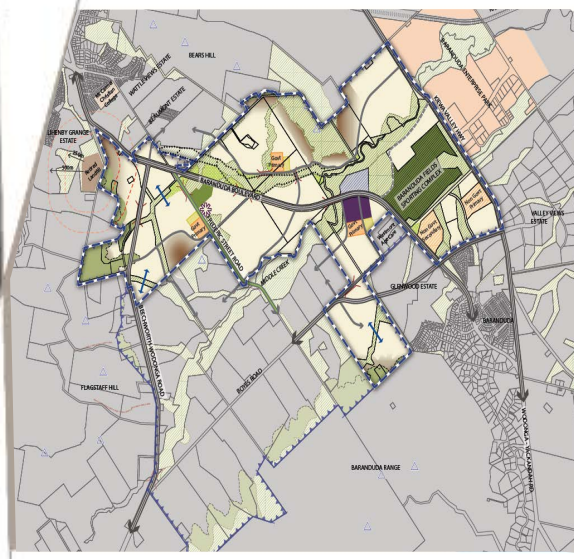
Strategic Transport Modelling Assessment

Leneva-Baranduda Growth Area

CG150428



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Contact Information

Cardno Victoria Pty Ltd
Trading as Cardno
ABN 47 106 610 913

Level 4
501 Swanston Street
Melbourne
Victoria 3000 Australia

Telephone: (03) 8415 7777
Facsimile: (03) 8415 7788
International: +61 3 8415 7777

victoria@cardno.com.au
www.cardno.com

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D01	27/07/15	Matthew Mudge / Erna Sukardi	MM / ES	Manesha Ravji	MR
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1 Introduction

1.1 Background

The Metropolitan Planning Authority (MPA) engaged Cardno Victoria Pty Ltd to undertake traffic modelling for the Leneva-Baranduda Growth Area in Wodonga to inform the development of the Leneva-Baranduda Precinct Structure Plan (PSP 1105).

The outputs of the modelling completed by Cardno can be used to inform subsequent SIDRA modelling to determine intersection configurations, Functional Layout Plans (FLPs), Precinct Infrastructure Plans (PIPs) and Development Contribution Plans (DCPs) for the area.

The MPA is managing the preparation of PSP in consultation with the City of Wodonga Council who is the Planning Authority for the area.

1.2 Study Area

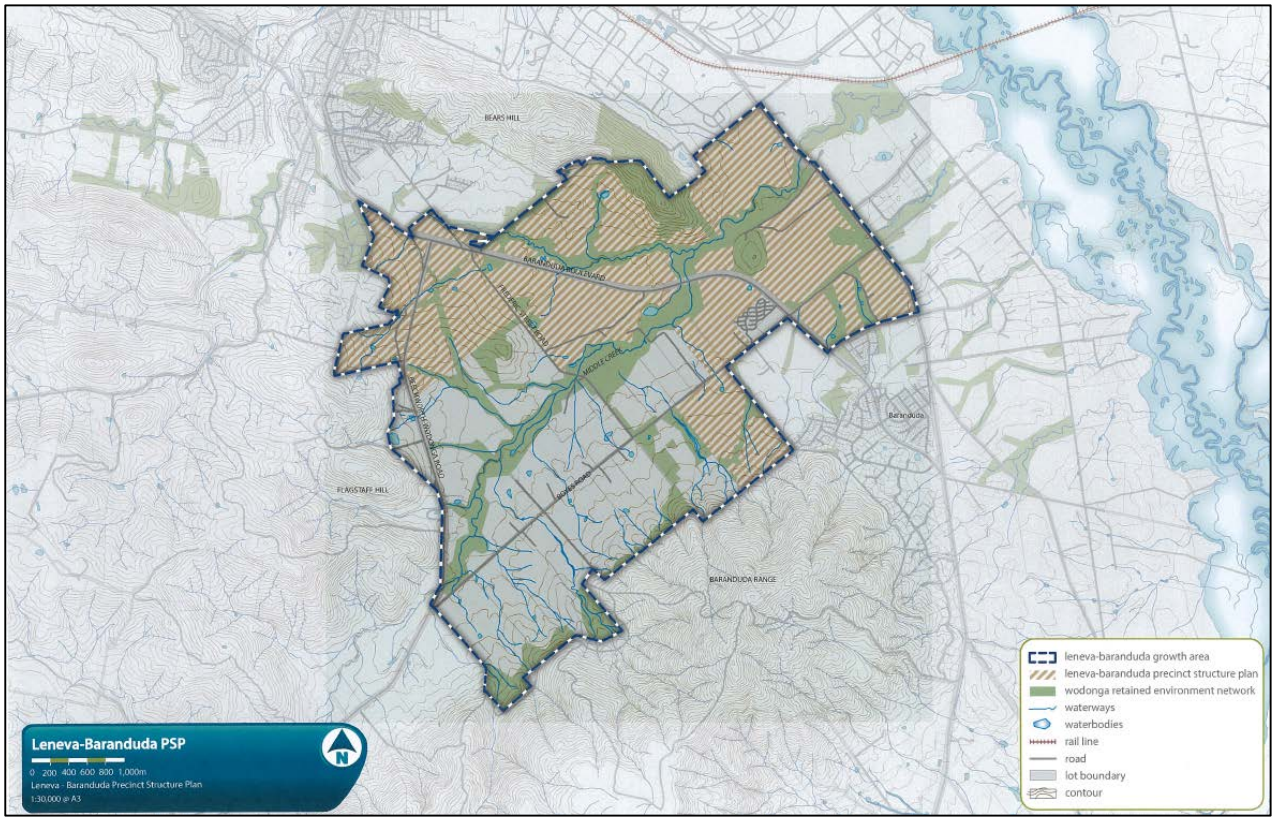
The Leneva-Baranduda Growth Area is located to the south west of Wodonga, and is expected to provide for approximately 13,000 new dwellings, with supporting educational and leisure facilities integrated around proposed activity/ neighbourhood centres. The location of the Leneva-Baranduda Growth Area within the greater Wodonga area is outlined in Figure 1-1.

Figure 1-1 Leneva-Baranduda Growth Area in Context of Wodonga LGA

Source: Local Government Gazette (March 2012)

The PSP covers an area of approximately 1070 hectares within the Growth Area as outlined in Figure 1-2.

Figure 1-2 Leneva-Baranduda PSP (1105) Growth Area



The Growth Area is anticipated to accommodate predominantly residential uses and will also include activity centres, schools, community facilities, passive pen spaces and sporting reserves.

1.3 Referenced Documents

In developing the traffic models and preparing this report, the following data sources and reports have been considered:

- Wodonga Arterial Network Study (WANS) – Development of a Strategic Transport Model Report, prepared by CPG (dated April 2011).
- Wodonga Integrated Transport Strategy (WITS) prepared by GTA Consultants (dated February 2014).
- Discussion Draft Leneva-Baranduda Growth Area Framework Plan 2012, prepared by Loone Town Planning (dated May 2012).
- Council's Strategic Planning Unit's Map of Estates Currently Developable in Wodonga (dated 11 September 2014).
- Draft Future Urban Structure Concepts for the Leneva-Baranduda Growth Area prepared by the MPA.
- The Local Government Infrastructure Design Association's Infrastructure Design Manual, version 4.4 (dated 22 August 2015).
- Other documents and data sources as nominated throughout this report.

1.4 Interim (2026) vs. Ultimate (2046) Analysis

An assessment of both interim and ultimate traffic volumes are included in this report. The interim volumes represent the +10 year development scenario (~2026) and the ultimate volumes the +30 year development scenario (~2046). The interim volumes will be used to inform the scope of road network infrastructure required to facilitate the development of the Growth Area, whilst the ultimate volumes will be used to validate the ultimate road reservation requirements.

2 Leneva-Baranduda Growth Area and PSP 1105

2.1 The Leneva-Baranduda Growth Area Location

The Leneva-Baranduda Growth Area is located to the south west of Wodonga and is expected to provide for approximately 13,000 new dwellings, with supporting educational and activity centre and recreational uses. The location of the Leneva-Baranduda Growth Area within the greater Wodonga area is outlined in Figure 2-1.

Figure 2-1 Leneva-Baranduda Growth Area in Context of Wodonga LGA

Source: Local Government Gazette (March 2012)

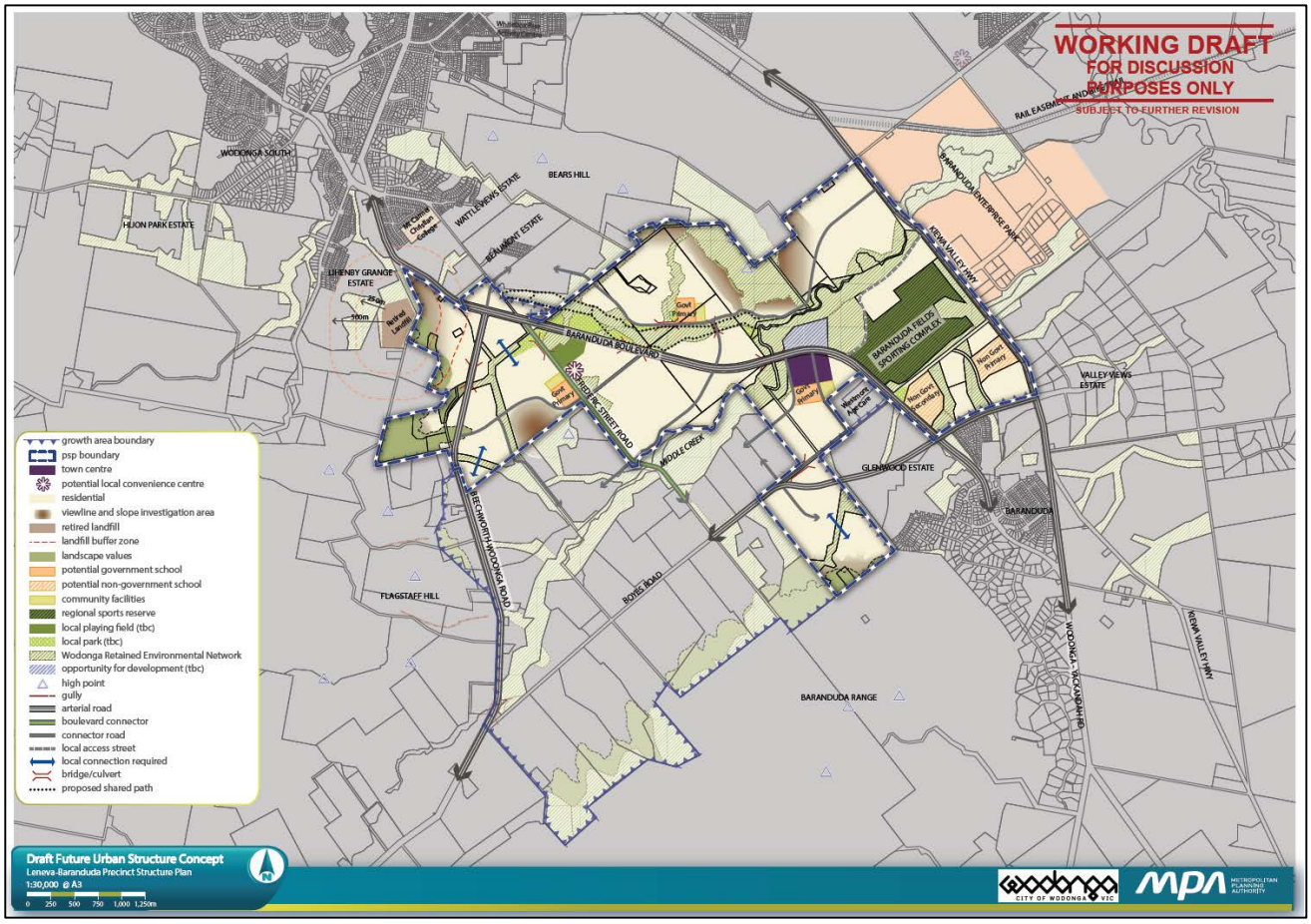
The City of Wodonga Council has identified Leneva-Baranduda as the priority growth area for Wodonga in the medium to long-term future.

2.2 The Leneva-Baranduda PSP (PSP 1105) Location

Leneva-Baranduda PSP (PSP 1105) area covers approximately 1070 hectares and is currently generally made up of farming land. It is anticipated that the PSP area will ultimately accommodate some 7,000 dwellings.

The PSP area generally covers the northern portion the Growth Area and the Draft Future Urban Structure for the PSP is shown in Figure 2-2 (with an enlarged version included in Appendix A).

Figure 2-2 Leneva-Baranduda (PSP 1105) – Draft Future Urban Structure



As outlined in Figure 2-2, the Baranduda Fields Sporting Complex lies within the PSP area and Middle Creek also runs through the PSP area. A notable portion of the Growth Area forms part of the "Wodonga Retained Environmental Network" which constrains the permeability of the transport network.

The PSP area is also bound by Flagstaff Hill to the west, Baranduda Range to the south-east, Kiewa Valley Highway to the north-east, and Bears Hill to the north, and the existing Baranduda Township to the south-east.

The Growth Area is also bordered by the Baranduda Enterprise Park industrial estate, a significant employment node, to the east.

2.3 Existing and Proposed Road Network Overview

Baranduda Boulevard is the existing key north-south road through the PSP area and runs from the Kiewa Valley Highway in the Baranduda Township to Beechworth-Wodonga Rd to the south of the Leneva Township. Boyes Road is the key existing east-west road through the Growth Area, it currently runs from Ellen McDonald Drive in the east to Beechworth-Wodonga Rd in the west. It is envisaged that Boyes Road will be upgraded to an Arterial Road in the future and extended further south-east to connect to Kiewa Valley Highway.

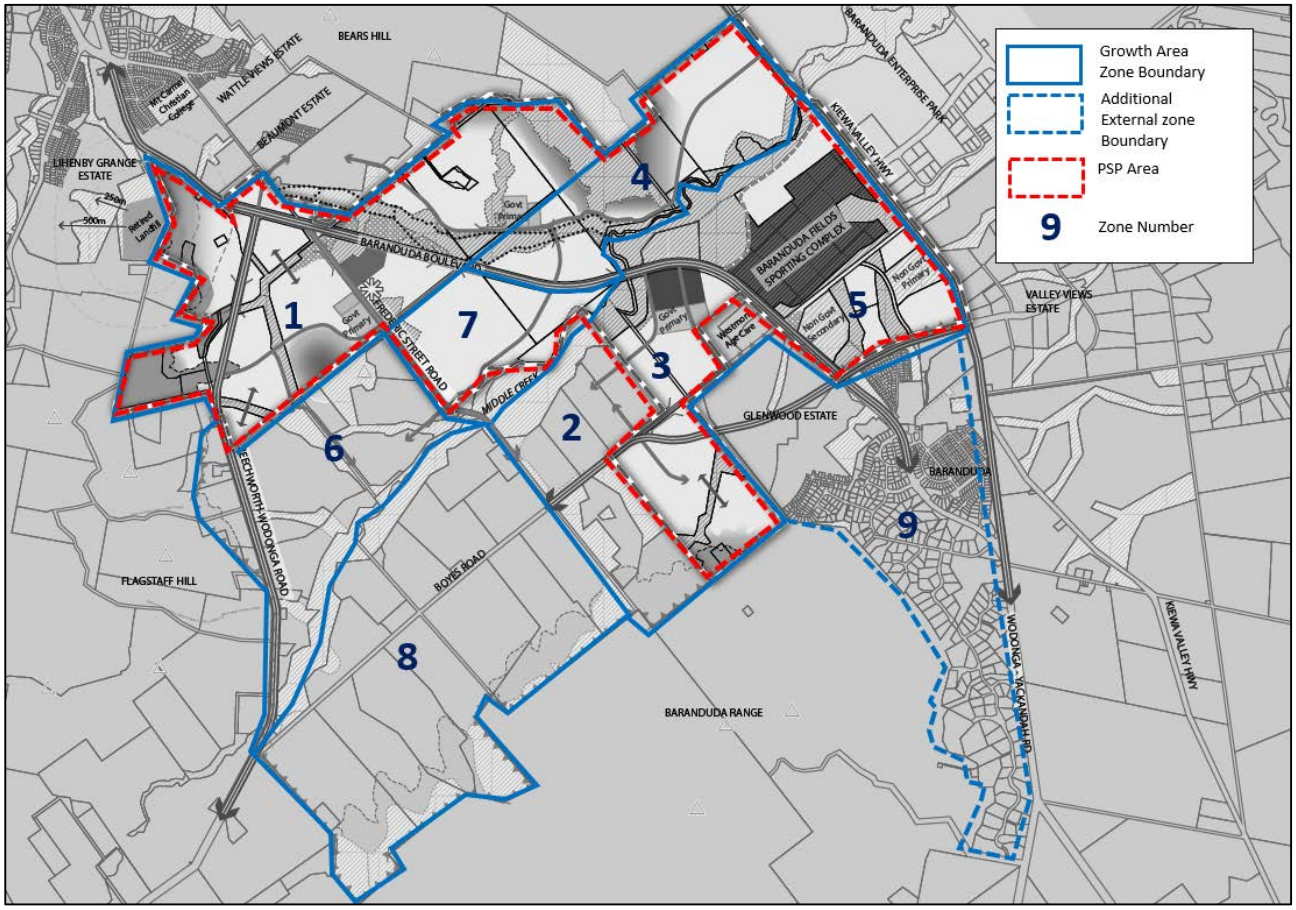
The proposed road network for the Growth Area is outlined in Figure 2-2 and consists of a series of Connector Streets with bridge river crossings. The Connector Street network within the Growth Area connects to the wider road network via intersections with the existing Arterial Road and Local Road networks.

2.4 Land Use Forecasts for the Growth Area and PSP

As outlined in Figure 2-2, the Draft Future Urban Structure for Leneva-Baranduda includes residential, Local Town Centre (LTC) educational facilities, community facilities, and passive and active open space provisions.

As discussed in more detail later in this report, for the purposes of the traffic modelling, the study area has been divided into nine 'zones', whereby the various proposed land uses have been allocated as per the Draft Future Urban Structure provided by the MPA. These zones are shown in Figure 2-3.

Figure 2-3 Proposed Growth Area Traffic Modelling Zones



With an understanding of the proportion and numbers/ sizes of each land use types within each zone, the trip generation due to the development within each zone can be calculated, as discussed later in Section 4-6 of this report.

The anticipated development yields for the PSP area and Growth Area are outlined in Table 2-1.

Table 2-1 Ultimate Anticipated Development Yields

Growth Area Zone (PSP)	Population	No. Households	Retail Floor Area (sqm)	Enrolments (no. students)	Employment (No. jobs)
1 (PSP)	8,457	3,317	1,500	451 [1]	
2	1,947	763			
3 (PSP)	2,577	1,011	10,000	451 [1]	1,800 [3]
4 (PSP)	3,645	1,429		451 [1]	
5 (PSP)	974	382		1,100 [2]	
6	3,621	1,420			
7 (PSP)	2,372	930			
8	9,730	3,816			
Total PSP	**18,026**	**7,069**	**11,500**	**2,453**	**1,800**
Total Growth Area (1-8)	**33,324**	**13,068**	**11,500**	**2,453**	**1,800**

[1] Government Primary School.
[2] Private Primary and Secondary School.
[3] Council owned 9 hectare land parcel. Number of jobs estimated by assuming that half the site will be developable floor area and applying a job rate of 4 jobs per 100sqm developable floor area.

The residential land use yields for the Growth Area were derived on the basis that the net developable area (NDA) for the PSP area is 642.6 hectares and the remainder of the Growth Area has a NDA of 545.4 hectares, and then applying a dwelling rate of 11 dwellings per hectare of NDA.

3 Existing and Future Road Network

3.1 Overview

The Leneva-Baranduda Growth Area is bordered by Beechworth-Wodonga Road to the west, and the Kiewa Valley Highway to the east. Within the Growth Area, the existing road network is made up of Baranduda Boulevard, Boyes Road, and Frederic Street Road.

Further discussion on the existing and future network is provided in the following subsections.

3.2 Beechworth-Wodonga Road

Wodonga-Beechworth Road, a VicRoads controlled Arterial Road, extends from the roundabout intersection with Baranduda Boulevard and Beechworth Road in the north-western corner of the Growth Area, along the western boundary of the Growth Area and south through to Beechworth. It is an extension of Beechworth Road which is an Arterial Road extending south from Wodonga City Centre.

The road is currently an undivided two-way, two-lane road and is envisaged by VicRoads to remain in its current configuration under ultimate (2046) conditions.

3.3 Kiewa Valley Highway

The Kiewa Valley Highway VicRoads controlled Arterial Road that extends south from Thomas Mitchell Drive / Murray Valley Highway which extends east from Wodonga City Centre. It passes along the north east boundary of the PSP area between the Baranduda Enterprise Park and onwards south to Baranduda where the road splits to Kiewa or Yackandandah just north of the Baranduda.

The Kiewa Valley Highway between the Murray Valley Highway turn off and Baranduda is envisaged by VicRoads to become a duel carriageway Arterial Road with two lanes in each direction under ultimate (2046) conditions.

3.4 Baranduda Boulevard

Baranduda Boulevard is currently an undivided two-way two-lane road connection through the PSP area between the Beechworth-Wodonga Road roundabout and the Yackandandah-Wodonga Rd in Baranduda Township with one lane in each direction.

The Draft Future Urban Structure for the PSP anticipates the upgrade of Baranduda Boulevard to a Secondary Arterial Road (two-way, four-lane) linking the Connector Streets within the Leneva-Baranduda Growth Area to the external Arterial Road network.

It is also expected that its roundabout intersection with Beechworth-Wodonga Road will be upgraded to a signalised intersection in the ultimate scenario.

3.5 Boyes Road

Boyes Road is currently an undivided two-way, two-lane road connection through the PSP area between Ellen McDonald Drive in the east to Beechworth-Wodonga Rd in the west.

Boyes Road is proposed to be upgraded to a Secondary Arterial Road and extended further south east Kiewa Valley Highway as part of the development of the Growth Area. Ultimately the draft Future Urban Structure indicates that Boyes Road will be upgrade from a local road to a Secondary Arterial Road (divided two-way, four lanes).

3.6 Frederic Street Road

Frederic Street Road is currently an undivided two-way, two-lane road connection through the PSP area between Boyes Road in the south and Baranduda Boulevard in the north. Ultimately the draft Future Urban Structure indicates that Frederic Street Road will be upgrade from a local road to a Boulevard Connector Street (divided two-way, two-lane).

3.7 Future Connector and Local Access Streets within the Growth Area

3.7.1 Connector Streets

The proposed Connector Street network within the PSP area will connect neighbourhoods and link to the Local Access Streets to the Arterial Road network. These streets will have a single traffic lane in each direction. The local Government Infrastructure design Association's Infrastructure design Manual (IDM), version 4.4, dated 22 August 2015, notes that Connector street (level 1) can carry volumes up to 6,000 vehicles per day.

3.7.2 Local Access Streets

Local Access Streets within the Growth Area are expected to consist of lanes, loops and through streets between Connector Streets. Local Access Streets will have a single traffic lane in each direction and carry volumes up to 2,500 vehicles per day in accordance with the IDM.

3.8 Summary of Existing and Proposed Road Cross Sections

Based on the above outlined road characteristics, the existing and proposed cross sections for key roads within and surrounding the study area are summarised in Table 3-1.

Table 3-1 Existing and Proposed Future Road Cross Sections

Road	Existing Configuration	Proposed Future Configuration
Beechworth-Wodonga Road	Two-way, two-lane undivided Arterial Road	Two-way, two-lane Arterial Road
Kiewa Valley Highway	Two-way, two-lane undivided Arterial Road	Two-way, four-lane Arterial Road
Baranduda Boulevard	Two-way, two-lane local road	Two-way, four-lane Arterial Road
Boyes Road	Two-way, two-lane local road	Two-way, four lane Arterial Road
Frederic Street Road	Two-way, two-lane local road	Two-way, two-lane Boulevard Connector Street

4 Traffic Modelling Overview

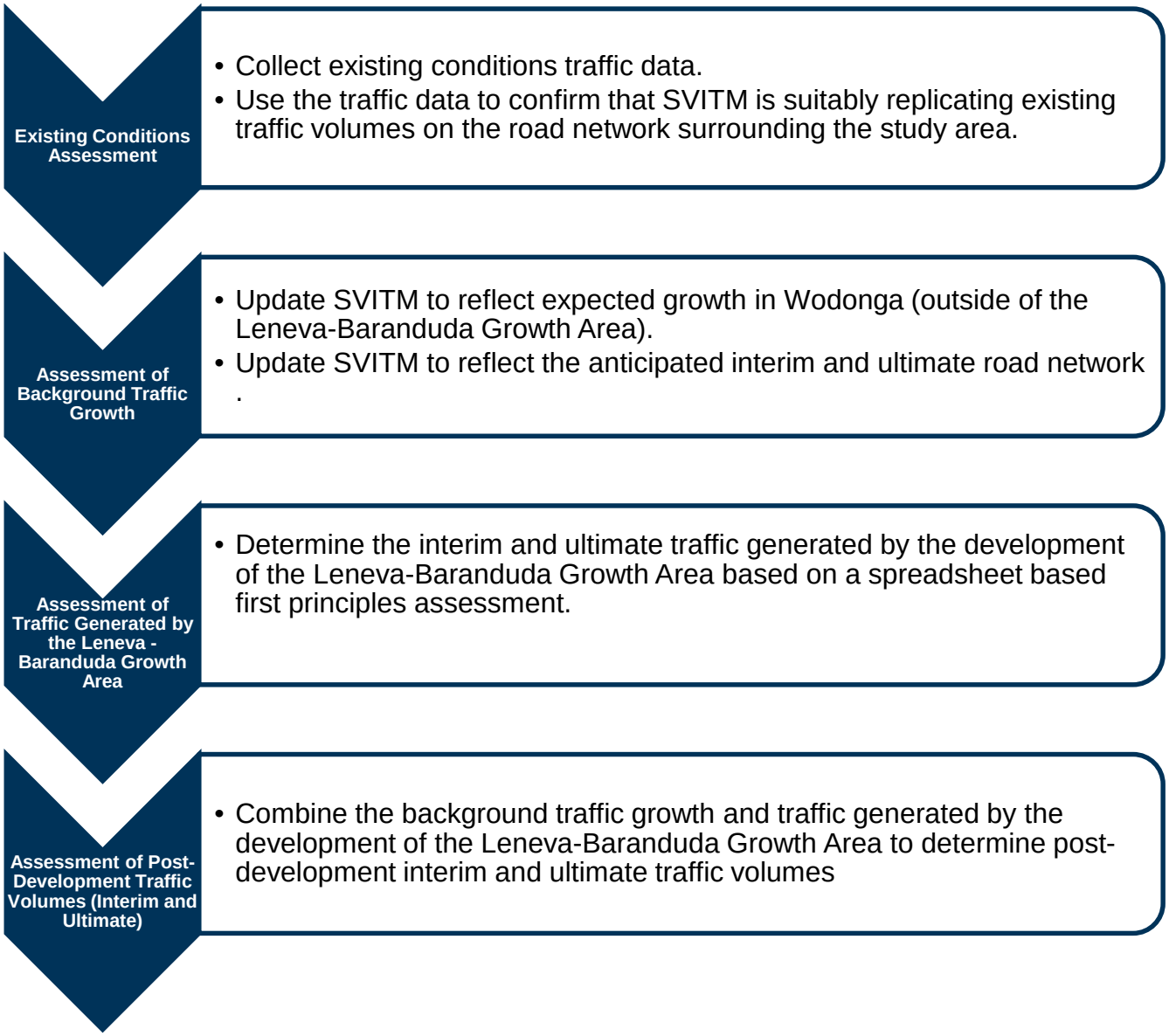
4.1 Modelling Methodology

The modelling methodology adopted for this study uses strategic modelling to assess the background traffic growth and first principles spreadsheet modelling to assess the traffic generated by the development of the of the Leneva-Baranduda Growth Area.

The strategic modelling component of the methodology entailed using the State-wide Victorian Integrated Transport Model (SVITM), a tool developed and maintained by the Department of Economic, Development, Jobs, Transport and Resources (DEDJTR) to assist in the planning of road and public transport infrastructure in Victoria. SVITM uses future population, employment and land use data projections to forecast travel behaviour and the impacts of changes to the road and network. The model is a link-based traffic model which is implemented in the CUBE Voyager software environment.

The modelling approach for assessing the expected interim (2026) and ultimate (2046) traffic volumes on the road network is outlined Figure 4-1.

Figure 4-1 Modelling Methodology



As outlined in Figure 4-1, the modelling methodology involved the following:

1. Assessing the current traffic volumes on the existing road network.
2. Assessing the background traffic growth and distribution on the wider road network on the basis that the Leneva-Baranduda is not developed and all other known development areas in Wodonga are fully developed.
3. Assessing the traffic generated by the development of the Leneva-Baranduda Growth Area by spreadsheet modelling in order to gain a more detailed understanding of the PSP traffic generation and the internal traffic generation within the Growth Area.
4. Combining the background traffic volumes and the traffic generated by the Leneva-Baranduda Growth Area to obtain "post-development" traffic volumes for the interim (2026) and ultimate (2046) scenarios.

4.2 Assessment of Existing Traffic Volumes

Existing conditions traffic data was sourced the Wodonga Arterial Network Study (WANS), Council's traffic survey data, available VicRoads survey data, and additional data collected by Cardno. This data was used to confirm that the SVITM was suitably replicating existing traffic volumes on road network surrounding the study area. Details of the collected survey data is provided in Appendix B.

4.3 Modelling Assumptions

The following assumptions were used in regard to the interim and ultimate development scenarios:

Interim (2026) Assessment

1. 75% of the entire Leneva-Baranduda Growth Area has been developed.
2. All other known residential development areas in Wodonga are 100% developed.
3. All Arterial Roads (Baranduda Boulevard, Kiewa Valley Highway, and Beechworth Wodonga Road) in the vicinity of the PSP area are two-way, two-lane roads.

Ultimate (2046) Assessment

1. 100% of the Leneva-Baranduda Growth Area has been developed.
2. Baranduda Boulevard and Beechworth Wodonga Road in the vicinity of the PSP area are undivided two-way, two-lane roads.
3. Kiewa Valley Highway in the vicinity of the PSP area is a two-way four-lane road.
4. Boyes Road is a two-way four-lane road that is extended further south-east to Kiewa Valley Highway.

5 Strategic Modelling Assessment of Background Traffic Volumes and Distributions

5.1 State-wide Victorian Integrated Transport Model (SVITM)

As outlined in Section 4.1, the State-wide Victorian Integrated Transport Model (SVITM) has been used to provide future year background and traffic growth and distribution data for this study. A copy of the model was sourced from the DEDJTR and validated for the Wodonga area such that it was suitable for future year testing.

The SVITM is a simplified representation of the real world and as such is used as a decision guidance tool. The transport model's strengths lie in indicating the likely scale of changes brought about by the implementation of transport infrastructure schemes, land use changes or policy driver measures, and the use of outputs in a sensible and pragmatic manner.

The outputs of the transport model have to be interpreted in accordance with the design of the model, taking into account the complexity of the model and its probable robustness. The benefit of using SVITM is that once it is validated for an existing situation, it can be used to forecast the effects of a variety of future land uses, transport infrastructure and/or policy changes on travel.

5.2 Refinement of the SVITM

5.2.1 Zone Structure Refinements

On review of the DEDJTR SVITM zone structure it was found to be a good base for Wodonga CBD area (sufficiently detailed in terms of zone sizes), however it did not have a sufficient zone structure to assess the Leneva-Baranduda Growth Area. For the purposes of this study nine new zones have been created within the study area, as previously outlined in Section 2.4.

The SVITM zone structures prior and after the zone refinement process are shown in Figure 5-1 and Figure 5-2 respectively.

Figure 5-1 SVITM Zone Structure Before Refinements

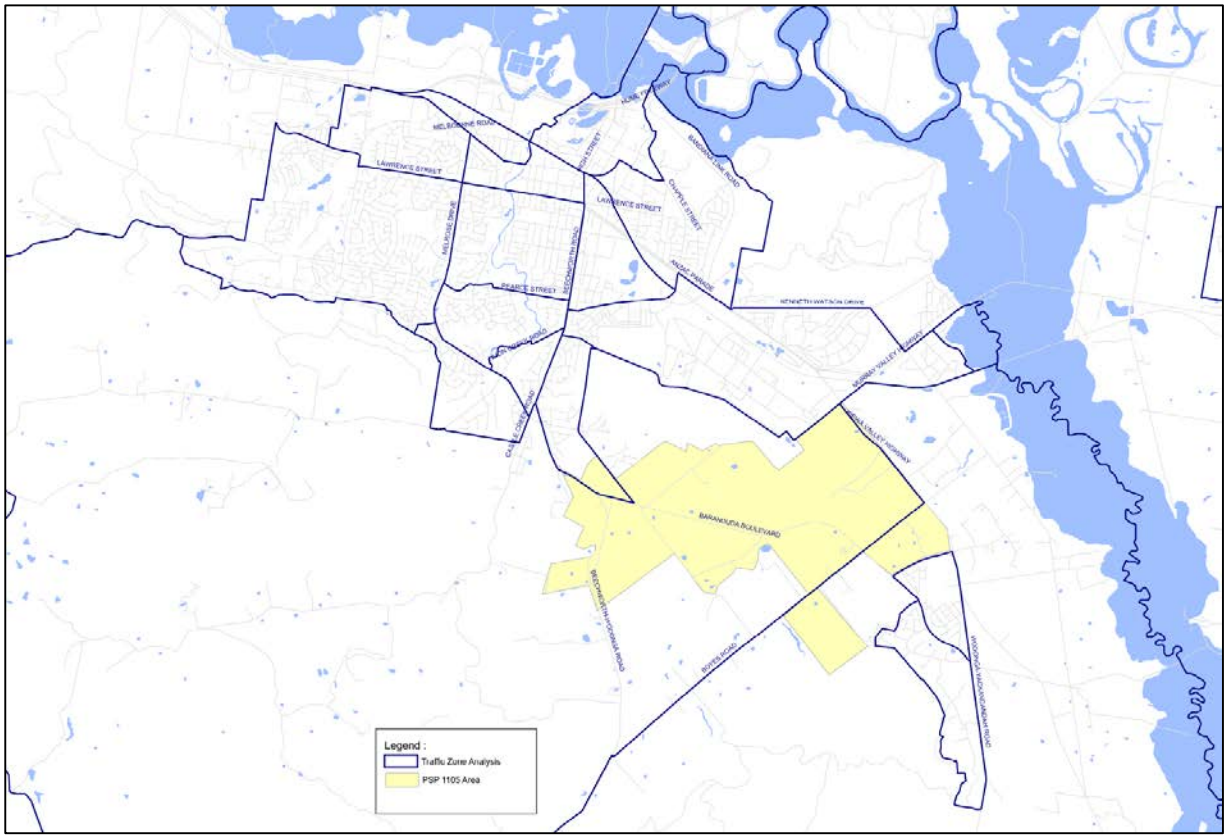
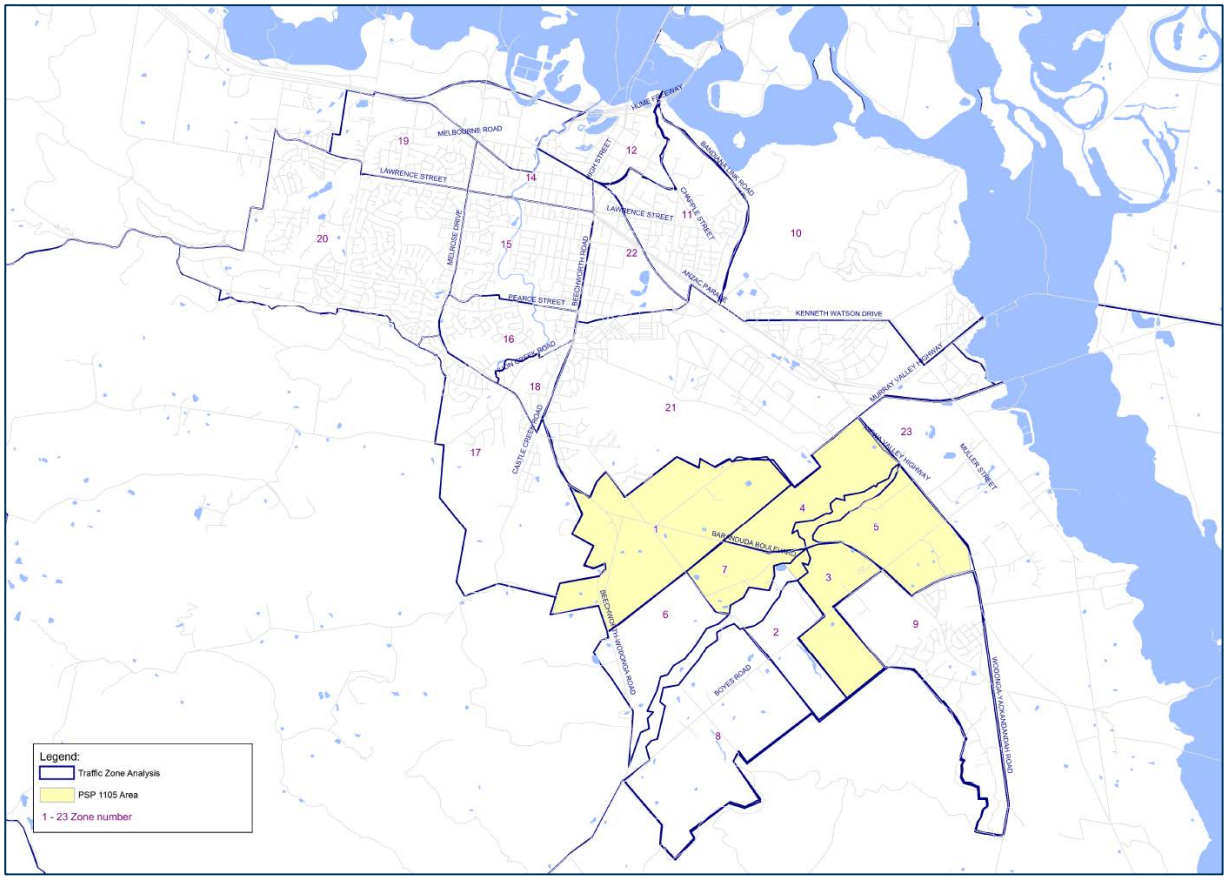


Figure 5-2 SVITM Zone Structure After Refinements



5.2.2 Road Network Refinements

In order to inform the future background traffic growth and distribution, the existing SVITM road network was also updated and refined to reflect existing and anticipated strategic network modifications within the Leneva-Baranduda Growth Area.

Figure 5-3 and Figure 5-4 show the adopted Base Case (existing conditions) and Interim / Ultimate Development Scenario road networks respectively.

Figure 5-3 Base Year Modelled Road Network

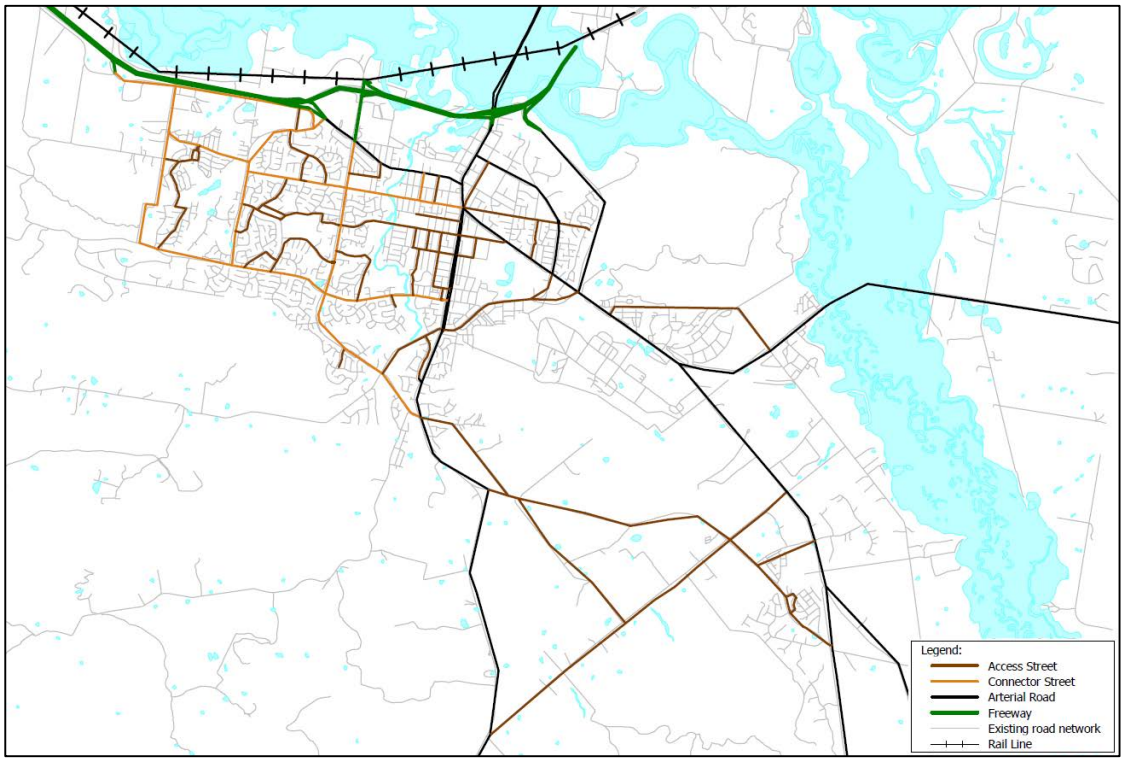
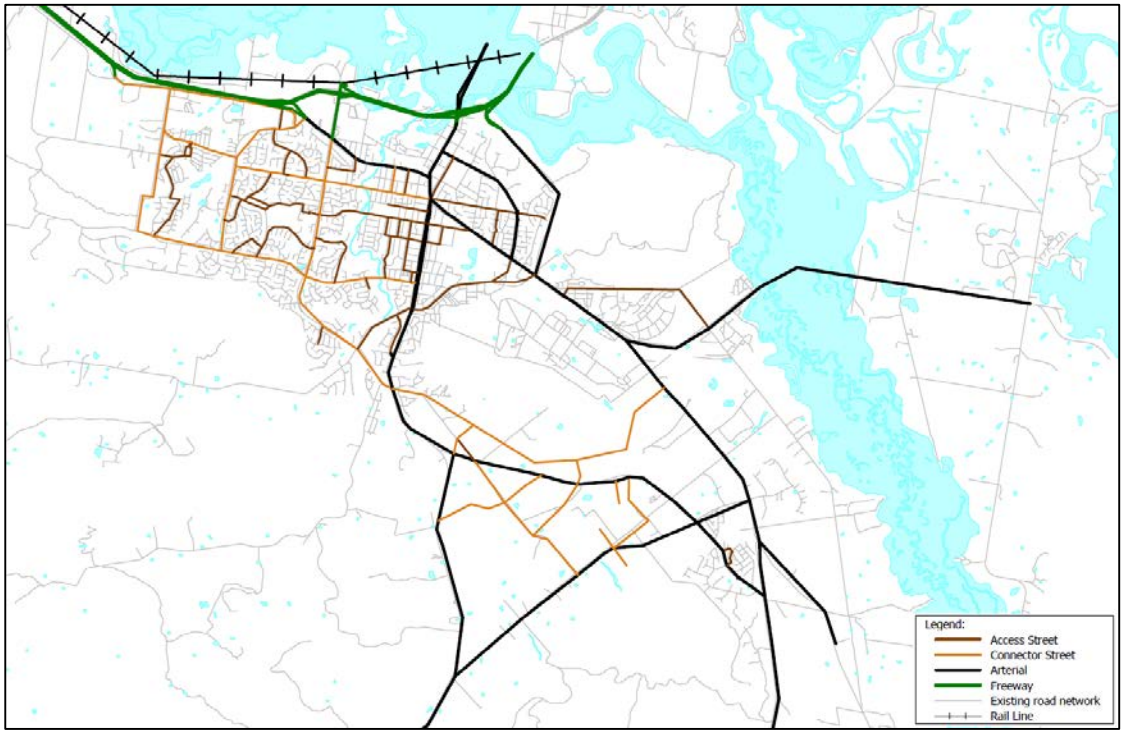


Figure 5-4 Interim and Ultimate Scenario Modelled Road Network

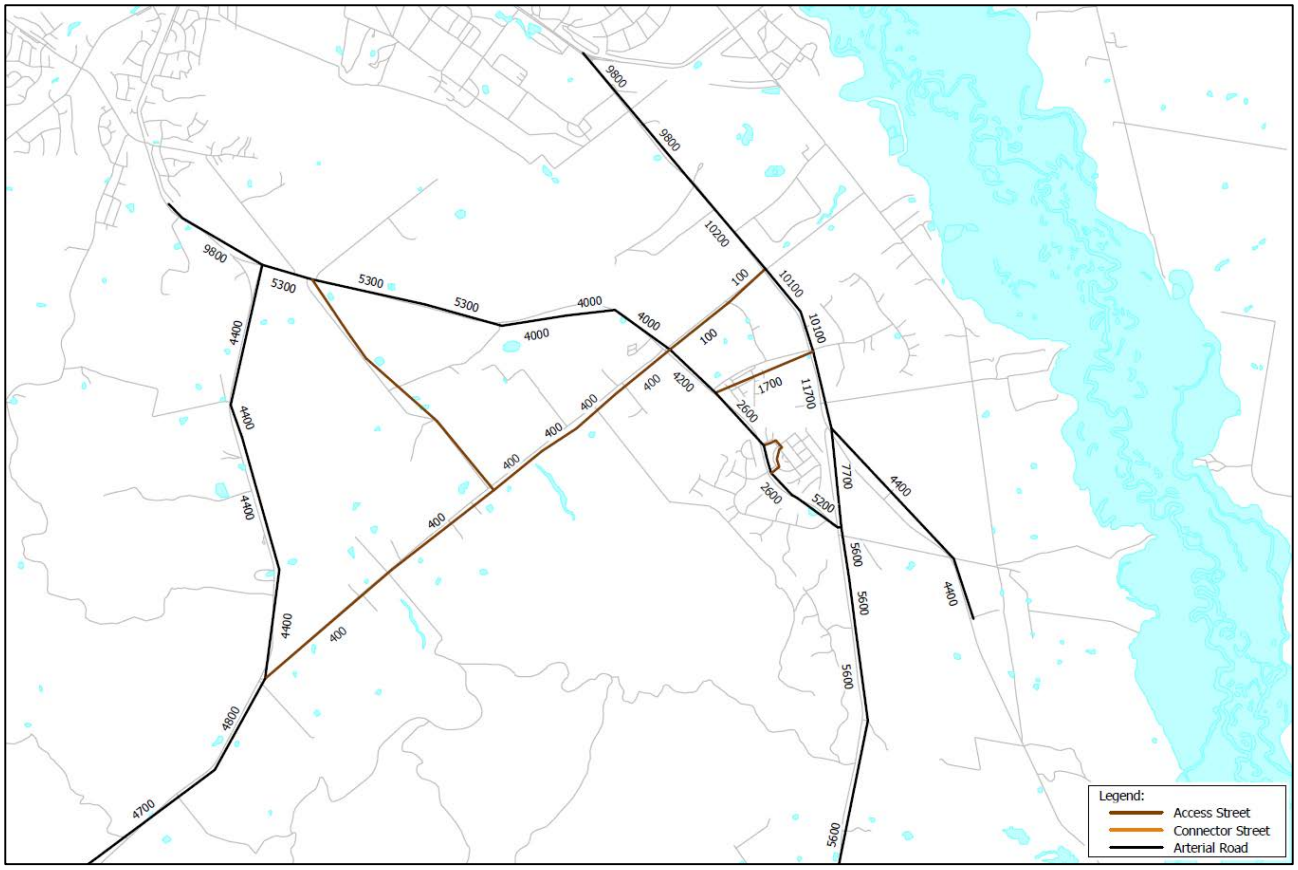


The modelled road network was also cross-checked against the Wodonga Arterial Network Study (WANS) road network and found to be consistent with the WANS recommendations.

5.3 Base Year Model Validation

The base year SVITM model was validated to ensure that it was "fit for purpose" in terms of assessing background traffic volume growth and travel patterns. The outcomes of this validation are included in Appendix C, and the base case modelled daily traffic volumes are summarised in Figure 5-5.

Figure 5-5 Modelled Base Case Daily Traffic Volumes (2-way)



5.4 Land Use Inputs

Zone demographic data for the Wodonga CBD area was sourced from the WANS study report and data provided by MPA in relation to developable estates in Wodonga (included in Appendix D). The land use data was grouped in order to correlate to the SVITM zone structure previously shown in Figure 5-2.

The draft Future Urban Structure Plan previously outlined in Figure 2-2 shows the proposed land uses within the Leneva-Baranduda Growth Area, and Figure 5-2 previously showed the additional zones incorporated into the SVITM in order to better reflect the proposed land uses within the Growth Area.

The modelled land use data inputted into SVITM for both the interim and ultimate assessment years for the purposes of assessing background traffic growth are shown in Table 5-1.

Table 5-1 SVITM Background Growth Land Use Inputs

Zone	Base Case (2011)			Interim (2026)			Ultimate (2046)		
	Dwelling	Jobs	Enrolments	Dwelling	Jobs	Enrolments	Dwelling	Jobs	Enrolments
1	-	-	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-	-	-
4	-	-	-	-	-	-	-	-	-
5	-	-	680	-	100	1,430	-	118	1,680
6	-	-	-	-	-	-	-	-	-
7	-	-	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-	-	-
9	1,035	120	-	1,730	213	-	2,180	274	-
10	455	742	-	2,775	1,162	-	3,700	1,383	-
11	1,216	3,113	-	1,383	3,656	-	1,492	3,798	-
12	280	3,042	340	260	4,037	380	264	4,460	380
13	170	1,294	-	180	1,429	-	180	1,483	-
14	702	2,405	500	735	2,640	500	748	2,788	500
15	2,329	1,062	1,395	2,439	1,204	1,580	2,488	1,268	1,685
16	691	210	490	710	260	535	712	283	550
17	841	96	-	1,153	142	-	1,345	169	-
18	205	24	-	210	26	-	210	26	-
19	1,450	2,222	2,425	1,770	2,382	3,050	1,900	2,453	3,310
20	4,080	847	1,550	4,254	1,053	1,815	4,346	1,097	1,950
21	1,141	165	390	2,250	268	465	3,000	295	500
22	993	750	1,800	1,148	864	1,980	1,205	1,066	2,080
23				-	2,800	-	-	3,250	-
Total	**15,587**	**16,088**	**9,770**	**20,995**	**22,246**	**11,935**	**23,770**	**24,225**	**12,835**

The above outlined land use yields indicate that notable growth is expected to the north of the Leneva-Baranduda Growth Area study area between 2011 and 2026 with the rate of growth generally expected to decrease between 2026 and 2046.

6 First Principles Assessment of the Study Area Generated Traffic

6.1 Overview

The Leneva-Baranduda Growth Area. This assessment involved applying empirical traffic generation rates to the proposed land uses and distributing the trips onto the wider road network. The following subsections discuss the adopted traffic generation rates and the traffic distribution methodology.

6.2 Adopted Traffic Generation Rates

The adopted traffic generation rates for the various proposed land uses have been soured from rates adopted in the assessment of other growth area PSPs, Cardno's case study data and the New South Wales Road and Traffic Authority (RTA) "Guide to Traffic Generating Development" document. The rates adopted for the various land uses are outlined in the following subsections.

6.2.1 Residential Dwellings

The RTA Guide suggests a peak hour trip rate of 0.85 trips per dwelling and a daily trip rate of 9 trips per dwelling. These rates are based on surveys conducted in areas where new residential subdivisions, initially with limited public transport accessibility, are being built.

The above rates are consistent with case study data collected by Cardno for residential developments in Inverloch, Lysterfield and Nillumbik.

Accordingly a peak hour rate of 0.85 trips per dwelling and a daily trip rate of 9 trips per dwelling have been adopted for the purposes of this study.

In addition, in accordance with the RTA Guide, it has been assumed that 25% of the trips will be internal to the Leneva Baranduda Growth Area involving local shopping and employment, schools and local social activities.

6.2.2 Education Uses

An AM peak trip rate of 0.75 trips per student and a daily trip rate of 1.5 trips per student have been adopted for the purposes of this assessment. These rates are consistent with the rates adopted by the MPA in assessing PSPs in growth areas. The adopted rates are also consistent with case study data collect by Cardo for schools in Mildura and Clyde North.

In addition a conservative trip generation rate of 0.25 trips per student has been adopted for the PM commuter peak hour. The rate is considered conservative on the basis that the afternoon school pick up peak and the evening commuted peak hour do not generally coincide.

6.2.3 Activity Centres

In order to assess the likely traffic generation of the Local Town Centre (LTC), reference is made to the RTA Guide. It is anticipated that the LTC will essentially operate as small shopping centre servicing the needs of the local community.

For shopping centres up to 10,000sqm in floor space, the RTA Guide suggests a daily traffic generation rate of 121 trips per 100sqm and 12.5 trips per 100sqm during the evening commuter peak hour.

In regards to the AM commuter peak the RTA Guide does not suggest a trip rate, similarly limited case study data is available for the AM peak period. For the purposes of this assessment it has been assumed that the AM peak trip rate will be 10% of the PM peak trip rate (i.e. 1.25 trips per 100 sqm) to account with staff and servicing activities.

The above outlined rates are consistent with rates adopted by the MPA in the preparation of PSPs in other growth areas.

6.2.4 Other Employment

Cardno has been advised that Council owns a 9 hectare parcel of land opposite the proposed LTC on Baranduda Boulevard. It is understood that Council it intends to preserve this site preserved for future opportunities (such as an emergency centre, library, university, hospital, medical centre, Regional Park and/or combination).

Given the uncertainty in relation the eventual land use that will be developed on this land parcel, Cardno has assumed the following for the purposes of this study:

1. 50% of the site will be developable floor area.
2. An employment density of four jobs per 100 sqm developable floor area based on employment densities for office and commercial uses outlined in the RTA Guide.
3. A peak hour trip rate of 0.75 trips per employee and a daily trip rate of 1.5 trips per employee.

6.2.5 Baranduda Enterprise Park

Given the proximity of the Baranduda Enterprise Park to the Leneva–Baranduda Growth Area, it was assessed on a first principles basis as part of the spreadsheet modelling.

For the purposes of this assessment it was assumed that the 265 hectare industrial site has a job density of 12.17 jobs per hectare based on the job density used in the transport modelling for the Croskell PSP in Melbourne's South-East Growth Corridor. In addition it was assumed that the site will be 75% developed in the interim scenario and 100% developed in the ultimate scenario.

A peak hour trip rate of 0.75 trips per employee and a daily trip rate of 1.5 trips per employee were subsequently adopted.

Accordingly, the Baranduda Enterprise Park Industrial Estate is ultimately anticipated to generate some 2,420 trips during the peak hours, and some 4,840 daily trips.

6.2.6 Summary of Adopted Trip Generation Rates

Based on the above outlined discussions, the adopted traffic generation rates are summarised in Table 6-1:

Table 6-1 Adopted Traffic Generation Rates

Use	AM Peak Rate	PM Peak Rate	Daily Rate
Residential	0.85 trips per dwelling	0.85 trips per dwelling	9 trips per dwelling
School	0.75 trips per student	0.25 trips per student	1.5 trips per student
Activity Centre	1.25 trips per 100sqm	12.5 trips per 100sqm	121 trips per 100sqm
Other Employment / Baranduda Enterprise Park	0.75 trips per employee	0.75 trips per employee	1.5 trips per employee

6.3 Traffic Distribution

The background traffic data including the future directional distribution of external trips generated by the Growth Area for this model was informed by the SVITM.

The internal traffic generation and distribution was modelled using a first principles approach with consideration given to trip attractors (such as the LTC and schools) within the Growth Area. In order to determine the volumes on the roads within the Growth Area, the user equilibrium with capacity restraint traffic assignment method has been used to estimate trip assignment. The capacity restraint assignment process is an equilibrium assignment process by which trips are loaded incrementally onto the network and road link travel times are iteratively recalculated based on a cost function that reflects link capacity. This method assumes that drivers will choose path with the least associated cost. The iteration process stops when a driver cannot reduce travel costs by shifting to another route.

6.4 Leneva-Baranduda Growth Area Generated Traffic Volumes

Based on the assumptions outlined above, the resulting ultimate traffic generation for the PSP area and wider Leneva-Baranduda Growth Area are summarised in Table 6-2:

Table 6-2 Leneva-Baranduda Growth Area Generated Traffic Volumes

Growth Area Zone (PSP)	No. Households	Retail Floor Area (sqm)	Enrolments (no. students)	Employment (No. jobs)	AM Peak Hour Trips	PM Peak Hour Trips	Daily Trips
1 (PSP)	3,317	1,500	451		3,176	3,120	32,345
2	763				649	649	6,867
3 (PSP)	1,011	10,000	451	1,800	2,673	2,672	24,576
4 (PSP)	1,429		451		1,553	1,327	13,538
5 (PSP)	382		1,100		1,150	600	5,088
6	1,420				1,207	1,207	12,780
7 (PSP)	930				791	791	8,370
8	3,816				3,244	3,244	34,344
PSP 1055 Total	**7,069**	**11,500**	**2,453**	**1,800**	**9,342**	**8,509**	**83,916**
Growth Area Total	**13,068**	**11,500**	**2,453**	**1,800**	**14,441**	**13,609**	**137,907**

As outlined in Table 6-2 the Growth Area is ultimately expected to generate some 14,400 trips during the AM peak hour, some 13,600 trips during the PM peak hour, and some 138,000 daily trips.

It is however expected that 25% of the trips will be internal within the Leneva-Baranduda Growth Area, therefore the trips generated onto the wider road network are expected to be in the order of some 103,430 trips per day, some 62,940 of which will be from the PSP area.

7 Assessment of Interim and Ultimate Traffic Volumes

7.1 Overview

Based on the assumptions and analysis outlined in Sections 4 to 6, the background growth, Growth Area generated and post-development traffic volumes for the interim and ultimate scenarios are outlined in the following sub-sections.

Reference is made in the following subsections to the capacity of the various road types. These capacities have been sourced from the Infrastructure Design Manual (for Access and Connector Streets), and from MPA's PSP Notes – our Roads: Connecting People for the Arterial Roads, are summarised in Table 7-1:

Table 7-1 MPA Road Classifications and Capacities

Road Type	Capacity (vehicles per day)	Traffic Lane Configuration
Access Street	1,000 - 2,500	2-way, 2-lanes
Connector Street Level 1	2,500 – 6,000	2-way, 2-lanes
Secondary (Local) Arterial	12,000 – 40,000[1]	2-way, 4-lanes
Primary Arterial	Greater than 30,000	2-way, 6-lanes

[1] Clause 56 of the Planning Scheme indicates that Arterial Roads carry more than 7,000vpd. The PSP Notes aim to provide a refined hierarchy to allow the more responsive development of land use and transport interactions to support the integration objective of the Transport Integration Act (2010).

In addition, reference is made to the Austroads Standards "Guide to Traffic Management – Part 3 Traffic Studies and Analysis" document which provides guidance on the daily traffic carrying capacity of urban roads. The daily capacity limits set out in this Austroads document are summarised in Table 7-2.

Table 7-2 Austroads Theoretical Daily Capacities

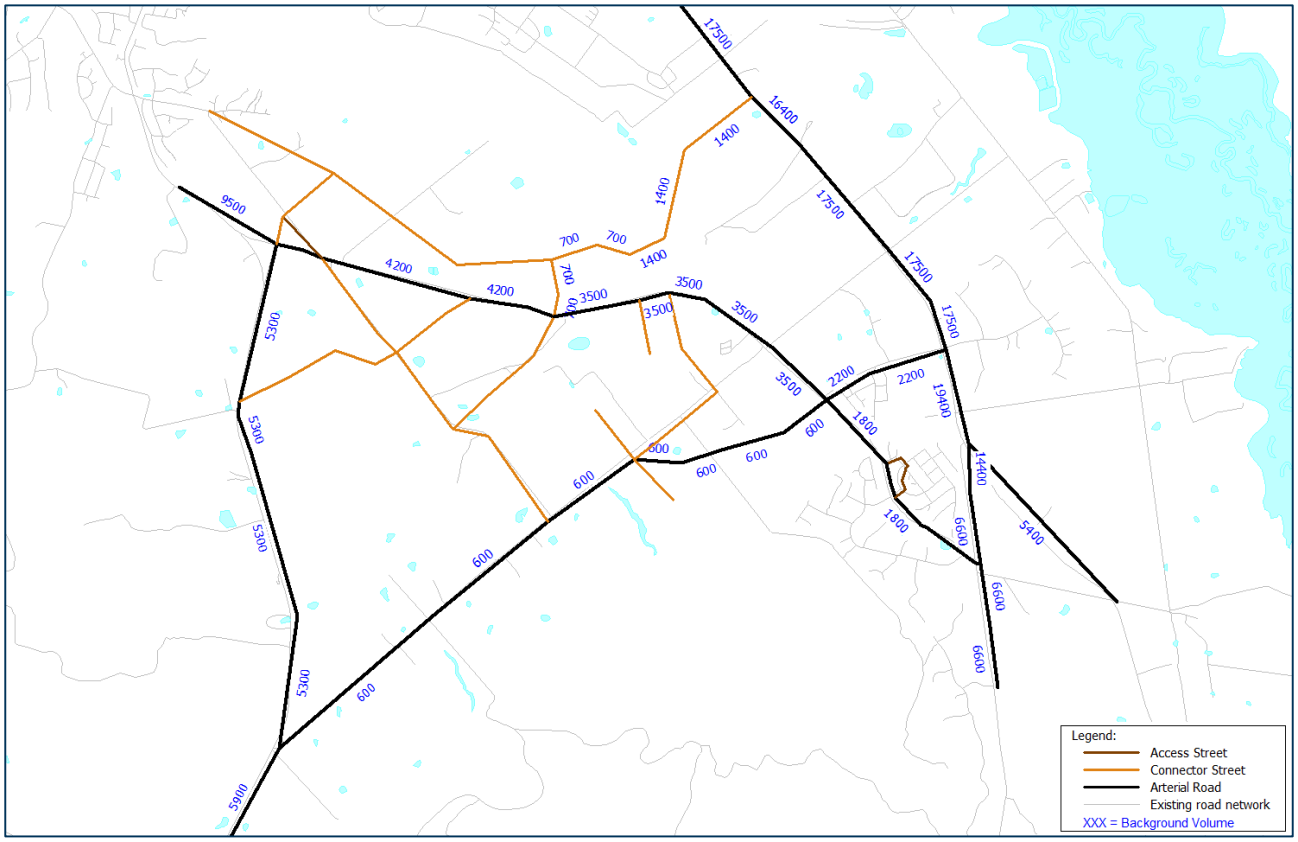
Road Type	Theoretical Daily Capacity (vehicles per day)
2-lane road	18,000
4-lane road	36,000
6-lane road	54,000

7.2 Interim (2026) Daily Traffic Volume Assessment

7.2.1 2026 Background Traffic Volumes

The expected 2026 daily background traffic volumes are outlined in Figure 7-1, with an enlarged copy included in Appendix E.

Figure 7-1 2026 Daily Background Traffic Volumes

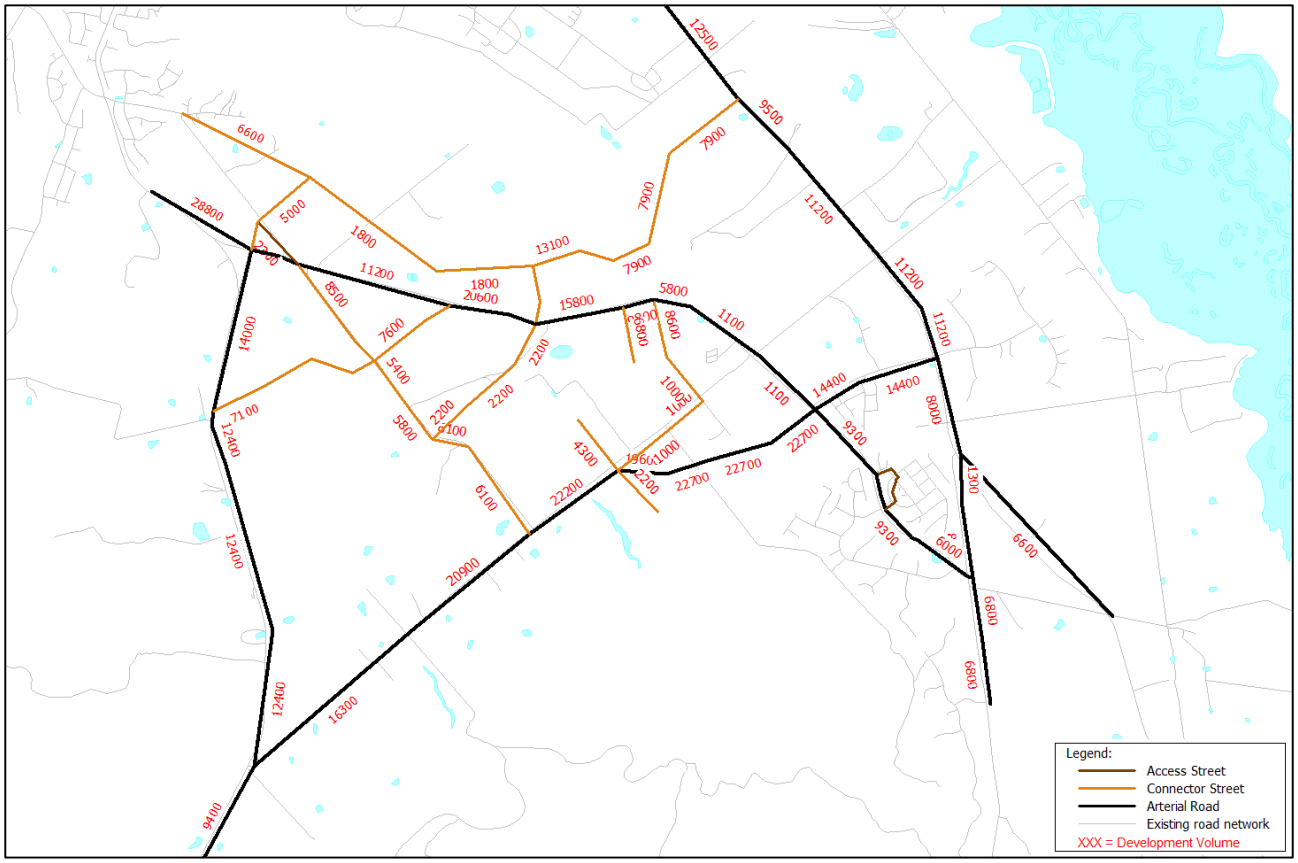


As outlined in Figure 7-1, the background growth on the road network is anticipated to be focused on the Arterial Roads (i.e. Kiewa Valley Road, Baranduda Boulevard and Beechworth-Wodonga Road).

7.2.2 2026 Growth Area Generated Traffic Volumes

The anticipated daily traffic volumes generated by the 75% development of the Leneva-Baranduda Growth Area are outlined in Figure 7-2, with an enlarged copy included in Appendix E.

Figure 7-2 2026 Growth Area Generated Traffic Volumes



As outlined in Figure 7-2, the daily traffic volumes generated by the interim development of the Growth Area are expected to result in a number of internal roads carrying traffic volumes greater than that reflective of Connector Streets (i.e. a maximum of 6,000 vehicles per day), however the volumes are still within the Austroads capacity for a two-way two-lane road.

7.2.3 2026 Post-Development Traffic Volumes

The anticipated interim post-development daily traffic volumes are outlined in Figure 7-3, with an enlarged copy included in Appendix E.

Figure 7-3 2026 Interim Post-Development Daily Traffic Volumes

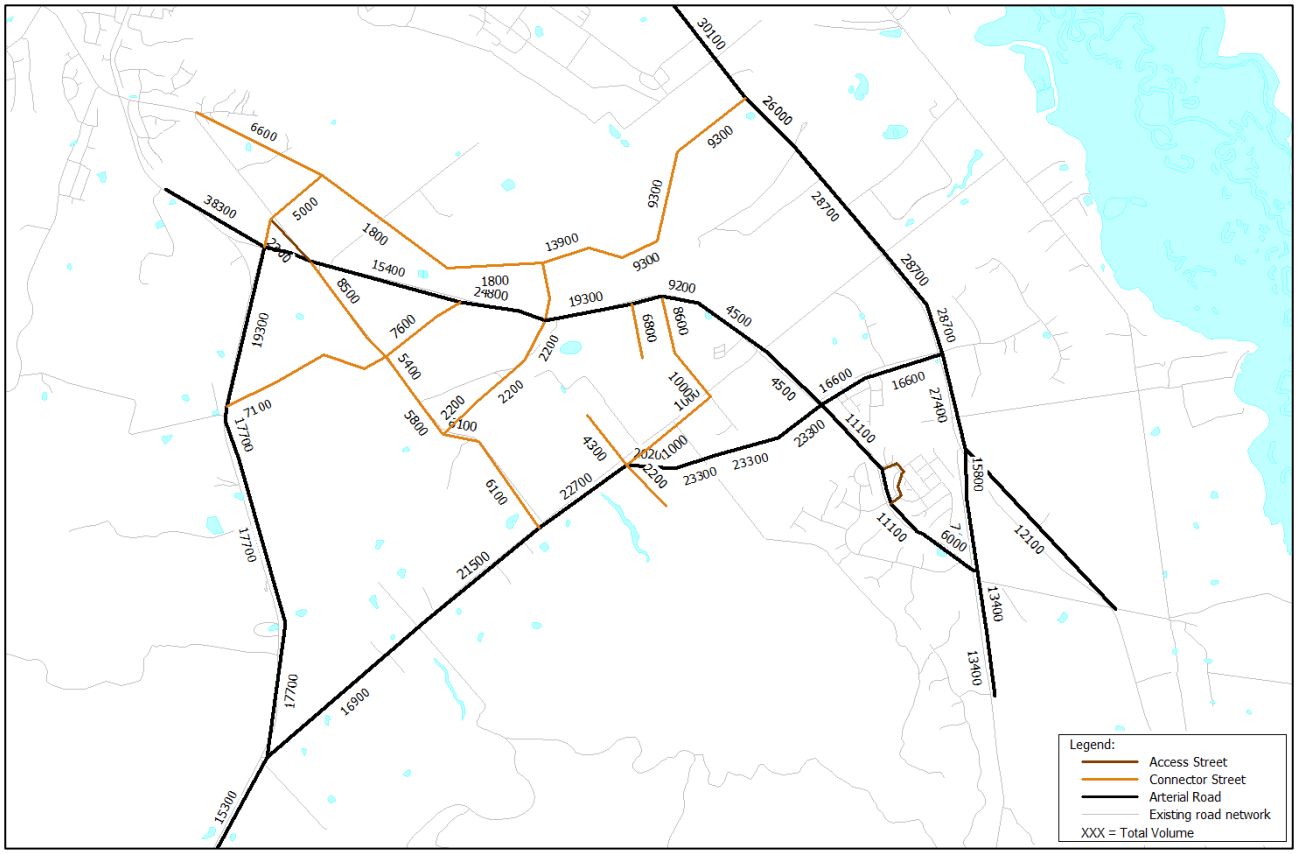


Figure 7-3 indicates the following:

- Beechworth-Wodonga Road is expected to carry volumes reflective of a Secondary Arterial Road in accordance with the MPA Road Classifications and Capacities. The volumes are however expected to be less than 18,000 vehicles per day, the Austroads specified capacity of a two-way, two-lane road.
- Volumes on Baranduda Boulevard increase in the vicinity of the Activity Centre / 9 hectare Council owned land parcel as a result of the concentration of activity in this area.
- Baranduda Boulevard is generally expected to carry volumes reflective of a Secondary Arterial Road (two-way, four-lane) in accordance with the MPA Road Classifications and Capacities and the Austroads theoretical capacities to the north of the LTC as a result of road connections to residential areas and other non-residential traffic generators (e.g. the LTC and the adjacent 9 hectare Council owned land parcel) within the Growth Area. To the south of the LTC, the expected volumes on Baranduda Road could be catered for by a two-way two-lane road as the expected volumes are within the Austroads theoretical capacity for a two-way two-lane road.
- Kiewa Valley Highway is expected to carry traffic volumes reflective of a Secondary Arterial Road (two-way, four-lane).
- Boyes Road is generally expected to carry volumes reflective of a Secondary Arterial Road (two-way, four-lane) in accordance with the MPA Road Classifications and Capacities and the Austroads theoretical capacities.
- Some section of Frederic Street Road, will carry volumes reflective of Boulevard Connector (i.e. up to 10,000 vehicles per day) as envisaged by the draft Future Urban Structure for the PSP area. Whilst greater than the upper limit for a Connector Street (6,000 vehicles per day) as specified in the Local Government's Infrastructure Design Association's Infrastructure Design Manual (IDM), it is noted that the volumes are within the Austroads theoretical capacity for a two-way two-lane road and can be catered for by a Boulevard Connector Street, with additional capacity provisions at intersections.
- The north-south Connector Streets in the vicinity of the Activity Centre carries volumes reflective of a higher order Connector Street near Baranduda Boulevard as a result of the connection it forms to the 9 hectare Council land parcel. A "Main Street" Connector Street could be provided in the vicinity of the LTC with additional capacity provided near the intersection with Baranduda Boulevard.

- The northern most east-west Connector Streets within the PSP area will carry volumes reflective of Secondary Arterial Road and not a Connector Street as envisaged by the draft Future Urban Structure for the PSP area. The expected volumes can still be however catered for a Connector Street standard road on the basis that their primary function is to provide local access, and the limited ability to provide additional parallel Connector Streets due to the existing Wodonga Retained Environmental Network Constraints. The expected local volumes on these streets will also assist in discouraging through traffic vehicles "rat-running" on these streets as through traffic will be attracted to less congested traffic routes with greater capacity in the area. Additional capacity provisions should however be provided at Connector Street-Connector Street and Connector Street-Arterial Road intersection.
- Outside of the PSP area, additional north-south and east-west Connector Street provisions will be required within the Leneva-Baranduda Growth Area to cater for the expected interim traffic volumes.

7.3 Interim (2026) Peak Hour Turning Volumes

Turning volumes at key intersections for the 1-hour AM and PM commuter peaks have been extracted from the spreadsheet model and are shown in Figure 7-4 and Figure 7-5 respectively with enlarge copies provided in Appendix G.

Figure 7-4 AM 1-Hour Peak Turning Volumes Year 2026

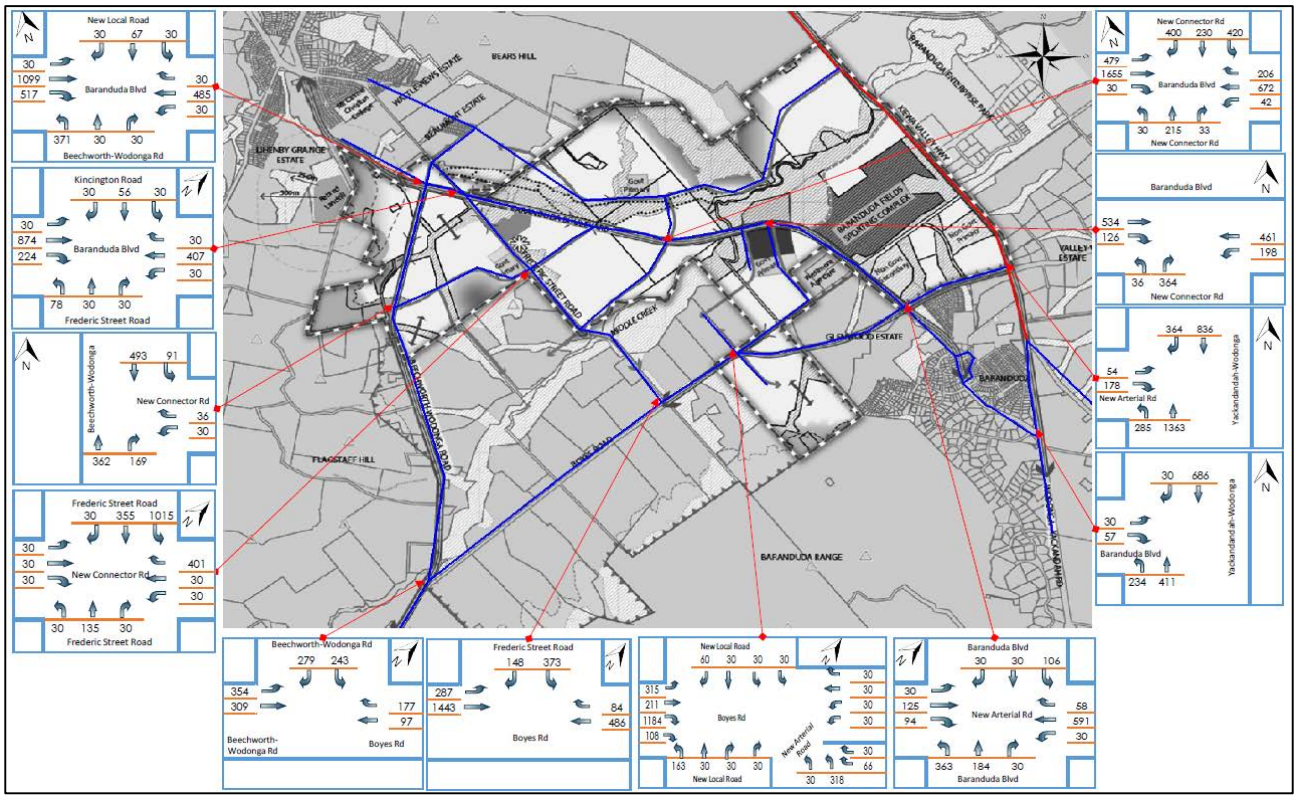


Figure 7-5 PM 1-Hour Peak Turning Volumes Year 2026

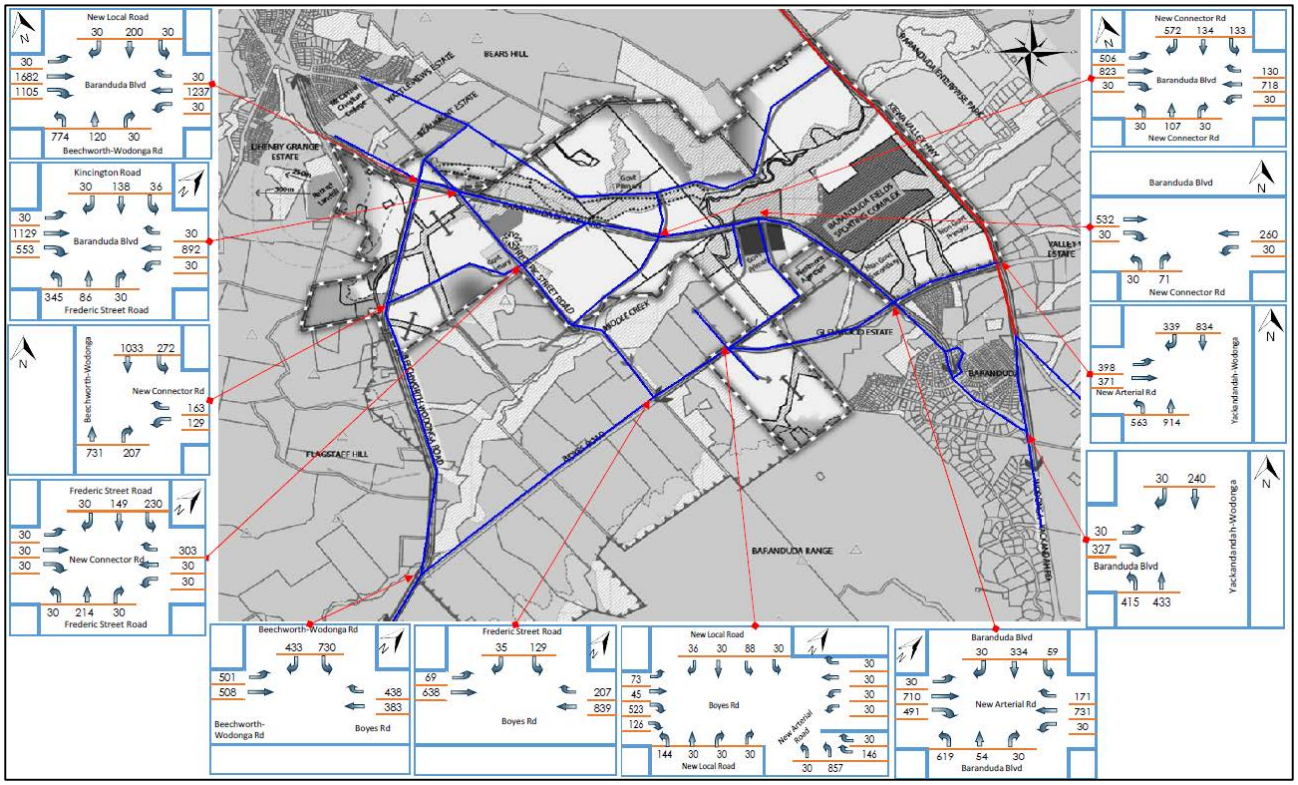


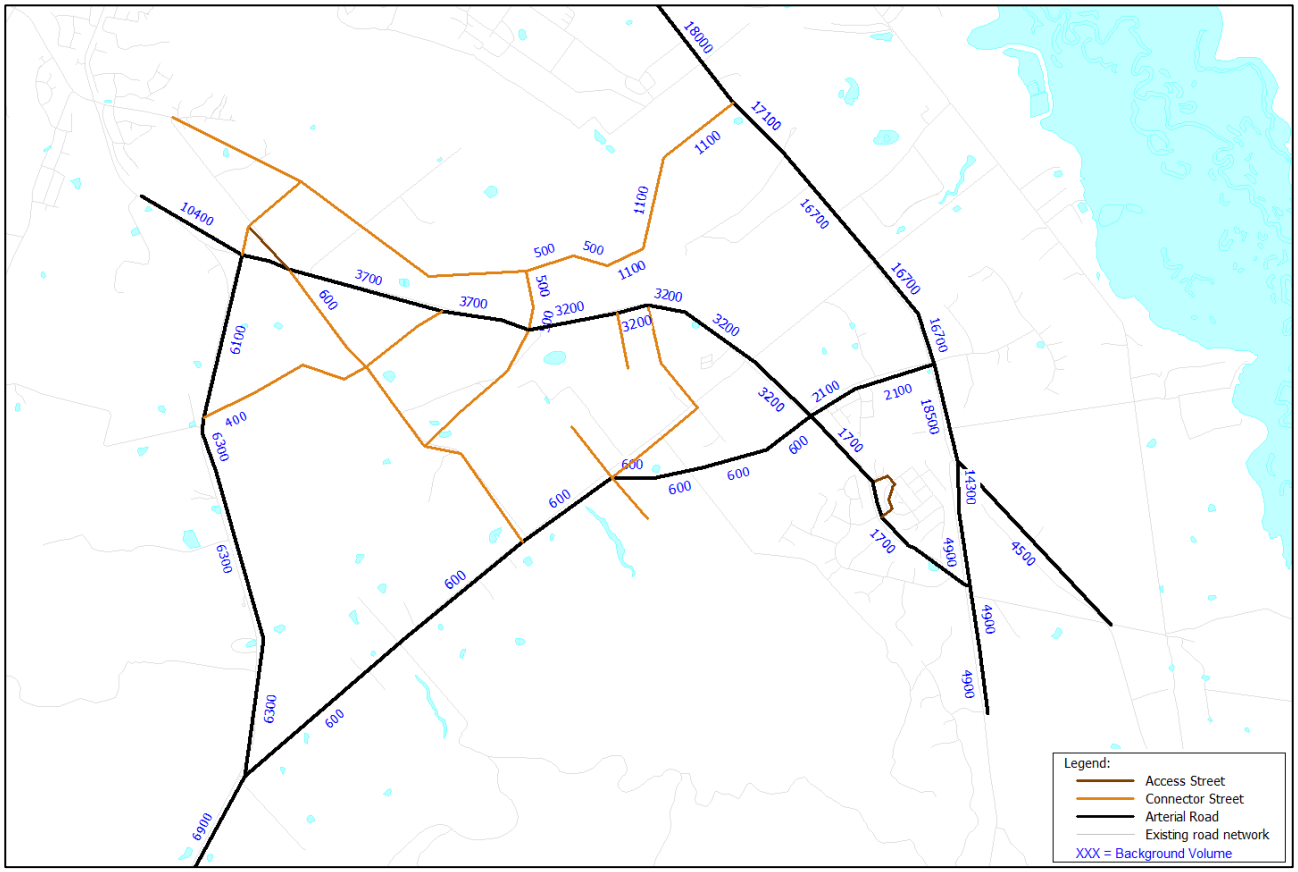
Figure 7-4 indicates that the Council owned 9 hectare development parcel (which is envisaged to provide for some 1,800 jobs), LTC and the secondary school within the PSP area, are expected to attract vehicle trips (employment and educational) from areas to the north of the study area. This results in the southbound traffic flows on Baranduda Boulevard (away from Wodonga) being greater than the northbound traffic flows (towards Wodonga) during the morning peak hour. Figure 7-5 indicates that the through traffic volumes on Baranduda Boulevard are expected to be more balanced in the PM peak as a result of the afternoon school peak and evening commuter peak not overlapping as is the case in the morning peak hour.

7.4 Ultimate (2046) Traffic Volume Assessment

7.4.1 2046 Background Traffic Volumes

The 2046 daily background traffic volumes are outlined in Figure 7-6, with an enlarged copy included in Appendix F.

Figure 7-6 2046 Daily Background Traffic Volumes

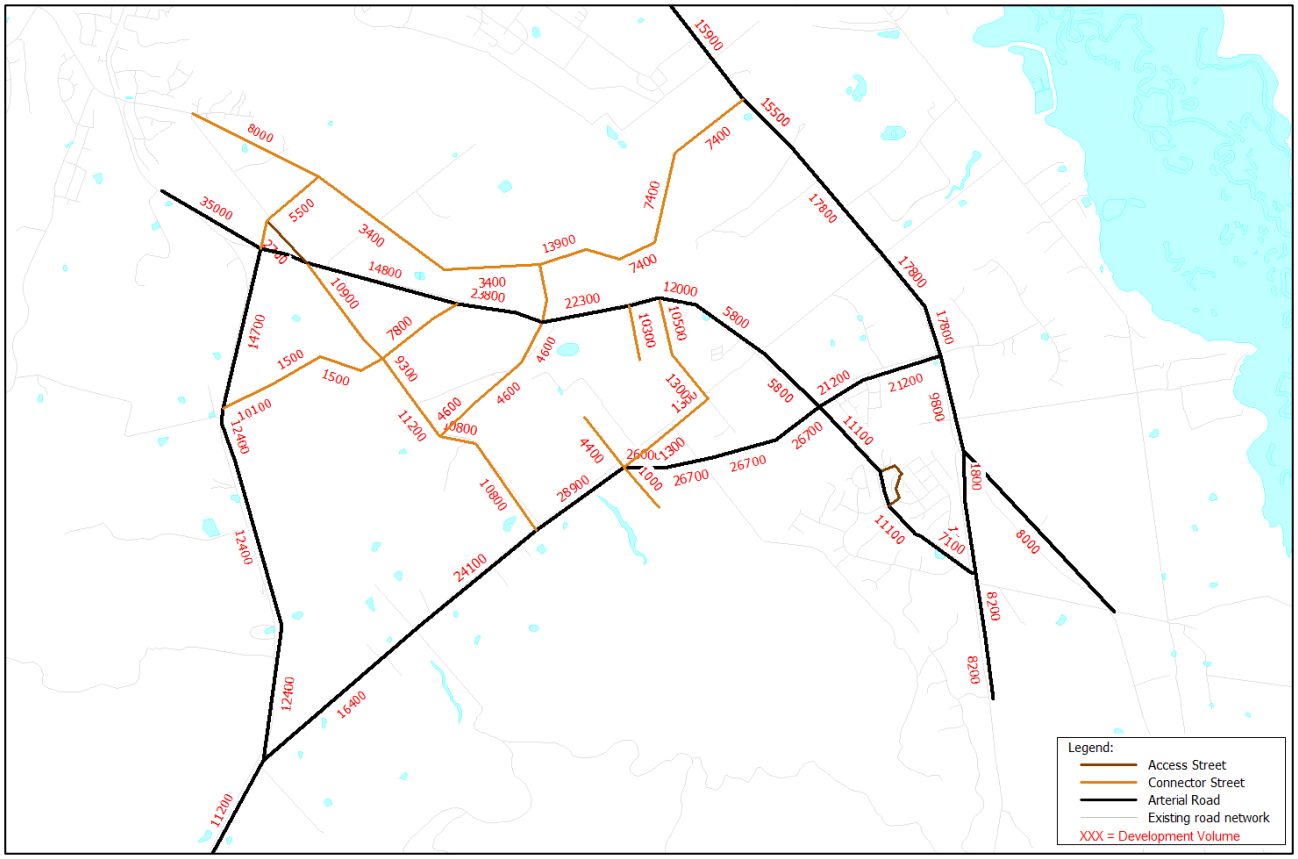


By 2046 the background traffic volumes on Kiewa Valley Road are expected to be nearing the upper Austroads capacity limit for a two-way, two-lane road indicating that it will require duplication even without the development of the Leneva-Baranduda Growth Area.

7.4.2 2046 Growth Area Generated Traffic Volumes

The anticipated daily traffic volumes generated by the full development of the Leneva-Baranduda Growth Area are outlined in Figure 7-7, with an enlarged copy included in Appendix F.

Figure 7-7 2046 Growth Area Generated Daily Traffic Volumes



Under ultimate conditions the Leneva-Baranduda Growth Area is expected to be fully developed. The volumes generated by the full development of the Growth Area will result in traffic volumes on Boyes Road, Baranduda Boulevard and Beechworth-Wodonga Road being reflective of a Secondary Arterial Road (two-way, four-lane roads).

7.4.3 2046 Post-Development Traffic Volumes

The anticipated ultimate post-development daily traffic volumes are outlined in Figure 7-8, with an enlarged copy included in Appendix F.

Figure 7-8 2046 Ultimate Post-Development Daily Traffic Volumes

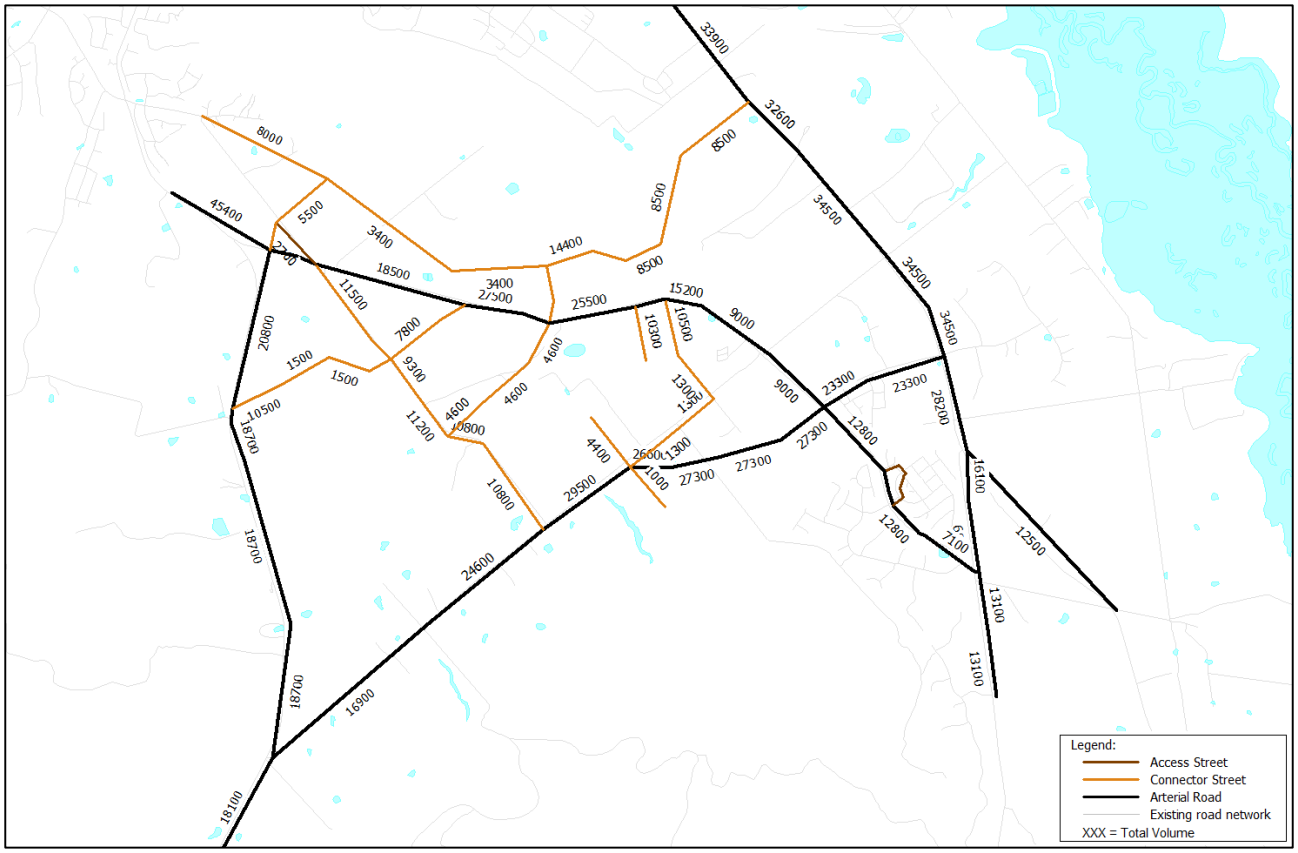


Figure 7-8 indicates that in addition to the interim findings the following are also anticipated under the ultimate conditions:

- Volumes on Fredric Street Road are reflective of a Secondary Arterial Road indicating a strong need of an additional north-south Connector Street between Frederic Street Road and Beechworth-Wodonga Road.
- Beechworth-Wodonga Road is expected to carry volumes reflective of a Secondary Arterial Road in accordance with the MPA Road Classifications and Capacities. The volumes are also expected to be slightly greater than 18,000 vehicles per day, the Austroads specified capacity of a two-way two-lane road indicating that consideration should be given to upgrading the road to a two-way four-lane road.
- Baranduda Boulevard is generally expected to carry volumes reflective of a Secondary Arterial Road (two-way, four-lane) in accordance with the MPA Road Classifications and Capacities and the Austroads theoretical capacities to the north of the LTC as a result of road connections to residential areas and other non-residential traffic generators (e.g. the LTC and the adjacent 9 hectare Council owned land parcel) within the Growth Area. To the south of the LTC, the expected volumes on Baranduda Road could still be catered for by a two-way two-lane road as the expected volumes are within the Austroads theoretical capacity for a two-way two-lane road.

7.5 Ultimate (2046) Peak Hour Turning Volumes

Turning volumes at key intersection for the 1 hour AM and PM commuter peaks have been extracted from the spreadsheet model and are shown in Figure 7-9 and Figure 7-10 respectively with enlarge copies provided in Appendix G.

Figure 7-9 AM 1-Hour Peak Turning Volumes Year 2046

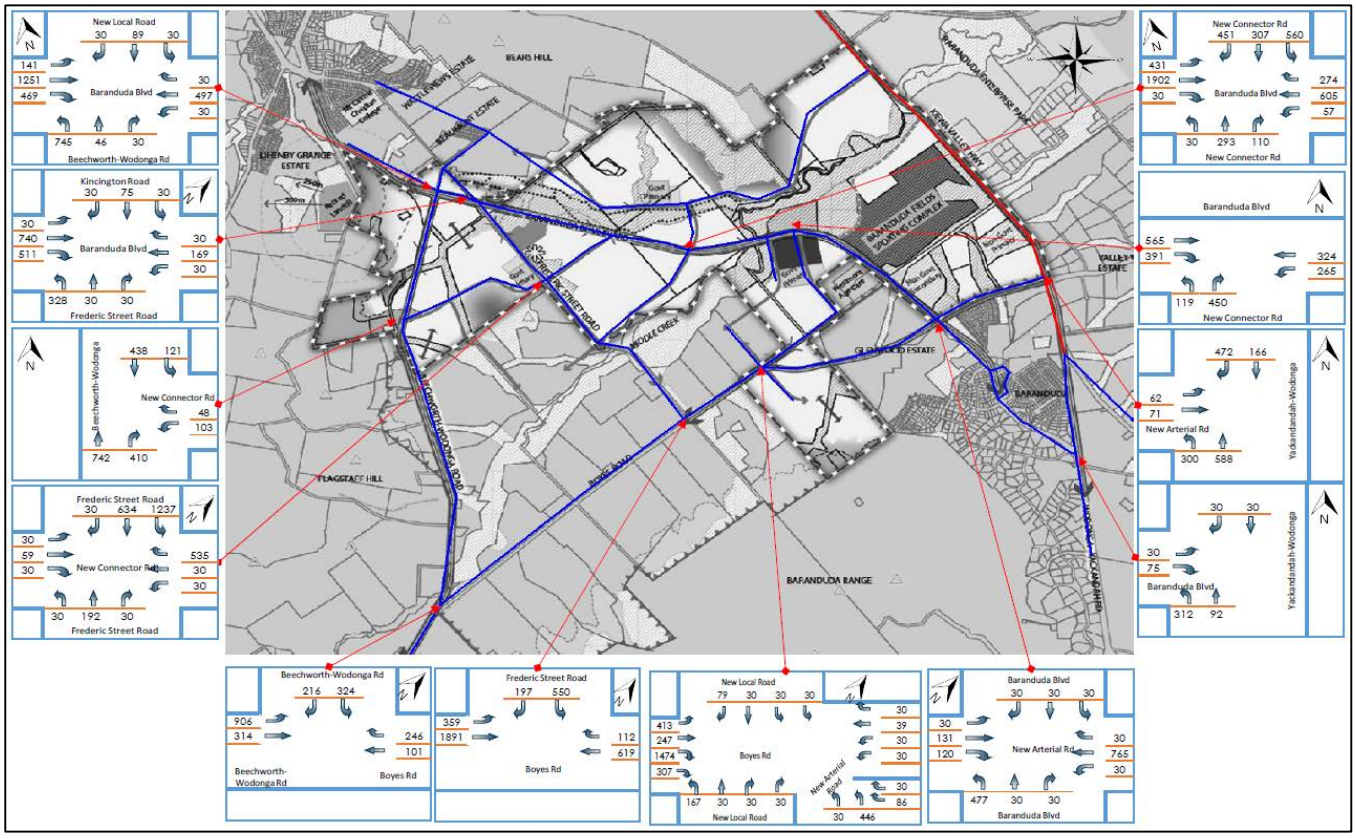


Figure 7-10 PM 1-Hour Peak Turning Volumes Year 2046

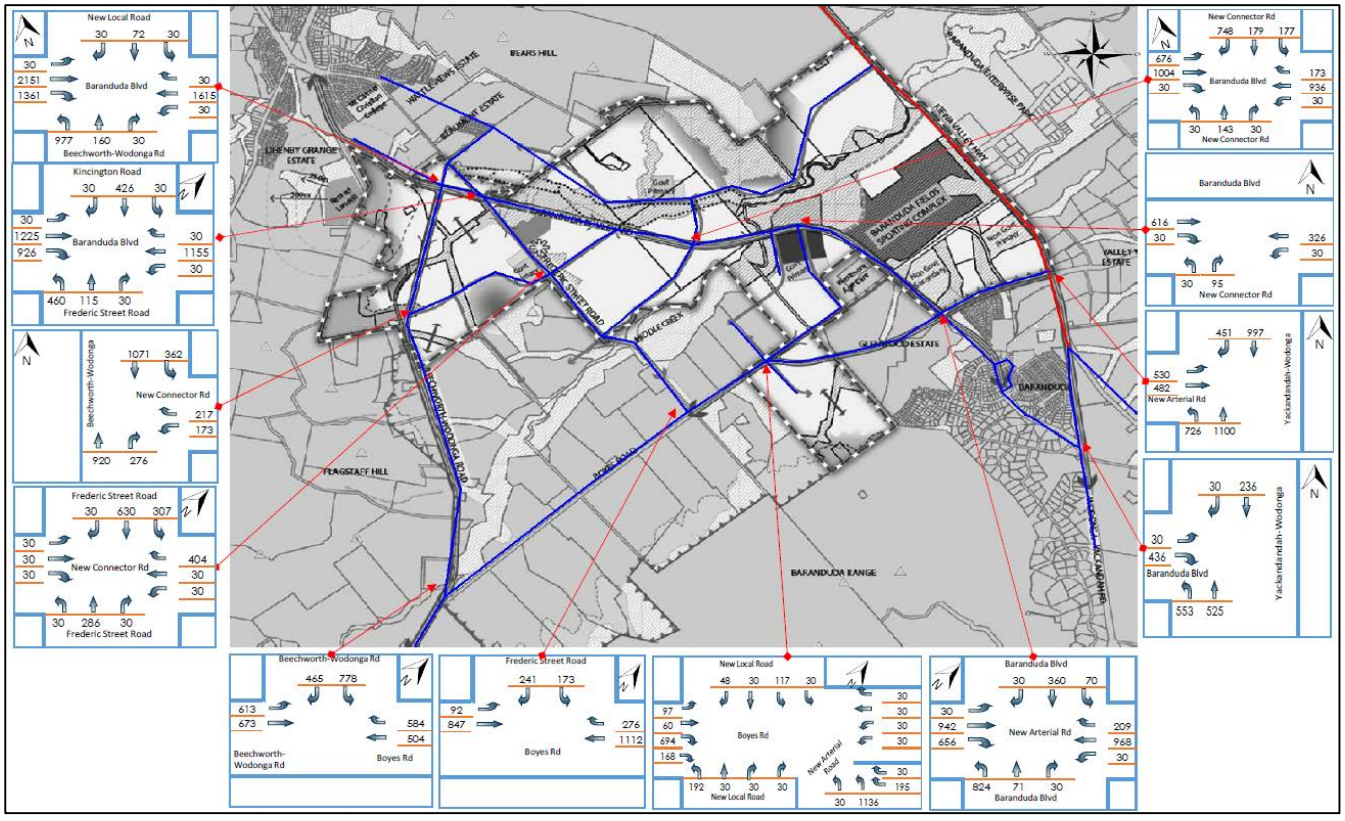


Figure 7-9 indicates that the Council owned 9 hectare development parcel (which is envisaged to provide for some 1,800 jobs), the LTC and the secondary school within the PSP area are expected to attract vehicle trips (employment and educational) from areas to the north of the study area. This results in the southbound traffic flows on Baranduda Boulevard (away from Wodonga) being greater than the northbound traffic flows (towards Wodonga) during the morning peak hour. Figure 7-10 indicates that the through traffic volumes on Baranduda Boulevard are expected to be more balanced in the PM peak as a result of the afternoon school peak and evening commuter peak not overlapping as is the case in the morning peak hour.

8 Road Network Assessment

8.1 Overview

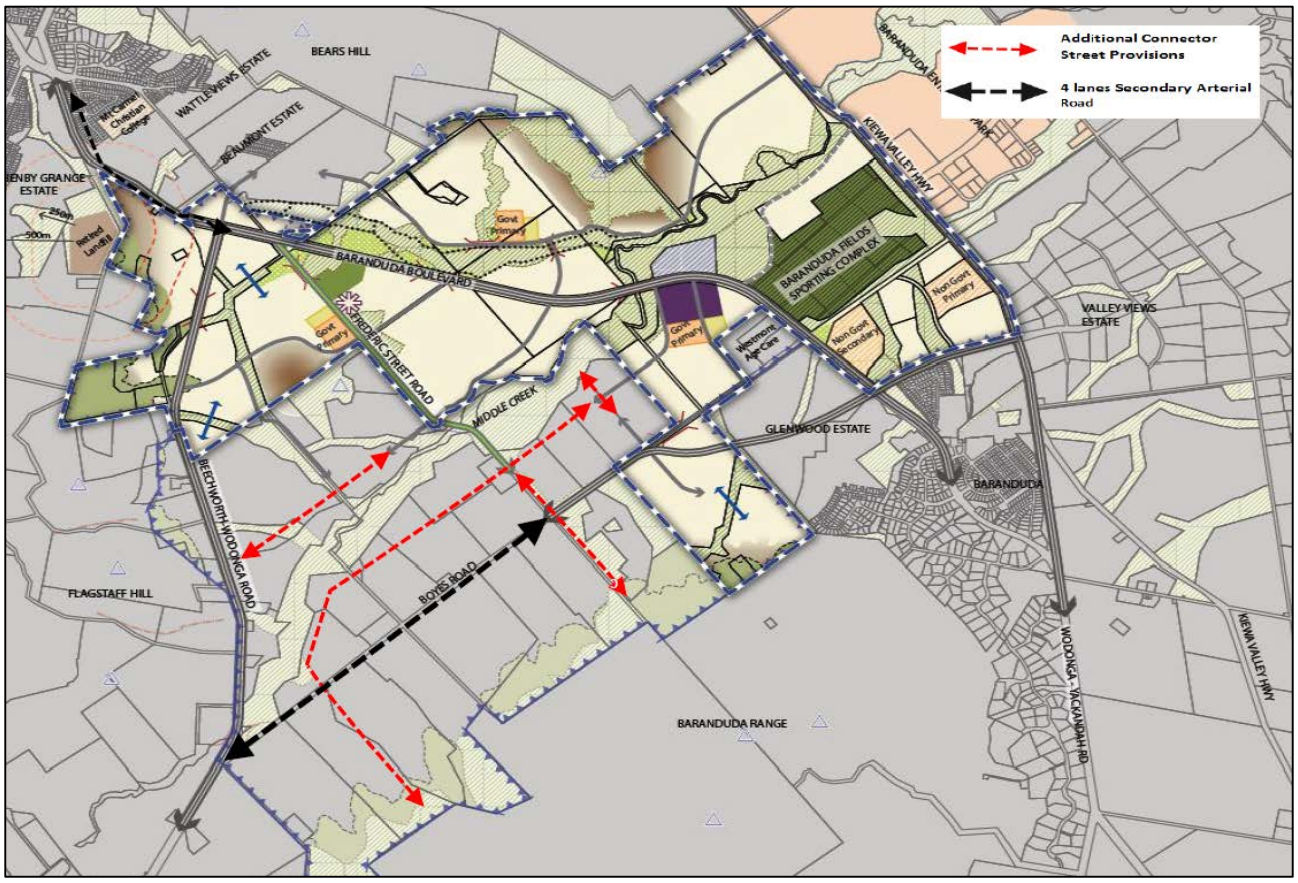
Based on the findings of the daily traffic modelling outlined in Section 7 and a review of the road network envisaged by the draft Future Urban Structure the interim and ultimate road network requirements were assessed with the findings outlined in the following sub sections.

It is highlighted that the constrained nature of the site, due to the irregular shape of the Growth Area, the existing locations of Arterial Roads, Middle Creek and the Wodonga Retained Environmental Network result in difficulties in terms of delivering a typical grid road network with a 1.6km grid for Arterial Roads and a supporting 800m grid network for Connector Streets.

8.2 Interim Road Network Requirements

Based on the findings of the interim analysis, the interim road network requirements for the Growth Area are outlined in Figure 8-1.

Figure 8-1 Interim Road Network Requirements



As outlined in Figure 8-1, a number of additional Connector Street connections will be required to ensure the traffic generated by the Growth Area can be accommodated.

The provision of additional east-west Connector Streets to the north of Boyes Road will also result in increased connectivity to the LTC activity area and relive pressure on the northern-most east-west Connector Street shown in the draft Future Urban Structure.

Daily traffic volumes on the LTC north-south Connector Streets are expected to be higher than the IDM specified capacity of 6,000 vehicles per day near Baranduda Boulevard as a result of the connection they form to the 9 hectare Council land parcel. The volumes through the LTC can however still be adequately catered for by a single lane in each direction (with additional capacity to be provided at intersections as required). Furthermore the provision of Connector Streets in this location will assist in slowing traffic speeds

and thereby allowing for enhanced pedestrian amenity which is essential given the activity centre and school land uses in this area.

In addition, to the north of the LTC, Baranduda Boulevard is generally expected to carry volumes reflective of a Secondary Arterial Road (as a result of new road connections to Baranduda Boulevard within the Growth Area) in accordance with the MPA Road Classifications and Capacities and the Austroads theoretical capacities To the south of the LTC, the expected volumes on Baranduda Road could be catered for by a two-way two-lane road given that the expected volumes are within the Austroads theoretical capacity for a two-way two-lane road.

Boyes Road is also expected to carry volumes reflective of a Secondary Arterial Road (two-way, four-lane) in accordance with the MPA Road Classifications and Capacities and the Austroads theoretical capacities.

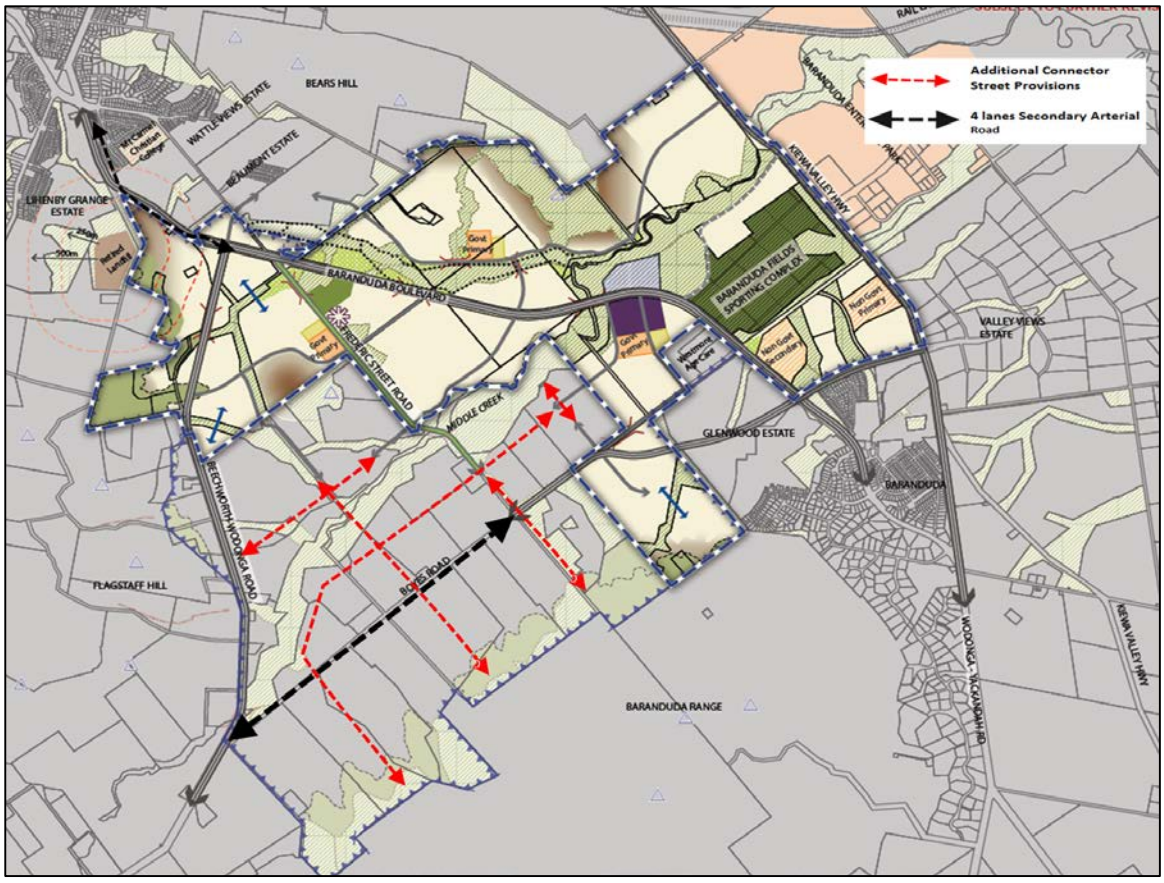
In addition in is noted that Beechworth-Wodonga Road is expected to carry volumes reflective of a Secondary Arterial Road in accordance with the MPA Road Classifications and Capacities. The volumes are however expected to be less than 18,000 vehicles per day, the Austroads specified capacity of a two-way, two-lane road indicating that the provision of a two-way two-lane road is suffice under interim conditions.

Finally it is noted that the modelling shows that Kiewa Valley Highway is expected to carry traffic volumes reflective of a Secondary Arterial Road (two-way, four-lane) indicating that consideration should be given to upgrading the road in the interim.

8.3 Ultimate Road Network Requirements

Based on the findings of the ultimate analysis, the ultimate road network requirements are outlined in Figure 8-2.

Figure 8-2 Ultimate Road Network Requirements



In addition to the identified additional interim road network requirements, Figure 8-2 shows that an additional north-south Connector Street will be required between Beechworth-Wodonga Road and Frederick Street Road to adequately cater for the anticipated ultimate traffic volumes. This additional north-south Connector

Street provision will result in Frederick Street Road carrying volumes more reflective of a Connector Street rather than a Secondary Arterial Road.

Furthermore, Beechworth-Wodonga Road is expected to carry volumes reflective of a Secondary Arterial Road in accordance with the MPA Road Classifications and Capacities and the Austroads theoretical capacities indicating that consideration should be given to upgrading the road to a two-way four-lane road.

9 Conclusions

This report addresses the land use inputs, the associated traffic demand and resulting road network requirements for the Leneva-Baranduda PSP (PSP1105) and the wider Leneva-Baranduda Growth Area for the interim and ultimate development scenarios.

Based on the analysis and discussions presented with this report the following conclusions are made:

General

- The Leneva-Baranduda PSP (PSP1105) is ultimately anticipated to generate some 82,490 daily vehicle movements (inclusive of some 20,620 internal trips).
- The entire Leneva-Baranduda Growth area is ultimately anticipated to generate some 141,820 daily vehicle movements (inclusive of some 35,460 internal trips).
- The road network outlined in the draft Future Urban Structure provides suitable road network connections for the development of the Leneva – Baranduda PSP area, however additional north-south and east-west Connector Street provisions will be required within the wider Growth Area.

Interim Road Network Considerations

- The interim analysis indicates that Baranduda Boulevard, to the north of the LTC, is generally expected to carry volumes reflective of a Secondary Arterial Road (two-way, four-lane) in accordance with the MPA Road Classifications and Capacities and the Austroads theoretical capacities (as a result of new road connections to Baranduda Boulevard within the Growth Area). To the south of the LTC, the expected volumes on Baranduda Road could be catered for by a two-way two-lane road given that the expected volumes are within the Austroads theoretical capacity for a two-way two-lane road.
- The interim analysis also indicates that Boyes Road is expected to carry volumes reflective of a Secondary Arterial Road (two-way, four-lane) in accordance with the MPA Road Classifications and Capacities and the Austroads theoretical capacities.
- Beechworth-Wodonga Road is expected to carry volumes reflective of a Secondary Arterial Road (two-way, four-lane) in accordance with the MPA Road Classifications and Capacities. The volumes are however expected to be less than 18,000 vehicles per day, the Austroads specified capacity of a two-way, two-lane road indicating that the provision of a two-way two-lane road is suffice under interim conditions.
- The interim modelling shows that Kiewa Valley Highway is expected to carry traffic volumes reflective of a Secondary Arterial Road (two-way, four-lane) indicating that consideration should be given to upgrading the road in the interim.
- A number of additional Connector Street connections will be required to ensure the traffic generated by the wider Growth Area can be accommodated. The provision of additional east-west Connector Streets to the north of Boyes Road will also result in increased connectivity to the LTC activity area and relive pressure on the northern-most east-west Connector Street shown in the draft Future Urban Structure.

Ultimate Road Network Considerations

- In addition to the interim road network requirements, the ultimate scenario modelling indicates that Beechworth-Wodonga Road is expected to carry volumes reflective of a Secondary Arterial Road (two-way, four-lane) in accordance with the MPA Road Classifications and Capacities and the Austroads theoretical capacities indicating that consideration should be given to upgrading the road to a two-way four-lane road under ultimate conditions.
- An additional north-south Connector Street provision between Beechworth-Wodonga Road and Frederick Street Road will also be required within the Growth Area and will result in Frederick Street Road carrying volumes more reflective of a Connector Street rather than a Secondary Arterial Road.

Leneva-Baranduda
Growth Area

APPENDIX A

DRAFT FUTURE URBAN STRUCTURE PLAN

Cardno
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WORKING DRAFT
FOR DISCUSSION PURPOSES ONLY
SUBJECT TO FURTHER REVISION

WODONGA SOUTH
HUON PARK ESTATE
Whitebox Rise Activity Centre
Mt Carmel Christian College
WATTLE VIEWS ESTATE
BEARS HILL
BEAUMONT ESTATE
LIHENBY GRANGE ESTATE
250m
500m
Retired Landfill
RAIL EASEMENT AND BIKE TRAIL
BARANDUDA ENTERPRISE PARK
KIEWA VALLEY HWY
Govt Primary
BARANDUDA BOULEVARD
BARANDUDA FIELDS SPORTING COMPLEX
Non Govt Primary
Govt Primary
FREDERIC STREET ROAD
Govt Primary
Westmont Age Care
Non Govt Secondary
VALLEY VIEWS ESTATE
MIDDLE CREEK
GLENWOOD ESTATE
BEECHWORTH-WODONGA ROAD
BARANDUDA
FLAGSTAFF HILL
BOYES ROAD
BARANDUDA RANGE
WODONGA - YACKANDAH RD
KIEWA VALLEY HWY

- growth area boundary
- psp boundary
- town centre
- potential local convenience centre
- residential
- viewline and slope investigation area
- retired landfill
- landfill buffer zone
- landscape values
- potential government school
- potential non-government school
- community facilities
- regional sports reserve
- local playing field (tbc)
- local park (tbc)
- Wodonga Retained Environmental Network
- opportunity for development (tbc)
- high point
- gully
- arterial road
- boulevard connector
- connector road
- local access street
- local connection required
- bridge/culvert
- proposed shared path

Draft Future Urban Structure Concept
Leneva-Baranduda Precinct Structure Plan
1:30,000 @ A3
0 250 500 750 1,000 1,250m

CITY OF WODONGA VIC
METROPOLITAN PLANNING AUTHORITY

Leneva-Baranduda
Growth Area

APPENDIX B

BASE CASE TRAFFIC VOLUMES

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Traffic Data

A1 Traffic Count Data from Council

The City of Wodonga provided Cardno with Metrocount survey data, sourced from surveys undertaken between February 2015 and May 2015. The summary of survey data is provided in Table A1.

Table A1: City Council Metrocount Survey Data

No	Road Name	AM Peak (2hr)	PM Peak (2hr)	Daily
1	Baranduda Blvd east of Beechworth WB	415	278	1,513
	Baranduda Blvd east of Beechworth EB	195	310	1,393
2	Baranduda Blvd north of Boyes Road WB	298	256	1,361
	Baranduda Blvd north of Boyes Road EB	180	300	1,398
3	Boyes Road east of Baranduda Blvd EB	44	22	152
	Boyes Road east of Baranduda Blvd WB	21	31	120
4	Boyes Road east of Beechworth WB	14	24	87
	Boyes Road east of Beechworth EB	32	15	109
5	Streets Road east of Beechworth Road WB	322	195	1,288
	Streets Road east of Beechworth Road EB	134	332	1,328
6	Yarralumla Driver west of Beechworth EB	360	383	1,942
	Yarralumla Driver west of Beechworth WB	339	376	1,923
7	Beechworth Road south of Yarralumla Drive NB	661	447	2,743
	Beechworth Road south of Yarralumla Drive SB	284	663	2,724

A2 Origin Destination Data from WANS

The traffic survey data was also extracted from Origin-Destination (O-D) survey data collected as part of the Wodonga Arterial Network Study. The locations of the count stations is shown in Figure A1 and the results of the O-D surveys for the AM and PM peaks are shown in Table A2 and Table A3 respectively.

Figure A1: WANS O-D Survey Station Location

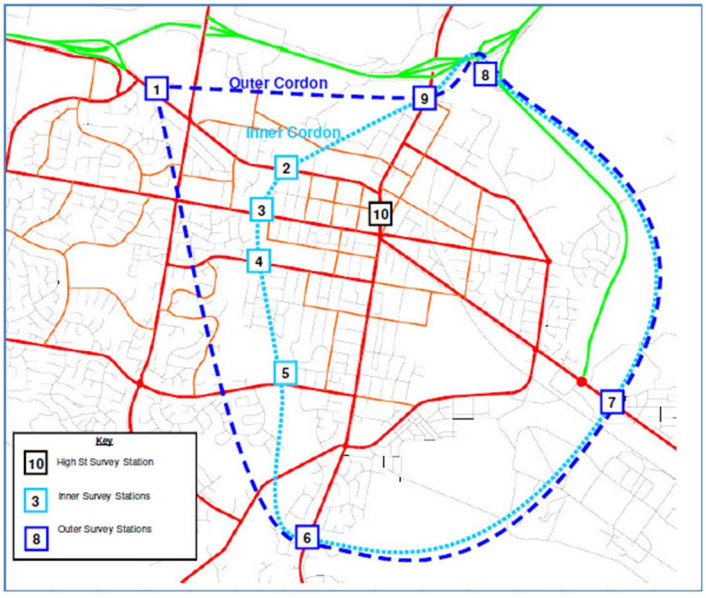

Table A2: AM Peak Hour (08:00 AM – 09:00 AM) WANS Total O-D Survey Summary

O-D Station	1	2	3	4	5	6	7	8	9	10	Matched	Local	Total
1	38	0	0	0	0	13	21	4	33		109	561	670
2	0	44	13	4	4	7	38	4	46		160	297	457
3	0	59	77	13	21	7	33	4	63		277	400	677
4	0	12	27	66	31	10	29	6	43		224	278	502
5	0	14	15	21	73	40	51	13	55		282	409	691
6	0	27	7	22	80	23	11	21	55		246	296	542
7	0	75	53	24	34	11	38	286	73		594	360	954
8	0	0	0	1	15	12	120	10	2		160	70	230
9	0	51	20	16	18	27	58	4	79		273	678	951
10											0	0	0
Total	38	282	212	167	276	150	399	352	449	0	2325	3349	7999

Table A3: PM Peak Hour (04:00 PM–05:00 PM) WANS Total O-D Survey Summary

O-D Station	1	2	3	4	5	6	7	8	9	10	Matched	Local	Total
1	50	0	0	0	0	14	21	3	45	0	133	493	626
2	0	94	27	4	10	20	39	4	74	0	272	269	541
3	0	53	58	19	17	7	26	2	27	0	209	248	457
4	0	7	17	42	10	4	24	0	18	0	122	177	299
5	0	11	9	14	47	64	41	9	44	0	239	180	419
6	0	17	11	7	69	9	4	12	47	0	176	116	292
7	0	59	55	39	105	18	32	241	99	0	648	338	986
8	0	1	2	1	8	27	181	6	7	0	233	100	333
9	0	98	51	16	55	64	77	8	82	0	451	579	1030
10	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	50	340	230	142	321	227	445	285	443	0	2483	2500	7466

A3 Cardno Data Collection

Cardno also commissioned AM and PM peak hour turning movement counts and weekly tube count surveys within the local study area in June 2015 to gain an understanding of current traffic characteristics of the area. The location of the surveys is presented in Figure A2, with the results summarised in Table A4.

Figure A1: Traffic Survey Locations

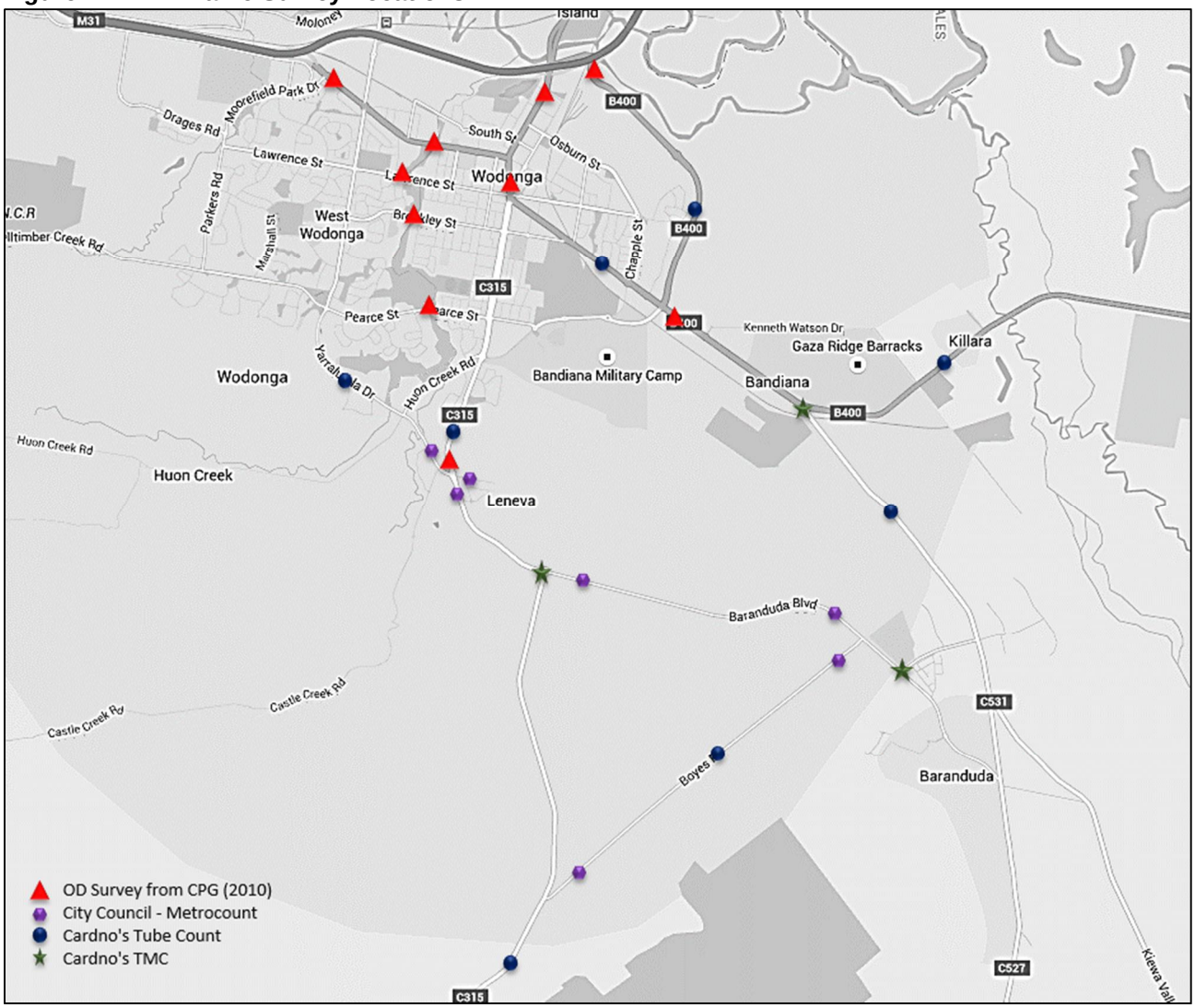

Table A4 Cardno Traffic Counts (TMC and Tube Count)

No	Location Description (Direction)	AM (2hr)	PM (2hr)	Daily	Note
1	Murray Valley Hwy 900m North of Anzac Pde (NB)	1,804	1,919	9,486	Tube Count Survey
	Murray Valley Hwy 900m North of Anzac Pde (SB)	1,445	1,927	9,668	
2	Thomas Mitchell Dr Btw Colman St and Gralen St (EB)	672	999	5,021	
	Thomas Mitchell Dr Btw Colman St and Gralen St (WB)	1,061	1,080	5,509	
3	Murray Valley Hwy 350m South of Whytes Rd (NB)	572	852	3,551	
	Murray Valley Hwy 350m South of Whytes Rd (SB)	674	630	3,559	
4	Kiewa Valley Hwy 350m South of Murray Valley Hwy (NB)	1,075	573	4,249	
	Kiewa Valley Hwy 350m South of Murray Valley Hwy (SB)	442	1,071	4,234	
5	Boyes Rd 400m North of Frederic Street Rd (NB)	33	20	114	
	Boyes Rd 400m North of Frederic Street Rd (SB)	14	22	97	
6	Beechworth-Wodonga Rd 500m South of Boyes Rd (NB)	351	170	1,293	
	Beechworth-Wodonga Rd 500m South of Boyes Rd (SB)	150	342	1,297	
7	Beechworth-Wodonga Rd 150m South of Sans Souci Dr (NB)	726	488	3,105	
	Beechworth-Wodonga Rd 150m South of Sans Souci Dr (SB)	397	809	3,190	
8	Yarralumla Dr 200m West of Jevington Dr (EB)	350	658	2,811	
	Yarralumla Dr 200m West of Jevington Dr (WB)	644	491	2,958	
1	**Murray Valley Hwy and Kiewa Valley Hwy**				Turning Movement Count
	Baranduda Blvd north of John Schubert Drive (SB)	211	369		
	Baranduda Blvd north of John Schubert Drive (NB)	339	227		
	John Schubert Drive east of Baranduda Blvd (EB)	274	163		
	John Schubert Drive east of Baranduda Blvd (WB)	165	258		
	Baranduda Blvd south of John Schubert Drive (NB)	436	246		
	Baranduda Blvd south of John Schubert Drive (SB)	200	483		
2	**Beachworth Rd and Beachwork Wodong Rd**				
	Baranduda Blvd west of Beechworth Wodonga Rd (EB)	210	293		
	Baranduda Blvd west of Beechworth Wodonga Rd (WB)	309	244		
	Beechworth Wodonga Rd south of Baranduda Blvd (NB)	354	181		
	Beechworth Wodonga Rd south of Baranduda Blvd (SB)	131	315		
	Beechworth Rd north of Beechworth Wodonga Rd (EB)	339	601		
	Beechworth Rd north of Beechworth Wodonga Rd (WB)	660	414		
3	**Murray Valley Hwy and Kiewa Valley Hwy**				
	Murray Valley Hwy west of Kiewa Valley Hwy (EB)	468	543		
	Murray Valley Hwy west of Kiewa Valley Hwy (WB)	562	847		
	Kiewa Valley Hwy south of Murray Valley Hwy (NB)	1,235	679		
	Kiewa Valley Hwy south of Murray Valley Hwy (SB)	530	1,014		
	Murray Valley Hwy north of Kiewa Valley Hwy (SB)	946	1,533		

Leneva-Baranduda
Growth Area

APPENDIX C

SVITM VALIDATION

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Strategic Model Validation

B1 Overview

B1.1 Model Valuation Procedure

Model validation is a process in which the model inputs are adjusted to reflect actual network characteristics to allow the strategic model to produce travel demands in line with actual measured traffic conditions.

Existing traffic counts are used as a reference point to compare against modelled link volumes after each model assignment run. Following any link adjustments the model demands are once again assigned and modelled, and the results are again compared to the surveyed traffic count data. This process is repeated until the model results converge to a point where they meet certain validation criteria.

Given the scale of strategic models (noting that State-wide Victorian Integrated Transport Model encompasses almost all of Victoria), strategic network models are generally calibrated to reflect existing traffic counts across a large corridor or region, and are not expected to accurately match traffic counts at individual locations. To achieve the model validation, the model is measured by comparing counts across a number of locations, such as along screen lines.

B1.2 Model Validation Guidelines

Model calibration and validation guidelines have been developed by VicRoads for use on strategic modelling projects, these guidelines are outlined in the VicRoads document *'Transport Modelling Guidelines, Volume 2: Strategic Modelling'*, dated April 2012. This document outlines the model validation targets for VITM modelled traffic volumes. Three key criteria are prescribed by VicRoads to assess the suitability of the base model. The VicRoads criteria are discussed further in the following Section.

B2 Model Validation Criteria

B2.1 VicRoads Validation Criteria - Overview

The VicRoads guidelines for the validation of strategic models require three main criteria to be met. The criteria includes the calculation of the Percent Root Mean Square Error (%RMSE), Scatter plots showing the slope of best-fit regression line, and the Coefficient of Determination (R^2).

B2.2 Root Mean Squared Error

The Percentage Root Mean Squared Error (%RMSE) is an indication of the correlation between modelled and surveyed traffic volumes. It is noted the %RMSE is dependent on the size of the count volume. %RMSE is ideal for use during the validation process of a strategic model as it emphasises counts with high volumes that need to be validated accurately. It is expressed as:

$$\%RMSE = 100N\frac{\sqrt{\frac{\sum(M-C)^2}{(N-1)}}}{\sum C}$$

Where:
%RMSE is the percentage root mean squared error
N is the number of count/modelled link pairs
$\sum$ is the summation of count/modelled link pair 1 to N
M is the modelled one-way link volume (peak period)
C is the measured average one-way link volume (peak period)

The VicRoads criteria for the validation of strategic models states that the overall %RMSE should be below 30%.

B2.3 Scatter Plots

Scatter plots plot surveyed and modelled traffic volumes for roads within the study area. Plots are required for each time period modelled. Based on these scatter plots two indicators can be produced, the slope of best fit and the R^2 value.

Coefficient of Determination (R^2)

The Coefficient of Determination (R^2) is used in the validation process as it is a measure of the correlation between modelled flows and count volumes in the form of a linear trend line. Although the R^2 value is an efficient means of expressing correlation between two sets of data, it is not sufficient to use the R^2 as the only method of validation as it is possible for the modelled flows to be well above or below measured counts and still produce a strong linear correlation. The R^2 value is defined as:

$$R2 = \frac{\sum(C - \bar{C})(M - \bar{M})}{\sqrt{\sum(C - \bar{C})^2 \sum(M - \bar{M})^2}}$$

Where:
r is the Coefficient of Determination (R-Squared)
$\sum$ is the summation of count/modelled link pairs
M is the modelled one-way link volume (peak period)
C is the measured average one-way link volume (peak period)

The industry standard R-squared target for strategic models is a value above 0.88, however most of guidelines state that models should be validated to have an R-Squared value above 0.90.

Slope of Best Fit

The slope of best-fit regression line is an overall measure of model performance. The validation criteria require that the gradient of the trend line be between 0.9 and 1.1 while restricted to passing through the graph origin.

GEH Statistic

The GEH statistic is an alternative measure to the scatter plot as a means of comparing surveyed and modelled traffic volumes.

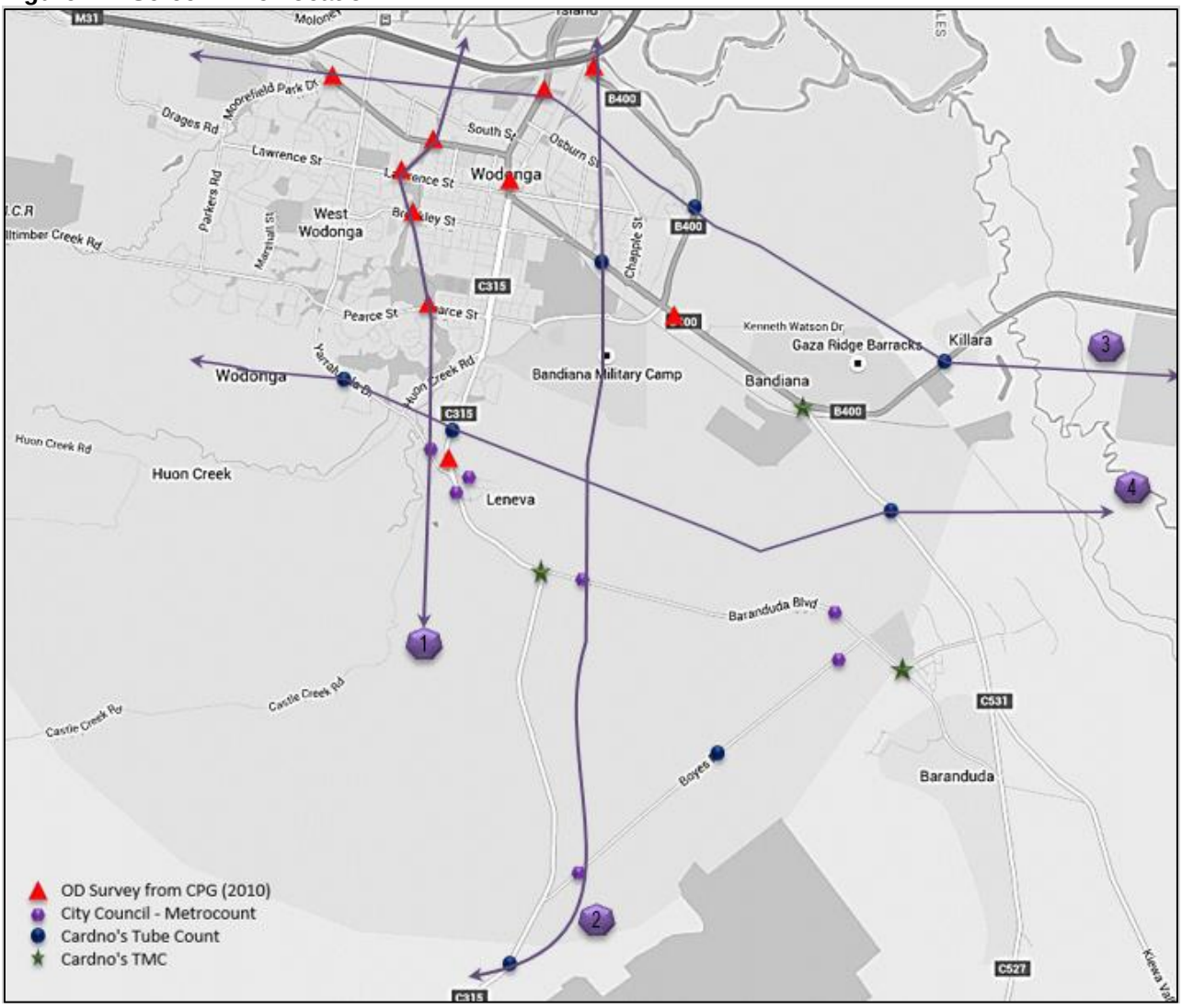
The VicRoads criteria notes that if the validation criteria for scatter plots are not marginally met, the GEH statistic should be used for model validation. VicRoads targets for applying GEH statistic are 50% of cases must have GEH <5, and 80% of cases to have GEH <10.

B3 Model Validation Results

B3.1 Screen Line Locations

As previously outlined, strategic models are generally validated to reflect a wide corridor or regional area, and are not validated to accurately match traffic count data at all individual locations in the modelled area, instead validation is typically measured by comparing traffic counts across a number of locations such as a screen lines. For the purposes of this study the screen lines adopted for validation purposes are shown in Figure B1.

Figure B1: Screen Line Location



Based on the above outlined, the observed and modelled traffic count data is summarised in Table B1:

Table B1: Screen Line Data: Modelled verses Surveyed

Screen Line	AM Observed	AM Modelled	PM Observed	PM Modelled
1	360	291	383	347
1	831	908	984	1,043
1	1,256	1,262	762	769
1	913	922	544	552
1	1,231	1,319	831	904
1	339	307	376	308
2	44	35	22	25
2	1,061	891	1,080	890
2	210	250	293	317
2	672	713	999	1,030
2	21	26	31	26
2	309	344	244	290
3	1,804	1,475	1,919	1,558
3	1,218	1,381	1,138	1,272
3	674	650	630	653
3	1,445	1,473	1,927	1,953
3	572	661	852	930
3	1,729	1,844	1,873	1,975
4	442	534	1,071	1,078
4	726	846	488	489
4	1,075	1,226	573	677
4	644	661	491	505
4	350	366	658	671
4	397	361	809	747

B3.2 Scatter Plots

The scatter plots for all the screen line locations AM and PM peaks are shown in Figure B2 and Figure B3 respectively.

Figure B2: AM Peak Scatter Plot

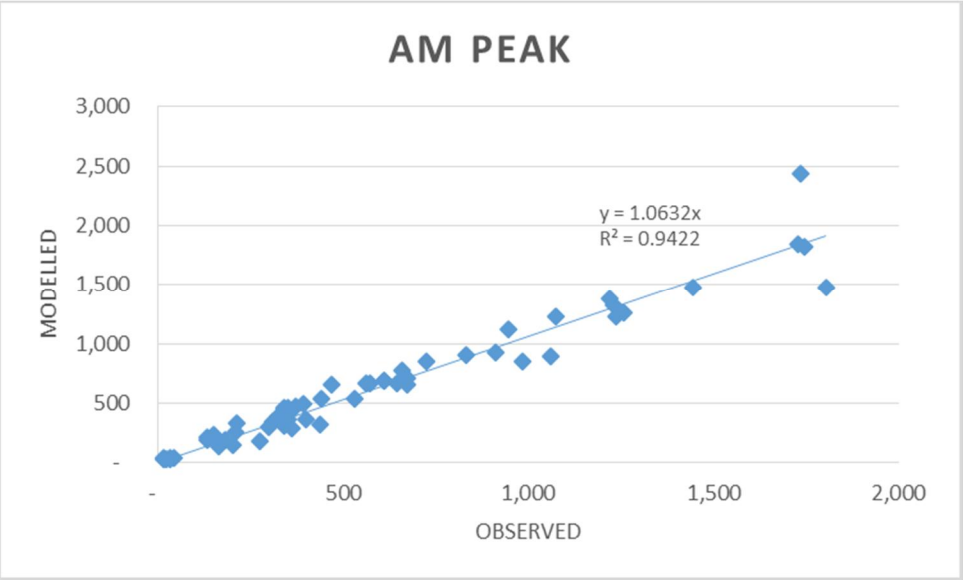


Figure B3: PM Peak Scatter Plot

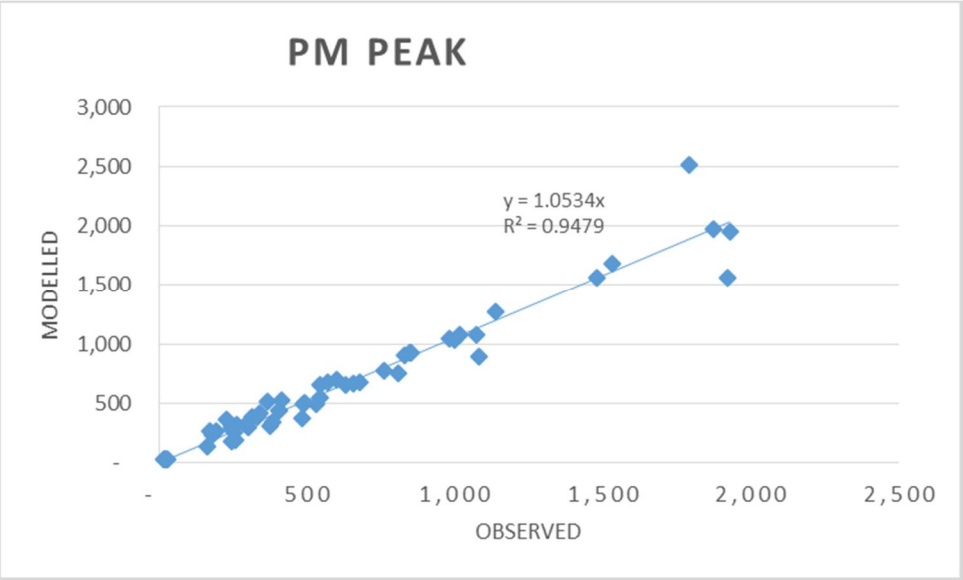


Figure B2 and Figure B3 show that the scatter plots for all the screen line locations accord with the VicRoads criteria.

The screen lines were also assessed on an individual basis with the results of the analysis summarised in Table B2:

Table B2: Screen Line Validation Results

Screen Line (SL)	AM					PM				
	%RMSE	Slope	R^2	GEH<5	GEH<10	%RMSE	Slope	R^2	GEH<5	GEH<10
Requirement	***>30%***	***0.9 – 1.1***	***0.9 – 1.1***	***<50%***	***<80%***	***>30%***	***0.9 – 1.1***	***0.9 – 1.1***	***<50%***	***<80%***
SL – 1	8	1.03	0.99	100%	100%	8	1.03	0.97	100%	100%
SL – 2	21	0.92	0.96	100%	100%	20	0.93	0.97	100%	100%
SL – 3	14	0.99	0.87	83%	100%	13	0.98	0.89	83%	100%
SL – 4	16	1.11	0.97	100%	100%	8	1.01	0.97	100%	100%
Overall	**23**	**1.06**	**0.94**	**93%**	**98%**	**21**	**1.05**	**0.95**	**93%**	**98%**

As highlighted in Table B2 screen line 3 (AM and PM peak), and screen line 4 (AM peak) are marginally outside the VicRoads criteria in some cases, accordingly the GEH statistic is also reported in Table B2. The GEH results outlined in Table B2 indicate that both the AM and PM peak period models are appropriately validated.

B2.3 Root Mean Squared Error

The results of the %RMSE validation for each screen line are also shown in Table B2 which indicates that the %RMSE for each screen line meet the relevant VicRoads criteria for both peak periods.

B4 Summary

The validation results demonstrate that both the AM and PM peak SVITM models meet the relevant VicRoads criteria, the Cardno refined base case SVITM models are considered to be fit for purpose in terms of assessing future year background traffic volumes and distributions for this study.

Leneva-Baranduda
Growth Area

APPENDIX D

WODONGA LAND USE DATA

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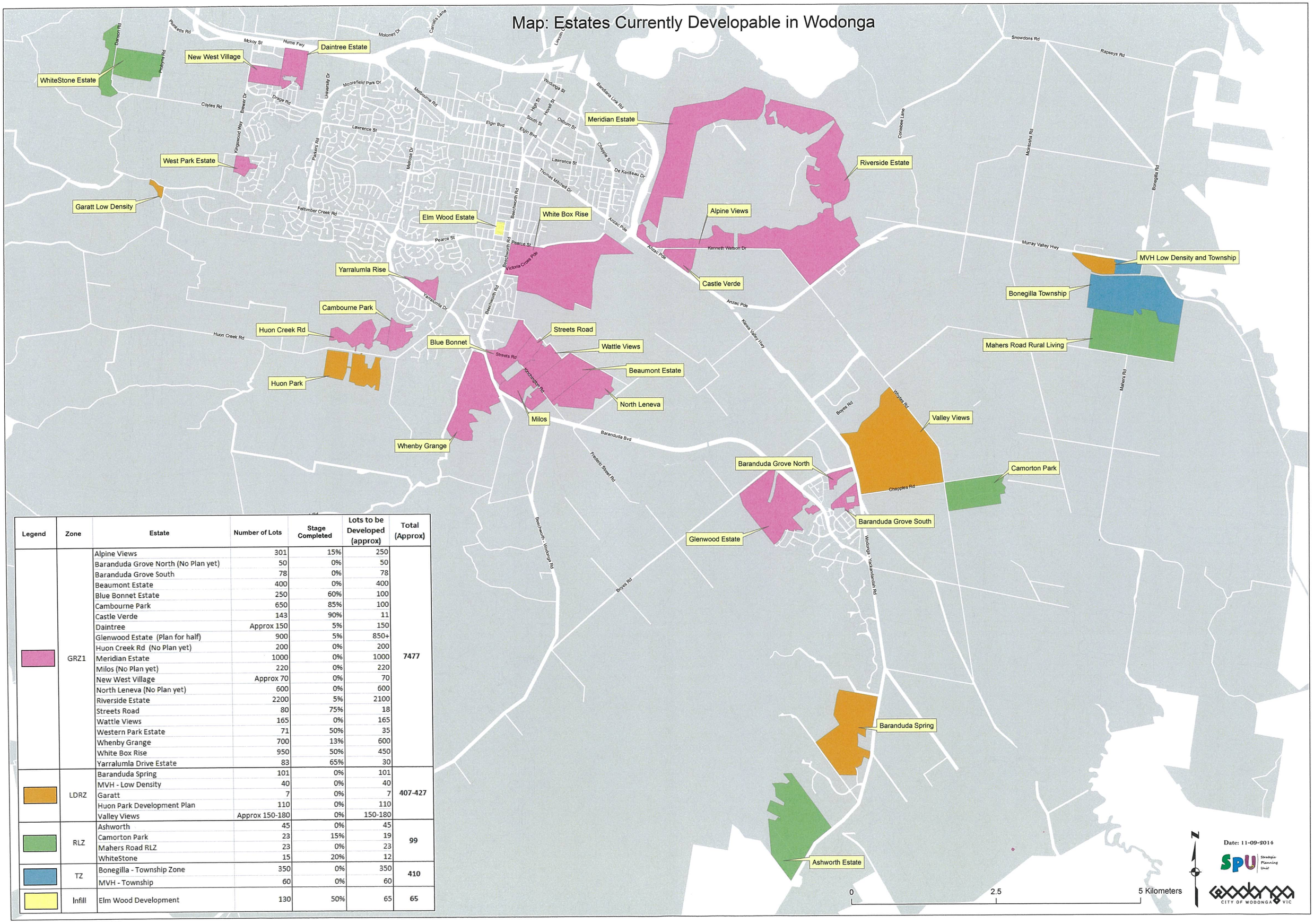
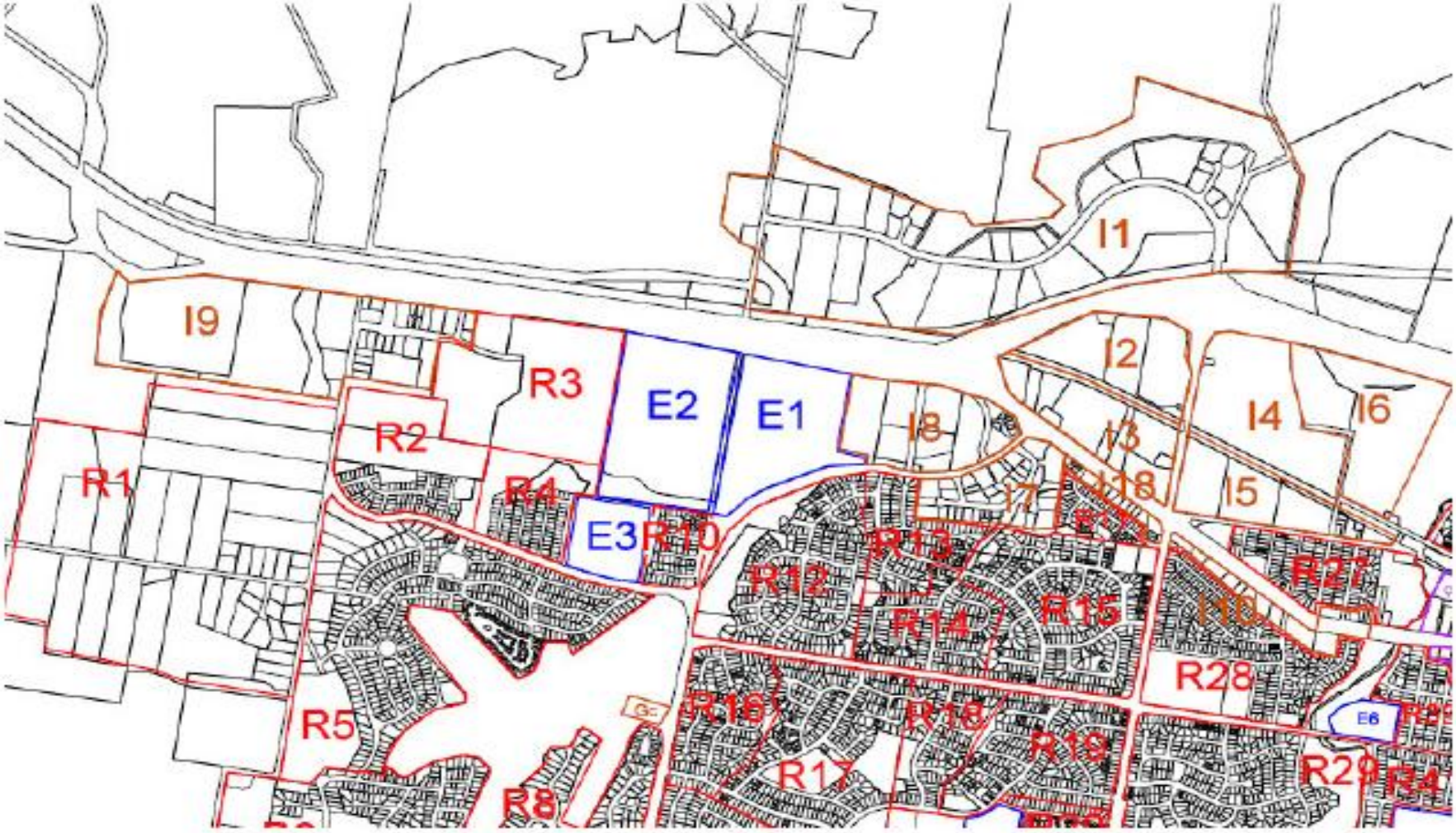
Map: Estates Currently Developable in Wodonga



Legend	Zone	Estate	Number of Lots	Stage Completed	Lots to be Developed (approx)	Total (Approx)
	GRZ1	Alpine Views	301	15%	250	7477
		Baranduda Grove North (No Plan yet)	50	0%	50	
		Baranduda Grove South	78	0%	78	
		Beaumont Estate	400	0%	400	
		Blue Bonnet Estate	250	60%	100	
		Cambourne Park	650	85%	100	
		Castle Verde	143	90%	11	
		Daintree	Approx 150	5%	150	
		Glenwood Estate (Plan for half)	900	5%	850+	
		Huon Creek Rd (No Plan yet)	200	0%	200	
		Meridian Estate	1000	0%	1000	
		Milos (No Plan yet)	220	0%	220	
		New West Village	Approx 70	0%	70	
		North Leneva (No Plan yet)	600	0%	600	
		Riverside Estate	2200	5%	2100	
		Streets Road	80	75%	18	
		Wattle Views	165	0%	165	
		Western Park Estate	71	50%	35	
		Whenby Grange	700	13%	600	
		White Box Rise	950	50%	450	
		Yarralumla Drive Estate	83	65%	30	
	LDRZ	Baranduda Spring	101	0%	101	407-427
		MVH - Low Density	40	0%	40	
		Garatt	7	0%	7	
		Huon Park Development Plan	110	0%	110	
		Valley Views	Approx 150-180	0%	150-180	
	RLZ	Ashworth	45	0%	45	99
		Camorton Park	23	15%	19	
		Mahers Road RLZ	23	0%	23	
		WhiteStone	15	20%	12	
	TZ	Bonegilla - Township Zone	350	0%	350	410
		MVH - Township	60	0%	60	
	Infill	Elm Wood Development	130	50%	65	65

Wodonga Arteria Road Network Study

Traffic Zones and Land Use



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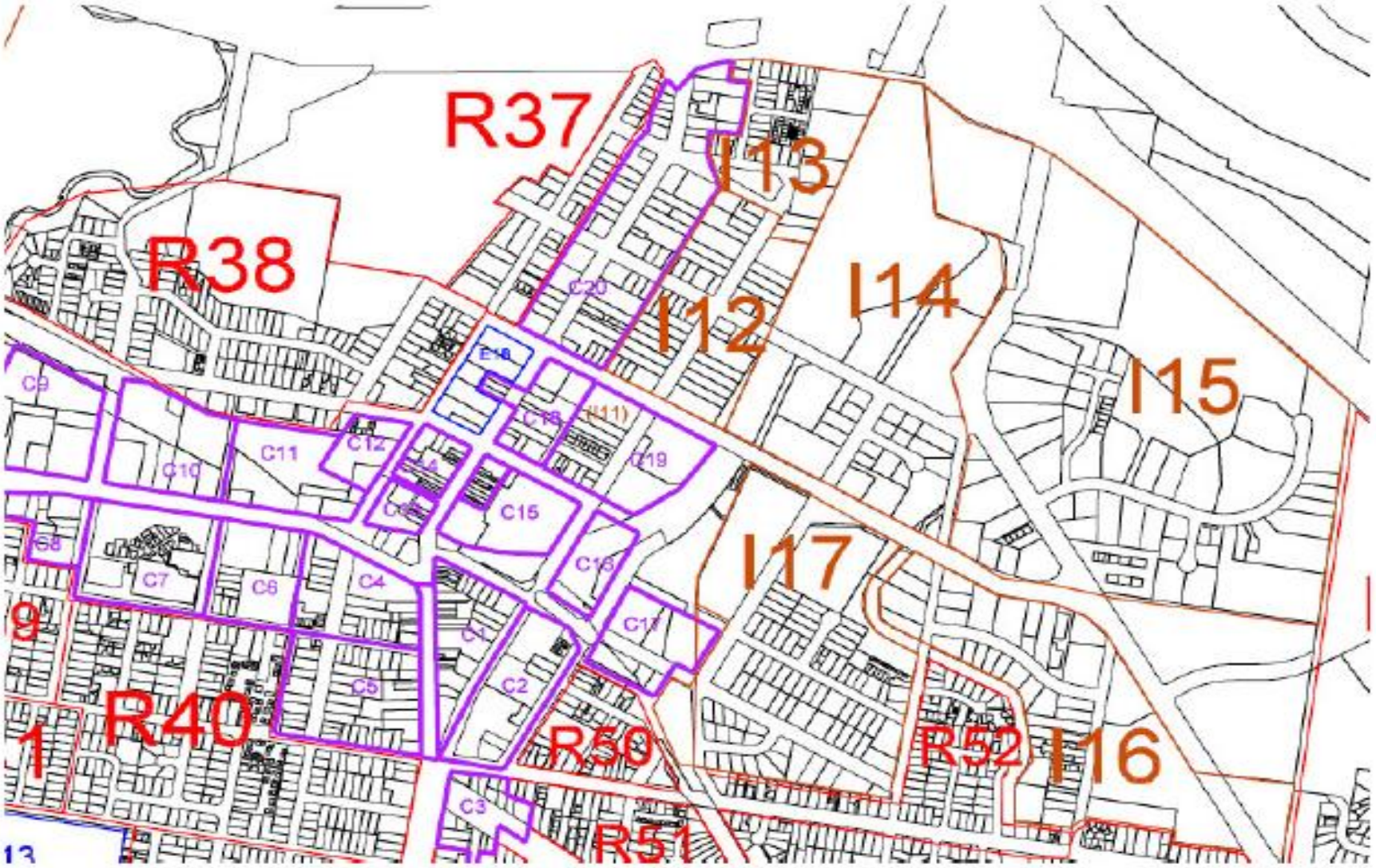
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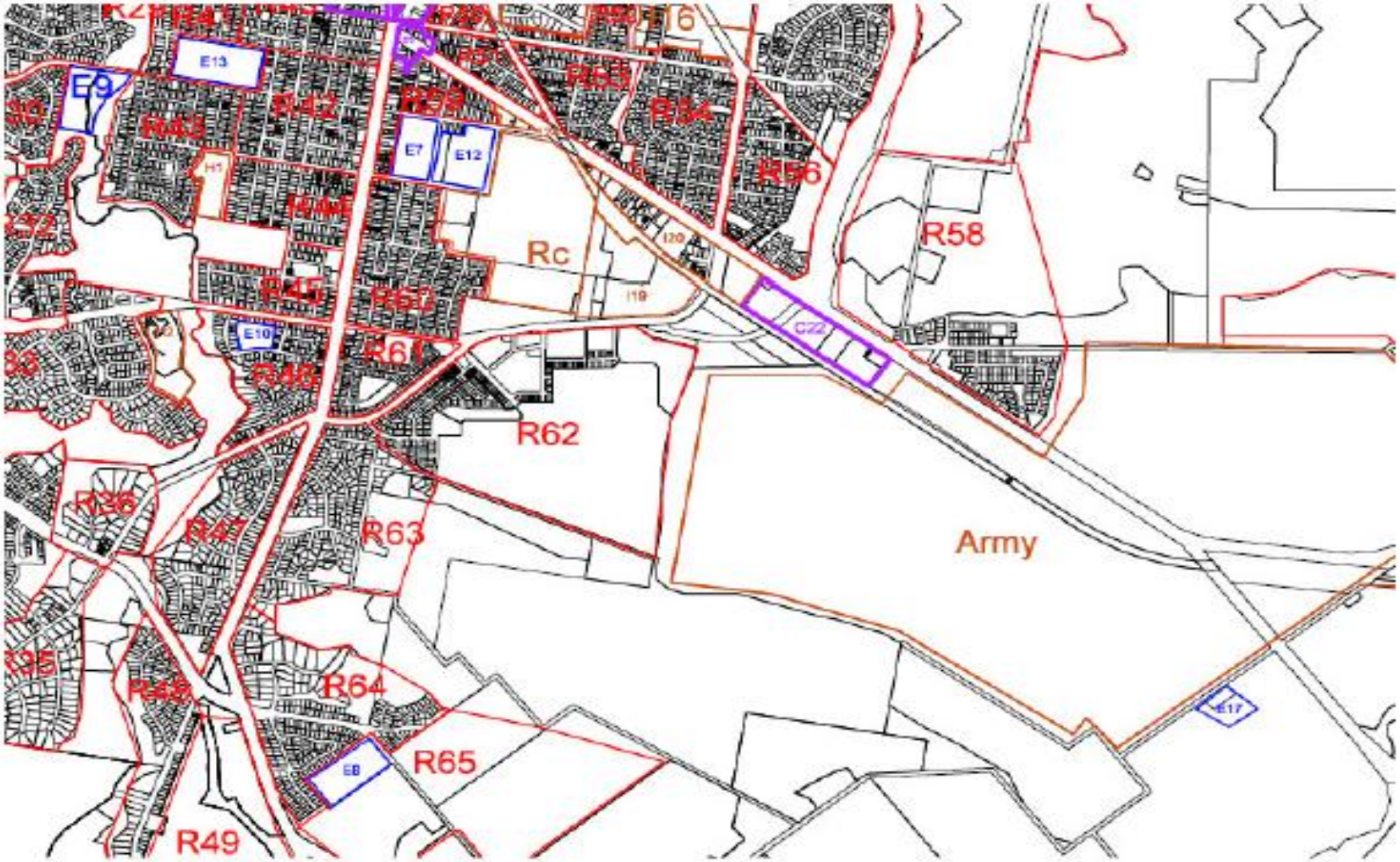
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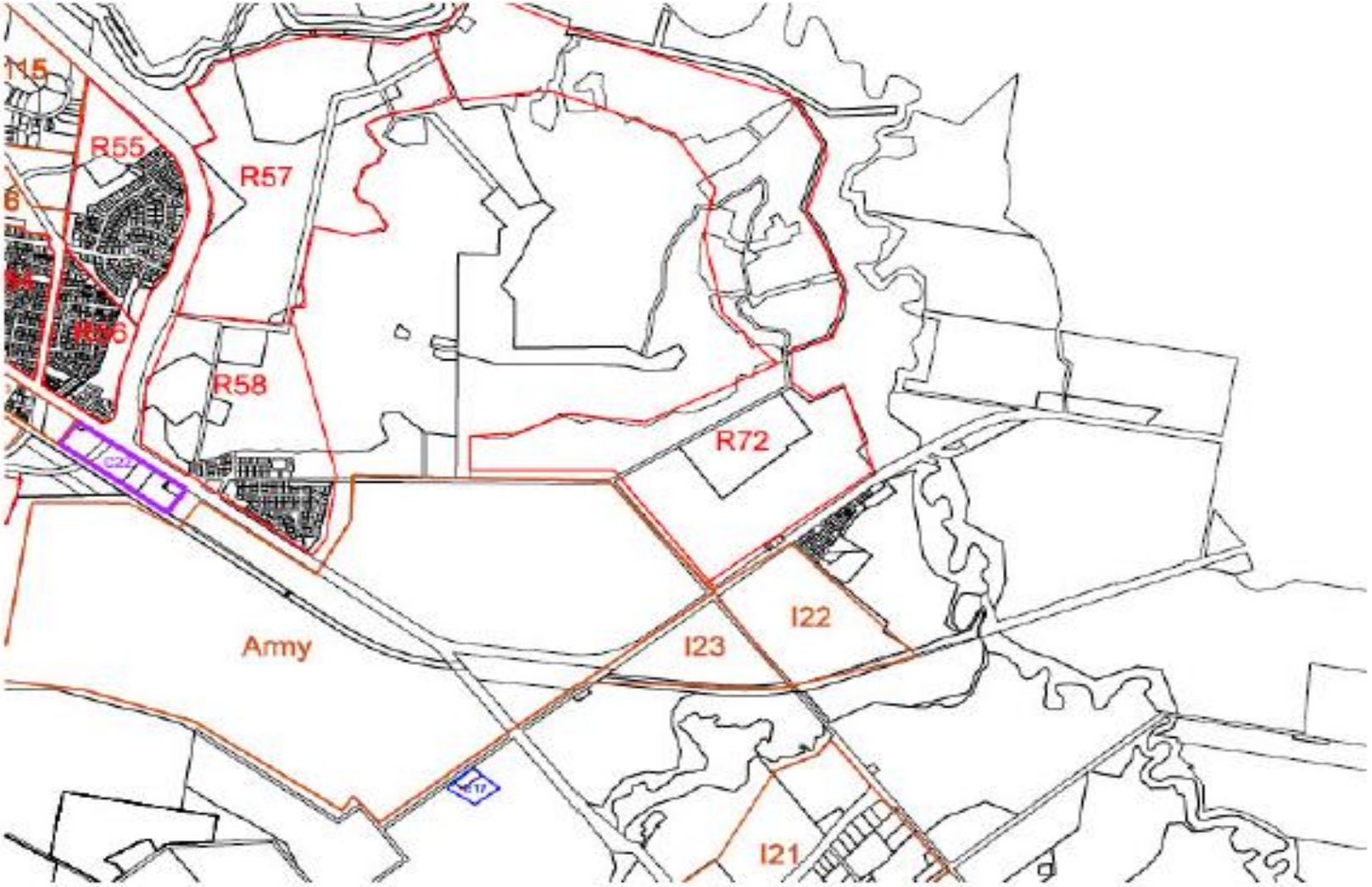
R49
E17


R55
R57
R56
R58
R72
Army
I23
I22
I21

R66
R70
R71
R67
R68

Sub Area Zone	Type	Zone	2010			2020			2030			Note
			Dwelling	Jobs	Enrolments	Dwelling	Jobs	Enrolments	Dwelling	Jobs	Enrolments	
20	Residential	R1	24	3		39	5		84	11		
19	Residential	R2	10	1		100	12		200	25		
19	Residential	R3	50	5		200	24		300	38		
19	Residential	R4	82	9		222	26		252	32		
20	Residential	R5	491	53		521	62		521	65		
20	Residential	R6	296	32		376	44		421	53		
20	Residential	R7	104	11		104	12		104	13		
20	Residential	R8	127	14		129	15		134	17		
20	Residential	R9	150	16		150	18		150	19		
19	Residential	R10	66	7		66	8		66	8		
19	Residential	R11	70	8		70	8		70	9		
19	Residential	R12	265	29		265	31		275	35		
19	Residential	R13	150	16		150	18		155	19		
19	Residential	R14	197	21		197	23		207	26		
19	Residential	R15	370	40		370	44		375	47		
20	Residential	R16	98	11		103	12		106	13		
20	Residential	R17	306	33		308	36		308	39		
20	Residential	R18	126	14		126	15		126	16		
20	Residential	R19	249	27		249	29		249	31		
20	Residential	R20	154	17		154	18		231	29		
20	Residential	R21	505	55		513	61		518	65		
20	Residential	R22	130	14		130	15		133	17		
20	Residential	R23	161	18		166	20		166	21		
20	Residential	R24	184	20		189	22		189	24		
20	Residential	R25	340	37		340	40		340	43		
20	Residential	R26	554	60		564	67		566	71		
13	Residential	R27	160	17		180	21		180	23		
14	Residential	R28	266	29		271	32		271	34		
15	Residential	R29	339	37		344	41		349	44		
15	Residential	R30	227	25		237	28		242	30		
15	Residential	R31	97	11		99	12		105	13		
15	Residential	R32	269	29		272	32		275	35		
16	Residential	R33	436	47		451	53		451	57		
17	Residential	R34	366	40		396	47		400	50		
17	Residential	R35	133	14		133	16		143	18		
16	Residential	R36	30	3		30	4		30	4		
12	Residential	R37	36	4		38	4		43	5		
12	Residential	R38	203	22		218	26		221	28		
14	Residential	R39	104	11		119	14		125	16		
14	Residential	R40	312	34		332	39		352	44		
15	Residential	R41	124	13		134	16		144	18		
15	Residential	R42	373	41		403	48		408	51		
15	Residential	R43	383	42		398	47		423	53		
15	Residential	R44	265	29		280	33		305	38		
15	Residential	R45	192	21		222	26		237	30		
16	Residential	R46	209	23		226	27		231	29		
18	Residential	R47	200	22		210	25		210	26		
17	Residential	R48	122	13		132	16		132	17		
17	Residential	R49	100	11		300	35		670	84		
22	Residential	R50	42	5		77	9		87	11		
22	Residential	R51	100	11		150	18		200	25		
11	Residential	R52	112	12		117	14		122	15		
11	Residential	R53	247	27		247	29		252	32		
11	Residential	R54	343	37		343	41		343	43		
11	Residential	R55	219	24		269	32		458	57		
11	Residential	R56	237	26		297	35		317	40		
10	Residential	R57	50	5		350	41		800	100		
10	Residential	R58	75	8		125	15		145	18		
22	Residential	R59	164	18		224	27		224	28		
22	Residential	R60	390	42		420	50		435	55		
22	Residential	R61	199	22		219	26		259	32		
21	Residential	R62	180	20		940	111		1040	130		
21	Residential	R63	211	23		231	27		231	29		
21	Residential	R64	120	13		150	18		150	19		
21	Residential	R65	50	5		400	47		550	69		
9	Residential	R66	0	0		200	24		700	88		
9	Residential	R67	290	32		450	53		630	79		
9	Residential	R68	360	39		370	44		550	69		
9	Residential	R69	80	9		120	14		160	20		
9	Residential	R70	60	7		140	17		140	18		
5	Residential	R71	60	7		120	14		165	21		
10	Residential	R72	0			309	37		493	62		Huon Hill & Killara
15	Industrial	H1		600			695			766		Hospital
16	Industrial	H2		80			112			147		Murray Valley Hospital
20	Industrial	Gc		20			20			20		Golf Course
22	Industrial	Rc		20			20			20		Racecourse
0	Industrial	I1		919			919			919		
13	Industrial	I2		150			150			150		
13	Industrial	I3		240			399			505		
13	Industrial	I4		550			550			550		
13	Industrial	I5		145			145			145		
13	Industrial	I6		110			110			110		
19	Industrial	I7		580			580			580		
19	Industrial	I8		462			462			462		
19	Industrial	I9		370			434			469		
14	Industrial	I10		308			308			308		

Sub Area Zone	Type	Zone	2010			2020			2030			Note
			Dwelling	Jobs	Enrolments	Dwelling	Jobs	Enrolments	Dwelling	Jobs	Enrolments	
12	Industrial	I11		200			0			0		
12	Industrial	I12		195			195			195		
12	Industrial	I13	53	45			45			45		
12	Industrial	I14	12	350			604			604		
11	Industrial	I15		725			916			916		
11	Industrial	I16		690			849			1026		
11	Industrial	I17		866			1025			1025		
19	Industrial	I18		175			175			175		
22	Industrial	I19		160			160			515		
11	Industrial	I20		304			368			439		
5	Industrial	I21		110			651			1006		
10	Industrial	I22		510			510			510		
10	Industrial	I23		20			338			693		Saleyards
21	Industrial	I24		0								Army
19	School	E1		280	1000		310	1400		340	1600	Wodonga Tafe
19	School	E2		100	700		120	1000		150	1300	Latrobe Uni
19	School	E3		30	360		35	390		38	410	Victory Primary School
20	School	E4		200	1050		230	1250		238	1350	Wodonga Catholic College
20	School	E5		15	170		15	170		20	200	Melrose Primary School
14	School	E6		40	500		40	500		40	500	Wodonga West PS
22	School	E7		46	700		51	740		60	800	Wodonga PS
21	School	E8		28	350		38	430		48	500	Mt Carmel Christian School
15	School	E9		36	400		41	440		50	500	St. Monica's Catholic Primary School
16	School	E10		30	460		40	520		46	550	Wodonga South Primary School
20	School	E11		16	200		26	260		46	400	Wodonga Secondary College
22	School	E12		120	1020		140	1140		160	1280	Wodonga Secondary College
15	School	E13		100	915		120	1035		140	1185	Wodonga Secondary College
5	School	E14		20	260		50	380		70	580	Baranduda Primary School
5	School	E15		30	350		50	500		80	700	Frayne College
5	School	E16		20	200		35	300		55	400	Trinity Anglican College
4	School	E17		14	200		14	200		14	200	Bandiana PS
12	School	E18		30	300		40	380		40	380	St Augustine's Catholic Primary School
12	Commercial	C1		0			471			491		High street
12	Commercial	C2		471			414			464		
22	Commercial	C3		394			160			160		Civic Precinct
14	Commercial	C4		311			361			411		
14	Commercial	C5		609			734			859		Additional offices
14	Commercial	C6		141			141			191		
14	Commercial	C7		320			383			446		Wodonga Centro
14	Commercial	C8		44			100			100		
14	Commercial	C9a		90			91			91		Aldi
14	Commercial	C9b		91			248			248		
14	Commercial	C10		189						0		
14	Commercial	C11		102			0			0		
12	Commercial	C12		80			40			40		
12	Commercial	C13		492			13			13		
12	Commercial	C14		40			107			107		
12	Commercial	C15		226			632			676		Birralee Centro
12	Commercial	C16		205			0			390		
12	Commercial	C17		0			250			590		Office Developmeny
12	Commercial	C18		110			80			80		
12	Commercial	C19					200			200		
12	Commercial	C20					492			492		
20	Commercial	C21					226			226		
11	Commercial	C22					205			205		Bunnings
		Total	**13859**	**15475**	**9135**	**17494**	**18430**	**11035**	**20644**	**22803**	**12835**	

Map : Currently Developable in Wodonga

Legend	Zone	Estate	Number of lots	Stage Completed	Lots to be Developed	Total (Approx)	VITM Sub Area Zone	VITM Zone
	GRZ1	Alpine Views	301	15%	250	7477	10	6830
		Baranduda Grove North (no Plan Yet)	50	0%	50		9	6622
		Baranduda Grove South	78	0%	78		9	6622
		Beumont Estate	400	0%	400		21	6628
		Blue Bonnet Estate	250	60%	100		21	6628
		Cambourne Park	650	85%	100		17	6613
		Castle Verde	143	90%	11		10	6830
		Daintree	150	5%	150		19	6623
		Glenwood Estate (Plan for Half)	900	5%	850		Outside study Area	6612
		Huon Creek Rd (No Plan Yet)	200	0%	200		Outside study Area	6612
		Meridian Estate	1,000	0%	1,000		10	6830
		Milos (No Plan yet)	220	0%	220		21	6628
		New West Village	70	0%	70		19	6623
		North Leneva (No Plan yet)	600	0%	600		21	6628
		Riverside Estate	2,200	5%	2,100		10	6830
		Streets Road	80	75%	18		21	6628
		Wattle Views	165	0%	165		21	6628
		Western Park Estate	71	50%	35		20	6831
		Whenby Grange	700	13%	600		17	6613
		White Box Rise	950	50%	450		21	6628
		Yarraluma Drive Estate	83	65%	30		16	6616
	LDRZ	Baranduda Spring	101	0%	101	408 -428	Outside study Area	6612
		MVH - Low Density	40	0%	40		Outside study Area	6631
		Garatt	7	0%	7		20	6831
		Huon Park Developmen Plan	110	0%	110		Outside study Area	6612
		Valley Views	180	0%	150 - 180		Outside study Area	6567
	RLZ	Ashworth	45	0	45	99	Outside study Area	6612
		Camorton Park	23	15%	19		Outside study Area	6567
		Mahers Road RLZ	23	0%	23		Outside study Area	6631
		WhiteStone	15	20%	12		Outside study Area	6615
	TZ	Bonegilla - Township Zone	350	0%	350	410	Outside study Area	6631
		MVH - Township	60	0%	60		Outside study Area	6631
	Infill	Elm Wood Development	130	50%	65	65	15	6621

VITM Zone	Sub Area Zone	Additional Dwelling	Dwelling Modelled
6622	9	128	2,180
6830	10	3361	3,700
6621	15	65	2,488
6616	16	30	712
6613	17	700	1,345
6623	19	220	1,900
6831	20	42	4,346
6628	21	1953	3,000
6567	Outside study Area	199	1,073
6612	Outside study Area	1306	1,400
6615	Outside study Area	12	259
6631	Outside study Area	473	464

Leneva-Baranduda
Growth Area

APPENDIX E

INTERIM (2026) TRAFFIC VOLUMES

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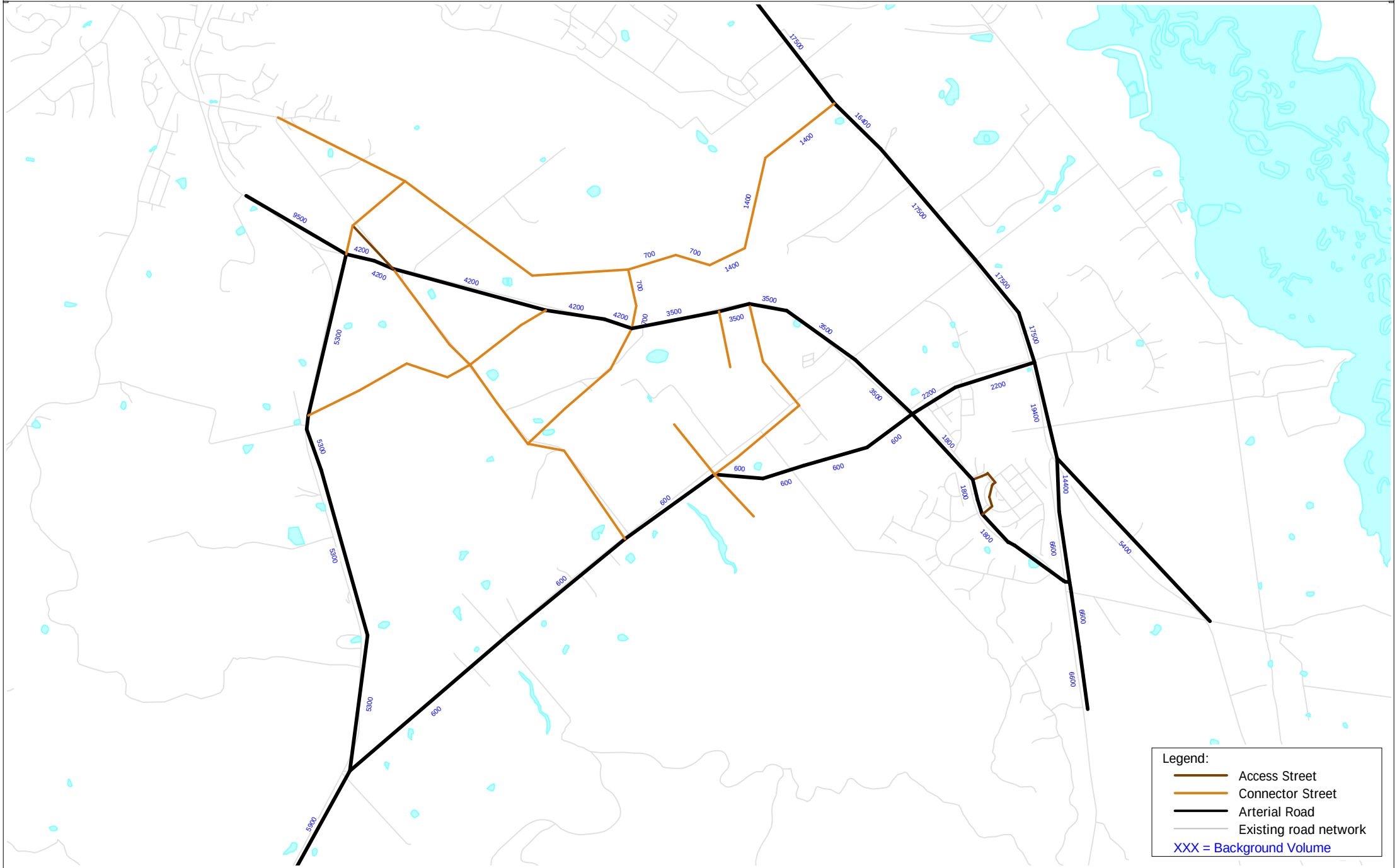
CG150428 - Leneva-Baranduda Growth Area Modelling
Daily Background Volume (2 way) Year 2026



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27/10/2015

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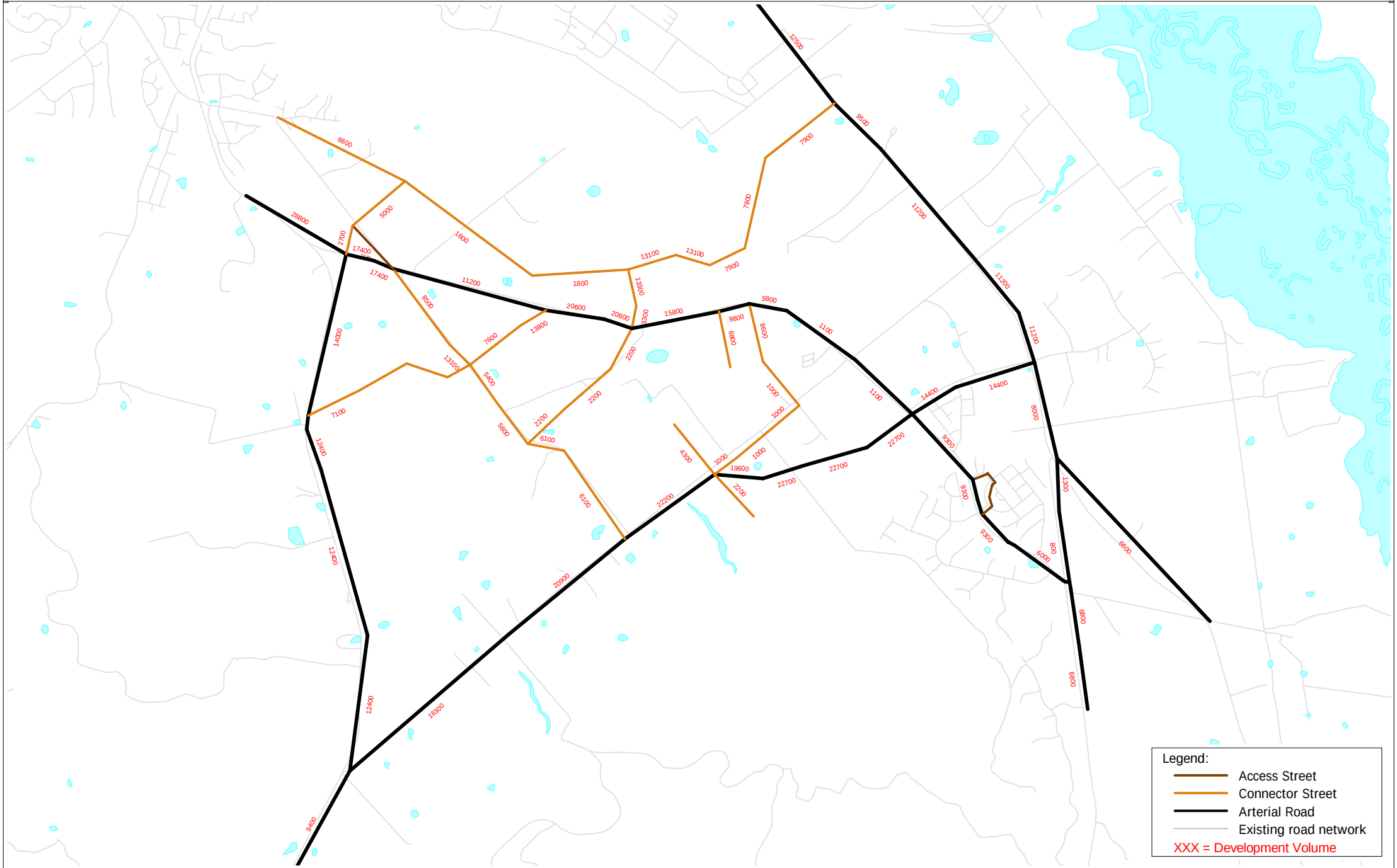
CG150428 - Leneva-Baranduda Growth Area Modelling
Daily Development Volume (2 way) Year 2026



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27/10/2015

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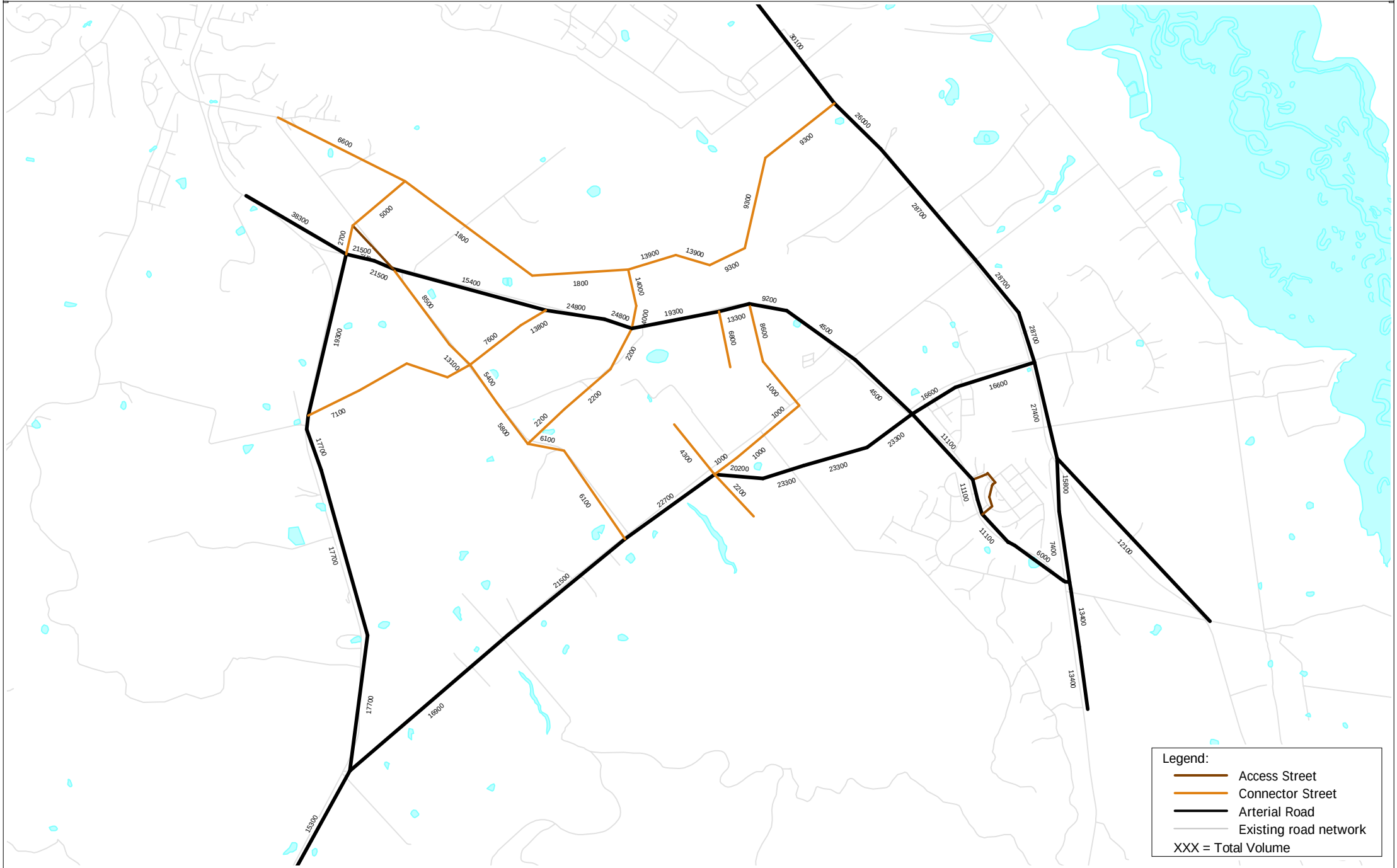
CG150428 - Leneva-Baranduda Growth Area Modelling
Daily Total Volume (2 way) Year 2026



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Leneva-Baranduda
Growth Area

APPENDIX F

ULTIMATE (2046) TRAFFIC VOLUMES

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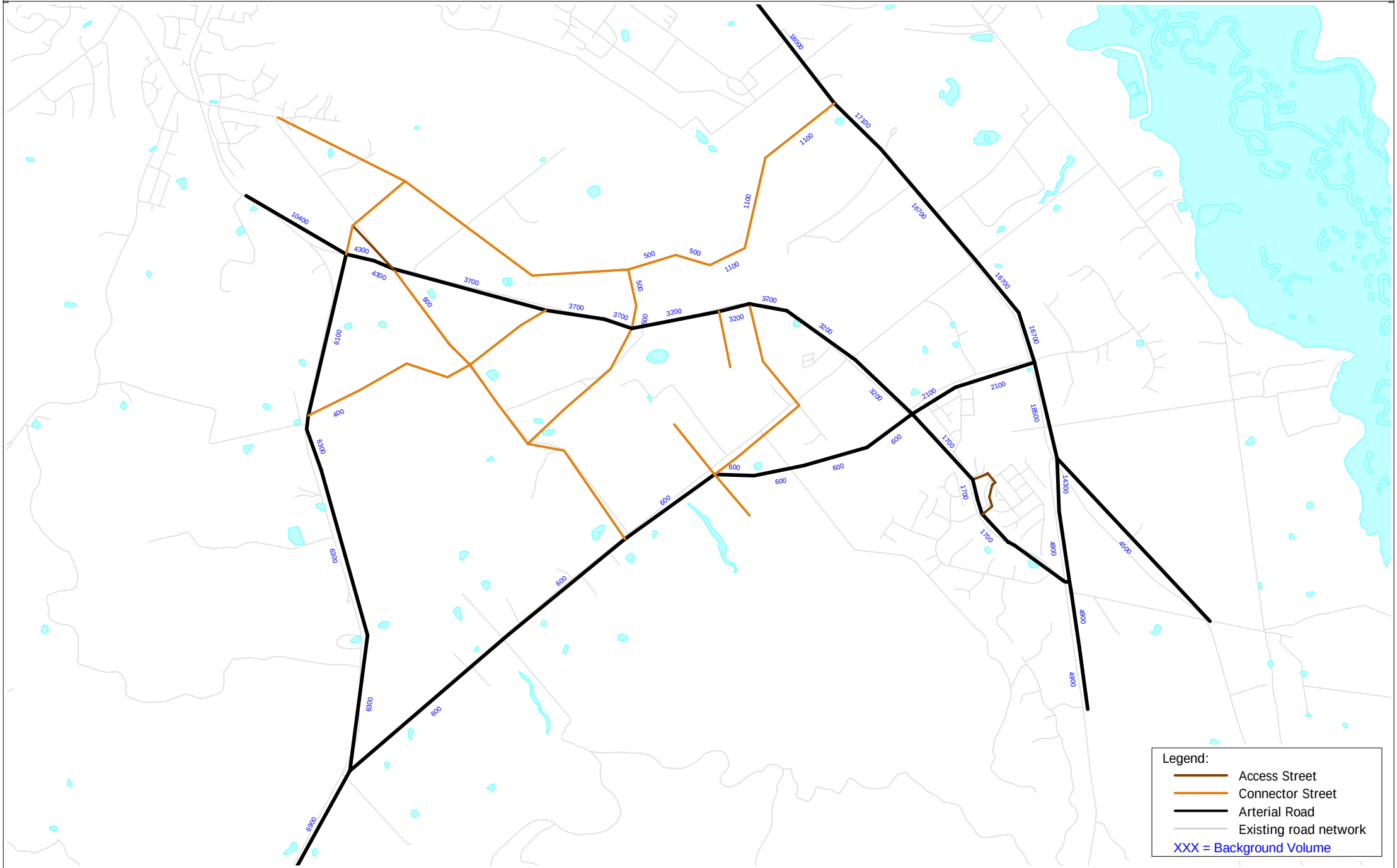
CG150428 - Leneva-Baranduda Growth Area Modelling
Daily Background Volume (2 way) Year 2046



Legend:
- Access Street
- Connector Street
- Arterial Road
- Existing road network

XXX = Background Volume

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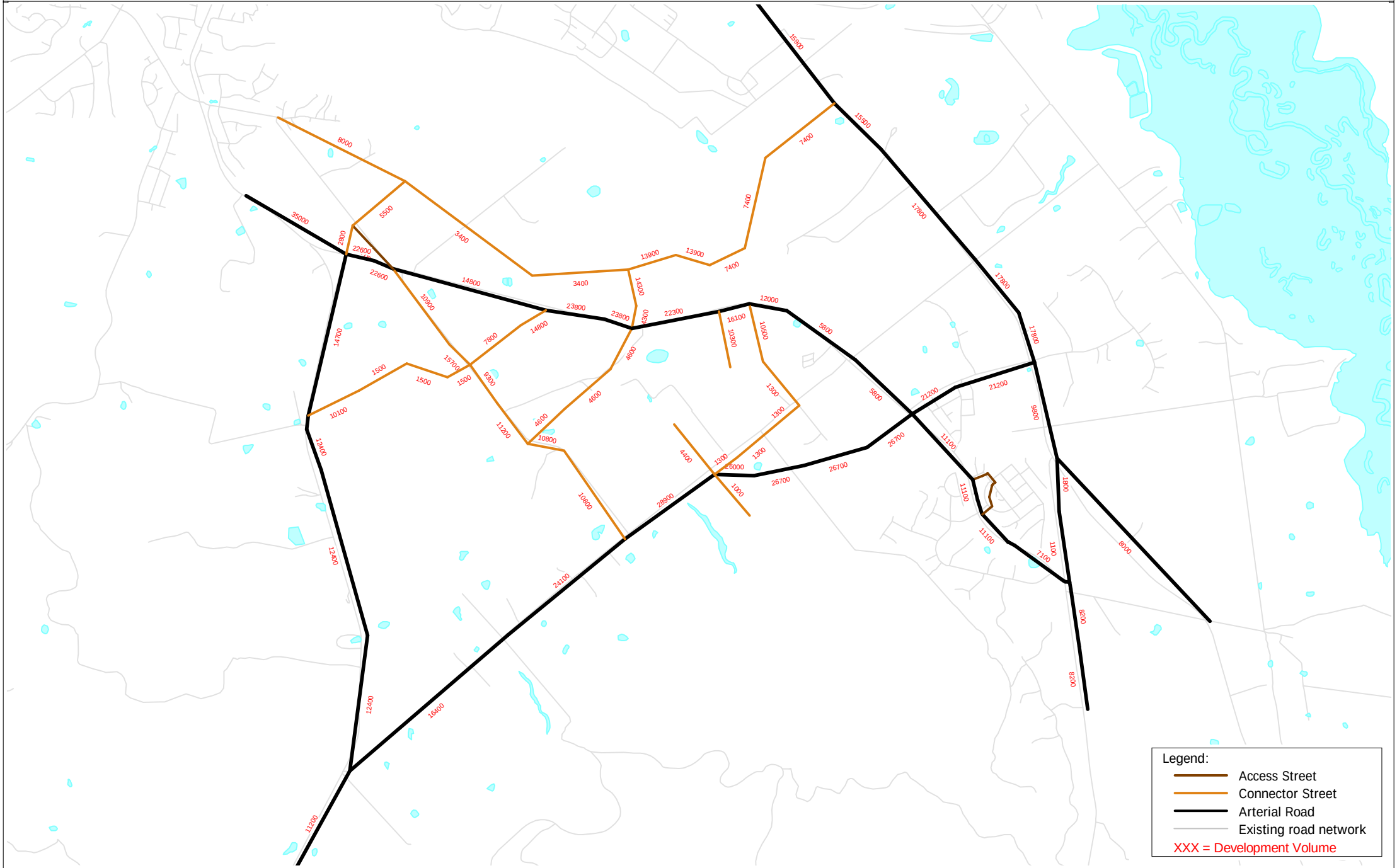
CG150428 - Leneva-Baranduda Growth Area Modelling
Daily Development Volume (2 way) Year 2046



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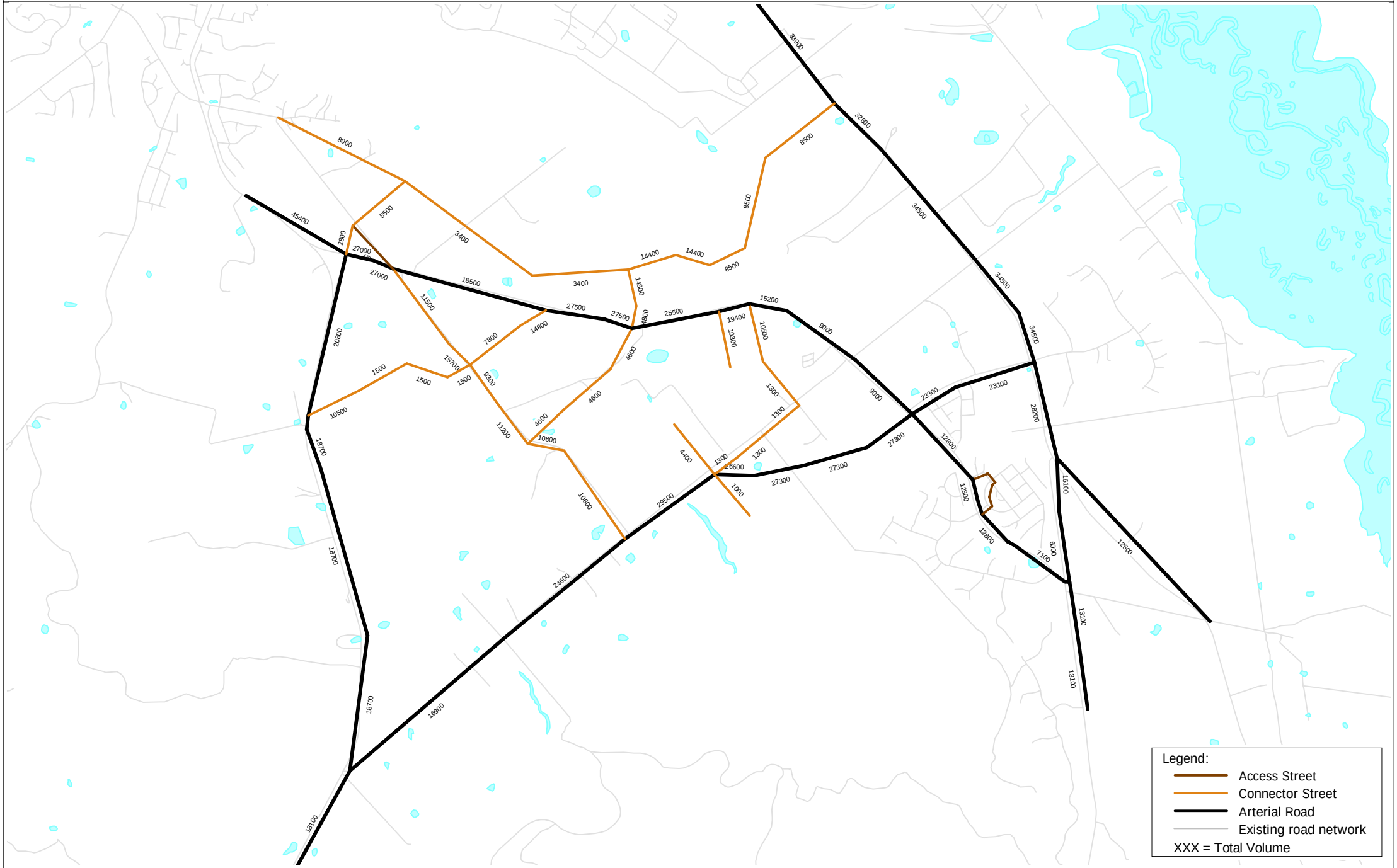
CG150428 - Leneva-Baranduda Growth Area Modelling
Daily Total Volume (2 way) Year 2046



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27/10/2015

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Leneva-Baranduda
Growth Area

APPENDIX G

TURNING MOVEMENT VOLUMES

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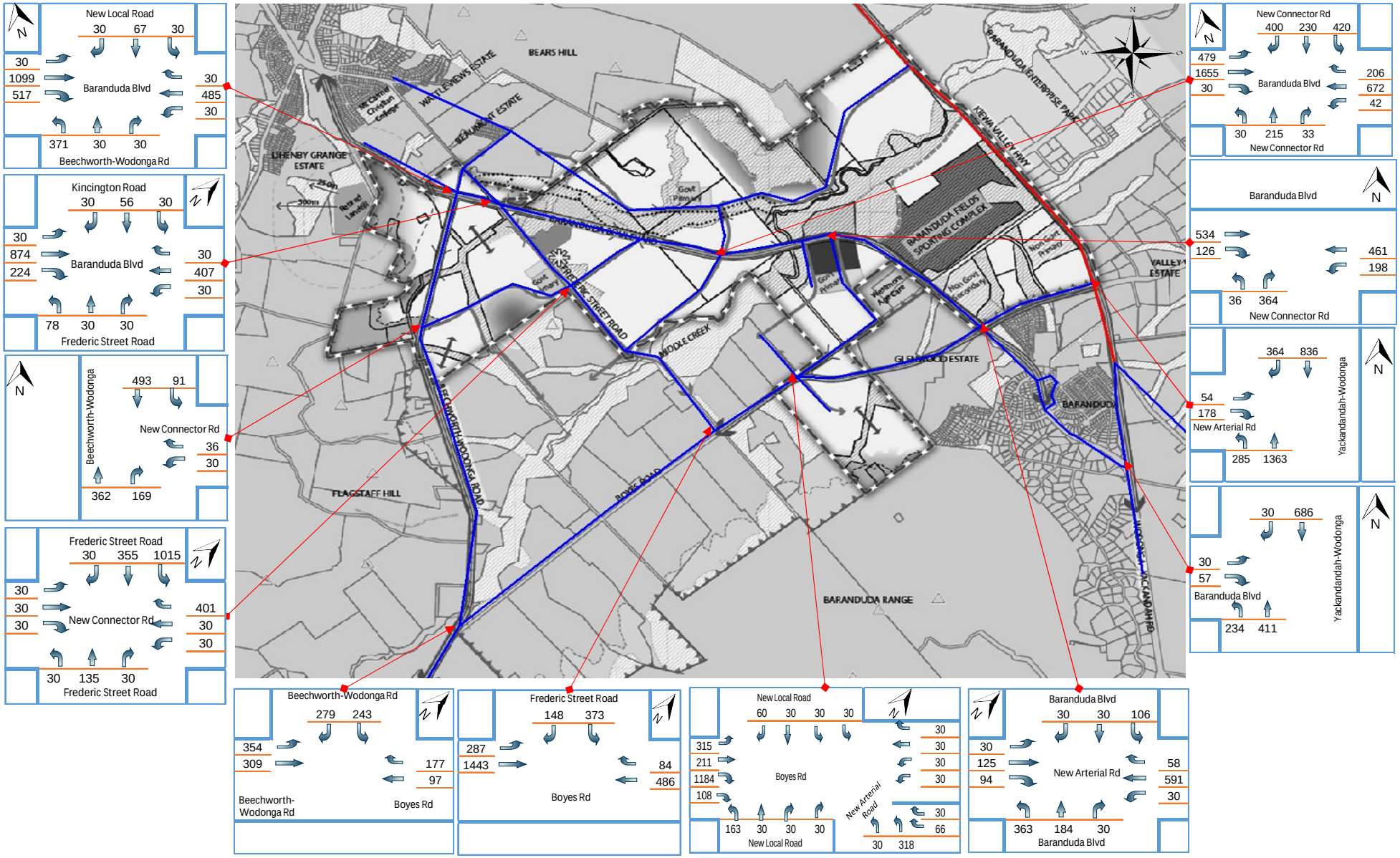
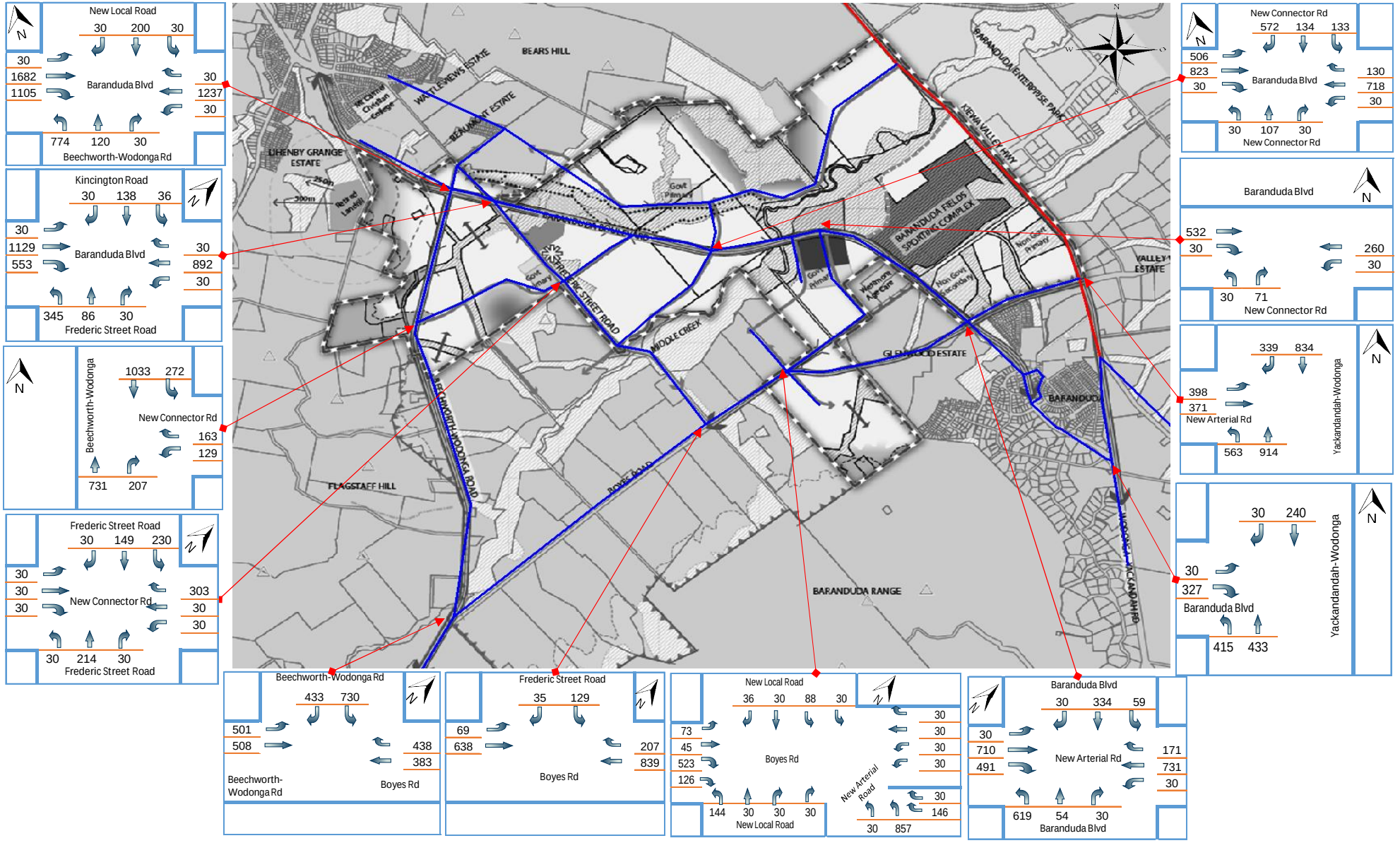
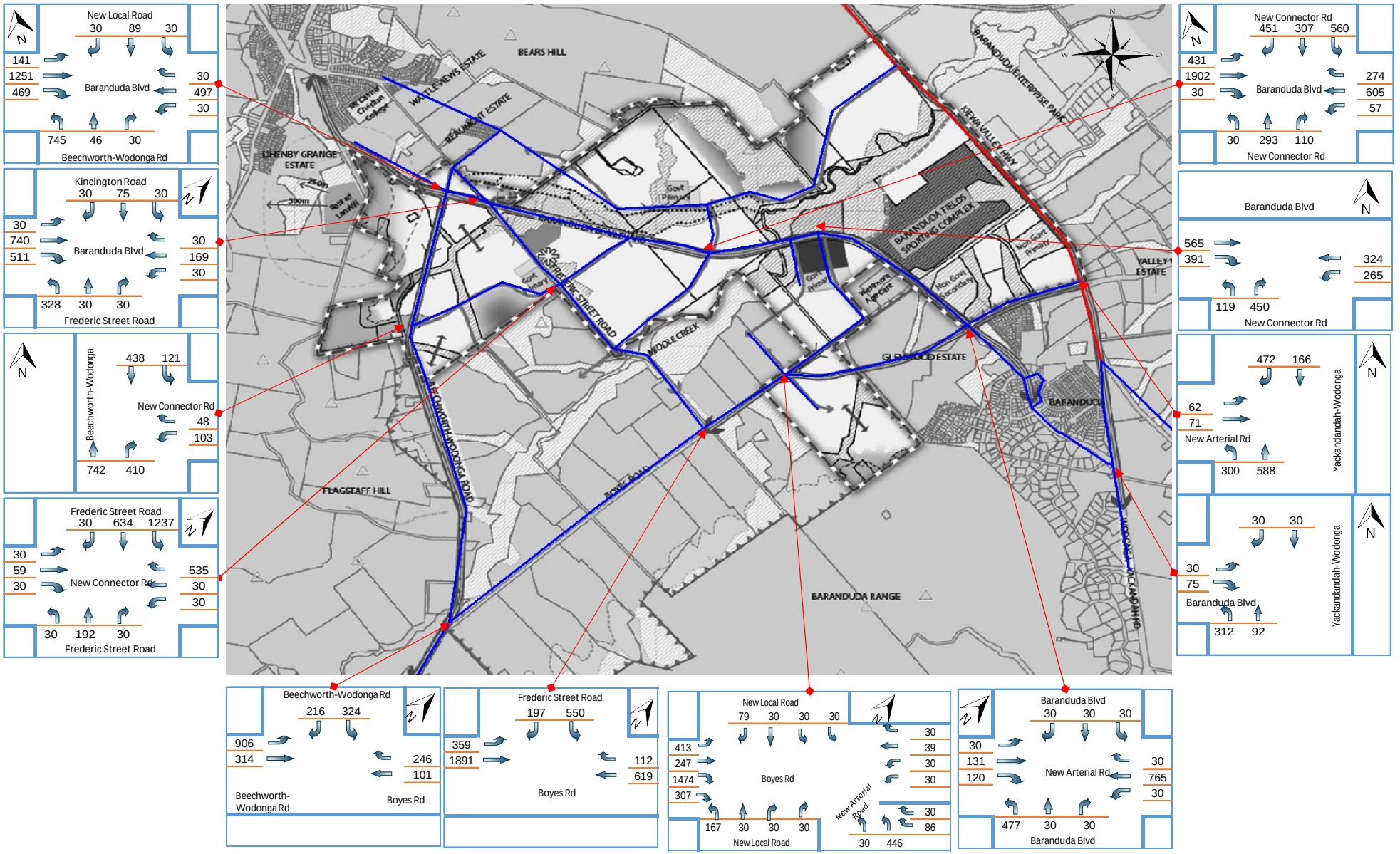
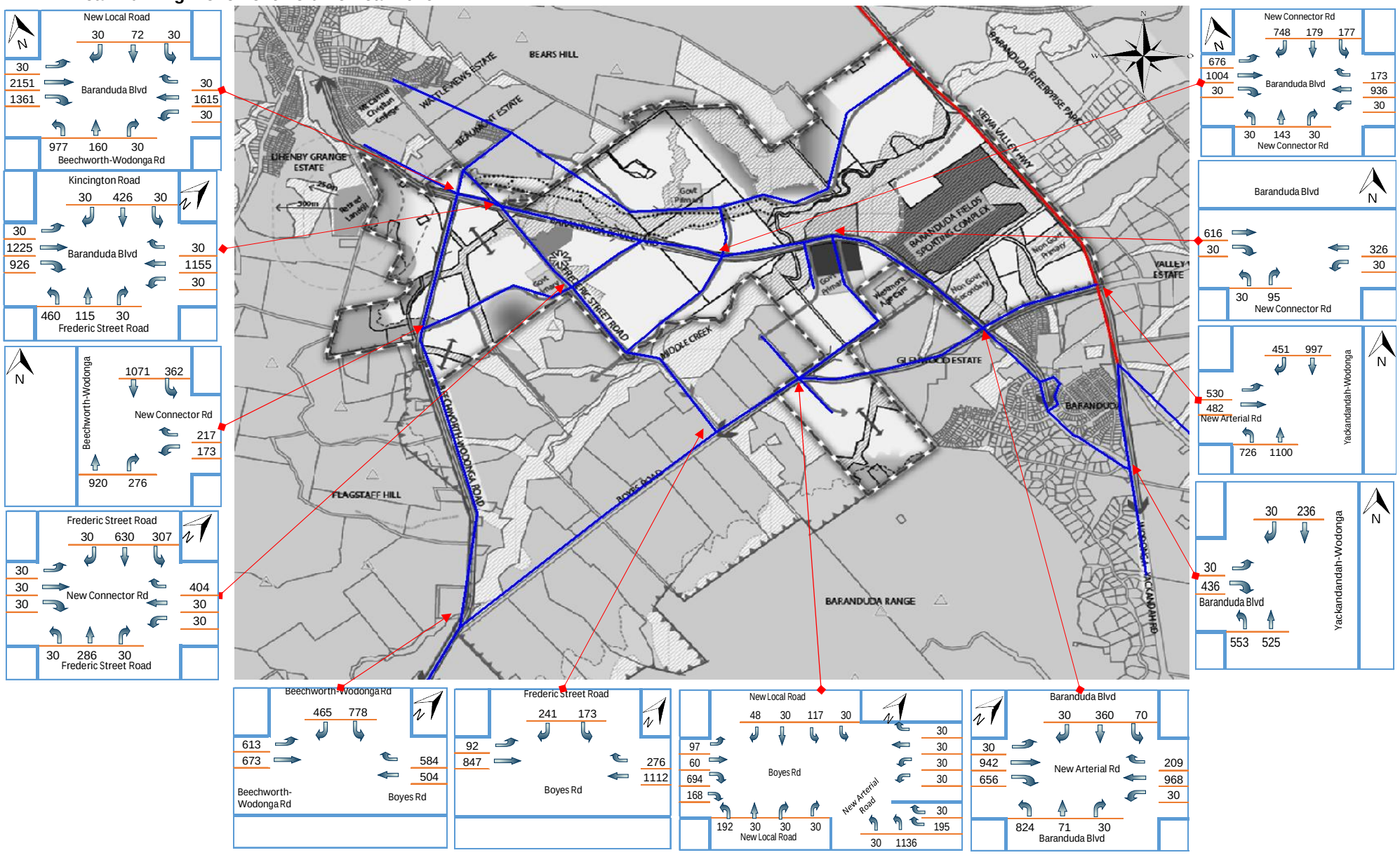
1 Hr AM Peak Turning Movement Volume Year 2026



1 Hr PM Peak Turning Movement Volume Year 2026



1 Hr AM Peak Turning Movement Volume Year 2046



1 Hr PM Peak Turning Movement Volume Year 2046