



Kellicar Road Precinct Planning Proposal

Detailed Traffic and Transport Assessment

Prepared for:

Kellicar Land Owners Group

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JMT
Consulting

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Executive Summary

Background

JMT Consulting has prepared this detailed traffic and transport assessment report to consider the rezoning of the land known as the 'Kellicar Road Precinct' involving the master-planned development of four sites within the Macarthur Town Centre, known as the 'Kellicar Road Precinct'. The four sites within the precinct are shown in the figure below.



Land subject to the planning proposal

Proposal description

The current master plan for the Kellicar Precinct envisages approximately 224,000m² GFA on the site, with a mix of residential, commercial and retail uses. The mixed-use nature of the development will facilitate 'trip containment' by allowing people to live, work and play all within the one area. An objective of the proposal is to transition the area from a car-dominated environment to a more people and pedestrian friendly destination with plazas, laneways, shopping, outdoor dining and landscaped areas as well as a variety of employment and residential uses.

Comparison of current and proposed yields

Land Use	Current (GFA, m ²)	Proposed (GFA, m ²)
Residential	-	143,300
Retail/ Bulky Goods	26,950	22,400
Commercial	1,400	58,300
Total	28,350	224,000

Transport strategy

The following objectives were developed in the formation of the transport strategy for the precinct:

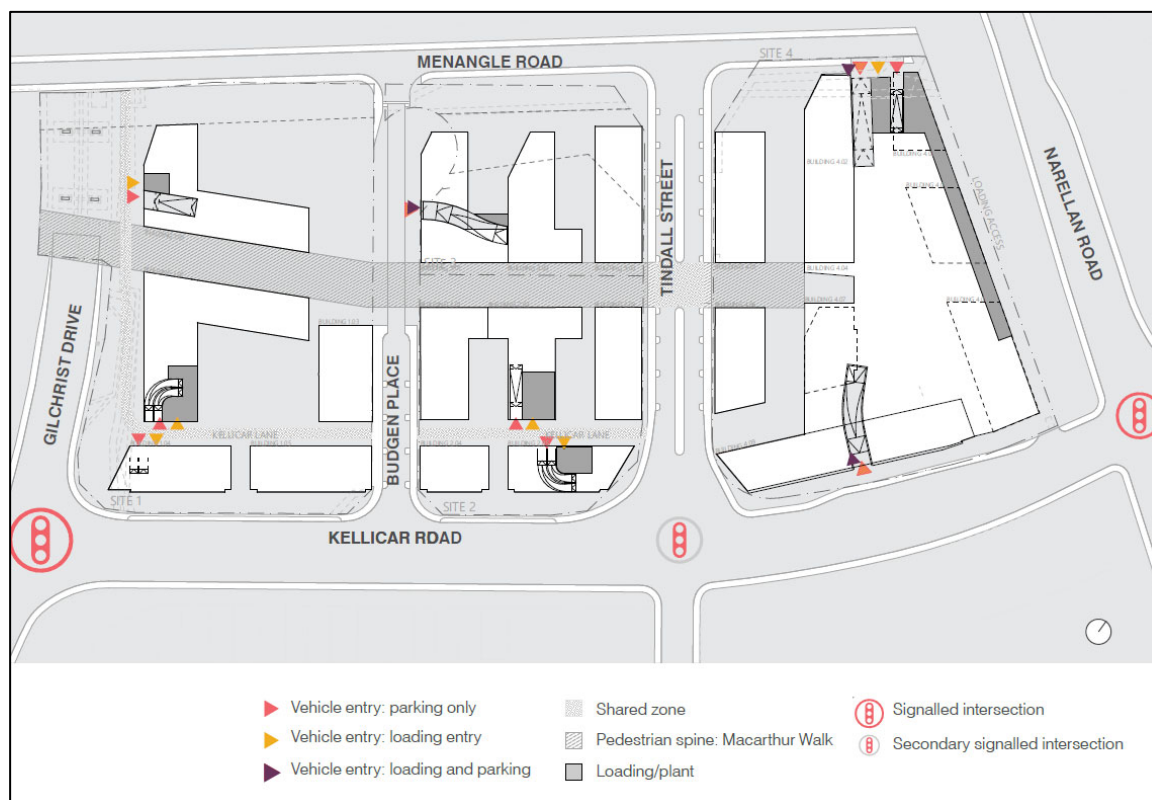
- To establish a clear and defined street hierarchy for pedestrian and traffic movement.
- To provide a street network with a high level of amenity, safety and permeability for all users.
- To introduce Macarthur Walk as a new east-west pedestrian promenade connecting pedestrians between retail anchors and Macarthur station.
- To prioritise pedestrian amenity throughout the precinct.
- To ensure the design of the local road network can service local traffic demand.

The proposal involves a significant improvement in pedestrian access and permeability in the precinct. In particular, the creation of 'Macarthur Walk', a major east-west pedestrian boulevard, will provide users of the precinct with direct access to Macarthur railway station. With a wide (20m) east-west pedestrian spine with a signature avenue of feature trees, Macarthur Walk will provide a comfortable and convenient public link through the site away from busy surrounding roads to Macarthur Station and Macarthur Square.

Vehicle access

A number of vehicle access points have been identified to provide access to the precinct based on the following key principles:

- Ensure the location, size and design of vehicle access minimises disruption of traffic on public roads.
- Ensure access points are appropriately sized to accommodate the design vehicle including for waste collection and building servicing/loading.
- Vehicle access points to be located to minimise pedestrian conflicts, support the reduction of private vehicle dependency and to encourage the use of sustainable transport.
- Vehicle access points to minimise impacts on streetscape and amenity and to maintain an active ground floor frontage to primary streets.



Proposed vehicle access points

Parking

The proposed maximum car parking rates for the precinct (based on land use) are summarised in the table below.

Proposed car parking rates

Use	Maximum car parking rates
Commercial	1 space per 70m ² GFA
Retail	1 space per 40m ² GFA
Residential	<ul style="list-style-type: none"> 0.5 spaces per 1 bedroom 1.2 spaces per 2 bedroom 1.8 spaces per 3 bedroom or more
Residential visitors	1 space per 10 dwellings
Other uses	To be justified in a transport and parking study, with reference to parking rates contained in the Campbelltown City (Sustainable City) DCP 2015

Over time, given the development of the precinct will take place over a number of years, it may be possible to reduce car parking provision as the use of public transport (including the opening of the new metro station) increases and private car use changes. The maximum parking rates proposed provide flexibility in allowing reduced parking rates in future once new public transport services come on line.

The master plan has made provision for some short term on-street car parking to be provided along Tindall Street and Bugden Place. Car share spaces would be provided within the precinct to enable those without access to a car to travel via private vehicle when it is the most appropriate means of transport, whilst still relying on public transport, walking and cycling for the majority of their trips. Bicycle parking will be provided both within individual development parcels, as well as the public domain, to increase travel by bicycle and reduce car dependence.

Encouraging mode shift

The Planning Proposal involves a suite of measure to encourage a mode shift away from private vehicle towards travel by public transport, walking and cycling. These initiatives include:

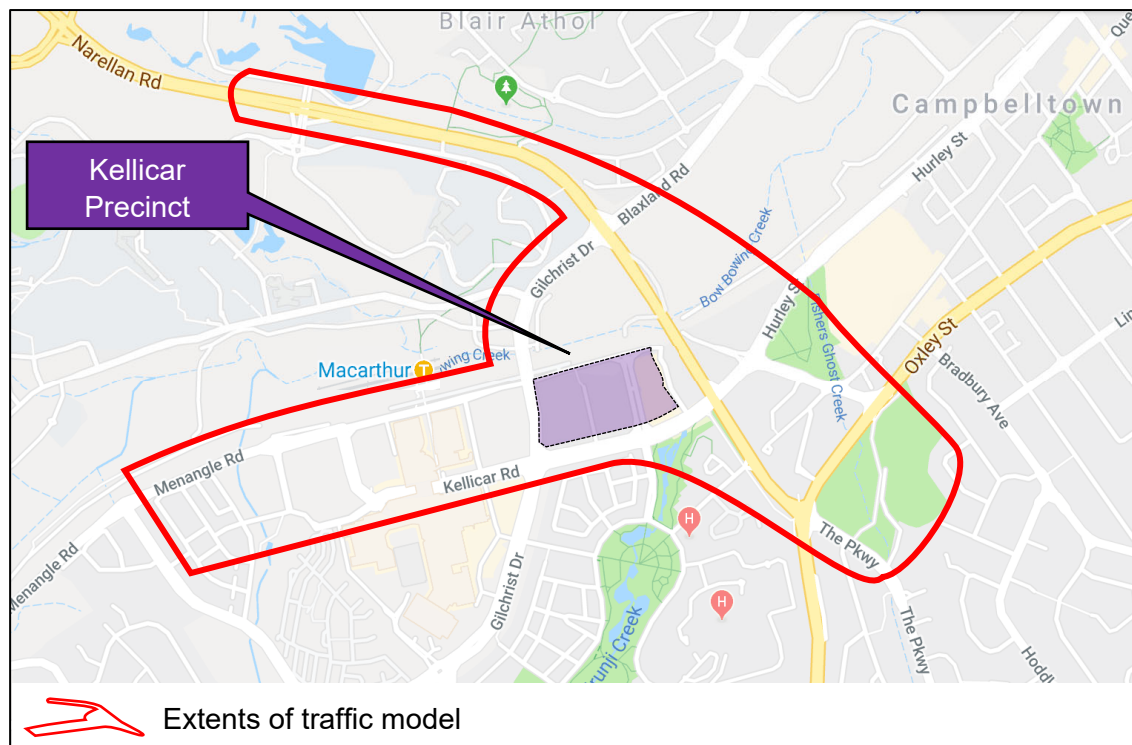
- Provision of a high quality public domain including the creation of 'Macarthur Walk' - a wide (20m) east-west pedestrian spine which will provide connections to Macarthur Station and Macarthur Square.
- Improved pedestrian connections through to Macarthur Station to support access by public transport
- A truly mixed use development which will allow residents and workers convenient access to shops and services, rather than relying on driving to nearby areas to undertake these tasks
- Provision of maximum car parking rates (rather than minimums as specified in Council's DCP)
- Bicycle parking to be provided as part of future development on the site, including within the public domain to support visitor trips
- Car share spaces to be provided within the precinct for use by residents as well as members of the public
- Development of site specific 'Green Travel Plans' for each development application lodged on the site
- Locating vehicle access points with the objective of minimising pedestrian conflicts and complementing the surrounding streetscape and amenity to maintain an active ground floor frontage.

As the precinct develops and further transport upgrades are provided these initiatives will be progressed and refined.

Detailed traffic assessment

It is relevant to acknowledge that the proposed floorspace under the Kellicar Road Precinct Planning Proposal is no greater than could be achieved under current planning controls. The Planning Proposal seeks an increase in building height, which will result in a different arrangement of built form across the precinct and which in turn warrants an enhanced public domain befitting of the urban precinct that the site will become.

Notwithstanding the above, and in accordance with the recommendation of the Gateway Determination, detailed micro-simulation traffic modelling (using the Aimsun software package) has been undertaken to consider the impacts of the proposal on the surrounding road network. The purpose of the traffic modelling is to provide an understanding of the road and transport infrastructure upgrades needed to support the Planning Proposal, including identification of transport network upgrades required to mitigate the traffic impacts of the scheme. The extents of the traffic model are shown below.



Traffic model extents

The traffic modelling has taken into consideration traffic growth arising from both the development of the Kellicar Road precinct as well as from development in the wider area. In addition the modelling has considered the implications of committed regional road upgrades (delivered by others) such as the Spring Farm Parkway and the Outer Sydney Orbital.

The detailed traffic assessment has not identified any major issues preventing the development of the Kellicar Road Precinct to the densities envisaged under the Planning Proposal, subject to the implementation of road upgrades. The traffic modelling indicates that the road network, with these road upgrades in place, will perform at a similar level should the rezoning not proceed.

Average vehicle delays at a number of intersections, including key sites such as Gilchrist Drive / Kellicar Road and Narellan Road / Kellicar Road significantly reduce as a result of the mitigation measures associated with the Planning Proposal.

The suggested staging of the identified mitigation works is summarised the table below. The staging has been developed based on the location of the mitigation measure with respect to each of the four sites. The staging also considers the traffic impacts of each stage of development and the need to mitigate these traffic impacts through road works.

Proposed staging of mitigation measures

Mitigation	Description	Recommended staging
Mitigation 1: Kellicar Road / Bugden Place	Close off the current right turn vehicle access into the precinct at Bugden Place from Kellicar Road	Concurrent with the development of Site 1 or at the time Bugden Place is extended through to Menangle Road.
Mitigation 2: Kellicar Road / Tindall Street	Creation a double right turn from Kellicar Road (east) into Tindall Street	Concurrent with the development of Site 2
Mitigation 3: Kellicar Road / Gilchrist Drive	Creation a double right turn from Kellicar Road (east) into Tindall Street and dedicated left turn lane on Tindall Street	Concurrent with the development of Site 1
Mitigation 4: Kellicar Road eastbound traffic lane	Creation of an additional through traffic lane along Kellicar Road in the eastbound direction between Bugden Place and Narellan Road	Concurrent with the development of Site 2 or 3, whichever comes later
Mitigation 5: Kellicar Road / Narellan Road	Creation a left turn slip lane from Kellicar Road (west approach) into Narellan Road	Concurrent with the development of Site 4

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1 Introduction

1.1 Background

JMT Consulting has been engaged by the Kellicar Land Owners Group to prepare a detailed traffic and transport assessment to support the rezoning of land known as the Kellicar Road Precinct. The purpose of the assessment is to identify traffic solutions for the precinct to support the rezoning proposal, with the aim of not sterilising future opportunity elsewhere in the city centre.

1.2 Site location

The Kellicar Road Precinct consists of Nos. 1, 2, 3 and 6 Bugden Place; and No. 4 Tindall Street, Campbelltown, and has a total area of approximately 64,000sqm, which excludes land along Menangle Road that is currently zoned SP2 (Infrastructure) as a road widening reservation. The combined sites are part of an existing retail precinct which is bounded by the following roads:

- Narellan Road (East)
- Gilchrist Drive (West)
- Menangle Road (North)
- Kellicar Road (South)

The extent of the precinct, which is divided into four sites based on current landholdings, is indicated in Figure 1 below.



Figure 1 Land subject to the planning proposal

1.3 Description of proposal

The current master plan for the Kellicar Road Precinct envisages approximately 224,000m² GFA on the site. The objective is to transition the area from a car-dominated environment to a more people and pedestrian friendly destination with plazas, laneways, shopping, outdoor dining and landscaped areas as well as a variety of employment and residential uses. The illustrative masterplan is depicted in Figure 2 below.



Figure 2 Illustrative master plan

The Kellicar Road Planning Proposal represents a significant opportunity for the Campbelltown-Macarthur city centre and could well be a trigger for ongoing investment and activity, as envisaged by the 'Reimagining Campbelltown' strategy. It is expected that individual sites within the 7ha precinct will be developed over a 5-20-year horizon, as current leases expire.

The current master plan for the Kellicar Road Precinct envisages approximately 224,000m² GFA on the site, as summarised in the table below.

Table 1 Comparison of current and proposed yields

Land Use	Current (GFA, m ²)	Proposed (GFA, m ²)
Residential	-	143,300
Retail/ Bulky Goods	26,950	22,400
Commercial	1,400	58,300
Total	28,350	224,000

2 Existing Transport Conditions

2.1 Travel patterns

2016 Journey to work (JTW) data was analysed to understand current travel trends for people living and working in Macarthur. The data indicates that people who work in the Macarthur Precinct generally use private vehicles as a form of commute, with public transport and active transport users only making up 7% of the workforce. However, a larger proportion of residents use public transport (21%) and active transport (3%) to travel to work.

These existing travel trends for employees and residents of Macarthur are shown in Figure 3 below.

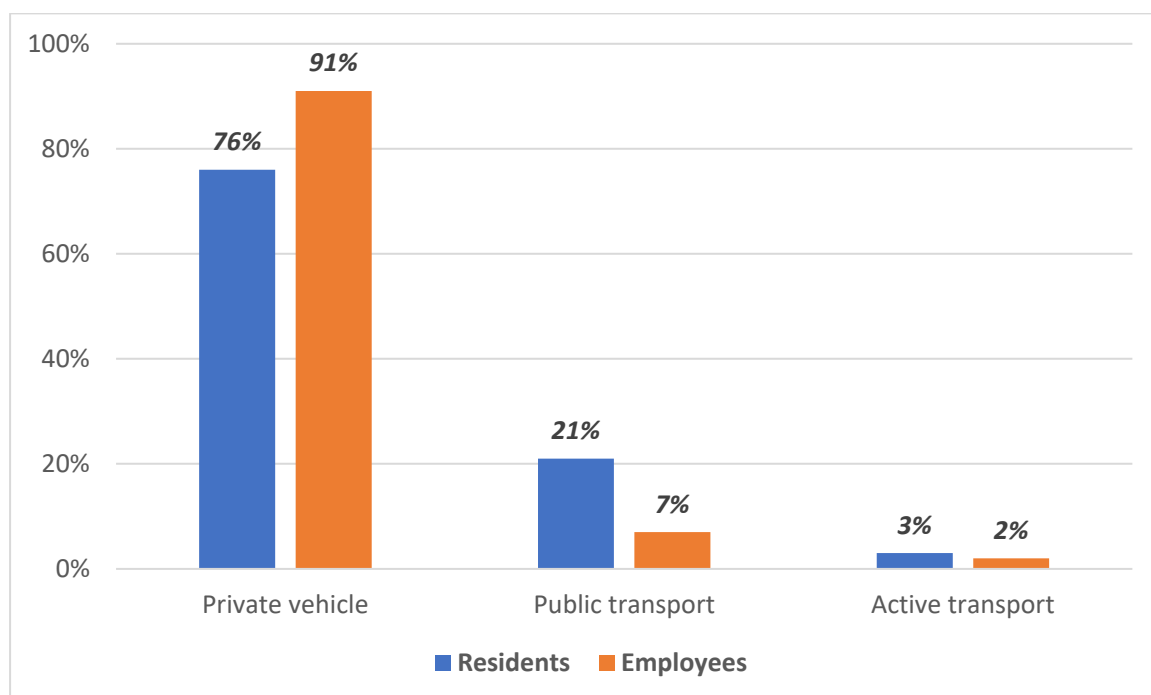


Figure 3 Existing travel patterns

2.2 Walking

Walking isochrones from the Macarthur Station are shown in Figure 4. Within the allocated walking times, the following destinations within Macarthur can be reached:

- 10 minutes: Macarthur Square Shopping Centre and the proposed Kellicar Road Precinct
- 15 minutes: Residential dwellings around Gilchrist Drive
- 20 minutes: Campbelltown Hospital

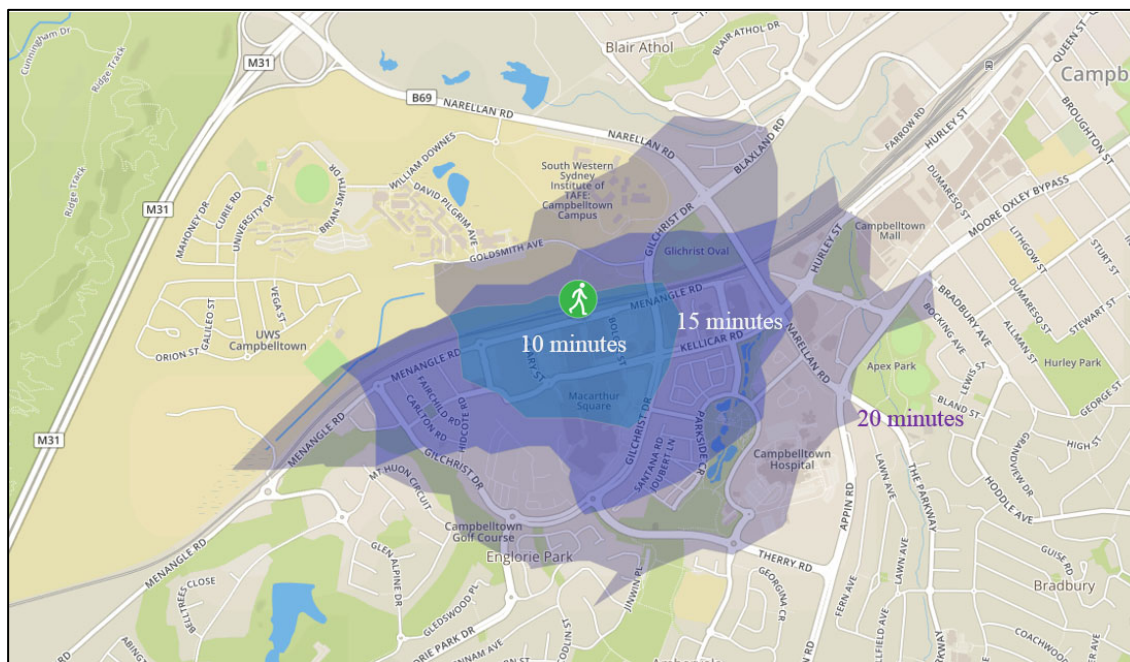


Figure 4 Walking isochrones from Macarthur Station

2.3 Cycleways

Existing cycleways in the vicinity of the precinct are illustrated in Figure 5, which include a mix of on and off road cycleways. Off-road cycleways are provided along key routes such as Kellicar Road, Gilchrist Drive and Menangle Road but are presently disjointed and not integrated as part of a city-centre network. The potential to grow and harness a city-centre active transport network is identified as a primary initiative under the Reimagining Campbelltown City Centre Master Plan.

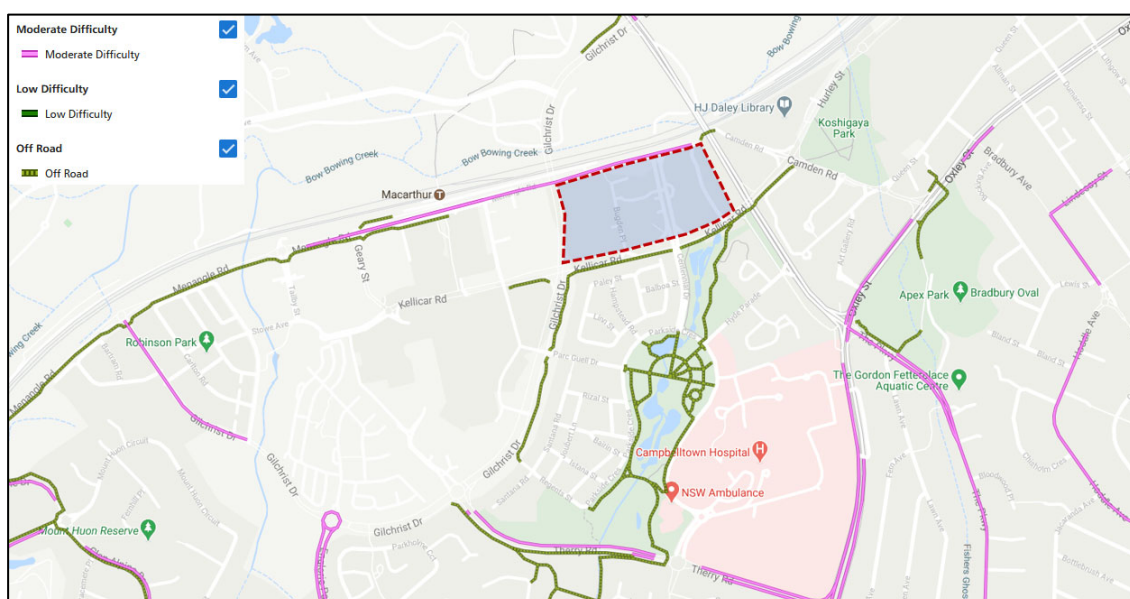


Figure 5 Existing cycleway network

2.4 Trains

Macarthur Train Station services the T2 Airport Line, T2 Inner West & South Line and the Southern Highlands Line. A number of off-street unrestricted commuter car parking spaces are located to the west of the station, and on-street parking located to the east.

The train station is wheel chair accessible with lifts and ramps provided. A kiss and ride facility is provided near the bus stops along Menangle Road, with the locations illustrated in Figure 6.

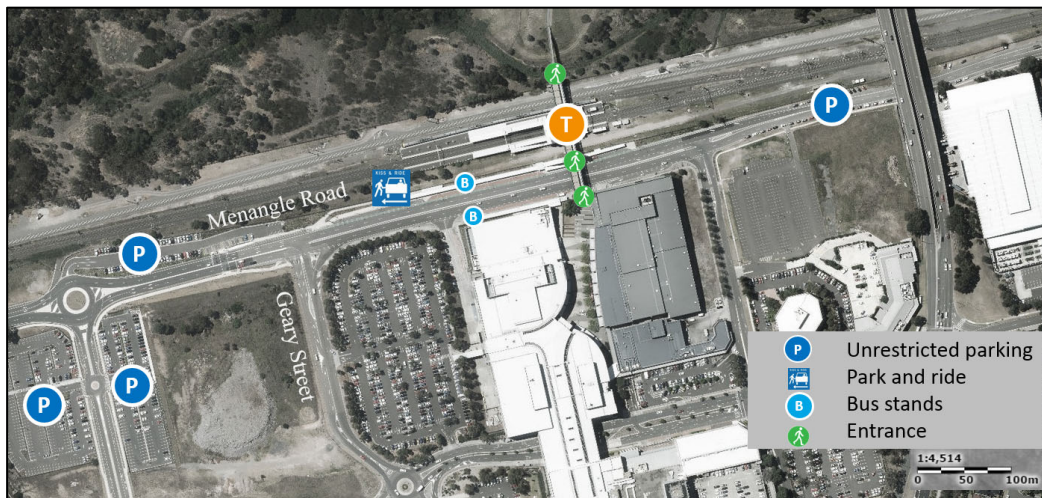


Figure 6 Train station access and facilities

2.5 Buses

Macarthur is currently served by the following bus routes

- Menangle to Campbelltown, via Macarthur (1 route)
- Wollongong to Campbelltown, via Appin and Macarthur (1 route)
- Camden to Campbelltown, via Macarthur (10 routes)
- Northbound towards Liverpool (4 routes), and
- Local buses serving e.g. Glen Alpine, Rosemeadow and Claymore (6 buses)

These routes are graphically depicted in Figure 7

Many bus routes serving Camden, northbound bus routes and local bus routes are circuitous and indirect, making for an illegible bus network. There are opportunities to improve the directness of local routes and increase bus frequencies with the increase in residential densities envisaged by the Planning Proposal and more generally by Reimagining Campbelltown. The low frequencies of these bus services, particularly outside of peak hours, are the primary limitation for increasing travel via bus.

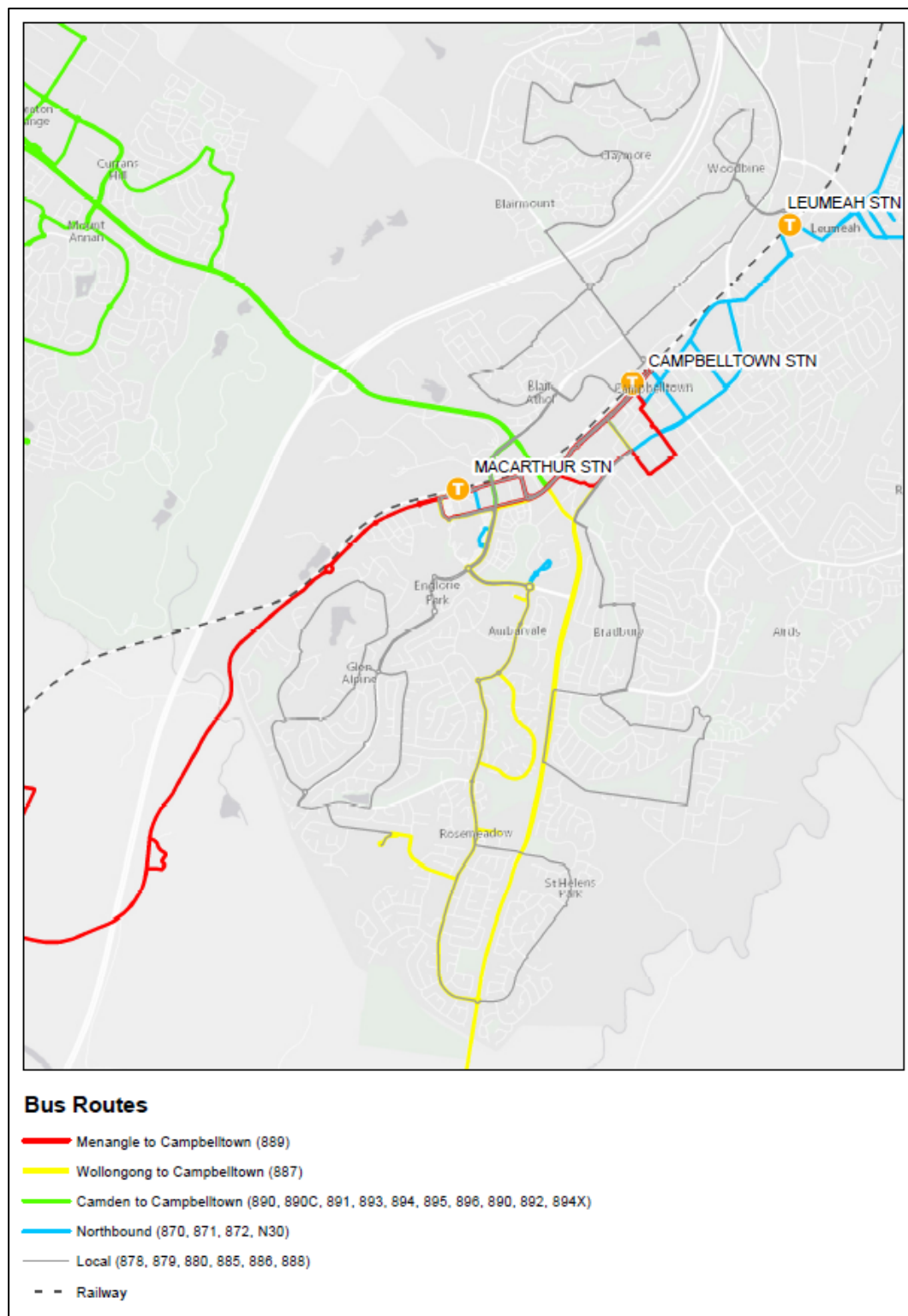


Figure 7 Bus routes serving Macarthur

2.6 Road network

To manage the extensive network of roads for which councils are responsible under the Roads Act 1993, the Roads & Maritime Services (RMS) in partnership with local government established an administrative framework of *State*, *Regional*, and *Local Road* categories.

State Roads are managed and financed by RMS and Regional and Local Roads are managed and financed by councils.

Regional Roads perform an intermediate function between the main arterial network of State Roads and council controlled Local Roads. Due to their network significance RMS provides financial assistance to councils for the management of their Regional Roads.

Key State Roads which provide access to the precinct are illustrated in Figure 8.

State Roads:

- Hume Motorway
- Narellan Road
- Menangle Road
- Oxley Street
- Appin Road
- Kellicar Road

Regional Roads

- Therry Road
- Gilchrist Drive
- Blaxland Road
- Hurley Street
- Queen Street

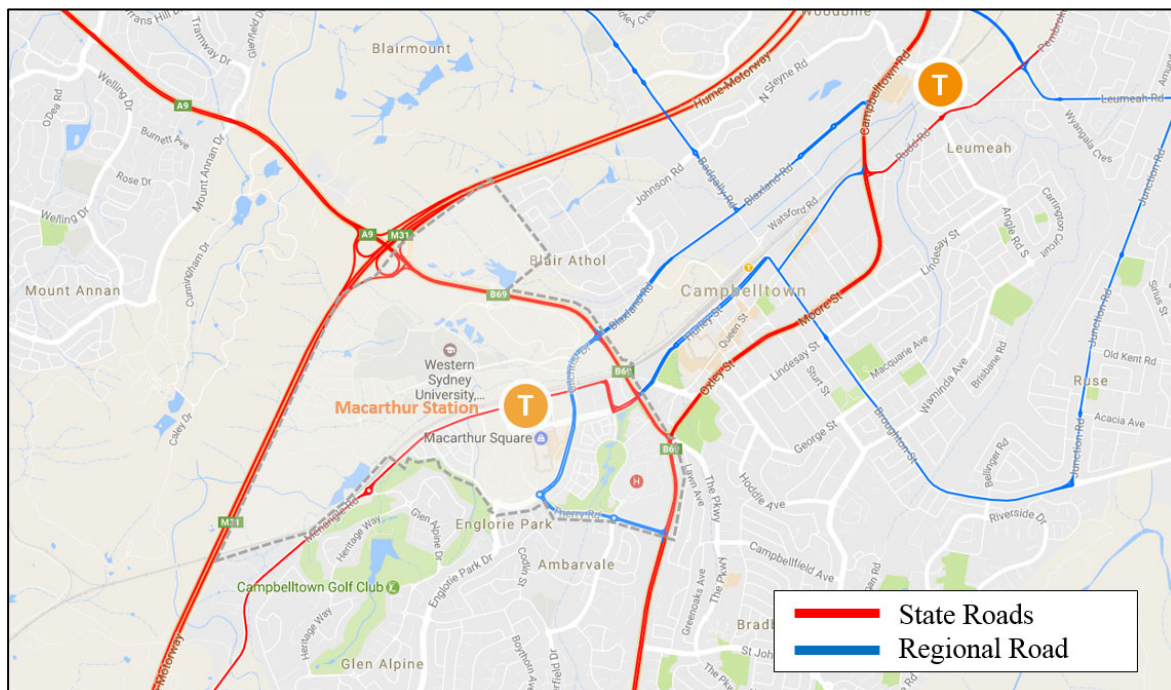


Figure 8 Key classified round around the precinct

2.7 Traffic volumes

Detailed traffic counts were undertaken to support the traffic modelling undertaken for the project. Following discussions with Council in August 2020 it was agreed that traffic counts collected both by Council and the applicant in recent years would form the basis of the existing year model. Further traffic counts have been undertaken to supplement this existing information, with all data collated together to form a reasonable set of assumptions to move forward with. Given data from different survey dates has been used, a ‘balancing’ process was undertaken which involved adjusting the traffic flows to ensure volumes at adjacent intersections (i.e. the exit flows and approach flows) match up with one another.

Table 2 Traffic count locations

Location	Survey date
Narellan Road / Blaxland Road / Gilchrist Drive	March 2017
Narellan Road / Appin Road / Oxley Street	March 2017
Kellicar Road / Narellan Road	April 2019
Kellicar Road / Tindall Street / Centennial Drive	April 2019
Kellicar Road / Gilchrist Drive	April 2019
Menangle Road / Gilchrist Drive	September 2020
Menangle Road / Geary Street	September 2020
Menangle Road / Bolger Street	September 2020
Menangle Road / Tindall Street	September 2020
Kellicar Road / Geary Street	September 2020
Kellicar Road / Bolger Street	September 2020
Kellicar Road / Centennial Drive	September 2020
Gilchrist Drive / Goldsmith Avenue	September 2020
Kellicar Road / Camden Road	September 2020
Oxley Street / Camden Road	September 2020
Existing site access points: <ul style="list-style-type: none"> - Kellicar Road / Bugden Place - Marketfair access (Kellicar Road and Menangle Road) - Bunnings exit (Menangle Road) - Tindall Street retail access 	September 2020



Figure 9 Traffic count locations – site access points

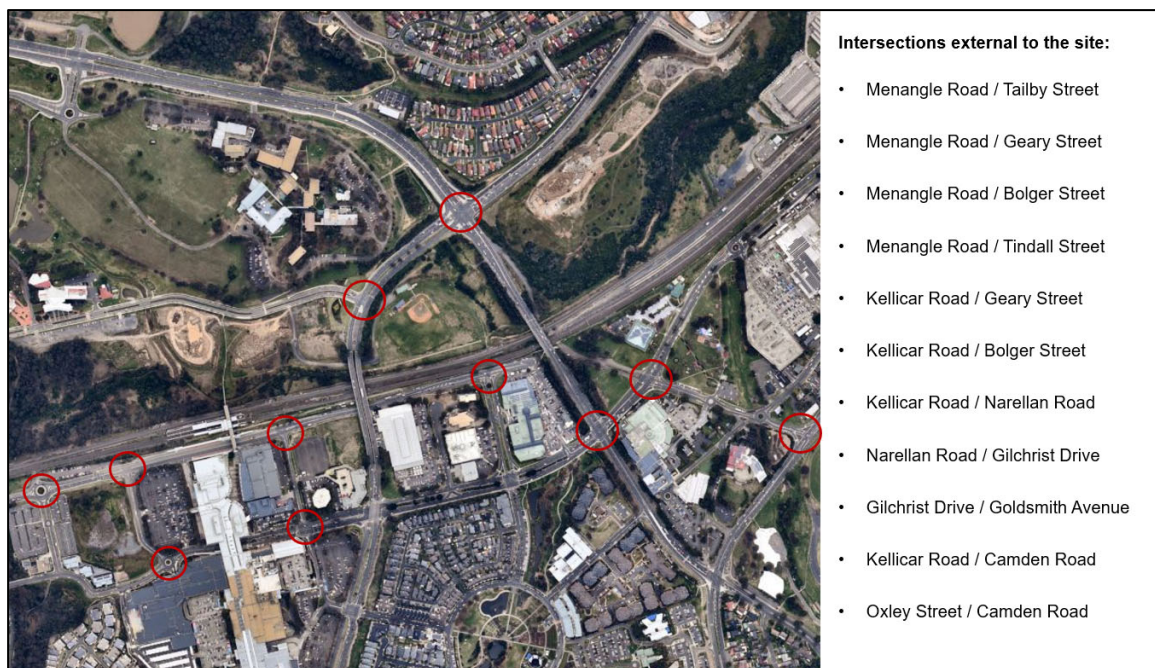


Figure 10 Traffic count locations – intersections external to the site

3 Transport Strategy

3.1 Precinct access approach

The suggested transport access strategy for the precinct is presented in Figure 11, which has been developed to meet the following key objectives:

- To establish a clear and defined street hierarchy for pedestrian and traffic movement.
- To provide a street network with a high level of amenity, safety and permeability for all users.
- To introduce Macarthur Walk as a new east-west pedestrian promenade connecting pedestrians between retail anchors and Macarthur station.
- To prioritise pedestrian amenity throughout the precinct.
- To ensure the design of the local road network can service local traffic demand.

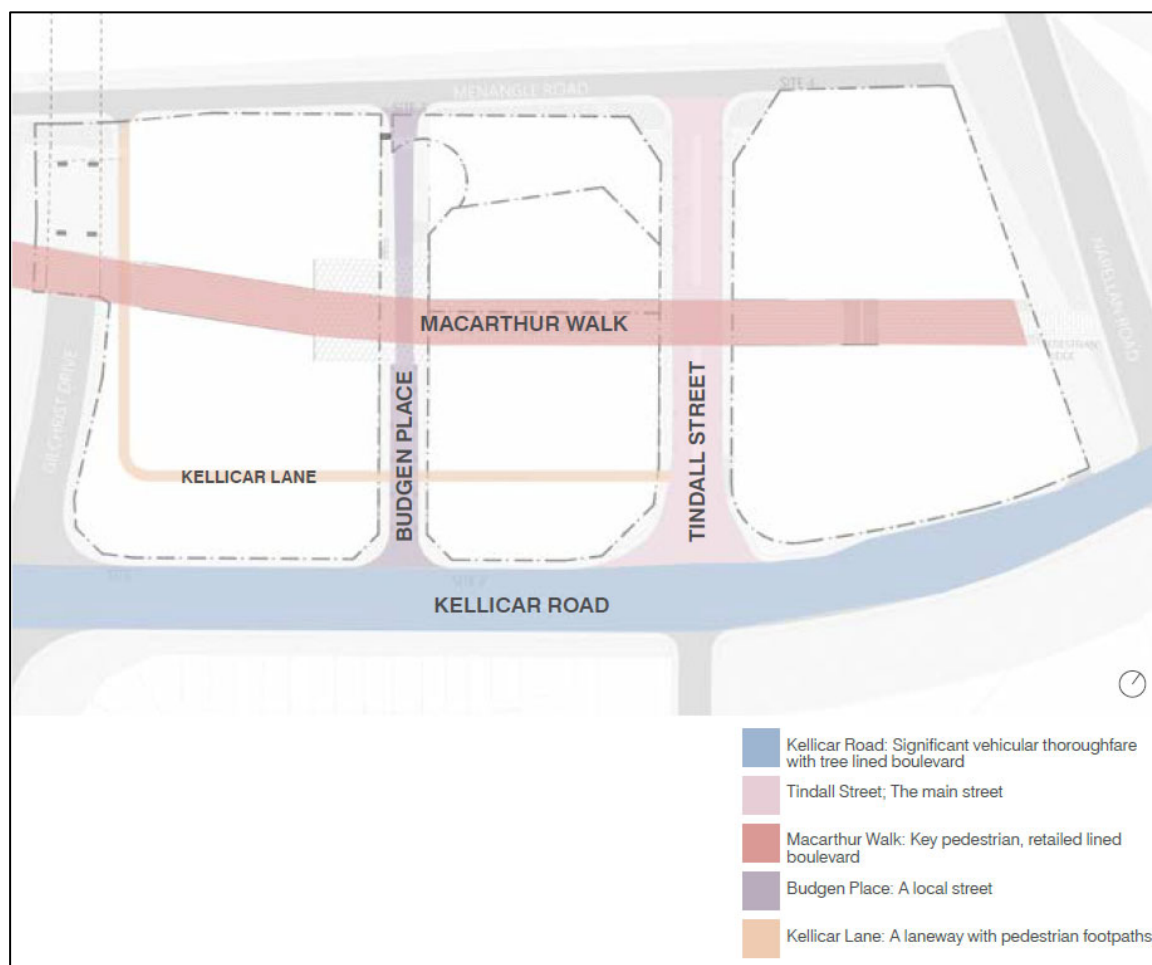


Figure 11 Precinct street hierarchy

3.2 Forecast travel trends

The proposed development will place approximately 1,600-1,800 residential dwellings within 800m of Macarthur Station and a short walk to other bus services connecting residents to nearby employment centres. Furthermore, the master plan looks to promote land use mix (introducing more commercial and retail land uses) and to improve pedestrian connectivity to Macarthur Station via the establishment of Macarthur Walk.

In considering the potential future private vehicle and public transport mode shares for the precinct, a comparison against other town centres such as Parramatta and Liverpool was conducted. This compared the proportion of residents travelling to work by either private vehicle or public transport.

The analysis (shown in Figure 12) highlights the gradual but growing trend of public transport use in precincts of Parramatta and Liverpool within a walking distance of the respective train stations. Parramatta shows the highest take up of public transport with 55% for 2011.

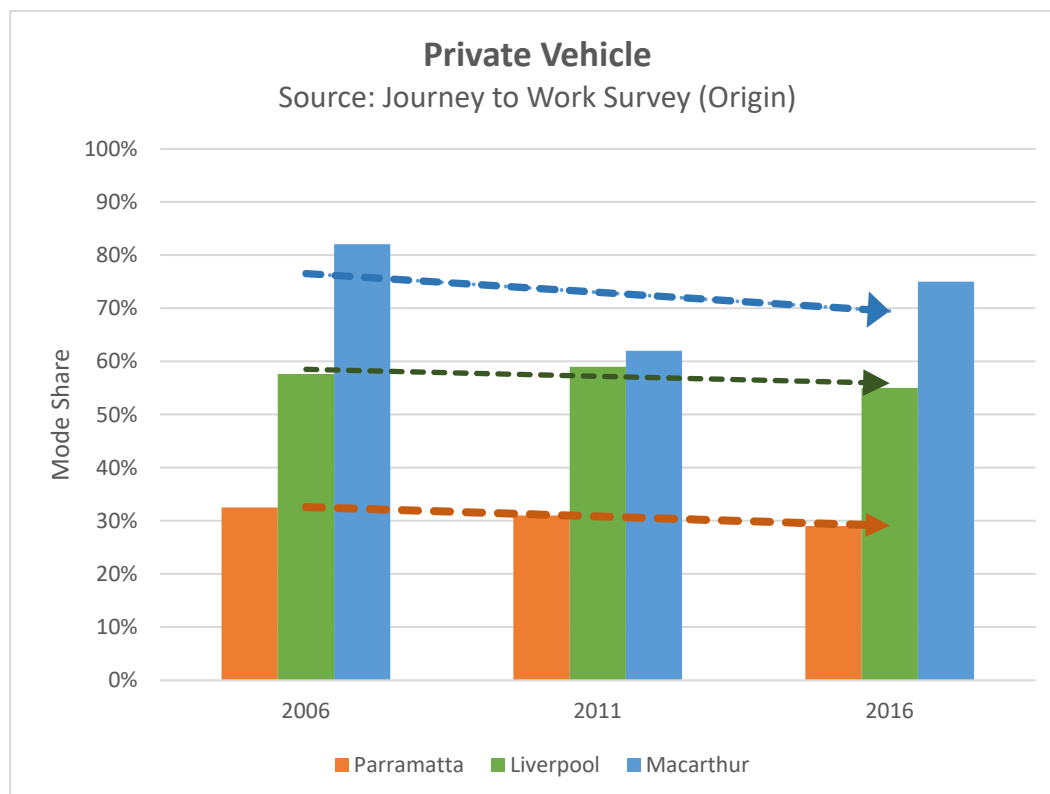


Figure 12 Private vehicle mode share comparison

Furthermore, as part of Transport for NSW's *More Trains, More Services* coordinated program, additional express train services have recently commenced which connect Macarthur with the Sydney CBD.

Taking into consideration the analysis conducted, the increased express rail services to/ from Macarthur, this development will look to target residential mode shares of 50% and 40% for private vehicles and public transport respectively. Due to the reduced parking provision to be provided within the site for commercial uses when compared to the Campbelltown DCP, as well as the site's location with respect to Macarthur Station, a reduction in vehicle mode share for workers has been assumed.

This forecast mode share for residents and employees of the Kellicar Road precinct is summarised in Figure 13.

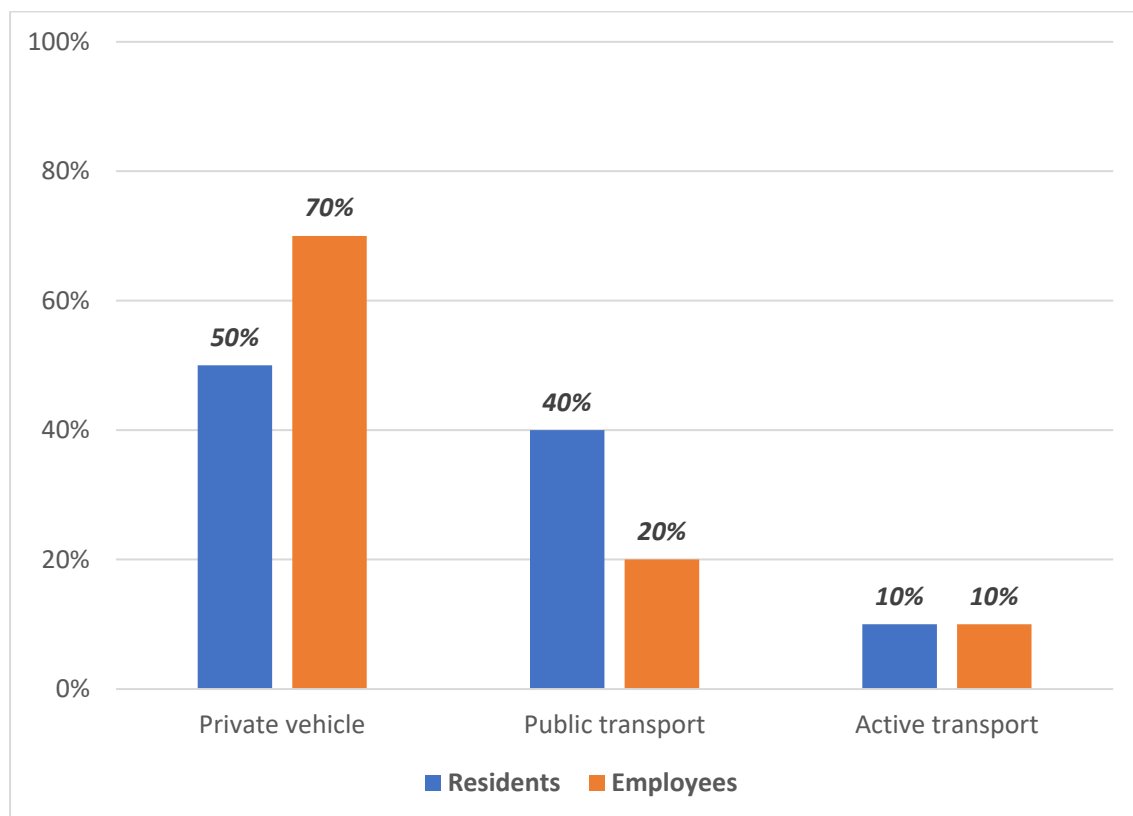


Figure 13 Forecast mode share for Kellicar Road Precinct – residential trips

3.3 Pedestrian movements

The proposal involves a significant improvement in pedestrian access and permeability in the precinct. In particular, the creation of 'Macarthur Walk', a major east-west pedestrian boulevard, will provide users of the precinct with direct access to Macarthur railway station.

With a wide (20m) east-west pedestrian spine with a signature avenue of feature trees, Macarthur Walk will provide a comfortable and convenient public link through the site away from busy surrounding roads to Macarthur Station and Macarthur Square.

Open space is also located adjacent to Menangle Road which provides a connection through the precinct as well as underneath Gilchrist Drive – providing another connection through to Macarthur Railway Station. Streets within the precinct, particularly Bugden Place and Tindall Street, would be calmed compared to their current function which will provide a more amenable pedestrian environment. The public domain plan for the Kellicar Road Precinct is illustrated in Figure 14 below.

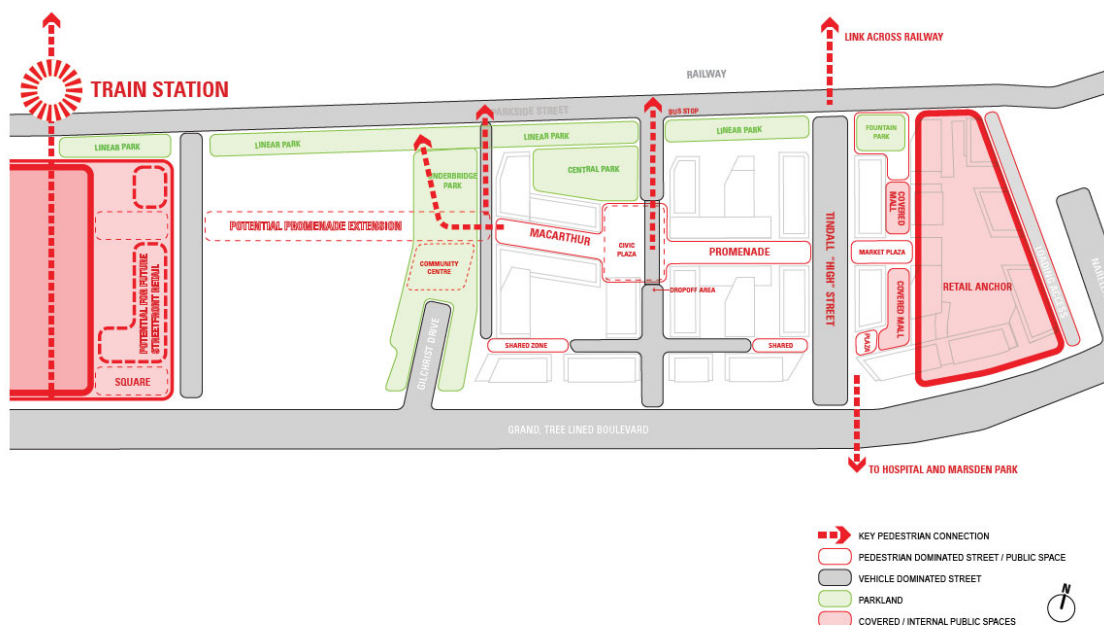


Figure 14 Public domain plan – Kellicar Road Precinct

As planning for the Campbelltown-Macarthur city centre continues, additional opportunities for enhanced pedestrian links will be explored. These will include pedestrian and cycle connections across the railway line as well as links through to the Campbelltown CBD.

3.4 Vehicle access

The strategy with regards to managing vehicle access within the precinct is presented in Figure 15 below, and includes:

- Retention of the existing vehicle access via Kellicar Road into Site 4
- Retention of existing vehicle access via Menangle Road into Site 4
- Provision of vehicle access points into Sites 1, 2 and 3 via internal streets within the precinct to reduce traffic impacts on main roads.

More detailed vehicle access arrangements would be documented at a development application stage, however the following key principles are applicable to the future development of the precinct:

- Ensure the location, size and design of vehicle access minimises disruption of traffic on public roads.
- Ensure access points are appropriately sized to accommodate the design vehicle including for waste collection and building servicing/loading.
- Vehicle access points to be located to minimise pedestrian conflicts, support the reduction of private vehicle dependency and to encourage the use of sustainable transport.
- Vehicle access points to minimise impacts on streetscape and amenity and to maintain an active ground floor frontage to primary streets.

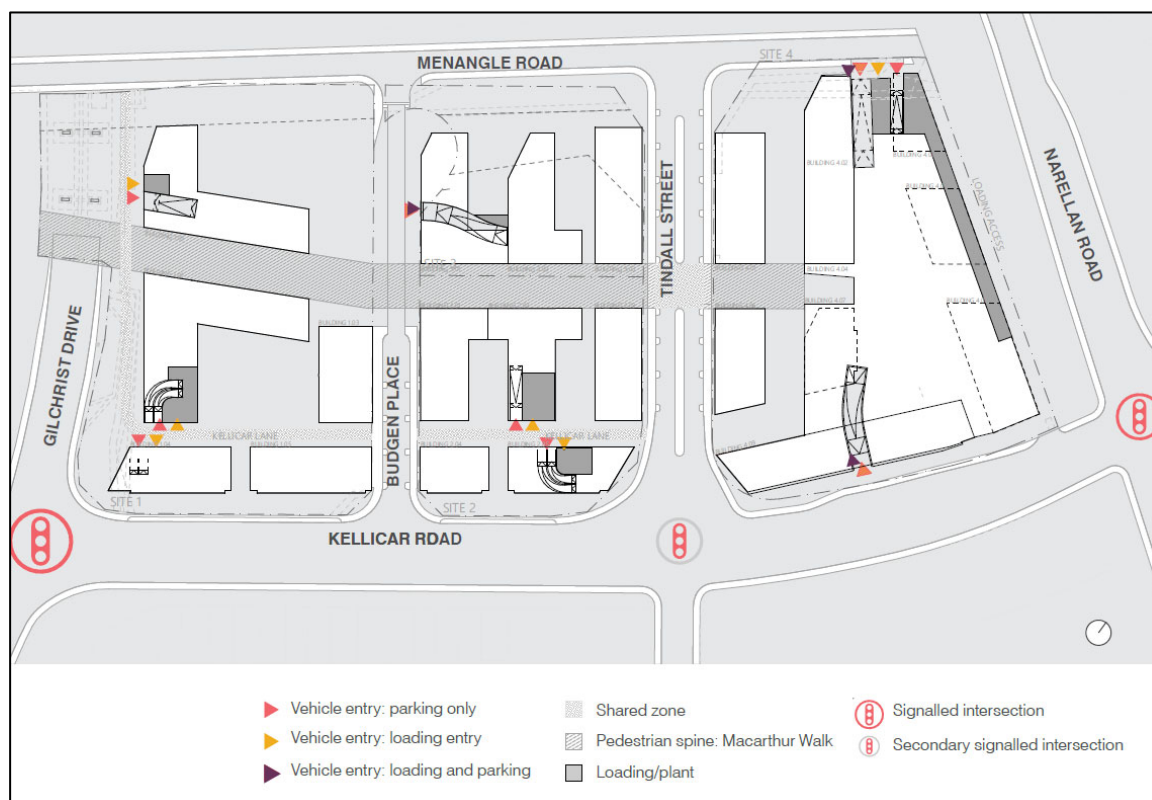


Figure 15 Vehicle access strategy

3.5 Car parking

3.5.1 Off-street car parking

It is important to note that the supply of on-site parking will have an influencing factor on traffic generation for all uses within the precinct – particularly the commercial and retail uses. Based on transport data collected by Transport for NSW for eight sites across Sydney, Figure 16 below provides an illustration of how car driver mode share for commercial uses has a direct correlation with the on-site parking rate.

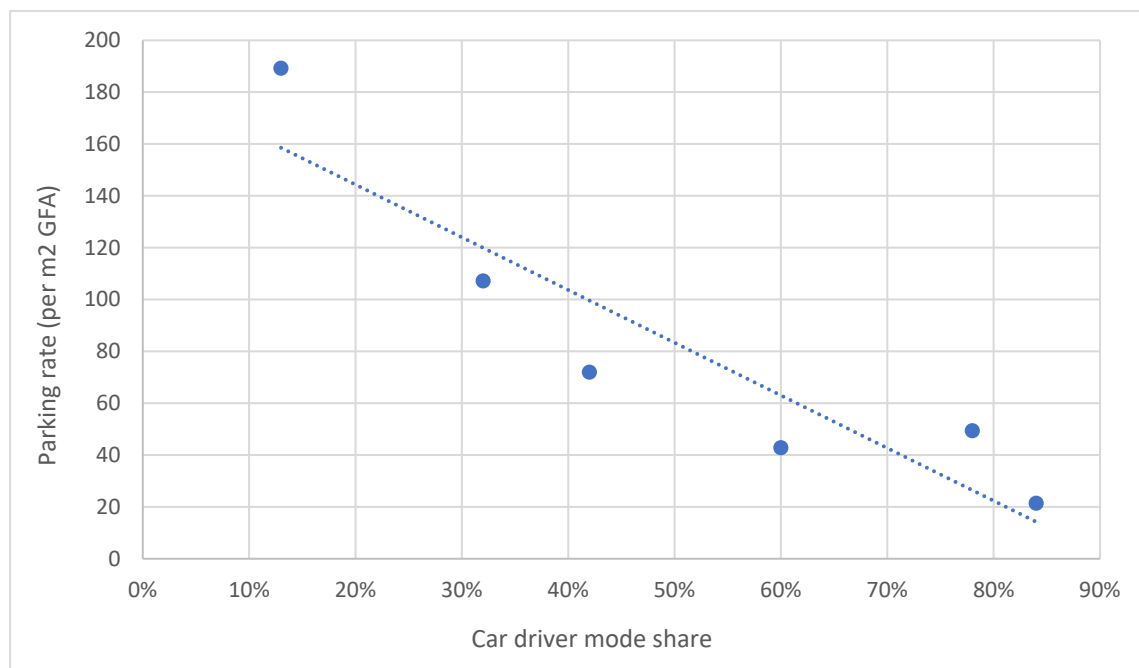


Figure 16 Relationship between car parking provision and car usage (commercial land uses)

Data source: Transport for NSW

Furthermore it is common that in large renewal precincts containing a mix of different uses and with good public transport access that parking rates are reduced when compared to the generic DCP rates. This reduction in car parking recognises the ability for parking to be shared between different uses as well as achieving the objective of minimising traffic impacts arising from the proposal. A recent example of lower parking rates in place for a major new development is within the Warrick Lane Precinct in the Blacktown CBD.

Accordingly, it is proposed that parking be generally constrained, but with reasonable regard for user behaviour, to promote the use of other modes of transport and to reduce the traffic impact of the development. Off-street parking rates for uses within the Kellicar Road precinct have been developed based on:

- A review of existing parking controls for Campbelltown Council and other adjoining LGAs
- The objective of minimising traffic impacts arising from the development and recognising the potential higher mode share for public transport, walking and cycling
- The proposed mix of uses within the Kellicar Road precinct which allow for the potential for trip containment and trip sharing – i.e. the combination of multiple trip purposes/destinations within the one journey and reduced overall trip length
- The strong public transport access available to the site

A summary of the maximum car parking rates for the precinct, as well as a comparison of the parking rates for Campbelltown, Liverpool and Parramatta are shown in Table 3.

Table 3 Proposed maximum car parking rates

Land Use	Parking Rates			
	Campbelltown DCP	Liverpool DCP	Parramatta DCP	Proposed Rates for Kellicar Road Precinct
Commercial	1 space per 25m ² GFA	1 space per 35m ² GFA	1 space per 70m ² GFA	1 space per 70m ² GFA
Retail	1 space per 25m ² GFA	1 space per 25m ² GFA	1 space per 60m ² GFA	1 space per 40m ² GFA
Residential	1.25 spaces / dwelling	<ul style="list-style-type: none"> • 1 space per 1 bedroom • 1.5 space per 2 bedroom • 2 spaces per 3 bedroom or more 	<ul style="list-style-type: none"> • 0.6 spaces per studio • 0.75 spaces per 1 bedroom • 1 spaces per 2 bedroom • 1.5 spaces per 3 bedroom 	<ul style="list-style-type: none"> • 0.5 spaces per studio or 1 bedroom • 1.2 spaces per 2 bedroom • 1.8 spaces per 3 bedroom or more
Residential Visitors	1 space per 10 dwellings	1 space per 4 dwellings	1 space per 4 dwellings	1 space per 10 dwellings
Other uses				To be justified in a transport and parking study, with reference to parking rates contained in the Campbelltown City (Sustainable City) DCP 2015

Over time, given the development of the precinct will take place over a number of years, it may be possible to reduce car parking provision as the use of public transport (including the opening of the new metro station) increases and private car use changes. The maximum parking rates proposed provide flexibility in allowing reduced parking rates in future once new public transport services come on line.

3.5.2 On-street car parking

The master plan has made provision for some short term on-street car parking to be provided along Tindall Street and Bugden Place. This on-street parking will be utilised by visitors to the residential sites, as well as those accessing other uses such as retail. On-street parking can be beneficial to the precinct by stimulating street activity, managing speed by providing side friction, and can contribute to passive surveillance.

Time limited parking is proposed to prevent all day parking in the precinct. A mix of 1, 2 and 4 hour time limited parking would be appropriate, depending on the location with respect to different uses. On-street areas would also be used to accommodate:

- Disabled parking
- Car share spaces
- Vehicle drop off including on-demand transport and taxis
- Loading zones

3.5.3 Car share

Car share spaces would be provided within the precinct to enable those without access to a car to travel via private vehicle when it is the most appropriate means of transport, whilst still relying on public transport, walking and cycling for the majority of their trips. Car share spaces would be provided in on street areas within the precinct and within building basements to be accessible for all users. Typical practice is to provide one car share space for every 50-100 residential dwellings, dependent on interest from car share operators. The final number to be provided will be detailed in subsequent development applications to be lodged for buildings within Kellicar Road Precinct.

3.5.4 Bicycle parking

Bicycle parking will be provided both within individual development parcels, as well as the public domain, to increase travel by bicycle and reduce car dependence. As a minimum, each residential development will provide for secure bicycle parking for 20% of residents, which aligns with the recommended rate in the *NSW Planning Guidelines for Walking and Cycling*.

Visitor bicycle parking will also be provided in the public domain and will support a number of local and regional cycle connections within the precinct.

3.6 Future transport infrastructure and trends

There are a number of planned pieces of transport infrastructure that will positively influence traffic patterns in the vicinity of the Kellicar Road Precinct. These projects have the potential to significantly improve access by public transport as well as reduce the extent of regional traffic movements through the Campbelltown-Macarthur CBD. These projects include the following:

Outer Sydney Orbital

Transport for NSW is identifying land for the Outer Sydney Orbital corridor which would provide for a future north south motorway and freight rail line. Provision of this future road link has the potential to significantly reduce regional traffic movements on local roads in the Campbelltown-Macarthur CBD.

North-South rail line

Transport for NSW proposes to protect the recommended North South Rail Line corridor to connect the T1 Western Line near St Marys and T8 South Line near Macarthur via the Western Sydney Airport (WSA). This rail line would significantly enhance public transport access to the Campbelltown-Macarthur CBD and reduce the reliance on private vehicle travel by providing high capacity rail connectivity to key areas of Western Sydney.

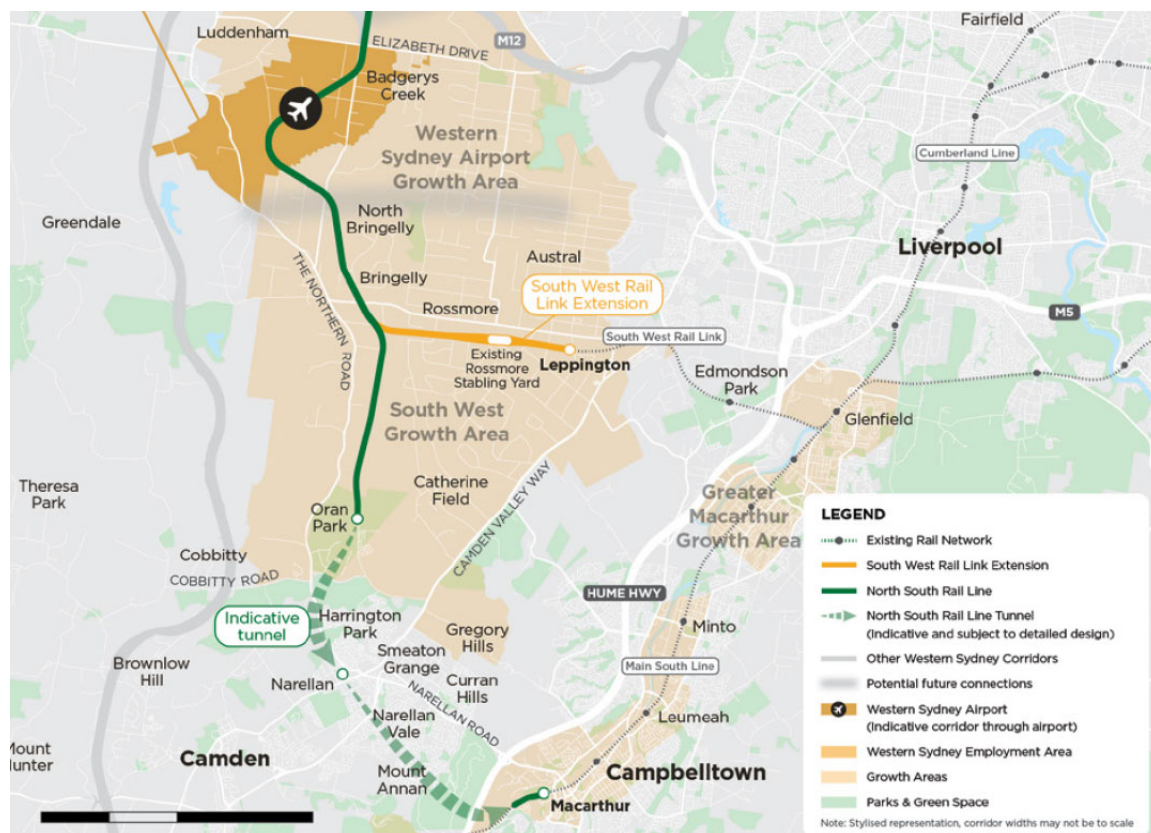


Figure 17 Recommended future rail corridors

Source: Transport for NSW, 2020

Spring Farm Parkway

Spring Farm Parkway would ultimately provide a connection between Camden Bypass, the Hume Motorway and Menangle Road to provide an east-west link that would service existing and future residential land releases and support the Greater Macarthur Growth Area. By providing on/off ramps to the Hume Highway at Menangle Road, it would reduce the number of vehicles entering the local road network within Macarthur.

Transport Trends

It is important to recognise that the Kellicar Precinct will likely be developed over a 5-20-year horizon. Therefore by the time the precinct is redeveloped there will be significant changes in transport technologies that will influence how people travel. In particular the automation of transport services, specifically shared autonomous vehicles and Mobility as a Service (MaaS)¹, has the potential to influence travel behaviours and reduce dependence on privately owned vehicles.

Furthermore, the potential connection of Campbelltown-Macarthur to the Western Sydney Airport via the North South Rail and improved bus services to and from Campbelltown-Macarthur will, over this period, result in a gradual shift in travel preferences to public transport. The degree of this modal shift is difficult to predict but ultimately is a goal for the whole of the Campbelltown-Macarthur city centre and, of course, the Kellicar Road Precinct. Modal shift can be driven by a range of factors including consumer choice, transport pricing, petrol or road user charges, vehicle registration costs and/or enhanced services. Building design and inclusions can also influence consumer choice and behaviour, e.g. by limiting the number of car parking spaces available to residents and workers.

Reimagining Campbelltown Initiatives

Unlocking access to and improving connectivity within the Campbelltown city centre (encompassing Leumeah and Macarthur) are recognised as key challenges by the recently adopted Reimagining Campbelltown City Centre Master Plan.

Foundation studies for a healthy streets strategy and a place-based integrated transport strategy, inter alia, are identified as key 'next steps', to be pursued in collaboration with the Greater Sydney Commission and state agencies.

The Kellicar Road Planning Proposal is consistent with the overall aims of the Reimagining Campbelltown initiative to improve pedestrian permeability in the city centre and to reduce dependency on private transport usage.

¹ MaaS combines mobility services from public transport, point to point transport vehicles, car rental and car/bicycle sharing under a single platform that is accessible from a smart device

3.7 Encouraging mode shift

The Planning Proposal involves a suite of measures to encourage a mode shift away from private vehicle towards travel by public transport, walking and cycling. These initiatives include:

- Provision of a high quality public domain including the creation of 'Macarthur Walk' - a wide (20m) east-west pedestrian spine which will provide connections to Macarthur Station and Macarthur Square.
- Improved pedestrian connections through to Macarthur Station to support access by public transport
- A truly mixed use development which will allow residents and workers convenient access to shops and services, rather than relying on driving to nearby areas to undertake these tasks
- Provision of maximum car parking rates (rather than minimums as specified in Council's DCP)
- Bicycle parking to be provided as part of future development on the site, including within the public domain to support visitor trips
- Car share spaces to be provided within the precinct for use by residents as well as members of the public
- Development of site specific 'Green Travel Plans' for each development application lodged on the site
- Locating vehicle access points with the objective of minimising pedestrian conflicts and complementing the surrounding streetscape and amenity to maintain an active ground floor frontage.

In addition to the above, the following measures are identified in the Reimagining Campbelltown City Centre Master Plan and other documents/strategies to improve connectivity and transport services within the city centre, to be delivered by others:

- The delivery (by others) of the connection of the Western Sydney airport rail line to Macarthur
- Reconsideration the road network hierarchy in the vicinity of the precinct, including downgrading the traffic function of Menangle Road (east of Gilchrist Drive) and creating a corridor which services both active transport (walking / cycling) and public transport
- An intermediate public transport corridor for Gilchrist Drive as part of the Greater Macarthur Investigation Area
- Additional pedestrian connections across the heavy rail line to better link the northern and southern parts of the precinct
- Improvement of the directness and frequency of local bus routes servicing the precinct. This may become more viable with the increase in higher density residential and commercial land uses

4 Detailed Traffic Assessment

4.1 Purpose

Whilst an overall aim for the city centre is to increase the level of active and public transport utilisation, it is imperative that planning for the Kellicar Road Precinct is cognisant of current travel behaviours and traffic levels. It is necessary therefore to ensure that the traffic generated by the project can be accommodated without worsening local traffic conditions and without compromising other development opportunity in the city centre.

Accordingly, and in reference to the recommendation of the Gateway Determination for the rezoning of the Kellicar Road Precinct, detailed micro-simulation traffic modelling (using the Aimsun software package) has been undertaken that considers the impacts of the proposal on the surrounding road network. The purpose of the traffic modelling is to provide an understanding of the road and transport infrastructure upgrades needed to support the Planning Proposal, including identification of transport network upgrades required to mitigate the traffic impacts of the scheme.

A key objective of the investigations undertaken by this report is to ensure that the function of the city centre is not compromised by the project and that future development is not sterilised as a result of the proposal.

The modelling has been undertaken in close consultation with Campbelltown City Council, including the sharing of relevant transport data and strategic modelling outputs to inform the overall assessment.

4.2 Methodology

An overview of the process undertaken for the traffic modelling is summarised below, and described in detail in the following sections:

- Development of a 'base year' micro-simulation traffic model which is reflective of existing traffic conditions in the precinct surrounding the site
- Working collaboratively with Council to obtain strategic modelling outputs which forecast the changes in traffic movements in the study area due to future development and the advent of future infrastructure projects (e.g. Spring Farm Parkway)
- Development of a 'future year' traffic model which considers the operation of the road network, both with and without the Kellicar Road Precinct rezoning
- Using the future year traffic model, identification of short, medium and long term traffic solutions for the precinct, with the aim of not sterilising future opportunity elsewhere in the city centre. These upgrades aim to ensure that the road network will operate at a similar level to that which would have occurred had the Planning Proposal not proceeded.

4.3 Traffic model extents

The extent of the traffic model is shown in Figure 18, with these extents confirmed following consultation with Campbelltown Council. This was based on an initial estimate of traffic generation and its first principles traffic distribution, with the extents determined by adequate dispersal of the volumes amongst existing background traffic. The model covers all key roads in the precinct including Kellicar Road, Menangle Road, Narellan Road and Gilchrist Drive.

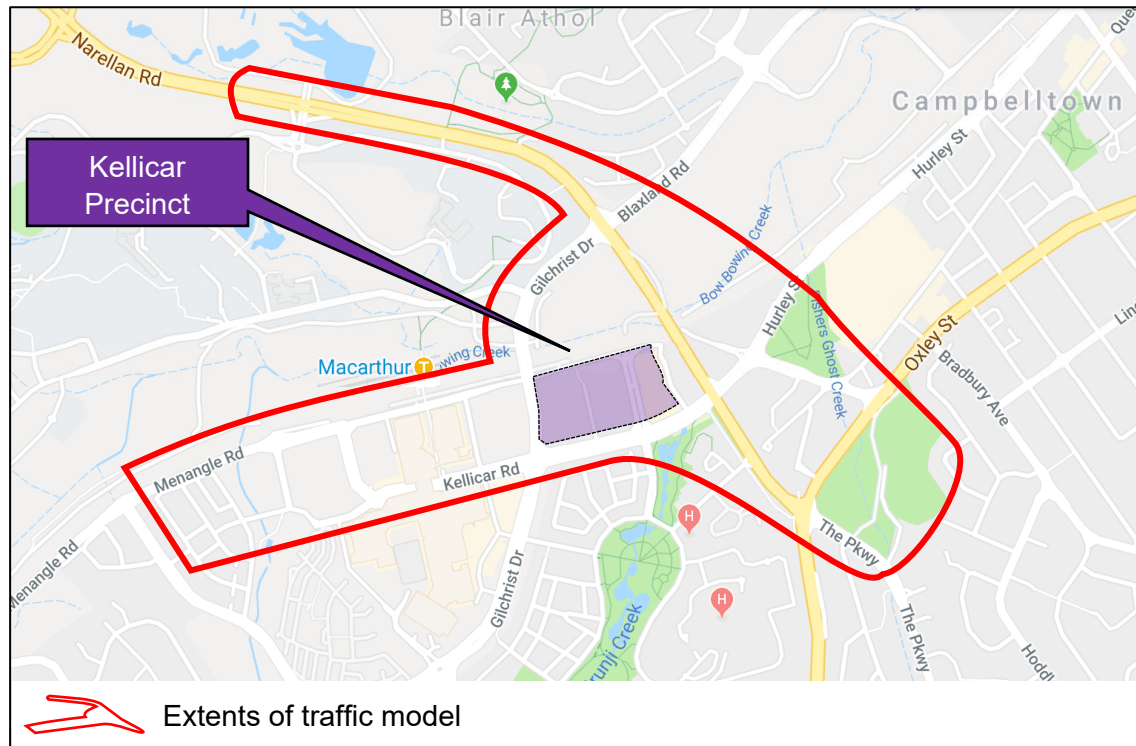


Figure 18 Traffic model extents

4.4 Base year traffic model

4.4.1 Model development

The base year traffic model layout is shown in Figure 19 below. The following information was used in the development of the model:

- SCATS history files (previously IDM data) to understand the traffic signal phasing and phase times in operation at the intersections controlled by traffic lights
- Lx files (provided by Transport for NSW) to understand adaptive SCATS behaviour
- Nearmap aerial imagery to confirm lane configurations / intersection layouts, supplemented by site visits and google street view.



Figure 19 Aimsun traffic model layout

4.4.2 Base model demand matrices development

General traffic demand matrices (LV + HV) for the Base 2019 model were developed for all travel zones for the respective peak periods. These matrices were then used as demand input in the model. The matrix development process is summarised as follows:

- Traffic counts were extracted for each peak hour from survey data to develop network diagrams.
- Manual adjustments were made to adjust illogical values and to balance the network diagrams.
- The OD matrix was developed manually from the balanced traffic counts by splitting the vehicles at each link as per the turn split percentages. This was then further adjusted manually to ensure the turn splits are close to the balanced network.
- All hourly matrices (light and heavy vehicles) were divided into 15-minutes time slices based on the 15 minute traffic flow profiles obtained from turn count surveys.

4.4.3 Signal timings

Signal times from the May 2019 SCATS signals timing data was utilised, with the base model adopting actuated signal timings. 2019 data was considered the most appropriate to use given the effects of the COVID-19 pandemic on general traffic movements in the area at the time of the development of the base year traffic model.

4.4.4 Data collection

The process for traffic data collection was previously document in Section 2.7 of this study. The resultant traffic volumes for the AM peak hour (8am – 9am) and PM peak hour (4.45pm – 5.45pm) are presented in Figure 20 and Figure 21 respectively on the following pages.

Scenario: 2020 Base

Vehicles: Lights

Intersection Control

Side Road/Zone

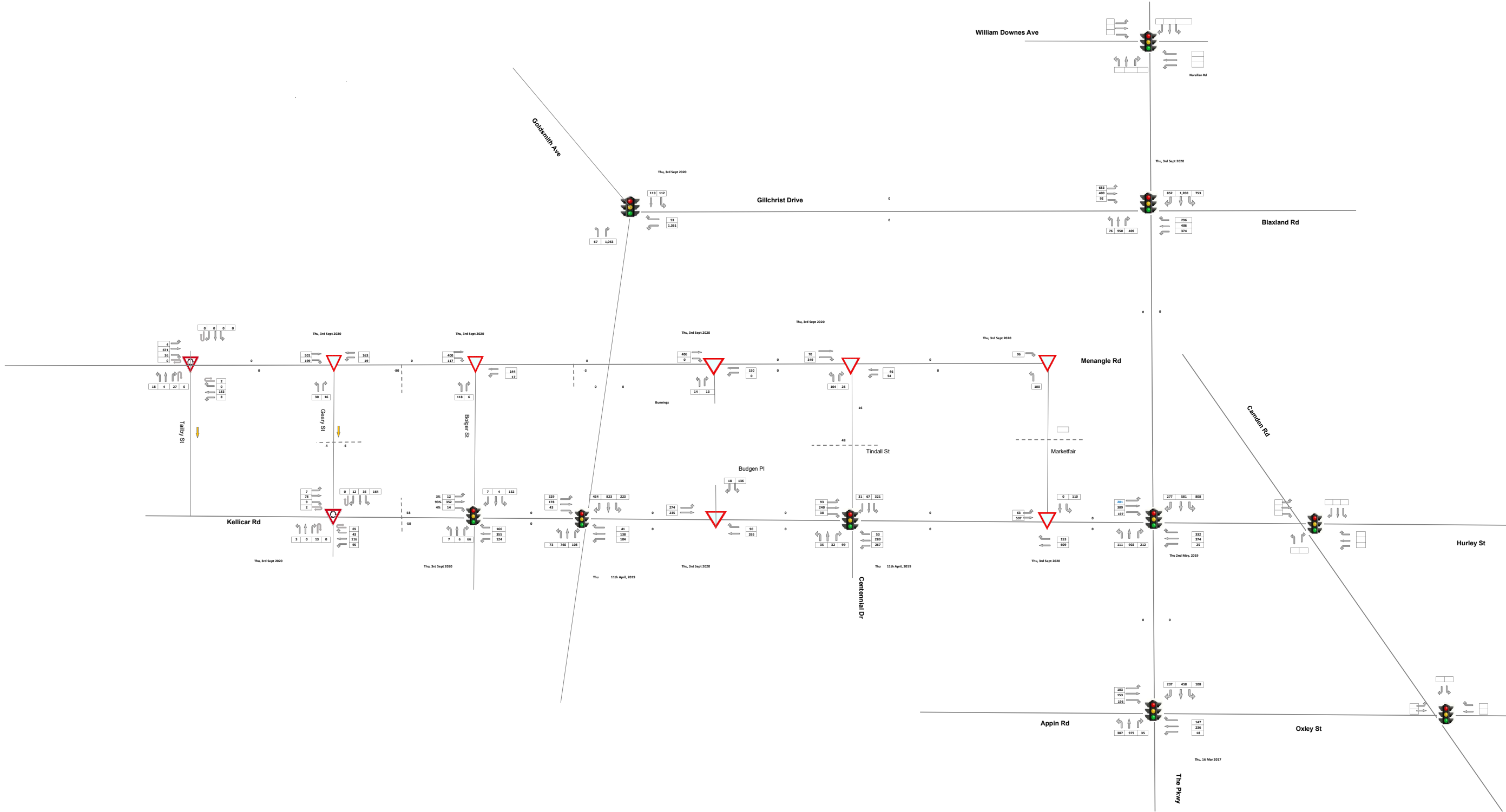
Signal

Give way

Roundabout

AM Peak: 0:00-0:05

PM Peak: 0:45-0:45



Scenario: 2025/26

Visuals: Lights

Legend

Blue Road/Close

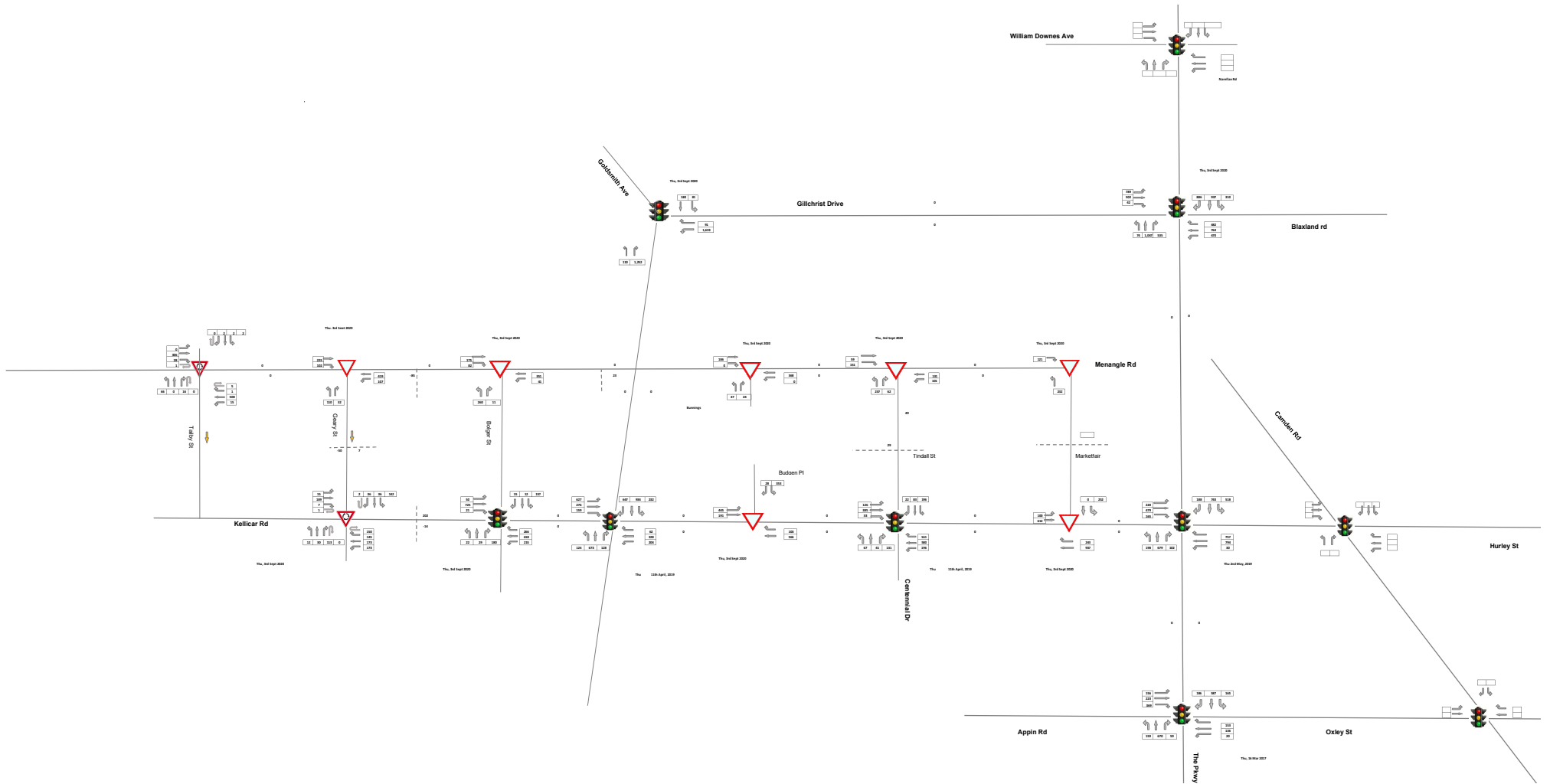
Signal

Start way

Roundabout

2025/26

2025/26



4.4.5 Model calibration

The Geoffrey E. Havers Statistic (GEH statistic) is a comparison factor between observed and modelled traffic counts, which allows the difference to be compared regardless of the total size of the count. It is expressed as:

$$GEH = \sqrt{\frac{2(M - C)^2}{M + C}}$$

Where M is the modelled count and C is the observed count.

The *RMS Modelling Guidelines* require the modelled counts to resemble the observed counts based on the GEH statistic in order for the model to be considered “calibrated”. In calibrating turn counts, the *Guidelines* require that:

- 100% of all turning counts have a GEH less than 10; and
- 85% of all turning counts have a GEH less than 5.

The performance of the models in relation to the RMS Modelling Guidelines calibration requirements is summarised below in Table 4. Detailed data relating to the model calibration is provided as Appendix A of this document.

Table 4 Turn count calibration summary

Criteria	AM Peak Hour	PM Peak Hour
GEH <10	100%	100%
GEH <5	91%	86%

As demonstrated by the above table, the models meet the RMS calibration requirements and thus sufficiently reproduce the turning movements as observed.

All turns included in the calibration process are visualised via a modelled vs. observed plot in Figure 22 and Figure 23, along with the tolerance limits boundary curves. Additionally, in regards to the calibration it should be noted that the R² of the line of best fit is 0.991 and 0.986 in the AM and PM peaks respectively, in excess of the 0.95 R² required by the *RMS Modelling Guidelines*;

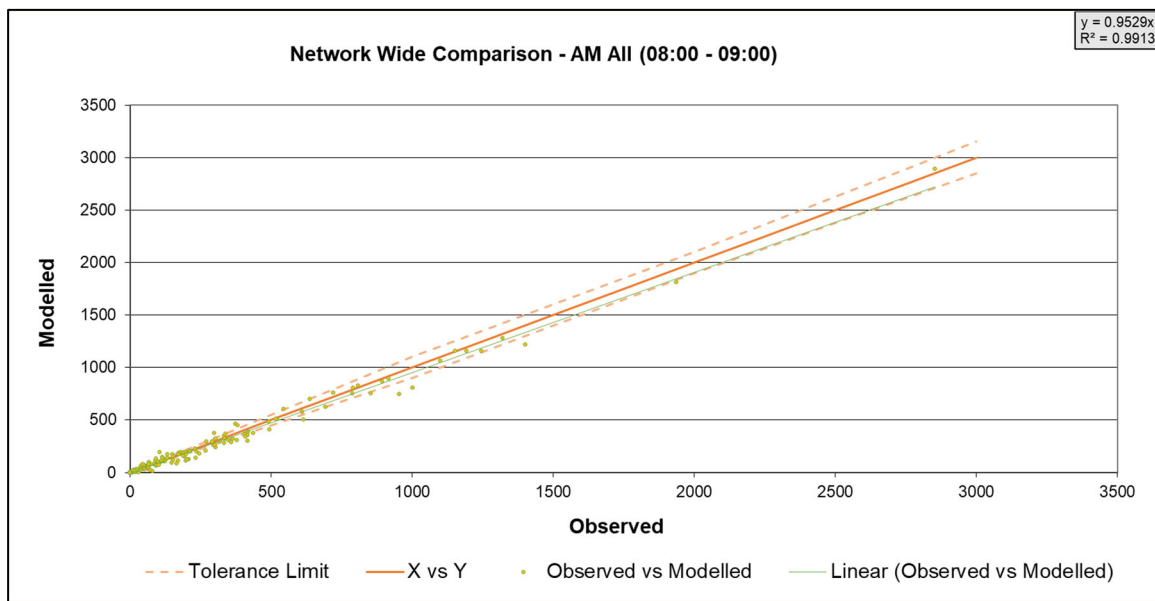


Figure 22 AM Turning Calibration: Modelled vs. Observed Count

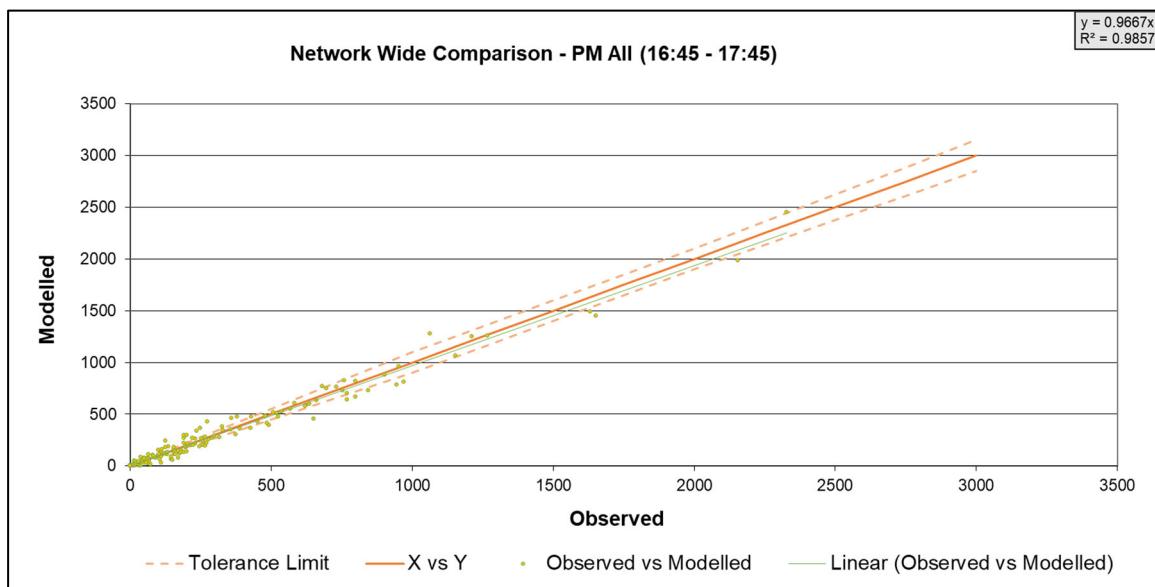


Figure 23 PM Turn Movement Calibration: Modelled vs. Observed Count

4.4.6 Model validation

Model validation was undertaken by using historical TomTom data from 2019 to understand typical travel times on Narellan Road (between Willow Downes Avenue and Oxley Street) and Kellicar Road (between Geary Street and Narellan Road).

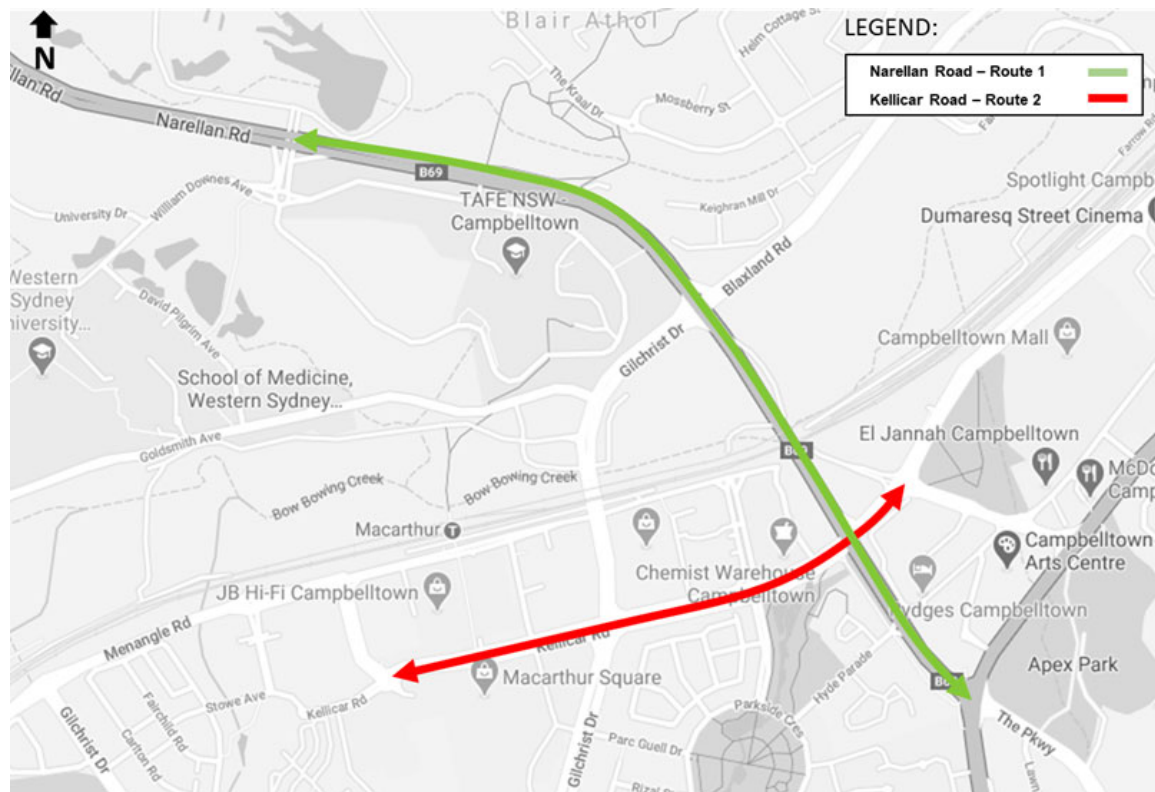


Figure 24 Travel time validation routes

The RMS Modelling Guidelines consider modelled travel times to be validated based on the following criteria (Table 11.5, page 108):

- Average Journey Time: the modelled average journey time to be within 15% or 1 minute (whichever is greater) of the observed average journey time.
- Average Section Time: the modelled average section time to be within 15% of the observed average section time, for individual sections

The observed journey travel times and their associated validation criteria in the AM Peak and PM Peak are detailed and compared with the average modelled journey times in Figure 25 through to Figure 32 for both Narellan Road and Kellicar Road. As evidenced in these figures, overall the model replicates acceptable journey times through the study area in both peak hours along both key road corridors.

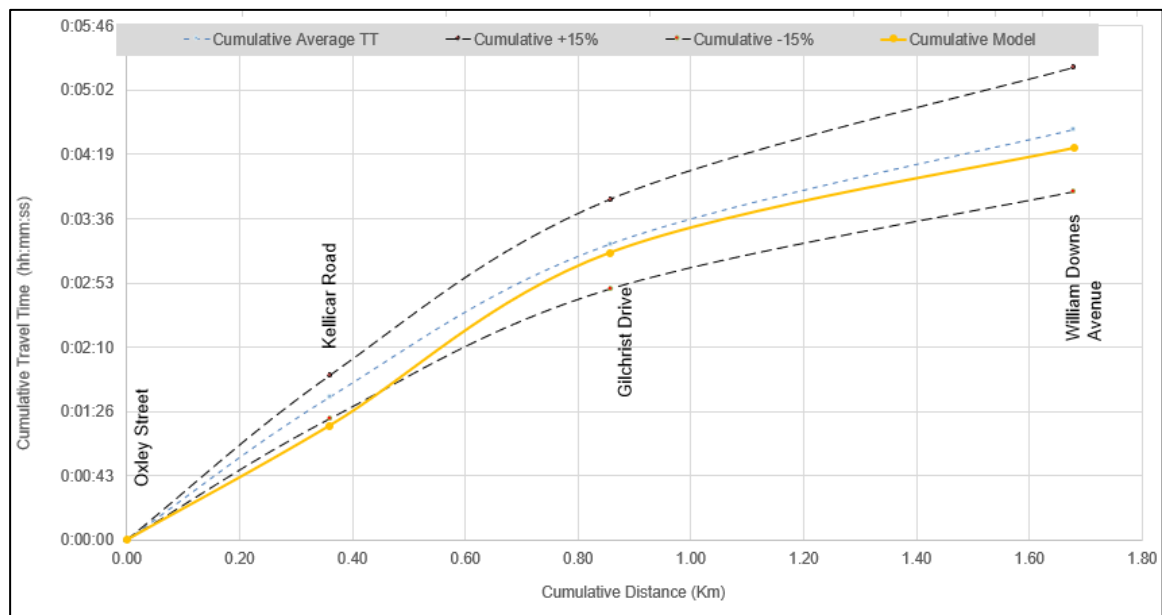


Figure 25 Travel time validation – Narellan Road northbound (AM peak hour)

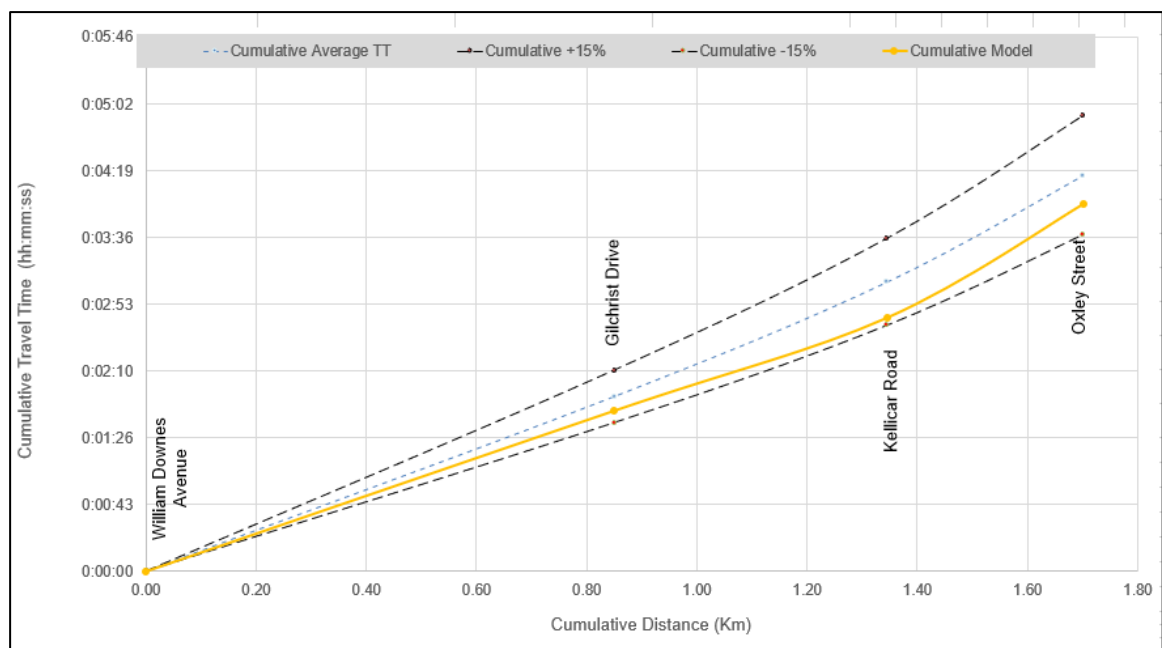


Figure 26 Travel time validation – Narellan Road southbound (AM peak hour)

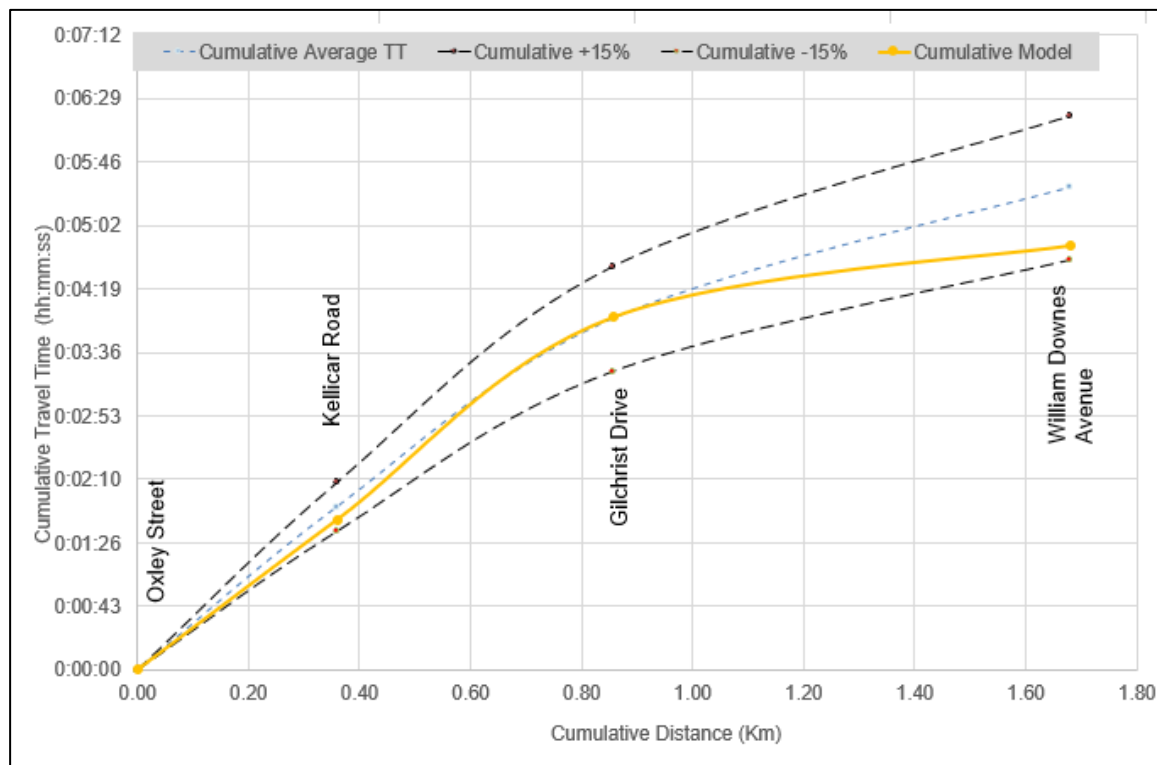


Figure 27 Travel time validation – Narellan Road northbound (PM peak hour)

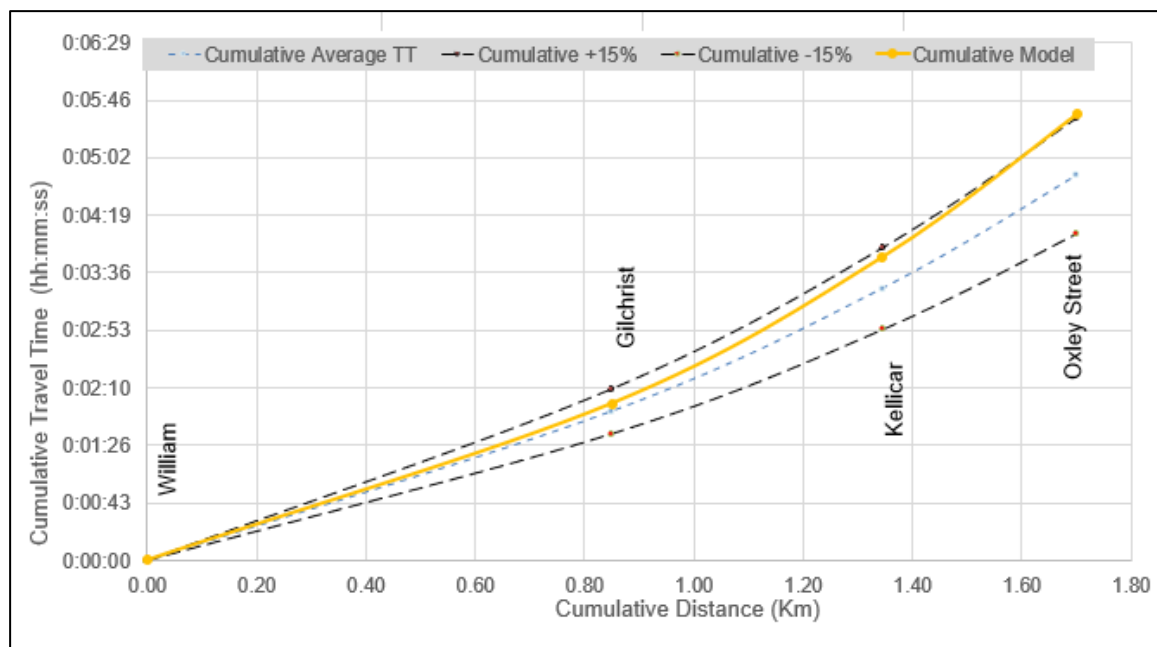


Figure 28 Travel time validation – Narellan Road southbound (PM peak hour)

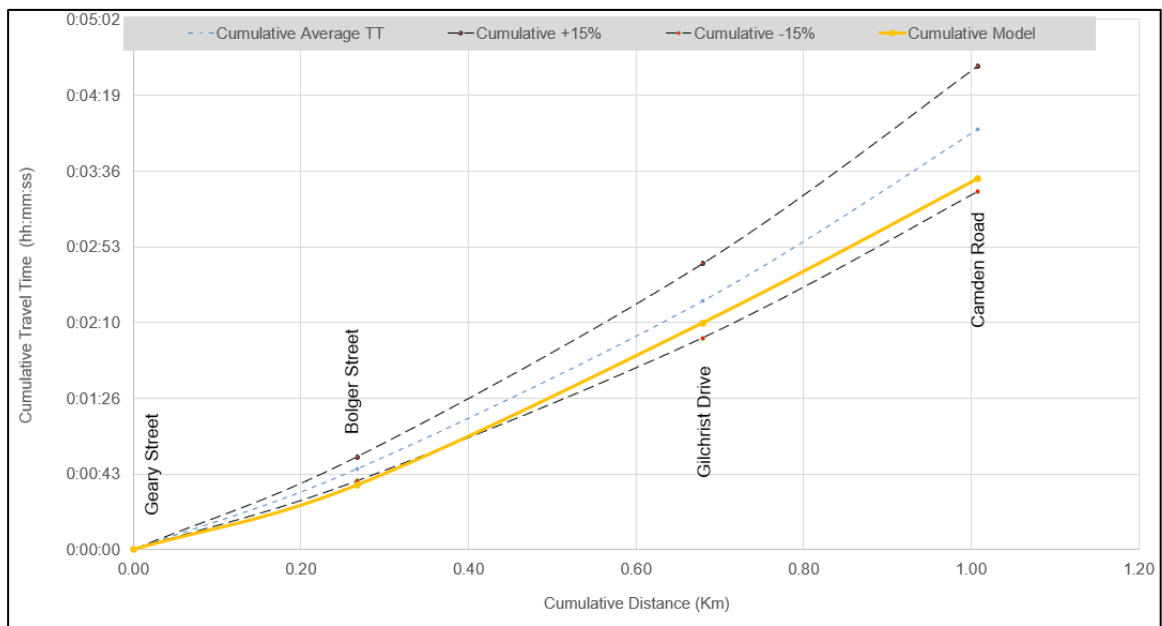


Figure 29 Travel time validation – Kellicar Road eastbound (AM peak hour)

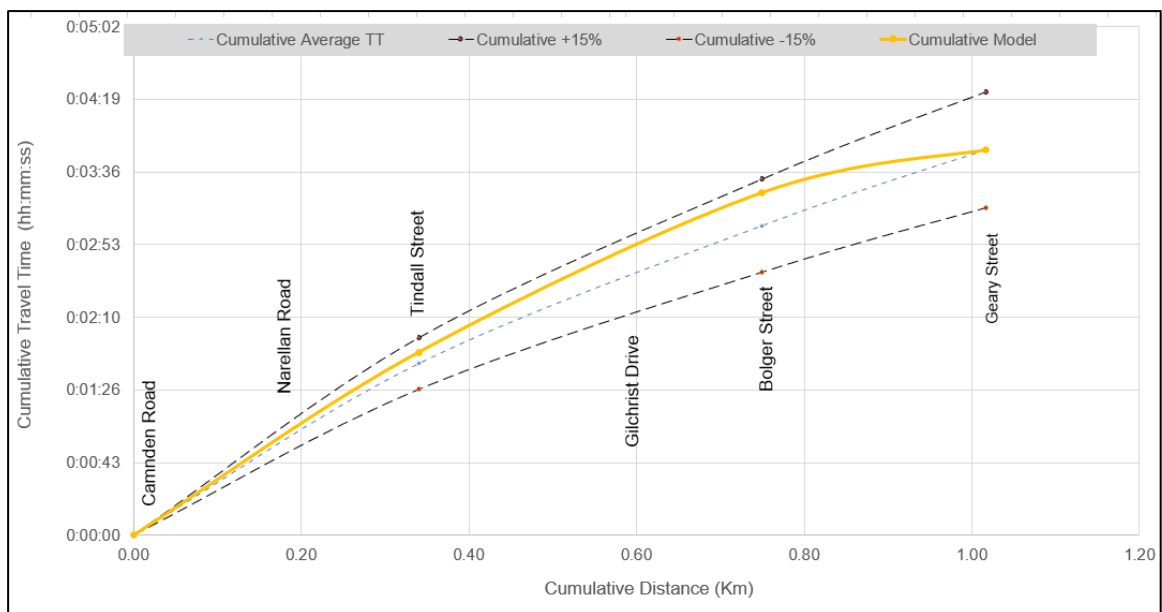


Figure 30 Travel time validation – Kellicar Road westbound (AM peak hour)

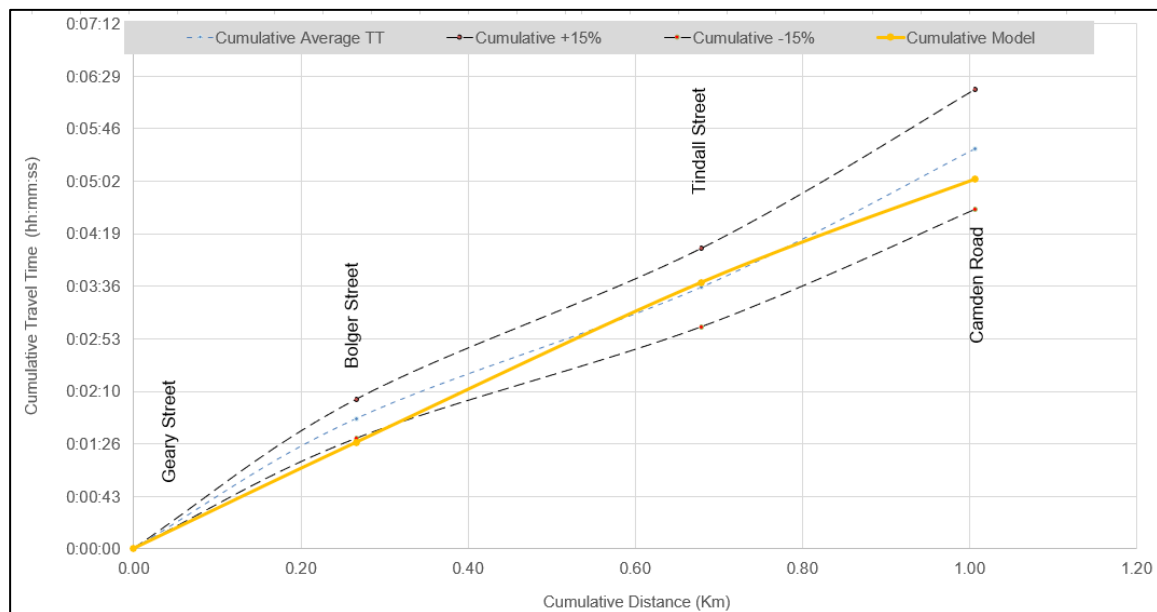


Figure 31 Travel time validation – Kellicar Road eastbound (PM peak hour)

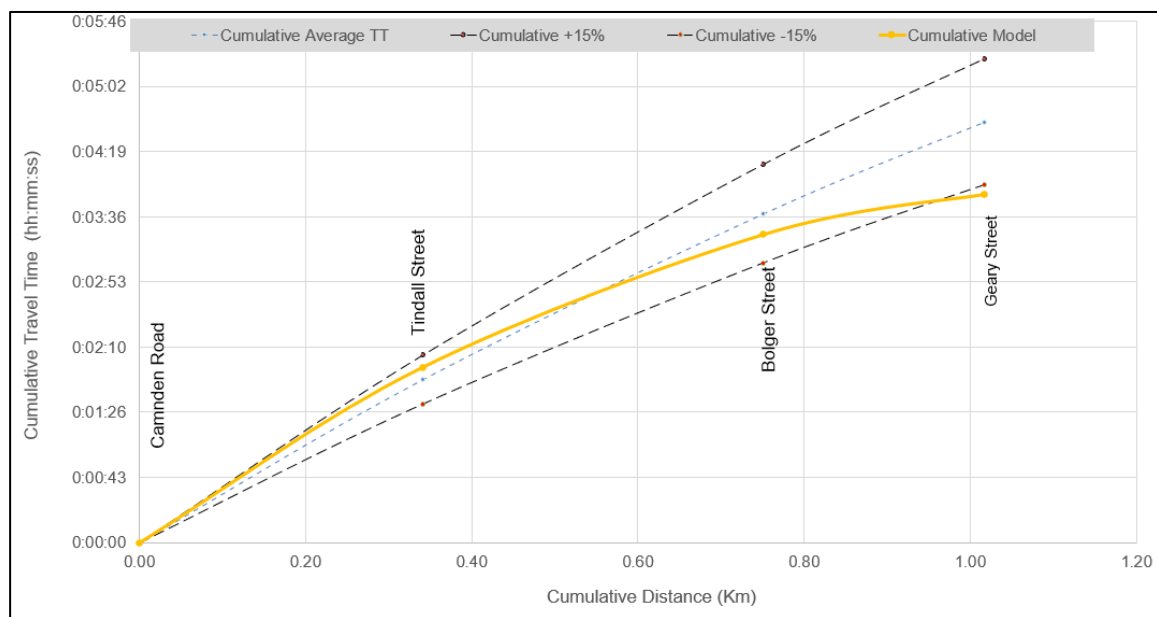


Figure 32 Travel time validation – Kellicar Road westbound (PM peak hour)

4.4.7 Base model summary

The base model sufficiently replicates traffic patterns and road network performance as observed. Turning movement calibration in both the AM and PM peak is proven to be acceptable in terms of the GEH criteria outlined by RMS. Additionally, the travel time validation is generally acceptable in terms of journey times along the observed routes. Consequently, the model is believed to be fit for purpose to understand the future year traffic impacts of the proposal. The model was developed in close consultation with Council who have endorsed the approach undertaken.

4.5 Future year traffic growth

To determine the future operation of the road network in the vicinity of the Kellicar Road Precinct, it is important to understand the growth in traffic compared to current situation. This growth can be attributable to:

- The development of the Kellicar Road precinct, based on the level of site traffic generation; and
- Traffic growth attributable to development in the wider area, not associated with the Kellicar Road precinct.

In addition to the above, the introduction of new road infrastructure in the area (e.g. Spring Farm Parkway) will alter existing movement patterns in both the AM and PM peak hours.

To inform the background traffic growth assessment, Campbelltown Council provide outputs of the strategic (TRACKS) model for the LGA which contemplates future traffic flows arising from development up to the year 2036. The 2036 future background traffic growth is based on the link flow plots provided by Council of the TRACKS model of 11 mid-block locations as presented in Table 5 on the following page. The following details the 2036 background demand estimation:

- Council provided Link Flow Volumes from the TRACKS model for 2016, 2026 and 2036 for several locations.
- Linear Interpolation was used to retrieve a 2019 volume for the link.
- The absolute growth difference between 2036 and 2019 TRACKS volume was added on top of the 2019 Aimsun Base Model Link Volumes.
- Surrounding roads were growthed up and balanced accordingly to match the future 2019 Aimsun Volume + (2019-2036) TRACKS growth.
- Aimsun Static Assignment was used iteratively to achieve link volumes as close to the 2019 Aimsun + TRACKS growth volumes as possible. The Origin-Destination matrix was manually adjusted with each iteration.

Table 5 Projected background traffic growth

Location	AM PEAK				PM Peak		
	Direction	2016	2026	2036	2016	2026	2036
Appin Rd (South of Therry Rd)	N	1333	1875	1449	871	1008	858
	S	640	330	345	896	1223	1945
Appin Rd (North of Therry Rd)	N	1455	2028	1815	1013	1253	1038
	S	776	600	629	930	1360	2017
Gilchrist Dr (north of Kellicar Rd)	N	1141	1163	1424	834	1134	1202
	S	1457	1302	1824	1155	1338	1672
Kellicar Rd (east of Tindall St)	E	650	1170	1422	1067	1114	1656
	W	847	1510	1247	1058	1405	1161
Kellicar Rd (west of Tindall St)	E	486	689	970	655	564	987
	W	170	224	239	766	272	179
Menangle Rd (east of Geary St)	E	711	824	726	1092	754	1085
	W	1122	1320	1240	1038	1668	1260
Menangle Rd (east of Tailby St)	E	892	1355	1666	396	1045	930
	W	364	672	936	828	1370	1923
Narellan Rd (north of Moore Oxley Bypass)	N	1166	1611	1356	707	1318	1111
	S	667	1043	1135	893	1111	1310
Narellan Rd (south of Gilchrist Dr)	N	1229	1964	1330	1453	2025	2226
	S	1027	2426	1649	1202	1828	1763
Narellan Rd (east of William Downes Ave)	E	2026	2426	2985	1866	2149	2080
	W	1510	1864	1522	1746	2318	2538
Narellan Rd (east of Hume Highway)	E	2463	2665	3315	1834	2395	2424
	W	1549	2012	1636	1841	2459	2769
Therry Rd (West of Woodhouse Dr)	E	437	365	409	648	681	715
	W	462	570	602	371	388	415
William Downes Ave (South of Narellan Rd)	N	159	556	595	260	562	756
	S	558	647	810	133	667	871

4.6 Forecast traffic generation

4.6.1 Traffic generation rates

Traffic generation forecasts for high density residential uses are generally derived from the RMS Guide to Traffic Generating Developments – Updated Traffic Surveys (Roads and Maritime, August 2013). Given the site's mix of uses, proposed on-site parking rates as well as it's proximity to Macarthur railway station, standard RMS rates have been adopted as follows:

Residential

- AM peak hour: 0.19 vehicle trips / dwelling
- PM peak hour: 0.15 vehicle trips / dwelling

Commercial

- AM peak hour: 1.6 trips / 100m² GFA
- PM peak hour: 1.2 trips / 100m² GFA

Retail

Trip generation rates for the retail component were based on recent survey data collected by Transport for NSW, as indicated in Figure 33 below.

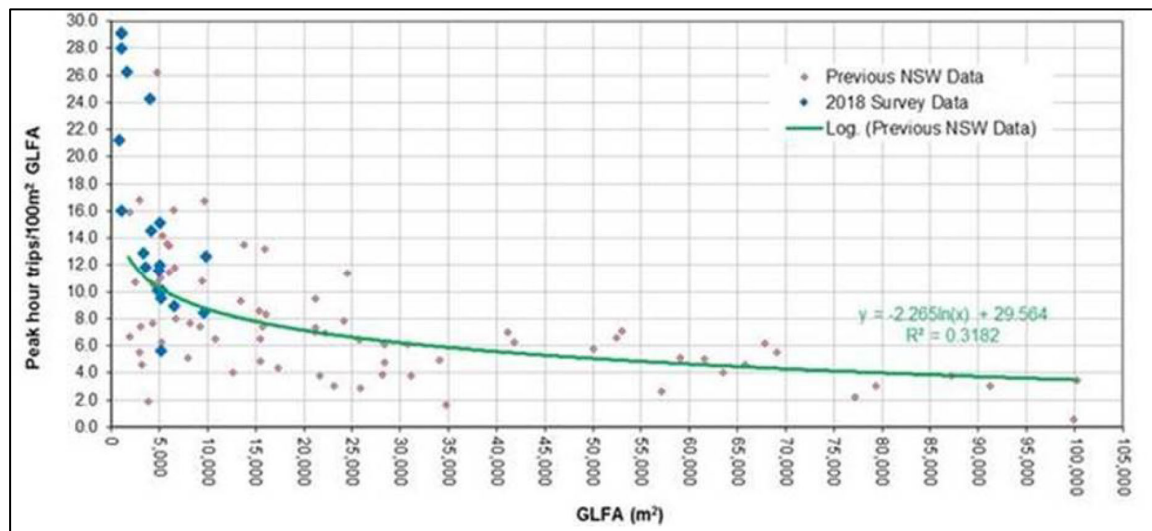


Figure 33 Retail traffic generation rates

- AM peak hour: 3.11 trips / 100m² GFA
- PM peak hour: 6.21 trips / 100m² GFA

4.6.2 Existing site traffic generation

The existing sites within the Kellicar Road precinct contain a number of high traffic generating uses such as Bunnings Warehouse and Marketfair shopping centre. These sites already generate a significant level of traffic, above and beyond a typical retail centre given their current uses. Based on the traffic surveys undertaken in on a weekday (Thursday) in September 2020, the existing level of traffic generation from the current sites within the precinct are summarised in Table 6 below. This indicates the site generates over 1,000 vehicles in the AM peak hour and 1,700 vehicles in the PM peak hour. These peak demands have been discounted from the assessment of traffic generated by the Kellicar Road Precinct's development.

Table 6 Existing site traffic generation

Site Access	AM peak hour (Thursday)			PM peak hour (Thursday)		
	In	Out	Total	In	Out	Total
Bunnings Exit	0	27	27	0	70	70
Marketfair Access (Kellicar Road)	210	110	320	301	183	484
Marketfair Access (Menangle Road)	89	97	186	114	219	333
Bugden Place	403	97	500	688	130	818
Tindall Street retail	36	9	45	23	13	36
Total	738	340	1078	1126	615	1741

4.6.3 Trip containment

The Kellicar Road precinct will be a mixed-use development with a number of supporting uses such as retail and commercial activities supporting the local residential population. The mixed-use nature of the development will facilitate trip containment, given residents will have opportunities to work and shop all within the one site. This containment will reduce the overall impact of the project on the external road network.

4.6.4 Site traffic generation

The forecast net increase in site traffic generation, taking into consideration the existing traffic movements, site development yields and expected levels of containment/passing trade, is summarised in Table 7 on the following page.

Table 7 Forecast traffic generation

Land Use	Quantum	Units	Generation Rate		Containment		Directionality				Forecast Traffic Generation					
			AM	PM	AM	PM	AM		PM		AM			PM		
							IN	OUT	IN	OUT	IN	OUT	TOTAL	IN	OUT	TOTAL
Residential	1,686	Dwellings	0.19	0.15	0.00	0.00	0.2	0.8	0.8	0.2	64	256	320	202	51	253
Commercial	58,320	m ² GFA	1.60	1.20	0.10	0.10	0.95	0.05	0.05	0.95	798	42	840	31	598	630
Retail	22,440	m ² GFA	3.11	6.21	0.15	0.15	0.8	0.2	0.5	0.5	474	118	592	592	592	1,184
Total Site Traffic Generation											1336	417	1752	826	1241	2067
<i>Existing Site Traffic Generation</i>											<i>738</i>	<i>340</i>	<i>1078</i>	<i>1126</i>	<i>615</i>	<i>1741</i>
Net Increase in Traffic Generation											598	77	674	-300	626	326

4.7 Traffic distribution

Considering the destination of residents travelling to work that currently live in the Macarthur area and the origin location of workers currently employed in the Macarthur area the likely direction of travel of residents and employees has been determined. These distribution assumptions are illustrated in Figure 34 (for outgoing vehicle trips) and Figure 35 (for incoming vehicle trips).



Figure 34 Direction split of outgoing vehicle trips



Figure 35 Direction split of incoming vehicle trips

4.8 Traffic modelling scenarios

The following scenarios have been considered as part of the future year detailed traffic modelling:

- (i) “Future base” (2036) - without the Kellicar Road Precinct development (AM and PM peak hour)
- (ii) “Future base + development” (2036) - with the Kellicar Road Precinct development (AM and PM peak hour) and no changes to the road network compared to the “future base” scenario
- (iii) “Future base + development + mitigations” - with the Kellicar Precinct development and potential traffic solutions to mitigate impacts of development (AM and PM peak hour)

All three scenarios take into consideration the background traffic growth arising from development in the broader precinct, as previously described in Section 4.5 of this document.

The road network for the “future base” scenario has remained unchanged from the existing year base model, with the exception of the access into the Market Fair shopping centre from Kellicar Road. Transport for NSW have plans to close off the current (uncontrolled) right turn from Kellicar Road into Market Fair, with this access point instead becoming ‘left in – left out’ only. This change has been adopted in all traffic models.



Figure 36 Future year base model layout

4.9 Proposed mitigation measures

In the process of undertaking the modelling it became evident that a number of upgrades to the transport network would be required to support the proposal. These upgrades are required to achieve the objective of ensuring that the road network will operate at a similar level to that which would have occurred had the Planning Proposal not proceeded.

During the traffic modelling process the following upgrades were identified. An indicative concept sketch of each measure is provided in the subsequent sections. More details engineering plans for these measures will be prepared at a subsequent stage of the planning process.

Mitigation 1: Kellicar Road / Bugden Place

Given the future traffic flows on Kellicar Road and increased turning movements into the site, it is proposed to close off the current right turn vehicle access into the precinct at Bugden Place as shown indicatively in Figure 37 below. This measure also restricts the extent of 'rat running' between Menangle Road and Kellicar Road via Bugden Place, with the traffic modelling indicating that many drivers will skip the traffic lights at Tindall Street to take this alternate route.

This mitigation measure complements the capacity improvements proposed at the Kellicar Road / Tindall Street intersection (see Mitigation 2)

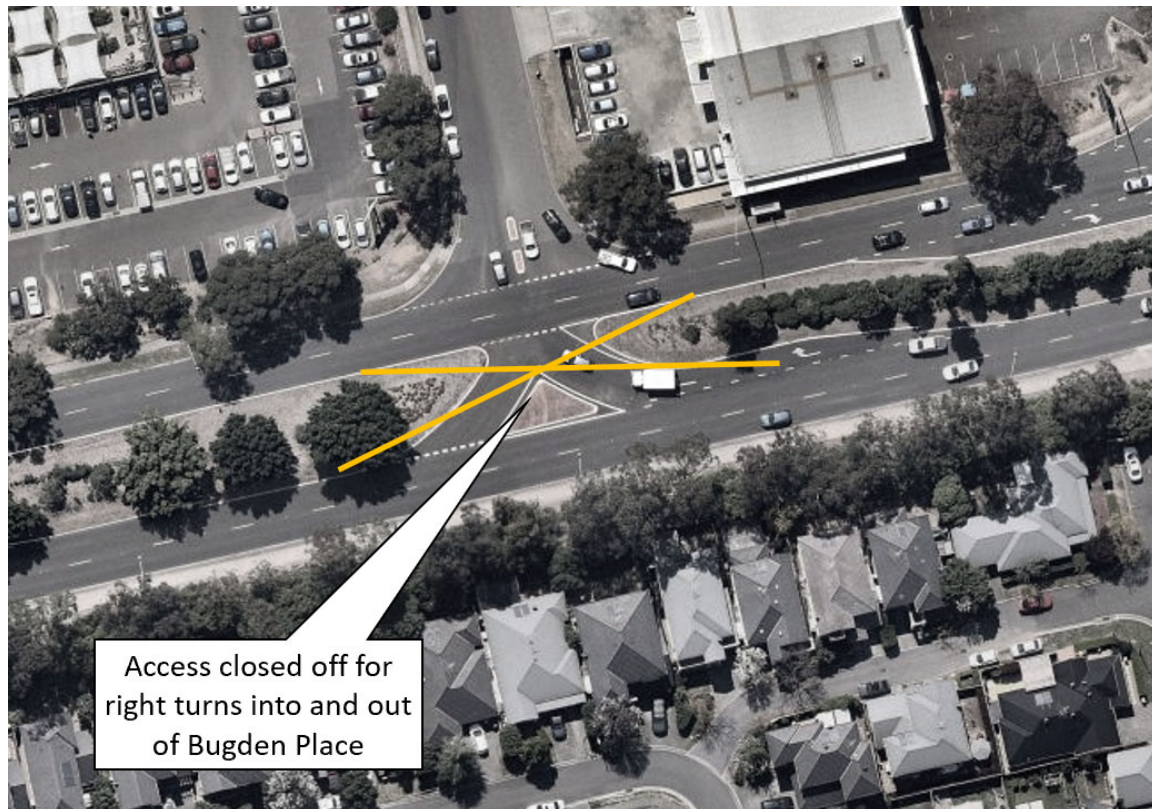


Figure 37 Proposed mitigation at Kellicar Road / Bugden Place intersection

Mitigation 2: Kellicar Road / Tindall Street

Due to the removal of the right turn access into Bugden Place from Kellicar Road (Mitigation 1) as well as the increased traffic demands it is proposed to create a double right turn from Kellicar Road (east) into Tindall Street. This provides additional traffic capacity to service all vehicles in the precinct, not only those associated with the Kellicar Road precinct.

Additionally this measure involves the creation of a third lane on Tindall Street north of Kellicar Road. Currently the short left turn slip lane on Tindall Street can prevent through traffic movements from proceeding through the intersection, with this mitigation measures resolving this issue by creating an extended left turn lane along Tindall Street into Kellicar Road.

It is noted that a component of this mitigation measure is currently being delivered by Transport for NSW, involving the creation of a right turn bay on Tindall Street (southbound) into Kellicar Road.

The indicative upgrade layout is shown in Figure 38 below.

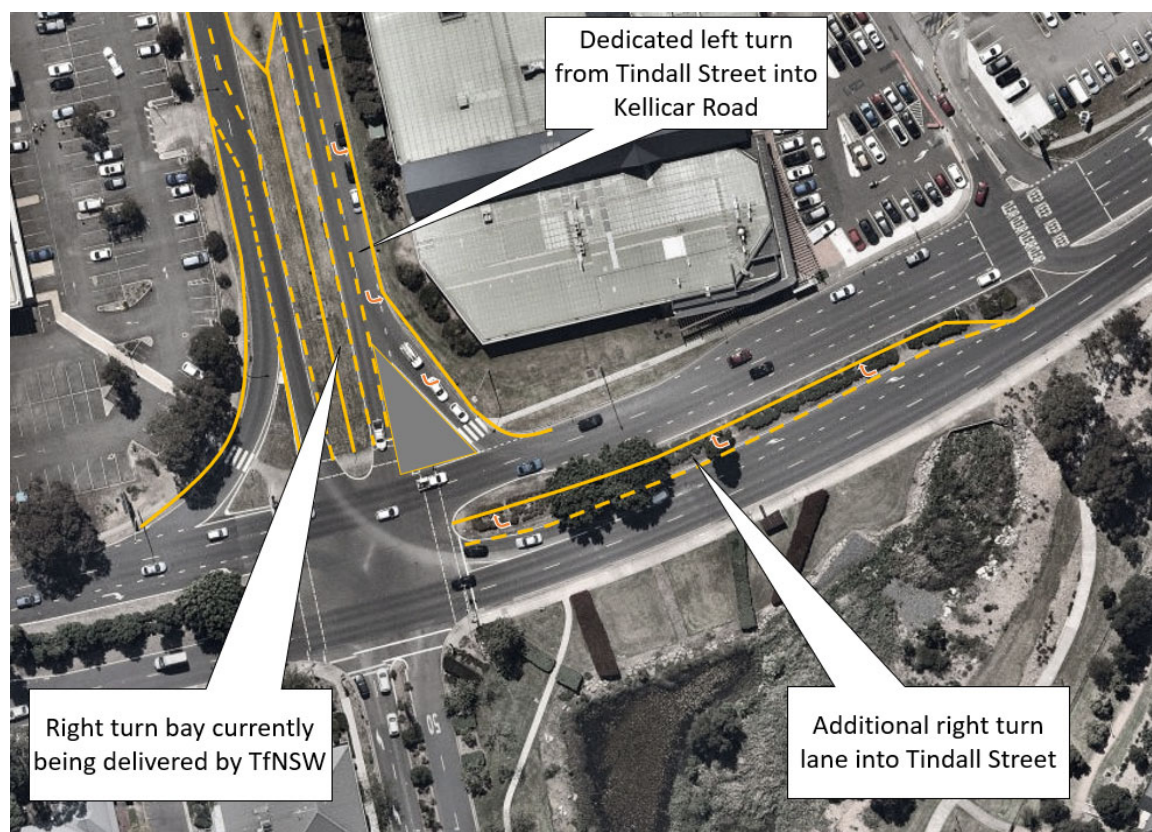


Figure 38 Proposed mitigation at Kellicar Road / Tindall Street intersection

Mitigation 3: Kellicar Road / Gilchrist Drive

This mitigation measure would enhance traffic capacity by providing a double right from Kellicar Road (east) into Gilchrist Drive. This double right turn accommodates the additional forecast traffic movements arising from both the Planning Proposal as well as the broader background traffic growth.

The indicative concept layout for this mitigation measure is shown in Figure 39 below.

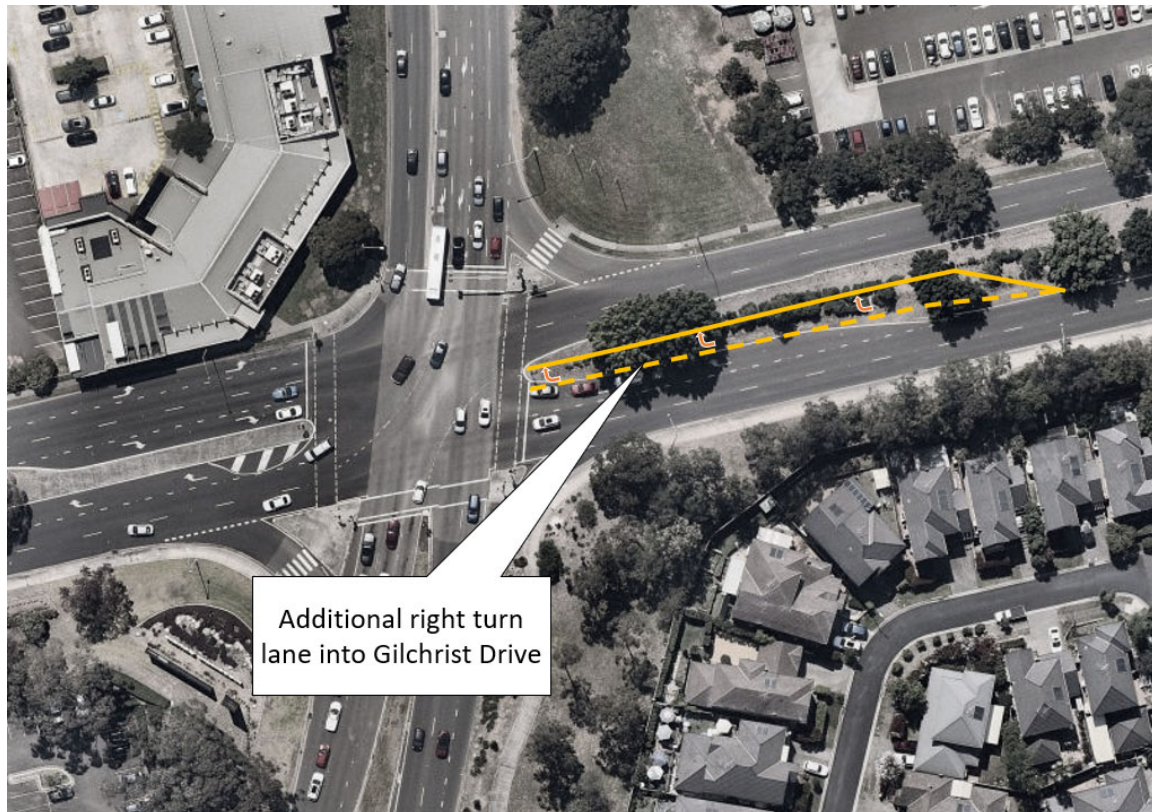


Figure 39 Proposed mitigation at Kellicar Road / Gilchrist Drive intersection

Mitigation 4: Kellicar Road eastbound traffic lane

To improve mid-block traffic capacity it is proposed to provide an additional through traffic lane along Kellicar Road in the eastbound direction between Bugden Place and Narellan Road – taking the total number of lanes to a minimum of three in this section of road. The indicative concept layout for this mitigation measure is shown in Figure 40 below.

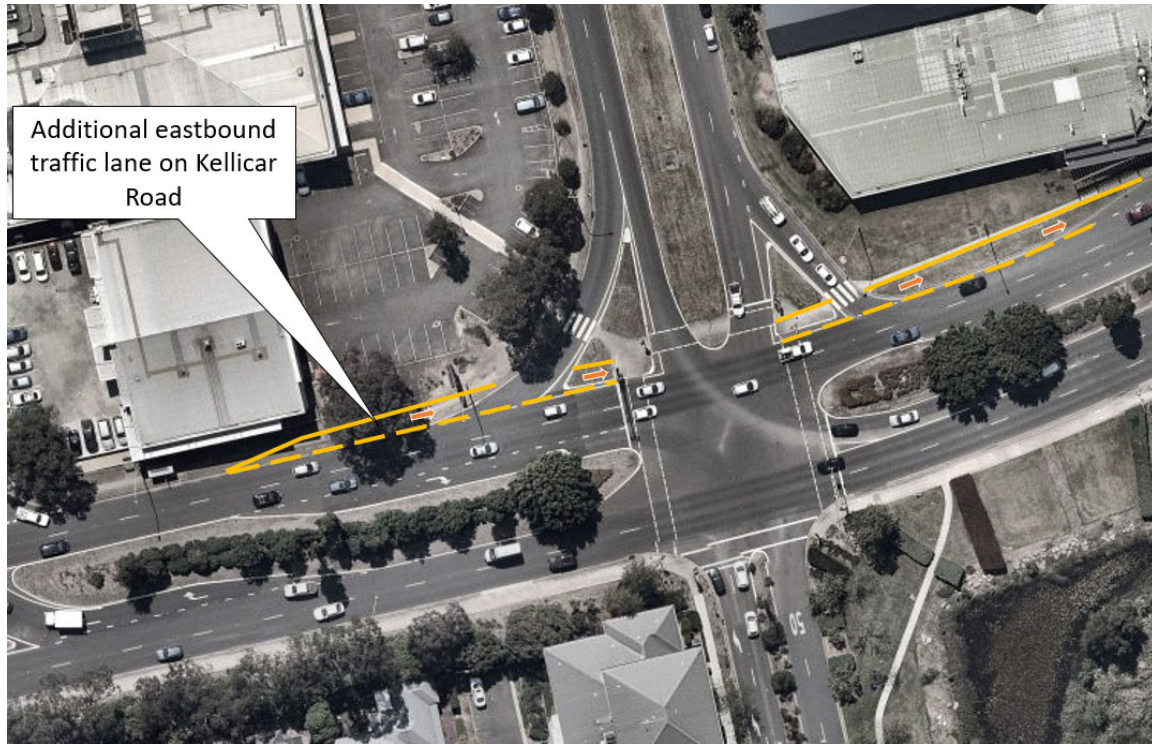


Figure 40 Proposed mitigation for Kellicar Road eastbound traffic

Mitigation 5: Kellicar Road / Narellan Road

The Kellicar Road / Narellan Road intersection is one of the busiest intersections in the Campbelltown – Macarthur area. There are significant traffic demands through this intersection as vehicles use this as a gateway to travel to/from the Hume Motorway.

To unlock capacity at this intersection and accommodate additional traffic demands a left turn slip lane could be provided from Kellicar Road into Narellan Road, as illustrated indicatively in Figure 41 below.

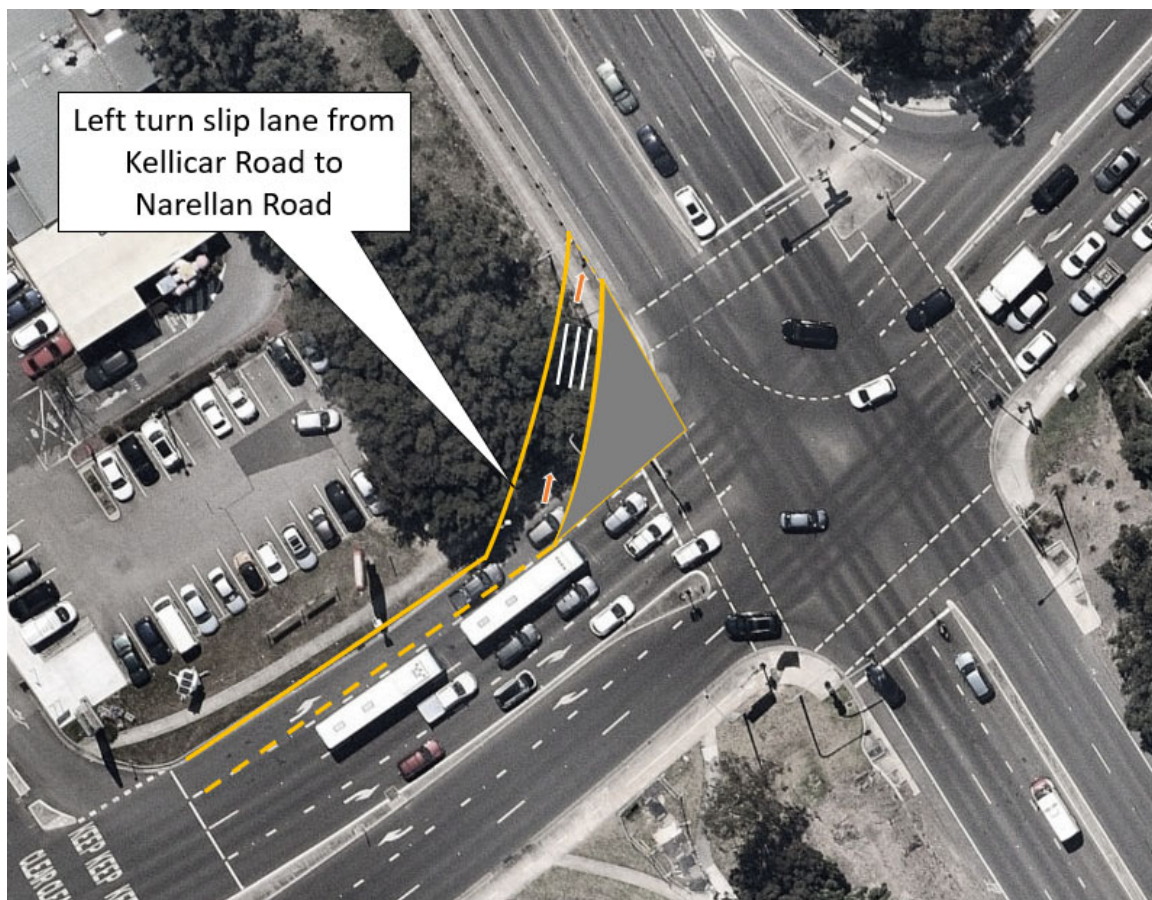


Figure 41 Proposed mitigation at Kellicar Road / Narellan Road intersection

4.10 Traffic modelling results

4.10.1 Network wide statistics

As the traffic model is a micro-simulation model covering a broad area the most appropriate way in assessing the traffic impacts of the proposal is to consider network wide results. This considers the performance of the network holistically rather than looking at individual locations in isolation.

Results of traffic modelling for both the AM peak hour and PM peak hour is presented in Table 8. These results reflect the increased traffic demands arising

from the Planning Proposal as well as the background traffic growth derived from Council's strategic model.

The modelling demonstrates that, with the provision of recommended mitigation measures, the road network is capable of operating in a similar manner to that under the 'future base' scenario and therefore that the Kellicar Road Planning Proposal does not compromise other development opportunity in the city centre.

Table 8 Network wide traffic modelling results

Peak Hour	Metric	Scenario		
		Future Base	Future base + development (no mitigations)	Future base + development (with mitigations)
AM Peak Hour (8am – 9am)	Unreleased vehicles	178	619	472
	Unreleased vehicles (%)	1.3%	4.2%	3.2%
	Speed (km/h)	19.86	18.04	19.19
PM Peak Hour (4.45pm – 5.45pm)	Unreleased vehicles	755	1058	826
	Unreleased vehicles (%)	4.5%	6.3%	4.9%
	Speed (km/h)	14.24	13.58	14.53

4.10.2 Intersection level of service

Intersection level of service statistics for all scenarios considered have been developed and are presented in the tables on the following pages. These confirm that overall intersection performance improves following the introduction of the mitigation measures. Average vehicle delays at a number of intersections, including key sites such as Gilchrist Drive / Kellicar Road and Narellan Road / Kellicar Road significantly reduce as a result of the mitigation measures associated with the Planning Proposal.

This confirms the findings of the network wide analysis which indicates that the Planning Proposal's impact on the road network is satisfactory subject to the implementation of the recommended traffic mitigation measures.

Table 9 Intersection level of service – AM peak hour

Intersection	Future Base		Future base + development (no mitigations)		Future base + development (with mitigations)	
	Level of Service	Average delay (seconds)	Level of Service	Average delay (seconds)	Level of Service	Average delay (seconds)
Menangle Road / Tindall Street	B	11	B	21	D	50
Menangle Road / Bugden Place	-	-	A	7	A	10
Gilchrist Drive / Kellicar Road	F	81	F	77	E	63
Bugden Place / Tindall Road	A	5	B	19	A	3
Tindall Street / Kellicar Road / Centennial Dr	C	37	C	35	C	42
Narellan Road / Kellicar Road	F	96	F	76	F	74

Table 10 Intersection level of service – PM peak hour

Intersection	Future Base		Future base + development (no mitigations)		Future base + development (with mitigations)	
	Level of Service	Average delay (seconds)	Level of Service	Average delay (seconds)	Level of Service	Average delay (seconds)
Menangle Road / Tindall Street	F	94	A	14	C	35
Menangle Road / Bugden Place	-	-	F	94	D	45
Gilchrist Drive / Kellicar Road	F	124	F	119	F	87
Bugden Place / Tindall Road	B	29	F	128	A	12
Tindall Street / Kellicar Road / Centennial Dr	F	95	C	42	D	56
Narellan Road / Kellicar Road	F	116	F	96	F	79

4.11 Staging of mitigation measures

It is important to recognise that development within the Kellicar Road Precinct, involving a total of 224,000m² GFA, will be delivered in stages. Therefore not all road upgrades identified in this detailed assessment will be required immediately. Instead it is recommended the road upgrades are delivered gradually in line with development of each site within the precinct.

The suggested staging of the identified mitigation works is summarised in Table 11. The staging has been developed based on the location of the mitigation measure with respect to each of the four sites, for example it is practical to deliver the left turn slip lane from Kellicar Road into Narellan Road at the same time Site 4 is developed. The staging is also based on the likely traffic impacts of each stage of development and the need to mitigate these traffic impacts through road works.

Table 11 Proposed staging of mitigation measures

Mitigation	Description	Recommended staging
Mitigation 1: Kellicar Road / Bugden Place	Close off the current right turn vehicle access into the precinct at Bugden Place from Kellicar Road	Concurrent with the development of Site 1 or at the time Bugden Place is extended through to Menangle Road.
Mitigation 2: Kellicar Road / Tindall Street	Creation a double right turn from Kellicar Road (east) into Tindall Street and dedicated left turn lane on Tindall Street	Concurrent with the development of Site 2
Mitigation 3: Kellicar Road / Gilchrist Drive	Creation a double right from Kellicar Road (east) into Gilchrist Drive	Concurrent with the development of Site 1
Mitigation 4: Kellicar Road eastbound traffic lane	Creation of an additional through traffic lane along Kellicar Road in the eastbound direction between Bugden Place and Narellan Road	Concurrent with the development of Site 2 or 3, whichever comes later
Mitigation 5: Kellicar Road / Narellan Road	Creation a left turn slip lane from Kellicar Road (west approach) into Narellan Road	Concurrent with the development of Site 4

5 Conclusion

JMT Consulting has prepared this detailed traffic and transport assessment to support the rezoning of the land known as the 'Kellicar Road Precinct' development of a master plan of four sites within the Macarthur Town Centre, known as the 'Kellicar Road Precinct'.

The current master plan for the Kellicar Precinct envisages approximately 224,000m² GFA on the site, with a mix of residential, commercial and retail uses. The mixed-use nature of the development will facilitate 'trip containment' by allowing people to live, work and play all within the one area.

An objective of the proposal is to transition the area from a car-dominated environment to a more people and pedestrian friendly destination with plazas, laneways, shopping, outdoor dining and landscaped areas as well as a variety of employment and residential uses.

The proposal involves a significant improvement in pedestrian access and permeability in the precinct. In particular, the creation of 'Macarthur Walk', a major east-west pedestrian boulevard, will provide users of the precinct with direct access to Macarthur railway station.

A number of vehicle access points have been identified to support access into the precinct, with these access points located to minimise disruption to pedestrians and traffic as well as supporting appropriate vehicle access into the on-site basement car parks.

Maximum car parking rates are proposed which provide flexibility in allowing reduced parking rates in future once new public transport services come on line. Over time it may be possible to reduce car parking provision as the use of public transport (including the opening of the new metro station) increases and private car use changes. Short term parking, car share and bicycle parking will also be provided as part of the development.

Detailed traffic modelling has been undertaken that considers the impacts of the proposal on the surrounding road network. The detailed traffic assessment has not identified any major issues preventing the development of the Kellicar Road Precinct to the densities envisaged under the Planning Proposal, subject to the implementation of road upgrades. The traffic modelling indicates that the road network, with these road upgrades in place, will perform at a similar level should the rezoning not proceed.

Based on the above key findings, it is considered that the proposal's impact on the transport network will be acceptable subject to the implementation of its proposed pedestrian improvements and the recommended road upgrade measures. The controls outlined in the site specific DCP are considered suitable based on the outcomes of the detailed traffic and transport assessment.

Appendix A: Base Model Calibration Data

P1521 Kellicar Precinct

AIMSUN Intersection Results - Base

AM Peak 0800-0900

All Vehicles

GEH Turn Summary 0800-0900

>10	0	0.0%
>5, <=10	15	8.7%
<=5	158	91.3%

ID	Intersection	Aimsun Code_Do Min	Turn Number	Movement Code	From	To	Turn	Surveyed	Model Output	Difference (Mod - Sur)	% Diff (Mod - Sur)	GEH
101	Narellan Road	7650	1	101-1	Narellan Road (N)	William Downes Avenue (W)	R	290	295	5	2%	0
	William Downes Avenue	7803	2	101-2		Narellan Road (S)	T	2855	2888	33	1%	1
	Narellan Road	7804	3	101-3		William Downes Avenue (E)	L	0	0	0	#DIV/0!	0
	William Downes Avenue	7801	4	101-4	William Downes Avenue (E)	Narellan Road (N)	R	2	3	1	50%	1
		7802	5	101-5		William Downes Avenue (W)	T	0	0	0	#DIV/0!	0
		7800	6	101-6		Narellan Road (S)	L	1	4	3	300%	2
		7797	7	101-7	Narellan Road (S)	William Downes Avenue (E)	R	2	1	-1	-50%	1
		7798	8	101-8		Narellan Road (N)	T	1936	1814	-122	-6%	3
		7758	9	101-9		William Downes Avenue (W)	L	117	104	-13	-11%	1
		7805	10	101-10	William Downes Avenue (W)	Narellan Road (S)	R	59	52	-7	-12%	1
		7806	11	101-11		William Downes Avenue (E)	T	0	0	0	#DIV/0!	0
		7755	12	101-12		Narellan Road (N)	L	85	75	-10	-12%	1
102	Narellan Road	7740	1	102-1	Narellan Road (N)	Gilchrist Drive (W)	R	893	869	-24	-3%	1
	Blaxland Road	7739	2	102-2		Narellan Road (S)	T	1247	1159	-88	-7%	3
	Narellan Road	7721	3	102-3		Blaxland Road (E)	L	790	808	18	2%	1
	Gilchrist Drive	7735	4	102-4	Blaxland Road (E)	Narellan Road (N)	R	334	349	15	4%	1
		7734	5	102-5		Gilchrist Drive (W)	T	495	410	-85	-17%	4
		7733	6	102-6		Narellan Road (S)	L	375	463	88	23%	4
		7724	7	102-7	Narellan Road (S)	Blaxland Road (E)	R	420	391	-29	-7%	1
		7732	8	102-8		Narellan Road (N)	T	1001	803	-198	-20%	7
		7727	9	102-9		Gilchrist Drive (W)	L	79	12	-67	-85%	10
		7736	10	102-10	Gilchrist Drive (W)	Narellan Road (S)	R	93	65	-28	-30%	3
		7738	11	102-11		Blaxland Road (E)	T	406	369	-37	-9%	2
		7730	12	102-12		Narellan Road (N)	L	720	759	39	5%	1
103	Gilchrist Drive	8162	1	103-1	Gilchrist Drive (N)	Goldsmith Avenue (W)	R	66	72	6	9%	1
	Goldsmith Avenue	8163	2	103-2		Gilchrist Drive (S)	T	1401	1218	-183	-13%	5
	Gilchrist Drive	8161	8	103-8	Gilchrist Drive (S)	Gilchrist Drive (N)	T	1101	1062	-39	-4%	1
		8160	9	103-9		Goldsmith Avenue (W)	L	68	99	31	46%	3
		8159	10	103-10		Gilchrist Drive (S)	R	123	109	-14	-11%	1
		8158	12	103-12	Goldsmith Avenue (W)	Gilchrist Drive (N)	L	118	133	15	13%	1
104	Menangle Road	8257	9	103-9	Marketfair (S)	Menangle Road (W)	L	104	93	-11	-11%	1
	Marketfair	8255	10	103-10	Menangle Road (W)	Marketfair (S)	R	99	96	-3	-3%	0
105	Menangle Road	7979	5	105-5	Menangle Road (E)	Menangle Road (W)	T	49	48	-1	-2%	0
	Tindall St	7851	6	105-6		Tindall St (S)	L	55	45	-10	-18%	1
	Menangle Road	7983	7	105-7	Tindall St (S)	Menangle Road (E)	R	28	25	-3	-11%	1
		7848	9	105-9		Menangle Road (W)	L	132	142	10	8%	1
		7982	10	105-10	Menangle Road (W)	Tindall St (S)	R	358	289	-69	-19%	4
		7981	11	105-11		Menangle Road (E)	T	71	71	0	0%	0
106	Menangle Road	8261	5	106-5	Menangle Road (E)	Menangle Road (W)	T	181	190	9	5%	1
	Bugden PI	8260	7	106-7	Bugden PI (S)	Menangle Road (E)	R	13	11	-2	-15%	1
	Menangle Road	8259	9	106-9		Menangle Road (W)	L	14	6	-8	-57%	3
		8262	11	106-11	Menangle Road (W)	Menangle Road (E)	T	416	352	-64	-15%	3
107	Menangle Road	8302	5	107-5	Menangle Road (E)	Menangle Road (W)	T	172	187	15	9%	1
	Bolger Street	8303	6	107-6	1 of 6	Bolger Street (S)	L	20	9	-11	-55%	3

P1521 Kellicar Precinct

AIMSUN Intersection Results - Base

AM Peak 0800-0900

All Vehicles

GEH Turn Summary 0800-0900		
>10	0	0.0%
>5, <=10	15	8.7%
<=5	158	91.3%

ID	Intersection	Aimsun Code_Do Min	Turn Number	Movement Code	From	To	Turn	Surveyed	Model Output	Difference (Mod - Sur)	% Diff (Mod - Sur)	GEH
	Menangle Road	8307	7	107-7	Bolger Street (S)	Menangle Road (E)	R	7	9	2	29%	1
		8306	9	107-9		Menangle Road (W)	L	123	107	-16	-13%	1
		8305	10	107-10	Menangle Road (W)	Bolger Street (S)	R	132	174	42	32%	3
		8304	11	107-11		Menangle Road (E)	T	410	343	-67	-16%	3

P1521 Kellicar Precinct

AIMSUN Intersection Results - Base

AM Peak 0800-0900

All Vehicles

GEH Turn Summary 0800-0900

>10	0	0.0%
>5, <=10	15	8.7%
<=5	158	91.3%

ID	Intersection	Aimsun Code_Do Min	Turn Number	Movement Code	From	To	Turn	Surveyed	Model Output	Difference (Mod - Sur)	% Diff (Mod - Sur)	GEH
108	Menangle Road	8248	5	108-5	Menangle Road (E)	Menangle Road (W)	T	191	195	4	2%	0
	Geary Street	8232	6	108-6		Geary Street (S)	L	22	14	-8	-36%	2
	Menangle Road	8251	7	108-7	Geary Street (S)	Menangle Road (E)	R	19	4	-15	-79%	4
		8250	9	108-9		Menangle Road (W)	L	31	19	-12	-39%	2
		8247	10	108-10	Menangle Road (W)	Geary Street (S)	R	199	112	-87	-44%	7
		8246	11	108-11		Menangle Road (E)	T	523	513	-10	-2%	0
109	Mcarthue St Park	72023	1	109-1	Mcarthue St Park (N)	(N)	U	0	0	0	#DIV/0!	0
	Menangle Road	72024	2	109-2		(W)	R	0	0	0	#DIV/0!	0
	Tailby St	72025	3	109-3		(S)	T	0	0	0	#DIV/0!	0
	Menangle Road	72026	4	109-4		(E)	L	0	0	0	#DIV/0!	0
		72027	5	109-5	Menangle Road (E)	(N)	U	3	0	-3	-100%	2
		72028	6	109-6		(W)	R	0	0	0	#DIV/0!	0
		72029	7	109-7		(S)	T	211	205	-6	-3%	0
		72030	8	109-8		(E)	L	8	10	2	25%	1
		72031	9	109-9	Tailby St (S)	(N)	U	0	0	0	#DIV/0!	0
		72032	10	109-10		(W)	R	27	4	-23	-85%	6
		72033	11	109-11		(S)	T	4	2	-2	-50%	1
		72034	12	109-12		(E)	L	18	11	-7	-39%	2
		72047	13	109-13	Menangle Road (W)	(N)	U	0	0	0	#DIV/0!	0
		72048	14	109-14		(W)	R	36	45	9	25%	1
		72049	15	109-15		(S)	T	692	621	-71	-10%	3
		72050	16	109-16		(E)	L	4	1	-3	-75%	2
110	Geary St	72035	1	110-1	Geary St (N)	(N)	U	0	0	0	#DIV/0!	0
	Kellicar Road	72036	2	110-2		(W)	R	14	1	-13	-93%	5
	Macarthur Square Access	72037	3	110-3		(S)	T	36	36	0	0%	0
	Kellicar Road	72038	4	110-4		(E)	L	165	85	-80	-48%	7
		72039	5	110-5	Kellicar Road (E)	(N)	U	66	32	-34	-52%	5
		72040	6	110-6		(W)	R	44	28	-16	-36%	3
		72041	7	110-7		(S)	T	174	171	-3	-2%	0
		72042	8	110-8		(E)	L	95	72	-23	-24%	3
		72043	9	110-9	Macarthur Square Access (S)	(N)	U	0	0	0	#DIV/0!	0
		72044	10	110-10		(W)	R	13	18	5	38%	1
		72045	11	110-11		(S)	T	3	1	-2	-67%	1
		72046	12	110-12		(E)	L	3	5	2	67%	1
		72051	13	110-13	Kellicar Road (W)	(N)	U	2	0	-2	-100%	2
		72052	14	110-14		(W)	R	9	4	-5	-56%	2
		72053	15	110-15		(S)	T	89	115	26	29%	3
		72054	16	110-16		(E)	L	7	9	2	29%	1

P1521 Kellicar Precinct

AIMSUN Intersection Results - Base

AM Peak 0800-0900

All Vehicles

GEH Turn Summary 0800-0900		
>10	0	0.0%
>5, <=10	15	8.7%
<=5	158	91.3%

ID	Intersection	Aimsun Code_Do Min	Turn Number	Movement Code	From	To	Turn	Surveyed	Model Output	Difference (Mod - Sur)	% Diff (Mod - Sur)	GEH
111	Bolger St	8012	1	111-1	Bolger St (N)	Kellicar Road (W)	R	7	0	-7	-100%	4
	Kellicar Road	8011	2	111-2		Bolger St (S)	T	4	6	2	50%	1
	Bolger St	8013	3	111-3		Kellicar Road (E)	L	150	173	23	15%	2
	Kellicar Road	8010	4	111-4	Kellicar Road (E)	Bolger St (N)	R	171	111	-60	-35%	5
		8009	5	111-5		Kellicar Road (W)	T	365	322	-43	-12%	2
		8008	6	111-6		Bolger St (S)	L	124	113	-11	-9%	1
		8003	7	111-7	Bolger St (S)	Kellicar Road (E)	R	66	71	5	8%	1
		8004	8	111-8		Bolger St (N)	T	6	10	4	67%	1
		8002	9	111-9		Kellicar Road (W)	L	7	12	5	71%	2
		8005	10	111-10	Kellicar Road (W)	Bolger St (S)	R	14	13	-1	-7%	0
		8006	11	111-11		Kellicar Road (E)	T	365	323	-42	-12%	2
		8007	12	111-12		Bolger St (N)	L	12	23	11	92%	3
112	Gilchrist Drive	8035	1	112-1	Gilchrist Drive (N)	Kellicar Road (W)	R	437	375	-62	-14%	3
	Kellicar Road	8034	2	112-2		Gilchrist Drive (S)	T	854	751	-103	-12%	4
	Gilchrist Drive	8018	3	112-3		Kellicar Road (E)	L	233	142	-91	-39%	7
	Kellicar Road	8036	4	112-4	Kellicar Road (E)	Gilchrist Drive (N)	R	41	42	1	2%	0
		8038	5	112-5		Kellicar Road (W)	T	148	94	-54	-36%	5
		8289	6	112-6		Gilchrist Drive (S)	L	104	194	90	87%	7
		8040	7	112-7	Gilchrist Drive (S)	Kellicar Road (E)	R	116	144	28	24%	2
		8039	8	112-8		Gilchrist Drive (N)	T	788	750	-38	-5%	1
		7990	9	112-9		Kellicar Road (W)	L	75	77	2	3%	0
		8044	10	112-10	Kellicar Road (W)	Gilchrist Drive (S)	R	49	58	9	18%	1
		8043	11	112-11		Kellicar Road (E)	T	192	150	-42	-22%	3
		8042	12	112-12		Gilchrist Drive (N)	L	340	366	26	8%	1
113	Bugdel PI	69345	1	113-1	Bugdel PI (N)	Kellicar Road (W)	R	21	34	13	62%	2
	Kellicar Road	69344	3	113-3		Kellicar Road (E)	L	152	121	-31	-20%	3
	Kellicar Road	69340	4	113-4	Kellicar Road (E)	Bugdel PI (N)	R	92	129	37	40%	4
		69338	5	113-5		Kellicar Road (W)	T	272	294	22	8%	1
		69343	11	113-11	Kellicar Road (W)	Kellicar Road (E)	T	237	198	-39	-16%	3
		69342	12	113-12		Bugdel PI (N)	L	304	239	-65	-21%	4
114	Tindall St	7867	1	114-1	Tindall St (N)	Kellicar Road (W)	R	31	7	-24	-77%	6
	Kellicar Road	7868	2	114-2		Centennial Drive (S)	T	67	75	8	12%	1
	Centennial Drive	7860	3	114-3		Kellicar Road (E)	L	333	277	-56	-17%	3
	Kellicar Road	7960	4	114-4	Kellicar Road (E)	Tindall St (N)	R	73	25	-48	-66%	7
		7864	5	114-5		Kellicar Road (W)	T	298	375	77	26%	4
		7865	6	114-6		Centennial Drive (S)	L	268	206	-62	-23%	4
		7871	7	114-7	Centennial Drive (S)	Kellicar Road (E)	R	100	101	1	1%	0
		7873	8	114-8		Tindall St (N)	T	32	21	-11	-34%	2
		7872	9	114-9		Kellicar Road (W)	L	35	40	5	14%	1
		7870	10	114-10	Kellicar Road (W)	Centennial Drive (S)	R	39	66	27	69%	4
		7869	11	114-11		Kellicar Road (E)	T	247	182	-65	-26%	4
		7875	12	114-12		Tindall St (N)	L	103	70	-33	-32%	4

P1521 Kellicar Precinct

AIMSUN Intersection Results - Base

AM Peak 0800-0900

All Vehicles

GEH Turn Summary 0800-0900

>10	0	0.0%
>5, <=10	15	8.7%
<=5	158	91.3%

ID	Intersection	Aimsun Code_Do Min	Turn Number	Movement Code	From	To	Turn	Surveyed	Model Output	Difference (Mod - Sur)	% Diff (Mod - Sur)	GEH	
115	Marketfair Access	7825	3	114-3	Marketfair Access (N)	Kellicar Road (E)	L	110	103	-7	-6%	1	
	Kellicar Road	7688	4	114-4	Kellicar Road (E)	Marketfair Access (N)	R	153	153	0	0%	0	
	Kellicar Road	7828	5	114-5	Kellicar Road (W)	Kellicar Road (W)	T	639	696	57	9%	2	
		7827	11	114-11		Kellicar Road (E)	T	616	504	-112	-18%	5	
		7826	12	114-12		Marketfair Access (N)	L	64	53	-11	-17%	1	
116	Narellan Road	7786	1	116-1	Narellan Road (N)	Kellicar Road (W)	R	295	262	-33	-11%	2	
	Kellicar Road	7785	2	116-2	Kellicar Road (E)	Narellan Road (S)	T	611	578	-33	-5%	1	
	Narellan Road	7779	3	116-3		Kellicar Road (E)	L	809	824	15	2%	1	
	Kellicar Road	7795	4	116-4		Narellan Road (N)	R	336	319	-17	-5%	1	
		7796	5	116-5		Kellicar Road (W)	T	382	451	70	18%	3	
		7794	6	116-6		Narellan Road (S)	L	25	25	0	0%	0	
	7790	7	116-7	Narellan Road (S)	Kellicar Road (E)	R	213	201	-12	-6%	1		
	7788	8	116-8	Kellicar Road (W)	Narellan Road (N)	T	955	748	-207	-22%	7		
	7789	9	116-9		Kellicar Road (W)	L	116	138	23	19%	2		
	7791	10	116-10		Narellan Road (S)	R	199	190	-9	-5%	1		
	7793	11	116-11	Kellicar Road (E)	T	318	291	-27	-8%	2			
	7792	12	116-12	Narellan Road (N)	L	209	127	-82	-39%	6			
	117	Narellan Road	7940	1	117-1	Narellan Road (N)	Appin Road (W)	R	302	257	-45	-15%	3
		Oxley St	7939	2	117-2	Oxley St (E)	The Pkwy (S)	T	230	228	-2	-1%	0
The Pkwy		7950	3	117-3	Oxley St (E)		L	303	320	17	6%	1	
Appin Road		7938	4	117-4	Narellan Road (N)		R	349	304	-45	-13%	2	
		7937	5	117-5	Appin Road (W)		T	492	486	-6	-1%	0	
		7837	6	117-6	The Pkwy (S)		L	113	112	-1	-1%	0	
7932		7	117-7	The Pkwy (S)	Oxley St (E)	R	202	122	-80	-40%	6		
7931		8	117-8	Appin Road (W)	Narellan Road (N)	T	417	298	-119	-29%	6		
7843		9	117-9		Appin Road (W)	L	18	14	-4	-22%	1		
7933		10	117-10		The Pkwy (S)	R	37	39	2	5%	0		
7935		11	117-11	Oxley St (E)	T	1194	1156	-38	-3%	1			
7927		12	117-12	Narellan Road (N)	L	517.5	512	-5.5	-1%	0			
118		Camdenm Road	69224	1	118-1	Camdenm Road (N)	Kellicar Road (W)	R	0	0	0	#DIV/0!	0
	Hurley St	69226	2	118-2	Hurley St (E)	Camden Road (S)	T	0	0	0	#DIV/0!	0	
	Camden Road	69203	3	118-3		Hurley St (E)	L	0	0	0	#DIV/0!	0	
	Kellicar Road	69228	4	118-4		Camdenm Road (N)	R	0	#N/A	#N/A	#N/A	#N/A	
		69227	5	118-5		Kellicar Road (W)	T	544	607	63	12%	3	
		69208	6	118-6		Camden Road (S)	L	50	60	10	20%	1	
	69220	7	118-7	Camden Road (S)	Hurley St (E)	R	49	37	-12	-24%	2		
	7773	9	118-9	Kellicar Road (W)	Kellicar Road (W)	L	199	174	-25	-12%	2		
	69223	10	118-10		Camden Road (S)	R	187	158	-29	-16%	2		
	69222	11	118-11		Hurley St (E)	T	1153	1156	3	0%	0		
	69216	12	118-12		Camdenm Road (N)	L	0	0	0	#DIV/0!	0		
	119	Camden Road		1	119-1	Camden Road (N)	Oxley St (S)	R	38	22	-16	-42%	3
Oxley St		7915	3	119-3	Oxley St (W)	Oxley St (W)	L	50	73	23	46%	3	
Oxley St		69267	4	119-4		Camden Road (N)	R	46	78	32	70%	4	
		7916	5	119-5		Oxley St (S)	T	916	894	-22	-2%	1	

P1521 Kellicar Precinct

AIMSUN Intersection Results - Base

AM Peak 0800-0900

All Vehicles

GEH Turn Summary 0800-0900		
>10	0	0.0%
>5, <=10	15	8.7%
<=5	158	91.3%

ID	Intersection	Aimsun Code_Do Min	Turn Number	Movement Code	From	To	Turn	Surveyed	Model Output	Difference (Mod - Sur)	% Diff (Mod - Sur)	GEH
		7902	11	119-11	Oxley St (S) (N)	Oxley St (W) #REF!	T	1321	1276	-45	-3%	1
		7918	12	119-12			L	378	308	-70	-19%	4

P1521 Kellicar Precinct

AIMSUN Intersection Results - Base

PM Peak 1645-1745

All Vehicles

GEH Turn Summary 0800-0900

>10	0	0.0%
>5, <=10	24	13.9%
<=5	149	86.1%

ID	Intersection							Surveyed	Model Output	Difference (Mod - Sur)	% Diff (Mod - Sur)	GEH
101	Narellan Road	7650	1	101-1	Narellan Road (N)	William Downes Avenue (W)	R	68	68	0	0%	0.0
	William Downes Avenue	7803	2	101-2		Narellan Road (S)	T	2154	1983	-171	-8%	3.8
	Narellan Road	7804	3	101-3		William Downes Avenue (E)	L	0	0	0	#DIV/0!	0.0
	William Downes Avenue	7801	4	101-4	William Downes Avenue (E)	Narellan Road (N)	R	0	0	0	#DIV/0!	0.0
		7802	5	101-5		William Downes Avenue (W)	T	0	0	0	#DIV/0!	0.0
		7800	6	101-6		Narellan Road (S)	L	1	2	1	100%	0.8
		7797	7	101-7	Narellan Road (S)	William Downes Avenue (E)	R	2	0	-2	-100%	2.0
		7798	8	101-8		Narellan Road (N)	T	2328	2455	127	5%	2.6
		7758	9	101-9		William Downes Avenue (W)	L	26	21	-5	-19%	1.0
		7805	10	101-10	William Downes Avenue (W)	Narellan Road (S)	R	38	85	47	124%	6.0
		7806	11	101-11		William Downes Avenue (E)	T	0	0	0	#DIV/0!	0.0
		7755	12	101-12		Narellan Road (N)	L	136	189	53	39%	4.2
102	Narellan Road	7740	1	102-1	Narellan Road (N)	Gilchrist Drive (W)	R	902	878	-24	-3%	0.8
	Blaxland Road	7739	2	102-2		Narellan Road (S)	T	971	812	-159	-16%	5.3
	Narellan Road	7721	3	102-3		Blaxland Road (E)	L	326	383	57	17%	3.0
	Gilchrist Drive	7735	4	102-4	Blaxland Road (E)	Narellan Road (N)	R	493	396	-97	-20%	4.6
		7734	5	102-5		Gilchrist Drive (W)	T	768	642	-126	-16%	4.7
		7733	6	102-6		Narellan Road (S)	L	480	480	0	0%	0.0
		7724	7	102-7	Narellan Road (S)	Blaxland Road (E)	R	537	522	-15	-3%	0.7
		7732	8	102-8		Narellan Road (N)	T	1064	1277	213	20%	6.2
		7727	9	102-9		Gilchrist Drive (W)	L	74	17	-57	-77%	8.5
		7736	10	102-10	Gilchrist Drive (W)	Narellan Road (S)	R	42	51	9	21%	1.3
		7738	11	102-11		Blaxland Road (E)	T	507	517	10	2%	0.4
		7730	12	102-12		Narellan Road (N)	L	799	816	17	2%	0.6
103	Gilchrist Drive	8162	1	103-1	Gilchrist Drive (N)	Goldsmith Avenue (W)	R	91	80	-11	-12%	1.2
	Goldsmith Avenue	8163	2	103-2		Gilchrist Drive (S)	T	1653	1449	-204	-12%	5.2
	Gilchrist Drive	8161	8	103-8	Gilchrist Drive (S)	Gilchrist Drive (N)	T	1267	1261	-6	0%	0.2
		8160	9	103-9		Goldsmith Avenue (W)	L	110	131	21	19%	1.9
		8159	10	103-10	Goldsmith Avenue (W)	Gilchrist Drive (S)	R	180	156	-24	-13%	1.9
		8158	12	103-12		Gilchrist Drive (N)	L	81	107	26	32%	2.7
104	Menangle Road	8257	9	103-9	Marketfair (S)	Menangle Road (W)	L	232	265	33	14%	2.1
	Marketfair	8255	10	103-10	Menangle Road (W)	Marketfair (S)	R	121	120	-1	-1%	0.1
105	Menangle Road	7979	5	105-5	Menangle Road (E)	Menangle Road (W)	T	131	110	-21	-16%	1.9

P1521 Kellicar Precinct

AIMSUN Intersection Results - Base

PM Peak 1645-1745

All Vehicles

GEH Turn Summary 0800-0900		
>10	0	0.0%
>5, <=10	24	13.9%
<=5	149	86.1%

ID	Intersection							Surv eyed	Model Output	Difference (Mod - Sur)	% Diff (Mod - Sur)	GEH
	Tindall St	7851	6	105-6		Tindall St (S)	L	101	155	54	53%	4.8
	Menangle Road	7983	7	105-7	Tindall St (S)	Menangle Road (E)	R	62	75	13	21%	1.6
		7848	9	105-9		Menangle Road (W)	L	249	363	114	46%	6.5
		7982	10	105-10	Menangle Road (W)	Tindall St (S)	R	157	113	-44	-28%	3.8
		7981	11	105-11		Menangle Road (E)	T	59	45	-14	-24%	1.9
106	Menangle Road	8261	5	106-5	Menangle Road (E)	Menangle Road (W)	T	380	473	93	24%	4.5
	Bugden Pl	8260	7	106-7	Bugden Pl (S)	Menangle Road (E)	R	26	25	-1	-4%	0.2
	Menangle Road	8259	9	106-9		Menangle Road (W)	L	47	44	-3	-6%	0.4
		8262	11	106-11	Menangle Road (W)	Menangle Road (E)	T	190	133	-57	-30%	4.5
107	Menangle Road	8302	5	107-5	Menangle Road (E)	Menangle Road (W)	T	359	465	106	30%	5.2
	Bolger Street	8303	6	107-6		Bolger Street (S)	L	41	43	2	5%	0.3
	Menangle Road	8307	7	107-7	Bolger Street (S)	Menangle Road (E)	R	13	13	0	0%	0.0
		8306	9	107-9		Menangle Road (W)	L	260	204	-56	-22%	3.7
		8305	10	107-10	Menangle Road (W)	Bolger Street (S)	R	87	86	-1	-1%	0.1
		8304	11	107-11		Menangle Road (E)	T	177	120	-57	-32%	4.7

P1521 Kellicar Precinct

AIMSUN Intersection Results - Base

PM Peak 1645-1745

All Vehicles

GEH Turn Summary 0800-0900		
>10	0	0.0%
>5, <=10	24	13.9%
<=5	149	86.1%

ID	Intersection							Surveyed	Model Output	Difference (Mod - Sur)	% Diff (Mod - Sur)	GEH
108	Menangle Road	8248	5	108-5	Menangle Road (E)	Menangle Road (W)	T	430	475	45	10%	2.1
	Geary Street	8232	6	108-6		Geary Street (S)	L	110	29	-81	-74%	9.7
	Menangle Road	8251	7	108-7	Geary Street (S)	Menangle Road (E)	R	32	2	-30	-94%	7.3
		8250	9	108-9		Menangle Road (W)	L	111	91	-20	-18%	2.0
		8247	10	108-10	Menangle Road (W)	Geary Street (S)	R	105	67	-38	-36%	4.1
		8246	11	108-11		Menangle Road (E)	T	232	212	-20	-9%	1.3
109	Mcarthur St Park	72023	1	109-1	Mcarthur St Park (N)	(N)	U	0	0	0	#DIV/0!	0.0
	Menangle Road	72024	2	109-2		(W)	R	2	0	-2	-100%	2.0
	Tailby St	72025	3	109-3		(S)	T	2	2	0	0%	0.0
	Menangle Road	72026	4	109-4		(E)	L	4	2	-2	-50%	1.2
		72027	5	109-5	Menangle Road (E)	(N)	U	5	2	-3	-60%	1.6
		72028	6	109-6		(W)	R	1	1	0	0%	0.0
		72029	7	109-7		(S)	T	520	507	-13	-3%	0.6
		72030	8	109-8		(E)	L	15	51	36	240%	6.3
		72031	9	109-9	Tailby St (S)	(N)	U	0	0	0	#DIV/0!	0.0
		72032	10	109-10		(W)	R	16	4	-12	-75%	3.8
		72033	11	109-11		(S)	T	0	0	0	#DIV/0!	0.0
		72034	12	109-12		(E)	L	66	72	6	9%	0.7
		72047	13	109-13	Menangle Road (W)	(N)	U	1	0	-1	-100%	1.4
		72048	14	109-14		(W)	R	28	38	10	36%	1.7
		72049	15	109-15		(S)	T	316	275	-41	-13%	2.4
		72050	16	109-16		(E)	L	0	0	0	#DIV/0!	0.0
	Geary St	72035	1	110-1	Geary St (N)	(N)	U	2	0	-2	-100%	2.0
		72036	2	110-2		(W)	R	37	5	-32	-86%	7.0
		72037	3	110-3		(S)	T	36	26	-10	-28%	1.8
		72038	4	110-4		(E)	L	146	66	-80	-55%	7.8
		72039	5	110-5	Kellicar Road (E)	(N)	U	150	55	-95	-63%	9.4
		72040	6	110-6		(W)	R	146	90	-56	-38%	5.2
		72041	7	110-7		(S)	T	191	225	34	18%	2.4
		72042	8	110-8		(E)	L	173	138	-35	-20%	2.8
		72043	9	110-9	Macarthur Square Access (S)	(N)	U	0	0	0	#DIV/0!	0.0
		72044	10	110-10		(W)	R	113	158	45	40%	3.9
		72045	11	110-11		(S)	T	30	19	-11	-37%	2.2
110	Kellicar Road	72035	1	110-1	Geary St (N)	(N)	U	2	0	-2	-100%	2.0
	Kellicar Road	72036	2	110-2		(W)	R	37	5	-32	-86%	7.0
	Macarthur Square Access	72037	3	110-3		(S)	T	36	26	-10	-28%	1.8
	Kellicar Road	72038	4	110-4		(E)	L	146	66	-80	-55%	7.8
		72039	5	110-5	Kellicar Road (E)	(N)	U	150	55	-95	-63%	9.4
		72040	6	110-6		(W)	R	146	90	-56	-38%	5.2
		72041	7	110-7		(S)	T	191	225	34	18%	2.4
		72042	8	110-8		(E)	L	173	138	-35	-20%	2.8
		72043	9	110-9	Macarthur Square Access (S)	(N)	U	0	0	0	#DIV/0!	0.0
		72044	10	110-10		(W)	R	113	158	45	40%	3.9
		72045	11	110-11		(S)	T	30	19	-11	-37%	2.2

P1521 Kellicar Precinct

AIMSUN Intersection Results - Base

PM Peak 1645-1745

All Vehicles

GEH Turn Summary 0800-0900		
>10	0	0.0%
>5, <=10	24	13.9%
<=5	149	86.1%

ID	Intersection							Surveyed	Model Output	Difference (Mod - Sur)	% Diff (Mod - Sur)	GEH
		72046	12	110-12	Kellicar Road (W)	(E)	L	13	15	2	15%	0.5
		72051	13	110-13		(N)	U	1	0	-1	-100%	1.4
		72052	14	110-14		(W)	R	7	1	-6	-86%	3.0
		72053	15	110-15		(S)	T	190	272	82	43%	5.4
		72054	16	110-16		(E)	L	16	7	-9	-56%	2.7

P1521 Kellicar Precinct

AIMSUN Intersection Results - Base

PM Peak 1645-1745

All Vehicles

GEH Turn Summary 0800-0900

>10	0	0.0%
>5, <=10	24	13.9%
<=5	149	86.1%

ID	Intersection							Surveyed	Model Output	Difference (Mod - Sur)	% Diff (Mod - Sur)	GEH
111	Bolger St	8012	1	111-1	Bolger St (N)	Kellicar Road (W)	R	15	4	-11	-73%	3.6
	Kellicar Road	8011	2	111-2		Bolger St (S)	T	12	9	-3	-25%	0.9
	Bolger St	8013	3	111-3		Kellicar Road (E)	L	161	109	-52	-32%	4.5
	Kellicar Road	8010	4	111-4	Kellicar Road (E)	Bolger St (N)	R	266	195	-71	-27%	4.7
		8009	5	111-5		Kellicar Road (W)	T	623	589	-34	-5%	1.4
		8008	6	111-6		Bolger St (S)	L	215	199	-16	-7%	1.1
		8003	7	111-7	Bolger St (S)	Kellicar Road (E)	R	180	133	-47	-26%	3.8
		8004	8	111-8		Bolger St (N)	T	29	30	1	3%	0.2
		8002	9	111-9		Kellicar Road (W)	L	22	26	4	18%	0.8
		8005	10	111-10	Kellicar Road (W)	Bolger St (S)	R	21	47	26	124%	4.5
		8006	11	111-11		Kellicar Road (E)	T	732	762	30	4%	1.1
		8007	12	111-12		Bolger St (N)	L	50	31	-19	-38%	3.0
112	Gilchrist Drive	8035	1	112-1	Gilchrist Drive (N)	Kellicar Road (W)	R	650	456	-194	-30%	8.2
	Kellicar Road	8034	2	112-2		Gilchrist Drive (S)	T	946	786	-160	-17%	5.4
	Gilchrist Drive	8018	3	112-3		Kellicar Road (E)	L	237	339	102	43%	6.0
	Kellicar Road	8036	4	112-4	Kellicar Road (E)	Gilchrist Drive (N)	R	62	25	-37	-60%	5.6
		8038	5	112-5		Kellicar Road (W)	T	329	344	15	5%	0.8
		8289	6	112-6		Gilchrist Drive (S)	L	204	216	12	6%	0.8
		8040	7	112-7	Gilchrist Drive (S)	Kellicar Road (E)	R	128	127	-1	-1%	0.1
		8039	8	112-8		Gilchrist Drive (N)	T	680	768	88	13%	3.3
		7990	9	112-9		Kellicar Road (W)	L	125	181	56	45%	4.5
		8044	10	112-10	Kellicar Road (W)	Gilchrist Drive (S)	R	159	145	-14	-9%	1.1
		8043	11	112-11		Kellicar Road (E)	T	279	256	-23	-8%	1.4
		8042	12	112-12		Gilchrist Drive (N)	L	635	602	-33	-5%	1.3
113	Bugdel Pl	69345	1	113-1	Bugdel Pl (N)	Kellicar Road (W)	R	28	39	11	39%	1.9
	Kellicar Road	69344	3	113-3		Kellicar Road (E)	L	358	350	-8	-2%	0.4
	Kellicar Road	69340	4	113-4	Kellicar Road (E)	Bugdel Pl (N)	R	106	115	9	8%	0.9
		69338	5	113-5		Kellicar Road (W)	T	567	553	-14	-2%	0.6
		69343	11	113-11	Kellicar Road (W)	Kellicar Road (E)	T	191	296	105	55%	6.7
		69342	12	113-12		Bugdel Pl (N)	L	453	426	-27	-6%	1.3
114	Tindall St	7867	1	114-1	Tindall St (N)	Kellicar Road (W)	R	22	24	2	9%	0.4
	Kellicar Road	7868	2	114-2		Centennial Drive (S)	T	84	97	13	15%	1.4
	Centennial Drive	7860	3	114-3		Kellicar Road (E)	L	199	189	-10	-5%	0.7

P1521 Kellicar Precinct

AIMSUN Intersection Results - Base

PM Peak 1645-1745

All Vehicles

GEH Turn Summary 0800-0900		
>10	0	0.0%
>5, <=10	24	13.9%
<=5	149	86.1%

ID	Intersection							Surv eyed	Model Output	Difference (Mod - Sur)	% Diff (Mod - Sur)	GEH
	Kellicar Road	7960	4	114-4	Kellicar Road (E)	Tindall St (N)	R	172	75	-97	-56%	8.7
		7864	5	114-5	Centennial Drive (S)	Kellicar Road (W)	T	584	604	20	3%	0.8
		7865	6	114-6		Centennial Drive (S)	L	197	181	-16	-8%	1.2
		7871	7	114-7		Kellicar Road (E)	R	133	131	-2	-2%	0.2
		7873	8	114-8	Kellicar Road (W)	Tindall St (N)	T	42	41	-1	-2%	0.2
		7872	9	114-9		Kellicar Road (W)	L	67	44	-23	-34%	3.1
		7870	10	114-10		Centennial Drive (S)	R	33	35	2	6%	0.3
		7869	11	114-11	Tindall St (N)	Kellicar Road (E)	T	390	362	-28	-7%	1.4
		7875	12	114-12		Tindall St (N)	L	126	243	117	93%	8.6

P1521 Kellicar Precinct

AIMSUN Intersection Results - Base

PM Peak 1645-1745

All Vehicles

GEH Turn Summary 0800-0900

>10	0	0.0%
>5, <=10	24	13.9%
<=5	149	86.1%

ID	Intersection							Surveyed	Model Output	Difference (Mod - Sur)	% Diff (Mod - Sur)	GEH
115	Marketfair Access	7825	3	114-3	Marketfair Access (N)	Kellicar Road (E)	L	254	262	8	3%	0.5
	Kellicar Road	7688	4	114-4	Kellicar Road (E)	Marketfair Access (N)	R	245	187	-58	-24%	3.9
	Kellicar Road	7828	5	114-5		Kellicar Road (W)	T	953	964	11	1%	0.4
		7827	11	114-11	Kellicar Road (W)	Kellicar Road (E)	T	621	577	-44	-7%	1.8
		7826	12	114-12		Marketfair Access (N)	L	101	103	2	2%	0.2
116	Narellan Road	7786	1	116-1	Narellan Road (N)	Kellicar Road (W)	R	197	189	-8	-4%	0.6
	Kellicar Road	7785	2	116-2		Narellan Road (S)	T	770	701	-69	-9%	2.5
	Narellan Road	7779	3	116-3		Kellicar Road (E)	L	526	476	-50	-10%	2.2
	Kellicar Road	7795	4	116-4	Kellicar Road (E)	Narellan Road (N)	R	758	824	66	9%	2.3
		7796	5	116-5		Kellicar Road (W)	T	799	671	-128	-16%	4.7
		7794	6	116-6		Narellan Road (S)	L	30	46	16	53%	2.6
		7790	7	116-7	Narellan Road (S)	Kellicar Road (E)	R	102	109	7	7%	0.7
		7788	8	116-8		Narellan Road (N)	T	696	748	52	7%	1.9
		7789	9	116-9		Kellicar Road (W)	L	202	296	94	47%	6.0
		7791	10	116-10	Kellicar Road (W)	Narellan Road (S)	R	170	150	-20	-12%	1.6
		7793	11	116-11		Kellicar Road (E)	T	484	417	-67	-14%	3.2
		7792	12	116-12		Narellan Road (N)	L	221	270	49	22%	3.1
117	Narellan Road	7940	1	117-1	Narellan Road (N)	Appin Road (W)	R	479	481	2	0%	0.1
	Oxley St	7939	2	117-2		The Pkwy (S)	T	291	271	-20	-7%	1.2
	The Pkwy	7950	3	117-3		Oxley St (E)	L	200	142	-58	-29%	4.4
	Appin Road	7938	4	117-4	Oxley St (E)	Narellan Road (N)	R	427	367	-60	-14%	3.0
		7937	5	117-5		Appin Road (W)	T	1155	1063	-92	-8%	2.8
		7837	6	117-6		The Pkwy (S)	L	272	225	-47	-17%	3.0
		7932	7	117-7	The Pkwy (S)	Oxley St (E)	R	155	183	28	18%	2.2
		7931	8	117-8		Narellan Road (N)	T	300	289	-11	-4%	0.6
		7843	9	117-9		Appin Road (W)	L	20	13	-7	-35%	1.7
		7933	10	117-10	Appin Road (W)	The Pkwy (S)	R	59	56	-3	-5%	0.4
		7935	11	117-11		Oxley St (E)	T	660	631	-29	-4%	1.1
		7927	12	117-12		Narellan Road (N)	L	273	425	152	56%	8.1
118	Camdenm Road	69224	1	118-1	Camdenm Road (N)	Kellicar Road (W)	R	0	0	0	#DIV/0!	0.0
	Hurley St	69226	2	118-2		Camden Road (S)	T	0	0	0	#DIV/0!	0.0
	Camden Road	69203	3	118-3		Hurley St (E)	L	0	0	0	#DIV/0!	0.0
	Kellicar Road	69228	4	118-4	Hurley St (E)	Camdenm Road (N)	R	0	#N/A	#N/A	#N/A	#N/A
		69227	5	118-5		Kellicar Road (W)	T	1212	1249	37	3%	1.1
		69208	6	118-6		Camden Road (S)	L	50	75	25	50%	3.2
		69220	7	118-7	Camden Road (S)	Hurley St (E)	R	58	29	-29	-50%	4.4
		7773	9	118-9		Kellicar Road (W)	L	375	306	-69	-18%	3.7

P1521 Kellicar Precinct

AIMSUN Intersection Results - Base

PM Peak 1645-1745

All Vehicles

GEH Turn Summary 0800-0900		
>10	0	0.0%
>5, <=10	24	13.9%
<=5	149	86.1%

ID	Intersection							Surv eyed	Model Output	Difference (Mod - Sur)	% Diff (Mod - Sur)	GEH
		69223	10	118-10	Kellicar Road (W)	Camden Road (S)	R	267	279	12	4%	0.7
		69222	11	118-11		Hurley St (E)	T	845	727	-118	-14%	4.2
		69216	12	118-12		Camdenm Road (N)	L	0	0	0	#DIV/0!	0.0
119	Camden Road	7915	1	119-1	Camden Road (N)	Oxley St (S)	R	223	204	-19	-9%	1.3
	Oxley St	69267	3	119-3		Oxley St (W)	L	50	71	21	42%	2.7
	Oxley St	7916	4	119-4	Oxley St (W)	Camden Road (N)	R	65	109	44	68%	4.7
		7902	5	119-5		Oxley St (S)	T	1631	1493	-138	-8%	3.5
		7918	11	119-11	Oxley St (S)	Oxley St (W)	T	755	733	-22	-3%	0.8
		8340	12	119-12	(N)	#REF!	L	260	243	-17	-7%	1.1