North Penrith Development

Transport Mobility and Accessibility Plan (TMAP)

Summary

This report assesses the traffic and transport impacts as required by the Director General for the North Penrith project. This is in support of an application under Part 3A of the EP&A Act for a Concept Plan and Project Application.

Objectives

The objectives of this TMAP are to:

- manage the transport impacts of the North Penrith development on surrounding sites and transport networks
- suggest ways to reduce growth in overall Vehicle Kilometres Travelled forecast to be generated by development, both by cars and commercial vehicles
- help reduce reliance on the private car
- maximise the use of public transport, walking and cycling for new and current trips in the vicinity of the development.

This TMAP will also address planning requirements for a future bus corridor through the development, linking Coreen Avenue to interchange on the southern side of Penrith Station.

Methods and findings

The proposal for master planned, mixed use community at North Penrith aligns with the objectives of the 2010 State Plan, its Metropolitan Transport Plan and the Metropolitan Strategy. It is designed to maximise the advantages of a key site adjacent to a train station with frequent and express train services as a location for new jobs and residences. It is within walking distance of the existing facilities and services of the Penrith CBD and Penrith Interchange. Its mix of land uses is the best means to reducing the length of future trips and encouraging the use of more sustainable modes, such as walking and cycling, and reducing the demand for parking for local activities.

The Project would improve access for bus routes from the north to Penrith Station, and make provision for a grade-separated underpass under the Western Rail Line so future buses could directly serve both sides of the Station. Such a facility would not only encourage use of transit to and from this site, but support new bus services to other planned major developments.
The combined impact of these improvements will be a shift towards greater public transport use and growth and advancement without previous levels of traffic congestion on the road network.

After considering how to first improve the use of transit and active modes, the remaining traffic growth was distributed across the local road network. The surrounding road network has existing congestion points at the intersections of:

- Parker Street and the Great Western Highway
- Castlereagh Road/Great Western Highway and the nearby junction of Castlereagh Road and Jane Street.

The amount of traffic expected to be generated by other approved or planned major developments in the area is estimated to require extensive road upgrades to maintain network performance. Once these improvements are in place, the additional traffic generated by this Project could largely be accommodated within either the capacity of the existing road network, or within the capacity created by the road upgrades for other developments. The upgrades required to mitigate the impact of this Project without the other developments, is a small subset of those required for all potential developments.

An appropriate road hierarchy and street designs have been produced for the Project. The public domain of the site has been laid out to achieve maximum permeability for walking and cycling. Good direct footpaths have been designed, mindful of key destinations such as the station, local shops, open space and bus stops. The future bus streets have been planned to provide priority for transit routes and good local connections to future bus stop locations. Cycle routes from Coreen Avenue to Penrith Station have been planned for directness and safety through the site.

Parking rates proposed are lower than those in Penrith Council's Draft DCP 2008. This is a deliberate part of the policy to encourage alternatives to car travel, but is also in accord with design principles to reduce the need for parking. However, the planned commuter parking station is both supported by the design, while it is not intended to be used by the residents or visitors to the North Penrith development.

The Project has planned for the access needs of the retained Penrith Training Depot and the new multi-level commuter car park. The Army's occasional need for large and oversized vehicles to leave its site has been accommodated in the new street plan, with a full swept path requirement analysis of the route of these larger vehicles.

Smart travel initiatives, such as the production of Travel Access Guides and Workplace Travel Plans, and requiring commercial developments to provide cyclist facilities have been included to assist in achieving the reductions in car usage.

Consultation

In the preparing this TMAP, the RTA, Transport NSW, Penrith Council and RailCorp were consulted as stakeholders. Any issues they raised are documented and addressed in this report.

Conclusions

The Project has demonstrated that it intends to capitalise on its strategic location adjacent to Penrith CBD and Station to reduce future car use while encouraging and facilitating the use of public transport, walking and cycling alternatives. The transport provisions outlines in the Package of works (see Section 5) are sufficient to manage the transport impacts of the Project on transport network performance. Of all the planned major developments in Penrith LGA, this Project is the most likely to have a reduced scale of traffic impact (per dwelling/per square metre of commercial space) because of its location on the rail and bus networks, its planned internal movement system and its balance of uses so many activities can be carried out locally. It strengthens the Penrith

Town Centre, and adds value to the proposed multi-level commuter car park. It achieves new housing and business options within the Penrith CBD, while respecting the heritage values of the site.

Recommendations

In order to achieve the traffic objectives of the Project, and to manage the traffic growth and local amenity for surrounding areas, the following actions are recommended:

Road network improvements

1. Upgrade turning space for large vehicles at the existing intersection of Coreen Avenue and the commuter car park road.

2. Provide one-lane roundabout at the new intersection of Coreen Avenue and the site entrance.

3. Road network capacity improvements are required to accommodate the future traffic flows forecast across the road network with, or without, the North Penrith Project. Due to the uncertainty of the timing and final activities associated with other developments in the Penrith area, the road network upgrades are proposed for those with a more direct nexus to the Project. Based on discussions with Landcom, upgrades of the following intersections are proposed:

    - Coreen Avenue/new site entrance road
    - Coreen Avenue/Coombes Drive (eastern intersection)
    - Coreen Avenue & Commuter car park road.

Travel plans

4. This project transport report will set a framework for use of travel modes, parking demands and traffic generation that will apply to subsequent users of the site. Landcom, through conditions on its future sales and tenancy agreements, will produce Transport Access Guides for new residents and require commercial tenants to produce a Workplace Travel Plans for their employees and clients.

5. Development controls will require commercial premises to provide cyclist end-of-trip facilities in accordance with the Planning guidelines for walking and cycling (NSW Planning, December 2004).

Transport works in kind by proponent

6. The widened kerbside lanes along the public transport corridor to Coreen Avenue, and the interchange facilities in the plaza adjacent to the station to promote the use of transit for travel.

7. Land reserved for a bus underpass of the Western Rail Line to promote the future development of the CBD bus network.

8. Direct and safe cycle and pedestrian routes from Coreen Avenue to Penrith Station to promote active modes as access to transit and for travel to the local CBD.

9. A wide plaza and good pedestrian access from Penrith Station to the new commuter car park.

10. Landcom will provide an upgraded access road to the commuter car park.

Cost, timing, apportionment

The estimated cost of the proposed road network upgrades, the apportionment to the North Penrith project on the basis of traffic growth contribution, and the proposed timings are shown in Table 1.

Table 1 Road network upgrade and contribution package

Upgrade	Est. Cost	Timing
Intersection of Coreen Avenue & Coombes Drive	$25,000	On completion of Stage 2A
Intersection of Coreen Avenue & Site Boulevard	$770,000	On release of Stage 1A
Intersection of Coreen Avenue & Commuter car park road	$30,000	On occupation of the Supermarket
Total cost	$825,000	

The cost of producing and implementing the travel plan is estimated at approximately $150,000 based on the number of residents and employees.

The timing of the introduction of bus lanes or peak period clearways is likely to be beyond the timeframe addressed in this study and would be determined by Transport NSW in conjunction with the other stakeholders. The timing of the planned bus underpass of the Western Rail Line is dependent on the level of congestion on the arterial road network and how that impacts upon bus reliability and speeds. This is in turn dependent on the timing and scale of other developments, such as the North St Marys and Penrith Lakes projects. It is also important that the preferred movement plan for the Penrith Business Centre be accepted and the bus tunnel integrated into that scheme so that it delivers the most benefits for the whole transport network.

Contents

1. Objectives of assessment

At a glance

This report assesses the traffic and transport impacts of the North Penrith project to support an application under Part 3A of the EP&A Act for a Concept Plan and Project Application. It addresses the Director General's Requirements as they relate to transport for the Master Plan.

Introduction

Landcom is preparing to submit an Environmental Assessment (EA) for Project Application and Concept Plan approval under Part 3A of the Environmental Planning and Assessment Act (1979) (EP&A Act) for a mixed-use development at North Penrith (the Project). Concurrently, a Project Application approval is being sought for Stage 1A and 1B of the Concept Plan proposal.
The Concept Plan contains these works, as well as a Stages 2, 3 and 4.

The purpose of this Transport Management and Accessibility Plan (TMAP) is to provide an assessment of the potential traffic and transport impacts for the EA and recommend key actions to reduce them. The report has been prepared to address the traffic and transport-related issues raised in the NSW Department of Planning, Director General's Requirements (DGRs), issued on the basis of the project Master Plan.

Background

The North Penrith project site abuts directly onto State rail land north of Penrith Station. It was previously used as an army base for the Royal Australian Engineers until 1994. It retains one building on the Commonwealth Heritage List, Thornton Hall, in the eastern part of the site. Plans are for it to be retained, renovated and used as a single dwelling. Adjoining land uses includes an army depot, a museum, industrial uses, a rail line and residences.

The site is part of a land holding currently occupied by the Department of Defence's Penrith Training Depot, with rail commuter car parking permitted with access to Penrith Train Station. The Penrith Training Depot activities will continue on an area of land retained by the Department of Defence. The previous army buildings on the site have been demolished. A new 1,000 space multi-level commuter car park will be constructed by Penrith City Council and leased in an arrangement with RailCorp. These activities are not associated with this development and neither is included in the Project Application or the Concept Plan, although their access is maintained and where appropriate enhanced, through the future access network.

The Project site has been the subject of planned redevelopments in various formats since 1990. These have not proceeded for a variety of reasons.

Study objectives

The Minister for Planning has accepted the proposed development for assessment within the requirements of Part 3A of the Environmental Planning and Assessment Act 1979 as amended.

The DGRs for the Concept Plan and Project Application's assessment were issued by the NSW Department of Planning on 2 July 2010. This report addresses the traffic and transport related conditions for both the Concept Plan and Project Application Stages. The specific DGRs addressed in this report are included in Table 2, along with a reference to the relevant section of this report.

Table 2 DGRs addressed in this report

DGR	Section in report
Concept plan	
1. Provide a Traffic Management and Accessibility Plan (TMAP) to identify the package of traffic and transport infrastructure measures required to support future development. It should identify regional and local intersection and road improvements, vehicular access options for adjoining sites, public transport needs, the timing and cost of infrastructure works and the identification of funding responsibilities associated with the development.	Section 5
2. The TMAP shall be based on a Transport and Accessibility Impact Assessment, prepared with reference to the RTA's Guide to Traffic Generating Developments that satisfactorily addresses:	Section 4
a) Impacts of the proposal on regional and local road networks.	Section 4
b) Opportunities to minimise traffic on sensitive road frontages.	Section 4
c) Proposed access and circulation.	Section 4
d) Efficiency of emergency vehicle access/egress.	Section 4
e) Proposed access from the wider road network as well the opportunities and constraints of alternative vehicular access points.	Section 4
f) Proposed pedestrian and cycle access within and to the site that connects to all relevant transport services and key off-site locations and measures to promote the use of these.	Section 4
g) Details of service vehicle movements (including vehicle type and likely arrival and departure times).	
h) Daily and peak traffic movements likely to be generated by the proposed development including the impact on nearby intersections and the need/associated funding for upgrading or road improvement works (if required). The impact assessment should consider the likely background growth of traffic volumes within vicinity of the site. Projects to be included in the calculation of background growth are to be agreed to by the RTA. The key intersections to be examined/modelled include: ▪ High Street/Castlereagh Road ▪ Jane Street/Castlereagh Road ▪ Coreen Avenue/Castlereagh Road ▪ Coreen Avenue/Richmond Road/Parker Street ▪ New Access/s/Coreen Avenue ▪ New Access/s/Castlereagh Road ▪ Any other intersections affected by the proposed development.	Section 4

DGR	Section in report
i) Assess the capacity of the rail services provided from the Penrith train station to support the proposed development and identify measures to encourage use of the services.	Section 4
3. Provide a road network plan identifying the proposed road hierarchy including cycleways, footpaths and car parking. The plan should identify public, private roads and typical cross sections and long sections.	Section 4
4. The proposed development shall make provision for a public transport corridor through the site which shall include a grade separated road crossing of the railway line linking the northern and southern sides. Details should be obtained further consultation with key officers of the RTA and Transport NSW.	Section 4
5. Demonstrate the provision of minimal levels of on-site car parking for the proposed development having regard to the appropriate parking codes, accessibility of the site and its proximity to public transport.	Section 4
6. Provide an estimate of the trips generated by the proposed development and proposed modal split. Identify measures to manage travel demand, increase the use of public transport and non-car transport modes, and assist in achieving the objectives and targets set out in the NSW State Plan 2010.	Section 2, Section 4
7. Assess the implications of the proposed development for non-car travel modes (including public transport use, walking, and cycling) and the potential for implementing a location specific sustainable travel plan, such as a Workplace Travel Plan (WTP) for workers and a Travel Access Guide (TAG) for residents of the future site.	Section 4, Section 5
Consultation The DGRs request a suitable level of consultation with the relevant NSW Government authorities. For the traffic and transport assessment, these are: ▪ Penrith City Council ▪ RailCorp ▪ NSW Roads and Traffic Authority ▪ Transport NSW.	Section 3
Project application	
Provide an updated Construction Traffic Management Plan (CTMP) to mitigate any potential impacts to public transport, walking and cycling accessibility, amenity, and safety during construction. The CTMP should identify vehicle routes, number of trucks, hours of operation, access arrangements and traffic control measures.	Section 4

Study area

The Project site is located immediately north of the Penrith CBD, in western Sydney, approximately 50 kilometres from Sydney CBD. It covers approximately 40.6 hectares of largely vacant land on the northern side of the Western Rail Line. Access to the northern side of Penrith Train Station is currently gained through the site. The present Penrith CBD is a short walk away on the southern side of the Western Rail Line. The site does not include the land parcel set aside for the new commuter car park, or the land retained by the Australian Army for the PTD.

The study area, shown in Figure 1, locates the site, as well as showing the surrounding areas of Penrith City Council.

Figure 1 Study area and environs

The area surrounding the site includes a variety of land uses, including

- Penrith CBD – Located south of the site, Penrith City Centre is a commercial centre with approximately 100,000 m^2 of commercial office space and 156,000 m^2 of retail floor space (PITLUS). It was estimated that there are around 14,000 jobs in the Penrith city centre (2006 Journey to Work Data). Penrith CBD provides a large range of Government, banking and medical services.
- North Penrith industrial area – located to the north and west of the site, it accommodates around 3,800 jobs and includes a mixture of retail and light industrial businesses (2006 Journey to Work Data).

- Residential areas within the suburb of Penrith to the east, including 2,239 dwellings and around 5,600 residents (2006 Journey to Work Data).
- The Museum of Fire and electricity sub-station located immediately west of the site.
- Nepean Private Hospital, located south-east of the site.

The commuter car park includes formal provision for around 750 parking spaces, but can regularly accommodate up to 850 vehicles, some parked informally. It also includes bicycle lockers and a kiss-and-ride area for rail passenger drop off/pick up. It is accessed from Coreen Avenue, via a one-lane roundabout, located east of the western intersection with Coombes Drive.

The PTD is accesses via The Crescent and Lemongrove Road. It is used by the Army Reserve which has Tuesday evening training, as well as training on one weekend per month. Large vehicles accessing the PTD currently use the site to turn around. Access to the PTD will be maintained to the Army's requirements through the site as well.

Report structure

The report presents the results of the assessment in the following sections:

- Site analysis (Section 2) – a review of the existing transport situation, including road network, traffic conditions, public transport and active transport.
- Planning context (Section 3) – a review of relevant transport policies, guidelines and studies to set the strategic and regional transport requirements the site should address.
- Method and Results (Section 4) provides the majority of the assessment, including:
    - detail of the proposed development including the hierarchy of the roads inside the development
    - the Transit Oriented Design principles included in the development
    - the access points to the road network
    - the impact of the development on the road and transport network
    - on-site parking provision (excluding the commuter car park)
    - how the site will achieve the relevant NSW Government and Penrith Council targets for transport
    - details of the Construction Transport Management Plan measures to be used.
- Assessment (Section 5) presents the conclusions of the study.
- References (Section 6) – a list of the documents referred to during the assessment.

North Penrith project

Landcom is proposing to develop the North Penrith site for a mixed land-use development, including residential (including a component of affordable housing and aged housing), retail, commercial, industrial and open space. The Project will have elements of a transit-oriented development with high quality urban design. The details of the Project are shown in Table 3.

Table 3 Indicative development yields

Future uses	Indicative outcomes
Housing	900-1,000 dwellings in a range of price points and dwelling types.
	Affordable housing, including housing for moderate-income earners, social housing and 100 for retirement/aged care housing.
Urban design	A local centre to meet the full range of community needs integrated into the urban form, with around 3,200 m^2 of retail (including a supermarket of 1,700 m^2) and 9,300 m^2 of commercial uses.
Recreation	7.2 hectares of open space including a new oval, water parks and pocket parks.
Industry	13,371 m^2 of industrial uses.
Transport	Elements of a transit orientated development with a movement network that promotes trip containment, walking, cycling and public transport.
Employment	Up to 770 direct jobs on the site and over 1,100 flow-on jobs

The site has been planned to locate the highest trip-generating land uses and highest density residential land close to Penrith Station and Interchange to maximise the convenience of public transport services. The land use plan is shown in Figure 2.

Figure 2 Land use plan

This also serves to create a village centre which complements the CBD across the pedestrian bridge within the Station. It contains spaces suitable for a range of services, to become a focus of life in the community. These attractions will increase the trip containment within the development. A station square in front of Penrith Station will create a public open space suitable for the pulses of heavy pedestrian movements that come when trains disgorge their peak passenger loads. Access between the new commuter car park and Penrith Station has been provided through the station square as well. The supermarket and other speciality stores would provide services for commuters so trips can be combined and travel made more efficient.

Roads, footpaths and cycle routes converge on the village centre, assisting in providing convenient access to Penrith Station. Four access points connect the development to the road network, including:

1. a new access to Coreen Avenue, west of Coombes Drive (eastern intersection)
2. the existing commuter car park access road
3. a connection through to the Castlereagh Road/Peachtree Road intersection; and
4. a connection to The Crescent near the current entrance to the PTD.

The site layout is shown in Figure 3.

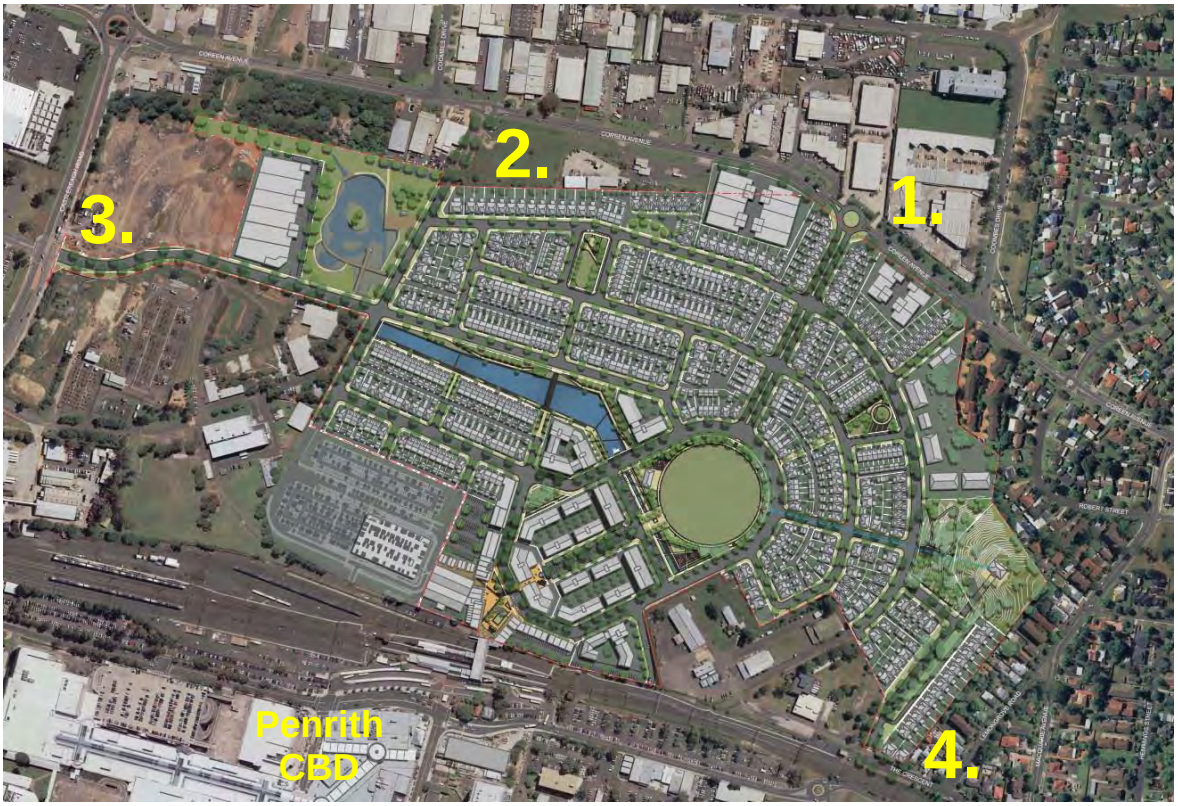

Figure 3 Indicative site layout plan

Staging

The development is planned in two main stages. The Concept Plan covers both stages. The first stage is the subject of the Project Application. The staging plan is shown in Figure 4.

Whilst the land for the village centre would be created and zoned by the end of the Stage 2A, it may not be fully occupied by the time the releases in subsequent stages, depending on the demand for commercial buildings and retail shop take-up.

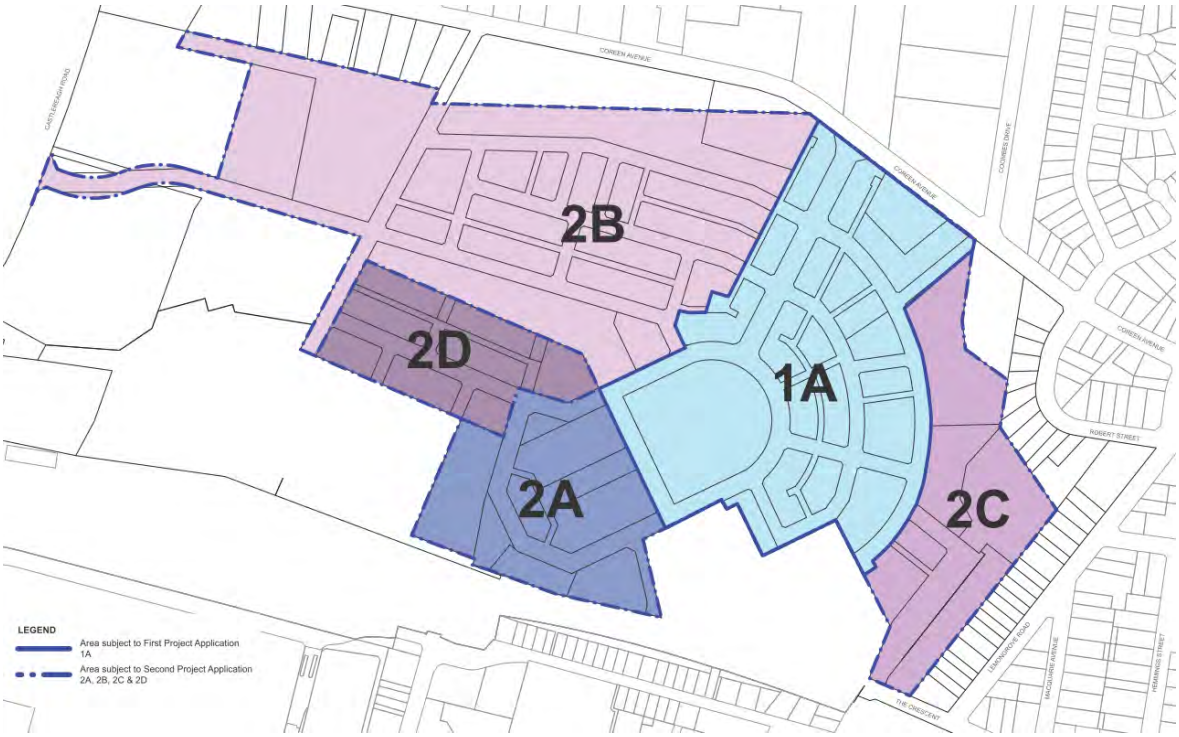

Figure 4 Staging plan

Types of residential development

The types of housing planned for the North Penrith project are likely to suit particular demographic groups that are not well-served by the standard development in Penrith LGA. Residential development will be a mixture of: loft studio apartments; 1, 2 and 3 bedroom apartments; 2 and 3 bedroom medium density dwellings (with, and without ancillary flats), affordable housing and aged care housing.

It is anticipated that this project would attract residents from market segments including:

- young couples and singles, typically without children
- University students (due to the convenient access to UWS)
- mature aged couples without children
- retirees
- low and moderate-income earners.

This demographic differs from the typical housing market in Penrith, where standard-sized single dwelling houses and family-focussed residences are more common. It is anticipated that these target residents would generate fewer car trips per household than a single dwelling property occupied by a family.

Based on the results of a social and economic assessment by SGS Economics and Planning, it is anticipated that the average number of residents per dwelling for the Project would be **2.0 people per dwelling**.

Transit Oriented Development Principles

The Project includes a small mixed use village centre and residential development. The development is intended to adopt as many functions of a TOD as is practical. The plan focuses on a 400 metre access zone and 800 metre access zone from the station area as shown in the concentric arcs in Figure 5. These distances are indicative of a potential 5 and 10 minute walking trips, considered to be a distance for station access conducive to higher public transport use. The existing Penrith Town Centre is located to the south of the Penrith Station. As shown in Figure 5, the Project site all falls within 800 metres (or a 10 minute) walk of the rail station, with the highest density closest to the Station.

The existing Penrith CBD is located immediately south of Penrith Station and joined directly by pedestrian access to and through the station. The Project 'village centre' aims to create a mixed use, medium density environment, with an attractive network of streets and spaces that connect key local assets and provide excellent permeability to the rail station, as well as permeable connection for vehicles, cyclists and public transport to adjacent existing development areas across Coreen Avenue to the north, and Castlereagh Road to the west.

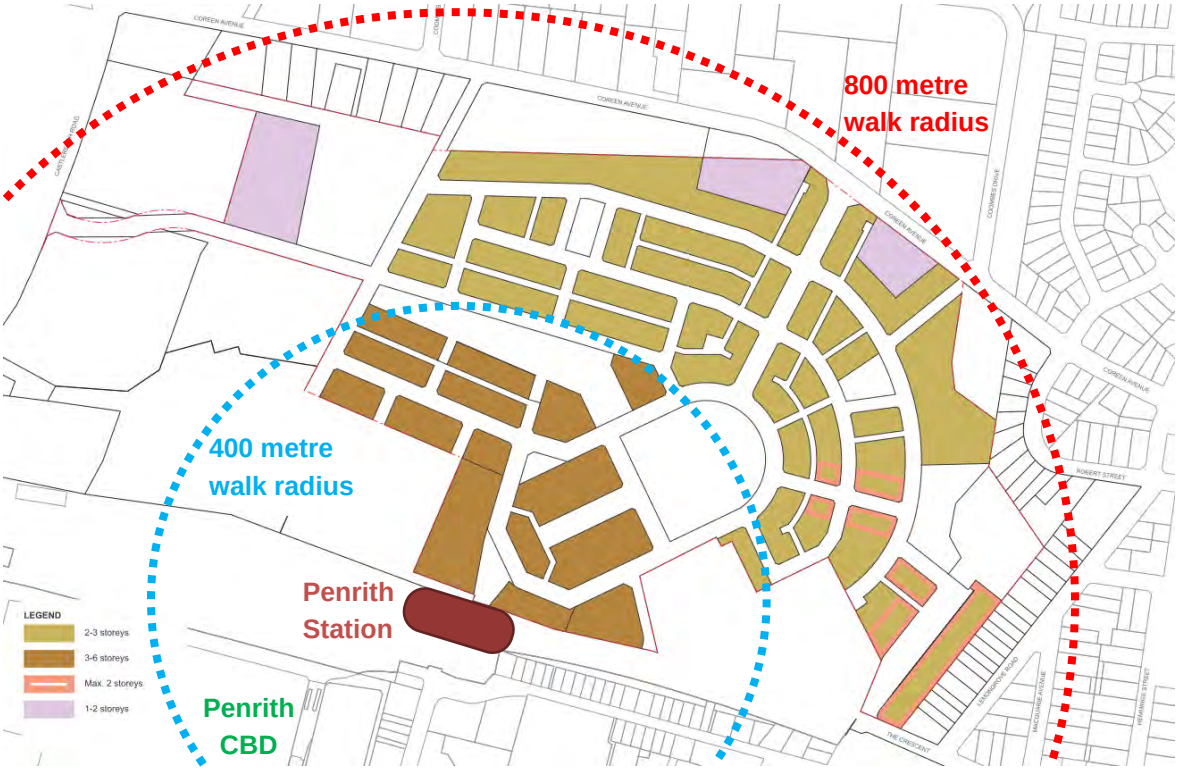

Figure 5 Building height and distance from Station

The key transformative changes targeted for North Penrith Village Centre are:

- *Transit Supportive Design* - The density, scale, design, mix of uses and reasonably direct connection of the station into the Penrith Village Centre should result in an exemplary project for its size and scale.
- *Transit Supportive Density* - Perhaps more than any other factor, density is critical to increasing transit orientation of new development. The medium density of the Project will add appreciably to its performance as a TOD, particularly in comparison to existing land uses in Penrith. Although small in scale, and thus termed more of a 'village' as compared to a 'town' (where a greater mix and development intensity would be expected), the residential density in close proximity to the station is reasonable (within 200-300 m there are expected to be limited 3-6 storey heights). Overall the master plan design and mix of uses in close proximity to the rail station with high frequency bus services stopping on main-street near the station square should create activity and transit supportive density/development.
- *Compact Pedestrian-Oriented Design* – The North Penrith master plan incorporates an attractive pedestrian environment in its design including the main street, civic mixed use area and with good connections between rail station, on-street bus stops and the park-and-ride facility. In addition, the general layout of the overall development provides excellent pedestrian permeability between the residential areas and the village centre.
- *Reduced Automobile Use*. The proposed density of the Project, the location adjacent to the station, and the mix of land uses to reduce trips lengths, can all be expected to encourage more walking, greater transit ridership and reduce the growth in use of the automobile.
- *Broader Synergistic Benefits*. The direct integration of high-quality development into the Penrith Village Centre can be expected to have a synergistic impact on public transport ridership by creating an attractive destination and improving the station environment for passengers. In addition, the North Penrith development should benefit the Penrith Town Centre (on the southern side of Penrith Rail Station) providing about 2,000 additional residents to support businesses and services in the Town Centre.

Key issues

The key transport issues for achieving a sustainable, liveable community, whilst minimising the impact on surrounding areas are:

- Capturing the maximum benefit from the site's favourable location on a frequent service transport interchange and within an easy walk of the Penrith CBD.
- Providing a legible and permeable street and footpath network, with street characteristics that encourage active travel behaviour.
- Linking regional bus services travelling from areas outside the site directly to Penrith Interchange.
- Adopting parking rates that reflect and endorse the lower demand for car travel, yet which facilitate the efficient operation of shops and businesses in the village centre.
- Accommodating the transport needs and impacts of the commuter car park and PTD.

- Adding trips to an external road network that already experiences congestion at key points, and which is expected to accommodate traffic from significant redevelopment elsewhere in Penrith.

These are challenges for the Project which have been addressed to deliver a sustainable transport plan. The proposed solutions are both practical and achievable in the context of the nature and location of the development.

2. Site analysis

At a glance

The North Penrith site is a key location on the Metro region's transit network, with walking distance access to frequent, express train services, Penrith Interchange buses and to Penrith CBD. Due to location and design, travel to/from the development will include more train and walking trips and fewer car trips than the typical development in Penrith LGA.

There are existing congestion points on the arterial road network during the AM and PM peak travel periods, including:

- The intersections of Great Western Highway/High Street/Castlereagh Road/Mulgoa Road and Castlereagh Road/Jane Street.
- The intersection of Great Western Highway and Parker Street.

Travel behaviour

Travel behaviour varies widely, but certain characteristics can be grouped depending on the:

- reason for the journey
- the time it occurs
- the mode or combination of modes of transport used.

There are several useful sets of data for estimating these travel characteristics for this area:

- Australian Bureau of Statistics publishes broad travel data gathered from the questions asked in the 5-yearly Census. Useful data includes the population, number of dwellings, purpose of travel, mode of travel and number and time of trips made.
- The Census results for NSW are further analysed by the Bureau of Transport Statistics (BTS) (formerly Transport Data Centre), within Transport NSW. The Journey to Work data set analyses work commuting trips and links their origin and destination, creating a matrix of movements around the Sydney Greater Metropolitan Area (GMA). This is useful to determine the current directions of travel to and from an area.
- BTS also undertakes a continuous Household Travel Survey (HTS) of a sample of people living in the GMA, where respondents complete a diary of their travel patterns for all purposes. The results are compiled on an annual basis.

Due to the sample size, only certain types of data are available from each data set.

Number of daily trips per person

The 2008/2009 release of HTS data indicates that people in Sydney GMS made 3.76 trips per person per day (Table 4.1.3). The 2007 Key Transport Indicators for the HTS indicates that Penrith Local Government Area (LGA) residents made approximately the same number of trips per person per day as the typical person in the GMA.

Reason for travelling

Trips generated from dwellings can be made for several reasons, which can often have different destinations and modes of travel. These purposes can include: commute to work, work related business, education/childcare, shopping, personal business, social/recreation, serve passenger or other. For the purposes of this study, these categories have been amalgamated to those shown in Table 4. Data from the 2007 and 2008/09 releases of the HTS for Sydney GMA and Penrith LGA were used to calculate these statistics. Travel behaviour during the AM peak can be different from those across the whole day (for example more education trips in the morning peak, more shopping trips during the middle of the day), so percentages are presented for both daily and AM peak trips.

Table 4 Reason for travel

Reason for travel	Weekday % of all trips	AM peak % of all trips
Commute, work related business	35%	33%
Education/Childcare	13%	37%
Shopping, personal business	28%	19%
Other, social/Recreational	24%	11%
Total	100%	100%

Source: HTS 2007 and HTS 2008/09
Note: Trips to serve passenger were apportioned across the other four categories and included in their percentages.

Transport mode share

The choice of travel mode varies depending on the range of transport services available, the length of the journey and the reason for travelling. The change in mode split for selected geographic areas is illustrated in Table 5.

Table 5 Method of travel from home to work for selected areas

Area	Sydney GMA	Penrith LGA	Penrith centre	Strathfield centre	Liverpool centre	Hornsby centre
Car, driver	61%	77%	65%	53%	63%	50%
Car, passenger	6%	7%	8%	5%	9%	5%
Train	16%	11%	15%	34%	17%	35%
Bus	7%	1%	1%	3%	3%	1%
Cycle	(see other)	0%	1%	0%	0%	0%
Walked only	8%	2%	9%	5%	7%	9%
Other	2%	1%	0%	0%	0%	1%
Total	100%	100%	100%	100%	100%	100%

Source: Sydney GMA = HTS 2008/09, Rest = ABS 2006 Census

Travel by residents in Penrith LGA by car is high - a mode share of 77% vehicle driver and 7% vehicle passenger. This is higher than for Sydney GMA as a whole. The suburb or town centre of Penrith (as defined by ABS) has a much lower car driver mode share, and is comparable to other regional centres with good access to train services. The suburb of Penrith has employment, schools and services within walking distance of housing, and has more convenient access to the train station, compared to the whole of Penrith LGA.

The HTS 2008/09 data provides data on the relative use of different modes of travel for different trip purposes for Sydney GMA. This is shown in Figure 6. It shows that the private car is used predominantly for commuting and business. Public transport is predominantly used for commuting and education, while walking is used for a significant percentage of trips made for shopping, recreation or personal business.

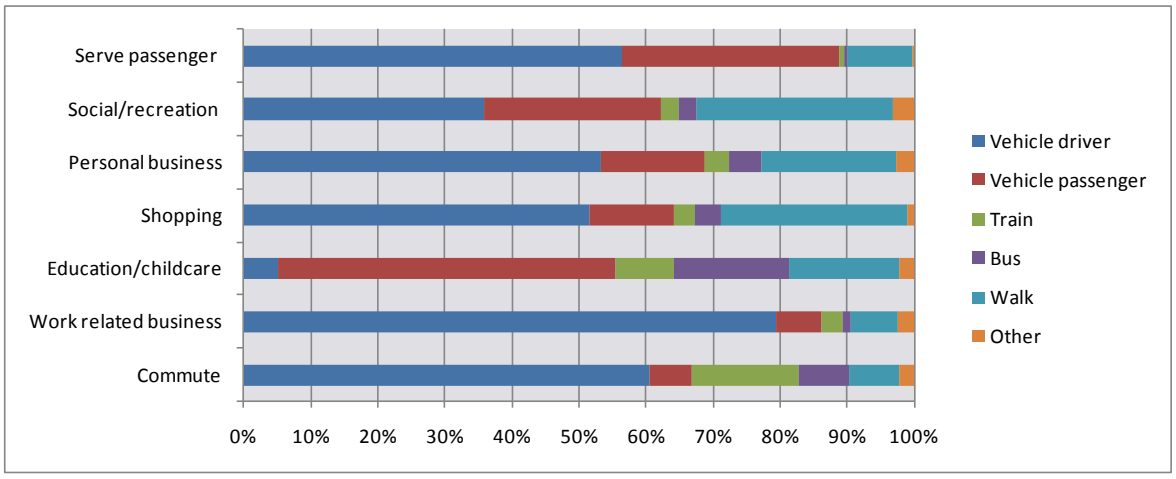

Figure 6 Mode of travel by trip purpose for Sydney GMA (Source: HTS, 2008/09)

The mode split for journey to work trips to Penrith, either from inside or outside the LGA is described in Table 6. The North Penrith site is within the western half of Penrith LGA. Mode splits from other Council areas are presented for comparison.

Table 6 Method of travel to work (by destination) to selected areas

Area	Penrith LGA West	Penrith LGA East	Penrith LGA	Strathfield LGA	Liverpool LGA	Hornsby LGA
Car, driver	81%	83%	82%	80%	81%	75%
Car, passenger	9%	8%	8%	6%	8%	7%
Train	4%	3%	4%	8%	4%	9%
Bus	2%	1%	1%	1%	2%	1%
Cycle	1%	1%	1%	0%	1%	0%
Walked only	3%	3%	3%	3%	4%	6%
Other	1%	1%	1%	1%	1%	1%
Total	100%	100%	100%	100%	100%	100%

Source: ABS 2006 Census

These data sources have been used to determine the mode split likely for the North Penrith project. The adopted mode split, shown in Table 7, is based on that of the suburb of Penrith. The mode splits for other residential purposes have been based on those for Penrith LGA or Sydney GMA as appropriate and adjusted on a pro-rata basis.

Table 7 Mode split for the North Penrith project

Mode of travel	Residential				Retail	Commercial	Industrial
	Work	Education	Shopping	Recreation			
Vehicle driver	64.8%	4.0%	44.1%	36.0%	44.1%	64.8%	64.8%
Vehicle passenger	8.3%	58.8%	17.4%	35.2%	17.4%	8.3%	8.3%
Train	15.1%	5.3%	2.2%	1.2%	2.2%	15.1%	15.1%
Bus	1.5%	10.6%	2.9%	1.1%	2.9%	1.5%	1.5%
Walk	8.9%	18.7%	31.5%	24.4%	31.5%	8.9%	8.9%
Cycle	0.9%	1.6%	1.3%	1.4%	1.3%	0.9%	0.9%
Other	0.5%	0.9%	0.7%	0.8%	0.7%	0.5%	0.5%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Car ownership

The number of cars owned per dwelling is a measure of an area's ability to generate traffic. Many new land release areas have high number of vehicles per dwelling, indicating that more people in the household have the ability to drive. Car ownership is influenced by the number of people per dwelling. Table 8 shows that Penrith suburb has a lower level of car ownership than both Penrith LGA and the Sydney Statistical Division (GMA without Newcastle, Central Coast, Blue Mountains, Southern Highlands and Wollongong).

Table 8 Car ownership per household

Car ownership per household	Penrith Suburb	Penrith LGA	Sydney Statistical Division
No vehicles	23%	9%	13%
1 vehicle	40%	32%	36%
2 vehicles	20%	36%	30%
3 vehicles or more	7%	17%	12%
Not stated	10%	6%	9%
Total	100%	100%	100%

Source: ABS, Census of Population and Housing, 2006, as reported on Penrith City Council website – Community Profile (accessed on 1 October 2010)

Converting the percentages from Table 8 above, the average number of vehicles per household for Penrith suburb is 1.01, for Penrith LGA is 1.55 and for Sydney Statistical Division is 1.32. Whilst not a direct measure of car usage, and adjusting for the number of people per dwelling, the Census results indicate that people in Penrith suburb, close to Penrith Station, have fewer cars than the average person living in Penrith LGA.

Direction of travel

The direction of travel has been assessed for both trips to and from the site. This has been based on the 2006 Census 'Journey to Work' (JTW) data. This dataset divides the Sydney GMA into local government areas, which are then divided further into 'travel zones'. For the distribution part of this assessment, the 'travel zone' system was selected as it enabled the origin or destination of trips to be identified inside and outside Penrith LGA.

Trips from North Penrith

The trip distribution for journey to work trips in the AM Peak from the North Penrith area is shown in Figure 7. As the travel zone containing the North Penrith site currently has no residential population, the characteristics of the neighbouring Lemongrove residential area (covering the area bounded by Lemongrove Road, Coreen Avenue, Parker Street and the Western Rail Line were used as typical of the present situation.

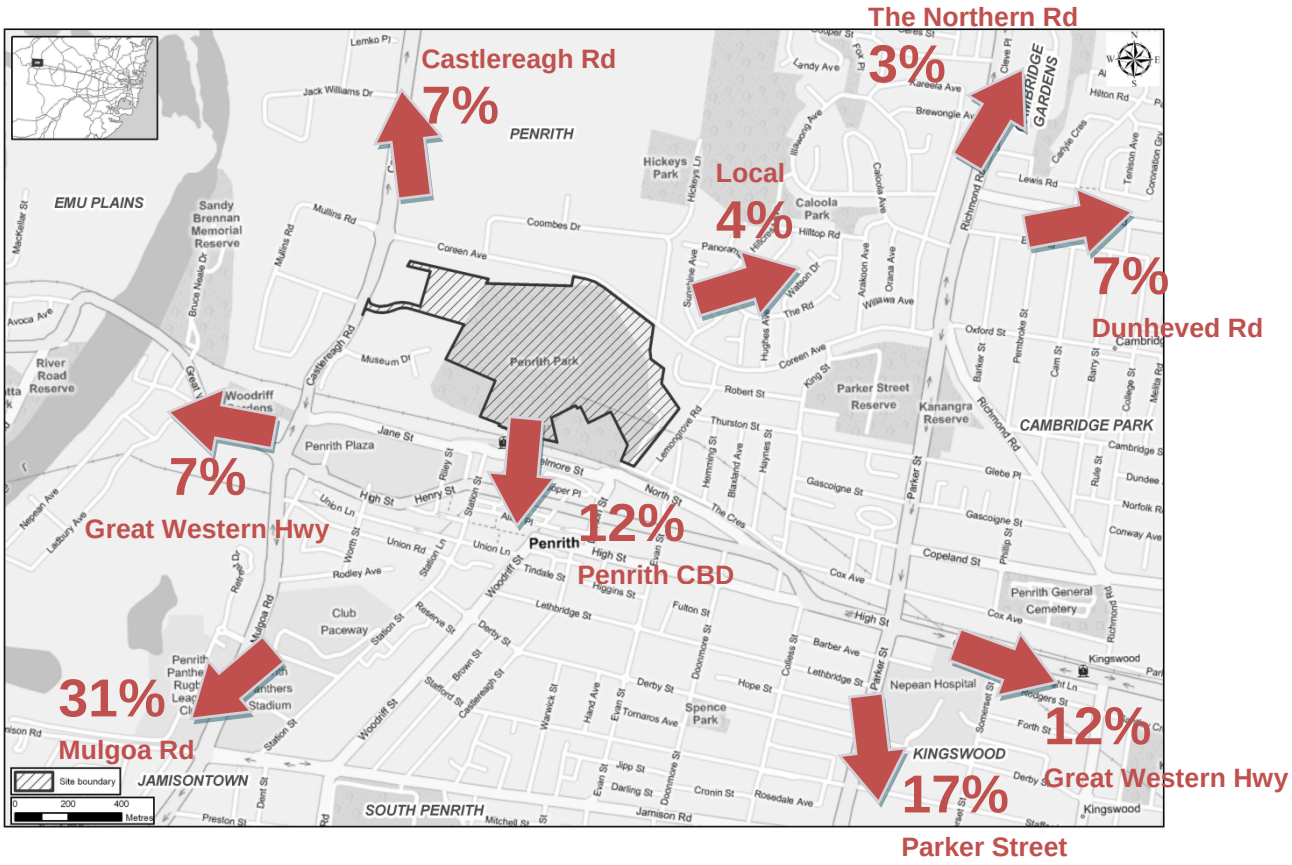

Figure 7 Direction of travel from the North Penrith site

The results show that:

- 45% of JTW trips stay within Penrith LGA
- 15% travel to Blacktown LGA
- 9% travel to Parramatta LGA
- 4% travel to each of the Blue Mountains and Hawkesbury LGAs
- 27% other LGAs.

Trips to North Penrith

The trip distribution for journey to work trips in the AM Peak to the North Penrith area is shown in Figure 8. The travel zone containing the North Penrith site also included the existing employment areas along Coreen Avenue and Coombes Drive.

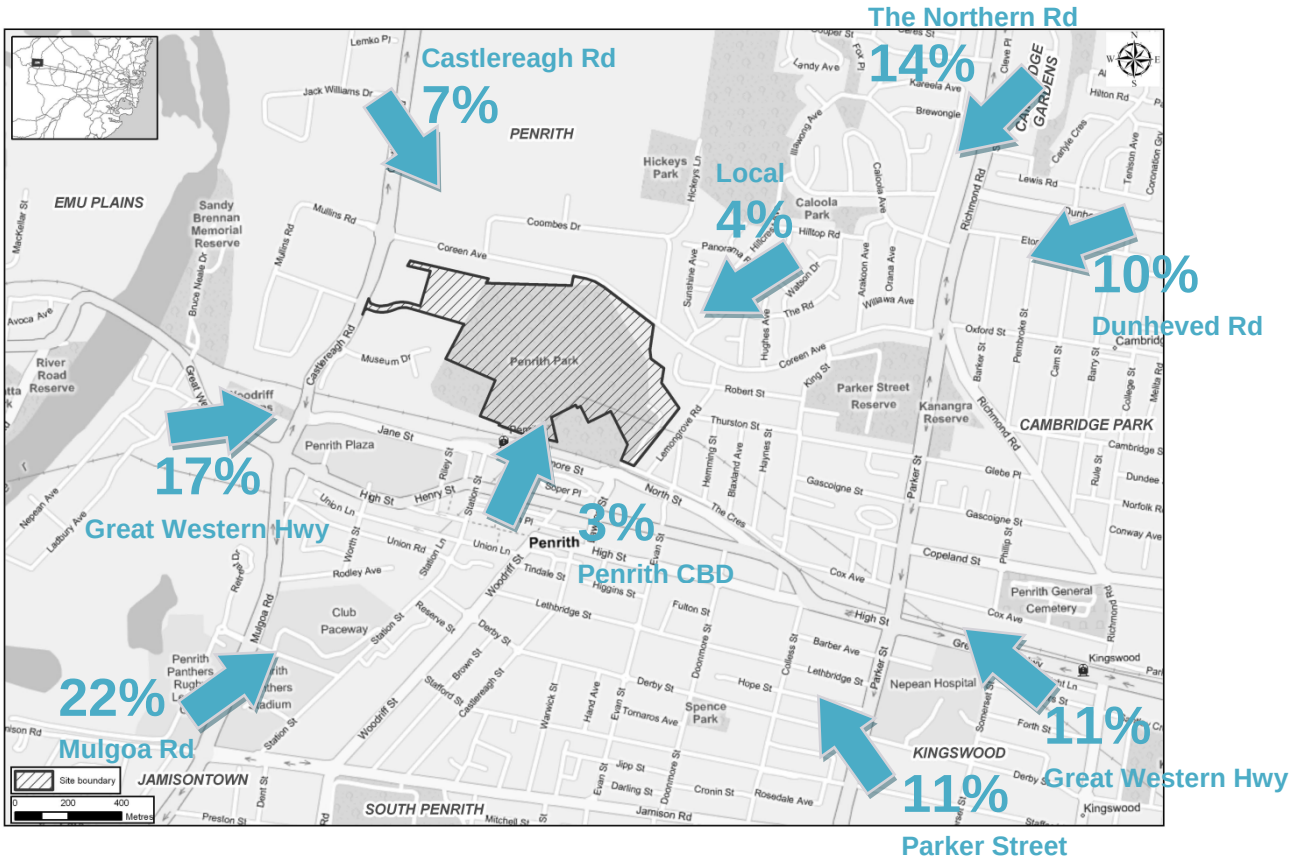

Figure 8 Direction of travel to the North Penrith site

The results show that:

- 55% of JTW trips originate from within Penrith LGA
- 13% travel from Blue Mountains LGA
- 10% travel from Blacktown LGA
- 5% travel from Hawkesbury LGA
- 17% other LGAs.

Public transport

Rail services

Penrith Station is served by the Western Line and the Blue Mountains Line providing direct links to Sydney CBD in the east (the Western Line continues north to Berowra as the North Shore Line and to Lithgow in the west. This part of the rail corridor is served by only two tracks which is a limiting factor in terms of rail capacity. The Western Express project, being planned and assessed by Transport NSW would increase the capacity for train services from Penrith to the Sydney CBD.

Penrith Station received an Easy Access upgrade in 2000 so a wider range of commuters with mobility restrictions could access the station. It included the installation of four lifts, a new overhead concourse, and other safety and security measures. The surrounds of the station have commuter parking for approximately 1,600 vehicles:

- RailCorp car park on the north side of Jane Street - 320 vehicles.
- Penrith Council car park on the north side of Belmore Street - 348 vehicles.
- Penrith Council commuter car parking is provided at Sloper Place, an off-street car park on the south side of Belmore Street - 124 vehicles.
- North Penrith site car parking – 850 vehicles (750 in formal spaces, approximately 100 in informal spaces).

Penrith Station walking catchment covers the entire North Penrith development site. That is, the entire site is within 800 m from the station, as shown in Figure 9. As the North Penrith site is currently vacant, another way of looking at this is that the station is not currently being utilised to its full potential, i.e. a large proportion of the walking catchment is undeveloped land. North Penrith redevelopment provides a good opportunity to increase the mode share of sustainable transport modes for Penrith.

Figure 9 800 m walk catchment from Penrith Train Station

Table 9 shows that on average, there is a combined eastbound rail service every 6 minutes in the AM peak hour and a westbound service every 7.5 minutes.

Table 9 Current train services at Penrith Station

Line	Direction	AM peak hour services	PM peak hour services	Operating hours (from Penrith)
Western Line	Eastbound	7	6	2:58 am - 12.32 am (next morning)
	Westbound	6 (4 terminate)	9 (2 terminate)	5:02 am - 1.10 am (next morning)
Blue Mountains Line	Eastbound	3	2	5:10 am - 12.36 am (next morning)
	Westbound	2	4	5:02 am - 1.10 am (next morning)

Source: CityRail Internet site

Penrith Station was ranked as the 38th busiest based on morning peak passengers entering and leaving the station in the *2008 A Compendium of CityRail Travel Statistics* Sixth Edition, June 2008. Table 10 shows the number of passengers using the station during time periods across a typical weekday.

Table 10 Daily passenger movements at Penrith Station (6:30 am – 9:30 am)

Time period	Entry	Exit
02:00 to 06:00	200	60
06:00 to 09:30	2,870	1,290
09:30 to 15:00	1,560	1,410
15:00 to 18:30	1,890	3,050
18:30 to 02:00	620	1,320
24 Hours	7,140	7,140

Source: 2008 A Compendium of Travel Statistics Sixth Edition (CityRail, June 2008)

For the *Penrith Interchange Scoping Study* (PB, August 2007), PB conducted a passenger survey from 6:30-9:30 on Tuesday, 4 December 2007. Table 11 shows the relative entry and exit numbers from the north and south side. The majority of entries occurred from the southern side, with the northern side numbers reflecting those parking in the northern commuter car park. The 100 people who exited via the northern side could potentially walk to the Coreen Avenue industrial area, or maybe used the northern commuter car park.

Table 11 Morning peak passenger movements at Penrith Station (6:30 am – 9:30 am)

Direction	Entry	Exit
North side	952	102
South side	1,614	1,145
Total	2,566	1,247

Source: PB August, 2008

Information on train loading from RailCorp surveys (undertaken on 11 March 2010) indicates that trains departing towards Central Station are, on average, around 30% full when they depart Penrith during the morning peak. Some services originating the Blue Mountains are at their seated capacity when they depart Penrith Station. In westbound direction in the PM peak, around 50% of trains have some spare seating when they depart Redfern Station.

Penrith Interchange

Penrith Interchange, on the southern and northern sides of Penrith Station, includes bus stands, taxi ranks, kiss-and-ride space, and bicycle facilities including racks and lockers. The layout of the Penrith Interchange is shown in Figure 10.

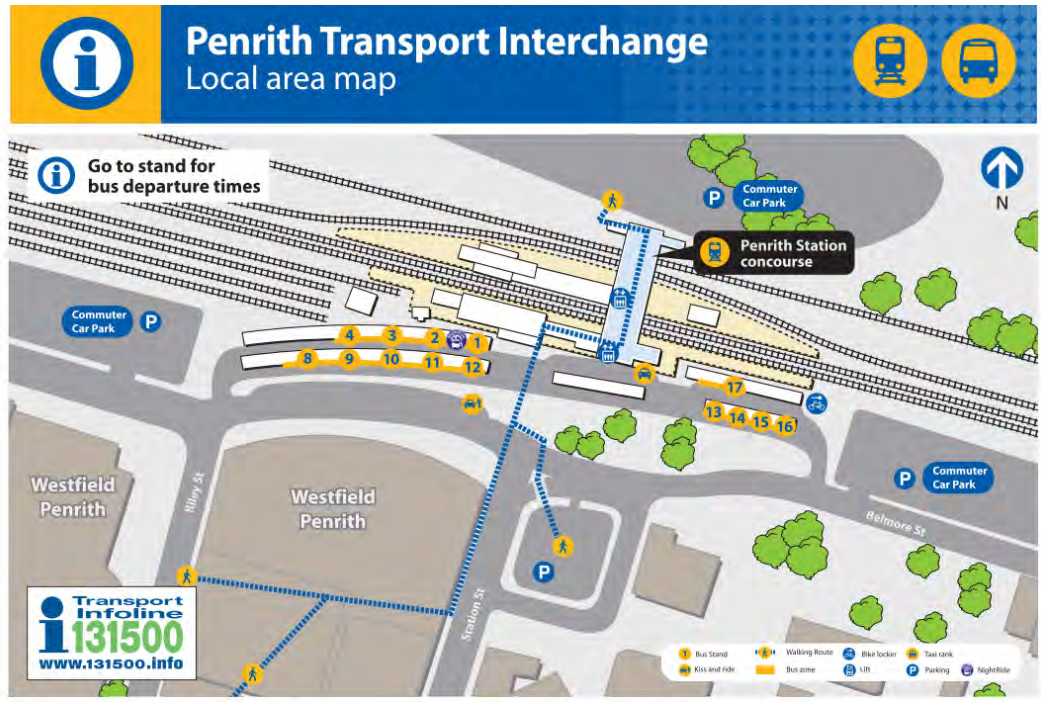

Figure 10 Penrith Station interchange layout (Source: www.131500.info)

Transport NSW is currently considering an Integrated Transport Plan for Penrith that may include the modification of Penrith Interchange. The results of this study were not available in time to be included in this assessment. The *Penrith Interchange Scoping Study* (PB, 2008) considered potential short, medium and long-term modifications to the Interchange. This study is discussed further in Section 3.

Bus services

Penrith is within Region 1 of the Sydney bus network. The local bus network consists of 19 Westbus local routes and three Blue Mountains Bus company routes. Added to these regular public services are special school bus trips. Many of these bus routes serve the areas south and West of Penrith. The buses that travel north from Penrith include:

- Northeast services – northeast of the rail line, serving St Marys, operated by Westbus – 780, 782, 785, N3 + north eastern school services.
- Northern services – north of the rail line, serving Cranebrook to Windsor, operated by Westbus - 673, 677, 678, 784, 786 + northern school services.

Many of these travel within the vicinity of the North Penrith site. The Westbus network is shown in Figure 11. The Blue Mountains Bus company services travel west from Penrith CBD.

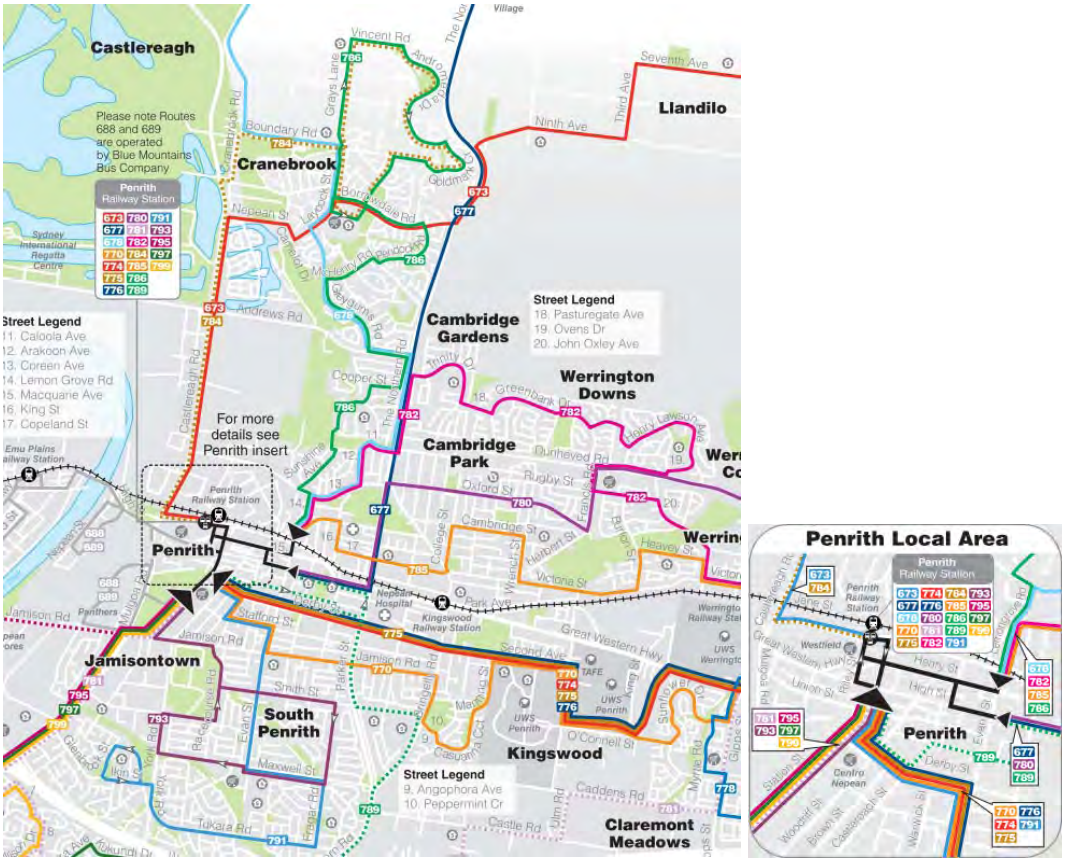

Figure 11 Penrith Bus Network (Source: Westbus Region 1 Map, October 2009)

As shown in the inset of Figure 11, the focus of the Penrith bus network is the interchange on the southern side of Penrith Station.

As a result of the 2003 Unsworth Review of bus services, the focus of the bus network was placed on 'strategic bus corridors', designed to provide high-frequency, reliable services between regional centres. Penrith has two strategic corridors, as shown in Figure 12. These include:

- Strategic Corridor 1A: Penrith to Mount Druitt via Coreen Avenue and Dunheved Road.
- Strategic Corridor 2: Penrith to Mount Druitt via the Great Western Highway.

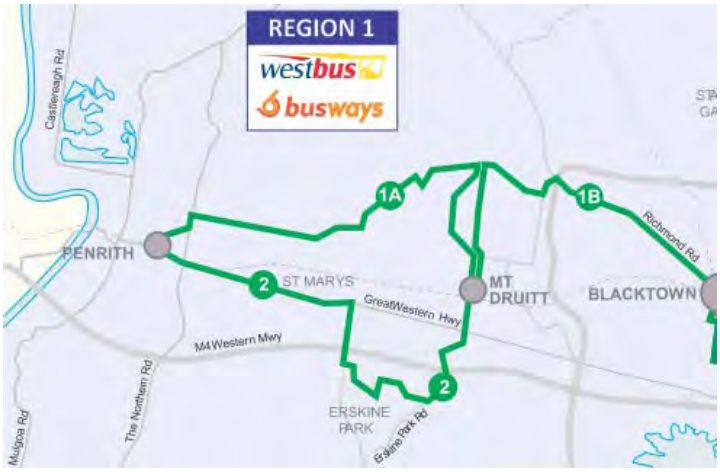

Figure 12 Sydney Strategic Bus Network (Source: Transport NSW, October 2009)

The original 2003 map of the Strategic Bus Corridors included a potential corridor through a future development (ADI St Marys development). However, this was omitted from subsequent revisions of the Strategic Bus Network.

The level of service that the bus routes in Penrith perform varies from one bus per day to four buses per hour. The timetabled peak departure/arrival frequencies for northern services are shown in Table 12.

Table 12 Current northern bus services to Penrith Interchange

Route and destination	AM peak frequency	Off peak frequency	PM peak frequency
673 – Windsor to Penrith via Bligh Park, Llandilo & Cranebrook	30 minutes	1 trip	1 trip
677 – Richmond to Penrith via Londonderry & The Northern Roads	60 minutes	1 trip	2 trips
678 – Richmond to Penrith via Agnes Bank, Castlereagh & Cranebrook	30-60 minutes	1 trip	60 minutes
780 – Mt Druitt to Penrith via Tregear, Ropes Crossing & Cambridge Park	15 minutes	30 minutes	15 minutes
782 - Werrington Station to Penrith via Cambridge Gardens	30 minutes	60 minutes	30 minutes
784 – Cranebrook to Penrith via Castlereagh Road	30 minutes	-	30 minutes
785 – Werrington Station to Penrith via Cambridge Park	30 minutes	60 minutes	30 minutes
786 – Cranebrook to Penrith via Greygums Road	30 minutes	30 minutes	30 minutes

Source: Westbus timetable as at 21 July 2010, AM peak = 6:30 am–9:00 am, PM peak = 4:30 pm–7:00 pm

The integrated network Region 1 of the Sydney metropolitan regions has recently been reviewed by Transport NSW with the cooperation of the local operators Westbus and Blue Mountains Bus Company on 11 October 2009. This network review introduced the following benefits for the Penrith area, such as:

- linking of regional centres including Blacktown and Penrith
- increasing the frequency on most routes
- increasing the opportunity to access educational precincts in the Penrith area
- improving of bus/rail connections
- introducing more buses through the NSW Government's growth buses program.

Road network

Regional road access to the study area is primarily provided by the Great Western Highway, The Northern Road (including Parker Street and Richmond Road) and Castlereagh Road/Mulgoa Road. A description of the roads in the study area and their characteristics is shown in Table 13.

Table 13 Description of key roads in the local network

Road name	Classification	Carriageway	Speed limit	Role in network
Great Western Highway	Arterial	Undivided, one lane each way west of Mulgoa Road Divided three lanes in each direction east of Parker Street	60 km/h	Original road between Blue Mountains
M4 Motorway	Motorway	Divided, three lanes in each direction	110 km/h	Express route for interstate and through traffic
Castlereagh Road	Arterial	Divided two lanes in each direction	60 km/h	Provides access to the north from the western side of Penrith
Mulgoa Road	Arterial	Divided two lanes in each direction	60 km/h	Connects the western side of Penrith to the M4 Motorway
Parker Street	Arterial	Divided, three lanes in each direction south of Copeland Street Divided, two lanes in each direction north of Copeland Street	70 km/h, school speed limit at Copeland Street	Connects the eastern side of Penrith to the M4 Motorway
Richmond Road	Arterial	Divided, two lanes in each direction	70 km/h	Part of The Northern Road / Parker Street corridor
Coreen Avenue	Collector	Undivided, one lane each way with parking on both sides	60 km/h from Castlereagh Road to Coombes Drive (east) and 50 km/h to Parker Street	connects Castlereagh Road in the west and Parker Street in the east
Lemongrove Road/ Macquarie Avenue, Evan Street	Collector	Undivided, one lane each way with parking on both sides (except Evan Street Bridge)	50 km/h	Alternative crossing of the Western Rail Line, provides local access to Penrith CBD
Coombes Drive	Local	Undivided, one lane each way with parking on both sides	50 km/h	Provides access to the industrial area north of Coreen Avenue
The Crescent/ Cox Street	Local	Undivided, one lane each way with parking on both sides	50 km/h	Provides access to the southern edge of the Lemongrove residential precinct
Copeland Street	Collector	Undivided, one lane each way with parking on both sides	50 km/h, school speed limit at Parker Street	Provides right-turn access at its intersection with Parker Street

The arterial roads listed in Table 13 are RTA state classified roads. Coreen Avenue is listed as a Regional Road, meaning that it has shared responsibility between the RTA and the Penrith City Council. The remaining roads are under the responsibility of Council.

Traffic volumes

Traffic data from several sources were used to obtain an understanding of current traffic conditions, including, RTA data, traffic counts commissioned for this assessment, and traffic data from previous studies and reports. They were combined to build up a picture of the traffic volumes and change on the surrounding road network.

The traffic counts commissioned for this study were undertaken on Thursday 29 July 2010 at:

- intersection of Castlereagh Road and Coreen Avenue
- intersection of Coreen Avenue and Coombes Drive
- intersection of Parker Street, Richmond Road, Coreen Avenue and Oxford Street.

They were factored to take into account seasonal changes in traffic across the year using RTA annual data.

Traffic counts of the North Penrith Commuter car park access road were undertaken by NPC on 6 July 2010.

Traffic data used from other reports included flows from:

- North Penrith Development Access to Peachtree Road (MWT, 1999)
- North Penrith Development Parker Street Effects (MWT, 2000)
- Traffic Impact Statement Roundabout Intersection Coreen Avenue and Commuter Car Park Access, Penrith (Sinnadurai and Drozd, 2009)
- Traffic counts undertaken for Penrith CBD Traffic Study (under preparation) (GHD, 2010).

Traffic counts on Castlereagh Road at Peachtree Road, The Crescent/Evan Street/Macquarie Avenue and Parker Street at Copeland Street from the 1999 and 2000 MWT studies were factored up to 2010 values using a comparison of 1999 and 2010 count data at the intersections of Castlereagh Road/Coreen Avenue and Parker Street/Richmond Road/Coreen Avenue/Oxford Street. The AM and PM peak hour estimated traffic volumes are shown in Figures 13 and 14.

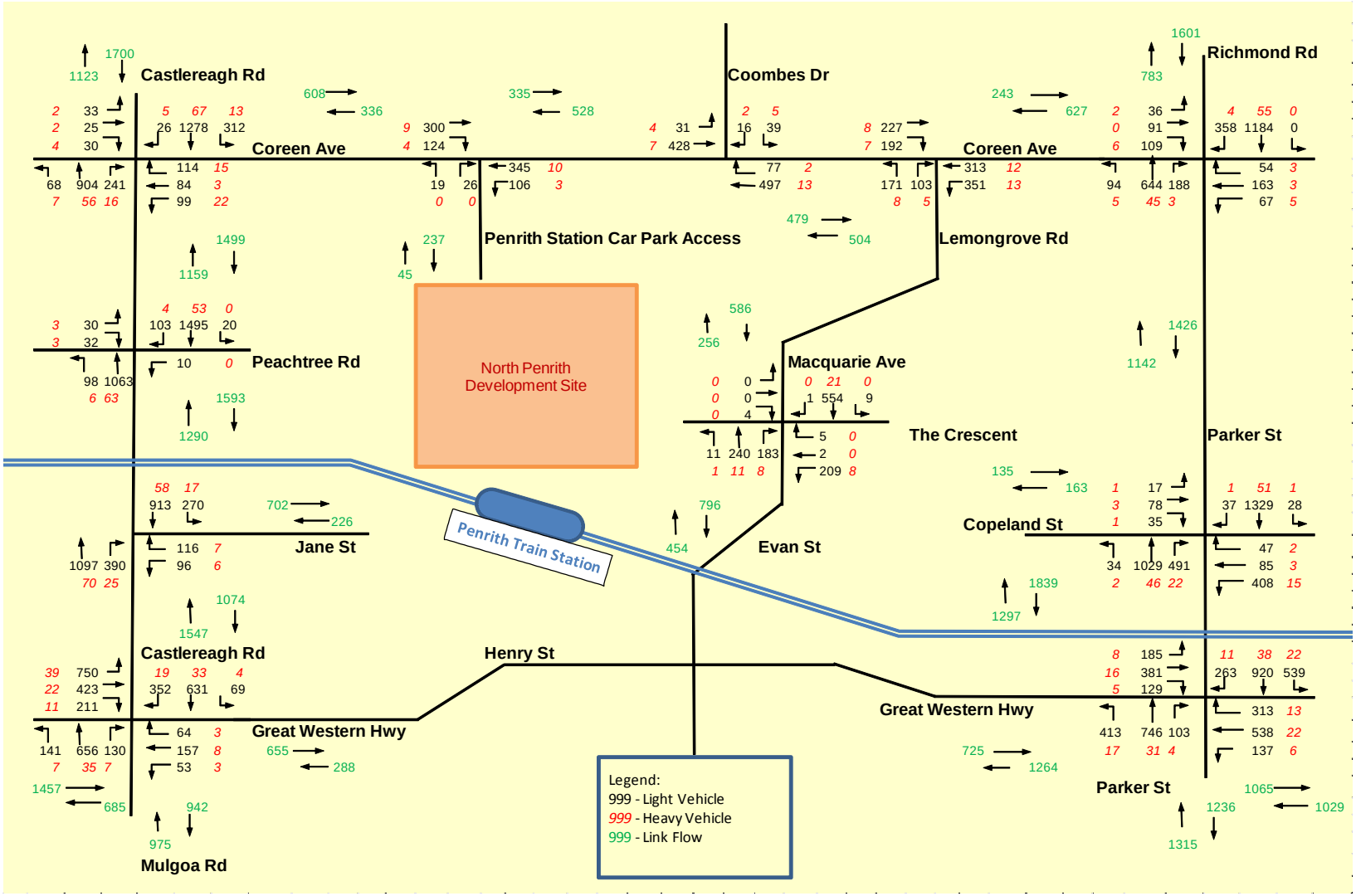

Figure 13 2010 AM Peak Traffic volumes

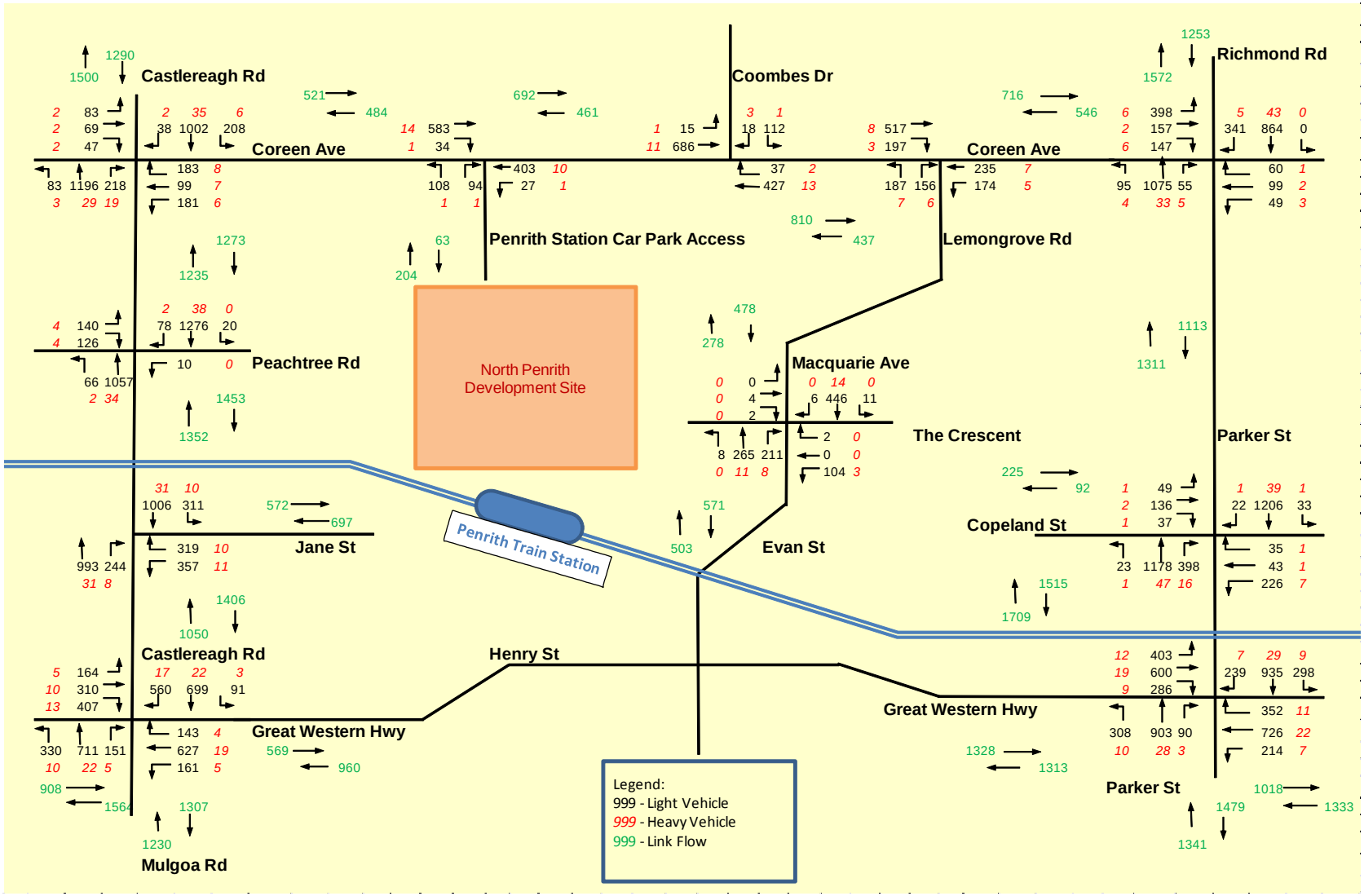

Figure 14 2010 PM Peak Traffic Volumes

The RTA publishes traffic volume data for major roads in Sydney, generally at three yearly intervals. Traffic counts are taken around the road network at selected locations. Some locations are counted continuously throughout the year. Others are counted for one or two week periods, and then adjusted depending on the time of year using the results from the continuously counted sites.

In the vicinity of the North Penrith project, RTA data was available at five locations, as shown in Table 14.

Table 14 Historic traffic count data

Road	Location	1989	1991	1993	1996	1999	2002	2005	2009
Great Western Highway	West of Parker Street	-	-	-	28,269	30,969	30,960	29,246	28,009
Castlereagh Road	North of Great Western Highway	-	-	29,401	35,819	34,011	33,081	33,196	34,153
Parker Street	North of Great Western Highway	-	-	-	35,144	39,396	40,380	41,144	37,982
Evan Street	At Railway overpass	9,458	11,762	11,220	12,442	13,191	13,153	11,648	12,677
Coreen Avenue	East of Castlereagh Road	10,751	12,654	11,345	13,350	13,091	12,336	13,756	-

Note: Parker Street count in vehicles, all other counts shown as 'axle pairs'.
Source: RTA Traffic Volume Data for Sydney Region

In general, there was no consistent trend on changing traffic demand, with the traffic volume some roads rising and dropping between successive counts. The AADT volumes were plotted against the year and a line of best fit calculated. The gradient of this line represents the growth rate for that road over that time period. The growth rates per annum calculated were:

- Great Western Highway -0.27%
- Castlereagh Road 0.40%
- Parker Street 0.53%
- Evan Street 0.87%
- Coreen Avenue 0.96%.

While there have been traffic volume increases and decreases, overall the roads shown have generally increased by a small percentage per annum. Traffic volume changes over time are a function of several variables, including travel patterns and the amount of development occurring in the area. The negative growth rate for the Great Western Highway is likely to change in the future with development planned at the UWS, and other developments as part of the Werrington Enterprise Living and Learning (WELL) Precinct.

Intersection performance

The performance of the intersections was simulated using the SIDRA intersection analysis computer program. The analysis is preliminary and used assumptions to determine the sensitivity of the scheme. SIDRA calculates intersection performance using measures such as:

- level of service (LoS)
- degree of saturation (DoS)
- average intersection delay
- queue length.

These terms are more fully explained in Appendix 2. The results of the intersection modelling are shown in Table 15 below.

Table 15 Intersection performance in 2010

Intersection	Intersection control	Time period	DoS	Average Delay (sec/veh)	LoS	Queue (m)
Parker Street/Coreen Avenue/Richmond Road	Signals	AM	0.91	47	D	> 200 m
		PM	1.00	51	D	> 200 m
Parker Street/ Copeland Street	Signals	AM	0.93	37	C	> 200 m
		PM	0.81	28	B	> 200 m
Parker Street/ Great Western Highway	Signals	AM	1.01	49	D	> 200 m
		PM	1.04	67	E	> 200 m
Coreen Avenue/ Coombes Drive	Give-way Priority	AM	0.50	25	B	110
		PM	0.63	41	C	110
Coreen Avenue/ Commuter Car Park Access	Roundabout	AM	0.41	14	A	28
		PM	0.53	14	A	45
Castlereagh Road/ Coreen Avenue	Roundabout	AM	0.71	35	C	79
		PM	0.74	17	B	75
Castlereagh Road/ Peachtree Road	Signals	AM	0.66	15	B	> 200 m
		PM	1.00	19	B	181
Castlereagh Road/ Jane Street*	Signals	AM	0.74	22	B	162
		PM	0.78	23	B	176
Castlereagh Road/Great Western Highway/ Mulgoa Road	Signals	AM	0.92	41	C	168
		PM	1.04	111	F	> 200 m

Note: Average delay for priority sign controlled intersections is for the worst movement. For traffic signal and roundabout intersections, this is the average delay for the entire intersection.
* The operation of the Castlereagh Road/Jane Street intersection will be affected by the queues from the Castlereagh Road/Great Western Highway/Mulgoa Road/High Street intersection, and vice versa.

Two intersections are showing unacceptable levels of delay during the afternoon peak. They are:

- Parker Street/Great Western Highway
- Castlereagh Road/Great Western Highway/Mulgoa Road/High Street.

In addition, the intersection of Parker Street/Richmond Road/Coreen Avenue and Oxford Street is operating close to its capacity. The other intersections assessed appear to be operating satisfactorily.

The results are showing long queues at some other intersections, but with acceptable levels of delay. It should be noted that SIDRA models intersections in isolation. The queues at some closely-spaced intersections may affect the operation of nearby intersections, such as at the Jane Street and High Street/Great Western Highway intersections on Castlereagh Road.

Traffic conditions

The estimated traffic volumes for the AM and PM peak hours were considered against the theoretical capacity of the road. Roads were allocated into the categories shown in Table 16, and assigned a theoretical capacity per lane for different levels of service. The 2010 estimated AM and PM peak hour mid-block traffic volumes were compared to the maximum traffic flow values per lane shown in Table 16. The threshold for acceptable performance is considered to be a LoS D.

Table 16 Maximum traffic flow per lane criteria for mid-block roads

LoS	Volume/ Capacity ratio	Urban divided/Undivided Highways with Clearways and signal coordination	Urban divided/Undivided Highways with interruptions	Residential streets
A	0.35	560	420	245
B	0.50	800	600	350
C	0.75	1,200	900	525
D	0.90	1,440	1,080	630
E	1.00	1,600	1,200	700
F	> 1.00	> 1,600	> 1,200	> 700

The results are shown in Appendix 4. All roads were assessed as operating satisfactorily, apart from the Great Western Highway Bridge across the Nepean River. Peak direction flows (eastbound during the AM peak and westbound during the PM peak) were indicated to be close to the theoretical capacity of the road (operating at LoS E).

Pedestrian and cycle infrastructure

There are no pedestrian facilities provided along Coreen Avenue fronting the site. Some sections of Coreen Avenue between Parker Street and Coombes Drive have concrete footpaths. A pedestrian refuge is located on Coreen Avenue, east of Hughes Avenue.

A cycle lane is provided at the newly upgraded intersection of Lemongrove Road and Coreen Avenue. Cycling can also occur in shared parking lanes on Coreen Avenue between Castlereagh Road and Parker Street. There is also a cycle track between Coombes Drive and Andrews Road, through Hickeys Park.

Heavy vehicles

A five tonne load limit exists on Coreen Avenue between Parker Street and Bel-Air Road. It is suggested that this was implemented to direct trucks from the Coreen Avenue industrial area away from the residential section of Coreen Avenue.

The PTD requires access for large articulated trucks that typically transport earthmoving equipment and other military vehicles. These trucks are up to 24 metres long and can have a combined weight of up to 40 tonnes. They currently enter and leave the PTD via The Crescent and Lemongrove Road, and use vacant space on the site to turn around. Movements of these large military vehicles are typically only required on two occasions per year.

Commuter car park

As described earlier, the commuter car park on the northern side of Penrith Station currently has marked provision for approximately 750 vehicles, but is regularly used by an additional 100 vehicles in informal and illegal ways. It includes bike lockers, although cyclists ride along the access road shared with general traffic. There is also a kiss-and-ride drop-off area. The access road, which also passes the Museum of Fire, has six speed humps designed to limit vehicle speeds.

Surveys undertaken by NPC between 5:00 am and 9:00 am on 6 July 2010 showed the following usage patterns:

- 680 commuter vehicles parked at the end of the survey
- 163 vehicles entering and leaving (kiss-and-ride or non-commuter)
- The busiest time for movements was between 6:30 am and 7:30 am when 339 commuter vehicles parked and 70 kiss-and-ride vehicles used the access road
- 60% of vehicles arrived from the west (40% from the east) off Coreen Avenue
- 52% of kiss-and-ride vehicles departed to the west (48% departed to the east).

Penrith Training Depot

The PTD is currently used by the Army Reserve for training. Meetings are held on Tuesday evenings and on one weekend per month. Vehicle entry and exit data supplied by the Army indicate that the site is accessed by, on average, 1,200 vehicles per month, including approximately 60 trucks (generally smaller Unimog or semi-trailers). Of this 1,200, about 800 are vehicles dropping off or picking up cadets or vehicles from Army Reservists.

This equates to approximately 25 car and 2 truck trips per day. On Tuesday evenings, there may be approximately 80 vehicles arriving for meetings and training.

Summary of transport network issues

The North Penrith site is located within walking distance of a rail station with frequent services on two rail lines. Trains operate in the peak commuter direction every 5 – 6 minutes. It is also within walking distance of Penrith CBD. The mode share of the area surrounding the site reflects these attributes, with lower private car usage and higher use of train and walking than the rest of Penrith LGA.

The site is located with convenient access onto Coreen Avenue and Castlereagh Road.
The surrounding road network has some traffic congestion points, which have had performance deficiencies for some time, including:

- The nearby intersections of the Great Western Highway, High Street, Castlereagh Road and Mulgoa Road and of Castlereagh Road and Jane Street are currently operating over-capacity during peak periods.
- The intersection of the Great Western Highway and Parker Street is currently operating over-capacity during peak periods.
- The intersection of Parker Street, Richmond Road, Coreen Avenue and Oxford Street is approaching its capacity.
- The one-lane each direction Great Western Highway at the bridge over the Nepean River is operating close to its theoretical capacity.

3. Strategic planning context

At a glance

Penrith's role as a Regional City has been strengthened in recent transport planning policy documents. Key transport infrastructure upgrades are planned, such as the Western Express rail project, and increases in bus services. This development is a significant contribution toward achieving these targets. However, the scale of development proposed throughout the LGA has the potential to place additional pressure on existing road network constraints and require road upgrades. The achievement of transport mode share targets that change future travel behaviour, will be critical to reaching an acceptable transport solution.

TMAP objectives

The TMAP process is described in the joint Department of Transport (now Transport NSW) and RTA document *Draft Interim Guidelines on Transport Management and Accessibility Plans*. The TMAP assessment is designed to identify the transport impacts of major land development project and recommend a package of measures to manage these impacts and reduce demand for travel by private car. The resulting TMAP agreement is a formal agreement between the developer and relevant stakeholders on the content, timing and cost of the package of measures to achieve desired travel patterns and on the apportionment of funding on the measures.

The objectives of the TMAP are to:

- manage the transport impacts of development
- help reduce growth in overall VKT generated by development, both by cars and by commercial vehicles
- help reduce reliance on the private car
- maximise the use of public transport, walking and cycling
- allow efficient freight movement, while managing the adverse impacts (minor issue for North Penrith project).

The TMAP should include the following elements:

- project context, including the strategic context and objectives, targets and performance criteria
- description of the project
- initial transport assessment including an assessment of the existing travel patterns
- transport assessment, including an assessment of the travel demand, distribution of trips, mode split, assessing the capacity of the transport network, identifying options to modify transport impacts and testing of the options
- TMAP and agreement outlining the proposed measures, funding, timing and evaluation.

State planning context

The project is fully described in section two, but to recap it is a master planned site with mixed uses and a density reflecting its location adjacent to Penrith Station. The plan has adopted the principles of transit-oriented development to maximise its contribution to the development targets established in the region's strategic plans.

Transport and planning policy emphasises the growing importance of Penrith City Centre within the Western Sydney region. This growing importance is reflected in funding and planning commitments highlighted in this section. Similarly, the rail station continues to grow in importance on the CityRail network for commuters to Blacktown, Parramatta, and the Sydney-CBD and for work and recreation trips to the Penrith City Centre.

2010 State Plan

The State government released the *2010 State Plan,* with its attendant sub-reports, early in the year and it is intended to consolidate and express in a single document the key initiatives it is pursuing. In the *Transport and Cities* section is of greatest relevance to this proposal, as it reiterates the State's commitment to both the growth of Penrith and changing its travel behaviour so that 25% of its work trips will be made by public transport by 2016. Overall travel in the region is supposed to reach a transit mode share of at least 28% by 2016. This will only be possible through the development of new styles of housing and commercial stock such as proposed in North Penrith, and through improvements in transit capacity such as the Western Express and Growth Buses program.

The project fully absorbs the principles in the State Plan as it should:

- improve the PT system by creating greater, balanced density where there is capacity
- improve road safety by master planning new communities for reduced speed on local streets, shorter trip lengths to reduce risk exposure, and greater use of safer modes
- increased walking and cycling – end of trip facilities in new destination buildings, improved bike and ride facilities at interchanges and well planned pedestrian and cycle friendly street networks
- increased jobs closer to home – North Penrith is a balanced development with new jobs being created in the west and immediately accessible to rail
- improved affordability – the housing mix specifically targets affordability, aging in place and other housing styles not traditionally available close to transport in Penrith.

This projects also supports the Green State initiatives to reduce GHG emissions associated with travel by changing behaviour and the Stronger Communities program through better access to services, better facilities for access by the mobility impaired, and planning communities for aging in place an.

Among the projects in the State Plan's Metropolitan Transport Plan that will both improve access to the project, and benefit from the project, are the new Western Express Rail upgrade to provide faster rail services to the employment centres between Penrith and Wynyard, via the city and the commuter car park program, as this project will make using the project proposed for North Penrith more attractive to commuters, without demanding capacity for the development.

State Infrastructure Strategy (2008)

The *2008 State Infrastructure Strategy Update* has been superseded to some extent by the Metropolitan Transport Plan, but it did contain funding commitments for local bus contract region reviews, bus priority improvements and strategic bus corridors across metropolitan Sydney, to support the Metropolitan Strategy. The update also proposes to investigate additional train stabling at Penrith Station, which may impact the space occupied by the interchange, depending on connections to active tracks.

The proposed additional train stabling will require additional land at the location selected.

Rail improvements beyond the stabling have not been identified in this strategy, though RailCorp has foreshadowed possible construction of an additional train track through Penrith Station, which could also potentially affect the space occupied by the interchange.

Urban Transport Statement (2006)

The *Urban Transport Statement* (UTS) recognises the growing importance of Penrith City Centre as the regional city. The Penrith LGA, has high growth targets with employment predicted to grow by 30% by 2030 or from 11,000 jobs to 30,000 jobs. As terminus of the western 'spine' from Penrith to the Sydney CBD, the LGA is expected to increase in population and employment density. This project is clearly in accord with those objectives.

The statement also noted the following scheduled transport improvements:

- the implementation of Strategic Bus Corridors 1a and 2a, between Penrith and Mt Druitt
- the provision of bus priority along Strategic Bus Corridors.

Strategic corridor services and bus priority improvements will provide the sustainable transport services to these new jobs and houses.

Metropolitan Strategy (2005)

The State Plan is still premised on the planning objectives of the Metropolitan Strategy. Penrith has been designated a regional city in the *Metropolitan Strategy* (DoP, 2005). The Penrith City Centre is important to achieving Metro Strategy transport and housing initiatives. The provision and use of sustainable travel modes and more intense housing and employment at station areas are key elements of the Metropolitan Strategy. This intensification at the city centre will enable residents to make shorter trips for employment and entertainment. Local, shorter trips are more suited to sustainable transport modes like walking and cycling. Regional or longer trips are more suited to sustainable transport modes like bus or carpool. As a regional city, Penrith is expected to have local and regional trip generators additional to employment, including universities, sport and cultural facilities.

Centres and corridors

The Metropolitan Strategy identifies regional employment growth along enterprise corridors, based on proximity to rail lines and motorways. Penrith City Centre is linked to regional and potential major centres by the Western Line and the M4 Motorway. Specifically, new employment in Penrith LGA is expected to contribute to 11,000 new jobs by 2031.

Housing

Housing at under-used or vacant sites in developed areas, or 'infill' housing, is being encouraged near existing transit nodes like Penrith Interchange. Areas within 800 metres of a railway station are expected to accommodate account for 59% of new dwellings constructed between 2004 and 2013. The project will contribute to achieving the following Metropolitan Strategy initiatives:

- provide a mix of housing near jobs, transport, and services
- renew local centres
- improve the quality of new development and urban renewal.

By increasing the residential and employment density in the centre, particularly through redevelopment of Council's surface car parks on the Belmore Street side of the station, these Metropolitan Strategy objectives will be promoted on a greater scale. Pursuing these objectives across both opportunities could enhance the urban design interface of the station, bus interchange, and city centre.

Nearby Greenfield release areas like Penrith Lakes, Waterside (Lakes Environs) and Glenmore Park, are expected to contribute at least 8,194 new dwellings by 2016, contributing to the 11,000 new jobs and 20,000 new dwellings in the Penrith LGA. New public transport connections between these release areas and Penrith Interchange will be required as Penrith City Centre becomes a destination and gateway to the regional transport network.

Local planning and strategies

Penrith City Council: Draft Development Control Plan 2008

The transport, access and parking section of the Draft DCP seeks to:

a) Develop a coherent urban system of compact walkable neighbourhoods with relatively intense, mixed use town centres;

b) Provide a highly-interconnected street network that clearly distinguishes between arterial routes and local streets, establishes good internal and external access for residents, maximises safety, encourages walking and cycling, supports public transport and minimises the impact of through traffic;

c) Reduce travel demand including the number of trips generated by development and the distances travelled, especially by car;

d) Promote and facilitate the use of public transport as a more sustainable alternative to the private car for personal travel;

e) Ensure that transit infrastructure is effectively integrated with other development, to maximise safety, security and convenience for transit users; and

f) Promote and facilitate walking and cycling within transit oriented precincts by establishing and maintaining high levels of amenity, safety and permeability in the urban form.

The design of the Project has incorporated these principles to achieve a positive transport outcome for a key site close to Penrith CBD.

It lists key transport corridors, the closest ones to the site being Castlereagh Road and Richmond Road. The requirement for setback for transport corridors will not be applicable to this development.

A set of road cross-section dimensions are listed for different road hierarchy types. The Project will propose a similar set of road cross-sections that are designed to be more suitable to the specific requirements of the North Penrith development. These will be base on the design requirements of Landcom Street Design Guidelines, Australian Standard AS2890.5-1993 and practical examples of street design in Sydney.

The Draft DCP also proposes minimum parking provision rates for different types of land use. Due to the TOD nature of the Project, rates that are lower than the Draft DCP rates will be proposed to reflect the lower demand for vehicle usage associated with the site immediately adjacent to Penrith Station and within easy walking distance of Penrith CBD. The DCP allows for lower parking rates to be provided it can be justified in a traffic impact statement.

The DCP also provides guidance for the design of parking areas, access driveways, pedestrian facilities and cycle facilities. The compliance with these guidelines will be discussed as appropriate throughout Section 4 of this document.

Penrith Integrated Transport and Land Use Strategy (final draft strategy report), (Geoplan, AQ Planning, Cardno, June 2008)

The Penrith Integrated Transport and Land Use Strategy (PITLUS) was funded by Penrith City Council and the NSW Department of Planning.

The North Penrith Urban Area (the Project) was considered as one of the potential future developments within the LGA. The development considered included:

- 50 hectares (ha)
- 850 dwellings
- 2,000 population
- 9.5 ha employment land with 950 jobs.

Whilst there are some differences with the currently proposed project, the main differences in terms of the traffic generation implications are: similar residential population but higher amount of employment assumed in PITLUS.

The 1996 Penrith City Council Bicycle Plan included the results of community consultation which listed improving cycle routes to rail stations, including Penrith as a priority. Coreen Avenue is listed as a ‘bikeway’. Coreen Avenue between Coombes Drive and Castlereagh Road is shown as having a proposed footpath.

Penrith CBD is listed as having been fully developed within an 800 m walk catchment of Penrith Station, although it is noted that the area north of the Station does not currently have a good utilisation of the land.

The PITLUS forecasts a large growth in trips within Penrith LGA and trips entering the LGA from outside. It also forecasts that while Penrith CBD will accommodate increases in employment numbers, other areas such as St Clair and the WELL precinct will grow to take on a higher proportion of employment in the LGA.

PITLUS adopts the 10% mode shift from private car travel to public transport, walking and cycling, even for existing residents. To achieve this, there would need to be an additional 400 – 500 bus trips by 2016 beyond natural growth. PITLUS makes reference to the services and facilities planned in the North Penrith Master Plan which include bus priority measures from the bus interchange and St Marys Release Area. It specifically mentions a bus lane underpass under the Penrith to Kingswood railway line from Belmore Street to Penrith North Army land.

For rail services, a three-fold increase in rail patronage would be required. PITLUS mentions the Western FastRail (addressed by the Western Express project) – a plan to construct new tracks and introduce express services from Penrith to Sydney CBD via Parramatta. Other rail improvements mentioned include an upgrade to Penrith stabling yard along with upgraded signalling.

Strategies listed include:

- Encourage vibrant, accessible, mixed use centres closely aligned with the public transport system.
- Ensure use of public transport is maximised, building forms and subdivision designs and layouts encourage walking, cycling and the use of public transport.
- The provision of locally accessible facilities is a high priority for people moving into a new area.
- Encouraging higher density development (including residential development where appropriate) around key public transport & activity nodes, especially land within the 800m rail catchment of Penrith station.
- Establishing transit oriented developments (TODs) around high frequency transit services (these areas should be higher in density and mixed use) – the North Penrith Project complies with the PITLUS definition of a TOD.

The North Penrith delivers on all these strategies.

Actions relevant to the North Penrith Project include:

AT6 Provide a variety of secure bike parking at railway stations, with priority at Penrith Station.

AT7 Install cycle parking, showers, lockers and other facilities in new developments (in accord, with the NSW Planning Guidelines foe Cycling & Walking.

PT8, PT10 and AT11 Implement pedestrian accessibility within 800 m of a railway station with regard to Australian Standards for the mobility impaired. The area around Penrith Station is a priority.

AT3 and PT11 Provide cycle routes between railway stations and residential areas.

PT25 Possible relocation/expansion of the Penrith Interchange to the northern side of the station.

PT16 Implement express bus services and bus priority measures from St Marys URA to Penrith rail station.

PK9 Potential changes to parking rates in commercial centres including: maximum and minimum rates; a mixture of short term and long term parking; maximum amounts of on-site parking; and opportunities for shared parking (mixed use and temporal).

PK12 Potential residential parking schemes around transit nodes, whereby residents are required to purchase a parking permit to park on-street to discourage car ownership in areas well served by public transport.

OTH2 Provide 'resident' transport and travel information packs containing information and incentives for sustainable travel. This should be supplied in new development areas. Such packs may include the following:

- available public transport services
- information of existing and proposed (including timing for delivery) pedestrian and cycle networks
- material on cost savings associated with reduced use of a car, including the elimination of a second household car.

As part of Travel Plans which developers are required to provide through the development assessment process, this pack could be further enhanced by providing:

- a one or two year public transport pass
- subsidised public transport passes for residents after the first one or two years
- a free bike with each home purchase.

PITLUS makes reference to the recommendations of the Penrith Arterial Road Study (Revised Penrith LGA Arterial Road Study (A Focus on Development Infrastructure), Sims Varley, (February 2005). PARS identified a list of improvements to the arterial road network that would need to take place between 2004 and 2016 to provide adequate capacity on the arterial road network. These included:

<u>Improvements 2004</u>

- Great Western Highway/Parker Street – install dual right turn bays on all approaches
- Great Western Highway/Castlereagh Road – extend Jane Street to Victoria Bridge approach.

<u>Improvements 2004-2006</u>

- Castlereagh Road (Andrews Road to Great Western Highway) – widen to six lanes
- Castlereagh Road/Mulgoa Road/High Street – bad southbound right-turn with opening of Jane Street extension
- Parker Street/Coreen Avenue – install dual southbound right-turn lane.

<u>Improvements 2011-2016</u>

- Great Western Highway/Parker Street – duplicate rail overpass to provide seven-lane southbound approach
- Coreen Avenue (Castlereagh Road to Richmond Road) – widen to four lanes.

It also included recommendations for Bus Priority on The Northern Road. The proposed timeframe for the 2004 and 2004-2006 upgrades has already passed without these improvements being completed.

Other studies

North Penrith Defence Lands Traffic and Transport Assessment, GTA Consultants (April 2009)

This assessment was submitted in support of the 2009 Master Plan for the North Penrith Project. The development assessed was slightly different from the current proposal. It included:

- Residential 1,100 dwellings
- Retail 4,000 m^2
- Commercial (Office) 8,700 m^2
- Light Industrial 11,500 $m^{2.}$

It considered one additional site access to Coreen Avenue (near the bend). This is no longer included in the Concept Plan application.

It had a similar concept for the village centre, including:

- a bus set down area
- direct access to the commuter car park via open space
- a mix of lower level retail and upper level residential buildings
- communal car parking for high turnover parking
- access over the railway line is provided by a stairs or lift.

It made recommendations as to the road hierarchy, street cross-sections, bus corridor and cycle routes. These recommendations have been modified and adapted to suit the current Concept Plan.

The report acknowledged that the development could be considered as a TOD-style development with reduced residential traffic generation.

Penrith Interchange Scoping Study, PB (August 2008)

This study was undertaken for the Ministry of Transport (now Transport NSW) and looks at the contribution Penrith Interchange can make to manage the travel choices of workers and residents in Penrith to achieve greater use of sustainable modes. The study developed options to upgrade Penrith Interchange to provide adequate bus capacity for the mid-term or 2016 design year, with adequate opportunity to expand should growth in bus patronage in the long-term (2031).

The report discussed the history of potential plans for the North Penrith site including the number of residents, commitments for job creation, the commuter car park and the interchange for buses from the ADI St Marys development. It states that the location of jobs and dwellings so close to the Penrith Station and Interchange could greatly assist the use of sustainable transport modes in Penrith. It concludes that the level of car parking provided at the site would directly impact the number of people who wish to access the site by private car, while a well-connected footpath and cycleway network would directly impact the number of people wishing to access the site and interchange by walking and cycling.

The study identifies that travel to Penrith is forecast to increase at a faster rate than trips from Penrith, requiring the future interchange to accommodate both inbound and outbound services. It identified the following future requirements for the interchange at Penrith:

- Bus layover 9 buses
- Bus set-down 2 buses
- Bus pick-up
    - North St Marys 1 bus
    - North 2 buses
    - Werrington 1 bus
    - South 3 buses
    - West 1 bus
- Kiss-and-ride (north) 90 metres
- Kiss-and-ride (south) 90 metres
- Taxi 10 taxis.

Growth in bus services was assumed to include 10 additional buses from the North St Marys area (including ADI and Penrith Lakes) and 1 from the north.

Three options were considered for the Penrith Interchange.

- Option 1: Reorganisation of bus stands and operation on the southern side, provision for kiss-and-ride and 15 minute kiss-and-ride spaces on the northern side.
- Option 2: Splitting of bus services on the northern and southern sides of the interchange based on direction of travel. Layover, set-down and three pick up spaces required on the north side, plus kiss-and-ride space. A tunnel was briefly considered to bring buses from the North Penrith site into the south side of the interchange. Tunnelling was rejected because of flood prone areas potentially affected by the nearby Nepean River.
- Option 3: All bus stands relocated to Henry Street, with Station Street between Henry Street and Jane Street converted into a pedestrian mall, and kiss-and-ride and taxi space provided on Jane Street and Belmore Street.

The recommended options were Option 1 for the short-term and Option 3 for the long-term. Option 2 was not recommended as it did not address the future need to radically improve public transport servicing of the city centre.

Penrith LGA Arterial Roads Study, Sims Varley (September 2002)

A study undertaken by Sims Varley on behalf of Lend Lease to develop a road network strategy to accommodate future planned land releases. It identified three existing network deficiencies in the study area, including:

- Great Western Highway and Parker Street
- Great Western Highway and Castlereagh Road
- Castlereagh Road and Jane Street.

It modelled future traffic network demands using a strategic model that included the traffic impacts of future land releases such as ADI St Marys, Penrith Lakes, Lakes Environs, Glenmore Park, Claremont Meadows, Caddens Release Area, North Penrith Urban Area, and others.

It recommended road and intersection upgrades including:

- an upgrade of the intersection of Great Western Highway and Castlereagh Road
- a major upgrade of the intersection of Great Western Highway and Parker Street
- Parker Street and Copeland Street – extra turn lanes
- traffic calming on Coreen Avenue to preserve the residential nature of the street
- the Jane Street extension
- Castlereagh Road widening
- it noted previous recommendations of a direct bus service between the Penrith Lakes and ADI St Marys developments with Penrith Station, and a cycleway from Penrith Lakes to Penrith CBD.

Stakeholder consultation

Several meetings were held with representatives of Transport NSW (TNSW), the RTA, Penrith Council and RailCorp to ensure that their transport-related issues are addressed in this TMAP. Some issues discussed have related to development procedure and urban design. The issues relevant to the traffic and transport assessment are discussed below.

Transport NSW

Bus underpass of Western Rail Line

TNSW requested that provision of a potential route for a bus-only underpass of the rail line be made. It should have the following characteristics:

- It should be a bus-only link, i.e. not open to general traffic or cycles.
- It should be able to rise up to the interchange level on the southern side of the rail line.
- Its basic constructability should be considered along with its concept design.
- An interim bus solution may not include underpass, so some of the northern bus services may need to continue on to serve in the town centre, and perhaps some of the southern terminating services be extended to the north.
- The North Penrith Project will need to demonstrate when the link is required, what triggers the need for the infrastructure, and who the appropriate provider of the infrastructure should be.
- A working group should be established to further explore the timing and design of the bus underpass, based on the recommendations of this study.

Bus corridor route

Coombes Drive is no longer favoured by Transport NSW as a strategic corridor, as the Strategic Bus Corridor network has been modified since the time when this link was proposed.

Transport NSW would prefer that the bus corridor through the Project was more centrally located within the Project frontage of Coreen Ave to give better access to buses from the east and west.

Bus routes should be designed for 14.5 m buses. *Advice from the local bus operator (Westbus), and other bus operators such as State Transit Authority is that the current fleet of 14.5 m long buses have rear-steering, and have a swept path similar to that of a standard 12.5 m bus. Bus stops will still require the flexibility of being able to be used by 14.5 m long buses.*

If a bus underpass was constructed, Transport NSW may consider through-routing, but would not require any services to terminate within the development. Buses would travel from the site to an external layover location.

The study should consider a future growth of around 40 buses during the morning peak spread across Penrith (i.e. all corridors).

Transport strategy

The Metropolitan plan outlines strategies to develop transit oriented development in key sites such as this site.

The State Plan contained the objective that Penrith would achieve a 20% non-car mode share by 2016. The developer can stipulate what form the public transport corridor would be provided to, provided it can justify its conclusion.

Any on-street or public off-street parking close to Penrith Station should not be interpreted as extra commuter parking, as commuter parking is being provided for in the new 1,000 space facility. Timed parking or a resident parking scheme should be considered for any public parking within 800 m of the rail station.

Transport NSW would like some provision for taxis on the north side of the Station (2/3 spaces).

Roads and Traffic Authority of NSW

The RTA's list of issues was contained within the DGRs, including the list of intersections that should be considered when determining the traffic impacts of the Project.

The traffic modelling methodology proposed for the assessment was discussed. The traffic assessment should forecast the traffic situation in the year 2026 to ensure that the impact of the full development is included, based on a development timeframe of 10 years from an assumed construction start year 2012.

Penrith City Council

A number of discussions have occurred with Penrith City Council for the project on a range of issues. For the issue of transport, these discussions have included:

- traffic assessment methodology
- site access

- bus corridor concept
- road hierarchy
- street design
- parking rates and location
- pedestrian and cycle routes.

Feedback from Council has been incorporated in successive revisions of the Project. Where relevant, Council's recommendations and the relevant design element are discussed through this assessment. This includes a discussion of the road cross-section configurations and parking rates contacted in the Draft DCP 2008.

Specific requirements of Council have been that streets be designed for a 12.5 m rigid heavy vehicle to enable garbage collection, and that shared pedestrian/bicycle pathways be 3.0 m wide unless space requirements require a lower width (down to a minimum of 2.5 metres).

RailCorp

RailCorp are planning to undertake construction of a new stabling yard at Emu Plains, so activity at Penrith stabling yards may decrease in the short-term. In the long-term, stabling would return when Emu Plains becomes full. There may also be construction related to the Western Express project. However, this would occur on the southern side of the rail line.

RailCorp would like the transport assessment to include the impact on the flow of pedestrians across the Penrith Station pedestrian bridge (including stairs) due to the addition of pedestrians from the North Penrith Project.

Targets

Mode share

The mode share of trips generated by a development is a standard measure of the success of strategies to reduce car usage. The car driver mode share is considered the most critical, as it directly translates to vehicles on the road at a one to one ratio. Car passenger mode share can be a measure of success of car-sharing strategies to reduce vehicles on the road.

The Journey to Work mode share is often selected as it is easily monitored through the Census data. Penrith LGA currently has a journey to work mode share of around 77% (2006 Census). Several strategies, such as PITLUS, include a 10% shift in mode share from car driver as an objective. This should also be a target for the development.

The State Plan also sets a target of greater than 20% of all trips within Penrith to be made by non-car modes.

Car parking

A constrained supply of parking can provide an incentive for visitors to the Project to consider modes of transport other than driving. This should produce an increase in car passenger, public transport and active transport mode share.

Reduced access to off-street car parking influences residents on whether or not to buy a first, or (potentially more importantly) second vehicle. Reducing the number of vehicles parked in the development reduces the temptation to use them for a higher percentage of trips.

In residential and retail/commercial situations, a reasonable level of parking is required to ensure their commercial success. This also leads to the vitality of the community living in the development.

It is proposed that, to capture the advantage of the Projects strategic location and its TOD potential, parking rates that are lower than those proposed in the Draft DCP 2008 should be adopted.

Constraining parking supply is also for short duration trips. Different land uses have different peak demand times, allowing parking spaces to be shared between land uses. Promoting sharing also promotes trip visiting more than one business, maximising the value from each parking space.

Road performance measures

Road infrastructure can operate at a range of throughputs before the level of congestion becomes acceptable. To a certain extent, congestion itself can act as a travel demand measure to influence trips to be made by public transport, active modes or re-timed to before or after the peak times. Encouraging these outcomes extracts greater efficiency from the transport network as a whole, allowing more people to be moved for the same expenditure on road infrastructure.

To balance the competing demands of reducing congestion and managing travel demand, it is proposed that the trigger for the consideration of road upgrades should be when a Level of Service D is exceeded. The feasibility and impact of road upgrade should also be considered.

Target measures

The proposed set of transport targets for the Project contains:

- journey to work mode share of less than 67% car driver at destination (based on a 10% mode shift from the Penrith LGA car driver mode share, as adopted by PITLUS)
- non-car share for all trips of greater than 20% (in accord with the NSW State Plan)
- maximum parking rates that are lower than those recommended by Penrith DCP 2008
- car parking to serve dual and complimentary uses within the village centre
- road infrastructure capacity upgrades to be considered when performance falls below Level of Service D.

4. Methods and results

At a glance

The design of the North Penrith Project has maximised the permeability of the street network, especially for walking and cycling, to make trips to the village centre and from Penrith Station as easy and accessible as possible. The bus corridor through the site to the Station has been proposed to improve connections from developments further away from rail services to be efficiently connected to the Penrith regional centre, and rail and regional bus services. The impact of the Project on the external road network has been assessed.

The transport impacts of the Project have been assessed on the external transport network and within the site boundary. This section described the analysis methods and the results of the analysis. The relevant aspects of the Project design are described to show how they address the transport requirements. The requirements are those of the entire Project (the Concept Plan), unless mentioned specifically as relevant only to the Project Application.

The traffic and transport impact analysis is presented as follows:

- traffic growth impact on external road network
- internal road hierarchy, access to external road network and internal street design
- public transport provisions
- walking and cycling provisions
- parking requirements
- TOD Principles
- allowances for large and emergency vehicles
- speed control measures
- future travel plans
- issues relevant to the Project Application.

Traffic model

The traffic modelling for this assessment has been completed using a combination of a Microsoft Excel spreadsheet model with SIDRA intersection modelling of the forecast turning movements to forecast future performance levels. The boundary of the area of influence that includes the assessed roads is shown in Figure 15. The model uses a traditional four-step modelling process, including trip generation, mode choice, distribution and assignment.

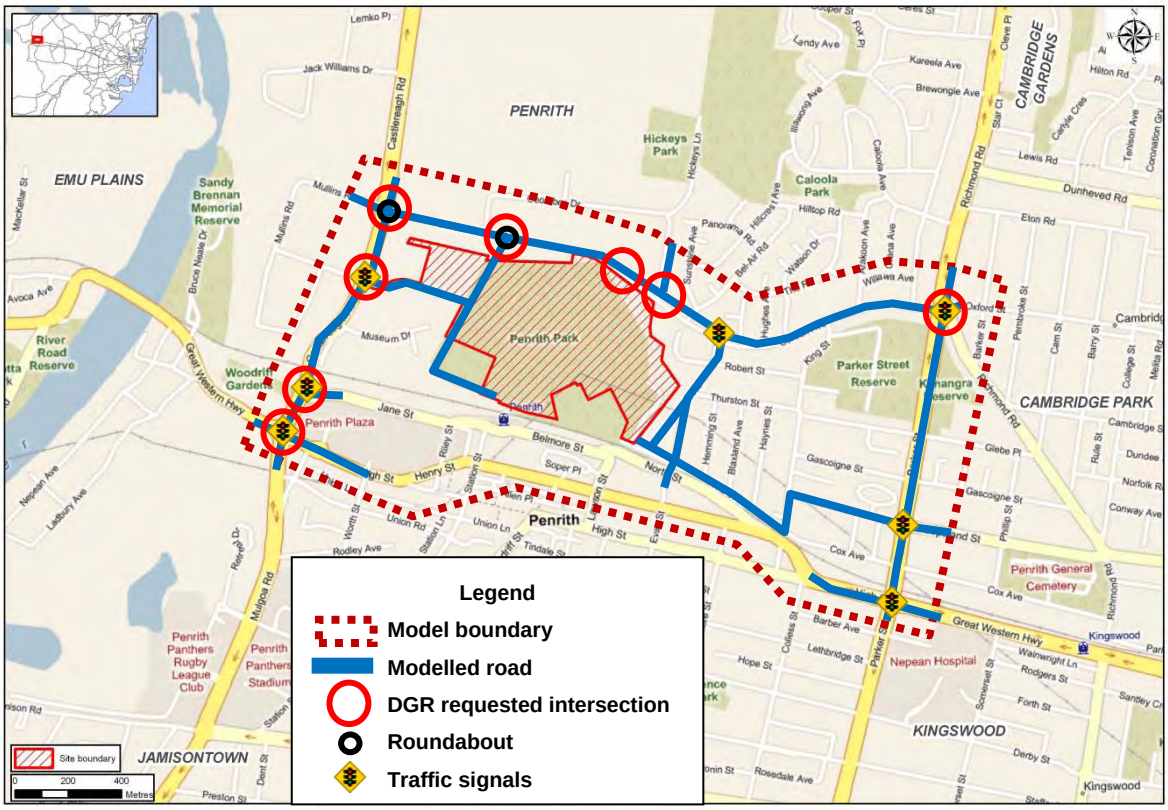

Figure 15 Traffic model boundary

Trips generated by the Project

Trip generation rate

Traffic generation rates are traditionally quoted instead of total trips (by all modes). They are also based on a set of assumptions on mode split that are not necessarily applicable to the circumstances of the North Penrith Project. To use rates that are applicable to North Penrith, and to allow the number of trips made by other modes to be calculated, the traditional car traffic generation rates have been converted to total trip generation rates.

Traffic generation rates from the RTA's *Guide to Traffic Generating Developments*, Version 2.2 for residential (medium density), office, retail and industrial were converted daily and peak trip rates (all mode) using mode split assumptions from the RTA Guide, as well as overall mode share for residences of 55% car driver from the 2009 release of HTS data.

To estimate the percentage of trips entering and leaving each land use, the assumptions in Table 17 were included in the trip generation calculation.

The development yields were based on the information summarised in Table 3 and the land use pattern shown in Figure 2, with one modification. At the time of model development, the retail yield anticipated was 2,900m^2, not the 3,200 m^2 shown in Table 3. Thus the traffic generation for the Project would be slightly higher than the numbers indicated in this section. The impact in the AM peak is small. The greatest change would be in the PM peak, when an additional 16 vehicles would be travelling to and from the additional retail floorspace. This equates to one extra vehicle movement every two minutes. This change is considered small enough to not change the outcome of this assessment, or require any additional road upgrades.

Table 17 Assumed in/out trip directions

Land use	AM peak trips		PM peak trips	
	In	Out	In	Out
Residential	10%	90%	80%	20%
Retail	80%	20%	50%	50%
Commercial	90%	10%	10%	90%
Industrial	90%	10%	10%	90%

The adopted trip generation rates are shown in Table 18. The residential rates are calculated assuming the daily trip value of 3.76 trips per person per weekday from the 2009 release of HTS data, and information that the Project is estimated to accommodate an average of 2.0 people per dwelling.

Table 18 Trip generation rates (all modes) for peak hours and weekday

Land use	Peak trips*	Weekday trips	AM peak trips		PM peak trips		Weekday trips	
			In	Out	In	Out	In	Out
Residential (per dwelling)	0.76	7.6	76	685	497	124	3,804	3,804
Retail (per 100 m^2)	24.5	244.9	142	36	355	355	3,551	3,551
Commercial (per 100 m^2)	3.8	19.2	321	36	36	321	893	893
Industrial (per 100 m^2)	1.5	7.4	175	19	19	175	485	485
Total			714	775	907	975	8,733	8,733

Note: 25% of retail peak trip generation assumed during AM peak, 82% of residential peak trip generation assumed during PM peak due to reduced education trips during PM peak (assuming 3:00 pm school finish).

Trip distribution

Trip distributions were estimated by trip purpose. Residential commuter and recreation journeys, retail, commercial and industrial journeys were distributed according to percentages shown in Figure 7 and 8 from Section 2. For the residential shopping and education trip purposes, trips were distributed based on the location of retail areas and education facilities. The distribution of shopping trips assumed is shown in Figure 16.

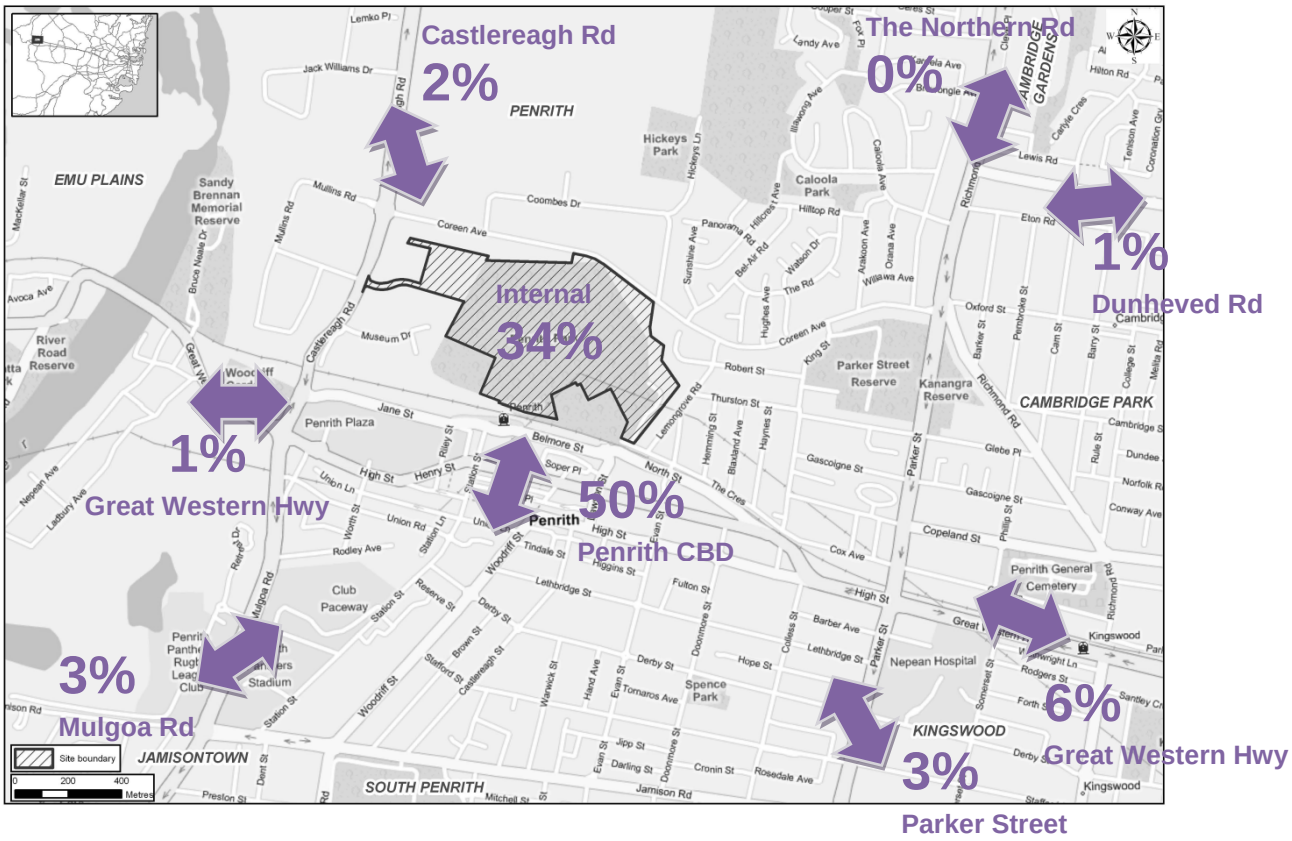

Figure 16 Direction of travel for residential shopping trips to/from the North Penrith Project

For education trips, the following distribution of trips was made based on the location and proximity of childcare, public schools, high schools and tertiary institutions:

- Penrith CBD: 50% - public schools, high schools
- Great Western Highway (east): 21% - high school, university
- Richmond Road: 16% - childcare, public schools
- Internal: 8% - childcare
- Dunheved Road 6% - childcare, public school.

The retail areas of the Project will primarily serve the following markets:

- Internal: 68%
- Castlereagh Road: 10%
- Richmond Road: 10%
- Dunheved Road 5%.

The remainder of trips were spread around the other approaches to the site.

Mode share

The trip purpose percentages from Table 4 and the mode split percentages from Table 7 were then applied to the trip numbers from Table 19. The resulting overall mode shares were calculated:

Table 19 Mode split for the North Penrith project – all trips

Mode of travel	Weekday AM peak	Weekday PM peak	Weekday 24 hour
Vehicle driver	46%	46%	47%
Vehicle passenger	22%	20%	19%
Train	9%	7%	6%
Bus	4%	3%	3%
Walk	17%	21%	23%
Cycle	1%	1%	1%
Other	1%	1%	1%
Total	100%	100%	100%

Comparing these to the mode share targets:

- The residential journey to work car driver mode share (from Table 7) of 65% is lower than the target maximum of 67% and therefore meets the 10% reduction in car driver mode share.
- The total overall mode share for non-car modes (from Table 19) is 27%, 30% and 32% respectively, which meets the PITLUS target of at least 20% of trips in Penrith LGA made by non-car modes.

Total travel in VKTs

The Project would reduce the amount of additional travel on the road network by:

- using its mixed land use to contain trips within the development
- promoting travel by public transport and active modes (walking and cycling)
- using its location within walking distance to Penrith CBD – the regional centre to reduce car trips
- using its close proximity to Penrith Station to eliminate commuters from the development driving to the train station
- the provision of the bus corridor has the potential to encourage residents of other developments to use public transport, thereby reducing their VKT.

Future base road network conditions without North Penrith Project

Traffic volumes are forecast to increase on the road network, irrespective of the Project due to natural background growth (from in-fill development and through traffic) and from planned major developments elsewhere in Penrith LGA.

Base growth in traffic

The historic traffic growth rates calculated in Section 2 were adopted to represent the base growth in traffic from 2010 to 2026. The growth rates per annum adopted were:

- Castlereagh Road 0.40%
- Parker Street 0.53%
- Evan Street 0.87%
- Coreen Avenue 0.96%.

For the Great Western Highway, it was considered that the overall negative growth rate experienced over recent years would not continue. For this study, the growth rate for Castlereagh Road was adopted for the Great Western Highway west of Penrith CBD, and the growth rate for Parker Street was adopted for the Great Western Highway east of Penrith CBD. These rates compare well with the BTS population forecasts for Penrith excluding the major developments.

As mentioned earlier, the growth in employment is anticipated to be higher than that of population. However, it is assumed that the increased residential population from major developments calculated below would allow additional future commuter trips to be included without double-counting.

Traffic generated by other developments

The traffic for other developments was added in separately from background growth to allow assumptions to be made about trip distribution and generation rates. Where available, traffic information from published traffic reports for the specific developments were used.

Information on the planned size and timing of the development was obtained from Penrith Council's 'forecast.id' internet site, and Bureau of Transport Statistic's Population and Employment forecasts for Sydney Metropolitan Region. The forecast.id information included the number of residential lot yields by year. The developments included are shown in Figure 17 and described in Table 20.

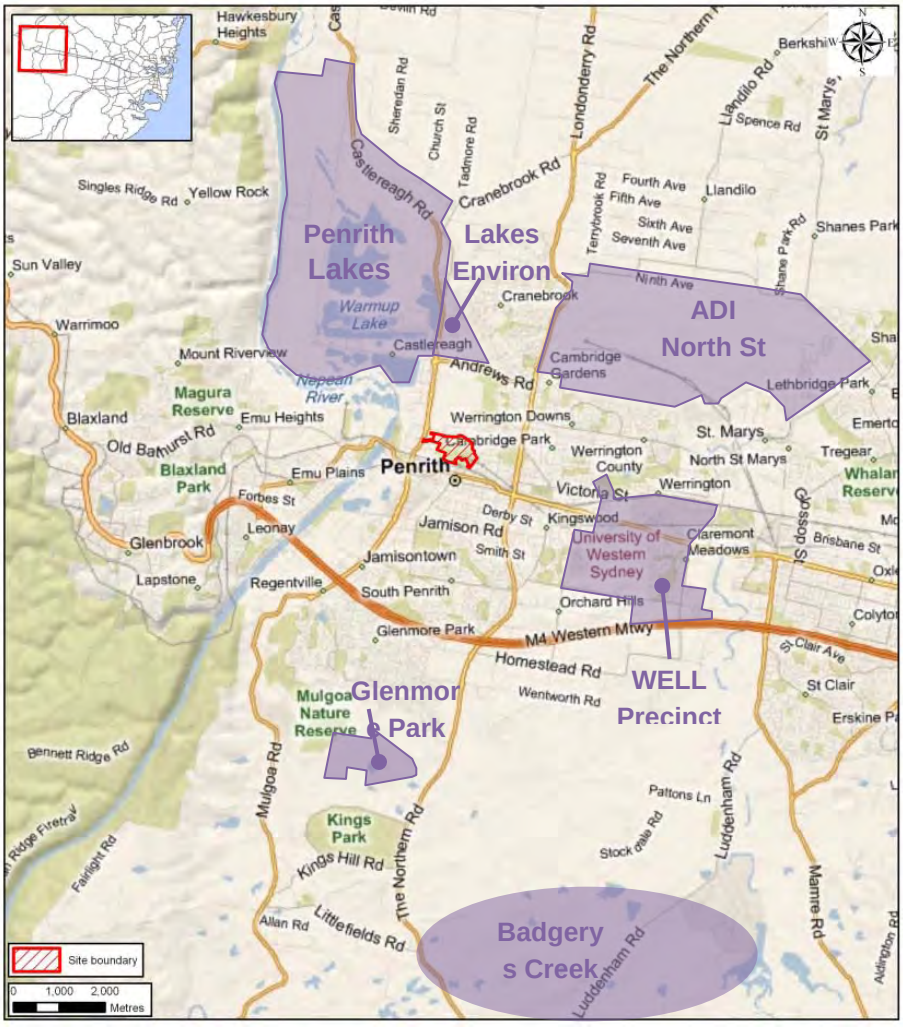

Figure 17 Location of future major projects

Table 20 Other developments in Penrith LGA

Development	2016 additional development	2026 additional development	Source
Penrith Lakes	107 dwellings 57 jobs	1,957 dwellings 57 jobs	Penrith Council's forecast.id internet site
Castlereagh Road employment growth	251 jobs	557 jobs	BTS Population and Employment forecasts
Cranebrook (including Lakes Environs)	309 dwellings 59 jobs	595 dwellings 213 jobs	Penrith Council's forecast.id internet site
St Marys Development (formerly ADI St Marys)	825 dwellings 84 jobs	3,325 dwellings 227 jobs	SKM 2008 Traffic and Transport Report, Penrith Council's forecast.id internet site
WELL (Werrington Enterprise Living and Learning) Precinct (including North Werrington, Werrington Mixed Use Area, UWS North Werrington Campus, South Werrington Urban Village, UWS Kingswood, Precinct Centre, UWS South Werrington Campus, Claremont Meadows, Caddens Release Area and Claremont Meadows Stage 2)	3,141 dwellings 7,826 jobs 5,124 students	3,801 dwellings 7,826 jobs 5,124 students	Maunsell AECOM 2007 TMAP report BTS Population and Employment forecasts
Glenmore Park Stage 2	1,164 dwellings 307 jobs	1,678 dwellings 434 jobs	Penrith Council's forecast.id internet site
Badgerys Creek (Travel Zone 1882)	1,085 dwellings 7 jobs	5,502 dwellings 927 jobs	BTS Population and Employment forecasts

Trip generation from these developments, unless stated in published reports, was based on an AM peak trip generation rate of 0.85 trips per residential dwelling and 0.83 trips per job (SKM 2008, St Marys Western Precinct Plan Traffic and Transport Report). A mode split of 52% was assumed for employment generated trips (RTA Guide to Traffic Generating Developments). Traffic was distributed onto the road network using an analysis of data from the 2006 Census 'Journey to Work' Travel Zone to Travel Zone data set for similar neighbouring travel zones.

Currently planned upgrades

The RTA has provided a list of road upgrades for modelling purposes for the Penrith area. In the vicinity of the Project, the upgrades are required to support the Penrith Lakes and North St Marys development, and affect Andrews Road, and Castlereagh Road and The Northern Road north of Andrews Road. There are no planned road upgrades between Andrews Road and the Great Western Highway.

Penrith Council have indicated that it plans to install a one-lane roundabout at the intersection of The Crescent, Macquarie Avenue and Evan Street to address current safety concerns due to poor sight distance.

The traffic modelling undertaken for the WELL precinct indicated the following road link upgrades in the vicinity of the Project:

- Castlereagh Road: widening to six lanes between Andrews Road and Jane Street (required in 2006)
- Coreen Avenue: linemarking for four lanes between Castlereagh Road and Richmond Road (required between 2012 and 2016).

Forecast road conditions

The base traffic growth and traffic generation from other major developments was added to the 2010 traffic volumes. The road network capacity was checked using the level of service thresholds shown in Table 16. The results are summarised in Table 21 and detailed in Appendix 4. They indicated that:

- the Great Western Highway bridge over the Nepean River may be over capacity by 2016
- Richmond Road, north of Coreen Avenue is approaching its capacity at LoS E by 2026
- Castlereagh Road, north of Coreen Avenue is approaching its capacity at LoS E by 2026.

Table 21 Forecast road performance Levels of Service

Road & location	Direction	2010 existing		2016 base		2016 with North Penrith		2026 base		2026 with North Penrith	
		AM peak	PM peak	AM peak	PM peak	AM peak	PM peak	AM peak	PM peak	AM peak	PM peak
Castlereagh Rd, north of Coreen Ave	NB	B	B	B	D	B	D	B	D	C	D
	SB	C	B	D	C	D	C	E	C	E	C
Coreen Ave, east of Castlereagh Rd	EB	C	B	C	B	C	C	C	B	C	C
	WB	A	B	A	B	A	C	A	C	B	C
Castlereagh Rd, south of Coreen Ave	NB	B	B	B	C	B	C	B	C	C	D
	SB	B	B	D	C	D	C	D	C	D	C
Castlereagh Rd, north of Jane St	NB	B	B	C	D	C	D	C	D	C	D
	SB	B	B	D	C	D	C	D	C	D	C
Jane St, east of Castlereagh Rd	EB	A	A	B	A	B	A	B	A	B	A
	WB	A	A	A	B	A	B	A	B	A	B
Castlereagh Rd, north of Great Western Hwy	NB	B	A	C	C	C	C	C	C	C	C
	SB	A	B	C	C	C	C	C	C	C	C
Great Western Hwy, west of Castlereagh Rd(1)	EB	B	A	C	A	C	A	C	B	C	B
	WB	A	B	A	C	A	C	A	C	A	C
Mulgoa Rd, south of Great Western Hwy	NB	A	B	B	C	B	C	B	C	B	C
	SB	A	B	C	B	C	C	C	C	C	C
High St, east of Castlereagh Rd	EB	A	A	B	A	B	A	B	A	B	A
	WB	A	B	A	B	A	B	A	C	A	C
Commuter Car park Rd, south of Coreen Ave	NB	A	A	A	A	A	A	A	A	A	A
	SB	A	A	B	A	B	A	B	A	B	A
Coreen Ave, east of Commuter Car park Rd	EB	A	C	B	C	C	C	B	C	C	D
	WB	B	B	C	B	C	C	C	C	C	C

Table 21 Forecast road performance Levels of Service (continued)

Road & location	Direction	2010 existing		2016 base		2016 with North Penrith		2026 base		2026 with North Penrith	
		AM peak	PM peak	AM peak	PM peak	AM peak	PM peak	AM peak	PM peak	AM peak	PM peak
Coreen Ave, east of Coombes Drive	EB	B	C	B	D	C	D	C	D	C	E
	WB	B	B	B	B	C	B	B	B	C	C
The Crescent, east of site	EB	A	A	A	A	A	A	A	A	A	A
	WB	A	A	A	A	A	A	A	A	A	A
Macquarie Ave, north of The Crescent	NB	A	A	A	A	A	A	A	A	A	A
	SB	B	B	C	B	C	B	C	B	C	B
Evan St south of The Crescent	NB	B	B	A	A	A	A	B	A	B	A
	SB	C	B	D	C	D	C	D	C	D	C
Richmond Rd, south of Dunheved Rd	NB	A	B	B	D	B	E	B	E	B	E
	SB	C	B	D	C	E	C	E	C	E	C
Coreen Ave, west of Parker St	EB	A	C	A	D	A	D	A	D	B	E
	WB	C	B	C	B	C	C	C	C	D	C
Parker St, south of Coreen Ave	NB	B	B	B	D	C	D	C	D	C	D
	SB	B	A	D	B	D	B	D	C	D	C
Copeland St, west of Parker St	EB	A	A	A	A	A	A	A	B	A	B
	WB	A	A	A	A	A	A	A	A	A	A
Parker St, north of Great Western Hwy	NB	A	B	B	C	B	C	B	C	B	C
	SB	B	A	C	B	C	B	C	B	C	B
Great Western Hwy, west of Parker St[(1)]	EB	A	B	A	B	A	B	A	B	A	B
	WB	B	B	B	B	B	B	B	C	B	C
Parker St, south of Great Western Hwy	NB	B	B	C	C	C	C	C	C	C	C
	SB	B	B	C	C	C	C	C	C	C	C
Great Western Hwy, east of Parker St	EB	A	A	B	A	B	A	B	A	B	A
	WB	A	A	A	B	A	B	A	B	A	B

Note 1: Great Western Highway has two lanes in each direction between Castlereagh Road and Ladbury Avenue

Forecast intersection performance

The forecast 2016 and 2026 traffic flows with, and without, the Project were entered into the SIDRA traffic models of the intersections. The results for the 2016 and 2026 scenarios with base growth and other developments, which exclude the subject project, are shown in Tables 22 and 23.

Table 22 Intersection performance in 2016 with base growth and other developments

Intersection	Intersection control	Time period	DoS	Average delay (sec/veh)	LoS	Queue (m)
Parker Street/Coreen Avenue/ Richmond Road	Signals	AM	1.32	> 200	LOS F	> 200
		PM	1.35	> 200	LOS F	> 200
Parker Street/ Copeland Street	Signals	AM	1.15	100	LOS F	> 200
		PM	0.95	33	LOS C	> 200
Parker Street/ Great Western Highway	Signals	AM	1.09	79	LOS F	> 200
		PM	1.29	168	LOS F	> 200
Coreen Avenue/ Coombes Drive	Give-way Priority	AM	0.61	48	LOS D	152
		PM	1.17	> 200	LOS F	171
Coreen Avenue/ Commuter Car Park Access	Roundabout	AM	0.53	14	LOS A	35
		PM	0.61	15	LOS B	58
Castlereagh Road/ Coreen Avenue	Roundabout	AM	1.67	> 200	LOS F	> 200
		PM	1.37	> 200	LOS F	> 200
Castlereagh Road/ Peachtree Road	Signals	AM	1.03	56	LOS D	> 200
		PM	1.00	31	LOS C	> 200
Castlereagh Road/Jane Street/Jane Street Extension	Signals	AM	1.39	169	LOS F	> 200
		PM	1.06	45	LOS D	> 200
Castlereagh Road/Great Western Highway/Mulgoa Road	Signals	AM	1.20	160	LOS F	> 200
		PM	1.17	162	LOS F	> 200

Note: Average delay for priority sign controlled intersections is for the worst movement. For traffic signal and roundabout intersections, this is the average delay for the entire intersection.

Table 23 Intersection performance in 2026 with base growth and other developments

Intersection	Intersection control	Time period	DoS	Average delay (sec/veh)	LoS	Queue (m)
Parker Street/Coreen Avenue/ Richmond Road	Signals	AM	1.42	> 200	F	> 200
		PM	1.47	> 200	F	> 200
Parker Street/ Copeland Street	Signals	AM	1.27	149	F	> 200
		PM	1.01	45	D	> 200
Parker Street/ Great Western Highway	Signals	AM	1.16	95	F	> 200
		PM	1.41	> 200	F	> 200
Coreen Avenue/ Coombes Drive	Give-way Priority	AM	0.69	78	F	187
		PM	1.28	> 200	F	> 200
Coreen Avenue/Commuter Car Park Access	Roundabout	AM	0.53	14	A	41
		PM	0.66	15	B	68
Castlereagh Road/ Coreen Avenue	Roundabout	AM	1.80	> 200	F	> 200
		PM	1.47	> 200	F	> 200
Castlereagh Road/ Peachtree Road	Signals	AM	1.06	72	F	> 200
		PM	1.03	41	C	> 200
Castlereagh Road/Jane Street/ Jane Street Extension	Signals	AM	1.43	182	F	> 200
		PM	1.10	56	D	> 200
Castlereagh Road/Great Western Highway/Mulgoa Road	Signals	AM	1.26	190	F	> 200
		PM	1.18	187	F	> 200

Note: Average delay for priority sign controlled intersections is for the worst movement. For traffic signal and roundabout intersections, this is the average delay for the entire intersection.

The forecasts indicate that the majority of intersections would require upgrading by 2016. This is mainly due to the traffic generated by other major developments, rather than background growth. If there is a delay in the construction of these developments, or if they do not proceed to the scale of development originally envisaged, these intersection upgrades could be delayed or deferred.

The intersection modelling has assumed that the Jane Street Extension would have occurred. It was assumed that this would involve construction of a new four lane road between the Castlereagh Road and Jane Street intersection and the Great western Highway, near Neale Drive.

Apart from the existing congestion locations mentioned in Section 2, the need to upgrade the intersections is driven by the traffic increases associated with other major planned developments. As mentioned previously, if they do not proceed to the scale of development originally envisaged, or if they can implement measures to reduce the amount of traffic released onto the road network (e.g. introduce public transport services or use mixed land use to contain trips within their development), these intersection upgrades could be deferred or modified.

The traffic congestion at a many of the intersections investigated is so great that they would require extensive upgrading to reach the target LoS to level D. These upgrades may not always be feasible due to the requirement for land acquisition, widening of bridges, etc. The proposed list of intersection upgrades is based on an assessment of which upgrades could be accommodated within the road reservation, vacant land or land not in proximity to buildings.

As these upgrades are generated due to the needs of other developments that are expected in advance of the Project's impact, it is not appropriate for this study to recommend more extensive upgrades as they can be accommodated within the indicative capacity of needed treatments.

Road and intersection upgrades

The issue of the Great Western Highway Bridge represents the worsening of an existing capacity issue. The existing bridge is likely to have heritage significance. Richmond Road and Castlereagh Road conditions would be congested. However, this could be managed if sufficient capacity is provided at downstream intersections.

The list of recommended capacity upgrades attributable to the Project at intersections is shown in Table 24. These were derived on the following principles:

- There are no published or available plans to address the current road network deficiencies to allow investment estimates for necessary works. The nature and scale of the upgrades potentially required are large and will have network-wide implications.
- Existing deficiencies should be the responsibility of relevant road authorities to address and are outside the scope of this assessment.
- There is some uncertainty regarding the scale and timing of other developments planned in the Penrith area. Whilst assumptions have been made in this study based on currently available information, there is the potential that expensive road upgrades may not be required if those developments do not proceed, or are build on a reduced scale. Such expenditure could also undermine the constraints intended to guide a changed mode choice, too.
- Many of the road and intersection upgrades that would bring performance levels back to the target LoS D appear to require unrealistic land acquisition.
- Upgrading the road network to the target LoS D has the potential to detract from initiatives to reduce private car usage.

- The Project is providing a relief point for future public transport services to bypass potential traffic congestion on the Penrith ring roads by reserving land for a future bus underpass of the Western Rail Line.

The proposed list of upgrades may not achieve the target performance criteria on their own. However, they present a feasible package of works to address the road network requirements of the future scenario with the other planned developments and the North Penrith Project.

Table 24 Intersection upgrades required for future base plus other developments plus North Penrith Project

Intersection	Recommended upgrades (in addition to existing layout)
Parker Street/Coreen Avenue/ Richmond Road	▪ 120 m long right turn bay on Coreen Avenue ▪ 50 m long left turn bay on Parker Street ▪ Additional through lane on Parker Street, 100 m on approach and departure ▪ Additional through lane on Richmond Road, 100 m on approach and departure ▪ Additional 135 m long right-turn bay on Richmond Road ▪ 25 m long left turn bay on Oxford Street ▪ 40 m long right turn bay on Oxford Street
Parker Street/ Copeland Street	▪ 120 m long right turn bay on Parker Street northbound ▪ 70 m long right turn bay on Copeland Street westbound ▪ 40 m long left-turn slip lane on Copeland Street eastbound
Coreen Avenue/ Coombes Drive	▪ Install 'seagull' treatment on Coreen Avenue
Coreen Avenue/Commuter Car Park Access	▪ Increase size and clear zone around of one-lane roundabout (to accommodate large vehicles turning)
Castlereagh Road/ Coreen Avenue	▪ Convert two-lane roundabout to traffic signals ▪ Additional through lanes on Castlereagh Road in each direction, 100m on approach and departure ▪ Two 150 m long right turn bays on Castlereagh Road northbound ▪ One through lane, one 75 m long left-turn bay and one 150 m long right turn bay on Coreen Avenue ▪ One 150 m long left turn slip lane and one 70 m long right turn bay on Castlereagh Road southbound ▪ One shared through-right lane and one 60 m long shared left-through lane on Mullins Road
Castlereagh Road/ Peachtree Road	▪ Additional through lanes on Castlereagh Road in each direction, 100m on approach and departure

These proposed intersection capacity upgrades have been re-modelled in SIDRA. The results are provided in Tables 25 and 26. The results show that, while intersection performance has improved, congestion still exists on the road network. As mentioned previously, further road upgrades would result in an unreasonable land requirement. Given the uncertainty about the timing and scale of the other developments driving the need and timing for these upgrades, a smaller, feasible set of upgrades has been assessed.

Table 25 Upgraded intersection performance in 2016 with base growth and other developments

Intersection	Intersection control	Time period	DoS	Average Delay (sec/veh)	LoS	Queue (m)
Parker Street/Coreen Avenue/ Richmond Road	Signals	AM	1.02	60	E	> 200
		PM	1.10	78	F	> 200
Parker Street/ Copeland Street	Signals	AM	1.13	95	F	> 200
		PM	0.87	25	B	> 200
Coreen Avenue/ Coombes Drive	Give-way Priority	AM	0.32	22	B	9
		PM	0.43	30	C	10
Castlereagh Road/ Coreen Avenue	Roundabout	AM	0.88	30	C	> 200
		PM	0.86	40	C	> 200
Castlereagh Road/ Peachtree Road	Signals	AM	0.73	17	B	> 200
		PM	0.83	19	B	> 200

Note: Average delay for priority sign controlled intersections is for the worst movement. For traffic signal and roundabout intersections, this is the average delay for the entire intersection.

Table 26 Upgraded intersection performance in 2026 with base growth and other developments

Intersection	Intersection control	Time period	DoS	Average Delay (sec/veh)	LoS	Queue (m)
Parker Street/Coreen Avenue/ Richmond Road	Signals	AM	1.07	84	F	> 200
		PM	1.17	99	F	> 200
Parker Street/ Copeland Street	Signals	AM	1.29	134	F	> 200
		PM	0.94	30	C	464
Coreen Avenue/ Coombes Drive	Give-way Priority	AM	0.35	24	B	11
		PM	0.47	34	C	13
Castlereagh Road/ Coreen Avenue	Roundabout	AM	0.87	34	C	> 200
		PM	0.88	44	D	> 200
Castlereagh Road/ Peachtree Road	Signals	AM	0.75	17	B	> 200
		PM	0.87	21	B	> 200

Note: Average delay for priority sign controlled intersections is for the worst movement. For traffic signal and roundabout intersections, this is the average delay for the entire intersection.

Future road network conditions with North Penrith Project

The traffic generated by the Project was added on top of the forecast future base and other development traffic for the 2016 and 2026 scenarios. As a basis for comparison, another scenario without the other developments was analysed to demonstrate what capacity improvements would be required if the other proposed developments proceed at a smaller scale or were delayed significantly.

Forecast road conditions

The results of the road network capacity analysis are shown in Table 21 with more of the background calculations included in Appendix 4. The road network is expected to operate at similar levels to the scenario with or without the Project for 2016 and 2026.

The exception is Coreen Avenue between the new site access and Parker Street. It is forecast to tip over from a LoS D to a LoS E (around 94% of its theoretical capacity) in the PM peak only. The carriageway of Coreen Avenue is wide enough to accommodate four lanes. However, the surrounding land use is residential. Widening it to four lanes may encourage more through and circulating traffic to use this route, reducing residential amenity further. If Coreen Avenue were to be widened, the one-lane roundabout at Bel-Air Road and the one-lane roundabout proposed for Coreen Avenue would be constraints, and would require upgrading to either a two-lane roundabout or traffic signals to achieve the target capacity of the widening.

The recommended strategy is to use the existing configuration of Coreen Avenue as a capacity constraint to protect the residential amenity along the load-restricted section of Coreen Avenue. If later decisions are to widen this road segment for traffic capacity, then the on-going land uses have to be questioned, and a new strategy should be considered for these uses on what is then effectively an arterial route.

The results indicate that all road links, including Coreen Avenue, would have sufficient capacity for the 2026 scenario with base traffic growth and the Project only (i.e. no traffic from other developments).

Forecast intersection performance

The results for 2016 and 2026 scenarios with base growth, other developments and the North Penrith Project are shown in Tables 27 and 28.

The intersections surrounding the Project would have sufficient capacity to accommodate the additional traffic generated by the Project at acceptable levels of performance (assuming the road upgrades recommended for the future base scenario in Table 24). There would be no additional intersection capacity upgrades required to accommodate the traffic generated by the Project.

Table 27 Intersection performance in 2016 with base growth, other developments and the Project

Intersection	Intersection control	Time period	DoS	Average delay (sec/veh)	LoS	Queue (m)
Parker Street/Coreen Avenue/ Richmond Road*	Signals	AM	1.02	60	E	> 200
		PM	1.09	97	F	> 200
Parker Street/ Copeland Street*	Signals	AM	1.15	102	F	> 200
		PM	0.88	26	B	> 200
Parker Street/ Great Western Highway	Signals	AM	1.11	82	F	> 200
		PM	1.30	173	F	> 200
Coreen Avenue/ Coombes Drive*	Give-way Priority	AM	0.36	26	B	11
		PM	0.48	35	C	12
Coreen Avenue/ Commuter Car Park Access	Roundabout	AM	0.53	14	A	40
		PM	0.64	15	B	63
Castlereagh Road/ Coreen Avenue*	Roundabout	AM	0.89	37	C	> 200
		PM	0.86	43	D	> 200
Castlereagh Road/ Peachtree Road*	Signals	AM	0.74	18	B	> 200
		PM	0.85	19	B	> 200
Castlereagh Road/Jane Street/Jane Street Extension	Signals	AM	1.39	166	F	> 200
		PM	1.06	45	D	> 200
Castlereagh Road/Great Western Highway/Mulgoa Road	Signals	AM	1.25	178	F	> 200
		PM	1.17	169	F	> 200

Note: * indicates upgraded intersection layout.

Note: Average delay for priority sign controlled intersections is for the worst movement. For traffic signal and roundabout intersections, this is the average delay for the entire intersection.

Table 28 Intersection performance in 2026 with base growth, other developments and the Project

Intersection	Intersection control	Time period	DoS	Average Delay (sec/veh)	LoS	Queue (m)
Parker Street/Coreen Avenue/ Richmond Road*	Signals	AM	1.08	92	F	> 200
		PM	1.17	97	F	> 200
Parker Street/ Copeland Street*	Signals	AM	1.32	149	F	> 200
		PM	0.96	34	C	> 200
Parker Street/ Great Western Highway	Signals	AM	1.16	102	F	> 200
		PM	1.43	> 200	F	> 200
Coreen Avenue/ Coombes Drive*	Give-way Priority	AM	0.42	34	C	14
		PM	0.55	48	D	16
Coreen Avenue/Commuter Car Park Access	Roundabout	AM	0.57	14	A	46
		PM	0.70	15	B	75
Castlereagh Road/ Coreen Avenue*	Roundabout	AM	0.95	48	D	> 200
		PM	0.89	52	D	> 200
Castlereagh Road/ Peachtree Road*	Signals	AM	0.82	24	B	> 200
		PM	0.92	26	B	> 200
Castlereagh Road/Jane Street/ Jane Street Extension	Signals	AM	1.43	176	F	> 200
		PM	1.10	57	E	> 200
Castlereagh Road/Great Western Highway/Mulgoa Road	Signals	AM	1.32	> 200	F	> 200
		PM	1.26	> 200	F	> 200

Note: * indicates upgraded intersection layout.

Note: Average delay for priority sign controlled intersections is for the worst movement. For traffic signal and roundabout intersections, this is the average delay for the entire intersection.

The 2026 scenario with base traffic growth and the Project only (i.e. no traffic from other developments) was also analysed in SIDRA. Without the traffic generated by the other developments, the road network could operate successfully with a much smaller set of road upgrades. Excluding the current congestion points, this scenario has the following capacity issues:

- right-turn queue on Parker Street southbound turning right into Coreen Avenue
- delay for traffic on Coombes Drive at its eastern intersection with Coreen Avenue
- delays for left-turning vehicles on Coreen Avenue westbound at the Castlereagh Road/Coreen Avenue/Mullins Road roundabout.

Based on this set of traffic issues, a much smaller set of intersection capacity upgrades, as shown in Table 29, would be required.

Table 29 Recommended intersection upgrades for base plus North Penrith Project only scenario

Intersection	Recommended upgrades (in addition to existing layout)
Parker Street/Coreen Avenue/ Richmond Road	▪ 120 m long right turn bay on Richmond Road ▪ 25 m long left turn bay on Oxford Street
Coreen Avenue/ Coombes Drive	▪ Install 'seagull' treatment on Coreen Avenue
Coreen Avenue/ New Site Access	▪ Install one-lane roundabout
Coreen Avenue/Commuter Car Park Access	▪ Widen one corner of roundabout (to accommodate large vehicles turning)
Castlereagh Road/ Coreen Avenue	▪ Retain two-lane roundabout ▪ Add left-turn slip lane and downstream merge on Coreen Avenue (to Castlereagh Road southbound)

The above scenario is included for information purposes only. It shows that the majority of road and intersection upgrades recommended are the result of traffic generated by other developments. The smaller size and lower traffic generating properties of the Project result in a much smaller impact from traffic growth.

Road hierarchy

The road hierarchy for the Project was based on the following objectives:

- provide a permeable network that reduces travel distances
- provide clear paths from Coreen Avenue to the village centre, and Penrith Station
- maintain direct access from Coreen Avenue to the commuter car park whilst minimising commuter car park traffic in residential areas
- slowing traffic as it moves through the village centre to improve amenity and pedestrian safety
- match road capacity and standard to the anticipated traffic volume
- facilitating access from the PTD for oversized trucks
- providing space for a bus underpass of the rail line
- minor local streets used for short streets only.

The forecast ranges of daily traffic on the internal roads within the Project are shown on Figure 18. They indicate that the most heavily trafficked road would be the commuter car park road, which accommodates the commuter car park traffic, as well as some of the Project traffic. The other well-used traffic route is from the new entrance on Coreen Avenue to the village centre.

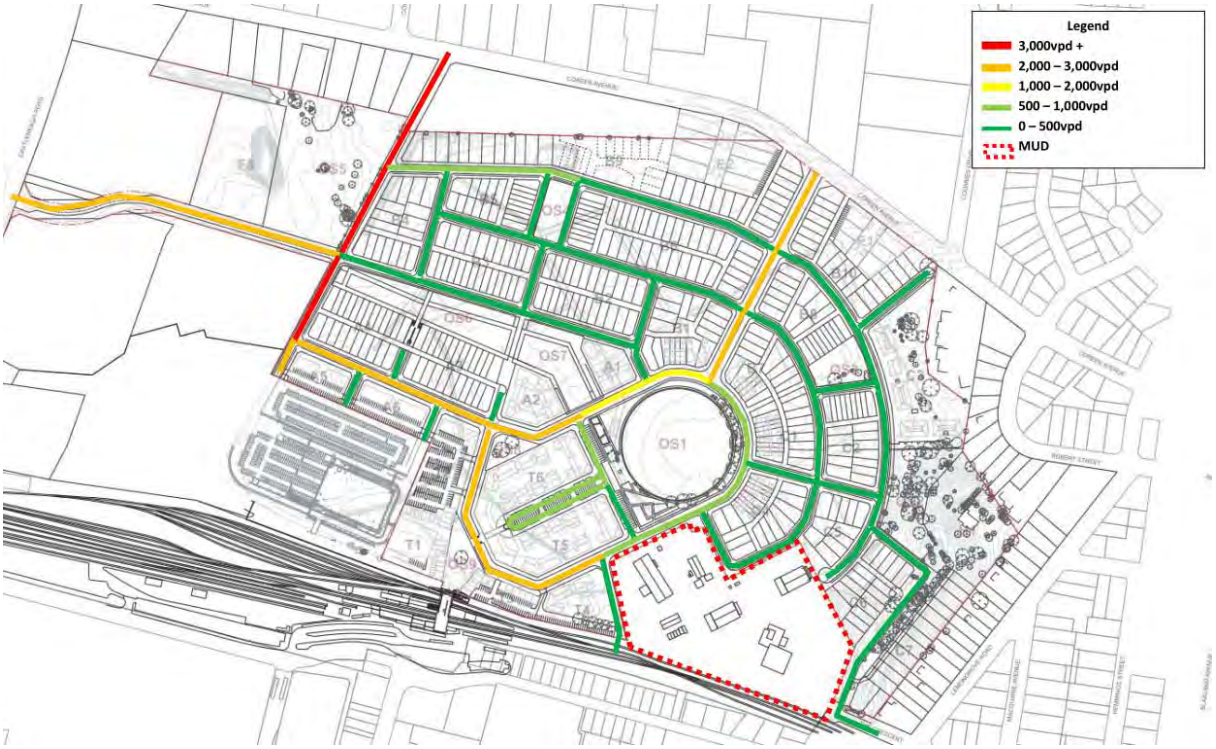

Figure 18 Forecast traffic on internal roads (full development)

The proposed road hierarchy is shown in Figure 19.

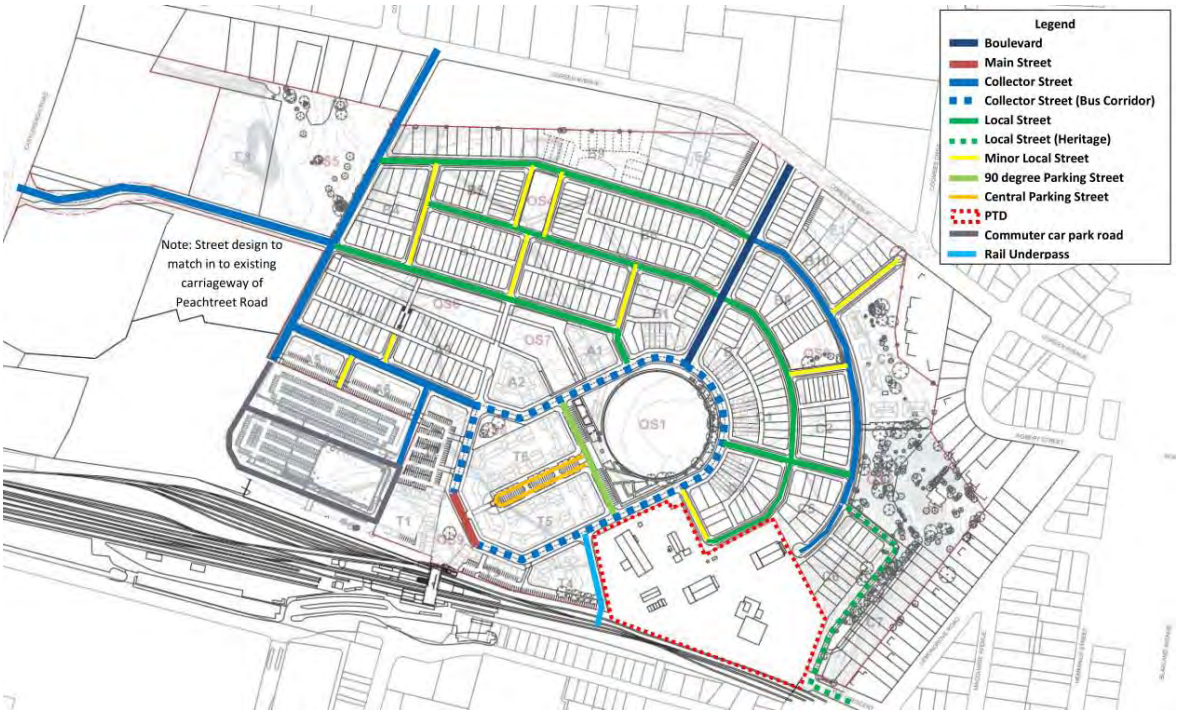

Figure 19 North Penrith road hierarchy

The road connection to The Crescent has been deliberately constrained and kept indirect to discourage through-site trips to PTD to preserve the residential nature of this part of the Project and the neighbouring Lemongrove Precinct, to improve safety and to improve the amenity of the streets around Thornton Hall.

Access intersections

Four access intersections are proposed to link the Project to the external road network (excluding the potential bus underpass). They are shown in Figure 20, and include:

1. existing intersection of Coreen Avenue and commuter car park access road
2. new intersection of a boulevard main access to the Project and Coreen Avenue, approximately 180 metres west of Coombes Drive (eastern intersection)
3. existing intersection of Castlereagh Road and Peachtree Road (left-in/left-out only)
4. existing intersection of The Crescent and site access.

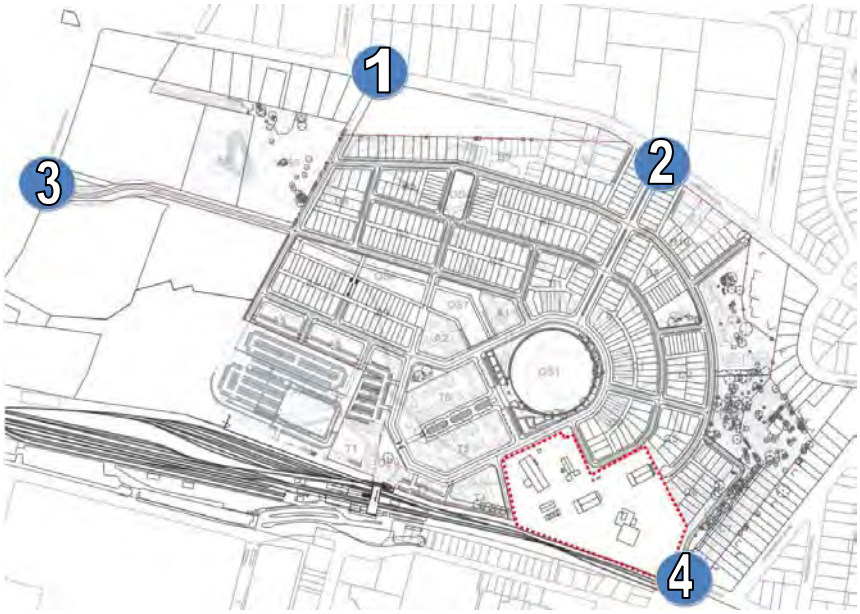

Figure 20 North Penrith access locations

It is proposed that both Coreen Avenue access intersections would provide full movement into and out of the Project, while the Castlereagh Road and Peachtree Road would remain as a left-in/left out intersection for the eastern side of Peachtree Road.

The option of opening up this side of Peachtree Road to full traffic movements was tested, but the additional delays due to the more complex traffic signal phasing required further intersection upgrades to Castlereagh Road to offset the reduced traffic signal green-time.

During the initial phase of the North Penrith project, intersection design options were considered for the intersection of Coreen Avenue, Coombes Drive and a potential North Penrith project site access. This location for the site access was considered based on the understanding that a bus corridor was planned from the North St Marys development to Penrith Station via Coombes Drive (eastern section) and the North Penrith project.

This location was discounted as the location for a site access because the off-set intersection created difficult intersection geometry, in favour of other options further west along Coreen Avenue.

Constraints to improving the geometry at this location are:

- A significant number of service access covers on the north-west corner of the existing junction of Coreen/Coombes – 10 plus the advertising sign structure were counted. They included high pressure gas, Optus and Telstra. Modifying or relocating these would add a substantial cost to the construction of the intersection.
- The private land at 132 Coreen Avenue, which if affected, would require property acquisition. While there is open space at the very corner of the property, it appears that this has been designed for on-site stormwater detention purposes. There is also a service access cover on the southern side of Coreen Avenue near the corner of the site boundary.

Transport NSW advised that TNSW were now pursuing bus planning for a corridor along Coreen Avenue and Dunheved Road (Corridor 1A), and were not currently considering a corridor via Coombs Drive, extending through Nepean Rugby Park to Andrews Road. This meant that the imperative to locate the site entrance for direct bus movements at this location no longer existed, and that a more suitable location could be found. The current site access proposed further west along Coreen Avenue adequately provides for bus movements along a bus corridor from Coreen Avenue to the northern side of Penrith Station.

The proposed intersection designs for each of these access intersections are:

1. retain existing one lane roundabout at Coreen Avenue and commuter car park access
2. new one-lane roundabout at site boulevard and Coreen Avenue
3. existing intersection of Castlereagh Road and Peachtree Road (left-in/left-out only)
4. existing intersection of The Crescent and site access.

A concept sketch of the new one-lane roundabout at the site boulevard intersection with Coreen Avenue is shown in Figure 21.

Base Image Source: ©2010 Google – Imagery © Sinclair Knight Merz

Figure 21 North Penrith access locations

The access through to The Crescent provides a role reducing the risk from too few connections when incidents occur. It also assists in spreading the traffic impact of the development onto the road network, rather than concentrating through fewer points and potentially overloading them. It provides a more direct path for residents of the south-eastern portion of the site to Penrith Town Centre which reduces emissions and accident risk. If it were not provided, there would be greater traffic pressure on the eastern (residential) end of Coreen Avenue increasing the VKT generated by the development. It also spreads the traffic impact of the PTD, providing another path for vehicles that avoids the Lemongrove area.

Internal intersections

Traffic volumes inside the Project are forecast to be low. SIDRA analysis of the busiest intersection where the commuter car park road connects with the Peachtree Road extension indicates that a priority sign controlled-intersection is sufficient to maintain acceptable performance.

Intersections within the site would be signposted with the higher-order roads according to the road hierarchy proposed in Figure 19 taking priority over lower-order roads.

Street design

The design for the streets within the Project have been designed based on the following:

- Penrith City Council's *Draft Development Control Plan 2008*
- Landcom's *Street Design Guidelines*
- AMCORD
- Australian Standard *AS2890.5-1993 On-street Parking*
- examples of street design in practice.

The proposed street cross-sections are shown in Figure 22. A comparison with Penrith Council's Draft DCP 2008 is included in Table 30.

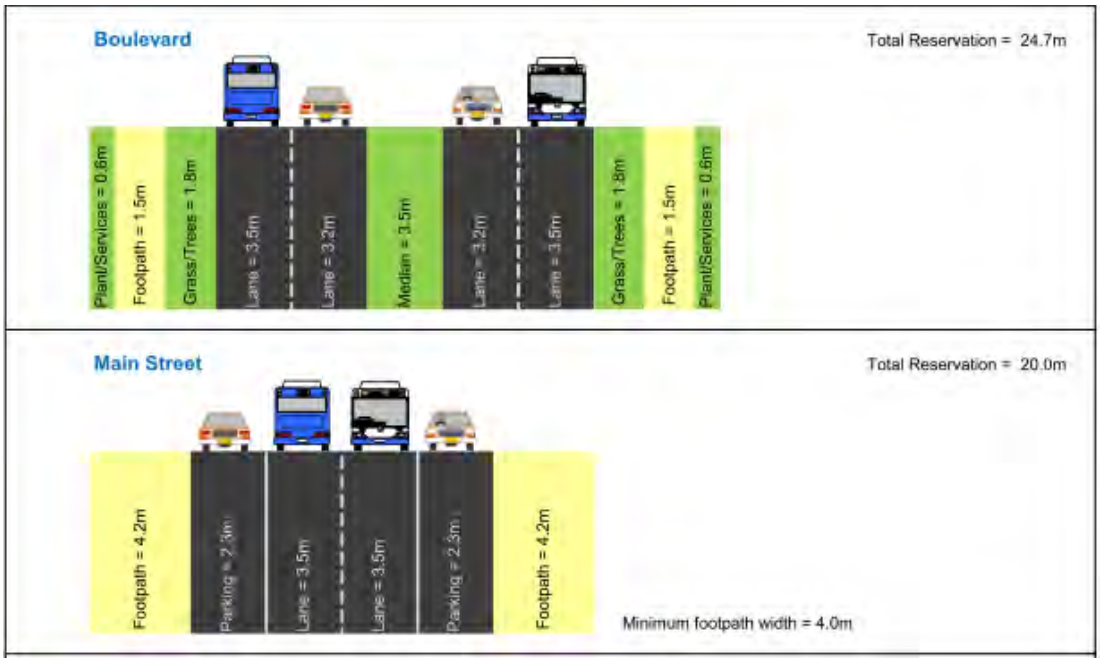

Figure 22 North Penrith street design (part 1)

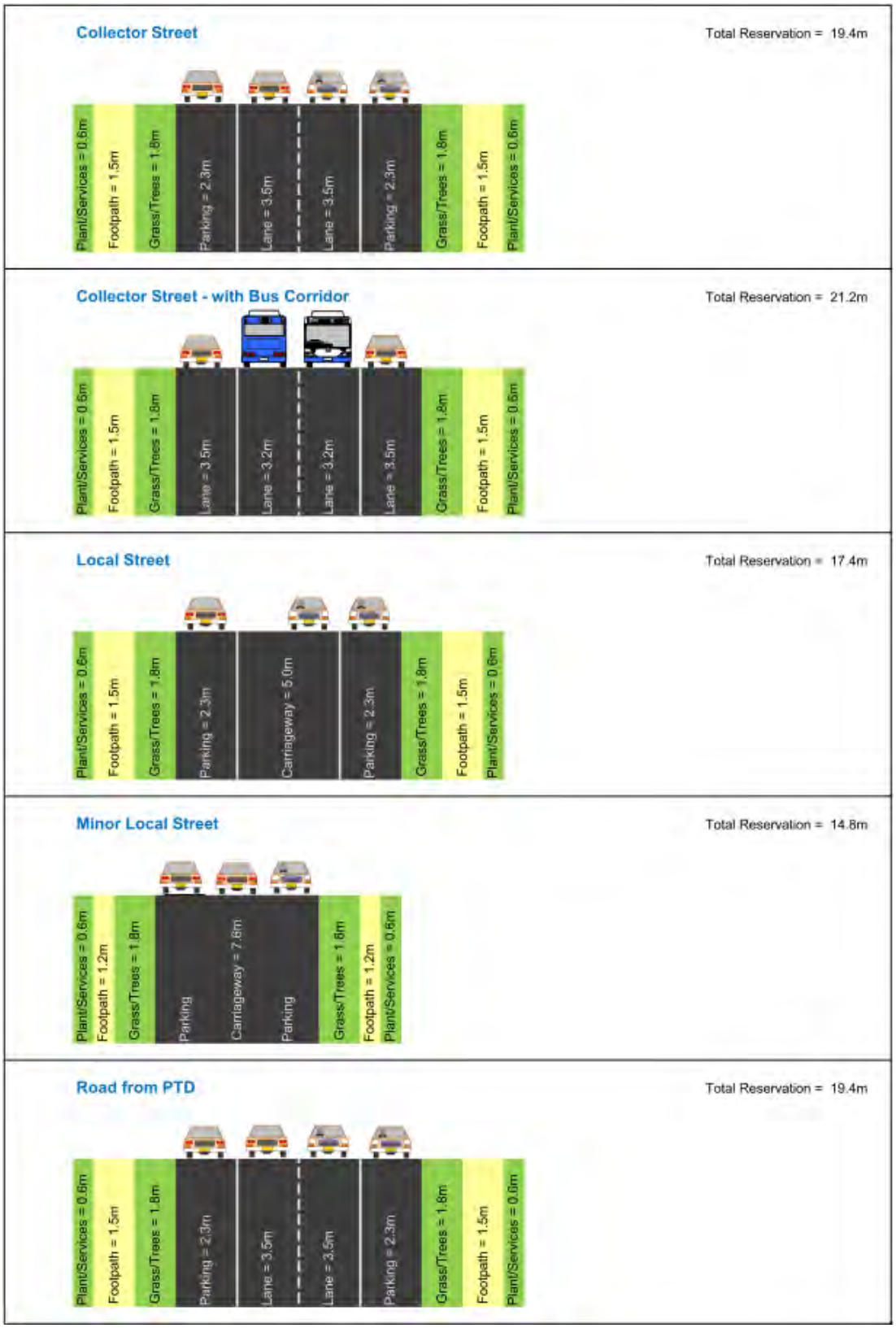

Figure 22 North Penrith street design (part 2)

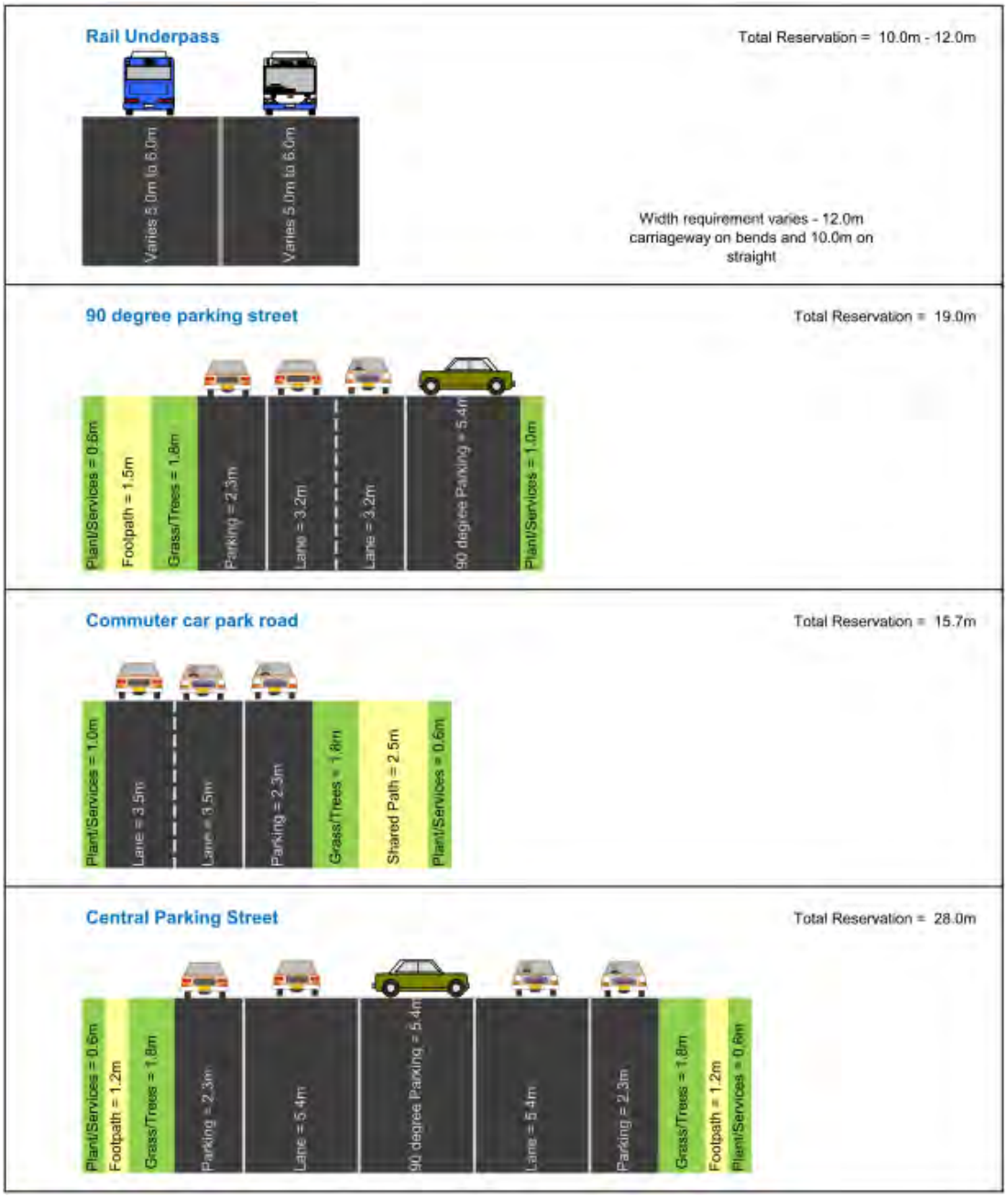

Figure 22 North Penrith street design (part 3)

Table 30 Comparison of proposed design and Penrith DCP guidelines

Street type	Proposed design	Penrith Council Draft DCP2008
Boulevard	3.5 m kerbside lane and 3.2 m median lane in each direction	No corresponding Penrith Council guideline
Main Street	One 3.5 m wide traffic lane and one 2.3 m parking lane on each side Footpaths should be at least 4.0 m wide	Parking is 200 mm narrower than corresponding Penrith Council, but compiles with AS 2890.5-1993
Collector Street	One 3.5 m wide traffic lane and one 2.3 m parking lane on each side	Parking is 200 mm narrower than corresponding Penrith Council, but compiles with AS2890.5-1993
Local Street	5.0 m carriageway and one 2.3 m parking lane on each side	Carriageway is 1.0 m narrower and parking is 200 mm narrower than corresponding Penrith Council guideline. Narrower carriageway is designed to reduce traffic speeds, complies with Landcom guidelines and AMCORD
Minor Local Street	7.6 m wide carriageway incorporating parking	Carriageway is 0.4 m narrower and parking is 0.2 m narrower than corresponding Penrith Council guideline. Narrower carriageway is designed to reduce traffic speeds, complies with Landcom guidelines and AMCORD

The other street designs have been designed to suit specific purposes.

Collector Street with Bus Corridor

This cross-section is based on a Collector Street profile with kerbside lanes wide enough to accommodate buses, to comply with the requirements of Transport NSW for the bus corridor.

Road from PTD

The carriageway of this street was widened from a standard Local Street to accommodate the swept path requirements of the oversized trucks that are required to access the PTD.

Bus underpass of the rail line

The width of this has been based on the width of the Patrick Street bus tunnel at Blacktown, after consultation with Transport NSW and the RTA. The wider dimension is required on the bend as the underpass travels under the rail line to provide additional space for buses.

90 degree parking street

The elements of the design of the 90 degree parking street are based on the requirements of AS 2890.5-1993. However, the complete design is based on a street operating successfully in several locations. The requirements of AS 2890.5-1993 assume that a moving lane of traffic is required to be maintained at all times to be able to pass a vehicle as it is completing a parking manoeuvre.

To control vehicle speeds, the design proposed requires vehicles to use the single traffic lane in their direction of travel, plus the oncoming traffic lane. This may require vehicles behind the parking vehicle to wait while the parking manoeuvre is completed. This design has been working successfully at the following locations:

- Grosvenor Street, Neutral Bay
- Beach Street, Coogee
- Ashburner Street in Manly.

The parking should be created as rear-to-kerb to allow vehicles leaving the parking to drive out in a forward motion, providing better sight distance for the driver. The dimensions at Grosvenor Street are smaller than we have specified, whilst the other two examples have roughly the same dimensions. Grosvenor Street also uses raised thresholds to reduce vehicle speeds, but this is not considered necessary in this design environment.

Central parking street

This street has also been designed with elements based on the requirements of AS 2890.5-1993, but with the objective of slowing traffic by providing only one lane of traffic. This street is a no-through road, whose purpose is to provide access to parking, dwellings and businesses. It is therefore appropriate that vehicle speeds be kept low, and that vehicles can wait while other vehicles make parking manoeuvres.

Public transport

Future requirements of bus corridor

Concept Plan DGR number 4 requires the creation of a bus corridor through the site to connect to Penrith Station. Based on discussions with Transport NSW, the bus corridor should have the following features.

- Bus corridor proposed through site to new facilities at northern side of Penrith Station to serve new communities to the north east/north west.
- The bus corridor should be built to meet the traffic conditions, but should also preserve the ability to be widened to two lanes per bus direction if required at a future date.
- There should be land reserved for a potential bus-only underpass of the Western Rail Line.
- Bus layover may be needed prior to the development of an underpass connecting to the Penrith City Centre, depending on the bus service plan adopted, but would not be needed later, if and after the underpass was implemented. This layover would not need to be located within the Project site.
- Bus stops to allow commuters to interchange to rail services at Penrith Station, and also to provide bus access to the Project.

Transport NSW have advised that there would potentially be an 40 additional bus services during the peak periods over the next 25 years, spread around the bus routes in the Penrith area. Given the likely future bus demands from the Penrith Lakes and North St Marys developments, we have assumed that there would be a demand of 20 bus services in and out of the Project along the bus corridor.

The Project is expected to generate a maximum hourly demand for 60 bus passengers during the peak hour. Many of these passengers would be expected to use existing bus services, including those on the southern side of the rail line such as the UWS buses. Given the existing bus services at Penrith Interchange, and the proposed expansion of bus services, the number of bus passengers generated by the development is expected to add an average of one passenger per bus. It is likely that these passengers could fit on the existing bus services (not including the future buses). Given these findings:

- there is sufficient capacity on the proposed bus network for the additional passengers generated by the Project; and
- demand from the Project is not the main reason for the providing a bus corridor through the development or a bus underpass of the rail line.

The bus corridor through the Project is favoured as it provides a priority route for buses that bypasses the existing congested rail crossings at Parker Street, Castlereagh Road and, to a lesser extent Evan Street. It demonstrates the importance and priority of transit to the community. It would act as a risk management option to maintain bus reliability should traffic congestion levels remain high on these links.

All roads and intersections within the development are forecast to reach traffic flows that can be accommodated within one traffic lane (3,000 vpd two-way). The traffic volume within the Project is not anticipated to cause delay to the bus services on the bus corridor.

Bus service strategy

Options for servicing the development and the bus routes in the area considered included:

- Diverting existing and future bus routes via the Project, then back onto the arterial road network and in to Penrith.
- Diverting existing and future bus routes via the Project to terminate at a new bus interchange on the northern side of Penrith Station.
- Diverting existing and future bus routes via the Project, and passing through via the bus underpass to the current interchange on the southern side of Penrith Station.
- As above but for future routes only.

In considering the advantages and disadvantages of each option, the following issues were discussed:

- Diverting buses through the site and then back onto the external road network would be inefficient in terms of time and travel distance. It would not avoid the other congested road links.
- Rail commuters are typically interested in the quickest and most convenient route to Penrith Station. Whereas trips made for shopping or employment in Penrith CBD prefer to be dropped off as close as possible to their final destination.
- Diverting passengers via the site and terminating on the north side of the Station has the potential to provide a quick link for rail commuters, but increase the walk for other journeys. It is likely that existing passengers would perceive this as a negative change, and hence it is recommended that existing bus routes remain on their current routes (provided congestion on these routes does not become excessive).

- New bus routes, such as those from Penrith Lakes and the North St Marys Development could be introduced and operate to the north side of the Station, as there is less expectation of a service directly to Penrith CBD. When the bus underpass of the rail link is opened, these services could be extended to the southern side to provide a closer connection to Penrith CBD.
- If an underpass were constructed, travelling around the southern side of the oval would not allow buses to have a convenient stop location on the north side of the Station, within the village centre. A bus corridor on the northern side of the oval would allow buses to access the village centre and then use the underpass.

Based on this assessment, interim and long-term bus options are proposed, as shown in Figures 23 and 24. The interim bus corridor option would be a one-way clockwise loop around the village centre to Coreen Avenue.

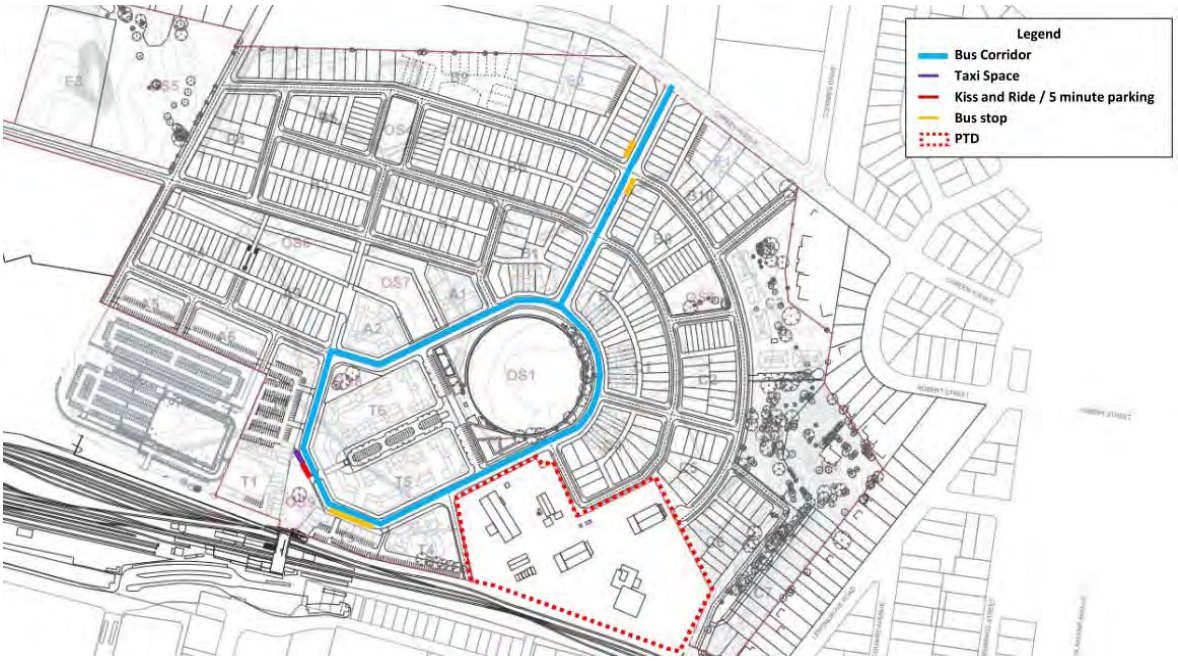

Figure 23 Interim bus corridor option

Also shown on these figures are the proposed locations for bus stops, kiss-and-ride space and a taxi rank. The bus stops close to Coreen Avenue would provide enough space for one bus on the departure side of the intersection (20 m long if adjacent to No Stopping at the intersection). The bus stop at the village centre would act as the set-down and pick up for passengers connecting to rail services, walking to Penrith CBD or accessing the village centre. It would provide sufficient space for two buses to use the stop at the same time.

The kiss-and-ride space would be provided in addition to the space reserved in the design of the commuter car park. It would be accommodated in 5 minute parking, which would also support the town centre retail and commercial activity outside of peak times.

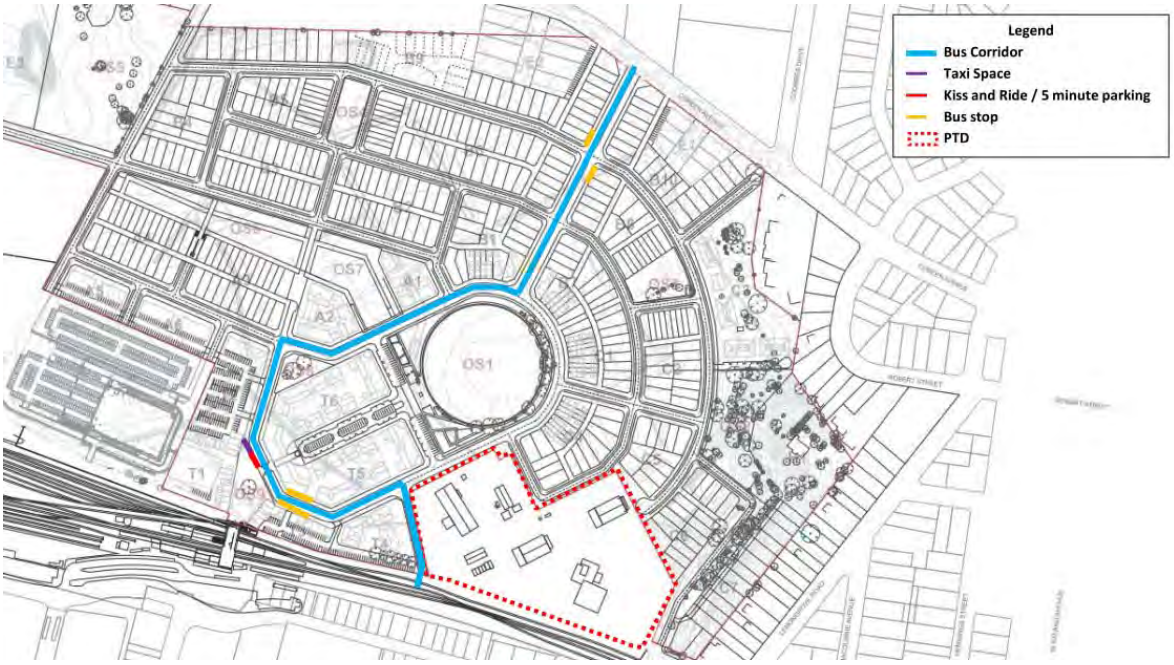

Figure 24 Long-term bus corridor options

Bus facilities

Bus stops have been placed based on the suggested spacing of 200 m – 400 m (State Transit Authority of NSW *Bus Stop Style Guide* (1999)). Bus stops at the town centre would provide good access for commuters, shoppers and employees of the commercial premises.

A pair of bus stops is proposed near the first junction inside the site from Coreen Avenue to provide access to the residential areas accessed along the surrounding streets.

Locating bus stops on the downstream side of the intersection allows the 'No Stopping' on the street corner to also act as the bus draw-in space, reducing the length required from 30 m to 20 m. Bus stops close to an intersection are preferable to those located mid-block, as they encourage pedestrians to cross at the intersection rather than in an unexpected location for passing vehicle drivers.

Bus stops should have bus shelters, or a hardstand, suitable awning with seating, requiring a footpath width of at least 4.0 m.

Bus underpass of the rail line

The timing of the introduction of bus lanes or peak period clearways is beyond the timeframe addressed in this study. The timing of the planned bus underpass of the Western Rail Line is dependent on the level of congestion on the arterial road network. This is in turn dependent on the timing and scale of other developments, such as the North St Marys and Penrith Lakes projects. At this stage, the responsibility for the implementation of the bus underpass is unclear.

The design parameters anticipated for the bus underpass are:

- depth of 7.75 m from the ground level – this depth may be greater than required. Advice from RailCorp is that services may run along the outside boundary of the rail corridor at a depth of up to 2.2 m

- gradient of 1 in 10 maximum – if the depth above is not required, this should be reduced to a desirable gradient of 1 in 8 (12.5%)
- 12.5 m long transition at each end to prevent buses scraping on the pavement
- 4.75 m clearance (from tangent points on the pavement surface)
- 3.0 m deep clearance under rail bridge to accommodate services and the bridge structure
- notional 12 m wide excavation – two 6.0 m wide lanes, allowing disembarking space or the potential for overtaking in the event of a breakdown, whilst not encouraging pedestrians or other unauthorised use
- a 2.5 m construction easement with no buildings would be provided on either side.

These have been discussed with Transport NSW and the RTA. This concept is drawn approximately to scale in Figure 25.

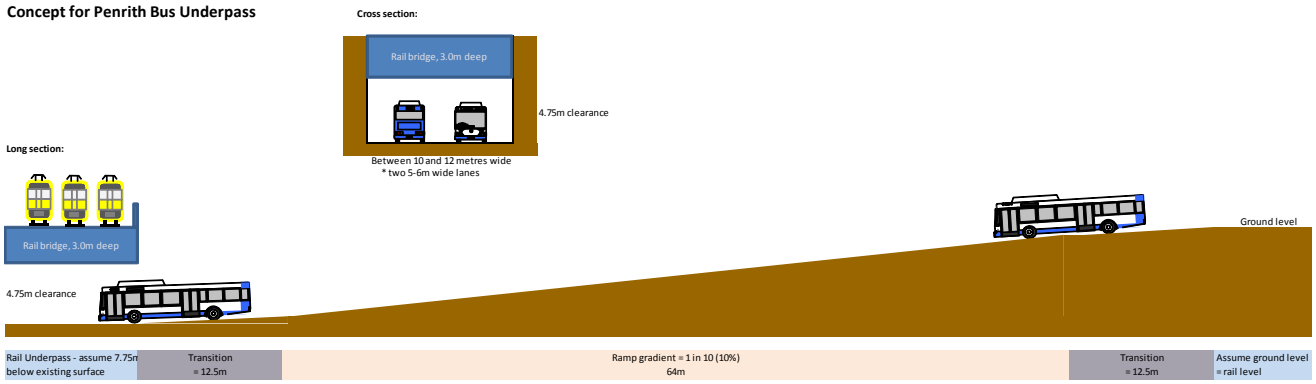

Figure 25 Possible bus underpass concept sketch

Commuter car park connection

Access between the commuter car park and Penrith Station would be encouraged through a pedestrian/cycle link passing through the station square, past the supermarket and other shops and into the commuter car park.

These retail facilities have been located in this way to provide commuters with more than just a parking space, and to allow then to interact with the development rather than just passing through.

The commuter car park (to be constructed by Penrith Council, and leased to RailCorp for 50 years for commuter parking) also includes bicycle lockers, kiss-and-ride space and parking for disabled drivers. It has been provided for commuter parking only. Separate parking for the Project would be provided within the Project.

It is proposed that a connection be created from an east-west collector street through to the internal commuter car park road to allow vehicle access to one of the car parking areas for the village centre. It is also proposed that the commuter car park roads be used by semi-trailers and delivery vehicles accessing the rear loading dock for the supermarket.

Train service capacity

As discussed in Section 2, train services between Penrith and Sydney CBD on average have spare capacity leaving Penrith, but are more congested on the return journey in the afternoon peak. There are currently spare seats on 50% of trains travelling west from Redfern in the PM peak. However, greater choice for train travel may fill this spare capacity. Transport NSW's proposed

Western Express project is planned to add express train services between Penrith and Sydney CBD.

Current plans are for the project to supply around 150 train trips during the peak period, of which 1/3 would be in the counter-peak direction. The Project is forecast to add between 5 and 10 passengers per train departing eastwards from Penrith. The future number of trains available to Penrith Station is not known. However, this number of passengers should be able to be accommodated on expected growth planning by RailCorp to address the State Plan's transit objectives.

Penrith Station stair and walkway capacity

Penrith Station's pedestrian bridge includes both paid and unpaid concourses, allowing pedestrians to travel freely between the north and south sides of the rail line. The bridge and stairs accommodate the pulses of train passenger movements when trains arrive. Pedestrian flows divide between the north and south side destinations. The south side flows are further split by the direct access to Platform 3 and the stairs to the ticket window on the pedestrian bridge.

With the population and employment in Penrith set to increase and train usage to be promoted, the bridge and stairs at Penrith Station are forecast to be subject to greater demand. RailCorp have requested that the future pedestrian flows at Penrith Station Bridge be checked with the addition of the additional pedestrians and train passengers generated by the development.

To do this, the station entry and exit flows from the *2008 Compendium of Travel Statistics*, from Table 10, were split using the results of the PB passenger surveys in 2007, from Table 11, into passengers arriving from the north and south side of the station. The flow of passengers per minute was estimated by first calculating the number of passengers per train and then converting this number into a flow per minute using the following assumptions:

- 40% of passengers from the south side the direct access to Platform 3 rather than the unpaid concourse
- 26% increase in Station entries and 42% increase in the Station exits in the AM Peak (reverse in PM peak)
- 15% contingency and 20% peak factor for train passengers
- train passengers take two minutes to pass through the station after the arrival or before the arrival of a train.

The pedestrian flows generated by the Project were calculated for train passengers, and pedestrians and bus passengers walking to the southern side of the rail line. A broad assumption was made that 50% of all walk trips generated by the development would cross the rail line. A peak factor of 200% was used for walk and bus trips.

A width of 3 metres was assumed for the stairs on each side and 2.5 m for the unpaid concourse. The pedestrian flows were converted to a flow rate per metre per minute and compared to the Fruin Level of Service Criteria (see Appendix 2 for more details).

The results indicate the following results:

- Southern stairs would operate at a LoS B
- unpaid concourse would operate at a LoS B
- Northern Stairs would operate at a LoS B.

The analysis has indicated that Penrith Station would have sufficient capacity to accommodate the future pedestrian flows, including those generated by the Project.

Pedestrians and cyclists

The pedestrian and cycle network have been designed to have a greater level of permeability than provided to vehicles to further promote their greater use. The bridges across the water body (shown in Figure 3) would reduce walk and cycle distances, whilst creating a pleasant, car free environment. The proposed walking and cycling network is shown in Figure 26.

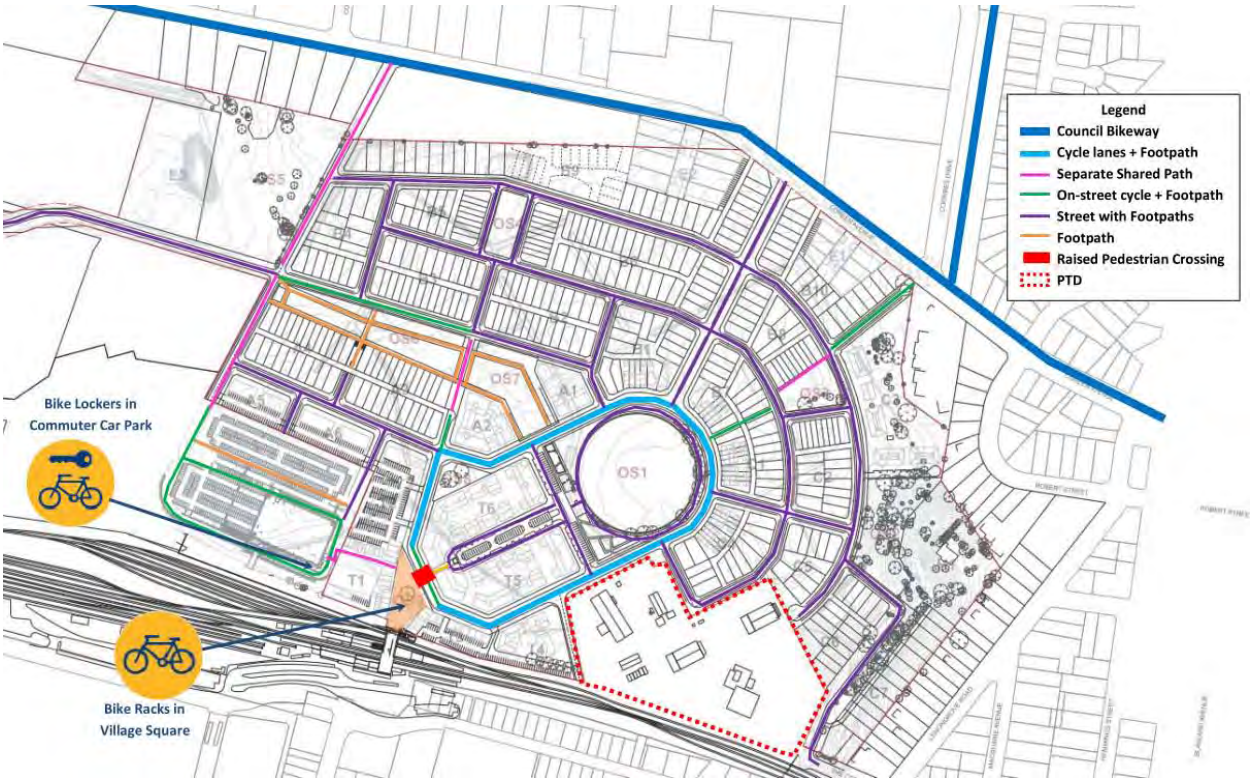

Figure 26 Pedestrian and cycle facilities

Walking

All Streets (except laneways) would have 1.5 m minimum footpaths, generally on both sides of the street. Some off-street paths would also be provided. The station square would be created to provide an open space area that would be the focus of public life in the Project. Its vibrancy would be increased through its use as the path between the commuter car park and Penrith Station.

A raised pedestrian crossing would be provided across the main street to reinforce that vehicles are passing through a mixed environment and to reduce vehicle speeds.

Footpaths and shared paths would be designed with regard to the *Planning guidelines for walking and cycling* (NSW Planning, December 2004).

Cycling

Penrith Council has provided an off-street cycle path between Coombes Drive and Andrews Road. Coreen Avenue is also listed as a proposed bikeway in PITLUS. The cycle concept for the Project has been planned to connect these routes to the following:

- provide access from Coreen Avenue at Coombes Drive to Penrith Station and North Penrith village centre
- provide access from Coreen Avenue from the west to North Penrith village centre
- provide access from Coreen Avenue to the commuter car park bicycle lockers.

The plan of the cycle routes is shown in blue, green or pink lines in Figure 26. Bike routes would be designed in accordance with the RTA's NSW Bicycle Guidelines (July 2005).

Eight bicycle racks would be provided in the station square, in addition to the bicycle rings to be provided by Penrith Council/RailCorp in the commuter car park. The number of racks required has been based on the estimated number of retail and recreational/social trips in the mixed use village centre made by bicycle estimated in the transport model. The calculation assumes that Penrith Station cycle-and-ride passengers would be accommodated in the bicycle facilities provided in the commuter car park, and that cyclists to the commercial land uses would have locking facilities provided within their building.

Commercial buildings would be required to provide cyclist end of trip facilities, including bike locking and showers, as per the requirements of the *Planning guidelines for walking and cycling* (NSW Planning, December 2004).

The cycle routes are proposed with a mixture of shared paths, mixed traffic and on-street cycle lanes. This has been done to avoid mixing cyclists with traffic on the streets with the highest traffic volumes, where possible. The continuity of the bike route would be provided with signage and pavement stencils to show the path of the cycle route.

- Separated cycle lanes are proposed within the 3.5 m kerbside lane. This would be accommodated with a 2.3 m wide parking lane and 1.5 m wide cycle lane. If the kerbside lane is required for bus operation, buses and cycles would share this kerbside lane.
- Mixed traffic cycle routes are only proposed on low-traffic roads (less than 1,000 vpd. This is much lower than the 3,000 vpd warrant for separate cycle lanes in the). Thus the likelihood of a bicycle and vehicle is reduced.
- Shared paths would be provided at various locations alongside the commuter car park road. They would be 3.0 m wide.

Parking

Reduced parking provision

The North Penrith project is in a unique position to provide a transit-friendly development in a regional city due to its:

- proximity to a rail station with frequent and express services
- proximity to regional and feeder bus connections
- close proximity (within walking distance) of Penrith Town Centre employment, regional shopping, entertainment and community facilities

- potential selection by people with a lower level of car use than those used as a basis for setting the Penrith Council parking requirements, such as university students, mature-age, young professionals, etc
- planned high degree of walkability and cycle-friendly trip lengths
- mixed use of retail, commercial and residential land uses, allowing the potential for trip containment and trip sharing – i.e. the combination of multiple trip purposes/destinations within the one journey and reduced overall trip length.

For these reasons, it is proposed that the provision for car parking within the site, and within the mixed-use village centre in particular, should be provided at a suitable rate for this project, which is a lower overall rate than typical developments in the suburban parts of the LGA.

Dual and complimentary use

Different land uses make their highest demand for car parking at different times of the day: commercial during the morning, retail in the afternoon, and residential at night. These different peak periods allow some of the parking to be used for different purposes at different times of the day. For example, people arriving for meetings at offices arrive during the morning, before the time of greatest retail demand in the afternoon. Visitors to residential dwellings can make use of on-street parking after the retail peak in the afternoon.

Early provision followed by increasing density without additional parking

The village centre will not have the critical mix of land uses in its initial stages to provide shared trips and transit-orientation. Public transport is already provided through the rail services at Penrith Station. To promote the overall success of the Project, and establish its vitality, in the initial phases of the development, parking should be provided at slightly higher rates through the early provision of centralised parking. However, these early concessions to allow parking should not be allowed to impact on the long term sustainability of the CBD. Overall, it is recommended that the provision of parking may be higher in the early stages of the development as bonus opportunities, with stricter application of maximum rates as the development fills with new ventures.

This allows short term concessions on the amount of parking allowed without discriminating against applicants who develop either earlier or later. They all have the same maximum on-site provision, but the rate of centralised parking to be provided would slightly diminish over time so that the overall parking provision finishes with the long-term sustainable rate. This will achieve the ‘park once and walk’ behaviour desirable in a village centre and successful TOD and it will encourage public transport trips for commuters.

Simplified rates

Simplifying the rate to residential and non residential (retail and commercial) has merit in terms of simplicity and flexibility. It allows land uses to change in individual shops/commercial spaces without the need to adjust the total parking provision (provided the overall mix of development stays approximately the same).

Parking rates

A typical TOD parking rate is a maximum of 1 space per 50 square metres of retail and commercial floor space. Penrith Draft DCP 2008 requires a minimum provision of 1 space for 40 square metres of retail and commercial. To acknowledge the lower parking demand and encourage travel by active and public transport, the rates shown in Table 31 are proposed for the North Penrith Development. These rates are lower than the requirements of the Draft DCP.

Table 31 Recommended parking rates and comparison to DCP requirements

Land use	North Penrith parking rate	Penrith Council Draft DCP2008
Multi-unit housing – villas and townhouses (including integrated housing)	Maximum on-site resident parking for each dwelling as per the following table: ▪ 1 bedroom: 1 space/dwelling ▪ 2+ bedrooms: 2 spaces/dwelling Visitor parking provided on-street	On-site resident parking for each dwelling ▪ 1 bedroom: 1 space ▪ 2 bedrooms: 1.5 spaces ▪ 3 or more bedrooms: 2 spaces In addition, provide visitor parking for developments that have 5 or more dwellings: 1 space for every 5 dwellings.
Multi-unit housing – apartments	Maximum on-site resident parking for each dwelling as per the following table: ▪ Studio: 0.5 spaces/dwelling ▪ 1-2 bedroom: 1 space/dwelling ▪ 3+ bedrooms: 2 spaces/dwelling Visitor parking provided on-street	On-site resident parking for each dwelling; ▪ 1 or 2 bedrooms: 1 space ▪ 3 or more bedrooms: 2 spaces In addition, provide visitor parking for developments that have 5 or more dwellings: ▪ 1 space for every 5 dwellings.
Loft Studios	1 space per dwelling (where the studio is part of a separate title from the principal dwelling)	-
Affordable housing	In accord with the requirements of State Environmental Planning Policy (Affordable Rental Housing) 2009	In accord with the requirements of State Environmental Planning Policy (Affordable Rental Housing) 2009
Seniors housing	In accord with the requirements of State Environmental Planning Policy (Housing for Seniors or People with a Disability) 2004	In accord with the requirements of State Environmental Planning Policy (Housing for Seniors or People with a Disability) 2004
Commercial premises (including business & office premises)	Maximum provisions of 1 per 50m² gross floor area Minimum provision of 1 per 75m² gross floor area	1 per 40 m² gross floor area
Shops (assuming Penrith Town Centre rate)	Maximum provisions of 1 per 50m² of net retail floor area (excluding arcades, colonnades etc not used for display or sale) Minimum provision of 1 per 75m² gross floor area	1 per 30 m² of net retail floor area (excluding arcades, colonnades etc not used for display or sale)
Supermarket	Maximum provisions of 1 per 26 m² gross floor area	1 per 10 m² of net retail floor area

Note this is a slight change in the policy to maximum/minimum parking rates from a minimum parking rates, which acknowledges that this development is expected to perform more like a TOD than a typical district centre.

In addition, should further development be sought at a later stage, it is recommended that parking for future expansion be limited to achieve an overall maximum rate of 1 space per 50 square metres of retail and commercial floor space.

Design and location of car parking

On-site parking

Some level of on-site parking will be required for residential dwellings, some staff parking, and short term visitors such as tradesman. Residential parking should be located within the building. Staff parking for retail and commercial development can be provided within the building, or as dedicated spaces within a centralised facility.

To improve the amenity of the village centre, on-site parking should be located away from street frontages. Permanent on-site parking must be provided in basements wherever possible. An alternative to basement parking is aboveground structured parking. Any parking of this nature should be enclosed within the building and active uses and facades should be presented to all street frontages (and drive ways minimised across major pedestrian and cycle routes).

Limited on street parking should be provided on the main-street to provide some activation ('a watching eye for the civic area and main street'), an element of additional traffic movement friction (which will reduce vehicle speeds), as well as improve mid-block crossing potential for pedestrians.

At grade car parks should only be provided at the rear of sites where they are not visible from active streets, and car park entries across active footpaths should be rationalised. At grade car parking is usually only acceptable for temporary car parking or very short term car parking. This can increase people activity, casual surveillance and personal safety.

Central parking

Centralising the parking and provision on a precinct basis rather than a property by property basis has several advantages:

- it keeps parking supply in critical locations under tighter policy control
- reduces the demand by allowing for multi-use trips from a single parking space (given an appropriate mix of uses)
- it encourages park once and walk behaviour which stimulates economic and social activity/vitality within the centre
- it allows for transition from the current high rates to some more sensible and sustainable long term rates, which will also encourage alternative transport (public transport, walk and cycle)
- it banks land that can be used for more economical productive purposes at a later date.

For this reason it is important for the high rates (more than 1 space per 50 square metres) that may be allowed in the early stages should not be attached to developments individually, but be provided as a centralised parking provision.

Due to the complexity of the development, it is recommended that a number of at grade smaller centralised parking areas are provided ranging in number of car parks provided at 50-70. To support this car parking signage will also be required to ensure shoppers/visitors understand where these centralised car parks are located.

Centralised parking can be above ground but visual amenity of street frontages should be protected. Location of any centralised parking should not occupy vital core space but fringe the village centre encouraging 'park once and walk' behaviour.

As a means of staging longer-term development, centralised car parking can also be used as 'temporary' central car parking. In this case such 'temporary' car parking should be located at or near the site of proposed future public transport; over time as development intensity may occur around the village centre these car parking areas can be redeveloped with a greater mix of uses (as well as providing the necessary 'existing' car parking function). Temporary car parking facilities in these locations can be interim uses on sites to be developed later for residential development or even for the public transport facilities themselves.

On-street parking

Kerb-side parking is a very handy element in the centre. It manages speed by providing friction, it generally stimulates street activity and can contribute to casual surveillance and it provides a buffer between the verge/footpath and the moving traffic. As mentioned previously, limited on-street parking on the main-street will be particularly important in assisting to achieve these desired outcomes. But provision has to be sensitive to bus routes, not encouraging "cruising and waiting" and targeted to support local businesses.

Parking controls

Time limits

Due to the proximity to Penrith Station, time limited parking should be considered to encourage commuters to use the facility provided by Penrith Council and RailCorp. Time limits of 2 hours would be appropriate for the village centre parking areas, as it would restrict commuter use and allow enough time for shopping/meetings.

Time limited parking is usually introduced with a pricing mechanism. Time limited parking theoretically provides turnover, but is not as effective in doing this as paid on-street parking. Additionally, time limited parking can act as a minor incentive for driving and parking, when compared with more sustainable modes as it gives the driver some certainty that a space will become available.

A similar time limited parking requirement is recommended for the centralised parking areas (e.g. a two hour provision). To encourage use of the centralised parking areas, there should not be a charge for these car parks, but instead off-street time limits should be enforced.

On-street parking spaces along residential streets within 800 metres of the Station may experience commuter parking demand if other facilities reach capacity. If this occurs, a four hour time limit on parking could be considered for the affected streets.

Meters

Meters usually have been the mainstay of enforcing time controlled parking in urban centres around the world. They are usually financially rewarding for the authority and effective in providing equal access to kerb-space. Metered parking is not current practice in Penrith Town Centre, but could be introduced in the future. It is one measure that could be used to manage excess parking demand and provide funding for further transit and active mode improvements. It is envisioned that parking meters could be utilised for on-street kerb-side parking.

Paid parking

Paid off-street parking has two fold benefits. It opens up private sector opportunities to provide parking and also acts as a disincentive for people to use their private vehicle, thus improving the sustainable transport alternatives.

TOD Principles

The TOD evaluation of the North Penrith project is based on the TOD principles and checklist included in Appendix 7. Principles and best practices are discussed below, with findings (shown in grey) are provided on how well the Project achieves these principles.

A Defined and Active Centre

The use mix in a village centre, particularly around the station and the main street, should provide a moderate level of activity throughout the day and night to ensure passive surveillance keeps people safe and feeling safe. By providing a mix of uses near the station, people can be attracted to the civic square and toward the station, and encouraged to use public transport. Similarly, people will be encouraged to use local shops and services while accessing transit or the commuter parking if they are aggregated to feel part of a shared trip. This practice supports both local economic development and public transport use.

The greatest concentration of employment uses should be provided nearest to the station. In the context of the Project, proximal mixed use development should be encouraged in the civic square and the adjacent main street. People travelling between transit and their place of employment expect to walk a shorter distance than those travelling between transit and their home are prepared to do. To maximise transit use, research shows that the residential component works optimally if located within 800 metres distance (a 10 minute walk) from the station, where as commercial/office workers prefer closer office locations, within 250 metres-400 metres of the station. Retail uses should be concentrated along a main street and its connecting feeder streets. The main street should connect to the station.

Although the size and scale of the Project is reasonably small, the mix of uses will stimulate a reasonable mix of uses and activity. It is also understood that the ground floor of predominantly retail use is intended to complement the existing Penrith CBD/City Centre.

The general layout of the master plan provides for a ‘defined and recognisable’ centre; in addition the reasonably permeable street network will provide long-term resilience for all modes of transport and changes in land use over time (decades).

Specifically, the focus of commercial office to be located within 200 m of the rail station (and in the village centre) is entirely appropriate for TOD success, as is the proposed higher density residential (3-6 storeys). Finally the location of industrial uses further away from the station and village centre provides reasonable vehicle access to these more car dominated activities and reduces their impact on the ‘village’ centre.

A mix of uses at Medium to High Densities

Diversity in housing is a key feature of successful transit oriented development and of resilient communities. Housing needs of people change over time. A good mixed centre provides for a range of lifestyles and affordability, thereby attracting a broader mix of people to the centre.
A broad range of housing and architectural styles should be encouraged. This includes apartment style living, shop-top housing, townhouses, mews dwellings and small lot housing.

The concept plan supports a mix of uses and densities. The range of low to medium densities will encourage a range of housing types. In comparison to the existing character of the surrounding area, in the core of the 'village centre' will be 3-6 storey medium density development. The density of the project will add to its performance as a TOD. The residential density of the Project is consistent with the density needed to support rail, particularly considering Penrith's reasonably outer suburban centre location.

Permeability and Compact Pedestrian-Oriented Design

Walking is the most important mode and should be the priority within the entire centre. At some point in every trip, we are all pedestrians and design should recognise such aspects. Strong and identifiable pedestrian connections should be provided between the major community building blocks. The pedestrian access network, based predominantly on streets, should be fine grained (i.e. short block faces and mid-block laneways), particularly close to the station and within the compact core.

The circulation network in a TOD should:

- reinforce a low speed, cycling and pedestrian friendly road network throughout the centre
- provide direct, safe, convenient, continuous and legible cycling and walking networks throughout the centre radiating from the transit centre and into networks in the surrounding residential areas
- provide excellent permeability for all modes of transport, thereby providing direct routes and reducing trip lengths for all (including vehicle trips).

Development should be designed such that it prioritises pedestrian and cycle movements to and from the street, within the site and within buildings. Front doors to buildings should be obvious and accessible. Cycle and pedestrian entrances should be equally, if not more convenient, than motor vehicle entrances. Pedestrian and cycle paths should take the most direct and convenient route between the building or site entrance and the storage facility or dwelling unit. People should be encouraged to use stairs and not escalators to access ground levels and entrances to buildings.

The permeable network and general walkable scale of the proposed development support the compact pedestrian viability of the Project. The street connectivity provides reasonable walk-ability to the station. The key areas of potential improvement include:

- The integration of the passenger rail bridge to the new village centre and civic plaza will be critical to be designed as a quality 'gateway' into North Penrith, particularly for transit passengers. It should also perform a pedestrian connection function between North Penrith and the existing Penrith CBD/town centre.
- Need to ensure safe and well designed pedestrian access from the park n ride facility via the civic square and retail area to and from the rail station and bus stops.
- Because of the severance introduced by the rail track, it is recommended that a review be conducted in the future to determine the need for a future direct road connection to the Penrith City Centre to provide shorter vehicle trips from the North Penrith development area to the existing City Centre (rather than longer trip routes along Castlereagh Road which will likely add to overall network congestion); this connection could possibly be in the proposed new 'bus only' underpass under the railway.

Bicycling

A bicycle grid should be incorporated in a TOD and include dedicated bike lanes and off-street bikeways (parallel but segregated by planting strips from foot paths) to allow for the creation of a coordinated network. The grid network should be linked to the regional bike path system. New commercial buildings should be required to provide enclosed bike storage and shower/changing facilities.

Transit

Public transport infrastructure should be a key aspect of the design and orientation of a TOD. The station should be about more than getting on or off the bus or train. Properly treated, the station should provide the initial impetus for development of the district surrounding the station.

Currently, the station serves approximately 14,000 passengers per day. The realization of the TOD can help to increase the ridership at the station by walk and ride patronage.

The rail station should serve as the gateway to the area, particularly for transit users – thus it should provide a significant civic statement. As outlined it is envisioned the station will be accessed by a main street and incorporate public/civic plaza to provide for local and transit travellers. It is also important to activate the station setting with a retail component, such as a newsagent, coffee shop and/or bakery.

Parking

Parking is a significant factor in success of transit oriented development. Too much parking for residents, workers and visitors, discourages public transport use. A small amount of short stay parking will be needed to support retail activity.

However, car parking allocations for all uses should be carefully managed and minimised. Generally, a target of 85 per cent occupancy for on-street parking should be considered as part of a comprehensive parking management strategy.

The aim is to provide pedestrian access to all areas of the TOD, while minimizing vehicle and pedestrian conflicts and visual intrusion of parking into the public environment. As described in more detail in another section of this report, parking standards should be changed to establish a maximum rather than minimum parking ratio amount. The parking standards should ideally also establish a dwelling unit size for which no parking is required (e.g. studio apartments).

Parking supply is one of the reasons TOD has yet to 'take off' as a mainstream development alternative in Australia. A TOD's main advantage over 'normal' development is a lower on-site parking requirement. Typically, project sponsors underestimate this advantage and end up with normal development patterns and little or no increase in public transport patronage.

In a TOD parking should be addressed at a precinct level with on-site, off-site and off-street and on-street parking all counted in the overall strategy for parking management and provision.

In the early stages of development, higher rates can be allowed through the use of off-street supply, but as more opportunities for contained activity which do not generate car trips occurs, the rate should be diminished. This then generates more sustainable and profitable on-site behaviour. People will walk and when they walk they spend more money.

Shared parking should also be required to reduce the overall parking supply demand in the core. In the residential areas, parking demand can be met with on-street spaces and off-site, dedicated structures rather than on-site garages and street facing driveways. If garages are provided on-site, they should be accessed by rear laneways.

In TODs, plans should examine the viability of requiring parking to be sold separately from all residential units. This can improve the affordability of housing for those who choose not to own a car. In addition, parking should not need to be located in the same building or block as the associated land uses.

Structured parking should be wrapped with buildings to minimize visual impact on public streets and spaces. In the core station area, surface parking lots should be phased out. In this manner, surface parking should serve as land banks until redeveloped with structures or open spaces.

Vehicle access to parking should be avoided on high-traffic pedestrian frontages. Parking access should be well identified for wayfinding.

As described in more detail in this section, parking policy provisions should improved to require such policy changes as 'maximum' (not 'minimum') parking rates, a shared or centralised parking schemes should be explored, and use of on-street and off-street management (meters and time management) to support the intended TOD and village centre outcomes sought.

In addition the commuter parking facility and integration with the overall development should ensure it provides a safe and secure quality pedestrian link via the village centre and civic square, to activate the village centre and ensure safety for rail/transit passengers.

Large vehicle swept path requirements

The additional space requirements of trucks and buses have been considered in the road layout of the Project. The specific vehicles and movements catered for include:

- 12.5 m long rigid buses on the bus corridors shown in Figures 23 and 24 (assumed 14.5 m long rear-steer buses with similar turning path requirements to 12.5 m long buses)

- 12.5 m long garbage trucks and delivery vehicles on all streets except laneways
- 19.0 m long semi trailer delivering to the loading dock at the rear of the supermarket (see Figure 27)
- 25.0 m long over-sized semi trailer for access to the PTD (see Figure 27).

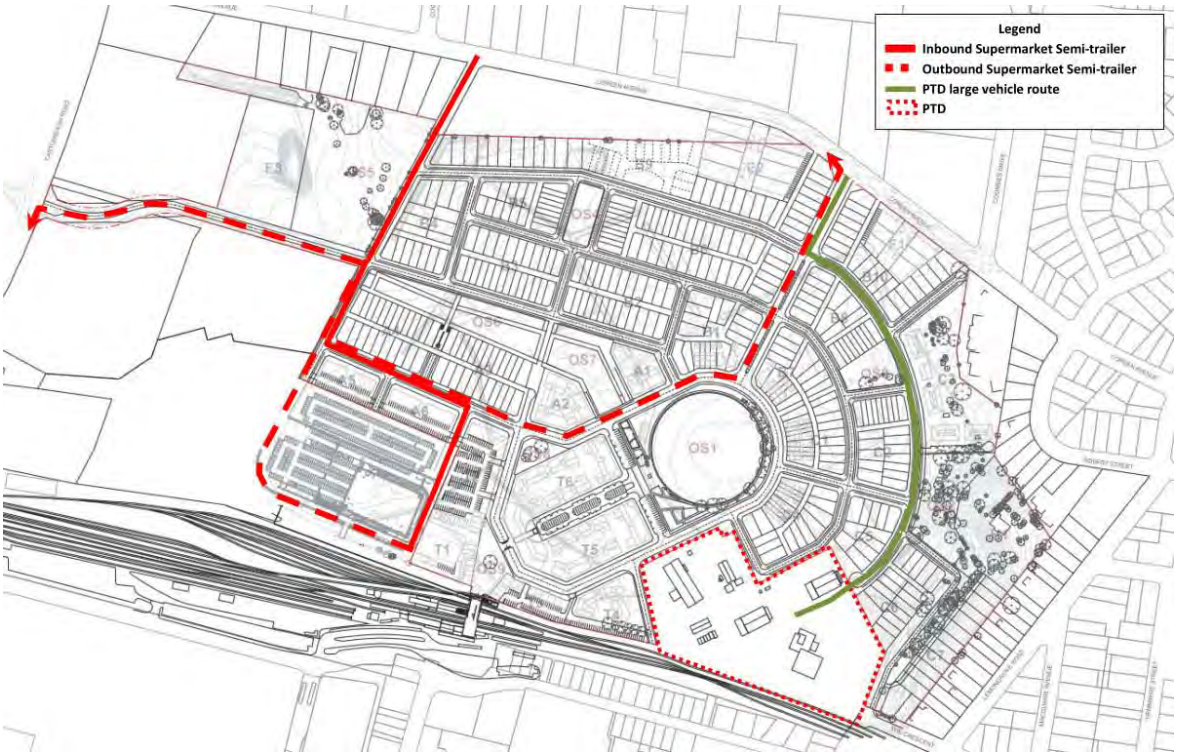

Figure 27 Large vehicle routes

The swept path requirements were tested using the AUTOTRACK program. The results are shown in Appendix 7. The results show that all turn movements can be made satisfactorily.

Emergency vehicle access

The access requirements of emergency services vehicles would be provided via the four entry points plus the bus underpass (if constructed), and the design of the street network to accommodate 12.5 m long rigid vehicles.

The maximum access time between the closest access point (not including the bus underpass) and any property in the Project has been estimated at 65 seconds, assuming a speed of 40 km/h.

Commuter car park access

Drivers using the commuter car park would have their current access arrangements improved in the proposed Project road layout, with the retention of the existing roundabout on Coreen Avenue and the connection of Peachtree Road through to the commuter car park road. This new connection would offer an alternative route for commuter vehicles arriving from the north or departing to the south along Castlereagh Road.

Based on the weekday (24 hour) traffic volume forecast for the Commuter car park road, commuter traffic (i.e. not associated with the North Penrith Project) represents up to 47% of the total traffic on this road.

Speed control measures

The streets within the development have been designed with reduced carriageway widths to act as a natural inhibitor of vehicle speeds. It is proposed that all streets within the development would be signposted as 50 km/h apart from the streets shown in red on Figure 28.

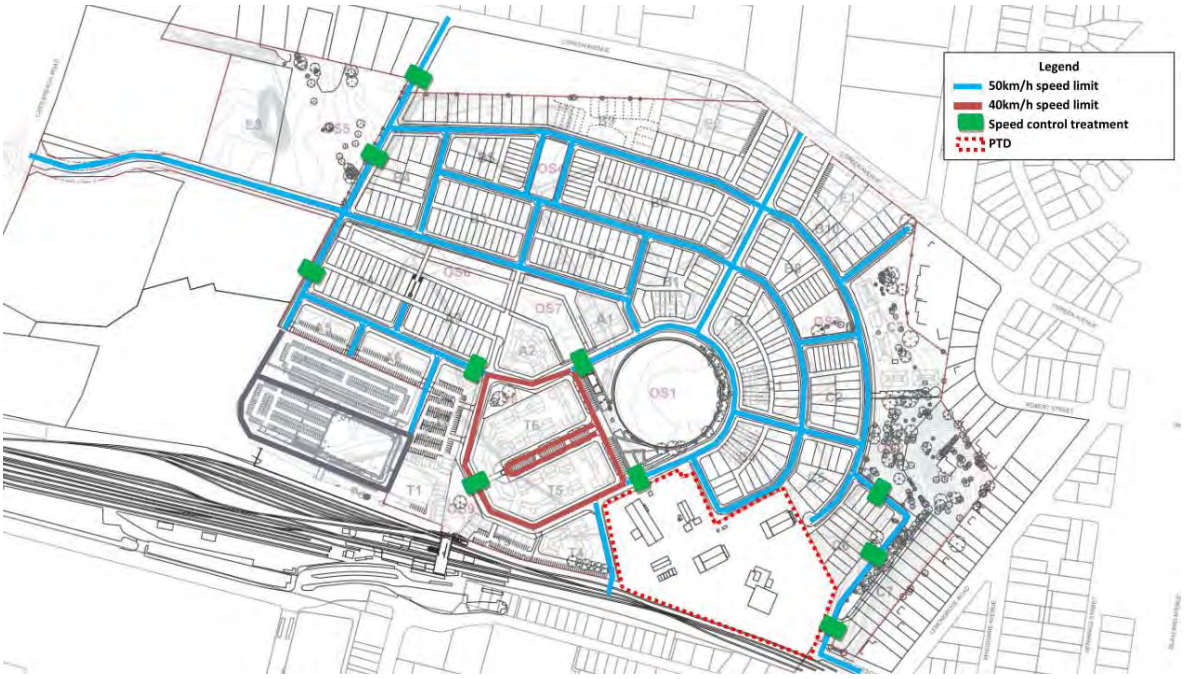

Figure 28 Large vehicle routes

There are three locations where speed control measures should be considered:

- Along the commuter car park road – there are currently six speed humps controlling speed on this long section of road. The addition of the Project would have a traffic calming measure. However, speed control devices should still be considered.
- At the entry points to the village centre and at the raised pedestrian crossing – to advice drivers in the change in street environment and improve adherence to the 40 km/h speed limit.
- On the road to The Crescent – to discourage this as a traffic route and to reduce speeds near historic Thornton Hall.

The speed control devices do not necessarily need to be full height speed humps. They could include a mixture of textured and coloured pavement and/or vertical displacement devices of low or standard height depending on the level of influence on driver behaviour desired.

In the context of the development, TravelSmart would be a series of transport initiatives which encourage people to change some of their personal travel choices. TravelSmart aims to reduce people's dependency on cars and help them to know their options for sustainable travel alternatives such as cycling, walking and public transport. It involves working with individuals to promote the use of alternatives to driving where possible.

Travel plans

One of the TMAP objectives is to reduce the level of private car usage in favour of more sustainable modes of travel such as walking, cycling and public transport. A method of achieving this is personalised marketing strategies to assist in modifying travel behaviour through communicating relevant travel choice information to the community. Marketing would begin through the provision of travel information kits (Travel Access Guides) which would be provided to all new residents in the Project. Each business would be required to produce a Workplace Travel Plan and provide the relevant information to employees.

These TAG and WTP strategies are similar to the TravelSmart schemes. Experience from the introduction of TravelSmart schemes in other locations was reported in 'Evaluation of Australian TravelSmart Projects in the ACT, South Australia, Queensland, Victoria and Western Australia: 2001–2005' (Australian Greenhouse Office located in the Department of the Environment and Heritage, 2005). The average change recorded for households is shown in Table 32.

Table 32 Average Household TravelSmart mode split change

Mode	Before	After	Change
car (driver)	58%	53%	-10%
car (passenger)	24%	24%	1%
motorcycle	0%	0%	0%
cycling	2%	3%	50%
bus and train	5%	6%	21%
Walking	11%	13%	23%

The following is taken from the TravelSmart Australia web site:

The TravelSmart program includes the development of a Travel Plan. A travel plan is a short, simple document that outlines a range of site-specific actions to encourage the use of more sustainable transport options. It focuses on the way people travel and develops a strategic approach to changing travel behaviour. It is not a one-off event to be undertaken and completed, nor is it a document to be produced and put on the shelf.

A travel plan includes going through a process of gathering information about how people travel, identifying the issues, barriers and opportunities, and coming up with actions to improve travel options. Travel plans produce many benefits. They help reduce the impact of travel on the environment but also make good business sense. They can cut traffic congestion around a local area and help people save money on travel by identifying more efficient use of the car whether for commuting or in-work travel.

A typical plan may look at:

- *walking*
- *cycling*
- *public transport*
- *incentives*

- *flexible ways of working (such as working from home or teleworking)*
- *carpooling*
- *company car fleet options (choice of vehicle, driver training, fleet operation).*

The plan incorporates analysis from a range of sources such as surveys, focus groups and workshops in order to clarify issues and identify the best approach forward. Travel plans are flexible and regularly evaluated to ensure they continue to reflect site-specific issues.

Project application

The Project Application area is shown on Figure 4. It covers the residential areas surrounding the Boulevard and the mixed-use village centre. Depending on the take-up rates of the commercial and retail land uses in the village centre, full occupation of the Project Application area may not be achieved by the time land release starts in the subsequent stages of the Concept plan. The 2016 scenario has been used as a proxy for the traffic and transport impacts of the Project Application.

Transport impacts

The impacts on the road network are dependent on the amount and timing of additional traffic generated by other developments. The majority of road upgrades described in Table 24 would be required by 2016 if all the other developments become operational as assumed. If they are delayed or downgraded in terms of scale of development, the road network would largely be able to accommodate the traffic generated by the Project Application.

Access to Stage 1 would be via the newly created intersection of Coreen Avenue and the site boulevard. The existing road to the commuter car park would remain open. The PTD would continue to operate in its current manner.

The bus and train networks have sufficient capacity to accommodate the additional trips generated by the Project Application. Both bus scenarios (Figures 23 and 24) could be accommodated within the roads proposed as under the Project Application. The interim bus scenario would be sufficient to accommodate the needs of the Project Application and the other local developments through 2016.

Pedestrian and cycling facilities would be timed to coincide with the development of the area of the Project. Early provision of a link from the completed residential areas of Stage 1A to Penrith Station would be required (during the construction of the village centre).

Construction traffic management plan

Construction would occur in several stages, as outlined in Figure 4. As a construction contractor has not been appointed, the exact methodology of construction is not yet known. A complete construction traffic management plan will be submitted for approval before the commencement of construction, but once the required detail is known. The preliminary points discussed below would be included in the construction management plan.

Site Traffic Management Plans (STMP's) will be developed for specific areas of work outside the site that may impact in some way on local traffic. STMP's describe the extent of the expected traffic impact, and the management and responsibility measures to be implemented.

The types of construction vehicles likely to be used during the stages of construction include:

- Site Establishment - utilities and small delivery trucks.
- Site Works & Demolition - tipper trucks, various delivery trucks.
- Excavation and Bulk Site Filling - tipper trucks, low loader float for excavator.
- Concrete Floor Slabs - concrete agitator trucks & pump.
- Framing - timber delivery semi trailer, crane.
- Roofing - semi delivery truck, crane.
- Brickwork - concrete agitator trucks & pump.
- Glazing and Lock-Up - utilities and small delivery trucks.
- Finishing & Fit-Out Trades - utilities and small delivery trucks.

During infrastructure servicing works, tradesman utility vehicles, water carts, delivery trucks and heavy vehicles such as lifting cranes are expected. Typically, each civil contractor or trade will complete their section of work prior to the next trade arriving on site ensuring smooth running of the project and safety on site, and thus minimising the number of daily vehicle movements.

It is expected that 10-15 trucks per day will arrive to site with the exception of days when bulk excavation and concrete pouring is done which is expected to be up to 30-45 trucks movements per day– approximately six per hour.

The proposed truck routes for the development would take the quickest path onto the arterial road network and would avoid Coreen Avenue between Coombes Drive (eastern intersection) and Parker Street due to the 5 tonne load restriction. The proposed truck route is shown on Figure 29. All movements into and out of the site will be in a forward direction.

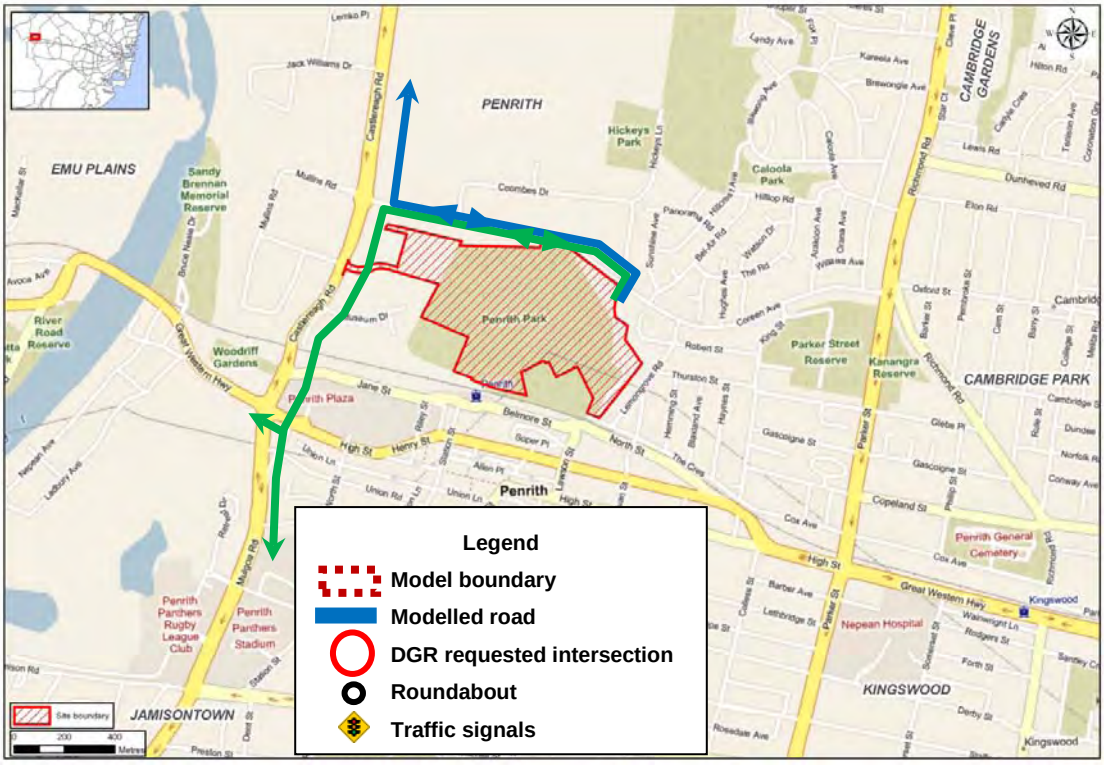

Figure 29 Proposed construction truck route

The source of fill used on the site is not currently known. It is likely that construction truck access would be required to the M4 Motorway and potentially to Castlereagh Road.

During construction, parking would be provided for construction staff and visitors on-site (for up to 80 vehicles). The construction contractor would provide construction workers them information on how to arrive at the site via walking, cycling and public transport.

Temporary closures and diversions of traffic would be required to undertake construction of the new roundabout on Coreen Avenue. A potential diversion route exists via Coombes Drive. However, this would only be used out of peak periods.

Pedestrians walking between the commuter car park and Penrith Station would be accommodated by hoardings, if required, to safely protect the footpath area during construction. Cyclists would continue to be able to use the public streets, unless specific situations temporarily arose where road closures affecting all traffic were required. Where possible, cyclists would be allowed to continue.

There may be situations where additional temporary lane closures may be required, such as during the erection of cranes. Further details of these would be submitted to the relevant authorities with the construction management plan when further details of the construction process were known. This includes details affecting pedestrian and bicycle movements.

Traffic Control measures will be planned and used such as temporary signage, traffic barriers and placement, traffic control crew, delineation devices, ROL applications, temporary speed zones, etc which must be in place for the duration of the activity or work area impact.

5. Assessment

At a glance

The North Penrith addresses many of the planning objectives for Greater Sydney and merits approval, however, its transport contributions can be maximised through the following adoption of traffic and transport measures in any determination on the Project.

Package of transport measures

The package of measures to manage the transport impacts includes policies that would direct future development under the master plan, infrastructure capacity and travel behaviour change promotion/incentives.

Walking and cycling

Figure 26 shows the walking and cycling facilities to be provided in the development, while Figure 22 indicated the location of footpaths and shared paths within the road reserve.

Footpaths and shared paths would be designed with regard to the *Planning guidelines for walking and cycling* (NSW Planning, December 2004). Commercial buildings would be required to provide cyclist end of trip facilities, including bike locking and showers, as per the same guideline.

Other infrastructure to be provided would include:

- a raised pedestrian crossing across the main street
- bicycle racks in the station square.

Bus infrastructure

The Project proposes to provide the following infrastructure:

- widened kerbside lane on all bus corridors shown in Figures 23 and 24 to accommodate bus priority or peak period clearways should it be required
- reservation of land suitable for a bus underpass of the Western Rail Line
- a bus stop capable of accommodating up to two buses in the village centre within 100 m walk from Penrith Station entrance. The bus stop would include a bus shelter or awning with seating as it would cater for boarding passengers as well
- bus stops in each direction on the boulevard near the first intersection inside the development. Bus shelters would be provided for stop identification and passenger comfort.

The widened kerbside lane and bus underpass are in excess of the needs of bus travel to this Project. They have been provided to support bus corridors to other planned projects. This should reduce their traffic generation and hence the amount of traffic required to be accommodated within the road network.

Penrith Station interchange

The Project would facilitate commuters walking between Penrith Station and the new commuter car park through the station square. Retail services would be provided to make their journey more pleasant.

Road infrastructure

The future road network requirements have been assessed for the 2016 and 2026 future scenarios with base traffic growth, then adding the other planned major developments and finally the Project.

The assessment of the future without the Project has shown that road and intersection upgrades along Castlereagh Road and Richmond Road/Parker Street/The Northern Road are required to solve existing traffic congestion locations or support the traffic impacts of other developments.

The recommended road and intersection upgrades are based on the assumptions of development scale and timing outlined in Section 4. If these other major developments are delayed or have modified yields, the need and timing of these upgrades may change. The intersection upgrades are shown in Table 33. The upgrades of existing congestion problems such as the Parker Street/Great Western Highway intersection and the proposed Jane Street extension are not described, as they are primarily the responsibility of the road authorities.

Table 33 Recommended intersection upgrades

Intersection	Recommended upgrades (in addition to existing layout)
Parker Street/Coreen Avenue/ Richmond Road	▪ 120 m long right turn bay on Richmond Road ▪ 25 m long left turn bay on Oxford Street
Coreen Avenue/ Coombes Drive	▪ Install ‘seagull’ treatment on Coreen Avenue
Coreen Avenue/ New Site Access	▪ Install one-lane roundabout
Coreen Avenue/Commuter Car Park Access	▪ Widen one corner of roundabout (to accommodate large vehicles turning)
Castlereagh Road/ Coreen Avenue	▪ Retain two-lane roundabout ▪ Add left-turn slip lane and downstream merge on Coreen Avenue (to Castlereagh Road southbound)

Based on the results of discussions with Landcom, a smaller list of intersection upgrades is proposed that represent the access requirements of the site and the immediate impacts of traffic generated by the site. The list includes the intersections of:

- Coreen Avenue/ Coombes Drive
- Coreen Avenue/ New Site Access
- Coreen Avenue/Commuter Car Park Access.

Travel plans

The Project would require that:

- all new residents are provided a Travel Access Guide (TAG)
- all businesses produce a Workplace Travel Plan (WTP) and provide it to their employees.

A typical TAG or WTP would include:

- welcome letter (including direction to the 131500 travel information line and website)
- train network map
- train timetables for Penrith Station
- bus map
- bus timetables for all bus routes serving the Penrith Interchange
- leaflet: Using the bus for the first time
- Penrith City Council cycle map
- site cycle and footpath map (including cycle locker locations)
- leaflet: How to use cycle lockers
- leaflet: Fares/Travel passes
- two free weekly travel passes per household.

A Construction Traffic Management Plan would be produced before the start of construction when more details about the construction method are known.

Cost estimate

After discussion with Landcom, a concept level engineering cost estimate has been prepared for each of the proposed upgrades and the travel plan. Table 34 shows a summary of the results. Cost estimates for the full list of upgrades is included in Appendix 9.

These are concept level budget costs only, prepared using standard unit rates based on previous projects. Rates for small-scale projects assume that they would be undertaken as part of a wider works program.

In addition we have allowed a 77% mark-up to cover overheads, margin and contingency, as follows:

- Traffic Control 8%
- Public utility plant relocation and/or protection 5%
- Contractor's Overheads 18%
- Contractor's margin 10%
- Design 4%
- Project Management 7%
- Risk and Contingency 25%
- Total % allowance 77%

No allowance has been made for the cost of land acquisition or on-going maintenance costs (due to lack of information). All costs are in $Australian dollars and are 2010 values.

The estimates are based upon information made available to PB at the time of preparing the estimates. The estimates have been prepared for this specific Client and Project, and should not be used or relied on for any other use. PB accepts no liability for actual costs varying from those estimated.

Table 34 Estimate of possible costs

Intersection	Recommended upgrades (in addition to existing layout)	Estimated cost
Coreen Avenue/ Coombes Drive	▪ Install 'seagull' treatment on Coreen Avenue	$25,000
Coreen Avenue/ New Site Access	▪ Install one-lane roundabout	$770,000
Coreen Avenue/ Commuter car park road	▪ Widen one corner of roundabout (to accommodate large vehicles turning)	$30,000

The cost of producing and implementing the travel plan is estimated at approximately $150,000 based on the number of residents and employees.

Funding mechanism

The ability of governments to seek contributions towards needed infrastructure is evident in legislation such as Section 94 of the EP&A Act. Section 94 allows local government to levy contributions towards costs of infrastructure based on principles of reasonableness and apportionment. The Section 94 contributions require a plan, establishing a set of infrastructure improvement works and the relationship between developments and the need for those upgrades.

Other mechanisms of infrastructure funding are available, that have the advantage of being able to accommodate different timeframes for infrastructure delivery and works-in-kind. The mechanism proposed for the North Penrith Project is a 'Statement of Commitments', covering contributions and works-in-kind, as well as undertakings to carry out further assessments, prepare plans and deliver infrastructure within the Project.

Apportionment

Apportionment is based on the principle that developments should contribute to the cost of transport infrastructure to the extent that they contributed to additional traffic served by the upgrade. Four scenarios have been considered as the basis for apportionment of costs:

1. Apportionment based on total demand.
2. Apportionment based on new development growth only.
3. Funding by Development.
4. Funding by Government.

Scenario 2 is applicable to infrastructure required to meet the needs of future increases in traffic (i.e. is not required for existing traffic levels). Apportionment can be attributed to different sources of future traffic, including different developments and background traffic growth. In this instance, the relevant road authorities would be responsible for the portion of the cost attributable to background traffic growth, and each development would be responsible for their own portion.

Scenario 3 represents those facilities which are 100% attributable to the development such as site access points. Apportionment for the full list of upgrades is included in Appendix 9.

Given the reduced list of intersection upgrades, the proponent is proposing to fund the entire cost of these works shown in Table 34.

Timing

The timing of the proposed intersection upgrades has been based on the point at which the degree of saturation for intersections changes to 1.0. The results for 2010, 2016 and 2026 have been used to enable interpolation between these years to recommend a year of upgrading. This has then been equated to a yield from the North Penrith Development. The timing for the full list of upgrades is included in Appendix 9.

The estimated years of upgrading are:

- Coreen Avenue/ New Site Access – 2012
- Coreen Avenue/Commuter car park road – 2015
- Coreen Avenue/Coombes Drive – 2018.

Converting these years into yields of development, the following stages are proposed:

- Coreen Avenue/New Site Access – On release of Stage 1A
- Coreen Avenue/Commuter car park road – On occupation of the Supermarket
- Coreen Avenue/Coombes Drive – On completion of Stage 2A.

The timing of the introduction of bus lanes or peak period clearways is beyond the timeframe addressed in this study. The timing of the planned bus underpass of the Western Rail Line is dependent on the level of congestion on the arterial road network. This is in turn dependent on the timing and scale of other developments, such as the North St Marys and Penrith Lakes projects.

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Appendix 1: Glossary

Term	Meaning
AADT	Average Annual Daily Traffic – a measure of the typical traffic volume on a road, expressed either as a number of vehicles per day or axle pairs per day
ABS	Australian Bureau of Statistics
AMCORD	Australian Model Code for Residential Development
AUTOTRACK	An AutoCAD based software package that simulated vehicles 'driving' along a road or into a parking space
Axle pairs	Measure of vehicle volume obtained by counting the number of axles passing a point and dividing by two. Trucks, some buses and vehicles with trailers will register as more than one vehicle, depending on their number of axles.
BTS	Bureau of Transport Statistics (formerly Transport Data Centre), a department within Transport NSW
CBD	Central Business District
CTMP	Construction Traffic Management Plan
DCP	Development Control Plan
DGR	Director General (of Planning) Requirements
DoS	degree of saturation (see Appendix 2)
Easy Access	Upgrade to enable access by disabled, hearing and visual impaired people
Ecologically Sustainable Development	Ecologically sustainable development requires the effective integration of economic and environmental considerations in decision-making. It can be achieved by implementing the following principles and programs: ▪ the precautionary principle ▪ inter-generational equity ▪ conservation of biological diversity and ecological integrity ▪ improved valuation, pricing and incentive mechanisms.
EP&A Act	Environmental Planning and Assessment Act 1979
GMA	Greater Metropolitan Area
HTS	Household Travel Survey
JTW	Journey to Work – data from the ABS Census
LGA	Local Government Area
LoS	level of service (see Appendix 2)
Mode share	Method of travel described as a percentage
NPC	National Project Consultants
NSW	New South Wales
PARS	Penrith Arterial Road Study
PB	Parsons Brinckerhoff
PITLUS	Penrith Integrated Transport and Land Use Study
PTD	Federal Department of Defence's Penrith Training Depot
Rear-steer	System where-by wheels on both front and rear axles turn (in opposite directions) to enable the vehicle to turn at a smaller radius
SIDRA	Intersection modelling software

Term	Meaning
STMP	Site Traffic Management Plan
TAG	Travel Access Guide
TMAP	Traffic Management and Accessibility Plan
TOD	Transit Oriented Development
UWS	University of Western Sydney
VKT	Vehicle kilometres of travel
WELL	Werrington Enterprise Living and Learning
WTP	Workplace Travel Plan

Appendix 2: Level of Service Criteria

Roads

Austroads 2009, 'Guide to Traffic Management Part 3: Traffic Studies and Analysis' includes a description of the Level of Service criteria for roads, which is provided below.

Level of Service is a qualitative measure describing operational conditions within a traffic stream, and their perception by motorists and/or passengers. A level of service definition generally describes these conditions in terms of factors such as speed and travel time, freedom to manoeuvre, traffic interruptions, comfort and convenience, and safety.

In general, there are six levels of service, designated A to F, with Level of Service A representing the best operating condition (i.e. free flow) and Level of Service F the worst (i.e. forced or breakdown flow).

Level of Service A	A condition of free flow in which individual drivers are virtually unaffected by the presence of others in the traffic stream. Freedom to select desired speeds and to manoeuvre within the traffic stream is extremely high, and the general level of comfort and convenience provided is excellent.
Level of Service B	In the zone of stable flow where drivers still have reasonable freedom to select their desired speed and to manoeuvre within the traffic stream. The general level of comfort and convenience is a little less than with Level of Service A.
Level of Service C	Also in the zone of stable flow, but most drivers are restricted to some extent in their freedom to select their desired speed and to manoeuvre within the traffic stream. The general level of comfort and convenience declines noticeably at this level.
Level of Service D	Close to the limit of stable flow and approaching unstable flow. All drivers are severely restricted in their freedom to select their desired speed and to manoeuvre within the traffic stream. The general level of comfort and convenience is poor, and small increases in traffic flow will generally cause operational problems.
Level of Service E	Traffic volumes are at or close to capacity, and there is virtually no freedom to select desired speeds or to manoeuvre within the traffic stream. Flow is unstable and minor disturbances within the traffic stream will cause breakdown.
Level of Service F	In the zone of forced flow, where the amount of traffic approaching the point under consideration exceeds that which can pass it. Flow breakdown occurs, and queuing and delays result.

Intersections

Level of Service

Level of service (LoS) is one of the basic performance parameters used to describe the operation of an intersection. The levels of service range from A (indicating good intersection operation) to F (indicating over saturated conditions with long delays and queues). At signalised and roundabout intersections, the LoS criteria are related to average intersection delay (seconds per vehicle). At priority controlled intersections, the LoS is based on the average delay (seconds per vehicle) for the worst movement. SIDRA provides analysis of the operating conditions which can be compared to the performance criteria set out in Table 37.

Table 35 Level of Service Criteria for Intersections

LoS	Average delay (seconds per vehicle)	Traffic Signals, Roundabout	Give Way and Stop Signs
A	Less than 14	Good operation	Good operation
B	15 to 28	Good with acceptable delays and spare capacity	Acceptable delays and spare capacity
C	29 to 42	Satisfactory	Satisfactory, but accident study required
D	43 to 56	Operating near capacity	Near capacity and 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	Greater than 71	Unsatisfactory with excessive queuing	Unsatisfactory with excessive queuing; requires other control mode

Source: RTA Guide to Traffic Generating Developments

Degree of saturation

Degree of saturation (DoS) is defined as the ratio of demand flow to capacity, and therefore has no unit. As it approaches 1.0, extensive queues and delays could be expected. For a satisfactory situation, DoS should be less than the nominated practical degree of saturation, usually 0.9. The intersection DoS is based on the movement with the highest ratio for all types of intersection.

Delay

Delay is the difference between interrupted and uninterrupted travel times through the intersection and is measured in seconds per vehicle. The delays include queued vehicles decelerating and accelerating to and/or from stop, as well as delays experienced by all vehicles negotiating the intersection. At signalised and roundabout intersections, the average intersection delay is usually reported and is taken as the weighted average delay by summing the product of the individual movement traffic volume and its corresponding calculated delays and dividing by the total traffic volume at the intersection. At priority controlled intersections, the average delay for the worse movement is usually reported.

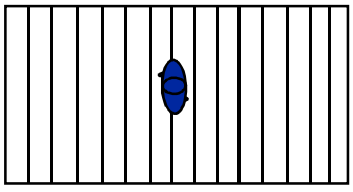
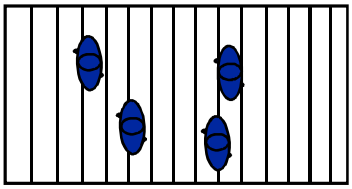
Queue length

Queue length is the number of vehicles waiting at the stop line and is usually quoted as the 95th percentile back of queue, which is the value below which 95% of all observed queue lengths fall. It is measured as the number of vehicles per traffic lane at the start of the green period, when traffic starts moving again after a red signal. The intersection queue length is usually taken from the movement with the longest queue length.

Pedestrians

See attached Fruin Level of Service Criteria.

Key to Stairway Levels of Service

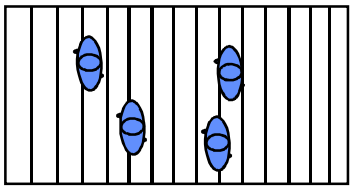
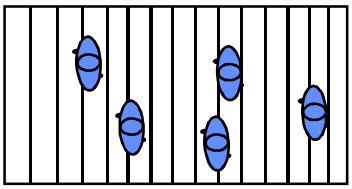
Stairway Level of Service A

Average Flow Volume: 16.4 PMM *

Average Speed: 38.1 m/min or more

Average Pedestrian Area Occupancy: 1.9 m²/p

Unrestricted choice of speed; relatively free to pass; no serious difficulties with reverse traffic movements; flow is approximately 30% of maximum capacity.

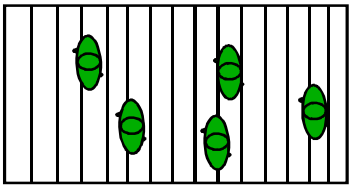
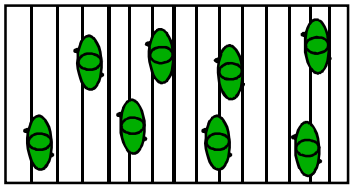
Stairway Level of Service B

Average Flow Volume: 23 PMM

Average Speed: 36.6 m/min

Average Pedestrian Area Occupancy: 1.4 m²/p

Restricted choice of speed; passing encounters interference; reverse flows create occasional conflicts; flow is approximately 34% of maximum capacity.

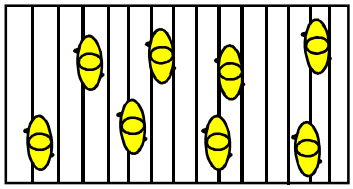
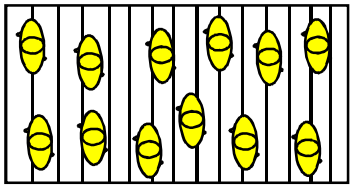
Stairway Level of Service C

Average Flow Volume: 23-32.8 PMM

Average Speed: 35 m/min

Average Pedestrian Area Occupancy: 0.9 - 1.4 m²/p

Speeds are partially restricted; passing is restricted; reverse flows are partially restricted; flow is approximately 50% of maximum capacity.

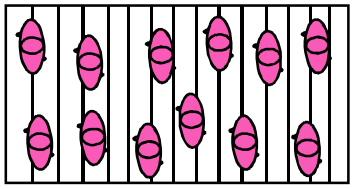
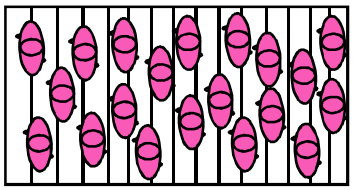
Stairway Level of Service D

Average Flow Volume: 32.8-43 PMM

Average Speed: 35 m/min

Average Pedestrian Area Occupancy: 0.65 - 0.93 m²/p

Speeds are restricted; passing is virtually impossible; reverse flows are severly restricted flows are approximately 50-65 % of maximum capacity.

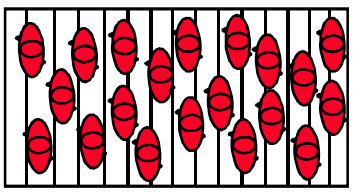
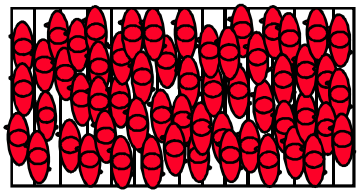
Stairway Level of Service E

Average Flow Volume: 42.7 - 55.8 PMM

Average Speed: 26 m/min

Average Pedestrian Area Occupancy: 0.4 m²/p

Speeds are severely restricted; passing is impossible; reverse traffic flows are severely restricted; intermittent stoppages of traffic flow are likely to occur; flows are approximately 65-85 % of maximum capacity.

Stairway Level of Service F

Average Flow Volume: 55.8 PMM or greater

Average Speed: 0-26 m/min

Average Pedestrian Area Occupancy: < 0.4 m²/p

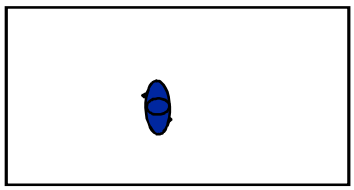
Speed is severely restricted; flow is subject to complete breakdown with many stoppages ; passing as well as reverse flows are impossible.

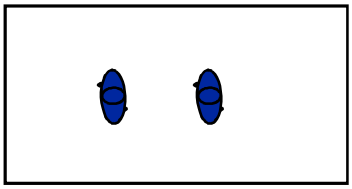
Source: Planning Design & Maintenance of Pedestrian Facilities; Goodell-Grivas- 1989.

* m²/p - Square metres of walkway area per pedestrian

*PMM - Pedestrians per metre width of stairway, per minute

Key to Transport Interchange Levels of Service





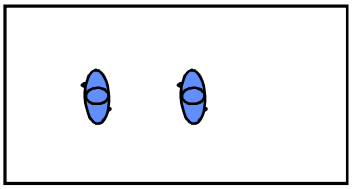
Level of Service A

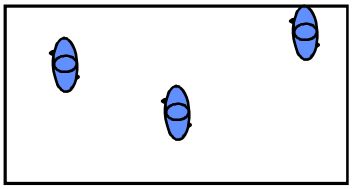
Average Pedestrian Area Occupancy: >= 3.26 m²/p *

Average Flow Volume: <= 23 PMM *

Average Speed > 1.32 m/min

Sufficient walkway area is available for pedestrians to freely select their own walking speed ans manoeuvre to avoid conflicts with other pedestrians.





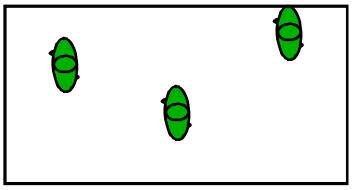
Level of Service B

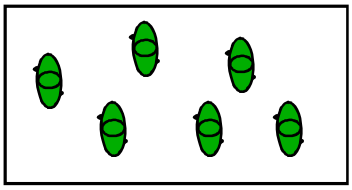
Average Pedestrian Area Occupancy: 2.33 - 3.26 m²/p

Average Flow Volume: 23 - 33 PMM

Average Speed: 1.26 - 1.32 m/min

Sufficient walkway is available for pedestriand to freely select their own walking speed. Minor conflicts will occur if reverse direction or crossing movements exist.





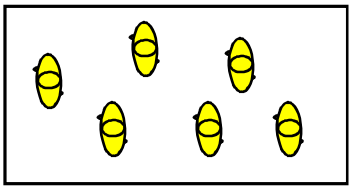
Level of Service C

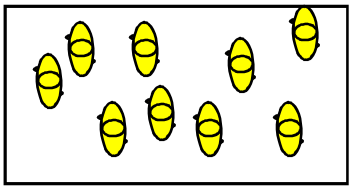
Average Pedestrian Area Occupancy: 1.4 - 2.33 m²/p

Average Flow Volume: 33 - 49 PMM

Average Speed : 1.14 - 1.26 m/min

Freedom to select walking speed and pass other pedestrians is restricted. Where pedestrians cross movements and reverse flow exists, there is a high probability of conflict requiring frequent adjustment of speed and direction to avoid contact.





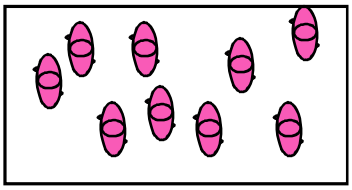
Level of Service D

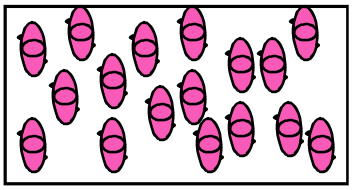
Average Pedestrian Area Occupancy: 0.93 - 1.4 m²/p

Average Flow Volume: 49 - 66 PMM

Average Speed : 1.12 - 1.14 m/min

The majority of pedestrians have their normal walking speed and manoeuvrability restricted. Pedestrians involved in reverse flow and crossing movements would be severely restricted.





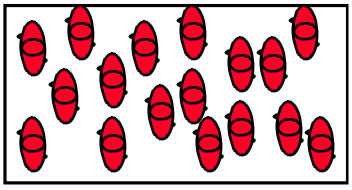
Level of Service E

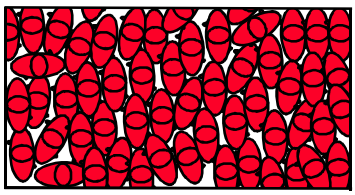
Average Pedestrian Area Occupancy: 0.47 - 0.93 m²/p

Average Flow Volume: 66 - 82 PMM

Average Speed : 0.63 - 1.12 m/min

Virtually all pedestrians have their normal walking speed and manoeuvrability restricted. Pedestrians attempting reverse flow and crossing movements would experience extreme difficulty.





Level of Service F

Average Pedestrian Area Occupancy: <= 0.27 - 0.47 m²/p

Average Flow Volume: variable, mak 82 PMM

Average Speed : 0 - 0.63 m/min

All movement in the major flow direction would be extremely restricted, and reverse or crossing movements would be virtually impossible. This level represents a complete breakdown in traffic flow.

Source: Planning & Design, John J Fruin, Ph.D. 1971.

* m²/p - Square metres of walkway area per pedestrian

* PMM - Pedestrians per metre width of walkway, per minute

Appendix 3: 2010 Existing Situation SIDRA Results

Intersection movement summary in 2010

Parker St / Coreen Ave / Richmond Rd

AM

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Parker St (S)											
1	L	104	5.1	0.828	51.1	LOS D	22.8	168.1	0.92	0.99	26.9
2	T	725	6.5	0.828	39.5	LOS C	24.1	178.5	0.93	0.88	30.2
3	R	201	1.6	0.912	70.6	LOS F	14.8	105.2	1.00	0.93	20.4
Approach		1031	5.4	0.912	46.7	LOS D	24.1	178.5	0.94	0.90	27.4
East: Oxford St (E)											
4	L	76	6.9	0.315	62.2	LOS E	5.7	42.6	0.94	0.77	22.2
5	T	175	1.8	0.913	73.2	LOS F	17.9	128.0	1.00	1.06	19.1
6	R	60	5.3	0.913	81.3	LOS F	17.9	128.0	1.00	1.06	19.1
Approach		311	3.7	0.913	72.1	LOS F	17.9	128.0	0.99	0.99	19.8
North: Richmond Rd (N)											
7	L	1	0.0	0.682	55.6	LOS D	36.8	267.3	0.90	1.01	25.2
8	T	1304	4.4	0.897	38.4	LOS C	37.0	268.6	0.91	0.89	30.9
9	R	381	1.1	0.891	55.5	LOS D	24.5	172.9	1.00	0.92	24.2
Approach		1686	3.7	0.897	42.3	LOS C	37.0	268.6	0.93	0.89	29.2
West: Coreen Ave (W)											
10	L	40	5.3	0.195	33.3	LOS C	3.2	23.4	0.87	0.76	30.4
11	T	96	0.0	0.616	45.6	LOS D	12.6	90.7	0.95	0.77	24.9
12	R	121	5.2	0.615	60.6	LOS E	12.6	90.7	0.98	0.82	22.4
Approach		257	3.3	0.615	50.8	LOS D	12.6	90.7	0.95	0.79	24.3
All Vehicles		3284	4.2	0.913	47.1	LOS D	37.0	268.6	0.94	0.90	27.0

PM

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Parker St (S)											
1	L	104	4.0	1.004	52.8	LOS D	40.7	292.5	1.00	1.04	26.7
2	T	1166	3.0	1.002	56.0	LOS D	52.4	376.5	1.00	1.11	24.8
3	R	63	8.3	0.375	63.4	LOS E	4.9	37.0	0.93	0.76	22.0
Approach		1334	3.3	1.002	56.1	LOS D	52.4	376.5	1.00	1.09	24.8
East: Oxford St (E)											
4	L	55	5.8	0.320	67.2	LOS E	4.5	33.1	0.97	0.75	21.1
5	T	106	2.0	0.939	80.9	LOS F	14.1	100.2	1.00	1.07	17.8
6	R	64	1.6	0.939	88.8	LOS F	14.1	100.2	1.00	1.07	17.8
Approach		225	2.8	0.940	79.8	LOS F	14.1	100.2	0.99	1.00	18.5
North: Richmond Rd (N)											
7	L	1	0.0	0.498	31.0	LOS C	20.9	152.2	0.48	1.07	33.8
8	T	955	4.7	0.574	18.2	LOS B	20.9	152.2	0.49	0.43	43.5
9	R	364	1.4	0.991	82.7	LOS F	28.8	204.2	1.00	1.01	18.4
Approach		1320	3.8	0.991	36.0	LOS C	28.8	204.2	0.63	0.59	32.3
West: Coreen Ave (W)											
10	L	425	1.5	0.578	21.1	LOS B	14.7	103.9	0.62	0.77	35.5
11	T	167	1.3	0.998	101.1	LOS F	28.9	206.5	1.00	1.25	15.3
12	R	161	3.9	0.998	108.7	LOS F	28.9	206.5	1.00	1.31	15.3
Approach		754	2.0	0.998	57.6	LOS E	28.9	206.5	0.78	0.99	22.7
All Vehicles		3633	3.2	1.004	50.6	LOS D	52.4	376.5	0.82	0.88	25.9

Intersection movement summary in 2010

Parker St / Copeland St

AM

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Parker St (S)											
1	L	38	5.6	0.224	10.7	LOS A	1.6	11.5	0.07	1.27	51.2
2	T	1132	4.3	0.422	2.0	LOS A	3.7	26.8	0.09	0.08	65.3
3	R	540	4.3	0.932	32.3	LOS C	24.3	176.1	0.99	0.90	33.3
Approach		1709	4.3	0.932	11.8	LOS A	24.3	176.1	0.37	0.36	50.7
East: Copeland St (E)											
4	L	445	3.5	0.425	25.2	LOS B	17.8	128.4	0.60	0.80	33.3
5	T	93	3.4	0.594	61.2	LOS E	11.1	80.0	0.98	0.80	19.4
6	R	52	4.1	0.593	68.7	LOS E	11.1	80.0	0.98	0.81	20.8
Approach		589	3.6	0.594	34.7	LOS C	17.8	128.4	0.70	0.80	28.8
North: Parker St (N)											
7	L	31	3.4	0.928	58.8	LOS E	18.1	130.5	0.92	0.94	24.8
8	T	1453	3.7	0.930	64.8	LOS E	47.6	343.4	0.99	1.03	22.8
9	R	40	2.6	0.181	69.1	LOS E	3.6	25.6	0.93	0.74	20.9
Approach		1523	3.7	0.930	64.8	LOS E	47.6	343.4	0.98	1.02	22.7
West: Copeland St (W)											
10	L	19	5.6	0.223	60.6	LOS E	2.8	20.1	0.88	0.73	22.2
11	T	85	3.7	0.505	59.3	LOS E	8.8	63.2	0.95	0.76	19.8
12	R	38	2.8	0.506	68.1	LOS E	8.8	63.2	0.97	0.80	20.9
Approach		142	3.7	0.505	61.8	LOS E	8.8	63.2	0.95	0.77	20.4
All Vehicles		3964	3.9	0.932	37.3	LOS C	47.6	343.4	0.68	0.70	30.8

PM

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Parker St (S)											
1	L	25	4.2	0.251	10.6	LOS A	1.8	12.8	0.07	1.37	51.3
2	T	1289	3.8	0.473	2.0	LOS A	4.3	31.0	0.09	0.08	65.3
3	R	436	3.9	0.814	29.2	LOS C	17.3	125.1	0.90	0.86	35.0
Approach		1751	3.8	0.814	8.9	LOS A	17.3	125.1	0.29	0.29	54.3
East: Copeland St (E)											
4	L	245	3.0	0.240	23.5	LOS B	9.7	69.6	0.54	0.76	34.2
5	T	46	2.3	0.414	59.5	LOS E	6.8	48.9	0.96	0.76	19.7
6	R	38	2.8	0.414	67.0	LOS E	6.8	48.9	0.96	0.78	21.1
Approach		329	2.9	0.414	33.6	LOS C	9.7	69.6	0.65	0.77	29.3
North: Parker St (N)											
7	L	36	2.9	0.809	52.7	LOS D	16.4	117.6	0.81	1.02	26.5
8	T	1311	3.1	0.810	44.9	LOS D	33.5	240.5	0.95	0.88	28.3
9	R	24	4.3	0.121	67.9	LOS E	2.2	15.9	0.93	0.72	21.2
Approach		1371	3.1	0.810	45.5	LOS D	33.5	240.5	0.94	0.88	28.1
West: Copeland St (W)											
10	L	53	2.0	0.341	58.5	LOS E	4.2	29.6	0.88	0.74	22.4
11	T	145	1.4	0.637	56.5	LOS D	13.1	93.0	0.98	0.81	20.4
12	R	40	2.6	0.638	64.0	LOS E	13.1	93.0	0.98	0.83	21.7
Approach		238	1.8	0.637	58.2	LOS E	13.1	93.0	0.96	0.80	21.1
All Vehicles		3688	3.4	0.814	27.9	LOS B	33.5	240.5	0.61	0.59	35.6

Intersection movement summary in 2010

Parker St / Great Western Hwy

AM

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Parker St (S)											
1	L	453	4.0	0.395	17.7	LOS B	13.1	94.5	0.52	0.76	44.2
2	T	818	4.0	0.815	50.8	LOS D	25.5	184.7	1.00	0.93	26.4
3	R	113	3.7	0.389	36.0	LOS C	5.1	36.8	0.94	0.78	32.4
Approach		1383	4.0	0.815	38.7	LOS C	25.5	184.7	0.84	0.86	30.8
East: Great Western Hwy (E)											
4	L	151	4.2	0.083	7.7	NA[9]	NA[9]	NA[9]	0.00	0.60	49.8
5	T	629	3.9	0.809	57.6	LOS E	17.5	126.9	0.99	0.90	22.3
6	R	303	4.0	1.000[3]	81.1	LOS F	22.2	160.8	1.00	0.95	19.6
Approach		1083	4.0	1.000	57.3	LOS E	22.2	160.8	0.85	0.87	23.1
North: Parker St (N)											
7	L	591	3.9	0.327	9.6	NA[9]	NA[9]	NA[9]	0.00	0.65	54.6
8	T	1008	4.0	1.005	74.6	LOS F	41.3	298.9	1.00	1.16	20.8
9	R	288	4.0	0.999	70.1	LOS E	16.6	120.4	1.00	1.05	21.6
Approach		1887	4.0	1.005	53.6	LOS D	41.3	298.9	0.69	0.98	26.0
West: Great Western Hwy (W)											
10	L	203	4.1	0.113	7.7	NA[9]	NA[9]	NA[9]	0.00	0.60	49.8
11	T	418	4.0	0.655	53.4	LOS D	13.7	98.9	0.99	0.82	23.4
12	R	141	3.7	0.464	60.2	LOS E	9.6	69.4	0.95	0.80	23.8
Approach		762	4.0	0.655	42.5	LOS C	13.7	98.9	0.72	0.76	27.3
All Vehicles		5116	4.0	1.005	48.7	LOS D	41.3	298.9	0.77	0.89	26.6

PM

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Parker St (S)											
1	L	335	3.1	0.309	18.3	LOS B	10.2	73.4	0.51	0.75	43.7
2	T	980	3.0	0.970	82.9	LOS F	40.0	287.0	1.00	1.18	19.3
3	R	98	3.2	0.375	37.1	LOS C	4.6	33.2	0.95	0.77	31.9
Approach		1413	3.1	0.970	64.4	LOS E	40.0	287.0	0.88	1.05	22.9
East: Great Western Hwy (E)											
4	L	233	3.2	0.128	7.7	NA[9]	NA[9]	NA[9]	0.00	0.60	49.8
5	T	850	2.9	1.037	110.8	LOS F	33.7	242.1	0.99	1.26	14.5
6	R	320	3.0	1.000[3]	74.8	LOS F	22.4	160.7	1.00	0.91	20.6
Approach		1402	3.0	1.037	85.5	LOS F	33.7	242.1	0.83	1.07	17.8
North: Parker St (N)											
7	L	323	2.9	0.178	9.5	NA[9]	NA[9]	NA[9]	0.00	0.65	54.6
8	T	1015	3.0	1.005	74.6	LOS F	41.5	298.3	1.00	1.16	20.8
9	R	259	2.8	0.988	65.7	LOS E	14.7	105.4	1.00	1.02	22.5
Approach		1597	3.0	1.005	60.0	LOS E	41.5	298.3	0.80	1.03	24.1
West: Great Western Hwy (W)											
10	L	437	2.9	0.240	7.7	NA[9]	NA[9]	NA[9]	0.00	0.60	49.8
11	T	652	3.1	0.968	86.5	LOS F	26.5	190.7	1.00	1.18	17.3
12	R	311	3.1	0.970	65.1	LOS E	20.2	145.0	1.00	0.85	22.6
Approach		1399	3.0	0.971	57.2	LOS E	26.5	190.7	0.69	0.93	23.3
All Vehicles		5811	3.0	1.037	66.5	LOS E	41.5	298.3	0.80	1.02	21.8

Intersection movement summary in 2010

Coreen Ave / Coombes Dr

AM

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South East: Coreen Ave (E)											
22	T	537	2.5	0.494	17.8	LOS B	15.4	110.2	1.00	0.00	37.4
23	R	83	2.5	0.495	25.3	LOS B	15.4	110.2	1.00	1.21	37.5
Approach		620	2.5	0.494	18.8	LOS B	15.4	110.2	1.00	0.16	37.4
North: Coombes Ave (N)											
7	L	46	11.4	0.277	23.6	LOS B	1.2	9.6	0.75	0.93	32.0
9	R	19	11.1	0.279	25.4	LOS B	1.2	9.6	0.75	0.97	32.3
Approach		65	11.3	0.278	24.1	LOS B	1.2	9.6	0.75	0.94	32.1
North West: Coreen Ave (W)											
27	L	37	11.4	0.259	9.5	LOS A	0.0	0.0	0.00	1.17	48.1
28	T	458	1.6	0.259	1.2	LOS A	0.0	0.0	0.00	0.11	57.0
Approach		495	2.3	0.259	1.8	LOS A	0.0	0.0	0.00	0.19	56.1
All Vehicles		1180	2.9	0.495	12.0	NA	15.4	110.2	0.57	0.22	42.9

PM

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South East: Coreen Ave (E)											
22	T	463	3.0	0.436	33.5	LOS C	15.3	110.2	1.00	0.00	29.6
23	R	41	5.1	0.437	41.1	LOS C	15.3	110.2	1.00	1.19	29.5
Approach		504	3.1	0.436	34.1	LOS C	15.3	110.2	1.00	0.10	29.6
North: Coombes Ave (N)											
7	L	119	0.9	0.633	37.1	LOS C	4.0	28.5	0.86	1.22	26.3
9	R	22	14.3	0.632	39.4	LOS C	4.0	28.5	0.86	1.16	26.8
Approach		141	3.0	0.632	37.4	LOS C	4.0	28.5	0.86	1.21	26.4
North West: Coreen Ave (W)											
27	L	17	6.3	0.392	9.3	LOS A	0.0	0.0	0.00	1.20	48.1
28	T	734	1.6	0.390	1.2	LOS A	0.0	0.0	0.00	0.11	57.0
Approach		751	1.7	0.390	1.4	LOS A	0.0	0.0	0.00	0.14	56.7
All Vehicles		1396	2.3	0.633	16.9	NA	15.3	110.2	0.45	0.23	38.9

Intersection movement summary in 2010

Coreen Ave / Commuter Car Park Access

AM

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Penrith Car Park Access											
1	L	20	0.0	0.053	9.8	LOS A	0.3	2.4	0.52	0.66	47.0
3	R	27	0.0	0.053	12.8	LOS A	0.3	2.4	0.52	0.72	44.7
Approach		47	0.0	0.053	11.5	LOS A	0.3	2.4	0.52	0.70	45.6
East: Coreen Ave (E)											
4	L	115	2.8	0.414	9.1	LOS A	3.9	28.1	0.46	0.64	47.7
5	T	374	2.8	0.414	8.3	LOS A	3.9	28.1	0.46	0.58	47.8
6	R	1	0.0	0.351	13.5	LOS A	3.9	28.1	0.46	0.78	44.6
Approach		489	2.8	0.414	8.5	LOS A	3.9	28.1	0.46	0.60	47.8
West: Coreen Ave (W)											
11	T	325	2.9	0.315	7.2	LOS A	3.1	21.9	0.18	0.52	49.3
12	R	136	3.1	0.316	11.1	LOS A	3.1	21.9	0.18	0.76	46.1
Approach		461	3.0	0.316	8.4	LOS A	3.1	21.9	0.18	0.59	48.3
All Vehicles		998	2.7	0.414	8.6	LOS A	3.9	28.1	0.33	0.60	47.9

PM

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Penrith Car Park Access											
1	L	115	0.9	0.247	10.7	LOS A	1.7	12.3	0.60	0.75	46.2
3	R	100	1.1	0.248	13.7	LOS A	1.7	12.3	0.60	0.80	43.9
Approach		215	1.0	0.248	12.1	LOS A	1.7	12.3	0.60	0.77	45.1
East: Coreen Ave (E)											
4	L	29	3.6	0.327	8.1	LOS A	3.2	22.8	0.22	0.62	48.6
5	T	435	2.4	0.328	7.3	LOS A	3.2	22.8	0.22	0.53	49.2
6	R	1	0.0	0.351	12.5	LOS A	3.2	22.8	0.22	0.82	45.1
Approach		465	2.5	0.328	7.4	LOS A	3.2	22.8	0.22	0.54	49.1
West: Coreen Ave (W)											
11	T	628	2.3	0.528	8.0	LOS A	6.3	44.9	0.49	0.56	47.7
12	R	38	2.8	0.526	11.9	LOS A	6.3	44.9	0.49	0.72	45.8
Approach		666	2.4	0.528	8.3	LOS A	6.3	44.9	0.49	0.57	47.6
All Vehicles		1346	2.2	0.528	8.6	LOS A	6.3	44.9	0.41	0.59	47.7

Intersection movement summary in 2010

Castlereagh Rd / Coreen Ave

AM

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Castlereagh Rd (S)											
1	L	79	9.3	0.519	7.7	LOS A	5.8	42.5	0.69	0.64	48.3
2	T	1011	5.8	0.521	6.3	LOS A	5.8	42.5	0.69	0.56	47.9
3	R	272	6.2	0.521	13.2	LOS A	5.8	42.5	0.69	0.76	45.7
Approach		1361	6.1	0.521	7.7	LOS A	5.8	42.5	0.69	0.61	47.5
East: Coreen Ave (E)											
4	L	127	18.2	0.457	21.8	LOS B	3.5	28.5	0.94	1.04	37.9
5	T	92	3.4	0.699	27.8	LOS B	6.8	51.3	1.00	1.19	33.4
6	R	137	11.5	0.698	34.9	LOS C	6.8	51.3	1.00	1.19	32.4
Approach		356	11.8	0.697	28.4	LOS C	6.8	51.3	0.98	1.14	34.4
North: Castlereagh Rd (N)											
7	L	342	4.0	0.710	9.8	LOS A	10.7	78.2	0.84	0.79	47.2
8	T	1416	5.0	0.709	8.6	LOS A	10.7	78.9	0.84	0.77	47.0
9	R	48	19.6	0.712	16.6	LOS B	10.7	78.9	0.84	0.90	44.3
Approach		1806	5.2	0.709	9.0	LOS B	10.7	78.9	0.84	0.78	47.0
West: Mullins Rd (W)											
10	L	37	5.7	0.094	13.3	LOS A	0.7	4.8	0.86	0.89	44.2
11	T	28	7.4	0.161	12.9	LOS A	1.1	8.4	0.87	0.91	43.5
12	R	37	11.4	0.160	20.0	LOS B	1.1	8.4	0.87	0.97	40.6
Approach		102	8.2	0.160	15.6	LOS B	1.1	8.4	0.87	0.93	42.6
All Vehicles		3625	6.3	0.712	10.6	LOS A	10.7	78.9	0.80	0.75	45.4

PM

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Castlereagh Rd (S)											
1	L	91	3.5	0.736	9.8	LOS A	10.5	75.4	0.82	0.84	47.6
2	T	1289	2.4	0.737	8.9	LOS A	10.5	75.4	0.83	0.83	47.0
3	R	251	8.0	0.737	16.4	LOS B	10.3	74.6	0.84	0.95	43.6
Approach		1631	3.3	0.737	10.1	LOS B	10.5	75.4	0.83	0.85	46.4
East: Coreen Ave (E)											
4	L	197	3.2	0.382	11.7	LOS A	2.6	18.9	0.82	0.94	45.6
5	T	112	6.6	0.454	9.6	LOS A	3.6	26.6	0.85	0.89	45.8
6	R	202	4.2	0.453	16.4	LOS B	3.6	26.6	0.85	1.01	43.0
Approach		511	4.3	0.453	13.1	LOS B	3.6	26.6	0.84	0.96	44.5
North: Castlereagh Rd (N)											
7	L	225	2.8	0.617	8.5	LOS A	6.7	48.2	0.71	0.76	48.0
8	T	1092	3.4	0.618	7.6	LOS A	6.7	48.2	0.72	0.72	47.9
9	R	55	5.8	0.615	15.3	LOS B	6.6	47.6	0.72	0.93	44.8
Approach		1372	3.4	0.618	8.0	LOS B	6.7	48.2	0.72	0.73	47.7
West: Mullins Rd (W)											
10	L	89	2.4	0.271	14.0	LOS A	1.8	12.5	0.88	0.94	43.4
11	T	75	2.8	0.263	10.5	LOS A	2.0	14.1	0.91	0.94	45.9
12	R	53	4.0	0.263	17.4	LOS B	2.0	14.1	0.91	0.99	42.7
Approach		217	2.9	0.271	13.6	LOS B	2.0	14.1	0.90	0.95	44.0
All Vehicles		3729	3.4	0.737	9.9	LOS A	10.5	75.4	0.79	0.83	46.5

Intersection movement summary in 2010

Castlereagh Rd / Peachtree Rd

AM

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Castlereagh Rd (S)											
1	L	109	5.8	0.639	13.9	LOS A	12.3	90.0	0.25	0.98	44.4
2	T	1185	5.6	0.639	5.4	LOS A	12.4	90.6	0.25	0.23	51.0
Approach		1295	5.6	0.639	6.1	LOS A	12.4	90.6	0.25	0.29	50.4
East: Peachtree Rd (E)											
4	L	11	0.0	0.140	86.0	LOS F	1.2	8.4	0.99	0.67	17.8
Approach		11	0.0	0.140	86.0	LOS F	1.2	8.4	0.99	0.67	17.8
North: Castlereagh Rd (N)											
7	L	21	0.0	0.033	12.8	LOS A	0.6	4.0	0.26	0.68	44.4
8	T	1629	3.4	0.632	14.3	LOS A	32.8	236.3	0.62	0.57	41.3
9	R	113	3.7	0.658	80.9	LOS F	9.9	71.5	1.00	0.81	18.6
Approach		1763	3.4	0.658	18.5	LOS B	32.8	236.3	0.64	0.59	38.4
West: Peachtree Rd (W)											
10	L	35	9.1	0.236	65.8	LOS E	3.1	23.6	0.89	0.73	21.4
12	R	37	8.6	0.130	65.8	LOS E	3.3	24.9	0.89	0.74	21.4
Approach		72	8.8	0.236	65.8	LOS E	3.3	24.9	0.89	0.74	21.4
All Vehicles		3140	4.4	0.658	14.7	LOS B	32.8	236.3	0.48	0.47	41.5

PM

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Castlereagh Rd (S)											
1	L	72	2.9	0.631	17.8	LOS B	16.6	119.4	0.36	0.98	41.4
2	T	1148	3.1	0.632	9.4	LOS A	16.7	120.0	0.36	0.33	46.2
Approach		1220	3.1	0.632	9.9	LOS A	16.7	120.0	0.36	0.37	45.9
East: Peachtree Rd (E)											
4	L	11	0.0	0.149	91.7	LOS F	1.3	8.9	0.99	0.67	17.0
Approach		11	0.0	0.149	91.7	LOS F	1.3	8.9	0.99	0.67	17.0
North: Castlereagh Rd (N)											
7	L	21	0.0	0.033	12.5	LOS A	0.6	4.0	0.24	0.68	44.6
8	T	1383	2.9	0.519	12.0	LOS A	25.3	181.3	0.52	0.47	43.5
9	R	84	2.5	0.393	72.8	LOS F	7.5	53.4	0.93	0.77	20.0
Approach		1488	2.8	0.519	15.4	LOS B	25.3	181.3	0.54	0.49	40.8
West: Peachtree Rd (W)											
10	L	143	2.8	1.000 [3]	75.5	LOS F	11.9	85.1	0.97	0.80	19.5
12	R	146	3.1	0.528	75.5	LOS F	12.1	86.9	0.97	0.81	19.5
Approach		288	2.9	1.000	75.5	LOS F	12.1	86.9	0.97	0.80	19.5
All Vehicles		3007	2.9	1.000	19.2	LOS B	25.3	181.3	0.51	0.47	38.4

Intersection movement summary in 2010

Castlereagh Rd / Jane St

AM

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Jane St (E)											
4	L	107	5.9	0.083	20.0	LOS B	3.2	23.7	0.51	0.66	34.9
6	R	129	5.7	0.167	41.4	LOS C	5.1	37.3	0.78	0.74	26.1
Approach		237	5.8	0.167	31.7	LOS C	5.1	37.3	0.66	0.70	29.5
North: Castlereagh Rd (N)											
7	L	302	5.9	0.617	7.3	LOS A	2.3	17.1	0.12	0.61	48.8
8	T	1022	6.0	0.743	28.8	LOS C	22.0	162.2	0.76	0.81	33.6
Approach		1324	6.0	0.743	23.9	LOS B	22.0	162.2	0.62	0.77	36.1
South West: Castlereagh Rd (S)											
31	T	1228	6.0	0.531	9.0	LOS A	4.9	36.2	0.11	0.63	48.3
32	R	437	6.0	0.613	45.9	LOS D	12.5	91.9	0.89	0.80	24.7
Approach		1665	6.0	0.613	18.7	LOS B	12.5	91.9	0.31	0.67	38.6
All Vehicles		3226	6.0	0.743	21.8	LOS B	22.0	162.2	0.46	0.71	36.7

PM

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Jane St (E)											
4	L	387	3.0	0.295	21.6	LOS B	10.8	77.5	0.57	0.71	34.0
6	R	346	3.0	0.438	44.1	LOS D	12.4	89.2	0.85	0.79	25.3
Approach		734	3.0	0.438	32.2	LOS C	12.4	89.2	0.70	0.75	29.2
North: Castlereagh Rd (N)											
7	L	338	3.1	0.675	7.2	LOS A	2.7	19.1	0.12	0.61	48.8
8	T	1092	3.0	0.778	29.6	LOS C	24.5	176.1	0.80	0.83	33.1
Approach		1429	3.0	0.778	24.3	LOS B	24.5	176.1	0.64	0.78	35.8
South West: Castlereagh Rd (S)											
31	T	1078	3.0	0.457	8.8	LOS A	3.9	28.0	0.10	0.62	48.4
32	R	265	3.2	0.365	43.4	LOS D	7.6	54.8	0.80	0.75	25.3
Approach		1343	3.1	0.457	15.6	LOS B	7.6	54.8	0.23	0.65	41.0
All Vehicles		3506	3.0	0.778	22.6	LOS B	24.5	176.1	0.50	0.72	35.8

Intersection movement summary in 2010

Castlereagh Rd / Great Western Hwy / Mulgoa Rd

AM

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Mulgoa Rd (S)											
1	L	156	4.7	0.386	36.8	LOS C	6.9	50.3	0.89	0.79	30.1
2	T	727	5.1	0.856	40.3	LOS C	17.2	125.6	1.00	1.02	27.2
3	R	144	5.1	0.644	45.8	LOS D	7.4	54.0	1.00	0.83	25.7
Approach		1027	5.0	0.856	40.6	LOS C	17.2	125.6	0.98	0.96	27.4
East: Great Western Hwy (E)											
4	L	59	5.4	0.427	36.0	LOS C	5.4	39.1	0.94	0.87	28.4
5	T	174	4.8	0.426	33.4	LOS C	5.4	39.1	0.95	0.78	27.0
6	R	71	4.5	0.522	48.5	LOS D	4.1	29.6	1.00	0.77	24.1
Approach		303	4.9	0.523	37.4	LOS C	5.4	39.1	0.96	0.80	26.5
North: Castlereagh Rd (N)											
7	L	77	5.5	0.918	43.1	LOS D	18.1	132.1	1.00	1.02	27.9
8	T	699	5.0	0.918	35.4	LOS C	18.2	133.1	1.00	1.02	28.8
9	R	391	5.1	0.872	47.5	LOS D	10.0	73.3	1.00	0.93	26.2
Approach		1166	5.1	0.918	40.0	LOS C	18.2	133.1	1.00	0.99	27.8
North West: Bus Lane											
28	T	5	100.0	0.059	47.9	LOS D	0.3	4.3	0.95	0.65	26.9
Approach		5	100.0	0.059	47.9	LOS D	0.3	4.3	0.95	0.65	26.9
West: Great Western Hwy (W)											
10	L	831	4.9	0.842	44.6	LOS D	18.8	137.4	1.00	0.98	27.2
11	T	468	4.9	0.902	45.1	LOS D	23.0	168.0	1.00	1.11	25.4
12	R	234	5.0	0.579	38.6	LOS C	10.1	73.5	0.94	0.82	29.3
Approach		1533	4.9	0.902	43.8	LOS D	23.0	168.0	0.99	1.00	26.9
All Vehicles		4035	5.1	0.918	41.4	LOS C	23.0	168.0	0.99	0.97	27.3

PM

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Mulgoa Rd (S)											
1	L	358	2.9	0.870	63.9	LOS E	22.9	164.3	1.00	0.98	22.0
2	T	772	3.0	0.892	58.9	LOS E	25.2	180.7	1.00	1.05	22.1
3	R	164	3.2	0.578	56.9	LOS E	10.5	75.2	0.98	0.81	22.6
Approach		1294	3.0	0.892	60.0	LOS E	25.2	180.7	1.00	1.00	22.1
East: Great Western Hwy (E)											
4	L	175	3.0	1.028	82.4	LOS F	36.0	258.1	1.00	1.16	17.7
5	T	680	2.9	1.029	98.0	LOS F	36.8	264.4	1.00	1.35	15.0
6	R	155	2.7	0.888	74.3	LOS F	11.6	83.1	1.00	1.04	18.8
Approach		1009	2.9	1.029	91.7	LOS F	36.8	264.4	1.00	1.27	15.9
North: Castlereagh Rd (N)											
7	L	99	3.2	1.018	89.4	LOS F	34.7	249.1	1.00	1.23	17.1
8	T	774	3.1	1.017	81.8	LOS F	35.0	251.3	1.00	1.23	17.8
9	R	592	2.9	1.039	110.7	LOS F	25.6	183.6	1.00	1.17	14.9
Approach		1465	3.0	1.040	94.0	LOS F	35.0	251.3	1.00	1.21	16.5
North West: Bus Lane											
28	T	1	100.0	0.017	66.8	LOS E	0.1	1.2	0.97	0.59	22.2
Approach		1	100.0	0.017	66.8	LOS E	0.1	1.2	0.97	0.59	22.2
West: Great Western Hwy (W)											
10	L	178	3.0	0.188	38.3	LOS C	5.9	42.0	0.76	0.75	29.5
11	T	416	3.1	0.701	38.7	LOS C	21.4	154.0	0.94	0.83	27.2
12	R	363	3.1	1.000 [3]	58.5	LOS E	21.7	155.7	1.00	0.86	23.1
Approach		957	3.1	1.000	46.1	LOS D	21.7	155.7	0.93	0.82	25.8
All Vehicles		4726	3.0	1.039	74.5	LOS F	36.8	264.4	0.99	1.08	19.0

Appendix 4: Road Capacity Analysis

Existing 2010 - AM Peak

Road & location	Direction	2010 Estimated Traffic Volumes (veh/hour)	Number of Lanes	Road Type	Capacity	V/C	Level of Service
Castlereagh Road, north of Coreen Avenue	Northbound	1,123	2	1	3,200	35%	B
	Southbound	1,700	2	1	3,200	53%	C
Coreen Avenue, east of Castlereagh Road	Eastbound	608	1	2	1,200	51%	C
	Westbound	336	1	2	1,200	28%	A
Castlereagh Road, south of Coreen Avenue	Northbound	1,159	2	1	3,200	36%	B
	Southbound	1,499	2	1	3,200	47%	B
Castlereagh Road, north of Jane Street	Northbound	1,290	2	1	3,200	40%	B
	Southbound	1,593	2	1	3,200	50%	B
Jane Street, east of Castlereagh Road	Eastbound	702	2	2	2,400	29%	A
	Westbound	226	2	2	2,400	9%	A
Castlereagh Road, north of Great Western Highway	Northbound	1,547	2	1	3,200	48%	B
	Southbound	1,074	2	1	3,200	34%	A
Great Western Highway, west of Castlereagh Road	Eastbound	1,457	2	1	3,200	46%	B
	Westbound	685	2	1	3,200	21%	A
Mulgoa Road, south of Great Western Highway	Northbound	975	2	1	3,200	30%	A
	Southbound	942	2	1	3,200	29%	A
High Street, east of Castlereagh Road	Eastbound	655	2	2	2,400	27%	A
	Westbound	288	2	2	2,400	12%	A
Commuter Carpark Road, south of Coreen Avenue	Northbound	45	1	3	700	6%	A
	Southbound	237	1	3	700	34%	A
Coreen Avenue, east of Commuter Carpark Road	Eastbound	335	1	2	1,200	28%	A
	Westbound	528	1	2	1,200	44%	B
Coreen Avenue, east of Coombes Drive	Eastbound	479	1	2	1,200	40%	B
	Westbound	504	1	2	1,200	42%	B
The Crescent, east of site	Eastbound	4	1	3	700	1%	A
	Westbound	15	1	3	700	2%	A
Macquarie Avenue, north of The Crescent	Northbound	256	1	2	1,200	21%	A
	Southbound	586	1	2	1,200	49%	B
Evan Street south of The Crescent	Northbound	454	1	2	1,200	38%	B
	Southbound	796	1	2	1,200	66%	C
Richmond Rd, south of Dunheved Rd	Northbound	783	2	1	3,200	24%	A
	Southbound	1,601	2	1	3,200	50%	C
Coreen Ave, west of Parker St	Eastbound	243	1	2	1,200	20%	A
	Westbound	627	1	2	1,200	52%	C
Parker St, south of Coreen Ave	Northbound	1,142	2	1	3,200	36%	B
	Southbound	1,426	2	1	3,200	45%	B
Copeland Street, west of Parker Street	Eastbound	135	1	3	700	19%	A
	Westbound	163	1	3	700	23%	A
Parker St, north of Great Western Hwy	Northbound	1,297	3	1	4,800	27%	A
	Southbound	1,839	3	1	4,800	38%	B
Great Western Hwy, west of Parker St	Eastbound	725	2	1	3,200	23%	A
	Westbound	1,264	2	1	3,200	40%	B
Parker St, south of Great Western Hwy	Northbound	1,315	2	1	3,200	41%	B
	Southbound	1,236	2	1	3,200	39%	B
Great Western Hwy, east of Parker St	Eastbound	1,065	3	1	4,800	22%	A
	Westbound	1,029	3	1	4,800	21%	A

Road Type= 1 = Urban Road with Clearways
2 = Urban Road with Interruptions
3 = Local Road

Existing 2010 - PM Peak

Road & location	Direction	2010 Estimated Traffic Volumes (veh/hour)	Number of Lanes	Road Type	Capacity	V/C	Level of Service
Castlereagh Road, north of Coreen Avenue	Northbound	1,500	2	1	3,200	47%	B
	Southbound	1,290	2	1	3,200	40%	B
Coreen Avenue, east of Castlereagh Road	Eastbound	521	1	2	1,200	43%	B
	Westbound	484	1	2	1,200	40%	B
Castlereagh Road, south of Coreen Avenue	Northbound	1,235	2	1	3,200	39%	B
	Southbound	1,273	2	1	3,200	40%	B
Castlereagh Road, north of Jane Street	Northbound	1,352	2	1	3,200	42%	B
	Southbound	1,453	2	1	3,200	45%	B
Jane Street, east of Castlereagh Road	Eastbound	572	2	2	2,400	24%	A
	Westbound	697	2	2	2,400	29%	A
Castlereagh Road, north of Great Western Highway	Northbound	1,050	2	1	3,200	33%	A
	Southbound	1,406	2	1	3,200	44%	B
Great Western Highway, west of Castlereagh Road	Eastbound	908	2	1	3,200	28%	A
	Westbound	1,564	2	1	3,200	49%	B
Mulgoa Road, south of Great Western Highway	Northbound	1,230	2	1	3,200	38%	B
	Southbound	1,307	2	1	3,200	41%	B
High Street, east of Castlereagh Road	Eastbound	569	2	2	2,400	24%	A
	Westbound	960	2	2	2,400	40%	B
Commuter Carpark Road, south of Coreen Avenue	Northbound	204	1	3	700	29%	A
	Southbound	63	1	3	700	9%	A
Coreen Avenue, east of Commuter Carpark Road	Eastbound	692	1	2	1,200	58%	C
	Westbound	461	1	2	1,200	38%	B
Coreen Avenue, east of Coombes Drive	Eastbound	810	1	2	1,200	67%	C
	Westbound	437	1	2	1,200	36%	B
The Crescent, east of site	Eastbound	6	1	3	700	1%	A
	Westbound	14	1	3	700	2%	A
Macquarie Avenue, north of The Crescent	Northbound	278	1	2	1,200	23%	A
	Southbound	478	1	2	1,200	40%	B
Evan Street south of The Crescent	Northbound	503	1	2	1,200	42%	B
	Southbound	571	1	2	1,200	48%	B
Richmond Rd, south of Dunheved Rd	Northbound	1,572	2	1	3,200	49%	B
	Southbound	1,253	2	1	3,200	39%	B
Coreen Ave, west of Parker St	Eastbound	716	1	2	1,200	60%	C
	Westbound	546	1	2	1,200	45%	B
Parker St, south of Coreen Ave	Northbound	1,311	2	1	3,200	41%	B
	Southbound	1,113	2	1	3,200	35%	A
Copeland Street, west of Parker Street	Eastbound	225	1	3	700	32%	A
	Westbound	92	1	3	700	13%	A
Parker St, north of Great Western Hwy	Northbound	1,709	3	1	4,800	36%	B
	Southbound	1,515	3	1	4,800	32%	A
Great Western Hwy, west of Parker St	Eastbound	1,328	2	1	3,200	42%	B
	Westbound	1,313	2	1	3,200	41%	B
Parker St, south of Great Western Hwy	Northbound	1,341	2	1	3,200	42%	B
	Southbound	1,479	2	1	3,200	46%	B
Great Western Hwy, east of Parker St	Eastbound	1,018	3	1	4,800	21%	A
	Westbound	1,333	3	1	4,800	28%	A

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Forecast 2016 Base + Other Developments - AM Peak

Road & location	Direction	2016 Estimated Traffic Volumes (veh/hour)	Number of Lanes	Road Type	Capacity	V/C	Level of Service
Castlereagh Road, north of Coreen Avenue	Northbound	1,512	2	1	3,200	47%	B
	Southbound	2,835	2	1	3,200	89%	D
Coreen Avenue, east of Castlereagh Road	Eastbound	706	1	2	1,200	59%	C
	Westbound	362	1	2	1,200	30%	A
Castlereagh Road, south of Coreen Avenue	Northbound	1,536	2	1	3,200	48%	B
	Southbound	2,552	2	1	3,200	80%	D
Castlereagh Road, north of Jane Street	Northbound	1,674	2	1	3,200	52%	C
	Southbound	2,643	2	1	3,200	83%	D
Jane Street, east of Castlereagh Road	Eastbound	915	2	2	2,400	38%	B
	Westbound	238	2	2	2,400	10%	A
Castlereagh Road, north of Great Western Highway	Northbound	1,933	2	1	3,200	60%	C
	Southbound	1,919	2	1	3,200	60%	C
Great Western Highway, west of Castlereagh Road	Eastbound	1,834	2	1	3,200	57%	C
	Westbound	863	2	1	3,200	27%	A
Mulgoa Road, south of Great Western Highway	Northbound	1,240	2	1	3,200	39%	B
	Southbound	1,693	2	1	3,200	53%	C
High Street, east of Castlereagh Road	Eastbound	857	2	2	2,400	36%	B
	Westbound	321	2	2	2,400	13%	A
Commuter Carpark Road, south of Coreen Avenue	Northbound	47	1	3	700	7%	A
	Southbound	250	1	3	700	36%	B
Coreen Avenue, east of Commuter Carpark Road	Eastbound	442	1	2	1,200	37%	B
	Westbound	610	1	2	1,200	51%	C
Coreen Avenue, east of Coombes Drive	Northbound	593	1	2	1,200	49%	B
	Southbound	548	1	2	1,200	46%	B
The Crescent, east of site	Eastbound	6	1	3	700	1%	A
	Westbound	14	1	3	700	2%	A
Macquarie Avenue, north of The Crescent	Northbound	270	1	2	1,200	22%	A
	Southbound	719	1	2	1,200	60%	C
Evan Street south of The Crescent	Northbound	0	1	2	1,200	0%	A
	Southbound	941	1	2	1,200	78%	D
Richmond Rd, south of Dunheved Rd	Northbound	1,181	2	1	3,200	37%	B
	Southbound	2,860	2	1	3,200	89%	D
Coreen Ave, west of Parker St	Eastbound	284	1	2	1,200	24%	A
	Westbound	801	1	2	1,200	67%	C
Parker St, south of Coreen Ave	Northbound	1,580	2	1	3,200	49%	B
	Southbound	2,586	2	1	3,200	81%	D
Copeland Street, west of Parker Street	Eastbound	181	1	3	700	26%	A
	Westbound	171	1	3	700	24%	A
Parker St, north of Great Western Hwy	Northbound	1,744	3	1	4,800	36%	B
	Southbound	3,046	3	1	4,800	63%	C
Great Western Hwy, west of Parker St	Eastbound	927	2	1	3,200	29%	A
	Westbound	1,390	2	1	3,200	43%	B
Parker St, south of Great Western Hwy	Northbound	1,720	2	1	3,200	54%	C
	Southbound	1,866	2	1	3,200	58%	C
Great Western Hwy, east of Parker St	Eastbound	1,940	3	1	4,800	40%	B
	Westbound	1,284	3	1	4,800	27%	A

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Forecast 2016 Base + Other Developments - PM Peak

Road & location	Direction	2016 Estimated Traffic Volumes (veh/hour)	Number of Lanes	Road Type	Capacity	V/C	Level of Service
Castlereagh Road, north of Coreen Avenue	Northbound	2,639	2	1	3,200	82%	D
	Southbound	1,677	2	1	3,200	52%	C
Coreen Avenue, east of Castlereagh Road	Eastbound	543	1	2	1,200	45%	B
	Westbound	592	1	2	1,200	49%	B
Castlereagh Road, south of Coreen Avenue	Northbound	2,276	2	1	3,200	71%	C
	Southbound	1,660	2	1	3,200	52%	C
Castlereagh Road, north of Jane Street	Northbound	2,407	2	1	3,200	75%	D
	Southbound	1,837	2	1	3,200	57%	C
Jane Street, east of Castlereagh Road	Eastbound	585	2	2	2,400	24%	A
	Westbound	932	2	2	2,400	39%	B
Castlereagh Road, north of Great Western Highway	Northbound	1,891	2	1	3,200	59%	C
	Southbound	1,800	2	1	3,200	56%	C
Great Western Highway, west of Castlereagh Road	Eastbound	1,094	2	1	3,200	34%	A
	Westbound	1,940	2	1	3,200	61%	C
Mulgoa Road, south of Great Western Highway	Northbound	1,987	2	1	3,200	62%	C
	Southbound	1,580	2	1	3,200	49%	B
High Street, east of Castlereagh Road	Eastbound	611	2	2	2,400	25%	A
	Westbound	1,165	2	2	2,400	49%	B
Commuter Carpark Road, south of Coreen Avenue	Northbound	215	1	3	700	31%	A
	Southbound	66	1	3	700	9%	A
Coreen Avenue, east of Commuter Carpark Road	Eastbound	784	1	2	1,200	65%	C
	Westbound	574	1	2	1,200	48%	B
Coreen Avenue, east of Coombes Drive	Northbound	909	1	2	1,200	76%	D
	Southbound	466	1	2	1,200	39%	B
The Crescent, east of site	Eastbound	6	1	3	700	1%	A
	Westbound	14	1	3	700	2%	A
Macquarie Avenue, north of The Crescent	Northbound	394	1	2	1,200	33%	A
	Southbound	504	1	2	1,200	42%	B
Evan Street south of The Crescent	Northbound	101	1	2	1,200	8%	A
	Southbound	602	1	2	1,200	50%	C
Richmond Rd, south of Dunheved Rd	Northbound	2,834	2	1	3,200	89%	D
	Southbound	1,667	2	1	3,200	52%	C
Coreen Ave, west of Parker St	Eastbound	908	1	2	1,200	76%	D
	Westbound	592	1	2	1,200	49%	B
Parker St, south of Coreen Ave	Northbound	2,456	2	1	3,200	77%	D
	Southbound	1,559	2	1	3,200	49%	B
Copeland Street, west of Parker Street	Eastbound	239	1	3	700	34%	A
	Westbound	134	1	3	700	19%	A
Parker St, north of Great Western Hwy	Northbound	2,912	3	1	4,800	61%	C
	Southbound	1,973	3	1	4,800	41%	B
Great Western Hwy, west of Parker St	Eastbound	1,460	2	1	3,200	46%	B
	Westbound	1,529	2	1	3,200	48%	B
Parker St, south of Great Western Hwy	Northbound	1,974	2	1	3,200	62%	C
	Southbound	1,889	2	1	3,200	59%	C
Great Western Hwy, east of Parker St	Eastbound	1,282	3	1	4,800	27%	A
	Westbound	2,202	3	1	4,800	46%	B

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Forecast 2016 Base + Other Developments + North Penrith Project - AM Peak

Road & location	Direction	2016 Estimated Traffic Volumes (veh/hour)	Number of Lanes	Road Type	Capacity	V/C	Level of Service
Castlereagh Road, north of Coreen Avenue	Northbound	1,523	2	1	3,200	48%	B
	Southbound	2,849	2	1	3,200	89%	D
Coreen Avenue, east of Castlereagh Road	Eastbound	764	1	2	1,200	64%	C
	Westbound	409	1	2	1,200	34%	A
Castlereagh Road, south of Coreen Avenue	Northbound	1,594	2	1	3,200	50%	B
	Southbound	2,600	2	1	3,200	81%	D
Castlereagh Road, north of Jane Street	Northbound	1,738	2	1	3,200	54%	C
	Southbound	2,721	2	1	3,200	85%	D
Jane Street, east of Castlereagh Road	Eastbound	951	2	2	2,400	40%	B
	Westbound	247	2	2	2,400	10%	A
Castlereagh Road, north of Great Western Highway	Northbound	1,982	2	1	3,200	62%	C
	Southbound	1,919	2	1	3,200	60%	C
Great Western Highway, west of Castlereagh Road	Eastbound	1,855	2	1	3,200	58%	C
	Westbound	889	2	1	3,200	28%	A
Mulgoa Road, south of Great Western Highway	Northbound	1,268	2	1	3,200	40%	B
	Southbound	1,732	2	1	3,200	54%	C
High Street, east of Castlereagh Road	Eastbound	857	2	2	2,400	36%	B
	Westbound	321	2	2	2,400	13%	A
Commuter Carpark Road, south of Coreen Avenue	Northbound	47	1	3	700	7%	A
	Southbound	250	1	3	700	36%	B
Coreen Avenue, east of Commuter Carpark Road	Eastbound	649	1	2	1,200	54%	C
	Westbound	662	1	2	1,200	55%	C
Coreen Avenue, east of Coombes Drive	Northbound	658	1	2	1,200	55%	C
	Southbound	617	1	2	1,200	51%	C
The Crescent, east of site	Eastbound	6	1	3	700	1%	A
	Westbound	14	1	3	700	2%	A
Macquarie Avenue, north of The Crescent	Northbound	270	1	2	1,200	22%	A
	Southbound	719	1	2	1,200	60%	C
Evan Street south of The Crescent	Northbound	0	1	2	1,200	0%	A
	Southbound	943	1	2	1,200	79%	D
Richmond Rd, south of Dunheved Rd	Northbound	1,207	2	1	3,200	38%	B
	Southbound	2,898	2	1	3,200	91%	E
Coreen Ave, west of Parker St	Eastbound	350	1	2	1,200	29%	A
	Westbound	870	1	2	1,200	73%	C
Parker St, south of Coreen Ave	Northbound	1,611	2	1	3,200	50%	C
	Southbound	2,625	2	1	3,200	82%	D
Copeland Street, west of Parker Street	Eastbound	181	1	3	700	26%	A
	Westbound	171	1	3	700	24%	A
Parker St, north of Great Western Hwy	Northbound	1,775	3	1	4,800	37%	B
	Southbound	3,085	3	1	4,800	64%	C
Great Western Hwy, west of Parker St	Eastbound	927	2	1	3,200	29%	A
	Westbound	1,390	2	1	3,200	43%	B
Parker St, south of Great Western Hwy	Northbound	1,735	2	1	3,200	54%	C
	Southbound	1,887	2	1	3,200	59%	C
Great Western Hwy, east of Parker St	Eastbound	1,959	3	1	4,800	41%	B
	Westbound	1,299	3	1	4,800	27%	A

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Forecast 2016 Base + Other Developments + North Penrith Project - PM Peak

Road & location	Direction	2016 Estimated Traffic Volumes (veh/hour)	Number of Lanes	Road Type	Capacity	V/C	Level of Service
Castlereagh Road, north of Coreen Avenue	Northbound	2,660	2	1	3,200	83%	D
	Southbound	1,698	2	1	3,200	53%	C
Coreen Avenue, east of Castlereagh Road	Eastbound	617	1	2	1,200	51%	C
	Westbound	619	1	2	1,200	52%	C
Castlereagh Road, south of Coreen Avenue	Northbound	2,346	2	1	3,200	73%	C
	Southbound	1,681	2	1	3,200	53%	C
Castlereagh Road, north of Jane Street	Northbound	2,473	2	1	3,200	77%	D
	Southbound	1,901	2	1	3,200	59%	C
Jane Street, east of Castlereagh Road	Eastbound	596	2	2	2,400	25%	A
	Westbound	965	2	2	2,400	40%	B
Castlereagh Road, north of Great Western Highway	Northbound	1,927	2	1	3,200	60%	C
	Southbound	1,800	2	1	3,200	56%	C
Great Western Highway, west of Castlereagh Road	Eastbound	1,109	2	1	3,200	35%	A
	Westbound	1,963	2	1	3,200	61%	C
Mulgoa Road, south of Great Western Highway	Northbound	2,009	2	1	3,200	63%	C
	Southbound	1,612	2	1	3,200	50%	C
High Street, east of Castlereagh Road	Eastbound	611	2	2	2,400	25%	A
	Westbound	1,165	2	2	2,400	49%	B
Commuter Carpark Road, south of Coreen Avenue	Northbound	215	1	3	700	31%	A
	Southbound	66	1	3	700	9%	A
Coreen Avenue, east of Commuter Carpark Road	Eastbound	892	1	2	1,200	74%	C
	Westbound	633	1	2	1,200	53%	C
Coreen Avenue, east of Coombes Drive	Northbound	994	1	2	1,200	83%	D
	Southbound	543	1	2	1,200	45%	B
The Crescent, east of site	Eastbound	6	1	3	700	1%	A
	Westbound	14	1	3	700	2%	A
Macquarie Avenue, north of The Crescent	Northbound	394	1	2	1,200	33%	A
	Southbound	504	1	2	1,200	42%	B
Evan Street south of The Crescent	Northbound	101	1	2	1,200	8%	A
	Southbound	603	1	2	1,200	50%	C
Richmond Rd, south of Dunheved Rd	Northbound	2,884	2	1	3,200	90%	E
	Southbound	1,707	2	1	3,200	53%	C
Coreen Ave, west of Parker St	Eastbound	993	1	2	1,200	83%	D
	Westbound	670	1	2	1,200	56%	C
Parker St, south of Coreen Ave	Northbound	2,493	2	1	3,200	78%	D
	Southbound	1,594	2	1	3,200	50%	B
Copeland Street, west of Parker Street	Eastbound	239	1	3	700	34%	A
	Westbound	134	1	3	700	19%	A
Parker St, north of Great Western Hwy	Northbound	2,949	3	1	4,800	61%	C
	Southbound	2,007	3	1	4,800	42%	B
Great Western Hwy, west of Parker St	Eastbound	1,460	2	1	3,200	46%	B
	Westbound	1,529	2	1	3,200	48%	B
Parker St, south of Great Western Hwy	Northbound	1,993	2	1	3,200	62%	C
	Southbound	1,906	2	1	3,200	60%	C
Great Western Hwy, east of Parker St	Eastbound	1,300	3	1	4,800	27%	A
	Westbound	2,220	3	1	4,800	46%	B

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Forecast 2026 Base + Other Developments - AM Peak

Road & location	Direction	2026 Estimated Traffic Volumes (veh/hour)	Number of Lanes	Road Type	Capacity	V/C	Level of Service
Castlereagh Road, north of Coreen Avenue	Northbound	1,580	2	1	3,200	49%	B
	Southbound	2,929	2	1	3,200	92%	E
Coreen Avenue, east of Castlereagh Road	Eastbound	740	1	2	1,200	62%	C
	Westbound	393	1	2	1,200	33%	A
Castlereagh Road, south of Coreen Avenue	Northbound	1,599	2	1	3,200	50%	B
	Southbound	2,640	2	1	3,200	83%	D
Castlereagh Road, north of Jane Street	Northbound	1,749	2	1	3,200	55%	C
	Southbound	2,730	2	1	3,200	85%	D
Jane Street, east of Castlereagh Road	Eastbound	953	2	2	2,400	40%	B
	Westbound	259	2	2	2,400	11%	A
Castlereagh Road, north of Great Western Highway	Northbound	2,018	2	1	3,200	63%	C
	Southbound	1,982	2	1	3,200	62%	C
Great Western Highway, west of Castlereagh Road	Eastbound	1,914	2	1	3,200	60%	C
	Westbound	901	2	1	3,200	28%	A
Mulgoa Road, south of Great Western Highway	Northbound	1,294	2	1	3,200	40%	B
	Southbound	1,745	2	1	3,200	55%	C
High Street, east of Castlereagh Road	Eastbound	893	2	2	2,400	37%	B
	Westbound	337	2	2	2,400	14%	A
Commuter Carpark Road, south of Coreen Avenue	Northbound	52	1	3	700	7%	A
	Southbound	271	1	3	700	39%	B
Coreen Avenue, east of Commuter Carpark Road	Eastbound	472	1	2	1,200	39%	B
	Westbound	659	1	2	1,200	55%	C
Coreen Avenue, east of Coombes Drive	Northbound	637	1	2	1,200	53%	C
	Southbound	506	1	2	1,200	42%	B
The Crescent, east of site	Eastbound	6	1	3	700	1%	A
	Westbound	14	1	3	700	2%	A
Macquarie Avenue, north of The Crescent	Northbound	293	1	2	1,200	24%	A
	Southbound	773	1	2	1,200	64%	C
Evan Street south of The Crescent	Northbound	520	1	2	1,200	43%	B
	Southbound	1,014	1	2	1,200	84%	D
Richmond Rd, south of Dunheved Rd	Northbound	1,240	2	1	3,200	39%	B
	Southbound	2,977	2	1	3,200	93%	E
Coreen Ave, west of Parker St	Eastbound	307	1	2	1,200	26%	A
	Westbound	850	1	2	1,200	71%	C
Parker St, south of Coreen Ave	Northbound	1,665	2	1	3,200	52%	C
	Southbound	2,693	2	1	3,200	84%	D
Copeland Street, west of Parker Street	Eastbound	194	1	3	700	28%	A
	Westbound	185	1	3	700	26%	A
Parker St, north of Great Western Hwy	Northbound	1,838	3	1	4,800	38%	B
	Southbound	3,189	3	1	4,800	66%	C
Great Western Hwy, west of Parker St	Eastbound	980	2	1	3,200	31%	A
	Westbound	1,482	2	1	3,200	46%	B
Parker St, south of Great Western Hwy	Northbound	1,816	2	1	3,200	57%	C
	Southbound	1,956	2	1	3,200	61%	C
Great Western Hwy, east of Parker St	Eastbound	2,018	3	1	4,800	42%	B
	Westbound	1,359	3	1	4,800	28%	A

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Forecast 2026 Base + Other Developments - PM Peak

Road & location	Direction	2026 Estimated Traffic Volumes (veh/hour)	Number of Lanes	Road Type	Capacity	V/C	Level of Service
Castlereagh Road, north of Coreen Avenue	Northbound	2,732	2	1	3,200	85%	D
	Southbound	1,748	2	1	3,200	55%	C
Coreen Avenue, east of Castlereagh Road	Eastbound	574	1	2	1,200	48%	B
	Westbound	637	1	2	1,200	53%	C
Castlereagh Road, south of Coreen Avenue	Northbound	2,344	2	1	3,200	73%	C
	Southbound	1,739	2	1	3,200	54%	C
Castlereagh Road, north of Jane Street	Northbound	2,493	2	1	3,200	78%	D
	Southbound	1,917	2	1	3,200	60%	C
Jane Street, east of Castlereagh Road	Eastbound	617	2	2	2,400	26%	A
	Westbound	996	2	2	2,400	41%	B
Castlereagh Road, north of Great Western Highway	Northbound	1,949	2	1	3,200	61%	C
	Southbound	1,891	2	1	3,200	59%	C
Great Western Highway, west of Castlereagh Road	Eastbound	1,144	2	1	3,200	36%	B
	Westbound	2,026	2	1	3,200	63%	C
Mulgoa Road, south of Great Western Highway	Northbound	2,055	2	1	3,200	64%	C
	Southbound	1,652	2	1	3,200	52%	C
High Street, east of Castlereagh Road	Eastbound	642	2	2	2,400	27%	A
	Westbound	1,218	2	2	2,400	51%	C
Commuter Carpark Road, south of Coreen Avenue	Northbound	234	1	3	700	33%	A
	Southbound	72	1	3	700	10%	A
Coreen Avenue, east of Commuter Carpark Road	Eastbound	848	1	2	1,200	71%	C
	Westbound	616	1	2	1,200	51%	C
Coreen Avenue, east of Coombes Drive	Northbound	983	1	2	1,200	82%	D
	Southbound	506	1	2	1,200	42%	B
The Crescent, east of site	Eastbound	6	1	3	700	1%	A
	Westbound	14	1	3	700	2%	A
Macquarie Avenue, north of The Crescent	Northbound	419	1	2	1,200	35%	A
	Southbound	548	1	2	1,200	46%	B
Evan Street south of The Crescent	Northbound	101	1	2	1,200	8%	A
	Southbound	655	1	2	1,200	55%	C
Richmond Rd, south of Dunheved Rd	Northbound	2,957	2	1	3,200	92%	E
	Southbound	1,758	2	1	3,200	55%	C
Coreen Ave, west of Parker St	Eastbound	973	1	2	1,200	81%	D
	Westbound	634	1	2	1,200	53%	C
Parker St, south of Coreen Ave	Northbound	2,554	2	1	3,200	80%	D
	Southbound	1,644	2	1	3,200	51%	C
Copeland Street, west of Parker Street	Eastbound	259	1	3	700	37%	B
	Westbound	142	1	3	700	20%	A
Parker St, north of Great Western Hwy	Northbound	3,037	3	1	4,800	63%	C
	Southbound	2,088	3	1	4,800	44%	B
Great Western Hwy, west of Parker St	Eastbound	1,557	2	1	3,200	49%	B
	Westbound	1,625	2	1	3,200	51%	C
Parker St, south of Great Western Hwy	Northbound	2,072	2	1	3,200	65%	C
	Southbound	1,997	2	1	3,200	62%	C
Great Western Hwy, east of Parker St	Eastbound	1,357	3	1	4,800	28%	A
	Westbound	2,299	3	1	4,800	48%	B

Road Type= 1 = Urban Road with Clearways
2 = Urban Road with Interruptions
3 = Local Road

Forecast 2026 Base + Other Developments + North Penrith Project - AM Peak

Road & location	Direction	2026 Estimated Traffic Volumes (veh/hour)	Number of Lanes	Road Type	Capacity	V/C	Level of Service
Castlereagh Road, north of Coreen Avenue	Northbound	1,600	2	1	3,200	50%	C
	Southbound	2,951	2	1	3,200	92%	E
Coreen Avenue, east of Castlereagh Road	Eastbound	847	1	2	1,200	71%	C
	Westbound	456	1	2	1,200	38%	B
Castlereagh Road, south of Coreen Avenue	Northbound	1,705	2	1	3,200	53%	C
	Southbound	2,704	2	1	3,200	84%	D
Castlereagh Road, north of Jane Street	Northbound	1,868	2	1	3,200	58%	C
	Southbound	2,880	2	1	3,200	90%	D
Jane Street, east of Castlereagh Road	Eastbound	1,017	2	2	2,400	42%	B
	Westbound	273	2	2	2,400	11%	A
Castlereagh Road, north of Great Western Highway	Northbound	2,110	2	1	3,200	66%	C
	Southbound	1,982	2	1	3,200	62%	C
Great Western Highway, west of Castlereagh Road	Eastbound	1,954	2	1	3,200	61%	C
	Westbound	924	2	1	3,200	29%	A
Mulgoa Road, south of Great Western Highway	Northbound	1,346	2	1	3,200	42%	B
	Southbound	1,808	2	1	3,200	56%	C
High Street, east of Castlereagh Road	Eastbound	893	2	2	2,400	37%	B
	Westbound	337	2	2	2,400	14%	A
Commuter Carpark Road, south of Coreen Avenue	Northbound	52	1	3	700	7%	A
	Southbound	271	1	3	700	39%	B
Coreen Avenue, east of Commuter Carpark Road	Eastbound	740	1	2	1,200	62%	C
	Westbound	760	1	2	1,200	63%	C
Coreen Avenue, east of Coombes Drive	Northbound	750	1	2	1,200	63%	C
	Southbound	716	1	2	1,200	60%	C
The Crescent, east of site	Eastbound	6	1	3	700	1%	A
	Westbound	14	1	3	700	2%	A
Macquarie Avenue, north of The Crescent	Northbound	293	1	2	1,200	24%	A
	Southbound	773	1	2	1,200	64%	C
Evan Street south of The Crescent	Northbound	521	1	2	1,200	43%	B
	Southbound	1,023	1	2	1,200	85%	D
Richmond Rd, south of Dunheved Rd	Northbound	1,296	2	1	3,200	40%	B
	Southbound	3,128	2	1	3,200	98%	E
Coreen Ave, west of Parker St	Eastbound	420	1	2	1,200	35%	B
	Westbound	972	1	2	1,200	81%	D
Parker St, south of Coreen Ave	Northbound	1,737	2	1	3,200	54%	C
	Southbound	2,857	2	1	3,200	89%	D
Copeland Street, west of Parker Street	Eastbound	204	1	3	700	29%	A
	Westbound	185	1	3	700	26%	A
Parker St, north of Great Western Hwy	Northbound	1,917	3	1	4,800	40%	B
	Southbound	3,369	3	1	4,800	70%	C
Great Western Hwy, west of Parker St	Eastbound	1,026	2	1	3,200	32%	A
	Westbound	1,500	2	1	3,200	47%	B
Parker St, south of Great Western Hwy	Northbound	1,843	2	1	3,200	58%	C
	Southbound	1,996	2	1	3,200	62%	C
Great Western Hwy, east of Parker St	Eastbound	2,202	3	1	4,800	46%	B
	Westbound	1,428	3	1	4,800	30%	A

Road Type= 1 = Urban Road with Clearways
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3 = Local Road

Forecast 2026 Base + Other Developments + North Penrith Project - PM Peak

Road & location	Direction	2026 Estimated Traffic Volumes (veh/hour)	Number of Lanes	Road Type	Capacity	V/C	Level of Service
Castlereagh Road, north of Coreen Avenue	Northbound	2,764	2	1	3,200	86%	D
	Southbound	1,779	2	1	3,200	56%	C
Coreen Avenue, east of Castlereagh Road	Eastbound	706	1	2	1,200	59%	C
	Westbound	675	1	2	1,200	56%	C
Castlereagh Road, south of Coreen Avenue	Northbound	2,468	2	1	3,200	77%	D
	Southbound	1,768	2	1	3,200	55%	C
Castlereagh Road, north of Jane Street	Northbound	2,609	2	1	3,200	82%	D
	Southbound	2,033	2	1	3,200	64%	C
Jane Street, east of Castlereagh Road	Eastbound	635	2	2	2,400	26%	A
	Westbound	1,049	2	2	2,400	44%	B
Castlereagh Road, north of Great Western Highway	Northbound	2,019	2	1	3,200	63%	C
	Southbound	1,891	2	1	3,200	59%	C
Great Western Highway, west of Castlereagh Road	Eastbound	1,165	2	1	3,200	36%	B
	Westbound	2,069	2	1	3,200	65%	C
Mulgoa Road, south of Great Western Highway	Northbound	2,104	2	1	3,200	66%	C
	Southbound	1,708	2	1	3,200	53%	C
High Street, east of Castlereagh Road	Eastbound	642	2	2	2,400	27%	A
	Westbound	1,218	2	2	2,400	51%	C
Commuter Carpark Road, south of Coreen Avenue	Northbound	234	1	3	700	33%	A
	Southbound	72	1	3	700	10%	A
Coreen Avenue, east of Commuter Carpark Road	Eastbound	1,017	1	2	1,200	85%	D
	Westbound	714	1	2	1,200	60%	C
Coreen Avenue, east of Coombes Drive	Northbound	1,128	1	2	1,200	94%	E
	Southbound	624	1	2	1,200	52%	C
The Crescent, east of site	Eastbound	6	1	3	700	1%	A
	Westbound	14	1	3	700	2%	A
Macquarie Avenue, north of The Crescent	Northbound	419	1	2	1,200	35%	A
	Southbound	548	1	2	1,200	46%	B
Evan Street south of The Crescent	Northbound	101	1	2	1,200	8%	A
	Southbound	656	1	2	1,200	55%	C
Richmond Rd, south of Dunheved Rd	Northbound	3,123	2	1	3,200	98%	E
	Southbound	1,830	2	1	3,200	57%	C
Coreen Ave, west of Parker St	Eastbound	1,118	1	2	1,200	93%	E
	Westbound	752	1	2	1,200	63%	C
Parker St, south of Coreen Ave	Northbound	2,704	2	1	3,200	85%	D
	Southbound	1,722	2	1	3,200	54%	C
Copeland Street, west of Parker Street	Eastbound	260	1	3	700	37%	B
	Westbound	151	1	3	700	22%	A
Parker St, north of Great Western Hwy	Northbound	3,201	3	1	4,800	67%	C
	Southbound	2,174	3	1	4,800	45%	B
Great Western Hwy, west of Parker St	Eastbound	1,576	2	1	3,200	49%	B
	Westbound	1,669	2	1	3,200	52%	C
Parker St, south of Great Western Hwy	Northbound	2,106	2	1	3,200	66%	C
	Southbound	2,027	2	1	3,200	63%	C
Great Western Hwy, east of Parker St	Eastbound	1,432	3	1	4,800	30%	A
	Westbound	2,474	3	1	4,800	52%	C

Road Type= 1 = Urban Road with Clearways
2 = Urban Road with Interruptions
3 = Local Road

Appendix 5: 2016 Future SIDRA Results

Intersection movement summary in 2016 Base + Other Development

Parker St / Coreen Ave / Richmond Rd

AM

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Parker St (S)											
1	L	138	4.6	0.958	61.5	LOS E	51.2	375.4	1.00	1.08	23.9
2	T	1180	5.7	0.957	49.4	LOS D	53.5	391.6	1.00	1.05	26.6
3	R	165	1.5	1.122	200.0	LOS F	21.6	152.8	1.00	1.20	9.2
Approach		1483	5.0	1.122	67.3	LOS E	53.5	391.6	1.00	1.07	22.0
East: Oxford St (E)											
4	L	80	6.6	0.451	79.0	LOS F	7.3	54.1	0.99	0.78	18.9
5	T	184	1.7	1.307	365.8	LOS F	44.2	315.8	1.00	1.76	5.4
6	R	63	5.0	1.308	373.9	LOS F	44.2	315.8	1.00	1.76	5.4
Approach		327	3.5	1.307	297.3	LOS F	44.2	315.8	1.00	1.52	6.5
North: Richmond Rd (N)											
7	L	1	0.0	1.273	315.6	LOS F	219.7	1595.2	1.00	2.14	6.3
8	T	2595	4.4	1.316	309.4	LOS F	232.6	1686.4	1.00	2.05	6.7
9	R	416	1.8	1.000 [3]	60.9	LOS E	31.3	222.7	1.00	0.88	22.8
Approach		3012	3.9	1.316	275.1	LOS F	232.6	1686.4	1.00	1.89	7.4
West: Coreen Ave (W)											
10	L	47	4.4	0.273	39.4	LOS C	4.0	28.4	0.91	0.77	28.2
11	T	101	0.0	0.861	64.1	LOS E	18.6	134.1	0.98	0.89	20.5
12	R	151	4.9	0.862	85.1	LOS F	18.6	134.1	1.00	0.98	18.1
Approach		299	3.2	0.861	70.7	LOS F	18.6	134.1	0.98	0.91	20.0
All Vehicles		5121	4.2	1.316	204.4	LOS F	232.6	1686.4	1.00	1.57	9.4

PM

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Parker St (S)											
1	L	131	4.0	1.349	336.2	LOS F	186.6	1341.6	1.00	1.89	5.8
2	T	2340	3.1	1.344	332.7	LOS F	218.0	1566.3	1.00	2.17	6.3
3	R	65	8.1	0.403	66.4	LOS E	5.3	39.7	0.94	0.76	21.3
Approach		2536	3.2	1.344	326.0	LOS F	218.0	1566.3	1.00	2.12	6.4
East: Oxford St (E)											
4	L	65	4.8	0.473	73.3	LOS F	5.6	41.0	1.00	0.76	19.9
5	T	112	1.9	1.238	293.8	LOS F	27.6	196.2	1.00	1.59	6.5
6	R	68	1.5	1.237	301.7	LOS F	27.6	196.2	1.00	1.59	6.5
Approach		245	2.6	1.237	237.3	LOS F	27.6	196.2	1.00	1.37	7.9
North: Richmond Rd (N)											
7	L	1	0.0	0.590	28.3	LOS B	29.3	212.7	0.63	1.05	35.8
8	T	1544	4.2	0.840	16.6	LOS B	30.2	217.6	0.64	0.59	44.0
9	R	210	1.4	1.238	291.3	LOS F	31.4	222.6	1.00	1.40	6.5
Approach		1755	3.6	1.238	49.5	LOS D	31.4	222.6	0.68	0.69	27.0
West: Coreen Ave (W)											
10	L	557	1.8	0.732	37.1	LOS C	28.1	199.6	0.90	0.86	28.5
11	T	177	1.2	1.322	367.1	LOS F	68.8	491.4	1.00	2.03	5.3
12	R	203	3.6	1.322	374.7	LOS F	68.8	491.4	1.00	2.22	5.5
Approach		956	2.1	1.323	177.3	LOS F	68.8	491.4	0.94	1.37	10.6
All Vehicles		5492	3.1	1.349	207.7	LOS F	218.0	1566.3	0.89	1.49	9.4

Intersection movement summary in 2016 Base + Other Development

Parker St / Copeland St

AM

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Parker St (S)											
1	L	41	5.1	0.343	10.6	LOS A	2.9	20.7	0.08	1.36	51.5
2	T	1892	4.2	0.645	2.1	LOS A	8.1	58.8	0.13	0.12	64.6
3	R	251	4.3	1.109	150.1	LOS F	24.3	176.1	1.00	1.17	11.5
Approach		2184	4.2	1.109	19.3	LOS B	24.3	176.1	0.23	0.26	43.5
East: Copeland St (E)											
4	L	479	3.5	0.673	44.0	LOS D	26.4	190.2	0.89	0.86	26.2
5	T	98	3.2	0.634	59.0	LOS E	11.7	83.9	0.99	0.81	19.8
6	R	60	3.5	0.634	66.6	LOS E	11.7	83.9	0.99	0.82	21.2
Approach		637	3.5	0.673	48.4	LOS D	26.4	190.2	0.91	0.85	24.5
North: Parker St (N)											
7	L	53	4.0	0.995	41.6	LOS C	18.1	131.1	1.00	0.87	31.4
8	T	2646	3.8	1.153	179.4	LOS F	157.3	1136.8	1.00	1.67	10.7
9	R	41	2.6	0.380	78.1	LOS F	3.9	28.0	1.00	0.74	19.2
Approach		2740	3.8	1.153	175.3	LOS F	157.3	1136.8	1.00	1.64	10.9
West: Copeland St (W)											
10	L	20	5.3	0.475	59.3	LOS E	5.5	40.1	0.90	0.77	22.7
11	T	91	3.5	1.074	98.7	LOS F	14.7	106.1	0.94	0.96	14.3
12	R	81	3.9	1.076	171.1	LOS F	14.7	106.1	1.00	1.33	10.8
Approach		192	3.8	1.075	125.2	LOS F	14.7	106.1	0.96	1.10	12.9
All Vehicles		5753	3.9	1.153	100.3	LOS F	157.3	1136.8	0.70	1.01	16.8

PM

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Parker St (S)											
1	L	66	3.2	0.442	10.9	LOS A	4.5	32.8	0.09	1.29	51.1
2	T	2469	3.6	0.831	2.9	LOS A	18.2	131.4	0.23	0.21	62.8
3	R	459	3.9	0.952	39.0	LOS C	24.3	176.1	1.00	0.89	30.0
Approach		2995	3.7	0.953	8.6	LOS A	24.3	176.1	0.34	0.34	54.2
East: Copeland St (E)											
4	L	260	2.8	0.282	30.2	LOS C	12.3	88.3	0.61	0.78	31.1
5	T	49	2.1	0.726	75.5	LOS F	10.1	72.2	1.00	0.87	17.0
6	R	61	3.4	0.725	83.0	LOS F	10.1	72.2	1.00	0.87	18.4
Approach		371	2.8	0.725	45.0	LOS D	12.3	88.3	0.73	0.81	25.5
North: Parker St (N)											
7	L	43	2.4	0.949	55.3	LOS D	18.2	130.4	0.95	0.90	25.9
8	T	1773	3.1	0.949	66.3	LOS E	65.2	469.0	0.99	1.05	22.4
9	R	25	4.2	0.162	78.7	LOS F	2.6	18.8	0.96	0.72	19.1
Approach		1841	3.1	0.949	66.2	LOS E	65.2	469.0	0.99	1.04	22.4
West: Copeland St (W)											
10	L	56	1.9	0.406	66.7	LOS E	4.9	34.9	0.91	0.75	20.8
11	T	153	1.4	0.758	68.7	LOS E	15.7	111.7	1.00	0.90	18.2
12	R	43	2.4	0.757	76.3	LOS F	15.7	111.7	1.00	0.90	19.5
Approach		252	1.7	0.758	69.6	LOS E	15.7	111.7	0.98	0.86	19.0
All Vehicles		5458	3.3	0.952	33.3	LOS C	65.2	469.0	0.62	0.63	33.1

Intersection movement summary in 2016 Base + Other Development

Parker St / Great Western Hwy

AM

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Parker St (S)											
1	L	467	4.1	0.419	24.2	LOS B	16.1	116.3	0.55	0.84	39.2
2	T	1140	4.0	0.725	39.2	LOS C	34.7	251.3	0.90	0.81	30.6
3	R	203	4.1	0.938	101.5	LOS F	18.8	136.3	1.00	1.01	16.5
Approach		1811	4.0	0.939	42.3	LOS C	34.7	251.3	0.82	0.84	29.5
East: Great Western Hwy (E)											
4	L	183	4.0	0.101	7.7	NA[9]	NA[9]	NA[9]	0.00	0.60	49.8
5	T	959	4.0	1.085	150.9	LOS F	48.9	354.2	0.99	1.29	11.4
6	R	208	3.9	1.016	135.2	LOS F	22.1	159.9	1.00	1.15	13.4
Approach		1351	4.0	1.085	129.1	LOS F	48.9	354.2	0.86	1.18	13.1
North: Parker St (N)											
7	L	1220	4.0	0.676	9.7	NA[9]	NA[9]	NA[9]	0.00	0.65	54.4
8	T	1715	4.0	1.094	129.2	LOS F	103.1	746.2	1.00	1.43	13.9
9	R	232	4.0	1.073	156.2	LOS F	26.4	191.5	1.00	1.12	11.7
Approach		3167	4.0	1.094	85.2	LOS F	103.1	746.2	0.61	1.11	19.2
West: Great Western Hwy (W)											
10	L	209	4.0	0.116	7.7	NA[9]	NA[9]	NA[9]	0.00	0.60	49.8
11	T	620	4.1	0.844	69.7	LOS E	24.3	175.9	1.00	0.96	19.9
12	R	146	4.3	0.716	81.2	LOS F	12.4	90.0	1.00	0.84	19.5
Approach		976	4.1	0.844	58.1	LOS E	24.3	175.9	0.79	0.86	22.8
All Vehicles		7304	4.0	1.094	79.0	LOS F	103.1	746.2	0.73	1.02	19.7

PM

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Parker St (S)											
1	L	344	3.1	0.378	32.6	LOS C	14.9	107.4	0.66	0.87	34.1
2	T	1604	3.0	1.267	317.5	LOS F	136.7	981.3	1.00	2.10	6.6
3	R	129	3.3	1.034	144.4	LOS F	14.7	105.9	1.00	1.13	12.5
Approach		2078	3.0	1.267	259.5	LOS F	136.7	981.3	0.94	1.83	7.8
East: Great Western Hwy (E)											
4	L	325	2.9	0.179	7.7	NA[9]	NA[9]	NA[9]	0.00	0.60	49.8
5	T	1823	3.0	1.291	204.4	LOS F	145.9	1047.4	0.97	0.62	16.4
6	R	169	3.0	1.122	211.9	LOS F	22.4	160.6	1.00	1.34	9.3
Approach		2317	3.0	1.291	177.3	LOS F	145.9	1047.4	0.84	0.67	17.4
North: Parker St (N)											
7	L	469	2.9	0.258	9.5	NA[9]	NA[9]	NA[9]	0.00	0.65	54.6
8	T	1452	3.0	1.151	186.6	LOS F	97.3	698.5	1.00	1.63	10.4
9	R	159	3.1	1.270	330.7	LOS F	26.6	191.5	1.00	1.42	6.1
Approach		2081	3.0	1.270	157.7	LOS F	97.3	698.5	0.77	1.40	11.9
West: Great Western Hwy (W)											
10	L	466	2.9	0.256	7.7	NA[9]	NA[9]	NA[9]	0.00	0.60	49.7
11	T	909	2.9	0.682	42.8	LOS D	27.9	200.2	0.92	0.81	26.3
12	R	161	3.0	1.070	170.0	LOS F	19.2	137.9	1.00	1.25	11.2
Approach		1537	2.9	1.070	45.5	LOS D	27.9	200.2	0.65	0.79	26.1
All Vehicles		8013	3.0	1.291	168.2	LOS F	145.9	1047.4	0.81	1.18	12.2

Intersection movement summary in 2016 Base + Other Development

Coreen Ave / Coombes Dr

AM

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South East: Coreen Ave (E)											
22	T	622	2.5	0.608	33.3	LOS C	21.3	152.2	1.00	0.00	29.6
23	R	87	2.4	0.607	40.7	LOS C	21.3	152.2	1.00	1.35	29.6
Approach		709	2.5	0.608	34.2	LOS C	21.3	152.2	1.00	0.17	29.6
North: Coombes Ave (N)											
7	L	48	10.9	0.489	45.8	LOS D	2.3	17.9	0.87	1.10	23.8
9	R	20	10.5	0.488	47.6	LOS D	2.3	17.9	0.87	1.07	24.3
Approach		68	10.8	0.488	46.4	LOS D	2.3	17.9	0.87	1.09	23.9
North West: Coreen Ave (W)											
27	L	38	11.1	0.321	9.5	LOS A	0.0	0.0	0.00	1.18	48.1
28	T	576	1.8	0.321	1.2	LOS A	0.0	0.0	0.00	0.11	57.0
Approach		614	2.4	0.321	1.7	LOS A	0.0	0.0	0.00	0.18	56.3
All Vehicles		1392	2.9	0.608	20.5	NA	21.3	152.2	0.55	0.22	36.6

PM

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South East: Coreen Ave (E)											
22	T	581	2.9	0.560	57.6	LOS E	23.9	171.4	1.00	0.00	22.3
23	R	43	4.9	0.560	65.2	LOS E	23.9	171.4	1.00	1.31	22.2
Approach		624	3.0	0.560	58.2	LOS E	23.9	171.4	1.00	0.09	22.3
North: Coombes Ave (N)											
7	L	125	0.8	1.171	272.9	LOS F	22.8	163.7	1.00	3.02	6.6
9	R	23	13.6	1.158	275.2	LOS F	22.8	163.7	1.00	2.47	6.9
Approach		148	2.8	1.166	273.2	LOS F	22.8	163.7	1.00	2.93	6.6
North West: Coreen Ave (W)											
27	L	18	5.9	0.436	9.3	LOS A	0.0	0.0	0.00	1.20	48.1
28	T	832	1.6	0.441	1.2	LOS A	0.0	0.0	0.00	0.11	57.0
Approach		849	1.7	0.441	1.4	LOS A	0.0	0.0	0.00	0.14	56.7
All Vehicles		1622	2.3	1.171	48.1	NA	23.9	171.4	0.48	0.37	24.7

Intersection movement summary in 2016 Base + Other Development

Coreen Ave / Commuter Car Park Access

AM

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Penrith Car Park Access											
1	L	21	0.0	0.060	10.3	LOS A	0.4	2.8	0.57	0.68	46.5
3	R	28	0.0	0.060	13.3	LOS A	0.4	2.8	0.57	0.74	44.2
Approach		49	0.0	0.060	12.0	LOS A	0.4	2.8	0.57	0.72	45.2
East: Coreen Ave (E)											
4	L	120	2.6	0.484	9.2	LOS A	4.9	35.4	0.51	0.65	47.5
5	T	449	2.8	0.483	8.4	LOS A	4.9	35.4	0.51	0.59	47.6
6	R	1	0.0	0.526	13.7	LOS A	4.9	35.4	0.51	0.77	44.5
Approach		571	2.8	0.484	8.6	LOS A	4.9	35.4	0.51	0.61	47.6
West: Coreen Ave (W)											
11	T	436	2.9	0.392	7.3	LOS A	4.2	30.2	0.21	0.52	49.2
12	R	143	2.9	0.392	11.1	LOS A	4.2	30.2	0.21	0.75	46.1
Approach		579	2.9	0.392	8.2	LOS A	4.2	30.2	0.21	0.58	48.4
All Vehicles		1199	2.7	0.526	8.6	LOS A	4.9	35.4	0.36	0.60	47.8

PM

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Penrith Car Park Access											
1	L	121	0.9	0.288	11.7	LOS A	2.1	14.9	0.68	0.80	45.2
3	R	105	1.0	0.288	14.7	LOS B	2.1	14.9	0.68	0.85	43.1
Approach		226	0.9	0.288	13.1	LOS B	2.1	14.9	0.68	0.82	44.2
East: Coreen Ave (E)											
4	L	32	3.3	0.405	8.2	LOS A	4.4	31.4	0.25	0.61	48.5
5	T	549	2.3	0.407	7.3	LOS A	4.4	31.4	0.25	0.53	49.0
6	R	1	0.0	0.351	12.6	LOS A	4.4	31.4	0.25	0.81	45.1
Approach		582	2.4	0.407	7.4	LOS A	4.4	31.4	0.25	0.53	48.9
West: Coreen Ave (W)											
11	T	721	2.3	0.604	8.2	LOS A	8.0	57.5	0.56	0.57	47.4
12	R	40	2.6	0.606	12.1	LOS A	8.0	57.5	0.56	0.70	45.8
Approach		761	2.4	0.604	8.4	LOS A	8.0	57.5	0.56	0.57	47.3
All Vehicles		1569	2.1	0.606	8.7	LOS A	8.0	57.5	0.46	0.60	47.4

Intersection movement summary in 2016 Base + Other Development

Castlereagh Rd / Coreen Ave

AM

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Castlereagh Rd (S)											
1	L	81	9.1	0.609	7.3	LOS A	7.6	55.9	0.65	0.61	48.5
2	T	1402	5.9	0.611	5.9	LOS A	7.6	55.9	0.65	0.53	48.3
3	R	278	6.1	0.611	12.8	LOS A	7.6	55.8	0.65	0.73	46.0
Approach		1761	6.1	0.611	7.0	LOS A	7.6	55.9	0.65	0.56	47.9
East: Coreen Ave (E)											
4	L	134	18.1	0.998	167.6	LOS F	13.8	111.6	1.00	1.70	10.7
5	T	97	3.3	1.670	657.0	LOS F	73.7	551.6	1.00	3.42	3.2
6	R	152	11.1	1.648	664.1	LOS F	73.7	551.6	1.00	3.37	3.4
Approach		382	11.6	1.656	488.6	LOS F	73.7	551.6	1.00	2.80	4.3
North: Castlereagh Rd (N)											
7	L	436	4.3	1.187	183.6	LOS F	176.6	1291.2	1.00	4.88	10.0
8	T	2515	5.5	1.186	182.4	LOS F	176.6	1291.2	1.00	4.88	10.1
9	R	48	19.6	1.181	190.5	LOS F	175.4	1291.0	1.00	4.72	10.6
Approach		2999	5.6	1.186	182.7	LOS F	176.6	1291.2	1.00	4.87	10.0
West: Mullins Rd (W)											
10	L	38	5.6	0.134	16.9	LOS B	0.9	6.6	0.89	0.95	41.2
11	T	29	7.1	0.230	16.8	LOS B	1.5	11.6	0.90	0.94	40.4
12	R	38	11.1	0.230	23.9	LOS B	1.5	11.6	0.90	0.98	38.1
Approach		105	8.0	0.229	19.4	LOS B	1.5	11.6	0.90	0.96	39.7
All Vehicles		5247	6.2	1.670	142.8	LOS F	176.6	1291.2	0.88	3.20	12.3

PM

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Castlereagh Rd (S)											
1	L	93	3.4	1.362	344.9	LOS F	269.8	1934.6	1.00	7.56	5.7
2	T	2385	2.8	1.368	344.3	LOS F	269.8	1934.6	1.00	7.36	5.8
3	R	256	7.8	1.368	352.2	LOS F	232.6	1681.4	1.00	7.02	6.1
Approach		2734	3.3	1.368	345.1	LOS F	269.8	1934.6	1.00	7.33	5.8
East: Coreen Ave (E)											
4	L	207	3.0	0.567	17.5	LOS B	4.3	31.2	0.91	1.05	40.6
5	T	117	6.3	0.789	20.2	LOS B	8.9	64.5	0.99	1.23	37.7
6	R	299	3.9	0.787	27.0	LOS B	8.9	64.5	0.99	1.23	36.0
Approach		623	4.1	0.787	22.6	LOS B	8.9	64.5	0.97	1.17	37.7
North: Castlereagh Rd (N)											
7	L	237	2.7	0.757	9.5	LOS A	11.1	79.7	0.80	0.80	47.6
8	T	1484	3.3	0.757	8.7	LOS A	11.1	79.7	0.81	0.80	47.3
9	R	55	5.8	0.760	16.6	LOS B	11.0	79.1	0.82	0.93	43.9
Approach		1776	3.3	0.757	9.1	LOS B	11.1	79.7	0.81	0.80	47.2
West: Mullins Rd (W)											
10	L	95	2.2	0.526	34.4	LOS C	4.0	28.3	0.96	1.08	30.9
11	T	79	2.7	0.467	22.7	LOS B	4.2	30.0	1.00	1.08	36.5
12	R	56	3.8	0.465	29.7	LOS C	4.2	30.0	1.00	1.08	35.0
Approach		229	2.8	0.527	29.2	LOS C	4.2	30.0	0.99	1.08	33.7
All Vehicles		5362	3.4	1.368	182.8	LOS F	269.8	1934.6	0.93	4.19	10.1

Intersection movement summary in 2016 Base + Other Development

Castlereagh Rd / Peachtree Rd

AM

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Castlereagh Rd (S)											
1	L	112	5.7	0.785	11.5	LOS A	13.5	98.6	0.21	1.00	46.6
2	T	1581	5.3	0.786	3.1	LOS A	13.5	99.2	0.21	0.20	54.2
Approach		1693	5.3	0.786	3.6	LOS A	13.5	99.2	0.21	0.25	53.6
East: Peachtree Rd (E)											
4	L	11	0.0	0.142	87.1	LOS F	1.2	8.5	0.99	0.67	17.6
Approach		11	0.0	0.142	87.1	LOS F	1.2	8.5	0.99	0.67	17.6
North: Castlereagh Rd (N)											
7	L	21	0.0	0.031	12.0	LOS A	0.5	3.6	0.23	0.68	45.1
8	T	2734	3.8	1.026	87.8	LOS F	147.1	1063.2	1.00	1.26	17.1
9	R	116	3.6	0.738	85.0	LOS F	10.5	75.6	1.00	0.85	18.0
Approach		2871	3.8	1.026	87.1	LOS F	147.1	1063.2	0.99	1.24	17.2
West: Peachtree Rd (W)											
10	L	36	8.8	0.253	70.0	LOS E	3.4	25.3	0.91	0.73	20.5
12	R	38	8.3	0.154	70.0	LOS E	3.5	26.5	0.92	0.74	20.6
Approach		74	8.6	0.253	70.0	LOS E	3.5	26.5	0.91	0.74	20.6
All Vehicles		4647	4.4	1.026	56.4	LOS D	147.1	1063.2	0.71	0.87	22.9

PM

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Castlereagh Rd (S)											
1	L	73	2.9	0.998	45.0	LOS D	103.8	744.9	1.00	1.10	28.2
2	T	2241	3.0	0.999	36.6	LOS C	104.0	746.9	1.00	1.11	28.5
Approach		2314	3.0	0.999	36.9	LOS C	104.0	746.9	1.00	1.11	28.4
East: Peachtree Rd (E)											
4	L	11	0.0	0.142	87.1	LOS F	1.2	8.5	0.99	0.67	17.6
Approach		11	0.0	0.142	87.1	LOS F	1.2	8.5	0.99	0.67	17.6
North: Castlereagh Rd (N)											
7	L	21	0.0	0.031	12.0	LOS A	0.5	3.6	0.23	0.68	45.1
8	T	1784	2.9	0.666	13.3	LOS A	36.0	258.1	0.61	0.57	42.1
9	R	86	2.4	0.887	97.1	LOS F	8.8	63.0	1.00	0.95	16.4
Approach		1892	2.8	0.887	17.1	LOS B	36.0	258.1	0.63	0.59	39.3
West: Peachtree Rd (W)											
10	L	147	2.7	1.000 [3]	74.4	LOS F	11.9	85.1	0.99	0.80	19.7
12	R	148	3.0	0.580	74.4	LOS F	11.9	85.6	0.99	0.81	19.7
Approach		295	2.9	1.000	74.4	LOS F	11.9	85.6	0.99	0.80	19.7
All Vehicles		4511	2.9	1.000	31.2	LOS C	104.0	746.9	0.84	0.87	31.1

Intersection movement summary in 2016 Base + Other Development

Castlereagh Rd / Jane St

AM

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Jane St (E)											
4	L	113	5.6	0.087	20.0	LOS B	3.4	24.7	0.51	0.66	34.9
6	R	137	6.2	0.177	41.6	LOS C	5.3	39.4	0.78	0.74	26.1
Approach		249	5.9	0.177	31.8	LOS C	5.3	39.4	0.66	0.70	29.4
North: Castlereagh Rd (N)											
7	L	516	5.9	0.899	25.3	LOS B	12.7	93.2	0.24	0.72	34.5
8	T	1906	6.0	1.385	391.0	LOS F	169.9	1250.7	1.00	2.02	5.1
Approach		2422	6.0	1.385	313.1	LOS F	169.9	1250.7	0.84	1.74	6.2
South West: Castlereagh Rd (S)											
31	T	1625	6.0	0.702	9.4	LOS A	8.7	64.3	0.16	0.64	47.9
32	R	446	5.9	0.626	46.0	LOS D	12.8	93.9	0.89	0.80	24.6
Approach		2072	6.0	0.702	17.2	LOS B	12.8	93.9	0.32	0.68	39.8
All Vehicles		4743	6.0	1.385	169.1	LOS F	169.9	1250.7	0.60	1.22	10.5

PM

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Jane St (E)											
4	L	409	3.1	0.312	21.7	LOS B	11.4	81.9	0.58	0.71	33.9
6	R	572	2.9	0.723	48.5	LOS D	20.8	149.3	0.92	0.85	24.0
Approach		981	3.0	0.723	37.3	LOS C	20.8	149.3	0.78	0.79	27.4
North: Castlereagh Rd (N)											
7	L	345	3.0	0.689	7.9	LOS A	3.2	22.9	0.13	0.61	48.2
8	T	1485	3.0	1.059	106.4	LOS F	70.1	502.9	1.00	1.23	15.2
Approach		1831	3.0	1.059	87.8	LOS F	70.1	502.9	0.84	1.11	17.4
South West: Castlereagh Rd (S)											
31	T	1962	3.0	0.832	9.6	LOS A	14.9	106.9	0.26	0.68	47.6
32	R	272	3.1	0.374	43.5	LOS D	7.8	56.0	0.80	0.76	25.3
Approach		2234	3.0	0.832	13.7	LOS A	14.9	106.9	0.33	0.69	43.0
All Vehicles		5045	3.0	1.059	45.2	LOS D	70.1	502.9	0.60	0.86	26.2

Intersection movement summary in 2016 Base + Other Development

Castlereagh Rd / Great Western Hwy / Mulgoa Rd

AM

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Mulgoa Rd (S)											
1	L	193	4.9	0.389	43.5	LOS D	11.5	84.0	0.75	0.78	27.6
2	T	944	5.0	0.682	42.7	LOS D	29.3	213.7	0.91	0.80	26.5
3	R	169	5.0	0.945	103.0	LOS F	16.2	118.3	1.00	1.03	15.1
Approach		1306	5.0	0.945	50.7	LOS D	29.3	213.7	0.90	0.83	24.4
East: Great Western Hwy (E)											
4	L	60	5.3	0.270	56.2	LOS D	9.3	67.9	0.82	0.91	22.5
5	T	206	5.1	0.270	48.4	LOS D	9.3	67.9	0.84	0.72	22.9
6	R	72	4.4	0.994	121.6	LOS F	8.5	61.5	1.00	1.09	13.4
Approach		338	5.0	0.994	65.3	LOS E	9.3	67.9	0.87	0.83	19.8
North: Castlereagh Rd (N)											
7	L	96	5.5	1.204	236.4	LOS F	124.4	909.0	1.00	1.76	7.8
8	T	1559	5.0	1.203	228.8	LOS F	124.4	909.0	1.00	1.76	8.1
9	R	399	5.0	1.113	190.5	LOS F	25.2	183.9	1.00	1.23	9.7
Approach		2054	5.0	1.203	221.7	LOS F	124.4	909.0	1.00	1.65	8.4
North West: Bus Lane											
28	T	5	100.0	0.111	88.8	LOS F	0.6	8.2	0.99	0.66	18.5
Approach		5	100.0	0.111	88.8	LOS F	0.6	8.2	0.99	0.66	18.5
West: Great Western Hwy (W)											
10	L	1019	5.0	1.191	200.5	LOS F	110.2	804.3	1.00	1.31	9.3
11	T	695	5.0	1.109	184.8	LOS F	91.8	669.8	1.00	1.56	9.3
12	R	215	5.0	1.000 [3]	115.1	LOS F	21.0	153.3	1.00	1.05	14.5
Approach		1929	5.0	1.191	185.3	LOS F	110.2	804.3	1.00	1.37	9.7
All Vehicles		5633	5.1	1.204	160.1	LOS F	124.4	909.0	0.97	1.32	10.9

PM

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Mulgoa Rd (S)											
1	L	401	2.9	0.824	58.0	LOS E	27.1	194.1	0.91	0.89	23.4
2	T	1522	3.0	1.170	234.3	LOS F	113.1	812.0	1.00	1.77	8.0
3	R	168	3.1	0.818	84.1	LOS F	14.5	103.9	1.00	0.90	17.5
Approach		2092	3.0	1.170	188.4	LOS F	113.1	812.0	0.98	1.53	9.6
East: Great Western Hwy (E)											
4	L	201	3.1	1.140	174.3	LOS F	68.6	492.8	1.00	1.30	10.2
5	T	898	3.0	1.140	195.1	LOS F	74.7	536.2	1.00	1.51	9.0
6	R	128	3.0	1.171	251.5	LOS F	19.2	137.9	1.00	1.44	7.5
Approach		1226	3.0	1.171	197.6	LOS F	74.7	536.2	1.00	1.47	9.0
North: Castlereagh Rd (N)											
7	L	101	3.1	1.113	162.8	LOS F	90.2	648.1	1.00	1.47	10.7
8	T	1325	3.0	1.114	155.4	LOS F	90.2	648.1	1.00	1.43	11.1
9	R	444	3.1	1.077	159.3	LOS F	25.6	183.7	1.00	1.16	11.2
Approach		1869	3.0	1.114	156.7	LOS F	90.2	648.1	1.00	1.37	11.1
North West: Bus Lane											
28	T	1	100.0	0.022	86.8	LOS F	0.1	1.6	0.98	0.60	18.8
Approach		1	100.0	0.022	86.8	LOS F	0.1	1.6	0.98	0.60	18.8
West: Great Western Hwy (W)											
10	L	292	2.9	0.322	47.3	LOS D	12.0	86.4	0.78	0.78	26.3
11	T	606	3.1	0.989	99.1	LOS F	59.8	429.8	1.00	1.16	15.0
12	R	254	3.0	1.000 [3]	89.1	LOS F	21.3	153.1	1.00	0.90	17.5
Approach		1152	3.0	1.000	83.8	LOS F	59.8	429.8	0.94	1.01	17.6
All Vehicles		6340	3.0	1.171	161.8	LOS F	113.1	812.0	0.98	1.38	10.8

Intersection movement summary in 2016 Base + Other Development with upgrades

Parker St / Coreen Ave / Richmond Rd

AM

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Parker St (S)											
1	L	138	4.6	0.234	9.2	LOS A	0.9	6.4	0.06	0.59	52.1
2	T	1132	5.7	0.836	48.9	LOS D	26.4	193.5	0.96	0.87	25.3
3	R	214	1.5	1.023	119.0	LOS F	21.6	152.8	1.00	1.07	14.1
Approach		1483	5.0	1.023	55.3	LOS D	26.4	193.5	0.88	0.87	23.6
East: Oxford St (E)											
4	L	80	6.6	1.000 [3]	78.0	LOS F	7.1	52.8	0.98	0.76	18.9
5	T	184	1.7	0.967	102.0	LOS F	18.1	128.6	1.00	1.11	14.5
6	R	63	5.0	0.513	76.8	LOS F	5.9	43.3	0.97	0.75	19.4
Approach		327	3.5	1.000	91.5	LOS F	18.1	128.6	0.99	0.96	16.2
North: Richmond Rd (N)											
7	L	1	0.0	0.863	69.9	LOS E	69.0	501.3	1.00	1.16	23.0
8	T	2491	4.4	1.011	61.5	LOS E	79.7	578.7	1.00	1.15	21.9
9	R	520	1.8	0.844	45.2	LOS D	26.4	187.8	0.80	0.84	27.5
Approach		3012	3.9	1.011	58.7	LOS E	79.7	578.7	0.97	1.10	22.7
West: Coreen Ave (W)											
10	L	47	4.4	0.114	12.4	LOS A	1.3	9.5	0.31	0.63	41.0
11	T	101	0.0	0.268	55.3	LOS D	8.0	55.7	0.89	0.71	21.9
12	R	151	4.9	0.434	64.9	LOS E	11.4	83.2	0.93	0.80	21.3
Approach		299	3.2	0.434	53.4	LOS D	11.4	83.2	0.82	0.74	23.4
All Vehicles		5121	4.2	1.023	59.5	LOS E	79.7	578.7	0.94	1.00	22.4

PM

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Parker St (S)											
1	L	131	4.0	0.194	8.6	LOS A	0.6	4.4	0.06	0.59	52.9
2	T	2340	3.1	1.085	120.6	LOS F	81.5	585.8	1.00	1.50	13.5
3	R	65	8.1	0.332	59.2	LOS E	4.9	36.8	0.91	0.74	22.8
Approach		2536	3.2	1.085	113.3	LOS F	81.5	585.8	0.95	1.43	14.2
East: Oxford St (E)											
4	L	65	4.8	0.756	76.8	LOS F	5.8	42.1	1.00	0.85	19.2
5	T	112	1.9	1.035	123.1	LOS F	11.8	83.9	1.00	1.17	12.6
6	R	68	1.5	0.665	75.0	LOS F	5.9	42.1	1.00	0.81	19.7
Approach		245	2.6	1.034	97.4	LOS F	11.8	83.9	1.00	0.98	15.7
North: Richmond Rd (N)											
7	L	1	0.0	0.520	39.9	LOS C	22.9	165.7	0.57	1.28	31.3
8	T	1373	4.2	0.607	20.1	LOS B	22.9	165.7	0.58	0.51	39.8
9	R	381	1.4	1.099	146.5	LOS F	31.4	222.6	0.97	1.15	11.8
Approach		1755	3.6	1.099	44.9	LOS D	31.4	222.6	0.66	0.64	27.1
West: Coreen Ave (W)											
10	L	576	1.8	0.860	36.0	LOS C	27.3	194.0	0.74	0.88	28.9
11	T	177	1.2	0.394	43.8	LOS D	27.3	194.0	0.89	0.74	25.0
12	R	203	3.6	0.484	52.3	LOS D	12.4	89.5	0.92	0.81	24.1
Approach		956	2.1	0.860	40.9	LOS C	27.3	194.0	0.81	0.84	27.0
All Vehicles		5492	3.1	1.099	78.1	LOS F	81.5	585.8	0.83	1.06	18.8

Intersection movement summary in 2016 Base + Other Development with upgrades

Parker St / Copeland St

AM

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Parker St (S)											
1	L	41	5.1	0.324	10.7	LOS A	3.0	21.7	0.08	1.35	51.4
2	T	1799	4.2	0.593	2.2	LOS A	7.6	55.2	0.12	0.11	64.7
3	R	344	4.3	1.092	114.2	LOS F	24.3	176.1	0.97	1.02	14.4
Approach		2184	4.2	1.092	19.9	LOS B	24.3	176.1	0.25	0.27	43.0
East: Copeland St (E)											
4	L	479	3.5	0.684	48.7	LOS D	29.3	211.4	0.90	0.86	24.9
5	T	98	3.2	0.285	57.3	LOS E	7.9	56.7	0.91	0.72	20.4
6	R	60	3.5	0.292	70.3	LOS E	5.4	39.2	0.93	0.77	20.2
Approach		637	3.5	0.684	52.0	LOS D	29.3	211.4	0.90	0.83	23.6
North: Parker St (N)											
7	L	53	4.0	0.997	44.1	LOS D	18.1	131.1	1.00	0.87	30.3
8	T	2646	3.8	1.132	168.5	LOS F	161.0	1163.7	1.00	1.54	11.3
9	R	41	2.6	0.422	86.7	LOS F	4.3	30.9	1.00	0.74	17.8
Approach		2740	3.8	1.132	164.9	LOS F	161.0	1163.7	1.00	1.52	11.5
West: Copeland St (W)											
10	L	20	5.3	0.105	8.2	LOS A	0.2	1.7	0.15	0.61	44.6
11	T	91	3.5	1.031	79.2	LOS F	12.9	93.4	0.92	0.83	16.7
12	R	81	3.9	1.030	148.0	LOS F	12.9	93.4	1.00	1.22	12.1
Approach		192	3.8	1.030	100.9	LOS F	12.9	93.4	0.87	0.97	15.2
All Vehicles		5753	3.9	1.132	95.2	LOS F	161.0	1163.7	0.70	0.95	17.4

PM

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Parker St (S)											
1	L	66	3.2	0.451	10.9	LOS A	4.7	34.0	0.09	1.30	51.1
2	T	2469	3.6	0.826	2.8	LOS A	17.7	128.0	0.22	0.21	62.9
3	R	459	3.9	0.869	40.6	LOS C	17.7	127.9	0.93	0.85	29.4
Approach		2995	3.7	0.869	8.8	LOS A	17.7	128.0	0.33	0.33	54.0
East: Copeland St (E)											
4	L	260	2.8	0.306	34.1	LOS C	13.2	94.3	0.66	0.79	29.5
5	T	49	2.1	0.143	55.5	LOS D	4.3	30.5	0.88	0.67	20.8
6	R	64	3.3	0.375	75.0	LOS F	6.0	43.0	0.96	0.77	19.4
Approach		374	2.8	0.375	43.9	LOS D	13.2	94.3	0.74	0.77	25.9
North: Parker St (N)											
7	L	43	2.4	0.873	55.0	LOS D	18.2	130.4	0.86	1.00	25.8
8	T	1773	3.1	0.870	44.5	LOS D	52.3	376.3	0.96	0.92	28.4
9	R	25	4.2	0.210	82.6	LOS F	2.7	19.5	0.98	0.72	18.5
Approach		1841	3.1	0.870	45.3	LOS D	52.3	376.3	0.96	0.91	28.2
West: Copeland St (W)											
10	L	56	1.9	0.279	10.8	LOS A	1.6	11.6	0.31	0.67	42.4
11	T	153	1.4	0.565	60.4	LOS E	12.4	88.1	0.94	0.76	19.7
12	R	43	2.4	0.565	69.5	LOS E	12.4	88.1	0.97	0.82	20.7
Approach		252	1.7	0.565	50.9	LOS D	12.4	88.1	0.81	0.75	22.8
All Vehicles		5461	3.3	0.873	25.4	LOS B	52.3	376.3	0.59	0.58	37.3

Intersection movement summary in 2016 Base + Other Development without upgrades

Parker St / Great Western Hwy

AM

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Parker St (S)											
1	L	467	4.1	0.419	24.2	LOS B	16.1	116.3	0.55	0.84	39.2
2	T	1140	4.0	0.725	39.2	LOS C	34.7	251.3	0.90	0.81	30.6
3	R	203	4.1	0.938	101.5	LOS F	18.8	136.3	1.00	1.01	16.5
Approach		1811	4.0	0.939	42.3	LOS C	34.7	251.3	0.82	0.84	29.5
East: Great Western Hwy (E)											
4	L	183	4.0	0.101	7.7	NA[9]	NA[9]	NA[9]	0.00	0.60	49.8
5	T	959	4.0	1.085	150.9	LOS F	48.9	354.2	0.99	1.29	11.4
6	R	208	3.9	1.016	135.2	LOS F	22.1	159.9	1.00	1.15	13.4
Approach		1351	4.0	1.085	129.1	LOS F	48.9	354.2	0.86	1.18	13.1
North: Parker St (N)											
7	L	1220	4.0	0.676	9.7	NA[9]	NA[9]	NA[9]	0.00	0.65	54.4
8	T	1715	4.0	1.094	129.2	LOS F	103.1	746.2	1.00	1.43	13.9
9	R	232	4.0	1.073	156.2	LOS F	26.4	191.5	1.00	1.12	11.7
Approach		3167	4.0	1.094	85.2	LOS F	103.1	746.2	0.61	1.11	19.2
West: Great Western Hwy (W)											
10	L	209	4.0	0.116	7.7	NA[9]	NA[9]	NA[9]	0.00	0.60	49.8
11	T	620	4.1	0.844	69.7	LOS E	24.3	175.9	1.00	0.96	19.9
12	R	146	4.3	0.716	81.2	LOS F	12.4	90.0	1.00	0.84	19.5
Approach		976	4.1	0.844	58.1	LOS E	24.3	175.9	0.79	0.86	22.8
All Vehicles		7304	4.0	1.094	79.0	LOS F	103.1	746.2	0.73	1.02	19.7

PM

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Parker St (S)											
1	L	344	3.1	0.378	32.6	LOS C	14.9	107.4	0.66	0.87	34.1
2	T	1604	3.0	1.267	317.5	LOS F	136.7	981.3	1.00	2.10	6.6
3	R	129	3.3	1.034	144.4	LOS F	14.7	105.9	1.00	1.13	12.5
Approach		2078	3.0	1.267	259.5	LOS F	136.7	981.3	0.94	1.83	7.8
East: Great Western Hwy (E)											
4	L	325	2.9	0.179	7.7	NA[9]	NA[9]	NA[9]	0.00	0.60	49.8
5	T	1823	3.0	1.291	204.4	LOS F	145.9	1047.4	0.97	0.62	16.4
6	R	169	3.0	1.122	211.9	LOS F	22.4	160.6	1.00	1.34	9.3
Approach		2317	3.0	1.291	177.3	LOS F	145.9	1047.4	0.84	0.67	17.4
North: Parker St (N)											
7	L	469	2.9	0.258	9.5	NA[9]	NA[9]	NA[9]	0.00	0.65	54.6
8	T	1452	3.0	1.151	186.6	LOS F	97.3	698.5	1.00	1.63	10.4
9	R	159	3.1	1.270	330.7	LOS F	26.6	191.5	1.00	1.42	6.1
Approach		2081	3.0	1.270	157.7	LOS F	97.3	698.5	0.77	1.40	11.9
West: Great Western Hwy (W)											
10	L	466	2.9	0.256	7.7	NA[9]	NA[9]	NA[9]	0.00	0.60	49.7
11	T	909	2.9	0.682	42.8	LOS D	27.9	200.2	0.92	0.81	26.3
12	R	161	3.0	1.070	170.0	LOS F	19.2	137.9	1.00	1.25	11.2
Approach		1537	2.9	1.070	45.5	LOS D	27.9	200.2	0.65	0.79	26.1
All Vehicles		8013	3.0	1.291	168.2	LOS F	145.9	1047.4	0.81	1.18	12.2

Intersection movement summary in 2016 Base + Other Development with upgrades

Coreen Ave / Coombes Dr

AM

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South East: Coreen Ave (E)											
22	T	622	2.5	0.324	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
23	R	87	2.4	0.256	16.8	LOS B	1.3	9.3	0.69	0.89	41.1
Approach		709	2.5	0.324	2.1	LOS B	1.3	9.3	0.08	0.11	56.8
North East: Coombes Dr Stage 2 (N)											
26	R	20	10.5	0.083	22.1	LOS B	0.3	2.7	0.73	0.92	37.6
Approach		20	10.5	0.083	22.1	LOS B	0.3	2.7	0.73	0.92	37.6
North: Coombes Dr (N)											
7	L	48	10.9	0.096	11.5	LOS A	0.4	3.2	0.58	0.81	39.4
9	R	20	10.5	0.075	20.3	LOS B	0.3	2.5	0.70	0.91	34.9
Approach		68	10.8	0.096	14.0	LOS B	0.4	3.2	0.61	0.84	37.9
North West: Coreen Ave (W)											
27	L	38	11.1	0.022	9.5	LOS A	0.0	0.0	0.00	0.69	48.1
28	T	576	1.8	0.299	1.2	LOS A	0.0	0.0	0.00	0.12	57.0
Approach		614	2.4	0.299	1.7	LOS A	0.0	0.0	0.00	0.15	56.3
All Vehicles		1412	3.0	0.324	2.8	NA	1.3	9.3	0.08	0.17	54.9

PM

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South East: Coreen Ave (E)											
22	T	581	2.9	0.304	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
23	R	43	4.9	0.197	23.2	LOS B	0.9	6.3	0.79	0.92	36.7
Approach		624	3.0	0.304	1.6	LOS B	0.9	6.3	0.05	0.06	57.5
North East: Coombes Dr Stage 2 (N)											
26	R	23	13.6	0.092	21.5	LOS B	0.4	3.1	0.72	0.91	38.0
Approach		23	13.6	0.092	21.5	LOS B	0.4	3.1	0.72	0.91	38.0
North: Coombes Dr (N)											
7	L	125	0.8	0.289	14.2	LOS A	1.4	10.2	0.71	0.92	37.2
9	R	23	13.6	0.140	30.0	LOS C	0.6	4.5	0.82	0.95	30.3
Approach		148	2.8	0.289	16.6	LOS C	1.4	10.2	0.73	0.93	35.9
North West: Coreen Ave (W)											
27	L	18	5.9	0.010	9.3	LOS A	0.0	0.0	0.00	0.69	48.1
28	T	832	1.6	0.431	1.2	LOS A	0.0	0.0	0.00	0.12	57.0
Approach		849	1.7	0.431	1.4	LOS A	0.0	0.0	0.00	0.13	56.7
All Vehicles		1645	2.5	0.431	3.1	NA	1.4	10.2	0.10	0.19	53.9

Intersection movement summary in 2016 Base + Other Development without upgrades

Coreen Ave / Commuter Car Park Access

AM

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Penrith Car Park Access											
1	L	21	0.0	0.060	10.3	LOS A	0.4	2.8	0.57	0.68	46.5
3	R	28	0.0	0.060	13.3	LOS A	0.4	2.8	0.57	0.74	44.2
Approach		49	0.0	0.060	12.0	LOS A	0.4	2.8	0.57	0.72	45.2
East: Coreen Ave (E)											
4	L	120	2.6	0.484	9.2	LOS A	4.9	35.4	0.51	0.65	47.5
5	T	449	2.8	0.483	8.4	LOS A	4.9	35.4	0.51	0.59	47.6
6	R	1	0.0	0.526	13.7	LOS A	4.9	35.4	0.51	0.77	44.5
Approach		571	2.8	0.484	8.6	LOS A	4.9	35.4	0.51	0.61	47.6
West: Coreen Ave (W)											
11	T	436	2.9	0.392	7.3	LOS A	4.2	30.2	0.21	0.52	49.2
12	R	143	2.9	0.392	11.1	LOS A	4.2	30.2	0.21	0.75	46.1
Approach		579	2.9	0.392	8.2	LOS A	4.2	30.2	0.21	0.58	48.4
All Vehicles		1199	2.7	0.526	8.6	LOS A	4.9	35.4	0.36	0.60	47.8

PM

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Penrith Car Park Access											
1	L	121	0.9	0.288	11.7	LOS A	2.1	14.9	0.68	0.80	45.2
3	R	105	1.0	0.288	14.7	LOS B	2.1	14.9	0.68	0.85	43.1
Approach		226	0.9	0.288	13.1	LOS B	2.1	14.9	0.68	0.82	44.2
East: Coreen Ave (E)											
4	L	32	3.3	0.405	8.2	LOS A	4.4	31.4	0.25	0.61	48.5
5	T	549	2.3	0.407	7.3	LOS A	4.4	31.4	0.25	0.53	49.0
6	R	1	0.0	0.351	12.6	LOS A	4.4	31.4	0.25	0.81	45.1
Approach		582	2.4	0.407	7.4	LOS A	4.4	31.4	0.25	0.53	48.9
West: Coreen Ave (W)											
11	T	721	2.3	0.604	8.2	LOS A	8.0	57.5	0.56	0.57	47.4
12	R	40	2.6	0.606	12.1	LOS A	8.0	57.5	0.56	0.70	45.8
Approach		761	2.4	0.604	8.4	LOS A	8.0	57.5	0.56	0.57	47.3
All Vehicles		1569	2.1	0.606	8.7	LOS A	8.0	57.5	0.46	0.60	47.4

Intersection movement summary in 2016 Base + Other Development with upgrades

Castlereagh Rd / Coreen Ave

AM

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Castlereagh Rd (S)											
1	L	81	9.1	0.396	23.6	LOS B	16.9	124.8	0.52	0.94	37.6
2	T	1402	5.9	0.397	12.6	LOS A	17.1	125.6	0.52	0.46	41.8
3	R	278	6.1	0.846	50.0	LOS D	11.6	85.6	0.99	0.86	25.2
Approach		1761	6.1	0.846	19.0	LOS B	17.1	125.6	0.59	0.55	37.4
East: Coreen Ave (E)											
4	L	134	18.1	0.813	80.8	LOS F	11.5	92.6	1.00	0.90	18.4
5	T	97	3.3	0.507	66.2	LOS E	8.1	58.6	0.99	0.78	19.5
6	R	152	11.1	0.881	86.2	LOS F	13.2	100.9	1.00	0.98	17.8
Approach		382	11.6	0.881	79.2	LOS F	13.2	100.9	1.00	0.90	18.4
North: Castlereagh Rd (N)											
7	L	436	4.3	0.372	9.3	LOS A	7.0	50.9	0.25	0.63	47.5
8	T	2515	5.5	0.836	30.9	LOS C	48.3	353.8	0.92	0.85	29.7
9	R	48	19.6	0.803	88.6	LOS F	5.1	41.5	1.00	0.87	17.3
Approach		2999	5.6	0.836	28.7	LOS C	48.3	353.8	0.83	0.82	31.2
West: Mullins Rd (W)											
10	L	38	5.6	0.424	81.7	LOS F	3.8	28.0	1.00	0.73	18.4
11	T	29	7.1	0.757	78.0	LOS F	6.6	49.6	1.00	0.85	16.6
12	R	38	11.1	0.757	85.2	LOS F	6.6	49.6	1.00	0.85	18.3
Approach		105	8.0	0.757	81.9	LOS F	6.6	49.6	1.00	0.81	17.9
All Vehicles		5247	6.2	0.881	30.2	LOS C	48.3	353.8	0.76	0.73	30.8

PM

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Castlereagh Rd (S)											
1	L	93	3.4	0.848	45.2	LOS D	46.8	335.8	0.94	0.96	28.7
2	T	2385	2.8	0.847	33.1	LOS C	47.0	337.3	0.94	0.89	28.7
3	R	256	7.8	0.778	40.8	LOS C	8.1	60.4	0.99	0.83	28.1
Approach		2734	3.3	0.847	34.2	LOS C	47.0	337.3	0.95	0.89	28.6
East: Coreen Ave (E)											
4	L	207	3.0	0.746	62.6	LOS E	14.1	101.1	0.96	0.86	21.9
5	T	117	6.3	0.324	49.0	LOS D	8.1	59.9	0.91	0.73	23.5
6	R	299	3.9	0.860	71.3	LOS F	21.4	154.6	1.00	0.95	20.4
Approach		623	4.1	0.860	64.2	LOS E	21.4	154.6	0.97	0.88	21.4
North: Castlereagh Rd (N)											
7	L	237	2.7	0.196	9.4	LOS A	3.7	26.8	0.24	0.63	47.5
8	T	1484	3.3	0.678	36.8	LOS C	26.7	192.3	0.90	0.80	27.4
9	R	55	5.8	0.642	78.8	LOS F	5.1	37.4	1.00	0.79	18.9
Approach		1776	3.3	0.678	34.5	LOS C	26.7	192.3	0.82	0.78	28.7
West: Mullins Rd (W)											
10	L	95	2.2	0.612	73.0	LOS F	7.8	55.4	1.00	0.79	19.9
11	T	79	2.7	0.851	72.3	LOS F	11.1	79.6	1.00	0.95	17.7
12	R	56	3.8	0.852	80.7	LOS F	11.1	79.6	1.00	0.95	19.3
Approach		229	2.8	0.851	74.6	LOS F	11.1	79.6	1.00	0.88	19.0
All Vehicles		5362	3.4	0.860	39.5	LOS C	47.0	337.3	0.91	0.85	26.9

Intersection movement summary in 2016 Base + Other Development with upgrades

Castlereagh Rd / Peachtree Rd

AM

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Castlereagh Rd (S)											
1	L	112	5.7	0.594	19.9	LOS B	14.0	102.6	0.34	0.99	39.8
2	T	1581	5.3	0.593	8.7	LOS A	14.1	103.4	0.34	0.30	46.2
Approach		1693	5.3	0.593	9.4	LOS A	14.1	103.4	0.34	0.35	45.6
East: Peachtree Rd (E)											
4	L	11	0.0	0.142	87.1	LOS F	1.2	8.5	0.99	0.67	17.6
Approach		11	0.0	0.142	87.1	LOS F	1.2	8.5	0.99	0.67	17.6
North: Castlereagh Rd (N)											
7	L	21	0.0	0.035	13.5	LOS A	0.6	4.3	0.27	0.69	43.7
8	T	2734	3.8	0.726	17.5	LOS B	42.6	308.0	0.71	0.66	37.6
9	R	116	3.6	0.564	77.2	LOS F	9.9	71.7	0.99	0.80	19.2
Approach		2871	3.8	0.726	19.9	LOS B	42.6	308.0	0.72	0.67	36.1
West: Peachtree Rd (W)											
10	L	36	8.8	0.240	62.8	LOS E	3.2	24.0	0.87	0.71	21.8
12	R	38	8.3	0.120	62.7	LOS E	3.4	25.2	0.87	0.72	21.9
Approach		74	8.6	0.240	62.8	LOS E	3.4	25.2	0.87	0.72	21.9
All Vehicles		4647	4.4	0.726	16.9	LOS B	42.6	308.0	0.58	0.55	38.5

PM

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Castlereagh Rd (S)											
1	L	73	2.9	0.833	24.7	LOS B	29.4	211.1	0.64	1.04	37.8
2	T	2241	3.0	0.833	12.4	LOS A	29.5	212.0	0.64	0.59	41.6
Approach		2314	3.0	0.833	12.8	LOS A	29.5	212.0	0.64	0.61	41.5
East: Peachtree Rd (E)											
4	L	11	0.0	0.123	75.7	LOS F	1.1	7.4	0.99	0.67	19.4
Approach		11	0.0	0.123	75.7	LOS F	1.1	7.4	0.99	0.67	19.4
North: Castlereagh Rd (N)											
7	L	21	0.0	0.036	15.0	LOS B	0.6	4.5	0.33	0.69	42.5
8	T	1784	2.9	0.525	16.5	LOS B	22.6	162.5	0.64	0.58	38.4
9	R	86	2.4	0.769	79.1	LOS F	7.6	54.0	1.00	0.87	18.9
Approach		1892	2.8	0.768	19.4	LOS B	22.6	162.5	0.65	0.59	36.6
West: Peachtree Rd (W)											
10	L	155	2.7	0.833	65.6	LOS E	11.3	80.8	0.90	0.91	21.3
12	R	140	3.0	0.345	53.7	LOS D	9.2	66.2	0.89	0.79	24.2
Approach		295	2.9	0.832	60.0	LOS E	11.3	80.8	0.89	0.85	22.6
All Vehicles		4511	2.9	0.833	18.8	LOS B	29.5	212.0	0.66	0.62	37.1

Intersection movement summary in 2016 Base + Other Development without upgrades

Castlereagh Rd / Jane St

AM

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Jane St (E)											
4	L	113	5.6	0.087	20.0	LOS B	3.4	24.7	0.51	0.66	34.9
6	R	137	6.2	0.177	41.6	LOS C	5.3	39.4	0.78	0.74	26.1
Approach		249	5.9	0.177	31.8	LOS C	5.3	39.4	0.66	0.70	29.4
North: Castlereagh Rd (N)											
7	L	516	5.9	0.899	25.3	LOS B	12.7	93.2	0.24	0.72	34.5
8	T	1906	6.0	1.385	391.0	LOS F	169.9	1250.7	1.00	2.02	5.1
Approach		2422	6.0	1.385	313.1	LOS F	169.9	1250.7	0.84	1.74	6.2
South West: Castlereagh Rd (S)											
31	T	1625	6.0	0.702	9.4	LOS A	8.7	64.3	0.16	0.64	47.9
32	R	446	5.9	0.626	46.0	LOS D	12.8	93.9	0.89	0.80	24.6
Approach		2072	6.0	0.702	17.2	LOS B	12.8	93.9	0.32	0.68	39.8
All Vehicles		4743	6.0	1.385	169.1	LOS F	169.9	1250.7	0.60	1.22	10.5

PM

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Jane St (E)											
4	L	409	3.1	0.312	21.7	LOS B	11.4	81.9	0.58	0.71	33.9
6	R	572	2.9	0.723	48.5	LOS D	20.8	149.3	0.92	0.85	24.0
Approach		981	3.0	0.723	37.3	LOS C	20.8	149.3	0.78	0.79	27.4
North: Castlereagh Rd (N)											
7	L	345	3.0	0.689	7.9	LOS A	3.2	22.9	0.13	0.61	48.2
8	T	1485	3.0	1.059	106.4	LOS F	70.1	502.9	1.00	1.23	15.2
Approach		1831	3.0	1.059	87.8	LOS F	70.1	502.9	0.84	1.11	17.4
South West: Castlereagh Rd (S)											
31	T	1962	3.0	0.832	9.6	LOS A	14.9	106.9	0.26	0.68	47.6
32	R	272	3.1	0.374	43.5	LOS D	7.8	56.0	0.80	0.76	25.3
Approach		2234	3.0	0.832	13.7	LOS A	14.9	106.9	0.33	0.69	43.0
All Vehicles		5045	3.0	1.059	45.2	LOS D	70.1	502.9	0.60	0.86	26.2

Intersection movement summary in 2016 Base + Other Development without upgrades

Castlereagh Rd / Great Western Hwy / Mulgoa Rd

AM

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Mulgoa Rd (S)											
1	L	193	4.9	0.389	43.5	LOS D	11.5	84.0	0.75	0.78	27.6
2	T	944	5.0	0.682	42.7	LOS D	29.3	213.7	0.91	0.80	26.5
3	R	169	5.0	0.945	103.0	LOS F	16.2	118.3	1.00	1.03	15.1
Approach		1306	5.0	0.945	50.7	LOS D	29.3	213.7	0.90	0.83	24.4
East: Great Western Hwy (E)											
4	L	60	5.3	0.270	56.2	LOS D	9.3	67.9	0.82	0.91	22.5
5	T	206	5.1	0.270	48.4	LOS D	9.3	67.9	0.84	0.72	22.9
6	R	72	4.4	0.994	121.6	LOS F	8.5	61.5	1.00	1.09	13.4
Approach		338	5.0	0.994	65.3	LOS E	9.3	67.9	0.87	0.83	19.8
North: Castlereagh Rd (N)											
7	L	96	5.5	1.204	236.4	LOS F	124.4	909.0	1.00	1.76	7.8
8	T	1559	5.0	1.203	228.8	LOS F	124.4	909.0	1.00	1.76	8.1
9	R	399	5.0	1.113	190.5	LOS F	25.2	183.9	1.00	1.23	9.7
Approach		2054	5.0	1.203	221.7	LOS F	124.4	909.0	1.00	1.65	8.4
North West: Bus Lane											
28	T	5	100.0	0.111	88.8	LOS F	0.6	8.2	0.99	0.66	18.5
Approach		5	100.0	0.111	88.8	LOS F	0.6	8.2	0.99	0.66	18.5
West: Great Western Hwy (W)											
10	L	1019	5.0	1.191	200.5	LOS F	110.2	804.3	1.00	1.31	9.3
11	T	695	5.0	1.109	184.8	LOS F	91.8	669.8	1.00	1.56	9.3
12	R	215	5.0	1.000 [3]	115.1	LOS F	21.0	153.3	1.00	1.05	14.5
Approach		1929	5.0	1.191	185.3	LOS F	110.2	804.3	1.00	1.37	9.7
All Vehicles		5633	5.1	1.204	160.1	LOS F	124.4	909.0	0.97	1.32	10.9

PM

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Mulgoa Rd (S)											
1	L	401	2.9	0.824	58.0	LOS E	27.1	194.1	0.91	0.89	23.4
2	T	1522	3.0	1.170	234.3	LOS F	113.1	812.0	1.00	1.77	8.0
3	R	168	3.1	0.818	84.1	LOS F	14.5	103.9	1.00	0.90	17.5
Approach		2092	3.0	1.170	188.4	LOS F	113.1	812.0	0.98	1.53	9.6
East: Great Western Hwy (E)											
4	L	201	3.1	1.140	174.3	LOS F	68.6	492.8	1.00	1.30	10.2
5	T	898	3.0	1.140	195.1	LOS F	74.7	536.2	1.00	1.51	9.0
6	R	128	3.0	1.171	251.5	LOS F	19.2	137.9	1.00	1.44	7.5
Approach		1226	3.0	1.171	197.6	LOS F	74.7	536.2	1.00	1.47	9.0
North: Castlereagh Rd (N)											
7	L	101	3.1	1.113	162.8	LOS F	90.2	648.1	1.00	1.47	10.7
8	T	1325	3.0	1.114	155.4	LOS F	90.2	648.1	1.00	1.43	11.1
9	R	444	3.1	1.077	159.3	LOS F	25.6	183.7	1.00	1.16	11.2
Approach		1869	3.0	1.114	156.7	LOS F	90.2	648.1	1.00	1.37	11.1
North West: Bus Lane											
28	T	1	100.0	0.022	86.8	LOS F	0.1	1.6	0.98	0.60	18.8
Approach		1	100.0	0.022	86.8	LOS F	0.1	1.6	0.98	0.60	18.8
West: Great Western Hwy (W)											
10	L	292	2.9	0.322	47.3	LOS D	12.0	86.4	0.78	0.78	26.3
11	T	606	3.1	0.989	99.1	LOS F	59.8	429.8	1.00	1.16	15.0
12	R	254	3.0	1.000 [3]	89.1	LOS F	21.3	153.1	1.00	0.90	17.5
Approach		1152	3.0	1.000	83.8	LOS F	59.8	429.8	0.94	1.01	17.6
All Vehicles		6340	3.0	1.171	161.8	LOS F	113.1	812.0	0.98	1.38	10.8

Intersection movement summary in 2016 Base + Other Development + North Penrith Development with upgrades

Parker St / Coreen Ave / Richmond Rd

AM

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Parker St (S)											
1	L	172	4.9	0.307	9.3	LOS A	1.2	8.4	0.07	0.59	51.9
2	T	1132	5.7	0.885	54.6	LOS D	28.1	206.0	1.00	0.94	23.6
3	R	214	1.5	1.023	119.0	LOS F	21.6	152.8	1.00	1.07	14.1
Approach		1517	5.0	1.023	58.5	LOS E	28.1	206.0	0.89	0.92	22.8
East: Oxford St (E)											
4	L	80	6.6	1.000 [3]	78.0	LOS F	7.1	52.8	0.98	0.76	18.9
5	T	184	1.7	0.967	102.0	LOS F	18.1	128.6	1.00	1.11	14.5
6	R	63	5.0	0.513	76.8	LOS F	5.9	43.3	0.97	0.75	19.4
Approach		327	3.5	1.000	91.5	LOS F	18.1	128.6	0.99	0.96	16.2
North: Richmond Rd (N)											
7	L	1	0.0	0.863	69.9	LOS E	69.0	501.3	1.00	1.16	23.0
8	T	2491	4.4	1.011	61.5	LOS E	79.7	578.7	1.00	1.15	21.9
9	R	561	2.1	0.893	47.0	LOS D	29.6	210.5	0.80	0.85	26.9
Approach		3053	3.9	1.011	58.8	LOS E	79.7	578.7	0.96	1.10	22.7
West: Coreen Ave (W)											
10	L	74	4.3	0.096	14.5	LOS B	2.1	15.5	0.44	0.67	39.6
11	T	101	0.0	0.266	55.0	LOS D	7.9	55.4	0.89	0.71	22.0
12	R	193	4.9	0.555	66.5	LOS E	14.3	104.3	0.96	0.82	21.0
Approach		367	3.4	0.555	52.9	LOS D	14.3	104.3	0.83	0.76	23.5
All Vehicles		5264	4.2	1.023	60.4	LOS E	79.7	578.7	0.94	1.01	22.2

PM

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Parker St (S)											
1	L	169	3.7	0.272	8.7	LOS A	1.0	7.0	0.06	0.59	52.7
2	T	2340	3.1	1.093	132.9	LOS F	93.0	668.1	1.00	1.44	12.5
3	R	65	8.1	0.398	73.4	LOS F	5.9	44.5	0.94	0.75	19.9
Approach		2575	3.2	1.093	123.2	LOS F	93.0	668.1	0.94	1.36	13.3
East: Oxford St (E)											
4	L	65	4.8	0.895	97.7	LOS F	7.0	51.0	1.00	0.95	16.2
5	T	112	1.9	1.086	176.0	LOS F	14.7	104.4	1.00	1.21	9.4
6	R	68	1.5	0.698	88.5	LOS F	6.9	48.9	1.00	0.82	17.6
Approach		245	2.6	1.086	130.8	LOS F	14.7	104.4	1.00	1.03	12.6
North: Richmond Rd (N)											
7	L	1	0.0	0.514	44.7	LOS D	27.3	198.3	0.58	1.28	29.4
8	T	1373	4.2	0.630	23.6	LOS B	27.3	198.3	0.59	0.52	37.1
9	R	424	1.7	1.089	151.3	LOS F	31.3	222.7	0.98	1.08	11.5
Approach		1798	3.6	1.089	46.0	LOS D	31.3	222.7	0.66	0.62	26.6
West: Coreen Ave (W)											
10	L	629	2.0	0.359	24.1	LOS B	9.3	66.1	0.56	0.73	33.9
11	T	177	1.2	1.091	171.1	LOS F	74.3	527.7	1.00	1.34	9.2
12	R	239	3.5	0.593	55.2	LOS D	15.8	113.7	0.88	0.81	23.4
Approach		1045	2.2	1.091	116.6	LOS F	74.3	527.7	0.88	1.10	13.5
All Vehicles		5663	3.1	1.093	97.4	LOS F	93.0	668.1	0.84	1.06	15.8

Intersection movement summary in 2016 Base + Other Development + North Penrith Development with upgrades

Parker St / Copeland St

AM

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Parker St (S)											
1	L	41	5.1	0.331	10.7	LOS A	3.1	22.2	0.08	1.36	51.4
2	T	1831	4.2	0.603	2.2	LOS A	7.9	57.0	0.12	0.11	64.6
3	R	344	4.3	1.092	114.2	LOS F	24.3	176.1	0.97	1.02	14.4
Approach		2216	4.2	1.092	19.7	LOS B	24.3	176.1	0.25	0.27	43.2
East: Copeland St (E)											
4	L	479	3.5	0.684	48.7	LOS D	29.3	211.4	0.90	0.86	24.9
5	T	98	3.2	0.285	57.3	LOS E	7.9	56.7	0.91	0.72	20.4
6	R	60	3.5	0.292	70.3	LOS E	5.4	39.2	0.93	0.77	20.2
Approach		637	3.5	0.684	52.0	LOS D	29.3	211.4	0.90	0.83	23.6
North: Parker St (N)											
7	L	53	4.0	0.997	44.1	LOS D	18.1	131.1	1.00	0.87	30.3
8	T	2687	3.8	1.152	183.9	LOS F	170.5	1232.2	1.00	1.60	10.5
9	R	41	2.6	0.422	86.7	LOS F	4.3	30.9	1.00	0.74	17.8
Approach		2781	3.7	1.152	179.8	LOS F	170.5	1232.2	1.00	1.57	10.7
West: Copeland St (W)											
10	L	20	5.3	0.105	8.2	LOS A	0.2	1.7	0.15	0.62	44.6
11	T	91	3.5	1.031	79.2	LOS F	12.9	93.4	0.92	0.83	16.7
12	R	81	3.9	1.030	148.0	LOS F	12.9	93.4	1.00	1.22	12.1
Approach		192	3.8	1.030	100.9	LOS F	12.9	93.4	0.87	0.97	15.2
All Vehicles		5825	3.9	1.152	102.4	LOS F	170.5	1232.2	0.70	0.98	16.5

PM

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Parker St (S)											
1	L	66	3.2	0.454	10.9	LOS A	4.8	34.5	0.10	1.30	51.2
2	T	2508	3.6	0.830	2.8	LOS A	18.2	131.6	0.23	0.21	62.8
3	R	459	3.9	0.869	40.9	LOS C	17.9	129.2	0.93	0.85	29.3
Approach		3034	3.6	0.869	8.8	LOS A	18.2	131.6	0.33	0.33	54.0
East: Copeland St (E)											
4	L	260	2.8	0.311	34.7	LOS C	13.3	95.3	0.67	0.79	29.3
5	T	49	2.1	0.148	56.5	LOS E	4.3	30.7	0.89	0.67	20.6
6	R	64	3.3	0.394	76.2	LOS F	6.0	43.3	0.97	0.77	19.2
Approach		374	2.8	0.394	44.7	LOS D	13.3	95.3	0.75	0.77	25.6
North: Parker St (N)											
7	L	43	2.4	0.877	54.3	LOS D	18.2	130.4	0.87	0.99	26.1
8	T	1811	3.2	0.876	44.6	LOS D	54.0	388.3	0.96	0.92	28.4
9	R	25	4.2	0.210	82.6	LOS F	2.7	19.5	0.98	0.72	18.5
Approach		1879	3.2	0.876	45.4	LOS D	54.0	388.3	0.96	0.92	28.1
West: Copeland St (W)											
10	L	56	1.9	0.281	10.8	LOS A	1.6	11.7	0.31	0.67	42.4
11	T	153	1.4	0.584	61.4	LOS E	12.4	88.4	0.95	0.76	19.5
12	R	43	2.4	0.584	70.6	LOS F	12.4	88.4	0.97	0.82	20.5
Approach		252	1.7	0.584	51.7	LOS D	12.4	88.4	0.81	0.75	22.6
All Vehicles		5538	3.3	0.877	25.6	LOS B	54.0	388.3	0.59	0.58	37.3

Intersection movement summary in 2016 Base + Other Development + North Penrith Development without upgrades

Parker St / Great Western Hwy

AM

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Parker St (S)											
1	L	467	4.1	0.414	23.6	LOS B	15.8	114.7	0.54	0.84	39.6
2	T	1157	4.0	0.725	38.5	LOS C	35.0	253.7	0.90	0.81	30.8
3	R	203	4.1	0.994	123.0	LOS F	20.7	149.9	1.00	1.09	14.2
Approach		1827	4.0	0.994	44.1	LOS D	35.0	253.7	0.82	0.85	28.8
East: Great Western Hwy (E)											
4	L	183	4.0	0.101	7.7	NA[9]	NA[9]	NA[9]	0.00	0.60	49.8
5	T	976	4.0	1.105	164.0	LOS F	52.1	377.0	0.99	1.33	10.6
6	R	208	4.0	1.016	135.2	LOS F	22.1	159.9	1.00	1.15	13.4
Approach		1367	4.0	1.105	138.7	LOS F	52.1	377.0	0.86	1.20	12.4
North: Parker St (N)											
7	L	1240	4.0	0.687	9.7	NA[9]	NA[9]	NA[9]	0.00	0.65	54.4
8	T	1747	4.0	1.097	130.7	LOS F	105.8	765.7	1.00	1.44	13.8
9	R	223	4.0	1.089	170.2	LOS F	26.4	191.5	1.00	1.15	10.9
Approach		3209	4.0	1.097	86.7	LOS F	105.8	765.7	0.61	1.12	19.0
West: Great Western Hwy (W)											
10	L	209	4.0	0.116	7.7	NA[9]	NA[9]	NA[9]	0.00	0.60	49.8
11	T	620	4.1	0.844	69.7	LOS E	24.3	175.9	1.00	0.96	19.9
12	R	146	4.3	0.716	81.2	LOS F	12.4	90.0	1.00	0.84	19.5
Approach		976	4.1	0.844	58.1	LOS E	24.3	175.9	0.79	0.86	22.8
All Vehicles		7380	4.0	1.105	82.0	LOS F	105.8	765.7	0.73	1.03	19.2

PM

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Parker St (S)											
1	L	344	3.1	0.380	33.9	LOS C	15.5	111.0	0.66	0.88	33.4
2	T	1624	3.0	1.274	325.4	LOS F	141.8	1017.8	1.00	2.08	6.4
3	R	129	3.3	1.070	172.9	LOS F	16.2	116.5	1.00	1.17	10.8
Approach		2098	3.0	1.274	268.2	LOS F	141.8	1017.8	0.94	1.82	7.6
East: Great Western Hwy (E)											
4	L	325	2.9	0.179	7.7	NA[9]	NA[9]	NA[9]	0.00	0.60	49.8
5	T	1847	3.0	1.298	204.6	LOS F	153.9	1105.3	0.97	0.58	17.7
6	R	164	3.0	1.127	218.6	LOS F	22.4	160.6	1.00	1.34	9.1
Approach		2336	3.0	1.298	178.2	LOS F	153.9	1105.3	0.84	0.64	18.3
North: Parker St (N)											
7	L	488	3.0	0.269	9.5	NA[9]	NA[9]	NA[9]	0.00	0.65	54.6
8	T	1475	3.0	1.161	196.3	LOS F	102.7	737.6	1.00	1.64	9.9
9	R	155	3.1	1.279	340.8	LOS F	26.6	191.5	1.00	1.41	5.9
Approach		2118	3.0	1.278	163.8	LOS F	102.7	737.6	0.77	1.40	11.6
West: Great Western Hwy (W)											
10	L	466	2.9	0.256	7.7	NA[9]	NA[9]	NA[9]	0.00	0.60	49.7
11	T	914	2.9	0.670	43.1	LOS D	28.6	205.3	0.91	0.80	26.2
12	R	156	3.0	1.073	175.5	LOS F	19.2	137.9	1.00	1.24	10.9
Approach		1537	2.9	1.074	45.8	LOS D	28.6	205.3	0.64	0.78	26.0
All Vehicles		8088	3.0	1.298	172.6	LOS F	153.9	1105.3	0.81	1.17	12.0

Intersection movement summary in 2016 Base + Other Development + North Penrith Development with upgrades

Coreen Ave / Coombes Dr

AM

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South East: Coreen Ave (E)											
22	T	695	2.6	0.362	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
23	R	87	2.4	0.290	19.2	LOS B	1.5	10.7	0.74	0.92	39.3
Approach		782	2.6	0.362	2.1	LOS B	1.5	10.7	0.08	0.10	56.7
North East: Coombes Dr Stage 2 (N)											
26	R	20	10.5	0.103	26.0	LOS B	0.4	3.2	0.79	0.94	35.2
Approach		20	10.5	0.102	26.0	LOS B	0.4	3.2	0.79	0.94	35.2
North: Coombes Dr (N)											
7	L	48	10.9	0.105	12.3	LOS A	0.5	3.5	0.62	0.84	38.8
9	R	20	10.5	0.085	22.6	LOS B	0.4	2.8	0.74	0.92	33.7
Approach		68	10.8	0.105	15.3	LOS B	0.5	3.5	0.66	0.87	37.1
North West: Coreen Ave (W)											
27	L	38	11.1	0.022	9.5	LOS A	0.0	0.0	0.00	0.69	48.1
28	T	645	2.0	0.335	1.2	LOS A	0.0	0.0	0.00	0.12	57.0
Approach		683	2.5	0.335	1.7	LOS A	0.0	0.0	0.00	0.15	56.4
All Vehicles		1554	3.0	0.362	2.8	NA	1.5	10.7	0.08	0.17	54.8

PM

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South East: Coreen Ave (E)											
22	T	661	2.7	0.345	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
23	R	43	4.9	0.236	27.8	LOS B	1.0	7.6	0.84	0.95	34.1
Approach		704	2.8	0.345	1.7	LOS B	1.0	7.6	0.05	0.06	57.3
North East: Coombes Dr Stage 2 (N)											
26	R	23	13.6	0.115	25.7	LOS B	0.5	3.7	0.78	0.93	35.4
Approach		23	13.6	0.115	25.7	LOS B	0.5	3.7	0.78	0.93	35.4
North: Coombes Dr (N)											
7	L	125	0.8	0.327	16.0	LOS B	1.6	11.6	0.76	0.96	36.0
9	R	23	13.6	0.170	35.4	LOS C	0.7	5.4	0.86	0.96	28.2
Approach		148	2.8	0.327	19.0	LOS C	1.6	11.6	0.78	0.96	34.5
North West: Coreen Ave (W)											
27	L	18	5.9	0.010	9.3	LOS A	0.0	0.0	0.00	0.69	48.1
28	T	921	1.7	0.477	1.2	LOS A	0.0	0.0	0.00	0.12	57.0
Approach		939	1.8	0.478	1.4	LOS A	0.0	0.0	0.00	0.13	56.8
All Vehicles		1815	2.4	0.477	3.2	NA	1.6	11.6	0.09	0.18	53.8

Intersection movement summary in 2016 Base + Other Development + North Penrith Development without upgrades

Coreen Ave / Commuter Car Park Access

AM

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Penrith Car Park Access											
1	L	21	0.0	0.062	10.6	LOS A	0.4	3.0	0.60	0.70	46.2
3	R	28	0.0	0.062	13.6	LOS A	0.4	3.0	0.60	0.75	44.0
Approach		49	0.0	0.062	12.3	LOS A	0.4	3.0	0.60	0.73	44.9
East: Coreen Ave (E)											
4	L	120	2.6	0.519	9.3	LOS A	5.5	39.6	0.53	0.65	47.4
5	T	494	3.0	0.519	8.5	LOS A	5.5	39.6	0.53	0.60	47.5
6	R	1	0.0	0.526	13.7	LOS A	5.5	39.6	0.53	0.77	44.4
Approach		615	2.9	0.518	8.7	LOS A	5.5	39.6	0.53	0.61	47.5
West: Coreen Ave (W)											
11	T	441	2.9	0.396	7.3	LOS A	4.3	30.7	0.21	0.52	49.1
12	R	143	2.9	0.395	11.1	LOS A	4.3	30.7	0.21	0.75	46.1
Approach		584	2.9	0.396	8.2	LOS A	4.3	30.7	0.21	0.58	48.4
All Vehicles		1248	2.8	0.526	8.6	LOS A	5.5	39.6	0.38	0.60	47.8

PM

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Penrith Car Park Access											
1	L	121	0.9	0.290	11.8	LOS A	2.1	15.1	0.68	0.81	45.1
3	R	105	1.0	0.290	14.7	LOS B	2.1	15.1	0.68	0.85	43.1
Approach		226	0.9	0.290	13.2	LOS B	2.1	15.1	0.68	0.83	44.1
East: Coreen Ave (E)											
4	L	32	3.3	0.410	8.2	LOS A	4.5	32.1	0.26	0.61	48.5
5	T	556	2.3	0.411	7.3	LOS A	4.5	32.1	0.26	0.53	49.0
6	R	1	0.0	0.351	12.6	LOS A	4.5	32.1	0.26	0.80	45.1
Approach		588	2.3	0.411	7.4	LOS A	4.5	32.1	0.26	0.53	48.9
West: Coreen Ave (W)											
11	T	760	2.4	0.633	8.3	LOS A	8.8	62.9	0.59	0.57	47.2
12	R	40	2.6	0.635	12.2	LOS A	8.8	62.9	0.59	0.70	45.7
Approach		800	2.4	0.633	8.5	LOS A	8.8	62.9	0.59	0.57	47.2
All Vehicles		1615	2.2	0.635	8.7	LOS A	8.8	62.9	0.48	0.59	47.3

Intersection movement summary in 2016 Base + Other Development + North Penrith Development with upgrades

Castlereagh Rd / Coreen Ave

AM

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Castlereagh Rd (S)											
1	L	81	9.1	0.410	25.2	LOS B	17.8	131.3	0.55	0.93	36.7
2	T	1402	5.9	0.411	14.2	LOS A	18.0	132.2	0.55	0.49	40.4
3	R	339	6.2	0.878	50.2	LOS D	13.9	102.4	0.99	0.89	25.1
Approach		1822	6.1	0.878	21.4	LOS B	18.0	132.2	0.63	0.58	35.9
East: Coreen Ave (E)											
4	L	171	15.4	0.892	86.8	LOS F	14.7	116.2	1.00	0.96	17.5
5	T	97	3.3	0.444	63.7	LOS E	8.0	57.5	0.98	0.77	20.0
6	R	164	10.9	0.834	80.4	LOS F	13.6	104.0	1.00	0.93	18.7
Approach		432	11.0	0.892	79.2	LOS F	14.7	116.2	0.99	0.91	18.4
North: Castlereagh Rd (N)											
7	L	437	4.3	0.395	10.1	LOS A	8.2	59.7	0.29	0.64	46.6
8	T	2528	5.5	0.890	42.1	LOS C	56.7	415.9	0.98	0.96	25.4
9	R	48	19.6	0.574	81.8	LOS F	4.8	39.4	1.00	0.76	18.3
Approach		3014	5.6	0.890	38.1	LOS C	56.7	415.9	0.88	0.91	27.2
West: Mullins Rd (W)											
10	L	38	5.6	0.495	83.6	LOS F	3.9	28.4	1.00	0.73	18.1
11	T	29	7.1	0.883	84.7	LOS F	6.8	51.8	1.00	0.94	15.7
12	R	38	11.1	0.883	92.0	LOS F	6.8	51.8	1.00	0.94	17.3
Approach		105	8.0	0.883	86.9	LOS F	6.8	51.8	1.00	0.86	17.1
All Vehicles		5373	6.2	0.892	36.7	LOS C	56.7	415.9	0.81	0.80	28.0

PM

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Castlereagh Rd (S)											
1	L	93	3.4	0.847	46.4	LOS D	49.4	354.4	0.94	0.95	28.2
2	T	2385	2.8	0.847	34.3	LOS C	49.6	355.9	0.94	0.88	28.2
3	R	329	7.0	0.780	47.0	LOS D	11.9	88.3	0.98	0.87	26.1
Approach		2807	3.3	0.847	36.2	LOS C	49.6	355.9	0.95	0.88	27.9
East: Coreen Ave (E)											
4	L	213	3.0	0.798	67.4	LOS E	15.4	110.6	0.95	0.88	20.9
5	T	117	6.3	0.301	50.6	LOS D	8.5	62.4	0.89	0.72	23.1
6	R	322	3.9	0.861	74.0	LOS F	24.2	175.1	1.00	0.95	19.9
Approach		652	4.0	0.861	67.7	LOS E	24.2	175.1	0.96	0.88	20.7
North: Castlereagh Rd (N)											
7	L	242	2.6	0.218	10.3	LOS A	4.7	33.3	0.27	0.64	46.6
8	T	1502	3.4	0.754	44.2	LOS D	30.6	220.1	0.96	0.84	24.8
9	R	55	5.8	0.691	85.2	LOS F	5.5	40.1	1.00	0.81	17.9
Approach		1799	3.3	0.754	40.9	LOS C	30.6	220.1	0.86	0.82	26.3
West: Mullins Rd (W)											
10	L	95	2.2	0.605	77.3	LOS F	8.2	58.5	1.00	0.79	19.1
11	T	79	2.7	0.840	76.4	LOS F	11.6	83.6	1.00	0.94	17.0
12	R	56	3.8	0.841	84.8	LOS F	11.6	83.6	1.00	0.94	18.6
Approach		229	2.8	0.840	78.8	LOS F	11.6	83.6	1.00	0.88	18.3
All Vehicles		5487	3.4	0.861	43.2	LOS D	49.6	355.9	0.92	0.86	25.7

Intersection movement summary in 2016 Base + Other Development + North Penrith Development with upgrades

Castlereagh Rd / Peachtree Rd

AM

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Castlereagh Rd (S)											
1	L	112	5.7	0.615	20.1	LOS B	14.9	108.9	0.35	1.00	39.7
2	T	1642	5.3	0.614	8.8	LOS A	15.0	109.8	0.35	0.32	46.0
Approach		1754	5.3	0.614	9.5	LOS A	15.0	109.8	0.35	0.36	45.5
East: Peachtree Rd (E)											
4	L	56	3.8	0.661	89.6	LOS F	5.8	42.1	1.00	0.79	17.2
Approach		56	3.8	0.661	89.6	LOS F	5.8	42.1	1.00	0.79	17.2
North: Castlereagh Rd (N)											
7	L	36	2.9	0.061	13.3	LOS A	1.0	7.5	0.28	0.66	43.7
8	T	2771	3.8	0.743	18.4	LOS B	44.6	322.1	0.73	0.68	36.9
9	R	116	3.6	0.600	78.5	LOS F	10.0	72.3	1.00	0.80	19.0
Approach		2922	3.8	0.743	20.7	LOS B	44.6	322.1	0.74	0.69	35.5
West: Peachtree Rd (W)											
10	L	36	8.8	0.240	62.8	LOS E	3.2	24.0	0.87	0.71	21.8
12	R	38	8.3	0.120	62.7	LOS E	3.4	25.2	0.87	0.72	21.9
Approach		74	8.6	0.240	62.8	LOS E	3.4	25.2	0.87	0.72	21.9
All Vehicles		4805	4.4	0.743	18.1	LOS B	44.6	322.1	0.60	0.57	37.6

PM

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Castlereagh Rd (S)											
1	L	73	2.9	0.848	24.6	LOS B	30.6	219.7	0.64	1.05	37.9
2	T	2315	3.0	0.846	12.3	LOS A	30.7	220.6	0.64	0.60	41.8
Approach		2387	3.0	0.846	12.6	LOS A	30.7	220.6	0.64	0.61	41.6
East: Peachtree Rd (E)											
4	L	73	2.9	0.742	79.7	LOS F	6.5	46.9	1.00	0.84	18.7
Approach		73	2.9	0.741	79.7	LOS F	6.5	46.9	1.00	0.84	18.7
North: Castlereagh Rd (N)											
7	L	38	0.0	0.063	14.4	LOS A	1.1	7.7	0.32	0.70	43.0
8	T	1789	2.9	0.519	15.9	LOS B	22.3	160.2	0.63	0.57	38.9
9	R	86	2.4	0.769	79.1	LOS F	7.6	54.0	1.00	0.87	18.9
Approach		1914	2.8	0.768	18.8	LOS B	22.3	160.2	0.64	0.58	37.1
West: Peachtree Rd (W)											
10	L	155	2.7	0.850	69.0	LOS E	11.6	82.9	0.91	0.92	20.6
12	R	140	3.0	0.371	55.7	LOS D	9.4	67.4	0.91	0.79	23.7
Approach		295	2.9	0.849	62.7	LOS E	11.6	82.9	0.91	0.86	22.0
All Vehicles		4668	2.9	0.850	19.3	LOS B	30.7	220.6	0.66	0.62	36.8

Intersection movement summary in 2016 Base + Other Development + North Penrith Development without upgrades

Castlereagh Rd / Jane St

AM

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Jane St (E)											
4	L	113	5.6	0.087	20.0	LOS B	3.4	24.7	0.51	0.66	34.9
6	R	146	5.8	0.188	41.7	LOS C	5.7	41.7	0.79	0.75	26.0
Approach		259	5.7	0.188	32.2	LOS C	5.7	41.7	0.67	0.71	29.3
North: Castlereagh Rd (N)											
7	L	554	6.1	0.930	24.7	LOS B	12.7	93.2	0.26	0.73	34.9
8	T	1906	6.0	1.385	391.0	LOS F	169.9	1250.7	1.00	2.02	5.1
Approach		2460	6.0	1.385	308.6	LOS F	169.9	1250.7	0.83	1.73	6.3
South West: Castlereagh Rd (S)											
31	T	1683	6.0	0.727	9.4	LOS A	9.6	70.3	0.18	0.65	47.9
32	R	446	5.9	0.626	46.0	LOS D	12.8	93.9	0.89	0.80	24.6
Approach		2129	6.0	0.727	17.1	LOS B	12.8	93.9	0.33	0.68	40.0
All Vehicles		4848	6.0	1.385	165.8	LOS F	169.9	1250.7	0.60	1.22	10.7

PM

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Jane St (E)											
4	L	409	3.1	0.312	21.7	LOS B	11.4	81.9	0.58	0.71	33.9
6	R	606	3.0	0.767	50.8	LOS D	22.7	163.0	0.94	0.88	23.5
Approach		1016	3.0	0.767	39.1	LOS C	22.7	163.0	0.79	0.81	26.8
North: Castlereagh Rd (N)											
7	L	357	2.9	0.712	8.2	LOS A	3.5	25.2	0.13	0.61	47.8
8	T	1485	3.0	1.059	106.4	LOS F	70.1	502.9	1.00	1.23	15.2
Approach		1842	3.0	1.059	87.4	LOS F	70.1	502.9	0.83	1.11	17.5
South West: Castlereagh Rd (S)											
31	T	1996	3.0	0.846	10.2	LOS A	16.4	118.0	0.28	0.69	47.0
32	R	272	3.1	0.374	43.5	LOS D	7.8	56.0	0.80	0.76	25.3
Approach		2267	3.0	0.846	14.2	LOS A	16.4	118.0	0.34	0.70	42.6
All Vehicles		5125	3.0	1.059	45.4	LOS D	70.1	502.9	0.61	0.87	26.1

Intersection movement summary in 2016 Base + Other Development + North Penrith Development without upgrades

Castlereagh Rd / Great Western Hwy / Mulgoa Rd

AM

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Mulgoa Rd (S)											
1	L	193	4.9	0.385	42.7	LOS D	11.4	83.2	0.75	0.78	27.9
2	T	973	5.0	0.690	42.2	LOS C	30.1	219.5	0.91	0.81	26.7
3	R	169	5.0	1.013	132.1	LOS F	18.2	132.9	1.00	1.13	12.5
Approach		1335	5.0	1.012	53.7	LOS D	30.1	219.5	0.90	0.84	23.6
East: Great Western Hwy (E)											
4	L	60	5.3	0.270	56.2	LOS D	9.3	67.9	0.82	0.91	22.5
5	T	206	5.1	0.270	48.4	LOS D	9.3	67.9	0.84	0.72	22.9
6	R	72	4.4	0.994	121.6	LOS F	8.5	61.5	1.00	1.09	13.4
Approach		338	5.0	0.994	65.3	LOS E	9.3	67.9	0.87	0.83	19.8
North: Castlereagh Rd (N)											
7	L	96	5.5	1.246	273.2	LOS F	140.8	1028.5	1.00	1.88	6.8
8	T	1647	5.0	1.245	265.5	LOS F	140.8	1028.5	1.00	1.87	7.1
9	R	380	4.9	1.134	209.5	LOS F	25.2	183.9	1.00	1.26	8.9
Approach		2122	5.0	1.245	255.9	LOS F	140.8	1028.5	1.00	1.76	7.4
North West: Bus Lane											
28	T	5	100.0	0.111	88.8	LOS F	0.6	8.2	0.99	0.66	18.5
Approach		5	100.0	0.111	88.8	LOS F	0.6	8.2	0.99	0.66	18.5
West: Great Western Hwy (W)											
10	L	1041	5.0	1.229	224.6	LOS F	120.5	879.6	1.00	1.36	8.5
11	T	695	5.0	1.109	184.8	LOS F	91.8	669.8	1.00	1.56	9.3
12	R	215	5.0	1.000 [3]	115.1	LOS F	21.0	153.3	1.00	1.05	14.5
Approach		1952	5.0	1.228	198.3	LOS F	120.5	879.6	1.00	1.40	9.2
All Vehicles		5752	5.1	1.246	178.1	LOS F	140.8	1028.5	0.97	1.37	10.0

PM

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Mulgoa Rd (S)											
1	L	401	2.9	0.818	56.5	LOS E	26.6	191.1	0.90	0.88	23.7
2	T	1545	3.0	1.165	229.7	LOS F	113.9	817.8	1.00	1.76	8.1
3	R	168	3.1	0.869	89.0	LOS F	14.9	107.3	1.00	0.94	16.8
Approach		2115	3.0	1.165	185.6	LOS F	113.9	817.8	0.98	1.53	9.7
East: Great Western Hwy (E)											
4	L	201	3.1	1.140	174.3	LOS F	68.6	492.8	1.00	1.30	10.2
5	T	898	3.0	1.140	195.1	LOS F	74.7	536.2	1.00	1.51	9.0
6	R	128	3.0	1.171	251.5	LOS F	19.2	137.9	1.00	1.44	7.5
Approach		1226	3.0	1.171	197.6	LOS F	74.7	536.2	1.00	1.47	9.0
North: Castlereagh Rd (N)											
7	L	101	3.1	1.152	193.2	LOS F	103.0	739.8	1.00	1.59	9.3
8	T	1400	3.0	1.151	185.8	LOS F	103.0	739.8	1.00	1.53	9.6
9	R	425	3.0	1.095	174.2	LOS F	25.6	183.7	1.00	1.19	10.4
Approach		1925	3.0	1.151	183.6	LOS F	103.0	739.8	1.00	1.46	9.8
North West: Bus Lane											
28	T	1	100.0	0.022	86.8	LOS F	0.1	1.6	0.98	0.60	18.8
Approach		1	100.0	0.022	86.8	LOS F	0.1	1.6	0.98	0.60	18.8
West: Great Western Hwy (W)											
10	L	308	3.1	0.341	47.6	LOS D	12.7	91.2	0.79	0.78	26.2
11	T	606	3.1	0.989	99.1	LOS F	59.8	429.8	1.00	1.16	15.0
12	R	254	3.0	1.000 [3]	89.1	LOS F	21.3	153.1	1.00	0.90	17.5
Approach		1168	3.1	1.000	83.3	LOS F	59.8	429.8	0.94	1.00	17.7
All Vehicles		6436	3.0	1.171	168.7	LOS F	113.9	817.8	0.98	1.40	10.4

Appendix 6: 2026 Future SIDRA Results

Intersection movement summary in 2026 Base + Other Development

Parker St / Coreen Ave / Richmond Rd

AM

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Parker St (S)											
1	L	146	5.0	1.044	81.4	LOS F	57.5	421.7	1.00	1.08	19.5
2	T	1267	5.7	1.045	86.2	LOS F	76.0	556.3	1.00	1.18	18.7
3	R	165	1.8	1.122	199.8	LOS F	21.5	152.9	1.00	1.20	9.3
Approach		1578	5.1	1.122	97.6	LOS F	76.0	556.3	1.00	1.18	17.0
East: Oxford St (E)											
4	L	94	6.7	0.529	79.7	LOS F	8.4	62.3	1.00	0.78	18.8
5	T	200	1.6	1.416	463.3	LOS F	54.1	386.2	1.00	1.94	4.3
6	R	68	4.6	1.417	471.4	LOS F	54.1	386.2	1.00	1.94	4.3
Approach		362	3.5	1.417	365.6	LOS F	54.1	386.2	1.00	1.64	5.4
North: Richmond Rd (N)											
7	L	1	0.0	1.273	406.3	LOS F	266.5	1934.9	1.00	2.39	5.0
8	T	2794	4.3	1.417	400.1	LOS F	280.5	2032.4	1.00	2.28	5.3
9	R	428	1.7	1.000 [3]	58.2	LOS E	31.8	225.9	1.00	0.87	23.5
Approach		3223	3.9	1.417	354.7	LOS F	280.5	2032.4	1.00	2.10	5.9
West: Coreen Ave (W)											
10	L	51	4.2	0.291	42.6	LOS D	4.4	31.7	0.92	0.78	27.1
11	T	109	0.0	0.918	69.5	LOS E	20.8	150.2	0.97	0.93	19.5
12	R	162	5.2	0.918	93.7	LOS F	20.8	150.2	1.00	1.06	16.9
Approach		322	3.3	0.917	77.5	LOS F	20.8	150.2	0.98	0.97	18.9
All Vehicles		5485	4.2	1.417	265.2	LOS F	280.5	2032.4	1.00	1.74	7.6

PM

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Parker St (S)											
1	L	138	3.8	1.469	444.8	LOS F	231.4	1663.5	1.00	2.09	4.5
2	T	2512	3.1	1.464	441.7	LOS F	266.3	1913.3	1.00	2.44	4.9
3	R	77	8.2	0.475	66.9	LOS E	6.2	46.2	0.95	0.77	21.2
Approach		2726	3.2	1.464	431.3	LOS F	266.3	1913.3	1.00	2.38	4.9
East: Oxford St (E)											
4	L	71	6.0	0.515	73.6	LOS F	6.0	44.4	1.00	0.77	19.8
5	T	121	1.7	1.337	382.4	LOS F	34.2	242.8	1.00	1.76	5.1
6	R	74	1.4	1.338	390.4	LOS F	34.2	242.8	1.00	1.76	5.2
Approach		265	2.8	1.337	302.5	LOS F	34.2	242.8	1.00	1.50	6.4
North: Richmond Rd (N)											
7	L	1	0.0	0.819	38.7	LOS C	44.2	320.9	0.81	1.06	31.0
8	T	1660	4.3	0.917	26.1	LOS B	44.9	323.7	0.81	0.81	36.8
9	R	210	1.5	1.238	291.3	LOS F	31.4	222.6	1.00	1.40	6.5
Approach		1871	3.7	1.238	55.8	LOS D	44.9	323.7	0.83	0.88	24.9
West: Coreen Ave (W)											
10	L	563	1.9	0.727	36.0	LOS C	28.1	199.8	0.89	0.86	28.9
11	T	192	1.1	1.461	490.2	LOS F	92.5	661.3	1.00	2.29	4.1
12	R	218	3.9	1.460	497.8	LOS F	92.5	661.3	1.00	2.52	4.3
Approach		1024	2.2	1.461	243.1	LOS F	92.5	661.3	0.94	1.51	8.4
All Vehicles		5886	3.2	1.469	273.2	LOS F	266.3	1913.3	0.94	1.70	7.4

Intersection movement summary in 2026 Base + Other Development

Parker St / Copeland St

AM

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Parker St (S)											
1	L	43	4.9	0.373	10.7	LOS A	3.3	24.0	0.08	1.36	51.4
2	T	2054	4.2	0.702	2.3	LOS A	10.1	73.3	0.15	0.14	64.0
3	R	233	4.2	1.131	172.5	LOS F	24.3	176.1	1.00	1.18	10.3
Approach		2331	4.2	1.131	19.5	LOS B	24.3	176.1	0.23	0.26	43.3
East: Copeland St (E)											
4	L	526	3.6	0.727	45.7	LOS D	30.5	220.1	0.91	0.87	25.7
5	T	107	3.9	0.618	59.0	LOS E	12.7	91.8	0.98	0.81	19.8
6	R	65	3.2	0.619	66.5	LOS E	12.7	91.8	0.98	0.82	21.2
Approach		699	3.6	0.727	49.7	LOS D	30.5	220.1	0.93	0.86	24.2
North: Parker St (N)											
7	L	55	3.8	1.004	43.1	LOS D	18.1	131.1	1.00	0.87	30.7
8	T	2847	3.8	1.273	276.9	LOS F	214.2	1547.7	1.00	2.00	7.4
9	R	45	4.7	0.588	85.4	LOS F	4.6	33.3	1.00	0.76	18.0
Approach		2947	3.8	1.273	269.6	LOS F	214.2	1547.7	1.00	1.96	7.6
West: Copeland St (W)											
10	L	22	4.8	0.550	58.4	LOS E	6.3	45.8	0.88	0.78	22.9
11	T	98	3.2	1.249	147.1	LOS F	21.4	154.1	0.92	1.02	10.7
12	R	92	3.4	1.247	319.3	LOS F	21.4	154.1	1.00	1.61	6.4
Approach		212	3.5	1.247	212.4	LOS F	21.4	154.1	0.95	1.25	8.6
All Vehicles		6188	3.9	1.273	148.6	LOS F	214.2	1547.7	0.70	1.17	12.4

PM

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Parker St (S)											
1	L	77	4.1	0.500	11.0	LOS A	5.2	37.5	0.10	1.28	51.0
2	T	2678	3.6	0.943	11.7	LOS A	45.1	325.7	0.45	0.47	49.7
3	R	474	3.8	1.000 [3]	42.1	LOS C	24.4	176.1	1.00	0.92	28.7
Approach		3228	3.7	1.000	16.1	LOS B	45.1	325.7	0.52	0.55	45.3
East: Copeland St (E)											
4	L	291	2.9	0.317	30.2	LOS C	13.4	96.3	0.63	0.79	31.1
5	T	55	3.8	0.913	88.5	LOS F	11.5	82.6	1.00	1.05	15.4
6	R	64	3.3	0.912	96.0	LOS F	11.5	82.6	1.00	1.05	16.6
Approach		409	3.1	0.912	48.3	LOS D	13.4	96.3	0.74	0.86	24.6
North: Parker St (N)											
7	L	45	2.3	1.004	51.5	LOS D	18.2	131.0	1.00	0.86	27.3
8	T	1887	3.2	1.005	89.7	LOS F	80.1	576.0	1.00	1.18	18.3
9	R	27	3.8	0.137	72.4	LOS F	2.6	19.0	0.94	0.73	20.3
Approach		1960	3.2	1.005	88.6	LOS F	80.1	576.0	1.00	1.17	18.4
West: Copeland St (W)											
10	L	61	1.7	0.431	65.2	LOS E	5.2	36.8	0.91	0.75	21.0
11	T	165	1.3	0.842	73.0	LOS F	17.3	122.7	1.00	0.98	17.5
12	R	47	2.2	0.843	80.5	LOS F	17.3	122.7	1.00	0.98	18.8
Approach		274	1.5	0.842	72.6	LOS F	17.3	122.7	0.98	0.93	18.5
All Vehicles		5872	3.4	1.005	45.2	LOS D	80.1	576.0	0.72	0.80	28.1

Intersection movement summary in 2026 Base + Other Development

Parker St / Great Western Hwy

AM

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Parker St (S)											
1	L	500	4.0	0.448	24.2	LOS B	16.6	119.9	0.57	0.85	39.2
2	T	1212	4.0	0.746	37.1	LOS C	35.8	259.3	0.91	0.82	31.4
3	R	199	4.0	1.067	168.1	LOS F	23.3	168.4	1.00	1.21	11.0
Approach		1912	4.0	1.068	47.4	LOS D	35.8	259.3	0.83	0.87	27.6
East: Great Western Hwy (E)											
4	L	194	3.8	0.107	7.7	NA[9]	NA[9]	NA[9]	0.00	0.60	49.8
5	T	1092	4.0	1.155	195.0	LOS F	63.5	459.5	0.99	1.45	9.2
6	R	187	3.9	1.074	172.6	LOS F	22.2	160.8	1.00	1.26	11.0
Approach		1473	3.9	1.155	167.5	LOS F	63.5	459.5	0.86	1.31	10.6
North: Parker St (N)											
7	L	1373	4.0	0.760	9.8	NA[9]	NA[9]	NA[9]	0.00	0.65	54.3
8	T	1832	4.0	1.132	158.0	LOS F	118.0	854.6	1.00	1.57	11.9
9	R	210	4.1	1.124	196.7	LOS F	26.4	191.6	1.00	1.21	9.6
Approach		3415	4.0	1.131	100.8	LOS F	118.0	854.6	0.60	1.18	17.0
West: Great Western Hwy (W)											
10	L	225	4.2	0.125	7.7	NA[9]	NA[9]	NA[9]	0.00	0.60	49.8
11	T	699	4.1	0.889	72.2	LOS F	27.7	200.4	1.00	1.02	19.5
12	R	157	4.0	0.900	92.9	LOS F	14.1	101.9	1.00	0.99	17.8
Approach		1081	4.1	0.900	61.7	LOS E	27.7	200.4	0.79	0.93	21.9
All Vehicles		7880	4.0	1.155	94.9	LOS F	118.0	854.6	0.73	1.09	17.3

PM

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Parker St (S)											
1	L	369	3.1	0.427	37.0	LOS C	17.0	122.4	0.70	0.90	31.9
2	T	1676	3.0	1.369	411.3	LOS F	163.8	1176.3	1.00	2.32	5.2
3	R	137	3.1	1.130	221.1	LOS F	19.1	137.3	1.00	1.26	8.7
Approach		2182	3.0	1.369	336.0	LOS F	163.8	1176.3	0.95	2.02	6.2
East: Great Western Hwy (E)											
4	L	343	3.1	0.189	7.7	NA[9]	NA[9]	NA[9]	0.00	0.60	49.8
5	T	2075	3.0	1.410	264.3	LOS F	199.8	1434.2	0.97	0.62	15.2
6	R	154	3.0	1.157	244.2	LOS F	22.4	160.6	1.00	1.39	8.2
Approach		2573	3.0	1.410	228.9	LOS F	199.8	1434.2	0.84	0.66	16.2
North: Parker St (N)											
7	L	519	3.0	0.285	9.6	NA[9]	NA[9]	NA[9]	0.00	0.65	54.6
8	T	1548	3.0	1.270	293.7	LOS F	129.8	932.0	1.00	1.96	7.0
9	R	155	2.9	1.278	340.9	LOS F	26.7	191.4	1.00	1.41	5.9
Approach		2222	3.0	1.278	230.7	LOS F	129.8	932.0	0.77	1.62	8.7
West: Great Western Hwy (W)											
10	L	498	3.0	0.274	7.7	NA[9]	NA[9]	NA[9]	0.00	0.60	49.7
11	T	1014	3.0	0.705	41.9	LOS C	31.7	227.5	0.91	0.81	26.6
12	R	147	3.1	1.101	196.8	LOS F	19.2	137.9	1.00	1.29	9.9
Approach		1659	3.0	1.101	45.3	LOS D	31.7	227.5	0.65	0.79	26.1
All Vehicles		8636	3.0	1.410	221.1	LOS F	199.8	1434.2	0.81	1.27	9.8

Intersection movement summary in 2026 Base + Other Development

Coreen Ave / Coombes Dr

AM

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South East: Coreen Ave (E)											
22	T	672	2.5	0.689	48.4	LOS D	26.2	187.0	1.00	0.00	24.6
23	R	95	2.2	0.686	55.9	LOS D	26.2	187.0	1.00	1.47	24.5
Approach		766	2.5	0.689	49.3	LOS D	26.2	187.0	1.00	0.18	24.6
North: Coombes Ave (N)											
7	L	53	12.0	0.675	76.2	LOS F	3.6	27.9	0.92	1.24	17.6
9	R	21	10.0	0.679	77.9	LOS F	3.6	27.9	0.92	1.17	18.1
Approach		74	11.4	0.677	76.7	LOS F	3.6	27.9	0.92	1.22	17.8
North West: Coreen Ave (W)											
27	L	42	12.5	0.345	9.6	LOS A	0.0	0.0	0.00	1.18	48.1
28	T	617	1.7	0.345	1.2	LOS A	0.0	0.0	0.00	0.11	57.0
Approach		659	2.4	0.345	1.7	LOS A	0.0	0.0	0.00	0.18	56.3
All Vehicles		1499	2.9	0.689	29.7	NA	26.2	187.0	0.56	0.23	31.6

PM

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South East: Coreen Ave (E)											
22	T	623	2.9	0.653	88.6	LOS F	30.3	217.8	1.00	0.00	16.9
23	R	46	4.5	0.652	96.2	LOS F	30.3	217.8	1.00	1.39	16.9
Approach		669	3.0	0.653	89.1	LOS F	30.3	217.8	1.00	0.10	16.9
North: Coombes Ave (N)											
7	L	136	0.8	1.281	388.2	LOS F	31.4	224.7	1.00	3.71	4.8
9	R	24	13.0	1.274	390.5	LOS F	31.4	224.7	1.00	2.99	5.0
Approach		160	2.6	1.282	388.5	LOS F	31.4	224.7	1.00	3.60	4.8
North West: Coreen Ave (W)											
27	L	19	5.6	0.474	9.3	LOS A	0.0	0.0	0.00	1.20	48.1
28	T	899	1.6	0.477	1.2	LOS A	0.0	0.0	0.00	0.11	57.0
Approach		918	1.7	0.477	1.4	LOS A	0.0	0.0	0.00	0.14	56.7
All Vehicles		1747	2.3	1.281	70.4	NA	31.4	224.7	0.47	0.44	19.6

Intersection movement summary in 2026 Base + Other Development

Coreen Ave / Commuter Car Park Access

AM

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Penrith Car Park Access											
1	L	23	0.0	0.067	10.5	LOS A	0.5	3.2	0.60	0.70	46.3
3	R	31	0.0	0.067	13.5	LOS A	0.5	3.2	0.60	0.75	44.0
Approach		54	0.0	0.067	12.2	LOS A	0.5	3.2	0.60	0.73	44.9
East: Coreen Ave (E)											
4	L	132	3.2	0.528	9.5	LOS A	5.7	40.7	0.55	0.65	47.3
5	T	484	2.8	0.529	8.7	LOS A	5.7	40.7	0.55	0.61	47.3
6	R	1	0.0	0.526	13.9	LOS A	5.7	40.7	0.55	0.77	44.3
Approach		617	2.9	0.529	8.8	LOS A	5.7	40.7	0.55	0.62	47.3
West: Coreen Ave (W)											
11	T	466	2.9	0.422	7.3	LOS A	4.7	33.8	0.23	0.52	49.1
12	R	155	2.7	0.422	11.1	LOS A	4.7	33.8	0.23	0.74	46.1
Approach		621	2.9	0.422	8.2	LOS A	4.7	33.8	0.23	0.57	48.3
All Vehicles		1292	2.8	0.529	8.7	LOS A	5.7	40.7	0.40	0.60	47.7

PM

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Penrith Car Park Access											
1	L	132	0.8	0.326	12.2	LOS A	2.5	17.4	0.72	0.83	44.7
3	R	115	0.9	0.327	15.1	LOS B	2.5	17.4	0.72	0.87	42.7
Approach		246	0.9	0.327	13.6	LOS B	2.5	17.4	0.72	0.85	43.8
East: Coreen Ave (E)											
4	L	34	3.1	0.437	8.2	LOS A	5.0	35.7	0.28	0.60	48.4
5	T	589	2.3	0.439	7.4	LOS A	5.0	35.7	0.28	0.53	48.8
6	R	1	0.0	0.526	12.6	LOS A	5.0	35.7	0.28	0.79	45.1
Approach		624	2.4	0.439	7.4	LOS A	5.0	35.7	0.28	0.53	48.8
West: Coreen Ave (W)											
11	T	778	2.3	0.660	8.5	LOS A	9.5	67.8	0.64	0.58	47.0
12	R	43	2.4	0.664	12.4	LOS A	9.5	67.8	0.64	0.69	45.7
Approach		821	2.3	0.660	8.7	LOS A	9.5	67.8	0.64	0.58	46.9
All Vehicles		1692	2.1	0.664	8.9	LOS A	9.5	67.8	0.52	0.60	47.1

Intersection movement summary in 2026 Base + Other Development

Castlereagh Rd / Coreen Ave

AM

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Castlereagh Rd (S)											
1	L	85	8.6	0.636	7.3	LOS A	8.2	60.2	0.67	0.61	48.4
2	T	1459	6.0	0.637	6.0	LOS A	8.2	60.2	0.67	0.53	48.2
3	R	293	6.1	0.638	12.8	LOS A	8.2	60.1	0.67	0.72	45.9
Approach		1837	6.1	0.637	7.1	LOS A	8.2	60.2	0.67	0.57	47.8
East: Coreen Ave (E)											
4	L	145	18.1	1.002	160.0	LOS F	14.4	116.2	1.00	1.73	11.2
5	T	104	3.0	1.797	764.1	LOS F	85.6	640.0	1.00	3.70	2.7
6	R	163	11.0	1.773	771.2	LOS F	85.6	640.0	1.00	3.65	2.9
Approach		413	11.5	1.782	554.3	LOS F	85.6	640.0	1.00	2.99	3.8
North: Castlereagh Rd (N)											
7	L	455	4.4	1.253	244.1	LOS F	224.2	1639.0	1.00	6.01	7.8
8	T	2594	5.5	1.254	242.9	LOS F	224.2	1639.0	1.00	6.01	7.9
9	R	51	18.8	1.263	251.0	LOS F	222.7	1638.2	1.00	5.81	8.3
Approach		3099	5.6	1.254	243.2	LOS F	224.2	1639.0	1.00	6.01	7.9
West: Mullins Rd (W)											
10	L	41	5.1	0.160	17.9	LOS B	1.1	7.9	0.91	0.95	40.4
11	T	32	6.7	0.275	18.1	LOS B	1.8	13.9	0.91	0.94	39.4
12	R	42	12.5	0.275	25.3	LOS B	1.8	13.9	0.91	0.98	37.2
Approach		115	8.3	0.275	20.7	LOS B	1.8	13.9	0.91	0.96	38.9
All Vehicles		5463	6.3	1.797	182.7	LOS F	224.2	1639.0	0.89	3.84	10.1

PM

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Castlereagh Rd (S)											
1	L	98	3.2	1.461	430.5	LOS F	323.4	2318.6	1.00	8.66	4.7
2	T	2456	2.8	1.464	429.9	LOS F	323.4	2318.6	1.00	8.41	4.7
3	R	269	7.8	1.465	437.8	LOS F	277.2	2004.4	1.00	8.00	5.0
Approach		2823	3.3	1.464	430.7	LOS F	323.4	2318.6	1.00	8.38	4.7
East: Coreen Ave (E)											
4	L	226	3.3	0.668	21.5	LOS B	5.5	39.6	0.94	1.10	37.8
5	T	127	6.6	0.903	34.8	LOS C	13.6	98.8	1.00	1.47	30.2
6	R	318	4.0	0.906	41.6	LOS C	13.6	98.8	1.00	1.47	29.5
Approach		672	4.2	0.906	33.5	LOS C	13.6	98.8	0.98	1.35	31.9
North: Castlereagh Rd (N)											
7	L	251	2.9	0.793	10.3	LOS A	12.8	92.1	0.84	0.84	47.4
8	T	1544	3.3	0.793	9.6	LOS A	12.8	92.1	0.85	0.85	47.0
9	R	58	5.5	0.793	17.4	LOS B	12.6	91.1	0.86	0.96	43.3
Approach		1853	3.4	0.793	9.9	LOS B	12.8	92.1	0.85	0.85	46.9
West: Mullins Rd (W)											
10	L	102	2.1	0.543	34.0	LOS C	4.1	29.4	0.97	1.08	31.1
11	T	85	2.5	0.484	22.6	LOS B	4.4	31.5	1.00	1.08	36.5
12	R	60	3.5	0.484	29.6	LOS C	4.4	31.5	1.00	1.08	35.1
Approach		247	2.6	0.542	29.0	LOS C	4.4	31.5	0.99	1.08	33.8
All Vehicles		5595	3.4	1.465	225.9	LOS F	323.4	2318.6	0.95	4.72	8.4

Intersection movement summary in 2026 Base + Other Development

Castlereagh Rd / Peachtree Rd

AM

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Castlereagh Rd (S)											
1	L	118	5.4	0.819	11.6	LOS A	15.6	114.1	0.25	1.00	46.6
2	T	1646	5.4	0.819	3.2	LOS A	15.7	114.8	0.25	0.23	53.9
Approach		1764	5.4	0.819	3.7	LOS A	15.7	114.8	0.25	0.28	53.3
East: Peachtree Rd (E)											
4	L	12	0.0	0.156	87.3	LOS F	1.3	9.3	0.99	0.68	17.6
Approach		12	0.0	0.156	87.3	LOS F	1.3	9.3	0.99	0.68	17.6
North: Castlereagh Rd (N)											
7	L	23	0.0	0.034	12.0	LOS A	0.6	4.0	0.23	0.68	45.1
8	T	2824	3.8	1.060	114.7	LOS F	167.4	1210.2	1.00	1.38	14.1
9	R	122	3.4	0.778	86.3	LOS F	11.1	79.7	1.00	0.87	17.8
Approach		2969	3.8	1.060	112.8	LOS F	167.4	1210.2	0.99	1.35	14.3
West: Peachtree Rd (W)											
10	L	38	8.3	0.267	70.1	LOS E	3.5	26.5	0.92	0.73	20.5
12	R	40	7.9	0.163	70.1	LOS E	3.7	27.8	0.92	0.74	20.5
Approach		78	8.1	0.267	70.1	LOS E	3.7	27.8	0.92	0.74	20.5
All Vehicles		4823	4.4	1.060	72.1	LOS F	167.4	1210.2	0.72	0.95	19.7

PM

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Castlereagh Rd (S)											
1	L	77	2.7	1.030	64.2	LOS E	118.8	853.3	1.00	1.20	22.6
2	T	2304	3.0	1.028	55.9	LOS D	119.2	855.8	1.00	1.20	22.8
Approach		2381	3.0	1.028	56.1	LOS D	119.2	855.8	1.00	1.20	22.7
East: Peachtree Rd (E)											
4	L	12	0.0	0.156	87.3	LOS F	1.3	9.3	0.99	0.68	17.6
Approach		12	0.0	0.156	87.3	LOS F	1.3	9.3	0.99	0.68	17.6
North: Castlereagh Rd (N)											
7	L	23	0.0	0.034	12.0	LOS A	0.6	4.0	0.23	0.68	45.1
8	T	1860	2.9	0.694	13.8	LOS A	38.9	279.0	0.64	0.59	41.6
9	R	91	2.3	0.929	102.7	LOS F	9.4	67.5	1.00	1.00	15.7
Approach		1974	2.8	0.929	17.8	LOS B	38.9	279.0	0.65	0.61	38.7
West: Peachtree Rd (W)											
10	L	147	2.6	1.000 [3]	74.4	LOS F	11.9	85.1	0.99	0.80	19.7
12	R	162	2.9	0.636	75.0	LOS F	13.0	93.0	1.00	0.82	19.6
Approach		309	2.7	1.000	74.7	LOS F	13.0	93.0	0.99	0.81	19.6
All Vehicles		4676	2.9	1.030	41.3	LOS C	119.2	855.8	0.85	0.92	27.2

Intersection movement summary in 2026 Base + Other Development

Castlereagh Rd / Jane St

AM

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Jane St (E)											
4	L	123	6.0	0.096	20.1	LOS B	3.7	27.0	0.51	0.66	34.9
6	R	148	5.7	0.191	41.7	LOS C	5.8	42.2	0.79	0.75	26.0
Approach		272	5.8	0.191	31.9	LOS C	5.8	42.2	0.66	0.71	29.4
North: Castlereagh Rd (N)											
7	L	532	5.9	0.917	25.4	LOS B	12.7	93.2	0.24	0.73	34.5
8	T	1962	6.0	1.426	427.4	LOS F	182.9	1346.0	1.00	2.10	4.7
Approach		2494	6.0	1.426	341.7	LOS F	182.9	1346.0	0.84	1.81	5.7
South West: Castlereagh Rd (S)											
31	T	1693	6.0	0.731	9.4	LOS A	9.7	71.3	0.18	0.65	47.9
32	R	472	6.0	0.662	46.4	LOS D	13.5	99.7	0.91	0.81	24.5
Approach		2164	6.0	0.731	17.5	LOS B	13.5	99.7	0.34	0.69	39.6
All Vehicles		4929	6.0	1.426	182.3	LOS F	182.9	1346.0	0.61	1.25	9.9

PM

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Jane St (E)											
4	L	445	3.1	0.339	22.0	LOS B	12.4	89.0	0.59	0.72	33.8
6	R	603	3.0	0.763	50.5	LOS D	22.5	161.7	0.94	0.88	23.5
Approach		1048	3.0	0.763	38.4	LOS C	22.5	161.7	0.79	0.81	27.0
North: Castlereagh Rd (N)											
7	L	363	2.9	0.724	8.7	LOS A	3.6	25.8	0.12	0.62	47.3
8	T	1546	3.0	1.102	141.6	LOS F	82.8	594.3	1.00	1.35	12.2
Approach		1909	3.0	1.102	116.3	LOS F	82.8	594.3	0.83	1.21	14.2
South West: Castlereagh Rd (S)											
31	T	2021	3.0	0.857	10.8	LOS A	17.8	128.1	0.29	0.70	46.4
32	R	285	3.0	0.392	43.7	LOS D	8.2	58.6	0.81	0.76	25.3
Approach		2306	3.0	0.857	14.8	LOS B	17.8	128.1	0.36	0.70	42.0
All Vehicles		5264	3.0	1.102	56.3	LOS D	82.8	594.3	0.62	0.91	23.1

Intersection movement summary in 2026 Base + Other Development

Castlereagh Rd / Great Western Hwy / Mulgoa Rd

AM

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Mulgoa Rd (S)											
1	L	202	5.2	0.405	43.0	LOS D	11.9	87.2	0.75	0.78	27.8
2	T	995	5.0	0.706	42.6	LOS D	31.0	226.4	0.92	0.81	26.5
3	R	166	4.8	1.066	168.5	LOS F	20.0	145.7	1.00	1.21	10.2
Approach		1363	5.0	1.066	58.0	LOS E	31.0	226.4	0.90	0.86	22.5
East: Great Western Hwy (E)											
4	L	63	5.0	0.275	55.4	LOS D	9.5	69.7	0.82	0.91	22.6
5	T	216	4.9	0.275	47.7	LOS D	9.5	69.7	0.83	0.72	23.1
6	R	77	5.5	1.075	175.1	LOS F	10.6	77.6	1.00	1.20	10.1
Approach		356	5.0	1.075	76.6	LOS F	10.6	77.6	0.87	0.86	18.0
North: Castlereagh Rd (N)											
7	L	100	5.3	1.258	283.5	LOS F	144.7	1056.6	1.00	1.91	6.6
8	T	1658	5.0	1.257	275.9	LOS F	144.7	1056.6	1.00	1.90	6.9
9	R	360	5.0	1.158	231.4	LOS F	25.2	183.9	1.00	1.31	8.2
Approach		2118	5.0	1.257	268.7	LOS F	144.7	1056.6	1.00	1.80	7.1
North West: Bus Lane											
28	T	5	100.0	0.111	88.8	LOS F	0.6	8.2	0.99	0.66	18.5
Approach		5	100.0	0.111	88.8	LOS F	0.6	8.2	0.99	0.66	18.5
West: Great Western Hwy (W)											
10	L	1065	5.0	1.241	232.8	LOS F	126.5	923.6	1.00	1.38	8.2
11	T	736	5.1	1.152	220.3	LOS F	105.9	773.4	1.00	1.69	8.0
12	R	215	5.1	1.000 [3]	115.1	LOS F	21.0	153.3	1.00	1.05	14.5
Approach		2016	5.1	1.241	215.7	LOS F	126.5	923.6	1.00	1.46	8.5
All Vehicles		5858	5.1	1.258	189.6	LOS F	144.7	1056.6	0.97	1.40	9.5

PM

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Mulgoa Rd (S)											
1	L	421	3.0	0.859	61.9	LOS E	29.7	212.9	0.91	0.92	22.4
2	T	1566	3.0	1.181	243.6	LOS F	118.8	853.2	1.00	1.81	7.7
3	R	177	3.0	0.973	112.0	LOS F	17.5	125.8	1.00	1.06	14.2
Approach		2164	3.0	1.181	197.5	LOS F	118.8	853.2	0.98	1.57	9.2
East: Great Western Hwy (E)											
4	L	211	3.0	1.168	197.5	LOS F	76.1	546.4	1.00	1.34	9.2
5	T	944	3.0	1.167	218.0	LOS F	82.8	594.1	1.00	1.58	8.2
6	R	128	2.9	1.168	252.0	LOS F	19.2	137.9	1.00	1.44	7.5
Approach		1282	3.0	1.168	218.0	LOS F	82.8	594.1	1.00	1.53	8.3
North: Castlereagh Rd (N)											
7	L	106	3.0	1.184	221.4	LOS F	112.9	810.7	1.00	1.69	8.2
8	T	1436	3.0	1.183	214.0	LOS F	112.9	810.7	1.00	1.62	8.5
9	R	405	2.9	1.114	191.1	LOS F	25.6	183.7	1.00	1.23	9.7
Approach		1947	3.0	1.183	209.6	LOS F	112.9	810.7	1.00	1.54	8.7
North West: Bus Lane											
28	T	1	100.0	0.022	86.8	LOS F	0.1	1.6	0.98	0.60	18.8
Approach		1	100.0	0.022	86.8	LOS F	0.1	1.6	0.98	0.60	18.8
West: Great Western Hwy (W)											
10	L	302	3.1	0.329	46.7	LOS D	12.4	89.0	0.78	0.78	26.5
11	T	649	2.9	1.039	130.2	LOS F	72.8	522.7	1.00	1.29	12.3
12	R	254	3.1	1.000 [3]	89.1	LOS F	21.3	153.1	1.00	0.90	17.5
Approach		1205	3.1	1.039	100.6	LOS F	72.8	522.7	0.94	1.08	15.4
All Vehicles		6600	3.0	1.184	187.3	LOS F	118.8	853.2	0.98	1.46	9.5