DOCUMENTS ASSOCIATED WITH REPORT C12/22-216

Attachment 2

Potential Extension of Light Rail between Sydney Olympic Park and Lidcombe - Preliminary Feasibility Study

SCT Consulting

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KPMG ACE

Parramatta Light Rail: Potential extension from Sydney Olympic Park to Lidcombe

Preliminary feasibility study

Cumberland City Council

5 July 2022

SCT Consulting

architectus

ACE

KPMG

Light Rail Extension

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1.0	16 May 2022	Draft report
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3.0	5 July 2022	Final report

Table of Contents

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[01]

Introduction and context

1.1 Introduction

Return to the Table of Contents

Cumberland City Council ("Council"), through its strategic documentation including *Cumberland 2030: Our Local Strategic Planning Statement* (February 2020) has identified key priorities to enable access and movement, including:

- Advocating for a range of transport options that connect our town centres and employment hubs, both locally and to Greater Sydney
- Aligning local infrastructure delivery with planned growth
- Improving accessibility within our town centres.

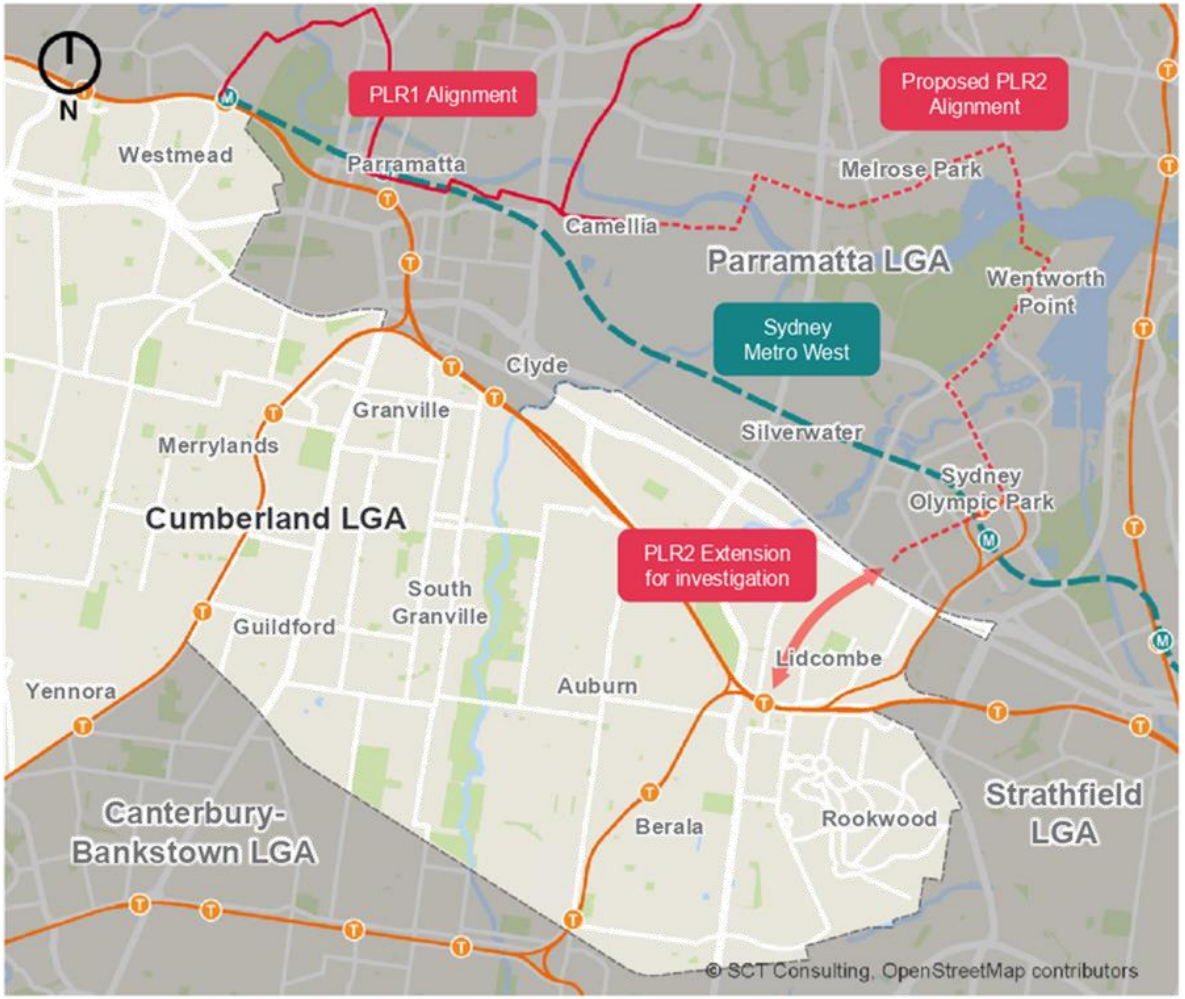
Through this lens, Council recognises the need for additional public transport corridors throughout its local government area (LGA) to sustain economic growth and support future population growth in the region.

To service the eastern portion of the LGA, Council highlights an extension of the Parramatta Light Rail Stage 2 corridor from Carter Street south through to Lidcombe Station as a key link for connecting:

- Current and future residents and employers to the transforming precincts of Sydney Olympic Park and Carter Street
- To more regions with Greater Sydney through Sydney Metro West at Sydney Olympic Park.
- The Lidcombe town centre and employment precincts towards the Parramatta Road corridor.

This report summarises the feasibility study undertaken to evaluate the options for and viability of a potential extension to Parramatta Light Rail Stage 2 (*PLR2 Extension*).

Figure 1-1 Overview of study area



1.2 Local strategic context

Return to the Table of Contents

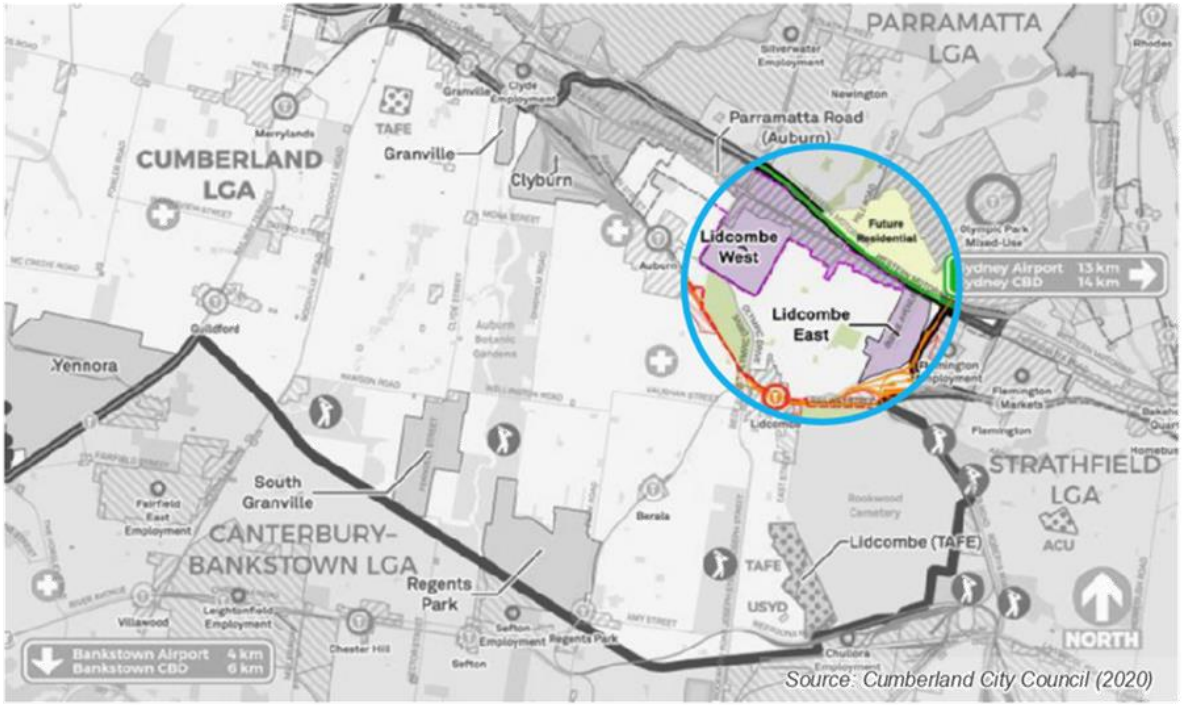
Light rail projects typically improve accessibility by providing a reliable and efficient public transport option, whilst also acting as a catalyst for development, renewal and investment along the corridor and surrounding regions.

Consequently, this study considers both movement and land use considerations in selecting and evaluating the feasibility of the preferred option.

To guide the study, key themes and objectives from strategic planning documents (Figure 1-2) have been identified.

Figure 1-2 Strategic documents reviewed

Figure 1-3 Overview of key precincts and land uses within study area



Source: Cumberland City Council (2020)

Land use considerations

- Desire to increase housing supply, including affordable housing, to respond to projected growth
- Increase retail, commercial and entertainment areas opportunities
- Develop diverse and activated streetscapes
- Transform some industrial land uses to attract advanced knowledge and manufacturing, digital and creative industries
- Revitalise and increase green space and recreational facilities (including Wyatt Park)
- Focus development around key strategic and movement corridors

Movement and transport considerations

- Improve accessibility between town centres and other strategic centres throughout Greater Sydney.
- Connect land uses through a vibrant and accessible green grid (to encourage healthy living)
- Reduce private vehicle dependence to improve sustainability, resilience and accessibility

1.3 Transport context

Return to the Table of Contents

The study area, between Carter Street and Lidcombe Station, is served by existing public transport connections including:

- Sydney Bus Route 401 Carter Street to Lidcombe
- Sydney Bus Route M92 Parramatta to Sutherland
- Sydney Trains at Lidcombe Station
- On-demand bus zone between Lidcombe, Sydney Olympic Park and Newington operated by BRIDJ.

A more detailed review of services and patronage is included in Appendix A – Context.

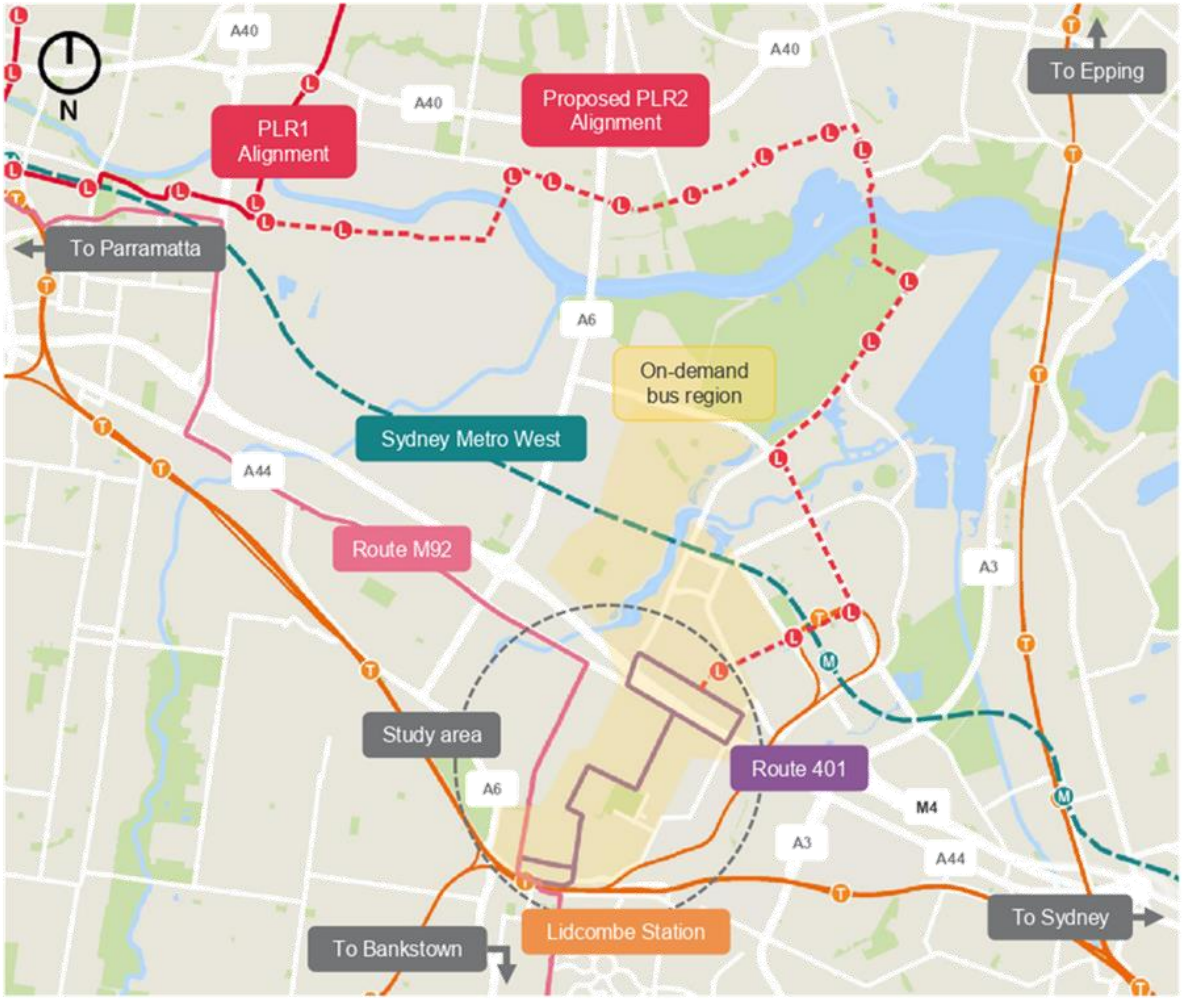
Several public transport projects are also in various stages of planning or delivery, including:

- Parramatta Light Rail (PLR) Stage 1, is currently under construction with an expected opening of 2023.
- Sydney Metro West, enabling works underway with an expected opening of 2030.
- PLR Stage 2, an alignment has been identified however there is no committed timeline or funding.

These projects improve connectivity between the study area and other local centres within the Greater Paramatta and Olympic Peninsula region as well as strategic centres throughout Greater Sydney.

The area is also well connected to Sydney's regional road network, bounded by the M4 Motorway, Parramatta Road (A44), Olympic Drive (A6) and Homebush Bay Drive (A3). Observation of local streets in the region indicated high levels of on-street parking used by residents and workers.

Figure 1-4 Overview transport modes near the study area (existing and future)



1.4 Land use and integration context

Return to the Table of Contents

The study area is predominately residential with progressively increasing density closer to key public transport nodes or corridors.

Sizeable business and industrial zones are located along Parramatta Road, including:

- Lidcombe North shops
- Lidcombe West industrial
- Lidcombe East industrial.

The light rail corridor may provide an opportunity to:

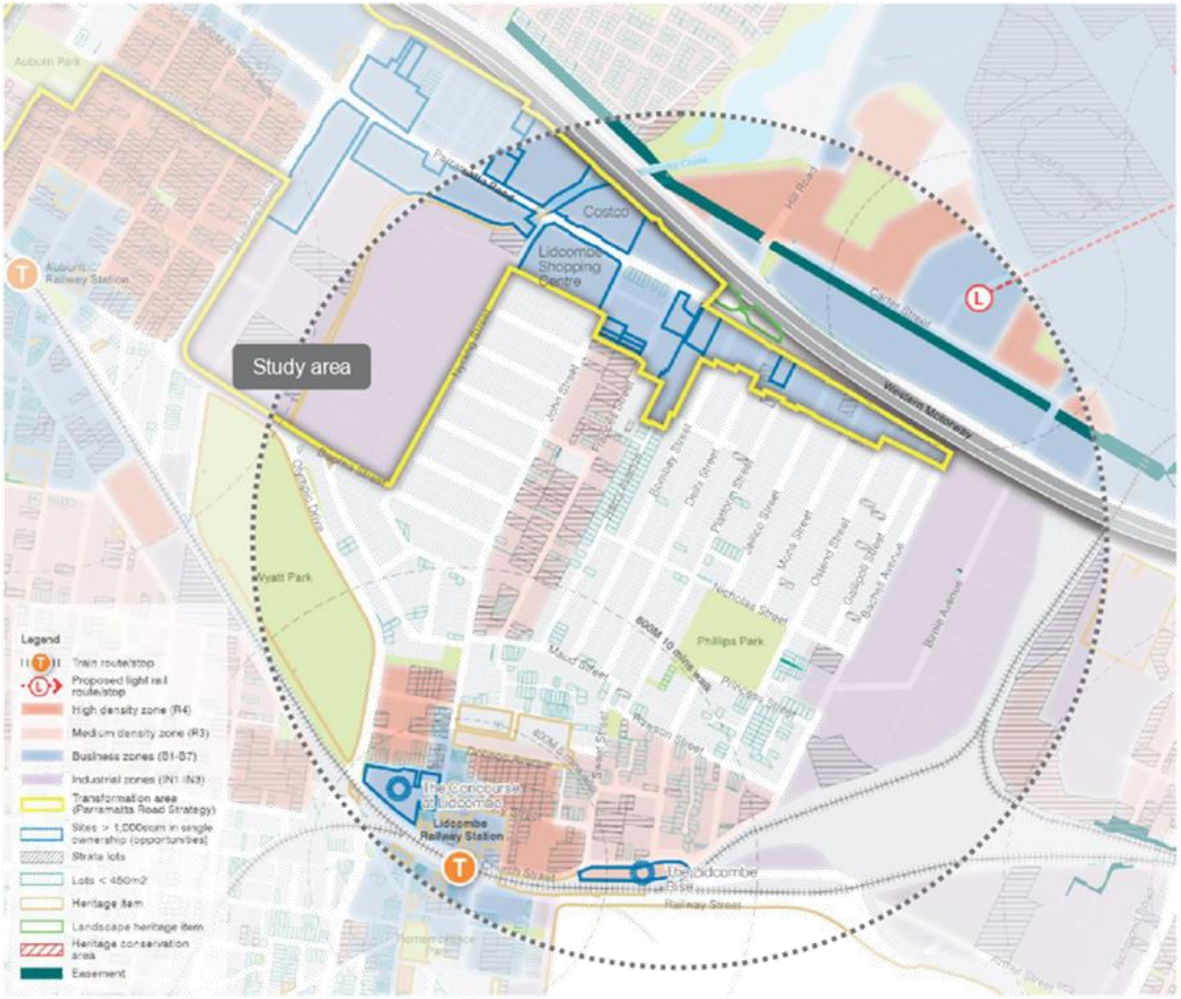
- Up-zone land to medium or high density along the proposed light rail route. Especially sites larger than 1,000sqm in single ownership.
- Improve the public transport connection to Lidcombe Shopping Centre and Costco as well as open space.

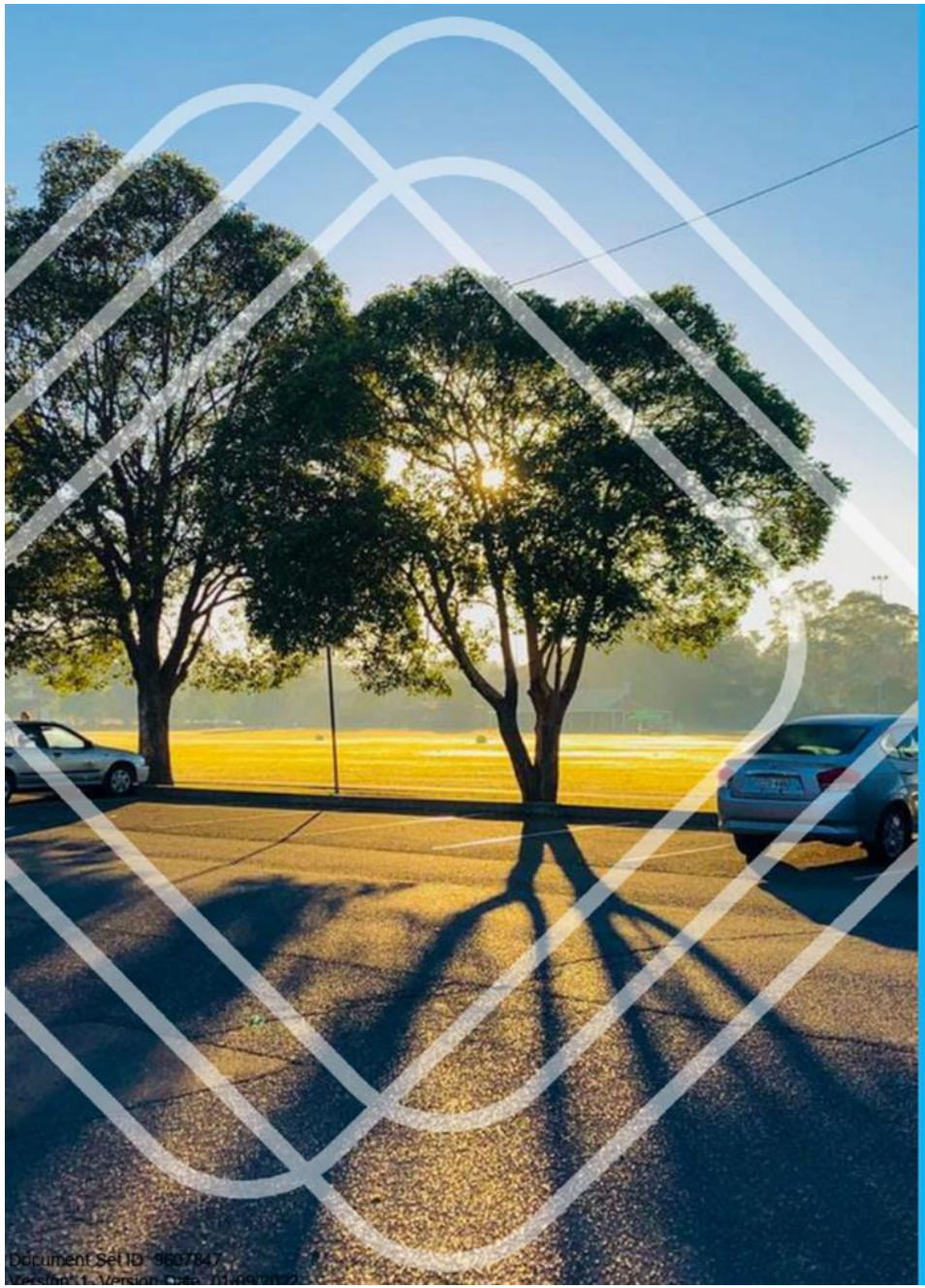
The level (and ease) of development and land use change may be constrained by the high number of strata title lots and proportion of lots that are less than 450sqm which would require significant amalgamation to achieve lot sizes appropriate for development.

Additionally, Industrial land close to centres must be retained to be consistent with Greater Sydney Commission's Region Plan which limits the potential for changes in planning controls around Birnie Avenue.

A more detailed review of land use and open space is included in Appendix A – Context.

Figure 1-5 Overview of land use within and near the study area





[02]

Options and multi-criteria assessment

2.1 Options overview

Return to the Table of Contents

The following long list of alignment options was considered in this study:

1. via Hill Road (at-grade), Parramatta Road and John Street (using the existing bus corridor)
2. via a grade-separated crossing of the M4 corridor through Mons Street and Swete Street (using the existing bus corridor)
3. via a grade-separated crossing of the M4 corridor through Ostend Street (or other parallel residential streets) and Church Street
4. via Birnie Avenue (at-grade) through the industrial area through to Bachell Avenue and Church Street
5. via a grade-separated crossing of the former Abattoirs Line from Sydney Olympic Park, also referred to as the Pippita Rail trail. Operates within the rail corridor until Bachell Avenue then through to Church Street.

In consultation with Council, each option was compared and scored based on the following themes:

- Customers and accessibility
- Places and development
- Traffic and integration
- Cost and constructability.

Figure 2-1 Overview of light rail extension options

2.2 Short-list selection

Return to the Table of Contents

The outcomes of the comparison are summarised in Table 2-1. The key strength, weaknesses, opportunities and threats (SWOT) of each option which informed the summary table are included in Appendix B – SWOT and comparison.

Based on the SWOT analysis and scoring outcomes, Council endorsed Options 1 and 4 to be considered in more detail for the study (Figure 2-2).

Figure 2-2 Short-listed light rail extension options

Although other options scored higher than Option 4, the alignment outcomes of Option 2 and 3 were quite similar to Option 1 (albeit scoring lower). Consequently, Option 4 was retained to provide an appropriate alternative that served a different catchment and land use.

Table 2-1 Comparison of long list of options

Key objectives and considerations	Alignment Option				
	1	2	3	4	5
Customers and accessibility					
Reliable and efficient journey time (including traffic interaction)	Poor	Neutral	Neutral	Poor	Good
New or increased customer catchment	Neutral	Neutral	Good	Good	Poor
Achieve an effective interchange at Lidcombe Station	Good	Neutral	Neutral	Neutral	Neutral
Places and development					
Connectivity to retail and employment land uses	Good	Neutral	Neutral	Good	Poor
Connectivity to recreational land uses	Neutral	Good	Good	Neutral	Poor
Connectivity to residential land uses	Good	Good	Good	Poor	Poor
Opportunities for place making and up-zoning regions	Good	Good	Good	Poor	Poor
Traffic and integration					
Minimise parking and property access restrictions	Poor	Poor	Poor	Neutral	Good
Minimise interaction with heavy vehicles	Neutral	Good	Good	Poor	Good
Cost and constructability					
Constructability of light-rail alignment (grade, turns, width)	Neutral	Poor	Poor	Neutral	Poor
Capital and operational cost (assumed)	Neutral	Poor	Poor	Neutral	Good

Legend: Good Outcome; Neutral Outcome; Poor Outcome

[03]

Common design themes

3.1 Design considerations

Return to the Table of Contents

This study adopts the standard kit of parts from Parramatta Light Rail (PLR) Stage 1 and 2. Including the following elements, based on what is publicly available:

- Light rail rolling stock (length, width and configuration)
- Stop configuration, including canopy style (as shown in the adjacent figures)
- Stop arrangements:
  - Terminus stops consistent with Westmead Interchange and Church Street stops from PLR Stage 1
  - Intermediate stops on residential streets are consistent with PLR Stage 2. Stops are bookended with a signalised crossing and zebra crossing.

Stop locations, discussed in more detail in Section 4.1 and Section 5.1 for each respective option, are based on:

- Key land uses within the catchment of the stop
- Opportunities for the stop to be integrated with the surrounding land use (or enable new land use)
- Minimise property acquisition
- Physical constraints, such as corridor width or grades
- A target stop spacing of 800m to balance customer amenity and oversaturation of the alignment (which increases cost and travel time). The stop spacing adopted is in line with guidelines for rapid bus routes and light rail in suburban areas.

Figure 3-1 Parramatta Light Rail Stage 1 renders

Image source: Transport for New South Wales

3.2 Integration with road network

Return to the Table of Contents

In developing both alignment options, the following principles have been adopted to minimise the impact on the local residents and businesses:

- Minimise the removal of on-street car parking, through the shared running of light rail and private vehicles on local streets where appropriate
- Retaining two-way traffic flow along the alignment, rather than reducing vehicle traffic to one-way.
- Right-turn bans near stops are recommended to minimise the risk of conflict due to the uncertainty of light rail vehicles stopping and accelerating from the stop.
- Positioning stops near large lot sizes or areas which can be amalgamated into single driveway access (on side street where possible).

Shared running is not currently implemented on light rail projects within NSW, though is successfully operated in other jurisdictions through local streets to balance the impact and convivence for customers.

If Transport for NSW opposes shared running, this may result in the removal of parking along the alignment to accommodate traffic lanes on either side of the alignment (as proposed for Carter Street).

As illustrated in Figure 3-2, the following road configurations are adopted for Options 1 and 4.

Figure 3-2 Overview of light rail configuration

3.3 Typical cross-sections

Return to the Table of Contents

Most of the study area has an approximate width of 20m between property boundaries, which can accommodate shared running with on-street parking.

Some property acquisition is required to accommodate the light rail stops or locations where traffic lanes are retained.

For both options, the following typical cross-sections have been implemented:

- Light rail stop with shared running
- Light rail stop with dedicated traffic lanes
- Running track with shared running
- Running track with dedicated traffic lane.

In developing the cross-sections, the following standard provisions have been adopted:

- Traffic lane 3.5m (standard provision)
- Shared running 3.7m (to increase the buffer to parking)
- Parking lane 2.3m (standard provision for 50km/h zone)
- Light rail corridor (dedicated) 3.3m
- Light rail platform
  - Side platform 3.7m per side
  - Island platform (terminus only) 4.5m

A summary of the corridor widths in the study area and example cross-sections from CSELR and PLR are included in Appendix C – Benchmarking and feasibility.

Figure 3-3 Stop with shared running

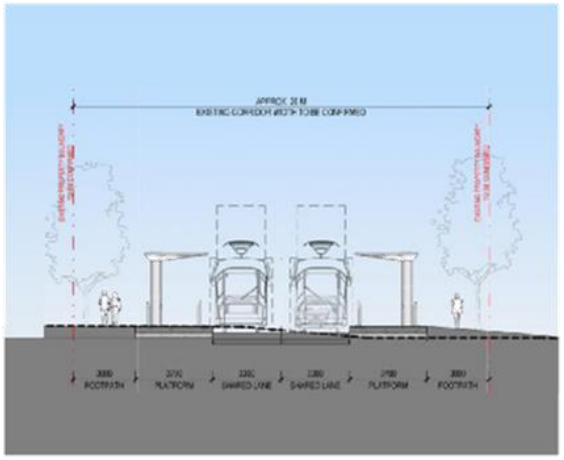


Figure 3-4 Stop with traffic lanes

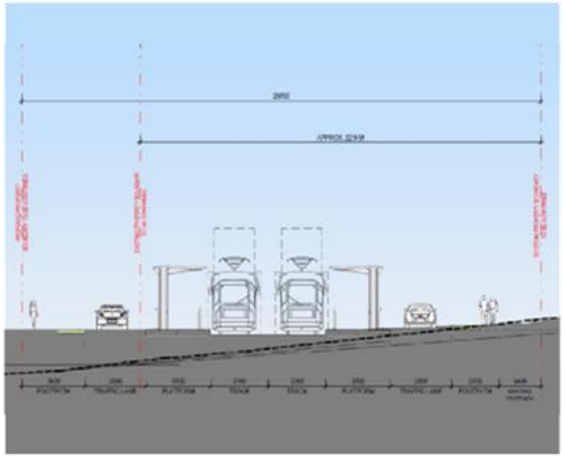


Figure 3-5 Shared running with parking

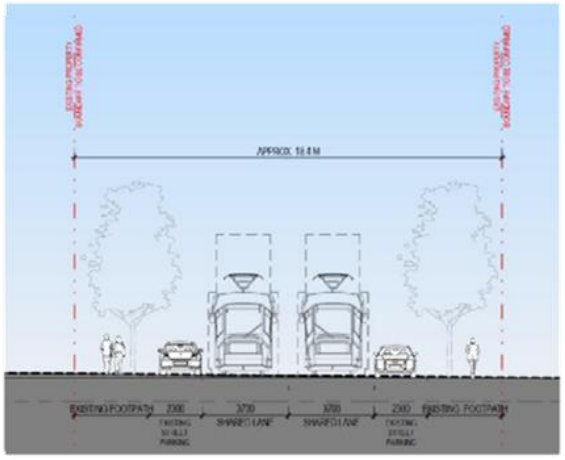
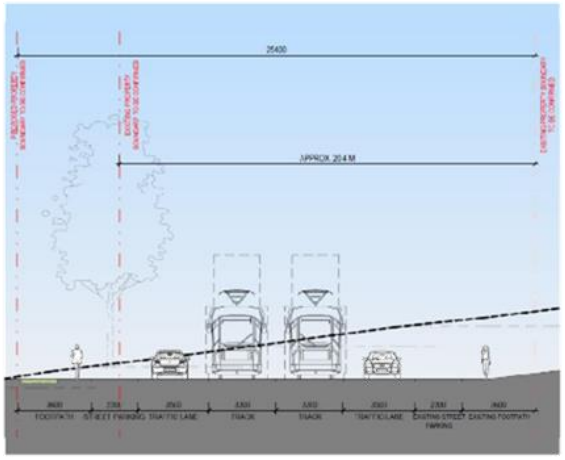


Figure 3-6 Separated running with traffic lane and parking



[04]

Option 1 Summary

4.1 Stop selection

Return to the Table of Contents

As discussed in Section 3.1, stops for the potential light rail extension (Figure 4-1) have been identified to balance customer catchments, proximity to key land use and property impacts.

The Carter Street (west) stop has been identified as an optional stop. As illustrated in Figure 4-2, there is significant up-zoning approved for the region which if developed could warrant an additional stop (in addition to the proposed PLR2 Uhrig Road terminus).

Figure 4-2 Approved land zoning Carter Street (west)

Several stop locations were considered for the Lidcombe North stop and are discussed in more detail overleaf.

It is acknowledged the catchment of the Chadwick Reserve stop overlaps with both Calool Street and the terminus at Lidcombe Town Centre, however the stop is retained to provide convenient access to Wyatt Park (with the addition of a signalised crossing or pedestrian overbridge at A6 Olympic Drive).

Figure 4-1 Overview of Option 1 potential stops

4.1 Stop selection

Return to the Table of Contents

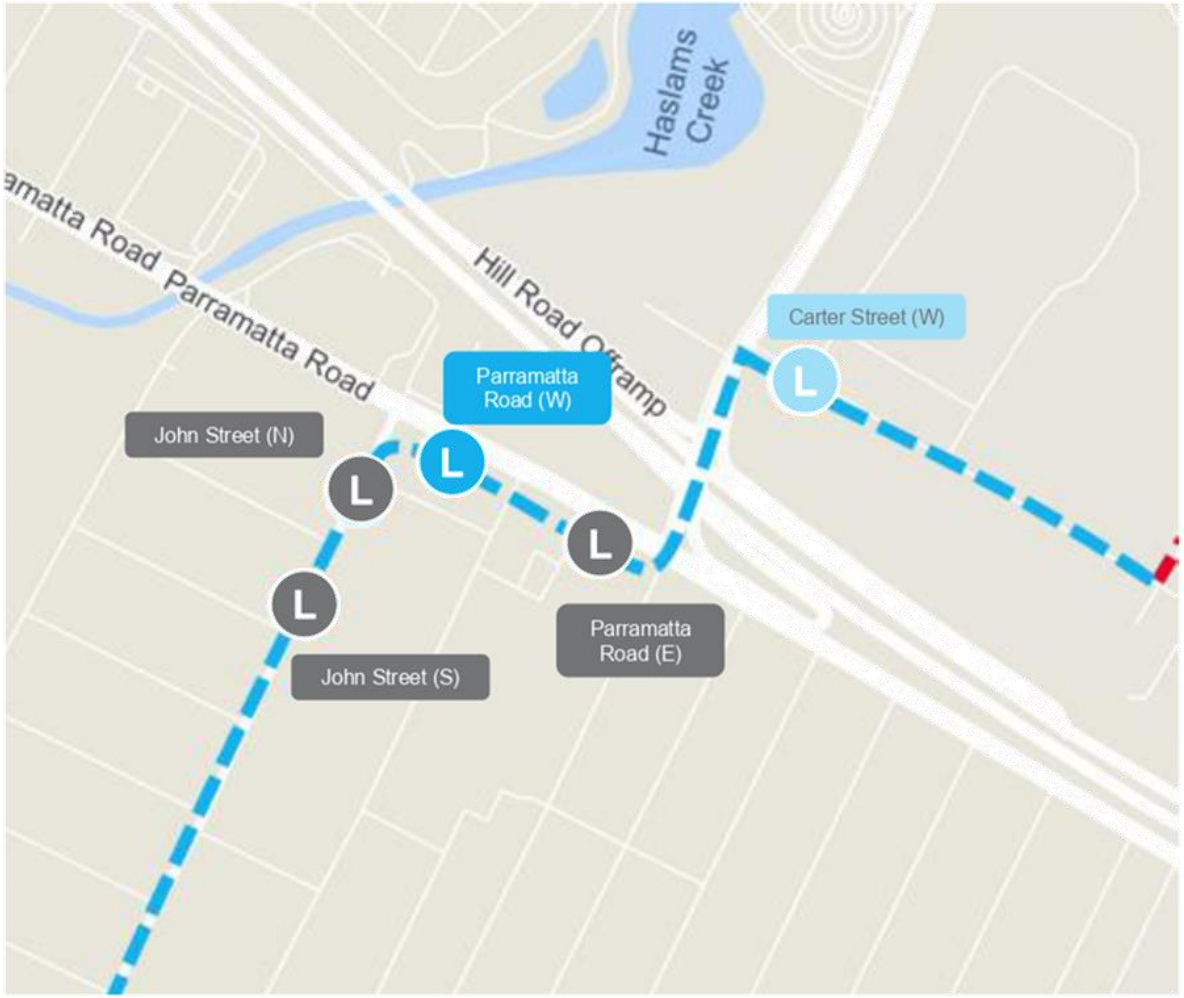
A high-level comparison was undertaken (Table 4-1) to select the preferred stop for the Lidcombe North shops area.

Table 4-1 Comparison of Lidcombe North stop options

Options comparison	
Parramatta Road (east)	
+	Reduced impact to road operations
+	Renewal of Parramatta Road corridor land uses
-	Longer distance to shops
-	Property acquisition cost to accommodate the stop
Parramatta Road (east)	
+	Proximity to existing shops
+	Reduced impact on road operations
+	Renewal of Parramatta Road corridor land uses
-	Property acquisition cost to accommodate the stop
John Street (north)	
+	Proximity to existing shops
-	Conflict with existing driveway access to multi-storey car-park
John Street (south)	
+	Can be accommodated within the road corridor
-	Longer distance to shops

Based on the comparison, and in consultation with Council, the Parramatta Road (west) stop was adopted for this study.

Figure 4-3 Option 1 - Lidcombe North stop options



4.2 Proposed alignment and design

Return to the Table of Contents

An indicative concept design has been developed for Option 1 to inform this study (Figure 4-4).

The drawing package is included in Appendix D – Option 1 Design which includes:

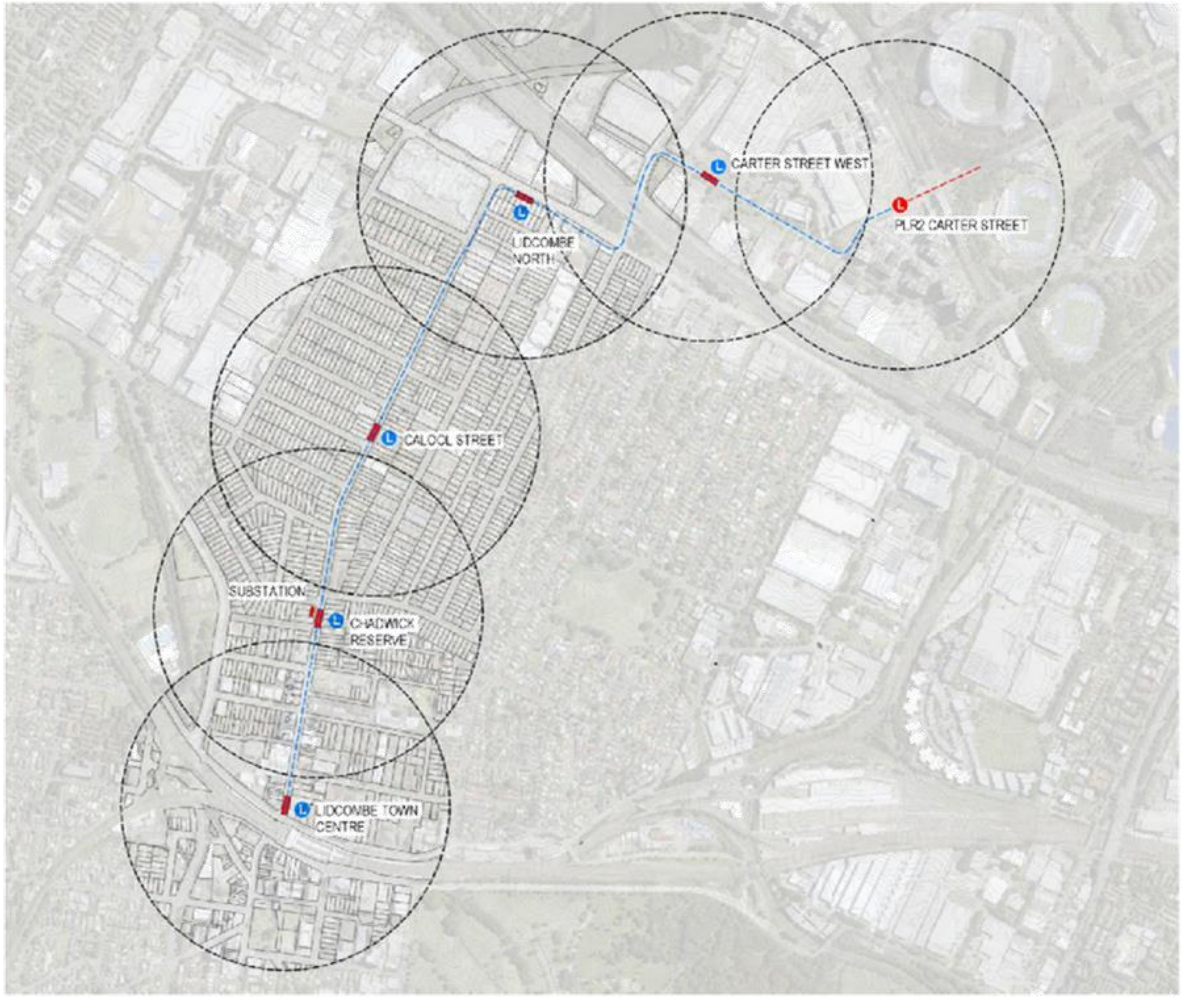
- Stop design
- Running track (including turning points)
- Chadwick Reserve parking and substation facility.

Figure 4-5 and Figure 4-6 illustrate how the light rail stops may be integrated into the streetscape. The project provides a catalyst for improving the environment, from a vehicle dominated space to a more people-friendly space which would enable retail activation and change in land use. The latter may include mixed-use developments, with retail, business or food and beverage outlets on the ground floor.

The Calool Street stop (Figure 4-5) illustrates a typical intermediate stop integrated into a local residential streetscape. A shortened canopy is adopted to minimise the visual impact.

The pedestrianisation of Lidcombe Town Centre (Figure 4-6) provides an opportunity for adjacent businesses to expand into the road corridor including on-street dining or the provision of pop-up style markets amongst a green space. A pedestrianised zone has been shown in this report (and associated sketches). The area could also be designed to allow for a mixture of local traffic and enhanced pedestrianisation.

Figure 4-4 Option 1 design overview



4.2 Proposed alignment and design

Return to the Table of Contents

Figure 4-5 Calool Street stop (top: current street view, bottom: potential opportunity render)

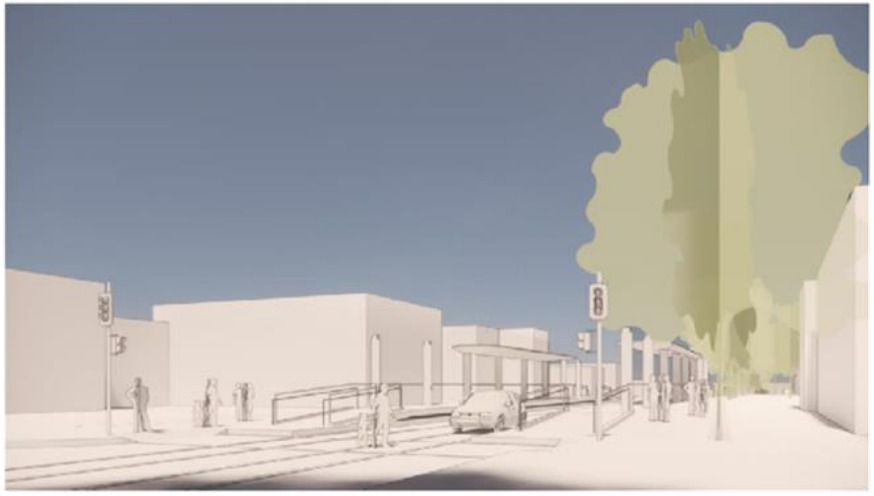


Figure 4-6 Lidcombe stop (top: current street view, bottom: potential opportunity render)

4.3 Land acquisition

Return to the Table of Contents

To accommodate the light rail alignment and stops land acquisition is required. Lots identified in Figure 4-7 are required where:

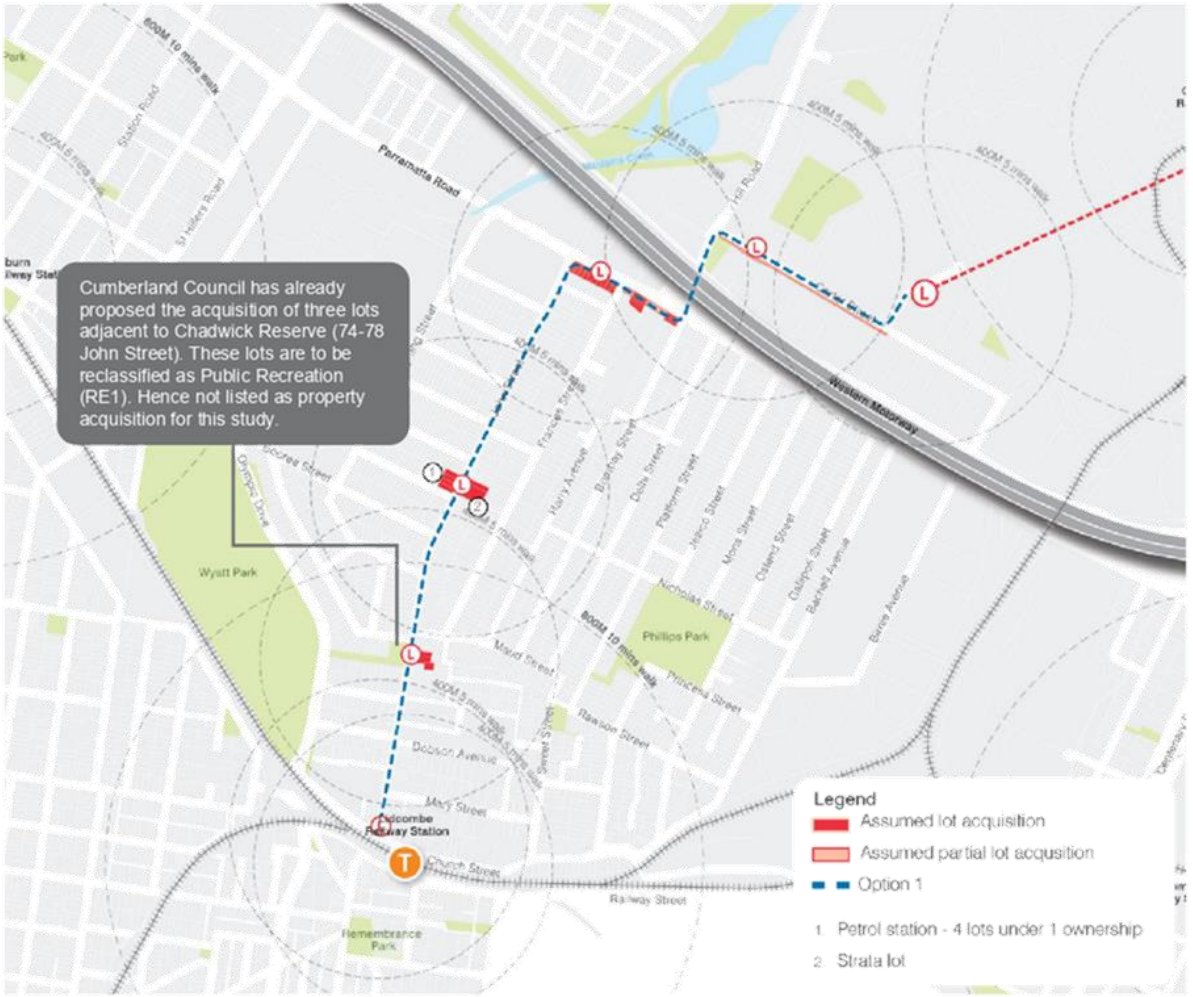
- Property (vehicle) access is compromised by proposed stops. At these locations, it is proposed lots are amalgamated to provide single driveway access (on the side street where possible).
- Road widening is required to accommodate the proposed cross-section, this includes:
  - A full acquisition where the road corridor widening results in a lot depth of less than 25m
  - A partial acquisition where property access is retained (or can be facilitated elsewhere on lot) and the lot depth (post-widening) is greater than 25m.

For the identified areas (full and partial) the currently approved rates (Table 4-2) have been used to estimate the acquisition GFA for the cost estimate.

Table 4-2 Option 1 land acquisition

Zoning	Area (m²)	Current FSR (:1)	Potential GFA (m²)
R2	4,362	-	-
R3	3,191	0.8	2,394
B6 (Parramatta Rd)	8,522	1.0	8,522
B6 (Carter St)	3,093	1.5	4,640
Total	**19,168**	**-**	**15,556**

Figure 4-7 Option 1 land acquisition



4.4 Potential land use uplift

Return to the Table of Contents

The addition of light rail within the study area enables the up-zoning of existing land use. In the absence of detailed testing, which is recommended in the next stage of the project, potential uplift has been estimated.

Estimates are based on DCP requirements for Residential flat buildings (RFBs) as well as indicative density increases in the areas immediately adjacent to the alignment (Area 1) and those within the stop catchments (Area 2).

The following limitations have been adopted for RFBs:

- Minimum street frontage of 24m (Cumberland DCP)
- Minimum Site area of 1,000m² (Cumberland DCP)
- FSR increased to 1:1 for 4 storey development with 2 storey street wall height
- FSR increased to 1.5:1 for 6 storey development with 4 storey street wall height

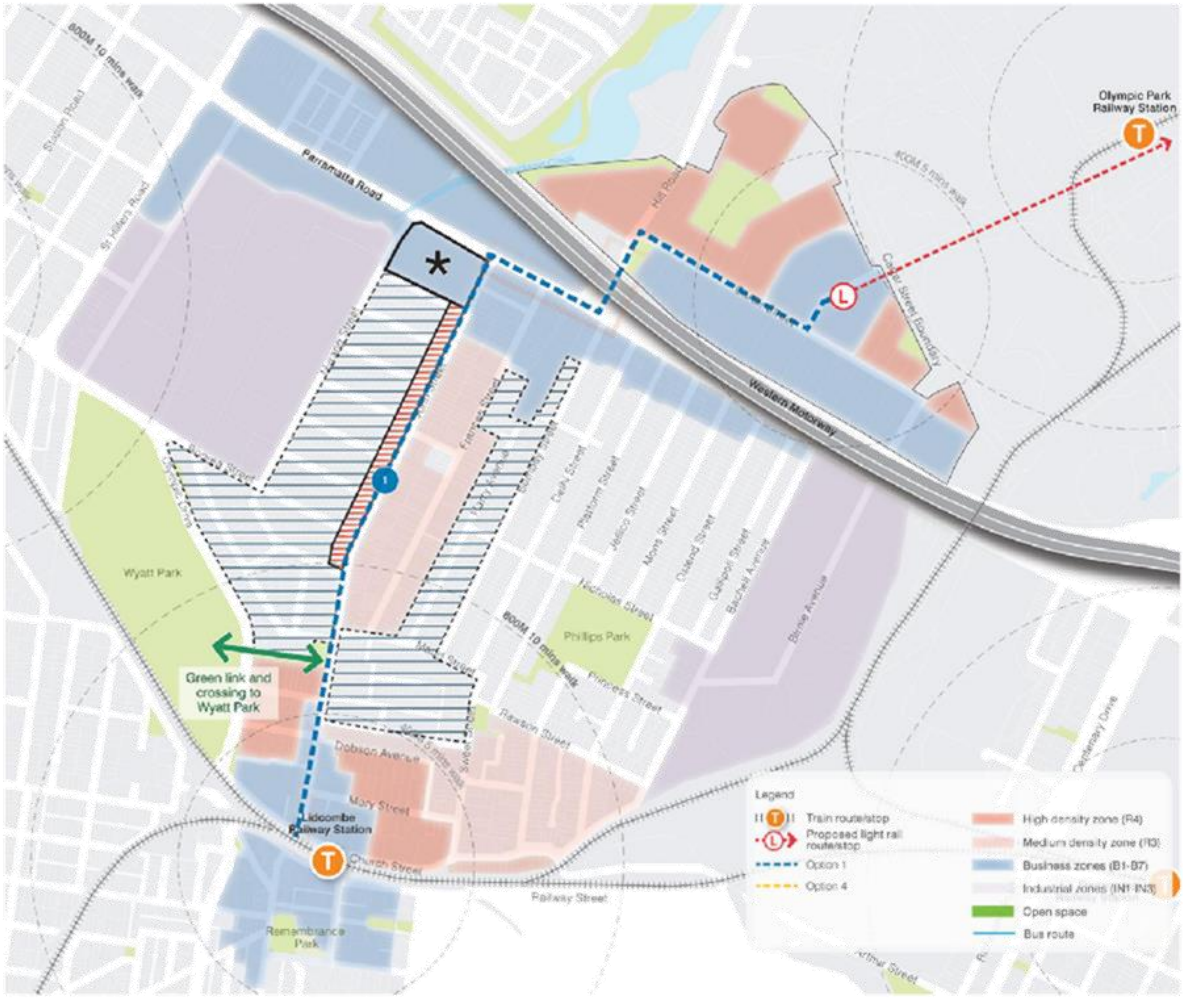
For the identified areas (Figure 4-8) the indicative yield estimates are summarised in Table 4-3.

Table 4-3 Option 1 uplift yield

Yield	Area 1	Area 2
Current lots	46	596
Current GFA (FSR)	28,800 (NA)	340,950 (NA)
Potential GFA (FSR)	43,200 (1.5:1)	340,950 (1:1)
Indicative dwellings	432-500*	3,400-3,960*

*Dwelling range assumes conservative average apartment sizes of 100m²/dwelling compared to the ADG minimums of 86m²/dwelling (assumed mix of 10% studio, 30% 1bed, 40% 2bed, 20% 3bed).

Figure 4-8 Option 1 land acquisition



4.5 Traffic considerations

Return to the Table of Contents

To accommodate light rail operations several changes are required to traffic operations, including:

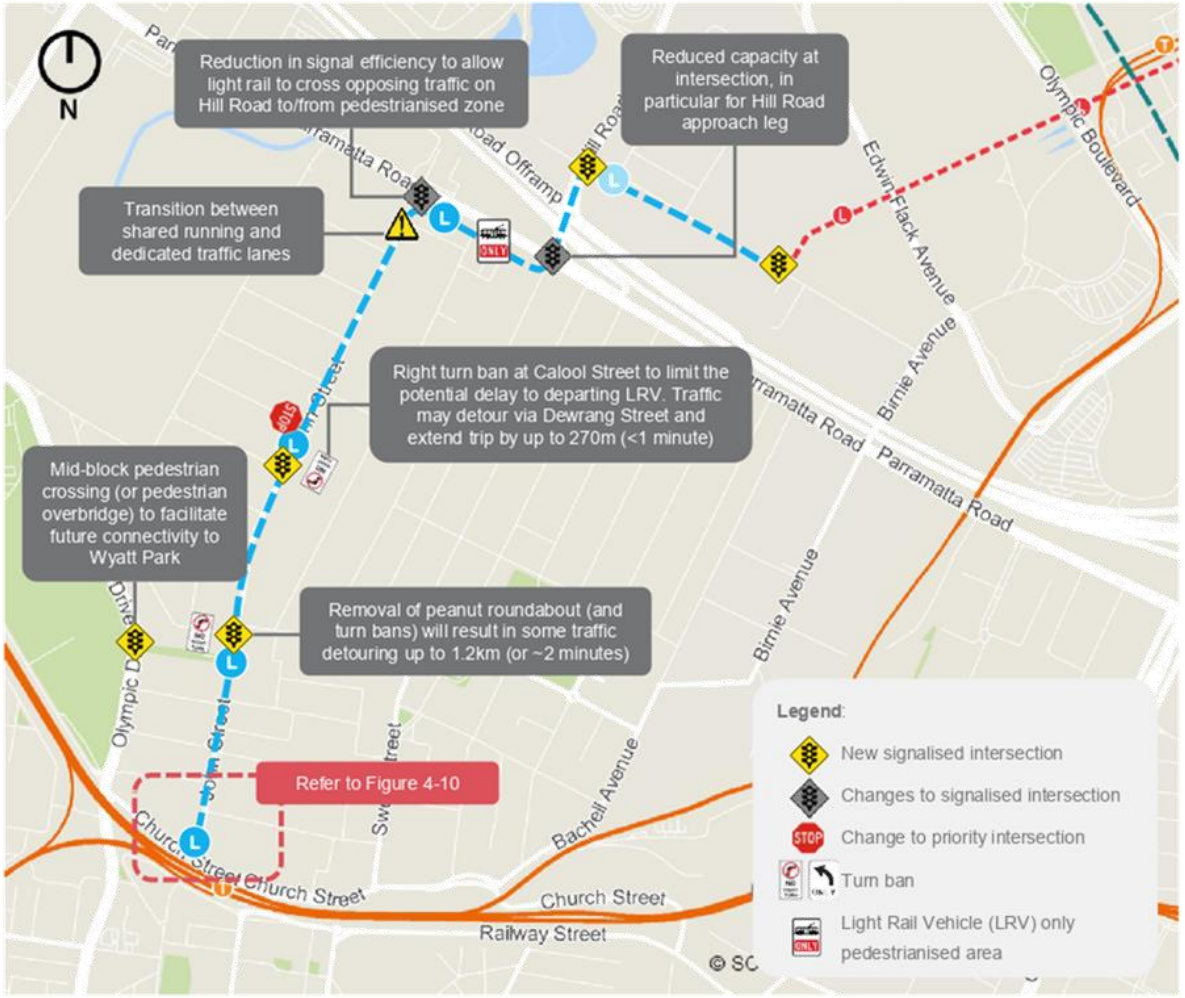
- New or changed signalised intersections
- New STOP lines on streets perpendicular to stops
- Re-routing of vehicles due to turn bans or pedestrianised (with light rail) zones.

Changes for Option 1 are highlighted in Figure 4-9. In addition to these changes, parking removal is also required to accommodate stops (such that property boundaries are not impacted) or to accommodate traffic lanes. Changes to the on-street parking provision is summarised in Table 4-4.

Table 4-4 On-street parking provision changes

Location	Change in provision
Carter Street (at stop and to accommodate new intersections)	-17
Carter Street (optional – proposed tree planting within parking lane)	-9
Hill Road	-
Parramatta Road	-
John Street (Lidcombe North)	-
John Street (Calool Street)	-4
John Street (Chadwick Reserve)	-13
Yarram Street	+3
Lidcombe Town Centre	-27
Total	**-33**

Figure 4-9 Overview traffic considerations



4.5 Traffic considerations

Return to the Table of Contents

Option 1 proposed the pedestrianisation of Lidcombe Town Centre between Mary Street and Church Street. This provides an opportunity for the town centre retail and hospitality to leverage the road space, however this restricts vehicular connectivity.

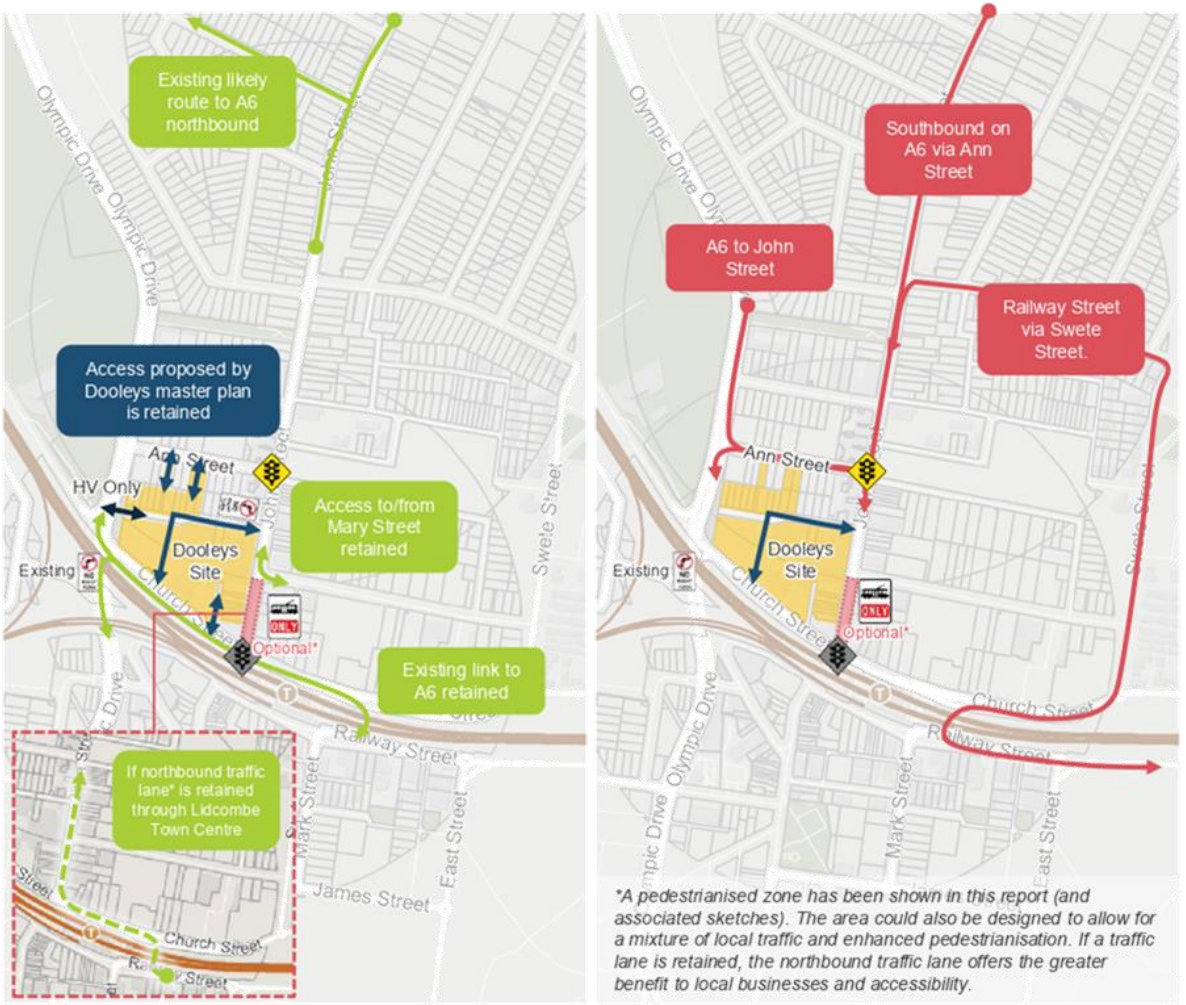
As illustrated in Figure 4-10, access to/from the key arterials is retained or re-routed.

A single traffic lane could be retained on John Street to minimise the impact on traffic circulation through the town centre. If adopted, the northbound lane should be retained which would reduce the extended circulation through Swete Street (from either Railway Street or the A6).

Access for the Dooleys Catholic Club (including the proposed master plan) is also retained, including:

- Proposed heavy vehicle access to/from Olympic Drive is not impacted
- Re-aligned Board Street (and access to/from John Street and Church Street) is not impacted.
  - The right turn from Board Street to John Street should be restricted to minimise risk of collision.
  - The street should be designed to discourage rat-running with the pedestrianisation of John Street south.
- Parking access from Ann Street is not impacted. It is recommended the intersection of Ann Street | John Street | Dodson Street is signalised to retain all turning manoeuvres safely.

Figure 4-10 Overview of traffic options at Lidcombe Town Centre (left: routes retained, right: re-routing)



[05]

Option 4 Summary

5.1 Stop selection

Return to the Table of Contents

As discussed in Section 3.1, stops for the potential light rail extension (Figure 5-1) have been identified to balance customer catchments, proximity to key land use and property impacts.

Due to spatial constraints and grades, the Lidcombe Terminus could not be located any further west, hence is located approximately 700m from Lidcombe Station.

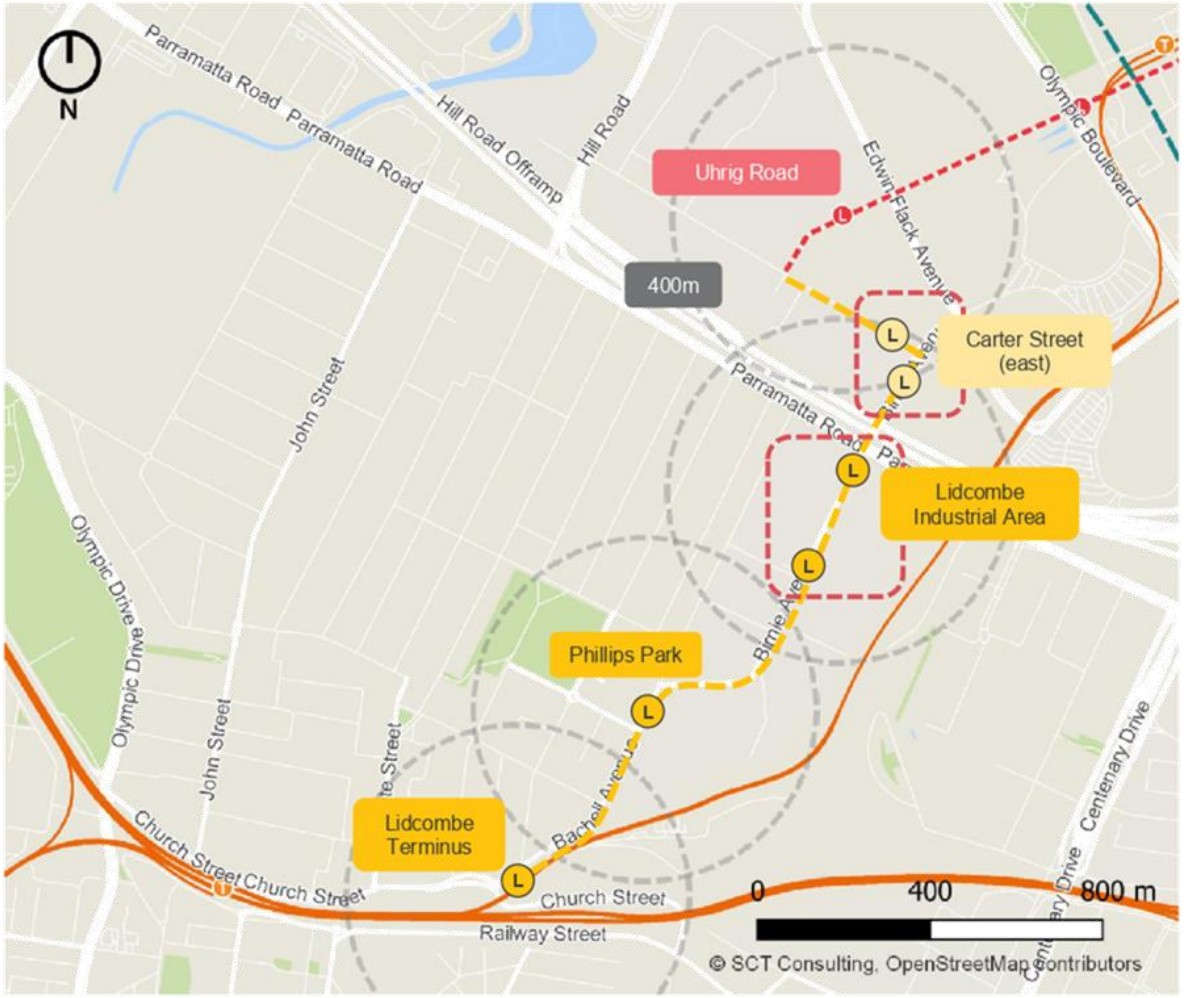
Several stop locations were considered for both the Carter Street and the Lidcombe Industrial Area stops and are discussed in more detail overleaf.

The Carter Street (east) stop has been identified as an optional stop. High-rise development on Carter Street is already underway, and with the addition of the Birnie Avenue development shown in Figure 5-2, an additional stop could be warranted.

Figure 5-2 Approved land zoning Carter Street (east)

Compared to Option 1, there are less key destinations along the Option 4 corridor warrant an higher stop density.

Figure 5-1 Overview of Option 4 potential stops



5.1 Stop selection

Return to the Table of Contents

A high-level comparison was undertaken (Table 5-1) to select the preferred stops for the Option 4 alignment.

Table 5-1 Comparison of stop options

Options comparison	
Carter Street (east)	
+	Immediate proximity to high-density residential
-	Requires turn-over of existing industrial land-uses to be accommodated
-	Property acquisition cost to accommodate the stop
Birnie Avenue	
+	Proximity to high-density residential
-	Steep grades would restrict stop location and access to the stop may not be DDA compliant
-	Property acquisition cost to accommodate the stop to minimise the impact on Hill Road throughput
Industrial Tech Precinct (north)	
-	Limited catchment east of stop on Parramatta Road (no building frontages between Birnie Avenue and rail corridor)
-	Walking access to most of the industrial lots is not from Parramatta Road
Industrial Tech Precinct (south)	
+	Proximity to industrial land-uses

In consultation with Council, Carter Street (east) and Industrial Area (south) were adopted for the study.

Figure 5-3 Option 4 – Carter Street and Industrial Area stop options

5.2 Proposed alignment and design

Return to the Table of Contents

An indicative concept design has been developed for Option 4 to inform this study (Figure 5-4).

The drawing package is included in Appendix E – Option 4 Design which includes:

- Stop design
- Running track (including turning points)
- Substation facility.

Figure 5-5 and Figure 5-6 illustrate how the light rail stops may be integrated into the streetscape. The project provides a catalyst for improving the environment, from a vehicle dominated space to a more people-friendly space which would enable retail activation and change in land use. The latter may include mixed-use developments, with retail, business or food and beverage outlets on the ground floor.

The Carter Street East stop (Figure 5-5) illustrates how a stop integrated into a local residential streetscape whilst retaining traffic lanes in both directions. A shortened canopy is adopted to minimise the visual impact.

The Philips Park stop (Figure 5-6), similar to the Calool Street stop in Option 1, is integrated into a residential and commercial streetscape. A shortened canopy is adopted to minimise the visual impact.

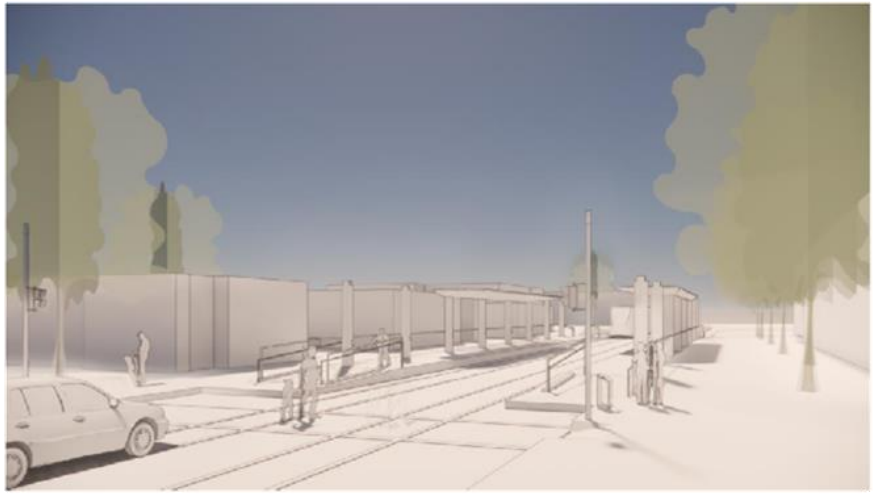
Figure 5-4 Option 4 design overview

5.2 Proposed alignment and design

Return to the Table of Contents

Figure 5-5 Carter Street stop (top: current street view, bottom: potential opportunity render)

Figure 5-6 Phillips Park stop (top: current street view, bottom: potential opportunity render)



5.3 Land acquisition

Return to the Table of Contents

To accommodate the light rail alignment and stops land acquisition is required. Lots identified in Figure 5-7 are required where:

- Property (vehicle) access is compromised by proposed stops. At these locations, it is proposed lots are amalgamated to provide single driveway access (on the side street where possible).
- Road widening is required to accommodate the proposed cross-section, this includes:
  - A full acquisition where the road corridor widening results in a lot depth of less than 25m
  - A partial acquisition where property access is retained (or can be facilitated elsewhere on lot) and the lot depth (post-widening) is greater than 25m.

For the identified areas (full and partial) the currently approved rates (Table 5-2) have been used to estimate the acquisition GFA for the cost estimate.

Table 5-2 Option 4 land acquisition

Zoning	Area (m²)	Current FSR (:1)	Potential GFA (m²)
B6	2,128	1.5	3,192
IN1	2,048	1.0	2,048
Total	**4,176**	**-**	**5,240**

Figure 5-7 Option 4 land acquisition

5.4 Potential land use uplift

Return to the Table of Contents

The addition of light rail within the study area enables the up-zoning of existing land use. In the absence of detailed testing, which is recommended in the next stage of the project, potential uplift for residential areas has been estimated with assumptions consistent with Option 1.

For the identified areas (Figure 5-8) the indicative yield estimates are summarised in Table 5-3.

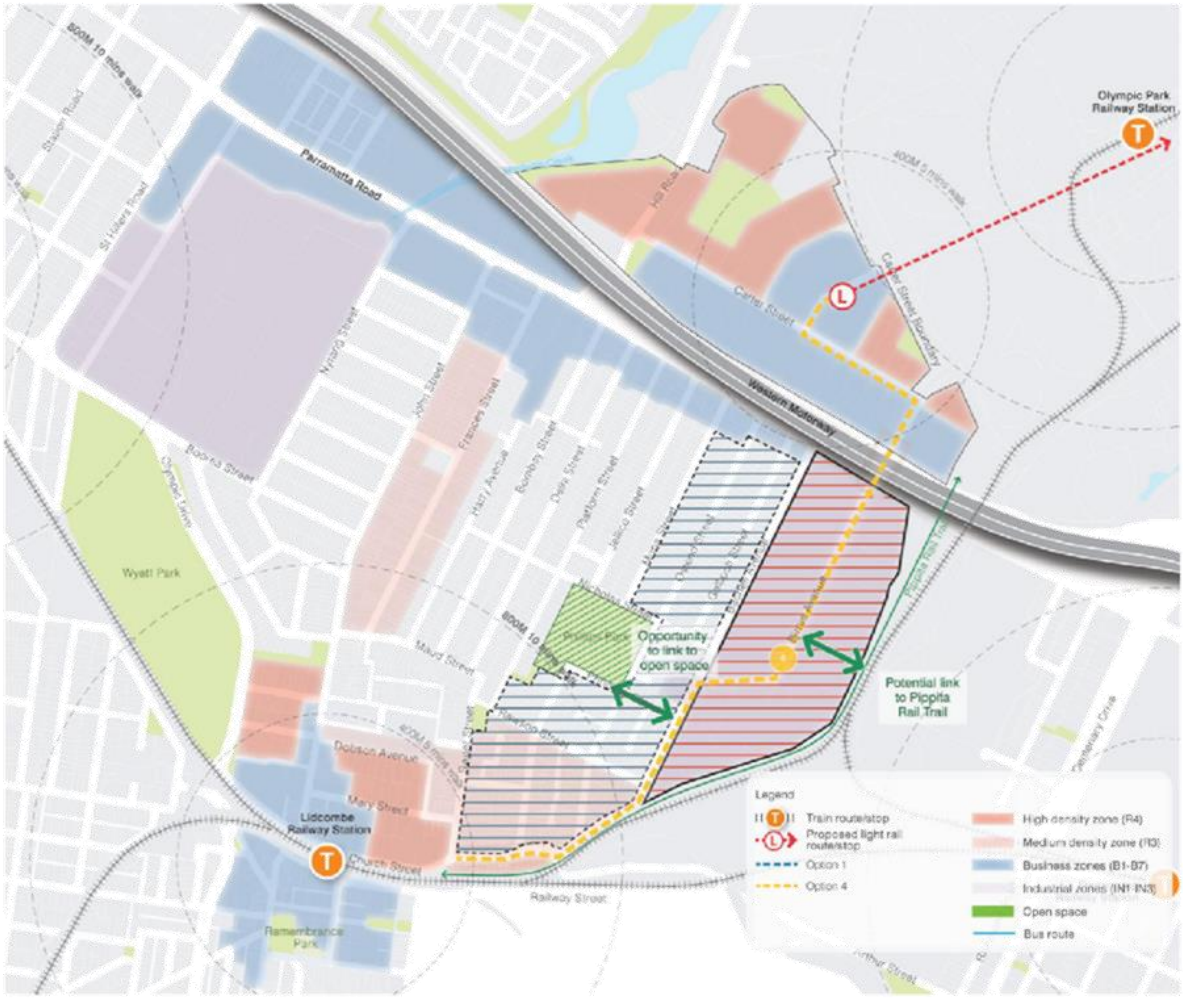
Table 5-3 Option 4 uplift yield

Yield	Area 1 R2	Area 1 R3
Current lots	331	173
Current GFA (FSR)	198,200 (NA)	96,450 (0.75:1)
Potential GFA (FSR)	198,200 (1:1)	144,675 (1.5:1)
Indicative dwellings	1,982-2,304*	1,446-1,682*

*Dwelling range assumes conservative average apartment sizes of 100m²/dwelling compared to the ADG minimums of 86m²/dwelling (assumed mix of 10% studio, 30% 1bed, 40% 2bed, 20% 3bed).

In the absence of an employment study, the assumption for the industrial area is that there will be no uplift as it is assumed that while the light rail may result in a shift in Industry (industrial to tech) there would be no increase in employment density.

Figure 5-8 Option 4 land acquisition



5.5 Traffic considerations

Return to the Table of Contents

To accommodate light rail operations several changes are required to traffic operations, including:

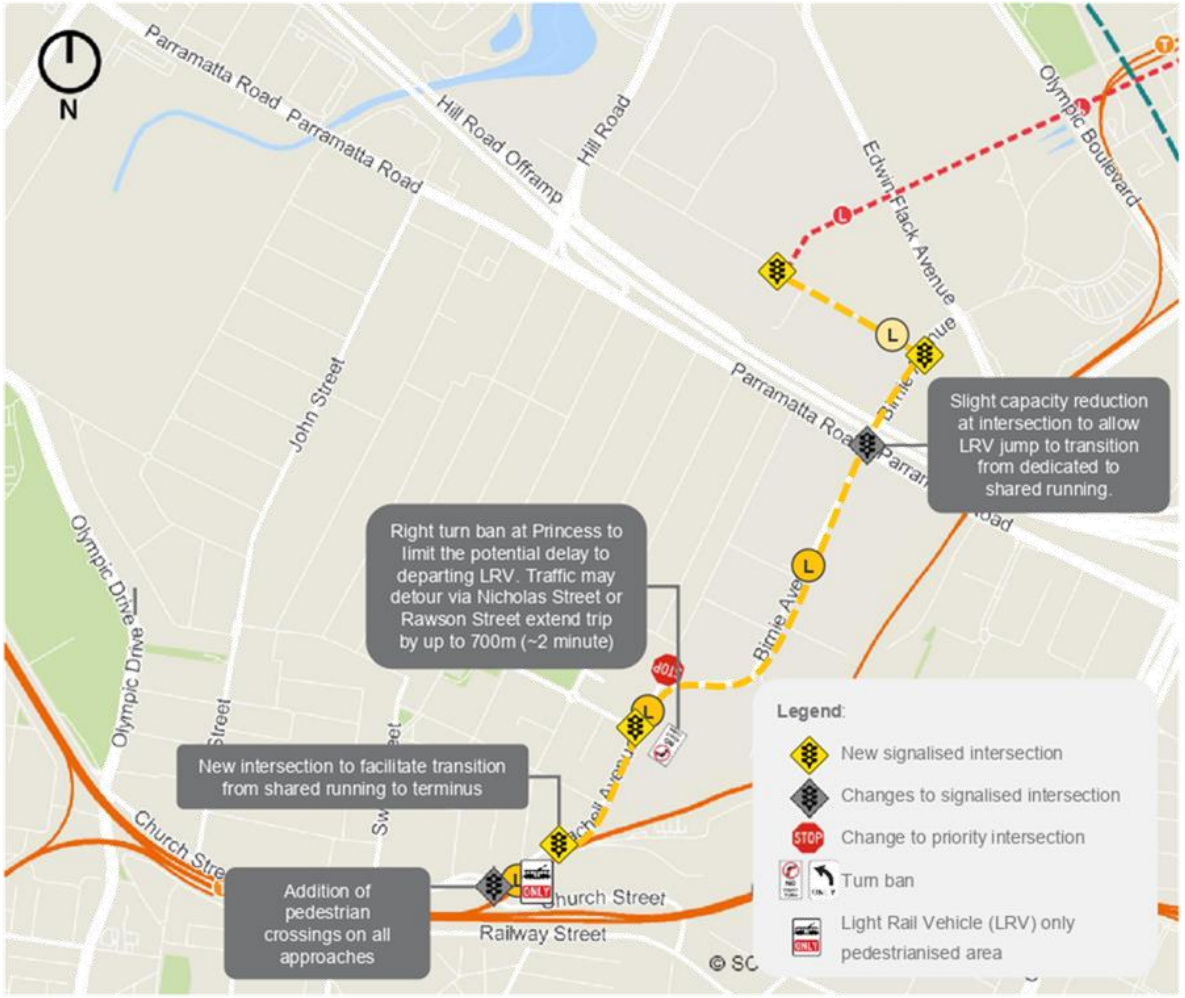
- New or changed signalised intersections
- New STOP line on when crossing alignment
- Re-routing of vehicles due to turn bans

Changes for Option 4 are highlighted in Figure 5-9. In addition to these changes, parking removal is also required to accommodate stops (such that property boundaries are not impacted) or to accommodate traffic lanes. Changes to the on-street parking provision is summarised in Table 5-4.

Table 4-4 On-street parking provision changes

Location	Change in provision
Carter Street (at stop and to accommodate new intersections)	-24
Carter Street (optional – proposed tree planting within parking lane)	-5
Birnie Avenue (north)	-
Birnie Avenue (south)	-
Birnie Avenue (Tech Precinct)	-21
Birnie Avenue (pre-Bachell Avenue)	-17
Bachell Avenue	-17
Bachell Avenue (terminus)	-5
Total	**-89**

Figure 5-9 Overview traffic considerations



[06]

Rapid economic appraisal

6.1 Potential patronage

Return to the Table of Contents

To inform the rapid economic analysis, and to assist the comparison between options, potential daily (and annual) patronage was estimated for each option based on a principles analysis of customer user groups.

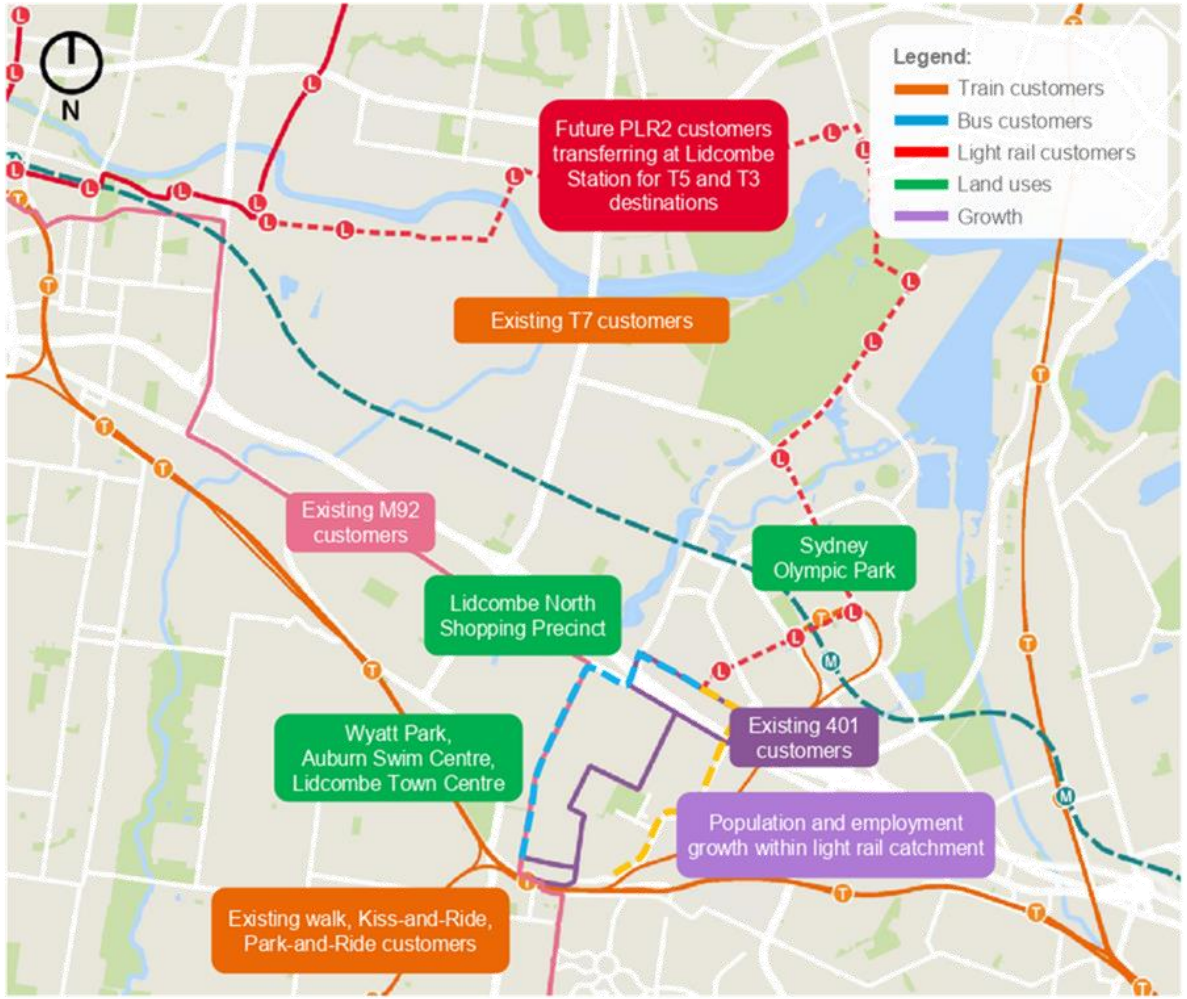
As highlighted in Figure 6-1, the analysis considered the following potential customers:

- Existing trips on other modes that may change to light rail, including:
  - T7 Olympic Park Line
  - Bus routes M92 and 401
  - Walking trips to/from Lidcombe Station
  - Kiss-and-Ride and Park-and-Ride to/from Lidcombe Station
- Future customers due to growth in the study area, including population and employment. This includes commute trips as well as shopping and recreation.
- Future customers who do not currently have a public transport option, which may choose to use a combination of PLR Stage 2 and this extension to access Lidcombe Station.

For each identified customer group, the number of daily trips is estimated using publicly available data sources including OPAL, Household Travel Survey and Department of Planning forecasts for population and employment (for 2036 and 2056).

The complete methodology and analysis is included in Appendix F – Patronage methodology and outcomes.

Figure 6-1 Potential customer user groups for light rail



6.1 Potential patronage

Return to the Table of Contents

The potential daily patronage is summarised in Table 6-1, and the complete methodology and analysis is included in Appendix F – Patronage methodology and outcomes.

Table 6-1 Typical weekday daily patronage

Customer groups	2036		2056	
	Option 1	Option 4	Option 1	Option 4
Existing T7 train customers	2,350	2,300	2,300	2,300
Existing M92 bus customers	950	0	950	0
Existing 401 bus customers	50	0	50	0
Existing walking customers to/from Lidcombe Station	1,200	900	1,200	830
Existing Kiss-and-ride & Park-and-ride customers to/from Lidcombe Station	150	150	150	120
Future customers from employment & population growth within light rail catchments	2,000	1,350	4,200	2,600
Future customers on PLR2 alignment transferring at Lidcombe Station	1,800	1,800	2,200	2,200
Future T7 customers	800	800	1,700	1,700
Future shopping trips	450	0	800	0
Future recreational trips	950	400	1,700	700
Total (excluding any potential uplift associated with light rail)	**~10,750**	~7,750	**~15,250**	~10,450
Future customers due to light rail related uplift (inclusive of commuter, shopping and recreation)	-*	-*	1,700	2,650
Total (including potential uplift associated with light rail)	-*	-*	**~16,950**	**~13,100**

Note: *It is assumed that project related land-use uplift does not occur at the projects day of opening (2036), and is progressively enabled and achieved by 2056.

Legend Higher patronage | Similar patronage | Lower patronage

6.2 Cost development

Return to the Table of Contents

An evidenced-based cost approach in line with estimating guidelines was adopted to develop preliminary cost estimates for the two options.

Key components of the cost estimation include:

- Direct costs: cover the costs of material, plant, labour and subcontractors for the construction of the physical works.
- Indirect Costs: cover site supervision, overheads and recurring costs and all necessary insurances including Public Liability, Professional Indemnity, Workplace Health & Safety, Portable Long Service Leave Levy, Insurance Excess and Contractor's Security.
- Client cost: cover the costs required for the client to deliver the project.
- Property Acquisition: cover the cost to acquire the land and property specified in Section 4.3 and Section 5.3.
- Contingency: covers the cost that will probably occur based on the performance of preceding projects or worst-case scenarios but is still an unknown amount. Typically for a deterministic P90 estimate, a contingency range of 40-70% is adopted depending on the level of confidence. For the study, a 40% contingency has been adopted based on the higher level of confidence in the costs based on benchmarking exercises.
- Escalation: covers the change in the cost of products, services and commodities over time. Assumed as 3 per cent per annum.
- Infrastructure and Place Corporate Charge: Assumed the project would be delivered through the PLR project office and hence contained in the client fee estimate.
- Operating Cost (OPEX): covers the running cost for the service. In the absence of a detailed study, the OPEX was adopted as 0.5% of the CAPEX cost excluding client cost, property acquisition and contingency.

A list of applicable direct and indirect costs and assumptions on the development of other costs are detailed in Appendix G – Cost estimate.

The itemised cost estimate for the two options (including the respective Carter Street stop for each alignment option) is summarised in Table 6-2.

The cost estimate for the two options without the Carter Street stop is included in Appendix G – Cost estimate.

Table 6-2 Cost estimate (alignments with the Carter Street stop option included)

CAPEX Component	Assumptions	Option 1	Option 4
Direct	Refer to Appendix G – Cost estimate	$222,507,426	$192,775,666
Indirect	Refer to Appendix G – Cost estimate. Equates to ~62% of Direct	$138,844,634	$120,292,016
Construction Cost		**$361,352,061**	**$313,067,681**
Client Cost	Assumed as 18% of construction cost	$65,043,371	$56,352,183
Property Acquisition	Areas as identified based on the market rate of $3000/m²	$46,938,519	$15,811,124
Base Estimate		**$473,333,950**	**$385,230,988**
Contingency	Assumed as 40% of construction costs excluding property	$170,558,173	$147,767,946
Escalation	Assumed as 3 per cent per annum	$249,036,272	$207,211,509
I&P Charge	Typically 3.8%, however excluded as noted	Excluded	
Total Outturn Cost		**$892,928,395**	**$740,210,443**
OPEX Component	**Assumptions**	**Option 1**	**Option 4**
Average annual cost	0.5% of the CAPEX cost excluding costs as noted	$8,180,753	$7,087,629

6.2 Cost development

Return to the Table of Contents

In developing the costs, the rates adopted in this study were benchmarked against other projects for appropriateness including:

- Parramatta Light Rail and Newcastle Light Rail for direct costs
- Other more recent TfNSW infrastructure projects for recent market trends on indirect costs and client costs.

The overall CAPEX cost estimate was also compared to other recent light rail projects to help ensure the project costing was comparable to projects recently delivered or in delivery.

CAPEX costs for other projects have been converted to real costs in 2022 in Figure 6-2 and compared to the two options in this study.

Key observations for the two options in this study:

- Costs are comparable to Parramatta Light Rail Stage 1 and Gold Coast Light Rail Stage 3
- Costs are lower than Sydney Light Rail
- Costs are higher than Canberra Light Rail, however this project was developed within an existing protected corridor.

Note: Auckland Light Rail consists of a sizeable section of underground works which significantly increases construction costs.

Figure 6-2 Comparison of CAPEX costs between recent light rail projects

Source: *Based on the analysis of published sources, 8 June 2022.*

6.3 Analytical framework for economic appraisal

Return to the Table of Contents

Four standalone project options were compared against the Base Case in the rapid CBA:

- **Option 0 – Base Case** – A "do minimum" option involving the maintenance of the status quo. Includes the continuation of existing train and bus service levels and road conditions, including parking policies.
- **Option 1** – The proposed light rail extension follows the route alignment along John Street.
- **Option 1 with Uplift** – Option 1 with additional demand from the uplift in residential zones along the route.
- **Option 4** – The proposed light rail extension follows the route alignment along Birnie Avenue, Bachell Avenue and Church Street.
- **Option 4 with Uplift** – Option 4 with additional demand from the uplift in residential zones along the route.

The general assumptions underpinning the rapid CBA are:

- **Appraisal period:** The appraisal assumes a 44-year project appraisal period from financial year (FY) 2020/21 to FY2064/65, based on a 30-year appraisal period for new rail assets, 6 years for construction and commencement in FY2035/36.
- **Base year:** The appraisal assumed FY 2020/21 as the base year. All costs and benefits have been discounted to arrive at a present value for FY2020/21. As this is a rapid appraisal for a preliminary feasibility study, FY2020/21 was chosen to simplify calculations given that the passenger trip data for each option was estimated for 2021.
- **Unit of account / price year:** The rapid economic appraisal was undertaken in real terms (that is, excluding inflation). All benefits and costs are expressed in constant FY2021/22 prices with most of the unit rates sourced from TfNSW guidelines.
- **Discount rates:** A real discount rate of 7 per cent per annum was applied in the rapid economic appraisal, consistent with the Transport for NSW (TfNSW) and Infrastructure Australia (IA) guidelines. Sensitivity tests were undertaken at real discount rates of 3 per cent and 10 per cent per annum to meet NSW government requirements, as well as 4 per cent to meet the Australian Government's requirements for the Project Proposal Report (PPR) for the Department of Infrastructure, Transport, Regional Development and Communications (DITRDC).
- **CBA Methodology:** The rapid appraisal was undertaken in accordance with TfNSW guidelines and Australian Transport Assessment and Planning (ATAP) guidelines for compliance with IA (where applicable).

The criteria in Table 6-3 were used to compare and rank the shortlisted option against the Base Case.

Table 6-3 Measures of economic worth in an economic appraisal

Measure	Description
Net present value (NPV)	NPV measures the difference between benefits and costs, while accounting for their varying timing. Net cash flows are discounted at a specified discount rate, reflecting the concept that future benefits and costs have less value compared to current benefits and costs. A project with an NPV greater than zero means that the present value of benefits exceeds the present value of costs and is considered economically worthwhile.
Benefit-cost ratio (BCR)	BCR measures the benefits received per dollar of project cost. It is used to indicate value for money. BCR is calculated by dividing the present value of all benefits by the present value of all costs (including recurring operating and maintenance). A project with a BCR greater than one means that the present value of benefits exceeds the present value of costs and is considered to provide value for money.
Internal rate of return (IRR)	For completeness and in accordance with convention, we have also included the IRR which is the rate of return that equalises the present value of benefits to the present value of costs, i.e. it is the discount rate which gives an NPV of zero.

6.4 Summary of appraisal results

Return to the Table of Contents

A rapid economic appraisal of four project options was undertaken against the Base Case ("do minimum"), using a rapid cost-benefit analysis from the perspective of the NSW community or state economy. Key outcomes are summarised in Table 6-4, with the complete detailed results included in Appendix H - Rapid economic appraisal detailed results.

The following key points emerge from the results of the rapid economic appraisal:

- The Base Case ("do minimum") is the preferred option since all the options lead to negative net economic benefits (net economic costs) for the NSW economy.
- Amongst the shortlisted options, Option 4 with Uplift is the best performing project option in terms of NPV but still delivers **net costs of $195.64 million** over the appraisal period (a NPV of -$195.64 million).
- However, in terms of BCRs, Option 1 with Uplift is the best performing project option with a **BCR of 0.33** amongst the shortlisted options.
- While it might be argued that Option 4 with uplift would minimise the net costs to the community, BCR is the recommended selection criterion in a budget-constrained financial environment. Furthermore, the differences in NPVs are not significant between options and are subject to a degree of uncertainty. Consequently, the BCR is likely to be the most appropriate selection criterion if further analysis proceeds.
- Compared with Option 1 (both sub-options), Option 4 (both sub-options) generally delivers lower value for money due to:
  - the increased walking distance for customers along Option 4 contributes to increased travel time and higher cost of travel, and hence a lower NPV for Option 4 options
  - the lack of alignment with existing bus services (routes 401, M92) results in a lower number of potential customers switching to light rail
  - a reduction in farebox revenue for Option 4 when compared to the Option 1 alignment
  - Comparatively lower passenger demand.

Table 6-4 Summary of rapid appraisal results (FY2021 present values at 7% real discount rate, $m, FY2022)

	Option 1	Option 1 with Uplift	Option 4	Option 4 with Uplift
Benefits				
Total benefits in PV(1)	$97.87	$105.50	$57.97	$68.62
Costs				
Total costs in PV(1)	$319.75	$319.75	$267.69	$267.69
Appraisal outcomes				
Net Present Value (NPV)(1)	-$221.88	-$214.25	-$209.72	-$199.07
Benefit-cost Ratio (BCR)	**0.31**	**0.33**	**0.22**	**0.26**
Internal Rate of Return (IRR)	N/A(2)	N/A(2)	N/A(2)	N/A(2)

Notes: (1) Totals may not add up due to rounding errors.
(2) IRR was not calculable due to irregular cash flows over the extended time horizon.

6.4 Summary of appraisal results

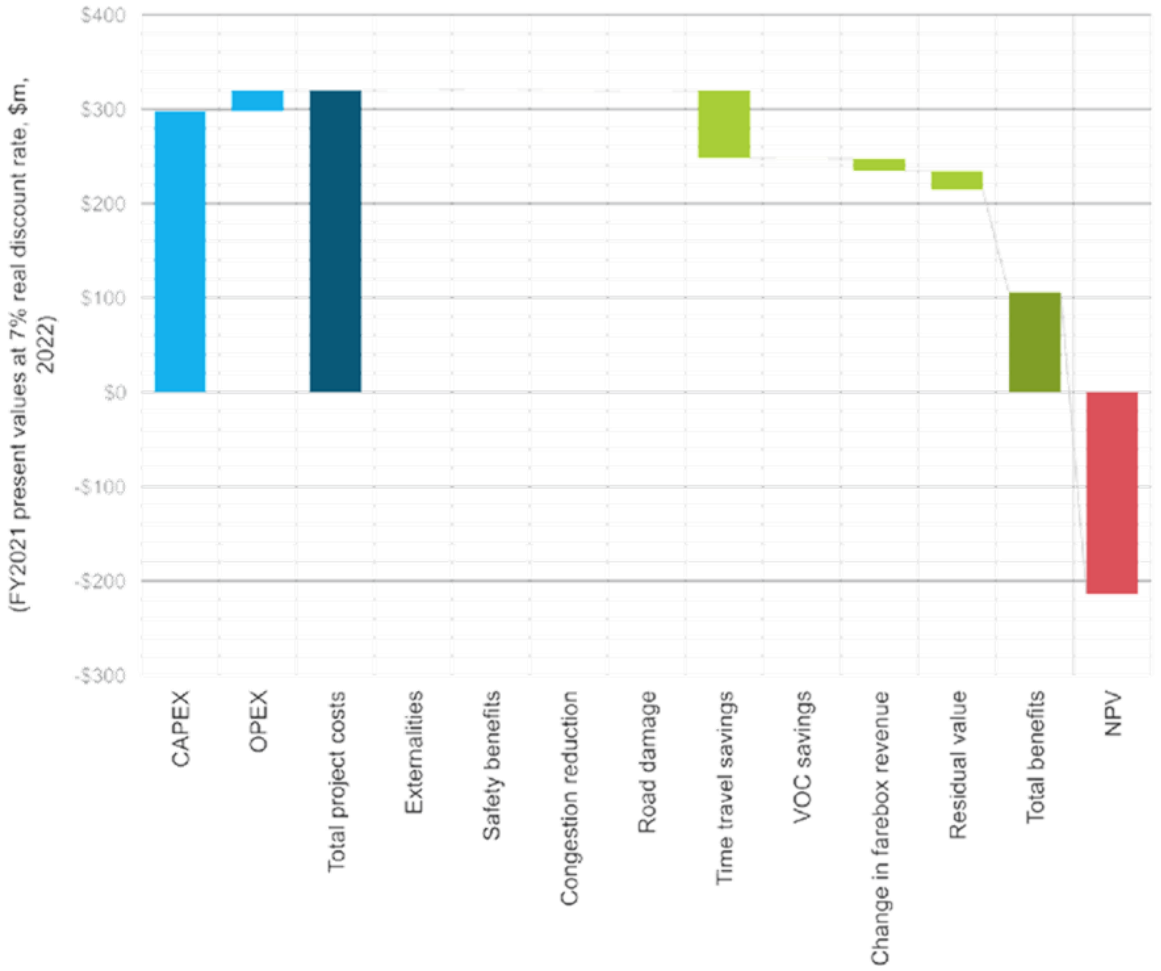
Return to the Table of Contents

To visualise the relative costs and benefits accounted for in the economic appraisal, Figure 6-3 illustrates the economic appraisal results for Option 1 with Uplift which has the highest BCR after the Base Case ("do minimum").

Key observations from the analysis (and figure):

- The present value of capital costs for Option 1 with Uplift is nearly $300 million. The capital costs for all the options are significantly higher than the total benefits returned for the investments, leading to a negative NPV.
- Travel time savings are the greatest benefits to be gained from the project options, accounting for nearly 70% of the total benefits. Other key benefits are the residual values of new assets (~20%) and the increase in passenger farebox revenue (~13%).
- Safety benefits, congestion reduction, road damage reduction and environmental externalities are all less than 0.5% of benefits due to the relatively strong competitiveness of private vehicles over light rail for short journeys.

Figure 6-3 Rapid appraisal results for Option 1 with Uplift



6.5 Sensitivity testing

Return to the Table of Contents

A range of sensitivity tests were undertaken to meet TfNSW and IA review requirements. Overall, the Base Case ("do minimum") remains the preferred option, compared with the four project options, for all the sensitivity tests.

Key scenarios are summarised in Table 6-5, with the complete detailed results (with both BCR and NPV) included in Appendix H - Rapid economic appraisal detailed results.

Amongst the project options, Option 1 with Uplift remains the best-performing project option after the Base Case ("do minimum") in terms of benefit-cost ratios. Option 4 remains the worst-performing option.

The following key points emerge from the sensitivity analysis table:

- Lower real social discount rates such as 3% and 4% generally produce higher NPVs and BCRs for the options. However, this is unlikely to be relevant, given the higher interest rate environment now prevailing.
- At 7% discount rate, the best NPVs and BCRs for the options occur if capital costs (or total costs).
- An increase in light rail demand will increase the BCRs but not as much as decreasing the capital costs.
- Under the worst-case scenario, all options return significant negative NPVs, ranging from -$357 million for Option 1 to -$308 million for Option 4 with Uplift.

Table 6-5 Results of sensitivity tests (only BCR values shown in summary)

Scenario	Benefit-Cost Ratio (BCR)			
	Option 1	Option 1 Uplift	Option 4	Option 4 Uplift
Core (Central Case Scenario)	**0.31**	**0.33**	**0.22**	**0.26**
Sensitivity – Discount Rates				
3% real discount rate	0.63	0.68	0.47	0.55
4% real discount rate	0.52	0.56	0.38	0.45
10% real discount rate	0.19	0.21	0.13	0.16
Sensitivity – Cost				
20% increase in capital costs at 7%	0.26	0.28	0.18	0.22
20% decrease in capital costs at 7%	0.38	0.41	0.27	0.31
40% increase in capital costs at 7%	0.22	0.24	0.16	0.19
40% decrease in capital costs at 7%	0.49	0.53	0.34	0.41
20% increase in total costs at 7%	0.26	0.27	0.18	0.21
20% decrease in total costs at 7%	0.38	0.41	0.27	0.32
Sensitivity – Benefit				
20% increase in benefits at 7%	0.35	0.38	0.25	0.30
20% decrease in benefits at 7%	0.26	0.28	0.19	0.22
Sensitivity – Patronage				
20% increase in light rail demand at 7%	0.36	0.38	0.25	0.30
20% decrease in light rail demand at 7%	0.26	0.28	0.18	0.22
Worst case scenario(1) at 7%	0.19	0.20	0.14	0.16

Notes: (1) Assumed to be a test of 40% increase in capital costs and 20% decrease in benefits

6.6 Further considerations

Return to the Table of Contents

The rapid economic appraisal did not quantify several costs and benefits, including:

- Incremental health benefits from walking to/from light rail stops
- Travel time reliability benefits
- Parking cost savings
- Placemaking benefits
- Local and regional development benefits, including agglomeration benefits (such as wider economic benefits – "WEBs").

Further qualitative consideration of the above costs and benefits is provided in Table 6-6.

It is expected that these benefits will slightly increase the total value of total benefits but not necessarily lead to positive net benefits to the NSW economy in the final analysis due to the length of the extensions considered and the size of the study area.

In conclusion, the current analysis indicates that Base Case ("do minimum") is the preferred option since all the shortlisted project options result in net costs for the NSW economy.

Based on the above considerations, several potential next steps have been identified and discussed in Section 7.2.

Table 6-6 Qualitative Assessment of Costs and Benefits

Element	Details
Incremental health benefits related to the project	The switch to light rail from heavy rail may lead to incremental health benefits for former heavy rail passengers as a result of walking to/from tram stops (compared to being dropped off and/or picked up from the train station). However, this is expected to be small or marginal in total value and has not been quantified.
Travel time reliability benefits	A light rail service operating on fixed infrastructure with a published timetable typically leads to more reliable journeys for passengers. However, given the short distance of the extension, this is expected to be small in total value and have not been quantified.
Parking cost savings	Given the few passengers likely to switch from car to light rail, parking cost savings are not expected to be material unless there are significant changes in parking policy along the light rail extension.
Placemaking	Potential improvements in amenity at light rail stops, transport changes and along the route extension such as: • Improved perceived passenger safety and security • Improved perceived pedestrian and shopper safety and security • Improved comfort and visual amenity for light rail passengers • Improved comfort and visual amenity for other passengers and citizens
Economic development	Potential changes in accessibility to Parramatta via light rail and access to jobs, education and business opportunities such as: • State government employment opportunities • Commercial & retail employment opportunities • TAFE NSW
	The impact of potential land use changes along the route extension as a result of the new infrastructure such as: • Residential developments • Green spaces and public infrastructure
	Potential long term structural changes in the local economy in the Cumberland region, such as: • Investment in community amenities • Potential development of businesses and industries • Potential further development of retail services
	Potential changes in the regional economy in Sydney's western suburbs including potential wider economic benefits (WEBs) from agglomeration in the study area.
Sustainability and environment	Potentially improved sustainability through decarbonisation via the provision of a relatively more sustainable form of transport over the long term, taking into account more reliance on renewable energy.
	Potentially contribute to a reduction in dependence on car and fuel energy in NSW in the long term, subject to complementary road pricing and parking policies
Reputation	Potentially enhanced reputation or reputation risks, such as: • Potentially enhanced reputation from supporting more sustainable transport • Potential reputation risks from stakeholder issues or construction delays

[07]

Outcomes and next steps

7.1 Summary

Return to the Table of Contents

This feasibility study was undertaken to evaluate the options for and viability of a potential extension to Parramatta Light Rail Stage 2 (PLR2 Extension) from Sydney Olympic Park to Lidcombe.

Key findings of the study include:

- A reliable and efficient public transport service is required to support the ongoing economic growth and future population in the region. The service, combined with the wider network, should improve connectivity for:
  - Town centres within the region, including those within the Cumberland and Parramatta LGAs
  - Residents to access strategic centres throughout Greater Sydney
  - Key commercial regions in Lidcombe North and Parramatta Road
  - Green space and recreational facilities including Wyatt Park.

  This would help improve accessibility and help reduce the reliance on private vehicles.
- Key developments and public transport infrastructure are proposed in nearby Sydney Olympic Park, which would benefit residents and employers in the Lidcombe region.
- Five alignments between Sydney Olympic Park and Lidcombe were identified (Figure 7-1) and assessed based on their contribution to customers, development, integration and cost.

Figure 7-1 Short-listed light rail extension options

- Based on their respective scoring, and input from Cumberland City Council (Council), Options 1 and 4 were retained for further investigation. These options addressed the key requirements and provided diversity in their impact on the region.
- Opportunities were investigated to accommodate light rail on the identified corridors, whilst minimising the impact on residents and network capacity. The concept designs were based on the following principles:
  - Using the Parramatta Light Rail kit of parts including rolling-stock and stop configurations
  - Minimise land-acquisition
  - Shared running to retain on-street parking and accessibility to properties
  - Purchase and amalgamate lots near stops to maximise place outcomes and the land yield
  - The positioning of light rail stops to balance ease of access and travel speed benefits.
- Daily patronage was assessed for 2036 and 2056 based on first principles, with Option 1 yielding 30-45% more potential customers.
- Cost estimated based on benchmarking of recent light rail projects yielded a total outturn cost of:
  - Option 1 $0.89bn
  - Option 4 $0.74bn
- The rapid economic appraisal indicated that all options would have net economic costs for the NSW economy, where:
  - Option 1 would have the highest core-scenario Benefit-Cost Ratio of 0.31 (or 0.33 with uplift)
  - Sensitivity testing indicated that the largest benefit to BCR would be through reduced CAPEX costs, which may occur in future as the over-heated construction market and material costs return to a new equilibrium
  - Further benefits could be assessed, including placemaking and wider economic benefits, but these may not result in a net positive outcome.

Based on the outcomes of the study, several potential next steps are identified and are discussed in Section 7.2 and Section 7.3.

7.2 Next steps

Return to the Table of Contents

The current analysis indicates that Base Case ("do minimum" or retain existing transport provisions) is the preferred option compared to the options assessed.

However, if Council elects to pursue further development of the project case, recommended next steps include:

- Investigate a single preferred design in more detail (supported by survey and civil analysis), to refine the assumptions regarding constructability and cost
- Develop a strategic transport demand model to capture all the relevant origin-destination pairs in the study area and potential mode switches to light rail
- Conducting the economic appraisal of the Lidcombe extension in the context of a wider light rail network or program (instead of a standalone extension) to capture network effects and new journey opportunities. Investigate the appraisal outcomes if the SOP to Lidcombe extension was appraised as part of a broader Stage 2 proposal.
- Comparing the preferred light rail with an alternative modes such as Bus Rapid Transit in a full economic appraisal, using a full cost-benefit analysis, to determine the best outcome for the Cumberland LGA economy and the NSW state economy.

This study also recognises that the decision to proceed with infrastructure projects (including transport) is not solely based on economic appraisal as the sole decision-making tool.

Consequently, opportunities to increase awareness and support for the project may include:

- Registering the project (as mode agnostic) on the Infrastructure Priority List with Infrastructure Australia
- Advocacy at the highest political levels
- Develop advocacy collateral to include in Council strategic documentation and marketing.

Alternatively, Council may elect to investigate, advocate and implement interim or alternative solutions, including other sustainable transport options. Potential options are discussed in Section 7.3.

7.3 Interim improvements to support the region

Return to the Table of Contents

To help achieve Council's vision for the region, including improved accessibility, reduced private vehicle reliance and land-use changes supported by transport provisions, several interim steps can be investigated and implemented to improve the existing service offering and potentially attract users.

It is acknowledged this list is not exhaustive, and suggestions are based on observations of the study area undertaken to inform the light rail study.

It is intended these suggestions act as a thought-starter for Council to investigate potential interim and alternative solutions whilst considering the on-going advocacy for the light rail extension.

Bus Route M92 conversion to Rapid Route

Figure 7-2 M92 double-decker bus at Lidcombe Station

The M92 currently operates as a high-capacity turn-up-and-go service connecting the key strategic centres of the Central City, Parramatta, Bankstown, Sutherland via Lidcombe (Figure 7-2).

This route serves a key north-south function providing an attractive connection in the absence of a north-south rail connection. As such is a prime candidate to conversion to a Rapid route, such as B-Line style product. Council should advocate for this route's conversion with increased frequency and modern buses with improved legibility (through livery and intelligent stops). These changes help alleviate the negative perception of 'unreliable' bus services.

Bus stop infrastructure improvements

Throughout the study corridor bus stop provisions are significantly varied. It was observed that many of the stops had poor or constrained access, limited infrastructure and no or limited information on services. Examples are captured in Figure 7-3 to Figure 7-5.

Bus stops must be compliant with the Disability Standards for Accessible Public Transport (DSAPT), including:

- Firm, evenly graded boarding point and compliant access footpaths
- An unobstructed space large enough to allow for the deployment of a ramp
- Tactile ground surface indicators (TGSIs) for vision impaired customers denoting stop and boarding point

Certain comfort elements such as shelter and seating are not required to be DSAPT compliant. However provision of these facilities significantly improve the customer experience and attractiveness of the mode.

Overall, a review of bus stops is recommended to capture existing facilities, prioritise and implement works.

Figure 7-3 No TGSIs (both) and poor surface (left)

Figure 7-4 The bus not stopping at head of queue (due to traffic) and the customers forced to use uneven surface

Figure 7-5 No seating or shelter at the bus stop

7.3 Interim improvements to support the region

Return to the Table of Contents

Bus Route 401 operating hours

The 401 operates only in peak periods with a 20-minute headway, which may dissuade customers from using public transport if their return journey is uncertain due to long wait times or no service. Council should advocate for Route 401 to operate outside of peak periods with a peak-period service headway of 10-minutes as Carter Street develops.

Pedestrian (zebra) crossings

Throughout the study area, in particular John Street, there are limited formalised crossing opportunities. It is recommended that pedestrian (zebra) crossings be provided near bus stops and Chadwick Reserve to improve accessibility and safety. The provision of compliant crossings will also help with Disability Discrimination Act compliance.

Reduction of the road speed limit

To help foster a pedestrian and cycling-friendly environment, investigations are recommended to reduce vehicle speed limits in the study area. Including:

- John Street from 60 km/h to the default 50 km/h urban speed limit
- Lidcombe Town Centre (including John Street and Church Street) to 40 km/h, consistent with other town centres such as Auburn.

Improved walking and cycling connections

Paired with the above changes, the provision of pedestrian and cycling infrastructure would assist in encouraging uptake of these sustainable transport alternatives.

Improved walking and cycling connections to Wyatt Park should be investigated including:

- Church Street to serve bus and rail customers from Lidcombe interchange
- Through Chadwick reserve for residents, which may include extension of the existing paved footpath as a shared path through to A6 Olympic Drive and a potential crossing (signalised or overbridge) of A6 Olympic Drive.

It is unlikely that Birnie Avenue can be converted into an pedestrian and cycling-friendly environment without a significant reduction in heavy-vehicle movements, a reduction in speed limit and the provision of footpaths on each side of the street (currently not provided on the eastern verge). Instead, the focus should be on improving access and provisions on the Pippita Rail Trail which runs parallel Birnie Avenue.

Wayfinding

Wayfinding signage should be provided (and integrated into the streetscape) to highlight the location and route to:

- Key transport nodes/stops
- Lidcombe North Shops
- Lidcombe Town Centre
- Cultural and recreational sites, including Wyatt Park.

The inclusion of directions, travel time and possible public transport alternatives help encourage users to use certain routes and sustainable modes. Examples are illustrated in Figure 7-6.

Figure 7-6 Wayfinding, City of Sydney (left) and Moreton Bay Regional Council (right)

Chadwick Reserve

In addition to the previously mentioned zebra crossings and shared path, it is recommended the park frontage be re-configured to remove the fence on John Street (Figure 7-7). Removal of this fence will help improve the accessibility and attractiveness of the reserve.

Figure 7-7 Fenced edge of Chadwick Reserve

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[Appendix A]

Context

A.1 Land-use

Opportunities

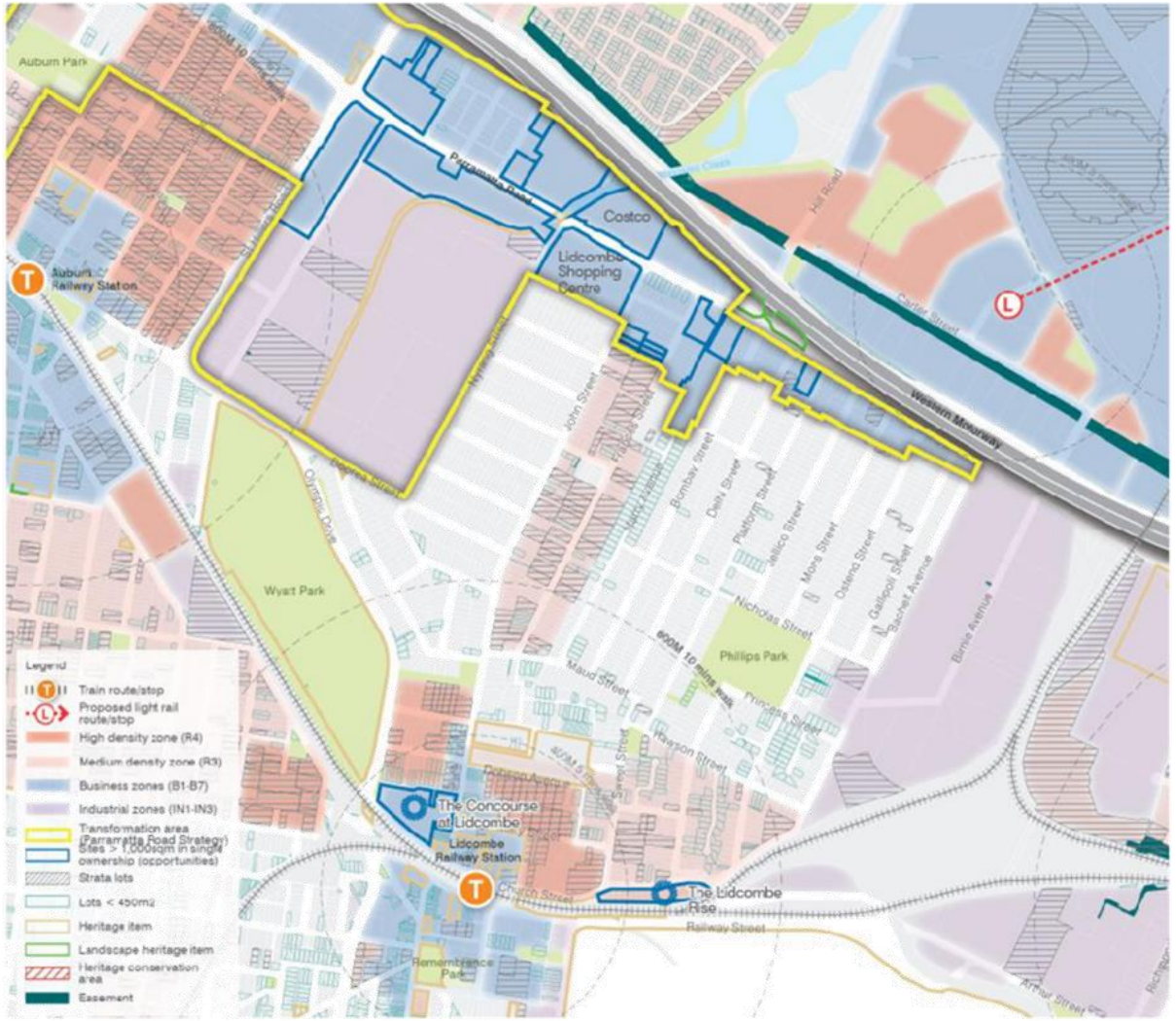
- Up-zone land to medium or high density along proposed light rail route
- Sites >1,000sqm in single ownership provide opportunities for up zoning to accommodate a significant increase in housing
- Improve the public transport connection to Lidcombe Shopping Centre and Costco

Constraints

- High number of strata title lots in medium and high-density zones limit potential for re-development
- Large proportion of lots <450sqm require significant lot amalgamation
- Need to retain Industrial land close to centres consistent with GSC's Region Plan
  - Limits potential for changes in planning controls around Birnie Avenue.

Key considerations for this project:

- Uplift only possible in certain corridors
- Smaller lots require amalgamation
- Key developments served by public transport



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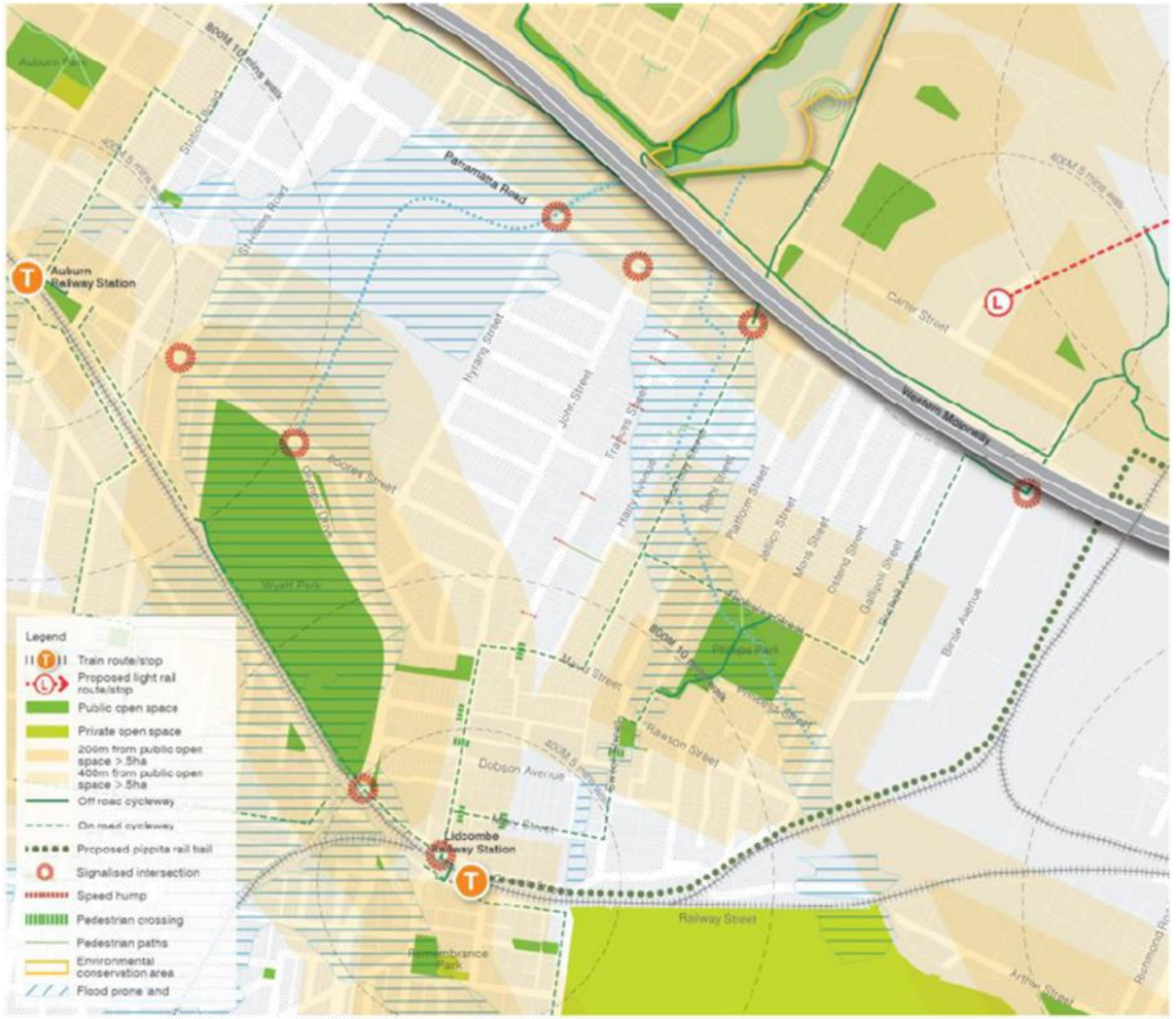
A.2 Open space

- Proximity to open space of >0.5ha is desirable (and potentially required) depending on the density of development.
- Existing open space coverage only partially overlaps with potential development or up-zoning areas
- Wyatt Park Plan of Management includes several proposed upgrades of facilities.



Key considerations for this project:

- Opportunity to improve connection to open spaces
- High-density development along corridor may need to provide additional open space
- Flood-prone areas along the alignment

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A.3 Existing transport context

Region served by existing connections:

- Bus Route 401 Carter Street to Lidcombe
- Bus Route M92 Parramatta to Sutherland
- Sydney Trains (T1 Western Line, T2 Inner West & Leppington Line, T3 Bankstown Line and T7 Olympic Park Line)
- Bounded by:
  - Parramatta Road (A44)
  - M4 Motorway
  - Olympic Drive (A6)

Key considerations for this project:

- Alignment potentially replicating or replacing existing bus service
- Generally high levels of on-street parking utilised by residents.
- Road reserves not sufficient to accommodate light rail without loss of on street parking
- Streets fronted by residential houses require regular driveway access
- Opportunity to Improve streetscape along light rail route to create a higher level of pedestrian amenity

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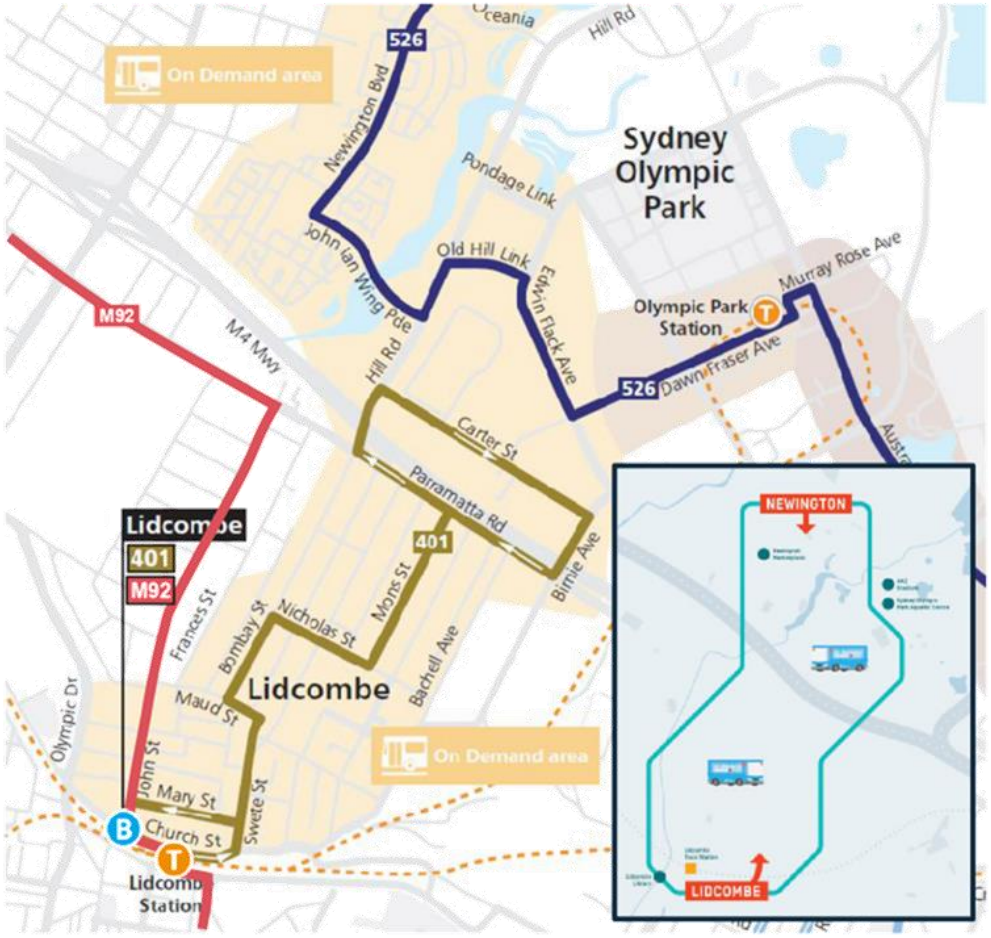
A.3 Existing transport context

Public Transport

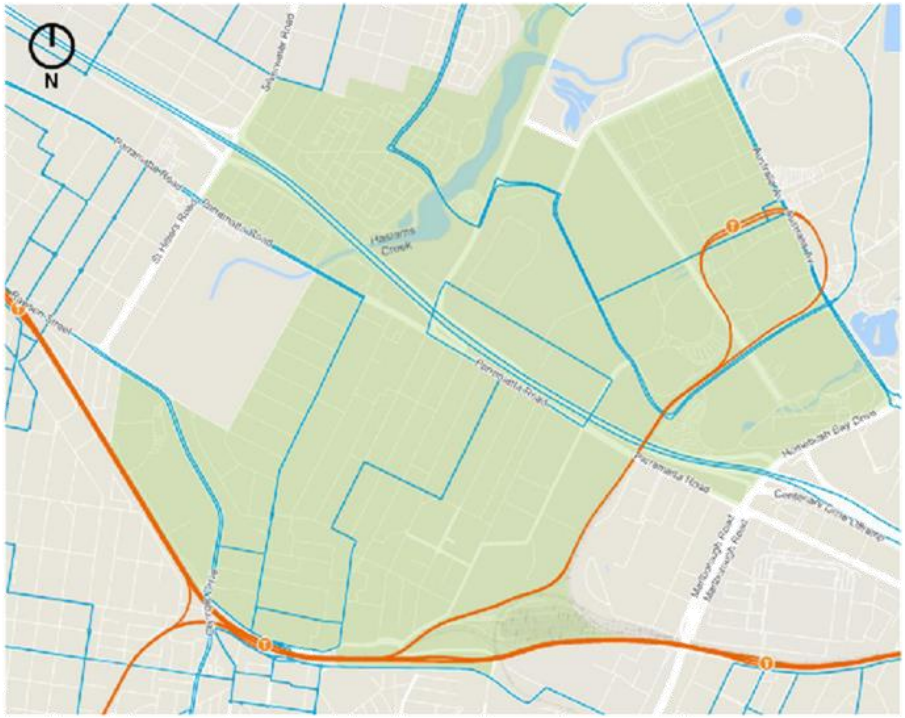
- Bus Route M92 – Up to 6 buses per hour (bph) during peak periods, 4 bph weekday off-peak and 3 bph on weekends.
- Bus Route 401 – Weekday peak period only loop service, operates 2-3 bph.
- On-demand buses, operate between 6am-7pm weekdays and 9am-5pm on weekends
- Sydney Trains (in peak direction)
  - T1 Western Line (up to 6 tph)
  - T2 Inner West and Leppington Line (up to 12 tph)
  - T3 Bankstown Line (up to 4 tph)
  - T7 Olympic Park Line (up to 6 tph)

Figure 1-2 Existing transport within study area (inset: on-demand bus zone)



Source: Transport for NSW (2022), Inset: On-demand Zone (BRIDJ, 2022)

A.3 Current bus patronage



Source: Transport for NSW (2020)

- Bus trips within the shaded area as a proxy for potential candidate trips for the light rail extension
- Opal data has been factored up based on a comparison between 2019 and 2020 for Bus Region 13 (which includes Lidcombe).
  - 3.8% in February
  - 37.3% difference in November

Key considerations for this project:

Daily volumes (based on Opal tap-on and off) for trips within the study area

- ~1,250 typical weekday (daily trips)
- ~650 typical weekend (daily trips)

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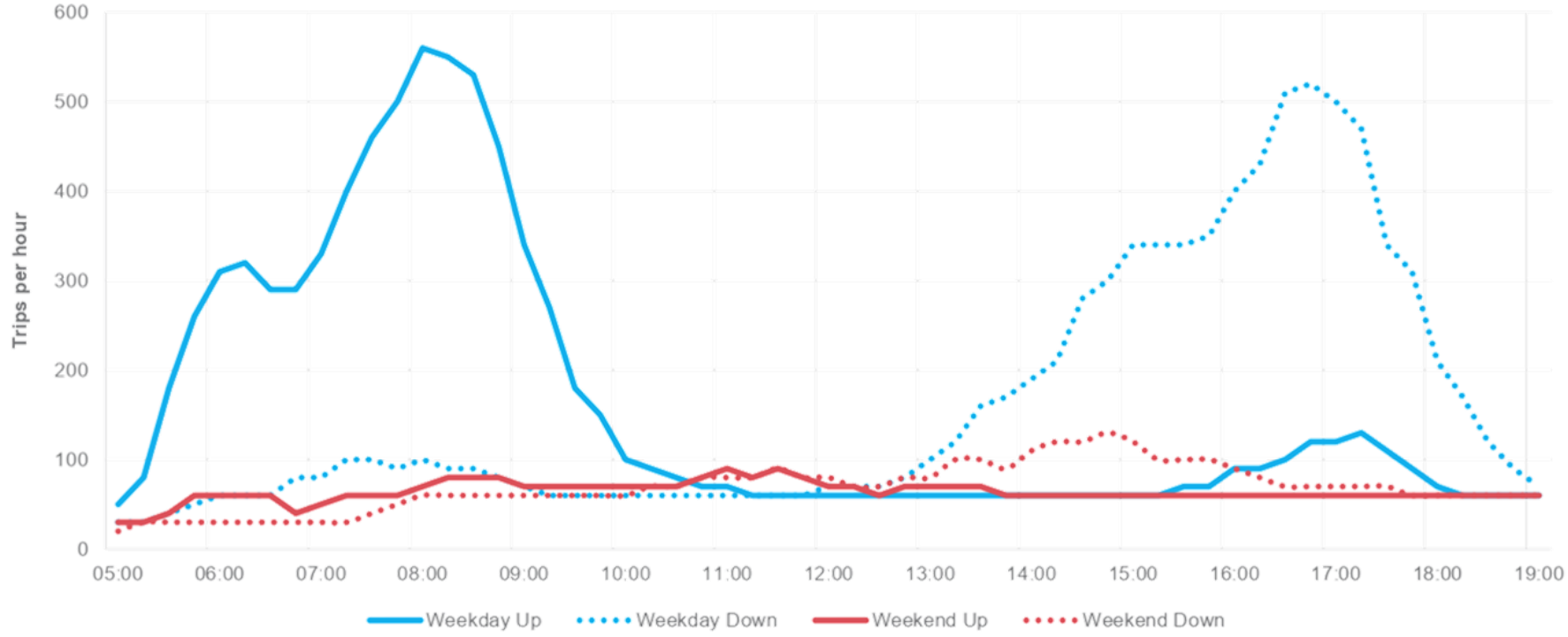
A.3 Current T7 Olympic Park Line patronage

- Patronage for non-event periods (typical week in September 2019)
- Travel time between SOP and Lidcombe of approximately 5-6 minutes
- Rolling hourly patronage shown below.

Key considerations for this project:

- Some portion of patrons may use Light Rail extension who have a destination or origin between the two rail stations
- Unlikely to attract customers away from the faster non-stop T7 shuttle for end-to-end journeys



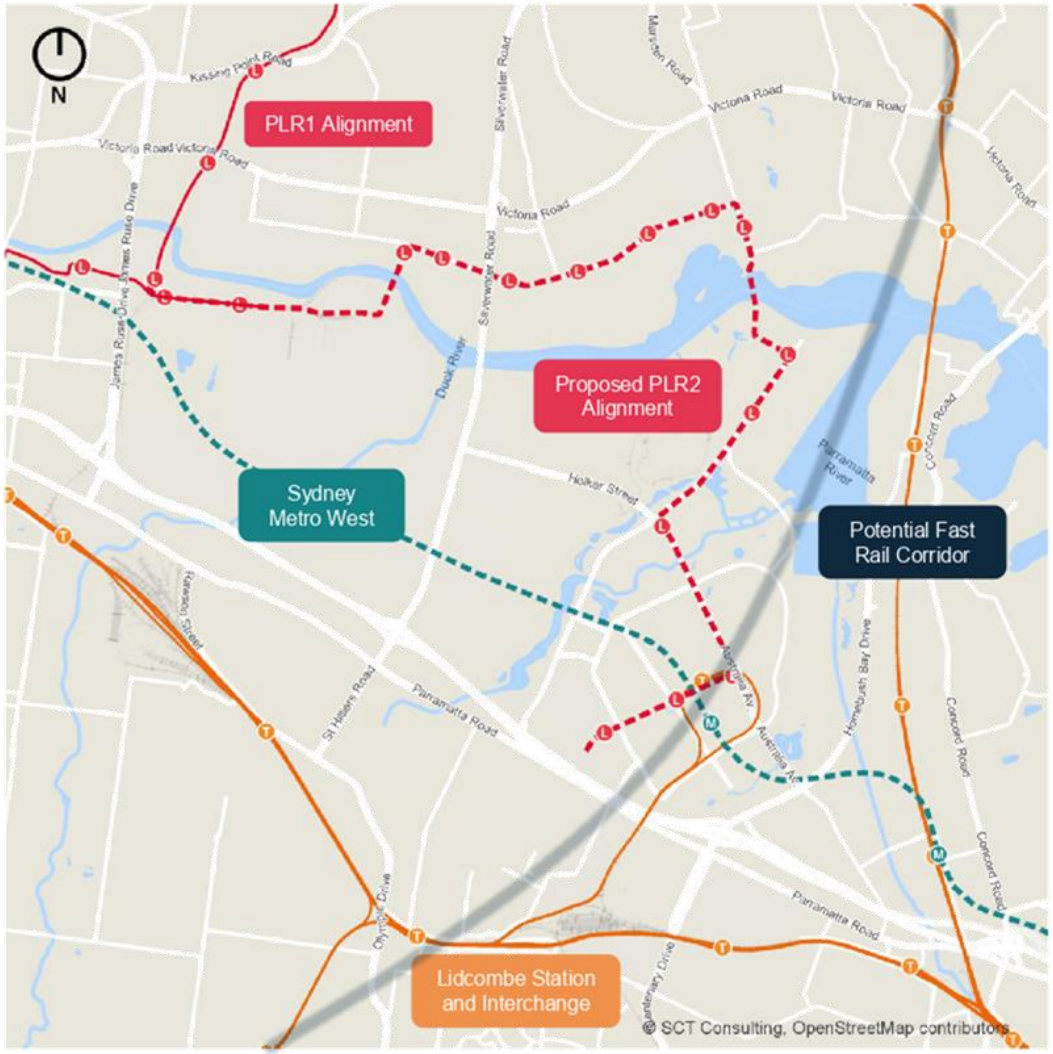
Source: Transport for NSW (2020). ROAM data rounded to 20 customer buckets, hence only Adult Opal customers shown to avoid over-estimating demand.

A.4 Future transport context

- Parramatta Light Rail Stage 1
  - Operational by 2023
- Paramatta Light Rail Stage 2
  - Alignment identified
  - Funding not committed
  - Estimated mid-2030s
- Sydney Metro West
  - Station confirmed at Sydney Olympic Park (near Olympic Boulevard)
  - Enabling works underway
  - Estimated operations by 2030
- Fast Rail
  - Sydney to Newcastle route identified
  - A stop within the Greater Parramatta region proposed with Sydney Olympic Park being considered as an option.
  - No commitment to construction or timeline
  - Federal and state funding commitment to next stage of project development

Key considerations for this project:

- Increased local and regional connectivity at Sydney Olympic Park



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[Appendix B]

SWOT and comparison

B.1 Options Overview

The following alignment options have been considered in consultation with Council:

1. via Hill Road (at-grade), Parramatta Road and John Street.
2. via grade-separated crossing of M4 corridor through Mons Street and Swete Street (existing bus corridor)
3. via grade-separated crossing of M4 corridor through Ostend Street (or other parallel residential streets) and Church Street
4. via Bernie Avenue (at-grade) through industrial area through to Bachell Avenue and Church Street
5. via grade-separated crossing of former Abattoirs Line from Sydney Olympic Park, also referred to as the Pippita Rail trail. Operates within the rail corridor until Bachell Avenue then through to Church Street

The SWOT analysis of each option considers:

- Customers and accessibility
- Places and development
- Traffic and integration
- Cost and constructability

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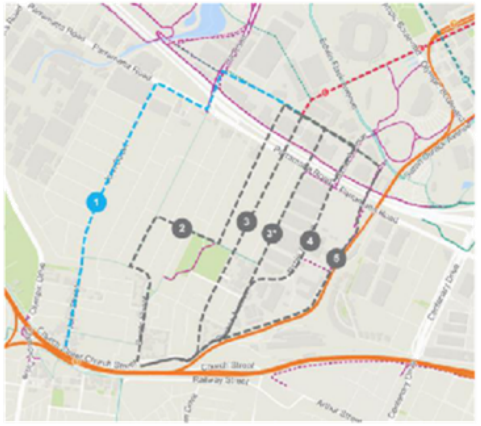
B.2 Option 1: John Street



Strengths

- Uses existing underpass at Hill Road (lower capital expenditure)
- Achieves frontage activation of Lidcombe town centre and streetscape improvements along John Street
- Provides connectivity to Lidcombe North Shopping precinct, supporting accessibility and growth of precinct. Likely to result in high patronage through incidental trips
- Terminus at Lidcombe in close proximity to town centre, station and bus interchange
- Connects well with planned high density residential development on the western side of Carter Street
- Potential for uplift at shopping centre site and medium density development along the western side of John Street
- Relativity flat route would pose few vertical challenges to light rail

Weaknesses

- Section along Parramatta Road will either require traffic lane reduction on Parramatta Road or land acquisition
- Journey time implications due to travel on Parramatta Road and crossing of the intersections at Hill Road and John Street (which are only 300m apart)
- Replicates existing high-frequency Bus Route M92 along John Street to Lidcombe
- Loss of on-street parking along John Street
- Capacity of Hill Road intersection will be significantly reduced with the completion of the Carter Street Precinct
- Uses significant length of Carter Street which may conflict with heavy vehicle movements

Opportunities

- Alignment runs parallel to Wyatt Park (south), within approximately 350m (or less than 5 minute walk) of the Swim Centre. Could serve as the public transport link to the future facilities. Stop could include precinct works to provide connection and wayfinding to sporting precinct.
- Potential to provide shared path or cycle path (with additional corridor width) along John Street linking retail and open space regions

Threats

- Creek Bridge on Bombay Street (between Simla Street and Nicholas Street) would need to be assessed to ascertain if it can support a light rail vehicle
- Ability to integrate with proposed Hill Road Upgrade Concept Design (2019-2021 Design), including removal of right turn at from Hill Road to Carter Street
- Disruption to retailers, other stakeholders and Parramatta Road during construction

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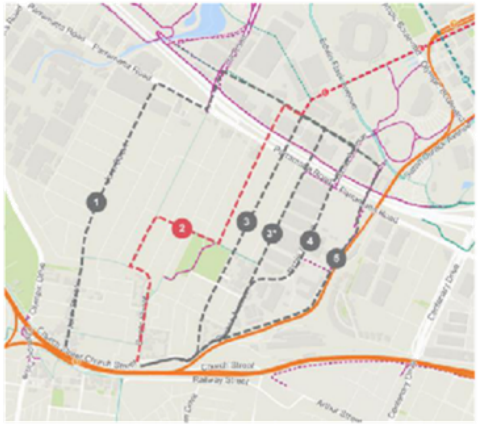
B.3 Option 2: Mons Street

Strengths

- Uses existing public transport corridor with wide road reserve
- Grade-separated crossing of M4 Motorway and Parramatta Road improves journey time reliability
- Potential opportunities for additional uplift/medium density zoning along the route particularly around Phillips Park (access to open space)
- Residential streets might generate regular commuter trips if the population has a lot of working-age and school-age cohorts. May also generate off-peak demand (e.g. pensioners shopping during the day)



Weaknesses

- Replicates Route 401 which has relatively low patronage.
- Alignment only serves residential developments – predominately low-density. Does not service any key destinations.
- Must negotiate multiple corners through low scale residential streets
- Loss of on-street parking along multiple streets

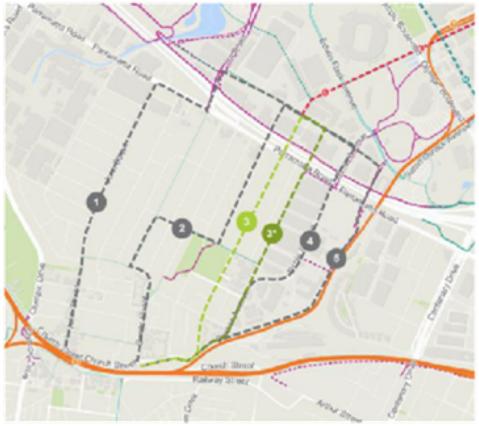
Opportunities

- Potential to also provide a grade separated active transport connection over M4 / Paramatta Road
- Opportunity to integrate stop with park to reduce parking loss

Threats

- Cost, grade and clearance requirements associated and with grade-separated crossing of M4 Motorway and Parramatta Road. Would require extensive ramps and property impacts/acquisition
- Church Street development and grades may restrict or preclude options for the alignment and terminus stop

B.4 Option 3: Ostend Street (and variations)



Strengths

- Alignment can serve both residential and industrial precinct
- Grade-separated crossing of M4 Motorway and Parramatta Road improves journey time reliability
- Most direct route between Carter Street and Lidcombe Station – potentially quickest journey time
- Potential opportunities for additional uplift/medium density zoning along the route particularly around Phillips Park (access to open space)
- Residential streets might generate regular commuter trips if the population has a lot of working-age and school-age cohorts. May also generate off-peak demand (e.g. pensioners shopping during the day)

Weaknesses

- Requires land acquisition and development of M4 over/underpass to connect from Uhrig Road to Ostend Street
- Alignment only directly serves residential developments – predominately low-density. Does not service any key destinations
- Loss of on-street parking along Ostent (or parallel street) including near Phillips Park.

Opportunities

- Potential to also provide a grade separated active transport connection over M4 / Paramatta Road
- Opportunity to integrate stop with park to reduce parking loss

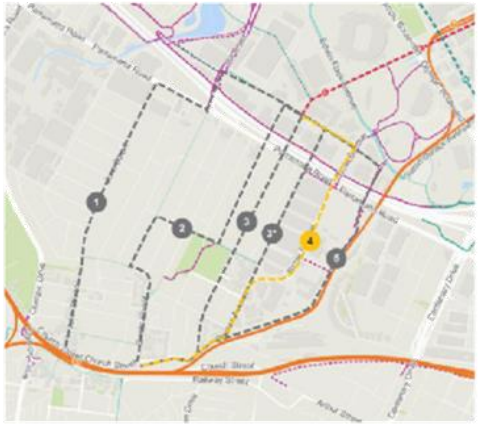
Threats

- Grade separated crossing at this location may not be possible without significant structure, cost and property acquisition
- Church Street development and grades may restrict or preclude options for the alignment and terminus stop

B.5 Option 4: Bernie Avenue

Strengths

- Uses existing underpass at Birnie Avenue
- Route travels through the Eastern Gateway cluster in Lidcombe East and would provide public transport connections to the premium high-tech industrial area
- Interference to residential homes (i.e. parking removal) is minimised as the route primarily passes through industrial land zones



Weaknesses

- Journey time implications due to travel on Parramatta Road and crossing of the intersection at Birnie Avenue Road | Parramatta Road
- Limited expected patronage outside of commuter peak periods
- Does not serve key destinations, high density residential or open spaces between Carter St and Lidcombe
- Heavy vehicle movements may be impacted for businesses on Birnie Avenue
- Uses significant length of Carter Street which may conflict with heavy vehicle movements

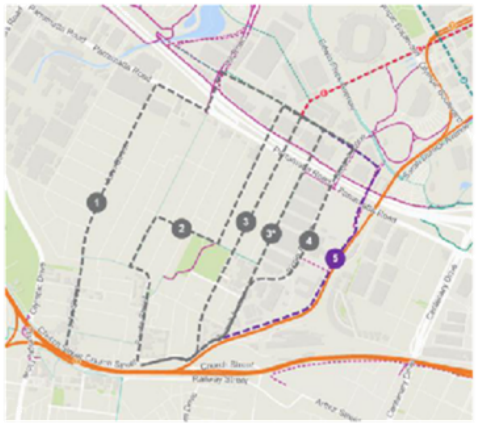
Opportunities

- Enable the transformation of industrial space (typically car-dependent) to innovation, high-tech and research facilities

Threats

- Church Street development and grades may restrict or preclude options for the alignment and terminus stop.
- Limited opportunities exist to convert industrial site employees into regular commuters, especially if parking is free/cheap and available.

B.6 Option 5: Pippita Rail Trail



Strengths

- Uses existing M4 crossing previously used by heavy rail (former Abattoirs Line)
- High journey time reliability as the as corridor does not to interact with key road corridors
- Interference to residential homes and industry (i.e. parking removal) is minimised
- Minimises loss of on street parking

Weaknesses

- Majority of alignment (south of M4 Motorway) operates through rail corridor (SP2 Rail Land Zoning) which reduces the potential customer catchment
- Limited expected patronage outside of commuter peak periods
- May not be able to accommodate both Light Rail and rail trail/active transport link on Pippita Rail Train. Displacing existing amenity
- Limited opportunity for access to adjacent properties from intermediate stops between Carter Street and Lidcombe.
- Limited opportunity for development upload as the alignment is bounded by the rail corridor (west) and existing employment/industrial land (unlikely to drastically change)

Opportunities

- Ability to re-purpose under-utilised infrastructure
- Improve amenity of pedestrian link

Threats

- Church Street development and grades may restrict or preclude options for the alignment and terminus stop
- Structural status of existing bridge is unknown. May require replacement or significant works to meet current standards
- Interaction with Sydney Trains to retain rail corridor access for maintenance etc
- Land along side the rail corridor is occupied by embankments and generally very uneven which would be difficult for light rail and require extensive earthworks adjacent to an active rail corridor

B.7 Comparison of options

Key objectives and considerations	Alignment Option				
	1	2	3	4	5
Customers and accessibility					
Reliable and efficient journey time (including traffic interaction)	Poor	Neutral	Neutral	Poor	Good
New or increased customer catchment	Neutral	Neutral	Good	Good	Poor
Achieve an effective interchange at Lidcombe Station	Good	Neutral	Neutral	Neutral	Neutral
Places and development					
Connectivity to retail and employment land-uses	Good	Neutral	Neutral	Good	Poor
Connectivity to recreational land-uses	Neutral	Good	Good	Neutral	Poor
Connectivity to residential land-uses	Good	Good	Good	Poor	Poor
Opportunities for place making and up-zoning regions	Good	Good	Good	Poor	Poor
Traffic and integration					
Minimise parking and property access restrictions	Poor	Poor	Poor	Neutral	Good
Minimise interaction with heavy vehicles	Neutral	Good	Good	Poor	Good
Cost and constructability					
Constructability of light-rail alignment (grade, turns, width)	Neutral	Poor	Poor	Neutral	Poor
Capital and operational cost (assumed)	Neutral	Poor	Poor	Neutral	Good

Legend Good Outcome Neutral Outcome Poor Outcome

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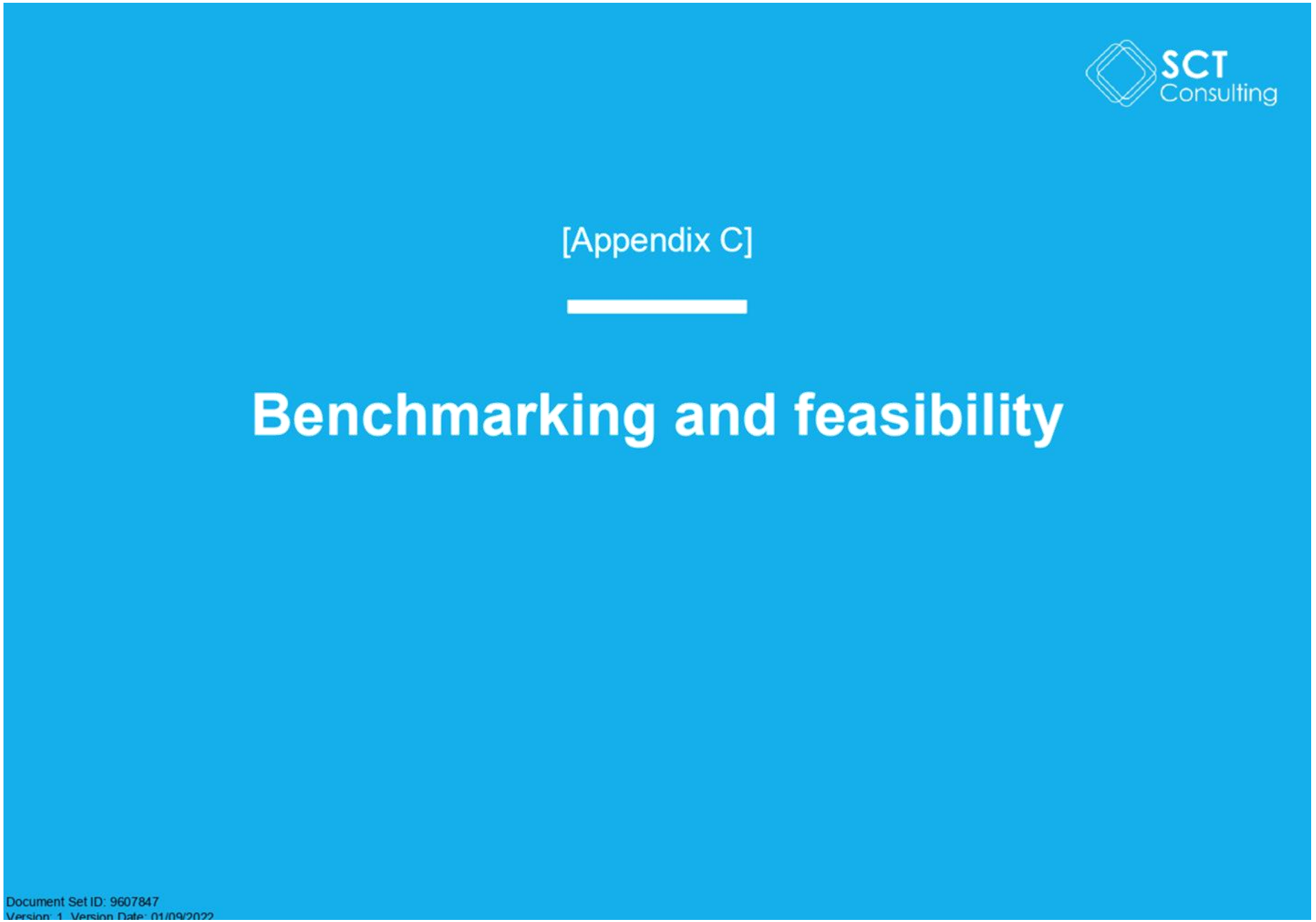
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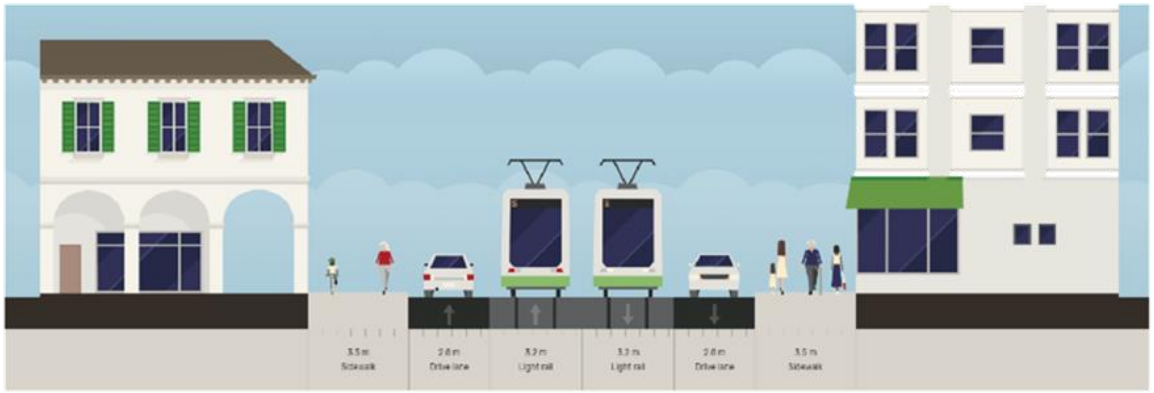
[Appendix C]
Benchmarking and feasibility
Document Set ID: 9607847
Version: 1, Version Date: 01/09/2022

C.1 Typical running sections – CSELR

CBD South East Light Rail – Devonshire St between Bourke St and Crown St

- Residential (pink), Mixed Use (Grey) and Local Centre (Cyan) zoning along the frontages
- Multiple side streets, shared zones and laneways connecting with Devonshire St that provide vehicular accesses to surrounding developments – no right turns permitted
- Limited number of property driveways
- Overall 19.0m cross-section
- Approximately 12m kerb-to kerb
- Two light rail tracks (no LR stops) (~6.4m)
- 1 eastbound and 1 westbound traffic lane (2.8m lane)
- 3.5m to 4m footpaths



Key considerations for this project:

- Side streets and laneways provide alternative property access
- No on-street parking provided
- Wide footpaths provided on both sides
- 19.0m cross-section

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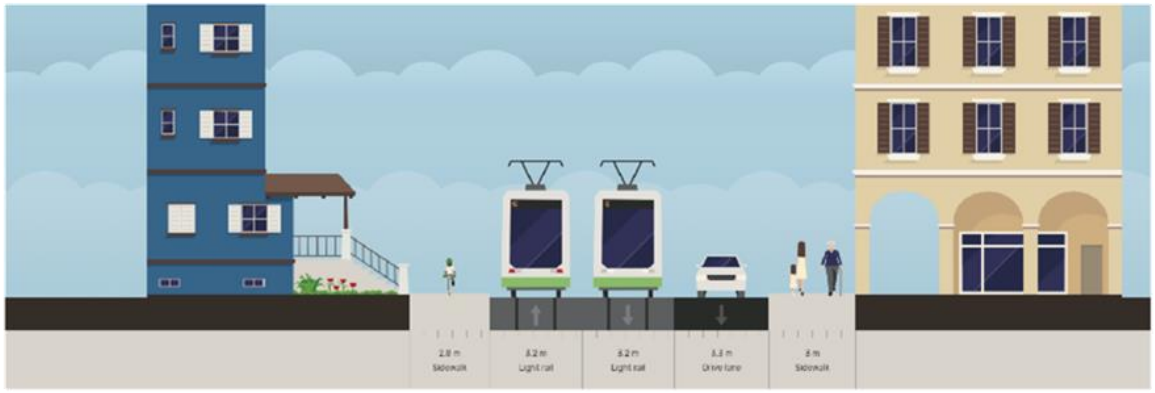
C.2 Typical running sections - CSELR

CBD South East Light Rail – Devonshire St between Crown St and Elizabeth St

- Residential (pink), Mixed Use (Grey), Local Centre (Cyan) and Recreational (Green) zoning along the frontages
- Multiple side streets, shared zones and laneways connecting with Devonshire St that provide vehicular accesses to surrounding developments – no right turns permitted
- Limited number of property driveways
- Sections without stop
  - Overall 15.5m cross-section
  - ~10m kerb-to kerb
  - Two light rail tracks (no LR stops) (~6.4m)
  - 1 eastbound traffic lane (3.2 to 3.6m lane)
  - 2.2m to 3.0m footpaths

Key considerations for this project:

- Side streets and laneways provide alternative property access
- One directional traffic lane
- Footpaths provided on both sides
- 15.5m cross section



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C.3 Typical running sections - CSELR

CBD South East Light Rail – Devonshire St between Crown St and Elizabeth St

- Residential (pink), Mixed Use (Grey), Local Centre (Cyan) and Recreational (Green) zoning along the frontages
- Section with stop
  - Overall 21m cross-section
  - ~16m kerb-to kerb (including stops)
  - Two light rail tracks (~6.4m)
  - 1 eastbound traffic lane (3.2m lane)
  - Two LR stops (~2.3m each) with 1m buffer between traffic land and the eastbound stop
  - 2.5m to 3.5m footpaths

Key considerations for this project:

- Stop placed adjacent to park and shares footpath provision within park
- Crossing facilities provided near stop
- 2.2m side platforms (less than 3.1m adopted for PLR)
- 21.0m cross section

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C.4 Typical running sections - PLR

Parramatta Light Rail – Hawkesbury Road near Children's Hospital

- Health services facilities (yellow) and residential (red)
- Section with stop
  - Overall 28m cross-section
  - ~21m kerb-to kerb (including stops and bus lane)
  - ~18m kerb-to kerb (including stops)
  - Two light rail tracks (~6.4m)
  - 2 traffic lane (3.5m lane)
  - 2.5m to 3.5m footpaths

Key considerations for this project:

- 4.5m island platform
- Footpaths provided on both sides
- No parking provided (except bus stop)
- Crossing facilities provided near stop
- 25.0m cross section (excluding bus lane)

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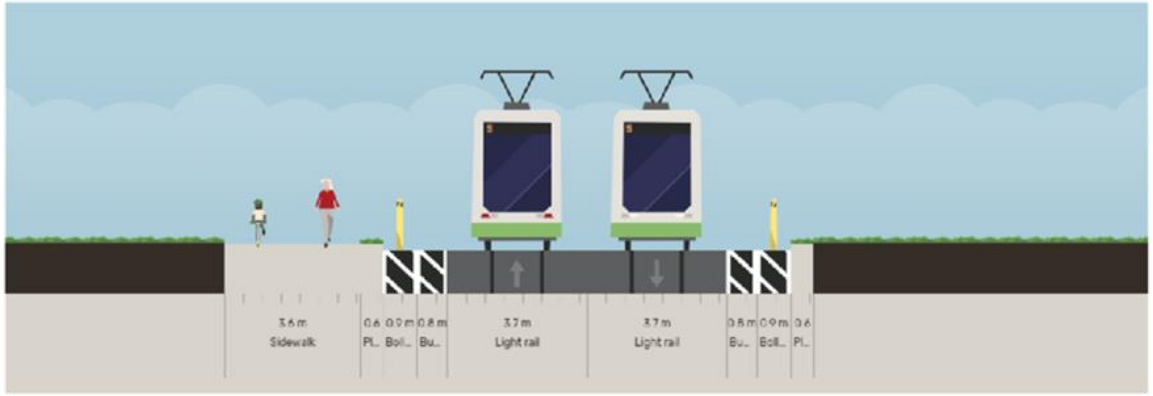
C.5 Typical running sections - PLR

Parramatta Light Rail – previous rail corridor

- Transition from single track to dual track
- Provision of active transport link parallel to corridor
- Overall 15.5m cross-section
- Cross section can be reduced:
  - Landscaped area
  - Running track (3.7 to 3.2m)



Key considerations for this project:

- Single section of running track
- 3.6-5.0m shared path

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C.6 Current corridor width

Width available between property boundaries (m)

<10 13 15 18 20

Implications:

- Retain two-way traffic flow in most locations. One-way road pairs would require vehicles to turn across tracks to access properties.
- Limited opportunity to provide property access from lanes or other streets. In end blocks could be rezoned to allow side or rear access for higher density or mixed land-uses.
- All on-street parking will be removed – significant impacts to on-street parking demand surrounding street network.
- One-way light rail loop network could be investigated, though may result in a poor customer outcome and increased cost.
- Limited locations available to accommodate stops (i.e. 25m width), may require:
  - Property acquisition
  - Consolidation with the nearby public land (i.e. park)
  - One-way traffic section for length of stop.
- Can not accommodate a 3rd track terminus

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C.7 Grades

Key considerations for this project:

- Alignment with grades of less than 7% (maximum allowable based on typical power) is possible

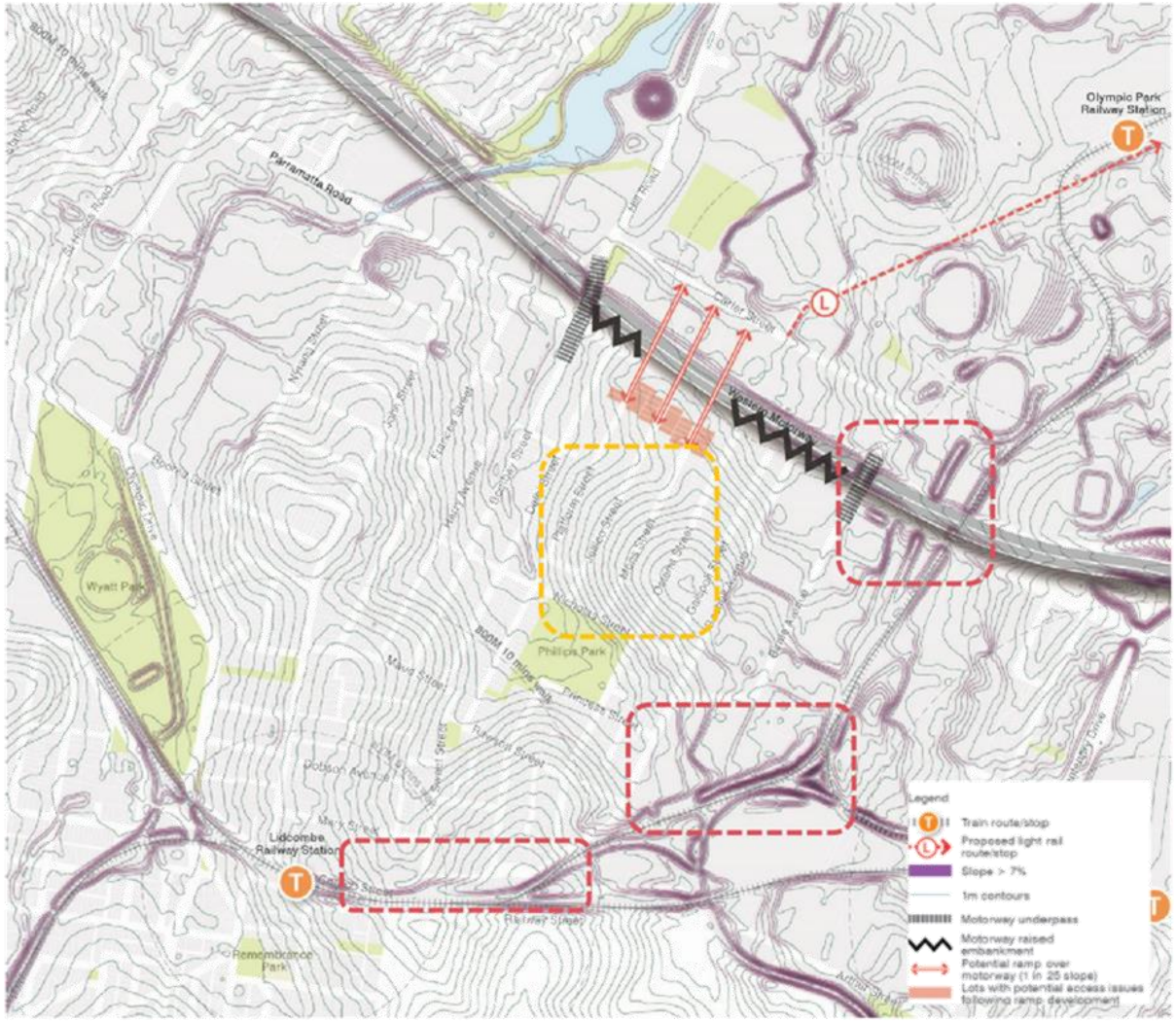
The site between Carter Street and Lidcombe station is relatively flat for with approximate grades of:

- 2.5% along John St (1 in 40)
- 6% along Jellicoe St above Phillip Park (1 in 17)

Grades through much of the area would not pose a specific barrier to light rail.

Some isolated sections of the site appear to be at a grade steeper than the maximum 7% (1 in 14) including:

- Church Street near the station
- Adjacent to rail corridor (Pippita Rail Trail)
- M4 Motorway
- Drainage channels.



PLR: Potential extension from Sydney Olympic Park to Lidcombe – Preliminary feasibility study

C.8 Grades – M4 crossing

Potential location for a grade separated crossing Parramatta Road/M4 is best limited to areas where the M4 is at grade:

- Mons Road
- Jellicoe Street
- Platform Street

A grade separated crossing of the M4 would require approximately 140m of ramping on either side (to achieve a 5m clearance at 1 in 25). This would impact multiple properties and street access south of the M4 Motorway.

Key considerations for this project:

- Crossing locations limited
- Crossing would require 140m of ramps on either side of the M4 Motorway
- Provision of crossing would have property access implications

SCT Consulting architectus™ KPMG ACE

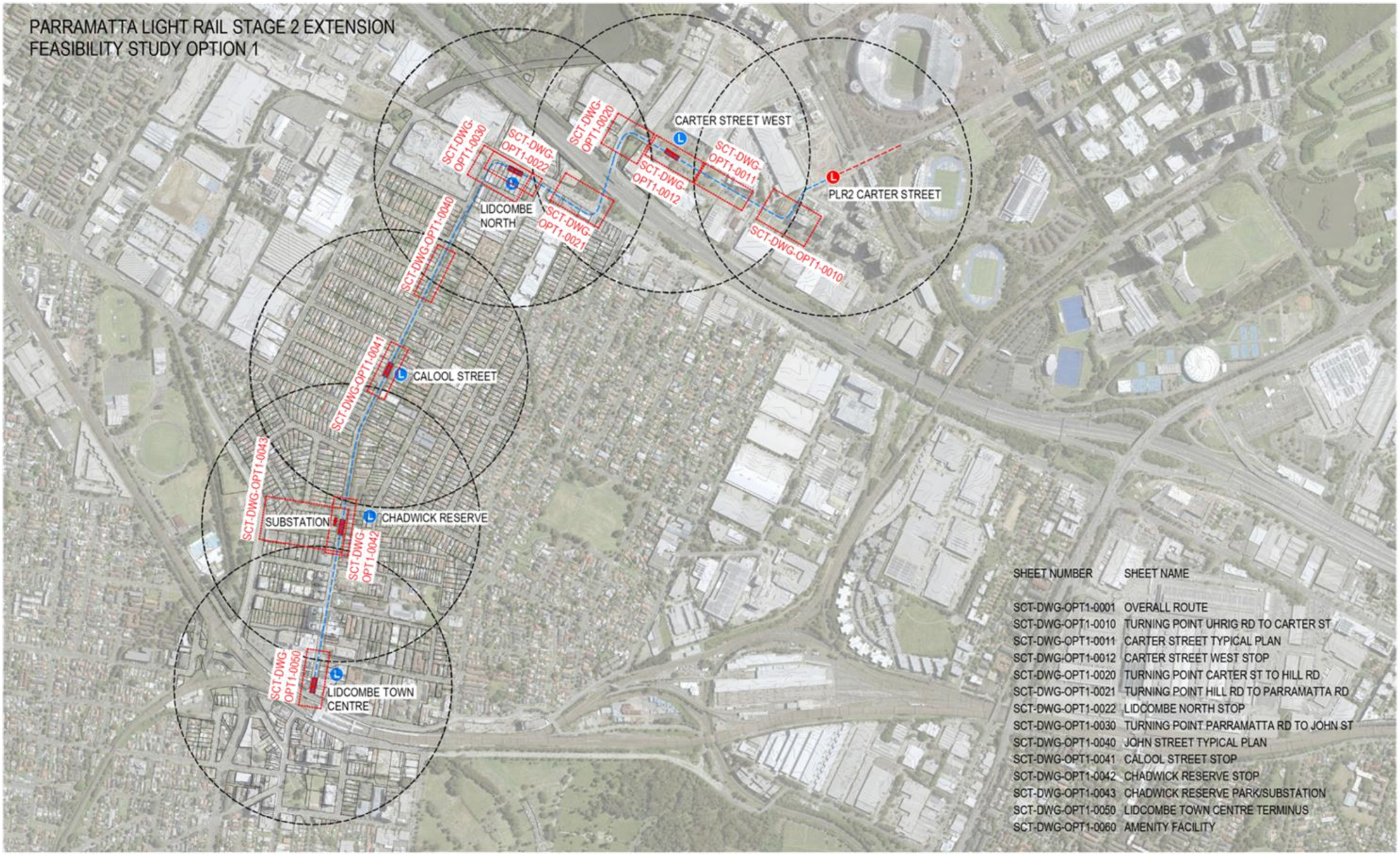
PLR: Potential extension from Sydney Olympic Park to Lidcombe – Preliminary feasibility study

SCT Consulting

[Appendix D]

Option 1 design pack

PARRAMATTA LIGHT RAIL STAGE 2 EXTENSION
FEASIBILITY STUDY OPTION 1



SHEET NUMBER	SHEET NAME
SCT-DWG-OPT1-0001	OVERALL ROUTE
SCT-DWG-OPT1-0010	TURNING POINT UHRIG RD TO CARTER ST
SCT-DWG-OPT1-0011	CARTER STREET TYPICAL PLAN
SCT-DWG-OPT1-0012	CARTER STREET WEST STOP
SCT-DWG-OPT1-0020	TURNING POINT CARTER ST TO HILL RD
SCT-DWG-OPT1-0021	TURNING POINT HILL RD TO PARRAMATTA RD
SCT-DWG-OPT1-0022	LIDCOMBE NORTH STOP
SCT-DWG-OPT1-0030	TURNING POINT PARRAMATTA RD TO JOHN ST
SCT-DWG-OPT1-0040	JOHN STREET TYPICAL PLAN
SCT-DWG-OPT1-0041	CALOOL STREET STOP
SCT-DWG-OPT1-0042	CHADWICK RESERVE STOP
SCT-DWG-OPT1-0043	CHADWICK RESERVE PARK/SUBSTATION
SCT-DWG-OPT1-0050	LIDCOMBE TOWN CENTRE TERMINUS
SCT-DWG-OPT1-0060	AMENITY FACILITY

FEASIBILITY DESIGN

NOTE: DIMENSIONS PROVIDED ARE INDICATIVE ONLY. EXISTING CONTEXT INFORMATION TO BE CONFIRMED AND VERIFIED
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Parramatta Light Rail 2 Extension

Drawing: **OVERALL ROUTE**
Drawing no: A.SCT-DWG-OPT1-0001
Issue:
Scale@A1: 1 : 5000
Date:

0 50 100 150 200 250 500 m
Do not scale drawings. Verify all dimensions on site

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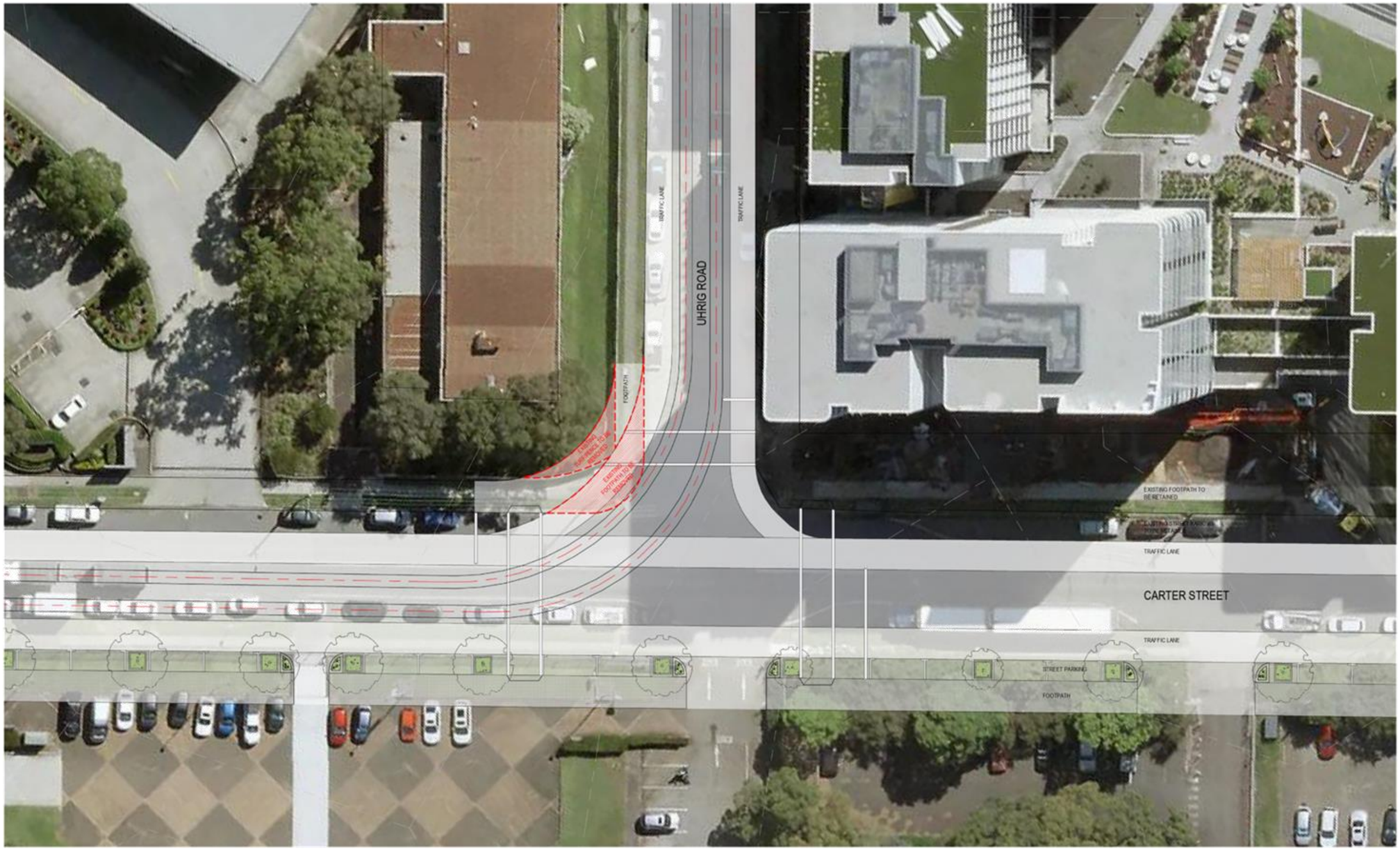
Document Set ID: 9607647



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Parramatta Light Rail 2 Extension

Drawing: **TURNING POINT UHRIG RD TO CARTER ST**
Drawing no: A.SCT-DWG-OPT1-0010
Issue:
Scale @A1: 1 : 200
Date:

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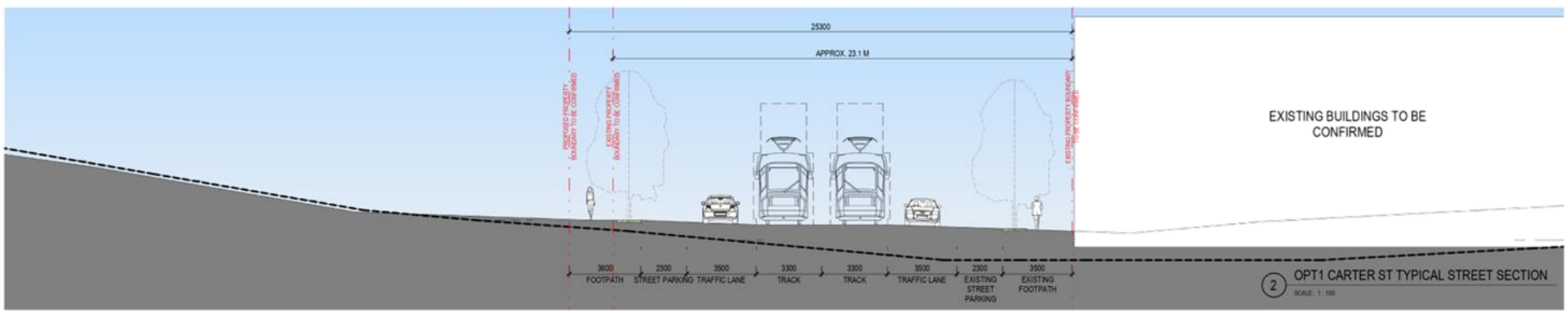
Document Set ID: 9607947



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Parramatta Light Rail 2 Extension

Drawing: **CARTER STREET TYPICAL PLAN**
Drawing no: A.SCT-DWG-OPT1-0011
Issue:
Scale@A1: As indicated
Date:

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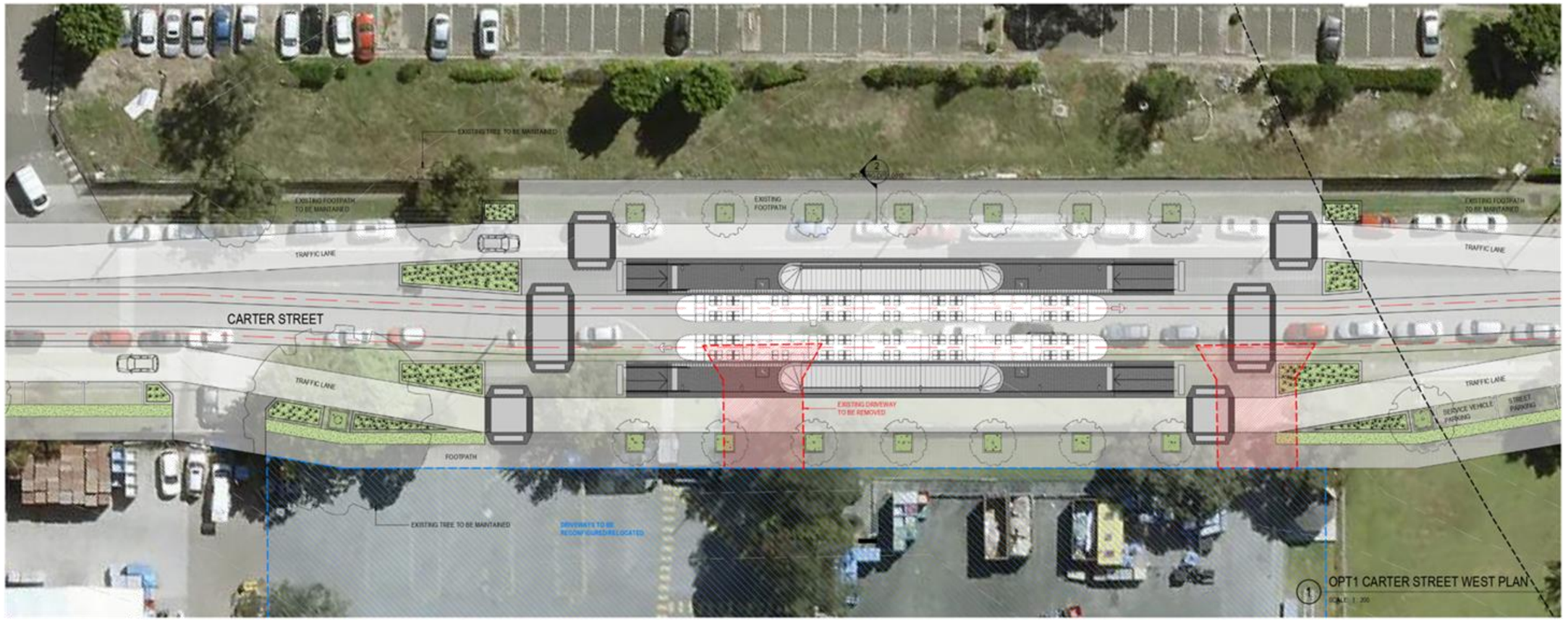

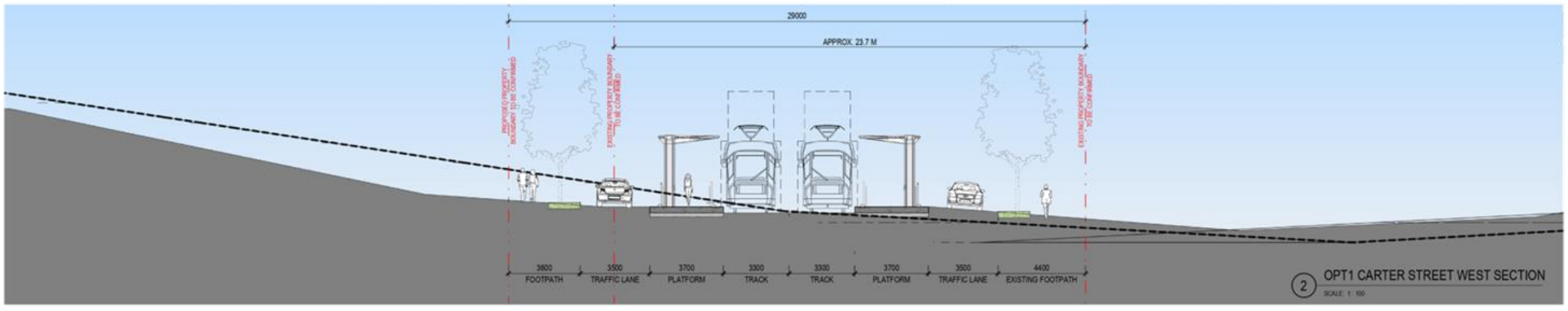

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Parramatta Light Rail 2 Extension

Drawing: **CARTER STREET WEST STOP**
Drawing no: A.SCT-DWG-OPT1-0012
Issue:
Scale @A1: As indicated
Date:

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Parramatta Light Rail 2 Extension

Drawing: **TURNING POINT CARTER ST TO HILL RD**
Drawing no: A.SCT-DWG-OPT1-0020
Issue:
Scale @A1: 1 : 200
Date:

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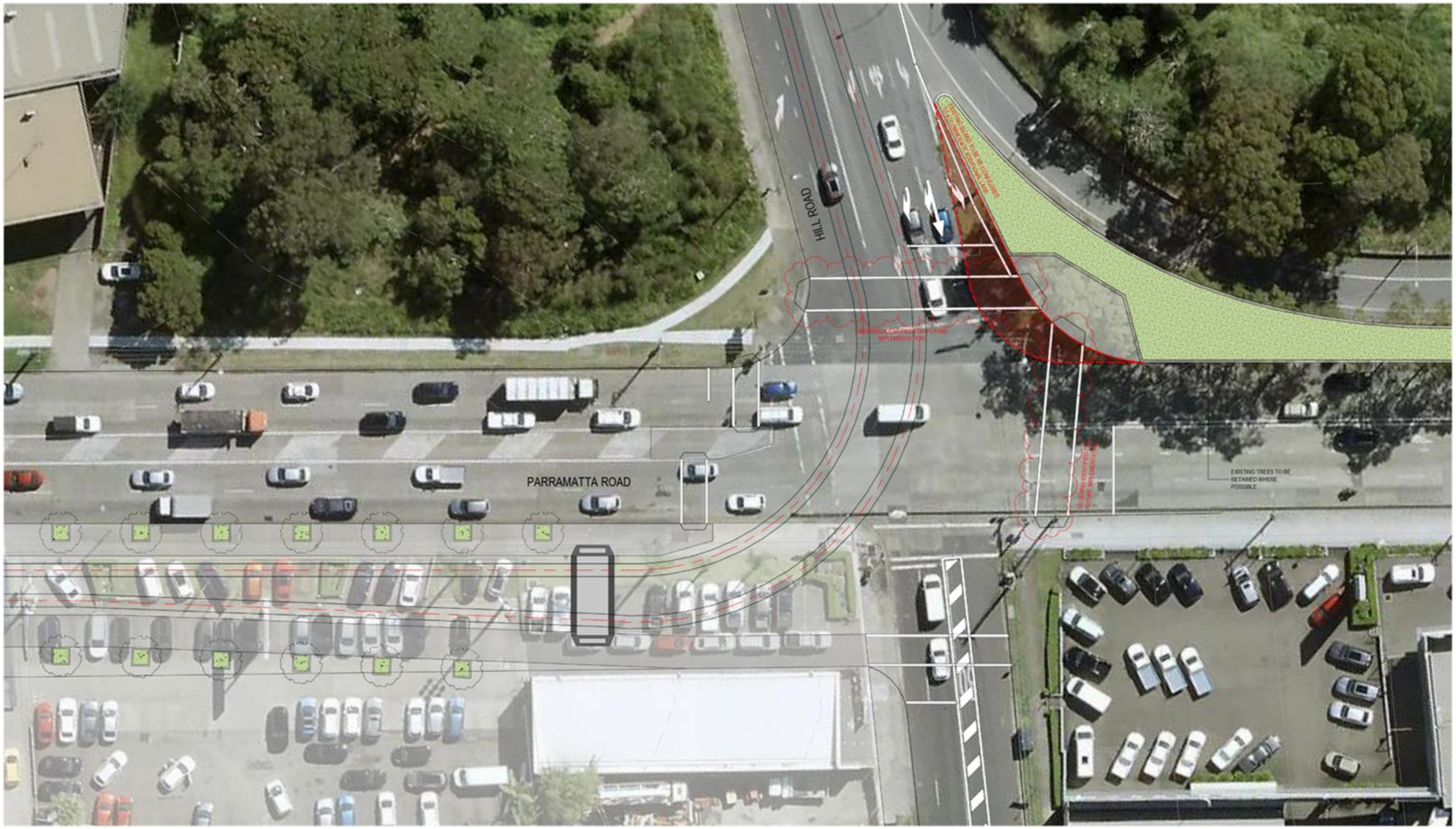

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Parramatta Light Rail 2 Extension

Drawing: **TURNING POINT HILL RD TO PARRAMATTA RD**
Drawing no: A.SCT-DWG-OPT1-0021
Issue: 1
Scale @A1: 1 : 200
Date:

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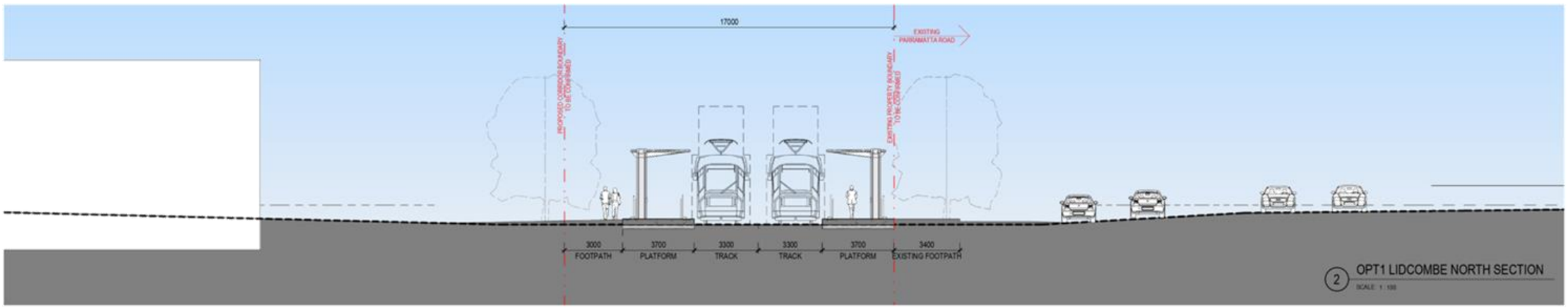

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Parramatta Light Rail 2 Extension

Drawing: **LIDCOMBE NORTH STOP**
Drawing no: A.SCT-DWG-OPT1-0022
Issue:
Scale @A1: As indicated
Date:

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Parramatta Light Rail 2 Extension

Drawing: **TURNING POINT PARRAMATTA RD TO JOHN ST**
Drawing no: A.SCT-DWG-OPT1-0030
Issue:
Scale @A1: 1 : 200
Date:

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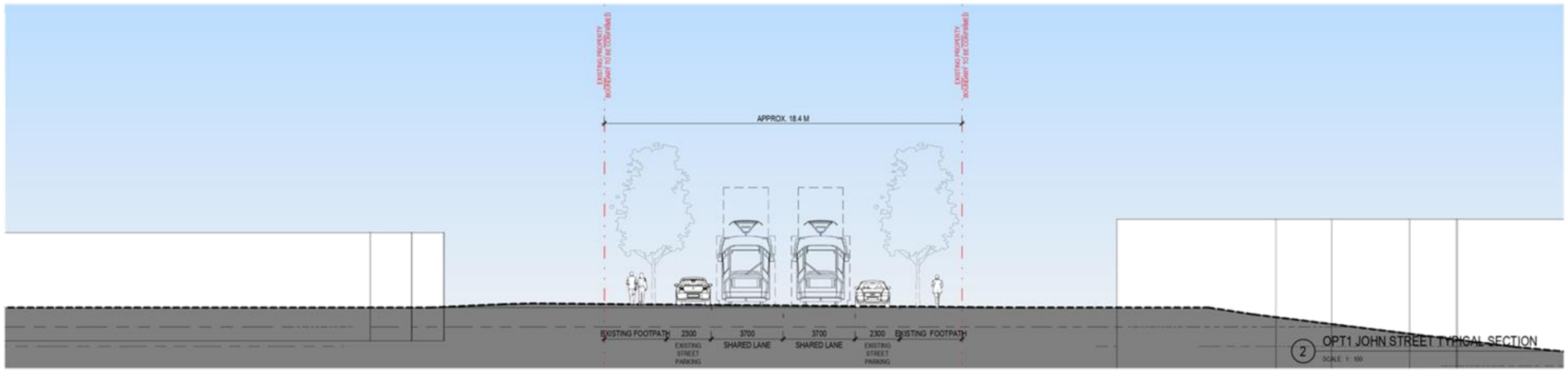

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Parramatta Light Rail 2 Extension

Drawing:	**JOHN STREET TYPICAL PLAN**
Drawing no:	A.SCT-DWG-OPT1-0040
Issue:	
Scale @A1:	As indicated
Date:	

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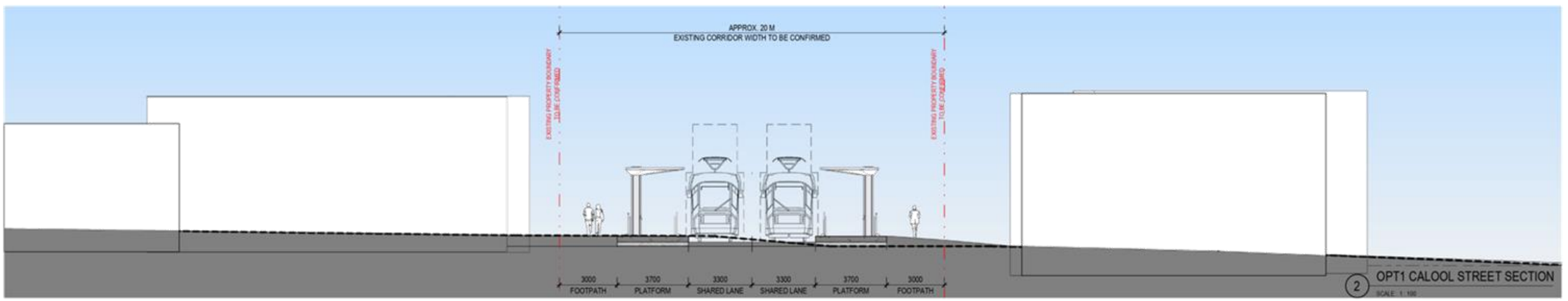

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Parramatta Light Rail 2 Extension

Drawing: **CALOOL STREET STOP**
Drawing no: A.SCT-DWG-OPT1-0041
Issue:
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Date:

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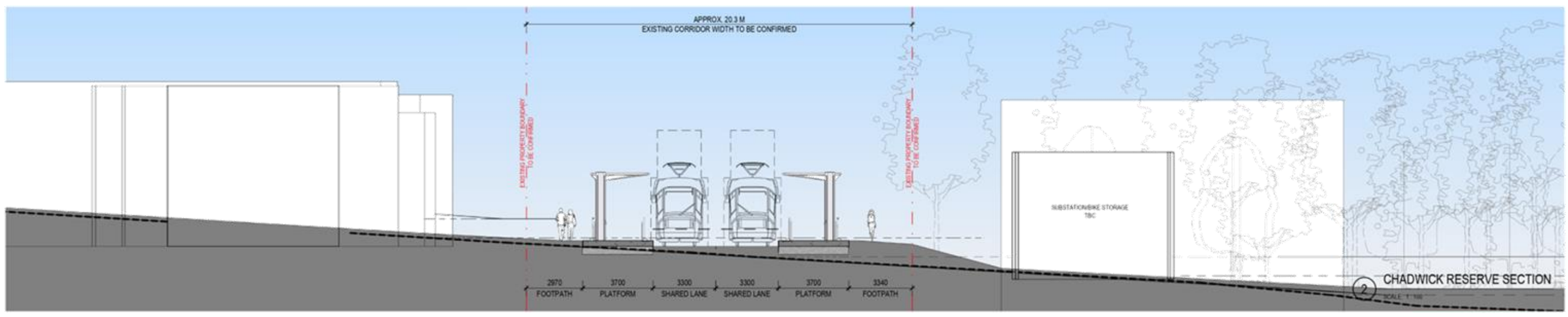

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Parramatta Light Rail 2 Extension

Drawing: **CHADWICK RESERVE STOP**
Drawing no: A.SCT-DWG-OPT1-0042
Issue:
Scale @A1: As indicated
Date:

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Parramatta Light Rail 2 Extension

Drawing: **CHADWICK RESERVE PARK/SUBSTATION**
Drawing no: A.SCT-DWG-OPT1-0043
Issue:
Scale @A1: 1 : 300
Date:

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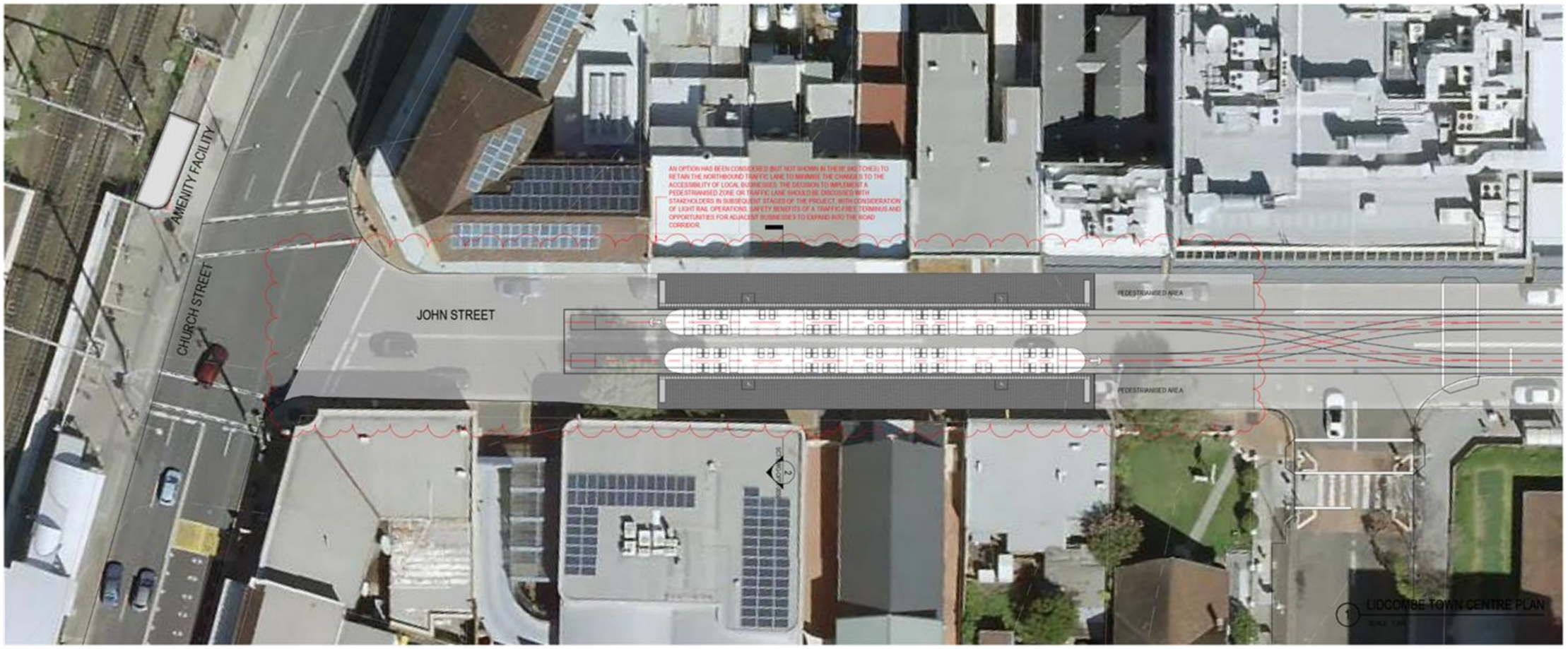

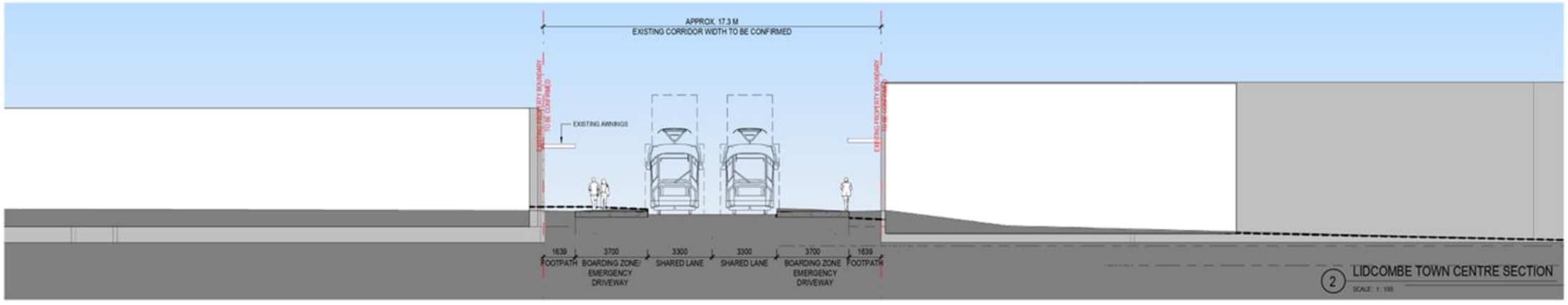

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Parramatta Light Rail 2 Extension

Drawing:	**LIDCOMBE TOWN CENTRE TERMINUS**
Drawing no:	A.SCT-DWG-OPT1-0050
Issue:	1
Scale @A1:	As indicated
Date:	

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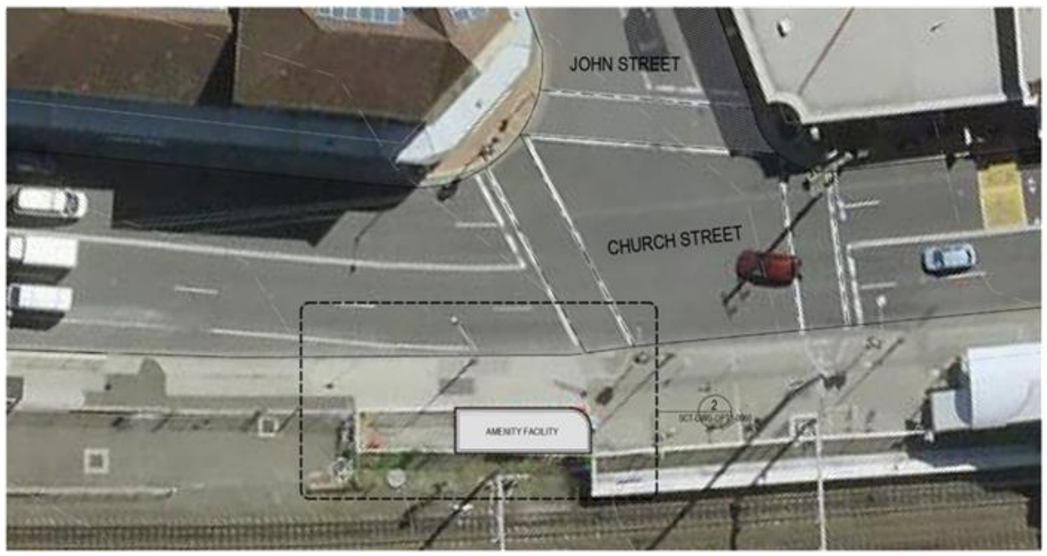
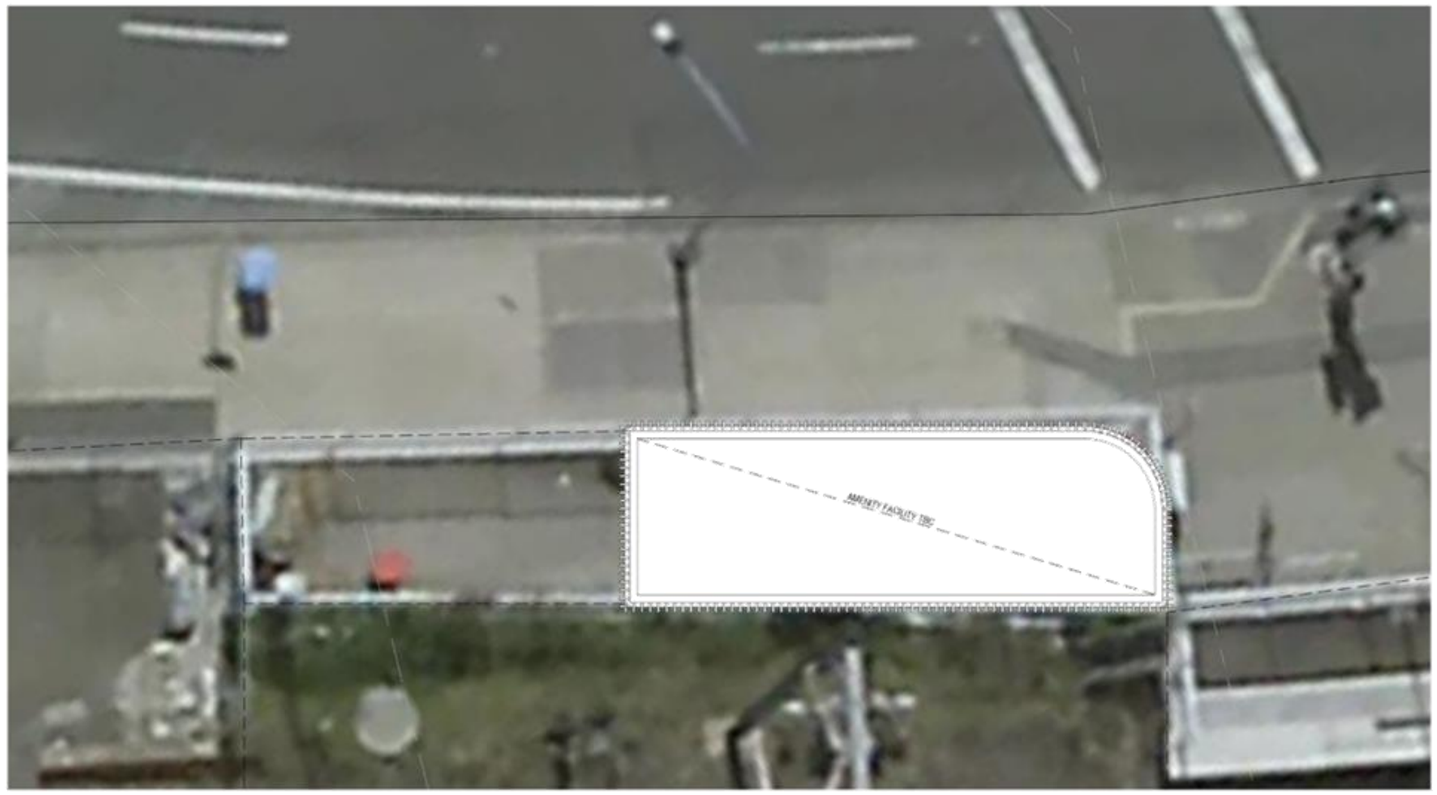


1 OPT1 AMENITY FACILITY
SCALE: 1 : 200



2 OPT1 AMENITY FACILITY - CALLOUT
SCALE: 1 : 50

FEASIBILITY DESIGN

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Parramatta Light Rail 2 Extension

Drawing: **AMENITY FACILITY**
Drawing no: A.SCT-DWG-OPT1-0060
Issue:
Scale @A1: As indicated
Date:

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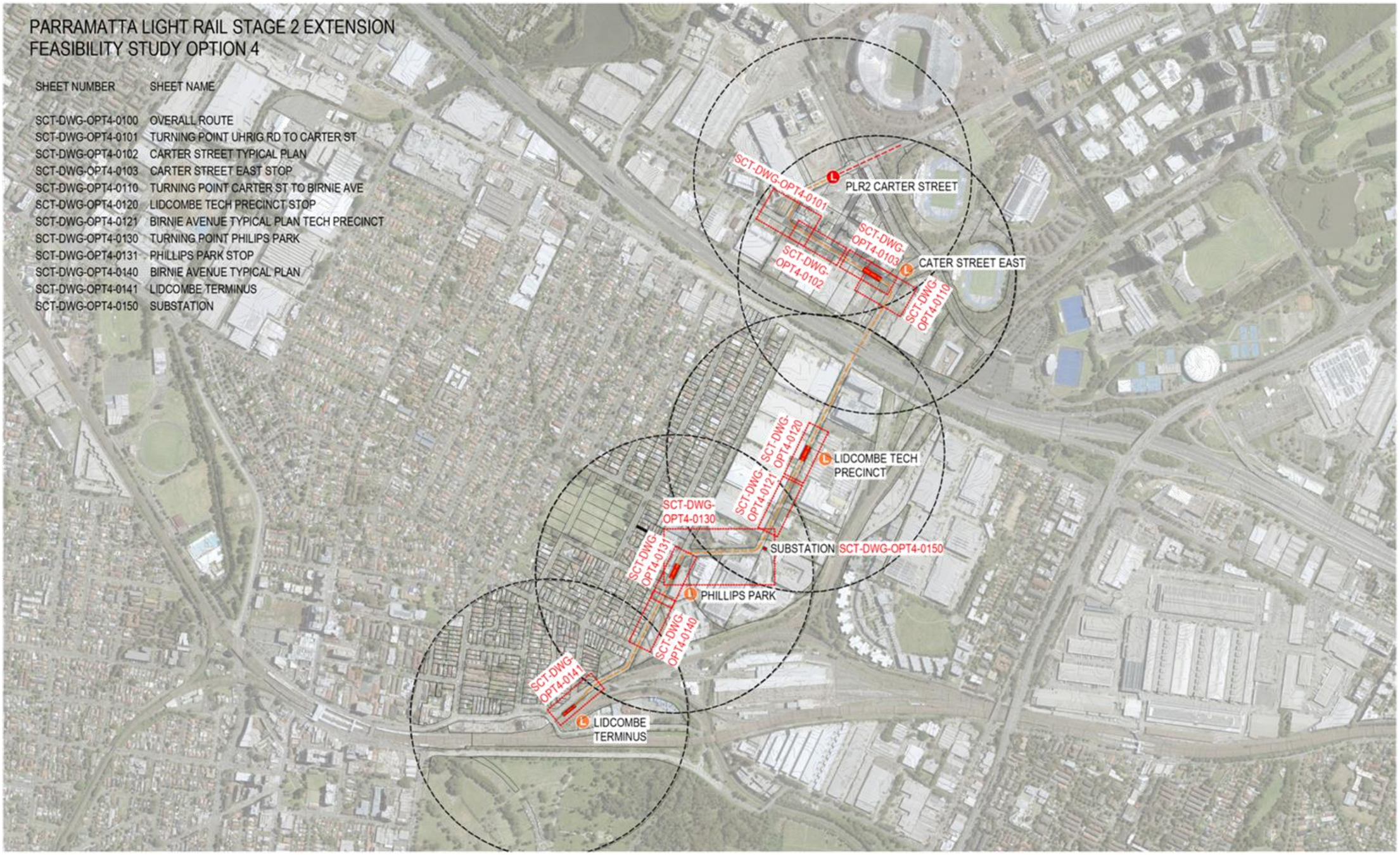
[Appendix E]

Option 4 design pack

PARRAMATTA LIGHT RAIL STAGE 2 EXTENSION
FEASIBILITY STUDY OPTION 4

SHEET NUMBER	SHEET NAME
SCT-DWG-OPT4-0100	OVERALL ROUTE
SCT-DWG-OPT4-0101	TURNING POINT UHRIG RD TO CARTER ST
SCT-DWG-OPT4-0102	CARTER STREET TYPICAL PLAN
SCT-DWG-OPT4-0103	CARTER STREET EAST STOP
SCT-DWG-OPT4-0110	TURNING POINT CARTER ST TO BIRNIE AVE
SCT-DWG-OPT4-0120	LIDCOMBE TECH PRECINCT STOP
SCT-DWG-OPT4-0121	BIRNIE AVENUE TYPICAL PLAN TECH PRECINCT
SCT-DWG-OPT4-0130	TURNING POINT PHILIPS PARK
SCT-DWG-OPT4-0131	PHILLIPS PARK STOP
SCT-DWG-OPT4-0140	BIRNIE AVENUE TYPICAL PLAN
SCT-DWG-OPT4-0141	LIDCOMBE TERMINUS
SCT-DWG-OPT4-0150	SUBSTATION



FEASIBILITY DESIGN

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Parramatta Light Rail 2 Extension

Drawing:	**OVERALL ROUTE**
Drawing no:	A.SCT-DWG-OPT4-0100
Issue:	
Scale @A1:	1 : 5000
Date:	

0 50 100 150 200 250 500 m
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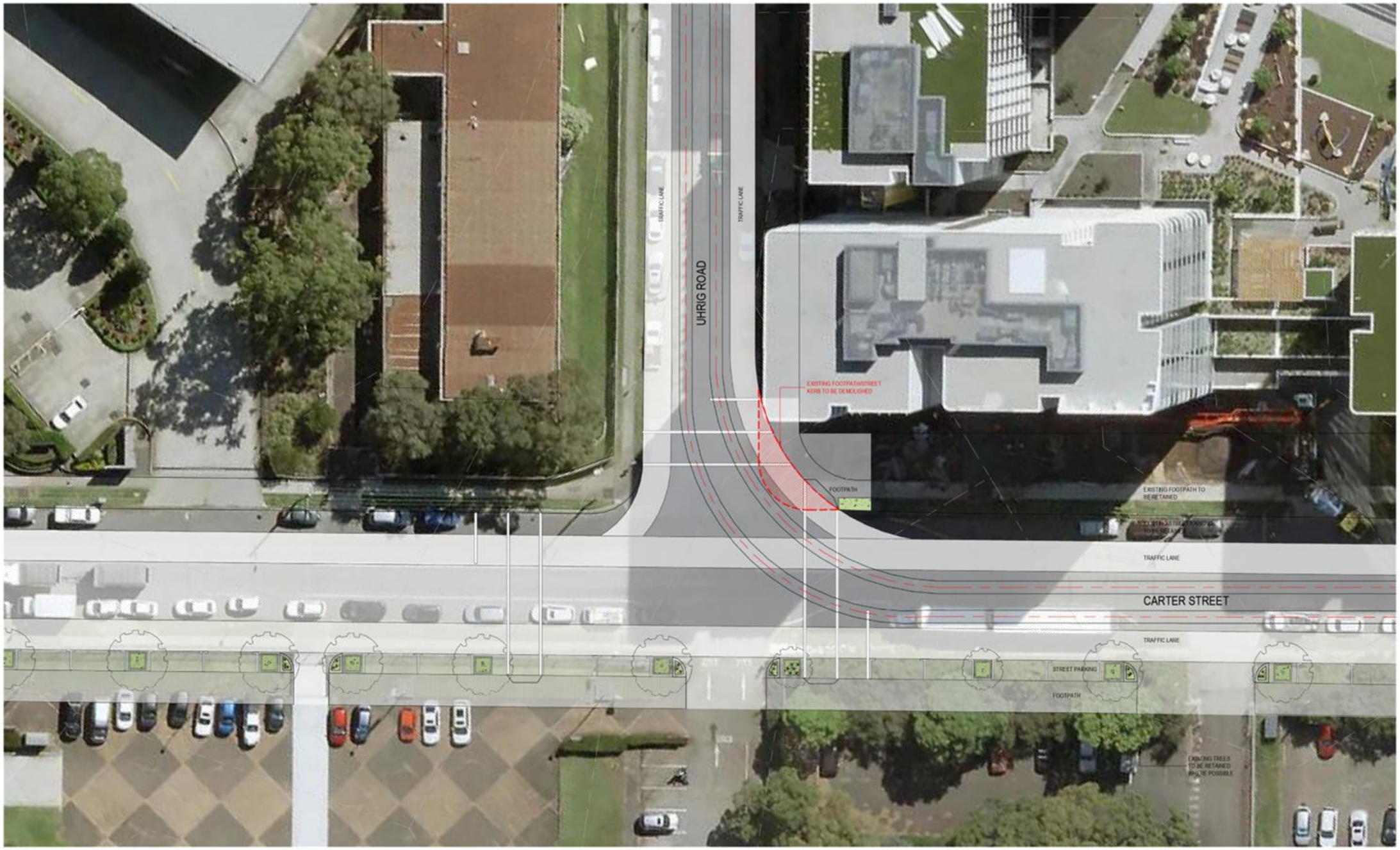

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Parramatta Light Rail 2 Extension

Drawing: **TURNING POINT UHRIG RD TO CARTER ST**
Drawing no: A.SCT-DWG-OPT4-0101
Issue:
Scale @A1: 1 : 200
Date:

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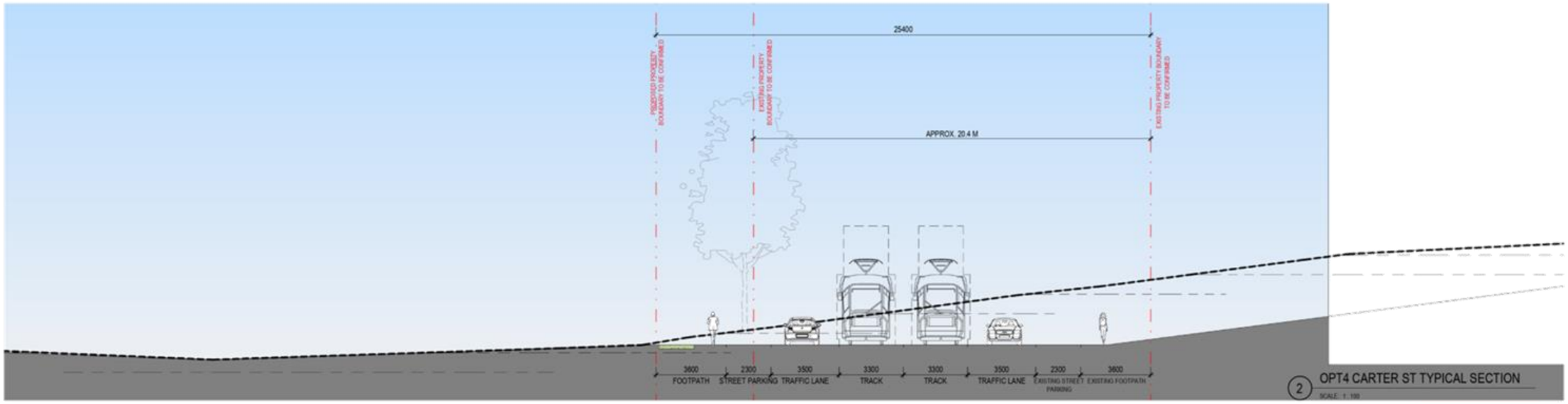

FEASIBILITY DESIGN

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BACKGROUND AERIAL IMAGES ARE INDICATIVE ONLY AND MAY NOT MATCH SURVEY / CADASTA FILE PROVIDED

Parramatta Light Rail 2 Extension

Drawing: **CARTER STREET TYPICAL PLAN**
Drawing no: A.SCT-DWG-OPT4-0102
Issue:
Scale @A1: As indicated
Date:

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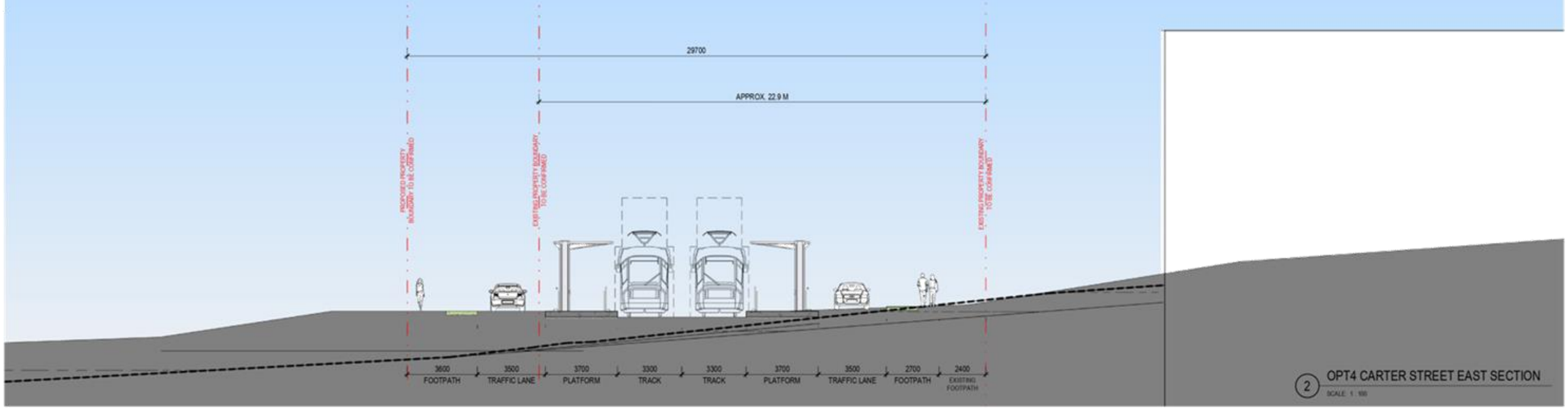

FEASIBILITY DESIGN

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Parramatta Light Rail 2 Extension

Drawing: **CARTER STREET EAST STOP**
Drawing no: A.SCT-DWG-OPT4-0103
Issue:
Scale @A1: As indicated
Date:

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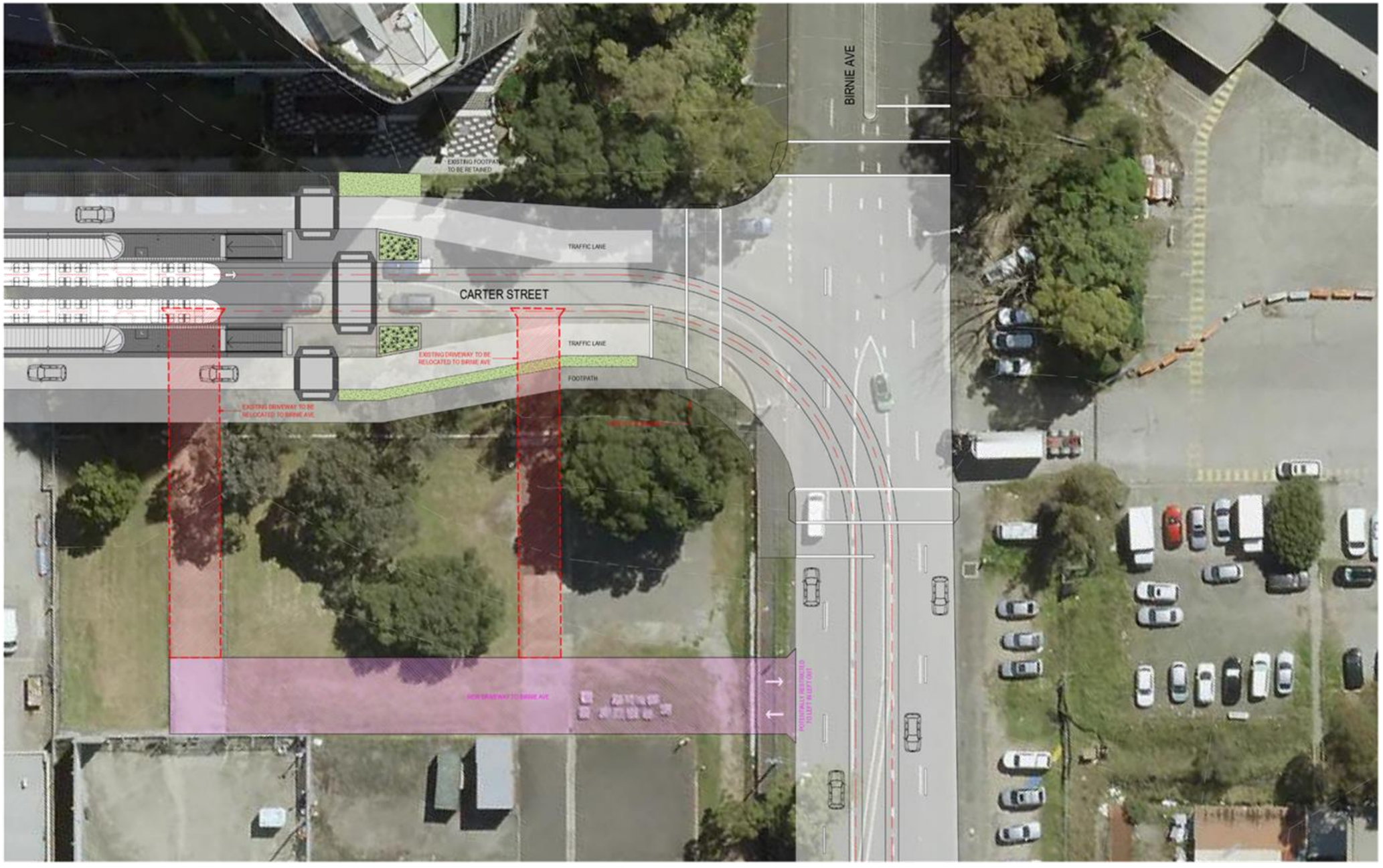

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Parramatta Light Rail 2 Extension

Drawing: **TURNING POINT CARTER ST TO BIRNIE AVE**
Drawing no: A.SCT-DWG-OPT4-0110
Issue:
Scale @A1: 1 : 200
Date:

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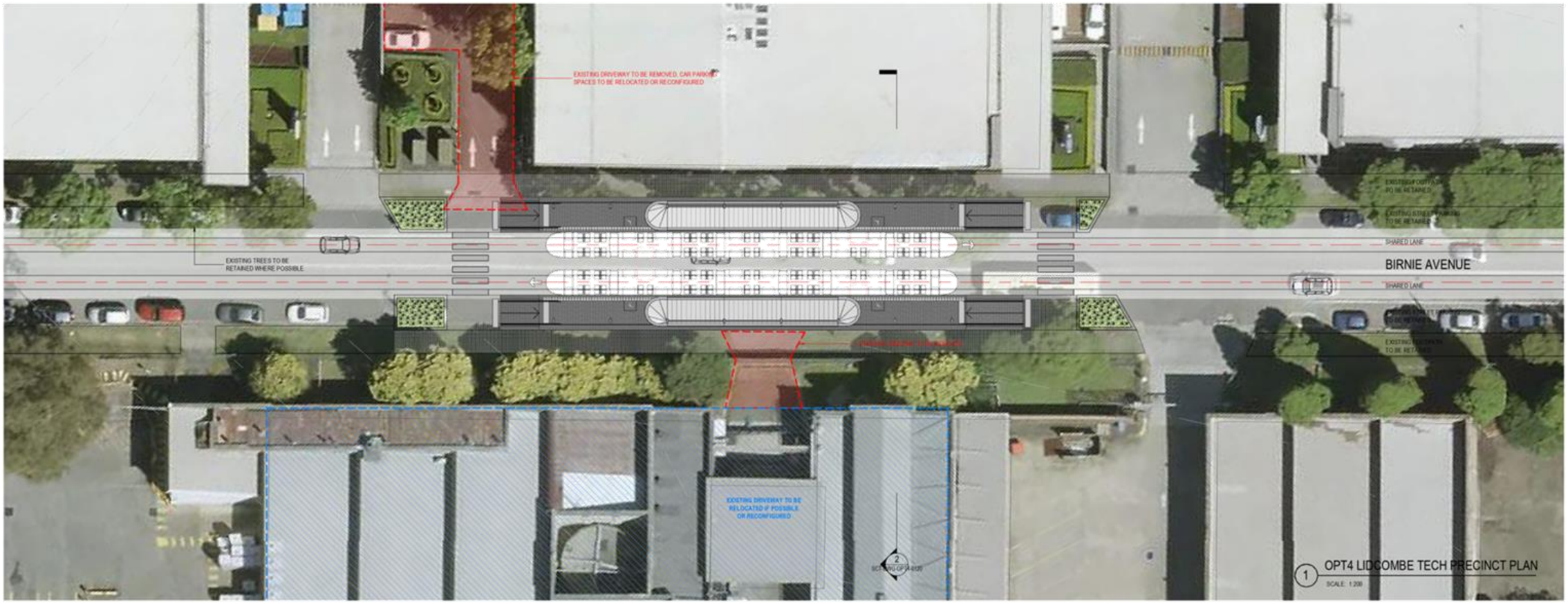

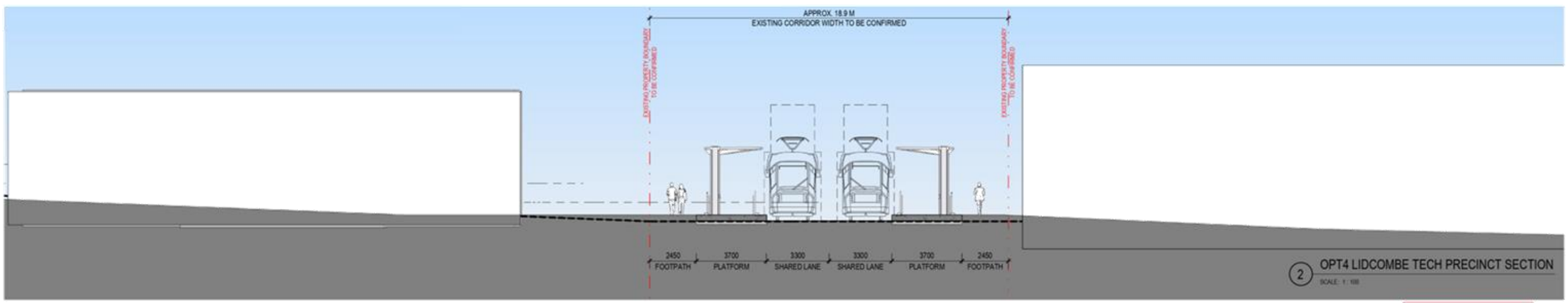

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Parramatta Light Rail 2 Extension

Drawing: **LIDCOMBE TECH PRECINCT STOP**
Drawing no: A.SCT-DWG-OPT4-0120
Issue:
Scale @A1: As indicated
Date:

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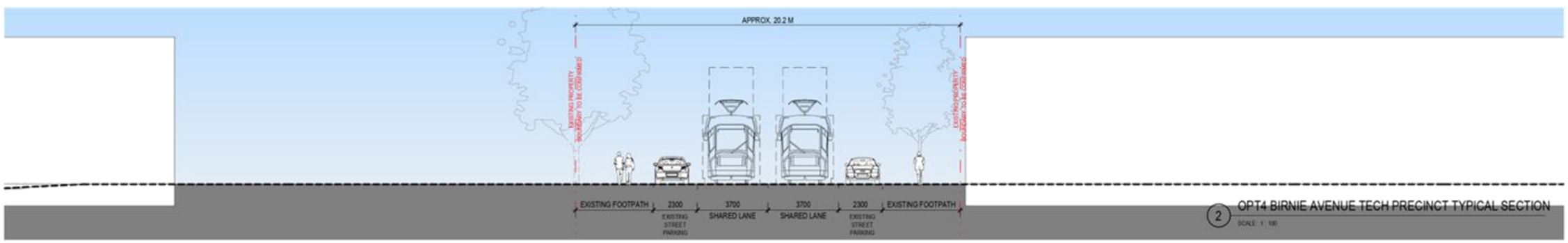
1 OPT4 BIRNIE AVENUE TECH PRECINCT TYPICAL PLAN
SCALE: 1:200



2 OPT4 BIRNIE AVENUE TECH PRECINCT TYPICAL SECTION
SCALE: 1:100

FEASIBILITY DESIGN

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Parramatta Light Rail 2 Extension

Drawing: **BIRNIE AVENUE TYPICAL PLAN TECH PRECINCT**
Drawing no: A.SCT-DWG-OPT4-0121
Issue:
Scale @A1: As indicated
Date:

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Document Set ID: 9607947

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Parramatta Light Rail 2 Extension

Drawing: **TURNING POINT PHILIPS PARK**
Drawing no: A.SCT-DWG-OPT4-0130
Issue:
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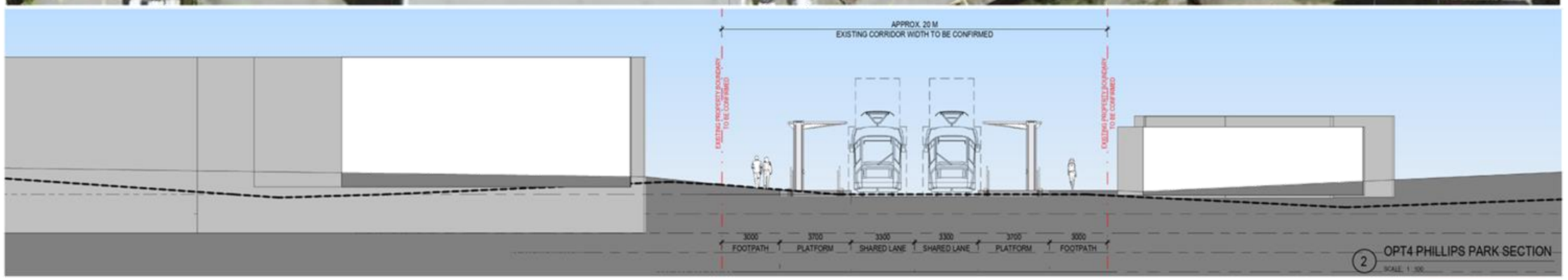

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Parramatta Light Rail 2 Extension

Drawing: **PHILLIPS PARK STOP**
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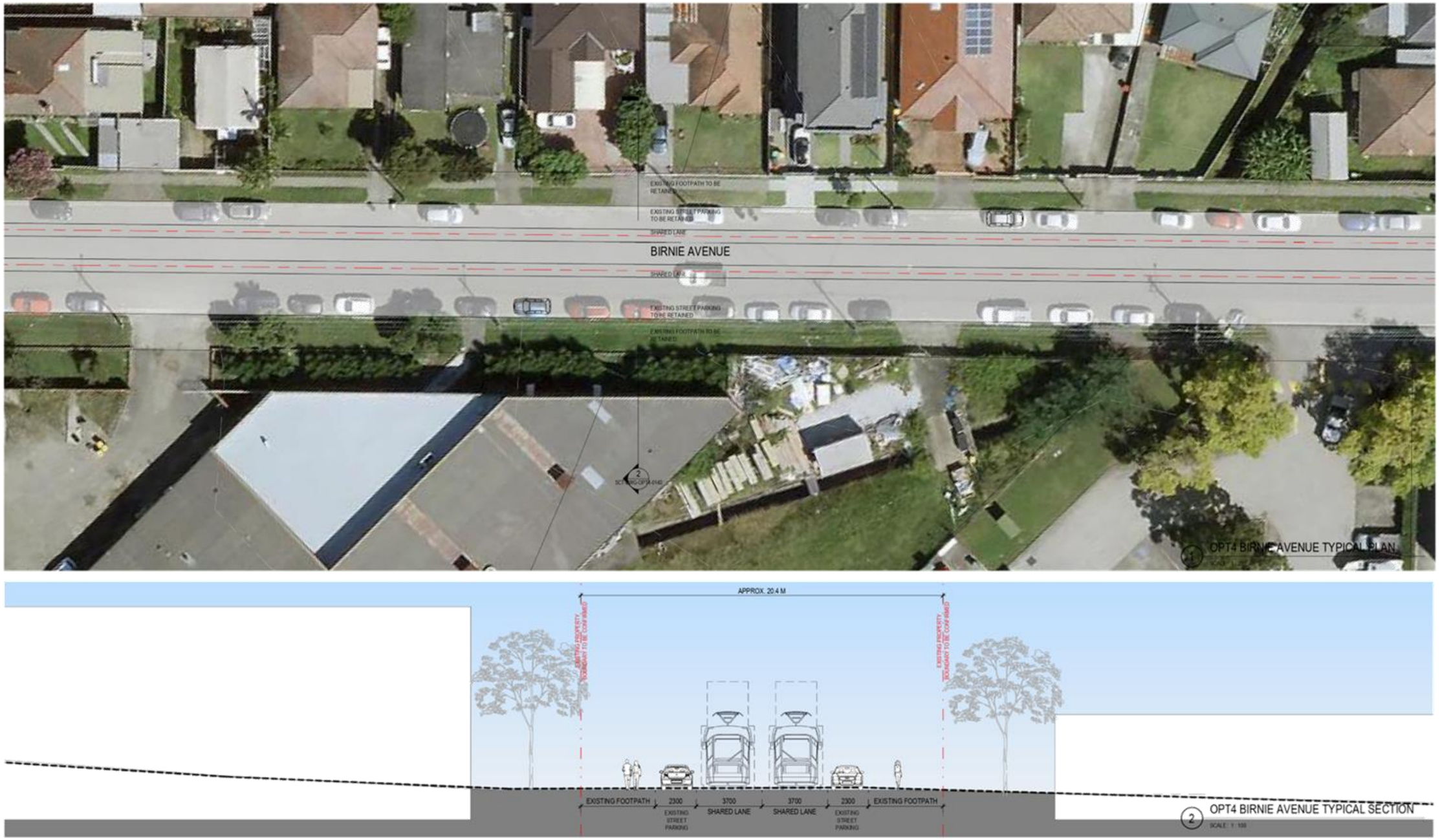

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Parramatta Light Rail 2 Extension

Drawing: **BIRNIE AVENUE TYPICAL PLAN**
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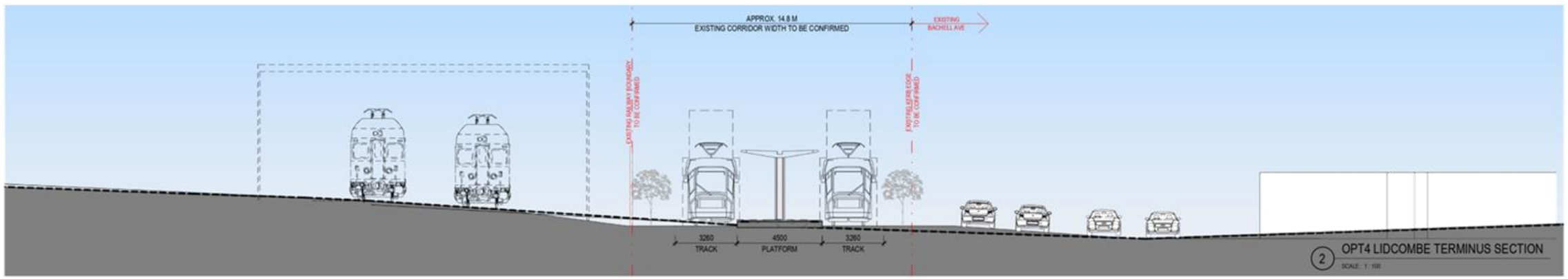

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Parramatta Light Rail 2 Extension

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Parramatta Light Rail 2 Extension

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[Appendix F]

Patronage methodology and outcomes

F.1 Potential customers

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F.2 Data and methodology

Customers	Data	Methodology
Existing T7 train customers	- Population and employment forecast - T7 patronage data	Based on distribution of employment and population within light rail and train catchment, estimate proportion of T7 daily trips that would switch to light rail trips
Existing M92 bus customers	- Bus tap on/off within relevant travel zones	Based on bus tap on/off data, identify daily bus trips within the study area that can be replaced by light rail
Existing 401 bus customers	- Bus tap on/off within relevant travel zones	Based on bus tap on/off data, identify daily bus trips within the study area that can be replaced by light rail
Existing walking customers to/from Lidcombe Station	- Lidcombe Station tap on/off data - % customers that walk to Lidcombe Station	Based on distribution of employment and population within light rail and train catchment, estimate proportion of daily walking linked trips that would switch to light rail trips
Existing Kiss-and-ride& Park-and-ride customers to/from Lidcombe Station	- Lidcombe Station tap on/off data - % customers that drive to Lidcombe Station	Based on distribution of employment and population within light rail and train catchment, estimate proportion of daily driving linked trips that would switch to light rail trips
Future customers from employment & population growth within light rail catchments	- Population and employment forecast - Indicative uplift in population along light rail corridor	Based on the growth in employment and residential population, and assumed future mode share, estimate the number of generated light rail trips, then multiply by 2 to get number of future daily trips (assuming customers would adopt the same mode to/from work)
Future customers on PLR2 alignment transferring at Lidcombe Station	- Population and employment forecast	Based on the growth in employment and residential population, and assumed future mode share, estimate the number of generated light rail trips, then multiply by 2 to get number of future daily trips (assuming customers would adopt the same mode to/from work)
Future T7 customers	- Population and employment forecast	Based on the growth in employment and residential population, and assumed future mode share, estimate the number of generated light rail trips, then multiply by 2 to get number of future daily trips (assuming customers would adopt the same mode to/from work)
Future shopping trips	- Household Travel Survey mode share by trip purpose	Based on the number of future commute trips, apply shopping trip factor to estimate future daily light rail trips for shopping purposes
Future recreational trips	- Household Travel Survey mode share by trip purpose	Based on the number of future commute trips, apply shopping trip factor to estimate future daily light rail trips for recreational purposes

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F.3 Existing train (T7) customers

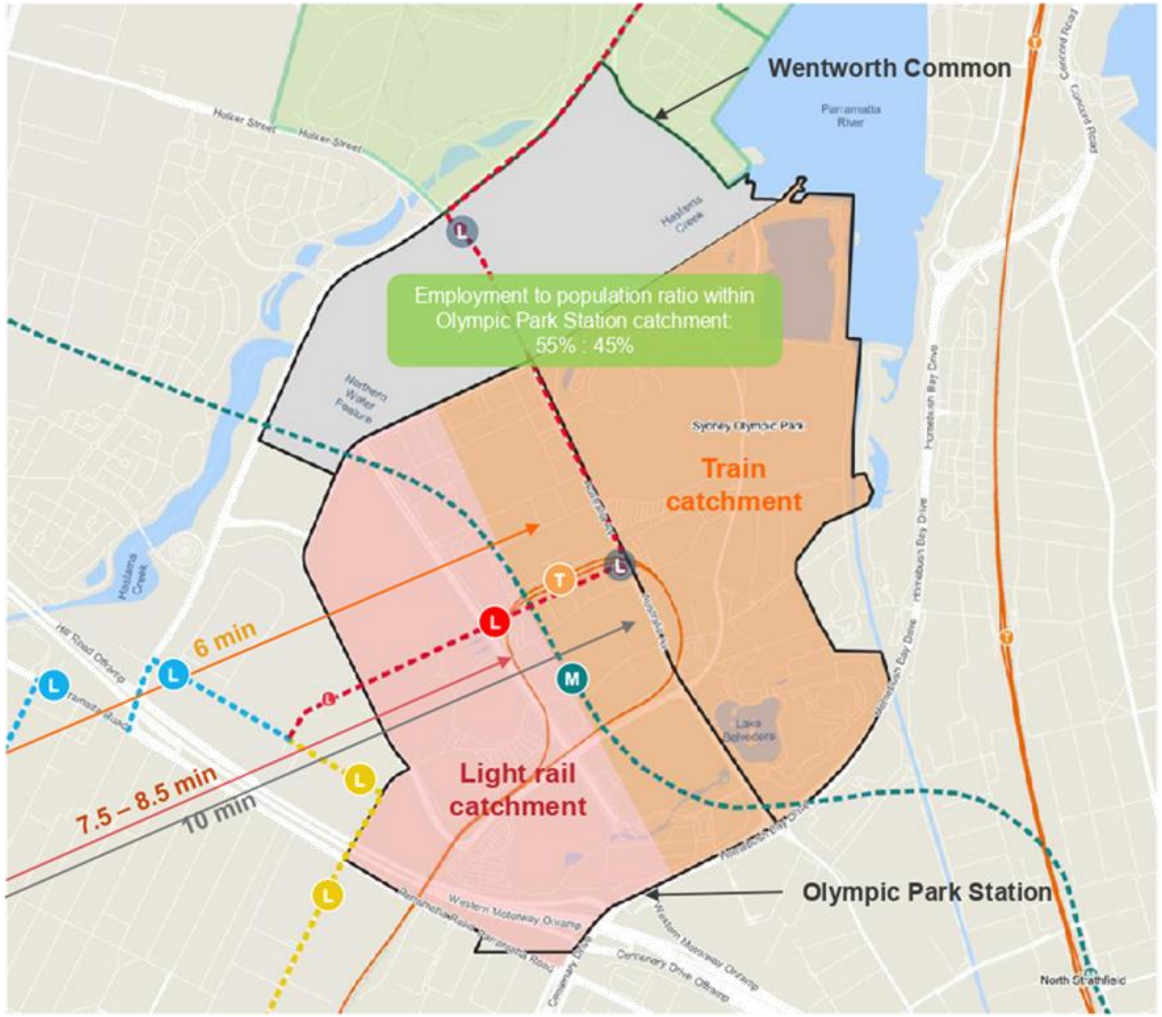
- Assume existing T7 customers will continue to transfer at Lidcombe Station in the future
- The Olympic Park station catchment may be separated into two Travel Zones (TZs)

Mode	Stop	Travel time	Convenience
T	Olympic Park	6 min	Longer ingress/egress time, **similar to light rail**
L	Olympic Boulevard	8 - 8.5 min	Longer train/light rail transfer time, **similar to train**
L	Jacaranda Square	9.6 min	Much longer than train travel time
L	Holker Street	12.5 min	Lack of employment and residence

- It is assumed that users would choose the mode that **minimises walking** unless travel time is disproportionately longer

Direction	Train customers	% switching	Light rail customers
Up	2,350	53% workers 47% residents	1,150
Down	2,350		1,150

Daily light rail trips from existing train customers: ~+2,300



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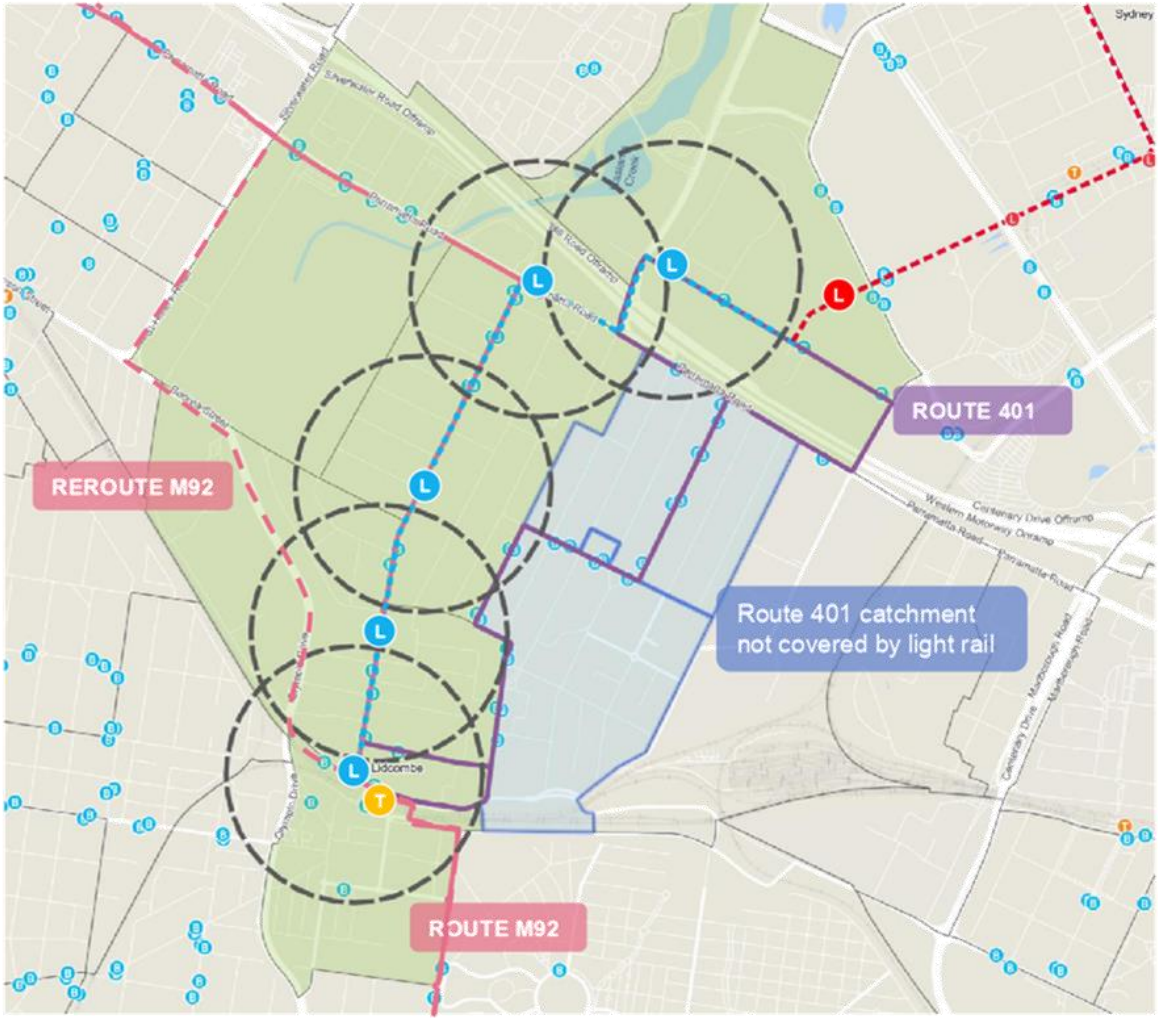
F.4 Existing bus customers – Option 1

- Existing Route M92 passengers that board / alight within the study can be serviced by light rail
- Proposed reroute of M92 may still service customers with origins / destinations beyond study area
- Customers at the northern end of Route 401 catchment may switch to light rail to access Lidcombe station.



Route	Bus customers	% switching	Light rail customers
M92	~950	100%	~950
401	~250	20%	~50

Daily light rail trips from existing bus customers: ~+1,000

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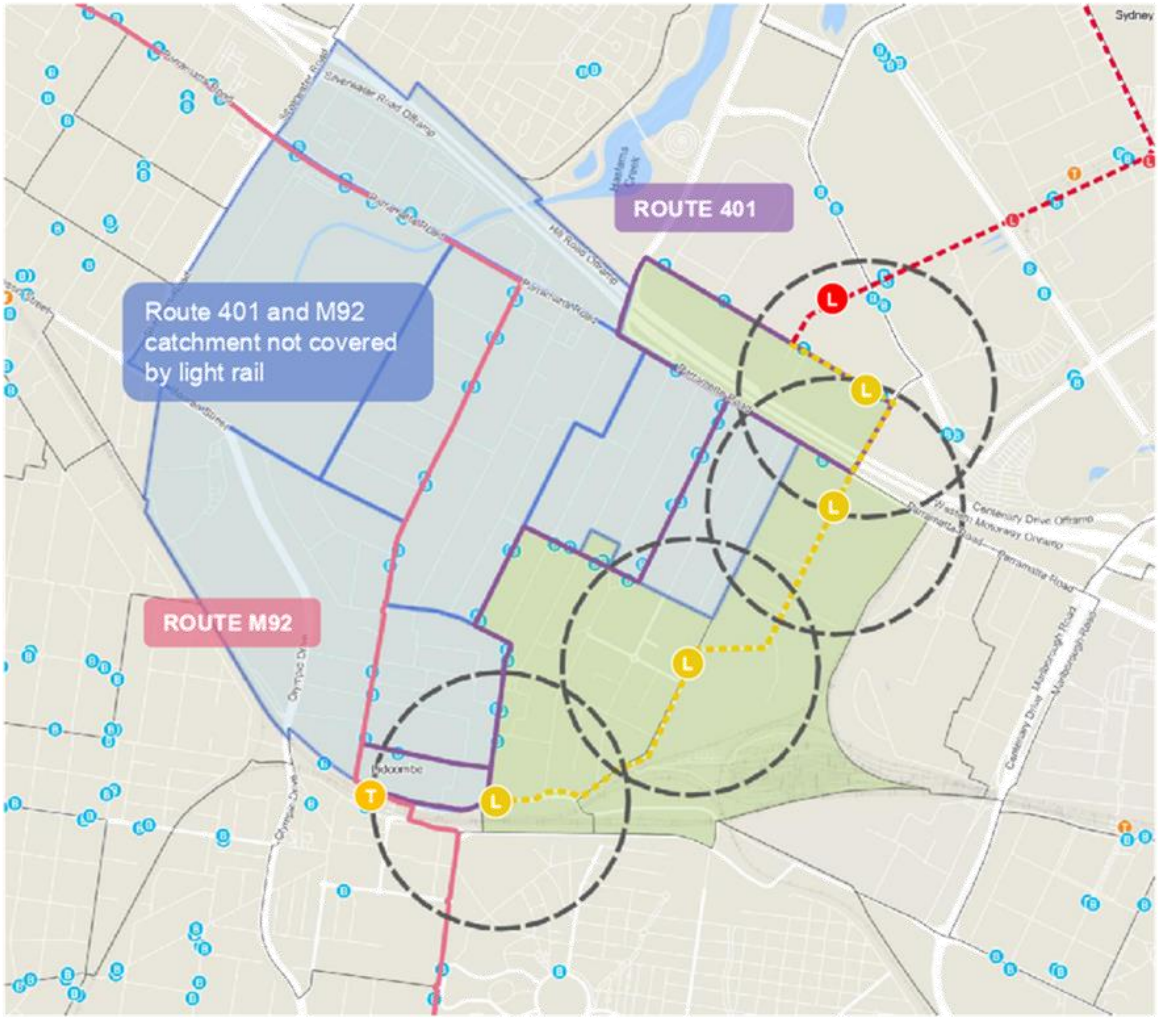
F.4 Existing bus customers – Option 4

- Existing route M92 customers will not switch to light rail due to the lack of overlap in coverage.
- Opal data shows that existing route 401 customers only use the service to access Lidcombe Train Station.
- Although Lidcombe Train Station is within walking distance from the Light rail terminus, route 401 customers would not switch as to light rail due to the increased walking distance.



Route	Bus customers	% switching	Light rail customers
M92	~1,050	0%	0
401	~200	0%	0

Daily light rail trips from existing bus customers: 0

F.5 Existing walking trips to/from Lidcombe Station – Option 1

Assumptions:

- Lidcombe Station has a bigger catchment than Auburn Station, Flemington Station and Berala Station due to access to more train lines
- Where Lidcombe Station catchment overlaps with other station catchments, passengers would go to the other station due to proximity

Information considered:

- Employment and population forecasts in 2056 in relevant Travel Zones (TZs)
- %area of each TZ that falls into the PLR catchment (400m)
- 56% of the customers arrive at Lidcombe Station by walking
- % passengers switching to light rail: 50%

Direction	Customers who walk	% switching	Light rail customers
to station	~1,250	50%	~625
from station	~1,150	50%	~575

Daily light rail trips from existing walk trips: ~+1,200

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F.5 Existing walking trips to/from Lidcombe Station – Option 4

Assumptions:

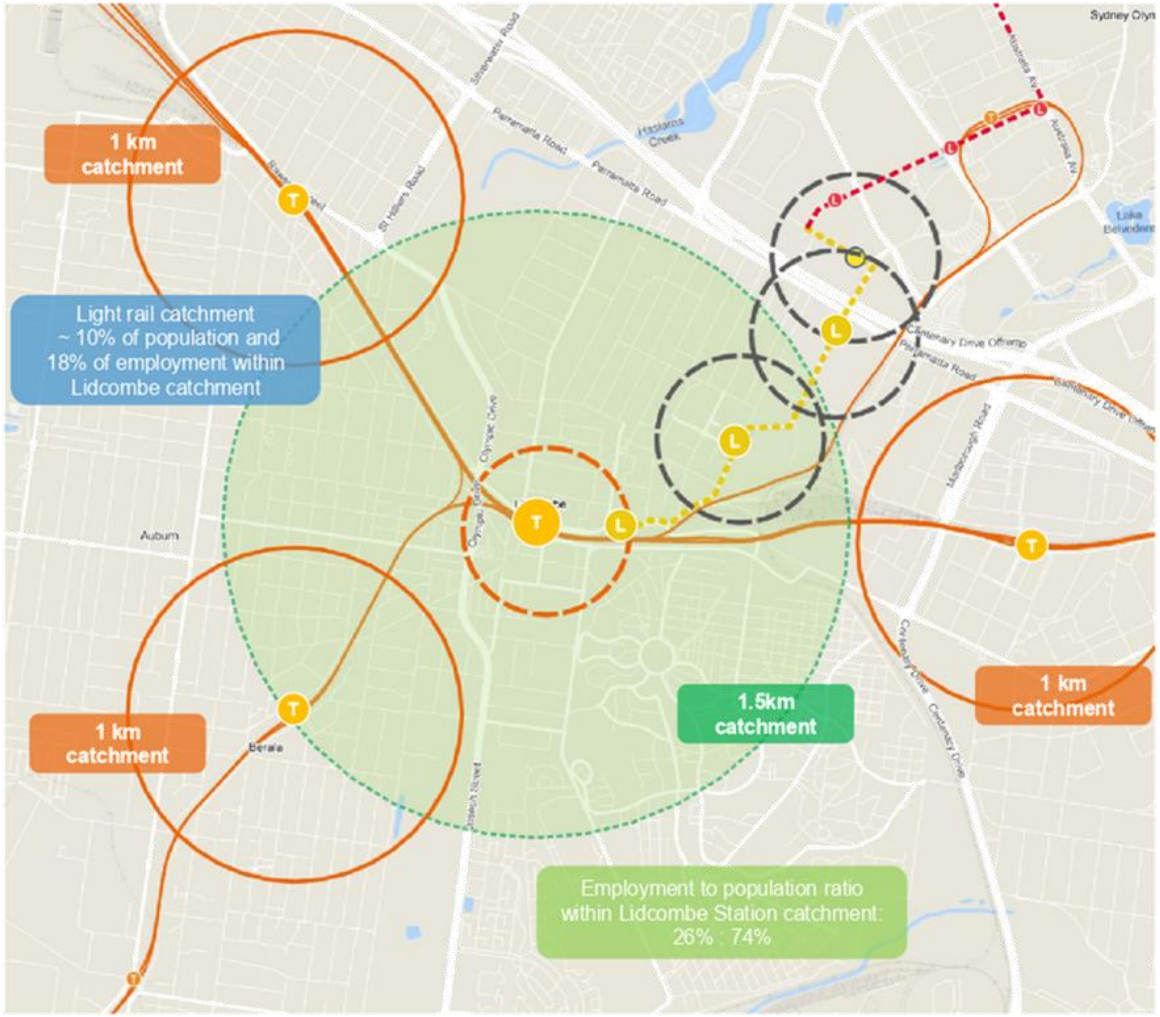
- Lidcombe Station has a bigger catchment than Auburn Station, Flemington Station and Berala Station due to access to more train lines
- Where Lidcombe Station catchment overlaps with other station catchments, passengers would go to the other station due to proximity

Information considered:

- Employment and population forecasts in 2056 in relevant Travel Zones (TZs)
- %area of each TZ that falls into the PLR catchment (400m)
- 56% of the customers arrive at Lidcombe Station by walking
- % passengers switching to light rail: 50%

Direction	Customers who walk	% switching	Light rail customers
to station	~850	50%	~425
from station	~800	50%	~400

Daily light rail trips from existing walk trips: ~+830



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F.6 Existing driving trips to / from Lidcombe Station – Option 1

Assumptions:

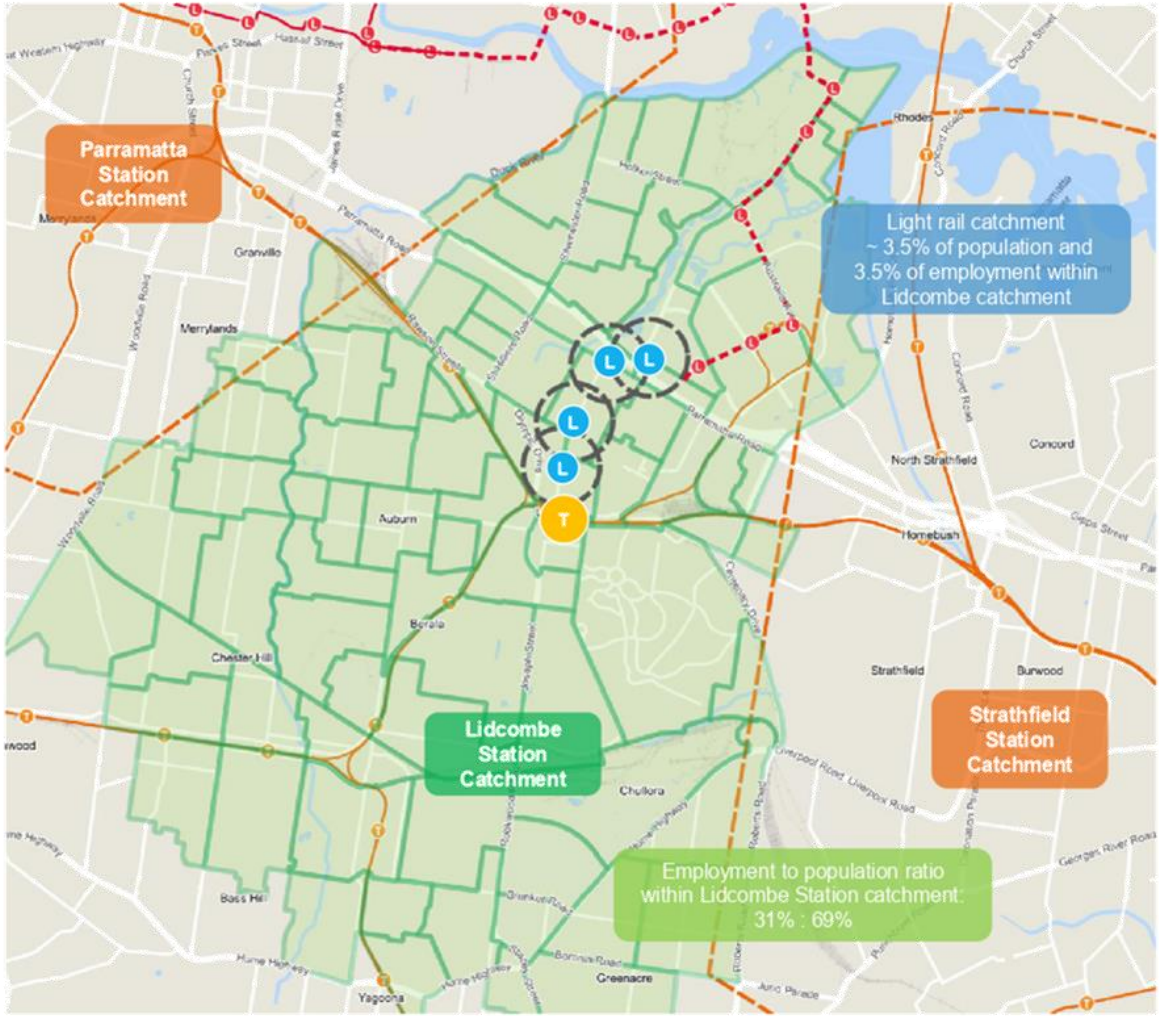
- Lidcombe Station has a bigger catchment than Auburn Station, Flemington Station and Berala Station due to access to more train lines
- Where Lidcombe Station catchment overlaps with other station catchments, passengers would go to the other station due to proximity

Information considered:

- Employment and population forecasts in 2056 in relevant Travel Zones (TZs)
- %area of each TZ that falls into the PLR catchment (400m)
- 40% of the customers arrive at Lidcombe Station by Kiss-and-ride & Park-and-ride
- % passengers switching to light rail: 50%

Direction	Customers who drive	% switching	Light rail customers
to station	~150	50%	~75
from station	~140	50%	~70

Daily light rail trips from existing Park-and-ride / Kiss-and-ride trips: ~+150



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F.6 Existing driving trips to / from Lidcombe Station – Option 4

Assumptions:

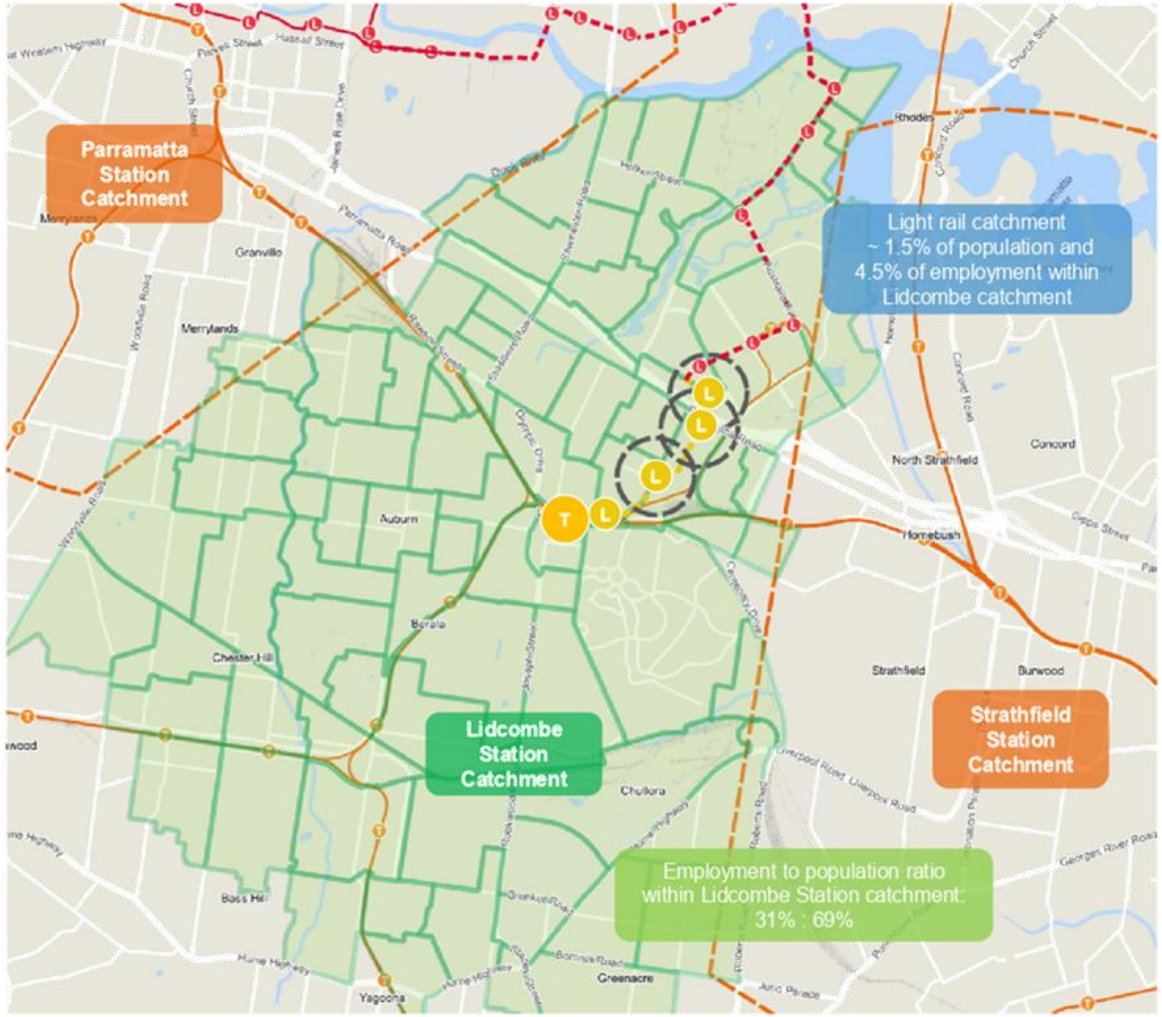
- Lidcombe Station has a bigger catchment than Auburn Station, Flemington Station and Berala Station due to access to more train lines
- Where Lidcombe Station catchment overlaps with other station catchments, passengers would go to the other station due to proximity

Information considered:

- Employment and population forecasts in 2056 in relevant Travel Zones (TZs)
- %area of each TZ that falls into the PLR catchment (400m)
- 40% of the customers arrive at Lidcombe Station by Kiss-and-ride & Park-and-ride
- % passengers switching to light rail: 50%

Direction	Customers who drive	% switching	Light rail customers
to station	~120	50%	~60
from station	~120	50%	~60

Daily light rail trips from existing Park-and-ride / Kiss-and-ride trips: ~+120



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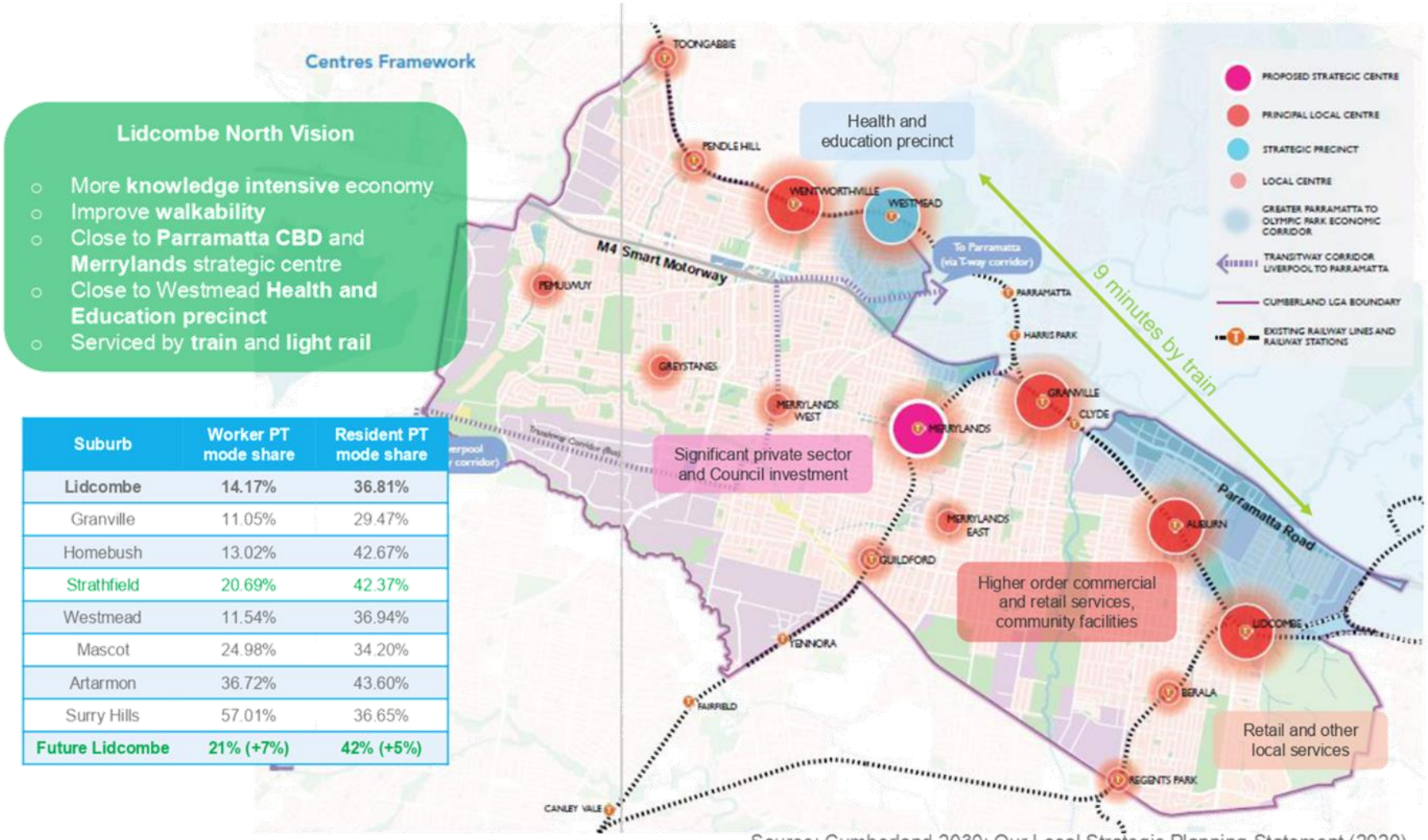
PLR: Potential extension from Sydney Olympic Park to Lidcombe – Preliminary feasibility study

F.7 Future of Lidcombe North – benchmarking for PT mode share



Suburb	Worker PT mode share	Resident PT mode share
Lidcombe	**14.17%**	**36.81%**
Granville	11.05%	29.47%
Homebush	13.02%	42.67%
Strathfield	20.69%	42.37%
Westmead	11.54%	36.94%
Mascot	24.98%	34.20%
Artarmon	36.72%	43.60%
Surry Hills	57.01%	36.65%
Future Lidcombe	**21% (+7%)**	**42% (+5%)**

Source: Cumberland 2030: Our Local Strategic Planning Statement (2020)

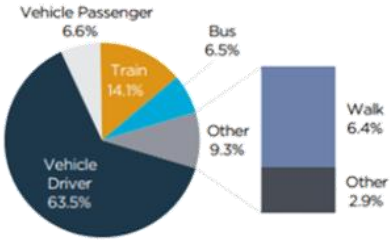
PLR: Potential extension from Sydney Olympic Park to Lidcombe – Preliminary feasibility study

F.8 Future customers in 2056 – Option 4

Information considered:

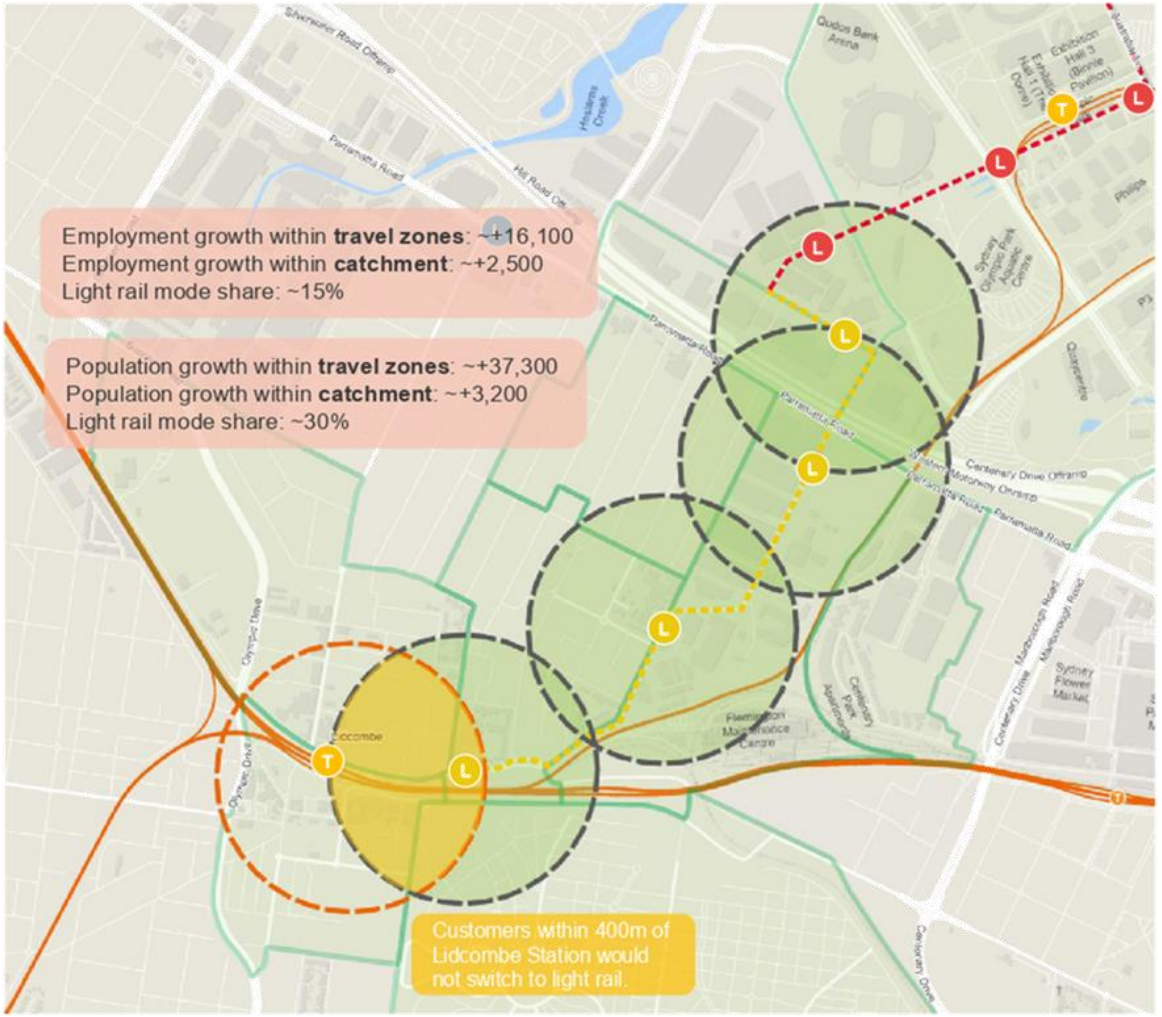
- Employment and population forecasts in 2056 in relevant Travel Zones (TZs)
- %area of each TZ that falls into the PLR catchment (400m)
- Public transport mode share for workers: 21%
- Public transport mode share for residents: 42%
- ~70% of the public transport customers within the light rail catchments will catch light rail instead of buses (rail mode share is 2.2x of bus mode share for commute trips)
- Assume customers would adopt the same mode for the return trip

Commute



Source: Household Travel Survey Report: Sydney 2012/13

Daily light rail trips from employment and residential growth within light rail catchments: ~+2,600



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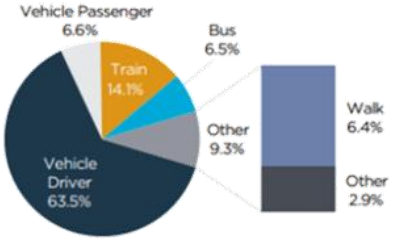
F.8 Future customers in 2056 – Option 1

Information considered:

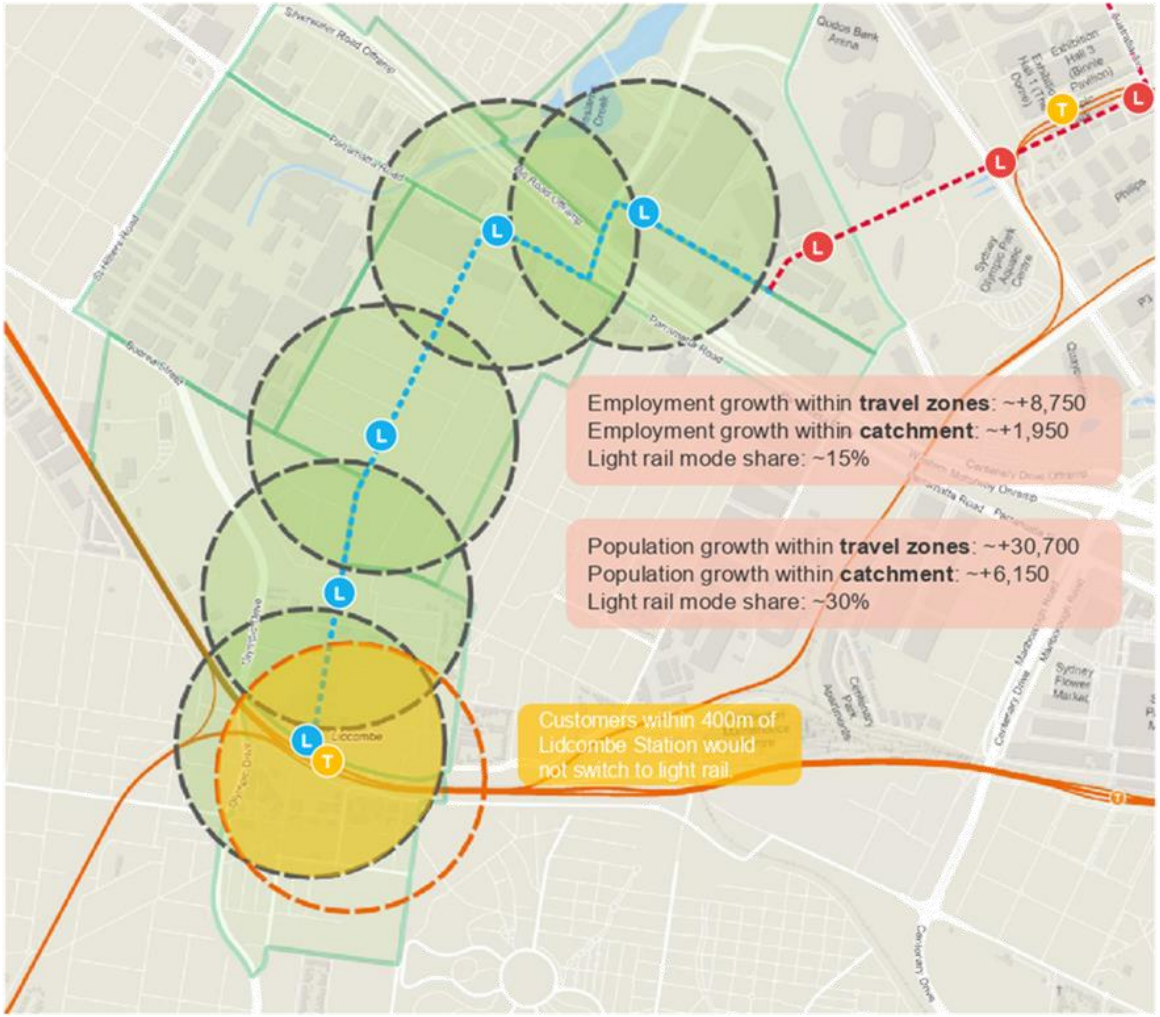
- Employment and population forecasts in 2056 in relevant Travel Zones (TZs)
- %area of each TZ that falls into the PLR catchment (400m)
- Public transport mode share for workers: 21%
- Public transport mode share for residents: 42%
- ~70% of the public transport customers within the light rail catchments will catch light rail instead of buses (rail mode share is 2.2x of bus mode share for commute trips)
- Assume customers would adopt the same mode for the return trip

Commute



Source: Household Travel Survey Report: Sydney 2012/13

Daily light rail trips from employment and residential growth within light rail catchments: ~+4,200



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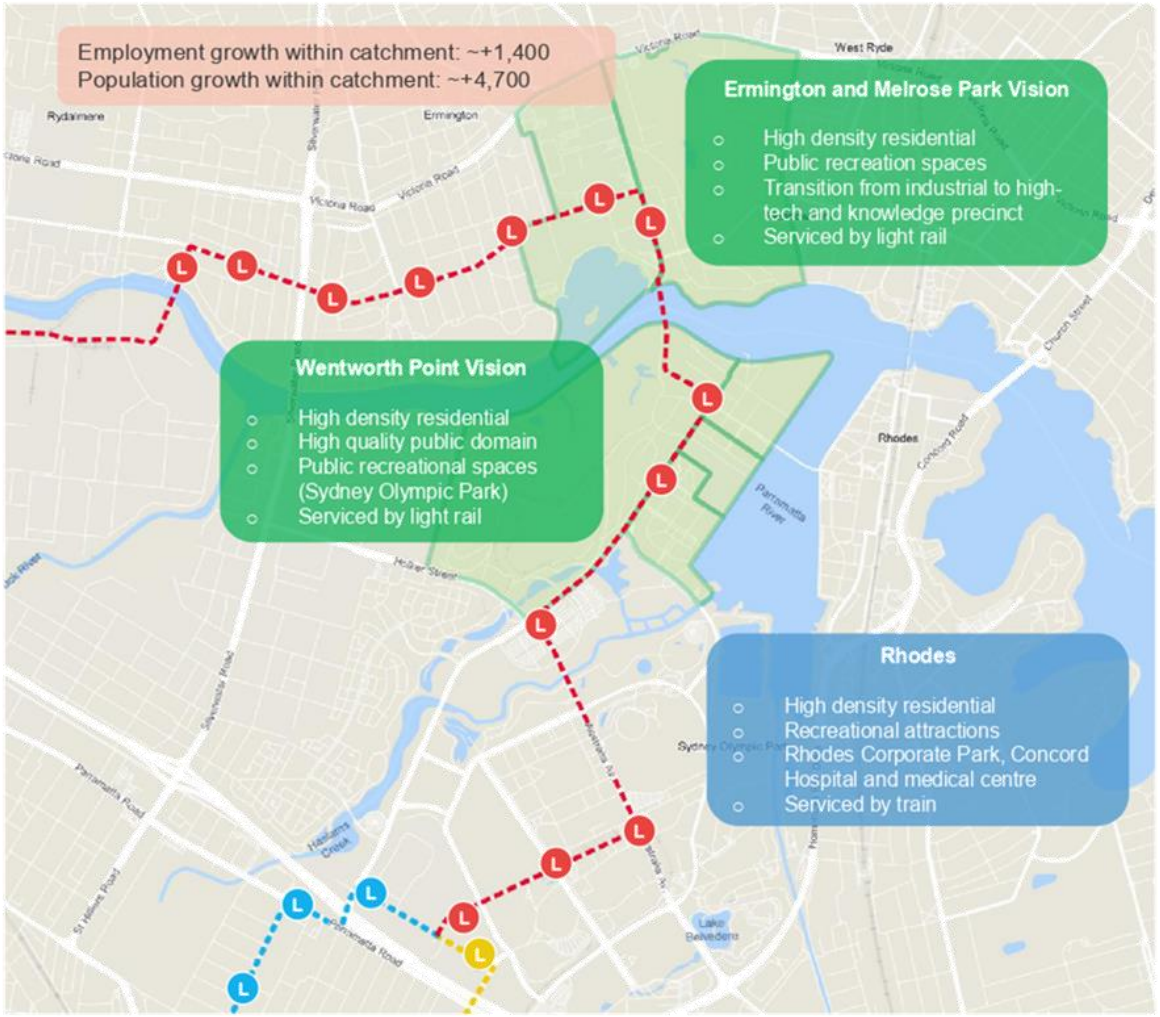
F.9 Future PLR2 customers transferring at Lidcombe Station

- Future customers within the PLR2 catchment may catch the light rail to transfer at Lidcombe, for Bankstown Line or Inner West Line
- Future rail mode share in Ermington, Melrose Park and Wentworth Point will be the same as Rhodes
- Rhodes rail mode share: 17% (Source: Rhodes East Traffic and Transport Report 2017)
- Assume customers would adopt the same mode for the return trip

Information considered:

- Employment and population forecasts in 2056 in relevant Travel Zones (TZs)
- Residents' place or work and workers' place of residence



Daily light rail trips from future PLR2 customers: ~+2,200

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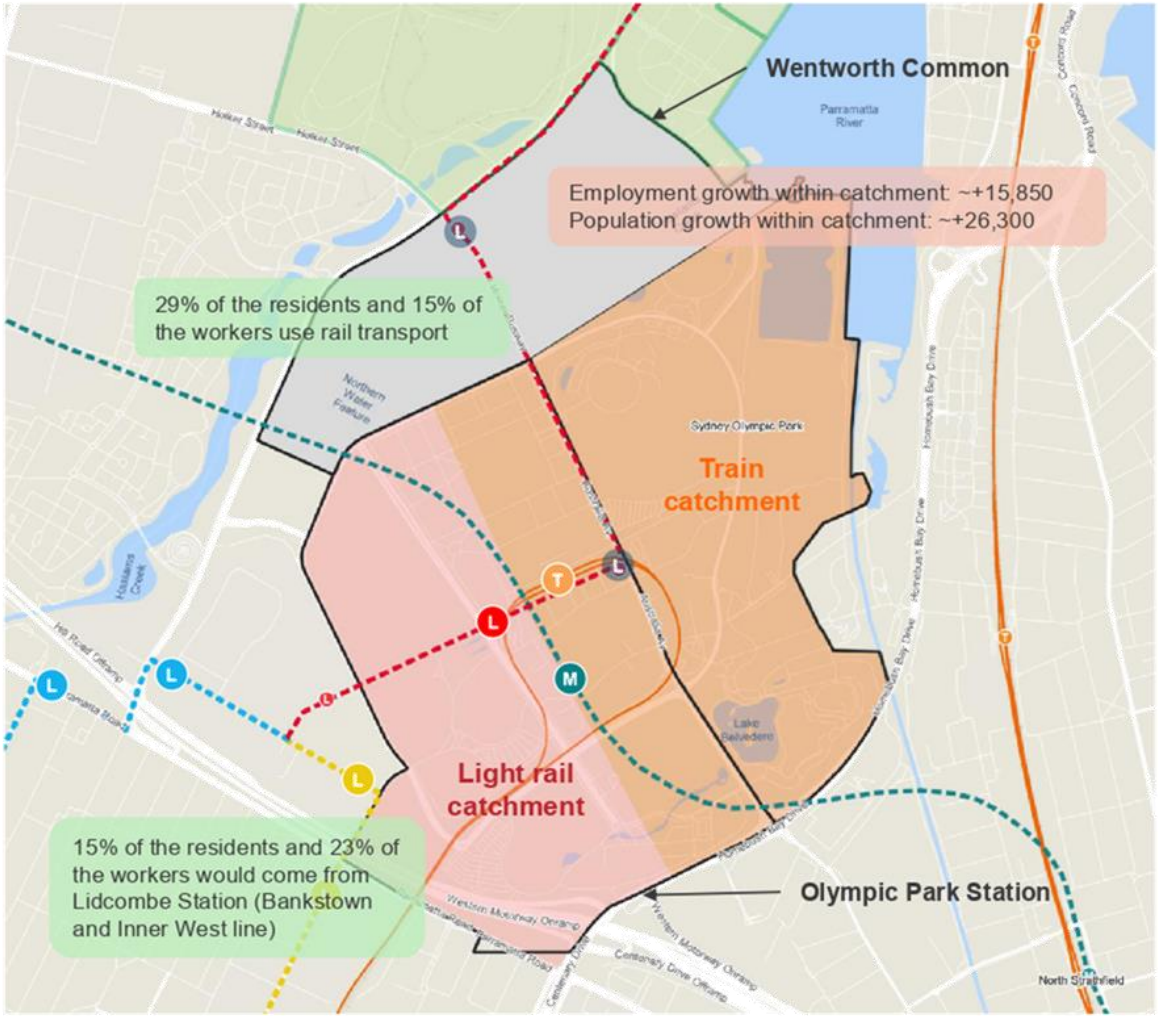
F.10 Future customers in 2056 switching from train (T7)

- Assume same future mode share as Lidcombe North, 42% of the future residents and 21% of the future workers would adopt public transport.
- ~70% of the public transport customers would adopt rail transport (rail mode share is 2.2x of bus mode share for commute trips)
- Based on worker's residence and resident's place of work, 15% of the future residents and 23% of the future works would transfer at Lidcombe Station (Bankstown and Inner West Line)
- Same as existing customers, it is assumed that users would choose the mode that minimises walking unless travel time is disproportionately longer. 53% of workers and 47% of the residents would catch light rail
- Assume customers would adopt the same mode for the return trip



Daily light rail trips from existing train customers: ~+1,700

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F.11 Shopping trips

- So far the estimated future trips generated by employment and population growth only consider work related trips
- 29% of daily trips in Cumberland Council are for commute, Education/childcare and personal business. These trips have an average rail mode share of 3.7%
- 14.7% of daily trips in Cumberland Council are for shopping purposes. These trips have an average rail mode share of 2.50%
- The number of rail trips that will be generated by shopping purposes are approximately **10%** of the rail trips generated for commute/work purposes.

Trip purpose	% of total trips
Commute	16.60%
Personal business	4.40%
Education / childcare	8.10%
Sum	29.10%
Weighted average rail mode share	12.60%
% of rail trips in total trips	3.67%

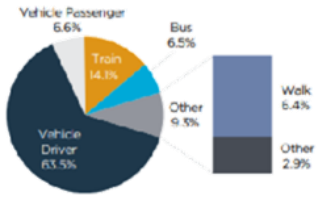
Source: Household Travel Survey: Cumberland LGA for year 2019/2020

Trip purpose	% of total trips
Shopping	14.70%
Rail mode share	2.50%
% of rail trips in total trips	0.37%

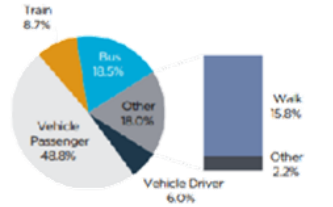
Source: Household Travel Survey: Cumberland LGA for year 2019/2020

Option 1	Option 4
Shopping opportunities near light rail catchment	
Lidcombe Town Centre	-
Lidcombe North Shopping precinct	-

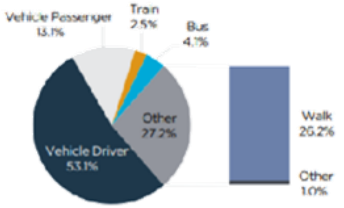
Commute



Education/Childcare



Shopping



Source: Household Travel Survey Report: Sydney 2012/13

Route	Future work trips	Shopping trip %	Total trips
Option 1	~8,100	10%	~800
Option 4	~6,450	0%	0

Daily light rail trips for shopping purposes :
Option 1: ~+800 **Option 4: 0**

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F.12 Social / Recreational trips

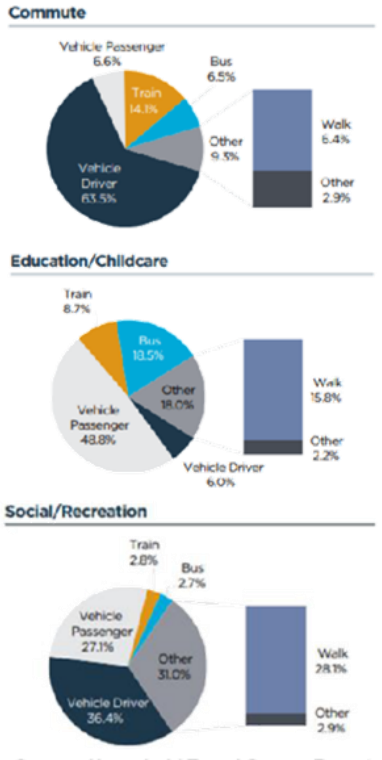
- 29% of daily trips in Cumberland Council are for commute, Education/childcare and personal business. These trips have an average rail mode share of 3.7%
- 27% of daily trips in Cumberland Council are for social/recreational purposes. These trips have an average rail mode share of 2.80%
- The number of rail trips that will be generated by recreational purposes are approximately **21%** of the rail trips generated for commute/work purposes.

Trip purpose	% of total trips
Commute	16.60%
Personal business	4.40%
Education / childcare	8.10%
Sum	29.10%
Weighted average rail mode share	12.60%
% of rail trips in total trips	3.67%

Source: Household Travel Survey: Cumberland LGA for year 2019/2020

Trip purpose	% of total trips
Social / recreation	27.30%
Rail mode share	2.80%
% of rail trips in total trips	0.76%

Source: Household Travel Survey: Cumberland LGA for year 2019/2020



Source: Household Travel Survey Report: Sydney 2012/13

Route	Future work trips	Recreational trip %	Total trips
Option 1	~8,100	21%	~1,700
Option 4	~6,450	10.5%	~700

Daily light rail trips for recreational purposes :
Option 1: ~+1,700 Option 4: ~+700

Option 1	Option 4
Recreational opportunities near light rail catchment	
Auburn Swim Centre	Phillips Park
Wyatt Park	-

Auburn Swim Centre and Wyatt Park will provide more recreational opportunities than Phillips Park, particularly after the planned Wyatt park improvements.

In consideration of the quantity and diversity of recreational opportunities in these key destinations, it is assumed that Option 4 will service 50% less recreational trips than Option 1

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F.13 Route patronage and trip length comparison - 2036

Customers	Option 1 – year 2036			Option 4 – year 2036		
	Patronage	Trip Length	Comment / Assumptions	Patronage	Trip Length	Comment / Assumptions
Existing T7 train customers	2,350	2,800 m	100% alignment length, between Lidcombe Station and Olympic Park Station	2,300	2,300 m	100% alignment length, between Lidcombe Station and Olympic Park Station
Existing M92 bus customers	950	950 m	to Calool Street Stop, midpoint between Parramatta Road and Lidcombe Station	0	-	
Existing 401 bus customers	50	2,800 m	100% alignment length, customers travel between Carter Street and Lidcombe Station	0	-	
Existing walking customers to/from Lidcombe Station	1,200	950 m	to Calool Street Stop, midpoint of waling catchment	900	840 m	to Phillips Park Stop, midpoint of waling catchment
Existing Kiss-and-ride & Park-and-ride customers to/from Lidcombe Station	150	1,400 m	50% alignment length	150	1,150 m	50% alignment length
Future customers from employment & population growth within light rail catchments	2,000	1,400 m	50% alignment length	1,350	1,150 m	50% alignment length
Future customers on PLR2 alignment transferring at Lidcombe Station	1,800	2,800 m	100% alignment length	1,800	2,300 m	100% alignment length
Future T7 customers	800	2,800 m	100% alignment length, between Lidcombe Station and Olympic Park Station	800	2,800 m	100% alignment length, between Lidcombe Station and Olympic Park Station
Future shopping trips	450	1,400 m	50% alignment length, midpoint of alignment	0	1,150 m	50% alignment length, midpoint of alignment
Future recreational trips	950	1,400 m	50% alignment length, midpoint of alignment	400	1,150 m	50% alignment length, midpoint of alignment
Total (excl. potential uplift)	**~10,750**			**~7,750**		

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F.14 Route patronage and trip length comparison - 2056

Customers	Option 1 – year 2056			Option 4 – year 2056		
	Patronage	Trip Length	Comment / Assumptions	Patronage	Trip Length	Comment / Assumptions
Existing T7 train customers	2,300	2,800 m	100% alignment length, between Lidcombe Station and Olympic Park Station	2,300	2,300 m	100% alignment length, between Lidcombe Station and Olympic Park Station
Existing M92 bus customers	950	950 m	to Calool Street Stop, midpoint between Parramatta Road and Lidcombe Station	0	-	
Existing 401 bus customers	50	2,800 m	100% alignment length, customers travel between Carter Street and Lidcombe Station	0	-	
Existing walking customers to/from Lidcombe Station	1,200	950 m	to Calool Street Stop, midpoint of waling catchment	830	840 m	to Phillips Park Stop, midpoint of waling catchment
Existing Kiss-and-ride & Park-and-ride customers to/from Lidcombe Station	150	1,400 m	50% alignment length	120	1,150 m	50% alignment length
Future customers from employment & population growth within light rail catchments	4,200	1,400 m	50% alignment length	2,600	1,150 m	50% alignment length
Future customers on PLR2 alignment transferring at Lidcombe Station	2,200	2,800 m	100% alignment length	2,200	2,300 m	100% alignment length
Future T7 customers	1,700	2,800 m	100% alignment length, between Lidcombe Station and Olympic Park Station	1,700	2,800 m	100% alignment length, between Lidcombe Station and Olympic Park Station
Future shopping trips	800	1,400 m	50% alignment length, midpoint of alignment	0	1,150 m	50% alignment length, midpoint of alignment
Future recreational trips	1,700	1,400 m	50% alignment length, midpoint of alignment	700	1,150 m	50% alignment length, midpoint of alignment
Total (excl. potential uplift)	**~15,250**			**~10,450**		

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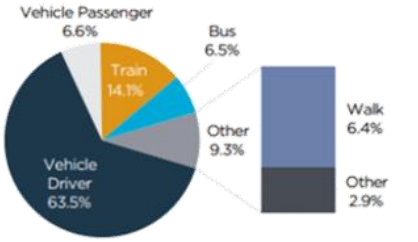
F.15 Future customers in 2056 – Option 1 – potential uplift

Information considered:

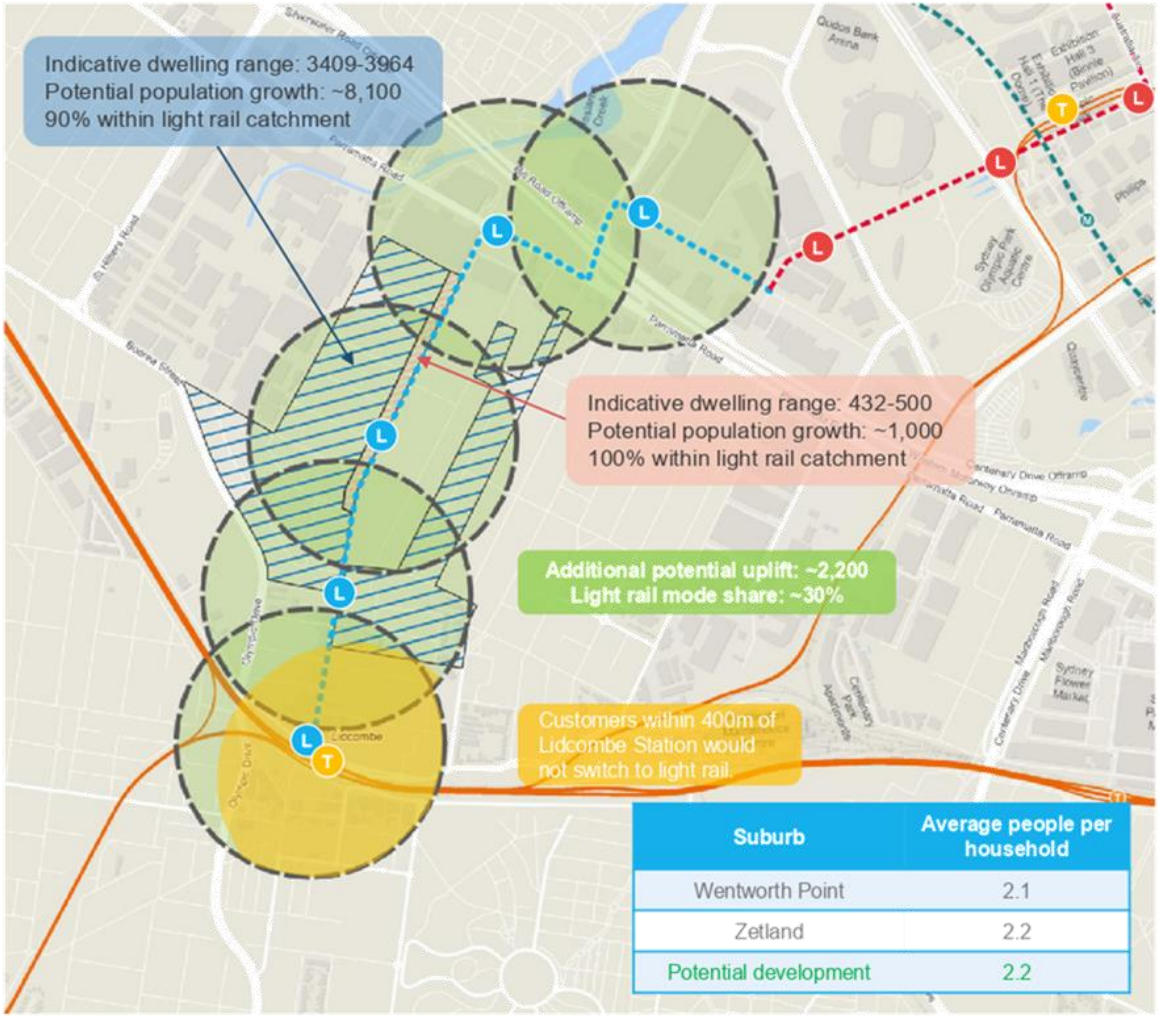
- Indicative uplift in residential density (only applicable in 2056 – assume rezoning and development happens after 2036)
- %area of high-density residential zones that falls into the PLR catchment (400m)
- Public transport mode share for residents: 42%
- Assume ~70% of the public transport customers within the light rail catchments will switch to light rail(rail mode share is 2.2x of bus mode share for commute trips)
- Assume customers would adopt the same mode for the return trip

Commute



Source: Household Travel Survey Report: Sydney 2012/13

Daily light rail trips from additional residential growth within light rail catchments: ~+1,300



Suburb	Average people per household
Wentworth Point	2.1
Zetland	2.2
Potential development	2.2

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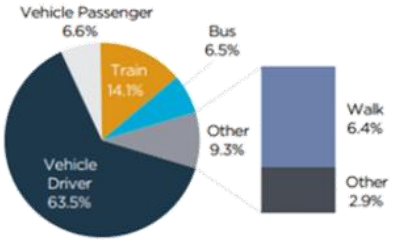
F.15 Future customers in 2056 – Option 4 – potential uplift

Information considered:

- Indicative uplift in residential density (only applicable in 2056 – assume rezoning and development happens after 2036)
- %area of high-density residential zones that falls into the PLR catchment (400m)
- Public transport mode share for residents: 42%
- Assume ~70% of the public transport customers within the light rail catchments will switch to light rail(rail mode share is 2.2x of bus mode share for commute trips)
- Assume customers would adopt the same mode for the return trip

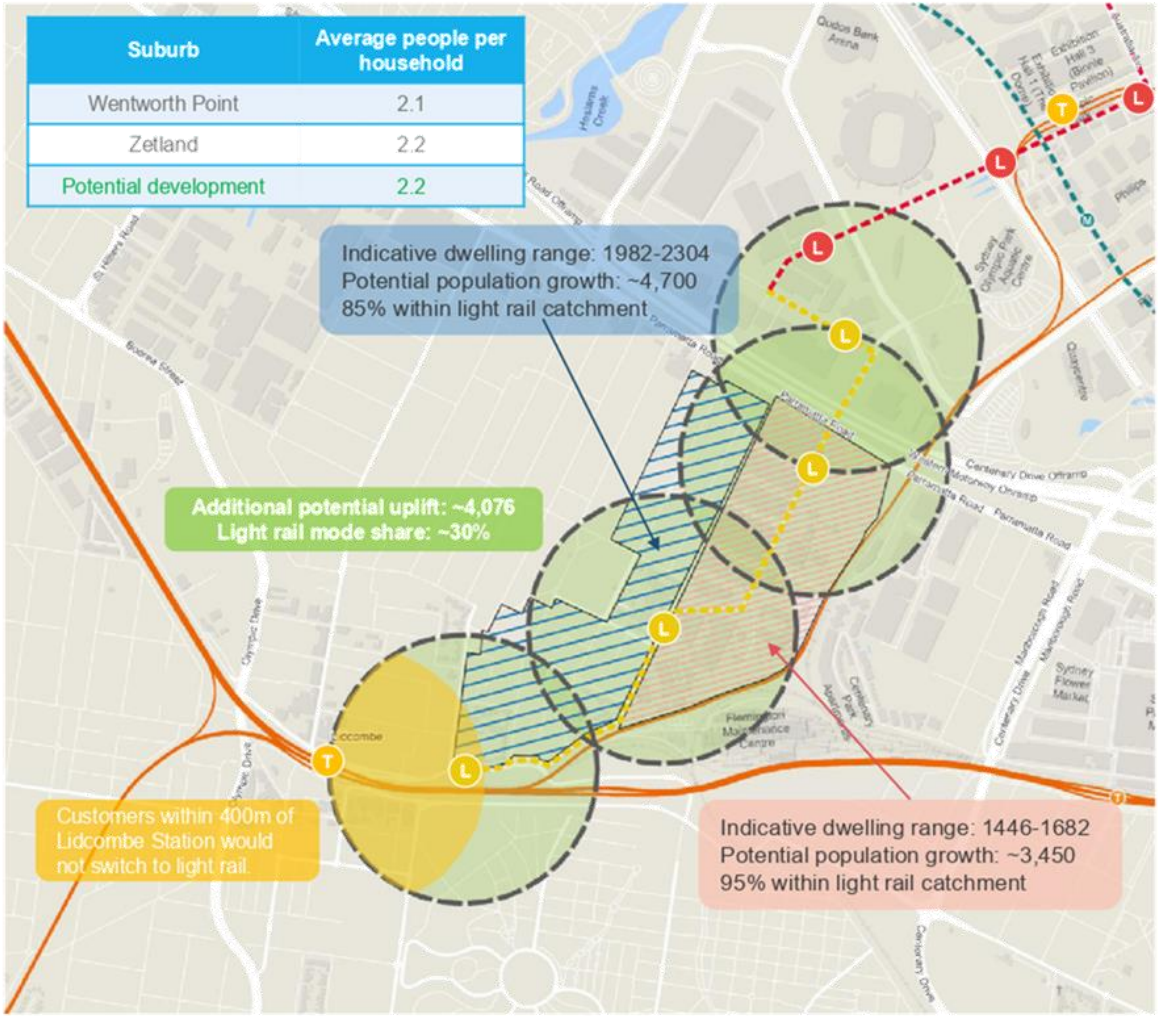
Commute



Source: Household Travel Survey Report: Sydney 2012/13

Daily light rail trips from additional residential growth within light rail catchments: ~+2,400

Suburb	Average people per household
Wentworth Point	2.1
Zetland	2.2
Potential development	2.2



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F.16 Route patronage and trip length comparison - 2056

Customers	Option 1 (2056 only)			Option 4 (2056 only)		
	Patronage	Trip Length	Comment / Assumptions	Patronage	Trip Length	Comment / Assumptions
Total (excl. potential uplift)	**~15,250**			**~10,450**		
Potential future customers from residential uplift within light rail catchments	1,300	1,400 m	50% alignment length	2,400	1,150 m	50% alignment length
Future shopping trips	150	1,400 m	50% alignment length, midpoint of alignment	0	1,150 m	50% alignment length, midpoint of alignment
Future recreational trips	250	1,400 m	50% alignment length, midpoint of alignment	250	1,150 m	50% alignment length, midpoint of alignment
Potential uplift	**1,700**			**2,650**		
Total (excl. potential uplift)	**~16,950**			**~13,100**		

F.17 Market segments for economic appraisal

Customers	Relevant Market Segment	Assumptions
Existing T7 train customers	T7	Distance walked: distance between SOP station and the centroid of light rail catchment
Existing M92 bus customers	M92	Distance walked: average bus stop spacing / 2
Existing 401 bus customers	401	Distance walked: average bus stop spacing / 2
Existing walking customers to/from Lidcombe Station	Walking	Average walking speed: 4km/h
Existing Kiss-and-ride & Park-and-ride customers to/from Lidcombe Station	Driving	Average vehicle speed: 39.75 km/h, based on general speed limit of 50km/h, and Percentage of Speed Limit of 79.5% for Sydney 2013-2018 (Road Congestion in Australia, 2019)
Future customers on PLR2 alignment transferring at Lidcombe Station	PLR2	**Melrose Park catchment:** Alternative mode is PLR2 to Parramatta Station, then Train to Lidcombe Station Distance walked: average bus stop spacing / 2 **Wentworth Park catchment:** Alternative mode is 533(bus) to SOP Station then Train to Lidcombe Station Distance walked: average bus stop spacing / 2 + distance from bus stop to SOP Station
Future T7 customers	T7	Distance walked: distance between SOP station and the centroid of light rail catchment
Future customers from employment & population growth within light rail catchments	T7, M92, 401, Walking, Driving, M92 + T7, 401 + T7, Walking + T7, Driving + T7	Assume two key destinations: Lidcombe Station and SOP Station. We assume customers access SOP Station by getting to Lidcombe Station first, then catch T7 to SOP Station. 57% of the workers and 67% of the residents will head to SOP Station based on their residence and place of work.
Future shopping trips	T7, M92, 401, Walking, Driving, M92 + T7, 401 + T7, Walking + T7, Driving + T7	Assume two key destinations: Lidcombe Station and SOP Station. We assume customers access SOP Station by getting to Lidcombe Station first, then catch T7 to SOP Station. 50% of the trips will head to SOP Station based on their residence and place of work.
Future recreational trips	T7, M92, 401, Walking, Driving, M92 + T7, 401 + T7, Walking + T7, Driving + T7	Assume two key destinations: Lidcombe Station and SOP Station. We assume customers access SOP Station by getting to Lidcombe Station first, then catch T7 to SOP Station. 50% of the trips will head to SOP Station based on their residence and place of work.

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F.17 Market segment analysis - general assumptions

- **Wait time**: service headway / 2, weighted by T7 demand profile throughout the day. It is assumed that the T7 demand profile is representative of the general travel behaviour.
- **Future customer mode choice**: For customer groups that belong to more than one market segment, the customer mode choice is estimated based on the existing customer's current route choice. For customers who would switch to light rail, the current mode share of them arriving at Lidcombe Station is as follows:

Existing customers	Option 1		Option 4	
	Number of trips	% Mode share	Number of trips	% Mode share
Existing M92 bus customers	950	40%	0	N/A
Existing 401 bus customers	50	2%	0	N/A
Existing walking customers to/from Lidcombe Station	1200	52%	830	87%
Existing Kiss-and-ride & Park-and-ride customers to/from Lidcombe Station	150	6%	120	13%

- For example, it is assumed that 50% of the shopping trips travel to SOP Station (Refer previous slide). The distribution of future shopping trips across different market segments is as follows:

Future customers	Origin / Destination	Option 1 mode share	Option 4 mode share
M92	Lidcombe Station (50%)	50% * 40% = 20%	N/A
401		50% * 2% = 1%	N/A
Walking		50% * 52% = 26%	50% * 87% = 43.5%
Kiss-and-ride & Park-and-ride		50% 6% = 3%	50% * 13% = 6.5%
M92 + T7	SOP Station (50%)	50% * 40% = 20%	N/A
401 + T7		50% * 2% = 1%	N/A
Walking +T7		50% * 52% = 26%	50% * 87% = 43.5%
Kiss-and-ride + T7 / Park-and-ride + T7		50% 6% = 3%	50% * 13% = 6.5%

F.18 Annualisation factor

- Sydney Light Rail data was initially analysed to derive the annualisation factor. However the data was either aggregated on a monthly basis, or only showed daily trips for select months. In the absence of data, the annualisation factor was determined based on the advice from *Australian Transport Assessment and Planning Guidelines*.
- Distribution of annual public transport demand by day type:

Time period	Number per annum	Share of total annual demand	Share of total annual demand per day
Average working weekday	251	87.9%	0.350%
Saturday	52	7.0%	0.135%
Sunday	52	4.1%	0.079%
Public Holiday	10	1.1%	0.110%
Total	**365**	**100%**	

Source: Australian Transport Assessment and Planning Guidelines, M1 – Public Transport (Transport and Infrastructure Council, May 2018)

- The **annualisation factor** to convert average working weekday results to annual results = 251 * 100 / 87.9 = **285.6**

F.19 Route comparison – key opportunities or limitations

	Option 1	Option 4
Existing M92 bus customers	Opportunity to replace M92 operation within study area and improve M92 customer experience by reducing bus dwell time	-
Future customers from employment & population growth within light rail catchments	Opportunity to serve planned medium/high density residential development on the western side of Carter Street and along western side of John Street	Opportunity to serve future high-tech industrial area
Light rail connectivity	Terminus at Lidcombe is close to Town Centre, Train Station and Bus Interchange	Terminus at Lidcombe is further away from Town Centre, Train Station and Bus interchange
Key destinations	Lidcombe Town Centre, Lidcombe North Shopping Precinct, Wyatt Park, Auburn Swim Centre	Phillips Park
Potential Incidental trips	High – alignment provides connectivity between medium/high density residential to key destinations	Low – limited expected patronage outside of commuter peak periods

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[Appendix G]

Cost estimate assumptions and summary

G.1 Cost components

Direct Costs
Typical Light Rail Alignment
Civil works
Demolition
Allowance for retaining structures (incl. noise walls)
Drainage
Trackwork (incl. track slab)
Services incl. rail systems HV and other services
Light rail stops
Terminus location
Typical Light rail stop (Island/side platforms)
Depot (Excluded from this study)
Service diversions
Allowance for Surveying and service investigations
Allowance for services diversion (Assumed street diversions)

Direct Costs
Additional Costs
Active Transport Corridor or any Green Space
Public art
Traffic management
Temporary works
Environmental controls
Provisional allowance for traction substation
Provisional allowance for additional rolling stock (x1)
Allowance for turnback facility

Indirect Costs
Design
Preliminaries (site-specific overheads)
Overheads (general) and profits

G.2 Assumptions

The costings provided are to satisfy the requirements of the preliminary study and is not for budgetary purposes or to seek funding approval.

Rates

- Assume the following benchmarks for in-directs and client costs:
  - Indirect Costs equate to approximately 62.4% of Direct Costs based on:
    - 15% on Direct Costs for Design Fees
    - 30% on Direct Costs for Preliminaries Fees
    - 12% on Direct Costs + Design + Preliminaries for Overhead & Profit (or Contractor's Margin)
  - Client Costs assumed as 18% of Construction Cost
  - Excludes the 3.8% on Total Outturn Cost for TfNSW Infrastructure & Place Charge
- The typical I&P charge of 3.8% is the corporate charge that is set by TfNSW estimating standard has been excluded.
  - This value is typically assessed on a project basis and is dependent on the agency that will be delivering this project. The applicability of this charge is determined by TfNSW Project Management Office, Hence, it is shown as a separate line item.
  - In this instance, is it assumed the project will be delivered by the Parramatta Light Rail project office, hence the costs are accounted for in the client fees.
- Market value of properties taken as $3,000/m²
- Excluded residual value to property lots
- Excluded any value capture to property or businesses
- Excluded business continuity costs to project
- Escalation to be 3% per annum
- A deterministic approach to contingency has been adopted with 40% applied to Construction and Client costs. The 40% contingency has been adopted due to the current base estimate rates incorporating an element of contingency and with consideration that this project is an extension.
- OPEX taken as 0.5% of Capex Costing per year, excluding Client Cost (plus I&P Charge), Property Acquisition (plus escalation on Property acquisition) and contingency and escalation on Client Cost.

Infrastructure

- Allowance of extra alignment length at Sydney Olympic Park for tie-in to existing PLR Stage 2
- Excluded bridge structures and associated works
- Excluded Retaining Structures and Noise Walls
- Assumed the terminus are not connected to any bus layover
- Assumed full depth cutting pavement
- Assumed minimal impact to existing transport infrastructure near underpass at Birnie Avenue below the M4 Motorway
- Provisional allowance made for Traction Substation
- Excluded traffic modifications to existing infrastructure
- Allowance made for Driver amenities at both respective Lidcombe terminus
- Allowance for turnback at Lidcombe terminus.

Project timeline

- Assumed 2030 start for 2-year development period and a 4-year delivery period (starting in 2030 and ending in 2035)
- Operational in 2036
- Appraisal period for OPEX is from 2036 to 2056.

G.3 Cost breakdown

Alignment Options	Option 1		Option 4	
	Without Carter Street	With Carter Street	Without Carter Street	With Carter Street
CAPEX Component				
Direct	$219,850,926	$222,507,426	$190,119,166	$192,775,666
Indirect	$137,186,978	$138,844,634	$118,634,360	$120,292,016
Construction Cost	**$357,037,905**	**$361,352,061**	**$308,753,525**	**$313,067,681**
Client Cost	$64,266,823	$65,043,371	$55,575,635	$56,352,183
Property Acquisition	$46,938,519	$46,938,519	$15,811,124	$15,811,124
Base Estimate	**$468,243,246**	**$473,333,950**	**$380,140,284**	**$385,230,988**
Contingency	$168,521,891	$170,558,173	$145,731,664	$147,767,946
Escalation	$246,255,776	$249,036,272	$204,431,012	$207,211,509
I&P Charge – 3.8%	Excluded			
Total Outturn Cost	**$883,020,913**	**$892,928,395**	**$730,302,960**	**$740,210,443**
OPEX Component				
Average annual cost	$8,083,084	$8,180,753	$6,989,960	$7,087,629
Total 20 year operational cost (2036-2056)	**$151,178,779**	**$153,005,500**	**$130,733,965**	**$132,560,686**

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[Appendix H]

Rapid economic appraisal detailed results

H.1 Additional assumptions

In addition to assumptions discussed in the cost estimation and the summary report, the following assumptions have informed the economic appraisal:

- The capital costs for all the options included the construction of a light rail stop at Carter Street:
  - Capital costs included all relevant infrastructure construction costs including a 3-car rolling stock acquisition cost for the extension (rolling stock was included in the Direct Cost estimate).
  - The capital costs for Option 1 were applied to both with and without Uplift scenarios
  - Similarly, the capital costs for Option 4 were applied to both with and without Uplift scenarios
- The estimation of user benefits and externalities was based on likely market segments which might switch to light rail as a strategic transport model was not available to provide detailed demand forecasts at a corridor or origin-destination level:
  - Our benefits analysis of travel times between different modes for a given market segment found that private vehicle trips was strongly competitive given the very short distance of the proposed light rail extension (for all alignment options).
  - Without the granularity of a detailed origin-destination matrix for the study area and cost-optimisation analysis, it was not possible to capture higher levels of modal shift from car to light rail, hence the marginal levels of road-related benefits being recorded (for example road decongestion).
- The OPEX rate adopted for the cost estimate is based on a benchmark of other projects, hence assumed to include normal operating expenditure including:
  - Driver labour
  - Customer service and ticketing
  - Cleaning
  - Materials and overheads (of the light rail vehicle).
- In addition to the OPEX rate, an allowance was included for the Light Rail vehicle operating costs (VOC) in line with ATAP Guidelines. This allowance covers other elements including power costs and some "light" rolling stock maintenance costs for example repairs.

H.2 Detailed Rapid Economic Appraisal Results

	Option 1	Option 1 with uplift	Option 4	Option 4 with uplift
Benefits				
Net incremental passenger farebox revenue	$12.89	$13.34	$8.82	$9.58
Travel time savings (incl. rule of half for induced demand)	$65.04	$72.07	$32.52	$41.79
Vehicle operating cost savings –former car users	$0.26	$0.31	$0.34	$0.52
Travel time reliability benefits	-	-	-	-
Parking cost savings – for former car users	-	-	-	-
Crash cost savings (net)	$0.08	$0.09	$0.10	$0.16
Road damage cost savings	$0.04	$0.05	$0.05	$0.08
Residual values of new assets	$19.68	$19.68	$16.29	$16.30
Incremental health benefits from walking to/from tram stops	-	-	-	-
Net environmental externalities(1)	-$0.52	-$0.50	-$0.67	-$0.59
Congestion cost savings	$0.40	$0.47	$0.52	$0.80
Potential land use benefits such as avoided infrastructure costs	-	-	-	-
Total benefits(2)	$97.87	$105.50	$57.97	$68.62
Costs				
Capital costs	$297.71	$297.71	$246.44	$246.44
Recurrent costs	$22.04	$22.04	$21.25	$21.25
Total costs(2)	$319.75	$319.75	$267.69	$267.69
Economic appraisal outcomes				
Net Present Value (NPV)(2)	-$221.88	-$214.25	-$209.72	-$199.07
Benefit-cost Ratio (BCR)	0.31	0.33	0.22	0.26
Internal Rate of Return (IRR)	N/A(3)	N/A(3)	N/A(3)	N/A(3)

Notes:
(1) Comprising mainly reduced carbon emissions and air pollution
(2) Totals may not add up due to rounding errors
(3) IRR was not calculable due to irregular cash flows over the extended time horizon

H.3 Sensitivity Analysis of Appraisal Results

Scenario	Net Present Values ($m, FY2022 prices)				Benefit-Cost Ratio (BCR)			
	Option 1	Option 1 w/ Uplift	Option 4	Option 4 w/ Uplift	Option 1	Option 1 w/ Uplift	Option 4	Option 4 w/ Uplift
Core (Central Case Scenario)	**-$222**	**-$214**	**-$210**	**-$199**	**0.31**	**0.33**	**0.22**	**0.26**
Sensitivity – Discount Rates								
3% real discount rate	-$190	-$165	-$232	-$196	0.63	0.68	0.47	0.55
4% real discount rate	-$219	-$200	-$237	-$211	0.52	0.56	0.38	0.45
10% real discount rate	-$185	-$181	-$166	-$161	0.19	0.21	0.13	0.16
Sensitivity – Cost								
20% increase in capital costs at 7%	-$281	-$274	-$259	-$248	0.26	0.28	0.18	0.22
20% decrease in capital costs at 7%	-$162	-$155	-$160	-$150	0.38	0.41	0.27	0.31
40% increase in capital costs at 7%	-$341	-$333	-$308	-$298	0.22	0.24	0.16	0.19
40% decrease in capital costs at 7%	-$103	-$95	-$111	-$100	0.49	0.53	0.34	0.41
20% increase in total costs at 7%	-$286	-$278	-$263	-$253	0.26	0.27	0.18	0.21
20% decrease in total costs at 7%	-$158	-$150	-$156	-$146	0.38	0.41	0.27	0.32
Sensitivity – Benefit								
20% increase in benefits at 7%	-$206	-$197	-$201	-$189	0.35	0.38	0.25	0.30
20% decrease in benefits at 7%	-$238	-$231	-$218	-$210	0.26	0.28	0.19	0.22
Sensitivity – Patronage								
20% increase in light rail demand at 7%	-$206	-$197	-$201	-$188	0.36	0.38	0.25	0.30
20% decrease in light rail demand at 7%	-$238	-$232	-$218	-$210	0.26	0.28	0.18	0.22
Worst case scenario(1) at 7%	**-$357**	**-$351**	**-$317**	**-$308**	**0.19**	**0.20**	**0.14**	**0.16**

Notes: *(1) Assumed to be a test of 40% increase in capital costs and 20% decrease in benefits*

H.4 Rapid CBA – Discounted Cashflow Analysis Schedules

Table H.4-1 Option 1 with uplift (the project option with the highest BCR after the Base Case) - Central Case Scenario at 7% real discount rate

	NPV	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
Capex	-$297.71	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	-$107.32	-$107.32	-$107.32	-$107.32	-$107.32	-$107.32	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Infra opex & RS heavy maintenance	-$16.98	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	-$3.53	-$3.53	-$3.53	-$3.53	-$3.53	-$3.53
LR Opex (VOC)	-$2.65	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	-$0.55	-$0.55	-$0.55	-$0.55	-$0.55	-$0.55
LR Opex (Labour, ticketing)	-$2.41	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	-$0.50	-$0.50	-$0.50	-$0.50	-$0.50	-$0.50
Total project costs	**-$319.75**																					
Externalities (LR)	-$0.636	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	-$0.13	-$0.13	-$0.13	-$0.13	-$0.13	-$0.13
Externalities (Car)	$0.136	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.02	$0.02	$0.02	$0.02	$0.02	$0.02
Safety benefits	$0.091	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.01	$0.01	$0.01	$0.01	$0.01	$0.02
Congestion reduction	$0.468	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.06	$0.06	$0.07	$0.07	$0.07	$0.08
Road damage	$0.046	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01
Time travel savings	$72.070	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$9.20	$10.16	$11.17	$12.22	$12.69	$13.15
VOC savings	$0.306	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.04	$0.04	$0.04	$0.05	$0.05	$0.05
Change in farebox revenue	$13.339	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$2.27	$2.32	$2.38	$2.43	$2.48	$2.53
Residual value	$19.682	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Total benefits	**$105.501**	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$11.47	$12.49	$13.56	$14.68	$15.20	$15.73
NPV	-$214.25																					
BCR	0.33																					

	NPV	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065
Capex	-$297.71	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Infra opex & RS heavy maintenance	-$16.98	-$3.53	-$3.53	-$3.53	-$3.53	-$3.53	-$3.53	-$3.53	-$3.53	-$3.53	-$3.53	-$3.53	-$3.53	-$3.53	-$3.53	-$3.53	-$3.53	-$3.53	-$3.53	-$3.53	-$3.53	-$3.53	-$3.53	-$3.53	-$3.53
LR Opex (VOC)	-$2.65	-$0.55	-$0.55	-$0.55	-$0.55	-$0.55	-$0.55	-$0.55	-$0.55	-$0.55	-$0.55	-$0.55	-$0.55	-$0.55	-$0.55	-$0.55	-$0.55	-$0.55	-$0.55	-$0.55	-$0.55	-$0.55	-$0.55	-$0.55	-$0.55
LR Opex (Labour, ticketing)	-$2.41	-$0.50	-$0.50	-$0.50	-$0.50	-$0.50	-$0.50	-$0.50	-$0.50	-$0.50	-$0.50	-$0.50	-$0.50	-$0.50	-$0.50	-$0.50	-$0.50	-$0.50	-$0.50	-$0.50	-$0.50	-$0.50	-$0.50	-$0.50	-$0.50
Total project costs	**-$319.75**																								
Externalities (LR)	-$0.636	-$0.13	-$0.13	-$0.13	-$0.13	-$0.13	-$0.13	-$0.13	-$0.13	-$0.13	-$0.13	-$0.13	-$0.13	-$0.13	-$0.13	-$0.13	-$0.13	-$0.13	-$0.13	-$0.13	-$0.13	-$0.13	-$0.13	-$0.13	-$0.13
Externalities (Car)	$0.136	$0.02	$0.03	$0.03	$0.03	$0.03	$0.03	$0.03	$0.03	$0.03	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.05
Safety benefits	$0.091	$0.02	$0.02	$0.02	$0.02	$0.02	$0.02	$0.02	$0.02	$0.02	$0.02	$0.02	$0.03	$0.03	$0.03	$0.03	$0.03	$0.03	$0.03	$0.03	$0.03	$0.03	$0.03	$0.03	$0.03
Congestion reduction	$0.468	$0.08	$0.09	$0.09	$0.10	$0.10	$0.10	$0.11	$0.11	$0.12	$0.12	$0.13	$0.13	$0.13	$0.14	$0.14	$0.14	$0.15	$0.15	$0.15	$0.15	$0.15	$0.15	$0.15	$0.16
Road damage	$0.046	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01	$0.02	$0.02
Time travel savings	$72.070	$13.62	$14.08	$14.55	$15.02	$15.48	$15.95	$16.41	$16.88	$17.34	$17.81	$18.27	$18.74	$19.20	$19.67	$20.13	$20.34	$20.55	$20.76	$20.97	$21.18	$21.39	$21.60	$21.81	$22.02
VOC savings	$0.306	$0.05	$0.06	$0.06	$0.06	$0.07	$0.07	$0.07	$0.07	$0.08	$0.08	$0.08	$0.08	$0.09	$0.09	$0.09	$0.09	$0.10	$0.10	$0.10	$0.10	$0.10	$0.10	$0.10	$0.10
Change in farebox revenue	$13.339	$2.59	$2.64	$2.69	$2.74	$2.80	$2.85	$2.90	$2.95	$3.00	$3.06	$3.11	$3.16	$3.21	$3.27	$3.32	$3.35	$3.39	$3.42	$3.46	$3.49	$3.53	$3.56	$3.60	$3.63
Residual value	$19.682	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$386.34
Total benefits	**$105.501**	$16.26	$16.79	$17.31	$17.84	$18.37	$18.89	$19.42	$19.95	$20.48	$21.00	$21.53	$22.06	$22.59	$23.11	$23.64	$23.89	$24.14	$24.38	$24.63	$24.88	$25.13	$25.37	$25.62	$412.20
NPV	-$214.25																								
BCR	0.33																								

Table H.4-2 Option 4 with uplift (the project option with the highest NPV after the Base Case) - Central Case Scenario at 7% real discount rate

	NPV	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
Capex	-$246.44	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	-$88.83	-$88.83	-$88.83	-$88.83	-$88.83	-$88.83	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Infra opex & RS heavy maintenance	-$14.71	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	-$3.06	-$3.06	-$3.06	-$3.06	-$3.06	-$3.06
LR Opex (VOC)	-$3.43	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	-$0.71	-$0.71	-$0.71	-$0.71	-$0.71	-$0.71
LR Opex (Labour, ticketing)	-$3.12	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	-$0.65	-$0.65	-$0.65	-$0.65	-$0.65	-$0.65
Total project costs	**-$267.69**																					
Externalities (LR)	-$0.822	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	-$0.17	-$0.17	-$0.17	-$0.17	-$0.17	-$0.17
Externalities (Car)	$0.232	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.02	$0.02	$0.02	$0.03	$0.03	$0.03
Safety benefits	$0.156	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.01	$0.01	$0.02	$0.02	$0.02	$0.02
Congestion reduction	$0.800	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.06	$0.07	$0.09	$0.10	$0.11	$0.12
Road damage	$0.078	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01
Time travel savings	$41.787	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$4.66	$5.26	$5.88	$6.55	$6.90	$7.25
VOC savings	$0.523	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.04	$0.05	$0.06	$0.06	$0.07	$0.08
Change in farebox revenue	$9.576	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.59	$1.63	$1.68	$1.72	$1.76	$1.80
Residual value	$16.293	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Total benefits	**$68.624**	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$6.23	$6.88	$7.58	$8.31	$8.73	$9.15
NPV	-$199.07																					
BCR	0.26																					

	NPV	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065
Capex	-$246.44	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Infra opex & RS heavy maintenance	-$14.71	-$3.06	-$3.06	-$3.06	-$3.06	-$3.06	-$3.06	-$3.06	-$3.06	-$3.06	-$3.06	-$3.06	-$3.06	-$3.06	-$3.06	-$3.06	-$3.06	-$3.06	-$3.06	-$3.06	-$3.06	-$3.06	-$3.06	-$3.06	-$3.06
LR Opex (VOC)	-$3.43	-$0.71	-$0.71	-$0.71	-$0.71	-$0.71	-$0.71	-$0.71	-$0.71	-$0.71	-$0.71	-$0.71	-$0.71	-$0.71	-$0.71	-$0.71	-$0.71	-$0.71	-$0.71	-$0.71	-$0.71	-$0.71	-$0.71	-$0.71	-$0.71
LR Opex (Labour, ticketing)	-$3.12	-$0.65	-$0.65	-$0.65	-$0.65	-$0.65	-$0.65	-$0.65	-$0.65	-$0.65	-$0.65	-$0.65	-$0.65	-$0.65	-$0.65	-$0.65	-$0.65	-$0.65	-$0.65	-$0.65	-$0.65	-$0.65	-$0.65	-$0.65	-$0.65
Total project costs	**-$267.69**																								
Externalities (LR)	-$0.822	-$0.17	-$0.17	-$0.17	-$0.17	-$0.17	-$0.17	-$0.17	-$0.17	-$0.17	-$0.17	-$0.17	-$0.17	-$0.17	-$0.17	-$0.17	-$0.17	-$0.17	-$0.17	-$0.17	-$0.17	-$0.17	-$0.17	-$0.17	-$0.17
Externalities (Car)	$0.232	$0.04	$0.04	$0.04	$0.05	$0.05	$0.05	$0.06	$0.06	$0.06	$0.07	$0.07	$0.07	$0.08	$0.08	$0.08	$0.08	$0.08	$0.09	$0.09	$0.09	$0.09	$0.09	$0.09	$0.09
Safety benefits	$0.156	$0.03	$0.03	$0.03	$0.03	$0.03	$0.04	$0.04	$0.04	$0.04	$0.04	$0.05	$0.05	$0.05	$0.05	$0.06	$0.06	$0.06	$0.06	$0.06	$0.06	$0.06	$0.06	$0.06	$0.06
Congestion reduction	$0.800	$0.13	$0.14	$0.15	$0.16	$0.17	$0.18	$0.20	$0.21	$0.22	$0.23	$0.24	$0.25	$0.26	$0.27	$0.28	$0.29	$0.29	$0.30	$0.30	$0.30	$0.31	$0.31	$0.31	$0.31
Road damage	$0.078	$0.01	$0.01	$0.01	$0.02	$0.02	$0.02	$0.02	$0.02	$0.02	$0.02	$0.02	$0.02	$0.03	$0.03	$0.03	$0.03	$0.03	$0.03	$0.03	$0.03	$0.03	$0.03	$0.03	$0.03
Time travel savings	$41.787	$7.61	$7.96	$8.32	$8.67	$9.02	$9.38	$9.73	$10.09	$10.44	$10.79	$11.15	$11.50	$11.86	$12.21	$12.56	$12.89	$12.83	$12.96	$13.09	$13.22	$13.35	$13.48	$13.61	$13.74
VOC savings	$0.523	$0.08	$0.09	$0.10	$0.11	$0.11	$0.12	$0.13	$0.14	$0.14	$0.15	$0.16	$0.16	$0.17	$0.18	$0.19	$0.19	$0.19	$0.19	$0.19	$0.20	$0.20	$0.20	$0.20	$0.20
Change in farebox revenue	$9.576	$1.84	$1.88	$1.93	$1.97	$2.01	$2.05	$2.09	$2.14	$2.18	$2.22	$2.26	$2.30	$2.34	$2.39	$2.43	$2.45	$2.48	$2.50	$2.53	$2.55	$2.58	$2.60	$2.63	$2.65
Residual value	$16.293	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$319.80
Total benefits	**$68.624**	$9.57	$9.99	$10.41	$10.83	$11.25	$11.67	$12.09	$12.51	$12.93	$13.35	$13.77	$14.19	$14.62	$15.04	$15.46	$15.82	$15.78	$15.94	$16.11	$16.27	$16.43	$16.59	$16.76	$336.72
NPV	-$199.07																								
BCR	0.26