UPDATED TRANSPORT IMPACT ASSESSMENT REPORT

APPENDIX G

Sydney Metro City & Southwest: Waterloo Over Station Development

Transport Impact Assessment Report

Applicable to:	Sydney Metro City & Southwest
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Owner	Sydney Metro
Status:	Revised Final
Version:	7
Date of issue:	18 September 2019
Review date:	18 September 2019

Contents

Glossary of terms and acronyms

Term/acronym	Definition
Adaptable dwelling	Housing which is designed and constructed in such a way that it can be modified easily in the future to become accessible to both occupants and visitors with disabilities or progressive frailties
Adaptable parking space	A parking space provided for an adaptable dwelling which can be modified easily in the future to become an accessible parking space
Aimsun	A traffic modelling software, performing traditional static macroscopic modelling to more detailed dynamic mesoscopic and microscopic simulation modelling.
AM peak hour	Unless otherwise stated, this refers to vehicle trips arriving at their destination during the average peak hour in the morning peak period between 7am and 9am on a normal working weekday.
ATP	Australian Technology Park
CBD	Central Business District
CTMP	Construction Traffic Management Plan
DCP	Development Control Plan
Do Minimum	A model scenario that does not incorporate the proposed project infrastructure
EIS	Environmental Impact Statement
Fruin Level of Service	John Fruin developed a set of planning principles to assess pedestrian crowding and is documented in his 1987 book *Pedestrian Planning and Design*. These principles have since been adopted as the global industry standard approach to planning for pedestrians. This methodology is used to interpret the performance of space and how people move and interact under certain conditions
Heavy vehicles	A heavy vehicle is classified as a Class 3 vehicle (a two-axle truck) or larder, in accordance with the Austroads Vehicle Classification System.
HTS	Household Travel Survey
IAP	Interchange Access Plan
JTW	Journey to Work
LAHC	Land and Housing Corporation
Legion	A pedestrian modelling software used to simulate pedestrian movements within a defined space, taking into account how individuals interact with each other and physical obstacles within their environment.

Term/acronym	Definition
LEP	Local Environment Plan
LGA	Local Government Area
LOS	Level of Service
Midblock	A general location on a road between two intersections
Mode	A type or method of transport movement
NSW	New South Wales
PCL	Pedestrian Comfort Level
PM peak hour	Unless otherwise stated, this refers to vehicle trips arriving at their destination during the average peak hour in the evening peak period between 4pm and 6pm on a normal working weekday.
PTPM	Public Transport Project Model A multi-modal model developed by TPA that forecasts patronage and demand related impacts of public transport projects and policies.
REF	Review of Environmental Factors
Roads and Maritime	NSW Roads and Maritime Services (formerly NSW Roads and Traffic Authority)
Roundabout	An intersection where all traffic travels in one direction clockwise around a central island
SEIFA	Socio-Economic Indexes for Areas Developed by the Australian Bureau of Statistics that ranks areas in Australia according to relative socio-economic advantage and disadvantage
SIDRA	An intersection and network modelling software used to evaluate intersection performance.
SSD	State Significant Development
TfNSW	Transport for New South Wales
TPA	Transport Performance and Analytics
TZ	Travel Zone The smallest standard geography used for a number of transport datasets in New South Wales, representing geographical areas that are used in origin-destination transport modelling.

Term/acronym	Definition
TZP	Travel Zone Projection These are land use projections (population, workforce and employment) produced by TPA and developed to support a strategic view of Sydney and represent the most likely urban future based on current data, trends and an understanding of policy/structural changes that may impact the future.
UrbanGrowth NSW	Urban Growth New South Wales Development Corporation
VKT	Vehicle Kilometres Travelled
Waterloo Precinct	Refers to the land within the Waterloo State Significant Precinct boundary. Also refers to the zones defined by the Australian Bureau of Statistics and Transport for New South Wales that fall within the Waterloo State Significant Precinct boundary.

Executive Summary

Background

Sydney Metro is seeking to secure concept approval for over station development (OSD) above and adjacent to Waterloo Station comprising a podium and three taller buildings which include commercial, residential, and community land uses. A total of seven buildings are proposed on the site. The concept State Significant Development (SSD) Application seeks consent for a building envelope and use for residential, retail, commercial, entertainment, community and recreational purposes, maximum building height, maximum gross floor area, pedestrian and vehicular access, circulation arrangements and associated car parking and the strategies and design parameters for the future detailed design of development.

This report has been prepared to outline the transport impacts and specifically respond to the Secretary's Environmental Assessment Requirements (SEARs) issued for the concept SSD Application on 29th June 2018.

Sydney Metro

Sydney Metro is a new standalone metro rail network identified in Transport for NSW's (TfNSW) *Sydney's Rail Future*. A component of Sydney Metro is Sydney Metro City & Southwest which is planned from Chatswood to Sydney CBD and Bankstown, which was approved as Critical State Significant Infrastructure in January 2017 (hereafter referred to as the CSSI Approval). Services on the new line are forecasted to being in 2024 and will run at a minimum of every 4 minutes in each direction, with an ultimate capacity for trains to carry up to 46,000 people per hour in one direction. Sydney Metro City & Southwest will remove T3 Bankstown line trains from the City Circle, providing congestion relief and greater capacity for T8 Airport, Inner West and South line trains. This will result in a moderate increase in train capacity stopping at Redfern Station from 2024. Preliminary forecasts for the 2036 AM peak hour indicate that around 3,700 customers would be entering and around 2,350 customers would be exiting the Waterloo Station (Chatswood to Sydenham EIS, 2016).

Access to Waterloo Station would be located at the northern end of the station on the corner of Raglan Street and Cope Street, with a second entry off a new public plaza adjacent to Cope Street. As part of the CSSI Approval, some existing bus stops around the Metro Quarter may be relocated to better integrate with the station entry and provide convenient interchange between the metro and bus network. In addition, point to point facilities and a taxi rank would be provided on Cope Street, further improving the amenities available to customers of the metro network. It is noted that the final resolution of interchange facilities will be undertaken as part of the development of the Interchange Access Plan (IAP) required under Condition E92 of the CSSI Approval.

Future mode share targets

An assessment of the potential future mode shares has been undertaken in consultation with TfNSW, Roads and Maritime Service (RMS) and City of Sydney and is based on existing data and the strategic opportunities for the Metro Quarter. The mode share targets in the AM peak for all trip purposes are outlined in Figure ES.3.

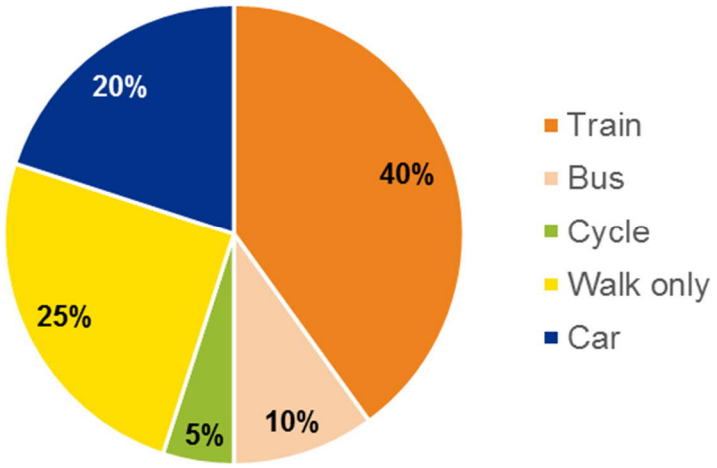

Figure ES.3 : Metro Quarter future mode share targets

These targets are based on a number of factors, including:

- Proximity to Waterloo Station, which will provide access to high quality mass transit services on Sydney Metro City & Southwest
- Densely located land uses, activities and attractors as well as proximity to Sydney CBD and Green Square, enabling shorter trip lengths more conducive to walking and cycling
- Low existing traffic generation rates in recent high density developments in Waterloo and Redfern, and high (81 per cent) AM peak non-car mode share observed at the Redfern traffic generation survey site (detailed further in Chapter 6)
- Enhancements to the bus network to strengthen east-west routes, enabled by Sydney Metro City & Southwest, and improved cycling connections with key surrounding destinations.
- Consideration of Category A rates outlined in City of Sydney's Development Control Plan (DCP) requirements to represent best practice in the provision of transport facilities appropriate for the Metro Quarter.

The Waterloo Metro Quarter

Proposed planning framework

The Metro Quarter, as part of the broader Waterloo State Significant Precinct, was nominated as an area of State planning significance, by the Minister for Planning (the Minister), to be investigated for new planning controls through a State Significant Precinct (SSP) Study. The Metro Quarter SSP Study was submitted to the Department of Planning & Environment (DPE) in final form in October 2018. The Study includes proposed statutory planning controls and a Development Control Plan (DCP) to guide future development within the Metro Quarter. The DCP includes provisions for residential and commercial car parking rates to be provided in accordance with the Category A and D rates under Sydney Local Environmental Plan 2012. Other key existing and proposed planning controls for the Metro Quarter are shown in Table ES.1.

Table ES.1 : Planning framework

	Existing	Proposed
Zoning	B4 mixed use	B4 mixed use
Height of buildings	Part 12, Part 15 metres	Part RL 115.3 (AHD) – North Part RL 104.2 (AHD) – Central Part RL 96.9 (AHD) – South
Floor Space Ratio	1.75:1	6.1:1 (including Metro Station TBC)

Indicative Concept Proposal

The indicative Concept Proposal for the Metro Quarter OSD comprises:

- approximately 68,750 square metres of gross floor area (GFA), comprising:
  - approximately 56,200 square metres GFA of residential accommodation, with potential to deliver approximately 700 dwellings, including 5 to 10 percent affordable housing and 70 social housing dwellings;
  - approximately 3,905 square metres of GFA for retail premises and entertainment facilities
  - approximately 8,645square metres of GFA for business and commercial premises and community and recreation facilities (indoor), including a minimum of 2,000 square metres for community uses.
- a three storey mixed-use non-residential podium, including a free standing building located within a public plaza of approximately 1,400 square metres.
- residential uses above podium level in various building forms including three taller buildings of 23, 25 and 29 storeys (Reduced Level (RL) 96.9, 104.2 and 116.9 metres AHD respectively)
- use of OSD space provisioning within the footprint of the CSSI Approval

- public domain works, through-site links, footpaths, provision for cycle facilities and enhanced pedestrian crossings and roads
- car parking for up to 427 vehicles
- cycle parking to support residential and non-residential land uses and visitors to the Quarter. Approval is also being sought for space within the future basement for a bike hub which would also support future bike parking for Waterloo Station
- loading, vehicular and pedestrian access arrangements
- strategies for utilities and services provision
- strategies for managing stormwater and drainage
- a strategy for the achievement of ecologically sustainable development
- a public art strategy
- provision for future signage zones
- a design excellence framework
- the future subdivision of parts of the OSD footprint (if required).

Planning approval has already been separately granted for the metro station on the site under the CSSI Approval, which will comprise approximately 8,415 square metres of GFA. The total GFA for the integrated station development, including the metro station GFA, is approximately 77,165 square metres, which is equivalent to a floor space ratio (FSR) of approximately 6:1. Transport interchange facilities including bus stops on Botany Road and point to point facilities on Cope Street will be provided under the CSSI Approval.

The existing heritage listed Waterloo Congregational Church does not form part of the concept SSD Study Area.

Proposal assessment

A detailed traffic and transport assessment of the proposal has been undertaken and considers the following key areas:

- Public transport – assesses the bus, heavy rail and metro networks, including proposed infrastructure, service frequency, bus route and stop coverage and service accessibility
- Active transport – assesses the pedestrian and cycling networks including footpath and shared path widths, pedestrian crossings, and access to and availability of pedestrian and cycle infrastructure
- Parking and demand management – assesses the number of parking spaces required to accommodate the Metro Quarter and surrounding area including on-road and off-road parking environments
- Road network – assesses the immediate and wider road network through microsimulation and intersection modelling to determine the performance of the road network in terms of average vehicle delay and Level of Service
- Vehicle access – assesses the proposed access points to and from the Metro Quarter and the function of surrounding streets

Findings from the assessment support the development of the implementation plan and strategy which is outlined in Figure ES.4.

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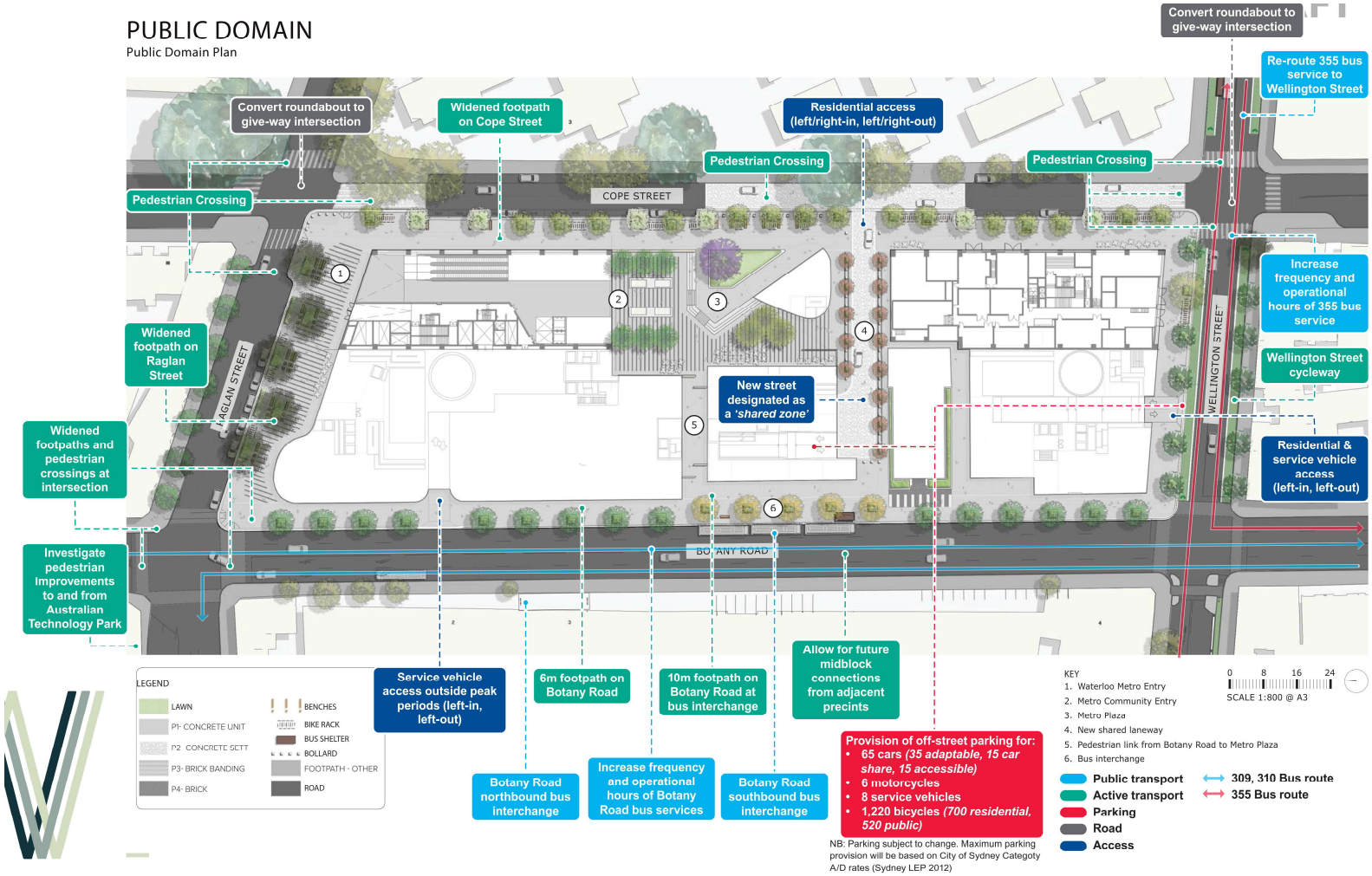


Figure ES.4 : Proposed future transport network around the Metro Quarter

1. Introduction

1.1 Purpose of this report

This report accompanies a concept State Significant Development Application (concept SSD Application) submitted to the Department of Planning and Environment (DPE) pursuant to Part 4 of the Environmental Planning and Assessment Act 1979 (EP&A Act). The concept SSD Application is made under Section 4.22 of the EP&A Act.

This report should be read in conjunction with the Nominated State Significant Precinct (SSP) Study – Waterloo, submitted to the Minister for Planning (The Minister) in July 2018. That study proposes new planning controls to facilitate the development proposed.

Sydney Metro is seeking to secure concept approval for over station development (OSD) above and adjacent to Waterloo Station comprising a podium and three taller buildings which include commercial, residential, and community land uses. The concept SSD Application seeks consent for a building envelope and use for residential, retail, commercial, entertainment, community and recreational purposes, maximum building height, maximum gross floor area (GFA), pedestrian and vehicular access, circulation arrangements and associated car parking and the strategies and design parameters for the future detailed design of development.

Sydney Metro proposes to procure the construction of the OSD as part of an integrated station development package, which would result in the combined delivery of the station, OSD and public domain improvements. The station and its public domain elements form part of a separate planning approval for Critical State Significant Infrastructure (CSSI) approved by DPE on 9 January 2017.

As the development is within a rail corridor, is associated with railway infrastructure and is for "commercial premises or residential accommodation" with a Capital Investment Value of more than $30 million, the project is identified as State Significant Development (SSD) pursuant to Schedule 1, 19(2)(a) of the State Environmental Planning Policy (State and Regional Development) 2011 (SRD SEPP).

This report has been prepared to outline the transport impacts and specifically respond to the Secretary's Environmental Assessment Requirements (SEARs) issued for the concept SSD Application on 29th June 2018 which states that the Environmental Impact Statement (EIS) is to address the following requirements:

Reference	SEARs Requirement	Where Addressed in Report
1	Address the relevant provisions, goals and objectives in the following: • NSW State and Premier Priorities • *A Metropolis of Three Cities* • *Eastern City District Plan* • *State Infrastructure Strategy 2018* • Relevant City of Sydney policies, codes and guidelines (where required pursuant to relevant Local Environmental Plan) • *Future Transport 2056* • *Guide to Traffic Generating Developments,* Roads and Maritime Services	Section 2 and throughout report
12	The EIS must include a Transport and Traffic Impact Assessment that provides, but is not limited to, the following:	
	accurate details of the current daily and peak hour vehicle, public transport, point to point transport services, pedestrian and bicycle movements from existing buildings/ uses on the site using the adjacent and surrounding road network.	Section 4.1
	forecast total daily and peak hour trips likely to be generated by the proposed development including vehicle, public transport, point to point transport services, pedestrian and bicycle trips, together with cumulative impacts of existing, proposed and approved developments in the area and any transport/ traffic upgrade.	Section 6.3
	detailed assessment of the existing and future performance of key intersections providing access to the site, supported by appropriate modelling and analysis to the satisfaction of RMS and TfNSW.	Section 4.4 Section 6.7
	measures to mitigate impacts of the proposed development on the operation of existing and future traffic, public transport, pedestrian and bicycle networks including	Section 6 Section 7

	any required upgrades.	
	measures to be implemented to encourage users of the development to make sustainable travel choices, including walking, cycling, public transport and car sharing, such as the integration with rail and bus infrastructure and provision of adequate bicycle parking and end of trip facilities.	Section 6 Section 7
	proposed car and bicycle parking provision for residents, workers and visitors, including consideration of the availability of public transport and the requirements of the relevant parking codes and Australian Standards	Section 6.6
	proposed provision of bus service infrastructure and pedestrian connections to support the bus/rail interchange function of the metro station, including an assessment of the public domain surrounding the site to accommodate the future pedestrian demands safely and adequately and mitigation measures identified.	Section 6.4 Section 6.5 Section 7
	proposed vehicle access arrangements, including for service and loading activities and measures to mitigate impacts to bus services and passengers interchanging between bus and rail.	Section 6.8

1.2 Overview of Sydney Metro in its context

Sydney Metro is Australia's biggest public transport project. A new standalone metro railway system, this 21st century network will deliver 31 metro stations and 66km of new metro rail for Australia's biggest city — revolutionising the way Sydney travels. Services start in the first half of 2019 on Australia's first fully-automated railway.

Sydney Metro was identified in *Sydney's Rail Future*, as an integral component of the *NSW Long Term Transport Master Plan*, a plan to transform and modernise Sydney's rail network so it can grow with the city's population and meet the future needs of customers. In early 2018, *the Future Transport Strategy 2056* was released as an update to *the NSW Long Term Transport Master Plan* and *Sydney's Rail Future*. Sydney Metro City & Southwest is identified as a committed initiative in the *Future Transport Strategy 2056*.

Sydney Metro is comprised of three projects:

Sydney Metro Northwest — formerly the 36km North West Rail Link. This $8.3 billion project is now under construction and will open in the first half of 2019 with a metro train every four minutes in the peak.

Sydney Metro City & Southwest — a new 30km metro line extending the new metro network from the end of Sydney Metro Northwest at Chatswood, under Sydney Harbour, through the CBD and south west to Bankstown. It is due to open in 2024 with an ultimate capacity to run a metro train every two minutes each way through the centre of Sydney.

Sydney Metro West – a new underground railway connecting the Parramatta and Sydney central business districts. This once-in-a-century infrastructure investment will double the rail capacity of the Parramatta to Sydney CBD corridor and will establish future capacity for Sydney's fast growing west. Sydney Metro West will serve five key precincts at Westmead, Parramatta, Sydney Olympic Park, The Bays and the Sydney CBD. The project will also provide an interchange with the T1 Northern Line to allow faster connections for customers from the Central Coast and Sydney's north to Parramatta and the Sydney CBD.

Sydney's new metro, together with signalling and infrastructure upgrades across the existing Sydney suburban rail network, will increase the capacity of train services entering the Sydney CBD – from about 120 an hour currently to up to 200 services beyond 2024. That represents an increase of up to 60 per cent capacity across the network to meet demand.

Figure 2.1: Sydney Metro alignment map

Sydney Metro City & Southwest includes the construction and operation of a new metro rail line from Chatswood, under Sydney Harbour through Sydney's CBD to Sydenham and on to Bankstown through the conversion of the existing line to metro standards.

The project also involves the delivery of six (6) new metro stations, including at Waterloo, together with new underground platforms at Central. Once completed, Sydney Metro will have the ultimate capacity for a train every two minutes through the CBD in each direction - a level of service never seen before in Sydney.

On 9 January 2017, the Minister approved the Sydney Metro City & Southwest - Chatswood to Sydenham application lodged by TfNSW as a CSSI project (reference SSI 15_7400).

The CSSI Approval includes all physical work required to construct the CSSI, including the demolition of existing buildings and structures on each site. Importantly, the CSSI Approval also includes provision for the construction of below and above ground structures and other components of future OSD (including building infrastructure and space for future lift cores, plant rooms, access, parking and building services, as relevant to each site). The rationale for this delivery approach, as identified within the CSSI application is to enable the OSDs to be more efficiently built and appropriately integrated into the metro station structures.

The EIS for the Chatswood to Sydenham alignment of the City & Southwest project identified that the OSD would be subject to a separate assessment process.

Since the CSSI Approval was issued, Sydney Metro has lodged four modification applications to amend the CSSI Approval as outlined below:

- Modification 1 - Victoria Cross and Artarmon Substation which involves relocation of the Victoria Cross northern services building from 194-196A Miller Street to 50 McLaren Street together with inclusion of a new station entrance at this location referred to as Victoria Cross North. The modification also involves the relocation of the substation at Artarmon from Butchers Lane to 98 – 104 Reserve Road. This modification application was approved on 18 October 2017.
- Modification 2 - Central Walk which involves additional works at Central Railway Station including construction of a new eastern concourse, a new eastern entry, and upgrades to suburban platforms. This modification application was approved on 21 December 2017.
- Modification 3 - Martin Place Station which involves changes to the Sydney Metro Martin Place Station to align with the Unsolicited Proposal by Macquarie Group Limited (Macquarie) for the development of the station precinct. The proposed modification involves a larger reconfigured station layout, provision of a new unpaid concourse link and retention of the existing MLC pedestrian link and works to connect into the Sydney Metro Martin Place Station. It is noted that if the Macquarie proposal does not proceed, the original station design remains approved. This modification application was approved on 22 March 2018.
- Modification 4 - Sydenham Station and Sydney Metro Trains Facility South which incorporated Sydenham Station and precinct works, the Sydney Metro Trains Facility South, works to Sydney Water's Sydenham Pit and Drainage Pumping Station and ancillary infrastructure and track and signalling works into the approved project. This modification application was approved on 13 December 2017.

The CSSI Approval as modified allows for all works to deliver Sydney Metro between Chatswood and Sydenham Stations and also includes upgrade of Sydenham Station.

The remainder of the City & Southwest alignment (Sydenham to Bankstown) proposes the conversion of the existing heavy rail line from west of Sydenham Station to Bankstown to metro standards. This part of the project, referred to as the Sydenham to Bankstown upgrade, is the subject of a separate CSSI Application (Application No. SSI 17_8256) for which an EIS was exhibited between September and November 2017. A Response to Submissions and Preferred Infrastructure Report was submitted to DPE in June 2018 for further exhibition and assessment. This application is subject to assessment and determination by DPE, taking into consideration a further Response to Submissions Report which was submitted to DPE in September 2018.

1.3 Nominated State Significant Precinct - Waterloo

Following the decision to locate a metro station in Waterloo, the Minister determined that parts of Waterloo are of State planning significance which should be investigated for urban renewal through the SSP process. SSP study requirements for such investigations were issued by the Minister on 19 May 2017.

Investigation of the Precinct is being undertaken by UrbanGrowth NSW Development Corporation (UrbanGrowth NSW), in partnership with Sydney Metro and the Land and Housing Corporation (LAHC). The outcome of the SSP process will be new planning controls that will enable future development applications for renewal of the Precinct.

The Precinct includes two separate but contiguous and inter-related parts:

- The Waterloo Metro Quarter (the Metro Quarter)
- The Waterloo Estate (the Estate)

A separate SSP Study for the Metro Quarter was lodged in July 2018 in advance of the SSP Study for the Estate to provide a planning framework for the construction of OSD within the Metro Quarter. The staged submission of the Metro Quarter SSP Study also facilitates the proposed development to be delivered concurrently with the metro station, as an integrated station development.

As this concept SSD Application relies upon the planning framework proposed in the Metro Quarter SSP Study, it is anticipated that the SSP Study and the Environmental Impact Statement (EIS) for the concept SSD Application will be exhibited concurrently.

1.4 Planning relationship between Waterloo Station and the OSD

While Waterloo Station and the OSD will form an integrated station development, the planning pathways defined under the EP&A Act require separate approval for each component of the development. In this regard, the approved station works (CSSI Approval) are subject to the provisions of Part 5.1 of the EP&A Act (now referred to as Division 5.2) and the OSD component is subject to the provisions of Part 4 of the EP&A Act.

For clarity, the approved station works under the CSSI Approval included the construction of below and above ground structures necessary for delivering the station and also enabling construction of the integrated OSD. This includes but is not limited to:

- demolition of existing development
- excavation
- integrated station and OSD structure (including concourse and platforms)
- lobbies
- retail spaces within the station building
- public domain improvements associated with the station
- access arrangements including vertical transport such as escalators and lifts
- space provisioning and service elements necessary to enable the future development of the OSD, such as lift cores, plant rooms, access, parking, retail, utilities connections and building services.

The vertical extent of the approved station works above ground level is defined by the 'transfer level' level (which for Waterloo is defined by approximately RL 33.1 over the northern station box and RL 35.1 over the southern station box), above which would sit the OSD. An example of this delineation is illustrated in Figure 2.2.

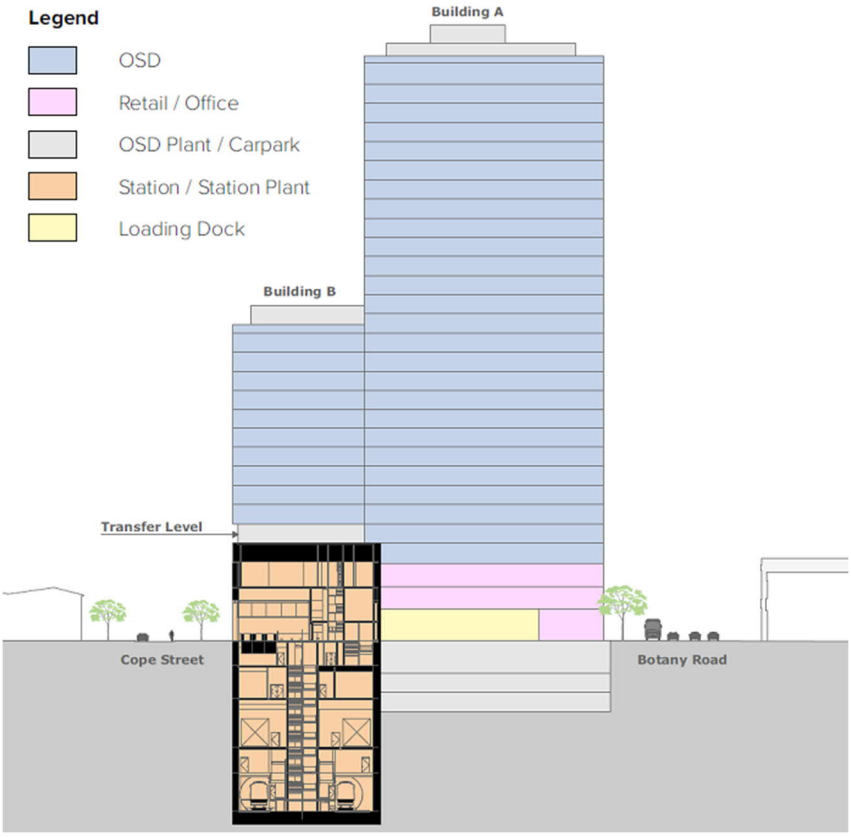


Figure 2.2: Delineation between the Metro station and OSD

It is noted that the structural and service requirements and space provisioning to support OSD vary from station to station. For example, based on the current level of design, Waterloo Station is not expected to provide for OSD lobbies, end of trip facilities and plant rooms. However, the detailed design may be amended to incorporate these elements as part of the integrated station development.

The CSSI Approval also establishes the general concept for the ground plane of Waterloo Station including access strategies for commuters, pedestrians and workers. In this regard, the main pedestrian access to the station would be via an entry located at the corner of Raglan and Cope Streets. The station design has continued to be developed having regard to its integration with the Metro Quarter OSD, and as a result, a second entrance to the station is to be provided from a proposed public plaza adjacent to Cope Street. Retail uses (approved under the CSSI Approval) would be located on the ground floor of the station development along the Cope Street frontage of the site.

Since the issue of the CSSI Approval, Sydney Metro has undertaken design work to determine the technical requirements for the structural integration of the OSD with the station. This level of design work, together with the planning and design undertaken for the remainder of the Metro Quarter has informed the concept proposal for the OSD. It is noted that ongoing design development of the works to be delivered under the CSSI Approval would continue with a view to developing an Interchange Access Plan (IAP) and Station Design Precinct Plan (SDPP) for Waterloo Station to satisfy Conditions E92 and E101 of the CSSI Approval. The detailed design for the Metro Quarter would continue to evolve having regard to the IAP and SDPP.

Public domain improvement works immediately adjacent to Waterloo Station would be delivered as part of the CSSI Approval to support pedestrian movements between transport modes (including to new and relocated bus stops, bike parking on Cope Street, and taxi and kiss-and-ride bays on Cope Street), while other public domain works within the Metro Quarter are proposed as part of the OSD. Final details of public domain works for the OSD will be provided with the detailed SSD Application(s) following finalisation of the SDPP and IAP for the CSSI Approval.

1.5 The site

1.5.1 Location

The site is located within the City of Sydney Local Government Area (LGA).

The Metro Quarter comprises land to the west of Cope Street, east of Botany Road, south of Raglan Street and north of Wellington Street. The heritage listed Waterloo Congregational Church located at 103–105 Botany Road is within this block but is not part of the site.

The site has an approximate area of 1.287 hectares (refer to Figure 2.3).

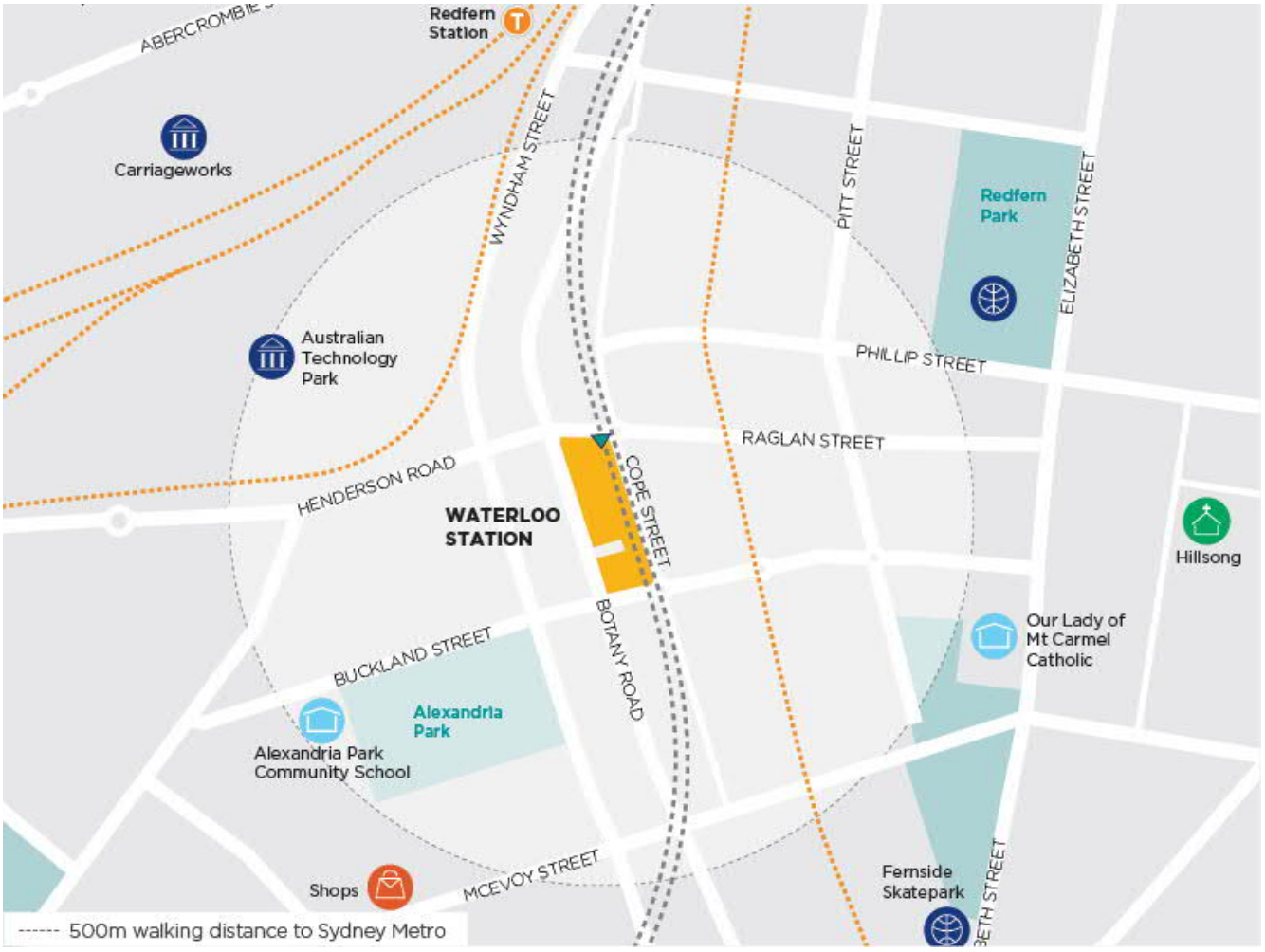


Figure 2.3: Waterloo Station location plan

1.5.2 Site context

The Metro Quarter is located in Redfern Street Village (see Figure 4) in the City of Sydney LGA approximately 3.3 kilometres south of Sydney CBD, 1 kilometre north of Green Square and less than 1 kilometre south of Redfern Station.

Directly east is the Waterloo Estate, which is owned by the NSW Government and is under the management of NSW LAHC. The Waterloo Estate comprises 2,012 social housing dwellings and a small number of private dwellings in medium and high density forms, ranging from single storey attached dwellings to apartment buildings of up to thirty storeys.

The Metro Quarter is less than 1 kilometre south-east of the Australian Technology Park (ATP), a technology micro-cluster that currently contains around 3,000 – 3,500 workers with a range of businesses in technology and creative industries; and a start-up/business incubator hub. It is set to grow into a business park that will soon accommodate new premises currently under construction (i.e. Commonwealth Bank Australia (CBA) has committed to two major office towers).

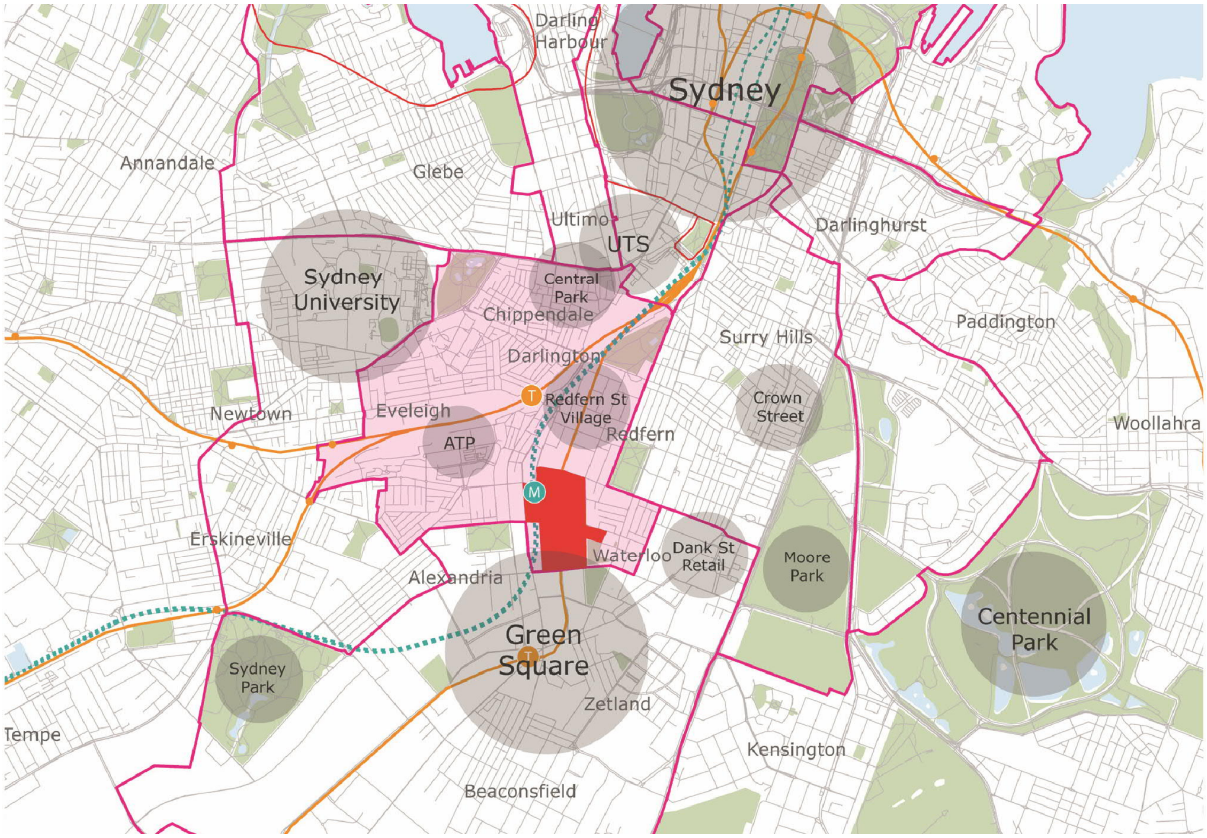


Figure 2.4: Location and site plan of the Waterloo State Significant Precinct (in red) and Redfern Street Village (in pink)

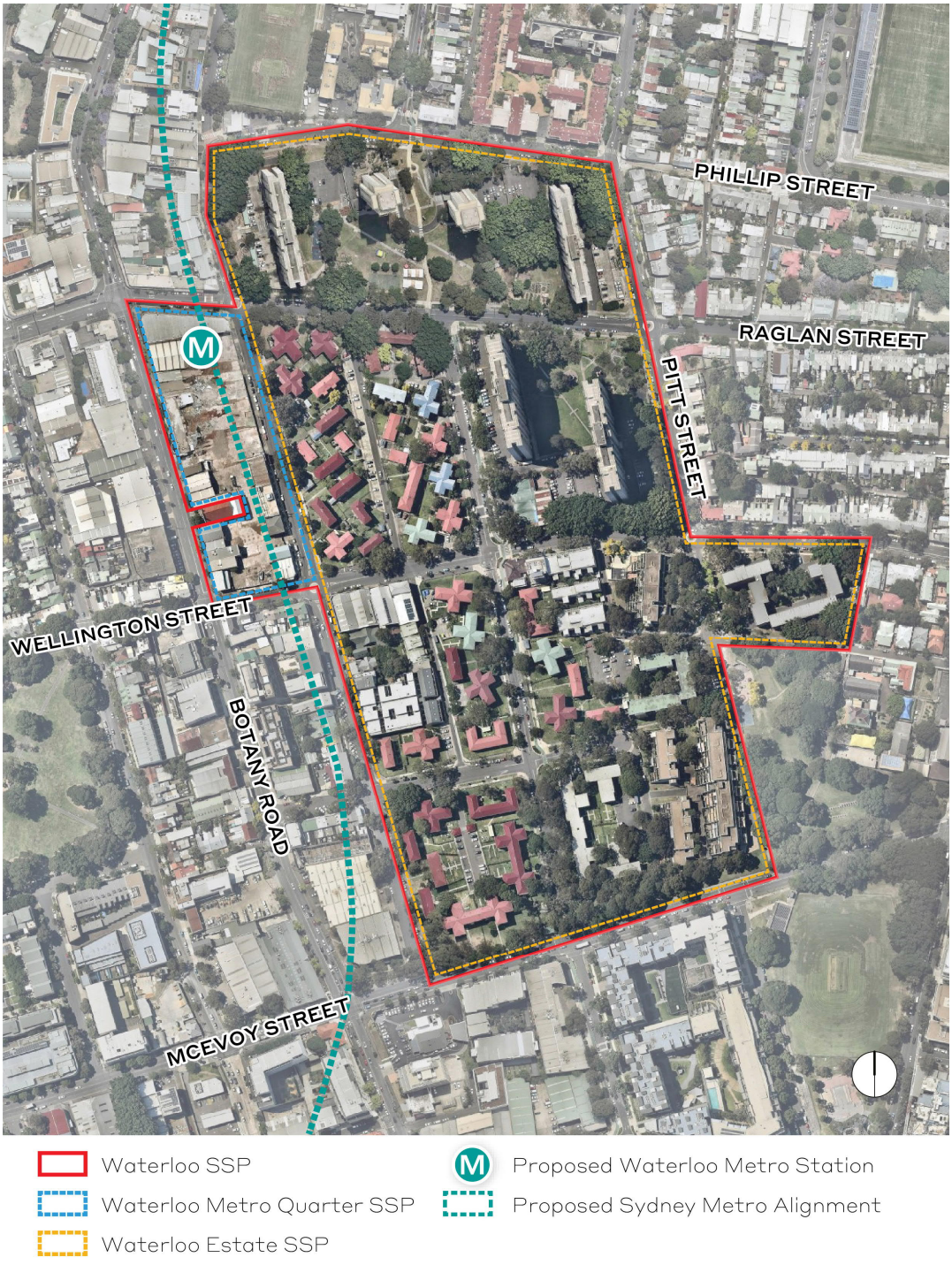


Figure 2.5: Nominated State Significant Precinct - Waterloo

The site comprises the following properties:

136B Raglan Street	Lot 4 DP 215751
59 Botany Road	Lot 5 DP 215751
65 Botany Road	Lot 1 DP814205
67 Botany Road	Lot 1 DP228641
124-128 Cope Street	Lot 2 DP228641
69-83 Botany Road	SP75492
130-134 Cope Street	Lot 12 DP399757
136-144 Cope Street	Lots A-E DP108312
85 Botany Road	Lot 1 DP27454
87 Botany Road	Lot 2 DP27454
89-91 Botany Road	Lot 1 DP996765
93-101 Botany Road	Lot 1 DP433969 & Lot 1 DP738891
156-160 Cope Street	Lot 31 DP805384
107-117A Botany Road	Lot 32 DP805384 & Lot A DP408116
119-121 Botany Road	Lot 1 DP205942 & Lot 1 DP436831
170-174 Cope Street	Lot 2 DP205942

The buildings and structures on the site are now demolished in accordance with the CSSI Approval with the exception of one building which is being used to support construction.

1.6 Overview of the proposed development

This concept SSD Application follows the submission of a SSP Study which supports a proposal to amend existing controls to facilitate the proposed development. The concept SSD Application will in turn comprises the first stage of seeking SSD development consent for the Metro Quarter OSD project. It will be followed by a future detailed SSD Application(s) for the design and construction of the OSD built form.

This concept SSD Application seeks approval for the planning and development framework and strategies to inform the future detailed design of the OSD. It specifically seeks approval for:

- maximum building envelopes, including maximum building heights, street-wall heights and ground and upper level setbacks
- a maximum gross floor area (GFA) of 68,750 square metres, comprising:
  - approximately 56,200 square metres GFA of residential accommodation, providing for approximately 700 dwellings, including 5 to 10 percent affordable housing and 70 social housing dwellings
  - approximately 3,905 square metres GFA of retail premises and entertainment facilities

  - approximately 8,645 square metres GFA for business and commercial premises and community, health service and recreational facilities (indoor), including at least 2,000 square metres of floor space for community uses
- a three storey podium and a free standing building located within a public plaza, accommodating non-residential land uses
- residential uses above podium level in various building forms including three taller buildings of 23, 25 and 29 storeys (Reduced Level (RL) 96.9, 104.2 and 116.9 metres AHD respectively)
- use of OSD space provisioning within the footprint of the CSSI Approval
- public domain works, through-site links, footpaths, provision for cycle facilities and enhanced pedestrian crossings and roads
- car parking for up to 427 vehicles
- cycle parking to support residential and non-residential land uses and visitors to the Metro Quarter. Approval is also being sought for space within the future basement for a bike hub which would also support future bike parking for Waterloo Station
- loading, vehicular and pedestrian access arrangements
- strategies for utilities and services provision
- strategies for managing stormwater and drainage
- a strategy for the achievement of ecologically sustainable development
- a public art strategy
- provision for future signage zones
- a design excellence framework
- the future subdivision of parts of the OSD footprint (if required).

It is noted that the Sydney Metro comprises GFA of approximately 8,415 square metres on the site, approved under CSSI Approval. The total GFA for the integrated station development, including the station GFA is approximately 77,165 square metres, which is equivalent to an FSR of approximately 6:1.

Key parameters of the Concept proposal based on the current level of design development are indicated at Figure 2.6 and Figure 2.7.

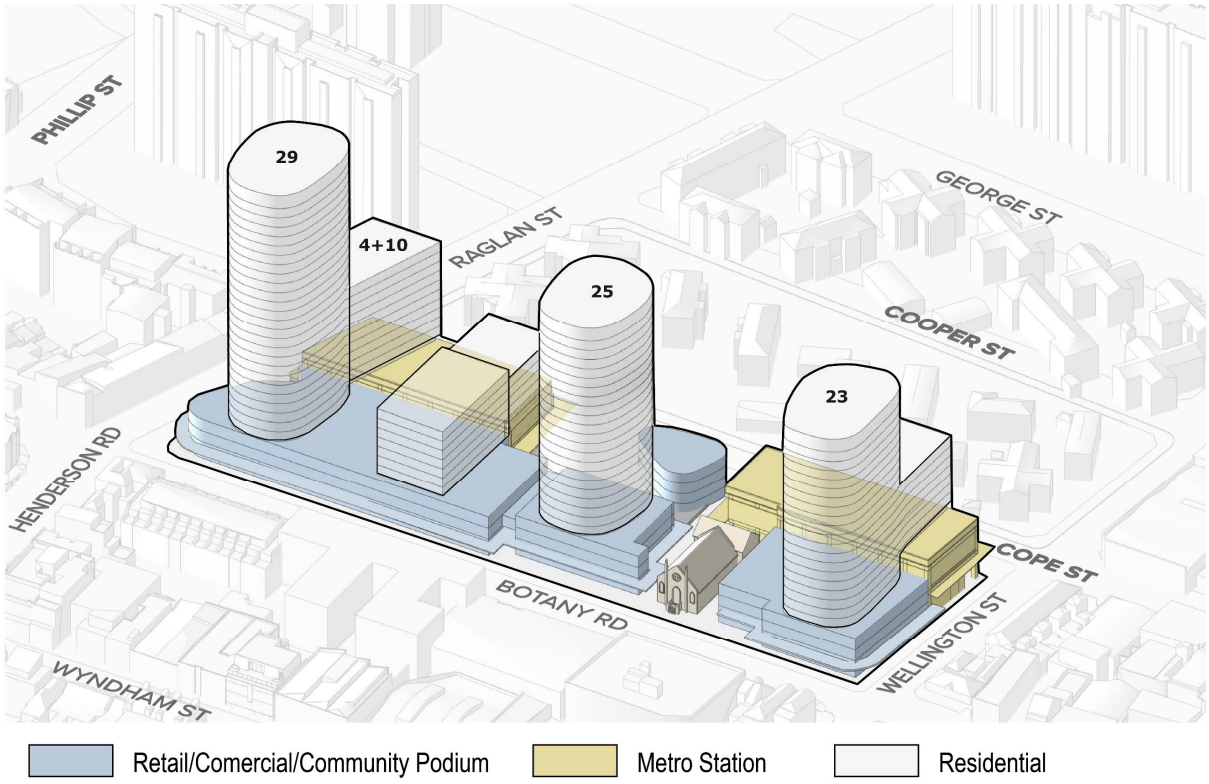


Figure 2.6: Proposed massing, viewed from the west

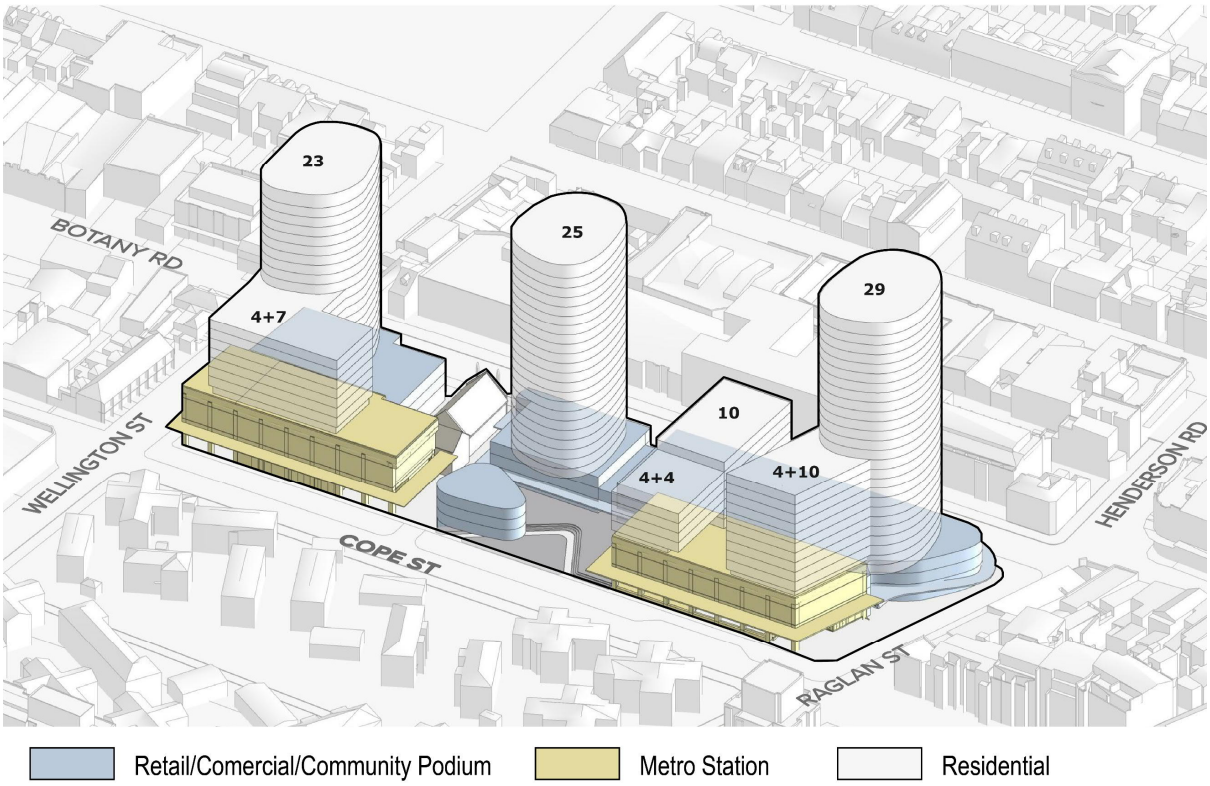


Figure 2.7: Proposed massing, viewed from the east

The proposal is a significant opportunity to contribute to the urban renewal process for the Waterloo SSP. The objective to deliver the Metro Quarter project as soon as reasonably possible after completion of the metro works (earmarked to open 2024) would ensure buildings within the Metro Quarter are occupied to support maximum patronage of the proposed metro station.

The Metro Quarter would contain a mix of uses including residential, commercial, retail, community facilities and services and cultural opportunities sufficient for daily life to be provided for within the wider neighbourhood and to support the activation of the precinct. This would help make Waterloo one of the most connected and attractive inner-city places to live, work and visit.

1.7 Staging and framework for managing environmental impacts

Sydney Metro proposes to procure the delivery of the Waterloo integrated station development in one single package, which would entail the following works:

- station structure fit-out, including mechanical and electrical
- OSD structure fit-out, including mechanical and electrical.

Separate delivery packages are also proposed by Sydney Metro to deliver the excavation of the station boxes/shafts ahead of the integrated station development delivery package, and linewide systems (e.g. track, power, ventilation) and operational readiness works prior to the Sydney Metro City & Southwest metro system being able to operate.

For the purposes of considering construction related impacts, three possible staging scenarios have been identified for delivery of the integrated station development:

1. Scenario 1 – the station and OSD are constructed concurrently by constructing the transfer slab first and then building in both directions. Both the station and OSD would be completed in 2024.
2. Scenario 2 – the station is constructed first and ready for operation in 2024. OSD construction may still be incomplete or soon ready to commence after station construction is completed. This means that some or all OSD construction is likely to still be underway upon opening of the station in 2024.
3. Scenario 3 – the station is constructed first and ready for operation in 2024. The OSD is built at a later stage, with timing yet to be determined. This creates two distinct construction periods for the station and OSD.

The final staging for the delivery of the OSD would be resolved as part of the detailed SSD Application(s).

For the purposes of providing a high level assessment of the potential environmental impacts associated with construction, the following have been considered:

- Impacts directly associated with the OSD, the subject of this concept SSD Application
- Cumulative impacts of the construction of the OSD at the same time as the station works (subject of the CSSI Approval).

Given the integration of the delivery of the Sydney Metro City & Southwest metro station with an OSD development, Sydney Metro proposes the framework detailed in Figure 2.8 to manage the design and environmental impacts, in relation to transport impacts, consistent with the framework adopted for the CSSI Approval.

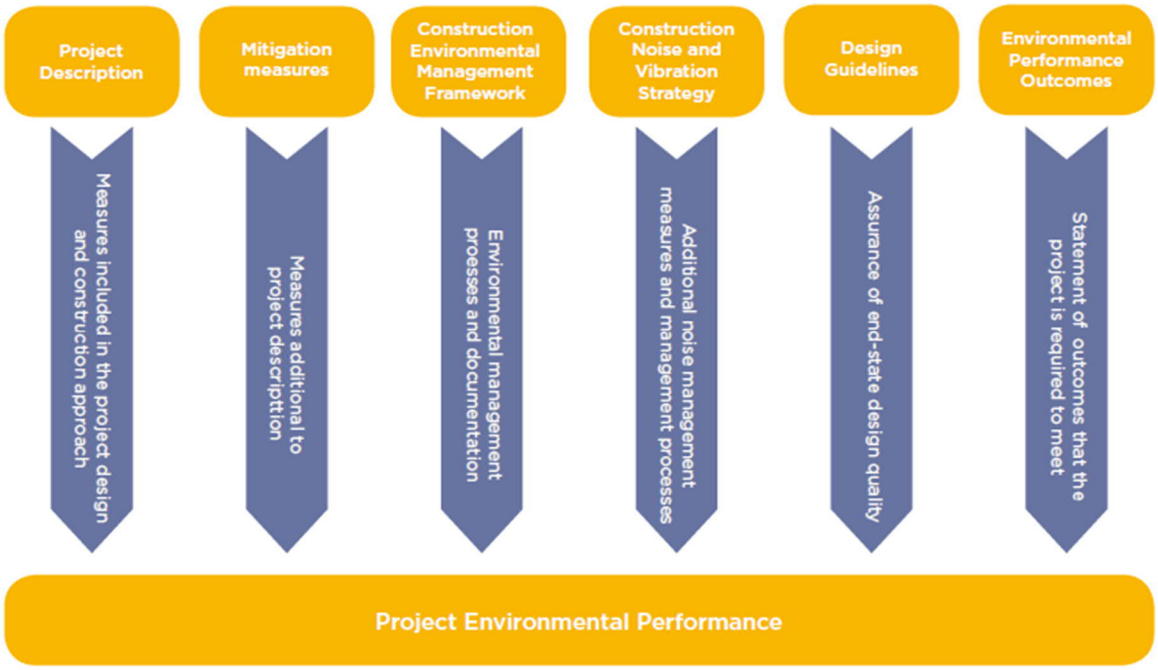


Figure 2.8: Project approach to environmental mitigation and management

This approach would be implemented until such time as completion of the station works (i.e. works under the CSSI Approval) is achieved. Beyond that point, standard construction environmental management practices would be implemented by the OSD developer in accordance with relevant guidelines and any conditions of approval.

2. Strategic planning context

2.1 Alignment with transport policies and plans

The Metro Quarter OSD supports a number of strategic plans including:

- *Future Transport Strategy 2056* (2018)
- *Building Momentum – State Infrastructure Strategy* 2018-2038 (2018)
- *A Metropolis of Three Cities – The Greater Sydney Region Plan* (2018)
- *Central to Eveleigh Urban Transformation Strategy* (2016)

These plans and their relationship to the Metro Quarter are detailed below.

2.1.1 Future Transport Strategy 2056

The *Future Transport Strategy 2056* (Future Transport) is an update of the *NSW Long Term Transport Master Plan* and is a 40-year strategy for mobility for Sydney and regional NSW. It sets out a vision, strategic directions and customer outcomes with a focus on technology and innovation across the transport system to transform the customer experience, improve communities and boost economic performance.

The strategy supports the development of liveable communities such as the Metro Quarter, where transport is vital to mobility as a 'placemaker'. The project would integrate with the Sydney Metro City & Southwest network, improving the liveability and character of the precinct. This would lead to the achievement of wider benefits from investment and encourages more desirable patterns of development, fulfilling a desired outcome identified in the strategy.

2.1.2 Building Momentum – State Infrastructure Strategy 2018-2038

Building Momentum - State Infrastructure Strategy 2018-2038 (SIS) is a 20-year strategy that identifies and prioritises the delivery of critical public infrastructure to drive productivity and economic growth. Infrastructure NSW's assessment of the State's existing infrastructure highlighted critical deficiencies in Sydney's road capacity. The SIS identifies strategic infrastructure options to meet the challenges of growth in travel demand and substantial increases in freight volumes.

Specifically, the SIS identifies Waterloo as a strategic urban renewal corridor required to accommodate the expected growth in housing and employment in the area. The strategy also recognises the importance of Urban Growth's role in delivering a commercially feasible, high-quality urban development in Waterloo, balancing housing supply against the consideration of urban design and place-making.

2.1.3 A Metropolis of Three Cities–The Greater Sydney Region Plan

A Metropolis of Three Cities – The Greater Sydney Region Plan establishes a 40-year strategic land use plan for Sydney. The plan was developed concurrently with Future Transport and the SIS, aiming to deliver better connections for people across Greater Sydney. The land use vision for Greater Sydney is a metropolis of three cities (Eastern Harbour City, Central River City and Western Parkland City). Consistent with Future Transport, one of the key elements of the plan is the vision of a 30-minute city regardless of location. The goal for this vision is to provide transport infrastructure that allows people to reach their nearest Metropolitan or Strategic Centre within 30 minutes, seven days a week.

Waterloo is identified in the plan as part of the Eastern Harbour City where urban renewal driven by Sydney Metro City & Southwest would occur. The project in conjunction with Sydney Metro and other projects would therefore complement the Greater Sydney Commission's framework for a liveable, productive and sustainable Eastern Harbour City. Potential indicators to deliver the plan that would be relevant to Waterloo include:

- Increased 30-minute access to a metropolitan centres and clusters
- Increased use of public resources such as open space and community facilities
- Increased walkable access to local centres
- Increased housing completions
- Increased access to open spaces
- Increased jobs in metropolitan and strategic centres
- Increased urban tree canopy.

2.1.4 Central to Eveleigh Urban Transformation Strategy

Waterloo Precinct is one of several precincts that form part of the *Central to Eveleigh* (C2E) Urban Transformation Corridor. The Corridor covers an area of 80 hectares and stretches 3 kilometres. The Corridor includes Central, Redfern, Macdonaldtown and Erskineville stations, the Australian Technology Park (ATP), and Eveleigh Rail Yards. *The Central to Eveleigh Urban Transformation Strategy* was finalised in November 2016 and is now being implemented via a number of separate projects, including the Metro Quarter.

The strategy is underpinned by *A Plan for Growing Sydney* and City of Sydney's *Sustainable Sydney 2030* strategies. The vision for C2E includes a range of related transport and land use considerations, categorised in four key areas:

- **Living**: Providing 14,000 new dwellings, including social and affordable housing, an expanded cycleway network, well-connected neighbourhoods, new public spaces, and jobs close to homes.
- **Community**: Redevelopment of Redfern Station, Sydney Metro's new Waterloo Station, enhanced connectivity and access, and 400 metre walk to public open spaces.
- **Working**: Providing 21,000 new jobs (including knowledge intensive and innovation industries), new links improving connectivity between work and education hubs, world class cultural infrastructure, and a creative hub promoting distributed workplaces.
- **Environment**: Providing 73,000 square metres of new public open space, 23 per cent uptake in car share, and higher public and active transport mode share.

2.1.5 Connecting our City – City of Sydney Transport Strategies

Connecting our City is the City of Sydney's vision for a world class transport network to support a strong and growing economy and a more sustainable environment. The Metro Quarter is closely aligned with the objectives of this long term transport plan. Key objectives from the plan such as the integration of land use and transport, improving efficiency and amenity and enhancing access will all be met through the development of the Metro Quarter.

3. Land use and demographics

This chapter details the existing land use environment and provides the local and regional context within which this assessment has been undertaken.

3.1 Centres, population and employment

Several key centres are located near Waterloo including Green Square, Mascot and the ATP. In addition, the metropolitan centre of Sydney CBD is located around 2.8 kilometres to the north. Figure 3.1 illustrates the hierarchy of centres and strategic public transport network surrounding Waterloo.

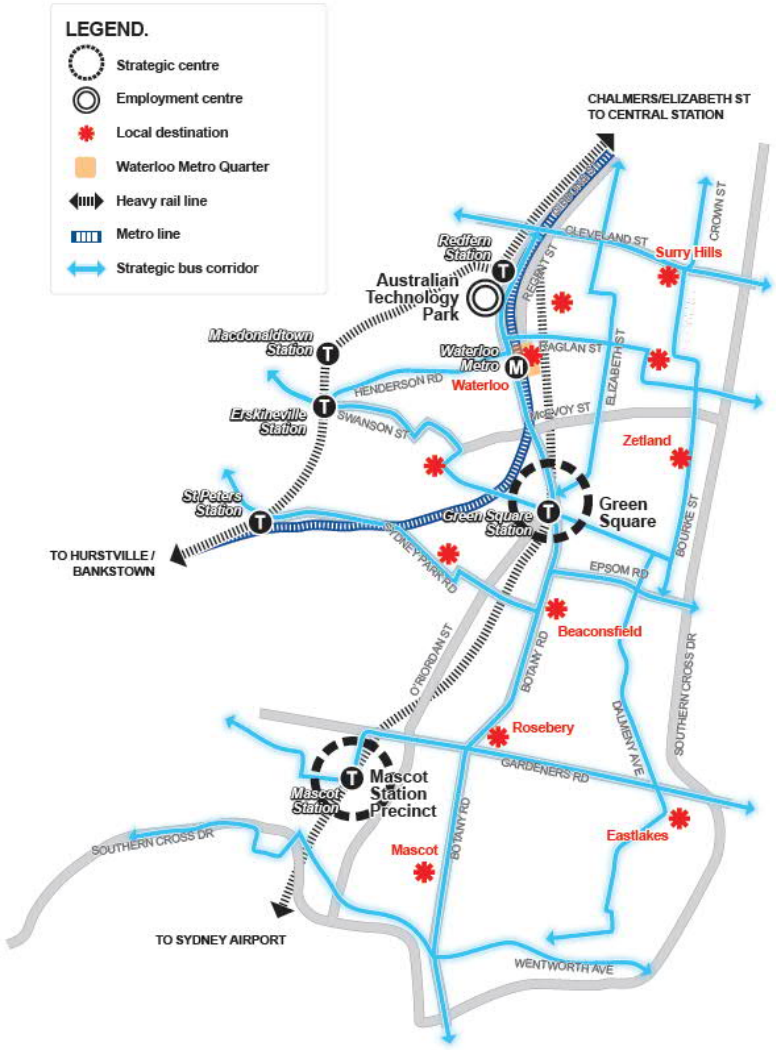


Figure 3.1: Centres and strategic traffic and transport network surrounding Waterloo

The emerging Green Square strategic centre is located around 1 kilometre to the south, focussed around Green Square Station and the future Green Square Town Centre. This will be a major retail, commercial and employment hub in the future. ATP and Mascot strategic centre, located west and south of Waterloo, respectively, are key employment nodes. Stretching between Waterloo and Mascot is the Southern Sydney Employment Lands.

Future transport networks will need to consider options for connecting the hierarchy of centres within the region. Sydney Metro City & Southwest will provide connections from Waterloo to the Sydney CBD while connections to key centres at Green Square, Redfern and Mascot will need to be provided by alternative options.

School and community facilities located near the Waterloo Precinct include Our Lady of Mount Carmel Primary School, Alexandria Park Community School and Green Square School (see Figure 3.2). Safe access to these destinations is an important component of the Metro Quarter given the number of vulnerable pedestrians using these facilities. The pedestrian trips generated by these users may also involve the crossing of roads carrying high traffic volumes such as Botany Road and McEvoy Street.

Figure 3.2: Local schools in the vicinity of the Metro Quarter

Table 3.1 shows the existing and future population and employment distribution for the broader Southern Sydney region based on Transport for NSW projections for 2036 (TZP16[1]).

The base case projections for the region show that from 2016 to 2036, the population is projected to almost double from 76,000 to 134,000 residents. During the same period, employment will grow from 80,000 to 105,000 jobs.

Table 3.1: Population and employment comparison

Area	2016		2036	
	Population	Employment	Population	Employment
Redfern / Waterloo	25,000	14,000	42,000	22,000
Green Square / Alexandria	26,000	36,000	54,000	48,000
Mascot / Eastlakes	25,000	30,000	38,000	35,000
Total	**76,000**	**80,000**	**134,000**	**105,000**

[1] TZP16 is the 2016 Travel Zone projection by TPA used to represent the most likely urban future based on current data, trends and an understanding of policy/structural changes that may impact the future.

3.2 Character

Waterloo is currently characterised by a mix of medium and high density development, consisting of townhouses, terraces, several high rise residential towers and some detached dwelling houses. Figure 3.3 shows the mix of dwellings in the Waterloo Precinct compared to the City of Sydney LGA and Greater Sydney region.

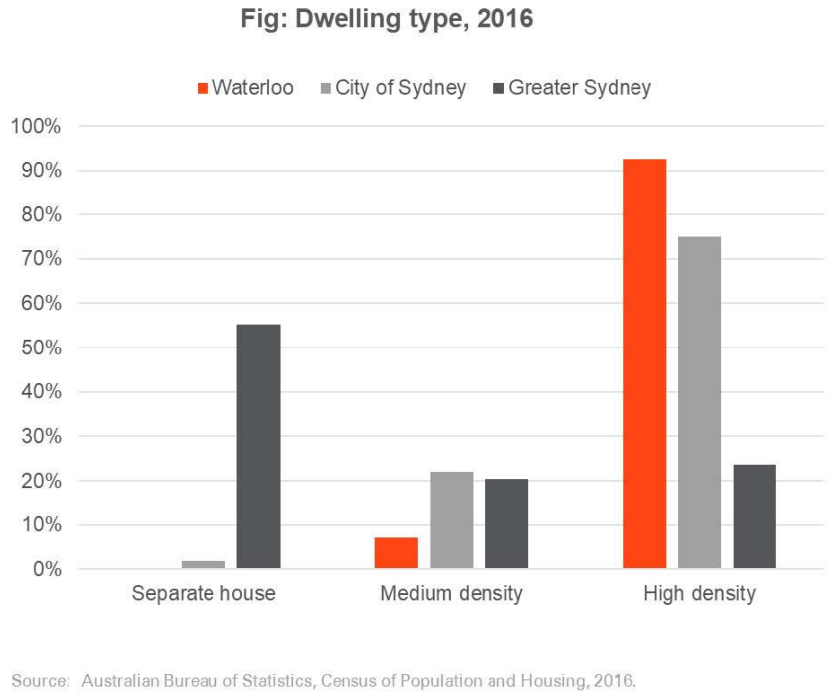


Figure 3.3: Dwelling types

3.3 Demographics

3.3.1 Age

The age profile of residents in the Waterloo Precinct, City of Sydney LGA and Greater Sydney region is shown in Figure 3.4.

Waterloo Precinct has an older resident population, with just under a third of residents aged over 65 years compared to 8 per cent for City of Sydney. This is likely to be related to the significant proportion of social housing within the precinct, with many residents living there for a long period of time.

Renewal in the precinct is likely to result in a shifting age profile, with a younger demographic moving into new housing stock. As a significant proportion of housing will still be reserved for social housing, there is still likely to be a slightly older age profile than other areas of City of Sydney. This will need to be considered in the development of networks, particularly local connections to key services such as hospitals.

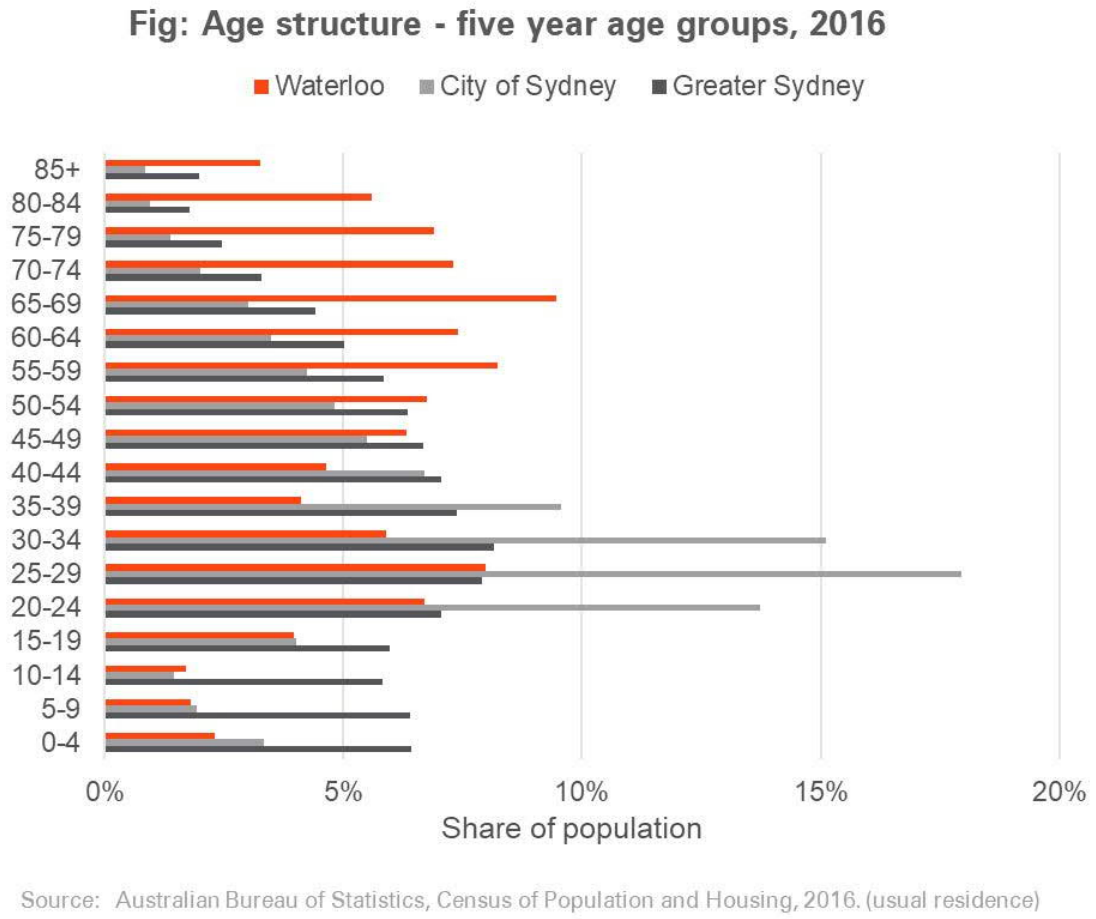


Figure 3.4: Age profile

3.3.2 Employment

Figure 3.5 shows employment rates for the Waterloo Precinct, City of Sydney LGA and Greater Sydney region.

In the Waterloo Precinct, the unemployment rate is 18.6 per cent for those in the labour force, compared to 6 per cent in City of Sydney LGA. This trend is strongly linked to the existing social housing provision in Waterloo. A shifting demographic profile and a younger professional workforce is likely to move into new housing stock alongside existing social housing tenants. The transport network will be required to serve the needs of all of these residents as well as workers and visitors to the Metro Quarter. Employed residents will require efficient connections to the employment centres such as the CBD whilst older residents and social housing tenants are likely to have a stronger reliance on local services connecting to community, health and retail areas.

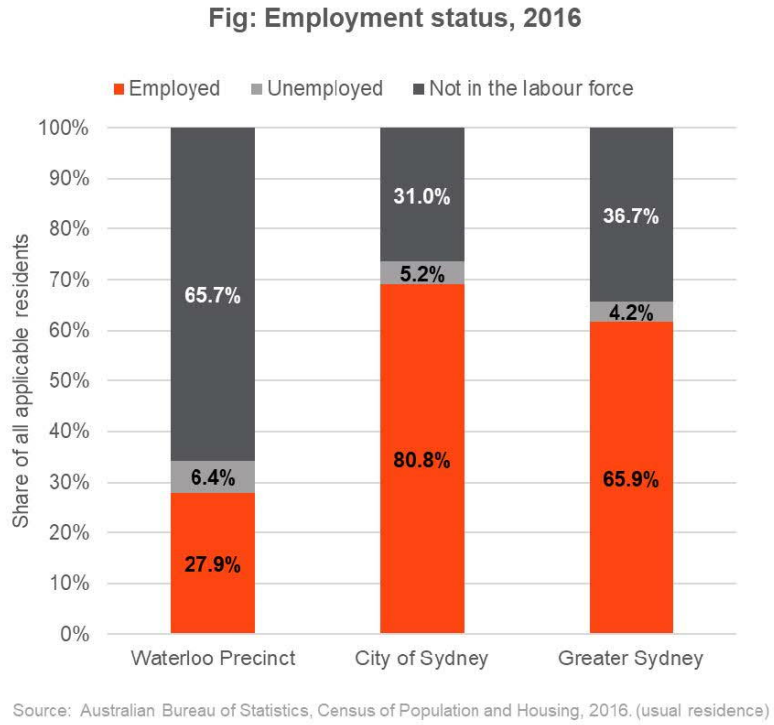


Figure 3.5: Employment and labour force status

4. Strategic network analysis

4.1 Travel behaviour

4.1.1 Mode share

Three areas have been used to investigate existing and potential mode share for the Metro Quarter:

- **Waterloo Precinct:** A single Travel Zone (TZ), representative of the Waterloo SSP
- **Waterloo Suburb:** The extent of the suburb of Waterloo
- **Waterloo-Redfern Wider Area:** A wider area for understanding travel patterns.

Key characteristics and the TZ's representing these areas is shown in Table 4.1

Waterloo Suburb and Waterloo-Redfern Wider Area have been included to provide regional context to current travel patterns in Waterloo Precinct. Key travel characteristics for these areas are also compared to the City of Sydney Local Government Area (LGA), Randwick LGA and Sydney Metropolitan Area in order to understand similarities and differences in travel behaviour relative to other parts of Sydney.

Table 4.1: Assumed travel zones and key characteristics

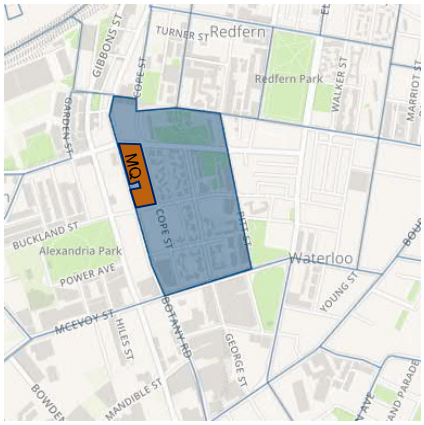
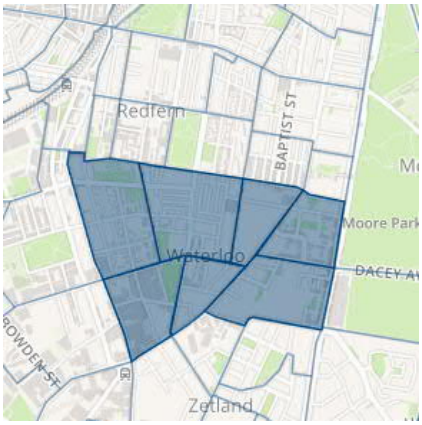
Waterloo Precinct	Waterloo suburb	Waterloo-Redfern wider area
		
Travel zone: 270	**Travel zones:** 270, 271, 272, 273, 274, 275, 276	**Travel zones:** 210, 211, 212, 213, 214, 215, 217, 218, 219, 220, 221, 270, 271, 272, 273, 274, 275, 276
Employed residents: 535	**Employed residents:** 4,586	**Employed residents:** 11,129
Jobs: 580	**Jobs:** 5,457	**Jobs:** 11,650

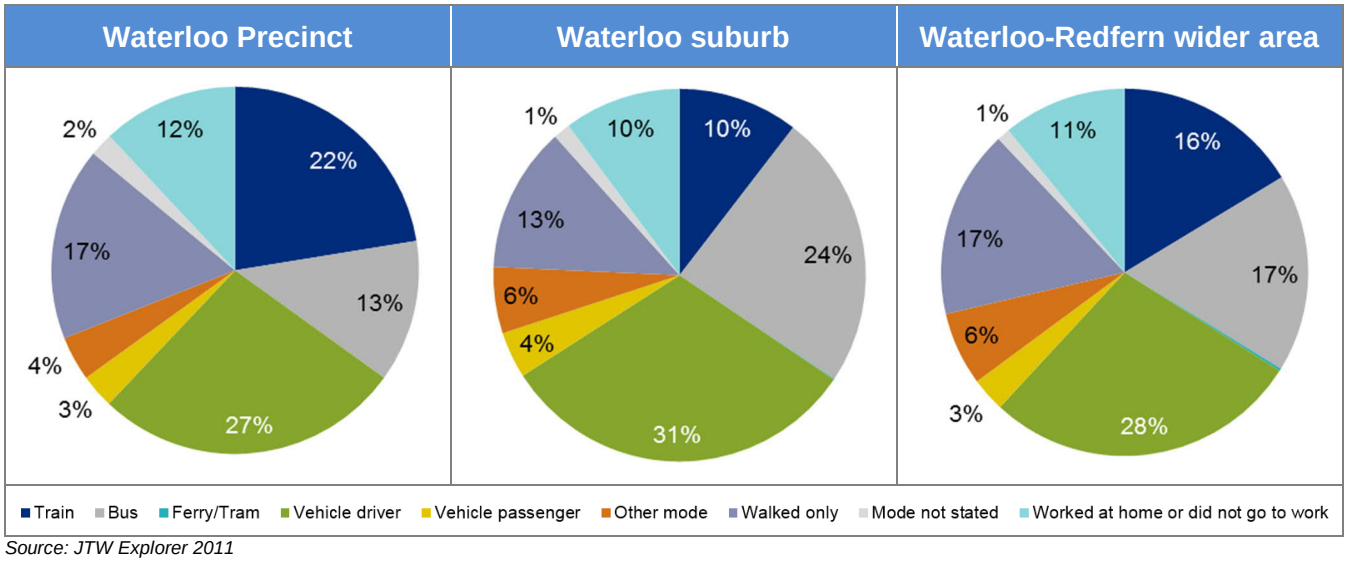
Table 4.2 compares current Journey to Work (JTW) mode share for resident travel out of the Waterloo Precinct, Waterloo Suburb area and the Waterloo-Redfern Wider Area.

In all three areas the greatest number of work trips is undertaken by public transport, ranging from 33 to 35 per cent mode share. This is closely followed by private vehicles (30 to 35 per cent), and walking (13 to 17 per cent). Heavy rail and bus mode share are similar across all areas, while residents of the Waterloo Precinct were more likely to use heavy rail than in other areas. As all areas are within walking distance of either Green Square or Redfern station, this may be due to the current demographics and employment characteristics in the Waterloo Suburb area.

Walking accounts for a relatively high proportion of trips to work; the walking mode share in Waterloo Precinct was similar to the wider Waterloo-Redfern Area (17 per cent), while it was slightly lower in Waterloo Suburb (13 per cent). Cycling trips (included in 'Other mode') accounted for up to 4 per cent of work trips in Waterloo Precinct, and up to 6 per cent of trips in other areas.

A significant proportion of people work at home (or did not travel to work on census day), ranging from 10 to 12 per cent mode share. This is highest in the Waterloo Precinct and lowest Waterloo Suburb, which may be reflective of the types of jobs worked by residents in these areas.

Table 4.2: 2011 JTW mode share, resident travel out of Waterloo



Source: JTW Explorer 2011

Comparison to other areas

Resident mode share in the suburb of Waterloo has been compared to key inner city suburbs in City of Sydney LGA, including Redfern, Woolloomooloo, Glebe, Ultimo and Pyrmont.

These suburbs have been selected based on an extensive benchmarking process, based on a range of data sources including the 2011 SEIFA index[2], public transport timetable data, Census 2011 data, and JTW 2011 data.

Five suburbs were identified as broadly comparable to Waterloo on the basis of:

- Socio-economic status
- Proportion of social and affordable housing
- Proportion of households with no motor vehicles
- Average public transport travel times to Sydney CBD, Parramatta CBD and Macquarie Park.

These locations are outlined in Table 4.3.

Table 4.3: Suburbs comparable to Waterloo for mode share benchmarking process

				Average public transport travel time, AM peak (8 – 9am) (mins)		
Location	**2011 SEIFA index**	**Social and affordable housing (%)**	**Households with no motor vehicles (%)**	**Sydney CBD**	**Parramatta CBD**	**Macquarie Park**
Waterloo (current)	*941*	*24%*	*29%*	*21*	*45*	*56*
Redfern	973	19%	35%	14	38	50
Woolloomooloo	945	18.%	38%	11	50	52
Glebe	1,001	16%	30%	25	50	55
Ultimo	974	8%	47%	22	50	55
Pyrmont	1,055	7%	26%	20	55	52

Greater than 60 mins 30 to 60 mins Less than 30 mins

[2] The SEIFA Index ranks areas in Australia according to relative socio-economic advantage and disadvantage

Figure 4.1 compares resident mode share for Waterloo, selected benchmark suburbs and the Sydney metropolitan area.

Compared to average JTW mode share across the Sydney metropolitan area, Waterloo and the selected benchmark suburbs have significantly lower car mode share. Mode share for public and active transport combined is much higher than the Sydney average. Non-car mode share for the selected City of Sydney LGA benchmark suburbs ranges between 53 and 70 per cent, compared with 28 per cent on average across the Sydney metropolitan area. Car mode share is particularly low in areas with high quality mass transit links and close proximity to Sydney CBD.

This comparison highlights the impact on travel mode choices of densely located land uses, activities and attractors typical of inner city locations. The availability of high quality public transport infrastructure and services, permeable and connected street networks, and high quality walking and cycling facilities are also highly important and complimentary.

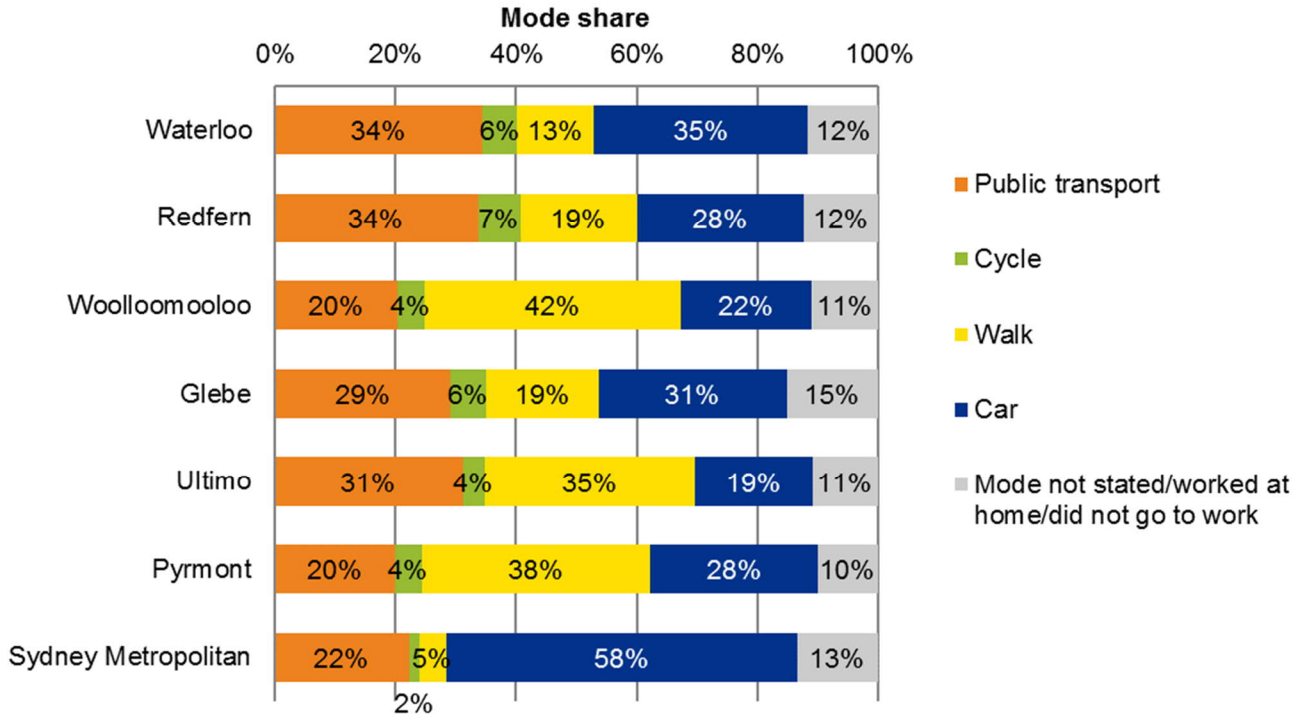


Figure 4.1: Resident mode share[3]

Source: JTW Explorer 2011

[3] Note: under the defined JTW categories, the proportion of "other mode" trips have been assumed to represent cycle mode share

4.1.2 Origins and destinations

Figure 4.2 and Figure 4.3 show the top origins and destinations into and out of the Waterloo Precinct. Sydney Inner City, which includes Sydney CBD is the most popular destination, accounting for over half of all work trips. This reinforces that Waterloo is an ideal location given its proximity to the Sydney CBD and surrounding centres such as ATP. The focus of work trips will continue to be the Sydney CBD and the primary public and active transport networks should reflect this.

Similarly, trips from Sydney Inner City to the Waterloo Precinct represent the highest proportion of all work travel origins, followed by the Eastern Suburbs. This is due to employment in Waterloo comprising largely population serving industries such as retail, with a largely localised workforce. Future employment within the Waterloo Precinct is likely to continue to comprise this type of employment, and therefore a focus on mixed-use, local connectivity, and affordable housing provision should support this outcome.

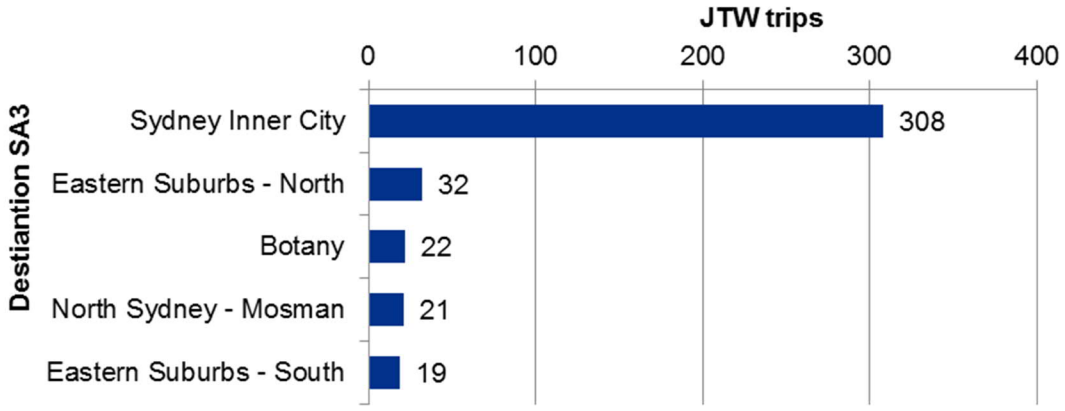


Figure 4.2: Top five destinations (resident travel out of the Waterloo Precinct – JTW 2011)

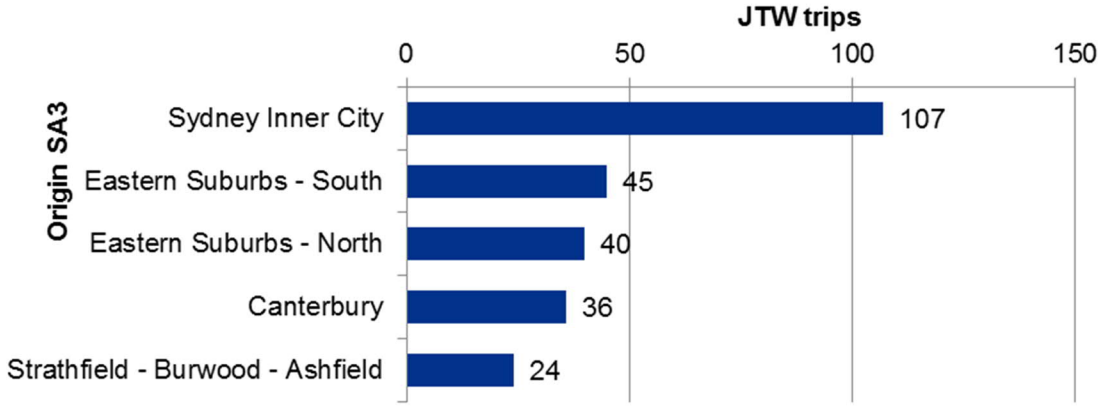


Figure 4.3: Top five origins (employee travel into the Waterloo Precinct – JTW 2011)

4.1.3 Trip purpose and length

Using 2014/15 Household Travel Survey (HTS) data, key trip characteristics in City of Sydney LGA (in which Waterloo Precinct is located), adjoining Randwick LGA and the Sydney metropolitan area have been compared. HTS data sample size only supports its effective use for analysis of larger areas, rather than the smaller areas able to be analysed with JTW data. As Waterloo is located within the City of Sydney LGA, it would tend to reflect the travel patterns of a central Sydney location.

Overall, the indicators below reflect the denser nature of activities and attractions in City of Sydney LGA, and to a lesser extent Randwick LGA, than across much of the Sydney metropolitan area. This results in a higher number of trips undertaken per person, but with shorter average trip lengths. Travel distances are shorter due to land use density and greater availability of alternative travel options including public transport, walking and cycling for many trips. There are also many more social and recreational trips made in City of Sydney LGA.

Trips per person

The number of weekday trips undertaken per person is greater in City of Sydney LGA than Randwick LGA, and both are greater than across the Sydney metropolitan area (Figure 4.4).

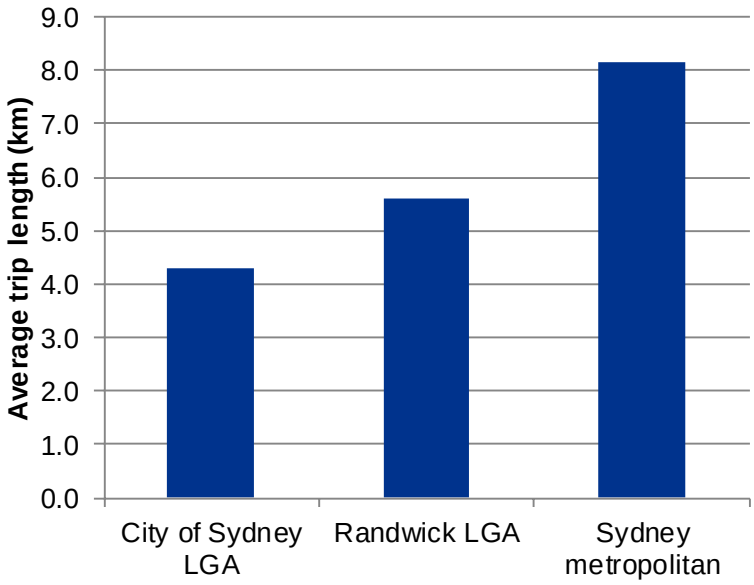


Figure 4.4: Weekday trips per person (HTS 2014/15)

Average trip length

The average trip length in City of Sydney LGA is lower than in Randwick LGA, and significantly lower than across the Sydney metropolitan area (Figure 4.5).

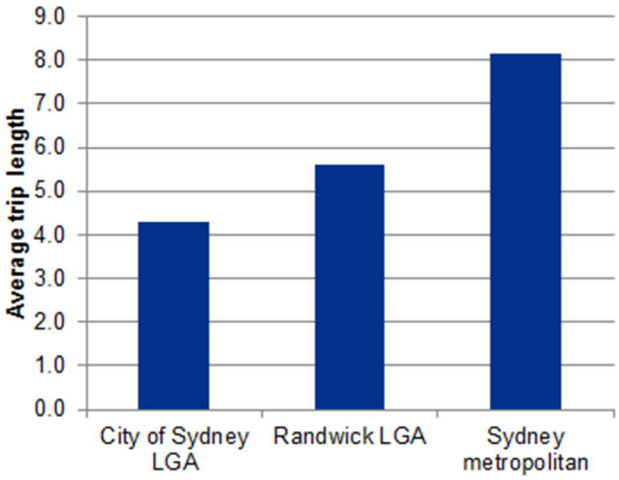


Figure 4.5: Average trip length (HTS 2014/15)

Vehicle kilometres travelled

Vehicle kilometres travelled (VKT) per person in City of Sydney LGA are lower compared with Randwick LGA, and less than half compared with the Sydney metropolitan area (Figure 4.6)

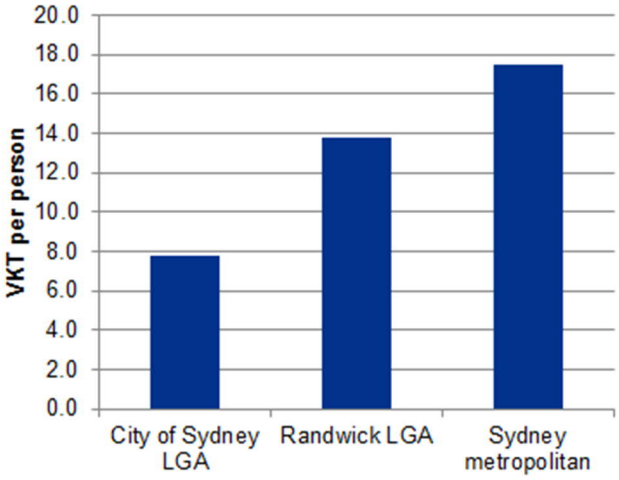


Figure 4.6: Vehicle kilometres travelled per person (HTS 2014-15)

Trip purpose

The purpose of trips undertaken in areas differs noticeably. Commute trips account for a larger proportion of trips than in Randwick LGA and metropolitan Sydney. Social recreation trips are much higher in City of Sydney LGA and Randwick LGA than metropolitan Sydney. Shopping and personal business trips are much less common in City of Sydney LGA and Randwick LGA than across metropolitan Sydney (Figure 4.7).

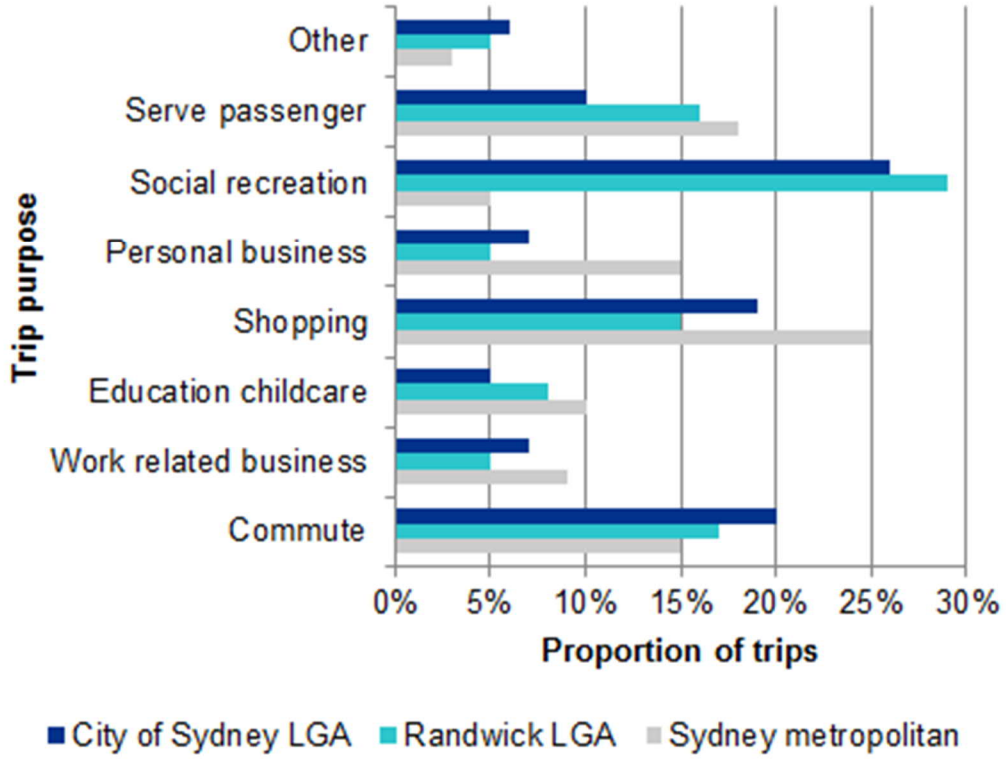


Figure 4.7: Trip purpose[4]

4.1.4 Existing trip generation

The existing site contains no off-street parking and traffic surveys of surrounding intersections indicate that the site generates a negligible number of vehicle and point to point trips. Public transport, pedestrian and bicycle trips to/from the existing site have not been analysed in detail however the surrounding land uses and roadside environment are not conducive to any significant level of non-car transport.

[4] Note: 'Serve passenger' applies to trips undertaken for the purposes of accompanying another person undertaking a trip, for example a carer accompanying a person requiring assistance.

4.2 Public transport

4.2.1 Heavy rail

The Metro Quarter is located approximately 1 kilometre from both Redfern Station and Green Square Station. Redfern Station is one of the busiest stations on the Sydney Trains network which provides very frequent services to a large range of destinations, including Sydney CBD. Green Square Station is served by the T8 Airport Line, providing access to Sydney CBD and Kingsford Smith Airport.

Redfern Station is constrained by a single concourse to the north of the station and narrow platforms which are accessed via a single set of stairs each. Only one platform is fully accessible with provision of a lift, and serves the T4 Eastern Suburbs & Illawarra Line.

4.2.2 Sydney Metro

Sydney Metro is a new standalone metro rail network identified in Transport for NSW's *Sydney's Rail* Future. A component of Sydney Metro is Sydney Metro City & Southwest which is planned from Chatswood to Sydney CBD and Bankstown, due to commence operating in 2024. Services on the new line will run at a minimum of every 4 minutes in each direction, with an ultimate capacity for trains to carry up to 46,000 people per hour in one direction. Sydney Metro City & Southwest will remove T3 Bankstown line trains from the City Circle, providing congestion relief and greater capacity for T8 Airport, Inner West and South line trains. This will result in a moderate increase in train capacity stopping at Redfern Station from 2024. Preliminary forecasts for the 2036 AM peak hour indicate that around 3,700 customers would be entering and around 2,350 customers would be exiting Waterloo Station (Chatswood to Sydenham EIS, 2016).

The Sydney Metro network is shown in Figure 4.8, while Figure 4.9 shows the rail network around Waterloo including Sydney Metro City & Southwest.

Figure 4.8: The Sydney Metro network

Source: Transport for NSW, 2016

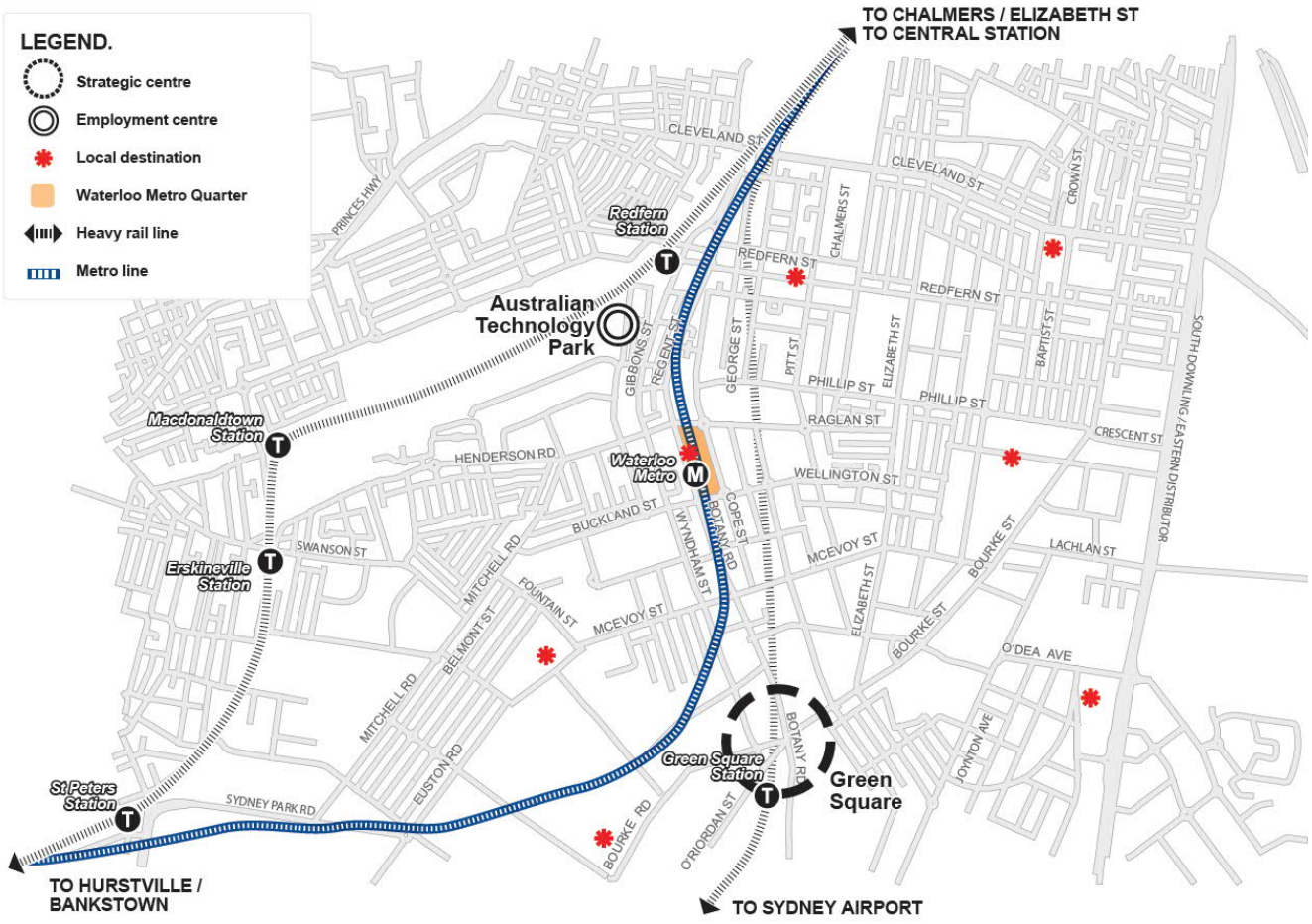


Figure 4.9: Rail network around Waterloo

Access to Waterloo Station would be located at the northern end of the station on the corner of Raglan Street and Cope Street, with a second entry off the proposed public plaza adjacent to Cope Street. Changes to bus stops have been identified during the Sydney Metro City & Southwest EIS (CSSI EIS) process and include the relocation of the southbound Botany Road stop further north to integrate with the Metro Station entrance. In addition, point to point facilities and a taxi rank would be provided on Cope Street, further improving the amenities available to customers of the metro network.

The forecast mode of arrival during the 2036 morning peak hour as identified in the CSSI EIS is presented in Figure 4.10. The majority of customers are anticipated to walk to the station from the local area while around 19 per cent of customers are expected to interchange between bus services and the metro network. These forecasts also account for cumulative growth in the broader area, including redevelopment of the Metro Quarter and Waterloo Estate.

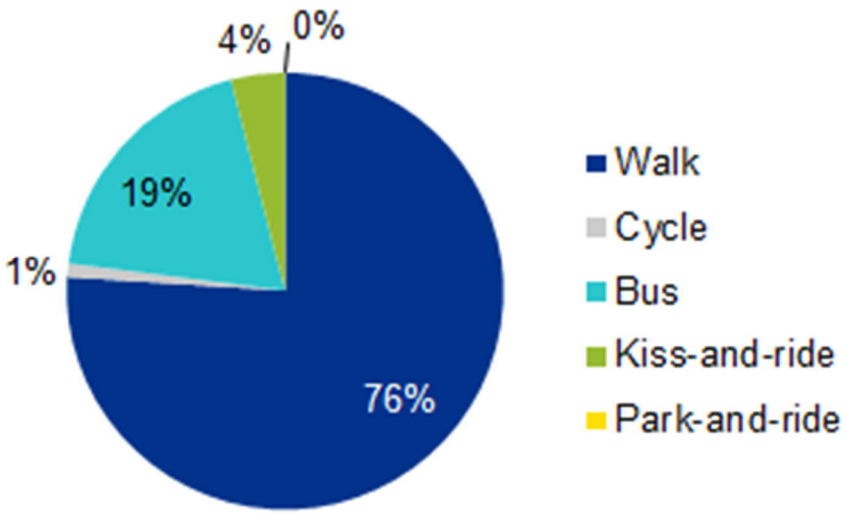


Figure 4.10: Forecast morning peak arrival mode at Waterloo Station

Source: Sydney Metro EIS Technical Paper 1: Traffic and Transport (May 2016)

4.2.3 Bus services

Today, the bus network in and around Waterloo is heavily focussed on north-south travel, particularly for access to Sydney CBD (as shown in Figure 4.11). Botany Road is a key bus corridor for these services which connects Sydney CBD with Redfern, Waterloo, Alexandria, Green Square, Mascot and Botany. These north-south routes are typically frequent and operate a wide span of hours. Bus services also operate east-west routes, linking Randwick, Coogee, Bondi Junction, Moore Park and Kingsford to the east with Glebe, Newtown, Marrickville and Sydenham to the west.

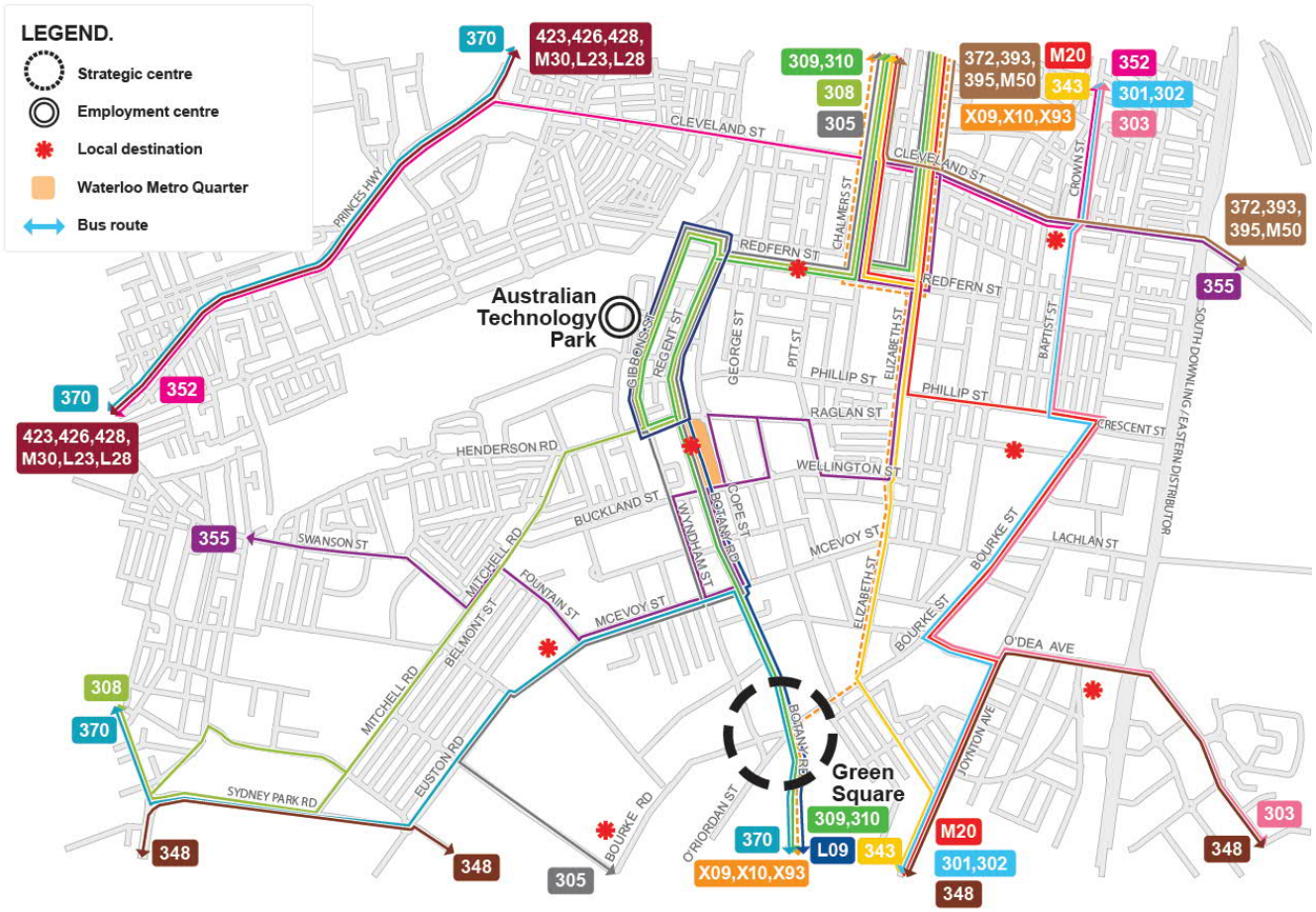


Figure 4.11: Existing bus network around Waterloo

4.3 Active transport

4.3.1 Cycle network

The regional cycle network surrounding Waterloo is shown in Figure 4.12.

The cycle network currently provides access to a range of key destinations including the University of Sydney, Redfern Station, Sydney CBD, Newtown and Moore Park. East-west movement is constrained by the existing heavy rail corridor to the west, which limits access to the north of the rail line and to Carriageworks and the University of Sydney (USYD). There are limited and sparsely located crossing opportunities, including Lawson Street at Redfern Station.

City of Sydney Council, as part of its cycle network strategy, has identified 10 priority cycle routes across the inner city including through Waterloo Precinct. Key routes include:

- City North to Green Square: Running north-south through Waterloo Precinct, complete as far as Green Square with a separated cycleway on George Street, Waterloo. This route would be the most direct north-south connection to the Waterloo Station
- Sydney Park to Central Park: Running east-west through Waterloo Precinct, upgrades are identified on Buckland, Wellington, Morehead and Phillip Streets, Waterloo. This route would be the most direct east-west connection to the Waterloo Station
- Newtown to Bondi Junction: Running east-west through Redfern on Wells and Turner Streets, upgrades currently in progress
- USYD to University of New South Wales: Running east west through Alexandria
- Sydney Harbour to Botany Bay: Running north-south along Bourke Street, complete with separated cycleway for much of its length.

As part of the Alexandria to Moore Park Connectivity Upgrade, a shared path is proposed along the northern side of McEvoy Street west of George Street, continuing on the southern side of McEvoy Street east of George Street. Cyclists would be required to cross McEvoy Street at its intersection with George Street. If approved, the upgrade would facilitate east-west movements to and from the Waterloo Precinct.

Figure 4.12: Existing and planned cycle connectivity around Waterloo

4.3.2 Pedestrian network

The existing structure of the street network in and around the Metro Quarter is generally well suited to walking. A clear grid pattern of streets allows for direct connections to be made and provides good legibility for people walking. The topography of the precinct begins to rise immediately east of the Metro Quarter. In addition, the footpaths surrounding the Metro Quarter are cracked and show signs of wear and tear, and may require resheeting to improve pedestrian safety.

The provision of pedestrian facilities at each intersection surrounding the Metro Quarter includes:

- Signalised pedestrian crossings on all approaches of the Botany Road / Raglan Street / Henderson Road intersection.
- Signalised pedestrian crossings on all approaches of the Botany Road / Wellington Street / Buckland Street intersection.

- A marked pedestrian crossing on the north approach of the Cope Street / Raglan Street roundabout. A median is available on all other approaches for pedestrians wishing to cross the road.
- A median on all approaches, allowing pedestrians to undertake a staged crossing if required.

Although crossing opportunities are provided at each intersection surrounding the Metro Quarter, upgrades to pedestrian facilities at the two roundabouts may be necessary to accommodate the large pedestrian demand expected on Raglan Street and Cope Street due to the metro line accessible at Waterloo Station.

Ensuring high quality urban design and streetscape outcomes for the development of the Metro Quarter would be required to enhance the pedestrian network and major roads such as Botany Road and McEvoy Street which form a barrier to pedestrian movements and access across these streets would need to be carefully planned.

4.4 Road network

4.4.1 Key roads

The road network in and around the Waterloo Precinct is fairly constrained. Most local streets in the area have 50km/h speed limits and are two lanes wide, with some streets 40km/h zones including George Street and Redfern Street. Major arterial roads include Botany Road, Wyndham Street, and Henderson Road.

Traffic data collected in May 2017 indicate traffic volumes greater than 1,000 vehicles per hour during the peak hour on Botany Road, Elizabeth Street, Henderson Road and McEvoy Street. Botany Road and Wyndham Street operate as a north-south one-way pair between Cleveland Street and Henderson Road providing a key link between Sydney Airport and its surrounding suburbs to the Sydney CBD and inner west. McEvoy Street and Henderson Road both run east-west, providing links between the inner-southern suburbs and the Sydney CBD or eastern suburbs. Key roads and current peak hour volumes are outlined in Table 4.4.

Table 4.4: Traffic volumes (bi-directional) and heavy vehicle proportions

Road	Morning peak hour (8-9am)		Evening peak hour (5-6pm)	
	Volume (vehicles)	Proportion of heavy vehicles	Volume (vehicles)	Proportion of heavy vehicles
Botany Road between Wellington Street and Raglan Street	1,860	7%	1,820	5%
Wyndham Street between Buckland Street and Henderson Road	610	10%	590	3%
Henderson Road between Wyndham Street and Botany Road	1,950	5%	2,110	2%
Raglan Street between Botany Road and Cope Street	580	4%	580	1%
McEvoy Street between Wyndham Street and Botany Road	1,710	9%	1,690	3%
McEvoy Street between Botany Road and George Street	1,190	8%	1,050	2%
Elizabeth Street between Raglan Street and Wellington Street	1,660	8%	1,970	4%
Wellington Street between Botany Road and Cope Street	370	3%	330	3%
Cope Street between Raglan Street and Wellington Street	170	5%	160	3%

Figure 4.13 shows the key regional roads surrounding Waterloo.

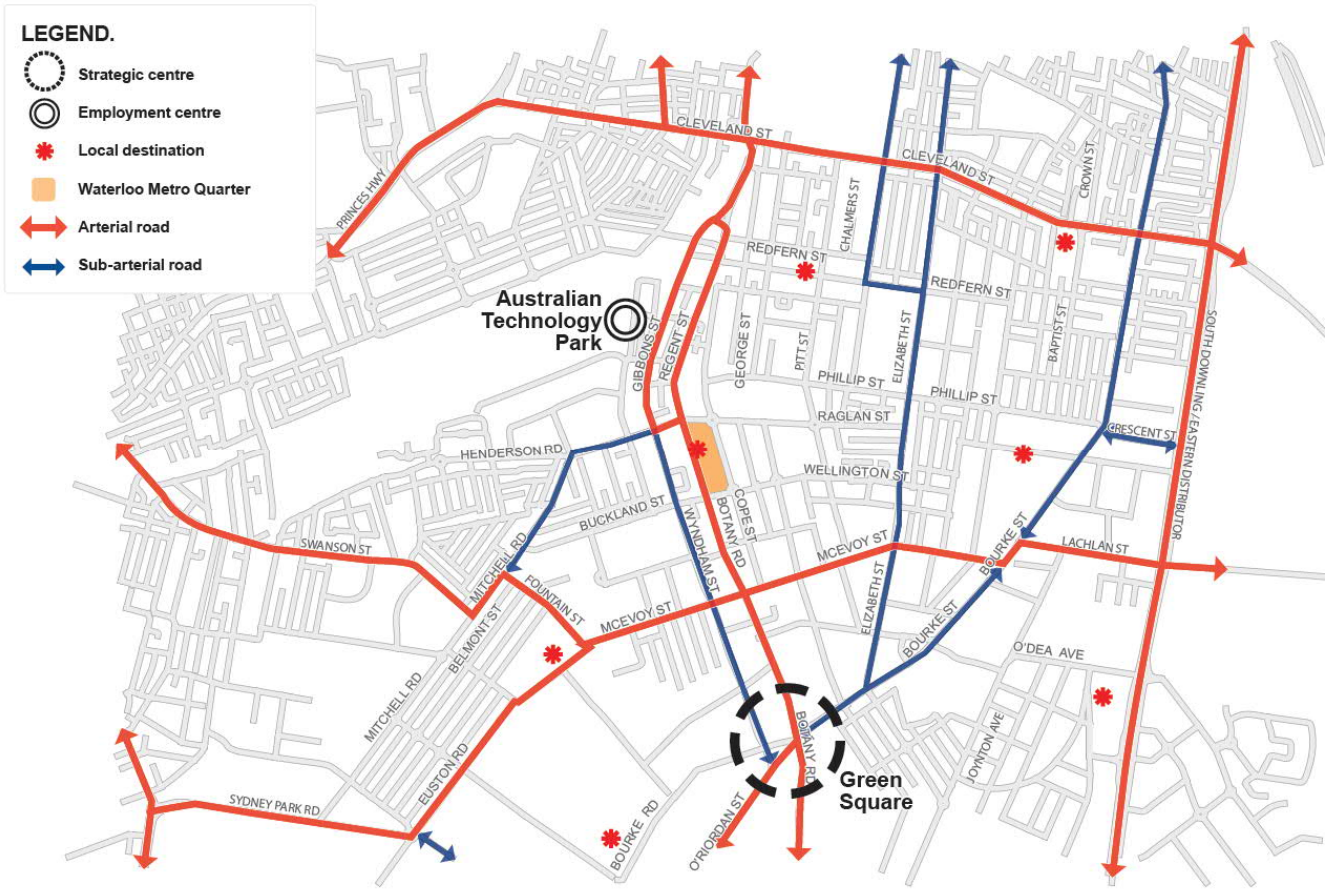


Figure 4.13: Arterial road network around Waterloo

4.4.2 Alexandria to Moore Park Connectivity Upgrade

RMS has developed concept designs for the Alexandria to Moore Park Connectivity Upgrade, which will involve upgrades along the corridor between the WestConnex interface at Euston Road and Anzac Parade. This includes intersection improvements and clearways on McEvoy Street, to the south of Waterloo Precinct, realignment of the intersection of Bourke, McEvoy and Lachlan Streets to the east, and widening of Lachlan Street. Additional capacity created by these works has the potential to reduce demand on lower order east-west corridors through the Waterloo Precinct such as Henderson Road, Raglan Street and Wellington Street. A Review of Environmental Factors (REF) for the connectivity upgrade is expected to be exhibited in mid-2018.

4.5 Strategic Opportunities

The strategic analysis has highlighted characteristics of the existing travel behaviour and transport network that can be built upon for the Metro Quarter. The main strategic opportunities that will inform the principles and assessment process for the Metro Quarter are highlighted below.

4.5.1 Proximity to Sydney Trains Network and future metro will provide excellent rail access

Sydney Metro City & Southwest will directly improve public transport access between the Waterloo Precinct and a range of destinations, including Sydney CBD, North Sydney, Chatswood, Macquarie Park, Sydenham and Bankstown. It will also indirectly provide improved travel times and connections with other parts of Sydney by interchanging with other public transport services at key locations. Sydney Metro will operate a wide span of hours, from early in the morning to late at night, seven days a week. This will provide a high level of service and access into and out of Waterloo Precinct across the whole day, supporting 24/7 activity.

The new metro station at Waterloo provides a unique opportunity to support low private vehicle demand in the Waterloo Precinct. Together with the existing rail access provided at Redfern Station and Green Square Station there would be a significantly diminished need to use motor vehicles for most travel into and out of the Waterloo Precinct in the future. This would result in less traffic on local streets, less added traffic on the wider road network, and would provide greater accessibility and mobility for residents without the need to service the significant cost of a vehicle.

4.5.2 Improved public transport to local destinations

Acting as the key north-south link through Waterloo Precinct, Sydney Metro will be a catalyst for improving the local public transport network. The metro offers the opportunity of building a larger network with more frequent services (in all directions) to serve the subregion surrounding Waterloo. In particular, there is an opportunity to enable stronger east-west connections, providing cross-regional links and feeding major rail lines.

Currently, bus services provide frequent north-south connections. With Sydney Metro, greater emphasis could be placed on east-west bus connections which feed into heavy rail and metro hubs. The east-west bus network services origin-destinations that have a strong relationship such as Newtown, Green Square, Surry Hills, Glebe, the University of Sydney and the University of New South Wales.

Services on Botany Road will also continue to be important as they provide access to the Southern Sydney Employment Lands and interchange to the metro to access CBD destinations. This second factor would be particularly attractive for people wishing to access mid-CBD and northern CBD areas, including North Sydney.

4.5.3 Street network structure and traffic management to limit impacts in and around Waterloo

In order to achieve good transport and land use outcomes and minimise traffic impacts on Waterloo Precinct, it is necessary to set a strategic framework to ensure any subsequent proposals are consistent with the future role and function of a particular street. This framework is a vital step in transport planning for Waterloo Precinct and is heavily influenced by the land use plans. In turn, the framework informs the land use and can create opportunities or constraints for the type of land use that can occur along a particular street.

The framework defines the future function of the street network on the basis of land use and transport objectives and desired outcomes for the Waterloo Precinct. The roads within and around the Precinct provide two primary functions for transport customers:

- **Movement:** The ability to travel between places
- **Place:** The ability to access origins and destinations of travel.

An understanding of the two functions of a street are vital when the two functions are competing, such as through increased movement requirements or improved place amenity. The movement and place function of a street informs planning for the level of access across each of the transport modes.

The Waterloo Precinct is bounded on two sides by Botany Road and McEvoy Street, both busy arterial road corridors with significant movement functions. In the vicinity of the Precinct, Botany Road also has a place function due to the presence of retail and commercial land uses fronting the road.

Within Waterloo Precinct Cope Street and Raglan Street east of Cope Street will have a prioritised place function, given the proximity of the proposed Sydney Metro Waterloo Station entrance is this area. This would shift the focus of these streets to minimise the movement function and prioritise access for people instead.

4.5.4 An urban form that promotes walking and cycling

Active transport will play a significant role in short and medium distance trips to, from and within the Metro Quarter.

As shown in Figure 4.14, the density of land uses and permeability of the street network results in the 800 metre walking catchments of Redfern Station, the future Sydney Metro Waterloo Station, and Green Square Station overlapping one another. This indicates significant potential for walking for many trips, particularly in combination with mass transit.

Dedicated north-south cycle facilities are currently provided on George Street. This provides strong connections to jobs, retail and leisure activities in Sydney CBD and Green Square, the latter set to grow significantly in the future with the development of Green Square Town Centre. A priority regional cycle route from Sydney Park to Central Park, one of 10 identified in City of Sydney's regional cycling network, pass through Waterloo Precinct in an east-west direction. Upgrades are identified on Buckland, Wellington, Morehead and Phillip Streets.

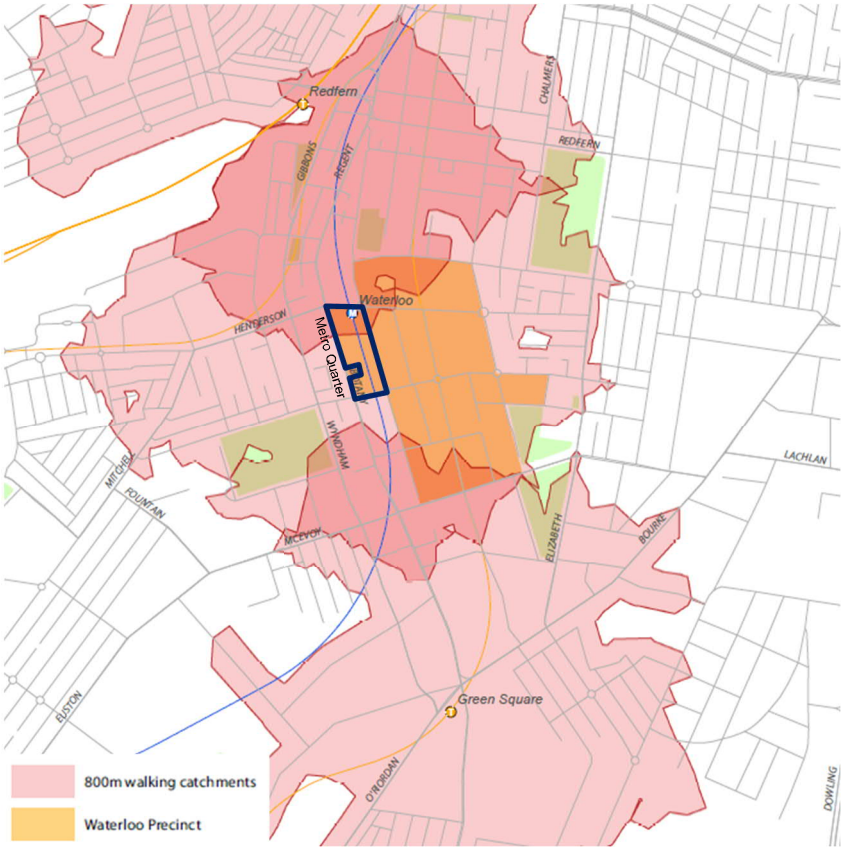


Figure 4.14: 800m walking catchments; Redfern Station, Waterloo Station and Green Square Station

4.5.5 Self-containment

A greater level of trip self-containment could be achieved in the Metro Quarter and surrounds with the right balance and mix of land uses. This could involve providing more opportunities to work, shop, and engage in recreational pursuits in and around the Metro Quarter.

4.6 Future mode share targets

An assessment of the potential future mode shares has been undertaken in consultation with TfNSW, RMS and City of Sydney and is based on existing data and the strategic opportunities for the Waterloo concept SSD. The mode share targets in the AM peak for all trip purposes are outlined in Figure 4.15.

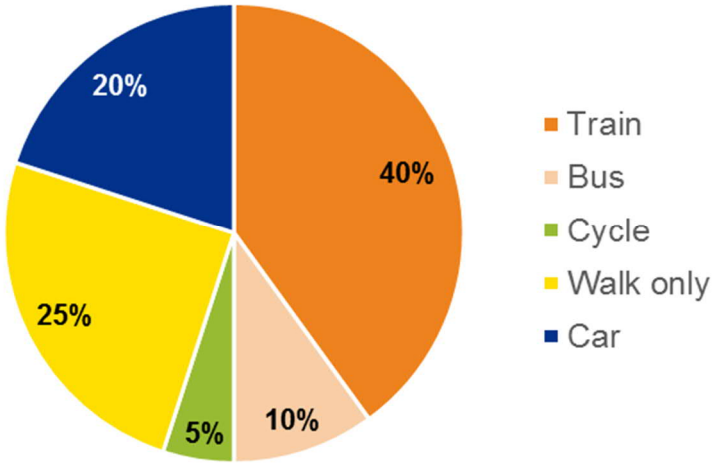


Figure 4.15: Metro Quarter future mode share targets

These targets are based on a number of factors, including:

- Proximity to Sydney Metro's Waterloo Station, which will provide access to high quality mass transit services on Sydney Metro City & Southwest
- Densely located land uses, activities and attractors as well as proximity to Sydney CBD and Green Square, enabling shorter trip lengths more conducive to walking and cycling
- Low existing traffic generation rates in recent high density developments in Waterloo and Redfern, and high (81 per cent) AM peak non-car mode share observed at the Redfern traffic generation survey site (detailed further in Chapter 6)
- Enhancements to the bus network to strengthen east-west routes, enabled by Sydney Metro City & Southwest, and improved cycling connections with key surrounding destinations.
- Consideration of Category A rates outlined in City of Sydney's DCP requirements to represent best practice in the provision of transport facilities appropriate for the Metro Quarter.

5. Proposal

5.1 Proposed planning framework

The existing and proposed (under the SSP Study) planning controls for the Metro Quarter are shown in Table 5.1.

Table 5.1: Planning framework

	Existing	Proposed
Zoning	B4 mixed use	B4 mixed use
Height of buildings	Part 12, Part 15 metres	Part RL 115.3 (AHD) – North Part RL 104.2 (AHD) – Central Part RL 96.9 (AHD) – South
Floor Space Ratio	1.75:1	6.1:1 (including Metro Station)

5.2 Indicative concept proposal

The Indicative Concept Proposal for the Metro Quarter ISD comprises:

- approximately 68,750 sqm of gross floor area (GFA), comprising:
  - approximately 56,200 sqm GFA of residential accommodation, with potential to deliver approximately 700 dwellings, including 5 to 10 percent affordable housing and 70 social housing dwellings;
  - approximately 3,905 sqm of GFA for retail premises and entertainment facilities.
  - approximately 8,645 sqm GFA for business and commercial premises and community, health and recreation facilities (indoor), including at least 2,000 square metres of floor space for community uses
- publicly accessible plazas fronting Cope Street (approximately 1,400 sqm) and Raglan Street (580sqm).
- a three storey mixed-use, non-residential podium, including a free standing building within the Cope Street Plaza.
- three taller residential buildings of 23, 25 and 29 storeys, and four mid-rise buildings of four to ten storeys above the podium and/or the approved metro station infrastructure.
- public domain works, through-site links, footpaths, provision for cycle facilities and enhanced pedestrian crossings and roads.

- car parking for up to 427 vehicles
- cycle parking to support residential and non-residential land uses and visitors to the Metro Quarter. Approval is also being sought for space within the future basement for a bike hub which would also support future bike parking for Waterloo Station
- loading, vehicular and pedestrian access arrangements
- strategies for utilities and services provision
- strategies for managing stormwater and drainage
- a strategy for the achievement of ecologically sustainable development
- a public art strategy
- provision for future signage zones
- a design excellence framework
- the future subdivision of parts of the OSD footprint (if required).

Approval has already been separately granted for a Sydney Metro station on the site, which will comprise approximately 8,415 square metres of GFA. The total GFA for the integrated station development, including the metro station GFA, is approximately 77,165 square metres, which is equivalent to an FSR of approximately 6:1.

Transport interchange facilities, including bus stops on Botany Road and kiss and ride facilities on Cope Street will be provided under the existing CSSI Approval. With regard to bicycle parking we note that a 100 bicycle storage facility and 80 public domain spaces will be provided as part of the CSSI Approval.

Three dimensional drawings of the Concept Proposal are shown in Figure 5.1 and Figure 5.2.

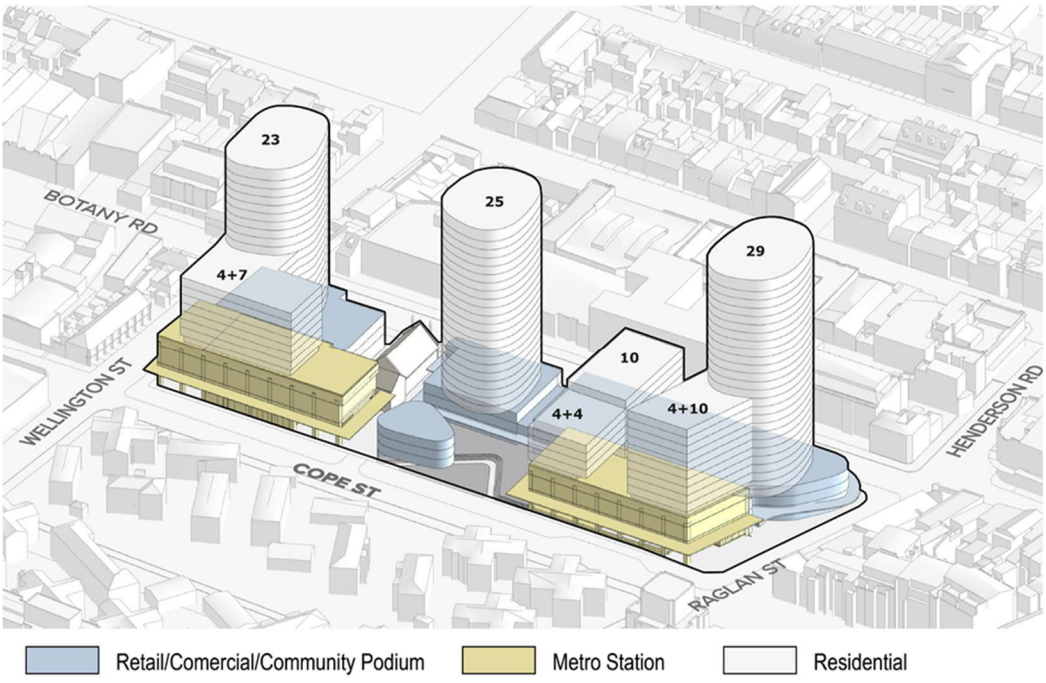


Figure 5.1: Three-dimensional drawing of the Indicative Concept Proposal, viewed from the east

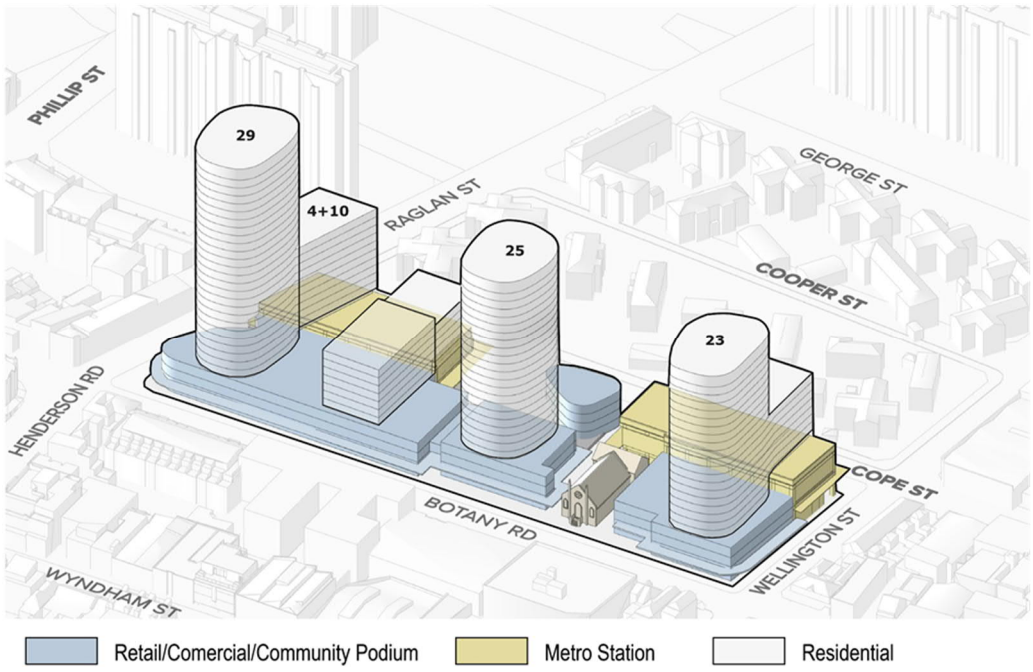


Figure 5.2: Three-dimensional drawing of the Indicative Concept Proposal, viewed from the west

6. Proposal assessment

6.1 Overview

This chapter presents a traffic and transport assessment of the Metro Quarter proposal. The additional demands on the transport network as a result of the Metro Quarter proposal have been quantified and the impacts to all transport modes have been assessed. Mitigation measures have been proposed where required in order to maximise the safety and efficiency of all road and public transport users.

Scoping meetings were held with RMS and TfNSW to confirm the methodology of this assessment on 2 May 2017 and 27 July 2017.

Other transport related issues have been investigated including on and off-street parking provision, bicycle facilities and vehicle access considerations.

Figure 6.1 shows the proposed public domain plan which has informed the assessment of the Metro Quarter proposal.

Figure 6.1: Proposed public domain plan

Source: Turf and Turner Studio

6.2 Guiding transport principles

The planning of the transport network for Metro Quarter has been informed by a guiding set of principles. These principles seek to ensure that the future residents and workers of the Metro Quarter will have the benefit of choice, not only for their travel mode, but for when and where they wish to travel for live, work and play activities. The principles build on the strategic opportunities for the precinct identified in Section 5.5. These principles have been reviewed by Transport for NSW, RMS, and City of Sydney during the planning process.

Principle 1: Support the development of transport networks that provide 24 hour / 7 days a week access

Ensure that residents and workers are provided with multiple high quality transport options to reach a variety of destination/s for live, work and play activities in a 24 hour/7 day a week economy and to support connections to the metro system.

Principle 2: Encourage access by public transport, walking and cycling to reduce car dependence

Provide high quality public and active transport linkages and sustainable approaches to parking provision that encourages residents to live car independent lifestyles if they choose to do so.

Principle 3: Support walkable urban environments

Ensure an integrated land use and transport outcome that supports walkable streets and high quality urban outcomes within the precinct, including active street frontages, fine-grained development pattern and a connected, permeable street network.

Principle 4: Strengthen east-west connections

Take advantage of the north-south connectivity provided by the metro by strengthening east-west connections, particularly for active transport and buses.

Principle 5: Minimise impacts to regional connections

Ensure that any impacts to regional connections for public transport and freight, such as Botany Road, are minimised where possible.

Principle 6: Support a hierarchy of access based on time of day

Develop and implement a hierarchy of access that prioritises access for people and goods based on time of day using the movement and place approach.

6.3 Future transport demand

The transport demand generated by the Metro Quarter development has been calculated based on the future mode share targets outlined in Section 4.6 and an analysis of total travel demand based on trip generation surveys. Metro quarter demand as well as background movements have also been informed by an assessment of the cumulative impacts of known surrounding developments such as Australian Technology Park and increased population in the neighbouring Waterloo Estate as well as infrastructure interventions including Alexandria to Moore Park and WestConnex.

RMS' *Guide to Traffic Generating Developments – Updated traffic surveys* (TDT 2013/04a) provides data on the number of person trips per dwelling for 8 high density sites in the Sydney metropolitan area, within walking distance of mass transit. This data, combined with the additional surveys undertaken for this study (see Section 7.7) reveals an average rate of 0.71 person trips (all modes) per dwelling in the peak hour. This trip rate accounts for all trip purposes.

Considering the 700 dwellings in the Metro Quarter development and applying the assumed mode shares leads to the trip volumes shown in Table 6.1. It is noted that point to point trips are included in the car mode share. The table therefore outlines all future vehicle, public transport, point to point transport services, pedestrian and bicycle trips generated by the development. Proposed non-residential uses in the Metro Quarter precinct are small in scale. As such it is assumed there will be limited associated vehicle traffic generation from these uses and that traffic generated will be outside the peak hour or undertaken as part of multi-purpose trips by residents.

It is noted that the new metro service and proposed bicycle infrastructure is forecasted to significantly increase the use of active and public transport options in the Waterloo area (walking and cycling from 22 to 30 percent, public transport use from 39 to 50 percent), and reduce car usage (from 40 to 20 percent). Further reductions in car mode share may be realised through the prioritising of pedestrians throughout the precinct and surrounding area, the provision of more frequent and reliable bus services and the provision of less than the maximum permissible car parking spaces under the draft Waterloo Metro Quarter DCP (WMQ DCP).

Table 6.1: Metro Quarter trip generation by mode

	Trips per dwelling (all modes)	Metro Quarter dwellings	All modes	Rail (40%)	Bus (10%)	Cycling (5%)	Walk (25%)	Car (20%)
AM peak hour	0.71	700	497	199	50	25	124	99
Daily	4.5		3,150	1,260	315	158	788	630

These demands have been used as the basis of the transport assessment presented in the remainder of this section.

6.4 Public transport

6.4.1 Rail

During the morning peak hour, 43 suburban trains heading towards Central Station stop at Redfern Station. In addition, a limited number of intercity trains also stop at Redfern Station during the morning peak hour. Average spare capacity on inbound trains during the morning peak period and outbound trains during the evening peak period at Redfern Station is limited. This is particularly evident on the T1 Western Line during the morning peak period and the T4 Illawarra Line during the evening peak period (refer to Figure 6.2 and Figure 6.3) where the majority of services operate at a load factor above 100 per cent. In these instances, there are not enough seats for every passenger. A load factor greater than 135 per cent, represented by the red column indicates that passengers experience crowding and dwell times may impact on the on-time running performance of the service.

Similarly, spare capacity on inbound train services stopping at Green Square Station during the morning peak period, particularly between 7:30am and 9am, is limited as shown in Figure 6.4. During the morning peak hour, 10 trains stop at Green Square Station for travel towards Central Station.

The introduction of Sydney Metro would increase the capacity of the rail network in Sydney. The metro line is anticipated to have a target capacity of 46,000 customers per hour in one direction (*Sydney Metro City & Southwest Final Business Case Summary*, October 2016). The capacity of the Sydney Metro is almost double that of an existing heavy rail line. As such, capacity issues evident on services passing through or stopping at Redfern Station and Green Square Station are likely to be relieved once Sydney Metro is operational as existing customers at these two stations would have the opportunity to use metro services at Waterloo Station. A service capacity of 46,000 customers per hour in one direction combined with the existing heavy rail network is therefore considered sufficient to cater for forecast demand generated by the Metro Quarter, including the cumulative demand from future developments in the vicinity of the Metro Quarter such as at Australian Technology Park and increased population in the nearby Waterloo Estate.

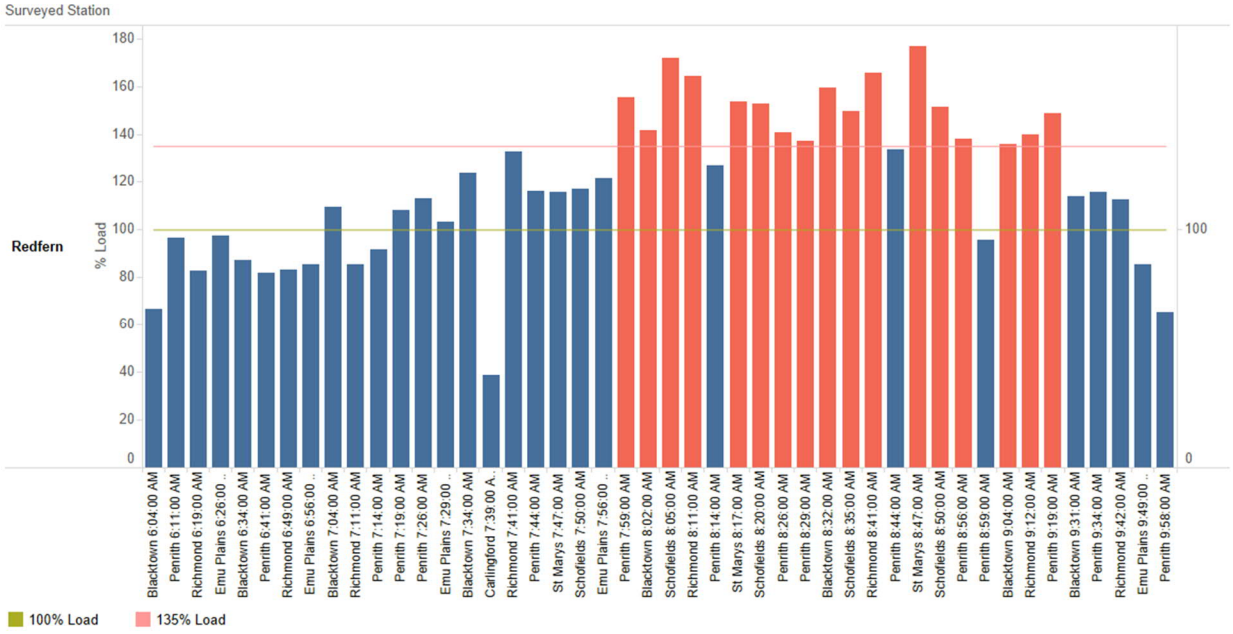


Figure 6.2: Passenger loading on the T1 Western Line at Redfern Station during the morning peak period (inbound)

Source: Transport for NSW – Train loads (March 2016)

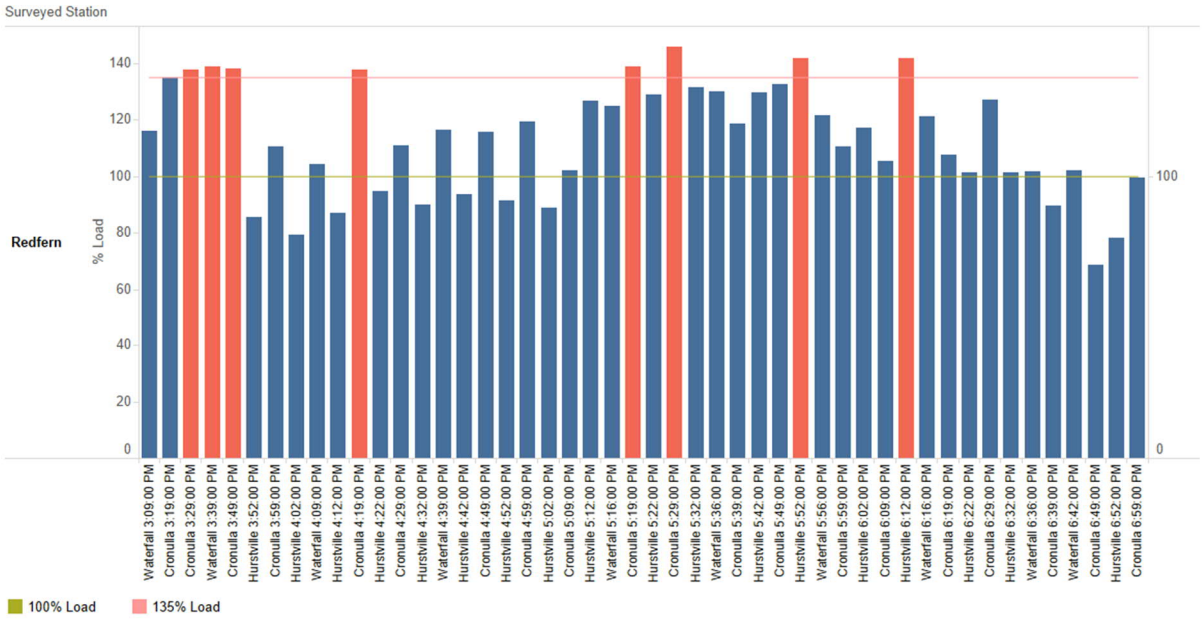


Figure 6.3: Passenger loading on the T4 Illawarra Line at Redfern Station during the evening peak period (outbound)

Source: Transport for NSW – Train loads (March 2016)

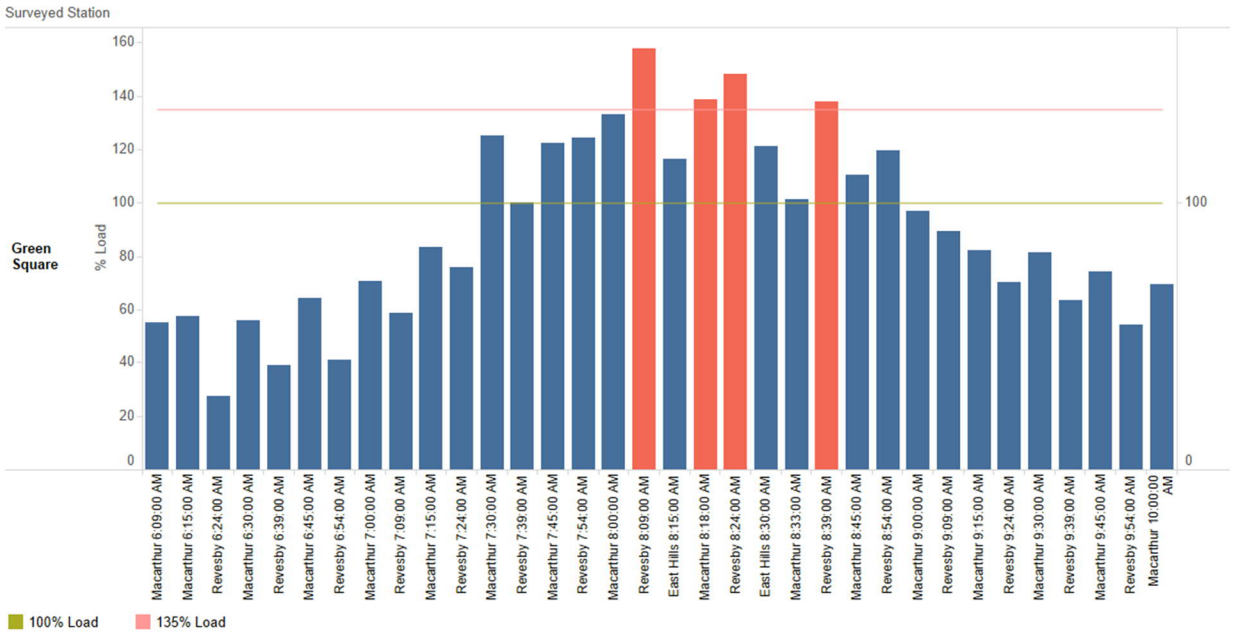


Figure 6.4: Passenger loading on the T8 Airport Line at Green Square Station during the morning peak period (inbound)

Source: Transport for NSW – Train loads (March 2016)

6.4.2 Bus

Figure 6.5 and Figure 6.6 shows loading on two key routes serving the Metro Quarter. Citybound route 309 services operating along Botany Road exceed seated capacity on some services in the AM peak hour. However, many of these customers alight services at Green Square Station leaving capacity available once services reach Waterloo.

Bus route 355 serving east-west trips in the area via Raglan / Wellington Street has spare capacity available on all services. The 355 service also serves a vital social function by providing access for many social housing tenants in the estate; particularly those who are mobility impaired.

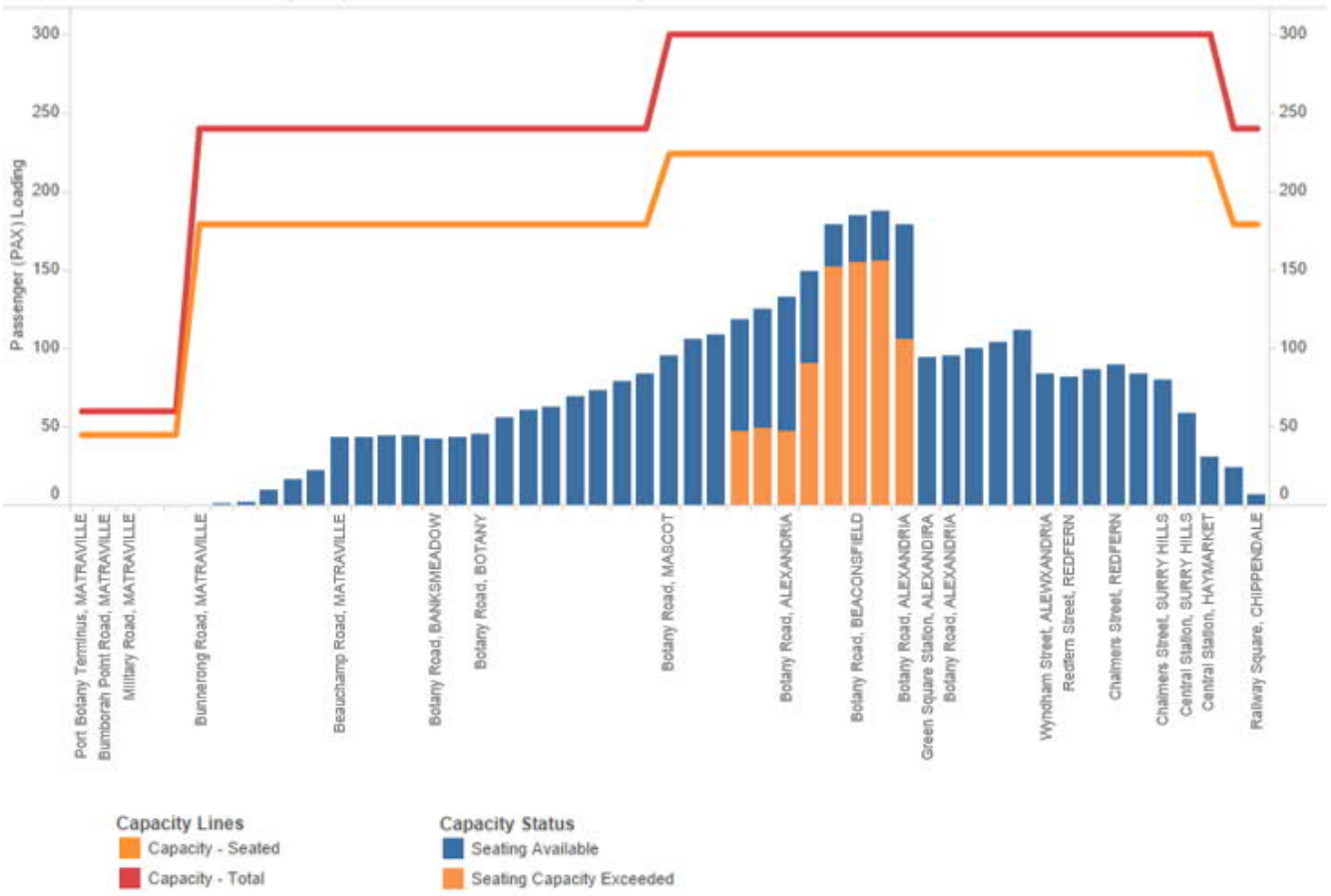


Figure 6.5: Bus service passenger loading on the 309 during the morning peak period (inbound)

Source: Opal data (May 2017)

Figure 6.6: Bus service passenger loading on the 355 during the morning peak period (inbound)

Source: Opal data (May 2017)

With the introduction of Waterloo Station, some localised changes to the bus network may be appropriate. These changes could also benefit the future residents within the Metro Quarter. Two potential changes that could be investigated include:

- Route 355: Bondi Junction to Marrickville Metro via Waterloo. Increase frequency / span of hours to match metro operation and re-route via Wellington Street to more directly serve the Waterloo Station.
- Route 309/310: Port Botany to Central, via Botany Road. Increase frequency and span of hours to match metro operation and serve significant bus-rail interchange demand.

Whilst future residents of the Metro Quarter will have a range of transport needs, the key requirements of various customer groups have been considered in the above analysis. Mass transit connections to key employment centres such as Sydney Metro and the existing heavy rail network will help to serve the needs of the working age residents undertaking trips for employment. The needs of older residents, social housing tenants and school age children will be primarily met by improved local bus services connecting to community, health and retail facilities.

6.5 Active transport

6.5.1 Future pedestrian demands

The Metro Quarter forms part of an integrated station development, which includes pedestrian demand generated by the Metro Station. An assessment of the future pedestrian demands for the Metro Quarter and Metro Station is captured in this assessment. Refer to Appendix B for a further understanding of demand modelled as part of the Metro Quarter and Metro Station interchange appraisals. Pedestrian demand directly generated by the proposed Metro Quarter development has been calculated separately for the purposes of this study and is derived from the demands shown in Section 6.3. For the purposes of assessing the total pedestrian demand from the Metro Quarter development, all public transport and walk only trips have been combined.

Table 6.2 outlines the pedestrian demands from both the proposed Metro Quarter and Waterloo Station. Metro Station demands have been sourced from the *Sydney Metro EIS Technical Paper 1: Traffic and Transport* (May 2016).

Table 6.2: Metro Quarter and Sydney Metro pedestrian trip generation (AM peak hour - 2036)

	Pedestrian trips	Proportion (%)
Metro Quarter development	373	6%
Waterloo Station	6,050	94%
Total	**6,423**	**100%**

The impact of walking trips generated by the Metro Quarter on the precinct and surrounding road network is considered negligible in comparison to forecast growth within the SSP. Notwithstanding this, the assessment of pedestrian infrastructure included as part of section 7.5 and Appendix B has been carried out to ensure that the planning of the active transport environment is consistent with area plans, enables growth and offers a safe and efficient environment for promoting travel by walking, cycling and public transport.

6.5.2 Future pedestrian trip distribution and access

The expected future distribution of pedestrian trips to/from the Metro Station in the AM peak is shown in Figure 6.7. In addition, pedestrian access routes for the Metro Quarter are shown in Figure 6.8.

As shown in the figures below, a major pedestrian desire line would be to and from Waterloo Station via Henderson Road and Raglan Street. Investigations have highlighted that a, widened pedestrian crossing spanning Botany Road at the Botany Road/Henderson Road/Raglan Street intersection and widened footpaths on Raglan Street on approach to the intersection would be required to accommodate the anticipated volume of pedestrians.

Pedestrian crossings would also be required across Cope Street to cater to pedestrians travelling between the Waterloo Estate and the metro station.

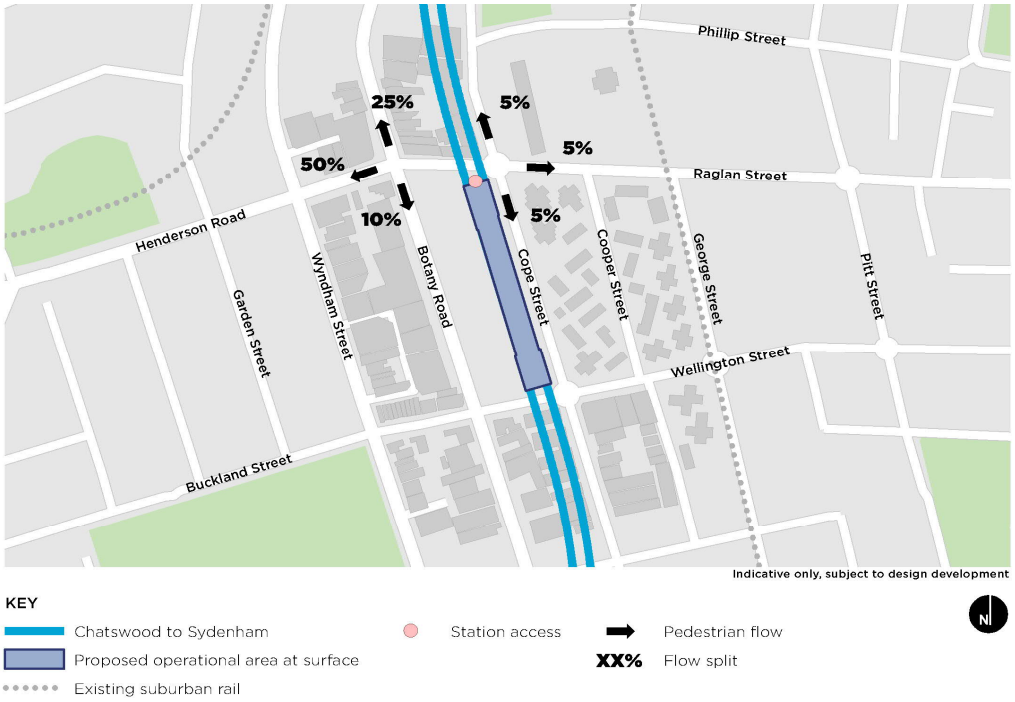


Figure 6.7: Expected distribution of future pedestrian trips

Source: Sydney Metro EIS Technical Paper 1: Traffic and Transport (May 2016)

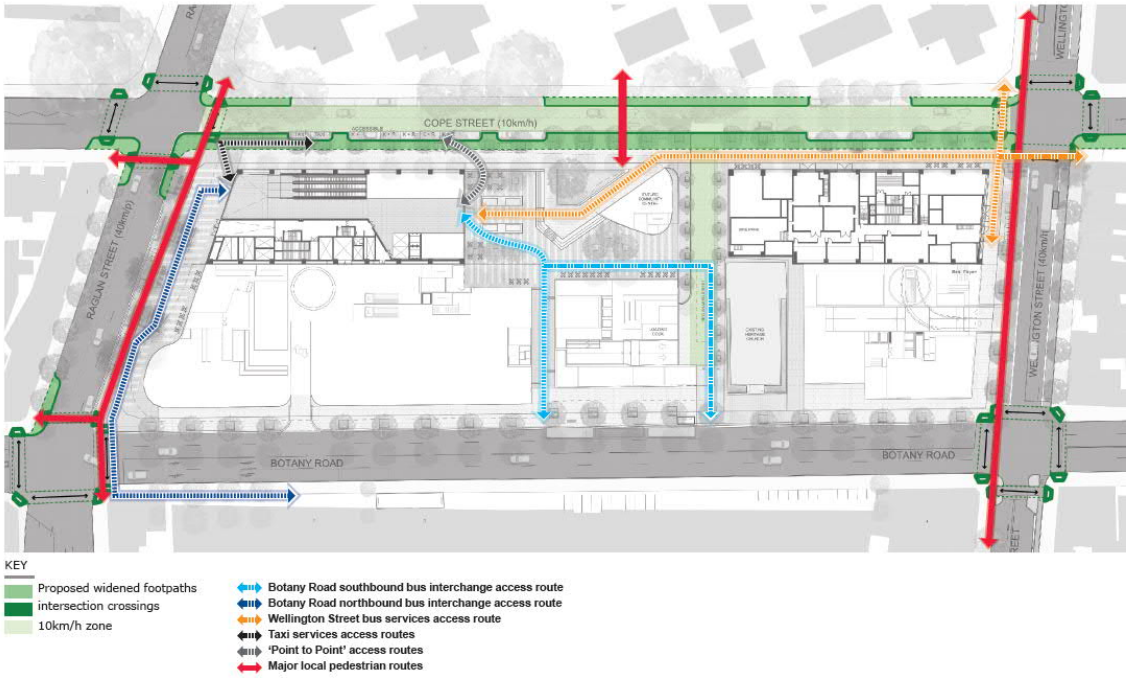


Figure 6.8: Metro Quarter key pedestrian access routes

6.5.3 Botany Road southbound bus interchange

The southbound Botany Road interchange forms an integral part of the integrated transport network with a significant number of passengers expected to interchange between the bus and metro services. An assessment of the performance of the interchange has been undertaken via dynamic pedestrian modelling using Legion software.

The following assumptions were made for this analysis:

- 2036 AM and PM forecast year assuming full development of Metro Quarter
- 27 per cent of hourly movements occur during the peak 15-minute period – based on existing Green Square opal data
- 26 buses per hour AM, 17 buses per hour PM (as advised by TfNSW)
- All buses stop at head of stand only with 30 seconds of dwell time
- There is sufficient capacity in all buses to service all waiting passengers
- Volumes of boarding and alighting passengers derived from outputs of the Public Transport Project Model (PTPM)

Figure 6.9 outlines the extents of the Legion model developed and the key pedestrian interchange movements.

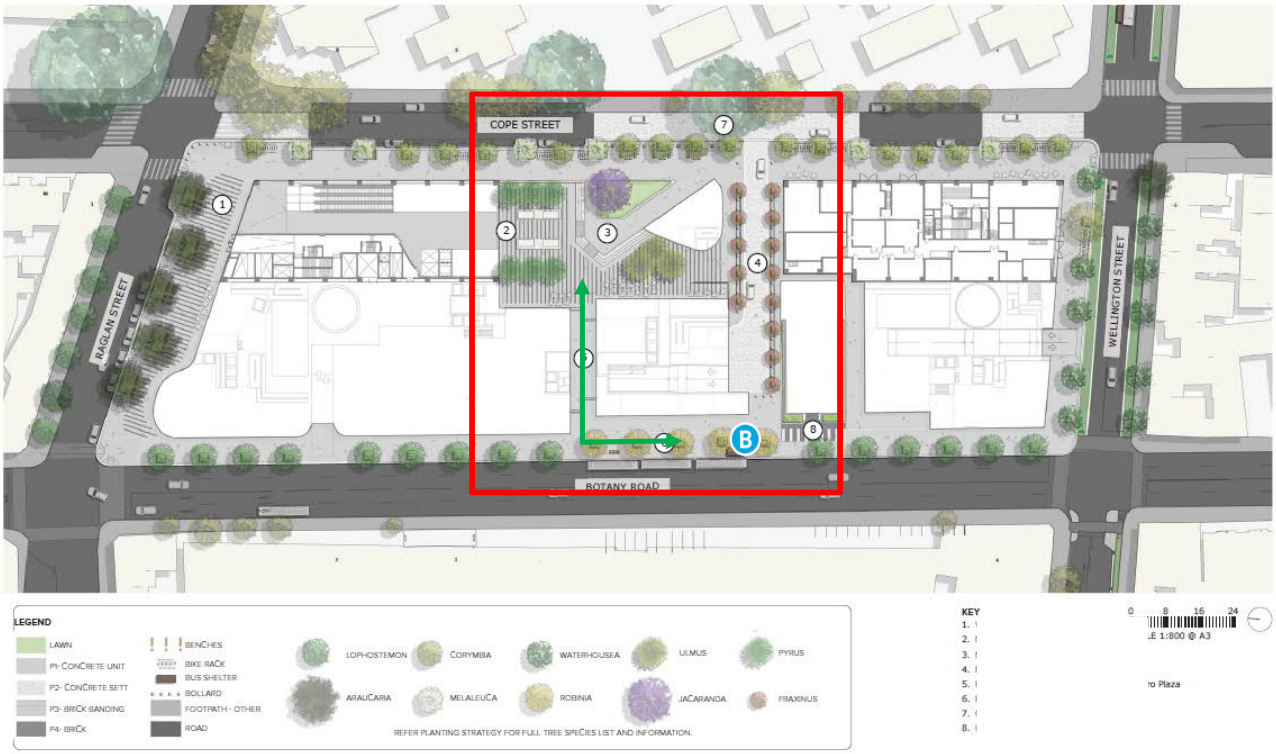


Figure 6.9: Botany Road bus interchange and key movements

Source: Turf and Turner Studio

Results of the dynamic pedestrian modelling are presented in terms of Fruin Level of Service for queuing areas and walkways and based on *London Underground Station Planning Standards and Guidelines (2012)*. Figure 6.10 explains the level of service performance indicators.

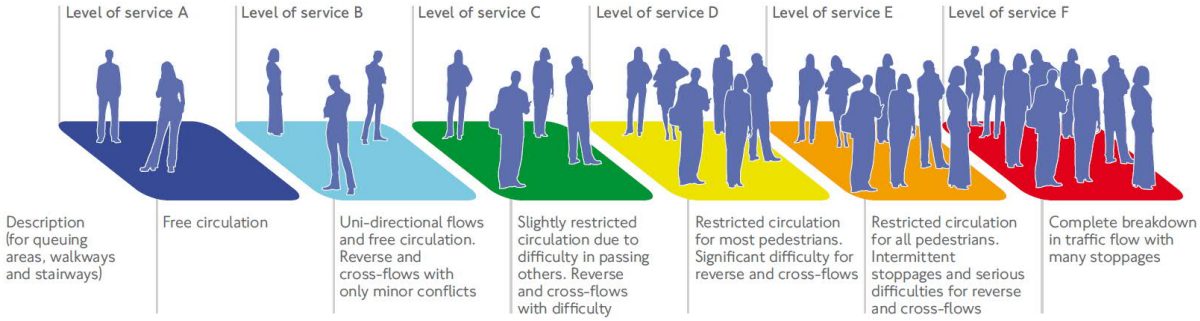


Figure 6.10: Fruin Level of Service

Cumulative mean density (people per square metre) is used to calculate pedestrian level of service. Mean density plots are shown in Figure 6.11 for the 2036 morning and evening peak periods. Analysis of the mean density plots show that the majority of footpath and bus waiting area would operate at Level of Service (LOS) A or B, indicating that the proposed footpath and bus waiting area is sufficiently wide to allow comfortable queuing conditions for bus passengers whilst also allowing 'through' pedestrians to easily pass through the area. There are some localised areas towards the head of the bus stand that are shown to operate at Level of Service D and E. However, these plots represent a worst case scenario where all passengers queue and board a bus at the head of stand. In reality, buses may arrive at similar times and hence passengers would spread further out along the footpath and within the waiting area. Even in a worst case scenario pedestrians travelling along the footpath will not be impeded by bus passengers.

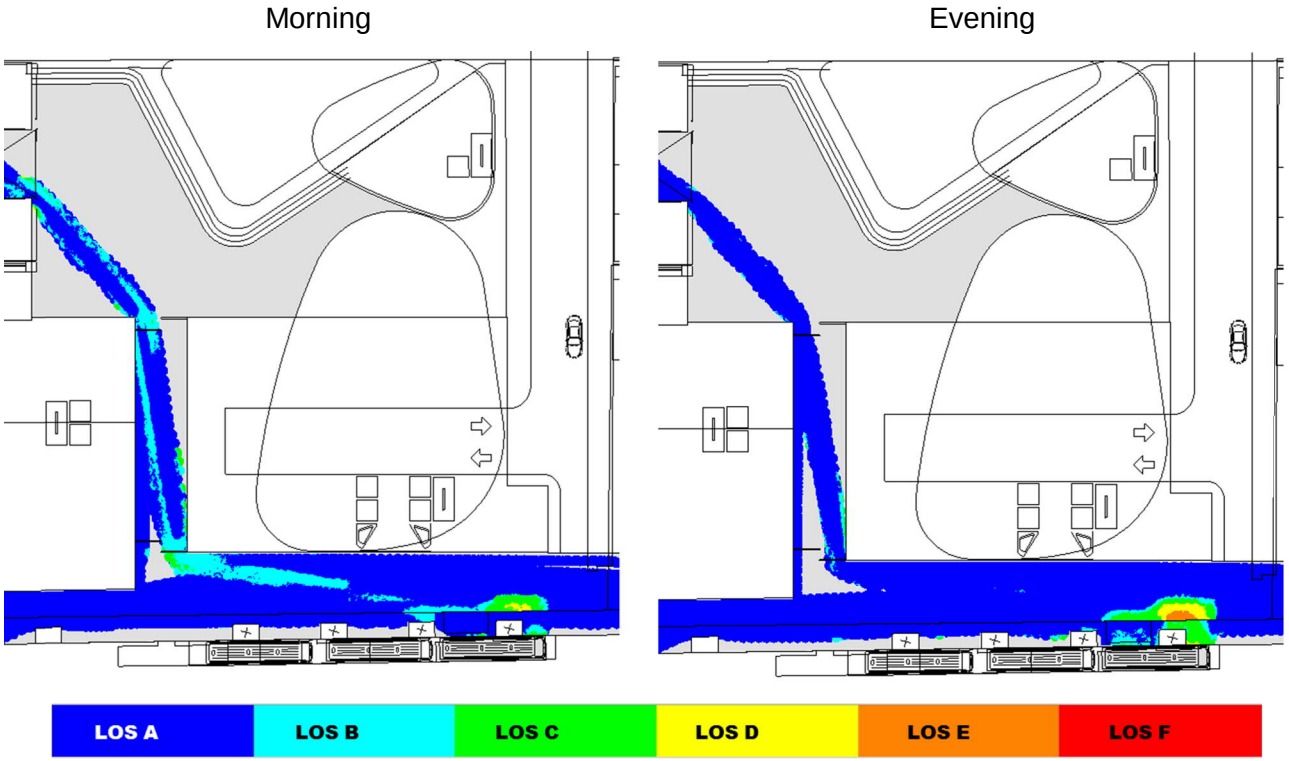


Figure 6.11: 2036 morning and evening peak cumulative mean density plots

6.5.4 Cope Street and Raglan Street

A static assessment of footpath widths on Raglan Street and Cope Street has been undertaken to ensure the proposed facilities are sufficient to safely cater for the large number of expected pedestrians in the Metro Quarter.

The assessment was undertaken at locations shown in Figure 6.12.

Figure 6.12: Cope Street and Raglan Street assessment locations

Source: Turf and Turner Studio

Pedestrian crowding was used as the metric for the static modelling undertaken, which is measured in pedestrians per metre of clear footway width per minute (ppmm). The crowding level (ppmm) is then categorised according to the Pedestrian Comfort Level (PCL) scale as shown in Figure 6.13.

Figure 6.13: Pedestrian Comfort Level

Source: Transport for London Pedestrian Comfort Guidance

Results of the static modelling are presented in Table 6.3. It is noted that proposed footpaths on Raglan and Cope Street are sufficient to safely cater for expected pedestrian demand with PCLs of A and A-, respectively.

Table 6.3: Raglan Street and Cope Street PCL

Street	Clear footway width (m)	People per hour	Pedestrian crowding (ppmm)	Pedestrian Comfort Level
Raglan Street	7.5	2,500	5.8	A
Cope Street	3.6	1,300	6.0	A-

6.5.5 Mid-block crossing of Botany Road

Movement and the proposed future performance outcomes of the network can be improved through the planning and implementation of additional pedestrian connections. The Metro Quarter allows for midblock connections between Cope Street and Botany Road, which is planned to serve access to precinct development and bus facilities situated on Botany Road. Spatial allowance has been allocated in the design for a future signalised midblock crossing on Botany Road between Raglan Street and Wellington Street, if it is found to be required in a future investigation. The implementation of this proposed improvement can be facilitated, but would be subject to adjacent land owners and the future planning of adjacent precincts to help establish an attractive pedestrian desire line for this type of facility.

6.5.6 Cycling

An overview of existing and potential future cycling routes was presented in Section 4.3.1. At a Metro Quarter level, the cycling infrastructure to be provided to support Waterloo Station will be significant. Planned City of Sydney cycling upgrades including the Wellington Street cycleway will greatly improve the safety and efficiency of cycling trips to and from the Metro Quarter. The impact of cycling trips generated by the proposed Metro Quarter development is considered to be negligible considering the large number of trips expected to be generated by users of the metro station itself.

Access between the Metro Quarter and the regional cycle network will be provided via Cope Street which will connect directly with the proposed Wellington Street cycleway. The Wellington Street cycleway will provide access to George Street which forms a major north-south cycling corridor providing connections to Sydney CBD to the north and Green Square/southern employment lands to the south. Spatial allocation has been provided so as not to preclude the construction of the cycleway in the future.

Botany Road and Wellington Street have been identified in City of Sydney's *Liveable Green Network* as roads which are proposed to form part of an integrated pedestrian and cycling network throughout the City of Sydney. The Metro Quarter would help facilitate the aims of the Liveable Green network by providing direct access to the network and increase the attractiveness of active transport modes through improved urban amenity.

6.6 Parking and demand management

6.6.1 Off-street parking

Car

The Metro Quarter development recognises the link between parking and travel behaviour, and that it is a key element of the integrated strategy for the precinct. The high levels of accessibility and non-car options available to residents will mean that the risks normally associated with low parking provision are minimised.

Category A parking rates from SLEP 2012 are proposed as the residential parking rate in the draft WMQ DCP. Category D rates are proposed to be applied to non-residential uses. Maximum parking provision allowed under Category A and D rates would be 427 total spaces, based on the currently assumed dwelling and non-residential mix. The final dwelling mix will be reviewed as part of the detailed SSD Application.

Table 6.4 outlines a breakdown of maximum off-street parking spaces based on the indicative concept proposal presented in section 5.2. The calculation of non-residential spaces is based on City of Sydney Category D formula: M = (G x A) / (50 x T)

Table 6.4: Indicative maximum off-street parking provision

Dwelling size	Max spaces per dwelling	Number of dwellings	Maximum spaces
Studio	0.1	22	2
1 bed	0.3	294	88
2 bed	0.7	314	220
3+ bed	1.0	70	70
Total residential			**380**
Retail GFA (G)	**Area of site (A)**	**Total GFA of all buildings (T)**	**Maximum spaces (M)**
3,905 m^2	12,800 m^2	68,750 m^2	15
Commercial GFA (G)	**Area of site (A)**	**Total GFA of all buildings (T)**	**Maximum spaces (M)**
8,645 m^2	12,800 m^2	68,750 m^2	32
Total			**427**

It is noted that the above are maximum parking spaces. Whilst Category A and Category D technically allow zero parking to be provided, any 'adaptable' dwellings in the Metro Quarter will be required to be allocated an adaptable car space[5]. The minimum parking provision for the Metro Quarter will therefore be linked to the number of adaptable dwellings provided.

Figure 6.14 shows the indicative basement car park layout for the Metro Quarter.

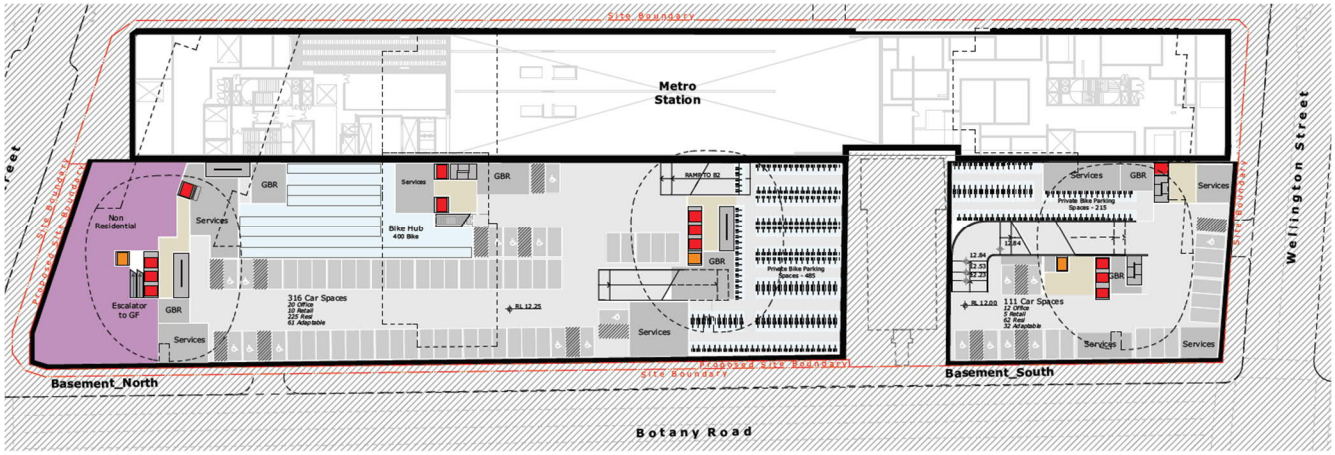


Figure 6.14: Indicative basement car park layout

Car share

A minimum rate of 1 car share space per 50 dwellings has been applied and is based on the City of Sydney's DCP 2012 which requires a minimum of 1 space per 50 off-street car spaces. 50 per cent of these spaces will be designed as accessible spaces as per Australian Standard AS2890.6. A minimum of 15 off-street car share spaces would ensure residents of the Metro Quarter have a suitable alternative travel mode available. The future provision of additional off-street or on-street car share spaces should also be considered in order to reduce the reliance on car ownership and contribute to sustainable modes of travel.

There is also the potential that on-street spaces managed by the City of Sydney would include car-share provision, encouraging more frequent use of the service by residents of the Metro Quarter and the general public. Access arrangements for off-street car share spaces will be determined at later development stages in accordance with City of Sydney requirements. As a general principle all car share spaces will need to be available to general public access regardless of location.

[5] An adaptable car space is parking space provided for an adaptable dwelling which can be modified easily in the future to become an accessible parking space

Service vehicle parking

The number of parking spaces for service vehicles has been based on the City of Sydney DCP requirement rate of 1 space for the first 50 dwellings, plus 0.5 spaces for every 50 dwellings or part thereafter. Given the 700 Metro Quarter dwellings, this would result in the provision of 8 service vehicle parking spaces.

Motorcycle parking

The number of parking spaces for motorcycles has been based on the City of Sydney DCP requirement rate of 1 space for every 12 car spaces. A total of up to427 off-street car spaces are proposed for the Metro Quarter, resulting in the provision of up to 36 motorcycle parking spaces.

Bicycle parking

Off-street bicycle parking to support the Metro Quarter OSD would be provided in line with the rates specified under the Sydney DCP 2012. However, as the exact future mix of commercial and community land uses within the ground floor and podium are to be further developed as part of the detailed SSD Application, an estimation of the required bike parking is provided below in order to understand indicative requirements. The bike parking requirements will be refined further in the detailed SSD Application.

An indicative breakdown of the bicycle parking based on the requirements of Sydney DCP 2012 is provided in Table 6.5.

Table 6.5: Bicycle parking rates, Sydney DCP 2012

Land Use	Apartments / GFA	Rate	Required
Residential	700 apartments	1 space per dwelling (residents)	700 spaces
		1 space per 10 dwellings (visitors)	70 spaces
Shops, restaurants and cafes	3,905m2 GFA	1 space per 250m² GFA (employees)	16 spaces
		2 plus 1 per 100m² over 100m² GFA (customers)	41 spaces
Office premises or business premises	8,645m2 GFA	1 per 150m² GFA (employees)	58 spaces
		1 per 400m² GFA (customers)	22 spaces
		Total	**907 spaces**

The concept proposal is expected to generate bicycle parking requirements for approximately 907 spaces. Bicycle parking requirements for the Waterloo Station will be provided as part of the CSSI Approval within a bicycle storage room in the southern station box (accommodating 100 spaces), as well as 40 bike rails (accommodating 80 bikes) within the public domain along Raglan, Cope and Wellington Streets (180 spaces in total).

The concept proposal includes 700 basement spaces for residents, 400 spaces in the basement for a bike hub and an additional 40 spaces provided at street level along Raglan Street. This equates to a total of 1,140 bicycle parking spaces (excluding the 180 spaces provided as part of the CSSI Approval), which satisfy the total number required for the Metro Quarter OSD.

The bike hub would be accessible from the proposed public plaza via a ramp and would also include end of trip facilities, including showers and lockers, consistent with the requirements of Sydney DCP 2012.

Overall, the bicycle parking provision of the integrated station development provides a total 1,320 spaces. The proposed locations of Metro Quarter OSD and CSSI Approval bicycle parking provision is shown in Figure 6.15 below. The basement design, including locations and arrangements of bicycle parking, will be further refined as part of the detailed SSD Application.

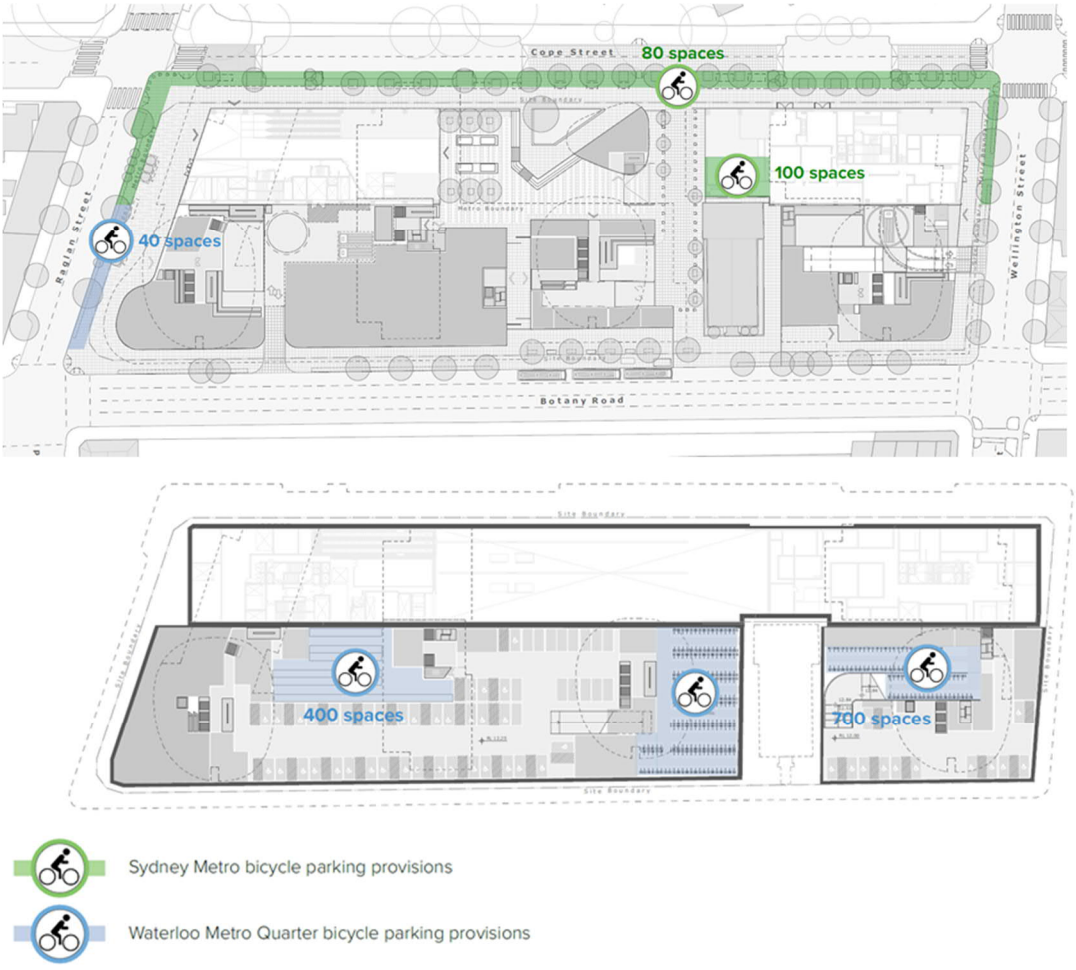


Figure 6.15: Bicycle parking locations within the concept proposal

6.6.2 On-street parking

The on-street parking approach is designed to avoid creating unrestricted long stay parking, minimising traffic and amenity impacts on Waterloo Precinct and the wider road network. Table 6.6 outlines the approach to on-street parking for the Metro Quarter.

City of Sydney's *Neighbourhood Parking Policy* manages on-street parking supply and demand using a range of parking controls and a parking permit scheme, applying throughout City of Sydney Local Government Area. Waterloo Precinct currently falls within the Redfern (Area 41) permit zone. The recommended controls and permit scheme conditions relevant to an urban renewal area outlined in this policy have been used to develop the on-street parking approach for Waterloo Precinct.

The on-street parking approach proposes controls and permit scheme conditions for areas within 400 metres of Waterloo Station. This is to acknowledge the high pedestrian activity that will take place in the vicinity of the station and to limit unnecessary vehicle movements around the station precinct.

Within 400 metres of Waterloo Station, short stay parking on selected local streets may be permitted. Permit holders would be prohibited from using these spaces for longer stays in this area. Exceptions may be granted to care workers in accordance with City of Sydney policies.

New developments are proposed to be ineligible for parking permits, including residents and businesses in the Metro Quarter, in line with the City's *Neighbourhood Parking Policy.* The proximity of the metro station and urban context is expected to reduce the need for private vehicle use significantly, limiting parking needs.

Table 6.6: Proposed on-street parking approach, Waterloo Precinct

Area	Land use characteristics	Parking controls	Permit scheme controls
Within 400m of Waterloo Station	• Mainly mixed-use with retail and related non-retail • High density residential • metro station	• 'Point to point' and taxi drop-off / pick-up at Waterloo Station • Restricted parking accommodating short stay users only on designated streets	• No permits for new developments • No permit holder exemptions (with exception of approved carers)

6.6.3 Travel plan

Travel demand within the Metro Quarter will be managed to reduce car dependency. This can be implemented through workplace travel plans and green travel plans which typically involve a set of practical initiatives that are put in place by employers or building managers before occupying a new or existing development that encourages staff and residents to choose alternatives to driving that are healthier and more sustainable. For travel plans to be successful in reducing vehicular travel demand, they should be developed in a tailored manner that respects the specific needs to each particular location / organisation.

Elements of such travel plans can include information programs for sustainable transport, active transport initiatives, flexible work hours, proactive cooperation with transport agencies to tailor public transport facilities to the site and employer initiated parking policies that support public transport use. Future developers of the Metro Quarter will be charged with supporting the development, delivery and monitoring of travel plans within the development site; in accordance with City of Sydney guidelines. Expected outcomes of the plans (e.g. mode share targets) should be monitored on an ongoing basis.

6.7 Road network

6.7.1 Aimsun traffic model

An Aimsun traffic model for the area surrounding Waterloo was built to test future land use and road network options. The base model has been calibrated and validated to weekday peak periods using intersection counts, travel time surveys, and origin-destination surveys. The purpose of the model is to assess cumulative network impacts within the highest demand weekday period. This approach and the study area extents were agreed with Transport for NSW, City of Sydney and RMS via email on 29 May 2017.

A range of traffic and transport data was collected to calibrate and validate transport models. Data collected included:

- Intersection counts of light vehicles, heavy vehicles, buses, pedestrians, and cyclists covering every signalised intersection in the surrounding area. Counts cover an average weekday between the hours of 6-10am and 3-7pm
- Travel time surveys on the key routes through the study area including Botany Road, McEvoy Street, and Elizabeth Street. Counts cover an average weekday between the hours of 6-10am and 3-7pm
- Origin-Destination surveys matching key entry / exit points within the surrounding area including Botany Road, O'Riordan Street, Bourke Street, Elizabeth Street, McEvoy Street and Henderson Road. Counts cover an average weekday between the hours of 6-10am and 3-7pm
- Traffic generation surveys of comparable residential / mixed used developments in Waterloo and Redfern including counts of pedestrians and cyclists. Counts cover an average weekday between the hours of 6-10am and 3-7pm. Intersection data was also collected at the same time to ensure volumes were comparable to previously collected days.

The base model was reviewed by RMS on 16 May 2018 and revised based on their feedback. The agreed final model was issued on 24 May 2018.

The model covers a region broadly defined by the following roads (refer Figure 6.16).

- Phillip Street / Henderson Road to the north
- Wyndham Street to the west
- Bourke Street / Bourke Road to the south
- Elizabeth Street to the east

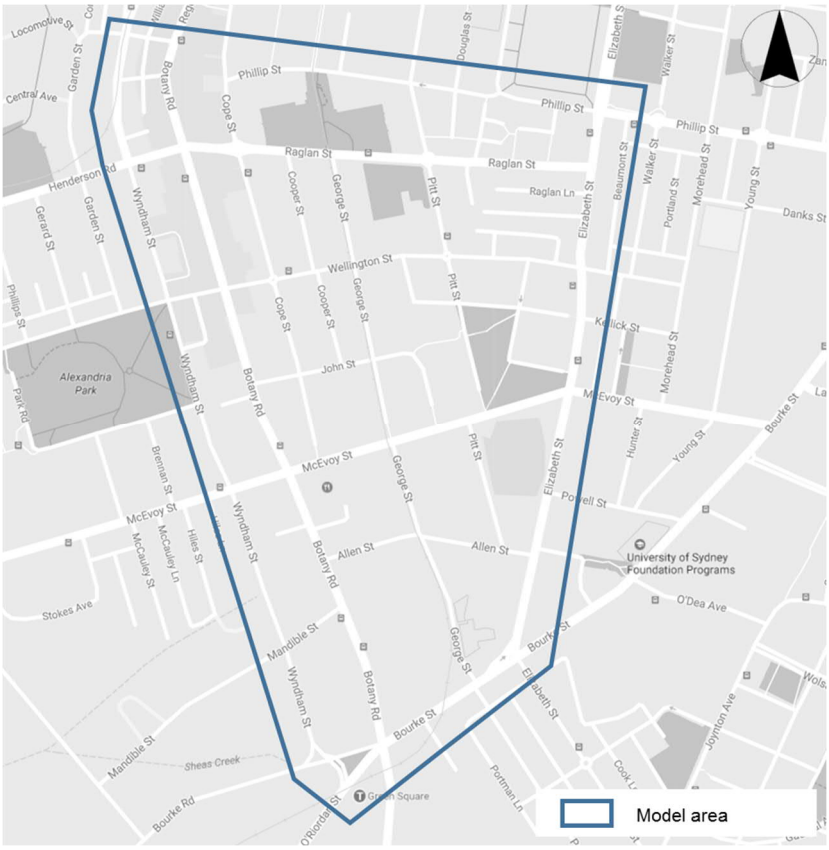


Figure 6.16: Aimsun model extents

6.7.2 Road network performance

Analysis of the base Aimsun model developed for the Waterloo Precinct indicates that the road network currently experiences congestion during both morning and evening weekday peak periods with vehicles travelling at low speeds compared to the speed limit. This is shown in Figure 6.17 and Figure 6.18 which shows the speed ratio (average travel time speed versus sign-posted speed limit) along each section of road during both peak periods. Constrained intersections where this is particularly evident include:

- Botany Road / Henderson Street and Wyndham Street / Henderson Road
- Botany Road / McEvoy Street and Wyndham Street / McEvoy Street
- Botany Road / Bourke Street and O'Riordan Street / Wyndham Street / Bourke Road
- Elizabeth Street / Bourke Street

These results support the approach that future car mode share for the Metro Quarter should be minimised as much as possible. The vast majority of new trips from the Metro Quarter will be undertaken by public transport and active transport.

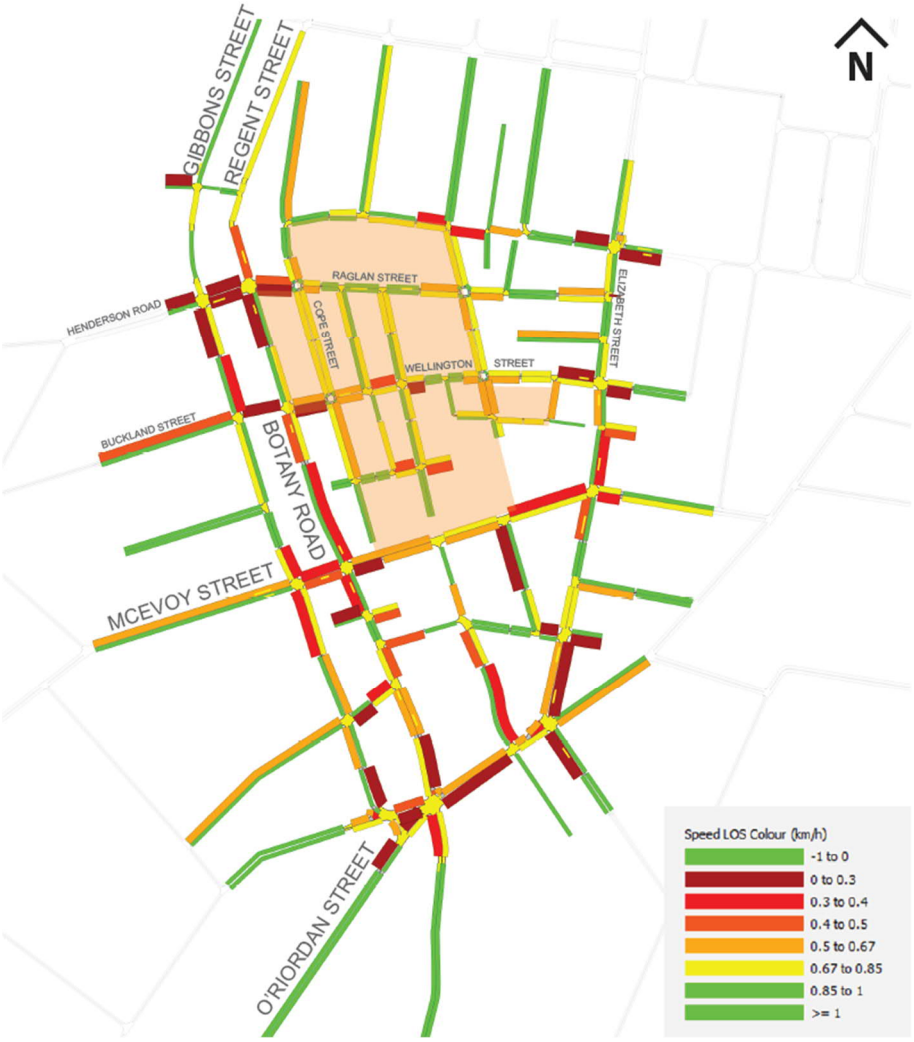


Figure 6.17: Morning peak 2017 base network Level of Service (Aimsun)

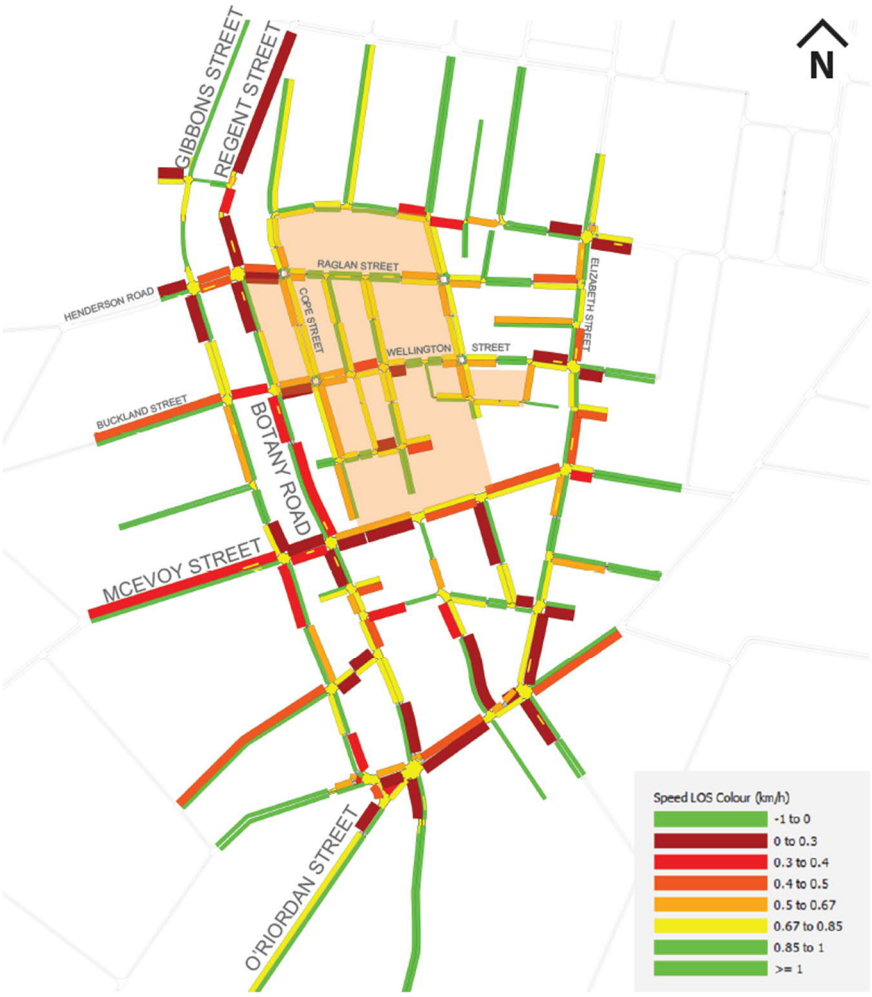


Figure 6.18: Evening peak 2017 base network Level of Service (Aimsun)

6.7.3 Trip generation

Trip generation rates are an influential component of the transport assessment process, directly related to and impacting on mode share. Trip generation rates for developments are influenced by the following key factors:

- The quality of public transport services and facilities
- Active transport links and street environment
- Levels of car parking provision and car ownership
- Demographics of the area
- Density and intensity of development
- Activities in the surrounding urban environment.

Trip generation rates are subsequently very site specific due to the interplay of these and other factors. As part of determining a meaningful base trip generation rate for Waterloo Precinct, a number of comparable high density developments have been selected and surveyed to determine the existing generation rates for all modes of travel. This approach has been used rather than adopting a blanket standard trip generation rate, such as those provided in RMS' *Guide to Traffic Generating Developments*, which is currently being updated by TfNSW and RMS.

To select appropriate developments to undertake trip generation surveys, a benchmarking process has been undertaken in order to select sites that were reflective of the future land use and transport scenario envisaged for Waterloo.

The location and site selection process involved two keys stages:

- Stage 1: Identifying locations comparable to Waterloo socio-economically and geographically, using the 2011 SEIFA index, Census data including household size, housing tenure, motor vehicle ownership and population data, and public transport timetable data
- Stage 2: Identify and select suitable survey sites in comparable locations, based on accessibility to public transport, development density, age of development, and the extent of parking supply restrictions.

The final shortlist of comparable locations for Stage 1 was identified previously in Table 4.3. Based on the Stage 2 criteria, two survey sites were identified; Site 1: 40-46 McEvoy Street, Waterloo and Site 2: 7-9 Gibbons Street, Redfern and are shown in Figure 6.19.

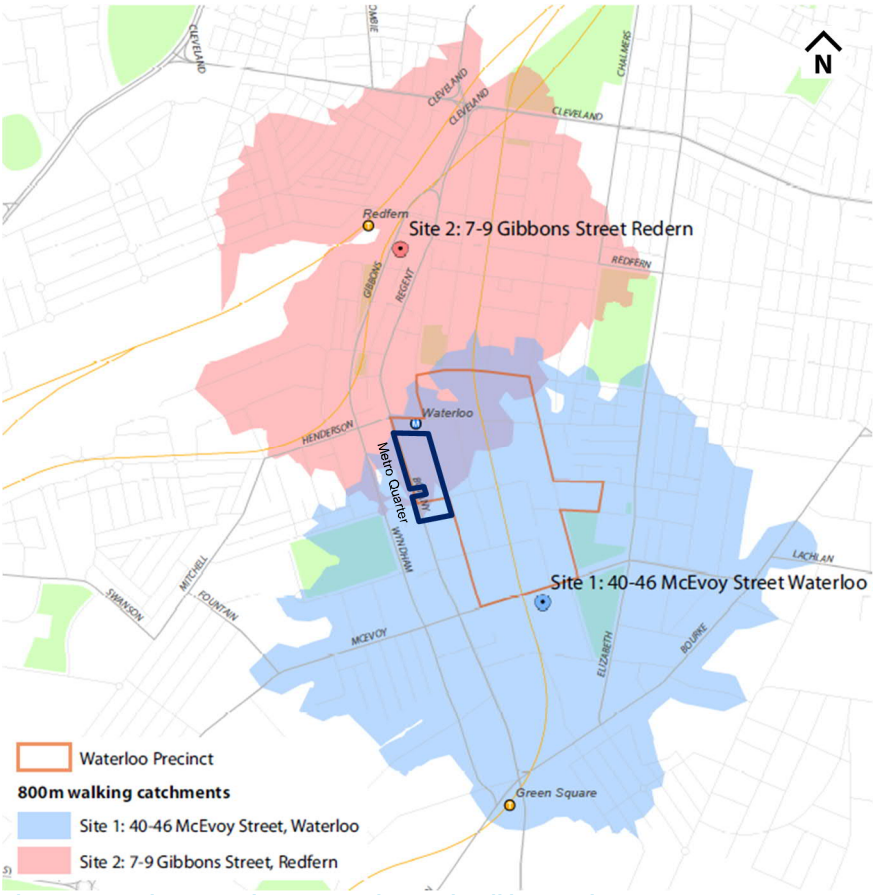


Figure 6.19: Trip generation survey sites and walking catchment

Site 1 in Waterloo had a consistent morning and evening peak hour trip generation rate of 0.14 vehicle trips per dwelling. This site is located within walking distance to Green Square Station and has significant levels of bus access to Sydney CBD.

Site 2 in Redfern had a trip generation rate of 0.09 and 0.08 vehicles trips per dwelling during the morning and evening peak hour, respectively. This site is located near Redfern Station, which provides access to a wide range of destinations of the heavy rail network.

Overall traffic generation rates from the two survey sites are lower than the high density average rate (0.19 and 0.15 vehicle trips per unit during the morning and evening peak hour, respectively) in RMS' *Guide to Traffic Generating Developments – Updated traffic surveys* (TDT 2013/04a), and comparable to specific RMS survey sites in Strathfield, St Leonards, Pyrmont and Chatswood as shown in Figure 6.20.

A trip generation rate of 0.14 vehicle trips per dwelling (based on Site 1 in Waterloo and agreed to by RMS, TfNSW and City of Sydney) was used in the assessment. This traffic generation rate has been developed assuming Category A parking rates from the SLEP 2012 are in place, in order to model a worst case scenario.

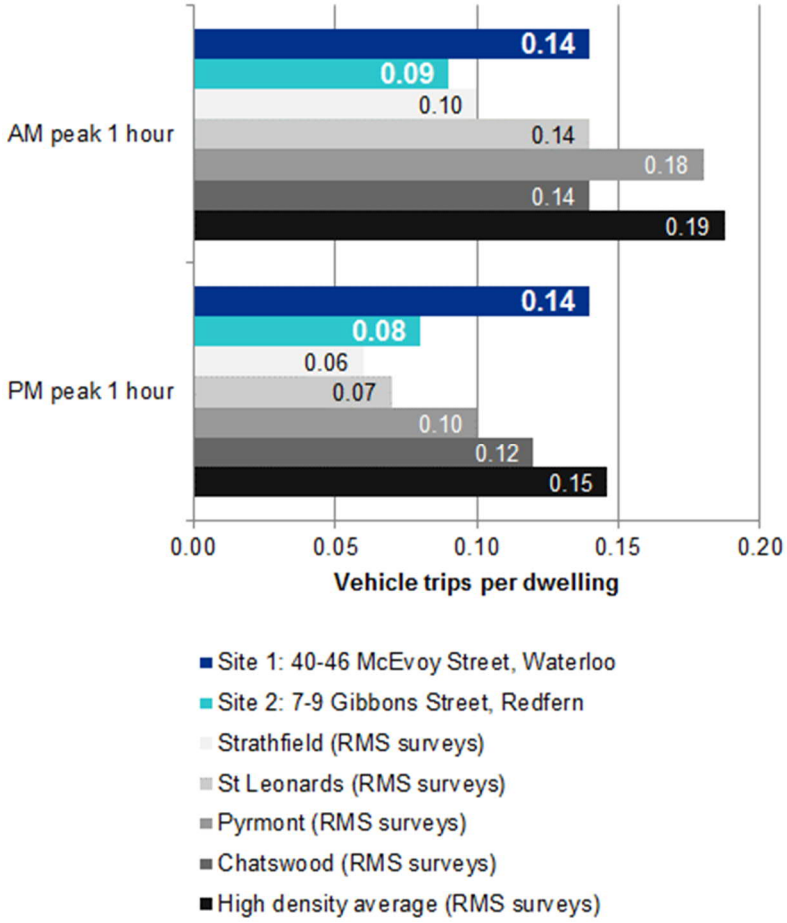


Figure 6.20: Trip generation rate per dwelling

Proposed non-residential uses in the Metro Quarter precinct comprise retail and commercial floorspace. The total traffic generation potential of the Metro Quarter is shown in Table 6.7. This traffic generation potential includes 'point to point' vehicle trips which may be generated by residents, workers and visitors of the Metro Quarter Development, and assumes the maximum number of parking spaces provided for commercial and retail land uses generates the same number of trips per hour during peak periods.

Table 6.7: Metro Quarter traffic generation summary

Land use	Gross Floor Area	Number of dwellings / non-residential parking spaces	Peak hour traffic generation per dwelling (trips)	Total peak hour traffic generation (trips)
Residential	56,500 m^2 GFA	700 dwellings	0.14	98
Retail	3,905 m^2 GFA	15 spaces	-	15
Commercial	8,645 m^2 GFA	32 spaces	-	32
All				**145**

This level of traffic generation and its impact on the surrounding road network is considered to be negligible. Traffic modelling to test the impact of such a small number of trips would generally not be required, however due to the expected large increase in pedestrian volumes as a result of the metro station, it was considered prudent to analyse the future performance of several key intersections in the precinct.

6.7.4 Intersection modelling

Three key intersections around the Metro Quarter have been assessed as outlined below and in Figure 6.21:

- Cope Street/Raglan Street
- Botany Road/Henderson Road/Raglan Street
- Henderson Road/Wyndham Street
- Buckland Street / Wyndham Street
- Botany Road/ Buckland Street /Wellington Street
- Wellington Street / Cope Street

These intersections were chosen on the basis that they are adjacent to the proposed development. As such these intersections will experience the largest increase in pedestrian volumes. These intersections also play a strategically important role in the road and bus networks so their future performance warrants investigation.

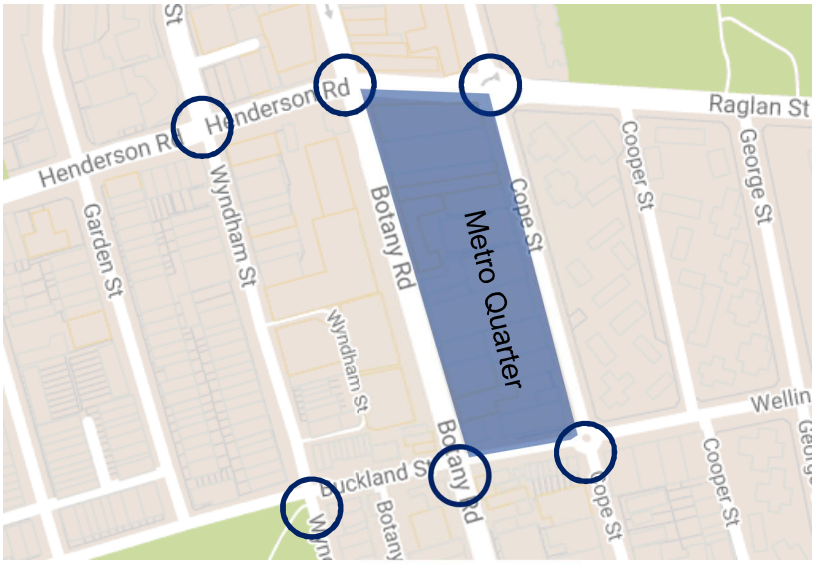


Figure 6.21: Intersection assessment locations

No changes to intersection layouts are proposed with the exception of the conversion of the Raglan Street/Cope Street roundabout and Wellington Street/Cope Street roundabout to give-way priority controlled intersections. A marked pedestrian crossing is proposed on Raglan Street outside of the Metro Station entrance. This configuration is consistent with Sydney Metro's proposed layout.

Modelling has been undertaken using SIDRA software for the following scenarios:

- 2017 Base
- 2036 Do Minimum – Includes Waterloo Station but no Metro Quarter development
- 2036 Metro Quarter – Includes Waterloo Station and Metro Quarter development

Traffic demand for the 2036 Do Minimum scenario was derived from applying a 0.25 per cent per year growth rate to existing traffic volumes based on analysis of past growth at permanent counter locations in the area. Pedestrian demands were provided by Sydney Metro.

Traffic and pedestrian demand for the 2036 Metro Quarter scenario were obtained by adding the Metro Quarter demand outlined in sections 6.5.1 and 6.7.1 to the Do Minimum demand.

Intersection performance has been measured by calculating the average delay of all movements and identifying a Level of Service based on RMS criteria in Table 6.8.

Table 6.8: Intersection level of service criteria (RMS Guide to Traffic Generating Developments)

Level of Service	Average delay (sec/vehicle)	Signals or roundabout	Give way or stop sign
A	<14	Good operation	Good operation
B	15-28	Good with acceptable delays & spare capacity	Acceptable delays & spare capacity
C	29-42	Satisfactory	Satisfactory
D	43-56	Operating near capacity	Near capacity & accident study required
E	57-70	At capacity; at signals, incidents will cause excessive delays Roundabouts require other control model	At capacity, requires other control mode
F	>70	Over capacity	Over capacity

Table 6.9 and Table 6.10 show the intersection performance of modelled intersections for the 2017 Base and 2036 scenarios during the morning and evening peak hour, respectively.

Table 6.9: Morning peak intersection performance

Intersection	2017 Base				2036 Do Minimum				2036 Metro Quarter			
	Vehicles		Pedestrians		Vehicles		Pedestrians		Vehicles		Pedestrians	
	Avg. delay (sec)	LOS	Avg. delay (sec)	LOS	Avg. delay (sec)	LOS	Avg. delay (sec)	LOS	Avg. delay (sec)	LOS	Avg. delay (sec)	LOS
Wyndham Street / Henderson Road	28	C	47	E	30	C	57	E	30	C	57	E
Botany Road / Henderson Road / Raglan Street	33	C	33	D	92	F	54	E	117	F	54	E
Cope Street / Raglan Street	5	A	N/A	N/A	23	C	N/A	N/A	34	C	N/A	N/A
Buckland Street / Wyndham Street	31	C	19	B	41	C	21	C	41	C	21	C
Botany Road/ Buckland Street /Wellington Street	10	A	20	B	12	A	31	D	13	A	31	D
Wellington Street / Cope Street	5	A	N/A	N/A	8	A	N/A	N/A	9	A	N/A	N/A

Table 6.10: Evening peak intersection performance

Intersection	2017 Base				2036 Do Minimum				2036 Metro Quarter			
	Vehicles		Pedestrians		Vehicles		Pedestrians		Vehicles		Pedestrians	
	Avg. delay (sec)	LOS	Avg. delay (sec)	LOS	Avg. delay (sec)	LOS	Avg. delay (sec)	LOS	Avg. delay (sec)	LOS	Avg. delay (sec)	LOS
Wyndham Street / Henderson Road	24	B	40	D	27	C	58	E	28	C	58	E
Botany Road / Henderson Road / Raglan Street	40	D	33	D	107	F	55	E	109	F	56	E
Cope Street / Raglan Street	6	A	N/A	N/A	25	C	N/A	N/A	38	C	N/A	N/A
Buckland Street / Wyndham Street	34	C	18	B	41	C	21	C	44	D	22	C
Botany Road/ Buckland Street /Wellington Street	10	A	22	C	15	B	27	C	15	B	27	C
Wellington Street / Cope Street	6	A	N/A	N/A	8	A	N/A	N/A	8	A	N/A	N/A

Modelled intersection performance indicates the following:

- All intersections are expected to experience an increase in delay in the 2036 Do Minimum scenarios compared to the 2017 Base scenarios. This is generally due to a combination of additional pedestrian demands and background traffic at these intersections.
- Intersection performance in 2036 Metro Quarter scenario is generally consistent with the 2036 Do Minimum scenario for the majority of intersections, indicating that the proposed development would have a minor impact on the performance of the surrounding road network.
- Botany Road / Henderson Road / Raglan Street intersection is forecast to operate at Level of Service F during the morning and evening peak in all 2036 scenarios, irrespective of the proposed development.
- Pedestrian delay time is also expected to increase in the 2036 scenarios compared to the 2017 base scenarios.

It is noted that these modelling results are sensitive to signal settings and cycle times. SIDRA has optimised the phasing to produce the least vehicle delay with a cycle time of 130 seconds for both signalised intersections. In reality shorter cycle times would result in improved pedestrian performance but increased delay for vehicles. The final operating configuration of these intersections will be at the discretion of RMS.

Additional options were investigated for the Botany Road / Henderson Road / Raglan Street intersection in order to improve safety and efficiency for all road users. These included:

- A new pedestrian connection between the metro station and the western side of Botany Road
- Scrambled pedestrian phasing at Botany Road

However, consultation with TfNSW in relation to the delivery of Waterloo Station has confirmed that the subject intersection is considered to be adequately sized to support the current configuration (phased crossing and widened pedestrian crossing on the southern side). Notwithstanding this, investigation into the viability of a new connection between the metro station and the western side of the Botany Road / Henderson Road / Raglan Street intersection is recommended.

Sensitivity testing – alternative land use mix scenario

In response to issues raised in submissions, sensitivity testing was undertaken to assess the impact of an alternative land use mix scenario, with a higher proportion of commercial floorspace and a lower number of residential dwellings. The alternative land use mix scenario and the associated number of trips generated is shown in Table 6.11.

Table 6.11: Metro Quarter traffic generation summary (alternative land use mix scenario)

Land use	Gross Floor Area	Number of dwellings / non-residential parking spaces	Peak hour traffic generation per dwelling (trips)	Total peak hour traffic generation (trips)
Residential	36,500 m^2 GFA	452 dwellings	0.14	64
Retail	3,905 m^2 GFA	15 spaces	-	15
Commercial	20,000 m^2 GFA	74 spaces	-	74
All				**153**

The alternative land use mix scenario would generate an additional 8 trips compared to the land use mix of the Indicative Concept Proposal detailed in Section 5.2.

Table 6.12 and Table 6.13 show the intersection performance of modelled intersections for the 2017 Base and 2036 scenarios with the alternative land use mix scenario during the morning and evening peak hour, respectively.

Table 6.12: Morning peak intersection performance (alternative land use mix scenario)

Intersection	2017 Base				2036 Do Minimum				2036 Metro Quarter (alternative land use mix)			
	Vehicles		Pedestrians		Vehicles		Pedestrians		Vehicles		Pedestrians	
	Avg. delay (sec)	LOS	Avg. delay (sec)	LOS	Avg. delay (sec)	LOS	Avg. delay (sec)	LOS	Avg. delay (sec)	LOS	Avg. delay (sec)	LOS
Wyndham Street / Henderson Road	28	C	47	E	30	C	57	E	30	C	57	E
Botany Road / Henderson Road / Raglan Street	33	C	33	D	92	F	54	E	118	F	54	E
Cope Street / Raglan Street	5	A	N/A	N/A	23	C	N/A	N/A	34	C	N/A	N/A
Buckland Street / Wyndham Street	31	C	19	B	41	C	21	C	41	C	21	C
Botany Road/ Buckland Street /Wellington Street	10	A	20	B	12	A	31	D	13	A	31	D
Wellington Street / Cope Street	5	A	N/A	N/A	8	A	N/A	N/A	9	A	N/A	N/A

Table 6.13: Evening peak intersection performance (alternative land use mix scenario)

Intersection	2017 Base				2036 Do Minimum				2036 Metro Quarter (alternative land use mix)			
	Vehicles		Pedestrians		Vehicles		Pedestrians		Vehicles		Pedestrians	
	Avg. delay (sec)	LOS	Avg. delay (sec)	LOS	Avg. delay (sec)	LOS	Avg. delay (sec)	LOS	Avg. delay (sec)	LOS	Avg. delay (sec)	LOS
Wyndham Street / Henderson Road	24	B	40	D	27	C	58	E	28	C	58	E
Botany Road / Henderson Road / Raglan Street	40	D	33	D	107	F	55	E	109	F	56	E
Cope Street / Raglan Street	6	A	N/A	N/A	25	C	N/A	N/A	38	C	N/A	N/A
Buckland Street / Wyndham Street	34	C	18	B	41	C	21	C	44	D	22	C
Botany Road/ Buckland Street /Wellington Street	10	A	22	C	15	B	27	C	15	B	27	C
Wellington Street / Cope Street	6	A	N/A	N/A	8	A	N/A	N/A	8	A	N/A	N/A

Modelled intersection performance indicates the following:

- Intersection performance in the 2036 Metro Quarter scenario with the alternative land use assumptions is generally consistent with the 2036 Do Minimum scenario for the majority of intersections, indicating that the proposed development would have a minor impact on the performance of the surrounding road network.
- Botany Road / Henderson Road / Raglan Street intersection is forecast to operate at Level of Service F during the morning and evening peak in all 2036 scenarios, irrespective of the proposed development.
- Pedestrian delay time is also expected to increase in the 2036 scenarios compared to the 2017 base scenarios.

6.7.5 Street hierarchy

As discussed in Section 4.5.3, TfNSW's movement and place framework allows streets to be classified according to their relative movement and/or place function. The framework has been applied to the road network surrounding the Metro Quarter and is presented in Figure 6.22.

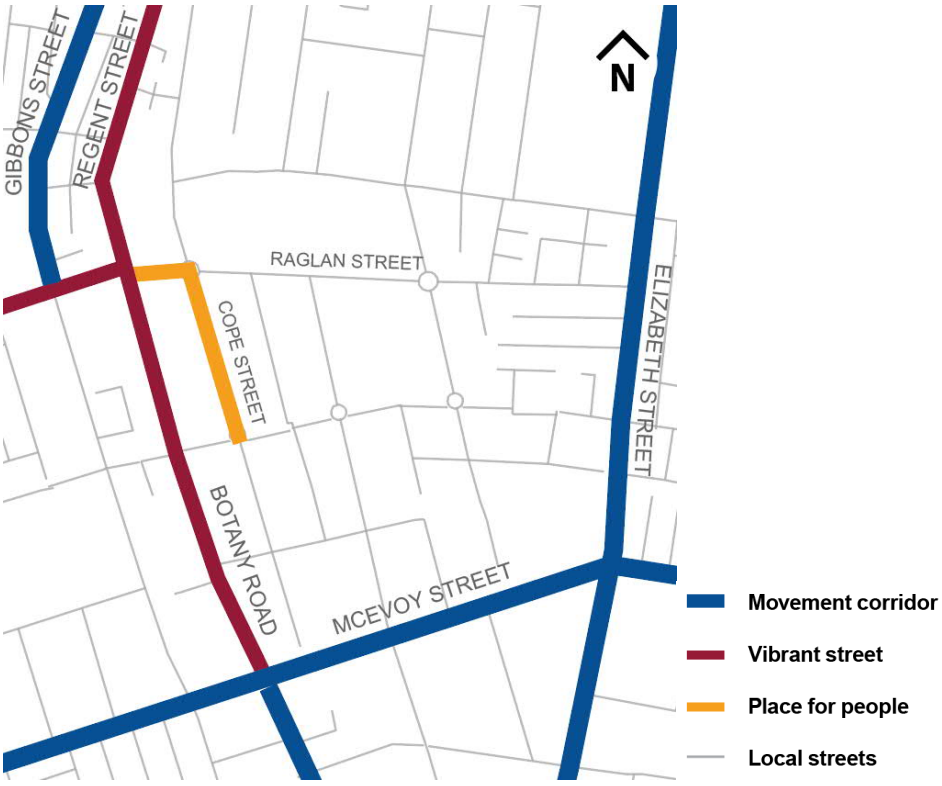


Figure 6.22: Metro Quarter movement and place

The future function of Cope Street as a busy pedestrian corridor represents a significant departure from its current role as a local street with limited foot traffic. As such, the design of the Metro Quarter would include adjustments to pedestrian facilities along Cope Street to cater for the large future demand, maintain safety and provide an excellent urban amenity outcome. This would involve the reconfiguration of Cope with a maximum 40km/h speed limit, wider footpaths and narrow traffic lanes. It is also recommended that the implementation of Cope Street as a 'slow street' with a speed limit below 40km/h be considered. In accordance with RMS' design and implementation of shared zones including provision for parking, a slow street should be considered where there is high pedestrian activity combined with the need to maintain sufficient vehicle access and throughput, and where there is a desire to activate ground floor retail and promote walking and cycling.

A 'slow-street' is preferred over a shared zone given potential issues regarding point to point areas, drainage design and the likely number of vehicles using Cope Street each day. The final design of the street would need to ensure that vehicles are encouraged to travel slowly through the area via the use of traffic calming measures. A narrow carriageway would allow pedestrians to efficiently cross the road where possible whilst slow vehicle speeds would encourage cyclists of all abilities to mix with traffic.

Converting Cope Street to a 'slow-street' would also complement City of Sydney's Liveable Green Network, particularly at its interface with Wellington Street where pedestrian and cyclist safety would improve.

6.8 Vehicle access

Proposed vehicle accesses on Botany Road, Cope Street and Wellington Street for the Metro Quarter are shown in Figure 6.23. These would be designed in accordance with AS 2890 and relevant RMS and City of Sydney guidelines. Accesses will be subject to further investigation during the detailed design process.

Service vehicle volumes are expected to be in the order of 10-15 per day, including both 8.8 metre medium rigid vehicles and 9.25 metre garbage trucks. It is anticipated that these movements will be restricted to outside of peak periods where possible. Furthermore, both service vehicle access locations are proposed as left-in/left-out to minimise impacts to the road network. Service vehicle impacts are therefore considered to be negligible assuming both are designed to ensure sufficient sight lines and widths for all expected vehicle types.

Access via Raglan Street has not been proposed due to the very large forecast pedestrian flows at this location and potential safety concerns.

Residential vehicle access points are proposed on Cope Street and Wellington Street. Any non-residential parking would be accessed via the same location. Assuming the parking space mix outlined in Figure 6.14, about 104 vehicles per hour would use the Cope Street access and about 41 vehicles per hour would use the Wellington Street access. These volumes are unlikely to cause operational network issues. Both accesses will need to be designed to ensure sufficient sight lines and widths for all expected vehicle types. Swept path analysis undertaken for these access points is provided at Appendix A.

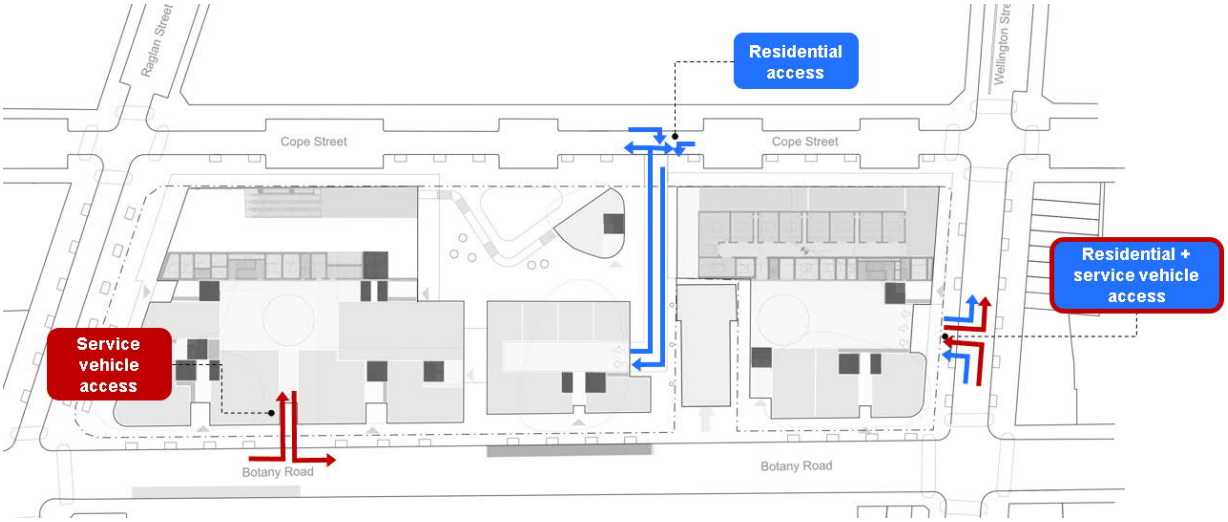


Figure 6.23: Proposed vehicle access

6.8.1 Proposed shared zone in 'new street'

The proposed street between Cope Street and the residential access may operate as a low speed laneway. This is due to the large number of pedestrians expected to use the link as well as the low volume of projected vehicle movements – about 104 trips in the peak hour.

There is also the potential for the proposed street to operate as a shared zone. Current guidance, based on *Safer Speeds Policy & Guidelines – Shared Zones* (Transport for NSW, 2012) indicates that a shared zone should carry no more than 100 vehicles per hour. Given that the estimated demand on the link is marginally above the threshold, the final function and management of the street will need to be confirmed at the detailed design stage in consultation with TfNSW and RMS

Implementing a shared zone will provide a high quality active transport link through the Metro Quarter which will increase permeability and help to disperse pedestrians and cyclist throughout the precinct. Therefore, a shared zone is the preferred option for this link.

6.8.2 Emergency vehicle access

The proposed layout provides road frontage to all areas of the Metro Quarter site. Access for emergency vehicles has therefore not been precluded. It is recommended that the detailed design of the site and vehicle access locations considers the needs of emergency service vehicles to ensure safe and easy access to all areas of the site.

6.9 Construction of the proposal

A Construction Environmental Traffic Management Plan (CETMP) would be prepared as part of the Development Application for the Metro Quarter. The CETMP would outline the guidelines, general requirements and specific procedures to be used for any works that may have an impact on traffic operation. The plan would be prepared in accordance with the City of Sydney's Appendix A: *Standard Requirements for Construction Traffic Management Plan.*

Items to be addressed would include but not be limited to:

- The safety of all road users
- Details of routes and roads to be used by construction vehicles
- Construction vehicle access arrangements
- Construction vehicle types
- Any temporary adjustments to existing traffic and transport infrastructure that may be required
- Details of any applications required to organise appropriate approvals for works zones and/or road closures, use of driveways, cranes, barricades or hoarding, and consent of construction hours
- Management of traffic including the use of traffic controllers to direct vehicles, pedestrians or cyclists

6.10 Infrastructure preservation and capital costing

No transport related corridor preservations additional to those already identified within relevant strategic plans and planning instruments have been proposed as part of this proposal. In addition, capital costing of transport items and assignment of funding responsibilities has not been undertaken and will be determined at a later date as the proposal progresses.

6.11 Draft Interchange Access Plan

An Interchange Access Plan is being developed for Waterloo Station by Sydney Metro, as required under Condition E92 of the CSSI Approval, in order to:

- Respond to the requirements of the Sydney Metro City & Southwest – Chatswood to Sydenham Critical State Significant Infrastructure conditions of approval.
- Inform the interchange design of transport and access facilities, including footpaths, cycle paths and bike parking and bus stops.
- Identify customer amenities, shelter, and road and traffic management required to ensure easy, accessible, safe and efficient customer transfer.
- Provide a list of actions for delivery partners and other stakeholders to enable the implementation of an easy customer transfer which supports the project objectives.

The Waterloo Interchange Access Plan will be finalised prior to the commencement of permanent above ground facilities at Waterloo Station. Further information on the methodology for planning and designing the interchange for Waterloo Station and its alignment with the Metro Quarter development is provided in the Waterloo Interchange Planning Technical Note at Appendix B.

The design and planning of the Waterloo Station intersection and the Metro Quarter precinct is integrated to help manage conflict and allow for efficient and safe movement of all modes of travel. The relevant details that help to demonstrate integrated planning and design outcomes are presented in Table 6.14.

Table 6.14 : Waterloo Station Interchange Access Plan review

Sydney Metro infrastructure	Integration with the surrounding network and community
Bicycle parking near the Metro Station entry on Raglan Street, consisting of a bicycle shed and racks	Bicycle parking is conveniently located within 30 metres of the entrance and within 50 metres of the gateline, improving the customer experience.
Bus stops on Botany Road and Wellington Street or Raglan Street	Bus stops on Botany Road and Wellington Street or Raglan Street would be accessible from widened footpaths surrounding the precinct and via the new street.
Taxi rank on the west side of Cope Street, adjacent to Metro Station	The taxi rank is located near the Metro Station entrance on Raglan Street and is easily accessible.
Relocation of the Botany Road southbound bus stop north of Raglan Street to south of Raglan Street	The Botany Road southbound interchange would include a widened footpath able to accommodate the expected pedestrian demand. The interchange is also easily accessible via the new street.
Point to point zone on the west side of Cope Street south of Raglan Street	The point to point zone is easily accessible as it is located near the Raglan Street entrance and the Community Centre.
Wellington Street cycleway (by others)	The proposed Wellington Street cycleway would interface with Cope Street, which is proposed to be traffic calmed and have a maximum speed limit of 40km/h. Therefore, cyclists have safe access routes via Cope Street or the new street when travelling to and from the metro station. The Wellington Street cycleway would also interface with the north-south cycle path on George Street, improving cycle connectivity. It is proposed that spatial and physical allowance is provided in the design of the streetscape and public domain on Wellington Street northern footpath to allow for the implementation of the proposed cycleway as part of the delivery of precinct development.
Widened pedestrian crossing on the south approach of the Botany Road / Henderson Road / Raglan Street intersection	A widened pedestrian crossing would accommodate the high volume of pedestrians anticipated due to Waterloo Station. This would also facilitate movements between the station and ATP, which is a major pedestrian desire line.
Slow points along Cope Street	Traffic calming along Cope Street would improve safety and promote active transport as an attractive mode of travel.

7. Implementation plan and strategy

7.1 Public transport

The assessment of public transport impacts due to the Metro Quarter proposal has demonstrated the following:

- Additional customer demand at Waterloo Station generated due to the Metro Quarter is anticipated to be relatively low (less than 200 peak hour trips) and can be accommodated given that the metro network will operate with a capacity of 46,000 people per hour per direction (almost double the capacity of existing heavy rail lines).
- Bus services generally operate with some spare capacity at existing stops surrounding the Metro Quarter. The Metro Quarter is expected to generate approximately 50 bus trips in the peak hour.
- Localised changes to bus routes 309, 310 and 355 such as increasing frequency / span of hours to match metro operation would improve the bus network and potentially benefit future residents within the Metro Quarter.
- Whilst future residents of the Metro Quarter will have a range of transport needs, key customer requirements will be met as follows:
    - Mass transit connections to key employment centres and the existing heavy rail network will help to serve the needs of the working age residents undertaking trips for employment.
    - Local bus services will help to serve the needs of older residents, social housing tenants and school age children.

7.2 Active transport

The assessment of active transport impacts due to the Metro Quarter proposal has demonstrated the following:

- The majority of pedestrian and cyclist demand generated near the Metro Quarter would be generated due to Waterloo Station rather than the proposed development.
- The footpath and waiting areas proposed at the Botany Road southbound bus interchange are sufficiently wide enough to accommodate waiting or queuing bus customers and pedestrians passing through the interchange.
- Improved footpaths on Henderson Road between ATP and Waterloo Station should be investigated given that this route would form a major pedestrian desire line.
- Widened pedestrian crossings spanning Botany Road at the Botany Road/Henderson Road/Raglan Street intersection and widened footpaths on Raglan Street on approach to the intersection would be required to accommodate the high volume of pedestrians anticipated.

- A midblock pedestrian crossing on Cope Street between Raglan Street and Wellington Street would be required, serving pedestrian trips between the Waterloo Estate and the Metro Quarter.
- The width of footpaths proposed on Cope Street and Raglan Street are sufficient to cater to the expected pedestrian demand.
- Cycling infrastructure to support Waterloo Station would significantly improve access to the Metro Quarter.
- Planned cycling upgrades such as the Wellington Street cycleway would improve the safety and efficiency of cycling trips throughout the Metro Quarter precinct.

7.3 Parking and demand management

The assessment of parking and demand impacts due to the Metro Quarter proposal has demonstrated the following:

- High levels of accessibility and non-car options available to future residents of the Metro Quarter minimises the need for parking provision.
- Provision of point to point and taxi areas, restricted short-stay parking on designated streets, and no exemptions for residents except for approved carers would minimise traffic and amenity impacts around the station precinct as unnecessary vehicle movements would be limited.
- Category A parking rates from SLEP 2012 are proposed under the draft WMQ DCP as the residential control given that these rates are the most restrictive parking control in the City of Sydney. Category D are proposed to be applied to non-residential uses. Maximum parking provision allowed under Category A and D rates would be 427 total spaces, based on the currently assumed dwelling and retail mix.
- A proposed supply of 8 off-street service vehicle parking spaces and 36 off-street motorcycle parking spaces, is in line with City of Sydney's DCP requirements.
- Provision of 700 residential bicycle parking spaces and 440 public bicycle parking spaces (comprising a bike hub and public domain), with end of trip facilities such as showers and lockers provided as part of the bike hub as per the requirements of the City of Sydney's DCP. These numbers exclude the 180 bicycle spaces provided under the CSSI Approval.
- Travel plans which may include information programs for sustainable transport, active transport initiatives, flexible working hours and proactive cooperation between agencies should be delivered and monitored by future developers of the Metro Quarter to encourage staff and residents to choose alternatives to driving.

7.4 Road

The assessment of road network impacts due to the Metro Quarter proposal has demonstrated the following:

- Microsimulation modelling of the road network around Waterloo indicates that:
  - the road network is constrained and hence future car mode share for the Metro Quarter should be minimised.
  - the anticipated low traffic generated due to the Metro Quarter (between 145 and 153 trips during peak hour) would have a negligible impact to the wider road network.
- Intersection modelling of the road network surrounding the Metro Quarter indicates that
  - there would be an increase in average vehicle delay with Waterloo Station in 2036 due to the large increase in pedestrian demand, however additional impacts due to the Metro Quarter would be negligible.
  - Botany Road / Henderson Road / Raglan Street intersection is forecast to operate at Level of Service F with and without the Metro Quarter development by 2036 and therefore it is recommended to investigate new pedestrian connections between the Metro Station and the western side of the intersection to improve efficiency and safety.
  - converting the roundabouts at Raglan Street/Cope Street and Wellington Street/Cope Street to give-way intersections with pedestrian crossings would improve pedestrian safety.
  - Metro Quarter development has a negligible impact on intersection performance.
- Cope Street to have a maximum of 40km/h speed limit, wider footpaths and narrow traffic lanes would cater to the large future demand, maintain safety and provide an excellent urban amenity outcome.

7.5 Vehicle access

The assessment of access impacts due to the Metro Quarter proposal has demonstrated the following:

- Left-in/left-out service vehicle access on Botany Road and Wellington Street and the low number of service vehicles anticipated per day (10-15 vehicles) would result in negligible impacts to the road network provided that sufficient sight lines and widths are implemented for all expected vehicle types.
- The 104 vehicles and 41 vehicles per hour anticipated to use the access points at Cope Street and Wellington Street, respectively, would minimally impact the road network and are unlikely to cause operational network issues given the low volume of vehicles.

- Operating a shared zone on the proposed new street between Cope Street and the vehicle access points (provided that fewer than 100 vehicles per hour use the new street) would provide a high quality active transport link through the Metro Quarter, increasing permeability and help to disperse pedestrians and cyclists through the precinct.

7.6 Summary strategy

A summary of the traffic and transport infrastructure to be provided for the Metro Quarter is shown in Figure 7.1.

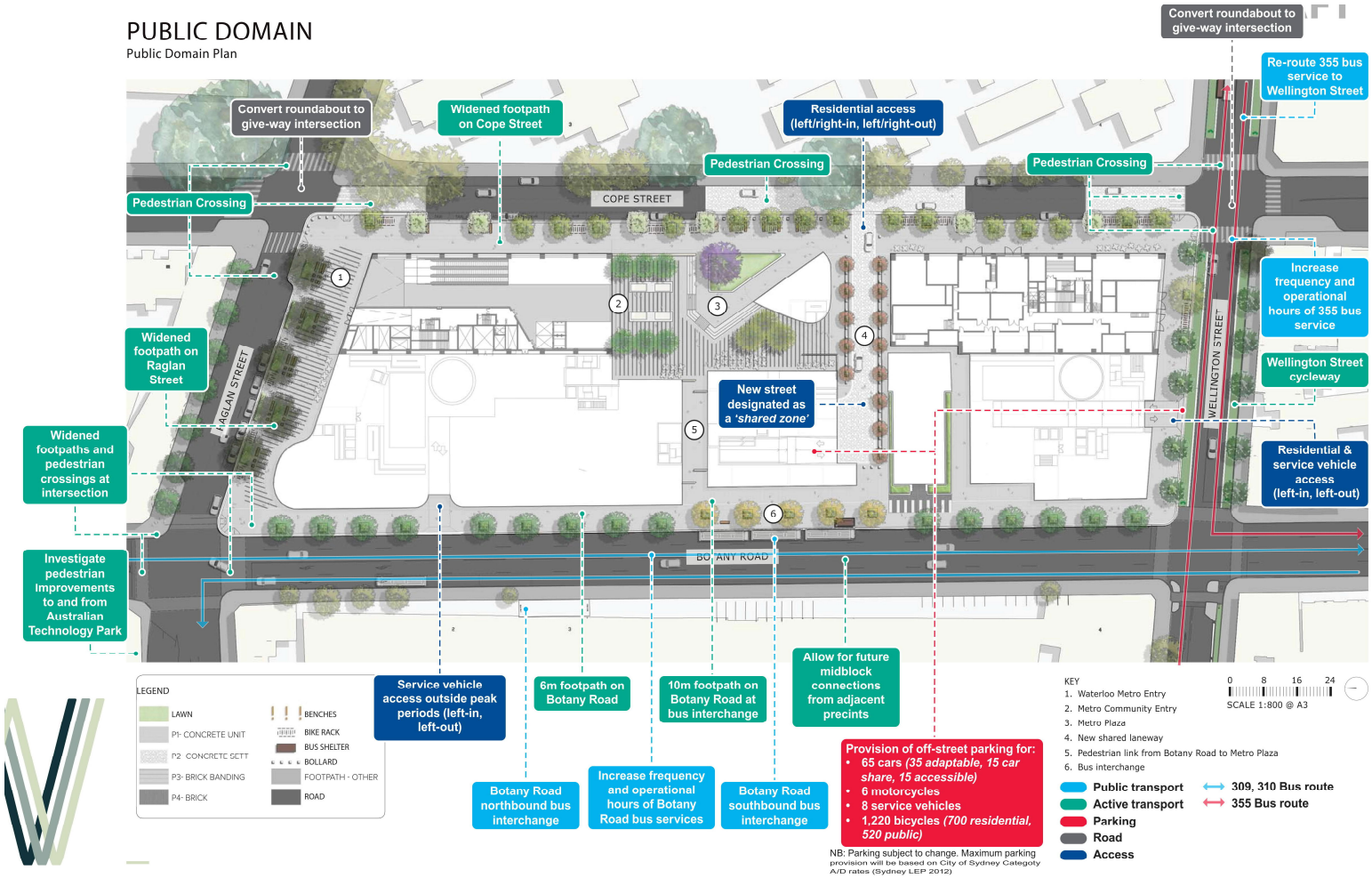


Figure 7.1: Summary of proposed measures to support the Metro Quarter

Provision of the proposed traffic and transport infrastructure shown above may be staged and implemented by the agencies outlined in Table 7.1.

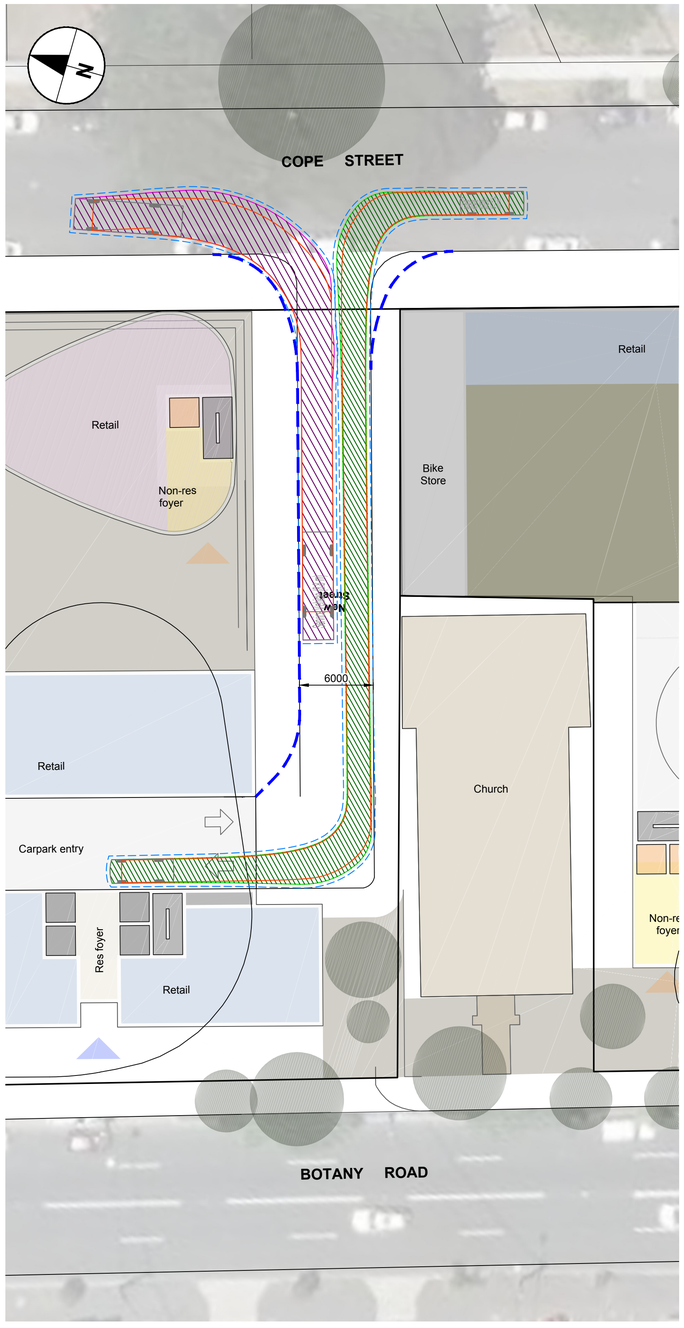
Table 7.1: Implementation plan

Reference	Item	Agency	Timing
PT1	Increase frequency and operational hours of Botany Road bus services	Transport for NSW	By Metro Station opening (2024)
PT2	Increase frequency and operational hours of Wellington Street or Raglan Street bus services	Transport for NSW	By Metro Station opening (2024)
PT3	Re-route bus route 355 to Wellington Street or Raglan Street	Transport for NSW	By Metro Station opening (2024)
AT1	Construct Wellington Street cycleway	City of Sydney	By Metro Station opening (2024)
AT2	Widen footpaths around the Metro Quarter	Sydney Metro / UrbanGrowth Development Corporation	As development occurs
AT3	Widen pedestrian crossings on Botany Road at the Botany Road / Raglan Street / Henderson Road intersection	Sydney Metro / UrbanGrowth Development Corporation	By Metro Station opening (2024)
AT4	Widen footpaths on Raglan Street on approach to the Botany Road / Henderson Road / Raglan Street intersection	Sydney Metro / UrbanGrowth Development Corporation	By Metro Station opening (2024)
AT5	Investigate pedestrian improvements to and from Australian Technology Park	TBC	By Metro Station opening (2024)
AT6	Provide a midblock pedestrian crossing on Cope Street	Sydney Metro / UrbanGrowth Development Corporation	By Metro Station opening (2024)
AT7	Allow for future mid-block connections from adjacent precincts	Sydney Metro / UrbanGrowth Development Corporation	As development occurs
P1	Provide off-street parking spaces for cars, service vehicles and motorcycles	Sydney Metro / UrbanGrowth Development Corporation	As development occurs
P2	Provide bicycle parking and end of trip facilities	Sydney Metro / UrbanGrowth Development Corporation	As development occurs. Commuter

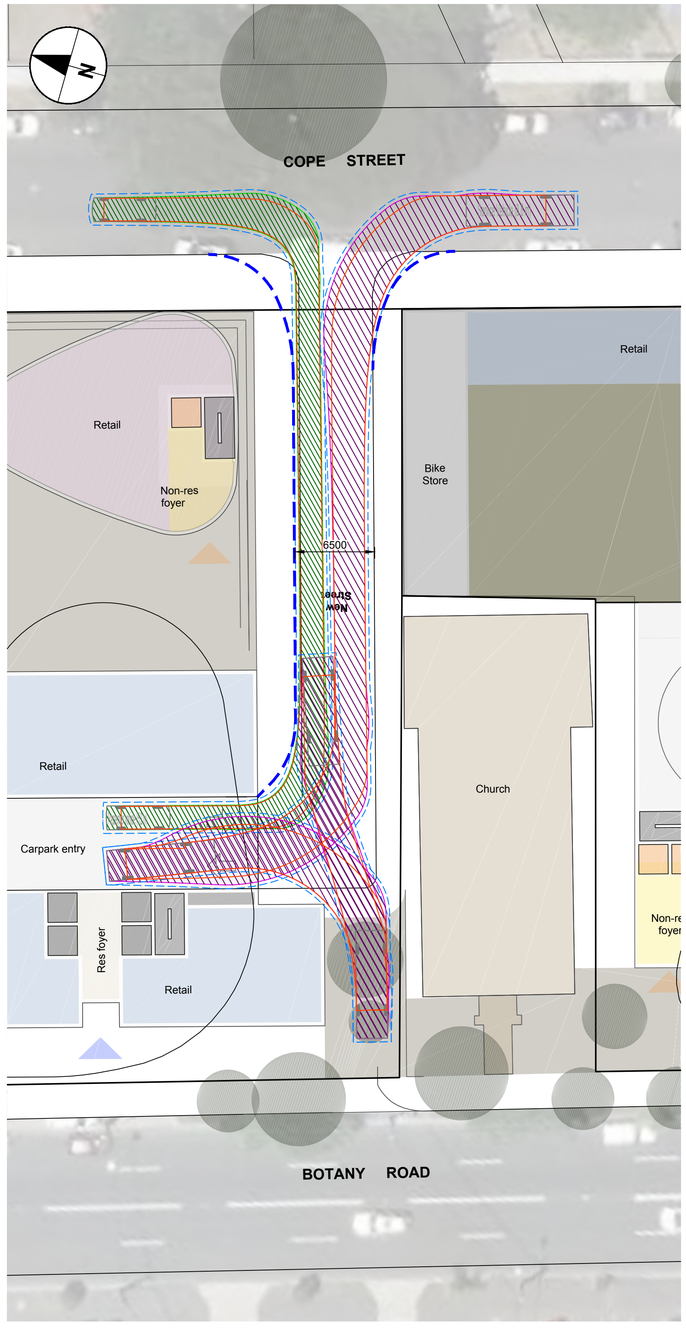
Reference	Item	Agency	Timing
			facilities by metro opening (2024)
R1	Convert Raglan Street / Cope Street roundabout to a give-way intersection with pedestrian crossings	Sydney Metro / UrbanGrowth Development Corporation	By Metro Station opening (2024)
R2	Convert Wellington Street / Cope Street roundabout to a give-way intersection with pedestrian crossings	Sydney Metro / UrbanGrowth Development Corporation	By Metro Station opening (2024)
R3	Reduce speed limit on Cope Street – either to 40km/h or implement a 'slow street' (20km/h)	City of Sydney / RMS	By Metro Station opening (2024)
A1	Provide Metro Quarter service vehicle access on Botany Road and Wellington Street	Sydney Metro / UrbanGrowth Development Corporation	By Metro Station opening (2024)
A2	Provide Metro Quarter residential vehicle access on Wellington Street and Cope Street	Sydney Metro / UrbanGrowth Development Corporation	As development occurs
A3	Operate a shared zone on the new street connecting to Cope	City of Sydney / RMS	By Metro Station opening (2024)

Appendix A. Swept Path Analysis

ISO A1 594mm x 841mm

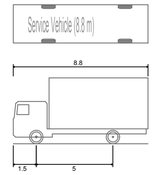


VEHICLE TRACKING - OPTION 1
DRIVEWAY WIDTH 6m
SCALE 1:250



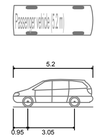
VEHICLE TRACKING - OPTION 2
DRIVEWAY WIDTH 6.5m
SCALE 1:250

LEGEND



Service Vehicle (8.8 m)

Overall Length	8.800m
Overall Width	2.500m
Overall Body Height	4.300m
Min Body Ground Clearance	0.427m
Track Width	2.500m
Lock-to-lock time	4.00s
Curb to Curb Turning Radius	12.500m



Passenger vehicle (5.2 m)

Overall Length	5.200m
Overall Width	1.940m
Overall Body Height	1.804m
Min Body Ground Clearance	0.295m
Track Width	1.840m
Lock-to-lock time	4.00s
Curb to Curb Turning Radius	6.300m

Last saved by: WONGJ3(2017-07-19) Last Plotted: 2017-07-19
Filename: P:\605X\60521100\5. CAD\25-SKETCH\ES\60521100-SKE-CI-0010.DWG

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1:250

SAFETY IN DESIGN INFORMATION
ARE THERE ANY ADDITIONAL HAZARDS / RISKS NOT NORMALLY ASSOCIATED WITH THE TYPES OF WORK DETAILED ON THIS DRAWING?
☒ NO
☐ YES

REGISTRATION

PROJECT MANAGEMENT INITIALS

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DESIGNER	CHECKED	APPROVED

PROJECT DATA

DATUM		SURVEY	

ISSUE/REVISION

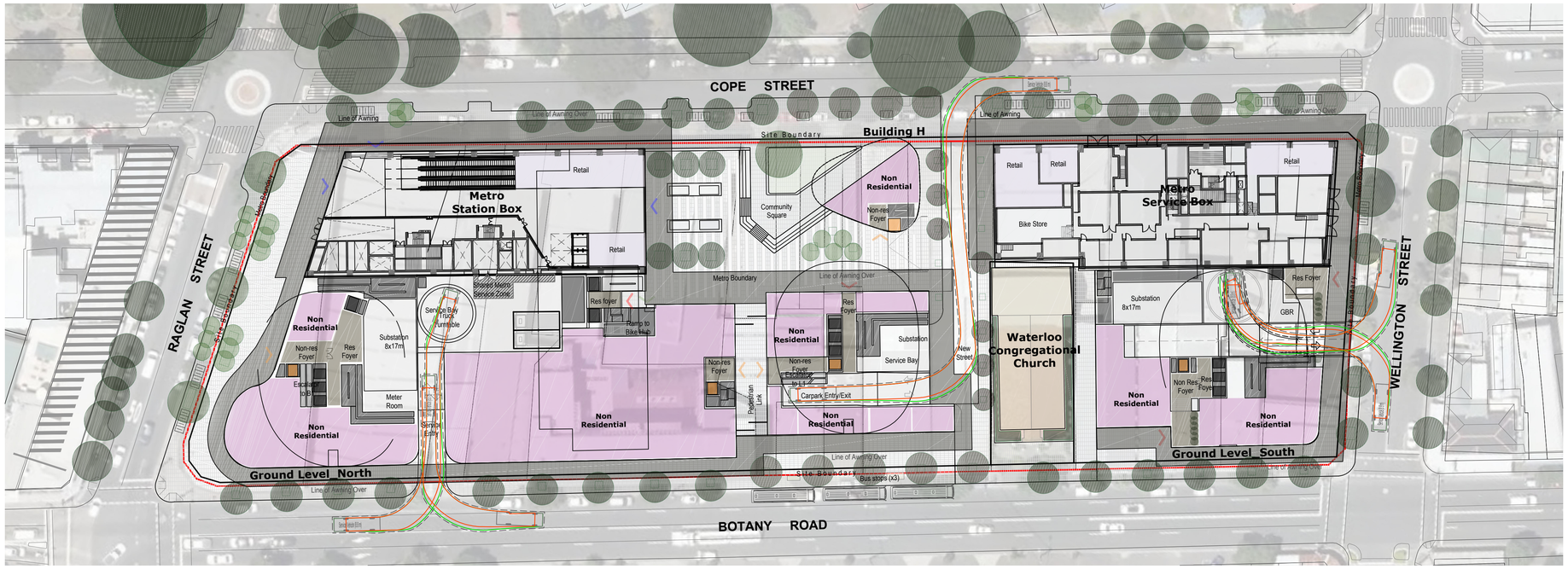
1		INFORMATION
I/R	DATE	DESCRIPTION

PROJECT NUMBER
60521100

SHEET TITLE
WATERLOO METRO QUARTER
VEHICLE TRACKING

SHEET NUMBER
60521100-SKE-CI-0010

ISO A1 594mm x 841mm



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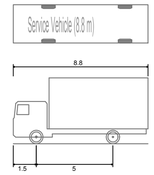

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60548168

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WATERLOO METRO QUARTER
VEHICLE TRACKING TURNPATHS
OVERALL VIEW

SHEET NUMBER

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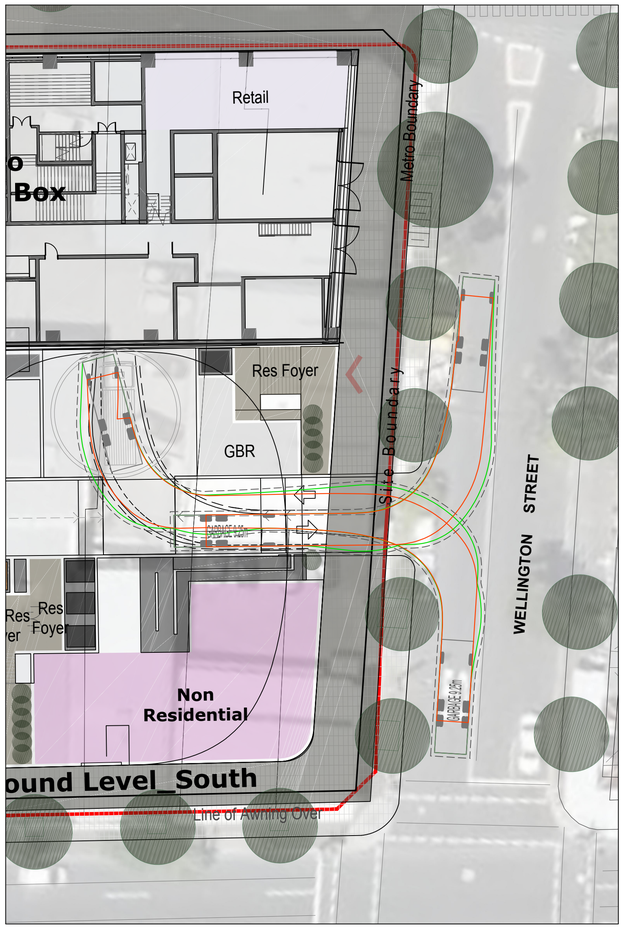

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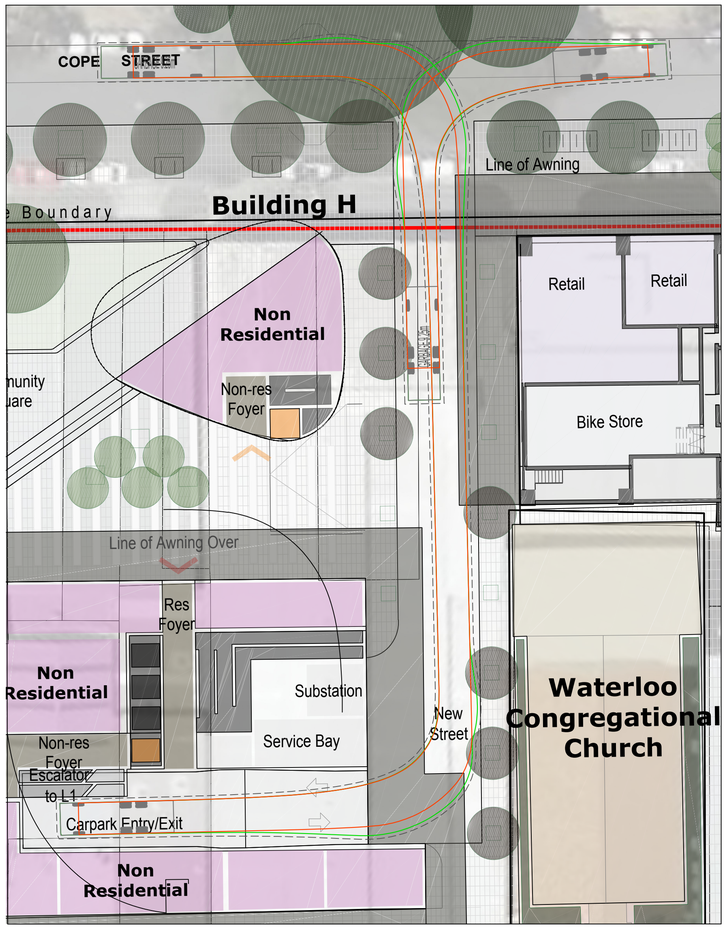

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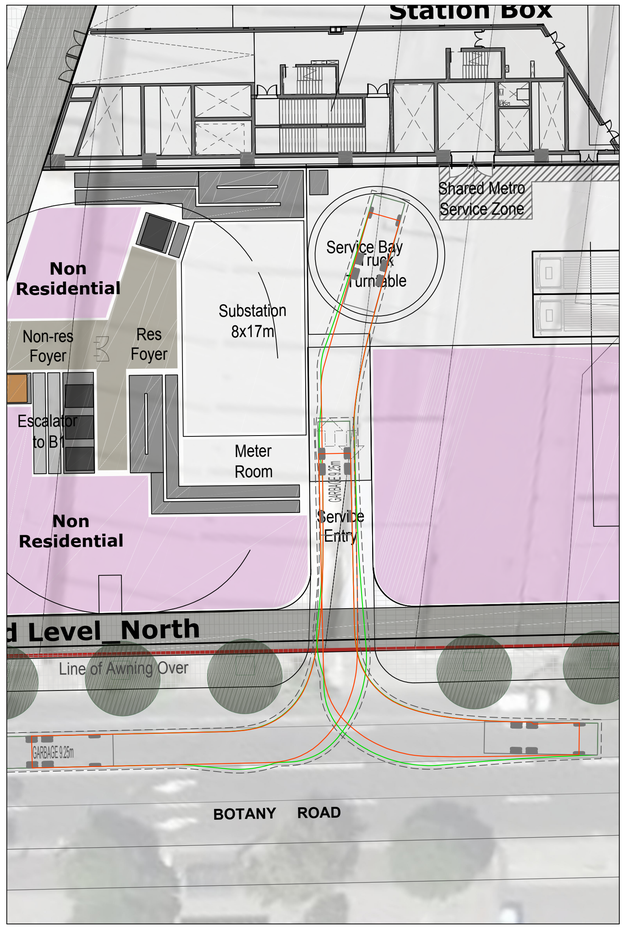

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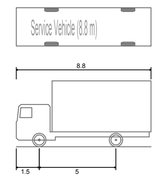

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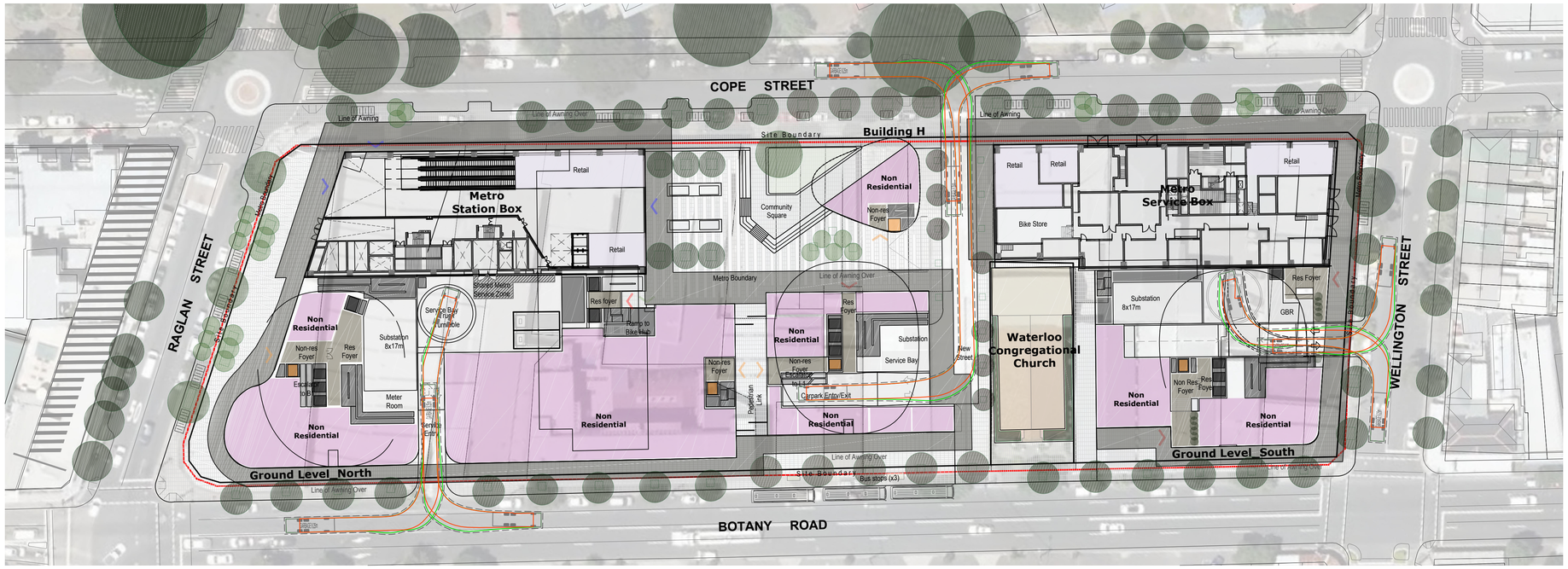

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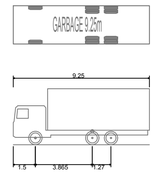

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Lock-to-lock time	6.00s
Wall to Wall Turning Radius	10.500m

VEHICLE TRACKING - 9.25m GARBAGE TRUCK

SCALE 1:500

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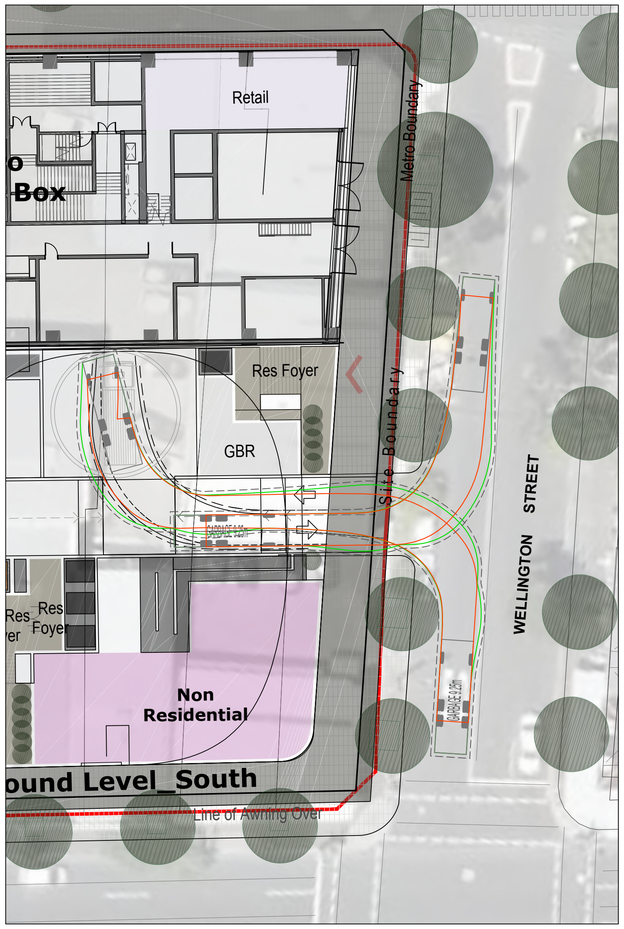

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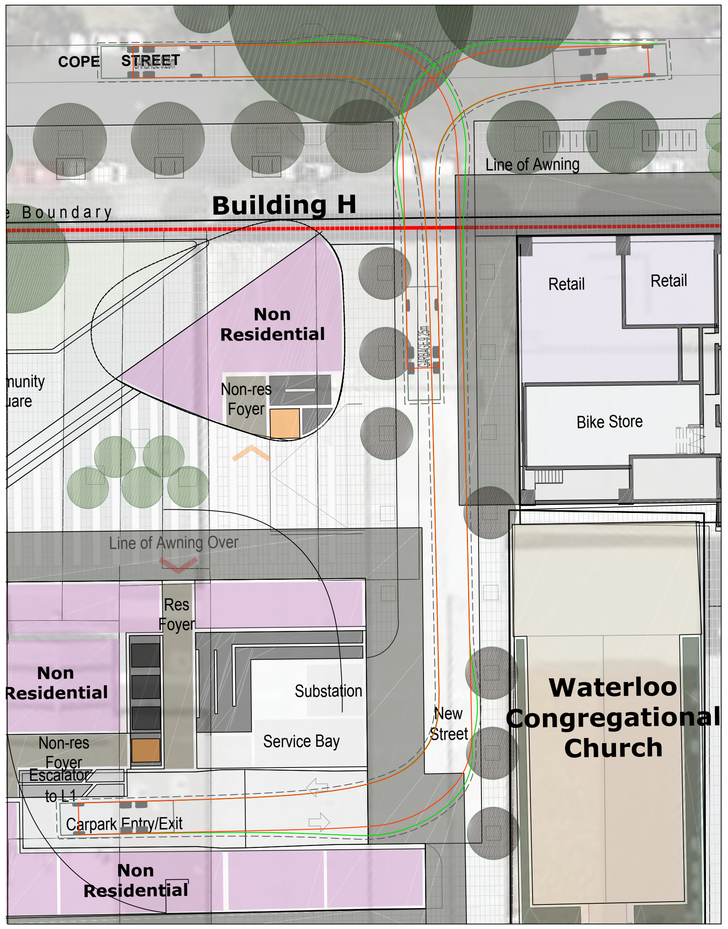

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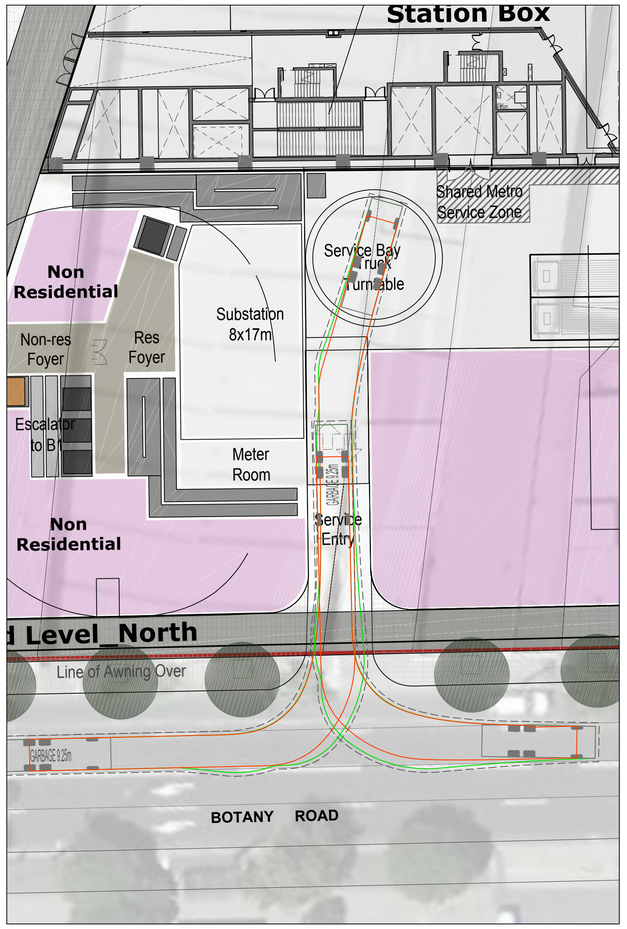

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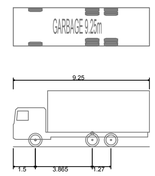

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VEHICLE TRACKING TURNPATHS

SHEET NUMBER
60548168-SKE-00-0000-CI-0024

Appendix B. Interchange Planning Technical Note

NSW GOVERNMENT | sydney METRO

City & Southwest

Waterloo Interchange Planning

Technical Note

Table of Contents

1. Introduction

1.1. Overview

Sydney Metro is Australia's biggest public transport project. A new standalone metro railway system, this 21st century network will deliver 31 metro stations and 66 kilometres of new metro rail for Australia's biggest city — revolutionising the way Sydney travels. Services start in the first half of 2019 on Australia's first fully-automated railway.

Waterloo Station is being delivered as part of Sydney Metro City & Southwest — a new 30 kilometre metro line extending the new metro network from the end of Sydney Metro Northwest at Chatswood, under Sydney Harbour, through the CBD and south west to Bankstown. It is due to open in 2024 with an ultimate capacity to run a metro train every two minutes each way through the centre of Sydney.

Sydney's new metro, together with signalling and infrastructure upgrades across the existing Sydney suburban rail network, will increase the capacity of train services entering the Sydney CBD – from about 120 an hour currently to up to 200 services beyond 2024. That's an increase of up to 60 per cent capacity across the network to meet demand.

Sydney Metro City & Southwest, shown in Figure 1, includes the construction and operation of a new metro rail line from Chatswood, under Sydney Harbour through Sydney's CBD to Sydenham and on to Bankstown through the conversion of the existing line to metro standards.

Figure 1 Sydney Metro alignment map

1.1.1. Planning Overview

On 9 January 2017, the Minister approved the Sydney Metro City & Southwest - Chatswood to Sydenham application lodged by Transport for NSW (TfNSW) as a Critical State Significant Infrastructure project (reference SSI 15_7400), hereafter referred to as the CSSI Approval.

The CSSI Approval includes all physical work required to construct the CSSI, including the demolition of existing buildings and structures on each site. The CSSI Approval envisaged Over Station Development (OSD) at some stations and includes provision for the construction of below and above ground structures and other components. The provisions for each station vary but include items such as building infrastructure and space for future lift cores, plant rooms, access, parking and building services, as relevant to each site. The rationale for this delivery approach, as identified within the CSSI application is to enable the OSD to be more efficiently built and appropriately integrated into the metro station structure.

The EIS for the Chatswood to Sydenham alignment of the City & Southwest project identified that the OSD would be subject to a separate assessment process.

1.1.2. Waterloo Metro Quarter Context

The Metro Quarter OSD will be integrated with the new Sydney Metro station at Waterloo, forming an integrated station development. The Metro Quarter integrated station development is bounded by Botany Road, Cope, Raglan and Wellington Streets.

The Metro Quarter OSD would deliver new homes, shops, community health services and a new public plaza with an adjoining community building, which generate the place making outcomes for the Waterloo integrated station development. A concept State Significant Development (SSD) Application will be lodged seeking planning approval for the Metro Quarter OSD. Together with the new Sydney Metro station at Waterloo, the Metro Quarter OSD provides a unique planning opportunity to make Waterloo a highly connected and attractive inner-city location or place to live, work and visit.

The Waterloo Station includes an interchange comprising facilities to allow multi-modal access to the station. The design and arrangement of the Waterloo interchange forms part of the CSSI Conditions of Approval (CoA).

The development and planning of the interchange concept was undertaken in coordination with UrbanGrowth NSW to support and accommodate movement and access needs of both the new Metro station and planned Metro Quarter (including the OSD concept proposal).

1.2. Purpose and Scope

The purpose of this Technical Note is to provide an overview of the methodology for planning and designing the interchange, in order to demonstrate that the interchange facilities allow for and provide the required flexibility to accommodate future transport connections and planned urban renewal within and surrounding the Metro Quarter. It has been prepared to support the interchange planning process and present its relationship to

the concept plan and proposed planning framework prepared by UrbanGrowth NSW as part of the State Significant Precinct (SSP) Study for the Metro Quarter.

The analysis presented in this Technical Note provides an overview of the Interchange Access Plan (IAP) development process, its alignment with Integrated Station Development planning (Metro Quarter) for Waterloo, and the current work and interchange concept developed to respond to CSSI CoA E92. It is noted that the IAP will continue to be developed as part of the detailed design progresses, and CoA E92 is not required to be satisfied until above ground works are planned to commence.

2. Interchange Planning Design Process

2.1. Overview

Sydney Metro undertakes interchange planning by considering the requirements and aspirations for an easy customer journey throughout the design process. As identified in Figure 2, the interchange planning process broadly comprises three stages: interchange concept, interchange design and operational analysis, and interchange design refinement and action plan — this process aligns with the integrated station development design process.

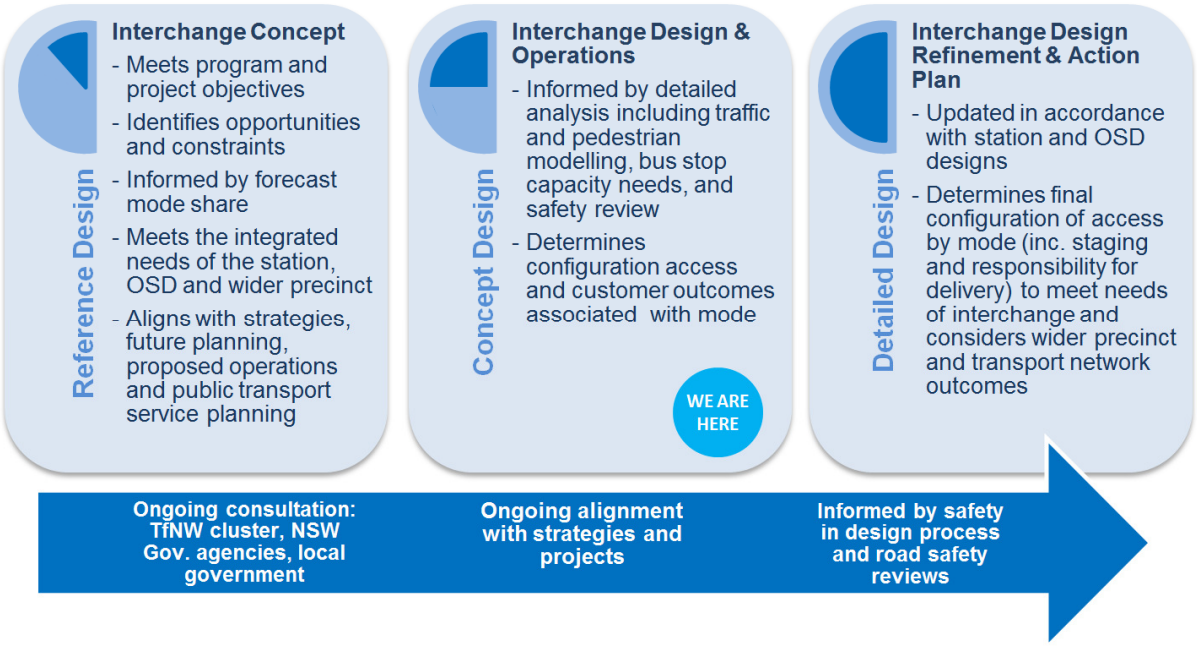

Figure 2: Interchange Planning Design Process

As part of the CSSI CoA for the new metro station, the performance and safety of the interchange design is required to continue to be validated as part the detailed design development tasks. This includes design audits, road safety audits and safety-in-design process risk reviews along with updated transport modelling to support road authority applications and approvals.

2.2. Consultation

Stakeholder consultation is an important component of the design development process undertaken to help ensure that proposed arrangements and assets appropriately respond to future growth and operating conditions for the interchange in its local context. This process is used to inform stakeholder requirements, which include: asset owners and service operators, at an end state and in the staged delivery of improvements that support growth and urban renewal. This element is identified and recorded as part of the final stage of the interchange planning process and reflected in the action plan.

3. Interchange Outcomes

3.1. Project Objectives

Sydney Metro's project objectives and interchange planning outcomes have informed the design of Waterloo interchange. These are presented in Table 1.

Table 1 Project Objectives and Interchange Outcomes

Sydney Metro Project Objectives	Waterloo Interchange Outcomes
• Improve the quality of the transport experience for customers • Provide a transport system that is able to satisfy long–term demand • Grow public transport patronage and mode share • Support the productivity of the Global Economic Corridor • Serve and stimulate urban development • Improve the resilience of the transport network • Improve the efficiency and cost effectiveness of the public transport system.	• Provide easy, safe and intuitive transfer to and from the metro station within the existing network and road environment. • Create a new transport focus in Waterloo and the surrounding precinct. • Integrate the station with local improvement plans. • Contribute to the sense of place and public domain. • Serve the wider precinct • Ensure flexibility to allow for future changes • Prioritise active transport and public transport access • Prioritise the needs of people with mobility impairment

3.2. Opportunities and Constraints

An opportunity and constraints analysis was completed to achieve network, precinct and station planning outcomes with the interchange design — these are presented in Table 2.

Table 2 Interchange Planning - Opportunity and Constraints Analysis

Opportunities	Constraints
• A new node in the transport network which can support bus / rail transfer • To support transport network resilience and reliability outcomes. • The safe integration of the metro station with the existing road network to facilitate safe transfers to and from the station and customers' destinations. Relieve customer congestion at Green Square and Redfern Stations. • Support development in the area • Contribute to the sense of place (community) and public domain • Consider what is required to facilitate greater cycle usage to access Sydney Metro	• The quality of the existing footpath environment • The operational performance of Botany Road • Congestion impacts to the service reliability of buses • A lack of priority for pedestrians at key intersections • Need to manage conflict points and limited spatial provision to facilitate and encourage walking as a mode access.

4. Strategic Planning Context

This section provides an overview of the relevant transport strategies and plans that are important in the planning of Waterloo interchange facilities.

4.1. Future Transport 2056

The strategy is an update of the 2012 *NSW Long Term Transport Master Plan*. It outlines a vision, strategic directions and customer outcomes. The strategy acknowledges the vital role transport plays in the land use, tourism, and the economic development of towns and cities. It includes issue-specific and place-based supporting plans that focus on integrated solutions rather than individual modes of transport. The strategy also focusses on the role of transport in delivering movement and place outcomes that support the character of the places and communities needed for the future.

A priority for Future Transport is to provide an integrated transport network solution, which aims to improve east-west connections in Sydney and to support north-south city serving corridors.

4.2. City of Sydney Liveable Green Network

The *Liveable Green Network 2012* (the Document) aims to create a pedestrian and cycling network that connects with the city and centres as well as major transport and entertainment hubs, cultural precincts, parks and open spaces.

This document refers to Botany Road as a pedestrian priority street, and Wellington and Cope Streets as cycling priority streets. The Document specifies cycle priority streets which should be provided with separated cycle infrastructure. Pedestrian priority streets are to have quality pavement materials, kerb extensions, continuous crossing treatments and landscape amenity.

4.3. City of Sydney Cycling Strategy and Action Plan 2018-2030

The draft *Cycling Strategy and Action Plan 2018-203*0 (the Plan) sets targets, priorities and actions for increasing bike trips in the City of Sydney. It identifies existing and proposed connections, which serve Sydney CBD, the Waterloo area and Green Square. This includes the existing George Street separated cycleway and a proposed new east-west facility along Wellington Street.

The planning for the Metro Quarter OSD and supporting interchange facilities under the CSSI Approval recognises these goals, the importance of network connectivity, and the need to facilitate cycling for travel and access.

4.4. Green Square – Waterloo Transport Action Plan

Transport for NSW is developing a Transport Action Plan with City of Sydney to improve access and support growth in the Green Square and Waterloo area. A key aim of this study is to address current network deficiencies to optimise the potential of future committed project to support continued growth in the short term. The Metro Quarter OSD will help to promote travel choices through supporting connections to public and active transport facilities.

5. Interchange Role and Function

This section provides an overview of the characteristics of transport interchange facilities that form part of the Waterloo interchange.

5.1. Interchange Context

Waterloo Station is recognised as a catalyst for urban renewal of the Waterloo Precinct. The planning for the Waterloo interchange has captured the access needs of the Metro Quarter and considers its integration with the wider precinct.

The walking catchment for the Waterloo Station covers a number of precincts that are targeted for growth. This includes the Waterloo Estate urban renewal area, potential future development sites in Alexandria and the Australian Technology Park (ATP) commercial precinct, illustrated in Figure 1.

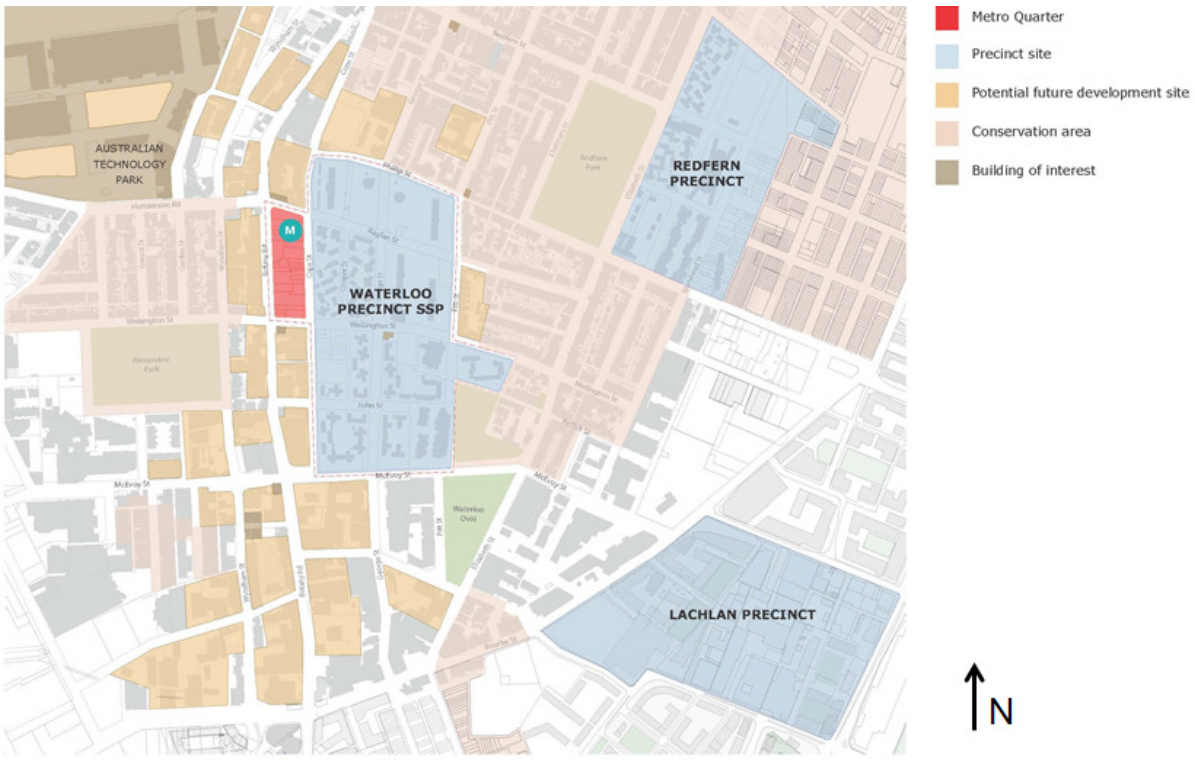

Figure 3 Local Context

The Waterloo interchange arrangement has been planned to support planned growth in the Metro Quarter and to support public transport access from the wider catchment.

5.2. Station Demand and Mode Share

Waterloo Station will function as both an origin and destination station with the forecast 2036 AM peak passenger demand by mode presented in Figure 4. The AM peak has been used in this report as during this time the highest surges in demand occur. The PM peak demand is generally spread more evenly across the peak period. The forecast indicates that the

number of customers accessing and exiting the station is relatively evenly distributed with both walking and bus access playing an important role.

Similar to the planning of other metro stations, walking is recognised as the primary mode of access and together with bus access, generating the highest movements within the interchange.

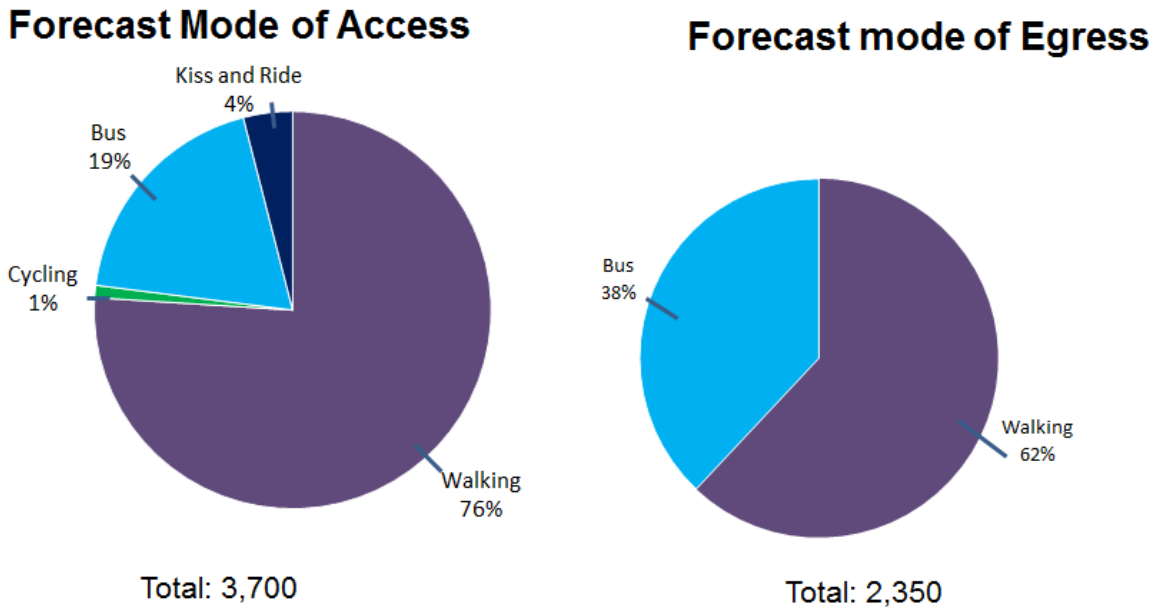

Figure 4 2036 1 hour AM peak demand and mode splits

5.3. Interchange Arrangement

The interchange has been designed to help manage conflicts, provide safe and efficient access for customers of the station and support smooth flow of customers moving through the interchange. The proposed interchange arrangement for Waterloo Station is illustrated in Figure 5 and the provision for each of the modes is listed in Table 3.

Figure 5 Proposed Waterloo Interchange Arrangement

Table 3 Waterloo Interchange Mode Provisions

Mode	Provision	Considerations
Pedestrian	Station access is near the corner of Raglan and Cope Streets and via the station plaza off Cope Street. Access to platforms from the station entrance is via lifts and escalators.	Additional footpath capacity and queuing space has been provided where higher pedestrian demand is forecast, such as: - along the southern side of Raglan Street - the western side of Botany Road - eastern side of Cope Street - the bus stop area along Botany Road In addition to these capacity enhancements, spatial and operational provision is also provided at points to accommodate queuing, conflict and place making opportunities. This includes storage areas and pedestrian crossing configuration at intersections, access points near station entrances, pedestrian through link connections and bus stop areas along Botany Road. Refer to section 6.4 for further information relating to the planning and review of pedestrian facilities.
Bike	180 bike parking spaces on day one of metro operations. An additional 140 spaces to be provided in OSD when constructed (for station users) Future proofing for	The station is planned to have a bike hub to help improve accessibility by extending the station catchment beyond the typical walk-up catchment. The bike parking provision is higher than the estimated mode share demand. This is intended to build on the opportunity offered by a relatively level cycling catchment and its proximity to the station, as well as connectivity to the existing and planned broader bike network. George Street cycleway together with slow and low

	additional 80 bike parking spaces	trafficked residential streets, a planned Wellington Street cycleway and a relatively high density cycling catchment are recognised as key elements for promoting a higher cycling mode share at this destination. Additional bike parking spaces will be safeguarded as part of the detailed design process. Refer to section 7 for further information relating to the planning and review of bike facilities.
Bus	Bus stops on Botany Road	The bus facilities on Botany Road are designed to accommodate high frequency bus services including future service capacity enhancements. Building setbacks have been provided near the bus stops in the Metro Quarter to facilitate storage and movement at bus stops together with providing spatial allocations for other place making functions. East-west bus route services and stops can be provided on either Wellington or Raglan Streets. The planning of these routes is still to be confirmed; however the interchange design is flexible and able to facilitate either of these options.
Taxi and Kiss and Ride	Cope Street and Raglan Street	These streets have adequate kerbside provision for parking and allow for easy access from/to the State Road network.

Figure 6 identifies key access paths and access for the Waterloo Station interchange and the proposed OSD. Access to the OSD is located where it minimises conflict between transport modes and/or is managed through increased setback.

Service vehicle access points from the road network is planned to minimise conflict with key pedestrian corridors and customer movement generated by bus operations. The location away from the proposed new Metro station entrance and consideration of road connectivity and the access needs of customers ensures that movement and conflict can be managed.

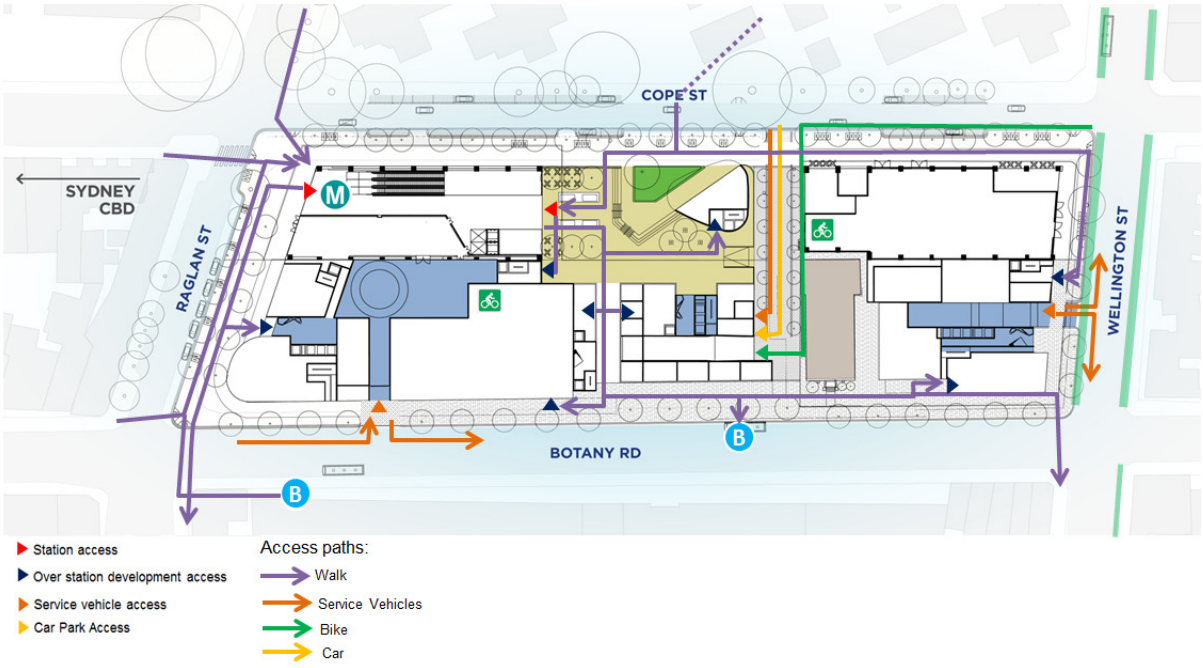

Figure 6 Waterloo Integrated Station Development Access Points

6. Pedestrian Access

This section provides an overview of the pedestrian analysis supporting the Metro Quarter and Waterloo Station.

6.1. Pedestrian Access and Desire Lines

The planning of the interchange and its surroundings is generated from a review of existing and future land use, estimated growth and origin and destination movement patterns. These estimated movement patterns and key desire lines for the new Metro station are illustrated in Figure 7.

Figure 7 Waterloo Station Pedestrian Distribution

A review of the trends highlighted in the analysis indicates that the majority of customers walking to the station will travel from the east, which includes the planned Metro Quarter and Waterloo Estate. This differs from alighting passengers during the same period, which has more of a focus towards areas situated to the west and northwest of the stations. This includes the ATP and destinations situated within and beyond Redfern and Darlington.

Waterloo Station customers will increase pedestrian demand at the surrounding intersections. The key intersections impacted by customer movement accessing the station are the Botany Road and Raglan Street/Henderson Road intersection and the Cope Street and Raglan Street intersection.

The design and operation of these surrounding intersections together with key urban domain features that form part of the transport interchange have been modelled to demonstrate safe and reliable operating conditions can be achieved.

6.2. Pedestrian Capacity Needs

A performance review of the footpaths and intersections has been undertaken using both pedestrian static analytical and simulation modelling tools. The outputs from the models have been used to understand the pedestrian operating performance of the interchange, points of conflict and potential deficiencies, and to inform the design development process.

6.2.1. Assessment Process

An overview of the process for assessing the proposed interchange design is provided in

Figure 8.

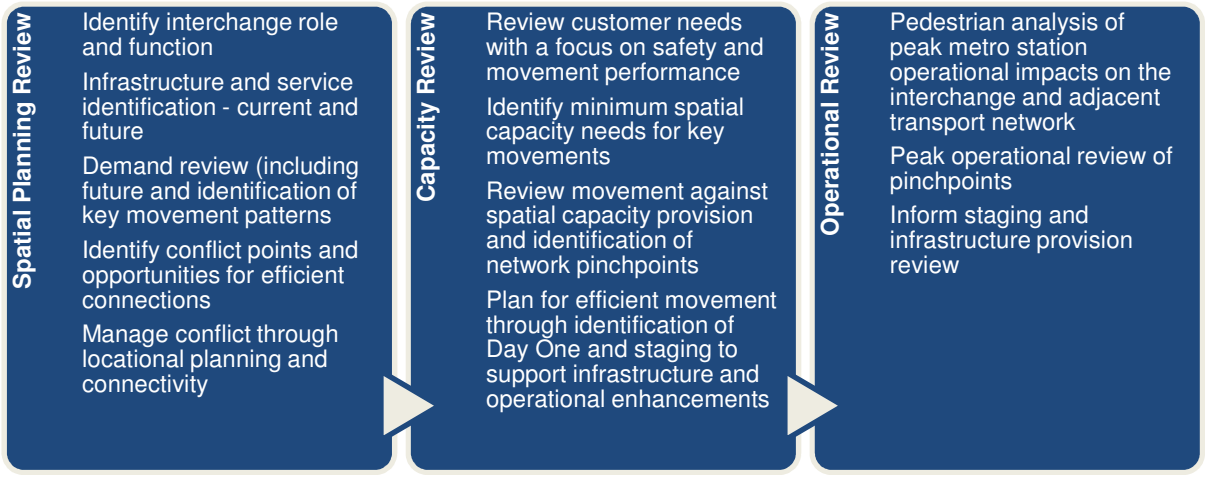

Figure 8 Interchange Design Assessment

6.2.2. Facility Demand

The approach for determining the future pedestrian demand is consistent with other Sydney Metro City & Southwest CBD located metro stations, and accounts for forecast growth in the surrounding precinct. The 2036 AM peak hour forecast pedestrian demand levels (shown for precinct corridors generated high pedestrian demand only) used in the pedestrian assessment are provided in Figure 9. The data presented in the diagram is simplified and presents precinct corridors that generate high levels of pedestrian demand only.

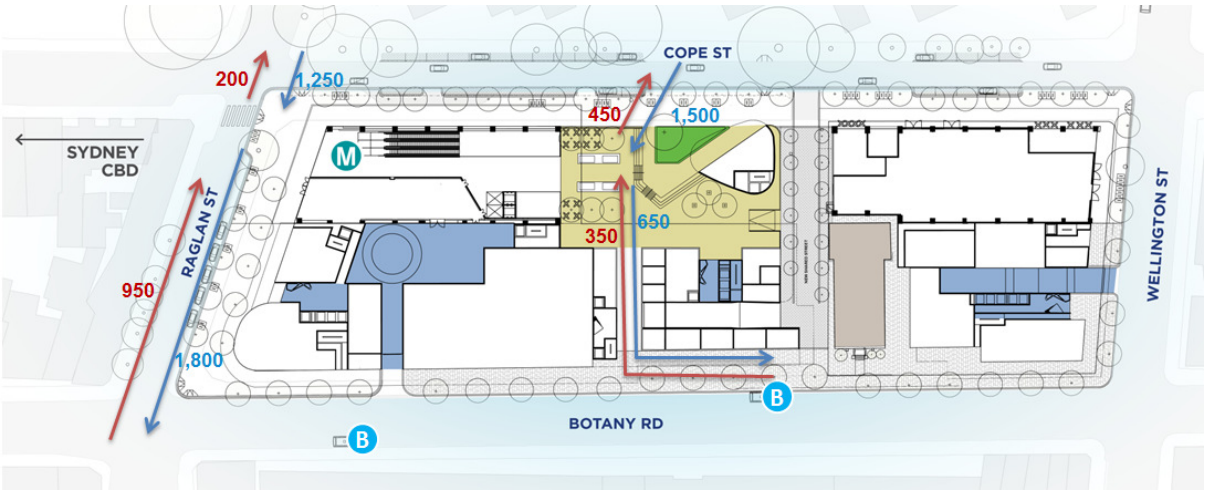

Figure 9 2036 Forecast Key Precinct Corridor Pedestrian Demand (AM Peak hour)

The pedestrian demand applied within the pedestrian assessment includes:

- Waterloo Station demand for peak periods in 2036.
- Current background movement and assumed growth resulting from the staged development of the wider precinct and its surroundings (includes Metro Quarter, Waterloo Estate, and Australian Technology Park).
- Consideration of increased flow rates within the peak period relating to both demand surges and the operation of Sydney Metro, traffic signals and bus services (operational review).

Refer to Appendix 1 for further details and assumptions.

6.2.3. Customer Modelling Profile

Planning for pedestrians involves considering the needs of customers with restricted mobility, people with disabilities, vision impairments, cognitive or invisible disabilities, elderly customers and children. This also involves considering the scenarios and environments customers are travelling in, such as customers travelling with prams, luggage and bulky items, crowding, wet or hot weather.

The customer profiles applied as part of establishing and testing peak hour operating conditions within the pedestrian simulation model are consistent with observations at Sydney Trains stations and the *Transport for London (TfL) Best Practice Guide for station modelling (January 2016 edition)*.

The customer profiles consider a range of users including wheelchair users, other mobility impairments, people with luggage and parents with young children. The TfL modelling guide is based on comprehensive research for Metro systems and relates accessibility profiles to urban locality and station function. For Waterloo, it recommends the application of approximately 3% of passengers in the AM peak and 10% of passengers in the PM peak as appropriate measures for an inner suburb station to understand the operational impacts for customers with restricted mobility.

6.2.4. Performance Measures

The assessment of safe and efficient pedestrian movements within the interchange and its access points from the surrounding precinct is based on Fruin Level of Service (LoS) performance measures, as presented in Figure 10. The design aims to achieve a Walkways LoS C or better for pedestrian flow as an average over the peak hour.

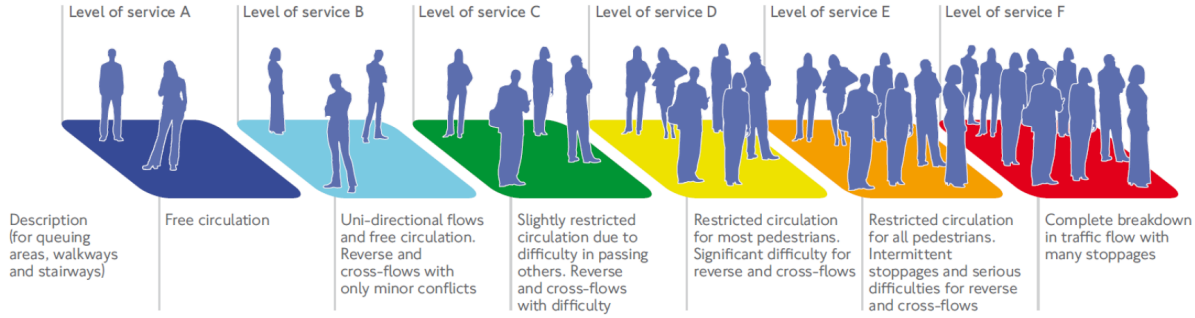

Figure 10 Fruin Level of Service Performance Measures

6.2.5. Facility Testing

The performance of the design was tested through the application of the following assessment techniques.

Table 4 Performance Testing

Demand Profile	Design Testing	Measure	Review Type
Peak hour	Infrastructure and spatial provision	Level of Service (LoS)	Design capacity
Peak 15 minutes (average)	Peak infrastructure and spatial provision	LoS	Peak design capacity
Peak minute (surge)	Customer experience	LoS & duration	Operational experience

The above three levels of testing enables a design to be reviewed against both standard peak capacity applications and to understand how it performs under more short term demand surges relating to the operation of the system or the surrounding transport network. An assessment against the peak 15 minute period provides a measure to determine required infrastructure to accommodate forecast peak demand. While assessment of the peak minute demand provides further insight into customer experience during peak surges from train arrivals and similar events associated with network operations.

6.3. Assessment

6.3.1. Spatial Review

The review of spatial needs for a transport interchange and associated development is addressed through appropriate provision for movement corridors, and separation and spatial arrangements of facilities. Refer to sections 5.3 and Figure 6 on interchange arrangements,

and section 6.1 on access to understand how movement corridors and conflict is planned and managed. The outcome of the review highlighted the following:

- Waterloo station will both attract and generate movement during peak periods with the dominant exit movements occurring to the west and the arrival movement from the east of Metro Quarter.
- The southern footpath along Raglan Street and metro station entry are estimated to accommodate higher pedestrian movements than other locations in the Metro Quarter.
- Building setbacks are used to ensure that provision is adequate and to help manage higher forecast pedestrian movements.
- The building setbacks also consider and provide spatially for facilitating customer movement at bus stops, over station development access points and storage needs associated with place making, such as outside dining and landscaping with seating.
- The entry to the new metro station through the Cope Street plaza helps to efficiently distribute demand across the precinct and manage conflict and spatial capacity needs associated with future movement associated with the proposed Waterloo Estate and Botany Road bus stops.
- The proposed midblock pedestrian link in the Metro Quarter helps to efficiently distribute demand across the precinct and manage conflict and spatial capacity needs associated with future movement associated with the proposed Metro Quarter OSD and Botany Road bus stops.
- A key area of focus for the capacity and operational reviews are the footpaths on Raglan Street south and Botany Road east and the intersection of Raglan Street and Botany Road.

6.3.2. Capacity Review - Static Pedestrian Modelling

The review of pedestrian facility capacity needs was undertaken using static pedestrian assessment techniques and applied to both the peak hour and peak 15 minute demand levels.

6.3.2.1. Footpath Provision

The footpath modelling focused on precinct corridors identified in the spatial review to have high pedestrian movement to help understand if the allocated spatial provision can be achieved. The areas of focus were identified to be the southern footpath on Raglan Street, and the eastern footpath on Botany Road and the midblock pedestrian link.

The allocated spatial provision for footpath width along these links in the design is greater than 3 metres. In most cases the allocated setback from the kerb line to building is 6m or more, and accommodates other features such as landscaping and street furniture. The clear width for pedestrian movement is identified in the design to be a minimum of 3 metres in all locations that attract high pedestrian flows.

A generic review of the capability of a 3 metre width footpath was undertaken to help understand if the capacity of the proposed footpath widths is able to accommodate the forecast demand generated in and around the precinct. This process indicated that a

footpath with a clear width of 3 metres or more can provide safe and efficient operating conditions at Level of Service C for two-way pedestrian flow for over 7,000 people per hour.

The assessment of forecast demand indicates peak hour flows of less than 3,000 people along a movement corridor and that this will be spread across a number of route options or footpaths. On this basis, the proposed footpath widths of 3m or more are deemed to provide safe and efficient access through operating at an acceptable level of service in the future and can accommodate growth generated by the proposed Metro Quarter integrated station development and its surroundings.

Further information on the assessment is contained in Appendix 2.

6.3.2.2. Storage at Intersections

A similar static assessment was undertaken to understand the spatial planning provision limitations of the surrounding footpath network for storage at intersections. The application of a Fruin Level of Service (LoS) C, and then D and E profile for queuing on the footpath was applied to understand operational impacts. The peak appraisal of storage and operational impacts allows for a maximum footpath width of 3 metres and 120 second traffic signal cycle time to determine the queuing capacity under each level of service.

The standard spatial operational profiles at busy urban intersections in constrained established areas are noted to operate below a LoS C during peak periods and are managed through increasing pedestrian crossing widths and adjusting traffic signal cycle times.) The assessment aims to provide an understanding of the potential impact on constrained areas that are situated adjacent to the site. The review indicated that approximately 1,100 (at LoS C) to 3,750 (at LoS E) pedestrians can be stored at a typical intersection corner in the peak hour for a single approach. This review considered a storage area with a 6 metre crossing width (proposed improvement), conservative assumptions for extended queuing and traffic signal operating times (adopted current 120 second cycle time), and a 15 minute peak surge factor as a worst case condition.

The capacity requirement based on the worst case forecast demand at an intersection corner for storage (single crossing and approach) is estimated to be less than 1,800 pedestrians per hour. This indicates that a level of service D or better can be achieved under peak 15 minutes' operations and constrained conditions. It is also noted that the above evaluation is conservative and does not account for a potential 30% increase in peak hour storage capacity that can be achieved as a result of changes in traffic signal cycle times from 120 to 90 seconds or the inclusion of further reductions in estimated demand resulting from the potential inclusion of additional pedestrian crossings.

Refer to Appendix 3 for further information on the assessment.

6.3.3. Operational Review

Microsimulation was applied in the review of key movement and storage areas within the Waterloo interchange and Metro Quarter proposal. The operating condition of areas can be better understood if demand surge effects relating to customer crowd movement profiles, arrival patterns and the duration of intensity are applied to the review process. The pedestrian analysis tested in this assessment applied a crowd profile, Metro service train arrivals (conservative simultaneous train arrival), 120 second traffic signal cycle times and crowding from the arrival of bus services.

The simulation of these characteristics together with other demand uplifts identified in Appendix 1 highlighted that a satisfactory average level of service of areas is achieved and that pinch-points and short periods of crowding can be safely managed within the design of the Metro Quarter precinct.

The modelling also recognises that external to the Metro Quarter precinct there are areas where pinch-points occur for short periods of time before the pedestrian phase at traffic signals are activated. Simulation modelling of these areas indicated that under peak surge conditions, crowds generated under future peak demand levels can be accommodated together with an allowance for other through movement. Snapshots of peak operating conditions generated by the pedestrian simulation model for 2036 peak before the activation of the pedestrian green phase at traffic signals and the crossing conditions when activated are presented in Appendix 4.

6.4. Key Pedestrian Findings

The key finding based on the pedestrian modelling undertaken is as follows:

- The assessment accounts for Sydney Metro station demand, the Metro Quarter and future planned development in surrounding precincts, such as movement generated by the proposed Metro Quarter, the proposed Waterloo Estate and proposed expansion of the Australian Technology Park.
- The spatial layout of the Metro Quarter allows for conflict to be managed, and efficient and safe customer flows.
- The design provision of the Metro Quarter includes minimum footpath widths of 6 metres (including landscaping) along the southern footpath of Raglan Street and eastern footpath of Botany Road, which aligns with the activity levels that are expected around the Metro Quarter.
- The pedestrian modelling indicates that estimated AM and PM demand generated in the Metro Quarter can achieve safe and efficient operational outcomes. This includes the intersection of Botany Road and Raglan Street.
- This is achieved without the adoption of traffic signal adjustments to pedestrian phasing or the inclusion of additional pedestrian crossings, which are expected to further improve experience of users and support the development of the wider precinct by offering opportunities to reduce and spread demand, additional access options, and reducing queueing and storage needs in individual locations.

7. Bike Analysis

As presented in Figure 4, the forecast bike mode share for station access is approximately one per cent. The total 2036 AM peak hour demand for customer arrivals at the station are forecasted to be 3,700 and equates to 37 bike riders. This is the highest volume of cyclists likely to arrive at any point in time and park their bike.

The proposed bike parking provision and staging is listed in Table 3. On day one of metro operations at Waterloo Station, 180 bike parking spaces are proposed for the station. This exceeds the forecast 3.5 hour (approximately double the peak hour demand) one per cent cyclist mode share by over 2.5 times, allowing for additional bikes to be parked throughout the day.

The additional provision for cycling allows the station to support and attract a higher mode share, particularly with the proposed staging of the precinct to allow for additional bike parking provision. Provision for dockless bike share will also be considered as part of the detailed design process, such as designated areas for dockless bike share.

The peak hour frequency from cyclists generated by the precinct is estimated to be less than 100 movements or two movements a minute and may double if a higher station cycle mode share is achieved.

Safe access for cyclists to the interchange and Metro Quarter will be provided from Cope Street. It is proposed that this street will be reduced to a 40 kilometres/hour speed limit road with road treatments to encourage low traffic speeds and manage conflict. Cope Street connects with Wellington Street, which is an existing on-road cycle route. As development progressively occurs, Wellington Road is proposed to be upgrade to a regional cycle route, supporting the Liveable Green Network and Cycling Strategy and Action Plan, discussed in section 4.

The design of the streetscape within the Metro Quarter is expected to allow spatial and physical provision for the introduction of the proposed Wellington Street cycleway. The proposed removal of roundabout and inclusion of additional pedestrian crossings will also help to facilitate the progressive redevelopment and improvement of the precinct and continue to support safe access.

8. Proposed Infrastructure Provision

The action plans that support the delivery of this infrastructure and services forms part of the next stage of the IAP. Figure 11 and Table 5 highlight the proposed infrastructure provision and staging associated with the metro station interchange and proposed Metro Quarter.

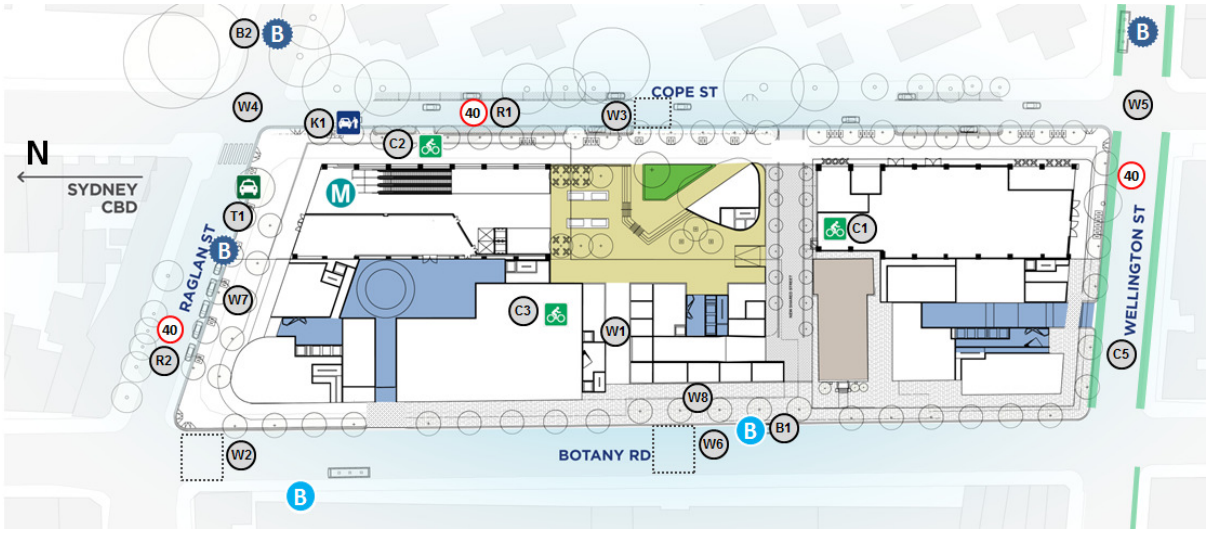

Figure 11 Waterloo Proposed Infrastructure Plan

Table 5 Proposed Facility and Service Improvements

Code	Action	Timing
Walking		
W1	Provide a direct pedestrian through site link across the Metro Quarter between Botany Road and Cope Street	Before Waterloo Station opens
W2	Provide spatial pedestrian crossing enhancements at the Botany Road and Raglan Street/Henderson Road intersection	Before Waterloo Station opens
W3.1	Safeguard a mid-block crossing on Cope Street between Raglan Street and Wellington Street within the integrated station development	Before Waterloo Station opens
W3.2	Provide a mid-block crossing on Cope Street between Raglan Street and Wellington Street intersection to facilitate safe and efficient movement	After Waterloo Station opens - timed with completion of development adjacent to Cope Street in the Estate
W4	Provide pedestrian crossings at the Cope and Raglan Streets intersection to facilitate safe and efficient movement	Before Waterloo Station opens
W5	Provide pedestrian crossings at the Cope and Wellington Streets intersection to facilitate safe and efficient movement	Before Waterloo Station opens
W6	Safeguard for a future mid-block pedestrian crossing in the Sydney Metro design on Botany Road between Raglan and Wellington Streets	Before Waterloo Station opens
W7	Offset buildings to allow spatial provision for increased pedestrian throughput and support place making opportunities on the southern side of Raglan Street.	Before Waterloo Station opens

W8	Set-back buildings to allow spatial provision for increased pedestrian throughput, queuing and support place making opportunities adjacent to the bus zone area on Botany Road in the Metro Quarter design	Before Waterloo Station opens
Cycling		
C1	Provide 100 Class B bike parking spaces	Before Waterloo Station opens
C2	Provide 80 Class C bike parking spaces	Before Waterloo Station opens
C3	Provide additional secure bike parking Class B	After Waterloo Station opens
C4	Safeguard for additional parking spaces in the Waterloo Metro Quarter Design to meet future demand.	Before Waterloo Station opens
C5	Safeguard and support the delivery of a bidirectional cycleway along Wellington Street	Before Waterloo Station opens
Bus		
B1	Relocate the southbound bus stop to the midblock on Botany Road between Raglan Street and Wellington Street	Before Waterloo Station opens
B2	Streamline east-west bus services to either Raglan Street or Wellington Street	Before Waterloo Station opens
B3	Provide bus stop capacity provision to accommodate planned improvements to route services and increased frequencies	Before Waterloo Station opens
Taxi		
T1	Provide a taxi rank	Before Waterloo Station opens
Kiss and Ride		
K1	Provide a kiss-and-ride zone	Before Waterloo Station opens
Road Network Modifications		
R1	Provide measures to traffic calm Cope Street to support the implementation of a 40 kilometre an hour speed limit	After Waterloo Station opens
R2	Excluding Botany Road design residential streets immediately surrounding Waterloo Station with a 40 kilometres/hour speed limit	Before Waterloo Station opens

9. Integration and Enabling Growth

The Metro Quarter and Waterloo Station interchange provides an environment that facilitates safe and efficient movement and enables growth. The Metro Quarter provides movement and place outcomes through the provision of generous building setbacks and appropriate streetscapes. These planning and design attributes enable and influence the area's ability to attract activation through:

- A quality built environment through design provision and its integration as part of the solution of landscaping, streetscape furniture and weather protection.
- Accommodating customer needs by, managing conflict and supporting access, dwell and through movement.

It is noted that there are existing areas that are historical and constrained, and as a result can be further improved. As the surrounding area continues to intensify through a combination of urban renewal projects that surround the site other opportunities to plan and support growth and this changing environment will emerge. Sydney Metro and UrbanGrowth NSW recognise the need to plan towards these outcomes and through the planning, design and delivery of the Metro Quarter and Waterloo Station interchange is expected to help drive and enable these desirable area planning objectives. This is achieved through:

- The provision of a pedestrian through site Metro Quarter link running east west and design safeguarding for a mid-block crossing on Botany Road. This facilitates and enables further increase in movement and a potential expansion of an east-west pedestrian link that could balance access needs to local services and facilities, and ultimately supports the planned intensification of surrounding precincts.
- A commitment through the planning of the Metro Quarter to provide the required spatial provision and end state kerb and streetscape alignment along the northern side of Wellington Street (between Botany Road and Cope Street) fronting the site to facilitate the easy implementation of the planned Wellington Street cycleway.
- A commitment through the planning of the Metro Quarter to provide the required spatial provision and end state kerb and streetscape alignment along Cope Street (between Wellington Street and Raglan Street), the southern side of Raglan Street (between Cope Street and Botany Road) and Botany Road (between Raglan Street and Wellington Street) fronting the site to facilitate the easy implementation of planned streetscape improvements that support the urban renewal of the Waterloo Estate and continual enhancement of Botany Road to function as a vibrant street.
- A commitment through the planning of the Metro Quarter to deliver pedestrian facilities and crossing points that facilitate access to services and facilities planned to be situated within the Metro Quarter.

Sydney Metro and UrbanGrowth NSW are committed to the planning and delivery of places that support the activity centre concept and working with stakeholders to ensure that staging, integrated design outcomes and delivery commitments of the Metro Quarter, and other surrounding precincts are realised and achieved.

Appendix 1 Pedestrian Modelling Demand Inputs

The assumptions used in the pedestrian models developed to test the proposed interchange configuration include:

- Estimated AM peak hour station departures in 2036 – 2,350 exits (walking 1,450) – this allocation includes 25% of all ATP peak hour person trips
- The Metro Quarter demand which is expected to generate 373 pedestrian trips across the site in the AM peak hour (Jacobs Transport Study for the Waterloo Metro Quarter State Significant Precinct Application)
- An additional 10% increase in station patronage for ATP expansion
- An additional 30% increase in background through pedestrian movement across the network (double that of other stations)
- The station demand forecast includes a 15% contingency to account for unknown development
- Assumes simultaneous train arrivals at the station
- Aligned with traffic modelling and current standard SCATS data (120 second traffic signal cycle times and not optimised for pedestrians).
- Peak hour demand includes peak 15 minute 20% surge factor.

Appendix 2 Footpath Peak Design Capacity Assessment

The Level of Service (LoS) design criteria adopted for the static pedestrian modelling assessment of footpaths are presented below.

Interchange Walkways

LoS	Average pedestrian area occupancy (sqm/pp)		Average flow volume (pp/min/m)	
	Lower bound	**Upper Bound**	**Lower bound**	**Upper Bound**
A	3.26	-	0	23
B	2.33	3.26	23	33
C	1.4	2.33	33	49
D	0.93	1.4	49	66
E	0.47	0.93	66	82
F	0	0.47	-	-

The peak minute footpath capacity was determined using Fruin Level of Service theory based on the upper bound threshold of LoS C, assuming a clear footpath width of 3m. The peak hour capacity was then calculated by assuming the peak minute includes a 20% surge factor.

The results of the analysis are presented below and account for two-way pedestrian flow.

Element	**Value**	**Unit**	
Footpath width	3	m	
LoS C Threshold	49	pp/min/m	
Peak Minute Capacity at LoS C	147	pp/min	
Peak Hour Capacity at LoS C	7,350	pp/hr	*assumes surge factor*

Note: This assumes the 3 metre width is clear of physical obstacles, consistent with the proposed Metro Quarter design.

Appendix 3 Pedestrian Storage Peak Design Capacity Assessment

This is an assessment of pedestrian storage at intersections (where pedestrians queue before a signalised crossing activates) within constrained locations. The design criteria for the Queuing Level of Service are presented below.

Level of Service Criteria

Queuing/ Dwell

LoS	Average pedestrian area occupancy (sqm/pp)		Average inter-person spacing (m)	
	Lower bound	**Upper Bound**	**Lower bound**	**Upper Bound**
A	1.2	-	1.2	-
B	0.9	1.2	1.06	1.2
C	0.65	0.9	0.91	1.06
D	0.28	0.65	0.61	0.91
E	0.19	0.28	-	0.61
F	-	0.19	-	-

The design achieves a minimum LoS C in the Metro Quarter and a minimum LoS D under this criteria in the worst case location of broader precinct. This experience is captured at a single intersection pinch point for brief periods before signalised crossings activate.

The assessment assumed a typical queuing area available at an intersection with dimensions of 8m x 3m and an allowance for street side furniture. The capacity of this location was reviewed against fixed queuing area LoS C, D and E spatial densities and assumed delays generated by a signal cycle time of 120 seconds and a 20% peak surge factor. The results of the assessment are presented below and highlight that a LoS D can easily be achieved under worst case operating conditions and the inclusion of additional future applied growth in pedestrian demand.

3m footpath spatial dwell allocation				
Data Inputs				
Length	8.0	m	*Allowing 6m crossing width + 1.0m either side for spill over*	
Width	3.0	m	*Assumes 3m footpath*	
Area	24.0	sqm		
Area of obstructions	0.25	sqm	*Allowing for signal pole etc.*	
Net area	23.8	sqm		
Assessment				
Allowable LoS	**C**	**D**	**E**	
Space per person	0.65	0.28	0.19	sqm
	1,096	2,545	3,750	Average capacity per hour assuming 120s cycle time
	913	2,121	3,125	Including 20% demand surge factor

Appendix 4 Peak Minute Operational Testing

This appendix presents snapshots from the pedestrian modelling simulation to visually demonstrate the potential operations. Figure 12 presents a snapshot of the worst case queuing expected at the intersection of Botany Road/Raglan Street immediately before the signalised pedestrian crossings at the intersection are activated. This also accounts for peak demand surges generated by ATP and bus arrivals on Botany Road.

Figure 12 Raglan and Botany Road Intersection – immediately before the activation of the pedestrian green phase

The snapshot demonstrates that the footpaths provide sufficient storage areas to accommodate the potential worst case queues, and allow pedestrians to pass by. It is noted that the queuing presented represents the worst case throughout the peak hour and in most situations it will be less than that shown with additional space available.

Figure 13 presents a snapshot of the intersection immediately after the pedestrian crossings phase is activated.

Figure 13 Raglan and Botany Road Intersection – during pedestrian green phase

The snapshot provides an understanding of the potential conflict experienced at the crossings, and demonstrates that the width is sufficient to accommodate the forecast flow and manage the conflict.