Transport Management and Accessibility Plan

Ivanhoe Estate, Macquarie Park

Ref: 0421r02v07
3/04/2018

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Document Control

Project No: 0421

Project: Ivanhoe Estate, Macquarie Park

Client: Aspire Consortium on behalf of NSW Land and Housing Corporation

File Reference: 0421r02v07 Ivanhoe Estate, Macquarie Park TMAP.docx

Revision History

Revision	Date	Details	Author	Approved by
-	30/10/2017	Draft	D. Budai	A. Johnson
1	27/11/2017	Issue I	D. Budai	A. Johnson
2	14/12/2017	Issue II	D. Budai	A. Johnson
3	21/12/2017	Issue III	D. Budai	A. Johnson
4	12/2/2018	Issue IV	D. Budai	A. Johnson
5	23/3/2018	Issue V	D. Budai	A. Johnson
6	28/3/2018	Issue VI	D. Budai	A. Johnson
7	3/4/2018	Issue VII	D. Budai	A. Johnson

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Executive Summary

Background

Ason Group has prepared this Transport Management and Accessibility Plan (TMAP) report to support a Concept Development Application for the Ivanhoe Estate Masterplan, a State Significant Development (SSD) 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 Proposal. It has been prepared for Aspire Consortium on behalf of NSW Land and Housing Corporation.

In September 2015 the Ivanhoe Estate on the north-eastern corner of Epping Road and Herring Road at Macquarie Park (the Site) was rezoned by the Department of Planning and Environment as part of the Macquarie University Station (Herring Road) Priority Precinct, to transform the area into a vibrant centre that benefits from the available transport infrastructure and the precinct's proximity to jobs, retail and education opportunities within the Macquarie Park Corridor.

The Ivanhoe Estate is currently owned by NSW Land and Housing Corporation (LAHC) and comprises 259 social housing dwellings. The redevelopment of the Ivanhoe Estate is part of the NSW Government Communities Plus program, which seeks to deliver new communities where social housing blends with private and affordable housing, with good access to transport, employment, improved community facilities and open space.

The Communities Plus program seeks to leverage the expertise and capacity of the private and non-government sectors. As part of this program, Aspire Consortium, comprising Frasers Property Australia, Citta Property Group and Mission Australia Housing, was selected as the successful proponent to develop the site in July 2017.

The Masterplan DA is the first step of the planned redevelopment of the Ivanhoe Estate and will create an integrated neighbourhood including social housing mixed with affordable and private housing, as well as seniors housing, a new school, child care centres, community facilities and retail development.

Description of Project Scope

The development of a new mixed tenure community in Sydney's Macquarie Park will integrate social, affordable and market housing together to provide a sustainable and inclusive neighbourhood.

The Aspire Consortium, comprising community housing provider Mission Australia Housing with developers Frasers Property Australia and Citta Property Group, was appointed by the NSW Government to redevelop and transform the 8.2 hectare Ivanhoe estate in Macquarie Park, under a project development agreement.

The project will see the transformation of 259 social housing properties on the 8.2 hectare site into a socially integrated neighbourhood of approximately 3,500 dwellings (subject to future design development) with a maximum of GFA of 281,685m^2.

A key focus of the project is to address housing needs while providing practical opportunities to transition social housing residents to housing independence. Mission Australia Housing will provide support to assist social housing residents to connect with education, training and employment opportunities.

The redevelopment will also seek to help to meet the growing demand for education by providing a non-government co-educational vertical high school including approximately 1,000 students and two 75 place child care centres. A range of community facilities, public space and approximately 1,246m^2 of retail floor space are also proposed.

The project proposes the delivery of a number of infrastructure upgrades to facilitate the main objective of a Transit Oriented Development whilst minimising the impacts to the existing and future road network. In this regard the development includes the delivery of:

- A signalised intersection of Herring Road and Ivanhoe Place,
- A new ingress from Epping Road, and
- A new bridge connection between Ivanhoe Place and Lyonpark Road.

In addition, a number of pedestrian and cycle connections are proposed to improve and encourage non-car travel modes. This includes the provision of pedestrian shared paths and bicycle connections through the site connecting to key destinations including Macquarie Shopping Centre, Macquarie University and University Railway Station and employment zones within the Giffnock Avenue and Lyon Park Road.

The methodology for the transport assessment has been based on adopting a yield of 3,600 residential dwellings (excluding residential aged care beds) which is higher than the yield proposed in the masterplan. The underlying rationale for modelling a higher yield is to ensure that there is a level of contingency and flexibility afforded in the assessment of the modelling and the trip generation rates of the masterplan. Notwithstanding, the assumptions for the adopted trip generation rates and the outcomes of the traffic modelling are considered to be conservative and could be further reduced with the package of measures recommended in Section 8.

Assessment Findings

The development is expected to generate in the order of 540veh/hr and 440 veh/hr during the morning and evening peak periods. This generation has been based on both Roads and Maritime Services traffic generation rates and surveys of comparable developments in regional centres including Chatswood and

St Leonards. The operation of the network under the Proposed Development Scenario demonstrates a moderate increase in delays key intersections surrounding the Site during the morning and evening peak periods. The impacts of the development are generally off-set by the delivery of proposed road network upgrades and improved permeability through the Herring Road precinct. In particular, the transport modelling undertaken for the precinct demonstrated that:

- The proposed upgrades to the intersection of Epping Road with Herring Road to be delivered under the Macquarie Park Bus Priority and Capacity Improvement project (MPBPCI) results in a significant improvement in the operation of the intersection in the medium term.
- The proposed bridge connection between Lyonpark Road and Ivanhoe Place will provide for an alternate east – west route to Waterloo Road through Macquarie Park. The provision of this bridge results in substantial redistribution of traffic through the Macquarie Park Corridor.
- The proposed unsignalised left turn slip lanes providing eastbound movements at Herring Road with Epping Road and southbound movements at Ivanhoe Place with Herring Road are required to reduce potential delays resulting from the redistributed traffic originating from the employment zones to the east of the site. These vehicles are expected to utilise the new bridge connection and Ivanhoe Place to access Herring Road rather than Waterloo Road as currently occurs.
- The Proposal has a minimal impact on the operation of Waterloo Road and Herring Road from that which will occur as a result of the MPBPCI. The intersection will operate with acceptable delays during the morning and evening peak periods.
- The operation of Byfield Street with Waterloo Road also benefits from the proposed bridge connection to the Ivanhoe Estate with vehicles exiting the Giffnock Avenue precinct provided with an alternate egress route to Epping Road.

Accordingly, subject to the construction of the proposed infrastructure upgrades associated with both the MPBCI and those related to this application (including the proposed bridge connection to Lyonpark Road, new left in from Epping Road and the signalisation of Ivanhoe Place with Herring Road) the impacts of the development are considered acceptable on transport planning grounds.

Key Project Recommendations

The proposed Master Plan will result in increased vehicular trips and use of the road network within the vicinity of the site, however there are opportunities to provide effective alternatives to vehicular travel through:

- Implementation of a precinct level travel demand management strategy that will encourage mode shift and trip reduction, and
- Enable future transport technologies and programs to enable travel alternatives.

There is an opportunity to develop a program of interim transport measures that could connect Ivanhoe residents to the Sydney transit network and enable a culture of public transport use as opposed to car ownership. This will ultimately have multiple benefits to the community including reducing road infrastructure requirements, placemaking of public spaces, enhancing environmental and residential health outcomes.

As such, a draft Sustainable Travel Strategy for Ivanhoe Estate has been designed and should be implemented to encourage the use of public transport, walking, cycling wherever possible for all journey purposes. A high quality active network will be provided throughout Ivanhoe Estate through continuous shared paths and crossing facilities at key locations. The design of a high quality, highly permeable network with limited delays to walk and cycle trips and which is pleasant, convenient, direct and integrated with land uses will encourage and facilitate pedestrian and cyclist accessibility.

The recommendations of this study are reflected in the package of measures developed for the project. Key points of this package include:

- Sustainable travel strategies, to include provision of marketing of public transport options and free travel
- Infrastructure improvements to provide easy pedestrian and cyclist access via a safe and efficient shared path and footpath network.
- Transport service improvements, including the implementation of a new developer funded community bus connecting the development with Macquarie Park employment zones and other local services.
- Public transport infrastructure, to provide safe and convenient means for the future residents to use public transport services and bus priority treatments to reduce the travel times for public transport users.
- Transport service improvements, including the implementation of a new bus service connecting the development Macquarie University train station and Macquarie Shopping Centre.
- Road infrastructure upgrades to provide access to the site via:
    - A signalised intersection of Herring Road and Ivanhoe Place,
    - A new ingress from Epping Road, and
    - A new bridge connection between Ivanhoe Place and Lyonpark Road.

As a comprehensive package of measures, this will meet the needs of future residents of Ivanhoe Estate while achieving a mode shift towards active and public transport. A summary of these measures and the other infrastructure related measures proposed for the project is summarised in **Table 1**.

Table 1: Package of Measures

Reference	Description
Household Travel Behaviour Measures	
1	Household Information Packs (HIPs) for each household in Ivanhoe Estate
2	One $20 Opal card for each household
Public Transport Measures	
3	Integration of public transport services
4	Improved Bus service coverage including provision of a community bus
5	Timing of bus services and development staging
6	Bus service frequencies to Service Planning Guidelines
7	Bus priority network surrounding Ivanhoe Estate
8	Design for bus priority and PT accessibility
Bicycle Measures	
9	Dedicated, high quality cycle routes
10	Bicycle parking at key locations
11	Bicycle User Group
12	Promotion of bicycle initiatives including provision of bike parking for each unit
Pedestrian Measures	
13	Highly permeable and safe pedestrian network
14	Walking school bus program
Parking Restraint Measures	
15	Restrained parking for high density residential
16	Estate co-sharing parking provision
Travel Planning Measures	
17	School travel plans
18	'Voluntary' workplace travel plans
Travel Demand Management Measures	
19	Car sharing scheme
Road Infrastructure Upgrades	
20	Signalisation of Herring Road with Ivanhoe Place
21	New Bridge connection between Ivanhoe Place and Lyonpark Road
22	New left in entry from Epping Road

1 Introduction

1.1 Background

Ason Group has prepared this Transport Management and Accessibility Plan (TMAP) report to support a Concept Development Application for the Ivanhoe Estate Masterplan, a State Significant Development (SSD) 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 Proposal. It has been prepared for Aspire Consortium on behalf of NSW Land and Housing Corporation.

In September 2015 the Ivanhoe Estate was rezoned by the Department of Planning and Environment as part of the Macquarie University Station (Herring Road) Priority Precinct, to transform the area into a vibrant centre that benefits from the available transport infrastructure and the precinct's proximity to jobs, retail and education opportunities within the Macquarie Park Corridor.

The Ivanhoe Estate is currently owned by NSW Land and Housing Corporation and comprises 259 social housing dwellings. The redevelopment of the Ivanhoe Estate is part of the NSW Government Communities Plus program, which seeks to deliver new communities where social housing blends with private and affordable housing, with good access to transport, employment, improved community facilities and open space.

The Communities Plus program seeks to leverage the expertise and capacity of the private and non-government sectors. As part of this program, Aspire Consortium, comprising Frasers Property Australia, Citta Property Group and Mission Australia Housing, was selected as the successful proponent to develop the site in July 2017.

The Masterplan DA is the first step of the planned redevelopment of the Ivanhoe Estate and will create an integrated neighbourhood including social housing mixed with affordable and private housing, as well as seniors housing, a new school, child care centres, community facilities and retail development.

1.2 Site Description

The Ivanhoe Estate site is located in Macquarie Park near the corner of Epping Road and Herring Road within the Ryde Local Government Area (LGA). The Site is approximately 8.2 hectares and currently accommodates 259 social housing dwellings, comprising a mix of townhouse and four storey apartment buildings set around a cul-de-sac street layout. An aerial photo of the site is provided in **Figure 1**.

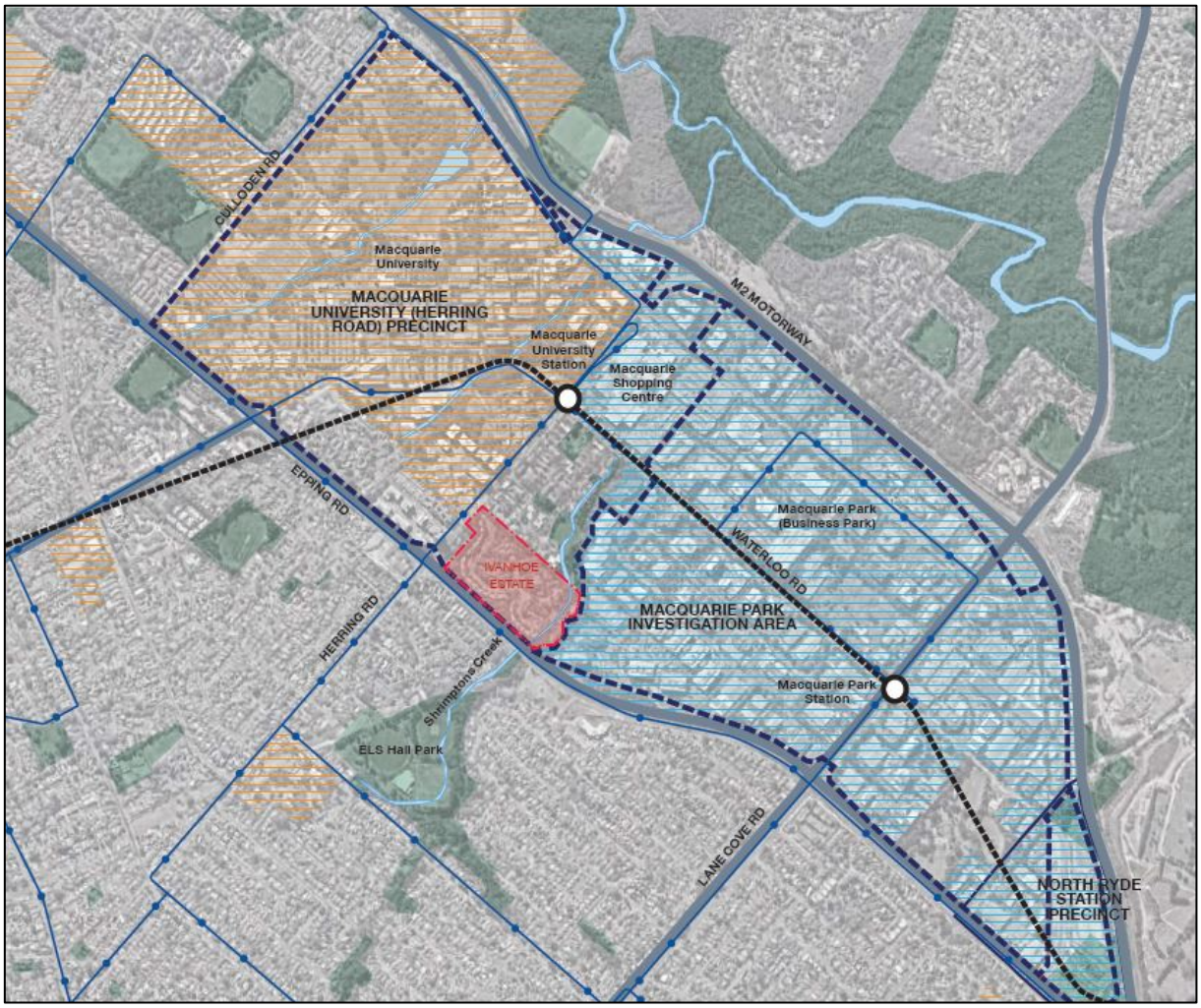

Figure 1: Site Location

Immediately to the north of the site are a series of four storey residential apartment buildings. On the north-western boundary, the site fronts Herring Road and a Lot which is currently occupied by four former student accommodation buildings and is likely to be subject to redevelopment. Epping Road runs along the south-western boundary of the site and Shrimptons Creek, an area of public open space, runs along the south-eastern boundary. Vehicle access to the site is via Herring Road.

The site is comprised of 17 individual lots and a part lot and are owned and managed by Land and Housing Corporation. The Masterplan site also incorporates adjoining land, being a portion of Shrimptons Creek and part of the commercial site at 2-4 Lyonpark Road. This land is included to facilitate a bridge crossing and road connection to Lyonpark Road.

1.3 Herring Road Urban Activation Precinct

In July 2012 the Herring Road Priority Precinct was nominated by the City of Ryde as a priority growth area due to the precincts excellent access to transport services, jobs, shopping, and education and responds to the increasing demand for housing near train stations. The location of the precinct (of which the Ivanhoe Estate forms part of) presented an excellent opportunity to build upon existing land use and movement patterns and create a transit-oriented development (TOD) focus. The extent of the Herring Road Priority Precinct is provided in **Figure 2**.

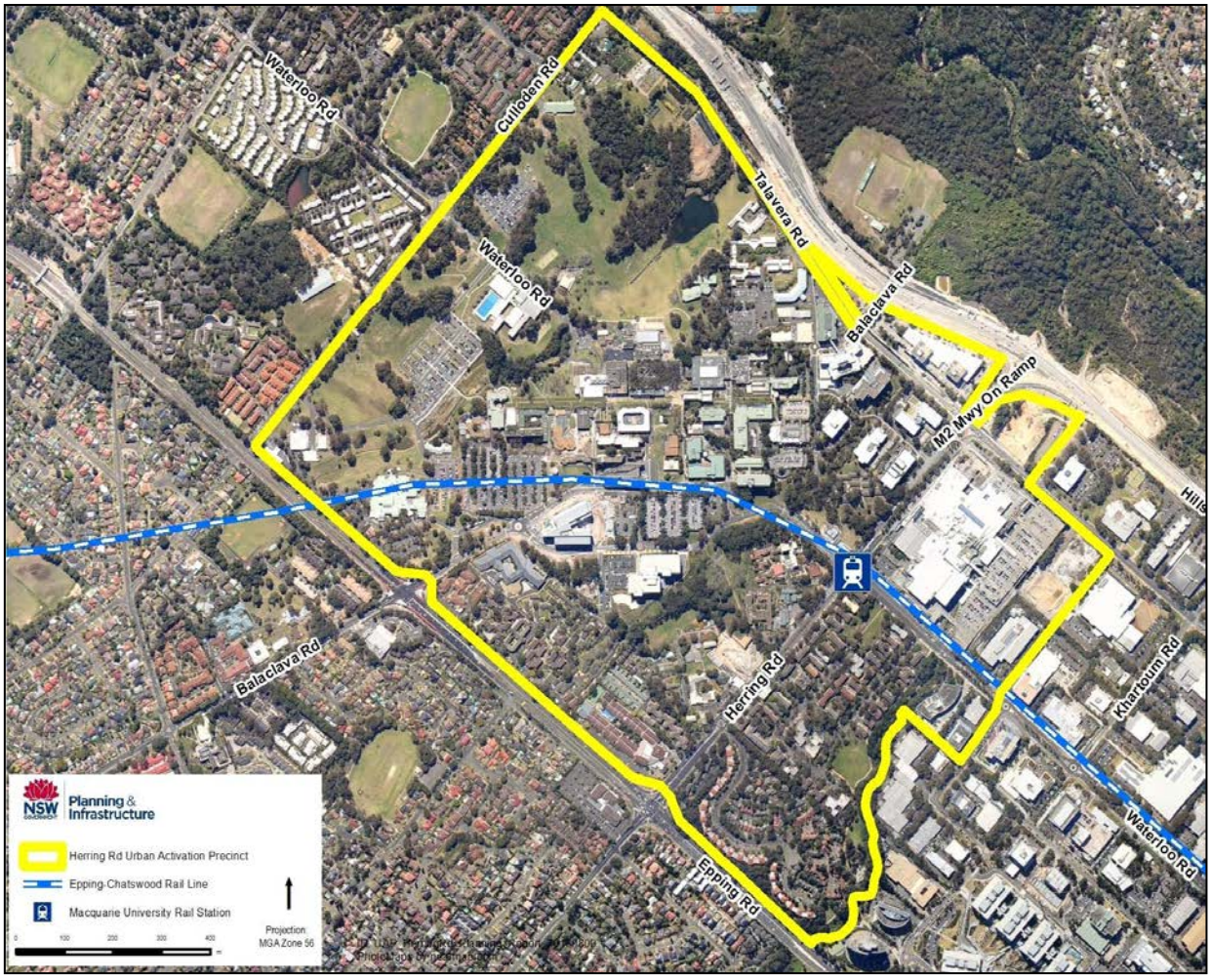

Figure 2: Herring Road Urban Activation Precinct

In relation to the transport and traffic components of the Proposal, the Herring Road precinct presented the opportunity to:

- increase the use and viability of public transport investment, matching frequent, fast, reliable public transport services and capacity with density of development
- increase residential densities in existing transport corridors to create a more connected and compact region that improves access opportunities to a greater range of metropolitan jobs
- enable mixed-use centres and residential neighbourhoods that provide opportunities for retail, employment, commercial and civic uses and a mix of medium to high density housing located within easy walking distance to transport
- promote 'active transport' to achieve shifts in transport modes that increase trips by public transport, increase cycling trips / walking trips, reduce and regulate parking and reduce 'car as driver' trips
- develop neighbourhoods with a mixed use and residential character that integrate local services and connect communities with a network of streets and paths that promote walking and cycling
- deliver new quality public spaces and improve the quality of existing public spaces and places accessible to the community
- provide opportunities for sustainability, such as energy efficiency, water conservation and water sensitive urban design

In September 2015 the precinct (including the Ivanhoe Estate) was rezoned by the Department of Planning and Environment and included:

- a mix of land uses to transform the precinct into an active place for living, learning and working
- a quality higher density urban community that utilises excellent transport infrastructure and access to job markets, educational facilities, retail, local services and recreational assets
- increased building heights and densities that can improve housing supply and choice
- a transformation of Herring Road into an active street, with wider pavements, new landscaping and new places to meet
- better connected and finer-grained streets and pedestrian / cycle and networks providing safer, more convenient and pleasant access
- opportunities for new and improved parks, spaces, playgrounds and community facilities

An illustrative Masterplan of the Herring Road precinct, is provided in **Figure 3**.

Figure 3: Herring Road Urban Activation Precinct Features

As part of the final documentation released by the Department, the Finalisation Report provides an overview of the Herring Road Priority Precinct and findings of the relevant public consultation and assessments undertaken to support the rezoning. The key findings which relate to this assessment include:

- The provision of housing in areas that are close to public transport and employment areas reduces the demand for private car use for travelling to work because of the other transport options available
- The assessment undertaken demonstrated that the "precinct can support additional residential development without major upgrades to the regional road network because of the public transport infrastructure currently available and planned in the future, as well as the changes in travel behaviour whereby people are using private vehicles less for travel during peak periods".
- The exhibited proposal suggested that car parking be provided at the rates adopted within the Council DCP

These outcomes are relevant to this assessment and form the basis of the proposed design of the Ivanhoe Estate.

1.4 Scope of Study

This TMAP has been prepared to fulfil the Secretary's Environmental Assessment Requirements (SEARs) for the preparation of an Environmental Impact Statement (EIS) for the Ivanhoe Estate Redevelopment (Concept Development Application), Macquarie Park (SSD 8707), dated 25th September 2017. Specifically, this TMAP addresses the SEARs detailed in Appendix A.

1.5 TMAP Objectives

The objectives of this TMAP are to generally:

- Meet the Secretary's environmental assessment requirements (SEARs) for the preparation of an Environmental Impact Statement (EIS) for the Ivanhoe Estate redevelopment, Macquarie Park;
- Deliver a Transit Oriented Development outcome consistent with the objectives of the Herring Road UAP;
- Integrate with the planned public transport improvements in the Macquarie Park precinct;
- Address the revised state and local mode share targets relevant to Macquarie Park;
- Deliver a sustainable transport outcome for the Site through accessibility by public transport, walking and cycling; and
- Manage the traffic impacts associated with the proposed Ivanhoe Estate development.

The purpose of the TMAP process is to formulate a package of policy, service and infrastructure measures to meet the requirements of the subject site development. This TMAP addresses local, and regional transport impacts and is also:

- a comprehensive assessment of the transport impacts (addressing both the movement of people and goods) of a major site development or re-development proposal; and
- the identification of a package of appropriate transport measures (including infrastructure, services and demand management initiatives) for the proposed development, which will help to manage the demand for travel to and from the development, and in particular, reduce the demand for travel by private car and commercial vehicle.

1.6 TMAP Study Area

This TMAP has considered the impacts of the development on the transport network around the wider Macquarie Park area, as presented in **Figure 4**. The assessment considers a public transport strategy

that allows future residents of Ivanhoe Estate to be able to travel to major transport hubs and other regional and employment centres such as Sydney CBD, Chatswood and Parramatta.

The extent of the road network over which the forecast demands and deficiencies were assessed, have been agreed with TfNSW, RMS and City of Ryde Council and confirmed in the SEARs.

Figure 4: TMAP Study Area

The intersections assessed as part of the TMAP include:

- Lyonpark Road / Epping Road
- Herring Road / Ivanhoe Place
- Herring Road / Epping Road
- Herring Road / Waterloo Road
- Waterloo Road / Byfield Street

1.7 Report Structure

This report is structured to provide an assessment of the traffic impact and transport accessibility issues relating to the proposed Ivanhoe Estate development. This report is laid out in accordance with TMAP Guidelines as follows:

- Section 1 provides an overview of the project, background information and the study objectives.
- Section 2 details the Ivanhoe Estate project, background information and Masterplan objectives.
- Section 3 provides the strategic context within which the assessment has taken place. This section provides a literature review of all relevant, state, regional, local and other documents.
- Section 4 provides details about the Ivanhoe Estate Transit Oriented Development.
- Section 5 establishes the existing transport context in the vicinity of the development site. It details a review and assessment of the existing road network to establish road network characteristics, performance criteria and any existing road network deficiencies. It also provides an overview of existing travel patterns in the region as well as existing public transport, walk and cycle provisions.
- Section 6 introduces the proposed Sustainable Travel Strategy as well as public and active transport initiatives that would assist the reduction of car dependency for the proposed development.
- Section 7 presents the traffic and transport impact assessment for the Masterplan proposal, including assessment of the road network impacts of the proposed development.
- Section 8 provides a summary of key findings and documents the package of measures to be implemented as part of the project. Timing of delivery and indicative costs for each component of the package of measures will be documented.

2 The Ivanhoe Estate Project

2.1 Introduction

The Aspire Consortium was awarded a contract by the NSW Government to redevelop the Ivanhoe Estate at Macquarie Park. The Consortium comprises of development partners, Frasers Property Australia, Citta Property Group and community housing partner, Mission Australia Housing.

The proposed Masterplan is a Concept DA (in accordance with Section 83B of the EP&A Act), which sets out the concept proposal for the development of the site. The concept contained in the Masterplan DA establishes the planning and development framework, which will form the basis for the detailed design of the future buildings and against which the future detailed DAs will be assessed.

2.2 Proposed Masterplan

The project will see the transformation of 259 social housing properties on the 8.2 hectare site into a socially integrated neighbourhood of approximately 3,500 dwellings (subject to future design development) with a maximum of GFA of 281,685m^2.

A key focus of the project is to address housing needs while providing practical opportunities to transition social housing residents to housing independence. Mission Australia Housing will provide support to assist social housing residents to connect with education, training and employment opportunities.

The redevelopment will also seek to help to meet the growing demand for education by providing a non-government co-educational vertical high school including approximately 1,000 students and two 75 place child care centres. A range of community facilities, public space and approximately 1,246m^2 of retail floor space are also proposed. **Figure 5** presents the Ivanhoe Estate Masterplan.

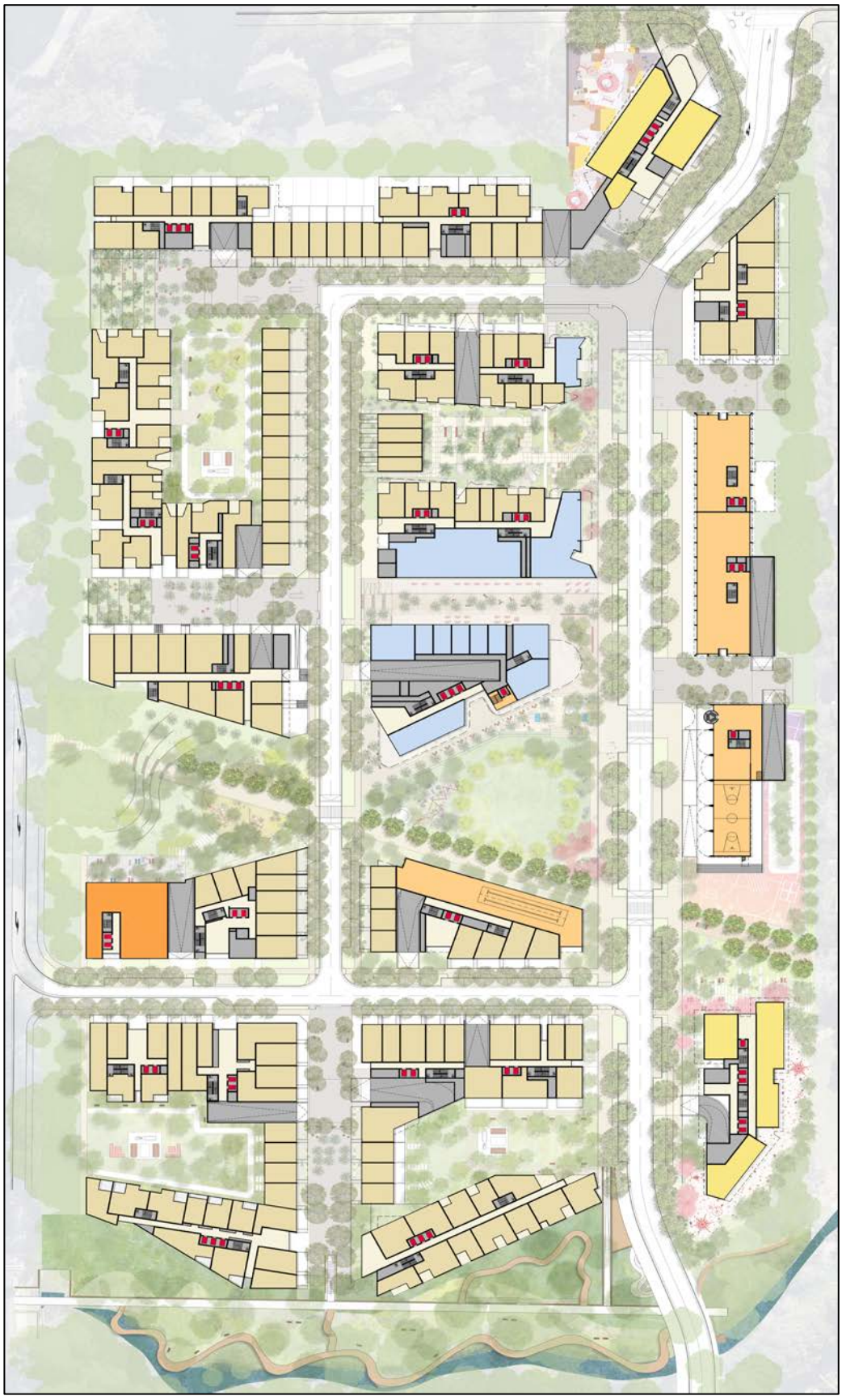

Figure 5: Ivanhoe Estate Masterplan, Site Plan

2.3 Internal Road Network and Site Access

In order to maximise the accessibility of the site to the external road network, access to Ivanhoe Estate is proposed via three locations (shown in **Figure 6**):

- A signalised intersection of Herring Road and Ivanhoe Place,
- A new ingress from Epping Road, and
- A new bridge connection between Ivanhoe Place and Lyonpark Road.

These accesses will provide for the distribution of traffic onto the broader road network and assist in minimising the impacts of the development on the existing operation of the road network.

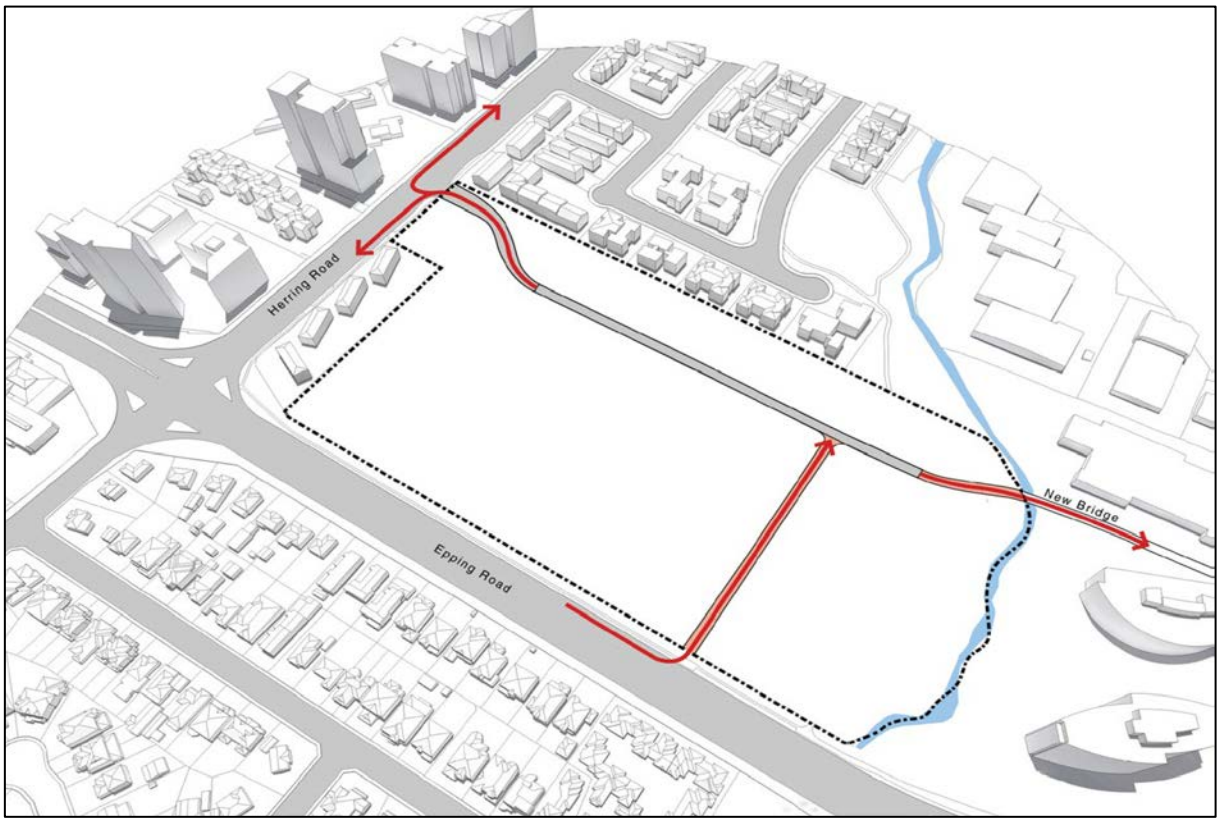

Figure 6: Ivanhoe Estate Masterplan, Site Access

The street network has been set to provide a logical integration of the site with the surrounding road network, future access locations and pedestrian desire lines, providing permeability through the future development.

The proposed road network includes the provision of a Main Street traversing an east-west connection between Herring Road and the Lyonpark Road via a proposed new bridge connection. Lower order roads have been set and aligned with the surrounding street network to create walking and cycling

connections between Ivanhoe Estate and the neighbouring recreational, educational and employment zones. **Figure 7** demonstrates the proposed internal road hierarchy.

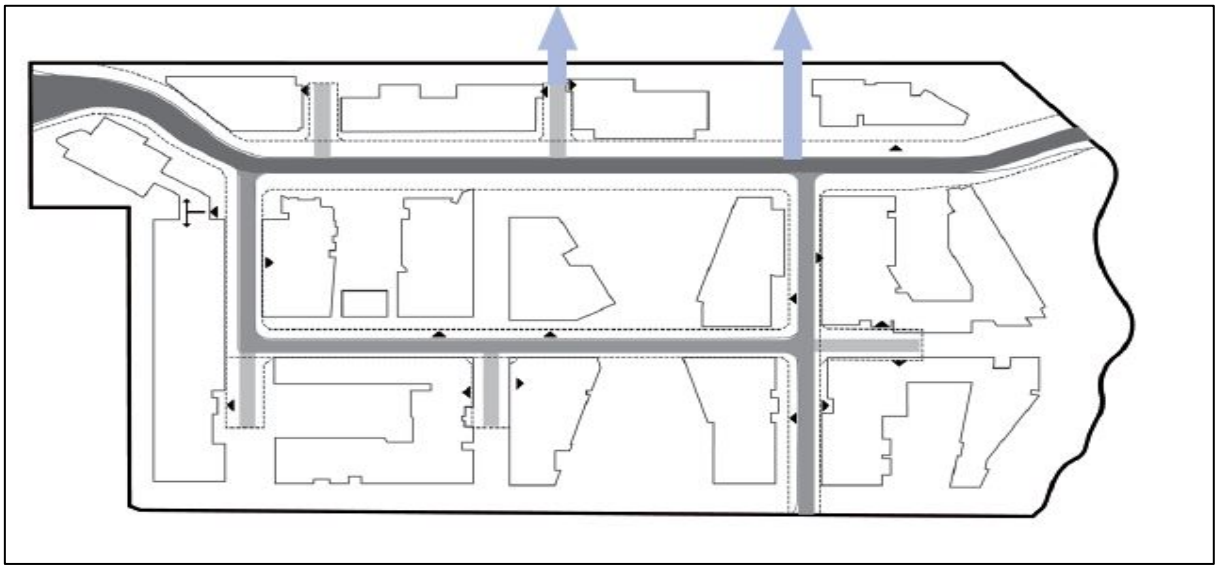

Figure 7: Ivanhoe Estate Internal Road Hierarchy

The typical road cross sections for the proposed 23.4m Main Street and 14.5m Neighbourhood Streets are provided in **Figure 8**. These roads have been developed having regard for Council's DCP and both accommodate two traffic lanes in either direction with parking provided on both sides of Main Street and on one side of the Neighbourhood Streets.

As a consequence of the signalisation of the intersection of Herring Road with Ivanhoe Place, local access for developments on the western side of Herring Road will be limited as they will no longer be able to utilise the existing roundabout, currently relied on by southbound vehicles. To mitigate against this, The Masterplan road network has been designed to facilitate the redistribution of these vehicles through the provision of connected streets, effectively providing a "U-Turn" facility. This measure will ensure that existing and future residents of developments on the western side of Herring Road are not adversely affected by the proposed signalisation of Ivanhoe Place.

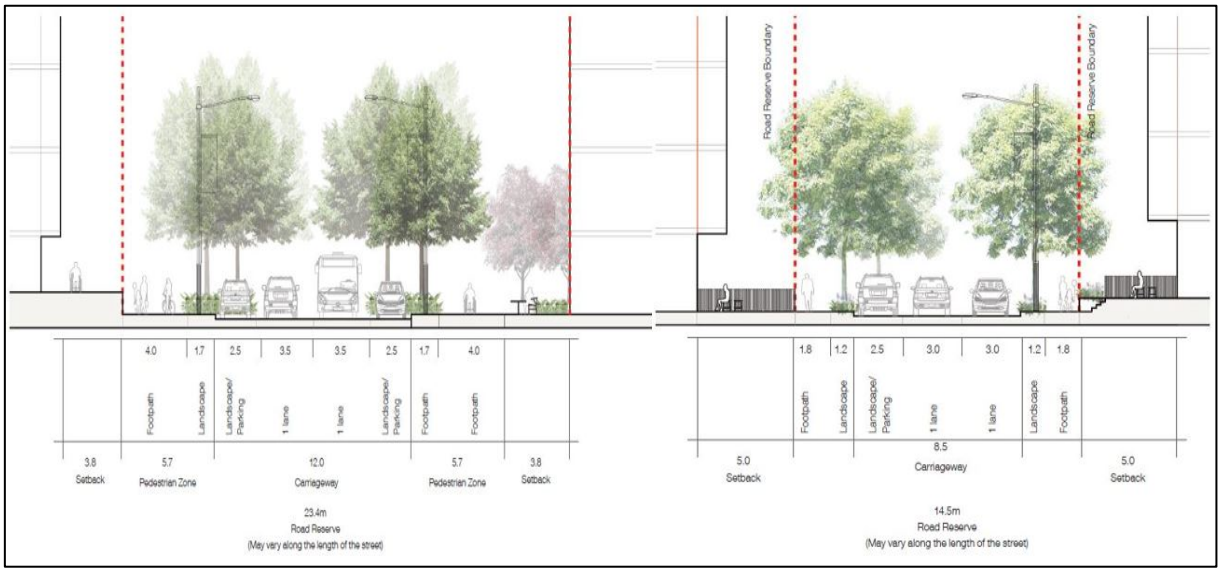

Figure 8: Ivanhoe Estate Typical Cross Sections

2.4 Pedestrian and Cycle Access

The pedestrian paths through the Site have been designed with a varying width between 1.8 to 2.4m. The routes – shown on **Figure 9** – connect along open space links providing access to the local road network and along key pedestrian desire lines, linking the site with Macquarie Park Shopping Centre and Macquarie University Railway Station. Shared paths at 4.0m in width are also provided along the length of Main Street and along the proposed bridge linking Herring Road with Lyonpark Road. This connection provides an important new pedestrian link between the employment zones of Lyonpark Road with Herring Road.

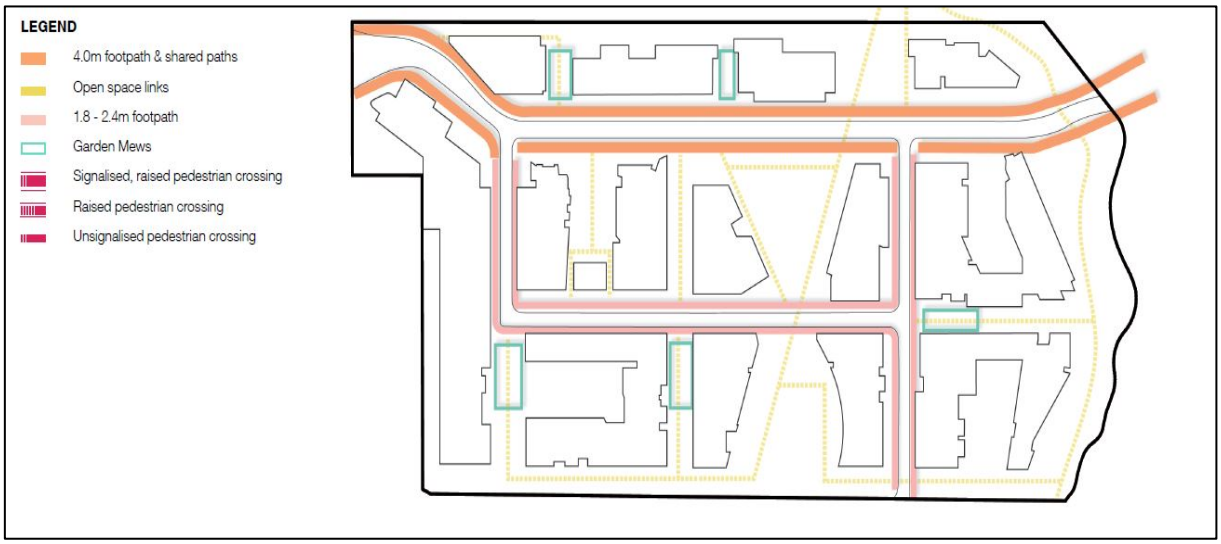

Figure 9: Ivanhoe Estate Masterplan Pedestrian Network

The proposal also includes the upgrade of the existing Shrimptons Creek pedestrian and cycle path which provides access to the regional cycle network traversing a north-south direction from the residential zones to the south of Epping Road to the north via Macquarie Shopping Centre. The cycle network proposed for the development is demonstrated in **Figure 10**.

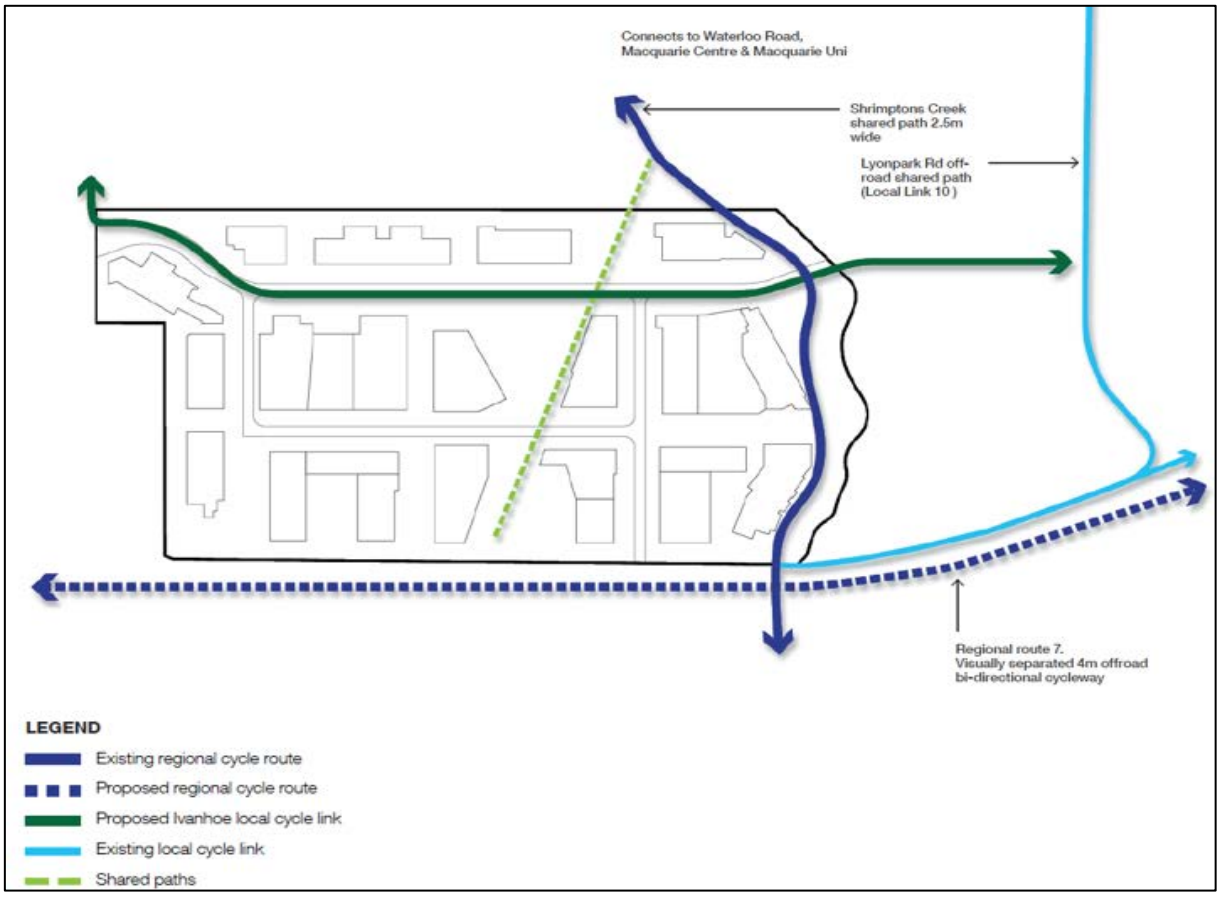

Figure 10: Ivanhoe Estate Masterplan Bicycle Network

2.5 Development Staging

The proposed staging plan is arranged to maximise the amount of public domain delivered in the first two stages of development. Stages are sequenced to maintain a consistent tenure split between social and market dwellings and to ensure that the necessary infrastructure comes online to service the relevant stages. The development staging is subject to change, however is currently envisaged to be progressed in accordance with **Figure 11**.

Figure 11: Ivanhoe Estate Staging Plan

The proposed staging plan is arranged to maximise the amount of public domain delivered in the first two stages of development. Stages are sequenced to maintain a consistent tenure split between social and market dwellings and to ensure that the necessary infrastructure comes online to service the relevant stages.

The development staging is subject to change, however is currently envisaged to be progressed in accordance with **Figure 11**.

3 Transit Oriented Development

Ivanhoe Estate offers a unique opportunity to achieve a Transit Oriented Development (TOD) within a precinct that has access to high frequency rail and bus networks, employment and educational facilities and critical services including the Macquarie Shopping Centre. The development is informed by TOD principles as it seeks to achieve transport and land integration, improved connectivity to the stations and throughout Macquarie Park and access to open space for residents.

3.1 Transit Oriented Development Principles

While there are various definitions in use around the world, there is common agreement that a TOD is characterised by:

- a rapid and frequent transit service;
- high accessibility to the transit station;
- a mix of residential, retail, commercial and community uses;
- high quality public spaces and streets, which are pedestrian and cyclist friendly;
- medium to high density development within 800 metres of the railway station; and
- reduced rates of private car parking.

The Transit Oriented Development Guide (Queensland Government) states that, in addition to these principles, transit-supportive land uses, and activities are those which:

- generate high volumes of pedestrians and transit passengers;
- generate high employment numbers or population density;
- contribute to reverse-flow movement in the transit network;
- encourage walking and cycling; and
- include activities that operate 18 or 24 hours per day throughout the week.

Ivanhoe Estate is consistent with recognised TOD principles as it would provide the following:

- mixed use development within 10 minutes' walk of the Macquarie University and Macquarie Park Stations, with greater focus on residential development, supported by appropriate community facilities;
- integration with retail, commercial, recreational and community uses therefore stimulating activity around the precinct;

- prioritisation of pedestrian and cycle activity and proximity to high quality bus and rail facilities and services;
- a high level of pedestrian and bicycle connectivity to nearby employment;
- reduced levels of private vehicle parking combined with provision for car share schemes and other transport alternatives to reduce car dependency;
- liveable and active public domain spaces for the community that integrate with proposed land uses and the stations, and
- high quality open space that is within walking distance.

3.2 Sustainability Targets

The State Government's NSW 2021 10-year plan contains targets for improving transport services and shifting trips away from the use of private vehicles toward public transport, walking and cycling. The plan also provides target mode shares for public transport for major centres in NSW. While no specific target is given for Macquarie Park, a target of increasing the proportion of total journeys to work by public transport in the Sydney Metropolitan Region to 28% by 2016 is given.

Increasing the use of walking and cycling for trips is also advocated, with the specific targets of more than doubling the mode share of bicycle trips and increasing the mode share of walking trips to 25% by 2016. The plan also aims to create planning policy that encourages job growth in centres close to where people live and to provide access by public transport.

These goals apply to the Sydney Metropolitan Region in general. Ivanhoe Estate aspires to be a TOD, hence it's transport targets should aim to achieve even higher shifts in travel behaviour away from car use than those stated in NSW 2021.

Therefore, the proposed set of transport targets for the development upon completion are:

- journey to work mode share of 30% car driver or less;
- bicycle mode share for all trips of 3%, compared to current value for the area of less than 1%;
- walking to increase to 23% of daily travel;
- provide a low provision of car parking;
- on-street car parking spaces to serve dual and complimentary uses within the estate;
- 40% non-car mode share for journeys to / from work, and
- 20% walking trips for all trip purposes.

3.3 Achieving the Principles

The TOD principles have been implemented in the Ivanhoe Estate proposal as follows:

Purpose-built concept

Ivanhoe Estate will be a mixed use neighbourhood with buildings arranged to maximise residential amenity outcomes and a diverse open space network creating an inclusive, community oriented public domain.

The urban design framework will enhance the existing character of the site, linking the established bushland corridor with a series of high quality public open spaces. A new main street is activated by community and retail uses, alongside a hard-landscaped town square and a soft-landscaped village green.

Mix of residential, retail, commercial and community uses

The Proposal seeks to contain a mix of land uses, including residential, retail, educational, commercial, a community centre, and open space. This would provide a level of activity throughout the day and night to increase passive surveillance which keeps people safe and feeling safe. The creation of active public spaces is important to overcome the quiet/closed after-hours nature of the surrounding business parks.

By providing a mix of uses near the station, people would be attracted to the public open space and toward the station, encouraging the use of public transport. Similarly, people would be encouraged to use local shops and services while accessing public transport. This practice supports both local economic development and public transport use.

People travelling between transit and their place of employment within the estate are also expected to walk either directly or from a linked public transport trip.

High quality public spaces and streets, which are pedestrian and cyclist friendly

Within a TOD, non-car trips increase when a mix of uses are easily accessible and arranged in a way that emphasises travel on foot rather than car. The transport hierarchy should promote movement of people firstly as pedestrians, secondly as cyclists, thirdly through public transport and lastly using private cars.

The pedestrian spine which runs through the middle of the development provides a strong and identifiable pedestrian connection between the major elements of the site. The pedestrian access network, based predominantly on streets, is ‘fine–grained’ (i.e. short block faces and mid-block laneways), particularly within the core.

The circulation network within the estate reinforces vehicle speeds, making the road network more cycle and pedestrian friendly providing direct, safe, convenient, continuous and legible cycling and walking networks throughout. The network radiates from the estate and into networks in the surrounding areas providing excellent permeability for all modes of transport, thereby providing direct routes and reducing trip lengths for all (including vehicle trips).

High density and close to a transit station

Residential or employment development near transit stations provides a ready market for transit trips. Consequently, higher densities strengthen the demand for transit. The development in Ivanhoe Estate TOD is at higher density in relation to the existing surrounding development pattern and would locate the highest passenger-generating land uses in close proximity (within 5 minutes' walk) to Macquarie University Station, several bus stops and the bus interchange on Herring Road. This close proximity matches resident and employee expectations of a short walk to/from their work/home location and the transit station.

Reduced parking

Parking is one of the most challenging aspects of any TOD. Over provision of parking discourages public transport use and would undermine the principles set above. A small amount of short stay parking would be needed to support retail activity. The limited amount of parking provided (in compliance with City of Ryde DCP) would be made available for shared use, where possible, to maximise efficiency and reduce the total amount of parking required.

Having regard to the principles and measures above, the aim of the project in terms of transport and movement related activities is to provide a development that prioritises non car travel modes and minimises vehicle and pedestrian conflicts.

4 Policy and Planning Context

4.1 Introduction

The strategic context of the study area is governed by three frameworks, being:

- State and regional strategic planning policies;
- Regional transport planning policies;
- And local transport planning context.

This section provides an overview of the main aspects of each of these and relevance to the study area.

4.2 State and Regional Strategic Planning Policies

NSW Government objectives related to transport and land use planning are detailed in several policies and planning documents. The relationship between these policies and planning documents is shown in **Figure 12** and their relevance to Macquarie Park is described below.

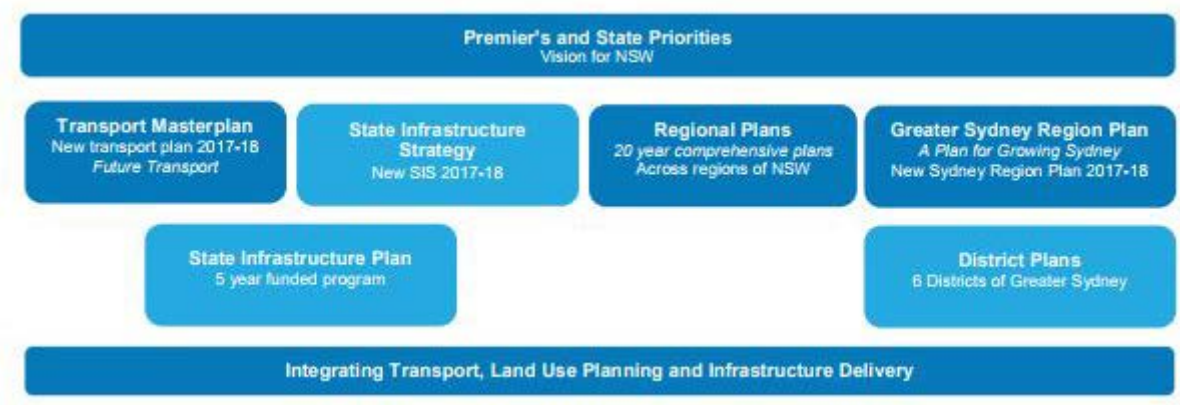

Figure 12: Relationship between NSW Government policies and planning documents

4.2.1 NSW State Priorities

NSW Government has committed to improving outcomes for the people of NSW – with clear goals and accountability by:

Improving road travel reliability – to ensure consistency of journey times on key roads continues to improve, we are working to make better use of existing road infrastructure, build extra road capacity and encourage commuters to use public transport and to undertake off-peak travel more often. This will

enable businesses and the community to move around the city with greater ease, reducing travel times, boosting productivity and reducing business costs.

Increase housing supply across NSW - Deliver more than 50,000 approvals every year A Plan for Growing Sydney estimates that Sydney will need 664,000 new homes over the next 20 years. The government is supporting future growth by establishing housing targets across NSW and providing record allocations to the Housing Acceleration Fund to build the infrastructure to support this growth.

Creating sustainable social housing – Increase the number of households successfully transitioning out of social housing by 5% over three years. Addressing the growing demand for social housing – and ensuring that it provides a sustainable safety net to the most vulnerable – requires a number of strategies. Working with households to successfully and safely transition them out of social housing increases the ability of those households to participate in the economy and exit the cycle of entrenched disadvantage.

Ensure on-time running for public transport – Maintain or improve reliability of public transport services over the next four years. Public transport services in Sydney are crucial in getting customers to their destinations. Although Sydney is undergoing a large amount of infrastructure construction, we are working to ensure that public transport services continue to run on time. The government is also improving integration across public transport services, updating timetables and providing clear information to get people to their destinations on time.

Ivanhoe Estate will contribute to achieving these goals through the development of a Transit Oriented integrated community of approximately 3,500 dwellings (subject to future design development), including approximately 1000 social housing units and 128 affordable rental units, over the next 10 to 12 years. As the first major project being delivered under the Future Directions and the Communities Plus program, the project will increase the supply of social housing properties by almost fourfold, which means more people in need can move off the social housing waiting list.

Connectivity and permeability of the urban design encourages public transport use.

4.2.2 NSW Long Term Transport Masterplan

The NSW Long Term Masterplan sets the framework for the NSW Government to deliver an integrated, modern transport system that puts the customer first and is principally focused on six key transport challenges:

1. Integrating modes to meet customer needs

2. Getting Sydney moving again

3. Sustaining growth in Greater Sydney

4. Providing essential access to regional NSW

5. Supporting efficient and productive freight

6. State-wide actions

The Masterplan responds to these challenges through four actions:

1. Integrating transport services

2. Modernising our system

3. Growing our networks to meet future demand

4. Maintaining important road and public transport assets

As a result of these actions, the Ivanhoe Estate residents and employees will benefit from:

- Rapid and more frequent services via the development of the Hurstville to Macquarie Park and Parramatta to Macquarie Park strategic bus corridors;
- Construction of a cycleway from North Ryde to Macquarie University (Waterloo Road, Macquarie Park);
- Strengthening of public transport links between Parramatta, the Sydney CBD, North Sydney and Macquarie Park;
- Increased train services to Macquarie University and Macquarie Park;
- The preservation of the Macquarie Park to Sydney Olympic Park and Parramatta to Macquarie Park major transport corridors for future transport requirements.

4.2.3 Future Directions for Social Housing in NSW

The eight hectare Ivanhoe Estate at Macquarie Park (currently with 259 social housing dwellings), will be transformed into a high quality integrated community with market, social and affordable dwellings. In contributing to the NSW Government's objectives of providing more social housing, more opportunities, support and incentives to build housing independence and provide better social housing experience, the community will drive better outcomes for tenants including helping those who are unable to transition out of social housing.

4.2.4 NSW Planning Guidelines for Walking and Cycling

The guidelines were developed to assist land use planners and related professionals to improve consideration of walking and cycling in their work. It is anticipated that this will ultimately create more opportunities for people to live in places with easy walking and cycling access to urban services and public transport.

Assistance is provided by these guidelines in the form of principles, background information, case studies and references to other supportive policies and guidelines. This information can be used to develop planning instruments, at all levels, that are supportive of walking and cycling.

A TMAP has been prepared for the NSW Government and City of Ryde Council to guide the redevelopment of the Macquarie Park employment corridor in this regard for the next 15 to 20 years.

4.3 Regional Transport Context Documents

4.3.1 Draft North District Plan

This draft District Plan includes three chapters focusing on the means to enhance the District's productivity, sustainability and liveability in accordance with A Plan for Growing Sydney and the Commission's mandate.

Macquarie University Station (Herring Road) Priority Precinct will deliver up to 5,800 new homes by 2031 and includes the redevelopment of Ivanhoe Estate. The rezoning proposal for the precinct was finalised in September 2015 and development will be staged over the next 10 to 20 years.

The North District will continue to require social housing, and much of this provision will come through Communities Plus. One of the four Communities Plus initiatives underway in Greater Sydney is Ivanhoe Estate. It currently accommodates 259 social housing dwellings that will be transformed into an integrated community that combines more social housing mixed with affordable and private housing.

The Ivanhoe Estate was rezoned as part of the Macquarie University Station (Herring Road) Priority Precinct. The Precinct optimises the use of existing and planned infrastructure and is well located for rail and bus services. It also has easy access to a major shopping centre, includes a top-ten university campus and is close to a growing local jobs market.

4.3.2 A Plan for Growing Sydney

A Plan for Growing Sydney aims to develop a competitive economy with world-class services and transport; to deliver greater housing choice to meet our changing needs and lifestyles; to create communities that have a strong sense of wellbeing; and to safeguard our natural environment by:

- Accelerating urban renewal across Sydney at train stations, providing homes closer to jobs;
- Growing a more internationally competitive Sydney CBD;
- Growing Greater Parramatta as Sydney's second CBD;
- Transforming the productivity of Western Sydney through growth and investment;
- Enhancing capacity at Sydney's Gateways – Port Botany, Sydney Airport, Badgerys Creek Airport;
- Delivering the infrastructure that is needed;
- Promoting Sydney's arts and culture, tourism and entertainment industries;
- Protecting our natural environment; and
- Managing long-term growth;

The priorities for Macquarie Park are to:

- Work with council to retain a commercial core in Macquarie Park for long-term employment growth;
- Work with council to concentrate capacity for additional mixed-use development around train stations, including retail, services and housing;
- Facilitate delivery of Herring Road, Macquarie Park Priority Precinct, and North Ryde Station Priority Precinct;
- Investigate potential future opportunities for housing in areas within walking distance of train stations;
- Support education and health-related land uses and infrastructure around Macquarie University and Macquarie University Private Hospital;
- Support the land use requirements of the Medical Technology knowledge hub;
- Investigate a potential light rail corridor from Parramatta to Macquarie Park via Carlingford;
- Investigate opportunities to deliver a finer grain road network in Macquarie Park;
- Investigate opportunities to improve bus interchange arrangements at train stations; and
- Work with council to improve walking and cycling connections to North Ryde train station.

4.3.3 Towards our Greater Sydney 2056

The drafted amendment to A Plan for Growing Sydney aligns with the vision established in the draft District Plans. This amendment reconceptualises Greater Sydney as a metropolis of three cities:

- Established Eastern City
- Developing Central City
- Emerging Western City

The Established Eastern City includes the Sydney City and economic corridors to its north through to Macquarie Park and south through Sydney Airport and Port Botany to Kogarah.

4.3.4 Development Near Rail Corridors and Busy Roads – Interim Guideline

To assist in reducing the health impacts of rail and road noise and adverse air quality on sensitive adjacent development this guideline is used in the planning, design and assessment of development in, or adjacent to, rail corridors and busy roads.

It contains general guidance for council strategic planning purposes, and also for other government agencies or private proponents investigating possible locations for residential development, places of worship, hospitals, child care centres and schools. It also provides guidance on site selection to reduce or avoid the need for mitigation measures

The Ivanhoe Estate Masterplan places significant emphasis on the delivery of an integrated transport and land use development that maximises the benefits of the State Government's investment in public transport.

4.3.5 Sydney's Bus Future 2013

Transport for NSW has a mandate to deliver simpler, faster and better bus services for customers, and attract more customers to use bus services throughout Sydney via a three-tiered network that will operate with each level delivering a defined level of service, consistency and reliability.

The bus interchange within 800m of Ivanhoe Estate as well as the routes surrounding the Site will be intrinsic components of Sydney's Bus Future by:

- Improving bus customers' experience;
- Integrating bus services across Sydney; and
- Serving future growth.

4.3.6 Sydney's Walking Future 2013

Three pillars of Sydney's Walking Future attempt to get people in Sydney walking more through actions that make it a more convenient, better connected and safer mode of transport:

- CONNECT through infrastructure and technology
- PROMOTE benefits and provide information
- ENGAGE through policy and partnerships

In 2011-12, the NSW Government delivered 65 pedestrian infrastructure projects, including the delivery of a $5 million pedestrian footbridge at Macquarie Park connecting Epping High School students and local residents to locations across Epping Road.

Transport Management Associations, which are partnerships across multiple levels of government and local businesses, are being piloted at Macquarie Park and will be rolled out progressively in other areas of Sydney.

4.3.7 Sydney's Cycling Future 2013

Three pillars of Sydney's Cycling Future attempt to make riding a safer and more convenient option, and encouraging residents to ride bikes for everyday transport:

- CONNECT safe, connected networks;
- PROMOTE better use of existing Infrastructure; and
- ENGAGE through policy and partnerships

Bicycle network plans will be developed with councils within five kilometre catchments of Major Centres, including Macquarie Park.

Transport Management Associations, which are partnerships across multiple levels of government and local businesses, are being piloted at Macquarie Park and will be rolled out progressively in other areas of Sydney.

4.4 Local Planning Context

4.4.1 Ryde Local Environmental Plan 2014

Ryde Local Environmental Plan (LEP) 2014 is a comprehensive Plan for the City of Ryde and together with the Ryde Development Control Plan (DCP) 2014 provides the necessary framework for how the City of Ryde will advance. It also balances the needs of residents, businesses and investors today with those of future generations.

4.4.2 City of Ryde DCP 2014 – Part 4.5 Macquarie Park Corridor

The Development Control Plan (DCP) 2014 provides guidelines, objectives and controls for people who wish to carry out development in the City of Ryde. Part 4.5 provides objectives, controls and design criteria to achieve desirable development outcomes in line with Council's vision for the Macquarie Park Corridor.

4.4.3 City of Ryde 2025 Community Strategic Plan

The City of Ryde 2025 Community Strategic Plan developed seven key outcomes for the Ryde LGA that responds to the clear and consistent priorities of the community including:

1. Liveable neighbourhoods
2. Wellbeing
3. Prosperity
4. Environmental sensitivity
5. Connections
6. Harmony and culture
7. Progressive leadership

Transport solutions for Macquarie Park and the university will be explored through a Transport Management Authority. Supporting a night time economy at the intersection of the university and the business park will provide additional animation to the precinct, making it attractive to the younger workforce that responds to the needs of innovative industry.

4.4.4 CoR Section 94 Development Contributions Plan (Interim Update 2014)

Section 94 of the Environmental Planning and Assessment Act 1979 enables Councils to levy contributions for public amenities and services as a consequence of development.

Sections in the Plan that are relevant to this TMAP are:

Section 3.6 Roads and Traffic Management Facilities Strategy Plan – significant investment in road infrastructure is required to facilitate and service future development within the Macquarie Park Corridor. This infrastructure will not provide significant benefit to residents or workers outside the Macquarie Park Corridor. Future employment development within this area will therefore be expected to provide or fund proposed road infrastructure.

Section 3.7 Transport and Accessibility Strategy Plan – Council has exhausted the opportunities for new parking spaces to be provided on Council-owned sites and by optimising on-street parking. Any further parking that is to be provided within the LGA centres requires acquisition of land and construction of new facilities.

Section 3.8 Cycleways Strategy Plan – The establishment of demand for cycleways requires consideration of the expected use of such facilities by the population. Cycleways often serve a dual role as pedestrian networks. Therefore, demand for walkways and bikeways can be assessed on the potential demand for pedestrian access as well as use by those riding bicycles.

Council's Section 94 Development Contributions Plan applies to all land within the Ryde local government area.

4.4.5 Macquarie Park Pedestrian Access and Mobility Plan

This plan provides a framework for developing safe and convenient pedestrian routes and fostering improvements in personal mobility.

Recommended actions are identified in the form of the PAMP Action Plan. The PAMP Action Plan also explores potential funding sources for the works identified in the plan.

Key issues:

- Lack of pedestrian crossing/ need for increased pedestrian crossings
- Pedestrian safety at all crossing
- Pedestrian safety at other locations
- Motorist behaviour

- Poor lighting/ request for improved lighting
- Widen footpath

Main locations of concern:

- Waterloo Road (between Herring Road and Khartoum Road, particularly at the Byfield Street and Khartoum Road roundabouts)
- Herring Road (around Macquarie Centre and Ivanhoe Place)
- Rivett Road (near Lucknow Road and Julius Avenue)
- Lane Cove Road (between Talavera Road and Waterloo Road)

4.4.6 Macquarie Park Traffic Study

The Traffic Study considers the needs and effects of the Structure Plan components of the Ryde DCP 2010 Section Part 4.5 Macquarie Park. The Traffic Study and the Pedestrian Study are designed to complement each other. When combined and implemented through the development process, the studies will each provide a solid foundation for an improved, integrated transport management approach which gives equal weighting to the needs of pedestrians and vehicles in Macquarie Park.

A target of 40% public transport mode share is achievable with the significant improvements in public transport in Macquarie Park and the introduction of workplace travel plans and workplace travel co-ordinators.

Key traffic generators in 2031 will be the Macquarie University, Macquarie Park Shopping Centre and Macquarie Park east of Lane Cove Road, as well as a significant increase in through traffic on the M2 to a lesser extent on Lane Cove Road.

Major infrastructure improvements are required at key locations on the major road system, particularly at Herring Road and Delhi Road interchanges with the M2, with an additional westbound off ramp from the M2 needed at Lane Cove Road or Waterloo Road.

5 Transport Context

This section outlines the existing travel behaviour of residents and employees in the general location of the Macquarie Park precinct. It also looks at locations with similar characteristics to inform the travel behaviour of the future residents of the Ivanhoe Estate. This section also describes the existing public transport and active transport infrastructure (both existing and future) and the current transport capacity and performance of the surrounding roads. This information will provide a benchmark from which to assess the likely changes attributable to the Project.

5.1 Travel Behaviour

Travel behaviour of residents and employees of the future development can be estimated through review of both the existing behavioural characteristics of residents and employees of Macquarie Park and of similar TOD locations. In this regard travel behaviour varies depending on a number of particular characteristics including:

- Trip purpose,
- Mode of transport, and
- The time in which a trip occurs.

A number of data sets are available which provide context to these characteristics which can assist at deriving future trip generations for the Project. These data sets include:

- Transport for NSW House Hold Travel Survey data (HTS), which provides travel data for personal travel behaviour within the Sydney Greater Metropolitan Area.
- The Australian Bureau of Transport Statistics Journey to Work data, which is based on the travel behaviour recorded through the Australian Bureau of Statistics 5 yearly Census. The data provides information on employment locations and method of travel to work.

A summary of the relevant travel patterns resulting from the above is discussed below.

5.1.1 Trip Purpose

Trips generated on the network occur for a variety of purposes including commuting to work, educational trips, recreational trips and others. The purpose of trips undertaken also varies through the day with for example a greater number of commuter trips occurring in the morning compared to the middle of the day. Data published for the 2014-2015 HTS has been used to provide an estimate of the likely future

trip purpose of residents of the Ivanhoe Estate. A summary of these trips for daily movements for the Ryde – Hunters Hill SA3 area and the adjusted morning peak period are provided in **Table 2**.

Table 2: Daily Trip Movements for the Ryde – Hunters Hill SA3 Area

Trip Purpose	Daily % of Total Trips	AM Peak % of Total Trips
Work	28%	45%
Education	12%	23%
Shopping	20%	10%
Other	40%	22%

5.1.2 Transport Mode Share

The choice of travel mode is influenced by a range of variables including access to public transport, location and access of employment, proximity to retail services and car ownership levels. The Macquarie Park precinct currently operates as a commercial centre providing predominantly 'destination' employment land uses (including education facilities and shopping centres), with limited residential 'origin' land uses.

A summary of the current mode share splits for the Herring Road precinct is presented in **Table 3**, as documented in the Aecom report prepared for the Herring Road UAP dated December 2013.

Table 3: Herring Road Precinct – Mode Share Splits

Mode Type	% Mode Share
Vehicle Driver	31%
Vehicle Passenger	2%
Train	23%
Bus	9%
Walk / Other	24%
Work From Home	*11%*

5.1.3 Journey-To-Work Destinations

The 2011 Census and associated Journey to Work data also provides an understanding of the existing and likely future destinations of employees within the Ivanhoe Estate. The existing employment destinations of residents within the Herring Road UAP are illustrated in **Table 4**.

Table 4: JTW Destinations

Origin	Destination	Zone	% of all trips
Herring Road UAP Travel Zones: 1544, 1539, 1541, 1543	Ryde - Hunters Hill (including MP)	12602	41%
	Sydney Inner City	11703	16%
	Chatswood - Lane Cove	12101	13%
	North Sydney - Mosman	12104	5%
	Hornsby	12102	2%
	Warringah	12203	2%
	Parramatta	12504	2%
	Ku-ring-gai	12103	1%
	Others		19%
	Total		**100%**

The data demonstrated 41% of existing residents within the Macquarie Park travel zones travelled to the Ryde - Hunters Hill for work. Other major journey-to-work destinations include Sydney Inner City (16%), Chatswood - Lane Cove (13%), and North Sydney - Mosman (5%). This demonstrates again that the likely future travel patterns of residents will be consistent with a TOD location with a high proportion of residents living and working within a similar location.

5.2 Rail Services

5.2.1 Rail Infrastructure

The Integrated Public Transport Service Planning Guidelines, Sydney Metropolitan Area (TfNSW, December 2013), states that train services influence the travel mode choices of areas within 800 metres walking distance (approximately 10 minutes) of a train station. It is therefore noteworthy that the main access of the Site is located approximately 400 metres from Macquarie University railway station, on the future Sydney Metro Northwest line (currently referred to as the Chatswood to Epping Rail Link). Accordingly, a significant proportion of future commuters travelling from the Site would be expected to use train services. An overview of the distance from the intersection of Herring Road and Ivanhoe Place to available public transport is presented in **Figure 13**.

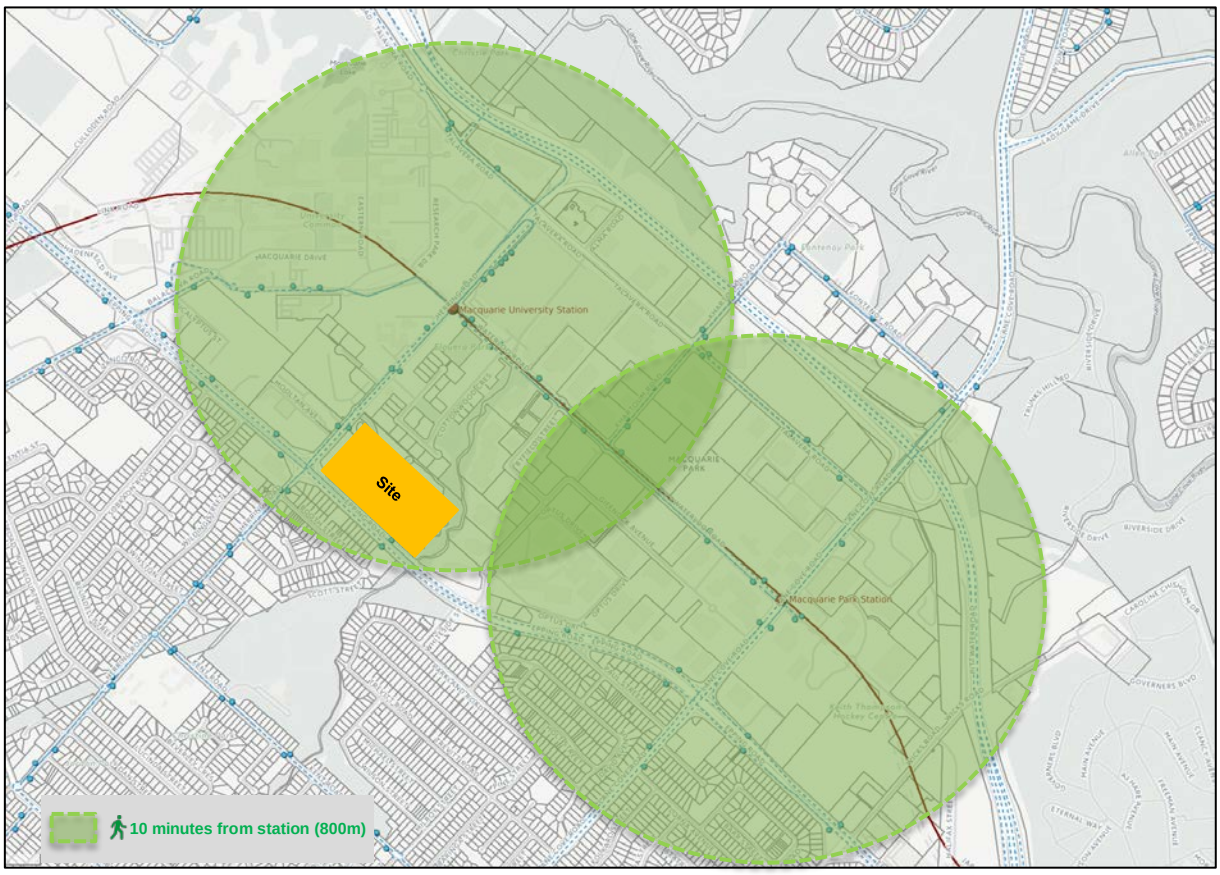

Figure 13: Distance to nearby Public Transport Services

It is anticipated that service frequencies will increase upon conversion of the Chatswood to Epping Rail Link to part of the Sydney Metro, The Integrated Public Transport Service Planning Guidelines, Sydney Metropolitan Area (TfNSW, December 2013), states that train services influence the travel mode choices of areas within 800 metres walking distance (approximately 10 minutes) of a train station. It is therefore noteworthy that the main access of the Site is located approximately 400 metres from Macquarie University railway station, on the future Sydney Metro Northwest line (currently referred to as the Chatswood to Epping Rail Link). Accordingly, a significant proportion of future commuters travelling from the Site would be expected to use train services.

The T1 railway network line runs through Macquarie University station, providing train services towards the City as well as to northern areas, as summarised below:

- T1 North Shore and Northern Line:
  - City to Berowra via Gordon (and return)
  - City to Hornsby via Macquarie University (and return)
- T1 Northern Line: City to Epping and Hornsby via Strathfield (and return).

Connections to intercity train services and other services on the rail network are available at Epping and Chatswood stations, in addition to a range of alternative services from Central Station.

Trains currently operate at Macquarie University railway station frequently to both directions (Citybound and northbound), on weekdays and weekends, between 5:30 am and midnight. The frequency of existing train operation during peak hours of a weekday vary between 10 and 15 minutes, on each direction. **Table 5** summarises the peak hour train frequencies at this station on a typical weekday.

Table 5: Existing Train Frequencies – Macquarie University T1 Line

Station – Line	To Epping	To Chatswood	Total
Morning Peak Hour (8-9AM)	7	4	11
Afternoon Peak Hour (5-6PM)	4	7	11

The Sydney Trains Network Map is shown in **Figure 14**.

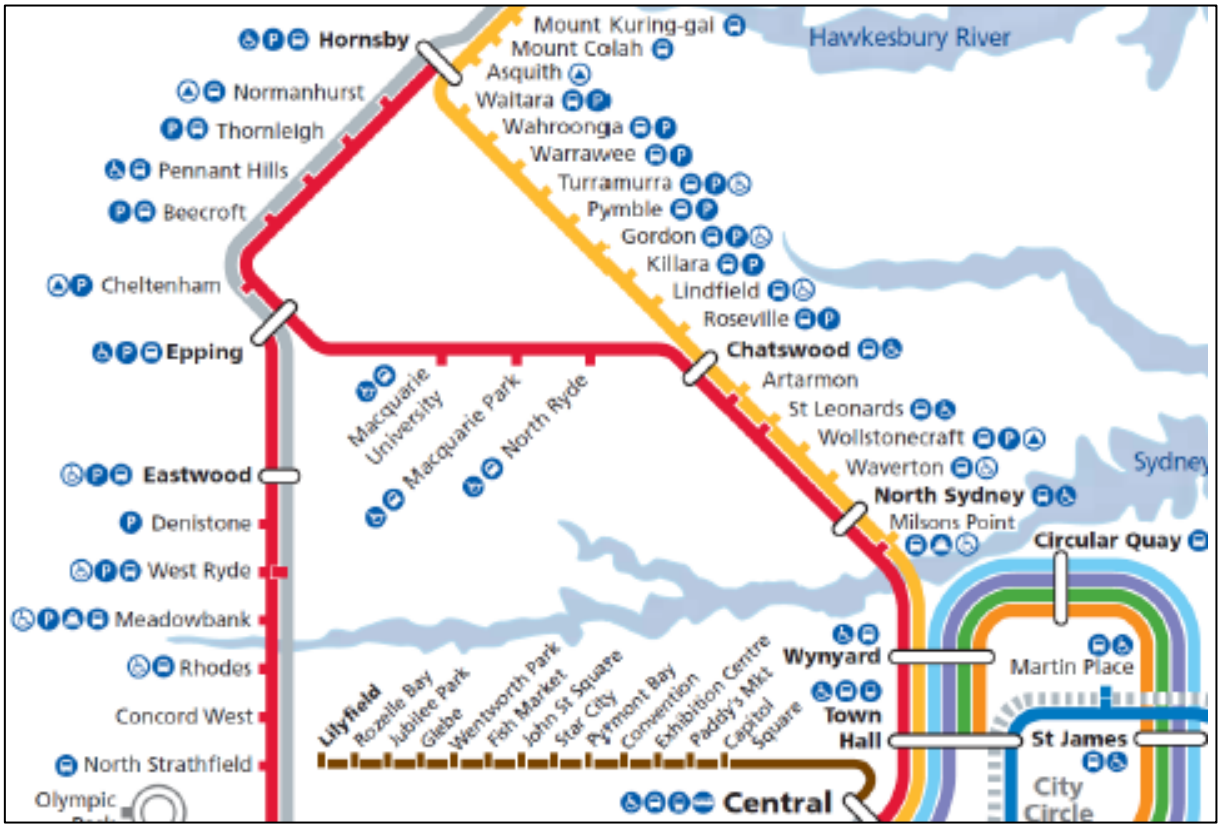

Figure 14: Suburban Rail Network

5.2.2 Sydney Metro Northwest

The Sydney Metro is a new standalone rail network identified in Sydney's Rail Future and consists of the Sydney Metro Northwest (SMNW) and the Sydney Metro City & Southwest. Sydney Metro Northwest is the first stage of Sydney Metro and will be the first fully-automated metro rail system in Australia. Sydney Metro City & Southwest is the second stage.

Sydney Metro Northwest is an integrated transport solution from Rouse Hill through to Chatswood. Sydney Metro Northwest will connect directly with the existing Epping to Chatswood railway to allow the new trains to operate 36 kilometres between Rouse Hill and Chatswood. While the second harbour crossing is being delivered, extending metro rail from Chatswood, customers will need to walk across the platform at Chatswood to change to an existing service. The proposed stations for the new Sydney Metro is shown in **Figure 15**.

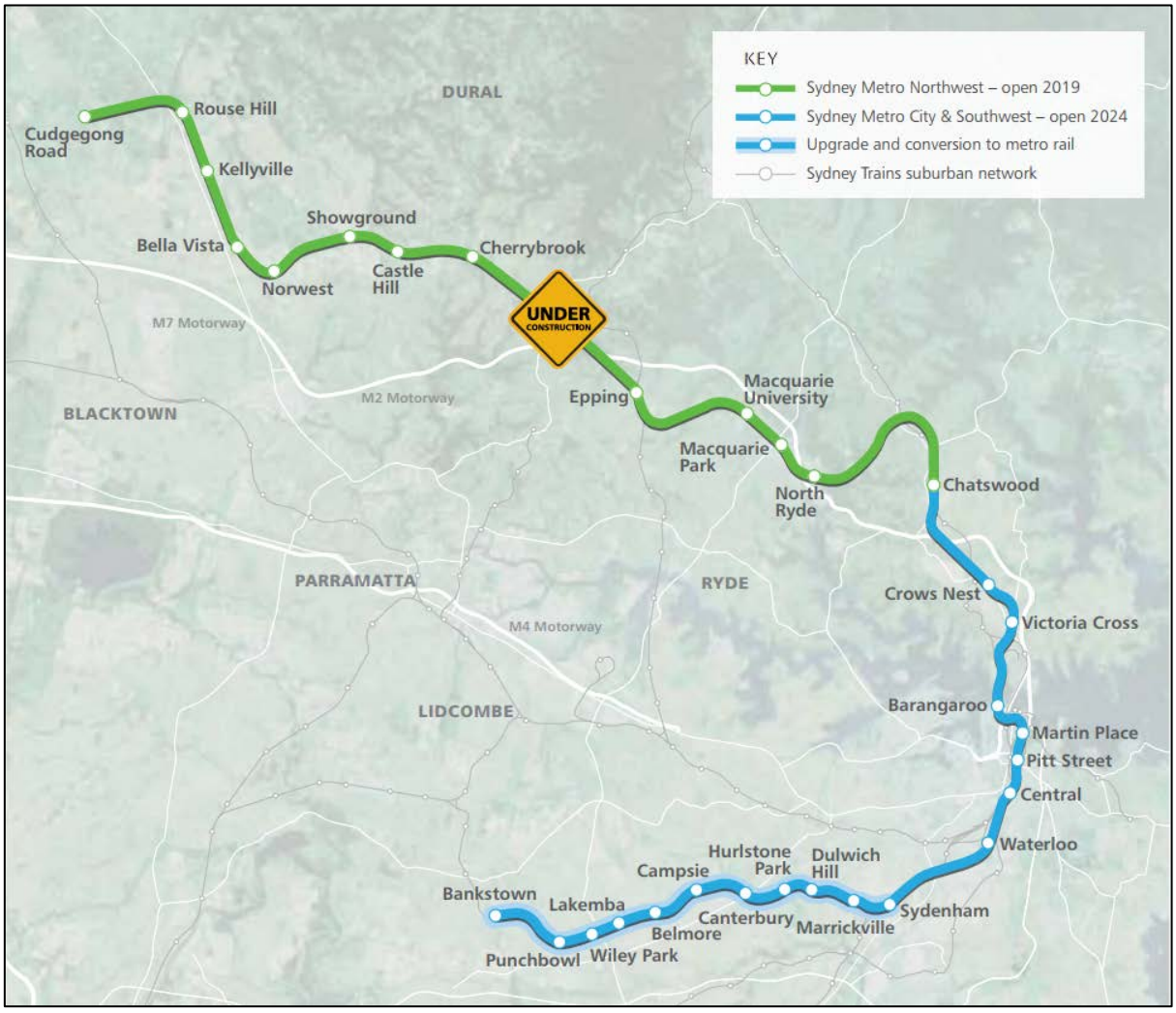

Figure 15: Proposed Stations for the SMNW

The key project features include:

- A train at least every 4 minutes in the peak
- 4000 commuter car parking spaces
- 8 new railway stations
- 5 existing railway stations upgraded
- 36km total project length
- 23km of new metro line
- 15km twin tunnels
- 4km elevated skytrain

Sydney Metro Northwest is delivering eight new railway stations and 4000 commuter car parking spaces to Sydney's growing North West. In peak hours, there will be a train at least every four minutes. On the North Shore Line from Chatswood towards the city, there will be a train every three minutes.

To convert the existing suburban line to next-generation metro standards, major upgrades will be needed, including overhauling the stations, 26 kilometres of new cabling, power and signalling systems and customer improvements such as platform screen doors. The five existing stations along the line, at Epping, Macquarie University, Macquarie Park, North Ryde and Chatswood, will have screen doors along the full length of the metro platforms to keep people and objects away from the tracks, improving customer safety and allowing trains to get in and out of stations much faster.

Sydney Metro Northwest will deliver, for the first time, a reliable public transport service to a region which has the highest car ownership levels per household in NSW. Over the coming decades, an extra 200,000 people will move into Sydney's North West, taking its population above 600,000, or twice the size of Canberra.

5.3 Bus Services

5.3.1 Existing Bus Services

The Macquarie Park precinct and specifically the Herring Road precinct is well serviced by bus infrastructure with the major bus interchange located approximately 400m from the site at the Macquarie Shopping Centre. The bus routes currently operating in Macquarie Park are presented in **Figure 16**.

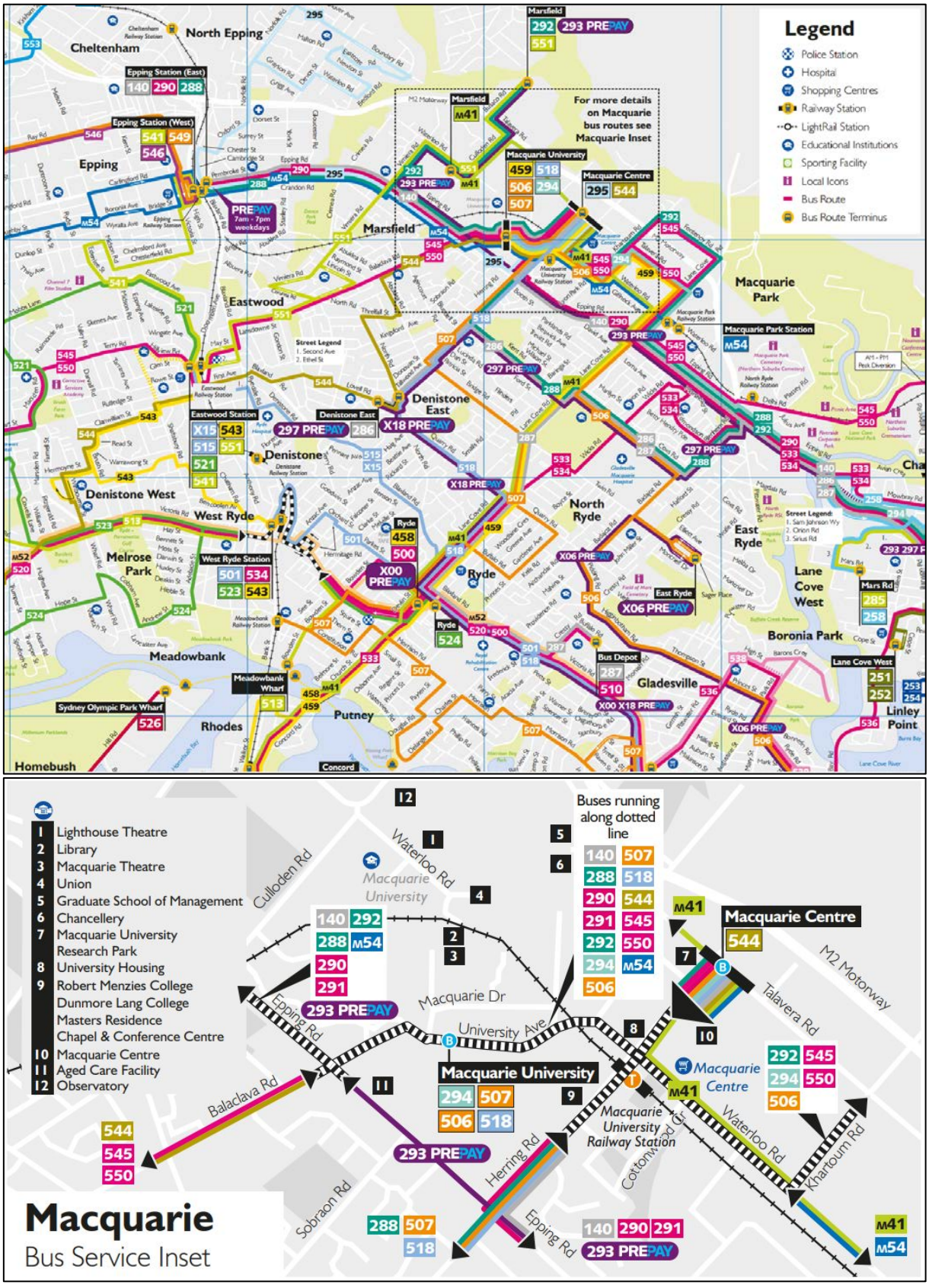

Figure 16: State Transit Bus Routes Map

Bus stops are generally “paired” i.e. location of a bus stop on any side of the road is matched with another bus stop on the opposite side of the road. Bus routes operating on these roads and their frequencies are summarised in **Table 6**.

Table 6: Macquarie Park Bus Frequencies

Route	Description	Nearest Bus Stop		Weekday Peak Frequency			
		TSN	Distance from Site (m)	AM		PM	
				7-8	8-9	4-5	5-6
140	Epping to Manly Wharf via Macquarie University	211341	50			1	1
	Manly Wharf to Epping via Macquarie University	211346	50		1		
197	Mona Vale to Macquarie University via Gordon	2113320	450	4	4	4	6
	Macquarie University to Mona Vale via Gordon	2113318	450	3	4	3	6
288	City Erskine Street to Epping	211341	50	2	1	4	5
	Epping to City Erskine Street	211346	50	4	4	4	4
290	City Erskine St to Epping via Macquarie University	211341	50				
	Epping to City Erskine St via Macquarie University	211346	50				
291	McMahons Point to Epping Station	211341	50	1	2	2	2
	Epping Station to McMahons Point	211346	50	4	3	2	2
292	City Erskine St to Marsfield via Macquarie Park	2113319	450	2	2	2	4
	Marsfield to City Erskine St via Macquarie Park	2113319	450	5	3	2	2
293	City Wynyard to Marsfield	2122118	300				3
	Marsfield to City Wynyard	2113239	320	5	3		
294	Macquarie University to City Wynyard	2113223	600	3			
	City Wynyard to Macquarie University	2113213	600	1	2		
506	Macquarie University to City Domain via East Ryde	2113319	450	2	2	3	1
	City Domain to Macquarie University via East Ryde	2113319	450	1	2	1	2
507	City Circular Quay to Macquarie University via Putney	211341	50		1	1	3
	Macquarie University to City Circular Quay via Putney	211346	50	1	1	2	2
518	City Circular Quay to Macquarie University	211341	50	2	3		
	Macquarie University to City Circular Quay	211346	50	3	1		
544	Auburn to Macquarie Centre via Eastwood	2113319	450	1	2	1	2
	Macquarie Centre to Auburn via Eastwood	2113232	450	1		2	2
545	Parramatta to Chatswood via Eastwood	2113319	450	4	6	5	6
	Chatswood to Parramatta via Eastwood	2113319	450	5	4	5	5
550	Parramatta to Chatswood via Macquarie Park	2113232	450				
611	Blacktown to Macquarie Park via M2	2113318	450	4	12	4	4
	Macquarie Park to Blacktown via M2	2113319	450	2	4	10	12
619	Rouse Hill to Macquarie Park via Castle Hill	2113318	450	3	7	4	2
	Macquarie Park to Rouse Hill via Castle Hill	2113319	450	1	2	6	7
621	Castle Hill to City Wynyard via Cherrybrook	2113318	450	1	2	2	2
	City Wynyard to Castle Hill via Cherrybrook	2113319	450	1	2	2	3

Route	Description	Nearest Bus Stop		Weekday Peak Frequency			
		TSN	Distance from Site (m)	AM		PM	
				7-8	8-9	4-5	5-6
628	Norwest to Chatswood	2113318	450			3	3
	Chatswood to Norwest	2113319	450	3	3		
630	Blacktown to Macquarie Park via Carlingford	2113318	450	2	1	2	2
	Macquarie Park to Blacktown via Carlingford	2113319	450	2	1	2	2
651	Castle Hill to City Wynyard	2113318	450	1	2	2	2
	City Wynyard to Castle Hill	2113319	450		2	2	2
740	Plumpton to Macquarie Park via Stanhope Gardens	2113318	450	2	3		
	Macquarie Park to Plumpton via Stanhope Gardens	2113319	450	1	1	2	2
M41	Macquarie Park to Hurstville	2113318	450	6	6	6	5
	Hurstville to Macquarie Park	2113319	450	5	6	4	6
M54	Parramatta to Macquarie Park via Epping	2113319	450	5	5	5	6
	Macquarie Park to Parramatta via Epping	2113319	450	6	6	6	6

5.3.2 Macquarie Park Bus Priority and Capacity Improvement

The Macquarie Park Bus Priority and Capacity Improvement (MPBPCI) project is being undertaken by TfNSW to improve the road network in Macquarie Park as part of the Bus Priority Infrastructure works, aimed to increase the reliability and efficiency of bus services, while easing congestion for all road users.

Key features of the Macquarie Park Bus Priority and Capacity Improvement (MPBPCI) project include:

- upgrading the intersection of Herring Road and Epping Road;
- upgrading the roundabout intersection of Herring Road and Ivanhoe Place to a signalised intersection;
- adjusting the median along Herring Road, between Ivanhoe Place and Waterloo Road to provide continuous bus lanes in both directions;
- upgrading the intersection of Herring Road and Waterloo Road;
- widening Waterloo Road between Cottonwood Crescent and Lane Cove Road to provide continuous bus lanes in both directions;
- upgrading the roundabout intersection of Byfield Street and Waterloo Road to a signalised intersection;
- upgrading the roundabout intersection of Khartoum Road and Waterloo Road to a signalised intersection;

- upgrading the intersection of Waterloo Road and Lane Cove Road;
- extending the existing southbound bus lane on Lane Cove Road, between Waterloo Road and Epping Road;
- upgrading the intersection of Lane Cove Road and Epping Road; and
- extending the right turn lane northbound on Lane Cove Road onto Epping Road eastbound, between Allengrove Crescent and Lorna Avenue.

The proposal, as outlined in the MPBPCI Project Review of Environmental Factors March 2017, would provide bus priority infrastructure and general capacity to address public transport reliability and cater for travel demand now and into the future for the Macquarie Park precinct. With the upcoming construction of the Sydney Metro North West requiring the upgrade of the ECR for seven months, the proposal has been split into two stages to manage change and disruption.

The project is to be under taken in two stages with the Stage 1 works (refer to **Figure 17**) proposed to commence in early 2018 and be completed prior to the ECR closure (expected late 2018). To minimise any impacts to traffic and buses during the upgrade period, road works along the Temporary Transport Plan bus routes would not be undertaken.

Stage 2 (refer to **Figure 18**) would include the remaining construction works and would commence after Sydney Metro North West is complete (likely from late 2019) and would take about 18-24 months to complete. The construction methodology for Stage 2 works would be planned during detailed design and closer to the construction date.

The scope for Stage 1 works is driven by the need to provide traffic improvements whilst also minimising impacts to utilities and avoiding works requiring any property acquisition due to the long lead time to carry out these activities. As a result, Stage 1 is of a nature and extent that can be delivered within the required timeframes with minimal risks. Larger scale upgrades to intersections and road widenings would be delivered as part of Stage 2, following the completion of Sydney Metro North West.

During the ongoing design development process, the Stage 1 scope of works and design that was presented in the Review of Environmental Factors has been revised as per the MPBPCO Project Submissions report dated October 2017 and shown below.

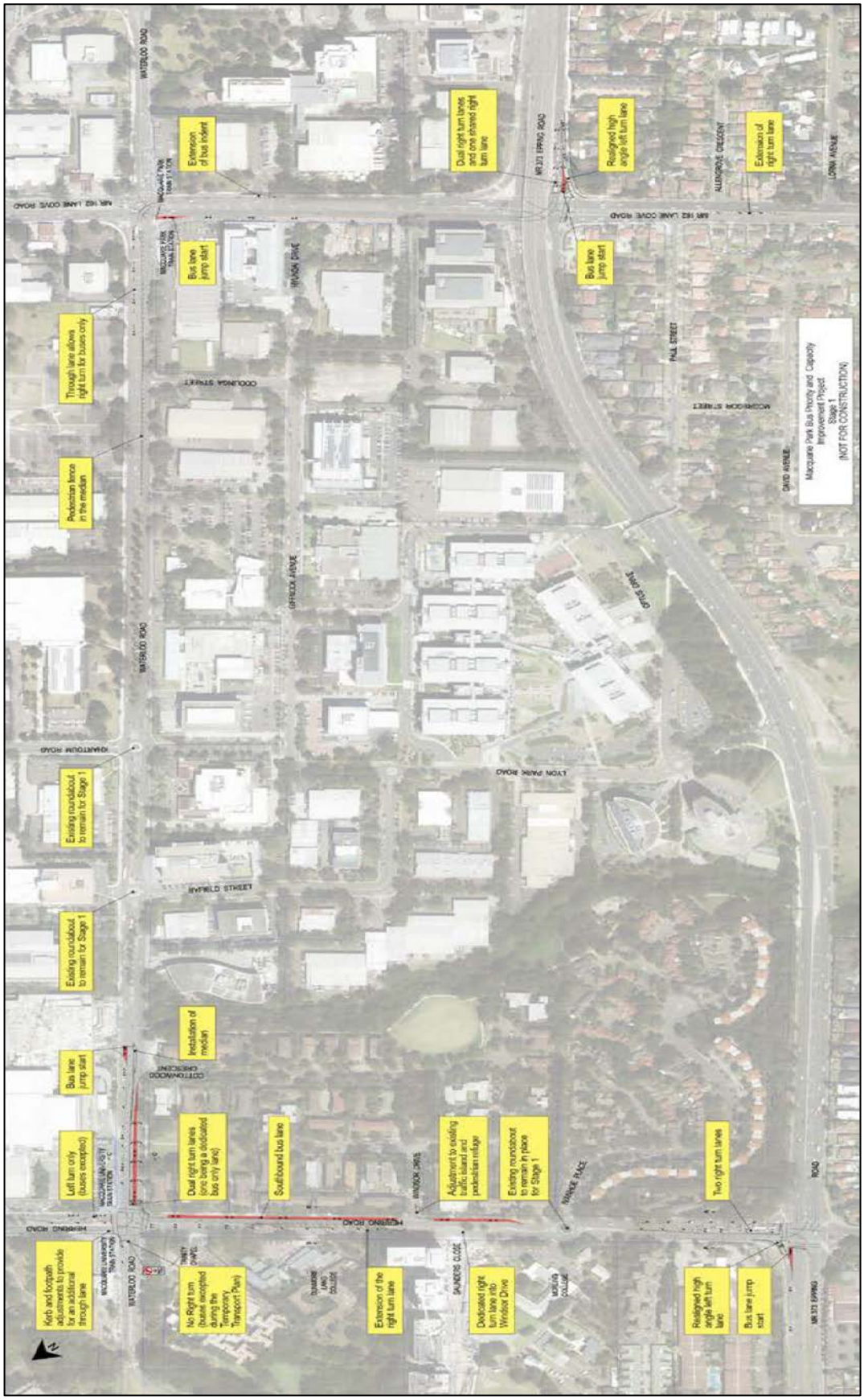

Figure 17: Proposed MPBPCI Stage 1 Works

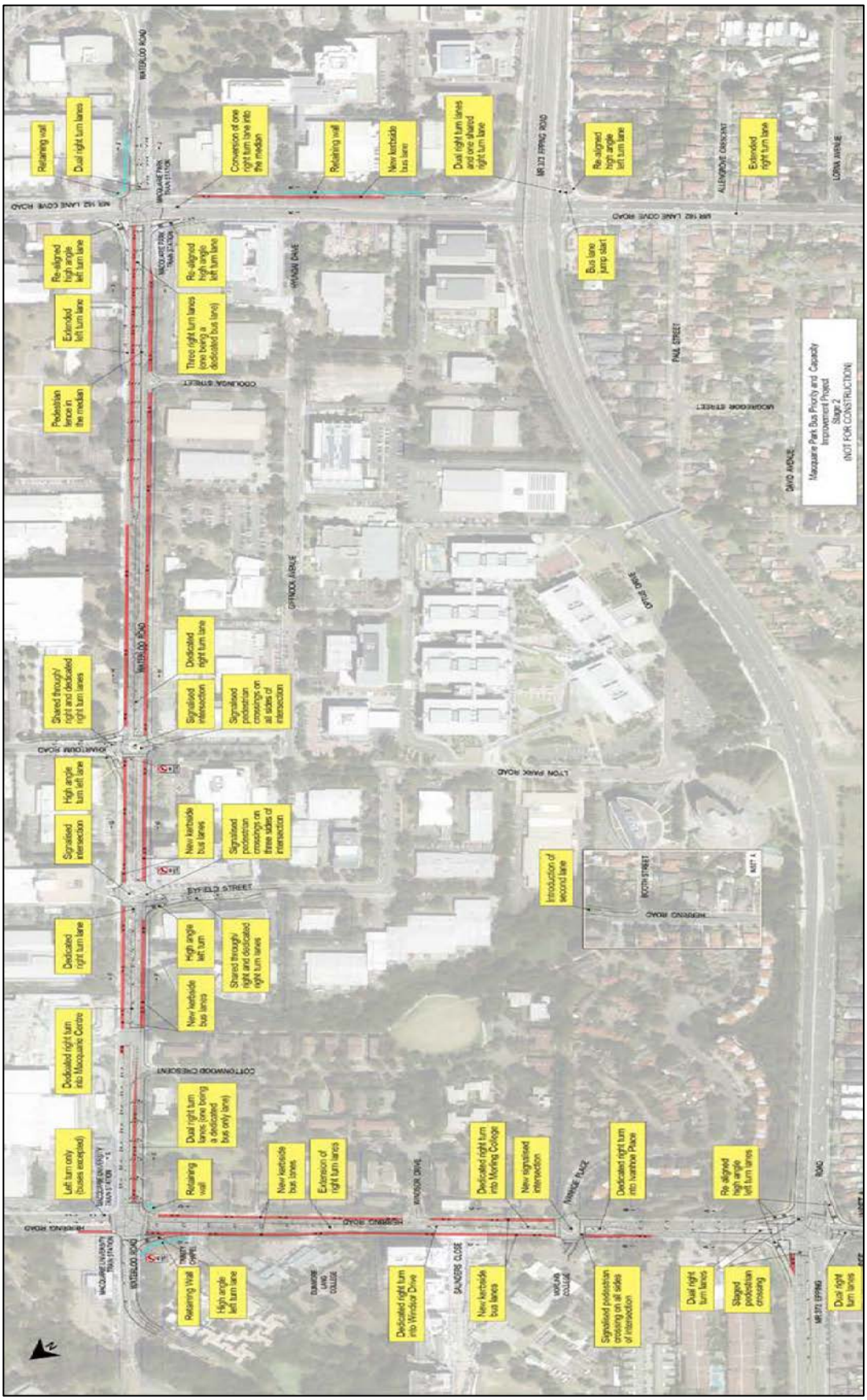

Figure 18: Proposed MPBPCI Stage 2 Works

5.3.3 Macquarie Park Rapid Bus Route

As part of the State Government's transport plan, the Sydney's Bus Future (2013) sets out the priorities for key changes to the bus network. The overall plan seeks to fast and reliable bus services connecting the major urban and suburban centres including Sydney CBD, Parramatta and Macquarie Park. **Table 7** shows the NSW Government's priorities and strategies for implementation of Rapid Bus Routes within Macquarie Park precinct, which will influence the future accessibility of the site to public transport services.

Table 7: Proposed Macquarie Park Rapid Bus Routes

Rapid Bus Routes – Key Actions	Customer Benefits
Parramatta - Macquarie Park via Carlingford and Epping	
• Extra services planned for 2014 • Bus priority projects under development for Epping Road • Further short term action to extend bus lane operating hours and speed up services through wider stop spacing • High capacity vehicles • High quality interchanges with consistent way finding and signage • Address bus pinch points with bus priority treatments on: o Pennant Hills Road between North Parramatta and Carlingford o Carlingford Road and Epping Road between Carlingford and Macquarie Park In the longer term: • Investigate Bus Rapid Transit along the length of the corridor with connections to Rydalmere • Interchange enhancements at Parramatta • Potential light rail via Eastwood as part of the Western Sydney Light Rail Network	• Over 50 extra bus services every weekday • Able to carry over 1,000 extra customers each day • More early morning, evening, night and weekend services • Improvements to travel time and reliability
Hurstville – Macquarie Park via Burwood	
• Implement bus priority along the corridor • High capacity vehicles • High quality interchanges with consistent way finding and signage • Address bus pinch points with bus priority treatments on: o Stoney Creek Road, Bexley Road, Concord Road and Lane Cove Road. between Hurstville and North Ryde o Waterloo Road, Macquarie Park (in conjunction with Ryde Council) In the longer term: • Complete bus priority for the route and extend bus lane operating hours • Investigate an interchange facility at Burwood • Investigate interchange facilities for service transfers with potential locations in the Top Ryde area	• Approximately 30 extra bus services every weekday • Able to carry over 700 extra customers each day • More early morning, evening, night and weekend services

Over 50 extra rapid services will operate every weekday between Parramatta and Macquarie Park, and 30 extra rapid services between Hurstville and Macquarie Park, with improvements starting to be delivered in the short term. The new and upgraded rapid routes are expected to strengthen connections and improve travel time between Parramatta, Macquarie Park, Castle Hill, Bankstown, Liverpool, the North West Growth Centre, and Sydney via Top Ryde.

5.4 City of Ryde Future Road Network

The future road Structure Plan for the Macquarie Park Corridor is set out in the City of Ryde Macquarie Park DCP (2004). The plan and access network provide a hierarchy of street types and orientations that provide additional permeability through the corridor. The future road network is shown in **Figure 19** includes two new access roads within the Ivanhoe Estate. These include a new east-west road (Road 3) connecting Lyonpark Road and Herring Road and a new north-south road (Road 28), west of Shrimptons Creek, connecting Ivanhoe Estate with Epping Road. It is noted, that both of these roads have been adopted in the design of the project and discussed further in the following sections.

The proposed future road network as shown in Figure 19, will provide improved pedestrian, cycle and vehicular connectivity to that which occurs currently. The proposed network will establish a clear hierarchy of public streets which, in addition to the new road connections, will provide greater movement opportunities and less delays within the corridor.

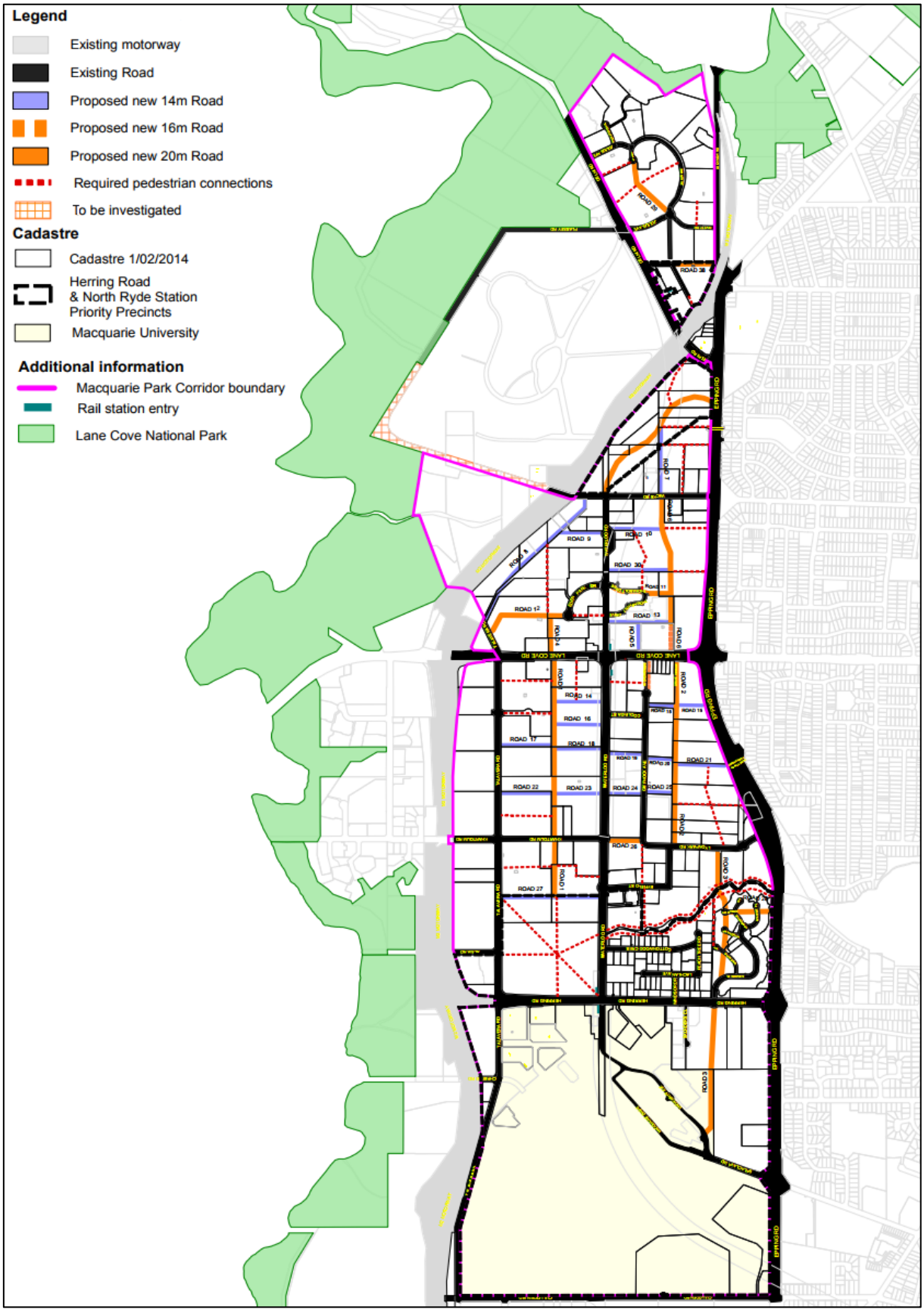

Figure 19: Macquarie Park RDCP Corridor

5.5 Existing Active Transport Provision

The City of Ryde promotes active transport through providing accessible walking and cycling routes for the community. The Macquarie Park area has several recreational walks and cycling facilities, as discussed in detail in the below sections.

5.5.1 Pedestrian Demands and Desire Lines

Macquarie Park is a specialised centre with a mixture of land uses. The primary land use in the corridor is a commercial core, with surrounding business parks. These land uses are mainly located around Waterloo Road, Epping Road and Lane Cove Road. Education and mixed uses form the remainder of the Macquarie Park Corridor, located to the northwest.

The Macquarie Park Pedestrian Access and Mobility Plan provides an extensive review of the existing pedestrian facilities in Macquarie Park. The ARUP report identifies Macquarie University as the major attractor between University Avenue and Culloden Road. There is also various mixed land located along Herring Road creating the pedestrian demands illustrated in **Figure 20**.

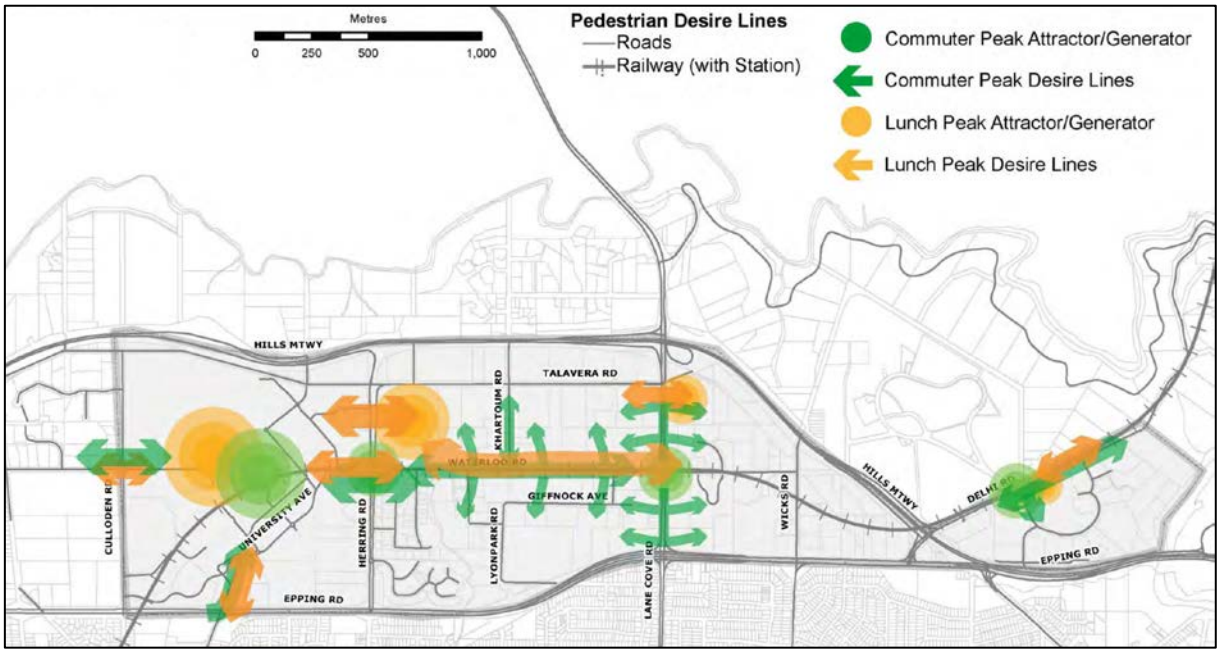

Figure 20: Macquarie Park Pedestrian Desire Lines (Arup)

The ARUP assessment also identifies Macquarie shopping centre is a key pedestrian trip attractor in the area. The centre provides a wide range of goods and services that draws shoppers from both within and outside of the Ryde LGA. During lunch time, there is a high level of pedestrian activity around the centre from students in Macquarie University and workers in Macquarie Park.

The Singtel Optus campus is one of the key single trip attractors/generators within the study area. Over 6000 Optus employees commute to this campus on Lyonpark Road daily. During morning and afternoon peak periods, Optus staff resulted in high pedestrian movement between both Macquarie Park and Macquarie University stations and Lyonpark Road. The lunch time peak period for pedestrian movement is skewed towards Macquarie Shopping Centre as discussed above.

5.5.2 Pedestrian Infrastructure

The existing pedestrian infrastructure through the Macquarie Park Precinct is presented in **Figure 21**, and demonstrates existing footpath and pedestrian crossing locations. In general, pedestrian facilities are provided along public roadways within limited permeability at midblock locations.

In relation to the Site, footpaths are provided on both sides of Herring Road to allow pedestrian access between the site and Macquarie University Railway Station and Waterloo Road. A pedestrian underpass linking the residential land uses to the south of Epping Road with Shrimptons Creek and eventually Macquarie Shopping Centre is located on the southern boundary of the site. Signalised crossing facilities are also provided at major intersections along Herring Road, Epping Road and Waterloo Road.

Notwithstanding, limited pedestrian access is provided between the Site and the Peach Tree Road and no access is provided to Lyonpark Road.

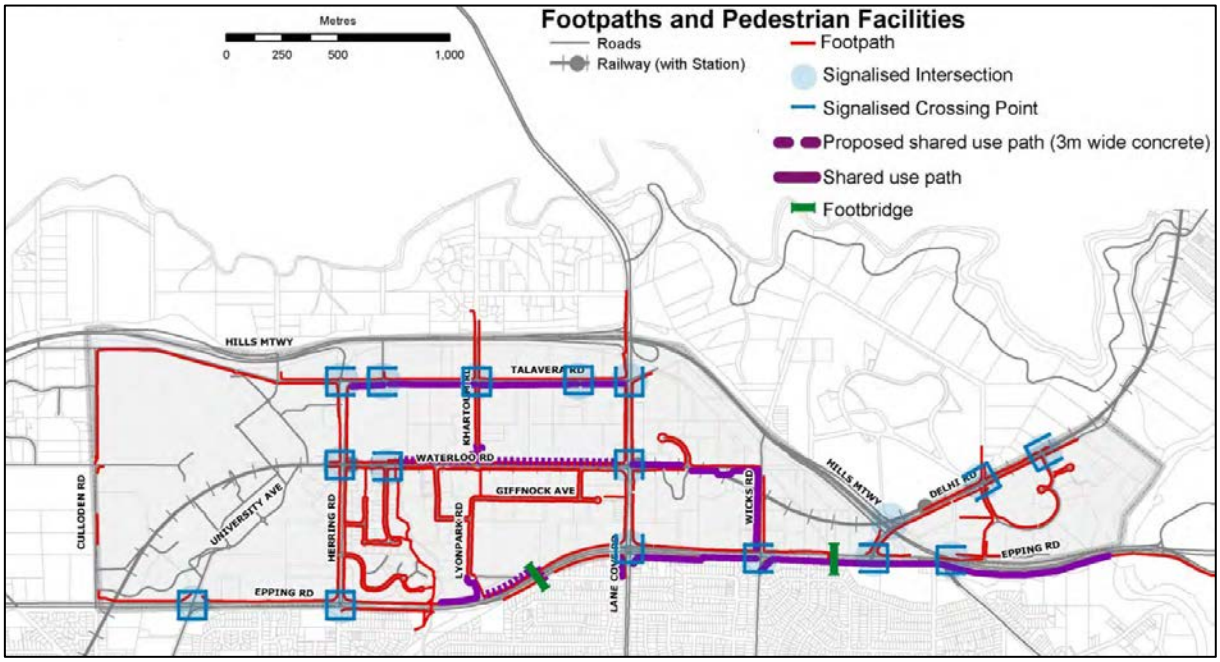

Figure 21: Existing Macquarie Park Pedestrian Facilities (Arup)

The accessibility of the Site to surrounding land uses is shown in **Figure 22** which demonstrates the 5 to 15 minutes walkable catchment to and from Herring Road / Ivanhoe Place intersection. The walking

catchment includes the Macquarie University Station, Macquarie University, Macquarie Shopping Centre, employment precincts along Waterloo Road and recreational areas.

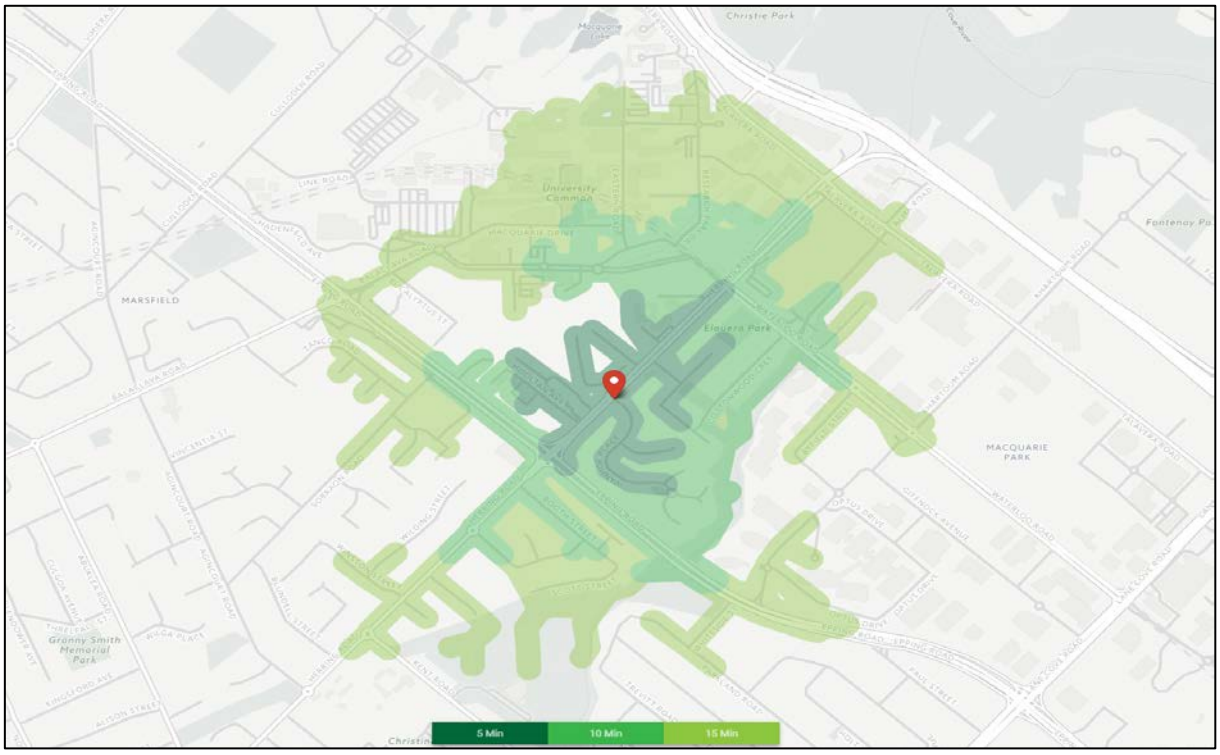

Figure 22: Walkable Catchment from Ivanhoe Place / Herring Road intersection

5.5.3 Cycling

The existing Macquarie Park cycle network is illustrated below in **Figure 23**. There are sections of well-developed, shared, off-road paths linking to the Site from all directions other than to the south and west where gaps in the network are evident.

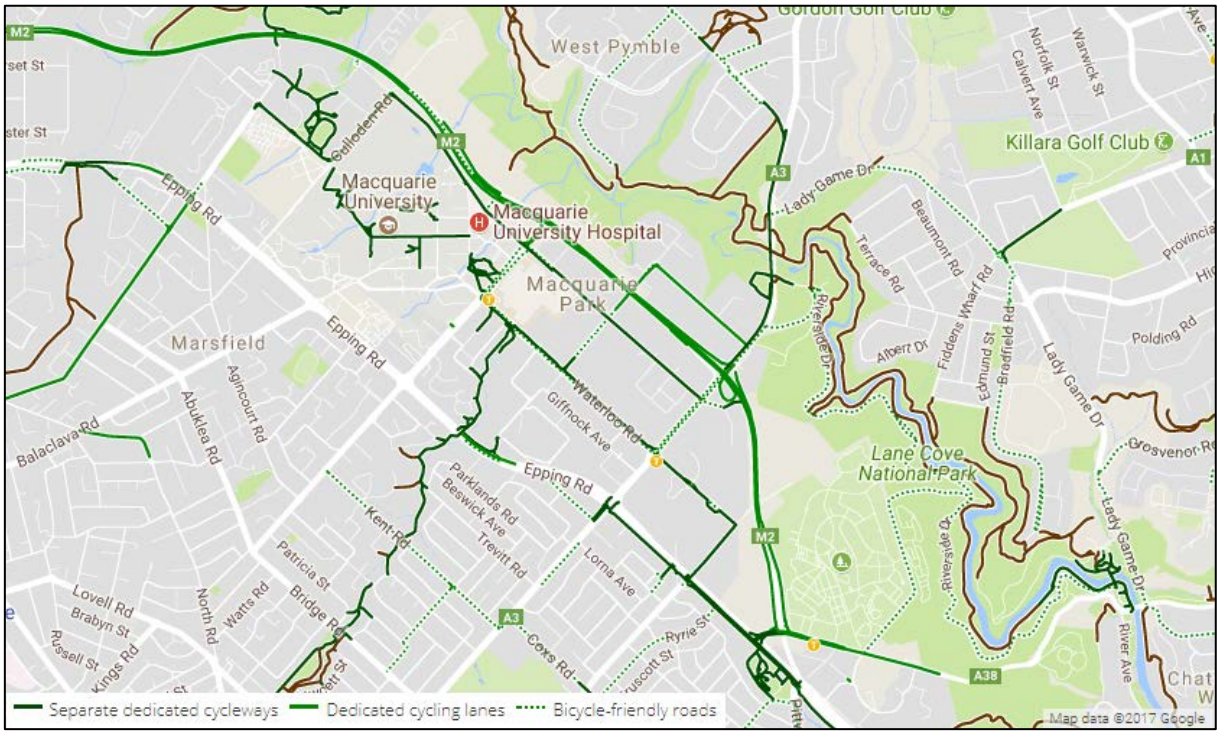

Figure 23: Existing Macquarie Park cycle network

There are a number of off-road shared cycle ways along the major roads, including Waterloo Road and Lane Cove Road. However, the network is incomplete, and parts of the network require shared access with pedestrians. The lack of a fine grain street network further restricts existing cycling opportunities.

The proposed City of Ryde Bicycle Network is illustrated in **Figure 24**, illustrating the number of routes still to be developed to provide save and attractive cycle access to the Site.

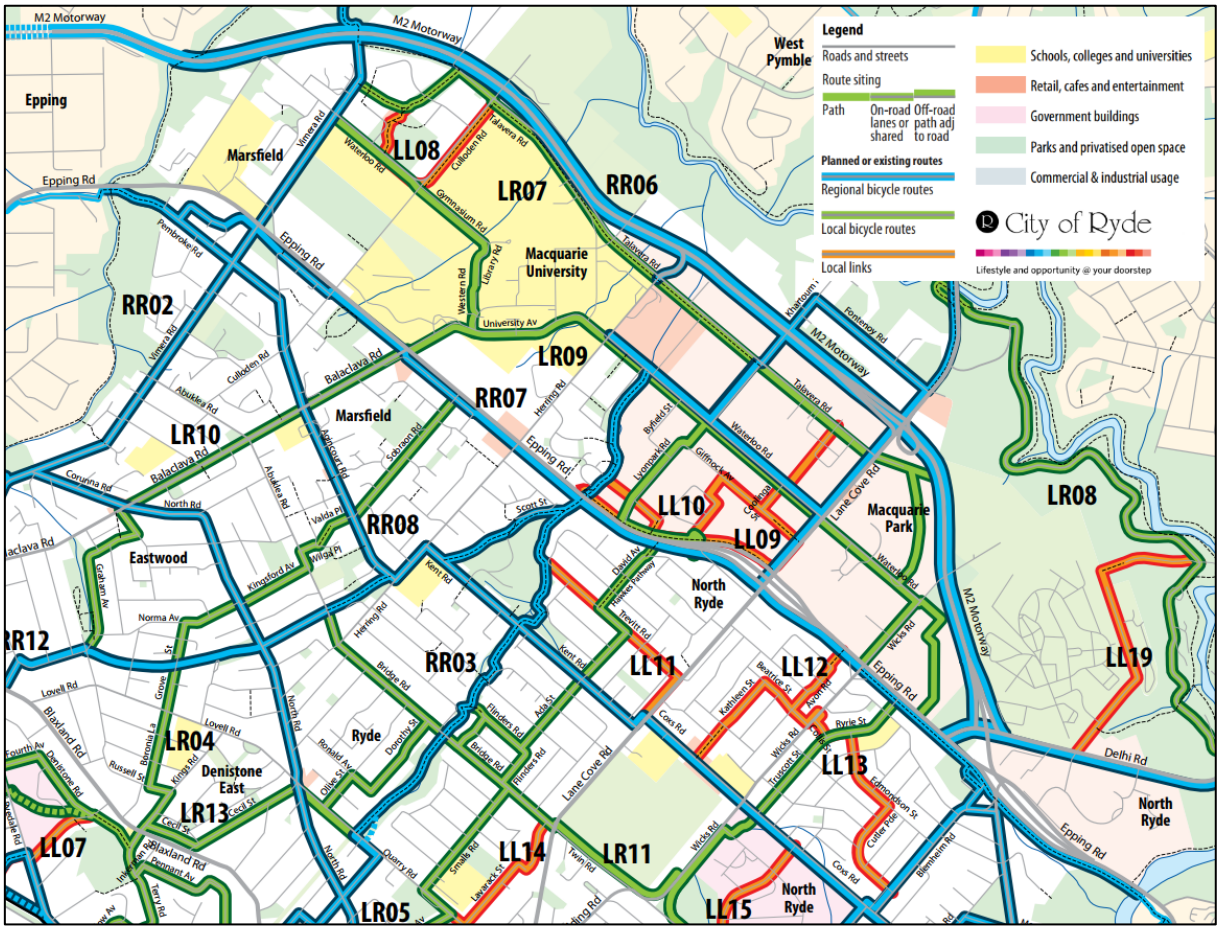

Figure 24: Proposed Bicycle Network

Existing and proposed sites for bicycle parking within Macquarie Park are illustrated in **Figure 25**. The focus is on providing for cyclists at train stations and along property frontages on Waterloo Road. Parking at train stations is traditionally for people commuting out of the area by public transport and these facilities could be utilised by Ivanhoe Estate residents. They could also potentially be utilised by people arriving in Macquarie Park in the morning by train and completing the last leg of their commute by bicycle from the station to the Site. If demand exists for this type of journey, then bike hire services may be a popular option in future.

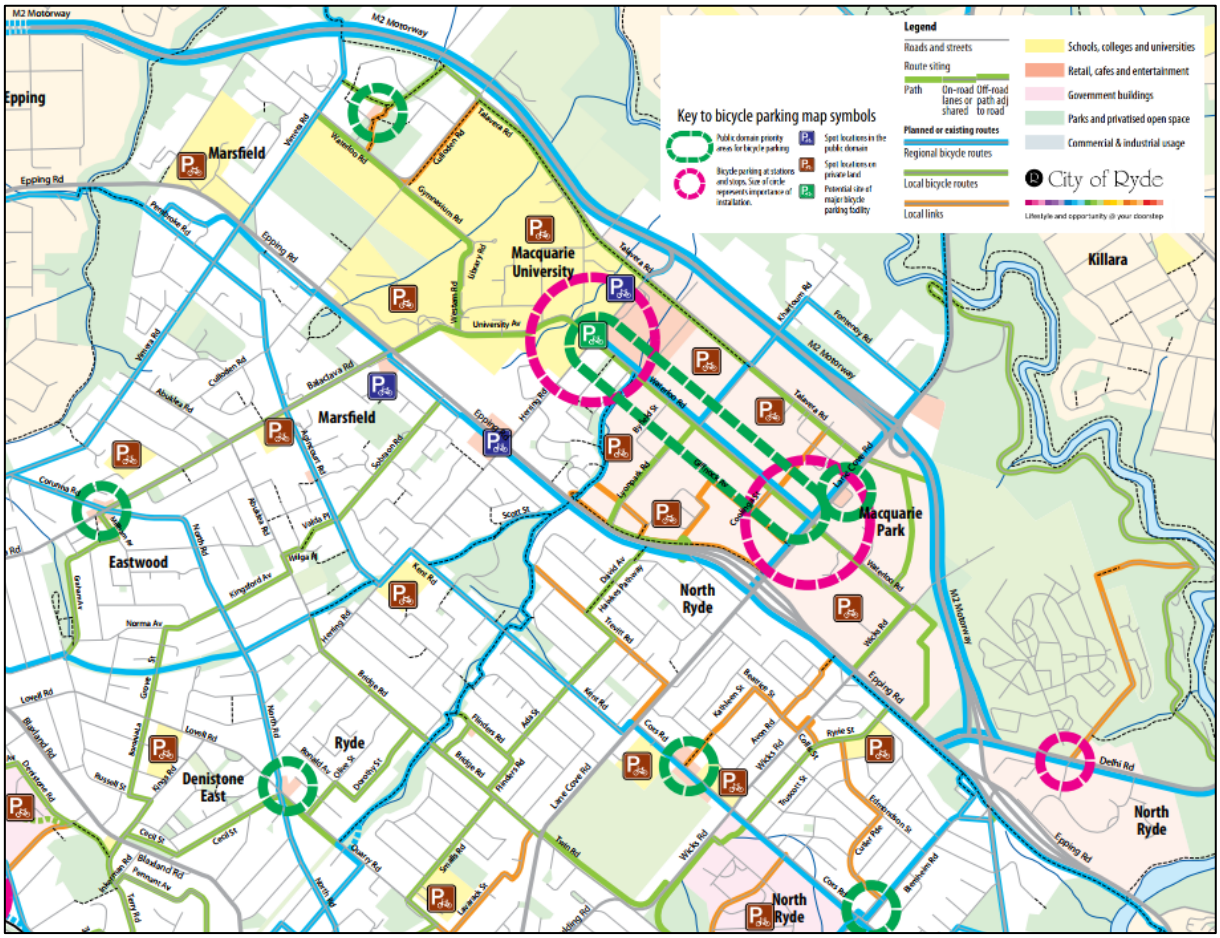

Figure 25: Bicycle Parking

5.6 Road Network

5.6.1 Existing Road Network

Some of the key roads that form the top levels of the current road hierarchy for the Macquarie Park Corridor in the locality of the Site are:

M2 Motorway

The M2 Hills Motorway is an arterial road approximately 1 kilometre north-east of the Site that connects with the Lane Cove Tunnel in North Ryde and heads north-west through Macquarie Park to Epping, then West through Beecroft, Carlingford then through Baulkham Hills and onto the Westlink M7 motorway. It is a privately owned motorway that became fully cashless, with no toll booths, in January 2012.

The following key features, located within the City of Ryde LGA have increased capacity and access to the Macquarie Park area:

- Christie Road: Eastbound exit and entrance
- Talavera Road: Westbound exit and entrance
- Lane Cove Road (A3): No exit westbound; no eastbound entrance from A3 northbound
- Delhi Road (A38): Eastbound exit and westbound entrance
- Lane Cove Tunnel: Eastern terminus continues as Lane Cove Tunnel; westbound exit to and eastbound entrance from Epping Road

The NorthConnex M1 to M2 tunnel (planned to open in 2019), includes motorway-to-motorway ramps to and from the portion of the M2 west of Pennant Hills Road/The Cumberland Highway.

Lane Cove Road

This is an arterial road 900 metres to the south-east of the Site which caters for regional north-south traffic travelling through the City of Ryde, forming part of the A3 outer arterial ring road connecting to the north and south coasts of the Sydney region, and interchanging with most of the radial arterial routes emanating from central Sydney.

The road connects regional and local traffic to the M2 Motorway in the north, and to Epping Road along the southern boundary of the Site. It also connect with the important collector routes of Waterloo Road and Talavera Road that run through the Macquarie Park Corridor. Lane Cove Road carries regional to,

from and around Macquarie Park whilst simultaneously providing local traffic and public transport access for the area.

Epping Road

Epping Road is an arterial road on the southern boundary of the Site which caters for regional east-west traffic travelling through the City of Ryde. Epping Road extends from the Pacific Highway and Lane Cove in the east to Epping in the west. It provides an important link between Sydney's Northern and North West suburbs and the North Shore and CBD. Epping Road provides an important access route to Macquarie University and other major land uses within Macquarie Park via Herring Road and Balaclava Road. The road serves the dual purpose of providing capacity for regional traffic through the City of Ryde LGA along with multi-modal local access.

Herring Road

Herring Road forms the north western boundary of the Site and was chosen as an urban activation precinct to accommodate some of Sydney's future growth due to its strategic location relative to the Sydney metropolitan region. It is approximately 18 kilometres northwest of the Sydney CBD, 9 kilometres west of Chatswood and 15 kilometres east of Parramatta.

Herring Road has been identified as an intrinsic component of Sydney's Global Economic Corridor, which extends from Sydney Airport and Port Botany through Sydney CBD, North Sydney, Chatswood, Macquarie Park towards Parramatta and Norwest Business Park. The road is an important part of the Macquarie Park Specialised Precinct, identified in the Metropolitan Strategy for Sydney as a location for future jobs and housing growth. It is well serviced by public transport and includes the Macquarie University railway station and bus interchange.

Waterloo Road

Waterloo Road is a collector road running parallel to the M2 motorway and through the middle of Macquarie Park. Waterloo Road provides an important multimodal corridor for bus, cycling and pedestrian movements through Macquarie Park, and connects the public transport Interchange and Macquarie University in the northwest with Lane Cove Road to the southeast. Waterloo Road extends through to Wicks Road in the east of the study area, and to University Avenue / Balaclava Road in the west. An unconnected section of Waterloo Road extends further west outside of Macquarie Park, with the road disconnected through the Macquarie University campus.

5.6.2 Peak Hour Traffic Flows and Existing Road Network Performance

The average peak hour traffic volumes for the arterial and collector road network within Macquarie Park are illustrated below in **Figure 26** for the AM peak period and in **Figure 27** for the PM peak period (extracted from RMS Traffic Model). These figures show that Lane Cove Road and Epping Road are relatively balanced with similar volumes in both directions in both the peak periods. This is attributed to strong demand on these routes from through traffic travelling to and from the Sydney CBD, as well as high commuter flows within Macquarie Park. Waterloo Road also has high volumes in both directions during the peak periods, illustrating the limited direct access links between the central precinct area and the adjacent arterial road network, with most traffic forced to travel via Waterloo Road to access central employment and business sites.

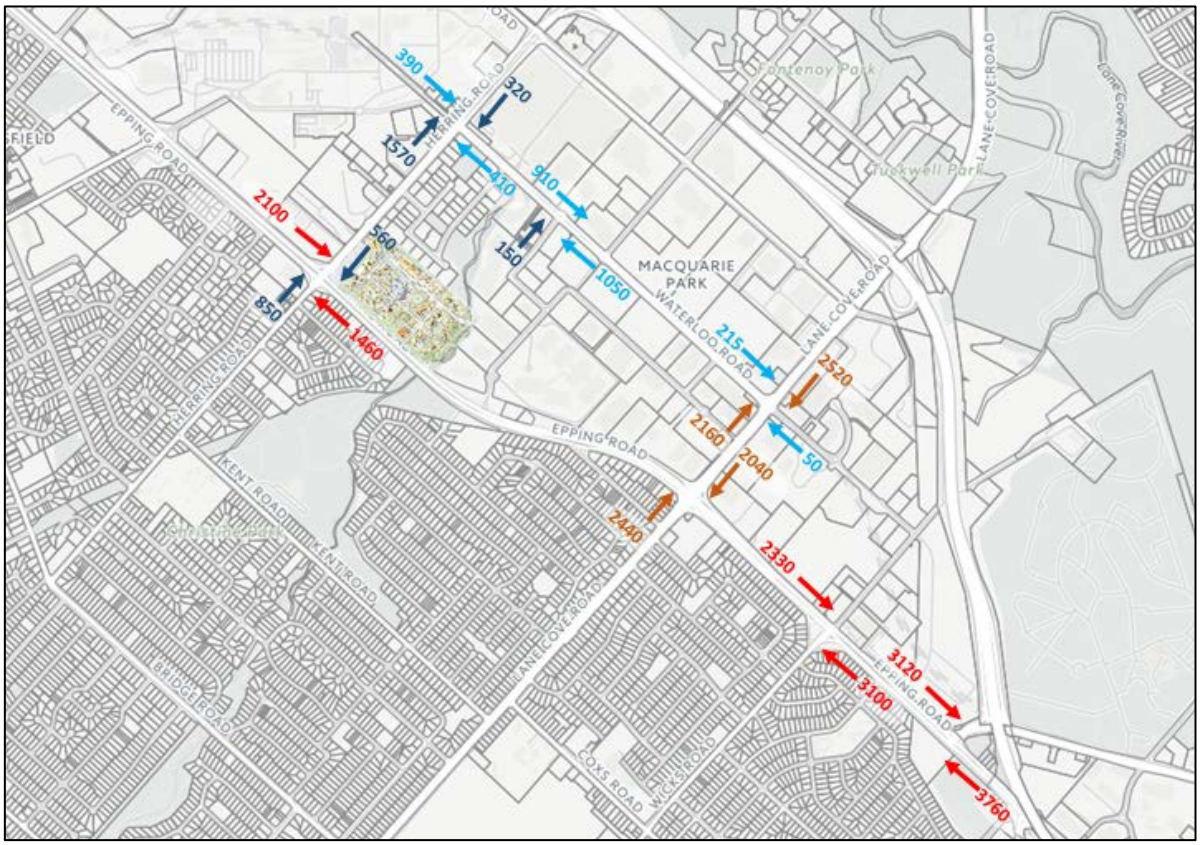

Figure 26: Existing AM Peak Hour Volumes

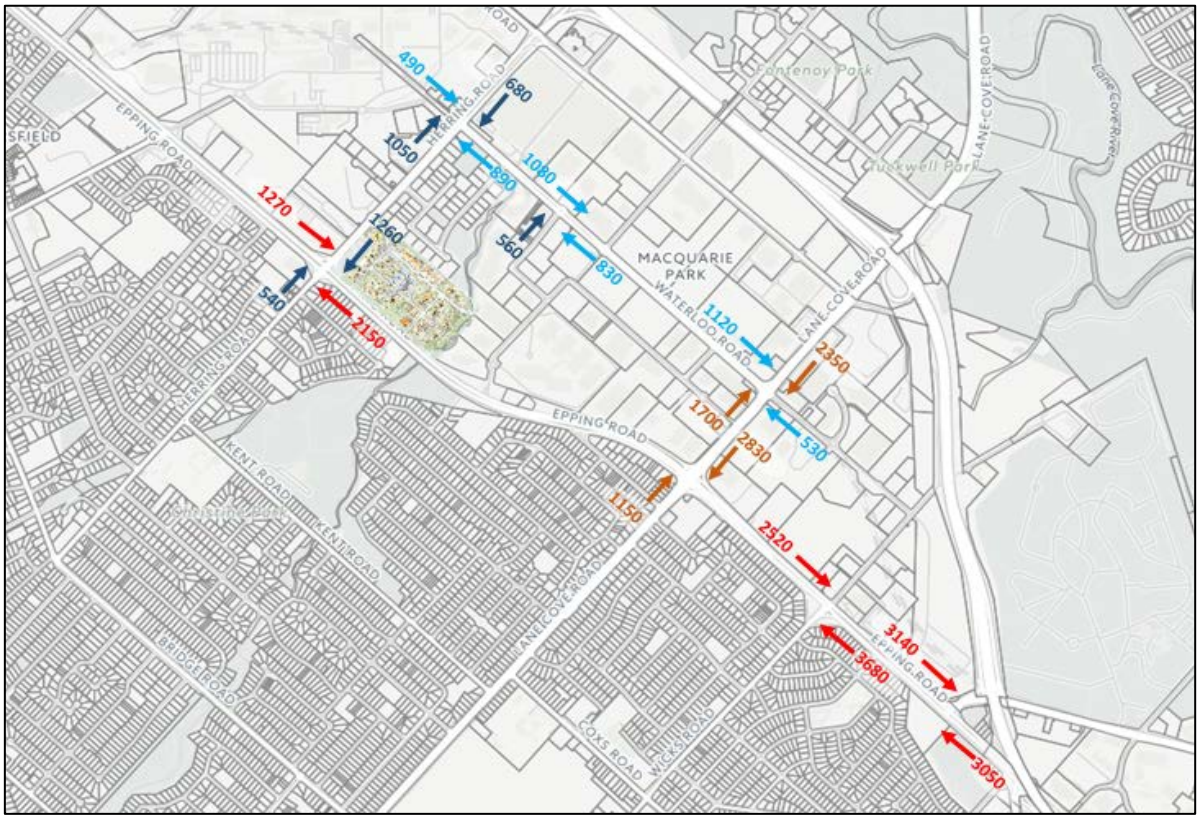

Figure 27: Existing PM Peak Hour Volumes

Traffic flow in Macquarie Park is dominated by regional traffic movements on Lane Cove Road, Epping Road in the AM and PM peak periods with internal roads (Waterloo Road, Khartoum Road and Lyonpark Road) accommodating destination based traffic associated with the employment zones in these locations. Herring Road traffic includes a much larger proportion of local traffic due to its functions as a local traffic access route to Macquarie University Station, the university itself, and Macquarie Shopping Centre.

5.6.3 Intersection Controls and Performance

The performance of the key intersections surrounding the site is summarised in **Table 9**. The modelling outputs a range of performance measures, in particular:

- Average Vehicle Delay (AVD) – The AVD (or average delay per vehicle in seconds) for intersections also provides a measure of the operational performance of an intersection and is used to determine an intersection's Level of Service (see below). For signalised intersections, the AVD reported relates to the average of all vehicle movements through the intersection. For priority (Give Way, Stop & Roundabout controlled) intersections, the AVD reported is that for the movement with the highest AVD.

- Level of Service (LOS) – This is a comparative measure that provides an indication of the operating performance, based on AVD.

The following table provides a recommended baseline for assessment as per the RMS Guide:

Table 8: RMS Level of Service

Level of Service	Average Delay (sec/veh)	Traffic Signals, Roundabout	Give Way and Stop Signs
A	< 14	Good operation	Good operation
B	15 to 28	Good with acceptable delays & spare capacity	Acceptable delays & spare capacity
C	29 to 42	Satisfactory	Satisfactory, but accident study required
D	43 to 56	Operating near capacity	Near capacity & accident study required
E	57 to 70	At capacity; at signals, incidents will cause excessive delays. Roundabouts require other control mode	At capacity, requires other control mode
F	> 70	Unsatisfactory and requires additional capacity.	Unsatisfactory and requires other control mode or major treatment.

The average intersection performance Level of Service (LoS) for the AM and PM peak periods of the key intersections identified in the SEARs are shown in Table 9. The intersection performance analysis is based on traffic volume data used by Transport for NSW for the Waterloo Road temporary bus shutdown network planning, and is based on 2016 data.

The intersection of Epping Road with Herring Road experiences significant delay in the AM and PM peak periods. The traffic demand and peak period congestion at this intersection is strongly influenced by traffic movements heading into Macquarie Park via Epping Road in the AM peak period and traffic movements exiting Macquarie Park in the PM peak period.

The Waterloo Road with Herring Road intersection has limited traffic capacity but has a significant demand from local and through traffic accessing the Macquarie Centre and to/from the M2. The large traffic demand conflicts with the high volume of competing pedestrian movements between the major generators of the University, Macquarie Centre, Bus Interchange and Macquarie Rail Station. The Waterloo Road southeast approach operates over capacity and with queues over 200 metres.

Table 9: Current Peak Intersection Performance

Intersection	Peak	Level of Service
		Delay (sec)
Epping Road / Herring Road	AM	F
		167
	PM	F
		76
Ivanhoe Place / Herring Road	AM	A
		12
	PM	A
		13
Waterloo Road / Herring Road	AM	F
		94
	PM	F
		121
Epping Road / Lyonpark Rd	AM	A
		7
	PM	A
		7
Waterloo Road / Byfield Street	AM	A
		12
	PM	A
		14

The Lane Cove Road with Waterloo Road intersection is a major access route into / out of Macquarie Park for all modes of transport, competing for space and time with through traffic on Lane Cove Road in both peak and off peak times, leading to relatively poor levels of service for all modes throughout the day. The intersection performance is particularly constrained during the PM peak and traffic exiting Macquarie Park via Waterloo Road in the PM peak experiences delay as the intersection is operating over capacity for these movements, with queues over 350 metres for regional traffic heading south along Lane Cove Road travelling away from M2 and Macquarie Park.

The intersection of Lane Cove Road and Epping Road has major conflicts between buses, cars, trucks and regional cycling routes, with poor levels of service for all modes during peak periods. The Epping Road approaches operate over capacity in the AM and PM peak periods, influenced by the demand for traffic entering and exiting Lane Cove Road in the peak periods.

5.7 Road Network Upgrades

A number of road network upgrades have been identified and or are proposed for the Macquarie Park precinct as part of the Herring Road UAP Finalisation report and other strategic documents prepared by RMS and Council. The upgrades proposed as part of the finalisation report as well as the timing of these upgrades is summarised in **Table 10**.

Table 10: Herring Road UAP Finalisation Report Improvements

Item	Road Improvements	Delivery	Timing
1	Upgrade of the Hills M2 motorway	Transurban	Completed
2	$7.2 million contribution to RMS towards upgrade of intersections on Epping Road	Macquarie University	As sites develop
3	Signalised intersection and crossing at Herring Road and Dunmore Lang College	Macquarie University	As sites develop
4	Signalised intersection and crossing at Herring Road and Ivanhoe Place	Land & Housing Corporation	As sites develop
5	Realignment of University Avenue and pedestrianize Macquarie Drive	Macquarie University	Within 5 years
6	New local road along northern boundary of 120- 128 Herring Road	Developers (Part 3A approval conditions)	As sites develop
7	Potential new local road connecting Herring Road and Balaclava Road (via Baptist Care and Morling College)	Developers in lieu of S94 contributions	As sites develop
8	Potential new local road connecting Peach Tree Road to Lyonpark Road (across Shrimptons Creek)	City of Ryde and/or Developers in lieu of S94 contributions	As sites develop
9	Potential new local road connecting Waterloo Road to Talavera Road (via 101 Waterloo Road)	Developers in lieu of S94 contributions	As sites develop
10	Potential new local road connecting Peach Tree Road extension to Ivanhoe Place	Developers in lieu of S94 contributions	As sites develop
11	Reconfiguration of internal roads at Ivanhoe Estate	Land & Housing Corporation	As sites develop
12	Shared use path along Epping Road between Herring Road and Culloden Road	Macquarie University	Within 5 years

These upgrades will assist in providing improved permeability through the precinct in addition to capacity improvements at key intersections. This includes the upgrades to the intersection of Epping Road and Herring Road, to be upgraded as part of the Bus Priority and Capacity improvements discussed in Section 5.3 Further to this, additional upgrades are proposed as part of this application including the provision of a new vehicular and pedestrian access to Lyonpark Road (Item 8), the signalisation of Ivanhoe Place with Herring Road (Item 4) and a new pedestrian connection to Peach Tree Road (Item 10). These are discussed further in the following sections.

5.8 On Street Parking

City of Ryde's Permit Parking Scheme has created a number of Resident Parking Zones to help manage the excess demand for on-street parking. These Resident Parking Zones have time limits for parking in residential streets, with a permit scheme to exempt residents who reside in these streets from these limits. The Scheme has been designed to minimise all-day parking in residential streets by people other than residents of those streets.

The Site is surrounded by three of these Residential Parking Zones and on-street parking is restricted to two-hour periods between 8am - 6pm, Monday to Friday within 500m of the Site. On-street parking outside of these zones is either banned or restricted further and infringement notices are issued to unauthorised vehicles which exceed the signposted time limits.

6 Sustainable Transport Measures

6.1 Introduction

Sustainable Transport and Travel Demand Management (TDM) strategies involve the application of policies, objectives, measures and targets to influence travel behaviour, to encourage uptake of sustainable forms of transport, i.e. non-car modes, wherever possible and to reduce the need to travel and hence reduce overall transport and travel demand and the impacts of new development.

An abundance of comprehensive studies link urban development and travel patterns and show that, even after accounting for socioeconomic and demographic differences, residents of communities with frequent, reliable, easily accessible public transport services and well designed pedestrian and bicycle networks drive significantly less, and walk, bicycle and ride public transport more than their counterparts in 'traditional' communities (Arrington and Cervero 2008, Cervero et al. 2004, Ewing et al. 2008, and Feigon et al. 2003).

Evidence shows that the uptake of alternative modes and level of vehicle trip reduction is highly dependent on local and regional conditions e.g. urban form, accessibility, permeability etc. (Ewing et al. 2003, Feigon et al.2003, Ewing et al. 2008, and Bartholomew 2007). This is mostly attributed to shorter distances between destinations – allowing people to live within easy walking or cycling distance of some of their destinations e.g. work, school, shops, and parks, and easy access to transit to reach farther destinations. Hence, vehicle ownership is lower, vehicular trips are shorter and less frequent, and non-motorized and public transportation have a larger share of the overall travel demand (Arrington and Cervero 2008). In addition, factors like footpath and bicycle path connectivity significantly increase the likelihood of rail commuters accessing stations by foot or bicycle (Cervero 2001).

Alternatives to private vehicles have a larger proportion of all trips in higher density developments and in mixed land use areas. Walking can rise significantly in high-density, mixed-use neighbourhoods. Ivanhoe Estate, proposed to be a Transit Oriented Development, allows residents to conduct their daily tasks close to home, and multiple tasks in one trip, travel by alternative modes, and reduce automobile trips and trip lengths.

6.2 Sustainable Travel Strategy for Ivanhoe Estate

A Sustainable Travel Strategy (STS) for Ivanhoe Estate is designed to encourage the use of public transport, walking, cycling wherever possible for all journey purposes. Where alternatives to the car are not viable, options to encourage car sharing can be promoted to minimise the need for single occupancy vehicle travel. The benefits of similar strategies are now widely understood and include:

- Reducing air and noise pollution and other types of negative environmental impact;
- Improving fitness, health and wellbeing due to increased physical activity;
- Reducing traffic congestion and associated road network delays and costs;
- Reducing the need for costly road infrastructure upgrades (which research has shown only serves to attract additional vehicle traffic, necessitating future highway upgrades);
- Helping residents save money by reducing their need to own and operate motor vehicles;
- Improving travel options, particularly for non-drivers or non-car owners;
- Reducing the need for parking provision and maximising land opportunity for other uses;
- Supporting strategic land use planning objectives, such as reduced urban sprawl; and
- Improving local environmental quality and community cohesion.

Implementing an STS will assist Ivanhoe Estate in achieving its strategic direction of becoming a liveable precinct which provides for healthy and active lifestyles, does not negatively adversely impact on the environment, seeks to address sustainability and climate change objectives, and does not lead to unnecessary vehicle trip generation and highway network congestion.

The role of the STS for Ivanhoe Estate is to encourage local trips by bus, bicycle and walking wherever possible and longer distance trips by bus and rail, by making these modes viable and realistic alternatives. This is facilitated through the design of the built form of Ivanhoe Estate to accommodate public transport penetration into residential areas as well as good quality, highly permeable pedestrian and bicycle networks throughout Ivanhoe Estate, including crossing facilities where appropriate and end-of-trip facilities such as bicycle parking.

The SEARs recommend that this TMAP address the potential for implementation of a location specific sustainable travel plan and the provision of facilities to increase the non-car mode share for travel to, from and within the Site. This section highlights how this will be achieved in Ivanhoe Estate through the implementation of an STS.

6.3 High Level Objectives

The high level objectives for Ivanhoe Estate aim to deliver public transport, walking and cycling journeys in line with NSW government state targets which fit within the overall sustainability and active transport principles set out above. Through the sustainable transport and travel demand management strategy, Ivanhoe Estate will be a sustainable, liveable precinct from day one which delivers the following:

- 40% non-car mode share for journeys to/from work

- 50% combined walk and cycle mode share for all school travel
- 50% combined walk and cycle mode share for all town centre trips
- 50% combined walk and cycle mode share as access mode for Macquarie Park Station

These high level objectives are consistent with the following NSW state government transport targets for Metropolitan Sydney, which apply to Ivanhoe Estate. The relevant state government targets for transport are as follows:

- 28% public transport mode share for journeys to work;
- 20% public transport mode share for journey to work into Liverpool CBD; and
- 5% bicycle mode share for trips of less than 10km.

6.4 Proposed Sustainable Travel Measures

The measures support delivery of the high level transport and travel demand management objectives and support the wider principles discussed. This is how the precinct planning process will deliver a sustainable precinct, in which travel by car is not the only option for residents and visitors to make the journeys they wish to make.

The measures include a range of different types of initiatives which together reinforce the principles and objectives of the sustainable travel strategy. These measures include:

1) Travel behaviour measures – Initiatives to encourage sustainable travel.

2) Service measures – Service delivery standards to maximise potential uptake of sustainable modes.

3) Infrastructure measures – Provision of infrastructure designed to facilitate sustainable travel.

6.4.1 Travel Behaviour Measures

1) Household Information Packs (HIPs) for each household in Ivanhoe Estate

Each household would be provided with a household information pack (HIP) which would include a sustainable travel kit. This would be delivered to each new residence upon completion to set out the sustainable travel options available to residents and the specific local initiatives available to encourage sustainable travel.

This would incorporate public transport leaflets, route maps and timetables, pedestrian and cycle network maps, information on sustainable community initiatives such as Bicycle User Groups, Car

Sharing Schemes, the Sydney Connect Scheme, and other local community projects to reduce travel or encourage uptake of sustainable modes.

The household-based personalised journey planning approach is a proven, effective methodology to encourage sustainable travel and reduce residents' vehicle travel. There is an opportunity to use this measure to embed the desired sustainable travel principles in Ivanhoe Estate.

2) One $20 Opal card for each household

In addition to the HIP, each household would be provided with an Opal card that has been preloaded with a nominal amount of $20 to encourage uptake of public transport by new residents from day one, aimed to influence future resident's travel behaviour of reducing car uses.

6.4.2 Public Transport Measures

3) Integration of public transport services – bus and rail connectivity and interchange

The bus route network surrounding Ivanhoe Estate has been designed to maximise integration with train services provided at Macquarie University Station and Macquarie Park stations. Bus services link the Site with a dedicated bus-rail interchange designed to minimise interchange disruption and encourage onward travel by public transport. Bus services also provide onward connections to regional centres of employment, retail and commerce.

Bus timetables should also have input from the Site to ensure that they are designed to coordinate with the rail timetables to minimise transfer time and overall journey time for residents and employees.

4) Bus service coverage

The proposed bus routes to service Ivanhoe Estate have been designed to maximise coverage and to provide connections for residents to major services such as schools, recreational facilities and Macquarie University.

According to the Bus Service Planning Guidelines, bus services should cover 90% of the proposed development that is within 400m of a bus route. The proposed bus network should be designed to maximise the coverage of the proposed Ivanhoe Estate development throughout the different stages of the development. However, circuitous routes should be avoided that provide inefficient and indirect bus service to passengers.

5) Timing of bus services and development staging – early 'Start up' buses

In order to reduce car dependency for Ivanhoe Estate, it is recommended that a bus service should be established from the opening of Stage 1 to encourage the use of public transport by the residents. The bus routes will connect Ivanhoe Estate with Macquarie University Station.

Aspire will work with Transport NSW and the local bus service provider to deliver a service prior to the opening of the SWRL and Macquarie University Station.

6) Bus service frequencies to Service Planning Guidelines

The public transport network is designed to meet or exceed the criteria for service levels based on the Transport NSW bus planning guidelines.

7) Good quality bus stops with coverage throughout Macquarie Park

Bus stops will be provided on bus routes at regular intervals, at approximately 400 metres between stops, throughout Macquarie Park, to provide good access to public transport networks. Stops will also be strategically placed adjacent to major trip attractors at schools and leisure facilities, and the dedicated bus-rail/Metro interchange facility provided at Macquarie University Station.

A bus stop within or adjacent to the Ivanhoe Estate will be designed with high standards of infrastructure, to provide shelter, seating, information such as timetable and network map. The facilities will be determined by surrounding land uses, account for service frequency and potential patronage.

In addition, the implementation of a new developer funded community bus connecting the development with Macquarie Park employment zones and other local services should be provided.

8) Design for bus priority

In order to develop and protect bus corridors within Ivanhoe Estate to facilitate bus permeability, the Site has been designed to accommodate bus movements, with minimal impediment to bus flow and to maximise journey time reliability.

Signalised intersections on bus routes surrounding Ivanhoe Estate will be provided with bus priority where appropriate. Priority works has also been identified at the following locations to support efficient bus access.

6.4.3 Bicycle Measures

9) Dedicated, high quality cycle routes throughout Ivanhoe Estate

Cycle routes are to be provided throughout Ivanhoe Estate to connect between residential areas, rail station, schools, leisure and other facilities. Therefore, these routes will provide for connections for all journey purposes for employment and education, as well as leisure and recreation. The routes will form part of a dedicated bicycle network which provides high quality infrastructure designed to make bicycle travel attractive, convenient, safe and efficient. In this way bicycle travel can be a realistic alternative, especially for local travel i.e. trips under 5kms.

10) Bicycle facilities

To maximise bicycle usage throughout the Site and the wider precinct, the provision of sufficient end of trip facilities, such as bicycle parking, at key locations is essential. Bicycle parking is therefore proposed to be provided in close proximity to the schools and sports facilities, within Ivanhoe Estate, at the rail stations and will also be encouraged as part of the development of employment and other commercial uses. Other areas of key open space will also have bicycle parking for leisure and recreational use. In addition, a single bike parking space is proposed for each unit, ensuring sufficient provision is provided for bike storage.

11) Encourage local Bicycle User Group (BUG) for Ivanhoe Estate

The local community could be encouraged to set up a dedicated Bicycle User Group (BUG) for Ivanhoe Estate, or join an existing BUG which is active in the local vicinity and which works to encourage bicycle use and promotes bicycle rides and initiatives.

12) Promotion of bicycle initiatives – NSW bicycle week, cycle to work day

In addition to a local BUG to promote and encourage cycling in the precinct, local schools, businesses and councils should actively participate in recognised NSW government bicycle initiatives such as bicycle week and cycle to work day.

6.4.4 Pedestrian Measures

13) A highly permeable and safe pedestrian network throughout Ivanhoe Estate

A permeable pedestrian network will be provided throughout Ivanhoe Estate through continuous pedestrian footpaths and pedestrian crossing facilities at key locations. The design of a high quality, highly permeable pedestrian network with limited delays to walk trips and which is pleasant, convenient, direct and integrated with land uses will encourage and facilitate pedestrian accessibility.

In addition to the factors described above, the pedestrian network will consider safety in design to provide well-lit pedestrian links which can be observed from local land uses and as such provide pedestrians with a perception of safety and ambience which can encourage pedestrian travel.

14) Walking school bus program

The school in Ivanhoe Estate will be encouraged to implement a walking bus. The walking school bus is a simple concept whereby a group of children walk to school with one or more adults. This can overcome parents' safety fears, often cited as their primary cause of reluctance to allow their children to walk to school. These types of programs can also lead to a mindset which encourages active travel throughout life for both children and parents for other journeys and is as educational and supportive of behavioural change as it is practical.

6.4.5 Travel Planning Measures

15) School travel plans

School travel plans should be mandatory for the school in Ivanhoe Estate. Local schools should have predominantly local catchments so should therefore aim for high levels of travel by sustainable modes, and especially active modes.

Active access will be facilitated by a series of continuous, high quality pedestrian and bicycle paths, and complimentary end of trip facilities should be provided through the Site. A range of additional initiatives ranging from the walking school bus to award and encouragement to those who travel actively will help develop a healthy, active culture and meet travel targets.

16) 'Voluntary' workplace travel plans

Workplace travel plans should be encouraged for new businesses in the Masterplan, which could be implemented through the provision of shared area-based initiatives and facilities wherever possible.

6.4.6 Parking Restraint Measures

17) Restrained parking rates for town centre high density residential development

The high density residential development in Ivanhoe Estate will have very good access by public transport, as well as good quality pedestrian and cycle networks, and a good range of local shops, services and facilities in close proximity, thereby reducing residents need to own and operate a car.

Therefore, parking requirements for the high density residential should be restrained to account for the availability of other travel options, as well as accessibility to local services. This will lead to reduced car

dependence and encourage uptake of other modes. The implementation of this measure will require further discussion with relevant Councils and may need to revise the DCP, if appropriate.

18) Co-sharing parking provision

The provision of parking in the estate should be co-ordinated and where possible shared across multiple land uses or shared between retail and commuter parking that do not have similar peak parking demands. This will create a more walkable, liveable centre, which is not car dominated and ensure balanced access across all modes.

Parking provision should encourage short stay trips, with some limited long stay parking for commuters. Any on-street parking should be limited to short term, disabled and taxi parking.

6.4.7 Travel Demand Management Measures

19) Car sharing scheme

City of Ryde Council should consider extending the provision of established car share schemes using an established provider (such as GoGet) to set up a car sharing network for Ivanhoe Estate. This would reduce residents' need to own and operate their own vehicle, safe in the knowledge that they can get access to a vehicle if they require one.

20) Encourage sustainable home deliveries of groceries using local producers

Additional measures, which can be encouraged through promotion in the Household Information Packs and supported through local community organisations, are to adopt sustainable practices for deliveries and sustainable principles in local food production. Creating and utilising a local food production network can reduce peoples' need to travel (for shopping) and hence reduce travel demand for residents, whilst also reducing the transport of food produce.

7 Transport Assessment

7.1 Introduction

This section assesses the likely traffic impacts of the proposed development Masterplan on the local road network. To offset the impacts of the Proposal and accommodate the density proposed, several infrastructure upgrades are proposed in addition to restricted car parking rates that will ensure the redevelopment of Ivanhoe Estate can be delivered. These upgrades provide significant public benefit (to future residents and the wider community) and support the growth of Macquarie Park. The methodology adopted in the identification of these upgrades and the implications of the development on the existing public transport and road network is outlined below.

In attempt to understand the esoteric issues of relevant stakeholders, to provide an opportunity to understand points of view not previously considered, and to arrive at some collective appreciation of the alternatives, an appropriate level of consultation has been undertaken at meetings with the following agencies:

- CBD Coordination Office within Transport for NSW: 5 September 2017
- RMS: 7th April 2017, 18th May 2017, 30th August 2017, and
- CoR Council: 30th August 2017

7.2 Proposed Car Parking Rates

Car parking for the development is proposed in accordance with the requirements of Council's Macquarie Park DCP and other relevant state planning documents. A summary of the parking rates proposed is provided in **Table 11** for both the residential and non-residential land uses proposed.

Adoption of the rates embodied within Council's DCP is supportable on traffic demand management point of view, recognising that the DCP rates are maximum rates based on the restrictive rates recommended for adoption under the RMS Guide to Traffic Generating Developments.

Table 11: Parking Rates

Land Use	Proposed Rate	Comments
Residential (Market, Affordable and Social)		
1 Bed	Max 0.6 spaces per Unit	DCP Requirement
2 Bed	Max 0.9 spaces per Unit	DCP Requirement
3 Bed	Max 1.4 spaces per Unit	DCP Requirement
Visitor	1 spaces per 20 Units	Half DCP requirement: reasonable for a portion to be provided on-street, Site's access to public/active transport
Car Share	1 space per 100 parking spaces	DCP requires 1 per 50 parking spaces however this is considered excessive given the scale of the development.
Residential Care Facility	1 space per 10 beds + 1 space per 2 employees	SEPP (Housing for seniors or people with a disability)
Independent Living Units	1 space per 5 dwellings	SEPP (Housing for seniors or people with a disability)
Non-Residential		
Retail	Max 1 space per 100m^2	LEP Requirement
Commercial	Max 1 space per 100m^2	LEP Requirement
Child Care	1 space per 8 children & 1 space per 2 employees	DCP Requirement
School	Pick Up / Drop Off facilities + maximum 30 staff spaces	No DCP requirement, may be operator driven, however minimal parking should be provided.

It is noted that the application seeks approval for a reduced parking rate for residential visitors of 1 space per 20 units. Adoption of this rate is deemed appropriate having regard to the high accessibility of the site to public transport. Furthermore, the suppression of visitor parking will also reduce the availability of residents to utilise spare parking capacity thereby supressing car ownership.

It is also proposed that the Social Housing be provided with parking at a rate not less than 0.5 spaces per unit, consistent with the relevant State Environmental Planning Policy for affordable housing.

Bike parking will be provided for all residential units, with non-residential land uses to be provided bike parking at a rate consistent with Council's DCP.

7.3 Trip Generation Assessment

7.3.1 Modal Analysis

As mentioned, the Macquarie Park precinct currently operates as a commercial centre with limited residential land uses. As a consequence of (and indeed an objective of) the Herring Road UAP, a shift towards a more urban centre in the short to medium term is expected with a future urban outcome similar to that of other centres in Sydney.

For the purpose of this assessment, the urban centres of St Leonards and Chatswood have been adopted as 'benchmarks' for comparison, as it is considered that these centres currently reflect a mix of uses and densities that represent the wider vision for the Macquarie Park area surrounding the Site, as well as benefit from similarly high levels of public (bus and rail) transport services. In order to demonstrate the suitability of adopting these centres as benchmarks, **Table 12** presents key measures for the 3 areas.

Table 12: 2016 - 2026 Population and Employment and Walk & Transit Score Comparison

Location	Travel Zones	Walk Score / Transit Score*	2016		2026	
			Resident Population	Employee Population	Resident Population	Employee Population
Macquarie Park	1544, 1537, 1539, 1541, 1543, 1536	90 / 78	3,327	23,525	8,710	26,613
Chatswood	1807, 1805, 1806, 1803	99 / 79	11,763	22,702	15,691	24,764
St Leonards	1843, 1832, 1844	85 / 73	6,914	25,367	11,379	28,153

Walk score is a measure of the walkability of an address in relation to amenities in particular categories. The use of walk score is a reasonable measure of the location of a site to key services – and is used in the calculation of Green Star Ratings. Walk Score figures in ***Error! Reference source not found.*** *are measured from the Railway Station.*

Table 12 demonstrates that employment levels (today and in the future) are consistent between the three areas, with moderate growth in employee numbers forecast to 2026. Regarding resident population, Table 12 shows that despite significant growth expected for Macquarie Park, resident numbers will remain lower that Chatswood or St Leonards.

However, it is important to note that a key principle of the development of a TOD is to provide a sustainable mixed-use community with places of residence and work within the TOD area. Within this context, the deficit or 'gap' between forecast resident numbers and employee numbers can be considered a justification for the predominantly residential Ivanhoe proposal as future residents of the Site are likely to find employment locally, compared with say Chatswood or St Leonards, where the gap is not as significant.

The forecast analysis above indicates that the current travel characteristics of Chatswood and St Leonards would provide a reasonable baseline upon which to assess the future travel characteristics of Macquarie Park. Within this context, the Journey to Work modal splits for these 2 areas are presented in **Table 13.**

Table 13: 2016 BTS Journey to Work Modal Splits

Location	Travel Zones	Vehicle Driver	Vehicle Passenger	Train	Bus	Walk / Other
Chatswood	1807,1805, 1806, 1803	31%	3%	40%	5%	21%
St Leonards	1843, 1832, 1844	26%	3%	48%	6%	17%
Average	-	29%	3%	44%	6%	19%

The modal splits as presented above demonstrate considerable demand for non-car travel modes with significant preference for public transport and walking trips. Based on the forecast analysis above, it is expected that the Macquarie Park area in the future would have similar modal splits and similar levels of public transport and active transport usage.

This is consistent with the findings of the Herring Road UAP which states that:

The 2011 Census Journey to Work data demonstrates that Herring Road exhibits many characteristics of a transit-oriented development and active 'live-work' community. The data shows that 24% of existing residents in the precinct either walk or cycle to work, a figure significantly higher than many other existing centres and urban renewal areas. A further 23% travel to work by rail and 9% by bus, which means 56% of local residents already choose not to drive to work. This illustrates that existing residents already benefit from the close proximity of diverse local employment opportunities provided by the university, the shopping centre and the business park. This in turn creates a robust platform for future increases in residential and mixed-use development activity.

It is evident therefore that the site benefits from proximity to good access to key services that influence travel choice with a clear existing and future preference for non-car travel modes, consistent with the expectations of a TOD.

Trip generation of the Project has been estimated through review of available Bureau of Transport Statistics data (including HTS and JTW data) as well as surveys of comparable development sites. The trip generation has been estimated for each land use proposed.

The development will also generate a substantial number of non-car trips associated with walking, cycling and public transport usage. The estimate of these trips has been established through adoption of mode share percentages adopted for St Leonards and Chatswood, calculated from the 2011 JTW data. This approach is justified on the basis of the Project's proximity to:

- Access to high frequency strategic bus corridors including express city bound services,
- Proximity to future Metro services between the CBD and the Macquarie Park,
- Proximity of the site to educational facilities,
- Proximity of the site to shopping services (Macquarie Shopping Centre),
- The accessibility to substantial employment within close walking distance, and
- Constrained parking provisions of the project.

In addition to the above, the modal analysis has considered the following targets and objectives based on relevant State and Local Government planning policies:

- Achieve 40% public transport usage within Macquarie Park,
- Increase walking trips to 25% through developing a NSW Walking Strategy,
- Increase bicycle trips made in Greater Sydney through completing the Metro Sydney Bike Network,
- Increase employment and housing within public transport catchments,
- Reduce travel times and create a 30min city

Having consideration for the all of the above, **Table 14** presents the morning peak hour forecast modal splits for the residential uses (by trip purpose) for the area of Macquarie Park that covers the Site.

Table 14: Mode Share of Residential Trips by Journey Purpose during the AM Peak Hour

Mode	Work	Education	Shopping	Other
Vehicle Driver	36%	2%	35%	32%
Vehicle Passenger	4%	26%	13%	22%
Train	33%	20%	5%	8%
Bus	7%	22%	6%	7%
Walk	18%	25%	40%	29%
Other	1%	5%	1%	2%

Application of the trip purpose proportions (refer to Table 2) to the mode share splits above, results in a combined AM peak hour modal split for all trip purposes. This is presented in **Table 15**.

Table 15: Forecast AM Peak Hour Mode Share for Residential Trips

Mode	Work
Vehicle Driver	27%
Vehicle Passenger	14%
Train	21%
Bus	11%
Walk	25%
Cycle / Other	2%

The resulting land use generation is summarised in the following sections.

7.3.2 Market Housing Generation Rate

The Proposal currently envisages the provision of 3,481 residential dwellings including a mixture of both market housing and social housing. In the development of the residential trip rates, it is necessary to consider the future land uses and offerings within Macquarie Park. In this regard, a review of available housing and employment data has been undertaken for areas within a 10-minute walking distance of the Ivanhoe Estate, and compared to the 2016 Bureau of Transport Statistics Journey to Work data for St Leonards and Chatswood as discussed in Section 7.3.1.

The analysis undertaken in Section 7.3.1 demonstrates that the current travel characteristics of Chatswood and St Leonards would provide a reasonable baseline upon which to assess the future travel characteristics of Macquarie Park.

In terms of how this translates to peak hour vehicle traffic generation, surveys of sites within both St Leonards and Chatswood were undertaken as part of the RMS Guide to Traffic Generating Developments – Updated Traffic Surveys 04a (the RMS Guide Update) issued in 2013. To supplement this data, Ason Group has undertaken additional surveys at both St Leonards and Chatswood as well as Macquarie Park and (for comparison) North Sydney. A summary of the survey results is presented in **Table 16** and compared to those undertaken by RMS.

Table 16: Market Housing Traffic Survey Results

Location	Number of Units	AM Trip Rate / Unit	PM Trip Rate / Unit
St Leonards (RMS)	70	0.14	0.07
St Leonards (Ason)	160	0.11	0.12
Chatswood (RMS)	129	0.14	0.12
Chatswood (Ason)	565	0.08	0.08
North Sydney (Ason)	439	0.05	0.05
Macquarie Park (Ason)	618	0.13	0.14

The trip rates surveyed range significantly from 0.05 trips per unit to 0.14 trips per unit. The surveys demonstrate a decrease in traffic generation rates in both St Leonards and Chatswood from the surveys undertaken by RMS in 2013. This is consistent with separate data provided by TfNSW which demonstrates an increase in patronage of 10% on the North Shore Line between 2016 and 2017 alone.

The average of the 4 rates above for St Leonards and Chatswood (which represent the likely future characteristics of the Herring Road precinct), results in an average trip rates of 0.12 trips per unit and 0.10 trips per unit for the morning and evening peaks. Notwithstanding this, a higher than average rate has been adopted for the market housing of:

- AM Peak: 0.14 trips per unit
- PM Peak 0.12 trips per unit

Application of these rates to the 2,324 units of proposed market housing results in the following peak hour traffic generation forecasts:

- AM Peak: 325 vehicle trips
- PM Peak 282 vehicle trips

With regard to person trips by all modes, by applying the adopted mode share in Table 15 to the morning peak hour vehicle trips above, **Table 17** presents the forecast person trips by all modes during the morning peak hour.

Table 17: Forecast AM Peak Hour Mode Share for Residential Trips

Mode	Work
Vehicle Driver	325
Vehicle Passenger	163
Train	250
Bus	125
Walk	297
Cycle / Other	26

7.3.3 Social and Affordable Housing

Social housing is rental housing provided by not-for-profit, non-government or government organisations to assist people who are unable to access suitable accommodation in the private rental market. Limited data is available for Social Housing developments and as such Ason Group requested Mission Australia Housing to provide locations suitable to undertake surveys based on characteristics such as, proximity to a train stations, bus services, major retail and employment. In addition, sites were requested that provided only social housing and parking at rates consistent with the requirements for car parking under the relevant SEPP. Three suitable locations were provided by Mission Australia Housing and surveys to determine the trip rate per unit were conducted over multiple days at each location. A summary of these survey results is presented in **Table 18**.

Table 18: Social Housing Traffic Survey Results

Location	Number of Units	AM Trip Rate / Unit	PM Trip Rate / Unit
1-3 Shortland Street, Telopea	103	0.02	0.03
23 Pyrmont Bridge Road, Camperdown	160	0.04	0.03
263 Beames Street, Mt Druitt	40	0.03	0.10
	Average Rates	**0.03**	**0.05**

It is evident from Table 18 that the trip rates as surveyed range from 0.02 trips per unit to 0.10 trips per unit in the peak hours. This is consistent with the expectation that social housing seeks to deliver accommodation for key workers within the community that they serve and therefore have limited need to commute lengthy distances.

Accordingly, and based on the average of the rates above for the Telopea, Camperdown and Mt Druitt sites, the following trip rates are proposed for adoption for the social housing:

- AM Peak: 0.03 trips per unit
- PM Peak 0.05 trips per unit

These rates are considered appropriate for adoption noting the absence of any appropriate rates provided in the RMS Guide that the adopted rates have been derived from surveys of existing social housing developments within proximity to rail and other services

For the purpose of the affordable housing, adoption of the surveyed rates of the market housing being 0.12 trips per unit and 0.1 trips per unit for the morning and evening peaks, has been adopted. These rates reflect the lower parking provisions required under the SEPP.

7.3.4 Independent Living Units

A rate of 0.1 trips per dwelling for the Independent Living Units (ILU's) has been adopted for this assessment and is consistent with the rates proposed under the RMS Guide and for other developments completed by Frasers (including the Bupa development at Clemton Park). This rate has been adopted for both the market and social housing ILU's.

7.3.5 High School

The masterplan includes a vertical high school with an approximate 1,000 student capacity. The future generation of the site has been derived based on surveys of two schools including St Mary's Cathedral College, located in Sydney CBD and Marist College, North Sydney.

Due to the difficulties associated with accurately assessing school trip generation, online questionnaire surveys were undertaken. The surveys were undertaken for both staff and students to establish modal splits, arrival and departure times, car occupancies, travel distance and duration. A summary of the findings is provided below:

St Mary's Cathedral College, Sydney

The surveyed students had the following travel characteristics:

- Of the 704 students at the secondary school, 353 students responded to the surveys (50%), and of the 72 staff members, 57 responded (79%).
- 78% of students arrived at school between 8.00-9.00AM with 57% arriving between 8.00-8.30am
- 92% of students departed between 3.00-3.30PM.
- 88% of respondents used public transport for the as main mode of transport to school with only 0.6% of students who travelled to school as a car driver and 5.3% travelled as passengers.
- 50% of students live within 15km from the school.
- It takes the majority of students (63%) between 0-45 minutes to travel to school.

The surveyed staff had the following characteristics

- The staff surveys showed that 41% of staff arrived between 7.30-8.00AM and 57% departed between 3.30-4.30PM.
- 61% of staff travelled via public or non-car travel modes and 33% of staff travelled by private car.
- Of the staff that do drive, 96% park on-site.

Marist College, North Sydney

The surveyed students had the following travel characteristics:

- Of the 837 students at the secondary school, 461 students responded to the surveys (55%), and of the 80 staff members, 51 responded (64%).
- 88% of students arrived at school between 7.30-8.30AM with 72% arriving between 8.00-8.30am
- 75% of students departed between 3.00-3.30PM.
- 78% of respondents used public transport for the as main mode of transport to school with 3% of students who travelled to school as a car driver and 7% travelled as passengers.
- 60% of students live between 0-10km away from the school,
- 54% of students took between 0--30 minutes to/from school.

The surveyed staff had the following characteristics

- The staff surveys showed that 95% of all staff arrive by 8.30am and 56% departed between 3.30-4.30PM.
- 63% staff travelled by private car with 96% of these staff parking on-site.

The surveys of the two schools demonstrated that.

- The majority of students (83%) use public transport for their trips to school with an average of 8% of trips being generated by car, as either a driver or as pick up / drop offs.
- Students generally arrive between 8.00-8.30am and depart prior to 3.30pm, and
- Staff generally arrive prior to 8.30am with 80% of staff generally departing prior to 4.30pm.

The surveys (which include 814 responses) therefore provides a suitable data set for adoption in the assessment of trips generated by students of the proposed high school. On this basis, the anticipated modal splits have been established and applied to the estimated future student population. The results of this are summarised in **Table 19** for the critical AM peak period.

Table 19: Student Modal Splits (AM Peak)

Travel Mode	% of Trips	Trips
Car Driver	2%	20
Car Passenger (Drop Off)	6%	60
Public Transport	83%	830
Walking	4%	40
Other	5%	50
Total	100%	1,000

The staff trip generation rate is based on the parking provided and number of staff. With 1,000 students, it is estimated that the school will employee approximately 50 staff. Having regard for the objectives of the Macquarie Park DCP and the Sites accessibility to public transport, it is proposed that staff parking be limited to senior staff only. As such it is assumed that no more than 15 staff parking spaces would be provided. This reflects a rate of approximately 0.3 spaces per employee, which whilst higher than that for commercial land uses, is deemed to be supportable. On this basis, a trip rate of 15 trips per hour during the morning and evening peak has been adopted for staff. It is noted that that the surveys indicated that 80% of staff departed prior to 5.00pm. Notwithstanding for the purpose of this assessment it has been assumed that all staff depart within the evening peak.

The above results in a morning peak trip rate of 94 vehicles per hour. No vehicle trips associated with students have been assumed during the PM peak on the basis of the survey results which demonstrated less than 2% of students remained on-site after 5.30pm. Having regard to the low car driver modes any trips during the PM peaks would be negligible. Accordingly, the trip rate adopted for the PM peak of 15veh/hr assumes the departure of staff vehicles only.

7.3.6 Retail

The retail offerings anticipated for the development are expected to be generally ancillary uses such as café's and convenience retail. Accordingly, trip generation for these uses is expected to be associated with staff arrivals and departures only. Accordingly, it has been assumed that a generation of 1 trip per 100m^2 of GFA would occur.

7.3.7 Office

The development includes the provision of approximately 571m^2 of office floor area, to be used by Mission Australia. Ryde Council's DCP permits parking for office to be provided at a maximum rate of 1 space per 100m^2 of GFA. Application of this rate to the proposed floor area would result in a maximum provision of 6 spaces. Accordingly, for the purpose of this assessment, it has been assumed that all employees would arrive during the AM peak and depart during the PM peak resulting in a trip rate of 1 trip per 100m^2 of GFA.

7.3.8 Child Care

The development is providing two child care centres with capacity of approximately 150 places. Due to the proposed density and population of the Ivanhoe Estate and adjoining developments (including the Stamford, and other Herring Road developments) it is expected that most child drop off and pick up's will occur via walking trips or linked trips by residents and employees already within the network. As such a nominal rate of 1 trip per 10 children has been applied.

Similarly, staff trips are also expected to be minimal having regard for the sites accessibility to public transport and suppressed parking provision. It is expected that the centres will employee approximately 30 staff with no more than 15 staff parking spaces being provided. These trips are expected to be in during the AM peak and out during the PM peak periods.

7.3.9 Development Vehicle Trip Generation Summary

Having regard to the above, the future generation of the site during the morning and evening peak periods is summarised in **Table 20.** These rates are based on surveys of comparable developments consistent with the future modal split assumptions for the precinct having regard for to the proximity of infrastructure including public transport services, shopping and employment.

Table 20: Adopted Trip Generation

Land Use	Approximate Yield	AM Trip Rate	PM Trip Rate	AM Generation (veh/hr)	PM Generation (veh/hr)
Residential Land Uses					
Market Dwellings [1]	2,324	0.14 / unit	0.12 / unit	325	282
Social Dwellings	875	0.03 / unit	0.05 / unit	26	44
Market Independent Living Units	132	0.10 / unit	0.10 / unit	13	13
Social Independent Living Units	141	0.03 / unit	0.05 / unit	4	7
Affordable Units	128	0.12 / unit	0.10 / unit	15	13
Residential Aged Care Facility [2]	120	0.10 / unit	0.10 / unit	12	12
			Residential Sub-total	395	371
Non-Residential Land Uses					
High School	1000 students	survey	survey	95	15
Child Care	150 children	0.1 per child +15 staff	0.1 per child + 15 staff	30	30
Office	571m^2	1 / 100m^2	1 / 100m^2	6	6
Ancillary Retail	1,246m^2	1 / 100m^2	1 / 100m^2	12	12
			Non-Residential Sub-total	144	63
			Total Estate Generation	**538**	**434**

1) Approximated market dwelling yield has been increased by 100 to allow a contingency in the traffic trip generation rates.
2) Beds not included in indicative yield.

As demonstrated in **Table 20**, it is anticipated that the generation of the site will be in the order of 538 veh/hr during the morning peak period and 434 veh/hr during the evening peak period. These trips will be distributed onto the network making use of all available routes, including the new connections proposed with Lyonpark Road and Epping Road.

The distribution of these trips onto the network and the resulting impacts on the operation of key intersections is discussed in the following sections.

7.4 Trip Distribution and Assignment

7.4.1 Residential Trip Distribution

The distribution of traffic onto the external road network has been generally based on the 2011 Journey to Work Data and other relevant studies undertaken within the Herring Road Urban Activation Precinct. The expected residential trip distribution is presented in **Table 21**.

Table 21: Residential Trip Distribution

Direction	AM Peak		PM Peak	
	Inbound	Outbound	Inbound	Outbound
North	38%	10%	10%	38%
South	16%	22%	22%	16%
East	37%	47%	47%	37%
West	10%	20%	20%	10%

7.4.2 Non-Residential Trip Distribution

The non-residential trip distribution has been based on the commercial distribution of existing developments within Macquarie Park. This distribution is deemed to be acceptable until such time more detailed information can be provided regarding the catchment of the proposed school. A summary of the non-residential distribution for adoption is provided in **Table 22**.

Table 22: Non-Residential Trip Distribution

Direction	AM Peak		PM Peak	
	Inbound	Outbound	Inbound	Outbound
North	17%	18%	18%	17%
South	27%	26%	26%	27%
East	41%	48%	48%	41%
West	15%	8%	8%	15%

7.5 Traffic Modelling

7.5.1 Modelling Background

In 2016 AECOM was commissioned to develop an Aimsun mesoscopic-microscopic "Hybrid" traffic model to inform the planning process for the future planning of Macquarie Park. The hybrid model developed and used for the assessment of the Ivanhoe Estate development, was adopted by RMS to assess proposed bus operation improvements associated with the MPBPCI. The model extents simulated as a microsimulation area (indicated by the orange shaded area in **Figure 28**) for the purpose of this assessment. The remainder of the network was modelled in mesoscopic simulation (indicated by the blue shaded area in Figure 28).

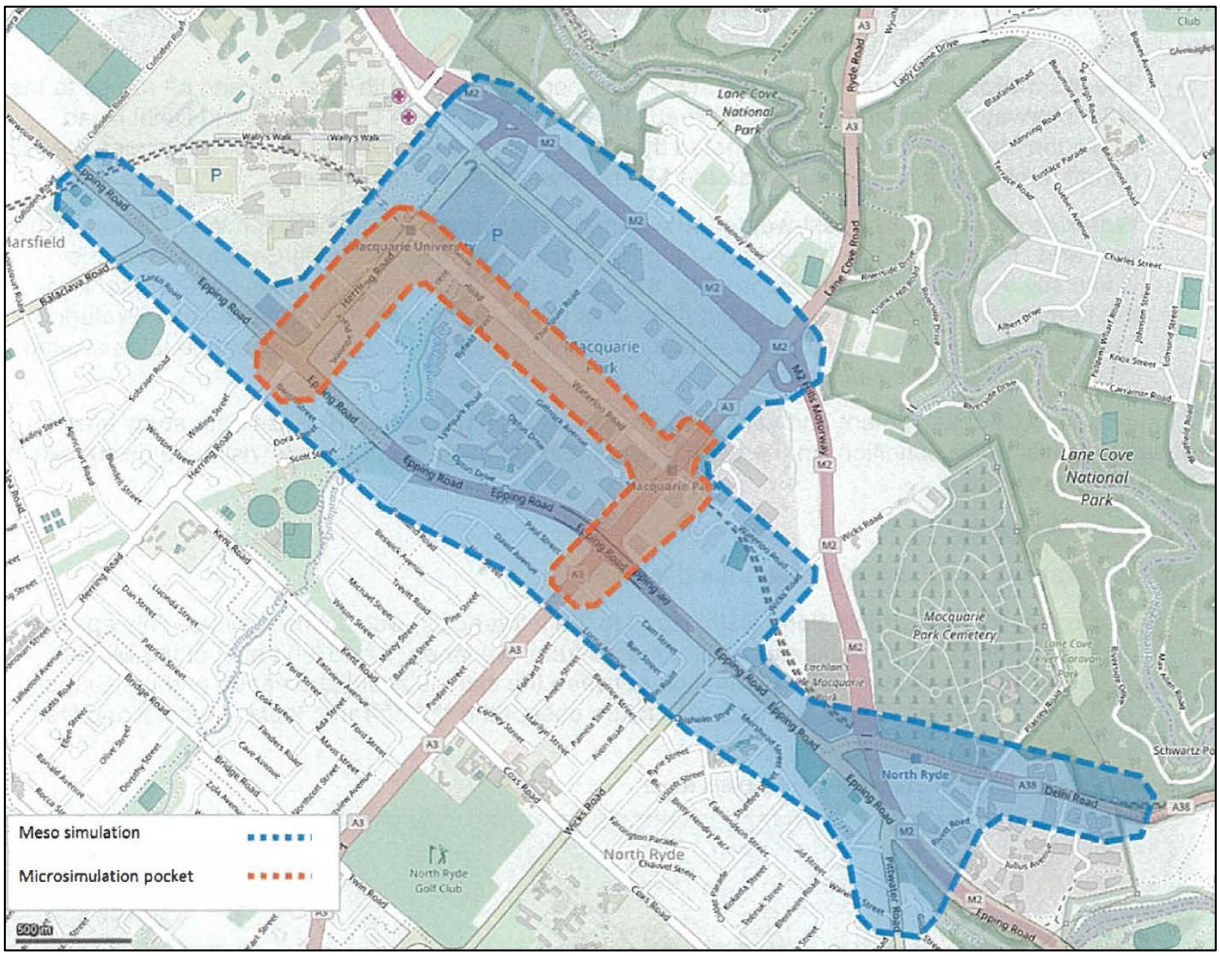

Figure 28: Aimsun 2016 Base Model Extents (Aecom)

7.5.2 Model Specification

This model provided to Ason Group by RMS was calibrated for the future year 2021 and included:

- All MPBPCI works and
- all known and committed developments expected within the study area by 2021.

Model calibration and validation for the hybrid model was based on RMS Traffic Modelling Guidelines and conducted by AECOM in the 2016 base model and included all intersection upgrades proposed under the MPBPCI Stage 1 and Stage 2 works.

7.5.3 Modelling Approach and Key Assumptions

Aimsun modelling platform (Version 8.1.4 R40678) was used for the development of the 2021 RMS Base model and all future scenarios for option testing. A new microsimulation area ('Micro Pocket') was configured into the mesoscopic model as highlighted in blue in **Figure 29** to provide detailed operational assessment at the critical locations specified in the SEARs.

The assessments were performed for the weekday AM and PM peak periods. The impact assessments incorporated forecast traffic growth from the 2021 Sydney Strategic Traffic Forecasting Model (STFM).

A demand zone for the Site was defined in the model to cover the key traffic entry/exit points in the network. The zone system was defined in respect of existing traffic generating developments and potential locations of future developments as supplied by RMS, to aid future scenario testing. Major developments (such as the Macquarie Centre) are represented by a number of zones that closely match the existing access arrangements in terms of driveways and vehicular accesses. At other locations where smaller developments are located, a number of developments are represented by one or two zones.

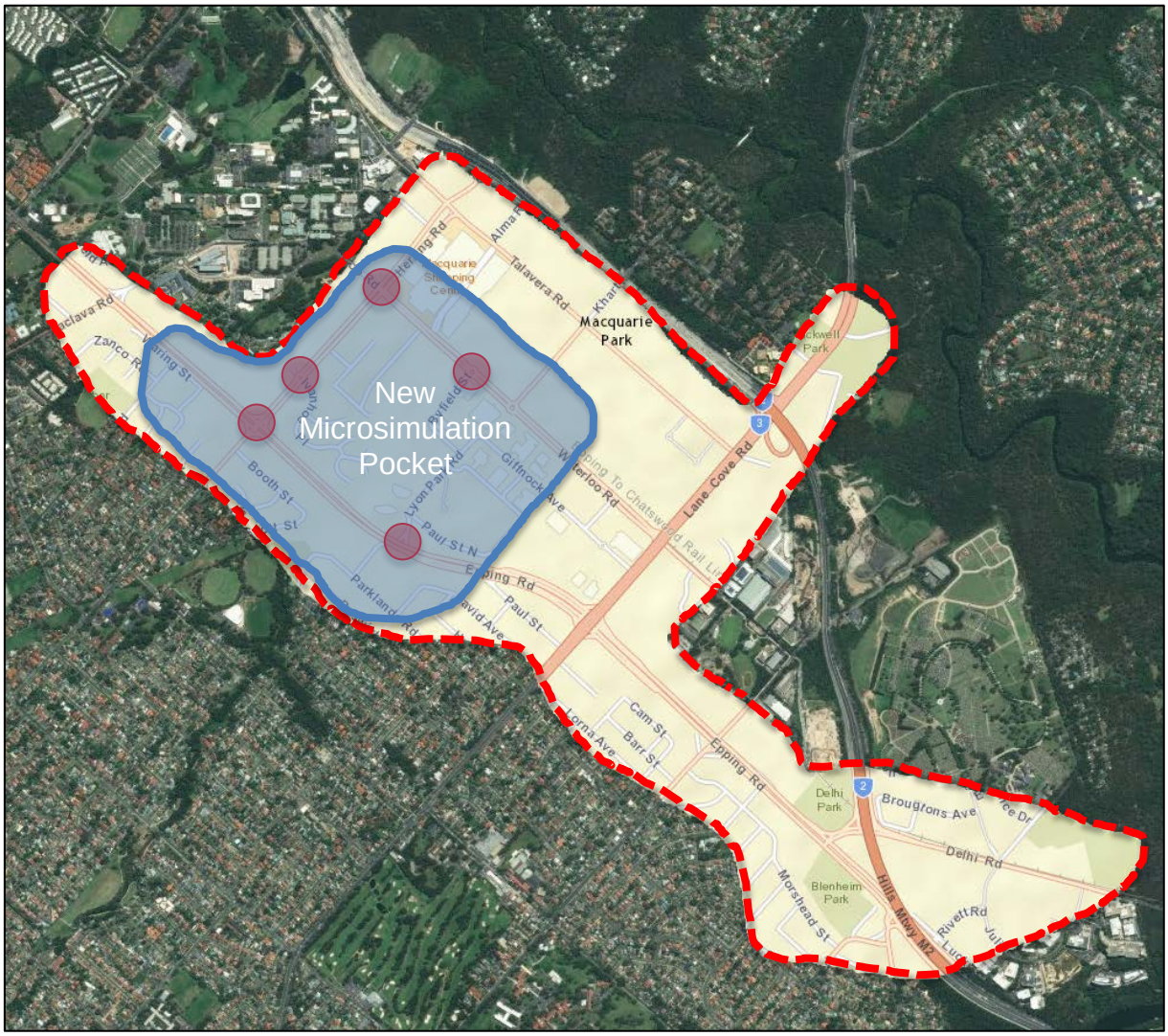

Figure 29: Aimsun 2021 Base Model Extents

7.5.4 Comparison of 2016 and 2021 Base Model

The MPBCI project identifies a number of upgrades on the road network surrounding the Site that would improve and support the traffic movement and predicted growth within and around Macquarie Park. The upgrades to the bus facilities within the area will also provide improvements to bus routes and support the ECR Temporary Transport Plan from late 2018 as part of the Sydney Metro Northwest and existing local, suburban and Rapid bus routes that service the area in the longer term.

The key features of the overall concept designs for the MPBPCI project have been included in the future model scenarios and include:

- Upgrade of the Herring Road/Epping Road intersection as shown in **Figure 30**.
- Upgrade of the intersection of Herring Road and Ivanhoe Place by replacing the existing roundabout with a signalised four-way intersection as shown in **Figure 31**.

- Adjustments to the median along Herring Road, between Ivanhoe Place and Waterloo Road to provide two general traffic through lanes and a dedicated bus lane in both directions.
- Upgrades to the intersection of Herring Road and Waterloo Road as shown in **Figure 32**.
- Widening of Waterloo Road (into the median and along the southern side and parts of the northern side of the road) between Cottonwood Crescent and Lane Cove Road to provide two general through traffic lanes and a dedicated bus lane in both directions.
- Upgrade of the Byfield Road and Waterloo Road intersection by replacing the existing roundabout with a signalised four way intersection, and upgrade of the Khartoum Road and Waterloo Road intersection by replacing the existing roundabout with a signalised four way intersection as shown in **Figure 33**.
- Upgrade of the Waterloo Road/Lane Cove Road
- Extension of the existing southbound bus lane on Lane Cove Road, between Waterloo Road and Epping Road, by widening the eastern kerb line to provide a continuous bus lane from Lane Cove Road to the commencement of the existing left turn lane into Epping Road eastbound.
- Upgrade of the Lane Cove Road/Epping Road.
- Extension of the dedicated right turn lane northbound on Lane Cove Road onto Epping Road eastbound by narrowing the median on Lane Cove Road between Allengrove Crescent and Lorna Avenue.

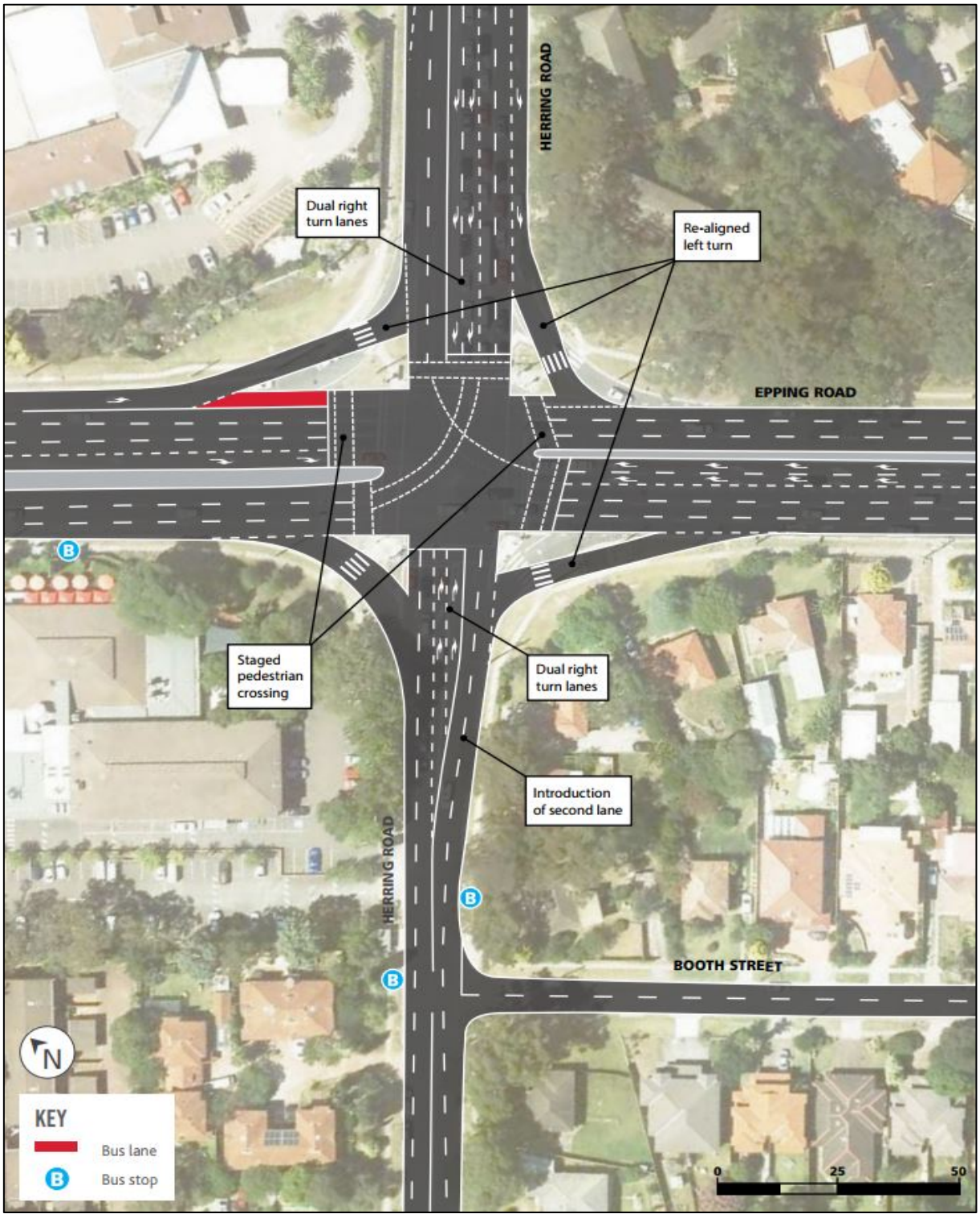

Figure 30: Proposed changes at the intersection of Herring Road and Epping Road

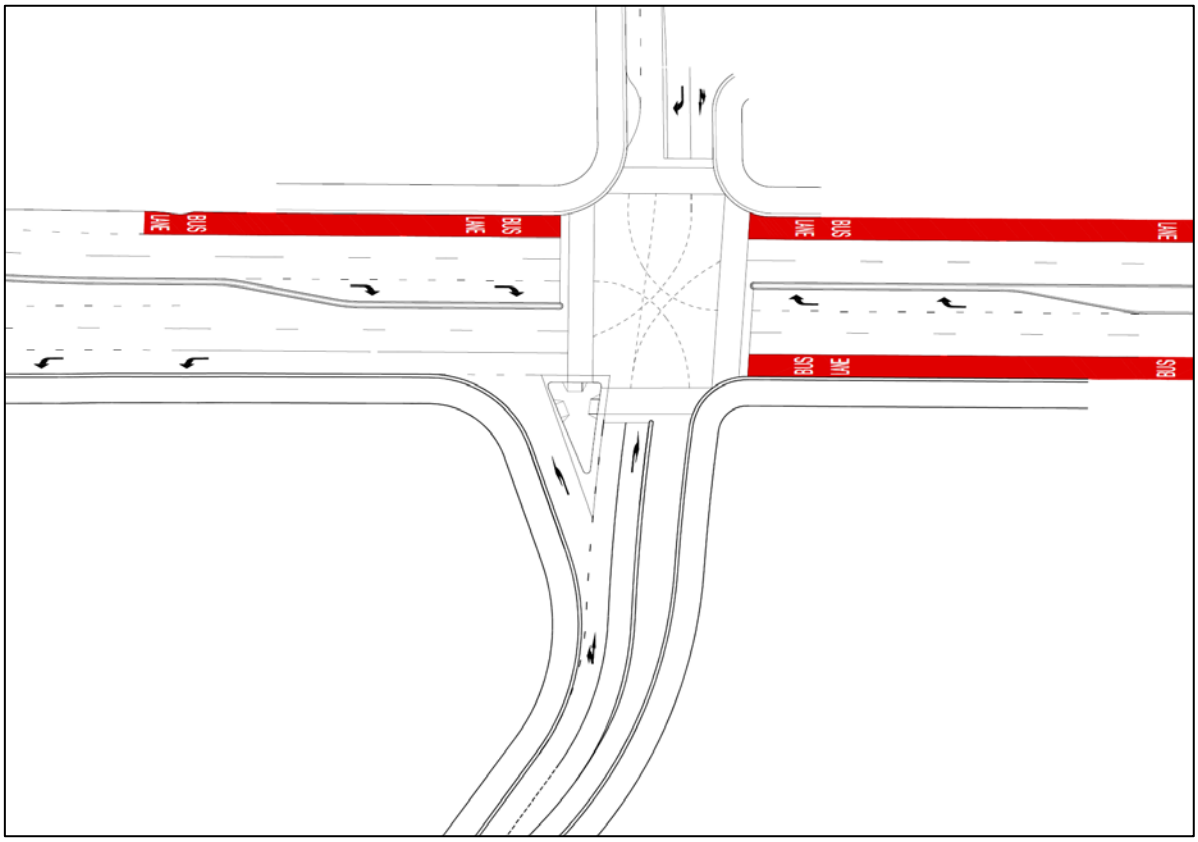

Figure 31: Proposed changes at the intersection of Herring Road and Ivanhoe Place

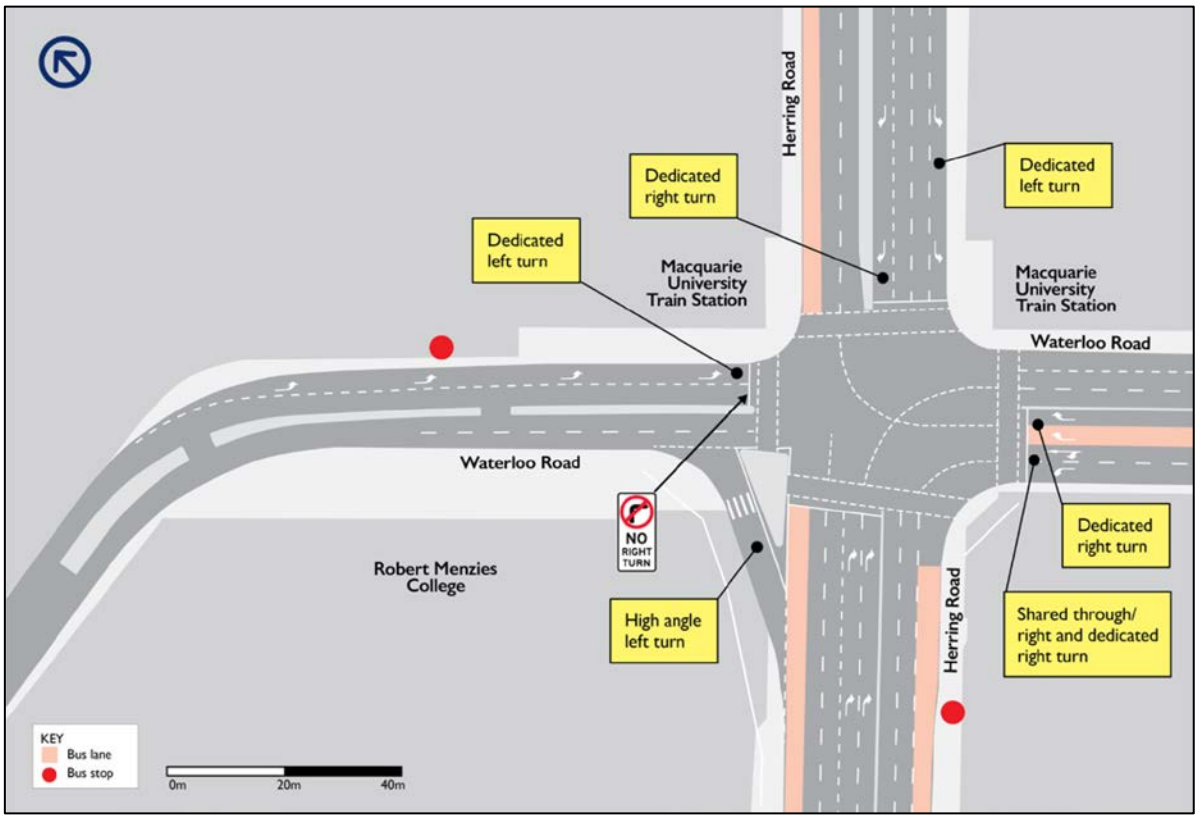

Figure 32: Proposed changes at the intersection of Herring Road and Waterfloo Road

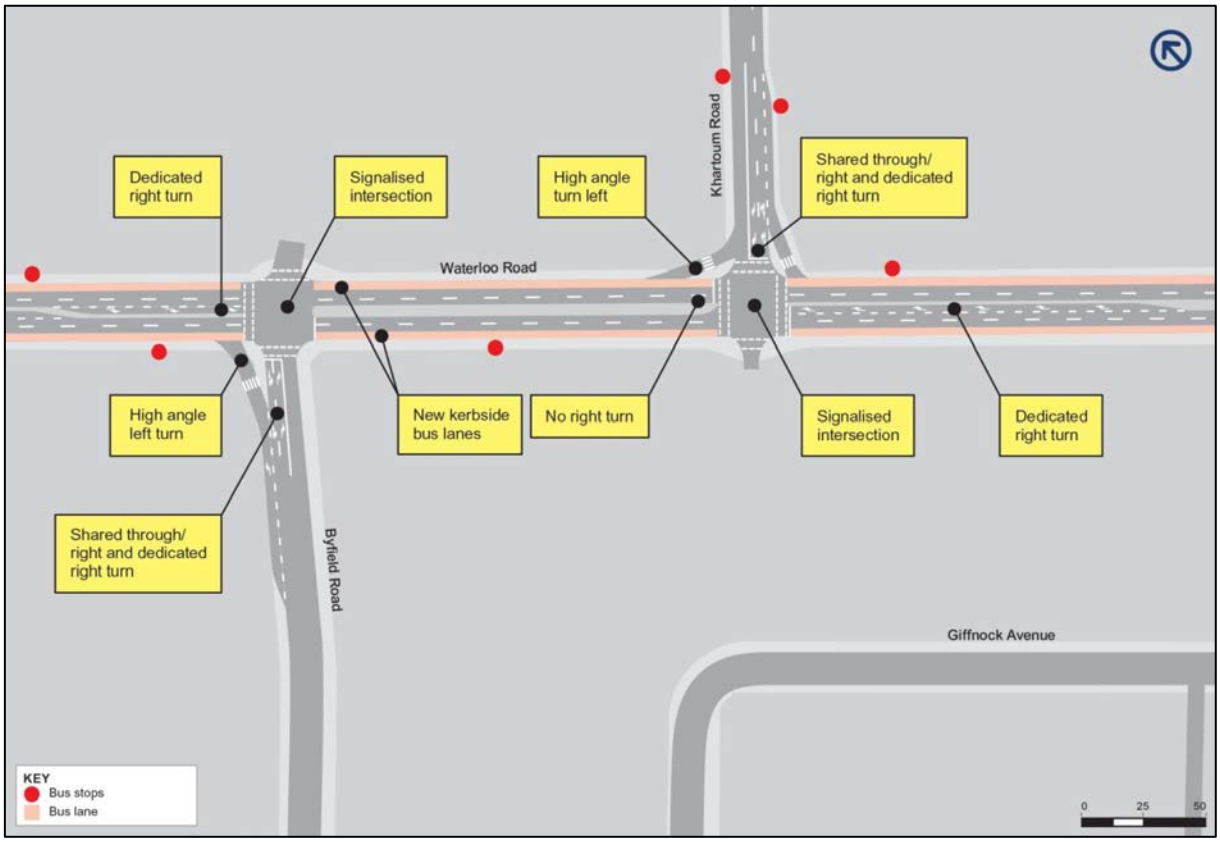

Figure 33: Proposed changes at the intersections of Waterfloo Road with Byfield Road and Khartoum Road

Traffic count data was extracted from the 2016 Base model and the 2021 RMS Base model to illustrate the changes that are forecast allowing for future approved development within the Macquarie Park area. It should be noted that, for the 2016 Base model, traffic generated by the Site was determined from traffic counts that captured the existing development. **Figure 34** and **Figure** 35 present the existing and future network 1111traffic flows for the morning and evening peak hours resulting from the proposed changes.

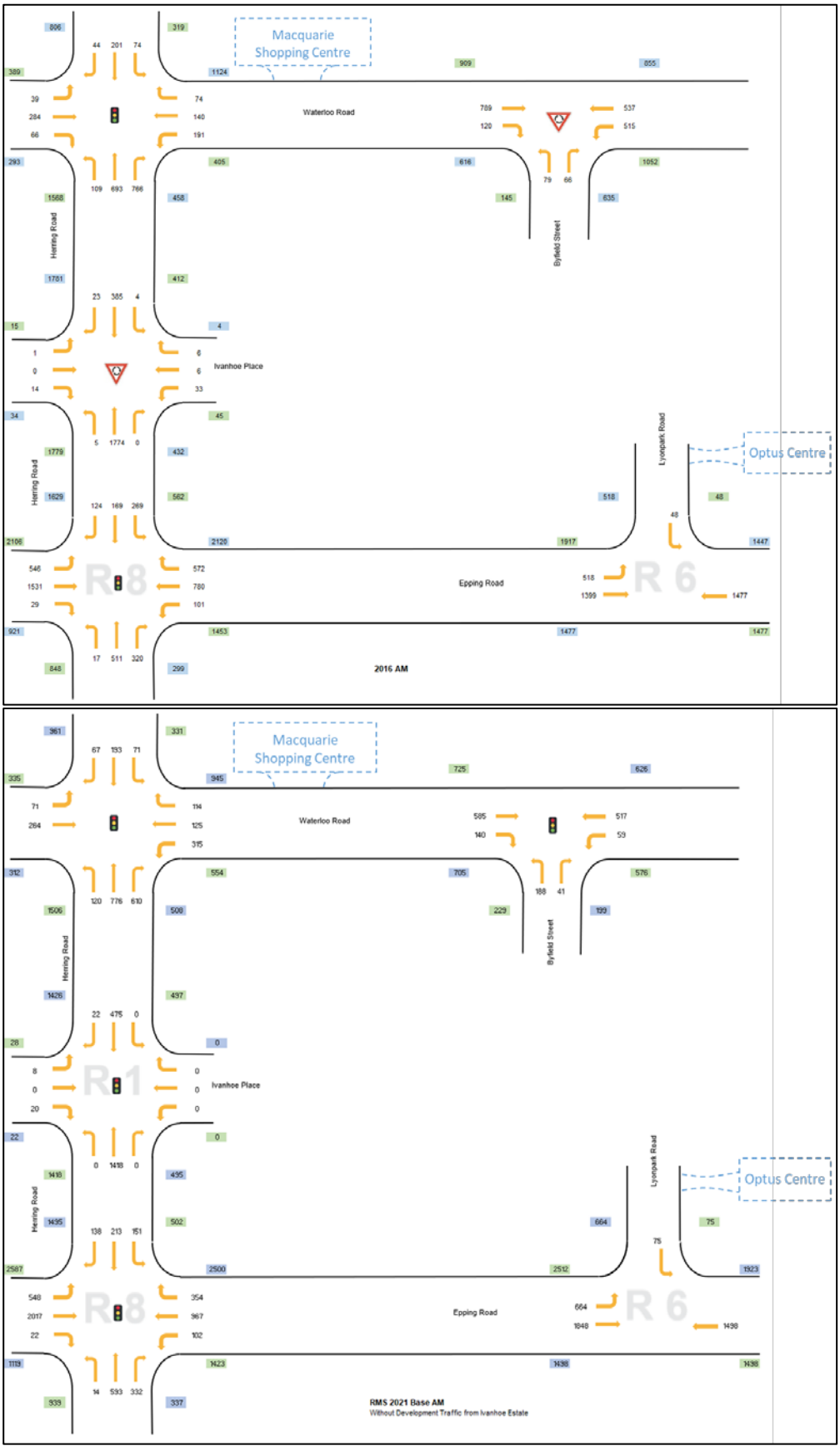

Figure 34: Comparison of 2016 Base with 2021 RMS Base Model Volumes (AM)

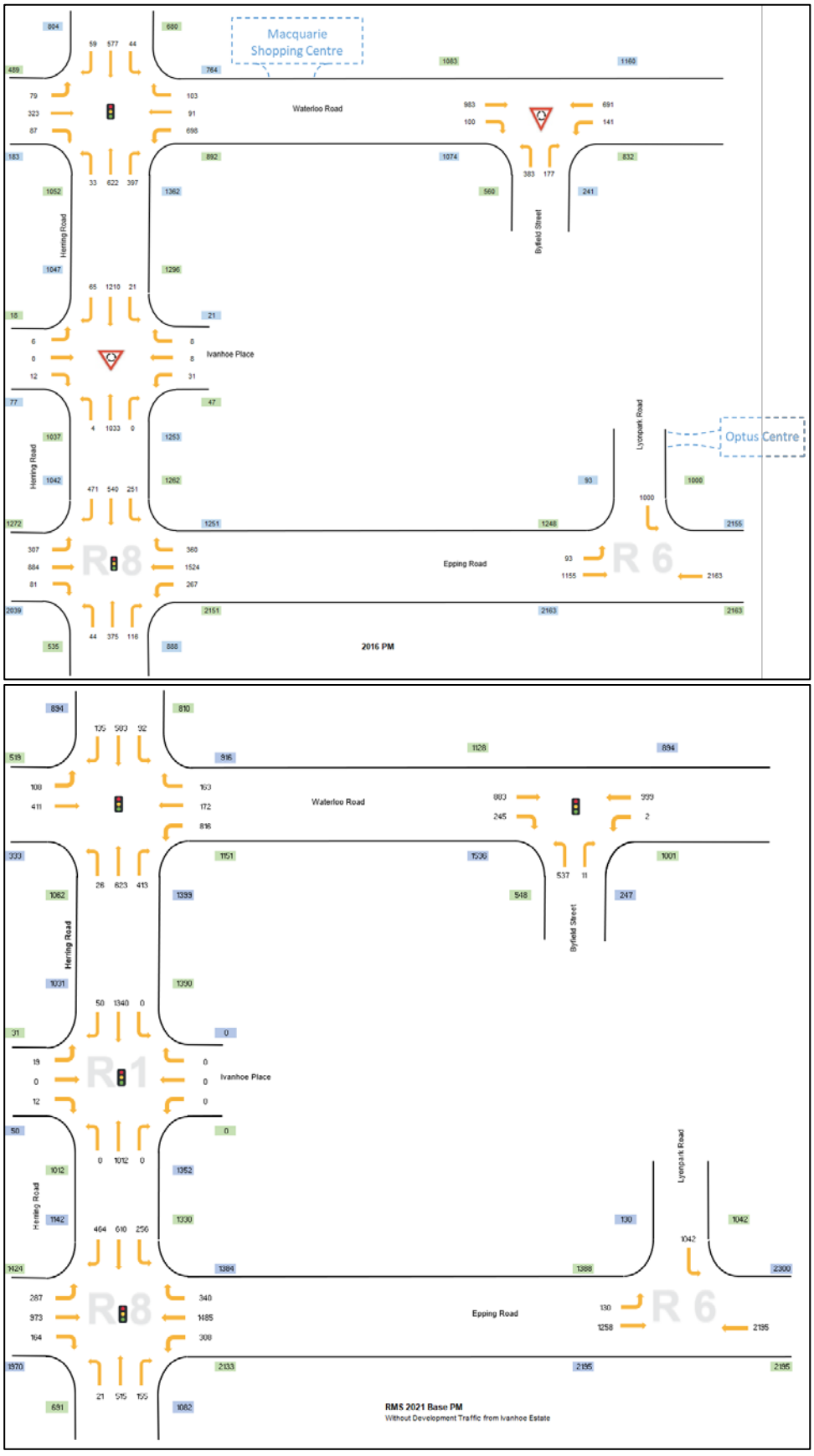

Figure 35: Comparison of 2016 Base with 2021 RMS Base Model Volumes (PM)

A comparison of the resulting LoS and intersection delay is provided in **Table 23**.

Table 23: Local Network Performance Comparison 2016 Base with 2021 RMS Base

Intersection	Peak	Level of Service (delay in seconds)	
		2016 Base	2021 RMS Base
Epping Road / Herring Road	AM	F	F
		167	78
	PM	F	E
		76	59
Ivanhoe Place / Herring Road	AM	A	B
		12	21
	PM	A	B
		13	24
Waterloo Road / Herring Road	AM	F	C
		94	35
	PM	F	D
		121	50
Epping Road / Lyonpark Road	AM	A	A
		7	7
	PM	A	A
		7	7
Waterloo Road / Byfield Street	AM	A	A
		12	10
	PM	A	B
		14	18

It is evident from **Table 23** that the road upgrades assumed under the RMS 2021 model result in reduced delays and improved LoS at key intersections. These improvements are predominately a result of:

- Additional lane capacity resulting in more green time at Herring Road / Waterloo;
- Removal of the right turn movement from Macquarie University into Herring Road; and
- Two new signalised intersections on Waterloo between Herring Road and Lane Cove Road, providing greater permeability to the network.

7.5.5 Project Network Upgrades

In addition to the upgrades proposed as part of the Bus Priority Works a number of upgrades to the road network have been assessed and are proposed as part of this application. These upgrades are proposed to off-set the impacts of the proposed development on the operation of the road network and improve traffic movement within the Macquarie Park Precinct more general. A summary of the network changes assessed as part of the investigations is provided below.

Signalisation of the intersection of Ivanhoe Place with Herring Road

Following the issue of the Macquarie Park Bus Priority and Capacity Improvement Project Submissions (MPBPCI) report by RMS in October 2017 the reviewed layout and alignment of the proposed traffic signals at the interaction of Ivanhoe Place with Herring Road is illustrated in **Figure 36**. The intersection has been designed to facilitate double diamond phasing (as requested by RMS) and includes:

- a 44m right turn movement from Herring Road into Ivanhoe Place for northbound approach
- A left turn slip lane and dedicated right turn and through lane on the westbound approach within the Ivanhoe Estate,
- A 52m right turn lane for the southbound approach for vehicles turning into the Morling College, and
- A shared through / right turn lane and dedicated right turn lane for the eastbound approach.

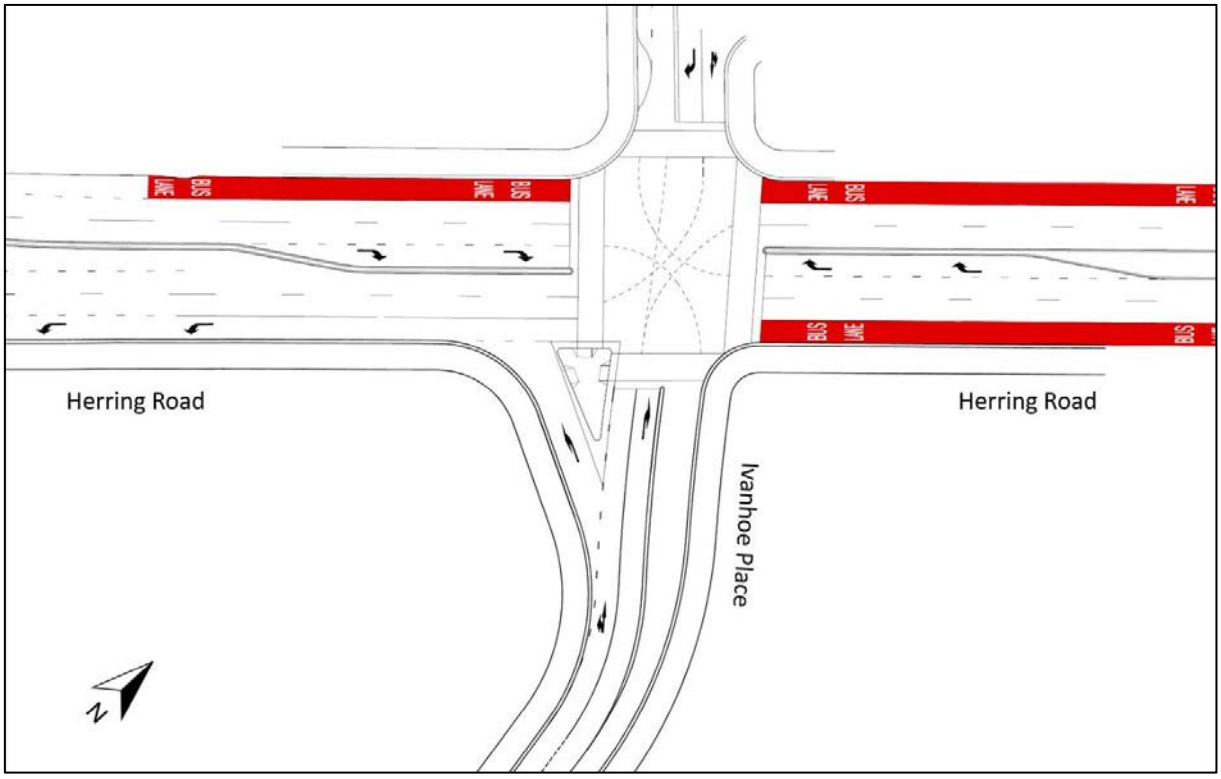

Figure 36: Herring Road and Ivanhoe Place intersection

The proposed intersection arrangements have been included in the future year model and provides the main access to the proposed development.

Left-in access from Epping Road to the Site

It is proposed that a new road connection from Epping Road be constructed approximately 300m east of the Herring Road with Epping Road intersection. The proposed access as shown on **Figure 37**,includes the construction of a new deceleration lane (to RMS requirements) and will provide access to the site without the need for vehicles to travel along Herring Road. This will provide reduced delays on Herring Road particularly during the evening peak hour.

Figure 37: Proposed left-in access from Epping Road to the Site

Bridge connection over Shrimptons Creek to Lyonpark Road

A bridge connection between Ivanhoe Place and Lyonpark Road is proposed, generally in accordance with Council's DCP Road Network and the Herring Road Finalisation Report. The inclusion of the bridge provides substantial benefits to both the future residents and existing stakeholders within Macquarie Park by providing an alternate east-west connection between the Giffnock Avenue / Optus Drive employment area and Herring Road. This provides an alternate route to Waterloo Road as well as access for future residents to Lyonpark Road and Epping Road.

This proposed bridge will provide passage across Shrimptons Creek for pedestrians and cyclists, both at road level and via boardwalk below the bridge, allowing diverse transition. The bridge will be designed to permit the continued north / south cycle connection along Shrimptons Creek. An indicative layout of the proposed bridge connection is provided in **Figure 38**.

Figure 38: Proposed bridge connection over Shrimptons Creek to Lyonpark Road

Signalisation of Lyonpark Road with Epping Road

A proposal for the signalisation Lyonpark Road into Epping Road was pursued in accordance with the City of Ryde Integrated Transport Strategy (2016) and discussions held with Ryde Council. As part of this assessment MU Group were engaged to provide conceptual signal layout plans suitable for assessment. In consultation with relevant authorities, the full signalisation (all movements) was not

considered appropriate due to the delays that would result to the through movement on Epping Road. Accordingly, a hybrid solution was assessed as shown in **Figure 39**, which provided for northbound right turn movements (westbound to northbound) and the resulting signalisation of the eastbound left turn movement from Lyonpark Road.

The proposed signalisation was not pursed due to the resultant delays and queues during the PM peak on Lyonpark Road. The modelling demonstrated queues in excess of 450m and a resulting Level of Service F (compared to a LoS A under the 2021 Base Case model) due to the required left turn signalisation. This option is therefore not proposed as part of the network upgrades that form part of this application.

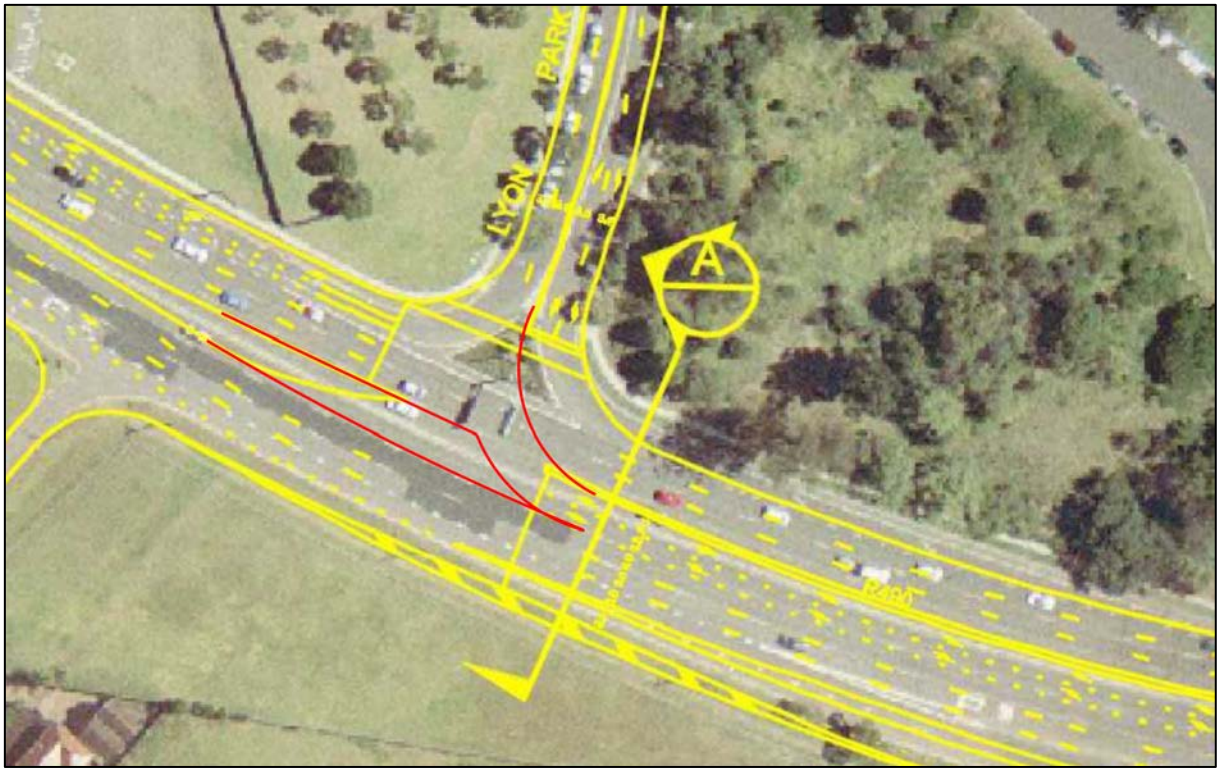

Figure 39: Proposed Lyonpark Road / Epping Road layout

Peach Tree Road Connection

A vehicular connection between Ivanhoe Place with Peach Tree Road was considered as part of the application. The connection was proposed along Shrimptons Creek and was assessed as both a one-way and two-way connection. The proposed two-way connection is shown in **Figure 40**. The connection which provided vehicular connectivity between the site and Waterloo Road (via Peach Tree Road and Cottonwood Crescent) was deemed to provide limited benefit to either the Ivanhoe development or regional traffic due to the limited access to the network afforded by the connection that

could not otherwise be achieved by virtue of the signalisation of Herring Road with Ivanhoe Place or the proposed bridge connection to Lyonpark Road.

Notwithstanding this, a vehicular connection has not been progressed due to the environmental impacts to Shrimptons Creek that would result as a consequence of the proposed road construction. As an alternative, a pedestrian and cycle connection are proposed which still provides for permeability through the Herring Road precinct with a substantially lower environmental impact. The removal of the vehicular connection was supported by Ryde Council.

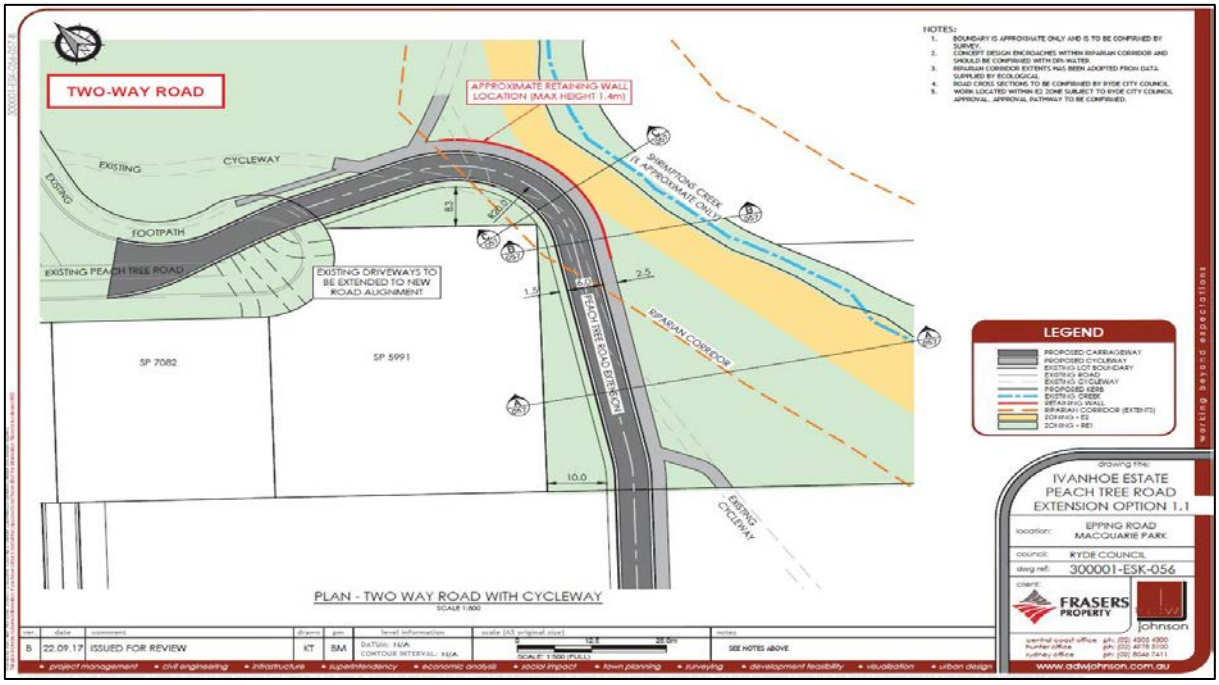

Figure 40: Proposed Peach Tree Road Connection

Nevertheless, the masterplan has identified some potential alternative locations for a road link to Peach Tree Rd and the areas north of Ivanhoe Estate, which could be implemented, subject to a separate Development Application process. These potential alternative locations are between Building B3 and the proposed high school (utilising a potential alternative alignment further away from Shrimptons Creek if adjoining land becomes available) or between the residential aged care facility and the proposed high school. The locations of these potential future connections are shown in blue in Figure 7.

7.5.6 Adopted Road Network

Having regard to the above, the following upgrades were assumed in the traffic modelling assessment and are proposed as part of the Masterplan application:

- Bridge Connection between Ivanhoe Place and Lyon Park Road (two way),
- Signalisation of Ivanhoe Place with Herring Road, and

- Left in access to Ivanhoe development from Epping Road, including new deceleration lane.

With consideration of the proposed improvements, **Figure 41** shows the Aimsun network that was modelled for the ultimate development scenario.

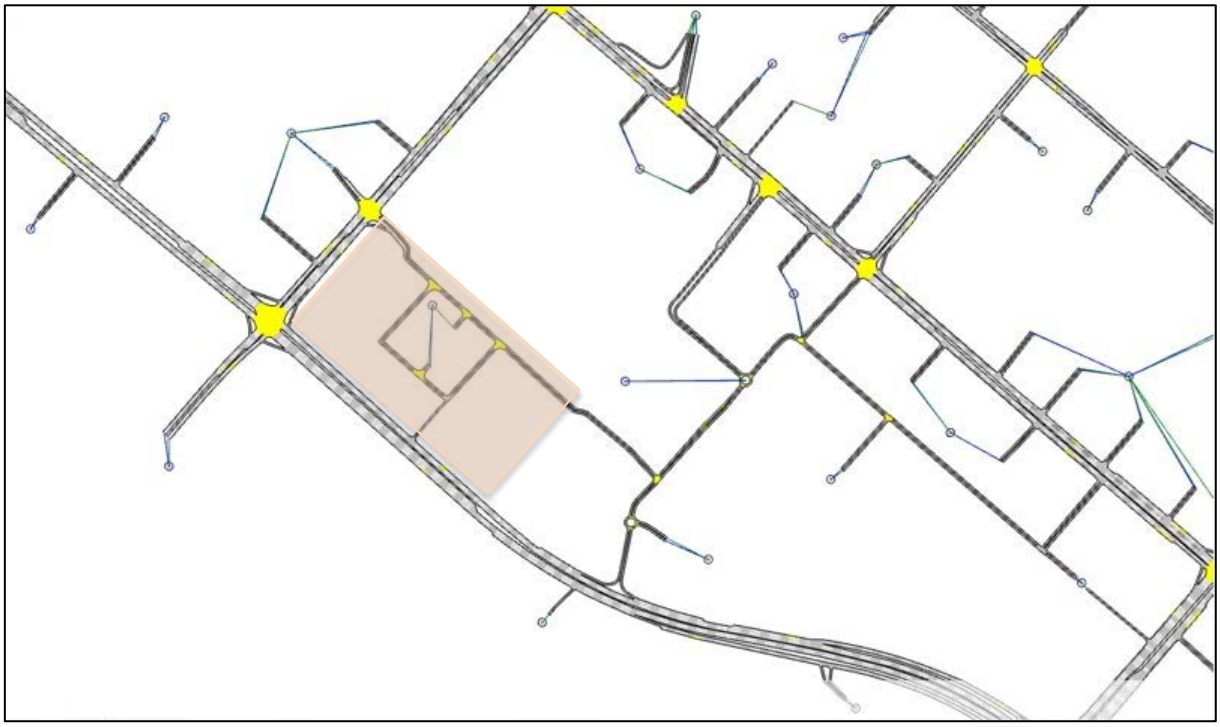

Figure 41: Aimsun Model Network with Improvements

7.5.7 Traffic Modelling Results

The proposed upgrades to the road network have resulted in a number of changes to the distribution of traffic onto the road network. In particular, the inclusion of the proposed bridge connection to Lyonpark Road provides a new connection between the employment zones around Giffnock Avenue (including the Optus campus) with Herring Road. As a consequence, vehicles previously using Waterloo Road / Herring Road to access Epping Road, are now provided with a much more direct route via the Proposed bridge and Main Street. This is evident by the approximately 950 veh/hr (westbound) using Ivanhoe Place during the Evening peak hour – during which time the site is expected to generate only 425veh/hr.

Similarly, the proposed bridge provides (via Lyonpark Road), an egress from the site for future residents of the Ivanhoe Estate (and indeed Macquarie Park more generally) onto Epping Road without the need for accessing Herring Road. This results in a significantly reduced impact at the critical intersection of Herring Road and Epping Road than that which would otherwise occur.

A comparison of the 2021 RMS Base model flows and the 2021 Base + Development flows (including road upgrades) is provided in **Figure 42** and **Figure 43** for the morning and evening peak hour.

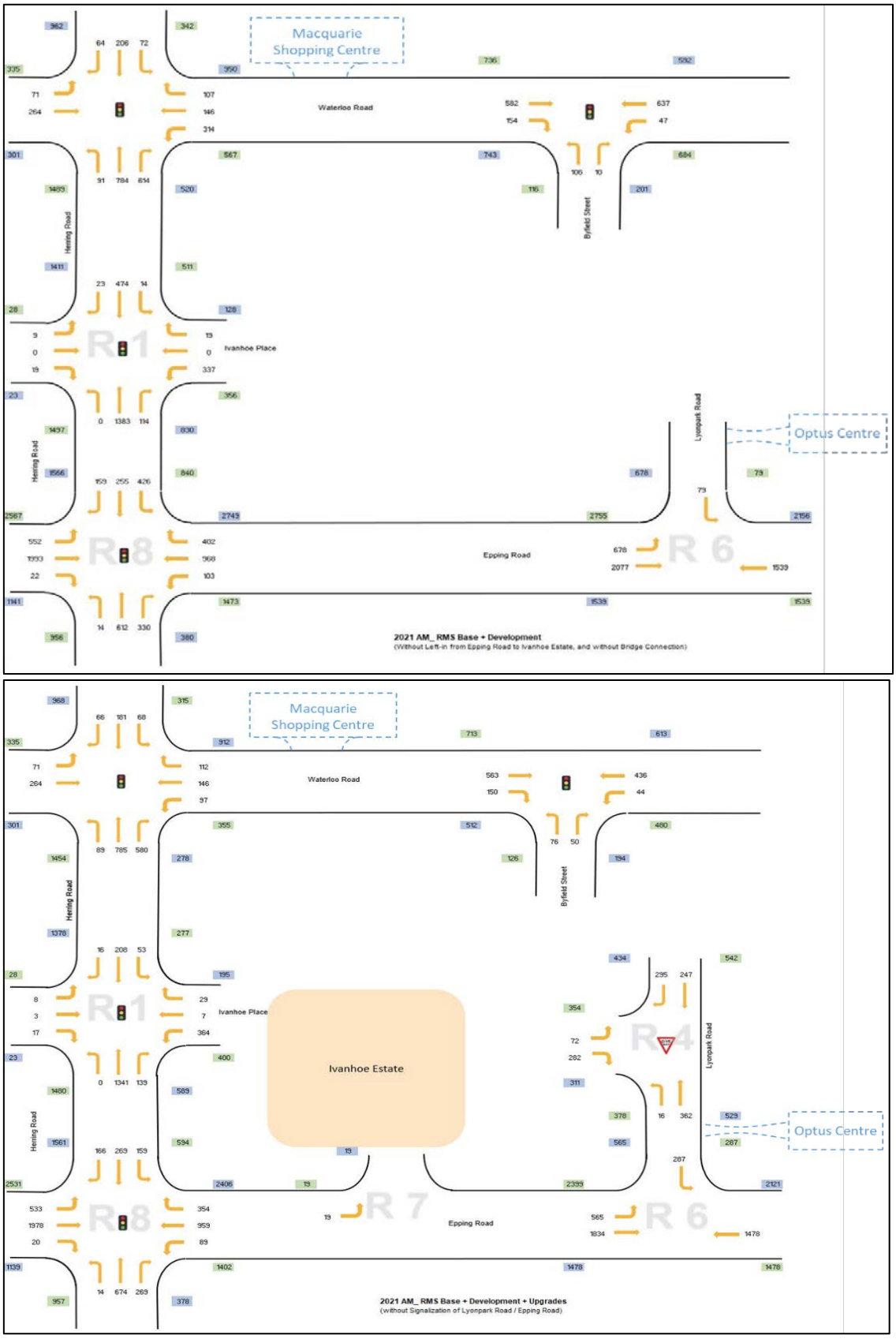

Figure 42: Comparison of 2021 RMS Base with 2021 RMS Base Model + Development Volumes (AM)

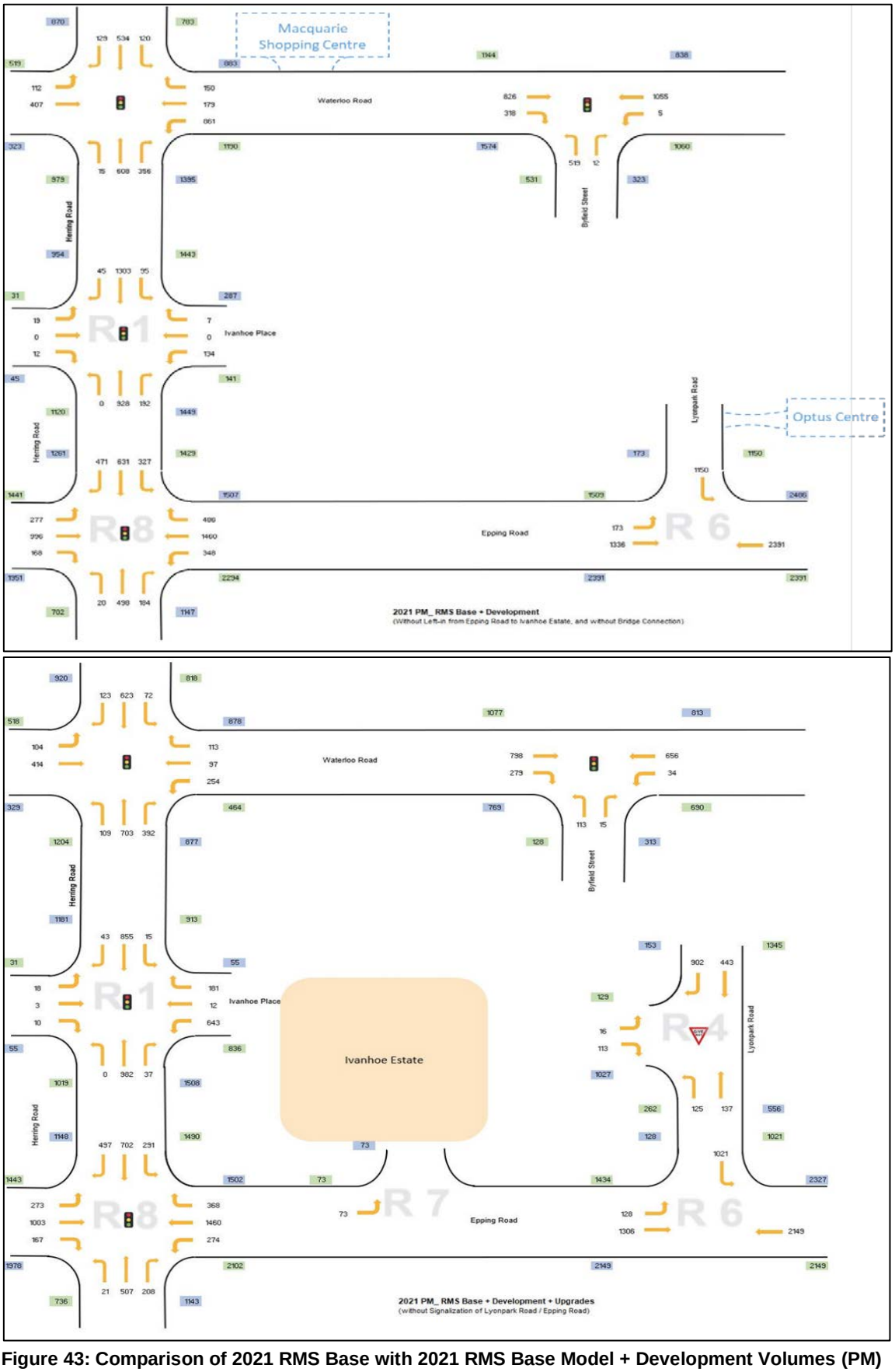

Figure 43: Comparison of 2021 RMS Base with 2021 RMS Base Model + Development Volumes (PM)

The performance of the key intersections has been analysed in detail by extracting intersection counts from Aimsun and analysed using SIDRA Intersection computer program. The impact of the proposed development on the critical intersections identified in the SEARs have been assessed as a net increase over and above the existing conditions and the results of this analysis are summarised in **Table 24**.

Table 24: Local Network Performance, Cumulative Future Scenario

Intersection	Peak	Level of Service (delay in seconds)		
		2021 RMS Base	2021 RMS Base + Development	2021 RMS Base + Development + Upgrades
Epping Road / Herring Road	AM	F	F	F
		78	86	88
	PM	E	E	E
		59	68	63
Ivanhoe Place / Herring Road	AM	B	B	B
		21	21	22
	PM	B	E	C
		24	62	31
Waterloo Road / Herring Road	AM	C	C	C
		35	39	36
	PM	D	D	D
		50	50	46
Epping Road / Lyonpark Road	AM	A	A	A
		7	7	7
	PM	A	A	A
		7	7	7
Waterloo Road / Byfield Street	AM	A	A	A
		10	14	12
	PM	B	B	B
		18	22	18

The modelling results demonstrated that:

Epping Road with Herring Road

The proposed upgrades to the intersection of Epping Road with Herring Road to be delivered under the MPBPCI results in a significant improvement in the operation of the intersection under the future (2021) year scenario. The proposed upgrades (which includes additional capacity on the southbound approach on Herring Road) reduces the average delay during the AM peak from 167 seconds to 88 seconds and from 76 seconds to 63 seconds during the PM peak period.

Under the future Base + Development + Upgrades scenario the operation of the intersection improves, however this improvement is off-set by the additional volumes that are accommodated resulting from the new bridge connection to Lyonpark Road. The introduction of the bridge connection, provides alternate access routes to the employment zones around Giffnock Avenue resulting in significant "rat running" through the site. As a consequence, the full improvement that would be accommodated at the intersection is not fully realised. Notwithstanding, the future operation of the intersection is considered to be supportable subject to the proposed capacity improvements as identified under the MPBCI being implemented.

Herring Road with Waterloo Road

Delays at the Herring Road with Waterloo Road intersection are expected to reduce considerably between 2016 and 2021 due to the removal of the existing southbound right turn movement from Macquarie University as part of the MPBPCI.

As a consequence of the proposed bridge connection between Lyonpark Road with Ivanhoe Place, further reductions at this intersection are expected. The inclusion of the bridge reduces travel times from the Giffnock Avenue employment zones to bother Herring Road and Epping Road making this route more favourable which results in a reduction in traffic volumes at the Herring Road / Waterloo Road intersection. This results in future levels of service of C and D in the morning and evening peak period.

Ivanhoe Place with Herring Road

The intersection of Ivanhoe Place with Herring Road is expected to operate at acceptable levels of service during the morning and evening peak periods. The intersection will accommodate only moderate volumes of development traffic during the morning peak with a high proportion of vehicles departing to the east via the new bridge connection to Lyonpark Road thereby bypassing the intersection.

During the evening peak period, volumes are expected to be in the order of 800-900 veh/hr on the Ivanhoe Place intersection leg. These vehicles, however, have only a moderate impact as approximately 70-80% are expected to travel towards Epping Road, making use of the unsignalised left turn slip lane.

Byfield Street with Waterloo Road

The intersection of Byfield Street with Waterloo Road operates at a LoS A/B under all future scenarios (that is as a signalised intersection as proposed under the MPBPCI). The operation of Byfield Street with Waterloo Road also benefits from the proposed bridge connection to the Ivanhoe Estate with vehicles exiting the Giffnock Avenue precinct provided with an alternate egress route to Epping Road.

It is noted that delays at this intersection are further reduced from the 2016 base model by virtue of the proposed extension of Khartoum Road to Giffnock Avenue (included in the RMS Base model).

Epping Road with Lyonpark Road

The intersection of Epping Road with Lyonpark Road remains at a level of service A under all future development scenarios. Whilst volumes at this intersection are expected to increase, the provision of the existing left turn acceleration lane results in any increases being able to be accommodated with minimal if any delays.

It is again noted that the signalisation of this intersection was investigated however the impacts on Epping Road and Lyonpark Road were deemed excessive and hence this option was not pursed.

7.5.8 Assessment Summary

The development is expected to generate in the order of 538 veh/hr and 434 veh/hr during the morning and evening peak periods. This generation has been based on both RMS rates and surveys of comparable developments in regional centres including Chatswood and St Leonards. The operation of the network under the Proposed development scenario (including upgrades), demonstrates minimal increase in delays at the intersection of Epping Road with Herring Road during the morning and evening peak periods. The additional delays resulting from the development are generally offset by the proposed bridge accessing Lyonpark Road which facilitates the eastbound movement and access to Lane Cove Road via Lyonpark Road and Epping Road.

Accordingly, the delivery of the proposed bridge connection, is critical to the Project and provides both regional and local benefits to the site and the Macquarie Park traffic more generally. It is noted that the bridge connection does not impact the operation of Lyonpark Road intersection with Epping Road which continues to operate at a LoS A under all scenarios.

7.6 Construction Traffic Impacts

A detailed Construction Traffic Management Plan (CTMP) will be prepared once development consent is granted for relevant stages and prior to issue of a Construction Certificate (CC). The CTMP in Appendix E provides an overview of construction traffic management and outlines the principles that would be implemented during the construction period. While the traffic impacts of construction of the development are likely to be minor, the following measures should be undertaken to minimise the impacts of the construction activities of the development:

- Traffic control would be required to manage and regulate traffic movements into and out of the site during construction.

- Disruption to road users would be kept to a minimum by scheduling intensive delivery activities outside of peak hours.
- Construction and delivery vehicles would be limited to the use of Epping Road, the M2 and the necessary local roads and restricted to non-peak periods.
- All vehicles to enter and exit the site in a forward direction with reverse movements to occur only as necessary and subject to supervision.
- All vehicles transporting loose materials will have the entire load covered and/or secured to prevent any items depositing onto the roadway during travel to and from the Site.

The CTMP will be detailed during future DA stages, and will be developed to comply with RMS requirements and TCAW manual, and prepared in consultation with City of Ryde Council, RMS and any other relevant stakeholders.

8 Summary and Conclusions

Ason Group has prepared this Transport Management and Accessibility Plan (TMAP) report to support a Concept Development Application for the Ivanhoe Estate Masterplan, a State Significant Development (SSD) 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 Proposal. It has been prepared for Aspire Consortium on behalf of NSW Land and Housing Corporation.

The project will see the transformation of 259 social housing properties on the 8.2 hectare site into a socially integrated neighbourhood of approximately 3,500 dwellings (subject to future design development) with a maximum of GFA of 281,685m^2.

The project proposes the delivery of a number of infrastructure upgrades to facilitate the main objective of a Transit Oriented Development whilst minimising the impacts to the existing and future road network . In this regard the development includes the delivery of:

- A signalised intersection of Herring Road and Ivanhoe Place,
- A new ingress from Epping Road, and
- A new bridge connection between Ivanhoe Place and Lyonpark Road.

In addition, a number of pedestrian and cycle connections are proposed to improve and encourage non-car travel modes. This includes the provision of pedestrian shared paths and bicycle connections through the site connecting to key destinations including Macquarie Shopping Centre, Macquarie University and University Railway Station and employment zones within the Coolinga Street and Lyon Park Road.

The development is expected to generate in the order of 538veh/hr and 434 veh/hr during the morning and evening peak periods. This generation has been based on both RMS rates and surveys of comparable developments in regional centres including Chatswood and St Leonards. The operation of the network under the Proposed development scenario (including upgrades), demonstrates minimal increase in delays at the intersections of Epping Road with Herring Road during the morning and evening peak periods. In particular, the modelling demonstrated that

- The proposed upgrades to the intersection of Epping Road with Herring Road to be delivered under the MPBPCI results in a significant improvement in the operation of the intersection in the medium term.
- The proposed bridge connection between Lyonpark Road and Ivanhoe Place will provide for an alternate east – west route to Waterloo Road through Macquarie Park. The provision of this bridge results in substantial redistribution of traffic through the precinct.

- The proposed unsignalised left turn slip lanes southbound on Herring Road at Epping Road and Ivanhoe Place are required to reduce potential delays particularly associated with volumes resulting from the new connections to the employment zones to the east of the site which are likely to utilise the new bridge connection and Ivanhoe Place to access Herring Road.
- The Proposal has a minimal impact on the operation of Waterloo Road and Herring Road and the intersection will operate with acceptable delays during the morning and evening peak periods.
- The operation of Byfield Street with Waterloo Road also benefits from the proposed bridge connection to the Ivanhoe Estate with vehicles exiting the Giffnock Avenue precinct provided with an alternate egress route to Epping Road.
- A proposal for the signalisation of the left turn movement from Lyonpark Road into Epping Road was tested and resulted in the failure of the intersection during the PM peak period. As such, any further analysis if this treatment has not been pursued.

Accordingly, subject to the construction of the proposed infrastructure upgrades associated with both the MPBCI and those related to this application (including the proposed bridge connection to Lyonpark Road, new left in from Epping Road and the signalisation of Ivanhoe Place with Herring Road) the impacts of the development are considered supportable.

Notwithstanding the above, a Sustainable Travel Strategy for Ivanhoe Estate has been designed to encourage the use of public transport, walking, cycling wherever possible for all journey purposes. A high quality active network will be provided throughout Ivanhoe Estate through continuous shared paths and crossing facilities at key locations. The design of a high quality, highly permeable network with limited delays to walk and cycle trips and which is pleasant, convenient, direct and integrated with land uses will encourage and facilitate pedestrian cyclist accessibility.

The recommendations of this study are also reflected in the package of measures developed for the project. Key points of this package include:

- Sustainable travel strategies, to include provision of marketing of public transport options and free travel
- Infrastructure improvements to provide easy pedestrian and cyclist access via a safe and efficient shared path and footpath network,
- Public transport infrastructure, to provide safe and convenient means for the future residents to use public transport services and bus priority treatments to reduce the travel times for public transport users.
- Transport service improvements, including the implementation of a new bus service connecting the development Macquarie University train station and Macquarie Shopping Centre.

- Road infrastructure upgrades to provide access to the site via:
  - A signalised intersection of Herring Road and Ivanhoe Place,
  - A new ingress from Epping Road, and
  - A new bridge connection between Ivanhoe Place and Lyonpark Road.

As a comprehensive package of measures (summarised in **Table 25**), this will meet the needs of future residents of Ivanhoe Estate while achieving a mode shift towards active and public transport.

Table 25: Summary of Proposed Sustainable Transport Measures

Reference	Description
Household Travel Behaviour Measures	
1	Household Information Packs (HIPs) for each household in Ivanhoe Estate
2	One $20 Opal card for each household
Public Transport Measures	
3	Integration of public transport services
4	Improved Bus service coverage including provision of a community bus
5	Timing of bus services and development staging
6	Bus service frequencies to Service Planning Guidelines
7	Bus priority network surrounding Ivanhoe Estate
8	Design for bus priority and PT accessibility
Bicycle Measures	
9	Dedicated, high quality cycle routes
10	Bicycle parking at key locations
11	Bicycle User Group
12	Promotion of bicycle initiatives including 1 bike space per apartment
Pedestrian Measures	
13	Highly permeable and safe pedestrian network
14	Walking school bus program
Parking Restraint Measures	
15	Restrained parking for high density residential
16	Estate co-sharing parking provision
Travel Planning Measures	
17	School travel plans
18	‘Voluntary’ workplace travel plans
Travel Demand Management Measures	
19	Car sharing scheme
Road Infrastructure Upgrades	
20	Signalisation of Herring Road with Ivanhoe Place
21	New Bridge connection between Ivanhoe Place and Lyonpark Road
22	New left in entry from Epping Road

Appendix A

Secretary's Environmental Assessment Requirements

Issue	Source	TMAP Reference
Address the relevant provisions, goals and objectives in the following: • NSW State Priorities • A Plan for Growing Sydney • Towards our Greater Sydney 2056 • Draft North District Plan • Development Near Rail Corridors and Busy Roads- Interim Guideline • Guide to Traffic Generating Developments (RMS) • Sydney's Bus Future 2013 • Sydney's Walking Future 2013 • Sydney's Cycling Future 2013 • NSW Planning Guidelines for Walking and Cycling • NSW Long Term Transport Masterplan • EIS Guidelines - Road and Related Facilities • Guide to Traffic Management- Part 12: Traffic Impacts of Development (AUSTROADS) • Future Directions for Social Housing in NSW • School Assets Strategic Plan • Draft Better Schools Design Guide • City of Ryde Development Control Plan 2014 • City of Ryde Section 94 Development Contributions Plan 2007 (Interim Update 2014 • Ryde 2025 Community Strategic Plan.	SEARs Key Issue 1 TfNSW SEARs Amendment	Section 3 Appendix B
Provide accurate details of the current daily and peak hour vehicle, public transport, pedestrian and bicycle movements and existing traffic and transport facilities provided on the road network located adjacent to the proposed development.	SEARs Key Issue 7	Sections: 5.1-5.5
Provide an estimated of total daily and peak hour trips likely to be generated by the proposed development including vehicle, public transport, pedestrian and bicycle trips.	SEARs Key Issue 7	Sections: 7.3 7.4
Provide a detailed assessment of the existing and future safety and performance of key intersections providing access to the site and/or otherwise nominated by Roads and Maritime Services, and any road/intersection upgrades or new roads/intersections required as a result of the development. The assessment of the existing and future road network operations needs to consider the cumulative impacts of traffic volumes from other developments in the locality. The assessment needs to be supported by appropriate modelling and analysis to the satisfaction of Roads and Maritime Services.	SEARs Key Issue 7	Sections: 7.3 7.4 7.5
Provide details of measures to mitigate any associated traffic impacts including any upgrading or road improvement works required to accommodate the proposed development.	SEARs Key Issue 7	Sections: 6 7.5.4 Appendix D
Provide design and operation of the proposed road network in consultation with Roads and Maritime Services and City of Ryde Council.	SEARs Key Issue 7	Section 7.5.2
Provide a staging plan for all proposed civil infrastructure works.	SEARs Key Issue 7	Section 2
Provide an assessment of traffic impacts in the event external transport infrastructure to be delivered by third parties is not delivered.	SEARs Key Issue 7	Section 7.5
Provide details of the proposed number of car parking spaces and compliance with appropriate parking codes and Australian Standards. It should demonstrate a minimalist approach to the provision of on-site parking and how traffic generation (number of vehicles and time of access) will be managed in response to capacity limitations on the road network.	SEARs Key Issue 7	Section 7.2
Provide the adequacy of public transport, pedestrian and bicycle networks and infrastructure to meet the likely future demand of the proposed development and details of	SEARs Key Issue 7	Sections: 6.2 6.4

Issue	Source	TMAP Reference
measures to mitigate potential impacts including required upgrades to pedestrian/cycle connections.		
Provide details of connections to existing and planned public transport networks and services and opportunities for greater usage for residents, school users, workers and visitors.	SEARs Key Issue 7	Sections: 6.2 6.4
Provide details of existing and proposed vehicular access for residents, school users, workers, visitors and emergency vehicles.	SEARs Key Issue 7	Sections: 4.3 6.4 Appendix D
Detail opportunities to provide safe and efficient loading and servicing for the development.	SEARs Key Issue 7	Sections: 5.2 5.3 5.7 7.5
Provide a Transport and Management Accessibility Plan including details of travel demand management measures to minimise the impact on general traffic and bus operations and to encourage sustainable travel choices and details of programs for implementation.	SEARs Key Issue 7	Sections 1-8
Provide a Green Travel Plan containing details of sustainable travel initiatives for residents, school users, workers and visitors.	SEARs Key Issue 7	Appendix D
Identify key road infrastructure components to be delivered with the development.	SEARs Key Issue 17	Sections: 5.7 7.5
Undertake an appropriate level of consultation with the following agencies: • City of Ryde Council. • Roads and Maritime Services. • CBD Coordination Office within Transport for NSW.	SEARs Key Issue 19	Section 7.1
Address the relevant provisions, goals and objectives in the following: • CoR Development Control Plan 2014 Part 4.5 Macquarie Park • CoR Draft Traffic Impact Assessment Guidelines • CoR Bicycle Strategy, 2014 • City of Ryde Urban Design Guidelines Ivanhoe Estate Redevelopment, 2016	City of Ryde SEARs Amendment, Key Issue 1	Sections: 2.4
The assessment needs to be supported by appropriate modelling and analysis to the satisfaction of Roads and Maritime Services: The assessment of intersections is required but does not list them or give guidance as to the extent of the assessment. • Amend to include reference to the Draft Traffic Impact Assessment Guidelines to identify the key intersections and extent of the study area. • Include 'to the satisfaction of Council' to ensure Council's needs are met as part of the assessment process.	City of Ryde SEARs Amendment, Key Issue 7	Section 7.5
'Planned' Public Transport however does not specify consultation with appropriate agencies to discuss the planned projects. • Amend to say '… via consultation with transport agencies and Macquarie Park Connect'.	City of Ryde SEARs Amendment, Key Issue 7	Section 7.1
Opportunities for loading to be provided for the development • Include 'A Loading Management Plan to be submitted	City of Ryde SEARs Amendment, Key Issue 7	Section 7.6 Appendix D

Issue	Source	TMAP Reference
Mitigation Measures in the assessment. • Amend to state that a sensitivity assessment will be provided for all transport infrastructure being delivered by third parties in order to identify the impact of traffic if external infrastructure is not delivered.	City of Ryde SEARs Amendment, Key Issue 7	Section 7
Green Travel Plan. • TMAP and Framework Travel Plan shall demonstrate how non-private vehicle mode share target of 40% shall be achieved and monitored. • The DCP Travel Plan shall be developed in accordance with City of Ryde's "Travel Plan	City of Ryde SEARs Amendment, Key Issue 7	Appendix D
Impacts in relation to the first stage – include 'staging plan for all civil infrastructure identifying items that will not be delivered as part of the first stage'. The plan is to include, but not be limited to: • Signalisation the Herring Road/"Road 3" • Signalisation Epping Road/Lyonpark Road intersection • Upgrade existing Epping Road pedestrian underpass • Delivery of the shared bicycle and pedestrian pathway along Shrimptons Creek • Upgrade of intersection of Herring Road and Epping Road • Upgrade of site access and Epping Road Intersection	City of Ryde SEARs Amendment, Key Issue 7	Sections: 4.5 5.5.2 6.4.4 7.5.4 7.5.7 7.5.8 7.6 Appendix D
Assessment of traffic and transport impacts during construction'. To include: • 'to comply with Council's CTMP Checklist'. (Attached). Also to include Demolition Traffic Management Plan.	City of Ryde SEARs Amendment, Key Issue 7	Sections: 4.5 7.6 Appendix C
Pedestrian and vehicular interactions to include: • Treatment of High pedestrian activity areas. • Interface between driveways and pedestrian footway • Safety check of Shared Paths through the Development.	City of Ryde SEARs Amendment, Key Issue 7	Sections: 5.5.2 6.4.4
A Proposal for the provision of Key Infrastructure Delivery including: • Identifying the key Infrastructure components to be delivered with the development (roads). • Identifying future asset owners of the proposed key infrastructure. • Staging of the delivery of the identified key infrastructure. • Estimated value of Key Infrastructure.	City of Ryde SEARs Amendment, Key Issue 26	Sections: 5.3.2 5.7 7.5.4
The applicant is proposing to have a left-out entry onto Epping Road and signalising the intersection of Epping Road and Lyonpark Road. These proposals may not be implemented due to the existing constraints and safety concerns. Therefore, the modelling should include at least one future scenario without these proposals.	RMS SEARs Amendment, Item 1	Section 7.5
A detailed analysis of the following intersections needs to be undertaken to identify any required mitigation measures: • Lyonpark Road / Epping Road • Herring Road / Ivanhoe Place • Herring Road / Epping Road • Herring Road / Waterloo Road • Waterloo Road / Byfield Street	RMS SEARs Amendment, Item 2	Section 7.5
Roads and Maritime has identified that a U-turn facility on Ivanhoe Place, close to the intersection with Herring Road, is required to maintain local access on the western side of Herring Road north of the Ivanhoe Place intersection, when the intersection of Herring Road and Ivanhoe place is signalised. The location of the U-turn facility is to be determined by the applicant in consultation with Roads and Maritime. Please note that the intersection of Herring Road and Ivanhoe Place needs to be signalised to facilitate the development of Ivanhoe Estate.	RMS SEARs supplementary input	Section 7.5

Issue	Source	TMAP Reference
Provide accurate details of the current daily and peak hour vehicle, public transport, pedestrian and bicycle movements and existing traffic and transport facilities provided on the road network located adjacent to the proposed development.	TfNSW SEARs Amendment, Key Issue 7	Sections: 6 7
Provide estimated total daily and peak hour trips likely to be generated by the proposed development, including vehicle, public transport, pedestrian and cycle trips.	TfNSW SEARs Amendment, Key Issue 7	Sections: 7.3 7.4
Provide details regarding the adequacy of public transport, pedestrian and bicycle networks and infrastructure to meet the likely future demand of the proposed development.	TfNSW SEARs Amendment, Key Issue 7	Section 6
Provide details of any upgrading or road improvement works required to accommodate the proposed development.	TfNSW SEARs Amendment, Key Issue 7	Sections: 5.3.2 5.7 7.5.4
Provide details regarding the design and operation of the proposed road network in consultation with Roads and Maritime Services and City of Ryde.	TfNSW SEARs Amendment, Key Issue 7	Section 7.1
Provide details of measures to mitigate any associated traffic impacts and impacts on public transport, pedestrian and cycle networks.	TfNSW SEARs Amendment, Key Issue 7	Sections: 5.2 5.3 6 7.5.4
For the proposed school, provide measures to maintain road and personal safety in line with CPTED principles.	TfNSW SEARs Amendment, Key Issue 7	Section 6.4.4
For the proposed school, provide the proposed access arrangements, including car and bus pick-up/drop-off facilities, and measures to mitigate any associated traffic impacts and impacts on public transport, pedestrian and bicycle networks, including pedestrian crossings and refuges and speed control devices and zones.	TfNSW SEARs Amendment, Key Issue 7	Sections: 6.4 7.3
Provide details of travel demand management measures to minimise the impact on general traffic and bus operations and to encourage sustainable travel choices and details programs for implementation.	TfNSW SEARs Amendment, Key Issue 7	Section 6 Appendix D
"…Roads and Maritime has identified that a U-turn facility on Ivanhoe Place, close to the intersection with Herring Road, is required to maintain local access on the western side of Herring Road north of the Ivanhoe Place intersection, when the intersection of Herring Road and Ivanhoe place is signalised…"	RMS SEARs supplemental input	Section 2.3

Appendix B

Policy and Planning Context Tables

B1 State and Regional Strategic Planning Policies

B1.1 NSW State Priorities

NSW State Priorities	
Organisation	NSW Government
Date	14 July 2017
Purpose	Improving outcomes for the people of NSW – with clear goals and accountability
Content	**Building infrastructure** Improving road travel reliability – to ensure consistency of journey times on key roads continues to improve, we are working to make better use of existing road infrastructure, build extra road capacity and encourage commuters to use public transport and to undertake off-peak travel more often. This will enable business and the community to move around the city with greater ease, reducing travel times, boosting productivity and reducing business costs. **Increasing housing supply** Increase housing supply across NSW - Deliver more than 50,000 approvals every year A Plan for Growing Sydney estimates that Sydney will need 664,000 new homes over the next 20 years. The government is supporting future growth by establishing housing targets across NSW, and providing record allocations to the Housing Acceleration Fund to build the infrastructure to support this growth. **Creating sustainable social housing** Increase the number of households successfully transitioning out of social housing by 5% over three years. Addressing the growing demand for social housing – and ensuring that it provides a sustainable safety net to the most vulnerable – requires a number of strategies. Working with households to successfully and safely transition them out of social housing increases the ability of those households to participate in the economy and exit the cycle of entrenched disadvantage. **Ensure on-time running for public transport** Maintain or improve reliability of public transport services over the next four years. Public transport services in Sydney are crucial in getting customers to their destinations. Although Sydney is undergoing a large amount of infrastructure construction, we are working to ensure that public transport services continue to run on time. The government is also improving integration across public transport services, updating timetables and providing clear information to get people to their destinations on time.
Relevance to Ivanhoe Estate	Ivanhoe Estate will be developed into an integrated community of market, social and affordable housing units over the next 10 to 12 years. As the first major project being delivered under the Future Directions and the Communities Plus program, the project will increase the supply of social housing properties by almost fourfold, which means more people in need can move off the social housing waiting list.

B1.2 NSW Long Term Transport Masterplan

NSW Long Term Transport Masterplan	
Organisation	NSW Government
Date	December 2012
Purpose	Setting the framework for the NSW Government to deliver an integrated, modern transport system that puts the customer first.

NSW Long Term Transport Masterplan	
Content	The Masterplan is principally focused on the **six key transport challenges** that emerged from our analysis and our engagement with our customers. • Integrating modes to meet customer needs • Getting Sydney moving again • Sustaining growth in Greater Sydney • Providing essential access to regional NSW • Supporting efficient and productive freight • Statewide actions The Masterplan responds to these challenges through **four types of action**: • Integrate transport services • Modernise our system • Grow our networks to meet future demand (including the important tasks of corridor preservation) • Maintain important road and public transport assets.
Relevance to Ivanhoe Estate	Develop strategic bus corridors to provide rapid and more frequent services: • Hurstville to Macquarie Park via Burwood • Parramatta to Macquarie Continue to build connected cycling networks in Greater Sydney • Construction of a cycleway from North Ryde to Macquarie University (Waterloo Road, Macquarie Park) Strengthen public transport links between Parramatta, the Sydney CBD, North Sydney and Macquarie Park An increase in train services to Macquarie University and Macquarie Park. Preserve 19 major transport corridors across Sydney for future transport requirements: • Macquarie Park to Sydney Olympic Park • Parramatta to Macquarie Park

B1.3 Future Directions for Social Housing in NSW

Future Directions for Social Housing in NSW	
Organisation	NSW Government
Date	2016
Purpose	Driving better outcomes for tenants including helping those who are able to transition out of social housing.
Content	Actions including: • More social housing • More opportunities, support and incentives to build housing independence • A better social housing experience
Relevance to Ivanhoe Estate	The eight hectare Ivanhoe Estate at Macquarie Park (currently with 259 social housing dwellings), will be transformed into a high quality integrated community with market, social and affordable dwellings.

B1.4 NSW Planning Guidelines for Walking and Cycling

NSW Planning Guidelines for Walking and Cycling	
Organisation	NSW Government
Date	December 2004

NSW Planning Guidelines for Walking and Cycling	
Purpose	Assisting land use planners and related professionals to improve consideration of walking and cycling in their work. It is anticipated that this will ultimately create more opportunities for people to live in places with easy walking and cycling access to urban services and public transport.
Content	Assistance is provided by these guidelines in the form of principles, background information, case studies and references to other supportive policies and guidelines. This information can be used to develop planning instruments, at all levels, that are supportive of walking and cycling.
Relevance to Ivanhoe Estate	In 2002, a TMAP was prepared for the NSW Government and Ryde Council to guide the redevelopment of the Macquarie Park employment corridor for the next 15 to 20 years.

B2 Regional Transport Context Documents

B2.1 Draft North District Plan

Draft North District Plan	
Organisation	Great Sydney Commission
Date	November 2016
Purpose	Setting out aspirations and proposals for Greater Sydney's North District
Content	This draft District Plan includes three chapters focusing on the means to enhance the District's productivity, sustainability and liveability in accordance with A Plan for Growing Sydney and the Commission's mandate.
Relevance to Ivanhoe Estate	Macquarie University Station (Herring Road) Priority Precinct will deliver up to 5,800 new homes by 2031 and includes the redevelopment of Ivanhoe Estate. The rezoning proposal for the precinct was finalised in September 2015. Development will be staged over the next 10 to 20 years. The North District will continue to require social housing, and much of this provision will come through Communities Plus. One of the four Communities Plus initiatives underway in Greater Sydney is at the 8.2 hectare Ivanhoe Estate at Macquarie Park. It currently accommodates 259 social housing dwellings that will be transformed into an integrated community of 2,500 homes including more social housing mixed with affordable and private housing. The Ivanhoe Estate was rezoned as part of the Macquarie University Station (Herring Road) Priority Precinct. The Precinct optimises the use of existing and planned infrastructure and is well located for rail and bus services. It also has easy access to a major shopping centre, includes a top-ten university campus and is close to a growing local jobs market. World-class urban design, community-based place making, and quality facilities will support a vibrant, cohesive and sustainable community.

B2.2 A Plan for Growing Sydney

A Plan for Growing Sydney	
Organisation	NSW Government Planning & Environment
Date	December 2014
Purpose	To development a competitive economy with world-class services and transport; to deliver greater housing choice to meet our changing needs and lifestyles; to create communities that have a strong sense of wellbeing; and to safeguard our natural environment.

A Plan for Growing Sydney	
Content	The actions include: • accelerating urban renewal across Sydney at train stations, providing homes closer to jobs • growing a more internationally competitive Sydney CBD • growing Greater Parramatta as Sydney's second CBD • transforming the productivity of Western Sydney through growth and investment • enhancing capacity at Sydney's Gateways – Port Botany, Sydney Airport and Badgerys Creek Airport • delivering the infrastructure that is needed • promoting Sydney's arts and culture, tourism and entertainment industries • protecting our natural environment • managing long-term growth
Relevance to Ivanhoe Estate	Priorities for strategic centres - Macquarie Park: • Work with council to retain a commercial core in Macquarie Park for long-term employment growth. • Work with council to concentrate capacity for additional mixed-use development around train stations, including retail, services and housing. • Facilitate delivery of Herring Road, Macquarie Park Priority Precinct, and North Ryde Station Priority Precinct. • Investigate potential future opportunities for housing in areas within walking distance of train stations. • Support education and health-related land uses and infrastructure around Macquarie University and Macquarie University Private Hospital. • Support the land use requirements of the Medical Technology knowledge hub. • Investigate a potential light rail corridor from Parramatta to Macquarie Park via Carlingford. • Investigate opportunities to deliver a finer grain road network in Macquarie Park. • Investigate opportunities to improve bus interchange arrangements at train stations. • Work with council to improve walking and cycling connections to North Ryde train station.

B2.3 Towards our Greater Sydney 2056

Towards our Greater Sydney 2056	
Organisation	Great Sydney Commission
Date	November 2016
Purpose	Outlines a draft amendment to A Plan for Growing Sydney which aligns with the vision established in the draft District Plans.
Content	This amendment reconceptualises Greater Sydney as a metropolis of three cities: • Established Eastern City • Developing Central City • Emerging Western City A productive Sydney A liveable Sydney A sustainable Sydney
Relevance to Ivanhoe Estate	The principles within the Towards our Greater Sydney 2056 align with intent of the Ivanhoe Estate and in particular the development of the Central City as an economic corridor providing housing in proximity to employment and critical services.

B2.4 Development Near Rail Corridors and Busy Roads – Interim Guideline

Development Near Rail Corridors and Busy Roads – Interim Guideline	
Organisation	NSW Government Department of Planning
Date	2008
Purpose	To assist in reducing the health impacts of rail and road noise and adverse air quality on sensitive adjacent development. To assist in the planning, design and assessment of development in, or adjacent to, rail corridors and busy roads.
Content	Strategic planning context: contains general guidance for council strategic planning purposes, and also for other government agencies or private proponents investigating possible locations for residential development, places of worship, hospitals, child care centres and schools. It also provides guidance on site selection to reduce or avoid the need for mitigation measures Potential impacts of roads and railways on adjacent development: contains information on development that may be impacted by rail corridors and busy roads. Potential impacts of adjacent development on roads and railways: contains information on development that may impact on rail corridors and busy roads.
Relevance to Ivanhoe Estate	The Ivanhoe Estate Masterplan places significant emphasis on the delivery of an integrated transport and land use development that maximises the benefits of the State Government's investment public transport

B2.5 Sydney's Bus Future 2013

Sydney's Bus Future 2013	
Organisation	NSW Government
Date	December 2013
Purpose	Deliver simpler, faster and better bus services for customers, and attract more customers to use bus services throughout Sydney.
Content	Three-tiered network will operate with each level delivering a defined level of service consistency and reliability. • Rapid service routes • Suburban service routes • Local service routes The three stages of Sydney's Bus Future: • Improve bus customers' experience • Integrate bus service across Sydney • Serve future growth

Sydney's Bus Future 2013	
Relevance to Ivanhoe Estate	Rapid bus routes: Parramatta – Macquarie Park via Carlingford and Epping Hurstville – Macquarie Park via Burwood Northern Sydney – Hornsby, Ryde, North Shore and Northern Beaches: Approximately 30 extra weekday services will link Macquarie Park to Burwood via Top Ryde Direct connections will link the Northern Beaches to major centres such as Chatswood, St Leonards and Macquarie Park Parramatta and Western Sydney: New and upgraded Rapid routes will strengthen connections between Parramatta, Macquarie Park, Castle Hill, Bankstown, Liverpool, the North-West Growth Centre, and central Sydney via Top Ryde Over 50 extra Rapid services will operate every weekday between Parramatta and Macquarie Park, with improvements starting to be delivered in the short term

B2.6 Sydney's Walking Future 2013

Sydney's Walking Future 2013	
Organisation	NSW Government
Date	December 2013
Purpose	Getting people in Sydney walking more through actions that make it a more convenient, better connected and safer mode of transport.
Content	Three pillars of Sydney's Walking Future • PROMOTE benefits and provide information • CONNECT through infrastructure and technology • ENGAGE through policy and partnerships
Relevance to Ivanhoe Estate	In 2011-12, the NSW Government delivered 65 pedestrian infrastructure projects, including the delivery of $5 million pedestrian footbridge at Macquarie Park connecting Epping High School students and local residents to locations across Epping Road. Transport Management Associations, which are partnerships across multiple levels of government and local businesses, are being piloted at Macquarie Park and will be rolled out progressively in other areas of Sydney.

B2.7 Sydney's Cycling Future 2013

Sydney's Cycling Future 2013	
Organisation	NSW Government
Date	December 2013
Purpose	Making bicycle riding a safer and more convenient option, and encouraging residents to ride bikes for everyday transport.
Content	Three pillars of Sydney's Cycling Future • CONNECT Safe, connected networks • PROMOTE Better use of existing Infrastructure • ENGAGE Policy and partnerships
Relevance to Ivanhoe Estate	Bicycle network plans will be developed with councils within five kilometre catchments of Major Centres, including Macquarie Park. Together with the Transport Management Association – a partnership between multiple levels of government and local businesses – currently being piloted at Macquarie Park, the proposed infrastructure will achieve the objectives of the Sydney's Cycling Future.

B3 Local Planning Context

B3.1 Ryde Local Environmental Plan 2014

Ryde Local Environmental Plan 2014	
Organisation	City of Ryde Council
Date	1 September 2017
Purpose	Ryde Local Environmental Plan (LEP) 2014 – a comprehensive Plan for the City of Ryde together with the Ryde Development Control Plan (DCP) 2014 provides the necessary framework for how the City of Ryde will advance. It also balances the needs of residents, businesses and investors today with those of future generations.
Content	The objective of clause 6.9 is to encourage additional commercial development in the Macquarie Park Corridor co-ordinated with an adequate access network and recreation areas.
Relevance to Ivanhoe Estate	The consent authority may approve development with a height and floor space ratio that does not exceed the increased building height and floor space ratio identified on the Macquarie Park Corridor Precinct Incentive Height of Buildings Map and the Macquarie Park Corridor Precinct Incentive Floor Space Ratio Map, but only if the consent authority is satisfied that: (a) there will be adequate provision for recreation areas and an access network, and (b) the configuration and location of the recreation areas will be appropriate for the recreational purposes of the precinct, and (c) the configuration and location of the access network will allow a suitable level of connectivity within the precinct.

B3.2 City of Ryde DCP 2014 – Part 4.5 Macquarie Park Corridor

City of Ryde Development Control Plan 2014	
Organisation	City of Ryde Council
Date	14 February 2017
Purpose	The Development Control Plan (DCP) 2014 provides guidelines, objectives and controls for people who wish to carry out development in the City of Ryde. Part 4.5 provides objectives, controls and design criteria to achieve desirable development outcomes in line with Council's vision for the Macquarie Park Corridor
Content	Development Control Plan 2014 Part: 4.5 Macquarie Park Corridor
Relevance to Ivanhoe Estate	Ivanhoe Estate is located on the southern boundary of the land covered by this part.

B3.3 City of Ryde 2025 Community Strategic Plan

Ryde 2025 Community Strategic Plan	
Organisation	City of Ryde Council
Date	25 June 2013
Purpose	Developed seven key outcomes for the Ryde Community Strategic Plan that responds to the clear and consistent priorities of our community.

Ryde 2025 Community Strategic Plan	
Content	7 Outcomes • A city of liveable neighbourhoods • A city of wellbeing • A city of Prosperity • A city environmental sensitivity • A city of connections • A city of harmony and culture • A city of progressive leadership
Relevance to Ivanhoe Estate	Traffic management issues of Macquarie Park need to be addressed. Transport solutions for Macquarie Park and the university will be explored through a Transport Management Authority. Supporting a night time economy at the intersection of the university and the business park will provide additional animation to the precinct making it attractive to the younger workforce that responds to the needs of innovative industry.

B3.4 City of Ryde Section 94 Development Contributions Plan (Interim Update 2014)

City of Ryde Section 94 Development Contributions Plan 2007 (Interim Update 2014)	
Organisation	City of Ryde Council
Date	10 December 2014
Purpose	Section 94 of the Environmental Planning and Assessment Act 1979 enables Councils to levy contributions for public amenities and services as a consequence of development.
Content	Section 3.6 Roads and Traffic Management Facilities Strategy Plan Section 3.7 Transport and Accessibility Strategy Plan Section 3.8 Cycleways Strategy Plan
Relevance to Ivanhoe Estate	Council's Section 94 Development Contributions Plan applies to all land within the Ryde local government area.

B3.5 Macquarie Park Pedestrian Access and Mobility Plan

Macquarie Park Pedestrian Access and Mobility Plan	
Organisation	City of Ryde Council (Arup)
Date	21 June 2013
Purpose	Provides a framework for developing safe and convenient pedestrian routes and fostering improvements in personal mobility.
Content	Recommended actions are identified in the form of the PAMP Action Plan. The PAMP Action Plan also explores potential funding sources for the works identified in the plan.

Macquarie Park Pedestrian Access and Mobility Plan	
Relevance to Ivanhoe Estate	Key issues: • Lack of pedestrian crossing/ need for increased pedestrian crossings • Pedestrian safety at all crossing • Pedestrian safety at other locations • Motorist behaviour • Poor lighting/ request for improved lighting • Widen footpath Main locations of concern: • Waterloo Road (between Herring Road and Khartoum Road, particularly at the Byfield Street and Khartoum Road roundabouts) • Herring Road (around Macquarie Centre and Ivanhoe Place) • Rivett Road (near Lucknow Road and Julius Avenue) • Lane Cove Road (between Talavera Road and Waterloo Road)

B3.6 Macquarie Park Traffic Study

Macquarie Park Traffic Study	
Organisation	City of Ryde (Bitzios Consulting)
Date	16 July 2013
Purpose	The Traffic Study considers the needs and effects of the Structure Plan components of the Ryde DCP 2010 Section Part 4.5 Macquarie Park. The Traffic Study and the Pedestrian Study listed above are designed to complement each other. When combined and implemented through the development process, the studies will each provide a solid foundation for an improved, integrated transport management approach which gives equal weighting to the needs of pedestrians and vehicles in Macquarie Park.
Content	Data Collection and Model Development Traffic Demands, Issues and Options Internal Road System Assessment Major Road System Assessment – 2031 Base Model Supplementary Options Assessment
Relevance to Ivanhoe Estate	A target of 40% public transport mode share is achievable with the significant improvements in public transport in Macquarie Park and the introduction of workplace travel plans and workplace travel co-ordinators. Key traffic generators in 2031 will be the Macquarie University, Macquarie Park Shopping Centre and Macquarie Park east of Lane Cove Road, as well as a significant increase in through traffic on the M2 to a lesser extent on Lane Cove Road. Major infrastructure improvements are required at key locations on the major road system, particularly at Herring Road and Delhi Road interchanges with the M2, with an additional westbound off amp from the M2 needed at Lane Cove Road or Waterloo Road.

Appendix C

Construction Traffic Management Plan

Prepared for

ASPIRE CONSORTIUM ON BEHALF OF NSW LAND AND HOUSING CORPORATION

Preliminary Construction Traffic Management Plan

Proposed Mixed Use Development
Ivanhoe Estate, Macquarie Park

Ref: 0421r03v05
23/2/2018

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Document Control

Project No: 0421

Project: Ivanhoe Estate, Macquarie Park

Client: Aspire Consortium on behalf of NSW Land and Housing Corporation

File Reference: Ivanhoe CTMP

Revision History

Revision	Date	Details	Author	Approved by
-	30/10/2017	Draft	D. Budai	A. Johnson
1	27/11/2017	Issue I	D. Budai	A. Johnson
2	14/12/2017	Issue II	D. Budai	A. Johnson
3	6/2/2018	Issue III	D. Budai	A. Johnson
4	12/2/2018	Issue IV	D. Budai	A. Johnson
5	23/2/2018	Issue V	D. Budai	A. Johnson

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Appendices

1 Introduction

1.1 Overview

A detailed Construction Traffic Management Plan (CTMP) will be prepared once development consent is granted for relevant stages and prior to issue of a Construction Certificate (CC). This document provides an overview of construction traffic management and outlines the principles that would be implemented during the construction period. The objectives of the CTMP are as follows:

- Minimise traffic impacts on the surrounding road network
- Ensure safety and efficiency for workers, pedestrians and road users
- Provide information regarding the construction vehicle access routes and any changed road conditions

It should be noted that an indicative construction programme will be developed by the developer during the DA phase, with an indicative timeframe outlined for each relevant stage of construction.

Please note, Ason Group is responsible for the preparation of this Plan only and not for its implementation, which is the responsibility of the project manager/builder.

1.2 Site Location

Ivanhoe Estate, on the corner of Epping Road and Herring Road (the Site) is located within Macquarie Park in the City of Ryde Council LGA, and is less 5 kilometres north-west of Chatswood and 11.5 kilometres north-west of Sydney CBD. The Site has an approximate area of 82,000m^2 with frontages to commercial premises to the east, residential properties to the north, Herring Road to the west, and Epping Road to the south.

A Site Plan giving an appreciation of the site and the existing conditions presented in Figure 1. The site consists of several residential houses, a childcare centre and a small parklands area. The site shares the corner of Epping Road and Herring Road with one of the entrances to Macquarie Park train station, and is well situated to take advantage of the public transport services in the area, with bus interchanges and train stations located within a 600m radius.

Figure 1: Site location and Road Hierarchy

2 Overview of Works

2.1 Hours of Operation

The construction work may vary depending on the phase of construction and associated activities and includes both construction and design personnel. Subject to approval, it is proposed to amend the hours of operation for standard construction-working hours. The proposed hours of operation are as follows:

- Monday to Friday (other than Public Holidays): 5:00AM to 9:00PM
- Saturday: 7:00AM to 5:00PM

The working hours above recognises the existing peak network operation of Epping Road and Herring Road. The main objective of the proposed amended working hours is to reduce construction vehicle flows during the peak periods. An assessment of the impacts of the extended working hours is included in Section 5 of this report.

Until the S96 application is approved, the hours of operation are as follows:

- Monday to Friday (other than Public Holidays): 7:00AM – 5:00PM.
- Saturday: 8:00AM – 4:00PM.
- Sunday and Public Holidays: No works to be undertaken.

2.2 Construction Vehicle Access Routes

It is proposed that construction vehicles would enter and exit the site via the routes shown in **Figure 2**. A copy of the truck route would be provided to all drivers prior to travel to the site. In accordance with the Vehicle Movement Plan (VMP) to be distributed by the lead contractor during prior to construction, all vehicles (both light and heavy) shall enter and leave the site in a forward direction.

Two options have been given for the construction vehicle access routes to site – one with the ability to turn right into and out of Ivanhoe Place, and the other without. During previous meetings, the Roads and Maritime Services (RMS) and Transport for NSW (TfNSW) has advised that the intersection of herring Road and Ivanhoe Place will be upgraded to a signalised intersection during Stage 2 construction which is expected to take place in 2020. Until then, the RMS may decide that larger vehicles will be unable to access the site with a right turn from existing roundabout at Herring Road and Ivanhoe Place, therefore an ancillary route has been displayed with a left-in-left-out type arrangement.

The routes shown in **Figure 2** are to be utilised by all construction vehicles travelling to and from the site and represents the shortest route between the local and regional road network - hence minimising the impacts of the construction process.

The key roads in the vicinity of the Site are as shown in Figure 3 and are described in the following sections.

- M2 Motorway – an RMS State Road (MR 6002) that generally runs in an east-west direction between Lane Cove in the east and Baulkham Hills in the west. The M2 Motorway is one of Sydney's major transport corridors to the north-western suburbs. It carries in the order of 95,000 vehicles per day (vpd).
- Epping Road – an RMS State Road (MR 373) that generally runs in an east-west direction between the M2 Motorway (at Lane Cove) in the east and Blaxland Road (Epping) in the west. Epping Road carries approximately 50,000 vpd.
- Herring Road – a collector road that generally runs in a north-south direction which provides direct access to the site from the M2 motorway and Epping Road. Herring Road has a posted speed limit of 60km/hr and has parking on both sides of the road. Given the existing access arrangements, all vehicular traffic will be advised to arrive to the site from the north and depart to the north along Herring Road.
- Waterloo Road – a collector road that runs in an east-west direction between Wicks Road and Herring Road. It is subject to a 60km/hr speed limit and generally carries two lanes of traffic in either direction.
- Lane Cove Road – a RMS Classified arterial road that generally runs in a north-south direction to the east of the site. It is subjected to a 70km/hr speed limit and generally carries three lanes of traffic in each direction within the vicinity of the site.

Construction of the Proposal would generate additional movements within the network. Given that the M2 and Epping Road routes currently carry high volumes of traffic, construction of the development is not anticipated to have a material impact to the existing volumes on the M2 and the local network. As a safety measure, a temporary left-in-left-out (LILO) access will be created on to Epping Road for the duration of construction for all vehicles, to ease congestion on the already failing intersection of Epping Road and Herring Road.

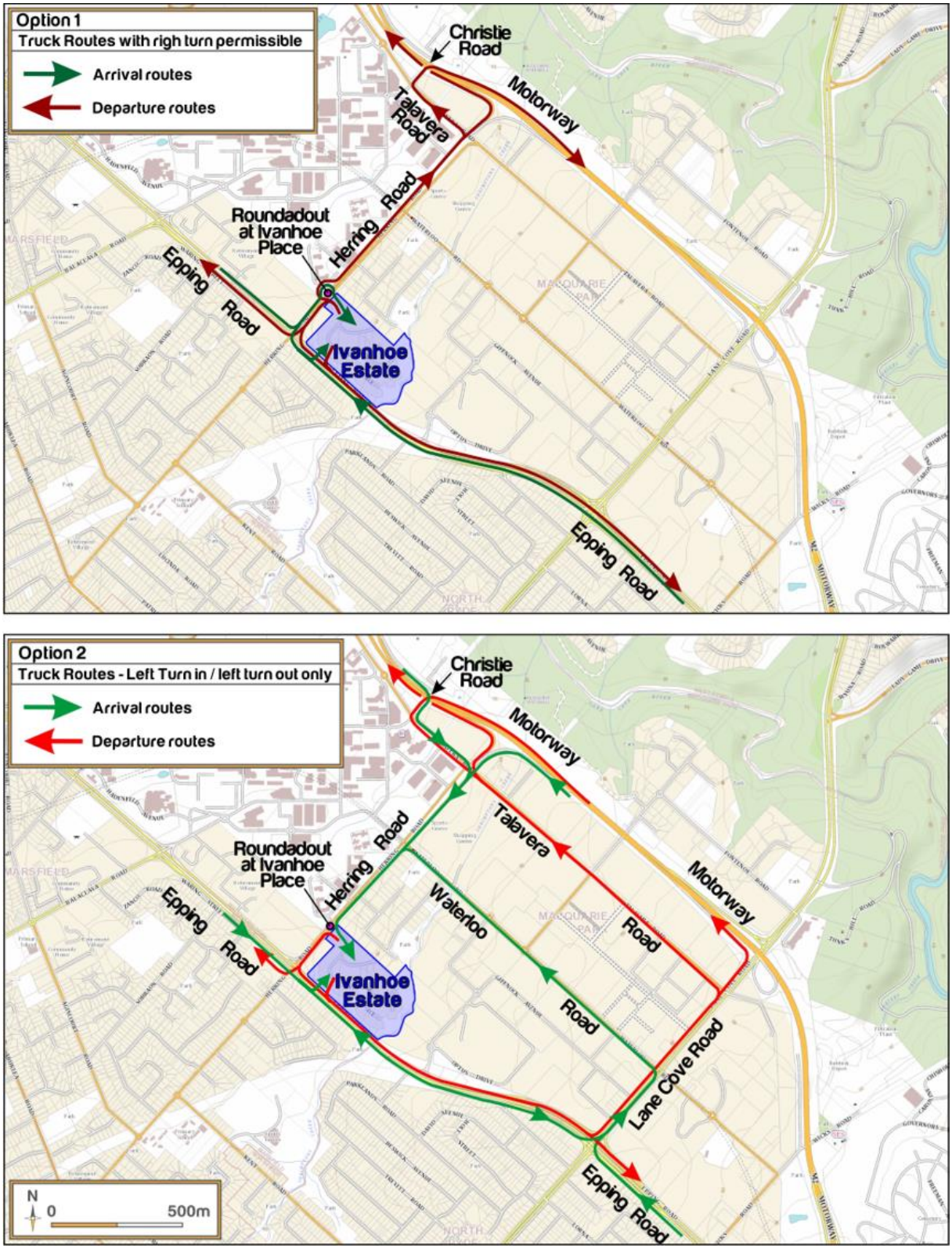


Figure 2: Heavy Vehicle Routes

2.3 Construction Vehicle Traffic Generation

2.3.1 Construction of Structure and Façade

Based on the construction methodology, duration of works and the type of truck being used, it is estimated that the construction of the core structure and façade is to generate a maximum of 108 construction heavy vehicle arrivals per day. This equates to approximately 14 vehicle movements (7 entry and 7 exit) on average over the proposed working hours (16 hours per day).

Recognising the proposed working hours of 5.00AM-9.00PM are intended to limit construction vehicle traffic movements during on-street peak periods to reduce impacts on the local road network, the majority of truck movements would be expected to occur over a reduced period of say 12 hours per day. Therefore, average heavy vehicle arrivals during non-peak periods may be in the order of 18 vehicles per hour (9 in, 9 out). Heavy vehicle arrivals would generally be minimal during the peak periods and operating at the aforementioned levels outside the peak periods.

It is also anticipated that a maximum of 400 contractors may be on-site at any one time during the main construction stage. The majority of workers will utilise public transport from the nearby Macquarie University Station to access the site, however, some contractors would still be required to drive to the site. Assuming 40% of contractors rely on public transport to access the site (as per Council's objectives for the locality), it is expected that a maximum of 240 contractors would arrive/depart on-site via private vehicles during the morning and evening periods. This includes vehicle passengers as part of car-pooling arrangements.

Assuming an average vehicle occupancy of 2.5 persons per vehicle and a 90-minute peak arrival period, the estimated traffic volumes would be 64 arrival/departure trips at the start and end of work periods. These flows would generally occur between the hours of 5.00AM-6.00AM and 8.00PM-9.00PM, which are outside the network peak periods.

A summary of the average traffic flows generated from this stage of works is shown in **Table 1**.

Table 1: Summary of Average Construction Vehicle Generation – Stage 1

Vehicle Type	Cars		Trucks		Combined	
	In	Out	In	Out	In	Out
Morning Site Peak (5.00AM-6.00AM)	64	-	9	9	73	9
Morning On-street Peak (7.00AM-9.00AM)	-	-	5	5	5	5
Evening On-street Peak (4.00PM-6.00PM)	-	-	5	5	5	5
Evening Site Peak (8.00PM-9.00PM)	-	64	9	9	9	73
Daily Movements	96	96	108	108	204	204

This compares with a proposed future traffic generation of 528 and 425 vehicles per hour during the morning and evening on-street peak periods, as documented in the *Traffic Impact Assessment*.

Noting that the anticipated construction peak traffic flows occur outside the network peaks, the proposed construction activities would not result in an adverse impact on the operational capacity of the surrounding network. It can be seen from table above that the estimated 'site peak' construction traffic flows (82 veh/hr including both heavy vehicles and site worker traffic) are sufficiently below the estimated peak traffic generated by the proposed development, once operational.

2.3.2 External Finishes / Fit-out

It is estimated that the final stages of construction would generate a maximum of 72 construction heavy vehicle arrivals per day. This equates to approximately an average of 12 vehicle movements (6 entry and 6 exit) over the proposed working hours, taking into consideration the reduced truck movements during on-street peak periods.

It is also anticipated that a maximum of 300 contractor staff will be on-site at any one time during the main construction stage. Similar to the previous stage, the majority of workers would be utilising public transport from the nearby Macquarie University Station or car pool to access the site. As such, it is expected that a maximum of 48 contractors would arrive/depart on-site via private vehicles during the morning and evening periods (5.00AM-6.00AM and 8.00PM-9.00PM).

A summary of the average traffic flows generated from this stage of works is shown in **Table 2**.

Table 2: Summary of Average Construction Vehicle Generation – Stage 2

Vehicle Type	Cars		Trucks		Combined	
	In	Out	In	Out	In	Out
Morning Site Peak (5.00AM-6.00AM)	48	-	6	6	54	6
Morning On-street Peak (7.00AM-9.00AM)	-	-	5	5	5	5
Evening On-street Peak (4.00PM-6.00PM)	-	-	5	5	5	5
Evening Site Peak (8.00PM-9.00PM)	-	48	6	6	6	54
Daily Movements	72	72	72	72	144	144

The table above demonstrates that the anticipated traffic flows are lower than that forecasted for the Stage 1 works, which reflects the type of work undertaken at this stage. As such, the proposed Stage 2 construction activities will also not result in an adverse impact on the operational capacity of the surrounding network.

2.4 Heavy Vehicle Management

In accordance with RMS requirements, all vehicles transporting loose materials will have the entire load covered and/or secured to prevent any large items, excess dust or dirt particles depositing onto the roadway during travel to and from the site. All subcontractors must be inducted by the lead contractor to ensure that the procedures are met for all vehicles entering and exiting the construction site. The lead contractors will monitor the roads leading to and from the Site and take all necessary steps to rectify any road deposits caused by site vehicles.

Vehicle movements to, from and within the Site shall do so in a manner, which does not create unreasonable or unnecessary noise or vibration. No tracked vehicles will be permitted or required on any paved roads. Public roads and access points will not be obstructed by any materials, vehicles, waste skips or the like, under any circumstances.

All drivers are to be familiar with the Driver Code of Conduct before attending the Site. A copy of the Code is included in **Appendix A.**

2.5 Extended Hours of Construction

As previously mentioned in the Section above, the extended hours of construction (5.00AM-9.00PM) has the benefit of allowing the majority of construction vehicle movements to occur outside of the network peak hours. This has the effect of reducing the impacts of construction on the operation of the surrounding road network, where it is at its most constrained.

2.6 Employee Parking

It is expected that construction employees would avail of the excellent public transport facilities, thereby ensuring that there would be minimal parking demand. The Site's accessibility to public transport is depicted in **Figure 3**.

It is anticipated that the construction activities will result in a maximum of 400 contractors on-site over the entire construction program. Accordingly, the estimated maximum number of contractor vehicles that would be on-site over the course of the day would be 96 vehicles. As such, parking space within the lot would exceed the expected parking demands. In this regard, there will be no reliance on on-street parking within the North Ryde and Macquarie Park areas.

Some parking for employees will be provided on-site with others encouraged to carpool and utilise the extensive public transport service in the area. As such, on-street parking will not be utilised by contractors or site employees, and the proposed construction activities will have minimal impact on the availability of surrounding public car parking throughout construction.

2.7 Emergency Vehicle Access

Emergency vehicle access to and from the site will be available at all times the site is occupied by construction workers. This process would be implemented through emergency protocols on the site, which would include a requirement for site personnel to assist with emergency access if required.

2.8 Public Transport

Macquarie Park in general, and more specifically the Site is well serviced with public transport, with more details on Public transport within the locality can be found in **Figure 3**.

The Site benefits from excellent access to bus services with bus stops for up to 25 services provided within 400m of the Site transporting commuters to the City, Hurstville, Blacktown and the Hills to name a few.

In addition, within a 400-metre radius of the Site, there is the Macquarie Park railway station which will transport commuters to the City, Penrith and Hornsby. Ancillary to the existing rail lines, the introduction of the Sydney Metro Northwest will further improve serviceability to and from the Site.

The construction activities will have no material impact on the existing public transport services along Herring Road or Epping Road with all bus services to continue as currently occurs.

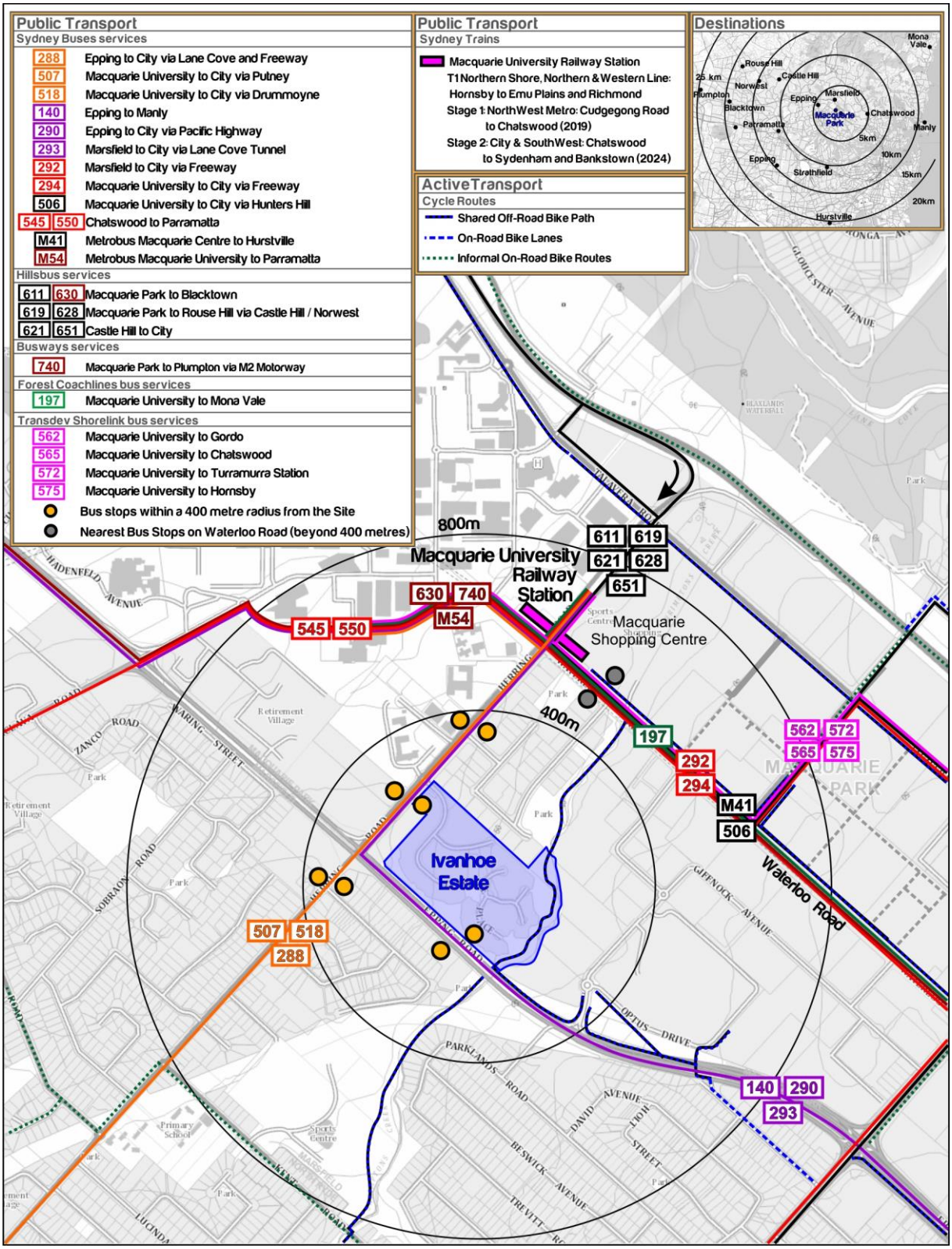


Figure 3: Public Transport Map

2.9 Pedestrian and Cyclist Access

As shown in **Figure 4** all construction activities will occur within the Site. Accordingly, the existing pedestrian and cycle connections on Herring Road and Epping Road will remain unchanged and will continue to operate as is.

All truck movements to the Site will make use of the existing access from Ivanhoe Place. The existing footpaths on Herring Road will remain open during construction., with Traffic Controllers stopping pedestrians and cyclists during the arrival and departure of heavy vehicles.

The dedicated cycleway that runs within the Site will ultimately be shut, although it is unclear during which stage of construction this will be. Although a matter for a specific stage's DA, the closure of this dedicated cycleway will not occur until a new cycleway is built, therefore ensuring cyclists and pedestrians will not be adversely affected during construction. All other footpaths outside the Site will remain unaffected by demolition works at all times.

Figure 4: Active Transport Map

3 Traffic Control

3.1 Traffic Control

The RMS guide “Traffic Control at Worksites” (TCAW) manual contains standard traffic control plans (TCPs) for a range or work activities. The manual objective is to maximise safety by ensuring traffic control at worksites complies with best practice. The RMS TCAW outlines the requirement for a Vehicle Movement Plan (VMP).

A VMP is a diagram showing the preferred travel paths for vehicles associated with a work site entering, leaving or crossing the through traffic stream. A VMP should also show travel paths for trucks at key points on routes remote from the work site such as places to turn around, accesses, ramps and side roads. It may be combined with or superimposed on to a TCP if warranted.

On roads with an average daily total (ADT) of more than 1,500 vehicles, approach speeds of between 60 km/hr and 80 km/hr, with truck movements > 20 veh/hr, and sight distance is less than 2*d* (where *d* equals the posted speed limit and in this instance the sight distance is required to be up to 160 metres), the following is required by the RMS TCAW manual:

- TCP with Traffic controllers/Traffic Signals Yes
- VMP Yes
- Warning Signs required during shifts Yes

For the purpose of this preliminary CTMP, truck movements have been assumed to be greater than 20 vehicles per hour, however, if truck movement were to be less than 20 vehicles per hour, the following would be required by the RMS TCAW manual:

- TCP with Traffic controllers/Traffic Signals N/A
- VMP N/A
- Warning Signs required during shifts N/A

Irrespective of the nominal RMS requirements, it is proposed to implement a site-specific version of TCP 195 (TCP 195 is shown in **Appendix B).** The site-specific TCP will be drawn during future DA stages. With these adopted construction traffic management principles, all construction vehicles will be able to exit the Site via the temporary priority controlled intersection.

3.2 Authorised Traffic Controller

There is a requirement for an authorised traffic controller to be present throughout the demolition, excavation and construction stages of the project. These responsibilities include:

- Supervision of all vehicle movements across pedestrian footpaths at all times, and
- Supervision of all loading and unloading of construction materials during the deliveries in the construction phase of the project.
- Pedestrian management, to ensure that adverse conflicts between vehicle movements and pedestrians do not occur.

4 Summary

While the traffic impacts of construction of the development are likely to be minor, the following measures should be undertaken to minimise the impacts of the construction activities of the development:

- Traffic control would be required to manage and regulate traffic movements into and out of the Site during construction.
- Disruption to road users would be kept to a minimum by scheduling intensive delivery activities outside of peak hours.
- Construction and delivery vehicles would be limited to the use of Epping Road, the M2 and the necessary local roads and restricted to non-peak periods.
- All vehicles to enter and exit the Site in a forward direction with reverse movements to occur only as necessary and subject to supervision.
- All vehicles transporting loose materials will have the entire load covered and/or secured to prevent any items depositing onto the roadway during travel to and from the Site.

The CTMP will be detailed during future DA stages, and will be developed to comply with RMS requirements and TCAW manual, and prepared in consultation with Ryde Council, RMS and any other relevant stakeholders. The above provides an appropriate overview of the likely impacts and outlines the principles that would be adopted in preparing the detailed Construction Traffic Management Plan.

Appendix A

Driver Code of Conduct

- Driver Code of Conduct -

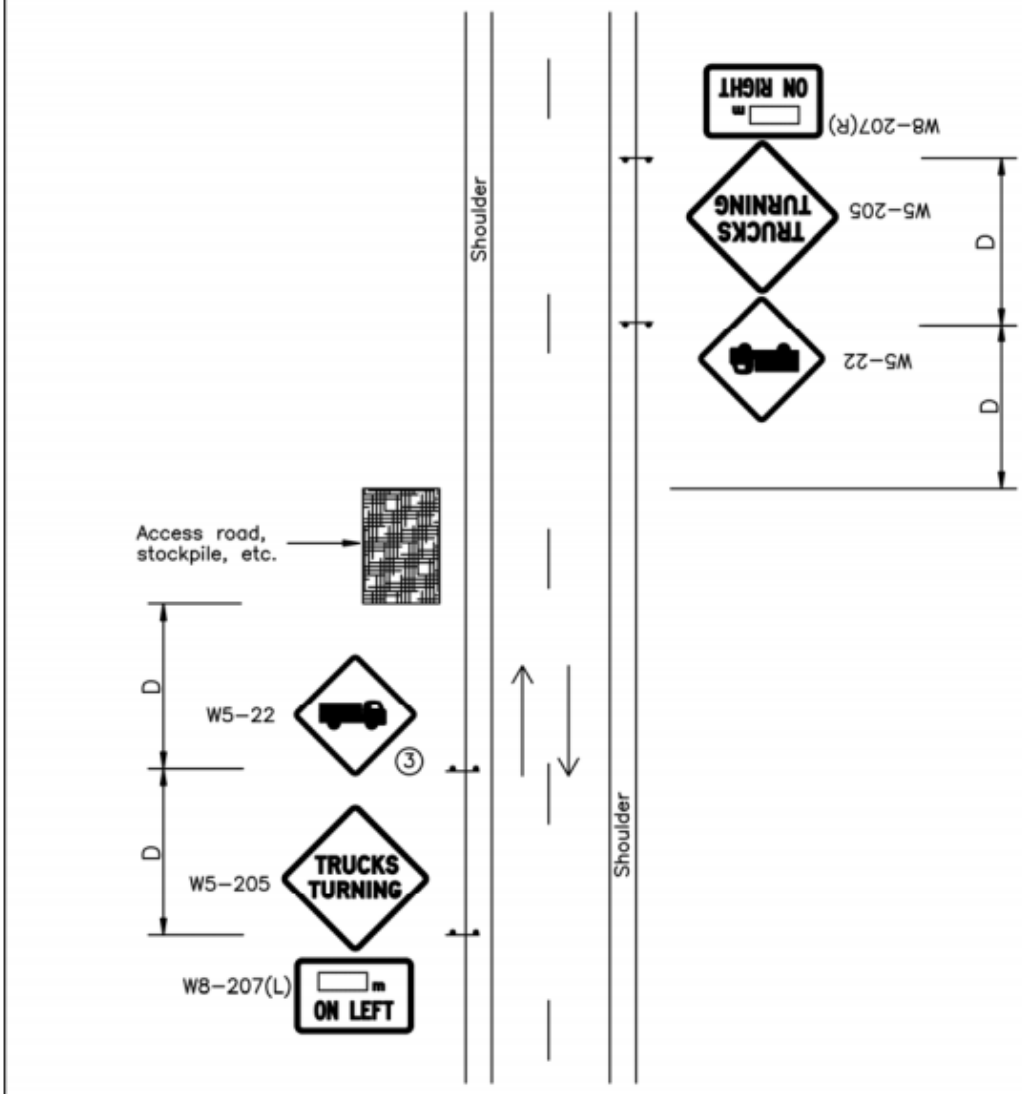
All vehicle operators accessing the Site must:

- Take reasonable care for his or her own personal health and safety.
- Not adversely, by way of actions or otherwise, impact on the health and safety of other persons.
- Notify their employer if they are not fit for duty prior to commencing their shift.
- Obey all applicable road rules and laws at all times.
- Obey the applicable driving hours in accordance with legislation and take all reasonable steps to manage their fatigue and not drive with high levels of drowsiness.
- Obey all on-site signposted speed limits and comply with directions of traffic control supervisors in relation to movements in and around temporary or fixed work areas.
- Ensure all loads are safely restrained, as necessary.
- Operate their vehicles in a safe and professional manner, with consideration for all other road users.
- Hold a current Australian State or Territory issued driver's licence.
- Notify their employer or operator immediately should the status or conditions of their driver's license change in any way.
- Comply with other applicable workplace policies, including a zero tolerance of driving while under the influence of alcohol and/or illicit drugs.
- Not use mobile phones when driving a vehicle or operating equipment. If the use of a mobile device is required, the driver shall pull over in a safe and legal location prior to the use of any mobile device.
- Advise management of any situations in which you know, or think may, present a threat to workplace health and safety.
- Drive according to prevailing conditions (such as during inclement weather) and reduce speed, if necessary.
- Have necessary identification documentation at hand and ready to present to security staff on entry and departure from the Site, as necessary, to avoid unnecessary delays to other vehicles.

Appendix B

Traffic Control Plan (TCP)

Traffic Control at Work Sites



NOTE:

① For use where roadside is generally undeveloped, ADT is more than 1,500 vehicles per day, sight distance is restricted and there are more than 20 truck movements per shift.

② See ***Traffic control at work sites***, Section 7.7, ***Signs for depots, stockpiles, quarries, gravel pits etc.***

③ For short term works use T2–25.

ACCESS TO DEPOT, STOCKPILE, QUARRY, GRAVEL PIT ETC.
ALL ROADS
LONG TERM USE

T000195

TCP 195

Appendix D

Green Travel Plan

asongroup

Prepared for

ASPIRE CONSORTIUM ON BEHALF OF NSW LAND AND HOUSING CORPORATION

Green Travel Plan

Proposed Mixed Use Development
Ivanhoe Estate, Macquarie Park

Ref: 0421r04v03
23/2/2018

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Document Control

Project No: 0421

Project: Ivanhoe Estate, Macquarie Park

Client: Aspire Consortium on behalf of NSW Land and Housing Corporation

File Reference: Ivanhoe Estate GTP

Revision History

Revision	Date	Details	Author	Approved by
-	25/10/2017	Draft	D. Budai	A. Johnson
1	27/11/2017	Issue I	D. Budai	A. Johnson
2	14/12/2017	Issue II	D. Budai	A. Johnson
3	6/2/2018	Issue III	D. Budai	A. Johnson
4	12/2/2018	Issue IV	D. Budai	A. Johnson
5	23/2/2018	Issue V	D. Budai	A. Johnson

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Appendices

1 Introduction

This Green Travel Plan (GTP) has been developed to support a Concept Development Application for the Ivanhoe Estate Masterplan, a State Significant Development (SSD) 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 Proposal. It has been prepared for Aspire Consortium on behalf of NSW Land and Housing Corporation.

2 Background and Objectives

This management strategy comprises a package of measures designed to address the specific travel needs and impacts of the proposed Ivanhoe Estate development on the corner of Epping Road and Herring Road, Macquarie Park (the Site). The overall intention of this Green Travel Plan (GTP) is to encourage and facilitate the use of alternatives to single-occupancy car travel for journeys associated with the Site.

Incorporation of physical infrastructure into the Master Plan and subsequent staged development applications will avoid the need and expense associated with retro-fitting facilities, and other measures i.e. marketing and promotion, etc. can be developed and ready to roll out at first occupation of the Site. This therefore provides a significant opportunity to influence travel behaviour before a tendency towards single occupancy car travel is entrenched. In addition, the availability of a GTP at this stage helps planning and road authorities to better understand the likely impacts of the development, bearing in mind the mitigating effects of the GTP, as part of the approval process.

The primary objectives of the GTP will be to:

- Reduce the environmental footprint of the proposed development
- Promote the use of 'active transport' modes, particularly for short-medium distance journeys.
- Reduce reliance on the use of private vehicles for all journeys.
- Encourage a healthier, happier and more active social culture.

Having regard for the above, this GTP would seek to adopt the movement hierarchy shown in with priority given to 'active transport'.

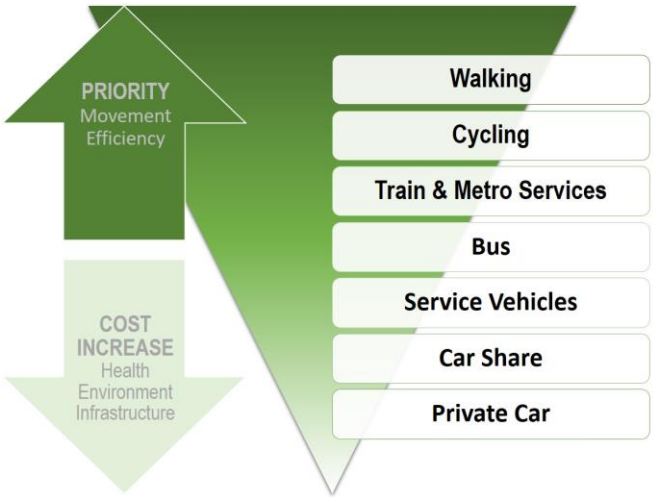


Figure 1: Movement Hierarchy

3 Site Audit and Targets

An audit of the Site and proposed development was conducted to determine facilities in the area and projected modal splits. The audit considered the following:

- Public transport services in the area, including proximity to the Site, frequency of services and accessibility;
- Location of nearby car share pods;
- Bicycle and pedestrian facilities, including accessibility, connectivity and safety;
- Mode-split data for the Site and local area;

Travel Zones (TZs) are the geographic units of the Bureau of Transport Statisics' (BTS) data collection, transport modelling and analysis. TZs allow for detailed spatial analysis as they are smaller than Statistical Local Areas (SLA), but generally larger than an ABS Collection District (CD) or Mesh Block (MB). In order to provide for a similar level of trip generation across zones, TZs are configured so that they tend to be small in areas with high land use densities and larger in areas of lower density. The key land uses of interest in defining TZs are employment, housing and transport infrastructure.

The Macquarie Park area is comprised of 13 TZs. TZs that are located within 800m of a train station (Macquarie University, Macquarie Park) along the T1 Line, have permeability through an accessible network of streets serving the stations, and have other similar travel characteristics to the completed Ivanhoe Estate development were analysed to establish the potential travel pattern and trip destinations.

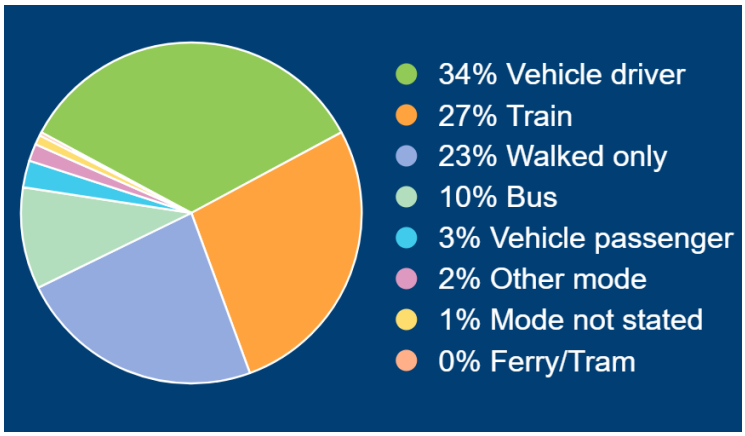


Figure 2: JTW Mode Split

The GTP is intended to develop a package of site specific measures to promote and maximise the use of sustainable travel modes, including walking, cycling, public transport and car sharing. It will include a review of existing transport choices and sets targets so that the effective implementation of the plan can be assessed. These targets are to be realistic but ambitious enough to initiate substantiative behavioural change to achieve the desired outcomes. The plan shall be monitored as part of an ongoing review to ensure it remains relevant and reflective of current conditions.

With regards to the Proposal, the existing public transport infrastructure available within close proximity to the Site has been identified in the Transport Access Guide in Appendix A. Due to the existing provision of multiple bus stops within close proximity to the Site, no additional infrastructure is proposed.

3.1 Mode Share Changes

The objectives for the Site aim to deliver public transport, walking, and cycling journeys in line with NSW government state targets. The following high level objectives are assumed in the redistribution of modal share:

These goals apply to the Sydney Metropolitan Region in general. Ivanhoe Estate aspires to be a TOD, hence it's transport targets should aim to achieve even higher shifts in travel behaviour away from car use than those stated in NSW 2021.

Therefore, the proposed set of transport targets for the development upon completion are:

- journey to work mode share of 40% car driver or less;
- bicycle mode share for all trips of 3%, compared to current value for the area of less than 1%;
- walking to increase to 23% of daily travel;
- provide a low provision of car parking;
- on-street car parking spaces to serve dual and complimentary uses within the estate;
- 40% non-car mode share for journeys to / from work;
- 50% combined walk and cycle mode share for all school travel;
- 50% combined walk and cycle mode share for all Macquarie Park trips; and
- 50% combined walk and cycle mode share as access mode for Macquarie Park Station.

These high level objectives dovetail with the following NSW state government transport targets for Metropolitan Sydney, which apply to Ivanhoe Estate. The relevant state government targets for transport are as follows:

- 28% public transport mode share for journeys to work;
- 20% public transport mode share for journey to work into Liverpool CBD; and
- 5% bicycle mode share for trips of less than 10km.

Figure 2 details the existing and proposed mode share targets. These targets have been developed with consideration to the NSW 2021 plan and the NSW Long Term Transport Master Plan. A target of 25% of trips undertaken by public transport is proposed in the aforementioned documents and Council also seeks to meet a target of 45% of total trips to be undertaken by public transport.

In consideration of these objectives, the following modal splits and journey characteristics are proposed:

- Train and Bus increases use a 28% public transport mode share target and the existing reference ratios. These increases are considered conservative, based on the proposed proximity, accessibility, and frequency of infrastructure and services.
- Bicycle increases to 5% mode share from NSW state government transport targets and corresponding 5% for Walk are derived from 50% combined walk and cycle mode share for all school travel, 50% combined walk and cycle mode share for all Site trips, and 50% combined walk and cycle mode share as access mode for Macquarie University Station. These increases are considered conservative, based on the proposed proximity and accessibility of infrastructure and services.
- Car Driver reductions have been subtracted from public transport, and bicycle and walk increases. From census data, non-car modes trips increase for localities that are close to railway stations along the South Rail Line.

A large number of rigorous empirical studies link urban development and travel patterns and show that, even after accounting for socioeconomic and demographic differences, residents of communities with frequent, reliable, easily accessible public transport services and well designed pedestrian and bicycle networks drive significantly less, and walk, bicycle and ride public transport more than their counterparts in ‘traditional’ communities (Arrington and Cervero 2008, Cervero et al. 2004, Ewing et al. 2008, and Feigon et al. 2003). The initiatives and strategies outlined **Table 1** also provide several incentives to avoid vehicle trips and is likely to be more than the proposed 14% for retail and 19% for residential.

4 Action Strategies

Six main strategies have been identified and the actions required for each are detailed in **Table 1** below. The table details how the targets the specific actions to be implemented as part of this GTP and who will be responsible for implementing each action. In developing this GTP and the strategies and actions comprising it, it is recognised that the end user is not known to the developer. Consequently, it is vital that the developer explains to future tenants the expectations regarding travel planning that are agreed for the Site to facilitate the important process of monitoring and review.

Table1: Proposed Ivanhoe Estate GTP Strategies

STRATEGY	HOW IT WORKS	IMPLEMENTATION	RESOURCES / RESPONSIBILITY
1 Travel Planning and Demand Management			
1.1 Car Sharing	Extend the provision of established car share schemes to set up a car sharing network for Ivanhoe Estate, reducing residents need to own and operate their own vehicle. Promote existing car sharing scheme (https://www.coseats.com/)	City of Ryde Council should consider extending the provision of established car share schemes to Ivanhoe Estate, reduce residents need to own and operate their own vehicle, safe in the knowledge that there can get access to a vehicle if they require one.	Developer, council
1.2 Carpooling	Establish a car pooling program to help people find someone to share in their daily commute.	Prepare information sheets specific to residential commuters and employees on site.	Building Management, commercial space staff
1.3 Travel Plans	• Develop mandatory Travel Plans for school and provide information for Workplace Travel Plans. • Management of Travel Plans • Promotion of Travel Plans	Provide information and resources, and implement a range of additional initiatives to reward and encourage those who travel actively to help develop a healthy, active culture and meet travel targets. Continued support of the person/organisation in charge of managing the GTP. Undertake a GTP event annually. Promote the follow initiatives via bulletins and web pages: • Travel Survey Results; and • Progress and update of GTP.	Developer, school, employees
1.4 Flexible Working hours	Allowing staff the flexibility to commute outside peak periods to reduce overall congestion and travel time.	Manage staff rosters where possible.	Employers
1.5 Teleworking	Provide the option to work remotely to reduce the number of vehicles on the road and encourage teleconferencing rather than travelling to meetings.	Manage staff rosters, and develop work-from-home policies and procedures, where possible.	Employers

STRATEGY	HOW IT WORKS	IMPLEMENTATION	RESOURCES / RESPONSIBILITY
2 Promoting Public Transport			
2.1 Travel Pass Loan Schemes	Commercial business may consider subsidising staff travel passes to increase public transport use. Alternatively, staff can pay for their own annual travel pass through their salary, spreading the cost over the year to make it more affordable.	Subject to owner/tenant negotiations and incentives.	Commercial tenant responsibility
2.2 Integration of Public Transport Services	Maximise integration of bus and train services providing linked timetables for residents to/from local and regional employment, retail, and commerce centres.	Dedicated bus-rail interchange designed. Increased headway and service commitments already made for bus and Metro services. Monitor and review services periodically.	Transport for NSW, Developer
2.3 Maximise Bus Service Coverage	Maximise coverage of the development and to provide connections for residents to major services.	The proposed bus network should be designed to maximise the coverage of the development throughout the different stages.	Transport for NSW, Developer
2.4 Implement Early Start-up Buses	Reduce car dependency by development and staging early ‘Start-up’ buses.	Bus service should be established from “Day of opening” to encourage the use of public transport by the residents. Bus routes will connect EPS, EP Park Station, Site, as well as regional destinations.	Transport for NSW, Developer
2.5 Maximise Bus Service Frequency	Meet or exceed Transport NSW bus planning guidelines.	Decrease headway where possible, especially during peak periods.	Transport for NSW, Developer
2.6 Good Quality Bus Stops with Pedestrian Links	Account for service frequency and potential patronage with high standards of infrastructure.	Design with high standards of infrastructure, to provide shelter, seating, information such as timetable and network map (real-time information?). Facilities provided at each bus stop will be determined by surrounding land uses, account for service frequency and potential patronage.	Transport for NSW, Developer
2.7 Public Transport for Business travel	The commercial space tenants can promote public transport as the first preference for business travel. This should be supported by employees having access to travel passes.	Subject to owner/tenant negotiations and incentives.	Commercial tenants
3 Promoting Cycling			
3.1 Provide Dedicated Cycle Routes	Provision for connections for all journey purposes for employment and education, as well as leisure and recreation. The routes will be a dedicated bicycle network.	Provide a dedicated bicycle network with high quality infrastructure designed to make bicycle travel attractive, convenient, safe, and efficient for all journey purposes.	Developer

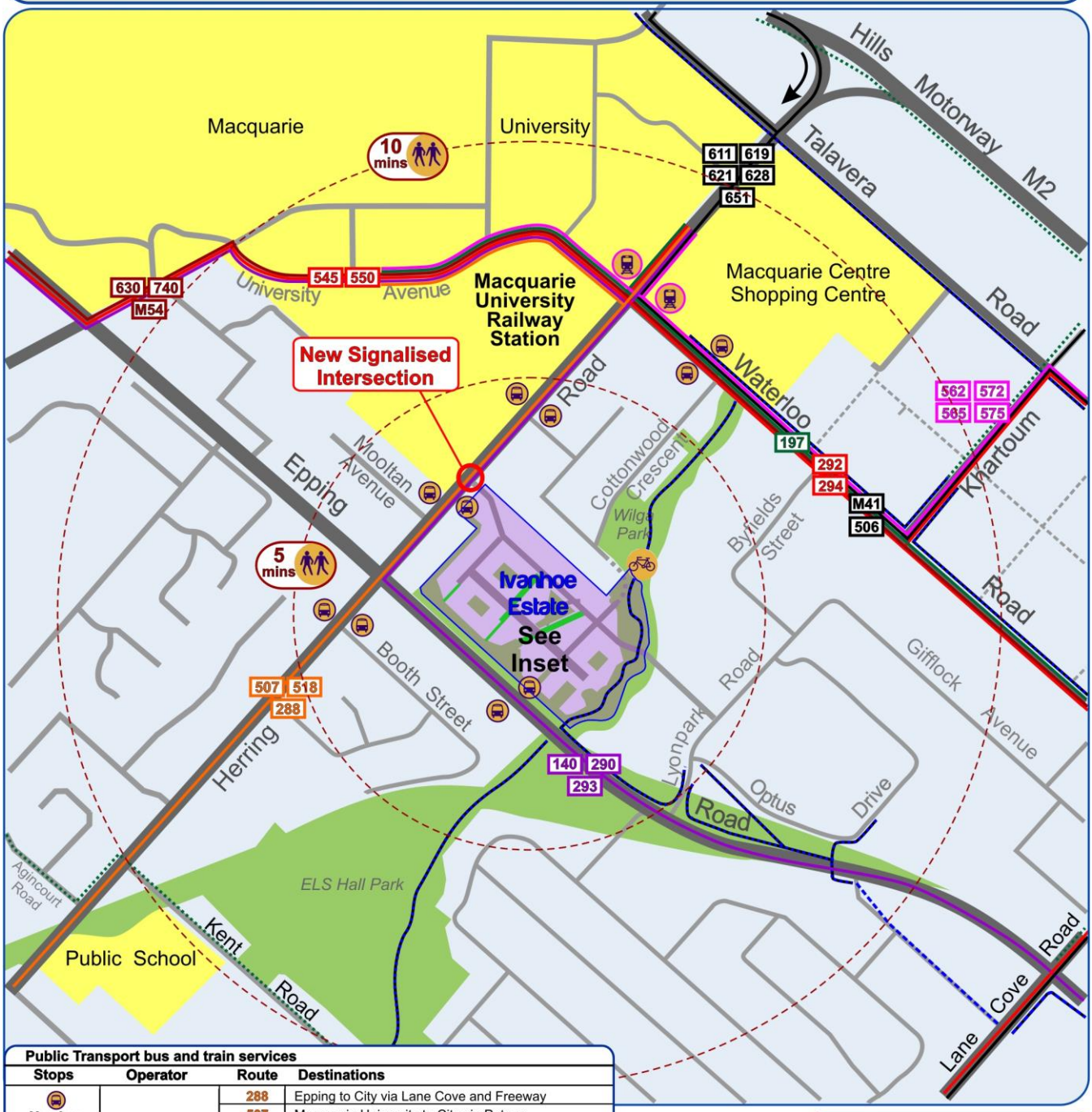
STRATEGY	HOW IT WORKS	IMPLEMENTATION	RESOURCES / RESPONSIBILITY
3.2 Bicycle Fleets	Building management staff and commercial tenant may consider having bicycle fleets which employees can use for local trips.	Utilisation of on-site bicycle parking facilities and purchase/lease of shared bicycles.	Building management
3.3 Providing & Maintaining End of Journey Facilities	Providing facilities such as showers, change rooms, lockers.	Bicycle parking spaces will be provided for residents and staff. Commercial tenant will provide access to other facilities such as showers.	Developer, commercial tenant
3.4 Bicycle Fleets	Building management staff and commercial tenant may consider having bicycle fleets which employees can use for local trips.	Utilisation of on-site bicycle parking facilities and purchase/lease of shared bicycles.	Building management
3.5 Promote Bicycle User Groups	Set up dedicated Bicycle User Group (BUG) for Ivanhoe Estate to encourage bicycle use and promote bicycle rides and initiatives.	Encourage the local community to set up a dedicated Bicycle User Group (BUG) for Ivanhoe Estate, or join an existing BUG which is active in the local area.	Developer, local BUGs
3.6 Promote Bicycle Initiatives	Promotion of bicycle initiatives – NSW bicycle week, cycle to work day etc.	In addition to a local BUG, promote and encourage cycling in the precinct. Local schools, businesses and councils should actively participate in recognised NSW government bicycle initiatives such as bicycle week and cycle to work day.	Local schools, businesses, City of Ryde Council
3.7 Provide Cycle Training	Encourages those who wouldn't previously consider cycle as a mode choice to do so.		Developer/Employer
4 Promoting Walking			
4.1 Provide a Pedestrian Network	Provision of a high quality, highly permeable pedestrian network throughout Ivanhoe Estate.	Design and construct continuous pedestrian footpaths and pedestrian crossing facilities at key locations. Limit delays to walk trips and make them pleasant convenient, direct, and integrated with land uses. Consider safety in design to provide well-lit links for safety and ambience to encourage pedestrian travel.	Developer
4.2 Providing End of Journey Facilities	Provision of sufficient end of trip facilities such, showers, change rooms, lockers etc to maximise pedestrian activity throughout the site and the wider precinct.	Provide pedestrian facilities and amenities in close proximity to schools and sports facilities, in the Site and at the rail station.	Developer, commercial tenants
4.3 Walking School Bus	Groups of children will walk to school with one or more adults to overcome parents' safety fears and reluctance to allow them to walk to school.	The proposed high school in Ivanhoe Estate will be encouraged to implement a walking bus program. These types of programs can also lead to a mindset which encourages active travel throughout life for both children and parents for other journeys, and is as educational and supportive of behavioural change as it is practical.	Schools, residents

STRATEGY	HOW IT WORKS	IMPLEMENTATION	RESOURCES / RESPONSIBILITY
5 Restraining Parking			
5.1 Reduce Residential Parking Rates	Restrain parking requirements for the Site high density residential apartments to account for the availability of other travel options.	The high density residential development in the Site will have very good access by public transport, as well as good quality pedestrian and cycle networks, and a good range of local shops, services and facilities in close proximity, thereby reducing residents need to own and operate a car.	Developer
5.2 Site Co-sharing Parking	Provision of co-ordinated and shared parking in the Site.	Provide parking in the Site that is co-ordinated and where possible shared across multiple land uses or shared between retail and commuter parking that don't have similar peak parking demands.	Developer, Employers, Councils
5.3 Transport Access Guide	Provide residents and staff with a Transport Access Guide (Appendix A) and advise them of the transport options available in the area.	Keep a copy of the Transport Access Guide current, relevant, useful and accessible. The TAG should be clearly displayed in communal areas.	Building management
6 Influencing Travel Behaviour			
6.1 Provision of Sustainable Travel Packs to Residents	Introduces residents to the GTP and provides information on walking and cycling routes, and travel by bus & train. Contact details for who is responsible for the GTP will also be provided	To be provided on first occupation of dwellings	Developer
6.2 Promotional Free Travel	Providing the option to work remotely means there will be fewer vehicles on the road.	Manage staff rosters, and develop work-from-home policies and procedures, where possible.	Employers
6.3 Transport Access Guide	Provide residents and staff with a Transport Access Guide advising them of the transport options available in the area.	Keep a copy of the Transport Access Guide current, relevant, useful and accessible. The TAG should be clearly displayed in communal areas.	Building management, employers
6.4 Sustainable Home Deliveries Guide	Encourage sustainable home deliveries of groceries using local producers.	Adopt sustainable practices for deliveries and sustainable principles in local food production to reduce peoples' need to travel (for shopping) and hence reduce travel demand for residents, whilst also reducing the transport of food produce.	Developer, local community organisations

Appendix A

Transport Access Guide

Transport Access Guide: Ivanhoe Estate, Macquarie Park



Public Transport bus and train services

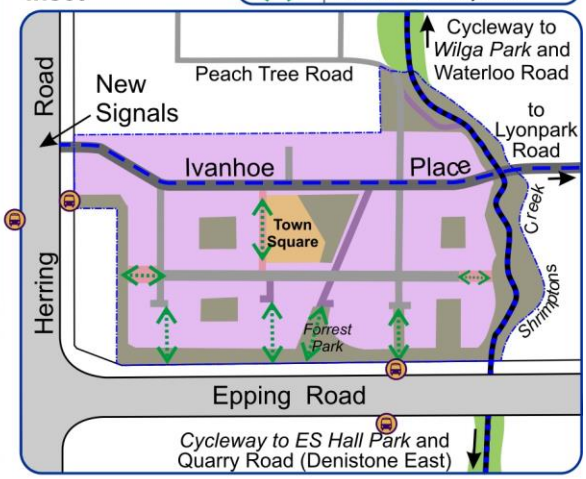
Stops	Operator	Route	Destinations
Herring Road	Sydney Buses	288	Epping to City via Lane Cove and Freeway
		507	Macquarie University to City via Putney
		518	Macquarie University to City via Drummoyne
Epping Road and Herring Road		140	Epping to Manly
		290	Epping to City via Pacific Highway
		293	Marsfield to City via Lane Cove Tunnel
		292	Marsfield to City via Freeway
		294	Macquarie University to City via Freeway
		506	Macquarie University to City via Hunters Hill
		545 550	Chatswood to Parramatta
		M41	Metrobus Macquarie Centre to Hurstville
		M54	Metrobus Macquarie University to Parramatta
Waterloo Road	Hillsbus	611 630	Macquarie Park to Blacktown
		619 628	Macquarie Park to Rouse Hill via Castle Hill / Norwest
		621 651	Castle Hill to City
	Busways	740	Macquarie Park to Plumpton via M2 Motorway
	Forest Coachlines	197	Macquarie University to Mona Vale
	Transdev ShoreLink	562	Macquarie University to Gordo
		565	Macquarie University to Chatswood
		572	Macquarie University to Turramurra Station
		575	Macquarie University to Hornsby

Macquarie University Railway Station	Sydney Trains	T1 Northern Shore, Northern and Western Line	Hornsby to Emu Plains and Richmond via Chatswood
	Sydney Metro	Stage 1: NorthWest (2019)	Cudgegong Road to Chatswood
		Stage 2: City & SouthWest (2024)	Chatswood to Sydenham and Bankstown

Active Transport cycle routes

	Shared Off-Road Bike Path
	On-Road Bike Lanes
	Informal On-Road Bike Routes
	Pedestrian Pathway Links

Inset



Appendix E

SIDRA Outputs

MOVEMENT SUMMARY

Site: 101 [Herring Road/Epping Road_Existing AM_ 2016]

Network: N101 [AM]

Epping Road - Herring Road
Existing
Signals - Fixed Time Isolated Cycle Time = 149 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Herring Road S (250m)													
1	L2	18	0.0	18	0.0	0.662	54.6	LOS D	23.1	165.6	0.94	0.82	32.1
2	T1	544	2.7	544	2.7	0.662	47.2	LOS D	23.1	165.6	0.90	0.77	15.6
3	R2	337	1.6	337	1.6	1.239	301.2	LOS F	57.1	405.3	1.00	1.55	13.5
Approach		899	2.2	899	2.2	1.239	142.5	LOS F	57.1	405.3	0.94	1.06	14.1
East: Epping Road E (1200m)													
4	L2	106	2.0	106	2.0	0.719	59.9	LOS E	19.3	136.8	0.98	0.86	39.4
5	T1	821	1.5	821	1.5	0.719	56.4	LOS D	21.3	151.3	0.98	0.85	43.6
6	R2	611	2.9	611	2.9	1.246	304.6	LOS F	50.6	362.9	1.00	1.46	11.6
Approach		1538	2.1	1538	2.1	1.246	155.2	LOS F	50.6	362.9	0.99	1.09	23.3
North: Herring Road N (200m)													
7	L2	293	4.7	293	4.7	0.179	6.2	LOS A	1.6	11.4	0.13	0.59	61.5
8	T1	186	6.2	186	6.2	0.401	61.8	LOS E	7.8	57.2	0.95	0.76	18.3
9	R2	131	1.6	131	1.6	0.401	67.8	LOS E	6.9	50.6	0.95	0.78	25.9
Approach		609	4.5	609	4.5	0.401	36.4	LOS C	7.8	57.2	0.55	0.68	39.1
West: Epping Road W (600m)													
10	L2	575	1.5	575	1.5	0.318	6.7	LOS A	0.0	0.0	0.00	0.57	58.0
11	T1	1616	1.8	1616	1.8	1.254	300.1	LOS F	92.3	655.8	1.00	1.87	16.2
12	R2	31	0.0	31	0.0	0.123	64.5	LOS E	1.9	13.4	0.89	0.73	27.8
Approach		2221	1.7	2221	1.7	1.254	221.0	LOS F	92.3	655.8	0.74	1.52	17.6
All Vehicles		5267	2.2	5267	2.2	1.254	167.0	LOS F	92.3	655.8	0.82	1.22	19.7

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Largest change in Average Back of Queue or Degree of Saturation for any lane during the last three iterations: 0.1 %
Number of Iterations: 6 (maximum specified: 10)

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P1	South Full Crossing	53	55.1	LOS E	0.2	0.2	0.86	0.86
P2	East Full Crossing	53	68.8	LOS F	0.2	0.2	0.96	0.96
P3	North Full Crossing	53	58.6	LOS E	0.2	0.2	0.89	0.89
P4	West Full Crossing	53	52.5	LOS E	0.2	0.2	0.84	0.84
All Pedestrians		211	58.8	LOS E			0.89	0.89

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: 101 [Herring Road/Ivanhoe Place_Existing AM_2016]

Network: N101 [AM]

Herring Road_Ivanhoe Place
Existing
Roundabout

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Herring Road (180m)													
1	L2	5	0.0	5	0.0	0.602	4.2	LOS A	5.0	35.8	0.17	0.36	29.5
2	T1	1877	2.0	1757	2.0	0.602	3.9	LOS A	5.0	35.8	0.18	0.37	44.0
3	R2	1	0.0	1	0.0	0.602	9.2	LOS A	4.5	32.3	0.18	0.37	51.2
Approach		1883	2.0	1763 N1	2.0	0.602	3.9	LOS A	5.0	35.8	0.18	0.37	44.0
East: Ivanhoe Place (125m)													
4	L2	35	0.0	35	0.0	0.045	3.4	LOS A	0.2	1.1	0.35	0.48	35.3
5	T1	6	0.0	6	0.0	0.045	3.3	LOS A	0.2	1.1	0.35	0.48	19.9
6	R2	6	0.0	6	0.0	0.045	8.5	LOS A	0.2	1.1	0.35	0.48	35.3
Approach		47	0.0	47	0.0	0.045	4.0	LOS A	0.2	1.1	0.35	0.48	31.7
North: Herring Road (380m)													
7	L2	4	0.0	4	0.0	0.153	4.0	LOS A	0.8	5.6	0.08	0.36	50.9
8	T1	418	4.5	418	4.5	0.153	3.7	LOS A	0.8	5.6	0.08	0.38	51.1
9	R2	24	4.3	24	4.3	0.153	9.0	LOS A	0.7	5.3	0.08	0.40	43.1
Approach		446	4.5	446	4.5	0.153	4.0	LOS A	0.8	5.6	0.08	0.38	50.6
West: Morling College (20m)													
10	L2	1	0.0	1	0.0	0.025	7.2	LOS A	0.2	1.1	0.77	0.71	17.1
11	T1	1	0.0	1	0.0	0.025	7.5	LOS A	0.2	1.1	0.77	0.71	31.3
12	R2	15	0.0	15	0.0	0.025	11.8	LOS A	0.2	1.1	0.77	0.71	17.1
Approach		17	0.0	17	0.0	0.025	11.2	LOS A	0.2	1.1	0.77	0.71	18.3
All Vehicles		2394	2.4	2274 N1	2.5	0.602	4.0	LOS A	5.0	35.8	0.17	0.37	45.5

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Largest change in Average Back of Queue or Degree of Saturation for any lane during the last three iterations: 0.1 %
Number of Iterations: 6 (maximum specified: 10)

N1 Arrival Flow value is reduced due to capacity constraint at oversaturated upstream lanes.

MOVEMENT SUMMARY

Site: 101 [Herring Road/Waterloo Road_Existing AM_2016] Network: N101 [AM]

Herring Road_Waterloo Road
Existing
Signals - Fixed Time Isolated Cycle Time = 139 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Herring Road (380m)													
1	L2	115	1.8	107	1.8	1.983	955.9	LOS F	30.0	213.0	1.00	1.44	2.5
2	T1	739	2.7	692	2.6	0.951	62.1	LOS E	52.2	373.6	0.88	1.01	24.7
3	R2	806	1.4	755	1.4	0.936	66.6	LOS E	22.3	157.8	1.00	1.06	15.9
Approach		1660	2.0	1555N1	2.0	1.983	126.1	LOS F	52.2	373.6	0.95	1.06	12.5
East: Waterloo Road (380m)													
4	L2	212	1.5	212	1.5	0.281	21.8	LOS B	6.3	44.7	0.71	0.76	31.3
5	T1	147	1.4	147	1.4	0.530	60.4	LOS E	9.4	66.7	0.98	0.79	25.1
6	R2	138	44.3	138	44.3	0.799	77.4	LOS F	10.0	96.4	1.00	0.91	21.3
Approach		497	13.3	497	13.3	0.799	48.7	LOS D	10.0	96.4	0.87	0.81	25.0
North: Herring Road (320m)													
7	L2	126	39.2	126	39.2	0.730	74.1	LOS F	8.8	82.7	1.00	0.86	12.9
8	T1	224	7.0	224	7.0	0.209	39.3	LOS C	5.7	42.0	0.79	0.64	20.6
9	R2	86	47.6	86	47.6	0.865	87.8	LOS F	6.7	65.6	1.00	0.95	18.4
Approach		437	24.3	437	24.3	0.865	58.9	LOS E	8.8	82.7	0.89	0.77	17.4
West: Waterloo Road (320m)													
10	L2	87	54.2	87	54.2	0.713	68.3	LOS E	11.7	101.4	1.00	0.87	22.5
11	T1	299	1.4	299	1.4	0.777	64.8	LOS E	14.7	104.1	1.00	0.89	14.4
12	R2	69	1.5	69	1.5	0.314	66.8	LOS E	4.4	31.1	0.95	0.76	14.0
Approach		456	11.5	456	11.5	0.777	65.8	LOS E	14.7	104.1	0.99	0.87	16.2
All Vehicles		3049	8.5	2944N1	8.8	1.983	93.7	LOS F	52.2	373.6	0.93	0.95	14.8

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Largest change in Average Back of Queue or Degree of Saturation for any lane during the last three iterations: 0.1 %
Number of Iterations: 6 (maximum specified: 10)

N1 Arrival Flow value is reduced due to capacity constraint at oversaturated upstream lanes.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P1	South Full Crossing	53	63.8	LOS F	0.2	0.2	0.96	0.96
P2	East Full Crossing	53	46.9	LOS E	0.2	0.2	0.82	0.82
P3	North Full Crossing	53	63.8	LOS F	0.2	0.2	0.96	0.96
P4	West Full Crossing	53	24.8	LOS C	0.1	0.1	0.60	0.60
All Pedestrians		211	49.8	LOS E			0.83	0.83

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: 101 [Waterloo Road_Byfield Sreet_Existing AM_2016]

Network: N101 [AM]

Waterloo Road_Byfield Sreet
Existing
Roundabout

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Byfield Sreet (350m)													
1	L2	83	1.3	83	1.3	0.078	5.4	LOS A	0.5	3.8	0.70	0.60	41.2
3	R2	69	1.5	69	1.5	0.087	11.5	LOS A	0.5	3.9	0.71	0.73	41.5
Approach		153	1.4	153	1.4	0.087	8.2	LOS A	0.5	3.9	0.71	0.66	41.4
East: Waterloo Road (155m)													
4	L2	542	1.6	542	1.6	0.430	4.9	LOS A	4.2	30.1	0.42	0.48	45.1
5	T1	625	10.9	625	10.9	0.430	4.8	LOS A	4.2	30.1	0.44	0.44	38.5
Approach		1167	6.6	1167	6.6	0.430	4.9	LOS A	4.2	31.0	0.43	0.46	42.9
West: Waterloo Road (380m)													
11	T1	882	7.3	846	7.5	0.341	4.4	LOS A	2.5	18.6	0.23	0.44	51.5
12	R2	126	1.7	121	1.7	0.341	9.1	LOS A	2.4	17.8	0.24	0.49	50.3
Approach		1008	6.6	967 N1	6.8	0.341	5.0	LOS A	2.5	18.6	0.23	0.45	51.3
All Vehicles		2328	6.2	2287 N1	6.4	0.430	5.1	LOS A	4.2	31.0	0.37	0.47	47.0

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Largest change in Average Back of Queue or Degree of Saturation for any lane during the last three iterations: 0.1 %
Number of Iterations: 6 (maximum specified: 10)

N1 Arrival Flow value is reduced due to capacity constraint at oversaturated upstream lanes.

MOVEMENT SUMMARY

Site: 101 [Herring Road/Epping Road_Existing PM _2016]

Network: N101 [PM]

Epping Road - Herring Road
Existing
Signals - Fixed Time Isolated Cycle Time = 149 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Herring Road S (250m)													
1	L2	46	0.0	46	0.0	0.896	83.4	LOS F	20.5	146.9	1.00	1.02	24.6
2	T1	402	3.4	402	3.4	0.896	78.7	LOS F	20.5	146.9	1.00	1.02	10.4
3	R2	122	1.7	122	1.7	0.662	73.4	LOS F	8.8	62.4	1.00	0.84	34.5
Approach		571	2.8	571	2.8	0.896	77.9	LOS F	20.5	146.9	1.00	0.98	18.9
East: Epping Road E (1200m)													
4	L2	281	1.5	281	1.5	0.974	96.2	LOS F	56.4	399.9	1.00	1.16	30.9
5	T1	1606	1.6	1606	1.6	0.974	88.3	LOS F	60.4	428.9	1.00	1.16	36.0
6	R2	386	3.3	386	3.3	0.971	111.8	LOS F	18.1	130.3	1.00	1.05	25.2
Approach		2274	1.9	2274	1.9	0.974	93.3	LOS F	60.4	428.9	1.00	1.14	33.6
North: Herring Road N (200m)													
7	L2	274	5.0	274	5.0	0.169	6.2	LOS A	1.6	11.6	0.13	0.59	61.5
8	T1	575	2.6	575	2.6	0.986	104.4	LOS F	39.6	283.0	1.00	1.20	12.4
9	R2	496	1.5	496	1.5	0.986	113.6	LOS F	33.8	241.0	1.00	1.13	18.4
Approach		1344	2.7	1344	2.7	0.986	87.8	LOS F	39.6	283.0	0.82	1.05	21.3
West: Epping Road W (600m)													
10	L2	323	1.6	323	1.6	0.179	6.7	LOS A	0.0	0.0	0.00	0.57	58.1
11	T1	931	1.5	931	1.5	0.477	40.9	LOS C	17.8	126.2	0.84	0.72	48.8
12	R2	85	1.2	85	1.2	0.425	72.7	LOS F	5.9	41.5	0.97	0.78	25.9
Approach		1339	1.5	1339	1.5	0.477	34.7	LOS C	17.8	126.2	0.64	0.69	48.0
All Vehicles		5527	2.1	5527	2.1	0.986	76.2	LOS F	60.4	428.9	0.87	0.99	32.4

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Largest change in Average Back of Queue or Degree of Saturation for any lane during the last three iterations: 3.4 %
Number of Iterations: 10 (maximum specified: 10)

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P1	South Full Crossing	53	41.4	LOS E	0.2	0.2	0.75	0.75
P2	East Full Crossing	53	64.0	LOS F	0.2	0.2	0.93	0.93
P3	North Full Crossing	53	44.5	LOS E	0.2	0.2	0.77	0.77
P4	West Full Crossing	53	68.8	LOS F	0.2	0.2	0.96	0.96
All Pedestrians		211	54.7	LOS E			0.85	0.85

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.

Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: 101 [Herring Road/Ivanhoe Place_Existing PM_2016]

Network: N101 [PM]

Herring Road_Ivanhoe Place
Existing
Roundabout

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Herring Road (180m)													
1	L2	4	0.0	4	0.0	0.564	4.6	LOS A	4.4	31.8	0.25	0.39	27.7
2	T1	1098	2.5	1098	2.5	0.564	4.2	LOS A	4.4	31.8	0.24	0.39	43.1
3	R2	1	0.0	1	0.0	0.564	9.5	LOS A	1.3	9.6	0.20	0.40	50.8
Approach		1103	2.5	1103	2.5	0.564	4.2	LOS A	4.4	31.8	0.24	0.39	43.0
East: Ivanhoe Place (125m)													
4	L2	33	3.2	33	3.2	0.109	7.8	LOS A	0.4	3.0	0.72	0.65	28.1
5	T1	8	0.0	8	0.0	0.109	7.6	LOS A	0.4	3.0	0.72	0.65	17.8
6	R2	8	0.0	8	0.0	0.109	12.8	LOS A	0.4	3.0	0.72	0.65	28.1
Approach		49	2.1	49	2.1	0.109	8.6	LOS A	0.4	3.0	0.72	0.65	25.4
North: Herring Road (380m)													
7	L2	22	4.8	22	4.8	0.721	4.1	LOS A	2.6	18.5	0.09	0.36	50.8
8	T1	1285	2.4	1285	2.4	0.721	3.7	LOS A	4.2	29.9	0.10	0.38	51.0
9	R2	68	1.5	68	1.5	0.721	9.0	LOS A	4.2	29.9	0.10	0.39	43.1
Approach		1376	2.4	1376	2.4	0.721	4.0	LOS A	4.2	29.9	0.10	0.38	50.5
West: Morling College (20m)													
10	L2	6	0.0	6	0.0	0.034	5.4	LOS A	0.2	1.1	0.69	0.66	18.8
11	T1	1	0.0	1	0.0	0.034	5.7	LOS A	0.2	1.1	0.69	0.66	35.1
12	R2	13	0.0	13	0.0	0.034	10.0	LOS A	0.2	1.1	0.69	0.66	18.8
Approach		20	0.0	20	0.0	0.034	8.3	LOS A	0.2	1.1	0.69	0.66	20.0
All Vehicles		2548	2.4	2548	2.4	0.721	4.2	LOS A	4.4	31.8	0.17	0.39	47.5

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Largest change in Average Back of Queue or Degree of Saturation for any lane during the last three iterations: 3.4 %
Number of Iterations: 10 (maximum specified: 10)

MOVEMENT SUMMARY

Site: 101 [Herring Road/Waterloo Road Existing PM_2016] Network: N101 [PM]

Herring Road_Waterloo Road
Existing
Signals - Fixed Time Isolated Cycle Time = 139 seconds (User-Given Phase Times)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Herring Road (380m)													
1	L2	35	3.0	35	3.0	1.368	374.6	LOS F	11.9	85.5	1.00	1.23	5.5
2	T1	665	3.0	665	3.0	1.368	392.5	LOS F	86.4	620.1	1.00	2.32	5.7
3	R2	418	1.5	418	1.5	0.803	73.2	LOS F	14.7	104.4	1.00	0.89	14.8
Approach		1118	2.4	1118	2.4	1.368	272.6	LOS F	86.4	620.1	1.00	1.76	6.8
East: Waterloo Road (380m)													
4	L2	735	1.4	735	1.4	0.776	42.0	LOS C	28.9	204.8	0.84	0.84	21.9
5	T1	96	1.1	96	1.1	0.776	45.9	LOS D	28.9	204.8	0.97	0.88	27.7
6	R2	169	37.3	169	37.3	0.730	69.7	LOS E	11.6	106.7	1.00	0.87	22.8
Approach		1000	7.5	1000	7.5	0.776	47.0	LOS D	28.9	204.8	0.88	0.84	22.8
North: Herring Road (320m)													
7	L2	105	57.0	105	57.0	0.517	65.7	LOS E	6.8	70.4	0.96	0.80	14.2
8	T1	619	3.4	619	3.4	0.730	51.1	LOS D	19.4	140.0	0.96	0.83	17.2
9	R2	105	42.0	105	42.0	0.512	67.0	LOS E	6.8	64.7	0.97	0.80	21.9
Approach		829	15.1	829	15.1	0.730	55.0	LOS D	19.4	140.0	0.96	0.82	17.6
West: Waterloo Road (320m)													
10	L2	128	36.1	128	36.1	0.454	48.2	LOS D	11.6	97.0	0.86	0.78	27.4
11	T1	340	1.5	340	1.5	0.494	44.7	LOS D	14.6	103.5	0.89	0.76	18.8
12	R2	92	1.1	92	1.1	0.319	62.1	LOS E	5.6	39.4	0.93	0.77	14.8
Approach		560	9.4	560	9.4	0.494	48.4	LOS D	14.6	103.5	0.89	0.77	20.4
All Vehicles		3507	8.0	3507	8.0	1.368	121.0	LOS F	86.4	620.1	0.94	1.12	11.4

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Largest change in Average Back of Queue or Degree of Saturation for any lane during the last three iterations: 3.4 %
Number of Iterations: 10 (maximum specified: 10)

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P1	South Full Crossing	53	51.1	LOS E	0.2	0.2	0.86	0.86
P2	East Full Crossing	53	51.9	LOS E	0.2	0.2	0.87	0.87
P3	North Full Crossing	53	49.3	LOS E	0.2	0.2	0.84	0.84
P4	West Full Crossing	53	48.5	LOS E	0.2	0.2	0.84	0.84
All Pedestrians		211	50.2	LOS E			0.85	0.85

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.

Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: 101 [Waterloo Road_Byfield Sreet_Existing PM_2016]

Network: N101 [PM]

Waterloo Road_Byfield Sreet
Existing
Roundabout

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Byfield Sreet (350m)													
1	L2	403	1.6	403	1.6	0.428	7.9	LOS A	3.6	25.7	0.90	0.82	38.5
3	R2	186	1.7	186	1.7	0.276	14.0	LOS A	1.9	13.6	0.84	0.86	39.4
Approach		589	1.6	589	1.6	0.428	9.9	LOS A	3.6	25.7	0.88	0.84	38.9
East: Waterloo Road (155m)													
4	L2	148	1.4	148	1.4	0.348	4.7	LOS A	3.0	22.1	0.38	0.44	45.3
5	T1	788	9.1	788	9.1	0.348	4.5	LOS A	3.0	22.1	0.39	0.43	39.1
Approach		937	7.9	937	7.9	0.348	4.5	LOS A	3.0	22.1	0.39	0.43	41.1
West: Waterloo Road (380m)													
11	T1	1094	6.8	1094	6.8	0.492	5.4	LOS A	4.1	30.5	0.49	0.54	49.9
12	R2	105	2.0	105	2.0	0.492	10.2	LOS A	3.9	28.9	0.50	0.57	49.4
Approach		1199	6.4	1199	6.4	0.492	5.8	LOS A	4.1	30.5	0.49	0.54	49.9
All Vehicles		2725	5.9	2725	5.9	0.492	6.2	LOS A	4.1	30.5	0.54	0.57	45.2

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Largest change in Average Back of Queue or Degree of Saturation for any lane during the last three iterations: 3.4 %
Number of Iterations: 10 (maximum specified: 10)

MOVEMENT SUMMARY

Site: 101 [AM_Herring_Epping _2021 RMS] Network: N101 [RMS AM - updated]

Epping Road - Herring Road
RMS Base 2021
Signals - Fixed Time Isolated Cycle Time = 149 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Herring Road S (250m)													
1	L2	15	0.0	15	0.0	1.014	109.0	LOS F	27.9	199.5	1.00	1.19	17.4
2	T1	631	2.5	631	2.5	1.014	113.0	LOS F	33.4	238.7	1.00	1.23	6.9
3	R2	349	1.5	349	1.5	0.724	67.5	LOS E	11.9	84.3	0.96	0.84	35.9
Approach		995	2.1	995	2.1	1.014	96.9	LOS F	33.4	238.7	0.98	1.09	17.4
East: Epping Road E (1200m)													
4	L2	107	2.0	107	2.0	0.428	33.6	LOS C	16.8	119.5	0.72	0.69	49.2
5	T1	1018	1.6	1018	1.6	0.428	28.0	LOS B	18.3	129.5	0.72	0.65	53.7
6	R2	381	3.6	381	3.6	1.015	132.4	LOS F	19.7	142.3	1.00	1.12	22.5
Approach		1506	2.1	1506	2.1	1.015	54.8	LOS D	19.7	142.3	0.79	0.77	42.4
North: Herring Road N (200m)													
7	L2	168	7.5	168	7.5	0.174	22.7	LOS B	5.8	43.4	0.53	0.71	51.3
8	T1	233	5.4	233	5.4	0.396	61.7	LOS E	7.7	56.3	0.95	0.76	18.5
9	R2	145	2.2	145	2.2	0.257	65.8	LOS E	4.7	33.4	0.92	0.76	26.1
Approach		546	5.2	546	5.2	0.396	50.7	LOS D	7.7	56.3	0.81	0.74	31.0
West: Epping Road W (600m)													
10	L2	577	1.5	577	1.5	0.489	13.6	LOS A	15.3	108.3	0.49	0.74	49.2
11	T1	2127	1.7	2127	1.7	1.015	108.5	LOS F	80.1	568.7	1.00	1.28	32.4
12	R2	23	0.0	23	0.0	0.310	86.2	LOS F	1.7	12.2	1.00	0.71	23.4
Approach		2727	1.6	2727	1.6	1.015	88.2	LOS F	80.1	568.7	0.89	1.16	33.3
All Vehicles		5775	2.2	5775	2.2	1.015	77.5	LOS F	80.1	568.7	0.87	1.01	32.7

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Largest change in Average Back of Queue or Degree of Saturation for any lane during the last three iterations: 10.8 %
Number of Iterations: 10 (maximum specified: 10)

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P1	South Full Crossing	53	31.0	LOS D	0.1	0.1	0.65	0.65
P2	East Full Crossing	53	68.8	LOS F	0.2	0.2	0.96	0.96
P3	North Full Crossing	53	39.2	LOS D	0.2	0.2	0.73	0.73
P4	West Full Crossing	53	67.8	LOS F	0.2	0.2	0.96	0.96
All Pedestrians		211	51.7	LOS E			0.82	0.82

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: 102 [AM_Herring_Ivanhoe 2021 RMS] Network: N101 [RMS AM - updated]

Herring Road_Ivanhoe Place
RMS Base 2021
Signals - Fixed Time Isolated Cycle Time = 75 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Herring Road (180m)													
1	L2	1	0.0	1	0.0	0.020	17.7	LOS B	0.2	2.9	0.57	0.42	17.7
2	T1	1503	2.2	1488	2.2	0.815	22.8	LOS B	25.9	183.5	0.93	0.91	20.4
3	R2	1	0.0	1	0.0	0.007	40.7	LOS C	0.0	0.3	0.94	0.58	19.1
Approach		1505	2.2	1490 N1	2.2	0.815	22.8	LOS B	25.9	183.5	0.93	0.91	20.4
East: Ivanhoe Place (125m)													
4	L2	1	0.0	1	0.0	0.004	15.1	LOS B	0.0	0.2	0.71	0.52	23.1
5	T1	1	0.0	1	0.0	0.004	10.6	LOS A	0.0	0.2	0.71	0.52	27.8
6	R2	1	0.0	1	0.0	0.003	24.9	LOS B	0.0	0.2	0.80	0.48	4.1
Approach		3	0.0	3	0.0	0.004	16.8	LOS B	0.0	0.2	0.74	0.51	10.2
North: Herring Road (380m)													
7	L2	1	0.0	1	0.0	0.023	17.7	LOS B	0.3	3.2	0.57	0.42	40.7
8	T1	512	3.7	512	3.7	0.275	13.7	LOS A	5.7	40.4	0.66	0.56	38.0
9	R2	23	0.0	23	0.0	0.150	42.3	LOS C	0.8	5.9	0.96	0.70	23.3
Approach		536	3.5	536	3.5	0.275	15.0	LOS B	5.7	40.4	0.67	0.56	36.8
West: Morling College (70m)													
10	L2	8	0.0	8	0.0	0.015	22.4	LOS B	0.2	1.6	0.69	0.62	11.2
11	T1	1	0.0	1	0.0	0.015	17.9	LOS B	0.2	1.6	0.69	0.62	20.6
12	R2	21	0.0	21	0.0	0.061	30.3	LOS C	0.6	4.4	0.83	0.68	9.1
Approach		31	0.0	31	0.0	0.061	27.7	LOS B	0.6	4.4	0.78	0.66	10.0
All Vehicles		2075	2.5	2059 N1	2.5	0.815	20.9	LOS B	25.9	183.5	0.86	0.81	24.9

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Largest change in Average Back of Queue or Degree of Saturation for any lane during the last three iterations: 10.8 %
Number of Iterations: 10 (maximum specified: 10)

N1 Arrival Flow value is reduced due to capacity constraint at oversaturated upstream lanes.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P1	South Full Crossing	53	31.8	LOS D	0.1	0.1	0.92	0.92
P2	East Full Crossing	53	18.8	LOS B	0.1	0.1	0.71	0.71
P3	North Full Crossing	53	31.8	LOS D	0.1	0.1	0.92	0.92
P4	West Full Crossing	53	18.1	LOS B	0.1	0.1	0.69	0.69
All Pedestrians		211	25.1	LOS C			0.81	0.81

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: 103 [AM_Herring_Waterloo _2021 RMS] Network: N101 [RMS AM - updated]

Herring Road_Waterloo Road
RMS Base 2021
Signals - Fixed Time Isolated Cycle Time = 139 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Herring Road (380m)													
1	L2	126	1.7	125	1.7	0.136	14.1	LOS A	3.0	22.6	0.47	0.64	44.9
2	T1	826	2.7	818	2.7	0.539	31.7	LOS C	21.3	150.9	0.79	0.70	34.9
3	R2	651	1.5	644	1.5	0.364	18.1	LOS B	8.2	58.2	0.66	0.75	34.4
Approach		1603	2.1	1587 N1	2.1	0.539	24.7	LOS B	21.3	150.9	0.71	0.72	35.5
East: Waterloo Road (380m)													
4	L2	332	1.6	332	1.6	0.368	18.1	LOS B	8.5	60.0	0.66	0.76	34.1
5	T1	132	1.6	132	1.6	0.368	41.7	LOS C	6.1	43.6	0.77	0.68	30.7
6	R2	180	34.5	180	34.5	0.535	69.3	LOS E	7.8	55.7	0.98	0.79	23.1
Approach		643	10.8	643	10.8	0.535	37.3	LOS C	8.5	60.0	0.77	0.75	28.3
North: Herring Road (320m)													
7	L2	123	40.2	123	40.2	0.352	29.8	LOS C	4.9	47.7	0.84	0.76	25.3
8	T1	216	7.3	216	7.3	0.352	47.1	LOS D	5.7	40.5	0.87	0.70	18.7
9	R2	111	37.1	111	37.1	0.523	67.0	LOS E	7.1	65.9	0.97	0.80	22.2
Approach		449	23.7	449	23.7	0.523	47.1	LOS D	7.1	65.9	0.89	0.74	21.1
West: Waterloo Road (320m)													
10	L2	121	39.1	121	39.1	0.275	44.2	LOS D	6.1	57.4	0.79	0.77	27.9
11	T1	278	1.5	278	1.5	0.508	60.2	LOS E	8.9	62.8	0.97	0.78	15.5
Approach		399	12.9	399	12.9	0.508	55.3	LOS D	8.9	62.8	0.92	0.78	19.4
All Vehicles		3095	8.4	3079 N1	8.5	0.539	34.6	LOS C	21.3	150.9	0.78	0.74	29.1

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Largest change in Average Back of Queue or Degree of Saturation for any lane during the last three iterations: 10.8 %
Number of Iterations: 10 (maximum specified: 10)

N1 Arrival Flow value is reduced due to capacity constraint at oversaturated upstream lanes.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P1	South Full Crossing	53	49.3	LOS E	0.2	0.2	0.84	0.84
P2	East Full Crossing	53	59.1	LOS E	0.2	0.2	0.92	0.92
P3	North Full Crossing	53	63.8	LOS F	0.2	0.2	0.96	0.96
P4	West Full Crossing	53	31.2	LOS D	0.1	0.1	0.67	0.67
All Pedestrians		211	50.8	LOS E			0.85	0.85

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.

Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: 104 [AM_Waterloo Road_Byfield Sreet_2021 RMS]

Network: N101 [RMS AM - updated]

Waterloo Road_Byfield Sreet
RMS Base 2021
Signals - Fixed Time Isolated Cycle Time = 139 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Byfield Sreet (350m)													
1	L2	198	1.6	198	1.6	0.186	5.8	LOS A	1.8	13.1	0.20	0.57	41.1
3	R2	43	2.4	43	2.4	0.075	58.2	LOS E	1.2	8.9	0.88	0.70	19.6
Approach		241	1.7	241	1.7	0.186	15.2	LOS B	1.8	13.1	0.32	0.59	32.7
East: Waterloo Road (155m)													
4	L2	31	3.4	31	3.4	0.110	17.0	LOS B	2.5	27.2	0.43	0.42	37.9
5	T1	604	11.3	604	11.3	0.239	13.1	LOS A	8.5	60.5	0.49	0.42	26.2
Approach		635	10.9	635	10.9	0.239	13.2	LOS A	8.5	60.5	0.48	0.42	27.3
West: Waterloo Road (380m)													
11	T1	667	9.1	664	9.2	0.208	5.1	LOS A	5.8	41.4	0.31	0.27	52.0
12	R2	147	1.4	146	1.4	0.239	11.7	LOS A	2.7	19.3	0.42	0.67	44.2
Approach		815	7.8	810 N1	7.8	0.239	6.3	LOS A	5.8	41.4	0.33	0.34	50.0
All Vehicles		1691	8.1	1686 N1	8.1	0.239	10.2	LOS A	8.5	60.5	0.39	0.41	41.1

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Largest change in Average Back of Queue or Degree of Saturation for any lane during the last three iterations: 10.8 %
Number of Iterations: 10 (maximum specified: 10)

N1 Arrival Flow value is reduced due to capacity constraint at oversaturated upstream lanes.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P1	South Full Crossing	53	63.8	LOS F	0.2	0.2	0.96	0.96
P4	West Full Crossing	53	63.8	LOS F	0.2	0.2	0.96	0.96
All Pedestrians		105	63.8	LOS F			0.96	0.96

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: 101 [PM_Herring_Epping _2021 RMS]

Network: N101 [RMS PM - updated]

Epping Road - Herring Road
RMS Base 2021
Signals - Fixed Time Isolated Cycle Time = 149 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Herring Road S (250m)													
1	L2	22	0.0	22	0.0	0.897	99.9	LOS F	23.0	164.9	1.00	1.07	21.9
2	T1	549	2.9	549	2.9	0.897	86.1	LOS F	23.4	167.6	1.00	1.05	9.7
3	R2	163	1.3	163	1.3	0.264	64.0	LOS E	5.2	36.7	0.91	0.77	36.8
Approach		735	2.4	735	2.4	0.897	81.7	LOS F	23.4	167.6	0.98	0.98	17.8
East: Epping Road E (1200m)													
4	L2	324	1.6	324	1.6	0.904	65.5	LOS E	46.3	328.2	1.00	1.02	37.5
5	T1	1565	1.6	1565	1.6	0.904	59.8	LOS E	50.1	355.6	1.00	1.01	42.6
6	R2	365	3.5	365	3.5	0.907	92.7	LOS F	15.3	110.4	1.00	0.97	28.4
Approach		2255	1.9	2255	1.9	0.907	66.0	LOS E	50.1	355.6	1.00	1.01	39.6
North: Herring Road N (200m)													
7	L2	279	4.9	279	4.9	0.246	10.0	LOS A	5.8	42.0	0.37	0.67	58.8
8	T1	648	2.4	648	2.4	0.890	75.4	LOS F	25.9	185.0	1.00	1.02	16.0
9	R2	488	1.9	488	1.9	0.709	67.8	LOS E	16.9	120.4	0.99	0.85	25.6
Approach		1416	2.8	1416	2.8	0.890	59.9	LOS E	25.9	185.0	0.87	0.89	26.7
West: Epping Road W (600m)													
10	L2	302	1.4	302	1.4	0.231	10.4	LOS A	5.1	35.9	0.33	0.68	52.9
11	T1	1024	1.5	1024	1.5	0.484	38.4	LOS C	19.0	134.8	0.82	0.71	49.7
12	R2	173	1.8	173	1.8	0.825	83.3	LOS F	13.3	94.6	1.00	0.90	23.9
Approach		1499	1.5	1499	1.5	0.825	37.9	LOS C	19.0	134.8	0.74	0.73	46.5
All Vehicles		5904	2.1	5904	2.1	0.907	59.3	LOS E	50.1	355.6	0.90	0.91	36.2

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Largest change in Average Back of Queue or Degree of Saturation for any lane during the last three iterations: 0.8 %
Number of Iterations: 10 (maximum specified: 10)

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P1	South Full Crossing	53	40.7	LOS E	0.2	0.2	0.74	0.74
P2	East Full Crossing	53	67.8	LOS F	0.2	0.2	0.96	0.96
P3	North Full Crossing	53	41.4	LOS E	0.2	0.2	0.75	0.75
P4	West Full Crossing	53	68.8	LOS F	0.2	0.2	0.96	0.96
All Pedestrians		211	54.7	LOS E			0.85	0.85

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.

Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: 102 [PM_Herring_Ivanhoe 2021 RMS]

Network: N101 [RMS PM - updated]

Herring Road_Ivanhoe Place
RMS Base 2021
Signals - Fixed Time Isolated Cycle Time = 75 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Herring Road (180m)													
1	L2	1	0.0	1	0.0	0.020	17.7	LOS B	0.2	2.9	0.57	0.42	17.7
2	T1	1076	2.4	1076	2.4	0.588	16.5	LOS B	14.6	103.6	0.80	0.70	25.0
3	R2	2	50.0	2	50.0	0.019	42.2	LOS C	0.1	0.7	0.94	0.61	17.8
Approach		1079	2.5	1079	2.5	0.588	16.5	LOS B	14.6	103.6	0.80	0.70	25.0
East: Ivanhoe Place (125m)													
4	L2	1	0.0	1	0.0	0.005	18.8	LOS B	0.0	0.3	0.71	0.52	19.9
5	T1	1	0.0	1	0.0	0.005	14.3	LOS A	0.0	0.3	0.71	0.52	24.6
6	R2	1	0.0	1	0.0	0.003	24.9	LOS B	0.0	0.2	0.80	0.48	4.1
Approach		3	0.0	3	0.0	0.005	19.4	LOS B	0.0	0.3	0.74	0.51	9.8
North: Herring Road (380m)													
7	L2	1	0.0	1	0.0	0.023	17.7	LOS B	0.3	3.2	0.57	0.42	40.7
8	T1	1422	2.3	1422	2.3	0.866	28.4	LOS B	28.3	200.8	0.95	1.00	27.4
9	R2	53	2.0	53	2.0	0.347	43.4	LOS D	2.0	14.0	0.98	0.74	22.9
Approach		1476	2.3	1476	2.3	0.866	29.0	LOS C	28.3	200.8	0.95	0.99	27.1
West: Morling College (70m)													
10	L2	20	0.0	20	0.0	0.031	21.2	LOS B	0.5	3.5	0.67	0.65	11.5
11	T1	1	0.0	1	0.0	0.031	16.6	LOS B	0.5	3.5	0.67	0.65	21.1
12	R2	13	0.0	13	0.0	0.039	30.1	LOS C	0.4	2.6	0.82	0.66	9.2
Approach		34	0.0	34	0.0	0.039	24.4	LOS B	0.5	3.5	0.73	0.66	10.8
All Vehicles		2592	2.4	2592	2.4	0.866	23.7	LOS B	28.3	200.8	0.88	0.87	26.3

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Largest change in Average Back of Queue or Degree of Saturation for any lane during the last three iterations: 0.8 %
Number of Iterations: 10 (maximum specified: 10)

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P1	South Full Crossing	53	31.8	LOS D	0.1	0.1	0.92	0.92
P2	East Full Crossing	53	18.8	LOS B	0.1	0.1	0.71	0.71
P3	North Full Crossing	53	31.8	LOS D	0.1	0.1	0.92	0.92
P4	West Full Crossing	53	18.1	LOS B	0.1	0.1	0.69	0.69
All Pedestrians		211	25.1	LOS C			0.81	0.81

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: 103 [PM_Herring_Waterloo _2021 RMS] Network: N101 [RMS PM - updated]

Herring Road_Waterloo Road
RMS Base 2021
Signals - Fixed Time Isolated Cycle Time = 139 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Herring Road (380m)													
1	L2	27	0.0	27	0.0	0.083	33.4	LOS C	1.5	13.4	0.76	0.65	34.2
2	T1	666	3.0	666	3.0	0.666	48.5	LOS D	20.2	143.0	0.94	0.81	28.6
3	R2	435	1.5	435	1.5	0.696	65.3	LOS E	14.2	100.7	1.00	0.84	16.2
Approach		1128	2.3	1128	2.3	0.696	54.6	LOS D	20.2	143.0	0.96	0.82	24.0
East: Waterloo Road (380m)													
4	L2	754	1.7	754	1.7	0.689	41.0	LOS C	30.8	218.6	0.88	0.85	22.3
5	T1	181	1.7	181	1.7	0.689	48.6	LOS D	21.4	152.1	0.96	0.84	27.5
6	R2	234	27.5	234	27.5	0.654	67.4	LOS E	11.3	80.6	0.98	0.81	23.4
Approach		1168	6.8	1168	6.8	0.689	47.4	LOS D	30.8	218.6	0.91	0.84	23.6
North: Herring Road (320m)													
7	L2	156	39.2	156	39.2	0.326	39.2	LOS C	8.1	77.5	0.76	0.76	21.2
8	T1	625	3.4	625	3.4	0.693	47.8	LOS D	18.7	132.3	0.93	0.80	18.5
9	R2	185	24.4	185	24.4	0.678	65.6	LOS E	12.1	102.7	0.99	0.84	22.5
Approach		966	13.2	966	13.2	0.693	49.8	LOS D	18.7	132.3	0.91	0.80	19.9
West: Waterloo Road (320m)													
10	L2	159	29.8	159	29.8	0.243	31.3	LOS C	6.6	58.2	0.66	0.75	32.9
11	T1	433	1.5	433	1.5	0.465	48.1	LOS D	12.5	88.6	0.90	0.76	18.2
Approach		592	9.1	592	9.1	0.465	43.6	LOS D	12.5	88.6	0.84	0.75	22.3
All Vehicles		3855	7.5	3855	7.5	0.696	49.5	LOS D	30.8	218.6	0.91	0.81	22.7

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Largest change in Average Back of Queue or Degree of Saturation for any lane during the last three iterations: 0.8 %
Number of Iterations: 10 (maximum specified: 10)

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P1	South Full Crossing	53	36.1	LOS D	0.1	0.1	0.72	0.72
P2	East Full Crossing	53	52.8	LOS E	0.2	0.2	0.87	0.87
P3	North Full Crossing	53	54.5	LOS E	0.2	0.2	0.89	0.89
P4	West Full Crossing	53	46.9	LOS E	0.2	0.2	0.82	0.82
All Pedestrians		211	47.6	LOS E			0.83	0.83

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.

Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: 101v [PM_Waterloo Road_Byfield Sreet_2021 RMS]

Network: N101 [RMS PM - updated]

Waterloo Road_Byfield Sreet
RMS Base 2021
Signals - Fixed Time Isolated Cycle Time = 139 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Byfield Sreet (350m)													
1	L2	565	1.5	565	1.5	0.593	23.5	LOS B	22.0	156.3	0.75	0.92	26.7
3	R2	12	0.0	12	0.0	0.019	56.3	LOS D	0.3	2.3	0.86	0.65	20.1
Approach		577	1.5	577	1.5	0.593	24.2	LOS B	22.0	156.3	0.75	0.92	26.4
East: Waterloo Road (155m)													
4	L2	2	0.0	2	0.0	0.106	24.8	LOS B	2.2	28.4	0.55	0.45	33.8
5	T1	1113	6.9	1113	6.9	0.585	25.3	LOS B	26.6	188.3	0.74	0.66	17.4
Approach		1115	6.9	1115	6.9	0.585	25.3	LOS B	26.6	188.3	0.74	0.66	17.4
West: Waterloo Road (380m)													
11	T1	988	7.3	988	7.3	0.318	6.0	LOS A	10.1	71.8	0.35	0.31	50.8
12	R2	258	1.6	258	1.6	0.479	20.8	LOS B	9.2	65.4	0.84	0.82	38.5
Approach		1246	6.2	1246	6.2	0.479	9.0	LOS A	10.1	71.8	0.45	0.42	46.9
All Vehicles		2938	5.5	2938	5.5	0.593	18.2	LOS B	26.6	188.3	0.62	0.61	32.8

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Largest change in Average Back of Queue or Degree of Saturation for any lane during the last three iterations: 0.8 %
Number of Iterations: 10 (maximum specified: 10)

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P1	South Full Crossing	53	51.1	LOS E	0.2	0.2	0.86	0.86
P4	West Full Crossing	53	63.8	LOS F	0.2	0.2	0.96	0.96
All Pedestrians		105	57.4	LOS E			0.91	0.91

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: 101 [AM_Herring_Epping _2021 Base+Dev]

Network: N101 [2021 Base+Dev AM - update]

Epping Road - Herring Road
AM
2021 RMS Base+Development
Signals - Fixed Time Isolated Cycle Time = 149 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Herring Road S (250m)													
1	L2	15	0.0	15	0.0	1.031	119.3	LOS F	28.5	203.8	1.00	1.22	16.4
2	T1	651	2.6	651	2.6	1.031	122.7	LOS F	37.8	270.5	1.00	1.27	6.5
3	R2	347	1.5	347	1.5	0.689	65.3	LOS E	11.6	81.9	0.95	0.82	36.5
Approach		1013	2.2	1013	2.2	1.031	103.0	LOS F	37.8	270.5	0.98	1.11	16.5
East: Epping Road E (1200m)													
4	L2	108	1.0	108	1.0	0.435	34.3	LOS C	17.1	121.2	0.73	0.70	48.9
5	T1	1019	1.5	1019	1.5	0.435	28.7	LOS C	18.5	131.4	0.73	0.65	53.4
6	R2	432	3.4	432	3.4	1.032	141.5	LOS F	25.0	180.1	1.00	1.15	21.4
Approach		1559	2.0	1559	2.0	1.032	60.3	LOS E	25.0	180.1	0.80	0.79	40.5
North: Herring Road N (200m)													
7	L2	458	3.4	458	3.4	0.444	26.5	LOS B	15.3	110.5	0.62	0.85	49.4
8	T1	277	4.6	277	4.6	0.469	62.5	LOS E	9.3	67.4	0.96	0.78	18.3
9	R2	167	1.3	167	1.3	0.295	66.2	LOS E	5.4	38.5	0.93	0.77	26.0
Approach		902	3.4	902	3.4	0.469	44.9	LOS D	15.3	110.5	0.78	0.81	36.0
West: Epping Road W (600m)													
10	L2	585	1.4	585	1.4	0.547	14.5	LOS B	17.2	121.6	0.53	0.75	48.2
11	T1	2102	1.7	2102	1.7	1.053	134.9	LOS F	86.7	615.9	1.00	1.40	28.4
12	R2	23	0.0	23	0.0	0.310	86.2	LOS F	1.7	12.2	1.00	0.71	23.4
Approach		2711	1.6	2711	1.6	1.053	108.5	LOS F	86.7	615.9	0.90	1.25	29.4
All Vehicles		6184	2.1	6184	2.1	1.053	86.2	LOS F	86.7	615.9	0.87	1.05	30.6

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Largest change in Average Back of Queue or Degree of Saturation for any lane during the last three iterations: 9.1 %
Number of Iterations: 10 (maximum specified: 10)

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P1	South Full Crossing	53	31.6	LOS D	0.1	0.1	0.65	0.65
P2	East Full Crossing	53	68.8	LOS F	0.2	0.2	0.96	0.96
P3	North Full Crossing	53	41.4	LOS E	0.2	0.2	0.75	0.75
P4	West Full Crossing	53	66.9	LOS F	0.2	0.2	0.95	0.95
All Pedestrians		211	52.2	LOS E			0.83	0.83

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: 102 [AM_Herring_Ivanhoe 2021 Base+Dev]

Network: N101 [2021 Base+Dev AM - update]

Herring Road_Ivanhoe Place
AM
2021 RMS Base+Development
Signals - Fixed Time Isolated Cycle Time = 75 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Herring Road (180m)													
1	L2	1	0.0	1	0.0	0.018	17.7	LOS B	0.2	2.6	0.57	0.42	17.7
2	T1	1465	2.2	1445	2.1	0.840	24.8	LOS B	28.2	199.7	0.92	0.93	19.3
3	R2	120	1.8	118	1.8	0.778	47.6	LOS D	4.8	34.2	1.00	0.90	17.2
Approach		1586	2.1	1564 N1	2.1	0.840	26.6	LOS B	28.2	199.7	0.92	0.93	19.0
East: Ivanhoe Place (125m)													
4	L2	355	1.5	355	1.5	0.349	6.2	LOS A	2.9	20.7	0.34	0.62	31.4
5	T1	1	0.0	1	0.0	0.349	1.7	LOS A	2.9	20.7	0.34	0.62	35.7
6	R2	20	0.0	20	0.0	0.060	25.8	LOS B	0.6	4.2	0.83	0.59	4.0
Approach		376	1.4	376	1.4	0.349	7.2	LOS A	2.9	20.7	0.37	0.62	23.1
North: Herring Road (380m)													
7	L2	15	0.0	15	0.0	0.042	17.8	LOS B	0.6	5.4	0.58	0.53	38.5
8	T1	512	3.9	512	3.9	0.275	13.7	LOS A	5.7	40.4	0.66	0.56	38.0
9	R2	24	0.0	24	0.0	0.157	42.4	LOS C	0.9	6.1	0.96	0.70	23.3
Approach		551	3.6	551	3.6	0.275	15.0	LOS B	5.7	40.4	0.67	0.56	36.8
West: Morling College (70m)													
10	L2	9	0.0	9	0.0	0.017	21.7	LOS B	0.3	1.8	0.68	0.63	11.4
11	T1	1	0.0	1	0.0	0.017	17.2	LOS B	0.3	1.8	0.68	0.63	20.9
12	R2	20	0.0	20	0.0	0.057	30.2	LOS C	0.6	4.2	0.82	0.68	9.1
Approach		31	0.0	31	0.0	0.057	27.1	LOS B	0.6	4.2	0.77	0.66	10.1
All Vehicles		2543	2.3	2521 N1	2.3	0.840	21.2	LOS B	28.2	199.7	0.78	0.80	23.5

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Largest change in Average Back of Queue or Degree of Saturation for any lane during the last three iterations: 9.1 %
Number of Iterations: 10 (maximum specified: 10)

N1 Arrival Flow value is reduced due to capacity constraint at oversaturated upstream lanes.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P1	South Full Crossing	53	31.8	LOS D	0.1	0.1	0.92	0.92
P2	East Full Crossing	53	18.8	LOS B	0.1	0.1	0.71	0.71
P3	North Full Crossing	53	31.8	LOS D	0.1	0.1	0.92	0.92
P4	West Full Crossing	53	18.1	LOS B	0.1	0.1	0.69	0.69

All Pedestrians	211	25.1	LOS C	0.81	0.81

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: 103 [AM_Herring_Waterloo _2021 Base+Dev]

Network: N101 [2021 Base+Dev AM - update]

Herring Road_Waterloo Road
AM
2021 RMS Base+Development
Signals - Fixed Time Isolated Cycle Time = 139 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Herring Road (380m)													
1	L2	96	1.1	94	1.1	0.125	19.3	LOS B	3.0	22.5	0.57	0.66	41.3
2	T1	835	2.6	817	2.6	0.637	39.4	LOS C	23.7	168.3	0.88	0.77	31.7
3	R2	646	1.5	633	1.5	0.623	30.9	LOS C	11.6	82.5	0.93	0.83	26.4
Approach		1577	2.1	1543 N1	2.1	0.637	34.6	LOS C	23.7	168.3	0.88	0.79	30.5
East: Waterloo Road (380m)													
4	L2	331	1.6	331	1.6	0.385	18.8	LOS B	8.0	56.5	0.69	0.77	33.5
5	T1	154	1.4	154	1.4	0.427	37.5	LOS C	7.9	55.8	0.77	0.60	32.3
6	R2	173	36.0	173	36.0	0.371	62.2	LOS E	6.9	48.9	0.93	0.78	24.6
Approach		657	10.6	657	10.6	0.427	34.6	LOS C	8.0	56.5	0.77	0.73	29.5
North: Herring Road (320m)													
7	L2	124	39.8	124	39.8	0.357	31.8	LOS C	5.4	52.8	0.84	0.76	24.3
8	T1	229	6.9	229	6.9	0.357	50.3	LOS D	6.3	44.7	0.90	0.72	17.9
9	R2	107	38.2	107	38.2	0.445	63.5	LOS E	6.7	62.4	0.95	0.79	22.9
Approach		461	23.1	461	23.1	0.445	48.3	LOS D	6.7	62.4	0.89	0.75	20.7
West: Waterloo Road (320m)													
10	L2	121	39.1	121	39.1	0.257	41.7	LOS C	5.9	55.5	0.77	0.76	28.7
11	T1	278	1.5	278	1.5	0.508	60.2	LOS E	8.9	62.8	0.97	0.78	15.5
Approach		399	12.9	399	12.9	0.508	54.6	LOS D	8.9	62.8	0.91	0.78	19.6
All Vehicles		3094	8.4	3060 N1	8.5	0.637	39.3	LOS C	23.7	168.3	0.86	0.77	27.2

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Largest change in Average Back of Queue or Degree of Saturation for any lane during the last three iterations: 9.1 %
Number of Iterations: 10 (maximum specified: 10)

N1 Arrival Flow value is reduced due to capacity constraint at oversaturated upstream lanes.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P1	South Full Crossing	53	63.8	LOS F	0.2	0.2	0.96	0.96
P2	East Full Crossing	53	61.9	LOS F	0.2	0.2	0.94	0.94
P3	North Full Crossing	53	63.8	LOS F	0.2	0.2	0.96	0.96
P4	West Full Crossing	53	37.5	LOS D	0.2	0.2	0.74	0.74
All Pedestrians		211	56.7	LOS E			0.90	0.90

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: 104 [AM_Waterloo Road_Byfield Sreet_2021 Base+Dev]

Network: N101 [2021 Base+Dev AM - update]

Waterloo Road_Byfield Sreet
AM
2021 RMS Base+Development
Signals - Fixed Time Isolated Cycle Time = 139 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Byfield Sreet (350m)													
1	L2	112	1.9	112	1.9	0.102	6.9	LOS A	1.4	10.0	0.24	0.58	39.8
3	R2	11	0.0	11	0.0	0.018	57.2	LOS E	0.3	2.1	0.87	0.65	19.9
Approach		122	1.7	122	1.7	0.102	11.2	LOS A	1.4	10.0	0.30	0.58	35.6
East: Waterloo Road (155m)													
4	L2	49	2.1	49	2.1	0.154	25.2	LOS B	3.4	35.1	0.57	0.54	32.2
5	T1	731	9.7	731	9.7	0.389	22.9	LOS B	15.4	109.4	0.66	0.57	18.5
Approach		780	9.2	780	9.2	0.389	22.9	LOS B	15.4	109.4	0.65	0.57	19.9
West: Waterloo Road (380m)													
11	T1	664	9.0	660	9.1	0.206	5.1	LOS A	5.8	41.1	0.31	0.27	52.0
12	R2	162	1.3	161	1.3	0.240	13.0	LOS A	2.9	20.7	0.50	0.70	43.3
Approach		826	7.5	821 N1	7.6	0.240	6.7	LOS A	5.8	41.1	0.35	0.35	49.5
All Vehicles		1728	7.9	1723 N1	7.9	0.389	14.4	LOS A	15.4	109.4	0.48	0.47	36.5

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Largest change in Average Back of Queue or Degree of Saturation for any lane during the last three iterations: 9.1 %
Number of Iterations: 10 (maximum specified: 10)

N1 Arrival Flow value is reduced due to capacity constraint at oversaturated upstream lanes.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P1	South Full Crossing	53	49.3	LOS E	0.2	0.2	0.84	0.84
P4	West Full Crossing	53	63.8	LOS F	0.2	0.2	0.96	0.96
All Pedestrians		105	56.6	LOS E			0.90	0.90

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: 101 [PM_Herring_Epping _2021 Base+Dev]

Network: N101 [2021 Base+Dev PM - update]

Epping Road - Herring Road
PM
2021 RMS Base+Development
Signals - Fixed Time Isolated Cycle Time = 149 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Herring Road S (250m)													
1	L2	20	0.0	20	0.0	0.942	114.7	LOS F	24.0	171.6	1.00	1.14	19.9
2	T1	532	3.0	532	3.0	0.942	99.1	LOS F	24.2	173.8	1.00	1.12	8.6
3	R2	194	1.6	194	1.6	0.342	66.8	LOS E	6.3	45.1	0.94	0.78	36.1
Approach		745	2.5	745	2.5	0.942	91.1	LOS F	24.2	173.8	0.98	1.03	17.4
East: Epping Road E (1200m)													
4	L2	366	1.4	366	1.4	0.944	78.3	LOS F	51.7	366.6	1.00	1.08	34.3
5	T1	1539	1.6	1539	1.6	0.944	73.3	LOS F	56.0	397.3	1.00	1.09	39.2
6	R2	519	2.8	519	2.8	0.948	99.8	LOS F	23.3	166.8	1.00	1.02	27.1
Approach		2424	1.9	2424	1.9	0.948	79.7	LOS F	56.0	397.3	1.00	1.07	35.9
North: Herring Road N (200m)													
7	L2	354	4.2	342	4.3	0.294	10.9	LOS A	8.3	60.6	0.42	0.69	58.2
8	T1	671	2.4	648	2.4	0.957	93.2	LOS F	29.0	207.4	1.00	1.13	13.7
9	R2	496	1.5	479	1.5	0.746	70.9	LOS F	17.1	121.0	1.00	0.86	25.0
Approach		1520	2.5	1468 N1	2.5	0.957	66.8	LOS E	29.0	207.4	0.87	0.94	25.6
West: Epping Road W (600m)													
10	L2	292	1.4	292	1.4	0.222	10.3	LOS A	4.8	33.9	0.32	0.68	53.0
11	T1	1048	1.5	1048	1.5	0.514	40.3	LOS C	20.0	141.8	0.84	0.73	49.0
12	R2	177	1.8	177	1.8	0.625	71.0	LOS F	12.2	86.8	0.99	0.82	26.4
Approach		1517	1.5	1517	1.5	0.625	38.1	LOS C	20.0	141.8	0.76	0.73	46.5
All Vehicles		6206	2.0	6155 N1	2.0	0.957	67.7	LOS E	56.0	397.3	0.91	0.95	34.0

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Largest change in Average Back of Queue or Degree of Saturation for any lane during the last three iterations: 5.2 %
Number of Iterations: 10 (maximum specified: 10)

N1 Arrival Flow value is reduced due to capacity constraint at oversaturated upstream lanes.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P1	South Full Crossing	53	42.2	LOS E	0.2	0.2	0.75	0.75
P2	East Full Crossing	53	68.8	LOS F	0.2	0.2	0.96	0.96
P3	North Full Crossing	53	42.9	LOS E	0.2	0.2	0.76	0.76
P4	West Full Crossing	53	68.8	LOS F	0.2	0.2	0.96	0.96

All Pedestrians	211	55.7	LOS E	0.86	0.86

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: 102 [PM_Herring_Ivanhoe 2021 Base+Dev]

Network: N101 [2021 Base+Dev PM - update]

Herring Road_Ivanhoe Place
PM
2021 RMS Base+Development
Signals - Fixed Time Isolated Cycle Time = 75 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Herring Road (180m)													
1	L2	1	0.0	1	0.0	0.022	18.9	LOS B	0.2	3.0	0.60	0.44	17.3
2	T1	987	2.6	987	2.6	0.651	17.7	LOS B	16.2	115.2	0.82	0.71	23.9
3	R2	202	1.6	202	1.6	0.995	77.9	LOS F	11.4	80.9	1.00	1.27	11.9
Approach		1191	2.4	1191	2.4	0.995	28.0	LOS B	16.2	115.2	0.85	0.81	19.0
East: Ivanhoe Place (125m)													
4	L2	141	1.5	141	1.5	0.184	14.8	LOS B	2.8	19.6	0.60	0.66	20.9
5	T1	1	0.0	1	0.0	0.184	10.3	LOS A	2.8	19.6	0.60	0.66	25.7
6	R2	7	0.0	7	0.0	0.022	25.4	LOS B	0.2	1.5	0.81	0.55	4.0
Approach		149	1.4	149	1.4	0.184	15.3	LOS B	2.8	19.6	0.61	0.66	17.4
North: Herring Road (380m)													
7	L2	100	1.1	100	1.1	0.158	20.5	LOS B	2.6	19.7	0.66	0.69	35.2
8	T1	1383	2.4	1383	2.4	1.044	101.4	LOS F	54.5	386.7	1.00	1.69	11.4
9	R2	47	2.2	47	2.2	0.234	40.5	LOS C	1.7	11.9	0.95	0.73	23.9
Approach		1531	2.3	1531	2.3	1.044	94.2	LOS F	54.5	386.7	0.97	1.59	12.2
West: Morling College (70m)													
10	L2	20	0.0	20	0.0	0.030	19.8	LOS B	0.5	3.3	0.64	0.65	12.1
11	T1	1	0.0	1	0.0	0.030	15.2	LOS B	0.5	3.3	0.64	0.65	21.9
12	R2	13	0.0	13	0.0	0.044	30.3	LOS C	0.4	2.6	0.82	0.67	9.1
Approach		34	0.0	34	0.0	0.044	23.6	LOS B	0.5	3.3	0.71	0.65	11.1
All Vehicles		2904	2.2	2904	2.2	1.044	62.2	LOS E	54.5	386.7	0.90	1.21	13.7

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Largest change in Average Back of Queue or Degree of Saturation for any lane during the last three iterations: 5.2 %
Number of Iterations: 10 (maximum specified: 10)

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P1	South Full Crossing	53	31.8	LOS D	0.1	0.1	0.92	0.92
P2	East Full Crossing	53	20.2	LOS C	0.1	0.1	0.73	0.73
P3	North Full Crossing	53	31.8	LOS D	0.1	0.1	0.92	0.92
P4	West Full Crossing	53	19.5	LOS B	0.1	0.1	0.72	0.72
All Pedestrians		211	25.8	LOS C			0.83	0.83

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: 103 [PM_Herring_Waterloo _2021 Base+Dev]

Network: N101 [2021 Base+Dev PM - update]

Herring Road_Waterloo Road
PM
2021 RMS Base+Development
Signals - Fixed Time Isolated Cycle Time = 139 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Herring Road (380m)													
1	L2	16	0.0	16	0.0	0.072	36.2	LOS C	1.1	10.6	0.79	0.64	33.3
2	T1	651	3.1	651	3.1	0.726	52.8	LOS D	20.5	145.3	0.98	0.85	27.3
3	R2	375	1.4	375	1.4	0.654	65.9	LOS E	12.2	86.2	0.99	0.82	16.1
Approach		1041	2.4	1041	2.4	0.726	57.2	LOS E	20.5	145.3	0.98	0.83	23.5
East: Waterloo Road (380m)													
4	L2	906	1.5	906	1.5	0.749	40.5	LOS C	36.0	255.3	0.90	0.87	22.4
5	T1	188	1.7	188	1.7	0.749	45.9	LOS D	26.2	185.9	0.96	0.86	28.1
6	R2	219	28.8	219	28.8	0.568	65.6	LOS E	10.1	71.7	0.97	0.80	23.8
Approach		1314	6.1	1314	6.1	0.749	45.5	LOS D	36.0	255.3	0.92	0.85	23.8
North: Herring Road (320m)													
7	L2	185	33.0	185	33.0	0.391	41.5	LOS C	9.9	91.5	0.79	0.78	20.3
8	T1	574	3.5	574	3.5	0.720	52.3	LOS D	18.0	128.0	0.96	0.83	17.4
9	R2	179	25.3	179	25.3	0.719	68.7	LOS E	12.1	102.8	1.00	0.86	21.8
Approach		938	13.5	938	13.5	0.720	53.2	LOS D	18.0	128.0	0.93	0.83	19.0
West: Waterloo Road (320m)													
10	L2	163	29.0	163	29.0	0.237	29.4	LOS C	6.5	57.1	0.64	0.74	33.7
11	T1	428	1.5	428	1.5	0.402	43.4	LOS D	11.7	83.1	0.86	0.72	19.5
Approach		592	9.1	592	9.1	0.402	39.5	LOS C	11.7	83.1	0.80	0.73	23.7
All Vehicles		3884	7.3	3884	7.3	0.749	49.6	LOS D	36.0	255.3	0.92	0.82	22.6

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Largest change in Average Back of Queue or Degree of Saturation for any lane during the last three iterations: 5.2 %
Number of Iterations: 10 (maximum specified: 10)

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P1	South Full Crossing	53	31.9	LOS D	0.1	0.1	0.68	0.68
P2	East Full Crossing	53	56.3	LOS E	0.2	0.2	0.90	0.90
P3	North Full Crossing	53	50.2	LOS E	0.2	0.2	0.85	0.85
P4	West Full Crossing	53	50.2	LOS E	0.2	0.2	0.85	0.85
All Pedestrians		211	47.1	LOS E			0.82	0.82

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: 104 [PM_Waterloo Road_Byfield Sreet_2021 Base+Dev]

Network: N101 [2021 Base+Dev PM - update]

Waterloo Road_Byfield Sreet
PM
2021 RMS Base+Development
Signals - Fixed Time Isolated Cycle Time = 139 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Arrival Flows Total veh/h	Arrival Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Byfield Sreet (350m)													
1	L2	546	1.5	546	1.5	0.547	23.8	LOS B	19.7	139.6	0.70	0.91	26.5
3	R2	13	0.0	13	0.0	0.021	57.3	LOS E	0.4	2.5	0.87	0.65	19.9
Approach		559	1.5	559	1.5	0.547	24.6	LOS B	19.7	139.6	0.70	0.90	26.3
East: Waterloo Road (155m)													
4	L2	5	0.0	5	0.0	0.122	29.0	LOS C	2.6	32.0	0.61	0.50	31.3
5	T1	1172	6.6	1172	6.6	0.690	31.4	LOS C	31.8	225.6	0.83	0.74	14.8
Approach		1177	6.6	1177	6.6	0.690	31.4	LOS C	31.8	225.6	0.83	0.74	14.9
West: Waterloo Road (380m)													
11	T1	928	7.7	928	7.7	0.295	5.5	LOS A	9.0	63.9	0.33	0.30	51.4
12	R2	335	1.6	335	1.6	0.551	32.1	LOS C	12.2	86.5	0.88	0.90	33.1
Approach		1263	6.1	1263	6.1	0.551	12.6	LOS A	12.2	86.5	0.48	0.46	43.5
All Vehicles		2999	5.4	2999	5.4	0.690	22.2	LOS B	31.8	225.6	0.66	0.65	30.0

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Largest change in Average Back of Queue or Degree of Saturation for any lane during the last three iterations: 5.2 %
Number of Iterations: 10 (maximum specified: 10)

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P1	South Full Crossing	53	44.4	LOS E	0.2	0.2	0.80	0.80
P4	West Full Crossing	53	63.8	LOS F	0.2	0.2	0.96	0.96
All Pedestrians		105	54.1	LOS E			0.88	0.88

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: 101 [AM_Herring_Epping_2021 Base+Dev+Upgrades]

Network: N101 [2021 Base+Dev+Upgrades AM - update]

Epping Road - Herring Road
AM
2021 RMS Base+Development+Upgrades
Signals - Fixed Time Isolated Cycle Time = 149 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Herring Road S (250m)													
1	L2	15	0.0	15	0.0	1.050	131.4	LOS F	33.7	240.3	1.00	1.27	15.4
2	T1	716	2.4	716	2.4	1.050	134.5	LOS F	43.1	308.1	1.00	1.32	6.0
3	R2	283	1.5	283	1.5	0.451	61.2	LOS E	8.9	63.3	0.91	0.79	37.5
Approach		1014	2.1	1014	2.1	1.050	114.0	LOS F	43.1	308.1	0.98	1.17	13.9
East: Epping Road E (1200m)													
4	L2	95	1.1	95	1.1	0.438	35.9	LOS C	17.2	122.0	0.74	0.70	48.2
5	T1	1009	1.5	1009	1.5	0.438	30.1	LOS C	18.5	131.1	0.74	0.66	52.8
6	R2	381	3.6	381	3.6	1.011	130.4	LOS F	20.8	149.8	1.00	1.11	22.7
Approach		1485	2.0	1485	2.0	1.011	56.2	LOS D	20.8	149.8	0.81	0.78	42.0
North: Herring Road N (200m)													
7	L2	178	8.3	178	8.3	0.178	21.2	LOS B	5.9	44.0	0.51	0.70	52.0
8	T1	292	4.3	292	4.3	0.493	62.8	LOS E	9.8	71.2	0.96	0.78	18.3
9	R2	175	1.8	175	1.8	0.309	66.4	LOS E	5.7	40.5	0.93	0.77	26.0
Approach		644	4.7	644	4.7	0.493	52.3	LOS D	9.8	71.2	0.83	0.76	29.9
West: Epping Road W (600m)													
10	L2	561	1.5	561	1.5	0.524	15.1	LOS B	16.7	118.4	0.53	0.75	47.6
11	T1	2086	1.7	2086	1.7	1.043	128.3	LOS F	83.9	596.1	1.00	1.37	29.3
12	R2	21	0.0	21	0.0	0.282	86.0	LOS F	1.6	11.1	1.00	0.70	23.4
Approach		2668	1.7	2668	1.7	1.043	104.1	LOS F	83.9	596.1	0.90	1.23	30.3
All Vehicles		5812	2.2	5812	2.2	1.050	87.8	LOS F	83.9	596.1	0.88	1.05	30.0

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Largest change in Average Back of Queue or Degree of Saturation for any lane during the last three iterations: 0.7 %
Number of Iterations: 10 (maximum specified: 10)

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P1	South Full Crossing	53	33.0	LOS D	0.1	0.1	0.67	0.67
P2	East Full Crossing	53	68.8	LOS F	0.2	0.2	0.96	0.96
P3	North Full Crossing	53	41.4	LOS E	0.2	0.2	0.75	0.75
P4	West Full Crossing	53	65.0	LOS F	0.2	0.2	0.93	0.93
All Pedestrians		211	52.0	LOS E			0.83	0.83

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: 102 [AM_Herring_Ivanhoe_2021 Base+Dev+Upgrades]

Network: N101 [2021 Base+Dev+Upgrades AM - update]

Herring Road_Ivanhoe Place
AM
2021 RMS Base+Development+Upgrades
Signals - Fixed Time Isolated Cycle Time = 75 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Herring Road (180m)													
1	L2	1	0.0	1	0.0	0.018	18.3	LOS B	0.2	2.6	0.58	0.43	17.5
2	T1	1421	2.1	1389	2.1	0.842	25.7	LOS B	27.7	196.5	0.92	0.94	18.9
3	R2	146	1.4	143	1.4	0.804	47.5	LOS D	5.8	41.4	1.00	0.93	17.2
Approach		1568	2.0	1533 N1	2.0	0.842	27.7	LOS B	27.7	196.5	0.93	0.94	18.6
East: Ivanhoe Place (125m)													
4	L2	383	1.4	383	1.4	0.352	6.0	LOS A	2.4	16.7	0.33	0.61	32.1
5	T1	7	0.0	7	0.0	0.352	1.5	LOS A	2.4	16.7	0.33	0.61	36.3
6	R2	31	0.0	31	0.0	0.091	26.1	LOS B	0.9	6.4	0.83	0.62	4.0
Approach		421	1.3	421	1.3	0.352	7.4	LOS A	2.4	16.7	0.37	0.61	21.4
North: Herring Road (380m)													
7	L2	56	1.9	56	1.9	0.097	19.4	LOS B	1.5	12.3	0.63	0.64	36.2
8	T1	232	6.8	232	6.8	0.124	13.3	LOS A	2.4	16.7	0.62	0.51	38.2
9	R2	17	0.0	17	0.0	0.094	40.7	LOS C	0.6	4.1	0.94	0.69	23.8
Approach		304	5.5	304	5.5	0.124	15.8	LOS B	2.4	16.7	0.64	0.54	36.4
West: Morling College (70m)													
10	L2	8	0.0	8	0.0	0.021	24.8	LOS B	0.3	2.1	0.73	0.62	10.8
11	T1	3	0.0	3	0.0	0.021	20.2	LOS B	0.3	2.1	0.73	0.62	19.8
12	R2	18	0.0	18	0.0	0.052	30.2	LOS C	0.5	3.7	0.82	0.68	9.2
Approach		29	0.0	29	0.0	0.052	27.6	LOS B	0.5	3.7	0.79	0.65	10.8
All Vehicles		2323	2.3	2288 N1	2.3	0.842	22.4	LOS B	27.7	196.5	0.79	0.82	21.5

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Largest change in Average Back of Queue or Degree of Saturation for any lane during the last three iterations: 0.7 %
Number of Iterations: 10 (maximum specified: 10)

N1 Arrival Flow value is reduced due to capacity constraint at oversaturated upstream lanes.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P1	South Full Crossing	53	31.8	LOS D	0.1	0.1	0.92	0.92
P2	East Full Crossing	53	19.5	LOS B	0.1	0.1	0.72	0.72
P3	North Full Crossing	53	31.8	LOS D	0.1	0.1	0.92	0.92
P4	West Full Crossing	53	18.8	LOS B	0.1	0.1	0.71	0.71
All Pedestrians		211	25.5	LOS C			0.82	0.82

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: 103 [AM_Herring_Waterloo_2021 Base+Dev+Upgrades]

Network: N101 [2021 Base+Dev+Upgrades AM - update]

Herring Road_Waterloo Road
AM
2021 RMS Base+Development+Upgrades
Signals - Fixed Time Isolated Cycle Time = 139 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Herring Road (380m)													
1	L2	94	1.1	92	1.1	0.110	15.4	LOS B	2.4	18.4	0.49	0.63	44.1
2	T1	836	2.6	819	2.6	0.534	31.7	LOS C	21.0	149.2	0.79	0.70	34.9
3	R2	611	1.6	598	1.6	0.333	17.5	LOS B	7.3	51.9	0.64	0.74	34.9
Approach		1540	2.1	1509 N1	2.1	0.534	25.0	LOS B	21.0	149.2	0.72	0.71	35.4
East: Waterloo Road (380m)													
4	L2	102	2.1	102	2.1	0.112	15.9	LOS B	2.2	15.6	0.56	0.70	35.9
5	T1	154	1.4	154	1.4	0.257	38.3	LOS C	7.7	54.8	0.79	0.65	32.0
6	R2	178	34.9	178	34.9	0.526	69.2	LOS E	7.7	54.6	0.98	0.79	23.1
Approach		434	15.3	434	15.3	0.526	45.7	LOS D	7.7	54.8	0.82	0.72	27.5
North: Herring Road (320m)													
7	L2	120	41.2	120	41.2	0.356	30.2	LOS C	4.8	46.9	0.84	0.76	25.1
8	T1	203	7.8	203	7.8	0.356	47.8	LOS D	5.4	38.2	0.87	0.70	18.6
9	R2	109	37.5	109	37.5	0.519	66.9	LOS E	7.1	65.4	0.97	0.80	22.2
Approach		433	24.6	433	24.6	0.519	47.6	LOS D	7.1	65.4	0.89	0.74	21.1
West: Waterloo Road (320m)													
10	L2	121	39.1	121	39.1	0.275	44.2	LOS D	6.1	57.4	0.79	0.77	27.9
11	T1	278	1.5	278	1.5	0.508	60.2	LOS E	8.9	62.8	0.97	0.78	15.5
Approach		399	12.9	399	12.9	0.508	55.3	LOS D	8.9	62.8	0.92	0.78	19.4
All Vehicles		2805	9.2	2774 N1	9.3	0.534	36.2	LOS C	21.0	149.2	0.79	0.73	28.8

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Largest change in Average Back of Queue or Degree of Saturation for any lane during the last three iterations: 0.7 %
Number of Iterations: 10 (maximum specified: 10)

N1 Arrival Flow value is reduced due to capacity constraint at oversaturated upstream lanes.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P1	South Full Crossing	53	49.3	LOS E	0.2	0.2	0.84	0.84
P2	East Full Crossing	53	60.0	LOS E	0.2	0.2	0.93	0.93
P3	North Full Crossing	53	63.8	LOS F	0.2	0.2	0.96	0.96
P4	West Full Crossing	53	31.2	LOS D	0.1	0.1	0.67	0.67
All Pedestrians		211	51.1	LOS E			0.85	0.85

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: 104 [AM_Waterloo Road_Byfield Sreet_2021 Base+Dev+Upgrades]

Network: N101 [2021 Base+Dev+Upgrades AM - update]

Waterloo Road_Byfield Sreet
AM
2021 RMS Base+Development+Upgrades
Signals - Fixed Time Isolated Cycle Time = 139 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Byfield Sreet (350m)													
1	L2	80	1.3	80	1.3	0.069	5.5	LOS A	0.6	4.2	0.16	0.55	41.5
3	R2	53	2.0	53	2.0	0.091	58.4	LOS E	1.5	10.9	0.89	0.71	19.6
Approach		133	1.6	133	1.6	0.091	26.5	LOS B	1.5	10.9	0.45	0.61	27.0
East: Waterloo Road (155m)													
4	L2	46	2.3	46	2.3	0.136	20.9	LOS B	3.1	32.2	0.50	0.50	34.8
5	T1	519	13.0	519	13.0	0.221	16.8	LOS B	8.0	56.6	0.54	0.47	22.6
Approach		565	12.1	565	12.1	0.221	17.0	LOS B	8.0	56.6	0.54	0.47	24.4
West: Waterloo Road (380m)													
11	T1	644	9.3	637	9.4	0.198	5.1	LOS A	5.5	39.2	0.31	0.26	52.0
12	R2	158	1.3	156	1.3	0.219	11.5	LOS A	2.9	20.3	0.41	0.67	44.4
Approach		802	7.7	793 N1	7.8	0.219	6.3	LOS A	5.5	39.2	0.33	0.34	49.9
All Vehicles		1500	8.8	1491 N1	8.9	0.221	12.2	LOS A	8.0	56.6	0.42	0.42	39.6

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Largest change in Average Back of Queue or Degree of Saturation for any lane during the last three iterations: 0.7 %
Number of Iterations: 10 (maximum specified: 10)

N1 Arrival Flow value is reduced due to capacity constraint at oversaturated upstream lanes.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P1	South Full Crossing	53	56.3	LOS E	0.2	0.2	0.90	0.90
P4	West Full Crossing	53	63.8	LOS F	0.2	0.2	0.96	0.96
All Pedestrians		105	60.0	LOS F			0.93	0.93

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: 101 [PM_Herring_Epping_2021 Base+Dev+Upgrades]

Network: N101 [2021 Base+Dev+Upgrades PM - update]

Epping Road - Herring Road
PM
2021 RMS Base+Development+Upgrades
Signals - Fixed Time Isolated Cycle Time = 149 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Herring Road S (250m)													
1	L2	22	0.0	22	0.0	0.921	105.4	LOS F	23.6	168.7	1.00	1.10	21.1
2	T1	541	2.9	541	2.9	0.921	91.6	LOS F	23.9	171.2	1.00	1.08	9.2
3	R2	219	1.4	219	1.4	0.370	66.2	LOS E	7.2	50.8	0.94	0.78	36.2
Approach		782	2.4	782	2.4	0.921	84.8	LOS F	23.9	171.2	0.98	1.00	18.9
East: Epping Road E (1200m)													
4	L2	288	1.5	288	1.5	0.925	74.5	LOS F	47.7	338.0	1.00	1.06	35.4
5	T1	1539	1.6	1539	1.6	0.925	67.8	LOS E	51.3	364.1	1.00	1.05	40.5
6	R2	395	3.5	395	3.5	0.926	95.9	LOS F	17.0	122.4	1.00	0.99	27.8
Approach		2222	1.9	2222	1.9	0.926	73.6	LOS F	51.3	364.1	1.00	1.04	37.6
North: Herring Road N (200m)													
7	L2	316	4.7	316	4.7	0.274	10.7	LOS A	7.3	53.5	0.41	0.69	58.3
8	T1	745	2.3	745	2.3	0.922	80.2	LOS F	31.3	223.0	1.00	1.07	15.3
9	R2	523	1.4	523	1.4	0.684	64.6	LOS E	17.7	125.1	0.98	0.84	26.4
Approach		1584	2.5	1584	2.5	0.922	61.2	LOS E	31.3	223.0	0.88	0.92	26.3
West: Epping Road W (600m)													
10	L2	287	1.5	287	1.5	0.219	10.3	LOS A	4.7	33.6	0.32	0.67	53.0
11	T1	1056	1.5	1056	1.5	0.528	41.2	LOS C	20.4	144.6	0.85	0.74	48.7
12	R2	176	1.8	176	1.8	0.794	80.6	LOS F	13.3	94.3	1.00	0.88	24.4
Approach		1519	1.5	1519	1.5	0.794	39.9	LOS C	20.4	144.6	0.77	0.74	45.9
All Vehicles		6107	2.0	6107	2.0	0.926	63.5	LOS E	51.3	364.1	0.91	0.93	34.9

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Largest change in Average Back of Queue or Degree of Saturation for any lane during the last three iterations: 7.3 %
Number of Iterations: 10 (maximum specified: 10)

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P1	South Full Crossing	53	42.9	LOS E	0.2	0.2	0.76	0.76
P2	East Full Crossing	53	65.0	LOS F	0.2	0.2	0.93	0.93
P3	North Full Crossing	53	43.7	LOS E	0.2	0.2	0.77	0.77
P4	West Full Crossing	53	68.8	LOS F	0.2	0.2	0.96	0.96
All Pedestrians		211	55.1	LOS E			0.86	0.86

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: 102 [PM_Herring_Ivanhoe_2021 Base+Dev+Upgrades]

Network: N101 [2021 Base+Dev+Upgrades PM - update]

Herring Road_Ivanhoe Place
PM
2021 RMS Base+Development+Upgrades
Signals - Fixed Time Isolated Cycle Time = 75 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Herring Road (180m)													
1	L2	1	0.0	1	0.0	0.028	23.8	LOS B	0.3	3.6	0.70	0.50	15.9
2	T1	1044	2.5	1044	2.5	0.794	27.8	LOS B	19.3	136.7	0.96	0.92	17.9
3	R2	39	2.7	39	2.7	0.258	43.0	LOS D	1.4	10.3	0.97	0.72	18.4
Approach		1084	2.5	1084	2.5	0.794	28.3	LOS B	19.3	136.7	0.96	0.91	17.9
East: Ivanhoe Place (125m)													
4	L2	677	1.6	677	1.6	0.763	18.0	LOS B	14.4	102.0	0.80	0.92	18.7
5	T1	13	0.0	13	0.0	0.763	13.5	LOS A	14.4	102.0	0.80	0.92	23.4
6	R2	191	1.7	191	1.7	0.389	21.1	LOS B	5.5	38.8	0.81	0.68	4.2
Approach		880	1.6	880	1.6	0.763	18.6	LOS B	14.4	102.0	0.80	0.87	10.7
North: Herring Road (380m)													
7	L2	16	0.0	16	0.0	0.057	24.7	LOS B	0.7	6.7	0.72	0.60	33.6
8	T1	912	2.8	912	2.8	0.919	45.4	LOS D	21.9	155.5	1.00	1.17	20.7
9	R2	45	0.0	45	0.0	0.294	43.1	LOS D	1.7	11.7	0.98	0.73	23.0
Approach		973	2.6	973	2.6	0.919	44.9	LOS D	21.9	155.5	0.99	1.14	20.9
West: Morling College (70m)													
10	L2	19	0.0	19	0.0	0.027	16.6	LOS B	0.4	3.1	0.57	0.61	14.2
11	T1	3	0.0	3	0.0	0.027	12.0	LOS A	0.4	3.1	0.57	0.61	24.5
12	R2	11	0.0	11	0.0	0.027	22.8	LOS B	0.3	1.8	0.70	0.64	11.4
Approach		33	0.0	33	0.0	0.027	18.2	LOS B	0.4	3.1	0.61	0.62	14.4
All Vehicles		2969	2.2	2969	2.2	0.919	30.8	LOS C	21.9	155.5	0.92	0.97	17.2

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Largest change in Average Back of Queue or Degree of Saturation for any lane during the last three iterations: 7.3 %
Number of Iterations: 10 (maximum specified: 10)

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P1	South Full Crossing	53	31.8	LOS D	0.1	0.1	0.92	0.92
P2	East Full Crossing	53	25.7	LOS C	0.1	0.1	0.83	0.83
P3	North Full Crossing	53	31.8	LOS D	0.1	0.1	0.92	0.92
P4	West Full Crossing	53	24.9	LOS C	0.1	0.1	0.82	0.82
All Pedestrians		211	28.5	LOS C			0.87	0.87

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: 103 [PM_Herring_Waterloo_2021 Base+Dev+Upgrades]

Network: N101 [2021 Base+Dev+Upgrades PM - update]

Herring Road_Waterloo Road
PM
2021 RMS Base+Development+Upgrades
Signals - Fixed Time Isolated Cycle Time = 139 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Herring Road (380m)													
1	L2	115	1.8	115	1.8	0.152	20.2	LOS B	3.8	28.8	0.57	0.67	40.7
2	T1	751	2.9	751	2.9	0.597	39.3	LOS C	21.5	152.6	0.87	0.76	31.8
3	R2	413	1.5	413	1.5	0.610	62.1	LOS E	13.0	92.1	0.97	0.82	16.8
Approach		1278	2.4	1278	2.4	0.610	44.9	LOS D	21.5	152.6	0.88	0.77	27.3
East: Waterloo Road (380m)													
4	L2	267	1.6	267	1.6	0.306	36.5	LOS C	10.5	74.2	0.73	0.77	23.9
5	T1	102	2.1	102	2.1	0.306	46.8	LOS D	7.5	53.5	0.87	0.73	28.5
6	R2	180	35.1	180	35.1	0.601	71.8	LOS F	7.9	56.4	1.00	0.79	22.6
Approach		549	12.6	549	12.6	0.601	50.0	LOS D	10.5	74.2	0.84	0.77	24.2
North: Herring Road (320m)													
7	L2	137	43.8	137	43.8	0.257	32.9	LOS C	6.4	63.2	0.68	0.73	23.8
8	T1	667	3.2	667	3.2	0.542	38.3	LOS C	18.3	129.6	0.84	0.73	21.4
9	R2	173	26.2	173	26.2	0.590	62.4	LOS E	10.9	93.3	0.97	0.82	23.2
Approach		977	12.9	977	12.9	0.590	41.7	LOS C	18.3	129.6	0.84	0.75	22.2
West: Waterloo Road (320m)													
10	L2	155	30.6	155	30.6	0.263	35.4	LOS C	6.9	61.4	0.71	0.76	31.1
11	T1	436	1.4	436	1.4	0.613	56.4	LOS D	13.7	97.1	0.97	0.81	16.2
Approach		591	9.1	591	9.1	0.613	50.9	LOS D	13.7	97.1	0.90	0.80	20.1
All Vehicles		3395	8.2	3395	8.2	0.613	45.9	LOS D	21.5	152.6	0.87	0.77	24.2

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Largest change in Average Back of Queue or Degree of Saturation for any lane during the last three iterations: 7.3 %
Number of Iterations: 10 (maximum specified: 10)

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P1	South Full Crossing	53	46.0	LOS E	0.2	0.2	0.81	0.81
P2	East Full Crossing	53	43.6	LOS E	0.2	0.2	0.79	0.79
P3	North Full Crossing	53	61.9	LOS F	0.2	0.2	0.94	0.94
P4	West Full Crossing	53	38.2	LOS D	0.2	0.2	0.74	0.74
All Pedestrians		211	47.4	LOS E			0.82	0.82

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: 101v [PM_Waterloo Road_Byfield Sreet_2021 Base+Dev+Upgrades]

Network: N101 [2021 Base+Dev+Upgrades PM - update]

Waterloo Road_Byfield Sreet
PM
2021 RMS Base+Development+Upgrades
Signals - Fixed Time Isolated Cycle Time = 139 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Byfield Sreet (350m)													
1	L2	119	1.8	119	1.8	0.101	7.8	LOS A	1.8	12.8	0.28	0.59	38.7
3	R2	16	0.0	16	0.0	0.027	57.4	LOS E	0.4	3.1	0.87	0.66	19.8
Approach		135	1.6	135	1.6	0.101	13.6	LOS A	1.8	12.8	0.35	0.60	33.7
East: Waterloo Road (155m)													
4	L2	36	0.0	36	0.0	0.174	33.3	LOS C	3.6	38.6	0.67	0.59	28.4
5	T1	752	9.5	752	9.5	0.500	32.5	LOS C	19.3	136.5	0.78	0.68	14.4
Approach		787	9.1	787	9.1	0.500	32.4	LOS C	19.3	136.5	0.77	0.67	15.3
West: Waterloo Road (380m)													
11	T1	899	8.0	899	8.0	0.285	5.5	LOS A	8.6	61.1	0.33	0.29	51.5
12	R2	294	1.4	294	1.4	0.380	15.5	LOS B	6.6	46.6	0.64	0.76	41.6
Approach		1193	6.4	1193	6.4	0.380	7.9	LOS A	8.6	61.1	0.41	0.41	48.0
All Vehicles		2115	7.1	2115	7.1	0.500	17.5	LOS B	19.3	136.5	0.54	0.52	35.1

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Largest change in Average Back of Queue or Degree of Saturation for any lane during the last three iterations: 7.3 %
Number of Iterations: 10 (maximum specified: 10)

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P1	South Full Crossing	53	39.0	LOS D	0.2	0.2	0.75	0.75
P4	West Full Crossing	53	63.8	LOS F	0.2	0.2	0.96	0.96
All Pedestrians		105	51.4	LOS E			0.85	0.85

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.