Carter Street Lidcombe
Urban Activation Precinct

Appendix D
Transport Assessment

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Carter Street Urban Activation Precinct

Transport Impact Assessment

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PARSONS BRINCKERHOFF

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Executive summary

The Carter Street Urban Activation Precinct (UAP) represents the last remaining redevelopment area within the Homebush Bay subregion. An opportunity exists to introduce new land uses in the form of infill development to leverage off the government investment in the subregion over the past 20 years. The success of adjacent commercial and residential development at Sydney Olympic Park and Newington demonstrates the opportunities that exist for the redevelopment of Carter Street based on sound planning and the delivery of a quality urban environment. The purpose of this report is to assess the transport requirements of the proposed rezoning and to suggest a range of measures to support the levels of growth proposed to the NSW Government for further assessment.

Carter Street UAP

The Carter Street UAP is being planned as a mixed land-use development, including residential, retail, employment and open space. The Department of Planning and Infrastructure (DP&I) has undertaken a planning process (of which this Transport Impact Assessment is a part) to determine the suitable mix of employment and residential population growth that the site can accommodate.

The maximum development is envisaged to consist of up to:

- 5,500 dwellings accommodating approximately 11,000 residents
- 170,000 m^2 GFA employment floor space providing approximately 8,500 employees
- 12,000 m^2 GFA retail floor space.

However, due to property cycles and multiple land parcel ownerships, the anticipated amount of employment land redevelopment is approximately 65% of 170,000 m^2 GFA, i.e. approximately 111,000 m^2 GFA.

There would be four main access intersections to the Carter Street UAP:

1. Hill Road and Carter Street
2. Hill Road and John Ian Wing Parade
3. Birnie Avenue and Carter Street
4. Edwin Flack Avenue, Dawn Fraser Avenue and Uhrig Road.

The Carter Street UAP will be a staged development, based on the timing of land sale/end of lease for each land owner. The estimated earliest year for the occupation of the first buildings is 2015, with the last block anticipated to be released by 2035. An indicative staging plan was developed in conjunction with the structure plan to assist planning of the progression of the development, whilst providing a level of flexibility to adapt to market opportunities if required. It is envisaged that the residential and retail areas are likely to commence development before the employment areas.

This staging of development has implications for the road network in terms of connectivity. The large lot that would enable the construction of one element of the internal road network – the John Ian Wing Parade extension, may not become available for development until the end of the development timeframe. Alternative routes into the development have been planned for the affected traffic during this time. When this link is constructed, a heavy vehicle load limit will be required to protect the amenity of the adjacent residential areas.

Road network capacity

The Homebush Bay subregion has five main gateways that are all operating at or close to capacity, with long delays and queues during peak periods. The surrounding arterial roads: Parramatta Road, the M4 Western Motorway, Silverwater Road and Homebush Bay Drive, all experience peak period congestion. Some intersections are already operating with high levels of delay (e.g. Hill Road and Carter Street, Birnie Avenue and Carter Street). Others have limited spare capacity to accommodate future growth. Upgrades of the road network are likely to be needed to accommodate the growth planned for the Homebush Bay subregion.

The WestConnex project will increase the capacity of the M4 Western Motorway and will introduce a new eastbound on-ramp at Hill Road. Further road widening and intersection modifications are planned that will impact access to Carter Street UAP. Discussions are occurring with Sydney Motorway Project Office (SMPO) regarding these changes and the access needs of the Carter Street UAP.

Traffic volumes on Parramatta Road are expected to increase at a rate of around 2% per annum. However, this will be influenced by the WestConnex project. It is expected that both the M4 Western Motorway and Parramatta Road will continue to operate with significant volumes of traffic in 2031.

Future urban growth

The Homebush Bay subregion contains other urban renewal sites, which utilise the same set of gateway intersections to the arterial road network. These include Sydney Olympic Park, Wentworth Point (including the Wentworth Point UAP), Newington as well as nearby redevelopment of areas along Parramatta Road to the east and west.

Including the Carter Street UAP, the area is expected to experience an increase of 51,800 residents accommodated in 23,800 dwellings by 2035. This is in addition to an additional 75,000 m^2 GFA of retail floor space, and over 500,000 m^2 GFA commercial floor space. With a drop of around 270,000 m^2 industrial floor space, this results in a net increase of 29,900 workers.

The Parramatta Road corridor urban revitalisation project being planned by Urban Growth NSW in conjunction with the WestConnex project will provide the environment for 25,000 new jobs and 25,000 residences to be created over the next 20 years along Parramatta Road, including the areas adjacent to the Carter Street UAP.

Transport mode share

The Carter Street UAP has the potential to achieve a future transport mode share that minimises its impact on the congested road network and takes advantage of the other transport opportunities available. The overall future mode share varies by time of day and trip purpose, but is summarised for all purposes for the AM peak as:

- vehicle driver 52%
- vehicle passenger 14%
- train 9%
- ferry/light rail 5%
- bus 3%
- walk 16%
- cycle 1%.

Mode shares for the commuter journey to work of 65% car driver and passenger, and 35% non-car modes, are consistent with targets for other developments such as the Wentworth Point UAP and Sydney Olympic Park Master Plan 2030.

Public transport

The Olympic Park Line provides rail travel to/from the heart of the Homebush Bay subregion, but its use is limited by the need to change trains at Lidcombe. The subregion has bus services that could be increased in frequency and have route adjustments to improve coverage and patronage. The proposed Homebush Bay Bridge will allow the bus network to provide improved connection to Rhodes and its rail station.

Sydney Olympic Park Master Plan 2030 recognised the impact of the road network capacity on the ability to realise the development yield outlined in the plan. A cap on the amount of high trip generating commercial space was applied until a new high capacity public transport line(s) were opened to facilitate higher travel by non-car modes. Demand for public transport services in the corridor between Parramatta and the Homebush Bay subregion is expected to increase in the future. A new high-capacity service between these two areas would assist in unlocking the development potential of the area and contribute to the Carter Street UAP meeting its transport mode share targets.

Changes to the local bus network have been proposed to improve accessibility to, from and within the area for residents and workers. They are also designed to improve connections to surrounding rail stations, Sydney Olympic Park Ferry Wharf and movement between Carter Street UAP, Sydney Olympic Park and Wentworth Point UAP.

Walking and cycling

The Homebush Bay subregion has a network of high quality cycle and pedestrian paths, as part of the Sydney Olympic Park network. For the Carter Street UAP, additional connections through the Precinct are proposed to connect Carter Street UAP into the wider area and allow east-west routes to pass through the Precinct.

Restricted parking

The parking rates proposed for the Carter Street UAP are a combination of those in adopted in the Auburn Council DCP and Sydney Olympic Park Master Plan 2030, but are suggested as maximum rates. These rates are considered to be suitable as they are matched to the target mode share, which is based on the level of public transport available and the close proximity to surrounding employment and recreation opportunities.

Road upgrades

The performance of the road network has been assessed for future scenarios with the additional traffic generated by the Carter Street UAP and the other developments in the area using the SIDRA intersection modelling package. A set of road upgrades have been suggested and staged to match the rate of development. These road upgrades are outlined in Table ES.1.

This intersection modelling has assumed traffic growth on Parramatta Road and from additional development, but has not considered the impacts of the WestConnex project including the new ramp, changing levels of through traffic (rat-running), redistribution of trips due to congestion in the subregion, or the impact of queues from adjacent upstream intersections. Given the interaction of the traffic issues and the importance of the area as a growth area for Sydney, it is recommended that a wider traffic model be developed that can assess these complexities.

Compatibility with Sydney Olympic Park event operations

Currently, the industrial uses of the Carter Street UAP area are compatible with the traffic operation of the events held at the neighbouring Sydney Olympic Park due to low weeknight and weekend activity. When the UAP is developed, the residents and workers will need to be accommodated by the neighbouring event road closures and enforcement of on-street parking time limits. The Carter Street UAP can coexist with the major events held at Sydney Olympic Park, with minor changes to the existing traffic management plans.

It is recommended that the list of non-SOPA controlled roads over which SOPA has authority to prepare and implement traffic management (including closing or temporarily banning parking) under the SOPA Act (2001) be revised, such that streets that provide access to residences and businesses, such as Carter Street and Uhrig Road are removed, and new residential streets are not added.

Package of transport measures

A package of transport measures, listed in Table ES.1 has been identified to enhance the transport network and provide a balanced approach to reducing transport impacts. The recommendations made are suggestions to Government to support the Carter Street UAP. They require further investigation as part of a broader regional transport assessment. Recommendations for new traffic signals require further assessment to determine whether they meet RMS traffic signal warrants and are subject to approval by RMS.

Table ES.1 Summary of recommended strategic transport planning measures

Measures		Location in report
	Measures to assist area-wide transport issues	
Road 1	Investigate the subregional arterial road network capacity through wider-area traffic modelling to determine its future capacity based on recommended intersection upgrades such as those developed for SOP Master Plan 2030. This should also be informed by the proposals identified in the WestConnex project	5.3
Road 2	Investigate suggested road network improvements ■ Parramatta Road, Hill Road and Bombay Street ■ Parramatta Road and Birnie Avenue ■ Hill Road and Old Hill Link ■ Edwin Flack Avenue and Birnie Avenue	5.3
Road 3	Investigate design solutions to provide vehicle, pedestrian and cycle access to the Carter Street UAP and accommodate the requirements of the WestConnex project	5.4
Transport 1	Undertake further feasibility studies into the Sydney Olympic Park Line of the proposed Western Sydney Light Rail Network incorporating a link to Carter Street	4.3, 6.2
Transport 2	Review and improve bus service coverage, frequency and hours of operation	6.3
Transport 3	Cycle connection along Carter Street in parallel to M4 Western Motorway	6.5
Transport 4	Investigate options to run more direct train services to Olympic Park	6.1
	Precinct related transport improvements	
Road 4	Access intersection improvements ■ Hill Road and Carter Street: signalisation, upgrade ■ Hill Road and John Ian Wing Parade: modification of existing signals and upgrade ■ Edwin Flack Avenue, Dawn Fraser Avenue and Uhrig Road: signalisation ■ Birnie Avenue and Carter Street: signalisation, upgrade.	5.3

Measures		Location in report
Road 5	Internal intersection improvements ■ Carter Street and Uhrig Road: signalisation and upgrade to assist movement of pedestrians and buses	5.3
Transport 5	Bus stop infrastructure	6.3
Transport 6	Cycle links and public bike parking	6.5
Transport 7	Pedestrian network improvements including pedestrian signals on the M4 Motorway eastbound off-ramp at Hill Road, mid-block crossings of Carter Street and footpaths	6.6
Transport 8	New resident transport information packs	6.9
Transport 9	Workplace travel plans	6.9
Transport 10	Wayfinding and directional signage	6.9
Transport 11	On-street parking management strategy	6.7
Transport 12	Car share scheme	6.9

Source: Parsons Brinckerhoff

Funding and apportionment

The delivery of the package of road network upgrades outlined may require funding from a range of sources including State government, Auburn Council, Sydney Olympic Park and contributions from developers. Based on preliminary calculations of traffic volumes and intersection upgrade costs for the intersection upgrades listed in Roads 2, 4 and 5 in Table ES.1, the total contribution required by the Carter Street UAP would be approximately 31% of the total cost.

Achievable development levels

An analysis of vehicle queuing levels forecast by the SIDRA intersection models developed for this study has been used to estimate the amount of additional traffic that the road network could sustain to support development within the Carter Street UAP. The two gateway intersections that the Carter Street UAP straddles, of Parramatta Road/Hill Road/Bombay Street and Parramatta Road/Birnie Avenue, are likely to be reaching critical performance levels when the commercial development in the Carter Street UAP is approximately 33% of its full theoretical floor space. However, this is due to the combined growth of the various developments in the area, and is influenced by the amount of traffic relief that the WestConnex project can provide to Parramatta Road.

Other local intersections will begin to experience queuing back to the upstream intersection when the commercial development in the Carter Street UAP is approximately 55% to 65% of its full theoretical floor space. Other strategies that may be required to reduce vehicle trip generation to achieve and the full level of commercial development without the need to construct more road upgrades include one or a combination of:

- a more extensive public transport upgrade
- higher public transport frequencies assisted by dedicated public transport priority
- reduce parking rates to encourage the use of alternative modes of transport (requires one of the above to provide a suitable alternative).

1. Introduction

This report documents the results of a transport impact assessment of the proposed rezoning of lands known as the Carter Street Urban Activation Precinct (UAP). The purpose of the report is to provide advice to the NSW Government on a range of transport measures that are required to support the levels of growth proposed under the rezoning proposal.

1.1 Urban activation

Sydney is growing rapidly, with current forecasts suggesting that more than 1.3 million additional people will live in Sydney by 2031, requiring 545,000 more homes and 625,000 more jobs[1]. The challenge for government is to make sure communities are provided with the infrastructure to support the growth. The UAP program aims to deliver more homes in places with access to infrastructure, transport, services and jobs.

Land use and transport planning are important considerations for the location of UAPs. Growth Infrastructure Plans allow state infrastructure agencies to plan for infrastructure to support regional growth. Growth Infrastructure Plans enable upfront coordination to allow more efficient planning, priority setting and infrastructure investment. Funding for infrastructure is also available from other sources, including the Precinct Support Scheme (to assist local councils to upgrade local infrastructure), as well as local developer levies collected through Section 94 plans.

1.2 Carter Street UAP

The Carter Street UAP precinct (the Precinct) adjoins the Sydney Olympic Park specialised precinct and, at its closest point, lies within 800 m of Olympic Park Station. It is located within the Auburn local government area. The precinct is currently zoned for light industrial and business park employment purposes.

Redevelopment of the precinct will complement Sydney Olympic Park in its current role as a specialised precinct and as a potential major centre, providing a mixture of housing, retail, employment and services complemented by good public transport and access to open space and recreational facilities.

The Homebush Bay subregion, incorporating the Carter Street UAP, Sydney Olympic Park, Wentworth Point (incorporating a UAP) and Newington is bounded by Parramatta Road, Silverwater Road, Homebush Bay Drive and Parramatta River. Five key ‘gateway’ intersections provide access to the arterial road network, including:

1. Parramatta Road, Hill Road and Bombay Street
2. Parramatta Road and Birnie Avenue
3. M4 Western Motorway ramps at Hill Road
4. Homebush Bay Drive and Australia Avenue
5. Silverwater Road and Holker Street.

The Carter Street UAP straddles the first three of these five gateways, and is therefore influenced by the amount of traffic generated by other developments in the subregion and significant amounts of through traffic. The site is bounded by the M4 Western Motorway on its southern border, with connection at Hill Road via west-facing ramps. The Precinct is within an 800 m to 1.7 km walk of Olympic Park Station.

[1] Department of Planning & Infrastructure Urban Activation website

A map of the Carter Street Precinct and the other developments within the Homebush Bay subregion is shown in Figure 1.1.

Figure 1.1 Carter Street Precinct context in the Homebush Bay subregion

1.3 Report structure

This report outlines the travel requirements of the Carter Street UAP by road, public transport, walking and cycling. The objective of this report is to:

- identify and manage the transport impacts of the UAP on the surrounding area and transport networks
- develop strategies to reduce reliance on the private car of the Carter Street UAP.

This report is structured as follows:

- Section 2 presents information on existing transport conditions, including:
  - existing travel behaviour
  - current levels and details of public transport services
  - road network characteristics, including a description of the surrounding road network, existing traffic volumes, local intersection performance and a description of how the road network operates
  - pedestrian and cycle networks and a description of the issues experienced
  - parking supply and demand.
- Section 3 details the proposed development and provides information on accesses and street design.
- Section 4 contains a:
  - review of the relevant State and Local government plans and strategies, and recent studies for other developments
  - strategic assessment of the transport issues forecast for the Homebush Bay subregion.
- Section 5 analyses the trip generation of the proposed development and assesses the impact of the UAP on the surrounding road network.
- Section 6 assesses the proposed rezoning in terms of its provision for and impact on public transport, pedestrians and cyclists, parking and events held at Sydney Olympic Park.
- Section 7 presents the conclusions of the assessment and lists the recommendations.

2. Existing situation

This section describes the existing situation in the study area regarding the road network, traffic conditions, public transport services, intersection performance, parking, pedestrian and cyclist amenity.

2.1 Travel behaviour

The travel behaviour of existing nearby residents and employees can provide a guide to how the future residents and employees of the Carter Street UAP may travel. Travel behaviour varies widely, but certain characteristics can be grouped depending on the:

- purpose for the journey
- the time period of journey
- the mode or combination of modes of transport used from the origin to the destination.

Three sets of data exist for assessing these travel characteristics:

- Australian Bureau of Statistics publishes broad travel data gathered from the questions asked in the five-yearly Census. Useful data includes the population, number of dwellings, amount of workers and students, mode of travel to work and time of work trips made.
- The Census results for NSW are further analysed by the Bureau of Transport Statistics (BTS), within Transport for NSW. The Journey to Work data set analyses work commuting trips and links their origin and destination zones, 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 and mode share.
- BTS also undertakes a continuous Household Travel Survey (HTS) which samples households in the GMA. The survey involves respondents completing a diary of their travel patterns for all trip purposes. The results are compiled on an annual basis, but can be combined to form a large pool of data.

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

Number of daily trips per person

The 2010/2011 release of HTS data (BTS, 2012) indicates that people in Sydney GMA made 3.74 trips per person per weekday, whilst people in Auburn LGA made an average of 3.9 trips per weekday per person.

Reason for travelling

Trips generated from dwellings can be made for several purposes, and may often have different destinations using varied modes of travel. Trip 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 2.1. Data from the 2010/2011 release of HTS data for Sydney GMA were used to estimate these rates. Travel behaviour during the peaks can be different from patterns rest of the whole day, so percentages are presented for daily, AM peak and PM peak trips.

Table 2.1 Trip purpose percentages by time of day for Sydney GMA

Trip purpose	Daily	AM peak	PM peak
Commute, work related business	28%	41%	29%
Education/Childcare	10%	28%	14%
Shopping, personal business	29%	16%	26%
Other, social/Recreational	32%	14%	31%
Total	**100%**	**100%**	**100%**

Source: Household Travel Survey (HTS) 2010/11 Release, Bureau of Transport Statistics, Transport for NSW (2012).
Note: Trips to serve passenger were apportioned across the other four categories and included in their percentages.

Car ownership

The number of cars owned per dwelling is a measure of residents in an area's ability to choose to travel other than by transit. 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 as well as affluence, job type and the availability of free parking. The average number of cars per household for the Auburn LGA measured in the 2010/2011 HTS survey was 1.3, compared to a Sydney GMA average of 1.55 vehicles per household. Based on a per capita basis, Auburn LGA with 0.43 vehicles per person had the second lowest number of vehicles per person of all local government areas across Sydney GMA, with only City of Sydney 0.41 cars per person. The Sydney GMA average was 0.59 vehicles per person.

Transport mode share

The choice of travel mode varies depending on the range of transport services available, car availability, need for predictable arrival, the length of the journey and the reason for travelling. The mode split for trips to work during the AM peak to employment precincts in the Homebush Bay subregion are shown in Table 2.2. The mode split percentages are calculated using data from the Bureau of Transport Statistics (BTS) 2011 Journey to Work (JTW) dataset.

Table 2.2 AM peak period mode split examples for trips to surrounding employment

Travel mode	Rhodes	Wentworth Point	Sydney Olympic Park	Newington	Carter Street
2011 Travel zones	**710, 711, 712**	**1318, 1320**	**1326**	**1325, 1327**	**1328**
Train	23%	6%	21%	5%	6%
Bus	1%	2%	4%	2%	1%
Ferry/Tram	0%	0%	0%	0%	0%
Vehicle driver	68%	86%	69%	84%	87%
Vehicle passenger	4%	4%	4%	5%	5%
Other mode (incl. cycle)	1%	0%	1%	2%	1%
Walked only	2%	2%	1%	2%	0%
Total	**100%**	**100%**	**100%**	**100%**	**100%**

Source: BTS, Journey to Work, 2011

The corresponding JTW mode share for work trips to the selected residential precincts near Carter Street are shown in Table 2.3. They show the potential range of mode shares that the future residents of the Carter Street UAP could achieve. Factors influencing this range include the level of access to public transport, the supply of parking and road congestion in the surrounding area.

Table 2.3 AM peak period mode split examples for trips from surrounding residences

Travel mode	Rhodes	Wentworth Point	Newington
2011 Travel zones	710, 711, 712	1318, 1320	1325, 1327
Train	42%	16%	20%
Bus	1%	2%	3%
Ferry/Tram	0%	2%	0%
Vehicle driver	46%	73%	69%
Vehicle passenger	4%	5%	4%
Other mode (incl. cycle)	1%	1%	2%
Walked only	6%	1%	2%
Total	**100%**	**100%**	**100%**

Source: 2011 Journey to Work (BTS, 2013), selected travel zones

Direction of travel

The trip distribution for journey to work trips (all modes) in the AM peak from and to Auburn LGA is listed in Table 2.4. Trips within Auburn LGA represent the largest share of all destinations/origins. For trips by Auburn residents to work, the major centres of Sydney and Parramatta are also important, followed by trips in all directions to close council areas. The pattern of worker trips to Auburn LGA reveals a large percentage coming from council areas in western Sydney.

Table 2.4 Destination and origin council area for commute trips to/from Auburn LGA

To LGA	% of trips from Auburn LGA
Auburn	20%
Sydney	18%
Parramatta	8%
Bankstown	6%
Ryde	4%
Strathfield	4%
Canada Bay	3%
Blacktown	3%
Other LGAs	34%
Total	**100%**

From LGA	% of trips to Auburn LGA
Auburn	11%
Blacktown	10%
Parramatta	8%
Bankstown	6%
The Hills Shire	5%
Fairfield	5%
Penrith	5%
Holroyd	4%
Other LGAs	41%
Total	**100%**

Source: 2011 Journey to Work (BTS, 2013), Auburn LGA, all modes

The pattern for car driver journeys to work is slightly different, with a smaller percentage of residents travelling to Sydney CBD by car, and a larger share of employees arriving by car from western council areas (and less from Auburn LGA).

2.2 Road network

The existing road network within the vicinity of the study area consists of Carter Street, Uhrig Road, Hill Road, Birnie Avenue, Edwin Flack Avenue, John Ian Wing Parade, Old Hill Link, Parramatta Road (Great Western Highway) and the M4 Western Motorway. Figure 2.1 shows map of the surrounding road network, including the relevant roads and their description is provided in this section.

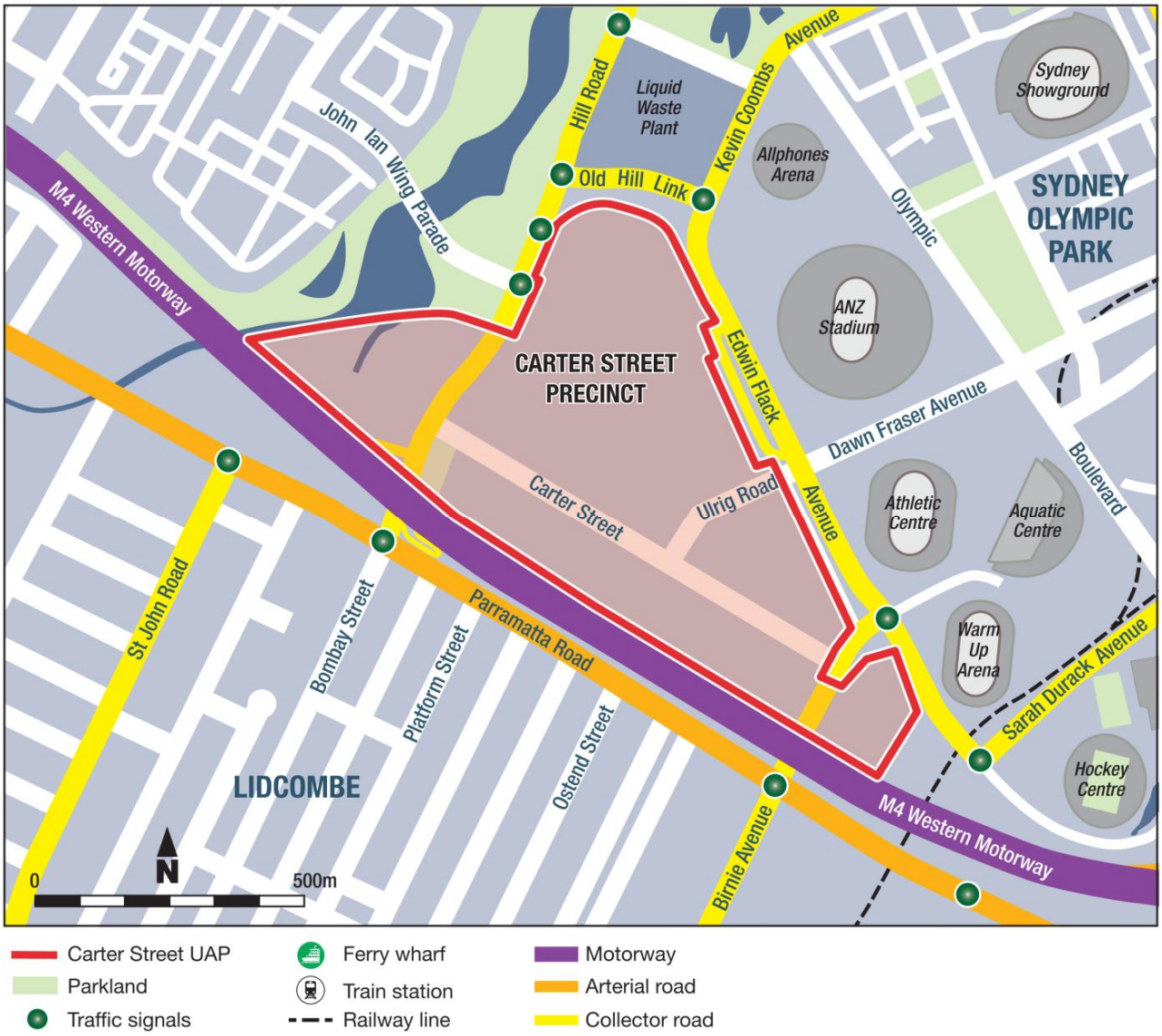


Figure 2.1 Surrounding road network

Carter Street runs through the middle of the Carter Street precinct and forms a give way controlled T-intersection with Hill Road in the west and Birnie Avenue in the east. It is a two-lane, two-way undivided road with a posted speed limit of 60 km/h. On-street parking spaces are provided on both sides of the road and 2 hour parking restrictions are introduced during special events. This route is approved for use by B-doubles.

Uhrig Road forms give way controlled T-intersection with Carter Street in the south and with Edwin Flack Avenue in the north. It has parking on both sides and 2 hour parking restrictions are introduced during special events. During certain major events at Sydney Olympic Park it is temporarily closed at Edwin Flack Avenue.

Hill Road is a collector road providing access between Parramatta Road, the Carter Street Precinct, Sydney Olympic Park, Silverwater industrial precinct and residential precincts in Wentworth Point and Newington. This road also provides access between Parramatta Road and Silverwater Road via Holker Street. Hill Road generally has two lanes in each direction, apart from the section between John Ian Wing Parade and Parramatta Road, which has three travel lanes for southbound traffic. It is approved for use by B-doubles but it is not approved for use by vehicles over 4.6 m in height. Hill Road is signposted with a 60 km/h speed zone. During special events at Sydney Olympic Park, Hill Road is a special event bus corridor. It also provides access to the Sydney Olympic Park car parks (P1 and P5).

Birnie Avenue provides the key external connection to the east of the Carter Street UAP. This is a two-lane, divided road linking Parramatta Road in the south and Sydney Olympic Park in the north. It connects with Edwin Flack Avenue in the north at an intersection which has been recently upgraded to traffic signals. In the south it provides access to the Lidcombe area. It provides access to the Sydney Olympic Park car parks (P2 and P4). Birnie Avenue is approved for use by B-doubles and is signposted with a 60 km/h speed zone.

Edwin Flack Avenue is a collector road, running through the southern boundary of Sydney Olympic Park. It is a two-lane each way, divided road with posted speed limit of 60 km/h. Concrete footpaths and dedicated bicycle lanes are provided on both sides of the road.

John Ian Wing Parade has a posted speed limit of 50 km/h and forms a signalised T-intersection with Hill Road on the western side. This road provides a link to the residential precincts in Newington and connects to Silverwater Road via other roads.

Old Hill Link runs between Hill Road in the west and Edwin Flack Avenue in the east. It also provides access to a Sydney Olympic Park car park (P1).

Parramatta Road (route A4) is a major arterial road linking Sydney CBD and Parramatta. Although a substantial portion of this route is parallel to the M4 Western Motorway, it continues to carry a large volume of traffic (approximately 38,000 vehicles per day[2]). The section near Homebush Bay generally provides a four-lane divided road configuration with two lanes per direction. Additional turn lanes are provided at major intersections.

Parramatta Road is designated as a B-double route and allows vehicles with a maximum vertical height clearance of 4.6 m. This route is generally signposted as a 60 km/h speed zone.

The **M4 Western Motorway** is an arterial road that extends from Strathfield in the east to Emu Plains in the west. It is one of Sydney's major motorways, providing high standard alignment and high speed driving conditions. It has a dual carriageway configuration with limited access through grade separated interchanges. The M4 Western Motorway has an exit ramp to Hill Road for eastbound traffic as well as an on-ramp from Hill Road for westbound traffic.

As a motorway, with a six lane divided road configuration, this road carries approximately 86,500 vehicles per day[3]. This road is designated as a B-double route and allows vehicles with a maximum vertical height clearance of 4.6 m with variable speed limit of 90 km/h or more.

The WestConnex project, incorporating an upgrade of the M4 Western Motorway, M4 East extension, Inner-West Bypass and M5 East duplication was recently announced by the NSW Government. The Roads and Maritime Services (RMS) has proposed the trial of a 'Managed Motorways Scheme' on the M4 to improve its efficiency and reduce the occurrence and impact of incidents. A new eastbound on-ramp from Hill Road to the M4 Western Motorway is also proposed for the WestConnex project as part of a package of ancillary works.

2 RMS Traffic Volume Data for Sydney Region 2008 - counting station 27.143

3 RMS Traffic Volume Data for Sydney Region 2008 - counting station 28.008

2.3 Traffic volumes

Intersection traffic surveys

Intersection traffic surveys were undertaken for a weekday AM and PM peak periods on Tuesday 9 April 2013 at the following key intersections:

- Hill Road/Carter Street (I-01) – give way controlled T-intersection
- Hill Road/John Ian Wing Parade (I-02) – signalised T-intersection
- Hill Road/Old Hill Link (I-03) – signalised T-intersection
- Edwin Flack Avenue/Old Hill Link (I-04) – signalised T-intersection
- Edwin Flack Avenue/Dawn Fraser Avenue/Uhrig Road (I-05) – stop controlled cross intersection
- Edwin Flack Avenue/Birnie Avenue (I-06) – signalised cross intersection
- Carter Street/Uhrig Road (I-07) – give way controlled T-intersection
- Parramatta Road/Birnie Avenue (I-08) – signalised cross intersection
- Parramatta Road/Hill Road/Bombay Street (I-09) – signalised cross intersection.

The AM peak period surveys were conducted from 6.30 am to 9.30 am, and the PM peak period from 4.00 pm to 7.00 pm. Data retrieved from the intersection surveys indicate that the weekday AM peak hour generally occurs between 7.45 am and 8.45 am and the PM peak hour between 5.00 pm and 6.00 pm.

Figures 2.2 and 2.3 show the intersection turning movement volumes in vehicles per hour (vph) during the analysed AM and PM peak hours respectively. These are regarded as the existing volumes for the assessment of the existing conditions. Traffic turn volumes for the intersection of Birnie Avenue and Carter Street (I-10) were derived from the turn flows at Edwin Flack Avenue/Birnie Avenue (I-06) and Parramatta Road/Birnie Avenue (I-08).

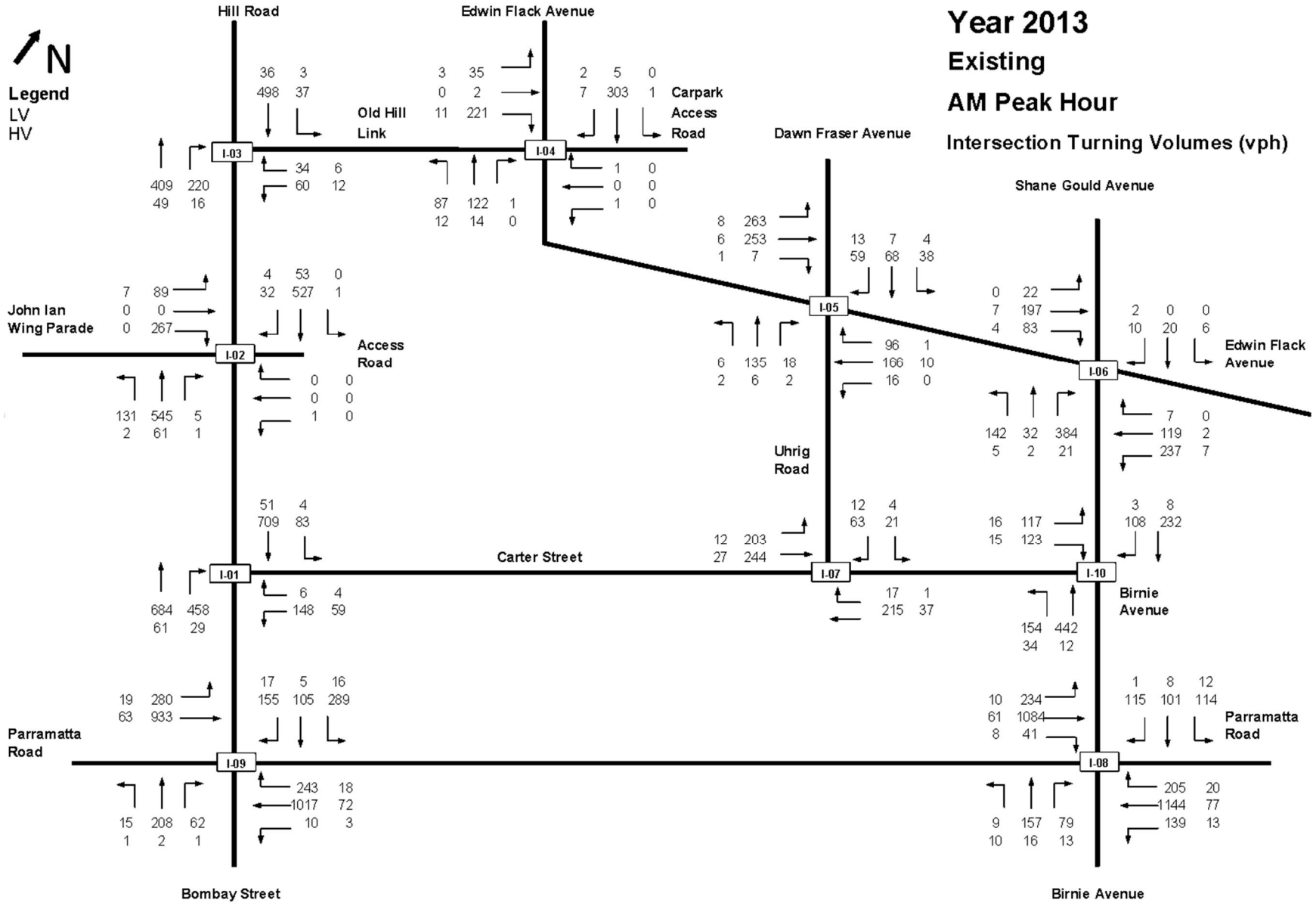


Figure 2.2 Existing AM peak hour intersection turning volumes – Year 2013

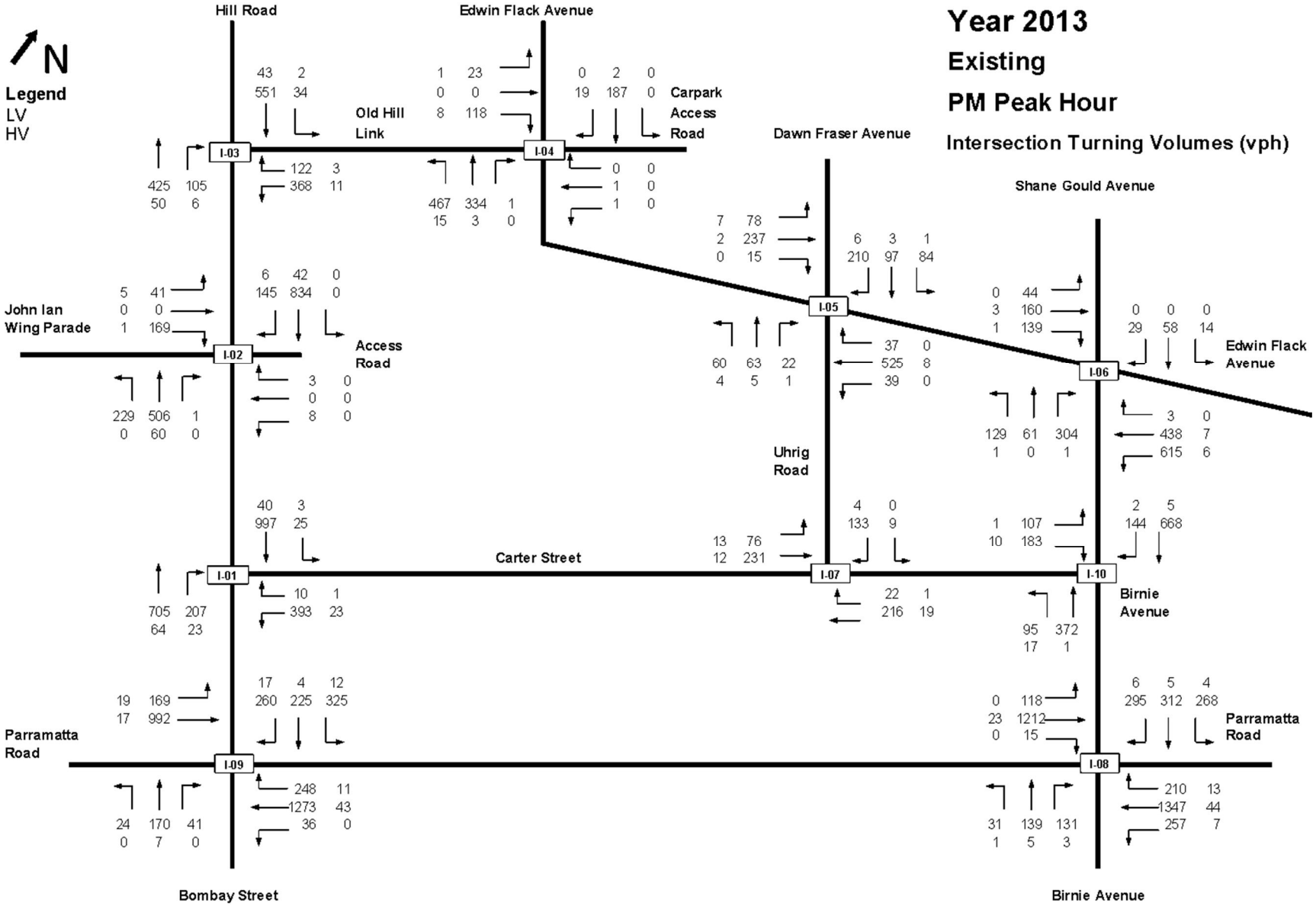


Figure 2.3 Existing PM peak hour intersection turning volumes – Year 2013

On the day of the traffic surveys, a section of Olympic Boulevard was temporarily closed after the Royal Easter Show. This is expected to have had an influence on the traffic volumes surveyed at the northern end of the study area. Based on an assessment of the volumes surveyed, it is concluded that in the AM peak, the closure diverted approximately 150 vehicles in the eastbound direction on Old Hill Road to turn right at Edwin Flack Avenue and left at Dawn Fraser Avenue, and 30 vehicles in the opposite direction, and the reverse movements (and volumes) diverted in the PM peak. This diverted traffic has been left as surveyed in the existing situation modelling to allow calibration to observed conditions, but adjusted back to its usual routes in future year modelling for this study to obtain a more reasonable assessment of a typical day's traffic patterns in the future year assessment.

IDM and SCATS intersection data

Intersection data including intersection diagnostic monitor (IDM) and Sydney Coordinated Adaptive Traffic Signal (SCATS) data was obtained from RMS for the Parramatta Road intersections with Hill Road and Birnie Avenue within the study area to determine traffic signal phasing and cycle times for a weekday AM and PM peak periods on the same day as the intersection turning counts. For other signalised intersections, traffic signal phasing and cycle times were measured during the site inspection. This data was then entered into the SIDRA intersection modelling package.

Site inspection

A site inspection was carried out on Tuesday 9 April 2013 to understand the function of the adjacent road network and existing traffic movement. Queue length observations were also completed during the site inspection. The queue lengths as modelled in SIDRA replicate the actual observed queue lengths as per the site inspection and therefore a good representation is modelled.

2.4 Historical traffic growth

Annual Average Daily Traffic (AADT) data of the nearest RMS counting stations were obtained from RMS to estimate the pattern of traffic within the study area. Table 2.5 summarises the historical traffic data and the annual average traffic growth between 2002 and 2008 on surrounding area.

Table 2.5 Summary of AADT within the study area

RMS counting station	Location	AADT					% Growth	
		2002	2005	2006	2007	2008	3 year period	6 year period
27.143	Parramatta Road, east of Birnie Avenue	38,734	40,139	39,941	38,268	38,232	-1.58%	-0.22%
28.119	M4 Western Motorway, on/off ramp at Homebush Bay Drive interchange	40,299	46,988	48,627	50,535	51,440	3.16%	4.61%
28.001	M4 Western Motorway, west of Homebush Bay Drive	81,266	83,759	83,778	84,809	86,496	1.09%	1.07%

Source: RMS Traffic Volume Data for Sydney Region (2005)

Table 2.5 shows that over the past 6 years, traffic volumes have been slightly decreased on Parramatta Road while M4 Western Motorway experienced a strong traffic growth with an increase of approximately 4.6%.

2.5 Traffic conditions

Traffic conditions observed during the site visit confirm that the gateways to the Homebush Bay subregion are under significant pressure from large traffic volumes during peak periods, and anecdotally during weekend peaks as well. Whilst traffic conditions at all of the five gateways affect traffic patterns within the Homebush Bay subregion, the intersections of Parramatta Road and Birnie Avenue, Parramatta Road with Hill Road, and Hill Road with the M4 Western Motorway are of particular importance to the ability of the road network to sustain increased development within the Carter Street UAP.

Traffic conditions at other intersections within the study area are not as extreme. However, traffic congestion issues are growing, and the large increase in development within the area is likely to contribute to increased delays and queuing without road upgrades.

The performance of each of the following intersections was analysed under existing conditions. The analysis, undertaken using the SIDRA software package.

- Hill Road/Carter Street (I-01) – give way controlled T-intersection
- Hill Road/John Ian Wing Parade (I-02) – signalised T-intersection
- Hill Road/Old Hill Link (I-03) – signalised T-intersection
- Edwin Flack Avenue/Old Hill Link (I-04) – signalised T-intersection
- Edwin Flack Avenue/Uhrig Road (I-05) – stop controlled cross intersection
- Edwin Flack Avenue/Birnie Avenue (I-06) – signalised cross intersection
- Carter Street/Uhrig Road (I-07) – give way controlled T-intersection
- Parramatta Road/Birnie Avenue (I-08) – signalised cross intersection
- Parramatta Road/Hill Road (I-09) – signalised cross intersection
- Carter Street/Birnie Avenue (I-10) – give way controlled T-intersection.

Through traffic currently uses the Sydney Olympic Park area, particularly Birnie Avenue, Edwin Flack Avenue and Australia Avenue, to avoid congestion on surrounding roads such as Parramatta Road and Homebush Bay Drive. In the future, the level of through traffic is not expected to increase as local activity increases and travel times through Sydney Olympic Park are no longer advantageous.

Intersection performance parameters

The ability of each of the assessed intersections to cater for existing and future traffic forecasts were investigated using the SIDRA intersection modelling software package. This package provides several useful parameters to determine the level of intersection performance. Explanations of the criteria used are provided in Appendix A.

Typically acceptable intersection performance is defined as follows:

- LoS D or better (the worst case scenario of vehicle delay was less than or equal to 56 seconds)
- Degree of Saturation (DoS) less than equal to 0.8 at priority controlled intersection, and 0.90 at a signalised controlled intersection
- 95th percentile back of queue does not interfere with other traffic movements.

Intersection performance

The performance of each of the key intersections was analysed for existing year 2013. The assessment of existing intersection performance was based on the existing surveyed traffic volumes for the AM and PM peak periods shown in Figure 2.2 and Figure 2.3 the results from the analysis are presented in Table 2.6. SIDRA model output containing more detail is provided in Appendix B.

Table 2.6 Summary of existing intersection performance

Site ID	Intersection	Peak period	Degree of Saturation	Average Delay (s)	Level of Service	95th percentile queue (m)
I-01	Hill Road and Carter Street	AM	0.85	23	B	57
		PM	1.08	116	F	252
I-02	Hill Road and John Ian Wing Parade	AM	0.61	18	B	78
		PM	0.49	14	A	87
I-03	Hill Road and Old Hill Link	AM	0.46	11	A	38
		PM	0.39	12	A	35
I-04	Edwin Flack Avenue and Old Hill Link	AM	0.30	14	A	21
		PM	0.57	13	A	70
I-05	Edwin Flack Avenue, Dawn Fraser Avenue and Uhrig Road[1]	AM	0.33	19	B	12
		PM	0.49	24	B	18
I-06	Edwin Flack Avenue and Birnie Avenue	AM	0.55	22	B	59
		PM	0.59	26	B	131
I-07	Carter Street and Uhrig Road	AM	0.28	18	B	12
		PM	0.30	14	A	9
I-08	Parramatta Road and Birnie Avenue	AM	0.88	30	C	278
		PM	1.12	50	D	327
I-09	Parramatta Road and Hill Road	AM	0.84	36	C	274
		PM	0.86	40	C	272
I-10	Birnie Avenue and Carter Street	AM	0.60	26	B	19
		PM	0.99	91	F	87

(1) Assumes diverted traffic returned to normal route. Results for surveyed traffic day were: AM peak – D/S 0.41, 21 seconds ave. delay, LoS B, 16m queue. PM peak – D/S 1.10, 146 seconds ave. delay, LoS F, 224m queue.

The intersection modelling results match on-site observations that:

- Traffic on Carter Street experiences delays at the intersections at each end of Carter Street.
- Traffic conditions at both intersections on Parramatta Road are within acceptable limits, but the degree of saturation is close to/above 1 during the AM and PM peaks, indicating both intersections have little spare capacity.
- Other intersections are performing with good levels of service.

At peak times, the queue length for the right turn from Hill Road into Carter Street is longer than the distance between the Hill Road/Carter Street intersection and M4 Western Motorway off-ramp (90 metres), as indicated on Figure 2.4. This causes queuing back onto the Motorway, and reduces the off-ramp stopping distance below safe levels.

Figure 2.4 Queuing issue on Hill Road

2.6 Public transport

Rail

Olympic Park Station operates on a spur line from the Main Western Line. Limited numbers of trains start at Olympic Park and travel directly into the City. However, in general regular passenger services operate as a shuttle to Lidcombe Station, where passengers transfer to a Western Line, Inner West Line or Bankstown Line train. Special event trains operate to/from Lidcombe, Strathfield and Central for large events held at Sydney Olympic Park. Table 2.7 shows the number of train services and operating hours at Olympic Park Station.

Table 2.7 Current train services at Olympic Park Station

Direction	AM peak hour services	Midday services per hour	PM peak hour services	Daily services	Weekday operating hours (from Olympic Park)
From Olympic Park	6	3	6	91	5.58 am–12.04 am
To Olympic Park	6	3	6	91	5.55 am–11.35 pm

Source: Olympic Park Line Timetable (CityRail, effective 10 October 2010)

Three trains on the Western Line and seven trains on the Inner West and South Lines stop at Lidcombe during the peak hour, although they do not necessarily match the arrival/departure times of the Olympic Park Line 'Sprint' service. Another five trains on the Bankstown Line stop at Lidcombe. There are no services changes proposed to the Olympic Park Line in the new Sydney Trains timetable implemented in October 2013.

Passenger information from the Bureau of Transport Statistics, shown in Table 2.8 indicates that the number of passenger movements through the station across a typical weekday is approximately 2,710 per day in 2012 (*Bureau of Transport Statistics website* 2012). This makes it the 91st busiest station on the Sydney Trains network. Other stations with equivalent patronage levels include International Airport (92nd) and Cronulla (90th).

Table 2.8 2012 daily passenger movements at Olympic Park Station

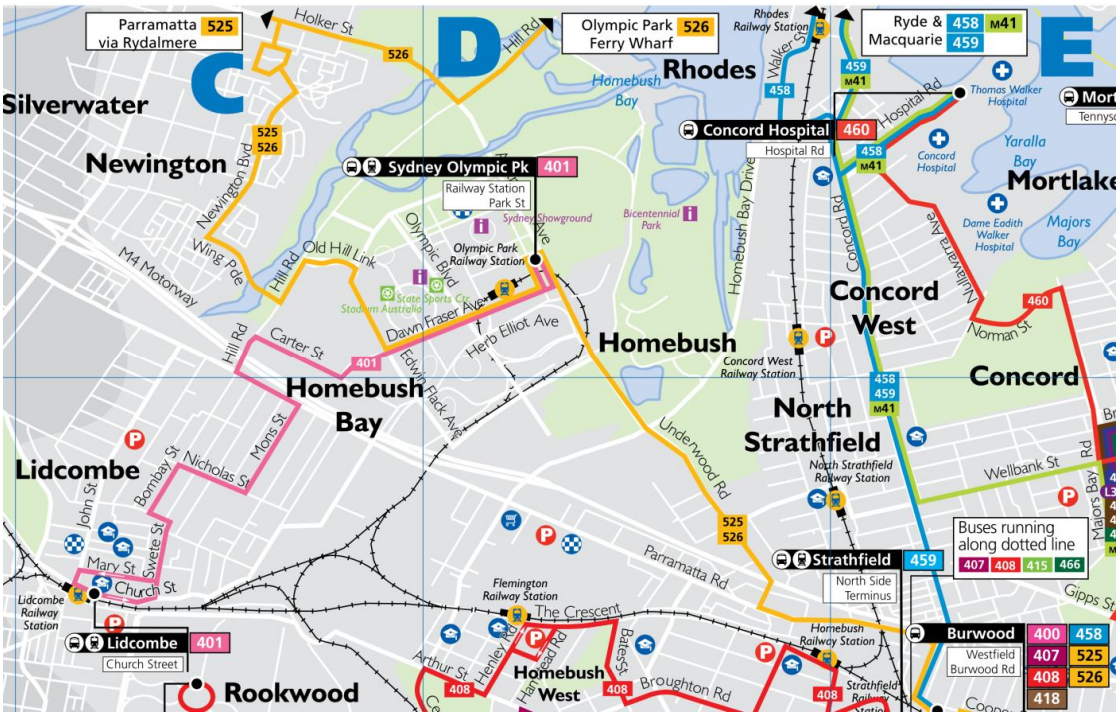
Time period	Entries	Exits
02.00 to 06.00	0	0
06.00 to 09.30	70	1,570
09.30 to 15.00	350	880
15.00 to 18.30	2,000	90
18.30 to 02.00	290	170
24 Hours	**2,710**	**2,710**

Source: Bureau of Transport Statistics 2012

Olympic Park Station is located between 800 m and 1.7 km walk away from parts of Carter Street, whereas the core catchment of a train station is typically up to 1 km. This walk distance reduces the attractiveness of rail as a transport mode for those with the longer walking distances. A high frequency bus service may bridge this gap, but current bus frequencies are not conducive to their use as a convenient access mode.

Bus

Bus services currently operate along Carter Street and Edwin Flack Avenue. The services are operated by Sydney Buses and include the 401, 525 and 526 bus routes. These bus routes and the surrounding network are shown in Figure 2.5. Veolia operates Metrobus M92 (not shown on map), which travels between Parramatta and Sutherland via Lidcombe.



Source: Sydney Buses Southern Region Guide, (effective March 2011)

Figure 2.5 Existing bus network

Existing bus service frequencies are detailed in Table 2.9. These frequencies create an adequate service, but passengers still need to refer to the timetable to avoid missing the bus and having an extended wait. Only Route 525 operates into the evening for residents arriving home late.

Table 2.9 Bus services within the study area

Bus route	Description	Hours of operation (weekdays)	Frequency
401[1]	Monday to Saturday daytime service between Sydney Olympic Park and Lidcombe	From Sydney Olympic Park (from 6.20 am to 7.30 pm)	AM peak: 20 minutes PM peak: 20 minutes Off peak: 20–40 minutes
		From Lidcombe (from 6.00 am to 7.00 pm)	AM peak: 20 minutes PM peak: 20 minutes Off peak: 20–40 minutes
525[1]	Daily full time service between Parramatta and Burwood via Rydalmere, Ermington, Silverwater, Newington, Sydney Olympic Park and Strathfield	From Parramatta (from 6.02 am to 9.40 pm)	AM peak: 20 minutes PM peak: 20 minutes Off peak: 30–60 minutes
		From Burwood (from 6.00 am to 10.41 pm)	AM peak: 20 minutes PM peak: 20 minutes Off peak: 30–60 minutes
526[1]	Daily full time service between Sydney Olympic Park Wharf and Burwood via Newington, Sydney Olympic Park and Strathfield	From Sydney Olympic Park (from 6.05 am to 7.28 pm)	AM peak: 20–30 minutes PM peak: 30 minutes Off peak: 20–30 minutes
		From Burwood (from 6.49 am to 6.48 pm)	AM peak: 20–30 minutes PM peak: 25–50 minutes Off peak: 20–30 minutes
M92[2]	Daily high frequency service connecting Parramatta to Sutherland via Auburn, Lidcombe, University of Sydney (Cumberland) and Bankstown	From Parramatta/Lidcombe (from 6:16am to 8:40pm)	AM peak: 10 minutes PM peak: 10 minutes Off peak: 15–20 minutes
		From Sutherland/Lidcombe (from 5.40 am to 8.10 pm)	AM peak: 10 minutes PM peak: 10 minutes Off peak: 15–20 minutes

(1) Sydney Buses website, viewed May 2013

(2) Veolia website.

Source: Sydney Buses website, viewed May 2013

Routes 525 and 526 follow a common route from Burwood to Sydney Olympic Park and Newington, providing a combined frequency of around 10 mins during peak hours. From October 2013, the operating hours of Route 526 have been extended with additional evening trips being introduced through to Wentworth Point and Sydney Olympic Park Wharf. Bus services to Wentworth Point will be further expanded as development in the area progresses.

Bus stops within walking distance of Carter Street are currently located at:

- on both sides of Carter Street, east of Hill Road
- on both sides of Carter Street, west of NSW rural fire service
- on both sides of Uhrig Road, north of Carter Street
- on both sides of Edwin Flack Avenue, west of ANZ Stadium.

Ferry

Ferry services stopping at Sydney Olympic Park Wharf operate along the Parramatta River between Rydalmere Wharf and Circular Quay during weekdays and weekends. A connecting bus transfers passengers in to Parramatta. The ferry service also stops at Milsons Point Wharf on its way to Circular Quay, giving access to North Sydney employment. The current timetable is shown in Table 2.10.

Table 2.10 Current ferry services at Sydney Olympic Park Wharf

Direction	AM peak hour services	midday services per hour	PM peak hour services	Daily services	Weekday operating hours (from Sydney Olympic Park Wharf)
To Sydney	5	1	3	25	6.05 am–10.35 pm
To Parramatta	3	1	3	27	6.25 am–11.33 pm

Source: Parramatta River Ferry Timetable (Transport for NSW (TfNSW), effective 24 October 2011)

Table 2.11 outlines ferry patronage at Sydney Olympic Park Ferry Wharf between 2010 and 2012. Ferry use has remained fairly constant over the three year period. The number of people using ferry from the subregion as commuters is modest at around 220 people per day.

Table 2.11 Ferry passenger entry and exits at Sydney Olympic Park Wharf

Year	Mon–Fri	Saturday	Sunday	Weekly total
May 2010	1,458	282	691	**2,431**
November 2010	1,915	608	512	**3,035**
May 2011	1,295	430	326	**2,051**
November 2011	1,842	450	721	**3,013**
May 2012	1,872	458	670	**3,000**
November 2012	2,180	502	479	**3,161**

Source: Bureau of Transport Statistics 2012

2.7 Pedestrians

Figure 2.6 presents the existing pedestrian facilities with in the study area. Whilst most roads have footpaths and crossing opportunities at traffic signals, the long block lengths and lack of mid-block crossing opportunities makes walking for local trips difficult. High traffic volumes and large numbers of trucks associated with the current industrial use reduce pedestrian amenity.

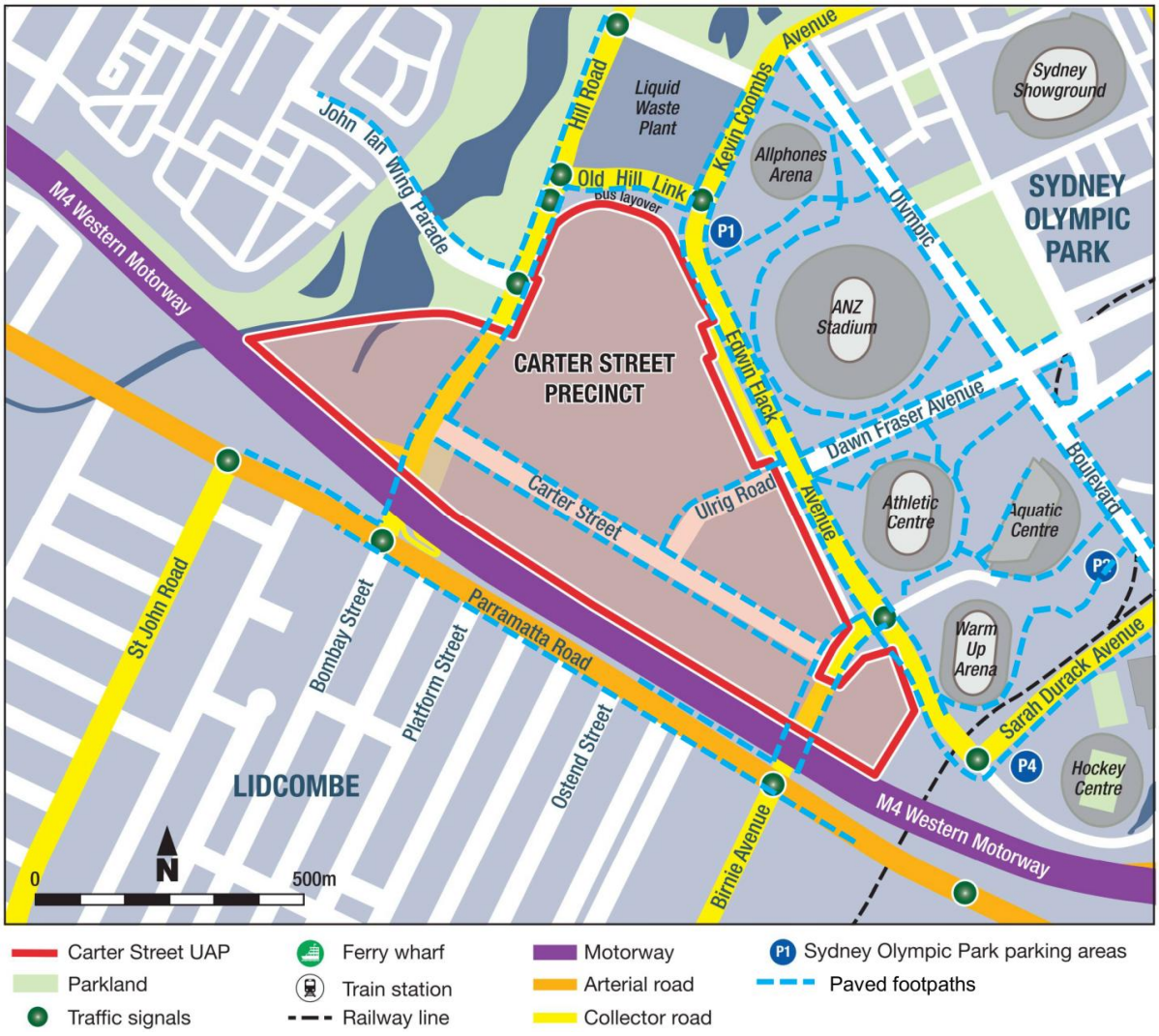


Figure 2.6 Existing footpaths in the Carter Street Precinct

The following paved concrete/asphalt footpaths are provided:

- on both sides of Carter Street, Birnie Avenue and Edwin Flack Avenue
- on eastern side of Hill Road and Uhrig Road
- on northern side of John Ian Wing Parade and Old Hill Link.

Signalised pedestrian crossings are located at following intersections:

- Birnie Avenue and Edwin Flack Avenue intersection
- Hill Road and John Ian Wing Parade intersection
- Hill Road and Edwin Flack Avenue intersection
- Edwin Flack Avenue and Old Hill Link intersection.

2.8 Cyclists

Existing cycle facilities are shown in Figure 2.7. The Homebush Bay subregion has a high standard of cycle facilities, as a legacy of transport planning for the 2000 Olympics. These facilities pass by the Carter Street UAP, but a gap exists in the network along Carter Street and Uhrig Road.

Source: www.bicycleinfo.nsw.gov.au

Figure 2.7 Existing cycle facilities

Cycle parking facilities are progressively being upgraded as part of the redevelopment of sites within Sydney Olympic Park. Commuter bicycle parking is available at Olympic Park Station, within the SOP town centre and at most venues and parks.

2.9 Parking

Parking is prohibited on major local roads with a dominant traffic flow function, such as Hill Road and Birnie Avenue. On-street parking is available on both sides of Carter Street and Uhrig Road. This parking is generally unrestricted apart from during special events, when 'Special Event Parking Area' restrictions are enacted. These restrictions allow parking for up to two hours, with an exemption for permit holders.

Observations on site and anecdotal evidence suggest that on-street parking is well used during business hours, due to demand from employees of local businesses. Parking is available outside business hours.

Parking is available in Sydney Olympic Park in several places. The closest pay parking stations are located adjacent to the intersection of Edwin Flack Avenue and Old Hill Link (parking station P1), along Edwin Flack Avenue (P2b), near the Athletics track (P2 and P2a) and near the Hockey Centre (P4). Costs are $4 an hour or $20 per day.

2.10 Summary of transport network issues

Based on this assessment, the issues identified with existing transport conditions are:

- Five key road gateways into the area that experience congestion during peak periods.
- Congestion on the three arterial roads on the west, south and eastern sides contributing to through traffic using the streets within the area.
- Olympic Park train station is an important transport asset, with the 10 minute frequency offering a good service. However, there is not a direct service to most destinations and therefore most trips require a transfer at Lidcombe.
- The walk distances from the Carter Street Precinct to Olympic Park train station are on the boundary of or outside the target catchment distance, reducing the use of rail.
- The bus network is adequate for the current land use, but frequencies, hours of operation and coverage will need to increase to meet increased demand from local growth. Bus services are affected by the congested traffic conditions.
- Local and regional pedestrian and cycle infrastructure in the wider Sydney Olympic Park area is of a high quality, with some gaps in the Carter Street UAP.

3. Carter Street Precinct UAP

The Carter Street UAP is being planned as a mixed land-use development, including residential, retail, employment and open space. DP&I is currently undertaking a planning process (of which this TIA is a part) to determine the suitable mix of employment and residential population growth that the site can accommodate. This process will result in a rezoning application, with subsequent development applications triggering actual changes in land use.

The Carter Street Precinct has been identified as being a suitable candidate to accommodate future urban growth due to its:

- access to transport infrastructure, including the M4 Western Motorway, Olympic Park Station, local bus services and cycle network
- relatively large land parcels and consolidated ownership
- position near Sydney Olympic Park which has experienced sustained growth over the past 10 years.

3.1 Development type

The potential land uses for the Precinct as shown in the structure plan (see Figure 3.1) are summarised in Table 3.1. The employment (commercial/business park) floor space would be provided along the southern boundary of the Precinct (alongside the M4 Western Motorway).

Table 3.1 Carter Street UAP structure plan yield

Land use	Land area (m^2)	Floor space ratio	GFA (m^2)	Yield
Residential				
▪ Carter Street	229,769	2.0:1	447,538	4,475
▪ Haslams Creek Residential - East of the Canal	28,344	1.5:1	42,516	425
▪ Haslams Creek Residential - West of the Canal	12,855	1.0:1	12,855	129
Swire Site	31,514	1.5:1	47,271	473
Sub-Total	**302,481**		**550,1791**	**5,502 dwellings[2] 11,554 population[3]**
Retail (ground floor)	12,000	1.0:1	12,000	
Employment	111,315	1.5:1	170,872	8,544 jobs[4]
Total	**425,797**		**733,052**	

Source: LFA (Pacific) Pty Ltd Architects, Urban Designers, 4 September 2013

(1) Residential land (englobo i.e. no internal roads or open space); GFA excludes 12,000 m^2 of Ground Floor Retail uses.
(2) Allows 100 m^2/unit (gross).
(3) Based on occupation rate of 2.1 people per unit.
(4) 20 m^2/per person for employment.

In addition to the areas indicated in Table 3.1, a further 4.20 ha would be allocated to open space, 5.01 ha to collector roads and 1.63 ha to utilities such as power, sewer and water facilities.

3.2 Internal street hierarchy

The internal street hierarchy, shown in Figure 3.1, has been developed to fit within the surrounding road network and provide access to all areas of the Precinct, whilst also protecting the urban amenity within the areas with the most activity. Recommendations for new traffic signals have been made at key local intersections to facilitate efficient traffic flow and assist pedestrian movement. These recommendations require further assessment to determine whether they meet RMS traffic signal warrants, design to the relevant standards and are subject to approval by RMS.

Source: LFA (Pacific) Pty Ltd Architects, Urban Designers, 4 September 2013

Figure 3.1 Carter Street UAP Structure Plan

Key elements include:

- Retaining Carter Street and the majority of Uhrig Road on their current alignment, which together with Hill Road and Birnie Avenue, provide a permeable framework of higher-order streets on which to connect local roads.
- Extending John Ian Wing Parade from Hill Road to Uhrig Road, to reduce reliance on Carter Street, take advantage of the existing traffic signals and split access requirements to two main entry points on Hill Road.
- Connect the areas west of Hill Road in to the intersection of Hill Road and Carter Street, as a fourth approach to the intersection.
- Connect the areas east of Birnie Avenue into the intersection of Birnie Avenue and Carter Street, as a fourth approach to the intersection.

- Treat Uhrig Road through design to discourage its use by through traffic between the M4 Western Motorway/Parramatta Road and Sydney Olympic Park.
- Reduce the walk distance to Olympic Park Station for pedestrians from all parts of the Precinct.
- Provide space for bus priority on Uhrig Road at Carter Street.

RMS have advised that the intersection of Hill Road and Carter Street may require relocation to reduce the impact of queuing on the operation of the M4 Western Motorway ramps. Further assessment and liaison with RMS is required to finalise the road network.

3.3 Street design

Detailed cross-sections for each of the streets are yet to be designed. When the internal streets are designed, these designs should have regard to the following:

- Sydney Olympic Park Master Plan 2030 street sections
- Auburn City Council's *Development Control Plans*
- Austroads *Guide to Road Design and Roads and Maritime Services supplements*
- Australian Standards series AS 1742, AS 1743 and AS 2890.

As preliminary guidance, the following points are made:

- Carter Street should incorporate one through lane and one widened parking lane (to be used as a second traffic lane during peaks) in each direction. Due to its continuing use for employment lands, it should be wide enough to continue to facilitate truck access, i.e. 3.5 m kerbside lanes and 3.2 m median lanes.
- Through lane widths on Uhrig Road should be a minimum of 3.2 m to accommodate buses, garbage trucks and removalist trucks.
- Due to the surrounding high density development and the desire to make better use of parking facilities by maximising their shared use, restricted off-street parking should be supplemented by on-street parking on local streets that is designed into the street carriageway.
- The width of local streets can be narrower than Carter Street to reduce speeds, but should retain the possibility for two large vehicles to pass each other. A desirable through lane width of 3.0 m is recommended.
- Streets and intersections should be designed to accommodate Auburn City Council's nominated garbage truck, which is presently an 8.8 metre long medium rigid vehicle (MRV).
- As a minimum, 1.5 m wide footpaths within a 4.0 m verge are recommended on each side of internal streets, with wider footpaths to be provided along Uhrig Road to enable convenient movement along the main retail street, which also provides pedestrian access to Olympic Park Station.

3.4 Access and internal intersections

The surrounding road network and internal road structure that is proposed in Figure 3.1 lends itself to four main access intersections:

1. Hill Road and Carter Street – new signals (subject to RMS approval) at this existing intersection with formalised fourth approach on the western side of Hill Road (Carter Street extension), capacity increase to cater for demand
2. Hill Road and John Ian Wing Parade - formalised fourth approach on the eastern side of Hill Road (John Ian Wing Parade extension) at this existing signalised intersection, capacity increase to cater for demand
3. Birnie Avenue and Carter Street – new signals (subject to RMS approval) at this existing intersection with formalised fourth approach on the eastern side of Birnie Avenue (Carter Street extension), capacity increase to cater for demand
4. Edwin Flack Avenue, Dawn Fraser Avenue and Uhrig Road – new signals (subject to RMS approval) at this existing intersection.

Other intersections between local streets within the Carter Street Precinct with Hill Road, Edwin Flack Avenue and Old Hill Link would be created as left-in/left-out restricted un-signalised intersections.

Within the Precinct, intersections between local streets and other local streets, Carter Street or Uhrig Road would be priority controlled (stop or give-way). The exception would be at the intersection of Carter Street and Uhrig Road, where traffic signals would be required to assist the movement of buses and pedestrians.

A right-turn restriction is proposed on traffic from the M4 Western Motorway eastbound off-ramp from turning into Carter Street, due to it being the shortest path between the off-ramp and the employment areas within the Carter Street UAP and the queuing issues on the off-ramp that results. This could result in trucks passing through the residential section of the John Ian Wing Parade Extension. To discourage this, a heavy vehicle load limit is proposed on John Ian Wing Parade Extension between Hill Road and Uhrig Road. This right-turn restriction may not be required depending on the resolution of the location of the intersection of Carter Street and Hill Road, which is the subject of ongoing liaison with RMS and TfNSW.

3.5 Staging

The estimated earliest year for release of the first buildings for occupation is 2015, with the last block anticipated to be released by 2035. An indicative staging plan was developed in conjunction with the structure plan to assist planning of the progression of the development, whilst providing a level of flexibility to adapt to market opportunities if required. It is envisaged that:

- The residential and retail areas are likely commence development before the employment areas.
- Residential development would be relatively evenly spread across a 20 year timeframe. For the purposes of this study, we have assumed that all of the dwellings would be developed by 2031.
- Economic land use studies have indicated that commercial space could be developed at a maximum target of 10,000 m^2 GFA per annum. For the purposes of this study we have assumed that this could start from 2020, with commercial development delayed by market demand and other sites in neighbouring areas such as Sydney Olympic Park becoming available.

The development of the Carter Street UAP is expected to proceed in stages, as development sites become available. For the purposes of the rezoning assessment, the approximate staging plan shown in Table 3.2 has been assumed.

Table 3.2 Carter Street UAP approximate staging plan

Cumulative development	Phase 1	Phase 2	Phase 3	Phase 4
Dwellings	1000	1,430	2,750	5,500
Residents	2,100	2,860	5,500	11,550
Retail GFA (m^2)	1,600	3,100	6,100	12,000
Employment GFA (m^2)	0	15,600	55,000	111,000*
Jobs	0	780	2,750	5,550*

Note: Development beyond these figures is possible but not expected based on property cycles and multiple land parcel ownerships. Total permissible under the proposal is 170,783 m^2 GFA with jobs

This approximate staging plan has been translated spatially into development areas by phase, as shown in Figure 3.2. The timing of the release of land for development is yet to be determined and will be influenced by land owners and market conditions.

This staging plan has implications for the road network, as the development of the large site on the eastern side of Hill Road/southern side of Edwin Flack Avenue in Phase 4 would mean that the connection of John Ian Wing Parade extension to Hill Road would not be possible until after 2027. Instead, vehicles travelling to the northern part of the Precinct will be required to travel via Carter Street and Uhrig Road or Old Hill Link. This issue is important in resolving the location of the intersection of Hill Road and Carter Street.

Figure 3.2 Carter Street UAP approximate staging plan

4. Strategic context

The Carter Street Urban Activation Precinct (UAP) has been identified as a potential location of urban renewal. However, the surrounding area also contains other Government-supported urban renewal projects. This concentration of urban growth places additional pressure on surrounding transport infrastructure, but also offers a unique opportunity to use magnitudes of scale to realise significant improvements rather than the smaller-scale solutions that may eventuate if each development is assessed on its own merits.

The Hill Road and Birnie Avenue accesses off Parramatta Road provide the principal access points to the Carter Street UAP. However access route capacity is shared with the other adjacent development areas. Geometric constraints such as the cost/ability to widen Hill Road and Birnie Avenue under the M4 Western Motorway and the proximity of intersections limit the potential for additional capacity to be provided on these links.

4.1 State planning context

The rezoning of land for urban activation in the Carter Street Precinct is supported by State Government strategies and planning documents. The most relevant documents are reviewed in this section.

Draft Metropolitan Strategy for Sydney to 2031 (NSW Government, March 2013)

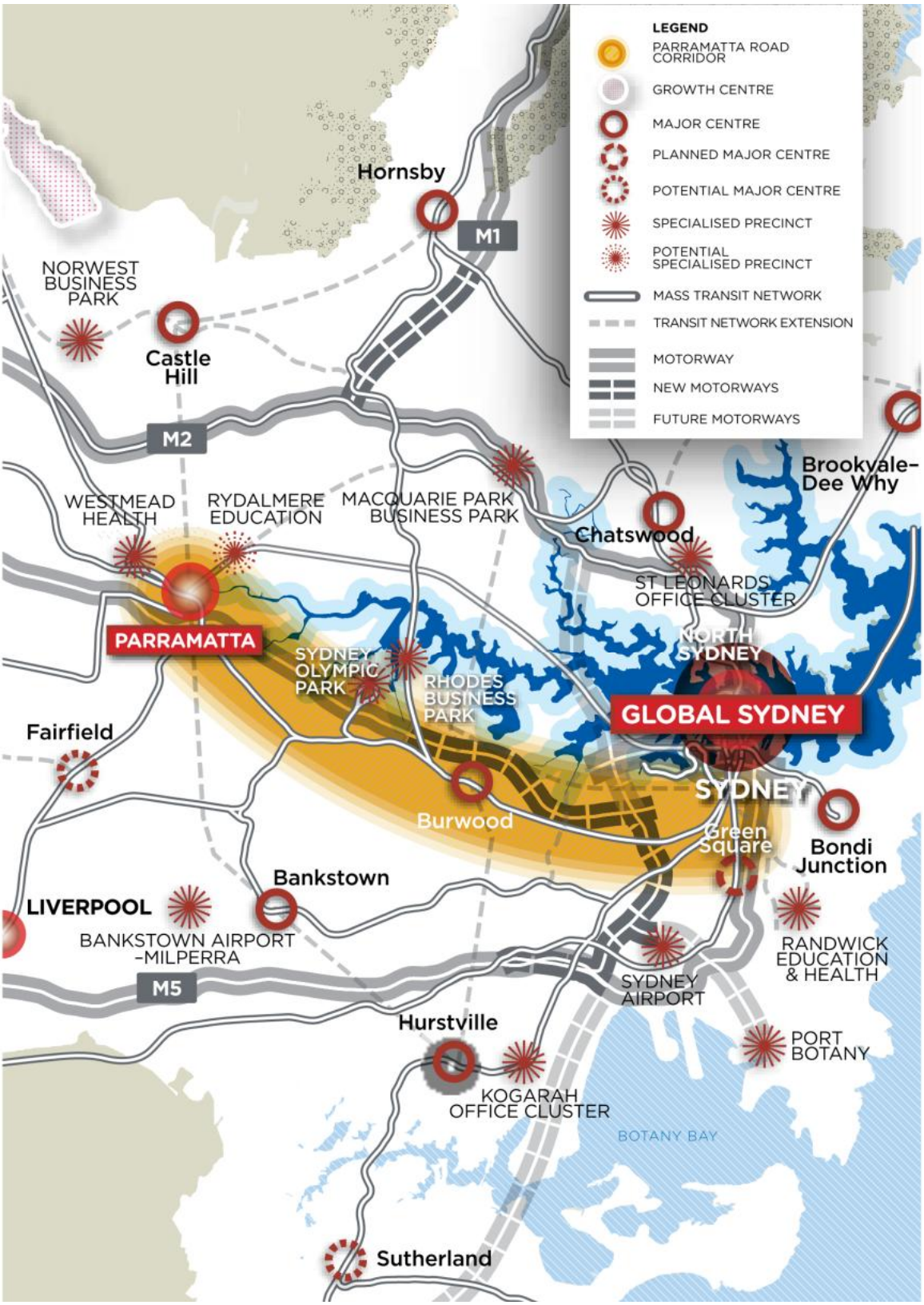
The Metropolitan Strategy is a long-term land use, urban and transport plan. It identifies the location of future urban development and the strategic transport corridors and major centres to become the focus of commercial and residential growth in the future.

The Metro Strategy outlines total growth targets by subregion, with the distribution of that growth to be determined by Subregional Delivery Plans. The Carter Street UAP is located in the West Central & North West subregion. The 2031 targets for this subregion are for an increase of population of 355,000 people, to be housed in 148,000 additional dwellings, with 142,000 additional jobs. The Carter Street UAP is one of the key growth areas designed to absorb some of this growth.

It identifies the Parramatta Road (which includes the Carter Street UAP) corridor as one of nine city-shapers. The priorities for the Parramatta Road Corridor include:

- deliver improved road connections through the WestConnex Motorway, ensuring improvements allow for better links between local centres so they can flourish and attract new investment
- deliver stronger east-west connections along, and at grade north-south connections across, Parramatta Road
- focus on Sydney Olympic Park as a Specialised Precinct to be a major location for employment, high density housing, sports and entertainment
- use the planned regeneration (in *Sydney Olympic Park Master Plan 2030)* to better integrate Sydney Olympic Park into adjacent areas
- facilitate delivery of Urban Activation Precincts at Carter Street and Wentworth Point as part of the wider regeneration of Sydney Olympic Park
- create high quality places and spaces at key points along and adjacent to Parramatta Road
- plan for well-designed housing including smaller dwellings and apartments to ensure the Corridor achieves a higher population density that can stimulate business and retail investment
- plan for a viable and frequent public transport service the length of the Corridor.

Figure 4.1 shows the Parramatta Road Corridor, Sydney Olympic Park specialised precinct and transport connections.



Source: Draft Metropolitan Strategy for Sydney to 2031 (NSW Government, March 2013)

Figure 4.1 Parramatta Road Corridor

NSW Long Term Transport Master Plan (Transport for NSW, December 2012)

The NSW Long Term Transport Master Plan (LTTMP) provides a framework for addressing transport challenges over the next 20 years. It identifies the Parramatta Road to CBD via Strathfield as a corridor under pressure, with trains on the Western Line experiencing high congestion and the M4 Western Motorway and Parramatta Road operating at capacity during peak periods. Proposed key actions include:

- Increasing rail frequency – this will increase the capacity for east-west rail journeys, primarily to Parramatta and Sydney CBD. However, rail use in the Homebush Bay subregion is restricted by the need to change trains at Lidcombe. Increasing the frequency on the Western Rail Line will reduce the amount of time lost during this interchange.
- M4 widening and connection to Port/Airport through the WestConnex project – see section 4.5 for a further discussion.

The Parramatta Road to CBD via Strathfield corridor is identified as a corridor for protection, along with the corridor from Sydney Olympic Park to Macquarie Park, in part due to the need for them to support future urban growth.

Source: Long Term Transport Master Plan (TfNSW, December 2012)

Figure 4.2 Corridors to support urban growth

Other actions identified along the Parramatta to CBD via Strathfield corridor include:

- address road pinch points on Parramatta Road between Granville and Strathfield
- progress development of Parramatta Valley Cycleway from Westmead to Sydney Olympic Park.

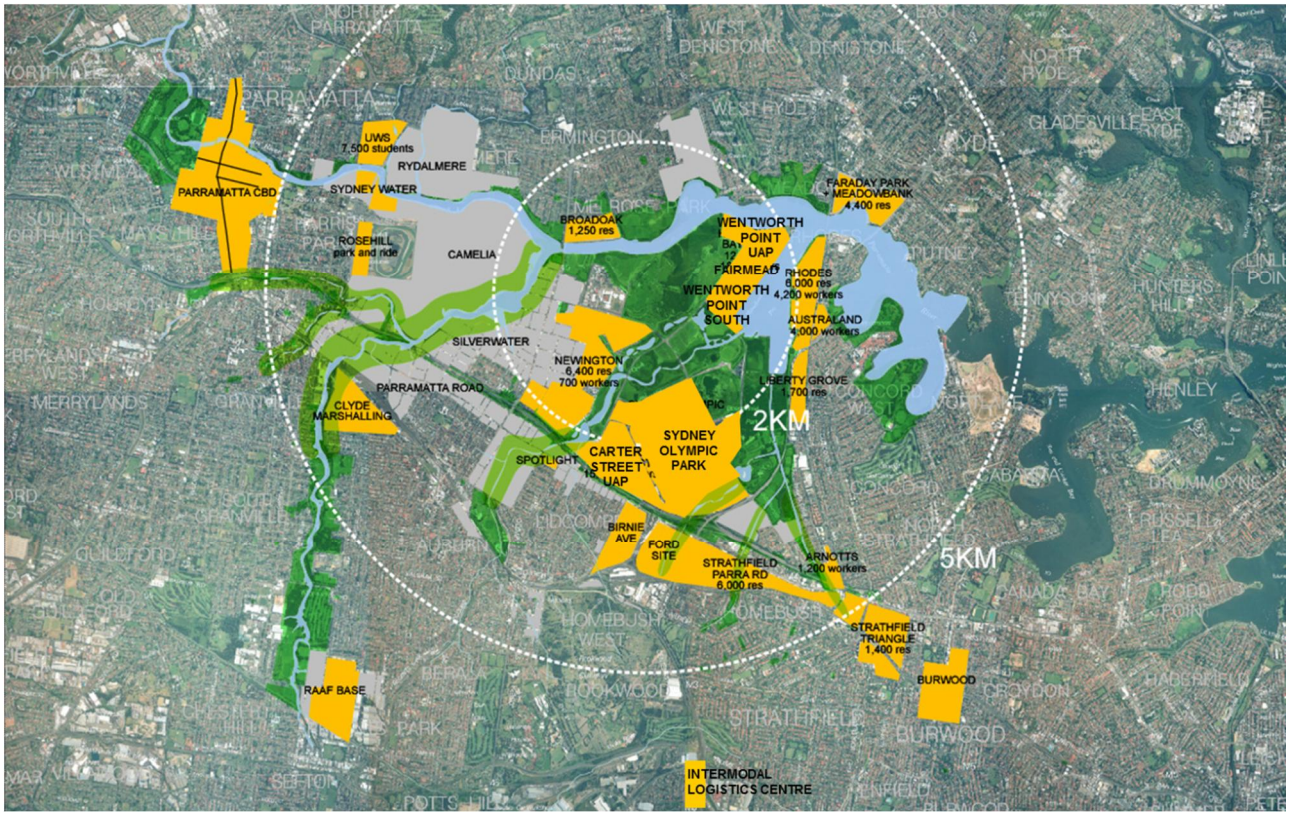
NSW 2021, a 10-year plan (NSW Government, 6 September 2011)

The State Government's *NSW 2021 10-Year plan* contains targets for improving transport services and shifting trips away from the use of private vehicles towards public transport, walking and cycling. The plan provides target mode shares for public transport for major centres in NSW, including a target of 50% to Parramatta CBD during peak hours by 2016, and a target of 28% across the Sydney Metropolitan Region.

Increasing the use of walking and cycling for trips is advocated, with the specific targets of more than doubling the mode share of bicycle trips and increasing the mode share of walking trips to 25% by 2016. This will be assisted through another aim of the plan to create planning policy that encourages job growth in centres close to where people live.

4.2 Surrounding developments

The Carter Street UAP is surrounded by several other developments to the north, east and west, as shown in Figure 4.3. The combined growth from these developments has the potential to justify a bigger scale of transport solution, which can have a more substantial and long-lasting impact. With two UAPs and the Government-supported redevelopment of Sydney Olympic Park town centre, there is a strong precedent to begin the process of planning for enhanced transport in the area.



Source: Adapted from Sydney Olympic Park Authority (2006)

Figure 4.3 Potential residential and employment growth sites in the Parramatta to Strathfield corridor

BTS Population and Employment Forecasts

To provide a cross-reference for the development yields listed in this section and in Section 5, the Bureau of Transport Statistics Population and Employment Forecasts (August 2012 Release) for the area have been extracted for 2011, 2021 and 2031. The results are shown in Table 4.1.

Table 4.1 BTS Population and Employment Forecasts

Description	Travel zone no.	Population			Residential dwellings			Workers		
		2011	2021	2031	2011	2021	2031	2011	2021	2031
Homebush Bay West	1613	3,093	10,932	12,389	1,595	5,695	6,652	664	701	726
Carter Street Precinct	1625	5	6	7	0	0	0	2,961	4,823	6,049
Sydney Olympic Park	1622, 1630	39	3,036	6,096	0	1,005	2,093	6,647	10,276	14,342
Sub-Total		**3,136**	**13,974**	**18,491**	**1,595**	**6,700**	**8,745**	**10,272**	**15,800**	**21,117**
Strathfield LEP Parramatta Road Corridor	1581, 1582, 1584, 1585, 1587	9,774	14,365	18,773	3,537	5,403	7,177	8,102	8,477	9,010
Parramatta Road Retail Precinct	1629	345	345	345	115	118	122	4,077	4,025	4,103
Sub-Total		**10,119**	**14,710**	**19,118**	**3,652**	**5,521**	**7,299**	**12,179**	**12,502**	**13,113**
Total		**13,255**	**28,684**	**37,609**	**5,247**	**12,221**	**16,044**	**22,451**	**28,302**	**34,230**

Source: BTS August 2012 Release Population and Employment Forecasts

The forecasts above are generally lower than the specific information gained from relevant studies for the respective developments. For example, Sydney Olympic Park Master Plan 2030 provides for 6,360 dwellings, as opposed to the 2,093 allowed for in the Population and Employment Forecasts.

Wentworth Point

The Wentworth Point area (also known as Homebush Bay West and Bay West) has commenced, and is planned as the site of further development in the future. The area has several land owners, and is being developed in stages.

The 2011 Census indicated that there were 1,190 dwellings inhabited by 2011, with a resident population of 2,759 people. Information provided by DP&I indicates that the cumulative maximum yield of residential development within Wentworth Point is estimated to be 9,500 dwellings, including an uplift in development approved on the basis of the associated construction of a new pedestrian, cycle, public transport bridge (the Homebush Bay Bridge). This has risen from the original estimate in the Homebush Bay West Development Control Plan (Auburn Council, 2004) of 6,000 dwellings.

The Wentworth Point area comprises (from north to south):

- Land owned by Sydney Olympic Park Authority near to and including Sydney Olympic Park Wharf – likely to yield approximately 200 dwellings and some retail space.
- Wentworth Point UAP – the second UAP within the precinct on land owned by RMS. Based on the Traffic Impact Assessment Urban Activation Precinct RMS Site, Wentworth Point, Homebush Bay (Traffix, April 2013), it is understood that this site could contain 2,300 dwellings, a small amount of retail for local shopping and possibly a new primary school.
- Fairmead Business, Sekisui House Australia, Homebush Bay Properties and Homebush Bay Holdings – a group of land parcels in the central portion of Wentworth Point comprising approximately 3,600 dwellings, including an uplift of approximately 1,350 dwellings approved provided the construction of the Homebush Bay Bridge for use by pedestrians, cycles, bus services and potentially light rail (see Figure 4.4) proceeds.
- Southern Wentworth Point including sites previously owned by TNT, Mariners and Palermo that has already largely been developed, with an ultimate yield of approximately 3,400 dwellings.

Source: Homebush Bay Bridge Draft Environmental Assessment Volume I - Main report (ARUP, February 2012)

Figure 4.4 Wentworth Point and Homebush Bay Bridge to Rhodes

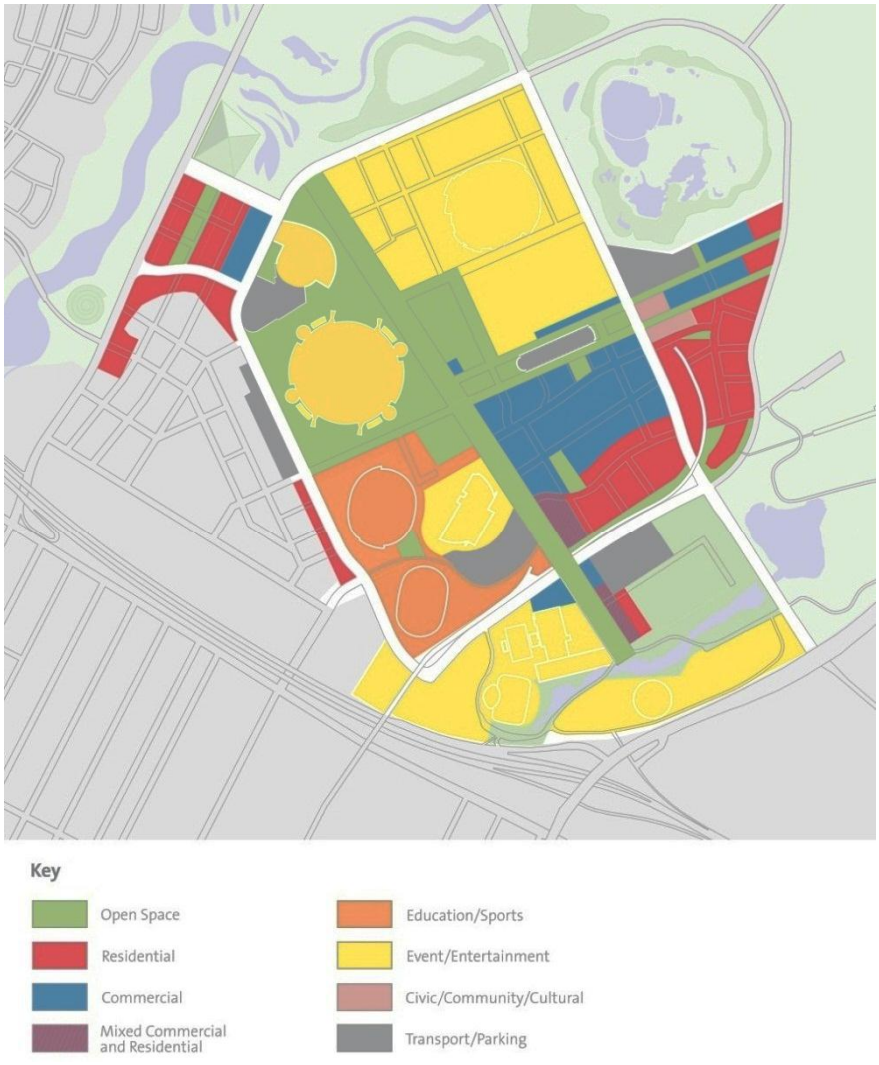
The Wentworth Point Transport Management and Accessibility Plan (Cattell Cooper, September 2012) for the Fairmead group of sites was focussed on the impact of the Homebush Bay Bridge and uplift in development (approximately 1,350 dwellings) required to fund its construction. It concluded that the Bridge could produce enough change in travel behaviour in the whole of Wentworth Point to result in no net increase in trips compared to the original development proposed in the Homebush Bay DCP. The target mode share of 65% car driver and passenger was adopted in favour of the existing 78%. As there was no net change in traffic generation, an in-depth traffic analysis was not undertaken.

The Traffic Impact Assessment Urban Activation Precinct RMS Site, Wentworth Point, Homebush Bay (Traffix, April 2013), assessed the traffic impact of the Wentworth Point UAP on local intersections and concluded that several intersections would need upgrading, including:

- construct traffic signals at the intersection of Hill Road and Bennelong Road
- improvements at the existing signal controlled intersection of the Bennelong Parkway with Australia Avenue
- construct traffic signals at the intersection of Hill Road and Burroway Road
- undertake improvements at the intersection of Hill Road with Holker Street
- construct a roundabout at the intersection of the Bennelong Parkway with Marjorie Jackson Parkway.

Sydney Olympic Park

The SOP Master Plan 2030 Transport Strategy allows for a total development of 1.425 million m^2 GFA (detailed in Table 4.2 and shown spatially in Figure 4.5). It includes 6,360 dwellings and a projected daily population of 14,000 residents, 5,000 students, 28,500 workers (including part-time workers at venues) and an expected 15,000 daily visitors.



Source: Sydney Olympic Park Master Plan 2030 (Sydney Olympic Park Authority, March 2010)

Figure 4.5 SOP Master Plan 2030 land use plan

Table 4.2 Sydney Olympic Park ultimate development scenario

Land use	Development area (GFA)
Commercial/office	414,836 m^2
Entertainment	14,586 m^2
Permanent residential	575,089 m^2
Temporary accommodation	65,976 m^2
Educational	104,590 m^2
Additions to existing venues	133,699 m^2
Community facilities	31,273 m^2
Retail	33,756 m^2
Transport infrastructure	51,430 m^2
Total	**1,425,236 m^2**

Source: Sydney Olympic Park Master Plan 2030 (Sydney Olympic Park Authority, March 2010)

Sydney Olympic Park Master Plan 2030 Transport Strategy (Parsons Brinckerhoff, August 2008) developed a number of transport objectives that have influenced Master Plan 2030 including:

- targeting an initial journey to work non-car mode share split of 25% in line with other specialised activity centres in the metropolitan area
- adopting a stretch target journey to work non-car mode share split of 40% with the introduction of a major public transport initiative such as metro rail in conjunction with increasing the level of commercial development
- monitoring and if necessary, adjusting the quantity of high traffic generating land uses to match road and public transport capacities
- strategically locating commercial and retail land uses around Olympic Park Station and close to local bus service corridors
- maintaining sufficient road capacity to support all levels of events, particularly during weekday commuter peak periods
- improving road connections to surrounding areas such as Newington and Bay West (Wentworth Point)
- limiting the provision of parking spaces for new developments to encourage transport use
- continuing the operation of high quality major event public transport services to existing high public transport mode shares
- maintaining regular public transport services, road access and parking supply sufficiently during major events
- designing a street network that supports bicycles, vehicles and pedestrian use
- building more efficient metropolitan and inter-city rail and bus connections
- integrating transport service planning with adjacent suburbs, especially to reduce reliance on private vehicle use for trips under 5 km
- spreading the commuter peak hours and promoting public and shared private commuter transport as alternatives to private motor cars
- meeting accessibility needs across the entire local transport and street network
- providing for new streets within development sites to facilitate vehicle access.

Many of these objectives are considered to be relevant to the Carter Street UAP. The transport assessment for Master Plan 2030 considered the overall transport capacity for Homebush Bay subregion (including an allowance of 60,000 m^2 for the Carter Street Precinct and 6,000 dwellings for Wentworth Point) and determined that full development of the commercial space potential within the area could not be supported by the current levels of public transport use and the current road network.

The transport assessment identified a number of local intersections that would require upgrading, including amongst others:

- Parramatta Road, Hill Road and Bombay Street
- Hill Road and the M4 Motorway ramps
- Hill Road and Carter Street
- Carter Street and Uhrig Road
- Edwin Flack Avenue, Dawn Fraser Avenue and Uhrig Road
- Edwin Flack Avenue and Birnie Avenue (recently completed)
- Birnie Avenue and Carter Street
- Parramatta Road and Birnie Avenue.

It also assessed long-term road upgrades and their potential to increase road capacity, including the M4 East (now part of the WestConnex project, and a new eastbound on-ramp from Hill Road to the M4 Western Motorway.

Parramatta Road Retail Precinct

The Parramatta Road Retail Precinct Transport Management and Accessibility Plan (TMAP) (Sinclair Knight Merz (SKM) on behalf of Auburn City Council, 10 February 2011) provided a traffic and transport assessment of potential office, bulky goods retail and shopping centre development along Parramatta Road to the west of Hill Road. The traffic model used for the study covered the surrounding area including the Carter Street Precinct. The proposal included an increase from 229,872 m^2 GFA in 2009 to 281,660 m^2 GFA by 2019 – an increase of 23%.

The SKM report was comprehensive in its modelling of the traffic conditions in the immediately surrounding area, but did not include all of the development in the area such as Strathfield LEP Parramatta Road Corridor, other than a 2% background growth allowance. Although stated in the text that the model included development at 'Sydney Olympic Park, Carter Street Precinct and Homebush Bay West', only the details of the Carter Street Precinct and SOP were provided. It is therefore not clear as to whether Wentworth Point was included.

The SKM study included an allowance of 30,442 m^2 GFA of commercial development for Carter Street and 75% development of the SOPA lands. The SKM study recommended a large number of road upgrades. Recommendations of upgrades for the intersection of Parramatta Road and Hill Road, to be introduced by 2019 included:

- additional through lane on Parramatta Road westbound
- extend right turn bay into Hill Road (Westbound). This would include prohibiting right turn into Platform Street
- Bombay Street – Three lane exit (one left turning, one shared through and right turning, one right turning) to Parramatta Road
- duplicating the right turning bay from Parramatta Road to Hill Road
- slip lane from Parramatta Road to Hill Road.

Other upgrades recommended as part of the Homebush Bay Area Traffic Study include:

- Carter Street/Birnie Avenue – left in/out only
- Carter Street/Birnie Avenue, and Birnie Avenue/Edwin Flack Avenue – left turn slip lane in and out of Carter Street and signalisation of both intersections
- Carter Street/Uhrig Road – remove parking to create four lane undivided road
- Edwin Flack Avenue/Birnie Avenue – slip lane on southern approach
- Edwin Flack Avenue/Old Hill Link – slip lane on southern approach
- Edwin Flack Avenue/Uhrig Road – signalisation of this intersection and pavement construction
- Hill Road/Carter Street – left in/left out only (this will require bus exception for existing bus routes)
- Hill Road/Old Hill Link – change configuration from two-through and one-right to one-through and two-right turning lanes (northbound).

The intersection of Parramatta Road and Birnie Road intersection was forecast to have an unacceptable level of service in the PM. However, the M4 Bridge restricted the ability to provide additional capacity.

Strathfield Local Environment Plan (LEP) Parramatta Road Corridor

Strathfield Council's plans for the Parramatta Road Corridor[4] include urban renewal along Parramatta Road to the east of Centenary Drive, including the retention and expansion of food-related business around Flemington Markets. The LEP documents provide floor space ratios, building heights and zonings, but do not provide specific information on yields. The Strathfield LEP Parramatta Road Corridor studies did not analyse the traffic impacts.

Summary

Each of the studies for these development areas has assumed an increase in total development yields for the Homebush Bay subregion, but the constraints of the surrounding road network, access gateways and non-direct train services have not changed. The Sydney Olympic Park Master Plan did consider wider public transport improvements as an essential component to cater for the development plans, but firm plans for new services are currently not available. The Traffix study was the most recent and contained a review of other studies, but did not consider the traffic capacity of the wider arterial road network. A comprehensive traffic and transport assessment of the area is recommended to enable a holistic plan to be developed.

4.3 Transport upgrades

WestConnex and Parramatta Road Corridor revitalisation

WestConnex is a major road network infrastructure project that combines several motorway projects into a package of 33 kilometres of new motorway links (See Figure 4.7). Projects include the widening of the M4, an M4 extension to Camperdown, duplication of the M5 East and the development of a new north-south connection to link the M4 with Sydney Airport and Port Botany and southern Sydney. Through these works WestConnex will directly address three of the six constrained transport corridors outlined in the LTTMP.

WestConnex has two key interdependent features:

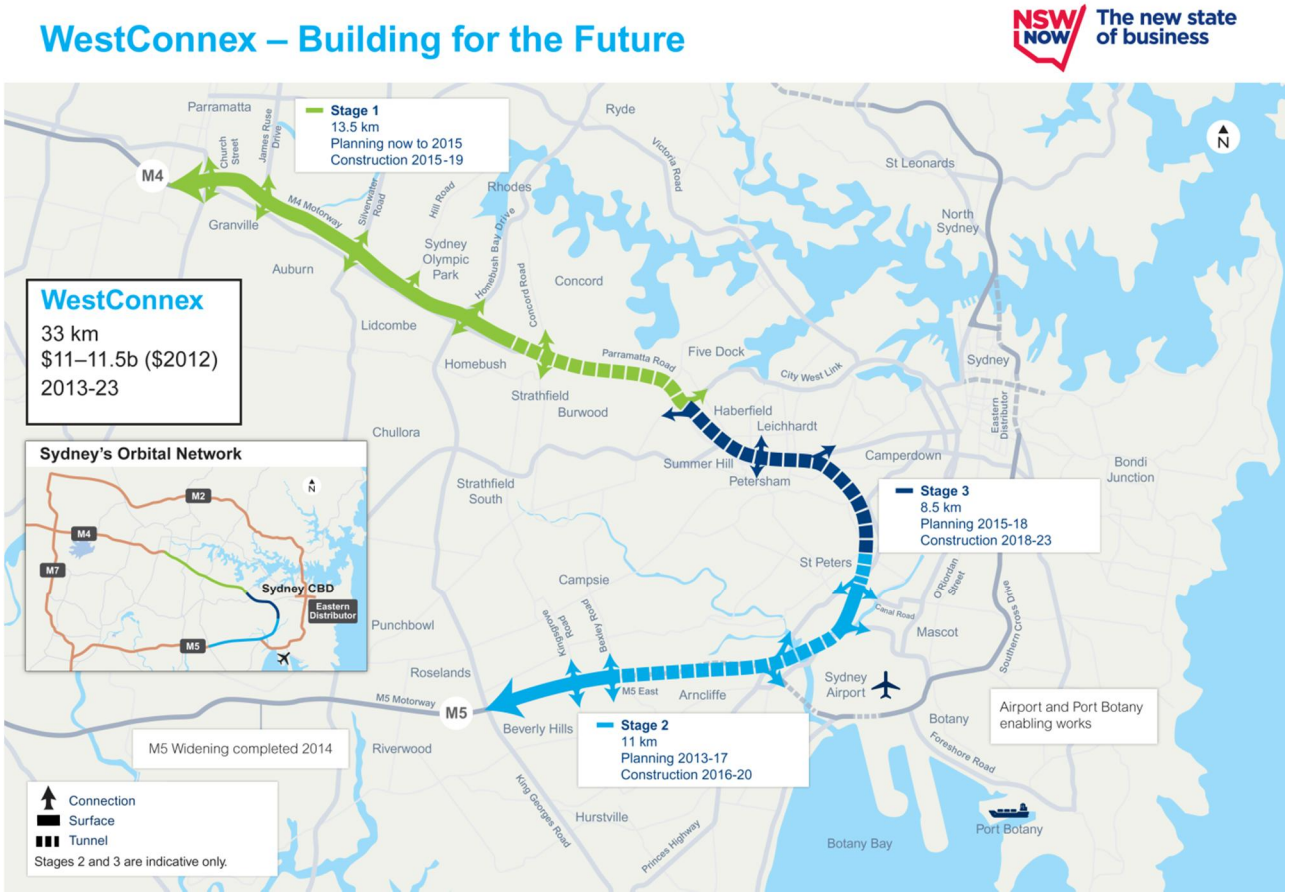
- a 33 km motorway, linking Sydney's west with the CBD, Port Botany, Sydney Airport and the south-west, to be built over 10 years

[4] Strathfield Comprehensive Local Environmental Plan Parramatta Road Corridor Urban Design (Strathfield Council and Sustainable Urbanism, February 2011)

- a 20 km urban revitalisation corridor to be developed progressively between Camperdown and Parramatta over 20 years.

The plan for WestConnex as outlined in the business case is to[5]:

- cut forecast travel times between Parramatta and Sydney Airport by up to 40 minutes
- effectively halve bus travel times between the Inner West and the CBD
- create 10,000 jobs during the construction phase, including hundreds of apprenticeships
- bypass up to 52 sets of traffic lights
- remove 3,000 trucks a day from Parramatta Road and put them underground, leading to revitalised neighbourhoods on the surface
- improve north-south travel times across Parramatta Road for public buses accessing the Western Rail line at Burwood and other stations
- provide the environment for 25,000 new jobs and 25,000 residences to be created over the next 20 years along Parramatta Road
- deliver more than $20 billion in economic benefits to NSW.



Source: WestConnex Business Case Executive Summary (Transport for NSW 2013)

Figure 4.6 Proposed WestConnex project

5 WestConnex Stage 1 Parramatta to Haberfield Factsheet (Transport for NSW, September 2013) WestConnex Business Case Executive Summary (Transport for NSW, 2013)

The LTTMP outlines the following outcomes of the WestConnex project which are of relevance to the urban development in the subregion.

- Support Sydney's long term economic growth through improved motorway access and connections linking Sydney's international gateways and Western Sydney and places of business across the city.
- Relieve road congestion so as to improve the speed, reliability and safety of travel in the M4 and M5 corridors, including parallel arterial roads.
- Cater for the diverse travel demands along these corridors that are best met by road infrastructure.
- Create opportunities for urban renewal, improved liveability, public and active transport improvements along and around Parramatta Road.
- Enhance the productivity of commercial and freight generating land uses strategically located near transport infrastructure.
- Optimise user pays contributions to support funding in a way that is affordable and equitable.

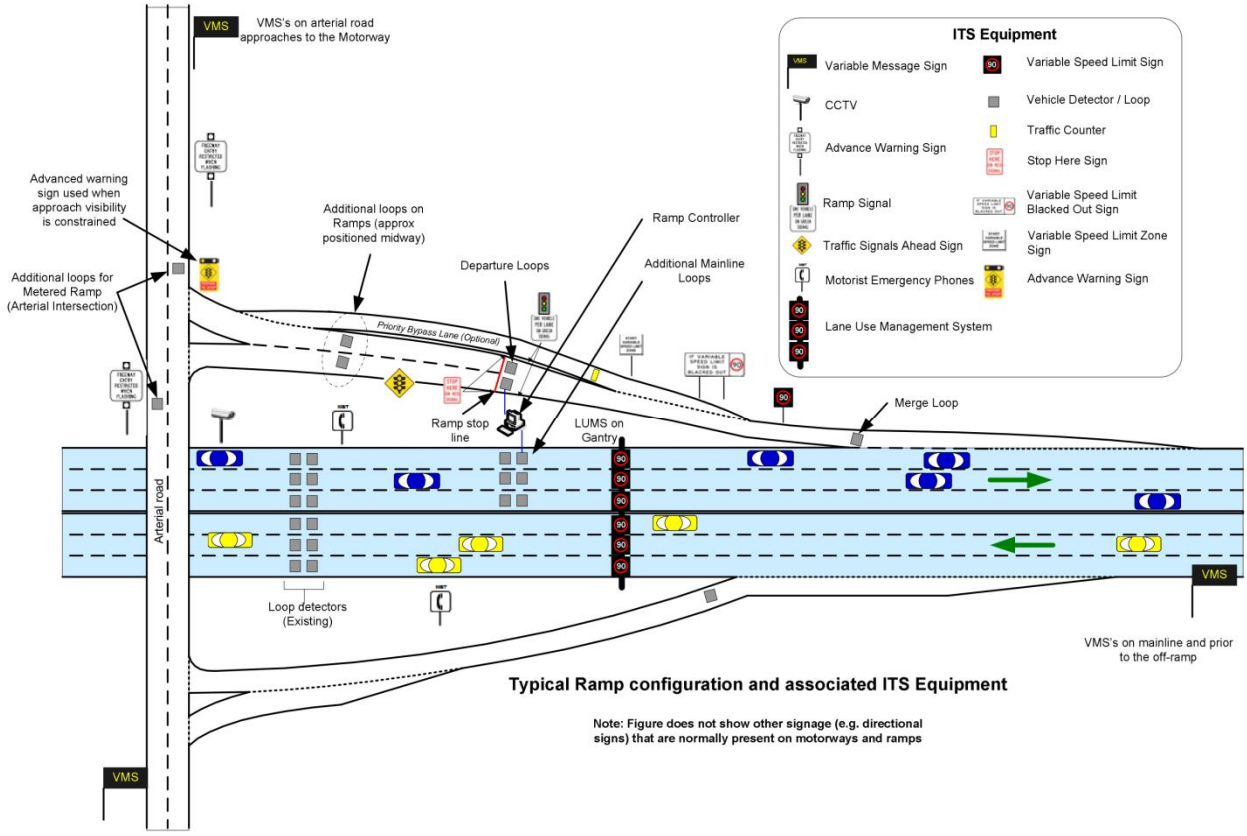
Part of the funding for the WestConnex project will come from a toll for motorway users, although the exact details and charges will not be finalised until construction starts. This toll may result in some diversion of traffic from the currently un-tolled motorway to Parramatta Road. Whilst the overall traffic capacity of the corridor would be increased, this may have further implications to the capacity of Parramatta Road and its associated intersections.

As part of the package of supporting works for the WestConnex project, new ramps are proposed:

- new on-ramp from Hill Road (southbound) to the M4 Western Motorway (eastbound)
- loop on-ramp from Homebush Bay Drive (southbound) to the M4 Western Motorway (westbound) – replacing signalised right-turn.

These new ramps are likely to increase flows southbound on Hill Road and may change the amount of traffic travelling through Sydney Olympic Park streets to bypass the Homebush Bay Avenue/M4 Motorway Interchange. A more detailed analysis of the interaction between the WestConnex project and the Carter Street UAP is provided in section 5.4.

RMS is proposing to undertake a trial of a Managed Motorways Scheme (MMS) on the M4 Western Motorway to make better use of the current motorway through the managing ('smoothing') of traffic demand to avoid/reduce the incidence of traffic flow 'breaking down'. The MMS would involve controlling the number and timing of vehicles entering the motorway to avoid stop-start conditions forming and improved detection of incidents and implementation of management strategies. The MMS involves the use of technology and targeted infrastructure to manage current infrastructure more efficiently, and has great potential for the entire motorway network. When constructed, the new Hill Road eastbound on-ramp will have MMS. The queue of vehicles held on the new ramp until there is a suitable gap on the Motorway may affect the flow of traffic southbound on Hill Road.



Source: M4 Managed Motorway Concept of Operations (RMS, 21 November 2012)

Figure 4.7 Managed Motorway Scheme concept sketch

Ramp signalling would involve using traffic signals on the ramps to 'drip feed' ramp traffic onto the motorway at a rate that can be accommodated by the merge area, rather than releasing a large platoon of vehicles at once. The traffic signals would give a green signal for a short time (say 2 seconds) to only release one or two vehicles, followed immediately by a red signal. The rate at which these green signals are shown would be controlled to match the merge capacity.

Western Sydney Light Rail Network

The role of light rail as an intermediate transit mode is increasing in NSW. State government currently has three light rail schemes under construction or in development including:

- Inner West light rail extension (opening early 2014)
- CBD and South East light rail (due for completion 2019/2020)
- Newcastle light rail (under investigation).

The Western Sydney Light Rail Network is a scheme proposed by Parramatta City Council to introduce light rail into the western suburbs of Sydney with a focus on supporting the growth of the Parramatta CBD. The NSW Long Term Transport Master Plan developed by Transport for NSW and the State Infrastructure Strategy by Infrastructure NSW both provided in principle support to exploring the merits of the Western Sydney Light Rail Network.

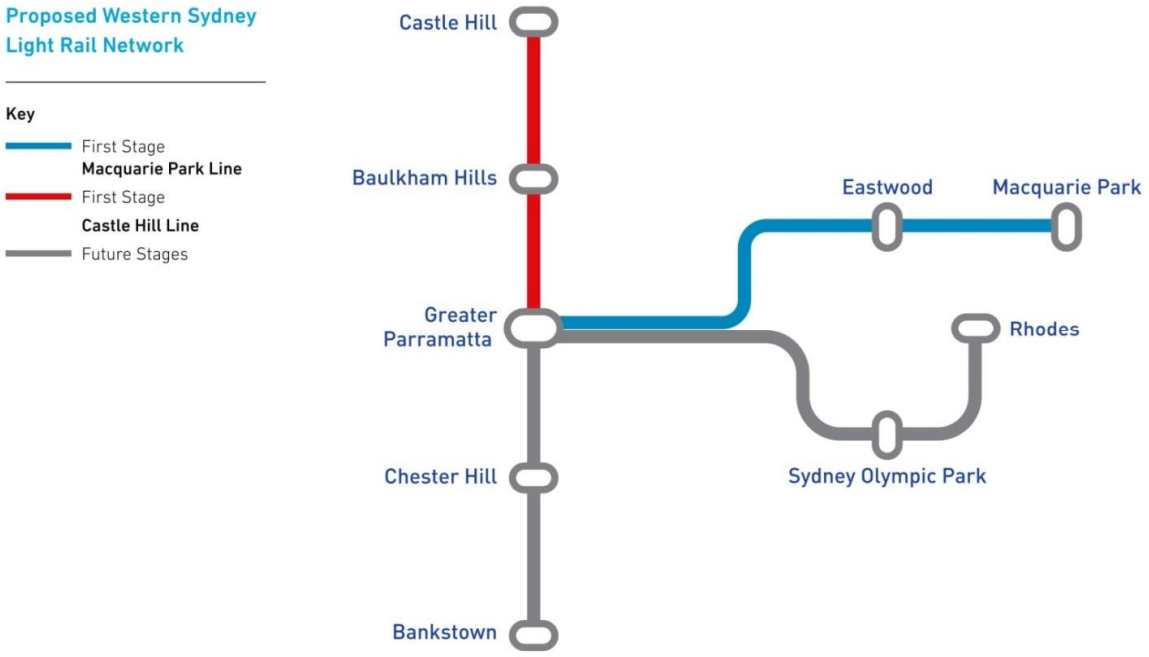
Light rail is one potential solution to the additional public transport services required to meet the mode share targets for the developments within the Homebush Bay subregion. A detailed feasibility into the Western Sydney Light Rail Network has been finalised. The Part 1 study outlined the benefits of developing a Light Rail line between Parramatta and Sydney Olympic Park. The development projections used in the patronage calculations did not include the most recent targets for the UAPs at Carter Street and Wentworth Point, which would further enhance its feasibility.

The levels of cumulative development proposed in the Homebush Bay subregion cannot be accommodated solely on the road network and the existing public transport network. Commercial development at Sydney Olympic Park town centre is capped under the SOP Master Plan 2030 until a new high-capacity public transport line(s) can be built. While an allowance was made for some redevelopment in the Carter Street Precinct, the development yield outlined in Table 3.1 is likely to contribute to further breaches of this cap in the future, unless a new public transport scheme can be introduced.

An analysis of trip patterns from 2011 indicates that there is a strong demand from employees living in the western suburbs to employment in Sydney Olympic Park and Carter Street UAP to travel to the area. Similarly, the proposed employment growth targets for the Parramatta CBD (to further reinforce its role as Sydney's second CBD) will require a workforce located within a reasonable travel time of the centre. The Homebush Bay subregion's residential capacity has the potential to meet these demands.

Figure 4.9 outlines Parramatta City Council's scheme, to incorporate a line via Sydney Olympic Park and Rhodes. While the Sydney Olympic Park Line was not included in the Parramatta's preferred first stage of the network implementation, the magnitude of development in the Homebush Bay subregion provides more urban regeneration opportunities and support to existing redevelopments (i.e. Rhodes, Wentworth Point, Newington, Sydney Olympic Park, Carter Street). It is recommended that in further studies an extension to Carter Street on the proposed Sydney Olympic Park line be investigated to support the Carter Street UAP.

Parramatta's light rail scheme is similar to a previous proposal for a Transitway between Parramatta and Strathfield that was first announced in Action for Transport 2010, the major transport policy document developed by the State Government in 1998. Since this time cross-regional bus services have been introduced (route 525) and the proposed West Metro was planned to link these two key centres (Sydney Olympic Park/Carter Street and Parramatta). Since the deferment of the Sydney Metro scheme, no further investigations have taken place into transport to support land use growth until the recent study by Parramatta Council. In that time (1998–2012), the worker and residential population of the Homebush Bay subregion has seen significant growth.



Source: Western Sydney Light Rail network, Part 2 Feasibility Report, (Parramatta City Council, August 2013)

Figure 4.8 Proposed Western Sydney Light Rail Network

The Western Sydney Light Rail Network scheme investigations by Parramatta City Council have now been completed. Parramatta City Council and its regional partners are now passing the scheme to state and federal government for further consideration and scheme development.

4.4 Regional road network constraints

The Homebush Bay subregion is bound by three regional roads and a motorway that are important elements of the Sydney's road network. A further complexity to the subregion is that two of these regional roadways are also north-south crossings of the Parramatta River/Sydney Harbour, of which there are only five between Parramatta and Sydney. This attracts a significant amount of cross-regional through traffic to these two crossings.

The urban redevelopment within Homebush Bay subregion, including the Carter Street UAP, is reliant on access to these regional roads through five gateway intersections which include:

- M4 Western Motorway ramps at Hill Road
- Parramatta Road and Hill Road
- Parramatta Road and Birnie Avenue
- Homebush Bay Drive and Australia Avenue
- Silverwater Road and Holker Street.

The capacity of the regional road network which provides access to the subregion is constrained in terms of available capacity in the commuter peaks. The regional road network is also influenced by traffic generated by traffic developments adjacent to the subregion as well as through traffic using strategic road network links such as crossings of the Parramatta River. The emergence of the WestConnex project also has the potential to significantly influence road operations in the subregion. This project is only in its early stages of planning and will evolve over the coming decade.

The important function of these gateway intersections for access to events at Sydney Olympic Park together with the future opportunities to introduce road based intermediate public transport (BRT and/or LRT) mean that any upgrades are complex and require specific planning and associated funding to ensure the urban redevelopment goals of government are considered and implementable to the benefit of the local communities within the subregion.

It is understood that Government has committed to establishing a solution to unlocking additional regional road capacity, noting that there are several stakeholders involved in this process, including local councils, Department of Planning and Infrastructure, Transport for NSW, SOPA and RMS. A regional road network capacity optimisation assessment should be undertaken to determine if all development opportunities and associated road upgrades can be achieved. These upgrades should then be implemented through the appropriate funding mechanisms based on contributions by the above listed stakeholders.

5. Traffic impact assessment

The traffic modelling for this assessment has been completed using a combination of a Microsoft Excel trip generation spreadsheet model with SIDRA intersection modelling of the forecast traffic volumes. The spreadsheet model uses a traditional four-step modelling process, including trip generation, mode choice, distribution and assignment. This method has been used to highlight the impacts of the Carter Street UAP. It acknowledges that there are regional changes to the traffic network as a result of increasing demand on regional arterial roads and the WestConnex project that will need to be assessed by a wider transport assessment by the relevant authority at a later date.

5.1 Trip generation

Trip generation has been estimated for each land use envisaged for the Precinct using published rates and travel information from BTS' Household Travel Survey (HTS).

Residential

BTS' Household Travel Survey is a good source of travel behaviour information for the future residents of the Precinct. The residential trip generation rate has been calculated assuming:

- 3.9 average trips per person per weekday[6]
- 8.6% of trips during the AM peak hour[7].

Based on the average number of people per dwelling planned for the developments in the Homebush Bay subregion, the rate per dwelling is estimated as 7.83 trips per day and 0.63 trips per dwelling (all modes) during the peak hour. After mode split and trip purpose calculations, this rate equates to 0.3 vehicle trips per dwelling during the peak hour. Given the anticipated low average occupation, restricted parking provision and access to public transport for the Precinct, this rate compares reasonably to the published RMS' *Technical Direction TDT2013-04* rate of 0.66 trips (all modes) per dwelling during the peak hour for high density dwellings, but is higher than the peak vehicle trip rate. This is considered reasonable given its proximity to high frequency public transport compared to the locations surveyed in TD2013-04.

Employment

Daily and peak trip generation rates (all modes) from the RMS' *Technical Direction TDT2013-04* for office were adjusted for forecast employee density. Assuming five employees per 100 m^2 to better reflect the anticipated employee density for the UAP employment areas, these rates have been converted to all-mode trip numbers as follows:

- 11.0 daily trips per 100 m^2 GFA
- 2.1 trips per 100 m^2 GFA during the evening peak hour.

The peak hour rate equates to 41% of employees travelling during the peak hour. This is compatible with the surveys of employee trip behaviour in Sydney Olympic Park.

6 Household Travel Survey Summary Report - 2012 Release (BTS, June 2012) – averaged for selected inner city and north shore council areas

7 Calculated from Figure 3.10.3 motorised (unlinked) trips for selected modes by time of day, average weekday, 2009/10 of Household Travel Survey Summary Report - 2011 Release (BTS, August 2011)

Retail

Similarly, the RMS TDT2013-04 rate for a small shopping centre (i.e. less than 10,000 m^2) has been converted to an all-mode trip generation rate. The RMS detailed retail trip generation formula, based on the estimated floor area of supermarket, speciality stores and office/medical was used to calculate a rate for the retail within the Precinct. These were then converted to total (all-mode) trips based on sites with a 49% car driver mode share. This equated to:

- 136.1 daily trips per 100 m^2 GFA
- 14.5 trips per 100 m^2 GFA during the Thursday evening peak hour.

During the peak, it is assumed that some of trips will be linked, i.e. stopping at the shop on their way to somewhere else, as opposed to trips exclusively for shopping.

Other developments

As mentioned in section 4, the Carter Street UAP is one of several developments within the Homebush Bay subregion. Some of these developments have already started, while some are still being planned. Table 5.1 outlines the current understanding of these developments and their progress to completion. In this assessment, the future number is taken as the ultimate development scenario.

Table 5.1 Homebush Bay subregion development and completion

Development		Residents	Dwellings	Retail (m^2 GFA)	Commercial (m^2 GFA)	Industrial (m^2 GFA)	Workers
Sydney Olympic Park[1]	Future	14,000	6,360	33,756	414,838		28,500
	Existing	1,855	840	6,260	105,022		6,650
Wentworth Point	Future	20,000	9,500	1,000			50
	Existing	2,760	1,190			39,000	660
Carter Street UAP[3]	Future	11,550	5,500	12,000	170,000		8,500
	Existing					245,000	2,960
Parramatta Road East[4]	Future	18,800	7,180	Not considered			
	Existing	9,800	3,540				
Parramatta Road Retail[5]	Future		50 motel rooms	123,179	152,022	3,600	6,970
	Existing			88,670	115,414	25,788	4,660
Newington[4]	Future	8,300	3,200	4,000	15,000		1,200
	Existing	6,470	2,400	4,000	13,500		1,060
Total	**Future**	**72,100**	**31,740**	**173,935**	**751,860**	**3,600**	**45,220**
	Existing	**20,885**	**7,970**	**98,930**	**233,936**	**309,788**	**15,990**
	% complete	**29%**	**25%**	**57%**	**31%**	**-**	**35%**

(1) Sydney Olympic Park Master Plan 2030 Transport Strategy (Parsons Brinckerhoff, August 2008).
(2) NSW Department of Planning & Infrastructure advice.
(3) LFA (Pacific) Pty Ltd Architects, Urban Designers, 4 September 2013.
(4) BTS August 2012 Release Population and Employment Forecasts
(5) Parramatta Road Retail Precinct Transport Management and Accessibility Plan (TMAP) (Sinclair Knight Merz, 10 February 2011).

Total trips

The change in total numbers of trips (all modes) between 2013 and 2031 for the AM and PM peaks as well as the typical weekday are shown in Table 5.2.

Table 5.2 Change in trip numbers (all modes) by site and time period for developments in the Homebush Bay subregion (2013–2031)

Development	Daily		AM peak hour		PM peak hour	
	In	Out	In	Out	In	Out
Sydney Olympic Park	42,330	42,330	5,520	3,610	3,490	3,610
Wentworth Point	31,390	31,390	1,350	4,000	2,750	890
Carter Street UAP	24,990	24,990	2,300	2,990	2,430	1,530
Parramatta Road East	13,600	13,600	600	1,750	1,200	380
Parramatta Road Retail	13,120	13,120	1,150	680	1,350	930
Newington	3,080	3,080	160	380	270	100
Total	**128,510**	**128,510**	**11,080**	**13,410**	**11,490**	**7,440**

Directional split

The percentage of trips into and out of the developments calculated by land use type based on percentages assumed for the AM and PM peak hours is shown in Table 5.3. The directional split assumed across the day is 50% trips in/50% trips out.

Table 5.3 Assumed directional split for peak hour trips

Time period	Direction	Residential	Retail	Commercial	Industrial
AM peak	In	25%	50%	90%	90%
	Out	75%	50%	10%	10%
	Total	**100%**	**100%**	**100%**	**100%**
PM peak	In	60%	50%	15%	15%
	Out	40%	50%	85%	85%
	Total	**100%**	**100%**	**100%**	**100%**

(1) ITE Trip Generation, 7th edition, rounded to the nearest 5%

Based on the RMS Technical Direction *TDT2013-04 Guide to Traffic Generating Developments Updated traffic surveys*, it is also assumed that the residential trip generation rate for the PM peak hour trip generation is 85% of the AM peak hour, i.e. less residential trips in the afternoon peak. Retail trip generation during the AM peak hour was assumed to be half of trip generation during the PM peak hour.

Mode share

The potential mode shares for the development in the area was based on the percentages for surrounding areas, calculated from 2011 JTW data presented in Tables 2.2 and 2.3. These were adjusted for the transport conditions in the surrounding area, including:

- increasing road congestion making travel via other modes more competitive
- constrained levels of parking provided on-site, especially for workers

- a new high capacity, frequent public transport service increasing the capacity and convenience of the public transport network
- increased living/working within the area, making walking, cycling and local bus trips more feasible.

The proposed mode shares for the area by land use, trip purpose and time of day are shown in Table 5.4. This process is in line with the transport assessments for surrounding developments, such as the Sydney Olympic Park (40% non-car modes for JTW), Fairmead Development (35% non-car modes) and Wentworth Point UAP (adopted Fairmead Development mode share).

Table 5.4 Mode share of trips by land use and journey purpose

Travel mode	Residential				Commercial
	Work	Education	Shopping	Other	
Vehicle driver	60%	30%	49%	43%	65%
Vehicle passenger	5%	37%	13%	27%	5%
Train	10%	13%	8%	5%	9%
Ferry	10%	0%	0%	0%	10%
Bus	5%	3%	2%	1%	5%
Walk	8%	16%	28%	23%	4%
Cycle	2%	0%	0%	0%	2%
Total	**100%**	**100%**	**100%**	**100%**	**100%**

(1) Retail adjusted for passing pedestrian/commuter trade during morning peak

NSW 2021 contains the targets of 28% of total journeys to work by public transport by 2016. The 24%/25% proposed for the Carter Street UAP is slightly lower than this target, but given the distance from Sydney Olympic Park Station and the interchange required at Lidcombe Station, the contribution to this target by rail was set at what is considered to be an achievable level.

Overall, the mode share adopted for the area is shown in Table 5.5.

Table 5.5 Mode share of trips (all purposes, all sites)

Travel mode	Weekday	AM peak hour	PM peak hour
Vehicle driver	50%	52%	52%
Vehicle passenger	15%	14%	13%
Train	8%	9%	8%
Ferry/Light Rail	3%	5%	3%
Bus	2%	3%	3%
Walk	21%	16%	19%
Cycle	1%	1%	1%
Total	**100%**	**100%**	**100%**

The NSW 2021 includes the target of doubling the mode share for trips by bicycle by 2016. Starting from a low base, improvements to the cycle mode share will be assisted by the change in land use and the connection of the Precinct into the surrounding cycle network. The 1% cycle mode share overall target is expected to be heavily biased towards local trips. Section 6.5 outlines the cycle network proposed for the Precinct.

Trip generation by site and time period

The net change in trips generated by each site between 2013 and ultimate development (assumed to occur in 2031 for the purposes of this analysis) have been allocated to different modes of transport using the trip purpose and mode share information outlined earlier. The resulting trip numbers are provided in Table 5.6.

Table 5.6 Change in weekday trips generated from each site by mode (2013 to 2031)

Development	Vehicle driver	Vehicle passenger	Train	Ferry/ Light rail	Bus	Walk	Cycle	Total
Into development								
Sydney Olympic Park	22,610	5,440	3,480	1,880	1,280	7,200	440	42,330
Wentworth Point	15,190	5,540	2,490	940	770	6,210	250	31,390
Carter Street UAP	12,180	4,170	1,980	670	590	5,220	180	24,990
Parramatta Road East	6,580	2,410	1,080	410	330	2,680	110	13,600
Parramatta Road Retail	6,650	1,560	1,030	160	250	3,410	60	13,120
Newington	1,500	530	250	100	80	590	30	3,080
Total	**64,710**	**19,650**	**10,310**	**4,160**	**3,300**	**25,310**	**1,070**	**128,510**
Out of development								
Sydney Olympic Park	22,610	5,440	3,480	1,880	1,280	7,200	440	42,330
Wentworth Point	15,190	5,540	2,490	940	770	6,210	250	31,390
Carter Street UAP	12,180	4,170	1,980	670	590	5,220	180	24,990
Parramatta Road East	6,580	2,410	1,080	410	330	2,680	110	13,600
Parramatta Road Retail	6,650	1,560	1,030	160	250	3,410	60	13,120
Newington	1,500	530	250	100	80	590	30	3,080
Total	**64,710**	**19,650**	**10,310**	**4,160**	**3,300**	**25,310**	**1,070**	**128,510**

Table 5.7 Change in AM peak hour trips generated from each site by mode (2013 to 2031)

Development	Vehicle driver	Vehicle passenger	Train	Ferry/ Light rail	Bus	Walk	Cycle	Total
Into development								
Sydney Olympic Park	3,360	430	500	450	250	440	90	5,520
Wentworth Point	640	250	130	60	50	210	10	1,350
Carter Street UAP	1,310	250	210	160	90	250	30	2,300
Parramatta Road East	280	110	60	30	20	90	10	600
Parramatta Road Retail	640	110	100	50	40	200	10	1,150
Newington	80	30	10	10	10	20	0	160
Total	**6,310**	**1,180**	**1,010**	**760**	**460**	**1,210**	**150**	**11,080**
Out of development								
Sydney Olympic Park	1,800	580	340	160	120	570	40	3,610
Wentworth Point	1,900	740	390	170	130	630	40	4,000
Carter Street UAP	1,450	520	280	130	100	480	30	2,990
Parramatta Rd East	830	320	170	80	60	270	20	1,750
Parramatta Rd Retail	350	80	50	10	10	180	0	680
Newington	180	70	40	20	10	60	0	380
Total	**6,510**	**2,310**	**1,270**	**570**	**430**	**2,190**	**130**	**13,410**

Table 5.8 Change in PM peak hour trips generated from each site by mode (2013 to 2031)

Development	Vehicle Driver	Vehicle Passenger	Train	Ferry/ Light rail	Bus	Walk	Cycle	Total
Into development								
Sydney Olympic Park	1,800	490	290	130	100	650	30	3,490
Wentworth Point	1,320	500	220	90	70	530	20	2,750
Carter Street UAP	1,210	390	200	80	60	470	20	2,430
Parramatta Road East	570	220	100	40	30	230	10	1,200
Parramatta Road Retail	680	160	110	10	20	360	10	1,350
Newington	130	50	20	10	10	50	0	270
Total	**5,710**	**1,810**	**940**	**360**	**290**	**2,290**	**90**	**11,490**
Out of development								
Sydney Olympic Park	3,610	540	530	430	240	670	90	6,110
Wentworth Point	890	330	150	60	50	350	20	1,850
Carter Street UAP	1,530	330	230	150	100	400	30	2,770
Parramatta Road East	380	140	60	30	20	150	10	790
Parramatta Road Retail	930	180	140	50	40	370	10	1,720
Newington	100	30	20	10	10	30	0	200
Total	**7,440**	**1,550**	**1,130**	**730**	**460**	**1,970**	**160**	**13,440**

The total number of trips by mode for the Carter Street UAP at ultimate development (excluding the reduction in trips due to the replacement of the current industrial uses) is shown in Table 5.9.

Table 5.9 Total future trips in Carter Street UAP by mode (2031)

		Vehicle driver	Vehicle passenger	Train	Ferry/ Light rail	Bus	Walk	Cycle	Total
Daily	In	18,070	4,620	2,800	1,570	1,040	5,580	360	34,040
	Out	18,070	4,620	2,800	1,570	1,040	5,580	360	34,040
AM peak hour	In	2,580	350	390	350	190	330	70	4,260
	Out	1,590	530	300	150	110	490	30	3,200
PM peak hour	In	1,420	410	230	110	80	490	30	2,770
	Out	**2,730**	**420**	**400**	**340**	**190**	**470**	**70**	**4,620**

Trip distribution

Trip distributions were estimated by trip purpose. Residential commuter and recreation journeys, commercial and industrial journeys were distributed according to percentages calculated from 2011 JTW shown in Table 2.4. For education trips, the location of schools, child care and tertiary facilities was taken into consideration. Retail trips were distributed based on assessment of the local and regional shopping areas.

Overall, the trip containment within the Homebush Bay subregion was estimated to be 26% for journeys to work. This figure is higher than used in previous studies, but with a new balance between population and employment, and the congestion at the gateway intersections, trip containment is considered to be an important component of the transport strategy.

5.2 2021 and 2031 future base scenarios

Traffic volumes are forecast to increase on the subregional road network, irrespective of the rezoning of the Carter Street UAP due to natural background growth (from in-fill development and through traffic) and from planned major developments elsewhere in the Homebush Bay subregion.

The historic traffic growth rates outlined in section 2.4 indicated relatively flat recent growth on Parramatta Road. In the future, growth of traffic along Parramatta Road is expected to increase due to in-fill development and growth in regional centres such as Parramatta and Burwood. To include the impacts of this growth, a 2% per annual linear growth rate was applied to the through traffic volumes on Parramatta Road. Future traffic assessment years of 2021 and 2031 were chosen to model the interim development and ultimate development scenarios.

Traffic growth from other developments has been included in the future base intersection models. Future road projects, such as WestConnex, will increase the overall road network capacity and reduce congestion levels in the future. Whilst M4 Western Motorway capacity would be increased through widening from three to four lanes in each direction at Hill Road, traffic growth and the application of a toll on the currently un-tolled section of the M4 may counteract the traffic relief for Parramatta Road (in this section) created by WestConnex. The WestConnex project also incorporates the revitalisation of Parramatta Road between the CBD and Parramatta to accommodate 25,000 new jobs and 25,000 new residents. This task will also influence the capacity and configuration of this key arterial route serving the Homebush Bay subregion. The new eastbound on-ramp at Hill Road will attract additional southbound/eastbound trips to Hill Road.

WestConnex is currently the only committed project scoped by RMS as a solution to the current traffic congestion points both within and adjacent to the Homebush Bay subregion. In addition to the key gateway intersections, key areas of congestion that directly impact the transport capacity of the Homebush Bay subregion include:

- Parramatta Road intersections with Silverwater Road and Centenary Drive
- Centenary Drive/Arthur Street
- Silverwater Bridge capacity
- Homebush Bay Road/Concord Road intersection.

It is expected that congested road conditions during peak periods will continue in the future in the surrounding road network. The impact of this has been simulated through the application of traffic growth rates on Parramatta Road. The impacts of constraints on alternative routes out of the subregion e.g. Holker Street/Silverwater Road are beyond the limitations of SIDRA intersection modelling.

The future traffic volumes for the 2021 and 2031 base AM and PM peak hour scenarios are provided in Appendix C. The Carter Street Precinct was assumed to continue to produce the current traffic volumes generated by the industrial areas. The results of the SIDRA intersection modelling are summarised in Tables 5.10 and 5.11. As Sydney Olympic Park Master Plan 2030 development is currently proceeding with the proposed road upgrades at key intersections being progressively completed, the results presented are for upgraded intersection layouts, where required. A description of the upgrade(s) included is also provided in the tables. Detailed SIDRA intersection modelling results are provided in Appendix D.

Table 5.10 Summary of 2021 future base intersection performance without Carter Street UAP

Site ID	Intersection *- upgrade description if required*	Peak period	Degree of Saturation	Average Delay (s)	Level of Service	95th Percentile Queue (m)[1]
I-01	Hill Road and Carter Street *- Signalised Intersection* *- Dual right turn on Hill Road* *- Left turn slip lane on Carter Street*	AM	0.74	28	B	211 (N)
		PM	0.67	26	B	199 (N)
I-02	Hill Road and John Ian Wing Parade *Existing intersection layout*	AM	0.79	21	B	179 (S)
		PM	0.65	14	A	137 (S)
I-03	Hill Road and Old Hill Link *- Extended right turn lane on Hill Road*	AM	0.74	20	B	128 (N)
		PM	0.48	18	B	85 (N)
I-04	Edwin Flack Avenue and Old Hill Link *Existing intersection layout*	AM	0.45	13	A	26 (N)
		PM	0.65	19	B	57 (S)
I-05	Edwin Flack Avenue, Dawn Fraser Avenue and Uhrig Road *Existing intersection layout*	AM	0.84	36	C	72 (W)
		PM	0.86	32	C	81 (E)
I-06	Edwin Flack Avenue and Birnie Avenue *Existing intersection layout*	AM	0.64	23	B	101 (W)
		PM	0.77	26	B	188 (S)
I-07	Carter Street and Uhrig Road *Existing intersection layout*	AM	0.45	24	B	24 (E)
		PM	0.49	19	B	19 (N)
I-08	Parramatta Road and Birnie Avenue *- Left turn lane on Parramatta Road west* *- Extra lane on Birnie Avenue north* *- Extended turning lanes on Parramatta Road east, west and Birnie Avenue north*	AM	0.88	28	B	283 (W)
		PM	0.91	45	D	413 (E)
I-09	Parramatta Road and Hill Road *- Left turn lane on Parramatta Road west* *- Extended right turn lane on Parramatta Road east*	AM	0.90	45	D	339 (W)
		PM	0.93	46	D	327 (W)
I-10	Birnie Avenue and Carter Street *- Signalised intersection* *- Left turn slip lane on Carter Street*	AM	0.76	24	B	95 (S)
		PM	0.72	25	B	132 (N)

(1) Letter indicates approach with the longest queue, N = north, E = east, S = south, W = west

The results of this modelling indicate:

- By 2021, regardless of whether Carter Street UAP is developed, existing congestion problems on Parramatta Road are expected to trigger the need for intersection upgrades.
- Existing intersection performance issues during the PM peak at each end of Carter Street will require signalisation of these two intersections to reduce delays on Carter Street.
- A minor upgrade at the intersection of Hill Road and Old Hill Link is required.

Table 5.11 Summary of 2031 future base intersection performance without Carter Street UAP

Site ID	Intersection *- upgrade description*	Peak period	Degree of Saturation	Average Delay (s)	Level of Service	95th percentile Queue (m)[1]
I-01	Hill Road and Carter Street *- Signalised Intersection* *- Dual right turn on Hill Road* *- Left turn slip lane on Carter Street*	AM	1.00	45	D	**452 (N)**
		PM	0.94	38	C	**496 (E)**
I-02	Hill Road and John Ian Wing Parade *Existing intersection layout*	AM	0.88	30	C	431 (S)
		PM	0.78	15	B	221 (S)
I-03	Hill Road and Old Hill Link *- Extended and dual right turn lane on Hill Road*	AM	0.85	28	B	238 (N)
		PM	0.64	24	B	132 (N)
I-04	Edwin Flack Avenue and Old Hill Link *Existing intersection layout*	AM	0.70	14	A	47 (W)
		PM	0.75	26	B	115 (N)
I-05	Edwin Flack Avenue, Dawn Fraser Avenue and Uhrig Road *- Signalised Intersection*	AM	0.76	24	B	100 (W)
		PM	0.79	27	B	123 (E)
I-06	Edwin Flack Avenue and Birnie Avenue *Existing intersection layout*	AM	0.69	24	B	147 (W)
		PM	0.81	23	B	135 (S)
I-07	Carter Street and Uhrig Road *- Signalised Intersection*	AM	0.74	16	B	142 (W)
		PM	0.55	14	A	55 (W)
I-08	Parramatta Road and Birnie Avenue *- Signalised Intersection* *- Left turn lane on Parramatta Road west* *- Extra lane on Birnie Avenue north* *- Extended turning lanes on Parramatta Road east, west and Birnie Avenue north*	AM	0.94	39	C	467 (W)
		PM	**1.08**	**107**	**F**	**over 500m (E)**
I-09	Parramatta Road and Hill Road *- Signalised Intersection* *- Left turn lane on Parramatta Road west* *- Extended right turn lane on Parramatta Road east*	**AM**	**1.14**	**111**	**F**	**over 500m (W)**
		PM	**1.13**	**113**	**F**	**over 500m (E)**
I-10	Birnie Avenue and Carter Street *- Signalised intersection* *- Left turn slip lane on Carter Street*	AM	0.69	22	B	99 (S)
		PM	0.73	28	B	140 (N)

(1) Letter indicates approach with the longest queue, N = north, E = east, S = south, W = west

The results of this modelling indicate:

- By 2031, additional intersections require signalisation due to increasing traffic from other developments.
- Queues from the intersection of Hill Road and Carter Street become an increasing problem:
  - The queue for the right-turn into Carter Street stretched back to Parramatta Road at peak times, blocking traffic coming off the M4 Western Motorway from crossing lanes to get into Carter Street.
  - The southbound queue on Hill Road will reach back through the intersection with John Ian Wing Parade.
- The design and location of the intersection of Hill Road and Carter Street would require further analysis to reduce the impact of queuing on the operation of the M4 Western Motorway ramps.
- The upgrades of the two Parramatta Road intersections are insufficient for the traffic volumes modelled, requiring the widening of Parramatta Road to three through lanes in each direction.

5.3 2021 and 2031 future with Carter Street UAP

The traffic from the Carter Street UAP was added in place of the traffic generated by the existing industrial uses to assess the net traffic generation from the proposed rezoning. The 2021 scenario was estimated as the completion of phase 2 as outlined in Section 3.5, i.e. it includes:

- 1,433 dwellings, housing approximately 2,866 residents (26% of the total proposed)
- 15,640 m^2 GFA employment space with approximately 782 jobs (9% of the total proposed)
- 3,100 m^2 GFA retail (26% of the total proposed).

The future traffic volumes for the 2021 and 2031 with Carter Street UAP AM and PM peak hour scenarios are provided in Appendix E. The results of the SIDRA intersection modelling for 2021 are summarised in Tables 5.12. A description of the upgrade(s) assumed for the future with Carter Street is provided in the tables. Detailed SIDRA intersection modelling results are provided in Appendix F.

Table 5.12 Summary of 2021 future intersection performance with Carter Street UAP

Site ID	Intersection *- upgrade description if required*	Peak period	Degree of Saturation	Average Delay (s)	Level of Service	95th Percentile Queue (m)
I-01	Hill Road and Carter Street *- Signalised Intersection* *- Right turn bays on Hill Road* *- Left turn slip lane on Carter Street* *- No right turn from access road to Hill Road* *- Left-turn only from Carter Street westbound* *- Median preventing vehicles coming from the M4 off-ramp from turning right into Carter Street*	AM	0.82	28	B	240 (N)
		PM	0.69	22	B	206 (N)
I-02	Hill Road and John Ian Wing Parade *Existing intersection layout*	AM	0.85	22	B	268 (S)
		PM	0.74	13	A	130 (S)
I-03	Hill Road and Old Hill Link *- Extended right turn lane on Hill Road*	AM	0.67	18	B	136 (N)
		PM	0.50	19	B	96 (N)
I-04	Edwin Flack Avenue and Old Hill Link *Existing intersection layout*	AM	0.69	14	A	51 (W)
		PM	0.65	20	B	69 (S)
I-05	Edwin Flack Avenue, Dawn Fraser Avenue and Uhrig Road *- Signalised Intersection*	AM	0.65	22	B	59 (W)
		PM	0.79	24	B	86 (E)
I-06	Edwin Flack Avenue and Birnie Avenue *Existing intersection layout*	AM	0.67	25	B	108 (W)
		PM	0.79	27	B	225 (S)
I-07	Carter Street and Uhrig Road *- Signalised Intersection*	AM	0.62	16	B	60 (W)
		PM	0.60	18	B	55 (W)
I-08	Parramatta Road and Birnie Avenue *- Left turn lane on Parramatta Road west* *- Extra lane on Birnie Avenue north* *- Right-turn ban from Parramatta Road west into Birnie Avenue south*	AM	0.90	30	C	**286 (W)**
		PM	**0.97**	**50**	**D**	**467 (W)**

Site ID	Intersection *- upgrade description if required*	Peak period	Degree of Saturation	Average Delay (s)	Level of Service	95th Percentile Queue (m)
I-09	Parramatta Road and Hill Road *- Left turn lane on Parramatta Road west* *- - No right turn to Bombay Street*	**AM**	**0.94**	**50**	**D**	**367 (W)**
		PM	**0.97**	**56**	**D**	**424 (W)**
I-10	Birnie Avenue and Carter Street *- Signalised intersection*	AM	0.61	18	B	65 (S)
		PM	0.70	18	B	89 (N)

(1) Letter indicates approach with the longest queue, N = north, E = east, S = south, W = west

The results of this modelling indicate:

- the road network can function with the 2021 level of development in the Homebush Bay subregion, but operates close to capacity
- the Parramatta Road intersections, even with upgrades, are almost at capacity
- the slip lane from Hill Road to the M4 Western Motorway westbound on-ramp will require extending to Carter Street to bypass the southbound queue on Hill Road at Parramatta Road
- queuing on Hill Road for the right-turn into Carter Street is an issue.

Road network capacity implications for full development

Traffic modelling was initially done for 2031 with full development of Carter Street UAP and the other developments in the area. This analysis using SIDRA identified that while (with additional upgrades) intersection performance within acceptable limits may be possible, queuing at a number of intersections would reach back to the upstream intersection, potentially affecting its performance. Given the large volume of traffic moving around the area during the peak periods, interruptions to flow from the adjacent intersection are expected to have significant consequences.

The threshold for acceptable road network performance was taken as the point at which queues along the major arterial and sub-arterial roads in the local area (Parramatta Road, Hill Road and Birnie Avenue) start affecting the upstream intersection. Additional traffic beyond this threshold may be possible, but is likely to result in significant congestion, with the road space being used as 'storage' of surplus vehicles until peak conditions begin to dissipate.

The surplus traffic issues affecting the network at 2031 relate to all of the developments planned within the Homebush Bay subregion, i.e. not just the Carter Street UAP. Wider-area traffic modelling is required to be able to accurately assess the potential for traffic generation above this threshold.

An assessment of the amount of traffic generated by each type of land use indicated that the commercial employment land generated the highest amount of traffic per square metre. To assess how much traffic could be accommodated on the network, two hypothetical scenarios were run in SIDRA:

1. 2021 with full residential and retail development, but no commercial development
2. 2031 with full residential, retail and commercial employment development.

The 95th percentile back of queue lengths at each of the critical intersections were noted and compared against the measured block length. Table 5.13 shows the results for the section of Hill Road between Parramatta Road and Pondage Link. The red numbers indicate where the block length was exceeded. Table 5.14 shows similar numbers for Birnie Avenue between Parramatta Road and Edwin Flack Avenue.

To estimate what the acceptable amount of traffic generation would be to stay under the threshold, the results for the two scenarios above were compared. The number shown in blue alongside the red number indicated the estimated percentage of commercial traffic generation that would result in queues within the block length.

The two gateway intersections that the Carter Street UAP straddles, of Parramatta Road/Hill Road/Bombay Street and Parramatta Road/Birnie Avenue, are likely to be reaching critical performance levels when the commercial development in the Carter Street UAP is approximately 33% of its full theoretical floor space. However, this is due to the combined growth of the various developments in the area, and is influenced by the amount of traffic relief that the WestConnex project can provide to Parramatta Road.

Other local intersections will begin to experience queuing back to the upstream intersection when the commercial development in the Carter Street UAP is approximately 55% to 65% of its full theoretical floor space. Based on the results of the intersection modelling, aside from the Parramatta Road capacity issue, the recommended level of development that can be sustained is:

- 5,500 dwellings accommodating approximately 11,550 residents (100% proposed)
- 111,000 m^2 GFA commercial employment floor space providing approximately 5,550 employees (65% proposed)
- 12,000 m^2 GFA retail floor space (100% proposed).

Other strategies that would be required to reduce vehicle trip generation and lift the percentage of full commercial development without the need to construct more road upgrades are discussed in section 5.6.

The percentage estimated is only approximate, as it includes the impact of other developments such as Sydney Olympic Park Master Plan 2030, Wentworth Point and non-WestConnex related Parramatta Road development. The analysis also assumes the 2% growth along Parramatta Road. A change in these assumptions may change the result. A wider-area traffic modelling exercise that includes the impacts of WestConnex would be able to quantify these effects in more detail.

Table 5.13 SIDRA queue length forecasts on Hill Road for 2031 with Carter Street UAP at full development

Position on the road network and distance between intersections	Northbound		Southbound	
	AM peak	PM peak	AM peak	PM peak
268 m to Pondage Link			268 m	95 m
Old Hill Link				
206 m	284 m (61%)	75 m		
			256 m (69%)	198 m
John Ian Wing Parade				
268 m	297 m (82%)	145 m		
			252 m	371 m (55%)
Carter Street				
91 m	152 m	136 m		
M4 Off-ramp				
139 m			410 m (33%)	292 m (66%)
Parramatta Road				

(1) Red numbers indicate locations where queue length exceeds the available block length

(2) Blue numbers indicate an estimate of how much the growth in traffic volume between 2011 and 2031 needs to be factored down to contain queuing within the block

Source: SIDRA modelling results for future 2031 AM and PM peak with full development in Carter Street and other developments in the Homebush Bay subregion

Table 5.14 SIDRA queue length forecasts on Birnie Avenue for 2031 with Carter Street UAP at full development

Position on the road network and distance between intersections	Northbound		Southbound	
	AM peak	PM peak	AM peak	PM peak
Edwin Flack Avenue				
110 m	85m	68m		
			35m	165 m (52%)
Carter Street				
228 m	63m	62m		
			131m	294 m (61%)
Parramatta Road				

(1) Red numbers indicate locations where queue length exceeds the available block length.

(2) Blue numbers indicate an estimate of how much the growth in traffic volume between 2011 and 2031 needs to be factored down to contain queuing within the block.

Source: SIDRA modelling results for future 2031 AM and PM peak with full development in Carter Street and other developments in the Homebush Bay subregion.

Using the reduced development numbers listed previously, the 2031 future intersection models were re-run. The results are summarised in Table 5.15. Detailed SIDRA intersection modelling results are provided in Appendix F. These results assume the intersection upgrades listed in blue text in Table 5.15. These upgrades are recommendations made to Government for further consideration at the appropriate time to support the Carter Street UAP. They can be staged over time to match the level of development, available road network and traffic generation.

Table 5.15 Summary of 2031 future intersection performance with Carter Street UAP (111,000 m^2 GFA commercial floor space)

Site ID	Intersection *- upgrade description if required*	Peak period	Degree of Saturation	Average Delay (s)	Level of Service	95th Percentile Queue (m)
I-01	Hill Road and Carter Street *- Signalised Intersection* *- Right turn bays on Hill Road* *- Left turn slip lane on Carter Street* *- No right turn from access road to Hill Road and Carter Street westbound* *- Median preventing vehicles coming from the M4 off-ramp from turning right into Carter Street* *- Additional northbound lane on Hill Road*	AM	0.85	18	B	218 (N)
		PM	0.96	34	C	489 (E)
I-02	Hill Road and John Ian Wing Parade *- Added fourth (east) approach for John Ian Wing Parade extension* *- Extended turn lanes on Hill Road south, north and John Ian Wing Parade west* *- Extra turn lanes on Hill Road south, north and John Ian Wing Parade west* *- Added left turn lanes on Hill Road in each direction* *- Additional northbound and southbound lane on Hill Road*	AM	0.85	33	C	290 (S)
		PM	1.07	37	C	208 (N)
I-03	Hill Road and Old Hill Link *- Extended and dual right turn lane on Hill Road* *- Additional southbound lane on Hill Road*	AM	0.67	25	B	291 (N)
		PM	0.64	19	B	85 (E)
I-04	Edwin Flack Avenue and Old Hill Link *Existing intersection layout*	AM	0.69	15	B	69 (W)
		PM	0.80	28	B	173 (N)

Site ID	Intersection *- upgrade description if required*	Peak period	Degree of Saturation	Average Delay (s)	Level of Service	95th Percentile Queue (m)
I-05	Edwin Flack Avenue, Dawn Fraser Avenue and Uhrig Road *- Signalised Intersection*	AM	0.75	25	B	87 (W)
		PM	0.81	27	B	105 (E)
I-06	Edwin Flack Avenue and Birnie Avenue *- Add turn lane on Birnie Avenue* *- Convert westbound left-turn lane to slip lane*	AM	0.82	24	B	97 (W)
		PM	0.96	38	C	447 (S)
I-07	Carter Street and Uhrig Road *- Signalised Intersection* *- Additional turn lane on each approach*	AM	0.67	18	B	96 (W)
		PM	0.86	21	B	188 (E)
I-08	Parramatta Road and Birnie Avenue *- Left turn lane on Parramatta Road west* *- Extra lane on Birnie Avenue north* *- Extra right-turn bay on Parramatta Road east* *- Extra left-turn bay on Parramatta Road east* *- Right-turn ban from Parramatta Road west into Birnie Avenue south* *- Extra right-turn bay on Birnie Avenue south*	AM	0.91	36	C	414 (W)
		PM	**1.15**	**98**	**F**	**883 (W)**
I-09	Parramatta Road and Hill Road *- Left turn lane on Parramatta Road west* *- Extended turn lane on Parramatta Road east* *- Right-turn ban from Parramatta Road west into Bombay Street south*	**AM**	**1.10**	**62**	**E**	**541 (W)**
		PM	**1.13**	**104**	**F**	**837 (E)**
I-10	Birnie Avenue and Carter Street *- Signalised intersection* *- Left turn slip lane on Carter Street* *- Left and right turn bays on Birnie Avenue south* *- Additional southbound lane on Birnie Avenue north*	AM	0.78	28	B	89 (W)
		PM	0.69	36	C	192 (N)
I-12	Uhrig Road and John Ian Wing Parade extension *- Signalised intersection* *- Left turn bay on John Ian Wing Parade extension*	AM	0.97	47	D	194 (NW)
		PM	0.70	20	B	131 (NE)

The results of this modelling indicate:

- The capacity of the Parramatta Road intersection with Birnie Avenue has been exceeded with delays and degrees of saturation over 1.0 on all approaches and queuing that affects adjacent intersections.
- The slip lane from Hill Road to the M4 Western Motorway westbound on-ramp will require extending to Carter Street to bypass the southbound queue on Hill Road at Parramatta Road.
- The queuing issue on the M4 Western Motorway off-ramp at Hill Road requires a restriction of traffic movements allowed at the intersection of Hill Road and Carter Street to avoid a safety and capacity problem on the M4 Western Motorway.
- The traffic volume on Hill Road is forecast to require widening in various places between the M4 Western Motorway Ramps and Old Hill Link.

The SIDRA modelling results for the 2031 with Carter Street scenario indicate that intersection performance can be brought within acceptable levels through a package of intersection upgrades, apart from at the Parramatta Road gateway intersections.

This intersection modelling has assumed growth on Parramatta Road and traffic from additional development, but has not considered the impacts of WestConnex and its revitalisation plans for the corridor, increasing levels of through traffic (rat-running), redistribution of trips due to congestion in the area, or the impact of queues from adjacent upstream intersections. Given the interaction of the traffic issues and the importance of the area as a growth area for Sydney, it is recommended that a wider traffic model be developed that can assess these complexities.

The signalisation of the future intersection of Uhrig Road and the John Ian Wing Parade extension is subject to further alignment assessment. The modelled alignment includes the realignment of Uhrig Road to divert traffic around a town centre open space north of the current intersection of Carter Street and Uhrig Road. The intersection layout can be adjusted to match the size and location of this open space.

Diverting vehicles from the M4 off-ramp to John Ian Wing Parade

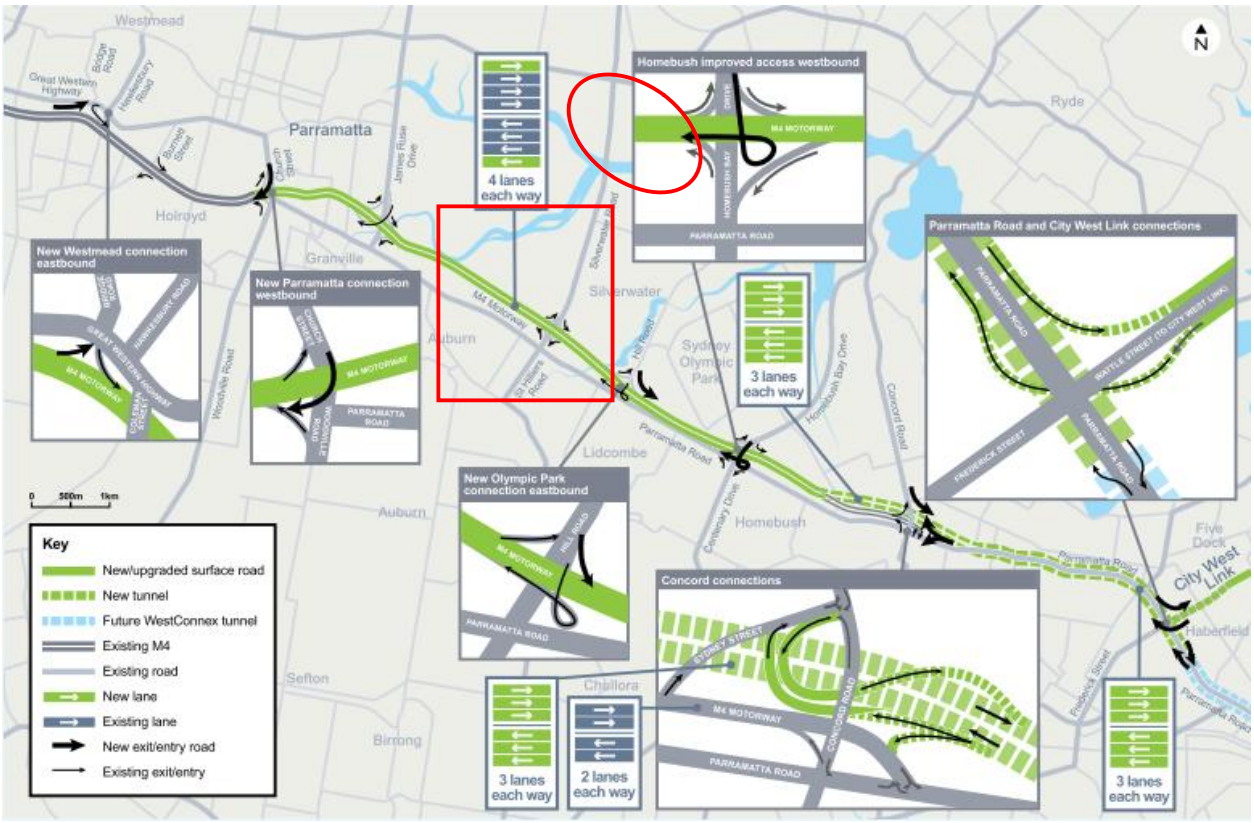
A solution to the right-turn issue on Hill Road at Carter Street is to prevent vehicles coming out of the M4 Western Motorway from turning right at Carter Street, directing them further up Hill Road to turn right into the John Ian Wing Parade extension or further up to Old Hill Link instead. This option would increase traffic along John Ian Wing Parade extension through the residential area planned within the Carter Street UAP. Due to the envisaged timing of the opening of the John Ian Wing Parade extension, vehicles would be required to divert via Old Hill Link and Edwin Flack Avenue until after the year 2027. This upgrade has been included in the 2031 modelling results in Table 5.15. A heavy vehicle load limit is proposed for the John Ian Wing Parade extension, to limit the number of trucks passing through the residential area.

Hill Road U-turn impacts

The right-turn from the M4 Motorway eastbound off-ramp at Hill Road is currently prohibited due to the proximity with the intersection of Hill Road and Parramatta Road and the requirements for traffic capacity into Sydney Olympic Park. Information from Auburn City Council indicates that people currently travelling from western Sydney to the North Lidcombe area south of Parramatta Road seek to avoid congestion at the Parramatta Road/Silverwater Road intersection by travelling to the M4 Motorway Hill Road eastbound off-ramp and completing a U-turn at the intersection of Hill Road and Carter Street or nearby driveways to travel south into Bombay Street. The proposed changes at the intersection of Hill Road and Carter Street being considered for the WestConnex project and the signalisation proposed for the Carter Street UAP will this U-turn more difficult, with a longer-route, and may deter people from attempting the U-turns altogether. This impact is considered unavoidable if the road network is to provide the necessary capacity to safely accommodate the WestConnex traffic and service the Sydney Olympic Park area and Wentworth Point and Carter Street UAPs.

5.4 Interaction with WestConnex project

The plans to proceed with the WestConnex project were announced on 18 September 2013, with a further announcement of a package of supporting works on 20 September 2013 that included a new eastbound access at Hill Road from Sydney Olympic Park to the M4. The new arrangement for ramp access to the M4 Western Motorway between Parramatta and Haberfield is shown in Figure 5.1.



Source: WestConnex Stage 1 Parramatta to Haberfield Fact Sheet (Transport for NSW, September 2013)

Figure 5.1 Proposed new M4 Western Motorway ramp access

Discussions have been held with WestConnex project staff from Sydney Motorway Project Office (SMPO) to understand the implications of the changes for the Carter Street UAP. The major points of interaction include:

- proposals to reduce congestion on Hill Road resulting in queues back onto the M4 Motorway, including:
  - eastbound off-ramp from M4 Motorway to Hill Road will be widened to two lanes
  - intersection between eastbound off-ramp and Hill Road northbound will be signalised
  - Carter Street will be converted to left-in/left-out at Hill Road
- Carter Street UAP traffic diverted via:
  - Hill Road, Old Hill Link and Edwin Flack Avenue or
  - Parramatta Road, Birnie Avenue and Carter Street
- new eastbound on-ramp will be two lanes, with Managed Motorway Scheme traffic management, narrowing to one lane as it joins the widened M4 Motorway
- ramp metering on the new eastbound on-ramp may increase queuing in the southbound direction on Hill Road, potentially affecting the ability of vehicles to get out of Carter Street
- Hill Road may need to be widened to accommodate the additional traffic
- no change to the westbound on-ramp.

Concerns regarding these road changes include:

- reduced traffic capacity for the Carter Street UAP when an increase in traffic generation is being planned
- additional travel distance for traffic displaced by the affected vehicles
- isolation of the Carter Street UAP land west of Hill Road from the rest of Carter Street UAP
- pedestrian and cycle crossing of Hill Road and the M4 Motorway ramps
- additional delays and queuing on Hill Road affecting traffic from Carter Street UAP, Sydney Olympic Park development and Wentworth Point UAP.

The proposed Hill Road traffic arrangement has been designed to accommodate the WestConnex ramp requirements while maintaining right-turn access to the Carter Street UAP at Hill Road. Specifically:

- the right-turn queuing issue referred to above, was also identified for this study (see section 2.5 and Figure 2.4) and treated by installing a median preventing vehicles arriving via the M4 eastbound off-ramp from turning right at Carter Street (yet maintaining the right-turn for vehicles from Parramatta Road and Bombay Street)
- the narrowing of Hill Road between Parramatta Road and the M4 off-ramp to one northbound lane, enabling two lanes to be dedicated to the M4 off-ramp, as proposed in the WestConnex changes
- widening of Hill Road north of the M4 off-ramp to reduce congestion leading to queue-back onto the Motorway and assisting traffic flow onto the M4 Western Motorway.

The issue of the design and location of the intersection of Hill Road and Carter Street requires further detailed analysis to reduce the impact of queuing on the operation of the M4 Western Motorway ramps. Discussions with WestConnex project staff from RMS and Sydney Motorway Project Office are continuing to determine a suitable arrangement for both projects.

M4 Western Motorway capacity

The westbound on-ramp from Hill Road to the M4 Western Motorway consists of tight loop with a merge onto the Motorway at the top of the ramp. There is concern that the capacity of the ramp at these locations will be exceeded. The ability of the M4 Western Motorway to accommodate this on-ramp volume is unknown, given the high current volumes on the M4 Western Motorway and unknown impacts that the WestConnex project (and its tolling of the currently un-tolled section of the M4 Western Motorway) could have.

The forecast traffic volumes on the on-ramp in each of the scenarios are shown in Table 5.16. It is noted that the volume in the PM peak increase significantly from the 2013 volume, due mainly to employees in the Sydney Olympic Park town centre and Carter Street UAP leaving work. The analysis of the 2011 Journey to work data indicated over 30% of employees in the area living in the central western portion of Sydney, indicating a strong demand for this on-ramp.

Table 5.16 Forecast volumes on the Hill Road on-ramp to the M4 Western Motorway

Year & scenario	AM peak hour	PM peak hour
2013 Existing situation	380	610
2021 Base	650	1,160
2021 with Carter Street UAP	730	1,280
2031 Base	930	**1,720**[1]
2031 with Carter Street UAP	1,200	**2,030**[1,2]

Note 1. This volume may exceed the capacity of the lane with its incline, number of trucks and tight horizontal curve
2. Assumes 111,000 m^2 GFA commercial space

The forecast volumes for 2028/29 could fill a Motorway lane on their own. In addition, the traffic volume on the eastbound off-ramp to Hill Road could reach approximately 1,740 vehicles per hour during the morning peak for the 2031 with Carter Street UAP and other developments scenario. It is recommended that further analysis of future flows on the M4 Western Motorway is required to determine whether the Motorway can accommodate these flows.

5.5 Strategies to reduce traffic impacts

The traffic congestion problems identified and the number of constraint points indicates that the local road network is approaching capacity, and that alternative strategies to reduce traffic generation are required to enable the full planned levels of development to occur. Even with the recommended road upgrades there will be little, if any, spare capacity for growth beyond 2031.

Strategies to reduce traffic demand are recommended to delay the need for the costly upgrades and preserve as much capacity as possible for future growth. Potential solutions include:

- A significant public transport scheme to reduce car driver mode share (local bus improvements will not be enough).
- Higher public transport frequencies assisted by dedicated public transport priority to reduce car driver mode share.
- Reduce parking rates to encourage the use of alternative modes of transport (requires one of the above to provide a suitable alternative).
- Encourage changed travel behaviour of drivers e.g. peak spreading (Sydney Olympic Park is already achieving a high degree of peak spreading, which has been included in the assumptions for the traffic modelling). Further peak spreading may be difficult to rely upon to produce the necessary change and result in unpleasant transport conditions).
- Upgrading of the other two gateways (Holker Street/Silverwater Road and Australia Avenue/Homebush Bay Drive) as well as the arterial road constraints at Silverwater Road bridge and the Silverwater Road/Parramatta Road intersection.

5.6 Summary of recommended road improvements

Table 5.17 lists the suggested strategies to manage the traffic impact of the Precinct. The measures are divided into measures that assist travel to/from the Homebush Bay subregion and locally significant measures. These recommendations require further investigation as part of a broader regional transport assessment.

Table 5.17 Summary of recommended strategic road network planning measures

Measures	
	Measures to assist area-wide traffic issues
1	Investigate the subregional arterial road network capacity through wider-area traffic modelling to determine its future capacity based on recommended intersection upgrades such as those developed for SOP Master Plan 2030. This should also be informed by the proposals identified in the WestConnex project.
2	Investigate suggested road network improvements ■ Parramatta Road, Hill Road and Bombay Street ■ Parramatta Road and Birnie Avenue ■ Hill Road and Old Hill Link ■ Edwin Flack Avenue and Birnie Avenue
3	Investigate design solutions to provide vehicle, pedestrian and cycle access to the Carter Street UAP and accommodate the requirements of the WestConnex project
	Precinct related road improvements
4	Assess suggested access intersection improvements ■ Hill Road and Carter Street: signalisation, upgrade ■ Hill Road and John Ian Wing Parade: modification of existing signals and upgrade ■ Edwin Flack Avenue, Dawn Fraser Avenue and Uhrig Road: signalisation ■ Birnie Avenue and Carter Street: signalisation, upgrade.
5	Assess internal intersection improvements ■ Carter Street and Uhrig Road: signalisation and upgrade to assist movement of pedestrians and buses

Source: Parsons Brinckerhoff

6. Transport assessment

The Homebush Bay subregion already has a high standard cycle and pedestrian network, a train line and bus priority as a legacy of the Sydney 2000 Olympics. However, additional connections are required to fill in missing links within transport network and bypass some of the limitations of existing system which is also highly geared towards event transport provision.

The recommended future public transport network is shown in Figure 6.1. This network includes a new corridor between Parramatta and Carter Street UAP with high-capacity, frequent services. The recommendations made in this section are suggestions to Government to support the Carter Street UAP. They require further investigation as part of a broader regional transport assessment. The details of each mode are discussed individually in this section.

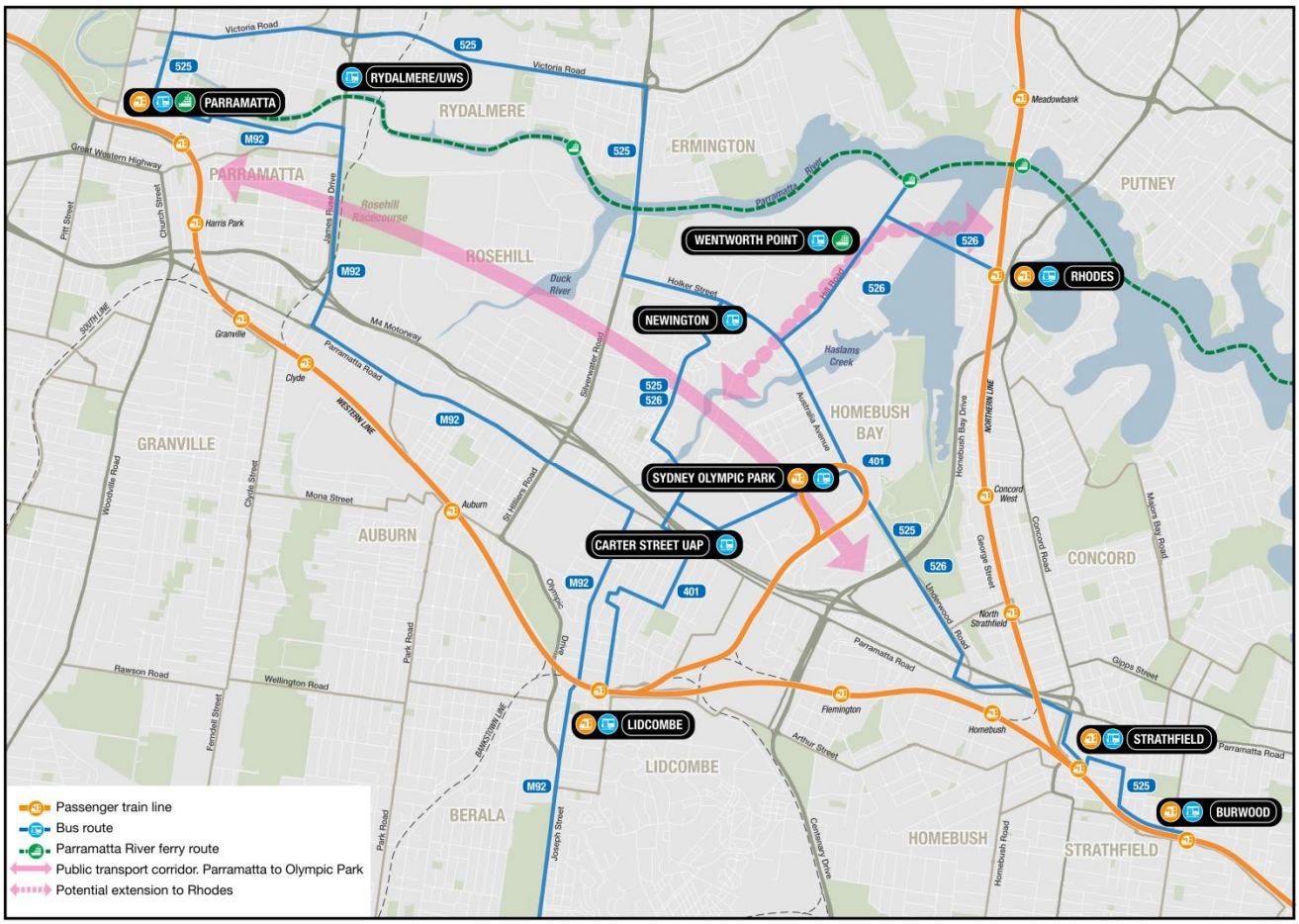
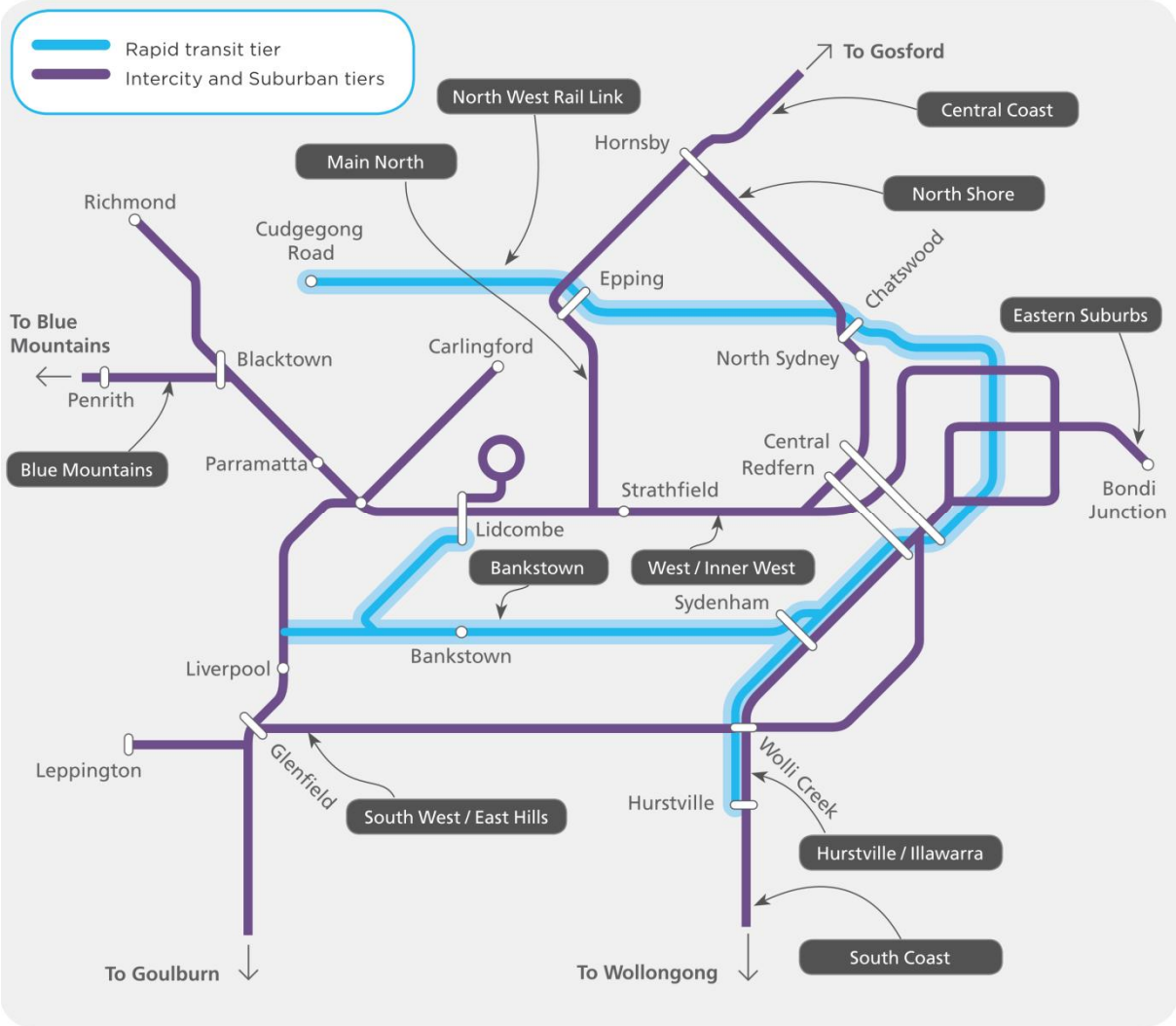


Figure 6.1 Potential future public transport network

6.1 Rail

Improvements to Sydney's rail network are being planned, as outlined in Sydney's Rail Future[8], with new rail lines and the conversion of some lines to single-deck/more frequent trains. These new single deck trains will be available at Lidcombe Station, travelling via the Bankstown Line, as shown in Figure 6.2. The Olympic Park Line is to remain as a shuttle service, with an interchange required at Lidcombe. Train frequencies on the Olympic Park Line are not expected to increase above their current six per hour.

The maximum use of train by Carter Street UAP residents and employees is forecast to occur during the afternoon peak, out of the area, with approximately 400 train passengers per hour (see Table 5.9). Assuming a seated capacity of 1,200 passengers per train and a 6 per hour frequency, this Carter Street UAP would contribute 66 people (approximately 6% of the train's seated capacity) during peak times. Given the most recent CityRail gate counts reported in Table 2.9, it is anticipated that there would be sufficient spare capacity to accommodate this increase.



Source: Sydney's Rail Future (Transport for NSW, June 2012)

Figure 6.2 Future passenger train network

While Olympic Park Station is well used during special events, and its regular use is increasing as development of the Sydney Olympic Park town centre progresses, its attractiveness for residents and workers in the Carter Street UAP is limited by the walk distance (typically over 1km).

[8] SYDNEY'S RAIL FUTURE, Modernising Sydney's Trains, (Transport for NSW, June 2012)

6.2 Light rail

As outlined in section 4.3.2, the levels of cumulative development proposed in the Homebush Bay subregion cannot be accommodated solely on the road network and the existing public transport network. The proposed Western Sydney Light Rail Network (WSLRN) scheme represents the type of transport upgrade that is required.

Whilst the advocates of the Western Sydney Light Rail Network, Parramatta City Council proposed the first stage to connect Parramatta to Macquarie Park and Castle Hill, the Part 1 Feasibility Study outlined the significant patronage potential of a scheme to Sydney Olympic Park and Rhodes. This analysis did not incorporate the levels of development outlined in the two UAPs within the Homebush bay subregion or the density uplift of the Fairmead proposal at Wentworth Point.

It is therefore recommended that further feasibility assessments be undertaken for the Sydney Olympic park Line of the WSLRN to the same level of detail as that undertaken for the Macquarie Park and Castle Hill alignments. This will allow the relative merits of the proposed light rail line to be assessed against other light rail proposals and its place in a broader regional transport network to be considered.

6.3 Bus

The existing bus network structure, shown in Figure 2.4 provides a sound base for growth in the future. The building of the Homebush Bay Bridge and some route modifications to reflect the Carter Street UAP are suggested to provide extensive public transport connections with minimal change to other services.

Homebush Bay Bridge

The extension of Route 526 via the Homebush Bay Bridge to Rhodes station and Shopping Centre was recommended in the Wentworth Point TMAP. This bridge will connect Wentworth Point and Newington to Rhodes. There is also the potential to extend this route further east, for example to Concord Hospital/Concord as a way of connecting these areas directly to Sydney Olympic Park.

Local connections

Other localised changes could include amending Route 525 (Burwood/Strathfield to Parramatta) to operate via Uhrig Road and the extended John Ian Wing Parade, instead of via Hill Road, Old Hill Link and Edwin Flack Avenue. This could provide the new shops and apartments with direct services to Parramatta, Newington, Strathfield and Burwood. Carter Street would have three services operating along it:

- Route 525 – to Parramatta, Rydalmere, UWS, Newington, SOP, Burwood and Strathfield
- Route 526 – to Newington, Wentworth Point, Rhodes, Burwood and Strathfield
- Route 401 – to Lidcombe and SOP.

Interchanges between services with facilities to accommodate transferring passengers would be required at:

- Olympic Park Station – interchange between train, Routes 401, 525 and 526
- Carter Street (west of Uhrig Road) – interchange between Routes 401, 525 and 526
- Holker Street Park-and-Ride – interchange between Routes 401, 525 and 526 (convenient place for transfer for Rhodes and Wentworth Point residents heading to Parramatta).

Bus service frequencies would need to be increased to match demand. Assuming approximately 40 passengers per bus, the Carter Street UAP on its own could generate demand for 3 to 2 bus loads in the peak direction and 2 to 3 bus loads in the counter-peak direction during both the AM and PM peaks.

Bus stops

The future location of bus stops is shown on Figure 6.3. The suggested changes from the existing locations are described below.

- Due to the intersection layout requirements of the future signalised intersection of Hill Road and Carter Street and to achieve even stop spacing, it is proposed that the two sets of bus stops on Carter Street between Hill Road and Uhrig Road would be amalgamated to a location approximately 200 m east of Hill Road.
- The stops on Uhrig Road, north of Carter Street would be retained, approximately in their current location.

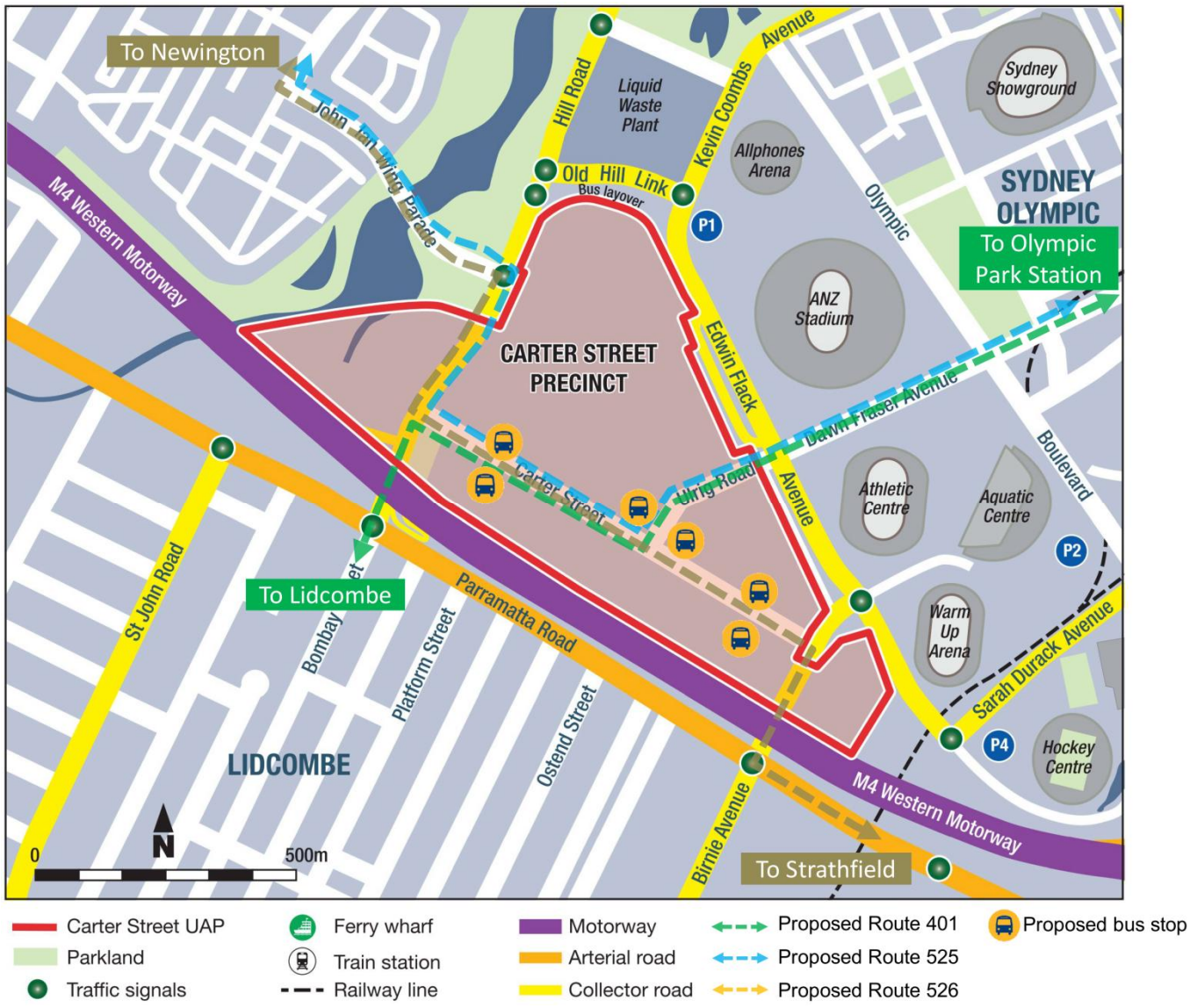


Figure 6.3 Proposed bus network and stop locations

The network proposed on Figure 6.1 is compatible with the future bus network in Sydney Olympic Park's Master Plan 2030, with some modifications to acknowledge the recent changes arising from the Homebush Bay Bridge.

Bus stops on route M92 are between 650 metres and 1.5 km walk from Carter Street UAP, similar to Olympic Park Station. The peak headway, of a bus every 10 minutes, is similar to that of the Olympic Park Sprint Line. However, for journeys between Carter Street and Parramatta CBD, using Route 401 and interchanging to Western Line trains is quicker in many instances according to TfNSW's 131 500 Transport Infoline.

Bus priority

Bus priority is proposed at the intersection of Carter Street and Uhrig Road to assist buses to complete the turns from Uhrig Road to Carter Street. This could be in the form of a queue-jump right-turn, or a special bus-only link, enabled by the creation of a public space at one end of the Uhrig Road main street treatment. A 'No Right Turn Buses Excepted' restriction on Carter Street at the intersection with Hill Road would enable bus services to continue on the preferred route. The Sydney Olympic Park Master Plan 2030 identified Uhrig Road, Carter Street, Birnie Avenue and Parramatta Road as a future strategic bus route corridor.

Bus travel times may be affected by future road congestion increases, especially at the five gateways to the Homebush Bay subregion. This would affect Route 525 on Holker Street, and Route 401 on Hill Road. The potential to provide bus priority at four of the five gateways is limited due to the difficulty of widening Hill Road and Birnie Avenue under the M4 Western Motorway overbridges.

A rule of thumb for the provision of new bus lanes or bus priority, is that they should support a bus frequency of one bus every two minutes or greater. Future (2031) bus frequencies with extra demand from Carter Street UAP and the other growth areas are likely to be in the order of a bus every five minutes, which is less than the target number that would justify new bus priority.

6.4 Ferry

Sydney's Ferry Future[9], announced the allocation of funds for the upgrade of Sydney Olympic Park Wharf as part of the Transport Access Program. The upgrades are designed to provide improved access for people with disabilities, older people and parents with prams. An example of the type of wharf upgrades is shown in Figure 6.4.

Figure 6.4 Example of Transport Access Program wharf upgrade at Milsons Point

[9] *SYDNEY'S FERRY FUTURE, Modernising Sydney's Ferries*, (Transport for NSW, May 2013)

The connection of Carter Street, Sydney Olympic Park town centre and Wentworth Point to the ferry would be maintained through the current bus route (Route 526) after the Homebush Bay Bridge is opened. Bus services would be scheduled to meet the ferry to provide a convenient interchange.

6.5 Cycling

The Homebush Bay subregion currently has a high-quality and well-connected cycle network, which part of the recreation infrastructure is a major attraction for residents moving to the area. Currently, the bicycle network passes by the Carter Street UAP on Hill Road and Birnie Avenue.

The proposed bicycle network and facilities are shown in Figure 6.5.

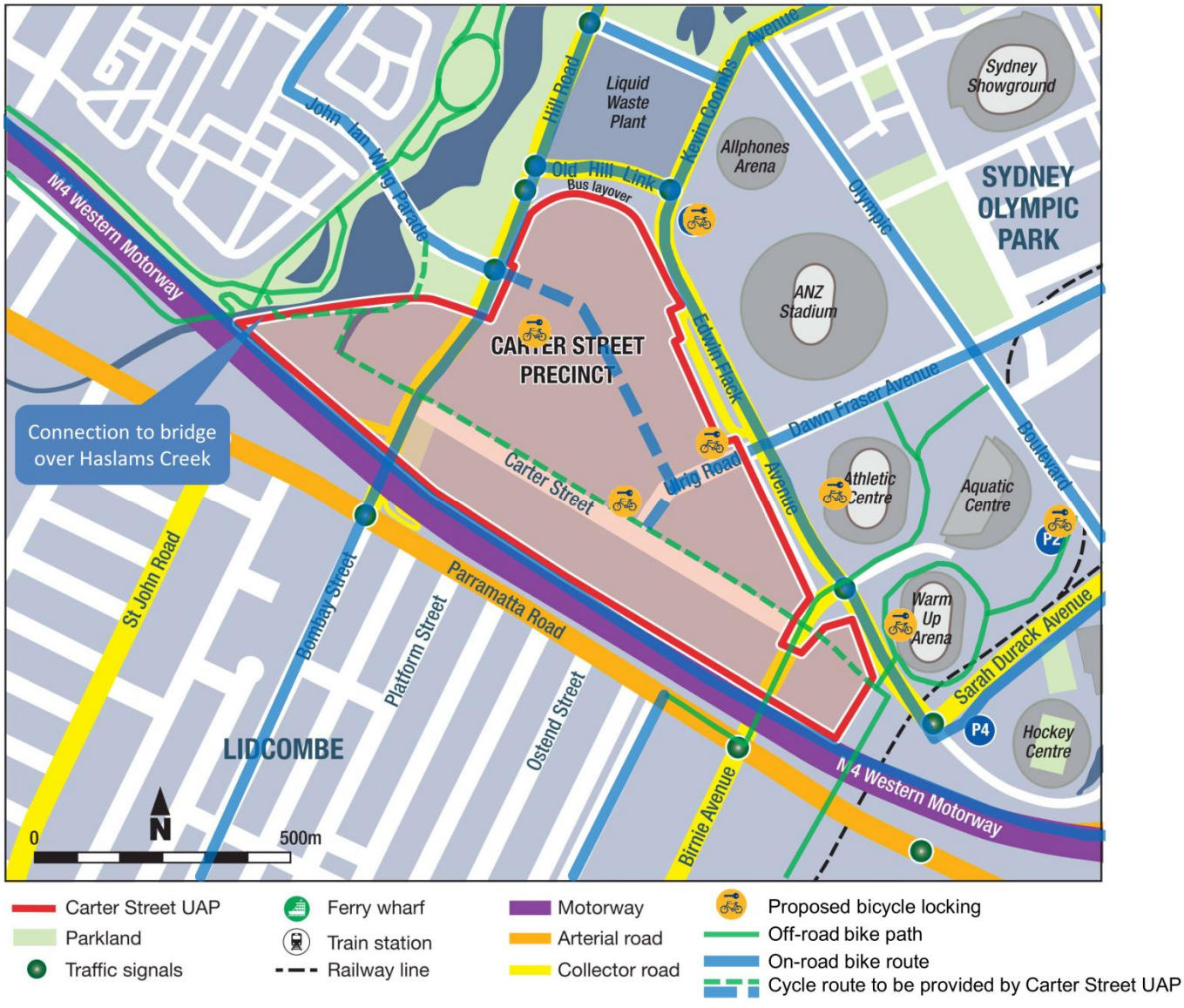


Figure 6.5 Proposed bicycle network and facilities

As part of the development it is proposed to connect the bicycle network through the Carter Street UAP and improve the convenience of using bicycles by:

- Adding an off-road shared pathway along Carter Street (potentially on the northern side), to connect to the paths on the western side of Haslams Creek, Sydney Olympic Park's network and the proposed conversion of the rail bridge over the M4 Western Motorway east of Birnie Avenue. This pathway would also run parallel to the M4 Western Motorway shoulder cycle lanes, offering an alternative on a lower-trafficked route.
- Adding on-road cycle lanes on Uhrig Road.
- Adding on-road cycle lanes on the John Ian Wing Parade extension.
- Connecting the proposed new pedestrian and cycle bridge over Haslams Creek and providing a shared path alongside the eastern bank of Haslams Creek as far as John Ian Wing Parade.
- Providing bicycle locking facilities along Uhrig Road and at open space locations.
- Incorporating bicycle locking and 'end of trip' facilities (showers, change rooms) into the DCP requirements for employment buildings.
- Incorporating generous bicycle parking in residential parking rates (see Section 6.7).

6.6 Pedestrians

The redevelopment of the Precinct is expected to have a positive impact on connectivity for pedestrians and cyclists. Within the Precinct, footpaths, shared paths and crossing opportunities would be created. The aim for the Precinct is to increase street activity, reduce car use and improve amenity through the creation of a walkable and cycle-friendly environment.

Access requirements

An assessment has been made of the needs of different types of pedestrian movements:

- employee:
  - access from Olympic Park Station and bus stops to employment within the Precinct
- commuter:
  - internal trips for residents working within the Precinct
  - walking trips to Sydney Olympic Park employment
  - walking to Olympic Park Station and bus stops
- education:
  - access to potential school site within Carter Street UAP
  - access to the John Ian Wing Parade bridge over Haslams Creek to get to Newington Public School
- entertainment:
  - internal trips for residents walking to Uhrig Road shopping
  - walking trips to Sydney Olympic Park shopping and restaurants
- recreation
  - Sydney Olympic Park parklands
  - Bicentennial Park
  - Haslams Creek shared paths, Blaxland Riverside Park, Millennium Parklands.

While the number of people walking from the Carter Street UAP to the Lidcombe area via Hill Road is expected to be small, the M4 Western Motorway ramps create a barrier for pedestrian access. The planned widening of the eastbound off-ramp to two lanes as part of the WestConnex project will create an issue for pedestrians unless this ramp is signalised with a pedestrian crossing.

Proposed network improvements

The following improvements are recommended:

- complete missing footpaths along the eastern side of Uhrig Road and construct all new streets with footpaths on both sides
- include pedestrian-only connections to reduce the block length for pedestrians, increasing permeability without having to construct new roads
- install pedestrian crossing facilities at the new signalised intersections (subject to meeting traffic signal warrants and RMS approval):
  - Carter Street and Hill Road
  - Carter Street and Uhrig Road
  - Carter Street and Birnie Avenue
  - Edwin Flack Avenue, Dawn Fraser Avenue and Uhrig Road
- install mid-block crossing opportunities on Carter Street and John Ian Wing Parade extension:
  - Carter Street mid-way between Hill Road and Uhrig Road
  - Carter Street mid-way between Uhrig Road and Birnie Avenue
  - John Ian Wing Parade extension at eastern end of open space
- install pedestrian signals (on the widened M4 Western Motorway eastbound off-ramp)
- progress the opening of the existing bridge over the M4 Western Motorway and Parramatta Road between Birnie Avenue and the Olympic Park Rail Line to shared pedestrian/cycle access.

6.7 Parking

The parking situation within the Carter Street UAP is influenced to a large extent by the surrounding land use and transport conditions:

- its roads experience event-related parking due to its proximity to ANZ Stadium
- its available road capacity at the shared gateways is limited by the amount of development surrounding it and growth on the arterial road network
- it is within walking distance of bus services and an extended walk distance of rail services, but both will require improvement/augmentation to cater for the anticipated numbers of passengers
- it will compete with surrounding development, and therefore needs to be compatible with parking rates in other precincts
- its proximity to Sydney Olympic Park employment and recreational facilities
- its planned high degree of walkability and cycle-friendly networks
- its mixed use of retail, commercial, residential and community 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.

Off-street parking

The Auburn DCP rates currently apply to the Carter Street UAP. However, there is the possibility for tailored parking rates to be incorporated in the new version of the Carter Street Precinct DCP. The Carter Street UAP shares a common boundary with Sydney Olympic Park. SOP is also has the largest comparable employment in the surrounding area. The parking rates in the surrounding development areas are listed in Table 6.1.

Table 6.1 Comparison of parking rates

Land use type	Auburn DCP[1]		SOPA Master Plan 2030[2]	Homebush Bay West DCP[3]	Wentworth Point TMAP	Wentworth Point UAP
max/min	exactly		**maximum**	**maximum**	**maximum**	minimum
Residential						
Studio				None		1/dwelling
1 bedroom	**1/dwelling**		**1/dwelling**	1/dwelling	1/dwelling	1/dwelling
2 bedroom	**1/dwelling**		**1.2/dwelling**	1.5/dwelling	1.5/dwelling	1.1/dwelling
3 bedroom	**2/dwelling**		**1.5/dwelling**	2/dwelling	2/dwelling	2/dwelling
4 bedroom	**2/dwelling**		3/dwelling			2/dwelling
Visitors	**0.2/dwelling**		0.25/dwelling	0.2/dwelling	0.2/dwelling	1/10 dwellings
Other						
Commercial	1/35 m^2 or 1/40 m^2 if more than 500 m from station		**1/80 m^2**	1/60 m^2		1/40 m^2
Retail	GLFA (m^2) Up to 10,000 10,000 to 20,000 20,000 to 30,000 Over 30,000	Spaces per 100 m^2 6.1 5.6 4.3 4.1	**Supermarkets: 4/100 m^2** **local retail 1/50 m^2**	1/40 m^2		1/40 m^2
Motorbike				1 per 25 car spaces	1 per 25 car spaces	

(1) Auburn Development Control Plan 2010 Parking and Loading.

(2) SOPA Master Plan 2030.

(3) Homebush Bay West Development Control Plan June 2004 Urban Design Advisory Service.

The largest difference between the Auburn DCP rates and the SOP Master Plan 2030 rates is for commercial and retail development, with the Auburn DCP rates higher. The SOP Master Plan rates are slightly higher for two and four bedroom apartments and visitor spaces but lower for three bedroom apartments. A rate for studio apartments is proposed based on experience from other LGAs.

The recommended parking rates (maximum to be provided) are summarised as follows:

- residential parking:
  - 0.5 spaces per studio dwelling
  - 1.0 spaces per one bedroom dwelling
  - 1.0 spaces per two bedroom dwelling
  - 2.0 spaces per three bedroom dwelling
  - 2.0 spaces per four bedroom dwelling

    - 0.20 visitor spaces per dwelling
- commercial rates one space per 80 m^2 GLFA
- retail parking at of one space per 50 m^2 GLFA with a higher rate for the small supermarket (one space per 25 m^2 GLFA).

Based on the recommended rates for residential, commercial and retail land use types, and assumptions about the mix of unit sizes, the potential amount of off-street private parking within the Carter Street UAP is:

- Residential: 5,225 (assuming 20% studios, 50% 1 bed, 25% 2 bed and 5% 3 bed or more dwellings) plus 1,100 visitor spaces
- Commercial: 2,125 (assuming full commercial development - or 1,380 assuming 111,000 m^2 GFA commercial development)
- Retail: 150 (assuming 4,000m^2 supermarket and 8,000 m^2 other)

This equates to a total of 8,600 off-street spaces. While the mix of dwellings may change, the total amount of parking within the Precinct is still a large number, and will require a large amount of space.

Centralised public parking

Centralising the public 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 sustainable long term rates, which will also encourage alternative transport (public transport, walk and cycle)
- it banks land that can be used for more economically productive purposes at a later date.

Due to the scale 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 50–100. 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 should be located on the fringe of the retail area encouraging ‘park once and walk’ behaviour.

On-street parking

Kerb-side parking can stimulate street activity, manage speed by providing friction, can contribute to casual surveillance and provides a buffer between the verge/footpath and the moving traffic. Limited on-street parking would be used to support local businesses and provide for visitor parking beyond the provisions in the recommended parking rates. On-street parking with a range of purposes and time limits are recommended to provide flexibility and avoid undesirable use:

- Disabled parking – 3% to comply with AS2890.1 (1993) (the 2004 edition did not include recommend percentages for accessible parking).
- Loading zones – whilst most would occur in off-street loading docks, some on-street space is proposed to facilitate short-stay deliveries on Uhrig Road. Loading zones would be time limited to 1 hour.

- Short-stay parking (1 hour limit 7.00 am to 6.00 pm Monday–Friday and 8.30 am to 12.30 pm Saturday) would be located on Uhrig Road in the retail area.
- Short stay parking (2 hour limit 9.00 am to 3.00 pm Monday–Friday and 8.30 am to 12.30 pm Saturday) would be located on both sides of Carter Street to assist the employment areas south of Carter Street, but would be required to revert to No Stopping during peak periods (6.00 am to 9.00 am and 3.00 pm to 7.00 pm Monday to Friday) to provide sufficient space for traffic movement.
- Unrestricted parking (with 'Special Event Parking Area' restrictions) would be considered for the remainder of on-street parking (mainly in the residential areas) to provide for residential visitors.

Bicycle parking

The provision of bicycle parking acts as an incentive to increase cycle use and restrict private vehicle use. It also acknowledges that many of the residents who move to the area will do so to take advantage of the areas excellent recreation facilities. The bicycle rates of relevant guidelines are shown in Table 6.2.

Table 6.2 Comparison of parking rates

Land use type	Auburn DCP[1]	SOPA Master Plan 2030[1]	Homebush Bay West DCP[2]	Wentworth Point TMAP
Commercial	1 per 1,000 m^2 (Newington Business Park example) 1 bicycle per 300 m^2 retail space (Newington Small Village example)	1 bicycle per 150 m^2 permanent, 1 visitor space per 750 m^2	1 bicycle per 300 m^2 permanent, 1 visitor space per 2,500 m^2	
Residential Studio 1 bedroom 2 bedroom 3 bedroom 4 bedroom Visitors	1 per 5 dwellings as part of mixed use development	none 1 per dwelling 1.2 per dwelling 1.5 per dwelling 2 per dwelling 1 per 4 dwellings	none none 0.5 per dwelling 0.5 per dwelling 1 per 15 dwellings	none none 0.5 per dwelling 0.5 per dwelling 1 per 15 dwellings

(1) Auburn Development Control Plan 2010 Parking and Loading

(2) SOPA Master Plan 2030

(3) Homebush Bay West Development Control Plan June 2004 Urban Design Advisory Service

The Carter Street UAP will have the same level of access to cycle paths as the adjacent Sydney Olympic Park, which also has significantly higher amounts of bicycle parking. Providing a similar level of bicycle parking is an inexpensive way to provide residents and employees the opportunity to bypass the forecast road congestion, with health and amenity benefits. As a minimum, one space per dwelling should be considered per apartment, especially for studio apartments without a car parking space.

The recommended parking rates for bicycles (minimum to be provided) are summarised as follows:

- residential parking:
  - residents: 1 space per dwelling
  - visitors: 1 space per 12 dwellings
- commercial:
  - staff: 1 space per 150 m^2 GLFA
  - visitors: 1 space per 750 m^2 GLFA
- retail
  - 1 bicycle per 300 m^2 retail space.

Based on the above rates, parking for approximately 7,360 bicycles would be required. Assuming 1.6 m^2 per bicycle, this equates to a space allocation of approximately 12,000 m^2 throughout the development.

6.8 Sydney Olympic Park event operations

Existing operations

Event operations are a key function of the Sydney Olympic Park precinct. The development of the Carter Street Urban Activation Precinct has considered this important function through consideration of the Major Event Impact Assessment Guidelines (SOPA, 2007). Currently the Carter Street precinct is predominantly light industrial in land use with a small number of commercial developments and public utility functions. Typically these land uses are highly compatible with events as they generate low levels of traffic during typical event times of weekday nights and weekends. The predominantly light industrial activity ensures low levels of employee related travel whilst the lack of residential development removes the sensitivity of traffic, noise and light issues generated by events.

The local road network and parking situation for events at SOP is currently controlled by the event 2P parking scheme which covers Uhrig Road and Carter Street. This effectively removes event parking from the Carter Street precinct. Other event transport functions that operate through and adjacent to the Carter Street precinct include:

- coach parking access routes to facilities on Edwin Flack Avenue
- overflow hire car parking in Uhrig Road
- access to car parks P1 and P5 via Hill Road
- access to car parks P2 and P4 via Birnie Avenue
- event bus route access to Plaza Bus Terminal via Hill Road for route 6 Menai and route 7 Cronulla.

Figure 6.6 is a map from the SOPA Act, which essentially outlines non-SOPA owned roads for which SOPA must prepare a traffic management plan, and therefore have the ability to open and close during major events, as required.

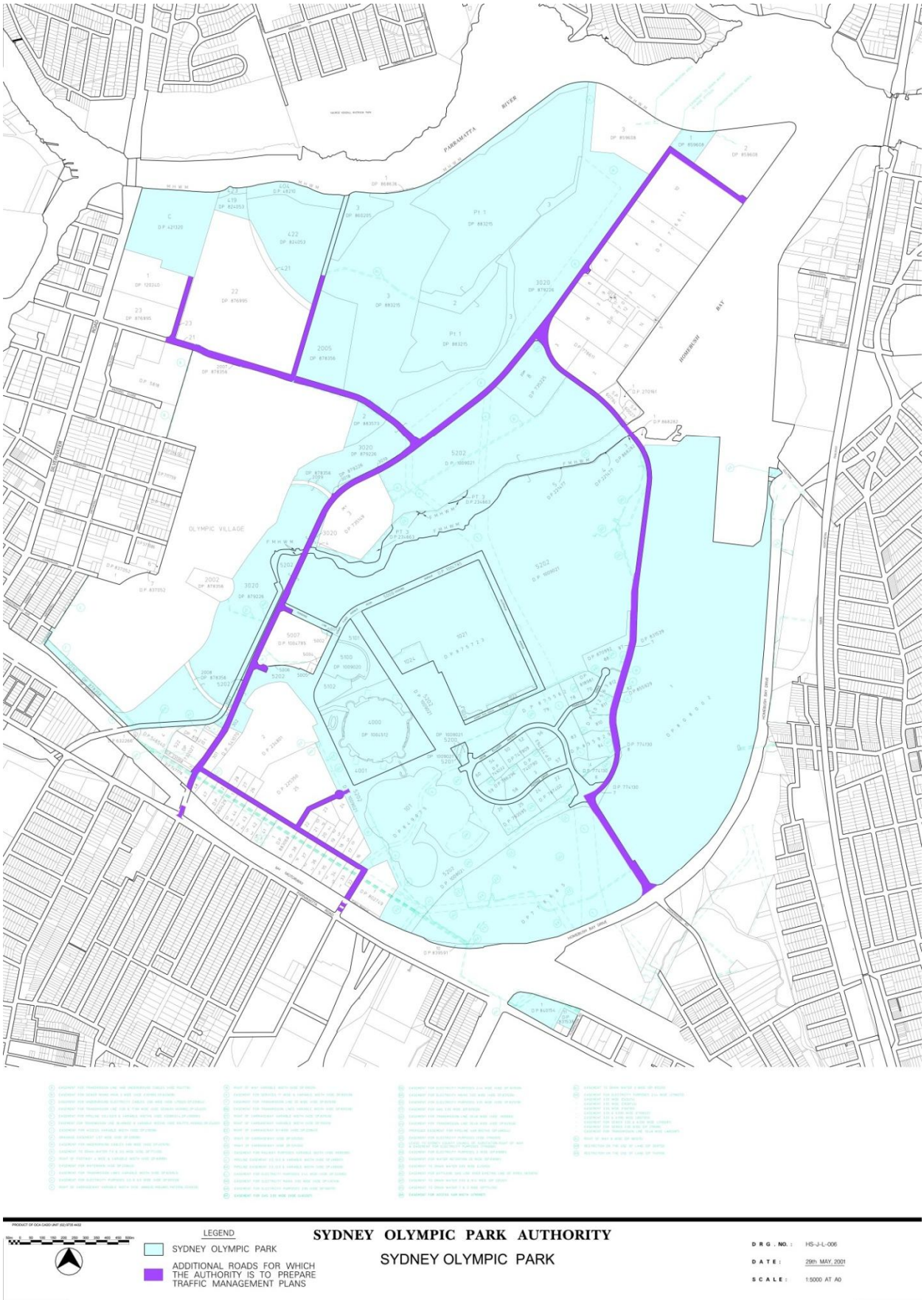
Special event closures

Two events of long duration impact the local and regional road system around Sydney Olympic Park:

- Sydney 500 V8 Supercar event
- Sydney Royal Easter Show

Both of these events require significant road closures staged over a number of weeks. These have the likelihood of impacting access to the Carter Street UAP during March/April and December. The road closures associated with the Royal Easter Show are focussed on the Showground precinct and the northern areas of SOP around the town centre.

Figure 6.7 outlines the street circuit layout for the Sydney 500 V8 Supercar event.



Source: SOPA (2013)

Figure 6.6 Traffic Management designation under the SOPA Act (2001)

Source: V8 Supercars (2013)

Figure 6.7 Sydney 500 V8 Supercar circuit

The overview of major road changes and closures for the event build and deconstruction for the 2013 event (December 6–8) are:

- construction begins on Monday 21 October and will go through until Thursday 5 December
- closure of Australia Ave between Murray Rose and Kevin Coombs Avenues on:
  - Monday 28 October until Saturday 2 November
  - Monday 25 November until Sunday 1 December
- contra-flow traffic on Australia Ave (eastern carriageway) from Sunday 3 November until Sunday 24 November
- closure of Olympic Boulevard from Dawn Fraser to Kevin Coombs Avenues from Monday 25 November until Thursday 5 December (subject to change)
- one-way system around race circuit from Monday 2 to Monday 9 December 2013
- changes to bus service routes from Monday 11 November until 20 December 2013.

The key impacts to the Carter Street UAP by this event are

- the closure of the Edwin Flack Avenue between Old Hill Link and Dawn Fraser Avenue circuit for three days during the event
- the changes to bus services
- the restricted use of Edwin Flack Avenue for a full week.

Development changes to event operations

The suggested changes to the Carter Street UAP that will influence event operations at Sydney Olympic Park include:

- transition of a significant amount of land use from light industrial to residential, particularly on streets designated for traffic management such as Uhrig Road and Carter Street
- 11,000 new residents in the Carter Street Precinct
- the upgrading of several local intersections (subject to RMS approval):
  - signalisation of Carter Street and Birnie Avenue intersection
  - signalisation of Carter Street and Hill Road intersection
  - signalisation of Uhrig Road and Edwin Flack avenue intersection
- upgrading of Hill Road and John Ian Wing intersection
- upgrading of Hill Road and Old Hill Link intersection
- upgrade to local and regional bus services connecting to Parramatta, Strathfield and adjacent developments such as Wentworth Point and Rhodes
- upgrade to local pedestrian and cycleway connections and associated urban domain amenity to match the character of Sydney Olympic Park.

The transition of the Carter Street precinct from a light industrial area to a predominantly residential community will result in an increase in the level of vibrancy in the western side of Sydney Olympic Park. Residential development is more compatible with event operations than commercial development as it typically generates less traffic which travels in the same direction as an event staged in the PM commuter peak i.e. towards the park. There is also a focus on containment of work trips for the new residents of Carter Street i.e. they live and work in the Sydney Olympic Park community.

The upgrading of intersections on the key gateway access routes of Hill Road and Birnie Avenue, as well as Edwin Flack Avenue, will improve both vehicle safety for turning movements and pedestrian safety for crossing movements, which are currently manually controlled at the Uhrig Road/Edwin Flack Avenue. Signalised control of intersections also allows the manual control of traffic signals on the main car park access routes from the Sydney Olympic Park Operations Centre where required.

The infrastructure plan also includes the upgrading of Hill Road which would improve the capacity to access P1 car park through the introduction of an additional right turn lane into Old Hill Link. The infrastructure plan also supports the signalisation of the Edwin Flack Avenue and Uhrig Road intersection to improve pedestrian safety for the increase in movements as the local population grows at Carter Street.

The redevelopment of Carter Street UAP and the other developments in the Homebush Bay subregion provides the opportunity to support the upgrading of regional transport infrastructure. This will have the dual benefit of assisting transport to Sydney Olympic Park during events.

Future requirements for SOPA Act

The roads in Figure 6.6 were designated in conjunction with the SOPA Act in May 2001. It appears that the map has not been revisited since this time despite the new high density residential development both within SOPA lands and Wentworth Point. This is likely to be due to the fact that no major event related problems currently exist. It should also be noted that none of the new streets in Wentworth Point South development have been added to the map since 2001.

The UAP development, with its predominantly residential and light industrial land use, requires local access to be maintained, even during events. As the roads impacted (Carter Street, Uhrig Road and any new roads) are not crucial for event operations, this will need to be reflected in the traffic management designation map (and hence the SOPA Act).

As the new streets within the Carter Street UAP support high density residential development, the likelihood of "feral parking" associated with events is low due the lack of availability of on-street parking. This condition for the future Carter Street UAP would be similar to Newington local roads which perform the same local parking function and they are not designated. There are also no restrictions to maintaining the existing 2P event parking restriction in Carter Street and Uhrig Road as this would be the same condition as other streets in the SOP event precinct.

Uhrig Road has been used in the past for overflow hire car parking from Dawn Fraser Avenue for peak capacity events and for access to coach parking. When the mixed use development proceeds in Uhrig Road, this would represent a conflict of uses with the Carter Street UAP, which is considered the higher order use. Access to coach parking would warrant an event road designation to be maintained with the development of the UAP until a suitable alternative location is found. If event traffic were to be redirected through the Carter Street UAP, it would disrupt the main traffic flows when it re-joins the main road network, which would be detrimental to the efficient use of Hill Road and Birnie Avenue as access roads to event car parks.

6.9 Transport measures

Provide new owners with a transport package including information and discount

One of the objectives of the study 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 information to be produced by each developer as a requirement of the DCP, including:

- travel information kits for residents (Travel Access Guides) for residents
- Workplace Travel Plans for employees.

Install wayfinding and directional signage throughout the development and at site entry points

Wayfinding signage would be installed at entry points to allow people to navigate their way around the Precinct. Maps would also be installed to allow people to know about the pedestrian and cycle connections through the Carter Street UAP to Sydney Olympic Park.

Car share schemes

Car share schemes are designed to provide a flexible option for people who only require occasional car use and choose not to own a vehicle. They provide access to a vehicle when it is the most suitable mode choice, while avoiding the need and expense of owning a vehicle. They would potentially require lower parking rates than proposed in Section 6.7 to provide sufficient incentive for residents and businesses to reconsider purchasing a first or second vehicle in favour of using the car share vehicle. Without a vehicle sitting in a garage, private car is not the first mode considered, increasing the likelihood that other mode sustainable modes will be chosen.

Successful car share operations are based in metropolitan areas with high-density and mixed-use development, good levels of pedestrian access and constrained parking (fewer car parks or parking that is more expensive). When used in conjunction with public transport, walking, and cycling, car sharing has the ability to be an integral part of the sustainable transport network for urban areas. Car share schemes have been established in areas from Maroubra to Chatswood and Manly, and Summer Hill to Bondi.

Car sharing also has the ability to reduce the total fleet vehicles for an employer and reduce the use of private vehicles for commuting. This trend is supported by current research, such as the Transportation Research Board report that estimated that 'at least five private vehicles are replaced by each shared car' in 2005. Sydney's Go-Get club advertises that its research shows that each car in the scheme gets seven others off the roads.

6.10 Summary of recommended transport improvements

Table 6.3 lists the suggested strategies to encourage the use of public transport and active transport by the Precinct. The measures are divided into measures that assist travel to/from the Homebush Bay subregion and locally significant measures. These recommendations require further investigation as part of a broader regional transport assessment.

Table 6.3 Summary of recommended strategic transport planning measures

Measures	
	Measures to assist area-wide transport issues
1	Undertake further feasibility studies into the Sydney Olympic Park Line of the proposed Western Sydney Light Rail Network incorporating a link to Carter Street
2	Review and improve bus service coverage, frequency and hours of operation
3	Cycle connection along Carter Street in parallel to M4 Western Motorway
4	Investigate options to run more direct train services to Olympic Park
	Precinct related transport improvements
5	Bus stop infrastructure
6	Cycle links and public bike parking
7	Pedestrian network improvements including pedestrian signals on the M4 Motorway eastbound off-ramp at Hill Road, mid-block crossings of Carter Street and footpaths
8	New resident transport information packs
9	Workplace travel plans
10	Wayfinding and directional signage
11	On-street parking management strategy
12	Car share scheme

Source: Parsons Brinckerhoff

7. Key recommendations

This transport impact assessment has been prepared for the rezoning of the Carter Street UAP based on the information available for this study. The rezoning will convert the Precinct that is currently used for industrial land uses to a mixed residential, retail and employment (commercial/office, business park) precinct. The assessment of the transport network required to support this rezoning has identified a number of influences from the wider Sydney road and rail networks that could play a key role in determining the magnitude of development within the Homebush Bay subregion. The following recommendations are made to assess the impact of these wider regional impacts.

7.1 Area-wide transport modelling

The traffic analysis undertaken for this study has used a method of intersection modelling to assess when road network performance is reaching the threshold of performance. The threshold for acceptable road network performance was taken as the point at which queues along the major arterial and sub-arterial roads in the local area start affecting the upstream intersection(s). Additional traffic beyond this threshold may be possible, but is likely to result in significant congestion, with the road space being used as 'storage' of surplus vehicles until peak conditions begin to dissipate. Wider-area traffic modelling is required to be able to accurately assess the potential for traffic generation above this threshold.

Given the interaction of the traffic capacity issues on the arterial road network and the interaction of intersection performance due to queuing, it is recommended that a wider traffic model be developed that can assess these complexities. This model will also offer a consistent platform with which to assess the road network upgrade cost apportionment.

7.2 Arterial road network capacity

The Homebush Bay subregion is bordered by four busy arterial roads, including Parramatta Road, the M4 Western Motorway, Silverwater Road and Homebush Bay Drive. All of these roads currently experience congestion and are expected to face increased demand in the future. The WestConnex project has been announced, which will provide additional road capacity in the east-west corridor and new ramps in the study area. Its impact on the amount of road capacity in the future and on flows on Parramatta Road and Hill Road is currently being investigated.

The Homebush Bay subregion also has five main gateways that are all operating at or close to capacity, with long delays and queues during peak periods. Some intersections are already operating with unacceptable levels of delay (Hill Road and Carter Street, Birnie Avenue and Carter Street, Silverwater Road and Holker Street) and require upgrading. Others have limited spare capacity to accommodate future growth.

The future arterial road network conditions will have a large influence on the amount of traffic that can be generated by the Homebush Bay subregion. Upgrades to the arterial road network may cause a re-distribution of trips in the area, changing the balance of traffic that uses each of the five gateway intersections. The ability of the arterial road network to accommodate the traffic flows generated by the Homebush Bay subregion needs to be assessed through a wider-area study of transport including the major arterial connections.

The interaction between the supporting road network changes associate with the WestConnex project and the Carter Street UAP requires further detailed analysis. Discussions with WestConnex project staff from RMS and Sydney Motorway Project Office are continuing to determine a suitable arrangement for both projects.

7.3 Public transport

The Sydney Olympic Park Master Plan 2030 recognised the impact of the road network capacity on the ability to realise the yield outlined in the plan. A cap on the amount of high trip generating commercial space was applied until a new high capacity public transport line(s) were opened to facilitate higher travel by non-car modes. One proposal that could fulfil this role is one line on the Western Sydney Light Rail, which would open up a direct connection to Parramatta. The feasibility of this line should be further investigated in light of the development proposals for the two UAPs and the increase in density of the Fairmead proposal at Wentworth Point.

Changes to the local bus network are recommended to adjust the bus network to the needs of the future communities in the Homebush Bay subregion. In addition to frequency and hours of operation changes, adjustments to the three bus routes that traverse the area (Routes 401, 525 and 526) are proposed. Adjustment to bus stop locations and improvements to passenger infrastructure have been proposed to increase bus patronage. These changes require further assessment by Transport for NSW.

7.4 Development levels

An analysis of the road network capacity has been used to estimate that the road network could sustain development within the Carter Street UAP to the following levels:

- 5,500 dwellings accommodating approximately 11,550 residents (100% proposed)
- 12,000 m^2 GFA retail floor space (100% proposed)
- 111,000 m^2 GFA commercial employment floor space providing approximately 5,550 employees (65% proposed).

Other strategies to reduce vehicle trip generation and lift the percentage of full commercial development without the need to construct more road upgrades include.

- a more extensive public transport upgrade
- higher public transport frequencies assisted by dedicated public transport priority
- reduce parking rates to encourage the use of alternative modes of transport (requires one of the above to provide a suitable alternative).

If a 10% reduction in car driver mode share could be achieved for journeys to work (and lower reductions in other trip purposes) on top of the currently assessed changed, the transport requirements of the full proposed development for the Carter Street UAP could be met. However, this would require a substantial new piece of public transport infrastructure.

7.5 Package of measures

A package of measures has been suggested to manage and provide a balanced approach to the transport impacts including initiatives, infrastructure capacity upgrades and travel behaviour change promotion/incentives. The list of the transport measures recommended is provided in Table 7.1. They require further investigation as part of a broader regional transport assessment. Suggestions for new traffic signals need to be assessed against the warrants for traffic signals and will need approval by RMS. The measures are divided into measures that assist travel to/from the Homebush Bay subregion and locally significant measures.

Table 7.1 Summary of recommended strategic transport planning measures

Measures		Location in report
	Measures to assist area-wide transport issues	
Road 1	Investigate the subregional arterial road network capacity through wider-area traffic modelling to determine its future capacity based on recommended intersection upgrades such as those developed for SOP Master Plan 2030. This should also be informed by the proposals identified in the WestConnex project	5.3
Road 2	Investigate suggested road network improvements ■ Parramatta Road, Hill Road and Bombay Street ■ Parramatta Road and Birnie Avenue ■ Hill Road and Old Hill Link ■ Edwin Flack Avenue and Birnie Avenue	5.3
Road 3	Investigate design solutions to provide vehicle, pedestrian and cycle access to the Carter Street UAP and accommodate the requirements of the WestConnex project	5.4
Transport 1	Undertake further feasibility studies into the Sydney Olympic Park Line of the proposed Western Sydney Light Rail Network incorporating a link to Carter Street	4.3, 6.2
Transport 2	Review and improve bus service coverage, frequency and hours of operation	6.3
Transport 3	Cycle connection along Carter Street in parallel to M4 Western Motorway	6.5
Transport 4	Investigate options to run more direct train services to Olympic Park	6.1
	Precinct related transport improvements	
Road 4	Access intersection improvements ■ Hill Road and Carter Street: signalisation, upgrade ■ Hill Road and John Ian Wing Parade: modification of existing signals and upgrade ■ Edwin Flack Avenue, Dawn Fraser Avenue and Uhrig Road: signalisation ■ Birnie Avenue and Carter Street: signalisation, upgrade.	5.3
Road 5	Internal intersection improvements ■ Carter Street and Uhrig Road: signalisation and upgrade to assist movement of pedestrians and buses	5.3
Transport 5	Bus stop infrastructure	6.3
Transport 6	Cycle links and public bike parking	6.5
Transport 7	Pedestrian network improvements including pedestrian signals on the M4 Motorway eastbound off-ramp at Hill Road, mid-block crossings of Carter Street and footpaths	6.6
Transport 8	New resident transport information packs	6.9
Transport 9	Workplace travel plans	6.9
Transport 10	Wayfinding and directional signage	6.9
Transport 11	On-street parking management strategy	6.7
Transport 12	Car share scheme	6.9

Source: Parsons Brinckerhoff

7.6 Funding and contributions

The delivery of the package of road network upgrades outlined in section 7.5 may require funding from a range of sources including State government, Auburn Council, Sydney Olympic Park and contributions from developers. The estimates of the cost of works and the contributions required will be included in the Rezoning Study to inform the Growth Infrastructure Plan.

Based on preliminary calculations of traffic volumes and intersection upgrade costs for the intersection upgrades listed in Roads 2, 4 and 5 in Table 7.1, the total contribution required by the Carter Street UAP would be approximately 31% of the total cost. This includes a 100% contribution to the intersections of Carter Street and Uhrig Road, Uhrig Road and John Ian Wing Parade Extension, which are considered to be wholly required for the Carter Street UAP. Excluding these intersections, the overall contribution to the upgrade costs would be 26%.

7.7 Timing

An assessment potential timeframes for the suggested transport upgrades is shown in Table 7.2. This list requires further consultation with the relevant agencies.

Table 7.2 Approximate staging of suggested transport improvements

Timeframe	Road and intersection	Public transport	Comments
Short Term (by 2015/ start of Carter Street Precinct development)	■ Intersection of Hill Road and Carter Street ■ Intersection of Birnie Avenue and Carter Street	■ Bus frequency improvements ■ Bus stop infrastructure	■ Addressing current issues/enabling construction traffic
Medium Term (between 2016 and 2021)	■ Intersection of Edwin Flack Avenue, Dawn Fraser Avenue and Uhrig Road (to suit development timeframe) ■ Intersection of Carter Street and Uhrig Road (to suit development timeframe) ■ Intersection of Parramatta Road and Birnie Avenue (approx. 2016) ■ Intersection of Parramatta Road, Hill Road and Bombay Street (approx. 2018) ■ Intersection of Hill Road and Old Hill Link (approx. 2021)	■ Bus priority ■ Route 526 extension (after opening of Homebush Bay Bridge) ■ Sydney Olympic Park Wharf upgrade. ■ Bus frequency improvements	■ Bus network to provide public transport network capacity until new line can be opened ■ Gateway intersection upgrades required early in medium-term ■ Access intersection upgrades to match development timeframe ■ Uhrig Road intersection upgrades to assist pedestrian and bus movement
Long Term (After 2021)	■ Intersection of Parramatta Road, Hill Road and Bombay Street (further upgrade, approx. 2022) ■ Intersection of Parramatta Road and Birnie Avenue (further upgrade, approx. 2023) ■ Intersection of Birnie Avenue and Carter Street (further upgrade, approx. 2025) ■ Intersection of Edwin Flack Avenue and Birnie Avenue (approx. 2028) ■ Intersection of Hill Road and John Ian Wing Parade (further upgrade, approx. 2028)	■ New public transport line from Parramatta to Sydney Olympic Park/ Carter Street ■ Bus network review to support new line ■ Bus frequency/hours of operation improvements	■ Further gateway intersection upgrades required. ■ Requires more assessment on a Homebush Bay subregion-wide and network level

Appendix A

Intersection performance criteria

A1. Intersection performance criteria

Level of Service (LoS)

Level of Service (Los) is a basic performance parameter used to describe the operation of an intersection. Levels of service range from A (indicating good intersection operation) to F (indicating over-saturated conditions with long delays and queues). At signalised intersections, the LoS criteria are related to average intersection delay (seconds per vehicle). At priority controlled (give-way and stop controlled) and roundabout intersections, the LoS is based on the modelled delay (seconds per vehicle) for the most delayed movement (refer to Table 6.1).

Table A1.1 Level of Service criteria for intersections

Level of Service	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 would 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: RMS Guide to Traffic Generating Developments, 2002

Degree of saturation (DoS)

The Degree of Saturation (DoS) is 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 value.

Average vehicle delay

This is the difference between interrupted and uninterrupted travel times through the intersection and is measured in seconds per vehicle. At signalised intersections and roundabouts, the average intersection delay is usually reported. At priority controlled intersections, the average delay for the most delayed movement is usually reported.

Queue length

Queue length is measured in metres reflecting 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 reflects 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.