A Transport Strategy for Liverpool City Centre

Client // Liverpool City Council
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Executive Summary

Liverpool City Council has submitted a planning proposal to rezone portions of the City Centre from B3 to B4 to facilitate mixed use development comprising, amongst other land uses, 7,000 residential units.

This report presents a Transport Strategy to support the intended changes to land use. The associated traffic analyses have considered the planned development for years 2026 and 2031.

A package of multimodal transport interventions is proposed.

Traffic modelling using a bespoke meso-model shows that, irrespective of the infrastructure upgrades proposed (including grade separation of the Hume Highway signalised intersections), the 2031 traffic generated within the Liverpool CBD cannot be accommodated on the primary road network (i.e. Hume Highway).

A consequence of this outcome will be extensive congestion and gridlock throughout the CBD road network (including intersections, and mid-block road sections) and on the regional roads (particularly Hume Highway) during the peak traffic periods.

In order for Liverpool City Centre to grow and develop into an economically successful and vibrant regional centre as intended, a package of strategic transformations will be required that encourage and support a major shift in peoples' travel habits. In particular:

- The current mode split in the City Centre will not be sustainable with the planned development in 2031.
- The dominance of car traffic needs to be changed.
- A significant modal shift to active transport and public transport needs to be achieved in the City Centre.
- Modal shift needs to be facilitated through a combination of initiatives and infrastructure projects that encourage active and public transport and discourage car travel within the CBD.

The remaining findings and outcomes from this study can be summarised as follows:

1. **Travel Demand**
   a. To minimise traffic impacts every effort should be made to promote sustainable transport outcomes. These include the promotion of public transport, walking and cycling; the development of mixed land use that facilitate 'trip-containment' where people live and work in the same area, and other travel demand management measures, such as ride share, Go-Get etc.

      The following measures and next steps are recommended:

      - Investigate opportunities to cooperate with car share operators such as GoGet.
      - Identify locations for car share pods (including Liverpool Station, satellite car parks, shopping centres and Council-owned car parks).
      - Include the provision of a Green Travel Plan or Work Travel Plan as a requirement for all City Centre developments in Liverpool's Development Control Plan (DCP) Part 4. This might require rewriting the current DCP or developing a new City Centre DCP as part of the LEP52 amendment process.

2. **Parking**

a. Current parking provision within the CBD, both on and off-street, is operating at capacity. Increasing the supply of parking will increase the volume of traffic travelling to and from the CBD and exacerbate congestion.
b. Central parking facilities should be classed as short-stay so that visitors, shoppers and business people can find convenient parking and support economic growth.
c. Long stay (commuter) parking should be located on the periphery of the CBD and served by shuttle buses.
d. Variable message signs should be connected to the various parking areas to indicate parking availability and the routes to it.

The following measures and next steps are recommended:

- Investigate the change of unrestricted on-street parking areas to 4P areas. This requires parking surveys and community consultation as many unrestricted areas are within residential areas.
- Convert Council-owned off-street parking into time restricted parking, restrictions should be 3P and less.
- Review the pricing structure for on and off-street parking in the City Centre and develop a pricing strategy that discourages long-term parking.
- Identify locations for additional satellite parking in the vicinity of the City Centre (similar to Collimore Park) and provide free shuttle bus services to the City Centre and Liverpool Station.
- Review parking rates for new developments in the City Centre and update LEP and DCP(s) accordingly. This should include a 'maximum parking rate' approach for residential and mixed use developments. The provision of Green and Work Travel Plans will support the reduction in parking spaces.
- Develop a dynamic parking signage strategy that directs users to car parks with available parking. This system needs to start outside the City Centre. The parking signage strategy should be supported by the development of a smart phone application that enables users to pre-book parking spaces and guide them to designated spots.
- Review feasibility of converting single storey into multi-storey car parks outside the City Centre.

3. **Walking and Cycling**

a. Good pedestrian connectivity within the CBD will support movement and business activity.
b. Cycleway planning is advanced but networks need to be completed.
c. The introduction of end-of-trip facilities (bike racks, lockers, showers etc.) within new developments is considered essential to support these activities.
d. Northern end of Macquarie Street already pedestrianised, extension pedestrian zone to southern end of Macquarie would introduce a north-south pedestrian spine with opportunities for place making and improved city centre environment.
e. Wayfinding for pedestrians and cyclists requires improvement for easier navigation of the city centre.

The following measures and next steps are recommended:

- Develop a City Centre wayfinding strategy for pedestrians and cyclists that includes routes and travel times to and between key locations such as train station and bus stops, shopping centres, libraries, service centres etc.
- Introduce secure bicycle parking facilities at key trip generators including Liverpool Station, shopping centres, library, service centres etc. These facilities need to be compliant with AS2890.3 (2015).

- Update the LCC DCP (Part4) on bicycle parking to include more specific requirements on parking spaces for different developments, provision of secure bike parking and shower/ changing facilities.
- Review the opportunities for place making and an improved pedestrian environment in Macquarie Street south of Moore Street. This should include additional space for pedestrians, upgrade and implementation of street furniture and review of parking arrangements.
- Review the opportunities for place making and an improved pedestrian environment in Railway Street to create a better connection between the core CBD and the train station. This should include additional space for pedestrians, upgrade and implementation of street furniture as well as review of traffic operations and parking arrangements.

4. **Public Transport**

a. The existing public transport provision in the Liverpool city centre is good with two train stations, bus interchange and regular bus and train services.
b. Clear designation of function for train stations (Liverpool as public transport interchange, Warwick Farm as P&R station) can help to further improve public transport services.
c. Bus services are running on various alignments through city centre and stop locations are dispersed. A transit boulevard along Moore Street would consolidate bus routes and stops, and would remove buses from parallel CBD streets to improve road and intersection performance for other traffic.
d. A transit boulevard along Moore Street and consolidation of bus stops could provide a better pedestrian environment, cycling links and the opportunity for place making.
e. Train services between Liverpool and the Sydney CBD are currently adequate but future demands could require upgrades with regards to service patterns and travel times.
f. Train services between Liverpool and Parramatta are currently inadequate and will benefit from more regular direct services.

The following measures and next steps are recommended:

- Undertake a feasibility study for a transit boulevard along Moore Street. This should include operations, design framework, impact on bus services in the City Centre and the wider network, impact on Liverpool Station Bus Interchange (capacity and operation), bus stops location and operation, opportunities for walking and cycling.
- Consult with bus operators in preparation for implementing the transit boulevard along Moore Street.
- Support a transit boulevard along Moore Street with a free shuttle bus service that services key locations within the City Centre (outside the transit boulevard) including the hospital.
- Continue supporting an extension of the Sydney Metro from Bankstown to Liverpool City Centre (and potentially further west) for improved train services between Liverpool and the Sydney CBD.
- Reduce or remove commuter parking at Liverpool Station and replace car parking with 'Kiss & Ride' spaces.

5. **Traffic**

a. Traffic demands within the study area are forecast to grow at a rate that is likely to exceed the capacity of the existing road network and without any intervention works with respect to demand management and road infrastructure improvements, the road network is forecast to markedly deteriorate in operating conditions and delays impacting on local and regional traffic as well as the Liverpool CBD connectivity.

b. The modelling undertaken as part of the study showed that the proposed land use intensification within the CBD will require appropriate road infrastructure projects that address current congestion issues and provide long-term remedies to support the road network in the long term.
c. The Hume Highway will continue to fulfil its role as a major arterial corridor that traverses the study area in the north-south direction and serves regional through trips as well as local trips that access the Liverpool CBD.
d. The high proportion of long distance trips in the overall composition of trips patterns will continue to have a significant impact on the intersections' capacity around the city centre. This issue combined with high vehicle demands generated by the land use intensification will diminish any potential benefits that localised road network improvements within the city centre may offer.
e. The modelling undertaken showed that infrastructure projects that address localised congestion issues and provide short-term remedies may not be sufficient to support the road network in the long term. While it is considerably less costly in most circumstances to upgrade individual intersections or road corridors, those are unlikely to provide a sound road network structure through a high-quality motorway and arterial road network with sufficient capacity for the future.
f. Providing an effective road transport infrastructure package that addresses existing and future capacity deficiencies as well as provides access to and from the Liverpool CBD will be fundamental for any future planning. This must be based on collaborative approach between Council, Transport for New South Wales and Roads and Maritime Services.
g. An integrated corridor strategy will be required for the Hume Highway corridor to balance the needs of regional and local traffic. The corridor is expected to experience significant transport challenges with traffic congestion forecast to increase and the existing road infrastructure having only limited scope for capacity improvements without expensive land acquisition to expand the footprint of the corridor. Notwithstanding, the medium-term strategy should seek to optimise the corridor operation rather than individual intersections through various traffic measures (intersection and corridor traffic signals review, local access review, etc.). In the long term, for the corridor to successfully fulfil its intended role there will be a need for a reduction in travel demands which may require major infrastructure solutions to expand the existing road network.
h. In recognition of the complex transport challenges confronting the study area, a solution that separates local and regional trips through a road bypass, and enables the improvement of the Hume Highway through Liverpool is likely to offer an expansion to the existing road network and an improvement for the access and connectivity between the motorway and arterial road networks. This option is likely to deliver a real alternative for external trips that would otherwise travel along Hume Highway, and enhances the road network to cater for future growth of the CBD and wider areas of Liverpool.

The following measures and next steps are recommended:

- Prepare an integrated corridor strategy for the Hume Highway corridor in cooperation with Transport for New South Wales and Roads and Maritime Services.
- Prepare a growth strategy that incorporates additional development outside the City Centre such as the Georges River Precinct. The strategy should include access to and from the City Centre as well as connectivity with the motorways.
- Review and test options for a road bypass of the Liverpool City Centre that guides external road trips away from the City Centre.

1. Introduction

1.1 Background

The Liverpool City Centre is located approximately 17km south west of the Sydney CBD and 12 km south of Parramatta CBD, and covers an area of approximately 1.6km^2. The State Government's 2014 *Plan for Growing Sydney* has identified Liverpool City Centre Precinct (LCCP) as a Regional City Centre, that will comprise a strong retail and economic core, supported by a broad health, community and education precinct. As such, Liverpool City Council (Council) is actively pursuing strategic infrastructure and planning mechanisms to bolster economic resilience, strengthen connectivity and safeguard the sustainability of this precinct.

To this end, Council has submitted a planning proposal to rezone portions of the City Centre from B3 to B4 to facilitate mixed use development comprising, amongst other land uses, 5,000 residential units, as a first step towards energising the City Centre. In addition, a number of other substantial developments and projects, including the Southwest Growth Centre, Sydney's Second Airport, and Moorebank Freight Terminal, are expected to be completed in the region over the next 20 years, all of which will contribute to the ongoing expansion of the Western Sydney area.

In recognition of future development and growth within and surrounding the LCCP, the demand for travel could be expected to increase dramatically, resulting in a multitude of transport challenges, including traffic congestion, excessive parking demands and significantly increased patronage on the public transport systems.

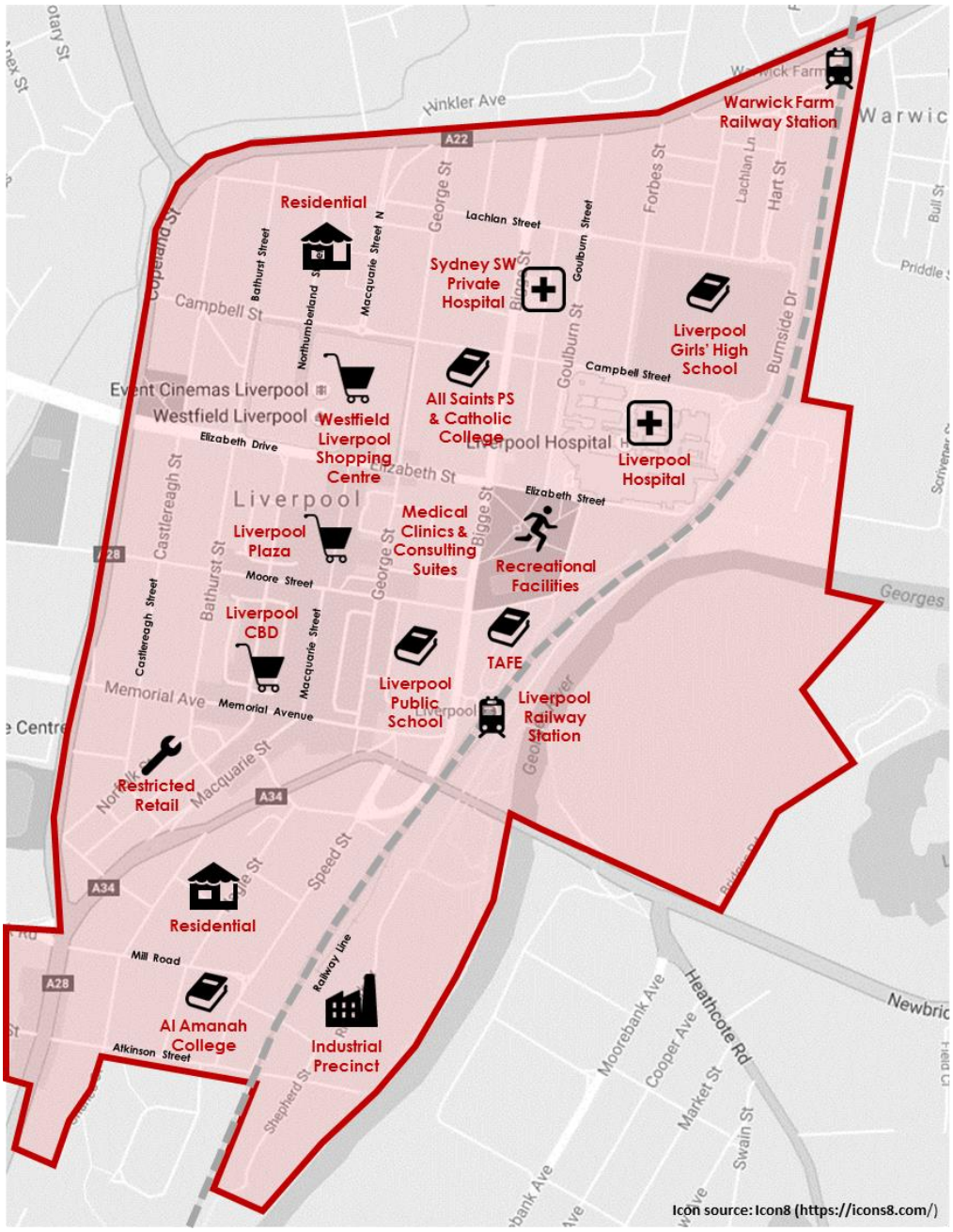
GTA Consultants (GTA) has been commissioned by Liverpool City Council to undertake a package of transport planning studies that, collectively, will present a transport strategy to support the intended growth of the City. The studies addressed parking, public transport, walking and cycling. The process has entailed reviewing the existing conditions, undertaking a needs and gap analysis and presenting a package of transport planning interventions intended to improve traffic conditions within the LCCP over the next 10 to 20 years. A traffic model has been used to assess the impacts of the proposed land use and transport developments on road network operations.

1.2 Study Area

The LCCP area is generally bounded by the Southern Railway Line to the east, Hume Highway to the north and west and Atkinson Street to the south.

The nominated study area, with key local features, is shown in Figure 1.1.

Figure 1.1: Liverpool City Centre Precinct



Basemap: Google Maps, Icon set: Icon8

The remaining sections of this report are structured as follows:

- Sections 2-6 summarise the prevailing (existing) traffic and transport conditions throughout the study area
- Section 7 explains the adopted approach to traffic modelling
- Section 8 summarises future growth in the area
- Section 9 discusses issues and opportunities
- Sections 10-16 address strategy development, and
- Section 17: Conclusion.

1.3 Background Information

The preparation of the Transport Strategy for Liverpool City Centre required the review and analysis of a series of background documentation and policies. These included:

- A Plan for Growing Sydney, NSW Government (dated Dec. 2014)
- Sydney Metropolitan Strategy 2036, NSW Government (dated Dec. 2010)
- NSW Long-Term Transport Masterplan, NSW Government (dated Dec. 2012)
- Growing Liverpool 2021, NSW Government (dated Aug. 2012)
- Liverpool Local Environmental Plan 2008
- Liverpool Development Control Plan 2008 and subsequent updates including Part 4
- Draft Liverpool LEP 2008 Amendment No. 52
- Draft Liverpool LEP 2008 Amendment No. 56
- NSW State Priorities
- Sydney's Rail Future
- Sydney's Bus Future
- Sydney's Walking Future
- Sydney's Cycling Future
- NSW Planning Guidelines for Walking and Cycling
- Bus Strategic Operations Plan (TfNSW, 2014)
- Proposed Sydney Metro Extension to Liverpool
- Integrated Land Use and Transport Policy Package
- RMS Guide for Traffic Generating Developments
- A Plan for Growing Sydney
- 2006 Liverpool CBD Parking Strategy Report [GTA Consultants]
- Bureau of Transport Statistics (BTS) Journey to Work and Household Travel Survey data 2011/2012.

2. Liverpool City Centre – Travel Patterns

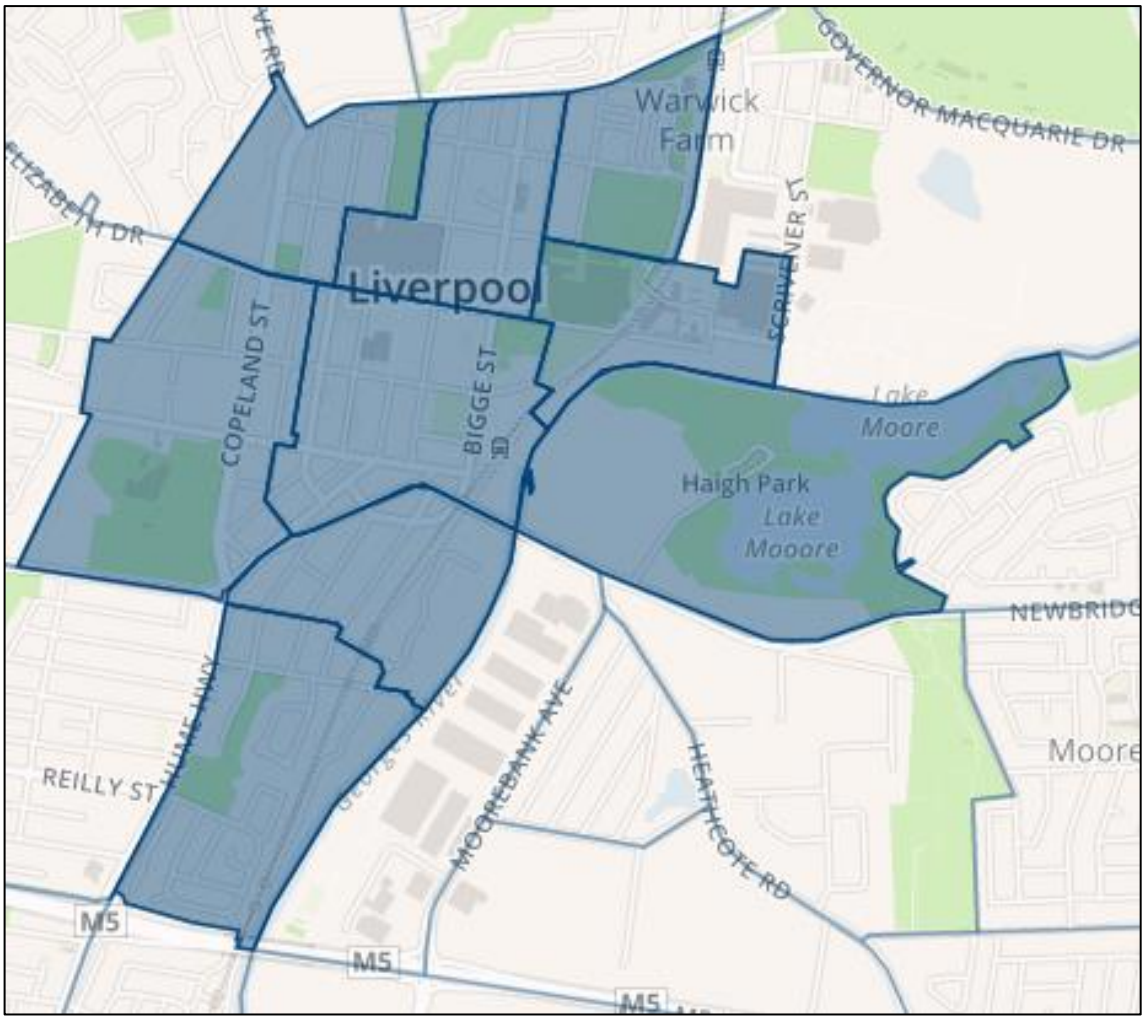
2.1 Existing Travel Patterns and Car Ownership

2.1.1 Journey to Work – Origin/Destination

2011 ABS Journey to Work data, sourced from the NSW Government Bureau of Transport Statistics (BTS), confirms commuter travel patterns to and from the LCCP study area.

The BTS divides the state of New South Wales into various 'Travel Zones', each representing a geographical unit of a few street blocks in size. The analysed Travel Zones, approximately constituting the LCCP study area, are highlighted in Figure 2.1 below and collectively are referred to as the 'statistical study area' in the following text.

Figure 2.1: Liverpool' Statistical Study Area' Travel Zones



Source: NSW BTS (2011)

The Journey to Work data indicates that almost 17,500 people are employed within the Liverpool statistical study area. Table 2.1 outlines the proportion of employees that originate from Liverpool compared to other areas.

Table 2.1: Origin – Where Employed Residents Travel From

Origin	Proportion
Liverpool	22%
Fairfield	13%
Campbelltown (NSW)	13%
Bringelly - Green Valley	12%
Camden	5%
Bankstown	4%
Other	*31%*

As shown, a significant proportion of employees originate from within the Liverpool area, with a smaller proportion originating from neighbouring geographical areas in all directions, as illustrated in Figure 2.2.

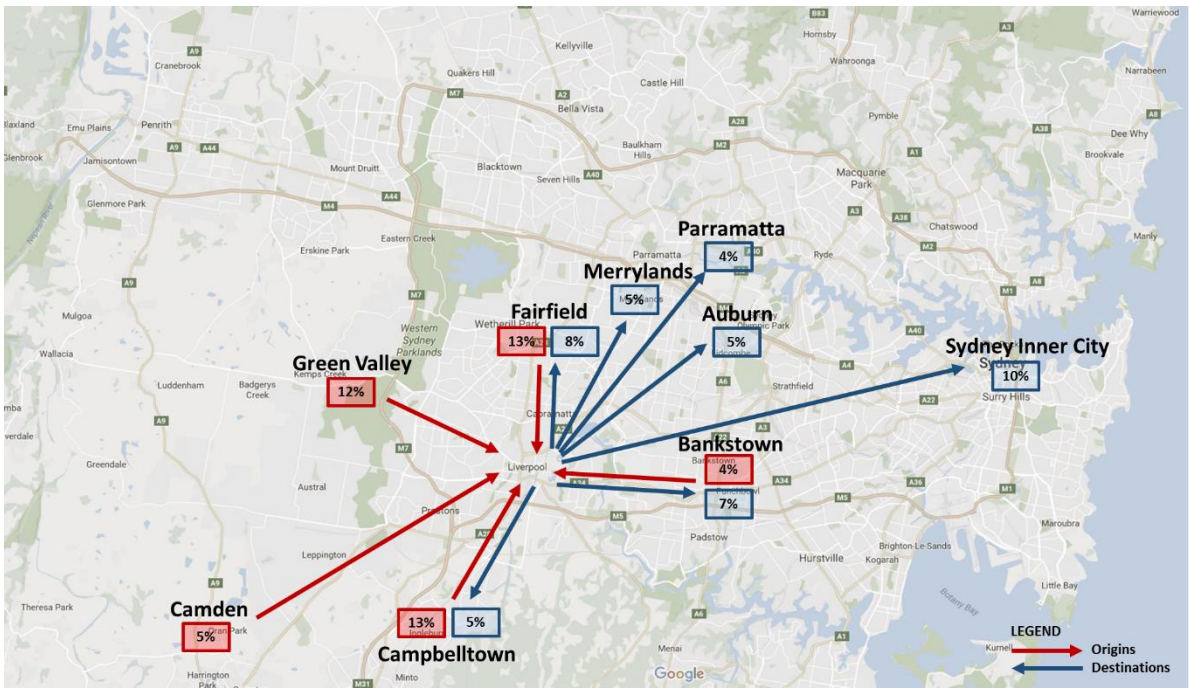
The statistics also indicate that approximately one-third of the 5,200 employed people who reside within the Liverpool statistical study area also work within the City.

A smaller proportion travel externally to Sydney CBD and neighbouring regions to the east, as shown in Table 2.2 and illustrated in Figure 2.2.

Table 2.2: Destination – Where Employed Residents Travel To

Destination	Proportion
Liverpool	28%
Sydney Inner City	10%
Fairfield	8%
Bankstown	7%
Merrylands - Guildford	5%
Campbelltown (NSW)	5%
Auburn	5%
Parramatta	4%
Other	*28%*

Figure 2.2: Employment Origins and Destinations (External to Liverpool)



2.1.2 Journey to Work – Mode of Travel

The ABS 2011 data also provides an insight into the mode of travel for journeys to and from work within the Liverpool statistical study area.

Figure 2.3 provides a breakdown of the mode share for journeys to places of employment within Liverpool, whilst Figure 2.4 outlines the proportion of each mode used by residents from Liverpool, irrespective of their place of work.

Figure 2.3: Origin - Mode of Travel for Employed Persons

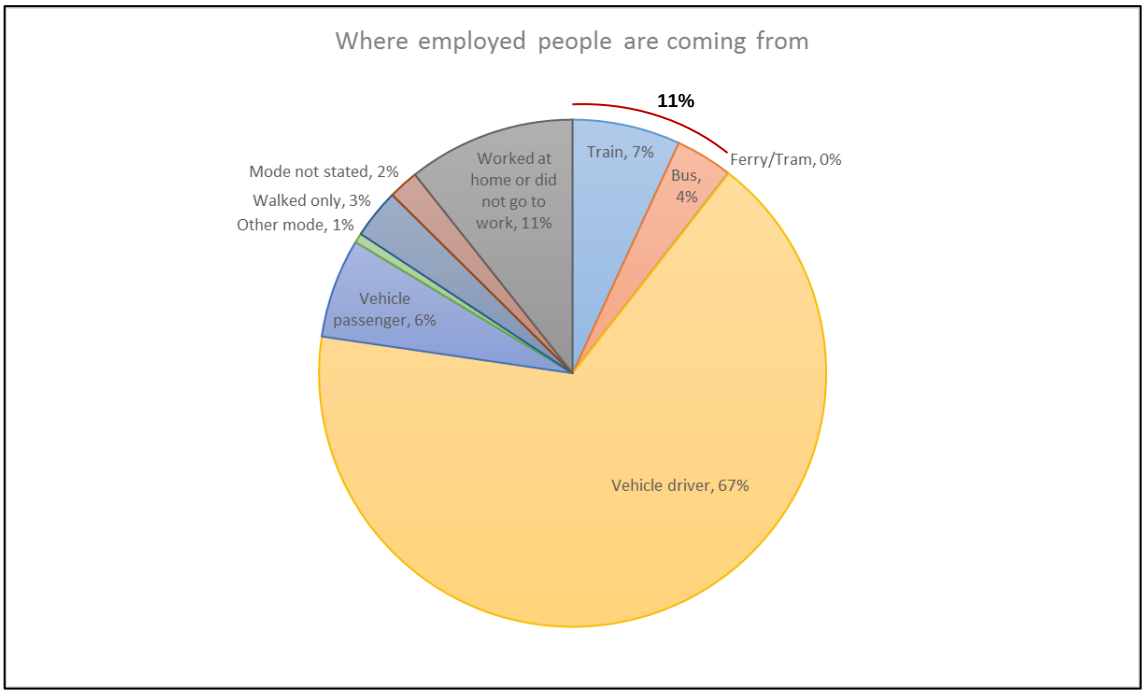
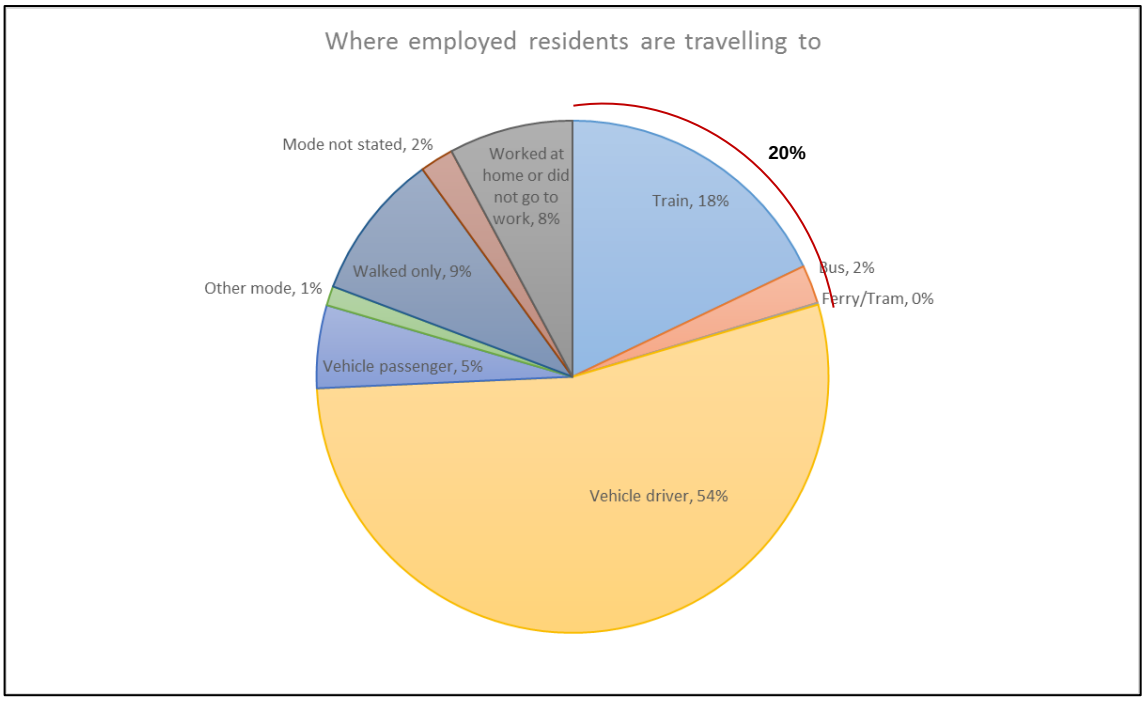


Figure 2.4: Destination - Destination Mode of Travel for Employed Residents



The data indicates that private vehicle use represents the key mode of travel for journeys to work both internal and external to Liverpool, with 73% of people travelling to and 59% of people coming from the area as either a driver or passenger of a private vehicle.

It is noted that 11% of people travelling to and 20% of people travelling from Liverpool use public transport (train and bus), with 3% and 9% utilising active modes respectively.

2.1.3 Car Ownership

Data obtained from the Australian Bureau of Statistics (ABS) indicates that car ownership within the LCCP is generally high, with approximately 90%[1] of the households owning one or more vehicles and only 10% of households not owning a car.

These figures generally correlate with the Greater Sydney area, where 87% of households own one or more cars, while 13% do not own a car. A comparison of car ownership in the LCCP from 2006 to 2011 is shown in Table 2.3.

Table 2.3: Liverpool City Car Ownership

Number of motor vehicles per dwelling	Percentage of households		
	2011 (53,762 households)	2006 (49,211 households)	Δ Net difference (2006 to 2011)
No motor vehicles	9%	11%	-2%
One motor vehicle	31%	33%	-2%
Two motor vehicles	37%	36%	+1%
Three motor vehicles	19%	16%	+3%
Overall	87% of households have 1+ cars	85% of households have 1+ cars	+2% of households have 1+ cars

[1] 'Not stated' responses from the 2011 and 2006 census data have been excluded.

Based on data obtained from the 2011 Census, it is evident that a greater number of dwellings now own at least one motor vehicle, increasing by 2% on average. This comparison indicates that there is a decrease in the number of residents who own from zero to one motor vehicle and an increasing trend toward residents owning more vehicles per household. This probably reflects the changing demographic and economic status of people within the community.

[1] Data obtained from ABS, 2011 Census of Population and Housing. These car ownership rates exclude 'not stated' responses received from the 2011 census.

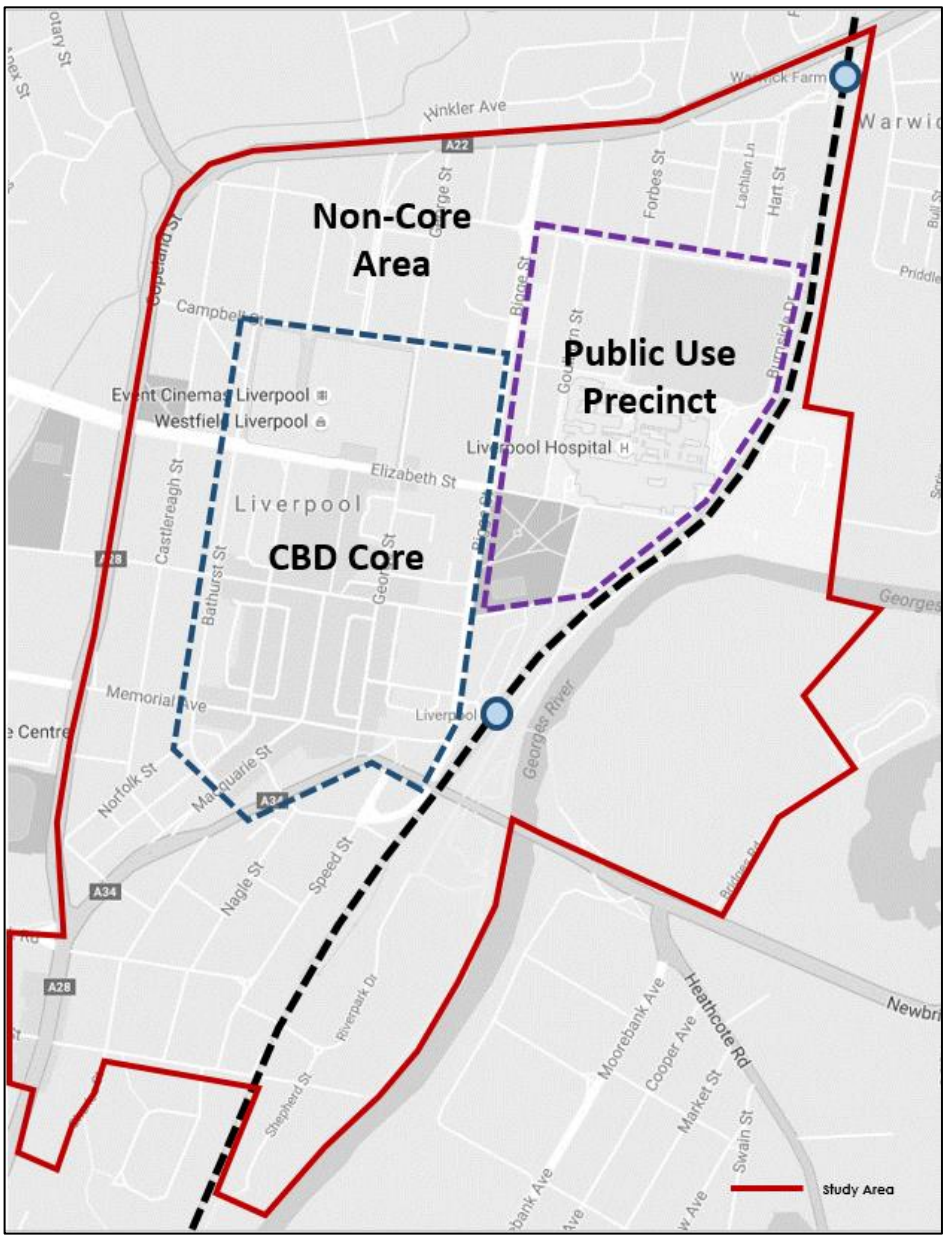
3. Car Parking - Existing Conditions

3.1 Overview

For the purpose of this report, the LCCP study area has been divided into three key precincts, as listed below and shown in Figure 3.1.

- CBD Core (City Centre)
- Public Use Precinct
- Non-Core Area.

Figure 3.1: LCCP Study Area – Key Precincts



Source: Google Maps

GTA undertook a site inspection at 12:00pm on Thursday 28 July 2016 to collect a sample of existing car parking supply and demand data for the LCCP Study Area.

Aerial photo imagery was used to confirm and validate the car parking occupancy results where applicable for both on-street and key off-street areas. As detailed in the following sections, the results of this survey show that car parking demands within the LCCP Study Area are extremely high and the available parking spaces are at (or approaching) capacity in most areas.

3.2 On-Street Car Parking

A total of some 2,450 on-street parking spaces are available across the LCCP Study Area as summarised by precinct in Table 3.1.

Table 3.1: On-Street Parking Space Supply within LCCP Study Area

Precinct	Spaces
CBD Core (City Centre)	540 spaces
Public Use Precinct	358 spaces
Non-Core Area	1,552 spaces
TOTAL	**2,450 spaces**

Broadly speaking, spaces closest to the CBD are restricted to stays of 1 hour or less, with 2 hour restrictions around the retail and services precincts and unrestricted parking provided in non-core and residential areas.

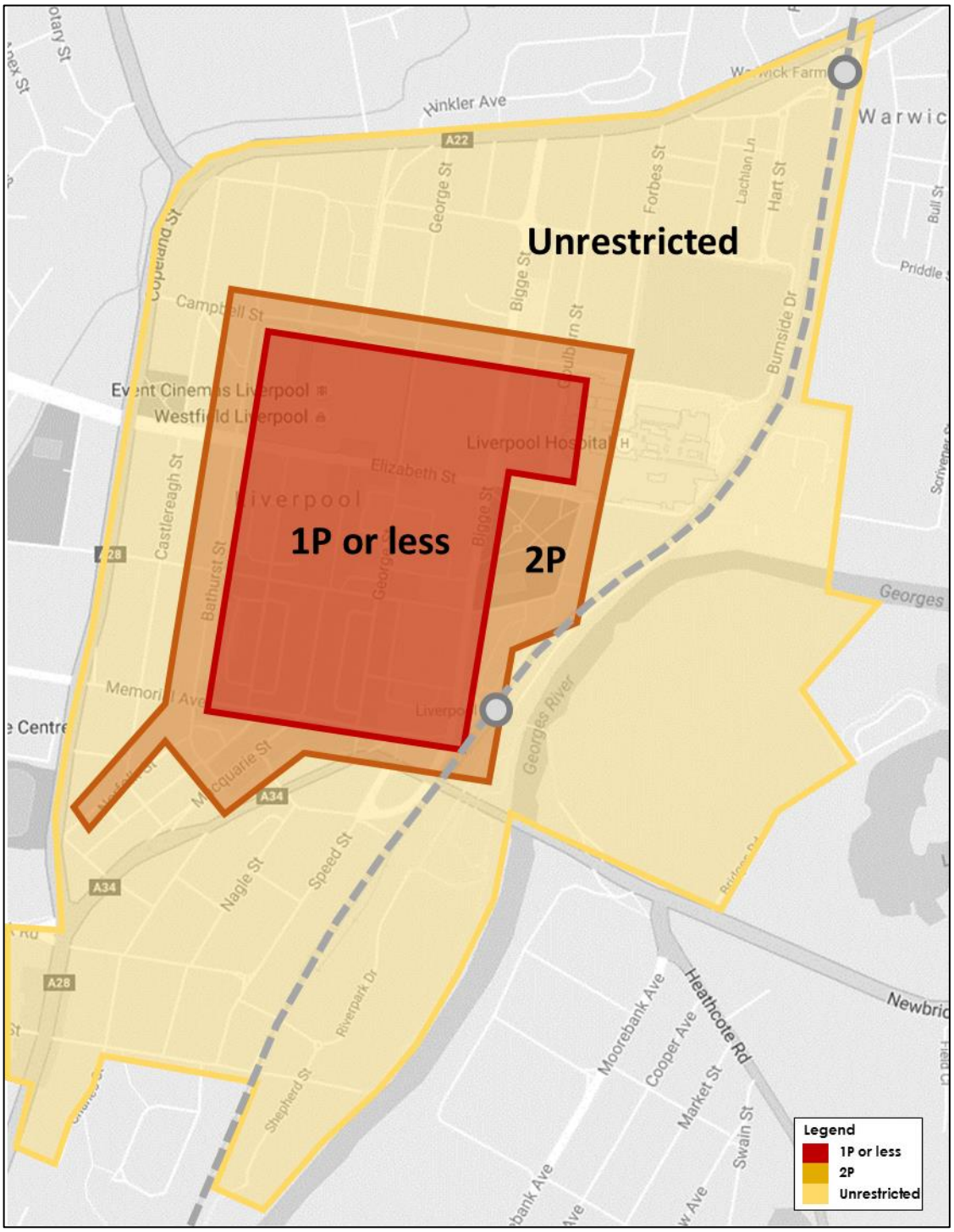
The general nature of current car parking restrictions is represented diagrammatically in Figure 3.2, whilst a summary of these restrictions including supply and demand is shown in Table 3.2.

Table 3.2: Total On-Street Car Parking Supply by Restriction (incl. Occupancy at 12:00pm)

Parking Restriction	Parking Supply [1] (no. of spaces)	Occupancy Rate [2]
1/2P	7	86%
1/4P	25	100%
1P	20	90%
1P (ticketed)	334	86%
2P	78	87%
2P (ticketed)	203	87%
Disabled Parking [3]	37	97%
Loading Zone	9	100%
Mail Zone	1	0%
No Parking (Police Excepted)	15	93%
Taxi Zone	12	92%
Unrestricted	1709	85%
Overall	**2450**	**86%**

[2] Indicative only, with figures primarily based from aerial photo imagery and on-site observations.
[3] Parking occupancy estimates based on an inspection undertaken by GTA on Thursday, 28 July 2016 at approx. 12:00pm (midday).
[4] All disabled spaces are unrestricted except for one space with a two-hour time restriction (2P).

Figure 3.2: General Nature of Existing On-Street Car Parking Restrictions within LCCP Study Area

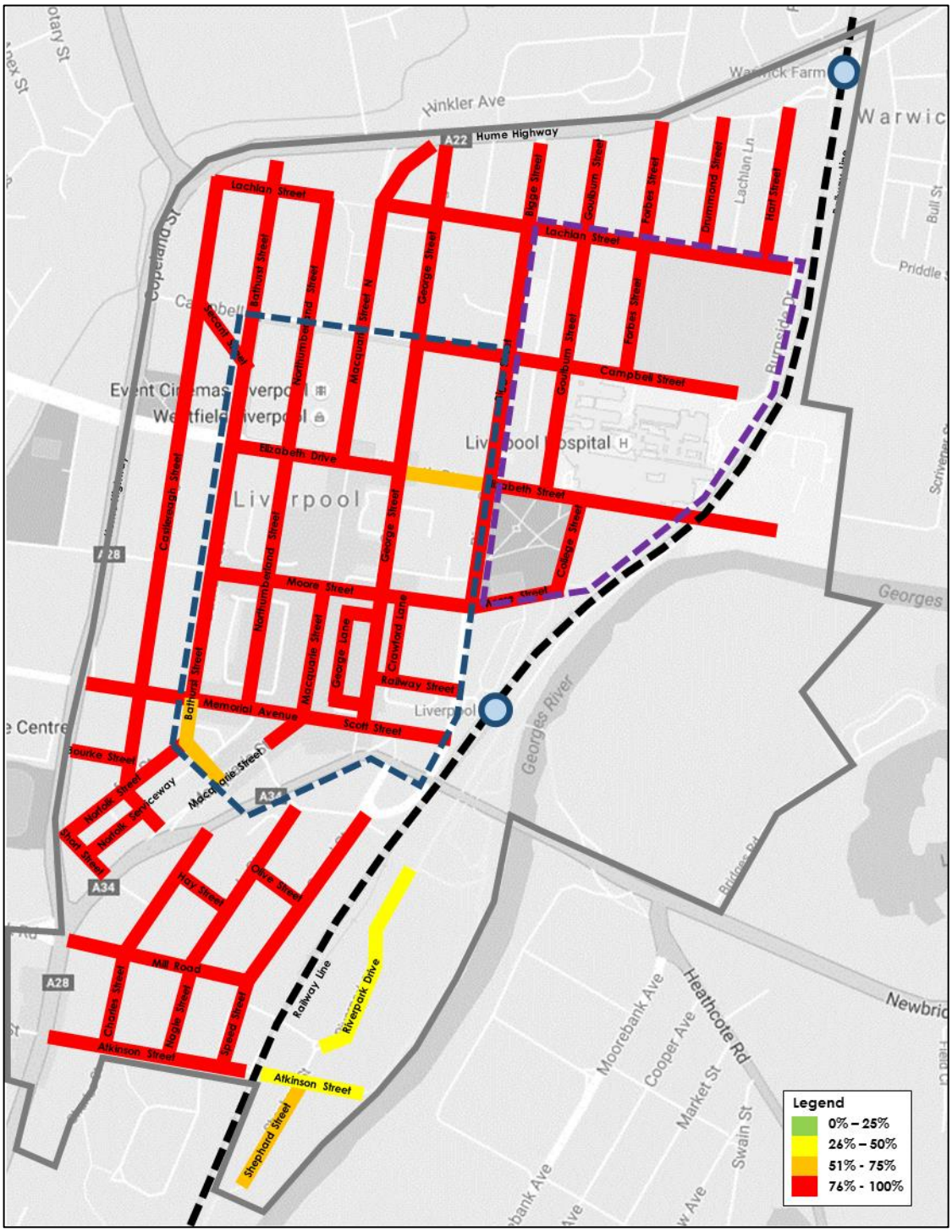


Source: Google Maps

As indicated in Table 3.2, existing car parking demands across the Study Area are high, with an overall occupancy rate of 86% at the peak time. This represents a typical demand of approximately 2,100 vehicles, with approximately 350 vacancies being available.

It is noted that a large portion of these vacancies exist within the outer periphery, generally within the Non-Core Area which largely comprises residential land uses A more detailed summary of parking occupancy by street across the LCCP Study Area is illustrated in Figure 3.3.

Figure 3.3: LCCP Study Area – On-Street Car Parking Occupancy for Key Roads (at 12:00pm)



Source: Google Maps

It is evident that the majority of major on-street car parking opportunities experience high degrees of demand, with only isolated areas of moderate to low occupancies recorded in the south-eastern region of the Study Area.

Further to the above, Figure 3.4 below has been prepared to summarise existing car parking occupancy within the Study Area by restriction within each of the three key precincts.

Figure 3.4: Availability of On-Street Parking by Restriction and Precinct (12:00pm – Typical Weekday)

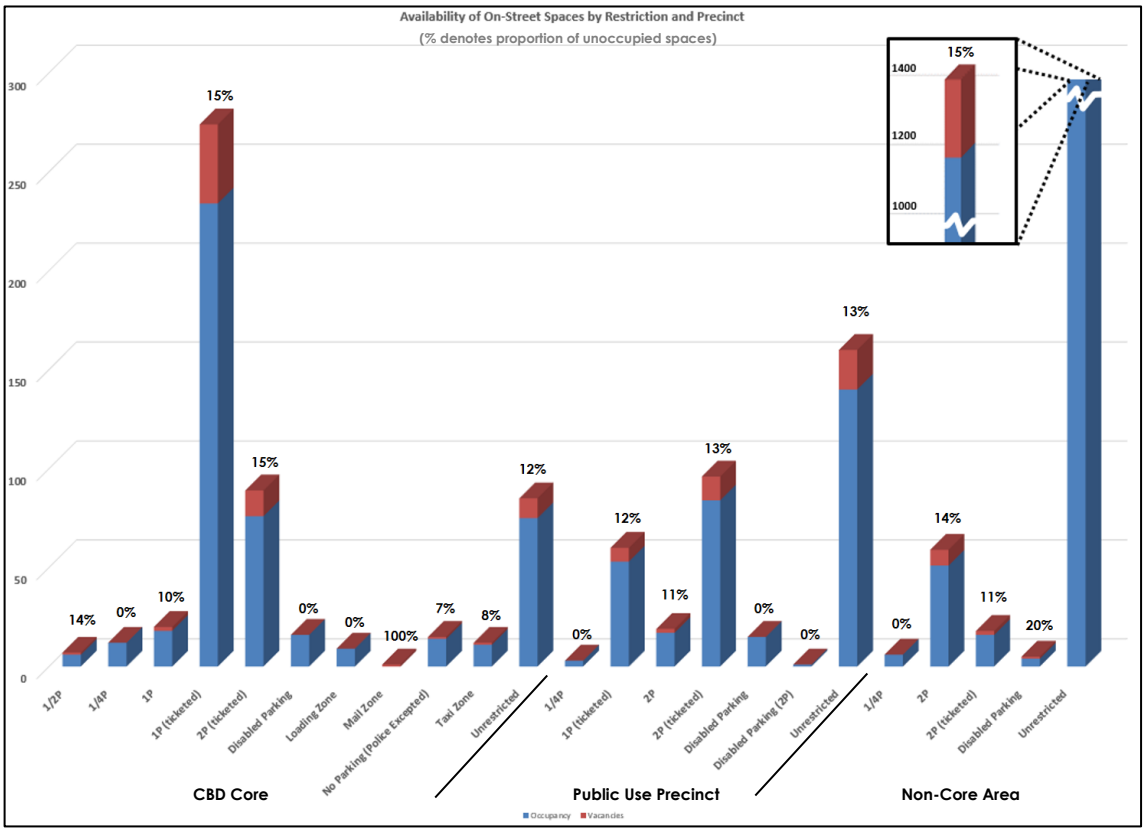


Figure 3.4 indicates that there are issues associated with both high demand and low supply (fewer than 30 total spaces) of very short-term car parking spaces (1/4P and 1/2P) across the Study Area. Free short-term car parking spaces (1P and 2P) are also well utilised, with 10-14% availability across all precincts, the highest occupancies being recorded within the CBD Core area.

Of the total vacancies recorded within the Study Area, a proportion are contained within the total of approximately 540 paid short-term parking spaces whilst the remaining vacancies are contained within the total of approximately 1,700 unrestricted parking spaces (majority located in the Non-Core Area).

With the exception of disabled spaces in the Non-Core Area, specific user type spaces including loading zones, mail zones and police parking areas. are generally in low supply and high demand,

3.3 Off-Street Car Parking

A total of 16 off-street car parks provide approximately 6,260 available spaces within the LCCP Study Area, and comprise a mix of free and paid options for both short and long-term users. On-site observations indicate that current parking demands within off-street car parking areas is high, with facilities in the CBD Core typically reaching capacity in the early morning (i.e. prior to approx. 10:00am).

The demand for off-street car parking is also high across the broader Study Area, with the exception of Light Horse Park Car Park which was observed to have an occupancy rate of between 0-25%. This may be reflective of its distance to the CBD Core as well as other local services and facilities.

The existing off-street parking supplies within the Study Area and their associated time restrictions / fees are summarised in Table 3.3 and represented graphically in Figure 3.5.

Table 3.3: Total Existing Publicly Accessible Off-Street Parking Supply and Restrictions/Fees*

Number	Parking Station	Payment Method	Type of Restriction	Owner *(Operator)*	Supply** (No. of Spaces)
1	**33 Moore Street**	Paid	Nil	Liverpool City Council *(Secure Parking)*	**274**
2	**Liverpool Plaza**	Limited free parking, then paid parking	1.5-hour free parking, paid parking thereafter	Perpetual Trustee Company *(Point Parking)*	**230**
3	**Westfield**	Limited free parking, then paid parking	3-hour free parking, paid parking thereafter	Westfield	**2,699** *(incl. 500 leased)*
4	**Norfolk Lane**	Paid	1-hour limit	Liverpool City Council	**26**
5	**52 Scott Street (Crunch Gym)**	Limited free parking, then paid parking	2-hours free parking and fee thereafter	Liverpool City Council *(Elders Real Estate)*	**179**
6	**Warren Serviceway**	Paid	Unlimited	Liverpool City Council	**704** *(incl. 120 reserved spaces)*
7	**Northumberland Street**	Limited free parking, then paid parking	3-hour limit to free parking on L3-4	Liverpool City Council	**440**
8	**Bathurst Street (North)**	Paid	3-hour limit	Liverpool City Council	**240**
9	**Bathurst Street (South)**	Free	2-hour limit (M-F) 1-hour limit (Sat)	Liverpool City Council	**49**
10	**Collimore Park**	Free	Unlimited	Liverpool City Council	**496**
11	**Speed Street**	Free	3-hour limit	Liverpool City Council	**87**
12	**Warwick Farm**	Free	Unlimited	Rail Corporation NSW	**328**
13	**Liverpool Railway Station**	Free	1-hour limit (15-min limit in peak times)	Rail Corporation NSW	**50**
14	**Liverpool Hospital**	Paid	Unlimited	NSW Health	**324** [1]
15	**Sydney Southwest Private Hospital**	Paid	Unlimited	Healthscope Ltd *(Wilson Parking)*	**84**
16	**Light Horse Park**	Free	Unlimited	Liverpool City Council	**50**
Overall					**6,260 spaces**

= Council-owned car parks

** Information relating to parking supply was provided by Liverpool City Council (dated as of 2016).

[5] A total of 1,343 spaces are provided at the Hospital on-site, with 1,019 spaces allocated to Hospital staff and employees and 324 spaces available to the public.

Figure 3.5: Location of Off-Street Car Parking Areas (incl. Supply and Restriction)

Source: Nearmap

3.3.1 Key Off-Street Car Parking Areas

Liverpool City Council has identified the following key off-street car parking areas within the study area for detailed investigation as outlined in Table 3.4.

Table 3.4: Key City Centre Off-Street Car Parking Areas

Number (from Table 2.3)	Restriction	Car Park	Number of Spaces	Charging Scheme
5	2P+	52 Scott Street (Crunch Gym)	179 spaces	Limited time free, then paid
6	U	Warren Serviceway	704 spaces	Paid
7	3P+	Northumberland Street	440 spaces	Limited time free, then paid
8	3P	Bathurst Street (North)	240 spaces	Paid
10	U	Collimore Park	496 spaces	Free
TOTAL			**2,059 spaces**	

These areas generally represent the largest Council-owned car parks within the study area accommodating a majority of long-term (3 hours or more) parking, most of which is fee-based with the exception of free parking provided at Collimore Park.

Further detail with respect to the physical characteristics of these car parks is outlined below.

52 Scott Street (Crunch Gym)

The car park at 52 Scott Street is currently owned by Liverpool City Council and leased to Elders Real Estate (sub-leased to Crunch Gym), with vehicle access provided off Terminus Street via a single two-way vehicular driveway.

Vehicle access is controlled by a boom-gate ticketed operating system, as shown in Figure 3.6.

Figure 3.6: Scott Street Car Park Access

Source: Google Maps (April 2016)

The car park provides 179 parking spaces, with two-hour free parking "grace-period" permitted and fees applicable thereafter, generally at a rate of $16 per hour.

Warren Serviceway

The Warren Serviceway car park is a multi-storey car park located on the corner of Bigge Street and George Street. The car park contains a total of 704 spaces over six levels, as indicated below:

- Ground Level to Level 3: 282 spaces
- Level 4 to Level 6: 248 spaces
- Reserved Parking Area (Ground Level): 174 spaces.

The main vehicle access is provided off Warren Serviceway via Bigge Street, with a separate access off George Street to access a proportion of 'discounted' car parking (approx. 120 spaces). It is understood that the cost to access this area is $30 per week or $99 per month, which was observed to have an occupancy rate of between 25-50%.

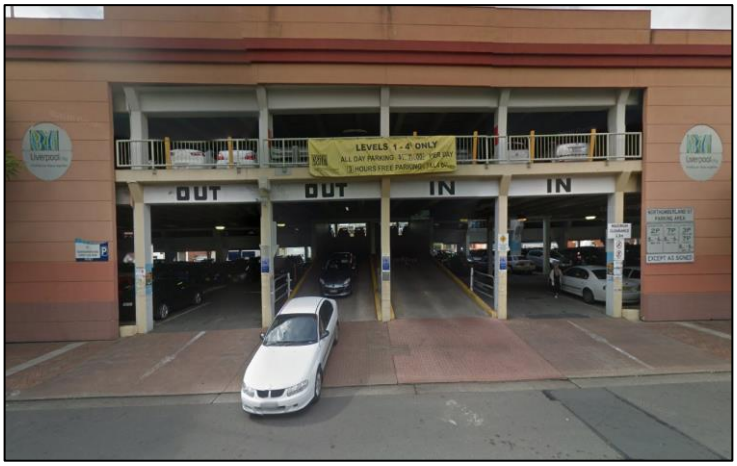
Permanent reserved spaces are made available on the Ground Level (i.e. 174 spaces), with costs being in the order of $195 per 28 days. In addition, it is noted that Council and Police staff parking is made available on Level 4 to Level 6 for a price of $10 per week.

Northumberland Street

The Northumberland Street car park provides up to 440 spaces with vehicle access provided directly off Northumberland Street, via a 20-metre-wide driveway (approx.) comprised of two entry and two exit lanes.

Notably, one access lane in each direction is segregated by grade, providing separate vehicle access to the Ground and Level 1 floors of the car park, as shown in Figure 3.7.

Figure 3.7: Northumberland Street Car Park Access



Source: Google Maps (April 2016)

The car park features a total of five levels of majority paid parking, with up to three hours of free parking available on Level 3 and Level 4. It is noted that car parking is available free of charge during weekends.

Bathurst Street (North)

The Bathurst Street (North) car park, shown in Figure 3.8, is provided with two vehicular access points, one located on Northumberland Street and one located on Bathurst Street.

Figure 3.8: Bathurst Street (North) Car Park Access

Source: Google Maps (April 2016)

The car park provides up to 240 spaces and provides three-hour time restrictions (3P) between 8:00am and 6:00pm Monday to Friday. Car parking is free of charge at all other times.

Collimore Park

The Collimore Park Car Park, shown in Figure 3.9, is located on the edge of the City Centre and is generally bounded by Elizabeth Drive to the north, Collimore Avenue to the east, Moore Street to the south and the Brickmakers Creek to the west boundary. Council operates a free shuttle bus service from Collimore Park Car Park to the corner of George and Moore Streets at half-hourly intervals during peak times between Monday to Friday.

Figure 3.9: Collimore Park Car Park Access (Collimore Avenue)

Source: Google Maps (April 2016)

The car park accommodates up to 496 parking spaces and was built in 2011 to provide much needed additional parking capacity within the LCCP Study Area. Vehicle access is provided via Moore Street and Collimore Avenue to the south and east boundaries, respectively.

3.3.2 Off-Street Parking Demand

On-site observations completed by GTA indicate that car parking is in high demand within each of the key off-street parking areas. The parking occupancies of each of the respective key off-street car parks is summarised in Figure 3.10.

Figure 3.10: Off-Street Car Parking Supply and Occupancy (12:00pm – Typical Weekday)

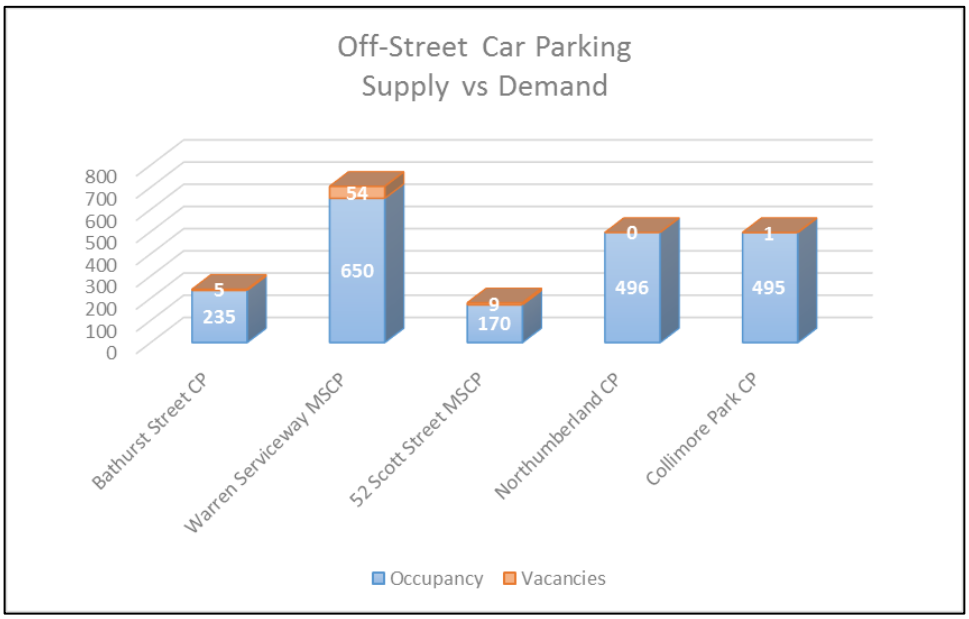


Figure 3.10 indicates that the key off-street car parks are currently operating near or at capacity, noting that the Warren Serviceway site features 54 vacancies generally located within the 'discounted'/reserved areas.

3.3.3 Design Review

A high-level design review of the key off-street car parking locations was also undertaken by GTA.

Existing car parking operations were observed to be generally satisfactory for the intended use (i.e. city / town centre parking), with a majority of off-street car parking spaces designed as 90-degree Class 2 / Class 3 parking facilities, with a one-way internal circulation.

Appropriate pedestrian amenity within the car parks was limited, typically with no separated paths between pedestrians and vehicles. In some instances, where internal stairs were not provided, pedestrians were observed to travel via the internal car park ramps to access/exit the car park.

A summary of the high-level design review completed for the key off-street car parks is documented in Table 3.5.

Table 3.5: Summary of Off-Street Car Parking Design Issues

Car Park	Issues			Recommendations / Comments
	Access points	Internal vehicle circulation	Pedestrian circulation	
Bathurst Street	○ Main access provided from Northumberland Street via single two-way driveway ○ Secondary access provided from Bathurst Street via two driveways	○ Line marking to indicate circulation ○ Signage outlining entry and exit points	No dedicated pedestrian path	○ Parking demand at capacity ○ Difficult to locate available parking easily ○ Recommend installing wayfinding signage to indicate multiple exit locations (e.g. "Exit via Bathurst Street / Exit onto Northumberland Street")
Warren Serviceway	○ Single driveway access off Warren Serviceway (via Bigge Street)	○ One-way internal circulation ○ Reversed ingress/egress movements on lower ground floor	No dedicated pedestrian path	○ Narrow internal ramps, difficult to circulate with larger vehicles ○ Parking spaces are narrow
52 Scotts Street (Crunch Gym)	○ Single 11.3m wide two-way driveway, with access off Terminus Street ○ Boom-gate ticketed control upon entry and exit		No dedicated pedestrian path	
Northumberland Street	○ Four single one-way access points (three "in" and one "out") ○ Two access points providing linkage to ground level with remaining two provided access to upper level L01	○ One-way internal circulation ○ Reversed ingress/egress movements within internal ramps ○ Line marking to indicate "in" and "out" movement	No dedicated pedestrian path	○ Additional signage indicating vehicle circulation recommended ○ Parking spaces are narrow
Collimore Park	○ Two driveway access points off Moore Street and Collimore Avenue	○ Two-way circulation ○ Several parking sections	No dedicated pedestrian path	○ Low parking occupancy of disabled parking spaces ○ Large area, multiple intersection points within car park – potential vehicle conflict points ○ Tight turn around bends

3.4 Wayfinding Signage

Wayfinding signage is located along key roads to provide directional guidance for motorists to the major off-street car parking areas within the City Centre, as shown in Figure 3.11.

It is noted that wayfinding signage for privately operated off-street car parks has not been reviewed i.e. Westfield Shopping Centre, Liverpool Plaza and Hospital etc.

Figure 3.11: Existing Wayfinding Signage Locations to Key Off-Street Car Parking Areas (Council Owned)

Whilst the broad strategic location of wayfinding parking signage (as nominated in the Figure 3.11) is generally considered satisfactory, the adequacy of specific sign placement is investigated further in Table 3.6.

Table 3.6: Existing Car Park Wayfinding Signage

Photograph	Car Park (CP)	Issue/Status
	Bathurst Street CP via Bathurst Street access	Satisfactory.
	Bathurst Street CP via Northumberland Street access	Satisfactory.
	Liverpool Plaza & Northumberland Street CPs	Multiple off-street car parks have been included on the sign. This may cause some confusion for motorists who are not familiar with the area.
	Liverpool Plaza & Bathurst Street & Warren Serviceway & Northumberland Street	Similarly, multiple parking locations have been included in the wayfinding sign, which may cause confusion for motorists unfamiliar with the area.

Photograph	Car Park (CP)	Issue/Status
	Warren Serviceway CP	Sign is difficult to see due to the presence of an existing tree on Bigge Street.
	Northumberland Street CP	Wayfinding sign is not made apparent due to the significant signage clutter on this post, particularly due to the sign positioned in conjunction with two larger road signs.
	Liverpool Plaza & Warren Serviceway & Northumberland St CPs	Multiple parking locations have been included in the wayfinding sign, which may cause confusion for motorists unfamiliar with the area.
	Northumberland Street CP	Nil.

3.5 Parking Pricing

On average, fee based car parking within the LCCP Study Area is priced in the order of:

- $1.50 per hour for off-street car parking
- $2.00 per hour for on-street car parking.

Specifically, the pricing structure for the key off-street parking areas is summarised in Table 3.7.

Table 3.7: Existing Pricing Structure of Key Off-Street Car Parking Areas

Car Park	Operating Hours	Payment Method	Pricing Structure	
Bathurst Street	24/7	Pay and Display	• $1.50 per hour (3P between 8am and 6pm, Mon-Fri) • All Other Times: Free Unrestricted Parking	
Warren Serviceway	24/7	Pay and Display	0-1 hours	$2.00
			1-2 hours	$3.00
			2-3 hours	$6.00
			3-4 hours	$8.00
			4-5 hours	$9.00
			5 + hours (max)	$13.00
52 Scotts Street (leased to Crunch Gym)	Mon-Thu: 6am-10pm Fri: 6am-9pm Sat-Sun: 8am-7pm	Ticketed	0-2 hours	Free
			2-2.5 hours	$8.00
			2.5-3 hours	$16.00
			3-3.5 hours	$24.00
			3.5-4 hours	$32.00
			4 + hours (max)	$40.00
Northumberland Street	24/7	Pay and Display	Ground	$1.50 per hour, up to 3 hours
			Level 1	$7 all-day parking
			Level 2	$7 all-day parking
			Level 3	3-hours free / $7 all-day parking
			Level 4	
Collimore Park	24/7	Free	Nil.	

3.6 Parking Enforcement

Parking within the City Centre is proactively patrolled by Council Officers, typically involving:

- checking whether a current ticket is displayed for 'Pay and Display' areas
- chalking vehicles in time restricted (un-ticketed) areas.

It is noted that the introduction of ticket machines within the City Centre has resulted in a reduced reliance on manual methods such as vehicle chalking. However, residents can submit a customer request for Council to dispatch an Officer to a specific location to assess potential vehicle parking infringements via Council's mobile customer request system ('Pathway').

In addition, data has been obtained from Council relating to the number of fines issued within the LCCP between 2013 and 2016. A summary of fines for on-street and off-street parking is shown in Table 3.8.

Table 3.8: Summary of Parking Infringements LCCP Study Area

Parking Type	No.			Total
	2013/14	2014/15	2015/16	
On-Street	3,941	9,901	16,513	**30,355**
Off-Street	1,271	3,200	4,745	**9,216**
TOTAL	**5,212**	**13,101**	**21,258**	**39,571**

Of the total parking infringements recorded, the following key offences were observed as follows:

- Parking without valid ticket displayed
- Parking after ticket expired
- Disobeying 'No Stopping' sign
- Parking for longer than allowed by sign.

More specifically, the top three on-street and off-street car parking offences are summarised in Table 3.9 and Table 3.10 respectively.

Table 3.9: Key Parking Infringements (On-Street)

Offence Type	2013/14	2014/15	2015/16	Total
1. Park without current ticket displayed	1,088	3,563	5,190	9,841
2. Park after ticket expired	578	2,094	3,019	5,691
3. Disobey No Stopping sign	865	1,569	2,367	4,801
Total	**2,531**	**7,226**	**10,576**	**20,333**

Table 3.10: Key Parking Infringements (Off-Street)

Offence Type	2013/14	2014/15	2015/16	Total
1. Park without current ticket displayed	815	1,921	3,111	5,847
2. Park after ticket expired	250	668	1,075	1,993
3. Park for longer than allowed by ticket signs	25	283	259	567
Total	**1,090**	**2,872**	**4,445**	**8,407**

The tables shown above clearly indicate that the incidence of parking infringement is increasing significantly at both on and off street parking locations. That may reflect improved levels of enforcement and/or increasing levels of parking demand and driver frustration at the lack of suitable parking facilities to meet that demand.

3.7 Car Parking Provision and Demand: Conclusions

As outlined above, a total of some 9,746 car parking spaces is provided within the nominated study area. The total supply includes some 2,450 on-street spaces and 7,296 off-street spaces, including hospital spaces and Council-controlled and commercially-operated facilities.

Parking observations indicate an existing demand of 8,891 spaces during the typical weekday peak period (92% occupancy). This demand includes 2,104 on-street spaces (86% occupancy) and 6,787 off-street spaces (93% occupancy).

Of the existing parking provision, a number of 'speciality spaces' exist and were observed to experience the following occupancies during the peak period as follows:

- Disabled: 37 spaces (97% occupied)
- Loading: 9 spaces (100% occupied)
- Mail: 1 space (0% occupied)
- No Parking (Police Excepted): 15 spaces (93% occupied)
- Taxi: 12 spaces (92% occupied)

It is evident that existing demands are extremely high, exceeding the typical theoretical capacity of 85% for on-street parking where drivers are unable to easily identify remaining vacant spaces. The existing demand also exceeds theoretical capacity for off-street parking (a level of around 90%), provided the car park is not excessively large and there are limited access/circulation choices.

Most parking areas within the nominated study area reach theoretical capacity by 10:00am, although some vacancies remain on-street in Atkinson Street and Shepard Street. Existing peak parking demands generally comprise of staff and customers to retail, commercial and services precincts (including library and hospitals). In addition, commuters, residents and visitors bolster parking demand across various periods of the day. As a result, short-term parking is at a premium, with medium-term parking accommodated within prime CBD car parks and commuter and staff parking spilling over into the surrounding streets with no time restrictions.

Demand exceeding capacity is indicative of insufficient parking and results in excessive circulation for users attempting to locate a vacant space. All other modes of transport travel in the transport network are subsequently impacted by the increased traffic movements, which represents a key issue in the sustainability of car parking within the Liverpool precinct. Parking management intervention is required to manage the existing demands and addressing this issue is a key priority outcome of this Strategy.

Careful planning is required to introduce time restricted parking zone into residential area which may result in resident requests for a residential parking scheme in future.

3.8 Car Parking Duration and Enforcement

Most of the high-demand on-street car parking within Liverpool currently employs ticketed parking systems, noting that a low proportion of spaces are provided free of charge. It is understood that whilst some parking infringements occur (including overstaying, parking without a ticket and parking in No Stopping areas) as outlined in previous sections, generally compliance with parking restrictions is acceptable.

Notwithstanding, parking issues are understood to be prevalent within the Warwick Farm precinct, due to new residential development and the existence of unrestricted parking in the

periphery areas of Liverpool (a permit scheme is not warranted under RMS guidelines at this stage).

Car parking infringements and non-compliance represent issues which need to be addressed to safeguard the integrity of parking arrangements within the locality. The Strategy must give consideration to the extensive future development within the precinct to prevent further non-compliance issues arising.

3.9 Current Travel Behaviour

As presented in Section 3, the majority of the Liverpool CCP study area is within an acceptable walking distance (up to 800 metres) of Warwick Park or Liverpool Railway Station, including the entire CBD core area. In addition, an extensive bus network services the Liverpool locality and areas to the north-west of the study area which fall outside the railway station catchment are generally within comfortable walking distance of a bus service.

Notwithstanding the availability of other forms of transport currently available which provide adequate connections within and around the centre, Liverpool remains heavily car reliant. 2011 Journey to Work data obtained from the Australian Bureau of Transport Statistics indicated that 73% of workers commute to Liverpool by a vehicle (including car passengers), with only 7% travelling by train, 4% by bus and 3% on foot. This is compounded by a slight growth in car ownership across the precinct, further increasing the availability of private vehicles for use.

There is thus clear potential for public transport and active transport modes to be promoted and pursued more aggressively, in line with planning goals and policies for the region. This is particularly pertinent given a high proportion of employees travel from within Liverpool or neighbouring Local Government Areas.

3.10 Railway Station Parking and Residential Impacts

Parking in residential areas were observed to be in high demand, particularly in areas in close proximity to the railway station (i.e. Warwick Farm and Liverpool Station), indicating that rail commuter and staff parking is overspilling into residential areas.

It is noted that stand-alone dwellings within the periphery area are typically provided with off-street parking (including garages and/or carports) and therefore residents are generally not expected to have a high reliance on on-street car parking.

This observation is validated through car parking surveys as presented in Figure 3.4, in which 'unrestricted' parking (generally within residential areas) offers the greatest proportion of vacancies, despite relatively high overall demand.

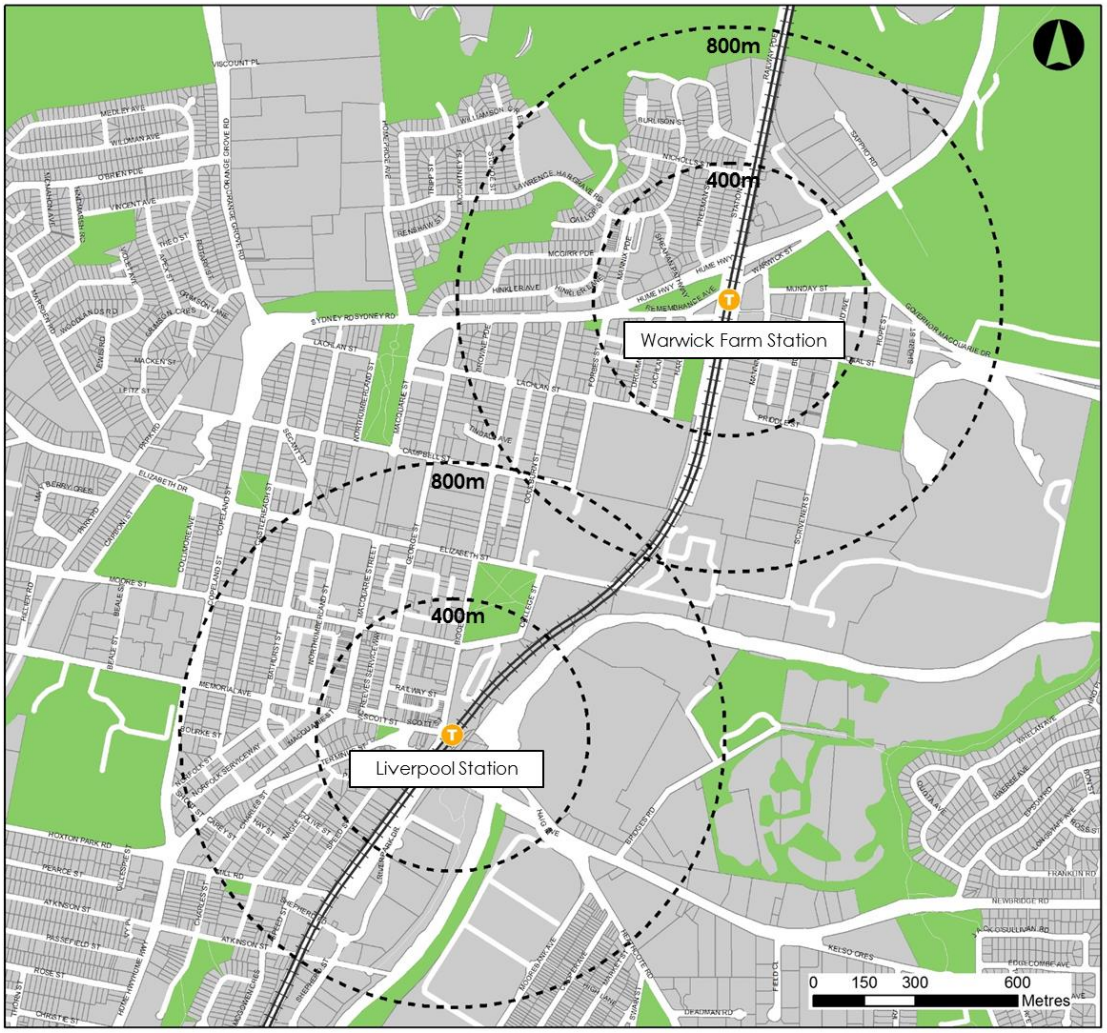
Opportunities therefore exist to exploit the availability of parking within unrestricted areas to assist with the outcomes of this Strategy, as discussed in later sections.

4. Public Transport – Existing Conditions

4.1 Rail Network

Liverpool CBD is served by Liverpool Station and Warwick Farm Station as shown on Figure 4.1 below.

Figure 4.1: Existing Rail Infrastructure



4.1.1 Patronage

Table 4.1 is an extract from the Bureaus of Transport Statistics (BTS) document *Train Statistics 2014: Everything you need to know about Sydney Trains and NSW TrainLink*. The table shows the number of passengers entering and exiting Liverpool and Warwick Farm Station throughout different periods of the day. These figures are based on actual counts of passengers entering and exiting the station undertaken on a typical weekday in 2013 outside of school holidays and not next to a public holiday.

Table 4.1: 2013 Typical Weekday Rail Patronage

Station	2:00 to 6:00		(AM Peak) 6:00 to 9:30		9:30 to 15:00		(PM Peak) 15:00 to18:30		18:30 to 2:00		24hrs	
	in	out	in	out	in	out	in	out	in	out	in	out
Liverpool	160	80	2,810	2,250	2,620	2,250	2,580	2,850	590	1,330	8,760	8,760
Warwick Farm	40	20	1,480	250	520	410	330	1,300	80	470	2,450	2,450
Total	**200**	**100**	**4,290**	**2,500**	**3,140**	**2,660**	**2,910**	**4,150**	**670**	**1,800**	**11,210**	**11,210**

Source: Bureau of Transport Statistics

11,210 passengers accessed the train stations within the Liverpool CBD in a typical 24-hour period. Of these, 8,760 (78%) used Liverpool Station and 2,450 (22%) used Warwick Farm Station.

4.1.2 Train Services

Liverpool Station and Warwick Farm Station are serviced by three train lines:

- T2 – Airport, Inner West & South Line
- T3 – Bankstown Line
- T5 – Cumberland Line

Trains generally stop at both stations with the exception of some express trains travelling along the T2 – Airport, Inner West & South Line that will do stop at Warwick Farm. Table 4.2 provides an overview of train services per station during different periods of the day.

Table 4.2: Train Service Tally

Station	2:00 to 6:00		(AM Peak) 6:00 to 9:30		9:30 to 15:00		(PM Peak) 15:00 to18:30		18:30 to 2:00		24hrs
	in	out	in	out	in	out	in	out	in	out	Total
Liverpool	4	10	27	35	39	40	34	29	45	30	293
Warwick Farm	4	9	27	30	39	39	30	30	42	30	280
Total	**8**	**19**	**54**	**65**	**78**	**79**	**64**	**59**	**87**	**60**	**573**

Source: Sydney Trains

4.1.3 Liverpool Station

Liverpool Station is located along the eastern boundary of the Liverpool City Centre beside the Georges River. It is also located adjacent to the Liverpool bus interchange where passengers are able to easily change modes of transport. The station provides approximately 85 spaces in a commuter car park with access off Bigge Street, and an additional 20 spaces at the station forecourt. A taxi rank and limited bike parking are also provided at the station forecourt.

The station consists of four platforms connected by overhead pedestrian walkways via stairs, escalators and lifts. The pedestrian walkway links to the city centre via the signalised intersection of Bigge Street and Railway Street.

Images of Liverpool Station are shown in Figure 4.2 to Figure 4.7 below.

Figure 4.2: Liverpool Station Entrance

Figure 4.3: Concourse Map

Figure 4.4: Liverpool Station Internal Walkway

Figure 4.5: Liverpool Station Platform

Figure 4.6: Liverpool Station Bus Interchange Access

Figure 4.7: Liverpool Station – Bigge Street Exit

4.1.4 Warwick Farm Station

Warwick Farm Station is located on the north-eastern edge of the Liverpool City Centre. The station acts predominantly as a "kiss and ride" station where the at-grade car park and multi-storey car park provide approximately 550 commuter parking spaces. Surrounding on-street parking is generally unrestricted and was observed to be used by commuters.

The station is only indirectly serviced by buses, the nearest bus stop is on Hume Highway, 120m away from the station.

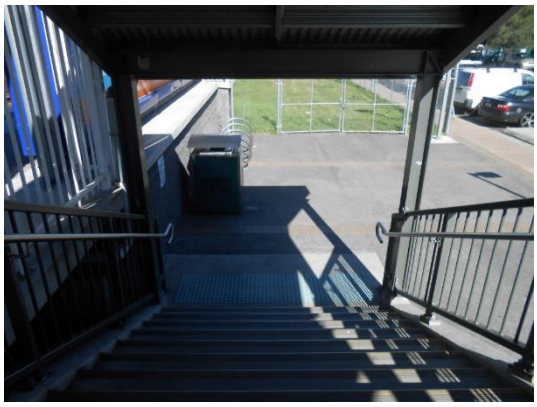
The station consists of two platforms connected by overhead pedestrian walkways via stairs and lifts. Access to the station is from Warwick Street in the east and Remembrance Avenue in the West. Images of Warwick Farm Station are shown in Figure 4.8 to Figure 4.11 below.

Figure 4.8: Warwick Farm Station

Figure 4.9: Warwick Farm Station - Platforms

Figure 4.10: Warwick Farm Station – Kiss and Ride

Figure 4.11: Warwick Farm Station – West Entrance



4.2 Bus Network

Bus services in the Liverpool City Centre are provided by the following bus operators

- Interline Bus Services
- Transdev
- Transit Systems

4.2.1 Liverpool Bus interchange

The Liverpool Bus Interchange is located adjacent to Liverpool Station on the eastern side of the city centre. The interchange is serviced by all three bus operators and has a single access point off Moore Street. This requires buses to turn around inside the bus station and has implications for interchange capacity and operational efficiency.

The interchange consists of four pedestrian platforms connected by overhead walkways. Buses manoeuvre around the platforms and access the interchange from a single point along Moore Street, its layout and access arrangements are shown in Figure 4.12 to Figure 4.18 below.

Figure 4.12: Liverpool Station and Bus Interchange

Figure 4.13: Bus Interchange

Figure 4.14: Bus Interchange - Overview

Figure 4.15: Bus Interchange – Bus Stop

Figure 4.16: Bus Interchange – Exit

Figure 4.17: Bus Interchange – Ground Level View

Figure 4.18: Bus Interchange – Bus Entrance / Exit

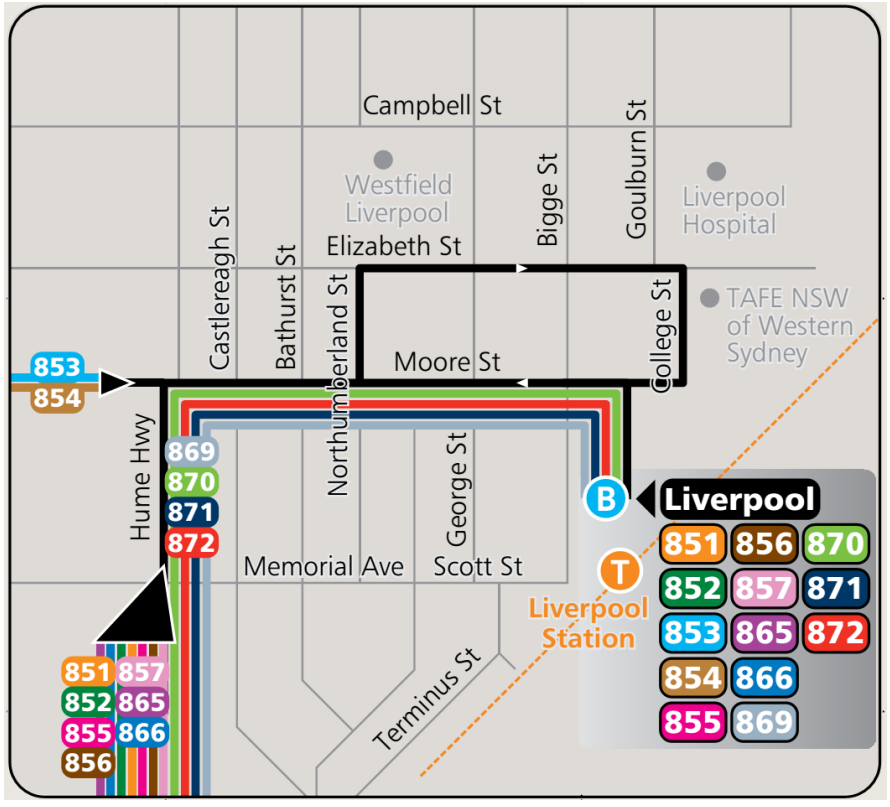
4.2.2 Interline Bus Services

Interline Bus Services (Interline) provides bus services to areas southwest of the Liverpool CBD including:

- Liverpool
- Campbelltown
- Bringelly
- Oran Park

Figure 4.19 is a network map of the company's services within the Liverpool CBD.

Figure 4.19: Interline Bus Services Network Map Extract



Source: Interline Bus Services

Interline operates a total of 22 bus routes of which 13 operate within the Liverpool CBD and terminate at the Liverpool Bus Interchange. Within the Liverpool CBD bus routes run predominantly along:

- Moore Street
- Hume Highway

With some routes running along:

- College Street
- Elizabeth Street
- Northumberland Street

Table 4.3 lists all the routes operated by Interline, the number of services each route provides during peak hour periods and whether the services are arriving or departing the Liverpool CBD.

Table 4.3: Interline Bus Services during Peak Periods

Route	7:00AM – 8:00AM			5:00PM – 6:00PM		
	Arrival	Departure	Sum	Arrival	Departure	Sum
851	2	2	4	1	1	2
852	2	2	4	2	1	3
855	2	0	2	0	1	1
856	2	0	2	0	1	1
857	0	1	1	2	2	4
865	2	3	5	2	2	4
866	2	2	4	1	2	3
869	2	2	4	2	1	3
870	3	2	5	2	2	4
871	0	0	0	0	0	0
872	2	2	4	2	2	4
853	3	1	4	5	4	9
854	2	4	6	3	4	7
Total	**24**	**21**	**45**	**22**	**23**	**45**

Interline Bus Services offers a total of 45 bus services during both the AM and PM peak hour period. Buses arrive and depart at approximately equal rates with slightly more buses arriving in the AM and departing in the PM.

4.2.3 Transdev

Transdev operates a total of 59 bus routes in south and southwestern Sydney, of which 5 operate within the Liverpool CBD and terminate at the Liverpool Bus Interchange. Within the Liverpool CBD bus routes run predominantly along:

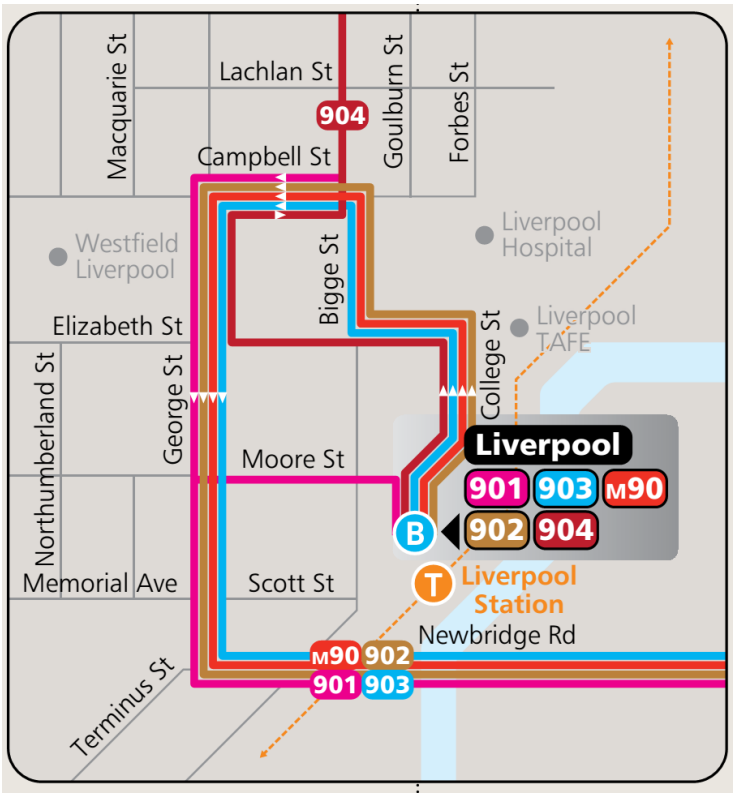
- College Street
- Elizabeth Street (East of Bigge Street)
- Bigge Street (South of Campbell Street)
- Campbell Street
- George Street
- Scott Street & Terminus Street
- Newbridge Road

With some routes running along:

- Moore Street
- Elizabeth Street (West of Bigge Street)
- Bigge Street (North of Campbell Street)

Figure 4.20 is a network map of the company's services within the Liverpool CBD.

Figure 4.20: Transdev Network Map Extract



Source: Transdev

Table 4.4 lists all the routes operated by Interline, the number of services each route provides during peak hour periods and whether the services are arriving or departing the Liverpool CBD.

Table 4.4: Transdev Services during Peak Periods

Route	7:00AM – 8:00AM			5:00PM – 6:00PM		
	Arrival	Departure	Sum	Arrival	Departure	Sum
901	2	2	4	2	2	4
902	2	2	4	2	2	4
903	0	2	2	0	2	2
904	2	2	4	1	2	3
M90	6	6	12	6	4	10
Total	**12**	**14**	**26**	**11**	**12**	**23**

4.2.4 Transit Systems

Transit Systems operates a total of 30 bus routes of which 11 operate within the Liverpool CBD and terminate at the Liverpool Bus Interchange. Within the Liverpool CBD bus routes run predominantly along:

- College Street
- Elizabeth Street
- Moore Street
- Northumberland Street

With some routes running along:

- George Street
- Campbell Street
- Goulburn Street
- Bathurst Street

Figure 4.21 is a network map of the company's services within the Liverpool CBD.

Figure 4.21: Transit Systems Network Map Extract

Source: Transit Systems

Table 4.5 lists all the routes operated by Interline, the number of services each route provides during peak hour periods and whether the services are arriving or departing the Liverpool CBD.

Table 4.5: Transit System Services during Peak Periods

Route	7:00AM – 8:00AM			5:00PM – 6:00PM		
	Arrival	Departure	Sum	Arrival	Departure	Sum
801	0	0	0	1	1	2
802	2	2	4	2	2	4
803	0	0	0	0	0	0
804	4	4	8	4	4	8
805	2	2	4	3	3	6
806	2	2	4	2	2	4
808	2	2	4	2	0	2
819	2	2	4	2	2	4
823*	-	3	3	-	3	3
827	2	2	4	2	2	4
T80	6	6	12	6	6	12
Total	**22**	**25**	**47**	**24**	**25**	**49**

*Route 823 forms a loop. For the purpose of this table it is considered to be a departure only route.

4.2.5 Combined CBD Bus Network

Figure 4.22: Combined Bus Network

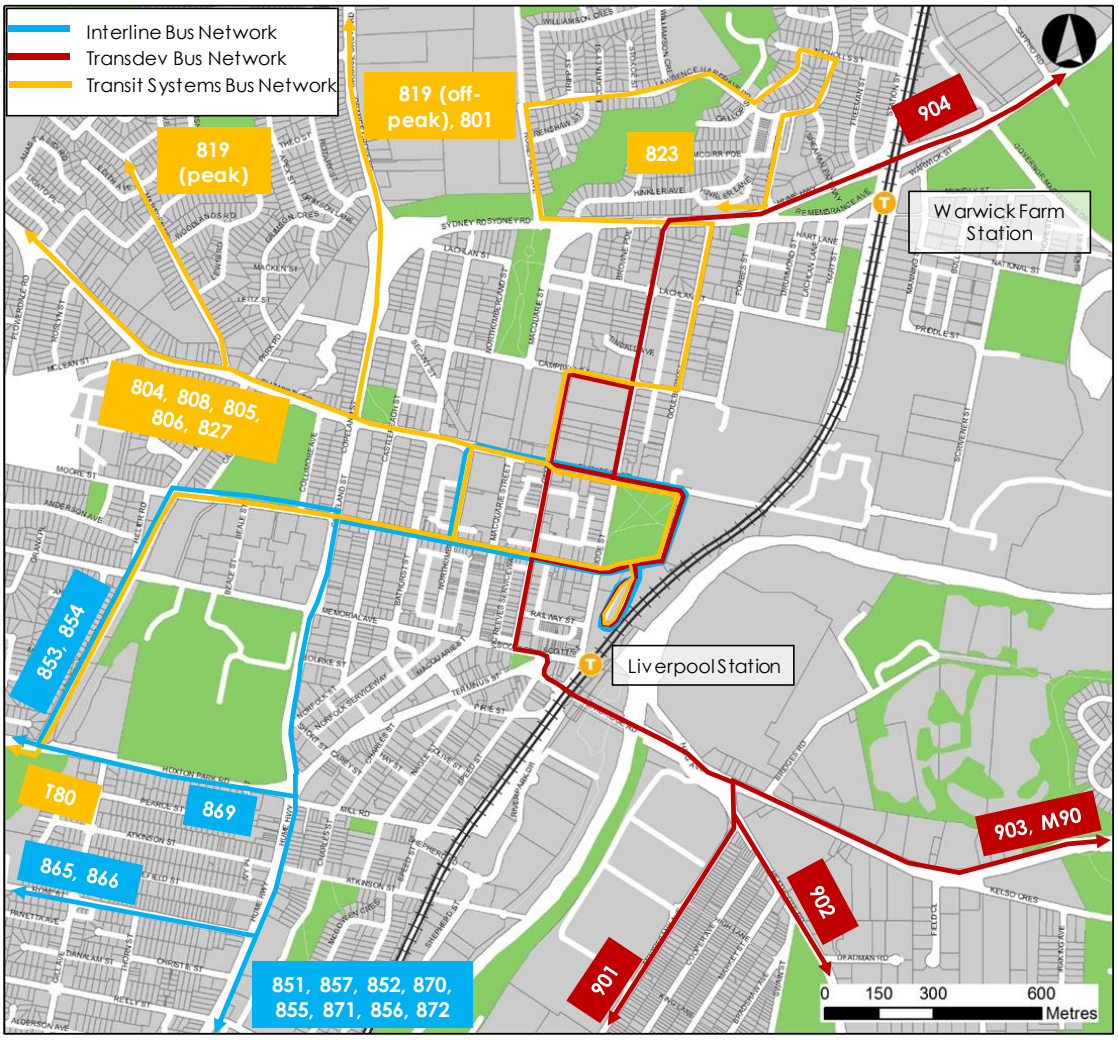


Table 4.6: Combined Bus Services

Route	7:00AM – 8:00AM			5:00PM – 6:00PM		
	Arrival	Departure	Sum	Arrival	Departure	Sum
Interline	24	21	45	22	23	45
Transdev	12	14	26	11	12	23
Transit Systems	22	25	47	24	25	49
Total	**58**	**60**	**118**	**57**	**60**	**117**

Table 4.6 lists all the routes operated by Interline, the number of services each route provides during peak hour periods and whether the services are arriving or departing the Liverpool CBD.

4.2.6 Public Transport Connections to Parramatta and Sydney CBD

Key transport connection requirements from Liverpool include public transport services to both the Sydney CBD and to Parramatta.

For services between Liverpool and the Sydney CBD, direct services are present via Lidcombe (T2 south line), and also via Bankstown (T3 Bankstown line). Indirectly, there are also services via the T2 East Hills line with an interchange required at Glenfield (with an assessment showing that despite an initial leg away from the city, there are approximately equal travel times).

For services to Parramatta, direct services are operational via the T5 Cumberland line, with indirect services requiring an interchange also possible at stations east of Granville. Additionally, there is the presence of the T80 route which provides services between Liverpool and Parramatta via the T-Way.

An assessment of frequencies and travel time journeys has been undertaken for journeys to and from Liverpool. In the case of AM services, it is reported with the service operational with an arrival at Parramatta or the Sydney CBD around 9am, and similarly, with a departure from Parramatta or the Sydney CBD around 5pm. The results are shown in Table 4.7 and Table 4.8.

The assessment shows that across three separate lines, travel times from Liverpool to the Sydney CBD are approximately 50 to 55 minutes depending on the service and directionality. For trips between Liverpool and Parramatta, journey times are typically around 25 to 30 minutes. The bus journey to Parramatta is substantially slower due to the T-Way detour and takes approximately 60 to 70 minutes.

Table 4.7: AM Services – Liverpool to Sydney CBD and Parramatta

Journey	Line	Departure-Arrival (Total Time)	Indicative Service Frequency via specified line	Services per day	Average trip
Liverpool to Sydney CBD	T2 Train via Lidcombe	8:11-8:59 (48 mins)	Approximately 8/hour	149	54 mins
	T3 Train via Bankstown	7:50-8:48 (58 mins)	Approximately 4/hour	86	64 mins
	T2 Train via East Hills	8:08-9:01 (53 mins)	N/A due to interchange	N/A due to interchange	N/A
Liverpool to Parramatta	Train via T5 Cumberland	8:29-8:54 (25 mins)	Approximately 2/hour	26	25 mins
	Train via Granville	8:21-8:50 (29 mins)	N/A due to interchange	N/A due to interchange	N/A
	T80 bus	7:48-8:56 (68 mins)	Approximately 6/hour	209	N/A

Table 4.8: PM Services –Sydney CBD and Parramatta to Liverpool

Journey	Line	Departure-Arrival (Total Time)	Indicative Service Frequency via specified line	Services per day	Average trip
Sydney CBD to Liverpool	T2 Train via Lidcombe	4:57-5:52 (55 mins)	Approximately 8/hour	151	55 mins
	T3 Train via Bankstown	5:09-6:05 (56 mins)	Approximately 4/hour	83	62 mins
	T2 Train via East Hills	5:06-6:02 (56 mins)	N/A due to interchange	N/A due to interchange	N/A
Liverpool to Parramatta	Train via T5 Cumberland	4:49-5:13 (24 mins)	Approximately 2/hour	25	25 mins
	Train via Granville	4:59-5:37 (38 mins)	N/A due to interchange	N/A due to interchange	N/A
	T80 bus	5:00-5:59 (59 mins)	Approximately 6/hour	209	N/A

Overall, Liverpool has 12 direct train services to the Sydney CBD, eight fast and four slightly slower services. This is regarded as an adequate service pattern between key city centres. Capacity and seating availability has only been reviewed with spot checks during this exercise, these spot checks showed around 20% of seats available on trains when they leave Liverpool. The journey time of 50 to 55 minutes for a distance of approximately 35km (i.e. approximately 1.50min/ km) is longer than between comparable centres and the Sydney CBD as shown in Table 4.9. Shortening the travel time between Liverpool and the Sydney CBD will significantly improve the train connections and make Liverpool more accessible.

Table 4.9: Journey times between Sydney centres and Sydney CBD in AM peak

Journey	Average Journey Time	Distance	Pace [min per km]
Hornsby – Central	37 min	26 km	1.42 min/km
Blacktown – Central	38 min	32 km	1.19 min/km
Sutherland – Central	33 min	23 km	1.43 min/km
Penrith – Central	52 min	52 km	1.00 min/km

Liverpool Station has two direct trains per hour to Parramatta, this is inadequate for city centres of such importance. Consideration should be given to increasing the volume and frequency of direct services.

The T80 bus connects Parramatta with Liverpool, but it is considered unlikely that people would catch this service end-to-end given its time competitiveness with train services.

4.2.7 Public Transport Challenges

The attractiveness of the public transport is contributed by accessibility and convenience. This includes the ability to access the transport service, frequency of services and the journey time to a traveller's destination.

Therefore, whilst this study aims to improve accessibility to public transport services at the Liverpool CBD, the quality of provisions in the overall transport network will have an impact on the public transport mode share to/ from Liverpool.

It can be seen from the above that throughout Liverpool City Centre, bus services follow a variety of routes, and bus stops are scattered throughout the street network. This lack of bus stop consolidation, together with inadequate wayfinding signage, can make finding and accessing the right stop difficult for users to comprehend if they are not familiar with the arrangements and may mitigate against the use of public transport.

To address the above issue and assist in the promotion of public transport, it is proposed that bus operations with the city centre be restructured by

- Providing bus corridors and streets where public transport is prioritised
- Ensuring high quality access and links for both buses and their passengers
- Integrating public transport with active travel modes, and
- Optimising the use of existing facilities.

Furthermore, external transport considerations that would impact public transport mode share include:

- the travel time between Sydney CBD and Liverpool/ Warwick Farm Railway Stations
- the availability of express transport services
- the accessibility of train stations by public transport, commuter parking availability, walkability and cycling facilities.

Liverpool City Centre is a key destination with significant residential developments arising in the surrounding areas. Convenient access to the city centre and to the Liverpool and Warwick Farm Railway Stations will be required to improve the attractiveness of public transport as a method of travel. At present, there are no express rail services to the Sydney CBD from Liverpool or Warwick Farm. Consideration for express services to Liverpool could be recommended to Transport for NSW and Sydney Trains as incentive to shift mode share to rail services as population in the surrounding areas increase.

5. Active Transport – Existing Conditions

5.1 Overview

Any two locations on the periphery of Liverpool CBD are less than 1,200m apart. This is equivalent to a 15 minute walk or a 5 minute bicycle journey. The existing, good conditions of active transport infrastructure provide opportunity to strengthen walking and cycling networks within the CBD

5.2 Existing Footpaths and Pedestrian Infrastructure

The Liverpool CBD has a generally well maintained and high quality pedestrian footpath network. Pedestrian footpaths generally fall under one of the following categories:

- **Fully Sealed, Consistent Surface:** This type of footpath can be found in the core of the CBD where large volumes of pedestrians are observed. The footpath is sealed from the shopfront to the roadside kerb and the surface has a uniform consistency. Examples of this footpath can be found along Macquarie Street between Moore Street and Scott Street as shown in Figure 5.2.
- **Fully Sealed, Inconsistent Surface:** This type of footpath can be found along pedestrian thoroughfares with high pedestrian volumes. The footpath is sealed from the adjacent property boundary to the roadside kerb however the surface has non-uniform consistency. Examples of this footpath occur along George Street, adjacent to Westfield Liverpool.
- **Partially Sealed**: Partially sealed footpaths are generally 1.0m – 1.5m wide and connect residential areas of the CBD to the commercial hub. They generally carry the lowest volumes of pedestrians.

Within the Liverpool CBD pedestrian infrastructure is focused along the commercial and retail centre. The different types of pedestrian infrastructure can be found in the following locations:

- Fully Sealed, Consistent Surface: City Centre Core
- Fully Sealed, Inconsistent Surface: On the edge of the city centre core
- Partially Sealed: Along residential areas within the City Centre.

The focal point of all pedestrian infrastructure is the Macquarie Street pedestrian zone as shown in Figure 5.1. The Macquarie Street walkway is aligned in a north-south direction and provides a fully pedestrianised walkway along Macquarie Street between Westfield Liverpool and Moore Street.

Figure 5.1: Macquarie Street Pedestrian Zone

Figure 5.2: Macquarie Street Footpath

Pedestrian Crossings

Several pedestrian crossings within the CBD provide mid-block connections. Crossing points exist along the following streets:

- Forbes Street (elevated, marked)
- Goulburn Street (refuge island)
- Elizabeth Street (marked only) x 3
- George Street (elevated, marked) x 2
- Macquarie Street (elevated marked, covered) George Lane (elevated, marked)
- Northumberland Street (elevated, marked) x 2.

The Macquarie Street pedestrian crossing is shown in Figure 5.3.

Pedestrian crossings are also located on every leg of a signalised intersection within the Liverpool City Centre.

Figure 5.3: Macquarie Street Pedestrian Crossing

Internal Walkways

Internal walkways are indoor walkways that connect two streets. They are generally surrounded by retail premises and have pedestrian crossings at either end. Internal walkways are useful in promoting permeability within an urban environment. Three internal walkways are located within the Liverpool City Centre:

- Liverpool Plaza – connecting Macquarie Street to Northumberland Street
- Stathis Arcade – connecting Macquarie Street to George Lane and Penn's Railways Arcade
- Penn's Railway Arcade - connecting George Street to George Lane and Stathis Arcade.

The internal walkways are shown in Figure 5.4 to Figure 5.7 below:

Figure 5.4: Stathis Arcade – Western Arcade

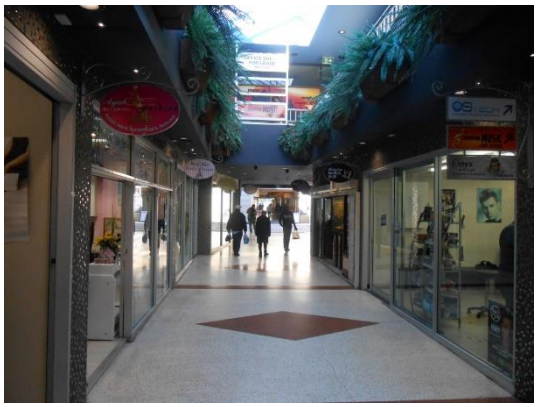


Figure 5.5: Penns Railway Arcade

Figure 5.6: Stathis Arcade - Entrance

Figure 5.7: Liverpool Plaza Entrance

5.3 Existing and Proposed Cycle Paths

The Liverpool CBD has a proposed cycling network that when completed will provide connections throughout the CBD and the surrounding LGA. A map of existing and proposed cycling infrastructure is shown in Figure 5.8.

The cycling network will consist of two types of cycle paths:

- **Off-Road Cycle Path:** This type of path is separate from the road network. It can be restricted to cyclists only or can be shared with pedestrians.
- **On-Road Cycle Path:** This type of path lies on the road network. For roads with high traffic volumes cyclists are given access to the road shoulder. For roads with low traffic volumes cyclists share the road with other vehicles.

For both on-road and off-road cycle paths signage and line marking is critical for conveying information to cyclists.

Figure 5.8: Liverpool CBD Cycling Network

Source: Liverpool City Council

Figure 5.8 shows that whilst a strong off-street cycling network within the CBD has been proposed significant sections of the network have yet to be built.

Existing off-road cycle paths run predominantly along the eastern side of the CBD. They connect the Parramatta to Liverpool "Rail Trail", an off-road cycle path that follows the railway line between Parramatta and Casula.

5.3.1 End of Trip Facilities

Cycling end of trip facilities assist cyclists in their journey by providing the necessary facilities to meet their transport, security and hygiene needs. End of trip facilities generally consist of the following:

- Bicycle parking for residents, staff and visitors depending on the context of the site
- Showers and toilets
- Lockers
- Repair Equipment

End of trip facilities within the CBD were generally limited to bicycle parking, mostly at Liverpool Station and Warwick Farm Station as shown in Figure 5.9 and Figure 5.10.

Throughout the Liverpool City Centre the following number of bicycle parking spaces were found:

- Liverpool Station – Less than 10
- Warwick Farm Station – Less than 20
- Liverpool City Centre Core – Less than 20

Figure 5.9: Bicycle parking - Liverpool Station

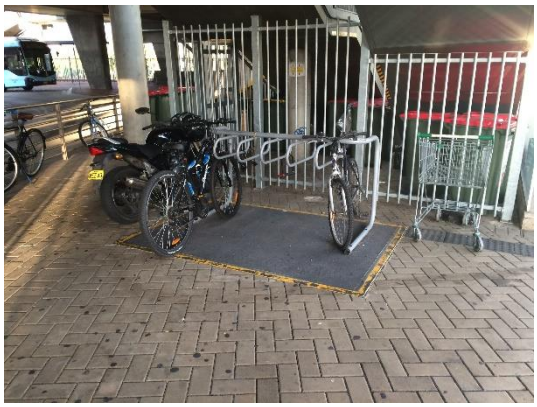


Figure 5.10: Bicycle parking – Warwick Farm Station

Figure 5.11: Bicycle Parking – Westfield Liverpool

Figure 5.12: Bicycle Parking – Macquarie Street

DCP 2008 Requirements

Inclusion of bicycle parking requirements within a council's Development Control Plan (DCP) contributes to a stronger cycling culture within a council LGA. The Liverpool DCP 2008 has an allocation for bicycle parking requirements for all new developments within the Liverpool CBD.

An extract from the Liverpool DCP 2008 stating bicycle parking requirements is shown below:

Bicycle parking for all development

- *1 bicycle space per 200sqm of leasable floor area. 15% of this requirement is to be accessible to visitors.*

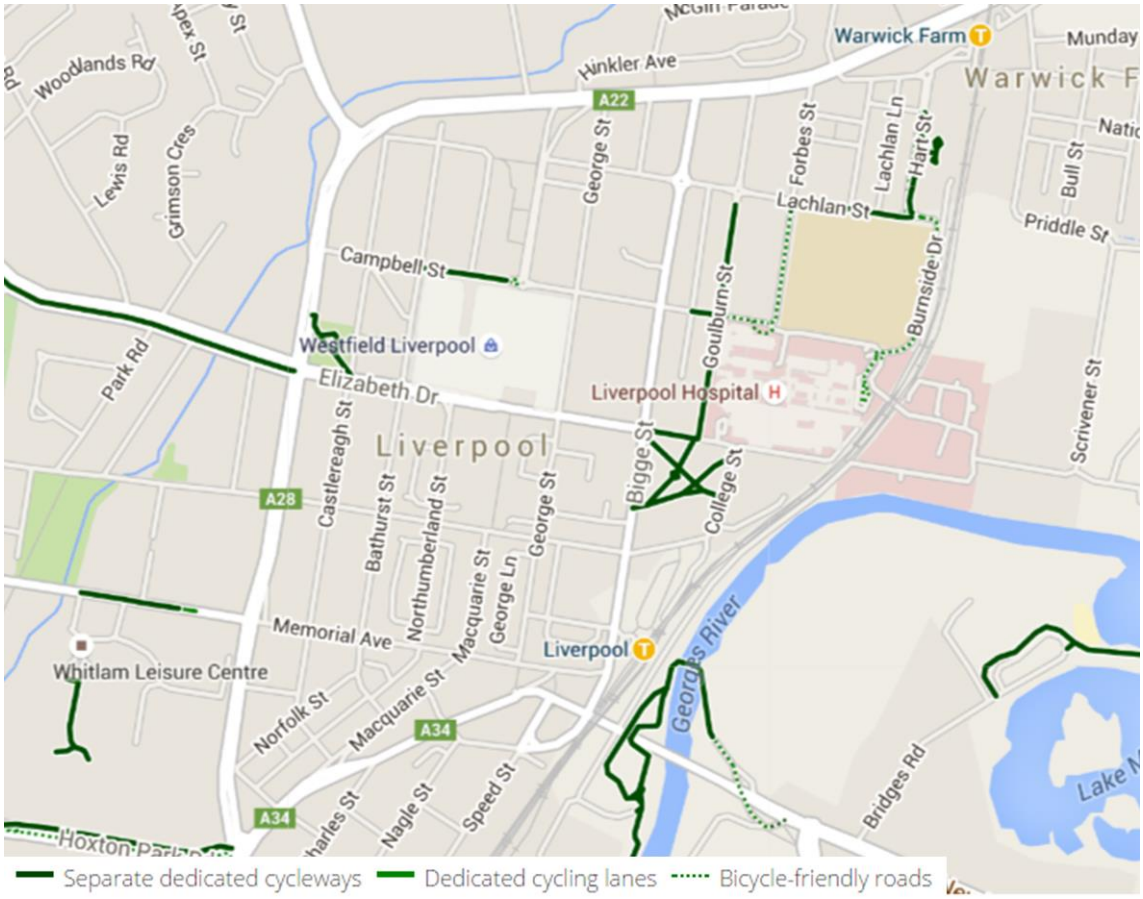
It is noted that no requirements exist for developments outside the Liverpool CBD. There are also no requirements for the inclusion of other end of trip facilities such as lockers and showers.

5.3.2 Sydney Cycleways

Sydney Cycleways is an online resource for cyclist maintained by the City of Sydney Council. The website provides information to cyclist including free cycling courses, the location of free minor bike repair "pop up" stores organised by the City of Sydney and maps and guides to cycleways within the Sydney metropolitan area.

The site offers an alternative map of existing cycle paths within the Liverpool CBD. This map is shown in Figure 5.13. Bicycle friendly roads like Burnside Drive located on the eastern end of the CBD are identified and recommended to cyclists on the site.

Figure 5.13: Sydney Cycleways Extract



Source: Sydney Cycleways

5.3.3 Strava Heat Map

Strava is a privately-owned website and mobile app used to track athletic activity via GPS. Users accessing Strava log their running and cycling data which can be represented as a heat map. The heat map shows the routes taken by the user with the colour intensity of each route being used to show how often a route is taken.

Strava Labs, a division of Strava compiled the data of all its users to develop a global heat map showcasing where cyclists and runners travel and how often these routes are travelled. Figure 5.14 is an extract from the global heat map and shows a heat map of the Liverpool CBD.

The heat map identifies routes commonly used by cyclists in the CBD. The Liverpool to Parramatta Rail Trail is shown to be active routes with cyclists filtering through the CBD to continue riding along the rail trail. Burnside Drive and the grounds of the hospital precinct are regularly used by cyclists to travel through the CBD. In general, cyclists will avoid roads with heavy traffic unless it is absolutely necessary.

It is important to note that the heat map produced by Strava Labs is a relative scale and does not reflect absolute numbers. The data used is also only limited to users of Strava which is generally limited to experienced riders who ride regularly. Whilst the heat map will not capture all cyclists it does capture a large sample of cyclists already using the cycling network.

Figure 5.14: Strava Heat Map of Cyclist Activity

Source: Strava Labs

6. Road Network Operations and Traffic Modelling

6.1 Existing Road Network Operations

The road network within the study area comprises motorway and arterial road corridors which experience varying congestion levels. Those corridors are characterised by different flow and driver characteristics but ultimately their operation is interlinked where localised congestion build-up can have a knock-on effect on a wider road transport network.

Hume Highway is a major arterial corridor that traverses the study area in the north-south direction. The corridor serves regional through trips as well as local trips that access the Liverpool CBD. At the northern end of the study area, Hume Highway is joined by Cumberland Highway with the intersection forming a major bottleneck. There are a number of east-west arterial corridors that traverse Hume Highway and create additional congestion hotspots that operate at capacity for prolonged periods of time which results in significant delays and queueing. Those major corridors include Hoxton Park Road, Elizabeth Drive and Newbridge Road (Terminus Street).

This sustained congestion along Hume Highway and limited access to the Liverpool CBD forces some trips to divert via the M5 (short diversions), Moorebank Avenue and Newbridge Road. A combination of those diverted trips and through traffic on the M5 places a considerable pressure on the weave section and often results in incidents and flow breakdowns.

Within the CBD, it's important to differentiate between the traffic flows that have the city centre either as a trip origin or a trip destination. These flows support the economic growth of the CBD and need to be prioritised when planning for the future. Trips that run through the city centre without an origin or destination within the city centre have a negative impact on traffic flows and traffic conditions and can inhibit economic growth. These trips should be discouraged from using the central city street network.

However, trips that bypass the city centre along major road corridors (i.e. Hume Highway, Newbridge Road) still have an indirect impact on the city centre road network performance: They consume available road space and intersection time that might otherwise be used by trips bound to and from the CBD.

6.2 Wider Road Network

The study area is traversed by two major motorway corridors – M5 and M7, both of which experience high levels of congestion throughout the day.

The **M5 South Western Motorway** plays a very important role in the Sydney motorway network that connects Sydney Airport and Port Botany with other sections of the wider network, including the M31, which leads to Canberra and Melbourne, and the M7, which connects the Western Sydney Employment Hub and the M4 and M2 Motorways. Within the study area, the M5 Motorway operates with three – four lanes in each direction and carries in the order of 125,000 vehicles per day. The key operational constraints on the M5 corridor are as follows:

- The merging of traffic entering the M5 at major interchanges, particularly at the M7/Camden Valley Way, Hume Highway and Moorebank Avenue

- Incidents resulting in lane closures and congestion escalation that impact on through traffic along the M5 as well as the surrounding road network.

The **Westlink M7** forms part of the north-south motorway corridor in Sydney's west, and is the western and north-western link in the Sydney Orbital Network. The M7 corridor runs from the M31 Hume Motorway and M5 South Western Motorway to the M2 Hills Motorway in the North. The corridor is a key link in the Sydney CBD bypass route, continuing along the M2 Hills Motorway and Pennant Hills Road (A6) to the M1 Pacific Motorway. Within the study area, the M7 is two lanes in each direction and has a distance-based toll operating in both directions. The corridor experiences similar congestion issues caused by merging traffic and incidents.

The **Hume Highway** forms part of a major east-west arterial corridor through Sydney's western suburbs. The road connects from Camden Valley Way and Campbelltown Road, Casula in the south-west to Parramatta Road in Haberfield, in the north-east. The corridor through the study area is generally a four and six lane road with frequent at grade intersections and uncontrolled access. The corridor (north of the M5) carries in the order of 60,000 vehicles per day and provides an alternative arterial route to access the M4 Motorway corridor.

Camden Valley Way forms part of a major north-south arterial corridor through south-west Sydney. The road provides a connection between Liverpool and Southern Highlands, and serves as an alternative north-south connection provided by the M31 Hume Highway Motorway and Campbell Town Road.

Hoxton Park Road forms part of an east-west arterial corridor through south-western Sydney. The corridor links the Hume Highway in Liverpool to Cowpasture Road in Hoxton Park. Between Gill Avenue and Banks Road, the Liverpool-Parramatta T-way bus rapid transit line runs in the centre of the road.

Elizabeth Drive is an east-west arterial corridor through Sydney's south-western suburbs. The road connects Northumberland Road in Liverpool to the Northern Road (A9) in Luddenham, passing through Bonnyrigg and Kemps Creek. It also forms the northern border of the proposed second Sydney Airport site at Badgerys Creek.

Heathcote Road is a north-south arterial corridor between Sydney's south-western and southern suburbs. The section within the study area passes through residential and industrial areas, and has generally two lanes in each direction.

Moorebank Avenue is a local road extending north from Cambridge Avenue to Newbridge Road. Moorebank Avenue predominately services industrial land uses on both sides of the carriageway as well as traffic accessing Liverpool CBD.

6.3 SIDRA Intersection Modelling

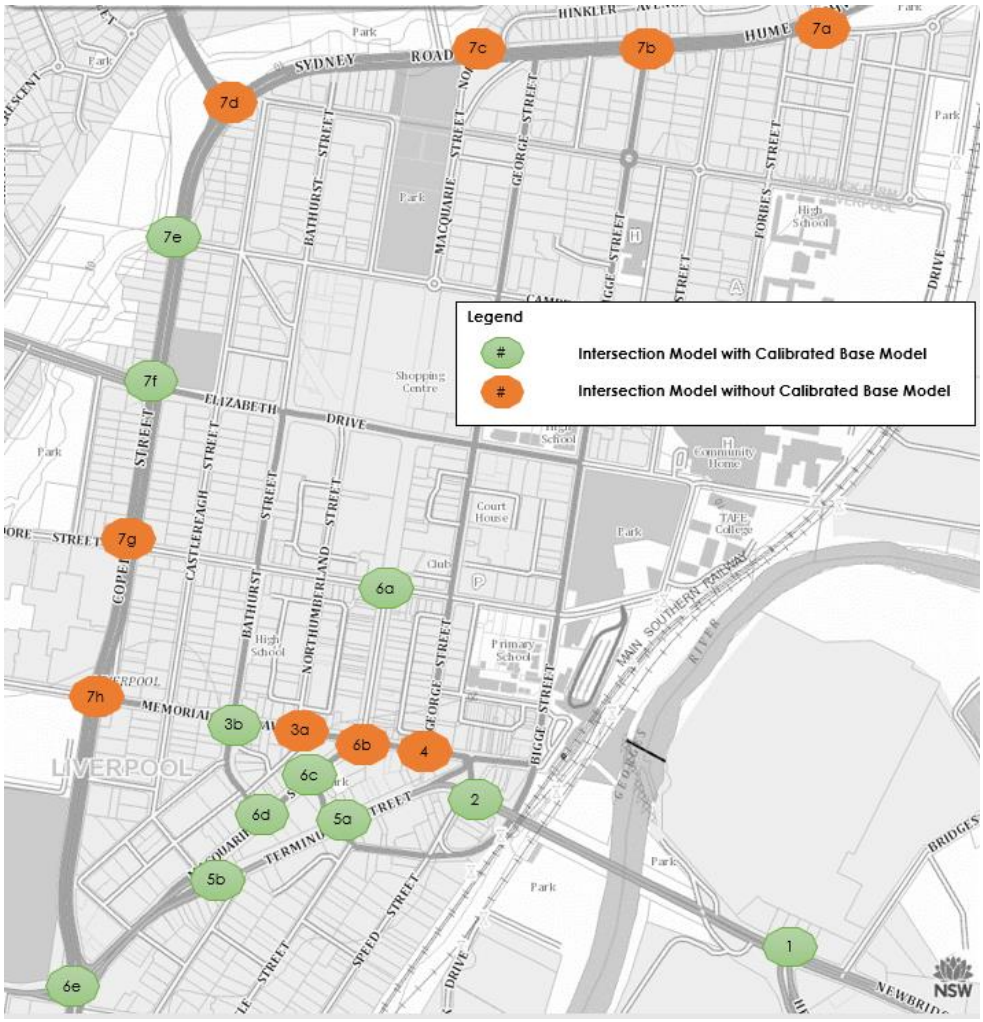
6.3.1 Study Area

Table 6.1 lists the intersections analysed as part of the future year option assessment. It should be noted that a number of these intersections were not calibrated for the exiting conditions because of the limited information available for the study. Figure 6.1 shows the location of the analysed intersections and it identifies the intersections that were not calibrated to existing conditions.

Table 6.1: List of Analysed Intersections

Number	Intersection Name
1	Newbridge Road and Heathcote Road and Moorebank Avenue
2	Newbridge Road and Speed Street and Terminus and Scott Street
3a	Memorial Avenue and Northumberland Street
3b	Memorial Avenue and Bathurst Street
4	Scott Street and George Street
5a	Terminus Street and Pirie Street
5b	Terminus Street and Macquarie Street
6a	Macquarie Street and Moore Street
6b	Macquarie Street and Memorial Avenue and Scott Street
6c	Macquarie Street and Pirie Street
6d	Macquarie Street and Bathurst Street
6e	Macquarie Street and Hoxton Park Road and Hume Highway
7a	Hume Highway and Remembrance Avenue/Mannix Parade
7b	Hume Highway and Bigge Street
7c	Hume Highway and Macquarie Street North and Homepride Avenue
7d	Hume Highway and Orange Grove Road
7e	Hume Highway and Campbell street
7f	Hume Highway and Elizabeth Drive
7g	Hume Highway and Moore Street
7h	Hume Highway and Memorial Avenue

Figure 6.1: Intersection Assessment Location



6.3.2 Time Period

The peak hours within the following time periods were assessed in the individual intersection based on traffic volumes:

- Weekday AM peak hour – 7 am to 10 am
- Weekday PM peak hour – 3 pm to 7 pm

6.3.3 Analyses Criteria

The operation of the key intersections within the study area have been assessed using SIDRA computer based modelling package which calculate intersection performance.

The commonly used measure of intersection performance, as defined by the RMS, is vehicle delay. SIDRA determines the average delay that vehicles encounter and provide a measure of the level of service.

Table 6.2 shows the criteria that are adopted in assessing the level of service.

Table 6.2: Level of Service Criteria

Level of Service (LoS)	Average Delay per vehicle (secs/veh)	Traffic Signals, Roundabout	Give Way & Stop Sign
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	Near capacity	Near capacity, accident study required
E	57 to 70	At capacity, at signals incidents will cause excessive delays	At capacity, requires other control mode
F	Greater than 70	Extra capacity required	Extreme delay, major treatment required

Source: Table 14.3 in the RMS Modelling Guidelines (version 1.0 – February 2013)

The role of the calibration and validation process adopted for the project was to develop a model that is fit for purpose and produces results that can be used in the context of the overall study.

6.3.4 Intersection Model Calibration and Validation Results

The adopted calibration criteria were to ensure that the modelled queues replicate the observed and surveyed queues as accurately as possible (approximately within 5 cars). The comparison of the modelled versus observed queues for the major movements is presented in Table 6.3.

Table 6.3: Intersection Major Movements Calibration Results

Intersection		AM		PM	
		Observed Queue Length (veh)	Modelled Queue Length (veh)	Observed Queue Length (veh)	Modelled Queue Length (veh)
1	East	22	19	42	36
	West	14	16	21	34
1a	East	20	24	16	17
	Northwest	12	11	12	17
2	East	9	5	9	22
	West	2	15	4	18

Intersection		AM		PM	
		Observed Queue Length (veh)	Modelled Queue Length (veh)	Observed Queue Length (veh)	Modelled Queue Length (veh)
3b	South	14	10	19	14
	North	9	7	6	8
5a	South	4	9	4	7
	North	7	7	9	13
5b	South	14	13	12	11
	North	11	6	13	9
6c	Northeast	9	2	13	6
	Southwest	6	8	8	6
6d	Northeast	8	5	9	7
	Southwest	12	10	9	4
6e	Northeast	17	22	30	25
7e	East	9	8	25	25
7f	East	11	11	26	30

The results of the calibration showed that the model is reasonably calibrated with majority of the modelled queue lengths are within the adopted criterion. There are few locations where modelled queue lengths differ from the survey results which is mainly due to variable signal phasing (by SCATS) that cannot be accurately replicated in the intersection models.

Based on the above, it is considered that the base model accurately replicated the existing conditions and is "fit-for-purpose" of future scenario testing.

6.3.5 Base Year Condition Model Results

The base year model was used to assess the level of service of the subject intersections. Table 6.4 presents the average intersection delay, degree of saturation and level of service (LoS) results.

Table 6.4: Intersection Base Model Results Summary

Int.	AM Peak			PM Peak		
	Intersection			Intersection		
	Delay (sec)	LoS	DOS	Delay (sec)	LoS	DOS
1 (Newbridge/Heathcote)	35	C	1.00	46	D	0.93
1 (Heathcote/Moorebank)	19	B	0.75	15	B	0.72
2	13	A	0.88	20	B	0.78
2a	3	A	0.12	3	A	0.08
3b	19	B	0.67	24	B	0.77
5a	39	C	0.80	23	B	0.41
5b	9	A	0.41	13	A	0.29
6c	17	B	0.41	18	B	0.41
6d	21	B	0.67	20	B	0.45
6e	89	F	1.05	61	E	0.95
7e	10	A	0.67	22	B	0.73
7f	58	E	0.95	56	D	0.92

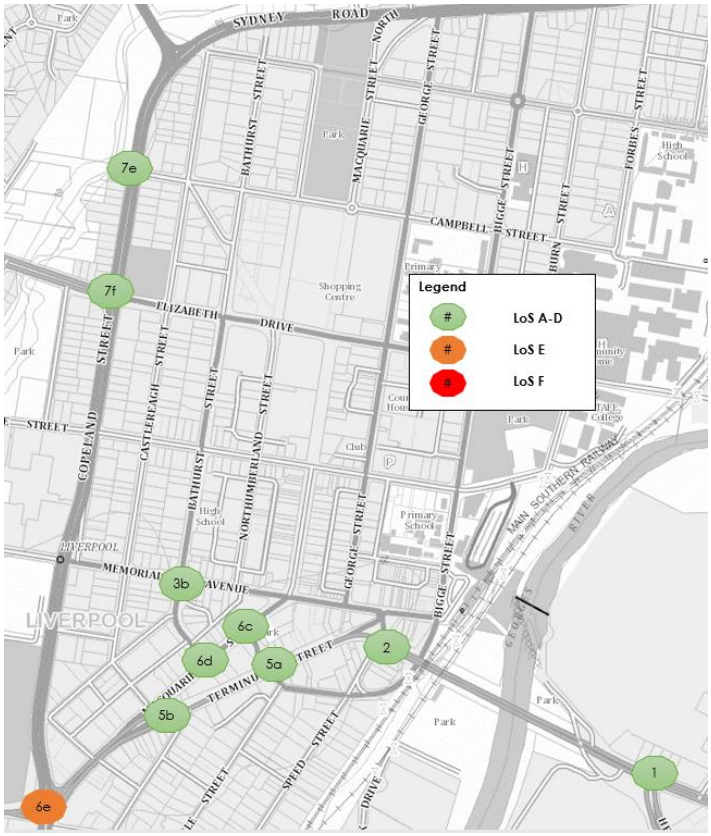
Note: Sidra files are provided electronically

The model results show the majority of the intersections are performing with an overall LoS of A to D with except of two intersections that performing at or above capacity in the morning peak (LoS E or F).

The base year intersection LoS is also graphically illustrated in Figure 6.2 and Figure 6.3 for AM and PM peaks respectively.

Figure 6.2: Intersection Base Year Model Results – Peak Hour Intersection LoS – AM Peak

Figure 6.3: Intersection Base Year Model Results – Peak Hour Intersection LoS – PM Peak



7. Future Growth and Development

7.1 Mode Share Targets

As detailed in the NSW 2021 State Plan, the following mode share targets have been set for public transport utilisation to the Sydney CBD (from 75% to 80%), and to key metropolitan centres (from 25% to 28%).

Specifically, the State Plan includes targets for the following key centres as outlined in Table 7.1.

Table 7.1: Public Transport Mode Share Targets for Key Centres

Key Centres	Target for Proportion of Public Transport Trips
Liverpool CBD	20%
Parramatta CBD	50%
Penrith CBD	25%

As noted earlier in this report, 73% of existing trips to and from Liverpool are made by private motor vehicle, with 7% travelling by train and 4% travelling by bus.

To achieve the public transport mode share target for Liverpool of 20%, changes to current parking management arrangements should be considered and the use of more sustainable modes of travel encouraged.

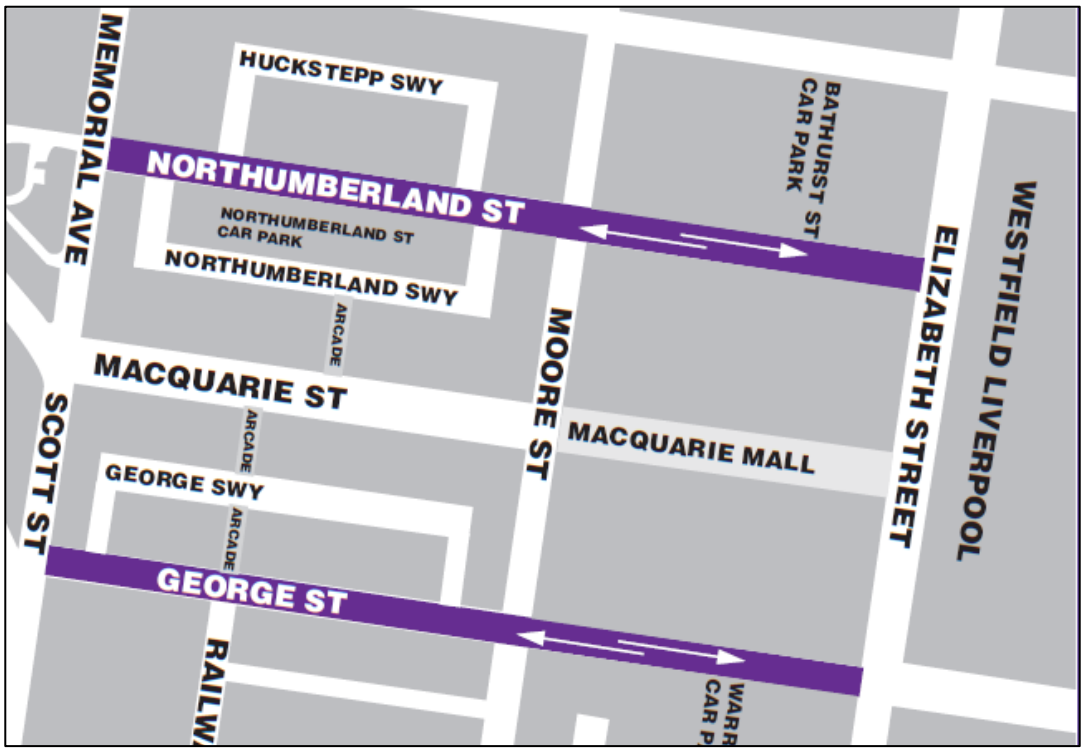
7.2 Future Redevelopment & Transport Improvement Works

Several key future developments and transport improvement works are to be completed within the LCCP Study Area. These projects are discussed in further detail under the following sub-sections.

Northumberland Street and George Street Two-Way Traffic Conversion

It is understood that Council intends to alter the existing traffic arrangements along George and Northumberland Streets from one-way to two-way traffic flow. These changes would occur for the road sections between Scott Street/Memorial Avenue and Elizabeth Street, as shown Figure 7.1.

Figure 7.1: Proposed Changes to George and Northumberland Streets



Source: Have Your Say Information Flyer, Liverpool City Council

It is noted that this revised arrangement would also impact upon vehicle access to/from the Northumberland Street car park, where a left-in / left-out access arrangement only will be permitted.

In addition to this, several road restrictions will be imposed on both Northumberland and George Streets to facilitate the two-way conversion, as shown in Figure 7.2 and Figure 7.3.

Figure 7.2: George Street Road Restriction Signage Plan (Post Two-Way Conversion)

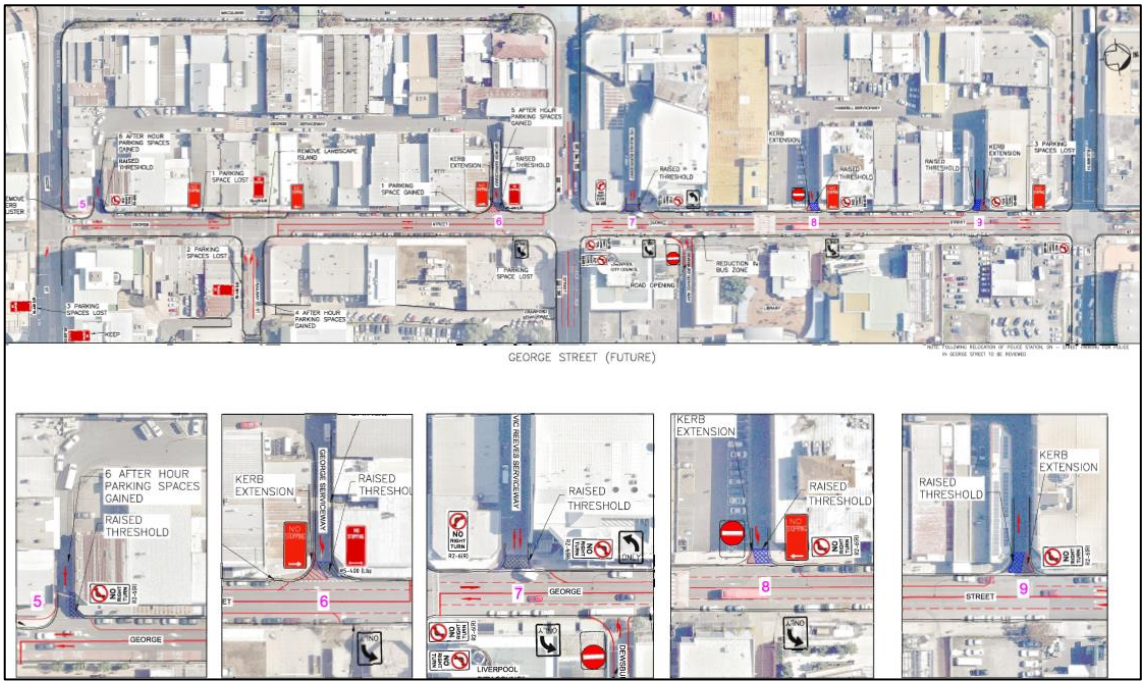
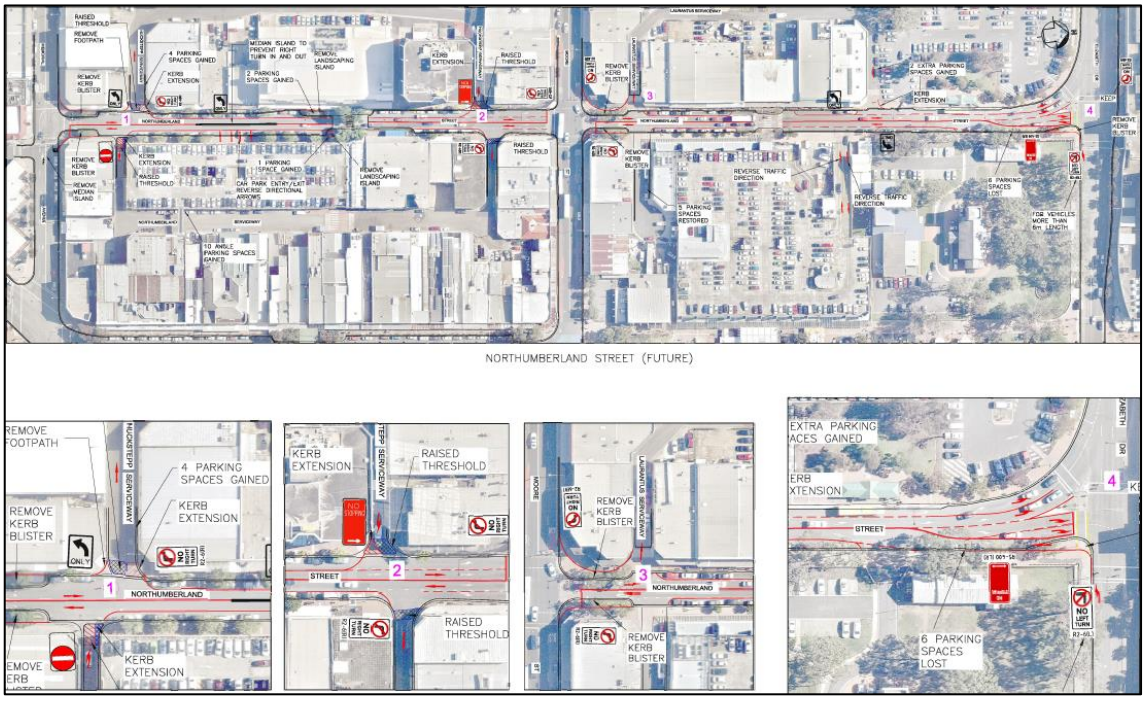


Figure 7.3: Northumberland Street Road Restriction Signage Plan (Post Two-Way Conversion)



University of Wollongong (South Western Sydney Campus) Development

A new South Western Sydney Campus is proposed for the University of Wollongong in Liverpool, with the University planning to grow to more than 7,000 students by the year 2030.

The Campus is set to be open in 2017 and will initially occupy two floors of Liverpool City Council's Moore Street building, before moving into a larger premises within the new Liverpool Civic Place development site, expected to be completed in 2019.

Macquarie Mall Revitalisation

Construction works associated with the improvement of the Macquarie Mall precinct commenced late in 2015 and is due to be completed in late 2016.

The project aims to create a vibrant communal hub delivering a high quality public domain, which involves repaving the mall with large format and modern granite pavers, implementation of mature trees, overhead lighting, water plan areas and modern street furniture to improve the amenity within the mall.

Bathurst Street Extension

Bathurst Street is planned to be extended to Terminus Street in accordance with the Liverpool Ring Road Masterplan. The proposal aims to provide efficient traffic flow from the Liverpool City Centre to the eastern suburbs and Bankstown airport via Newbridge Road. Construction of the project is anticipated to commence in the 2017/18 financial year, subject to the completion of detailed design works.

Liverpool Civic Place Redevelopment

It is understood that Council plans to activate the southern end of the Liverpool City Centre and redevelop the land located at 52 Scott Street, otherwise known as Liverpool Civic Place.

The development of approx. 60,000sqm (GFA), comprises the following uses:

- Council office – 13,000sqm GFA
- Library – 3,000sqm GFA
- Hotel / Apartments / Student Accommodation – 44,000sqm GFA.

It is understood that some 600 car parking spaces would be provided to accommodate the demands of the development uses on the site, with access provided directly off Terminus Street. Construction on the project is anticipated to commence in late 2016 / early 2017.

7.3 Development Car Parking Rate Requirements

Liverpool LEP (LLEP) 2008 Car parking rates for commercial and retail development within the Liverpool City Centre (Commercial Core and Mixed Use zones) are specified within the Liverpool LEP 2008, as reproduced below:

"Development consent must not be granted to development on land in the Liverpool city centre that is Zone B3 Commercial Core or B4 Mixed Use that involves the erection of a new building or an alteration to an existing building that increases the gross floor area of the building unless:

- *at least one car parking space is provided for every 200 square metres of any new gross floor area that is on the ground floor level of the building, and*
- *in respect of any other part of the building:*
- *at least one car parking space is provided for every 100 square metres of any new gross floor area that is to be used for the purposes of retail premises, and*

- *at least one car parking space is provided for every 150 square metres of any gross floor area that is to be used for any purpose."*

It is understood that an amendment to the current Liverpool LEP 2008 is set to be released. The proposed amendments are to include:

- rezoning certain properties from B3 Commercial Core to B4 Mixed Use.
- amending the development standards pertaining to Height of Building and Floor Space Ratio for certain sites.
- establishing three planning precincts in the Liverpool City Centre, being Fine Grain precinct, Mid Rise precinct and Long Term Civic Sites precinct.
- permitting the development of larger sites (over 1500m^2) in the Mid-Rise precinct as Opportunity Sites, allowing tower development in increased FSR, based on access, increased amenity and public benefit.
- adding a new 'Active Street Frontage' Map to LLEP 2008, which identifies streets on which new developments must have active street frontages.

Notwithstanding the above, no changes are expected to the car parking rates outlined in the current LLEP.

Liverpool DCP 2008 – Development in Liverpool City Centre (Part 4)

Car parking rates for other land uses, and development outside the Liverpool City Centre zone, is specified within the Development Contributions Plan as reproduced in Figure 7.4 below.

Figure 7.4: Liverpool City Centre DCP 2008 – Car Parking Provision Rates

Table 3 Car parking
Car Parking For Residential Development
- 1 Space per two studio apartments
- 1 space per one bedroom or two bedroom apartments
- 1.5 spaces per three of more bedroom units
- 1 space per 10 units or part thereof, for visitors
- 1 space per 40 units for service vehicle (including removalist vans (and car washing bays, up to a maximum of 4 spaces per building.
Car parking for all other development
- 1 space per 100 sqm of floor area
- Sufficient service and delivery vehicle parking adequate to provide for the needs of the development.
Motorcycle parking for all development
- Provision is to be made for motorcycle parking at the rate of 1 motorcycle space per 20 car spaces
Minimum Car parking requirements for people with disabilities
- Provide 2% of the total demand generated by a development, for parking spaces accessible, designed and appropriately signposted for use by persons with disabilities.
Bicycle parking for all development
- 1 bicycle space per 200 sqm of gross floor area. 15% of this requirement is to be accessible to visitors.

Further, the DCP notes that a minimum provision of 2% of the total parking provision shall be dedicated to people with disabilities, or a minimum 1 space per development (whichever is the greater).

State Environment Planning Policy (SEPP 65)

In accordance with the SEPP65, the Apartment Design Guide provides guidance on car parking for developments within proximity to public transport in metropolitan Sydney and centres in regional areas, as follows:

"Objective 3J-1 – For development in the following locations:

- *on sites that are within 800 metres of a railway station or light rail stop in the Sydney Metropolitan Area; or*
- *on land zoned, and sites within 400 metres of land zoned, B3 Commercial Core, B4 Mixed Use or equivalent in a nominated regional centre*

the minimum car parking requirements for residents and visitors is set out in the Guide to Traffic Generating Developments, or the car parking requirement by the relevant council, whichever is less."

Roads and Maritime Services, Guide to Traffic Generating Developments

Having regard to SEPP65, the Roads and Maritime Services (RMS) Guide to Traffic Generating Developments sets out traffic and parking generation rates for development in Australia, including Metropolitan and Non-Metropolitan areas.

With respect to car parking for residential developments, the RMS Guide sets out the following rates as reproduced in Table 7.2.

Table 7.2: Car Parking Rates for Residential Dwellings – RMS Guide to Traffic Generating Developments

Land Use	Type	Minimum parking rate(s)
Residential [1]	Dwelling houses	1 parking space per dwelling house [2]
	Medium density	1 space per unit, plus 1 space per each 5 x 2-bedroom unit or part thereof, plus 1 space per each 2 x 3-bedroom or more unit or part thereof, plus 1 space per each 5 units (visitor parking)
	High density	0.4 space per 1-bedroon unit, plus 0.7 spaces per 2-bedroom unit, plus 1.2 space per 3-bedroom unit, plus 1 space per 7 units (visitor parking)

[6] The provision of at least one loading dock for residential use is desirable.

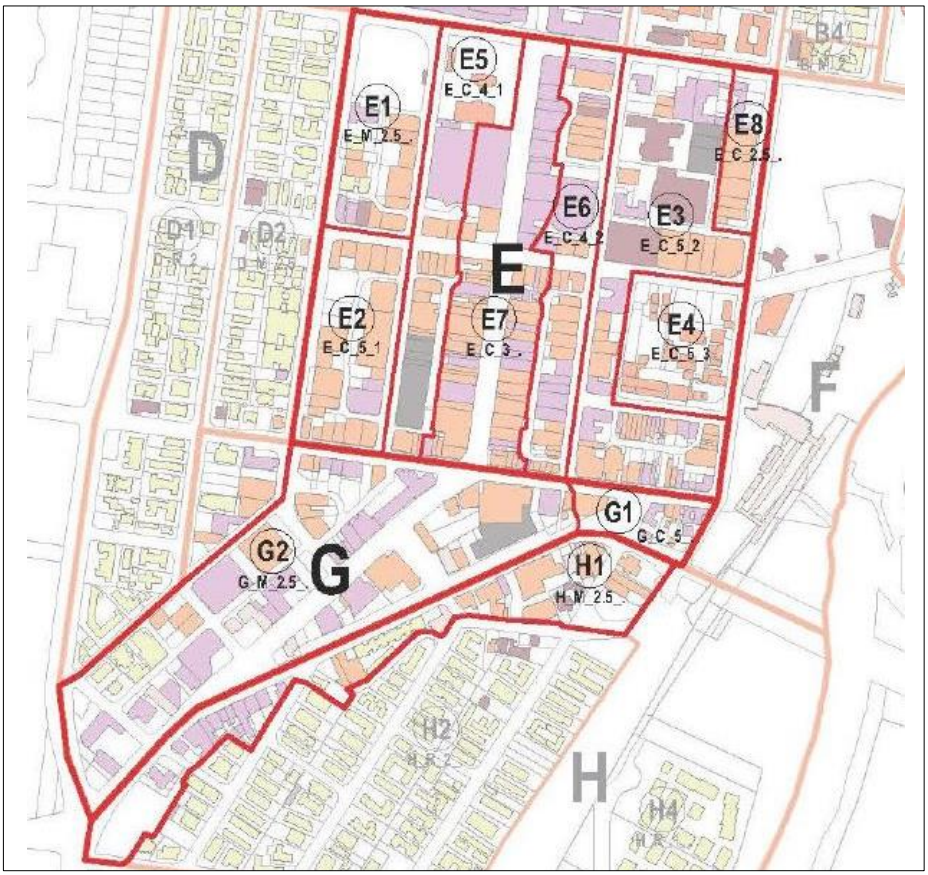
[7] If there is dual occupancy on a residential lot, a minimum of two parking spaces is recommended

7.4 Future Car Parking Demands

7.4.1 Anticipated Key Growth Areas

As advised by Liverpool City Council, it is understood that future development growth is to occur largely within the Core CBD area and, more specifically, across 11 key sub-precincts as illustrated in Figure 7.5.

Figure 7.5: LCCP – Areas of Anticipated Development Growth



The level of existing and future floor area within each of these sub-precincts is discussed further as follows.

7.4.2 Existing Floor Areas and Yields

Advice provided by Council indicates that the existing development extent within the Liverpool City Centre is as presented in Table 7.3.

Table 7.3: Existing Development Yields

Precinct No.	Retail	Commercial	Community	Residential
E1	2,952 m²	5,277 m²	1,725 m²	36 units
E2	4,374 m²	23,060 m²	-	0 units
E3	8,760 m²	21,627 m²	31,921 m²	0 units
E4	-	-	5,178 m²	-
E5	6,220 m²	4,411 m²	1,581 m²	0 units
E6	7,764 m²	18,502 m²	381 m²	0 units
E7	18,917 m²	19,149 m²	-	0 units
E8	790 m²	10,477 m²	-	0 units
G1	-	3,471 m²	-	0 units
G2	15,240 m²	17,510 m²	774 m²	50 units
H1	3,037 m²	13,431 m²	1,173 m²	49 units
Total	**68,054 m²**	**146,915 m²**	**42,733 m²**	**135 units**

7.4.3 Future Development Yields

Future development within the City Centre is anticipated to be significantly increased within the next 10-20 years. The scale of each development use within each separate precinct area is summarised in Table 7.4.

Table 7.4: Future Development Yields

Precinct No.	Retail	Commercial	Community	Residential
E1	12,298 m²	19,778 m²	51 m²	614 units
E2	11,342 m²	11,933 m²	-	418 units
E3	9,785 m²	94,149 m²	21,626 m²	818 units
E4	-	-	5,178 m²	-
E5	9,330 m²	20,304 m²	1,392 m²	152 units
E6	13,466 m²	10,031 m²	-	528 units
E7	20,853 m²	25,439 m²	-	549 units
E8	3,374 m²	713 m²	-	673 units
G1	-	1,559 m²	-	398 units
G2	13,681 m²	120,164 m²	774 m²	2,026 units
H1	13,659 m²	18,107 m²	707 m²	760 units
Total	**107,788 m²**	**322,177 m²**	**29,728 m²**	**6,936 units**

7.4.4 Future Car Parking Demand

Given the projected future development yields within the Liverpool City Centre, car parking demand is also expected to increase dramatically in the near future.

The estimated existing and future parking demand within the City Centre is summarised in Table 7.5.

Table 7.5: Parking Demand Estimates

Land Use	Parking Rate	Minimum Parking Requirements		Net Difference (Future – Existing)
		Existing	Future	
Retail	1 space per 100m²	681 spaces	1,078 spaces	+397 spaces (58%)
Commercial	1 space per 150m²	980 spaces	2,148 spaces	+1,168 spaces (119%)
Community		285 spaces	198 spaces	-87 spaces (-31%)
Residential[1]	○ 0.4 spaces per 1-bedroom ○ 0.7 spaces per 2-bedroom ○ 1.2 spaces per 3-bedroom ○ 1 space per 7 units (visitor parking)	118 spaces	5,984 spaces	+5,866 spaces (4995%)
Total		**2,064 spaces**	**9,408 spaces**	**+7,344 spaces (356%)**

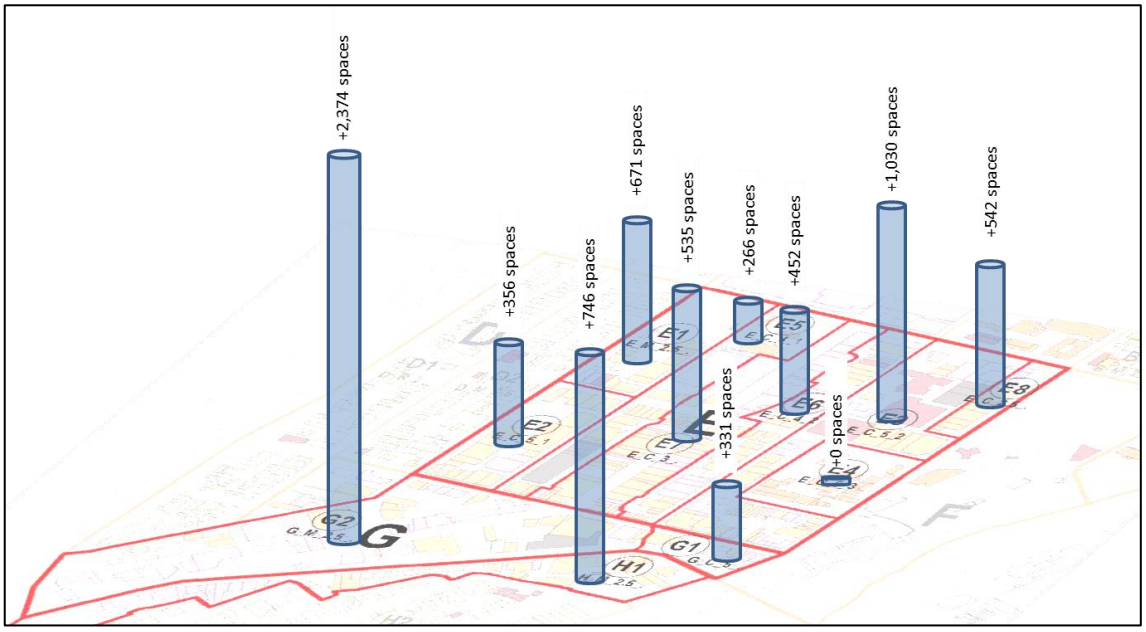
[8] For the purpose of estimating parking demand, residential parking rates have been assumed based on high residential development with an apartment mix of 10% 1-bedroom, 80% 2-bedroom and 10% 3-bedroom or more.

[9] Parking rates for non-residential uses have been based from the Liverpool LEP 2008, with residential uses based off the Roads and Maritime Services' Guide to Traffic Generating Developments

Taking into consideration the aforementioned parking rates within the City Centre, parking demand could be expected to be increased by 356%, assuming a linear relationship between increased development and parking demand.

The distribution of the increased parking demand is shown in Figure 7.6.

Figure 7.6: Distribution of additional car parking demand



As shown, the greatest increases in demand are anticipated in areas G2 and E3, with car parking demand growth in excess of 1,000 spaces. This growth is predominantly attributed to the significant anticipated increase in commercial and residential development in these precincts.

7.5 Future Traffic Demands

7.5.1 Introduction

TfNSW has provided the following data that has been extracted from their Strategic Transport Model (STM) for the following scenarios:

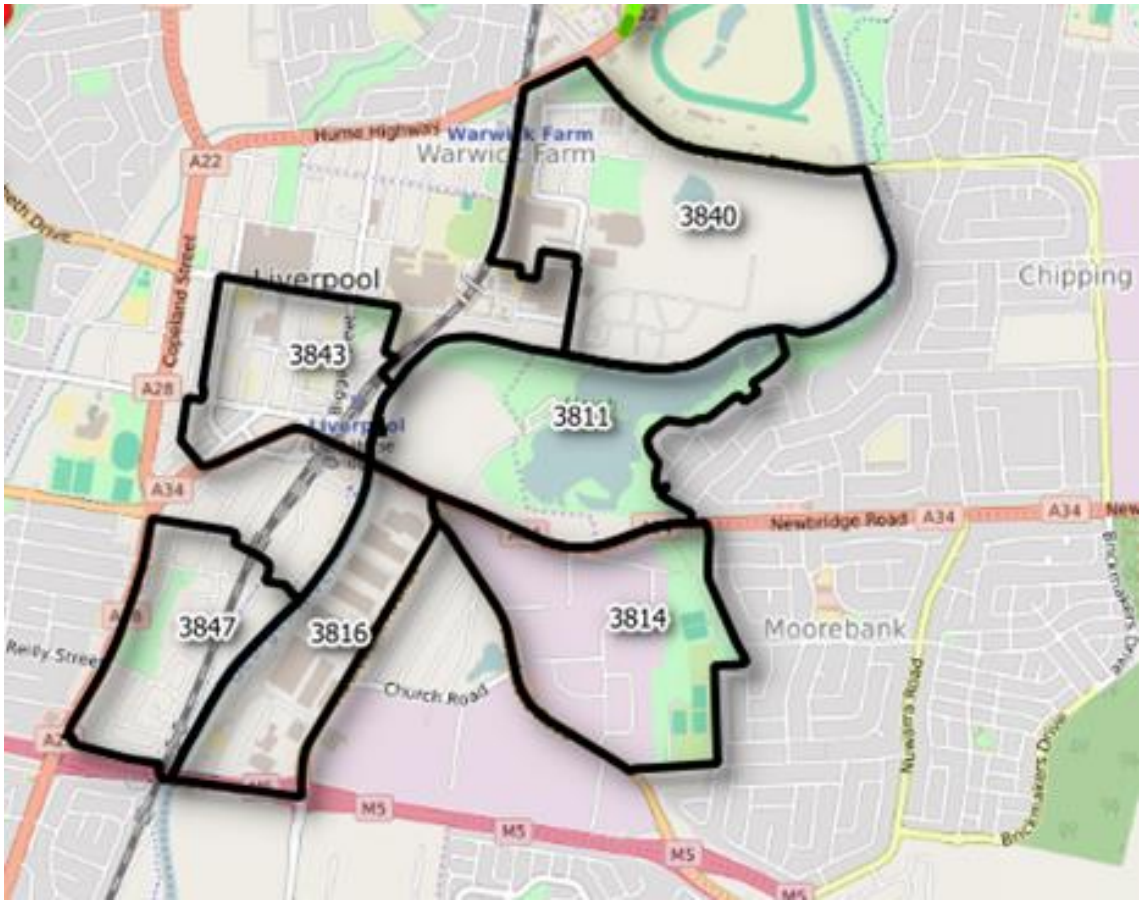
- 2016 base year model
- 2026 future case with the Council projected population and employment intensities
- 2031 future case with the Council projected population and employment intensities

7.5.2 CBD

The following population and employment intensities were provided by Council to Transport for New South Wales (TfNSW) to be used in the STM model runs. The intensities were provided as the new totals in the Travel Zones (TZ). Figure 7.7 shows the location of the main TZ's.

- TZ3843 (Liverpool Station)
  - Employment 2026 ➔ 10,488
  - Employment 2031 ➔ 15,635
  - Population 2026 ➔ 6,016
  - Population 2031 ➔ 18,028
- TZ3847 (Liverpool Bicentennial Museum)
  - Employment 2026 ➔ 146
  - Employment 2031 ➔ 145
  - Population 2026 ➔ 5,288
  - Population 2031 ➔ 5,294

Figure 7.7: Travel Zone Locations



7.5.3 Results

Table 7.6 and Table 7.7 summarise a comparison between the STM critical peak periods (2-hour) demand totals generated for the operational cordon in the base year relative to years 2026 and 2031 respectively.

Table 7.6: STM Traffic Demand Summary (Yr2026 & Yr2016)

Scenario	AM Peak Period (2hr)			PM Peak Period (2hr)		
	Car	LCV	Truck	Car	LCV	Truck
Base Year (2016) - vehicles	76,380	12,670	1,902	83,091	8,537	1,749
Future Year (2026) - vehicles	84,276	14,897	2,547	92,612	10,021	2,354
Growth over 10 years	**10%**	**18%**	**34%**	**11%**	**17%**	**35%**
Yearly Growth	**1%**	**2%**	**3%**	**1%**	**2%**	**3%**

Table 7.7: STM Traffic Demand Summary (Yr2031 & Yr2016)

Scenario	AM Peak Period (2hr)			PM Peak Period (2hr)		
	Car	LCV	Truck	Car	LCV	Truck
Base Year (2016) - vehicles	76,380	12,670	1,902	83,091	8,537	1,749
Future Year (2031) - vehicles	89,225	16,266	2,869	98,249	10,929	2,635
Growth over 15 years	**17%**	**28%**	**51%**	**18%**	**28%**	**51%**
Yearly Growth	**1%**	**2%**	**3%**	**1%**	**2%**	**3%**

The results from the STM indicate total vehicle demands are forecasted to increase by approximately 20% between years 2016 and 2031. This is relatively a considerable growth; however, Liverpool is nominated to be the third largest growth area in Sydney metropolitan.

Growth Area Demand

Table 7.8 summarises critical peak period (2-hour) demand total generated from the growth areas presented below.

Table 7.8: Growth Area Traffic Demand Summary

Peak Period (2hr)	Year	Total Growth Area		
		Origin	Destination	Total
AM	2016	2,295	7,802	10,097
	2026	3,587	9,134	12,721
	2031	4,989	11,597	16,586
PM	2016	6,710	2,561	9,271
	2026	8,311	4,057	12,368
	2031	10,806	5,787	16,593

The results from the STM indicate total vehicle demands in the future year 2026 are forecasted to increase by approximately 26% and 33% in the AM and PM peak periods respectively, while the traffic demand growths to year 2031 are 64% and 79% in the AM and PM peak periods respectively.

Mode Share

Travel demand matrices were extracted from STM for years 2016, 2026 and 2031 to understand the mode share of trips to and from the study area during different periods of the day. Table 7.9 and Table 7.10 summarise the mode share of trips to and from the study area for years 2016, 2026 and 2031 in the AM and PM peak periods respectively.

Table 7.9: Mode Share – AM Peak (2-hour period)

	2016	2026	2031
From Liverpool			
Car	72%	68%	67%
RLF	20%	23%	24%
Bus	6%	7%	8%
Bike	0%	0%	0%
Walk	1%	1%	1%
Taxi	0%	0%	0%
To Liverpool			
Car	84%	81%	80%
RLF	10%	12%	12%
Bus	5%	6%	6%
Bike	0%	0%	0%
Walk	1%	1%	1%
Taxi	0%	0%	0%
Within Liverpool			
Car	66%	65%	63%
RLF	0%	1%	1%
Bus	4%	4%	4%
Bike	1%	1%	1%
Walk	29%	30%	31%
Taxi	0%	0%	0%

Table 7.10: Mode Share – PM Peak (2-hour period)

	2016	2026	2031
From Liverpool			
Car	88%	86%	85%
RLF	7%	9%	9%
Bus	3%	4%	4%
Bike	1%	1%	1%
Walk	1%	1%	1%
Taxi	0%	0%	0%
To Liverpool			
Car	82%	79%	77%
RLF	13%	15%	16%
Bus	4%	5%	5%
Bike	0%	0%	0%
Walk	1%	1%	1%
Taxi	0%	0%	0%
Within Liverpool			
Car	68%	67%	66%
RLF	0%	0%	0%
Bus	3%	3%	3%
Bike	1%	1%	1%
Walk	28%	28%	30%
Taxi	0%	0%	0%

The results indicate the public transport shares (RLF + Bus) are predicted to grow relative to the Car mode share. It is also observed from the results that Walking is an alternative mode for the trips within Liverpool (trip generated and designated from/to the CBD).

7.6 Transport Policy

A review of relevant local and state transport policies, as presented in Sections 4 & 5 and in Appendix A, identifies the following key strategic goals for Liverpool CCP and the broader Sydney network:

- Provide cities which are well connected via a properly networked and efficient transport system.
- Actively encourage mode-shift by providing sustainable travel choices.
- Maintain important road, parking and public transport assets to a high standard.
- Improve access and prioritise the turn-over of vehicles on important city streets and parking for short-term commuters.

The Liverpool Car Parking Strategy provides an opportunity to shape car parking and transport solutions which contribute to achieving broader strategic goals for the city and regions beyond.

8. Towards a Transport Strategy for Liverpool: Car Parking

8.1 Introduction

The following details the development of a set of car parking strategy recommendation for the Liverpool CCP and Study Area. These recommendations have been developed with regard for the issues and opportunities identified in earlier sections of this report and are aimed at suitably managing existing and future car parking provisions and demands in a balanced manner which considers the needs of all stakeholders.

8.2 Key Strategic Objectives

The recommendations of the Strategy have been developed having regard for the following set of objectives. These priorities relate to the background policy documents and existing conditions technical discussion presented in earlier sections of this report.

- Maximise use of available parking resources.
- Provide for CBD customers and visitors over other long-stay users, such as commuters and staff.
- Minimise travel time circulating streets and car parking facilities to locate an available space.
- Sacrifice on-street car parking where it can be used to facilitate improved active and sustainable transport modes, such as bicycle lanes or pedestrian amenity improvements.

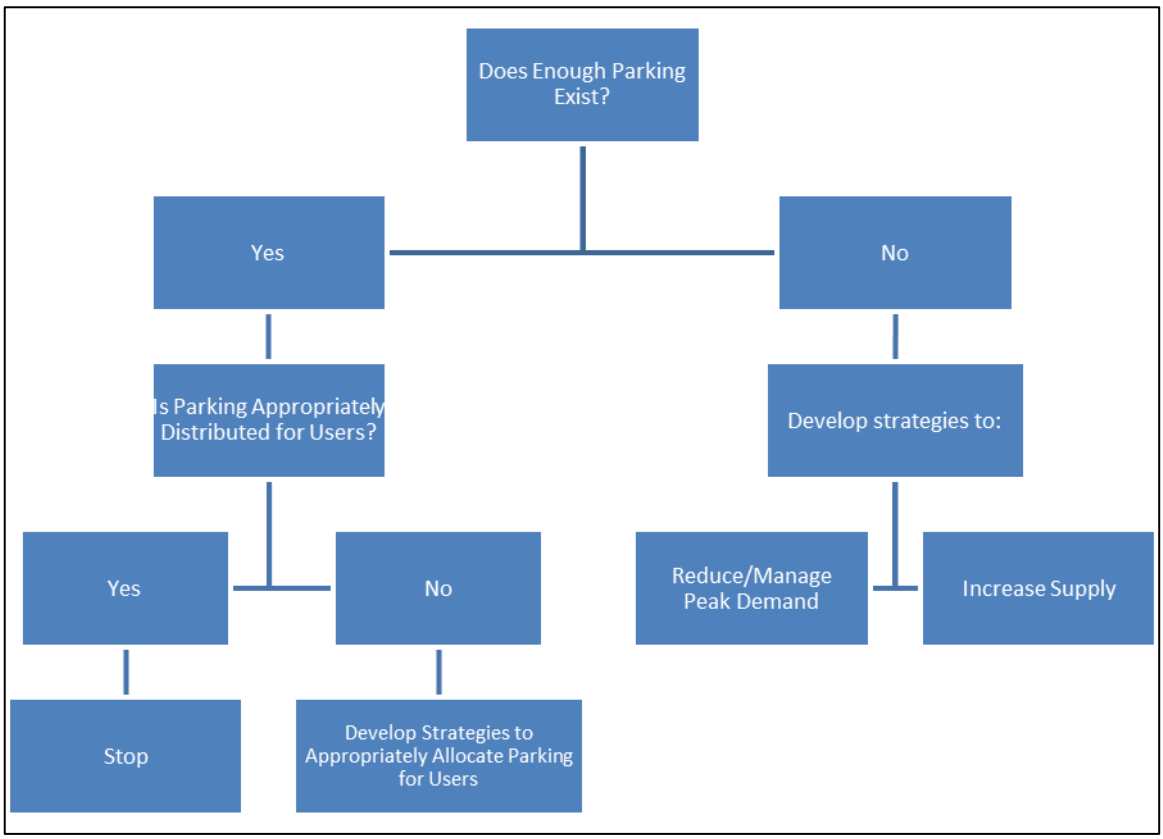
To achieve these outcomes and safeguard the sustainability of the Liverpool City Centre, the strategic approaches outlined in the following sections are recommended.

8.3 Decision Framework

In deriving an appropriate, tailored car parking strategy from a list of candidate solutions, it is critical to establish a broad decision framework and key priorities in order to clearly ascertain the most important outcomes and develop appropriate approaches to achieve them.

In this respect, the following outlines the process required to develop a relevant car parking strategy for the Liverpool CCP. In the first instance, it is important to establish whether an adequate quantum of car parking exists. Further decision points outline the approaches to overcome issues of quantity, distribution and allocation, as relevant.

Figure 8.1: Strategy Decision Framework



In this case, it has been clearly established that demand exceeds the theoretical car parking capacity for both on-street spaces and off-street facilities. The predominant focus of the strategies outlined below therefore focuses upon approaches which address both demand- and supply-side issues.

8.4 Additional Short-Term Parking

It has been established the theoretical capacity of 85-90% is outweighed by heavy demand for car spaces within the Liverpool City Centre Precinct. The overall objective in respect of the existing parking management is to reduce demand and increase 'effective' supply, such that operation of the available parking resource sits within theoretical capacity limits. Improving the operation of parking in the Centre will assist in ensuring that there is less excessive circulation and allows for parking to be prioritised to key users.

In this respect, an appropriate response is to increase the turnover of more parking spaces to allow a greater a number of vehicles to use the same space, or ensure that a specific user group can park in appropriate locations. The modification or broader spread of parking restrictions could redistribute available capacity to those priority users currently exceeding their available capacity.

To enable this outcome to be achieved given the deficit of parking availability, it is first necessary to prioritise use of the available spaces to the highest priority users. In this instance, the highest priority should be given to retail customers and visitors to the precinct. These users generally demand parking which is short-term and high-turnover in nature, but provide economic stimulation and custom to local businesses and services and generally have the highest elasticity to detrimental parking impacts, such as perceived or actual unavailability of spaces. Customers

and visitors should thus be provided with the highest user experience through allocation of the most convenient and accessible spaces.

To this end, it is recommended that additional short-term parking be established to accommodate the highest-priority user groups (customers and visitors). This is proposed to be achieved through the conversion of all Council-controlled off-street car parking locations within the CBD to short-term time-restricted parking of 3P or less. It is noted that this will require community consultation being undertaken and potentially supplementary car parking surveys.

Strategy Recommendation 1

Convert all Council-controlled off-street car parking locations within the CBD to short-term time-restricted parking of 3P or less.

It is anticipated that conversion of Council-controlled off-street car parking locations within the CBD will provide an additional 1,090 spaces (approx.) for strictly short-term users, including 520 spaces at Warren Serviceway, 240 spaces at Bathurst Street and 330 spaces at Northumberland Street. It is anticipated that providing in excess of 1,000 additional short-term parking spaces will significantly improve turnover, maximising the available parking assets and assist with prioritising customers and visitors to the precinct. The changed restrictions are reflected in Figure 8.2.

Figure 8.2: Proposed Changes to Council Off-Street Car Parking Facilities

In the instance that any short-term spaces remain vacant within these facilities following the implementation of this strategy, these spaces could be leased back to long-term users, such as staff car parking.

In more specific terms the following car parking restrictions could be considered:

- Northumberland Street car park
    - Ground floor – change 3P to 2P ticket
    - Levels 1 & 2 – change all-day parking to 3P ticket
    - Levels 3 & 4 – change all-day and 3 hours free parking to 4P ticket
- Bathurst Street car park
    - It is understood that this car park is used extensively by Westfield employees on a weekend
    - Recommend to remain as 3P ticket however introduce paid parking on Saturday and Sunday
- Speed Street car park

        - Paid parking should be considered for introduction in line with other activity centre parking areas
- Warren Serviceway car park
        - This is a gated car park which is understood to primarily cater for the medical precinct. It understood that Council would seek for restrictions associated with this car park to remain as current for the immediate future. Further consideration of changes to this car park may be given in the future.

In addition, it is recognised that the majority of residual on-street capacity exists in the unrestricted on-street areas surrounding the high-demand CBD core precinct. To provide additional short-term car parking supply, it is recommended that short-term parking time restrictions be extended further into the currently unrestricted on-street areas within the Activity Centre zone. A 4P restriction could provide a reasonable balance in the first instance to begin to prioritise peripheral parking for shorter stay users.

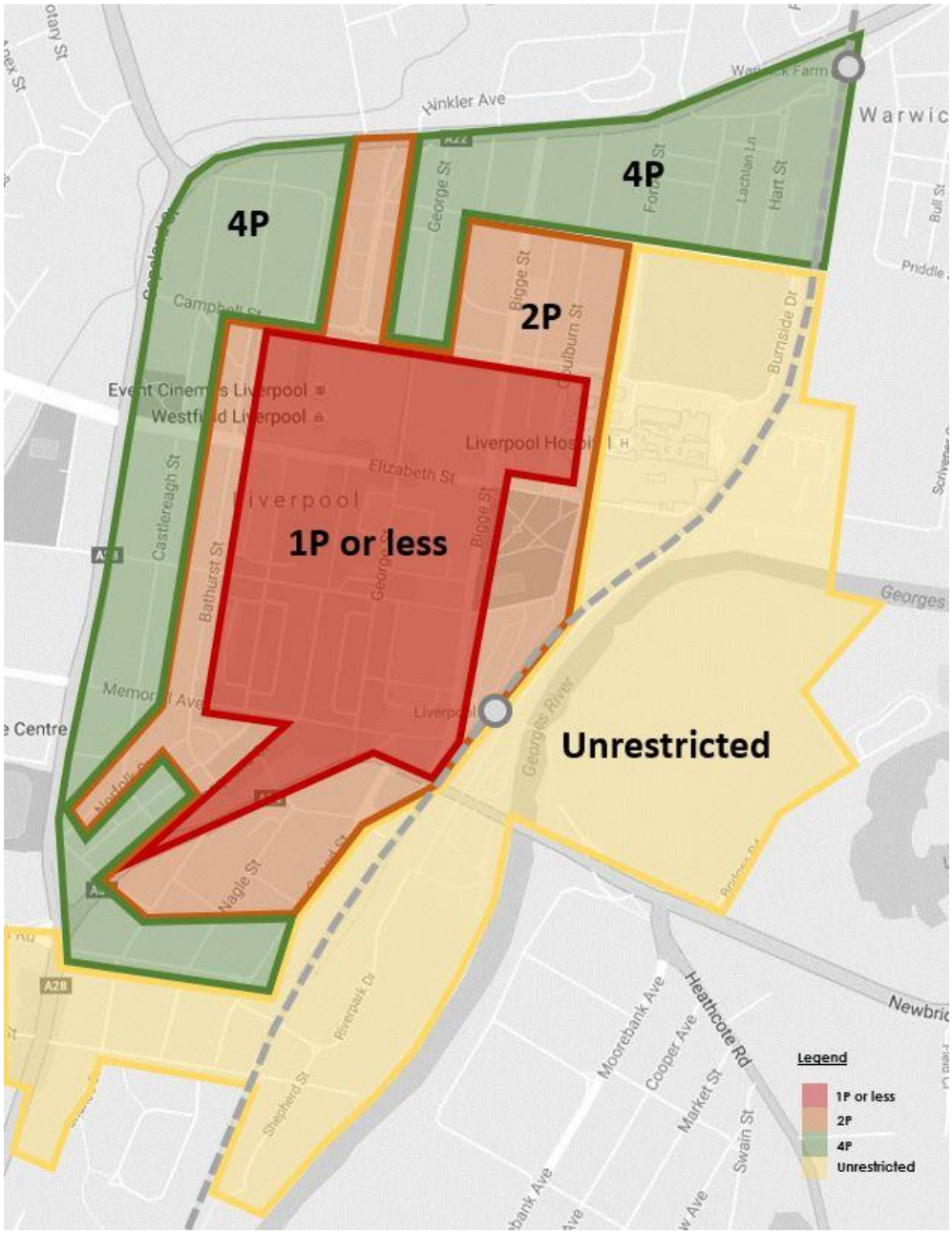
Careful planning is required to introduce further time restricted parking zone into residential area. Such changes may result in resident requests for a residential parking scheme in the future. It is recommended that further parking surveys are conducted to understand whether the streets within the unrestricted areas are currently used by local residents.

Strategy Recommendation 2

Extend short-term parking further into the currently unrestricted adjacent on-street areas within the Activity Centre zone.

As for Recommendation 1, this is anticipated to promote turnover for high-priority users and protect areas as appropriate, aligning with key strategic priorities to provide for customers and visitors over other users and maximise the utilisation of available parking resources.

Figure 8.3: Proposed Future Car Parking Restrictions



8.5 Peripheral Parking Stations

At present, given the existing high demand for car parking, there is the potential that long-term users (such as staff and commuters) generally occupy the most convenient long-term spaces available, as they arrive first. This results in shoppers and customers parking further from their destination and creates the perception that inadequate short-term parking exists.

Car parking provision on residential streets surrounding the CBD core, particularly in the vicinity of Warwick Farm and Liverpool Railway Stations, is particularly susceptible to high parking demand from commuter, staff and other long-term users, given the unrestricted nature of the spaces and acceptable walking distance from transport and employment options.

It is therefore recommended that peripheral parking stations are established for commuters and staff external to the CBD area.

Strategy Recommendation 3

Develop peripheral parking stations for commuter and staff parking, external to the CBD area.

This approach will alleviate parking demand in residential areas by non-residential users, improve accessibility to desired destinations through purpose-built parking facilities and prevent avoidable vehicular traffic from entering the central city precinct.

In respect of potential locations consideration could be given to:

- Collimore car park
- Lady Woodward park
- Future development areas such as Warwick Farm/Moorebank/Georges River precincts.

Council should consider supplementing these locations with a shuttle bus service outside peak hours, say 8.30am – 4pm, in a continues loop covering the CBD.

Of these locations, Collimore car park would represent the most logical site for the development of the first peripheral parking station having the following characteristics:

- This site is currently under the control of Council.
- The site located with convenient access to the arterial road network, however separated from the core CBD area.
- The site has convenient pedestrian access to the core CBD area. While walking distance exceeds that typically accepted by long stay users, pedestrian access is available for drivers not seeking to make use of the proposed shuttle service.
- The use of the site for car parking is consistent with its current use, being an at-grade car park. As such the development of a multi-level car park on the site would not be expected significantly impact on the urban fabric and surrounds. Indeed, a quality car park structure may improve the urban design of the site.

8.6 Future Car Parking Supplies

Given the significant anticipated future growth within the precinct, is it inevitable that in addition to the proposed demand-side recommendations, it will ultimately be necessary to generate additional car parking supply.

In this regard, it is recommended that more car parking spaces are built within new parking stations on the periphery of the Liverpool CBD Ring Road, having regard for available public and private land holdings and the location of the proposed peripheral park-and-ride sites for commuters.

Strategy Recommendation 4

Develop future car parking supplies for customers and visitors in the form of precinct parking structures, located on the periphery of the CBD Ring Road.

This approach will further prioritise short-stay high-priority users closer to the City Centre by preventing avoidable traffic within the core precinct.

Potential sites to provide such parking under the control of Council could include the Bathurst Street car park on the corner of Bathurst Street and Elizabeth Drive. This site is located on the

peripheral of the core CBD area with access to the CBD ring road. The site also provides a suitable size to allow for effective and efficient site development.

In addition, consideration must be given to providing car parking on-site at future development sites, as well as the potential to undertake parking improvement works at existing car parking stations to ensure all available parking remains attractive and is efficiently utilised.

8.7 Dynamic Signage

The theoretical capacities of 85% (of actual capacity) for on-street and 90% for off-street car parking facilities reflects the perceived unavailability of spaces due to difficulty in locating a vacancy or extensive circulation in order for a user to park a vehicle. The theoretical capacity of a car parking area therefore converges with the actual capacity as greater guidance to available spaces is provided.

Technological advances in parking guidance technology have improved the ability for car parking users to be matched with available spaces, therefore reducing the gap between car parking demand and perceived supply.

As outlined in earlier sections of this report, existing car park wayfinding signage was often inadequate in size, placement, clarity and clearance from obstructions. The static nature of the signage also provided little guidance as to the availability of spaces within each facility and an inability to direct users to more appropriate car parking locations based on vacancies.

To overcome these issues, it is recommended that wayfinding signage be improved to gain use of car parking that would otherwise not be found or fully utilised under constrained conditions. This would be best achieved by introducing dynamic signage to assist drivers in locating and gaining access to remaining spaces within car parking areas, particularly during periods of high demand.

Strategy Recommendation 5

Prepare an electronic / dynamic signage strategy to maximise the use of off-street parking locations and to minimise vehicle circulation in finding parking vacancies. This may include the integration of a phone-based application platform.

This recommendation assists with maximising the use of available parking resources and minimising travel time spent circulating streets and car parking facilities to locate available spaces, directly aligning with key priorities of this Strategy.

8.8 CBD Parking Pricing Structure

As presented in earlier sections, car parking pricing in Liverpool CBD is significantly less expensive than other Sydney CBDs, including Parramatta and Sydney, where parking prices exceed double the price for on-street parking and cost up to $29 per hour for off-street car parking facilities within Central Sydney. In addition, a typical Liverpool car space is priced at approximately $1.50 to $2.00 per hour, representing in a short-term paid car parking charge which is lower than many public transport fares within the locality. For example, a short bus ride up to 3km ($2.10 adult fare) or a short train ride up to 10km ($2.36 off-peak adult fare), providing no incentive to adopt alternative transport modes.

There is thus scope to increase parking pricing, which can be a powerful demand management tool and natural enforcement agent, providing an economic disincentive to using a private vehicle where avoidable and consequently decreasing demand for car parking. Raising the price of parking incentivises sustainable travel, including car and bike share operators, public

transport and active transport modes, equalising the perceived variable costs of car travel and making alternative transport modes more attractive.

More broadly, increasing parking pricing also represents a tangible reflection of local policy and attitudes towards private vehicle travel and mode choice, prioritising amenity over vehicle movement and according with travel plans and goals implemented by local and state governments.

It is also noted that Council currently provides 15-minutes free on-street parking by means of a free parking ticket. This is currently available throughout the City Centre. While areas of short term parking such as 15 minute parking are relevant to be included within the study area, reconsideration should be given to the provision of free parking at these spaces. This is reflective of the priority and proximity of these spaces to key uses.

Strategy Recommendation 6

Consider alterations to CBD parking pricing structure to prioritise the convenience of key on-street car parking areas and act as a demand management tool to encourage active and sustainable transport modes.

8.9 Implementation

Having regard to the nature of the discussions presented in Section 7 of this report, it is evident that the recommendations of this car parking strategy would benefit from being introduced in a staged manner, in accordance with the expected implementation timeframes for each of the recommendations.

For reference, Table 8.1 presents a summary of the recommended strategies and an anticipated delivery timeframe.

Table 8.1: Implementation Timeframe

Item	Strategy	Timeframe
1	Convert all Council-controlled off-street car parking locations within the CBD to short-term time-restricted parking of 3P or less.	Short (1-4 years)
2	Extend short-term parking further into the currently unrestricted adjacent on-street areas within the Activity Centre zone.	Short (1-4 years)
3	Develop peripheral parking stations for commuter and staff parking, external to the CBD area.	Medium (4 to 8 years)
4	Develop future customer/visitor parking supplies in precinct parking structures, located on the periphery of the CBD Ring Road.	Medium (4 to 8 years)
5	Prepare an electronic / dynamic signage strategy.	Medium (4 to 8 years)
6	Consider alterations to CBD parking pricing structure.	Long (8+ years)

9. Towards a Transport Strategy for Liverpool: Public and Active Transport

9.1 Introduction

Promoting active transport and public transport options with regards to access and egress from railway stations is becoming a key mobility policy objective. As noted, providing long term parking near stations is not likely to be considered a sustainable policy, particularly within city centres. People are more inclined to undertake public and active transport linked train journeys in centres such as Liverpool if the connectivity and reliability of infrastructure and operations is good.

To promote a shift in mode choice, upgrades and initiatives are required to incentivise such trips. This section outlines a number of options which can be considered to promote active transport and public transport trips within the Liverpool CBD.

9.2 Key Strategic Objectives

The recommendations of the Strategy have been developed having regard for the following set of objectives. These priorities relate to the background policy documents and existing conditions technical discussion presented in earlier sections of this report.

- Provide corridors and locations where public and active transport is prioritised
- Focus on concentrated, high quality access and links
- Integrate public transport with active travel modes
- Optimise the use of existing facilities.

Based on these approaches, a range of recommendations were developed that implemented together will provide a strategy for public and active transport in the Liverpool City Centre.

9.3 Function of Stations

The Liverpool City Centre services over 11,000 commuters on a typical weekday. Commuters access the rail network through Liverpool Station and Warwick Farm Station.

An analysis of patron behaviour shows that commuters access both stations through different transport modes. Liverpool Station is generally treated as a public transport interchange. Commuters using the bus network change modes between bus and rail at the Liverpool Bus Interchange / Liverpool Station.

Some commuter car parking spaces exist on site however, in the context of the site these are considered an inefficient use of space. Vehicles accessing the Liverpool Station commuter car park during peak periods are unlikely to find a suitable parking space. In addition, the vehicles also contribute to congestion in the local road network.

Warwick Farm Station is primarily used as a park and ride station. The surrounding car parking spaces allow for a significantly larger number of commuters to access the station by car. The station experiences relatively less traffic congestion during the morning peak periods. It also has minimal access to the surrounding bus network.

By formally designating each station a function, the abovementioned trends can be used to further improve the public transport network. Inefficiencies in the transport network arise when commuters treat Warwick Farm Station as a transport interchange and Liverpool Station as a kiss and ride station. Should each station have their main function recognised, steps can be taken to better inform commuters which station is best for them to access for the benefit of local transport networks and operations.

9.4 Transit Boulevard along Moore Street to Consolidate Bus Routes

Under the current operational arrangements for buses within the Liverpool CBD, there are a number of issues which are present which detract from the coherence and efficiency of the bus network. Most notably, as is shown in Figure 9.1 and Figure 9.2, three different bus operators have varying alignments for bus routes and locations for bus stops. The routes and stops are incoherent, especially for infrequent users of public transport.

Figure 9.1: Existing bus stop location in study area

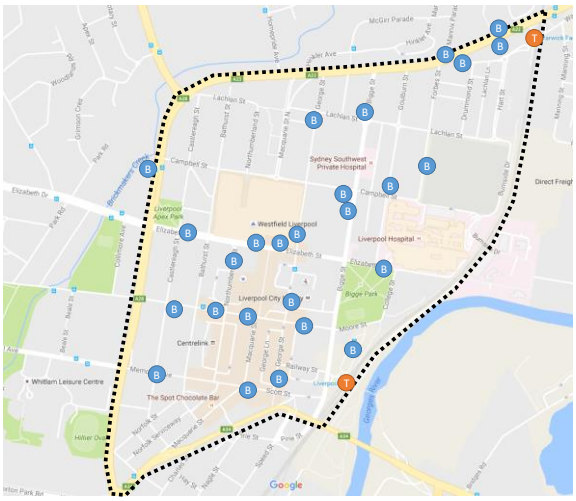
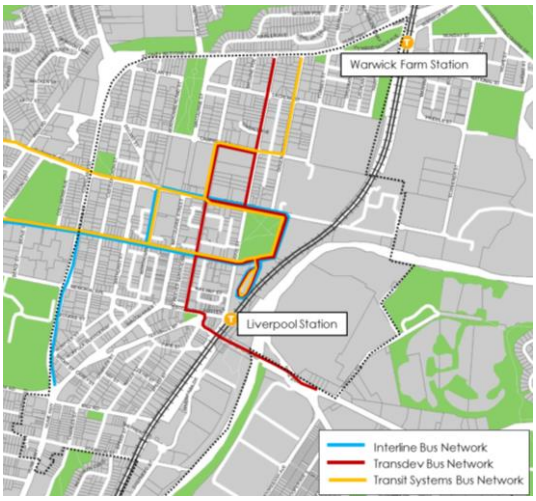


Figure 9.2: Bus operator route corridors



Bus operations within the Liverpool CBD should be rationalised and their reliability improved through the realignment of routes and the consolidation of bus stops. This involves the introduction of a designated road corridor for use by buses only. The removal of general traffic from such a corridor will significantly improve the reliability and speed of bus operations. Importantly, the consolidation of bus stops within a single corridor will improve the public's understanding of which buses operate from which stops.

What has been described above can be referred to as a *transit boulevard* and can be exclusively used by public transport, active transport, as well as service and emergency vehicles. In the case of Liverpool where a small-scale transit boulevard is proposed; the key objective is to delineate the various types of traffic to improve reliability and to add a disincentive to private vehicle movement in the CBD by removing road space for use by such vehicles.

An example of a transit boulevard is shown in Figure 9.3. The image shows Mönckebergstraße, this transit boulevard is in Hamburg/ Germany and links the central station with the town hall. In the image, buses, service vehicles and taxis can be seen in a controlled low traffic environment. The transit boulevard has been designed with two traffic lanes. At bus stops, the boulevard narrows to one lane (i.e. one passing lane for both directions). This artificially reduces traffic speed and promotes a more pedestrian friendly environment. Similarly, Figure 9.4 shows a transit

boulevard in London on Oxford Street which has a median and the presence of a high number of pedestrians in the local environment. Once again, despite the presence of large vehicles, the road corridor has been designed to be narrow to artificially slow traffic speeds.

Figure 9.3: Transit boulevard in Hamburg

Source: Google Maps, accessed 8 November 2016

Figure 9.4: Transit boulevard in London

Source: Google Maps, accessed 8 November 2016

The consolidation of bus routes onto a 'trunk corridor' within the CBD would rationalise operations and go towards enhancing the public's experience with public transport services. A transit boulevard along Moore Street between the bus interchange entry/exit opposite Bigge Park and Bathurst Street is proposed. The western extent is defined as Bathurst Street such that a north-south access is maintained to the eastern side of the Hume Highway. A high-level concept of the rationalisation of bus routes (inbound and outbound routes), bus stops and the location of the transit boulevard corridor are illustrated in Figure 9.5. Private parking would be removed from Moore Street within the transit boulevard corridor, but given the quantity of parking removed and existing parking restrictions, it would likely have negligible impacts to the current conditions. A high-level concept of the application of a transit boulevard is illustrated in Figure 9.6.

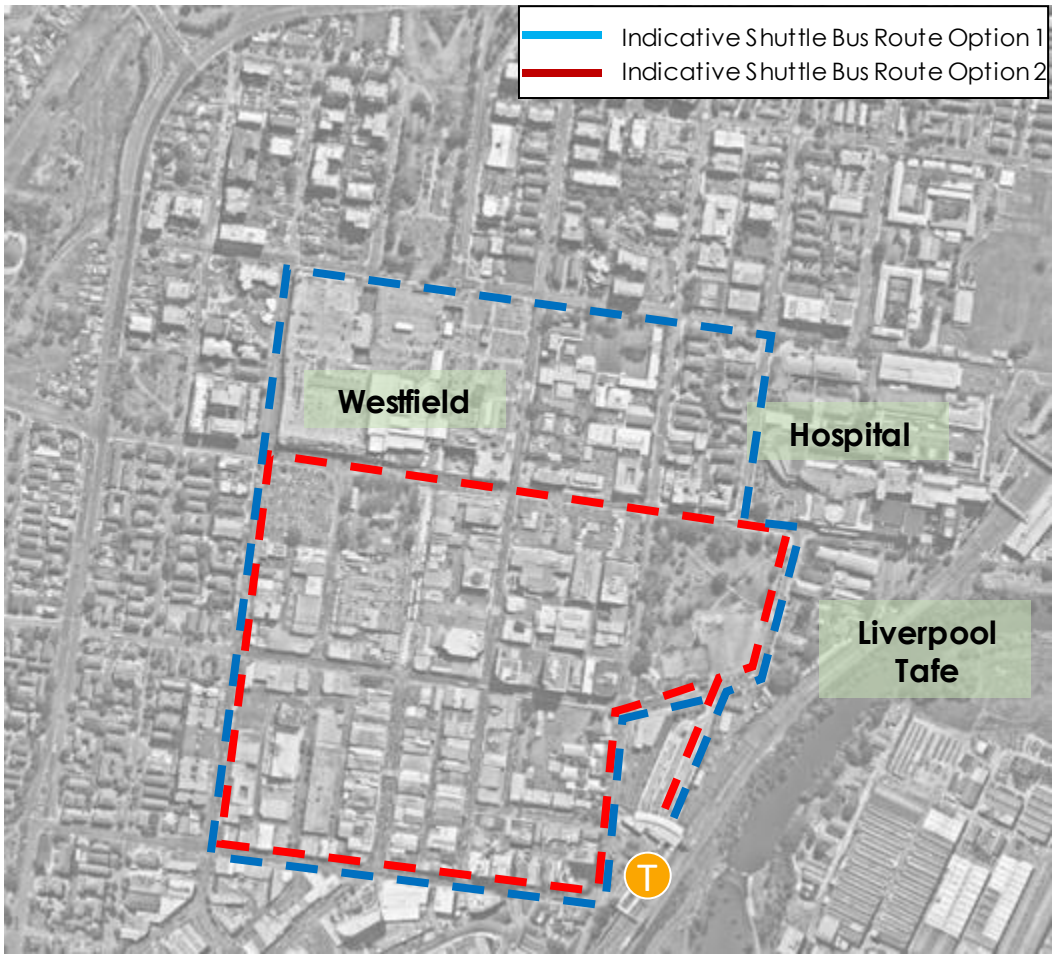
Figure 9.5: Transit boulevard concept

Figure 9.6: Moore Street transit boulevard concept

The implementation of a transit boulevard would ideally be completed in conjunction with other initiatives recommended through the other parallel studies which have been commissioned. Council should further investigate how exactly Moore Street should be reconfigured in regards to the commissioning and development of a concept design for Moore Street. Key stakeholders will need to be liaised with throughout the process including Transport for NSW, Roads and Maritime Services, the bus operators, as well as the public and businesses more broadly. Whilst Moore Street is reconfigured and preference given to public transport, this will lead to disruption to existing private vehicle parking. However, it is important to remember that because bus operations are becoming centralised, with some stops removed elsewhere, the parking loss may be neutral given a potential for new parking on streets such as Memorial Avenue.

A transit boulevard will consolidate the bus stops in the City Centre. Whilst the proposed bus stops on Moore Street are within easy walking distance of key destinations, some destinations lose direct bus access. To facility more direct access, it is recommended that a shuttle bus service, ideally a free service, is introduced with the opening of the transit boulevard. The shuttle bus should start and terminate at the Liverpool Bus Interchange to provide easy interchange with local and regional bus routes. Figure 9.7 show indicative route options.

Figure 9.7: Indicative route options for City Centre shuttle bus service



9.5 Active Transport Access to Liverpool Station

Liverpool Station is a primary access point for pedestrians and cyclists within the Liverpool City Centre. It was observed that commuters leaving the station walk or cycle to the retail core along Macquarie Street. This area includes the Westfield Liverpool, the Macquarie Street pedestrianised zone and the retail precinct immediately south of this pedestrianised zone along Macquarie Street.

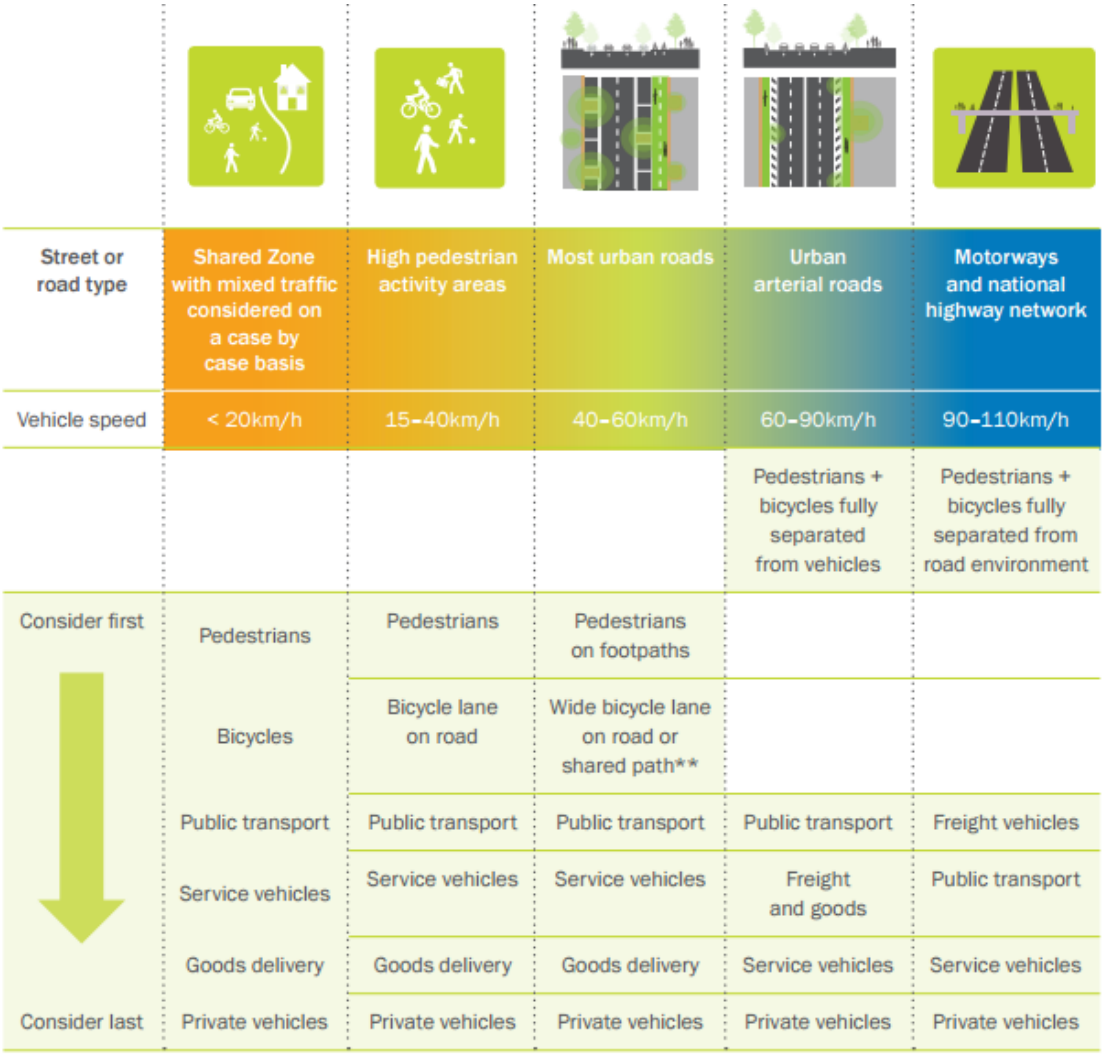
At present, pedestrian facilities linking Liverpool Station to the surrounding areas are underdeveloped. One such link connects the station to Macquarie Street via Railway Street, Penn's Railway Arcade and Stathis Arcade. An attractive retail frontage and a greater emphasis on pedestrian mobility along the link will work towards increasing active travel. Access to the two retail arcades are difficult to locate and are subject to poor lighting. A refurbishment of both

arcades along with the retail frontage and footpaths along Railway Street will complete the link between Liverpool Station and Macquarie Street.

The functional hierarchy of transport should be considered as part of active transport access to the station. For example, the City of Sydney has applied to Roads and Maritime Services to reverse the priority of traffic control at an intersection near Taylor Square. Traditionally, a light is green by default for a vehicle until it receives a signal from a pedestrian. However, under the City of Sydney's proposal, the lights would be green to pedestrians and cyclists by default, with a change only when a vehicle is detected. Such a change in priority would be consistent with the National Road Safety Strategy which outlines that pedestrians and cyclists should have the highest priority in transport networks (Figure 9.8).

Liverpool Council has recently commissioned a bike plan. Council should go about a methodical process of implementing the strategic route development. The importance of the 'last mile' should be emphasised. For example, the link from the Hume Highway (including the crossing of the Highway) to Liverpool station should be a key consideration given that delays are 'amplified' at the end of a journey. End of trip facilities such as bicycle racks and lockers are also pertinent in people undertaking such mode choices.

Figure 9.8: Road hierarchy



Street or road type	Shared Zone with mixed traffic considered on a case by case basis	High pedestrian activity areas	Most urban roads	Urban arterial roads	Motorways and national highway network
Vehicle speed	< 20km/h	15–40km/h	40–60km/h	60–90km/h	90–110km/h
				Pedestrians + bicycles fully separated from vehicles	Pedestrians + bicycles fully separated from road environment
Consider first	Pedestrians	Pedestrians	Pedestrians on footpaths		
	Bicycles	Bicycle lane on road	Wide bicycle lane on road or shared path**		
	Public transport	Public transport	Public transport	Public transport	Freight vehicles
	Service vehicles	Service vehicles	Service vehicles	Freight and goods	Public transport
	Goods delivery	Goods delivery	Goods delivery	Service vehicles	Service vehicles
Consider last	Private vehicles	Private vehicles	Private vehicles	Private vehicles	Private vehicles

Source: https://infrastructure.gov.au/infrastructure/pab/active_transport/files/infra1874_mcu_active_travel_report_final.pdf, accessed 8 November 2016

9.6 Wayfinding

Wayfinding between Westfield Liverpool, the retail hub of Liverpool City Centre and Liverpool Station was found to be poor. Wayfinding plays a key part in increasing pedestrian and cyclist confidence in their ability to navigate local and regional environments. At present, no wayfinding systems exist to direct pedestrians and cyclists to and from key destinations.

A wayfinding system should be implemented to direct pedestrians and cyclists throughout Liverpool City Centre. The system should be easily recognisable and direct pedestrians and cyclists to locations using the shortest and safest routes possible.

For Liverpool City Centre, the primary destinations should be between Liverpool Station and Westfield Liverpool. Wayfinding signs should be posted at key intersections and at entrances to covered pedestrian walkways including arcades.

Figure 9.9 and Figure 9.10 show examples of a pedestrian wayfinding system.

Figure 9.9: Wayfinding in Sydney Olympic Park

Figure 9.10: Wayfinding in Parramatta

9.7 Pedestrian Link - Macquarie Street South

The segment of Macquarie Street south of Moore Street and north of Scott Street is an important pedestrian link. The segment connects the Macquarie Street pedestrianised zone to the Stathis Arcade, Penn's Railway Arcade and subsequently Liverpool Station.

At present the segment is underutilised by pedestrians within the city centre. Pedestrian and cyclist behaviour were made in July 2016 and it was observed that the discontinuation of the pedestrian zone at the Macquarie Street / Moore Street intersection adversely disrupted pedestrian flow.

One reason for this disruption is the presence of a pedestrian fence shown in Figure 9.11 and Figure 9.12. Whilst it is understood that the purpose of the fence is to ensure the safety of pedestrians, steps can be taken to increase pedestrian flow whilst ensuring safety. One option is extending the pedestrianised zone to the southern section of Macquarie Street. An international example of a pedestrianised mall which utilises retractable bollards is outlined later in this section.

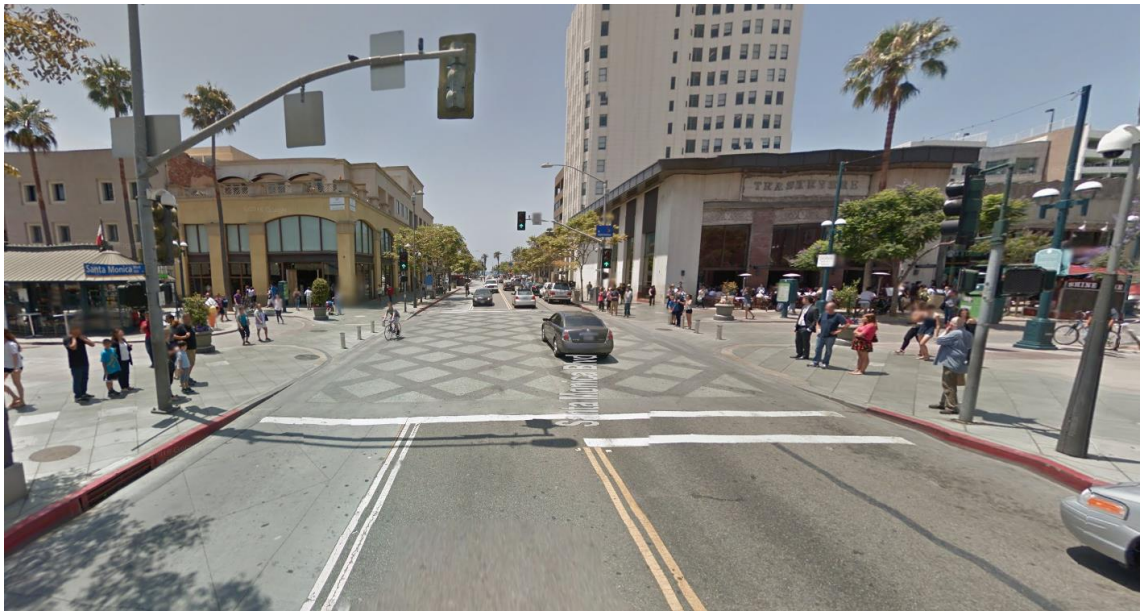
It is possible to undertake a short-term trial of such an initiative by closing the road to traffic, but if adopted in the longer term, such a change should be complemented by a broader landscaping and streetscaping improvement project. Experimenting with temporary road closures for the benefit of walking and community events is discussed in Sydney's Walking Future through the 'Streets for People' initiative.

Figure 9.11: Macquarie Street Crossing

Figure 9.12: Macquarie Street – Pedestrian Fence

In Sydney, most pedestrianised streets are only one block in length (Pitt Street, Sydney and Victoria Avenue, Chatswood for example), and accordingly, there is no conflict at the intermediate pedestrian crossings. However, under this proposal to extend the pedestrianised section of Macquarie Street, Moore Street would be retained for traffic movement perpendicular to the pedestrian mall. Two such examples of a pedestrianised mall which span several blocks include Martin Place in Sydney's CBD, as well as Santa Monica's 3rd Street Promenade in California (shown in Figure 9.13). Such a concept can be replicated on Macquarie Street.

Figure 9.13: Santa Monica 3rd Street Promenade



Source: Google Maps, accessed 10 November 2016

9.8 Bicycle End of Trip Facilities

End of trip facilities for cyclists are a key component of the active transport network. End of trip facilities are sometimes neglected at the expense of route development, but secure parking facilities are critical in an individual electing to cycle. Within the Liverpool City Centre dedicated cycling facilities were found to be uncommon.

Cycling end of trip facilities that were found in the city centre were found in various locations. In some cases they were found close to major trip generators such as the bicycle parking found on Macquarie Street near Moore Street.

Others were found near major trip generators but were in an exposed location. Bicycle parking found in these circumstances discourage long term or all day parking due to fear of theft. Such examples include parking found at the northern entrance of Westfield Liverpool and outside Liverpool TAFE located on Bigge Street. These end of trip facilities are shown in Figure 9.14 and Figure 9.15.

Establishing a strong network of bicycle end of trip facilities that also include facilities such as lockers and showers will greatly support the active transport network.

Figure 9.14: Bicycle Parking – Westfield Liverpool

Figure 9.15: Bicycle Parking – Bigge Street

Transport for NSW has recently started installing bicycle cages at selected stations on the rail network, with Woy Woy and Blacktown among the first to get these new cages[2]. People opt into having access to these cages through their Opal card, and these provide long term security for cyclists. Council should liaise with Transport for NSW with regards to having such infrastructure installed at Liverpool station. The cage installed at Woy Woy station is shown in Figure 9.16.

Figure 9.16: Secure access bicycle cage at Woy Woy station

Source: https://www.bicyclenetwork.com.au/general/policy-and-campaigns/3834/, accessed 8 November 2016

[2] http://www.transportnsw.info/en/transport-status/news/detail.page?news=templatedata/Content/News-Article/data/2016/opal-activated-bike-sheds.xml, accessed 8 November 2016

10. Development of Strategic Options for Modelling

10.1 Operational Modelling Assessment

10.1.1 Introduction

Note that this section includes extracts from a separate, comprehensive report that details the modelling approach and outcomes.

Road network operations throughout Liverpool CBD have been modelled using AIMSUN modelling software (mesomodel) supplemented by detailed intersection assessments using SIDRA software. It should be noted that whilst the AIMSUN model was calibrated against existing (2016) traffic movements, it was not used to test remedial measures designed to solve current congestion issues. It was recognised that the implementation of current planning initiatives will cause a significant increase and redistribution of traffic flows that will require a package of remedial measures. Any interim road network improvements should therefore be drawn from the 'ultimate' list of projects as this will avoid the implementation of short-term works that could prove to be abortive in the longer term.

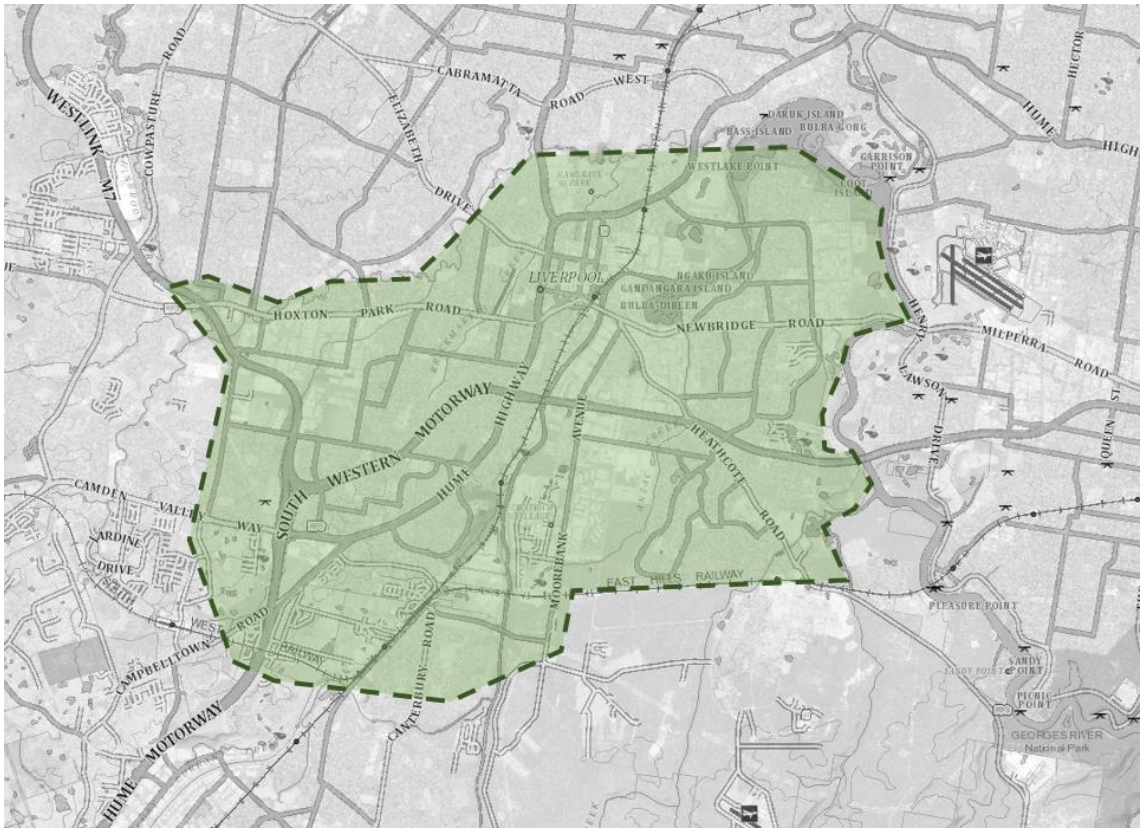
The following time periods were assessed at the operational level:

- Weekday AM Peak Hour – 5 am to 10 am
- Weekday PM Peak Hour – 2 pm to 7 pm

10.1.2 The Modelled Study Area

The area selected for the study has a complex transport network that includes three strategic motorway corridors (M31, M5 and M7), which are supplemented by a number of key arterial routes. The nominated study area also includes the Liverpool CBD and surrounding areas as presented in Figure 10.1.

Figure 10.1: Study Area



The study area consists of the residential suburbs of Casula, Wattle Grove, Holsworthy, Hammondville, Moorebank, Warwick Farm, Lurnea, Edmondson Park and Glenfield, industrial developments in Chipping Norton, Prestons, Hoxton Park and Moorebank, a bulky goods centre at the junction of Camden Valley Way and Campbelltown Road (Crossroads) and in Liverpool, as well as the Liverpool Town Centre commercial and retail precinct.

10.1.3 Future Travel Conditions

Vehicle demands within the study area are forecasted to increase by approximately 20% between years 2016 and 2031. As a results, the road network in without any intervention works with respect to demand management or road infrastructure improvements 2026 and 2031, is forecast to markedly deteriorate in operating conditions and delays. In 2026, the average speed in both peaks is forecast to decrease in the order of 2% compared to the existing conditions. The deterioration in average speed in 2036 is more severe with the reduction in average speed in the order of 10% and 13% in the AM and PM peaks respectively.

It is expected that the primary cause of the forecast deterioration in operating conditions in 2031 will undoubtedly be due to an increase in traffic demands (through traffic as well as the CBD associated traffic). Ultimately, the existing road network is unlikely to provide sufficient capacity to absorb the forecast growth in vehicle demands and future congestion patterns (locations and time distribution) are expected to be consistent with the existing conditions, although severity and time distribution will be exacerbated by increased vehicle demands.

The following critical locations have been identified to operate at or above capacity in the future scenarios:

- Hume Highway and Hoxton Park Road intersection

- The Hume Highway and M5 interchange
- The Hume Highway and Governor Macquarie Drive intersection
- Hoxton Park Road, Joadja Road and Banks Road intersection
- Hoxton Park Road corridor

10.1.4 Potential Localised Mitigation Measures

A number of localised (intersection) mitigation measures have been investigated to demonstrate the level of capacity deficiency within the road network and the magnitude of works that would be required (property acquisition, environmental impacts, etc.).

The following mitigation measures were investigated:

- **Newbridge Road and Heathcote Road Intersection**
  - Additional through lane on both approaches on Newbridge Road
  - Additional shared left and right turns lane on the approach from Heathcote Road
- **Heathcote Road and Moorebank Avenue Intersection**
  - Additional lane on the approach from Moorebank Avenue
- **Terminus Street and Pirie Street Intersection**
  - Additional a 200-meter through lane to the eastbound movement (100m before the intersection and 100m after the intersection)
  - Increase the pocket lane length of the westbound right turn to 90m for both lanes
- **Hume Highway, Hoxton Park Road and Terminus Street Intersection**
  - Additional lane to the through movements on the Hume Highway (four lanes each direction)
- **Hume Highway and Homepride Avenue Intersection**
  - Convert the eastbound left turn to a through and left turns lane
  - Additional through lane to the eastbound movement till beyond the Hume Highway and Macquarie Street North intersection
- **Hume Highway and Elizabeth Street Intersection**
  - Additional lane to the through movements on the Hume Highway (four lanes each direction).

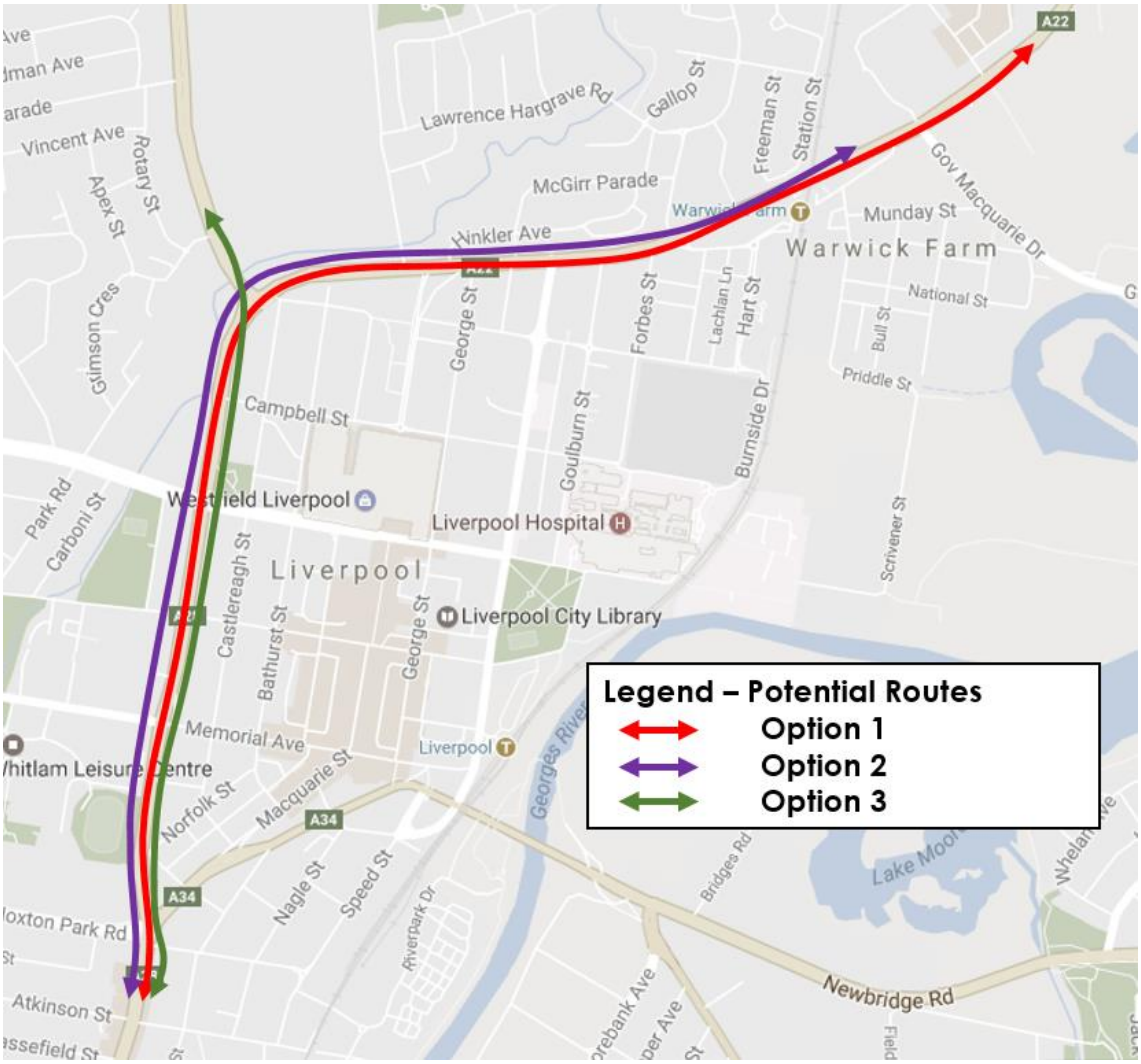
10.2 Potential Network Mitigation Measures

The results of the assessment showed that operational conditions along the Hume Highway will continue to deteriorate and an integrated corridor strategy will be required to balance the needs of regional and local traffic. A review of the existing and future travel patterns identified that the through tips will continue to form a majority of trips on the Hume Highway. In 2031 PM peak, approximately 50% and 90% of all northbound and southbound trips respectively can be classified as through (external trips).

In recognition of the above as well as the complex transport challenges confronting the study area, a bypass options that offers an expansion to the existing road has been assessed. The principle of this option is based on the improved access and connectivity for the through traffic, and the ability to improve of the Hume Highway through Liverpool.

The introduction of the Liverpool Bypass option appears to have a considerable impact on travel patterns within the study area. The bypass is expected to absorb a large share of northbound and southbound trips that currently travel via Hume Highway through Liverpool and therefore free up capacity and improve accessibility to and from the CBD for general traffic as well as public transport.

Figure 10.2: Potential Routes for the Liverpool Bypass



A comparison between the Bypass Option 2 and 3 scenarios' results shows the Option 3 is having a relatively better network performance results (lower average delay and lower waiting to enter demand). However, the values remain comparable between both options.

Table 10.1: Network Performance – 20131 PM Peak Period

Statistic	Yr2031 – PM Peak Period				
	Do Min		Bypass Opt 2	Bypass Opt 3	
Network Performance Statistics					
VHT (5hr period) – (hours)	49,696		48,557	48,297	
VKT (5hr period) – (km)	1,760,308		1,755,249	1,761,581	
Average Speed All (5hr period) – (km/hr)	39		39	39	
Average Delay (5hr period) – (sec/km)	58		58	57	

Overall, the results of the Bypass Options showed only marginal improvement in the network performance relative to the Do Minimum. This is caused by the deficiencies at the connections between the bypass and the arterial road network where additional optimisation measures (interchanges) should be investigated. Alternative locations and connection for the bypass should also be considered.

11. Summary of Transport Strategy Approach and Recommendations

The objective of this study was to develop a transport strategy that supports the intended increase in land use densities throughout Liverpool City Centre currently proposed by the City Council. The overall approach has been to advance measures that balance the need to support economic growth with an integrated package of sustainable transport outcomes that seek to minimise the increase in traffic loads on a road network that is already severely congested and constrained. In this regard, it is important to bear in mind that the provision of short stay parking supports business and other, typically off-peak visitor trips to the area, whilst the provision of long stay and, to some extent, residential parking, promotes commuter trips that contribute to peak period traffic congestion.

Consequently, the overall approach is to advance a strategy that:

- Encourages the use of public transport through the provision of improved bus and train operations
- Encourages the use of walking and cycling
- Promotes business and other economic activity through the provision of short stay parking close to the business core of the central city
- Facilitates (but does not encourage) long stay commuter parking through the provision of parking garages remote from the CBD but within walking / shuttlebus distance
- Seeks to improve traffic circulation and reduce congestion within the central city through a package of street and intersection interventions, and
- Seeks to improve access to the primary road network through selective intersection upgrades and improvements.

Specific actions are as follows:

With respect to parking:

- Convert all Council-controlled off-street car parking locations within the CBD to short-term time-restricted parking of 3P or less.
- Extend short-term parking further into the currently unrestricted adjacent on-street areas within the Activity Centre zone.
- Develop peripheral parking stations for commuter and staff parking, external to the CBD area.
- Develop future car parking supplies for customers and visitors in the form of precinct parking structures, located on the periphery of the CBD Ring Road.
- Prepare an electronic / dynamic signage strategy to maximise the use of off-street parking locations and to minimise vehicle circulation in finding parking vacancies. This may include the integration of a phone-based application platform.
- Consider alterations to CBD parking pricing structure to prioritise the convenience of key on-street car parking areas and act as a demand management tool to encourage active and sustainable transport modes.

With respect to public transport:

- Give Liverpool Station (transport interchange) and Warwick Farm Station (park&ride) designated functions to improve public transport.

- Create a transit boulevard along Moore Street to be exclusively used by public transport, active transport, as well as service and emergency vehicles. This will improve the reliability and speed of bus operations.
- Consolidate bus stops in the city centre to improve the public's understanding of which buses operate from which stops.

With respect to the road network:

- The Hume Highway carries high traffic volumes bypassing the Liverpool City Centre but this traffic has a significant impact on intersection performances around the city centre, potentially restricting other traffic to access or egress the city centre. It is recommended to ensure that city centre can easily be accessed as a destination.
- The internal road network in the city centre is dealing with competing traffic flows including destination traffic and through traffic (in particular between Newbridge Road and the Hume Highway). It is recommended to guide extraneous traffic around the city centre rather than through the city centre.
- The following mitigation measures were applied to the intersection models:

  i. **Intersection 1 – Newbridge Road and Heathcote Road**
     - Add a through lane on both approaches on Newbridge Road
     - Add a shared left and right turns lane on the approach from Heathcote Road

  ii. **Intersection 3 – Heathcote Road and Moorebank Avenue**
     - Add a lane on the approach from Moorebank Avenue

  iii. **Intersection 5a – Terminus Street and Pirie Street**
     - Add a 200-meter through lane to the eastbound movement (100m before the intersection and 100m after the intersection)
     - Increase the pocket lane length of the westbound right turn to 90m for both lanes

  iv. **Intersection 6e – Hume Highway, Hoxton Park Road and Terminus Street**
     - Add a lane to the through movements on the Hume Highway (four lanes each direction)

  v. **Intersection 7c – Hume Highway and Homepride Avenue**
     - Convert the eastbound left turn to a through and left turns lane
     - Add a through lane to the eastbound movement till beyond the Hume Highway and Macquarie Street North intersection

  vi. **Intersection 7f – Hume Highway and Elizabeth Street**
     - Add a lane to the through movements on the Hume Highway (four lanes each direction)

  These mitigation measures were tested individually, using SIDRA intersection analysis software and as part of the meso-scopic Aimsun network. In both tests the mitigation measures showed improvements of the intersection operations. However, none of the mitigation measures were tested for design feasibility. This is recommended to be the next step.

With respect to walking and cycling:

- Improve walking and cycling access to Liverpool Station by providing bicycle parking facilities and refurbishment of Penn's Railway Arcade and Stathis Arcade along with the retail frontage and footpaths along Railway Street.

- Implement a wayfinding system to direct pedestrians and cyclists throughout Liverpool City Centre. The system should be easily recognisable and direct pedestrians and cyclists to locations using the shortest and safest routes possible.
- Pedestrianise the southern end of Macquarie Street and complement this by broader landscaping and streetscaping improvements.
- Link the city centre into Liverpool's strategic bike route network and provide bike parking facilities at popular destinations.

Council has developed a range of short, medium and long term projects for the Liverpool CBD and nearby regional traffic and transport works including some strategic cost estimates. These are shown in Appendix A to this report.

Appendix A

Liverpool City Council – Proposed CBD and Regional Traffic and Transport Projects

Appendix 'A'

Liverpool CBD and nearby Regional Traffic & Transport Works

Proposed works	Cost estimate	% of development contribution	Timing
Local Improvements			
Bathurst Street extension and required widening of Terminus/Pirie Streets intersection for redevelopment of adjoining properties	4,500,000	100%	Short
Bigge Street/Moore St St upgrade	1,000,000	100%	Short
Extend Dewsbury Lane to George ST (Left out only)	400,000	0%	Short
Bigge Street/Elizabeth Street intersection upgrade	500,000	100%	Short
Extend Warren Service way to the new east-west link btn George St and Bigge St (as part of redevelopment of the Peter Warren Development Site)	200,000	100%	Short
Improve Pirie/Speed Streets intersection	800,000	100%	Short
Review and improve Council existing shuttle bus service route and frequency	500,000	100%	Short
Install additional bicycle storage facilities	300,000	100%	Short
Improve pedestrian faclities along Bigge St, from Stations to TAFE, Hospital, Westfields	1,000,000	100%	Short
Provide pedestrian/cyclist wayfinding signage	500,000	100%	Short
Development of a public and active transport travel guide (Green travel plan) - Study	50,000	100%	Short
Electronic/dynamic parking signage strategy - Study	100,000	100%	Short
Electronic/dynamic parking signage strategy - Implementation	1,000,000	100%	Short
Introduce Go-Get car share scheme ???	10,000	100%	Short
Change unrestricted on-street parking areas to 4P, includes survey	60,000	100%	Short
Feasiblity study of multi-storey car parks including at Collimore Park, and other	150,000	100%	Short
Review and update Council's DCP for Liverpool Centre to include maximum parking space provision rate and bicycle end-trip facilities	50,000	100%	Short
Review Council carpark fees and prepare a pricing strategy for on and off street parking. Conversion of all Council owned off-street car parking within the CBD to short term restricted parking of 3P or less.	350,000	100%	Short
Construction of multi-storey car park at Collimore Park (1,000 spaces) - 500 shortfall spaces contributed by developments	35,000,000	30%	Medium/Long
Moore St Transit Blv (Design/Delivery)	8,200,000	100%	Medium
Pedestrian improvements Macquarie St btn Moore St and Scott St, including angled parking and street lights	2,430,000	100%	Medium
Improvement of pedestrian waiting time at signalised intersections	300,000	100%	Medium
Widening and signposting to provide two lanes in each direction on Bigge Street	20,000,000	100%	Medium
Street Lighting	1,500,000	100%	Long
Sub Total	**78,900,000**		
Regional Improvements			
Strategic investigation and a business case for eastbound off-ramp from M5 to Hume Highway	450,000	100%	Short
Newbridge Rd/Speed St/Terminus intersection upgrade	2,000,000	100%	Short
Countinue representation and assist with business case for Liverpool to Bankstown Metro	280,000	100%	Short
Corridor study for Terminus Street, with concept	300,000	100%	Short
Hume Higway/Hoxton Park Rd/Macquaire St upgrade (Investigate)	400,000	20%	Medium
Hume Higway/Hoxton Park Rd/Macquaire St upgrade (Design/delivery)	80,000,000	20%	Medium
Newbridge Rd/Heathcote Road/Moorebank Ave intersection upgrade	35,000,000	10%	Medium
Eastbound off-ramp from M5 to Hume Highway	20,000,000	10%	Medium
Hume Highway/Hoxton Park Rd to Homepride Anenue upgrade, corridor improvement	5,000,000	10%	Medium
Widening of Terminus Street, from Hume Hwy to Lighthorse bridge	10,000,000	50%	Medium
Pedestrian bridge on Hume Highway at Elizabeth St intersection	3,500,000	50%	Medium
Brickmakers Creek Bypass	950,000,000	5%	Medium
Widening of Light Horse Bridge	80,000,000	2%	Long
Newbridge Rd Widening	2,000,000	2%	Long
Sub Total	**$ 1,188,930,000**		
Grand Total	**$ 1,267,830,000**		

Regional Contribution rate	**$ 9,530.00**	**per dwelling**
Local Contribution rate	**$ 6,352.94**	**per dwelling**

Total rate	**$ 15,883.00**	**per dwelling**

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