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1. INTRODUCTION
1. INTRODUCTION

1.1 BACKGROUND

Sydney’s population is expected to rise by more than 1.7 million by 2036 and this additional population will require some 570,000 more homes and 700,000 more jobs. A Plan for Growing Sydney is the NSW Government’s plan for achieving this target and identifies how this new housing stock can be created and ensures that these residents have access to employment opportunities supported by the delivery of critical infrastructure.

While a large proportion of this new housing will be delivered in the South West and North West Priority Growth Areas, the Greater Macarthur Investigation Area (GMIA) has been identified in A Plan for Growing Sydney as another potential area where urban development could occur to help in reaching the population growth targets.

The NSW Department of Planning and Environment (DPE) has undertaken preliminary investigations into the establishment of new population centres within the Greater Macarthur Area, at Menangle Park & Mt Gilead, West Appin and Wilton. These four centres have the potential to deliver up to 60,000 homes and 37,000 jobs in the GMIA.

The travel demand associated with the growth of residents presents a significant challenge for transportation to efficiently connect these people with the broader Sydney transportation network. The need for transport infrastructure will need to be balanced with the need to maintain the character of the existing townships, and minimise the impacts of continuing freight traffic that currently travels through the area.

Jacobs has been commissioned by DPE to undertake this strategic transport infrastructure study. This study has identified a preferred future transport network for the area which has been tested through the use of Aimsun mesoscopic traffic modelling.

1.2 PURPOSE OF THIS REPORT

This report broadly documents the process of developing a preferred structure plan for the GMIA and the assessment of the plan through the use of Aimsun mesoscopic traffic modelling.

The traffic modelling has been used to provide a rational forward plan for the overall road network infrastructure requirements for GMIA (2026, 2036 and 2051). The infrastructure requirements identified in this report as well as the staging of these works will assist in determining the Special Infrastructure Contribution (SIC) levies that developers will be required to pay or provde as works-in-kind.

This report details the traffic modelling outcomes of the initial assessment as part of the structure plan process, which will form the basis of further transport planning and modelling work as part of the detailed precinct planning process for GMIA.

This report represents independent advice to the NSW Government and is not to be read as government policy. Infrastructure presented in this report is not currently funded.

The next stages of planning will include the development of Land Use and Infrastructure Implementation Plans, formulation of Special Infrastructure Contributions Frameworks and detailed precinct planning.

This report will need to be revised and updated as the nature of the precinct plans and land uses within GMIA are confirmed during the detailed planning and design process.

The report does not aim to describe every detail in the planning, design and modelling process. Moreover, excessive detail would defeat the purpose of provding a clear top-down view of the broad structure plan and the development of key transport infrastructure elements.

1.3 ASSUMPTIONS AND LIMITATIONS

The scope of this work entails a number of assumptions and limitations on the latitude of this study. The main assumptions and limitations of this work include:

- The road network structure within the mesoscopic model focuses on the higher order road network only i.e. motorways, arterials and sub-arterials. Further refinement of the local and collector road network will be required as part of the detailed precinct planning process.
- The road network alignments coded within the mesoscopic model should be treated as notional. They are physical reflections of the links rather than the optimal location or alignment of links. This said, they do provde a potential reference for network interface points with adjacent links and development.
- The development of future traffic demand is based on land use data provded by the Department of Planning and Environment (DPE). Variations and changes to this land use will influence travel patterns in the study area and may impact the findings and recommendations of this report.
- The land use inputs into the traffic modelling process appear to be significantly higher than outcomes within LU16 version 1.3. This is further exacerbated by the significant difference between the number of employment opportunities as compared to the residential population, which is unlikely to support proper “self-containment” within GMIA.
- An indicative urban hierarchy has been established in the absence of a detailed centres hierarchy to assist in the development of a multi-modal transport network.
- Estimates of mode split, external, travel demand and patterns are limited to outputs provded by Transport for NSW from the Sydney Strategic Travel Model (STM). The interpretation of STM outputs needs to be undertaken with some caution in a context such as GMIA, given the coarse nature of the zonal system.

This study has considered a wide range of issues concerning the possible introduction of road and transit corridors in the study area. As the study is a strategic investigation, it has not been possible to accurately quantify every aspect of the route assessment process.

Modelling and analysis underpinning this study was undertaken prior to the availability of detailed route information regarding the proposed Outer Sydney Orbital (OSO). As planning for GMIA continues it will be necessary to consider the latest details of the OSO corridor.

1.4 REPORT STRUCTURE

The report is structured as follows:

Section 2: Preferred structure plan - Presents the preferred structure plan and describes the proposed integrated transport network impacting the study area.

Section 3: Model development - Outlines the mesoscopic model development including strategic demand models, trip generation, trip distribution, mode choice and assignment.

Section 4: Appraisal of the preferred plan - Outlines the performance of the functional elements of the road network identified in the preferred structure plan, and identifies infrastructure requirements to meet the desired standards of service.

Section 5: Summary and findings – Presents a summary of the model findings and sets the principal conclusions of the study.

Appendix A: Wilton access requirements - presents a high level review of access arrangement options for the road network surrounding Wilton.
2. PREFERRED STRUCTURE PLAN

GREATER MACARTHUR INVESTIGATION AREA

Not Government Policy
2.1 CONTEXT

Location

The Greater Macarthur Investigation Area (GMIA) is located in the South West District as identified in A Plan for Growing Sydney in December 2014. The regional city centres of Campbelltown-Macarthur and Liverpool are located approximately 5km (to the north) 25km (to the north-east) respectively.

The GMIA is also positioned to the south of the South West Priority Growth Area (SWPGA) and at the bottom of the linear north-south growth corridor that includes the Glenfield to Macarthur Urban Renewal Corridor.

The GMIA is located approximately 60 km south-west of Sydney CBD and approximately 35 km from both the new Western Sydney Airport and Port Kembla. The location also presents a number of strategic opportunities due to its proximity to key long term city shaping infrastructure such as the Outer Sydney Orbital (OSO) and Maldon to Dombarton Freight Rail Link (M2D).

This sub-region is a vital thoroughfare for State significant passenger & freight traffic and will become more critical in the future to support the freight task of the state. This includes potential links to Port Kembla by both Road and Rail based modes. Especially from 2030 and beyond as Port Botany’s ability to solely accommodate Sydney’s growing Freight Task reaches capacity.

In addition, this area is critical in providing access between Sydney and the south and south west of Australia.

The regional context is shown in Figure 2.1.

Figure 2.1: Regional context
Scale
The GMIA comprises almost 16,000 hectares of rural and semi-rural land in the Campbelltown and Wollondilly local government areas. The GMIA is currently being investigated by DPE to examine the additional housing release around proposed centres at Menangle Park, Mt Gilead, West Appin and at Wilton. These areas represent one of the few large scale greenfield sites remaining in the Sydney basin than can accommodate new urban development.

The 2016 population within the GMIA is approximately 8,500 and by 2051 the population is expected to increase to approximately 160,000 and be supported by approximately 37,000 jobs. Since existing infrastructure is unable to serve this future growth, improvement and expansion of the transport network will be required to effectively meet the access and mobility needs of this emerging area. The key to managing this growth will be through a highly compact and connected urban, land use and transport framework focussed at precincts and centres served by an integrated land use and transport system.

Movement and access
The GMIA has direct access to the M31 Hume Motorway, Picton Road, Appin Road and the Southern Highlands rail line providing the opportunity for a range of land uses. The long term development of GMIA is planned to coincide with the emergence of major economic facilities within the region broadly defined by the Western Sydney Airport (WSA) within the Western Sydney Priority Growth Area (WSPGA), Moorebank Intermodal Terminal and the future expansion of Port Kembla as the NSW’s second container terminal. Taken together, these major opportunities support an emerging urban and economic sub-region located south of Campbelltown-Macarthur shown in Figure 2.2.
Three cities

Towards our Greater Sydney 2056, the draft amendment to A Plan for Growing Sydney released by the Greater Sydney Commission in November 2016 outlines a vision for a metropolis of three cities. This represents a shift from the current spatial structure of Sydney focused around east-west radial corridors such as the western rail line and M4 motorway, to a structure focused around emerging north-south connections with the three cities connected by the primary east-west connections already in existence.

The three cities structure is intended to act as a central organising strategy in the planning for Greater Sydney as a metropolis of 8 million people by 2056. The three cities comprise the following:

The established Eastern City:
The currently established Sydney City, with its economic corridors to the north through to Macquarie Park and to the south through Sydney Airport and Port Botany to Kogarah.

The developing Central City:
Centred on the Greater Parramatta to Olympic Peninsula, the central city is anticipated to undergo the most significant urban transformation over the next 10-15 years and will be one of Greater Sydney’s administrative and business centres and the Westmead health and education precinct will continue to grow and lead best practice in medical and education related industries.

The emerging Western City:
Focusing on the economic growth to be generated by the new Western Sydney Airport, the emerging Western City will provide a greater diversity in housing, employment and social opportunities for the growing population of Western Sydney. The provision of diverse housing supply, an integrated transport system, employment and social opportunities will create a place that people will want to call home.

Figure 2.3 illustrates the changing spatial structure of the Sydney Metropolitan Area from the initial structure developed under the County of Cumberland Planning Scheme in 1948 through to the current three city structure envisaged under the draft amendment to A Plan for Growing Sydney in 2016.
2.2 THE SPATIAL FRAMEWORK

The spatial framework has been developed based upon a philosophy that seeks to integrate various planning elements that contribute to the Greater Macarthur Investigation Area (GMIA) structure. This is illustrated in Figure 2.4 and is summarised described as follows:

- The positioning of key land uses and transport connections to complement established and new urban structures within the GMIA.
- A range of residential densities and associated product mix, including an emphasis on lower to medium density product types.
- The plan targets a residential population in the order of 160,000 residents, complemented by an employment population of approximately 37,000 workers (or 25% of the residential population).
- Definition of an integrated multi-modal transport system ensuring alternatives to the car within the core urban area and connectivity across the entire proposed urban area. This includes strengthening the use and electrification of the Southern Highlands railway line with the introduction of two new stations. One located at Maldon and another located between Menangle and Douglas Park.
- The facilitation of mass and intermediate transit corridors and the optimisation of these through support for highly accessible centres and high quality connections. The structure plan incorporates two urban spines at Macarthur-Mt Gilead-Appin-Douglas Park and Maldon-Wilton-Wilton East with the provision of intermediate transit corridors providing local opportunities through population distribution, density, employment location and facilities and services.
- The road network has been defined by an interconnected grid road network and has been designed in conjunction with land use planning in order to create discrete internal ‘neighbourhoods’ and mixed use centres of development.
- Emphasis has been placed on achieving a high level of internal connectivity within the GMIA and the diversion of externally focused road-based journeys to occur around the edges of - rather than through - key centres.
- Road capacity enhancements have been identified for the existing higher order road network, as well as new connections and interchanges on the M31 Hume Motorway between Picton Road and Narellan Road.
- The establishment of key east-west road links through the development of higher order parkways at Spring Farm Road, Link Road A, Macquarie Vale Road and Douglas Park Drive ensuring through traffic does not infiltrate and dik de residential areas. Key north-south road links such as Appin Road, M31 Hume Motorway and Menangle Road are required to be widened as part of the broader connectivity strategy for GMIA.
- Investigate the potential re-alignment of the Maldon to Dombarton rail link (between Maldon and Wilton) to align with potential freight dependent industries along Picton Road (east of Menangle Road). The realignment facilitates a greater degree of responsiveness to the proposed centre at Wilton and balances the amenity and performance of this emerging centre.
2.3 CENTRES

A new hierarchy of centres is proposed, which defines three types of centres: regional, major and neighbourhoods.

The establishment of a hierarchy of centres allows various structural options to be explored through the recognition of clearly defined population catchments and the services and facilities required to meet the needs of each catchment.

As defined by the structure plan process the ultimate population for the GMIA is approximately 160,000 residents with a supporting employment of 37,000 jobs.

Figure 2.5 lays out a schematic example of the urban hierarchy. In the context of the GMIA and the wider regional area, the hierarchy has been assumed as follows:

- Campbelltown represents the regional city centre
- Appin, Narellan, Menangle Park, and Wilton represent the major centres
- Camden, Mt Gilead, Douglas Park, West Appin represent neighbourhood/local centres.

A hierarchy of centres has been developed in lockstep with the development of movement corridors. A schematic representation of the distribution of centres and the corresponding transport hierarchy is shown in Figure 2.6.
A key component of the overall planning process involves the protection of long term corridors for mass and intermediate transit infrastructure within the GMIA and the optimisation of this through support for highly accessible centres and high quality connections to key activity centres.

In this context, a schematic hierarchy concept has been developed to ensure that focus is on building transit corridors to support centres and linked to emerging nodes within GMIA and beyond.

The transport movement network and hierarchy has been based on the NSW Long Term Transport Master Plan (LTTMP) as follows:

**Mass Transit** – comprising rail and rapid transit linking key centres in the GMIA and adjoining urban areas to the north and north-west.

**Intermediate Transit** – rapid bus and light rail services providing system integration and access to key centres from residential areas.

**Local Transit** - comprising a bus-based network providing access to local centres and neighbourhoods and cross town movements.

**Higher Order Road Network** - Motorways and primary arterial roads providing regional connectivity for people and goods.
## 2.4 LAND USE

A staged land use scenario has been developed which distributes approximately 60,000 dwellings and 37,000 jobs across the GMIA.

The development of an optimal land use scenario has been undertaken as part of the integrated transport and land use planning process. The process has ensured as many dwellings and jobs as possible are located at highly connected and accessible nodes in the transport network. This philosophy minimises the length and number of vehicle trips in the network by improving the connectivity, safety and accessibility of public transport, walking and cycling.

Higher residential densities have been focused around high capacity public transport corridors to maximise the catchment and increase the effectiveness of these services. New centres will also be located near key transport nodes to ensure that jobs and services are focused around areas with the highest levels of accessibility.

Figure 2.8 and Figure 2.9 outline the proposed employment and population distribution throughout the GMIA. For the purpose of assessing the staged implications of future growth within GMIA, the following stages have been adopted:

- 30% of proposed dwellings taken up by 2026
- 70% of proposed dwellings taken up by 2036
- 100% of proposed dwellings taken up by 2051

Table 2.1 presents the approximate staging of population and employment in each of the three GMIA precincts.

It is noted that the timing of development in West Appin is currently unknown and is unlikely to occur in the short term. The study has assumed some development in the medium term in order to allow planning of the wider transport network.

### Table 2.1: Population and employment projections

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<th>Year</th>
<th>Population</th>
<th>Jobs</th>
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</thead>
<tbody>
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<td>Mt Gilead &amp; Menangle Park</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2026</td>
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<td>4,000</td>
</tr>
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<td>2036</td>
<td>45,000</td>
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</tr>
<tr>
<td>2051</td>
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<td>10,000</td>
</tr>
<tr>
<td>West Appin</td>
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<td></td>
</tr>
<tr>
<td>2026</td>
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<td>0</td>
</tr>
<tr>
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</tr>
<tr>
<td>2051</td>
<td>40,000</td>
<td>11,000</td>
</tr>
<tr>
<td>TOTAL</td>
<td>160,000</td>
<td>37,000</td>
</tr>
</tbody>
</table>
2.5 TRANSPORT AND MOVEMENT

2.5.1 Overview
The Preferred Structure Plan addresses the local, regional and nationally significant transport needs with a particular focus on the GMIA. It is a high-level strategic plan, designed as part of an ongoing process of delivery, whereby the various elements of the Preferred Plan will be subject to detailed study, design and refinement but always within the same strategic framework. The Preferred Plan presents the opportunity to manage the GMIA’s potential for urban development and renewal in order to:

- Respond to the growth in travel associated with increased population and economic activity
- Provide the levels of access and mobility to, from and within the GMIA required to meet the needs of workers, residents, visitors and students
- Encourage the reduction of car reliance by providing alternative modes of transport with a preference for public transport
- Ensure a high level of connectivity within the GMIA through improved public transport linkages, walking and cycling networks
- Provide an appropriate hierarchy of roads to serve and separate local and regional traffic
- Meet the aspirations of residents in terms of liveability and quality of life.

The planning and evaluation of the Preferred Plan for the GMIA involved a multi-layered process involving the key following steps:

- Analysis of land use for the GMIA including the distribution of population and employment densities
- Analysis of travel demand using the Sydney Travel Demand Model (STM) of 2026, 2036 and 2051 horizon years and selection of suitable public transport network

Further refinement of the transport and road network using the GMIA Aimsun mesoscopic model and evaluation of the Preferred Plan. The identified transport network has been tested using the STM and then further evaluated using Aimsun mesoscopic model that provided key network performance results. Following an evaluation of the model outputs, initial transport network concepts were further refined.

Demand drivers and transport task
At present, private vehicles are the dominant transport mode in GMIA, accounting for approximately 90% of trips. Public transport mode share is approximately 6% and active transport makes up less than 4% of trips. The lack of an integrated public transport system reinforces the high level of car dependency and impacts negatively on the quality of life for people living and working in the GMIA.

The most up to date information on issues relating to network capacity for three modes (road, rail and bus) within GMIA is provided for the 2-hour AM peak period for 2016, 2026, 2036 and 2051. This information is illustrated below in Figure 2.10 and is sourced from the Strategic Travel Model (STM) for the GMIA study area. These modelling outputs indicate that the combined network capacity serving GMIA is approaching its theoretical capacity.

For 2051, a considerable shortfall representing approximately 60,000 passenger trips in the 2-hour peak is clearly evident. The future demand in passenger trips is likely to exceed the existing theoretical capacity by approximately 50%. These results indicate that additional capacity needs to be added to the GMIA transport network in the form of higher-order modes of public transport to meet the future growing population needs.

Guiding principles
The planning of the transport network for GMIA has been informed by a guiding set of principles. These principles seek to ensure that the future residents and workers of GMIA will have the benefit of choice, not only for their travel mode, but also for when and where they wish to travel for live, work and play activities. These principles cannot be achieved without a complementary approach to land use planning that ensures the urban structure takes full advantage of the most highly accessible locations created by the transport structure, whilst also balancing important environmental, social, and economic objectives.

- Provide travel choices- Ensure that residents and workers are provided with multiple high quality transport options to reach a variety of destinations for live, work and play activities in a 24 hour/7 day a week economy.
- Encourage the use of sustainable modes- Provide high quality public and active transport linkages as part of an inter-connected network providing access to centres within and outside the region, and minimising reliance on private vehicles.
- Support liveable communities- Ensure an integrated land use and transport outcome that supports higher density mixed use communities and centres within walking catchments of high quality public transport.
- Cater for a sustainable level of future demand- Support projected demand by creating high capacity public transport systems and additional road capacity on higher order connections; provide that additional capacity does not compromise other key principles of the plan.
- Protect transport network productivity- Protect productive freight and passenger transportation by minimising impacts on nationally significant connections such as such as the M31 Hume Motorway, Picton Road, Maldon to Dombarton Freight Rail Link and Southern Sydney Freight Line.
2. PREFERRED STRUCTURE PLAN

Multi-layered integrated approach

The planning and evaluation involved a multi-layered integrated approach described as follows:

Establishing a hierarchy of centres

- Providing retail, commercial, employment and community centres based upon proximity to population
- Establishing a series of “centres” within GMIA that can be effectively served by public and active transport
- Ensuring sufficient space is provided for employment and that economic assets are protected

Green infrastructure and environment

- Distribution of land uses that best correlate to environmental systems and conservation areas.

Provide a multi-modal transport network

- Ensuring a high level of connectivity within the GMIA through improved public transport linkages, walking and cycling networks
- Building upon existing mass transit links (i.e. Southern Highlands rail line) to create movement and connectivity corridors between proposed centres
- Identifying long term public transport corridors which ensure accessibility to land uses contained around key transit nodes.

Provide an interconnected grid road network

- Road hierarchy based on the distribution of centres to facilitate both local and regional trips and the stepped distribution of traffic from higher to lower order roads
- Promoting connectivity, permeability and legibility based on a grid network
- Road network structured and designed according to land use planning framework.

Provide an integrated network

- The preferred structure plan builds on all the urban elements through a fully integrated transport plan
- A transport hierarchy is proposed whereby transport is integrated into the overall structure for GMIA
- This allows the servicing of the existing areas and the potential expansion of the GMIA plan along existing and future corridors.
2.5.2 Integrated Public Transport Network

The public transport network has been designed based on the transport and movement principles shown below.

- **Legible** - A clear hierarchy of transit based on mass, intermediate and local services. Ensuring the right transit mode is used to serve its appropriate purpose / demand
- **Connected and Accessible** - An interconnected network that provides connections into the mass transit network
- **High Quality Interchange Experience** - A frequent all-day network that allows ‘frequency to frequency’ interchange to avoid excessive wait times for connecting services
- **Efficient and Equitable** - A network that avoids long and unreliable routes whilst balancing local transport and coverage needs.

**Mass transit spine (M1) – Picton / Wilton to Macarthur**

The primary spine runs along the existing Southern Highlands rail line connecting to either Picton or Wilton (via electrification and quadruplication in the long term) and north to Macarthur. Potential stations at Douglas Park North and Maldon would provide interchange to local connections and access to potential employment lands.

**Intermediate transit (I1) – Douglas Park to Macarthur via Appin**

The secondary spine is a new corridor connecting Douglas Park Station, West Appin, North Appin, Gilead, and Macarthur. This spine provides connections to the new major centre (West Appin), existing regional centres (Campbelltown / Macarthur), and local centres in-between (e.g. Gilead). This is consistent with the on-street rapid transit corridor identified in the *Western City District Structure Plan 2036* (Greater Sydney Commission, 2017).

**Intermediate transit (I2) – Douglas Park North to Wollongong via University of Wollongong**

An additional secondary route is provided to create a high quality, high frequency connection from Douglas Park North Station / West Appin to the primary regional centre at Wollongong. This route also provides coverage of areas of Appin along Macquariedale Road.

**Intermediate transit (I3) – Maldon to East Wilton**

An additional secondary route connects the new station at Maldon with Wilton Town Centre and East Wilton. This corridor is an integral higher capacity link connecting local services throughout Wilton with mass transit at Maldon. The use of this corridor for intermediate transit will need to be investigated as part of the Maldon to Dombarton business case.

**Local transit (L1) – Picton to Wilton Junction via West Wilton:** Local service coverage of West Wilton and connection to Picton / Wilton centres and feeding of mass / intermediate corridors.

**Local transit (L2) – Douglas Park to Wilton South via Bingara Gorge:** Local service coverage of Bingara Gorge and Wilton North feeding to mass / intermediate corridors.

**Local transit (L3) – Camden to Douglas Park North via Camden South:** Local connection between mass transit corridor and Camden.

**Local transit (L4) – Appin to Macarthur via Appin Road:** Provisions north-south service coverage for areas of Appin and Gilead connecting to Rosemeadow and the primary centre at Campbelltown / Macarthur.

**Local transit (L5) – Gilead to Narellan via Menangle Park:** Local east-west coverage for Gilead between multiple N-S corridors and connecting to Menangle Park Station and Narellan centre.

Figure 2.11: Strategic public transport network
Key interchanges

New mass transit stops are proposed at Douglas Park North and Maldon to provide interchange to intermediate and local services, and access to potential employment lands. Other key interchange points are located at Maldon, Douglas Park and Macarthur, with Macarthur providing connections to key destinations such as Western Sydney Airport, Liverpool, Parramatta and Sydney CBD. Local interchanges will also be provided at Menangle Park and Picton.

Proposed intermediate transit corridors and stops will be based on 800m catchment radius, ensuring a high level of coverage and accessibility. Local transit corridors will support both rail and intermediate networks to provide a finer grain, local service. Bus stop locations along these corridors have been determined based on a 400m catchment radius to ensure a high level of coverage within GMIA.

Corridors may also be a catalyst for change in existing urban areas in the longer term. Increased capacity may allow for increased densities where desired or necessary.

Whilst intermediate and mass transit are vital in the longer term, local bus services will play a key role in the short term.

Table 2.2: Strategic public transport network characteristics

<table>
<thead>
<tr>
<th>Mass Transit Network</th>
<th>Intermediate Transit</th>
<th>Local Transit Network</th>
</tr>
</thead>
<tbody>
<tr>
<td>Service type</td>
<td>Express in peak and all-stop all day</td>
<td>All-stop</td>
</tr>
<tr>
<td>Frequency</td>
<td>Turn up and go</td>
<td>Turn up and go</td>
</tr>
<tr>
<td>Service span</td>
<td>7 days</td>
<td>At least every 15min</td>
</tr>
<tr>
<td>Average speed</td>
<td>25-70km/h</td>
<td>15-30km/h</td>
</tr>
<tr>
<td></td>
<td>15-20km/h</td>
<td>15-20km/h</td>
</tr>
<tr>
<td>Coverage</td>
<td>Relatively small set of high volume corridors</td>
<td>Wider coverage but still focussed on direct connections</td>
</tr>
<tr>
<td></td>
<td>More extensive coverage, as direct as possible</td>
<td></td>
</tr>
<tr>
<td>Capacity</td>
<td>High</td>
<td>Medium</td>
</tr>
<tr>
<td>Stop spacing</td>
<td>&gt;1km</td>
<td>400-1km</td>
</tr>
<tr>
<td></td>
<td>400m</td>
<td>400m</td>
</tr>
</tbody>
</table>
Public transport patronage

The Sydney Travel Model (STM) was used for a high level review of the proposed transport network comprising mass, intermediate, local and transit networks.

The peak headways and demand are shown in Table 2.3 for the ultimate 2051 scenario. Lower patronage results for some local routes are a result of large zone structures in the STM as well as the inability for modelling of short local trips within travel zones. The routes identified are required in order to provide a minimum level of service coverage.

It is observed that there is significant demand for public transport in the GMIA. The provision of high quality and efficient public transport services will be vital to ensuring this demand is met and private vehicle usage is minimised as much as possible. A failure to significantly invest in public transport infrastructure would lead to increased car trips and a degradation of the road network performance in the GMIA.

Table 2.3: Public transport service and patronage (2051 AM peak hour)

<table>
<thead>
<tr>
<th>Route</th>
<th>Type</th>
<th>Description</th>
<th>Headway (min)</th>
<th>Estimated demand (pax)</th>
</tr>
</thead>
<tbody>
<tr>
<td>M1</td>
<td>Mass</td>
<td>Southern highlands line</td>
<td>7.5</td>
<td>2,400</td>
</tr>
<tr>
<td>I1</td>
<td>Intermediate</td>
<td>Douglas Park to Macarthur via Appin</td>
<td>7.5</td>
<td>2,500</td>
</tr>
<tr>
<td>I2</td>
<td>Intermediate</td>
<td>Douglas Park North to Wollongong via Appin and UOW</td>
<td>6</td>
<td>1,400</td>
</tr>
<tr>
<td>I3</td>
<td>Intermediate</td>
<td>Maldon to East Wilton</td>
<td>7.5</td>
<td>500-1,000~</td>
</tr>
<tr>
<td>L1</td>
<td>Local</td>
<td>Picton to Wilton Junction via West Wilton</td>
<td>10</td>
<td>300</td>
</tr>
<tr>
<td>L2</td>
<td>Local</td>
<td>Douglas Park to Wilton South via Bingara Gorge</td>
<td>10</td>
<td>100</td>
</tr>
<tr>
<td>L3</td>
<td>Local</td>
<td>Camden to Douglas Park North via Camden South</td>
<td>15</td>
<td>100</td>
</tr>
<tr>
<td>L4</td>
<td>Local</td>
<td>Appin to Macarthur via Appin Road</td>
<td>10</td>
<td>1,000</td>
</tr>
<tr>
<td>L5</td>
<td>Local</td>
<td>Gilead to Narellan via Menangle Park</td>
<td>6</td>
<td>200</td>
</tr>
</tbody>
</table>

2.5.3 Road Network

The structure plan is based on an interconnected, legible, urban-scale grid street pattern that will provide optimal opportunities for bus/freight serving and access. The road network has been planned and spatially dimensioned integrally with the land use planning. This has ensured that the higher order road network and its position in the road hierarchy is appropriate to its role and the traffic demands placed upon it.

The proposed ultimate road network hierarchy for GMIA broadly aligns with the hierarchy characteristics presented in NSW Long Term Transport Master Plan (LTTPM) TfNSW 2012, which includes the following higher order classifications:

- **Motorways** – primarily dedicated to supporting traffic functions and facilitating the commercial and freight movement between strategically important ports, airports, employment areas, industrial areas, freight terminals and intermodal terminals. Major inter-regional traffic movements are catered for in a safe and operationally efficient manner with strict access control via grade separated interchanges and carriageway separation.

- **Primary arterial roads** – predominantly carry through traffic from one region to another, forming principal avenues of communication for urban traffic movements. Traffic movements are prioritised with a focus on capacity, congestion management, speed and safety. Primary arterials generally have a higher speed limit than transit arterials.

- **Transit arterials** – are key routes between mixed use centres that support road-based public transport and feature significant transit priority infrastructure. A lower speed environment is provided to increase the safety and attractiveness of active transport and direct property access is restricted where possible.

- **Sub-arterials** – connect the arterial roads to areas of development or carry traffic directly from one part of a region to another. They may also relieve traffic on arterial roads in some circumstances. The sub-arterial road environment balances the traffic movement function and the need for access.

In general, the local and collector road network has not been considered in this study as these links will be investigated and planned as part of detailed precinct planning works. Some investigation and modelling of lower order roads has been undertaken in Wilton due to the more advanced nature of planning and design in this precinct. Details of these investigations can be found in Appendix A.
Functional hierarchy based on transport function and land use context

A more nuanced classification of roads based on their role in the multi-modal transport system and land use context is needed for the GMIA. This ‘movement and place’ approach has been developed based on experience in other jurisdictions and is critical to achieving the desired transport and land use outcomes – especially within a context that demands sound economic justification.

The framework defines the future function of the street network on the basis of land use and transport objectives and desired outcomes for the GMIA. The roads within and around growth areas and precincts provide two primary functions for transport customers:

- Movement: the ability to travel between places
- Place: the ability to access origins and destinations of travel

An understanding of the two functions of a street are vital when the two functions are competing, such as through increased movement requirements or improved place amenity. The movement and place function of a street informs planning for the level of access across each of the transport modes. The street network consists of a mixture of different road types serving different functions within the transport network. A sample of this type of classification is provided in Figure 2.13. It is noted that this study has focused on the planning of motorways and movement corridors. Identification of vibrant streets, places for people and local streets will be undertaken at the detailed precinct planning stage.

Access management

The objective of access management is principally to maintain the efficiency and safety of the road network while protecting, if not enhancing, the quality of the land and developments alongside. Management of access to land development and the location and design of access points and developments are linked to the function of the road, the types and volumes of traffic, and the different trip purposes that it serves.

There is a three-way relationship between the speed environment of a given road, the nature and intensity of vehicle interaction between the road and adjacent land, and the quality of the outcomes (safety and efficiency in particular). The M31 Hume Motorway is a high speed, high capacity road on the National Land Transport Network (NLTN) where safety and efficiency outcomes need to be protected. This will necessarily imply a degree of control over site access to developments and other points of access.

In managing access to the arterial road and motorway network serving GMIA, the following key objectives will need to be achieved:

- To ensure that the safety and efficiency of the road network is not compromised by inappropriate direct site access to adjacent land uses or between closely spaced arterial/sub-arterial intersections, and between motorway interchanges
- To preserve the amenity and efficiency of adjacent land uses, while recognising the need to make adequate provisions for the safe and efficient movement of arterials and motorways
- To reach an appropriate balance between road functions and land-related functions and accessibility, so that roads and land use can be properly integrated.
- To eliminate traffic flow interference and conflicts associated with access movements by providing total functional separation between the road and adjacent land
- To ensure land use access can be provided without being impeded by high speed and/or high volume traffic movements.

Table 2.4 Typical characteristics of road network components

<table>
<thead>
<tr>
<th>Function</th>
<th>Land use access function</th>
<th>Speed Environment</th>
<th>Permitted network connections</th>
<th>Permitted intersections</th>
<th>Intersection spacing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motorway</td>
<td>No direct site access</td>
<td>80 to 110km/h</td>
<td>Primary Arterial Sub-arterial</td>
<td>Grade separated interchange</td>
<td>3 to 5km</td>
</tr>
<tr>
<td>Primary Arterial</td>
<td>Limited access, service</td>
<td>80km/h</td>
<td>Motorway Sub-arterial</td>
<td>Traffic signals</td>
<td>0.8 to 1.0km</td>
</tr>
<tr>
<td>Transit Arterial</td>
<td>Limited access, service</td>
<td>60 to 80km/h</td>
<td>Sub-arterial Collector</td>
<td>Traffic signals</td>
<td>0.5km</td>
</tr>
<tr>
<td>Sub-arterial</td>
<td>Limited access, service</td>
<td>80 to 80km/h</td>
<td>Primary arterial Collector</td>
<td>Traffic signals</td>
<td>0.5km</td>
</tr>
<tr>
<td>Collector</td>
<td>Limited controls on location and arrangement</td>
<td>50km/h</td>
<td>Sub-arterial Collector Local</td>
<td>Traffic signals Roundabout</td>
<td>100-200m</td>
</tr>
<tr>
<td>Local</td>
<td>Limited controls on access with primary land use access function</td>
<td>50km/h</td>
<td>Collector Roundabout Priority</td>
<td>40-60m</td>
<td></td>
</tr>
</tbody>
</table>
2. PREFERRED STRUCTURE PLAN

The proposed network

The proposed ultimate road network for 2051 is shown in Figure 2.15. The key features of the proposed road network are:

- A road hierarchy that is compatible with the land use and range of roles that each key road is likely to serve. This incorporates a grid of arterial and sub-arterial roads to distribute traffic within the GMIA and promote access to the regional road network.

- Provides optimal opportunities for the road network to be serviced by an integrated public transport network for roads serving a public transport function.

- Separates road user classes across the road hierarchy, which will generally aid in maintaining the efficiency and safety of the environment for all users along the M31 Hume Motorway.

- An alignment of roads and intersections that support the existing and future movement of people and goods.

- Understands and provides for competing demands for access to the road network, from pedestrians, cyclists, and public transport services which can be local, sub-regional and regional.

- The protection of critical transport corridors such as the Outer Sydney Orbital and Maldon to Dombarton rail link.

- The provision of four (4) major east-west links across and connecting to the M31 Hume Motorway at:
  - Spring Farm Link Road
  - Link Road A
  - Macquarie Drive
  - Douglas Park Drive

- A road network that has been broadly spatially dimensioned to support the aims of the structure plan comprising:
  - The M31 Hume Motorway to have an ultimate configuration of 4 lanes in each direction with capacity enhancements at existing interchanges.
  - The M31 Hume Motorway to have provision for Smart Motorway infrastructure.
  - Four (4) new grade separated interchanges along the M31 Motorway (between Narellan Road and Picton Road).
  - Provision of sufficient space to accommodate the needs of transit corridors and freight services.
  - Primary arterials to have an ultimate configuration of 3 lanes in each direction.

A critical need for the Appin Bypass and Georges River Parkway has not been identified in this strategic study. These corridors should however be protected and their ability re-assessed as development occurs in GMIA.

All proposed infrastructure will be subject to more detailed investigation at the precinct planning stage. Some more detailed investigation and modelling of the road network has been undertaken in Wilton due to the more advanced nature of planning and design in this precinct. Details of these investigations can be found in Appendix A.

Figure 2.15: Indicative Road Network Structure
Indicative cross sections

Road corridor cross sections are useful in considering the role of the road hierarchy in the overall transport and land use system, the relationship between different road users, how different road users are accommodated, and how frontages to the road corridor are managed. Figure 2.16 show typical cross sections proposed for the GMIA for three higher order road types:

- Primary Arterial road
- Transit arterial
- Sub-arterial road.

These are indicative only and the final layout will be subject detailed precinct planning and road design. The specific land uses adjacent to these corridors will have a significant influence on the final cross section layout. In particular, where no active land use abuts a major road, a full off-road cycle path will be more appropriate than an on-road lane.

Source: Adapted from Growth Centres Road Framework (NSW Roads and Maritime Services 2008)

Figure 2.16: Indicative road cross sections

Primary Arterial

Transit arterial

Sub-arterial

Source: Adapted from Growth Centres Road Framework (NSW Roads and Maritime Services 2008)
2.5.4 Freight Movement

The movement of freight is an important factor for the Greater Macarthur Investigation Area (GMIA) due to its proximity to Port Kembla, Western Sydney Airport, Moorebank and Minto intermodal terminals, Southern Sydney Freight Line (SSFL) and industrial areas located at Maldon. The types of freight products driving volume through the region and GMIA include coal, grain, steel/minerals, building material, waste and container freight.

The bulk of coal and grain movements from the Central West of NSW through Sydney are destined for export at Port Kembla and the Port of Newcastle. In addition to these commodities, port related container traffic is also expected to grow within the West and South West Districts of the Sydney Metropolitan Area. Nearly 15% of all import container movements occur within the South-West region of Sydney stretching from Moorebank, Liverpool, Campbelltown to Maldon.

The proposed Maldon to Dombarton (M2D) freight rail link is a candidate project to address future long term freight access needs to/from Port Kembla and the South Coast. As freight and passenger volumes grow in the longer term, the need for an increase in freight rail services and capacity enhancements along the SSFL and the proposed M2D rail link will be required. These enhancements will be required to accommodate the delivery of Port Kembla Outer Harbour development, and the future expansion of Port Kembla as the NSW’s second container terminal.

The Outer Sydney Orbital (OSO) long term multimodal corridor (i.e. road and freight rail) would support freight growth and provide opportunities to move a greater share of freight around the metropolitan area on road, thereby bypassing the congested passenger rail network. The OSO would support freight and productivity growth moving from west of the Blue Mountains to/from Port Kembla and to the local region.

There is also a potential for increased road freight movements for GMIA with the future expansion of Port Kembla, Western Sydney Airport and the development of Moorebank intermodal terminal. This is likely to put additional pressure on the road network within GMIA such as M31 Hume Motorway, Picton Road and Narellan Road. The proposed upgrades of these key freight corridors will be required to cater for population and employment growth in GMIA and continued growth in road related freight movement.

In the absence of a detailed freight study the structure plan has considered the following measures to cater for the movements of freight:

- Ensure the structure plan balances the freight needs of the community and environmental needs
- Land uses managed and located to support the range of uses that benefit the broad community and minimise conflicts between freight uses
- Clustering of freight dependent land uses to take advantage of key freight corridors and where freight axes intersect such as M31 Motorway and Maldon to Dombarton freight rail link
- Protection of future freight corridors such as Maldon to Dombarton freight rail link and the Outer Sydney Orbital
- Providing and maintaining safe and efficient access to/from and along the higher order road network particularly on M31 Motorway and Picton Road
- Separation of freight rail movements from passenger rail movements wherever possible.

Figure 2.17: Sydney Metropolitan Freight Network
2.5.5 Walking and cycling

A connected, safe and accessible walking and cycling network will be vital in order to minimise car usage and enhance the well-being of all future GMIA residents and visitors. The walking and cycling network will work hand in hand with well-designed urban form to ensure the GMIA develops into vibrant and connected communities.

The proposed active transport network has been developed in order to maximise the attractiveness of active modes throughout the GMIA. All key strategic road corridors will include provision for safe and efficient cycling and walking infrastructure. The strategic network includes off-road and on-road features as described below:

- **Off-road** – Completely separated from general traffic to maximise safety and efficiency. Off-road paths will cater for longer distance trips and will generally be in the form of a shared path with cyclists and pedestrians. The existing path alongside the Westlink M7 motorway provides an example of this type of infrastructure.

- **On-road** – Bike lanes, bike paths and footpaths within the road reserve. These may be a mix of physically separated cycleways, shared paths and painted bike lanes. On-road facilities will be provided where vehicle speeds are expected to be lower and where active landuses are found adjacent to the road corridor.

The proposed strategic network is shown in Figure 2.18.

Key north-south regional connections will be provided by off-road paths along:

- M31 Hume Motorway
- Menangle Road
- Finns Road-Old Hume Highway-Camden Bypass
- Appin Road.

Key east-west regional connections will be provided by off-road paths along:

- Narellan Road
- Spring Farm Parkway
- Maquariedale Road
- Picton Road.

This study has not considered the design of the local road network as this will need to be developed as part of the precinct planning process. The local network will however be vital to the overall active transport structure of the GMIA. A legible and well connected grid network will ensure permeability is maximised for walking and cycling trips. Providing high levels of priority to pedestrians and cyclists throughout the lower order network will help to minimise auto-dependency by promoting active modes as an alternative to the car. A high quality active transport network will also improve public transport usage by increasing the catchment of services.

![Figure 2.18: Regional Bike Network](image-url)
2. PREFERRED STRUCTURE PLAN

3. MODEL DEVELOPMENT
3. MODEL DEVELOPMENT

3.1 OVERVIEW

Given the size of the Greater Macarthur Investigation Area (GMIA) and the scale of development that is being proposed at Wilton, Menangle Park, West Appin and Mount Gilead, Aimsun mesoscopic traffic modelling provides the ideal tool to assess the requirements of the surface transportation road network. Mesoscopic modelling allows for large-scale modelling to be undertaken using dynamic assignment that takes into account the effects of congestion on the network and allows for the identification of network constraints at the arterial and sub-arterial level. It also allows for more detailed examination of specific locations to test the effects of the land-based demands being proposed. The traffic model was used to assist in finalising the spatial framework of the GMIA structure plan and to determine required road infrastructure to support the proposed land use densities and distribution.

Mesoscopic modelling is a dynamic traffic simulation framework that models the interactions of traffic in a similar manner to microsimulation traffic modelling, albeit at a lower level of detail. Figure 3.1 describes the relationship of traffic models at the macro, meso and micro levels and illustrates where the GMIA traffic model sits within this hierarchy.

Mesoscopic modelling provides sufficient detail to determine the performance of the network under proposed future land use demands and guidance on the need for further road infrastructure improvements. In addition, mesoscopic simulation allows for true dynamic equilibrium assignment, where vehicles can select their optimum travel routes based on their previous travel experiences. This provides confidence that the modelled pattern of traffic represents a realistic response to all of the delays and capacity constraints that would be experienced by traffic.

3.2 MODELLING PROCESS

Traffic modelling has been undertaken using a multi-tiered modelling approach using a combination of macroscopic, mesoscopic and microscopic modelling (refer to Figure 3.2).

Macroscopic (static) modelling has been used for demand forecasting and mode split, while operational assessment has been undertaken using mesoscopic and microscopic traffic modelling. The general model hierarchy is as follows:

1. Sydney Strategic Travel Model (STM) – Demand forecasting and mode split
2. Greater Macarthur mesoscopic model – Operational mesoscopic modelling of study area

Sydney strategic travel model (STM)

The Sydney Strategic Travel Model (STM) is run by the Transport Performance and Analytics (TPA) team in Transport for NSW. This model is a tour-based four-step travel model, taking into account trip generation, mode split, trip distribution and trip assignment (using static equilibrium assignment). The STM covers the whole of the Sydney Greater Metropolitan Area (GMA) and models traffic demand over a whole weekday period, based on a combination of census data from the Australian Bureau of Statistics (ABS) and the Transport for NSW Household Travel Survey. The STM has been used to undertake external trip generation, trip distribution and mode split for the GMIA traffic model.

Greater Macarthur mesoscopic/hybrid model

The Greater Macarthur mesoscopic/hybrid traffic model has been developed for the assessment of the land use and road network options for Greater Macarthur. This model has been developed in Aimsun and is primarily a traffic assignment model.