the channel.
- Operation – potential for increased flooding to adjacent land due to loss of overbank flood conveyance and/or storage due to the supports for the walkway on each bank.
- Operation – potential for increased flooding to adjacent land due to debris blockage under the walkway during flood conditions. Without access to the channel for regular maintenance, debris would accumulate over time and eventually lead to almost complete blockage of the channel, causing flood flows to be conveyed over adjacent land rather than in the channel. To mitigate this impact regular access points would have to be provided, for example as removable sections of walkway, to enable removal of debris and channel cleaning. This would add considerable maintenance cost to the responsible authority. Regular maintenance would reduce but not eliminate the risk of blockage during an extreme event.

Traffic, access and parking

During the construction phase increased construction vehicles would be required to delivery materials and equipment.

No changes to operational impacts for traffic and parking are anticipated.

Noise and vibration

Construction of the GreenWay shared path above the canal would have a significantly increased construction noise and vibration impact in particular due to piling works. The nearest residential facades would be located at a distance of less than 10 metres to the works. Construction work would potentially encroach on safe working distances for vibration intensive plant and a detailed vibration assessment and vibration monitoring during construction would probably be required to minimise the risk of structural damage to the canal.

No change to operation noise and vibration impacts are expected.

Amenity and property

Some visual impacts and privacy issues would result from having the GreenWay shared path at the rear of residential properties on Weston Street. Screening would need to be considered during detailed design to minimise these impacts.

Alternative scheme 1 would have private property impacts. Partial acquisition at the rear of some properties on Weston Street may be required to accommodate GreenWay shared path structure. Temporary land take of private properties may also be required during construction.

Alternative scheme 2

Ecology

Alternative schemes 2 would require clearing of vegetation along Hawthorne Canal. Although largely weed growth and planting, this would add to the incremental loss of vegetation and habitat as a result of the project. It would also reduce the width of the green corridor that runs though this section. Alternative scheme 2 would have a greater impact and result in further vegetation clearing that alternative scheme 1.

Heritage

Alternative scheme 2 would have the same impacts as alternative scheme 1.

Flooding and climate change

Alternative scheme 2 would involve the construction of a concrete walkway on the right overbank area of Hawthorne Canal over a distance of approximately 300 metres adjacent to Weston Street. This alternative scheme would therefore introduce the following additional environmental risks during construction and operation:

- Construction – potential for water quality impacts on the canal due to mobilisation of sediment during the works.
- Construction – potential for increased flooding to adjacent land if a flood event occurred while temporary works were present that caused obstruction to the channel.
- Construction – potential for damage to the existing concrete lined channel due to construction activities such as piling or ground loading.

- Operation – potential for increased flooding to adjacent land due to loss of right overbank flood conveyance and/or storage due to the support for the walkway on the right overbank.

- Operation – potential for increased flooding to adjacent land due to debris blockage under the walkway during flood conditions.

Traffic, access and parking

During the construction phase increased construction vehicles would be required to delivery materials and equipment.

No changes to operational impacts for traffic and parking are anticipated.

Noise and vibration

Construction of the GreenWay shared path on an elevated structure adjacent to the canal would have a significantly increased construction noise and vibration impact in particular due to piling works. The nearest residential facades would be located at a distance of around 10 metres to the works. Construction work would potentially encroach on safe working distances for vibration intensive plant and a detailed vibration assessment and monitoring during construction would be required to minimise the risk of structural damage to the canal and embankment.

Amenity and property

Visual impacts and privacy issues would potentially be greater from this alternative design as a result of the elevation of the shared path, vegetation screening removal and direct line of sight into the rear of properties on Weston Street. A privacy screen would be required between the elevated shared path and the residences on Weston Street to address views into backyards and to protect privacy of residents of Weston Street.

Property acquisition and temporary land take are considered unlikely for this alternative however this would need to be confirmed with further investigation into construction method and detailed design.

3.4.7 Environmental sustainability

Base case

Greenhouse gas emissions associated with the construction and operation phases for the base case would be negligible.

Alternative scheme 1 and alternative scheme 2

Greenhouse gas emissions associated with the construction of the alternative would be much higher than the base case, as a result of:

- fuel consumed in construction equipment
- embodied emissions in the additional concrete and steel
- emissions associated with vegetation clearing.

Greenhouse gas emissions would be mostly associated with energy consumed in any lighting provided along the GreenWay shared path.

3.4.8 Safety and security

Base case

Some safety issues associated would exist with the base case with respect to the on-street cycle path, with potential conflict between cars and bicycles, especially at the intersection of Weston Street and Old Canterbury Road and as cars reverse out of driveways.

Alternative scheme 1 and alternative scheme 2

These schemes would remove the potential risk of conflict between bicycles and cars on the local road network.

Less passive surveillance would occur on the GreenWay shared path in corridor alternatives. Lighting along the GreenWay would need to be considered during detailed design to maximise user security.

4. Multi-criteria analysis of alternative schemes

A multi criteria analysis (MCA) was been undertaken on the alternative schemes to measure the benefits and impacts of each of the alternative schemes against the base case project. This chapter presents the MCA methodology, process and results to assist in determining whether any of the alternative schemes would be adopted over the base case.

4.1 Methodology

The MCA has been divided into seven main issue categories which the alternative schemes can be measured against, as described in Table 3-1 and listed below:

- user experience
- stakeholder views
- community feedback
- constructability
- cost
- environmental impacts (including ecology; heritage; flooding and climate change; parking, traffic and access; noise and vibration; and amenity and property)
- environmental sustainability
- safety and security.

4.1.1 Scoring

For the purpose of this MCA process, the base case was ranked as zero for each of the above categories. Each alternative scheme was then scored against the base case for each of the categories based on whether the alternative scheme provided a benefit (positive score) or adverse impact (negative score) in comparison to the base case.

Scores are allocated up to a maximum of +2 and a minimum of -2. If the alternative scheme would not result in an overall change in impact for a particular issue category with respect to the base case, a score of zero was given.

Where an issue category has multiple components, for example urban design and safety (visual impact, privacy, security and safety), all relevant issues were considered with respect to that alternative scheme and an overall score was given on balance of those issues.

Each of the environmental sub-issues were scored separately and then considered together to provide an overall score for environmental impact. Where an alternative scheme had a high number of minor impacts (or benefits), this was considered to be a larger overall impact (or benefit) resulting in a score of -2 (or +2).

4.1.2 Performance measures

To assist with the scoring, a set of performance measures was developed for each issue category. Performance measures are presented in Table 4.1.

Table 4.1 Performance measures

Category	Performance measure	Scoring				
		-2	-1	0	1	2
General	*n/a*	*Worse outcome than base case*	*Slightly worse outcome than base case*	*No better or worse than base case*	*Slightly better outcome than base case*	*Better outcome than base case*
User experience	Customer expectations, operating requirements (e.g. travel times), functionality of GreenWay, connectivity and accessibility.	Reduces functionality and useability of light rail or GreenWay operations; diminishes connectivity and/or accessibility	Marginally affects functionality and useability of light rail or GreenWay operations; minor impact to connectivity and/or accessibility	No overall change to user experience	Increases functionality and useability of light rail or GreenWay operations; improves connectivity and/or accessibility	Benefits to functionality and useability of light rail or GreenWay operations; greatly improves connectivity and/or accessibility
Stakeholder views	Preferred positions or advice from key stakeholders, including regulatory agencies and asset owners.	Would meet significant objection from stakeholder(s), unlikely to be supported	Would not meet stakeholders requirements of objectives	Stakeholders have no opinion	Potential benefits to stakeholders, addresses stakeholders requirements	Would provide better outcome for stakeholders, likely to be endorsed
Community feedback	Likely response from community to alternative scheme(s) noting the key areas of concern raised or benefits of schemes identified.	Would meet significant objection from the community, unlikely to be supported	Would not address community concerns raised to date	Community has no opinion	Potential community benefits, addresses community concerns and issues	Would provide better outcome for wider community, likely to be broadly endorsed
Constructability	Ease/difficulty in construction	Issues and impacts associated with construction	Minor issues and impacts associated with construction	No overall change to constructability	Slightly reduced issues and impacts associated with construction	Reduced issues and impacts associated with construction
Cost	Indicative cost for construction of each of the schemes.	Likely to be >20% more expensive than base case	Likely to be >5% more expensive than base case	No significant cost implications	Likely to be <5% less expensive than base case	Likely to be <20% less expensive than base case
Environmental impacts:	Overall assessment of potential environmental impacts or benefits of each scheme – construction and operation	Impacts to the environment that would require major and/or specific mitigation measures	Minor impacts to the environment that would require standard mitigation measures	No overall change in impact to the environment	Minor benefits or reduced impacts to the environment	Benefits or reduced impacts to the environment

Category	Performance measure	Scoring				
		-2	-1	0	1	2
Ecology	*Vegetation clearing, habitat removal or fragmentation*	*Large extent of clearing, impacts to threatened species, fragmentation*	*Clearing of vegetation and/or habitat*	*No additional impacts to vegetation*	*Small reduction in extent of clearing*	*Extensive reduction in extent of clearing*
Heritage	*Impacts to heritage items*	*Potential impact to state listed heritage item*	*Potential impact to locally listed heritage item*	*No additional impacts to heritage items*	*Small reduction in impacts to heritage item*	*Major reduction in impacts to heritage item*
Flooding and climate change	*Impacts to flooding, climate change adaptability*	*Potential major flooding impacts; nil climate change adaptability*	*Potential flooding impact; limited climate change adaptability*	*No additional flooding impacts*	*Minor reduction in flooding impacts; adaptable to climate change*	*Major reduction in flooding impacts; adaptable to climate change*
Parking and traffic access	*Impacts to parking, traffic and/or access*	*Additional parking, traffic or access issues*	*Minor additional parking, traffic or access issues*	*No additional parking, traffic or access issues*	*Minor improvement in parking, traffic or access*	*Improvement in parking, traffic or access*
Noise and vibration	*Noise and/or vibration impacts – construction and/or operation*	*Increased noise and/or vibration impacts during operation and/or construction*	*Marginally increased noise and/or vibration impacts during operation and/or construction*	*No overall change in noise and vibration impacts*	*Marginally reduced noise and/or vibration impacts during operation and/or construction*	*Reduced noise and/or vibration impacts during operation and/or construction*
Amenity and property	*Impacts to amenity, community connectivity, property (acquisition), etc*	*Overall reduction in amenity, or connectivity; property acquisition*	*Slight reduction in amenity or connectivity;*	*No overall change in impacts*	*Some benefits to local amenity, improvements to connectivity*	*Enhances local amenity, improvements to connectivity*
Environmental sustainability	Carbon footprint, resource efficiency	Increased carbon footprint; very low resource efficiency	Slightly increased carbon footprint; low resource efficiency	No change in carbon footprint or resource efficiency	Slightly reduced carbon footprint; good resource efficiency	Reduced carbon footprint; very good resource efficiency
Safety and security	Public safety considerations and security for commuters and users	Potential major reduction in security; scheme considerably less safe than base case	Potential reduction in security; scheme marginally less safe than base case	No overall change in, security and safety (on balance)	Slight improvement to security; scheme marginally safer than base case	Enhances security; scheme considerably safer than base case

4.1.3 Workshop

A workshop was held on 3 November to confirm the methodology and performance measures and to determine the scores for all categories for each alternative scheme. The workshop was attended by members of the Light Rail Project Team with a broad representation of technical skills to cover off on the relevant issues. A list of the workshop attendees is provided in Appendix A.

4.2 Multi-criteria analysis

The results of the MCA are presented in Tables 4.2 to 4.6.

4.2.1 Dulwich Hill Interchange stop location

Table 4.2 Dulwich Hill Interchange alternative scheme 1 MCA

Category	Score	Key comments
User experience	0	• Decreased connectivity with Dulwich Hill Railway Station (increases distance between stop and station) and bus routes along Wardell Road. • Further distance for community south of Dulwich Hill Railway Station to access stop. • Increased access and connectivity with Jack Shanahan Park and GreenWay. • Increases potential catchment area for light rail (better access for residents on western side of railway, e.g. Hercules Street). • Reduced operational flexibility with single track end of line.
Stakeholder views	-1	• EcoTransit strongly opposed to this scheme.
Community feedback	+1	• Some members of community (especially Bedford Crescent residents) are opposed to stop in front of Bedford Crescent (due to noise, visual, parking impacts). • Would still result in main access between light rail stop and Dulwich Hill Railway Station along Bedford Crescent and laneway. • Some members of community support as provides community access between the east and west sides of the line, shops, bus and rail routes.
Constructability	+2	• No requirements to excavate rockface at Bedford Crescent (reduced spoil and haulage, reduced construction impact). • Works impacting on Bedford Crescent would be minor. • No construction directly adjacent to operating railway – avoids need for potential coordination with RailCorp. • No need for possessions (potential requirements for base case) and associated program delays.
Cost	+2	• Construction costs reduced considerably (no excavation of rockface).
Environmental impacts:		
Ecology	*0*	• *Slight reduction in extent of clearing.* • *Pocket park with planting included.*
Heritage	*0*	• *No heritage impacts (base case and alternative scheme).*
Flooding and climate change	*0*	• *No flooding/climate change impacts (base case and alternative scheme).*

Category	Score	Key comments
Parking, traffic and access	*+1*	• *Fewer parking spaces removed on Bedford Crescent.* • *Main access still via Bedford Crescent, turning area provided on Bedford Crescent.* • *Reduced construction vehicle traffic on road network.* • *Kiss and ride facility provided.*
Noise and vibration	*+1*	• *Reduced construction noise (no excavation of rockface).* • *Minor operational noise impact improvements.*
Amenity and property	*+1*	• *Improved connectivity between east and western side of rail corridor communities.* • *Enhances connectivity of Jack Shanahan Park and GreenWay from east of corridor.* • *Reduced visual impact at Bedford Crescent (retain trees on Bedford Crescent).*
Environmental impacts total	***+1***	• Overall slight benefit (reduced parking and noise impacts, improves connectivity and amenity).
Environmental sustainability	+1	• Reduced carbon footprint (less excavation), good resource efficiency (less spoil for off-site disposal).
Safety and security	0	• Interchange distance is longer and less visible – CPTED required to minimise security impacts. • Removes potential operational interface with heavy rail line.
Total	**6**	

Table 4.3 Dulwich Hill Interchange alternative scheme 2 MCA

Category	Score	Key comments
User experience	-1	• Decreased connectivity with Dulwich Hill Railway Station (increases distance between stop and station). • Increased access and connectivity with Jack Shanahan Park and GreenWay. • Increases potential catchment area for light rail (better access for residents on western side of railway, e.g. Hercules Street). • Reduced operational flexibility with single track end of line. • Further distance for community south of Dulwich Hill Railway Station to access stop. • Poor pedestrian access down Keith Lane.
Stakeholder views	-2	• EcoTransit strongly opposed to this scheme.
Community feedback	+1	• Some members of community (especially Bedford Crescent residents) are opposed to stop in front of Bedford Crescent (due to noise, visual, parking impacts). • Some members of community support as provides community access between the east and west sides of the line, shops, bus and rail routes. • Some residents from Keith Lane oppose this option.
Constructability	+2	• No requirements to excavate rockface at Bedford Crescent (reduced spoil and haulage, reduced construction impact). • Works impacting on Bedford Crescent would be minor. • No construction directly adjacent to operating railway – avoids need for potential coordination with RailCorp. • No need for possessions (potential requirements for base case) and associated program delays.
Cost	+2	• Construction costs reduced considerably (no excavation of rockface. • No lift requirement – construction and operation (maintenance) reduced cost.
Environmental impacts:		
Ecology	*0*	• *Slight reduction in extent of clearing – minimal overall impact however.*
Heritage	*0*	• *No heritage impacts (base case and alternative scheme).*
Flooding and climate change	*0*	• *Minor flooding/climate change impacts (base case and alternative scheme).*
Parking, traffic and access	*-2*	• *Retains full width (and parking spaces) on Bedford Crescent.* • *Poor access and potential parking and traffic impacts on Keith Lane.*
Noise and vibration	*+1*	• *Reduced construction noise (no excavation of rockface).*
Amenity and property	*0*	• *Enhances connectivity of Jack Shanahan Park and GreenWay.* • *Lighting impacts on Keith lane.*
Environmental impacts total	***0***	• Overall slight benefit (reduced parking and noise impacts, improves connectivity between communities and to public space and improves amenity).
Sustainability	+1	• Reduced carbon footprint (less excavation), good resource efficiency (less spoil for off-site disposal).
Safety and security	-1	• Passive surveillance poor along Keith Lane and Macarthur Parade – pedestrian security. • Removes potential interface with heavy rail line.
Total	**2**	

4.2.2 Marion Street crossing

Table 4.4 Marion Street crossing alternative scheme MCA

Category	Score	Key comments
User experience	+1	• Improves user experience of GreenWay by removing need to stop at Marion Street and enhancing continuity. • Removes traffic signals for road users. • Some users may still choose to cross at grade (with no signalised crossing) to avoid using ramp. • Grade of ramp/bridge may not be preferred for less mobile pedestrians, people with prams, elderly. • Some users may still choose to cross at grade using existing traffic island (with no signalised crossing) to avoid using ramp. • Stop locations moves slightly north.
Stakeholder views	+2	• RTA expressed support for this scheme. • Leichhardt Council supports this scheme. • Bicycle NSW, Bikes Sydney, and Leichhardt Bicycle User Group support this scheme. • Friends of the Greenway and Greenway Steering Committee support this scheme. • Impacts on council depot access road– design would need to ensure access is maintained during operation.
Community feedback	-1	• Some residents on Hawthorne Parade (south of Marion Street) opposed to overpass (tree clearing, reduction in privacy, visual impacts). • Some residents on Hawthorne Parade (north of Marion Street) may be opposed to bridge structure commencing in Richard Murden Reserve. • Broader community have supported not having a signalised intersection – prefer bridge. • Some communities would prefer signalised crossing to control crossing of crowds after sporting events.
Constructability	-2	• Large structure to be constructed over Hawthorne Canal and Marion Street. • Possible road closures of Marion Street during construction. • Narrow work area on south side of Marion Street. • Impacts to Richard Murden Reserve during construction.
Cost	-2	• Bridge structure considerably more expensive than signalised crossing option – two span bridge. • Construction of additional lift and stair. • Operational maintenance costs increased with extra lift.
Environmental impacts:		
Ecology	*-1*	• *Removal or trees north and south of Marion Street.*
Heritage	*-1*	• *Impacts to Hawthorne Canal possible.* • *Impacts to Haberfield Conservation Area and Marion Street underbridge.*
Flooding and climate change	*-1*	• *Minor change to flooding and climate change impacts.*
Parking, traffic and access	*+1*	• *Removes traffic signals from Marion Street (however traffic signals at Marion Street have minimal impact on traffic flows during peak).* • *Increased construction vehicle traffic and possible temporary road closures.*
Noise and vibration	*-1*	• *Increased construction noise impact.*
Property and amenity	*-2*	• *Reduction in amenity for Hawthorne Street residents (visual impact, privacy)..*
Environmental impacts total	***-2***	• Overall slight negative (reduced amenity and increased noise for Hawthorne Street residents, additional clearing/habitat loss, some traffic benefits).

Category	Score	Key comments
Environmental sustainability	-1	• Increased carbon footprint through construction of overpass and removal of vegetation, more resource intensive (use of materials and equipment). • Potentially slightly reduced operational impact as a result of no traffic lights being required.
Safety and security	+1	• Grade separated crossing reduces potential conflict between pedestrians and vehicles compared to at grade (signalised) crossing – removes conflict on Marion Street. • Removes cyclists from travelling on footpath on Marion Street. • Some users may still choose to cross at grade using existing traffic island (with no signalised crossing) to avoid using ramp.
Total	**-4**	

4.2.3 Weston Street on street cycle pathway

Table 4.5 Weston Street shared path alternative scheme 1 MCA

Category	Score	Comments
User experience	+2	• Improves user experience of GreenWay by enhancing continuity and removing need to leave corridor and use local roads. • More direct. • No interface with vehicles on the road for cyclists.
Stakeholder views	-1	• Sydney Water, as asset owner, would need to endorse any works that could impact Hawthorne Canal. • Marrickville Council have indicated support for in corridor option. • GreenWay Steering Committee and Friends of the GreenWay prefer on street – no vegetation clearing impacts. • Bicycle NSW support the base case.
Community feedback	+2	• Community (Weston Street residents) have indicated mixed views on preferred location. Broader support is for the in corridor option (i.e. alternative scheme). • Broader community generally supportive of in corridor option.
Constructability	-2	• Construction of extended raised pathway in corridor considerably more difficult than base case (road markings and signage). • Limited room for construction equipment / activities. • Requirement to rebuild canal structure. • Railway embankment stability issues and unknown geotechnical conditions. • Temporary construction site required on private land.
Cost	-2	• Cost of in-corridor option considerably more expensive than base case. • Potential costs associated with construction temporary land take leases. • Increased maintenance requirements of canal structure to reduce blockages.
Environmental impacts:		
Ecology	*-1*	• Removal of vegetation in corridor (provides screening and habitat), decreasing width of green corridor in the area.
Heritage	*-1*	• Potential impacts to Hawthorne Canal. • Impact on Pressure Tunnel.
Flooding & climate change	*-1*	• Water quality impacts during construction. • Potential flooding impacts due to debris blockages. • Potential for diversion of channel during construction.
Parking, traffic & access	*0*	• Limited change in impacts to parking, traffic and access.
Noise and vibration	*-1*	• Increased construction noise and vibration impacts.
Amenity and property	*-1*	• Potential property acquisition. • Increased visual impacts and privacy issues at rear of residents on Weston Street.
Environmental impacts total	***-2***	• Overall alternative scheme generally has a worse environmental outcome than base case due to removal of vegetation, impacts to heritage item, potential flooding impacts and potential property acquisition.
Environmental sustainability	-1	• Increased carbon footprint through construction of shared path and removal of vegetation, more resource intensive (use of materials and equipment).
Safety and security	+1	• Reduces potential conflict between cyclists and vehicles on Weston Street. • Security – relatively less passive surveillance on the GreenWay.
Total	**-3**	

Table 4.6 Weston Street shared path alternative scheme 2 MCA

Category	Score	Comments
User experience	+2	• Improves user experience of GreenWay by enhancing continuity and removing need to leave corridor and use local roads. • More direct. • No interface with vehicles on the road for cyclists.
Stakeholder views	-1	• Sydney Water, as asset owner, would need to endorse any works that could impact Hawthorne Canal. • Marrickville Council have indicated support for in corridor option. • GreenWay Steering Committee and Friends of the GreenWay prefer on street – no vegetation clearing impacts. • Bicycle NSW support the base case.
Community feedback	+2	• Community (Weston Street residents) have indicated mixed views on preferred location. Broader support is for the in corridor option. • Broader community generally supportive of in corridor option.
Constructability	-2	• Construction of extended raised pathway in corridor considerably more difficult than base case (markings and signage). • Limited room for construction equipment / activities. • Requirement to rebuild canal structure. • Railway embankment stability issues and unknown geotechnical conditions.
Cost	-2	• Cost of in corridor option considerably more expensive than base case. • Additional lighting costs along the GreenWay.
Environmental impacts:		
Ecology	*-1*	• Removal of vegetation in corridor (provides screening and habitat), decreasing width of green corridor in the area.
Heritage	*-1*	• Impacts to Hawthorne Canal. • Impact on Pressure Tunnel.
Flooding and climate change	*-1*	• Water quality impacts during construction. • Potential flooding impacts – design would have to meet 1 in 100 year flood level (unknown).
Parking, traffic and access	*0*	• Limited change in impacts to parking, traffic and access.
Noise and vibration	*-1*	• Increased construction noise and vibration impacts.
Amenity and property	*-2*	• Increased visual impacts and privacy issues at rear of residents on Weston Street. • Vegetation screening removed. • Line of sight from GreenWay directly into rear of properties.
Environmental impacts total	***-2***	• Overall alternative scheme generally has a worse environmental outcome than base case due to removal of vegetation, impacts to heritage item, potential flooding impacts and visual impacts.
Safety and security	+1	• Reduces potential conflict between cyclists and vehicles on Weston Street. • Security – relatively less passive surveillance on the GreenWay.
Environmental sustainability	-1	• Increased carbon footprint through construction of shared path and removal of vegetation, more resource intensive (use of materials and equipment).
Total	**-3**	

4.3 Preferred schemes

4.3.1 Dulwich Hill Interchange stop location

Based on the assessment above, alternative scheme 1 is preferred due to:

- improved connectivity between communities, to the stop facility from the west side of the rail corridor and to community infrastructure facilities such as Jack Shanahan Park and the GreenWay shared path
- general community acceptance of the scheme
- improved visual amenity, ecological and parking and traffic operational impacts
- improvement in environmental sustainability
- reduction in construction method complexity and construction impacts on the surrounding community
- the cost savings able to be achieved through the design of this scheme
- ability for interchange between heavy rail and buses and the light rail to still be effective.

The MCA did identify that alternative scheme 1 would benefit if the interchange with the heavy rail and bus services and the light rail services could be further improved. To address this area for improvement further design refinement was committed to by Transport NSW. This is to be completed prior to finalisation of the Submissions Report.

4.3.2 Crossing of Marion Street

Based on the assessment above, the base case is preferred due to:

- general community acceptance of the scheme
- improved visual amenity, ecology and environmental sustainability impacts
- reduction in heritage impacts
- ease of construction and reduced construction impacts on the surrounding community
- the cost savings able to be achieved through the design of this scheme.

4.3.3 GreenWay between Davis Street and Old Canterbury Road (Weston Street)

Based on the assessment above, the base case is preferred due to:

- reduction in environmental impacts in particular in relation to heritage, flooding, ecology and noise and vibration (during construction)
- increased privacy and security benefits
- ease of construction and reduced construction impacts on the surrounding community
- the cost savings able to be achieved through the design of this scheme.

It is acknowledged that the assessment did highlight that locating the GreenWay within the rail corridor would enhance the user experience. However, this would have environmental impacts, visual amenity issues and cost implications.

5. Further investigations of in corridor alternatives for the GreenWay near Weston Street

To provide further clarity and understanding on the issues associated with the Weston Street alternative schemes, Transport NSW commissioned a parallel study by an independent consultant (GHD) for the GreenWay section between Davies Street and Old Canterbury Road (i.e. Weston Street). The purpose of the study was to independently consider constructability and cost issues associated with other alternatives to the base case. The findings of the study are included in "*Sydney Light Rail - Inner West Extension Options Study – GreenWay, Alternatives for Davis Street to Old Canterbury Road* (GHD, November 2010), which is included as Appendix B. The alternatives considered were as follows:

- Option 1 (including three sub-options) – Western option with the GreenWay on the western side of the rail corridor and adjacent to the Hawthorne Canal. This option is generally similar to Weston Street shared path alternative scheme 1 and scheme 2 as described in Sections 2.3.2 and 3.2.3 of this report.
- Option 2 (including three sub-options) – Eastern option with the GreenWay on the eastern side of the rail corridor.
- Option 3 (including two sub-options) – Adjustment of light rail to single track operation.
- Option 4 – Outside of rail corridor option where the GreenWay is taken to the east side of the rail corridor and utilises adjacent residential streets.

Options were put through an options filter comprising a suite of criteria under the broad headings of functionality, cost and impacts and using the base case as a benchmark. Option 1 (sub-option 1B – Western Option, cantilever structure at pinch points, portalised or cantilever structure generally) was determined as the study preferred option (of the options considered) as "*it provided the best overall outcome of all the options in terms of functionality, cost and adverse impacts when assessed qualitatively".*

It was noted in the report however, that "*Whilst technically feasible, this option nonetheless presents significant construction challenges and risks due to the existing terrain and the proximity of the Hawthorne Canal"* and *"This option is estimated to cost significantly more than the current base case".*

Transport NSW has reviewed options presented in the report and the findings of the assessment. The findings of the GHD study do not change Transport NSW's view that the base case is preferred between Davis Street and Old Canterbury Road as it is considered that Option 1B is similar to Weston Street alternative scheme 2, as described above in Section 2.3.3, and as such would have similar issues (described in Section 3.4) .

6. Conclusions and next steps

6.1 Conclusion

This report identifies the preferred project in relation to the following components of the Sydney Light Rail Extension – Inner West:

- Dulwich Hill Interchange stop location
- GreenWay crossing of Marion Street
- GreenWay between Davis Street and Old Canterbury Road (Weston Street).

The preferred option for the Dulwich Hill Interchange stop is alternative scheme 1. On balance, this option provides a more cost effective solution whilst maintaining operational functionality and has reduced environmental impacts compared to the scheme presented in the EA.

For the GreenWay crossing of Marion Street, the project as described in the EA (the 'base case') is confirmed as being the preferred option.

For the GreenWay between Davis Street and Old Canterbury Road (Weston Street), the project as described in the EA (the 'base case') is confirmed as being the preferred option.

6.2 Where to from here?

The EA assessed the environmental impacts of the base case project - as one of the alternatives schemes (the Dulwich Hill Interchange stop) has been identified as a preferred component of the project going forward this requires further environmental impact assessment. This assessment will be undertaken and documented in the Sydney Light Rail Extension – Inner West: Submission Report.

7. References

GHD, November 2010. *Sydney Light Rail - Inner West Extension Options Study – GreenWay, Alternatives for Davis Street to Old Canterbury Road*

NSW Government February 2010a. *Metropolitan Transport Plan – Connecting the City of Cities*

Parsons Brinckerhoff October 2010, *Sydney Light Rail Extension – Stage 1 – Inner West Extension. Environmental Assessment*

Appendix A

Workshop attendees list

Workshop attendees

Organisation	Name
Transport NSW	Brendan Baker
Transport NSW	Peter Bourke
Transport NSW	Jeremy Kidd
Transport NSW	Rob Patterson
Transport NSW	Deborah Palmer
Transport NSW	Catherine O'Flynn
Transport NSW	Stuart Hodgson
Transport NSW	Kim Crestani
Parsons Brinckerhoff	Alex McDonald
Parsons Brinckerhoff	Emma Taylor
Parsons Brinckerhoff	Scott Ney