

Technical Paper 002: Strategic Traffic and Transport Analysis

Supplement to the Parramatta CBD Strategic Transport Study



To:
City of Parramatta**Project name:**
Parramatta CBD Strategic Transport Study**CC:****Project ref:****From:**
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Technical Paper 002

Subject: Strategic Traffic and Transport Analysis

SUMMARY

This paper has been developed to summarise more detailed analysis of the traffic and transport network than that presented in, and in support of, the main Strategic Transport Study document. Identification of transport needs to support Parramatta's growth has been informed by the Sydney Strategic Travel Model (STM) outputs provided by Transport for NSW Transport Performance and Analytics (TPA) team. Demand forecasts produced by STM are developed based on a number of assumptions and processes that attempt to replicate people's travel choices and behaviour, as well as a number of assumptions on future growth and changes in the transport network. The STM is hence considered to be best suited to examining the effect of significant proposals (such as that for the Parramatta CBD) at a strategic level. Further, more detailed transport modelling will be undertaken prior to gazettal of the Planning Proposal to build on these initial forecasts. The key messages of the analysis are summarised as follows.

- The estimated growth from Council's draft Planning Proposal does not represent significant change from that currently assumed in Government's planning (i.e. BTS demographic forecasts), which currently underpins the investigation into currently proposed projects (i.e. Parramatta Light Rail, Sydney Metro West).
- Nonetheless the forecast growth is expected to significantly increase demand on the transport network supporting Parramatta's CBD, particularly in the long term, driving the need for significant investment.
- Meeting long term (2056) future demand would require significant additional public transport infrastructure: additional rail infrastructure and services including significant additional train station capacity, higher capacity and higher frequency bus services, the proposed Light Rail network to Strathfield and Carlingford as well as investigation into the feasibility of other corridors.
- Travel demand is expected to be primarily contained within the SA3s immediately adjacent Parramatta; the average trip distance will decrease and the number of short distance trips increase as more homes are provided closer to major destinations within and around Greater Parramatta
 - This creates a huge opportunity for mode shift to sustainable transport modes, if supporting pedestrian, cycle and other public transport infrastructure is provided: this would create a sustainable transport network for Parramatta CBD whilst making it closer to becoming a 'places for people'.
- The capacity and performance of the road network external to the CBD has been coarsely analysed as part of this study
 - The peak period performance of the trunk road network is anticipated to be improved by works such as the M4 Widening, however other links on approach to and within the CBD are forecast to worsen in the future, should private vehicle use trends not be successfully intervened
 - The feasibility of the Planning Proposal may hence somewhat depend on the successful re-modelling of travel, enabled through future investment in sustainable transport modes and disincentivising of private vehicle use
 - Currently in-development mesoscopic traffic modelling will be able to better determine more detailed forecast performance of the road network within the CBD under various loading scenarios, and timeline 'tipping points' of the road network.

1. Introduction

1.1 Context

The Parramatta CBD Strategic Transport Study aims to provide transport strategies that should be implemented to support the expected growth in the CBD, as informed by transport data and post-analysis of outputs from the Sydney Strategic Travel Model (STM). The study identifies, at a strategic level, current and forecast travel patterns and travel demand. The study also reviews the appropriateness of current policies and planned transport infrastructure and services against proposed land use changes in the Parramatta CBD.

This paper has been developed to provide a more detailed summary of the traffic and transport network analysis than that include in the main Strategic Transport Study document. In doing so, the paper comprises of two main parts:

- Evaluating the existing and forecast transport demand generated by the Parramatta CBD. This includes the directionality of trips, the travel modes and trip distances.
- Detailed strategic analysis of each transport mode. Note that the critical AM peak formed the focus of the assessment as it is typically considered the critical peak due to converging trip types during this period.

1.2 Demographic projections

Subsequent to the development of the *Parramatta CBD Planning Strategy*, Council developed three potential development scenarios for sensitivity testing as part of this transport study. The development **capacity** of each scenario, and assumed 'market consumption' periods are summarised for residential population and employees in **Table 1** and **Table 2** respectively. The resultant calculated demographic projections for the CBD for each the 2036 and 2056 timeframes are summarised in **Table 3**.

The figures presented in each table are based on economic and market analysis advice provided to Council, and represent 'most likely' scales of future development uplift. The values shown also critically form the key underlying assumptions of this study, and the preliminary assessment of the draft Planning Proposal. These yields may be refined through the planning approvals process, and as technical studies are undertaken. Should higher development yields within the CBD be forecast or realised then further analysis would be required to understand the impacts on the transport network.

Table 1. Timeframes for medium and high growth scenarios – population forecasts

	Residential population		% Uptake by	
	Capacity	Assumed year of full uptake	2036	2056
Medium capacity	28,200	2047	65%	100%
High capacity	47,100	2055	51%	100%

Source: City of Parramatta, 2016

Table 2. Timeframes for medium and high growth scenarios – employment forecasts

	Employment		% Uptake by	
	Capacity	Assumed year of full uptake	2036	2056
Medium capacity	42,200	2049	61%	100%
High capacity	48,800	2055	51%	100%

Source: City of Parramatta, 2016

Table 3 Parramatta CBD proposed residential population and employment forecasts

Scenario		Demographic forecasts			
		Population		Employment	
2016	Current	20,800		53,900	
2036	Existing controls	34,100	(+13,300)	76,300	(+22,400)
	Medium capacity	39,000	(+18,200)	79,500	(+25,600)
	High capacity	45,000	(+24,200)	78,900	(+25,000)
2056	Medium capacity	49,000	(+28,200)	96,100	(+42,200)
	High capacity	67,900	(+47,100)	102,700	(+48,800)

Source: City of Parramatta, 2016

Note: An assumed linear take-up of capacity results in a slightly lower employment forecast in 2036 for the 'high capacity' scenario when compared to the 'medium capacity' scenario

1.3 STM methodology

Strategic transport modelling has been undertaken to support the transport assessment of the various potential Parramatta CBD land use scenarios. The modelling has been undertaken using STM, which is developed and maintained by Transport Performance and Analytics (TPA). The STM is a strategic metropolitan-scale model that forecasts travel patterns in Sydney under different land use, transport and pricing scenarios. For this reason it has been adopted as an appropriate tool to assess the various land use scenarios for the Parramatta CBD, at a strategic level. However it is not generally considered to provide a sufficient level of accuracy for specific public transport or road projects. In this methodology the STM is used to:

- Quantify overall increases in travel demand generated by the Parramatta CBD.
- Forecast growth in overall mechanised mode demand in a 'business as usual' manner, accounting for changes in planned transport and land use.
- Identify the growth in demand along key corridors / links for each mode in the immediate proximity to the Parramatta CBD.

The demand forecasts produced by STM are developed based on a number of assumptions and processes that attempt to replicate people's travel choices and behaviour, as well as a number of assumptions on future growth and changes in the transport network. The STM is considered to be best suited to examining the effect of significant proposals (such as that for the Parramatta CBD) at a strategic level. Further, more detailed transport modelling will be undertaken prior to gazettal of the Planning Proposal to build on these initial forecasts.

The initial forecasts have been used to estimate indicative impacts on relevant transport infrastructure and services. The underlying assumptions applied within STM include:

- Baseline demographic forecasts in accordance with those recently developed by Transport for NSW, which includes adjustments to the previous projections (September 2014 Release) to be reflective of outcomes from recent urban (land use and transport) planning investigations: this includes localised precincts plans such as Parramatta North, Parramatta Road Urban Transformation, Camellia etc.
- 'Project' demographic forecasts in accordance with yields provided by Council, as summarised in Section 1.2 above. These forecasts were spread across the 17 travel zones (TZs) that comprise the CBD study area.
- A transport network that includes planned transport infrastructure that has received a strong Government commitment to deliver - including projects such as WestConnex and Parramatta Light Rail (note that Sydney Metro West was not a committed project at the time of model processing).

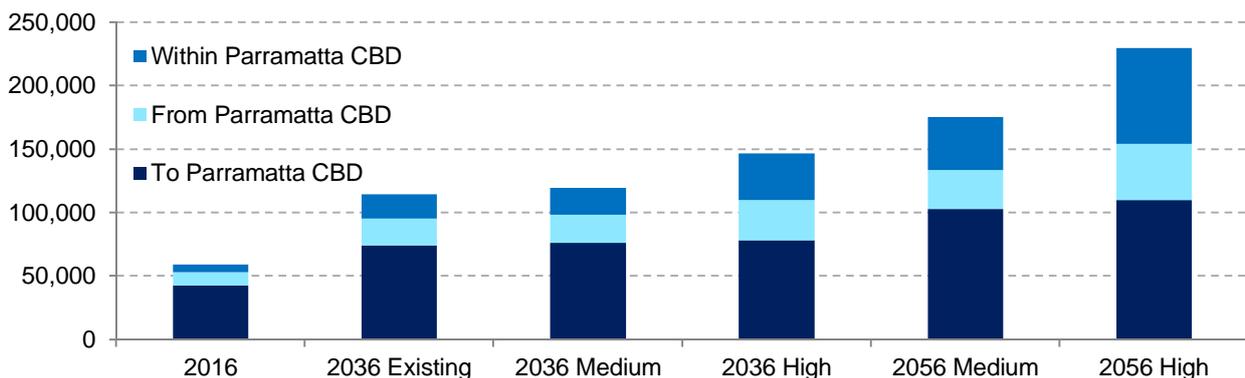
It should be noted that the STM outputs do not directly account for the effects that travel demand management (or other intervention) techniques or future technologies may impact on the utilisation of the transport network. These are discussed qualitatively where relevant in the sections following, and should be taken into consideration as part of more detailed modelling and investigations.

2. Transport demand

2.1 Overall demand

Total demand at Parramatta CBD was estimated from STM outputs and is summarised in **Figure 1** below. Note that 2016 values are estimates from the model and are fairly aligned with existing Journey to Work (JTW) data; this is referred to in the following **Sections 2.2** and **2.3**. The total number of trips generated by Parramatta CBD is estimated to more than double by 2036, and could potentially more than triple by 2056. The demand is expected to impact on the broader trunk transport network with a two-hour AM peak net growth of 48,000-59,000 trips in the medium term (2036) and 90,000-108,000 trips in the long term (2056).

Figure 1. Estimated travel demand (two hour AM peak)



Source: TPA, 2016

The proposed 2036 medium growth scenario does not represent significant change in demand from what current planning controls allow, or what current TPA forecasts include. High growth scenarios show significantly higher total demand, though most of the relative difference is 'contained' trips - due to the higher residential mix of the proposal - with more modest impact on broader travel demand.

2.2 Trip origins

TPA provides a range of JTW data on travel patterns and behaviour, derived from the 2011 census data. Of the circa 43,600 employees that commute to Parramatta CBD, approximately 13 per cent live within Parramatta SA3¹. The second most common work trip origin is Merrylands – Guildford SA3 (eight per cent) followed by Blacktown SA3, Baulkham Hills and Penrith with each less than seven per cent. Several key messages can be found from JTW data:

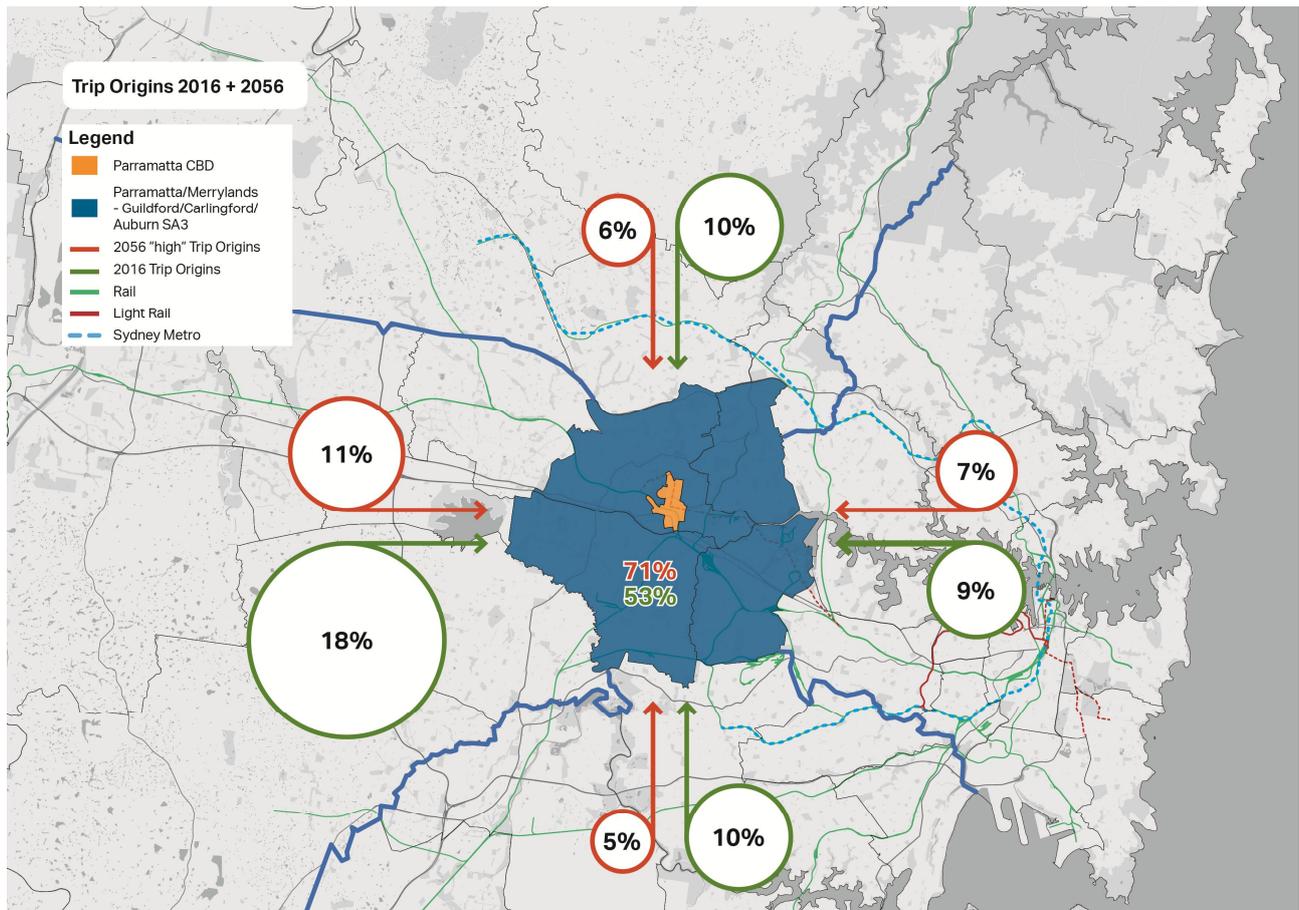
- The dispersed nature of work origins underlines the strategic importance of the Parramatta CBD and its place as a major employment centre.
- Almost a third of workers commute to Parramatta CBD from the west. This reinforces Parramatta's position as 'Western Sydney's CBD'.
- A high proportion of inbound trips originate from the SA3s directly surrounding Parramatta CBD.

STM outputs were used estimate future trends in the spatial distribution of trips to the Parramatta CBD, as summarised in **Figure 2** for the 2016 and 2056 'High' scenario. While travel demand varies based on each scenario, there are a number of underlying themes which remain constant across all five scenarios in terms of spatial distribution:

- The proportion of trips originating from Parramatta CBD and its surrounding SA3s is expected to increase considerably due to the urban uplift of specific areas.
 - This includes the Parramatta, Merrylands – Guildford, Carlingford and Auburn SA3s.
- This is forecast to occur at the expense of longer trips as workers move closer to their work place.
- Although less significant, more workers are expected to commute from the west than other directions relative to Parramatta CBD.

¹ Statistical Area Level 3: an area designed to provide a regional breakdown of Sydney / Australia, usually with a population of 30,000 to 130,000 people

Figure 2. Travel demand for trips to Parramatta (2016 and 2056 'High' two hour AM peak)



Source: AECOM adapted from TPA, 2016

2.3 Trip destinations

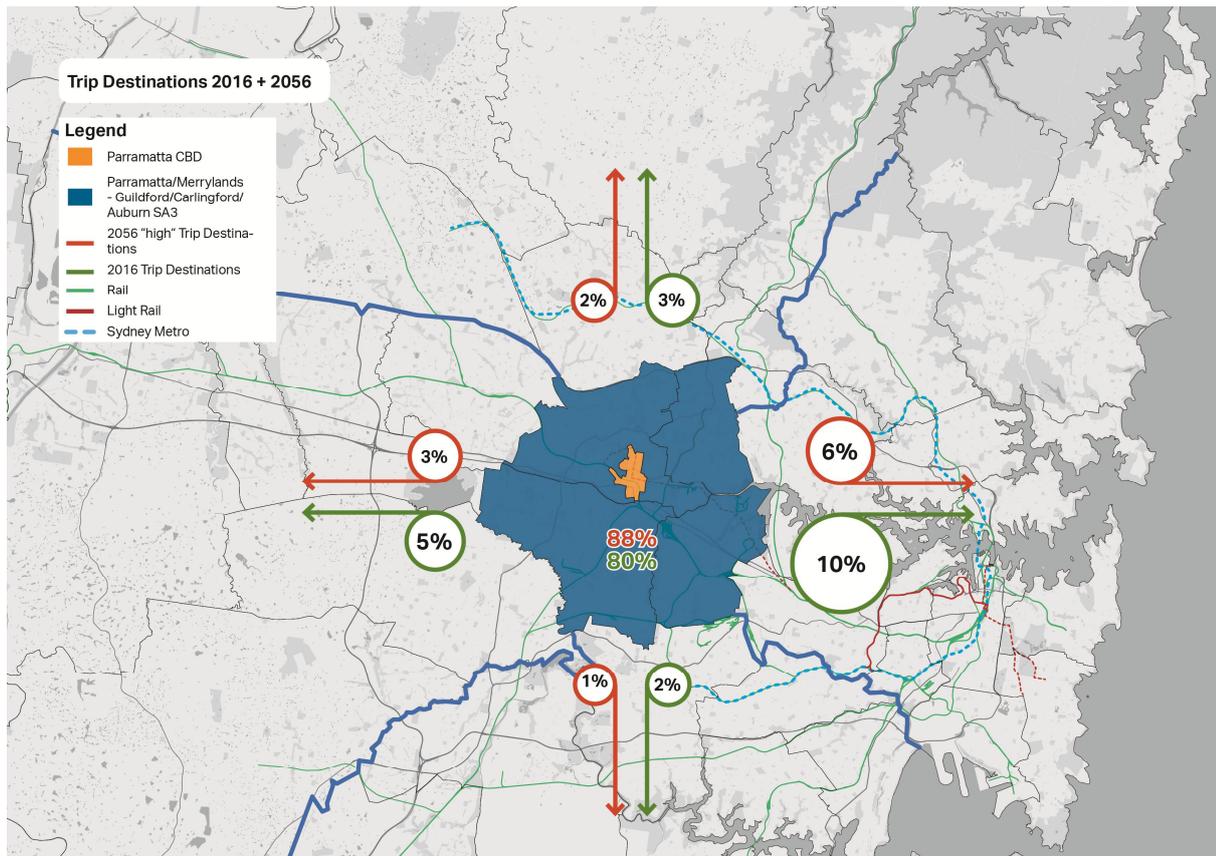
According to JTW data there are approximately 8,200 employed residents living in the Parramatta CBD; this is equivalent to less than 20 per cent of JTW trip destinations to the CBD. The majority of work in Sydney's major employment centres which include, Parramatta CBD (Parramatta SA3), Sydney CBD (Sydney Inner City SA3), Macquarie Park (Ryde – Hunters Hill SA3) and Sydney Olympic Park (Auburn SA3). The following key trends were observed for JTW trip destinations from the Parramatta CBD:

- The majority of trip destinations are to the Parramatta CBD itself and those SA3s directly surrounding.
- A bigger proportion of trips are made to the east, which is consistent with the location of the main employment centres such as Sydney CBD, Macquarie Park, North Sydney and Chatswood.

STM outputs further highlight the aforementioned trends. The estimated future travel demand for trip destinations are summarised in **Figure 3** below. Similarly to trip origins, trip destinations are forecast to mainly increase within Parramatta CBD and its surrounding suburbs. This could be due to the major expected commercial uplift strengthening Parramatta's position as Sydney's second CBD. The key trends expected are:

- Well over three quarters of trips originating in Parramatta CBD will have a destination in the CBD or in surrounding SA3s. This is likely to further increase compared to existing conditions due to the major uplift in employment and residential in the area.
- The proportion of trips to the east decrease by four per cent whilst the number of trips going north, south and west will remain low at less than three per cent.

Figure 3. Travel demand for trips from Parramatta CBD (2016 and 2056 'High' two hour AM peak)



Source: AECOM adapted from TPA, 2016

With the expected trends in travel demand to and from the Parramatta CBD it is expected that the average travel distance may decrease in the future as both employees and residents take advantage of the mixed commercial and residential uplift expected in the CBD and those areas directly surrounding it; this is further analysed in **Section 2.4**. It must be noted that the above figures indicate the directionality of trips on a percentage basis. This may not appropriately represent the relative growth in certain SA3s further away from Parramatta CBD; this is further discussed in **Section 2.5**.

2.4 Trip distances

2.4.1 Average trip distance

The total number of trips by mode to, from and within Parramatta SA3 was generated from STM outputs. This included total number of trips, vehicle kilometres travelled (VKT) and person kilometres travelled (PKT) for different modes namely car, car passenger, rail, bus, bike, walk and taxi. The existing average trip distance for all modes is presented in **Table 4** below. The Parramatta SA3 data was compared to existing data at the Local Government Area (LGA) level from the 2014/2015 Household Travel Survey (HTS).

Table 4. Existing weighted average trip distance

	Parramatta SA3	Parramatta LGA	Sydney LGA	North Sydney LGA
Source	STM	HTS	HTS	HTS
Average trip distance (km)	10.8	8.2	4.3	5.8

Source: AECOM adapted from TPA, 2016 and HTS, 2015

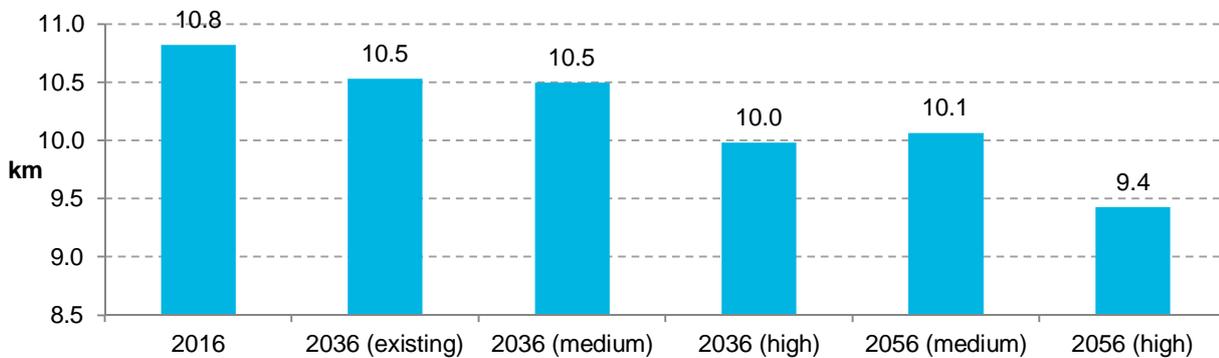
An average trip distance of 10.8 km was estimated for Parramatta SA3. This includes an average of:

- 14km for trips to Parramatta SA3
- 13.6km for trips from Parramatta SA3
- 2.3km for trips within Parramatta SA3.

The difference between Parramatta SA3 and Parramatta LGA may be due to discrepancies between STM and HTS data. HTS presents data for the average weekday while STM estimates data for the two hour AM peak. Both sources also cover different geographical locations, with Parramatta LGA extending further to the northeast (Telopea) and south (Granville). Nonetheless the data suggests that trip distances are significantly higher for Parramatta compared to other areas such as Sydney LGA (4.3km) and North Sydney LGA (5.8km). This is expected considering the relatively lower residential density of areas the workforce are coming from.

The forecasted average trip distance for all future scenarios is summarised in **Figure 4** below. STM outputs estimate that the average trip distance is expected to decrease 1.4km to 9.4km under the 2056 'High' scenario; this is equivalent to a 13 per cent reduction. This is primarily driven by both the increase in the number of trips, and the shorter trip distance for trips within Parramatta SA3. This suggests that employees are expected to live closer to their workplace following the urban development of areas within Parramatta SA3.

Figure 4. Weighted average trip distance for Parramatta SA3

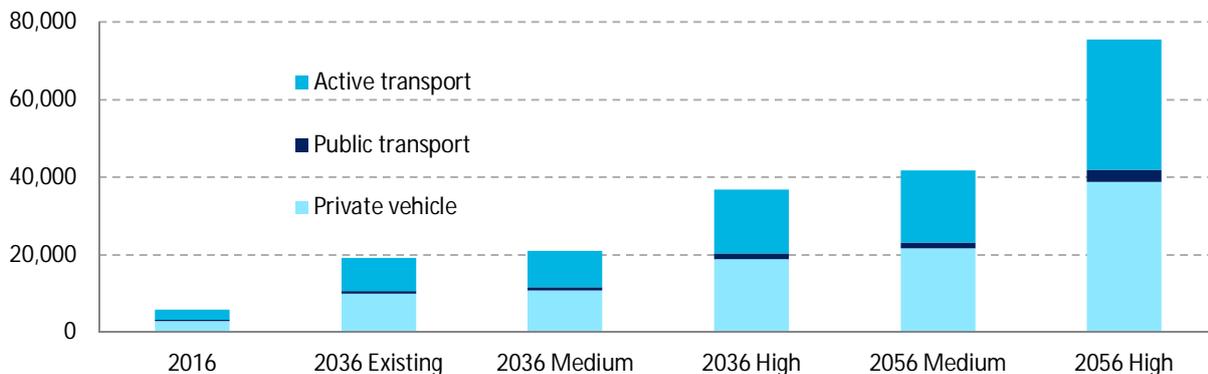


Source: TPA, 2016

2.4.2 Short distance trips

Short distance trips during the two hour AM peak were analysed to provide a basis for potential conversion to active transport. Parramatta SA3 spans a 3km radius from the Parramatta CBD and trips occurring within the SA3 zone average 3.2km. With an average cycle trip length of 9km it was deemed that the number of private vehicle and public transport trips occurring within Parramatta SA3 is suitable for potential conversion to active transport. **Figure 5** presents the estimated number of short distance trips (within Parramatta CBD) according to the three main modes namely private vehicle, public transport and active transport.

Figure 5. Estimated short distance trips and mode share (two hour AM peak)



Source: TPA, 2016

The key observations are:

- The number of short distance trips within the Parramatta CBD is expected to increase significantly
 - In fact short distance trips are expected to increase as a proportion of total trips; this creates a great opportunity for uplift in active transport.
- STM forecasts a significant portion of these are private vehicle, however it is considered public and active transport would take up a higher portion of these trips: and further that any traffic modelling underpinned by STM outputs should closely review these particular forecasts.

At the SA3 level more private vehicle and public transport trips are made compared to the Parramatta CBD. As expected with higher trip distances, active transport is less prominent at the SA3 level.

Trips within Parramatta CBD currently represent ten per cent of total AM peak trips generated by Parramatta CBD. This is forecast to increase to up to 33 per cent by 2056 due to the mixed residential and commercial land use uplift. Both the decrease in average trip distance and the increase in short distance trips create a huge opportunity for a potential shift in mode from private vehicle to active transport. This is further discussed in the travel mode analysis from **Section 2.5** below.

2.5 Travel mode

2.5.1 Trip origins

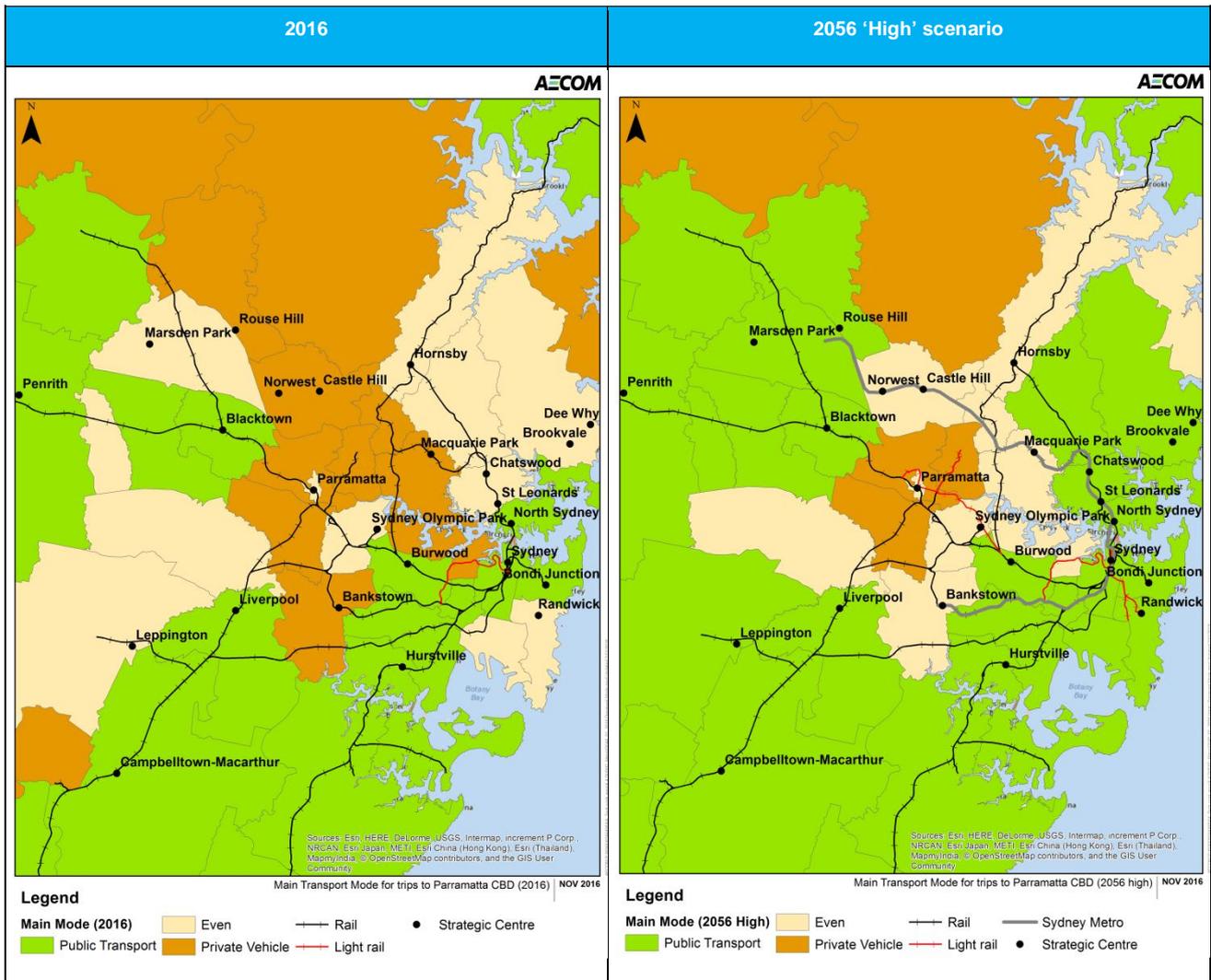
JTW data indicates that on a typical weekday approximately 56 per cent of trips to Parramatta are made by private vehicle. Public transport accounts for 37 per cent while active transport accounts for less than five per cent. Parramatta CBD has a significantly higher private vehicle mode share than Sydney CBD (16 per cent) and North Sydney (33 per cent). 75 and 57 per cent of employees commute to Sydney CBD and North Sydney via public transport, respectively. Approximately six per cent walk to work.

To gain a better understanding of travel modes patterns and future trends, the dominant travel mode for each SA3 was determined from STM outputs, as shown in **Figure 6**. A transport mode with a mode share greater or equal to 60 per cent for each SA3 was considered as dominant. SA3s with a more even mode split were represented in beige. This was the case for the Parramatta CBD with an overall even amount of active transport and private vehicle trips.

The main trends that can be observed with regards to travel modes for trips to Parramatta CBD are:

- Public transport is currently the main transport mode for trips from SA3s located along the rail line particularly in the east, south and west. However only a low proportion of trips to Parramatta CBD originate from these areas.
- Private vehicle is mainly used for SA3s without clear access to train services and those SA3s in the vicinity of the Parramatta CBD where the majority of trips originate from. It is believed that private vehicle offers time benefits along with additional convenience and potential cost benefits too considering the low parking rates in the CBD.
- In the 2056 'High' scenario, the majority of SA3s in the east, south and west will use public transport as their main transport mode.
- Private vehicle will remain the main transport mode for SA3s directly surrounding the Parramatta CBD including Parramatta SA3, Auburn SA3 and Merrylands-Guildford SA3. This implies that private vehicle will remain more attractive to commuters than public transport for those shorter distance trips. The number of trips originating from these SA3s is expected to be considerably higher than those SA3s further away.

Figure 6. Main transport mode for trips to the Parramatta CBD (two hour AM peak)



Source: AECOM adapted from TPA, 2016

2.5.2 Trip destinations

According to JTW data approximately 42 per cent of Parramatta CBD employed residents travel to work by private vehicle. More of them travel by public transport (45 per cent) while approximately 11 per cent walk. Similarly to trip origins the use of private vehicle is less prominent in the Sydney CBD (12 per cent) with over half (55 per cent) of employed residents walking to work. North Sydney residents tend to use public transport similarly to the Parramatta CBD. However they have a smaller percentage of commuters travelling via private vehicle (28 per cent).

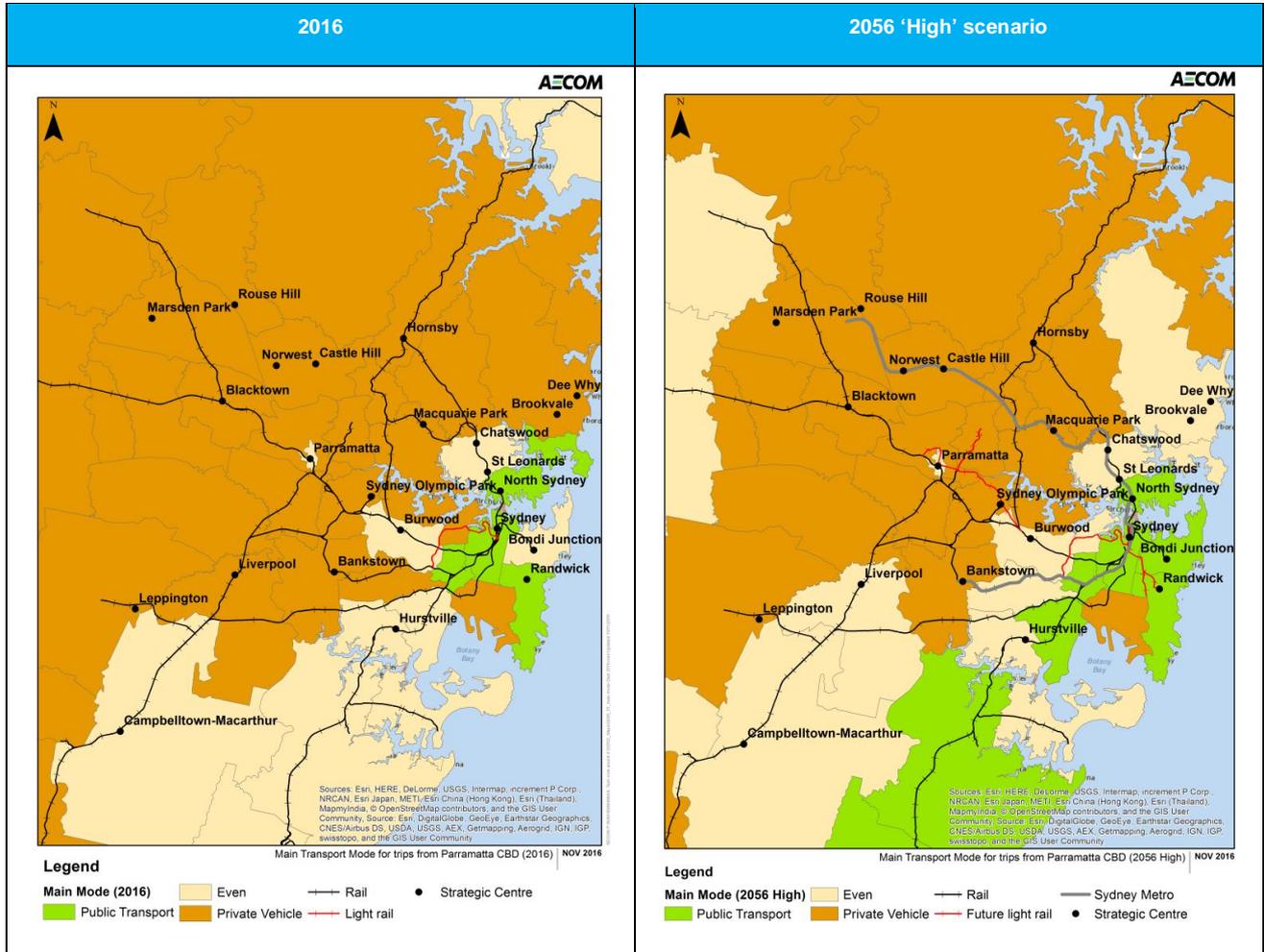
The forecast changes in mode share based on STM outputs are represented in **Figure 7**. Note that STM outputs for the 2016 'Existing' scenario do not accurately reflect existing conditions from JTW. This may be due to the relatively low number of outbound trips which may emphasize minor modelling inaccuracies. It was still however used for comparative purposes with other scenarios.

The key observations are:

- There is a strong dependence on cars for the majority of trips except for the Sydney CBD, the eastern suburbs and the south where commuters tend to prefer public transport. Private vehicle are forecast to remain the main transport mode for SA3s directly surrounding the Parramatta CBD.
- This highlights car ownership for Parramatta CBD residents and their car-dependence particularly for shorter distance trips as described in the previous section. Considering the relative residential growth expected for Parramatta CBD,

parking supply policies particularly for new developments should be thoroughly investigated. This could aid in reducing traffic within and around the Parramatta road network. More effective ways of commuting to the major employment centres such as Macquarie Park need to be considered. Active transport could be enhanced to link major employment centres. As an example, a draft principal bicycle network proposes a regional connection along the Carlingford Railway Line to Macquarie Park via Epping.

Figure 7. Main transport mode for trips from the Parramatta CBD (two hour AM peak)



Source: AECOM adapted from TPA, 2016

3. Traffic analysis

A link based Volume to Capacity Ratio (VCR) analysis has been undertaken at 16 key locations on the State road network, with a focus on key links / corridors converging on the Parramatta CBD. This includes eight locations on the CBD external cordon, five river crossings and three locations on the Western Sydney Regional Ring Road as shown in **Figure 8**.

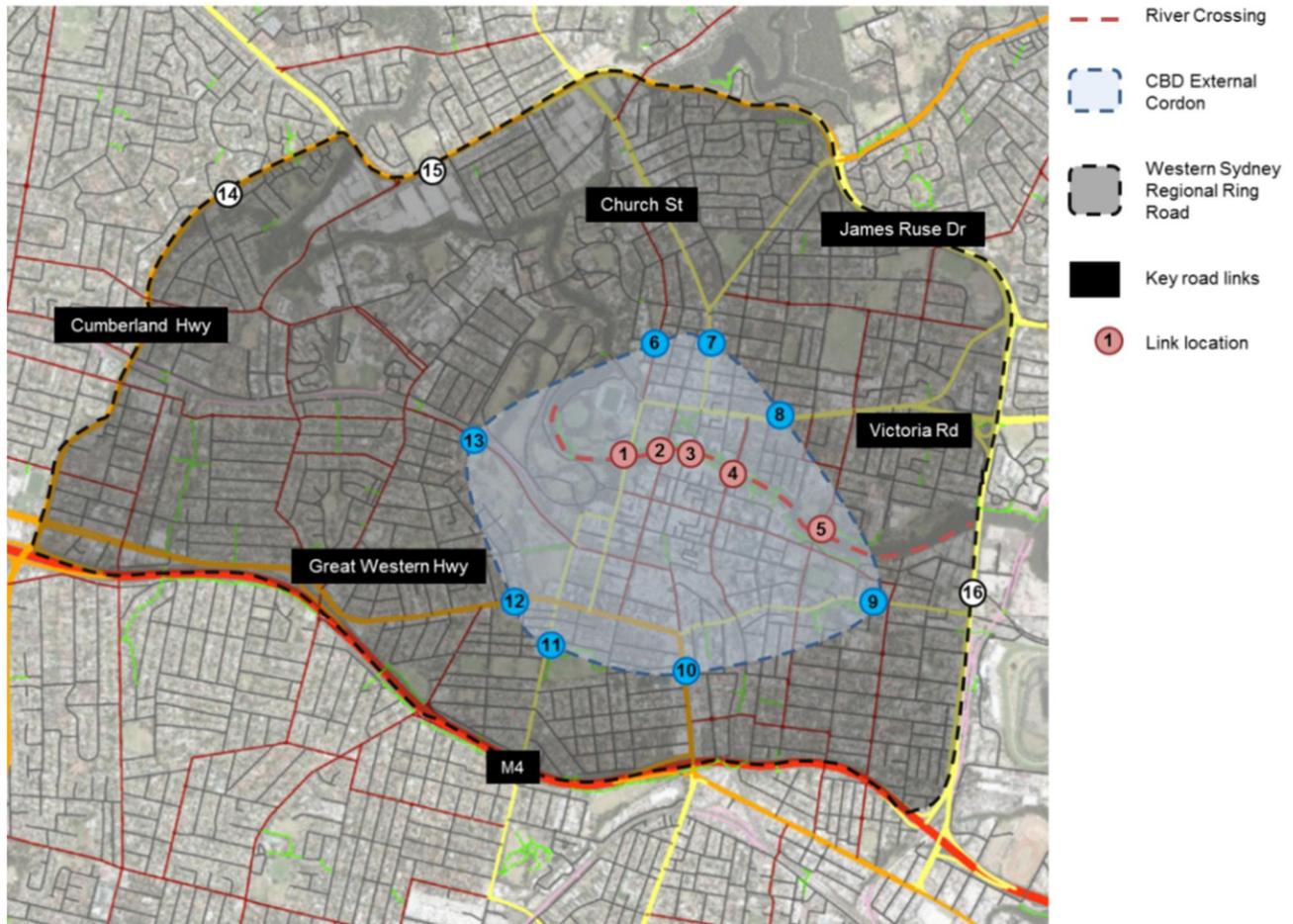
The locations have been selected based on a combination of availability of existing traffic data, cost sensitivity of the infrastructure and the appropriateness of STM application (as advised by Transport for NSW: not recommended for projecting growth within the CBD).

The analysis has been undertaken to make strategic level commentary on the likely performance of the road network in the future at key locations, with more detailed (AIMSUN) traffic modelling investigations currently in development. Notwithstanding the above, additional links can be analysed upon request where considered valuable to do so.

Table 5. List of key links

Site No.	Cordon	Road	Intersection / near
1	River Crossings	O'Connell St	Parramatta River
2		Marsden St	Parramatta River
3		Church St	Parramatta River
4		Wilde Ave	Parramatta River
5		Macarthur St	Parramatta River
6	CBD External Cordon	O'Connell St (1)	Fennell St
7		Church St (2)	Harold St
8		Victoria Road	Wilde Ave
9		Hassall St (3)	Alfred St
10		Great Western Hwy (4)	Rosehill St
11		Pitt St (5)	Glebe St
12		Great Western Hwy (4)	Good St
13	Park Parade (6)	Alexandra Ave	
14	Western Sydney Regional Ring Road	Cumberland Hwy	Mahoney Rd
15		Cumberland Hwy	Briens Rd
16		James Ruse Dr	Hassall St

Figure 8. Location of key links



A three step process was used to determine both existing and future VCR-based LoS under each demand scenario:

- 1. Estimate link volumes** – AM peak hour flows were determined based on traffic counts made available by Transport for NSW. Future link demand was estimated based on difference plots output from STM for each future year scenario. An hourly conversion factor of 1.9 and a PCU factor of 2.5 for HVs were assumed.
- 2. Estimate link capacity** – Based on Austroads Guidelines, validated by site observations and travel speed data.
- 3. Determine VCR-based LoS** – Based on ranges for interrupted roadway facilities defined in the *Highway Capacity Manual* (2010), as shown in **Table 6**.

Table 6: LoS based on VCR and travel speeds

LOS	A	B	C	D	E	F
≤ 60 km/h	≤ 0.24	≤ 0.38	≤ 0.54	≤ 0.77	≤ 1	> 1
= 70 km/h	≤ 0.26	≤ 0.41	≤ 0.59	≤ 0.81	≤ 1	> 1
= 80 km/h	≤ 0.28	≤ 0.44	≤ 0.64	≤ 0.85	≤ 1	> 1

Figure 9 provides a summary of the existing and forecast LoS at the aforementioned key locations.

Figure 9. AM peak VCR analysis results







VCR analysis of the M4 Motorway presented in the *M4 Widening EIS* indicates that the M4 Motorway would generally perform within capacity in the local vicinity to 2031 with all three stages of WestConnex delivered. The exception being between Church Street and Burnett Street interchanges, through which STM outputs indicate the Planning Proposal will have minimal impact: circa 60 vehicles per hour (vph) difference between 2036 'Existing' versus 'High' growth scenarios.

Links were identified to reach their theoretical capacity in the progressively increasing future network scenarios labelled as follows:

- 2036 "existing" scenario
 - James Ruse Drive inbound:
 - Cumberland Highway eastbound
- 2036 "medium" scenario
 - Macarthur Street inbound
 - Church Street (near Harold Street) inbound
 - Great Western Highway (near Good Street) inbound
 - Park Parade (near Alexandra Avenue) inbound
- 2056 "medium" scenario
 - Victoria Road inbound
- 2056 "high" scenario
 - Marsden Street inbound
 - Wilde Avenue inbound
 - Cumberland Highway westbound

As observed, if current car-dependency trends are not significantly curbed by the long term (2056), it is expected that the majority of links will reach capacity in peak periods (in the peak direction), resulting in significant congestion across the trunk road network both within and in general proximity to the Parramatta CBD.

With the expected increase in private vehicle trips into Parramatta CBD, future initiatives should focus on reducing private vehicle mode share particularly within Parramatta and adjacent SA3s. Notwithstanding this focus, there will likely be a need for targeted investment in and maximising the efficiency of, the trunk road network at select locations to address short and medium term needs during the transitional period, whilst also reviewing the allocation of and availability of road space to address the needs of all road-based modes. The identification, form and timing of these works should form the focus of more detailed modelling investigations, taking into the consideration the broader transport objectives of the CBD.

A high level analysis suggested that similar road capacity issues may arise during the PM peak despite a wider demand spread. Key links directly within Parramatta CBD, but also the major road links connecting to the west and south are likely to reach capacity as soon as 2036, particularly along the Great Western Highway. Also as the AM peak conditions are mostly constrained by inbound links on approach to the CBD, it is likely that key impacted links in the PM peak will be those allowing vehicles to exit the CBD.

4. Public transport analysis

The public transport network supporting the current CBD plays a key role in fulfilling the transport need of local employees, accommodating 37 per cent of the JTW task. This role is forecast to increase with the proposed implementation of Light Rail through the CBD in the future as well as planned improvements to the bus network and potentially significant enhancements to rail infrastructure for western Sydney.

Following is a discussion of the current role, constraints and opportunities of each public transport mode, as well as planned, proposed or potential upgrades and improvements for the future.

4.1 Rail

4.1.1 Existing conditions

Rail forms the spine of the public transport network in Sydney, and this is no different in the west. Train currently accommodates 28 per cent of JTW trips by Parramatta CBD employees and 37 per cent of JTW trips by local residents. Parramatta CBD is currently serviced by the Parramatta Station, the fourth busiest train station in Sydney with almost 70,000 customer movements on a typical weekday. The station is serviced by trains on the T1 Western line, T5 Cumberland line and the Blue Mountains line, as shown in **Figure 10**.

The demand and capacity of current rail services through the Parramatta CBD have been estimated based on information made available by Transport for NSW and are summarised in **Table 7**. Analysis of the AM peak hour data indicates:

- The T1 Western Line express and limited stop services are well utilised though narrowly within nominal capacity, whilst the all stops services have a relatively low utilisation. Critical sections of the line appear to be on approach to the Parramatta Station in the west but even more so on approach to the Sydney CBD at Redfern to the east.
- The T5 Cumberland Line experiences heavy loadings on approach to the Parramatta CBD from the south with seating capacity reached.
- The Blue Mountains Line has very low utilisation through Parramatta Station with the critical section being to the west at Penrith.

The data suggests that demand is approaching nominal capacity on critical T1 Western Line and Cumberland Line services, inferring a likely need to invest in additional rail capacity in the near future.

Figure 10. Rail network including 2013 AM peak hour services



Source: Transport for NSW, 2016

Table 7. Current AM peak hour passenger demand and capacity at Parramatta (AM peak hour)

Service	No. trains	Seating capacity (pph)	Nominal capacity (pph)	Demand (pph)	% Nominal capacity
Western express	4	3,520	4,720	4,120	87%
Western Limited Stops	8	7,050	9,450	8,830	93%
Western All Stops	4	3,470	4,670	2,160	46%
T1 Western Total^	16	14,040	18,840	15,110	80%
Cumberland All Stops	2	1,750	2,350	2,205	94%
T5 Cumberland Total	2	1,750	2,350	2,205	94%
Blue Mountains Limited Stops	2	1,660	2,260	1,330	59%
Blue Mountains All Stops	2	1,660	2,260	1,380	61%
Blue Mountains Total	4	3,320	4,520	2,710	60%

Source: AECOM based on information made available by Transport for NSW, 2015

4.1.2 Future scenario

Table 8 highlights the forecast demand for each service during the AM peak hour for each of the five future scenarios, based on STM outputs. The estimated growth under existing conditions would see the T1 Western Line exceed its maximum capacity by 32 and 42 per cent in its express and limited stops services by 2036, respectively. Both services could also operate at double capacity by 2056. The T5 Cumberland Line would operate over capacity while the Blue Mountains Line is expected to also exceed capacity by 2056.

Table 8. Forecast future rail demand during the AM peak hour

Service	% of nominal capacity				
	2036 Existing	2036 Medium	2036 High	2056 Medium	2056 High
Western express	132%	133%	144%	171%	189%
Western Limited Stops	142%	143%	155%	184%	204%
Western All Stops	70%	70%	76%	90%	100%
T1 Western Total	122%	122%	133%	158%	175%
Cumberland All Stops	122%	123%	122%	141%	142%
T5 Cumberland Total	122%	123%	122%	141%	142%
Blue Mountains Limited Stops	89%	90%	97%	116%	128%
Blue Mountains All Stops	93%	93%	101%	120%	133%
Blue Mountains Total	91%	91%	99%	118%	130%

Source: AECOM based on information made available by Transport for NSW, 2015 and TPA, 2016

Based on these estimates, the additional passenger capacity required through Parramatta Station in the long term would be equivalent to the following number of services (based on the 2056 'High' growth scenario):

- 12 additional services on the T1 Western Line;
- 2 additional services on the Blue Mountains Line; and
- 1 additional service on the T5 Cumberland Line.

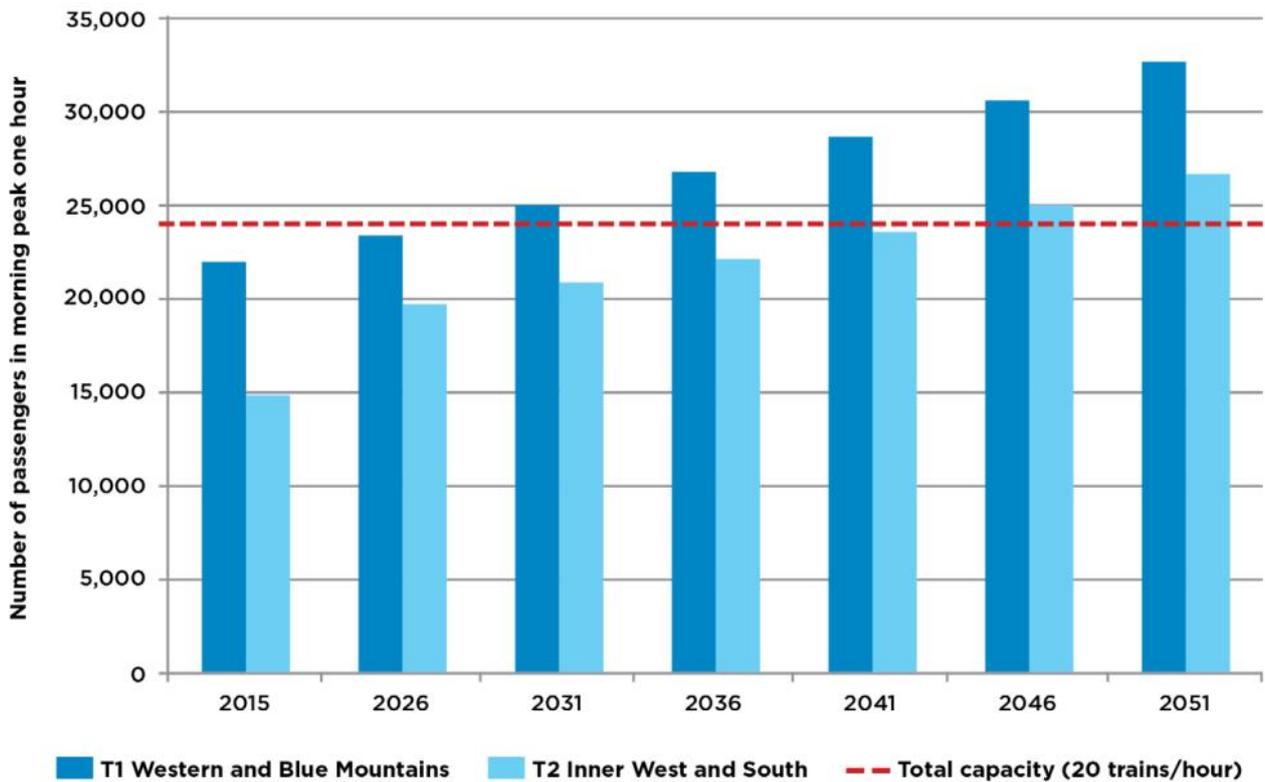
Note that existing constraints at Parramatta Station would make it impossible to accommodate the estimated number of train passengers and train services; this is further highlighted in **Section 4.1.3**.

Whilst current investment commitment in rail is focussed on the delivery of Metro services to the northwest, Sydney CBD and southwest, the Australian and NSW governments are also undertaking a scoping study to better understand the need, timing and service options for rail investment to support Western Sydney. Early outcomes of the study were published in the *Western Sydney Rail Needs Scoping Study Discussion Paper* in September 2016. Key outcomes and messages from the preliminary works are discussed as follows.

In order to address short term needs along the T1 Western Line, the NSW Government is undertaking signalling and track upgrade works to increase capacity and improved journey times and reliability. However, preliminary findings of the study confirm higher order solutions are required to address longer term needs.

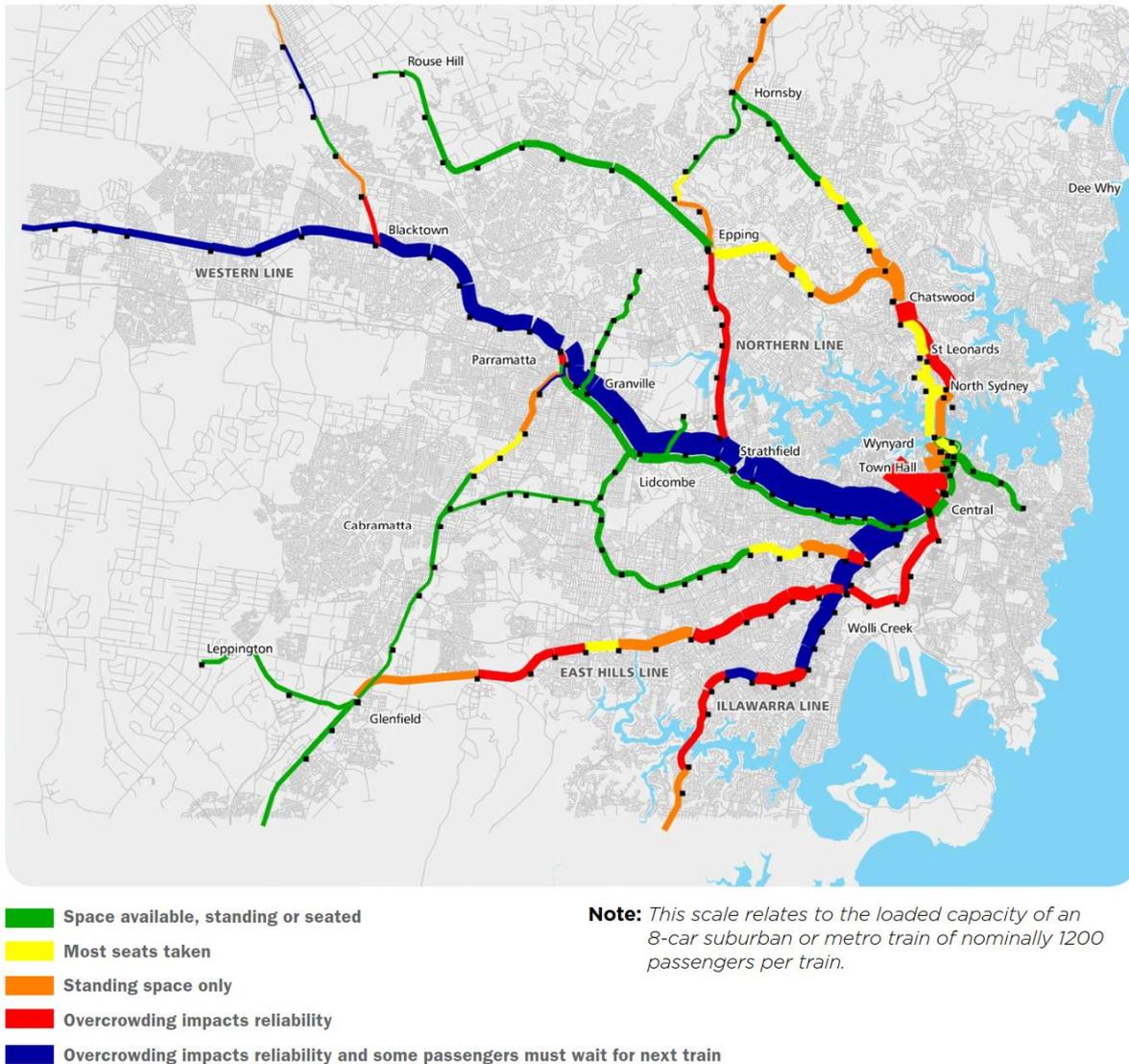
Patronage demand forecasting undertaken to inform the current study is illustrated in **Figure 11** which highlights that by approximately 2031, the T1 Western Line will exceed the capacity of 20 trains an hour. **Figure 12** further demonstrates that the significant majority of the T1 Western Line is forecast to be overcrowded in the longer term (i.e. by 2051). The figure also highlights the forecast continued relative under-utilisation of the T5 Cumberland Line to the south.

Figure 11. Forecast AM peak hour passenger loads on the T1 and T2 lines



Source: Western Sydney Rail Needs Scoping Study: Discussion Paper, Transport for NSW, 2016

Figure 12. Forecast (2051) Sydney train network crowding levels



Source: Western Sydney Rail Needs Scoping Study: Discussion Paper, Transport for NSW, 2016

Without increased rail capacity and services to address long term needs, it is considered that:

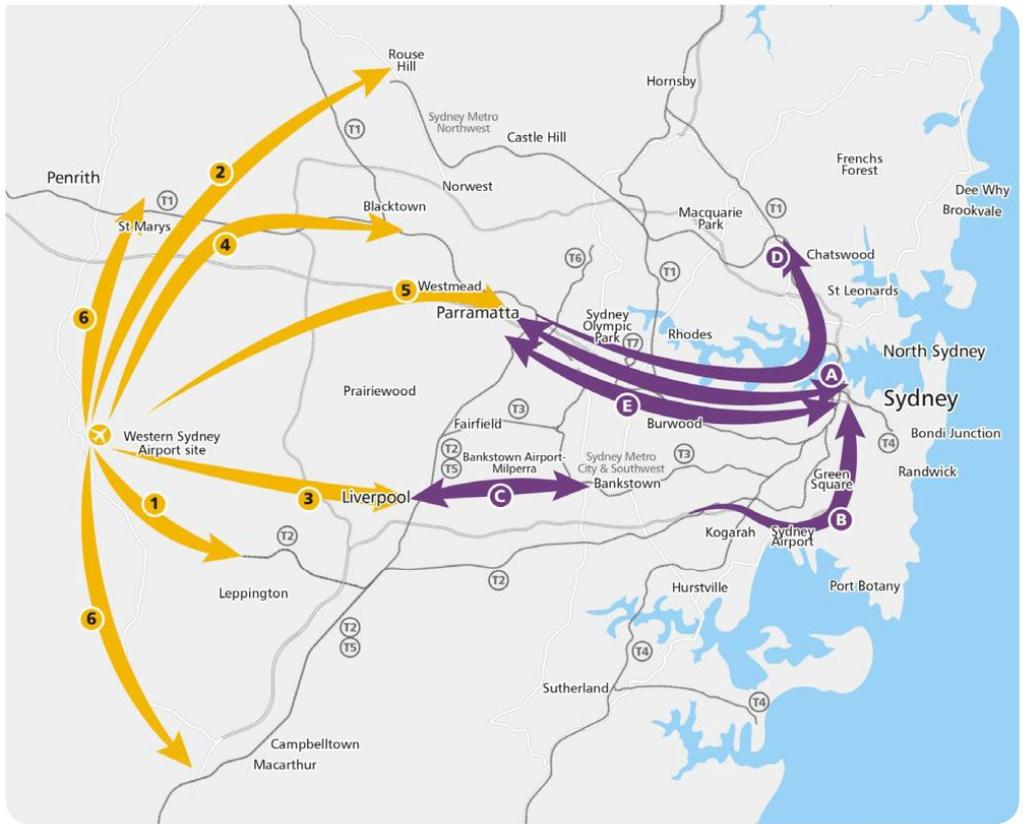
- Rail customers may shift to other car-dependent modes of transport, which would impact on other road users and potentially enhance congestion on the local and State road network
- This includes those accessing the Parramatta CBD: reduced rail accessibility and increased car dependency and congestion could lead to decreased urban amenity and land devaluation in the CBD.

An initial set of eleven options to address long term needs have been identified as part of preliminary investigations, four of which pass through Parramatta (**Figure 13**):

- Increase capacity of existing network (D)
- New western Metro-style service (A)
- New higher speed tunnel from Parramatta to Sydney CBD (E)
- Direct express rail service: WSA to Parramatta CBD (and Sydney CBD)(5)

It is understood that there is currently no funding for potential rail network upgrades to the corridor: consideration and assessment of funding mechanisms will form part of the finalisation of the study.

Figure 13. Western Sydney rail options



- | | | |
|--|---|---|
| <ul style="list-style-type: none"> 1 WSA to the South West Rail Link 2 WSA to Sydney Metro Northwest 3 WSA to Liverpool 4 WSA to the T1 Western Line via St Marys 5 Direct rail express service: WSA to Parramatta 6 A north-south link: Macarthur-WSA-St Marys-Schofields | <ul style="list-style-type: none"> A New western metro-style service B Converting the T2 Airport Line between Revesby and Sydney CBD to a separate metro-style service C Extending the Sydney Metro City & Southwest D Increase capacity of existing network E New higher speed tunnel linking Parramatta and the Sydney CBD | <ul style="list-style-type: none"> T1 North Shore, Northern and Western Line T2 Airport, Inner West and South Line T3 Bankstown Line T4 Eastern Suburbs and Illawarra Line T5 Cumberland Line T6 Carlingford Line T7 Olympic Park Line |
|--|---|---|
- ✘ Western Sydney Airport (WSA) site

Source: Western Sydney Rail Needs Scoping Study: Discussion Paper, Transport for NSW, 2016

In parallel with the WSRNSS, the NSW Government has announced Sydney Metro West, which is in line with Option 'A' above: a new Metro-style service, to be provided mostly underground and to be delivered in the late 2020's. The announcement includes proposed stations at Parramatta as well as Sydney Olympic Park and the Bays Precinct. The proposal will provide improved connections between Sydney's dual CBD's, as well as other key precincts including Sydney Olympic Park and the Bays.

Figure 14. Western Sydney rail options



Source: Transport for NSW, 2016

4.1.3 Parramatta Station

Forecast additional passenger loads that can be expected from the five different scenarios in 2036 and 2056 were analysed to better understand the likely impacts on Parramatta Interchange. The expected number of entries and exits at Parramatta Station during the AM peak hour are presented in **Table 10** below. The forecast suggests that:

- Station exits could increase by up to 90 per cent by 2036 and by up to 175 per cent by 2056. This would be equivalent to approximately 17,300 and 25,000 exits by 2036 and 2056 respectively. This would surpass existing station exits at Town Hall, estimated to be around 23,300 during the AM peak according to BTS (2014). A comparison is provided in **Table 9** below.
- Station entries could almost double and quadruple by 2036 and 2056 respectively.

Table 9. Comparison of station entries and exits

Scenario	Wynyard	Town Hall	Central	Parramatta		
	2014	2014	2014	2016	2036 “medium”	2056 “high”
Entries	2,500	3,400	5,600	3,100	7,000	15,100
Exits	21,400	23,300	22,700	9,100	17,300	25,000
Total	23,900	26,700	28,300	12,200	24,300	40,100

Source: AECOM adapted from TPA, 2016 and BTS (2014).

Table 10. STM Forecast Parramatta Station entries and exits for the AM peak hour

Scenario	2016	2036 Existing	2036 Medium	2036 High	2056 Medium	2056 High
Entries	3,100	6,800	7,000	9,600	10,500	15,100
Exits	9,100	16,900	17,300	17,200	24,100	25,000
Total	12,200	23,700	24,300	26,800	34,600	40,100

Source: AECOM adapted from TPA, 2016

As previously identified, the analysis excludes potential impacts of Sydney Metro West, or other potential rail projects or potential effects of future travel demand management measures – each may affect the interchange functionality at Parramatta Interchange and also proportion of the CBD travel task facilitated by rail. The analysis highlights the need for significant enhancements to existing station capacity (or alternatively planning for a second rail station) in cooperation with potential new rail corridors.

4.2 Light rail

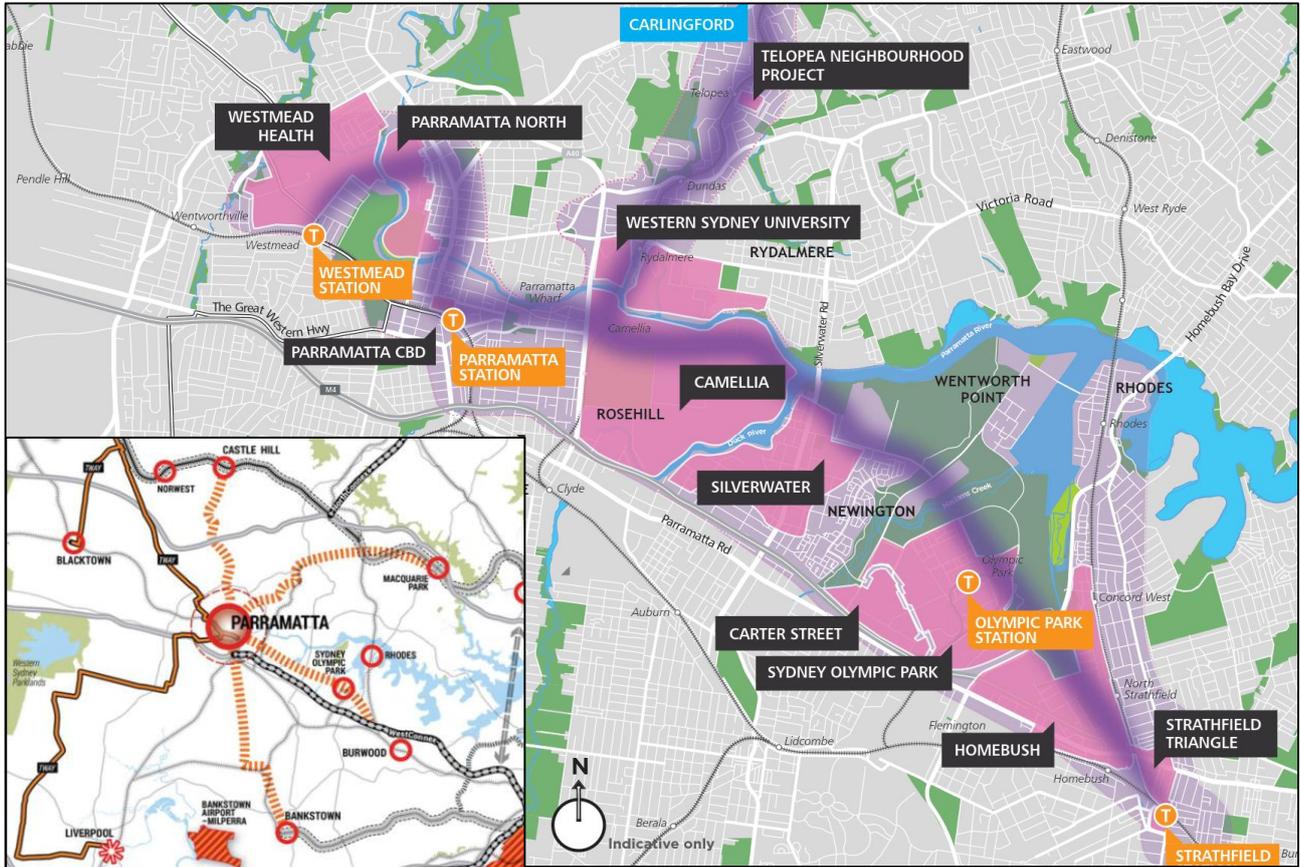
Light rail services do not currently exist in the Parramatta CBD; however delivery of light rail infrastructure and services is currently in planning stages. Following Council-led feasibility investigations, the NSW Government identified four preferred light rail corridors radiating from the Parramatta CBD (see inset **Figure 15**) followed by an announcement in late 2015 with plans for a 22 kilometre light rail network centred on the Parramatta CBD. The light rail network, shown in **Figure 15**, will improve public transport connections to major employment hubs (Parramatta CBD, Westmead, Sydney Olympic Park and Rydalmere), urban renewal projects (Parramatta North, Greater Parramatta to Olympic Peninsular) and other major trip generators (ANZ Stadium, Allphones Arena, Sydney Showground, Western Sydney Stadium, Western Sydney University and Rosehill Racecourse). The construction of the light rail aligns with the future transport demand which reveal an increase for short trips. Construction is programmed to commence in late 2018, subject to business case development and planning approval.

Upon review of patronage forecasts output from STM, and based on feedback from Transport for NSW, the forecasts provided were not in line with those currently informing design development and planning for the light rail service (which are confidential). Hence detailed analysis of future demand for light rail has not been considered valuable based on the information available, and has not been undertaken as part of this study.

It has been recommended that Council work with NSW Government to ensure that forecast growth within the Parramatta CBD is appropriately accounted for in the planning and delivery of the Light Rail network.

Commentary on the suitability of bus in fulfilling the future transport needs on other radial corridors from the CBD is provided in the bus section following.

Figure 15. Proposed Parramatta Light Rail network



Source: Transport for NSW, 2016

4.3 Bus

4.3.1 Existing conditions

Buses play a key role in the Parramatta CBD, whilst the majority of JTW trips are made by car and rail the bus network plays a key role in providing transit accessibility to the CBD and to rail via the Parramatta Interchange. Buses are required to cover an extensive geographic catchment. Almost 3,600 employees (9%) commute by bus to work in the Parramatta CBD and 600 residents (8%) commute by bus from the Parramatta CBD.

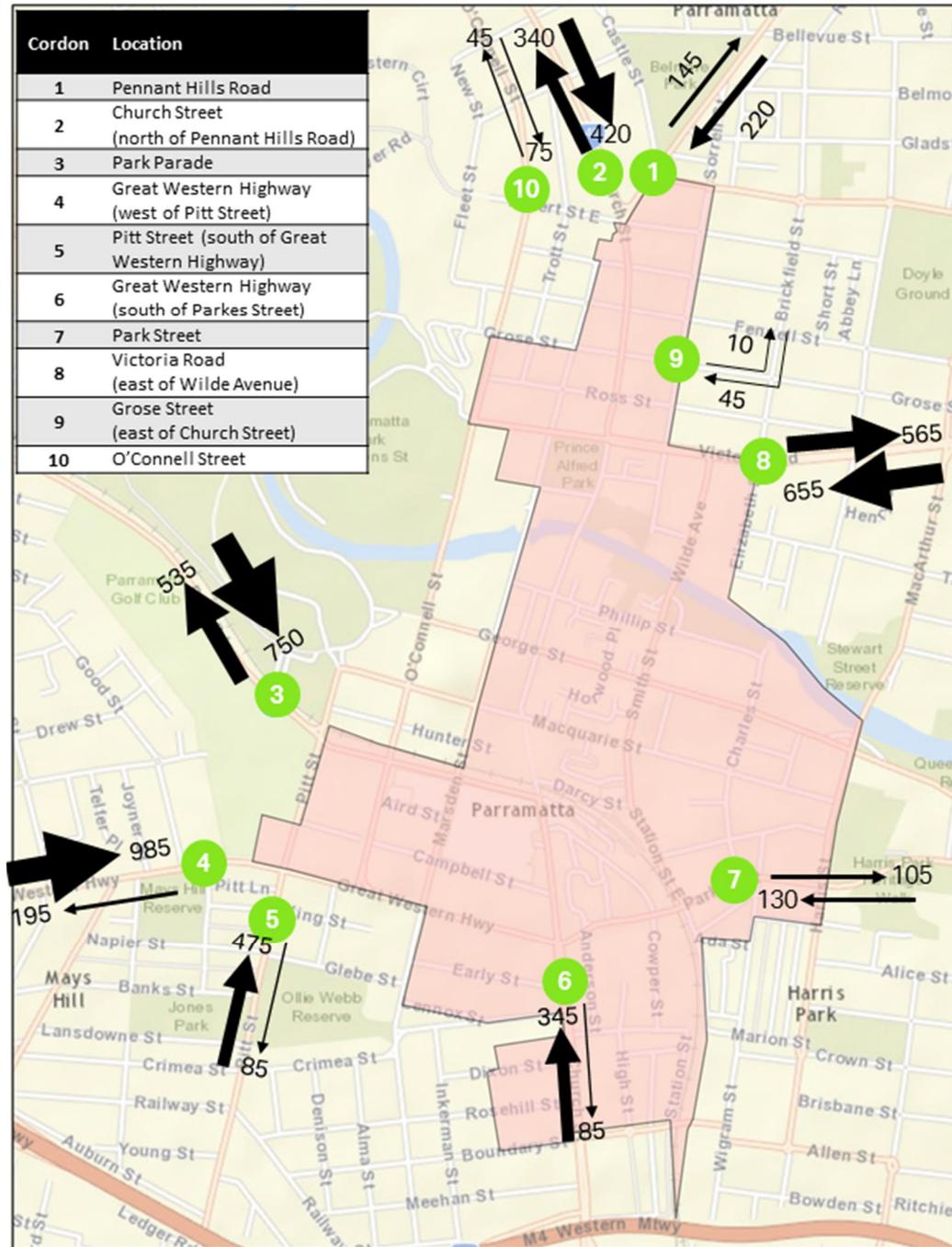
Four different operators provide a total of over 50 bus services in the Parramatta CBD; Sydney Buses, Hillsbus, Transdev and TransitSystems. Transport for NSW also operates a free shuttle (route number 900) around the CBD. The majority of the bus routes terminate at the Parramatta Interchange. The busiest bus corridors include Argyle Street, Smith Street-Wilde Avenue, Victoria Road and Church Street.

Bus demand was determined from bus loading surveys conducted by Skyhigh in May 2014. Ten bus cordons were identified around the Parramatta CBD and are graphically presented in **Figure 16** below. The observed volumes suggest that the highest loads are generally to the west of the Parramatta CBD. This is consistent with JTW data and STM outputs.

In the morning peak hour the four busiest cordons (2, 3, 4 and 8) account for more than 75% of all inbound and outbound bus trips. This underlines the strategic importance of Park Parade, the Great Western Highway, Victoria Road and Church Street in terms of providing bus access to the CBD, as well as the key streets that connect Parramatta Interchange to these corridors including Wilde Avenue, Smith Street, Station Street and Argyle Street. The four key

cordons are located on corridors containing bus priority lanes with two cordons (2 and 4) operating along transit-ways (T-Ways); this highlights the importance of dedicated infrastructure for public transport. These levels of demand show that heavier modes may have to be considered, such as Bus Rapid Transit (BRT) or even Light Rail Transit (LRT).

Figure 16. Existing AM peak hour bus demand at key cordon locations



Source: AECOM, adapted from Skyhigh (2014)

At Parramatta Interchange, where a majority of Parramatta CBD buses converge to provide approximately 250 bus services in each the AM and PM peak hours, the following operational observations were made during peak periods:

- Key layover storage areas at Argyle Street and Station Street were at or near capacity
- Passenger waiting areas can become crowded
- Bus queues can accumulate on occasion as clusters of buses arrive at / depart the interchange simultaneously

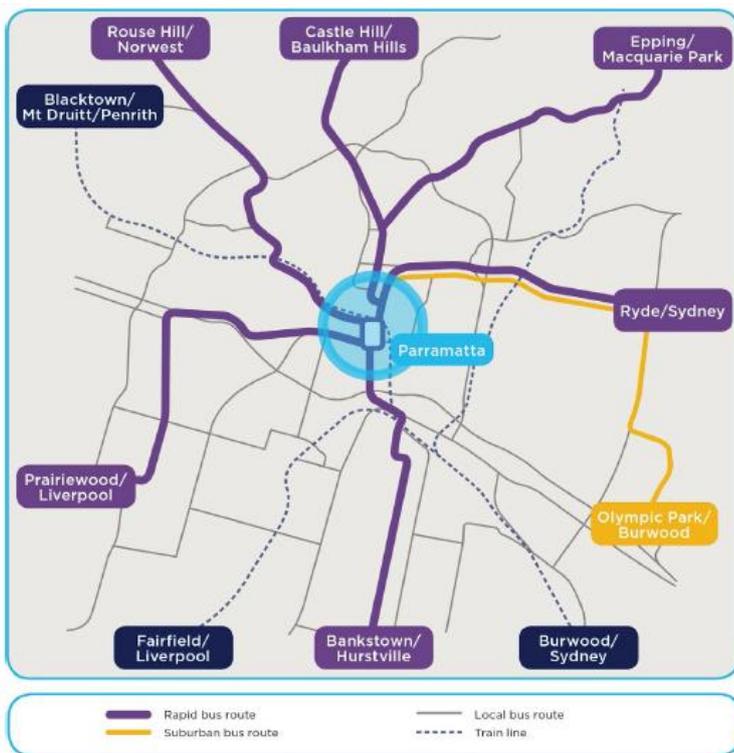
The observations suggest a lack of capacity to support higher order growth in bus patronage operations without spatial / operational optimisation and / or investment in supporting bus infrastructure.

4.3.2 Future scenario

In 2013, the NSW Government released *Sydney's Bus Future*, a long term plan to redesign the bus network to meet customer needs. The document identifies the city's most important bus routes, as the focus for investment in bus priority and more frequent services. The routes that pass through the Parramatta CBD include those listed below and illustrated in **Figure 17**.

- **Rapid** routes:
 - Castle Hill–Liverpool via Parramatta (M60 and T80 routes)
 - Parramatta–CBD via Ryde (M52 route)
 - Parramatta–Macquarie Park via Carlingford and Epping (M54 route)
 - Rouse Hill–Hurstville via T-way, Parramatta and Bankstown (M91 and T65 / T66 routes)
- **Suburban** routes:
 - Parramatta – Burwood via Newington (current 525 route)

Figure 17. Rapid and suburban bus routes planned around the Parramatta CBD



Source: Sydney's Bus Future, 2013

The Bus Priority Infrastructure Program supports *Sydney's Bus Future* by delivering projects that make bus services faster and more reliable. Whilst currently identified projects are not of direct relevance to the Parramatta CBD, it is understood that changes to bus routes that service the Parramatta CBD may be required as a result of:

- The need for additional services along future light rail corridors shortlisted by Transport for NSW, in order to accommodate a transition between the two modes.
- Intensified growth in travel demand resulting from development uplift in urban renewal areas / precincts. Current large-scale strategies / plans in the area include:
 - Greater Parramatta to Olympic Peninsula
 - Parramatta North Urban Transformation
 - Parramatta Road Urban Transformation Strategy

Growth in bus patronage demand at each cordon has been extracted from STM for each land use scenario and summarised in **Table 11**. Note the following demands are considered to be conservatively low, given they do not account for the anticipated level of future mode shift from private vehicle to public transport.

Table 11. Estimated inbound bus demand at each cordon (AM peak hour: 7:45AM to 8:45AM)

Cordon	2014	2036			2056	
		Existing Controls	Medium	High	Medium	High
1	220	490	500	510	840	900
2	420	900	920	920	1410	1470
3	750	1910	1940	1960	2900	3070
4	985	2200	2230	2220	3650	3760
5	475	640	650	650	870	890
6	345	800	820	840	1330	1450
7	130	730	740	750	1100	1180
8	655	1180	1210	1210	2020	2130
9	45	100	110	120	210	260
10	75	75	75	75	75	75
Total	4,100	9,025	9,195	9,255	14,405	15,185

Source: AECOM adapted from Transport for NSW, 2016

On average, bus patronage at the ten cordons is expected to double up to 2036 and quadruple up to 2056. On the busiest cordon, this could be equivalent to demand for an additional 45 services by 2036 or 75 by 2056. At this scale, increasing the number of standard bus services may not be plausible to effectively meet future levels of demand on major bus corridors.

For efficient operation, bus service intervals should not be lower than the duration of traffic light phase cycles; this is to avoid bus queuing at intersections and bus stops particularly on roads without priority infrastructure. It is suggested that bus intervals should not be lower than two to three minutes. The existing and estimated future number of buses per hour and bus interval times are summarised in **Table 12**. The bus frequencies assume services will increase in response to demand with an increased number of standard buses, as nominal capacity of services at each cordon is reached.

Table 12. Existing and future estimated (AM peak hour) bus cordon inbound demand

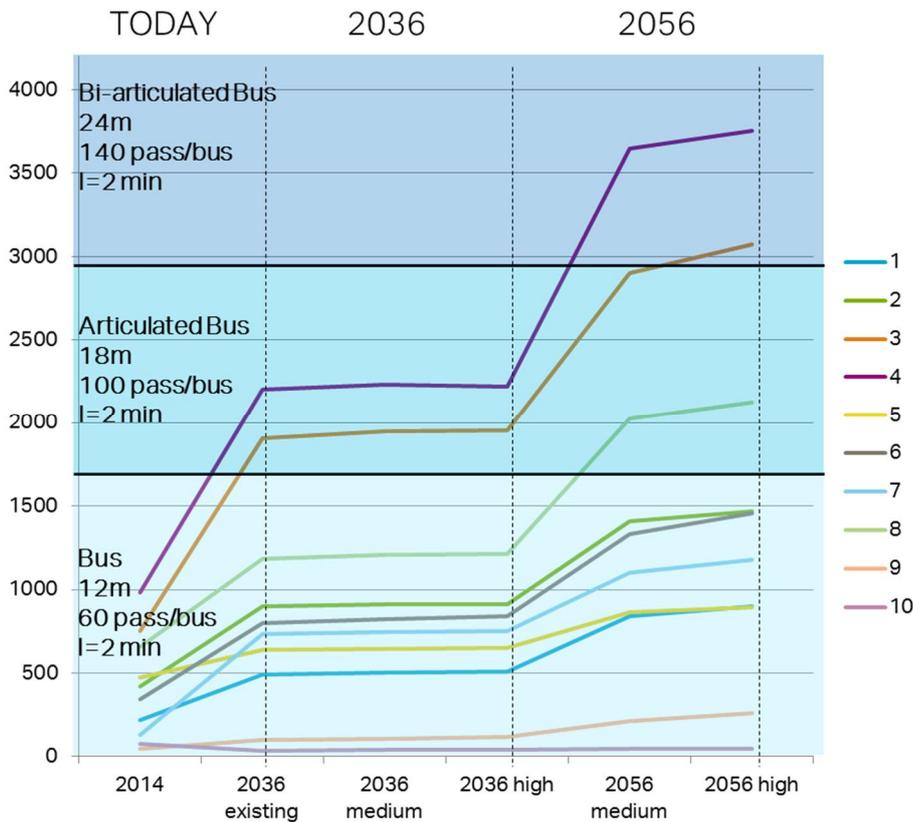
Scenario Cordon	Existing			2036 'High'			2056 'High'		
	Existing demand	Buses / hr	Interval (min)	Estimated demand	Buses / hr	Theoretical interval	Estimated demand	Buses / hr	Theoretical interval
1	220	7	8.6	510	8	7.1	900	15	4
2	420	14	4.3	910	15	3.9	1470	24	2.5
3	750	33	1.8	1960	33	1.8	3070	51	1.2
4	985	20	3	2220	37	1.6	3760	63	1
5	475	13	4.6	650	13	4.6	890	15	4
6	345	12	5	840	14	4.3	1450	24	2.5
7	130	12	5	750	13	4.8	1180	20	3.1
8	655	23	2.6	1210	23	2.6	2130	35	1.7
9	45	2	30	120	2	30.1	260	4	14
10	75	2	30	75	2	30	75	2	30
Total	4,100	138		9,255	160		15,185	253	

Source: Skyhigh (2014) and AECOM adapted from Transport for NSW (2016)

Currently, the number of bus services varies from two to 33 buses per hour. A total of seven corridors have interval times of less than 5 minutes; two of which already lower or equal to three minutes. With the estimated growth in bus patronage, theoretical interval times could go as low as one minute in 2056, with six bus cordon locations exceeding the minimum recommended interval time of three minutes between two buses. In addition to the service frequency requirements, consideration needs to be given to the operational requirements of supporting the increases in bus numbers, particularly through the CBD road network and at the Parramatta Interchange where the services converge. With the forecast level of demand on certain corridors, it is recommended to consider higher order transit services.

Figure 18 provides an overview of the potential requirements of regular buses, articulated buses and bi-articulated buses in accommodating the estimated level of demand at each of the ten cordons, assuming typical two minute minimum headway. Note that the range values for each bus type are maxima (it is recommended to target a level of vehicle occupancy of 80 % and a 3 minute interval).

Figure 18. Forecast bus patronage demand at each cordon



With these ranges, it appears that the level of demand on some corridors radiating from the Parramatta CBD (corridors 3 – Park Parade, 4 – Great Western Highway and 8 – Victoria Road) may warrant investigation for higher order transit (at least bi-articulated buses), particularly considering they do not account for potential additional shift in modal demand as a result of travel demand management measures. Furthermore, the forecasts do not account for the additional attractiveness factors typically associated with light rail, or targeted urban renewal strategies typically associated with light rail (and rail) projects.

It is understood that more detailed public transport patronage modelling has been undertaken to inform detailed light rail corridor investigations. It is recommended that the NSW Government and Council collaborate to identify the best solution for the public transport network servicing Parramatta CBD. The roles of ‘intermediate’ modes including bus and light rail (and ferry) in the future needs to be coordinated with integrated land use and rail planning.

4.4 Ferry

4.4.1 Existing conditions

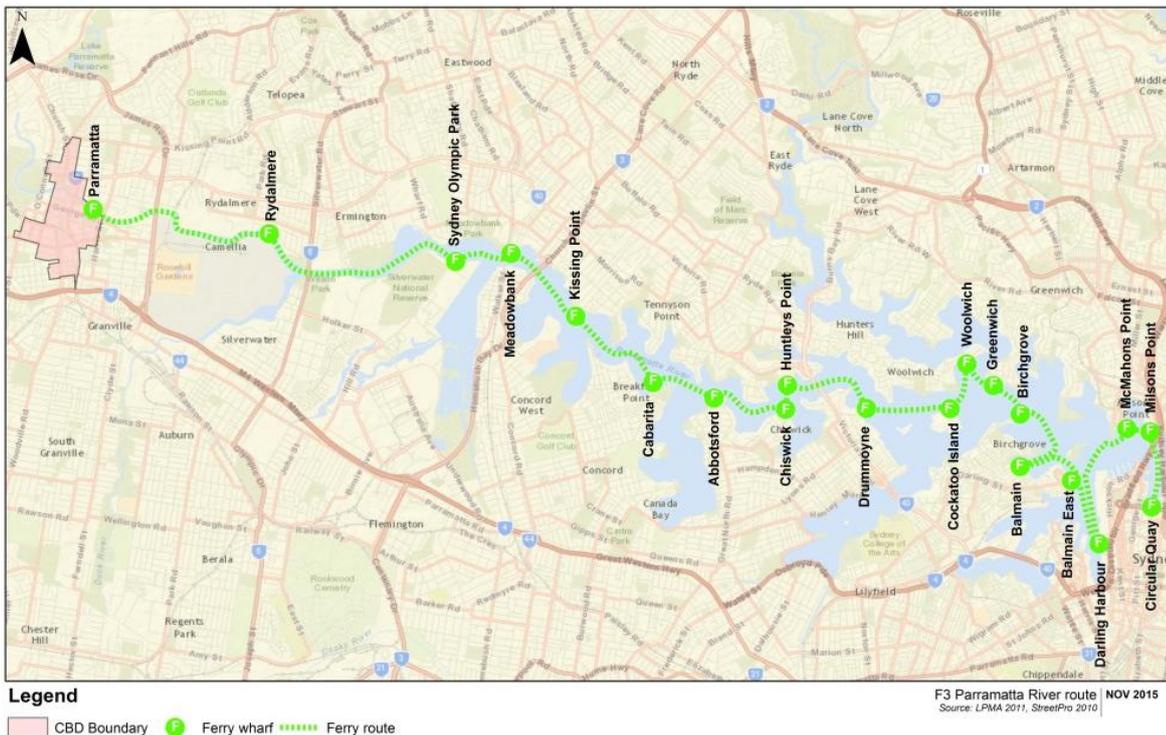
Parramatta Wharf provides access to the Parramatta CBD by ferry. The wharf is located on the Parramatta River, on the eastern fringe of the CBD. The wharf is serviced by the F3 Parramatta River route which operates from Parramatta and Cockatoo Island to Circular Quay, as shown in **Figure 19**. Ferry services accommodate less than one per cent of the current mode share for employees accessing the Parramatta CBD. Average line load data collected for the F3 Parramatta River ferry service illustrates very low patronage at wharves at the western end of the service during peak periods, increasing at the eastern end in proximity to the Sydney CBD, however still remain below 70% seating capacity. Barrier count data shows that passenger movements accessing central Parramatta by ferry have been consistently less than 200 passengers per two-hour (weekday) peak period.

This can be attributed to several factors including:

- **Slow journey times.** The full length ferry journey between Circular Quay and Parramatta is 75 to 90 minutes compared with 48 minutes by train and 40 minutes by car.
- **Infrequent services.** Ferry services operate hourly even in peak periods.
- **Perceived unreliability.** Ferry services to/from Parramatta are affected by low tides. Passengers must consult a Transport for NSW calendar when this occurs, as replacement buses run between Parramatta and Rydalmere.

Despite the above observations, the ferry does perform a key recreational and leisure service that is often at capacity on weekends.

Figure 19. F3 Parramatta River ferry route



Source: Sydney Ferries, 2015

4.4.2 Future scenario

Transport for NSW is proposing to upgrade Parramatta Wharf as part of the Transport Access Program (TAP). The upgraded wharf will provide improved amenity and safety, quicker and more efficient boarding and disembarking and increased wharf capacity. Transport for NSW also plans to modernise the ferry fleet, developing a new style ferry for the Parramatta River: this work is underway. These proposals will make ferry services more accessible, efficient and attractive and may result in some increased patronage at Parramatta. However it is not anticipated these works will result in significant change in the currently minor role ferries have in accommodating trips accessing the Parramatta CBD.

Preliminary forecasts output from STM further indicated that demand for ferry services would not significantly increase in the future, regardless of land use scenario.

It is considered that future strategies for ferry services should focus on catalysing the mode and encouraging / activating travel via this aesthetically attractive travel mode through measures such as:

- Increasing the number of services to Parramatta Wharf, particularly as uplift of the Greater Parramatta to Olympic Peninsular urban renewal precinct occurs, and to serve weekend recreational and leisure needs
- Better integrate the wharf with other modes, such as the planned Parramatta Light Rail, enhancing linked trip options via ferry
- Consider ways to reduce the impact of tides on service accessibility to the Parramatta Wharf through mechanism such as dredging of the Parramatta River (as undertaken prior to the Sydney 2000 Olympic Games).

5. Active transport analysis

5.1 Walking

5.1.1 Existing conditions

The Parramatta CBD includes basic pedestrian facilities such as paved footpaths, sloped kerbs, tactile pavers and signalised crossings. Scramble crossings are prominent within the CBD core. Dedicated pedestrian and cyclist bridges are also provided across the Parramatta River at Elizabeth Street and within Parramatta Park. The amenity for pedestrians in the CBD varies quite significantly with open and attractive pedestrian spaces provided around certain areas such as Parramatta Town Hall and along the Parramatta River, whilst footways are narrow and aged in other areas. Council's *Integrated Transport Plan* for 2009/2010 to 2014/2015 identifies Church Street and the area around Parramatta Interchange as the busiest pedestrian activity areas in the study area. The second busiest area is east of Church Street and north of Parramatta Interchange. This has been validated with more recent pedestrian modelling commissioned by Council, as illustrated in **Figure 20**.

The *Integrated Transport Plan* also identifies the following pedestrian issues: Westfield Parramatta impacts pedestrian accessibility, Parramatta Park is a barrier to pedestrian movements to Westmead, and Parramatta River walkway is not well connected with the Parramatta CBD. Note that the latter is being addressed in the Council's River Strategy.

Figure 20: Current Thursday AM peak hour pedestrian volumes



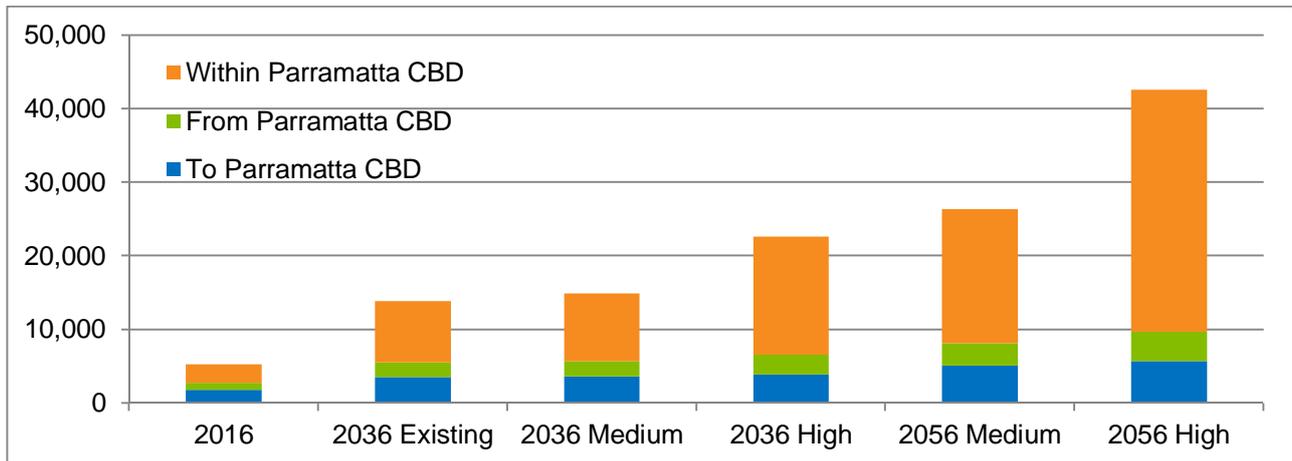
Source: Draft Parramatta Walking Strategy, Cardno, 2016

5.1.2 Future scenarios

As previously mentioned in **Section 2.4.2**, the projected increase in short distance trips and particularly active transport trips is significant for the Parramatta CBD.

Figure 21 highlights the estimated increase in number of walking trips to, from, and within the Parramatta CBD based on STM outputs. The main observation is that the number of walking trips within Parramatta CBD is forecast to grow significantly compared to trips to and from the CBD.

Figure 21. Estimated number of walking trips



Source: TPA, 2016

One of the strengths of the planning proposal is that the proposed mix of residential and commercial land uses could foster walking to a much greater extent than is currently exhibited. With the road network likely to become more congested over time the percentage of private vehicle trips could decrease significantly for the presented shorter distance trips; creating potential for a much higher shift to active transport.

Future transport planning should aim to strengthen pedestrian paths within and on approach to the CBD by connecting missing links and increasing capacity to accommodate the estimated larger flow of pedestrians. Note that Council is currently in the process of developing a Walking Strategy document in parallel to this study which includes more detailed demand modelling and needs analysis.

5.2 Cycling

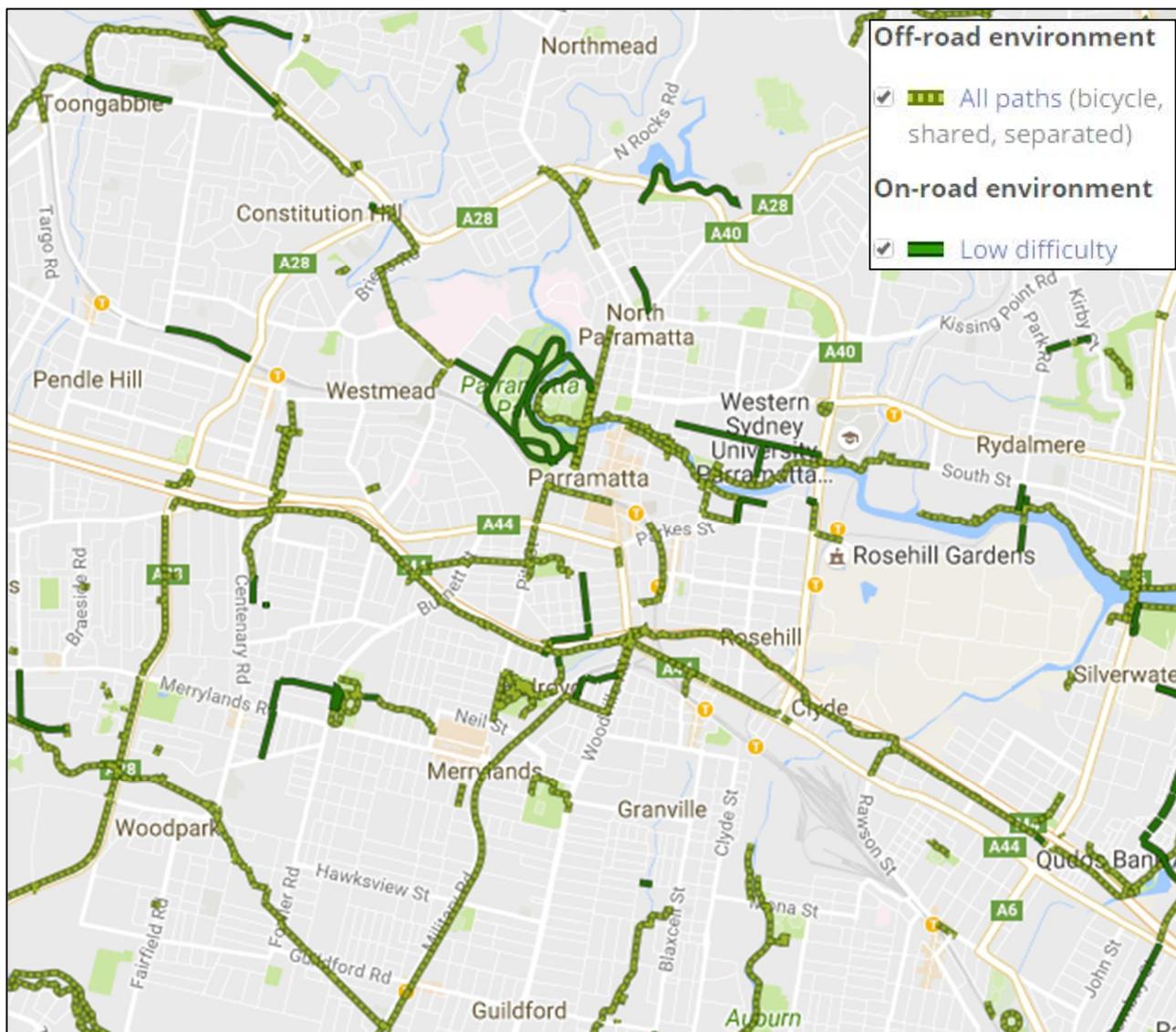
5.2.1 Existing context

The Parramatta CBD is directly connected to a primary east-west cycling route via the Parramatta Valley Cycleway along the Parramatta River. Dedicated paths are provided to the M4 Motorway viaduct route with a separated crossing of the M4 and an uninterrupted off-road route extending to Merrylands. Off-road and low difficulty on-road dedicated cycle paths in proximity to Parramatta CBD are presented in **Figure 22**.

North of the Parramatta CBD planning proposal area however, there are few dedicated cycling facilities. Key regional cycle routes include Parramatta Valley Cycleway, M4 Motorway viaduct route, Liverpool to Parramatta Rail Trail, Liverpool to Parramatta T-way, and North-West T-way.

The cycle network is particularly disconnected within and on approach to the CBD, particularly for north-south trips. The majority of cycle routes to the north are in an on-road environment with moderate to high difficulty for cyclists, with limited dedicated infrastructure. A majority of the dedicated cycle infrastructure lies to the south and serves radial desire lines centred on the CBD; however gaps are present in the network.

Figure 22. Existing cycling infrastructure



Source: Cycleway Finder V3, Roads and Maritimes, 2016

In March 2015, City of Parramatta Council participated in the “Super Tuesday Bike Count.” City of Parramatta Council conducted a visual survey of cycle counts in the morning peak between 7am and 9am. Across the count area, observations included:

- A 20 percent increase in cyclists compared with 2014.
- An increase greater than 30 per cent was recorded for three intersections in the Parramatta CBD:
 - Church Street and Argyle Street (65 per cent)
 - Macarthur Street, George Street and Harris Street (54 per cent)
 - Wilde Avenue, Phillip Street and Smith Street (34 per cent)
- Of the remaining intersections, three also experienced an increase in cyclists, two saw no increase and one (Macarthur Street and Thomas Street) experienced a decrease. Macarthur Street and Thomas Street remains the busiest intersection for cyclists in the Parramatta CBD.

In addition, it can be noted that councils along the PVC show a steady 10-20% demand increase annually; showing the benefits of the provision of a safe and separated facility.

Table 13 below shows cycle counts at key intersections in the Parramatta CBD during the two hour AM peak (7am – 9am) on a typical weekday in 2014 and 2015. This is also graphically represented **Figure 23**.

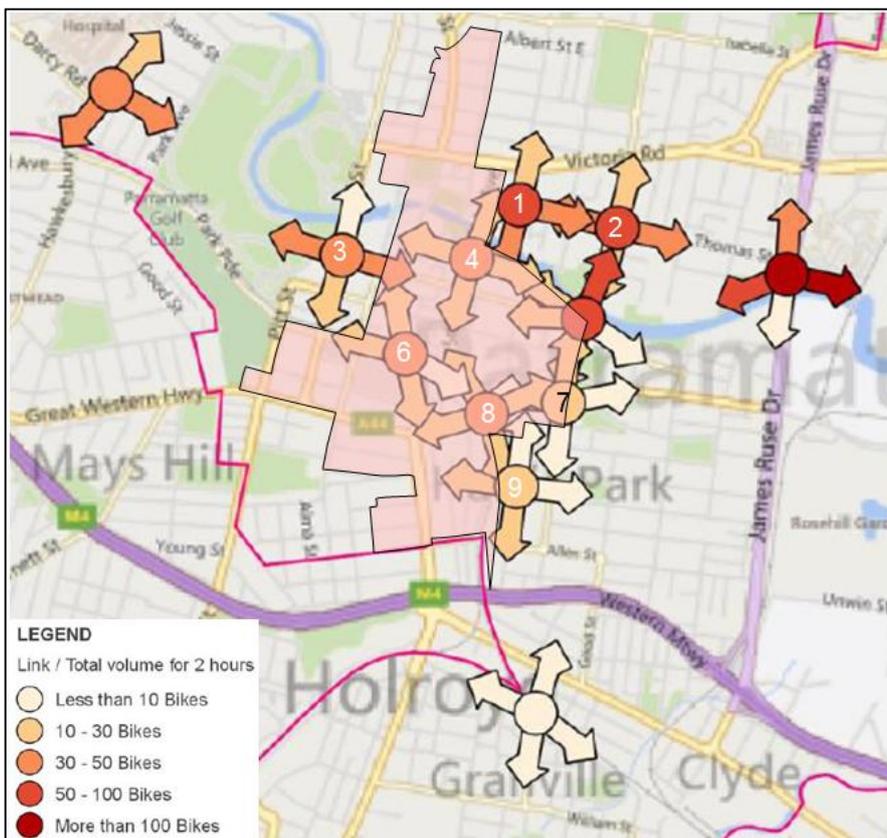
The busiest intersection was Thomas Street and Macarthur Street, with 64 cyclists during the two hour morning peak period. It was closely followed by the intersection of Thomas Street and Elizabeth Street (62 cyclists) and Macarthur Street, George Street and Harris Street (57 cyclists).

Table 13. Two hour bicycle count for 2014 and 2015.

Map ID	Intersection	Cycle counts		
		2014	2015	Percentage change
1	Elizabeth St / Thomas St	62	62	0%
2	Macarthur St / Thomas St	72	64	-11%
3	O'Connell St / George St / Parramatta Park cycleway	40	50	25%
4	Wilde Ave / Phillip St / Smith St	32	43	34%
5	Macarthur St / George St / Harris St	37	57	54%
6	Church St / Argyle St	23	38	65%
7	Harris St / Parkes St	14	18	29%
8	Station St / Parkes St	33	39	18%
9	Wigram St / Marion St / Station St	18	18	0%

Source: Parramatta City Council; 2015

Figure 23. Two hour bicycle count

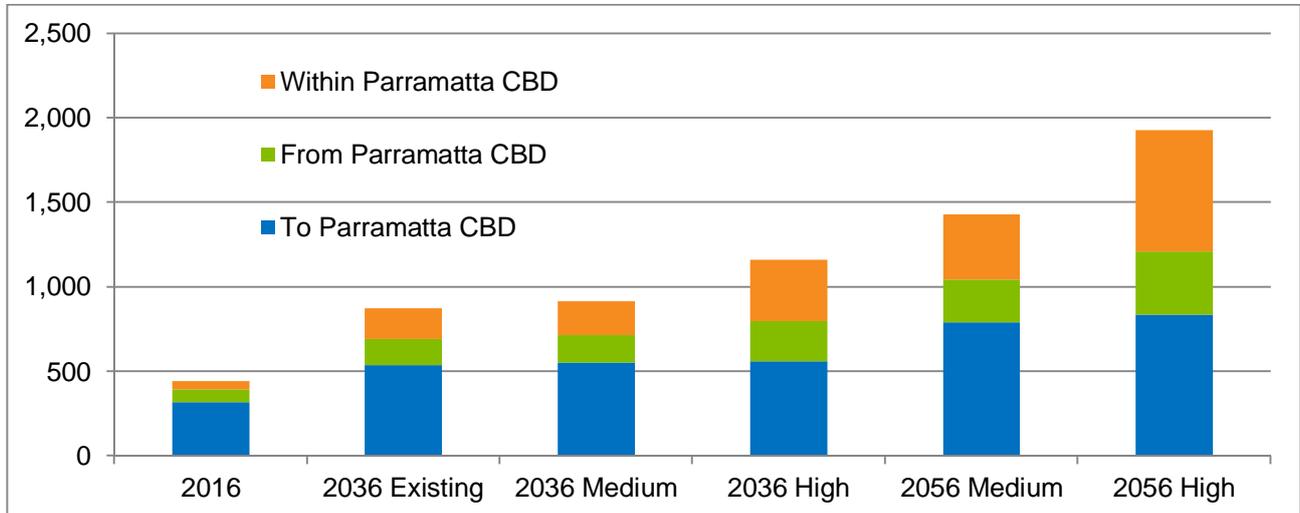


Source: Parramatta City Council; 2015

5.2.2 Future scenario

STM outputs suggest a modest growth for commuters cycling to work as shown in **Figure 24**. The number of cycling trips only represents a small proportion of active transport trips, with the majority being attributed to walking trips.

Figure 24. Estimated cycle demand (two hour AM peak)



Source: TPA, 2016

In the short term, the NSW Government will continue to focus on improving cycle connectivity within five kilometres of strategic centres. ‘Connecting Parramatta’ is a key initiative identified in *Sydney’s Cycling Future* and comprises three projects:

- Parramatta Valley urban renewal
- Completing the network within the Parramatta CBD
- Merrylands to Parramatta
- Westmead Connection
- Escarpment Boardwalk

A cycling connection between Parramatta and Bankstown is also planned in the near future.

In the medium term, the NSW Government will look to improve connectivity within a ten kilometre catchment of the Parramatta CBD. Two projects will be assessed to determine their feasibility:

- A northern connection along Darling Mills Creek and Subiaco Creek
- A southern connection along the Duck River.

The completion of these cycling connections will significantly improve connectivity and safety, and the appeal of cycling as a transport option.

Other cycle way projects include the completed M4 connection, Baludarri Wetlands Walk, Lennox Portals and Subiaco Creek which is under construction. Bicycle corridors requiring delivery include the City Centre Cycleway, Escarpment Boardwalk, Westmead Connection, Duck River, Carlingford Line and Northern Connection (Darling Mills).

Similar short to medium term initiatives should be further investigated considering the potential for active transport uplift in the Parramatta CBD and surrounding SA3s within a five kilometre radius; as detailed in **Section 2.4.2**.

Note that Council is currently in the process of developing a Bike Plan in parallel to this study.

6. Summary

The following includes a summary of the key messages and findings from this traffic and transport paper.

Study methodology

- Council developed three potential development scenarios – existing controls, medium and high growth – for 2036 and 2056 primarily based on economic and market analysis advice.
- Identification of transport needs to support Parramatta's growth has been informed by post-analysis of Strategic Travel Model (STM) outputs provided by Transport for NSW
- The STM is considered to be best suited to examining the effect of significant proposals (such as that for the Parramatta CBD) at a strategic level: more detailed transport modelling will be undertaken prior to gazettal of the Planning Proposal to build on these initial forecasts.
- Numerous assumptions underpin the STM outputs including the baseline demographic forecasts and planned transport network include influential projects such as WestConnex and Parramatta Light Rail (but excludes Sydney Metro West).
- STM however does not directly account for the potential effects of specific travel demand management interventions or future technologies that may have significant impact on the utilisation of the network.

Travel demand

- The total number of trips generated by Parramatta CBD is estimated to increase by two to three times by 2036, and could potentially increase by three to four times by 2056. High growth scenarios show significantly higher total demand, though a significant portion can be attributed to 'contained' trips due to a higher residential mix.
- The proportion of shorter trips will increase significantly, a likely outcome of the proposed significant residential component of the CBD, and proposed uplift of nearby precincts (such as Parramatta North, Camellia, etc) as homes are provided closer to jobs: creating a huge opportunity for a potential shift in mode from private vehicle to active and public transport modes.
- The west will continue to be the main external origin of trips, whilst areas to the east are forecast to provide the main destinations (to major employment centres such as Sydney CBD and Macquarie Park).
- Private vehicle is the main transport mode, with a mode share much higher than other major centres such as the Sydney CBD and North Sydney. Despite promising signs of an increase in public transport use, private vehicle remains prominent in those surrounding SA3s with the highest travel demand. This highlights Parramatta's dependence on private vehicle due to its parking supply and low parking rates.

Traffic analysis

- A VCR analysis was conducted at 16 different locations along Parramatta's river crossing, the CBD external cordon and the Western Sydney Regional Ring Road to determine the impact of the proposals on Parramatta's road network.
- Several links including the Great Western Highway, Church Street, MacArthur Street, Cumberland Highway and James Ruse Drive are already operating close to capacity.
- On the CBD external cordon, an additional 3,900 to 4,800 vehicles could be expected by 2036 and up to 6,500 to 7,600 by 2056: the analysis suggests that the majority of links will reach capacity by 2056 if Parramatta's car-dependency continues.
- A 'business as usual' approach to the supply side for road capacity to accommodate private vehicle use will not create a sustainable Parramatta CBD, and is not recommended as a path forward in the transport response, or the Planning Proposal assessment process: Parramatta's transport response to growth must employ lessons learnt from other CBDs within Sydney and internationally to achieve re-moding of travel and meet higher order objectives around sustainability, economic productivity, urban activation and form, land value, and community health.
- With the expected increase in private vehicle trips into Parramatta CBD, future initiatives should focus on reducing private vehicle mode share particularly within Parramatta and adjacent SA3s. Notwithstanding this focus, there will likely be a need for targeted investment in, and maximising the efficiency of, the trunk road network at select locations to address short and medium term needs during the transitional period, whilst also reviewing the allocation of and availability of road space to address the needs of all road-based modes. The identification, form and timing of these works should form the focus of more detailed modelling investigations.

Public transport analysis

- STM outputs suggest the demand along the T1 Western Line is expected to continue growing and could require a significant number of additional services of up to 12. Capacity along the T5 Cumberland Line and the Blue Mountains Line is also expected to increase with additional services required.
- Demand at Parramatta Station is estimated to double by 2036, surpassing current turnover through Town Hall during peak periods. This indicates that significant additional capacity is required or alternatively planning for a second rail station in cooperation with potential new rail corridors.
- Bus demand, particularly coming from the west, could also double by 2036. Along the busiest cordons this could be equivalent to 40 additional services. Increasing the number of services to meet estimated demand may not be feasible at this scale. Higher order transit may be required in the future.
- The findings of the demand modelling exercise infer that there is not a strong link between CBD growth and growth on ferry service demand. It is hence considered that future strategies should focus on catalysing the mode through measures such as: increased number of services and better integration of the wharf with other modes.
- Delivery of light rail infrastructure and services is currently in planning stages. It is considered that the Planning Proposal will increase demand for Light Rail in Parramatta, and increase the need for and feasibility of a future light rail network.

Active transport analysis

- 71 per cent and 88 per cent of trips to and from Parramatta CBD respectively will be less than 10 kilometres under the Planning Proposal. This presents a significant opportunity to invest in a connected, dedicated and direct cycle and pedestrian network that Parramatta is currently lacking.
- Considering the proposed uplift in both commercial and residential land uses within Parramatta CBD, investment in pedestrian and cycle infrastructure could also create a mode shift from private vehicle to active transport. This would in turn alleviate the pressure on Parramatta's road network and help Parramatta CBD thrive to become a place for people.