# Contents

<table>
<thead>
<tr>
<th>1</th>
<th>Introduction</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td>Study Background</td>
<td>1</td>
</tr>
<tr>
<td>1.2</td>
<td>Study Objectives</td>
<td>1</td>
</tr>
<tr>
<td>1.3</td>
<td>Report Structure</td>
<td>2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2</th>
<th>Summary of Proposed Development</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1</td>
<td>North West Growth Centre Precinct</td>
<td>3</td>
</tr>
<tr>
<td>2.2</td>
<td>Riverstone East Precinct</td>
<td>3</td>
</tr>
<tr>
<td>2.3</td>
<td>Draft Indicative Layout Plan</td>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>3</th>
<th>Transport Conditions</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1</td>
<td>Existing Travel Patterns</td>
<td>5</td>
</tr>
<tr>
<td>3.2</td>
<td>Road Network</td>
<td>6</td>
</tr>
<tr>
<td>3.3</td>
<td>Crossings of the Richmond Rail Line</td>
<td>10</td>
</tr>
<tr>
<td>3.4</td>
<td>Traffic Volumes</td>
<td>12</td>
</tr>
<tr>
<td>3.5</td>
<td>Heavy Vehicles</td>
<td>14</td>
</tr>
<tr>
<td>3.6</td>
<td>Rail Services</td>
<td>15</td>
</tr>
<tr>
<td>3.7</td>
<td>Bus Services</td>
<td>18</td>
</tr>
<tr>
<td>3.8</td>
<td>Walking and Cycling</td>
<td>20</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>4</th>
<th>Precinct Planning Principles</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1</td>
<td>Transport Planning Objectives</td>
<td>22</td>
</tr>
<tr>
<td>4.2</td>
<td>Road Classification and Capacity</td>
<td>22</td>
</tr>
<tr>
<td>4.3</td>
<td>Road Cross Sections</td>
<td>23</td>
</tr>
<tr>
<td>4.4</td>
<td>Heavy Vehicles</td>
<td>23</td>
</tr>
<tr>
<td>4.5</td>
<td>Public Transport Provision</td>
<td>24</td>
</tr>
<tr>
<td>4.6</td>
<td>Walking and Cycling</td>
<td>25</td>
</tr>
<tr>
<td>4.7</td>
<td>Parking</td>
<td>28</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>5</th>
<th>Road Network Assessment</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.1</td>
<td>Assessment Criteria</td>
<td>29</td>
</tr>
<tr>
<td>5.2</td>
<td>Strategic Network Modelling</td>
<td>31</td>
</tr>
<tr>
<td>5.3</td>
<td>Traffic Generation and Trip Containment</td>
<td>32</td>
</tr>
<tr>
<td>5.4</td>
<td>Future Traffic Volumes</td>
<td>32</td>
</tr>
<tr>
<td>5.5</td>
<td>Traffic Distribution</td>
<td>35</td>
</tr>
<tr>
<td>5.6</td>
<td>Road Network Hierarchy</td>
<td>35</td>
</tr>
<tr>
<td>5.7</td>
<td>Intersection Capacity Analysis</td>
<td>41</td>
</tr>
<tr>
<td>5.8</td>
<td>Heavy Vehicle Movements</td>
<td>49</td>
</tr>
</tbody>
</table>
6 Public Transport, Walking and Cycling

6.1 Bus Network

6.2 Rail Services

6.3 Pedestrian and Cycling Network

7 Summary and Conclusions

Tables

Table 1 Existing services along the Richmond rail line
Table 2 Functional classification of roads
Table 3 GCC standard road types and road corridor widths
Table 4 Parking Rates – Residential Uses
Table 5 Parking Rates – Non-Residential Uses
Table 6 Mid-Block capacities of urban roads
Table 7 Roadway levels of service definition
Table 8 Intersection level of service
Table 9 Traffic generation rates
Table 10 2036 Traffic Volumes Summary – Riverstone East
Table 11 Sensitivity analysis - Guntawong Road closure
Table 12 Recommended Intersection Controls
Table 13 Warrants for Traffic Signals at Intersections
Table 14 Traffic Modelling Results

Figures

Figure 1 North West Growth Centre
Figure 2 North West Growth Centre Structure Plan
Figure 3 Riverstone East precinct aerial
Figure 4 Draft Riverstone East Stage 1 ILP
Figure 5 Existing travel patterns, North West Growth Centre
Figure 6 Windsor Road
Figure 7 Schofields Road upgrade
Figure 8 Garfield Road East
Figure 9 Existing Road Network
Figure 10 Proposed road network strategy for the NWGC
Figure 11 Traffic survey locations
Figure 12 Existing traffic volumes
Figure 13 Existing heavy vehicle proportions
Figure 14 Cudgegong Road station layout
Figure 15 North West Rail Link
Figure 16  Existing bus services
Figure 17  Existing cycling network
Figure 18  Separation of bicycles and motor vehicles
Figure 19  Transport for NSW residual lands
Figure 20  Traffic implications of Guntawong Road closure
Figure 21  Riverstone East Road Hierarchy
Figure 22  Stage 1 and Stage 2 Road Network
Figure 23  Intersection configurations – indicative 2036 layout
Figure 24  Recommended traffic facilities
Figure 25  Proposed bus network – Riverstone East
Figure 26  North West Sector bus servicing plan
Figure 27  North West Growth Centre Bus Catchment Area
Figure 28  Sydney’s Future Bus Network
Figure 29  Marsden Park transport corridor
Figure 30  Proposed pedestrian / cycle network

Appendices

Appendix A
Typical Road Cross Sections

Appendix B
Traffic Model Outputs
1 Introduction

1.1 Study Background

The Riverstone East Precinct is a major future urban release area which is proposed to be developed as part of Sydney’s North West Growth Centre (NWGC). Arup has been appointed by Department of Planning and Environment (DP&E) to undertake a transport assessment, one of a set of specialist studies that will inform the development of the draft Indicative Layout Plan (ILP) for the Riverstone East Precinct.

1.2 Study Objectives

The purpose of this study is to provide an assessment of the Riverstone East precinct by all modes of transport including walking, cycling, public transport and passenger vehicles. This will need to consider the development of adjacent precincts within the North West Growth Centre, as well as upcoming infrastructure works such as the North West Rail Link. The transport assessment will identify suitable facilities for Riverstone East employees and residents to walk, cycle, access to public transport or use private cars.

Specific objectives of the study will be to:

- provide a strategic overview of the existing and future transport network in the North West Growth Centre;
- assess and test the transport impacts of the proposed development of the study area as reflected in the Indicative Layout Plan (ILP), taking into consideration potential development staging;
- recommend infrastructure upgrades and other measures to address those impacts within the vicinity of Riverstone East;
- make recommendations for suitable land uses that will interface with the future NWRL stabling yard in the Riverstone East Precinct;
- prepare an agreed implementation framework, in negotiation with the NSW Government transport agencies, Blacktown Council, and DP&E, for the key infrastructure components;
- ensure all modes of transport, including private vehicle, public transport (bus and rail), walking and cycling are considered in the planning and development of each Precinct.
1.3 Report Structure

This transport assessment for the Riverstone East precinct is structured as follows:

- **Section 1: Introduction**

  This section

- **Section 2: Summary of Proposed Development**

  Overview of the future development of the North West Growth Centre and Riverstone East precinct

- **Section 3: Transport Conditions**

  Summary of existing transport services in the North West Growth Centre, including roads, public transport, walking and cycling

- **Section 4: Precinct Planning Principles**

  Identification of key criteria and objectives when planning for the development of the Riverstone East precinct

- **Section 5: Road Network Assessment**

  Analysis of future road network conditions following the development of the Riverstone East precinct, including an analysis of intersection capacities

- **Section 6: Public Transport, Walking and Cycling**

  Assessment of the future transport provision for non-car modes of travel, supporting the project objective of reducing car dependency for residents and employees of the Riverstone East precinct.

- **Section 7: Summary and Conclusions**

  Summary of the key findings of this document
2 Summary of Proposed Development

2.1 North West Growth Centre Precinct

The North West Growth Centre (NWGC), comprising 16 precincts, is approximately 10,000 hectares and will contain about 70,000 new dwellings for 200,000 people. 11 of these 16 precincts have been rezoned for development, those being:

- North Kellyville
- Alex Avenue
- Riverstone
- Riverstone West
- Colebee
- Area 20
- Marsden Park Industrial
- Schofields
- Box Hill
- Box Hill Industrial
- Marsden Park

The NWGC spans three local government areas (LGA) – Blacktown, Hawkesbury and The Hills Shire. The NWGC is undergoing a streamlined planning process to enable land to be rezoned in a shorter period. Figure 2 on the following page illustrates the existing North West Growth Centre Structure Plan (edition 3). It should be noted the alignment of the North West Rail Link indicated on this plan differs from the preferred route along Schofields Road.
A key element of the urban form is the walkable neighbourhood which is the area within a 400 metre radius from a local shop (or group of shops) or from another community focus (e.g., a community centre with a bus stop). Walkable neighbourhoods are clustered around mixed use main street retail centres shown as red on the plan. These centres include housing, community facilities, shops for daily convenience etc.

As part of Government’s commitment to deliver better, sustainable new communities it announced that a new rail line would be constructed to serve the new communities. As part of the early planning for this project, the Government will investigate route alignment options.

Note: The North West Rail Link alignment has since been updated and runs west along Schofields Road.
2.2 Riverstone East Precinct

The Riverstone East precinct is located in the eastern, central portion of the North West Growth Centre, wholly within the Blacktown Local Government Area (LGA). It is currently zoned General Rural under the Blacktown Local Environmental Plan 1988 with certain land at the northern end of the precinct zoned for residential purposes.

The precinct is bounded by Windsor Road to the east and north, Schofields Road to the south and First Ponds Creek to the west. In the wider area, the precinct is located approximately 50km from the Sydney CBD, 9km northwest of Blacktown and 5km west of Rouse Hill.

It is comprised of 656 hectares in total; it is immediately surrounded by Alex Avenue to the south west, Area 20 to the south east, Box Hill and Box Hill Industrial to the north east, and Riverstone to the direct west.

![Figure 3 Riverstone East precinct aerial](image)

2.3 Draft Indicative Layout Plan

The draft indicative layout plan (ILP) developed for Stage 1 and Stage 2 of the Riverstone East precinct is presented in Figure 4 on the following page.
Figure 4  Draft Riverstone East Stage 1 and 2 ILP
3 Transport Conditions

3.1 Existing Travel Patterns

Existing travel characteristics of residents in the North West Growth Centre area have been identified based on 2011 Journey to Work Census data¹ and 2012 Household Travel Survey Information². The existing mode share of residents is illustrated in Figure 5.

The results indicate the significant majority of journey, irrespective of purpose, are made by private vehicle. Train travel accounts for 11% of total work trips, however this would be expected to increase following the completion of the North West Rail Link (anticipated for 2019).

Walking and cycling account for low proportion of work related trips, household travel survey data indicates these modes account for a much higher proportion of household trips.

---

¹ Based on travel zones within the North West Growth Centre
² Based on travel information for residents in the Blacktown LGA
3.2 Road Network

The existing road network supporting the Riverstone East precinct, as well as potential future road infrastructure upgrades, is outlined in Figure 9. Details of key roads serving the precinct are described below.

3.2.1 Windsor Road

Windsor Road forms the primary access route into the precinct, running along the eastern boundary of the site. It is classified as a sub-arterial road, with two traffic lanes in each direction with provision of a third lane for right turn vehicles at certain intersections. East of Commercial Road (at Rouse Hill town centre) Windsor Road widens to three lanes in each direction, reflecting the increasing traffic demands at this location.

Figure 6 Windsor Road
### 3.2.2 Schofields Road

Schofields Road, at the southern boundary of the site, is currently being upgraded between Windsor Road and Tallawong Road to provide two traffic lanes in both directions. In July 2014 traffic signals were installed at the intersections of both Cudgegong Road and Tallawong Road. Further work along this road corridor is to be carried out in the coming years which will provide for a four lane divided road corridor along the full length of Schofields Road between Windsor Road and Richmond Road.

The upgrade of Schofields Road, to become a ‘transit boulevard’, will provide connections for pedestrians, cyclists and buses to surrounding land uses. A wide central median will be provided to allow for a six lane corridor in the future should demand necessitate. This will meet the future transport needs of the North West Growth Centre.

![Schofields Road upgrade](image)

**Figure 7** Schofields Road upgrade
3.2.3  Garfield Road East

Garfield Road East currently provides the primary east-west road connection through the Riverstone East precinct. It provides a link between Windsor Road and Riverstone Parade (to Riverstone Railway Station), extending west to Richmond Road. It is currently an undivided two lane sealed road, with an 80km/h speed limit.

Garfield Road currently provides the primary east-west road connection through Riverstone. It provides a link between Windsor Road and Riverstone Parade (to Riverstone Railway Station), extending west to Richmond Road. It is currently an undivided two lane sealed road, with a 50km/hr speed limit within the study area. It currently forms an at grade intersection with the Richmond railway line.

Roads and Maritime have identified Garfield Road as a future east-west road corridor providing connectivity between Windsor Road and Garfield Road. This infrastructure would be delivered by the time the North West Growth Centre reaches approximately 75% of its population and employment development.

![Garfield Road East](image)

Figure 8  Garfield Road East
Existing Road Network

Scale at A4

1:100,000

Job Title
Riverstone East

Client
Department of Planning and Environment

Issue Date By Chkd Appd
F1 2014-11-18 JT JM AH

Figure 9

ARUP
Level 10 | 251 Kent Street
Sydney NSW 2000

Job No
234974-00

Drawing Status
For Issue

Drawing No
234974-00

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3.3 Crossings of the Richmond Rail Line

The RMS has developed a strategy for the provision of grade-separated road crossings across the Richmond rail line. The road network strategy identifies the need for five grade-separated crossings of the Richmond Rail line:

- Burdekin Road, Quakers Hill
- Westminster Street bridge, Schofields (existing with limited capacity)
- Schofields Road, Schofields (in progress as part of the Schofields Road upgrade project)
- Garfield Road, Riverstone (currently a level-crossing of the rail line)
- Bandon Road, Vineyard (currently a level-crossing of the rail line).

A summary of the planned strategy is illustrated in Figure 10 below.

![Figure 10 Proposed road network strategy for the NWGC](source: Roads and Maritime Services (2014))

The road network strategy has been divided into short, medium and long terms works as described in detail in the sections below.
3.3.1 Short Term Works

The planned short term works (to be completed within the next four years) will directly influence traffic conditions within the Riverstone town centre. These works include:

- Work with Blacktown City Council to develop local strategies to improve traffic flow within Riverstone town centre to boost capacity and minimise delays, with the existing level crossing retained. The specific location and extent of these works are currently being developed.
- Link Westminster Street with Garfield Road West to provide an alternative route for local traffic away from the Garfield Road level crossing.
- Work with the Department of Planning and Environment and Blacktown City Council to reserve a road corridor along Garfield Road between Richmond Road and Windsor Road for future widening.

3.3.2 Medium Term Works

The strategy has recommended an upgrade of Bandon Road to function as a transit boulevard (including an underpass of the Richmond railway line) which would provide a high quality road connection between Windsor Road and Richmond Road. This upgrade would be completed by the time the NWGC reaches approximately 25% of its population and employment development. Based on current projections, this could occur by 2021. Works include the construction of an underpass and creation a new road connection between Richmond Road and Windsor Road. The existing level crossings at Bandon Road and Level Crossing Road would be closed at this time.

3.3.3 Long Term Works

The road network strategy has recommended the construction of a grade separated crossing at Garfield Road, replacing the existing level crossing. This infrastructure would be delivered by the time the NWGC reaches approximately 75% of its population and employment development. Based on current projections, this could occur between 2031 and 2036. Works would also include an upgrade Garfield Road between Richmond Road and Windsor Road.
3.4 Traffic Volumes

Surveys were undertaken in March 2014 to understand the existing level of traffic in the vicinity of the Riverstone East and Vineyard precincts. Intersection counts and seven day automated counts were undertaken at a total of 19 locations in the area as illustrated in Figure 11. These counts were used to calibrate and validate the traffic model developed for this study, further outlined in Section 5.

Figure 11  Traffic survey locations

The results of the surveys are shown in Figure 12 on the following page and indicate Windsor Road carries the majority of traffic in the precinct. Traffic volumes on Windsor Road progressively increase from north to south, attributable to the more densely developed areas around Rouse Hill and The Ponds.
Figure 12  Existing traffic volumes
3.5 Heavy Vehicles

Traffic surveys conducted for this study identified the existing level of heavy vehicles utilising key roads supporting the study area. Key findings from the surveys, with respect to heavy vehicle traffic, were as follows:

- Heavy vehicles currently account for approximately 14% of all vehicles utilising Windsor Road adjacent to the precinct.
- 12% of traffic (approximately 1,100 vehicles per day) were identified as heavy vehicles along Garfield Road (within the Riverstone East precinct). This is a significant number and reflects the current function of Garfield Road as the predominant east-west link between Windsor Road and Richmond Road.
- Heavy vehicles only accounted for 6% of traffic on Schofields Road, lower than other surveyed locations due to the proximity of nearby residential areas.
- On Riverstone Parade to the north-west of the study area, 16% of all vehicles surveyed were identified as heavy vehicles. This reflects the number of light industrial uses in this area and relatively low number of local residents.

The outcomes of the surveys with respect to heavy vehicles are illustrated in Figure 13.

Figure 13  Existing heavy vehicle proportions
3.6 Rail Services

3.6.1 Richmond Rail Line

The Riverstone East precinct is currently served by the Richmond railway line, a branch of the main western line. The Richmond Line currently provides access to key centres located throughout Sydney via both direct links and onward connections. A summary of the existing services along the Richmond Line is shown in Table 1.

Table 1 Existing services along the Richmond rail line

<table>
<thead>
<tr>
<th>Departing Station</th>
<th>Direction</th>
<th>Average Frequency of Services (Weekday)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>AM Peak (7am – 9am)</td>
</tr>
<tr>
<td>Riverstone</td>
<td>Northbound</td>
<td>30 minutes</td>
</tr>
<tr>
<td></td>
<td>Southbound</td>
<td>30 minutes</td>
</tr>
<tr>
<td>Schofields</td>
<td>Northbound</td>
<td>20 minutes</td>
</tr>
<tr>
<td></td>
<td>Southbound</td>
<td>12 minutes</td>
</tr>
</tbody>
</table>

In 2011 a duplication of the rail line was completed between Quakers Hill and Schofields, including the opening of the new Schofields Station. This duplication has allowed for more frequent train services travelling to and from Schofields. The new station at Schofields includes 230 park and ride spaces and a new bus interchange servicing residents of the North West Growth Centre.

A second stage of the project includes a new and relocated Vineyard station and an upgrade of the existing Riverstone Station. This second stage of the project is not presently proceeding, however the planning of the Riverstone Precinct considered a new station location at Vineyard.
3.6.2 Sydney Metro Northwest

Sydney Metro Northwest (previously known as the North West Rail Link), is the first stage of Sydney Metro. The project is scheduled for completion in 2019 and will deliver eight new railway stations to Sydney’s North West, providing a connection into Chatswood and the Sydney CBD. Passengers will be provided with rail services every 4 minutes during peak periods and every 10 minutes across the day.

The rail line will provide connections between the NWGC and major destinations such as Norwest, Castle Hill, Macquarie Park, Chatswood, North Sydney and the Sydney CBD. The new rail line will ultimately connect with Metro City & Southwest - the second stage of the Sydney Metro network.

Future residents of the Riverstone East precinct will be provided with a high quality rail interchange via a new station at Cudgegong Road. Located between Tallawong Road and Cudgegong Road, the new station will provide for 1,000 commuter car parking spaces and space for 6 buses. The station design will include pedestrian linkages to these areas as well as secure parking and storage for up to 45 bicycles. The station layout is shown in Figure 14, and is wholly located within the Area 20 precinct.

Figure 14 Cudgegong Road station layout

An overview of the proposed rail link is shown in Figure 15 on the following page.
Figure 14: Sydney Metro Northwest

Source: Transport for NSW
3.7 Bus Services

Due to the current low level of development, there are currently limited bus services within the vicinity of the Riverstone East precinct. These typically run at low frequencies throughout the day, and include the following routes:

- **Route 608**: Windsor to Rouse Hill (via Windsor Road)
- **Route 661**: Windsor to Riverstone via McGraths Hill (via Commercial Road and Crown Street)
- **Route 662**: Riverstone to Maraylya and Oakville (via Boundary Road)
- **Route 663**: Windsor to Wisemans Ferry via Pitt Town
- **Route 746**: Riverstone to Box Hill (via Crown Street and Windsor Road)
- **Route 752**: Blacktown to Rouse Hill via Quakers Hill & The Ponds
- **Route 757**: Mt Druitt to Riverstone via Rooty Hill Rd North & Marsden Park (via Richmond Road to Riverstone Station)
- **Route T75**: Blacktown to Rouse Hill and Riverstone (via Schofields Road, Tallawong Road and Cudgegong Road)
- **Route T74**: Blacktown to Riverstone via The Ponds (via Burdekin Road and Railway Terrace)

A summary of the existing bus routes serving the Riverstone East precinct are illustrated in Figure 16 on the following page.
3.8 Walking and Cycling

Due to the current undeveloped, primarily rural nature of Riverstone East, existing pedestrian and cycling routes and facilities within and surrounding the precinct are limited.

Pedestrian crossing facilities are provided at signalised intersections of Windsor Road, including at Garfield Road, Rouse Road and Burns Road. The majority of streets in the precinct currently contain footpaths, although these are often damaged and/or narrow in sections.

A shared pathway is provided on the western side of Windsor Road (between Rouse Road and Commercial Drive) which facilitates regional cycling movements. Regional cycling links are also provided on the surrounding network, including cycle lanes on the M7 Motorway and on-road cycle lanes on Quakers Hill Parkway.

A number of roads in the precinct are designated as on-road cycleways, however include no dedicated bicycle facility (e.g. on-road markings). These designated cycle routes often carry large volumes of traffic and are generally only appropriate for confident riders.

A summary of the existing off-road bicycle paths in the vicinity of the study area is shown in Figure 17 on the following page.
# Precinct Planning Principles

This following section presents the overall principles and objectives that contributed to the development of the proposed transport network for the Riverstone East Precinct.

## 4.1 Transport Planning Objectives

In developing the preferred transport network, in conjunction with the precinct master planners, the following key transport objectives have been considered. These aim to provide for a coherent, legible transport network that supports movement both to, and within, the Riverstone East precinct.

- Provide a road network that allows for good access to all modes of transport, particularly public transport, walking and cycling;
- Design a physical site layout which encourages walking and cycling, particularly to key land uses and public transport nodes;
- Ensure the road network for Riverstone East provides suitable connections to adjacent development precincts in the North West Growth Centre;
- Integrate transport and land use planning so that high intensity land uses have strong accessibility to public transport;
- Provide high quality access to public transport stops to reduce the dependence on private vehicles. Future residents of Riverstone East should be located within at least a 400m radius of a bus stop;
- Develop an appropriate road hierarchy which provides adequate carrying capacity on higher order roads to meet reasonable community expectations;
- Protect residential areas from through traffic intrusion, particularly heavy vehicles.

## 4.2 Road Classification and Capacity

Guidelines for road network design can be allocated into three main categories:

- Road classification (road hierarchy) – how will traffic move through the precincts and are roads designed to accommodate particular function in mind?
- Road capacity – are adequate lanes provided on the streets to accommodate traffic without significant congestion?
- Intersection performance – are delays at intersections acceptable?

The Growth Centres Development Code (Growth Centres Commission, 2006) classifies the hierarchy based on anticipated levels of daily traffic as summarised in Table 2. The classification of each road will dictate its physical form (i.e. number of lanes, road reserve width), function (what types of vehicles utilise the road) and the speed limit.
Table 2  Functional classification of roads

<table>
<thead>
<tr>
<th>Road Type</th>
<th>AADT*</th>
<th>Functions and Connections</th>
<th>Speed Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arterial/Freeway</td>
<td>&gt;35,000</td>
<td>Connects large urban areas</td>
<td>80km/hr +</td>
</tr>
</tbody>
</table>
| Transit Boulevard| 30,000 – 35,000 | Located close to centres  
Pedestrian friendly environment  
Allows for long term upgrades and dedicated busways | 60 - 80km/hr |
| Sub-Arterial    | 10,000 – 35,000 | Arterial roads to town centres  
Carries major bus routes | Up to 70km/hr |
| Collector       | 3,000 – 10,000  | Connects neighbourhoods  
Can accommodate public transport | Up to 60km/hr |
| Local           | 1,000 – 3,000   | Priority to pedestrians and cyclists  
Designed to slow residential traffic | Up to 50km/hr |

* Annual Average Daily Traffic

4.3  Road Cross Sections

Typical road corridor cross sectional design requirements for future urban development have been determined as a standard to be adopted throughout the North West Growth Centre. These are summarised in Table 3. Drawings showing each of the typical road cross sections are included as Appendix A to this report.

Table 3  GCC standard road types and road corridor widths

<table>
<thead>
<tr>
<th>Road Type</th>
<th>Traffic Load (Vehicles/Day)</th>
<th>Road Corridor Width</th>
<th>Road Carriageway Lanes, Number and Width</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arterial Road</td>
<td>35,000 +</td>
<td>To be determined by the RMS</td>
<td>To be determined by the RMS</td>
</tr>
<tr>
<td>Transit Boulevard</td>
<td>30,000-35,000</td>
<td>41 metres</td>
<td>4 Lanes Divided plus 2x 5.5 metre service roads</td>
</tr>
<tr>
<td>Sub Arterial Road</td>
<td>10,000-35,000</td>
<td>35 metres</td>
<td>4 Lanes Divided plus 2x 1.8 metres cycle lanes</td>
</tr>
<tr>
<td>Collector Road</td>
<td>3,000-10,000</td>
<td>20 metres</td>
<td>12 metres or 13 metres if a bus route</td>
</tr>
<tr>
<td>Local Road</td>
<td>1,000-3,000</td>
<td>16 metres</td>
<td>10-11 metres</td>
</tr>
</tbody>
</table>

In general all future road cross sections, as summarised in Table 3, should be reviewed at the precinct master planning Development Control Plan (DCP) stage to minimise any un-necessary “land take” requirement.

4.4  Heavy Vehicles

As identified in Section 3.5, heavy vehicles presently comprise a significant proportion of total traffic through the precinct. The ILP for Riverstone East should aim to minimise heavy vehicle intrusion to enhance the amenity of the area. Measures to achieve this objective include:
• Introducing load limits on certain roads within the precinct (buses excepted);
• Restricting certain left turn movements from Windsor Road into the precinct for vehicles over 6m; and
• Providing advisory signposting that requires that heavy vehicles use major arterial routes such as Windsor Road and Schofields Roads.

4.5 Public Transport Provision

For new precincts within the North West Growth Centre, where private vehicle has historically dominated the transport landscape, it is vital that strong public transport linkages are provided at an early stage when new residents establish their travel habits. As illustrated in Figure 5, private vehicle is the dominant mode of travel in the NWGC. Reducing this dependence on private vehicles must form one of the key objectives of this transport study.

Local bus routes should be planned so that they run through the core of the precinct, as opposed to along arterial roads with poor pedestrian connectivity. This provides a higher level of public transport accessibility to future residents of Riverstone East. Regional bus routes should be provided which allow more direct, time efficient services to key regional centres such as Rouse Hill and Blacktown. A number of local bus services would also service stations on the North West Rail Link to encourage multi-modal public transport trips.

Adequate facilities will need to be provided for public transport users to encourage a mode shift away from private vehicles. This includes infrastructure items such as bus shelters, waiting areas and other bus priority measures. The provision of a good quality, permeable footpath network will be critical in ensuring users are able to easily access public transport stops.

Land use planning will also play a vital role in facilitating increased use of public transport. High density developments should be located close to public transport nodes as these will be the areas where the highest mode shares to public transport will be achieved. Consideration should also be given to major pedestrian attractors such as schools and their proximity to the public transport network. Streets and roads containing public transport stops should be activated wherever possible to enhance the amenity and attractiveness for pedestrians waiting for services.
4.6 Walking and Cycling

Walking and cycling will play an important role in meeting the future transport needs of the Riverstone East precinct. Providing a mix of uses within the precinct, in close proximity to the village centre, will promote the use of sustainable travel modes.

It is important walking and cycling routes are integrated with those provided in adjacent growth centre precincts and regional cycle routes such as the Windsor Road shared path and Westlink M7 cycleway. Linkages to major land uses such as schools, retail and public transport nodes should also form a key consideration when planning pedestrian and cycle routes.

4.6.1 Pedestrian Connectivity

Footpaths should be provided on both sides of the road carriageway in accordance with the standard road cross sections described in Section 4.3. Appropriate pedestrian crossing facilities should be incorporated at intersections and along key desire lines to ensure safe and efficient pedestrian movements. Signalised intersections should provide crossing legs on all approaches, while pedestrian refuges should be integrated in the design of any roundabout within the precinct. Associated infrastructure such as pram ramps and bike lanterns at all traffic signals should be installed.

Bus stops should be located to allow for good pedestrian accessibility. Where possible, stops should be positioned close to traffic signals or alternative safe pedestrian crossing facilities (e.g. pedestrian refuges, zebra crossings). Adequate shelter and seating should be provided, particularly to service less mobile users.

4.6.2 Cycling

The NSW Bicycle Guidelines (Roads and Traffic Authority, 2003) summarises the needs and requirements of bicycle users by the following five design principles:

- **Safety**: A good quality route enhances the safety of all users, including cyclists, pedestrians and motorists. Streets and intersections along key bicycle routes should be designed to a standard which incorporates cyclist movements.

- **Coherence**: The bicycle network should link popular destinations with local residential streets via a mix of both local and regional routes. The network should be continuous and easily identifiable to both novice and experienced cyclists.

- **Directness**: Bicycle routes should be as direct as possible, having consideration for major barriers such as road intersections and steep topography. The rider should ideally be able to maintain a safe and comfortable consistent riding speed throughout their journey.

- **Attractiveness**: The bicycle network must be designed so that it complements and enhances its environment in such a way that cycling is attractive. Clear and strategically placed wayfinding information should indicate distances and times to major destinations.
• **Comfort:** Bicycle routes must be comfortable and easy to use for all cyclists. Depending on the road environment and topography, some level of separation (e.g. clearly marked bicycle lanes, painted green) may be required.

The above requirements are also noted in The Cycling Aspects of Austroads Guides (2014), which contains information that relates to the planning, design and traffic management of cycling facilities. Austroads notes the following key components of a good quality bicycle network.

- a designated regional network of roads and paths that serves longer-distance commuter and recreational trips
- designated local networks and routes designed to provide low-stress routes, to feed the regional network and to provide for shorter local trips to shopping centres, recreational activities, public transport hubs
- full construction of route sections between origins and destinations consistent with the route purpose
- convenient access into and through residential, commercial and industrial subdivisions, and major developments
- access and facilities to travel with a bicycle on public transport
- secure long and short-term parking facilities at major destinations
- safer routes to schools
- well-defined bicycle facilities on arterial roads where significant cyclist demand exists including specifically for commuter trips
- appropriate maintenance practices which result in smooth surfaces
- calming in local streets
- paths which are interesting, that include rest areas at appropriate intervals on regional routes, and are designed to appropriate geometric standards
- implementation of regulatory, warning and guidance signage on paths.

When determining the most appropriate cycling treatment on a bicycle route, consideration must be given to the traffic speed and traffic volume. The NSW Bicycle Guidelines provide direction relating to the most suitable cycling treatment for different roads, as reproduced in Figure 18.
Figure 18  Separation of bicycles and motor vehicles

Source: NSW Bicycle Guidelines, Figure 3.2

The physical separation of cyclists from motor vehicles on to a bike path or shared path (minimum 3m wide) is recommended on local and collector roads that have traffic volumes of more than 5,000 vehicles per day on a 60 km/h road, as well as roads serving certain land uses including schools and open space areas. Shared paths act a safe, convenient bicycle facility where physical separation between cyclists and vehicles is necessary on roads with high vehicles speeds and volumes.

Directional signage should be installed to improve connectivity and wayfinding, with regulatory signs and lines to be installed as per NSW Bicycle guidelines. Street lighting along cycleways should be considered in reserve areas.
Bicycle parking facilities should be provided at key destinations (e.g. train stations, village centres and major developments) to accommodate the needs of both short and long term cyclists. Parking for short stay cyclists should be provided in areas with passive surveillance - if the parking is visible it will be perceived as more secure and achieve greater utilisation. Parking for long stay cyclists should be in secure, lockable facilities which provides weather protection and conveys a sense of high priority for the treatment of riders.

4.7 Parking

On-site parking for land uses within the Riverstone East precinct should be provided in accordance with the rates outlined in Blacktown City Council Growth Centre Precincts DCP 2010, as summarised in Table 4 and

Table 4  Parking Rates –Residential Uses

<table>
<thead>
<tr>
<th>Zone</th>
<th>Car Parking Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>R2 zone (shop top housing)</td>
<td>• 1-2 bedrooms: 1 covered space (min)</td>
</tr>
<tr>
<td></td>
<td>• 3 bedrooms or more: 2 covered spaces (min)</td>
</tr>
<tr>
<td>R3 zone</td>
<td>• 1-2 bedrooms: 1 covered space (min)</td>
</tr>
<tr>
<td></td>
<td>• 3 bedrooms or more: 2 covered spaces (min)</td>
</tr>
<tr>
<td></td>
<td>• 1 visitor car parking space per 5 apartments</td>
</tr>
<tr>
<td>B2 and B4 zones</td>
<td>• 1-2 bedrooms: 1 covered space (max)</td>
</tr>
<tr>
<td></td>
<td>• 3 bedrooms or more: 2 covered spaces (max)</td>
</tr>
<tr>
<td></td>
<td>• 1 visitor car parking space per 8 apartments</td>
</tr>
</tbody>
</table>

Table 5  Parking Rates – Non-Residential Uses

<table>
<thead>
<tr>
<th>Land Use</th>
<th>Car Parking Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commercial/office premises</td>
<td>1 space per 40m² GFA</td>
</tr>
<tr>
<td>Retail shops/showrooms (less than 200m² GFA)</td>
<td>1 space per 30m² GFA</td>
</tr>
<tr>
<td>Retail shops/showrooms (greater than 200m² GFA)</td>
<td>1 space per 22m² GFA</td>
</tr>
<tr>
<td>Restaurants/cafes</td>
<td>1 space per 10m² of dining area</td>
</tr>
<tr>
<td></td>
<td>1 space per 3 employees</td>
</tr>
</tbody>
</table>