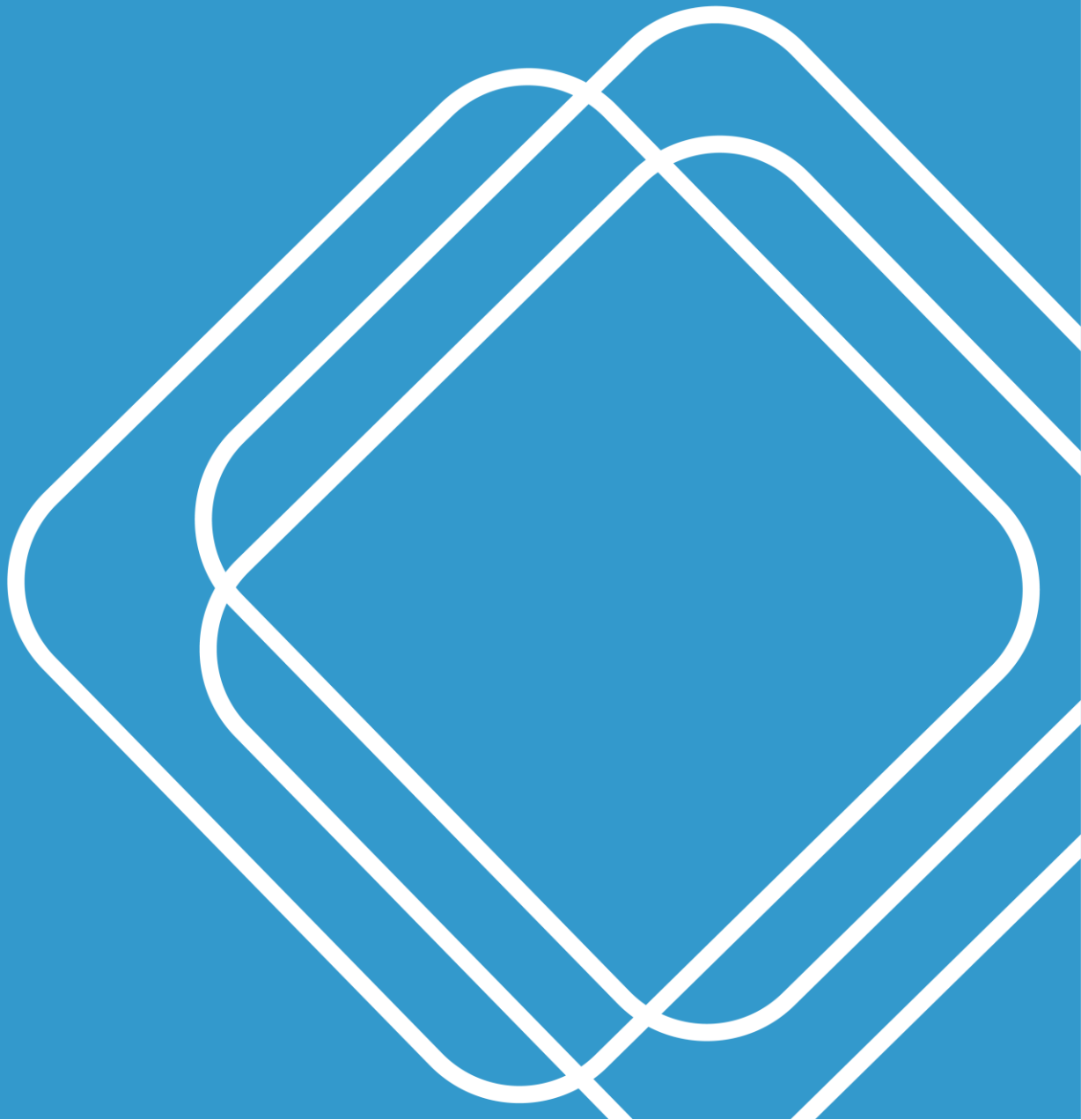
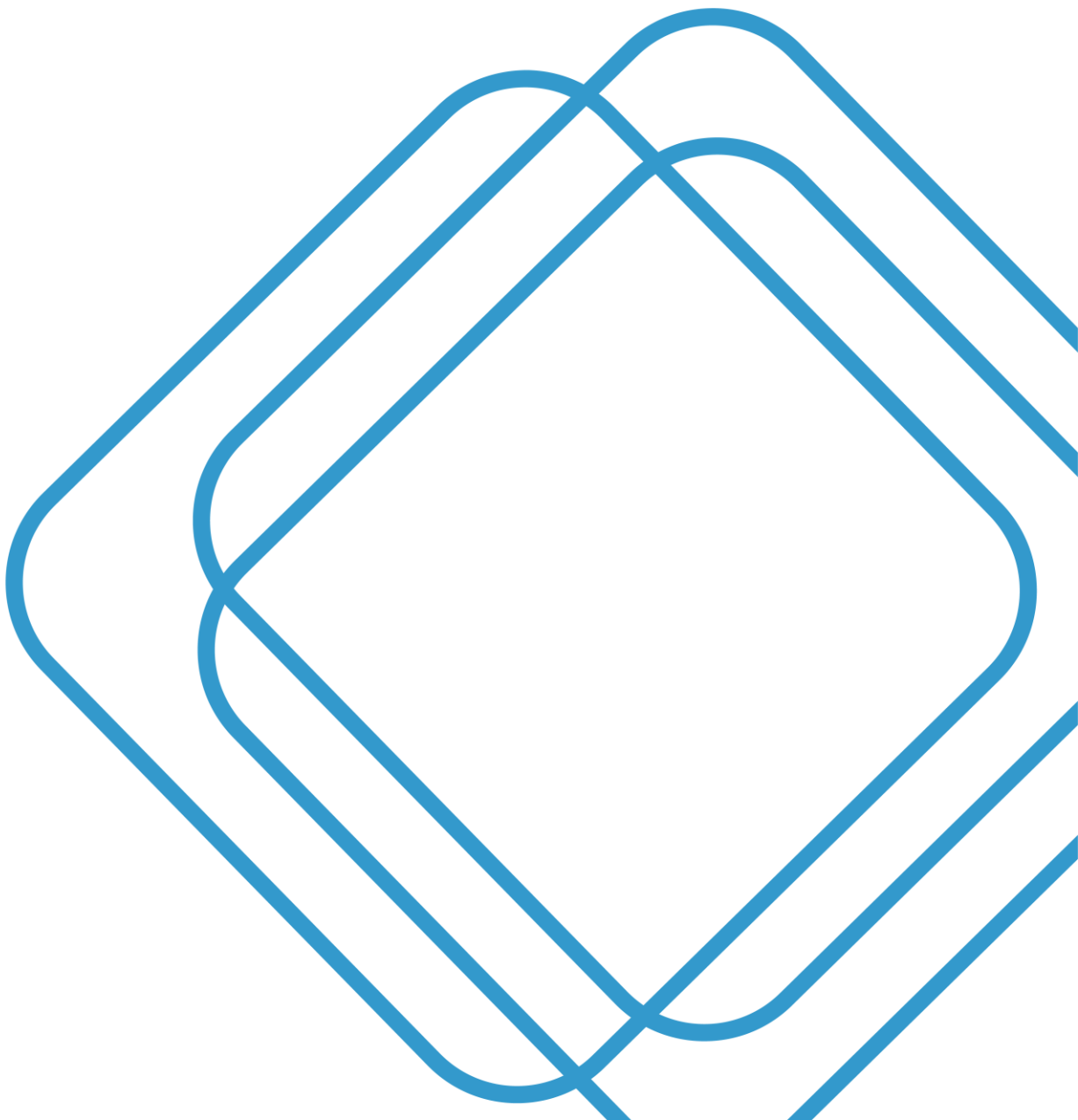


WARWICK FARM STRUCTURE PLAN PLANNING PROPOSAL

Traffic and Transport Impact Assessment

24 JUNE 2020





Quality Assurance

Project:	Warwick Farm Structure Plan Planning Proposal		
Project Number:	SCT_00153		
Client:	Liverpool City Council		
Prepared by:	SCT Consulting PTY. LTD. (SCT Consulting)	ABN:	50 055 972 248

Quality Information

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Contents

Executive Summary	i
1.0 Introduction	1
1.1 Background.....	1
1.2 Purpose and scope of report.....	2
1.3 Report structure	2
2.0 Strategic Context	3
2.1 Site context.....	3
2.2 Future Transport 2056 Strategy	4
2.3 Western City District Plan	5
2.4 Liverpool Collaboration Area Place Strategy	6
2.5 Liverpool Local Strategic Planning Statement	7
2.6 Liverpool Bike Plan 2018-2023	8
3.0 Existing Conditions	10
3.1 Travel behaviour	10
3.2 Road network and classification	12
3.3 Public transport network	14
3.4 Active transport network	14
3.5 Existing traffic conditions	17
4.0 The Planning Proposal	21
4.1 Preferred structure plan	21
4.2 Proposed transport network.....	22
4.3 Travel demand management measures	23
5.0 Traffic and Transport Impact Appraisal	26
5.1 Background traffic growth	26
5.2 Modelling scenarios	28
5.3 Trip generation and distribution	29
5.4 Road network impacts	33
5.5 Public transport impacts.....	38
5.6 Active transport impacts.....	38
6.0 Conclusion.....	39
6.1 Conclusion	39

Executive Summary

Purpose of this report

SCT Consulting has been engaged by Liverpool City Council to undertake a traffic and transport impact assessment to support a planning proposal for the Warwick Farm Precinct, located in the Liverpool Local Government Area (LGA). The precinct covers 28 hectares, bounded by Governor Macquarie Drive to the northeast, Hume Highway to the northwest, Warwick Farm station and the railway line to the west and Priddle Street to the south (**Figure ES1**).

Figure ES1 Warwick Farm structure plan area indicative aerial view



Source: CM+ (2020), Warwick Farm Structure Plan – Preferred Structure Plan - Rev 03

The precinct is proposed to be rezoned to a combination of B4 Mixed Use and R4 High Density Residential. As it is located directly east of Warwick Farm station, one stop from Liverpool CBD, it has good access to employment, public transport, and retail facilities, and is well positioned to be integrated into infrastructure development in the wider Liverpool Collaboration Area.

Future planning context

The Western City District Plan establishes a housing target of 184,500 for the District by 2036. It also sets a target of between 7,000 to 10,000 new jobs specifically in the Liverpool LGA by 2036. Overarching priorities and actions that will shape the future for the Western City District include giving people housing choices by providing housing supply, choice and affordability, with access to jobs and services and designing places for people by creating and renewing great places such as Warwick Farm precinct. This will be supported by improved and coordinated transport and other infrastructure to realise the vision of 30-minute city and modal change to sustainable transport.

The Liverpool Collaboration Area Place Strategy has committed to undertaking precinct-level planning to integrate potential growth at Warwick Farm with Liverpool City Centre. Specific projects included in the Strategy for further development include upgrading the Warwick Farm Station interchange underpass and associated commuter car parking and access improvements. Pinch points on Hume Highway between Warwick Farm and Crossroads (at Casula) will be investigated and a new connection over Georges River is proposed to improve accessibility and connectivity between Newbridge Road and Governor Macquarie Drive.

Council is also working to improve active transport infrastructure through the Liverpool Bike Plan 2018-2023. With safer and better cycle facilities available near Warwick Farm station, future residents and employees will have the option to access services in Liverpool City Centre using sustainable transport.

Existing conditions

2016 Census Journey to Work data was analysed to determine current travel behaviour in the area during peak travel periods. The study area showed a similar car driver mode share, 50 percent, in comparison to the 53 percent of Greater Sydney. Train usage was 22 percent, six percentage points higher than the Greater Sydney average, while bus usage was very low at one percent given lack of bus routes that serve the entire precinct. Walking trips made up 11 percent, almost three times the Sydney average. The number of cycling trips recorded in Warwick Farm in the 2016 Census was zero.

The road network around the precinct includes Hume Highway, Governor Macquarie Drive, Munday Street, Warwick Street and Shore Street. A SIDRA Network model has been prepared for key intersections on the edge of the precinct to understand the existing network performance and to test the impacts of the development. Intersection performance has been assessed for the weekday AM and PM peak hours. Due to the ongoing COVID-19 pandemic, it has not been possible to undertake intersection turning counts for the assessment. Instead, base year traffic volumes in the assessment are based on historic Sydney Coordinated Adaptive Traffic System (SCATS) traffic volume data.

Modelling of the Hume Highway / Governor Macquarie Drive intersection indicates that it is currently running at capacity and is performing poorly at Level of Service (LoS) E during the AM peak hour.

Warwick Farm train station is within a 10-minute walk from the majority of the precinct, and provides nine services per hour in each direction on the T2, T3 and T5 lines during a typical morning peak. The train lines connect to Liverpool and Leppington to the south, Parramatta and Blacktown to the north as well as Sydney CBD via either Granville or Bankstown. There are no bus routes that serves the entire precinct, apart from the infrequent bus route 904 that operates on Hume Highway.

Cycling infrastructure within the precinct is currently limited to a shared path on Munday Street, and a small section of Manning Street and Warwick Street connecting to the station. There is also a shared path along Hume Highway to the north of the precinct. The bike mode share might increase with connections to a wider cycle network such as the delivery of Liverpool Bike Plan 2018-2023.

Proposed structure plan

The proposed Warwick Farm structure plan contains retail and commercial premises (approximately 24,400 m²) in response to the site's proximity to frequent train services. The high density residential component of the structure plan is estimated to accommodate 2,252 dwellings. Local sports venues and the existing Rosedale Oval are located in the southeast of the precinct that will serve as recreation destinations for future residents.

Figure ES2 The Warwick Farm precinct preferred structure plan



Source: CM+ (2020), Preferred Structure Plan REV03

In order to relieve Priddle Street, Manning Street and Munday Street (which currently carry all heavy vehicles travelling to and from the industrial area located to the south of the Warwick Farm precinct), a road bypass is proposed to connect Scrivener Street with Governor Macquarie Drive near Shore Street (**Figure ES2**). The bypass will remove the heavy vehicle and through traffic from the local streets within the Warwick Farm precinct. The new Governor Macquarie Drive / Shore Street intersection is proposed to be signalised and would become the main access point to and from the precinct. The Munday Street / Governor Macquarie Drive intersection is proposed to be downgraded to a left in / left out priority intersection. Governor Macquarie Drive is also proposed to be duplicated between Hume Highway and the access of the Warwick Farm Racecourse, as part of the structure plan.

The existing local road network within Warwick Farm precinct will be maintained. To improve the permeability of the precinct, multiple east-west through site links are proposed. New local streets will also be created in the “Masters site” north of Munday Street that align with Bull Street and Stroud Avenue.

A new footpath will be provided on the west side of Governor Macquarie Drive (between Hume Highway and Munday street) to maximise accessibility of future residents. Warwick Street, Munday Street, Manning Street and National Street (between Manning Street and Bull Street) are proposed to be have shared path on one side and a footpath on another to improve connections with Warwick Farm train station. Other local streets are proposed to have footpaths on both sides with on-road cycleways, due to the low traffic environment. Multiple through-site links in the east-west direction would enhance the connection between the residential area and the train station.

Transport assessment

The structure plan is estimated to generate 986 vehicle trips in the AM peak, and 1,168 vehicle trips in the PM peak.

During the peak hours in 2030, the intersection of Hume Highway / Governor Macquarie Drive continues to operate as the critical pinch-point of the surrounding road network. The intersection of Governor Macquarie Drive / Munday Street would also fail when development traffic is added to the surrounding road network, without any intersection upgrades.

The proposed infrastructure upgrades that have been tested to cater for background traffic growth and the traffic generated by the proposed structure plan include:

2030 Future Year Background Traffic Growth

- A new left turn slip lane from Hume Highway westbound to Governor Macquarie Drive southbound, with a 60m long turning bay;
- An additional southbound lane on Governor Macquarie Drive between Hume Highway and Munday Street; and
- An additional northbound lane on Governor Macquarie Drive between Warwick Farm Racecourse and Munday Street.

2030 Future Year Structure Plan

- An additional right turn bay from Hume Highway eastbound to Governor Macquarie Drive southbound;
- Extension of the new left turn slip lane from Hume Highway westbound to Governor Macquarie Drive southbound, from 60m to 150m;
- Extension of the existing kerbside short lane on Hume Highway eastbound;
- An additional southbound lane on Governor Macquarie Drive between Munday Street and Warwick Farm Racecourse; and
- Signalisation of the Shore Street / Governor Macquarie Drive intersection and conversion of the Munday Street / Governor Macquarie Drive intersection to a left in / left out priority intersection.

The intersection performance results under different scenarios in 2030 are listed in **Table ES1**. The traffic modelling confirms that the upgraded road network would cater for the structure plan and operate satisfactorily during the peak hours in year 2030. The two major signalised intersections, i.e. Hume Highway / Governor Macquarie Drive and Governor Macquarie Drive / Shore Street, perform at LoS D (or above) with the infrastructure upgrades.

The capacity of the public transport network is expected to be sufficient to service the increased public transport demands, with three train lines and up to nine peak hour train services in each direction. The active transport plan for the precinct will link new pedestrian and cycle paths with the existing shared path on Hume Highway and with future routes included in the Liverpool Bike Plan, and is considered sufficient to accommodate future pedestrian and cyclist demands.

Table ES1 2030 intersection performance (Level of Service)

No.	Intersection	Scenario 1: 2030 With Background Traffic Growth, Do Nothing	Scenario 2: 2030 With Background Traffic Growth And Network Upgrades	Scenario 3: 2030 With Development, Do Nothing	Scenario 4: 2030 With Development And Further Network Upgrades
2030 AM peak					
1	Hume Highway / Governor Macquarie Drive	F	D	F	D
2	Hume Highway / Warwick Street	A	A	A	A
3	Governor Macquarie Drive / Munday Street	B	B	F	A
4	Governor Macquarie Drive / Shore Street	B	A	C	C
5	Governor Macquarie Drive / Warwick Farm Racecourse Access Road	A	A	A	A
2030 PM peak					
1	Hume Highway / Governor Macquarie Drive	F	D	F	D
2	Hume Highway / Warwick Street	A	A	A	A
3	Governor Macquarie Drive / Munday Street	B	C	F	A
4	Governor Macquarie Drive / Shore Street	B	A	A	D
5	Governor Macquarie Drive / Warwick Farm Racecourse Access Road	A	A	A	A

Source: SCT Consulting, 2020

Conclusion

The proposed structure plan is positively aligned with strategic planning and transport policy. Because the precinct is located immediately next to Warwick Farm station, it has the opportunity to be delivered as a transit-oriented development with fast and frequent public transport access to Liverpool CBD and other major centres in Sydney.

The structure plan will fill the gaps in the existing active transport network and promotes pedestrian and cyclist movements by maintaining good permeability within the precinct and providing connections to the surrounding cycling and walking network.

Without infrastructure upgrades, the road network will not have sufficient capacity to accommodate these additional trips. With a range of network upgrades, an acceptable level of intersection performance (LoS D) can be achieved. Some of these network upgrades are required just to cater for background traffic growth from other nearby developments (Scenario 2), whereas other upgrades will be additionally required to accommodate the traffic generated by the Warwick Farm precinct (Scenario 4). These intersection upgrades are close to the maximum scale for at-grade intersections typically seen in Sydney.

The additional road capacity from the widening of Governor Macquarie Drive and the intersection upgrades is forecast to quickly fill up with the traffic generated by the development, and background traffic growth. There would be very little capacity left for any further long-term additional traffic from the south, for example using a potential new bridge over Georges River (to be provided by the Liverpool Waterfront precinct). A new road bridge over Georges River would also have wider traffic implications for the Collaboration Area (as it would effectively form an eastern bypass of Liverpool CBD), and the traffic impacts of any such road bridge should be scrutinised in more detail in the planning for the Liverpool Waterfront precinct.

1.0 Introduction

1.1 Background

Liverpool City Council has resolved that a structure plan and planning proposal be prepared to rezone the Warwick Farm precinct to a combination of B4 Mixed Use and R4 High Density Residential. The Warwick Farm precinct is bounded by Governor Macquarie Drive to the northeast, Hume Highway to the northwest, Warwick Farm station and the railway line to the west and Priddle Street to the south.

Land uses in the precinct have a historical association with the horse racing and training industry. Industrial development to the south of the Warwick Farm precinct emerged from the 1970s that resulted in residential development, equine industry and industrial development with a widened road network for large trucks in this part of the Warwick Farm precinct.

The current zoning of the precinct includes B5 Business Development in the north, R3 Medium Density Residential in the northwest, R2 Low Density Residential in the south (with horse training facilities as an additional permitted use) and RE1 Public Recreation in the southeast.

The proposed urban renewal structure plan for the Warwick Farm precinct will be consistent with a B4 Mixed Use and R4 High Density Residential zone including residential, commercial and retail land uses. The structure plan includes open space, community and recreation facilities.

SCT Consulting has been engaged by Liverpool City Council to undertake a traffic and transport impact assessment to support planning proposal for the Warwick Farm structure plan, as shown in Figure 1–1.

Figure 1–1 Warwick Farm structure plan area indicative aerial view



Source: CM+ (2020), Warwick Farm Structure Plan – Preferred Structure Plan - Rev 03

The precinct covers a total area of approximately 28 hectares. The preferred structure plan would contain around 2,252 high density residential dwellings and around 24,400 m² commercial GFA including retail and office premises. The proposed open space area would be around 100,000 m² including the current Rosedale Oval in the southeast of the precinct.

1.2 Purpose and scope of report

The purpose of this Traffic and Transport Impact Assessment is to support the planning proposal for the Warwick Farm Structure Plan. The objectives of the assessment are to:

- Inform future planning controls to ensure a coordinated and efficient approach to land use planning, environmental management and transport infrastructure;
- Provide an integrated approach to determining the optimal mix of land uses and density concentrations as a means of minimising trip generation and transport-related demand;
- Ascertain the cumulative and regional traffic and transport impacts associated with future land-based demands associated with the rezoning; and
- Maximise efficiency and safety of the existing / proposed transport systems in proximity to the subject site.

The scope of this traffic and transport impact assessment is to:

- Undertake a review of the relevant strategic planning and transport planning context;
- Review existing traffic and transport conditions;
- Understand the status of any planned and committed development proposals and infrastructure upgrades;
- Understand trip generation and trip distribution to assess the likely implications of the proposed development;
- Determine likely infrastructure upgrades required to cater for the proposed development; and
- Identify public and active transport measures and sustainable travel initiatives for the development.

Due to the ongoing COVID-19 pandemic, it has not been possible to undertake intersection turning counts for the assessment. Instead, base year traffic volumes in the assessment are based on historic Sydney Coordinated Adaptive Traffic System (SCATS) data. Compared to primary data collection, the SCATS data has some limitations, which are discussed further in **Section 3.5** of this report.

1.3 Report structure

This report has been structured into the following sections:

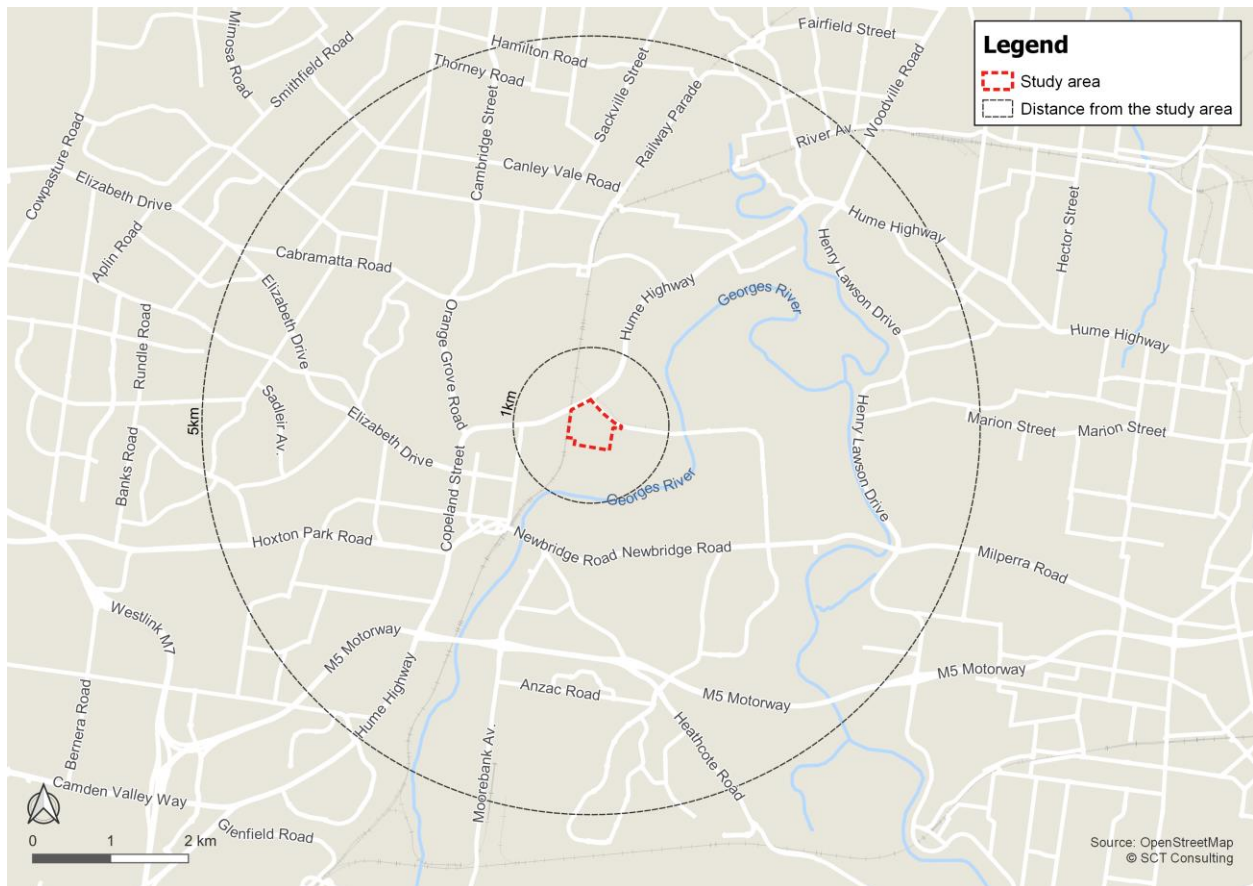
- **Section 2** reviews the relevant strategic planning and transport planning context;
- **Section 3** describes the existing transport conditions in and around the precinct for all modes of transport;
- **Section 4** describes the proposed development including development yield and proposed transport network;
- **Section 5** discusses the traffic and transport appraisal which covers the traffic modelling methodology; the likely trip generation from the development; the forecast traffic impacts; and the mitigation measures that have been tested; and
- **Section 6** presents the conclusions of the assessment.

2.0 Strategic Context

2.1 Site context

The Warwick Farm precinct is bounded by Governor Macquarie Drive to the northeast, Hume Highway to the northwest, Warwick Farm station and the railway line to the west and Priddle Street to the south. The precinct's regional context is shown in **Figure 2-1**.

Figure 2-1 Site context



Source: SCT Consulting, 2020

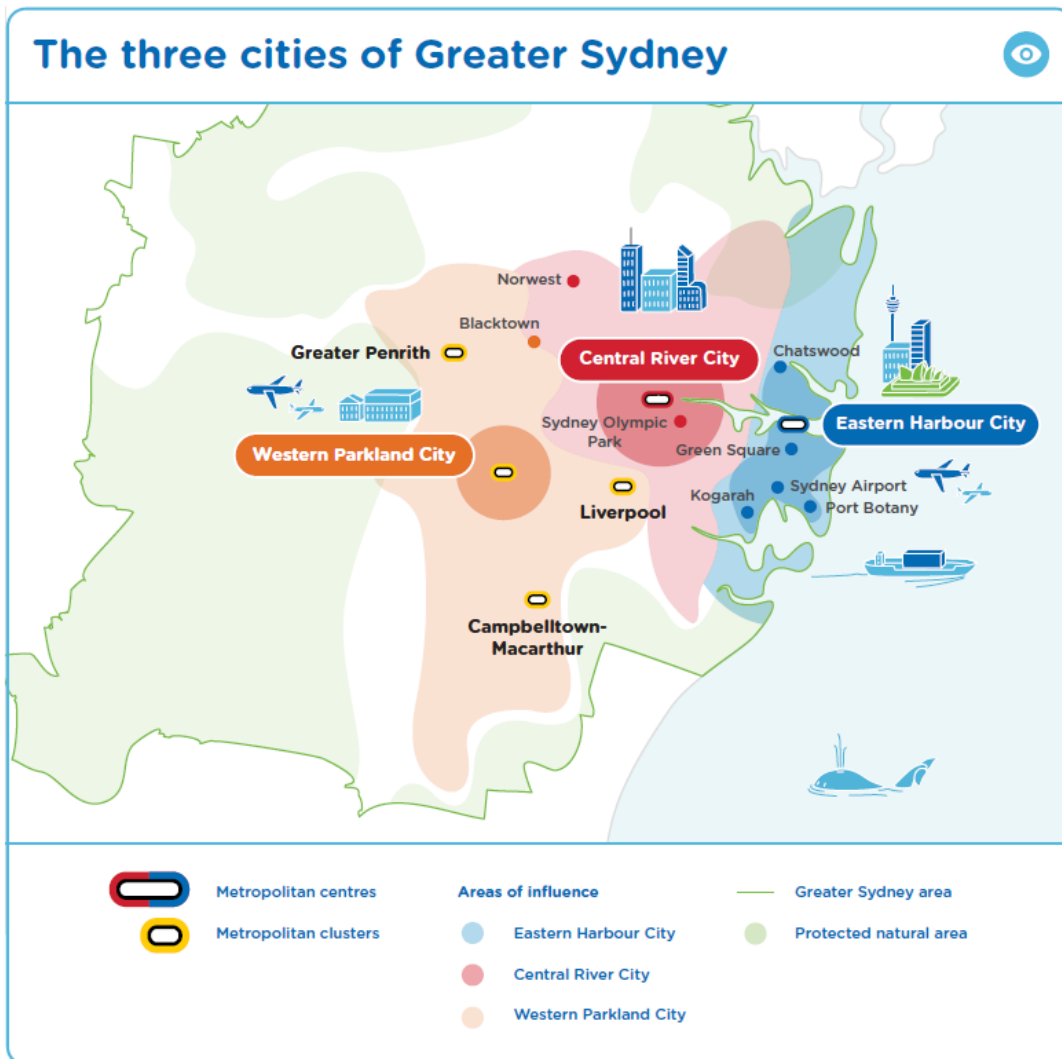
The precinct includes a pocket of land zoned R2, a small area zoned R3 adjacent to the railway station, Rosedale Park in the southeast, and the 'Masters site' adjacent to Hume Highway (currently zoned B5) in the north. Warwick Farm Station sits on the western edge of the precinct and provides frequent train services to Liverpool CBD, Parramatta, Bankstown and Sydney CBD.

In line with State Government's planning advice to maximise densities close to rail stations, the proposed structure plan aims to redevelop the Warwick Farm precinct into a high density community with ready access to employment, public transport and commercial facilities. The proposed development is well positioned to be integrated into infrastructure development in the wider regional area, as outlined in the following sections.

2.2 Future Transport 2056 Strategy

The Future Transport Strategy 2056 (NSW Government, 2018) defines NSW Government’s vision for how transport can support growth and the economy of New South Wales over the next 40 years. Similar to the Greater Sydney Region Plan, it sets out a vision of three cities to guide many of the planning, investment and customer outcomes including faster, convenient and reliable travel times to major centres, as shown in **Figure 2–2**. Liverpool is part of the Western Parkland City within Sydney’s metropolis of three cities.

Figure 2–2 A future metropolis of three cities



Source: NSW Government (2018), Future Transport Strategy

Existing and potential transit connections, together with new technology and innovation, will make the network surrounding the precinct more responsive to demand and better able to manage congestion in the future.

For the three cities identified, more specific outcomes listed as part of the Strategy which will benefit the precinct’s transport context include:

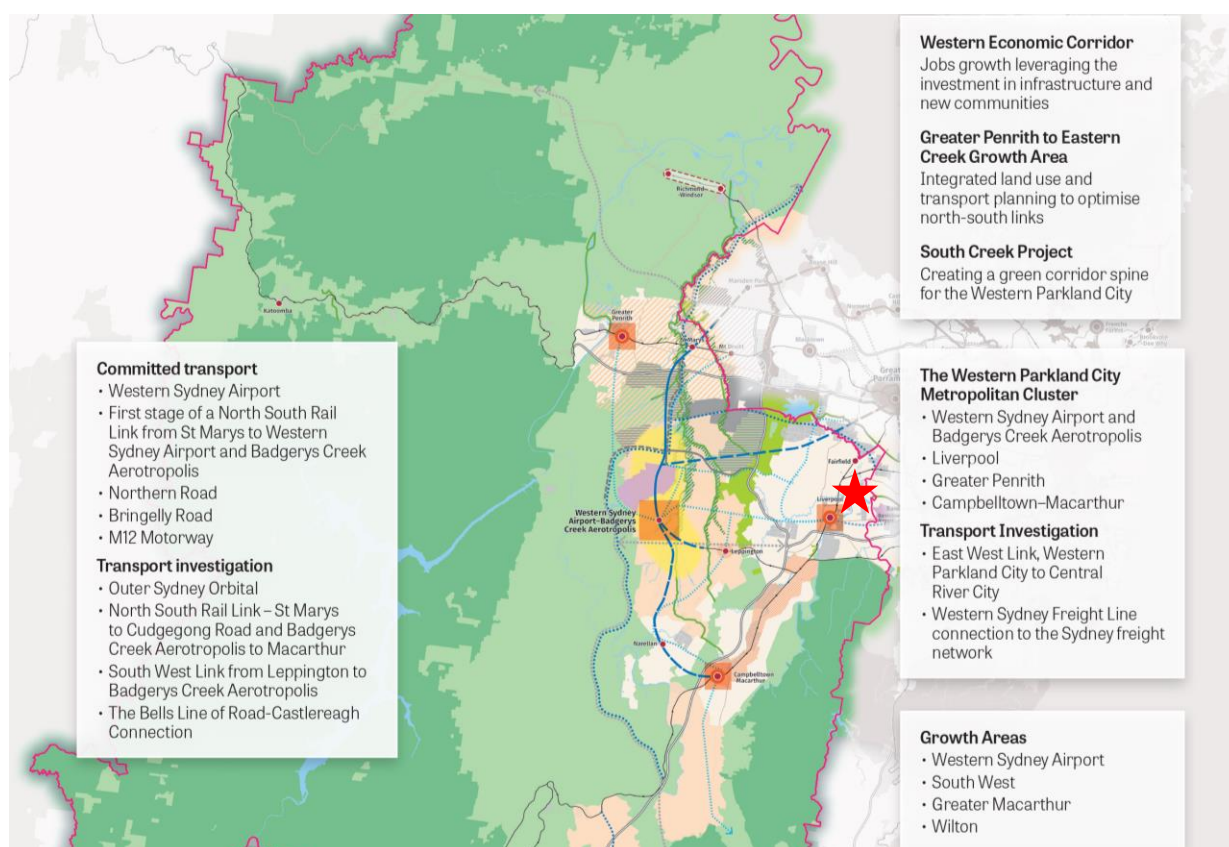
- 30-minute access for customers to their nearest Centre by public transport 7-days a week;
- Fast and convenient interchanging with walking times no longer than five minutes between services;
- Walking or cycling is the most convenient option for short trips around centres and local areas, supported by a safe road environment and attractive paths; and
- Fully accessible transport for all customers.

Implications for the precinct: Liverpool is identified a key area for infrastructure investment within the Western Parkland City. Future transport initiatives aimed to connect residents to centres will increase permeability of public transport networks throughout residential areas. This benefits the precinct through improved accessibility to jobs in the region and to other city centres. Specific provision for pedestrian and cyclist activity and efficient interchanging contributes to a safe and comfortable walking environment, promoting public transport mode share.

2.3 Western City District Plan

The Western City District Plan covers the Local Government Areas of Blue Mountains, Camden, Campbelltown, Fairfield, Hawkesbury, Liverpool, Penrith and Wollondilly. It aims to ensure future generations have excellent connections to local jobs, housing, services, and great places. The Warwick Farm precinct is located to the northeast of Liverpool strategic centre (**Figure 2–3**).

Figure 2–3 Western City District Plan (red star added to highlight Warwick Farm precinct)



Source: Greater Sydney Commission (2018), Western City District Plan

The Plan establishes a housing target of 184,500 new dwellings by 2036, with 8,250 additional dwellings in Liverpool LGA by 2021. The Plan also sets a target for the Liverpool LGA to accommodate between 7,000 and 10,000 new jobs by 2036. The Draft District Plan outlines a number of overarching priorities and actions that will shape the future and guide policy decisions for this District, including:

- Giving people housing choices by providing housing supply, choice and affordability, with access to jobs and services;
- Designing places for people by creating and renewing great places and local centres, and respecting the district’s heritage;
- Developing a more accessible and walkable city by establishing the land use and transport structure to deliver a liveable, productive and sustainable Western Parkland City; and
- Valuing green spaces and landscape by actions including creating a protecting and enhancing bushland and biodiversity Planning Priority, better managing rural areas and delivering high quality open space.

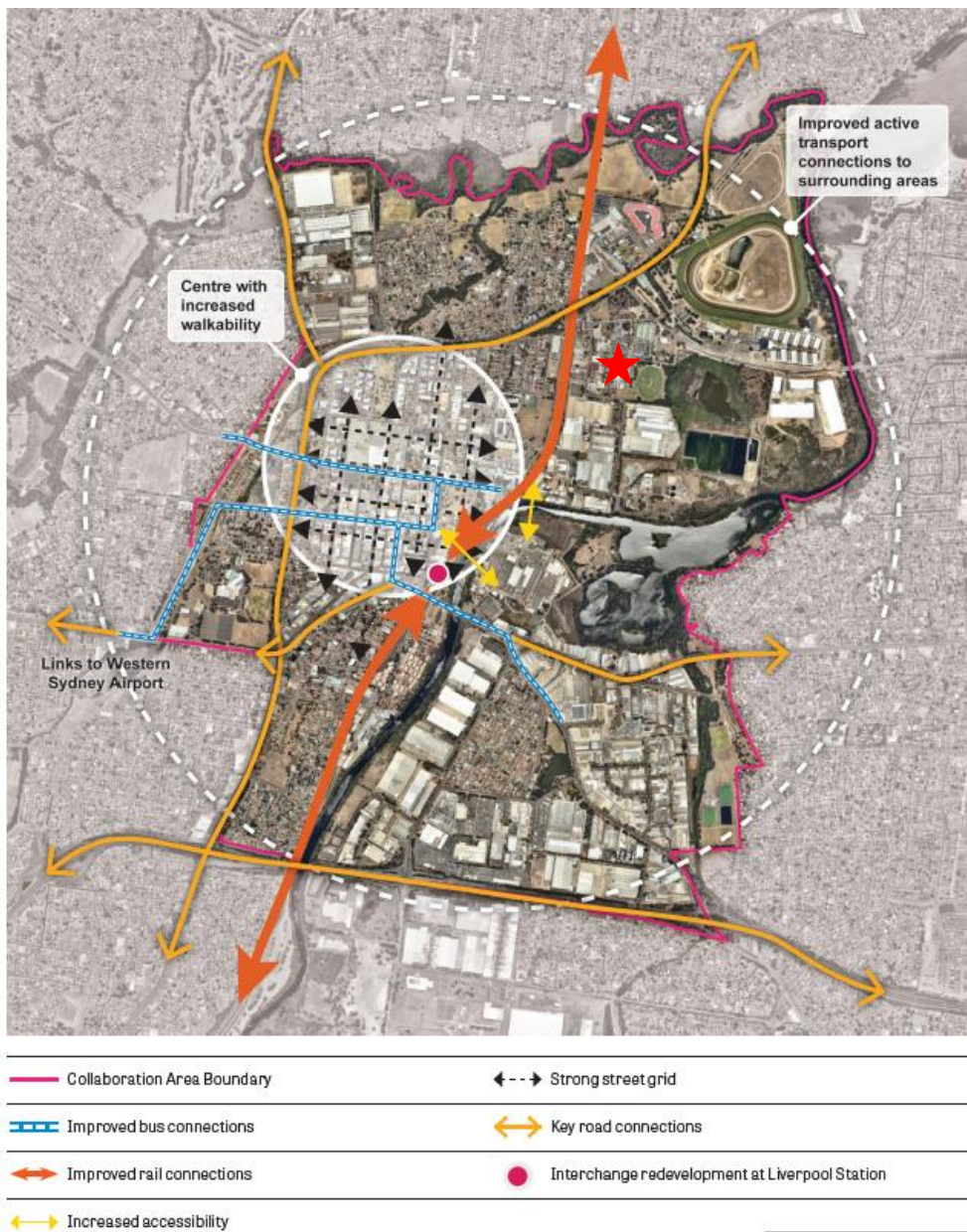
Implications for the precinct: The proposed structure plan for the Warwick Farm precinct supports maximising housing density and diversity and accommodating more jobs along a major public transport corridor. It also provides the opportunity to promote sustainable transport use by improving pedestrian and cycle facilities in and around the precinct, in line with the priorities of the Western City District Plan.

2.4 Liverpool Collaboration Area Place Strategy

The Liverpool Collaboration Area Place Strategy identifies the actions for delivering future infrastructure, housing and employment growth in central Liverpool. It lists out impediments and opportunities and sets priorities for the Collaboration Area. The Place Strategy aims to inform public and private policy and investment decisions by identifying and recognising complex, place-specific issues.

Figure 2–4 indicates the connectivity opportunities for the Liverpool Collaboration Area. These include improving active transport connections from Liverpool CBD to surrounding areas, and a potential new connection over Georges River east of Liverpool CBD.

Figure 2–4 Collaboration Area connectivity opportunities and assets (red star added to highlight Warwick Farm precinct)



Source: Greater Sydney Commission (2018), Liverpool Collaboration Area Place Strategy

The Liverpool Collaboration Area is well connected to the Western Parkland City and other strategic locations across Greater Sydney. Key transport priorities under the strategy include:

- Plan for movement and place functions in Liverpool City Centre, improve accessibility and walkability, and reduce congestion in and around the centre;
- Improve public transport to and from Liverpool;
- Create and renew great places for people; and
- Develop a network of high-quality open space linked by the Greater Sydney Green Grid and invest in improvements to the Georges River and its foreshores.

Specific outcomes listed as part of the Strategy which will benefit the Warwick Farm precinct's transport context include:

- Develop an integrated transport strategy that applies movement and place and addresses the transport challenges associated with delivering the vision, shared objectives and growth profile;
- Redeveloping train stations and bus interchange with mixed use development; easier pedestrian access to bus services; a pedestrian, cycle and public transport crossing of the Georges River and a better interface with the river and open space; and
- Develop a linear parkland and a continuous network of public open spaces aligned with Green Grid priorities along the Georges River that links the City Centre with the Sydney Water site, Warwick Farm, Chipping Norton Lakes and the Holsworthy Defence site.

Implications for the precinct: The Strategy identifies a priority action to upgrade the Warwick Farm Station interchange underpass and associated commuter car parking and access improvements. Pinch points along Hume Highway between Warwick Farm and Crossroads (at Casula) will also be investigated.

2.5 Liverpool Local Strategic Planning Statement

The Liverpool Local Strategic Planning Statement (LSPS) has been created to set Liverpool City Council's strategic planning vision for the next 20 years. It lists planning priorities across four areas: Connectivity, Productivity, Liveability, and Sustainability. On Connectivity, the LSPS vision is to have fast and frequent connections within the Liverpool LGA and to other centres.

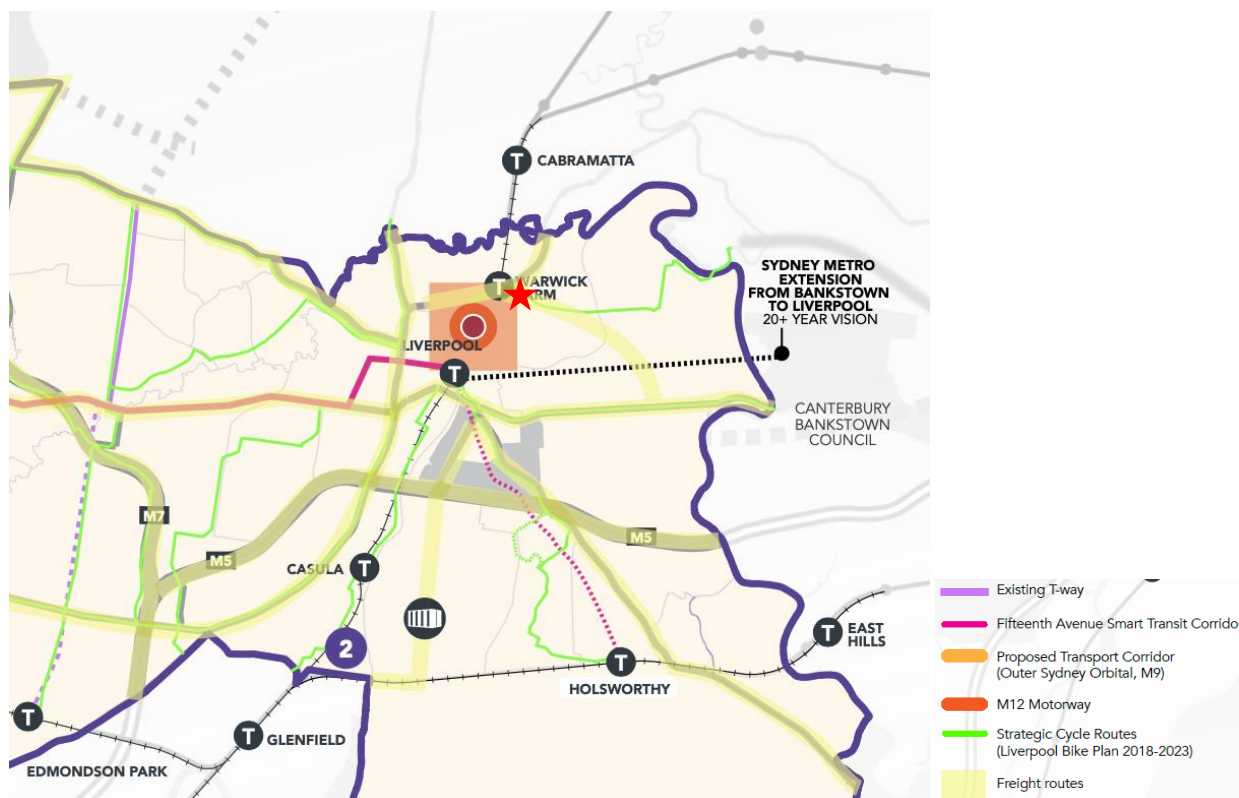
A short-term action from the LSPS is to prepare a structure plan and planning proposal to rezone Warwick Farm racing precinct to mixed use. In order to improve the connectivity at LGA level, proposed improvements include:

- Advocate for improvements to public transport connections and timetabling for suburban areas and centres;
- Improvements to the road network surrounding Liverpool City Centre to support additional developments in the Liverpool Collaboration Area;
- Improve local road access to suburbs and centre; and
- Road network upgrades to minimise traffic impacts from Moorebank Intermodal Terminals.

Council is also working to improve active transport access and connectivity, acknowledging the health and amenity benefits of walking and cycling, by implementing the Liverpool Bike Plan 2018-2023. By 2040 there will be a complete connected network of cycle paths in new and established areas. This will also support emerging forms of micro-mobility in the LGA, including e-bikes and e-scooters.

The transport improvement initiatives identified in the LSPS are illustrated in **Figure 2-5**.

Figure 2–5 Transport improvement initiatives (red star added to highlight Warwick Farm precinct)



Source: Liverpool City Council (2020), Connected Liverpool 2040: Liverpool’s Local Strategic Planning Statement

Implications for the precinct: The Liverpool LSPS intends to improve the public transport network and roads and services in suburban areas. The precinct will benefit from public transport and road network upgrades associated with delivering a 30-minute city. With the development of adjacent strategic centres and local centres comes employment opportunities and access to health, education and community services. The expansion of the cycle network will further benefit the precinct’s connectivity to Liverpool CBD and the wider LGA.

2.6 Liverpool Bike Plan 2018-2023

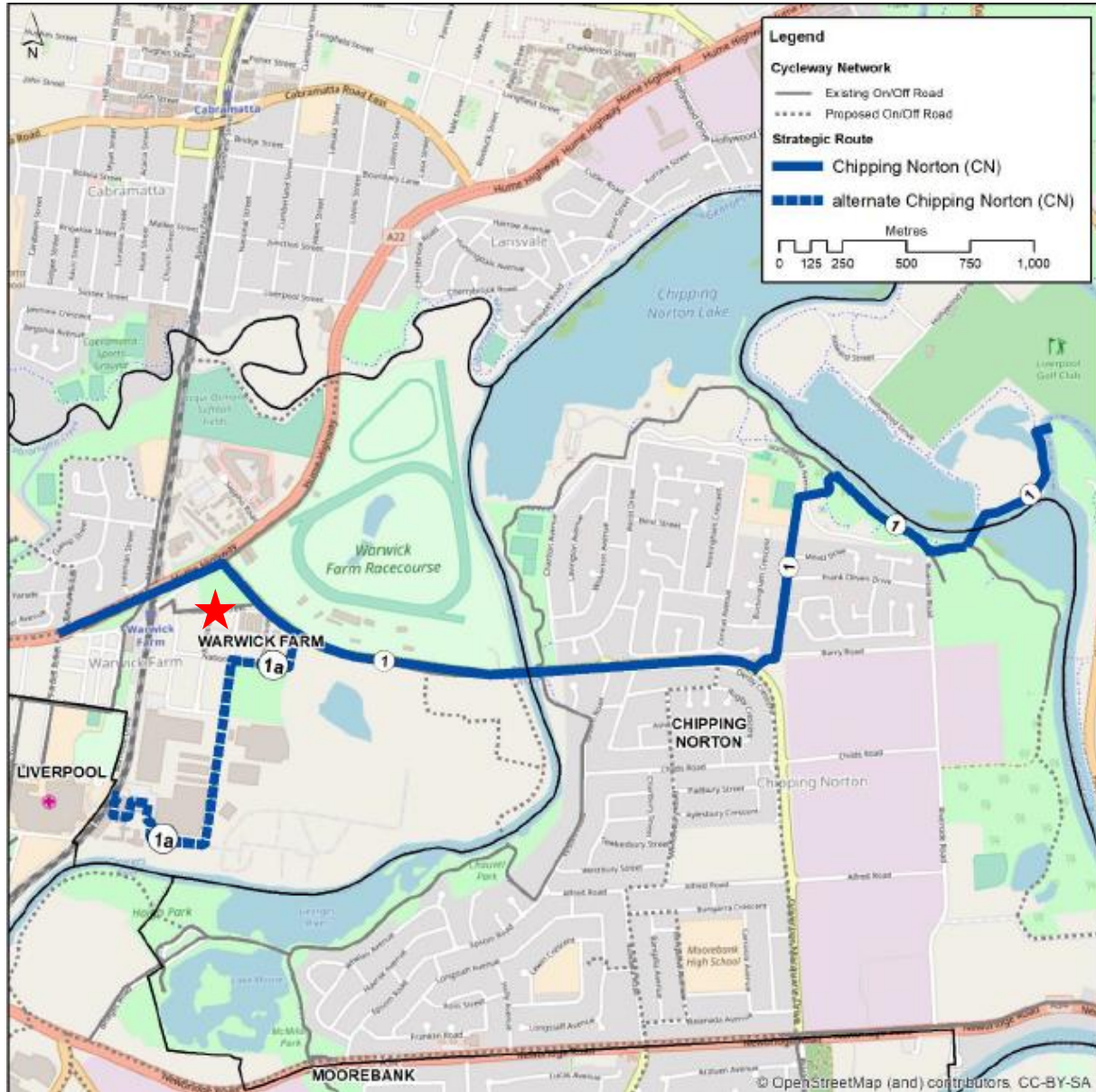
The Liverpool Bike Plan 2018-2023 outlines the provision of bicycle-related infrastructure in the Liverpool LGA. It is also a communication strategy designed to promote and increase the rates of cycling in Liverpool. Poor connectivity within Liverpool CBD, a number of missing connectivity links, and poor wayfinding signage were identified as the issues in the Bike Plan. The key objectives of the Liverpool Bike Plan are listed as follows:

- To provide strategic direction and a plan of action for the provision of cycleways, bicycle facilities and the promotion of cycling within Liverpool;
- To identify both existing and proposed cycleway routes in the context of key trip generators, neighbourhood attractions and recreational opportunities;
- To establish a safe, well-connected, easy-to-use cycling environment through the delivery of infrastructure and facilities within the five-year timeframe of this plan and beyond;
- Encourage members of the community to utilise both recreational and commuter trails through awareness and education programs in an effort to improve health outcomes for the community; and
- Implement the strategies and concepts contained within various Commonwealth and State government cycling strategies, and work with other stakeholders to encourage cycling and provide new cycling infrastructure.

In the vicinity of Warwick Farm Precinct, the Liverpool to Chipping Norton route provides a link to the north east of the LGA. The route starts on the Hume Highway at the northern end of the Liverpool CBD. From the Hume Highway it turns onto Governor Macquarie Drive. The route crosses over the Governor Macquarie Drive Bridge where a link to the Georges River Cycleway exists. The route then runs eastward further to meet the Chipping Norton Lakes

Cycleway near Black Muscat Park. Alternatively, the route can be directed through the hospital precinct near the City Centre where a crossing of the railway line exists. The route would then be directed along Scrivener Street, Stroud Street and National Street where it will connect to the Governor Macquarie Drive Bridge. (Figure 2-6).

Figure 2-6 Proposed cycle route in the vicinity of the precinct (red star added to highlight Warwick Farm precinct)



Source: Liverpool Council (2018), Liverpool Bike Plan 2018-2023

Implications for the site: The proposed Chipping Norton Cycleway along Hume Highway and Governor Macquarie Drive will connect the precinct to the wider region. With safer and better cycle facilities available near Warwick Farm station, future residents have the option to access services in Liverpool City Centre by bike.

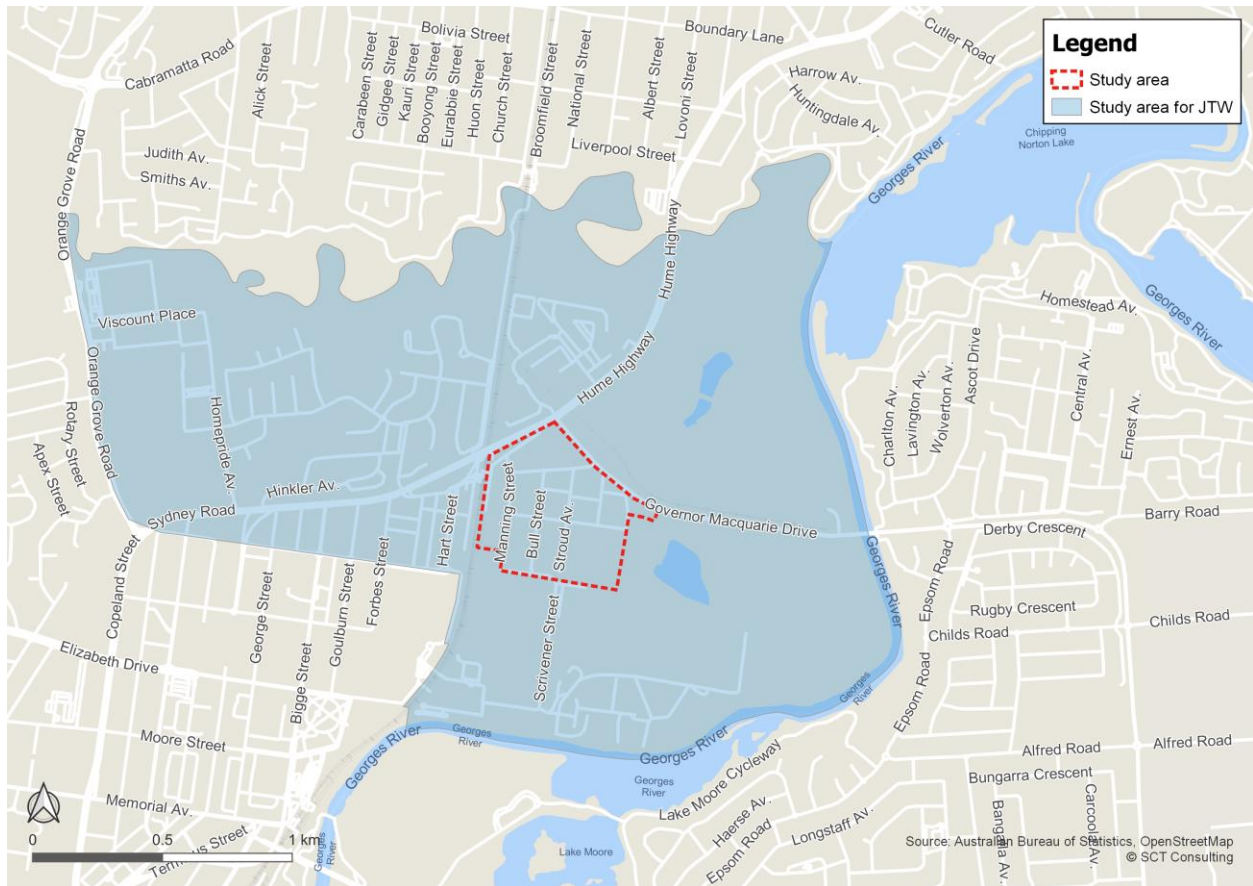
3.0 Existing Conditions

3.1 Travel behaviour

3.1.1 Census Journey to Work mode shares

2016 Census Journey to Work data for the Warwick Farm Statistical Area level 2 (SA2) was analysed to determine travel behaviour of the existing residents, as shown in **Figure 3–1**.

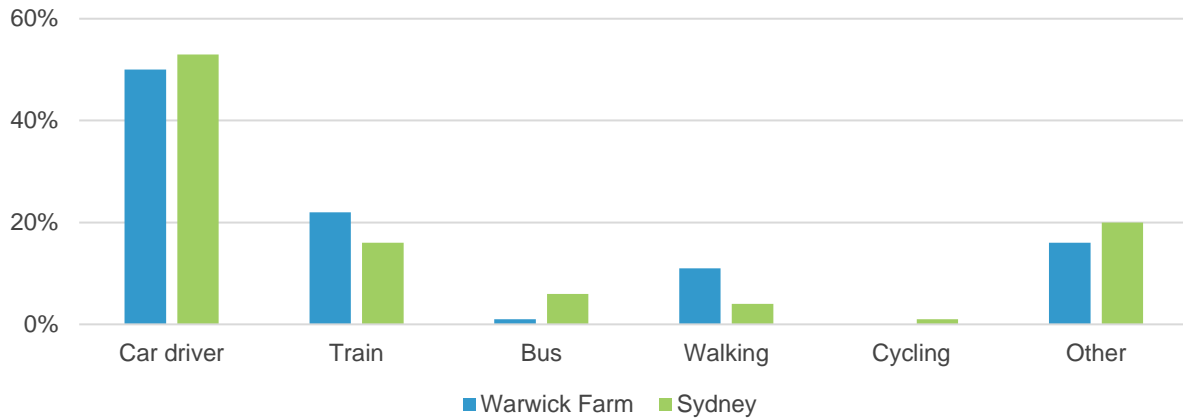
Figure 3–1 Study area for journey to work analysis



Source: SCT Consulting, 2020

The study area showed a similar car driver mode share, 50 percent, in comparison to the 53 percent of Greater Sydney. Train usage was 22 percent, six percentage points higher than the Greater Sydney average, while bus usage was very low at one percent given lack of bus routes that serve the entire precinct. Walking trips made up 11 percent, almost three times the Sydney average. The number of cycling trips recorded in the 2016 Census was zero (**Figure 3–2**).

Figure 3–2 Comparison of Journey to Work mode shares between Warwick Farm and Sydney

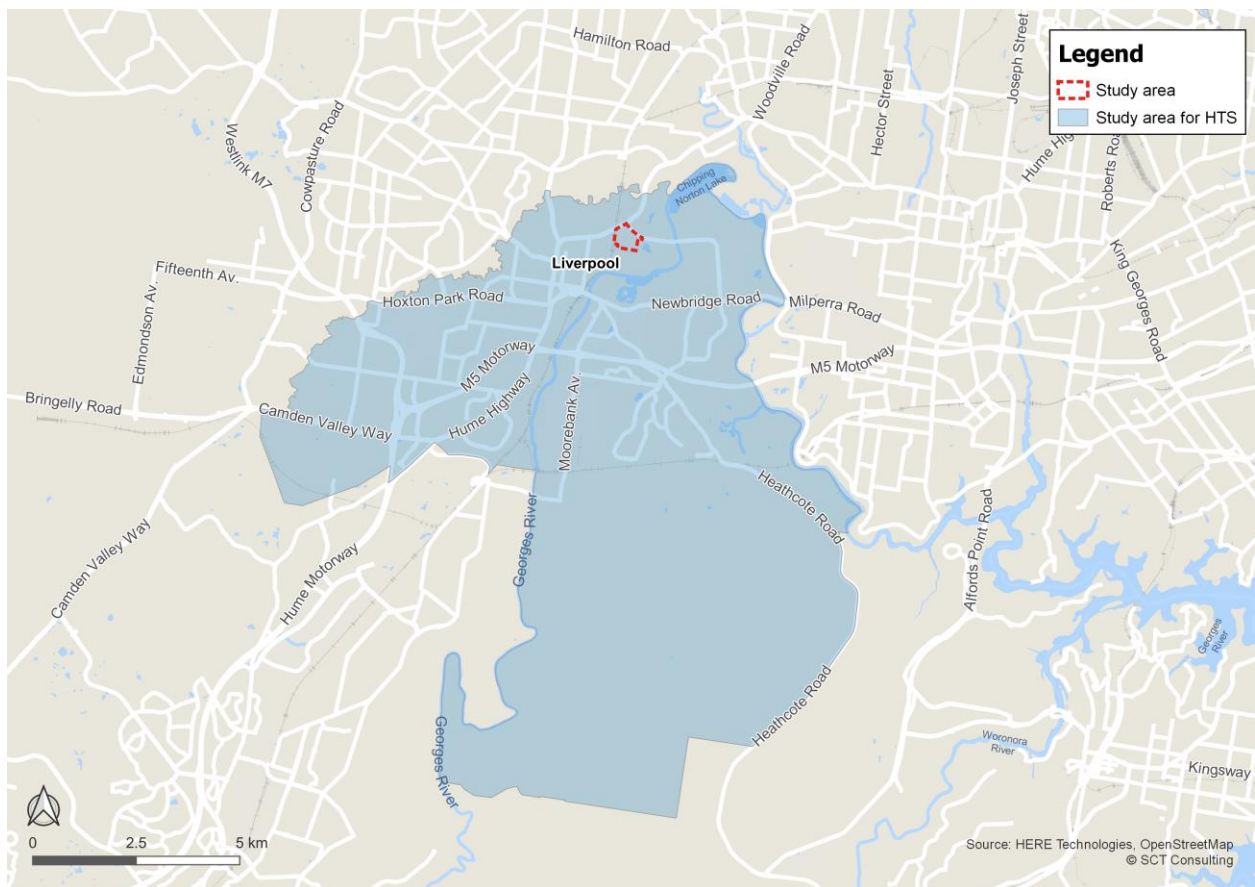


Source: SCT Consulting, 2020

3.1.2 Household Travel Survey mode shares and trip lengths

The Warwick Farm precinct sits within the Liverpool Statistical Area level 3 (SA3), as shown in **Figure 3–3**. TfNSW Household Travel Survey data for this SA3 has been analysed to determine mode shares and average trip lengths. Unlike the Census Journey to Work data, Household Travel Survey data covers all trip purposes, not just commuting trips. However, as the survey sample size is much smaller, Household Travel Survey data is only available at higher geographies such as SA3s.

Figure 3–3 Study area for household travel survey analysis



Source: SCT Consulting, 2020

Table 3-1 and **Table 3-2** provide a summary mode shares and trip purposes by residents of the Liverpool SA3 against the Greater Sydney average. The average travel distance for each category is also listed.

Table 3-1 Household Travel Survey – residents in the Liverpool SA3, travel by mode

Mode of travel	Liverpool		Greater Sydney	
	Percentage of total trips	Average distance	Percentage of total trips	Average distance
Vehicle Driver	58%	11 km	48%	10 km
Vehicle Passenger	24%	10 km	21%	9 km
Train	5%	23 km	6%	18 km
Bus	3%	8 km	6%	8 km
Walk Only	9%	2 km	18%	1 km
Other	1%	2 km	2%	6 km
Total	100%	-	100%	-

Source: TfNSW Household Travel Survey data by SA3, 2018/19

The study area had more vehicle drivers and vehicle passengers at 58 percent and 24 percent compared to Greater Sydney's 48 percent and 21 percent, reflecting very high car dependency. Other modes of transport such as bus and walking trips were only half of the Greater Sydney average.

Table 3-2 Household travel survey – residents in the Liverpool SA3, travel by purpose

Trip purpose	Liverpool		Greater Sydney	
	Percentage of total trips	Average distance	Percentage of total trips	Average distance
Commute	19%	17 km	17%	15 km
Work related business	6%	20 km	7%	16 km
Education/childcare	11%	7 km	10%	6 km
Shopping	16%	10 km	15%	6 km
Personal business	4%	5 km	5%	7 km
Social/recreation	16%	10 km	25%	9 km
Serve passenger	27%	7 km	19%	6 km
Other	2%	4 km	2%	4 km
Total	100%	-	100%	-

Source: TfNSW Household Travel Survey data by SA3, 2018/19

For almost all modes and trip purposes, the average distance travelled by residents of the Liverpool SA3 is slightly longer than the Greater Sydney average. This can be attributed to the area's lower density than other parts of Sydney, requiring residents to travel further to reach their destinations.

3.2 Road network and classification

The major roads in the vicinity of the precinct include Hume Highway, Governor Macquarie Drive, Munday Street, Manning Street, Warwick Street and Shore Street. The road network surrounding the Warwick Farm precinct is shown in **Figure 3-4**.

Figure 3–4 Road network around the site



Source: SCT Consulting, 2020

The characteristics of the roads surrounding the subject precinct are:

- **Hume Highway** is a primary road connecting Liverpool to Sydney’s Inner West. It is a state road (A22) and has three lanes in each direction with a posted speed limit of 70 km/h. A clearway is in operation from 6am to 7pm on weekdays and 9am to 6pm on weekends in both directions. In the vicinity of the precinct, there is a footpath on the northern side and a shared pedestrian/cycle path on the southern side. Pedestrian crossings are provided at the intersection of Hume Highway / Governor Macquarie Drive (except on the east side) and an underpass is available to the west of Warwick Farm Station to connect Warwick Farm to the south of Hume Highway with Station Street to the north of Hume Highway.
- **Governor Macquarie Drive** is a distributor road with a speed limit of 60 km/h. It intersects with Hume Highway to the north and Newbridge Road to the south. It has two northbound lanes and flares up to three lanes including two right turn lanes when approaching Hume Highway. One southbound lane is provided with additional right turn lane at the Munday Street intersection. The road has only one lane in each direction between Munday Street and the signalised access to Warwick Farm Racecourse. The road has recently been upgraded to two lanes in each direction plus turning lanes between the Warwick Farm Racecourse and Georges River. The section of the road between Georges River and Newbridge Road remains one lane in each direction, with future plans to be upgraded to two lanes in each direction. Footpaths are not provided on the west side in the vicinity of the Masters site at the corner of Governor Macquarie Drive and Hume Highway. Pedestrian crossings are present on all approaches of the Munday Street intersection. No parking is permitted on either side of the road.
- **Warwick Street** is a local road that connects Warwick Farm Station and Manning Street with Hume Highway. It has one lane in each direction with a speed limit of 50 km/h. Except for the recently completed shared path on the south side of the road close to the station, there is no footpath on either side of the road, making it unattractive for walking. Vehicles are permitted to park on both sides of the road, with no time restrictions.
- **Munday Street / Manning Street / Priddle Street** is the local collector road that connects Governor Macquarie Drive with the industrial area to the south of the Warwick Farm precinct. It has one traffic lane and one parking

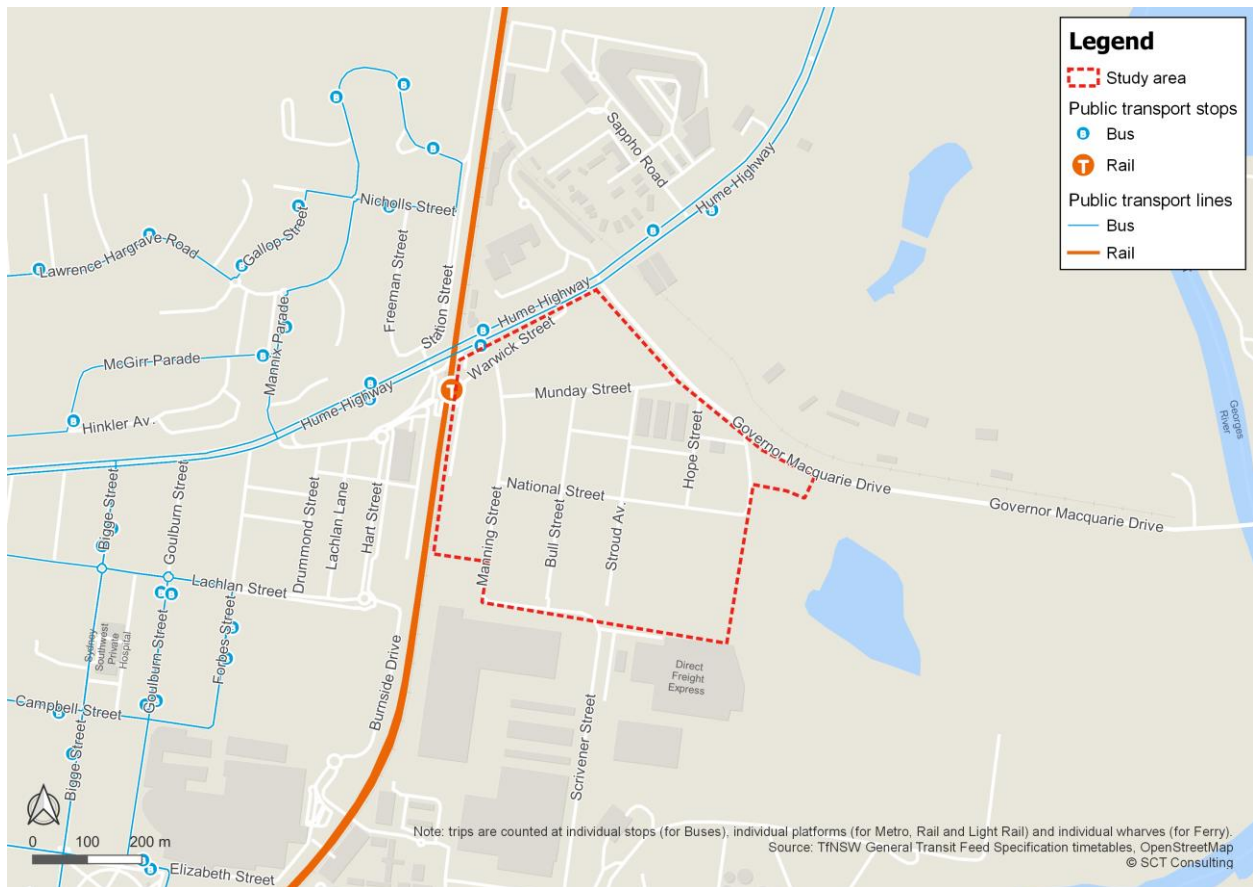
lane in each direction. A recently completed shared path is provided on the northern side. The speed limit is 50 km/h.

- **Shore Street** is a one way (northbound) one lane local road that mainly services the residences and visitors of the Rosedale Oval and nearby racecourse. It currently terminates at a left-out only intersection with Governor Macquarie Drive. There are no parking restrictions along the road.

3.3 Public transport network

Public transport facilities around the precinct are shown in **Figure 3–5**.

Figure 3–5 Public transport around the site



Source: SCT Consulting, 2020

Warwick Farm station is within a 10-minute walk from the majority of the precinct, which provides nine services per hour in each direction on the T2, T3 and T5 lines during a typical morning peak. The train lines connect to Sydney’s key centres including Liverpool, Parramatta, Strathfield, and Sydney CBD. There are three major commuter parking facilities to the east and west of the station, totalling to over 800 parking spaces¹.

There are no bus routes that serve the entire precinct, apart from bus route 904 on Hume Highway. Route 904 provides relatively infrequent bus services between Fairfield to Liverpool via Carramar. It provides 15 services per day and only two services during a typical weekday peak hour in each direction.

3.4 Active transport network

Shared pedestrian/cycle paths are provided on the southern side of Hume Highway, on the northern side of Munday Street, and a small section of Manning Street and Warwick Street connecting to the station. A shared path crossing of

¹ Parkopedia (2020), Number of parking spaces available, <https://www.parkopedia.com.au/parking/neighbourhood/Warwick-Farm-NSW/?arriving=202006191230&leaving=202006191430>

Hume Highway is provided via an underpass located to the west of the Warwick Farm Station, although the underpass is in poor condition.

There is an extended shared path network to the southwest of the site to connect Liverpool City Centre, providing potential opportunity to promote cycle use in the local area, although it is evident there are still gaps of cycling infrastructure provision to connect to the regional network (**Figure 3-6**).

Figure 3-6 Bicycle network in the vicinity of the precinct

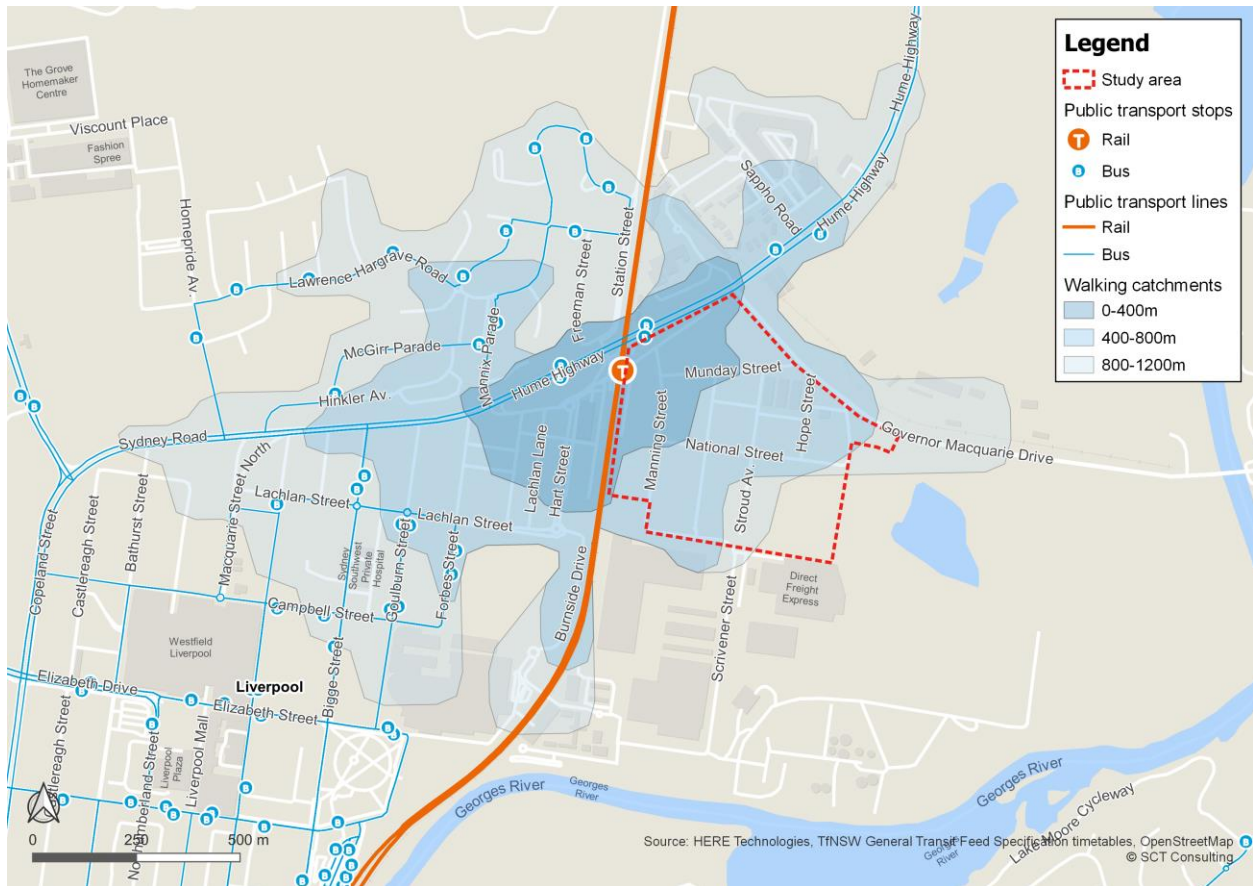


Source: SCT Consulting, 2020

The majority of the precinct is within 800 metres walking distance from Warwick Farm train station (**Figure 3-7**). Footpaths are provided on some internal streets within the precinct in various quality, while shared paths on major roads such as Hume Highway may see conflicts between cyclists and pedestrians. Along Governor Macquarie Drive, there is no footpath on the western side between Munday Street and Hume Highway and on the eastern side between Munday Street and Shore Street.

Pedestrian crossings are available at the signalised intersections of Governor Macquarie Drive / Munday Street and Governor Macquarie Drive / Hume Highway.

Figure 3-7 Walking distances to Warwick Farm Station



Source: SCT Consulting, 2020

Overall, walking and cycling infrastructure is currently limited and disconnected, and therefore likely to be under-used. However, the bike mode share might increase after the delivery of new connections to a wider cycle network, as proposed in the Liverpool Bike Plan 2018-2023.

3.5 Existing traffic conditions

A SIDRA Network model has been prepared for key intersections on the edge of the precinct to understand the existing network performance and to test the impacts of the development. Intersection performance has been assessed for the weekday AM and PM peak hours, for the intersections shown in **Figure 3–8**. Three of these modelled intersections are signalised intersections and two are priority intersections. Intersections were modelled using a single network within SIDRA due to the close spacing of junctions.

Figure 3–8 Intersections to be assessed



Source: SCT Consulting, 2020

3.5.1 Key assumptions for base year model

Key assumptions used to develop the base year model are discussed below:

3.5.1.1 SCATS detector data

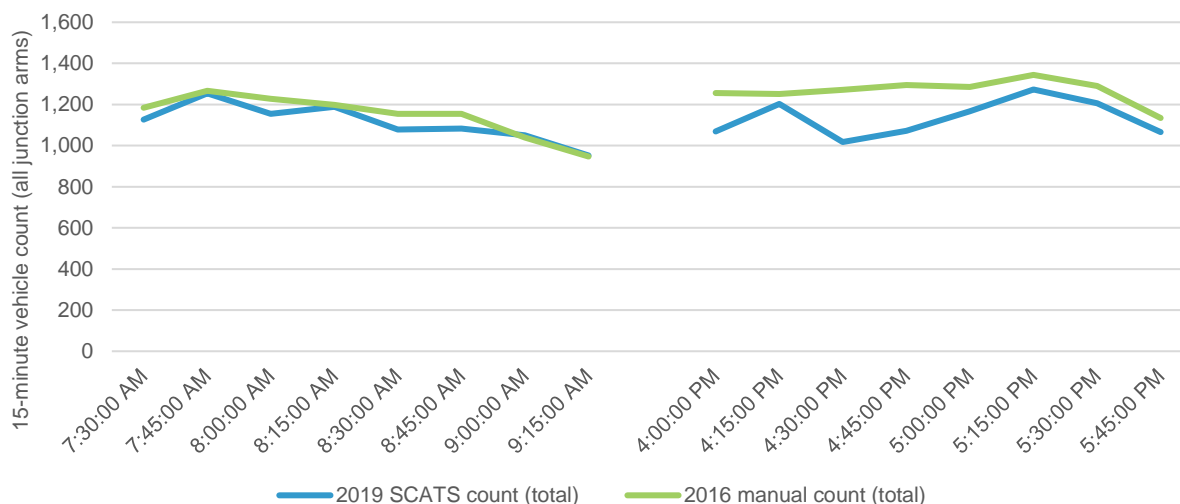
Due to the ongoing COVID-19 pandemic, it was not possible to undertake representative intersection turning counts. Instead, base year traffic has been based on historic Sydney Coordinated Adaptive Traffic System (SCATS) vehicle detector data collected for the project.

For the three signalised intersections, SCATS traffic volume data has been acquired from TfNSW for 10 December 2019, a typical Tuesday during school term. Based on the daily traffic volume profile for the signalised intersections, the following peak periods have been defined:

- **AM peak hour: 7:30AM to 8:30 AM;** and
- **PM peak hour: 5PM to 6PM.**

Figure 3–9 compares the 2019 SCATS volumes at the Hume Highway / Governor Macquarie Drive intersection to a manual traffic count undertaken on behalf of Council in 2016. The 2019 SCATS data and the 2016 manual count data are very similar. This confirms that the December 2019 SCATS data is representative of normal traffic conditions.

Figure 3–9 Comparison of 2019 SCATS data and 2016 manual traffic count at the Hume Highway / Governor Macquarie Drive intersection



Source: SCT Consulting analysis of TfNSW SCATS data (2019) and Metrix intersection count (2016)

3.5.1.2 Mixed turning lanes

Because the SCATS volume data is based on lane detectors, the data cannot distinguish between different movements in mixed turning lanes (e.g. left and through). This impacts the following intersection turning movements at the Hume Highway / Governor Macquarie Drive / Todman Road intersection:

- Hume Highway eastbound: left (into Todman Road) and through;
- Hume Highway westbound: left (into Governor Macquarie Drive) and through;
- Todman Road: left (onto Hume Highway eastbound) and through (onto Governor Macquarie Drive); and
- Governor Macquarie Drive: left (onto Hume Highway westbound) and through (onto Todman Road).

For these lanes, the turning proportions in the 2016 manual traffic count has been used to estimate how many vehicles will likely have turned left, and how many will have travelled through.

It also impacts the following turning movement at the Governor Macquarie Drive / Munday Street intersection:

- Governor Macquarie Drive northbound: left (into Munday Street) and through.

For this lane, the number of left turners is unknown, as there is no manual count to compare to. However, the opposite movement (Munday Street right turn onto Governor Macquarie Drive southbound) is known from SCATS data. It has therefore been assumed that the number of left turners entering Munday Street in the AM peak is equivalent to the number of right turners exiting Munday Street in the PM peak, and vice versa.

3.5.1.3 Priority intersections

For the two priority intersections, no traffic volume data is available, and due to the COVID-19 pandemic, no representative data could be collected. Instead, the traffic assessment has relied on a series of assumptions for these two intersections. As both of the priority intersections are relatively minor, this is considered to be a reasonable and proportionate approach for a Transport Impact Assessment at this early stage of planning.

The assumptions for the two priority intersections are detailed below and have been agreed with Council:

Hume Highway / Warwick Street

- Hume Highway left-in entry into Warwick Street: equivalent to 50 percent of traffic turning right from Governor Macquarie Drive southbound into Munday Street.
- Warwick Street left-out exit onto Hume Highway westbound: equivalent to 50 percent of traffic turning left from Munday St onto Governor Macquarie Drive northbound.

Governor Macquarie Drive / Shore Street

- Left-out traffic on Shore Street is equivalent to 10 percent of traffic turning left from Munday St onto Governor Macquarie Drive northbound.

3.5.1.4 Traffic demand adjustments

Since there are limited access points on Governor Macquarie Drive, traffic volumes for upstream and downstream lanes between intersections should be very close. In acknowledgement of this, further demand adjustments were conducted to balance the mid-block traffic volumes between to SCATS detector counts.

3.5.1.5 Site layouts and signal timing data

Intersection layouts were derived from a combination of Nearmap imagery, Google Streetview, and site visits. Traffic signal timing data was obtained from Transport for NSW for all of the signalised intersections for 10th December 2019.

3.5.1.6 Other limitations and assumptions

Finally, the following limitations of the historic SCATS traffic volume data should be noted:

- The SCATS traffic volume data does not distinguish between light and heavy vehicles. To compensate for this, the split between light and heavy vehicles in the 2016 manual traffic count at the Hume Highway / Governor Macquarie Drive intersection was applied to the December 2019 SCATS volumes, and similar proportions were extrapolated to the surrounding nearby intersections.
- The SCATS traffic volume data does not include any information on pedestrians crossing at signalised intersections. Pedestrian capacity has therefore not been assessed. All signal timing cycles in the base year model including pedestrian crossing phases were based on the historic SCATS signal timing data.

3.5.2 Model calibration

The intersection models were calibrated using the input data to reflect observations of traffic behaviours on site. One of the key goals is to calibrate the models such that the degree of saturation of all movements was 1.0 or below. This is a standard procedure to ensure that the models are not over-predicting congestion under current conditions. Key assumptions made to achieve calibration for the intersection of Hume Highway / Governor Macquarie Drive were:

- 100 percent peak flow factor for Hume Highway given near saturated flow during peak hours;
- Up to six seconds end gain for the movements on Hume Highway and four seconds for Governor Macquarie Drive and Todman Road; and
- Split phase G to G and G2 (for PM peak) and adjust phase time within the range of raw traffic signal data from TfNSW to allocate more phase time for the movement with heavy demand.

Currently existing pedestrian crossings were not included in the model at the below locations, given the lack of data on pedestrian volumes:

- Western approach of Hume Highway / Governor Macquarie Drive;
- All approaches of Munday Street / Governor Macquarie Drive; and
- Western approach of Governor Macquarie Drive / Access Road to Warwick Farm Racecourse.

Since current pedestrian demand is likely to be very limited and some footpaths are disconnected, it is not expected that pedestrian crossing phases would be triggered every cycle within the peak hour assessed.

3.5.3 Intersection level of service

Intersection Level of Service (LoS) is a typical design tool used by traffic engineers to identify when roads are congested. The Level of Service as defined in TfNSW Traffic Modelling Guidelines is provided in **Table 3-3**.

Table 3-3 Level of Service definitions

Level of Service	Average delay per vehicle (seconds)	Performance explanation
A	Less than 14.5	Good operation
B	14.5 to 28.4	Good with acceptable delays and spare capacity
C	28.5 to 42.4	Satisfactory
D	42.5 to 56.4	Operating near capacity
E	56.5 to 70.4	At capacity, at signals incidents will cause excessive delays. Roundabouts require other control method.
F	70.5 or greater	At capacity, at signals incidents will cause excessive delays. Roundabouts require other control method.

Source: Roads and Maritime Services (2002), Traffic Modelling Guidelines

In addition, the following other measures of performance are included to complement Level of Service:

- **Degree of Saturation (DoS):** a measure of the volume / capacity for the worst turning movement at the intersection. DoS 1 implies the turning movement is at capacity; and
- **Queue:** the 95th percentile queue length, meaning that the queue length is less than or equal to this length 95% of the time. The 95th percentile rather than maximum is typically used because intersections sometimes experience very large random queues that do not last for a long time. By treating these as outliers, queue lengths are less affected by random noise. This is reported for the worst approach at the intersection.

3.5.4 2019 intersection performance

The outcomes of the intersection performance are presented in **Table 3-4** based on a modelling assessment by SIDRA software.

Table 3-4 Existing (2019) intersection performance in proximity of the precinct

Intersection	AM peak				PM peak			
	Delay	LoS	DoS	Queue	Delay	LoS	DoS	Queue
Hume Highway / Governor Macquarie Drive	75.3s	E	1.00	367m	52.3s	D	0.99	226m
Hume Highway / Warwick Street	7.4s	A	0.53	317m	8.2s	A	0.41	128m
Governor Macquarie Drive / Munday Street	11.0s	A	0.69	85m	15.1s	B	0.81	152m
Governor Macquarie Drive / Shore Street	17.3s	B	0.73	1m	7.7s	A	0.67	1m
Governor Macquarie Drive / Warwick Farm Racecourse Access Road	5.5s	A	0.97	78m	3.5s	A	0.49	55m

Source: SCT Consulting, 2020

The SIDRA results show that while majority of intersections on Governor Macquarie Drive operate at LoS B or above, the intersection of Hume Highway / Governor Macquarie Drive is running at capacity and is performing poorly at LoS E, particularly during the AM peak hour. A queue length over 360 metres occurs in the southwest approach (through movement) in the AM peak, whereas the queue extends nearly 230m on the northeast approach (left turn movement) in the PM on Hume Highway.

4.0 The Planning Proposal

4.1 Preferred structure plan

The preferred structure plan has been developed to enable development of appropriate controls such as zoning and Floor Space Ratio (FSR), as well as to provide a richer picture of how the precinct is proposed to be laid out, as shown in **Figure 4-1**.

Figure 4-1 The Warwick Farm precinct preferred structure plan



Source: CM+ (2020), Preferred Structure Plan REV03

Key features of the structure plan are:

- Mixed use development containing retail and commercial premises in the west near the train station;
- High density residential buildings up to 15 levels in “Masters site” to the north of Munday Street;
- Local sports venue and the existing Rosedale Oval in the southeast as recreation destinations;
- Delivery of a bypass to the southeast of the precinct, connecting with Governor Macquarie Drive via a signalised intersection at Shore Street;
- Downgrading of the Munday Street / Governor Macquarie Drive intersection to a left-in / left-out intersection;
- Duplication of Governor Macquarie Drive between Hume highway and Warwick Farm Racecourse Access Road; and
- Potential pedestrian bridges over the rail line to connect with Liverpool City Centre.

The total GFA and number of dwellings for the precinct is shown in **Table 4-1**. It should be noted that the yields are the best and most realistic estimates at the time of preparing this report, and will continue to evolve as the structure plan develops. The best estimate yields are prepared for the purpose of undertaking the traffic assessment pre-gateway determination.

Table 4-1 Proposed yield of the precinct structure plan

Use	Yield	
R4 High density residential	2,252 dwellings	
Commercial ^A	Retail	18,313 m ² GFA
	Office	6,104 m ² GFA
Local open space	9.7 Ha	

Source: CM+ (2020), Preferred Structure Plan REV03

^ANote: the preferred structure plan only defines the total amount of commercial GFA. For the purposes of this Transport Impact Assessment, a split of this total commercial GFA into retail and office GFA of 75% and 25% respectively has been assumed, in consultation with the urban designers and Council officers.

4.2 Proposed transport network

The proposed transport network needs to cater for the travel characteristics of the proposed land uses as well as integrate appropriately with the surrounding network.

4.2.1 Road network

In order to relieve Priddle Street, Manning Street and Munday Street (which currently carry all heavy vehicles travelling to and from by the industrial area located to the south of the Warwick Farm precinct), a road bypass is proposed to connect Scrivener Street with Governor Macquarie Drive near Shore Street. The bypass will remove the heavy vehicle and through traffic from the local streets within the Warwick Farm precinct.

The new Governor Macquarie Drive / Shore Street intersection will be signalised and become the main access point for the precinct from the east, while the Munday Street / Governor Macquarie Drive intersection is proposed to be downgraded to a priority left-in / left-out intersection because of its proximity to the Shore Street intersection. Governor Macquarie Drive is also expected to be duplicated between Hume Highway and the access of the Warwick Farm Racecourse as part of the structure plan.

Figure 4–2 shows the proposed road network of the structure plan.

Figure 4–2 Future road network



Source: CM+ (2020), For QS and contributions plan

The existing local road network within the Warwick Farm precinct will be kept, to maintain the permeability of the precinct, with multiple new east-west through site links proposed to further improve permeability for walking, cycling

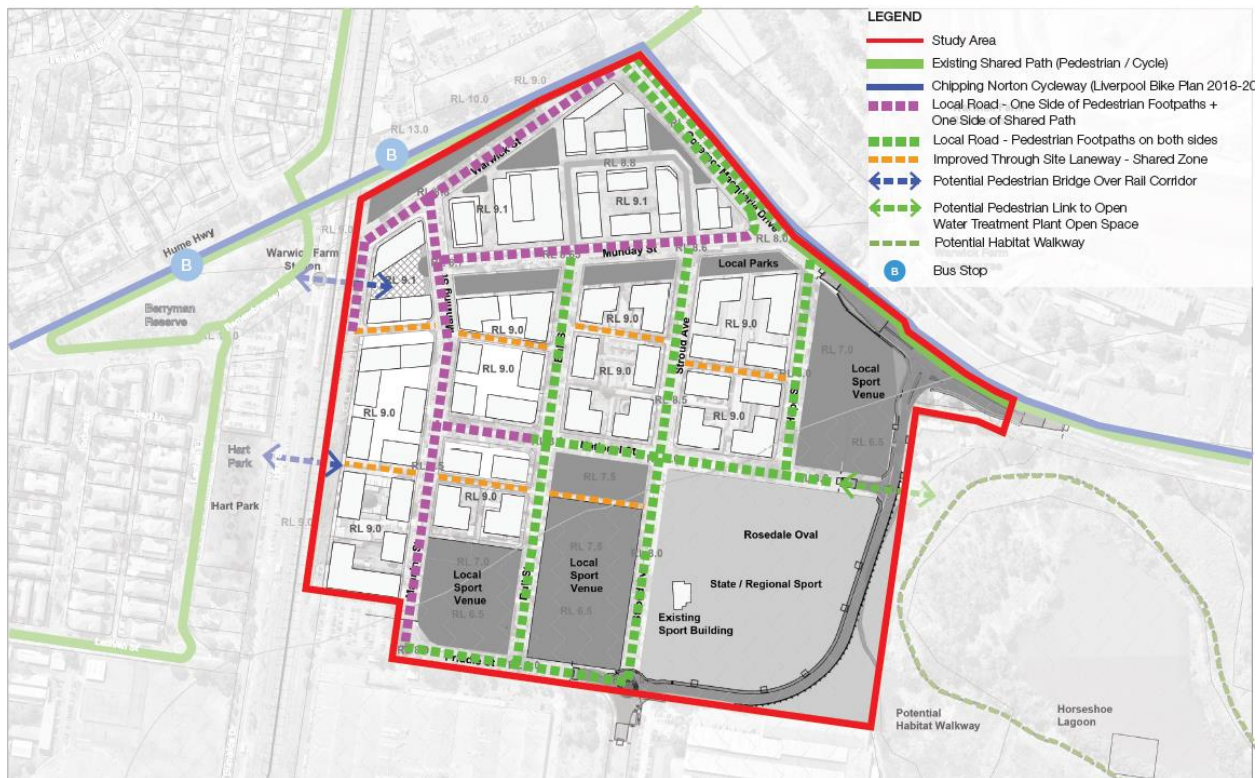
and local traffic. New local streets will also be created in the “Masters site” north of Munday Street that align with Bull Street and Stroud Avenue.

Due to the need to ensure a safe evacuation route in case of flooding, Munday Street, Warwick Street, Manning Street (partially), Bull Street (partially), National Street (partially), Stroud Avenue (partially) and other east-west links are proposed to be raised from their current level.

4.2.2 Active transport network

As discussed in **Section 3.4**, shared paths are currently only available on Munday Street and a short section of Manning Street and Warwick Street close to train station. There are extensive opportunities for high quality walking and cycling facilities for the remaining streets within the precinct (**Figure 4-3**).

Figure 4-3 Active transport network



Source: CM+ (2020), Warwick Farm Active Transport Plan

A new footpath will be provided on the west side of Governor Macquarie Drive (between Hume Highway and Munday street) to maximise access for future residents. Warwick Street, Munday Street, Manning Street and National Street (between Manning Street and Bull Street) will have a shared path on one side and footpath on another to improve connections to Warwick Farm train station.

National Street (between Bull Street and Shore Street), Bull Street, Stroud Avenue, Hope Street and Priddle Street are proposed to have footpaths on both sides with on-road cycleways, due to the low traffic environment. Multiple new through-site links in the east-west direction would enhance the connection between the residential area and the train station.

The proposal also considers two potential crossing facilities over the rail line, which would improve accessibility to Liverpool CBD to the west of the rail line.

4.3 Travel demand management measures

Sustainable transport and Travel Demand Management (TDM) strategies involve the application of policies, objectives, measures and targets to influence travel behaviour, and to encourage uptake of sustainable forms of transport, i.e. non-car modes, wherever possible. TDM measures have proven to reduce congestion created by growth within urban areas and unlock urban renewal opportunities. They result in travel behaviour that uses less road

space than single occupant vehicle commute and takes advantage of spare transport capacity outside the morning and afternoon peaks.

TDM strategies generally guide all relevant customers (residents, employees and visitors) in changing the travel behaviour in the following ways:

- Reduce travel;
- Re-mode (consideration of travel via alternative modes);
- Re-time (consideration of travel at alternative times); and
- Re-route.

It is recommended that a Travel Plan be developed and monitored for the Warwick Farm precinct to deliver best practice travel programs and initiatives to manage travel demand for the proposed development. Key initiatives and measures could be developed to:

- **Reduce the need to travel:**
 - Planning for a range of uses are to be provided or integrated in the development to provide a range of services in a single location to maximise trip containment within or in proximity of the site and encourage use of active transport (walking and cycling) for short trips.
 - Encourage the use of internet to reduce the need to travel such as Australia Post, parcel drop-off /pick-up facilities.
 - Encourage the use of internet and technology to facilitate remote working via smart work hubs with high quality facilities or working from home.
 - Develop and use of carpooling for wider precinct and community.
- **Re-think the mode of travel:**
 - Walking and cycling:
 - A highly permeable and safe pedestrian network throughout the development.
 - Dedicated cycle routes that connects to the regional routes and major transport hubs.
 - Key design principles to integrate walking and cycling network and facilities into the planning and delivery of the development.
 - High quality, safe and accessible end-of-trip facilities (centralised cycle hubs that are integrated within development at convenient locations, on-street secure bicycle storage located conveniently at end of cycle destinations, parking hubs for shared bikes, lockers and showers).
 - Free bicycles for residents, employees and visitors to travel within the site and nearby transport interchanges (to be agreed with Councils and TfNSW).
 - Promotion of bicycle initiatives – NSW bicycle week, cycle to work day, free bike check-up events.
 - Establishment of a Bicycle User / Consultation Group.
 - 'Cycle Update' newsletter.
 - **Public transport:**
 - Reimbursement of public transport costs such as giving out of Opal card with credits.
 - Early provision of frequent public transport services to establish a non-car travel behaviour.
 - Good quality public transport stops in the vicinity of the development.
 - Tailored information with clear mapping and walking catchments at public transport stops.
 - Provision of public transport information from home via television channel or community app.
 - Parking measures as a mean to encourage alternative modes of travel:
 - Reduced parking rates with flexibility in parking arrangements such as decoupled parking, shared vehicles parking to accommodate parking needs of all residents.
 - Parking spaces / stations dedicated to electric vehicles, with charging stations.

- Parking spaces dedicated to car share scheme and community car-share vehicles, both on-street and incorporated in easily-accessed public car parks.
- **Re-time and Re-route journeys:**
 - Development of specific community app / community engagement program to enable changing travel behaviour which includes:
 - Active and public transport maps
 - Personalised journey planner
 - Notifications to latest travel information
 - Shared vehicles information
 - Car-pooling opportunities
 - Other precinct-related information
 - Real-time information embedded into development and public transport stops.
 - Employers to promote and encourage flexible working hours and arrangements.

While it is important to develop a Travel Plan that is aimed at managing travel demand and reducing reliance on car travel, it is just as important to monitor and evaluate the effectiveness of individual measures and the need to adjust the measures. The planning and implementation of a targeted Travel Plan with the above green travel initiatives / principles for the Warwick Farm would provide significant opportunities for alternative travel options and reduce the need of car travel.

5.0 Traffic and Transport Impact Appraisal

This section assesses the impact of the proposed structure plan on the transport network. The future year for the assessment is assumed to be 2030, a 10-year window for completion of the development.

5.1 Background traffic growth

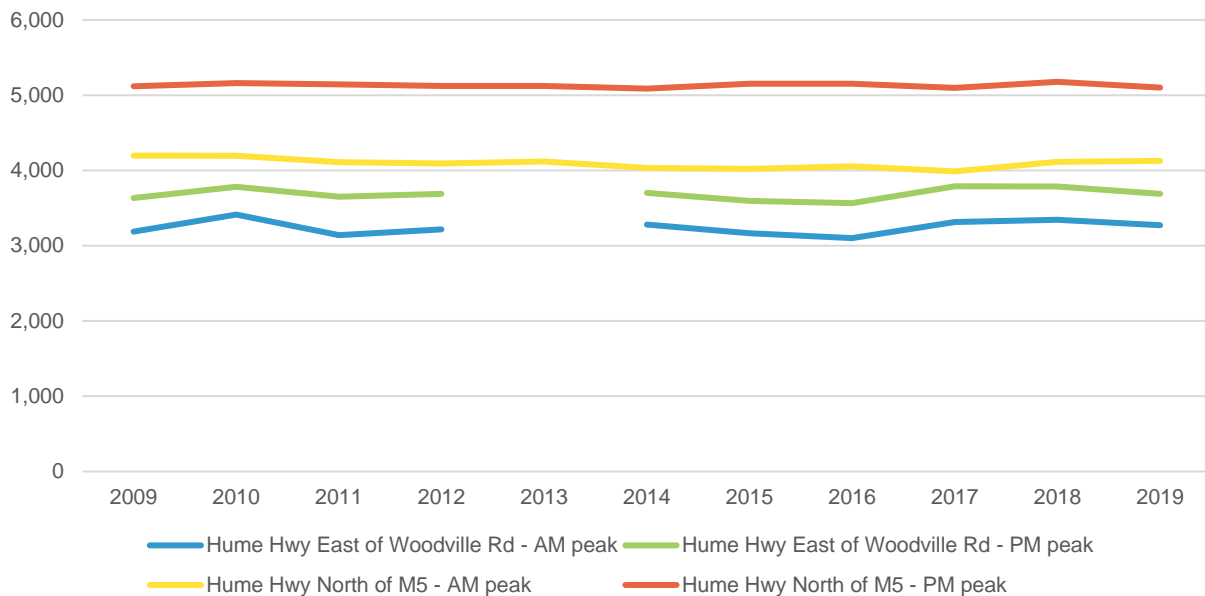
5.1.1 General background traffic growth trends

Background traffic growth on Hume Highway was analysed based on extrapolation of traffic growth between 2009 and 2019, taken from two nearby TfNSW permanent traffic counters:

- Hume Highway, east of Woodville Road; and
- Hume Highway, north of South Western Motorway (M5).

Data for 2020 has been deliberately excluded due to the COVID-19 pandemic. The results are shown in **Figure 5–1**.

Figure 5–1 Average weekday traffic volumes on Hume Highway (both directions), by permanent counter location and peak period



Source: TfNSW Traffic Volume Viewer

Note: 2013 data is not shown for Hume Highway East of Woodville Road, as data is only available for the westbound direction.

From this analysis, it is clear that there has been no significant change in traffic volumes along the Hume Highway between 2009 and 2019 during the peak hours. General background traffic volumes are therefore assumed to remain constant between now and the assessment future year of 2030, and no general background traffic growth has been applied to the 2019 traffic volumes.

5.1.2 Background traffic growth due to other nearby future developments

Council has received a number of planning proposals applying to the area around Warwick Farm area. A review of those planning proposals has been undertaken to understand the likely impact of these proposed developments on the road network around the Warwick Farm precinct.

Newbridge Road rezoning

Land between Brighton Lakes Recreation & Golf Club and Newbridge Road (east of Brickmakers Drive) is planned to be rezoned to accommodate new residential, commercial, retail developments, and a marina. The total development scale of all five development sites will reach over 4,400 residential dwellings and 17,000 m² GFA of non-residential uses (according to Plots A to E as shown **Figure 5–2**).

A cumulative traffic impact assessment was undertaken in the planning proposal of *Lot 6 Newbridge Road, Moorebank Proposed Mixed Use Development*² to estimate the traffic growth on the road network in 2028 when all five plots are completed.

Figure 5–2 The scope of cumulative traffic impact analysis in Lot 6 Newbridge Road planning proposal



Source: MLA Transport Planning (2020), Lot 6 Newbridge Road, Moorebank Proposed Mixed Use Development Planning Proposal Traffic and Parking Review

For the Warwick Farm precinct, the traffic impacts of the Newbridge Road development on Governor Macquarie Drive are most directly relevant. By comparing the traffic demands with and without the Newbridge Road development in its traffic impact assessment report, it is estimated that traffic on the Governor Macquarie Drive will see a significant increase, as listed in **Table 5-1**.

Table 5-1 Estimated traffic growth on Governor Macquarie Drive as a result of the Newbridge Road planning proposal

Direction	Additional traffic growth (vehicles)	
	AM peak	PM peak
Northbound	+140	+58
Southbound	-86*	+161

Source: SCT Consulting estimates based on MLA Transport Planning (2020), Lot 6 Newbridge Road, Moorebank Proposed Mixed Use Development Planning Proposal Traffic and Parking Review

* the forecast reduction in AM peak southbound traffic volumes in the Newbridge Road traffic assessment report is the result of a proposed reconfiguration of the Governor Macquarie Drive / Newbridge Road intersection, which repurposes one of the existing left-turn lanes as a through lane. This intersection reconfiguration has not yet been agreed with Council and TfNSW at this stage, and the resulting forecast decrease is therefore not considered to be a reliable indicator of the likely impacts on Governor Macquarie Drive.

²MLA Transport Planning (2020), Lot 6 Newbridge Road, Moorebank Proposed Mixed Use Development Planning Proposal Traffic and Parking Review

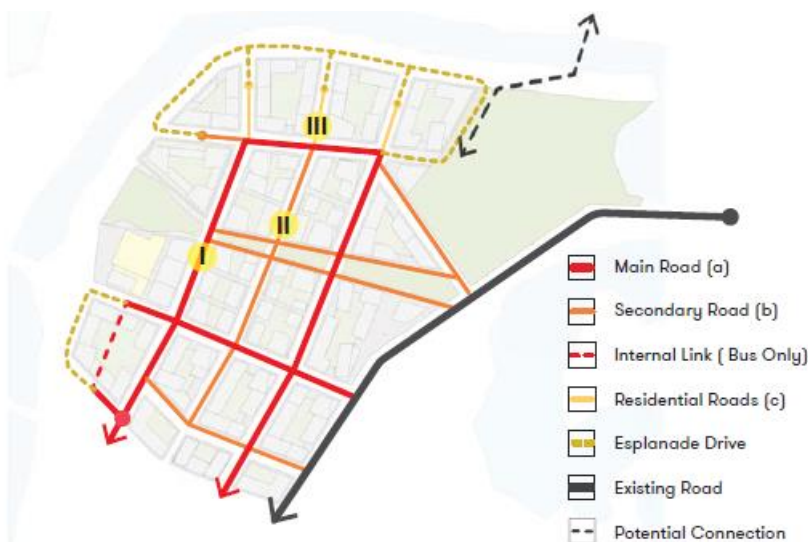
The traffic growth assumptions for Governor Macquarie Drive were discussed on 25 May 2020 between Liverpool City Council and SCT Consulting. Since the proposed reconfiguration of the Governor Macquarie Drive / Newbridge Road intersection that causes the reduction in southbound AM peak traffic volumes (see **Table 5-1**) has not yet been agreed with Council or with TfNSW at this stage, the resulting forecast decrease is therefore not considered to be a reliable indicator of the likely impacts on Governor Macquarie Drive. Instead, for the AM peak southbound movement, an annual growth rate of 1.5 percent was assumed to account for the future impacts of the Newbridge Road development in this transport impact assessment. This equals **+143** vehicles by 2030.

Liverpool Waterfront Precinct Planning Proposal

The Liverpool Waterfront Precinct (also known as Moore Point) is located on the northern side of Newbridge Road and east of Liverpool CBD. It is located south of the Warwick Farm precinct on the other side of Georges River. The planning proposal seeks to rezone the precinct to a B4 mixed use including over 12,000 residential units, 13,000m² retail and 93,000m² commercial premises. According to the demand forecast, the precinct would generate 3,172 and 2,698 vehicle trips for AM and PM peak when the development is fully built.

Given the locality of the precinct and the physical barrier of the Georges River, it is anticipated that vast majority of traffic would access the development via Newbridge Road to the south. However, a potential connection was proposed across Georges River (**Figure 5-3**) that may attract some development traffic to re-route onto Governor Macquarie Drive to the north instead.

Figure 5-3 Road network plan from the planning proposal



Source: Traffic traffic and transport planners (2016), Gateway Traffic and Transport Assessment – Planning Proposal Liverpool Waterfront

The potential new bridge over Georges River could increase traffic on the surrounding road network of the Warwick Farm precinct, including Governor Macquarie Drive. Through consultation with Liverpool City Council, since this connection across the Georges River is not confirmed and could potentially be limited to pedestrians, cyclists and buses, the scenarios modelled in this transport impact assessment do not include any traffic generated by the Liverpool Waterfront Precinct as additional background traffic.

Nonetheless, a sensitivity analysis has been conducted (as discussed in **Section 5.4.3**) to examine the amount of remaining capacity on Governor Macquarie Drive, such that Council can consider the feasibility and impacts of a potential new bridge connection over Georges River associated with the Liverpool Waterfront Precinct.

Hence, for the purposes of this assessment, only the additional traffic from the Newbridge Road development on Governor Macquarie Drive has been included as background traffic (ranging from +58 to +161 vehicles, depending the direction and peak hour).

5.2 Modelling scenarios

The Traffic Impact Assessment has tested the following future year scenarios:

- 2030 With Background Growth, Do Nothing:** This scenario examines the impact of background traffic growth only, with no changes to the road network;

2. **2030 With Background Growth And Network Upgrades:** This scenario identifies necessary upgrades to the surrounding road network, to alleviate the impact of background traffic growth only;
3. **2030 With Development, Do Nothing:** This scenario examines impact of the full delivery of the Structure Plan (including the background traffic growth), with no changes to the road network; and
4. **2030 With Development And Further Network Upgrades:** This scenario identifies necessary upgrades to the surrounding road network, to alleviate the impact of background traffic growth and the delivery of the Structure Plan, such that acceptable performance is achieved for all intersections.

A combination of concepts of road upgrades has been explored based on previous studies and/or proposals that have been considered by Council, including:

- Delivery of a bypass for the industrial area between Governor Macquarie Drive and Scrivener Street, via Shore Street and a new road around the Rosedale Oval. For the purposes of the assessment, it is assumed that all traffic to/from the industrial area to the south would use the bypass, and would therefore be diverted away from Munday Street and Warwick Street. Traffic generated by the precinct’s development would use Warwick Street and Munday Street;
- Conversion of the Governor Macquarie Drive / Shore Street intersection to a signalised intersection, to connect with the bypass;
- Conversion of the Governor Macquarie Drive / Munday Street intersection to a left-in left-out intersection, with its proximity to Shore Street and Hume Highway;
- Duplication of Governor Macquarie Drive between Hume Highway and the Warwick Farm Racecourse Access Road; and
- Implementation of additional turning lane(s) for the Hume Highway / Governor Macquarie Drive intersection.

These infrastructure upgrade options have been tested in Scenario 2 and 4 to identify appropriate upgrade solutions required to cater for background traffic growth and development traffic increase, respectively.

5.3 Trip generation and distribution

For trips generated by the development, project-specific vehicle trip generation rates will be applied. These vehicle trip generation rates are *discussed in more detail in SCT Consulting’s Technical Note Traffic Generation Rates: Review and Recommendations (April 2020)*.

The recommended vehicle trip generation rates are summarised in **Table 5-2**.

Table 5-2 Trip generation assumptions

Land use	AM peak	PM peak
Residential (flats)	0.30 vehicles / unit	0.29 vehicles / unit
Retail	3.0 vehicles / 100 m ² GLFA	6.2 vehicles / 100 m ² GLFA
Commercial	2.49 vehicles / 100m ² GFA	1.70 vehicles / 100m ² GFA

Source: SCT Consulting, 2020

5.3.1 Trip containment (internal trips)

Given the size of the precinct is relatively small, there is unlikely to be any vehicle trip containment (i.e. vehicle trips with a start and finish within the precinct). However, there is likely to be significant containment of trips from residential units to retail within the precinct made on foot.

Referring to *Retail and economic analysis exhibition report*³, the forecasted averaged retail provision rate for traditional retail is 1.51m² per capita and average persons for high density residence is 2.3 people per dwelling. This results in a total of 7,821m² retail space servicing the precinct residents, which is 43 percent of the proposed retail GFA⁴. Hence, a 43 percent reduction is applied to the retail vehicle trip generation, assuming these trips will be made by precinct residents on foot or by bicycle.

³ Deep End Services (2018), Retail and economic analysis exhibition report.

⁴ 2,252 dwellings (proposed high density residential units) *2.3 persons per dwelling* 1.51 / 18,313 total proposed retail GFA = 43%.

5.3.2 Trips removed from the network (from current land uses to be replaced by the proposed development)

While the structure plan will generate additional traffic, it will also remove trips from the network made by current residents and users of the precinct. The precinct is currently characterised by low-density residential dwellings and horse-training facilities. In the future year, these trips will no longer be made, and they have therefore been removed from the network to establish the structure plan's 'net' trip generation.

The following logic has been followed to remove existing trips from the network:

- According to 2016 Census data⁵, there are 112 residential dwellings in the precinct.
- For low-density residential dwellings, TfNSW's *Technical Direction TDT 2013/04a: Guide to Traffic Generating Developments: Updated traffic surveys*⁶ recommends a trip generation rate of 0.95 vehicle trips in the AM peak, and 0.99 vehicle trips in the PM peak.
- However, trip generation for journeys to work is likely to be far lower for current residents in the precinct than the Sydney average, due to the unique nature of the precinct. The precinct currently mainly consists of horse training stables attached to residential dwellings, and as a result about two-thirds of residents walk to work (46%) or work at home (17%). Only 20% drive to work, much lower than the Sydney average of 53%⁷.
- According to TfNSW Household Travel Survey data, approximately 20% of all car trips are commuting trips⁸. It is not known how many of these occur during the AM and PM peaks, but it is likely that during these peaks, the proportion of vehicle trips that are commuting trips is a lot higher. For the purposes of the assessment, it is assumed that half of all peak-hour vehicle trips are commuting trips.
- So, if half of all peak-hour vehicle trips are commuting trips, but the precinct's vehicle driver mode share for journeys to work is only two-fifths of the Sydney average, then the following peak-hour vehicle trip generation rate is likely to be more accurate for the precinct:
 - AM peak: 0.95 (standard vehicle trip generation rate) $\times 0.5$ (non-commuting trips) $+ 0.95 \times 0.5$ (commuting trips) $\times 0.4$ (two-fifths of average Sydney vehicle driver mode share for journeys to work) = **0.67**
 - PM peak: 0.99 (standard vehicle trip generation rate) $\times 0.5$ (non-commuting trips) $+ 0.99 \times 0.5$ (commuting trips) $\times 0.4$ (two-fifths of average Sydney vehicle driver mode share for journeys to work) = **0.69**

This results in the following numbers of trips made by current residents being removed from the network in the future-year assessment:

- **75 trips in the AM peak; and**
- **77 trips in the PM peak.**

It is not known how many external workers currently work in the horse-training precinct (the lowest level of geography for which Place of Work data is available, the Travel Zone, also includes the industrial area to the south). The number of external trips by workers who may currently drive into the horse-training precinct during the peak hours is considered to be negligible for the purposes of the assessment.

The total net vehicle trip generation is shown in **Table 5-3**.

⁵ Australian Bureau of Statistics Census TableBuilder, 2016 Census DWTD Dwelling Type by SA1 (SA1 1160106 – Warwick Farm).

⁶ Roads and Maritime Services (2013), *Technical Direction TDT 2013/04a: Guide to Traffic Generating Developments: Updated traffic surveys*, August 2013.

⁷ TfNSW 2011 Census Journey to Work data by Travel Zone. Note that due to changes implemented by the Australian Bureau of Statistics to confidentialise Census 2016 data and protect individuals from re-identification, 2016 Census Travel to Work data is not available by Travel Zone.

⁸ Transport for NSW (2014), *Household Travel Survey Report: Sydney 2012/13*, Table 4.2.1, Table 4.3.1 and Table 4.3.3.

Table 5-3 Total net vehicle trip generation for Warwick Farm precinct

Land use	AM peak hour (In / Out proportion)	PM peak hour (In / Out proportion)	Total net vehicle trips		
			Yield	AM peak	PM Peak
Residential [^]	0.30 vehicles / dwelling (10% / 90%)	0.29 vehicles / dwelling (90% / 10%)	2, 252 dwellings	601	576
Retail	3.0 vehicles / 100 m ² GLFA (50% / 50%)	6.2 vehicles / 100 m ² GLFA (50% / 50%)	13,735 m ² GLFA	234	488
Office	2.49 vehicles / 100m ² GFA (90% / 10%)	1.70 vehicles / 100m ² GFA (10% / 90%)	6,104m ² GFA	152	104
Total			-	986	1,168

Source: SCT Consulting, 2020

[^] The net vehicle trips for residential land use have considered the replacement of current land use by the proposal (see **Section 5.3.2**).

Trip distribution was calculated based on the job destinations of residents and residence of workers data for Liverpool LGA. The resultant inbound and outbound distribution for the precinct vehicle trips were weighted by the total number of residential trips and office related trips, and are summarised in **Table 5-4**.

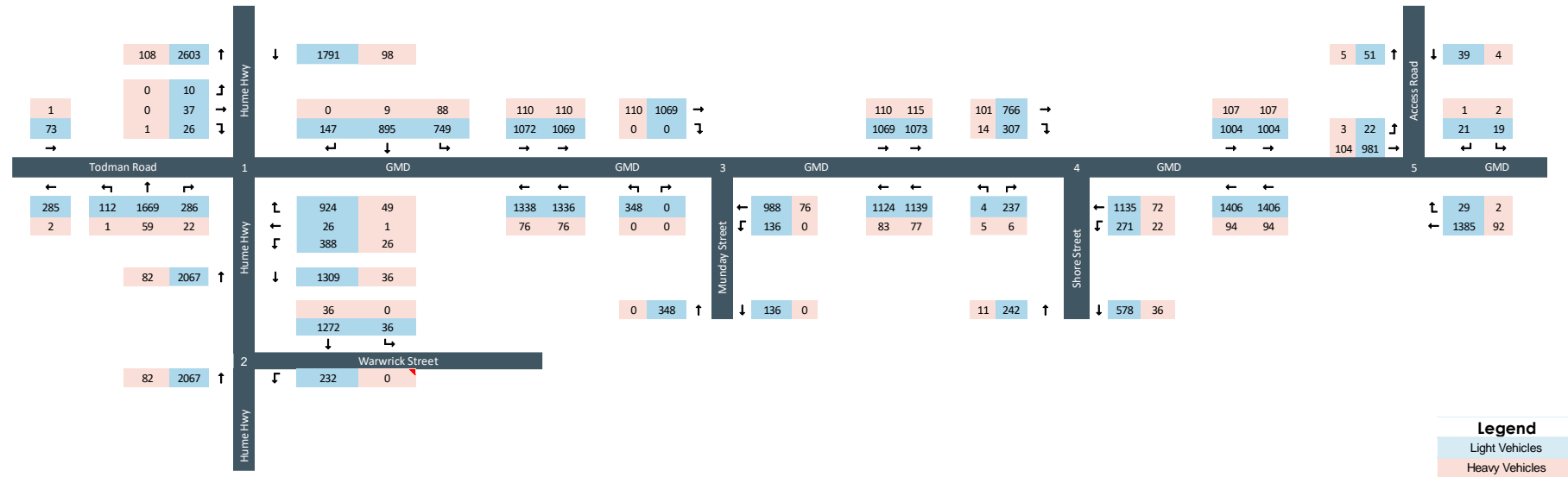
Table 5-4 Traffic distribution for Warwick Farm precinct

Land use	AM outbound / PM inbound	AM inbound / PM outbound
Hume Highway (NE towards Villawood)	45%	32%
Hume Highway (SW towards Liverpool)	31%	43%
Governor Macquarie Drive (SE towards Chipping Norton)	23%	25%
Total	100%	100%

Source: SCT Consulting, 2020

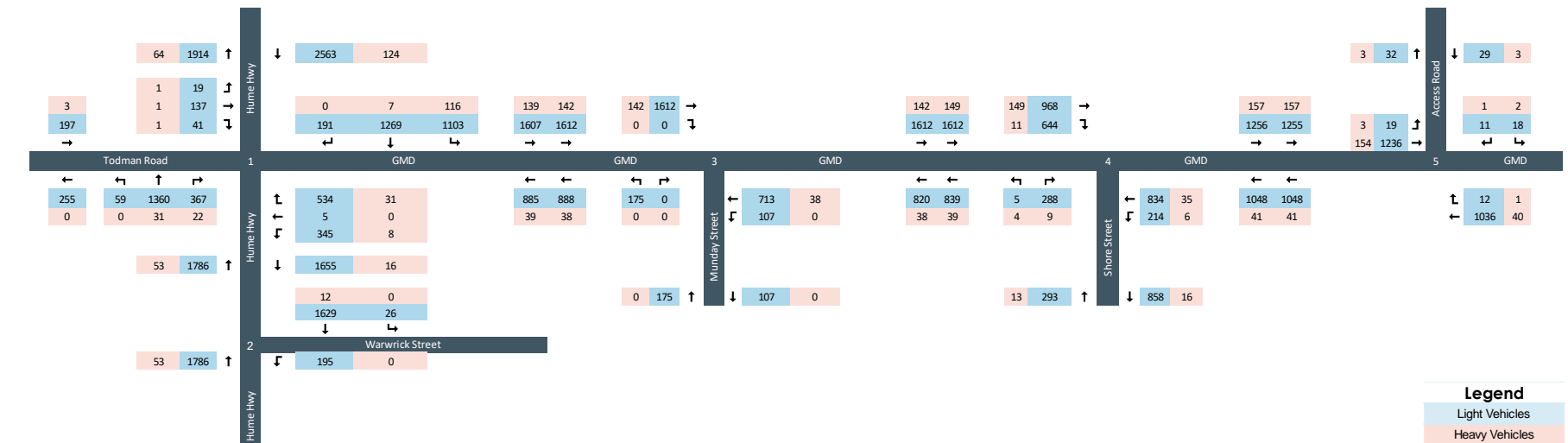
The turning flow diagrams for the traffic generated by the development (Scenario 4 With Development And Further Network Upgrades) for 2030 AM and PM peak are provided in **Figure 5-4** and **Figure 5-5**, respectively. Freight traffic is designated to use the new Shore Street bypass. The Munday Street / Governor Macquarie Drive intersection is converted to a left-in / left-out intersection while the Shore Street / Governor Macquarie Drive intersection is a full directional signalised intersection to service the precinct.

Figure 5-4 Turning flow diagram for 2030 AM peak (Scenario 4: 2030 With Development And Further Network Upgrades)



Source: SCT Consulting, 2020

Figure 5-5 Turning flow diagram for 2030 PM peak (Scenario 4: 2030 With Development And Further Network Upgrades)



Source: SCT Consulting, 2020

5.4 Road network impacts

5.4.1 Mid-block analysis for Governor Macquarie Drive

The trip generation for development estimated in **Section 5.3** as well as background traffic growth derived from **Section 5.1** has been applied to the 2019 mid-block traffic volumes. The resultant 2030 peak hour mid-block traffic volumes are summarised in **Table 5-5**. Network modelling identified that the values in bold trigger the need for an additional lane on Governor Macquarie Drive given the demand at capacity of one lane⁹.

Table 5-5 2030 forecast traffic volumes on Governor Macquarie Drive

Scenarios	Direction [^]	Between Hume Highway and Munday Street	Between Munday Street and Shore Street	Between Shore Street and Racecourse Access Road
2030 AM peak				
2019 Base year	EB	800 (89)	810 (91)	810 (91)
	WB	967 (65)	800 (84)	810 (84)
Scenario 1: 2030 With Background Traffic Growth, Do Nothing & Scenario 2: 2030 With Background Traffic Growth And Network Upgrades	EB	943 (105)	953 (107)	953 (107)
	WB	1,107 (74)	1,425 (94)	1,420 (94)
Scenario 3: 2030 With Development, Do Nothing	EB	1,177 (105)	1,110 (107)	1,110 (107)
	WB	1,412 (74)	1,504 (94)	1,500 (94)
Scenario 4: 2030 With Development And Further Network Upgrades	EB	1,182 (110)	1,188 (115)	1,110 (107)
	WB	1,413 (76)	1,216 (83)	1,500 (94)
2030 PM peak				
2019 Base year	EB	998 (119)	1,151 (138)	1,151 (138)
	WB	742 (34)	855 (38)	850 (38)
Scenario 1: 2030 With Background Traffic Growth, Do Nothing & Scenario 2: 2030 With Background Traffic Growth And Network Upgrades	EB	1,159 (139)	1,312 (157)	1,312 (157)
	WB	800 (38)	913 (41)	908 (41)
Scenario 3: 2030 With Development, Do Nothing	EB	1,751 (139)	1,412 (157)	1,412 (157)
	WB	925 (38)	1,094 (41)	1,088 (41)
Scenario 4: 2030 With Development And Further Network Upgrades	EB	1,755 (142)	1,761 (149)	1,413 (157)
	WB	926 (39)	878 (39)	1,088 (41)

Source: SCT Consulting, 2020

[^]EB = eastbound and WB = westbound

Note: Total peak (1-hour) traffic volumes are shown in the table with forecast heavy vehicles shown in brackets.

⁹ The capacity per lane varies and is factored by length of the lane, speed limit and allocated green time at downstream intersection etc.
Warwick Farm Structure Plan Planning Proposal

5.4.2 Intersection performance

The performance of the intersections under each scenario is shown in **Table 5-6**. During the peak hours in 2030, the intersection of Hume Highway / Governor Macquarie Drive continues to operate as the critical pinch-point of the surrounding road network. The intersection of Hume Highway / Governor Macquarie Drive records a LoS F and DoS over 1.00 for both peak hours in future year with background traffic growth scenario and future year with development scenario, without any infrastructure upgrades.

The intersection of Governor Macquarie Drive / Munday Street would also fail when development traffic is added to the surrounding road network, without any intersection upgrades.

The constraints of the network capacity lead to reduced demand that can enter the network, making it necessary for infrastructure upgrades to achieve acceptable performance of all intersections. The proposed infrastructure upgrades required to cater for background traffic growth and the structure plan are listed below.

5.4.2.1 Scenario 2: network upgrades to accommodate 2030 background traffic growth

- A new left turn slip lane from Hume Highway westbound to Governor Macquarie Drive southbound, with a 60m long turning bay;
- An additional southbound lane on Governor Macquarie Drive between Hume Highway and Munday Street; and
- An additional northbound lane on Governor Macquarie Drive between Warwick Farm Racecourse and Munday Street.

5.4.2.2 Scenario 4: further network upgrades to accommodate 2030 structure plan growth

- An additional right turn bay from Hume Highway eastbound to Governor Macquarie Drive southbound;
- Extension of the new left turn slip lane from Hume Highway westbound to Governor Macquarie Drive southbound, from 60m to 150m;
- Extension of the existing kerbside short lane on Hume Highway eastbound;
- An additional southbound lane on Governor Macquarie Drive between Munday Street and Warwick Farm Racecourse; and
- Signalisation of the Shore Street / Governor Macquarie Drive intersection and conversion of the Munday Street / Governor Macquarie Drive intersection to a left in / left out priority intersection.

Figure 5-6 highlights the infrastructure upgrades required to cater for 2030 traffic demand including background traffic growth only (Scenario 2), and background traffic plus additional precinct traffic (Scenario 4).

For the Hume Highway / Governor Macquarie Drive intersection, signal phasings for Governor Macquarie Drive and Todman Road were adjusted to split given dual turning lanes in the southeast approach and imbalanced traffic demand between the two approaches. A coordinated signal timing was implemented for the three signal intersections along Governor Macquarie Drive and cycle time were set above 140 seconds based on current intersection operation.

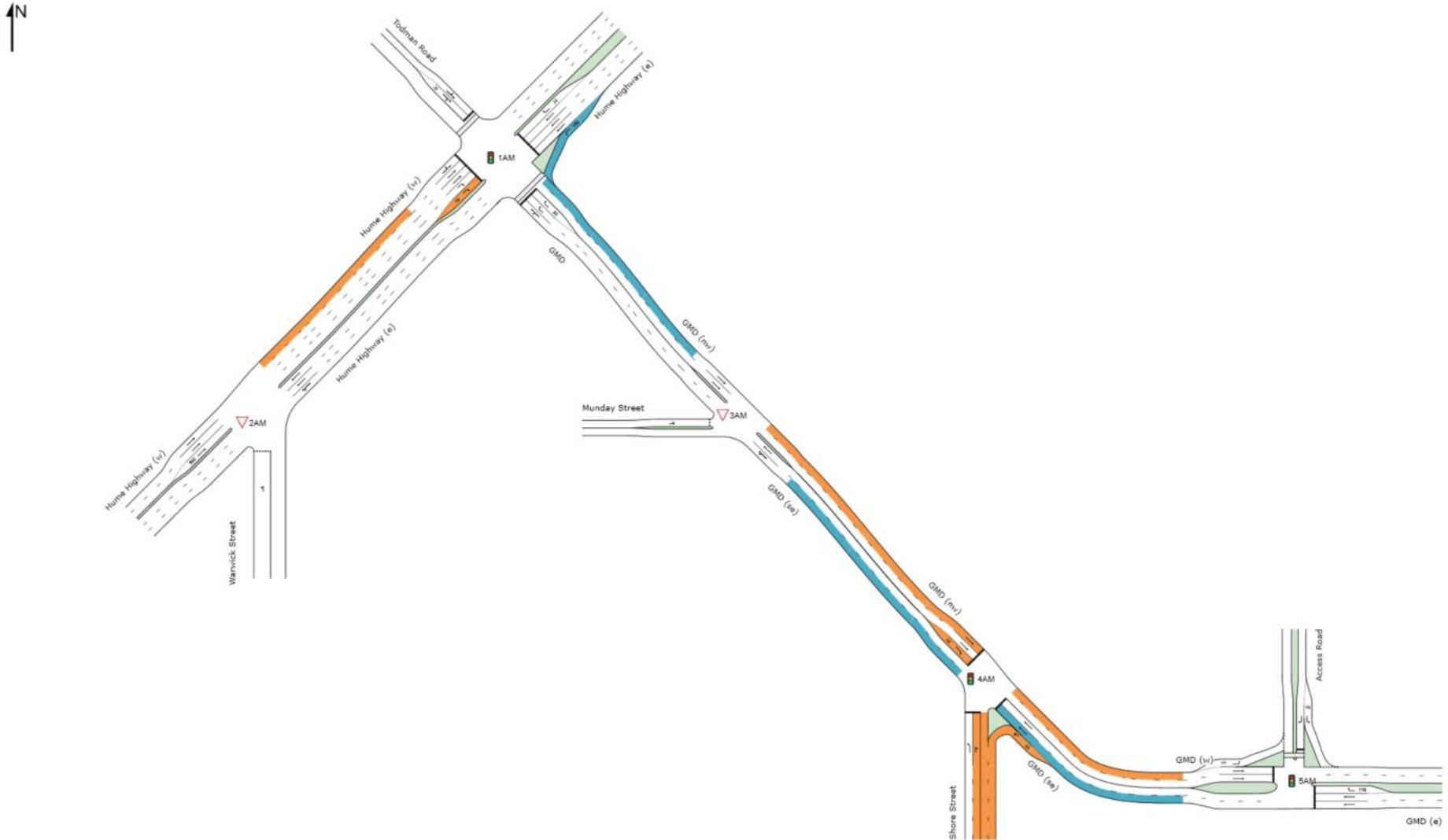
The network operates satisfactorily with the inclusion of the proposed infrastructure upgrades where DoS are all between 0.9 to 1.0 at Hume Highway / Governor Macquarie Drive for the two peak hours. Intersection upgrades to achieve this are close to the maximum scale for at-grade intersections typically seen in Sydney.

Table 5-6 2030 intersection performance

No.	Intersection	Scenario 1: 2030 With Background Traffic Growth, Do Nothing			Scenario 2: 2030 With Background Traffic Growth And Network Upgrades			Scenario 3: 2030 With Development, Do Nothing			Scenario 4: 2030 With Development And Further Network Upgrades		
		Delay	LoS	DoS	Delay	LoS	DoS	Delay	LoS	DoS	Delay	LoS	DoS
2030 AM peak													
1	Hume Highway / Governor Macquarie Drive	96.4s	F	1.12	47.6s	D	0.96	296.5s	F	2.09	55.1s	D	0.99
2	Hume Highway / Warwick Street	7.3s	A	0.52	7.4s	A	0.52	7.7s	A	0.55	7.9s	A	0.55
3	Governor Macquarie Drive / Munday Street	16.2s	B	0.91	23.9s	B	0.78	258.3s	F	2.2	10.6s	A	0.46
4	Governor Macquarie Drive / Shore Street	27.4s	B	0.97	7.7s	A	0.55	39s	C	0.81	30.2s	C	0.86
5	Governor Macquarie Drive / Warwick Farm Racecourse Access Road	5.4s	A	0.97	5.8s	A	0.46	5.9s	A	0.97	4.7s	A	0.50
2030 PM peak													
1	Hume Highway / Governor Macquarie Drive	101.9s	F	1.23	50.0s	D	0.92	531.2s	F	4.07	50.9s	D	0.99
2	Hume Highway / Warwick Street	8.2s	A	0.41	8.2s	A	0.42	8.8s	A	0.47	8.8s	A	0.47
3	Governor Macquarie Drive / Munday Street	15s	B	0.84	38.5s	C	0.87	88.4s	F	1.4	7.1s	A	0.53
4	Governor Macquarie Drive / Shore Street	8.3s	B	0.69	5.8s	A	0.76	10.9s	A	0.72	45.3s	D	0.95
5	Governor Macquarie Drive / Warwick Farm Racecourse Access Road	3.5s	A	0.49	4.8s	A	0.49	3.2s	A	0.49	5.7s	A	0.52

Source: SCT Consulting, 2020

Figure 5-6 2030 Infrastructure upgrades



Source: SCT Consulting, 2020

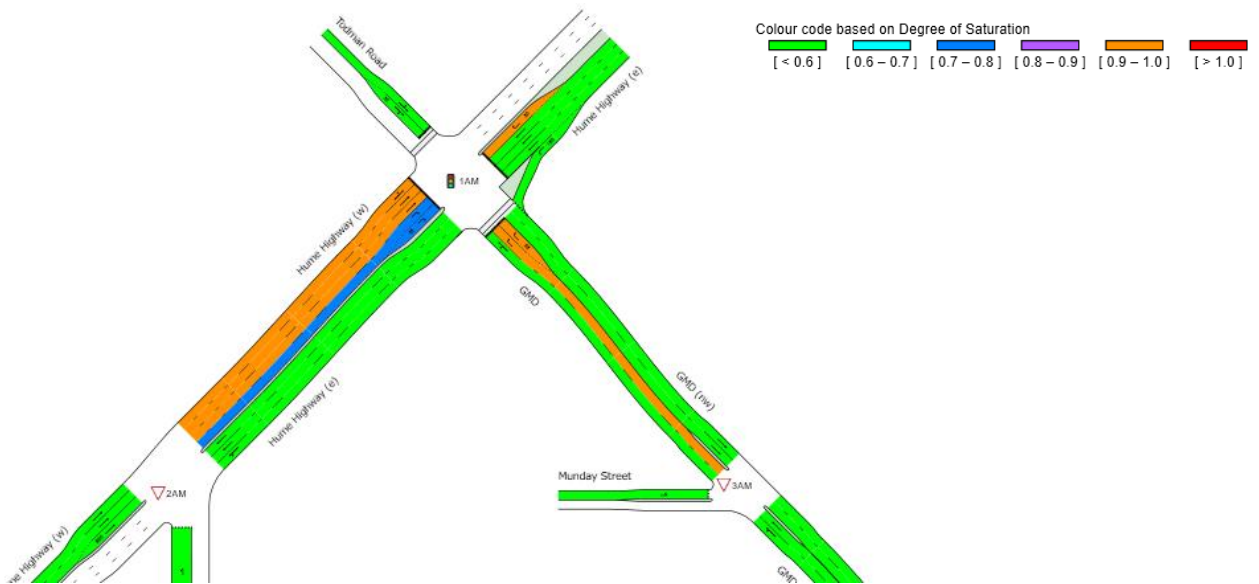
Note that the blue sections represent the upgrade needed for background traffic growth only (Scenario 2) whereas the orange sections represent the upgrade needed for additional precinct traffic (Scenario 4).

5.4.3 Remaining capacity on Governor Macquarie Drive

In order to estimate the remaining capacity on Governor Macquarie Drive to allow for potential further long-term additional traffic, including to / from the Liverpool Waterfront Precinct associated with a potential bridge over the Georges River, *Scenario 4 2030 With Development And Further Network Upgrades* was further investigated. Scenario 4 assumes all infrastructure upgrades are implemented to achieve acceptable LoS when the Warwick Farm precinct is delivered.

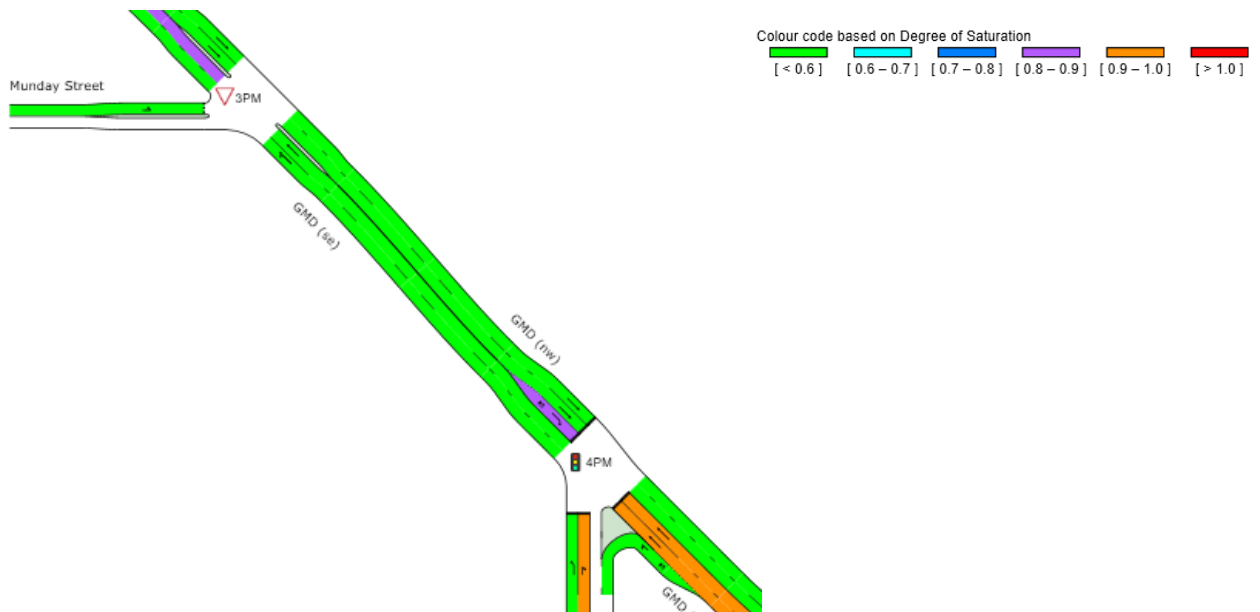
In line with the potential routing to / from Liverpool Waterfront Precinct via Governor Macquarie Drive, it is identified that the most saturated sections of Governor Macquarie Drive are located at the southeast approach of the Hume Highway / Governor Macquarie Drive intersection (**Figure 5-7**), and the right turn lane from Governor Macquarie Drive into Shore Street (**Figure 5-8**) for both peak hours. It is also identified that there is more remaining capacity at mid blocks than at intersection approaches. A summary of the remaining capacity is presented in **Table 5-7** to estimate how many further vehicles could feasibly be added onto Governor Macquarie Drive beyond the delivery of the Warwick Farm structure plan – for example, from the Liverpool Waterfront Precinct.

Figure 5-7 2030 Degree of Saturation for the network (AM peak, Scenario 4)



Source: SCT Consulting, 2020

Figure 5-8 2030 Degree of Saturation for the network (PM peak, Scenario 4)



Source: SCT Consulting, 2020

Table 5-7 Remaining capacity analysis on Governor Macquarie Drive (Scenario 4)

Period	Directions	Total capacity	Remaining capacity*	Remaining capacity (No. of vehicles equivalent)
AM	Westbound	1,053 vehicles/hour	1.5%	16 vehicles/hour
	Eastbound	688 vehicles/hour	30.1%	207 vehicles/hour
PM	Westbound	917 vehicles/hour	19.5%	179 vehicles/hour
	Eastbound	773 vehicles/hour	11%	85 vehicles/hour

Source: SCT Consulting, 2020

*The remaining capacity considers capacity of two right turn lanes for the southeast approach at Hume Highway / Governor Macquarie Drive and the right turn lane of northwest approach at Governor Macquarie Drive / Shore Street given the potential routing for Liverpool Waterfront Precinct traffic.

5.5 Public transport impacts

The potential residents resulting from the preferred structure plan will be located within a short walking distance to Warwick Farm train station, which provides a wide coverage of destinations across Sydney.

The public transport capacity for the precinct is expected to be sufficient to service the increased in public transport demands, with three train lines and up to nine peak hour train services to provide sufficient capacity during peak hours.

It is recognised that the precinct is currently not well served by buses. With the current road network being as it is, and the precinct surrounded by the train line, Georges River and Warwick Farm Racecourse, it will be very challenging to deliver any feasible new bus services to cater for new precinct demand. In the long term, this could change if a new crossing over Georges River is delivered as part of the Liverpool Waterfront precinct development.

5.6 Active transport impacts

With the growing needs for public transport accessibility and better connectivity within the precinct, it will be important to ensure a safe, quality and well-connected footpaths and cycle path system around the site to promote sustainable transport use.

The structure plan includes footpaths or shared paths as well as additional through site links across the precinct, making active transport one of the most convenient modes for both short and long distance trips. The road network is currently grid-like in structure with multiple through site links, providing numerous crossing opportunities and reducing travel distance between residential areas, open spaces, mix use component and train station. The pedestrian and cycling generated by the precinct during the peak periods are therefore considered to be at a level able to be accommodated by the existing and planned infrastructure.

6.0 Conclusion

6.1 Conclusion

This traffic and transport impact assessment concludes that:

- The proposed structure plan is positively aligned with strategic planning and transport policy, including the Future Transport Strategy 2056, the Western City District Plan, and the Liverpool Collaboration Area Place Strategy. Because the precinct is located immediately next to Warwick Farm station, it has the opportunity to be delivered as a transit-oriented development with fast and frequent public transport access to Liverpool CBD and other major centres in Sydney.
- The structure plan will fill the gaps in the existing active transport network and promotes pedestrian and cyclist movements through maintaining good permeability within the precinct and providing connection to the surrounding cycling and walking network. This also facilitates the access to local open spaces, commercial premises and public transport by sustainable transport modes.
- The structure plan is estimated to generate 986 vehicle trips in the AM peak, and 1,168 vehicle trips in the PM peak.
- Without infrastructure upgrades, the road network will not have sufficient capacity to accommodate these additional trips. In particular, the capacity of the Hume Highway / Governor Macquarie Drive intersection would be significantly exceeded (LoS F). However, this intersection is currently already congested (AM peak LoS E, PM peak LoS D), and is forecast to deteriorate further by 2030 due to additional traffic from other nearby developments (LoS F). The poor performance of the intersection is therefore not just a result of the additional precinct traffic.
- With a range of network upgrades, an acceptable level of intersection performance (LoS D) can be achieved. Some of these network upgrades are required just to cater for background traffic growth from other nearby developments (Scenario 2), whereas other upgrades will be additionally required to accommodate the traffic generated by the Warwick Farm precinct (Scenario 4). These intersection upgrades are close to the maximum scale for at-grade intersections typically seen in Sydney.
- The additional road capacity from the widening of Governor Macquarie Drive and the intersection upgrades is forecast to quickly fill up with the traffic generated by the development, and background traffic growth. There would be very little capacity left for any further long-term additional traffic from the south, for example using a potential new bridge over Georges River (to be provided by the Liverpool Waterfront precinct). A new road bridge over Georges River would also have wider traffic implications for the Collaboration Area (as it would effectively form an eastern bypass of Liverpool CBD), and the traffic impacts of any such road bridge should be scrutinised in more detail in the planning for the Liverpool Waterfront precinct.

APPENDIX A

Traffic Generation Rates: Review and Recommendations

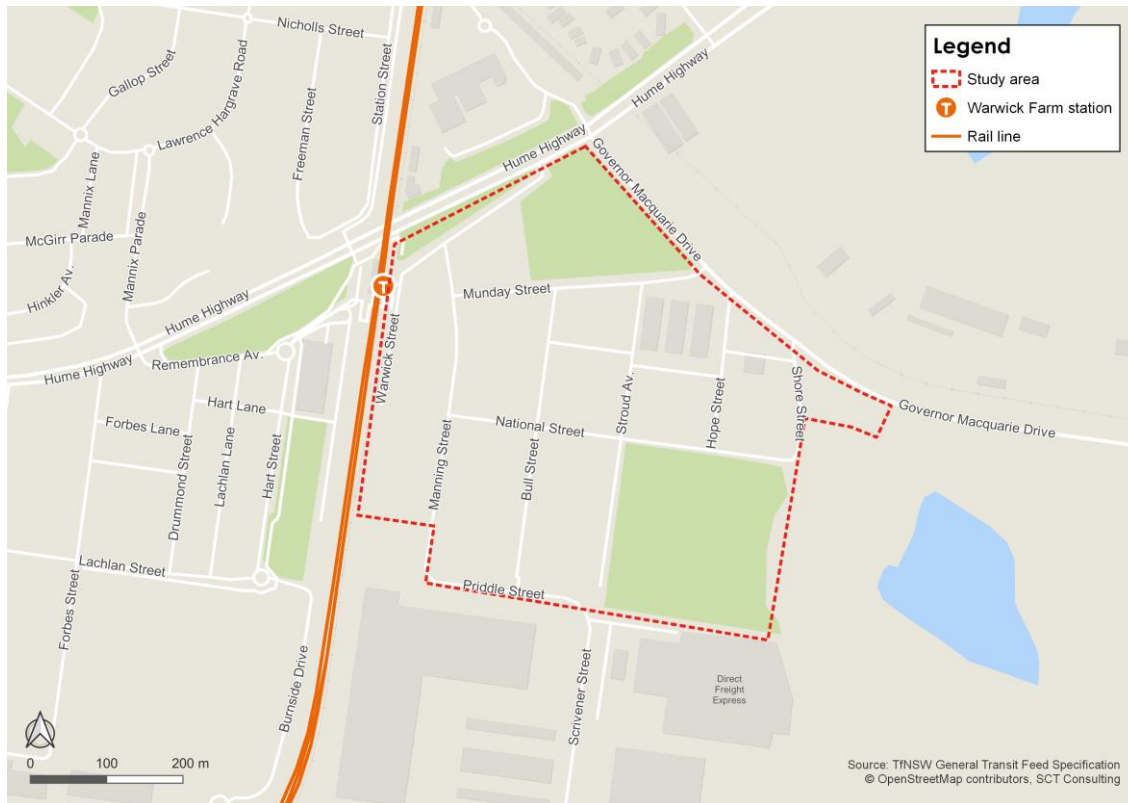
Technical Memorandum

Quality Information	
Project:	Warwick Farm Structure Plan and Planning Proposal
Project Number:	SCT_00153
Document Name:	Traffic Generation Rates: Review and Recommendations
Prepared:	Florian Langstraat, Senior Consultant
Reviewed:	Andy Yung, Director
Authorised:	Andy Yung, Director

Background

SCT Consulting is working with CM+ to develop a Structure Plan for the Warwick Farm precinct, on behalf of Liverpool Council. The precinct is bounded by Governor Macquarie Drive to the north-east, Hume Highway to the north, and the railway line to the west (**Figure 1**).

Figure 1 Warwick Farm Structure Plan study area



To date, CM+ has prepared three draft options for the Structure Plan: Option 1, Option 2A and Option 2B. Following review, Council has indicated that **Option 2B** is its preliminary preferred option. Option 2B consists of indicatively:

- 169,850m² of residential Gross Floor Area (GFA), estimated to be equivalent to 1,982 dwellings; and
- 40,383 m² of commercial GFA.

To enable this Structure Plan to be delivered, a planning proposal is envisaged to rezone the study area to a mix of B4 (Mixed Use) and R4 (High Density Residential). An indicative aerial view of Option 2B is shown in **Figure 2**.

Figure 2 Aerial view of Structure Plan Option 2B



Source: CM+, Warwick Farm Structure Plan, March 2020

The purpose of this note is to advise on appropriate vehicle trip generation rates for the Structure Plan. Once agreed with Council, these trip generation rates can then form the basis of a traffic impact assessment for the Structure Plan, to support the planning proposal.

Guidance on trip generation in NSW is provided by TfNSW's *Guide to Traffic Generating Developments*¹ and subsequent *Technical Direction TDT 2013/04a: Guide to Traffic Generating Developments: Updated traffic surveys*². The guidance provides advice on the traffic impacts of land use developments, based on traffic surveys in various locations in Sydney.

Residential trip generation

For the purposes of this note, it is assumed that all new dwellings in the proposed Structure Plan will be high-density residential flat dwellings (as shown in **Figure 2**).

Typical vehicle trip generation rates

Typical vehicle trip generation rates for high density residential flat dwellings in Sydney are shown **Table 1**.

Table 1 Typical vehicle trip generation rates for high density residential flat dwellings

Weekday rates	Sydney average	Sydney range
AM peak (1 hour) vehicle trips per unit	0.19	0.07-0.32
PM peak (1 hour) vehicle trips per unit	0.15	0.06-0.41
Daily vehicle trips per unit	1.52	0.77-3.14

Source: Roads and Maritime Technical Direction TDT 2013/04a: Guide to Traffic Generating Developments: Updated traffic surveys

It should be noted, however, that these vehicle trip generation rates are based on surveys in a range of different locations in Sydney. Many of these are much closer to Sydney CBD, and have access to more frequent public transport services than the Warwick Farm study area.

¹ Roads & Traffic Authority (2002), *Guide to Traffic Generating Developments*, October 2002.

² Roads and Maritime Services (2013), *Technical Direction TDT 2013/04a: Guide to Traffic Generating Developments: Updated traffic surveys*, August 2013.

Table 2 Vehicle trip generation rates and mode shares for surveyed high density residential flat dwellings in TfNSW guidance

Surveyed location	Weekday vehicle trip generation			% mode split		
	AM peak (veh / unit)	PM peak (veh / unit)	Daily (veh / unit)	Car Driver	Car Passenger	Non-Car
Site 1: St Leonards	0.14	0.07	0.77	22%	5%	73%
Site 2: Chatswood	0.14	0.12	1.23	23%	12%	64%
Site 3: Cronulla	0.07	0.11	0.93	31%	1%	67%
Site 4: Rockdale	0.32	0.18	2.25	42%	15%	43%
Site 5: Parramatta	0.27	0.12	1.67	33%	9%	57%
Site 6: Liberty Grove	0.28	0.41	3.14	48%	20%	32%
Site 7: Strathfield	0.10	0.06	1.16	28%	3%	69%
Site 8: Pyrmont	0.18	0.10	1.03	34%	6%	60%

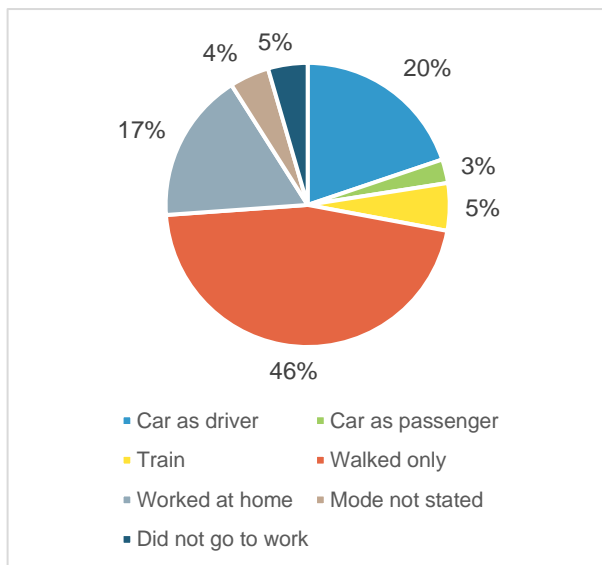
Source: Roads and Maritime Technical Direction TDT 2013/04a: Guide to Traffic Generating Developments: Updated traffic surveys

It is clear that most of these surveyed locations are characterised by very good access to fast and frequent public transport, and low car driver mode shares.

Travel behaviour in the Warwick Farm study area

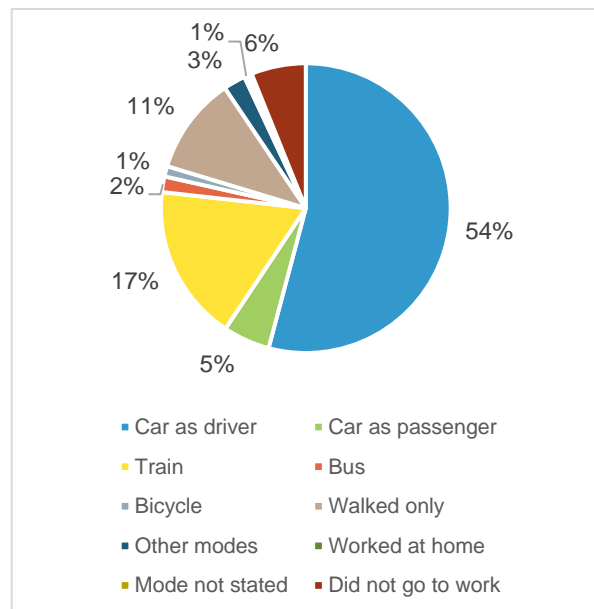
Figure 3 shows mode shares for residents in the Warwick Farm Structure Plan study area travelling to work. Currently the study area mainly consists of horse training stables attached to residential dwellings, and as a result about two-thirds of residents walk to work (46%) or work at home (17%). All other mode shares, particularly car driver and car passenger, are therefore low.

Figure 3 Travel to work mode shares for residents in the Structure Plan study area (Travel Zone 3840)



Source: TfNSW 2011 Census Journey to Work data by Travel Zone

Figure 4 Travel to work mode shares for residents in the Warwick Farm Station West Travel Zone (3837)



Source: TfNSW 2011 Census Journey to Work data by Travel Zone

Because of the unique nature of the current horse training precinct, it is not recommended to use current mode shares for the precinct as a predictor of future travel behaviour. Potential future residents of flat buildings in the study area will behave very differently from current residents who work in the horse training businesses next to their place of residence.

As the ‘next best alternative’ data source, **Figure 4** shows journey to work mode shares for residents in the Warwick Farm Station West Travel Zone, on the other side of the railway line. These mode shares are considered to be much more representative of typical travel behaviour by residents in the area north-east of Liverpool CBD. The Warwick Farm Station West Travel Zone is largely made up of mid-rise residential flat buildings, and could therefore be a good indicator of what future mode shares in the study area could look like if the Structure Plan was delivered.

Figure 5 shows the boundaries of these Travel Zones for reference.

Figure 5 Travel Zone boundaries around the study area



Recommended vehicle trip generation rates

The car driver mode share for the Warwick Farm Station West Travel Zone is 54% (**Figure 4**). This is clearly much higher than most of the surveyed locations in the TfNSW guidance (**Table 2**), such as St Leonards (22%), Chatswood (23%) and Cronulla (31%). It is therefore not recommended to use the average vehicle trip generation rates suggested by the TfNSW guidance.

Instead, residential vehicle trip generations rates can be established by using the surveyed locations that resemble the Warwick Farm study area most closely. In the TfNSW guidance, these are Rockdale (Site 4, with a car driver mode share of 42%) and Liberty Grove (Site 6, with a car driver mode share of 48%). The recommended approach to establishing vehicle trip generation rates for the Warwick Farm Structure Plan is to take the average of these two surveyed locations.

Table 3 Recommended weekday residential vehicle trip generation rates

Surveyed location	AM peak (veh / unit)	PM peak (veh / unit)	Daily (veh / unit)
Site 4: Rockdale	0.32	0.18	2.25
Site 6: Liberty Grove	0.28	0.41	3.14
Average (recommended)	0.30	0.29	2.69

Source: Roads and Maritime Technical Direction TDT 2013/04a: Guide to Traffic Generating Developments: Updated traffic surveys

Impact of parking provision on vehicle trip generation rates

A recent study by Roads and Maritime Services (now TfNSW)³ conducted a large number of traffic generation surveys at a range of metropolitan, sub-metropolitan and regional sites to inform better policy on trip generation for residential uses. The study found that for metropolitan and sub-metropolitan sites, **the number of parking spaces is a better predictor of traffic generation than the number of units**. As a result, the traffic generation rates for residential uses in those contexts were measured as trips per parking space – not per unit.

The existing TfNSW guidelines also already allow vehicle trip generation rates to be established based on the number of parking spaces, rather than on the number of dwellings. Vehicle trip generation rates per parking space are summarised in **Table 4**.

Table 4 Weekday residential vehicle trip generation rates per parking space

Surveyed location	AM peak (veh / parking space)	PM peak (veh / parking space)	Daily (veh / parking space)
Sydney average (all surveyed sites)	0.15	0.12	0.34
Sydney range (all surveyed sites)	0.09-0.29	0.05-0.28	0.56-2.16
Site 4: Rockdale	0.29	0.17	2.03
Site 6: Liberty Grove	0.19	0.28	2.16
Average of Site 4 and Site 6	0.24	0.23	2.10

Source: Roads and Maritime Technical Direction TDT 2013/04a: Guide to Traffic Generating Developments: Updated traffic surveys

At this stage of planning, the number of parking spaces to be provided is not yet known. However, it is recommended that the above vehicle trip generation rates per unit (**Table 3**) be updated to vehicle trip generation rates per car space, once a preferred parking strategy for the precinct has been established.

Retail trip generation

At this stage of planning, it is not yet known what the proposed new commercial Gross Floor Area will consist of. For the purposes of this note, it is assumed that a proportion will be retail, and the remainder will be office use. Retail trip generation is discussed in this section, and office trip generation in the next section.

The TfNSW guidance provides advice on vehicle trips generated by shopping centres, based on surveys of shopping centres undertaken in 1978, 1990 and 2001 (**Table 5**). Vehicle trip generation rates are presented per 100 m² of GLFA, and highly dependent on the overall size of the shopping centre.

Table 5 Weekday vehicle trip generation rates for shopping centres in TfNSW guidance

Range in total floor area (GLFA, m ²)	Peak hour generation rate (vehicles per 100 m ² GLFA)		
	Thursday peak hour	Friday peak hour	Saturday peak hour
0 – 10,000	12.3	12.5	16.3
10,000 – 20,000	6.2	6.7	7.5
20,000 – 30,000	6.0	5.9	7.0
30,000 – 40,000	4.6	3.7	6.1
40,000 – 70,000	4.4	4.4	5.5
70,000+	3.1	4.0	3.6

Source: Roads and Maritime Technical Direction TDT 2013/04a: Guide to Traffic Generating Developments: Updated traffic surveys

It should be noted that these retail areas are significantly larger than the retail component of the Structure Plan is ever likely to be, so these numbers should only be used as a provisional estimate of likely vehicle trip generation by the retail component of the Structure Plan.

³ Bitzios Consulting (2017), Trip Generation Surveys: High Density Residential (Car Based) Analysis Report. Available from: <https://data.nsw.gov.au/data/dataset/3-trip-generation-surveys-high-density-residential--car-based---analysis-report-/resource/d691dd58-e61c-4c3b-ab6a-a3895d088dc3>

Recommended approach

As the intended use of the proposed commercial GFA is not yet known, it is challenging to establish an accurate trip generation rate at this early stage of planning. For retail uses, **Table 5** provides an early indication, but these rates may not be appropriate in all circumstances. For example, rates based on surveys of large shopping centres may not be appropriate if the retail component of the development ends up being very small. The TfNSW guidance also provides more specific vehicle generation rates for uses such as:

- Service stations and convenience stores;
- Markets;
- Restaurants;
- Recreational facilities;
- Gyms;
- Health care services; and
- Child care centres.

In the absence of further detail at this stage, it is recommended that the peak hour vehicle trip generation rates from **Table 5** be used as an interim estimate of likely trip generation. The correct rate will depend on the total GLFA of the retail component of the Structure Plan.

Similar to the residential component, the number of parking spaces provided is likely to be a better predictor of traffic generation than the GLFA, once this is known.

Office trip generation

Lastly, the TfNSW guidance also provides advice on vehicle trips generated by offices, based on surveys of eight offices in Sydney undertaken in 2011 (**Table 6**).

Table 6 Weekday vehicle trip generation rates for surveyed offices in TfNSW guidance

Surveyed location	GFA (m ²)	AM peak vehicle trips (veh / 100m ² GFA)	PM peak vehicle trips (veh / 100m ² GFA)
North Sydney	31,400	0.17	0.14
Chatswood	10,214	1.03	0.84
Sydney Olympic Park	34,131	1.48	1.41
Hurstville	3,254	2.86	1.84
Macquarie Park	5,748	2.07	1.84
Parramatta	27,000	0.69	0.61
Liverpool	2,817	2.49	1.70
Norwest	1,200	2.75	1.17

Source: Roads and Maritime Technical Direction TDT 2013/04a: Guide to Traffic Generating Developments: Updated traffic surveys

Of these, some are comparable to the Warwick Farm precinct, but many are located in much bigger centres, with access to frequent public transport to a much wider range of destinations. Taking an average of the vehicle trip generation rates in these surveys is therefore not recommended.

Instead, it is recommended to use the Liverpool survey as the closest comparator to the Warwick Farm precinct. The recommended vehicle trip generation rate for any office components of the Structure Plan is therefore **2.49 vehicles / 100m² GFA in the AM peak, and 1.70 vehicles / 100m² GFA in the PM peak**.

Similar to the residential and retail components, the number of parking spaces provided is likely to be a better predictor of traffic generation than the GFA, once this is known.

Conclusions and recommendations

This Technical Note has provided recommendations for appropriate residential, retail and office trip generation rates for the proposed Warwick Farm Structure Plan. Because of the unique nature of the precinct at present (horse training, with many residents working immediately next door to their home), current travel behaviour in the study area is not a good predictor of how future residents are likely to travel. Instead, the adjacent Warwick Farm Station West Travel Zone has been used as an indication of typical mode choice.

In summary, the following vehicle trip generation rates are recommended for use in a traffic impact assessment of the Structure Plan:

Table 7 Recommended weekday vehicle trip generation rates

Land use	AM peak	PM peak
Residential (flats)	0.30 / unit	0.29 / unit
Retail	TBD depending on total GLFA (see Table 5)	
Commercial	2.49 / 100m ² GFA	1.70 / 100m ² GFA

[Type Source Info] For all land uses, the number of parking spaces provided is likely to be a better indicator of trip generation than a fixed rate per unit, GLFA or GFA. It is recommended that the above vehicle trip generation rates be updated to vehicle trip generation rates per car space, once a preferred parking strategy for the precinct has been established.

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Updated Warwick Farm Structure Plan

20 August 2021 at 15:48

Will,

We have considered the latest structure plan and here is a summary of traffic impact compared to previous traffic assessment:

1. The number of dwellings proposed (3,224 dwellings) is a reasonable increase to what was previously assessed (2,252 dwellings), with taller buildings generally proposed across the precinct. However, that there is a reduction of about 4,300 sqm of non-residential GFA compared to what was previously assessed.
2. The increase in dwellings is forecast to generate an additional 290 peak hour trips from the residential component. However, this would be offset by the reduction in non-residential GFA (commercial and retail). Commercial trips are forecast to reduce by 20-30 trips in the peak hours, but there is a much larger reduction forecast in retail trips. The increased in dwellings mean an increased population and therefore a much higher proportion of the retail component is forecast to serve internal trips within the precinct. Therefore, the number of vehicles entering and exiting the precinct for retail is forecast to reduce by about 150 trips in the AM peak hour and about 300 trips in the PM peak hour.
3. Overall, the total vehicle trips are forecast to increase in the AM by 120 trips (12% increase) and reduce in the PM peak by about 40 trips (4% decrease).
4. The changes in traffic volume vary from intersection to intersection in each peak hour, depending on entry and exit routes and so the SIDRA models have been rerun at critical intersections with the updated turning movements to check if any further upgrades are required. The 2020 traffic impact assessment had noted that the Hume Highway / Governor Macquarie Drive and Governor Macquarie Drive / Shore Street intersections were expected to perform at or close to capacity in the 2030 peak hours.
 - a. Governor Macquarie Drive / Shore Street intersection – with the updated traffic volumes, the intersection is still forecast to operate at LOS C and LOS D in the AM and PM peak hours respectively. Hence, no additional infrastructure upgrades proposed to this intersection.
 - b. Hume Highway / Governor Macquarie Drive intersection – with the updated traffic volumes, the intersection is still forecast to operate at LOS D in the PM peak hour. In the AM peak hour, the forecast performance reduces to LOS E (which in highly urbanised context still considered acceptable). However, there is minimal opportunity to add infrastructure to improve performance, with the conflicting movements already being provided with the maximum feasible amount of capacity in balancing the traffic demand and surrounding environment. It is considered that no further infrastructure upgrades should be included as part of the project.
5. The street structure and hierarchy generally remains the same as previous preferred option, with the eastern option of Manning Street bypass proposed (the preferred option based on consultation feedback) Active transport network is assumed to remain the same as the previous proposal.

The following provides responses to Greg's questions:

- Updated Table A2:

Land use	Total vehicle trips			
	AM Peak	%	PM Peak	%
Residential	892	81	858	76
Retail	87	19	181	24
Office	125		85	
Total	1,104	100	1,12	100

- No additional infrastructure upgrades proposed to the intersections.

Feel free to contact us on Monday if you need any clarifications.

Regards,

Andy Yung

Director

[Redacted]

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SCT Consulting



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