

Appendix B

Traffic, Transport and Access Impact Assessment



Sydney CBD and South East Light Rail **Proposed Modifications to the UNSW High Street Stop and the Randwick Terminus** Traffic, Transport and Access Impact Assessment

Client // Transport for NSW
Office // NSW
Reference // 14S9035138
Date // 25/11/15

Sydney CBD and South East Light Rail

Proposed Modifications to the UNSW High Street Stop and the Randwick Terminus

Traffic, Transport and Access Impact Assessment

Issue: B 25/11/15

Client: Transport for NSW
Reference: 14S9035138
GTA Consultants Office: NSW

Quality Record

Issue	Date	Description	Prepared By	Checked By	Approved By	Signed
A	27/10/15	Final	R Manahan O Faiz	R Dus	C Wilson	C Wilson
B	25/11/15	Revised following TfNSW comments	R Manahan	D van den Dool	C Wilson	

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Glossary of Terms

Term	Meaning
AADT	Annual Average Daily Traffic
ABS	Australian Bureau of Statistics
AIMSUN	From "Advanced Interactive Microscopic Simulator for Urban and Non-Urban Networks". AIMSUN is a computer-based transport simulation software package developed by Transport Simulation Systems (TSS) Inc., and is used for travel demand and traffic data analysis, planning and traffic simulation.
AS	Australian Standards
BTS	Bureau of Transport Statistics, a division of Transport for NSW
CBD	Central Business District
CEMP	Construction Environmental Management Plan
CSELR	Sydney Central Business District and South East Light Rail Project
CTMP	Construction Traffic Management Plan
DDA	<i>Disability Discrimination Act 1992</i>
DoS	Degree of Saturation
DP&E	New South Wales Department of Planning and Environment
DSAPT	Disability Standards for Accessible Public Transport
EIS	Environmental Impact Study
EP&A Act	<i>Environmental Planning and Assessment Act 1979</i>
HV	Heavy vehicles
JTW	Journey to Work
Hybrid transport model	Typically refers to a hybrid mesoscopic-microscopic model that applies microscopic simulation to areas of specific interest, while simulating a surrounding network in lesser detail with a mesoscopic model. (Refer to other definitions below.)
Km	kilometres
km/h	kilometres per hour
LEP	Local Environmental Plan
LGA	Local Government Area
LOS	Level of Service – a qualitative measure of traffic flow and crowding, with LOS A characterised by free flow and LOS F by forced flow or breakdowns.
LRV	Light rail vehicle
m	metres
Mesoscopic simulation	Refers to a coarser level of detail in transport and traffic simulation modelling compared with microsimulation (refer below) that analyse transport elements in small groups, but easier to apply, calibrate and validate compared to microsimulation models. Mesoscopic models are typically used for larger study areas.
Microsimulation	Refers to the 'microscopic' level of traffic modelling and simulation, in which individual elements of the traffic stream, such as vehicles and/or pedestrians, is represented and analysed. It provides the greatest detail on individual movements, and are best applied to small areas, as microsimulation of large areas require significant inputs to calibrate and validate the model.
min	minutes
mm	millimetres
NSW	State of New South Wales
OOHW	Out of Hours Works
RMS	Roads and Maritime Services (formerly Roads and Traffic Authority)

continued

Term	Meaning
Roads Act	Roads Act 1993
SCATS	Sydney Coordinated Adaptive Traffic System (SCATS®) – a system developed by the Roads and Traffic Authority of New South Wales (now Roads and Maritime Services) to operate and coordinate a network of traffic signals.
SCATSIM	SCATS Simulation – a software package that allows a replication and integration the SCATS® system to be linked to a transport simulation software package for modelling purposes, to ensure all signals within the model are operating realistically and are capable of an adaptive response to prevailing traffic conditions.
SCCAS	Sydney City Centre Access Strategy (NSW Government, 2013).
Screenline	An imaginary line in a transport network used as a reference section across which traffic flows are measured.
sec	seconds
SSI	State Significant Infrastructure
TCP	Traffic Control Plan
Sub-area	A sub-set of a larger transport model for which more detailed modelling is undertaken.
TfNSW	Transport for New South Wales
TT&AIA	Traffic, Transport and Access Impact Assessment (this report)
UNSW	University of New South Wales

Executive Summary

Background

Since approval (as previously modified) of the Sydney Central Business District (CBD) & South East Light Rail Project (CSELR) by the Minister for Planning on 17 February 2015, ongoing design development and stakeholder consultation has taken place. This stakeholder consultation has highlighted the need to improve the design for the UNSW High Street stop and the Randwick Terminus light rail facilities, and develop measures to address these issues.

Transport for NSW engaged a team of specialists to investigate and assess the impacts of the proposed modifications to the approved project design ('approved Project') and inform the preparation of a Modifications Report.

GTA Consultants was tasked by TfNSW to undertake a Transport, Traffic and Access Impact Assessment (TT&AIA) to investigate the impacts of the proposed modifications during both the end-state and the construction stage, to identify potential issues and recommend mitigation measures.

Proposed modifications

The proposed modifications being assessed in this report largely includes:

- relocation and re-design of the Randwick terminus stop
- reconfiguration of the UNSW High Street stop arrangement
- provision of a new access laneway from Arthur Street to properties on High Street as a result of the new UNSW High Street stop configuration
- some changes to the local traffic network to accommodate the modified stops, including introduction of a one-way westbound section on High Street between Wansey Road and Botany Street, introduction of a one-way eastbound section on High Street between Clara Street and Avoca Street, minor changes to bus routes and stops, and installation of new traffic lights at the following intersections:
 - Botany Street/ Arthur Street
 - Arthur Street/ Belmore Road
 - Botany Street/ Barker Street.
- revised arrangement for the High Cross Park interchange, including relocated bus stops.

Impacts of modifications

The proposed modifications will result in the following key impacts:

- Light rail stop access
 - changes in access to the UNSW High Street stop will require customers using the northern platform and walking to/from UNSW to cross the full width of High Street, compared with a shorter crossing in the approved Project. This will have potential impacts to signal phasing of the Wansey Road/ High Street intersection and corresponding traffic operations.
 - The modified UNSW High Street stop will improve free flow of passengers, with the separation of the northern and southern platforms.

- The modified Randwick terminus stop will no longer require light rail passengers to cross either Avoca Street, Cuthill Street, or Belmore Road to access the stop.
- Interchange function
 - The proposed modification of the Randwick terminus stop will remove the opportunity for direct bus-light rail interchange at High Cross Park. Interchanging passengers will need to walk longer distances to transfer modes.
- Traffic network operation
 - The traffic rerouting will result in general increases in average traffic delays at the key intersections.
- Traffic flows
 - The proposed modifications will require traffic along High Street to reroute, with majority shifting to use Arthur Street, increasing Year 2021 peak hour traffic volumes to between one quarter and 3.5 times the volumes in the approved Project.
 - Other roads expected to experience increased AM peak traffic volumes include southbound Anzac Parade between High Street and Barker Street, eastbound Barker Street northbound Botany Street between Barker Street and High Street, Belmore Road and Alison Road.
 - During the PM peak, traffic volume increases are expected along north/westbound Alison Road, northbound Belmore Road and Avoca Street.
- Travel times
 - Travel times throughout the study area for selected routes along Alison Road, Anzac Parade and High Street are generally consistent between the approved Project and the modified Project scenarios.
- Kerbside parking
 - The proposed modifications will reduce the availability of kerbside parking in the study area.
 - Impacts on Arthur Street indicate a loss of 52 spaces.
- Bus travel times
 - Redirecting the High Street bus routes via Arthur Street will increase inbound bus travel times in the AM peak with the proposed modifications.
 - The bus travel times in the PM peak outbound direction will not significantly increase from with the proposed modification. Two of the three routes investigated would experience shorter travel times with the proposed modifications.
- Cycling
 - The closure of the eastbound lane on High Street between Wansey Road and Botany Street and the westbound lane between Clara Street and Avoca Street will require further investigation to alternate cycle routes in the precinct.
 - Opportunities to use Arthur Street as alternate cycle routes have been previously identified by Council and in the EIS. However, with the proposed modifications, traffic volumes along Arthur Street will be expected to increase, negatively impacting on opportunities for cycle routes through Arthur Street.
- Property Access
 - The proposed relocation of the UNSW High Street stop will require closure of vehicular access to four properties on High Street. To maintain access, a new laneway from Arthur Street is proposed.

- Emergency vehicle access through High Street will be maintained with emergency vehicles responding to emergencies being allowed to use the light rail tracks where the road section of High Street is closed to general traffic. These include the westbound direction between Avoca Street and Clara Street, and eastbound direction between Wansey Road and Botany Street.
- Construction Impacts
 - The proposed modification will reduce the construction footprint required at High Cross Park.
 - The proposed modifications would no longer require the closure of Avoca Street to allow for light rail track construction, as these tracks would terminate on High Street west of Avoca Street.

1. Introduction

1

1.1 Background

The Sydney CBD and South East Light Rail (CSELR) project was identified as a key priority transport infrastructure project for the NSW Government in the *NSW Long Term Transport Master Plan*. *Sydney's Light Rail Future* presents the NSW Government's plan to expand light rail in Sydney.

The CSELR Project was declared Critical State Significant Infrastructure (SSI) by the NSW Minister for Planning on 25 June 2013. Part 5.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) establishes an assessment and approval regime for SSI developments. Accordingly, an Environmental Impact Statement was exhibited from 14 November 2013 to 16 December 2013. A subsequent Submissions Report (incorporating a preferred infrastructure report) was prepared and submitted to the Department of Planning and Infrastructure (now the Department of Planning and Environment) in March 2014. Planning approval was granted by the Minister for Planning under Part 5.1 of the EP&A Act on 4 June 2014.

In 2014, a number of changes were made to the design of the approved Project, which included the use of longer light rail vehicles (LRVs), changes to the alignment and stop arrangements, the removal of one stop in the Sydney CBD, and revised construction methodology for the some sections of the alignment. These modifications were approved by the Minister for Planning on 17 February 2015.

Further investigations and consultation with stakeholders undertaken in 2015 after the approval of the 2014 modifications have been proposed to the design of the CSELR project, to enable the project to consider the most current conditions along the corridor.

This Traffic, Transport and Access Impact Assessment (TT&AIA) covers the following proposed modifications to the approved CSELR Project:

- relocation and re-design of the Randwick terminus stop
- reconfiguration of the UNSW High Street stop arrangement
- provision of a new access laneway from Arthur Street to properties on High Street as a result of the new UNSW High Street stop configuration
- some changes to the local traffic network to accommodate the modified stops, including introduction of a one-way westbound section on High Street between Wansey Road and Botany Street, introduction of a one-way eastbound section on High Street between, Clara Street and Avoca Street, minor changes to bus routes and stops, and installation of new traffic lights at the following intersections:
 - Botany Street/ Arthur Street
 - Arthur Street/ Belmore Road
 - Botany Street/ Barker Street
- revised arrangements for the High Cross Park interchange, including relocated bus stops.

This report documents the findings of the assessment.

1.2 Purpose of this assessment

This TT&AIA report sets out an assessment of the anticipated traffic, transport and access impacts of the proposed modifications to the CSELR project. The assessment covers the change in impacts between the approved Project configuration and the modified Project during both the end-state and the construction stage, including consideration of the following:

- road network operating conditions
- traffic flow changes
- vehicular access and egress requirements
- kerbside parking availability
- bus operations in the precinct
- pedestrian and cyclist flows
- access arrangements for a number of private and institutional properties.

1.3 Assessment approach

The assessment of the impacts of the proposed modifications has been undertaken through a review of the traffic, transport and access impacts of the approved design for the Randwick Terminus and the High Street Stop, as identified in:

- *CBD and South East Light Rail Environmental Impact Statement* (CSELR EIS – Parsons Brinckerhoff, November 2013)
- *CSELR Submissions Report - Incorporating Preferred Infrastructure Report* (Parsons Brinckerhoff, March 2014)
- *CSELR Modifications Report* (Parsons Brinckerhoff, December 2014)
- *CSELR Submissions Report to Project Modification* (Parsons Brinckerhoff, March 2015).

Descriptions of the proposed modifications have been developed on the basis of information provided by Transport for NSW.

1.4 Report structure

Following this introduction, the remainder of this document is structured as follows:

Chapter 2 – Transport context

Chapter 3 – Proposed modifications

Chapter 4 – Changes in end-state impacts arising from modifications

Chapter 5 – Changes in construction-stage impacts

Chapter 6 – Summary.

2. Transport context

2

2.1 Assessment approach

For the purpose of this assessment, a computer-based transport simulation model previously developed for the evaluation of the CSELR in 2012 has been used. The CSELR model is an area-wide AIMSUN¹ mesoscopic model operating with SCATSIM² signal control that allows for dynamic simulation of an area large enough to account for regional route diversion.

Given the direct relationship between the CSELR project and this assessment, a sub-area model of the road network surrounding the proposed modification has been traversed from the wider CSELR model to include the above mentioned key diversionary routes, arterial corridors and intersections. This sub-area network was run using hybrid simulation (at the mesoscopic and microscopic simulation levels) and has been refined to form a more robust base from which the testing of the scenario corresponding to the proposed modifications has been based upon.

One of the main benefits of this approach is that the sub-area network would still consider the broad level traffic impacts of the area wide model external to the sub-area, while enabling a more detailed and refined assessment of the smaller scale sub-area.

2.2 Study Area

The study area for this assessment follows the AIMSUN transport model sub-area developed to assess traffic, transport and access impacts on the High Street corridor.

Figure 2.1 shows the extents of the High Street sub-area transport model, which correlates to the study area adopted for this assessment. Also shown for reference is the South East sub-area developed in 2012 from the wider CBD and South East AIMSUN model.

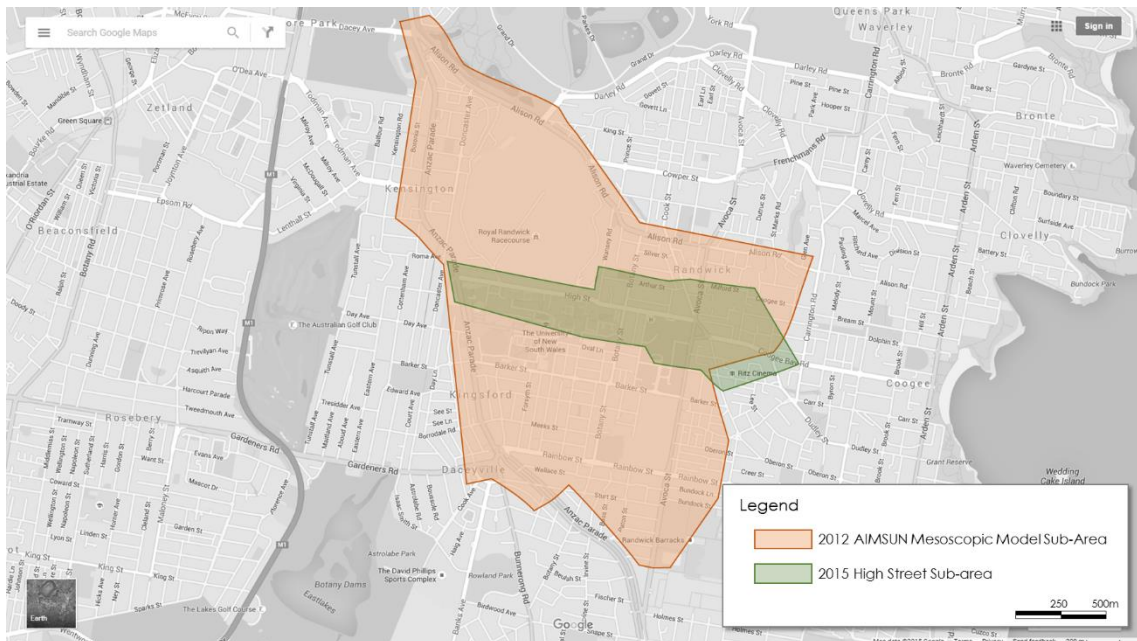
This assessment focuses on the High Street corridor between Wansey Road and Belmore Road, as well as the Randwick transport interchange precinct, including the road network surrounding High Cross Park.

The assessment also considers, to a lesser extent, the impacts of the proposed modifications on the arterial roads in the vicinity of the study area, i.e. Alison Road and Anzac Parade.

¹ AIMSUN (from "Advanced Interactive Microscopic Simulator for Urban and Non-Urban Networks" – a computer-based transport simulation software package developed by Transport Simulation Systems (TSS) Inc., and is used for travel demand and traffic data analysis, planning and traffic simulation.

² SCATS Simulation – a software package that allows a replication and integration the SCATS® system to be linked to a transport simulation software package for modelling purposes, to ensure all signals within the model are operating realistically and are capable of an adaptive response to prevailing traffic conditions. It provides a true image of the live SCATS network including Traffic Signal Controllers at each intersection.

Figure 2.1: Extents of sub-area transport model



Map Source: Google Maps

2.3 Road network

Table 2.1 provides a description of the key roads comprising the main network elements assessed in the study area, including the key external arterial roads (Anzac Parade and Alison Road), the High Street sub-area road network and adjacent roads likely to be impacted by the proposed modifications.

Table 2.1: Key Roads in Study Area Network

Road Name	Functional Hierarchy Classification [1]	General Configuration	Speed Limit, km/h	Other Characteristics
Alison Road	Arterial	2 lanes per direction with kerbside parking, with localised widening for turn bays	60	Narrow central median separates the two directions of traffic. The section between Doncaster Avenue and John Street is provided with a pedestrian barrier fence along the median and along the southern footpath.
Anzac Parade	Arterial	2 lanes per direction with time restricted kerbside parking land converting to bus lane during peak periods. Localised widening provided for for turn bays	60	Central median separates the two directions of traffic
High Street	Collector	1 lane in each direction with kerbside parking	50	Kerbside parking converts to bus zones or travel lanes at approaches to key intersections.
Belmore Road	Sub-arterial	Between Alison Road and High Street, it contains 1 lane in each direction with kerbside parking. Between High Street and Coogee Bay Road, it is one-way, 2 lane road with kerbside parking.	50	Belmore Road functions as the main retail shopping strip of Randwick, between Avoca Street and Alison Road.
Avoca Street	Arterial	1 lane in each direction with kerbside parking	60	School Zone between Mears Ave and Albert St
Wansey Road	Collector	1 lane in each direction with kerbside parking	50	Parallel kerbside parking allowed both sides tends to constrict flows. No centreline is marked. Existing kerbside parking arrangements will altered as part of the approved Project.
Botany Street	Sub-arterial	1 lane in each direction with kerbside parking	50	Indicated as bicycle route in Randwick Council bike plan.
Coogee Bay Road	Sub-arterial	1 lane in each direction with kerbside parking	60	Main access to Cogee
Arthur Street	Local	1 lane in each direction with kerbside parking	50	Parking comprises of both parallel and 90 degree angle parking
Clara Street	Local	1 lane in each direction with kerbside parking	50	Currently used as link between High Street and Belmore Avenue by a number of bus routes
Barker Street	Collector	1 lane in each direction with kerbside parking	50	Secondary east-west link used as an alternative to High Street

[1] Based on Randwick City Council Road Hierarchy

A number of other local roads provide property access to individual developments. These are not envisioned to be impacted by the proposed modifications, and have not been assessed in further detail.

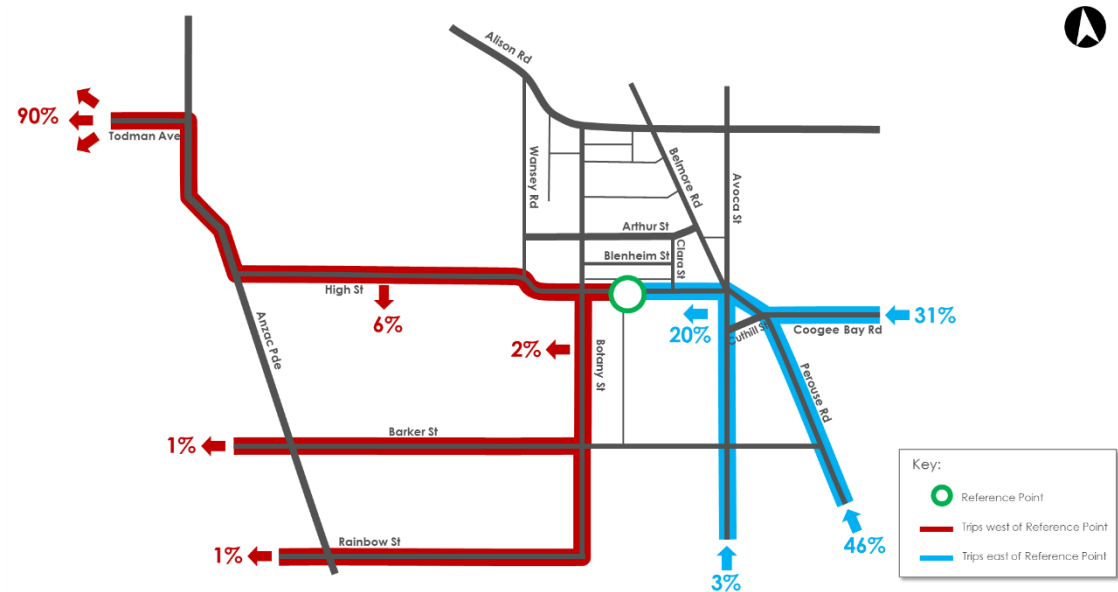
2.4 Trip demand patterns

In order to understand the level of potential changes in travel patterns as well as the type of trips that are most likely to be affected relating to potential trip and traffic diversion and redirection as a result of the proposed modifications, a review of Year 2021 trips expected to pass through the study area in the approved Project scenario was undertaken with the use of the AIMSUN model. A point located near the intersection of High Street and Botany Street has been selected as reference for this analysis of trip patterns.

The results diagrammatically shown in Figure 2.2 to Figure 2.5 illustrate the trip pattern distribution for the approved Project scenario for inbound (towards the CBD) and outbound (from the CBD) trips through the designated reference point, for both the AM and PM peaks.

The figures indicate that a majority of the eastbound and westbound trips along High Street in the approved Project scenario originate around the Todman Avenue zone to the west of Anzac Parade. There is also a relatively large proportion of trips, mainly in the PM peak, that originate from other areas to the west of Anzac Parade in the vicinity of Barker Street and roads to the south. It is important to note that those trips are not necessarily only short distance trips (local to local zones) and those trips are also likely to include long distance trips to areas outside of the CSELR model area.

Figure 2.2: Distribution of inbound trips (towards CBD) – Approved Project Scenario, AM Peak



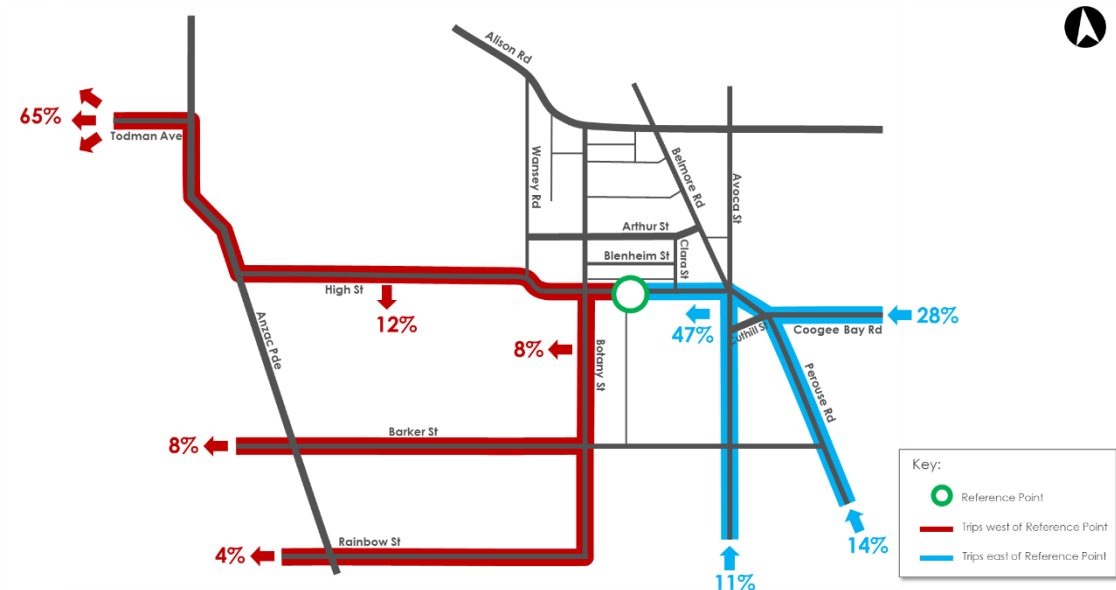
Note: not to scale

Figure 2.3: Distribution of outbound trips (from CBD) – Approved Project Scenario, AM Peak



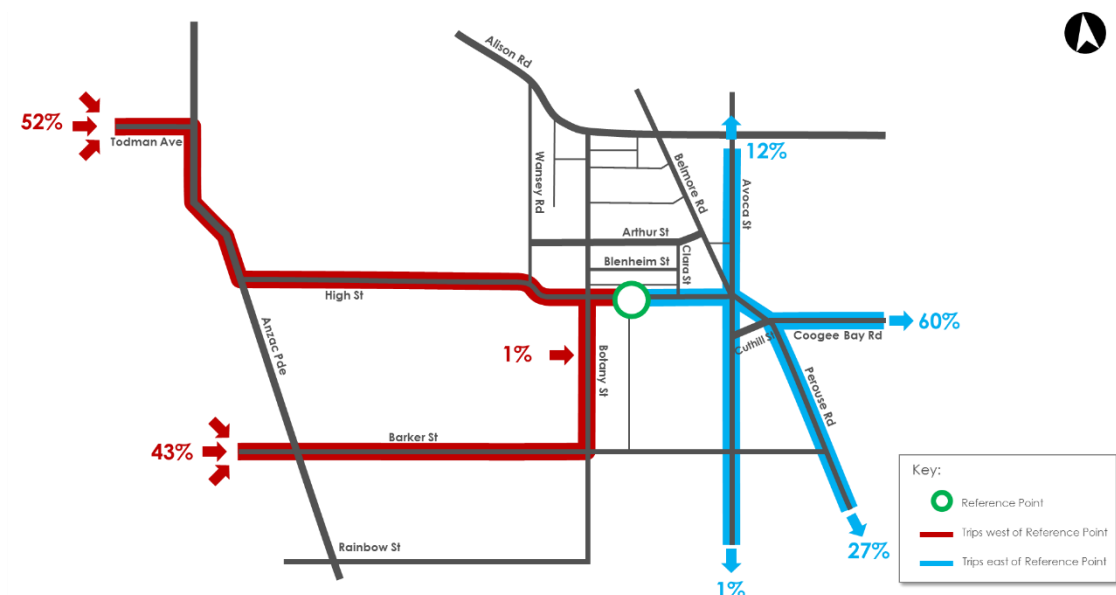
Note: not to scale

Figure 2.4: Distribution of inbound trips (towards CBD) – Approved Project Scenario, PM Peak



Note: not to scale

Figure 2.5: Distribution of outbound trips (from CBD) – Approved Project Scenario, PM Peak



Note: not to scale

2.5 Intersection operations

The commonly used measure of intersection performance, as defined by Roads and Maritime Services (RMS), is “average vehicle delay”. Table 2.2 shows the criteria that typically adopted in assessing the operation of an intersection.

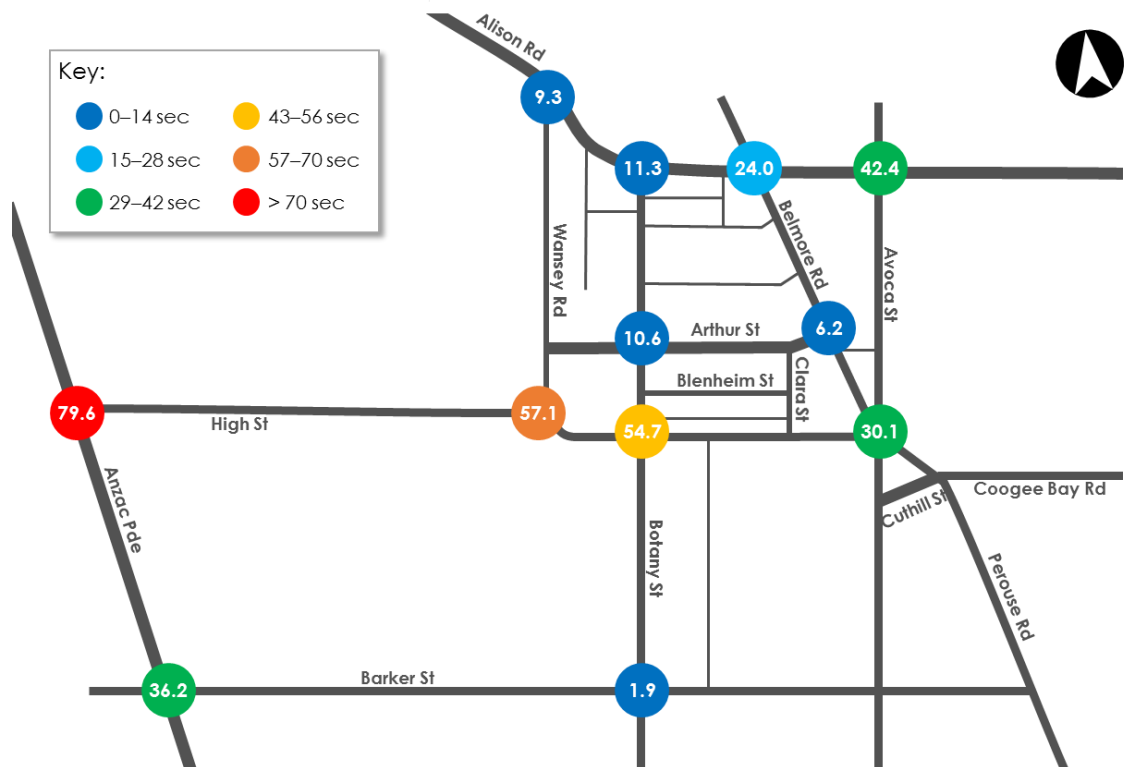
Table 2.2: Operational Criteria for Intersection Operation

Average Delay per vehicle (seconds/vehicle)	Traffic Signals, Roundabout	Give Way & Stop Sign
Less than 14	Good operation	Good operation
15 to 28	Good with acceptable delays and spare capacity	Acceptable delays and spare capacity
29 to 42	Satisfactory	Satisfactory, but accident study required
43 to 56	Near capacity	Near capacity, accident study required
57 to 70	At capacity, at signals incidents will cause excessive delays	At capacity, requires other control mode
Greater than 70	Extra capacity required	Extreme delay, major treatment required

Source: Roads and Maritime Services

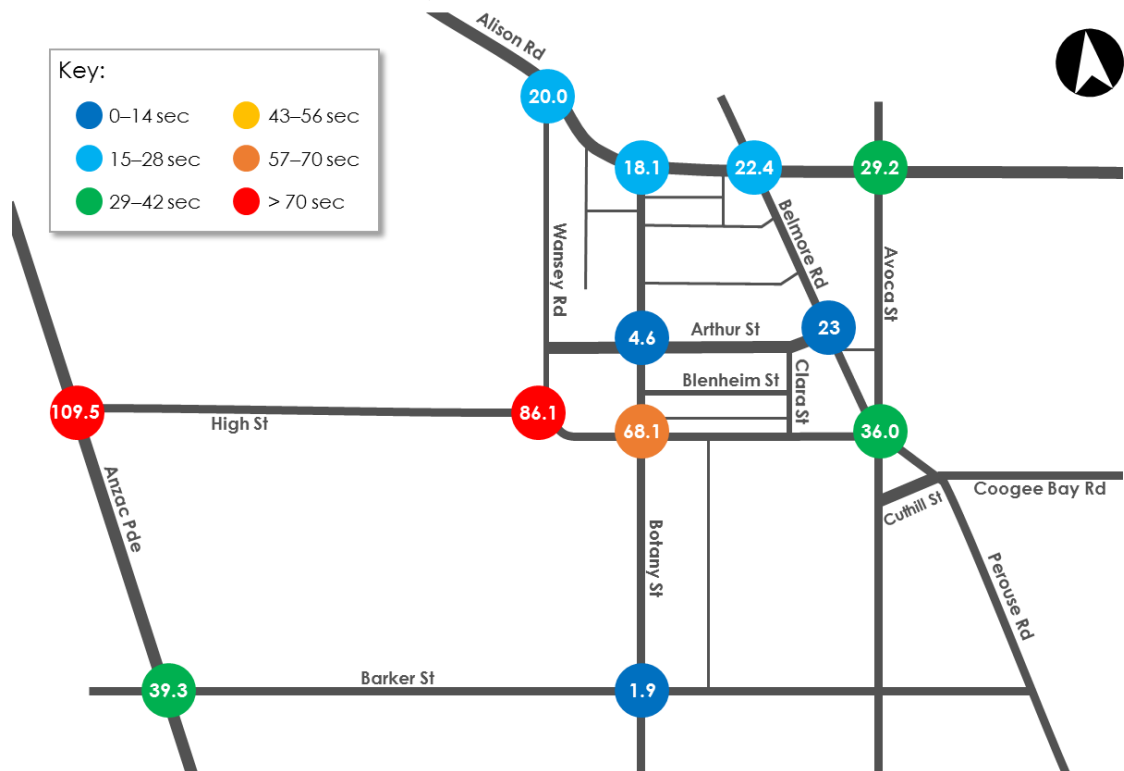
The average intersection delay levels corresponding to the Year 2021 AM and PM peak periods under the approved Project scenario for the key intersections in the study area are respectively shown in Figure 2.6 and Figure 2.7.

Figure 2.6: Average intersection delays for 'Approved Project' scenario – AM Peak



Note: not to scale

Figure 2.7: Average intersection delays for 'Approved Project' scenario – PM Peak



Note: not to scale

2.6 Bus operations

In line with the CSELR project, bus service changes were developed in parallel with the Sydney City Centre Access Strategy (SCCAS), prepared in 2013.

The detailed bus strategy is documented in the SCCAS. While focused on the CBD, the bus service changes affecting High Street and the Randwick precinct are summarised in Table 2.3.

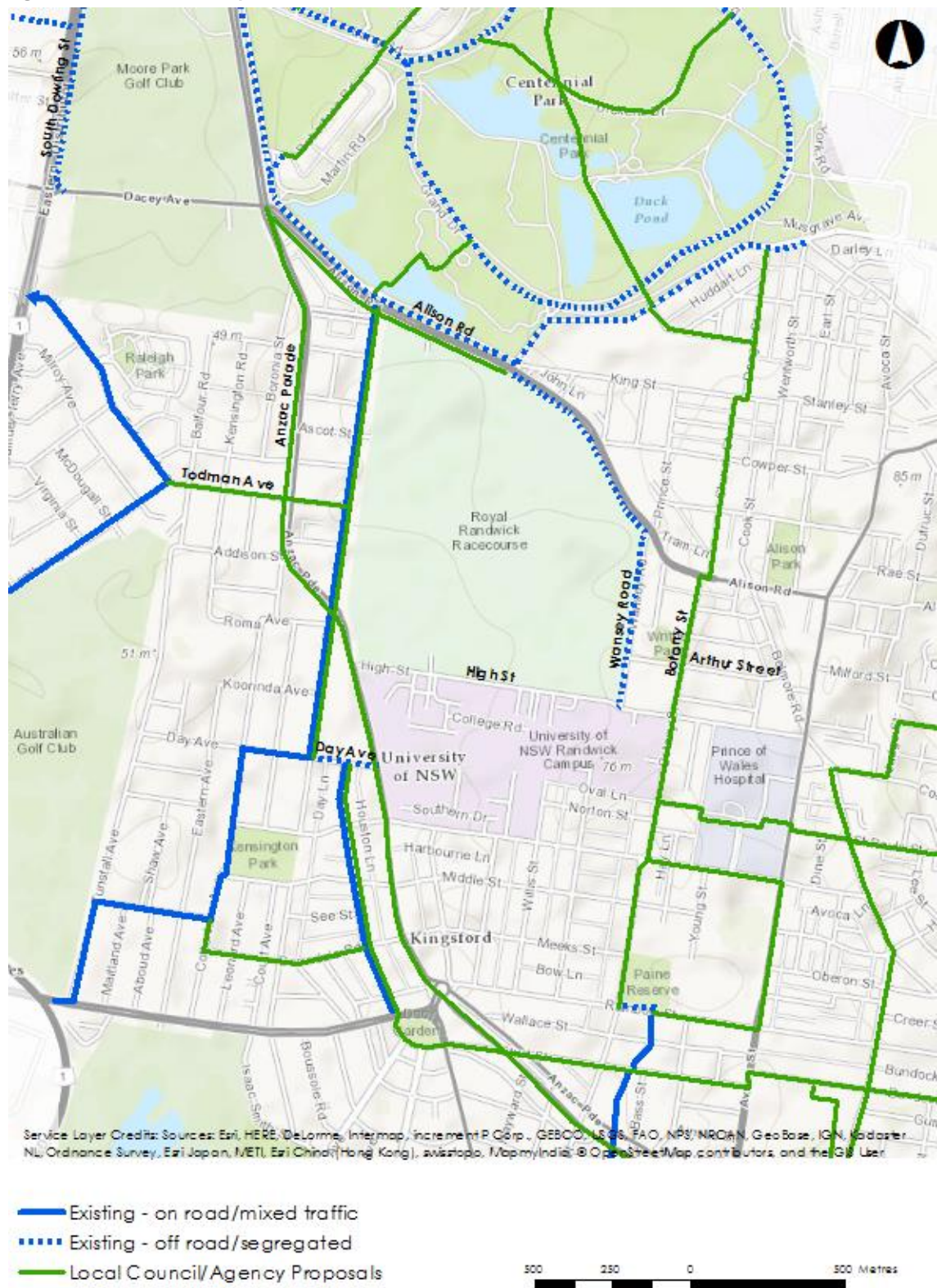
Table 2.3: High Street/ Randwick Bus Network

Route Number	Old (Pre SCCAS) Route	SCCAS Bus Plan
370	Coogee-MarketPlace Leichhardt via Newtown	Route operates as existing
372	Coogee-Railway Square via Cleveland Street	Coogee-Railway Square via Cleveland Street, through routed with 412/413 to align with the city centre bus network redesign
373	Coogee-Circular Quay via Oxford Street	Route cancelled
375	N/A	New service operating Maroubra Beach-Sydney University via Randwick Junction, High Street and Todman Avenue
376	Maroubra Beach-Circular Quay via Marine Parade, Alison Road and Foveaux Street	Route cancelled, replaced with 375
377	Maroubra Beach-Circular Quay via Marine Parade, Alison Road and Oxford Street	Operates existing route to Alison Road via Belmore Road and terminates
M50	Metrobus route between Maroubra Junction and Leichhardt	Will no longer operate in the Eastern Suburbs to align with the Sydney city centre bus network redesign

2.7 Bicycle network

Randwick City Council and Roads and Maritime Services are responsible for bicycle facilities and infrastructure in the study area. A review of the Randwick Bike Plan has been previously undertaken as part of the CSELR project, and in consultation with Randwick City Council (among other stakeholders). A draft bicycle network map corresponding to changes that would be brought about by the CSELR (including potential changes in cycling demand patterns as a result of the approved Project) is shown in Figure 2.8.

Figure 2.8: Randwick Bicycle Network



Source: Draft CSELR Pedestrian and Cyclist Network and Facilities Strategy (GTA Consultants, 2015).

2.8 Pedestrian activity

Footpaths are provided along both sides of streets in the study area, though some are narrow (less than 1.5m) or obstructed by poles, signage, bins or landscaping.

Figure 2.9 shows key pedestrian activity areas in the study area. These are generated by:

- Randwick Centre: commercial area at Belmore Road shops, businesses, on-street parking, schools, local residences.
- The Spot: local shops and cafes and restaurants, movie theatre, on-street parking, schools, local residences.
- Hospital Precinct: on-street parking, commercial area.
- UNSW: on-street and off-street parking, local residences.

Movements to/from existing bus stops in each of the key activity areas also generate strong desire lines:

- Randwick Centre: informal pedestrian movements across Belmore Street between bus stops.
- The Spot: informal pedestrian movements across Perouse Road between bus stops, shops / cafes and residences.
- Prince of Wales Hospital: pedestrians cross High Street close to the bus stop – the formal crossings are located too far away.
- UNSW: pedestrians cross at the signalised crossing – key desire lines are cut off by median fencing.

At Belmore Road, Avoca Street and High Street, only a few pedestrian crossings along main desire lines are signalised. At desirable crossing locations, no pedestrian crossings are provided - pedestrians cross informally along desire lines.

The approved Project is expected to alter pedestrian desire lines, focusing on the light rail stops. For the UNSW High Street stop, key pedestrian activity will mainly be student demand between the stop and the campus, with a concentration of pedestrians crossing High Street near Wansey Road.

At the Randwick stop, the approved Project will contribute towards an increased number of pedestrians crossing Avoca Street south of High Street, walking between the light rail stop and the Prince of Wales Hospital precinct.

2.9 Approved light rail track alignment

As part of the approved Project, the light rail alignment along High Street would be located in the centre of the street formation between Wansey Road and Avoca Street before turning south at the junction with Avoca Street to a stop with an interchange within High Cross Park.

Correspondingly, one eastbound lane and one westbound traffic lane would be maintained on either side of the light rail alignment along the length of High Street between Wansey Road and the Avoca Street/Belmore Road intersection.

Figure 2.9: Key Pedestrian Activity Areas (existing)



3. Proposed modifications

3.1 Summary of proposed modifications

This Traffic, Transport and Access Impact Assessment (TT&AIA) has been prepared to investigate the implications of the following proposed modifications to the CSELR project:

- relocation and re-design of the Randwick terminus stop
- reconfiguration of the UNSW High Street stop arrangement
- provision of a new access laneway from Arthur Street to properties on High Street as a result of the new UNSW High Street stop configuration
- some changes to the local traffic network to accommodate the modified stops, including introduction of a one-way westbound section on High Street between Wansey Road and Botany Street, introduction of a one-way eastbound section on High Street between Clara Street and Avoca Street, minor changes to bus routes and stops, and installation of new traffic lights at the following intersections:
 - Botany Street/ Arthur Street
 - Arthur Street/ Belmore Road
 - Botany Street/ Barker Street
- revised arrangement for the High Cross Park interchange, including relocated bus stops.

The assessment covers changes in both end-state and construction stage impacts on traffic, transport and access between the approved Project and the proposed modifications, including consideration of:

- road network operating conditions
- traffic flow changes
- vehicular access and egress requirements
- kerbside parking
- bus operations in the precinct
- pedestrian and cyclist flows
- access arrangements for a number of private and institutional properties.

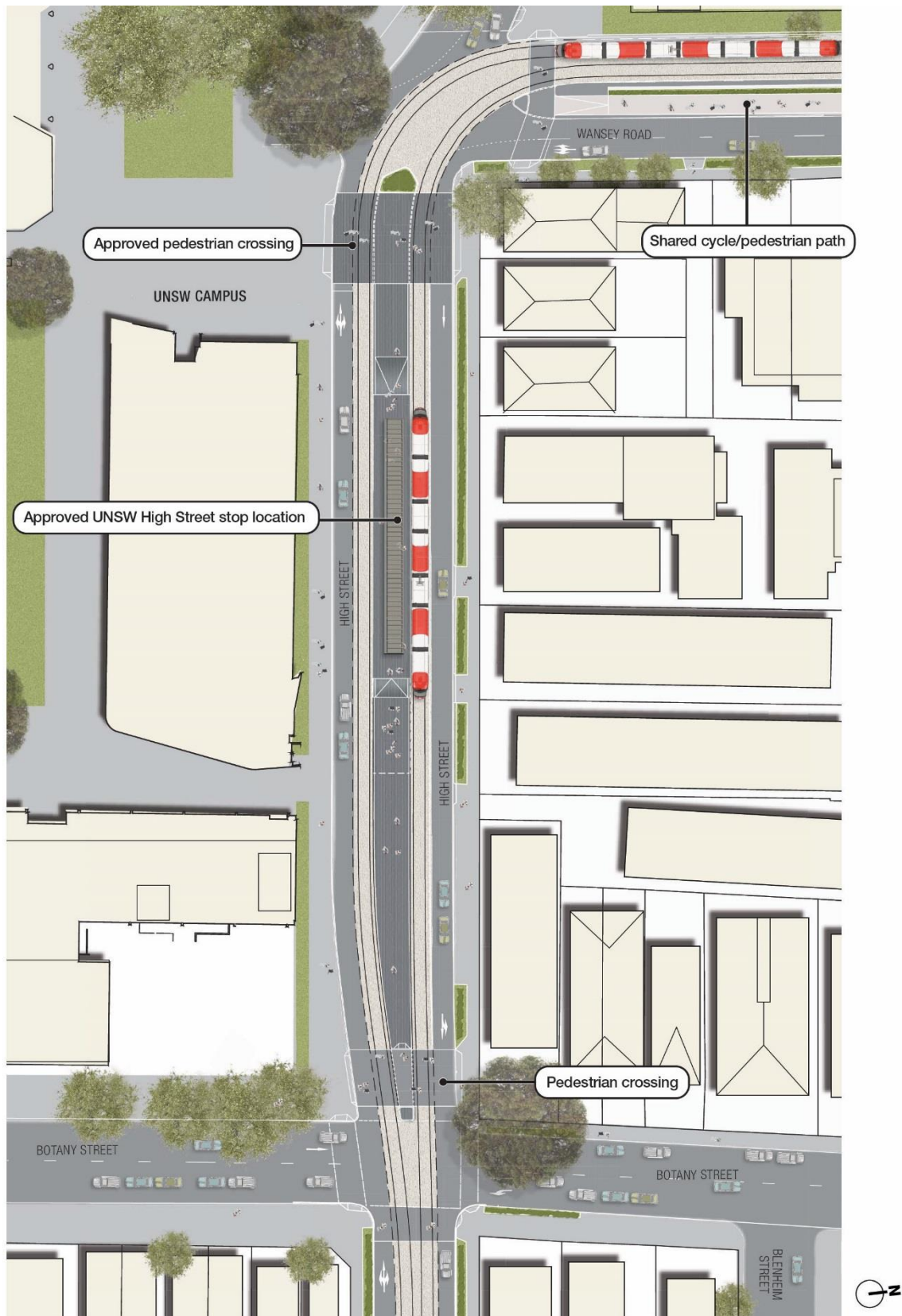
3.2 UNSW High Street stop

3.2.1 Configuration of approved UNSW High Street stop

The UNSW High Street stop, as described in section 6.11.2 of the *CSELR Project Submissions Report* (Transport for NSW, 2014), was located in the centre of High Street, approximately 40 metres to the east of the intersection of High Street and Wansey Road. The stop comprised an island platform configuration with a width of approximately 6.4m and 67m in length.

The approved Project provided for signalised pedestrian crossings at both the western and eastern ends of the platform near the intersections of High Street with Wansey Road and Botany Street respectively. The existing trees on both the northern and southern side of High Street at the UNSW High Street stop were to be removed. The approved Project would require approximately six metres of UNSW to be acquired for the Project. The approved stop location and arrangement of the UNSW High Street stop is shown in Figure 3.1.

Figure 3.1: Configuration of Approved UNSW High Street Stop



Source: Transport for NSW
Note: Indicative only.

3.2.2 Proposed modification to UNSW High Street stop

Ongoing consultation with Randwick City Council and UNSW in 2015 identified potential improvements to the layout of the UNSW High Street stop proposed in the approved Project, to improve pedestrian safety.

The proposed modification to the UNSW High Street stop would change the configuration of the approved stop from a single island platform to two side platforms. The northern platform would be integrated as part of the existing pedestrian footpath with a combined width of approximately 4.5m. The southern platform would consist of a platform approximately 6m wide with a fenced barrier between the southern edge of the platform and the westbound traffic lane along High Street. The stop would be located approximately 5–6m north of the previously approved location.

A canopy shelter would be provided on the southern platform for shade and weather protection. The northern platform would not be provided with a canopy shelter due to the primarily disembarking function of this platform. Passengers would cross High Street at the signalised crossings at either Wansey Road or Botany Street.

The proposed modification would result in the removal of the eastbound traffic lane along High Street between Wansey Road and Botany Street. For this section of the alignment, the eastbound light rail track would become a bus and light rail-only shared zone³. Existing eastbound general traffic would be required to utilise an alternative route along Arthur Street. The existing westbound traffic lane would be retained. However this lane would be realigned by approximately four to five metres to the south to accommodate the stop platform. A new pedestrian footpath would also be provided at this location on UNSW land.

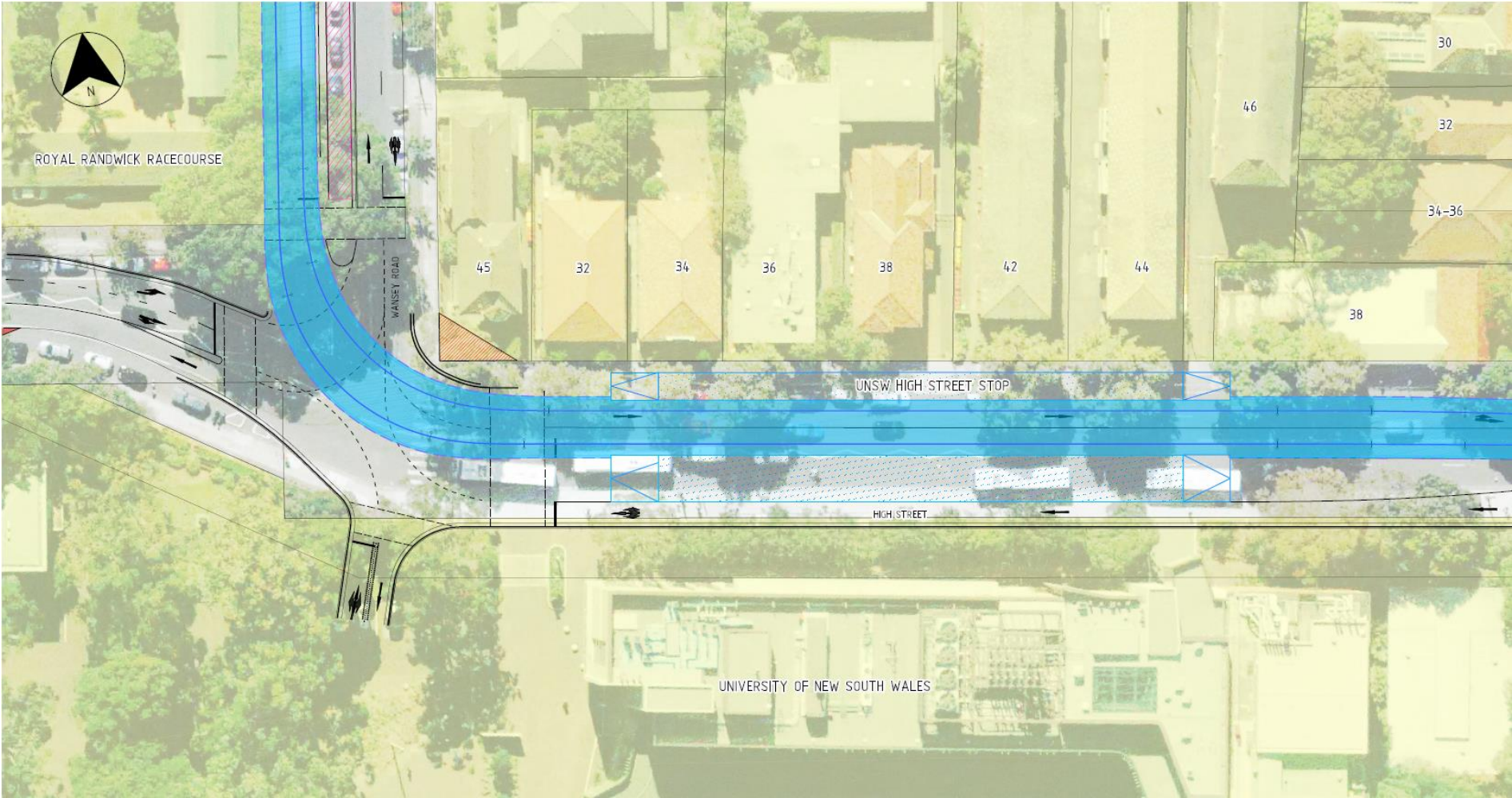
As a result of the proposed removal of the eastbound traffic lane, the existing driveway access to four properties on the north side of High Street would be removed and relocated to a new access laneway to be provided from Arthur Street (refer to Section 3.6).

As with the approved design, the stop would continue to be compliant with the DDA.

The revised stop arrangement for the UNSW High Street stop is shown in Figure 3.2 and an elevation for the revised stop arrangement is shown in Figure 3.3.

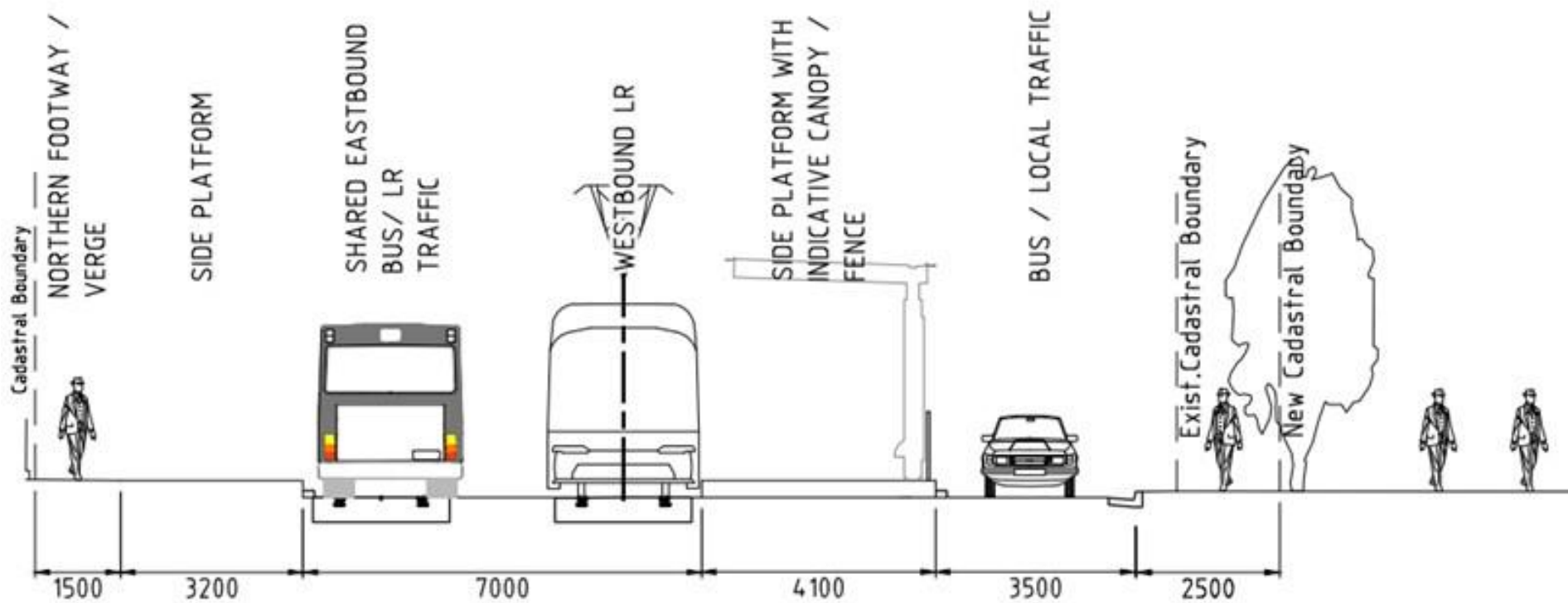
³ Emergency vehicles transporting patients would also be allowed access.

Figure 3.2: Plan of the revised UNSW High Street stop arrangement



Source: Transport for NSW

Figure 3.3: Elevation of the revised UNSW High Street stop arrangement



Source: Transport for NSW
Note: Indicative only.

3.3 Randwick stop and interchange⁴

3.3.1 Configuration of approved Randwick stop and interchange

The Randwick stop and interchange, as described in section 6.12.2 of the *CSELR Project Submissions Report* (Transport for NSW, 2014), was located on the northern edge of High Cross Park along Belmore Road. The stop provided a light rail terminus and interchange with existing Eastern Suburbs buses. The stop would also service the Randwick retail precinct on Belmore Road and Avoca Street, the Sydney Children's Hospital, the Prince of Wales Hospital and Royal Hospital for Women and the broader residential area of Randwick. The approved location of this Randwick terminus stop would however require passengers to cross each of these roads to access their destinations.

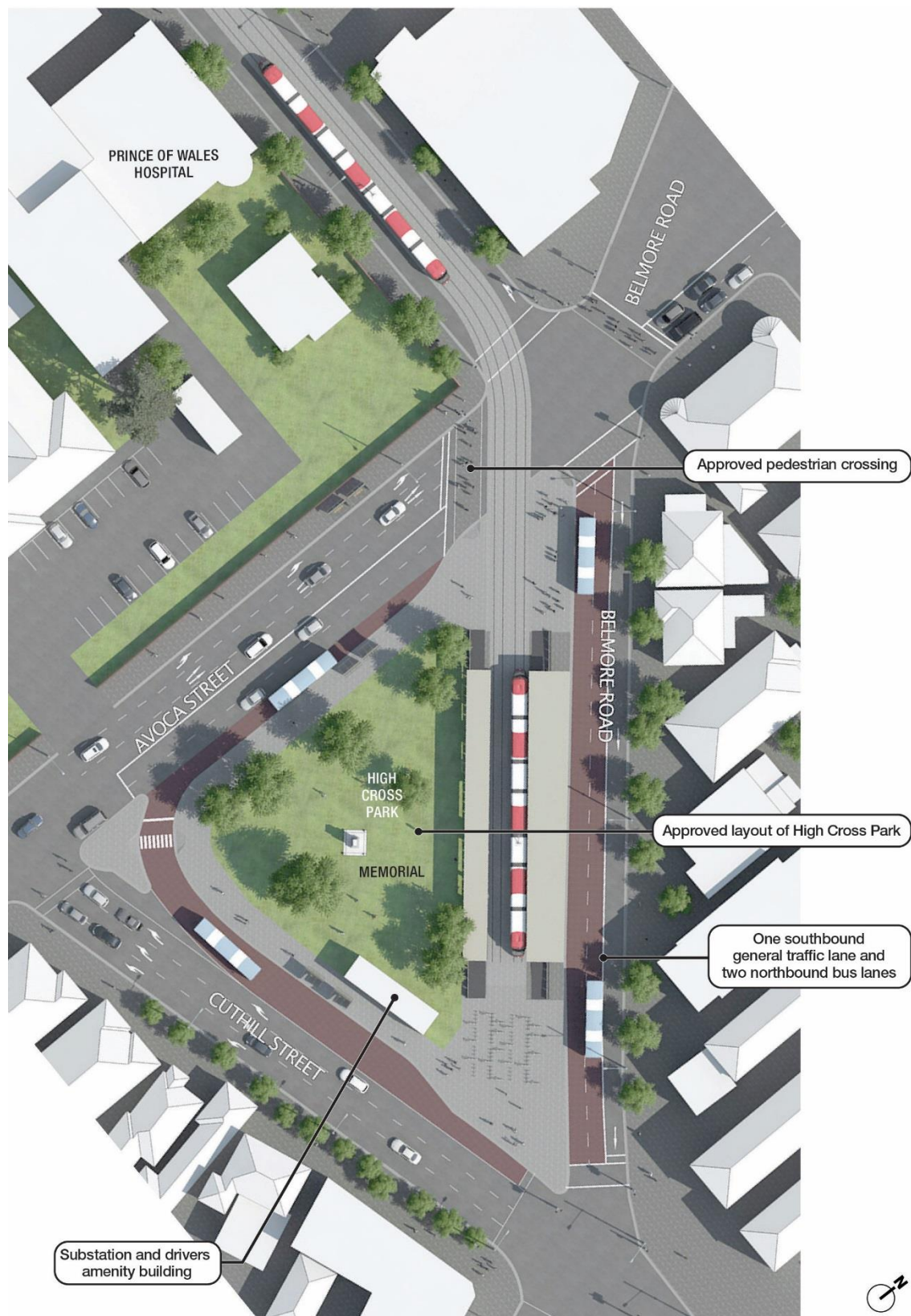
The approved stop included two side platforms between approximately 3.2m and 5.1m wide, allowing for direct interchange with buses, including during both the morning and afternoon peak periods, providing for efficient transfer of passengers at this location. Bus stops were to be located on Belmore Road (servicing morning peak buses) and Avoca Street and Cuthill Street (servicing afternoon peak buses)

The approved Project also included an above ground substation and driver's amenity facilities to be located towards the south-eastern end of High Cross Park, near the intersection of Cuthill Street and Belmore Road.

The approved stop location and arrangement of the Randwick stop and interchange is shown in Figure 3.4.

⁴ Also referred to in this report as the 'Randwick Terminus'.

Figure 3.4: Layout of Approved CSELR Randwick Terminus



Source: Transport for NSW
Note: Indicative only.

3.3.2 Proposed modification to Randwick terminus stop

Ongoing consultation with Randwick City Council and progressive design reviews undertaken in 2015 highlighted the opportunity to improve the approved layout of the proposed Randwick Terminus, in particular:

- to reduce impacts of the proposed terminus on open space and trees at High Cross Park
- to reduce further encroachment on land in High Cross Park to allow for the cross-over rail to be located within the park.

The revised design of the Randwick terminus stop would relocate the stop to High Street, west of the intersection of High Street and Avoca Street. The modified location for the stop would provide an approximately 67m long, 4.2m wide island platform with a weather protection shelter towards the eastern end of the platform. Revised pedestrian crossings would be provided at both the eastern and western ends of the platform.

A single, eastbound traffic lane for general traffic on High Street would be maintained to the north of the revised stop location between Clara Street and Avoca Street. The existing westbound traffic lane would be removed at this location.

The eastbound and westbound traffic lanes would be retained between Clara Street and Botany Street.

The existing pedestrian paths along the northern and southern sides of High Street would be retained as part of the proposed modification. The proposed modification would also result in a slightly revised vehicle access to the Prince of Wales Children's Hospital, including the provision of a revised public drop off zone for the Prince of Wales Children's Hospital on the southern side of High Street and a revised emergency drop off point opposite Clara Street.

Similar to the design described in the CSELR EIS (Transport for NSW, 2013), track crossovers would be provided to the west of the relocated Randwick terminus stop to allow for the light rail vehicles (LRVs) to turn around for the return trip (westbound). The platform was designed to be compliant with the Disability Discrimination Act 1992 (DDA).

The revised stop location and arrangement of the Randwick terminus is shown in Figure 3.5. An indicative elevation is shown in Figure 3.6.

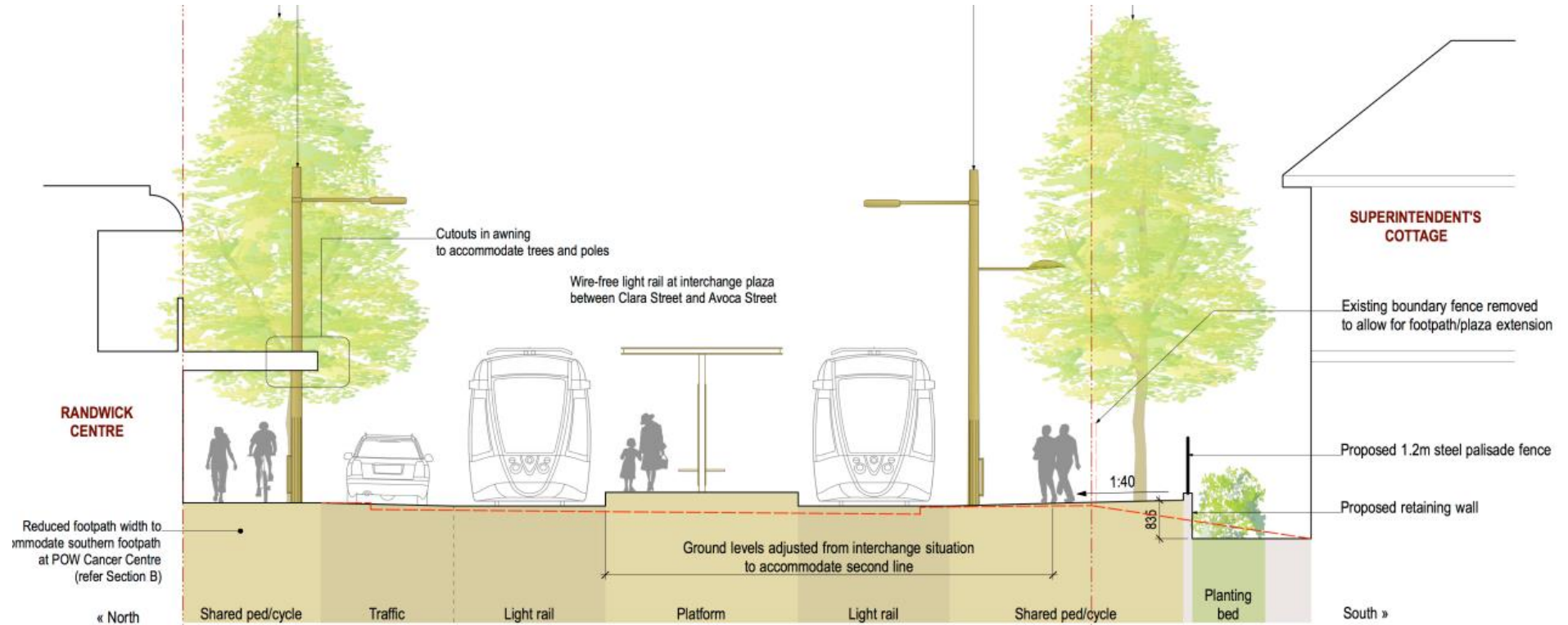
Figure 3.5: Plan of the proposed location for the revised Randwick terminus stop arrangement



Source: Transport for NSW

Note: Indicative only. Subject to detailed design.

Figure 3.6: Typical elevation (looking east) of the revised location of the Randwick terminus stop



Source: Transport for NSW

Note: Indicative only. Subject to detailed design.

3.4 Changes to local traffic network and associated works

3.4.1 Local traffic and access

Approved Project

As described above, a single eastbound and a westbound traffic lane were to be maintained on either side of the light rail alignment along the length of High Street as part of the approved Project. New traffic signals were to be installed at a number of intersections along the alignment, including the intersection of High Street with Wansey Road, Hospital Road and Clara Street.

At the Randwick terminus stop, two traffic lanes along Avoca Street and Belmore Road (west of Avoca Street) were to be maintained. Additionally, general traffic along Belmore Road was to be reduced to one lane (southbound) and two northbound bus lanes, as indicated in Figure 3.4.

At the location of the UNSW High Street stop, the approved Project included the provision of one lane of traffic on either side of the proposed island platform. These traffic lanes allowed for movement of all vehicles, including general traffic in both directions. The currently unsignalised intersection of High Street and Wansey Road was to be signalised with the existing traffic signals at the intersection of High Street and Botany Street retained. Additionally, Wansey Road was to be one way (southbound) between Alison Road and Arthur Street, with the section between Arthur Street and High Street allowing for general traffic in both directions.

Proposed Modification

The proposed relocation of the Randwick terminus stop and the reconfiguration of the UNSW High Street stop would result in changes to general traffic movements along High Street. These changes would include removal of eastbound traffic between Wansey Road and Botany Street and removal of westbound traffic between Avoca Street and Clara Street.

As a result, general traffic which currently travels along these sections of High Street would be required to travel along an alternative route in order to reach their destinations. This could be either Alison Road, Arthur Street or Barker Street, depending on the origin and final destination of their trip.

With respect to the proposed changes associated with the UNSW High Street stop, it is anticipated that most vehicles would travel along Wansey Road and Arthur Street, and either continue along Arthur Street or Botany Street depending on their final destination. These traffic changes and their impacts are assessed in the Section 4 of this report, including impacts on availability of kerbside parking.

3.4.2 Intersection upgrades

Due to the proposed removal of eastbound traffic along High Street between Wansey Road and Botany Street, the modified design would require local traffic improvements to accommodate the anticipated changes in traffic movements within the local area. These changes would include:

- provision of traffic signals at the intersection of Arthur Street and Botany Street, which would require the removal of up to approximately eight existing car parking spaces along Arthur Street to the east of Botany Street to accommodate turning lanes at this location (refer to Figure 3.7)
- provision of traffic signals at the intersection of Arthur Street and Belmore Road, which would require the removal of up to approximately eight car parking spaces along

Arthur Street between Belmore Road and Arthur Lane to accommodate turning lanes at this location (refer to Figure 3.8)

- conversion of the existing roundabout at the intersection of Barker Street and Botany Street to a signalised intersection (refer to Figure 3.9)
- formal street line marking along Arthur Street between Wansey Road and Belmore Road.

3.4.3 Other proposed traffic facility modifications

In addition to the proposed changes along Arthur Street, the following road infrastructure changes are proposed to be undertaken in conjunction with the proposed modification (to be undertaken by Randwick City Council):

- kerb adjustments to Belmore Road near High Street to widen the footpath and reduce the length of the Belmore Road pedestrian crossing
- removal of the existing slip lane from Belmore Road into Avoca Street (southbound)
- re-surfacing of the Avoca Street footpath (in the vicinity of the proposed morning bus interchange location)
- installation of bicycle storage facilities within the precinct surrounding the Randwick terminus stop.

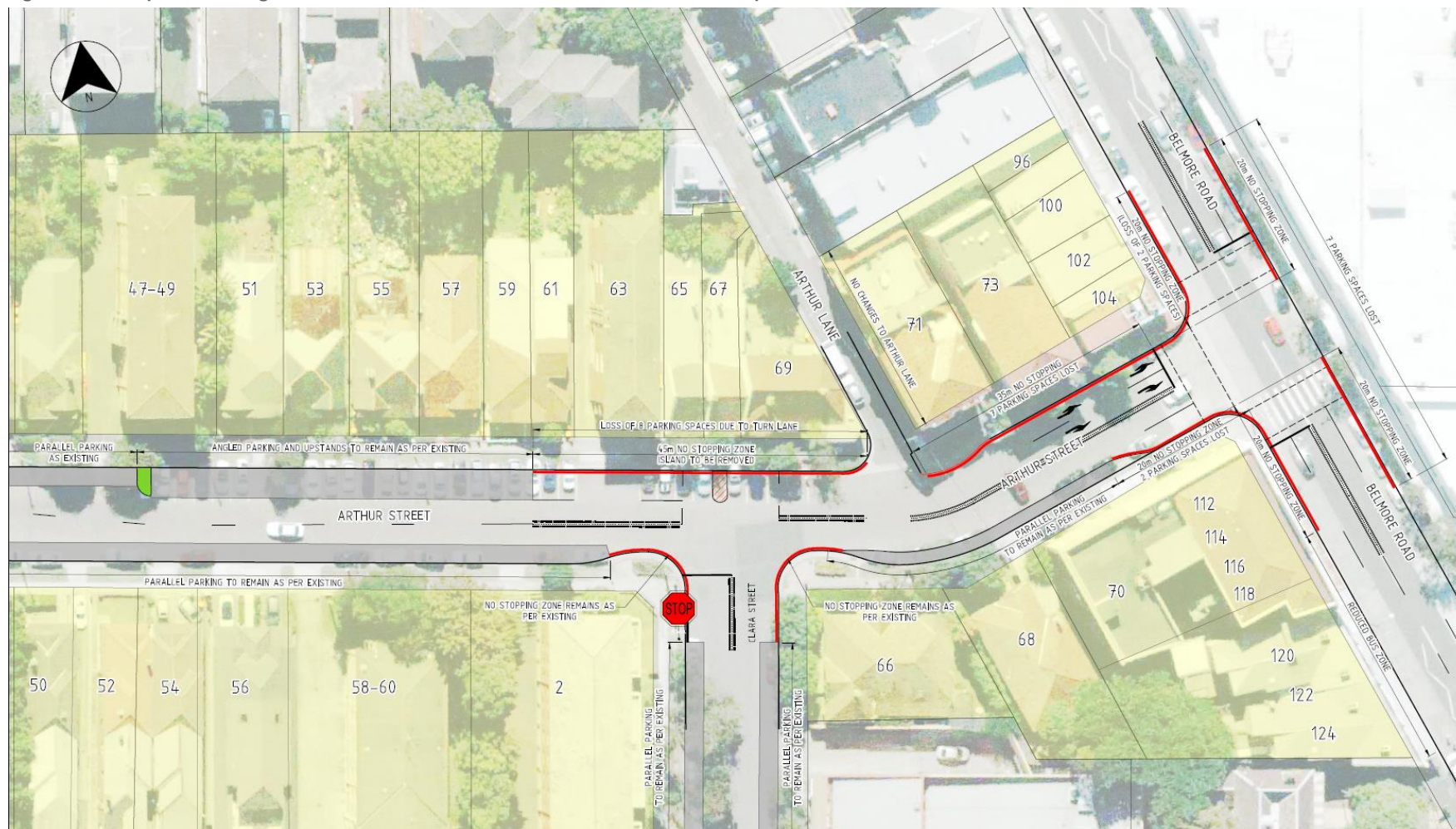
Figure 3.7: Proposed arrangement for Arthur Street/ Botany Street intersection improvement



Source: Transport for NSW

Note: Indicative only. Subject to detailed design.

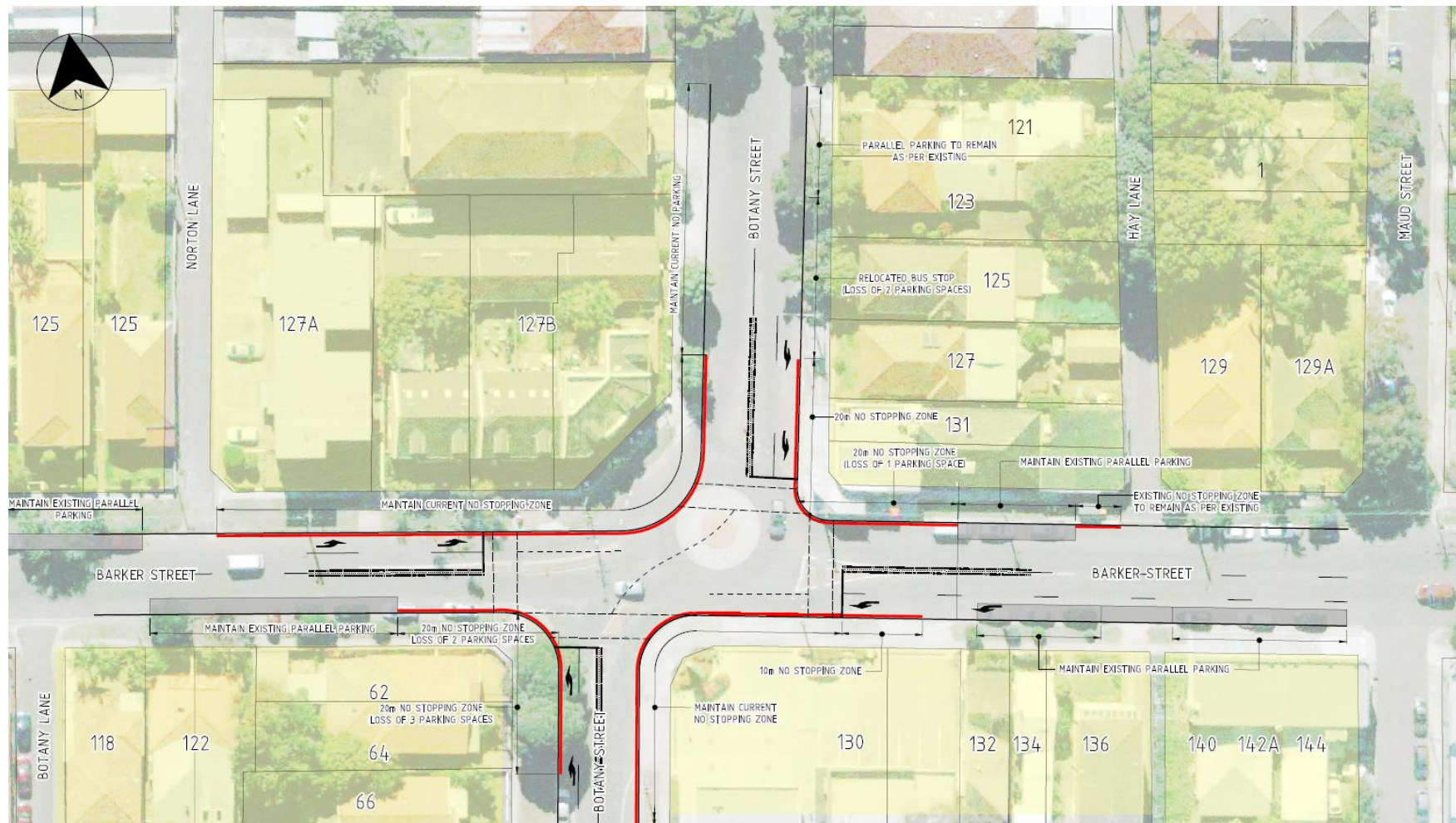
Figure 3.8: Proposed arrangement for Arthur Street/ Belmore Road intersection improvement



Source: Transport for NSW

Note: Indicative only. Subject to detailed design.

Figure 3.9: Proposed arrangement for Barker Street/ Botany Street intersection improvement



Source: Transport for NSW

Note: Indicative only. Subject to detailed design.

3.5 Proposed modifications to bus routes and stops

3.5.1 Bus route changes

Approved Project

As identified in the CSELR EIS, no bus services were to be re-routed as part of the approved Project. However, some changes to the location of existing bus stops along High Street were identified as part of a wider change to the broader bus network. These changes included:

- New bus stops were proposed on Belmore Road (servicing morning peak buses) and Avoca Street and Cuthill Street (servicing afternoon peak buses) as part of an overall interchange with the Randwick terminus (refer to Figure 3.4).
- The current westbound UNSW stop would be replaced by an indented bay within UNSW land.
- The bus stop west of Botany Street would be removed.
- Outside the Prince of Wales Hospital, the eastbound bus stop on High Street would be removed. The stop location would be relocated to Clara Street.

Proposed Modification

Due to the relocation of the UNSW High Street and the Randwick terminus stops, as well as the proposed closure of traffic lanes associated with the modified stop configurations, changes to a number of bus routes in the proposed SCCAS Bus Plan would in turn need to be modified.

Principally, these involve diversions to bus routes that will be using High Street between Clara Street and Avoca Street. Buses that would be traveling eastbound on High Street between Wansey Road and Botany Street will be allowed to use the light rail corridor, while those travelling westbound will be using the general traffic lanes.

Between Botany Street and Clara Street, general traffic will continue to be allowed in both directions, and buses will still be able to travel as such.

Figure 3.10 shows the required route changes to bus routes (Route 370 in this example) using High Street between Clara Street and Avoca Street as part of the proposed modifications.

Figure 3.11 and Figure 3.12 show how the proposed modifications will not require route changes to other High Street and Belmore Road bus routes, with the example of Route 400 (High Street) and Route 373 (Belmore Road), respectively.

Figure 3.10: Proposed bus route change – Route 370



Figure 3.11: Bus route 400, indicating no route change required

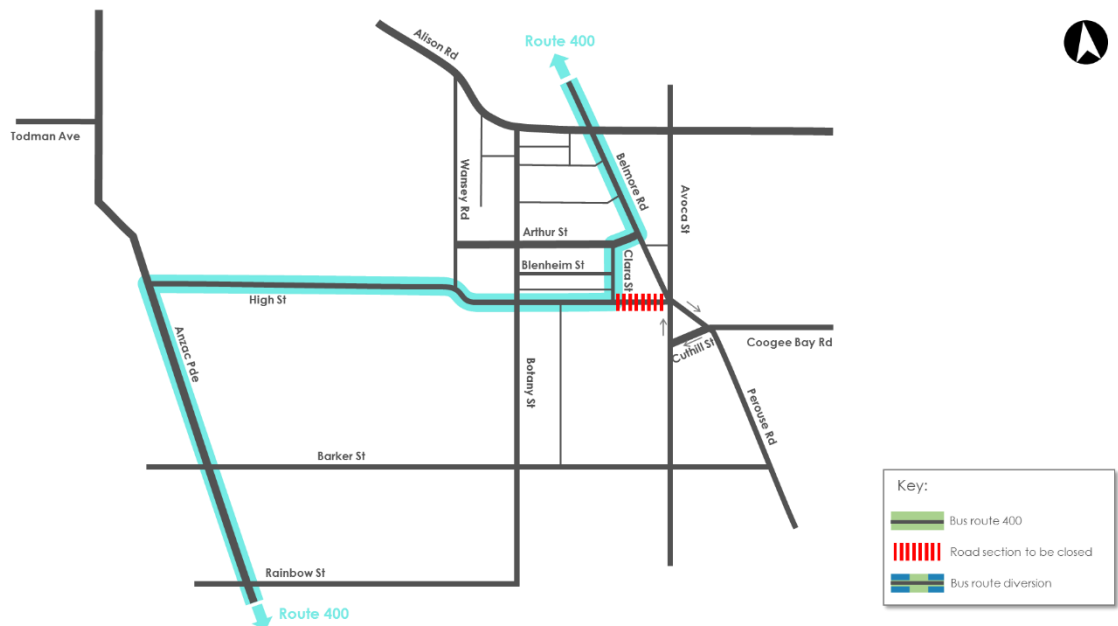
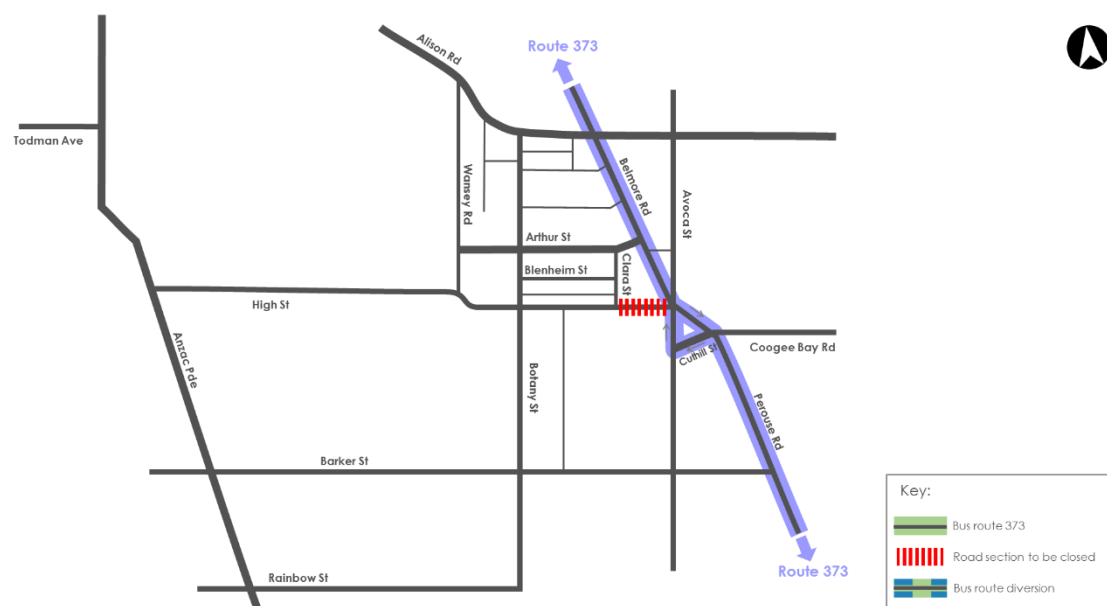


Figure 3.12: Belmore Road bus routes indicating no route changes required



3.5.2 Bus stops

High Street bus stops

The existing westbound bus stop outside the Prince of Wales Hospital would be removed as part of the modified design. The stop would no longer be required due to the removal of the westbound lane along High Street. The stop would be relocated to Clara Street, near the intersection of Clara Street and High Street. This would result in the loss of approximately four short term parking spaces along this street. A new bus shelter would also be provided at this location.

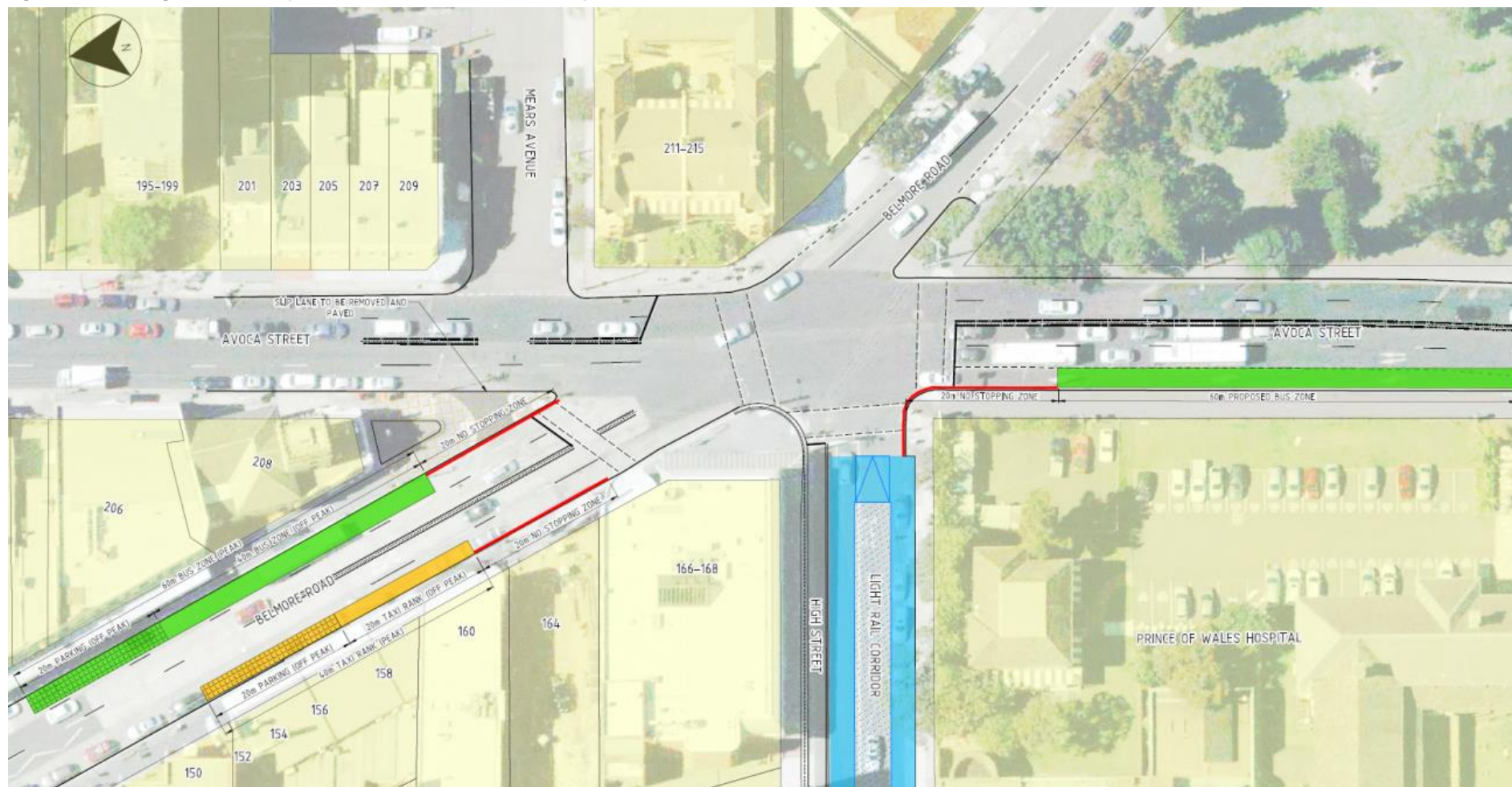
Belmore Road and Avoca Street bus stops

A southbound bus stop currently exists at the intersection of Belmore Road and Avoca Street which allows for the provision of up to approximately two buses. The bus zone along Belmore Road at this location is proposed to be extended by approximately 20m to allow for an additional bus at this location in the afternoon peak period. The provision of the additional bus stop would result in the removal of approximately four short term parking spaces. An indicative arrangement of this stop is provided in Figure 3.13. As part of the revised bus stop arrangement, the existing awning along Belmore Road would be extended to permit the afternoon bus stop to be located as close to the corner of Belmore and Avoca as possible.

A new northbound morning bus stop zone on the western side of Avoca Street would be provided as part of the proposed modification. This would allow up to four buses to stop within the western-most lane along Avoca Street, to the south of High Street during the morning peak period. As a result of the proposed changes to bus stops along Belmore Road and Avoca Street, the previously proposed bus stops within High Cross Park along Avoca Street (southbound) and Cuthill Street (refer to Figure 3.13) would no longer be required. This would result in a reduced impact to High Cross Park, including the retention of a number of trees and open space within the park.

The proposed locations of bus stops and the taxi rank are shown in Figure 3.13.

Figure 3.13: Configuration of Proposed Randwick Terminus bus stops



Source: Transport for NSW.

Note: Indicative only. Subject to detailed design.

3.6 Property access changes

3.6.1 Laneway access from Arthur Street

As described previously, the proposed removal of the eastbound traffic lane along High Street for general traffic between Wansey Road and Botany Street would result in existing access to four properties along High Street being removed. These properties are:

- 34 High Street (Kenvale College Hospitality and Event Management)
- 42 and 44 High Street (residential apartment buildings with shared access – approximately 32 units)
- 46 High Street (residential apartment building – approximately 10 units).

In order to maintain vehicle access to these properties, it is proposed that a new public laneway be provided from the rear of these properties to Arthur Street to provide a reconfigured driveway access to all four affected properties. The cul-de-sac would also be suitable to meet access requirements for vehicles such as garbage collection and removalist vehicles without the need to reverse along the new laneway.

The proposed laneway would consist of widening an existing private the existing laneway from Arthur Street to approximately 6m, leading to a widened 'hammerhead' cul-de-sac area approximately 8m wide along rear boundaries of the affected properties.

The laneway would consist of an asphalt surface (or other suitable material to be determined during detailed design). Ancillary work that would be required includes:

- a new retaining wall
- potential modifications to existing drainage, utilities, regrading of existing surfaces to tie in with proposed ramps
- minor vegetation clearing along Arthur Street.

The revised laneway would provide access to the existing car parking spaces at the rear of the Kenvale College Hospitality and Event Management site. The laneway would also require revised storage space for garbage bins for the private properties affected by the proposed modification, similar to the current situation however at the rear of each property to provide access for garbage trucks via the new laneway. The location for this storage would be determined during detailed design, in consultation with the relevant property owners. Collection of these bins would continue to occur whereby the bins are collected from the storage locations within each property.

Due to ground level differences, a retaining wall between approximately 0.1m and 1.5m high would be required towards the north east side of the cul-de-sac.

New fencing would be provided along the boundary of the laneway and cul-de-sac area with appropriate lighting to maintain a suitable level of safety. Some minor vegetation clearance on Arthur Street would be required to maintain suitable sight distances along Arthur Street for vehicles accessing Arthur Street from the new laneway.

An indicative layout of the proposed laneway is shown in Figure 3.14.

Figure 3.14: Plan of the proposed rear access laneway arrangement from Arthur Street



Source: Transport for NSW.

Note: Indicative only. Subject to detailed design.

The revised driveway access is also proposed to be classified as a formal public road following completion of the project. The formal creation of this road would be undertaken by Transport for NSW in accordance with the *Roads Act 1993*. Under Clause 9 of the *Roads Act 1993*, a public road may be created through registration of a plan of subdivision. This registration, including any supporting information, would be included as part of the detailed Deposited Plan of the subdivision prepared during detailed design.

3.6.2 Access along High Street

No removal of property access along the remainder of High Street would occur as a result of the proposed modification. Access to properties opposite the Randwick terminus stop, on the north side of High Street between Clara Street and Avoca Street would however potentially be restricted to light vehicles only as a result of the proposed location of the High Street terminus platform and light rail tracks.

3.7 Summary

Figure 3.15 shows a summary of the proposed modifications to traffic arrangements and transport facilities for the study area.

Figure 3.15: Summary of proposed modifications



4. Changes in end-state impacts arising from modifications

4.1 Light rail operations

4.1.1 Stop accessibility

UNSW High Street stop

The proposed modification to the UNSW High Street stop involves conversion of the approved island platform configuration to a side platform arrangement, with the northern platform integrated with the northern footpath on High Street.

The modified Project will require AM peak alighting passengers to cross the full length of High Street, compared with the situation in the approved Project, in which light rail passengers alighting at the UNSW High Street stop and heading towards UNSW will only need to cross one track and the westbound traffic lane. This change will likely have an impact on the length of signal phase time required to accommodate pedestrian crossing, and would impact on the operation of the Wansey Road/ High Street intersection.

Randwick Terminus

Relocating the Randwick Terminus and stop to east of the High Street/ Avoca Street/ Belmore Road intersection would reduce walking distances to light rail customers in the direction of the Randwick Hospital Precinct, as well as those with destinations (or origins) within the Randwick shopping precinct on Belmore Road. These customers will likely experience shorter walking distances compared with the location of the stop in the approved Project.

4.1.2 Interchange functionality

The relocation of the Randwick stop and terminus, and the associated relocation of bus stops that are part of the proposed modifications, would still allow bus–light rail transfers required for a functional transport interchange. However, the proposed modifications would require longer walking distances to achieve this.

A positive impact arising from the proposed modification is that light rail passengers who would not need to be interchanging (i.e. using light rail only) would no longer need to cross the road in order to access the location of the light rail stop in High Cross Park in the approved Project.

4.2 Traffic

4.2.1 Network operations

The AIMSUN transport modelling results provides a holistic view of the performance of the road network in the study area and provides information on the expected travel pattern changes as a result of the geometric layout under the proposed modifications scenario, which was considered as part of this assessment. Table 4.1 highlights the key network results from the model.

Table 4.1: Network Statistics Summary

Statistic	AM Peak			PM Peak		
	Approved Project Scenario	Modified Project Scenario	Percent Difference	Approved Project Scenario	Modified Project Scenario	Percent Difference
Average Speed (km/h)	26.6	26.5	0%	26.1	26.3	+1%
Average Delay (8-9am) (sec/km)	99.0	102.9	4%	93.9	90.9	-3%

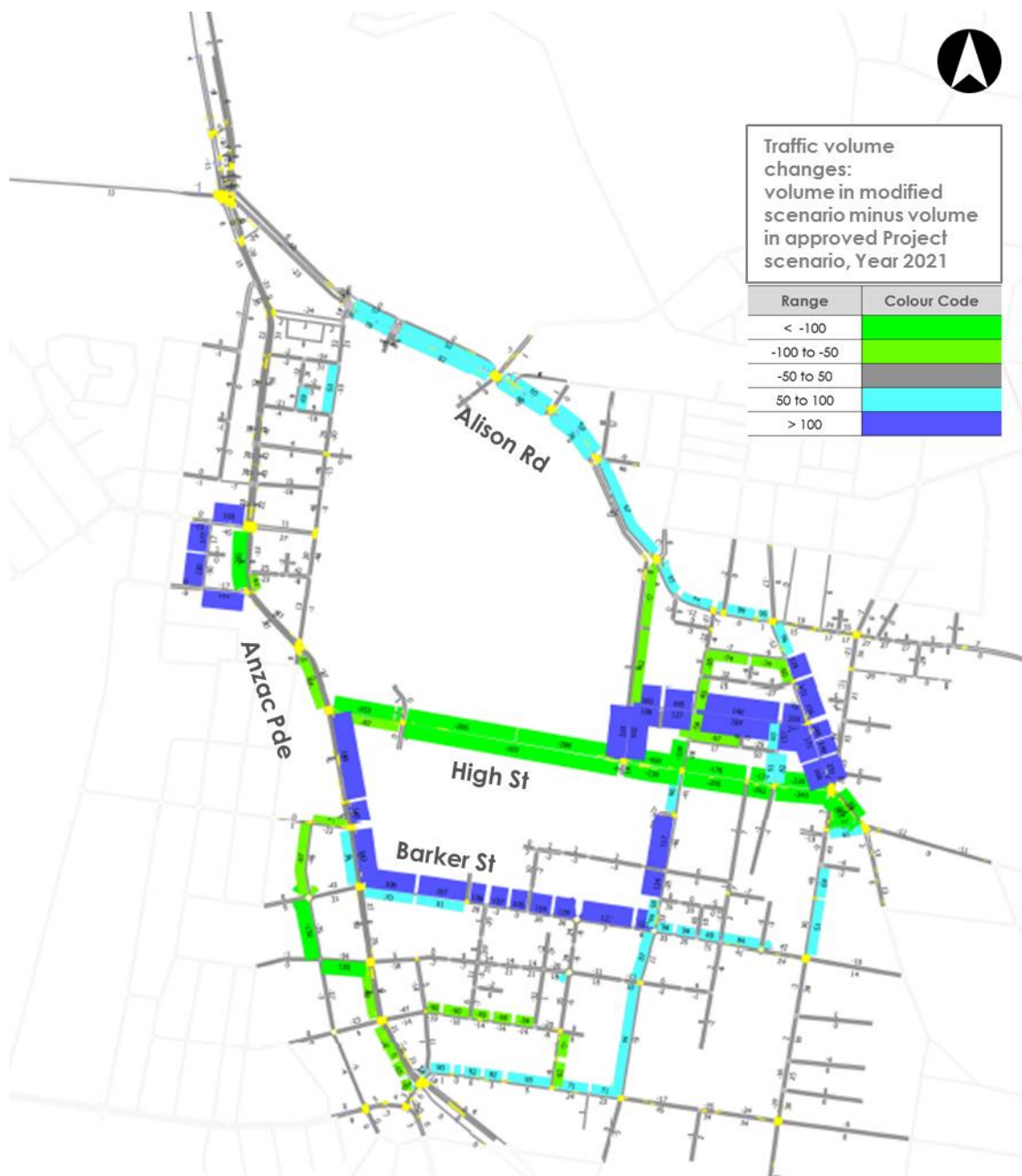
The AM Peak modelling results illustrate a marginal impact to the network operation, with a 4 percent increase in average delay across the assessed road network and negligible impact to the average speed.

In the PM peak, the road network operation improves marginally with average delay reduced by 3 per cent and average speed is faster by 1 per cent.

4.2.2 Forecast traffic volume changes

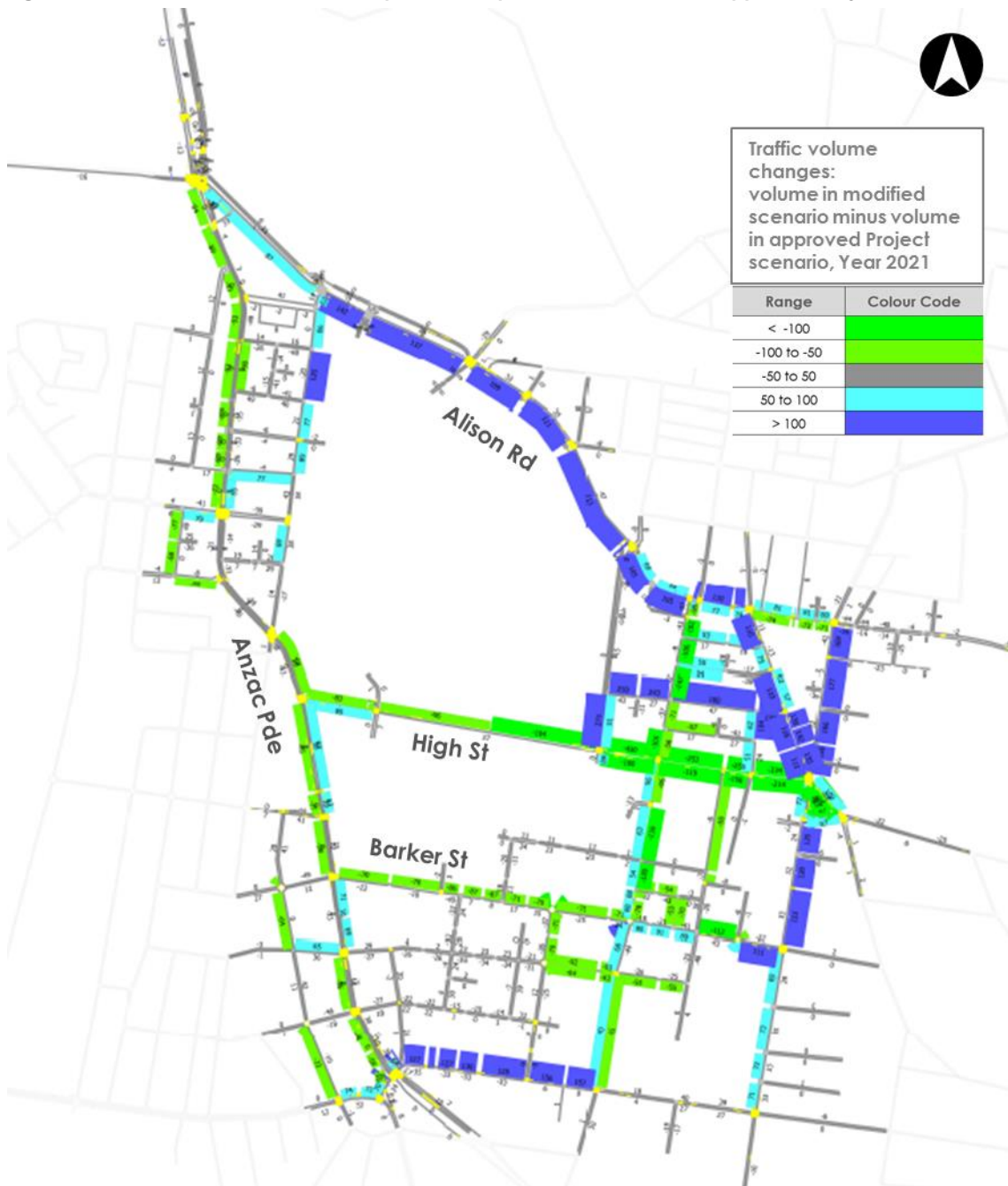
The difference in Year 2021 forecast traffic volumes throughout the study area network for the proposed modified Project approved Project scenarios are presented in Figure 4.1 and Figure 4.2 for the AM and PM peaks, respectively.

Figure 4.1: Year 2021 Traffic Flow Comparison: Proposed Modification vs Approved Project – AM Peak



Source: CSEL R AIMSUN Model (GTA, 2015)
Note: Indicative links shown, not to scale.

Figure 4.2: Year 2021 Traffic Flow Comparison: Proposed Modification vs Approved Project – PM Peak



Source: CSELr AIMSUN Model (GTA, 2015)
Note: Indicative links shown, not to scale.

Figure 4.1 and Figure 4.2 also show that in the modified Project scenario, Arthur Street and Alison Road become the primary routes for diverted trips, and to a certain extent, Barker Street and Botany Street south of High Street in the AM peak.

4.2.3 Strategic Links – Screenline Flows

In addition to the assessment of traffic volume changes throughout the sub-area network, traffic volumes at key screenlines in the network have also been assessed to provide a better understanding of changes in traffic flow patterns.

These screenlines are shown in Figure 4.3, and the resulting screenline flows are shown in Table 4.2.

Figure 4.3: Screenline Flow Data Locations

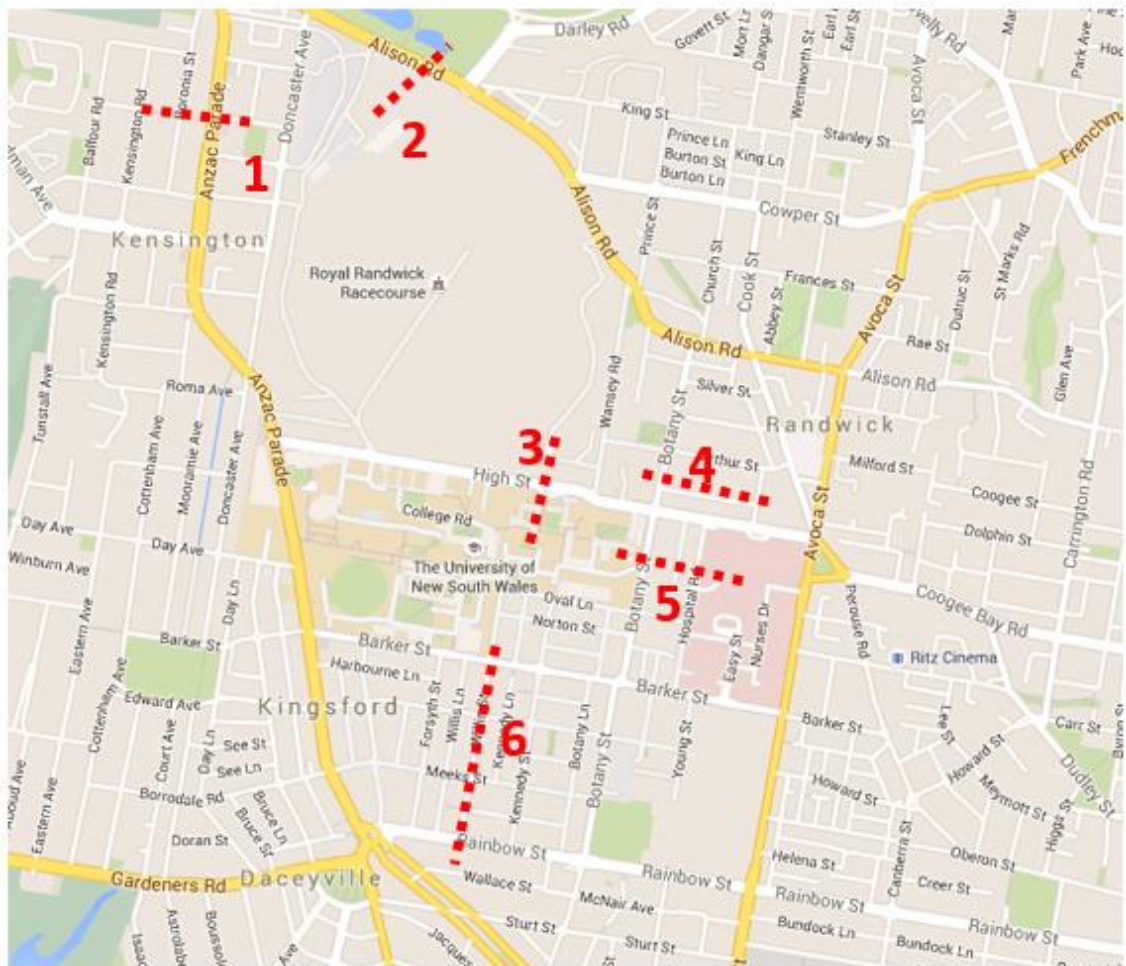


Table 4.2: Summary of Peak Hour Traffic Volumes along Screenlines

Screenline	Direction	AM Peak		PM Peak	
		Approved Project Scenario	Modified Project Scenario	Approved Project Scenario	Modified Project Scenario
1 Anzac Parade	Northbound	1,532	1,544	1,388	1,244
	Southbound	1,212	1,178	2,222	2,214
2 Alison Road	Eastbound	1,728	1,710	2,118	2,156
	Westbound	3,792	3,760	2,480	2,616
3 High Street	Eastbound	1,194	910	1,078	966
	Westbound	1,016	844	908	1,066
4 Botany Street North	Northbound	1,310	1,286	1,070	1,004
	Southbound	1,434	1,524	1,140	1,126
5 Botany Street South	Northbound	1,276	1,408	1,564	1,660
	Southbound	1,236	1,154	944	740
6 Barker Street	Eastbound	850	1,004	1,466	1,678
	Westbound	1,408	1,360	1,500	1,380

The results of the screenline flow assessment for both the AM and PM peaks indicate the following:

- Traffic flows along Anzac Parade (Screenline 1) and Alison Road (Screenline 2) are generally consistent in both scenarios in both AM and PM peaks. This indicates that the travel pattern is not significantly affected by the proposed changes on High Street.
- Westbound PM peak flows along Alison Road by more than 100 vehicles.
- Traffic flows are reduced on High Street eastbound, as a result of the lane closures and diversions on High Street. Consequently, traffic flows increase on the adjacent alternate routes, in particular Arthur Street and Barker Street.

4.2.4 Arthur Street impacts

In order to further understand the likely impacts on local amenities, further screenline analysis was undertaken for individual sections along Arthur Street blocks, as shown in Figure 4.4. The results of this assessment are presented in Table 4.3, noting that the results also shows the percentage change in the volume compared to the volumes resulting from the approved Project scenario.

Figure 4.4: Screenline Flow Sections along Arthur Street

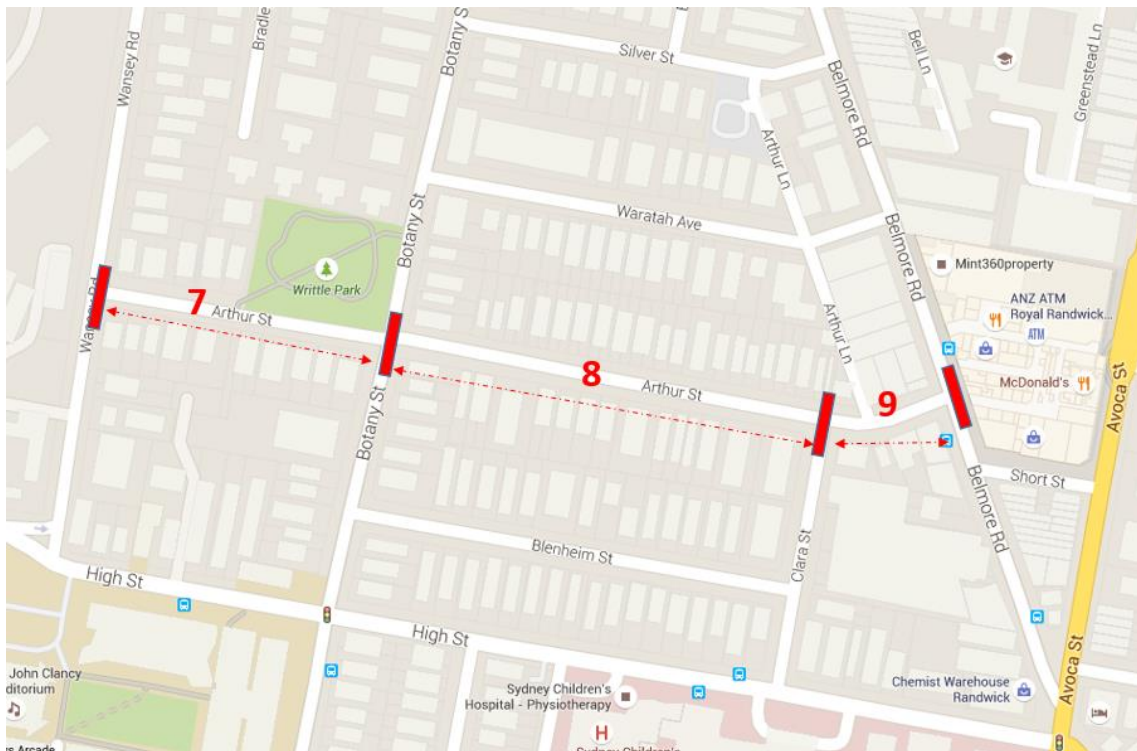


Table 4.3: Screenline Flows along Arthur Street, vehicles per hour

Arthur Street Screenline	Direction	AM Peak			PM Peak		
		Approved Project Scenario	Modified Project Scenario	Percent difference	Approved Project Scenario	Modified Project Scenario	Percent difference
Screenline 7: Between Wansey Rd and Botany St	Eastbound	486	784	61%	414	786	90%
	Westbound	374	580	55%	168	208	24%
Screenline 8: Between Botany St and Clara St	Eastbound	234	470	101%	156	470	201%
	Westbound	156	418	168%	130	200	54%
Screenline 9: Between Clara St and Belmore Rd	Eastbound	100	420	320%	108	514	376%
	Westbound	214	688	221%	248	504	103%

The volume changes along different sections of Arthur Street highlight the challenges resulting from rerouting High Street traffic. The results show that in the modified Project scenario, the section of Arthur Street between Clara Street and Belmore Road (Screenline 9) will experience significant increases in volumes during both AM and PM peaks. Similarly, sections of Arthur Street between Wansey Road and Clara Street (Screenlines 7 & 8) are expected to experience various increases in volumes that could inevitably impact on local amenities, including access to properties.

The forecast Year 2021 volumes would likely be in the upper ranges or exceeding the limits for environmental performance standards for local residential streets of about 300 maximum vehicles per hour, and about 500 vehicle per hour maximum for collector streets, as provided in the A summary of the environmental performance standards on local residential streets is provided in the *Guide to Traffic Generating Developments* (RMS, October 2002).

4.2.5 Intersection operations

The impact of the modified project to the operation of key intersections within the study area has been assessed and is presented in Figure 4.5 and in Figure 4.6 for the AM and PM peaks, respectively. The impacts of the modified Project compared to the approved Project in terms of average intersection delays are presented in Figure 4.7 and Figure 4.8 for the AM and PM peaks, respectively.

Figure 4.5: AM Peak Average Intersection Delays with Proposed Modifications

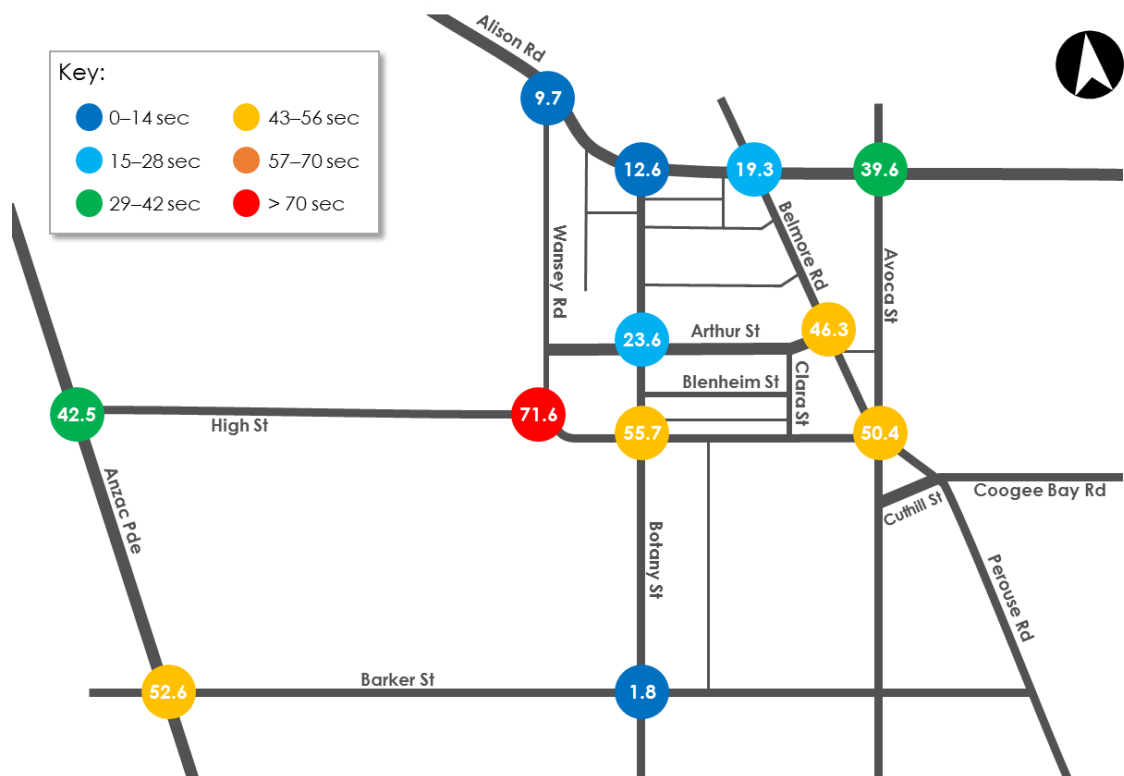


Figure 4.6: PM Peak Average Intersection Delays with Proposed Modifications

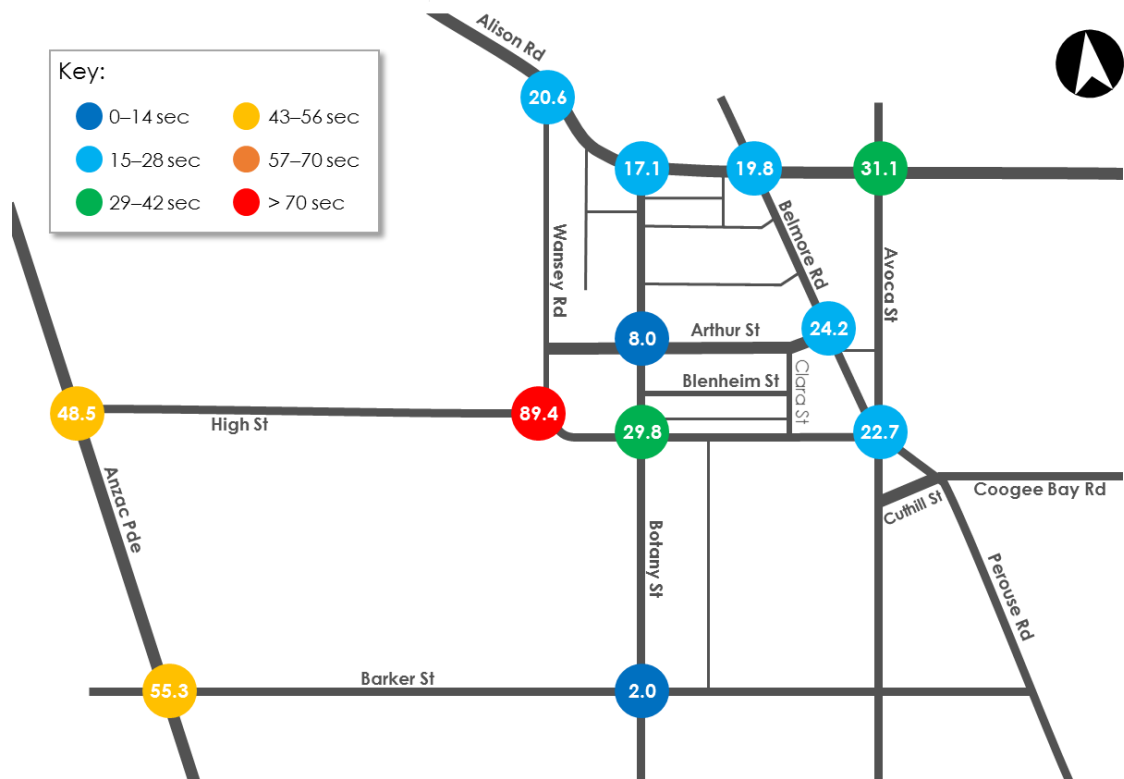


Figure 4.7: Changes in AM Peak Average Intersection Delays with Proposed Modifications, seconds

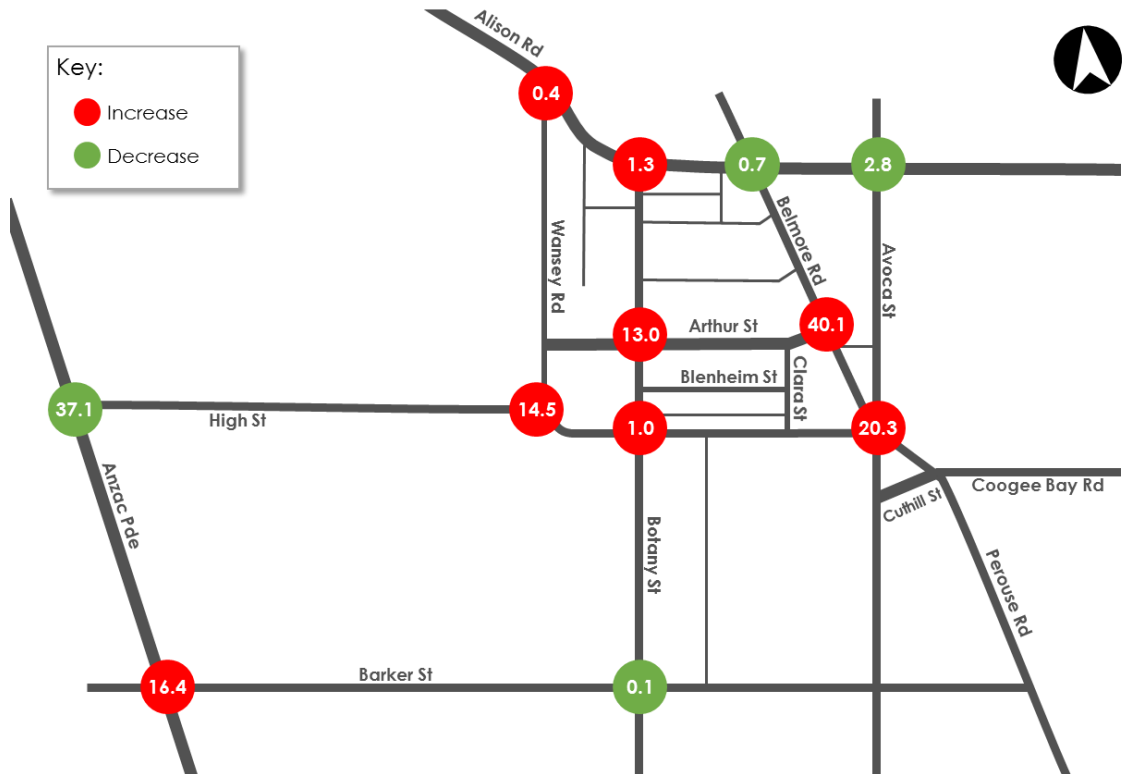
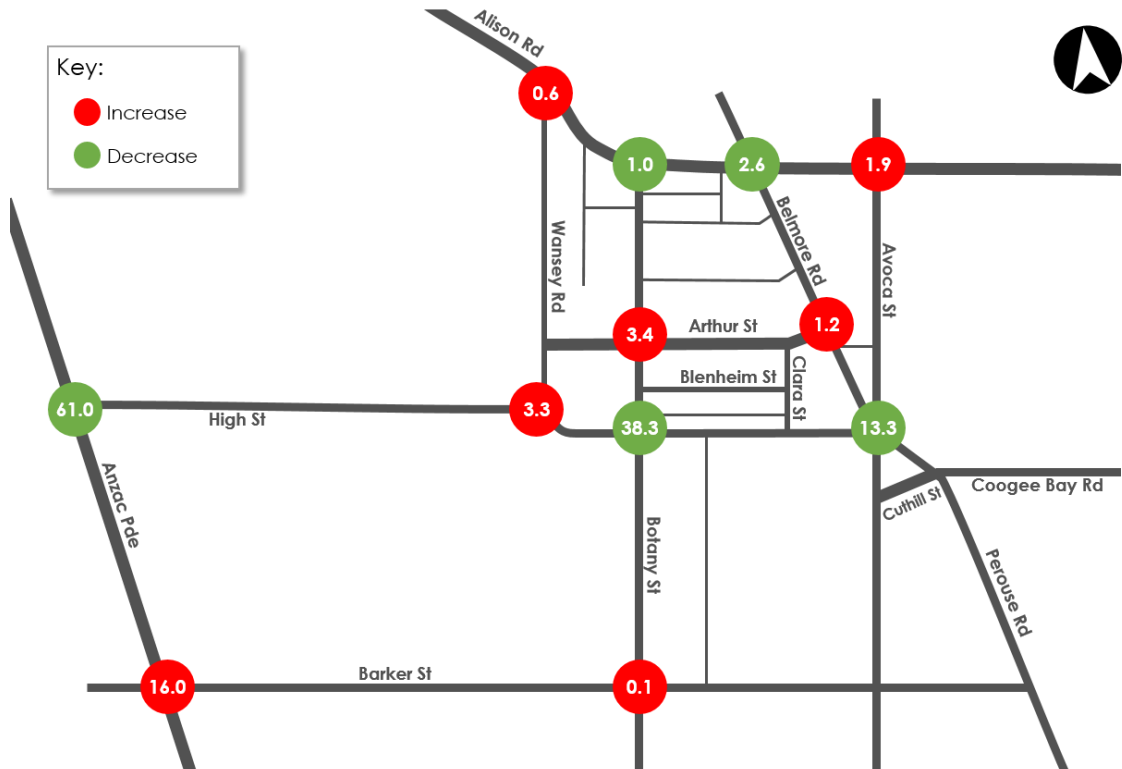


Figure 4.8: Changes in PM Peak Average Intersection Delays with Proposed Modifications, seconds



The forecast changes in delay as presented in Figure 4.7 and Figure 4.8 indicates that during the AM peak, average delays would generally increase at the intersections nearest to the light rail stops, though the High Street/ Botany Street intersection would remain unchanged. The (currently unsignalised) intersection of Arthur Street and Belmore Street shows the highest increase in average delay from the approved Project scenario, with a 40sec increase in average delays. The Arthur Street/ Botany Street intersection will see a 13sec increase in average delay, while the High Street/ Wansey Road intersection will see a 14.5sec increase in average delay.

During the PM peak, average delays at the intersections near the UNSW High Street stop is generally consistent with the conditions in the approved Project scenario, with increases of about 3 seconds at intersections along the Arthur Street alternate route. The High Street intersections with Botany Street and Avoca Street, due to lower traffic volumes, will result in average delay decreases of 38.3sec and 13.3sec, respectively. The High Street/ Anzac Parade intersection will also likely experience a decrease in average delay over the approved Project scenario. However, In both the AM and PM peaks, the Anzac Parade/ Barker Street intersection is expected to see a 16sec increase in average vehicle delays.

Relating the average vehicle delays with intersection operation described in Table 2.2, the intersections immediately adjacent to the UNSW High Street stop and Randwick stop locations, i.e. the Arthur Street/ Belmore Road, Belmore Road/ Avoca Street and High Street/ Botany Street intersections would be operating at capacity during the AM peak, while additional capacity will be required for the Wansey Road/ High Street intersection for both the AM and PM peaks.

4.2.6 Travel times

Sectional travel times on three key routes within the study area have been assessed for the approved Project and the modified project scenarios. The key routes are along Anzac Parade, Alison Road and Perouse Road to Todman Avenue as illustrated in Figure 4.9. The result of the assessment is presented in Table 4.4.

Figure 4.9: Travel Time Routes Assessed



Basemap: Googlemaps

Table 4.4: Travel Time Comparison – approved Project vs proposed Modified Project

Road Section	Direction	Estimated Travel Distance (m)	AM Peak (7–9am) Average Travel Time, seconds			PM Peak (4–6pm) Average Travel Time, seconds		
			Approved Project Scenario	Modified Project Scenario	Percent change	Approved Project Scenario	Modified Project Scenario	Percent change
Anzac Pde, between Alison Rd and Rainbow St	Northbound	3,600	582	567	-2.6%	546	548	0.4%
	Southbound	3,450	442	442	0.0%	472	466	-1.3%
Alison Rd, between Anzac Pde and Avoca St	Westbound	3,675	483	482	-0.2%	495	509	2.8%
	Eastbound	3,200	423	401	-5.2%	472	491	4.0%
Perouse Rd– Todman Ave via High St, between Kensington Rd and St Pauls St	Westbound	2,950	449	462	2.9%	467	465	-0.4%
	Eastbound	3,650	449	556	23.8%	430	543	26.3%

Table 4.4 illustrates the average travel time and average distance travelled for trips along Anzac Parade, Alison Road and Todman Ave- Perouse Road via High Street for both AM and PM peak respectively. A comparative analysis of the approved Project scenario and the modified project scenario travel times indicate the following changes for each key route:

- Anzac Parade – Northbound**
 The results show that the travel times for the northbound direction along Anzac Parade respectively remain relatively consistent for the two scenarios and highlight that the changes in travel patterns due to High Street closures will have marginal impact on the operation of this route, with the model results indicating a minor reduction in travel time during the AM Peak.
- Anzac Parade – Southbound**
 Similarly to the northbound trips, Table 4.4 shows that travel time for the southbound trips will remain unchanged in the modified project scenario when compared to the approved Project scenario.
- Alison Road – Westbound**
 The average travel time and average distance plots for Alison Road Westbound indicate that the westbound travel times are likely to remain unaffected in both scenarios in both the AM and PM peaks.
- Alison Road – Eastbound**
 The results indicate that travel times for eastbound trips along Alison Road would increase by approximately 20 seconds. This is caused by congestion at the Alison Road / Avoca Street intersection resulting from traffic rerouting from Belmore Road. This redirection is caused by increased delays along the section of Belmore Road where High Street traffic travels via Arthur Street.
- Perouse Road to Todman Avenue via High Street – Westbound**
 The average travel time and average distance plots for westbound trips between Perouse Road and Todman Avenue show only minor changes in the average travel times for this route.
- Todman Avenue to Perouse Road via High Street – Eastbound**
 The result of the average travel time and average distance plots for eastbound trips between Todman Avenue and Perouse Road, shows that these trips will be subject to the highest rate of rerouting, resulting in increased travel journeys. The increase in travel

time is largely attributed to the closure of the eastbound movement on along High Street for the modified project.

4.3 Bus operations

There would be minor impacts to the bus services that pass the High Street/ Randwick interchange. Table 4.5 details the changes to the existing bus network as part of the approved Project and the implications of the proposed modifications on the approved Project bus network.

Table 4.5: High Street/ Randwick Bus Network Changes (AM Peak)

Route Number	Old Route	Approved Route	Implication of Proposed Modification on Approved Route
370	Coogee-MarketPlace Leichhardt via Newtown	Route operates as existing	Section of route on High Street between Clara Street and Avoca Street to be diverted through Belmore Road, Arthur Street and Clara Street, then back to High Street.
372	Coogee-Railway Square via Cleveland Street	Coogee-Railway Square via Cleveland Street, through routed with 412/413 to align with the city centre bus network redesign	No route change required.
373	Coogee-Circular Quay via Oxford Street	Route cancelled	N/A
375	N/A	New service operating Maroubra Beach-Sydney University via Randwick Junction, High Street and Todman Avenue	Route diverted through Belmore Road, Arthur Street and Clara Street.
376	Maroubra Beach-Circular Quay via Marine Parade, Alison Road and Foveaux Street	Route cancelled, replaced with 375	N/A
377	Maroubra Beach-Circular Quay via Marine Parade, Alison Road and Oxford Street	Operates existing route to Alison Road via Belmore Road and terminates	Bus stop relocation
M50	Metrobus route between Maroubra Junction and Leichhardt	Will no longer operate in the Eastern Suburbs to align with the Sydney city centre bus network redesign	N/A

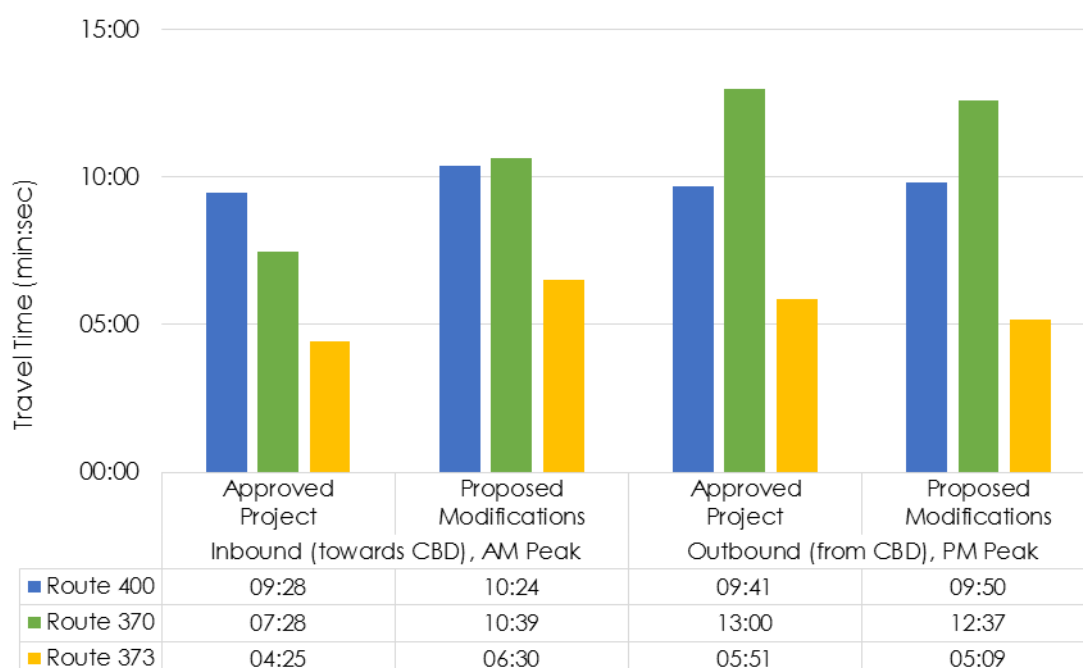
In order to understand impacts of bus route diversions on travel times, representative routes were selected for typical bus route patterns through High Street. For this exercise, bus routes 370, 400 and 373 have been analysed for various sections, as shown in Figure 4.10. The results of this bus travel time assessment are presented in Figure 4.11 noting that the analysis has only been undertaken for peak directions for both approved and modified Project scenarios.

Figure 4.10: Assessed High Street Representative Bus Routes



Basemap: Googlemaps, 2015

Figure 4.11: Comparative Bus Travel Time Results for Selected Representative Bus Route Groups



The bus travel results illustrate the following:

- Redirecting the High Street bus routes via Arthur Street will increase inbound bus travel times in the AM peak with the proposed modifications.
- The bus travel times in the PM peak outbound direction will not significantly increase from with the proposed modification. Two of the three routes investigated would experience shorter travel times with the proposed modifications.
- Bus routes along Belmore Road (represented by Route 373) can expect longer delays as an indirect result of the proposed closure of High Street westbound (between Avoca Street and Clara Street), brought about by increased delays at the Belmore Road/ Arthur Street intersection in the inbound direction during the AM peak.
- In the PM peak, the outbound services along Belmore Road (Route 373) are expected to benefit from the simplified signal phasing arrangements at the High Street/ Avoca Street/ Belmore Road intersection, which will operate with only three signal phases with the proposed modification. In contrast, this intersection requires five signal phases in the approved Project scenario in order to accommodate light rail and general traffic movements.

4.4 Kerbside parking

The modified proposal includes additional modifications to the road upgrade and geometry. The modifications include changes to the intersection upgrades along Arthur Street and Barker Street. The impact of the proposed modifications to kerbside parking in comparison with the approved Project is summarised in Table 4.6.

Table 4.6: Impacts on kerbside parking

Street	Section	Proposed Modification	Potential Impact
Arthur Street and adjacent roads:			
Arthur Street (North Side)	Wansey Road to Botany Street	20m No Stopping (Loss of 3 parking spaces)	Loss of 3 parking spaces
	Botany Street to Arthur Lane	20m No Stopping at Botany Street, 45m No Stopping/turn lane at Arthur Lane	Loss of 9 parking spaces
	Arthur Lane to Belmore Road	35m No Stopping/turn lane	Loss of 7 parking spaces
Arthur Street (South Side)	Arthur Lane to Belmore Road	10m No Stopping	Loss of 1 parking space
	Botany Street to Arthur Lane	20m No Stopping at Botany Street and new upstand	Loss of 7 parking spaces
	Wansey Road to Botany Street	20m No Stopping at driveway and 20m No Stopping at Botany Street	Loss of 5 parking spaces
Wansey Road (West side)	Arthur Street to High Street	No Stopping full length	No impacts to parking relative to approved Project
Wansey Road (East side)	Arthur Street to High Street	No Stopping full length	No impacts to parking relative to approved Project
Botany Street (West side)	Within 20m of Arthur Street	20m No Stopping north of Arthur Street and 20m south of Arthur Street	No impacts to parking
Botany Street (East side)	Within 20m of Arthur Street	20 No Stopping north of Arthur Street and 10m No Stopping south of Arthur Street	Loss 2 parking spaces
Clara Street	Within 20m of Arthur Street	As per existing	NA
Arthur Lane	Within 20m of Arthur Street	As per existing	NA
Belmore Road (West side)	Within 20m north of Arthur Street	20m No Stopping	Loss of 2 parking spaces
	Within 20m south of Arthur Street	20m No Stopping	Reduced Bus Zone
Belmore Road (East side)	Within 20m of Arthur Street	20m No Stopping north of Arthur Street, 10m south of Arthur Street	Loss of 7 parking spaces

continued

Street	Section	Proposed Modification	Potential Impact
Barker Street and adjacent roads:			
Barker Street (North side)	Botany Lane to Botany Street	As per existing	NA
	Botany Street to Maud Street	20m No Stopping	Loss of 1 parking space
Barker Street (South side)	Botany Lane to Botany Street	20m No Stopping	Loss of 2 parking space
	Botany Street to Maud Street	20m No Stopping	Loss of 1 parking space
Botany Street	20m north of Barker Street	20m No Stopping, Relocation of bus stop	Loss of 2 parking spaces
	20m south of Barker Street	20m No Stopping	Loss of 3 parking spaces
Belmore Road/ Avoca Street intersection:			
Belmore Road (East side)	Within 60m north of the intersection	60m bus zone peak, 40m bus zone off peak and 20m parking off peak, 20m No Stopping	No impacts to parking
Belmore Road (West side)	Within 60m north of the intersection	20m taxi rank off peak, 20m parking off peak	No impacts to parking
Avoca Street (West side)	Within 80m north of the intersection	20m No Stopping Zone, 60m Proposed Bus Zone	No impacts to parking
Total Impact			Loss of 52 parking spaces

4.5 Walking and cycling

There would be changes to access arrangements for pedestrians and cyclists within the UNSW High Street and Randwick Precincts as part of the proposed modification to the light rail alignment. The following changes detail the key changes in access arrangements.

4.5.1 Randwick Terminus Precinct Access Plan

The proposed modification includes the relocation of the bus stops as well as the light rail stop to maintain pedestrian accessibility between light rail and bus. The proposed arrangement ensures that the light rail stop and bus stops are in adjacent locations to allow users to efficiently transfer between light rail and bus.

The northbound bus stop which was previously located at the light rail interchange would be relocated to Avoca Street, south of High Street. The southbound bus stop on Avoca Street would be removed and southbound bus services would continue to utilise the existing bus stop located on Belmore Road, north of High Street. Figure 3.13 shows the proposed bus stop arrangement.

The pedestrian connection between the southbound bus stop on Belmore Road and the light rail stop on High Street would be improved through the removal of the slip lane and associated pedestrian crossing on Belmore Road. The slip lane/ pedestrian crossing would be replaced by a footpath which would reduce the number of times pedestrians are required to cross the road to access the light rail stop from the bus stop.

4.5.2 UNSW High Street Access Plan

As discussed in Section 3.2, the modification to the UNSW High Street Stop includes the reconfiguration of the stop from a single centre platform to two platforms, one for each direction. The westbound platform would be located at the centre of High Street, with the eastbound platform to be integrated with the footpath on the northern side.

The separation of the platform improves the free flow of passengers, particularly given the high patronage of the stop during the AM peak. It is noted that this AM peak patronage would largely be transferred to the northern footpath given the higher patronage. The AM passengers would

largely include alighting light rail passengers, who would now need to cross the full width of High Street (compared with the situation in the approved Project, in which these passengers only needed to cross a shorter section of High Street).

While the proposed modification would reduce the likelihood of alighting and boarding passengers interfacing with each other, there are potential impacts on the signal operation of the High Street/ Wansey Road intersection, which will likely require longer pedestrian crossing times.

The pedestrian crossings located west of the UNSW High Street stop would be maintained as per approved arrangement to allow the light rail passengers to access both sides of the High Street road.

Cyclist accessibility through High Street will be reduced with the removal of the eastbound traffic lane. Cyclists who could use the eastbound traffic lane in the approved Project would be required to divert to roads located north of High Street including Waratah Avenue or Blenheim Street. For these links, Waratah Street and Blenheim Street could be suitable cycling routes as they accommodate relatively lower traffic volumes than Arthur Street.

Waratah Street and Blenheim Street, however, do not connect to the Wansey Road shared path. Thus, access to the Wansey Road shared path from the east would require the use of Arthur Street from Botany Street. Further investigation is recommended during the detailed design stage to allow for a more efficient connection along Arthur Street, in consideration of increased traffic flows. This investigation would be undertaken as part of the Pedestrian and Cyclist Network and Facilities Strategy as required by Condition B33 of the Infrastructure Approval for the CSELR project.

4.6 Property access

4.6.1 Private properties

With the closure of vehicle access on particular traffic flows along High Street, the proposed modifications would impact on vehicular access to a number of properties along High Street. In particular, changes to vehicular access to the following properties are expected to be required with the proposed modification:

- 34 High Street (Kenvale College Hospitality and Event Management)
- 42 and 44 High Street (residential apartment buildings with shared access – approximately 32 dwelling units)
- 46 High Street (residential apartment building – approximately 10 dwelling units).

Vehicle access to these properties will need to be via the proposed new laneway from Arthur Street.

4.6.2 Sydney Children's Hospital – emergency vehicle access

The existing emergency vehicle area of the Sydney Children's Hospital on High Street will continue to be accessible from various directions, as per existing arrangements. The closure of the eastbound traffic lane on High Street between Wansey Road and Botany Street, and the westbound traffic lane between Clara Street and Avoca Street will restrict movements of general traffic. However, emergency vehicles heading for the Sydney Children's Hospital ambulance area will be allowed to use the light rail corridor. This, however, would impact emergency vehicle access during times in which LRVs are occupying the light rail tracks.

In order to minimise the risk of emergency vehicles being held up by LRVs, it is recommended that alternate access routes which avoid the affected traffic lanes identified and communicated to emergency service operators.

Figure 4.12: Ambulance Access



5. Changes in construction-stage impacts

5

5.1 Key changes in construction activities and staging

5.1.1 Key changes

The key changes in construction activities associated with the proposed modifications would include:

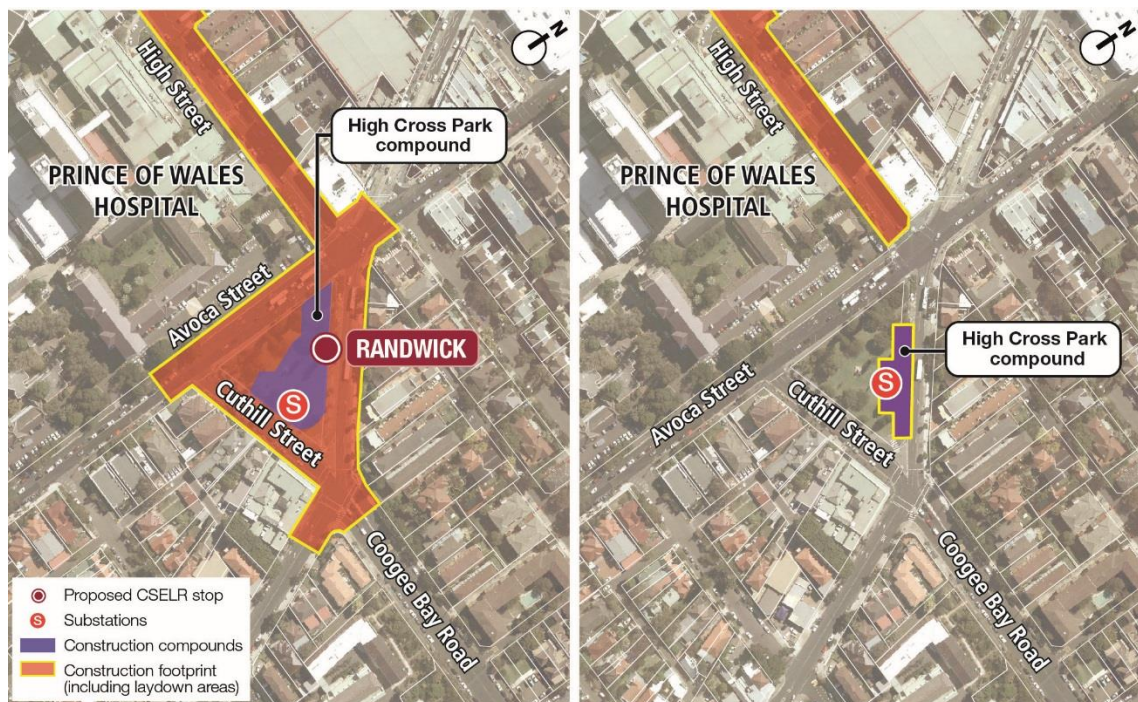
- reduction in size of construction compound required at High Cross Park (refer Figure 5.1)
- potential traffic disruptions and footpath diversions along Arthur Street, associated with reconfiguration of the kerbside parking arrangements, reconfiguration of the Wansey Road, Botany Street, Clara Street and Belmore Road intersections, and construction of the replacement access driveway for 42-44 High Street
- installation of traffic signals and associated works at the following intersections:
 - Botany Street/ Arthur Street
 - Arthur Street/ Belmore Road
 - Botany Street/ Barker Street
- potential footpath closures on the north side of High Street associated with the UNSW High Street stop, between Wansey Road and Botany Street
- construction activities on the Belmore Road footpath associated with the closure of the southbound slip lane to Avoca Street
- potential traffic disruptions on Avoca Street northbound (south of High Street) associated with the new bus zone.

Other key impacts of the proposed modifications include:

- reduced traffic impacts on Avoca Street, Cuthill Street and Belmore Road surrounding High Cross Park as a result of a reduced construction area and traffic generation, including the removal of construction works required to provide the bus stops in the approved Project
- reduced road closure requirements as a result of the light rail tracks no longer required to be built across Avoca Street.

Other than these, no other significant changes and impacts are anticipated relating to the construction of the modified UNSW High Street and Randwick Terminus stops, compared with impacts identified with the approved Project.

Figure 5.1: Construction Compound Locations- Approved Project vs Modified Project



Source: Transport for NSW

5.1.2 Arthur Street alternative property access

The provision of the alternate property access on Arthur Street would likely involve the following construction activities:

- pre-construction activities such as site survey and services investigation
- clearing and set-up of temporary construction fencing
- demolition of existing structures
- relocation of services
- excavation
- construction of retaining walls and ramps
- installation of conduits, drainage and other services
- installation of sub-base and compaction of material
- paving
- installation of final services, gates and signage.

5.1.3 High Street road closures

The likely staging of the closure of High Street to allow construction of the light rail tracks are:

- closure of High Street between Clara Street and Avoca Street
- construction of Arthur Street/ Belmore Road signalised intersection
- construction of Arthur Street works, including kerbside parking rearrangement and Botany Road/ Arthur Street signalisation
- closure of westbound traffic
- opening for eastbound traffic.

5.2 Modified construction access routes

The overall construction routes developed as part of the Construction Traffic Management Plan for the approved Project are not proposed to be modified. They will continue to be used as part of the existing infrastructure approval.

5.3 Recommended mitigation measures

As part of the Pedestrian and Cyclist Network and Facilities Strategy for the CSELR project, the proposed alternate cycle route along Arthur Street that would serve as the temporary cycle link during construction of the CSELR while High Street is closed outlined in the EIS will require further revision with Arthur Street accommodating increased traffic flows. It is recommended that discussions with Randwick City Council be undertaken to investigate further opportunities for alternative cycle routes during construction. This may include the use of Waratah Avenue between Belmore Road and Botany Street to replace Arthur Street.

6. Summary

Modifications to the approved design and location of the UNSW High Street and Randwick terminus stops as part of the CSELR project have been developed as a result of opportunities to improve pedestrian efficiency and safety, among others.

This report sets out an assessment of the changes in traffic, transport and access impacts of these proposed modifications over those of the approved Project.

The proposed modifications include:

- relocation and re-design of the Randwick terminus stop from High Cross Park to High Street west of the Avoca Street intersection
- reconfiguration of the UNSW High Street stop arrangement from an island platform to side platforms, with the northern platform
- provision of a new access laneway from Arthur Street to properties on High Street as a result of the new UNSW High Street stop configuration
- some changes to the local traffic network to accommodate the modified stops, including introduction of a one-way westbound section on High Street between Wansey Road and Botany Street, introduction of a one-way eastbound section on High Street between Clara Street and Avoca Street, minor changes to bus routes and stops, and installation of new traffic lights at the following intersections:
 - Botany Street/ Arthur Street
 - Arthur Street/ Belmore Road
 - Botany Street/ Barker Street
- revised arrangement for the High Cross Park interchange, including relocated bus stops.

These proposed modifications are expected to generate the following changes in end-state traffic, transport and access impacts over those of the approved Project:

Light rail stop access

- Changes in access to the UNSW High Street stop will require customers using the northern platform and walking to/from UNSW to cross the full width of High Street, compared with a shorter crossing in the approved Project. This will have potential impacts to signal phasing of the Wansey Road/ High Street intersection and corresponding traffic operations.
- The modified UNSW High Street stop will improve free flow of passengers, with the separation of the northern and southern platforms.
- The modified Randwick terminus stop will no longer require light rail passengers to cross either Avoca Street, Cuthill Street, or Belmore Road to access the stop.

Interchange function

- The proposed modification of the Randwick terminus stop will remove the opportunity for direct bus-light rail interchange at High Cross Park. Interchanging passengers will need to walk longer distances to transfer modes.

Traffic network operation

- The traffic rerouting will result in general increases in average traffic delays at the key intersections.

Traffic flows

- The proposed modifications will require traffic along High Street to reroute, with majority shifting to use Arthur Street, increasing Year 2021 peak hour traffic volumes to between one quarter and 3.5 times the volumes in the approved Project.
- Other roads expected to experience increased AM peak traffic volumes include southbound Anzac Parade between High Street and Barker Street, eastbound Barker Street northbound Botany Street between Barker Street and High Street, Belmore Road and Alison Road.
- During the PM peak, traffic volume increases are expected along north/ westbound Alison Road, northbound Belmore Road and Avoca Street.

Travel times

- Travel times throughout the study area for selected routes along Alison Road, Anzac Parade and High Street are generally consistent between the approved Project and the modified Project scenarios.

Kerbside parking

- The proposed modifications will reduce the availability of kerbside parking in the study area.
- Impacts on Arthur Street indicate a loss of 52 spaces.

Bus travel times

- Redirecting the High Street bus routes via Arthur Street will increase inbound bus travel times in the AM peak with the proposed modifications.
- The bus travel times in the PM peak outbound direction will not significantly increase from with the proposed modification. Two of the three routes investigated would experience shorter travel times with the proposed modifications.

Cycling

- The closure of the eastbound lane on High Street between Wansey Road and Botany Street and the westbound lane between Clara Street and Avoca Street will require further investigation to alternate cycle routes in the precinct.
- Opportunities to use Arthur Street as alternate cycle routes have been previously identified by Council and in the EIS. However, with the proposed modifications, traffic volumes along Arthur Street will be expected to increase, negatively impacting on opportunities for cycle routes through Arthur Street. It is recommended that further investigation be undertaken as part of the CSELR Pedestrian and Cyclist Network and Facilities Strategy to allow for a more efficient connection during operation.

Property Access

- The proposed relocation of the UNSW High Street stop will require closure of vehicular access to four properties on High Street. To maintain access, a new laneway from Arthur Street is proposed.
- Emergency vehicle access through High Street will be maintained with emergency vehicles responding to emergencies being allowed to use the light rail tracks where the road section of High Street is closed to general traffic. These include the westbound direction between Avoca Street and Clara Street, and eastbound direction between Wansey Road and Botany Street.

Construction Impacts

- The proposed modification will reduce the construction footprint required at High Cross Park.
- The proposed modifications would no longer require the closure of Avoca Street to allow for light rail track construction, as these tracks would terminate on High Street west of Avoca Street.