Anzac Parade corridor future Light Rail station and system capacity analysis

For the Randwick LGA residential growth strategy

Prepared for Randwick City Council | 20 January 2017

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Final

Report J14157RP2 | Prepared for Randwick City Council | 20 January 2017

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1 Introduction

EMM Consulting Pty Limited (EMM) has been engaged to undertake a future Light Rail station and system capacity analysis to identify capacity requirements for the future public transport commuter services in the Anzac Parade corridor. It will be important to maintain reasonable future peak hour passenger crowding levels for Anzac Parade public transport services to ensure that the Randwick Local Government Area (LGA) dwelling growth projections are achievable with minimum levels of car usage for future urban developments.

The future Light Rail capacity analysis calculates what continuing bus services will need to be retained travelling to and from the City via the Anzac Parade (or Todman Avenue) routes for the currently proposed capacity for new dwellings within the Kensington to Kingsford (K2K) Anzac Parade corridor precinct to be achieved. The current K2K precinct planning strategy has capacity for approximately 4,900 additional dwellings over a 15 year period.

This analysis calculates the future Light Rail passenger and general public pedestrian crossing demand for the signalised pedestrian crossings and the station platforms at the main Kingsford (Nine Ways) and Kensington (Todman Avenue) stations. The future requirements for bus interchange, cycling access and bicycle storage facilities at each station are also considered.

The year 2016, 2020 and 2031 passenger demand for the corridor has been calculated for the one hour morning and afternoon peak periods from journey to work travel data and includes 'per tram' passenger boarding and alighting estimates for each station. The calculated total travel demand for the route north of Carlton Street can be compared with the formal Transport for New South Wales (TfNSW) morning peak hour passenger demand projections for the system, which were presented in the initial CBD and South East Light Rail (CSELR) EIS planning report in December 2013 and the subsequent planning modification assessment reports in 2014 and 2015.

The calculated EMM year 2016 morning peak hour passenger demand for the route has been verified by a calibration check of the existing one hour morning peak period north-bound bus passenger volumes on Anzac Parade north of Carlton Street, between 7.45 and 8.45 am on Friday 11 November 2016.

The UNSW Anzac Parade station passenger boarding and alighting movements have not been formally reviewed for this study. However, the general influence of the future morning peak hour UNSW Student travel movements within the K2K study area and at other locations on Anzac Parade has been quantified.

North of Carlton Street, the university student travel movements will all be in the opposite direction to the peak direction for the local commuter travel movements which is inbound to the Sydney CBD in the morning peak hour and out-bound in the afternoon peak hour. However, south of Carlton Street, there will be some cumulative university student and local commuter travel demand movements during the morning peak hour which are considered by this study, namely:

- the additional localised student travel demand north-bound between the Kingsford (Nine Ways) station and the UNSW Station, from the locally based students travelling to the university in addition to local commuters from areas in the south of Randwick LGA, and

- the additional localised student travel demand south-bound for passengers boarding trams at the two Kensington area Light Rail stations north of the University, which are at Todman Avenue and Carlton Street.

2 Existing situation

2.1 Existing transport network

The existing Anzac Parade and Alison Road bus routes for all the proposed Light Rail routes within Randwick LGA were summarised by a Council commissioned study (Randwick Light Rail Pre Feasibility Study, GHD 2011). The current Randwick LGA and Anzac Parade corridor bus routes map for 2016 is shown in Appendix A. There have been some minor changes to these bus routes over the period since 2011, including the route X93 express services from Anzac Parade south of Kingsford which now travel to the CBD via Gardeners Road, Botany Road and Elizabeth Street through Rosebery and Waterloo.

2011 is an appropriate base year to consider the existing corridor public transport network as it is the most recent year for which the ABS Census journey to work travel information is available. It also includes the relatively recent bus capacity enhancements for the Anzac Parade route from the introduction of the metro bus route services M10 and M50, which effectively provide an additional twelve buses per hour travelling in each direction on Anzac Parade through Kensington during the peak hour periods.

The GHD 2011 report identified that in the one hour morning peak period, Anzac Parade between Kingsford and Kensington, carried a total of 72 city-bound buses per hour (55 travelling via Anzac Parade south of Kingsford, 11 travelling via Bunnerong Road and six M50 buses travelling via High Street from Coogee). Fifteen of these buses were denoted as X (express) or L (limited stop) services in 2011. In addition, in the Kingsford and Kensington areas there are up to eight buses per hour in the peak hours on route 303, which travels to and from the Sydney CBD via Todman Avenue, Waterloo and Surry Hills, giving a total of 80 city-bound buses per hour for the existing corridor public transport system.

Based on the typical maximum capacity for a standard bus which is 60 passengers (including seated and standing passengers), the effective base year capacity (in 2011) for the existing corridor public transport system in the city-bound direction (80 buses per hour) was 4,800 passengers per hour, or 4,320 passengers per hour for the 72 buses travelling via Anzac Parade.

On Friday 11 November 2016, a north-bound bus passenger calibration check was undertaken for the existing Anzac Parade buses north of Carlton Street. The calibration check recorded the general % of seats occupied for each northbound bus and the number of standing passengers and is summarised in Appendix B. The calibration check indicated there were approximately 3,266 north-bound passengers on 77 buses travelling via Anzac Parade north of Carlton Street. This represents 42.4 persons per bus, which is just over 70% average occupancy, for the busiest one hour period between 7.45 to 8.45 am at Kensington, which corresponds to arrival times between 8.00 to 9.00 am for buses reaching the CBD.

2.2 Existing corridor travel demand

The Randwick LGA has historically had a relatively high proportion of public transport journey to work travel, for an area without direct access to the heavy rail network. The Anzac Parade corridor has as high if not higher public transport proportional usage (between 30% to 40%) than many areas of Sydney which have direct (walk up) access to heavy rail services.

The 2011 Census journey to work travel statistics for Randwick LGA residents which are shown in Appendix C include public transport journey to work statistics for many sub totals of different combinations of bus trips, bus feeder trips to heavy rail services and other bus and rail based public/private travel mode combinations.

For the total Randwick LGA residents journey to work travel trips which were classified as bus-based (which are 13,093 trips per day) there are effectively a further 15% additional trips (1,978 trips per day) also using buses to access the heavy rail network from areas in Randwick LGA.

The ratio between the existing number of households (excluding visitor only, non private and unclassified households) in the LGA in 2011 (which was 47,563) and the total morning peak period "out-bound" journey to work travel trips (which was 63,020), gives the average LGA journey to work trip ratio on weekdays as 1.325 trips per household. This ratio would be applicable to future dwellings with the average LGA household size (based on the usual resident population) which is 2.71 persons per dwelling.

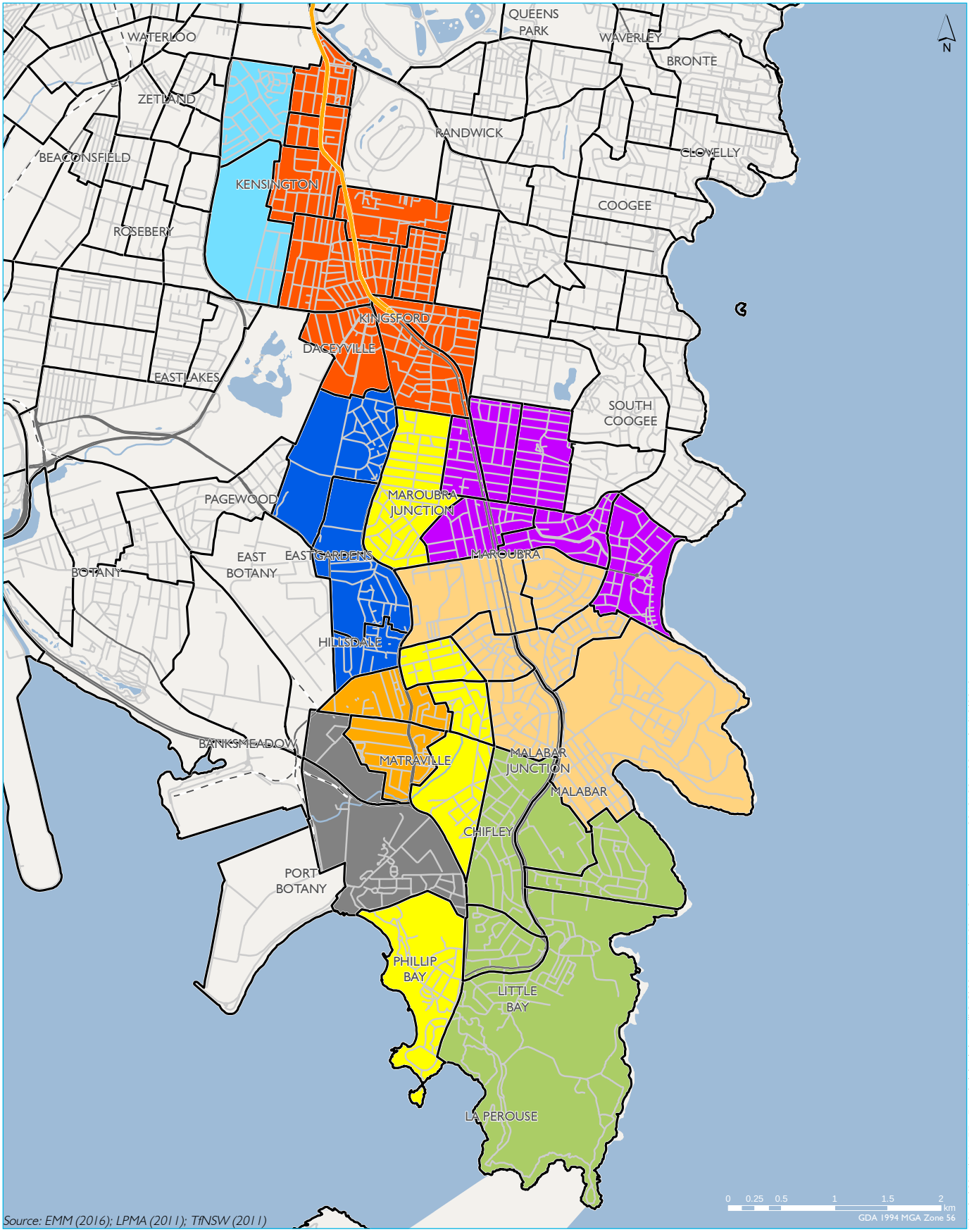
For future apartment dwellings within the K2K precinct and the other major centres such as Randwick and Maroubra, where the average household size would generally be lower than 2.71 persons, the future average number of morning peak period "out-bound" journey to work commuter trips would be lower than the LGA average, and would be approximately:

- Kensington area, 2.3 persons per household = 1.124 journey to work trips per household, and
- Kingsford, Randwick and Maroubra areas, 2.5 persons per household = 1.221 journey to work trips per household

For other new dwellings in other areas of the LGA the current average LGA household size (2.71 persons per household) would generally continue to apply giving approximately 1.325 journey to work trips per household for future dwellings in these areas. The EMM one hour morning and afternoon peak travel demand estimates for the Anzac Parade corridor are calculated based on a detailed local analysis of the TfNSW 'Travel Zone' 2011 journey to work census data for nine defined bus and light rail catchment areas of the Anzac Parade and Bunnerong Road routes, which are shown on the Catchment Map in Figure 2.1.

The calculated corridor (bus and/or future light rail passenger) boarding and alighting volumes for each of the nine catchment areas are shown in Appendix D for the morning (AM) and afternoon (PM) one hour peak periods for the year 2011 (the most recent census base year) and an adjustment for the period 2011 to 2016. The adjustment calculates the additional travel demand generated by new LGA residents during the five year period using the new dwelling distribution between suburbs over ten years (based on the financial years 2004/5 to 2013/14 inclusive), which is shown below (based on Sydney Water data for new connections to households).

- Maroubra 26.6%
- Little Bay 19.1%
- Randwick 16.7%
- Kensington 15.5%
- Kingsford 7.1%
- Matraville 6.5%
- Coogee 3.5%
- South Coogee 2.8%; and
- Other areas 2.2%



Source: EMM (2016); LPMA (2011); TfNSW (2011)

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KEY

- Anzac Parade light rail
- Rail line
- Main road
- Local road
- Watercourse
- Travel Zone boundary

Travel Zone

- Botany Industrial
- Bunnerong Road East
- Bunnerong Road West
- Light Rail Walk Up Catchment
- Little Bay and La Perouse
- Maroubra and Maroubra Beach
- Matraville
- Route 303 Bus Catchment
- South Maroubra and Malabar

Anzac Parade corridor future light rail and bus routes catchment map

Randwick Light Rail

Figure 2.1

EMM

The average new dwellings growth for Randwick LGA over the period was +528 dwellings per year, which corresponds to +2,640 dwellings over a five year period.

The detailed Anzac Parade and Todman Avenue morning peak hour city-bound bus passenger movements calculated by the EMM passenger travel demand model are shown in Appendix D. The combined passenger travel demand estimates for the existing corridor bus services in 2011 and 2016, are summarised in Table 2.1.

Table 2.1 Existing morning peak hour corridor public transport passenger demand estimates

Growth increment	AM peak hour via Anzac Parade	AM peak hour via Todman Avenue	AM peak hour city-bound travel demand via both routes
2011 base year travel demand	3,209	201	3,410
2011 to 2016 growth adjustment	237	0	237
Calculated year 2016 travel demand	**3,446**	**201**	**3,647**

The calibration check which was undertaken for the morning peak hour Anzac Parade bus services (north of Carlton Street) on Friday 11 November 2016 shows the EMM passenger demand model prediction of 3,446 north-bound bus passenger per hour was approximately 5.5% high in comparison to the observed total 3,266 north-bound bus passengers per hour.

However, most of this discrepancy can probably be accounted for by the calibration check survey having been undertaken on a Friday, when the commuter travel volumes are normally lower than on other weekdays. The calibration check therefore confirms the accuracy of the EMM passenger demand model predictions for the year 2016 corridor bus services, as being within approximately 5% of the actual observed bus passenger volumes for a typical weekday in 2016.

3 Future proposed change

3.1 Dwelling growth projections

The historic dwellings growth distribution for the LGA is has now been superceded by a future growth forecast for Randwick City Council for the fifteen years to 2031.

The future dwellings growth forecast of +15,150 dwellings within the LGA (Department of Planning and Environment 2014) over the fifteen year period to 2031 would be distributed between three generic locations and types of future development which are town centre zones, major sites/ urban renewal areas and other 'Infill' areas, where a future 40%/30%/30% dwellings growth distribution is assumed, which represents:

- 6,060 new dwellings in town centres (including 4,900 in the Kensington to Kingsford 'K2K' area);
- 4,545 new dwellings in major sites and/or identified urban renewal areas, and
- 4,545 new dwellings built as infill developments within existing residential precincts.

The majority of the estimated 4,900 new town centre dwellings (Council's draft Planning Strategy for Kensington and Kingsford town centres) which are likely to be constructed within the future K2K precinct area would be constructed within the Kingsford (Nine Ways) and Kensington (Todman Avenue) Light Rail station catchments, with approximately 1,800 and 1,400 new dwellings respectively within these two station catchments. For the purposes of future analysis of the Light Rail system passenger demand from all areas of the Randwick LGA, the following overall LGA distribution of the future predicted urban growth of +15,150 dwellings has been predicted by EMM to occur within the following Light Rail catchment areas:

- 35% of new dwellings within the Kensington and Kingsford (Anzac Parade) Light Rail catchment areas;
- 32% of new dwellings within the Randwick, Clovelly, Coogee, Bundock Street and South Coogee (Randwick High Street) Light Rail catchment areas;
- 24% of new dwellings within the Maroubra and other areas of Anzac Parade (south) Light Rail and bus feeder service catchment areas; and
- 9% of new dwellings within the Matraville and other areas of Bunnerong Road (south) Light Rail and bus feeder service catchment areas.

In addition to the predicted Randwick LGA dwelling growth generating additional Light Rail passenger travel demand from the Bunnerong Road (south) catchment areas, there is predicted to be significant additional passenger demand from new dwellings constructed within the Pagewood, Hillsdale and Eastgardens localities within the adjoining Bayside LGA over the same fifteen year future period.

The future growth in the local employment based travel demand within the local employment centres adjacent to the Anzac Parade and Bunnerong Road routes through Randwick and the adjoining Bayside LGA is estimated to increase in line with general population growth at a rate of +1% annually. This increases the future Light Rail corridor peak hour travel demand growth in the counter peak direction (except for the future growth in the UNSW student travel movements which requires separate forecasting, as described in Section 5.1).

3.2 Future corridor travel demand

The calculated additional future bus and/or Light Rail passenger boarding and alighting volumes for the year 2031 projected dwellings growth (+15,150 dwellings within Randwick LGA) combined with +1% annual employment growth in the adjoining local employment centres, is shown in Appendix E.

Also shown in Appendix E is the interim growth scenario for +4,040 dwellings within Randwick LGA which has been calculated to correspond to the proposed first full year of the future Light Rail system operations in 2020.

The future total locally based passenger demand for the Anzac Parade corridor (including the Light Rail and the remaining bus services which are continuing to operate) is summarised in Table 3.1 for the city-bound and out-bound directions, for the one hour morning and afternoon peak periods. In this analysis, there has been no increase assumed in the peak hour public transport travel mode share as there are concerns regarding the capacity of the future Anzac Parade Light rail system to actually accommodate increased passenger volumes, in comparison to the existing Anzac Parade and Bunnerong Road bus based public transport systems.

Table 3.1 Summary of Anzac Parade corridor peak hour Light Rail travel demand

Calculation of future corridor travel demand (north of Carlton Street)	AM peak hour city-bound	AM peak hour out-bound	PM peak hour city-bound	PM peak hour out-bound
2011 base year travel demand	3,410	1,071	918	2,923
2011 to 2016 growth adjustment	237	54	46	194
Total base year 2016 travel demand	**3,647**	**1,125**	**964**	**3,117**
+4,040 LGA dwellings growth from 2016	398	43	37	341
Total future year 2020 travel demand	**4,045**	**1,168**	**1,001**	**3,458**
+15,150 LGA dwellings growth from 2016	1,494	161	138	1,280
Total future year 2031 travel demand	**5,141**	**1,286**	**1,102**	**4,397**

3.3 Future corridor requirements for bus and Light Rail services

The interim corridor analysis in Table 3.1, which is based on the year 2020 travel demand, for the first full year of operation of the Light Rail system, assumes the Light Rail system is operating at the TfNSW proposed initial frequency for the Anzac Parade route which is one tram every 8 minutes (7.5 trams per hour) in each direction. This provides interim peak hour passenger capacity for the Light Rail system of 3,495 passengers per hour in each direction, based on 466 persons per tram

The longer term analysis in Table 3.1 is based on the year 2031 urban development scenario for the corridor which assumes the future Light Rail system is operating at the TfNSW proposed maximum frequency for the Anzac Parade route with one tram every 6.5 minutes (9.23 trams per hour) in each direction. This would provide a future maximum peak hour capacity for the Light Rail system of 4,300 passengers per hour in each direction, based on the proposed design capacity of 466 persons per tram.

The future predicted year 2020 and year 2031 travel demand for the Light Rail system in Table 3.1 shows that in both the interim and year 2031 situations, the overall future corridor travel demand will significantly exceed the respective capacity of the Light Rail system, such that a significant proportion of the existing corridor bus services would need to be retained, operating in addition to the Light Rail services.

The combined future capacity for the future Anzac Parade corridor public transport system linking the K2K area to the Sydney CBD will depend on the proportion of the existing peak hour bus services (primarily express buses) which are to be retained.

In this regard, it will be desirable to maintain the current attractiveness of the K2K area public transport system by avoiding any major increase in the morning peak crowding levels. The base year corridor travel demand analysis for 2011, in Table 3.1, shows the existing corridor bus services carry 3,410 city-bound passengers per hour during the morning peak hour, which corresponds to an average one hour morning peak period crowding level of 71.4% for the combined 2011 total (Anzac Parade + Todman Avenue) bus capacity of 4,800 persons with 80 city-bound buses over a one hour period.

To avoid a significant deterioration in the future peak hour public transport 'level of service' for the Anzac Parade corridor (as measured by peak hour passenger crowding levels), it is recommended that the future average morning peak hour passenger crowding level for the route, north of Carlton Street, should not increase above 80%.

For comparison purposes, with the interim (year 2020) and the longer term (year 2031) corridor public transport system operations, the required future number of bus services operating in addition to the Light Rail system are shown in Table 3.2, for a range of future one hour average morning peak period passenger crowding levels, either 80%, 90% or 100%.

Table 3.2 Future combined corridor opearating capacity with bus and light rail services

Future system operations	Future one hour peak average crowding level	Required corridor hourly capacity	Light Rail system capacity	Residual bus system capacity	Number of buses per hour
Interim	80%	5,056	3,495	1,561	26
operations	90%	4,494	3,495	999	17
(year 2020)	100%	4,045	3,495	550	9
Long term	80%	6,426	4,300	2,126	36
operations	90%	5,712	4,300	1,412	24
(year 2031)	100%	5,141	4,300	841	14

The results of the corridor capacity and crowding 'level of service' calculations in Table 3.2 show that for the first year of the Light Rail system operations in 2020, with the proposed Randwick LGA dwellings growth of +4,040 dwellings over the four year period from 2016 to 2020 (including +1,300 dwellings within the K2K area), approximately 26 of the existing 80 morning peak hour peak direction bus services will need to be maintained to provide the recommended maximum level of service (as measured by an 80% one hour peak period average crowding level).

This would generally maintain the existing levels of passenger comfort for local commuters which were provided by the base year (2011) morning peak hour city-bound bus services where 80 buses per hour operated via the Anzac Parade and Todman Avenue routes to the Sydney CBD.

For the proposed longer term Randwick LGA projected dwellings growth of +15,150 dwellings over a fifteen year period to 2031 (including +4,900 dwellings within the K2K area), just under half of the existing morning peak hour peak direction bus services (36 hourly bus services compared to 80 currently) will need to be maintained travelling through to the Sydney CBD.

This will also effectively maintain an equivalent level of passenger service and comfort in 2031 (measured in terms of the one hour morning peak period average crowding levels) to that which has historically been provided by current (year 2011 or year 2016) morning peak hour city-bound bus services travelling via the Anzac Parade and Todman Avenue routes.

4 Station access review

At the two primary K2K study area stations, which are at Kingsford (Nine Ways) and Todman Avenue, the predicted passenger crowding levels have been calculated for the proposed platform areas at stations and the signalised pedestrian crossing areas on the north-bound and south-bound carriageways of Anzac Parade.

At the Anzac Parade pedestrian crossings, there will also be locally based pedestrian movements in addition to the Light Rail passengers crossing the road at each station location.

Each station platform area and pedestrian crossing is assessed according to the level of service capacity standards for 'movement' and 'waiting' areas which were defined by Fruin (Table 4.1).

Table 4.1 Crowd density for levels of service (Fruin)

Level of Service	Speed for walking movement	Crowd Density for Movement (walking areas) (metres squared per person)	Crowd Density for Standing (waiting areas where passengers are generally not moving) (metres squared per person)
A = Free Flowing	over 1.3 m/sec	over 3.25	over 1.21
B = Minor Conflicts	1.27 to 1.3 m/sec	2.32 to 3.25	0.93 to 1.21
C = Some Restriction to flow	1.18 to 1.27 m/sec	1.39 to 2.32	0.65 to 0.93
D = Restricted Movement for most	1.0 to 1.18 m/sec	0.93 to 1.39	0.28 to 0.65
E = Restricted Movement for all	0.5 to 1.0 m/sec	0.46 to 0.93	0.19 to 0.28
F = Shuffling Movement	Less than 0.5 m/sec	Less than 0.46	Less than 0.19

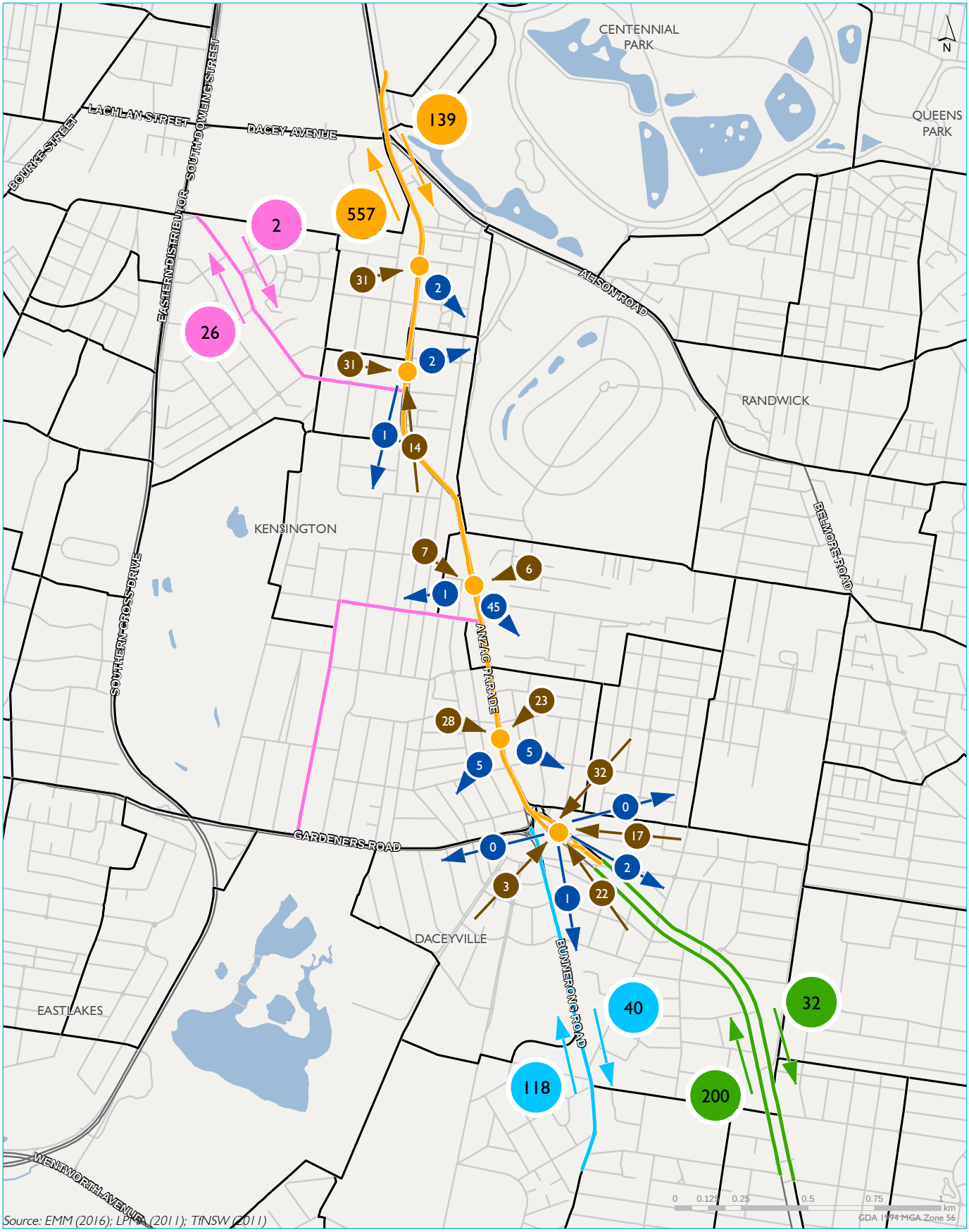
1. *Source Fruin J. J.Pedestrian Planning and Design, 1973.*

For the Randwick Anzac Parade corridor Light Rail system, the maximum recommended level of crowding for the design of the station platforms and pedestrian crossing areas is level of service C. This corresponds to pedestrians waiting at a maximum density of 0.65 m^2 per person.

For moving crowds of pedestrians, the rate of movement deceases with increasing crowd density. The maximum level of service C design standard requires at least 1.39 m^2 per person which corresponds to flow rates of around 1.2 metres per second which is close to the optimum speed of pedestrian travel which can actually be achieved in most situations.

In 2031, the total future residential and locally based employment travel demand (excluding UNSW students) for the Anzac Parade corridor Light Rail system (including any remaining bus routes which are continuing to operate) is summarised in Table 4.2 for the city-bound and out-bound directions, for the average per tram boarding and alighting movements during the one hour morning and afternoon peak periods.

The peak hour per tram boarding and alighting movements at the individual station stops and the bus feeder service interchange movements at the Kingsford interchanges, which have been calculated for the morning and afternoon peak hour system operations are shown in Figure 4.1 and Figure 4.2.



Source: EMM (2016); LPI (2011); TfNSW (2011)

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KEY (excludes UNSW student travel)

- Main road
- Local road
- Watercourse
- Waterbodies
- Travel Zone boundary
- Interchange point

Per tram passenger movements

- Passenger alighting (count)
- Passenger boarding (count)
- Proposed light rail (count)

Per tram bus passenger movements

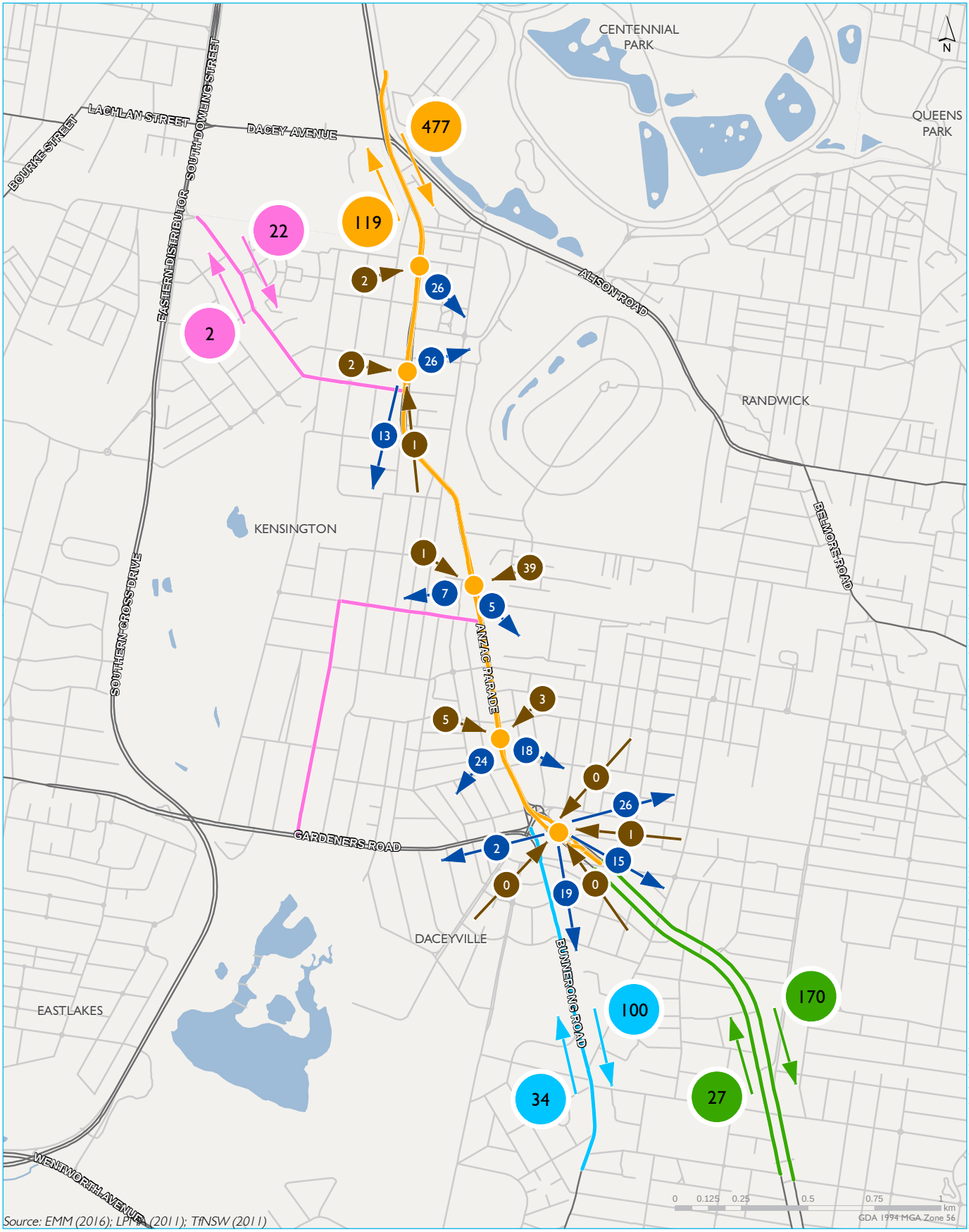
- Anzac Parade (count)
- Bunnerong Road (count)
- Eastern - Day - Todman (count)

Future (2031) AM peak hour per tram public transport movements

Randwick Light Rail

Figure 4.1

EMM



Source: EMM (2016); LPI (2011); TfNSW (2011)

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KEY (excludes UNSW student travel)

- Main road
- Local road
- Watercourse
- Waterbodies
- Interchange point

Per tram passenger movements

- Passenger alighting (count)
- Passenger boarding (count)
- Proposed light rail (count)

Per tram bus passenger movements

- Anzac Parade (count)
- Bunnerong Road (count)
- Eastern - Day - Todman (count)

Future (2031) PM peak hour per tram public transport movements

Randwick Light Rail

Figure 4.2

EMM

Table 4.2 Summary of peak hour per tram corridor travel demand (north of Carlton Street)

Growth increment	AM peak hour city-bound	AM peak hour out-bound	PM peak hour city-bound	PM peak hour out-bound
2011 base year travel demand	369	116	99	317
2011 to 2016 growth adjustment	26	6	5	21
+15,150 LGA dwellings growth	162	17	15	139
Total future year 2031 travel demand	**557**	**139**	**119**	**477**

As it is not known specifically which bus services will be continuing to operate over which sections of the Anzac Parade corridor light rail route in the future, to be conservative, each station passenger demand analysis has considered that all the potential Anzac Parade corridor passenger movements to and from that station catchment, could potentially occur on the Light Rail system. Notwithstanding this assumption, a significant proportion of the future total corridor passenger movements would probably continue to be carried on retained bus services.

At the Kingsford (Nine Ways) station the major proportion of the peak hour peak direction passenger movements will be interchange movements between buses and trams at the station (at least until any extension of the Light Rail route to Maroubra or further south is implemented). The future potential effect of such a route extension cannot be determined and cannot be formally incorporated into the study at the current time.

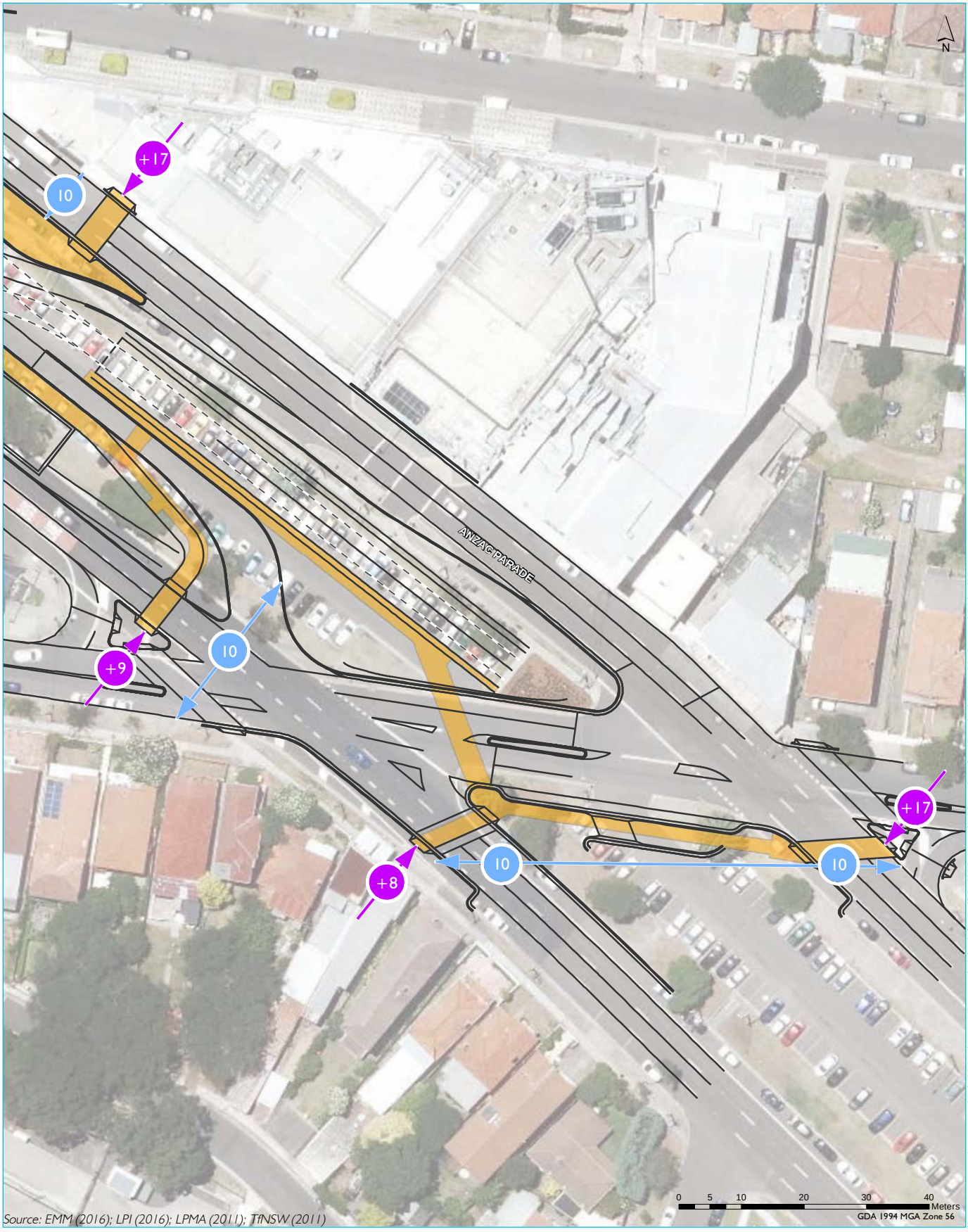
However as there is effectively minimal bus storage or turn around capacity with the current design for the Kingsford (Nine Ways) station, it must provisionally be assumed that although the majority of the peak hour peak direction bus passengers will be transferring to or from trams at Kingsford, most actual buses will not be terminating there in the future. All buses would either continue to or start from other locations (either in or out of service) and the necessary bus turnaround and waiting (layover) function between journeys would occur there. It is understood that some of this bus turnaround and/or layover activity may potentially occur either in the Kensington area at Todman Avenue, or near Taylor Square, Darlinghurst or at the currently under utilised Edgecliff bus Interchange or even at other (yet to be identified) locations within Sydney's Inner East.

At both of the two main K2K stations the capacity of proposed facilities for cyclists to use the trams and/or store their bicycles has also been reviewed, together with future potential integration issues for the Light Rail route in combination with Randwick regional cycleway routes in the Anzac Parade locality.

4.1 Kingsford (Nine Ways) interchange station

The Kingsford (Nine ways) station and bus interchange is the largest station on the Anzac Parade section of the Light Rail route and two maps are required to show the proposed pedestrian interchange walk up movements, Figure 4.3 for the southern end of the station and Figure 4.4 for the northern end.

On either side of the station, three signalised pedestrian crossing movement locations are anticipated to be provided, giving six pedestrian crossings in total to distribute the future anticipated 'walk up' bus passenger boarding and alighting movements from the adjacent residential precincts at the southern end of the Kingsford town centre, including parts of Daceyville.



Source: EMM (2016); LPI (2016); LPMA (2011); TfNSW (2011)

KEY

- Site survey (CAD)
- Proposed light rail (centreline)
- Pedestrian access

Passenger movements per tram

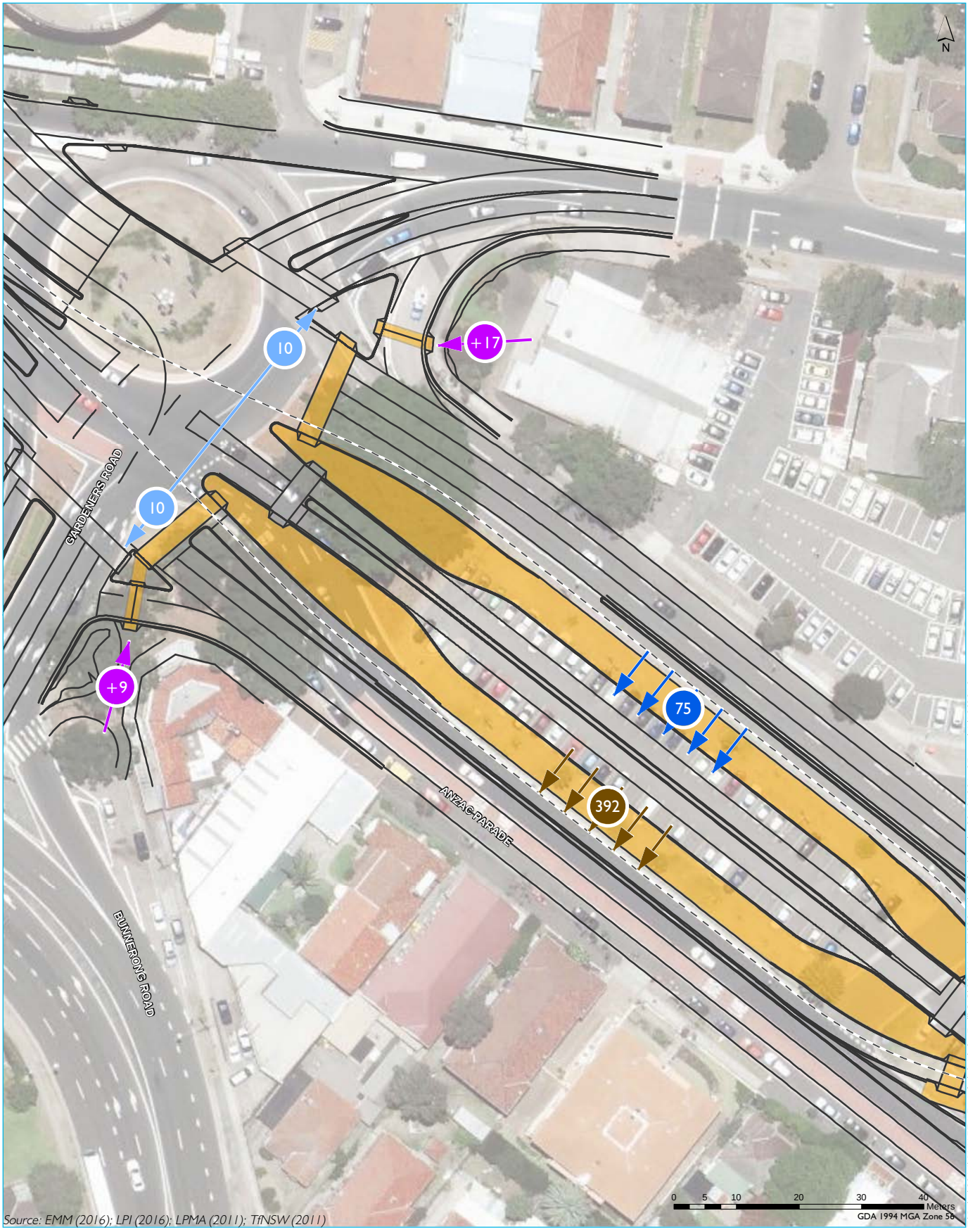
- Station pedestrian access (count)
- General public pedestrian crossing (count)

AM peak future Kingsford Interchange Station (south end) passenger movements

Randwick Light Rail

Figure 4.3

EMM



Source: EMM (2016); LPI (2016); LPMA (2011); TfNSW (2011)

KEY

- Site survey (CAD)
- Proposed light rail (centreline)
- Pedestrian access

Passenger movements per tram

- Station pedestrian access (count)
- General public pedestrian crossing (count)
- Passenger alighting (count) including bus interchange
- Passenger boarding (count) including bus interchange

AM peak future Kingsford Interchange Station (north end) passenger movements

Randwick Light Rail

Figure 4.4

EMM

4.1.1 Bus interchange access

The proposed lengths and widths of the two large interchange platforms at Kingsford are approximately 6 m wide and 120 m long, excluding the tapered sections at each end. This combined total platform areas of 720 m^2 for each platform will have to accommodate the combined Anzac Parade and Bunnerong Road corridor bus interchange passenger volumes at the station plus any local area walking passengers. The respective 'per tram' total passenger boarding and alighting movements for each platform during the morning and afternoon peak periods will be, as follows:

- North-bound light rail (boarding) platform, morning peak period = 200 passengers from Anzac Parade buses, plus 118 passengers from Bunnerong Road buses, plus 49 walk up passengers (east side) plus 25 walk up passengers (west side) = total 392 passengers.

- North-bound light rail (boarding) platform, afternoon peak hour = 27 passengers from Anzac Parade buses, plus 34 passengers from Bunnerong Road buses, plus 1 walk up passenger (east side) plus 0 walk up passengers (west side) = total 62 passengers.

- South-bound light rail (alighting) platform, morning peak hour = 32 passengers to Anzac Parade buses, plus 40 passengers to Bunnerong Road buses, plus 2 walking passengers (east side) plus 1 walking passenger (west side) = total 75 passengers.

- South-bound light rail (alighting) platform, afternoon peak hour = 170 passengers to Anzac Parade buses, plus 100 passengers to Bunnerong Road buses, plus 42 walking passengers (east side) plus 21 walking passengers (west side) = total 333 passengers.

4.1.2 Capacity for pedestrians

The level of service capacity assessment for the Kingsford Light Rail station platforms and the pedestrian crossing movements at Anzac Parade to the eastern and western sides are summarised in Table 4.3.

As shown in Figure 4.3 and Figure 4.4, three formal pedestrian crossing locations will be provided on both the eastern and western sides of the station generally at the northern, mid-point and southern end of the Kingsford (Nine Ways) station area which extends for approximately 300 metres between the Nine Ways intersection in the north and the Sturt Street intersection in the south.

The number of peak hourly pedestrian crossing movements, from the western side to the eastern side of Anzac Parade south of the Nine Ways roundabout, is very low currently as there are no signalised pedestrian crossing facilities.

The rate of pedestrian crossing movements currently is approximately one pedestrian every two minutes at any specific location, but these movements are likely to increase to up to 10 pedestrians approximately every two minutes at locations in the vicinity of the future Light Rail station, once formal pedestrian crossing facilities are provided.

Table 4.3 Capacity analysis of pedestrian movement and waiting areas (Kingsford Nine Ways)

Area	Description of use	Dimensions and area	Number of passengers per tram (within a two minute period potentially)	Crowding level of service
K1, Tram Boarding Platform Western Side	Passengers arriving by bus and crossing the platform to board the tram, plus other waiting (walk up) passengers from the local Kingsford (south) area	6 m wide x 120 m long (720 m^2 in total)	Maximum 392 persons per tram during the morning peak period	1.84 m^2 per person (level of Service C for a movement area) This assumes passengers at the platform are primarily moving from buses to a waiting tram or walking from the local area immediately prior to boarding a tram.
K2, Tram Alighting Platform Eastern Side	Passengers arriving by tram and crossing the platform to board waiting buses plus other local passengers walking to the local Kingsford (south) area	6 m wide x 120 m long (720 m^2 in total)	Maximum 333 persons per tram during the afternoon peak period	2.16 m^2 per person (level of Service C for a movement area) This assumes passengers at the platform are primarily moving from a tram to buses or are walking to the local area immediately after alighting from a tram.
K3, Three pedestrian crossings on the eastern side of the station	The pedestrian crossings will be used by the locally based light rail passengers and other unrelated pedestrian traffic crossing Anzac Parade in the locality	Each crossing is approximately 3-4 m wide and between 10 and 15 m long (44 m^2 typically)	Maximum 17 persons per crossing per tram during the morning peak period plus 10 unrelated local area pedestrian movements (total 27 persons)	1.62 m^2 per person (level of service C for a movement area)
K4, Three pedestrian crossings on the western side of the station	The pedestrian crossings will be used by the locally based light rail passengers and other unrelated pedestrian traffic crossing Anzac Parade in the locality	Each crossing is approximately 3-4 m wide and between 8 and 15 m long (40 m^2 typically)	Maximum 8 persons per crossing per tram during the morning peak period plus 10 unrelated local area pedestrian movements (total 18 persons)	2.22 m^2 per person (level of service C for a movement area)

4.1.3 Provision for cyclists

Secure bicycle parking (approximately 30 parking spaces) is proposed to be provided by ALTRAC in a designated structure in the south-western part of the station area.

Access via a designated cycling route will be provided to the bicycle parking facility for cyclists travelling north or south via Anzac Parade within the wide central median area south of the station. However, this cycle route will not continue through the station precinct to the north and cyclists would need to use other routes to travel around the station precinct if continuing their journeys to the north.

It is assumed that cyclists would not generally be allowed to take bicycles on the Light Rail vehicles during the peak hours but possibly this may be allowed at other times of the day, when the passenger crowding levels are lower.

4.2 Todman Avenue

There are no formally proposed bus interchange to Light Rail passenger movements anticipated in the vicinity of the Todman Avenue Light Rail station, between the existing bus stops in either Todman Avenue or Anzac Parade and the future Light Rail Station. Some informal bus to Light Rail interchange passenger movements may occur although bus interchange parking or waiting areas are not specifically allowed for in the station design.

The proposed future layout of the Light Rail station platform is shown in Figure 4.5. The station has a single central platform which is 4.4 m wide and approximately 80 m in length (350 m^2 total area) excluding the tapered sections at each end.

The total per tram total passenger boarding and alighting movements for the Todman Avenue Station during the morning and afternoon peak periods are, as follows:

- morning peak period = 45 passengers boarding per tram from the local area of Anzac Parade plus 3 passengers per tram alighting. These passengers (48 in total) would normally be equally distributed travelling to and from the local areas on the east side and the west side of Anzac Parade and the northern and southern ends of the Todman Avenue station, and

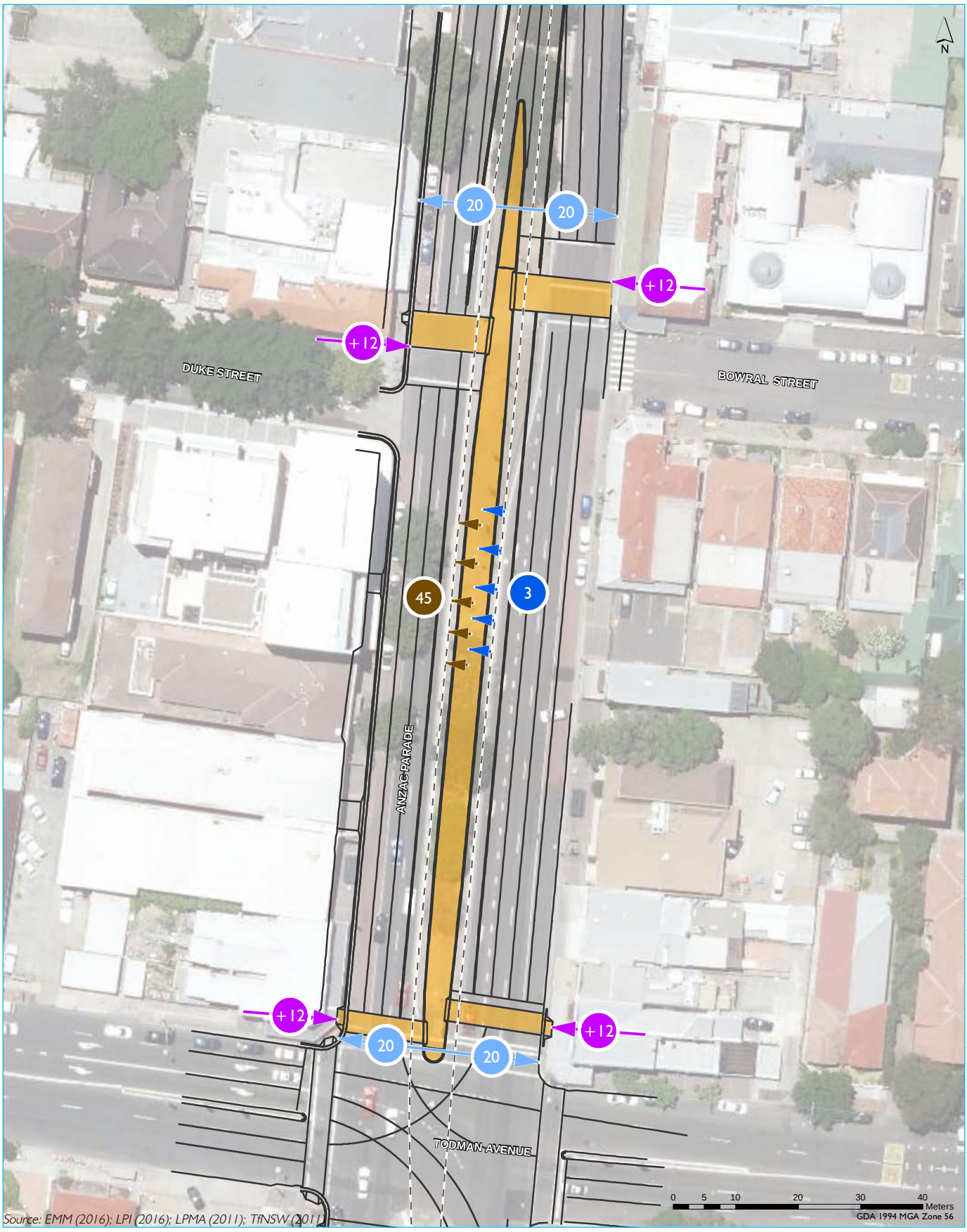
- afternoon peak period = 3 passengers boarding per tram from the local area of Anzac Parade plus 39 passengers per tram alighting. These passengers (42 in total) would normally be equally distributed travelling to and from the local areas on the east side and the west side of Anzac Parade and the northern and southern ends of the Todman Avenue station.

4.2.1 Capacity for pedestrians

Signalised pedestrian crossings exist currently at both the northern and southern ends of the station, which cross the full width of Anzac Parade in two stage. These crossings will be incorporated into the future Light Rail station design.

The existing level of pedestrian crossing movements per two minute period, from the western to the eastern sides of Anzac Parade, at both the existing (Todman Avenue - north side and Duke Street) pedestrian crossings are up to 10 pedestrian crossing movements every two minutes at each pedestrian crossing. With increased future levels of urban development in the Kensington locality, these existing locality pedestrian crossing movements may potentially increase to up to 20 pedestrian crossing movements every two minutes, crossing Anzac Parade in a two stage crossing movement generally.

The level of service capacity assessment for the Todman Avenue Light Rail station platform and the pedestrian crossing movements at Anzac Parade at the northern and southern station ends is summarised in Table 4.4.



Source: EMM (2016); LPI (2016); LPMA (2011); TfNSW (2011)

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KEY

- Site survey (CAD)
- Proposed light rail (centreline)
- Pedestrian access

Passenger movements per tram

- Station pedestrian access (count)
- General public pedestrian crossing (count)
- Passenger alighting (count)
- Passenger boarding (count)

AM peak future Todman Avenue Station passenger movements

Randwick Light Rail

Figure 4.5

EMM

Table 4.4 Capacity analysis of pedestrian movement and waiting areas (Todman Avenue)

Area	Description of use	Dimensions and area	Number of passengers per tram (within a two minute period potentially)	Crowding level of service
T1, Tram Boarding Platform (morning peak hour)	Primarily passengers waiting to board trams from the local Kensington area	4.4 m wide x 80 m long (350 m^2 in total)	Maximum 48 persons per tram (primarily boarding trams) during the morning peak period	7.29 m^2 per person (level of Service A for a standing area) This assumes passengers at the platform are generally waiting to board a tram.
T2, Tram Alighting Platform (afternoon peak hour)	Primarily passengers leaving the station area after alighting from a tram to walk to the local Kensington area	4.4 m wide x 80 m long (350 m^2 in total)	Maximum 42 persons per tram (primarily alighting from trams) during the afternoon peak period	8.33 m^2 per person (level of Service A for a movement area) This assumes passengers at the platform are generally moving to leave the station area as quickly as possible.
T3,Pedestrian crossings at the northern end of the station	The pedestrian crossings will be used by the locally based light rail passengers and other unrelated pedestrian traffic crossing Anzac Parade in the locality	Each crossing is approximately 5-6 m wide and between 12 and 15 m long (74 m^2 typically)	Maximum 12 persons per crossing per tram during the morning peak period plus 20 unrelated local area pedestrian movements (total 32 persons)	2.31 m^2 per person (level of service C for a movement area)
T4,Pedestrian crossings at the southern end of the station	The pedestrian crossings will be used by the locally based light rail passengers and other unrelated pedestrian traffic crossing Anzac Parade in the locality	Each crossing is approximately 3-4 m wide and between 12 and 15 m long (47 m^2 typically)	Maximum 12 persons per crossing per tram during the morning peak period plus 20 unrelated local area pedestrian movements (total 32 persons)	1.47 m^2 per person (level of service C for a movement area)

4.2.2 Provision for cyclists

A minimum of 20 bicycle parking stations are proposed to be provided by ALTRAC for each Light Rail station. At Todman Avenue, the location of the proposed bicycle parking facility is yet to be determined.

There is generally no proposed provision for a future on road cycleway route along Anzac Parade in addition to the Light Rail system. However, in the Kensington locality, other routes such as Doncaster Avenue are designated as cycling routes as an alternative route to using Anzac Parade.

Nevertheless, due to its generally straight and level alignment and the existence of bus lanes which can also be used by cyclists on many sections, Anzac Parade is a popular cycling route currently and this relatively high on-road cycling usage is anticipated to continue in the future. For this reason, wherever it is feasible for the existing Anzac Parade corridor bus lanes to be retained, the bus lanes should be retained to maintain the benefit for both buses and cyclists travelling via Anzac in the future.

5 Additional factors considered

5.1 Effect of University of NSW student travel demand

The UNSW staff travel demand numbers are included in the official TfNSW journey to work travel statistics which are derived from the ABS Census data. Therefore, it is mainly the additional university student travel demand which needs to be considered in terms of the general effects on the future Anzac Parade public transport corridor travel demand and capacity, in both the city-bound and the out-bound directions, during both the morning and afternoon peak travel periods.

The UNSW student travel demand is primarily in the contra peak direction to local commuter travel as it is mainly heading towards the University (away from the Sydney CBD) in the morning peak hour and in the opposite direction in the afternoon peak hour. While this travel demand is now primarily using the Anzac Parade corridor currently, with the Light Rail system in the future it will need to be evenly distributed between the Anzac Parade and High Street Light Rail routes to effectively utilise the spare 'counter peak' direction passenger capacity on both routes. Its impacts will therefore be less concentrated on the Anzac Parade corridor route in the future than they are currently.

From the most recent UNSW travel survey report in 2016, there are now approximately 36,573 students present at the campus on an average weekday during the term time. Of this number, approximately 59.8% (21,871) travel by public transport. Of these:

- 37.4% (8,179) arrive during the morning peak one hour 8-9 am; and
- 27.8% (6,080) depart during the afternoon peak one hour 5-6 pm.

About 62.5% of these students (5,111 during the morning peak hour and 3,800 during the afternoon peak hour) use the university express buses. The remaining 37.5% of these students (3,068 during the morning peak hour and 2,280 during the afternoon peak hour) use a variety of other public bus services on routes travelling from the north, east, south, west or south-west, including routes 303, 348, 370, 391/2/3/4/5/6/7/9, 400, 410, L94, M10 and M50. From the bus passenger survey results in the UNSW travel survey report in 2016, the estimated proportions of students travelling by these buses are:

- 37% travelling from the south from areas within Randwick LGA;
- 32% travelling from the west and the south west from areas adjoining Randwick LGA;
- 21% travelling from local areas to the north (not using the university express services), and
- 10% travelling from local areas to the east.

On a typical weekday morning, there are approximately 1,135 students during peak hour using 'other public buses', ie routes 391/2/3/4/5/6/7/9, L94 and M10 on Anzac Parade or Bunnerong Road, south of the University, travelling northwards to the University. There are also approximately 644 students per hour using other public buses (not the University express services) within the Anzac Parade corridor north of the University, travelling southwards to the University.

A summary and future growth projection of the UNSW student travel demand for the existing UNSW express buses (future Light Rail) and other bus services, based on presumed future growth rates of +10% for the four year period from 2016 to 2020 and +40% for the fifteen year period to 2031, is presented in Table 5.1.

Table 5.1 Summary and future growth projection of UNSW student bus/light rail travel demand

Direction from/to	Existing year 2016 student travel demand from UNSW survey	Future projected demand in 2020 (+10% growth from 2016)	Future projected demand in 2031 (+40% growth from 2016)
Express buses from CBD	5,111	5,622	7,155
Other buses from south	1,135	1,249	1,589
Other buses from west or south-west	982	1,080	1,375
Other buses from east	307	338	430
Other buses from north	644	708	902
Total all routes (am peak hour)	**8,179**	**8,997**	**11,451**
Express buses to CBD	3,800	4,180	5,320
Other buses to south	844	928	1,182
Other buses to west or south-west	730	803	1,022
Other buses to east	228	251	319
Other buses to north	478	526	669
Total all routes (pm peak hour)	**6,080**	**6,688**	**8,512**

The primary option for the current UNSW student travel demand is to use the express buses which travel to and from the Sydney CBD. However, when the Light Rail system is operating, this demand will be effectively transferred to the future Light Rail services on both the Anzac Parade and Randwick branches. Also, this travel demand is projected to increase from 5,111 students per hour in 2016 to up to 7,155 students by 2031 (Table 5.1). This student travel demand will effectively take up most, if not all, the spare travel capacity on both the Anzac Parade and High Street branches of the Light Rail route in the counter (commuter) peak direction, which is anticipated to be approximately 3,000 to 3,500 passengers per hour on each branch of the Light Rail system.

In the year 2016, the additional 1,135 students per hour using the ordinary public bus services on Anzac Parade routes 391/2/3/4/5/6/7/9, L94 and M10, south of the university, will represent an extra 31% peak hourly loading for the public buses travelling north-bound within the Kensington to Kingsford area, in addition to the calculated year 2016 total of 3647 local commuter passengers also travelling on these buses.

The equivalent total of 644 additional university students travelling south-bound will represent an extra 57% loading approximately for the ordinary public bus services on Anzac Parade travelling south-bound through the Kensington to Kingsford area, in comparison to the calculated year 2016 travel demand from local employment, which is 1,125 persons travelling south-bound in the morning peak hour at Carlton Street.

These additional UNSW student travel movements are potentially significant in terms of the overall corridor passenger crowding levels in the north-bound direction, between Kingsford and the University Station, although the additional student travel demand does not generally affect the morning peak hour corridor movements, north of Carlton Street.

In the south-bound direction approximately one third of the overall south-bound student total of 644 using public buses currently would be boarding buses or future trams during the morning peak hour at the two local Kensington area stations north of the University (Todman Avenue and Carlton Street).

This proportion, approximately 214 students, would generate approximately 107 students per hour boarding at each station. On a per tram basis, with nine trams per hour, the additional university student boarding numbers would be approximately 12 students boarding each southbound tram at the two stations.

These additional University student boardings would have only a minimal effect on the future Light Rail station platform capacity analysis for the Todman Avenue and Carlton Street stations, in the morning peak hour as the future platform crowding levels at each stations would be relatively low (level of service A) as determined by the station capacity analysis in Table 4.4 and Figure 4.5 of this report.

Although the additional UNSW student travel demand over the Light Rail route north-bound between the Kingsford (Nine Ways) and the UNSW Light Rail stations could significantly increase the future corridor passenger movements and crowding levels (on both buses and Light Rail) during the one hour morning peak travel period, this additional student travel is not anticipated to affect the future Light Rail station capacity boarding analysis in Table 4.3 and Table 4.4, because any students travelling on a bus south of Kingsford, which is continuing north-bound either to Todman Avenue or the Sydney CBD, would generally continue travelling on the same bus north-bound from Kingsford to the University as they would not benefit from transferring to the Light Rail services for such a short section of their journey.

This does however require that significant numbers of north-bound buses will still be retained in the Anzac Parade corridor travelling north of Kingsford, as is shown in Table 3.2, where at least 26 buses per hour in the interim (year 2020) scenario and 36 buses per hour in the longer term (year 2031) analysis scenario will be required to operate north of Kingsford in addition to the Anzac Parade corridor Light Rail services.

5.2 Effect of future system extension to Maroubra

Additional future summary tables of the predicted morning peak hour corridor travel demand north-bound have been produced for three future (year 2020 and year 2031) scenarios in Appendix F. These three scenarios present a sensitivity analysis of the Kingsford terminus option if an enhanced future corridor public transport travel mode share can be achieved (factor x1.1 for increased public transport usage) for the areas which will have direct walk up access to the future Light Rail stations and the future effect of extending the Light Rail system to Maroubra Junction with an additional intermediate station on Anzac Parade between Kingsford and Maroubra, just south of the Avoca Street junction.

The three future corridor travel demand scenarios which are shown in Appendix F also include the peak hourly travel demand up to 2031 from the UNSW students living within Randwick LGA, who are travelling north-bound between Kingsford and the university. The three scenarios represent:

- the base corridor travel demand analysis which assumes no change in the corridor public transport travel mode share up to 2031;
- The enhanced corridor travel demand analysis which assumes a 10% proportional increase in the corridor public transport usage, to and from the areas which will have direct walk-up access to Light Rail (ie Kensington and Kingsford), and
- the extension of the Anzac Parade Light Rail route to Maroubra Junction, with an enhanced corridor travel mode share (10% proportional increase in the corridor public transport usage) for the areas which would have direct walk-up access to Light Rail (ie Kensington, Kingsford and the areas on either side of Anzac Parade, south to Maroubra Junction).

The future corridor travel demand charts in Appendix F are directly comparable to the morning peak hour north-bound Light Rail passenger volume charts which have published by TfNSW in the December 2013 EIS and the subsequent modification reports for the CSELR project, but include an extra coloured section to illustrate the additional UNSW student passenger travel demand compared to the local commuter travel demand for the route.

The future extension of the Light Rail corridor (walk up) catchment, when the route is extended to Maroubra Junction is shown in Figure 5.1 and the future (year 2031) predicted corridor public transport travel demand projections for the morning and afternoon peak one hour travel periods are shown in Figure 5.2 and Figure 5.3.

The required future bus network operations for the corridor for each scenario are shown in Table 5.2. The the number of existing corridor bus services which will need to be maintained travelling through to the Sydney CBD, to maintain the overall future system passenger crowding level at approximately 80% for the corridor north of Carlton Street is calculated in Table 5.2, notwithstanding that between Kingsford and the UNSW station, the localised future morning peak hour north-bound passenger crowding would actually increase to approximately 90%.

Table 5.2 Summary of future morning peak hour travel demand to CBD north of Kensington

Year	Predicted corridor demand north of Carlton Street	Actual peak demand before reaching UNSW station	Required system capacity for 80% loading north of Carlton Street	Proposed LRT capacity per hour in both directions	Required additional bus capacity per hour	Number of retained buses per hour continuing to CBD *
Base Model Analysis (Kingsford Terminus) with no Public Transport travel mode share increases with Light Rail System						
2020	4,045	(4,451)	5,056	3,495	1,561	26
2031	5,141	(5,670)	6,426	4,300	2,126	35
Enhanced Model (Kingsford Terminus) with x 1.1 Public Transport travel mode share in areas with walk up access to Light Rail						
2020	4,194	(4,540)	5,239	3,495	1,744	29
2031	5,342	(5,792)	6,678	4,300	2,378	40
Enhanced Model (Maroubra Extension) with x 1.1 Public Transport travel mode share in areas with walk up access to Light Rail						
2020	4,278	(4,624)	5,348	3,495	1,853	31
2031	5,438	(5,888)	6,798	4,300	2,498	42

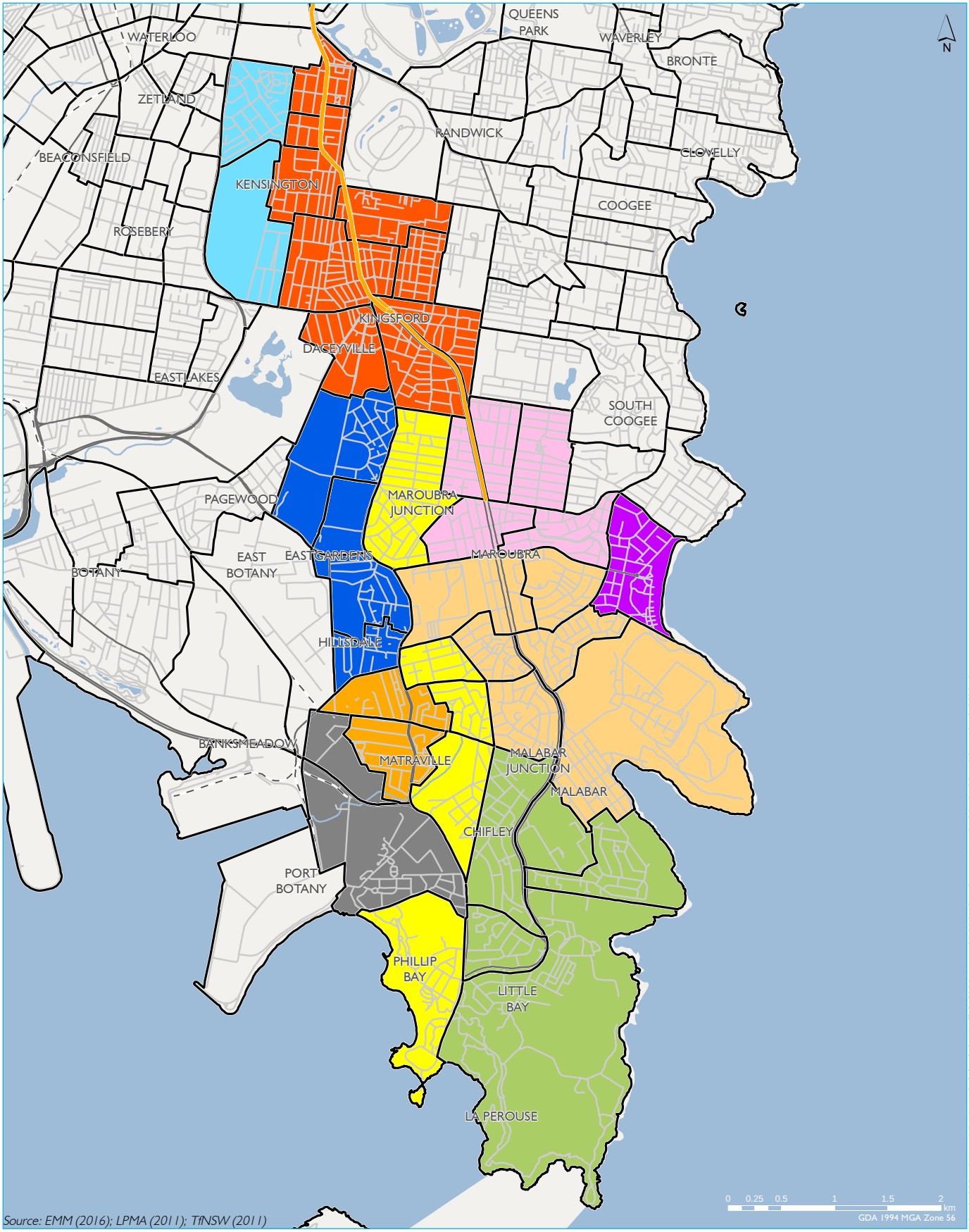
Note: Includes buses travelling to the Sydney CBD via Todman Avenue.*

5.3 Capacity for future buses to continue travelling to the Sydney CBD

Recent increases in the number of peak hourly express bus services

It is understood from the December 2013 CSELR EIS and subsequent announcements that the NSW government is effectively committed to retaining existing express bus services from the Randwick area, in both the Alison Road and the Anzac Parade 'corridors' travelling through to the Sydney CBD.

In this context, it should be noted that the number of north-bound peak hourly express bus services travelling via the Anzac Parade route through Kingsford and Kensington has actually increased from approximately 15 buses per hour in 2011 to approximately 30 buses per hour in November 2016, based on the bus timetables for bus routes X92/4/6/7/9 and L94, for the one hour period 7.45 to 8.45 am at Carlton Street (This period corresponds to the actual peak one hour morning arrival time of between 8.00 to 9.00 am for buses arriving at the Sydney CBD). If these existing express buses are retained, together with approximately eight buses per hour travelling on the route 303 via Todman Avenue to the Sydney CBD, the NSW government can relatively easily maintain up to 38 buses per hour travelling through the Kingsford and Kensington areas to the Sydney CBD in a one hour morning peak period. This would meet the future requirement which is identified by this study (Table 5.2) for future Anzac Parade bus services to operate in addition to the Light Rail system, to support the projected Randwick LGA residential growth of +15,150 dwellings over the fifteen year future period to 2031.



Source: EMM (2016); LPMA (2011); TfNSW (2011)

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KEY

- Anzac Parade light rail
- Rail line
- Main road
- Local road
- Watercourse
- Travel Zone boundary

Travel Zone

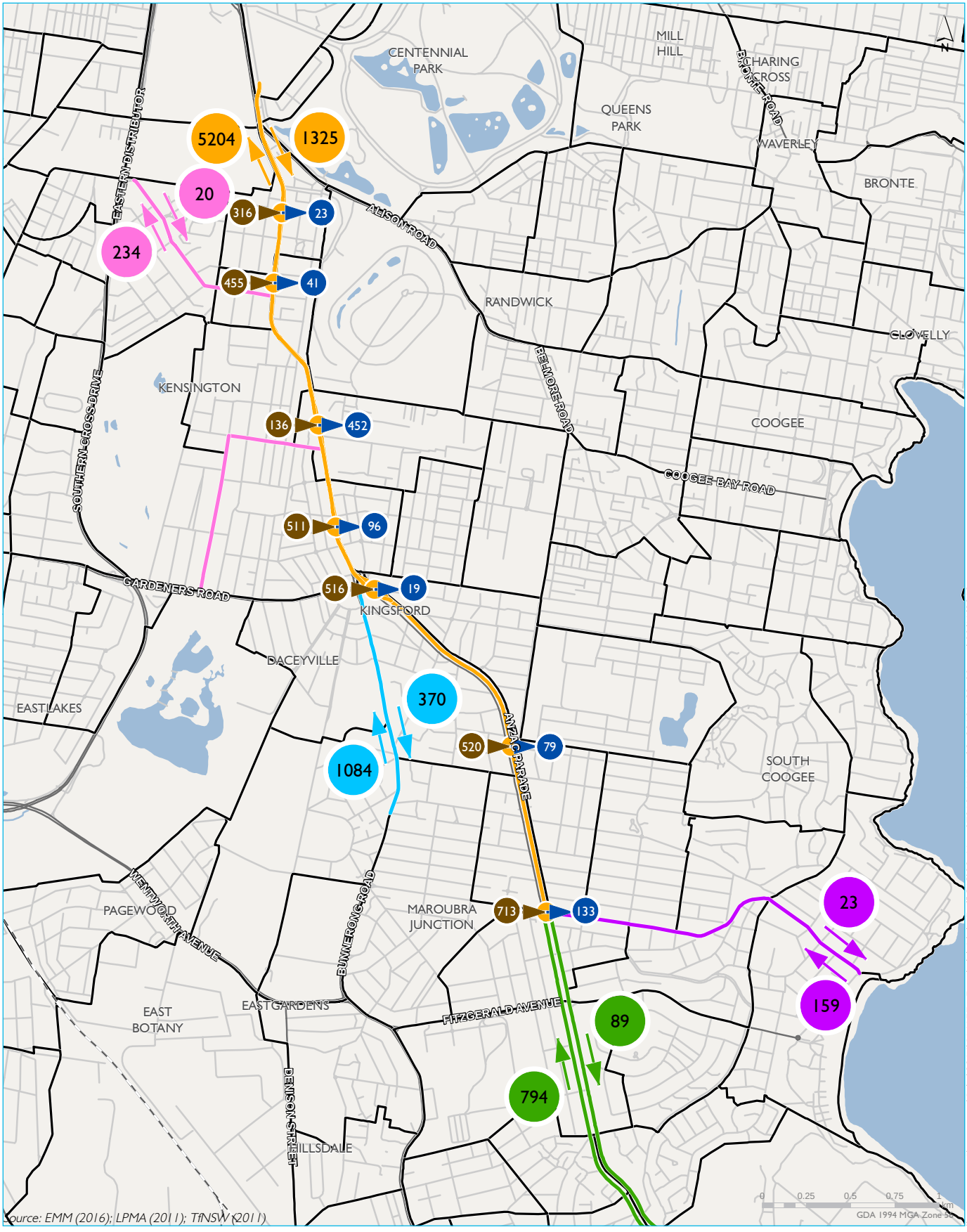
- Botany Industrial
- Bunnerong Road East
- Bunnerong Road West
- Light Rail Walk Up Catchment
- Little Bay and La Perouse
- Maroubra Beach
- Maroubra Extension
- Matraville
- Route 303 Bus Catchment
- South Maroubra and Malabar

Anzac Parade corridor future light rail and bus routes catchment map

Randwick Light Rail

Figure 5.1

EMM



KEY (excludes UNSW student travel)

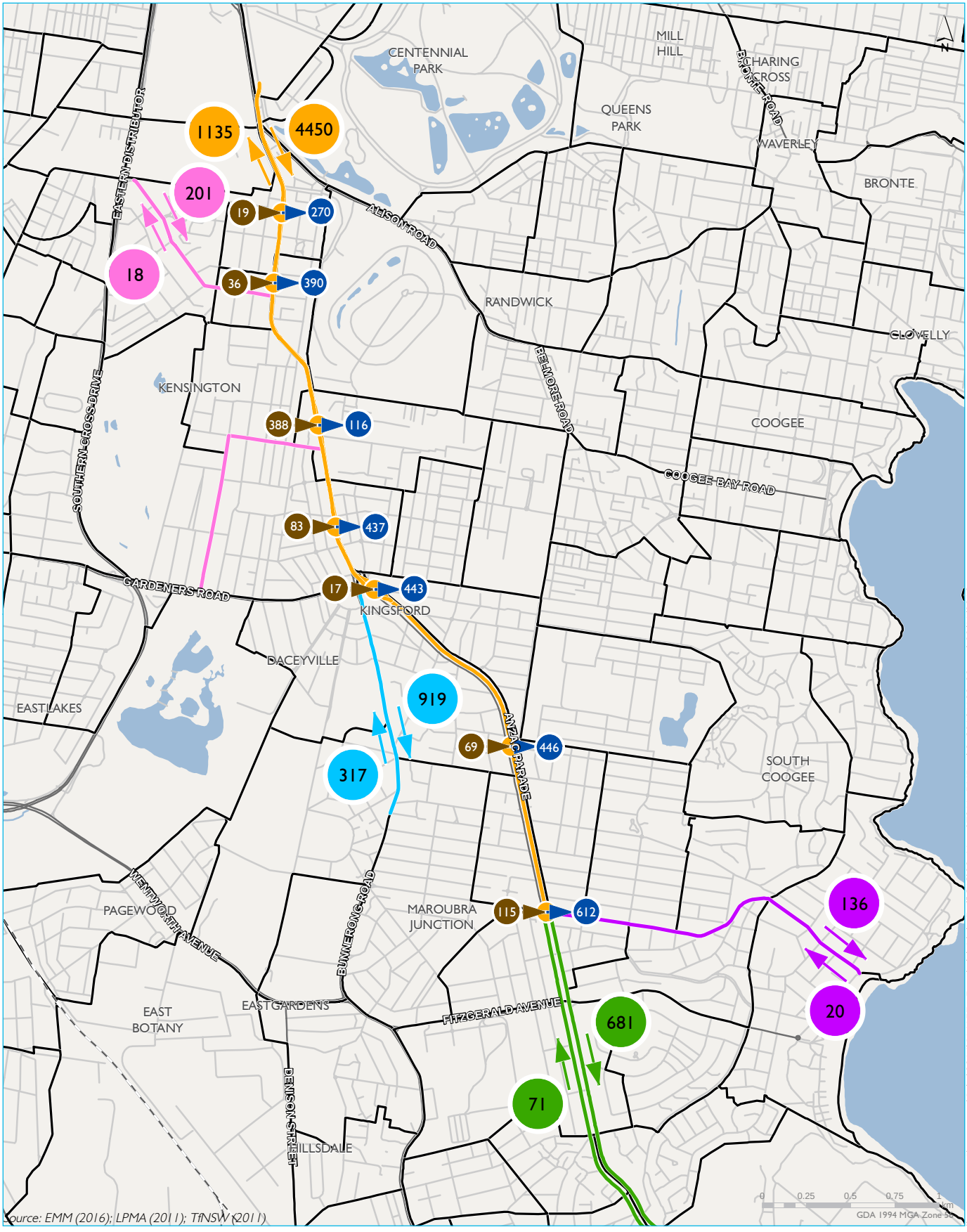
- Main road
- Local road
- Rail line
- Watercourse
- Waterbodies
- Light rail station
- Passenger alighting (count)
- Passenger boarding (count)
- Proposed light rail (count)
- Eastern - Day - Todman bus route (count)
- Bunnerong Road (count)
- Anzac Parade (count)
- Maroubra Road (count)

Future (2031) AM peak hour corridor public transport movements

Randwick Light Rail

Figure 5.2

EMM



Source: EMM (2016); LPMA (2011); TfNSW (2011)

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KEY (excludes UNSW student travel)

- Main road
- Local road
- Rail line
- Watercourse
- Waterbodies
- Light rail station
- Passenger alighting (count)
- Passenger boarding (count)
- Proposed light rail (count)
- Eastern - Day - Todman bus route (count)
- Bunnerong Road (count)
- Anzac Parade (count)
- Maroubra Road (count)

Future (2031) PM peak hour corridor public transport movements

Randwick Light Rail

Figure 5.3

EMM

Recent changes to bus capacity in the Sydney CBD (Elizabeth Street)

Since October 2015 (with the closure of George Street for the CBD Light Rail construction), all the CBD buses are effectively already using the ultimate future routes which they will be using once the Light Rail system operating.

As Elizabeth Street and the other bus destinations in the Sydney CBD are now carrying approximately 80 in-bound buses per hour from the Bunnerong Road and Anzac Parade via Kingsford and Kensington bus routes, there is no reason in principle why up to 40 buses per hour from these routes could not be retained in the future to continue to travel to and from the Sydney CBD in the peak hours via these routes.

The bus capacity of Elizabeth Street has been significantly improved in the short term by "doubling up" the bus lanes by designating the second lane out from the kerb as a 'moving' bus lane and the kerbside lane as the ‘stopping’ bus lane. Some replacement north-south road capacity for general traffic has been provided on College Street (including the removal of the cycleway) which provides additional north-south capacity for car traffic diverted from Elizabeth Street.

However, the stated objectives in the TfNSW reports (Sydney's Bus Future, 2013) and (Sydney City Centre Access Strategy, 2013) consistently refer to a total of over 1,000 buses per hour entering the Sydney CBD during the one hour 8-9 am morning peak period at that time. In these reports, of these 1,000 buses per hour, 220 buses can be removed once the CSELR Light Rail system is operating and a further 160 buses are able to be replaced by the future NW Rail Link (now Metro) train services.

The anticipated reduction of 220 in-bound buses per hour travelling into the Sydney CBD represents significantly more than the current total morning peak hour inbound Anzac Parade and Alison Road bus services (about 150 buses per hour in total). Therefore the anticipated reduction must include significant changes with the morning peak inbound CBD bus services on routes other than from Anzac Parade and Alison Road. These other changes may include early termination at the Edgecliff bus interchange or through routing to avoid the key CBD bus route streets such as Elizabeth Street.

The objective of reducing the total in-bound morning peak hour bus services to the CBD by 220 buses with the CSELR Light Rail and related bus network changes is relatively ambitious, but is effectively a stated objective that TfNSW and City of Sydney will be trying to achieve when future changes to the CBD bus services are implemented in the year 2019, once the CSELR Light Rail system is operating.

Future changes to the local Kingsford and Kensington area bus lanes

In the local Anzac Parade Kensington and Kingsford areas, there will be some loss of general traffic capacity with the future introduction of the CSELR Light Rail system as although the road will generally retain three lanes each way at most locations (such as at Todman Avenue), where the existing bus lanes could still be kept, elsewhere (such as at Carlton Street) there will be a reduction to the general road traffic capacity to two lanes each way and the existing bus lanes could not be esily retained.

The CSELR Light Rail system will require the partial removal of some of the bus lanes on Anzac Parade, but in many locations they could (and probably should) still be kept, in particular at locations such as Todman Avenue, which will effectively remain as a major bus stop location in the future on Anzac Parade, as well as a Light Rail stop.

Ultimately, if significant numbers of in-bound morning peak hour bus services (and the equivalent out-bound bus services during the afternoon peak hour) are not able to be retained for the Anzac Parade corridor, this will bring forward the required future timing for an extension to the Bondi Junction heavy rail line, either to Kingsford or Maroubra (or even as a loop via Mascot connecting back to the Illawarra line at Sydenham). This would be a necessary longer term option to improve the public transport access capacity for all areas of Randwick LGA once the effective capacity of the current bus and (now under construction) Light Rail systems are reached.

With likely future limits on the number of peak hour buses which are allowed to travel to and from the Sydney CBD from areas of Randwick LGA, this ultimate "heavy rail' option may be required within the general timeframe of the 2031 dwelling growth projections for Randwick LGA.

5.4 Comparison with historic crowding levels for Sydney trains and buses

Another potential concern with the future Anzac Parade corridor Light Rail system is that the proposed Light Rail vehicle passenger capacity rates are significantly higher than previously accepted Sydney public transport benchmark crowding levels for either heavy rail 'double deck train' or bus services.

Previously 2,000 persons per train has been the accepted 'crush capacity' maximum passenger loading for a Sydney eight car double deck train and 70 persons (43 seated plus 27 standing) was the maximum permissible loading for the older style, pre wheelchair accessible, 12.5 m long Sydney buses.

The respective maximum passenger crowding rates for these two situations are approximately 2000 persons/800 m^2 area available to passengers = 2.5 persons per m^2 for an 8 car Sydney train and 70 persons/25 m^2 area available to passengers = 2.8 persons per m^2 for a pre wheelchair accessible 12.5 m long Sydney bus.

In comparison, the proposed 66 m long Randwick Light Rail tram vehicles can have 466 persons/143 m^2 area available to passengers = 3.3 persons per m^2, which is about 25% higher than the average of the previously identified maximum crowding levels (which were defined as crush capacity) for either Sydney trains or buses.

Realistically, the maximum practical crowding level for the proposed 66 m long Randwick trams is probably about 80% of the maximum stated capacity of 466 persons and is about 380 persons per tram. Once an operating trams gets above this level of crowding (which is 2.65 persons per m^2), there is going to be a tendency for passengers to wait on the platform and hope the next tram is less crowded rather than try and force their way on.

This comparison also supports a recommended '80% design capacity' average one hour morning peak period occupancy limit for the future Light Rail system peak hour operations for local commuters (notwithstanding that higher actual crowding levels may possibly be achieved for the UNSW students travelling in the opposite direction).

This practical occupancy limit is recommended to support a public transport focus for future residential growth in Randwick LGA and encourage higher public transport use in preference to car travel by locally based commuters. It is also generally consistent with the currently observed one hour morning peak period passenger crowding levels, which are between 70% and 80% capacity, for the existing network of bus routes serving the Anzac Parade corridor within the Kensington and Kingsford areas.

6 Summary and conclusions

6.1 Light Rail system capacity

This assessment has undertaken an overall review of the future Light Rail system capacity to determine the future ability of the additional public transport capacity along the Anzac Parade route to support future residential growth in accordance with the projected dwelling growth (including the Kensington and Kingsford town centres and other areas further south towards Maroubra, Matraville and La Perouse).

It is a significant concern that the proposed Light Rail system capacity will actually be lower than the capacity of the existing peak hour bus services which are currently using Anzac Parade and Todman Avenue and the future corridor public transport system will effectively be operating at full capacity from the commencement of operations in 2019. This will require a significant number of existing peak hourly bus services (mainly the existing express bus service) to be retained if the system is to provide adequate public transport capacity for all the relevant areas of Randwick LGA in the future.

The key conclusions in relation to the study analysis are:

The overall LGA and K2K dwelling targets

The currently proposed dwelling targets for Randwick LGA and the K2K town centres are achievable, subject to the provision of adequate public transport capacity. A significant proportion of the existing corridor bus based public transport system will need to be retained for reasonable corridor morning peak hour average passenger crowding levels to be maintained, in both the interim year 2020 (first full year of the system operations) and the longer term year 2031 LGA residential strategy full development scenario.

In 2020, with approximately +4,040 additional dwellings forecast to be constructed in Randwick LGA and the peak hour Light Rail (tram) frequency at eight minutes, the future northbound corridor peak passenger loading (between Kingsford and the University Station) will exceed the Light Rail system capacity by approximately 1,000 passengers per hour and an additional 26-29 buses per hour will be required travelling north of Kingsford through to the Sydney CBD or other equivalent destinations.

In 2031, with +15,150 additional dwellings forecast to be constructed in Randwick LGA and the peak hour Light Rail (tram) frequency at 6.5 minutes, the future northbound corridor peak passenger loading (between Kingsford and the University Station) will exceed the Light Rail system capacity by approximately 1,500 passengers per hour and an additional 35-40 buses per hour will be required travelling north of Kingsford through to the Sydney CBD or other equivalent destinations.

In the longer term beyond the year 2031, or earlier if it is not considered feasible by TfNSW and City of Sydney to retain significant peak hour bus services travelling to or from the Sydney CBD from relevant areas of Randwick LGA, an extension to the Eastern Suburbs (Bondi Junction) heavy rail line would be required, either to Kingsford or Maroubra (or even as a loop via Mascot connecting back to the Illawarra line at Sydenham) to ensure adequate public transport capacity can be provided to all relevant areas of Randwick LGA in the future.

Future public transport system peak hour passenger crowding levels

The future consequences if significant existing bus services are not maintained with the Light Rail system operations are that the future peak hour passenger crowding levels on the Anzac Parade public transport system will significantly worsen in comparison to the current levels. This will adversely affect the future attractiveness and use of public transport travel for existing users and new residents moving to the area.

This outcome would be contrary to the TfNSW objectives for providing an improved public transport system for the Anzac Parade route and the public transport focused travel objectives which underlie the draft Planning Strategy for Kensington and Kingsford town centres.

The predicted future morning peak hour travel demand north-bound within the corridor will be significantly influenced by locally based UNSW student travel movements between the Kingsford and University stations. Although the future overall average north-bound passenger crowding level for the future public transport system can be maintained at approximately 80% for the corridor north of Carlton Street, the localised future passenger crowding level would increase to approximately 90% between the Kingsford and University stations.

6.2 Light Rail station platform and pedestrian crossing capacity

The detailed future (commuter) level of service evaluation of the Light Rail station platform and pedestrian crossing operations at the future Kingsford (Nine Ways) and Todman Avenue stations is summarised in Table 6.1.

The table also includes consideration of the likely additional effect of the UNSW student travel demand at each assessed location for the additional north-bound and south-bound student travel demand which would be either boarding or alighting from trams at each station stop.

Table 6.1 Summary of Level of Service evaluation of station platforms and pedestrian crossings

Station Location	Area (m^2)	Average passengers and pedestrians per tram (from commuters)	Level of Service	Potential additional number of UNSW student passengers per tram	Potential effect of additional UNSW student passengers
Kingsford K1, Tram Platform Boarding (am peak)	720	397	C	122	It is assumed that the north-bound university students would not generally transfer from buses to the Light Rail at Kingsford and would not therefore affect the platform crowding levels.
Kingsford K2, Tram Platform Alighting (pm peak)	720	337	C	90	It is assumed that the south-bound university students would generally be on buses from UNSW and would not therefore affect the platform crowding levels
Kingsford K3 Eastern Side pedestrian Crossings (am peak)	44	27	C	5	The additional university student crossing numbers are relatively minor and would not affect the overall crossing level of service
Kingsford K4 Western Side pedestrian Crossings (am peak)	40	18	C	3	The additional university student crossing numbers are relatively minor and would not affect the overall crossing level of service

Table 6.1 Summary of Level of Service evaluation of station platforms and pedestrian crossings

Station Location	Area (m^2)	Average passengers and pedestrians per tram (from commuters)	Level of Service	Potential additional number of UNSW student passengers per tram	Potential effect of additional UNSW student passengers
Todman Avenue T1, Tram Platform Boarding (am peak)	350	48	A	12	The additional student numbers are relatively minor and would not affect the station platform level of service
Todman Avenue T2, Tram Platform Alighting (pm peak)	350	42	A	9	The additional student numbers are relatively minor and would not affect the station platform level of service
Todman Avenue T3 Northern End pedestrian crossings (am peak)	74	32	C	6	The additional student crossing numbers are relatively minor and would not affect the pedestrian crossing level of service
Todman Avenue T4 Southern End pedestrian crossings (am peak)	47	32	C	6	The additional student crossing numbers are relatively minor and would not affect the pedestrian crossing level of service

6.3 Future effects of extension to Maroubra and buses in the Sydney CBD

In terms of the overall corridor effect of a future extension of the Anzac Parade corridor Light Rail System to Maroubra Junction, there would be a relatively small increase in the overall corridor peak hourly travel demand, north-bound during the morning peak hour and south-bound during the afternoon peak hour.

In terms of the three scenarios where the future public transport capacity and demand has been analysed, where the results are summarised in Table 5.2, the maximum potential capacity of the Light Rail system will already be exceeded with the construction of the Light Rail route to Kingsford. The further effect of a system extension to Maroubra Junction would increase the overall corridor public transport travel demand, with correspondingly less spare capacity for the future Light Rail passengers boarding within the K2K town centres and an increase in the number of supporting bus services needing to be retained in the corridor to meet the overall projected future public transport travel demand.

It is understood from the December 2013 CSELR EIS and subsequent announcements that the NSW government is effectively committed to retaining existing express bus services from the Randwick area, in both the Alison Road and the Anzac Parade 'corridors' travelling through to the Sydney CBD.

In the future Elizabeth Street will become the primary bus route destination within the Sydney CBD streets. This is occurring currently with the closure of George Street for the CBD Light Rail construction as all the buses which previously used George Street are already now using their ultimate future routes which they will be using with the Light Rail system operating.

Although there is demonstrated capacity now for Elizabeth Street to carry all the required bus services which are travelling to and from the major bus destinations in the Sydney CBD for the eastern area and Parramatta Road (Inner West) bus services, potentially if there are further changes to other bus routes, the capacity to continue to accommodate up to 40 buses per hour from the Bunnerong Road and the Anzac Parade bus routes could be adversely affected in the future.

6.4 Future need and timing for an extension to the Bondi Junction heavy rail line

Ultimately, if significant numbers of city-bound morning peak hour bus services (and the equivalent out-bound bus services during the afternoon peak hour) are not able to be retained for the Anzac Parade and Alison Road routes serving Randwick LGA, this will bring forward the required future timing for an extension to the Bondi Junction heavy rail line, either to a terminus at Kingsford or Maroubra (or even as a loop continuing via Mascot connecting back to the Illawarra line at Sydenham).

Also, due to the relatively minor capacity increase to the existing Anzac Parade and Alison Road corridor bus based public transport systems which will result from the Light Rail System and the desire for more walkable areas of Randwick LGA in the future, an extension to the Bondi Junction heavy rail line remains a necessary longer term option to increase the public transport access capacity for all areas of Randwick LGA.

This ultimate future "heavy rail' extension option would be potentially required within the current timeframe (before 2031) of the residential growth strategy for Randwick LGA, if a significant proportion (50% approximately) of the current city-bound morning peak hour bus services (and the equivalent out-bound bus services during the afternoon peak hour) are not able to be retained for both the Anzac Parade and Alison Road routes.

6.5 Future changes to Anzac Parade bus lanes and cycling provision

Another related issue for the Anzac Parade route road cross section is that due to its generally straight and level alignment and the provision of bus lanes currently, Anzac Parade is a popular travel route for cyclists. For this reason, wherever it is feasible for the existing Anzac Parade corridor bus lanes to be retained, these bus lanes should be retained in view of their benefit for both buses and cyclists travelling via Anzac Parade in the future.

Appendix A

Existing Randwick LGA bus routes map


For route information in this area, refer to Southern Region Guide.
Common Bus Route Along Dotted Line
Sydney
Darlinghurst
Elizabeth Bay
Double Bay
Bellevue Hill
Bondi Junction
Glebe
Redfern
Surry Hills
Paddington
Woollahra
Edgecliff
Kings Cross
Moore Park
Centennial Park
Queens Park
Waverley
Newtown
Erskineville
Waterloo
Alexandria
Zetland
Randwick
Clovelly
St Peters
Marrickville Metro
Kensington
Kingsford
Coogee
Rosebery
Mascot
Eastlakes
Daceyville
South Coogee
Airport
Botany
Pagewood
Maroubra Junction
Maroubra
Banksmeadow
Hillsdale
Matraville
Chifley
Malabar
Port Botany
Phillip Bay
Little Bay
La Perouse
Sydenham & Wolli Creek
Eastern Region Bus Service Inset
Sydenham
Marrickville
Wolli Creek
Tempe
Undercliffe
Marrickville South
Continues on main map
Continues on Southern Region Guide

Appendix B

Existing corridor bus calibration check

Summary of bus passenger calibration check count for Anzac Parade north of Carlton Street from 7.45 to 8.45 am on Friday 11 November 2016

Bus Loading	**Number of buses**	**Persons per bus**	**Total Persons**
Full plus 20 Standing	4	70	280
Full plus 15 Standing	5	65	325
Full plus 12 Standing	1	62	62
Full plus 10 Standing	1	60	60
Full plus 8 Standing	1	58	58
Full plus 5 Standing	13	55	715
Full plus 2 Standing	4	52	208
Full plus 1 Standing	1	51	51
Full to seated capacity	3	50	150
95% seats occupied	0	47	0
90%	4	45	180
85%	8	43	344
80%	7	40	280
75%	1	37	37
70%	1	35	35
65%	1	33	33
60%	4	30	120
55%	3	27	81
50%	2	25	50
45%	2	23	46
40%	3	20	60
35%	4	17	68
30%	2	15	30
25%	2	13	26
Total all observations	**77**		**3,266**

Appendix C

2011 Census Journey to work travel statistics for Randwick LGA

AUSTRALIAN BUREAU OF STATISTICS 2011 Census of Population and Housing
Randwick (C) (LGA16550) 36.3 sq Kms

List of tables
Find out more:
Method of Travel to Work
Sex

B46 METHOD OF TRAVEL TO WORK BY SEX

Count of employed persons aged 15 years and over

	Males	*Females*	*Persons*
One method:			
Train	164	156	320
Bus	5,703	7,259	12,962
Ferry	4	5	9
Tram (includes light rail)	0	5	5
Taxi	157	99	256
Car, as driver	15,799	12,096	27,895
Car, as passenger	938	1,678	2,616
Truck	384	12	396
Motorbike/scooter	630	125	755
Bicycle	963	248	1,211
Other	189	132	321
Walked only	1,721	2,154	3,875
Total one method	*26,652*	*23,969*	*50,621*
Two methods:			
Train and:			
Bus	1,012	966	1,978
Ferry	0	0	0
Tram (includes light rail)	3	3	6
Car, as driver	57	48	105
Car, as passenger	12	41	53
Other	12	3	15
Total	*1,096*	*1,061*	*2,157*
Bus and:			
Ferry	18	9	27
Tram (includes light rail)	14	19	33
Car, as driver	175	206	381
Car, as passenger	59	160	219
Other	104	78	182
Total	*370*	*472*	*842*
Other two methods	152	110	262
Total two methods	*1,618*	*1,643*	*3,261*
Three methods:			
Train and two other methods	106	97	203
Bus and two other methods (excludes train)	43	28	71
Other three methods	16	3	19
Total three methods	*165*	*128*	*293*
Worked at home	1,066	1,428	2,494
Did not go to work	2,074	3,530	5,604
Method of travel to work not stated	372	375	747
Total	**31,947**	**31,073**	**63,020**

This table is based on place of usual residence.

B30 HOUSEHOLD COMPOSITION BY NUMBER OF PERSONS USUALLY RESIDENT(a)

Count of occupied private dwellings(b)

	Family households	*Non-family households(c)*	*Total*
Number of persons usually resident:			
One	..	12,994	12,994
Two	13,104	2,942	16,046
Three	6,958	1,106	8,064
Four	6,602	427	7,029
Five	2,374	146	2,520
Six or more	845	65	910
Total	**29,883**	**17,680**	**47,563**

(a) Includes up to three residents who were temporarily absent on Census Night.
(b) Excludes 'Visitors only' and 'Other non-classifiable' households.
(c) Comprises 'Lone person' and 'Group households'.
.. Not applicable

List of tables
Find out more:
Sex

B01 SELECTED PERSON CHARACTERISTICS BY SEX (1 of 2)

Count of persons

	Males	*Females*	*Persons*
Total persons	63,367	65,622	128,989
Age groups:			
0-4 years	3,965	3,736	7,701
5-14 years	6,051	5,750	11,801
15-19 years	3,571	3,350	6,921
20-24 years	6,710	6,496	13,206
25-34 years	12,066	12,277	24,343
35-44 years	9,805	10,164	19,969
45-54 years	7,791	8,025	15,816
55-64 years	6,007	6,307	12,314
65-74 years	3,918	4,365	8,283
75-84 years	2,525	3,336	5,861
85 years and over	957	1,817	2,774
Counted on Census Night:			
At home	60,920	63,341	124,261
Elsewhere in Australia	2,447	2,282	4,729
Indigenous persons:			
Aboriginal	878	848	1,726
Torres Strait Islander	37	36	73
Both Aboriginal and Torres Strait Islander(a)	28	16	44
Total	*943*	*900*	*1,843*
Birthplace:			
Australia	34,298	35,265	69,563
Elsewhere(b)	24,032	25,613	49,645
Language spoken at home:			
English only	39,107	40,809	79,916
Other language(c)	18,278	20,484	38,762
Australian citizen	45,854	49,705	95,559

This table is based on place of usual residence unless otherwise stated.

(a) Applicable to persons who are of both Aboriginal and Torres Strait Islander origin.

(b) Includes 'Australian External Territories', 'Inadequately described', and 'At sea'.

(c) Includes 'Inadequately described' and 'Non-verbal, so described'.

(d) Comprises 'Pre-school', 'Infants/Primary' (including Government, Catholic, Other Non Government), 'Secondary' (including Government, Catholic, Other Non Government), 'Technical or Further Educational Institution (including TAFE Colleges)', and 'University or other Tertiary Institutions'. Excludes persons who did not state which type of educational institution they were attending.

(e) Applicable to persons aged 15 years and over.

(f) Data are based on place of enumeration.

(g) Includes 'Visitors only' and 'Other non-classifiable' households, 'Non-private dwellings' and 'Migratory, off-shore and shipping' SA1s.

Appendix D

AM and PM peak hour passenger boarding for 2011 and 2016 dwellings scenarios

AM Peak Period Light Rail Journey to work trips from Anzac Parade bus catchment analysis (2011 Census)

Zone	Description	Inbound trips towards CBD			* Corridor and Peak Hour Factor	Per Tram Passenger	Outbound Trips towards Randwick			* Corridor and Peak Hour Factor	Per Tram Passenger
		Total Trips	%Bus	Trips by Bus	0.35	Departures 2011	Total Trips	%Bus	Trips by Bus	0.35	Arrivals 2011
611	Carlton	1619	33	534	215	23	384	11	42	17	2
613	Todman (central)	1222	33	403	162	18	451	11	50	20	2
614 N	Todman (south)	347	27	94	38	4	232	12	28	11	1
614 S	UNSW (west)	347	27	94	38	4	232	12	28	11	1
615	UNSW (main campus)	463	29	134	54	6	6024	14	843	339	37
617	Strachan (west)	1491	28	417	168	18	776	13	101	41	4
618	Strachan (east)	665	33	219	88	10	599	14	84	34	4
420	Kingsford SW Daceyville	293	21	62	25	3	295	2	6	2	0
621	Kingsford SE	1242	26	323	130	14	246	5	12	5	1
620	Kingsford East	898	24	216	87	9	391	9	35	14	2
619	Kingsford NE	1413	33	466	188	20	12	14	2	1	0
612	Todman West 303 Bus	1401	21	294	118	13	494	8	40	16	2
616	Tunstall Street 303 Bus	735	28	206	83	9	16	13	2	1	0
637	Maroubra Anzac W	787	35	275	111	12	1532	14	214	86	9
636	Maroubra Anzac E	1671	35	585	235	26	383	14	54	22	2
638	Maroubra Storey Street	1167	20	233	94	10	346	8	28	11	1
642	Maroubra Fitzgerald NW	1220	29	354	142	15	789	10	79	32	3
643	Maroubra Fitzgerald NE	973	20	195	78	8	195	8	16	6	1
644	Maroubra Beach	1274	25	319	128	14	345	14	48	19	2
645	Heffron	762	24	183	74	8	19	5	1	0	0
646	Fitzgerald SE	762	24	183	74	8	168	5	8	3	0
647	Malabar north	1084	18	195	79	9	274	9	25	10	1
626	Malabar south	713	17	121	49	5	391	7	27	11	1
624 E	Beauchamp E	460	22	101	41	4	72	12	9	3	0
627 E	Franklin E	594	16	95	38	4	101	9	9	4	0
630	Long Bay	29	12	3	1	0	1252	4	50	20	2
631	Bilga Crescent	709	15	106	43	5	89	5	4	2	0
633	Little Bay	809	12	97	39	4	438	6	26	11	1
629 E	Chifley east	930	16	149	60	6	160	7	11	5	0
632 E	Phillip Bay east	500	11	55	22	2	99	10	10	4	0
640	Maroubra west	1758	22	387	156	17	563	10	56	23	2
624 W	Beauchamp W	460	22	101	41	4	72	12	9	3	0
627 W	Franklin W	594	16	95	38	4	101	9	9	4	0
629 W	Chifley west	930	16	149	60	6	160	7	11	5	0
632 W	Phillip Bay west	500	11	55	22	2	99	10	10	4	0
421	Pagewood north	532	16	85	34	4	130	0	0	0	0
423	Eastgardens	0	0	0	0	0	2955	17	502	202	22
424	Hillsdale north	1332	23	306	123	13	818	5	41	16	2
425	Hillsdale south	1448	22	319	128	14	152	5	8	3	0
625	Matraville north	693	18	125	50	5	1263	3	38	15	2
628	Matraville south	982	14	137	55	6	217	5	11	4	0
428	Botany Industrial north	3	0	0	0	0	730	2	15	6	1
429	Botany Industrial south	0	0	0	0	0	1961	3	59	24	3
Total Catchment Trips		35812		8471	3410	369	26026		2660	1071	116
Anzac Parade bus interchange						142					27
Bunnerong Road bus interchange						77					33
Todman route 303 bus trips						22					2
Total Walk Up Trips						129					54

Hourly Movements Northbound	Boardings	Total
Anzac Parade S	1308	
Bunnerong Road	708	2016
Nine Ways	429	2445
Strachan Street	256	2702
University	92	2793
Todman Ave	200	2993
Carlton Street	215	3208
Total Anzac Pde		3208
To CBD via Todman	201	
Total To CBD		3410

Zones in the local walk up catchment

Note * Includes additional 15% bus rail feeder trips. Corridor and Peak Hour Factors are 70% of public transport trips are in the CBD -Randwick Corridor and 50% of these occur in a 1 hour peak period (am peak)

PM Peak Period Light Rail Journey to work trips from Anzac Parade bus catchment analysis (2011 Census)

Zone	Description	Inbound trips towards CBD			* Corridor and Peak Hour Factor	Per Tram Passenger	Outbound Trips towards Randwick			* Corridor and Peak Hour Factor	Per Tram Passenger
		Total Trips	%Bus	Trips by Bus	0.3	Departures 2011	Total Trips	%Bus	Trips by Bus	0.3	Arrivals 2011
611	Carlton	384	11	42	15	2	1619	33	534	184	20
613	Todman (central)	451	11	50	17	2	1222	33	403	139	15
614 N	Todman (south)	232	12	28	10	1	347	27	94	32	4
614 S	UNSW (west)	232	12	28	10	1	347	27	94	32	4
615	UNSW (main campus)	6024	14	843	291	32	463	29	134	46	5
617	Strachan (west)	776	13	101	35	4	1491	28	417	144	16
618	Strachan (east)	599	14	84	29	3	665	33	219	76	8
420	Kingsford SW Daceyville	295	2	6	2	0	293	21	62	21	2
621	Kingsford SE	246	5	12	4	0	1242	26	323	111	12
620	Kingsford East	391	9	35	12	1	898	24	216	74	8
619	Kingsford NE	12	14	2	1	0	1413	33	466	161	17
612	Todman West 303 Bus	494	8	40	14	1	1401	21	294	102	11
616	Tunstall Street 303 Bus	16	13	2	1	0	735	28	206	71	8
637	Maroubra Anzac W	1532	14	214	74	8	787	35	275	95	10
636	Maroubra Anzac E	383	14	54	18	2	1671	35	585	202	22
638	Maroubra Storey Street	346	8	28	10	1	1167	20	233	81	9
642	Maroubra Fitzgerald NW	789	10	79	27	3	1220	29	354	122	13
643	Maroubra Fitzgerald NE	195	8	16	5	1	973	20	195	67	7
644	Maroubra Beach	345	14	48	17	2	1274	25	319	110	12
645	Heffron	19	5	1	0	0	762	24	183	63	7
646	Fitzgerald SE	168	5	8	3	0	762	24	183	63	7
647	Malabar north	274	9	25	9	1	1084	18	195	67	7
626	Malabar south	391	7	27	9	1	713	17	121	42	5
624 E	Beauchamp E	72	12	9	3	0	460	22	101	35	4
627 E	Franklin E	101	9	9	3	0	594	16	95	33	4
630	Long Bay	1252	4	50	17	2	29	12	3	1	0
631	Bilga Crescent	89	5	4	2	0	709	15	106	37	4
633	Little Bay	438	6	26	9	1	809	12	97	33	4
629 E	Chifley east	160	7	11	4	0	930	16	149	51	6
632 E	Phillip Bay east	99	10	10	3	0	500	11	55	19	2
640	Maroubra west	563	10	56	19	2	1758	22	387	133	14
624 W	Beauchamp W	72	12	9	3	0	460	22	101	35	4
627 W	Franklin W	101	9	9	3	0	594	16	95	33	4
629 W	Chifley west	160	7	11	4	0	930	16	149	51	6
632 W	Phillip Bay west	99	10	10	3	0	500	11	55	19	2
421	Pagewood north	130	0	0	0	0	532	16	85	29	3
423	Eastgardens	2955	17	502	173	19	0	0	0	0	0
424	Hillsdale north	818	5	41	14	2	1332	23	306	106	11
425	Hillsdale south	152	5	8	3	0	1448	22	319	110	12
625	Matraville north	1263	3	38	13	1	693	18	125	43	5
628	Matraville south	217	5	11	4	0	982	14	137	47	5
428	Botany Industrial north	730	2	15	5	1	3	0	0	0	0
429	Botany Industrial south	1961	3	59	20	2	0	0	0	0	0
Total Catchment Trips		26026		2660	918	99	35812		8471	2923	317
Anzac Parade bus interchange						23					121
Bunnerong Road bus interchange						29					66
Todman route 303 bus trips						2					19
Total Walk Up Trips						46					111

Note * Includes additional 15% bus rail feeder trips. Corridor and Peak Hour Factors are 70% of public transport trips are in the CBD -Randwick Corridor and 50% of these occur in a 1 hour peak period (am peak)

AM Peak Period Light Rail Journey to work trips (2011 to 2016 growth increment)

Zone	Description	Inbound trips towards CBD			* Corridor and Peak Hour Factor	Per Tram Passenger Departures 2011	Assume 5% Growth Outbound Trips towards Randwick			* Corridor and Peak Hour Factor	Per Tram Passenger Arrivals 2011
		Total Trips	%Bus	Trips by Bus	0.35		Total Trips	%Bus	Trips by Bus	0.35	
611	Carlton	115	33	38	15	2	19	11	2	1	0
613	Todman (central)	115	33	38	15	2	23	11	2	1	0
614 N	Todman (south)	115	27	31	12	1	12	12	1	1	0
614 S	UNSW (west)	115	27	31	12	1	12	12	1	1	0
615	UNSW (main campus)			0	0	0	301	14	42	17	2
617	Strachan (west)	38	28	11	4	0	39	13	5	2	0
618	Strachan (east)	38	33	13	5	1	30	14	4	2	0
420	Kingsford SW Daceyville	38	21	8	3	0	15	2	0	0	0
621	Kingsford SE	38	26	10	4	0	12	5	1	0	0
620	Kingsford East	38	24	9	4	0	20	9	2	1	0
619	Kingsford NE	38	33	13	5	1	1	14	0	0	0
612	Todman West 303 Bus			0	0	0	25	8	2	1	0
616	Tunstall Street 303 Bus			0	0	0	1	13	0	0	0
637	Maroubra Anzac W	143	35	50	20	2	77	14	11	4	0
636	Maroubra Anzac E	143	35	50	20	2	19	14	3	1	0
638	Maroubra Storey Street	143	20	29	12	1	17	8	1	1	0
642	Maroubra Fitzgerald NW	143	29	41	17	2	39	10	4	2	0
643	Maroubra Fitzgerald NE	143	20	29	12	1	10	8	1	0	0
644	Maroubra Beach	143	25	36	14	2	17	14	2	1	0
645	Heffron			0	0	0	1	5	0	0	0
646	Fitzgerald SE			0	0	0	8	5	0	0	0
647	Malabar north			0	0	0	14	9	1	0	0
626	Malabar south	20	17	3	1	0	20	7	1	1	0
624 E	Beauchamp E			0	0	0	4	12	0	0	0
627 E	Franklin E			0	0	0	5	9	0	0	0
630	Long Bay			0	0	0	63	4	3	1	0
631	Bilga Crescent			0	0	0	4	5	0	0	0
633	Little Bay	666	12	80	32	3	22	6	1	1	0
629 E	Chifley east	14	16	2	1	0	8	7	1	0	0
632 E	Phillip Bay east	9	11	1	0	0	5	10	0	0	0
640	Maroubra west			0	0	0	28	10	3	1	0
624 W	Beauchamp W			0	0	0	4	12	0	0	0
627 W	Franklin W			0	0	0	5	9	0	0	0
629 W	Chifley west	14	16	2	1	0	8	7	1	0	0
632 W	Phillip Bay west	3	11	0	0	0	5	10	0	0	0
421	Pagewood north			0	0	0	7	0	0	0	0
423	Eastgardens			0	0	0	148	17	25	10	1
424	Hillsdale north	125	23	29	12	1	41	5	2	1	0
425	Hillsdale south			0	0	0	8	5	0	0	0
625	Matraville north	115	18	21	8	1	63	3	2	1	0
628	Matraville south	115	14	16	6	1	11	5	1	0	0
428	Botany Industrial north			0	0	0	37	2	1	0	0
429	Botany Industrial south			0	0	0	98	3	3	1	0
Total Catchment Trips		2627		590	237	26	1301		133	54	6
Anzac Parade bus interchange						14					1
Bunnerong Road bus interchange						3					2
Todman route 303 bus trips						0					0
Total Walk Up Trips						9					3

Hourly Movements Northbound	Boardings	Total
Anzac Parade S	129	
Bunnerong Road	27	157
Nine Ways	16	173
Strachan Street	9	182
University	12	194
Todman Ave	28	222
Carlton Street	15	237
Total Anzac Pde		237
To CBD via Todmai	0	
Total To CBD		237

Zones in the local walk up catchment

Note * Includes additional 15% bus-rail feeder trips. Corridor and Peak Hour Factors are 70% of public transport trips are in the CBD -Randwick Corridor and 50% of these occur in a 1 hour peak period (am peak)

PM Peak Period Light Rail Journey to work trips (2011 to 2016 Growth Increment)

Zone		Description	Inbound trips towards CBD			* Corridor and Peak Hour Factor	Per Tram Passenger	Outbound Trips towards Randwick			* Corridor and Peak Hour Factor	Per Tram Passenger
			Total Trips	%Bus	Trips by Bus	0.3	Departures 2011	Total Trips	%Bus	Trips by Bus	0.3	Arrivals 2011
	611	Carlton	19	11	2	1	0	115	33	38	13	1
	613	Todman (central)	23	11	2	1	0	115	33	38	13	1
614 N		Todman (south)	12	12	1	0	0	115	27	31	11	1
614 S		UNSW (west)	12	12	1	0	0	115	27	31	11	1
	615	UNSW (main campus)	301	14	42	15	2			0	0	0
	617	Strachan (west)	39	13	5	2	0	38	28	11	4	0
	618	Strachan (east)	30	14	4	1	0	38	33	13	4	0
	420	Kingsford SW Daceyville	15	2	0	0	0	38	21	8	3	0
	621	Kingsford SE	12	5	1	0	0	38	26	10	3	0
	620	Kingsford East	20	9	2	1	0	38	24	9	3	0
	619	Kingsford NE	1	14	0	0	0	38	33	13	4	0
	612	Todman West 303 Bus	25	8	2	1	0			0	0	0
	616	Tunstall Street 303 Bus	1	13	0	0	0			0	0	0
	637	Maroubra Anzac W	77	14	11	4	0	143	35	50	17	2
	636	Maroubra Anzac E	19	14	3	1	0	143	35	50	17	2
	638	Maroubra Storey Street	17	8	1	0	0	143	20	29	10	1
	642	Maroubra Fitzgerald NW	39	10	4	1	0	143	29	41	14	2
	643	Maroubra Fitzgerald NE	10	8	1	0	0	143	20	29	10	1
	644	Maroubra Beach	17	14	2	1	0	143	25	36	12	1
	645	Heffron	1	5	0	0	0			0	0	0
	646	Fitzgerald SE	8	5	0	0	0			0	0	0
	647	Malabar north	14	9	1	0	0			0	0	0
	626	Malabar south	20	7	1	0	0	20	17	3	1	0
624 E		Beauchamp E	4	12	0	0	0			0	0	0
627 E		Franklin E	5	9	0	0	0			0	0	0
	630	Long Bay	63	4	3	1	0			0	0	0
	631	Bilga Crescent	4	5	0	0	0			0	0	0
	633	Little Bay	22	6	1	0	0	666	12	80	28	3
629 E		Chifley east	8	7	1	0	0	14	16	2	1	0
632 E		Phillip Bay east	5	10	0	0	0	9	11	1	0	0
	640	Maroubra west	28	10	3	1	0			0	0	0
624 W		Beauchamp W	4	12	0	0	0			0	0	0
627 W		Franklin W	5	9	0	0	0			0	0	0
629 W		Chifley west	8	7	1	0	0	14	16	2	1	0
632 W		Phillip Bay west	5	10	0	0	0	3	11	0	0	0
	421	Pagewood north	7	0	0	0	0			0	0	0
	423	Eastgardens	148	17	25	9	1			0	0	0
	424	Hillsdale north	41	5	2	1	0			0	0	0
	425	Hillsdale south	8	5	0	0	0			0	0	0
	625	Matraville north	63	3	2	1	0	115	18	21	7	1
	628	Matraville south	11	5	1	0	0	115	14	16	6	1
	428	Botany Industrial north	37	2	1	0	0			0	0	0
	429	Botany Industrial south	98	3	3	1	0			0	0	0
Total Catchment Trips			1301		133	46	5	2502		561	194	21
Anzac Parade bus interchange							1					12
Bunnerong Road bus interchange							1					1
Todman route 303 bus trips							0					0
Total Walk Up Trips							2					8

Note * Includes additional 15% bus-rail feeder trips. Corridor and Peak Hour Factors are 70% of public transport trips are in the CBD -Randwick Corridor and 50% of these occur in a 1 hour peak period (am peak)

Appendix E

AM and PM peak hour passenger boardings for +15,150 dwellings forecast

AM Peak Period Light Rail Journey to work trips (Interim +4040 dwellings growth increment)

Zone	Description	Inbound trips towards CBD			* Corridor and Peak Hour Factor	Per Tram Passenger Departures 2020	Assume 4% Growth Outbound Trips towards Randwick			* Corridor and Peak Hour Factor	Per Tram Passenger Arrivals 2020
		Total Trips	%Bus	Trips by Bus	0.35		Total Trips	%Bus	Trips by Bus	0.35	
611	Carlton	117	33	39	16	2	15	11	2	1	0
613	Todman (central)	206	33	68	27	3	18	11	2	1	0
614 N	Todman (south)	206	27	56	22	2	9	12	1	0	0
614 S	UNSW (west)	45	27	12	5	1	9	12	1	0	0
615	UNSW (main campus)	0	29	0	0	0	241	14	34	14	1
617	Strachan (west)	215	28	60	24	3	31	13	4	2	0
618	Strachan (east)	215	33	71	29	3	24	14	3	1	0
420	Kingsford SW Daceyville	0	21	0	0	0	12	2	0	0	0
621	Kingsford SE	197	26	51	21	2	10	5	0	0	0
620	Kingsford East	197	24	47	19	2	16	9	1	1	0
619	Kingsford NE	197	33	65	26	3	0	14	0	0	0
612	Todman West 303 Bus	45	21	9	4	0	20	8	2	1	0
616	Tunstall Street 303 Bus	45	28	12	5	1	1	13	0	0	0
637	Maroubra Anzac W	94	35	33	13	1	61	14	9	3	0
636	Maroubra Anzac E	94	35	33	13	1	15	14	2	1	0
638	Maroubra Storey Street	45	20	9	4	0	14	8	1	0	0
642	Maroubra Fitzgerald NW	45	29	13	5	1	32	10	3	1	0
643	Maroubra Fitzgerald NE	45	20	9	4	0	8	8	1	0	0
644	Maroubra Beach	45	25	11	4	0	14	14	2	1	0
645	Heffron	45	24	11	4	0	1	5	0	0	0
646	Fitzgerald SE	138	24	33	13	1	7	5	0	0	0
647	Malabar north	138	18	25	10	1	11	9	1	0	0
626	Malabar south	138	17	23	9	1	16	7	1	0	0
624 E	Beauchamp E	45	22	10	4	0	3	12	0	0	0
627 E	Franklin E	45	16	7	3	0	4	9	0	0	0
630	Long Bay	0	12	0	0	0	50	4	2	1	0
631	Bilga Crescent	45	15	7	3	0	4	5	0	0	0
633	Little Bay	141	12	17	7	1	18	6	1	0	0
629 E	Chifley east	138	16	22	9	1	6	7	0	0	0
632 E	Phillip Bay east	45	11	5	2	0	4	10	0	0	0
640	Maroubra west	45	22	10	4	0	23	10	2	1	0
624 W	Beauchamp W	45	22	10	4	0	3	12	0	0	0
627 W	Franklin W	45	16	7	3	0	4	9	0	0	0
629 W	Chifley west	138	16	22	9	1	6	7	0	0	0
632 W	Phillip Bay west	45	11	5	2	0	4	10	0	0	0
421	Pagewood north	0	16	0	0	0	5	0	0	0	0
423	Eastgardens	727	20	145	59	6	118	17	20	8	1
424	Hillsdale north	0	23	0	0	0	33	5	2	1	0
425	Hillsdale south	22	22	5	2	0	6	5	0	0	0
625	Matraville north	45	18	8	3	0	51	3	2	1	0
628	Matraville south	139	14	20	8	1	9	5	0	0	0
428	Botany Industrial north	0	0	0	0	0	29	2	1	0	0
429	Botany Industrial south	0	0	0	0	0	78	3	2	1	0
Total Catchment Trips		4214		990	398	43	1041		106	43	5
Anzac Parade bus interchange						12					1
Bunnerong Road bus interchange						10					1
Todman route 303 bus trips						1					0
Total Walk Up Trips						20					2

Hourly Movements Northbound	Boardings	Total
Anzac Parade S	108	
Bunnerong Road	93	201
Nine Ways	66	267
Strachan Street	53	319
University	5	324
Todman Ave	50	374
Carlton Street	16	389
Total Anzac Pde		389
To CBD via Todman	9	
Total To CBD		398

Zones in the local walk up catchment

Note * Includes +15% additional bus-rail feeder trips. Corridor and Peak Hour Factors are 70% of public transport trips are in the CBD -Randwick Corridor and 50% of these occur in a 1 hour peak period (am peak)

PM Peak Period Light Rail Journey to work trips (Interim +4040 dwellings growth increment)

Zone	Description	Inbound trips towards CBD			* Corridor and Peak Hour Factor	Per Tram Passenger	Outbound Trips towards Randwick			* Corridor and Peak Hour Factor	Per Tram Passenger
		Total Trips	%Bus	Trips by Bus	0.3	Departures 2020	Total Trips	%Bus	Trips by Bus	0.3	Arrivals 2020
611	Carlton	15	11	2	1	0	117	33	39	13	1
613	Todman (central)	18	11	2	1	0	206	33	68	23	3
614 N	Todman (south)	9	12	1	0	0	206	27	56	19	2
614 S	UNSW (west)	9	12	1	0	0	45	27	12	4	0
615	UNSW (main campus)	241	14	34	12	1	0	29	0	0	0
617	Strachan (west)	31	13	4	1	0	215	28	60	21	2
618	Strachan (east)	24	14	3	1	0	215	33	71	25	3
420	Kingsford SW Daceyville	12	2	0	0	0	0	21	0	0	0
621	Kingsford SE	10	5	0	0	0	197	26	51	18	2
620	Kingsford East	16	9	1	0	0	197	24	47	16	2
619	Kingsford NE	0	14	0	0	0	197	33	65	22	2
612	Todman West 303 Bus	20	8	2	1	0	45	21	9	3	0
616	Tunstall Street 303 Bus	1	13	0	0	0	45	28	12	4	0
637	Maroubra Anzac W	61	14	9	3	0	94	35	33	11	1
636	Maroubra Anzac E	15	14	2	1	0	94	35	33	11	1
638	Maroubra Storey Street	14	8	1	0	0	45	20	9	3	0
642	Maroubra Fitzgerald NW	32	10	3	1	0	45	29	13	4	0
643	Maroubra Fitzgerald NE	8	8	1	0	0	45	20	9	3	0
644	Maroubra Beach	14	14	2	1	0	45	25	11	4	0
645	Heffron	1	5	0	0	0	45	24	11	4	0
646	Fitzgerald SE	7	5	0	0	0	138	24	33	11	1
647	Malabar north	11	9	1	0	0	138	18	25	9	1
626	Malabar south	16	7	1	0	0	138	17	23	8	1
624 E	Beauchamp E	3	12	0	0	0	45	22	10	3	0
627 E	Franklin E	4	9	0	0	0	45	16	7	2	0
630	Long Bay	50	4	2	1	0	0	12	0	0	0
631	Bilga Crescent	4	5	0	0	0	45	15	7	2	0
633	Little Bay	18	6	1	0	0	141	12	17	6	1
629 E	Chifley east	6	7	0	0	0	138	16	22	8	1
632 E	Phillip Bay east	4	10	0	0	0	45	11	5	2	0
640	Maroubra west	23	10	2	1	0	45	22	10	3	0
624 W	Beauchamp W	3	12	0	0	0	45	22	10	3	0
627 W	Franklin W	4	9	0	0	0	45	16	7	2	0
629 W	Chifley west	6	7	0	0	0	138	16	22	8	1
632 W	Phillip Bay west	4	10	0	0	0	45	11	5	2	0
421	Pagewood north	5	0	0	0	0	0	16	0	0	0
423	Eastgardens	118	17	20	7	1	727	20	145	50	5
424	Hillsdale north	33	5	2	1	0	0	23	0	0	0
425	Hillsdale south	6	5	0	0	0	22	22	5	2	0
625	Matraville north	51	3	2	1	0	45	18	8	3	0
628	Matraville south	9	5	0	0	0	139	14	20	7	1
428	Botany Industrial north	29	2	1	0	0	0	0	0	0	0
429	Botany Industrial south	78	3	2	1	0	0	0	0	0	0
Total Catchment Trips		1041		106	37	4	4214		990	341	37
Anzac Parade bus interchange						1					10
Bunnerong Road bus interchange						1					9
Todman route 303 bus trips						0					1
Total Walk Up Trips						2					18

Note * Includes +15% bus-rail feeder trips. Corridor and Peak Hour Factors are 70% of public transport trips are in the CBD -Randwick Corridor and 50% of these occur in a 1 hour peak period (am peak)

AM Peak Period Light Rail Journey to work trips (Ultimate +15150 dwellings growth increment)

Zone	Description	Inbound trips towards CBD			* Corridor and Peak Hour Factor	Per Tram Passenger Departures 2031	Assume 15% Growth Outbound Trips towards Randwick			* Corridor and Peak Hour Factor	Per Tram Passenger Arrivals 2031
		Total Trips	%Bus	Trips by Bus	0.35		Total Trips	%Bus	Trips by Bus	0.35	
611	Carlton	440	33	145	58	6	58	11	6	3	0
613	Todman (central)	771	33	254	102	11	68	11	7	3	0
614 N	Todman (south)	771	27	208	84	9	35	12	4	2	0
614 S	UNSW (west)	167	27	45	18	2	35	12	4	2	0
615	UNSW (main campus)	0	29	0	0	0	904	14	127	51	6
617	Strachan (west)	808	28	226	91	10	116	13	15	6	1
618	Strachan (east)	808	33	267	107	12	90	14	13	5	1
420	Kingsford SW Daceyville	0	21	0	0	0	44	2	1	0	0
621	Kingsford SE	737	26	192	77	8	37	5	2	1	0
620	Kingsford East	737	24	177	71	8	59	9	5	2	0
619	Kingsford NE	737	33	243	98	11	2	14	0	0	0
612	Todman West 303 Bus	167	21	35	14	2	74	8	6	2	0
616	Tunstall Street 303 Bus	167	28	47	19	2	2	13	0	0	0
637	Maroubra Anzac W	354	35	124	50	5	230	14	32	13	1
636	Maroubra Anzac E	354	35	124	50	5	57	14	8	3	0
638	Maroubra Storey Street	167	20	33	13	1	52	8	4	2	0
642	Maroubra Fitzgerald NW	167	29	48	19	2	118	10	12	5	1
643	Maroubra Fitzgerald NE	167	20	33	13	1	29	8	2	1	0
644	Maroubra Beach	167	25	42	17	2	52	14	7	3	0
645	Heffron	167	24	40	16	2	3	5	0	0	0
646	Fitzgerald SE	517	24	124	50	5	25	5	1	1	0
647	Malabar north	517	18	93	37	4	41	9	4	1	0
626	Malabar south	517	17	88	35	4	59	7	4	2	0
624 E	Beauchamp E	167	22	37	15	2	11	12	1	1	0
627 E	Franklin E	167	16	27	11	1	15	9	1	1	0
630	Long Bay	0	12	0	0	0	188	4	8	3	0
631	Bilga Crescent	167	15	25	10	1	13	5	1	0	0
633	Little Bay	530	12	64	26	3	66	6	4	2	0
629 E	Chifley east	517	16	83	33	4	24	7	2	1	0
632 E	Phillip Bay east	167	11	18	7	1	15	10	1	1	0
640	Maroubra west	167	22	37	15	2	84	10	8	3	0
624 W	Beauchamp W	167	22	37	15	2	11	12	1	1	0
627 W	Franklin W	167	16	27	11	1	15	9	1	1	0
629 W	Chifley west	517	16	83	33	4	24	7	2	1	0
632 W	Phillip Bay west	167	11	18	7	1	15	10	1	1	0
421	Pagewood north	0	16	0	0	0	20	0	0	0	0
423	Eastgardens	2726	20	545	219	24	443	17	75	30	3
424	Hillsdale north	0	23	0	0	0	123	5	6	2	0
425	Hillsdale south	84	22	18	7	1	23	5	1	0	0
625	Matraville north	167	18	30	12	1	189	3	6	2	0
628	Matraville south	523	14	73	29	3	33	5	2	1	0
428	Botany Industrial north	0	0	0	0	0	110	2	2	1	0
429	Botany Industrial south	0	0	0	0	0	294	3	9	4	0
Total Catchment Trips		15804		3711	1494	162	3904		399	161	17
Anzac Parade bus interchange						44					4
Bunnerong Road bus interchange						38					5
Todman route 303 bus trips						4					0
Total Walk Up Trips						77					8

Hourly Movements Northbound	Boardings	Total
Anzac Parade S	404	
Bunnerong Road	349	753
Nine Ways	246	999
Strachan Street	198	1198
University	18	1216
Todman Ave	186	1402
Carlton Street	58	1461
Total Anzac Pde		1461
To CBD via Todman	33	
Total To CBD		1494

Zones in the local walk up catchment

Note * Includes +15% additional bus-rail feeder trips. Corridor and Peak Hour Factors are 70% of public transport trips are in the CBD -Randwick Corridor and 50% of these occur in a 1 hour peak period (am peak)

PM Peak Period Light Rail Journey to work trips (Ultimate +15150 dwellings growth increment)

Zone	Description	Inbound trips towards CBD			* Corridor and Peak Hour Factor	Per Tram Passenger	Outbound Trips towards Randwick			* Corridor and Peak Hour Factor	Per Tram Passenger
		Total Trips	%Bus	Trips by Bus	0.3	Departures 2031	Total Trips	%Bus	Trips by Bus	0.3	Arrivals 2031
611	Carlton	58	11	6	2	0	440	33	145	50	5
613	Todman (central)	68	11	7	3	0	771	33	254	88	10
614 N	Todman (south)	35	12	4	1	0	771	27	208	72	8
614 S	UNSW (west)	35	12	4	1	0	167	27	45	16	2
615	UNSW (main campus)	904	14	127	44	5	0	29	0	0	0
617	Strachan (west)	116	13	15	5	1	808	28	226	78	8
618	Strachan (east)	90	14	13	4	0	808	33	267	92	10
420	Kingsford SW Daceyville	44	2	1	0	0	0	21	0	0	0
621	Kingsford SE	37	5	2	1	0	737	26	192	66	7
620	Kingsford East	59	9	5	2	0	737	24	177	61	7
619	Kingsford NE	2	14	0	0	0	737	33	243	84	9
612	Todman West 303 Bus	74	8	6	2	0	167	21	35	12	1
616	Tunstall Street 303 Bus	2	13	0	0	0	167	28	47	16	2
637	Maroubra Anzac W	230	14	32	11	1	354	35	124	43	5
636	Maroubra Anzac E	57	14	8	3	0	354	35	124	43	5
638	Maroubra Storey Street	52	8	4	1	0	167	20	33	12	1
642	Maroubra Fitzgerald NW	118	10	12	4	0	167	29	48	17	2
643	Maroubra Fitzgerald NE	29	8	2	1	0	167	20	33	12	1
644	Maroubra Beach	52	14	7	2	0	167	25	42	14	2
645	Heffron	3	5	0	0	0	167	24	40	14	1
646	Fitzgerald SE	25	5	1	0	0	517	24	124	43	5
647	Malabar north	41	9	4	1	0	517	18	93	32	3
626	Malabar south	59	7	4	1	0	517	17	88	30	3
624 E	Beauchamp E	11	12	1	0	0	167	22	37	13	1
627 E	Franklin E	15	9	1	0	0	167	16	27	9	1
630	Long Bay	188	4	8	3	0	0	12	0	0	0
631	Bilga Crescent	13	5	1	0	0	167	15	25	9	1
633	Little Bay	66	6	4	1	0	530	12	64	22	2
629 E	Chifley east	24	7	2	1	0	517	16	83	29	3
632 E	Phillip Bay east	15	10	1	1	0	167	11	18	6	1
640	Maroubra west	84	10	8	3	0	167	22	37	13	1
624 W	Beauchamp W	11	12	1	0	0	167	22	37	13	1
627 W	Franklin W	15	9	1	0	0	167	16	27	9	1
629 W	Chifley west	24	7	2	1	0	517	16	83	29	3
632 W	Phillip Bay west	15	10	1	1	0	167	11	18	6	1
421	Pagewood north	20	0	0	0	0	0	16	0	0	0
423	Eastgardens	443	17	75	26	3	2726	20	545	188	20
424	Hillsdale north	123	5	6	2	0	0	23	0	0	0
425	Hillsdale south	23	5	1	0	0	84	22	18	6	1
625	Matraville north	189	3	6	2	0	167	18	30	10	1
628	Matraville south	33	5	2	1	0	523	14	73	25	3
428	Botany Industrial north	110	2	2	1	0	0	0	0	0	0
429	Botany Industrial south	294	3	9	3	0	0	0	0	0	0
Total Catchment Trips		3904		399	138	15	15804		3711	1280	139
Anzac Parade bus interchange						3					37
Bunnerong Road bus interchange						4					32
Todman route 303 bus trips						0					3
Total Walk Up Trips						7					66

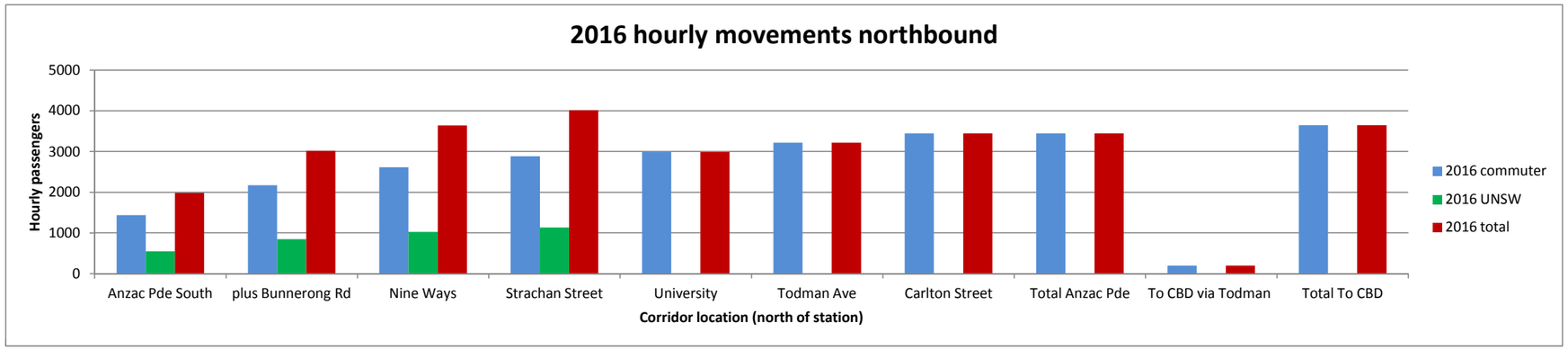
Note * Includes +15% bus-rail feeder trips. Corridor and Peak Hour Factors are 70% of public transport trips are in the CBD -Randwick Corridor and 50% of these occur in a 1 hour peak period (am peak)

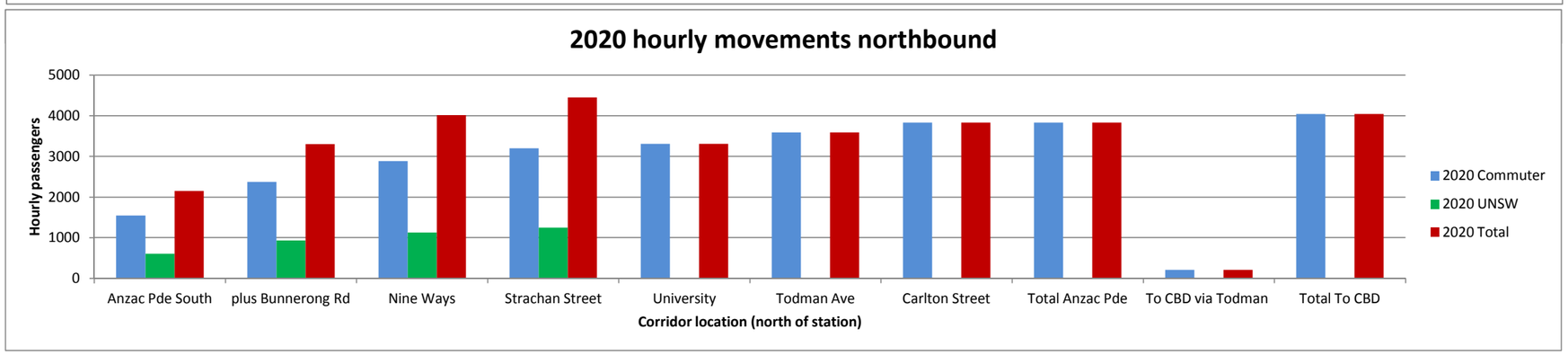
Appendix F

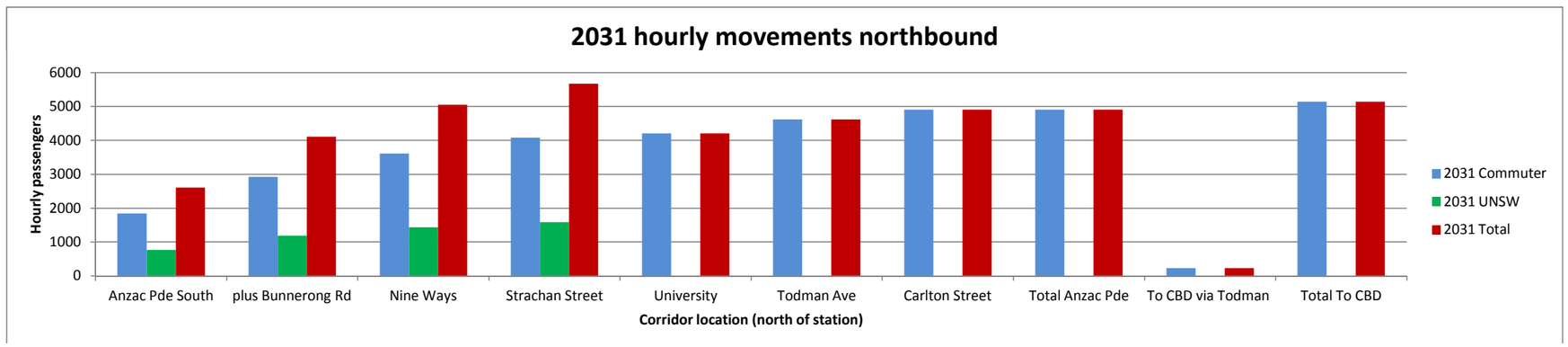
Summary tables of future corridor travel demand growth projections

Summary of Northbound Corridor Volumes Base Analysis No Change to Travel Mode Share

	Base	Growth to	Growth to	Growth to								
	2011	2016	2020	2031								
Hourly movements northbound					**2016 commut**	**2016 UNSV**	**2016 total**	**2020 Commu**	**2020 UNSV**	**2020 Total**	**2031 Commu**	**2031 UNSV**	**2031 Total**
Anzac Pde South	1308	129	108	404	1437	549	1986	1545	604	2149	1841	769	2610
plus Bunnerong Rd	2016	157	201	753	2173	847	3020	2374	932	3305	2926	1186	4111
Nine Ways	2445	173	267	999	2618	1027	3645	2885	1130	4014	3617	1438	5055
Strachan Street	2702	182	319	1198	2883	1135	4018	3202	1249	4451	4081	1589	5670
University	2793	194	324	1216	2988		2988	3312		3312	4204		4204
Todman Ave	2993	222	374	1402	3215		3215	3589		3589	4617		4617
Carlton Street	3208	237	389	1461	3446		3446	3835		3835	4907		4907
Total Anzac Pde	3208	237	389	1461	3446		3446	3835		3835	4907		4907
To CBD via Todman	201	0	9	33	201		201	210		210	234		234
Total To CBD	3410	237	398	1494	3647		3647	4045		4045	5141		5141

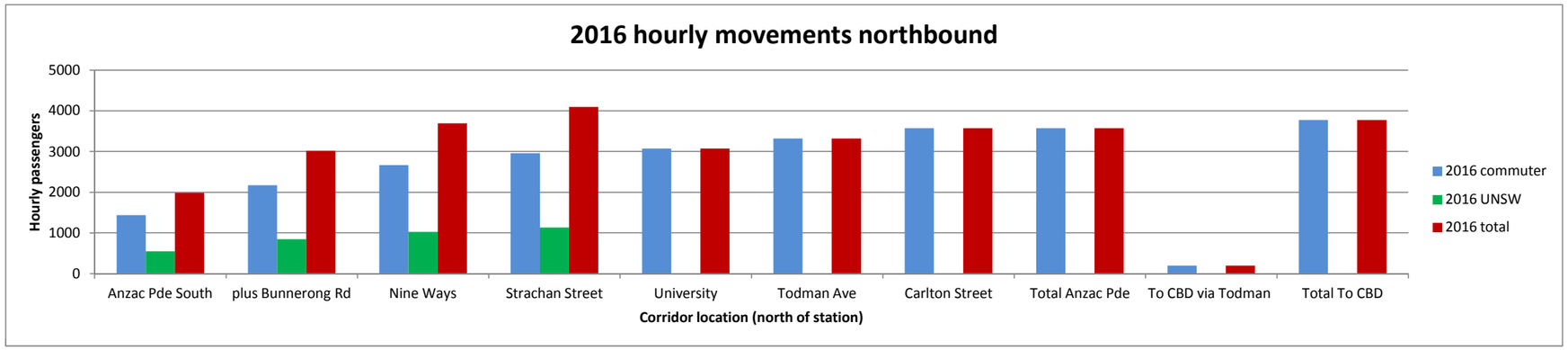


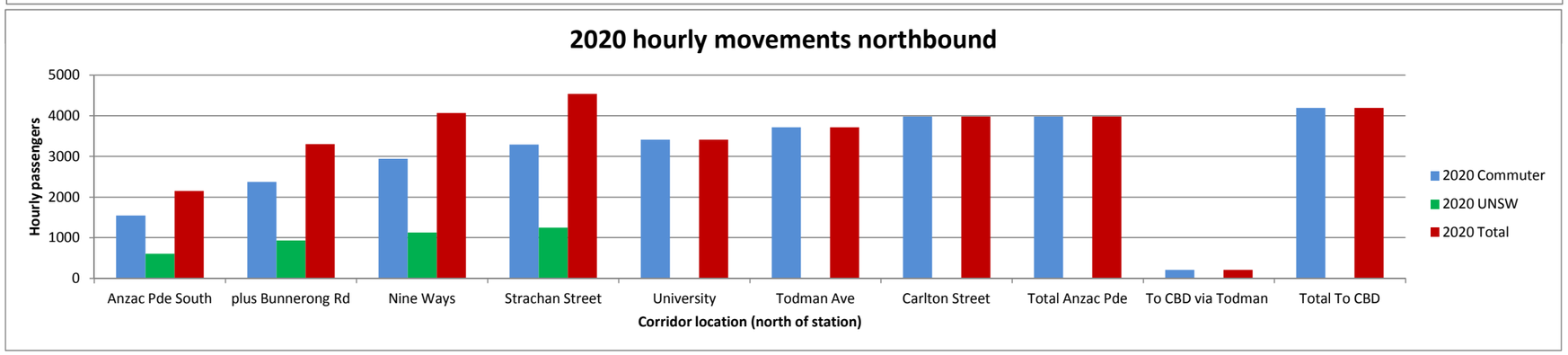


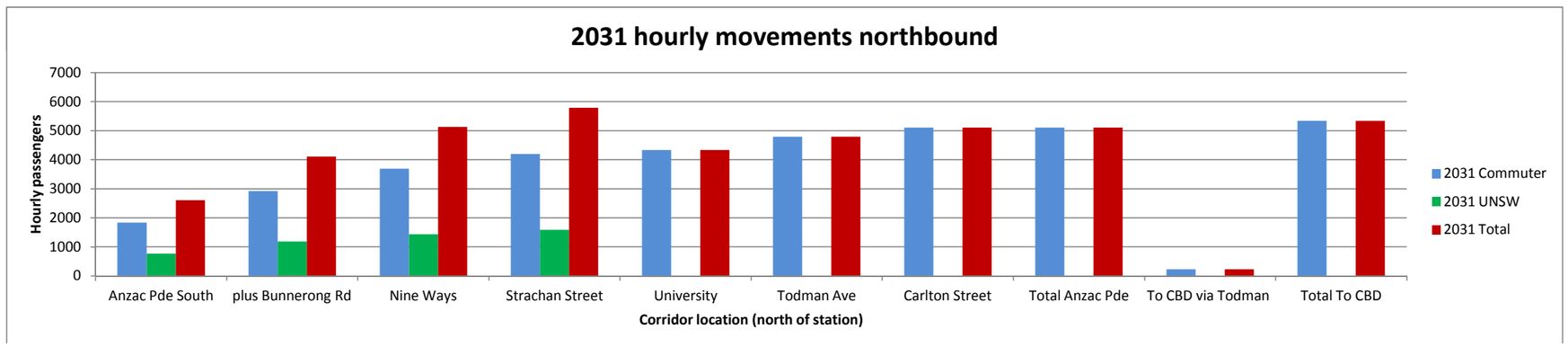


Summary of Northbound Corridor Volumes Final Kingsford Route Option with PT travel mode share increase

	Base	Growth to	Growth to	Growth to											
	2011	2016	2020	2031											
Hourly movements northbound					**2016 commut**	**2016 UNSV**	**2016 total**		**2020 Commu**	**2020 UNSV**	**2020 Total**		**2031 Commu**	**2031 UNSV**	**2031 Total**
Anzac Pde South	1308	129	108	404	1437	549	1986		1545	604	2149		1841	769	2610
plus Bunnerong Rd	2016	157	201	753	2173	847	3020		2374	932	3305		2926	1186	4111
Nine Ways	2492	174	274	1026	2666	1027	3693		2940	1130	4070		3692	1438	5130
Strachan Street	2774	185	332	1244	2959	1135	4094		3291	1249	4540		4203	1589	5792
University	2876	199	337	1264	3075		3075		3412		3412		4339		4339
Todman Ave	3095	229	392	1469	3324		3324		3716		3716		4793		4793
Carlton Street	3329	246	409	1533	3575		3575		3984		3984		5108		5108
Total Anzac Pde	3329	246	409	1533	3575		3575		3984		3984		5108		5108
To CBD via Todman	201	0	9	33	201		201		210		210		234		234
Total To CBD	3530	246	418	1566	3776		3776		4194		4194		5342		5342

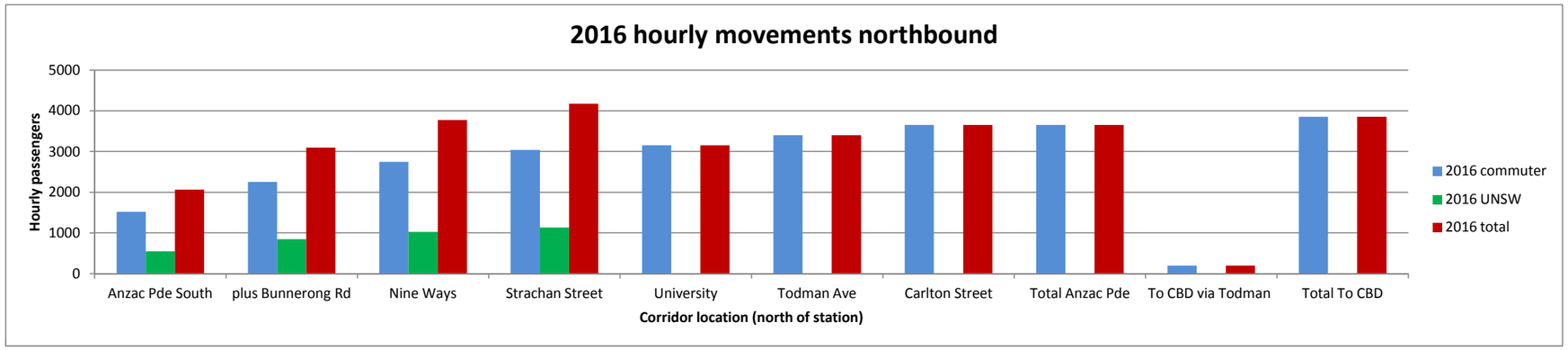


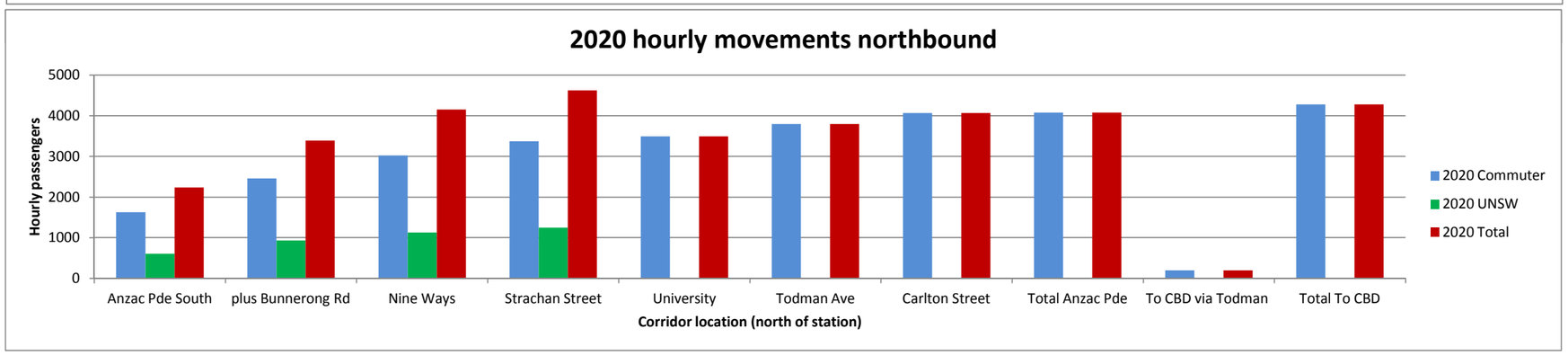


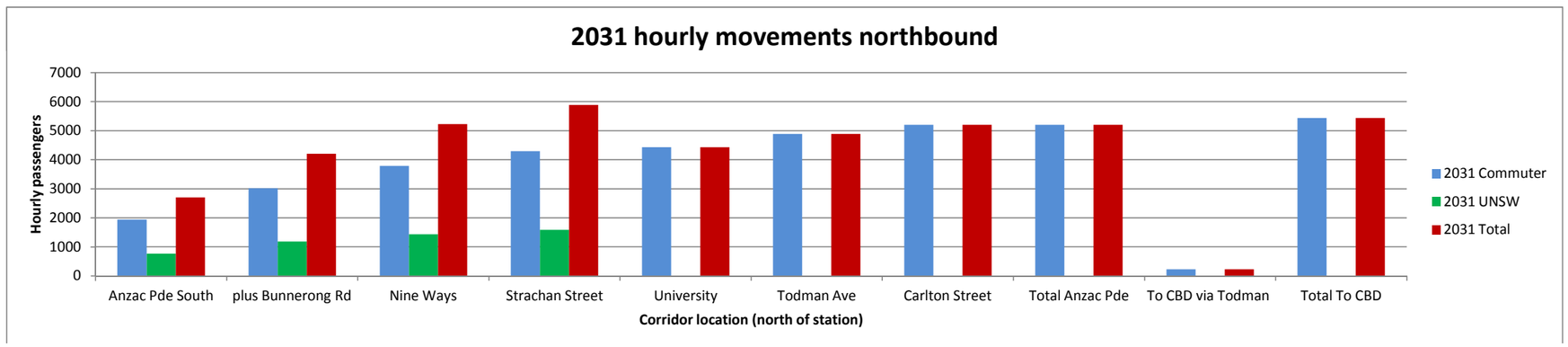


Summary of Northbound Corridor Volumes Maroubra Extension Option with travel mode share increase

	Base	Growth to	Growth to	Growth to											
	2011	2016	2020	2031											
Hourly movements northbound					**2016 commut**	**2016 UNSV**	**2016 total**		**2020 Commu**	**2020 UNSV**	**2020 Total**		**2031 Commu**	**2031 UNSV**	**2031 Total**
Anzac Pde South	1380	138	112	420	1518	549	2067		1630	604	2234		1938	769	2707
plus Bunnerong Rd	2088	165	205	769	2253	847	3100		2458	932	3390		3022	1186	4208
Nine Ways	2563	183	278	1042	2746	1027	3773		3024	1130	4154		3788	1438	5226
Strachan Street	2846	193	336	1260	3039	1135	4174		3375	1249	4624		4299	1589	5888
University	2947	207	341	1280	3154		3154		3495		3495		4434		4434
Todman Ave	3166	238	396	1485	3404		3404		3800		3800		4889		4889
Carlton Street	3401	254	413	1549	3655		3655		4068		4068		5204		5204
Total Anzac Pde	3401	254	422	1549	3655		3655		4077		4077		5204		5204
To CBD via Todman	201	0	0	33	201		201		201		201		234		234
Total To CBD	3602	254	422	1582	3856		3856		4278		4278		5438		5438







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