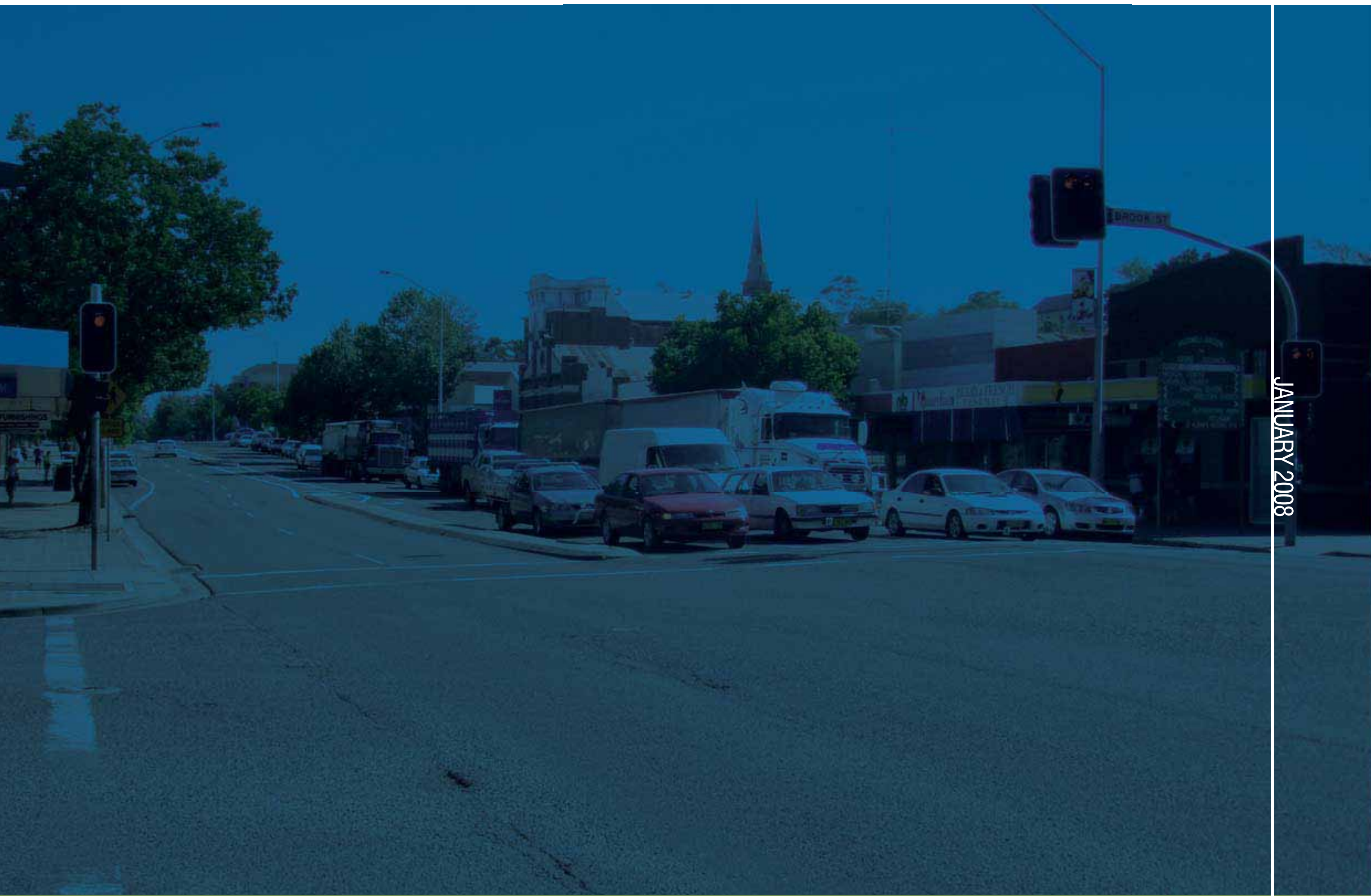
Muswellbrook Shire Council

The Muswellbrook Traffic Study is a strategic document that will be used as a guide only, used to inform decisions in future works programs. While it may contain a suggested Road Works Plan, it does not form a formal commitment to those works – and it is not intended to undermine the integrity or intent of the existing Capital Works Program. The actual adopted Management Plan and Budget is what forms Council's formal commitment. Similarly, it may inform decisions in respect to development, but the report does not compel Council to impose such conditions on development.

MUSWELLBROOK TRAFFIC STUDY & PLAN



JANUARY 2008

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100 YEARS ®

Muswellbrook Traffic Study

March, 2010

Muswellbrook Shire Council

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NCSI Certified Quality System ISO 9001

2112488A PR_1748_RevF

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Date:	10 March 2010..
Distribution:	Muswellbrook Shire Council, PB file ....

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Executive summary

Muswellbrook Shire Council engaged Parsons Brinckerhoff (PB) to undertake a Traffic Study using a traffic model built for Muswellbrook Town Centre, and then prepare a suggested Roadworks Plan from the structured assessment of road infrastructure projects in the model. Traffic growth forecasts on potential changes to the road network were based on growth associated with major future residential and commercial developments proposed or approved in the study area.

The 2006 Census indicated that Muswellbrook Local Government Area (LGA) had about 15,400 residents. Of which, the town of Muswellbrook has a population of approximately 10,500. Denman, and a number of smaller villages, make up the balance of the shire's population.

The objectives of the traffic study were to:

- understand traffic growth and the need for management and road infrastructure development in the Muswellbrook urban area
- develop a traffic strategy for Council to manage the impacts from development in the Muswellbrook urban area, covering developer contributions, traffic management and road safety.

Future residential population will predominantly come from Greenfield sites, such as the potential subdivision on the eastern side of the New England Highway, or on vacant lots in release areas such as Eastbrook Links Estate, St Mary's Estate, NorthView Estate and Yammanie. If these developments proceed, they are expected to be occupied in stages between 2007 and 2037. Totals residential growth could reach 3,954 dwelling units with 35,100 square metres of commercial development. Most of this growth is expected to occur in the South Muswellbrook area. These developments could increase the LGA population by up to 10,300 persons, an increase of 67%, over the next 25 years.

PB developed a comprehensive, six-stage approach to deliver Council's key objectives.

Stage 1: data collection

Stage 2: calibrate a traffic model

Stage 3: forecast future traffic flows for 2016 and 2037

Stage 4: evaluate potential traffic impact on roads and intersections

Stage 5: analyse future intersection improvements required for growth

Stage 6: prepare a suggested Works Program for future traffic facilities.

Information obtained during the data collection phase included:

- The 2001 Journey to Work (JTW) data from the Census showed that about 89% of work trips to Muswellbrook are made by private vehicle, 12% of which are car passengers. Only 0.5% of workers travel by bus, while another 6% walk to work. Private vehicles dominate the journey to work. The census also found that more than 50% people lived and worked within the Muswellbrook LGA. These trips, contained within the LGA, are regarded as local trips for the purpose of the study

- Traffic surveys conducted in 2007 counted about 8,900 vehicles per day (vpd) on the New England Highway, south of Muswellbrook, and about 10,900 vpd north of the Muswellbrook town centre. Within the town centre, local traffic increased the flow. On Bridge Street, traffic peaked at 18,200 vehicles per day. The New England Highway carried between 1,500 and 1,700 heavy vehicles a day, which represented around 14% of total traffic.

Results from the traffic model showed that:

- of the nineteen intersections analysed, four intersections along the New England Highway currently showed some capacity problems during the PM peak, particularly in terms of delays for traffic turning to, and from, the local streets

- Table 4-7 summarised the level of service estimations for 2007. In the future, background traffic growth in Muswellbrook from regional through-traffic, aging of the population and in-fill development should not cause appreciable reductions in the performance of these intersections. “Background” traffic growth is used in this sense as against traffic generated by the major proposed developments. This suggests that impacts from “natural” traffic growth would be minor and unlikely reduce intersection performance in the timeframe of the study

- The model compared three future cases with scenarios for 2020 and 2037 to measure impacts attributable to patterns of regional traffic growth, other than background traffic, future development proposals and changes to the road network, such as the proposed Muswellbrook Bypass. The six scenarios were:

  - Base Case (S1 & S4), that assigned background traffic growth to the existing road network for future years 2020 and 2037 – effectively this was a “do nothing” scenario for benchmark comparisons

  - Case 1 (S2 & S5) used the base case forecasts, but added the traffic likely to be generated by the identified proposals by 2020 and 2037

  - Case 2 (S3 & S6) similar to Case 1, but added the proposed Muswellbrook Bypass to the road network for years 2020 and 2037 to measure the traffic likely to use the Bypass and how that diverted traffic would affect the future flows on other key roads.

Detailed traffic forecasts from the above scenarios are discussed in Section 7.

- Section 8 describes how particular intersections would be forecast to perform in the six scenarios. Table 8-3 summarises impacts from proposed development on 11 intersections. Comparing intersection modelling results with, and without, the Bypass included in the road network showed that the Bypass would improve traffic performance at key intersections along the New England Highway, such as with Bimbadeen Drive, Rutherford Road, Hunter Street, and Thompson Street

- Table 8-5 and Table 8-7 summarise proposed traffic works and suggest an indicative works program for local intersections.

- Figure 8-17 provides sketches of the future works that may be required in the Muswellbrook Study area.

It should be acknowledged that the Muswellbrook Traffic Study is a technical document to make the appropriate strategic decisions with respect to future Roads Infrastructure and it is not intended to undermine the integrity or intent of the existing Capital Works program.

Section 9 reviewed Traffic Management approaches to manage traffic speeds and pedestrian safety. A list of projects for these purposes is included in the suggested Works Programs. Many of these projects have community implications and a more detailed LATM plan for consultation is recommended before adopting a final proposal to ensure the proposed treatment is the preferred option for the wider community.

The proposed 5-year works program is shown overleaf to address future capacity and safety concerns.

Edgeline marking has been proposed at several locations as a traffic management treatment. PB has found that edgeline marking has been an effective treatment because it offers a low cost means of reducing the level of speeding behaviour. Edgeline marking could influence a driver's perception of speed and result in a reduction in their preferred travel speed. Edgeline marking can also provide a more positive delineation of travel and parking lanes.

Proposed 5-year Works Program (2008 to 2013)

Location	Level of Service calculations for 2007 (Table 4-7)	LoS S4 2037 with natural traffic growth and no development/bypass (Table 8-1)	LoS S5 2037 with future development on the 2037 network with no Bypass (Table 8-2)	LoS S6 2037 with future development on the 2037 network with Bypass (Table 8-4)	Description of works (see Table 8-5 for capacity and Table 9-1 safety improvements)	Comments	Estimated project cost	Suggested priority based on capacity and safety criteria
INTERSECTION UPGRADE PROJECTS								
Rutherford Rd/New England Hwy	F	F	F	F	▪ New signals (see Figure 8-2)	▪ Council has advised that traffic signals will be installed in 2008-2009. ▪ Time separation for traffic in major road and minor road ▪ Signals could accommodate the pedestrian desire line between shops across the intersection ▪ Increase pedestrian and cyclist safety ▪ Reduce traffic speeds through increased delay on main road ▪ Reduce crashes+ (reduce opposing vehicle turning and rear-end crash types, but may migrate crashes to other, less serious, types, e.g. crashes involving adjacent approaches at intersection) ▪ High installation costs ▪ Requires RTA approval ▪ Needs to meet RTA warrants	▪ >$500,000	High
Rutherford Rd/Acacia Dr	A	A	F	F	▪ New roundabout (see Figure 8-2)	▪ On capacity grounds, a roundabout is not required immediately, however, consideration should be given to bringing forward a roundabout for the future LATM study ▪ The installation of a roundabout can reduce more serious crash types significantly+ ▪ Need to ensure that pedestrian and cyclist safety is not reduced. ▪ Relatively high construction cost, but low maintenance cost (depending on the type of landscaping treatment adopted)	▪ >$300,000	Medium
Rutherford Rd/Ironbark Rd	A	A	E	D	▪ New roundabout (see Figure 8-3) ▪ Edgeline marking on Ironbark Road approaching Rutherford Road intersection	▪ On capacity grounds, a roundabout is not required immediately, however, consideration should be given to bringing forward a roundabout for the future LATM study ▪ Roundabouts: ‣ Reduce serious crash types significantly+, but need to consider pedestrian safety ‣ Relatively high construction cost, but low maintenance cost (depending on the type of landscape treatment) ▪ Edgeline markings ‣ Reduce various crash types significantly+ ‣ Reduce traffic speeds ‣ Provide protection and delineation for parked cars ‣ Low installation cost but adds to future maintenance burden ‣ May restrict commercial vehicle access ‣ May introduce squeeze points for cyclists	▪ >$300,000 for roundabout ▪ $6,000 ($10/m linemarking)	Medium

Location	Level of Service calculations for 2007 (Table 4-7)	LoS S4 2037 with natural traffic growth and no development/bypass (Table 8-1)	LoS S5 2037 with future development on the 2037 network with no Bypass (Table 8-2)	LoS S6 2037 with future development on the 2037 network with Bypass (Table 8-4)	Description of works (see Table 8-5 for capacity and Table 9-1 safety improvements)	Comments	Estimated project cost	Suggested priority based on capacity and safety criteria
Thompson Street/New England Hwy	F	F	F	F	▪ New signals (see Figure 8-5)	▪ The proposed signalisation accords with RTA requirements ▪ Time separation for traffic in major road and minor road ▪ Increase pedestrian and cyclist safety ▪ Reduce traffic speeds through increased delay on main road ▪ Reduce crashes[+] (reduce opposing vehicle turning and rear-end crash types, but may migrate crashes to other types, e.g. crashes involving adjacent approaches at intersection) ▪ High installation costs ▪ Design requires RTA approval and project must meet RTA warrants	▪ >$500,000	High
Haydon Street/Maitland Road/New England Hwy	F	F	F	F	▪ Give-way and raised median (see Figure 8-8A) ▪ Short right turn bay and a pedestrian refuge island on New England Highway (Figure 8-8B)	Option 1: Modify this intersection to left-in-left-out arrangement. ▪ Reduce the number of conflict points by providing a median in the Highway and restricting the right turn movements at the intersection ▪ The give-way, median closure and turn ban control can reduce crashes at the intersection[+] ▪ Restricts residential access ▪ May divert traffic onto surrounding streets (i.e. New England Highway and Haydon Street) ▪ Turns may divert to less safe locations Option 2: Provide a short right turn lane and pedestrian refuge island. ▪ Insufficient capacity on the one-lane section on the Highway ▪ Potential right to left merge problem on approach to the right turn bay ▪ Improve pedestrian access across the Highway ▪ PB recommended the Council to consider the provision of suitable signs and linemarking, and roadway lighting.	▪ $30,000 to $50,000 ▪ Greater than $150,000	High High
New England Hwy/Hunter Street	F	E	F	F	▪ New seagull (see Figure 8-12)	▪ Increase traffic efficiency and provide staged right turn from Hunter Street ▪ Reduce serious crash risks significantly[+]	▪ >$500,000	High

Brecht Street/Brentwood Street	A	A	A	A	▪ Provide pedestrian refuge islands
					▪ Provide a roundabout to slow down traffic on Brecht Street
						▪ Increases pedestrian safety and connectivity at refuge islands
						▪ Refuge islands:
						  ▸ Reduce traffic speed
						  ▸ May restrict commercial vehicle access
						  ▸ Increase pedestrian safety and connectivity
						▪ Roundabout:
						  ▸ Reduce high speed travel in Brecht Street
						  ▸ Minimise crash severity from side impact events
							▪ $10,000 for pedestrian refuge island
							▪ $>$300,000 for roundabout
								High

Location	Level of Service calculations for 2007 (Table 4-7)	LoS S4 2037 with natural traffic growth and no development/bypass (Table 8-1)	LoS S5 2037 with future development on the 2037 network with no Bypass (Table 8-2)	LoS S6 2037 with future development on the 2037 network with Bypass (Table 8-4)	Description of works (see Table 8-5 for capacity and Table 9-1 safety improvements)	Comments	Estimated project cost	Suggested priority based on capacity and safety criteria
						▸ Reduce various crash types significantly+ ▸ Relatively high construction cost, but low maintenance cost (depending on the type of landscaping treatment)		
New England Highway/ Aberdeen Street	-	-	-	-	▪ Review linemarking (turn lanes) and intersection control ▪ Review crash history in the vicinity of the intersection ▪ Prepare plans to address crash problems	▪ Improve intersection safety and reduce crash risks	▪ Further investigation in a separate study	High
ROAD PROJECTS								
Acacia Drive	-	-	-	-	▪ Provide edgeline marking between Rutherford Road and Bloodwood Road ▪ Provide 4 roundabouts along Acacia Drive intersections	▪ Reduce travel speed by introducing edgeline on either side of the road ▪ Edgeline markings ▸ Reduce various crash types significantly+ ▸ Reduce traffic speeds ▸ Provide protection and delineation for parked cars ▸ Low installation cost ▸ May restrict commercial vehicle access ▸ May introduce squeeze points for cyclists ▪ Roundabout: ▸ Prevent the acceleration of vehicles up Acacia Drive, which would dramatically reduce speed ▸ Reduce various crash types significantly+ ▸ Need to consider pedestrian safety ▸ Relatively high construction cost, but low maintenance cost (depending on the type of landscaping treatment)	▪ $17,200 ($10/m linemarking) ▪ $>$300,000 for each roundabout	High
Bloodwood Road	-	-	-	-	▪ Provide edgeline marking between Bimbadeen Drive and Acacia Drive ▪ Provide raised pavement within intersection as constructed in the new road Osborn Avenue	▪ Reduce travel speed by introducing edgeline and threshold treatments ▪ Edgeline markings: ▸ Reduce various crash types significantly+ ▸ Reduce traffic speeds ▸ Provide protection and delineation for parked cars ▸ Low installation cost ▸ May restrict commercial vehicle access ▸ May introduce squeeze points for cyclists ▪ Raised pavement within intersection ▸ Reduce traffic speeds ▸ Signals a change in the road environment	▪ $4,300 ($10/m linemarking) ▪ $20,000 for raised intersection threshold treatment	High

Location	Level of Service calculations for 2007 (Table 4-7)	LoS S4 2037 with natural traffic growth and no development/bypass (Table 8-1)	LoS S5 2037 with future development on the 2037 network with no Bypass (Table 8-2)	LoS S6 2037 with future development on the 2037 network with Bypass (Table 8-4)	Description of works (see Table 8-5 for capacity and Table 9-1 safety improvements)	Comments	Estimated project cost	Suggested priority based on capacity and safety criteria
						▸ Reduce crash risk ▸ Minor inconvenience to motorists ▸ Can increase noise levels depending on the use of the material ▸ Can require drainage alterations ▸ Requires line-marking and adequate illumination ▸ Often an expensive treatment ▸ Visually attractive		
Hakea Drive	-	-	-	-	▪ Provide consistent treatment between Weemala Place and Acacia Drive, as with Bloodwood Road	▪ Reduce travel speed by introducing edgeline and threshold treatment ▪ Edgeline marking can reduce various crash types significantly+ ▪ Edgeline marking also: ▸ Reduces traffic speeds ▸ Provides protection and delineation for parked cars ▸ Low installation cost ▸ May restrict commercial vehicle access ▸ May introduce squeeze points for cyclists ▪ Raised pavement within intersection ▸ Reduce traffic speeds ▸ Reduce crash risk ▸ Minor inconvenience to motorists ▸ Can increase noise levels depending on the use of the material ▸ Can require drainage alterations ▸ Requires line-marking and adequate illumination ▸ Often an expensive treatment ▸ Visually attractive	▪ $5,000 ($10/m linemarking) ▪ $20,000 for raised intersection threshold treatment	High
Beech Street	-	-	-	-	▪ Provide edgeline marking between Acacia Drive and Calgaroo Avenue ▪ Review pedestrian connectivity in a LATM study	▪ Reduce travel speed by introducing edgeline on either side of the road ▪ Improve pedestrian accessibility ▪ Edgeline marking can reduce various crash types significantly+ ▪ Reduces traffic speeds ▪ Provides protection and delineation for parked cars ▪ Low installation cost ▪ May restrict commercial vehicle access ▪ May introduce squeeze points for cyclists	▪ $6,600 ($10/m linemarking)	High

Location	Level of Service calculations for 2007 (Table 4-7)	LoS S4 2037 with natural traffic growth and no development/bypass (Table 8-1)	LoS S5 2037 with future development on the 2037 network with no Bypass (Table 8-2)	LoS S6 2037 with future development on the 2037 network with Bypass (Table 8-4)	Description of works (see Table 8-5 for capacity and Table 9-1 safety improvements)	Comments	Estimated project cost	Suggested priority based on capacity and safety criteria
Rutherford Road	-	-	-	-	▪ Provide pedestrian crossing facilities (for example zebra crossing)	▪ Accommodate pedestrian desire lines to/from shops ▪ Increased driver awareness of pedestrians for safety ▪ Increase pedestrian convenience ▪ Reduced potential for jaywalking ▪ Reduced collision risk with pedestrians ▪ Proper signposting and marking are of critical importance ▪ Require adequate sight distance and pedestrian visibility ▪ Require high quality and distinctive lighting at night ▪ Cannot be provided where RTA warrant is not met ▪ Loss of on-street parking ▪ Can be costly if drainage pits need adjustment (spot treatment).	▪ $10,000 for zebra crossing	High
Calgaroo Avenue	-	-	-	-	▪ Provide roundabout at the Beech Street intersection	▪ The roundabout would prevent the acceleration of vehicles up Calgaroo Avenue which would dramatically reduce speed ▪ This treatment is consistent with the roundabout at the Grevillea Street intersection ▪ The installation of a roundabout can reduce various crash types significantly[+] ▪ Consider pedestrian safety ▪ Relatively high construction cost, but low maintenance cost (depending on the type of landscaping treatment)	▪ >$300,000 for roundabout	High
Ironbark Road/Skellatar Stock Route	-	-	-	-	▪ Road reconstruction to urban standards	▪ Currently the road does not meet the RTA standard as an urban road. Upgrade road by widening to the standard lane width with gains in road capacity	▪ Cost to be determined upon final design	Medium
Lorne Street/ Mitchell Street route	-	-	-	-	▪ Prepare an area-wide LATM plan to address rat-running issues. Limitation of area to be defined by Council.	▪ Reduce through traffic in local streets	▪ Further investigation in a separate study	Medium
Adams Street	-	-	-	-	▪ Provide roundabout at Thompson Street/ Adams Street intersection ▪ Provide pedestrian refuge along pedestrian desire lines	▪ Roundabout: ‣ Prevent the acceleration of vehicles up Acacia Drive which would dramatically reduce speed ‣ Reduce various crash types significantly[+] ‣ Need to consider pedestrian safety ‣ Relatively high construction cost, but low maintenance cost (depending on the type of landscape treatment) ▪ Pedestrian refuge island ‣ Reduce traffic speed ‣ May restrict commercial vehicle access ‣ Increase pedestrian safety and connectivity	▪ >$300,000 for roundabout ▪ $10,000 for pedestrian refuge	Medium

Location	Level of Service calculations for 2007 (Table 4-7)	LoS S4 2037 with natural traffic growth and no development/bypass (Table 8-1)	LoS S5 2037 with future development on the 2037 network with no Bypass (Table 8-2)	LoS S6 2037 with future development on the 2037 network with Bypass (Table 8-4)	Description of works (see Table 8-5 for capacity and Table 9-1 safety improvements)	Comments	Estimated project cost	Suggested priority based on capacity and safety criteria
Shaw Crescent	-	-	-	-	▪ Provide edgeline marking along Shaw Crescent ▪ Remove trees on the roadside around the bends	▪ Reduce travel speed by introducing edgeline markings ▪ Edgeline markings: ‣ Reduce various crash types significantly[+] ‣ Reduce traffic speeds ‣ Provide protection and delineation for parked cars ‣ Low installation cost ‣ May restrict commercial vehicle access ‣ May introduce squeeze points for cyclists ▪ Remove trees on the roadside to improve better sight line around bends	▪ $3,000 ($10/m linemarking) ▪ $8,000 ($2,000/ tree)	Medium
Access from urban areas to Denman Road	-	-	-	-	▪ Provide type of intersections for connecting roads from local developments	▪ The design of intersections connecting with rural roads should be in accord with RTA/ AUSTROADS guidelines	▪ Further investigation in a separate study	Low
Access from urban areas to the northern approach of the New England Highway	-	-	-	-	▪ Provide type of intersections for connecting roads from local developments	▪ The design of intersections connecting with rural roads should be in accord with RTA/ AUSTROADS guidelines	▪ Further investigation in a separate study	Low
Access from urban areas to the southern approach of the New England Highway	-	-	-	-	▪ Provide type of intersections for connecting roads from local developments	▪ The design of intersections connecting with rural roads should be in accord with RTA/ AUSTROADS guidelines	▪ Further investigation in a separate study	Low
Narrow bridge immediately south of No. 15 George Street	-	-	-	-	▪ Muswellbrook Shire Council has proposed to improve traffic and pedestrian safety by providing for one lane traffic only across the bridge with a Give Way sign against southbound traffic travelling downhill from Hill Street. It is proposed to reduce the width of the trafficable lane and include a pedestrian path across the bridge. The separation of vehicular and pedestrian traffic across the bridge could by using a section of New Jersey kerb or an equivalent.	▪ PB advised Council to consider the following in the detailed design: ‣ Enhance drivers' awareness of the one-lane bridge, New Jersey kerb and pedestrian path, particularly during night time and adverse weather conditions. ‣ Provide delineation on approach to and on the bridge along George Street. These include edge line and centreline. ‣ Provide signage including pedestrian warning signs and hazard markers on the New Jersey kerb ‣ Provide the required signage for the one-lane bridge in accordance with AS 1742.2-2009. ‣ Provide appropriate treatment to the roadside hazards located within the clear zone. ‣ Undertake design stage and pre-opening stage road safety audits.	▪ Further investigation in a separate study	Medium

Note: cost estimates are approximate and require to be finalised following a detailed design (i.e. underground utility, relocation of kerb lines, re-pavement, lighting and traffic control etc.)

[+] Source: Appendix C, Accident Reduction Guide Part 1, Roads and Traffic Authority, August 2005

RTA Comments on Draft Report

Appendix C provides a letter from RTA with its comments on a draft Muswellbrook Traffic Study report.

The main points raised by RTA in reference to the report were:

- the RTA has not delegated its powers in relation to road works, traffic control facilities, connections to roads and other works on classified roads, which in Muswellbrook are the New England Highway (HW9) and Denman Road/Sydney Street (MR209)

- Bridge and Sydney Streets should be upgraded to two lanes in each direction within a suitable timeframe

- the New England Highway/Rutherford intersection needs to be upgraded to accommodate future predicted traffic flows. (Council has advised that traffic signals are expected in 2008/2009)

- the following intersections require further investigation of lane configurations to accommodate predicted future traffic flows:

  - New England Highway/Rutherford Road

  - New England Highway/Thompson Street

  - New England Highway/Bell Street

  - Maitland Street/Sydney Street

Options to be considered include increasing capacity via additional lanes, turning restrictions or grade separation. RTA has given conditional support to traffic signals at the New England Highway/Thompson Street intersection.

- the RTA has concerns with upgrading the New England Highway/Hunter Street intersection as a seagull intersection particularly with sight distance to the north and potential bridge works that may be required to ensure the proposed design complies with RTA *Road Design Guide* and relevant Australian Standards

- all traffic and transport infrastructure improvements required to accommodate development traffic should be funded through a Council Section 94 Contributions Plan or funded directly by the developer

- the RTA will NOT fund any transport infrastructure works as a direct result of future development in the area.

1. Introduction

1.1 Background

Muswellbrook Shire Council engaged Parsons Brinckerhoff (PB) to undertake a Traffic Study and prepare a suggested Roadworks Plan to assist them to upgrade their road infrastructure as a result of major future residential and commercial developments in the area. Muswellbrook is facing both the economic benefits of a strong demand for primary resources and the challenges associated with accommodating rapid change and growth.

The Muswellbrook town centre is shown in Figure 1-1.

Future development plans for Muswellbrook include:

- residential development proposals in the Eastbrook Links Estate, St Mary’s Estate and Yammanie areas and proposed residential developments at the NorthView Estate in the North Muswellbrook area
- potential future residential developments on the eastern side of the New England Highway (close to the Caravan Park) concurrently with commercial in South Muswellbrook near Rutherford Road.

These proposals could result in an additional 3,954 dwellings in the next 25 years from an existing population of 15,420 (2006 Census for the Muswellbrook Local Government Area (LGA)). Assuming an average household size of 2.62 (as per 2006 Census), the proposed residential developments would increase the LGA population by about 10,280, an increase of two-thirds over the next 25 years.

For this study Council was interested in capturing:

- The needs of all road users, including those driving private vehicles, passengers on buses, cyclists and pedestrians
- The performance of the existing road network
- The speed of regional traffic travelling through the town on State Roads
- The safety of residents and visitors on local and state roads
- Council’s expenditures to maintaining its road assets.

1.2 Study objectives

The objectives of the traffic study were to:

- develop an understanding of the context of traffic management and development in the Muswellbrook urban area
- develop a strategic document that will guide Council to better manage development in the Muswellbrook urban area especially in the areas of developer contributions, traffic management and road safety.

1.3 Study Procedure

The study procedure:

- assessed the impact of identified developments on the road network and considered appropriate traffic management measures
- extended RTA's Lower Hunter Regional Traffic Model (TransCAD) to include local traffic conditions at Muswellbrook and its immediate surroundings for assessing traffic impacts within the Muswellbrook Study area by measuring traffic flow forecasts, speeds and volume/capacity ratios. Key road works were input into the model.

In summary, the study included:

- a comprehensive understanding of all vehicle travel in the study area for year 2007
- a means of assessing future development proposals systematically within the study area
- a robust means of traffic forecasting to set parameters for future road and intersection design
- a set of traffic forecasts for years 2020, 2037 with and without land use and road network changes such as the Muswellbrook bypass
- a means of evaluating the benefits of the regional and local infrastructure proposals such as the Muswellbrook Bypass and traffic works proposed in the earlier South Muswellbrook Traffic Study (prepared by Environmental Resources Management Australia Pty Ltd , July 2000)
- a traffic model that can be maintained and used to inform future Council decisions, both at the broad local level for Council officers' use, and at a more regional level for the City's road hierarchy. The model outputs may also be used for traffic apportionment, which is a critical aspect of applying Council's Section 94 Contributions Plan to new development applications
- a strategic document that will guide Council in its decisions in the study area on topics such as traffic management, and Developer apportionment or the implications of updating the improvements in the Section 94 plan.

This report outlines the study process, assumptions and findings of the study so the model can be understood, as well as recommendations on traffic strategies for the projects on which Council sought advice.

1.4 The study area

As shown in Figure 1-1, the Muswellbrook study area covers the Muswellbrook town centre and its immediate environs. This area was based on the network likely to be impacted by proposed development and regional traffic growth.

The study area generally extends beyond the limits of Figure 1-1 to include:

- east to the Denman Road/Sydney Street intersection. The border of the study area to the east was Muscle Creek Road and further south along the New England Highway to Pamger Drive

- north of Ramrod Creek, along the New England Highway to Ironbark Road (east), along Denman Road to the intersection with Skellatar Stock Route Road
- west to the flood levee bank at Kayuga Bridge then along the New England Highway to Sandy Creek Road
- although the Muswellbrook Bypass is located outside the immediate study area, it would influence traffic conditions on the New England Highway within the Study Area. Therefore, the network was defined so that the bypass could be included or excluded as required.

Supplementary to Figure 1-1 and Figure 1-2, the following definitions are provided to clarify descriptions of the areas referred to in the report:

Muswellbrook LGA –. It is the base spatial unit used to collect and disseminate statistics on localities. It aligns with local government boundaries, which is a legal definition, except for some areas that are not effectively separable. Figure 1-2 maps the Muswellbrook LGA and its surrounding LGAs.

Muswellbrook CBD – the Central Business District of Muswellbrook generally refers to the commercial area where retail shops and offices are located. All key commercial and retail activities in Muswellbrook are located in the CBD, mainly fronting Bridge Street (the New England Highway). Essentially, the CBD was defined as the area bounded by Market Street to the south, Sowerby Street to the east, Wilkins Street to the north and the Main North railway line to the west.

North Muswellbrook – the part of Muswellbrook which includes the CBD area, residential lands developed around the CBD and some lands with special uses, for example schools and the hospital. It is generally limited to area north of the railway line.

South Muswellbrook – the southern part of Muswellbrook that is primarily residential, with some commercial activity along Rutherford Road, Maitland Street and Sydney Street. Most of the current major proposed residential developments are located in this area. It is generally the area south of the railway line.

RTA's Lower Hunter Regional Model area – the development of the Muswellbrook traffic network model extended coverage from Singleton and RTA's Lower Hunter Regional Model. The final model would include an integration of the Lower Hunter, Singleton and Muswellbrook study area. The RTA's model covers the six statistical local areas that constitute the Lower Hunter: Newcastle – inner, Newcastle – remainder, Lake Macquarie, Cessnock, Maitland and Port Stephens. It also includes the northern section of Wyong. Figure 1-2 shows the coverage of the RTA model.

1.5 Delivery of key study objectives

PB developed a comprehensive six stage study approach to deliver the key study objectives:

1. review of existing traffic conditions
2. collection of up-to-date traffic data through travel surveys
3. development of a local road network traffic model (in the TransCAD platform)

4. estimate future background and new development traffic generation
5. prepare a road network improvement plan
6. prepare a suggested 5-year Works Program for all intersection and road improvements identified in the study.

The study process chart in Figure 1-3 provides an overview of PB's six stage approach and the expected outcomes at each stage. Detailed tasks in each of five stages are shown in Figure 1-4.

Below is a brief description of PB's six stage approach:

Stage 1 – Data review and collation

This stage consisted of:

- reviewing historical and existing data resources from both RTA and Council
- understanding the regional and local traffic context
- describing the road network
- updating Council's road hierarchy plan
- reviewing the RTA car trip origin/destination data (for year 2002)
- presenting findings in Section 2 on existing traffic conditions and current traffic issues.

Stage 2 – Traffic surveys and modelling

This stage involved:

- analysing the new traffic data and assignment of traffic to all roads included in the model
- calibrating and validating the model for year 2007. Three types of data were collected for the calibration; all day mid-block counts by automatic counter, peak hour intersection turning movement counts and travel times by sampling on key routes
- traffic forecasts for years 2020 and 2037 to include full occupation of all the developments currently proposed
- using a two-level traffic modelling methodology. A higher level network model using the TransCAD software and a series of detailed intersection models using SIDRA software to identify network capacity and road infrastructure issues
- Sections 2 to 5 containing results from the traffic surveys, modelling assumptions, calibrations and validation outcomes.

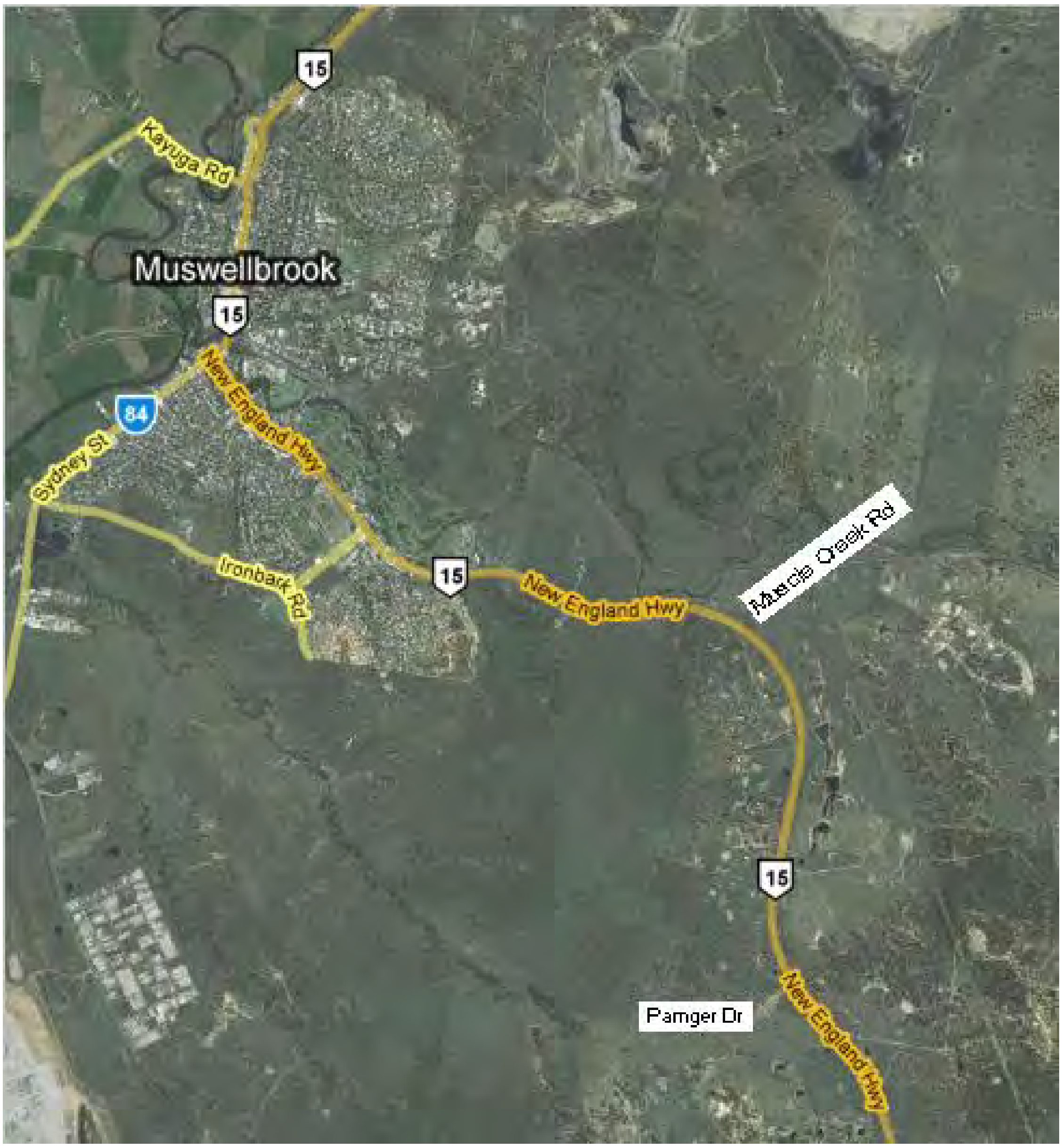


Figure 1-1 Muswellbrook study area

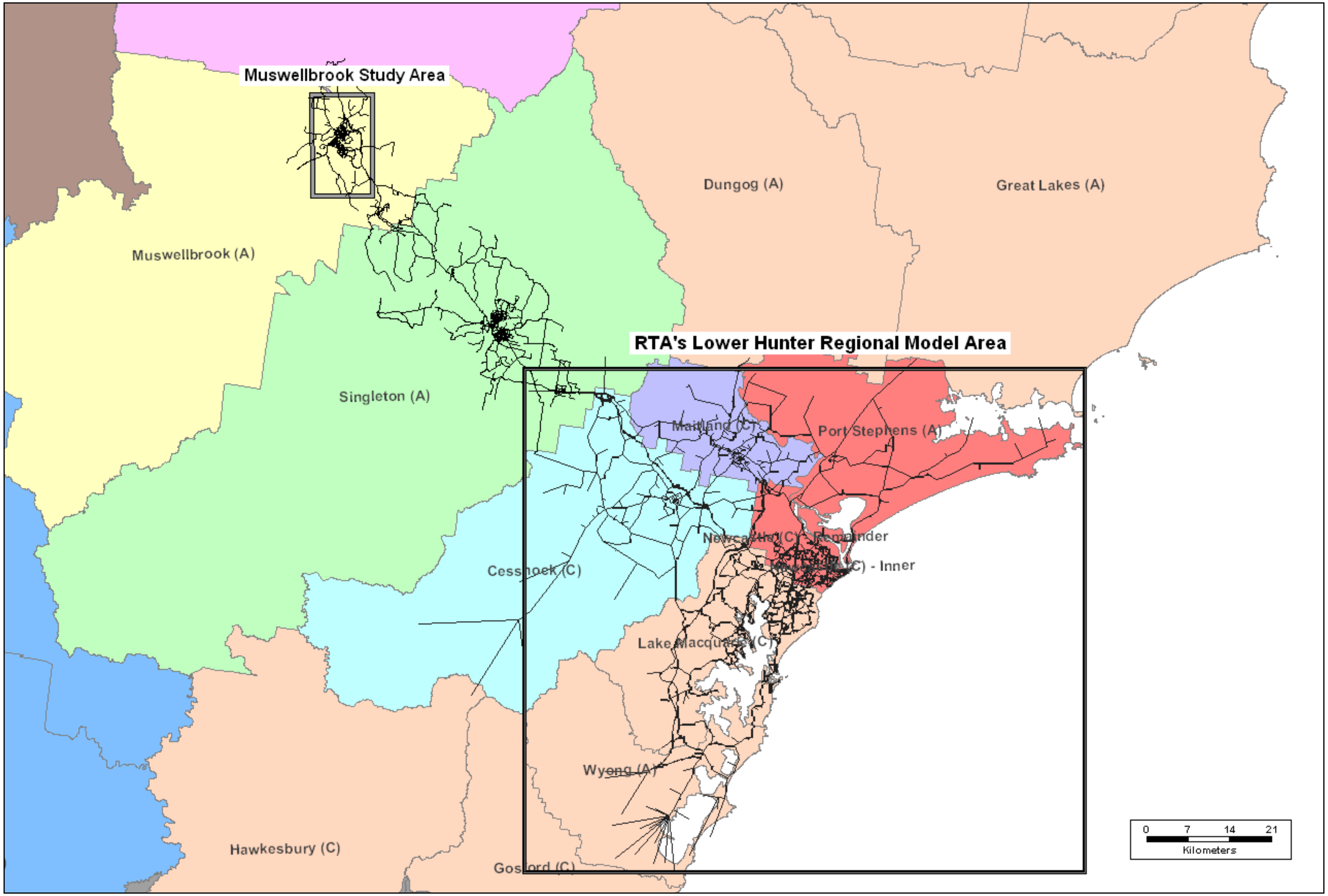


Figure 1-2 RTA's Lower Hunter Regional Model Area and its extensions

Stage 3 – Traffic improvement/ management options

Review what upgrades and facilities might be required to accommodate the additional traffic demand at each future year. PB tested a range of traffic improvements measures at road and intersection level to support anticipated growth from potential development at a satisfactory level of performance.

Stage 4 – Preferred traffic management measures

Develop a preferred set of road and intersection improvement works. The aim was maximising the benefits of the local road and intersection improvements.

Stage 5 – Traffic management issues

Identify a staging plan for road and intersections improvements identified in stage 4. Staged traffic works were developed for two periods; between 2007 and 2016, and 2016 and 2026. These years were selected to be consistent with census data collection years so that forecasts can be monitored as data is collected and feedback into the program.

Stage 6 – suggested Works Program

Prepare a 5-year Works Program for all intersections and road works identified in the study.

1.6 Report structure

This report has the following structure:

- Section 1: Introduction - background to the study area, traffic study process and objectives of this study
- Section 2: Regional and local transport context - provide a review of road network, land use, journey to work data, public transport network and usage, and road hierarchy
- Section 3: Traffic data surveys - extensive data collection program that forms basis of traffic model and our analysis
- Section 4: Traffic results - quantifies daily and peak hour traffic flows and current network capacity on key roads and intersections within the study area
- Section 5: Traffic model - modelling methodology and the process of network calibration for year 2007 to establish reliability of the model
- Section 6: Future land use and network changes - potential developments and background traffic growth considered for trend analysis into the future. Also the implications of the proposed Muswellbrook Bypass being added to the road network
- Section 7: Traffic forecasts - future 2020, 2037 forecasts for the base case, with major developments and under two scenarios, with and without the proposed Muswellbrook Bypass
- Section 8: Capacity improvements and traffic works - discussion of traffic implications of road and intersection improvements work. It also presents a recommended traffic works program through 2026

- Section 9: Identify traffic management issues on local and state roads
- Section 10: Provides a suggested 5-year Works Program
- Section 11: Summary and conclusions
- Section 12: References of the guidelines, data and documents used in this study.

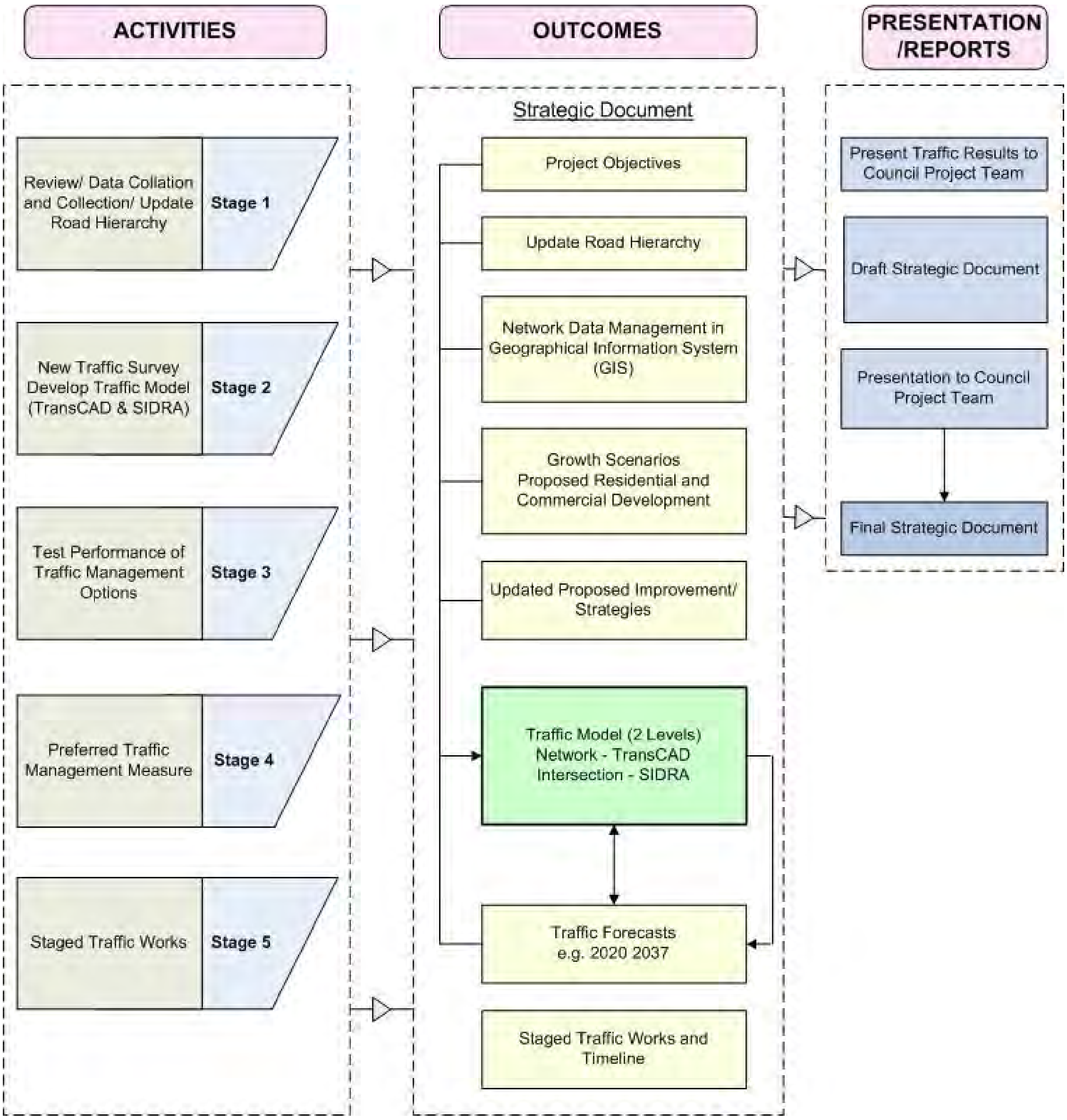


Figure 1-3 Overview of study process

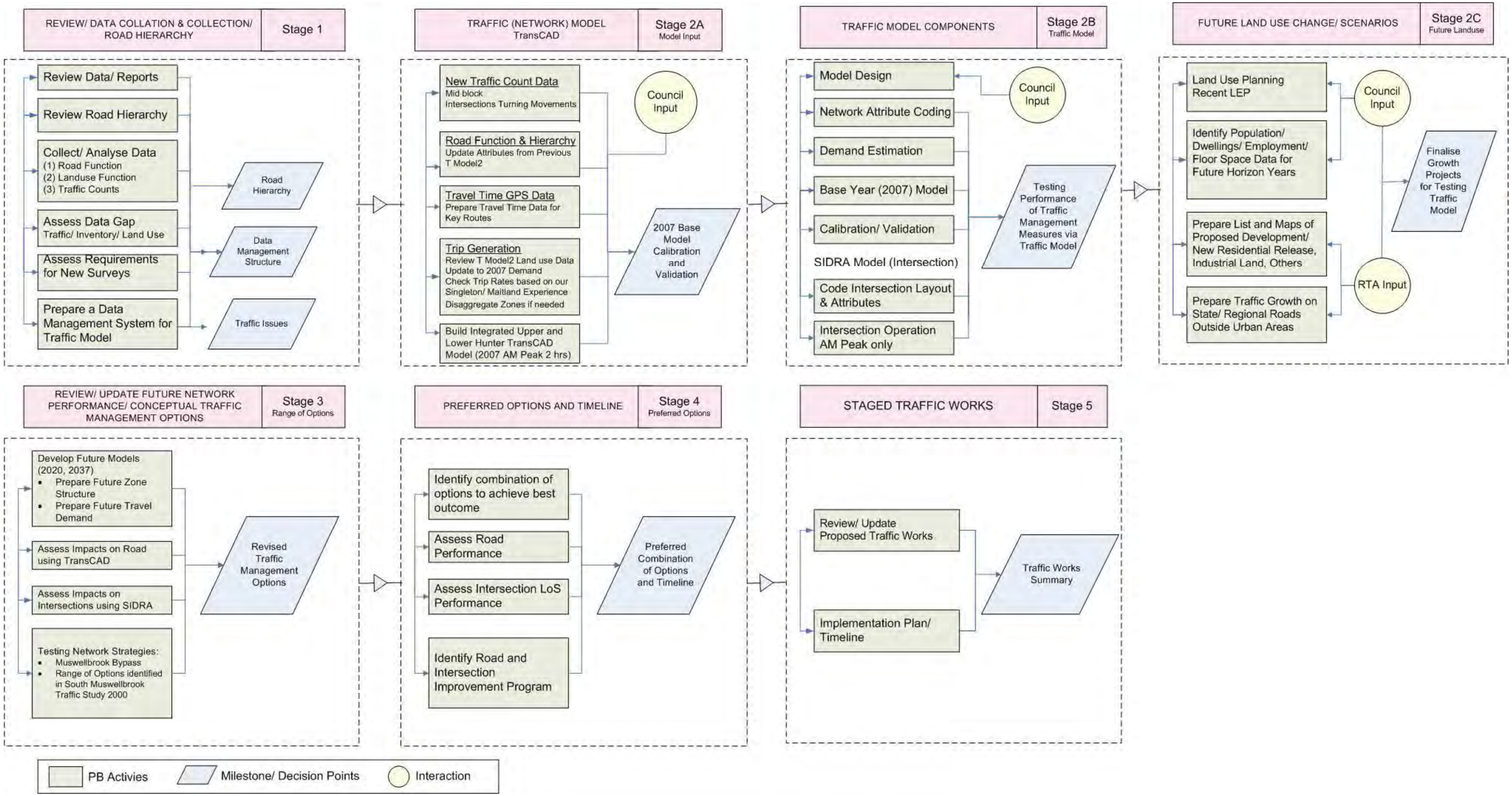


Figure 1-4 Detailed study work flow

2. Regional and local transport contexts

This section reviewed the existing transport network, as well as regional and local travel demands within the study area. The following topics in this section provide an overview of transport characteristics for the study area.

2.1 Road network

The existing road network in, and surrounding, the Muswellbrook study area is shown in Figure 1-1

- the New England Highway is the major arterial road serving the town of Muswellbrook, connecting it to Newcastle and Queensland
- Bridge Street (H9) is the “main street” of Muswellbrook
- Sydney Street (Denman Road) is another main road linking to the New England Highway
- a number of cross streets connect Maitland Street (New England Highway), Bridge Street and Sydney Street, with the most heavily used roads being Rutherford Road, Ironbark Road/Skellatar Stock Route and Brook Street. Rutherford Road and Ironbark Road are often used as alternative routes by motorists avoiding local congestion and delays at traffic signals along the Maitland Street and Sydney Street
- An alternative to the Maitland Street/Bridge Street route is St Heliers Street, Cook Street, Carl Street, Victoria Street and Bell Street. They provide secondary access between Muswellbrook North and Muswellbrook South
- Routes across the barrier of the railway line include Bowman Street, Doyle Street, Brook Street and Hunter Street.

2.2 Land use

Land use is one of the key influences on demand for transport infrastructure. In broad terms, the study area land uses can be classified into residential, commercial, industrial and special uses as follows.

Residential

The majority of land within the Muswellbrook study area has been developed for residential purposes with land reserved for special purposes including schools and hospitals. Proposed residential developments including Eastbrook Links Estate and Yammanie Subdivision are located in the South Muswellbrook area.

Commercial

- the major commercial and retail activities in Muswellbrook are located along the Bridge Street and corner of Maitland Street and Sydney Street
- bulky retail development (Bi-Lo) is located on Rutherford Road. Existing commercial floor space (as Gross Floor Area, or GFA) was estimated from a recent aerial photo in the order of 114,100 m2
- key shopping areas including retailers such as Franklins, Big W and Woolworths are located on Bridge Street, Sowerby Street and Brook Street within the CBD.

Industrial

- the majority of land developed for industrial purposes is in the vicinity of Mitchell Line Road in South Muswellbrook. The industrial GFA is in the order of 79,800 m2
- north Muswellbrook contains approximately 28,300 m2 industrial land on Common Road and the New England Highway (south of McCullys Gap Road).

For modelling purposes, we have assigned detailed land use data to ten travel zones (see Figure 2-1).

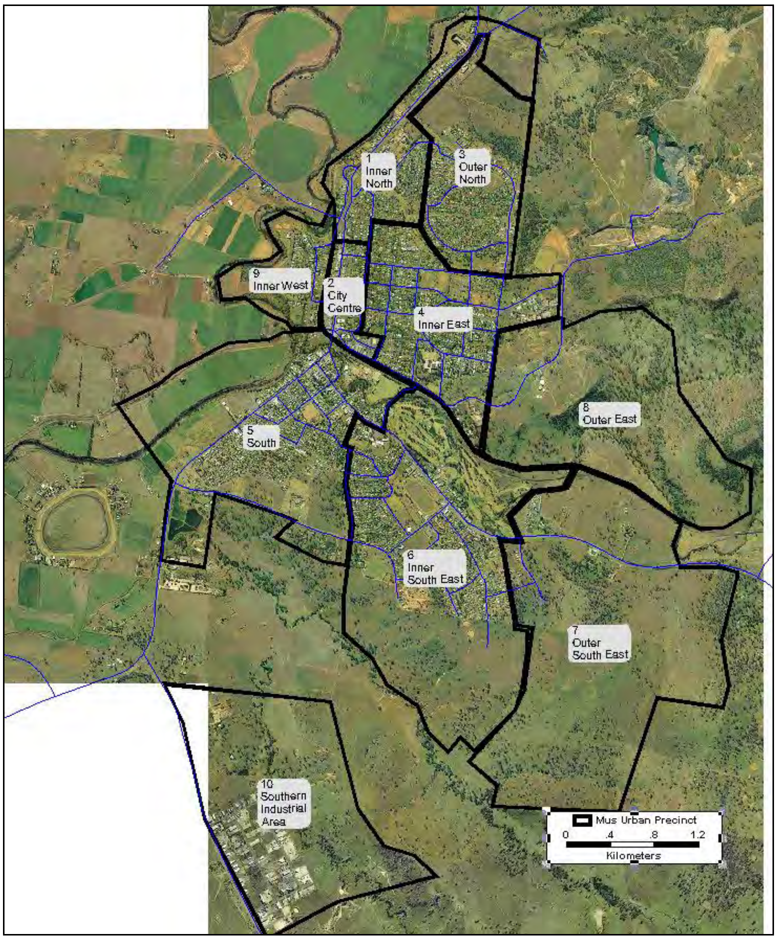


Figure 2-1 10 Land use precincts

Estimates of land use for 2007 are summarised in Table 2-1. Comparing the estimated population figure in the study area with overall Muswellbrook SLA population, the study area represents about two thirds of the Shire's population. Figure 2-2 shows existing land use patterns for the study area.

Table 2-1 Existing land use estimates for 2007

Urban Precinct	Residential	Commercial	Industrial	School	Hospital
Units	**Dwellings**	**GFA ($100m^2$)**	**GFA ($100m^2$)**	**Students**	**Beds**
1_InnerNorth	386		87		
2_CityCentre	60	676			
3_OuterNorth	538		31		
4_InnerEast	756		165	1,786	60
5_South	992	332		365	
6_InnerSouth East	937	133		1,477	
7_OuterSouth East	74			46	
8_OuterEast					
9_InnerWest	161				
10_Southern Industrial Area			515		
Others	78				
Grand Total	**3,982**	**1,141**	**798**	**3,674**	**60**

Note: (1) others = other areas within the study area; (2) commercial and industrial gross floor areas were estimated from aerial photos; (3) Employment distribution data are for year 1999. Precincts 8 and 9 employment figures are probably mine related. Average household size is 2.62 as per 2006 Census data.

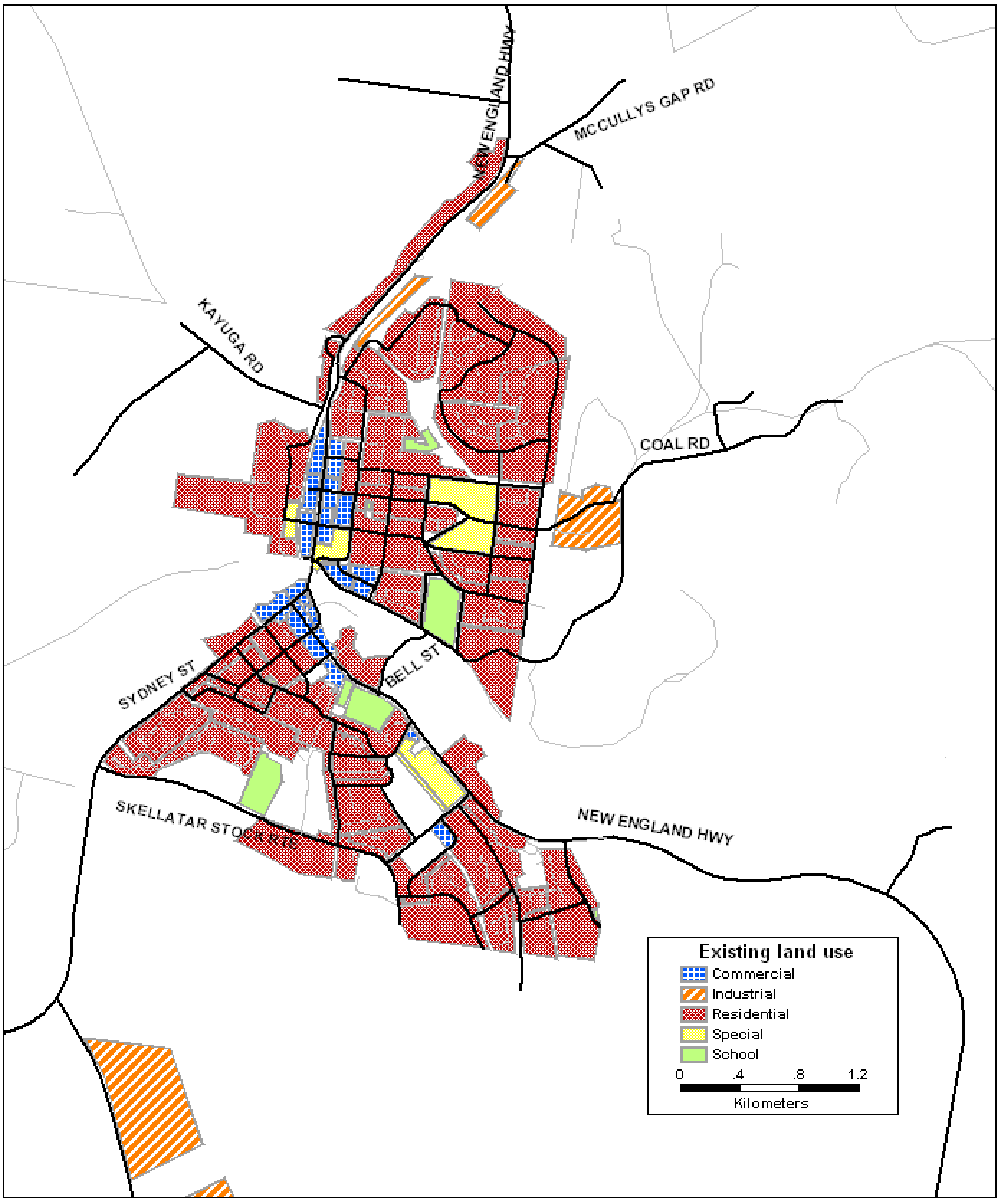


Figure 2-2 Existing land use patterns

2.3 Journey to work analysis

The NSW Transport Data Centre (TDC) provided 2001 journey-to-work data (JTW) data for the study area as at the time writing this report 2006 JTW data was not available.

Mode share

Journey to work travel by mode in 2001 is shown in Table 2-2.

Table 2-2 2001 Journey to Work mode share – Muswellbrook as Destination SLA

Mode of transport	No of Employees	% Mode share
Bus	26	0.5%
Car driver	4,346	76.9%
Car passenger	653	11.6%
Motorbike	84	1.5%
Other	98	1.7%
Taxi	6	0.1%
Train	6	0.1%
Truck	98	1.7%
Walked only	334	5.9%
Total	**5,651**	**100.0%**

Origin/destination of journey-to-work trips

JTW data was analysed to determine the origin of work trips to and from the Muswellbrook study area which was a key input to PB's traffic model. Data was grouped by geographic areas into a number of sectors served by the external road network.

Detailed work trip distribution from the 2001 Census showed:

- workplace of employed people living in Muswellbrook SLA (refer to Figure 2-3):
  - Muswellbrook SLA (77%)
  - Singleton SLA (7.6%)
  - Maitland, Cessnock and Newcastle (<1%)
  - SLAs to the North of Muswellbrook via New England Highway (4%)
- home origin of employed people who worked in Muswellbrook SLA (refer to Figure 2-4):
  - Muswellbrook SLA (69%)
  - Cessnock SLA (2.4%)
  - Maitland SLA (2%)
  - Newcastle SLAs (1.3%)
  - SLAs to the North of Muswellbrook via New England Highway (13%).

2.4 Public transport network and use

The current transit network has a low existing service base. JTW data indicated less than 1% of people used public transport to travel to work. Current accessibility challenges for public transport are:

- low density and dispersed housing development
- expensive taxi option given dispersed locations
- no passenger route bus services
- limited destination passenger rail system with schedules that are not commuter focussed
- Little integration in the public transport system so that potential users can make connections.

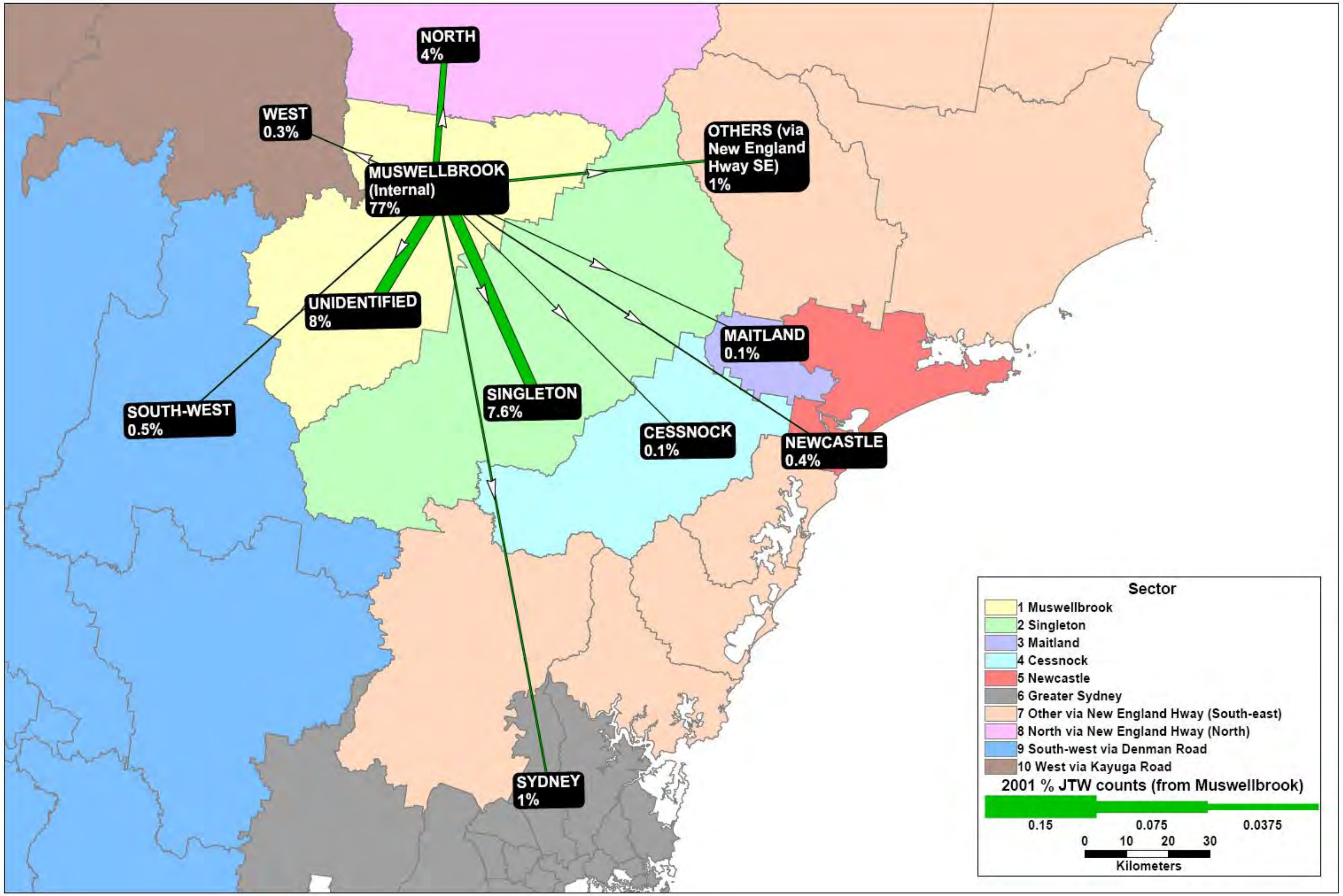


Figure 2-3 2001 JTW geographic trips destination (from Muswellbrook)

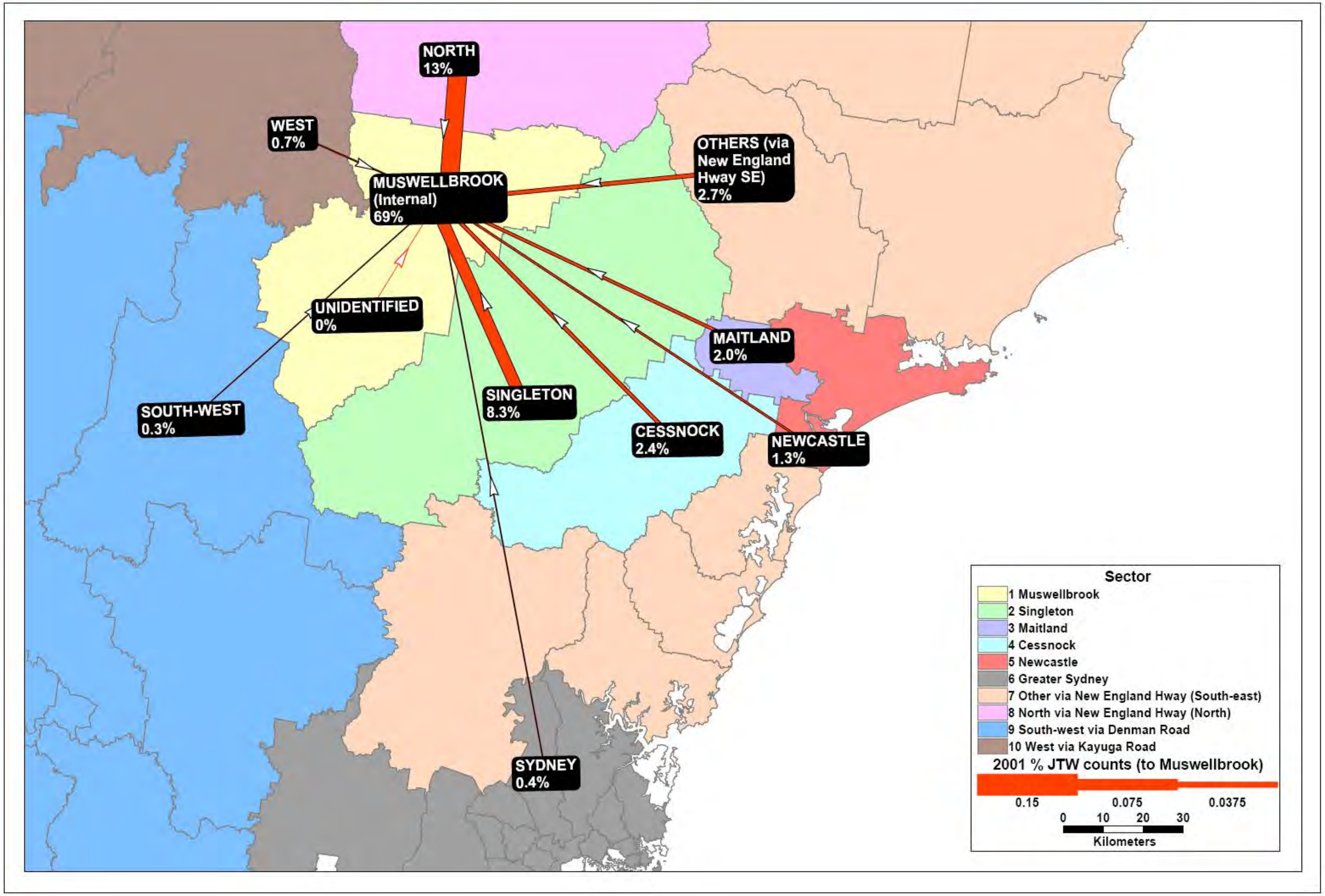


Figure 2-4 2001 JTW geographic trips origin (to Muswellbrook)

2.4.1 Bus services

The only regular scheduled passenger services are long distance coach. There are no scheduled bus services other than school routes in Muswellbrook. The school routes are served by two operators as noted in the Table 2-3.

Table 2-3 Existing school bus services

Serving	Operator
Muswellbrook – Kayuga	Howards Bus & Charter Pty Ltd
Muswellbrook – Antienne	Howards Bus & Charter Pty Ltd
Dalswinton – Muswellbrook	Reg Osborn Pty Ltd
Denman – Muswellbrook	Reg Osborn Pty Ltd
Denman – Muswellbrook (Aberdeen)	Reg Osborn Pty Ltd
Denman -Muswellbrook High Run 1	Reg Osborn Pty Ltd
Muswellbrook – Sandy Hollow	Reg Osborn Pty Ltd
Muswellbrook - Roxburgh	Reg Osborn Pty Ltd

2.4.2 Rail services

On a typical weekday, Muswellbrook Station is served by four rail services to Newcastle, three to Scone. Table 2-4 and Table 2-5 showed weekday and weekend rail services respectively.

Table 2-4 Weekday rail services

To Newcastle		From Newcastle	
Depart Muswellbrook	**Arrive Newcastle**	**Depart Newcastle**	**Arrive Muswellbrook**
06:12	08:00	03:15	05:01
10:43	11:54	08:14	10:02
19:01	20:38	16:05	17:51
20:45	22:39	17:46	19:33

Table 2-5 Weekend rail services

To Newcastle		From Newcastle	
Depart Muswellbrook	**Arrive Newcastle**	**Depart Newcastle**	**Arrive Muswellbrook**
06:56	08:41	03:54	05:45
21:01	22:47	17:44	19:31

2.5 Road hierarchy

Roads are generally classified by their functions and characteristics. In general, the Roads and Transport Authority of NSW (RTA) is responsible for the construction and maintenance of state roads. Councils are responsible for the construction and maintenance of regional and local roads.

- PB's traffic model was based on Council's *Strategic Plan for Road Management*, 2004.

Councils' road asset data indicate there are about 695 km of roads in the Muswellbrook LGA of which about 72 km are state roads, 39 km are regional roads and the remaining 584 km (84%) are local roads. A road hierarchy review for Muswellbrook was undertaken by:

- comparing the functional classification system with Council's road classification system
- preparing a road hierarchy map on the basis of data listed in Council's road asset document. This was a very comprehensive document and provided functional classification of each of road under Council's jurisdiction.

Functional classification of road

Guidelines for the Austroads functional classification of roads are:

- Arterial Roads – predominantly carry through traffic from one region to another forming principal avenue of communication for urban traffic movements. Typically traffic volumes would be in excess of 15,000 vehicles per day (vpd)
- Sub-arterial Roads – connect the arterial roads to areas of development or carry traffic directly from one part of a region to another, they may also relieve traffic on arterial roads in some circumstances. Typically traffic volumes would range from 5,000 vpd to 20,000 vpd
- Collector Roads – connect the sub-arterial roads to the local road system in developed areas. Typical traffic volumes range from 2,000 vpd to 10,000 vpd although residential amenity would begin to decline with volumes in excess of 5,000 vpd
- Local Roads – are the sub-divisional roads within a particular developed area. These are used to provide local access, and typically carry low volumes, i.e., less than 2,000 vpd.

Table 2-6 shows the summary of criteria for functional classification of roads.

Table 2-6 Austroads Functional classification of roads

	Arterial	Sub-arterial	Collector	Local
Traffic Volume (AADT)	>15,000	5,000 – 20,000	2,000 – 10,000	<2,000
Traffic Composition				
Through Traffic	√	Some	Little	No
Local Traffic	No	No	√	√
Heavy & Commercial Vehicles	√	√	No	No
Local Delivery Vehicles	√	√	√	√
Buses	√	√	√	Maybe
Bicycles	No	No	In marked lanes only	√
Number of Lanes	4 or more	4 or more	2 or more	2 or more
Interconnections	Sub arterial	Arterial collector	Sub arterial local	Collector
Parking				
Peak Period	No	No	√	√
Off peak	No	√	√	√
Period Parking	No	Maybe	√	√
Unrestricted	No	No	Maybe	√
Angle Parking	No	No	Maybe	√
Intersection Control	√	√	Maybe	–
Bus and Transit Lanes	√	√	–	–
Speed Limit (kph)	60 – 80	60	60	60 (1)
Lane and Separation Lines	√		Preferred	No
Medians	√	Maybe	No	No
Road Closures	No	No	No	√

Source: Functional Classification of Roads, 1980, Traffic Authority of New South Wales.

Note (1) the current general speed limit of local roads is 50km/h.

Functional classification of road as per Council

Council broadly classifies roads into two categories being urban and rural as these communities require roads of a different standard. For each category, Council maintained road types by numbering functional classification being 1 to 5 for rural roads and 6 to 9 for urban roads. For modelling purposes, PB has developed a correlation matrix between Councils' and the functional road categories. The process confirms that Council's existing road hierarchy accords with the standard guidelines. Figure 2-5 presents existing road hierarchy adopted for the traffic model.

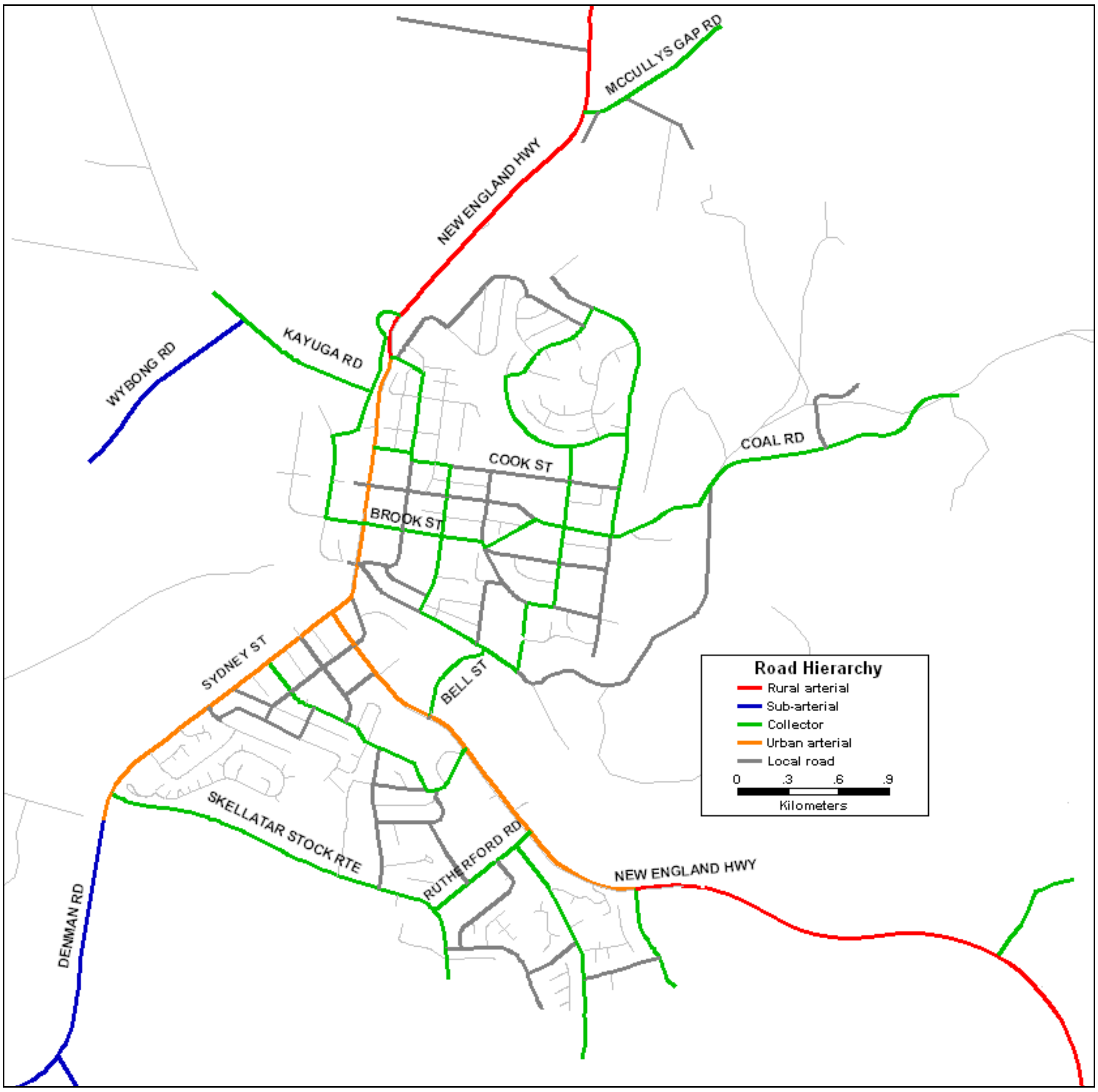


Figure 2-5 Road hierarchy used in the traffic model for 2007

2.6 Historical traffic growth

Historic traffic data on key roads, including New England Highway (H9), Sydney Street (MR209) and Wybong Road were used to establish a local trend for traffic growth throughout the study area. Traffic volumes at six locations within the Muswellbrook LGA were sourced from the Roads and Traffic Authority of NSW (RTA) *Traffic Volume Data for Hunter and Northern Regions*, 2004. In general, RTA reports traffic data in terms of annual average daily traffic (AADT). Historic data were available for:

- New England Highway, at southern town boundary
- Maitland Street (New England Highway), south of MR209, Sydney Street
- Bridge Street (New England Highway) south of Hill Street
- New England Highway, 0.2 km south of Sandy Creek Bridge
- Sydney Street, west of Maitland Street (SH9)
- Wybong Road, at Hunter River Bridge.

Table 2-7 shows traffic volumes changes at the above locations between 1998 and 2004, a 6 year period. The RTA data showed that:

- around 10,000 vpd on the New England Highway, north and south of the town centre of Muswellbrook
- traffic on Bridge Street (H9) just south of the Hill Street or Sydney Street was the highest recorded on the route in the study area in the order of 17,000 vehicles per day
- Sydney Street carried about 9,000 vehicles per day. However, traffic growth declined by 3.7% between 1998 and 2004
- between 1998 and 2004, traffic on the New England Highway through Muswellbrook has increased from about 0.3% to 1.2% per annum.
- traffic growth on New England Highway at the northern boundary of town was very marginal, between 0.1% and 0.3% per annum
- on average for the entire network, traffic growth was approximately 0.5% per annum between 1998 and 2004, which was consistent with the rate of Muswellbrook LGA population growth.

Table 2-7 AADT trends at RTA counting stations

Station No	Road	Location	AADT		Annual Growth
			1998	2004	1998 – 2004
New England Highway					
05.244	New England Highway	at southern town boundary	10,114*	10,269*	0.3%
05.245	Maitland Street (New England Highway)	south of MR209, Sydney Street	15,191	16,253	1.2%
05.247	Bridge Street (New England Highway)	south of Hill Street	16,852	17,106	0.3%
05.063	New England Highway	0.2KM south of Sandy Ck Bridge, at northern town boundary	10,834	10,887	0.1%
Other side streets					
05.477	Sydney Street,MR209	west of SH9, Maitland Street	11,355	8,860	-3.7%
05.471	Wybong Rd	at Hunter River Bridge	2,211	2,279	0.5%

Note: * Axle pair counts

The study also considered unpublished RTA data on traffic volumes for the New England Highway between 2002 and 2007 are shown in Table 2-8. This data shows that traffic on the New England Highway has increased between 1% and 2%. The maximum growth rate was 2.7%.

Table 2-8 Historical growth trend on the New England Highway between 2002 and 2007

Data Source	Road	Section	Weekday Daily Traffic		
			2002	2007	Annual Growth
RTA	New England Highway	South of Muswellbrook Council Access Road	7,783		2.7%
PB	New England Highway	East of Bimbadeen Drive		8,900	
RTA	New England Highway	North of Merriwa Road	10,305		1.1%
PB	New England Highway	South of McCullys Gap Road		10,900	

Note: AADT data measures number of axle pairs and tube counts measure number of vehicles.

2.7 Existing traffic distribution

Traffic in the Muswellbrook study area is a mixture of through and local traffic movements. In 2002, RTA conducted an origin destination survey (O/D) on the New England at Muswellbrook, capturing all travel, not just work travel. The primary objective of the survey was to assess the nature of through and local traffic on a typical weekday. Data were captured at the following survey locations:

- Maitland Street (east of Muswellbrook Council Chambers)
- New England Highway (north of Aberdeen Street turn-off to Merriwa)
- Right turn to and left turn from Bell Street to New England Highway (High Vehicle bypass)
- Right turn to and left turn from Bridge Street to Maitland Street
- Entry and exit driveways to Muswellbrook Shopping Centre (between William Street and Brook Street).

PB used this O/D data in the traffic model as it formed the basis of the through traffic distribution, particularly for the New England Highway. Figure 2-6 shows O/D survey locations. Table 2-9 presents the external traffic patterns (O/D data) at five locations.

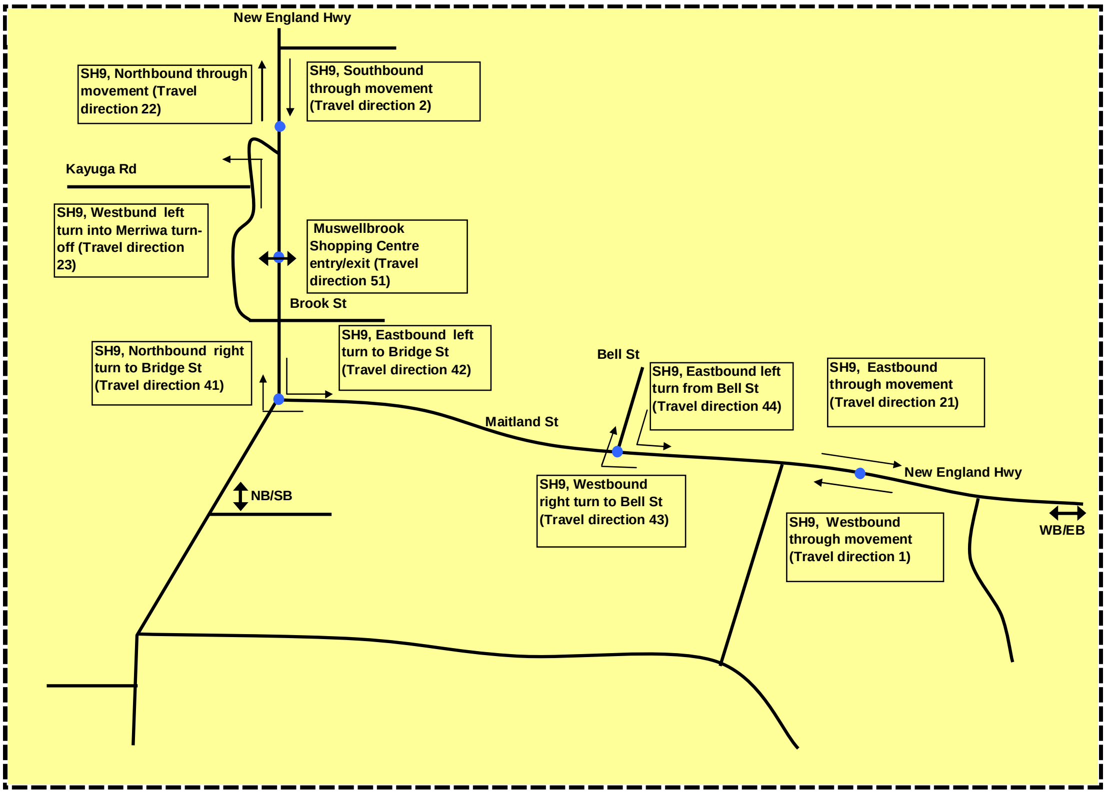


Figure 2-6 O/D survey locations

Table 2-9 O/D trip patterns for 12 hours period (between 6 am and 6 pm)

	Destination by travel direction								
Origin +	**21**	**22**	**23**	**41**	**42**	**43**	**44**	**51**	**Total**
1	595	915	30	1,260	280	260	180	160	**3,681**
	16%	25%	1%	34%	8%	7%	5%	4%	**100%**
2	830	670	40	205	390	35	115	320	**2,607**
	32%	26%	2%	8%	15%	1%	4%	12%	**100%**
41	325	960	20	270	680	95	310	355	**3,015**
	11%	32%	1%	9%	23%	3%	10%	12%	**100%**
42	890	185	10	505	185	120	150	240	**2,285**
	39%	8%	0%	22%	8%	5%	7%	11%	**100%**
43	110	115	0	160	145	90	280	140	**1,040**
	11%	11%	0%	15%	14%	9%	27%	13%	**100%**
44	345	95	5	265	125	205	145	95	**1,280**
	27%	7%	0%	21%	10%	16%	11%	7%	**100%**
51	125	260	35	145	245	65	180	0	**1,055**
	12%	25%	3%	14%	23%	6%	17%	0%	**100%**
Total	**3,220**	**3,200**	**140**	**2,810**	**2,050**	**870**	**1,360**	**1,310**	**14,963**
	22%	**21%**	**1%**	**19%**	**14%**	**6%**	**9%**	**9%**	**100%**

Note: Origin and destination trip pattern was summarised by travel direction as shown in Figure 2.6. For instance 1 indicates westbound through movement on the H9.

Key trip patterns in Muswellbrook include:

- about 25% to 32% of all trips were through traffic (non stopping) while travelling north or south via New England Highway
- the majority (60% to 70%) of all traffic in Muswellbrook was of a "local" nature. This behaviour was consistent with the JTW findings described in Section 2.3
- about 34% of traffic travelling via the New England Highway from South Muswellbrook had a destination either in town centre or further north. Of that, about 25% of trips were non stopping traffic with destinations further north. This indicated that about 9% of northbound New England Highway traffic had a destination at Muswellbrook town centre
- about 7% of traffic travelling via New England Highway from South Muswellbrook used Bell Street as an alternative access to Bridge Street. This may in part be due to rail bridge height restrictions on Bridge Street
- only a minor portion (between 1% and 2%) of New England Highway traffic had an origin or destination further west than Kayuga or Merriwa.

2.8 Key local traffic issues

Council requested that PB to look specifically at a few current local traffic issues:

- usage of Haydon Street, Lorne Street and Mitchell Street
- Bridge Street, Sydney Street and Maitland Street are arterial roads designed to carry major north-south and east-west cross movements. Occasional delays at the traffic signals at Maitland Street and Sydney Street may encourage motorists to try Haydon Street, Lorne Street and Mitchell Street as an alternative route, particularly for north south movements. We interrogated the 2007 traffic data at these locations to see how the traffic splits. Section 4 shows our results of this investigation
- speeds of traffic on:
  - Acacia Drive
  - Beech Street
  - Bloodwood Road
  - Brecht Street/Brentwood Street
  - Calgaroo Avenue
  - Carl Street
  - Doyle Lane
  - Hunter Terrace
  - New England Highway/Aberdeen Street
  - Skellatar Stock Route
  - Thompson Street
  - Shaw Crescent
- Local residents had concerns about speeding on these local roads. The Brecht Street/Brentwood Street intersection was reported as having a number of issues including speeding, increased traffic volumes and safety
- Council provided 2005 traffic data on local roads including AADT, 85th percentile and maximum speed. Section 4 also reports the results of this investigation. Figure 4-7 shows a summary of the 85th percentile speed profile collected in 2007.

3. Traffic data service

An extensive data collection program was undertaken for model development. The following sections summarise the data gap found from our review, the data collection techniques used, and an explanation of how the data were used.

3.1 Data gap assessment

In general, two methods are commonly used to update an existing network traffic model.

- carry out new traffic surveys when data are not available or old data were measured on a different network, so travel patterns may have changed
- Estimate using historical traffic data and background growth rates to forecast current performance. For this study, we undertook a comprehensive data assessment that led us to adopt this method.

The purposes of the data assessment were to:

- establish any data gaps so that additional sites could be identified to ensure comprehensive traffic counts
- prepare a sufficient traffic data bank to enable calibration of the model
- having sufficient previous counts to forecast historical growth factors to estimate a common set of volumes for year 2007
- comparing estimated data with actual traffic counts, where recent counts are available
- Recommending any additional data collection to finalise the necessary data set to calibrate the model.

The following documents were reviewed:

- Traffic Volume Data for Hunter & Northern Region, 2004, Roads and Traffic Authority, New South Wales
- South Muswellbrook Traffic Study, 2000, Environmental Resources Management Australia Pty Ltd
- Australian Bureau of Statistics (ABS) Census, 1996 and 2001
- New England Highway O/D Survey, 2002, Northern Transport Planning and Engineering Pty Ltd
- various AADT traffic data collected on local roads by/for the Muswellbrook Shire Council between 2004 and 2006
- various intersection counts undertaken in 1999 as part of the South Muswellbrook Traffic Study
- Recent traffic counts at New England Highway with Rutherford Road intersection conducted in 2007 by PB as part of the *New England Highway/Rutherford Road traffic study*.

The *South Muswellbrook Traffic Study* provided peak intersection turning movement data in 1998/1999 for eleven intersections. We looked at growth trends from two perspectives:

- using Census figures on population growth between 1996 and 2001
- historic traffic growth on key roads from RTA data sources (see previous section 2.6).

On the basis of predicted growth, previous counts were factored to year 2007 and then compared against new counts. Helpfully in this regard, we recently conducted counts for one intersection at the New England Highway and Rutherford Road in February 2007. This count was compared with estimated data for the intersection in order to assess how well the data expansion for an average annual day fit a one-off actual account. This exercise was to evaluate the validity of old counts and assess what risks would arise from using the old data to calibrate and validate the new traffic model. We searched for recent data from other intersections to do additional testing; however, we were not able to locate any.

3.1.1 Growth data

Census population data for Muswellbrook LGA extracted from the Australian Bureau of Statistics (ABS) website is shown in Table 3-1. It showed that population decreased by about 1 percent between 1996 and 2001. In 2006, the trend was positive, but only now is approaching the 1996 total.

Table 3-1 Census population data

Year	Population (persons)	Annual Growth 1996 to 2001
1996	15,562	-
2001	14,796	-1%
2006	15,420	1%

Historic traffic growth data presented in Section 2.6 indicated an average growth of 0.5% per annum between 1998 and 2004. Traffic growth appeared to grow at the same rate or slightly faster than population growth. In conclusion, the analysis suggests that a growth rate of 0.5% per annum may be an appropriate factor to update the old counts.

3.1.2 Comparison between estimated old data with new counts

Figure 3-1 showed eleven traffic counts location sourced from the *South Muswellbrook Traffic Stud*y (ERM, 2000). These were sufficient to capture peak travel patterns for South Muswellbrook area. However, during our inception meeting, Council indicated, PB's traffic model should also capture travel patterns for the town centre, and the North Muswellbrook area. Current data holdings were not sufficient for this task. Figure 3-2 contains a comparison of vehicle turning data at the New England Highway/Rutherford Road intersection from both sources. We used 0.5% annual growth to factor the old data. Mid-block volumes were also calculated from the turning volumes and are also shown in Figure 3-2. We concluded:

- traffic on the New England Highway and Rutherford Road generally increased in line with estimated data
- count data indicate that between 2004 and 2007, the rate of traffic growth may have exceeded 0.5% per year

- patterns of travel behaviour observed at actual counts appeared to be different than earlier patterns
- in percentage terms, differences in AM peak traffic volumes ranged between 39% and 2%, so there was little uniformity in the growth from new travellers
- peak traffic in the PM showed more differences than AM peak, ranging between 36% and 39%
- although, in absolute terms traffic differences only ranged from 50 to 120 vehicles over the two hour period, there were significant indications of changes in travel behaviour between the two data sets.

To further assess differences, we also undertook a sensitivity test by doubling traffic growth to 1 percent per annum. Figure 3-3 shows the results from a higher annual growth assumption at this intersection. The accelerating growth did not improve the overall results.

3.1.3 Findings

Our findings from the data review were:

- historic traffic growth in Muswellbrook has ranged between 0% and 0.5% per annum on the New England Highway and local roads to the most recent published figures of annualised growth
- recent once-off traffic survey data suggested recent annual growth rates higher than 0.5%. This could be due to new local developments and acceleration of through traffic growth on the New England Highway
- factoring old traffic data with growth rates to obtain intersection volumes did not provide a good match to actual survey data
- new traffic data suggest there has been an overall change in travel behaviour through Muswellbrook's intersections
- previous traffic counts sufficiently captured travel patterns for the South Muswellbrook area but were not sufficient to underpin a traffic model for the town centre and North Muswellbrook.
- The potential risks of not updating the traffic count database were:
- misrepresentation of travel behaviour would bias model calibration and validation results
- misrepresentation of current intersection operations could result in poor design advice
- invalid relationships between growth and traffic distribution would bias Section 94 Contribution apportionment.

Figure 3-1 Intersections surveyed in the South Muswellbrook Traffic Study (ERM, 2000)

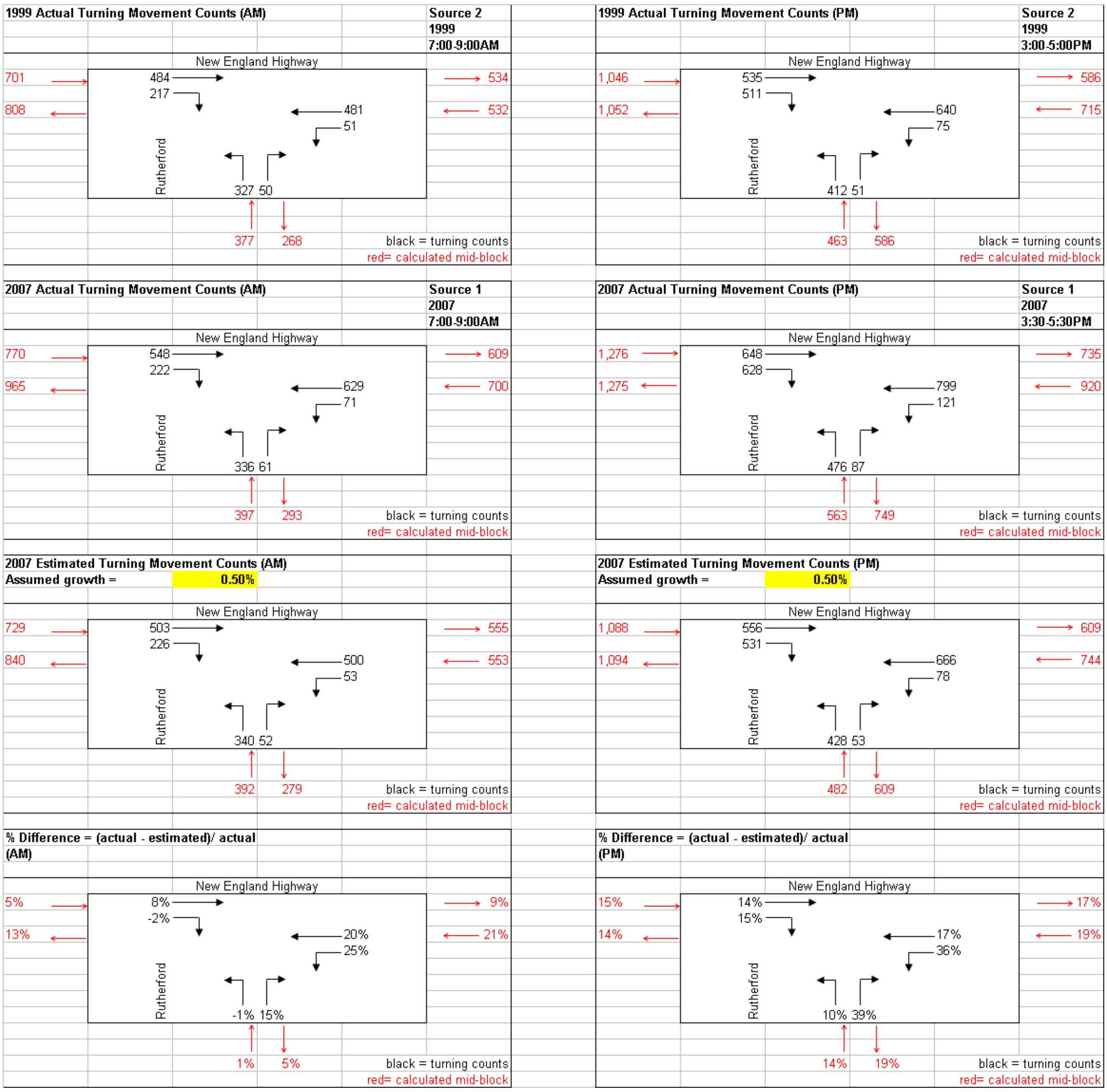


Figure 3-2 New England Highway/ Rutherford Road intersection observed and estimated counts (assumed 0.5% growth rate)

Note old PM peak counts were conducted between 3-5 PM, but, recent 2007 counts were conducted during 3:30 and 5:30 PM. This would explain a small part of the difference.

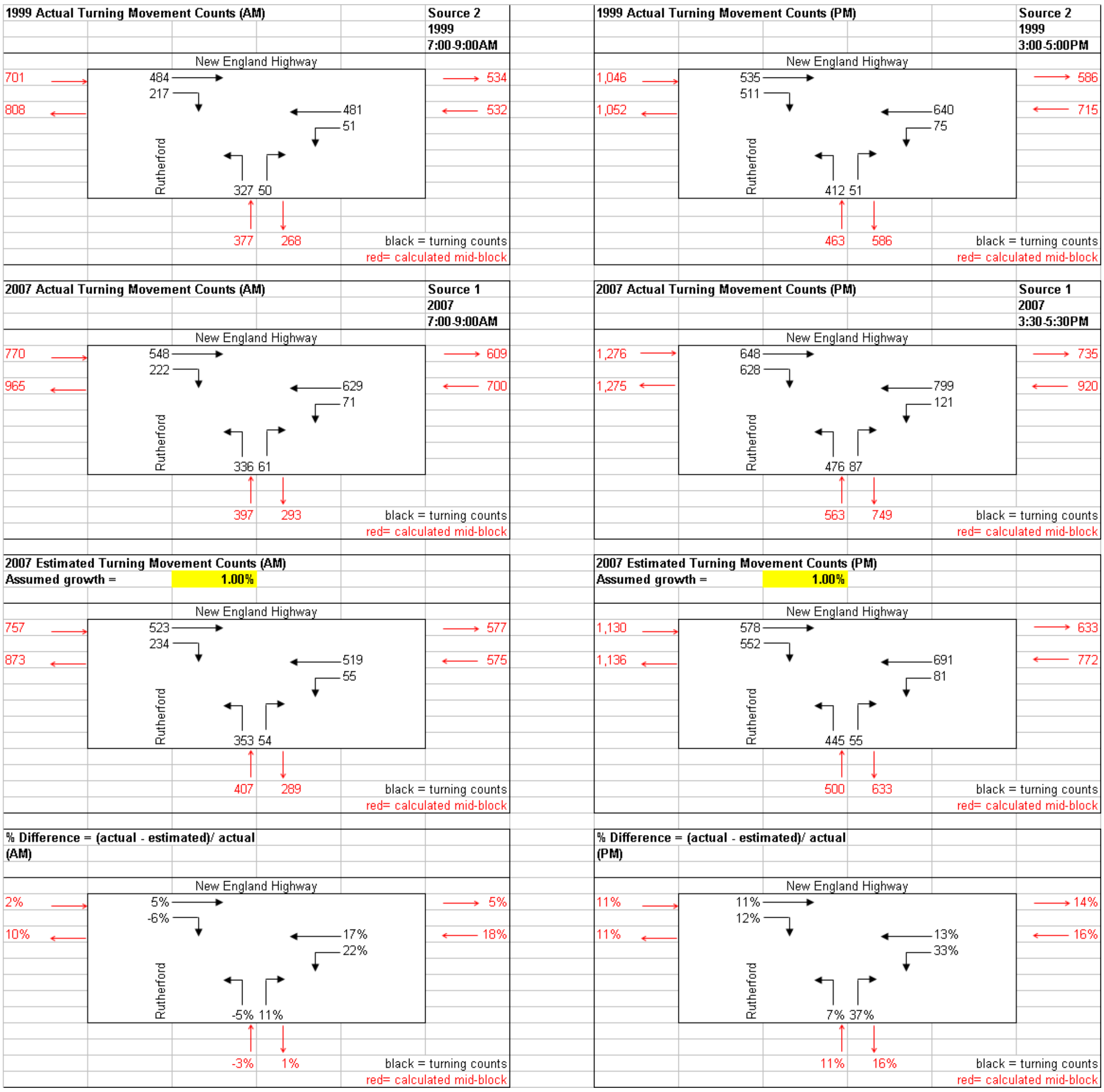


Figure 3-3 New England Highway/ Rutherford Road intersection observed and estimated counts (applying 1.0% annual growth rate)

3.1.4 Recommendations to Council

PB recommended to Council that new traffic surveys be undertaken at the eleven locations previously counted. New counting sites in both town centre and North Muswellbrook areas were also added. Council authorised PB to conduct new traffic surveys with the following survey methodology and locations.

3.2 New traffic surveys

We developed a comprehensive traffic data collection program in consultation with the Council staff. Three types of surveys were conducted in the study area:

- automatic tube counters installed mid-block for periods of at least a week
- surveyor observed intersection turning movement counts during peak periods
- vehicle travel time surveys.

Sections below describe locations of mid-block, intersections and travel time surveys.

3.2.1 Mid-block counts

PB and Council staff agreed on a number of sites for mid-block surveys covering arterial, sub arterial and collector roads within the study area. Seven sites were finally selected for mid-block traffic counts:

- M-1 New England Highway, east of Bimbadeen Drive
- M-2 New England Highway, west of Rutherford Road
- M-3 Bridge Street, south of Brook Street
- M-4 New England Highway, south of McCullys Gap Road
- M-5 Kayuga Road, west of Aberdeen Street
- M-6 Sydney Street, north of Anzac Parade
- M-7 Denman Road, south of Racecourse Road.

The surveys were conducted between 28 April 2007 and 4 May 2007 for a continuous seven-day period. All vehicles were classified into the 12 AUSTROADS categories. Section 4 describes in detail results from this survey.

3.2.2 Intersection turning movement counts

Council staff nominated nineteen intersections for detailed turning movement counts:

- I-01 New England Highway and Bimbadeen Drive
- I-02 Acacia Drive and Bloodwood Road
- I-03 New England Highway and Rutherford
- I-04 Acacia Drive and Rutherford Road
- I-05 Ironbark Road and Rutherford Road
- I-07 Adams Street and Ruth White Avenue
- I-08 New England Highway and Thompson Street
- I-09 Sydney Street and Mitchell Street
- I-10 Sydney Street and Skellatar Stock Route

- I-12 Maitland Street and Sydney Street
- I-13 Maitland Street and Lorne Street
- I-14 New England Highway and Bell Street
- I-15 Bridge Street, William Street and Market Street
- I-16 Bridge Street and Brook Street
- I-17 King Street, Brentwood Street, Doyle Street and George Street
- I-18 New England Highway and Hunter Street
- I-19 Queen Street and Lexia Street
- I-20 Brecht Street, Cook Street and Semillon Street
- I-21 Brecht Street and Brentwood Street.

Intersection turning movement surveys were conducted on Friday 4 May 2007 during both morning and afternoon peak periods. A Friday was selected after analysis of earlier counts showed it to be the day of greatest traffic flow on the local network. The morning peak period surveys were conducted from 7 AM to 9 AM, and the afternoon peak period was counted from 3 PM to 5 PM. Section 4 provides the detailed results from this survey. Figure 3-4 shows mid block and intersection turning movement survey sites.

3.2.3 Travel time survey

Travel time data is another important input to the validation of calibrated network performance of a traffic model, and in particular, for the speed/flow curves adopted for use in this study. Motorists are forecast to prefer routes offering the quickest travel times and lowest congestion in comparison to alternative routes (if any), so the model has to approximate the relative speeds of the routes available. The survey was conducted on Friday, 4 May 2007 between 7 AM to 9 AM. Travel times were collected using GPS data loggers along a set of defined routes shown in Figure 3-5. Locations of travel time routes are reported as part of the AM peak travel time validation process (see Section 5).

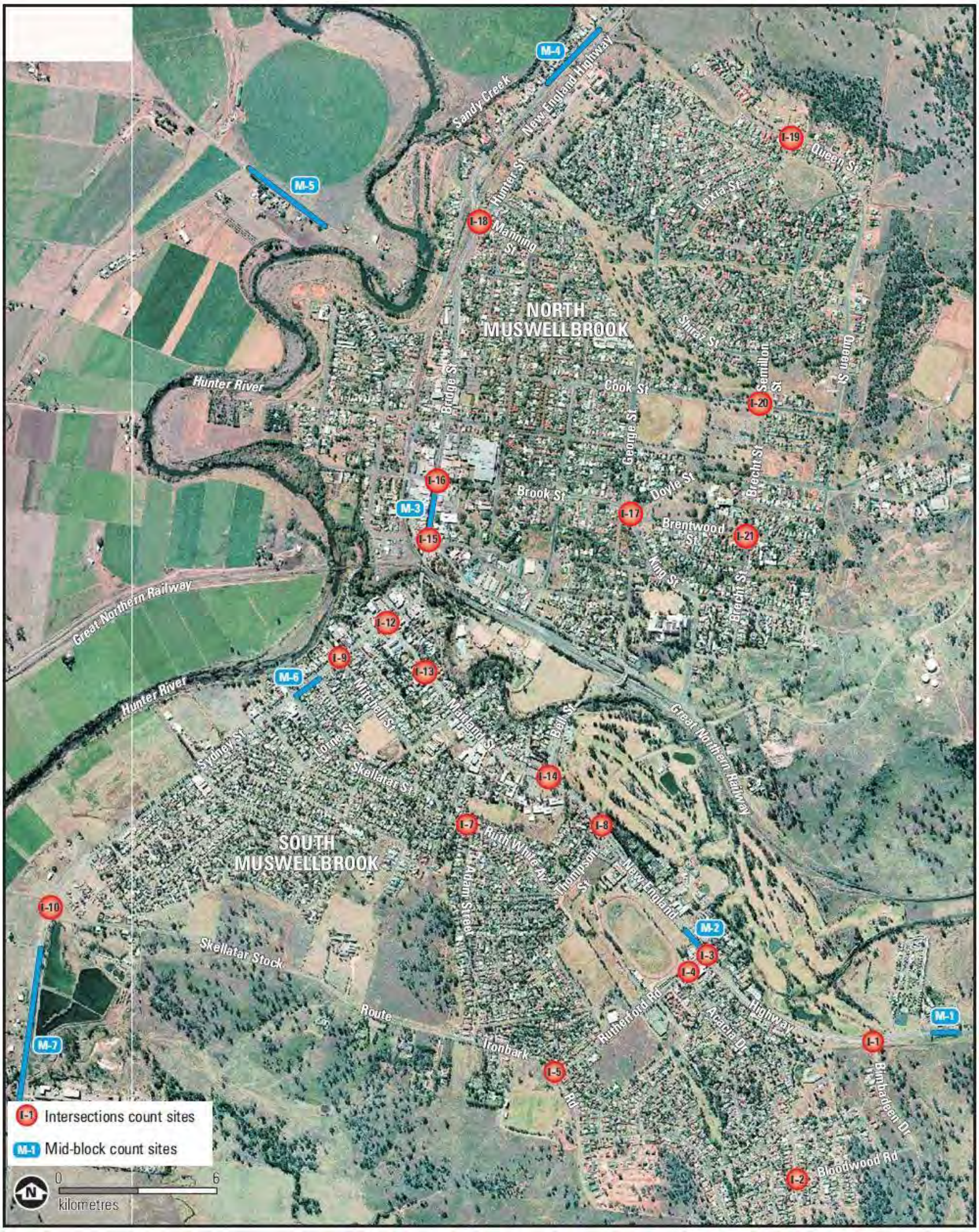


Figure 3-4 Traffic survey locations

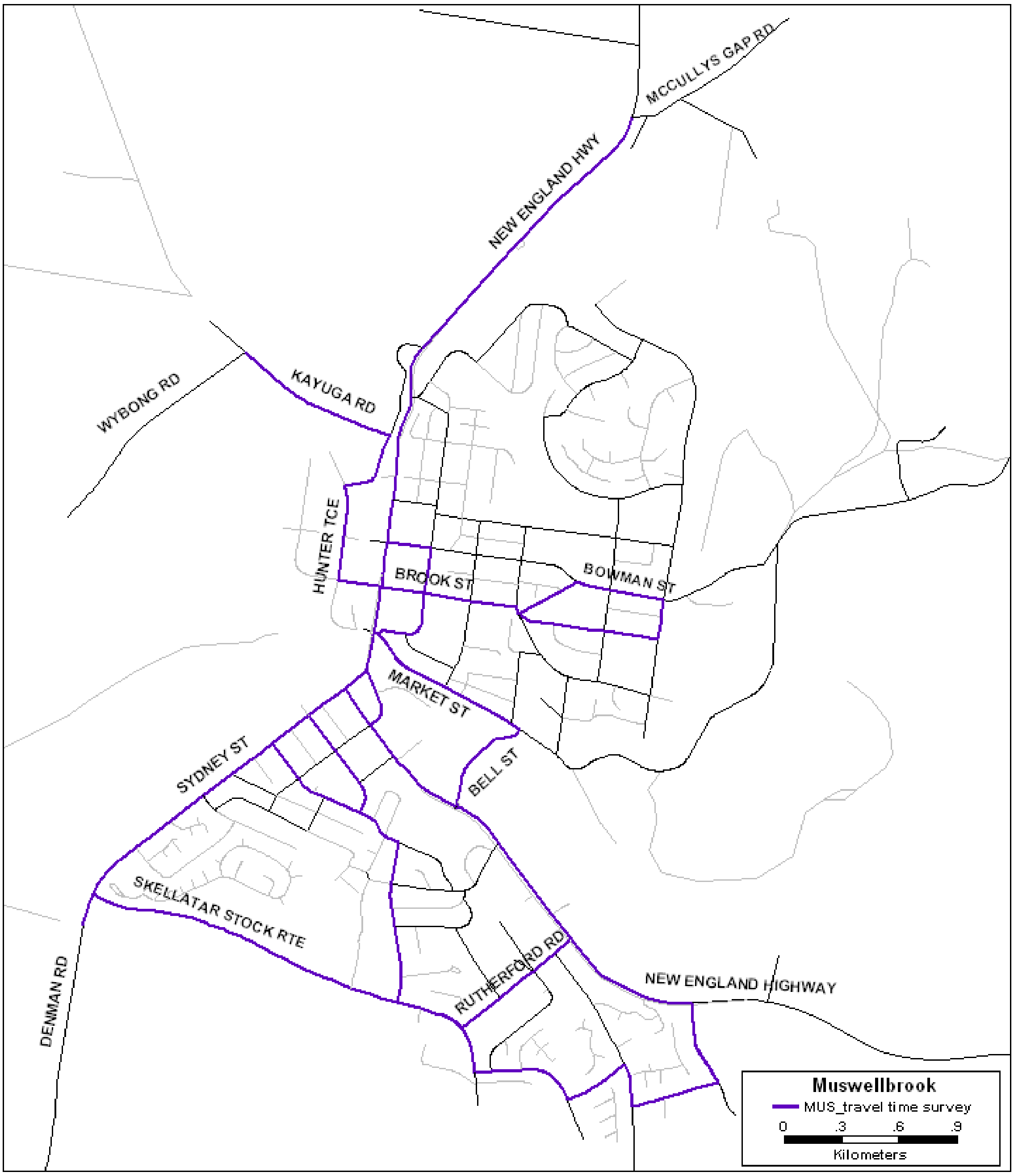


Figure 3-5 Travel time survey routes

3.3 Other traffic/land use data

3.3.1 Trip generation data

In general, trip generation is a key input into the traffic model and should be examined carefully prior to forecasting future network impact. A common source for trip generation rates is the RTA's *Guide to Traffic Generating Developments* (2002). However, trip generation rates vary from one site to another due to the number of factors, for example available modes of travel and household size.

PB recently conducted a residential trip generation survey at Singleton in 2006 and industrial trip generation survey at Maitland in 2005.

- JTW data indicated that in Singleton about 88% of work trips are made by private vehicles, which was very similar to Muswellbrook's rate which was about 89%. The Singleton survey confirmed that the rates produced by the RTA, despite their age, were valid once intra-zonal trips were considered. Given the similar mode share distribution, residential trip generation data for Singleton was used for this study
- similarly, industrial trip generation data from Rutherford and Thornton North industrial estate was also used for industrial trips in Muswellbrook study area.

3.3.2 Network inventory data

A field survey was undertaken by PB to collect a consistent set of road attribute data needed to establish a reliable network description in the model. Most roads in the study area were physically inspected by PB's traffic engineers, with the following road attributes recorded:

- link type – A consistent set of types was defined (Section 5.3.1), reflecting the role and function of each road
- posted speed limits – the upper limit free-flow speed for use in traffic assignment
- number of traffic lanes in each direction – base of AM peak period capacities
- intersection layout, cycle time, phasing, on-street parking restrictions. This data provides input data for intersection modelling.

The field inventory process was supplemented with PB's local knowledge of roads in and around the Muswellbrook central business district. Section 5.3 describes in detail the development of the 2007 base year road network, based on the inventory data collected.

3.3.3 GIS inventory data/aerial photo

The Council provided an extensive set of Geographic Information System (GIS) data to assist in development of the model which is also in a GIS format, and in presenting model outcomes. We also purchased JTW and population census data at travel zone and collector's district levels respectively. This material included:

- locational datasets for arterial, sub-arterial, collector and local roads
- geographic data file showing existing zoning and land use

- a database of 2001 population census data at collectors district level (CCD)
- geographic data files (waterways, lakes, towns)
- 2002/03 aerial photograph covering study area road network.

3.3.4 Land use data and forecasts

Land use data including number of dwellings and non-residential floor area in square metres was obtained:

- we counted dwellings from a recent aerial photograph. Additional dwellings by area built between 20002/03 and 2007 were obtained from the Council records
- floor space was obtained from aerial photos and other data sources provided by the Council.

In conjunction with the above, we also reviewed State Government population and employment forecasts for Muswellbrook, from a base year of 2001, 2006, for future years 2011, 2016, 2021 and 2026. The forecasts were prepared in 2004, so recent development proposals within the Muswellbrook study area were not considered.

3.3.5 Regional traffic growth data

Data on regional traffic growth through the Muswellbrook study area were obtained from a number of sources, including:

- *F3 to Branxton Link-Traffic and Transport Study*, PB, 2005
- Department of Transport and Regional Services, *Demand Projections for AusLink Non-urban corridor, Methodology and Projections*, Working Paper 66, 2006
- RTA's Planning Section in the Newcastle Regional Office.

This data was a key input to the development of growth factors for forecasting future through and external traffic movements using the study area's road network (see Section 6.2).

4. Traffic results

This chapter quantifies daily and peak hour traffic flows and current capacity on key roads and intersections within the study area. This provides a context within which to consider likely traffic changes that would result from future development proposals. Traffic results are based on comprehensive survey data on key roads and intersections for year 2007. A number of terms are used in measuring traffic throughout the report.

Average annual daily traffic (AADT) represents volumes calculated for an average day in a year, so it is seasonally adjusted by factors from RTA permanent counting stations and includes every day of the week.

Average daily traffic (ADT) represents volumes derived from a shorter counting period, usually one or two selected weeks in the year.

Average weekday traffic (AWT) derived from the sample week of working days/school days, as opposed to the average over the entire year.

Average weekend traffic (AWET) is the average weekend traffic from the same source.

Peak hour traffic is the highest hourly traffic volume measured in one hour throughout the network.

4.1 Traffic movements patterns

Traffic movement data were prepared for key roads and intersections within the study area. Data were used in a number of areas to determine critical peak day of travel, peak hour, light and heavy vehicles composition and directional flow. The data were also used to assess current capacity problems on the network, more specifically at the intersection level. Detailed traffic data are included in Appendix A. This section discusses traffic results from the seven sites shown in Figure 4-1.

4.1.1 Daily traffic profiles

Daily traffic results were calculated at seven mid-block count locations for 2007 in accord with current road hierarchy grouped by arterial, sub-arterial and collector roads. Figure 4-2 shows the variation of traffic profile over a one week period. The results showed that:

- traffic on roads was not constant but varied from day to day between Monday and Thursday, traffic on the New England Highway was relatively constant, but there is a sharp peak on Fridays. This could be due to a higher proportion of mine workers travelling on Friday to locations outside Muswellbrook or increased inter-regional tourist activity.

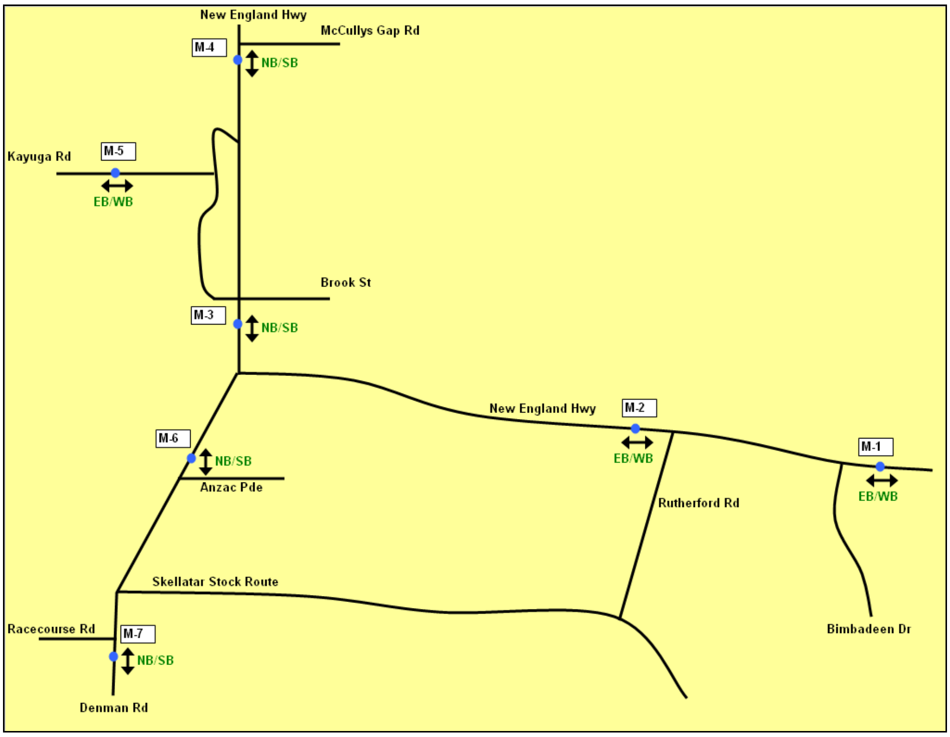
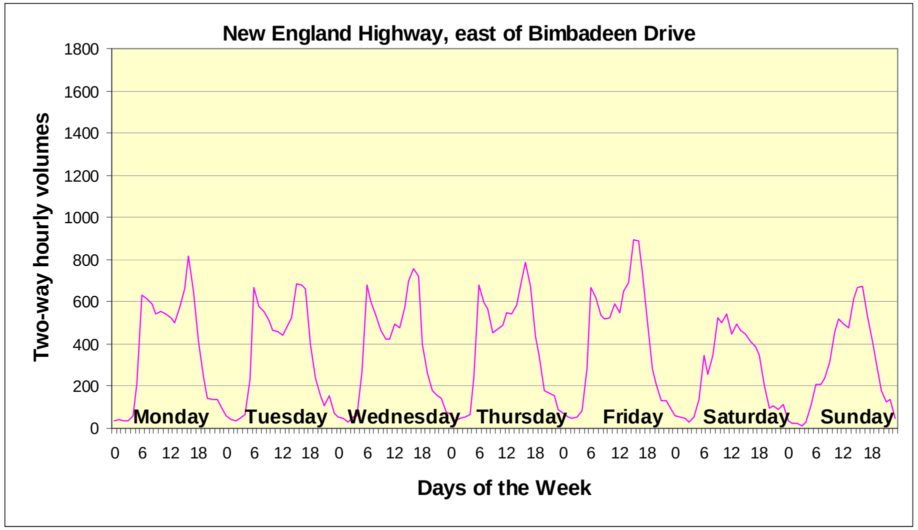


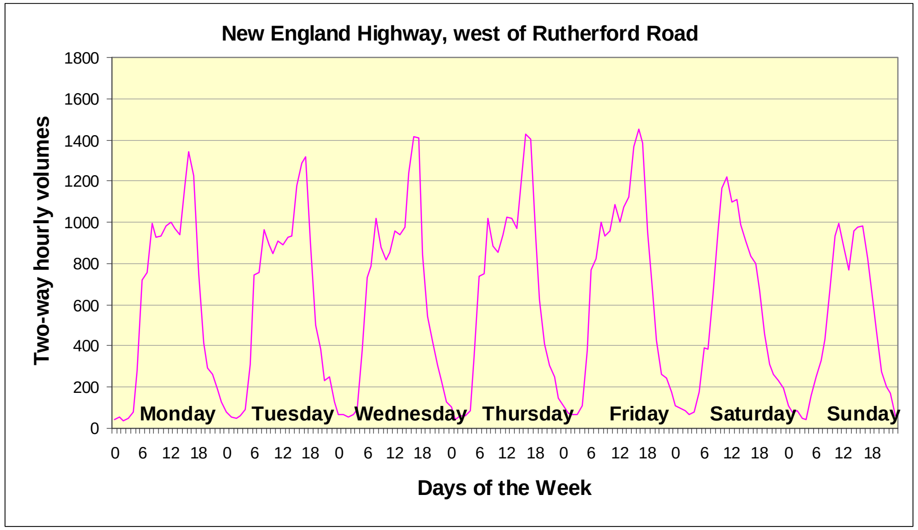
Figure 4-1 Count Sites and travel directions index for mid-block volumes

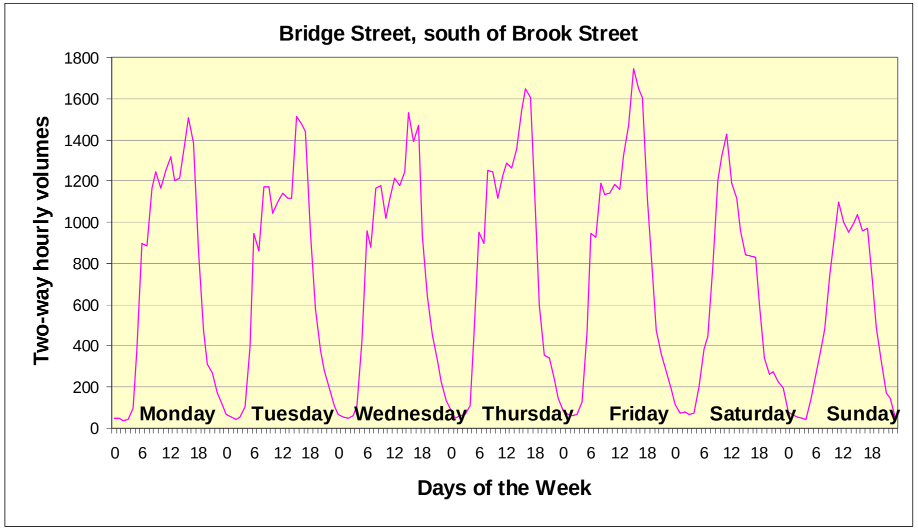
- Bridge Street, as the arterial route through the town centre, showed consistent traffic levels between Monday and Wednesday, but with peaks on Thursday and Friday. This would be explained by the earlier point but also reflects high levels of local shopping activity
- Sydney Street and Denman Road exhibited similar traffic levels across the work week, relatively unaffected by regional traffic patterns or retail travel
- Kayuga Road, as a collector road, showed a marginal increase in traffic on Tuesday when compared other weekdays.

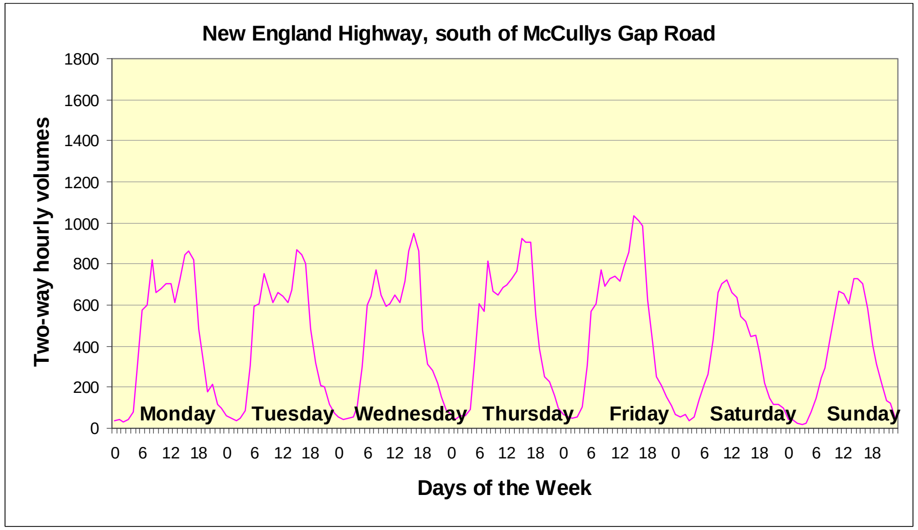
Generally Friday traffic volumes were relatively higher on most key roads within the study area. It was the critical day. We then searched to the data to select the peak hour for Friday. Appendix A provides detailed traffic data collected from 2007 survey.

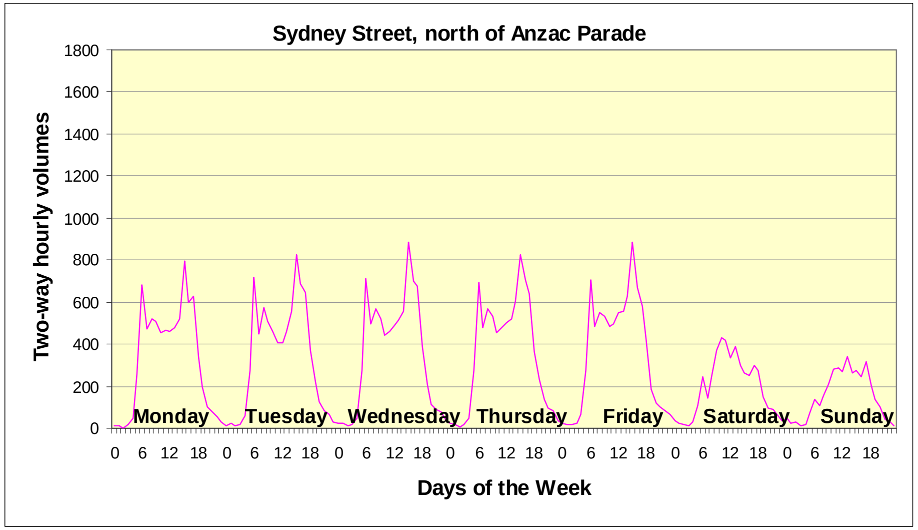
Arterial roads:



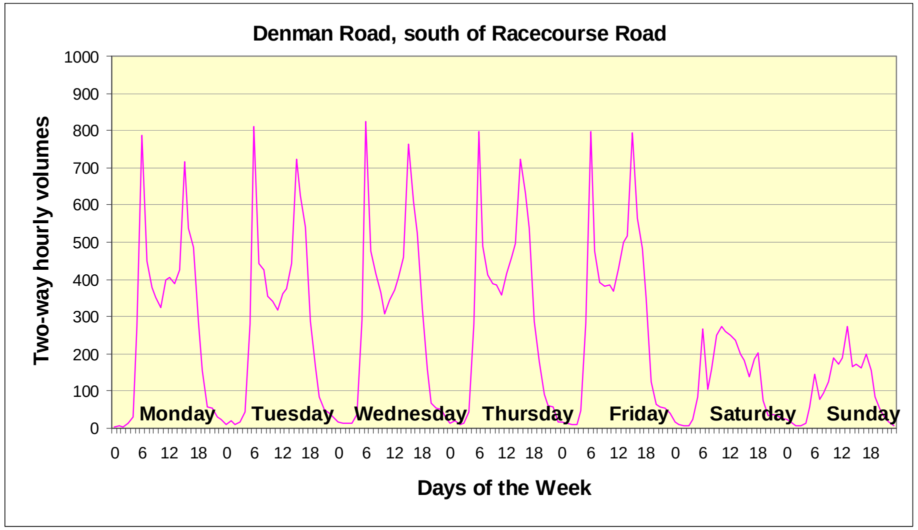








Sub-arterial road:



Collector road:

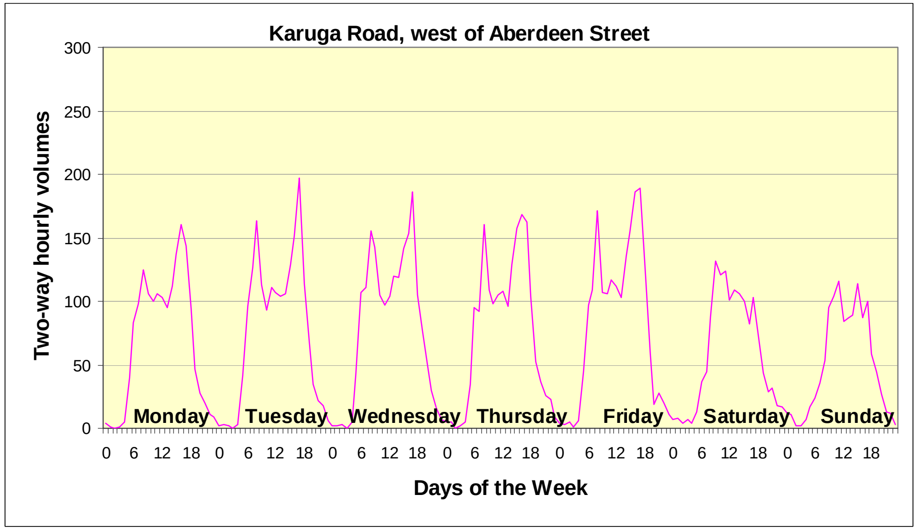


Figure 4-2 Daily variation of traffic volumes on key roads in Muswellbrook

Note: Graph vertical axis varies by hierarchy of roads.

4.1.2 Daily traffic volumes

Table 4-1 presents daily traffic volumes in terms of average weekday, weekend and critical day-Friday. The average daily figures in Table 4-1 are not directly comparable with the annual average daily traffic figures (see Table 2-7) due to seasonal variations and different count years. However, both data sets implied a general traffic trend across the network. For instance, traffic on the Bridge Street, south of Hill Street, was significantly higher than traffic on the New England Highway, south of town boundary.

Table 4-1 Daily traffic volumes by road hierarchy

					% Traffic Change	
Site ID	**Road sections**	**Average Weekday**	**Average Weekend**	**Critical day (Friday)**	**Friday Vs Weekday**	**Weekend Vs Weekday**
	Arterial roads:					
M-1	New England Highway, east of Bimbadeen Drive	8,900	6,700	9,800	10%	-25%
M-2	New England Highway, west of Rutherford Road	15,300	12,300	16,500	8%	-20%
M-3	Bridge Street, south of Brook Street	18,200	13,000	19,500	7%	-29%
M-4	New England Highway, south of McCullys Gap Road	10,900	7,800	11,900	9%	-28%
M-6	Sydney Street, north of Anzac Parade	8,200	4,100	8,500	4%	-50%
	Sub-arterial road:					
M-7	Denman Road, south of Racecourse Road	6,900	2,800	7,200	4%	-59%
	Collector road:					
M-5	Kayuga Road, west of Aberdeen Street	1,800	1,300	1,900	6%	-28%

Note: volumes are rounded to the nearest hundred units.

Some observations from Table 4-1 traffic results:

- New England Highway carried about 8,900 vehicles per day (vpd), south of Muswellbrook and 10,900 vpd north of the Muswellbrook town boundary. A large proportion of traffic at both locations was regional through traffic or with either an origin or destination to the Muswellbrook study area
- daily traffic on the New England Highway at South Muswellbrook varied significantly. Counts recorded about 8,900 vpd east of Bimbadeen Drive. This increased to about 15,300 vpd west of Rutherford Road. This significant traffic increase on the New England Highway was the contribution of local traffic to and from South Muswellbrook
- traffic on Bridge Street increased to 18,200 vehicles per day through the town centre, south of Brook Street. The higher traffic volumes in the centre of Muswellbrook compared to those to the north or south, demonstrated the high contribution made by local trips within the study area

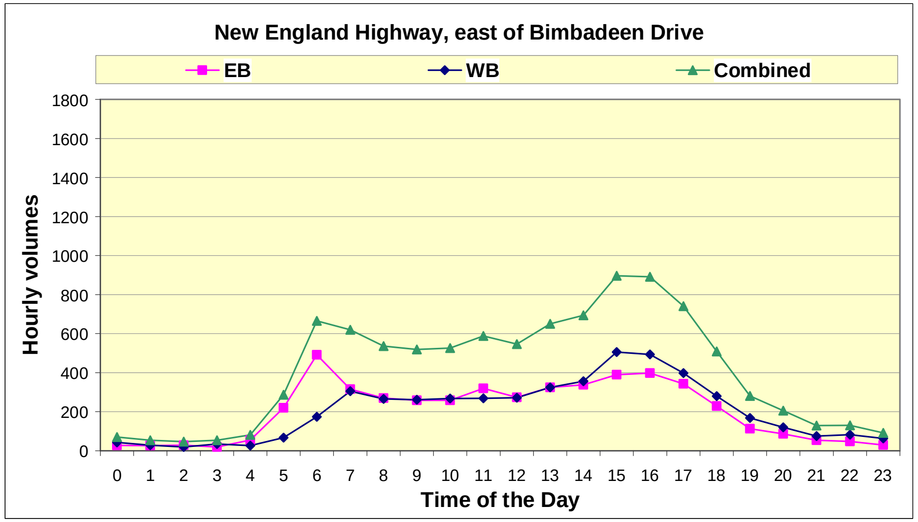
- Sydney Street carried about 8,200 vpd, similar to traffic levels on the New England Highway, south of the town boundary
- sub arterial and collector roads, including Denman Road and Kayuga Road, carried between 6,900 vpd and 1,800 vpd, respectively
- critical Friday traffic across the network was between 4% to 10% higher than average weekday traffic
- weekend traffic was significantly lower than weekday traffic, for instance, it was 20% to 30% lower along the New England Highway.

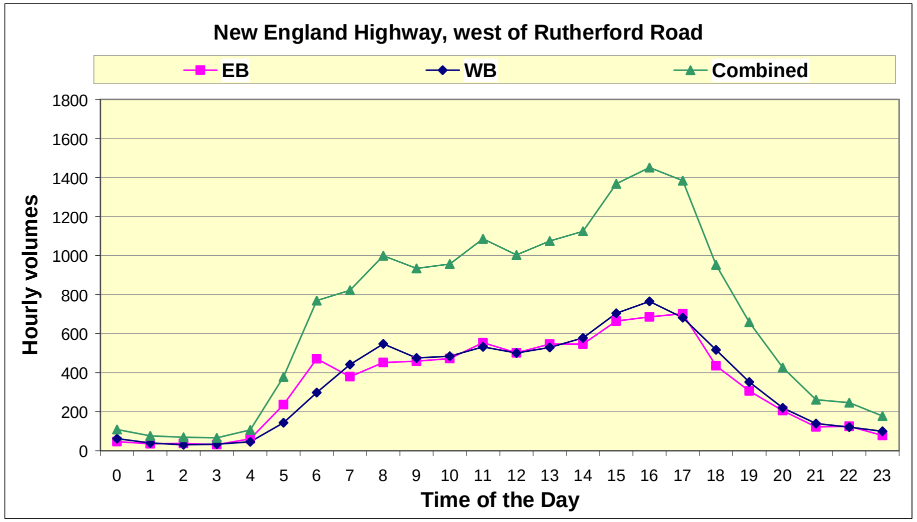
4.1.3 Hourly variations

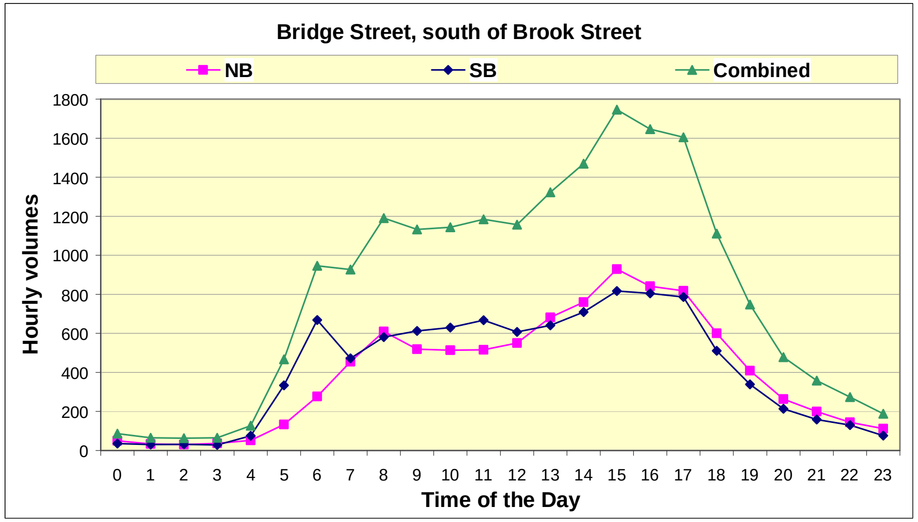
Figure 4-3 shows the hourly traffic volumes on the critical day (Friday) by direction of travel. This information was used to establish the pattern of vehicular travel that took place throughout the day, and to identify peak traffic periods. Some points are noted in relation to peak hour traffic behaviour on key roads:

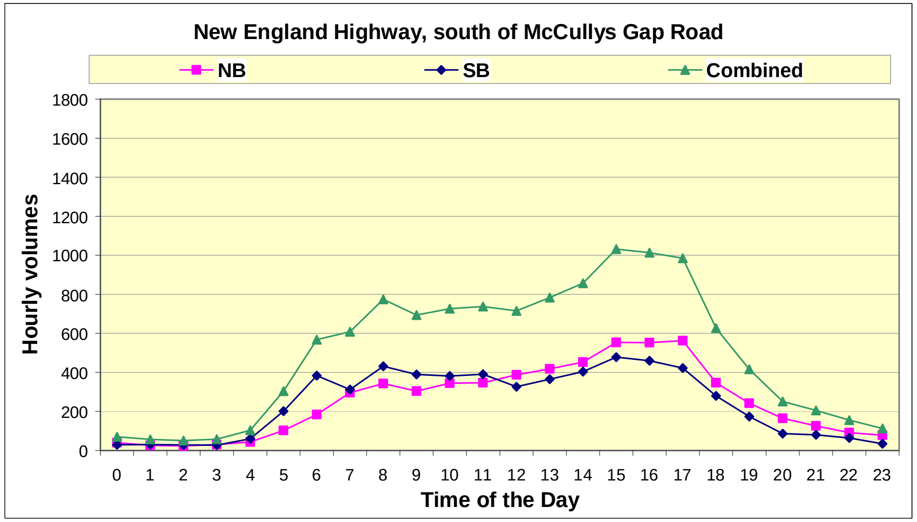
- morning peak period begins early (6 AM) on the New England Highway, north and south of Muswellbrook reflecting trips made by mine workers
- morning traffic reached its highest volume between 8 and 9 AM on New England Highway, west of Rutherford Road and Bridge Street, south of Brook Street. This was due to the local business peak, schools and other trips within the study area
- AM peak traffic on Sydney Street and Denman Road occurred between 6 am and 7 AM
- PM peak traffic at most sites was about 2% to 3% higher than AM peak
- PM peak normally occurred between 3 and 4 PM at most sites, reflecting the dominance of shift work and school travel
- the duration of PM peak was longer than the AM peak, for instance, Bridge Street, south of Brook Street, and the New England Highway, west of Rutherford Road, showed a steady PM peak period between 3 and 5 pm.

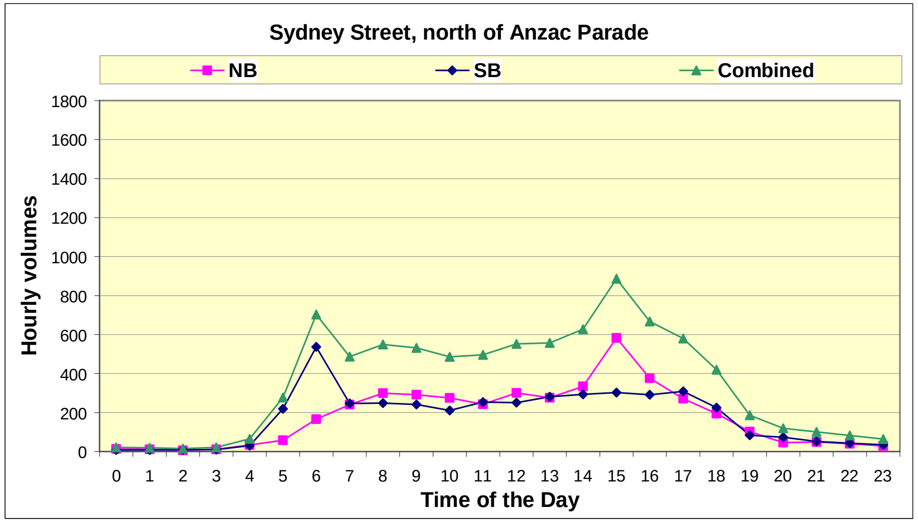
Arterial roads:



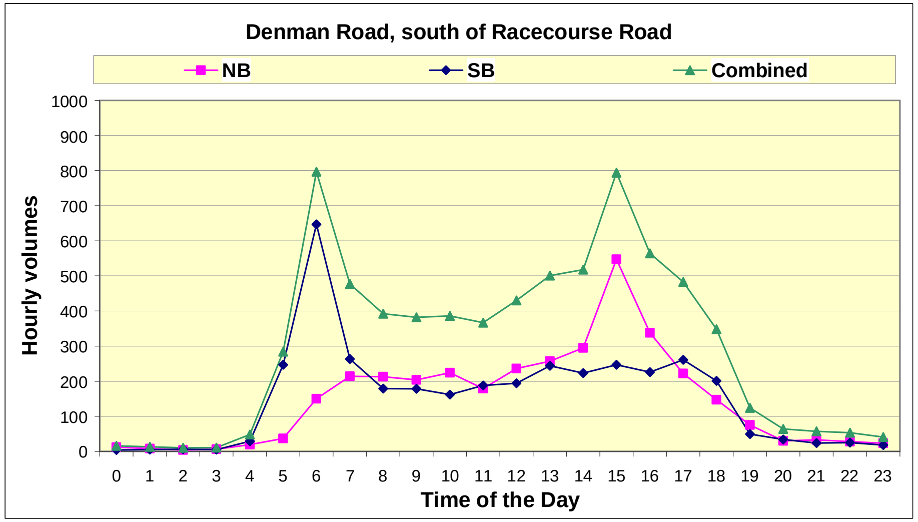








Sub-arterial road:



Collector road:

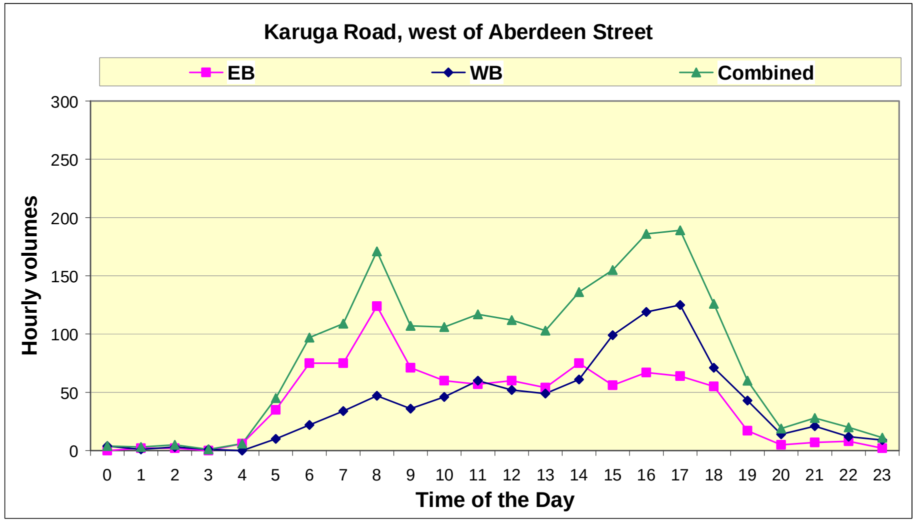


Figure 4-3 Hourly variation on the critical day Friday

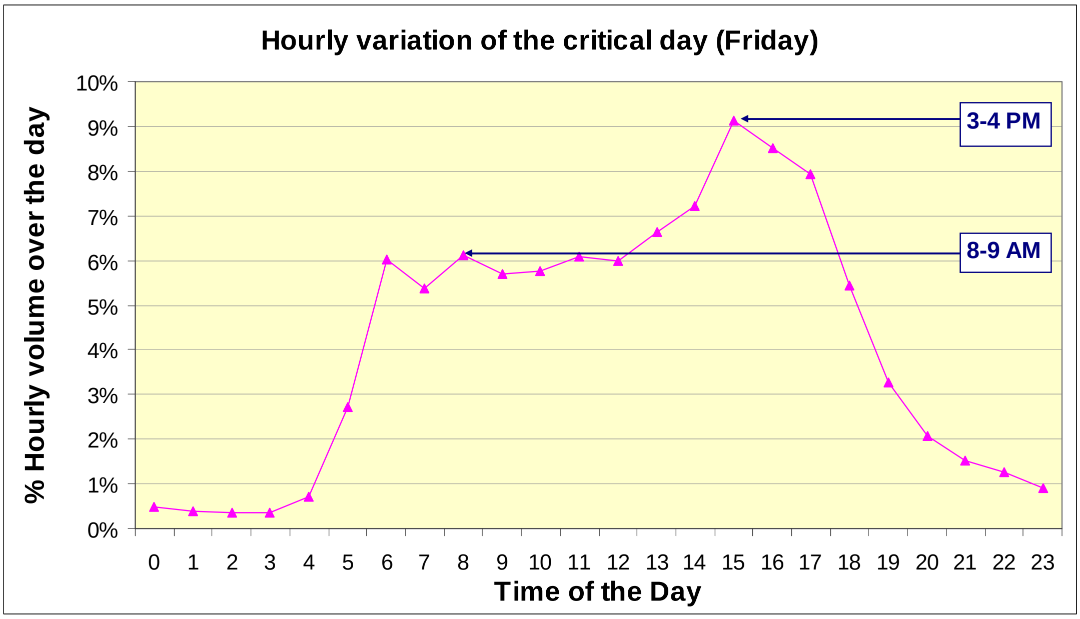


Figure 4-4 Generalised hourly profiles for combined sites for critical day (Friday)

Having established the AM and PM peaking pattern from Figure 4-3, a generalised traffic profile that represented the study area was derived by averaging each hour's traffic data for all seven sites (see Figure 4-4). The generalised graph showed the AM peak hour occurred between 8 and 9 AM, and PM peak occurred between 3 and 4 PM respectively. The graph shows that AM and PM peak hour volumes were between 6% and 9% of the daily volumes.

Table 4-2 shows AM and PM peak one hour volumes for all sites. Peak hour directional data on the New England Highway and Sydney Street did not demonstrate a dominant flow in a particular direction in either the AM or PM peak period. This traffic patterns was plausible given the mix of residential and commercial land generating travel both in the North and South Muswellbrook areas.

Table 4-2 AM and PM peak hour volumes on the critical day

Site ID	Road sections	AM Peak (8 to 9am)			PM Peak (3 to 4pm)		
		NB/EB	SB/WB	Total (2-way)	NB/EB	SB/WB	Total (2-way)
	Arterial roads:						
M-1	New England Highway, east of Bimbadeen Drive	270	270	540	390	510	900
M-2	New England Highway, west of Rutherford Road	450	550	1,000	660	710	1,370
M-3	Bridge Street, south of Brook Street	610	580	1,190	930	820	1,750
M-4	New England Highway, south of McCullys Gap Road	340	430	770	550	480	1,030
M-6	Sydney Street, north of Anzac Parade	300	250	550	580	310	890
	Sub-arterial road:						
M-7	Denman Road, south of Racecourse Road	210	180	390	550	240	790
	Collector road:						
M-5	Kayuga Road, west of Aberdeen Street	120	50	170	60	100	160

4.1.4 Directional distribution

Directional distribution is an important factor in road capacity analysis. Capacity and level of service can vary substantially on the basis of directional distribution. Table 4-3 shows daily traffic distribution by direction for seven sites. Daily traffic on key roads, including the New England Highway and Bridge Street, showed a relatively even split in direction or “balanced flow”. This indicated an efficient use of road infrastructure and should lead to effective upgrades to maintain levels of service.

Table 4-3 Directional distribution of traffic

Site ID	Road sections	NB/EB	SB/WB	2-Way
	Arterial roads:			
M-1	New England Highway, east of Bimbadeen Drive	4,900 (50%)	4,900 (50%)	9,800 (100%)
M-2	New England Highway, west of Rutherford Road	8,200 (49%)	8,300 (51%)	16,500 (100%)
M-3	Bridge Street, south of Brook Street	9,500 (49%)	10,000 (51%)	19,500 (100%)
M-4	New England Highway, south of McCullys Gap Road	6,100 (51%)	5,800 (49%)	11,900 (100%)
M-6	Sydney Street, north of Anzac Parade	4,200 (50%)	4,300 (50%)	8,500 (100%)
	Sub-arterial road:			
M-7	Denman Road, south of Racecourse Road	3,500 (49%)	3,700 (51%)	7,200 (100%)
	Collector road:			
M-5	Kayuga Road, west of Aberdeen Street	1,000 (51%)	900 (49%)	1,900 (100%)

Note: NB/EB – northbound/eastbound, SB/WB – southbound/westbound; volumes are rounded to the nearest hundred units.

4.1.5 Heavy vehicles

According to the AUSTROADS vehicle classification system, heavy vehicles include trucks with two or more axles, buses, semi-trailers and B-doubles (classification categories 3-12). Table 4-4 below shows the number of heavy vehicles recorded during the morning (8:00–9:00AM) and afternoon (3:00–4:00PM) peak hours and over the entire day. The numbers in parentheses contain the percentage of heavy vehicles within the total volume on that road. In general, the New England Highway in Muswellbrook had a relatively high proportion of heavy vehicles, with State Roads in the region averaging 8% to 12%. Heavy vehicle data showed:

- daily the New England Highway carried between 1,500 to 1,700 heavy vehicles, which was 13% to 15% of total traffic
- the number of heavy vehicles on Bridge Street was similar to the New England Highway, but they represented a lower proportion of total traffic given the higher local traffic content on this portion of the route
- as Denman Road is a key access road to industrial areas, it carried a higher proportion of heavy vehicles, approximately 12% to 18% of its total traffic.

Table 4-4 Heavy vehicles distribution

Site ID	Road sections	AM Peak	PM Peak	Daily
	Arterial roads:			
M-1	New England Highway, east of Bimbadeen Drive	90 (16%)	100 (11%)	1,470 (15%)
M-2	New England Highway, west of Rutherford Road	110 (11%)	100 (7%)	1,640 (10%)
M-3	Bridge Street, south of Brook Street	110 (10%)	110 (6%)	1,690 (9%)
M-4	New England Highway, south of McCullys Gap Road	90 (12%)	110 (11%)	1,600 (13%)
M-6	Sydney Street, north of Anzac Parade	60 (11%)	60 (7%)	740 (9%)
	Sub-arterial road:			
M-7	Denman Road, south of Racecourse Road	70 (18%)	80 (10%)	860 (12%)
	Collector road:			
M-5	Kayuga Road, west of Aberdeen Street	20 (13%)	20 (10%)	150 (8%)

Note: volumes are rounded to the nearest ten units.

4.1.6 Intersection turning movements

Intersection turning movement data were key inputs to SIDRA analysis of intersection capacity. These counts also provided a basis for traffic distribution at the local level. Figure 4-5 and Figure 4-6 present recorded turning movements at nineteen intersections during the AM (8-9am) and PM (3-4 PM) peak periods on a Friday. Some observations:

- New England Highway/Bimbadeen Drive intersection

  Bimbadeen Drive functions as residential vehicle access to South Muswellbrook. Peak traffic on Bimbadeen Drive was about 70 to 115 vehicles per hour (vph). The critical right turn movement to and from Bimbadeen Drive was of the order of 15 to 40 vph. At this level of turning, gaps in the New England Highway through traffic should provide adequate opportunities to turn, particularly during the AM peak. However, during the PM peak, westbound through traffic on the New England Highway increased to about 500 vph, double the AM volume, and that may create occasional delays

- Council officers had received complaints about use of Bloodwood Road and Acacia Drive to access Rutherford Road as an alternative to the New England Highway. This is a popular local route for Eastbrook subdivision residents to access Rutherford Road. Traffic data at the Acacia Drive/Bloodwood Road intersection indicated about 10 to 60 vehicles from Eastbrook subdivision might used Bloodwood Road to access Rutherford Road. The cross movement traffic between Bloodwood Road and Acacia Drive was low in the AM peak (10 vph) but increased to 60 vph in the PM

- another concern was raised about increased use of Bimbadeen Dr/Ironbark Road as an alternative to the New England Highway. This issue was investigated through analysis of turning traffic at key intersections on the New England Highway between Bimbadeen Drive and Sydney Street. Traffic data did not indicate any dominant left turn movement followed by dominant right turn movement at key. The route comprised of Bimbadeen Drive, Blood Street and Ironbark Road carried about 50 to 150 vph in the AM and about

130 to 200 vph in the PM peaks which would align with expected movements from local residences

- Rutherford Road had the highest turning movements of all intersections in South Muswellbrook. Critical peak hour turning movements at Rutherford Road were between 150 to 300 vph. Through traffic on the New England Highway was between 300 and 400 vph at this point. This reduced the opportunities for Rutherford Road traffic to find gaps in the traffic stream for turns. Under these conditions, the level of service (LoS) value would be expected to decline at this intersection
- Thompson Street was experiencing demands in a similar basis, with between 100 and 150 vph wanting to access the Highway. Through traffic on the New England Highway at this location increased to between 500 and 700 vph, given the westbound left turning traffic from Rutherford Road. This intersection was also likely to have a forecast decline in LoS
- Bell Street had turning traffic levels of between 200 and 300 vph and was a popular route for North Muswellbrook residents. Also Bell Street can act as over-height vehicle bypass given the clearance restriction on the rail bridge over Bridge Street
- traffic distribution among Haydon Lorne and Mitchell Streets was estimated by looking at detailed turning data from the Maitland Street/Haydon Street and Sydney Street/Mitchell Street intersections. Data indicated about 20 to 40 vehicles used Haydon Street and 100 to 200 vehicles used Lorne Street during AM /PM peak hours. The majority of traffic on both Lorne Haydon Streets was turning, as few cross movements were recorded (less than 5 vehicles per hour). It is not a heavily used alternative for arterial routes
- both Brook Street and William Street were key access routes to the town centre and North Muswellbrook area. Peak hour traffic on William Street was about 350 to 400 vph, the majority of which was turning
- Brook Street traffic levels were almost double those in William Street, being in the order of 550 to 730 vph. This was due to its role as access to the town centre as traffic reduced significantly east of Carl Street
- Brecht Street traffic showed commuter peak patterns due to residential traffic from North Muswellbrook. Brecht Street southbound traffic was higher in the AM peak and northbound traffic was higher in the PM. Southbound traffic on Brecht Street was between 80 and 120 vph which an acceptable range for environmental capacity in a residential area. Northbound traffic was similar at 70 and 115 vehicles in peak hours
- Brentwood Street carried between 130 and 180 vph in peak hours. Turning traffic between Brentwood Street and Brecht Street was low, between 5 and 20 vph. With this low turning demand, the intersection is unlikely to experience capacity problems in the foreseeable future
- Hunter Street, at the New England Highway, carried residential and commercial/business traffic to and from North Muswellbrook. Data indicated about 80 to 100 vph turn to and from Hunter Street to access the Highway. During the PM peak, through traffic on the Highway is high, between 440 and 550 vph, and may cause delays as traffic turning from Hunter Street waited for suitable gaps. The northbound, right turn movement to the Highway particularly required further analysis.

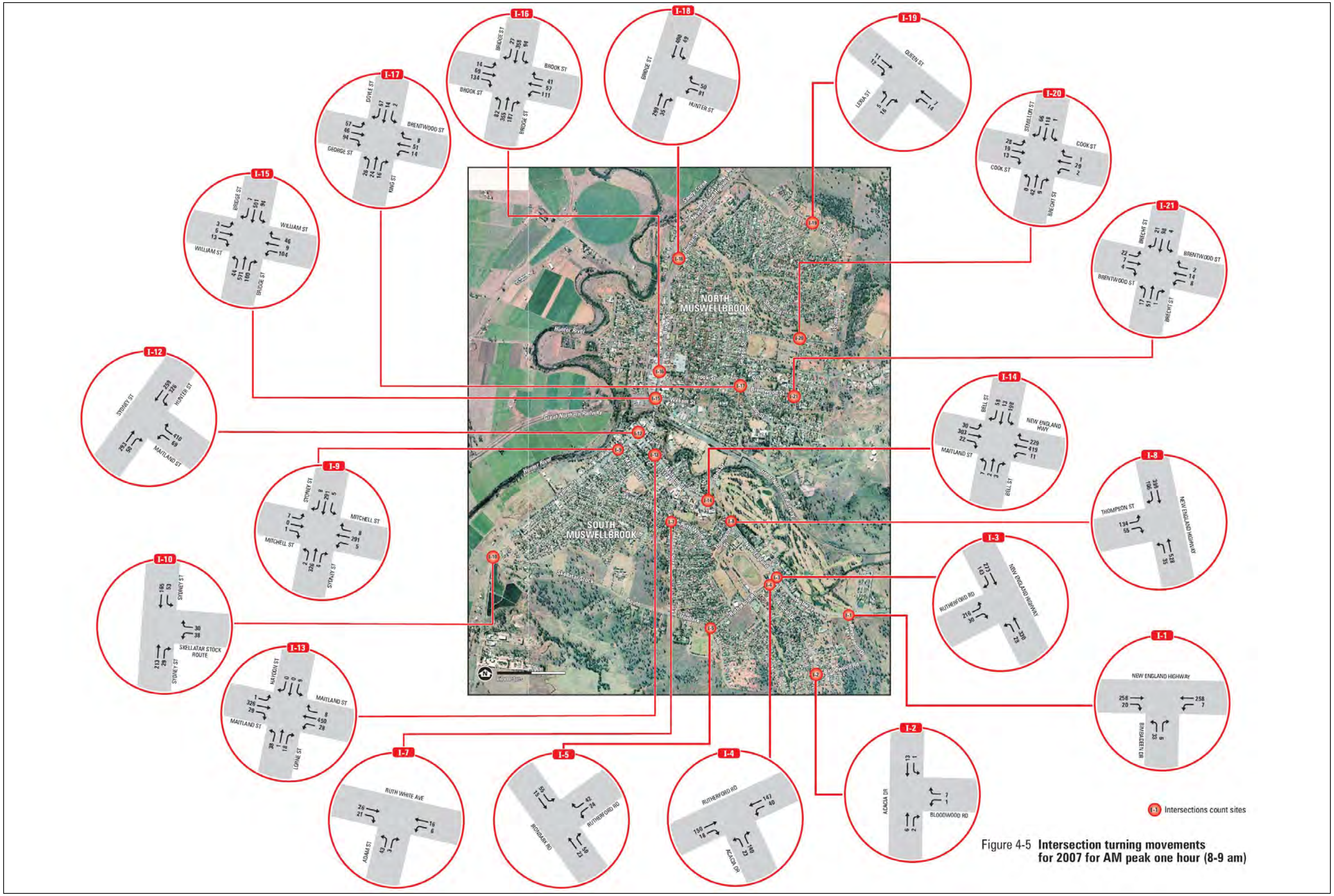


Figure 4-5 2007 AM peak intersection turning movements (8-9 am)

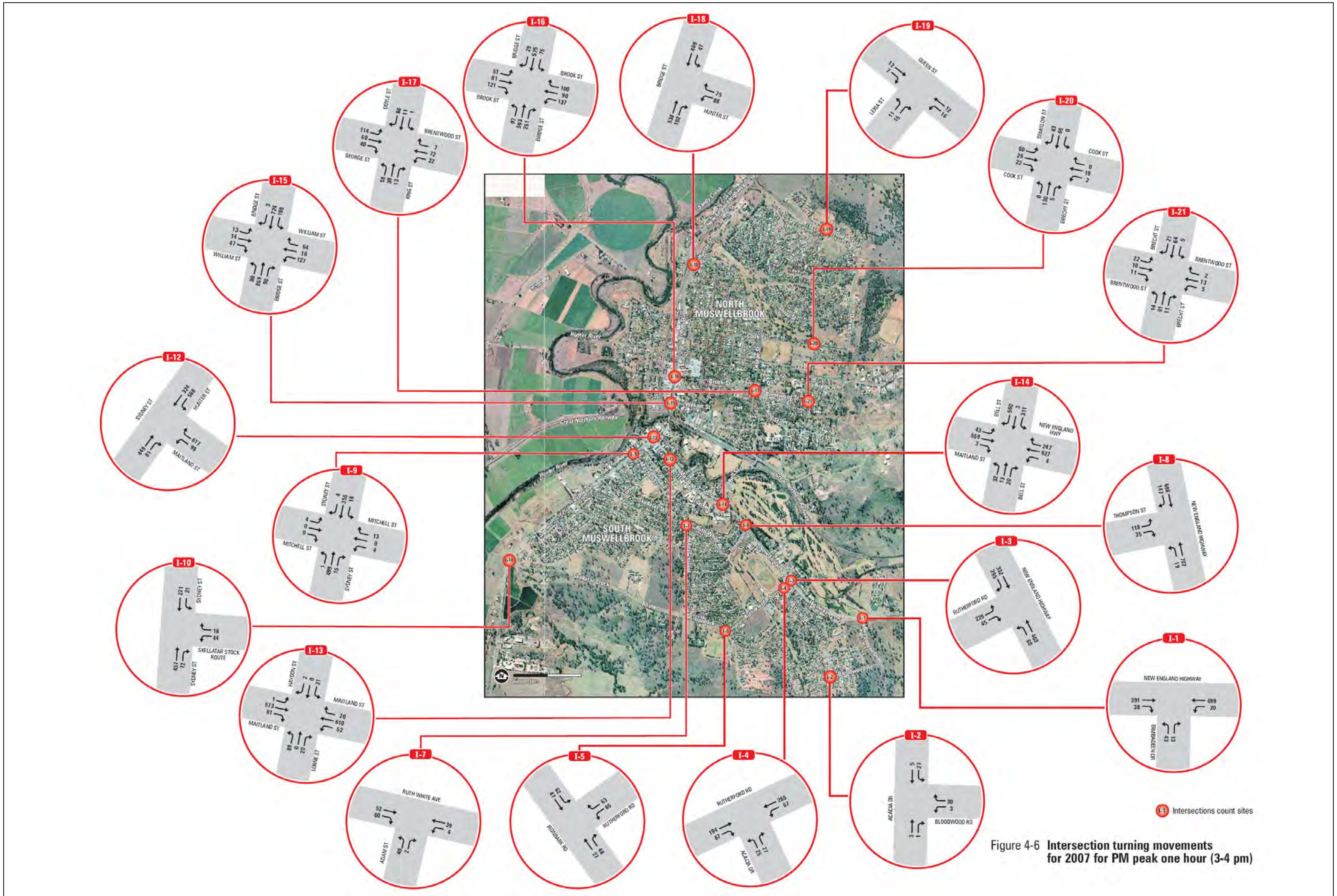


Figure 4-6 2007 PM peak intersection turning movements (3-4 pm)

4.1.7 Speed profiles

As part of the traffic counting program, speed data were also collected at the seven mid-block count locations. Results of the speed distribution, shown in Figure 4-7 were expressed graphically using the 85th percentile observations to eliminate outlying behaviours

- New England Highway, east of Bimbadeen Drive
- New England Highway, west of Rutherford Road
- New England Highway, south of McCullys Gap Road
- Bridge Street, south of Brook Street
- Sydney Street, north of Anzac Parade
- Denman Road, south of Racecourse Road
- Kayuga Road, west of Aberdeen Street

By definition, speed is the actual speed of a vehicle at a specified point on a road. It is measured by the time between axles crossing the pressure tubes. Speed data were used primarily as input to the traffic model.

There are minor variations in speed with the highest speeds occurring mostly a night. Only in the off-peak hours in Kayuga Road were speed differences found for the two directions of travel, but records would have been very few.

This data set also informs Council's traffic management planning, as it allowed them to review speed limit observance and need for advisory speed signing.

Speed data was not recorded separately on the local roads. The speeding issue on these roads was derived from the list of complaints Council has received from local residents as mentioned in Section 2.8 – Key Local Traffic Issues

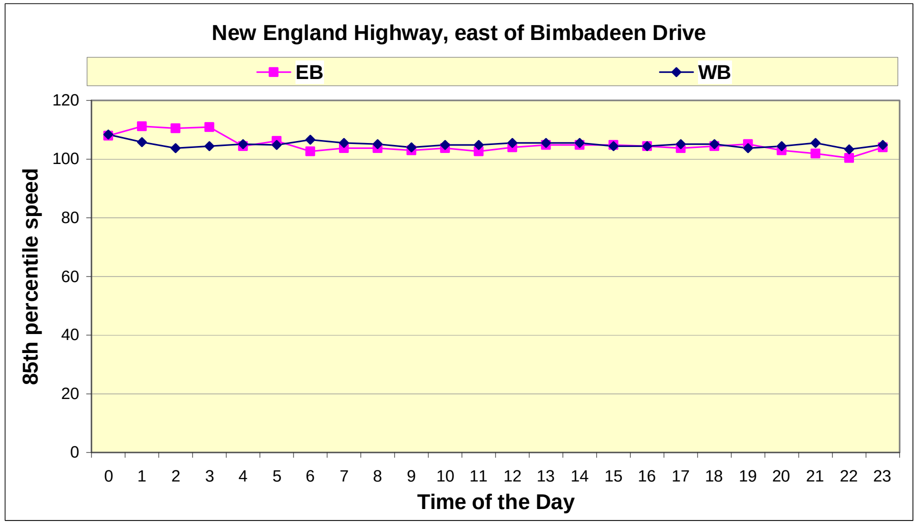
4.2 Network capacity

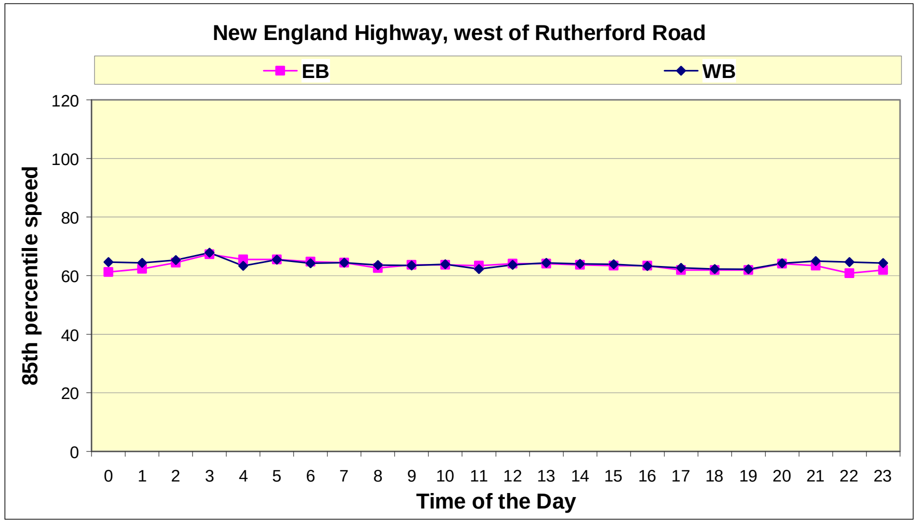
4.2.1 Assessment Criteria

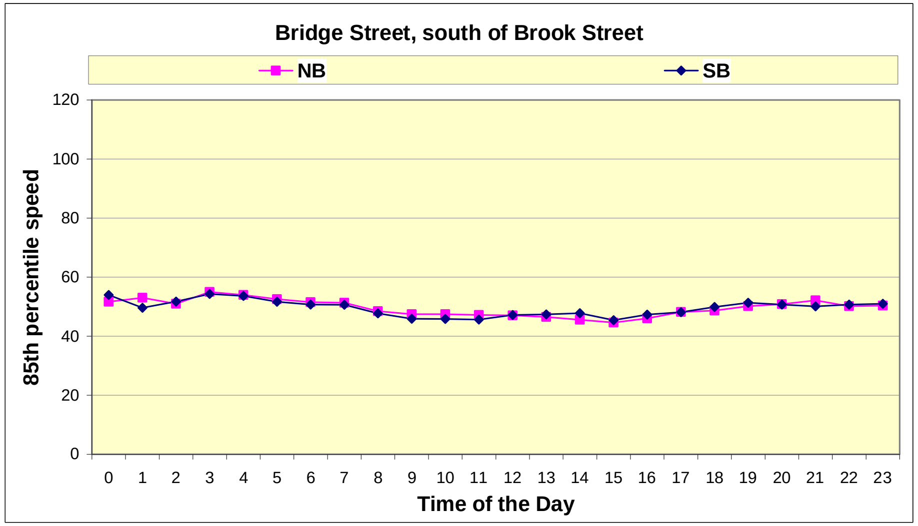
The performance of the road network was assessed in terms of both intersection and mid-block capacity. The performance of the urban road network is largely influenced by the operating conditions of intersections and side streets, which are generally more constrained from a capacity viewpoint than the mid-block roadway sections. However, mid-block capacity is often used to assess when particular road section may require widening or duplication. Both intersection and mid-block capacity are expressed in terms of Level of Service (LoS).

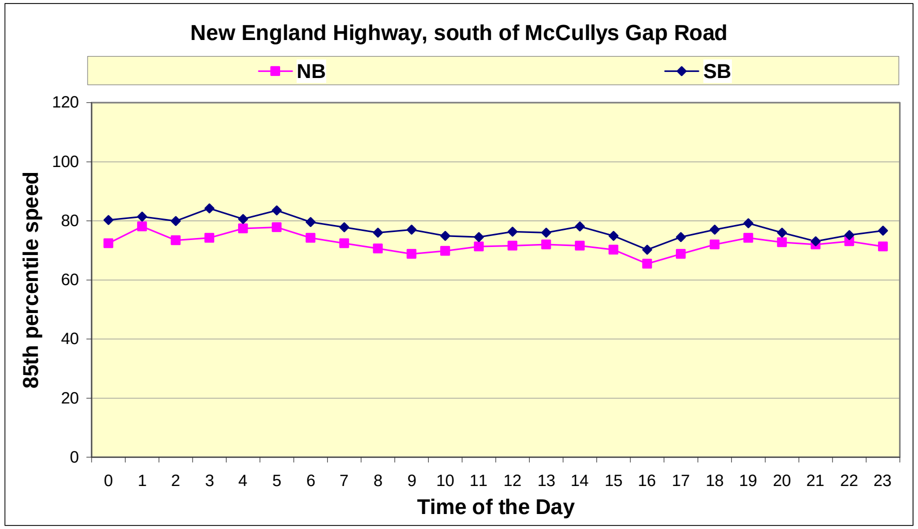
LoS is fundamental to the planning, design and operation of roads and provides the basis for determining the number of lanes to be provided in the road network. In general, there are six levels of service, from A to F, with level of service "A" representing the best operating condition and level of service "F" representing the worst operating condition. LoS for the key roads in Muswellbrook has been assessed according to guidelines in *Roadway Capacity* (Austroads) and RTA *Guide to Traffic Generating Developments*, 2002.

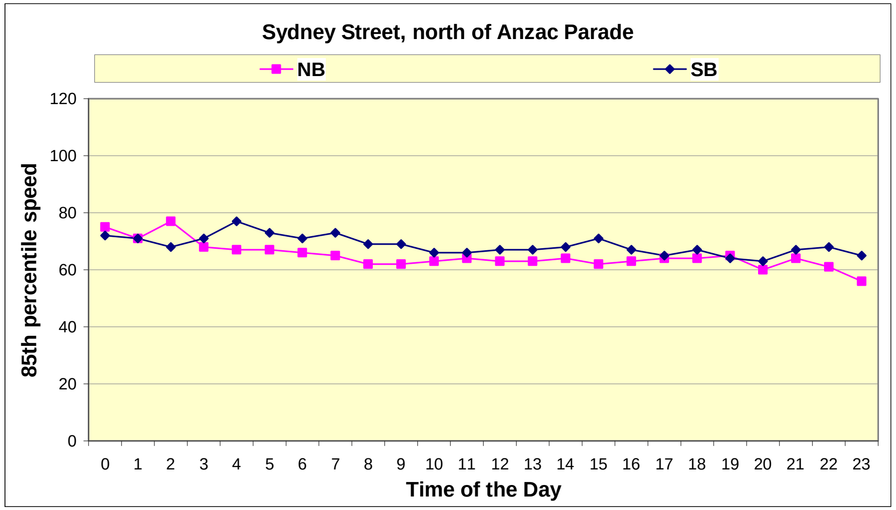
Arterial roads:



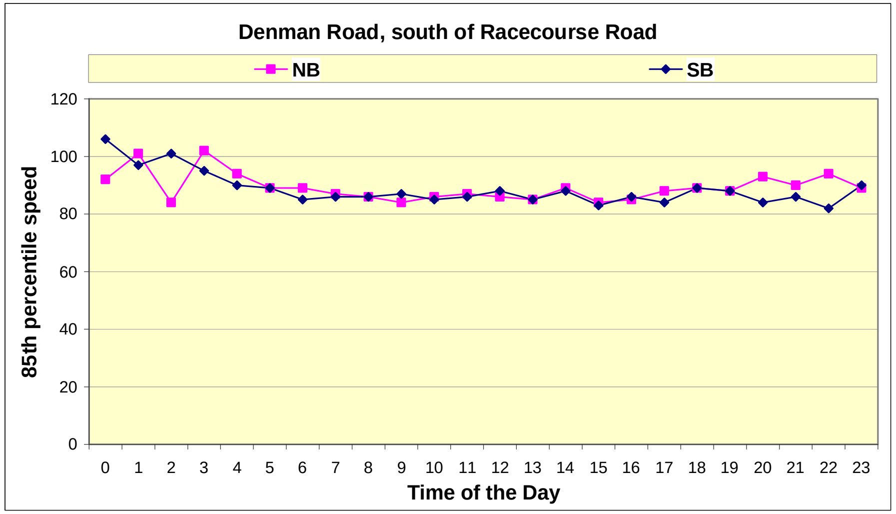








Sub-arterial road:



Collector road:

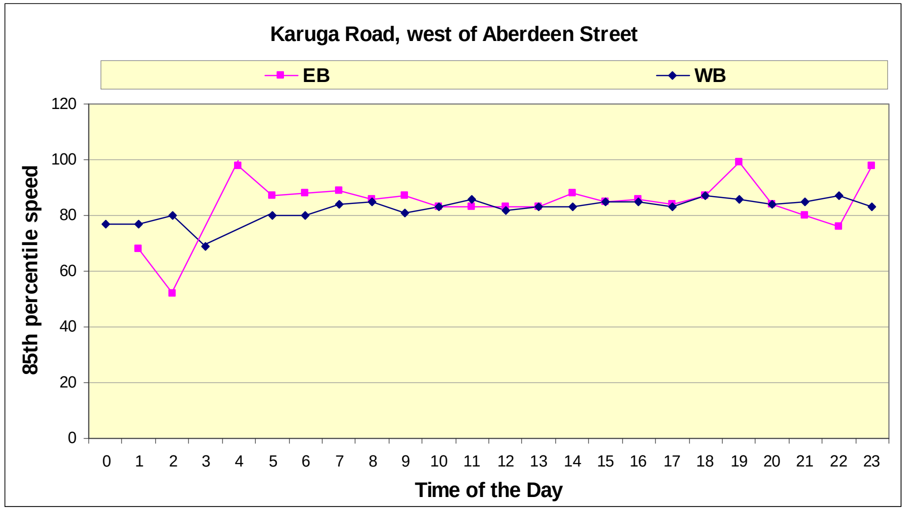


Figure 4-7 Speed profiles on key roads in the study area

NOTE: NB – northbound; SB – southbound; EB – eastbound; WB – westbound; Combined – 2-way volumes

Intersection performance

We used aaSIDRA (SIDRA) intersection simulation software to estimate intersection level of service (LoS) and other associated parameters including degree of saturation, average delay and maximum queue length. At signalised and roundabout intersections, the LoS criteria are related to ***average intersection delay*** (seconds per vehicle). At sign controlled intersections (Giveway and Stop), the LoS is based on the ***average delay (seconds per vehicle) for the worst movement***. Table 4-5 summarises intersection LoS criteria.

Table 4-5 Level of Service Criteria for Intersections

Level of Service	Average Delay (seconds per vehicle)	Traffic Signals, Roundabout	Give Way and Stop Signs
A	Less than 14	Good operation	Good operation
B	15 to 28	Good with acceptable delays and spare capacity	Acceptable delays and spare capacity
C	29 to 42	Satisfactory	Satisfactory, but accident study required
D	43 to 56	Operating near capacity	Near capacity and accident study required
E	57 to 70	At capacity. At signals, incidents will cause excessive delays. Roundabouts require other control mode	At capacity; requires other control mode
F	Greater than 71	Unsatisfactory with excessive queuing	Unsatisfactory with excessive queuing; requires other control mode

Source: RTA Guide to Traffic Generating Developments, 2002

Degree of Saturation

Degree of saturation (DoS) is defined as the ratio of demand flow to capacity, and therefore has no unit. As it approaches 1.0, extensive queues and delays could be expected. For DoS greater than 1.0, a small increment in traffic volumes would result in an exponential increase in delays and queue length. For a satisfactory situation, the DoS should be less than the nominated practical degree of saturation, usually 0.90. The intersection DoS is based on the movement through the intersection with the highest DoS ratio.

Average Delay

Delay is the difference between interrupted and uninterrupted travel times through the intersection and is measured in seconds per vehicle. The delays include queued vehicles decelerating and accelerating to and/or from stop, as well as delays experienced by all vehicles negotiating the intersection. At signalised and roundabout intersections, the average intersection delay is usually reported. It is taken as the weighted average delay by summing the product of the individual movement traffic volume and its corresponding calculated delays and dividing by the total traffic volume at the intersection. At sign controlled intersections, the average delay for the worse movement is usually reported.

Maximum Queue Length

Queue length is the number of vehicles waiting at the stop line and is usually quoted as the 95th percentile back of queue, which is the value below which 95 percent of all observed queue lengths fall. It is measured as the number of vehicles per traffic lane at the start of the green period, when traffic starts moving again after a red signal. The intersection queue length is usually taken from the movement with the longest queue length.

Mid-block LoS

Mid-block LoS is a term used to describe the potential for delay during traffic operation, usually in peak demand situations. It is a simple performance indicator which describes the interaction of vehicles in the traffic stream. As traffic volumes increase on a given section of road, motorists will experience possible reductions in speed, increased difficulty in manoeuvring within the traffic stream and reduced gaps between vehicles. Accordingly there is a reduction in the "level of service" as the traffic volume increases. A reduction in level of service occurs incrementally with increased traffic and would eventually reach a point when additional road capacity may be required to maintain acceptable performance.

Mid-block LoS is difficult to measure in the field, and surrogate measures are often used. Similar to intersection performance criteria, the letters A-F are often assigned to different ranges of operating conditions with LOS A representing the best and F the worst. Level of service ratings of F are commonly considered unacceptable.

Technical Publications (including *Guide to Traffic Engineering Practice Part 2 Roadway Capacity*- Austroads, *The Highway Capacity Manual* –TRB and RTA's *Guide to Traffic Generating Developments*) provide an indication of the thresholds for each level of service range. These thresholds are sometimes referred to as maximum service flows which are derived from volume to capacity ratios.

For the purpose of determining maximum acceptable service flows for roads in the wider road network surrounding Muswellbrook study area, a LoS threshold of "E" was selected. Our LoS bands for urban and rural roads were derived from above published guidelines, are described in Table 4-6.

Table 4-6 Assumed Link LoS Thresholds

LoS Band	Urban (one way, vph/lane)	Rural (two way, vph/lane) Flat Terrain	Rural (two way, vph/lane) Mountainous
A	200		
B	380	590	230
C	600	970	410
D	900	1,550	680
E	1,400	2,500	1,400

4.2.2 Results of intersection LoS assessment

Intersection modelling was undertaken at 19 key intersections for both AM and PM peak hours by assuming:

- lane configurations were based on existing layout, unless specified as an improved option. Existing intersection layouts were obtained from a site visit
- traffic signal parameters including phasing, cycle time and green time at New England Highway/Sydney Street, Bell Street/New England Highway, Bridge Street/Brook Street intersections were based on Traffic Signal Control Scheme Plans obtained from RTA and confirmed during a site visit
- for non-signalised intersections, the critical gap and follow up headways for minor roads were assumed to be:
  - left turn (4.5 sec, 2.5 sec)
  - through (5 sec, 3 sec)
  - Right turn (5.5 sec, 3.5 sec).

The above parameters are consistent with values suggested in AUSTROADS *Guide to Traffic Engineering Practice-Part 5: Intersection at Grade*. During PB's site visit, the engineer also observed critical gap acceptance at key sign controlled intersections in Muswellbrook and they were found to be generally consistent with above values. Table 4-7 contains the intersection LoS results for year 2007. The LoS was based on intersection turning movement during Friday peaks.

To identify current capacity problems, we looked at three key parameters including degree of saturation (DoS), level of service (LoS) and queue length altogether, rather than LoS only. Inappropriate interpretation of these parameters can create confusion in particular for sign controlled intersections. For instance, for sign controlled intersections, LoS is determined by the highest delay for minor traffic movements and LoS could register F with few actual vehicles being delayed. In this case, intersection would not have significant capacity issue except for one minor movement in the peak and therefore may not merit consideration as poorly performing.

Four intersections on the New England Highway currently show capacity problems with delays for side street traffic in the PM peak.

- New England Highway/Rutherford Road
- New England Highway/Thompson Street
- New England Highway/Haydon Street/Lorne Street
- New England Highway/ Hunter Street.

Our individual observations were:

- the New England Highway/Rutherford Road intersection was operating satisfactorily at LoS D for AM, but F in the PM peak. Existing traffic demand was well below the effective intersection capacity. However, PM peak, traffic going through this intersection experienced delays and queues especially motorists on Rutherford Road and those trying to turn right from the Highway into Rutherford Road. Right turns from Rutherford Road experienced the longest average delay. The critical movement in the PM peak hour was the right turn from Rutherford Road into the Highway
- during the PM peak through traffic on the New England Highway reached 700 vph which reduced gaps for the Thompson Street, eastbound, right turn movement (37 vph). The model prediction is for up to 6 vehicles to queue in Thompson Street, with delays of more than 5 minutes.

Table 4-7 Intersection LoS results for 2007 based on surveyed turning movement data

Site ID	Intersection	Intersection Control	AM Peak				PM Peak				Comments	
			DoS	Delays (sec)	LoS	Queue(m)	DoS	Delays (sec)	LoS	Queue (m)	AM	PM
I-01	Bimbadeen Dr/New England Hwy	Give-way	0.17	18	B	2	0.29	35	C	3	No capacity issue	No capacity issue
I-02	Acacia Dr/Bloodwood Rd	Give-way	0.01	7	A	0	0.03	7	A	1	No capacity issue	No capacity issue
I-03	Rutherford Rd/New England Hwy	Give-way	0.45	50	D	22	1.00	246	F	56	40 vph RT from Rutherford Rd to NEH; 3veh queue	59 vph RT from Rutherford Rd to NEH; 8 veh queue
I-04	Rutherford Rd/Acacia Dr	Give-way	0.24	9	A	8	0.19	11	A	6	No capacity issue	No capacity issue
I-05	Rutherford Rd/Ironbark Rd	Give-way	0.06	7	A	2	0.08	8	A	2	No capacity issue	No capacity issue
I-07	Adams Street/Ruth White Ave	Give-way	0.03	7	A	1	0.07	7	A	2	No capacity issue	No capacity issue
I-08	Thompson Street/New England Hwy	Give-way	0.57	66	E	19	1.00	357	F	44	55 vph RT from Thompson Street to NEH; 3 veh queue	37 vph RT from Thompson Street to NEH; 6 veh queue
I-09	Sydney Street/Mitchell Street	Give-way	0.20	13	A	1	0.27	17	B	1	No capacity issue	No capacity issue
I-10	Sydney Street/Skellatar Stock Route	Give-way	0.17	12	A	10	0.31	16	B	23	No capacity issue	No capacity issue
I-12	Sydney Street/New England Hwy	Signals	0.51	20	B	101	0.71	21	B	155	No capacity issue	No capacity issue
I-13	Haydon Street/New England Hwy	Give-way	0.15	30	C	12	0.39	94	F	21	No capacity issue	20 vph T & RT from Lorne Street (south approach); 2 veh queue
I-14	Bell Street/New England Hwy	Signals	0.52	13	A	49	0.75	14	A	66	No capacity issue	No capacity issue
I-15	Bridge Street/William Street	Roundabout	0.37	6	A	20	0.50	7	A	32	No capacity issue	No capacity issue
I-16	Bridge Street/Brook Street	Signals	0.69	32	C	88	0.82	33	C	126	No capacity issue	No capacity issue
I-17	Doyle Street/George Street	Roundabout	0.14	6	A	7	0.15	5	A	7	No capacity issue	No capacity issue

Site ID	Intersection	Intersection Control	AM Peak				PM Peak				Comments	
			DoS	Delays (sec)	LoS	Queue(m)	DoS	Delays (sec)	LoS	Queue (m)	AM	PM
I-18	New England Hwy/Hunter Street	Give-way	0.30	30	C	10	0.95	155	F	53	No capacity issue	79 vph RT from Hunter Street to NEH; 8 veh queue
I-19	Lexia Street/Queen Street	Give-way	0.02	7	A	1	0.02	7	A	1	No capacity issue	No capacity issue
I-20	Semillon Street/Cook Street	Roundabout	0.15	7	A	7	0.12	6	A	5	No capacity issue	No capacity issue
I-21	Brecht Street/Brentwood Street	Stop control	0.06	11	A	1	0.06	11	A	1	No capacity issue	No capacity issue

- Lorne Street and Haydon Street traffic were delayed by the New England Highway traffic flow, particularly eastbound right turn movement from Lorne Street. In the PM peak, about 20 vehicles on Lorne Street were delayed by more than one minute. The model predicted about 2 vehicles being queued on Lorne Street waiting for an appropriate gap in the New England Highway traffic stream
- with increased residential and commercial activities in North Muswellbrook, the New England Highway/Hunter Street intersection showed capacity constraints, particularly during the PM peak. The northbound right turn movement from Hunter Street to New England Highway is being delayed by more than two minutes for finding an acceptable gap in Highway traffic stream. The model predicted about 8 vehicles would queue on Hunter Street.

Other intersections were operating satisfactorily under current traffic conditions, at LoS categories “A” to “C”.

In conclusion, only the above four intersections had a capacity problem. All other intersections within the Muswellbrook study area did not exhibit capacity problems.

4.2.3 Results for mid-block LoS

Assessments on mid-block LoS are summarised in Table 4-8 for AM (8-9am) and PM (3-4pm). In summary,

- the New England Highway had reasonable capacity for current through traffic movements. Turning traffic on side streets including Rutherford Road, Thompson Street, Lorne Street and Hunter Street experience some delays waiting for reasonable gaps to turn safely onto the Highway. Local intersections operated at good LoS with spare capacity.

Table 4-8 Mid-block capacity for key roads

			Traffic volumes		LoS	
ID	**Road**	**Land use**	**AM**	**PM**	**AM**	**PM**
	Arterial roads:					
M-1	New England Highway, east of Bimbadeen Drive	Rural	540	900	B	C
M-2	New England Highway, west of Rutherford Road	Urban	550	710	A	A
M-3	Bridge Street, south of Brook Street	Urban	610	930	A	B
M-4	New England Highway, south of McCullys Gap Road	Rural	770	1,030	B	C
M-6	Sydney Street, north of Anzac Parade	Urban	300	580	B	C
	Sub-arterial roads:					
M-7	Denman Road, south of Racecourse Road	Rural	390	790	A	B
	Collector roads:					
M-5	Kayuga Road, west of Aberdeen Street	Rural	170	160	A	A

NOTE: For urban type, traffic volume is the highest one-way vph; For rural type, traffic volume is the two-way, vph for two-lanes

5. Traffic modelling

This section discusses model design, assumptions, input data and modelling steps used to forecast traffic on key roads and intersections within the Muswellbrook study area. It defines the geographic scope of the model, the structure of the model components, and outlines model calibration/validation process. The base year 2007 model was developed to reflect the interaction between existing land uses and the transport network. The future traffic model was developed to assess traffic impacts likely to arise from a given set of land use changes, including residential and commercial development for years 2020 and 2037 respectively.

5.1 Overview

An overview of the two-level (TransCAD & aaSIDRA) traffic modelling methodology adopted for this study is shown in Figure 5-1. Features of the methodology are;

- Network Model platform: TransCAD
- TransCAD Modelling Period: 7-9AM
- Modelling Year: 2007 (existing), 2020 (future), 2037 (future)
- Coverage: RTA's Lower Hunter Model Area + Singleton Study Area + Muswellbrook Study Area
- Intersection Model platform: aaSIDRA
- aaSIDRA Modelling Period: AM Peak one hour and PM peak one hour
- Coverage: key existing intersections + selected future intersections.

The network model was developed using TransCAD transportation planning software. TransCAD provides a full set of transport and traffic modelling functionalities fully integrated within a Geographic Information System (GIS). The model's GIS capability in terms of data management, data manipulation and presentation greatly enhances the efficiency of the model input and output.

RTA's Lower Hunter Regional Model was used under license from the RTA and augmented to include the Muswellbrook study area network. To allow integration with the Lower Hunter and Singleton models, the Muswellbrook model was built using the same time period this being AM peak period between 7 and 9 AM.

The calibration and validation process was mainly undertaken for Muswellbrook using 2007 AM peak survey data discussed earlier. Intersection model (aaSIDRA) was built for both AM and PM critical peak hours and was used as a basis for testing intersection design works. The PM peak hour travel pattern was the reverse of the AM peak travel plus observed PM peak factors from intersection data.

5.2 Modelling objectives

The following modelling objectives were developed to satisfy Muswellbrook Shire Council's roadworks planning objectives:

- to develop a means of assessing future development proposals that can systematically assess impacts across the study area
- to assess the transport implications of future network changes including Muswellbrook Bypass proposal
- to build a traffic model with continuous consultant support that can inform future Council decisions, both at the local level for Council officers' use, and at a more regional level to support the City's road hierarchy
- to devise a scenario-testing tool to help with quantifying apportionment of the Section 94 Contributions Plan.

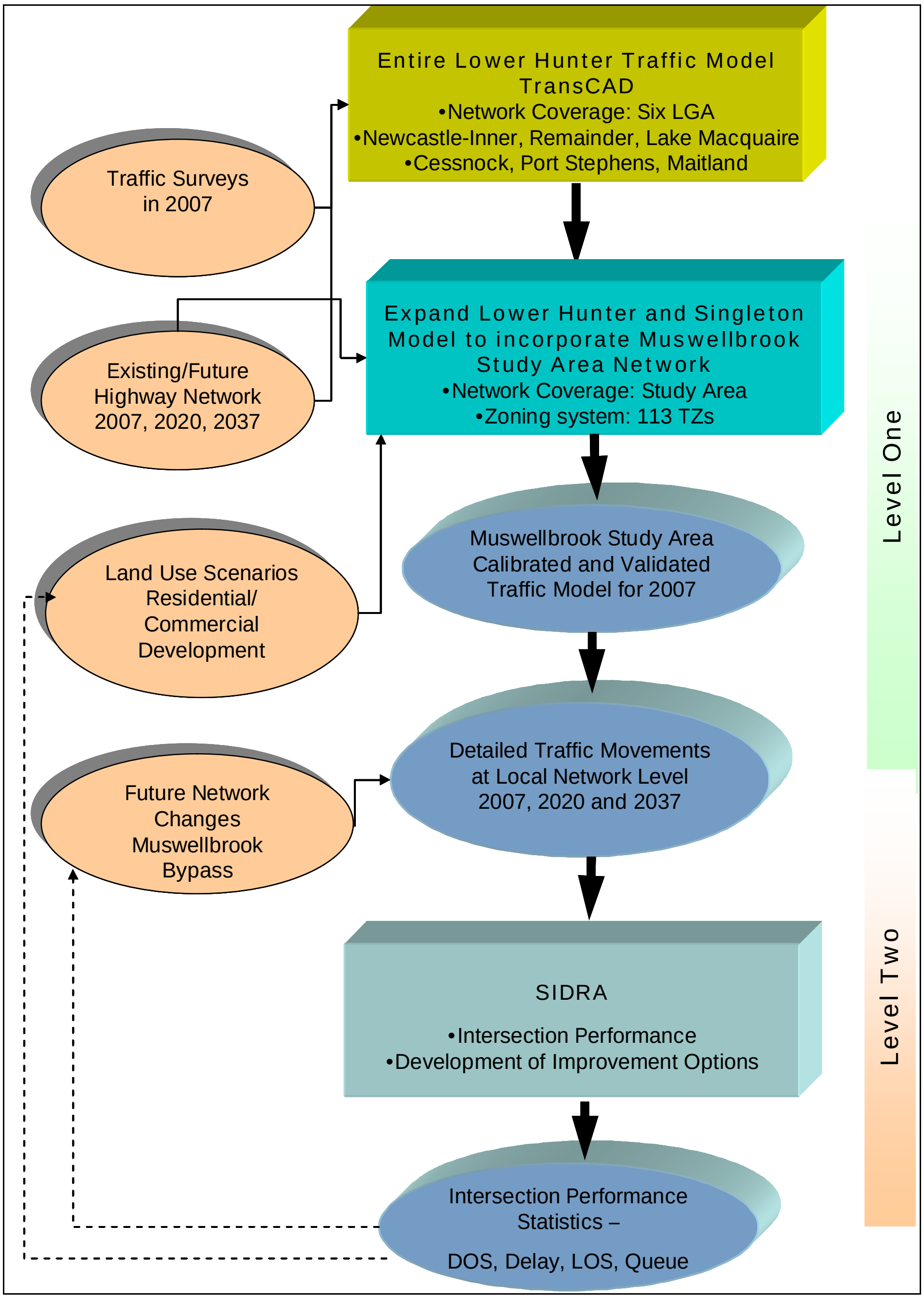


Figure 5-1 Modelling Overview

5.3 Key model inputs

5.3.1 Network

Network structure

The 2007 base year road network was based on RTA's Lower Hunter Regional Model and has following two main data layers:

- a road link structure for the RTA's Lower Hunter Regional Model area, the Singleton study area and Muswellbrook study area incorporating the main urban and rural arterial road network, collector and local roads
- a node coordinate system which defines intersection and travel zone locations and links the road network overlay to a GIS-base map.

Network attributes

The following data sources supplied by the Council were used in the base model network:

1. road hierarchy map (as noted in Figure 2.5)
2. posted speed limits
3. GIS mapping files which contain link attributes, including road centreline data (e.g. number of traffic lanes), lot boundaries, and land uses by lot/zone
4. aerial photographs.

We undertook extensive data checking to ensure 2007 base network reflected actual road network and traffic behaviour within the Muswellbrook study area.

1. Link type

The link type attributes used in both the RTA's Lower Hunter Regional Model and the Singleton Local Area model were retained for the Muswellbrook Model. Link values applicable to the Muswellbrook network are shown in Table 5-1.

Table 5-1 Link type as defined by TransCAD

Link Code	Link Type	Description
15	Centroid connector – External	External zone load points
16	Centroid connector- Internal	Internal study area zones
21	Sub arterial (Urban)	Urban
23	Collector	Local access function
24	Local road	Roads with distribution function
25	Arterial (Urban)	Urban Within the main urban areas
26	Arterial (Rural)	Rural Arterial roads outside of urban areas
30	Sub arterial (Rural)	Rural

2. Speed flow curves

Speed-flow (or volume-delay) curves define, for each link type, the rate at which travel times increase during the traffic assignment process as traffic volumes increase. They form an important input to the modelling describing the effects of traffic congestion on travel times by route alternatives. AM peak speed-flow curves used in the Singleton Local model were applied to the Muswellbrook study area. Speed-flow relationships for this study were developed using the Bureau of Public Roads (BPR) function, which relates congested speed as a function of volume-to capacity ratio according to the following formula:

$$t = t_0\left(1 + \alpha\left(v / C\right)^{\beta}\right)$$

Note: t = travel time of the link-minutes
t_0 = free flow travel time-minutes
α = ink type specific parameter
β = link type specific parameter
C =capacity (vehicle/hr)
V = traffic volume (vehicle/hr).

The constants α and β are used to calibrate the BPR function for local conditions and represent the effects of roadside friction factors including pedestrians, parking access and other general roadside activity. Separate speed-flow curves were applied to roads with different link types. The speed-flow curve values were adjusted appropriately to best fit Muswellbrook travel conditions.

3. Link capacity

Values of hourly capacities for the respective link types were based on the typical capacities assumed in the RTA's Lower Hunter Regional model and Singleton local area model. During the calibration process, capacity of specific links was adjusted iteratively. Table 5-2 summarised the initial values assumed in the Muswellbrook model.

Table 5-2 Link capacity (TransCAD)

Link Code	Link Type	Capacity per lane per hour (pcu)
15	Centroid connector – External	100,000
16	Centroid connector- Internal	100,000
21	Sub arterial (Urban)	1,000
23	Collector	900
24	Local road	650
25	Arterial (Urban)	1,500
26	Arterial (Rural)	1,600
30	Sub arterial (Rural)	1,200

4. Link impedances

Measures of link impedance (usually travel time) is a key input to the traffic assignment process. The impedance value was estimated from travel time survey data.

5. Travel Zones

The zoning system was based on Census Collection Districts (CCD) in the Muswellbrook area. The CCDs were further sub-divided to achieve the fine level of detail needed to ensure land use and vehicle access points were properly reflected in the model. PB's model included some 101 travel zones as summarised in Table 5-3.

Table 5-3 Travel zones in Muswellbrook traffic model

Land use	**Number of Zones**
Residential	39
Commercial	17
Industrial	5
Special others (hospital, schools, recreational)	17
Externals	9
Future (residential)	12
Future(commercial)	2
Totals	**101**

5.3.2 Traffic demand/trip table

Trip tables are essentially a spreadsheet/matrix of the travel demand or number of trips that occur between each origin-destination pair ("O-D pair") of travel zones in the model without having regard to the actual route taken through the physical network. PB used trip tables in two key areas:

- for AM peak period model calibration purposes, current year trip tables, adjusted to match observed traffic volumes in key locations, were used
- future year trip tables were developed for forecast years 2020 and 2037 taking into account the calibration adjustment to the base year
- in general, a trip table represents four types of trips as follows:
  - external to external – through traffic with origin and destination are outside of Muswellbrook study area
  - extern to internal – traffic origin is outside of Muswellbrook but destination is within Muswellbrook study area
  - internal to external – traffic origin is within Muswellbrook study area but destination is outside of Muswellbrook
  - internal to internal – traffic which travels within Muswellbrook study area. These are local trips.

Developing a new trip table from survey data is a high cost interview survey, time consuming and iterative process. Therefore, trip table for 2007 was estimated from the following data:

- 2001 trip distribution from the Census' Journey to work question
- 2002 O/D patterns on the New England Highway from an RTA survey
- land use data segregated by dwelling, office, retail, industrial, schools and hospitals
- mid-block and intersection turning movement data
- external traffic contribution factors by mining-related traffic. For instance, traffic generated to and from mining sites accounts for a large proportion external to internal trips and vice versa. We have reflected the influence of mining on traffic via external zones in the model.

An iterative process was adopted to estimate base year two hour AM peak trip table:

- the production and attraction of trips at each travel zone was assigned and estimated by land use. Production relates to outbound trips and attraction relates to inbound trips. Appropriate AM peak period trip generation rates were adopted. Appropriate expansion factors were applied to reflect a 7-9 am peak period
- 2001 Journey to work trip distributions were applied to mainly internal-internal, external-internal and internal- external zone pairs. This distribution was adjusted via a matrix estimation process which matched traffic counts at external stations
- regional through trips (external to external) were estimated from RTA's origin destination surveys (OD) conducted in 2002. We have refined external traffic behaviour via a matrix estimation process which also matched traffic counts at external stations
- a gravity model trip distribution algorithm was used to distribute internal to internal trips. This was an iterative process and in each run, we matched internal trip distribution against the 2001 JTW results
- repeat the above processes until a satisfactory traffic distribution was obtained which not only matched JTW distribution patterns but also mid-block and intersections turning movements distribution.

Table 5-4 summarises the 2007 base year trip distribution obtained from the above process.

Table 5-4 Demand of the trip purpose for AM peak two hours

Trip purpose	2007 Calibrated Demand (7-9 AM, PCU)	%
Internal to internal	4207	54%
External to external	958	12%
External to internal	1473	19%
Internal to external	1178	15%
Total	**7817**	**100%**

Travel demand within the Muswellbrook study area expressed as “desire lines” is shown in Figure 5-2. For the overall demand, the figure shows movements between external to external or external to internal by precincts composed of zones. In general, we have showed demand into three major precincts identified as north, south and west (see Figure 5-2 for precinct boundaries). Some strong local movements reflected by short trips are also shown by circles within precincts. The key results were:

- through traffic is not a large proportion of traffic through the town via New England Highway. The 2002 OD results (based on 12 hours 6 am and 6 pm) indicated through traffic on the New England Highway represented between 21 % and 29% of all traffic
- local traffic predominates the North and South Muswellbrook precincts (more than 50%)
- strong traffic movements between South and North Muswellbrook were observed
- strong traffic movement was observed between Muswellbrook and external areas including external NEH South, external NEH North and external Denman Rd. This was probably due to strong mining related activities in these areas
- internal trips are short trips which generally occurred within precincts. For instance trips by people who lived and worked in North Muswellbrook precinct are indicated within the circle.

5.4 Model calibration

5.4.1 Targets and result summary

Model calibration is the process by which the initial model inputs and parameters are adjusted in a logical and controlled way until the model sufficiently matches a set of observed traffic data. This calibration process confirms that appropriate parameters have been chosen, thus ensuring that when the model is used to make a forecast the results will be consistent with the inputs and current behavioural responses. This model was calibrated at three levels:

- cordon lines which control total traffic entering and leaving the study area. The external count sites on the New England Highway, Kayuga Road, Coal Road, Common Road and Sydney Street formed the model cordon boundary
- individual roads based on traffic counts
- individual intersections based on traffic counts.

Model calibration criteria were based on the US Federal Highway Administration (FHWA) and the *Model Reasonableness and Checking Manual* as describes below:

- the correlation coefficient, (R2) for region-wide observed traffic counts versus estimated volumes should be greater than 0.88
- the percent Root Mean Square Error (%RMSE) should be below 30%
- observed vs modelled travel time should replicate closely observed patterns
- “GEH” statistics comply (see Table 5-5).

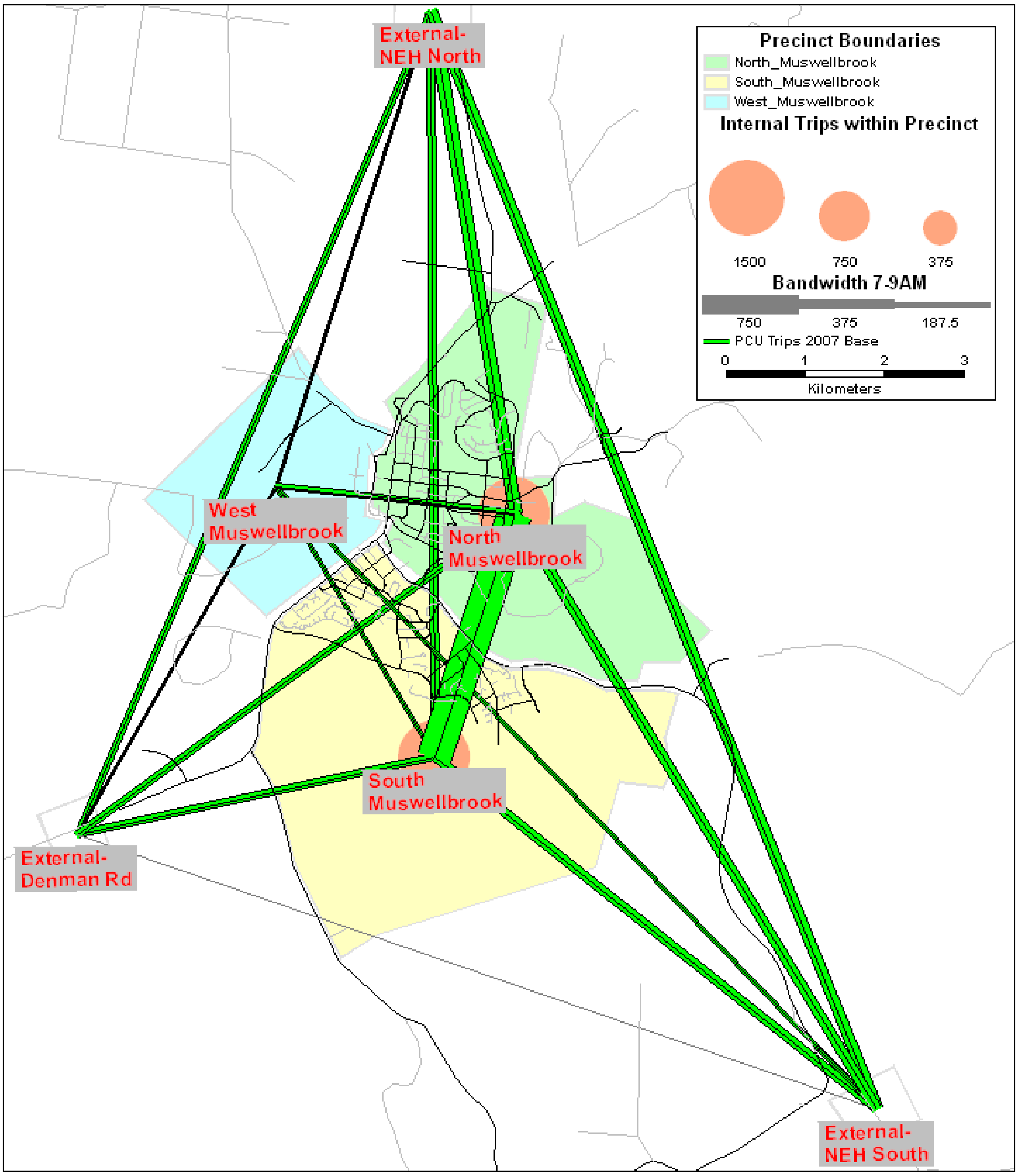


Figure 5-2 2007 base traffic distribution patterns

Table 5-5 presents the calibration and validation targets and results achieved for this model.

Table 5-5 Calibration and validation targets and results for 2007 (7-9 AM)

Calibration Objective	Calibration target	Model compliance
Road traffic characteristics lead to realistic route choice	For links:	For links/intersections (130 sites)
	$R^2 > 0.9$	$R^2 = 0.99$
	%RMSE <30%	%RMSE =8%
	% difference within ± 15% = 85% of sites	% difference within ± 15% = 95% of sites
	GEH	GEH
	<5 – require 60% or higher	<5 = 100%
	<10 – require 95% or higher	<10 = 100%
	<12 – require 100%	<12 = 100%

Note: GEH statistics were calculated using peak one hour passenger car unit volumes
%RMSE = % root mean square error

5.4.2 Observed and modelled link volumes

Within the study area, a total of 130 counting stations were examined in detail. In general, one four leg intersection count may produce four equivalent link sites. Adjustments to link attributes were made until modelled traffic volumes were acceptably close to the actual traffic volumes. In general, the model replicated most of sites within a range of +/-1 percent. Figure 5-3 showed the scatter plot of the observed and modelled volumes with R^2 values 0.99, indicating a close correlation between counts and model volumes. Thus it may be reasonably concluded that the calibration of the Muswellbrook 2007 base model is acceptable and can act as the platform for modelling future traffic conditions.

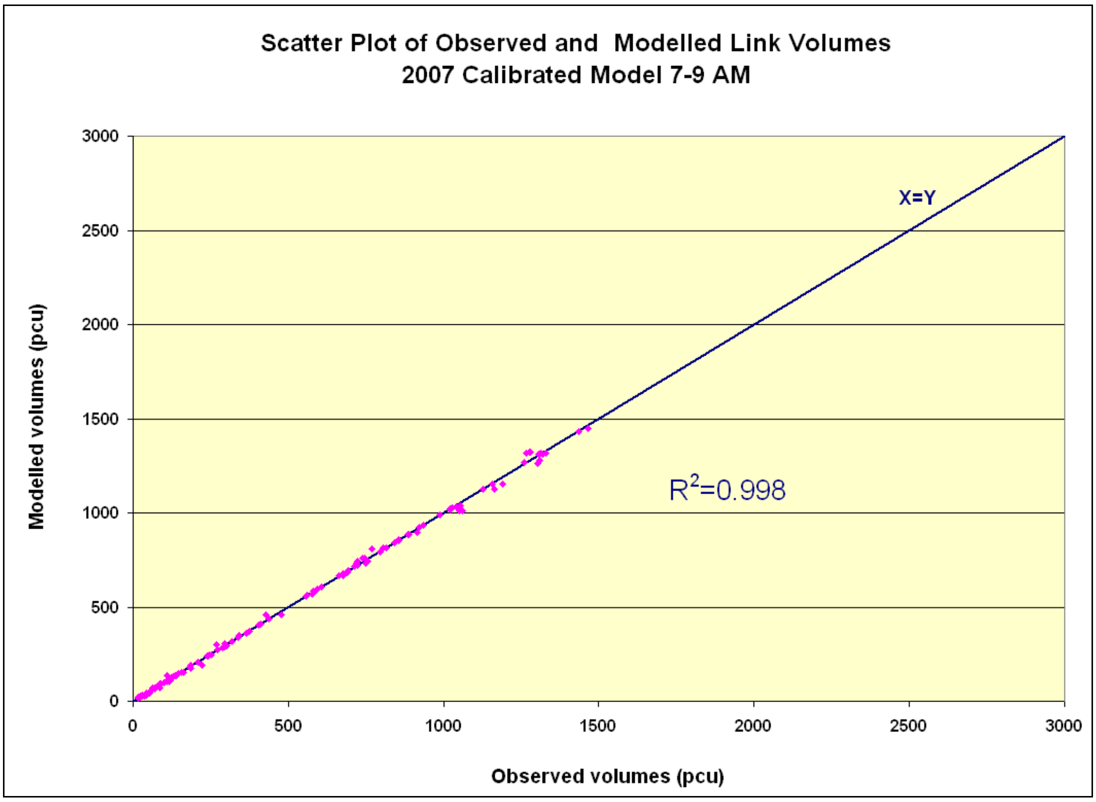


Figure 5-3 Scatter plot of observed and modelled link volumes (2007 7-9AM, PCU)

As part of the model validation process, PB conducted a travel time survey on the New England Highway between 7 and 9 am on a Friday in May 2007. Travel time data were collected using a GPS data logger installed in a test car. Table 5-6 shows travel time data from runs on the New England Highway. Travel time varied between 5.3 minutes and 8.6 minutes, depending on travel direction. The 2007 AM validation model shows a 6 minute travel time on the New England Highway, which falls within the range of survey travel time.

Table 5-6 AM peak period travel time on the New England Highway (7 and 9am)

Route	Section	Direction	Run 1 (minute)	Run 2 (minute)
New England Hwy	between Bimbadeen Dr and McCullys Gap Rd	Northbound	8.6	8.3
New England Hwy	between Bimbadeen Dr and McCullys Gap Rd	Southbound	6.4	5.3

5.4.3 Observed and modelled turning movements

The performance indicators of key intersections based on actual counts were compared to those derived using turning volumes from the base model. Table 5-7 presents a comparison between LoS, DoS and delays. Operational parameters for the surveyed intersections were close to those based on modelled turning movements. The results imply that intersections without actual counts could generally be relied upon in the future.

In conclusion, the calibration results for link flow and turning movements are within standard ranges of acceptance. We therefore confirm that the Muswellbrook model can be used to forecast future traffic with reasonable confidence.

Table 5-7 Intersection LoS comparison for year 2007 (using surveyed verses modelled movements)

Site ID	Intersection	Intersection Control	AM Peak						PM Peak					
			Model			Survey			Model			Survey		
			DoS	Delays (sec)	LoS	DoS	Delays (sec)	LoS	DoS	Delays (sec)	LoS	DoS	Delays (sec)	LoS
I-01	Bimbadeen Dr/New England Hwy	Give-way	0.19	21	B	0.17	18	B	0.24	28	B	0.29	35	C
I-02	Acacia Dr/Bloodwood Rd	Give-way	0.01	7	A	0.01	7	A	0.02	7	A	0.03	7	A
I-03	Rutherford Rd/New England Hwy	Give-way	0.42	54	D	0.45	50	D	1.00	243	F	1.00	246	F
I-04	Rutherford Rd/Acacia Dr	Give-way	0.17	9	A	0.24	9	A	0.11	9	A	0.19	11	A
I-05	Rutherford Rd/Ironbark Rd	Give-way	0.05	7	A	0.06	7	A	0.07	7	A	0.08	8	A
I-07	Adams Street/Ruth White Ave	Give-way	0.03	7	A	0.03	7	A	0.05	7	A	0.07	7	A
I-08	Thompson Street/New England Hwy	Give-way	0.50	56	D	0.57	66	E	0.65	111	F	1.00	357	F
I-09	Sydney Street/Mitchell Street	Give-way	0.18	13	A	0.20	13	A	0.23	15	B	0.27	17	B
I-10	Sydney Street/Skellatar Stock Route	Give-way	0.18	12	A	0.17	12	A	0.22	14	A	0.31	16	B
I-12	Sydney Street/New England Hwy	Signals	0.47	20	B	0.51	20	B	0.56	19	B	0.71	21	B
I-13	Haydon Street/New England Hwy	Give-way	0.18	29	C	0.15	30	C	0.35	50	D	0.39	94	F
I-14	Bell Street/New England Hwy	Signals	0.43	13	A	0.52	13	A	0.56	13	A	0.75	14	A
I-15	Bridge Street/William Street	Roundabout	0.35	6	A	0.37	6	A	0.41	7	A	0.50	7	A
I-16	Bridge Street/Brook Street	Signals	0.53	30	C	0.69	32	C	0.86	37	C	0.82	33	C
I-17	Doyle Street/George Street	Roundabout	0.12	5	A	0.14	6	A	0.10	5	A	0.15	5	A

Site ID	Intersection	Intersection Control	AM Peak						PM Peak					
			Model			Survey			Model			Survey		
			DoS	Delays (sec)	LoS	DoS	Delays (sec)	LoS	DoS	Delays (sec)	LoS	DoS	Delays (sec)	LoS
I-18	New England Hwy/Hunter Street	Give-way	0.24	26	B	0.30	30	C	0.42	45	D	0.95	155	F
I-19	Lexia Street/Queen Street	Give-way	0.02	7	A	0.02	7	A	0.02	7	A	0.02	7	A
I-20	Semillon Street/Cook Street	Roundabout	0.13	7	A	0.15	7	A	0.12	6	A	0.12	6	A
I-21	Brecht Street/Brentwood Street	Stop control	0.05	11	A	0.06	11	A	0.06	11	A	0.06	11	A

Note: In estimating PM peak model turning flows, we have used a factor of 1.2 to AM counts derived from a range of count locations.

6. Future land use and network changes

6.1 Potential developments

Future residential development in Muswellbrook will largely occur on Greenfield sites such as potential tract on eastern side of the New England Highway or in vacant sites within approved release areas such as Eastbrook Links Estate, St Mary's Estate, NorthView Estate, and Yammanie. Our model assumed:

- a total addition of 3,954 lots and 35,100 square metres of commercial development within study area over the next 30 years (see Figure 6-1)
- by 2020, Council forecasts about 2,488 dwellings could be developed, which is about 63% of total target.

Table 6-1 summarises estimates for timing of residential yields and commercial area for future forecast horizons of 2020 and 2037.

Table 6-1 Future land use assumptions

Area	Development name	No of dwellings/ Area	Unit	Land use	Cumulative Staging		
					2007	2020	2037
Area 1	St Mary's Estate	150	dwellings	Residential	0	150	150
Area 2a	Eastbrook Links Estate	315	dwellings	Residential	75	315	315
Area 2b	Eastbrook Links Estate	297	dwellings	Residential	0	297	297
Area 3	Highbrook Park	80	dwellings	Residential	0	80	80
Area 4a	Yammanie	100	dwellings	Residential	0	100	100
Area 4b	Yammanie	80	dwellings	Residential	0	80	80
Area 5	Potential residential development	170	dwellings	Residential	0	170	170
Area 6	Eastbrook Links Estate	563	dwellings	Residential	0	280	563
Area 7	Potential residential development	600	dwellings	Residential	0	90	600
Area 8a	Potential commercial development	33,600	m^2	Commercial	0	33,600	33,600
Area 8b	Potential residential development	40	dwellings	Residential	0	40	40
Area 9b	Muswellbrook Fair	1,500	m^2	Commercial	849	1,500	1,500
Area 10	NorthView Estate	213	dwellings	Residential	0	213	213
Area 11	Potential residential development at eastern side of New England Highway	1,346	dwellings	Residential	0	673	1,346
Totals		**3,954**	**dwellings**	**Residential**	**75**	**2,488**	**3,954**
Totals		**35,100**	**m^2**	**Commercial**	**849**	**35,100**	**35,100**

6.2 Background traffic growth

Future traffic conditions in and around the Muswellbrook study area will be influenced by the combined factors of background traffic growth and by changes to the transport network, as well as the new development discussed earlier. Background traffic changes are attributable to planned and known changes in population and employment, as well as through traffic growth on the New England Highway. An annual growth assumption of 1.45% between 2007 and 2020 followed by 1% growth between 2021 and 2037 was adopted in the modelling process. This growth assumption was based on extensive research undertaken by PB as part of the F3 Freeway to Branxton Study, undertaken for the RTA. A wide range of data sources were referenced to develop this traffic growth forecast. Data sources reviewed included:

- Bureau of Transport and Regional Services (BTRE), Demand Projections for AusLink Non-Urban Corridors: Methodology and Projections, Working Paper 66
- an ABS survey of freight movements completed in 2001 and reported in Freight Movements, Summary (Catalogue 9220.0)
- FDF Pty Ltd's Freight Info database of 1999 inter-regional freight flows – this data set forms the basis of the Freight inter-regional database and forecasting package developed for AUSTROADS
- BTRE Information Sheet 22 Freight between Australian Cities 1972 to 2001, which includes historical trends and forecasts to 2020 for the Sydney-Brisbane corridor by mode of transport
- NSW Freight Scoping Study prepared by SKM in 2002, which brings together freight data from a range of sources and includes high, medium and low forecasts by mode and major commodity groups for 2005, 2010, 2015 and 2020
- trends in traffic counts on the New England Highway from RTA counting sites.

Having established above growth trend, the analysis also recognised that the Pacific Highway is now a designated B-Double route (August 2002) following the completion of the upgrade of Yelgun-Chinderah section of the Highway. In other words, regional traffic growth on the New England Highway is expected to be moderated due to progressive upgrading works on the Pacific Highway. On this basis, a growth rate of 1.45% per annum was considered appropriate on the New England Highway through Muswellbrook.

6.3 Network changes

There are several changes to the future transport network that might influence Muswellbrook travel patterns. Future network changes are being planned by regional and local authorities.

The Muswellbrook Bypass proposal could change travel at a regional level, while new local roads and connections from new release areas could change travel patterns at the local level. Figure 6-1 shows all known local network changes and the proposed Muswellbrook Bypass. Proposed new roads are shown in blue. The future network may afford better connections to/from New England Highway and Denman Road from new subdivision roads. If built, the proposed Bypass is expected to reduce regional through traffic on the New England Highway, particularly heavy vehicles, and improve pedestrian accessibility in the town centre.

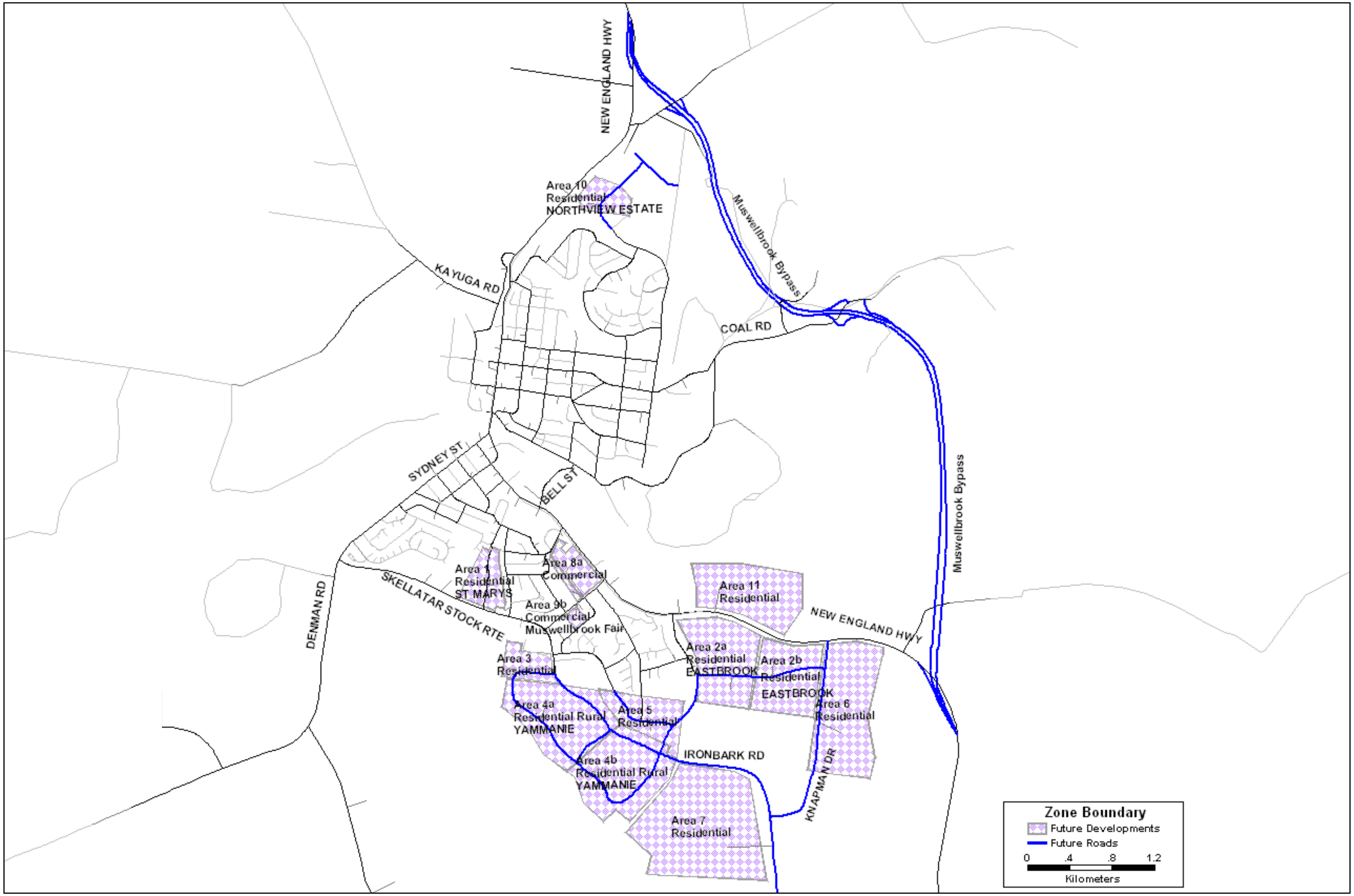


Figure 6-1 Future land use and network changes

6.4 Future trip distribution

In assigning future trip distribution to and from the Muswellbrook study area, we looked at potential activity growth associated with coal mining. There are five operational mines influencing the study area, including Xstrata/Mangoola, Mt Arthur Coal, Bengalla Mining, Drayton Coal and Muswellbrook Coal Company within the Shire of Muswellbrook (see Figure 6-2). All are expected to expand. Muswellbrook Council's "Business Guide" listed in its website detailed descriptions of approved coal mines extensions. For instance, Mt Arthur Coal and Xstrata/Mangoola when expanded would increase employment by 500 to 1,000 jobs. The impact of increased growth from these five mining developments would also encourage population growth within the South Muswellbrook area where the majority of residential development is predicted. Therefore, future mining growth was a key consideration in PB's traffic distribution model.

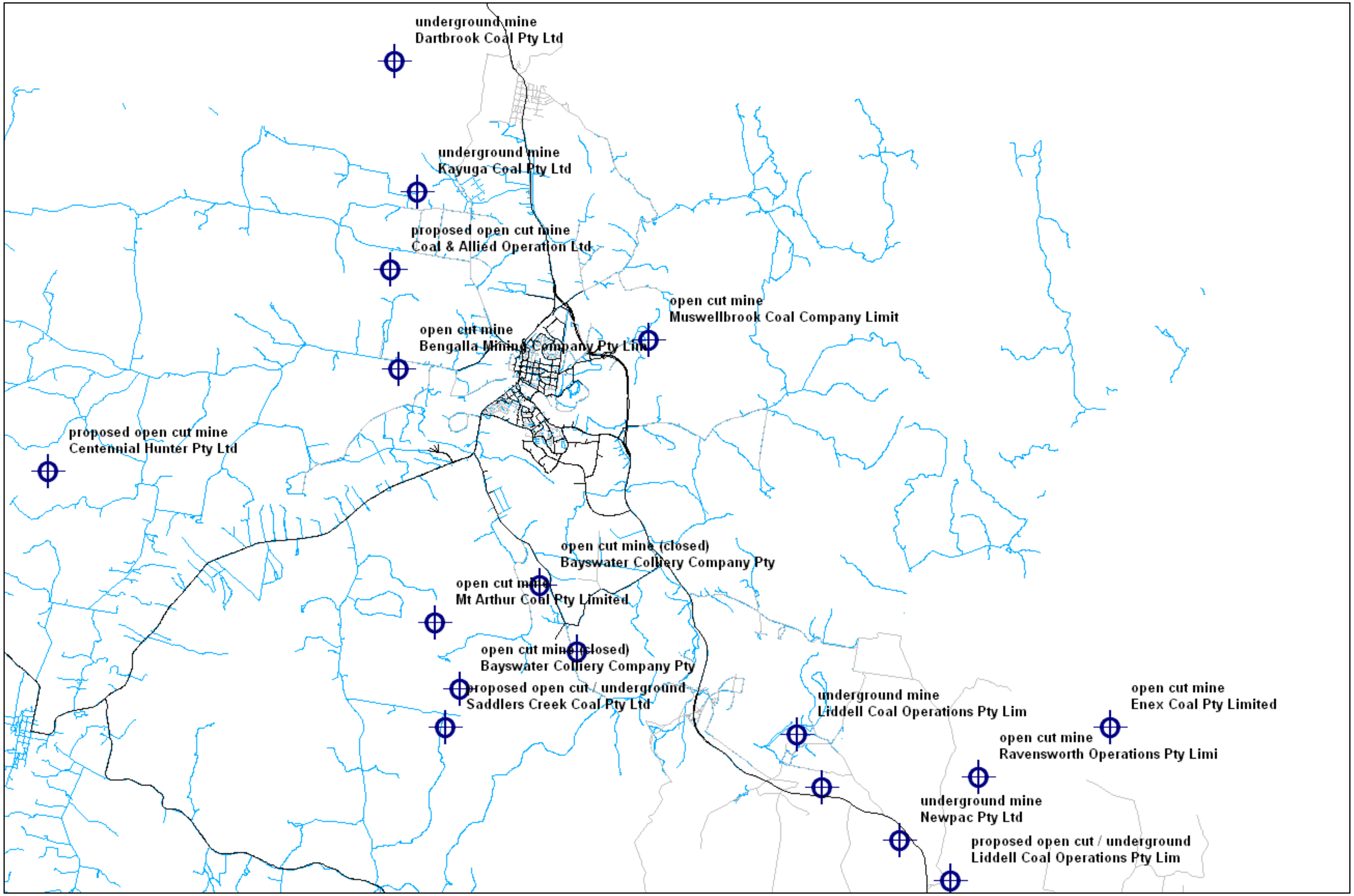


Figure 6-2 Coal mine locations in the vicinity of the study area

7. Future traffic

7.1 Scenarios

Traffic demand forecasts were prepared for years 2020 and 2037. The model predicted AM peak two hour traffic flows on the wider road network within the Muswellbrook study area. Broadly, three cases were developed for considering the impacts of regional background growth. Within each case two future year scenarios were considered; one for 2020 and the other for 2037 as follows:

- **Base Case** (S1 & S4) involved background “natural” growth on the existing road network for 2020 and 2037 respectively. These were effectively “do nothing” scenarios which assessed impact on roads and intersections from both regional and local background growth, but without nominated developments and without a Muswellbrook Bypass
- **Development Case 1** (S2 & S5): similar to the base cases, but traffic generated by the proposed developments were included. The road network is as at present with only the subdivisional roads added. The results from these scenarios provided impact of proposed developments explicitly on the current road network
- **Development Case 2** (S3 & S6): same as case 1 but with the proposed Muswellbrook Bypass assumed to be opened by 2020. This case redistributed traffic in response to the opening of the Bypass.

Table 7-1 summarises the assumptions from the cases and resulting six scenarios.

Table 7-1 Modelled scenarios for 2020 and 2037

Model scenario	2020-existing road network(1)	2020-Proposed - land use development(2)	2020 future network with Bypass	2037-existing road network(2)	2037-Proposed - land use development(2)	2037 future network with Bypass
S1	☑					
S2	☑	☑			☑	
S3		☑	☑		☑	
S4	☑					
S5		☑		☑	☑	
S6		☑			☑	☑

Note: (1) Proposed future development as listed in Table 6-1. (2) Existing road network is the network used for 2007 base model but with additional local roads for access to proposed new developments.

7.2 Future demand

The key input into PB's future demand model is the traffic generation rate. An objective of this traffic study was to validate earlier trip generation rates used in the South Muswellbrook Traffic Study (2000).

- future traffic demand was estimated for development proposals by using trip generation rates adopted from a number of sources, including RTA's *Guide to Traffic Generating Developments* (2002), *South Muswellbrook Traffic Study* (ERM, 2000) and other trip generation surveys in the Hunter region
- in 2006 PB conducted a residential trip generation survey in the Lower Hunter at Maitland and in the Upper Hunter at Singleton. Private car was the dominating travel mode for both Maitland and Singleton, with similar travel characteristics to Muswellbrook
- census data indicated that 88% of work trips in Singleton were by private vehicle which is very similar to Muswellbrook at about 89%
- the previous South Muswellbrook Traffic Study assumed 0.88 vehicle trips per dwellings which is marginally higher than both RTA's and PB's surveyed rates
- trip generation results indicated that the peak one hour generation rate was 0.84 (weekday peak hour vehicle trips per dwelling) for Maitland. For Singleton study, the trip generation rate varied between 0.72 and 0.89 with the average value of 0.83
- the RTA's trip generation rate was 0.85 vehicle trips per dwellings.

On the basis of above trip rates from various sources we conclude that previous trip rate being used in Muswellbrook study is still valid. We therefore, adopted the conservative trip generation rate of <u>0.88 trips per dwelling</u> for this traffic study.

7.2.1 Commercial developments

- a non-residential development considered was the Muswellbrook Fair, which is a possible commercial development near Rutherford Road (Area 8a) (total 35,100 m2 comprised of all developments for future year up to 2037, see Table 6-1 for details)
- the trip generation rate for this site was based on RTA's *Guide to Traffic Generating Developments* 2002 i.e.2 trips per 100m^2 gross floor area (GFA).

Table 7-2 summarises the additional traffic demand in terms of passenger car unit (PCU) for future years, 2020 and 2037.

Table 7-2 Additional traffic demand (2-hr 7-9AM, pcu)

Future development proposals	Trips for future years	
	2020	2037
Residential units	4,006	6,441
Commercial/office floor space	1,045	1,045
Total	**5,051**	**7,485**

Note: a factor of 1.88 was used to convert 1 hour peak trip rate to a 2 hour trip rate.

7.3 Forecast traffic volumes

The forecast AM peak period (2 hours) trip matrices for 2020 and 2037 were assigned to the respective base case (S1 & S4), development case 1 network (S2 & S5) and development case 2 network (S3 & S6) scenarios. Model results were produced for 2020 and 2037. The peak two hours to peak one hour factor was based on the traffic counts data detailed in Section 4. A factor derived from local traffic counts of 0.53 was used to estimate peak one hour AM forecast. Detailed AM peak assignment outcomes are contained in PB project files that support the model construction.

In this section of the report, summary of assignment details are presented over screenlines and selected links in the respective networks. Selected tables and figures illustrate traffic movements for each of the six scenarios. These tables and figures provide an understanding of the main future traffic implications of the proposed developments – potential use of the Muswellbrook Bypass and indications of changes in traffic demand on existing links.

In the sections below, the model results are reported in a consistent fashion for each of the six scenarios. Typically results are presented in:

- tables summarising traffic growth between 2007, 2020 and 2037 on the S1 and S4 scenarios without future developments (see Table 7-3 and Table 7-4). This estimated impact due to background traffic growth across the network
- tables summarising AM peak hour forecasts for 2020 and 2037 under S2 and S5 scenarios (see Table 7-5 and Table 7-6). This estimated traffic impact from proposed developments
- tables summarising the AM peak one hour traffic forecasts for 2020 and 2037 on S3 and S6 scenarios (see Table 7-7 and Table 7-8). This estimated impact on the road network from proposed Muswellbrook Bypass
- plots of AM peak two hour traffic volumes for 2007 on the existing network, 2020 on S2 and S3 scenarios and 2037 on S5 and S6 scenarios – these figures visually demonstrate the level of traffic across the network influenced by Muswellbrook Bypass project, and include an indication of the level of congestion on each road. This level of congestion is reported in terms of volume-to-capacity ratios (see Figure 7-2 to Figure 7-6).
- we prepared traffic forecasts for above six scenarios at both screenlines and individual roads. Nine screenlines were defined at key locations through out the study area to estimate traffic change across the network
- Screenlines 1 and 2 measured traffic flows across main south corridor (south of the proposed Muswellbrook Bypass). The New England Highway formed screenlines 1 and 2, being the only road to capture entering/leaving traffic to and from south
- Screenline 3 measured traffic on the New England Highway, east of Knapman Dr. This location allowed the traffic changes associated with the South Muswellbrook residential developments to be captured
- Screenline 4 measured traffic flows across the proposed residential developments in South Muswellbrook. Bimbadeen Drive and Knapman Drive formed this screenline

- Screenline 5 measured traffic flows across the existing and proposed developments, west of the New England Highway. Key roads included in the screenline were Rutherford Road, Thompson Street, Francis Street, Lorne Street and Sydney Street
- Screenline 6 measured traffic flows across the south-western precinct of Muswellbrook. Key roads included in it were the New England Highway, east of Rutherford Road, Acacia Drive, Ironbark Road and Sydney Street
- Screenline 7 measured traffic flows between the southern and northern part of Muswellbrook. Bell Street and Bridge Street formed this screenline
- Screenline 8 measured traffic flows across the northern part of the study area. New England Highway, north of Aberdeen Street, and Queen Street formed this screenline
- Screenline 9 measured traffic flows across the main north corridor (north of the proposed Muswellbrook Bypass) in the study area. The New England Highway formed screenline 9 as the only road to capture entering/leaving traffic to and from the north.

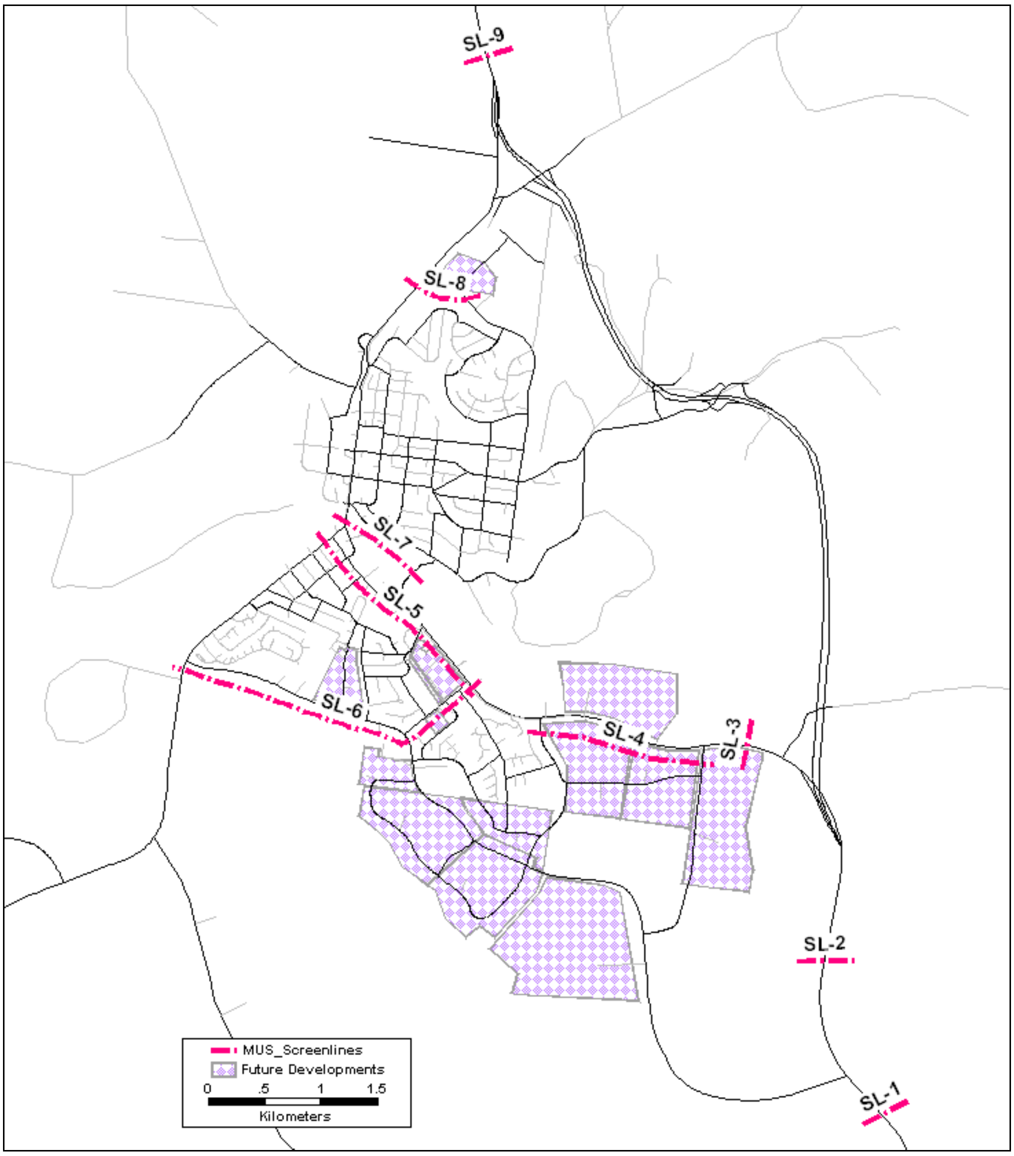


Figure 7-1 Screenline locations across the Muswellbrook network

7.3.1 Base case traffic forecasts (scenarios S1 & S4) (no future development, 2020 and 2037 networks, no Bypass)

Table 7-3 summarises AM peak traffic forecast for 2020 and 2037 on nine screenlines across the study area. For comparison, 2007 modelled flow is also shown. Results were that:

- 2020 forecasts indicated between 760 and 830 peak hour volumes on screenlines 1 to 3 increasing to 1940 at screenline 7. This implied that traffic on the New England Highway, east of Rutherford Road, carries mainly regional traffic but local traffic (to and from South Muswellbrook) doubled the flow on the New England Highway. This trend was consistent with JTW data and the OD survey
- traffic on screenlines 8 and 9 dropped significantly (about 50%) compared to screenline 7. This demonstrated heavy local traffic interaction between the north and south Muswellbrook areas
- another important finding from the screenline analysis was the regional background growth across the network. The model forecasted very minor increases, between 3% and 6% over the next 13 years. Increases between 40 and 120 vehicles were considered minor changes over a 30 year period
- Scenarios S1 and S4 indicated that regional background growth was unlikely to cause significant deterioration in road and intersection performance beyond that predicted in 2007.

Table 7-4 also summarises AM peak traffic forecasts for scenarios S1 and S4 on roads as classified in the road hierarchy. Traffic forecasts at road level also showed similar growth patterns to those reported at the screenlines.

7.3.2 Development case 1 traffic forecasts (scenarios S2 & S5) (with future development, 2020 & 2037 networks, no Bypass)

As in Table 7-3, Table 7-5 summarises AM peak traffic forecasts for scenarios S2 and S5 on the nine screenlines for 2020 and 2037. Modelling results indicated peak hour traffic increases on screenlines 4, 5 and 6 as significant impacts from residential/commercial developments in the South Muswellbrook area. The highest traffic increase was forecast at screenline 6, about 2,300 vehicles in 2020, then 3,700 vehicles in 2037. Overall, the combined developments in the study area would increase ***screenline traffic*** levels from 40% to 200% by 2037. In particular:

- Significant traffic increases were forecast at screenline 4 of approximately 700 vehicles and 1,000 vehicles by years 2020 and 2037, respectively. This was due to the proposed residential developments on the south side of New England Highway
- Peak hour traffic increases on Ironbark Road and Sydney Street (south of Ironbark Road) maybe under-forecast as both roads provide access to mining areas. This may explain the large traffic increases at screenline 6
- the 50% traffic increase on the New England Highway (screenlines 1,2,3) suggested strong connections between new residential developments and southern mining areas

- the 40% traffic increase on the New England Highway (screenlines 7 and 8) would partly be due to local travel between South and North Muswellbrook
- Further to the north, traffic was forecast to increase about 23% on the New England Highway (screenline 9).

In conclusion, proposed residential developments largely from South Muswellbrook would significantly impact not only on key arterial roads, but also local roads connecting to both the New England Highway and Sydney Street/Denman Road. Table 7-6 has AM peak traffic forecasts for scenarios S2 and S5 on individual roads.

Table 7-3 AM peak one hour traffic forecasts on screenlines for scenarios S1 & S4 (two way volumes)

Screenline	Road sections	2007 Modelled	2020 Demand S1	Changes attributable to background growth between 2007 and 2020		2037 Demand S4	Changes attributable to background growth between 2007 and 2037	
				Volume change	%		Volume change	%
1	New England Hwy, south of Ironbark Rd	720	760	40	6%	800	80	12%
2	New England Hwy, north of Ironbark Rd	720	760	40	6%	800	80	12%
3	New England Hwy, east of Knapman Dr	780	830	50	6%	870	90	12%
4	Bimbadeen Dr, south of New England Hwy	80	80	0	0%	80	0	0%
5	Rutherford Rd + Thompson Street + Francis Street + Lorne Street + Sydney Street, south of New England Hwy	1,680	1,690	10	1%	1,710	30	1%
6	New England Hwy + Acacia Dr + Woollybutt Way + Ironbark Rd, east of Rutherford Rd + Sydney Street, south of Ironbark Rd	1,870	1,930	60	3%	1,990	120	6%
7	Bell Street, north of New England Hwy + Bridge Street, north of Haydon Street	1,880	1,940	60	3%	2,000	120	6%
8	New England Hwy, north of Aberdeen Street + Queen Street, west of Lexia Street	950	1,000	50	6%	1,050	100	11%
9	New England Hwy, further north of McCullys Gap Rd (also known as Sandy Creek Rd)	840	890	50	6%	940	100	12%

NOTE: volumes are rounded to the nearest tenth unit. Source: MUS_Flow-V2_RevB.xls

Table 7-4 AM peak one hour traffic forecasts on key roads for scenarios S1 & S4

Site ID	Road section	Direction	2007 Modelled	2020 Demand S1	Changes attributable to background growth between 2007 and 2020		2037 Demand S4	Changes attributable to background growth between 2007 and 2037	
					Volumes	%		Volumes	%
	Arterial roads:								
M-1	New England Highway, east of Bimbadeen Drive	EB	390	420	30	6%	440	50	12%
		WB	390	410	20	6%	430	40	12%
M-2	New England Highway, west of Rutherford Road	EB	540	560	20	4%	580	40	9%
		WB	610	630	20	4%	660	50	7%
M-3	Bridge Street, south of Brook Street	NB	700	730	30	4%	750	50	8%
		SB	700	730	30	4%	750	50	8%
M-4	New England Highway, south of McCullys Gap Road	NB	430	460	30	6%	480	50	12%
		SB	490	520	30	6%	550	60	11%
M-6	Sydney Street, north of Anzac Parade	NB	365	370	5	1%	380	15	3%
		SB	320	330	10	2%	340	20	4%
	Sub-arterial road:								
M-7	Denman Road, south of Racecourse Road	NB	305	310	5	2%	320	15	4%
		SB	310	320	10	2%	320	10	5%
	Collector road:								
M-5	Kayuga Road, west of Aberdeen Street	EB	125	130	5	2%	135	10	6%
		WB	55	60	5	4%	65	10	10%

NOTE: volumes are rounded to the nearest tenth unit. Source: MUS_Flow-V2_RevB.xls

Table 7-5 AM peak one hour traffic forecasts on screenlines for scenarios S2 & S5 (two way volumes) on existing network*

Screenline	Road sections	2020 Demand S1	2020 Demand S2	Changes attributable to proposed developments in 2020		2037 Demand S4	2037 Demand S5	Changes attributable to proposed developments in 2037	
				Volumes	%			Volumes	%
1	New England Hwy, south of Ironbark Rd	760	1,170	410	53%	800	1,450	650	81%
2	New England Hwy, north of Ironbark Rd	760	1,140	380	50%	800	1,340	540	67%
3	New England Hwy, east of Knapman Dr	830	1,220	390	48%	870	1,440	570	64%
4	Knapman Dr + Bimbadeen Dr, south of New England Hwy	80	790	710	864%	80	1,060	980	1191%
5	Rutherford Rd + Thompson Street + Francis Street + Lorne Street + Sydney Street, south of New England Hwy	1,690	2,890	1200	71%	1,710	3,440	1730	101%
6	New England Hwy + Acacia Dr + Woollybutt Way + Ironbark Rd, east of Rutherford Rd + Sydney Street, south of Ironbark Rd	1,930	4,220	2290	119%	1,990	5,670	3680	185%
7	Bell Street, north of New England Hwy + Bridge Street, north of Haydon Street	1,940	2,730	790	41%	2,000	3,150	1150	58%
8	New England Hwy, north of Aberdeen Street + Queen Street, west of Lexia Street	1,000	1,410	410	42%	1,050	1,580	530	50%
9	New England Hwy, further north of McCullys Gap Rd (also known as Sandy Creek Rd)	890	1,090	200	23%	940	1,250	310	33%

NOTE: * - Existing road network is the network used for the 2007 base model with additional local roads for the access of the proposed new developments but excludes the Muswellbrook Bypass. Volumes are rounded to the nearest tenth unit. Source: MUS_Flow-V2_RevB.xls

Table 7-6 AM peak one hour traffic forecasts on key roads for development case S2 & S5 on existing network*

Site ID	Road section	Direction	2020 Demand S1	2020 Demand S2	Changes attributable to proposed developments in 2020		2037 Demand S4	2037 Demand S5	Changes attributable to proposed developments in 2037	
					Volumes	%			Volumes	%
	Arterial roads:									
M-1	New England Highway, east of Bimbadeen Drive	EB	420	680	260	62%	440	900	460	104%
		WB	410	930	520	127%	430	1,430	1,000	230%
M-2	New England Highway, west of Rutherford Road	EB	560	890	330	60%	580	1,020	440	75%
		WB	630	1,150	520	81%	660	1,660	1,000	153%
M-3	Bridge Street, south of Brook Street	NB	730	1,070	340	47%	750	1,280	530	69%
		SB	730	940	210	29%	750	1,030	280	36%
M-4	New England Highway, south of McCullys Gap Road	NB	460	620	160	35%	480	730	250	52%
		SB	520	590	70	13%	550	640	90	17%
M-6	Sydney Street, north of Anzac Parade	NB	370	375	5	1%	375	380	5	1%
		SB	330	370	40	11%	340	510	170	51%
	Sub-arterial road:									
M-7	Denman Road, south of Racecourse Road	NB	310	550	240	76%	320	670	350	110%
		SB	320	780	460	147%	320	1,020	700	217%
	Collector road:									
M-5	Kayuga Road, west of Aberdeen Street	EB	130	180	50	35%	130	200	70	52%
		WB	60	130	70	116%	60	180	120	175%

NOTE: * - Existing road network is the network used for the 2007 base model with additional local roads for the access of the proposed new developments but excludes the Muswellbrook Bypass. Volumes are rounded to the nearest tenth unit. Source: MUS_Flow-V2_RevB.xls

7.3.3 Development case 2 traffic forecasts (scenarios S3 & S6) with Muswellbrook Bypass

The Roads and Traffic Authority (RTA) has explored the possibility of constructing a bypass of Muswellbrook town centre to remove conflicts between heavy vehicles and local traffic, and to improve the amenity within the town centre.

In June 2005, the Department of Transport and Regional Services (DoTaRS) approved the adoption of Modified Option E, as the preferred route for the Muswellbrook Bypass. The preliminary concept design for the preferred route has a two-lane, single carriageway bypass east of Muswellbrook, approximately 8.8km long with:

- three partial interchanges and one full interchange within the project
- two bridge crossings over the Main Northern Railway line
- two bridges over Muscle Creek and Sandy Creek
- provision of overtaking lanes in both directions.

The proposed Bypass is intended for inclusions in Council's draft shire-wide LEP, scheduled for completion in 2007/2008. RTA's final concept plan is subject to the Federal Government's final AusLink funding program.

PB tested the traffic implications of proposed Bypass on the New England Highway considering future residential/commercial developments. These were scenarios S3 and S6. As in the previous four scenarios, Table 7-7 summarises AM peak traffic forecasts for scenarios S3 and S6 on nine screenlines. Table 7-8 summarises AM peak traffic forecasts for scenarios S3 and S6 on individual roads. Some observations are noted from both Tables 7.7 and 7.8:

- the proposed Bypass would effectively reduce regional though traffic on the New England Highway in the town centre
- the reduction in traffic on the New England Highway varied between 17% and 24%, depending on the section of the Highway considered
- the bypass was modelled to divert around 300 vehicles per peak hour by the end of the next 30 year period
- the bypass would reduce daily traffic on the New England Highway by between 2500 and 4600 vehicles based on origin destination (OD) patterns observed in 2002
- traffic reduction was significant only along the New England Highway. Other roads, such as Sydney Street and Denman Road showed little or no change due to the proposed Bypass.

Table 7-7 AM peak one hour traffic forecasts on screenlines for development case S3 & S6 with Muswellbrook Bypass

Screenline	Road sections	2020 Demand S2	2020 Demand S3	Changes attributable to proposed Muswellbrook Bypass in 2020		2037 Demand S5	2037 Demand S6	Changes attributable to proposed Muswellbrook Bypass in 2037	
				Volumes	%			Volumes	%
1	New England Hwy, south of Ironbark Rd	1,170	1,170	0	0%	1,450	1,450	0	0%
2	New England Hwy, north of Ironbark Rd	1,140	1,150	10	1%	1,340	1,390	50	4%
3	New England Hwy, east of Knapman Dr	1,220	830	-390	-32%	1,440	1,000	-440	-30%
4	Knapman Dr + Bimbadeen Dr, south of New England Hwy	790	790	0	0%	1,060	1,070	10	0%
5	Rutherford Rd + Thompson Street + Francis Street + Lorne Street + Sydney Street, south of New England Hwy	2,890	2,890	0	0%	3,440	3,400	-40	-1%
6	New England Hwy + Acacia Dr + Woollybutt Way + Ironbark Rd, east of Rutherford Rd + Sydney Street, south of Ironbark Rd	4,220	3,820	-400	-9%	5,670	5,190	-480	-8%
7	Bell Street, north of New England Hwy + Bridge Street, north of Haydon Street	2,730	2,340	-390	-15%	3,150	2,670	-480	-15%
8	New England Hwy, north of Aberdeen Street + Queen Street, west of Lexia Street	1,410	1,160	-250	-18%	1,580	1,250	-330	-21%
9	New England Hwy, further north of McCullys Gap Rd (also known as Sandy Creek Rd)	1,090	1,090	0	0%	1,250	1,250	0	0%

NOTE: Volumes are rounded to the nearest tenth unit. Source: MUS_Flow-V2_RevB.xls

Table 7-8 AM peak one hour traffic forecasts on screenlines for development case S3 & S6 with Muswellbrook bypass

Site ID	Road section	Direction	2020 Demand S2	2020 Demand S3	Changes attributable to proposed Muswellbrook bypass in 2020		2037 Demand S5	2037 Demand S6	Changes attributable to proposed Muswellbrook bypass in 2037	
					Volumes	%			Volumes	%
	Arterial roads:									
M-1	New England Highway, east of Bimbadeen Drive	EB	680	490	-190	-28%	900	690	-210	-23%
		WB	930	730	-200	-22%	1,430	1,210	-220	-16%
M-2	New England Highway, west of Rutherford Road	EB	890	700	-190	-21%	1,020	810	-210	-20%
		WB	1,150	940	-210	-18%	1,660	1,410	-250	-15%
M-3	Bridge Street, south of Brook Street	NB	1,070	900	-170	-16%	1,280	1,050	-230	-18%
		SB	940	790	-150	-16%	1,030	850	-180	-17%
M-4	New England Highway, south of McCullys Gap Road	NB	620	480	-140	-22%	730	550	-180	-25%
		SB	590	470	-120	-20%	640	500	-140	-22%
M-6	Sydney Street, north of Anzac Parade	NB	370	370	-	-	380	380	-	-
		SB	370	370	-	-	510	510	-	-
	Sub-arterial road:									
M-7	Denman Road, south of Racecourse Road	NB	550	550	-	-	670	670	-	-
		SB	780	780	-	-	1,020	1,020	-	-
	Collector road:									
M-5	Kayuga Road, west of Aberdeen Street	EB	180	180	-	-	200	200	-	-
		WB	130	130	-	-	180	180	-	-

NOTE: Volumes are rounded to the nearest tenth unit. Source: MUS_Flow-V2_RevB.xls

7.3.4 Impact on network

Traffic increases of the magnitude forecast over the next 30-year period place significant new demands on the existing road network at Muswellbrook. An indication of this demand is gained from examining the traffic loadings on the network forecast for 2037. The loadings are illustrated on Figures 7.2 to 7.6 in the form of traffic bands and volume to capacity (v/c) ratios on the network. We measured volume/capacity ratios because as systems approach design capacity, their performance becomes less predictable and more unstable. The notional volume/capacity (v/c) ratio (i.e. the degree of congestion) is presented in four bands:

- no capacity problems (v/c <0.50) Road improvements not justified
- acceptable capacity (v/c >0.50 but <0.80) Road improvements may be justified
- approaching capacity (v/c >0.80 but <1.0) Road improvements can be justified
- Over capacity (v/c >1). Road improvements clearly justified.

Figure 7-2 shows v/c ratios for 2007. Results show that:

- no capacity concerns on the New England Highway. However, turning traffic causes some delays at key intersections (Rutherford Road, Thompson Street, Haydon Street and Hunter Street) on the New England Highway (see Table 4-7 for intersection delay and LoS)
- Figure 7-3 and Figure 7-5 show the impact of additional traffic from the development cases on the existing network. There would be increased use of New England Highway at Bimbadeen Drive and Rutherford Road. The railway underpass on the New England Highway would be subject to this traffic growth
- Figure 7-4 and Figure 7-6 show forecast v/c ratios with the proposed Bypass for 2020 and 2037 respectively. The traffic model indicated the proposed Bypass would reduce traffic on the New England Highway by 17% to 24%, but it is unlikely to eliminate turning traffic delays at local street intersections. This is forecast to remain an issue, particularly at Bimbadeen Drive, Rutherford Road, Thompson Street and Hunter Street intersections, where local traffic growth will reduce intersection performance even if the Bypass were built.

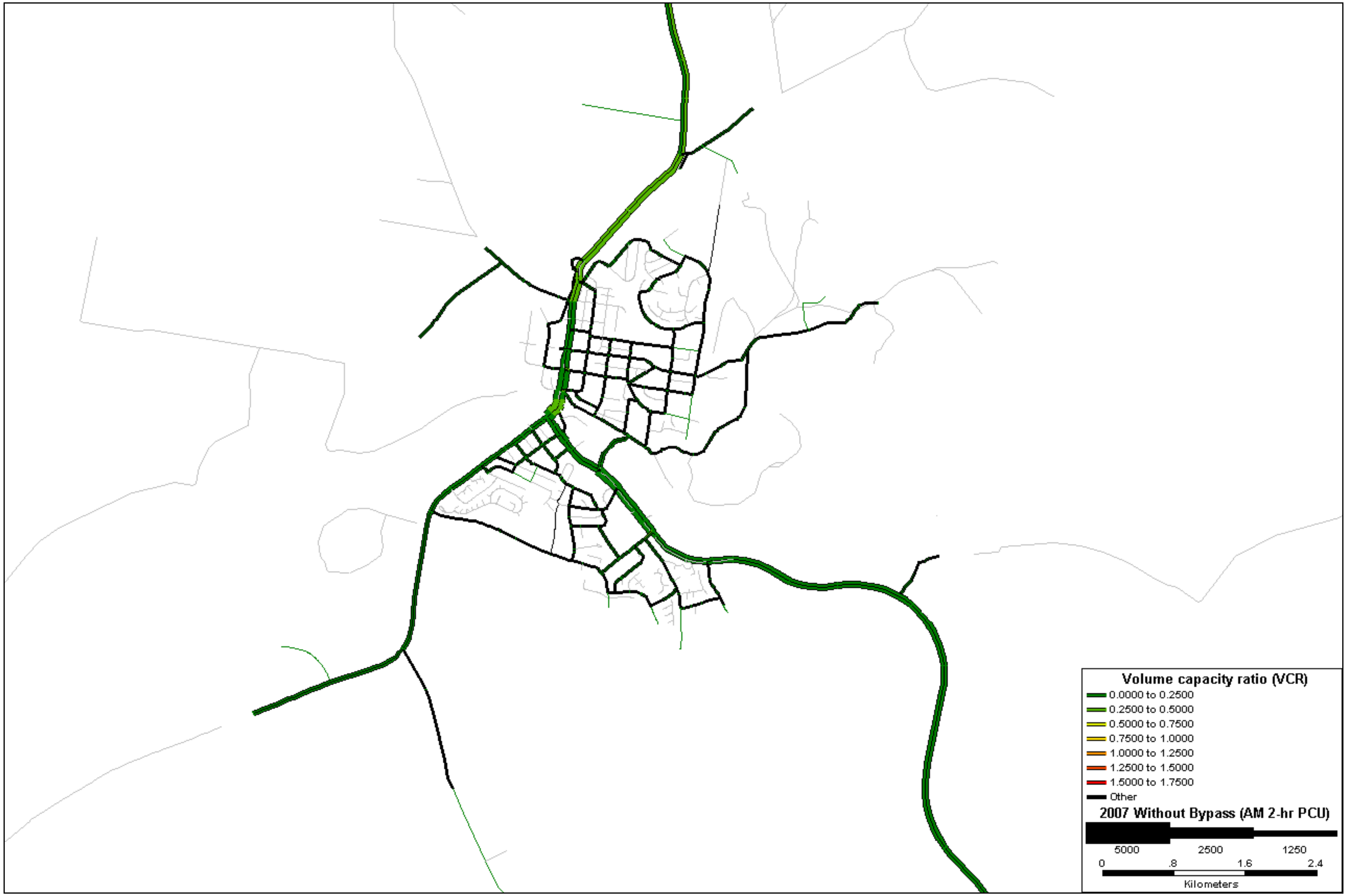


Figure 7-2 Flow and volume capacity ratio (VCR) plot for 2007

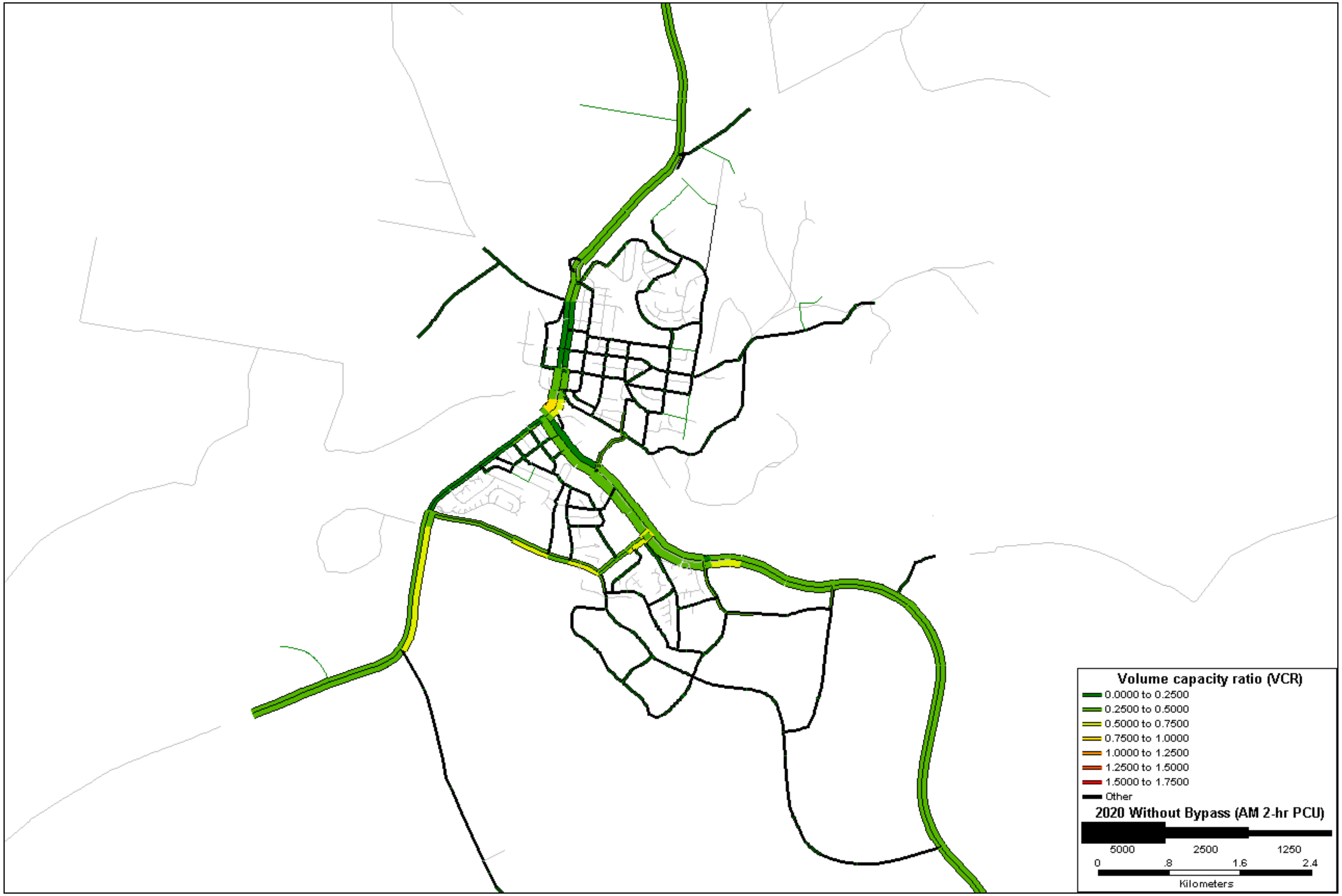


Figure 7-3 Flow and volume capacity ratio (VCR) plot for 2020, without Muswellbrook Bypass

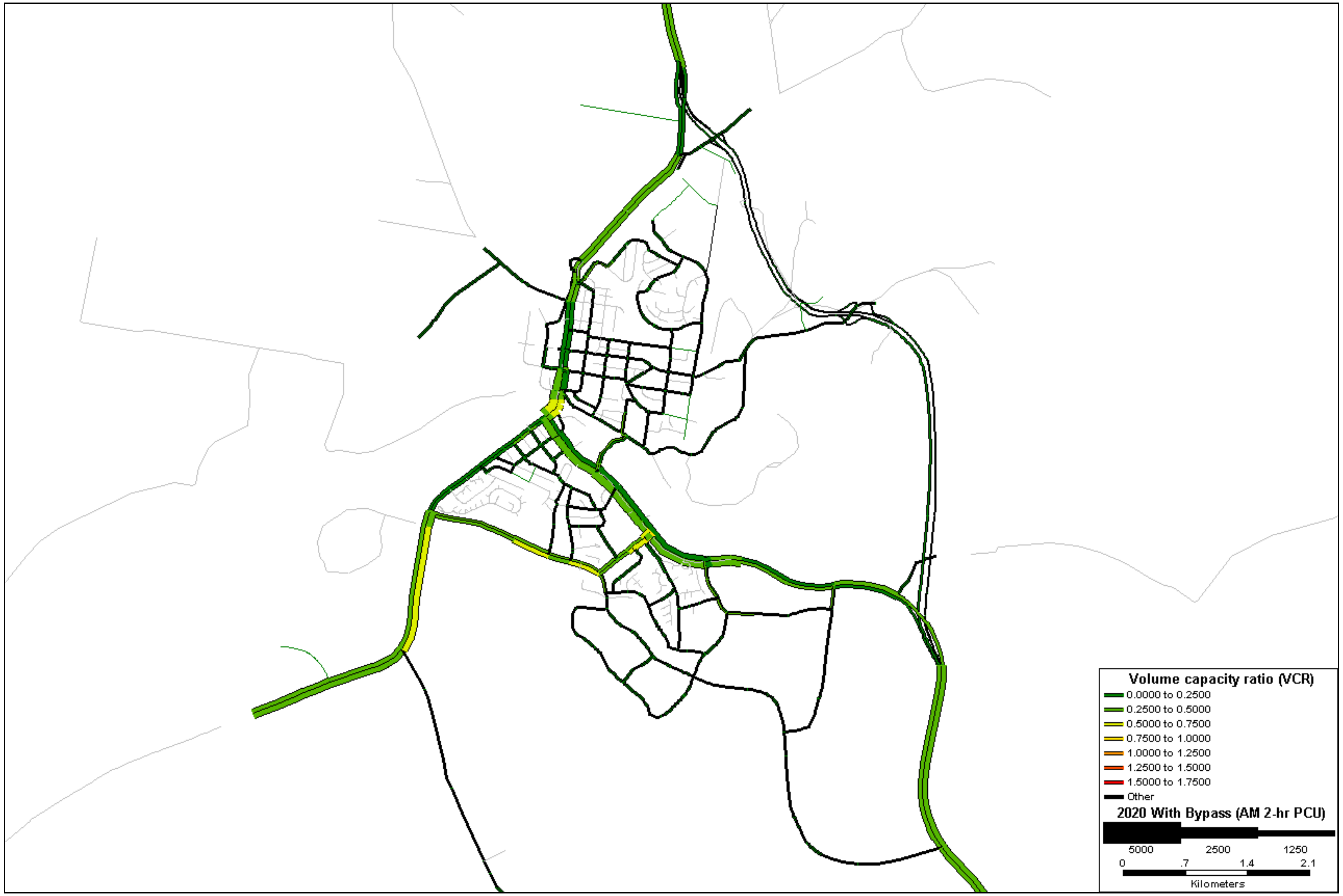


Figure 7-4 Flow and volume capacity ratio (VCR) plot for 2020, with Muswellbrook Bypass

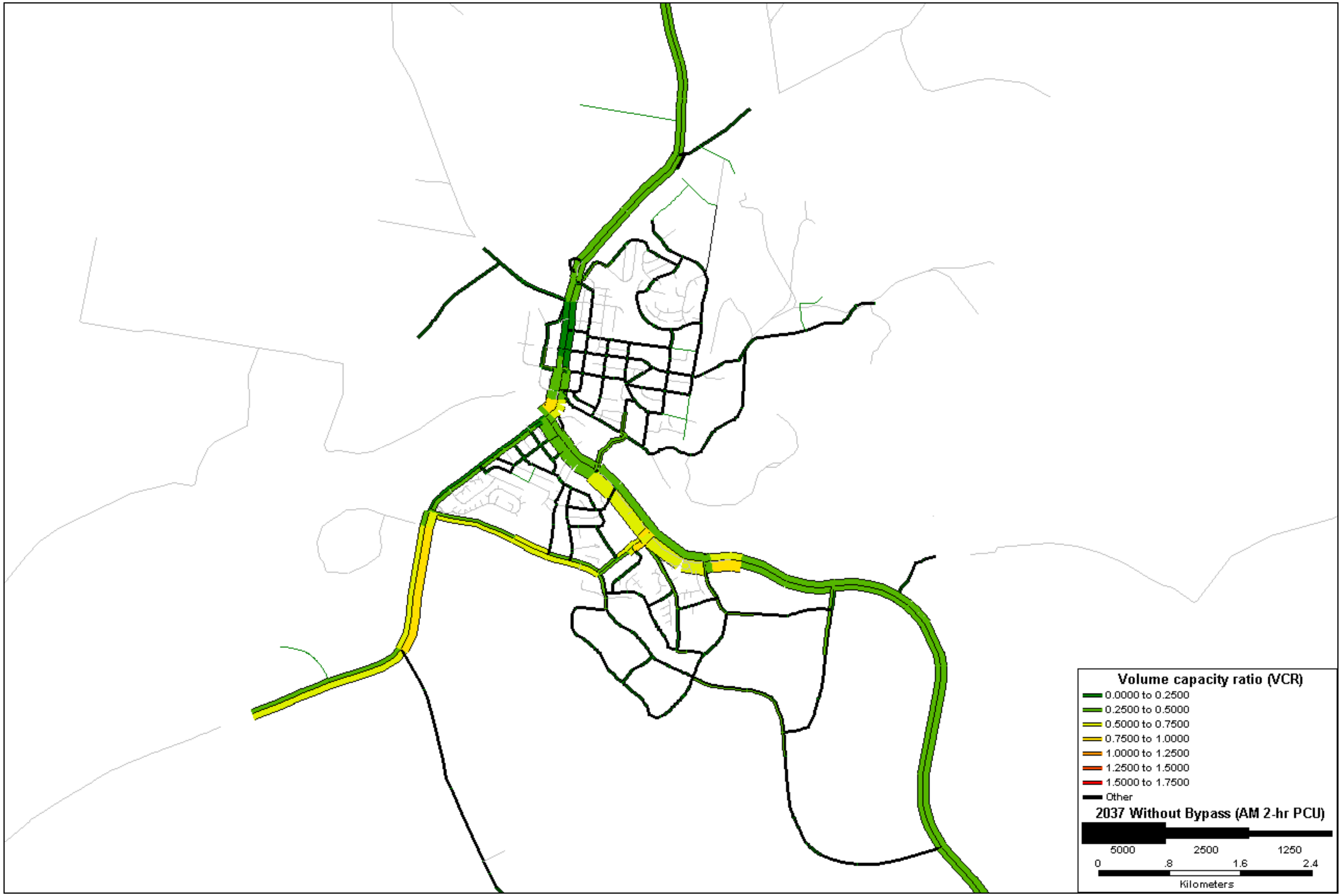


Figure 7-5 **Flow and volume capacity ratio (VCR) plot for 2037, without Muswellbrook Bypass**

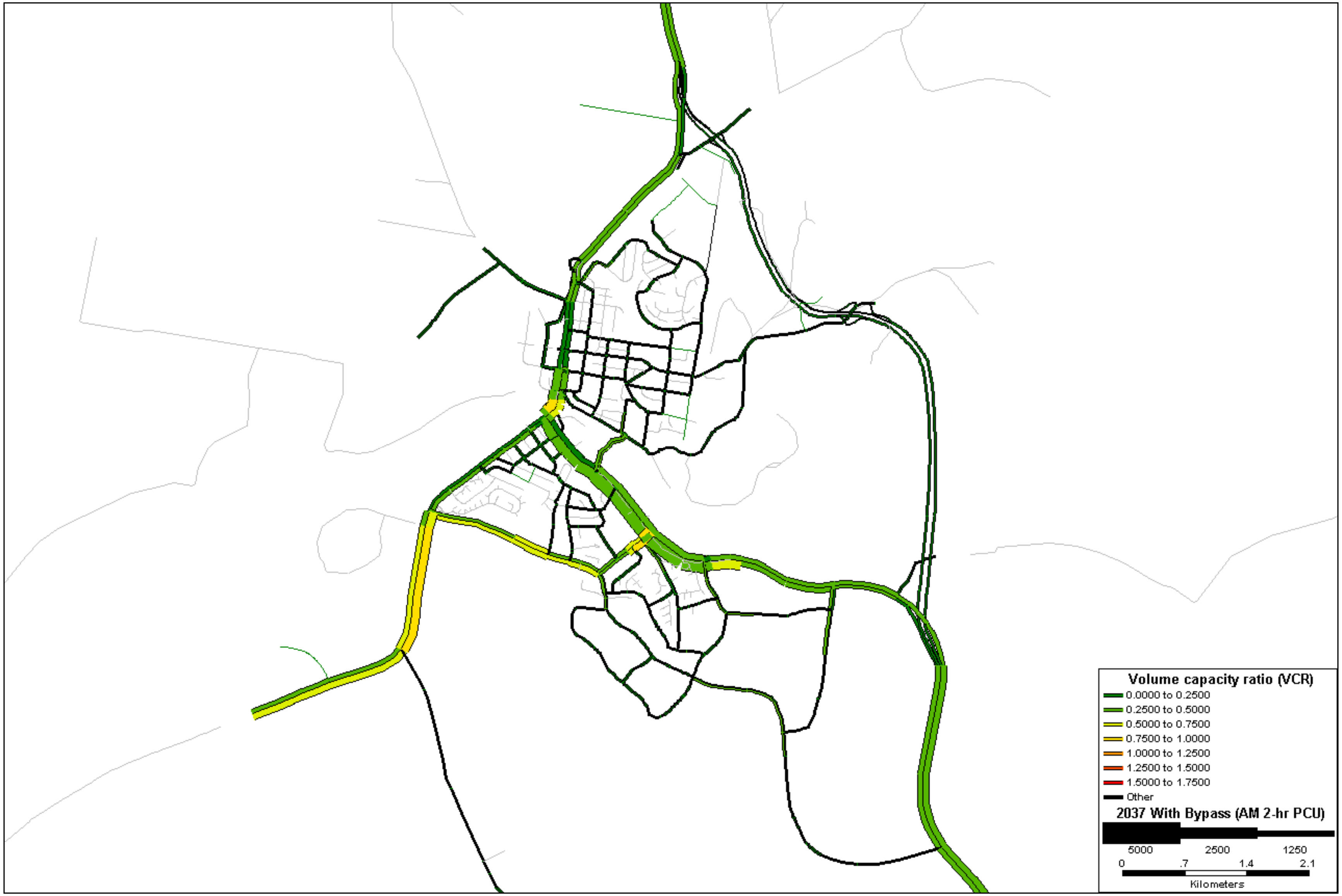


Figure 7-6 Flow and volume capacity ratio (VCR) plot for 2037, with Muswellbrook Bypass

8. Intersection performance and upgrade plans

8.1 Overview

- Muswellbrook's road network will need to be upgraded progressively over the next 30 years to cater for traffic from the future developments
- timing of the individual road and intersection improvements will depend on the rate of residential and commercial development
- for the purpose of predicting traffic, all future developments were assumed to occur and be occupied between 2007 and 2037
- the performance of key intersections were assessed for all six scenarios (S1 to S6) for both the AM and PM peak hour traffic to determine the extent of any intersection improvements attributable to the proposed developments
- estimates of turning movements at intersections for each scenario were derived from the Muswellbrook Model
- design improvement works at critical intersections were forecast for 2037 as the worst case. Any upgrading work needed by 2037 should also work for 2020, as growth in 2020 was assumed to be lower than in 2037.

Improvements due to the Muswellbrook Bypass were assessed in a four step process:

- scenarios S4 (natural growth on the 2037 network) and S5 (future development on the 2037 network) models were run assuming no bypass
- potential improvements were identified at critical intersections which showed capacity problems (LoS F or DoS >1.0)
- the SIDRA model was run iteratively at the intersections with different assumed improvements until a satisfactory LoS was obtained
- the S6 (future development on the 2037 network) model was run to see if improvements identified in the third step were still needed if the bypass was built.

8.1.1 Impact of background growth – scenario S4 (natural growth on the 2037 network without the bypass)

Table 8-1 gives a summary of intersection performances under background traffic growth assumptions for year 2037. For comparison, we have also included 2007 model results so that incremental impact attributable to future background growth could be identified. As expected, some small growth was observed as future DoS and queue lengths were marginally higher than 2007 forecasts. Capacity problems were identified at four intersections along the New England Highway under 2007 traffic conditions.

- New England Highway/Rutherford Road
- New England Highway/Thompson Street
- New England Highway/Haydon Street
- New England Highway/Hunter Street.

At these intersections, turning traffic to and from the local intersecting roads is delayed but given the low background traffic forecast through 2037 (assuming no future development), there was no further impetus to improve these intersections or justify expenditure on capacity grounds.

Table 8-1 Intersection LoS for scenario S4 – impact of background traffic

Site ID	Intersection	Intersection Control	AM Peak								PM Peak							
			2007 Model				2037 Scenario S4				2007 Model				2037 Scenario S4			
			DoS	Delays (sec)	LoS	Queue (m)	DoS	Delays (sec)	LoS	Queue (m)	DoS	Delays (sec)	LoS	Queue (m)	DoS	Delays (sec)	LoS	Queue (m)
I-01	Bimbadeen Dr/New England Hwy	Give-way	0.19	21	B	1	0.21	24	B	2	0.24	28	B	4	0.27	33	C	4
I-02	Acacia Dr/Bloodwood Rd	Give-way	0.01	7	A	0	0.01	7	A	0	0.02	7	A	1	0.02	7	A	1
I-03	Rutherford Rd/New England Hwy	Give-way	0.42	54	D	19	0.48	73	F	21	1.00	243	F	51	1.00	289	F	53
I-04	Rutherford Rd/Acacia Dr	Give-way	0.17	9	A	6	0.17	9	A	6	0.11	9	A	3	0.11	9	A	3
I-05	Rutherford Rd/Ironbark Rd	Give-way	0.05	7	A	1	0.05	7	A	1	0.07	7	A	2	0.07	7	A	2
I-07	Adams Street/Ruth White Ave	Give-way	0.03	7	A	1	0.03	7	A	1	0.05	7	A	1	0.05	7	A	1
I-08	Thompson Street/New England Hwy	Give-way	0.50	56	D	16	0.60	75	F	20	0.65	111	F	20	0.85	191	F	30
I-09	Sydney Street/Mitchell Street	Give-way	0.18	13	A	0	0.18	13	A	0	0.23	15	B	1	0.22	15	B	1
I-10	Sydney Street/Skellatar Stock Route	Give-way	0.18	12	A	12	0.19	13	A	12	0.22	14	A	15	0.23	15	B	16
I-12	Sydney Street/New England Hwy	Signals	0.47	20	B	93	0.51	20	B	103	0.56	19	B	108	0.59	20	B	117
I-13	Haydon Street/New England Hwy	Give-way	0.18	29	C	11	0.34	39	C	13	0.35	50	D	14	0.59	76	F	19

Site ID	Intersection	Intersection Control	AM Peak								PM Peak							
			2007 Model				2037 Scenario S4				2007 Model				2037 Scenario S4			
			DoS	Delays (sec)	LoS	Queue (m)	DoS	Delays (sec)	LoS	Queue (m)	DoS	Delays (sec)	LoS	Queue (m)	DoS	Delays (sec)	LoS	Queue (m)
I-14	Bell Street/New England Hwy	Signals	0.43	13	A	42	0.46	13	A	45	0.56	13	A	50	0.60	13	A	54
I-15	Bridge Street/William Street	Roundabout	0.35	6	A	18	0.37	6	A	20	0.41	7	A	22	0.43	7	A	25
I-16	Bridge Street/Brook Street	Signals	0.53	30	C	80	0.55	29	C	87	0.86	37	C	105	0.86	36	C	113
I-17	Doyle Street/George Street	Roundabout	0.12	5	A	6	0.13	5	A	6	0.10	5	A	5	0.15	4	A	7
I-18	New England Hwy/Hunter Street	Give-way	0.24	26	B	8	0.30	33	C	10	0.42	45	D	14	0.56	65	E	19
I-19	Lexia Street/Queen Street	Give-way	0.02	7	A	1	0.02	7	A	1	0.02	7	A	1	0.02	7	A	1
I-20	Semilion Street/Cook Street	Roundabout	0.13	7	A	6	0.13	7	A	6	0.12	6	A	5	0.12	6	A	5
I-21	Brecht Street/Brentwood Street	Stop control	0.05	11	A	1	0.03	10	A	1	0.06	11	A	2	0.03	10	A	1

8.1.2 Impact of development traffic – scenario S5 (future development on the 2037 network with no Bypass)

- Table 8-2 gives a summary of intersection performance if all the proposed developments were occupied in 2037 (Scenario S5)
- SIDRA was applied to a proposed access onto the New England Highway with Knapman Drive, built as apart of Eastbrook Links Estate. We have not modelled internal access roads from each proposed developments
- the three intersection parameters considered were DoS, LoS and queue length. For Give-way or Stop sign controlled intersections, DoS and queue length were important rather than LoS alone. For comparison, we also included 2037 scenario S4 (background growth) model results so that the incremental impact attributable to traffic generated by future developments could be identified.

In assessing model results from Table 8-2, we determined development traffic impact in two ways:

- level 1 impact: Intersections which showed capacity problems as a direct consequence of traffic from proposed developments. For instance, if LoS dropped from B or C to F, in conjunction with higher DoS, and queue length, then we considered this as level 1 impact
- level 2 impact: Intersections which already showed some capacity constraints (existing condition or for future background growth) particularly from turning traffic to/from local adjoining roads with New England Highway. If both DoS and queue length were affected as a result of the proposed developments, then we considered this as level 2 impacts. For instance, LoS values may not have changed while DoS and/or queue length increased significantly.

Table 8-3 lists five intersections at Level 1 and six intersections at Level 2.

- this approach demonstrated a nexus between the proposed developments and intersection upgrading works for the apportionment of Section 94 contributions. This can transparently explain the apportionment of costs for upgrades among proponents, Council as local road authority and RTA as State road authority
- although this approach provided an equitable apportionment among various stakeholders, without the future developments our analysis did not suggest immediate upgrading works were required or justified. On this basis, developers may be responsible for large proportion of any intersection upgrading works. A detailed cost apportionment may be investigated further when Council updates its Section 94 Plan.

Table 8-2 Intersection LoS for scenario S5 – impact of development traffic

Site ID	Intersection	Intersection Control	AM Peak								PM Peak							
			2037 Scenario S4 (no future development)				2037 Scenario S5 (with future developments)				2037 Scenario S4 (no future development)				2037 Scenario S5 (with future developments)			
			DoS	Delays (sec)	LoS	Queue (m)	DoS	Delays (sec)	LoS	Queue (m)	DoS	Delays (sec)	LoS	Queue (m)	DoS	Delays (sec)	LoS	Queue (m)
I-01	Bimbadeen Dr/New England Hwy	Give-way	0.21	24	B	2	1.06	>300	F	139	0.27	33	C	4	1.00	>300	F	101
I-02	Acacia Dr/Bloodwood Rd	Give-way	0.01	7	A	0	0.11	8	A	2	0.02	7	A	1	0.13	9	A	2
I-03	Rutherford Rd/New England Hwy	Give-way	0.48	73	F	21	>1.40	>300	F	>600	1.00	289	F	53	>1.40	>300	F	>600
I-04	Rutherford Rd/Acacia Dr	Give-way	0.17	9	A	6	>1.40	>300	F	>600	0.11	9	A	3	1.09	201	F	127
I-05	Rutherford Rd/Ironbark Rd	Give-way	0.05	7	A	1	0.85	28	B	71	0.07	7	A	2	0.98	57	E	134
I-07	Adams Street/Ruth White Ave	Give-way	0.03	7	A	1	0.05	7	A	2	0.05	7	A	1	0.09	7	A	2
I-08	Thompson Street/New England Hwy	Give-way	0.60	75	F	20	1.00	>300	F	148	0.85	191	F	30	1.00	>300	F	>300
I-09	Sydney Street/Mitchell Street	Give-way	0.18	13	A	0	0.29	17	B	1	0.22	15	B	1	0.34	21	B	2
I-10	Sydney Street/Skellatar Stock Route	Give-way	0.19	13	A	12	0.71	24	B	68	0.23	15	B	16	0.99	68	E	>300
I-12	Sydney Street/New England Hwy	Signals	0.51	20	B	103	1.04	32	C	>400	0.59	20	B	117	1.06	41	C	>400
I-13	Haydon Street/New England Hwy	Give-way	0.34	39	C	13	1.00	>300	F	72	0.59	76	F	19	1.00	>300	F	163

Site ID	Intersection	Intersection Control	AM Peak								PM Peak							
			2037 Scenario S4 (no future development)				2037 Scenario S5 (with future developments)				2037 Scenario S4 (no future development)				2037 Scenario S5 (with future developments)			
			DoS	Delays (sec)	LoS	Queue (m)	DoS	Delays (sec)	LoS	Queue (m)	DoS	Delays (sec)	LoS	Queue (m)	DoS	Delays (sec)	LoS	Queue (m)
I-14	Bell Street/New England Hwy	Signals	0.46	13	A	45	1.02	25	B	164	0.60	13	A	54	1.24	42	C	291
I-15	Bridge Street/William Street	Roundabout	0.37	6	A	20	0.61	6	A	48	0.43	7	A	25	0.90	10	A	73
I-16	Bridge Street/Brook Street	Signals	0.55	29	C	87	0.71	30	C	129	0.86	36	C	113	1.00	47	D	245
I-17	Doyle Street/George Street	Roundabout	0.13	5	A	6	0.13	5	A	6	0.15	4	A	7	0.13	5	A	6
I-18	New England Hwy/Hunter Street	Give-way	0.30	33	C	10	0.92	154	F	45	0.56	65	E	19	1.00	>300	F	60
I-19	Lexia Street/Queen Street	Give-way	0.02	7	A	1	0.11	7	A	3	0.02	7	A	1	0.13	7	A	3
I-20	Semilion Street/Cook Street	Roundabout	0.13	7	A	6	0.16	6	A	7	0.12	6	A	5	0.16	6	A	7
I-21	Brecht Street/Brentwood Street	Stop control	0.03	10	A	1	0.05	11	A	1	0.03	10	A	1	0.07	11	A	2

Table 8-3 Type of impact at intersections for scenario S5

Site ID	Intersection	Existing Control	Impact			Impacts for development traffic
			Level 1	Level 2	Which Peak	
I-01	Bimbadeen Dr/New England Hwy	Give-way	√		AM & PM	DoS increased from 0.2 to 1.1; LoS dropped from B(AM)/C(PM) to F; Queue increased from 30m to >100m.
I-03	Rutherford Rd/New England Hwy	Give-way		√	AM & PM	DoS increased from 0.5(AM)/1.0(PM) to >1.4; LoS remain unchanged at F; Queue increased significantly.
I-04	Rutherford Rd/Acacia Dr	Give-way	√		AM & PM	DoS increased from 0.2 to >1.4; LoS dropped from A to F; Queue increased significantly.
I-05	Rutherford Rd/Ironbark Rd	Give-way	√		PM	DoS increased from 0.1 to 1.0; LoS dropped from A to E; Queue increased from 5m to 130m.
I-08	Thompson Street/New England Hwy	Give-way		√	AM & PM	DoS increased from 0.6(AM)/0.9(PM) to 1.0; LoS remain unchanged at F; Queue increased from 30m to >300m.
I-10	Sydney Street/Skellatar Stock Route	Give-way	√		PM	DoS increased from 0.2 to 1.0; LoS dropped from B to E; Queue increased from 15m to >300m.
I-12	Sydney Street/New England Hwy	Signals		√	AM & PM	DoS increased from 0.6 to 1.0; LoS dropped from B to C; Queue increased from 120m to >300m.
I-13	Haydon Street/New England Hwy	Give-way		√	AM & PM	DoS increased from 0.3(AM)/0.6(PM) to 1.0; LoS dropped from C(AM)/F(PM) to F; Queue increased from 20m to >160m.
I-14	Bell Street/New England Hwy	Signals		√	AM & PM	DoS increased from 0.5(AM)/0.6(PM) to >1.0; LoS dropped from A to B(AM)/C(PM); Queue increased from 50m to 300m.
I-16	Bridge Street/Brook Street	Signals		√	PM	DoS increased from 0.9 to 1.0; LoS dropped from C to D; Queue increased from 110m to 250m.
I-18	New England Hwy/Hunter Street	Give-way	√		AM & PM	DoS increased from 0.3(AM)/0.6(PM) to 1.0; LoS dropped from C(AM)/E(PM) to F; Queue increased from 20m to 60m.

8.1.3 Impact of development traffic with Muswellbrook Bypass – scenario S6 *(future development on the 2037 network with Bypass)*

- Section 7.3.3 showed that the Bypass is predicted to reduce traffic levels on segments of the New England Highway between 17 percent and 24 percent on the 30 year forecasts based on the 2002 OD survey
- we tested the implications of traffic reductions on intersection operations along the New England Highway and compared the results with the results for Scenario S5 (no Bypass)
- the Bypass will divert future New England Highway traffic from the town and, hence would improve effective capacity at key intersections including Bimbadeen Drive, Rutherford Road, Hunter Street, and Thompson Street. Local traffic growth will be the key factor in determining when these intersections require upgrades
- our analysis indicated that even with the Bypass, key intersections along the New England Highway were unlikely to be relieved of upgrading if development growth occurs as locally generated traffic would dominate intersection performance.

8.2 Concepts for road works and intersection improvements

- Sections 8.1.1 to 8.1.3 identified deficient performance at 11 intersections as a result of proposed developments (see Table 8-3 for list of intersections)
- effective upgrading works included a range of traffic control measures including seagulls, signals and roundabouts
- appropriate storage lanes were provided to accommodate the forecast queue lengths at each intersection
- a number of improvement options were tested for New England Highway intersections not only at the individual intersections level but from a network perspective. For instance, Table 8-5 has conceptual traffic works required to minimise performance impacts from proposed developments. The proposed improvements are mainly driven by capacity constraints rather than by road safety
- local intersection improvements were also taken from the South Muswellbrook Traffic Study and included in Table 8-5
- LATM and speeding on local roads have been assessed in Section 9 using the results from the model when necessary
- figures 8-1 to 8-16 provide conceptual layouts for intersection upgrade works. Council did comment of draft concepts and this feedback was included in the revised concept plans. The SIDRA model was run iteratively to test the performance of proposed works. To look at maximum potential traffic stress case, we tested full development without a Bypass.
- Table 8-6 summarises intersection performance forecast with proposed traffic works. It shows proposed traffic works would improve intersection performance The corresponding degrees of saturation (DoS) and queue lengths were also forecast to improve. In summary, the package of traffic management measures described in Table

8-5 would be reasonably expected to deliver satisfactory service on the Muswellbrook road network even if all proposed developments go forward.

It should be noted that the recommendations are only strategic decisions with respect to future Roads Infrastructure. It is not intended to undermine the integrity or intent of the existing Capital Works program.

Table 8-4 Intersection LoS for scenario S6 – impact of development traffic with Muswellbrook bypass

Site ID	Intersection	Intersection Control	AM Peak								PM Peak							
			2037 Scenario S5 (No Muswellbrook Bypass)				2037 Scenario S6 (With Muswellbrook Bypass)				2037 Scenario S5 (No Muswellbrook Bypass)				2037 Scenario S6 (With Muswellbrook Bypass)			
			DoS	Delays (sec)	LoS	Queue (m)	DoS	Delays (sec)	LoS	Queue (m)	DoS	Delays (sec)	LoS	Queue (m)	DoS	Delays (sec)	LoS	Queue (m)
I-01	Bimbadeen Dr/New England Hwy	Give-way	1.06	>300	F	139	0.91	526	F	74	1.00	>300	F	101	1.00	>300	F	55
I-02	Acacia Dr/Bloodwood Rd	Give-way	0.11	8	A	2	0.09	8	A	1	0.13	9	A	2	0.10	8	A	2
I-03	Rutherford Rd/New England Hwy	Give-way	>1.40	>300	F	>600	>1.40	>300	F	>600	>1.40	>300	F	>600	>1.40	>300	F	>600
I-04	Rutherford Rd/Acacia Dr	Give-way	>1.40	>300	F	>600	>1.40	>300	F	>600	1.09	201	F	127	1.09	198	F	122
I-05	Rutherford Rd/Ironbark Rd	Give-way	0.85	28	B	71	0.84	27	B	71	0.98	57	E	134	0.97	52	D	125
I-07	Adams Street/Ruth White Ave	Give-way	0.05	7	A	2	0.05	7	A	2	0.09	7	A	2	0.09	7	A	2
I-08	Thompson Street/New England Hwy	Give-way	1.00	>300	F	148	1.00	>300	F	85	1.00	>300	F	>300	1.00	>300	F	152
I-09	Sydney Street/Mitchell Street	Give-way	0.29	17	B	1	0.29	17	B	1	0.34	21	B	2	0.34	21	B	2
I-10	Sydney Street/Skellatar Stock Route	Give-way	0.71	24	B	68	0.71	24	B	68	0.99	68	E	>300	0.99	68	E	>300
I-12	Sydney Street/New England Hwy	Signals	1.04	32	C	>400	0.81	23	B	210	1.06	41	C	>400	1.00	32	C	286

Site ID	Intersection	Intersection Control	AM Peak								PM Peak							
			2037 Scenario S5 (No Muswellbrook Bypass)				2037 Scenario S6 (With Muswellbrook Bypass)				2037 Scenario S5 (No Muswellbrook Bypass)				2037 Scenario S6 (With Muswellbrook Bypass)			
			DoS	Delays (sec)	LoS	Queue (m)	DoS	Delays (sec)	LoS	Queue (m)	DoS	Delays (sec)	LoS	Queue (m)	DoS	Delays (sec)	LoS	Queue (m)
I-13	Haydon Street/New England Hwy	Give-way	1.00	>300	F	72	1.00	>300	F	51	1.00	>300	F	163	1.00	>300	F	90
I-14	Bell Street/New England Hwy	Signals	1.02	25	B	164	0.87	17	B	110	1.24	42	C	291	1.19	29	C	157
I-15	Bridge Street/William Street	Roundabout	0.61	6	A	48	0.52	6	A	35	0.90	10	A	73	0.73	8	A	44
I-16	Bridge Street/Brook Street	Signals	0.71	30	C	129	0.80	32	C	99	1.00	47	D	245	1.00	44	D	175
I-17	Doyle Street/George Street	Roundabout	0.13	5	A	6	0.12	5	A	6	0.13	5	A	6	0.12	5	A	6
I-18	New England Hwy/Hunter Street	Give-way	0.92	154	F	45	0.43	36	C	15	1.00	>300	F	60	0.71	87	F	25
I-19	Lexia Street/Queen Street	Give-way	0.11	7	A	3	0.11	7	A	3	0.13	7	A	3	0.13	7	A	3
I-20	Semilion Street/Cook Street	Roundabout	0.16	6	A	7	0.15	7	A	7	0.16	6	A	7	0.15	6	A	7
I-21	Brecht Street/Brentwood Street	Stop control	0.05	11	A	1	0.05	11	A	1	0.07	11	A	2	0.07	11	A	2

Table 8-5 Summary of intersection upgrading works (worst case scenario "without Muswellbrook Bypass")

Site ID	Intersection	Existing Control	Proposed Control	Potential Improvements
I-01	Bimbadeen Dr/New England Hwy/New access road	Give-way	New Signals	Two options were tested. Option-1 involved new signals with three approaches. Option 2 is similar to option 1 but with a possible new access connecting eastern side development on the New England Highway (near Caravan Park). This new access will form the fourth approach at this intersection. Specific traffic works are: 1. pedestrian crossing at all approaches. 2. provide a 65m left turn lane with right lane on Bimbadeen Dr. 3. provide a 130m right turn lane on New England Hwy (west approach). 4. widen New England Hwy, approx 200m east of Bimbadeen Dr to 4-lanes. See Figure 8-1 for Option-1 and 2 concept plan).
I-02	Acacia Dr/Bloodwood Rd	Give-way	Give-way	Minor widening with channelisation work is required (source: South Muswellbrook Traffic Study). LATM measure may improve speeding issue on the Bloodwood Road.
I-03	Rutherford Rd/New England Hwy	Give-way	New Seagull or Signals	Three options were tested. Option-1 involved upgrading existing intersection to a new full seagull. Option 2 involved new traffic signals with pedestrian crossing at two approaches. Option 3 is similar to option 2, but with pedestrian crossing at all three approaches. Other specific works as part of new signals: 1. provide a 100m left turn lane on Rutherford Rd. 2. provide a 100m left turn lane on New England Hwy (east approach) 3. provide a 250m right turn lane on New England Hwy (west approach). See Figure 8-2 for options concept plan. LoS results from Table 8-6 shows that under seagull option, intersection still will experience heavy delays to and from Rutherford Road turning traffic. New signals appear to be preferred option.
I-04	Rutherford Rd/Acacia Dr	Give-way	New Roundabout	Upgrade to a single-lane roundabout. See Figure 8-2.
I-05	Rutherford Rd/Ironbark Rd	Give-way	New Roundabout	Upgrade to a single-lane roundabout. See Figure 8-3.

Site ID	Intersection	Existing Control	Proposed Control	Potential Improvements
I-08	Thompson Street/New England Hwy	Give-way	New Seagull or Signals	We tested two options. Option-1 Upgrade to full seagull arrangements providing a sufficient storage capacity for turning movements. See Figure 8-4 (Option-1). Option-2: New signals with pedestrian crossings at all three approaches. See Figure 8-5 (Option-2). From capacity perspectives, both options should work. Currently there are three signals on the New England Highway between Bimbadeen Dr and Sydney Street. This section of New England Highway is about 2.5 km and with proposed new two signals at Rutherford Road and Bimbadeen Dr, effective signals spacing will be about 500 meters. Another new Signal at Thompson Street would have negative implication on through traffic performance on the New England Highway. A full seagull at Thompson Street will have sufficient gap for turning traffic arise from adjacent signals at Bell Street and Rutherford Road. On this basis, a seagull at Thompson Street/New England Hwy can be preferred option.
I-10	Sydney Street/Skellatar Stock Route	Give-way	New Seagull	Upgrade to painted seagull arrangements initially providing a sufficient storage capacity for turning movements. With development taking place gradually, a full seagull (with concrete median) is recommended. See Figure 8-6.
I-12	Maitland Rd/Sydney Street	Signals	Signals	Upgrade existing signals to provide additional capacity. Key traffic works include: 1. provide a dual right turn lanes with a shared left turn on Maitland Street (east approach). 2. extend the right turn bay to 200m on Sydney Street (south approach). 3. extend the left turn bay to 130m on Sydney Street (north approach). See Figure 8-7.
I-13	Haydon Street/New England Hwy	Give-way	Give-way	Option 1: Modify this intersection to left-in-left-out arrangement. See Figure 8-8A. A number of key intersections between Bimbadeen Dr and Brook Street are likely to be affected from increased development. Our modelling results in Table 8-3 showed such impact. Haydon Street (with New England Highway) is at close proximity with two key intersections on the New England Hwy –Maitland Street/Sydney Street signals and Bridge Street/ William Street roundabout. Any cross movements with the New England Hwy particularly at Haydon Street would affect through traffic performance on the New England Hwy. In conjunction, capacity constraint on the Bridge Street railway underpass (north of Haydon Street) affect through traffic performance. Considering all above factors, it was logical to make Hayden Street as let in left out, so that through traffic capacity on the New England Hwy could be maintained in the long run. Option 2: Provide a short right turn lane and pedestrian refuge island. See Figure 8-8B. Council has developed a concept to modify this intersection to provide a turning lane in Maitland Street to allow traffic to turn right into Haydon Street. This will also mean north bound traffic is slowed and channelled into one lane as it approaches the proposed pedestrian refuge north of the intersection. Traffic can turn left into Lorne and Haydon

Site ID	Intersection	Existing Control	Proposed Control	Potential Improvements
				Streets from Maitland Street at any time while traffic from Haydon and Lorne Streets can only turn left into Maitland Street.
I-14	Bell Street/New England Hwy	Signals	Signals	Upgrade existing signals to provide additional capacity. Key traffic works include: 1. extend the right turn bay to 150m on New England Hwy (east approach). 2. extend the left turn slip lane to 110m on Bell Street (north approach). See Figure 8-9.
I-15	Bridge Street/William Street	Roundabo ut	Roundabout	Council has recently developed a concept plan for Muswellbrook Main Street to improve pedestrian activity in the town centre. Under the concept plan, Bridge Street/William Street intersection will be affected making Market Street approach only for pedestrian. This will also change roundabout capacity. We modelled this intersection as a modified 3-leg roundabout with Market Street (east approach) became pedestrian access only. See Figure 8-10.
I-16	Bridge Street/Brook Street.	Signals	Signals	Closure of Market Street for vehicular traffic will have impact on Brook Street and associated intersection with Bridge Street. Model forecasts traffic increase on Brook Street between 150 and 250 vehicles per hour. Forecasts also indicate some traffic increase on Sowerby Street. With above traffic changes, existing signals at Bridge Street/Brook Street unlikely to have significant impact. The signals will require modified phasing and cycle time. Turning bay may require extension to accommodate queue during peak period. Suggested traffic works included: 1. extend the right turn bay to 80m on Bridge Street (south approach). 2. extend the left turn bay to 90m on Brook Street (east approach). See Figure 8-11.
I-18	New England Hwy/Hunter Street	Give-way	New Seagull	Hunter Street at New England Highway provides key access to and from North Muswellbrook area. The geometric configuration of this intersection is poor and requires some form of upgrading works. A painted seagull likely to improve turning traffic delays to and from New England Highway and resultant intersection LoS. Also signage at Manning Street/Hunter Street intersection needs to be improved so that priority movements are identified. See Figure 8-12 for a seagull arrangement. Manning Street traffic should provide “Giveway” to Hunter Street traffic and are also shown in Figure 8-12.
I-21	Brecht Street/Brentwood Street	Stop control	Stop control	From capacity perspectives, modelling results indicate minor impact on local intersections in North/South Muswellbrook. However, some road safety issues existed on both Brecht Street/Brentwood Street. Residents complained about speeding on these roads. We suggest LATM measures be investigated.
I-22	Knapman Dr/New England Hwy	-	Left-In-Left-Out or seagull or new signals	Under the Development Application of Eastbrook Links Estate, Council set out a condition of consent which is “left in left out” arrangement at this intersection. However, this condition was proposed in lieu with a new roundabout at New England Highway/ Bimbadeen Dr intersection. Following the recent consultation among RTA, Developer and Council, New England Highway/ Bimbadeen Dr intersection is proposed to upgrade to new signals. We anticipate Council has had number of discussions with the developer and yet to resolve final

Site ID	Intersection	Existing Control	Proposed Control	Potential Improvements
				traffic management options – new signals or roundabout. On this basis, we have tested three options that can improve traffic at Knapman Dr/New England Highway intersection. Option-1: Left-in-left-out arrangement Option-2: Full seagull arrangements providing sufficient storage capacity for turning movements. See Figure 8-13 (Option-2). Option-3: New signals with pedestrian crossings at all three approaches. See Figure 8-14 (Option-3). Results from three options are summarised in Table 8-6. From capacity perspectives all three options would provide good LoS. Detailed internal traffic circulation within the Eastbrook Links Estate should be investigated including how each access is managed at New England Highway. But developer should provide this information to Council as part of Eastbrook Development Application.
I-24	Ironbark Rd/Knapman Dr	-	Give-way	New intersection with auxiliary lanes (Type B). See Figure 8-15.
I-25	Bimbadeen Dr/Calgaroo Ave	-	Give-way	New intersection with basic (Type A). See Figure 8-16.
Other minor intersections would be required to upgrade but not tested using SIDRA model (1)-				
S-01	Sydney Street/Skellatar Street	Give-way	Give-way	Painted channelisation (Type C) lanes both directions
S-07	Skellatar Street/Lorne Street	Give-way	New Roundabout	4 way requires a small roundabout for safety
S-09	Adams Street/Ironbark Rd	Give-way	Give-way	Painted channelisation (Type C) lane
S-12	Weemala Pl/Bloodwood Rd	Give-way	Give-way	Intersection with auxiliary lanes (Type B)

Note: (1) South Muswellbrook Traffic Study, 2000 identified list of local intersections to be improved as development progress. PB has not tested all local intersections by using SIDRA models, as our investigation suggest most of local intersections should not have capacity problem. We only tested key local intersections which could have capacity issue.

Table 8-6 LoS results for improved intersection traffic conditions for scenario S5

Site ID	Intersection	Intersection Control	AM Peak				PM Peak			
			DoS	Delays (sec)	LoS	Queue (m)	DoS	Delays (sec)	LoS	Queue (m)
I-01	Bimbadeen Dr/New England Hwy	New Signals	0.70	35	C	121	0.82	33	C	159
I-02	Acacia Dr/Bloodwood Rd	Give-way#	0.09	8	A	1	0.10	8	A	2
I-03	Rutherford Rd/New England Hwy	New Seagull	>1.40	>300	F	>600	>1.40	>300	F	>600
		New Signal Opt-2	0.85	35	C	251	0.95	44	D	298
		New Signal Opt-3	0.93	39	C	216	0.99	48	D	343
I-04	Rutherford Rd/Acacia Dr	New Roundabout	0.61	10	A	58	0.80	8	A	97
I-05	Rutherford Rd/Ironbark Rd	New Roundabout	0.46	8	A	27	0.57	8	A	47
I-07	Adams Street/Ruth White Ave	Give-way#	0.05	7	A	2	0.09	7	A	2
I-08	Thompson Street/New England Hwy	New Seagull Opt- 1	0.82	85	F	32	0.53	24	B	13
		New Signals Opt -2	0.70	12	A	157	0.84	15	B	242
I-09	Sydney Street/Mitchell Street	Give-way#	0.29	17	B	1	0.34	21	B	2
I-10	Sydney Street/Skellatar Stock Route	New Seagull	0.64	13	A	52	0.69	16	B	68
I-12	Maitland Rd/Sydney Street	Modify Signals	0.70	27	B	208	1.00	50	D	278
I-13	Haydon Street/New England Hwy	Give-way (LILO) Option 1	0.38	37	C	8	0.50	55	D	4
		Short right turn lane and pedestrian refuge Option 2 ^	1.00	271	F	38	0.52	55	D	5
I-14	Bell Street/New England Hwy	Modify Signals	0.82	32	C	264	0.87	32	C	340
I-15	Bridge Street/William Street	Modify Roundabout	0.40	5	A	20	0.52	5	A	35

Site ID	Intersection	Intersection Control	AM Peak				PM Peak			
			DoS	Delays (sec)	LoS	Queue (m)	DoS	Delays (sec)	LoS	Queue (m)
I-16	Bridge Street/Brook Street	Modify Signals	0.61	28	B	137	0.68	30	C	148
I-17	Doyle Street/George Street	Roundabout #	0.12	5	A	6	0.12	5	A	6
I-18	New England Hwy/Hunter Street	New Seagull	0.34	12	A	10	0.37	17	B	15
I-19	Lexia Street/Queen Street	Give-way#	0.11	7	A	3	0.13	7	A	3
I-20	Semillon Street/Cook Street	Roundabout #	0.15	7	A	7	0.15	6	A	7
I-21	Brecht Street/Brentwood Street	Stop control#	0.05	11	A	1	0.07	11	A	2
I-22	Knapman Dr/New England Hwy	New LILO* Opt -1	0.37	13	A	18	0.40	15	B	10
		New Seagull Opt-2	0.37	13	A	18	0.70	23	B	42
		New Signals Opt -3	0.70	19	B	133	0.83	22	B	199
I-24	Ironbark Rd / Knapman Dr	New Give-way	0.14	9	A	0	0.17	10	A	0
I-25	Bimbadeen Dr/Calgaroo Ave	New Give-way	0.06	7	A	1	0.14	7	A	4
I-26	Osborn Ave/Ironbark Rd	Roundabout #	0.48	6	A	33	0.54	6	A	43

NOTE: * - LILO = Left in left out arrangement; #=Existing traffic controls; ^ = Council recommendations. Further capacity assessment is shown in Appendix D.

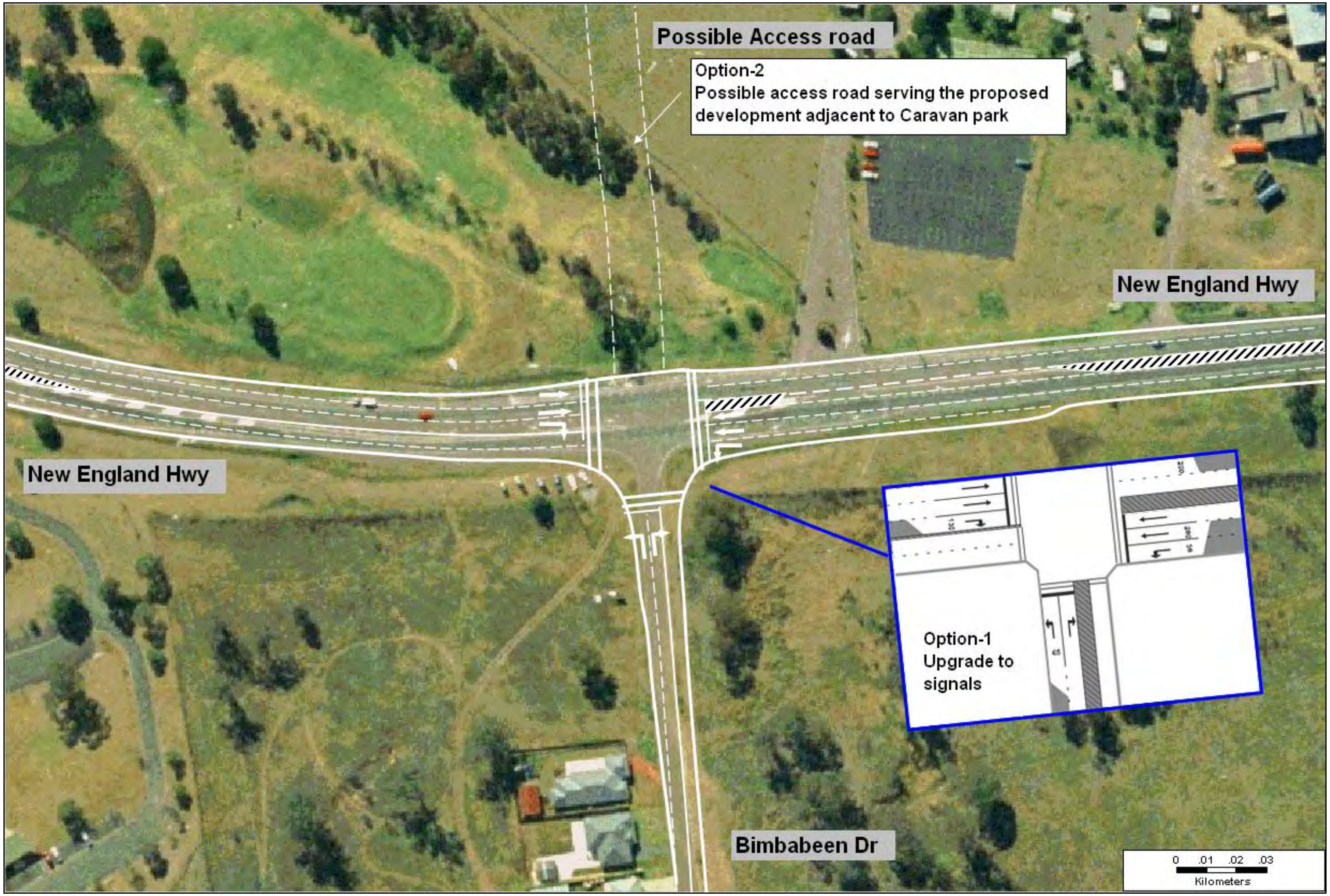


Figure 8-1 New signal at New England Hwy/Bimbadeen Dr

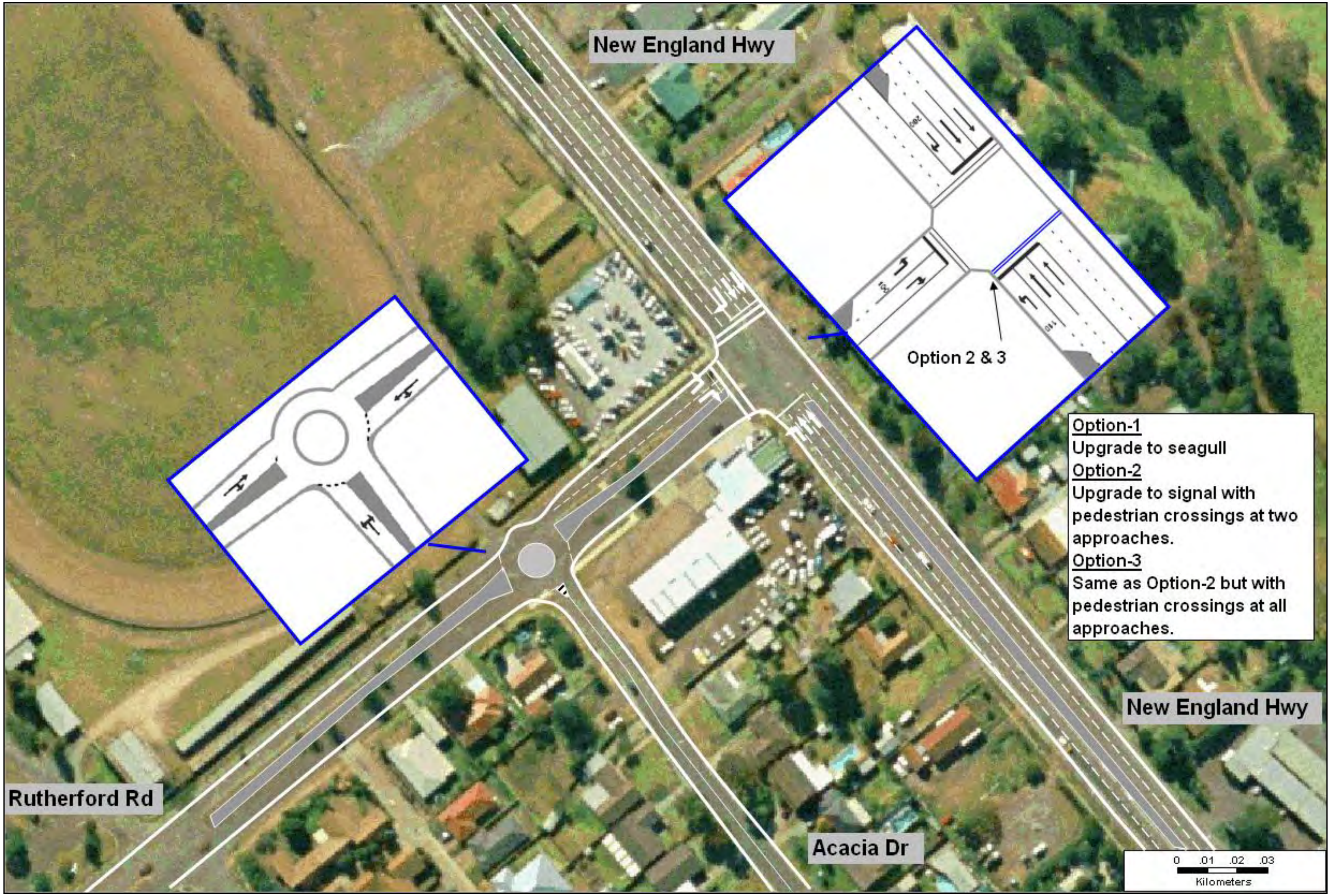


Figure 8-2 New signal at New England Hwy/Rutherford Rd and new roundabout at Rutherford Rd/Acacia Dr

Figure 8-3 New single-lane roundabout at Rutherford Rd/Ironbark Rd

Figure 8-4 Seagull type arrangement at New England Hwy/Thompson Rd (Option-1)

Figure 8-5 New signal at New England Hwy/Thompson Rd (Option-2)

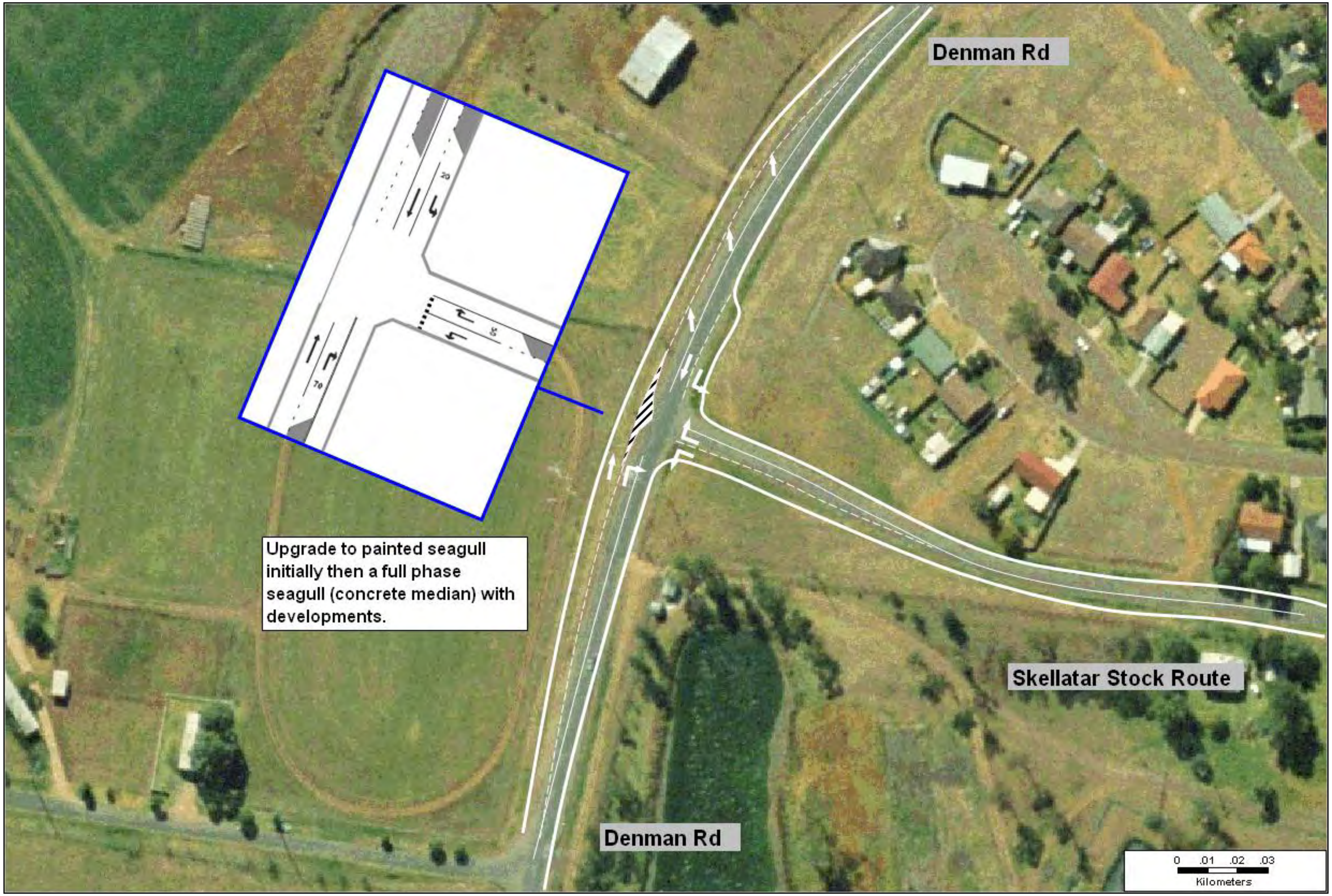


Figure 8-6 Seagull type arrangement at Denman Rd/Skellatar Stock Route

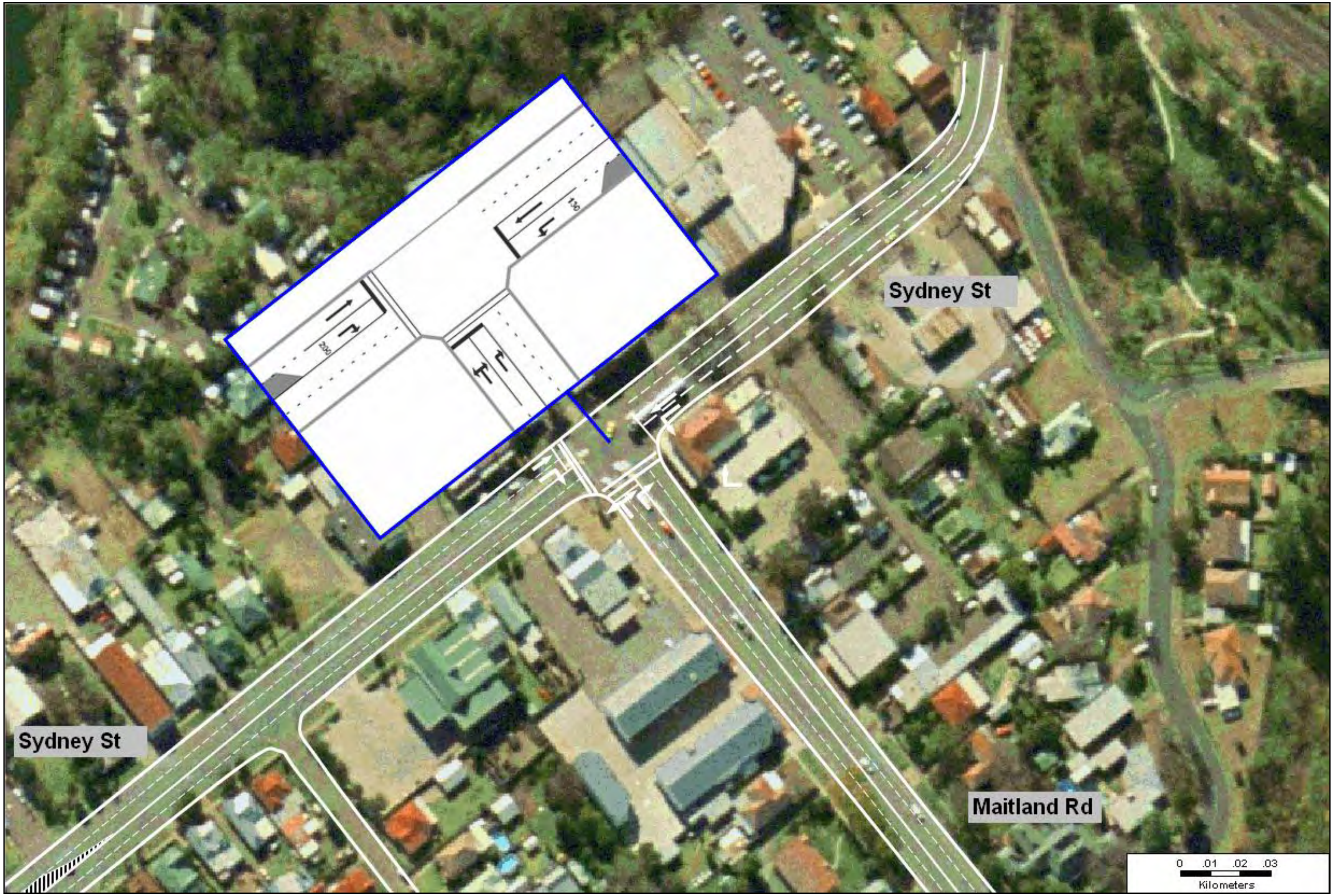


Figure 8-7 Intersection upgrade at Maitland Rd/Sydney Street (by extending the length of turn bays)

Figure 8-8A Left-in-left-out arrangement at Maitland Rd/Lorne Street/Haydon Street

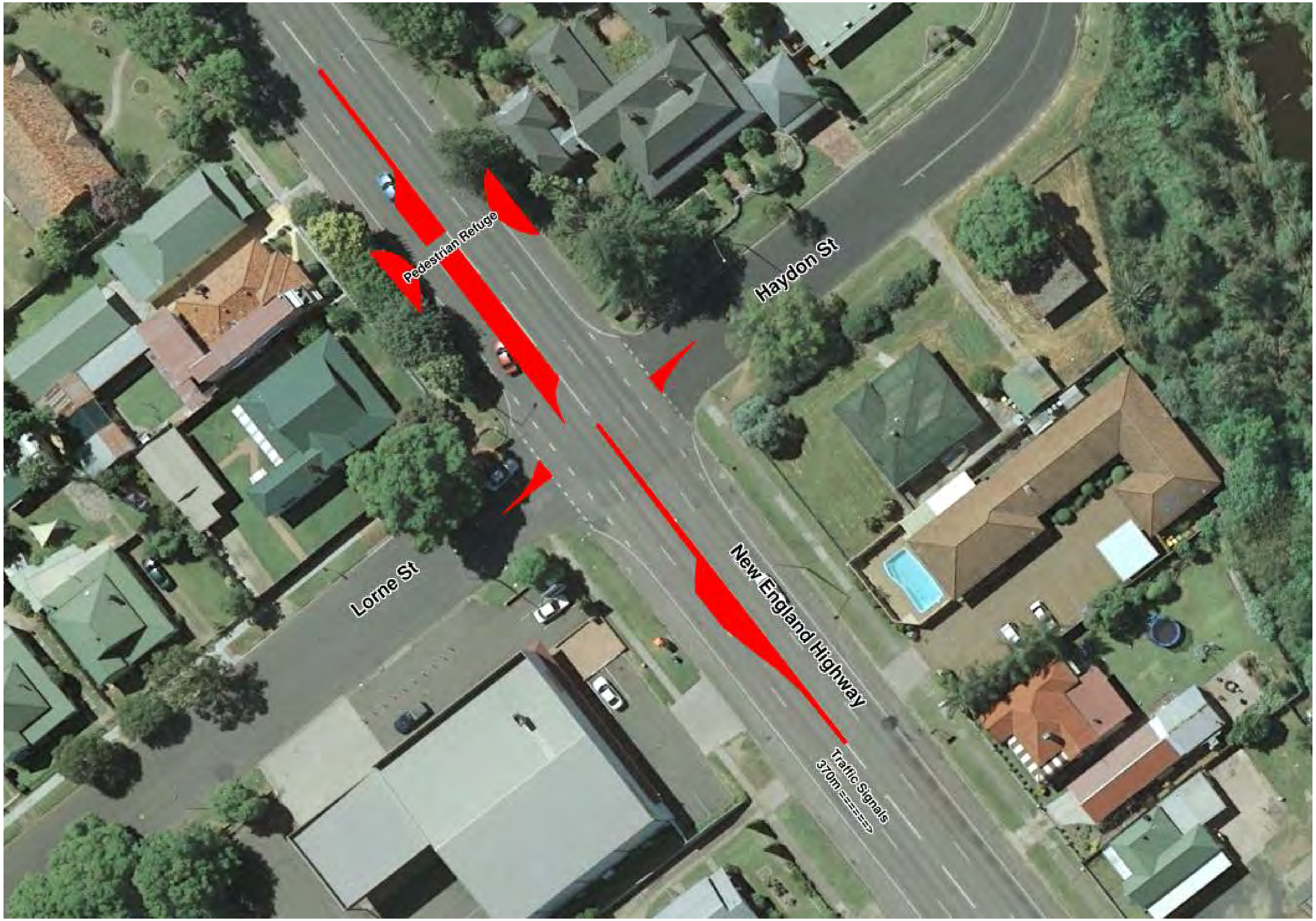


Figure 8-8B Short right turn lane and pedestrian refuge at Maitland Rd/Lorne Street/Haydon Street

Figure 8-9 Intersection upgrade at New England Hwy/Bell Street (by extending the length of turn bays)

Figure 8-10 Modified to 3-leg roundabout at Bridge Street/William Street (Market Street becomes pedestrian precinct)

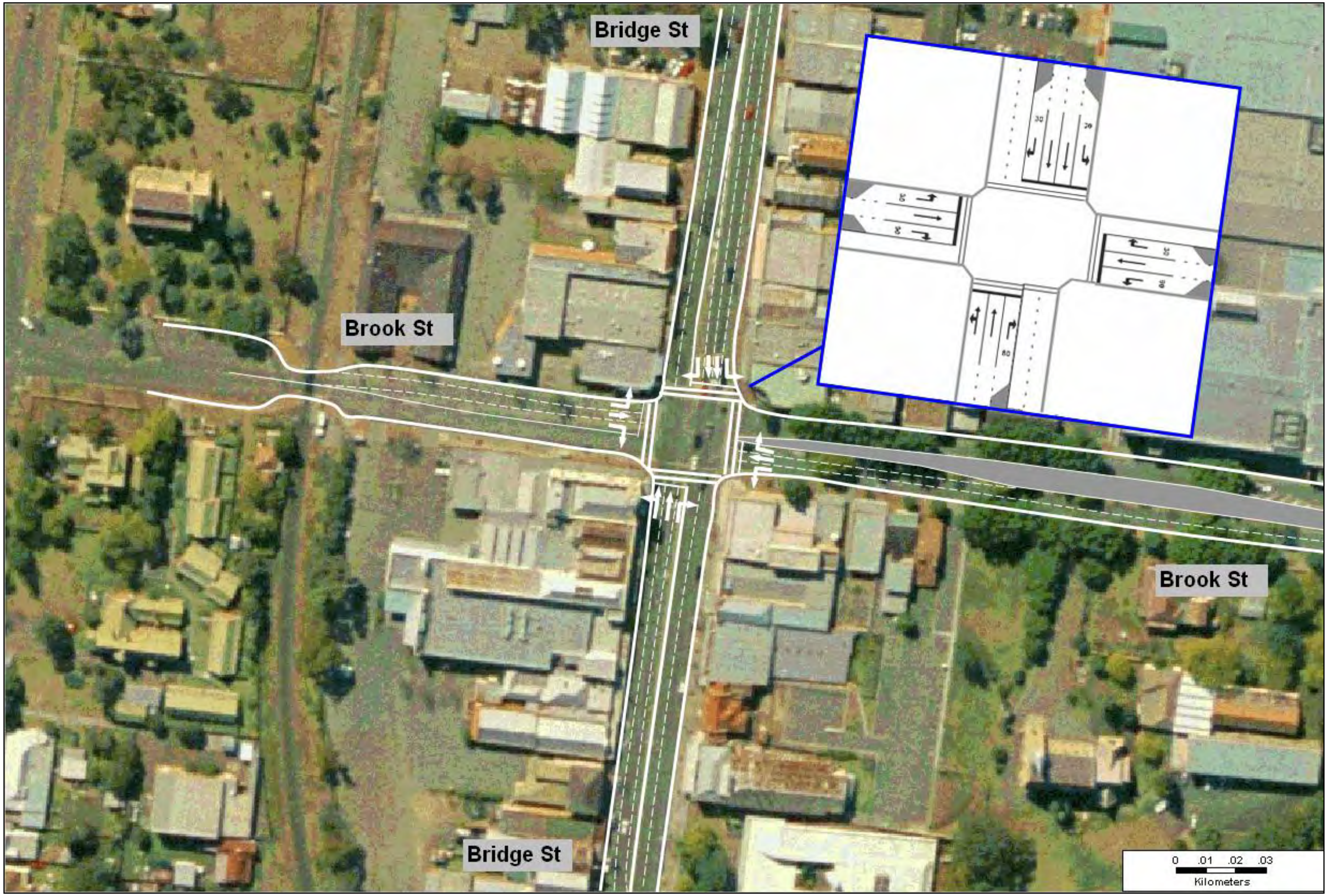


Figure 8-11 Intersection upgrade at Bridge Street/Brook Street (by extending the length of turn bays)

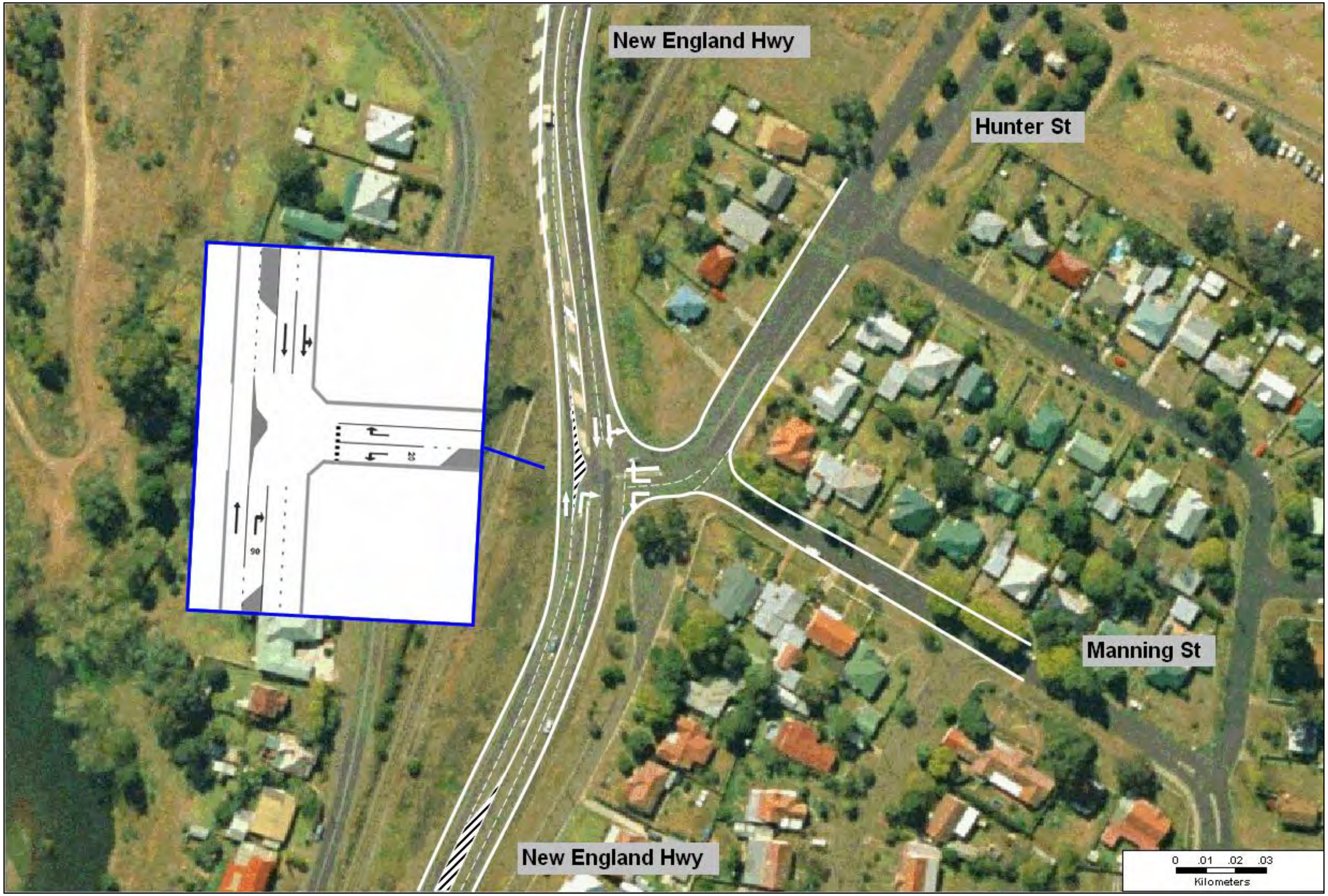


Figure 8-12 Seagull type arrangement at New England Hwy/Hunter Street

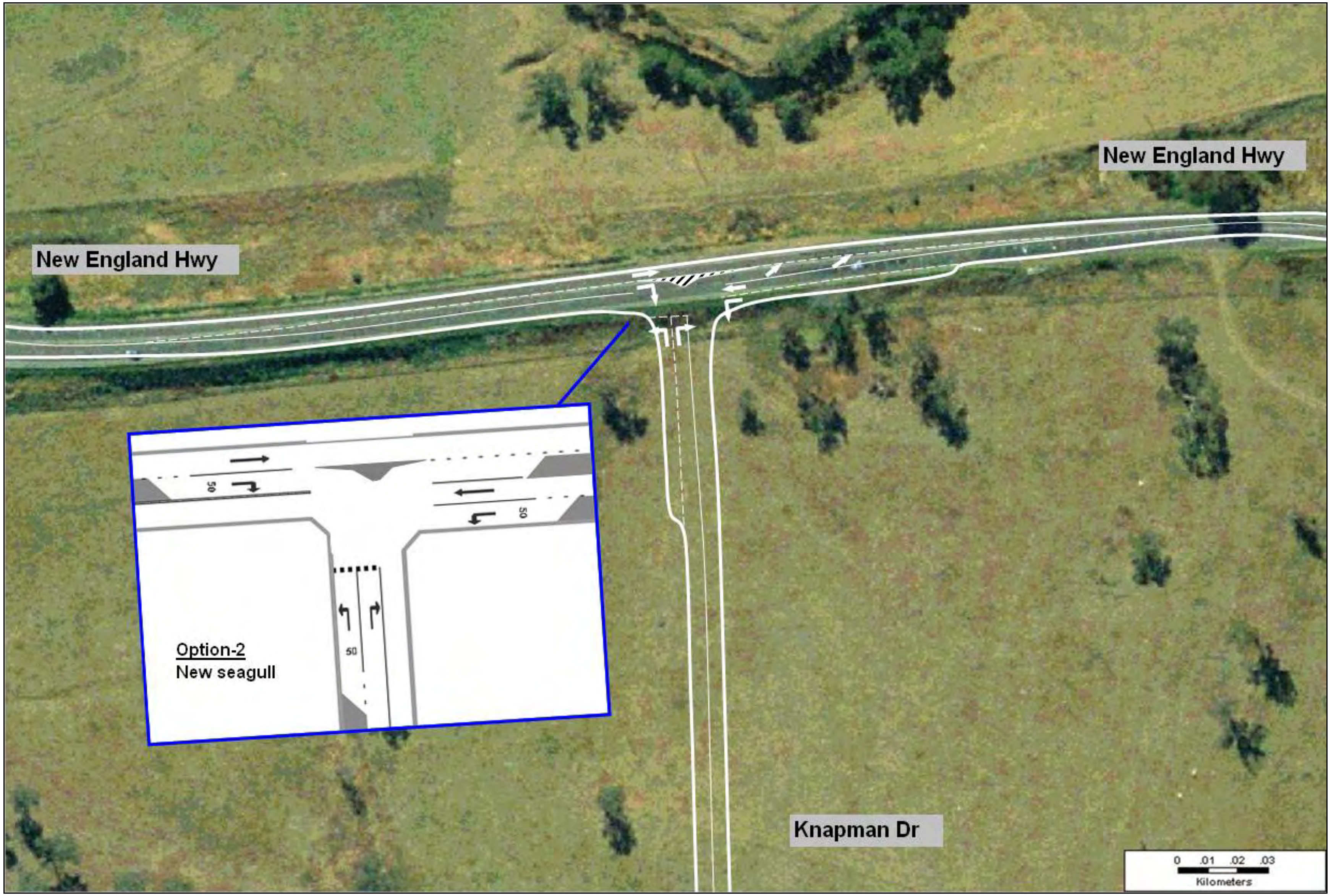


Figure 8-13 New Seagull type arrangement at New England Hwy/Knapman Dr (Option-2)

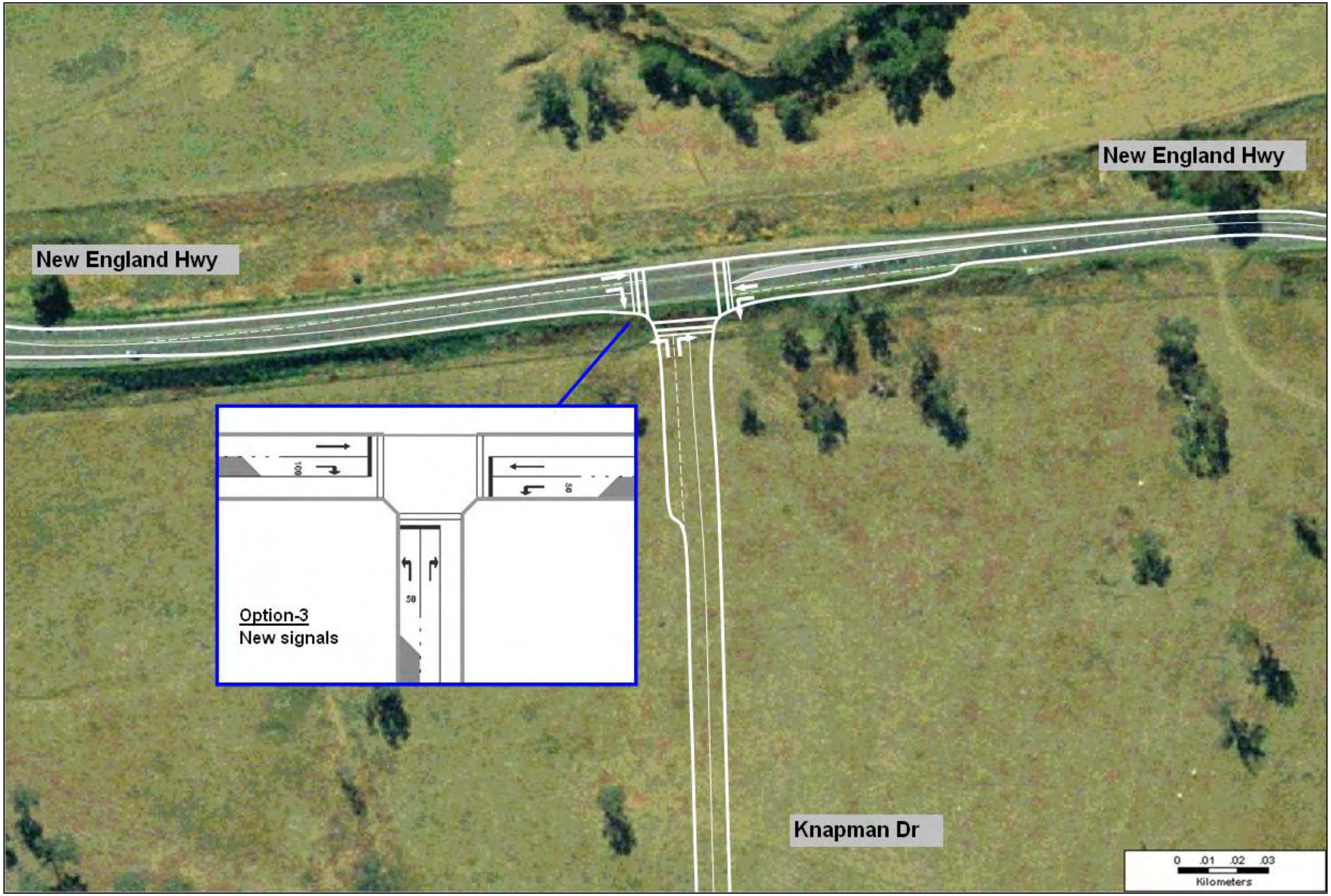


Figure 8-14 New signal at New England Hwy/Knapman Dr (Option-3)

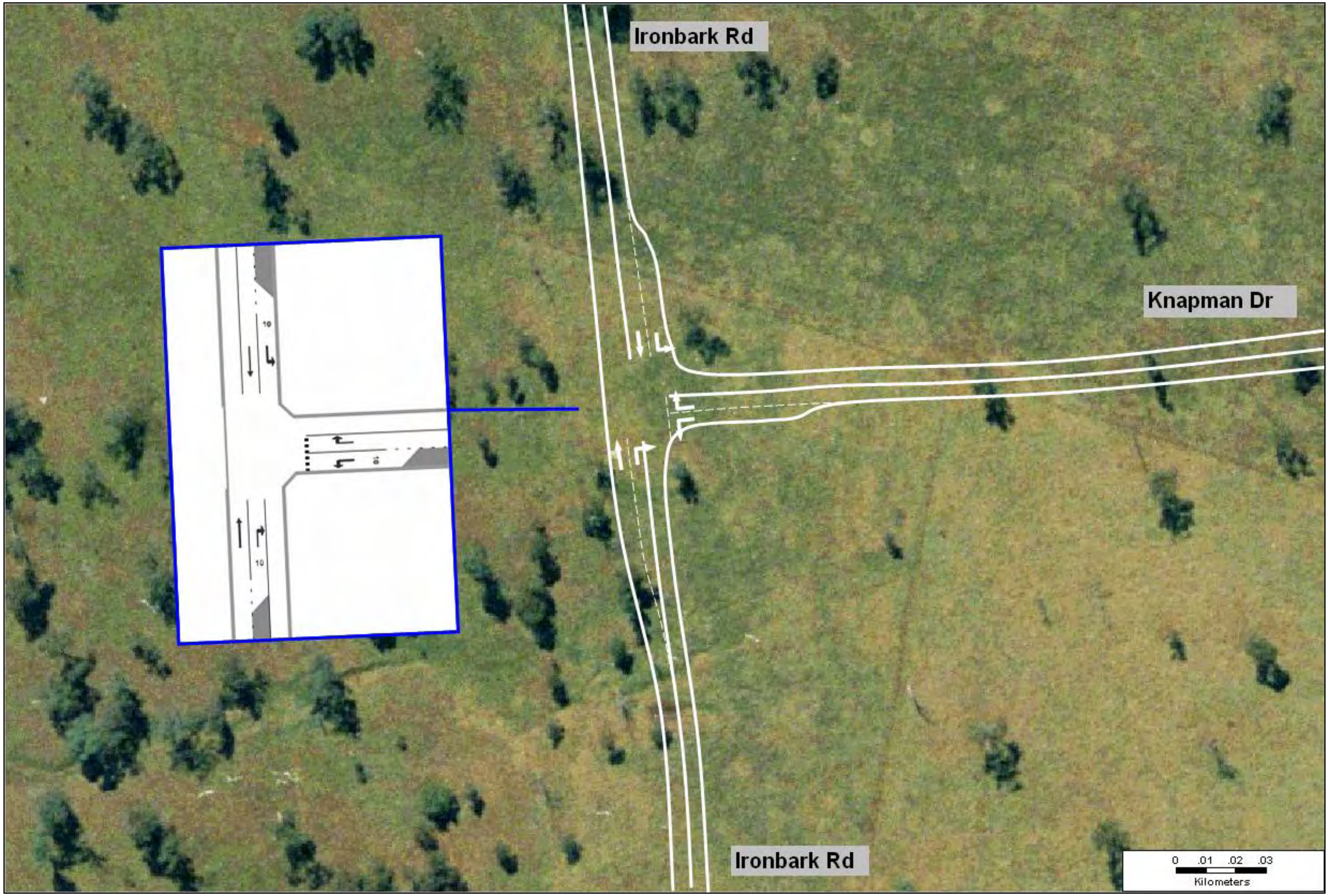


Figure 8-15 New intersection at Ironbark Rd/Knapman Dr (with auxiliary lanes-type B)

Figure 8-16 New intersection at Bimbadeen Dr/Calgaroo Ave (with auxiliary lanes-type B)

9. Traffic management issues

Section 8 of this report has used the transport model to assess intersection performance for the 2007 Base Network and for two future time horizons, 2020 and 2037 with and with future development and with and without a Muswellbrook bypass. The program of works resulting from this analysis is included in Section 10.

Traffic Management issues still need to be addressed. Muswellbrook Shire Council has requested a review of traffic management issues at several local roads within Muswellbrook. In particular:

- the intersections of Ironbark Road with Rutherford Road and Acacia Drive with Rutherford Road
- a range of options for local area traffic management/calming requirements in existing streets including Acacia Drive, Bloodwood Road, Hakea Drive, Beech Street, Rutherford Road, Calgaroo Avenue, Ironbark Road/Skellatar Stock Route, Skellatar Street, Lorne Street, Mitchell Street, Thompson Street, Adams Street and George Street
- Assess options for alternative or additional accesses to various urban precincts from trunk and arterial roads to optimise travel times and road safety in the network. In particular access from the urban areas to Denman Road and the northern and southern approaches to the New England Highway.

It should be acknowledged that the Muswellbrook Traffic Study is a technical document to make the appropriate strategic decisions with respect to future Roads Infrastructure and it is not intended to undermine the integrity or intent of the existing Capital Works program.

Table 9-1 presents the identified traffic management issues and recommendations. As agreed by Muswellbrook Shire Council, no schematic diagrams have been prepared for the following recommended treatment options.

Appendix B presents the suggested 5-year Works Program for traffic management treatment options in addressing the current capacity constraints and the safety concerns as raised by Council in a meeting dated 15 July 2008.

Edgeline marking has been proposed at several locations as a traffic management treatment. PB has found that edgeline marking has been an effective treatment because it offers a low cost means of reducing the level of speeding behaviour. Edgeline marking could influence a driver’s perception of speed and result in a reduction in their preferred travel speed. Edgeline marking can also provide a more positive delineation of travel and parking lanes.

Table 9-1 Traffic management issues and recommendations

Location	Traffic issues	Traffic management treatment options
Ironbark Road/Rutherford Road Intersection	▪ Intersection safety	▪ A review of this intersection would improve safety by constructing a roundabout (see Figure 8-3) ▪ Edgeline marking between New England Highway and Rutherford Road
Acacia Road/Rutherford Road Intersection	▪ Intersection safety ▪ Speeding issues in Rutherford Road may cause safety concerns when traffic entering from Acacia Road	▪ A review of this intersection would improve safety by constructing a roundabout (see Figure 8-2)
Acacia Road	▪ Wide expanse of pavement and straight alignment	▪ Edgeline marking with potential of roundabout at local intersection to assist speed reduction
Bloodwood Road	▪ Speeding issues	▪ Edgeline marking ▪ Raised intersection threshold treatment as constructed in the new road Osborn Avenue
Hakea Drive	▪ n/a	▪ Provide consistent treatment as with Bloodwood Road ▪ Review in a LATM study
Beech Street	▪ Speeding issues ▪ No provision of footpath	▪ Edgeline marking ▪ Review pedestrian connectivity in a LATM study
Rutherford Road	▪ Speeding issues ▪ Lack of pedestrian crossing facilities to accommodate desire lines to shops	▪ Provision of pedestrian crossing facilities
Calgaroo Avenue	▪ No provision of footpath ▪ Some speeding issues have been addressed with the provision of speed hump and pedestrian refuge facility	▪ Review in a LATM study for traffic speeding and pedestrian access treatments (e.g. footpath, roundabout) ▪ Raised intersection threshold treatment as constructed in the new road Osborn Avenue
Ironbark Road/Skellatar Stock Route	▪ Speeding issues ▪ Low standard rural road ▪ Traffic flow increasing over next 20 years ▪ Some occasional access to private properties	▪ Road reconstruction to urban standards
Brentwood Street/ Brecht Street	▪ High crash rate possibly due to poor sight distance	▪ Provision of a roundabout to slow down traffic on Brecht

Location	Traffic issues	Traffic management treatment options
	to the south. The available sight distance to the intersection is approximately 50-60m which is below standard for a 50km/h road ▪ Steep slope on Brecht Street which encourages high speed travel	Street ▪ Pedestrian refuge islands
Lorne Street/ Mitchell Street route	▪ Through traffic avoids traffic signals at Sydney Street/ Maitland Street using Lorne Street and Mitchell Street	▪ Prepare an area-wide LATM plan to address rat-running issues. Limitation of area to be defined by Council.
New England Highway/ Thompson Street	▪ Intersection capacity issues	▪ Install signals (see Figure 8-5). Further discussion is required with the RTA
Adams Street	▪ Speed issues ▪ Pedestrian access issues	▪ Roundabout at Thompson Street/ Adams Street ▪ Pedestrian refuge along pedestrian desire lines
New England Highway/ Aberdeen Street intersection	▪ Potential crash risks in relation to the poor sight distance to the south	▪ Review linemarking and intersection control ▪ Review crash history in the vicinity of the intersection ▪ Prepare plans to address crash types
Access from urban areas to Denman Road	▪ Type of intersections to be provided for connecting roads from local developments	▪ Denman is a rural road. Intersections onto rural roads should be in accordance with RTA/ AUSTROADS guidelines
Access from urban areas to the northern approach of the New England Highway	▪ Standard and locations of intersections	▪ New England Highway is a state road under the care and control of the RTA. Therefore the location and standard of future intersections need RTA approval.
Access from urban areas to the southern approach of the New England Highway	▪ Standard and locations of intersections	▪ New England Highway is a state road under the care and control of the RTA. Therefore the location and standard of future intersections need RTA approval.
Narrow bridge immediately south of No. 15 George Street	▪ Narrow bridge (6.5 m) ▪ Lack of pedestrian facilities across the bridge	▪ Muswellbrook Shire Council has proposed to improve traffic and pedestrian safety by providing for one lane traffic only across the bridge with a Give Way sign against southbound traffic travelling downhill from Hill Street. It is proposed to reduce the width

Location	Traffic issues	Traffic management treatment options
		of the trafficable lane and include a pedestrian path across the bridge. The separation of vehicular and pedestrian traffic across the bridge could by using a section of New Jersey kerb or an equivalent. Refer to Appendix D for the preliminary design. ■ PB advised the Council to consider the following recommendations in the detailed design as a minimum: • Enhance drivers' awareness of the one-lane bridge, New Jersey kerb and pedestrian path, particularly during night time and adverse weather conditions. • Provide delineation on approach to and on the bridge along George Street. These include edge line and centreline. • Provide signage including pedestrian warning signs and hazard markers on the New Jersey kerb. • Provide the required signage for the one-lane bridge in accordance with AS 1742.2-2009 (refer to Appendix E). These signs include Narrow Bridge (W4-1) sign, One Lane (W8-16) sign, Give Way Ahead (W-3-2), One Lane (R9-9) sign, width markers (D4-3L and D4-3R), as well as No Overtaking or Passing (R6-1) sign. • Provide appropriate treatment to the roadside hazards located within the clear zone. • Undertake design stage and pre-opening stage road safety audits.

9.1 Pedestrian accessibility

It is recommended that Muswellbrook Shire Council undertake a Pedestrian Access and Mobility Plan (PAMP) to address pedestrian access and accident issues. The PAMP is to be prepared in accordance to the RTA guidelines and Council should approach the RTA for funding for undertake the program.

A PAMP will address pedestrian access between pedestrian generators and pedestrian safety issues caused by pedestrians having to walk on the roadways because there are no footpaths on many roads within the town.

9.2 Council's Section 94 Plan and apportionment of costs

The Environmental Planning and Assessment Act allows Councils to charge developers a contribution towards the cost of providing local services and facilities which are required as a result of new development. The levy ensures that new development contributes to the cost of providing new facilities and services, or maintaining a level of services in the LGA.

Section 94 Plan apportions future development costs based on developments that will impact on the infrastructure.

This report provides a basis for apportioning costs between local community areas, local developments for future road infrastructure projects.

10. Suggested Works Program

The Muswellbrook Traffic Study is a technical document to make the appropriate strategic decisions with respect to future Roads Infrastructure and it is not intended to undermine the integrity or intent of the existing Capital Works program.

This section includes a suggested 5-Year Works Program for the road and intersection works identified in previous Sections 8 and 9. The Works Programs includes:

- the location of the intersection or road works
- the existing and future LoS that can be achieved by implementing the proposed changes
- a description of the proposed changes that will be required in the next 5 years. Changes that may be required when the Muswellbrook bypass is built have not been identified at this time as the bypass is not expected to be completed in the next 5 years
- a brief description of the reasons why these improvements are required
- an estimated cost of the proposed changes
- a priority for when the changes are required. Projects have been assigned a low, medium and high priority for when the project should be completed over the next 5 years.

This report has identified intersection and road improvements up to year 2037. However these projects have not been included in the Works Program because their need should be re-assessed over the next 5 years or by 2013.

Many factors can influence when a particular project is required such as the building rate of development and the take up rate from the market. In absence such guidance, we developed an indicative implementation plan for infrastructure improvements based on level of service (LoS) and degree of saturation (DoS) as they define intersection performance. The staging of works fell into two time frames, between 2007-2016 or 2017-2026. We ranked each intersection on the basis of LoS and DoS performance. The high ranking intersections were recommended for early improvement. The less critical intersections were deferred to the longer time period. Table 8-7 summarised the proposed traffic works with an indicative work program.

Table 10-1 Proposed traffic works and indicative work program

Site ID	Description	Traffic works (see Table 8-5 for detailed intersection upgrade)	Indicative timing of upgrading works	
			2007 – 2016	2017 – 2026
At Intersections				
I-01	Bimbadeen Dr/New England Hwy	New signals	☑	
I-03	Rutherford Rd/New England Hwy	New signals	☑	
I-04	Rutherford Rd/Acacia Dr	New roundabout	☑	
I-05	Rutherford Rd/Ironbark Rd	New roundabout		☑
I-08	Thompson Street/New	New seagull	☑	

Site ID	Description	Traffic works (see Table 8-5 for detailed intersection upgrade)	Indicative timing of upgrading works	
			2007 – 2016	2017 – 2026
	England Hwy			
I-10	Sydney Street/Skellatar Stock Route	New seagull		☑
I-12	Maitland Rd/Sydney Street	Minor upgrading works	☑	
I-13	Haydon Street/New England Hwy	Left-in-left-out arrangement	☑	
I-14	Bell Street/New England Hwy	Minor upgrading works	☑	
I-15	William St / Bridge St Intersection	Modify to a 3-leg roundabout with no vehicular access to Market Street (east approach)	should be implemented concurrently with Main Street Concept Plan Only possible in conjunction with the Bypass as it is a Heavy Vehicle access route	
I-16	Bridge Street/Brook Street	Minor upgrading works	☑	
I-18	New England Hwy/Hunter Street	New seagull		☑
I-22	Knapman Dr/New England Hwy	New seagull or signals	should occur concurrently with Eastbrook Links Estate	
I-24	Ironbark Rd/Knapman Dr	New intersection with auxiliary lanes (Type B)		
I-25	Bimbadeen Dr/Calgaroo Ave	New intersection- basic (Type A)		

Figure 8-17 locates the above infrastructure works through the year 2026. Figure 8-18 shows proposed road hierarchy once future developments and the Bypass are complete.

In conclusion, the package of preferred network changes would deliver sufficient capacity to the arterial and local road network under full development of all proposals. The traffic management measures have a finite capacity and all reasonable steps should be taken to have new developments provide encouragement for walking and cycle trips so that traffic growth is managed.

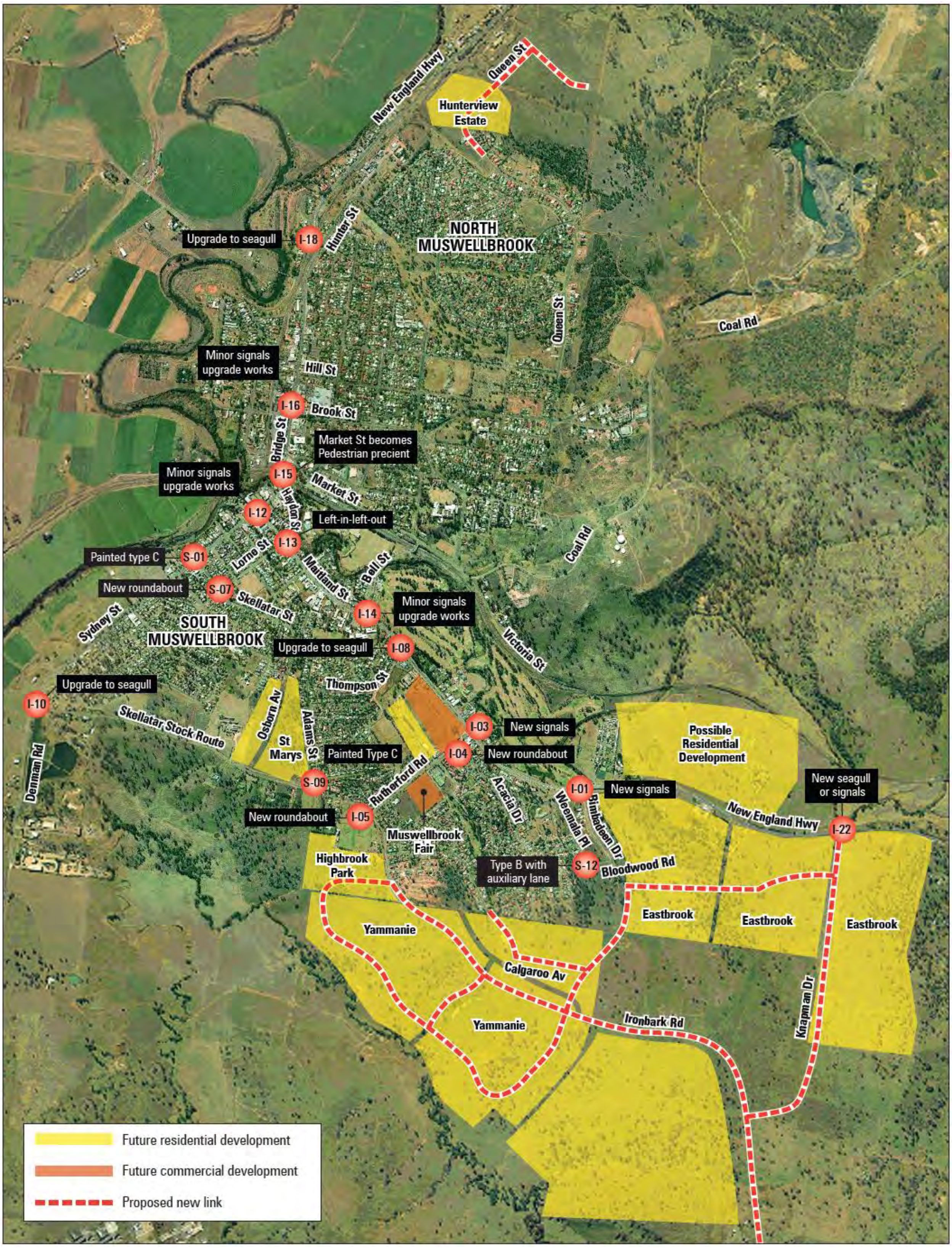


Figure 10-1 Proposed infrastructure works up to 2026

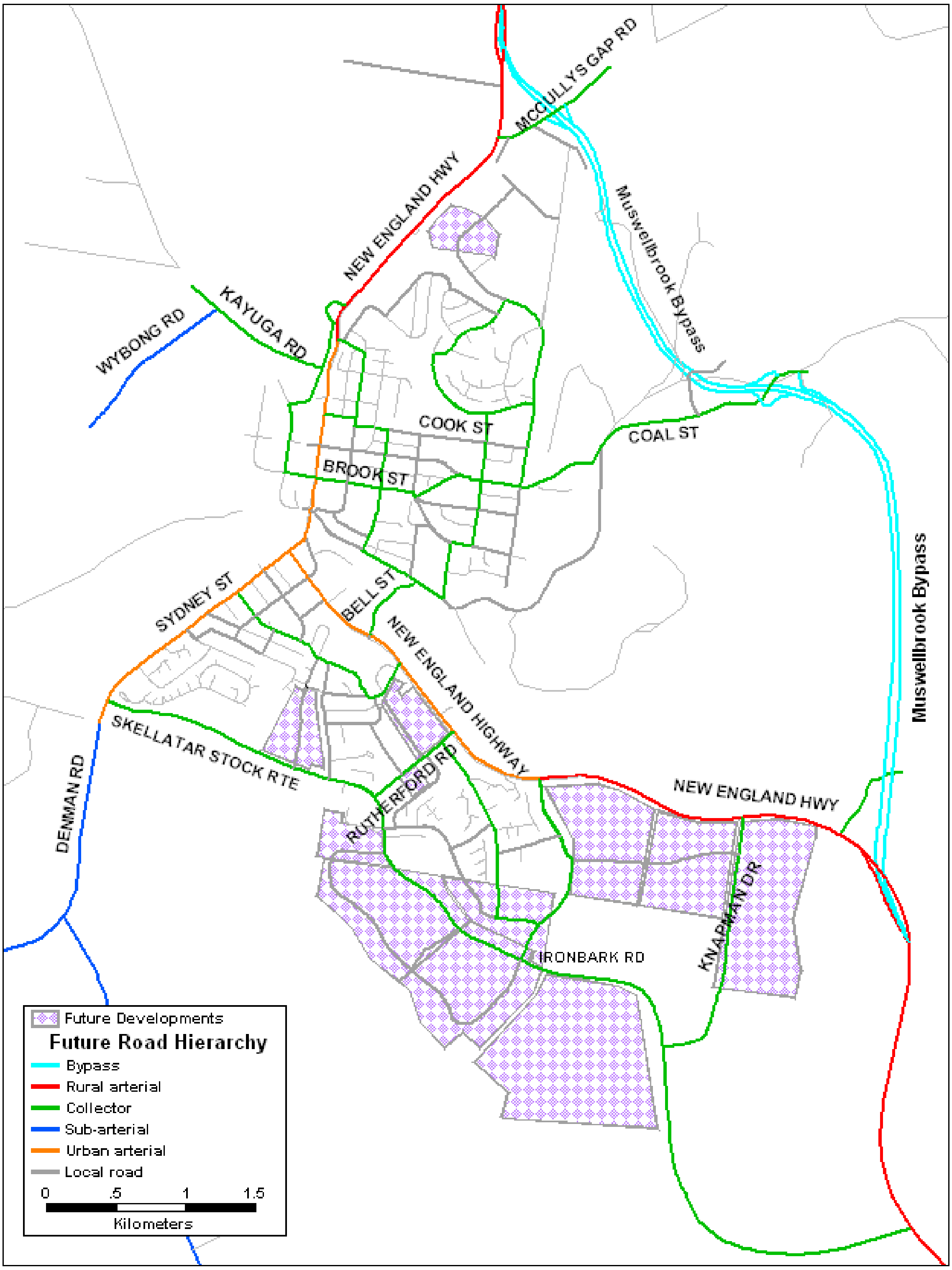


Figure 10-2 Proposed road hierarchy with future developments

11. Summary and conclusions

Overview

Muswellbrook Shire Council engaged PB to develop a road traffic model for the Muswellbrook Town Centre and its surroundings to assist Council and the Roads and Traffic Authority (RTA) in assessing the traffic implications of the future residential and commercial development proposals. The proposal includes some 3,954 dwelling units and 35,100 square meters of commercial development, mostly planned for the South Muswellbrook area.

Future residential development in Muswellbrook will largely be on greenfield sites such as eastern side of the New England Highway or in new release areas at Eastbrook Links Estate, St Mary's Estate, NorthView Estate and Yammanie. It is anticipated that proposed developments would be developed in stages between 2007 and 2037. The recent Census data indicated that in 2006, Muswellbrook Local Government Area (LGA) had a population of around 15,420. The cumulative impact of the proposed residential developments would increase LGA population by about 10,280, an increase of two-thirds over 30 years.

PB developed a comprehensive five stage study approach specifically to achieve Council's key study objectives. The study involved review of existing traffic conditions, collection of new traffic data, the development of a local road network traffic model (TransCAD), the estimation of future background traffic growth, estimation of traffic generation from proposed developments, implication of the proposed Muswellbrook Bypass on road network performance and traffic assessment of a network improvement plan.

Work trips and origin/destination patterns

An analysis of 2001 Journey to Work Census (JTW) data showed that about 89% of work trips to Muswellbrook are made by private vehicle, including the 12% by car passengers. Only 0.5% of workers reported travelling by bus, while 6% walked. The private vehicle is by far the dominant mode of transport to work. JTW data was further used to estimate the origin of work trips to and from Muswellbrook study area. Of note:

- more than 50% of workers lived and worked within Muswellbrook. These trips are regarded as local trips
- about 15% of people lived in the Muswellbrook but worked outside it, with job locations in Singleton, Maitland, and Cessnock, with Singleton attracting the most (about 8%)
- about 31% of people worked in Muswellbrook but lived outside it and travelled here from Singleton, Maitland, Cessnock and north of Muswellbrook, particularly from Murrurundi and Scone.

The origin destination data from RTA's 2002 survey of motorists on the New England Highway also provided similar trip patterns to work trips. About 28% of the sample was through traffic using the New England Highway during the 12 hours between 6 am and 6 pm. The majority of traffic in Muswellbrook was of a "local" nature (60% to 70%).

Existing traffic volumes

The New England Highway (H9) is the major arterial road serving regional traffic but it is also the main street. RTA records indicated between 1998 and 2004, annual traffic growth on the New England Highway in Muswellbrook varied between 0.3% and 1.2% per annum. Since 2004, growth has accelerated somewhat to between 1% and 2% per annum.

A traffic survey conducted in 2007 showed that New England Highway carried 8,900 vehicles per day (vpd), south of Muswellbrook, and 10,900 vpd north of the town. Counts had 8,900 vpd east of Bimbadeen Drive, which increased to 15,300 vpd west of Rutherford Road. In the centre of town, traffic at Bridge Street increased to 18,200 vpd. The higher traffic volumes in town compared to those to its north or south, demonstrated the crucial role of local trips within study area. Friday traffic was found to be the highest, with 4% to 10% more vehicles than an average weekday. The New England Highway carried about 1,500 to 1,700 heavy vehicles a day around 14% of all traffic.

Existing intersection capacity and impact from back ground growth

The intersection modelling was undertaken for both AM and PM peak hours. Of the nineteen intersections analysed, four intersections with the New England Highway showed some delays during the PM peak in 2007, particularly for turning traffic to and from adjoining local streets.

- New England Highway/Rutherford Road
- New England Highway/Thompson Street
- New England Highway/Haydon Street/Lorne Street
- New England Highway/ Hunter Street.

Other intersections are operating satisfactorily under current traffic conditions, with the LoS “A” to “C”.

Given the low trend for through traffic growth, its contribution to background traffic growth is minor and unlikely justify the future upgrading of intersections in the next 30 years. The basis for seeking upgrades to roads and intersections within the study area will predominantly be traffic growth associated with discrete future developments.

Future traffic impacts on the network

There are several changes to the future transport network that might influence Muswellbrook travel patterns. The Muswellbrook Bypass proposal could divert vehicles at the regional level, while network growth arising from roads serving new subdivisions could alter connections at the local level. Figure 6-1 shows both local network changes and the proposed Muswellbrook Bypass that were considered in this report. The proposed Bypass was expected to attract through traffic, particularly heavy vehicles, from the New England Highway.

Traffic demand forecasts were prepared for years 2020 and 2037. Broadly, three cases were developed considering regional background growth, future development proposals and network changes. Each case had two scenarios, one for 2020 and another for 2037. The three cases were:

- **Base Case** (S1 & S4) involved background growth on the existing road network for 2020 and 2037 respectively. These were effectively “do nothing” scenarios which assessed only regional and local background growth, without proposed development or the Muswellbrook Bypass
- **Development Case 1** (S2 & S5) this was the base case but added proposed development traffic. It combined background growth and the proposed developments on the existing network. The results from these scenarios measured the impact of proposed developments on the road network
- **Development Case 2** (S3 & S6) had the same land use assumptions as the development case, but added the proposed Muswellbrook Bypass to the network and redistributed traffic.

Detailed traffic forecasts for the scenarios are summarised in Section 7 at nine screenlines (see Figure 7-1) and at road level. In terms of peak hour volumes, the model predicted 40 to 120 more vehicles would cross the screenlines in 30 years with just background growth assumptions (see Table 7-3 for results on background growth).

Under the development case 1 scenarios (S2 & S5), the model predicted significant traffic increases on screenlines 4, 5 and 6 due to residential and commercial developments in the South Muswellbrook area. Highest traffic increases were forecast at screenline 6. If all proposed developments went ahead, *screenline traffic* levels would increase between 40% and 200% by 2037 (see Table 7-5 for results on development traffic growth). The analysis suggested proposed residential developments largely from South Muswellbrook would have significant impact not only on key arterial roads, but also on local roads providing access to the New England Highway and the Sydney Street/Denman Road route.

The proposed Muswellbrook Bypass has a favourable performance impact almost entirely on the New England Highway as addressed in Section 7.3.3. Results from Development Case 2 (S3 & S6) are summarised in Table 7-7 and Table 7-8: Forecasts estimated the Bypass would reduce traffic on the New England by between 17% and 24%, depending on section of the Highway and local traffic influences. The Bypass divert between 2500 and 4600 vehicles per day from the New England Highway. This reduction of traffic was based on origin destination (OD) patterns observed on the New England Highway in 2002.

Figure 7-2 to Figure 7-6 show forecast traffic volumes across the Muswellbrook network in graphical form, which is the mapping output from the TransCAD model. Traffic forecasts are by the width of the traffic band and volume to capacity (v/c) ratios on the network.

Impact on intersections and traffic works

The timing of the individual road and intersection improvements depend on a number of factors, but the rate of residential and commercial construction and market demand for occupation are the main drivers the traffic impacts on road performance. Section 8 described impact on key intersections from the six growth scenarios. Table 8-3 summarised impacts from the proposed developments at eleven intersections.

Intersection modelling under the Bypass scenario predicted it would relieve capacity constraints at key intersections along the New England Highway, including Bimbadeen Drive, Rutherford Road, Hunter Street, and Thompson Street. But the extent of capacity relief would be limited given the dominance of local traffic movements at these intersections. Local traffic growth from the proposed developments will be the key factor in the timing of intersection upgrades. Our analysis confirmed that the Bypass is unlikely to improve the LoS of key intersections if new development also occurs. Figures 8-1 to 8-16 sketch conceptual layouts considered for intersection upgrades. Table 8-5 and Table 8-7 describe the traffic works and provide an indicative work program based on traffic demands. The full package of traffic works would deliver sufficient capacity in the arterial and local road network that even with full development of all the proposals, Muswellbrook roads would deliver satisfactory performances. Yet traffic intersection designs have finite capacities and all reasonable steps should be taken to have new developments provide encouragement for walking and cycle trips so that traffic growth is managed.

Suggested Works Program

The Muswellbrook Traffic Study is a technical document to make the appropriate strategic decisions with respect to future Roads Infrastructure and it is not intended to undermine the integrity or intent of the existing Capital Works program.

Table 8-5 and Table 9-1 present the identified issues and recommended works to improve intersection capacity and safety concerns. Appendix B shows a suggested 5-year Works Program on the basis of priority in relation to the traffic issues identified within this report. A range of cost effective and high cost works have been recommended from edgeline marking to the provision of traffic signals. A cost estimate has been provided with priority assigned to each option. PB also recommended further investigations in pedestrian accessibility and management issues; as well as specific intersection design problems in a local area traffic management study.

12. References

Traffic volume data for Hunter & Northern Region, 2004, Roads and Traffic Authority, New South Wales

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Road asset and hierarchy data, Muswellbrook Council

New England Highway O/D survey 8th March 2002 and economic assessment, Muswellbrook Bypass, Northern Transport Planning and Engineering Pty Ltd

South Muswellbrook Traffic Study, July 2000, Muswellbrook Shire Council, Environmental Resources Management Australia Pty Ltd

Traffic data at various roads and intersections in 2007, Austraffic, Traffic and Transport Data Specialist

Trip generation survey for Lower Hunter and Singleton in 2006, Parsons Brinckerhoff

RTA Guide to Traffic Generating Developments, 2002

Journey to Work Data (JTW) 2001, Transport Planning Data Centre (TPDC)

Population data for 2001 and 2006 for Muswellbrook, Hunter Councils Community Profile website

2002/03 aerial photograph for the Muswellbrook study area

Demand projections for AusLink non urban corridor, methodology and projections, working paper 66, 2006

Guide to Traffic Engineering Practice Part 2 Roadway Capacity, Austroads

Guide to Traffic Engineering Practice Part 5 Intersection at Grade, Austroads

The Highway Capacity Manual TRB

Sharing the Main Street, Roads and Traffic Authority, 2nd Edition, February 2000

Accident Reduction Guide Part 1, Roads and Traffic Authority, August 2005

Appendix A

Traffic count data

EFFECTIVE DATA SOLUTIONS

N.S.W. | VIC. | QLD. | S.A. | W.A. | N.T. | A.C.T. | TAS.

2945 - Muswellbrook Intersection Surveys

May-07

JOB NUMBER 2945

JOB NAME MUSWELLBROOK

CLIENT PB

SURVEY LOCATIONS
1. New England Highway and Bimbadeen Drive
2. Acacia Drive and Broodwood Road
4. Acacia Drive and Rutherford Road
5. Ironbark Road and Rutherford Road
7. Adams Street and Ruth White Avenue
8. New England Highway and Thompson Street
9. Sydney Street and Mitchell Street
10. Sydney Street and Skellatar Stock Route
12. Maitland Street and Sydney Street
13. Maitland Street and Lorne Street
14. New England Highway and Bell Street
15. Bridge Street, William Street and Market Street
16. Bridge Street and Brook Street
17. King Street, Brentwood Street, Doyle Street and George Street
18. New England Highway and Hunter Street
19. Queen Street and Lexia Street
20. Brecht Street, Cook Street and Semilion Street
21. Brecht Street and Brentwood Street

SURVEY TYPE VEHICLE MOVEMENT SURVEY

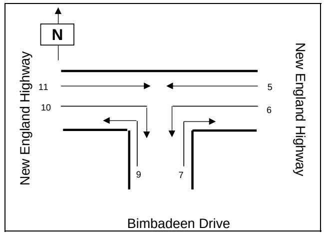
SURVEY DATE Friday, 4 May 2007

Intersection of New England Highway and Bimbadeen Drive

Friday, 4 May 2007

Australasian Traffic Surveys

Survey Start	7:00 AM 15:00 PM
Intersection Type	T Junction
Intersection No.	1
North Approach	
East Approach	New England Highway
South Approach	Bimbadeen Drive
West Approach	New England Highway
Date	4/05/07
Classfication	Light Heavy



TIME PERIOD	VEHICLE MOVEMENT																		VEHICLE MOVEMENT																				
	1			2			3			4			5			6			7			8			9			10			11			12			GRAND TOTAL		
	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ
7:00 - 7:15													42	6	48	4	0	4	3	0	3				4	0	4	2	0	2	72	13	85				127	19	146
7:15 - 7:30													72	11	83	5	1	6	2	0	2				1	0	1	2	0	2	67	7	74				149	19	168
7:30 - 7:45													76	9	85	2	1	3	5	0	5				3	0	3	1	0	1	68	8	76				155	18	173
7:45 - 8:00													60	10	70	1	3	4	4	0	4				8	0	8	3	1	4	65	7	72				141	21	162
8:00 - 8:15													59	11	70	3	0	3	1	1	2				4	3	7	5	0	5	67	3	70				139	18	157
8:15 - 8:30													54	4	58	2	0	2	0	0	0				8	2	10	4	0	4	69	14	83				137	20	157
8:30 - 8:45													61	10	71	0	0	0	3	0	3				7	0	7	6	0	6	41	8	49				118	18	136
8:45 - 9:00													50	9	59	2	0	2	1	0	1				8	1	9	2	3	5	48	8	56				111	21	132
Σ													474	70	544	19	5	24	19	1	20				43	6	49	25	4	29	497	68	565				1077	154	1231

TIME PERIOD	VEHICLE MOVEMENT																		VEHICLE MOVEMENT																				
	1			2			3			4			5			6			7			8			9			10			11			12			GRAND TOTAL		
	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ
15:00 - 15:15													104	11	115	2	0	2	2	0	2				6	0	6	3	0	3	77	14	91				194	25	219
15:15 - 15:30													95	8	103	1	0	1	2	0	2				5	1	6	9	3	12	99	3	102				211	15	226
15:30 - 15:45													112	10	122	6	0	6	2	0	2				10	3	13	8	1	9	82	12	94				220	26	246
15:45 - 16:00													113	9	122	4	0	4	3	0	3				5	3	8	13	2	15	80	10	90				218	24	242
16:00 - 16:15													141	8	149	6	0	6	7	0	7				13	0	13	6	0	6	94	12	106				267	20	287
16:15 - 16:30													96	10	106	4	0	4	1	0	1				9	0	9	8	0	8	94	7	101				212	17	229
16:30 - 16:45													124	10	134	5	0	5	2	0	2				7	0	7	5	1	6	70	8	78				213	19	232
16:45 - 17:00													114	5	119	6	0	6	3	0	3				8	0	8	2	0	2	87	16	103				220	21	241
Σ													899	71	970	34	0	34	22	0	22				63	7	70	54	7	61	683	82	765				1755	167	1922

TIME PERIOD	VEHICLE MOVEMENT																		VEHICLE MOVEMENT																					
	1			2			3			4			5			6			7			8			9			10			11			12			GRAND TOTAL			
	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	
7:00 - 8:00	0	0	0	0	0	0	0	0	0	0	0	0	250	36	286	12	5	17	14	0	14	0	0	0	16	0	16	8	1	9	272	35	307	0	0	0	572	77	649	
7:15 - 8:15	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**267**	**41**	**308**	**11**	**5**	**16**	**12**	**1**	**13**	**0**	**0**	**0**	**16**	**3**	**19**	**11**	**1**	**12**	**267**	**25**	**292**	**0**	**0**	**0**	**584**	**76**	**660**	**Peak**
7:30 - 8:30	0	0	0	0	0	0	0	0	0	0	0	0	249	34	283	8	4	12	10	1	11	0	0	0	23	5	28	13	1	14	269	32	301	0	0	0	572	77	649	
7:45 - 8:45	0	0	0	0	0	0	0	0	0	0	0	0	234	35	269	6	3	9	8	1	9	0	0	0	27	5	32	18	1	19	242	32	274	0	0	0	535	77	612	
8:00 - 9:00	0	0	0	0	0	0	0	0	0	0	0	0	224	34	258	7	0	7	5	1	6	0	0	0	27	6	33	17	3	20	225	33	258	0	0	0	505	77	582	

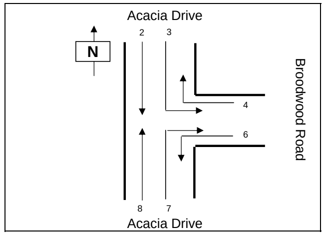
TIME PERIOD	VEHICLE MOVEMENT																		VEHICLE MOVEMENT																					
	1			2			3			4			5			6			7			8			9			10			11			12			GRAND TOTAL			
	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	
15:00 - 16:00	0	0	0	0	0	0	0	0	0	0	0	0	424	38	462	13	0	13	9	0	9	0	0	0	26	7	33	33	6	39	338	39	377	0	0	0	843	90	933	
15:15 - 16:15	0	0	0	0	0	0	0	0	0	0	0	0	461	35	496	17	0	17	14	0	14	0	0	0	33	7	40	36	6	42	355	37	392	0	0	0	916	85	1001	
15:30 - 16:30	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**462**	**37**	**499**	**20**	**0**	**20**	**13**	**0**	**13**	**0**	**0**	**0**	**37**	**6**	**43**	**35**	**3**	**38**	**350**	**41**	**391**	**0**	**0**	**0**	**917**	**87**	**1004**	**Peak**
15:45 - 16:45	0	0	0	0	0	0	0	0	0	0	0	0	474	37	511	19	0	19	13	0	13	0	0	0	34	3	37	32	3	35	338	37	375	0	0	0	910	80	990	
16:00 - 17:00	0	0	0	0	0	0	0	0	0	0	0	0	475	33	508	21	0	21	13	0	13	0	0	0	37	0	37	21	1	22	345	43	388	0	0	0	912	77	989	

Intersection of Acacia Drive and Broodwood Road

Friday, 4 May 2007

Australasian Traffic Surveys

Survey Start	7:00 AM 15:00 PM
Intersection Type	T Junction
Intersection No.	2
North Approach	Acacia Drive
East Approach	Broodwood Road
South Approach	Acacia Drive
West Approach	
Date	4/05/07
Classfication	Light Heavy



TIME PERIOD	VEHICLE MOVEMENT																		VEHICLE MOVEMENT																				
	1			2			3			4			5			6			7			8			9			10			11			12			GRAND TOTAL		
	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ
7:00 - 7:15				0	0	0	3	0	3	3	0	3				0	0	0	0	0	0	2	0	2													8	0	8
7:15 - 7:30				0	0	0	2	0	2	7	0	7				0	0	0	0	0	0	0	0	0													9	0	9
7:30 - 7:45				0	0	0	4	0	4	3	0	3				0	0	0	0	0	0	1	0	1													8	0	8
7:45 - 8:00				1	0	1	3	0	3	2	0	2				0	0	0	0	0	0	0	0	0													6	0	6
8:00 - 8:15				1	0	1	1	1	2	0	0	0				0	0	0	2	0	2	1	0	1													5	1	6
8:15 - 8:30				0	0	0	2	1	3	0	0	0				1	0	1	0	0	0	1	0	1													4	1	5
8:30 - 8:45				0	0	0	3	0	3	4	0	4				0	0	0	0	0	0	3	0	3													10	0	10
8:45 - 9:00				0	0	0	5	0	5	3	0	3				0	0	0	0	0	0	1	0	1													9	0	9
Σ				2	0	2	23	2	25	22	0	22				1	0	1	2	0	2	9	0	9													59	2	61

TIME PERIOD	VEHICLE MOVEMENT																		VEHICLE MOVEMENT																				
	1			2			3			4			5			6			7			8			9			10			11			12			GRAND TOTAL		
	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ
15:00 - 15:15				2	0	2	8	0	8	4	0	4				0	0	0	0	0	0	1	0	1													15	0	15
15:15 - 15:30				0	0	0	4	0	4	3	0	3				0	0	0	0	0	0	1	0	1													8	0	8
15:30 - 15:45				1	0	1	8	1	9	6	1	7				0	0	0	0	0	0	1	0	1													16	2	18
15:45 - 16:00				1	0	1	3	0	3	8	0	8				0	0	0	0	0	0	0	0	0													12	0	12
16:00 - 16:15				1	0	1	8	1	9	7	0	7				2	0	2	1	0	1	1	0	1													20	1	21
16:15 - 16:30				2	0	2	6	0	6	8	0	8				1	0	1	0	0	0	1	0	1													18	0	18
16:30 - 16:45				3	0	3	4	0	4	2	0	2				0	0	0	0	0	0	2	0	2													11	0	11
16:45 - 17:00				1	0	1	6	0	6	4	0	4				1	0	1	0	0	0	0	0	0													12	0	12
Σ				11	0	11	47	2	49	42	1	43				4	0	4	1	0	1	7	0	7													112	3	115

TIME PERIOD	VEHICLE MOVEMENT																		VEHICLE MOVEMENT																					
	1			2			3			4			5			6			7			8			9			10			11			12			GRAND TOTAL			
	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	
7:00 - 8:00	**0**	**0**	**0**	**1**	**0**	**1**	**12**	**0**	**12**	**15**	**0**	**15**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**3**	**0**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**31**	**0**	**31**	**Peak**
7:15 - 8:15	0	0	0	2	0	2	10	1	11	12	0	12	0	0	0	0	0	0	2	0	2	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	28	1	29	
7:30 - 8:30	0	0	0	2	0	2	10	2	12	5	0	5	0	0	0	1	0	1	2	0	2	3	0	3	0	0	0	0	0	0	0	0	0	0	0	0	23	2	25	
7:45 - 8:45	0	0	0	2	0	2	9	2	11	6	0	6	0	0	0	1	0	1	2	0	2	5	0	5	0	0	0	0	0	0	0	0	0	0	0	0	25	2	27	
8:00 - 9:00	0	0	0	1	0	1	11	2	13	7	0	7	0	0	0	1	0	1	2	0	2	6	0	6	0	0	0	0	0	0	0	0	0	0	0	0	28	2	30	

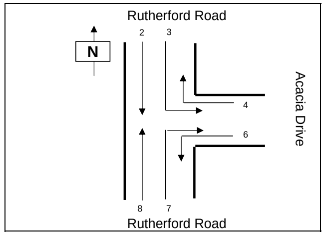
TIME PERIOD	VEHICLE MOVEMENT																		VEHICLE MOVEMENT																					
	1			2			3			4			5			6			7			8			9			10			11			12			GRAND TOTAL			
	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	
15:00 - 16:00	0	0	0	4	0	4	23	1	24	21	1	22	0	0	0	0	0	0	0	0	0	3	0	3	0	0	0	0	0	0	0	0	0	0	0	0	51	2	53	
15:15 - 16:15	0	0	0	3	0	3	23	2	25	24	1	25	0	0	0	2	0	2	1	0	1	3	0	3	0	0	0	0	0	0	0	0	0	0	0	0	56	3	59	
15:30 - 16:30	**0**	**0**	**0**	**5**	**0**	**5**	**25**	**2**	**27**	**29**	**1**	**30**	**0**	**0**	**0**	**3**	**0**	**3**	**1**	**0**	**1**	**3**	**0**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**66**	**3**	**69**	**Peak**
15:45 - 16:45	0	0	0	7	0	7	21	1	22	25	0	25	0	0	0	3	0	3	1	0	1	4	0	4	0	0	0	0	0	0	0	0	0	0	0	0	61	1	62	
16:00 - 17:00	0	0	0	7	0	7	24	1	25	21	0	21	0	0	0	4	0	4	1	0	1	4	0	4	0	0	0	0	0	0	0	0	0	0	0	0	61	1	62	

Intersection of Acacia Drive and Rutherford Road

Friday, 4 May 2007

Australasian Traffic Surveys

Survey Start	7:00 AM 15:00 PM
Intersection Type	T Junction
Intersection No.	4
North Approach	Rutherford Road
East Approach	Acacia Drive
South Approach	Rutherford Road
West Approach	
Date	4/05/07
Classfication	Light Heavy



TIME PERIOD	VEHICLE MOVEMENT 1			2			3			4			5			6			VEHICLE MOVEMENT 7			8			9			10			11			12			GRAND TOTAL		
	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ
7:00 - 7:15				18	0	18	4	0	4	11	1	12				5	0	5	3	0	3	13	0	13													54	1	55
7:15 - 7:30				19	2	21	5	1	6	10	1	11				3	0	3	4	0	4	27	1	28													68	5	73
7:30 - 7:45				17	3	20	7	1	8	17	0	17				4	0	4	4	0	4	27	1	28													76	5	81
7:45 - 8:00				10	1	11	8	0	8	21	1	22				4	0	4	9	0	9	28	1	29													80	3	83
8:00 - 8:15				16	1	17	4	1	5	15	0	15				4	0	4	1	0	1	34	0	34													74	2	76
8:15 - 8:30				25	2	27	4	3	7	27	1	28				3	0	3	2	0	2	45	1	46													106	7	113
8:30 - 8:45				29	3	32	8	1	9	33	1	34				6	0	6	6	0	6	39	2	41													121	7	128
8:45 - 9:00				63	8	71	17	2	19	62	1	63				10	0	10	9	0	9	27	2	29													188	13	201
Σ				197	20	217	57	9	66	196	6	202				39	0	39	38	0	38	240	8	248													767	43	810

TIME PERIOD	VEHICLE MOVEMENT 1			2			3			4			5			6			VEHICLE MOVEMENT 7			8			9			10			11			12			GRAND TOTAL		
	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ
15:00 - 15:15				33	0	33	15	1	16	17	1	18				4	0	4	11	0	11	41	3	44													121	5	126
15:15 - 15:30				44	0	44	15	0	15	15	1	16				6	0	6	11	0	11	45	0	45													136	1	137
15:30 - 15:45				70	1	71	18	1	19	15	0	15				4	0	4	15	0	15	44	0	44													166	2	168
15:45 - 16:00				58	3	61	12	2	14	18	0	18				8	0	8	10	0	10	36	0	36													142	5	147
16:00 - 16:15				66	1	67	18	1	19	17	1	18				5	0	5	29	0	29	57	0	57													192	3	195
16:15 - 16:30				65	1	66	15	0	15	23	3	26				8	0	8	13	0	13	57	0	57													181	4	185
16:30 - 16:45				56	2	58	16	0	16	12	0	12				7	0	7	9	0	9	51	0	51													151	2	153
16:45 - 17:00				65	1	66	21	0	21	19	0	19				5	0	5	14	0	14	53	1	54													177	2	179
Σ				457	9	466	130	5	135	136	6	142				47	0	47	112	0	112	384	4	388													1266	24	1290

TIME PERIOD	VEHICLE MOVEMENT 1			2			3			4			5			6			VEHICLE MOVEMENT 7			8			9			10			11			12			GRAND TOTAL			
	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	
7:00 - 8:00	0	0	0	64	6	70	24	2	26	59	3	62	0	0	0	16	0	16	20	0	20	95	3	98	0	0	0	0	0	0	0	0	0	0	0	0	278	14	292	
7:15 - 8:15	0	0	0	62	7	69	24	3	27	63	2	65	0	0	0	15	0	15	18	0	18	116	3	119	0	0	0	0	0	0	0	0	0	0	0	0	298	15	313	
7:30 - 8:30	0	0	0	68	7	75	23	5	28	80	2	82	0	0	0	15	0	15	16	0	16	134	3	137	0	0	0	0	0	0	0	0	0	0	0	0	336	17	353	
7:45 - 8:45	0	0	0	80	7	87	24	5	29	96	3	99	0	0	0	17	0	17	18	0	18	146	4	150	0	0	0	0	0	0	0	0	0	0	0	0	381	19	400	
8:00 - 9:00	**0**	**0**	**0**	**133**	**14**	**147**	**33**	**7**	**40**	**137**	**3**	**140**	**0**	**0**	**0**	**23**	**0**	**23**	**18**	**0**	**18**	**145**	**5**	**150**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**489**	**29**	**518**	**Peak**

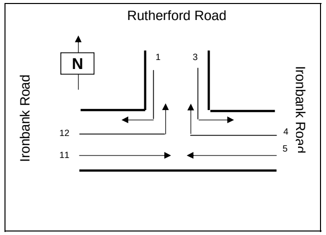
TIME PERIOD	VEHICLE MOVEMENT 1			2			3			4			5			6			VEHICLE MOVEMENT 7			8			9			10			11			12			GRAND TOTAL			
	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	
15:00 - 16:00	0	0	0	205	4	209	60	4	64	65	2	67	0	0	0	22	0	22	47	0	47	166	3	169	0	0	0	0	0	0	0	0	0	0	0	0	565	13	578	
15:15 - 16:15	0	0	0	238	5	243	63	4	67	65	2	67	0	0	0	23	0	23	65	0	65	182	0	182	0	0	0	0	0	0	0	0	0	0	0	0	636	11	647	
15:30 - 16:30	0	0	0	259	6	265	63	4	67	73	4	77	0	0	0	25	0	25	67	0	67	194	0	194	0	0	0	0	0	0	0	0	0	0	0	0	681	14	695	
15:45 - 16:45	0	0	0	245	7	252	61	3	64	70	4	74	0	0	0	28	0	28	61	0	61	201	0	201	0	0	0	0	0	0	0	0	0	0	0	0	666	14	680	
16:00 - 17:00	**0**	**0**	**0**	**252**	**5**	**257**	**70**	**1**	**71**	**71**	**4**	**75**	**0**	**0**	**0**	**25**	**0**	**25**	**65**	**0**	**65**	**218**	**1**	**219**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**701**	**11**	**712**	**Peak**

Intersection of Ironbank Road amd Rutherford Road

Friday, 4 May 2007

Australasian Traffic Surveys

Survey Start	7:00 AM 15:00 PM
Intersection Type	T Junction
Intersection No.	5
North Approach	Rutherford Road
East Approach	Ironbank Road
South Approach	
West Approach	Ironbank Road
Date	4/05/07
Classfication	Light Heavy



TIME PERIOD	VEHICLE MOVEMENT																		VEHICLE MOVEMENT																				
	1			2			3			4			5			6			7			8			9			10			11			12			GRAND TOTAL		
	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ
7:00 - 7:15	9	0	9				3	0	3	6	0	6	7	0	7																1	0	1	5	0	5	31	0	31
7:15 - 7:30	5	1	6				4	0	4	6	0	6	3	0	3																1	0	1	10	0	10	29	1	30
7:30 - 7:45	5	1	6				2	0	2	3	0	3	1	1	2																2	0	2	9	0	9	22	2	24
7:45 - 8:00	6	0	6				3	0	3	13	0	13	5	0	5																0	0	0	12	0	12	39	0	39
8:00 - 8:15	10	0	10				9	1	10	9	1	10	3	1	4																3	1	4	17	1	18	51	5	56
8:15 - 8:30	5	0	5				4	0	4	21	0	21	5	0	5																2	0	2	4	0	4	41	0	41
8:30 - 8:45	7	2	9				5	0	5	4	1	5	5	1	6																5	0	5	16	3	19	42	7	49
8:45 - 9:00	17	1	18				4	1	5	13	1	14	8	0	8																4	0	4	14	0	14	60	3	63
Σ	64	5	69				34	2	36	75	3	78	37	3	40																18	1	19	87	4	91	315	18	333

TIME PERIOD	VEHICLE MOVEMENT																		VEHICLE MOVEMENT																				
	1			2			3			4			5			6			7			8			9			10			11			12			GRAND TOTAL		
	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ
15:00 - 15:15	15	0	15				8	0	8	7	0	7	6	1	7																18	1	19	28	2	30	82	4	86
15:15 - 15:30	12	0	12				14	0	14	9	0	9	10	0	10																13	0	13	15	0	15	73	0	73
15:30 - 15:45	16	0	16				17	1	18	9	1	10	4	0	4																17	0	17	17	0	17	80	2	82
15:45 - 16:00	11	0	11				16	0	16	11	1	12	11	2	13																13	1	14	12	0	12	74	4	78
16:00 - 16:15	15	1	16				13	1	14	13	1	14	5	2	7																7	0	7	19	0	19	72	5	77
16:15 - 16:30	19	1	20				17	0	17	12	0	12	3	0	3																7	2	9	14	0	14	72	3	75
16:30 - 16:45	20	1	21				11	0	11	12	0	12	10	0	10																13	0	13	14	0	14	80	1	81
16:45 - 17:00	11	0	11				16	0	16	9	0	9	11	0	11																9	0	9	12	0	12	68	0	68
Σ	119	3	122				112	2	114	82	3	85	60	5	65																97	4	101	131	2	133	601	19	620

TIME PERIOD	VEHICLE MOVEMENT																		VEHICLE MOVEMENT																					
	1			2			3			4			5			6			7			8			9			10			11			12			GRAND TOTAL			
	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	
7:00 - 8:00	25	2	27	0	0	0	12	0	12	28	0	28	16	1	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	4	36	0	36	121	3	124	
7:15 - 8:15	26	2	28	0	0	0	18	1	19	31	1	32	12	2	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	1	7	48	1	49	141	8	149	
7:30 - 8:30	26	1	27	0	0	0	18	1	19	46	1	47	14	2	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	1	8	42	1	43	153	7	160	
7:45 - 8:45	28	2	30	0	0	0	21	1	22	47	2	49	18	2	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	1	11	49	4	53	173	12	185	
8:00 - 9:00	**39**	**3**	**42**	**0**	**0**	**0**	**22**	**2**	**24**	**47**	**3**	**50**	**21**	**2**	**23**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**14**	**1**	**15**	**51**	**4**	**55**	**194**	**15**	**209**	**Peak**

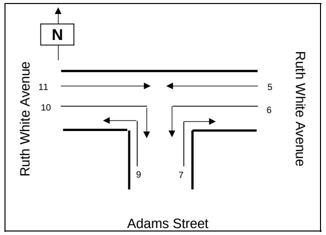
TIME PERIOD	VEHICLE MOVEMENT																		VEHICLE MOVEMENT																					
	1			2			3			4			5			6			7			8			9			10			11			12			GRAND TOTAL			
	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	
15:00 - 16:00	**54**	**0**	**54**	**0**	**0**	**0**	**55**	**1**	**56**	**36**	**2**	**38**	**31**	**3**	**34**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**61**	**2**	**63**	**72**	**2**	**74**	**309**	**10**	**319**	**Peak**
15:15 - 16:15	54	1	55	0	0	0	60	2	62	42	3	45	30	4	34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	50	1	51	63	0	63	299	11	310	
15:30 - 16:30	61	2	63	0	0	0	63	2	65	45	3	48	23	4	27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	44	3	47	62	0	62	298	14	312	
15:45 - 16:45	65	3	68	0	0	0	57	1	58	48	2	50	29	4	33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	40	3	43	59	0	59	298	13	311	
16:00 - 17:00	65	3	68	0	0	0	57	1	58	46	1	47	29	2	31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	36	2	38	59	0	59	292	9	301	

Intersection of Adams Street and Ruth White Avenue

Friday, 4 May 2007

Australasian Traffic Surveys

Survey Start	7:00 AM	15:00 PM
Intersection Type	T Junction	
Intersection No.	7	
North Approach		
East Approach	Ruth White Avenue	
South Approach	Adams Street	
West Approach	Ruth White Avenue	
Date	4/05/07	
Classfication	Light	Heavy



TIME PERIOD	VEHICLE MOVEMENT 1			2			3			4			5			6			7			8			9			10			11			12			GRAND TOTAL		
	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ
7:00 - 7:15													2	0	2	0	1	1	0	0	0				4	0	4	2	0	2	1	0	1				9	1	10
7:15 - 7:30													0	0	0	1	0	1	0	0	0				2	1	3	4	0	4	2	0	2				9	1	10
7:30 - 7:45													1	0	1	1	0	1	0	0	0				5	0	5	4	0	4	4	0	4				15	0	15
7:45 - 8:00													2	0	2	1	0	1	2	0	2				8	0	8	7	0	7	5	0	5				25	0	25
8:00 - 8:15													0	1	1	2	0	2	0	0	0				7	0	7	7	0	7	5	0	5				21	1	22
8:15 - 8:30													2	0	2	1	0	1	2	0	2				8	0	8	5	0	5	5	0	5				23	0	23
8:30 - 8:45													7	0	7	2	1	3	1	0	1				11	0	11	3	0	3	10	0	10				34	1	35
8:45 - 9:00													6	0	6	0	0	0	0	0	0				17	0	17	6	0	6	5	1	6				34	1	35
Σ													20	1	21	8	2	10	5	0	5				62	1	63	38	0	38	37	1	38				170	5	175

TIME PERIOD	VEHICLE MOVEMENT 1			2			3			4			5			6			7			8			9			10			11			12			GRAND TOTAL		
	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ
15:00 - 15:15													2	0	2	1	0	1	4	1	5				18	0	18	9	0	9	9	0	9				43	1	44
15:15 - 15:30													2	0	2	0	0	0	3	0	3				17	0	17	13	0	13	17	0	17				52	0	52
15:30 - 15:45													6	0	6	2	0	2	1	0	1				8	0	8	24	0	24	14	1	15				55	1	56
15:45 - 16:00													14	3	17	0	0	0	1	0	1				14	0	14	12	0	12	10	0	10				51	3	54
16:00 - 16:15													12	0	12	1	0	1	0	0	0				6	0	6	13	0	13	12	0	12				44	0	44
16:15 - 16:30													4	0	4	1	0	1	0	0	0				12	0	12	11	0	11	13	2	15				41	2	43
16:30 - 16:45													6	0	6	0	0	0	0	0	0				6	0	6	10	0	10	7	0	7				29	0	29
16:45 - 17:00													8	0	8	0	0	0	3	0	3				5	0	5	14	0	14	6	0	6				36	0	36
Σ													54	3	57	5	0	5	12	1	13				86	0	86	106	0	106	88	3	91				351	7	358

TIME PERIOD	VEHICLE MOVEMENT 1			2			3			4			5			6			7			8			9			10			11			12			GRAND TOTAL			
	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	
7:00 - 8:00	0	0	0	0	0	0	0	0	0	0	0	0	5	0	5	3	1	4	2	0	2	0	0	0	19	1	20	17	0	17	12	0	12	0	0	0	58	2	60	
7:15 - 8:15	0	0	0	0	0	0	0	0	0	0	0	0	3	1	4	5	0	5	2	0	2	0	0	0	22	1	23	22	0	22	16	0	16	0	0	0	70	2	72	
7:30 - 8:30	0	0	0	0	0	0	0	0	0	0	0	0	5	1	6	5	0	5	4	0	4	0	0	0	28	0	28	23	0	23	19	0	19	0	0	0	84	1	85	
7:45 - 8:45	0	0	0	0	0	0	0	0	0	0	0	0	11	1	12	6	1	7	5	0	5	0	0	0	34	0	34	22	0	22	25	0	25	0	0	0	103	2	105	
8:00 - 9:00	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**15**	**1**	**16**	**5**	**1**	**6**	**3**	**0**	**3**	**0**	**0**	**0**	**43**	**0**	**43**	**21**	**0**	**21**	**25**	**1**	**26**	**0**	**0**	**0**	**112**	**3**	**115**	**Peak**

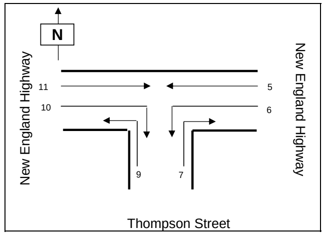
TIME PERIOD	VEHICLE MOVEMENT 1			2			3			4			5			6			7			8			9			10			11			12			GRAND TOTAL			
	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	
15:00 - 16:00	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**24**	**3**	**27**	**3**	**0**	**3**	**9**	**1**	**10**	**0**	**0**	**0**	**57**	**0**	**57**	**58**	**0**	**58**	**50**	**1**	**51**	**0**	**0**	**0**	**201**	**5**	**206**	**Peak**
15:15 - 16:15	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**34**	**3**	**37**	**3**	**0**	**3**	**5**	**0**	**5**	**0**	**0**	**0**	**45**	**0**	**45**	**62**	**0**	**62**	**53**	**1**	**54**	**0**	**0**	**0**	**202**	**4**	**206**	**Peak**
15:30 - 16:30	0	0	0	0	0	0	0	0	0	0	0	0	36	3	39	4	0	4	2	0	2	0	0	0	40	0	40	60	0	60	49	3	52	0	0	0	191	6	197	
15:45 - 16:45	0	0	0	0	0	0	0	0	0	0	0	0	36	3	39	2	0	2	1	0	1	0	0	0	38	0	38	46	0	46	42	2	44	0	0	0	165	5	170	
16:00 - 17:00	0	0	0	0	0	0	0	0	0	0	0	0	30	0	30	2	0	2	3	0	3	0	0	0	29	0	29	48	0	48	38	2	40	0	0	0	150	2	152	

Intersection of New England Highway and Thompson Street

Friday, 4 May 2007

Australasian Traffic Surveys

Survey Start	7:00 AM 15:00 PM
Intersection Type	T Junction
Intersection No.	8
North Approach	
East Approach	New England Highway
South Approach	Thompson Street
West Approach	New England Highway
Date	4/05/07
Classfication	Light Heavy



TIME PERIOD	VEHICLE MOVEMENT																		VEHICLE MOVEMENT																				
	1			2			3			4			5			6			7			8			9			10			11			12			GRAND TOTAL		
	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ
7:00 - 7:15													63	4	67	9	1	10	8	2	10				13	0	13	24	2	26	81	18	99				198	27	225
7:15 - 7:30													87	10	97	6	0	6	9	1	10				15	2	17	21	1	22	76	10	86				214	24	238
7:30 - 7:45													101	10	111	4	0	4	8	0	8				11	1	12	18	0	18	74	9	83				216	20	236
7:45 - 8:00													112	14	126	6	0	6	14	1	15				22	1	23	23	0	23	82	11	93				259	27	286
8:00 - 8:15													104	11	115	9	0	9	16	0	16				32	0	32	31	0	31	89	9	98				281	20	301
8:15 - 8:30													123	12	135	11	0	11	18	0	18				33	2	35	29	3	32	95	16	111				309	33	342
8:30 - 8:45													138	13	151	8	0	8	12	0	12				35	1	36	22	1	23	87	11	98				302	26	328
8:45 - 9:00													119	8	127	7	0	7	9	0	9				31	0	31	20	0	20	79	13	92				265	21	286
Σ													847	82	929	60	1	61	94	4	98				192	7	199	188	7	195	663	97	760				2044	198	2242

TIME PERIOD	VEHICLE MOVEMENT																		VEHICLE MOVEMENT																				
	1			2			3			4			5			6			7			8			9			10			11			12			GRAND TOTAL		
	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ
15:00 - 15:15													154	16	170	5	0	5	6	1	7				34	1	35	27	0	27	130	16	146				356	34	390
15:15 - 15:30													132	12	144	5	0	5	16	0	16				45	1	46	19	0	19	138	6	144				355	19	374
15:30 - 15:45													152	14	166	1	0	1	10	0	10				29	1	30	56	1	57	160	14	174				408	30	438
15:45 - 16:00													148	13	161	6	0	6	7	0	7				18	0	18	29	2	31	151	14	165				359	29	388
16:00 - 16:15													195	9	204	7	0	7	9	0	9				39	2	41	29	0	29	164	9	173				443	20	463
16:15 - 16:30													162	14	176	5	0	5	8	1	9				27	2	29	30	0	30	173	13	186				405	30	435
16:30 - 16:45													175	9	184	2	0	2	11	0	11				25	0	25	39	0	39	122	12	134				374	21	395
16:45 - 17:00													168	9	177	6	0	6	6	0	6				37	0	37	37	0	37	148	14	162				402	23	425
Σ													1286	96	1382	37	0	37	73	2	75				254	7	261	266	3	269	1186	98	1284				3102	206	3308

TIME PERIOD	VEHICLE MOVEMENT																		VEHICLE MOVEMENT																					
	1			2			3			4			5			6			7			8			9			10			11			12			GRAND TOTAL			
	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	
7:00 - 8:00	0	0	0	0	0	0	0	0	0	0	0	0	363	38	401	25	1	26	39	4	43	0	0	0	61	4	65	86	3	89	313	48	361	0	0	0	887	98	985	
7:15 - 8:15	0	0	0	0	0	0	0	0	0	0	0	0	404	45	449	25	0	25	47	2	49	0	0	0	80	4	84	93	1	94	321	39	360	0	0	0	970	91	1061	
7:30 - 8:30	0	0	0	0	0	0	0	0	0	0	0	0	440	47	487	30	0	30	56	1	57	0	0	0	98	4	102	101	3	104	340	45	385	0	0	0	1065	100	1165	
7:45 - 8:45	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**477**	**50**	**527**	**34**	**0**	**34**	**60**	**1**	**61**	**0**	**0**	**0**	**122**	**4**	**126**	**105**	**4**	**109**	**353**	**47**	**400**	**0**	**0**	**0**	**1151**	**106**	**1257**	**Peak**
8:00 - 9:00	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**484**	**44**	**528**	**35**	**0**	**35**	**55**	**0**	**55**	**0**	**0**	**0**	**131**	**3**	**134**	**102**	**4**	**106**	**350**	**49**	**399**	**0**	**0**	**0**	**1157**	**100**	**1257**	**Peak**

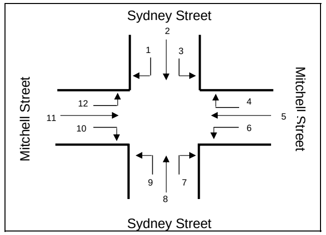
TIME PERIOD	VEHICLE MOVEMENT																		VEHICLE MOVEMENT																					
	1			2			3			4			5			6			7			8			9			10			11			12			GRAND TOTAL			
	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	
15:00 - 16:00	0	0	0	0	0	0	0	0	0	0	0	0	586	55	641	17	0	17	39	1	40	0	0	0	126	3	129	131	3	134	579	50	629	0	0	0	1478	112	1590	
15:15 - 16:15	0	0	0	0	0	0	0	0	0	0	0	0	627	48	675	19	0	19	42	0	42	0	0	0	131	4	135	133	3	136	613	43	656	0	0	0	1565	98	1663	
15:30 - 16:30	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**657**	**50**	**707**	**19**	**0**	**19**	**34**	**1**	**35**	**0**	**0**	**0**	**113**	**5**	**118**	**144**	**3**	**147**	**648**	**50**	**698**	**0**	**0**	**0**	**1615**	**109**	**1724**	**Peak**
15:45 - 16:45	0	0	0	0	0	0	0	0	0	0	0	0	680	45	725	20	0	20	35	1	36	0	0	0	109	4	113	127	2	129	610	48	658	0	0	0	1581	100	1681	
16:00 - 17:00	0	0	0	0	0	0	0	0	0	0	0	0	700	41	741	20	0	20	34	1	35	0	0	0	128	4	132	135	0	135	607	48	655	0	0	0	1624	94	1718	

Intersection of Sydney Street and Mitchell Street

Friday, 4 May 2007

Australasian Traffic Surveys

Survey Start	7:00 AM	15:00 PM	
Intersection Type	T Junction		
Intersection No.	9		
North Approach	Sydney Street		
East Approach	Mitchell Street		
South Approach	Sydney Street		
West Approach	Mitchell Street		
Date	4/05/07		
Classfication	Light	Heavy	



TIME PERIOD	1			2			3			4			5			6		
	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ
7:00 - 7:15	0	0	0	59	13	72	0	0	0	0	0	0	0	0	0	1	0	1
7:15 - 7:30	0	0	0	50	6	56	1	0	1	0	0	0	0	0	0	1	0	1
7:30 - 7:45	0	1	1	54	6	60	3	0	3	2	0	2	0	0	0	0	0	0
7:45 - 8:00	2	0	2	57	8	65	1	0	1	1	0	1	0	0	0	2	0	2
8:00 - 8:15	2	0	2	57	7	64	0	0	0	0	0	0	0	0	0	1	0	1
8:15 - 8:30	3	0	3	57	7	64	3	0	3	3	0	3	0	0	0	1	0	1
8:30 - 8:45	1	0	1	77	4	81	1	0	1	2	0	2	1	0	1	2	0	2
8:45 - 9:00	2	0	2	78	4	82	1	0	1	3	0	3	0	0	0	0	0	0
Σ	10	1	11	489	55	544	10	0	10	11	0	11	1	0	1	8	0	8

TIME PERIOD	7			8			9			10			11			12			GRAND TOTAL		
	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ
7:00 - 7:15	3	0	3	58	6	64	0	0	0	0	0	0	0	0	0	1	0	1	122	19	141
7:15 - 7:30	3	0	3	37	9	46	0	0	0	0	0	0	0	0	0	0	0	0	92	15	107
7:30 - 7:45	0	0	0	47	5	52	0	0	0	0	0	0	1	0	1	0	0	0	107	12	119
7:45 - 8:00	0	0	0	61	6	67	0	0	0	0	0	0	0	0	0	3	1	4	127	15	142
8:00 - 8:15	1	0	1	62	10	72	0	0	0	0	0	0	0	0	0	2	0	2	125	17	142
8:15 - 8:30	1	0	1	65	10	75	2	0	2	1	0	1	0	0	0	1	0	1	137	17	154
8:30 - 8:45	1	0	1	71	3	74	0	0	0	0	0	0	0	0	0	1	0	1	157	7	164
8:45 - 9:00	1	0	1	99	6	105	0	0	0	0	0	0	0	0	0	3	0	3	187	10	197
Σ	10	0	10	500	55	555	2	0	2	1	0	1	1	0	1	11	1	12	1054	112	1166

TIME PERIOD	1			2			3			4			5			6		
	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ
15:00 - 15:15	1	0	1	76	11	87	3	0	3	1	1	2	0	0	0	3	0	3
15:15 - 15:30	0	0	0	76	9	85	1	0	1	1	0	1	0	0	0	2	0	2
15:30 - 15:45	1	0	1	89	9	98	5	0	5	4	0	4	0	0	0	1	0	1
15:45 - 16:00	1	0	1	81	9	90	3	0	3	2	0	2	0	0	0	1	0	1
16:00 - 16:15	2	0	2	76	5	81	7	0	7	1	0	1	0	0	0	1	0	1
16:15 - 16:30	0	0	0	80	6	86	3	0	3	6	0	6	0	0	0	1	0	1
16:30 - 16:45	0	0	0	83	6	89	4	0	4	2	1	3	0	0	0	1	0	1
16:45 - 17:00	0	0	0	75	2	77	3	0	3	4	0	4	0	0	0	1	0	1
Σ	5	0	5	636	57	693	29	0	29	21	2	23	0	0	0	11	0	11

TIME PERIOD	7			8			9			10			11			12			GRAND TOTAL		
	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ
15:00 - 15:15	2	0	2	141	9	150	1	0	1	0	0	0	0	0	0	1	0	1	229	21	250
15:15 - 15:30	4	0	4	131	2	133	0	0	0	0	0	0	0	0	0	1	0	1	216	11	227
15:30 - 15:45	5	0	5	172	7	179	0	0	0	0	0	0	0	0	0	1	0	1	278	16	294
15:45 - 16:00	5	0	5	120	4	124	0	0	0	0	0	0	0	0	0	1	0	1	214	13	227
16:00 - 16:15	1	0	1	97	3	100	0	0	0	0	0	0	0	0	0	1	0	1	186	8	194
16:15 - 16:30	4	0	4	93	3	96	1	0	1	0	0	0	0	0	0	1	0	1	189	9	198
16:30 - 16:45	1	0	1	99	6	105	0	0	0	0	0	0	0	0	0	2	0	2	192	13	205
16:45 - 17:00	4	0	4	108	1	109	0	0	0	0	0	0	0	0	0	0	0	0	195	3	198
Σ	26	0	26	961	35	996	2	0	2	0	0	0	0	0	0	8	0	8	1699	94	1793

TIME PERIOD	1			2			3			4			5			6		
	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ
7:00 - 8:00	2	1	3	220	33	253	5	0	5	3	0	3	0	0	0	4	0	4
7:15 - 8:15	4	1	5	218	27	245	5	0	5	3	0	3	0	0	0	4	0	4
7:30 - 8:30	7	1	8	225	28	253	7	0	7	6	0	6	0	0	0	4	0	4
7:45 - 8:45	8	0	8	248	26	274	5	0	5	6	0	6	1	0	1	6	0	6
8:00 - 9:00	**8**	**0**	**8**	**269**	**22**	**291**	**5**	**0**	**5**	**8**	**0**	**8**	**1**	**0**	**1**	**4**	**0**	**4**

TIME PERIOD	7			8			9			10			11			12			GRAND TOTAL			
	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	
7:00 - 8:00	6	0	6	203	26	229	0	0	0	0	0	0	1	0	1	4	1	5	448	61	509	
7:15 - 8:15	4	0	4	207	30	237	0	0	0	0	0	0	1	0	1	5	1	6	451	59	510	
7:30 - 8:30	2	0	2	235	31	266	2	0	2	1	0	1	1	0	1	6	1	7	496	61	557	
7:45 - 8:45	3	0	3	259	29	288	2	0	2	1	0	1	0	0	0	7	1	8	546	56	602	
8:00 - 9:00	**4**	**0**	**4**	**297**	**29**	**326**	**2**	**0**	**2**	**1**	**0**	**1**	**0**	**0**	**0**	**7**	**0**	**7**	**606**	**51**	**657**	**Peak**

TIME PERIOD	1			2			3			4			5			6		
	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ
15:00 - 16:00	**3**	**0**	**3**	**322**	**38**	**360**	**12**	**0**	**12**	**8**	**1**	**9**	**0**	**0**	**0**	**7**	**0**	**7**
15:15 - 16:15	4	0	4	322	32	354	16	0	16	8	0	8	0	0	0	5	0	5
15:30 - 16:30	4	0	4	326	29	355	18	0	18	13	0	13	0	0	0	4	0	4
15:45 - 16:45	3	0	3	320	26	346	17	0	17	11	1	12	0	0	0	4	0	4
16:00 - 17:00	2	0	2	314	19	333	17	0	17	13	1	14	0	0	0	4	0	4

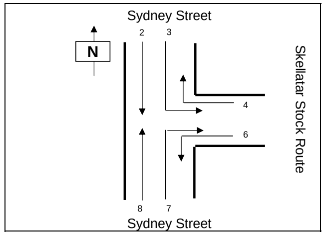
TIME PERIOD	7			8			9			10			11			12			GRAND TOTAL			
	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	
15:00 - 16:00	**16**	**0**	**16**	**564**	**22**	**586**	**1**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**4**	**0**	**4**	**937**	**61**	**998**	**Peak**
15:15 - 16:15	15	0	15	520	16	536	0	0	0	0	0	0	0	0	0	4	0	4	894	48	942	
15:30 - 16:30	15	0	15	482	17	499	1	0	1	0	0	0	0	0	0	4	0	4	867	46	913	
15:45 - 16:45	11	0	11	409	16	425	1	0	1	0	0	0	0	0	0	5	0	5	781	43	824	
16:00 - 17:00	10	0	10	397	13	410	1	0	1	0	0	0	0	0	0	4	0	4	762	33	795	

Intersection of Sydney Street and Skellatar Stock Route

Friday, 4 May 2007

Australasian Traffic Surveys

Survey Start	7:00 AM 15:00 PM
Intersection Type	T Junction
Intersection No.	10
North Approach	Sydney Street
East Approach	Skellatar Stock Route
South Approach	Sydney Street
West Approach	
Date	4/05/07
Classfication	Light Heavy



TIME PERIOD	VEHICLE MOVEMENT																		VEHICLE MOVEMENT																				
	1			2			3			4			5			6			7			8			9			10			11			12			GRAND TOTAL		
	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ
7:00 - 7:15				67	9	76	3	0	3	3	0	3				18	2	20	7	1	8	49	9	58													147	21	168
7:15 - 7:30				46	6	52	0	0	0	1	0	1				8	0	8	6	1	7	35	11	46													96	18	114
7:30 - 7:45				46	5	51	3	1	4	0	0	0				11	0	11	7	1	8	36	5	41													103	12	115
7:45 - 8:00				49	7	56	1	0	1	1	0	1				4	0	4	8	1	9	48	4	52													111	12	123
8:00 - 8:15				38	5	43	5	0	5	1	0	1				13	2	15	6	2	8	43	7	50													106	16	122
8:15 - 8:30				39	5	44	8	0	8	3	1	4				5	0	5	5	1	6	50	9	59													110	16	126
8:30 - 8:45				40	3	43	16	3	19	8	0	8				9	3	12	8	0	8	37	4	41													118	13	131
8:45 - 9:00				32	3	35	20	1	21	14	3	17				6	0	6	7	0	7	58	5	63													137	12	149
Σ				357	43	400	56	5	61	31	4	35				74	7	81	54	7	61	356	54	410													928	120	1048

TIME PERIOD	VEHICLE MOVEMENT																		VEHICLE MOVEMENT																				
	1			2			3			4			5			6			7			8			9			10			11			12			GRAND TOTAL		
	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ
15:00 - 15:15				44	11	55	12	1	13	19	5	24				13	1	14	22	0	22	115	7	122													225	25	250
15:15 - 15:30				40	7	47	4	0	4	16	1	17				8	0	8	10	1	11	94	1	95													172	10	182
15:30 - 15:45				52	7	59	2	0	2	6	2	8				8	1	9	33	1	34	176	4	180													277	15	292
15:45 - 16:00				56	8	64	6	0	6	3	0	3				12	0	12	12	1	13	99	3	102													188	12	200
16:00 - 16:15				45	5	50	4	0	4	2	1	3				10	2	12	16	0	16	79	1	80													156	9	165
16:15 - 16:30				46	2	48	7	2	9	2	0	2				10	1	11	9	0	9	69	6	75													143	11	154
16:30 - 16:45				40	6	46	5	0	5	9	1	10				11	0	11	16	0	16	72	3	75													153	10	163
16:45 - 17:00				41	2	43	5	0	5	7	0	7				9	0	9	16	0	16	63	2	65													141	4	145
Σ				364	48	412	45	3	48	64	10	74				81	5	86	134	3	137	767	27	794													1455	96	1551

TIME PERIOD	VEHICLE MOVEMENT																		VEHICLE MOVEMENT																					
	1			2			3			4			5			6			7			8			9			10			11			12			GRAND TOTAL			
	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	
7:00 - 8:00	0	0	0	208	27	235	7	1	8	5	0	5	0	0	0	41	2	43	28	4	32	168	29	197	0	0	0	0	0	0	0	0	0	0	0	0	457	63	520	
7:15 - 8:15	0	0	0	179	23	202	9	1	10	3	0	3	0	0	0	36	2	38	27	5	32	162	27	189	0	0	0	0	0	0	0	0	0	0	0	0	416	58	474	
7:30 - 8:30	0	0	0	172	22	194	17	1	18	5	1	6	0	0	0	33	2	35	26	5	31	177	25	202	0	0	0	0	0	0	0	0	0	0	0	0	430	56	486	
7:45 - 8:45	0	0	0	166	20	186	30	3	33	13	1	14	0	0	0	31	5	36	27	4	31	178	24	202	0	0	0	0	0	0	0	0	0	0	0	0	445	57	502	
8:00 - 9:00	**0**	**0**	**0**	**149**	**16**	**165**	**49**	**4**	**53**	**26**	**4**	**30**	**0**	**0**	**0**	**33**	**5**	**38**	**26**	**3**	**29**	**188**	**25**	**213**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**471**	**57**	**528**	**Peak**

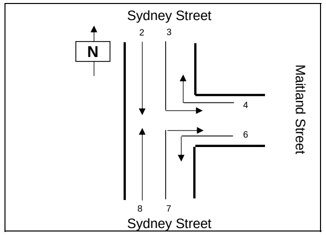
TIME PERIOD	VEHICLE MOVEMENT																		VEHICLE MOVEMENT																					
	1			2			3			4			5			6			7			8			9			10			11			12			GRAND TOTAL			
	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	
15:00 - 16:00	**0**	**0**	**0**	**192**	**33**	**225**	**24**	**1**	**25**	**44**	**8**	**52**	**0**	**0**	**0**	**41**	**2**	**43**	**77**	**3**	**80**	**484**	**15**	**499**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**862**	**62**	**924**	**Peak**
15:15 - 16:15	0	0	0	193	27	220	16	0	16	27	4	31	0	0	0	38	3	41	71	3	74	448	9	457	0	0	0	0	0	0	0	0	0	0	0	0	793	46	839	
15:30 - 16:30	0	0	0	199	22	221	19	2	21	13	3	16	0	0	0	40	4	44	70	2	72	423	14	437	0	0	0	0	0	0	0	0	0	0	0	0	764	47	811	
15:45 - 16:45	0	0	0	187	21	208	22	2	24	16	2	18	0	0	0	43	3	46	53	1	54	319	13	332	0	0	0	0	0	0	0	0	0	0	0	0	640	42	682	
16:00 - 17:00	0	0	0	172	15	187	21	2	23	20	2	22	0	0	0	40	3	43	57	0	57	283	12	295	0	0	0	0	0	0	0	0	0	0	0	0	593	34	627	

Intersection of Maitland Street and Sydney Street

Friday, 4 May 2007

Australasian Traffic Surveys

Survey Start	7:00 AM 15:00 PM
Intersection Type	T Junction
Intersection No.	12
North Approach	Sydney Street
East Approach	Maitland Street
South Approach	Sydney Street
West Approach	
Date	4/05/07
Classfication	Light Heavy



TIME PERIOD	VEHICLE MOVEMENT																		VEHICLE MOVEMENT																				
	1			2			3			4			5			6			7			8			9			10			11			12			GRAND TOTAL		
	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ
7:00 - 7:15				59	6	65	61	13	74	51	5	56				9	3	12	20	2	22	54	5	59													254	34	288
7:15 - 7:30				40	1	41	56	5	61	65	10	75				17	4	21	5	3	8	44	6	50													227	29	256
7:30 - 7:45				47	5	52	50	8	58	76	9	85				12	1	13	8	0	8	39	5	44													232	28	260
7:45 - 8:00				49	3	52	68	4	72	65	10	75				16	4	20	9	4	13	50	5	55													257	30	287
8:00 - 8:15				52	5	57	65	4	69	90	9	99				18	1	19	8	2	10	52	6	58													285	27	312
8:15 - 8:30				59	7	66	73	11	84	79	10	89				15	4	19	10	1	11	56	9	65													292	42	334
8:30 - 8:45				61	3	64	60	8	68	96	10	106				11	2	13	12	1	13	72	4	76													312	28	340
8:45 - 9:00				68	4	72	92	13	105	107	9	116				16	2	18	14	2	16	89	5	94													386	35	421
Σ				435	34	469	525	66	591	629	72	701				114	21	135	86	15	101	456	45	501													2245	253	2498

TIME PERIOD	VEHICLE MOVEMENT																		VEHICLE MOVEMENT																				
	1			2			3			4			5			6			7			8			9			10			11			12			GRAND TOTAL		
	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ
15:00 - 15:15				73	7	80	120	10	130	135	14	149				18	1	19	18	0	18	120	9	129													484	41	525
15:15 - 15:30				67	6	73	118	5	123	128	12	140				21	2	23	24	1	25	131	1	132													489	27	516
15:30 - 15:45				86	4	90	126	11	137	131	10	141				23	8	31	20	2	22	136	4	140													522	39	561
15:45 - 16:00				78	8	86	121	12	133	130	7	137				20	1	21	19	4	23	118	3	121													486	35	521
16:00 - 16:15				64	5	69	143	7	150	160	6	166				19	0	19	13	3	16	93	1	94													492	22	514
16:15 - 16:30				75	4	79	139	9	148	162	11	173				27	1	28	19	1	20	91	3	94													513	29	542
16:30 - 16:45				78	4	82	115	13	128	140	9	149				18	2	20	21	3	24	86	2	88													458	33	491
16:45 - 17:00				67	4	71	126	10	136	138	8	146				20	0	20	31	1	32	84	3	87													466	26	492
Σ				588	42	630	1008	77	1085	1124	77	1201				166	15	181	165	15	180	859	26	885													3910	252	4162

TIME PERIOD	VEHICLE MOVEMENT																		VEHICLE MOVEMENT																					
	1			2			3			4			5			6			7			8			9			10			11			12			GRAND TOTAL			
	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	
7:00 - 8:00	0	0	0	195	15	210	235	30	265	257	34	291	0	0	0	54	12	66	42	9	51	187	21	208	0	0	0	0	0	0	0	0	0	0	0	0	970	121	1091	
7:15 - 8:15	0	0	0	188	14	202	239	21	260	296	38	334	0	0	0	63	10	73	30	9	39	185	22	207	0	0	0	0	0	0	0	0	0	0	0	0	1001	114	1115	
7:30 - 8:30	0	0	0	207	20	227	256	27	283	310	38	348	0	0	0	61	10	71	35	7	42	197	25	222	0	0	0	0	0	0	0	0	0	0	0	0	1066	127	1193	
7:45 - 8:45	0	0	0	221	18	239	266	27	293	330	39	369	0	0	0	60	11	71	39	8	47	230	24	254	0	0	0	0	0	0	0	0	0	0	0	0	1146	127	1273	
8:00 - 9:00	**0**	**0**	**0**	**240**	**19**	**259**	**290**	**36**	**326**	**372**	**38**	**410**	**0**	**0**	**0**	**60**	**9**	**69**	**44**	**6**	**50**	**269**	**24**	**293**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1275**	**132**	**1407**	**Peak**

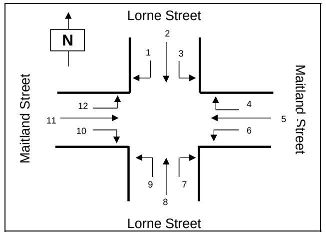
TIME PERIOD	VEHICLE MOVEMENT																		VEHICLE MOVEMENT																					
	1			2			3			4			5			6			7			8			9			10			11			12			GRAND TOTAL			
	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	
15:00 - 16:00	0	0	0	304	25	329	485	38	523	524	43	567	0	0	0	82	12	94	81	7	88	505	17	522	0	0	0	0	0	0	0	0	0	0	0	0	1981	142	2123	
15:15 - 16:15	0	0	0	295	23	318	508	35	543	549	35	584	0	0	0	83	11	94	76	10	86	478	9	487	0	0	0	0	0	0	0	0	0	0	0	0	1989	123	2112	
15:30 - 16:30	**0**	**0**	**0**	**303**	**21**	**324**	**529**	**39**	**568**	**583**	**34**	**617**	**0**	**0**	**0**	**89**	**10**	**99**	**71**	**10**	**81**	**438**	**11**	**449**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2013**	**125**	**2138**	**Peak**
15:45 - 16:45	0	0	0	295	21	316	518	41	559	592	33	625	0	0	0	84	4	88	72	11	83	388	9	397	0	0	0	0	0	0	0	0	0	0	0	0	1949	119	2068	
16:00 - 17:00	0	0	0	284	17	301	523	39	562	600	34	634	0	0	0	84	3	87	84	8	92	354	9	363	0	0	0	0	0	0	0	0	0	0	0	0	1929	110	2039	

Intersection of Maitland Street and Lorne Street

Friday, 4 May 2007

Australasian Traffic Surveys

Survey Start	7:00 AM 15:00 PM
Intersection Type	Cross Junction
Intersection No.	13
North Approach	Lorne Street
East Approach	Maitland Street
South Approach	Lorne Street
West Approach	Maitland Street
Date	4/05/07
Classfication	Light Heavy



TIME PERIOD	VEHICLE MOVEMENT																		VEHICLE MOVEMENT																				
	1			2			3			4			5			6			7			8			9			10			11			12			GRAND TOTAL		
	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ
7:00 - 7:15	0	0	0	0	0	0	1	0	1	2	0	2	61	7	68	3	0	3	6	0	6	0	0	0	6	0	6	1	0	1	87	15	102	0	0	0	167	22	189
7:15 - 7:30	0	0	0	0	0	0	6	0	6	0	0	0	76	11	87	3	0	3	6	1	7	0	0	0	10	0	10	5	0	5	61	9	70	0	0	0	167	21	188
7:30 - 7:45	0	0	0	0	0	0	1	0	1	1	0	1	76	9	85	9	1	10	6	0	6	0	0	0	9	1	10	2	1	3	57	8	65	1	0	1	162	20	182
7:45 - 8:00	0	0	0	0	0	0	7	0	7	2	0	2	81	11	92	6	1	7	2	2	4	0	0	0	8	0	8	3	0	3	75	7	82	0	0	0	184	21	205
8:00 - 8:15	0	0	0	0	0	0	1	0	1	3	1	4	101	10	111	9	0	9	3	0	3	0	0	0	9	0	9	4	1	5	68	5	73	0	0	0	198	17	215
8:15 - 8:30	0	0	0	0	0	0	2	1	3	2	0	2	87	14	101	4	0	4	4	2	6	0	0	0	12	0	12	4	0	4	78	14	92	1	0	1	194	31	225
8:30 - 8:45	0	0	0	0	0	0	3	0	3	2	0	2	106	13	119	4	0	4	6	0	6	1	0	1	8	0	8	7	0	7	55	9	64	0	0	0	192	22	214
8:45 - 9:00	0	0	0	0	0	0	2	0	2	0	0	0	109	10	119	11	0	11	3	0	3	0	0	0	9	0	9	13	0	13	82	15	97	0	0	0	229	25	254
Σ	0	0	0	0	0	0	23	1	24	12	1	13	697	85	782	49	2	51	36	5	41	1	0	1	71	1	72	39	2	41	563	82	645	2	0	2	1493	179	1672

TIME PERIOD	VEHICLE MOVEMENT																		VEHICLE MOVEMENT																				
	1			2			3			4			5			6			7			8			9			10			11			12			GRAND TOTAL		
	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ
15:00 - 15:15	1	0	1	2	0	2	5	0	5	6	0	6	135	14	149	11	1	12	7	0	7	1	0	1	19	0	19	21	1	22	119	10	129	0	0	0	327	26	353
15:15 - 15:30	0	0	0	0	0	0	3	0	3	2	0	2	120	13	133	4	0	4	9	0	9	0	0	0	21	0	21	6	0	6	134	6	140	1	0	1	300	19	319
15:30 - 15:45	0	0	0	0	0	0	3	0	3	6	0	6	128	15	143	15	0	15	4	0	4	0	0	0	30	1	31	16	0	16	119	13	132	0	0	0	321	29	350
15:45 - 16:00	0	0	0	0	0	0	7	0	7	3	0	3	115	9	124	10	3	13	5	0	5	0	0	0	14	1	15	19	1	20	110	16	126	0	0	0	283	30	313
16:00 - 16:15	0	0	0	0	0	0	4	0	4	6	0	6	166	8	174	9	0	9	7	0	7	0	0	0	23	0	23	12	1	13	148	10	158	0	0	0	375	19	394
16:15 - 16:30	2	0	2	0	0	0	7	0	7	5	0	5	156	13	169	15	0	15	4	0	4	0	0	0	20	0	20	12	0	12	146	11	157	1	0	1	368	24	392
16:30 - 16:45	0	0	0	0	0	0	6	0	6	4	0	4	139	9	148	11	0	11	3	0	3	1	0	1	19	0	19	19	0	19	119	14	133	0	0	0	321	23	344
16:45 - 17:00	1	0	1	0	0	0	4	0	4	4	0	4	139	5	144	8	0	8	2	0	2	1	0	1	9	0	9	16	0	16	143	10	153	0	0	0	327	15	342
Σ	4	0	4	2	0	2	39	0	39	36	0	36	1098	86	1184	83	4	87	41	0	41	3	0	3	155	2	157	121	3	124	1038	90	1128	2	0	2	2622	185	2807

TIME PERIOD	VEHICLE MOVEMENT																		VEHICLE MOVEMENT																					
	1			2			3			4			5			6			7			8			9			10			11			12			GRAND TOTAL			
	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	
7:00 - 8:00	0	0	0	0	0	0	15	0	15	5	0	5	294	38	332	21	2	23	20	3	23	0	0	0	33	1	34	11	1	12	280	39	319	1	0	1	680	84	764	
7:15 - 8:15	0	0	0	0	0	0	15	0	15	6	1	7	334	41	375	27	2	29	17	3	20	0	0	0	36	1	37	14	2	16	261	29	290	1	0	1	711	79	790	
7:30 - 8:30	0	0	0	0	0	0	11	1	12	8	1	9	345	44	389	28	2	30	15	4	19	0	0	0	38	1	39	13	2	15	278	34	312	2	0	2	738	89	827	
7:45 - 8:45	0	0	0	0	0	0	13	1	14	9	1	10	375	48	423	23	1	24	15	4	19	1	0	1	37	0	37	18	1	19	276	35	311	1	0	1	768	91	859	
8:00 - 9:00	**0**	**0**	**0**	**0**	**0**	**0**	**8**	**1**	**9**	**7**	**1**	**8**	**403**	**47**	**450**	**28**	**0**	**28**	**16**	**2**	**18**	**1**	**0**	**1**	**38**	**0**	**38**	**28**	**1**	**29**	**283**	**43**	**326**	**1**	**0**	**1**	**813**	**95**	**908**	**Peak**

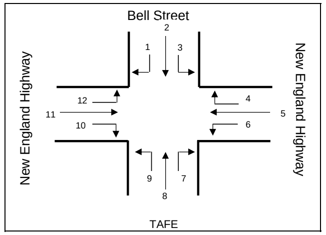
TIME PERIOD	VEHICLE MOVEMENT																		VEHICLE MOVEMENT																					
	1			2			3			4			5			6			7			8			9			10			11			12			GRAND TOTAL			
	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	
15:00 - 16:00	1	0	1	2	0	2	18	0	18	17	0	17	498	51	549	40	4	44	25	0	25	1	0	1	84	2	86	62	2	64	482	45	527	1	0	1	1231	104	1335	
15:15 - 16:15	0	0	0	0	0	0	17	0	17	17	0	17	529	45	574	38	3	41	25	0	25	0	0	0	88	2	90	53	2	55	511	45	556	1	0	1	1279	97	1376	
15:30 - 16:30	2	0	2	0	0	0	21	0	21	20	0	20	565	45	610	49	3	52	20	0	20	0	0	0	87	2	89	59	2	61	523	50	573	1	0	1	1347	102	1449	
15:45 - 16:45	2	0	2	0	0	0	24	0	24	18	0	18	576	39	615	45	3	48	19	0	19	1	0	1	76	1	77	62	2	64	523	51	574	1	0	1	1347	96	1443	
16:00 - 17:00	**3**	**0**	**3**	**0**	**0**	**0**	**21**	**0**	**21**	**19**	**0**	**19**	**600**	**35**	**635**	**43**	**0**	**43**	**16**	**0**	**16**	**2**	**0**	**2**	**71**	**0**	**71**	**59**	**1**	**60**	**556**	**45**	**601**	**1**	**0**	**1**	**1391**	**81**	**1472**	**Peak**

Intersection of New England Highway and Bell Street

Friday, 4 May 2007

Australasian Traffic Surveys

Survey Start	7:00 AM 15:00 PM
Intersection Type	T Junction
Intersection No.	14
North Approach	Bell Street
East Approach	New England Highway
South Approach	TAFE
West Approach	New England Highway
Date	4/05/07
Classfication	Light Heavy



VEHICLE MOVEMENT

TIME PERIOD	1			2			3			4			5			6		
	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ
7:00 - 7:15	2	1	3	1	0	1	20	2	22	21	0	21	58	5	63	0	0	0
7:15 - 7:30	6	0	6	0	0	0	24	1	25	22	1	23	82	12	94	0	0	0
7:30 - 7:45	6	0	6	3	0	3	24	2	26	37	0	37	80	11	91	1	0	1
7:45 - 8:00	9	0	9	9	0	9	24	0	24	35	3	38	91	12	103	4	0	4
8:00 - 8:15	13	1	14	4	0	4	38	1	39	33	1	34	96	11	107	1	0	1
8:15 - 8:30	7	0	7	0	0	0	41	1	42	59	3	62	88	12	100	3	0	3
8:30 - 8:45	19	2	21	3	0	3	59	3	62	81	0	81	96	12	108	1	0	1
8:45 - 9:00	15	1	16	6	0	6	53	2	55	52	0	52	94	10	104	6	0	6
Σ	77	5	82	26	0	26	283	12	295	340	8	348	685	85	770	16	0	16

VEHICLE MOVEMENT

TIME PERIOD	7			8			9			10			11			12			GRAND TOTAL		
	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ
7:00 - 7:15	0	0	0	1	0	1	0	0	0	0	0	0	85	15	100	1	0	1	189	23	212
7:15 - 7:30	0	0	0	0	0	0	0	0	0	1	0	1	64	8	72	7	0	7	206	22	228
7:30 - 7:45	1	0	1	0	0	0	0	0	0	3	0	3	63	6	69	3	0	3	221	19	240
7:45 - 8:00	0	0	0	0	0	0	1	0	1	15	0	15	78	10	88	1	0	1	267	25	292
8:00 - 8:15	0	0	0	1	0	1	3	0	3	6	0	6	59	7	66	4	0	4	258	21	279
8:15 - 8:30	1	0	1	0	0	0	1	0	1	5	0	5	70	19	89	10	0	10	285	35	320
8:30 - 8:45	1	0	1	0	0	0	1	0	1	3	0	3	62	9	71	10	0	10	336	26	362
8:45 - 9:00	1	0	1	1	0	1	4	0	4	8	0	8	65	12	77	5	1	6	310	26	336
Σ	4	0	4	3	0	3	10	0	10	41	0	41	546	86	632	41	1	42	2072	197	2269

VEHICLE MOVEMENT

TIME PERIOD	1			2			3			4			5			6		
	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ
15:00 - 15:15	10	0	10	1	0	1	51	3	54	44	3	47	143	13	156	2	0	2
15:15 - 15:30	11	0	11	5	0	5	44	1	45	51	1	52	123	13	136	1	0	1
15:30 - 15:45	22	4	26	2	0	2	90	0	90	65	1	66	133	14	147	2	0	2
15:45 - 16:00	9	1	10	0	0	0	76	3	79	45	0	45	121	11	132	2	0	2
16:00 - 16:15	7	0	7	0	0	0	69	2	71	80	1	81	163	9	172	0	0	0
16:15 - 16:30	17	0	17	1	0	1	69	2	71	53	2	55	161	15	176	0	0	0
16:30 - 16:45	11	0	11	0	0	0	54	0	54	50	2	52	145	7	152	1	0	1
16:45 - 17:00	6	0	6	0	0	0	69	4	73	71	2	73	140	4	144	0	0	0
Σ	93	5	98	9	0	9	522	15	537	459	12	471	1129	86	1215	8	0	8

VEHICLE MOVEMENT

TIME PERIOD	7			8			9			10			11			12			GRAND TOTAL		
	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ
15:00 - 15:15	0	0	0	2	0	2	1	0	1	4	0	4	116	10	126	8	1	9	382	30	412
15:15 - 15:30	2	0	2	1	0	1	0	0	0	4	0	4	120	4	124	12	0	12	374	19	393
15:30 - 15:45	8	0	8	5	0	5	3	0	3	0	0	0	124	15	139	9	1	10	463	35	498
15:45 - 16:00	1	0	1	0	0	0	0	0	0	0	0	0	117	14	131	13	1	14	384	30	414
16:00 - 16:15	1	0	1	3	0	3	8	0	8	3	0	3	134	8	142	6	0	6	474	20	494
16:15 - 16:30	10	0	10	5	0	5	21	0	21	0	0	0	136	11	147	13	0	13	486	30	516
16:30 - 16:45	0	0	0	0	0	0	0	0	0	0	0	0	108	13	121	10	1	11	379	23	402
16:45 - 17:00	1	0	1	0	0	0	3	0	3	0	0	0	106	11	117	14	0	14	410	21	431
Σ	23	0	23	16	0	16	36	0	36	11	0	11	961	86	1047	85	4	89	3352	208	3560

VEHICLE MOVEMENT

TIME PERIOD	1			2			3			4			5			6		
	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ
7:00 - 8:00	23	1	24	13	0	13	92	5	97	115	4	119	311	40	351	5	0	5
7:15 - 8:15	34	1	35	16	0	16	110	4	114	127	5	132	349	46	395	6	0	6
7:30 - 8:30	35	1	36	16	0	16	127	4	131	164	7	171	355	46	401	9	0	9
7:45 - 8:45	48	3	51	16	0	16	162	5	167	208	7	215	371	47	418	9	0	9
8:00 - 9:00	**54**	**4**	**58**	**13**	**0**	**13**	**191**	**7**	**198**	**225**	**4**	**229**	**374**	**45**	**419**	**11**	**0**	**11**

VEHICLE MOVEMENT

TIME PERIOD	7			8			9			10			11			12			GRAND TOTAL			
	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	
7:00 - 8:00	1	0	1	1	0	1	1	0	1	19	0	19	290	39	329	12	0	12	883	89	972	
7:15 - 8:15	1	0	1	1	0	1	4	0	4	25	0	25	264	31	295	15	0	15	952	87	1039	
7:30 - 8:30	2	0	2	1	0	1	5	0	5	29	0	29	270	42	312	18	0	18	1031	100	1131	
7:45 - 8:45	2	0	2	1	0	1	6	0	6	29	0	29	269	45	314	25	0	25	1146	107	1253	
8:00 - 9:00	**3**	**0**	**3**	**2**	**0**	**2**	**9**	**0**	**9**	**22**	**0**	**22**	**256**	**47**	**303**	**29**	**1**	**30**	**1189**	**108**	**1297**	**Peak**

VEHICLE MOVEMENT

TIME PERIOD	1			2			3			4			5			6		
	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ
15:00 - 16:00	52	5	57	8	0	8	261	7	268	205	5	210	520	51	571	7	0	7
15:15 - 16:15	49	5	54	7	0	7	279	6	285	241	3	244	540	47	587	5	0	5
15:30 - 16:30	**55**	**5**	**60**	**3**	**0**	**3**	**304**	**7**	**311**	**243**	**4**	**247**	**578**	**49**	**627**	**4**	**0**	**4**
15:45 - 16:45	44	1	45	1	0	1	268	7	275	228	5	233	590	42	632	3	0	3
16:00 - 17:00	41	0	41	1	0	1	261	8	269	254	7	261	609	35	644	1	0	1

VEHICLE MOVEMENT

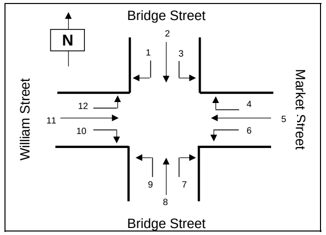
TIME PERIOD	7			8			9			10			11			12			GRAND TOTAL			
	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	
15:00 - 16:00	11	0	11	8	0	8	4	0	4	8	0	8	477	43	520	42	3	45	1603	114	1717	
15:15 - 16:15	12	0	12	9	0	9	11	0	11	7	0	7	495	41	536	40	2	42	1695	104	1799	
15:30 - 16:30	**20**	**0**	**20**	**13**	**0**	**13**	**32**	**0**	**32**	**3**	**0**	**3**	**511**	**48**	**559**	**41**	**2**	**43**	**1807**	**115**	**1922**	**Peak**
15:45 - 16:45	12	0	12	8	0	8	29	0	29	3	0	3	495	46	541	42	2	44	1723	103	1826	
16:00 - 17:00	12	0	12	8	0	8	32	0	32	3	0	3	484	43	527	43	1	44	1749	94	1843	

Intersection of Bridge Street, William Street and Market Street

Friday, 4 May 2007

Australasian Traffic Surveys

Survey Start	7:00 AM	15:00 PM
Intersection Type	Cross Junction	
Intersection No.	15	
North Approach	Bridge Street	
East Approach	Market Street	
South Approach	Bridge Street	
West Approach	William Street	
Date	4/05/07	
Classfication	Light	Heavy



TIME PERIOD	VEHICLE MOVEMENT																		VEHICLE MOVEMENT																				
	1			2			3			4			5			6			7			8			9			10			11			12			GRAND TOTAL		
	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ
7:00 - 7:15	1	0	1	111	17	128	12	2	14	1	0	1	0	0	0	5	2	7	17	2	19	87	9	96	4	0	4	7	0	7	0	0	0	0	0	0	245	32	277
7:15 - 7:30	2	0	2	86	4	90	10	1	11	2	3	5	0	0	0	11	2	13	13	0	13	94	16	110	3	0	3	2	0	2	0	0	0	0	0	0	223	26	249
7:30 - 7:45	5	0	5	81	10	91	11	2	13	8	1	9	0	0	0	14	4	18	17	0	17	95	14	109	4	0	4	7	0	7	0	0	0	1	0	1	243	31	274
7:45 - 8:00	4	1	5	114	7	121	15	0	15	4	0	4	0	0	0	15	0	15	17	1	18	95	13	108	6	0	6	2	0	2	1	0	1	0	0	0	273	22	295
8:00 - 8:15	2	0	2	101	9	110	14	4	18	8	0	8	0	0	0	19	3	22	15	4	19	116	11	127	6	0	6	2	0	2	0	0	0	0	0	0	283	31	314
8:15 - 8:30	0	0	0	109	13	122	19	4	23	11	2	13	3	0	3	20	3	23	24	9	33	122	11	133	7	0	7	3	0	3	2	0	2	0	0	0	320	42	362
8:30 - 8:45	2	0	2	118	11	129	21	3	24	7	2	9	2	0	2	25	4	29	23	3	26	132	14	146	11	0	11	7	0	7	3	0	3	3	0	3	354	37	391
8:45 - 9:00	3	0	3	126	14	140	24	5	29	16	0	16	4	0	4	28	2	30	21	1	22	152	13	165	20	0	20	1	0	1	0	1	1	0	0	0	395	36	431
Σ	19	1	20	846	85	931	126	21	147	57	8	65	9	0	9	137	20	157	147	20	167	893	101	994	61	0	61	31	0	31	6	1	7	4	0	4	2336	257	2593

TIME PERIOD	VEHICLE MOVEMENT																		VEHICLE MOVEMENT																				
	1			2			3			4			5			6			7			8			9			10			11			12			GRAND TOTAL		
	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ
15:00 - 15:15	0	0	0	165	16	181	24	1	25	16	0	16	4	0	4	25	0	25	20	1	21	213	21	234	22	0	22	12	2	14	4	0	4	4	0	4	509	41	550
15:15 - 15:30	0	0	0	160	7	167	27	2	29	6	2	8	3	0	3	22	3	25	31	1	32	203	10	213	19	1	20	15	0	15	4	0	4	1	0	1	491	26	517
15:30 - 15:45	0	0	0	161	10	171	24	1	25	25	2	27	7	0	7	35	3	38	29	3	32	226	12	238	20	1	21	8	0	8	5	0	5	3	0	3	543	32	575
15:45 - 16:00	1	0	1	179	15	194	37	3	40	16	3	19	6	0	6	26	6	32	15	0	15	204	10	214	29	0	29	9	0	9	5	0	5	6	0	6	533	37	570
16:00 - 16:15	2	0	2	182	11	193	22	1	23	15	0	15	2	0	2	32	1	33	22	0	22	219	9	228	11	0	11	18	1	19	1	0	1	4	0	4	530	23	553
16:15 - 16:30	0	0	0	191	14	205	24	1	25	6	0	6	1	0	1	24	0	24	21	0	21	219	15	234	19	0	19	11	0	11	3	0	3	0	0	0	519	30	549
16:30 - 16:45	0	0	0	181	13	194	41	0	41	16	0	16	2	0	2	21	3	24	25	0	25	162	12	174	14	0	14	7	0	7	2	0	2	0	0	0	471	28	499
16:45 - 17:00	0	0	0	164	13	177	25	0	25	17	1	18	2	0	2	23	0	23	13	1	14	190	12	202	7	0	7	9	0	9	0	0	0	0	0	0	450	27	477
Σ	3	0	3	1383	99	1482	224	9	233	117	8	125	27	0	27	208	16	224	176	6	182	1636	101	1737	141	2	143	89	3	92	24	0	24	18	0	18	4046	244	4290

TIME PERIOD	VEHICLE MOVEMENT																		VEHICLE MOVEMENT																					
	1			2			3			4			5			6			7			8			9			10			11			12			GRAND TOTAL			
	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	
7:00 - 8:00	12	1	13	392	38	430	48	5	53	15	4	19	0	0	0	45	8	53	64	3	67	371	52	423	17	0	17	18	0	18	1	0	1	1	0	1	984	111	1095	
7:15 - 8:15	13	1	14	382	30	412	50	7	57	22	4	26	0	0	0	59	9	68	62	5	67	400	54	454	19	0	19	13	0	13	1	0	1	1	0	1	1022	110	1132	
7:30 - 8:30	11	1	12	405	39	444	59	10	69	31	3	34	3	0	3	68	10	78	73	14	87	428	49	477	23	0	23	14	0	14	3	0	3	1	0	1	1119	126	1245	
7:45 - 8:45	8	1	9	442	40	482	69	11	80	30	4	34	5	0	5	79	10	89	79	17	96	465	49	514	30	0	30	14	0	14	6	0	6	3	0	3	1230	132	1362	
8:00 - 9:00	**7**	**0**	**7**	**454**	**47**	**501**	**78**	**16**	**94**	**42**	**4**	**46**	**9**	**0**	**9**	**92**	**12**	**104**	**83**	**17**	**100**	**522**	**49**	**571**	**44**	**0**	**44**	**13**	**0**	**13**	**5**	**1**	**6**	**3**	**0**	**3**	**1352**	**146**	**1498**	**Peak**

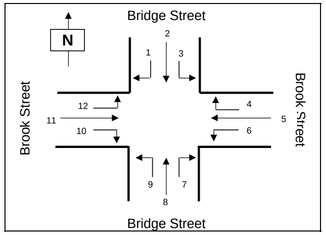
TIME PERIOD	VEHICLE MOVEMENT																		VEHICLE MOVEMENT																					
	1			2			3			4			5			6			7			8			9			10			11			12			GRAND TOTAL			
	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	
15:00 - 16:00	1	0	1	665	48	713	112	7	119	63	7	70	20	0	20	108	12	120	95	5	100	846	53	899	90	2	92	44	2	46	18	0	18	14	0	14	2076	136	2212	
15:15 - 16:15	3	0	3	682	43	725	110	7	117	62	7	69	18	0	18	115	13	128	97	4	101	852	41	893	79	2	81	50	1	51	15	0	15	14	0	14	2097	118	2215	
15:30 - 16:30	**3**	**0**	**3**	**713**	**50**	**763**	**107**	**6**	**113**	**62**	**5**	**67**	**16**	**0**	**16**	**117**	**10**	**127**	**87**	**3**	**90**	**868**	**46**	**914**	**79**	**1**	**80**	**46**	**1**	**47**	**14**	**0**	**14**	**13**	**0**	**13**	**2125**	**122**	**2247**	**Peak**
15:45 - 16:45	3	0	3	733	53	786	124	5	129	53	3	56	11	0	11	103	10	113	83	0	83	804	46	850	73	0	73	45	1	46	11	0	11	10	0	10	2053	118	2171	
16:00 - 17:00	2	0	2	718	51	769	112	2	114	54	1	55	7	0	7	100	4	104	81	1	82	790	48	838	51	0	51	45	1	46	6	0	6	4	0	4	1970	108	2078	

Intersection of Bridge Street and Brook Street

Friday, 4 May 2007

Australasian Traffic Surveys

Survey Start	7:00 AM 15:00 PM
Intersection Type	Cross Junction
Intersection No.	16
North Approach	Bridge Street
East Approach	Brook Street
South Approach	Bridge Street
West Approach	Brook Street
Date	4/05/07
Classfication	Light Heavy



TIME PERIOD	VEHICLE MOVEMENT 1			2			3			4			5			6			7			8			9			10			11			12			GRAND TOTAL		
	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ
7:00 - 7:15	0	0	0	79	16	95	6	1	7	2	0	2	3	0	3	17	2	19	17	0	17	61	10	71	15	0	15	18	0	18	5	0	5	4	0	4	227	29	256
7:15 - 7:30	2	0	2	68	5	73	3	1	4	2	0	2	4	0	4	18	0	18	17	0	17	63	16	79	12	3	15	18	1	19	5	0	5	3	0	3	215	26	241
7:30 - 7:45	1	0	1	57	13	70	6	1	7	8	0	8	3	1	4	17	2	19	21	3	24	68	11	79	18	1	19	11	0	11	8	0	8	6	0	6	224	32	256
7:45 - 8:00	5	0	5	90	4	94	14	2	16	9	0	9	10	0	10	18	3	21	31	2	33	62	9	71	8	4	12	26	1	27	12	1	13	0	0	0	285	26	311
8:00 - 8:15	4	1	5	77	12	89	15	0	15	11	1	12	4	0	4	20	2	22	34	4	38	79	6	85	17	0	17	23	1	24	12	0	12	3	0	3	299	27	326
8:15 - 8:30	6	0	6	76	13	89	26	0	26	10	2	12	12	1	13	25	1	26	44	5	49	78	9	87	20	3	23	35	4	39	17	0	17	2	2	4	351	40	391
8:30 - 8:45	9	1	10	66	11	77	33	1	34	9	1	10	23	2	25	30	3	33	48	7	55	84	7	91	22	1	23	43	1	44	23	2	25	4	0	4	394	37	431
8:45 - 9:00	5	1	6	88	15	103	23	0	23	6	1	7	15	0	15	28	2	30	43	2	45	82	10	92	19	0	19	27	0	27	14	1	15	3	0	3	353	32	385
Σ	32	3	35	601	89	690	126	6	132	57	5	62	74	4	78	173	15	188	255	23	278	577	78	655	131	12	143	201	8	209	96	4	100	25	2	27	2348	249	2597

TIME PERIOD	VEHICLE MOVEMENT 1			2			3			4			5			6			7			8			9			10			11			12			GRAND TOTAL		
	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ
15:00 - 15:15	9	0	9	111	13	124	19	0	19	19	0	19	19	1	20	39	0	39	55	3	58	126	15	141	27	4	31	30	2	32	14	0	14	7	1	8	475	39	514
15:15 - 15:30	8	0	8	118	8	126	22	0	22	15	0	15	21	1	22	43	1	44	69	2	71	137	11	148	25	0	25	21	1	22	29	1	30	5	0	5	513	25	538
15:30 - 15:45	8	0	8	106	13	119	14	1	15	29	0	29	31	0	31	41	1	42	77	1	78	146	10	156	26	3	29	29	0	29	17	0	17	11	0	11	535	29	564
15:45 - 16:00	9	0	9	133	11	144	23	1	24	21	0	21	24	0	24	8	2	10	72	1	73	169	12	181	22	4	26	32	2	34	21	0	21	6	0	6	540	33	573
16:00 - 16:15	8	0	8	117	9	126	18	0	18	30	0	30	19	0	19	43	1	44	69	0	69	187	9	196	24	0	24	34	1	35	27	0	27	12	2	14	588	22	610
16:15 - 16:30	4	0	4	147	11	158	18	0	18	20	0	20	16	0	16	32	3	35	78	4	82	172	11	183	37	1	38	17	0	17	16	0	16	20	0	20	577	30	607
16:30 - 16:45	3	0	3	109	11	120	14	0	14	18	0	18	14	1	15	38	1	39	61	0	61	142	10	152	34	1	35	27	1	28	16	0	16	12	0	12	488	25	513
16:45 - 17:00	18	0	18	126	14	140	21	0	21	15	0	15	18	0	18	39	1	40	51	3	54	191	7	198	38	1	39	33	0	33	36	0	36	11	0	11	597	26	623
Σ	67	0	67	967	90	1057	149	2	151	167	0	167	162	3	165	283	10	293	532	14	546	1270	85	1355	233	14	247	223	7	230	176	1	177	84	3	87	4313	229	4542

TIME PERIOD	VEHICLE MOVEMENT 1			2			3			4			5			6			7			8			9			10			11			12			GRAND TOTAL			
	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	
7:00 - 8:00	8	0	8	294	38	332	29	5	34	21	0	21	20	1	21	70	7	77	86	5	91	254	46	300	53	8	61	73	2	75	30	1	31	13	0	13	951	113	1064	
7:15 - 8:15	12	1	13	292	34	326	38	4	42	30	1	31	21	1	22	73	7	80	103	9	112	272	42	314	55	8	63	78	3	81	37	1	38	12	0	12	1023	111	1134	
7:30 - 8:30	16	1	17	300	42	342	61	3	64	38	3	41	29	2	31	80	8	88	130	14	144	287	35	322	63	8	71	95	6	101	49	1	50	11	2	13	1159	125	1284	
7:45 - 8:45	24	2	26	309	40	349	88	3	91	39	4	43	49	3	52	93	9	102	157	18	175	303	31	334	67	8	75	127	7	134	64	3	67	9	2	11	1329	130	1459	
8:00 - 9:00	**24**	**3**	**27**	**307**	**51**	**358**	**97**	**1**	**98**	**36**	**5**	**41**	**54**	**3**	**57**	**103**	**8**	**111**	**169**	**18**	**187**	**323**	**32**	**355**	**78**	**4**	**82**	**128**	**6**	**134**	**66**	**3**	**69**	**12**	**2**	**14**	**1397**	**136**	**1533**	**Peak**

TIME PERIOD	VEHICLE MOVEMENT 1			2			3			4			5			6			7			8			9			10			11			12			GRAND TOTAL			
	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	
15:00 - 16:00	34	0	34	468	45	513	78	2	80	84	0	84	95	2	97	131	4	135	273	7	280	578	48	626	100	11	111	112	5	117	81	1	82	29	1	30	2063	126	2189	
15:15 - 16:15	33	0	33	474	41	515	77	2	79	95	0	95	95	1	96	135	5	140	287	4	291	639	42	681	97	7	104	116	4	120	94	1	95	34	2	36	2176	109	2285	
15:30 - 16:30	**29**	**0**	**29**	**503**	**44**	**547**	**73**	**2**	**75**	**100**	**0**	**100**	**90**	**0**	**90**	**124**	**7**	**131**	**296**	**6**	**302**	**674**	**42**	**716**	**109**	**8**	**117**	**112**	**3**	**115**	**81**	**0**	**81**	**49**	**2**	**51**	**2240**	**114**	**2354**	**Peak**
15:45 - 16:45	24	0	24	506	42	548	73	1	74	89	0	89	73	1	74	121	7	128	280	5	285	670	42	712	117	6	123	110	4	114	80	0	80	50	2	52	2193	110	2303	
16:00 - 17:00	33	0	33	499	45	544	71	0	71	83	0	83	67	1	68	152	6	158	259	7	266	692	37	729	133	3	136	111	2	113	95	0	95	55	2	57	2250	103	2353	

Australasian Traffic Surveys 774 Pennant Hills Rd Carlingford NSW 2118

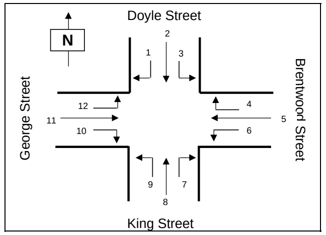
Ph: (02) 8812 3377 Fax: (02) 8812 3450

Intersection of King Street, Brentwood Street, Doyle Street and George Street

Friday, 4 May 2007

Australasian Traffic Surveys

Survey Start	7:00 AM 15:00 PM
Intersection Type	Cross Junction
Intersection No.	17
North Approach	Doyle Street
East Approach	Brentwood Street
South Approach	King Street
West Approach	George Street
Date	4/05/07
Classfication	Light Heavy



TIME PERIOD	1 Light	1 Heavy	1 Σ	2 Light	2 Heavy	2 Σ	3 Light	3 Heavy	3 Σ	4 Light	4 Heavy	4 Σ	5 Light	5 Heavy	5 Σ	6 Light	6 Heavy	6 Σ
7:00 - 7:15	6	1	7	0	1	1	0	0	0	1	0	1	5	1	6	2	0	2
7:15 - 7:30	11	0	11	1	0	1	1	0	1	0	0	0	7	0	7	1	0	1
7:30 - 7:45	5	1	6	2	0	2	0	0	0	1	0	1	4	0	4	4	0	4
7:45 - 8:00	15	0	15	1	0	1	0	0	0	1	0	1	7	1	8	2	0	2
8:00 - 8:15	12	2	14	1	0	1	0	0	0	2	0	2	7	1	8	0	0	0
8:15 - 8:30	16	2	18	3	0	3	1	0	1	1	0	1	11	0	11	1	0	1
8:30 - 8:45	19	1	20	7	0	7	1	0	1	2	0	2	15	0	15	7	0	7
8:45 - 9:00	15	0	15	3	0	3	0	0	0	3	0	3	17	0	17	6	0	6
Σ	99	7	106	18	1	19	3	0	3	11	0	11	73	3	76	23	0	23

TIME PERIOD	7 Light	7 Heavy	7 Σ	8 Light	8 Heavy	8 Σ	9 Light	9 Heavy	9 Σ	10 Light	10 Heavy	10 Σ	11 Light	11 Heavy	11 Σ	12 Light	12 Heavy	12 Σ	GRAND TOTAL Light	GRAND TOTAL Heavy	GRAND TOTAL Σ
7:00 - 7:15	1	0	1	0	0	0	1	0	1	5	0	5	5	0	5	11	1	12	37	4	41
7:15 - 7:30	7	0	7	4	0	4	2	0	2	0	0	0	5	0	5	20	2	22	59	2	61
7:30 - 7:45	5	0	5	4	0	4	3	0	3	2	1	3	6	1	7	14	0	14	50	3	53
7:45 - 8:00	0	0	0	6	0	6	2	1	3	5	0	5	17	0	17	14	2	16	70	4	74
8:00 - 8:15	3	0	3	3	0	3	3	0	3	8	1	9	11	1	12	13	0	13	63	5	68
8:15 - 8:30	4	0	4	4	0	4	7	0	7	14	1	15	10	0	10	13	0	13	85	3	88
8:30 - 8:45	7	0	7	11	0	11	8	2	10	38	1	39	8	0	8	15	1	16	138	5	143
8:45 - 9:00	2	0	2	6	0	6	5	1	6	30	1	31	15	1	16	14	1	15	116	4	120
Σ	29	0	29	38	0	38	31	4	35	102	5	107	77	3	80	114	7	121	618	30	648

TIME PERIOD	1 Light	1 Heavy	1 Σ	2 Light	2 Heavy	2 Σ	3 Light	3 Heavy	3 Σ	4 Light	4 Heavy	4 Σ	5 Light	5 Heavy	5 Σ	6 Light	6 Heavy	6 Σ
15:00 - 15:15	18	0	18	1	0	1	0	0	0	1	0	1	8	0	8	1	0	1
15:15 - 15:30	16	0	16	3	0	3	0	0	0	0	0	0	11	0	11	4	0	4
15:30 - 15:45	21	0	21	4	0	4	0	0	0	1	0	1	24	0	24	4	0	4
15:45 - 16:00	23	1	24	2	0	2	0	0	0	3	0	3	15	0	15	10	0	10
16:00 - 16:15	20	1	21	1	1	2	1	0	1	1	0	1	21	0	21	4	0	4
16:15 - 16:30	19	1	20	3	0	3	0	0	0	2	0	2	11	1	12	4	0	4
16:30 - 16:45	11	2	13	1	0	1	1	0	1	0	0	0	13	0	13	4	0	4
16:45 - 17:00	16	0	16	3	0	3	1	0	1	1	0	1	10	0	10	4	0	4
Σ	144	5	149	18	1	19	3	0	3	9	0	9	113	1	114	35	0	35

TIME PERIOD	7 Light	7 Heavy	7 Σ	8 Light	8 Heavy	8 Σ	9 Light	9 Heavy	9 Σ	10 Light	10 Heavy	10 Σ	11 Light	11 Heavy	11 Σ	12 Light	12 Heavy	12 Σ	GRAND TOTAL Light	GRAND TOTAL Heavy	GRAND TOTAL Σ
15:00 - 15:15	1	0	1	7	0	7	10	2	12	9	0	9	13	0	13	20	0	20	89	2	91
15:15 - 15:30	3	0	3	3	0	3	16	1	17	45	1	46	20	0	20	23	0	23	144	2	146
15:30 - 15:45	3	0	3	8	0	8	14	2	16	17	0	17	17	0	17	21	1	22	134	3	137
15:45 - 16:00	2	0	2	7	1	8	12	0	12	8	0	8	13	0	13	33	0	33	128	2	130
16:00 - 16:15	5	0	5	14	0	14	20	1	21	5	0	5	16	0	16	29	0	29	137	3	140
16:15 - 16:30	1	2	3	8	0	8	9	0	9	10	0	10	14	0	14	30	0	30	111	4	115
16:30 - 16:45	5	0	5	4	0	4	6	0	6	4	0	4	20	0	20	22	0	22	91	2	93
16:45 - 17:00	5	0	5	10	0	10	8	0	8	11	0	11	8	0	8	22	1	23	99	1	100
Σ	25	2	27	61	1	62	95	6	101	109	1	110	121	0	121	200	2	202	933	19	952

TIME PERIOD	1 Light	1 Heavy	1 Σ	2 Light	2 Heavy	2 Σ	3 Light	3 Heavy	3 Σ	4 Light	4 Heavy	4 Σ	5 Light	5 Heavy	5 Σ	6 Light	6 Heavy	6 Σ
7:00 - 8:00	37	2	39	4	1	5	1	0	1	3	0	3	23	2	25	9	0	9
7:15 - 8:15	43	3	46	5	0	5	1	0	1	4	0	4	25	2	27	7	0	7
7:30 - 8:30	48	5	53	7	0	7	1	0	1	5	0	5	29	2	31	7	0	7
7:45 - 8:45	62	5	67	12	0	12	2	0	2	6	0	6	40	2	42	10	0	10
8:00 - 9:00	**62**	**5**	**67**	**14**	**0**	**14**	**2**	**0**	**2**	**8**	**0**	**8**	**50**	**1**	**51**	**14**	**0**	**14**

TIME PERIOD	7 Light	7 Heavy	7 Σ	8 Light	8 Heavy	8 Σ	9 Light	9 Heavy	9 Σ	10 Light	10 Heavy	10 Σ	11 Light	11 Heavy	11 Σ	12 Light	12 Heavy	12 Σ	GRAND TOTAL Light	GRAND TOTAL Heavy	GRAND TOTAL Σ	
7:00 - 8:00	13	0	13	14	0	14	8	1	9	12	1	13	33	1	34	59	5	64	216	13	229	
7:15 - 8:15	15	0	15	17	0	17	10	1	11	15	2	17	39	2	41	61	4	65	242	14	256	
7:30 - 8:30	12	0	12	17	0	17	15	1	16	29	3	32	44	2	46	54	2	56	268	15	283	
7:45 - 8:45	14	0	14	24	0	24	20	3	23	65	3	68	46	1	47	55	3	58	356	17	373	
8:00 - 9:00	**16**	**0**	**16**	**24**	**0**	**24**	**23**	**3**	**26**	**90**	**4**	**94**	**44**	**2**	**46**	**55**	**2**	**57**	**402**	**17**	**419**	**Peak**

TIME PERIOD	1 Light	1 Heavy	1 Σ	2 Light	2 Heavy	2 Σ	3 Light	3 Heavy	3 Σ	4 Light	4 Heavy	4 Σ	5 Light	5 Heavy	5 Σ	6 Light	6 Heavy	6 Σ
15:00 - 16:00	78	1	79	10	0	10	0	0	0	5	0	5	58	0	58	19	0	19
15:15 - 16:15	**80**	**2**	**82**	**10**	**1**	**11**	**1**	**0**	**1**	**5**	**0**	**5**	**71**	**0**	**71**	**22**	**0**	**22**
15:30 - 16:30	83	3	86	10	1	11	1	0	1	7	0	7	71	1	72	22	0	22
15:45 - 16:45	73	5	78	7	1	8	2	0	2	6	0	6	60	1	61	22	0	22
16:00 - 17:00	66	4	70	8	1	9	3	0	3	4	0	4	55	1	56	16	0	16

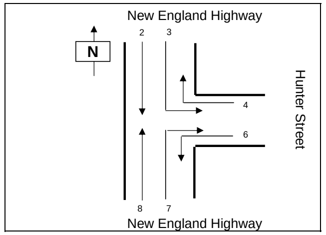
TIME PERIOD	7 Light	7 Heavy	7 Σ	8 Light	8 Heavy	8 Σ	9 Light	9 Heavy	9 Σ	10 Light	10 Heavy	10 Σ	11 Light	11 Heavy	11 Σ	12 Light	12 Heavy	12 Σ	GRAND TOTAL Light	GRAND TOTAL Heavy	GRAND TOTAL Σ	
15:00 - 16:00	9	0	9	25	1	26	52	5	57	79	1	80	63	0	63	97	1	98	495	9	504	
15:15 - 16:15	**13**	**0**	**13**	**32**	**1**	**33**	**62**	**4**	**66**	**75**	**1**	**76**	**66**	**0**	**66**	**106**	**1**	**107**	**543**	**10**	**553**	**Peak**
15:30 - 16:30	11	2	13	37	1	38	55	3	58	40	0	40	60	0	60	113	1	114	510	12	522	
15:45 - 16:45	13	2	15	33	1	34	47	1	48	27	0	27	63	0	63	114	0	114	467	11	478	
16:00 - 17:00	16	2	18	36	0	36	43	1	44	30	0	30	58	0	58	103	1	104	438	10	448	

Intersection of New England Highway and Hunter Street

Friday, 4 May 2007

Australasian Traffic Surveys

Survey Start	**7:00 AM 15:00 PM**
Intersection Type	**T Junction**
Intersection No.	**18**
North Approach	**New England Highway**
East Approach	**Hunter Street**
South Approach	**New England Highway**
West Approach	
Date	**4/05/07**
Classfication	**Light Heavy**



VEHICLE MOVEMENT

TIME PERIOD	1			2			3			4			5			6			7			8			9			10			11			12			GRAND TOTAL		
	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ
7:00 - 7:15				55	13	68	1	0	1	2	0	2				15	1	16	5	0	5	52	11	63													130	25	155
7:15 - 7:30				59	7	66	10	0	10	6	1	7				8	0	8	4	2	6	51	11	62													138	21	159
7:30 - 7:45				48	9	57	5	1	6	14	0	14				9	1	10	6	1	7	61	8	69													143	20	163
7:45 - 8:00				85	6	91	5	0	5	9	1	10				17	0	17	6	1	7	52	12	64													174	20	194
8:00 - 8:15				77	9	86	2	0	2	13	0	13				12	3	15	5	1	6	69	7	76													178	20	198
8:15 - 8:30				103	10	113	10	2	12	10	2	12				18	1	19	6	0	6	60	15	75													207	30	237
8:30 - 8:45				73	8	81	14	1	15	9	1	10				23	1	24	8	0	8	67	9	76													194	20	214
8:45 - 9:00				104	16	120	18	2	20	15	0	15				21	2	23	14	1	15	62	10	72													234	31	265
Σ				604	78	682	65	6	71	78	5	83				123	9	132	54	6	60	474	83	557													1398	187	1585

VEHICLE MOVEMENT

TIME PERIOD	1			2			3			4			5			6			7			8			9			10			11			12			GRAND TOTAL		
	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ
15:00 - 15:15				113	11	124	6	0	6	20	2	22				10	0	10	19	0	19	108	18	126													276	31	307
15:15 - 15:30				104	8	112	11	1	12	17	1	18				10	0	10	18	4	22	110	9	119													270	23	293
15:30 - 15:45				103	13	116	6	3	9	19	0	19				21	0	21	19	0	19	114	11	125													282	27	309
15:45 - 16:00				112	10	122	17	2	19	17	1	18				24	0	24	25	1	26	117	12	129													312	26	338
16:00 - 16:15				104	8	112	9	1	10	22	1	23				15	1	16	25	1	26	131	10	141													306	22	328
16:15 - 16:30				107	12	119	8	1	9	15	0	15				25	2	27	31	0	31	133	10	143													319	25	344
16:30 - 16:45				82	14	96	11	0	11	26	0	26				20	0	20	23	1	24	99	9	108													261	24	285
16:45 - 17:00				83	9	92	8	1	9	17	1	18				23	0	23	16	1	17	108	3	111													255	15	270
Σ				808	85	893	76	9	85	153	6	159				148	3	151	176	8	184	920	82	1002													2281	193	2474

VEHICLE MOVEMENT

TIME PERIOD	1			2			3			4			5			6			7			8			9			10			11			12			GRAND TOTAL			
	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	
7:00 - 8:00	0	0	0	247	35	282	21	1	22	31	2	33	0	0	0	49	2	51	21	4	25	216	42	258	0	0	0	0	0	0	0	0	0	0	0	0	585	86	671	
7:15 - 8:15	0	0	0	269	31	300	22	1	23	42	2	44	0	0	0	46	4	50	21	5	26	233	38	271	0	0	0	0	0	0	0	0	0	0	0	0	633	81	714	
7:30 - 8:30	0	0	0	313	34	347	22	3	25	46	3	49	0	0	0	56	5	61	23	3	26	242	42	284	0	0	0	0	0	0	0	0	0	0	0	0	702	90	792	
7:45 - 8:45	0	0	0	338	33	371	31	3	34	41	4	45	0	0	0	70	5	75	25	2	27	248	43	291	0	0	0	0	0	0	0	0	0	0	0	0	753	90	843	
8:00 - 9:00	**0**	**0**	**0**	**357**	**43**	**400**	**44**	**5**	**49**	**47**	**3**	**50**	**0**	**0**	**0**	**74**	**7**	**81**	**33**	**2**	**35**	**258**	**41**	**299**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**813**	**101**	**914**	**Peak**

VEHICLE MOVEMENT

TIME PERIOD	1			2			3			4			5			6			7			8			9			10			11			12			GRAND TOTAL			
	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	
15:00 - 16:00	0	0	0	432	42	474	40	6	46	73	4	77	0	0	0	65	0	65	81	5	86	449	50	499	0	0	0	0	0	0	0	0	0	0	0	0	1140	107	1247	
15:15 - 16:15	0	0	0	423	39	462	43	7	50	75	3	78	0	0	0	70	1	71	87	6	93	472	42	514	0	0	0	0	0	0	0	0	0	0	0	0	1170	98	1268	
15:30 - 16:30	**0**	**0**	**0**	**426**	**43**	**469**	**40**	**7**	**47**	**73**	**2**	**75**	**0**	**0**	**0**	**85**	**3**	**88**	**100**	**2**	**102**	**495**	**43**	**538**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1219**	**100**	**1319**	**Peak**
15:45 - 16:45	0	0	0	405	44	449	45	4	49	80	2	82	0	0	0	84	3	87	104	3	107	480	41	521	0	0	0	0	0	0	0	0	0	0	0	0	1198	97	1295	
16:00 - 17:00	0	0	0	376	43	419	36	3	39	80	2	82	0	0	0	83	3	86	95	3	98	471	32	503	0	0	0	0	0	0	0	0	0	0	0	0	1141	86	1227	

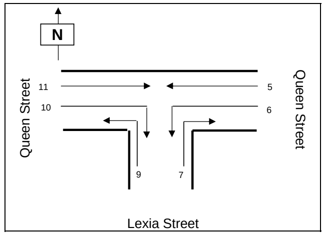
Australasian Traffic Surveys 774 Pennant Hills Rd Carlingford NSW 2118 Ph: (02) 8812 3377 Fax: (02) 8812 3450

Intersection of Queen Street and Lexia Street

Friday, 4 May 2007

Australasian Traffic Surveys

Survey Start	**7:00 AM 15:00 PM**
Intersection Type	**T Junction**
Intersection No.	**19**
North Approach	
East Approach	**Queen Street**
South Approach	**Lexia Street**
West Approach	**Queen Street**
Date	**4/05/07**
Classfication	**Light Heavy**



TIME PERIOD	1			2			3			4			5			6			7			8			9			10			11			12			GRAND TOTAL		
	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ
7:00 - 7:15													3	0	3	1	0	1	0	0	0				0	0	0	0	0	0	1	0	1				5	0	5
7:15 - 7:30													1	0	1	2	0	2	2	0	2				1	0	1	4	0	4	1	0	1				11	0	11
7:30 - 7:45													1	0	1	1	0	1	0	0	0				3	0	3	2	0	2	2	0	2				9	0	9
7:45 - 8:00													1	0	1	1	0	1	0	0	0				0	0	0	3	0	3	3	0	3				8	0	8
8:00 - 8:15													0	1	1	1	1	2	5	0	5				0	0	0	1	0	1	0	0	0				7	2	9
8:15 - 8:30													2	0	2	4	0	4	3	1	4				0	0	0	1	0	1	4	1	5				14	2	16
8:30 - 8:45													1	0	1	3	0	3	4	1	5				0	0	0	4	0	4	3	0	3				15	1	16
8:45 - 9:00													3	0	3	4	1	5	2	0	2				5	0	5	6	0	6	3	0	3				23	1	24
Σ													12	1	13	17	2	19	16	2	18				9	0	9	21	0	21	17	1	18				92	6	98

TIME PERIOD	1			2			3			4			5			6			7			8			9			10			11			12			GRAND TOTAL		
	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ
15:00 - 15:15													2	0	2	0	0	0	3	1	4				1	0	1	3	0	3	3	0	3				12	1	13
15:15 - 15:30													3	0	3	3	0	3	3	1	4				1	0	1	0	0	0	1	0	1				11	1	12
15:30 - 15:45													3	0	3	7	1	8	4	0	4				2	0	2	2	0	2	0	0	0				18	1	19
15:45 - 16:00													5	0	5	1	1	2	7	1	8				3	0	3	1	0	1	5	0	5				22	2	24
16:00 - 16:15													3	0	3	3	0	3	1	0	1				5	0	5	3	0	3	3	0	3				18	0	18
16:15 - 16:30													1	0	1	3	0	3	2	0	2				1	0	1	1	0	1	4	0	4				12	0	12
16:30 - 16:45													4	1	5	8	0	8	4	0	4				3	0	3	1	0	1	1	0	1				21	1	22
16:45 - 17:00													2	0	2	4	0	4	3	0	3				3	0	3	1	0	1	2	0	2				15	0	15
Σ													23	1	24	29	2	31	27	3	30				19	0	19	12	0	12	19	0	19				129	6	135

TIME PERIOD	1			2			3			4			5			6			7			8			9			10			11			12			GRAND TOTAL			
	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	
7:00 - 8:00	0	0	0	0	0	0	0	0	0	0	0	0	6	0	6	5	0	5	2	0	2	0	0	0	4	0	4	9	0	9	7	0	7	0	0	0	33	0	33	
7:15 - 8:15	0	0	0	0	0	0	0	0	0	0	0	0	3	1	4	5	1	6	7	0	7	0	0	0	4	0	4	10	0	10	6	0	6	0	0	0	35	2	37	
7:30 - 8:30	0	0	0	0	0	0	0	0	0	0	0	0	4	1	5	7	1	8	8	1	9	0	0	0	3	0	3	7	0	7	9	1	10	0	0	0	38	4	42	
7:45 - 8:45	0	0	0	0	0	0	0	0	0	0	0	0	4	1	5	9	1	10	12	2	14	0	0	0	0	0	0	9	0	9	10	1	11	0	0	0	44	5	49	
8:00 - 9:00	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**6**	**1**	**7**	**12**	**2**	**14**	**14**	**2**	**16**	**0**	**0**	**0**	**5**	**0**	**5**	**12**	**0**	**12**	**10**	**1**	**11**	**0**	**0**	**0**	**59**	**6**	**65**	**Peak**

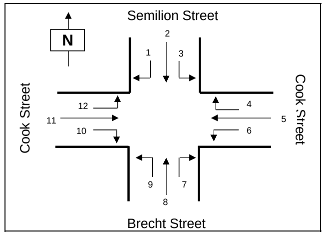
TIME PERIOD	1			2			3			4			5			6			7			8			9			10			11			12			GRAND TOTAL			
	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	
15:00 - 16:00	0	0	0	0	0	0	0	0	0	0	0	0	13	0	13	11	2	13	17	3	20	0	0	0	7	0	7	6	0	6	9	0	9	0	0	0	63	5	68	
15:15 - 16:15	0	0	0	0	0	0	0	0	0	0	0	0	14	0	14	14	2	16	15	2	17	0	0	0	11	0	11	6	0	6	9	0	9	0	0	0	69	4	73	
15:30 - 16:30	0	0	0	0	0	0	0	0	0	0	0	0	12	0	12	14	2	16	14	1	15	0	0	0	11	0	11	7	0	7	12	0	12	0	0	0	70	3	73	
15:45 - 16:45	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**13**	**1**	**14**	**15**	**1**	**16**	**14**	**1**	**15**	**0**	**0**	**0**	**12**	**0**	**12**	**6**	**0**	**6**	**13**	**0**	**13**	**0**	**0**	**0**	**73**	**3**	**76**	**Peak**
16:00 - 17:00	0	0	0	0	0	0	0	0	0	0	0	0	10	1	11	18	0	18	10	0	10	0	0	0	12	0	12	6	0	6	10	0	10	0	0	0	66	1	67	

Intersection of Brecht Street, Cook Street and Semilion Street

Friday, 4 May 2007

Australasian Traffic Surveys

Survey Start	7:00 AM 15:00 PM
Intersection Type	Cross Junction
Intersection No.	20
North Approach	Semilion Street
East Approach	Cook Street
South Approach	Brecht Street
West Approach	Cook Street
Date	4/05/07
Classfication	Light Heavy



TIME PERIOD			VEHICLE MOVEMENT 1			2			3			4			5			6		
			Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ
7:00	-	7:15	5	0	5	5	0	5	0	0	0	0	0	0	2	0	2	0	0	0
7:15	-	7:30	4	0	4	17	0	17	0	0	0	0	0	0	6	2	8	2	0	2
7:30	-	7:45	3	0	3	10	1	11	0	0	0	0	0	0	4	0	4	1	0	1
7:45	-	8:00	7	0	7	21	0	21	0	0	0	0	0	0	6	0	6	1	0	1
8:00	-	8:15	8	0	8	16	1	17	1	0	1	0	0	0	6	0	6	2	0	2
8:15	-	8:30	12	1	13	27	2	29	0	0	0	0	0	0	4	1	5	0	0	0
8:30	-	8:45	24	0	24	48	0	48	0	0	0	1	0	1	12	0	12	0	0	0
8:45	-	9:00	21	0	21	24	0	24	0	0	0	0	0	0	6	0	6	0	0	0
Σ			84	1	85	168	4	172	1	0	1	1	0	1	46	3	49	6	0	6

TIME PERIOD			VEHICLE MOVEMENT 7			8			9			10			11			12			GRAND TOTAL		
			Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ
7:00	-	7:15	0	0	0	5	1	6	0	0	0	4	0	4	0	0	0	2	0	2	23	1	24
7:15	-	7:30	0	0	0	5	0	5	0	0	0	4	0	4	0	0	0	2	0	2	40	2	42
7:30	-	7:45	0	0	0	7	0	7	0	0	0	1	0	1	0	0	0	2	0	2	28	1	29
7:45	-	8:00	0	0	0	7	0	7	0	0	0	2	0	2	4	0	4	2	0	2	50	0	50
8:00	-	8:15	2	0	2	8	2	10	0	0	0	0	0	0	3	0	3	4	0	4	50	3	53
8:15	-	8:30	1	1	2	5	0	5	0	0	0	3	0	3	2	1	3	2	0	2	56	6	62
8:30	-	8:45	3	1	4	13	0	13	0	0	0	0	3	3	4	0	4	12	0	12	117	4	121
8:45	-	9:00	1	0	1	14	0	14	0	0	0	4	3	7	9	0	9	10	0	10	89	3	92
Σ			7	2	9	64	3	67	0	0	0	18	6	24	22	1	23	36	0	36	453	20	473

TIME PERIOD			VEHICLE MOVEMENT 1			2			3			4			5			6		
			Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ
15:00	-	15:15	19	0	19	9	0	9	0	0	0	0	0	0	7	0	7	0	0	0
15:15	-	15:30	3	1	4	15	0	15	0	0	0	0	0	0	2	1	3	1	0	1
15:30	-	15:45	7	1	8	21	0	21	0	0	0	0	0	0	1	0	1	0	0	0
15:45	-	16:00	17	0	17	14	0	14	0	0	0	0	0	0	8	0	8	1	0	1
16:00	-	16:15	10	0	10	15	1	16	0	0	0	0	0	0	5	0	5	0	0	0
16:15	-	16:30	8	0	8	12	2	14	0	0	0	0	0	0	5	0	5	1	0	1
16:30	-	16:45	13	1	14	27	1	28	1	0	1	0	0	0	5	0	5	1	0	1
16:45	-	17:00	12	0	12	14	0	14	0	0	0	0	0	0	3	0	3	1	0	1
Σ			89	3	92	127	4	131	1	0	1	0	0	0	36	1	37	5	0	5

TIME PERIOD			VEHICLE MOVEMENT 7			8			9			10			11			12			GRAND TOTAL		
			Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ
15:00	-	15:15	0	0	0	15	0	15	0	0	0	2	0	2	3	0	3	7	1	8	62	1	63
15:15	-	15:30	0	0	0	15	0	15	0	0	0	11	2	13	8	1	9	25	0	25	80	5	85
15:30	-	15:45	2	0	2	39	0	39	0	0	0	3	4	7	6	1	7	14	1	15	93	7	100
15:45	-	16:00	2	0	2	27	1	28	0	0	0	3	2	5	6	0	6	12	1	13	90	4	94
16:00	-	16:15	0	1	1	29	1	30	0	0	0	6	1	7	6	0	6	15	0	15	86	4	90
16:15	-	16:30	0	0	0	33	0	33	0	0	0	3	0	3	7	0	7	16	1	17	85	3	88
16:30	-	16:45	1	0	1	27	1	28	0	0	0	1	1	2	4	0	4	15	0	15	95	4	99
16:45	-	17:00	1	0	1	28	0	28	0	0	0	0	0	0	3	0	3	10	0	10	72	0	72
Σ			6	1	7	213	3	216	0	0	0	29	10	39	43	2	45	114	4	118	663	28	691

TIME PERIOD			VEHICLE MOVEMENT 1			2			3			4			5			6		
			Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ
7:00	-	8:00	19	0	19	53	1	54	0	0	0	0	0	0	18	2	20	4	0	4
7:15	-	8:15	22	0	22	64	2	66	1	0	1	0	0	0	22	2	24	6	0	6
7:30	-	8:30	30	1	31	74	4	78	1	0	1	0	0	0	20	1	21	4	0	4
7:45	-	8:45	51	1	52	112	3	115	1	0	1	1	0	1	28	1	29	3	0	3
8:00	**-**	**9:00**	**65**	**1**	**66**	**115**	**3**	**118**	**1**	**0**	**1**	**1**	**0**	**1**	**28**	**1**	**29**	**2**	**0**	**2**

TIME PERIOD			VEHICLE MOVEMENT 7			8			9			10			11			12			GRAND TOTAL			
			Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	
7:00	-	8:00	0	0	0	24	1	25	0	0	0	11	0	11	4	0	4	8	0	8	141	4	145	
7:15	-	8:15	2	0	2	27	2	29	0	0	0	7	0	7	7	0	7	10	0	10	168	6	174	
7:30	-	8:30	3	1	4	27	2	29	0	0	0	6	0	6	9	1	10	10	0	10	184	10	194	
7:45	-	8:45	6	2	8	33	2	35	0	0	0	5	3	8	13	1	14	20	0	20	273	13	286	
8:00	**-**	**9:00**	**7**	**2**	**9**	**40**	**2**	**42**	**0**	**0**	**0**	**7**	**6**	**13**	**18**	**1**	**19**	**28**	**0**	**28**	**312**	**16**	**328**	**Peak**

TIME PERIOD			VEHICLE MOVEMENT 1			2			3			4			5			6		
			Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ
15:00	-	16:00	46	2	48	59	0	59	0	0	0	0	0	0	18	1	19	2	0	2
15:15	-	16:15	37	2	39	65	1	66	0	0	0	0	0	0	16	1	17	2	0	2
15:30	**-**	**16:30**	**42**	**1**	**43**	**62**	**3**	**65**	**0**	**0**	**0**	**0**	**0**	**0**	**19**	**0**	**19**	**2**	**0**	**2**
15:45	-	16:45	48	1	49	68	4	72	1	0	1	0	0	0	23	0	23	3	0	3
16:00	-	17:00	43	1	44	68	4	72	1	0	1	0	0	0	18	0	18	3	0	3

TIME PERIOD			VEHICLE MOVEMENT 7			8			9			10			11			12			GRAND TOTAL			
			Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	
15:00	-	16:00	4	0	4	96	1	97	0	0	0	19	8	27	23	2	25	58	3	61	325	17	342	
15:15	-	16:15	4	1	5	110	2	112	0	0	0	23	9	32	26	2	28	66	2	68	349	20	369	
15:30	**-**	**16:30**	**4**	**1**	**5**	**128**	**2**	**130**	**0**	**0**	**0**	**15**	**7**	**22**	**25**	**1**	**26**	**57**	**3**	**60**	**354**	**18**	**372**	**Peak**
15:45	-	16:45	3	1	4	116	3	119	0	0	0	13	4	17	23	0	23	58	2	60	356	15	371	
16:00	-	17:00	2	1	3	117	2	119	0	0	0	10	2	12	20	0	20	56	1	57	338	11	349	

Australasian Traffic Surveys 774 Pennant Hills Rd Carlingford NSW 2118

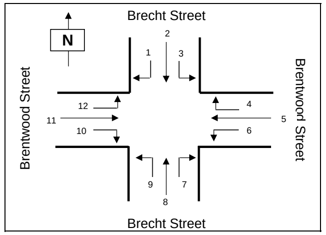
Ph: (02) 8812 3377 Fax: (02) 8812 3450

Intersection of Brecht Street and Brentwood Street

Friday, 4 May 2007

Australasian Traffic Surveys

Survey Start	7:00 AM 15:00 PM
Intersection Type	Cross Junction
Intersection No.	21
North Approach	Brecht Street
East Approach	Brentwood Street
South Approach	Brecht Street
West Approach	Brentwood Street
Date	4/05/07
Classfication	Light Heavy



VEHICLE MOVEMENT

TIME PERIOD	1			2			3			4			5			6			7			8			9			10			11			12			GRAND TOTAL		
	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ
7:00 - 7:15	3	0	3	7	0	7	1	0	1	1	0	1	2	0	2	1	0	1	0	0	0	7	0	7	1	0	1	0	0	0	1	0	1	4	0	4	28	0	28
7:15 - 7:30	5	0	5	14	0	14	0	0	0	1	1	2	4	0	4	1	0	1	1	0	1	6	0	6	1	0	1	0	0	0	1	0	1	1	0	1	35	1	36
7:30 - 7:45	4	0	4	9	0	9	1	0	1	0	0	0	2	0	2	0	0	0	0	0	0	6	0	6	2	0	2	0	0	0	2	0	2	1	0	1	27	0	27
7:45 - 8:00	4	1	5	15	0	15	1	0	1	0	0	0	1	0	1	0	0	0	0	0	0	4	0	4	2	0	2	3	1	4	2	0	2	8	0	8	40	2	42
8:00 - 8:15	2	0	2	18	0	18	1	0	1	0	0	0	3	0	3	1	0	1	1	0	1	8	3	11	1	0	1	1	0	1	1	0	1	6	1	7	43	4	47
8:15 - 8:30	5	0	5	20	3	23	0	0	0	0	0	0	1	0	1	1	0	1	0	0	0	9	1	10	5	0	5	0	0	0	3	0	3	3	0	3	47	4	51
8:30 - 8:45	8	0	8	34	6	40	1	0	1	2	0	2	5	0	5	0	1	1	0	0	0	18	1	19	6	0	6	1	0	1	1	0	1	9	0	9	85	8	93
8:45 - 9:00	6	0	6	17	0	17	2	0	2	0	0	0	5	0	5	5	0	5	0	0	0	17	0	17	5	0	5	1	1	2	2	0	2	3	0	3	63	1	64
Σ	37	1	38	134	9	143	7	0	7	4	1	5	23	0	23	9	1	10	2	0	2	75	5	80	23	0	23	6	2	8	13	0	13	35	1	36	368	20	388

VEHICLE MOVEMENT

TIME PERIOD	1			2			3			4			5			6			7			8			9			10			11			12			GRAND TOTAL		
	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ
15:00 - 15:15	5	0	5	10	0	10	0	0	0	0	0	0	1	0	1	2	1	3	2	0	2	2	0	2	0	0	0	0	1	1	0	0	0	4	0	4	26	2	28
15:15 - 15:30	8	0	8	25	2	27	2	0	2	0	1	1	0	0	0	0	0	0	1	0	1	7	2	9	3	0	3	3	0	3	4	0	4	6	0	6	59	5	64
15:30 - 15:45	8	0	8	11	5	16	1	0	1	0	0	0	3	0	3	1	0	1	4	0	4	34	0	34	5	0	5	5	0	5	2	0	2	5	1	6	79	6	85
15:45 - 16:00	5	1	6	16	3	19	0	0	0	0	0	0	1	1	2	1	0	1	1	0	1	16	0	16	5	0	5	1	0	1	4	0	4	7	0	7	57	5	62
16:00 - 16:15	7	0	7	16	1	17	1	2	3	2	0	2	6	0	6	1	0	1	4	0	4	19	0	19	0	1	1	4	0	4	1	0	1	5	1	6	66	5	71
16:15 - 16:30	0	0	0	11	1	12	1	0	1	0	0	0	2	0	2	2	0	2	2	0	2	22	0	22	3	0	3	0	1	1	3	0	3	3	0	3	49	2	51
16:30 - 16:45	3	0	3	22	0	22	0	0	0	0	0	0	4	0	4	2	0	2	0	0	0	11	0	11	2	1	3	4	0	4	2	0	2	9	0	9	59	1	60
16:45 - 17:00	1	0	1	13	0	13	0	0	0	0	1	1	4	0	4	0	0	0	1	0	1	13	0	13	2	0	2	2	0	2	4	0	4	2	0	2	42	1	43
Σ	37	1	38	124	12	136	5	2	7	2	2	4	21	1	22	9	1	10	15	0	15	124	2	126	20	2	22	19	2	21	20	0	20	41	2	43	437	27	464

VEHICLE MOVEMENT

TIME PERIOD	1			2			3			4			5			6			7			8			9			10			11			12			GRAND TOTAL			
	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	
7:00 - 8:00	16	1	17	45	0	45	3	0	3	2	1	3	9	0	9	2	0	2	1	0	1	23	0	23	6	0	6	3	1	4	6	0	6	14	0	14	130	3	133	
7:15 - 8:15	15	1	16	56	0	56	3	0	3	1	1	2	10	0	10	2	0	2	2	0	2	24	3	27	6	0	6	4	1	5	6	0	6	16	1	17	145	7	152	
7:30 - 8:30	15	1	16	62	3	65	3	0	3	0	0	0	7	0	7	2	0	2	1	0	1	27	4	31	10	0	10	4	1	5	8	0	8	18	1	19	157	10	167	
7:45 - 8:45	19	1	20	87	9	96	3	0	3	2	0	2	10	0	10	2	1	3	1	0	1	39	5	44	14	0	14	5	1	6	7	0	7	26	1	27	215	18	233	
8:00 - 9:00	**21**	**0**	**21**	**89**	**9**	**98**	**4**	**0**	**4**	**2**	**0**	**2**	**14**	**0**	**14**	**7**	**1**	**8**	**1**	**0**	**1**	**52**	**5**	**57**	**17**	**0**	**17**	**3**	**1**	**4**	**7**	**0**	**7**	**21**	**1**	**22**	**238**	**17**	**255**	**Peak**

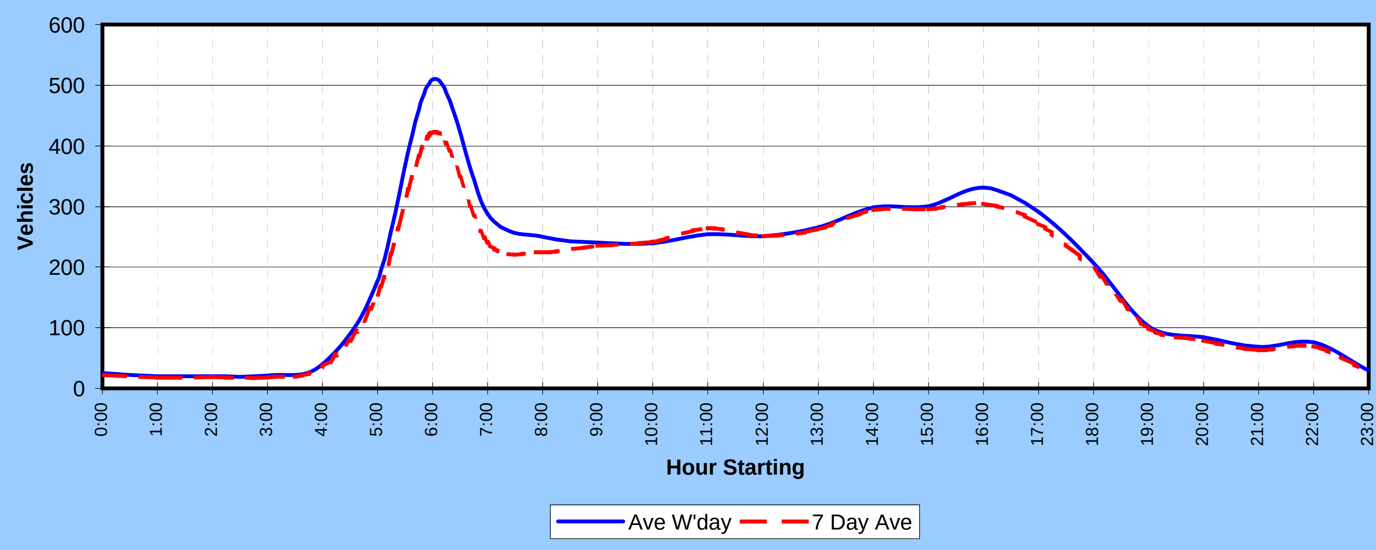
VEHICLE MOVEMENT

TIME PERIOD	1			2			3			4			5			6			7			8			9			10			11			12			GRAND TOTAL			
	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	Light	Heavy	Σ	
15:00 - 16:00	26	1	27	62	10	72	3	0	3	0	1	1	5	1	6	4	1	5	8	0	8	59	2	61	13	0	13	9	1	10	10	0	10	22	1	23	221	18	239	
15:15 - 16:15	**28**	**1**	**29**	**68**	**11**	**79**	**4**	**2**	**6**	**2**	**1**	**3**	**10**	**1**	**11**	**3**	**0**	**3**	**10**	**0**	**10**	**76**	**2**	**78**	**13**	**1**	**14**	**13**	**0**	**13**	**11**	**0**	**11**	**23**	**2**	**25**	**261**	**21**	**282**	**Peak**
15:30 - 16:30	20	1	21	54	10	64	3	2	5	2	0	2	12	1	13	5	0	5	11	0	11	91	0	91	13	1	14	10	1	11	10	0	10	20	2	22	251	18	269	
15:45 - 16:45	15	1	16	65	5	70	2	2	4	2	0	2	13	1	14	6	0	6	7	0	7	68	0	68	10	2	12	9	1	10	10	0	10	24	1	25	231	13	244	
16:00 - 17:00	11	0	11	62	2	64	2	2	4	2	1	3	16	0	16	5	0	5	7	0	7	65	0	65	7	2	9	10	1	11	10	0	10	19	1	20	216	9	225	

Road	New England Hwy		
Location	East of Bimbadeen Drive		
Site No.	1		
Start Date	Saturday	28-Apr-07	
Direction	Eastbound		

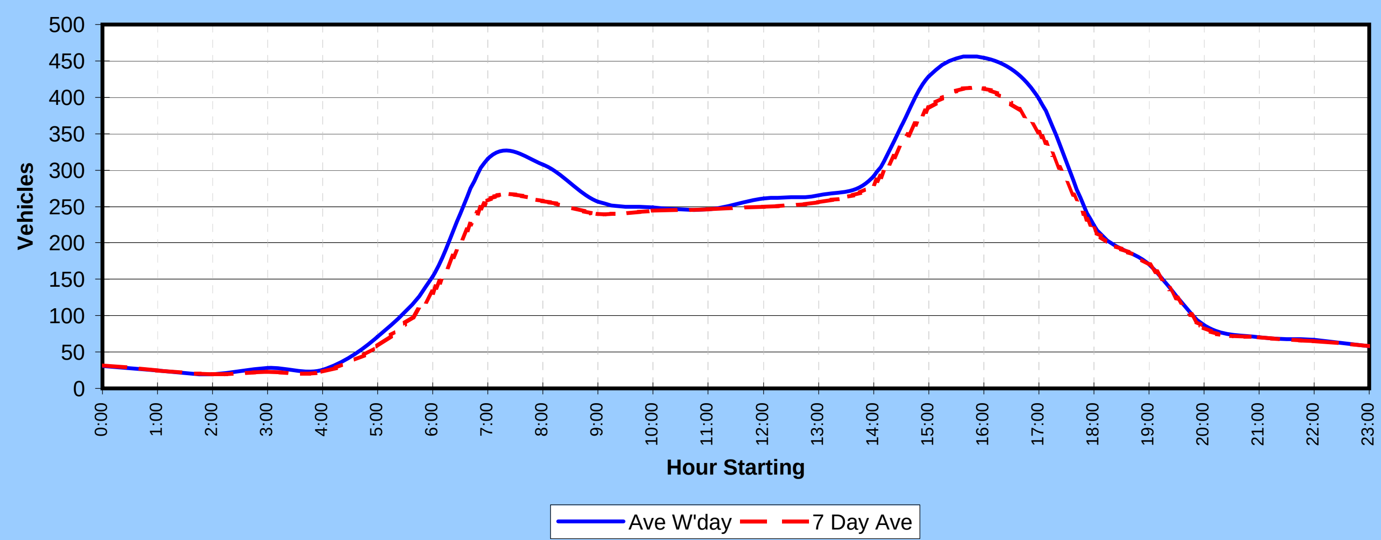
Average Weekday	4394
7 Day Average	4106
Weekday Heavy's	18.4%
7 Day Heavy's	16.4%

Time	Day of Week							Ave W'day	7 Day Ave
	Mon 30-Apr	Tue 1-May	Wed 2-May	Thu 3-May	Fri 4-May	Sat 28-Apr	Sun 29-Apr		
AM Peak	489	520	522	527	491	314	258		
PM Peak	355	278	312	331	398	239	343		
0:00	19	21	27	32	27	18	11	25	22
1:00	19	15	25	14	26	14	12	20	18
2:00	18	21	13	21	28	25	7	20	19
3:00	21	17	24	25	19	13	6	21	18
4:00	31	39	32	44	55	28	19	40	35
5:00	144	159	187	176	220	106	87	177	154
6:00	489	520	522	527	491	256	147	510	422
7:00	280	268	300	277	315	126	116	288	240
8:00	232	262	241	247	270	183	139	250	225
9:00	245	235	234	230	258	263	183	240	235
10:00	268	221	198	252	258	261	231	239	241
11:00	257	214	211	272	319	314	258	255	264
12:00	253	208	245	277	274	234	264	251	251
13:00	240	253	227	284	325	239	268	266	262
14:00	268	276	279	331	340	227	340	299	294
15:00	263	278	271	302	391	216	343	301	295
16:00	355	274	312	318	398	184	294	331	305
17:00	264	246	300	304	343	173	271	291	272
18:00	175	184	204	240	229	159	183	206	196
19:00	88	86	91	133	113	70	110	102	99
20:00	76	80	89	89	86	43	89	84	79
21:00	59	64	87	81	54	34	61	69	63
22:00	73	86	86	89	48	32	76	76	70
23:00	34	22	34	28	29	24	18	29	27
Total	4171	4049	4239	4593	4916	3242	3533	4394	4106
% Heavies	18.1%	20.1%	20.4%	19.1%	14.9%	9.3%	10.6%	18.4%	16.4%



Road	New England Hwy			Average Weekday	4503
Location	East of Bimbadeen Drive			7 Day Average	4158
Site No.	1			Weekday Heavy's	16.7%
Start Date	Saturday	28-Apr-07		7 Day Heavy's	14.4%
Direction	Westbound				

Time	Mon 30-Apr	Tue 1-May	Wed 2-May	Thu 3-May	Fri 4-May	Sat 28-Apr	Sun 29-Apr	Ave W'day	7 Day Ave
AM Peak	359	311	304	321	306	262	263		
PM Peak	460	415	443	468	507	256	381		
0:00	15	36	29	32	43	40	24	31	31
1:00	22	28	20	23	28	38	14	24	25
2:00	17	12	18	29	20	25	14	19	19
3:00	14	32	29	29	35	15	8	28	23
4:00	26	24	28	22	26	24	12	25	23
5:00	68	71	80	71	67	33	19	71	58
6:00	143	147	155	152	174	90	61	154	132
7:00	335	311	304	320	306	132	94	315	257
8:00	359	294	296	321	266	162	102	307	257
9:00	295	277	229	223	261	262	133	257	240
10:00	287	241	228	218	269	241	226	249	244
11:00	284	246	214	218	270	230	263	246	246
12:00	274	235	252	273	272	214	230	261	250
13:00	259	236	252	257	325	256	206	266	256
14:00	307	249	291	254	356	235	274	291	281
15:00	399	407	427	402	507	229	324	428	385
16:00	460	409	443	468	493	230	381	455	412
17:00	387	415	422	367	398	214	259	398	352
18:00	234	213	195	198	280	184	229	224	219
19:00	154	152	173	207	168	135	201	171	170
20:00	65	74	91	87	120	55	90	87	83
21:00	77	46	69	86	75	76	64	71	70
22:00	63	68	55	64	82	60	61	66	65
23:00	68	51	45	61	63	88	30	58	58
Total	4612	4274	4345	4382	4904	3268	3319	4503	4158
% Heavies	16.4%	17.1%	17.7%	17.6%	15.0%	7.6%	5.5%	16.7%	14.4%



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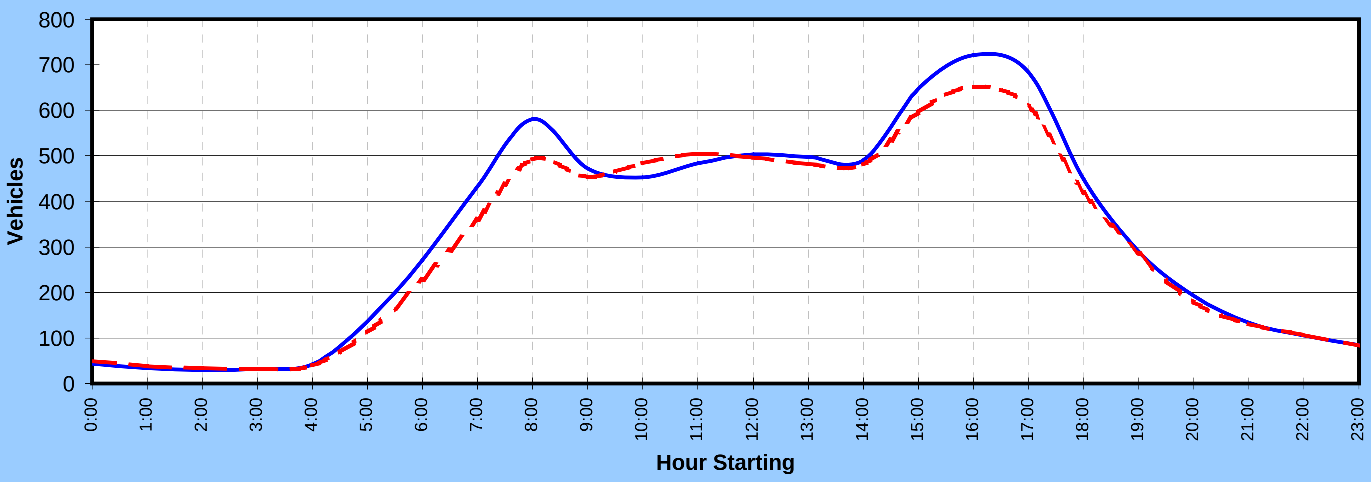
Road	New England Hwy			Average Weekday	7811
Location	North of Rutherford Rd			7 Day Average	7343
Site No.	2			Weekday Heavy's	10.7%
Start Date	Saturday	28-Apr-07		7 Day Heavy's	9.3%
Direction	Northbound				

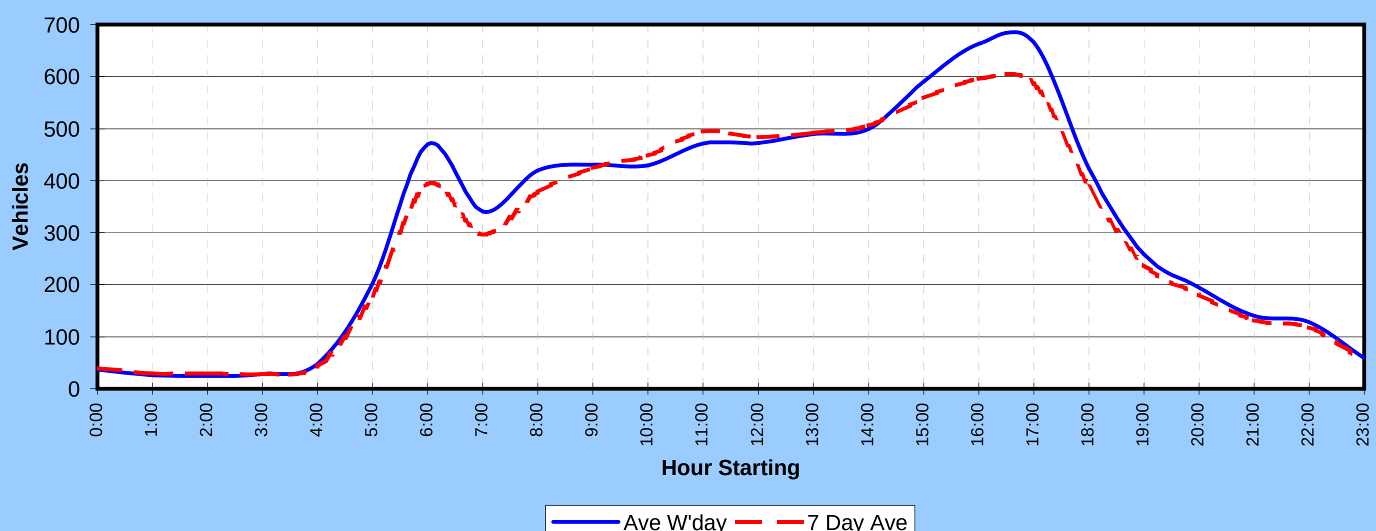
Time	Mon 30-Apr	Tue 1-May	Wed 2-May	Thu 3-May	Fri 4-May	Sat 28-Apr	Sun 29-Apr	Ave W'day	7 Day Ave
	Day of Week								
AM Peak	604	553	587	614	547	598	536		
PM Peak	698	701	731	741	765	527	506		
0:00	17	50	34	54	62	62	65	43	49
1:00	30	39	35	23	40	58	39	33	38
2:00	20	29	36	32	31	43	44	30	34
3:00	20	42	36	33	34	34	25	33	32
4:00	43	42	47	34	46	38	21	42	39
5:00	114	130	157	141	143	57	47	137	113
6:00	263	264	270	261	298	147	91	271	228
7:00	424	436	444	422	442	196	151	434	359
8:00	604	553	587	614	547	327	215	581	492
9:00	504	477	463	443	475	479	341	472	455
10:00	474	436	432	438	485	582	536	453	483
11:00	526	488	432	442	532	598	515	484	505
12:00	529	471	502	515	501	527	426	504	496
13:00	513	479	491	479	529	521	360	498	482
14:00	499	450	495	430	579	484	427	491	481
15:00	612	618	675	629	704	449	482	648	596
16:00	698	673	731	741	765	452	506	722	652
17:00	633	701	722	677	682	438	405	683	608
18:00	395	445	427	456	517	360	333	448	419
19:00	229	254	288	324	352	288	260	289	285
20:00	143	196	206	196	220	167	124	192	179
21:00	142	104	141	141	139	151	94	133	130
22:00	90	118	93	107	122	136	83	106	107
23:00	80	83	68	88	100	127	35	84	83
Total	7602	7578	7812	7720	8345	6721	5625	7811	7343
% Heavies	10.8%	10.9%	10.8%	11.1%	10.2%	5.4%	3.8%	10.7%	9.3%



Road	New England Hwy		
Location	North of Rutherford Rd		
Site No.	2		
Start Date	Saturday	28-Apr-07	
Direction	Southbound		

Average Weekday	7511
7 Day Average	7114
Weekday Heavy's	11.4%
7 Day Heavy's	10.0%

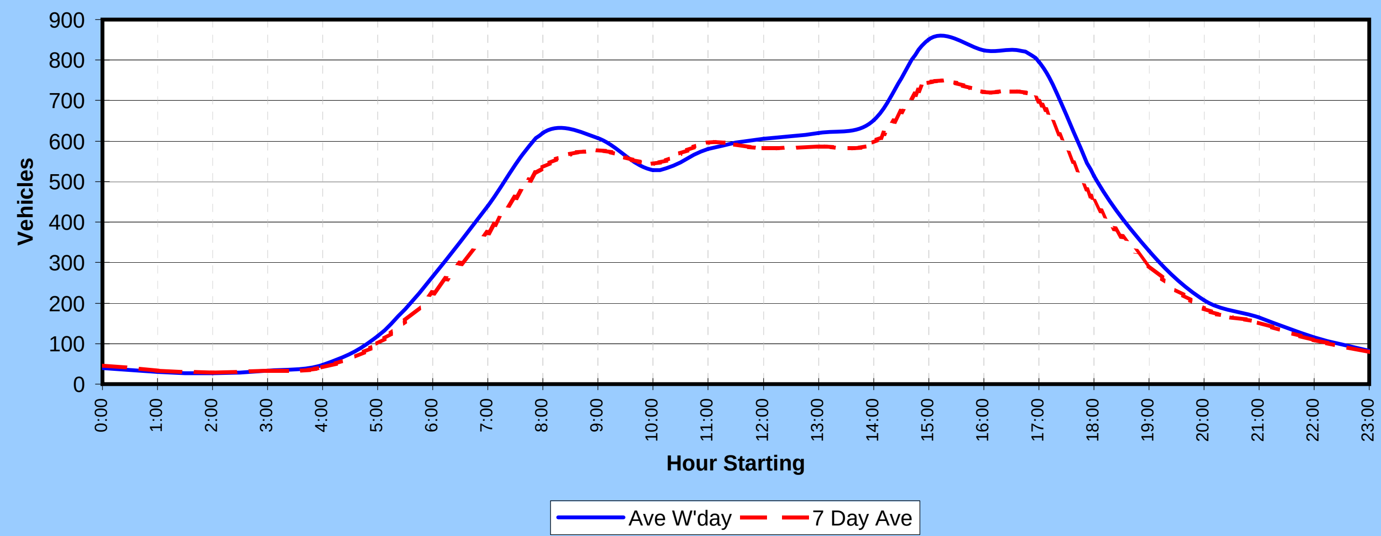
Time	Day of Week							Ave W'day	7 Day Ave
	Mon	Tue	Wed	Thu	Fri	Sat	Sun		
	30-Apr	1-May	2-May	3-May	4-May	28-Apr	29-Apr		
AM Peak	458	479	465	500	556	625	483		
PM Peak	645	620	685	725	702	588	532		
0:00	25	28	33	50	47	45	44	37	39
1:00	22	18	33	18	36	39	43	25	30
2:00	18	21	16	30	39	42	40	25	29
3:00	27	21	33	28	32	32	23	28	28
4:00	38	48	42	51	62	40	21	48	43
5:00	167	184	221	207	236	123	110	203	178
6:00	456	479	465	479	471	245	158	470	393
7:00	330	320	346	328	380	189	181	341	296
8:00	393	411	434	407	452	323	220	419	377
9:00	423	412	418	443	459	478	335	431	424
10:00	457	413	387	418	472	587	398	429	447
11:00	458	419	425	500	556	625	483	472	495
12:00	474	419	455	510	502	571	455	472	484
13:00	458	451	451	541	546	588	411	489	492
14:00	440	487	482	544	546	506	532	500	505
15:00	563	560	561	603	665	461	498	590	559
16:00	645	613	685	684	686	382	474	663	596
17:00	593	620	685	725	702	359	418	665	586
18:00	354	441	412	472	435	312	288	423	388
19:00	188	249	253	298	306	170	207	259	239
20:00	152	191	212	212	206	146	151	195	181
21:00	119	128	164	167	122	113	106	140	131
22:00	101	135	137	144	125	94	88	128	118
23:00	50	46	58	60	79	66	26	59	55
Total	6951	7114	7408	7919	8162	6536	5710	7511	7114
% Heavies	11.3%	12.2%	12.5%	11.6%	9.7%	4.8%	6.8%	11.4%	10.0%



AUSTRALASIAN TRAFFIC SURVEYS

Road	Bridge Street		Average Weekday	9096
Location	South of Brook St		7 Day Average	8334
Site No.	3		Weekday Heavy's	9.7%
Start Date	Saturday	28-Apr-07	7 Day Heavy's	8.5%
Direction	Northbound			

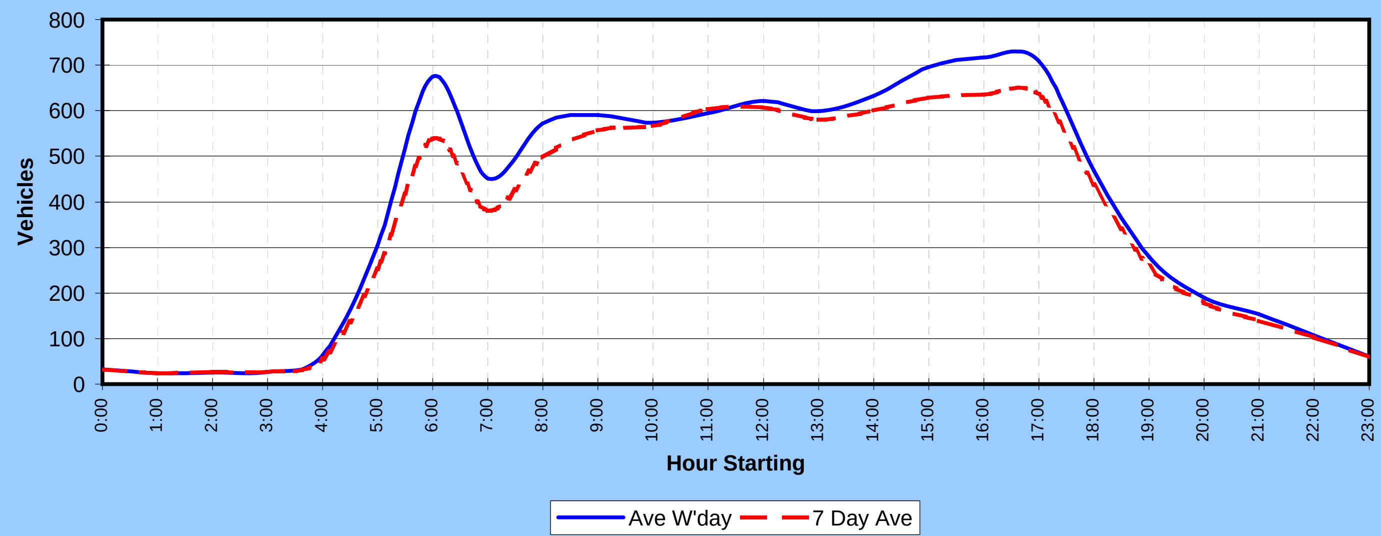
Time	Day of Week Mon 30-Apr	Tue 1-May	Wed 2-May	Thu 3-May	Fri 4-May	Sat 28-Apr	Sun 29-Apr	Ave W'day	7 Day Ave
AM Peak	679	619	638	656	610	731	543		
PM Peak	843	841	897	875	930	581	532		
0:00	21	41	34	49	50	74	54	39	46
1:00	25	34	28	33	34	47	37	31	34
2:00	20	21	28	33	31	38	30	27	29
3:00	26	36	27	37	37	35	31	33	33
4:00	42	41	54	45	52	34	15	47	40
5:00	103	120	112	126	135	61	40	119	100
6:00	275	253	267	257	277	144	104	266	225
7:00	442	426	426	450	456	230	188	440	374
8:00	616	619	602	656	610	404	236	621	535
9:00	639	606	638	634	520	629	378	607	578
10:00	594	488	475	567	516	674	493	528	544
11:00	679	537	582	590	516	731	543	581	597
12:00	653	553	597	673	550	581	467	605	582
13:00	630	566	607	615	684	561	442	620	586
14:00	634	521	666	672	765	476	439	652	596
15:00	711	841	897	875	930	422	532	851	744
16:00	843	829	743	862	842	440	495	824	722
17:00	747	785	778	845	822	412	491	795	697
18:00	469	473	486	543	600	244	346	514	452
19:00	276	334	359	268	409	146	268	329	294
20:00	169	211	229	159	265	110	169	207	187
21:00	142	141	168	171	199	149	90	164	151
22:00	87	109	106	128	144	127	63	115	109
23:00	73	69	76	83	112	114	25	83	79
Total	8916	8654	8985	9371	9556	6883	5976	9096	8334
% Heavies	9.6%	9.8%	10.6%	9.6%	8.7%	4.4%	3.9%	9.7%	8.5%



AUSTRALASIAN TRAFFIC SURVEYS

Road	Bridge Street		Average Weekday	9164
Location	South of Brook St		7 Day Average	8427
Site No.	3		Weekday Heavy's	9.2%
Start Date	Saturday	28-Apr-07	7 Day Heavy's	8.2%
Direction	Southobund			

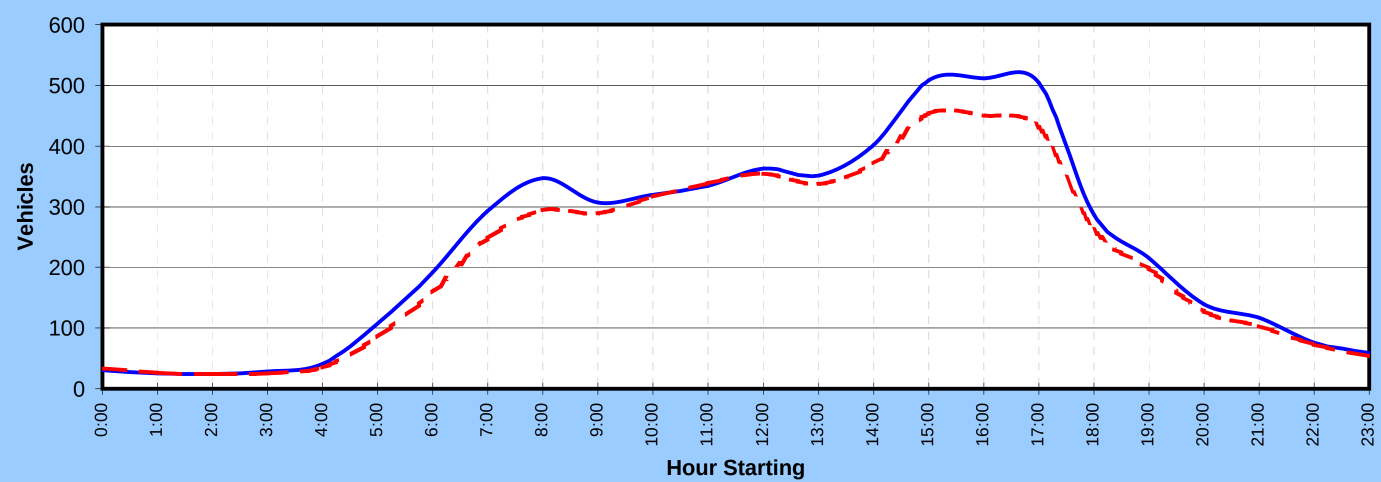
Time	Day of Week Mon 30-Apr	Tue 1-May	Wed 2-May	Thu 3-May	Fri 4-May	Sat 28-Apr	Sun 29-Apr	Ave W'day	7 Day Ave
AM Peak	621	693	695	694	670	699	554		
PM Peak	674	677	692	796	820	607	557		
0:00	26	28	34	39	36	41	23	33	32
1:00	23	20	26	16	32	24	28	23	24
2:00	18	22	23	29	32	44	23	25	27
3:00	19	20	33	31	30	35	19	27	27
4:00	55	63	57	64	76	40	27	63	55
5:00	281	275	317	318	335	140	100	305	252
6:00	621	693	695	694	669	242	157	674	539
7:00	445	434	454	450	472	216	194	451	381
8:00	550	556	569	602	581	381	248	572	498
9:00	613	568	544	613	616	575	366	591	556
10:00	577	559	549	554	630	647	455	574	567
11:00	575	560	533	636	670	699	554	595	604
12:00	667	592	625	616	608	607	534	622	607
13:00	578	555	570	651	644	556	511	600	581
14:00	587	597	583	688	710	483	557	633	601
15:00	672	677	634	676	820	421	504	696	629
16:00	674	657	652	796	805	398	466	717	635
17:00	642	656	692	766	788	420	483	709	635
18:00	396	484	448	500	511	361	363	468	438
19:00	198	247	284	330	339	194	223	280	259
20:00	142	172	222	197	215	151	153	190	179
21:00	130	139	166	171	159	126	80	153	139
22:00	86	92	120	107	130	100	83	107	103
23:00	54	42	62	65	76	85	28	60	59
Total	8629	8708	8892	9609	9984	6986	6179	9164	8427
% Heavies	9.0%	9.5%	9.3%	9.5%	8.6%	4.2%	5.8%	9.2%	8.2%



Road	New England Hwy		
Location	south of Mccullys gap rd		
Site No.	4		
Start Date	Saturday	28-Apr-07	
Direction	Northbound		

Average Weekday	5582
7 Day Average	5085
Weekday Heavy's	13.8%
7 Day Heavy's	11.9%

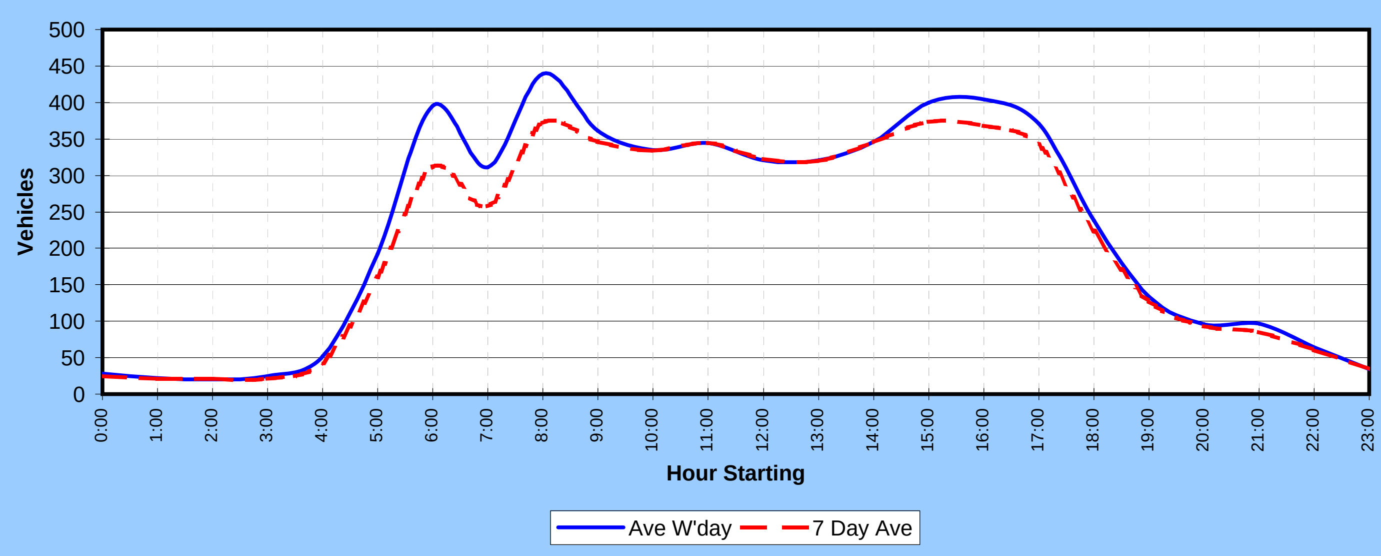
Time	Day of Week							Ave W'day	7 Day Ave
	Mon 30-Apr	Tue 1-May	Wed 2-May	Thu 3-May	Fri 4-May	Sat 28-Apr	Sun 29-Apr		
AM Peak	376	349	327	365	347	364	337		
PM Peak	494	494	529	514	563	341	355		
0:00	15	32	28	37	40	54	29	30	34
1:00	22	32	20	25	26	37	21	25	26
2:00	14	19	26	39	23	33	14	24	24
3:00	21	29	26	34	31	21	13	28	25
4:00	34	39	50	38	44	29	9	41	35
5:00	99	121	108	105	103	44	20	107	86
6:00	193	183	203	199	184	86	64	192	159
7:00	298	297	297	280	296	139	126	294	248
8:00	376	326	327	365	343	177	142	347	294
9:00	305	322	310	295	304	296	187	307	288
10:00	348	301	310	294	346	333	281	320	316
11:00	367	349	282	325	347	364	337	334	339
12:00	376	335	344	372	388	338	324	363	354
13:00	353	315	319	349	418	341	265	351	337
14:00	414	358	391	393	453	270	319	402	371
15:00	475	484	514	514	554	278	355	508	453
16:00	488	494	529	491	553	247	348	511	450
17:00	494	490	474	498	563	233	262	504	431
18:00	284	255	261	285	347	203	193	286	261
19:00	201	199	193	242	242	128	181	215	198
20:00	93	119	174	147	165	82	113	140	128
21:00	123	105	119	112	126	72	64	117	103
22:00	62	62	77	88	92	71	60	76	73
23:00	65	46	48	57	78	56	27	59	54
Total	5520	5312	5430	5584	6066	3932	3754	5582	5085
% Heavies	13.2%	13.7%	14.9%	14.5%	12.7%	5.8%	4.7%	13.8%	11.9%



Road	New England Hwy		
Location	south of Mccullys gap rd		
Site No.	4		
Start Date	Saturday	28-Apr-07	
Direction	Southbound		

Average Weekday	5350
7 Day Average	4953
Weekday Heavy's	15.8%
7 Day Heavy's	13.9%

Time	Day of Week							Ave W'day	7 Day Ave
	Mon 30-Apr	Tue 1-May	Wed 2-May	Thu 3-May	Fri 4-May	Sat 28-Apr	Sun 29-Apr		
AM Peak	446	427	443	451	431	374	329		
PM Peak	374	388	420	417	479	326	411		
0:00	19	28	30	33	30	15	15	28	24
1:00	22	18	22	19	31	16	21	22	21
2:00	16	17	21	21	28	32	11	21	21
3:00	22	18	32	25	27	18	6	25	21
4:00	43	49	54	52	60	28	18	52	43
5:00	188	185	193	195	201	99	61	192	160
6:00	382	412	396	405	384	127	80	396	312
7:00	302	307	345	291	312	124	121	311	257
8:00	446	427	443	451	431	254	152	440	372
9:00	357	352	336	371	390	369	247	361	346
10:00	334	314	286	358	382	374	288	335	334
11:00	336	310	323	362	391	358	329	344	344
12:00	329	312	307	329	327	326	330	321	323
13:00	262	300	295	382	365	293	339	321	319
14:00	311	315	327	374	405	277	411	346	346
15:00	369	388	351	411	479	244	374	400	374
16:00	374	348	420	417	460	203	357	404	368
17:00	324	313	387	407	422	221	319	371	342
18:00	197	228	218	266	280	162	211	238	223
19:00	114	117	119	143	174	95	132	133	128
20:00	85	92	108	107	86	67	105	96	93
21:00	89	98	99	117	80	45	69	97	85
22:00	55	54	77	70	64	43	64	64	61
23:00	33	25	36	41	35	42	25	34	34
Total	5009	5027	5225	5647	5844	3832	4085	5350	4953
% Heavies	14.5%	15.7%	16.8%	17.7%	14.2%	6.8%	8.7%	15.8%	13.9%

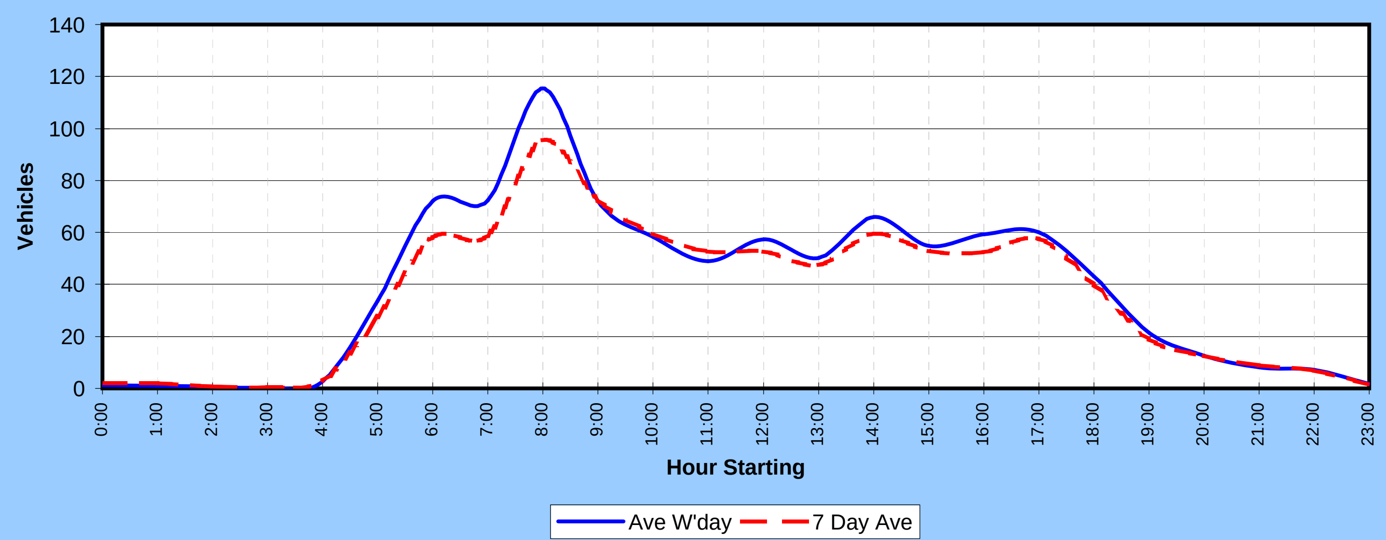


Prepared by : Australasian Traffic Surveys

AUSTRALASIAN TRAFFIC SURVEYS

Road	Kayuga Rd		Average Weekday	921
Location	west of Aberdeen St		7 Day Average	844
Site No.	5		Weekday Heavy's	8.3%
Start Date	Saturday	28-Apr-07	7 Day Heavy's	7.5%
Direction	Eastbound			

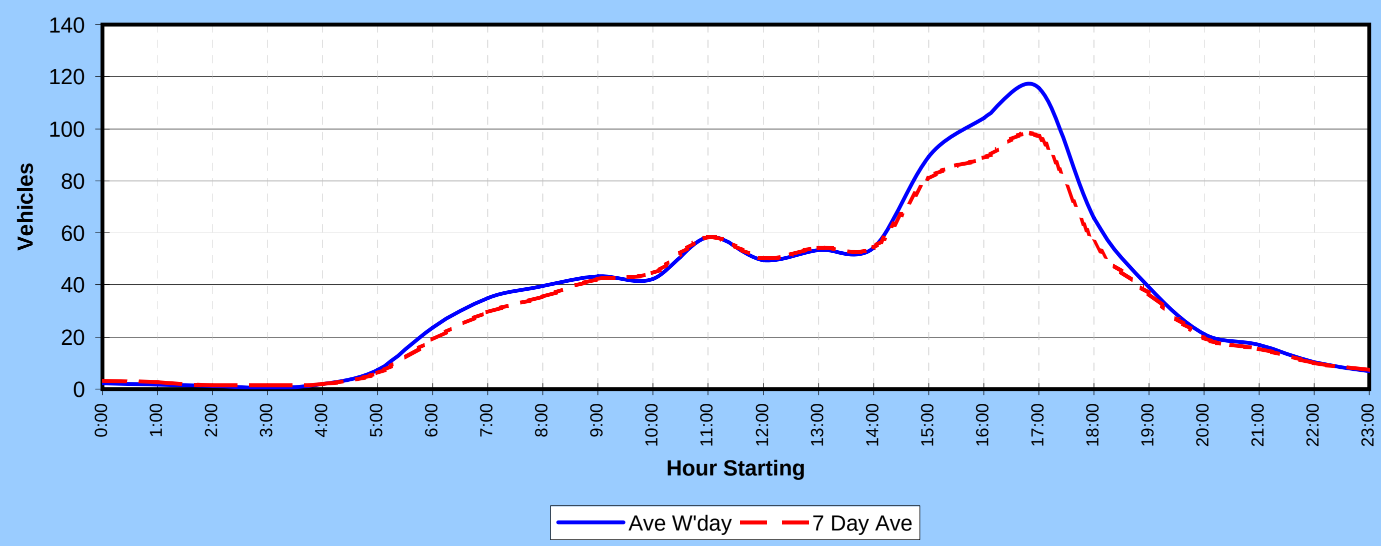
Time	Day of Week							Ave W'day	7 Day Ave
	Mon	Tue	Wed	Thu	Fri	Sat	Sun		
	30-Apr	1-May	2-May	3-May	4-May	28-Apr	29-Apr		
AM Peak	100	124	115	114	124	97	58		
PM Peak	65	71	71	68	75	56	52		
0:00	1	1	1	3	0	2	6	1	2
1:00	1	0	1	1	2	4	5	1	2
2:00	0	1	1	0	2	1	1	1	1
3:00	0	0	0	1	0	2	0	0	0
4:00	3	1	1	3	6	3	4	3	3
5:00	35	35	37	27	35	11	13	34	28
6:00	62	75	77	71	75	30	16	72	58
7:00	66	86	68	67	75	26	23	72	59
8:00	100	124	115	114	124	67	24	115	95
9:00	65	67	86	72	71	97	50	72	73
10:00	60	50	64	57	60	68	57	58	59
11:00	46	55	42	45	57	65	58	49	53
12:00	59	56	51	61	60	40	41	57	53
13:00	38	48	61	50	54	43	39	50	48
14:00	65	60	62	68	75	43	44	66	60
15:00	59	48	56	55	56	44	52	55	53
16:00	56	54	52	68	67	31	39	59	52
17:00	41	71	71	53	64	56	47	60	58
18:00	29	51	37	43	55	36	29	43	40
19:00	20	23	34	13	17	12	13	21	19
20:00	13	12	15	18	5	10	15	13	13
21:00	8	5	14	7	7	14	7	8	9
22:00	4	8	7	9	8	4	8	7	7
23:00	2	0	1	3	2	1	2	2	2
Total	833	931	954	909	977	710	593	921	844
% Heavies	7.4%	8.4%	7.8%	8.1%	9.4%	4.6%	5.2%	8.3%	7.5%



Prepared by : Australasian Traffic Surveys

Road	Kayuga Rd	Average Weekday	884
Location	west of Aberdeen St	7 Day Average	817
Site No.	5	Weekday Heavy's	6.4%
Start Date	Saturday 28-Apr-07	7 Day Heavy's	5.7%
Direction	Westbound		

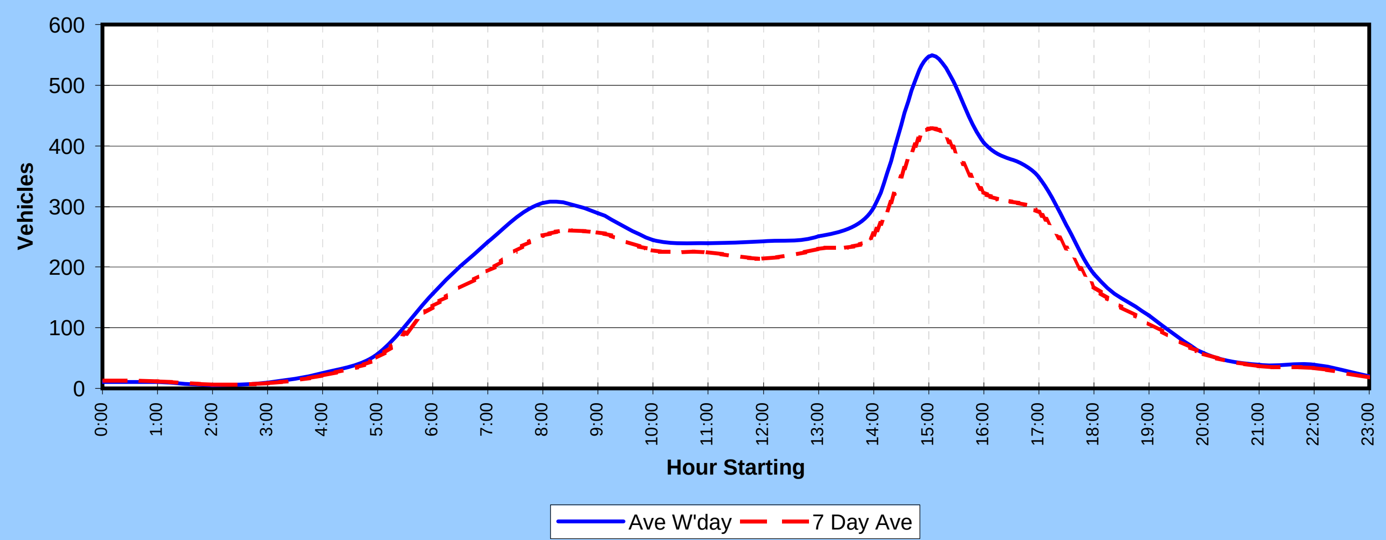
Time	Day of Week Mon 30-Apr	Tue 1-May	Wed 2-May	Thu 3-May	Fri 4-May	Sat 28-Apr	Sun 29-Apr	Ave W'day	7 Day Ave
AM Peak	60	56	57	60	60	59	58		
PM Peak	104	126	115	109	125	66	62		
0:00	3	1	1	2	4	5	6	2	3
1:00	0	3	1	4	1	4	6	2	3
2:00	0	1	2	0	3	3	1	1	1
3:00	1	0	0	1	1	5	2	1	1
4:00	2	2	4	2	0	1	3	2	2
5:00	5	7	7	8	10	2	4	7	6
6:00	21	21	30	24	22	7	8	24	19
7:00	32	41	43	25	34	19	13	35	30
8:00	26	39	40	46	47	21	29	40	35
9:00	41	46	57	37	36	35	45	43	42
10:00	40	43	41	41	46	53	47	42	44
11:00	60	56	55	60	60	59	58	58	58
12:00	44	51	53	47	52	61	43	49	50
13:00	57	56	59	46	49	66	48	53	54
14:00	47	46	57	61	61	63	45	54	54
15:00	78	81	86	103	99	56	62	89	81
16:00	104	97	101	100	119	51	49	104	89
17:00	103	126	115	109	125	47	53	116	97
18:00	65	63	68	61	71	37	29	66	56
19:00	27	44	42	39	43	32	32	39	37
20:00	15	23	35	19	14	19	12	21	20
21:00	12	17	16	19	21	18	6	17	16
22:00	7	10	9	14	12	14	4	10	10
23:00	7	6	6	6	9	16	1	7	7
Total	797	880	928	874	939	694	606	884	817
% Heavies	5.3%	7.4%	6.1%	6.8%	6.3%	2.9%	3.6%	6.4%	5.7%



Road	Sydney St		
Location	east of Anzac Parade		
Site No.	6		
Start Date	Saturday	28-Apr-07	
Direction	Eastbound		

Average Weekday	4152
7 Day Average	3562
Weekday Heavy's	8.5%
7 Day Heavy's	7.7%

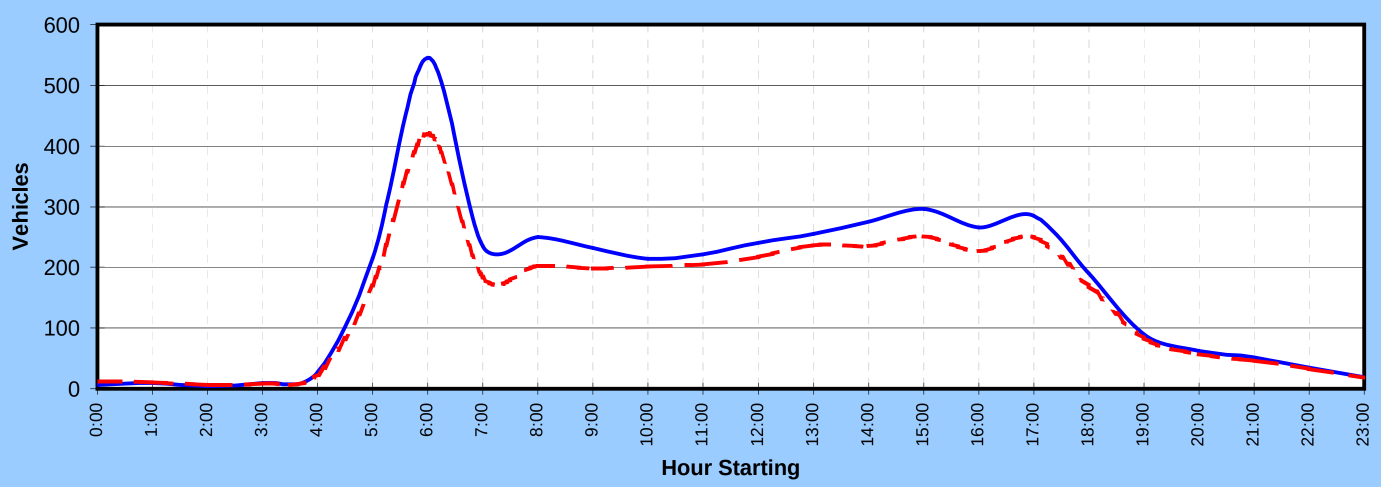
Time	Mon 30-Apr	Tue 1-May	Wed 2-May	Thu 3-May	Fri 4-May	Sat 28-Apr	Sun 29-Apr	Ave W'day	7 Day Ave
AM Peak	304	312	314	319	300	237	144		
PM Peak	515	517	577	543	584	184	171		
0:00	3	8	13	14	13	11	25	10	12
1:00	6	12	13	13	11	14	10	11	11
2:00	1	7	7	4	6	6	16	5	7
3:00	11	8	10	6	11	5	8	9	8
4:00	23	26	22	21	34	14	8	25	21
5:00	47	56	64	60	58	34	32	57	50
6:00	170	156	139	151	166	99	67	156	135
7:00	247	232	260	230	240	81	58	242	193
8:00	284	312	314	319	300	142	91	306	252
9:00	304	280	292	276	291	228	130	289	257
10:00	232	227	238	253	275	237	136	245	228
11:00	253	222	245	236	242	233	144	240	225
12:00	216	194	227	275	301	157	129	243	214
13:00	248	217	265	250	276	184	171	251	230
14:00	265	282	274	335	334	146	140	298	254
15:00	515	517	577	543	584	121	140	547	428
16:00	350	437	440	423	376	119	120	405	324
17:00	365	362	383	359	271	138	153	348	290
18:00	177	180	202	188	195	157	82	188	169
19:00	120	125	126	128	102	72	80	120	108
20:00	57	61	56	70	46	51	56	58	57
21:00	30	40	40	37	49	41	23	39	37
22:00	31	44	40	38	40	32	12	39	34
23:00	15	20	20	18	29	16	5	20	18
Total	3970	4025	4267	4247	4250	2338	1836	4152	3562
% Heavies	7.9%	8.9%	8.7%	8.8%	8.4%	3.9%	3.6%	8.5%	7.7%



AUSTRALASIAN TRAFFIC SURVEYS

Road	Sydney St		Average Weekday	4036
Location	east of Anzac Parade		7 Day Average	3464
Site No.	6		Weekday Heavy's	8.8%
Start Date	Saturday	28-Apr-07	7 Day Heavy's	8.1%
Direction	Westbound			

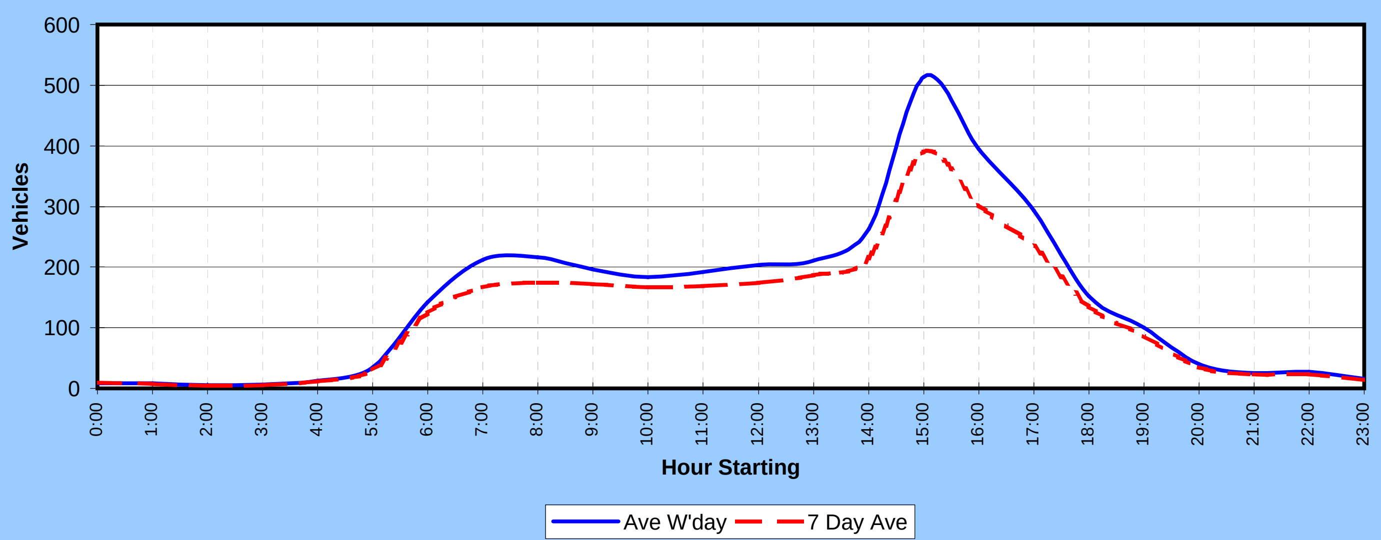
Time	Mon 30-Apr	Tue 1-May	Wed 2-May	Thu 3-May	Fri 4-May	Sat 28-Apr	Sun 29-Apr	Ave W'day	7 Day Ave
AM Peak	511	562	575	543	537	192	147		
PM Peak	280	311	306	284	309	206	169		
0:00	6	3	8	9	8	26	21	7	12
1:00	7	13	11	7	8	12	14	9	10
2:00	1	4	5	2	9	9	14	4	6
3:00	8	8	8	12	10	6	6	9	8
4:00	23	34	25	26	31	17	9	28	24
5:00	211	218	212	217	219	71	38	215	169
6:00	511	562	575	543	537	144	68	546	420
7:00	227	217	235	250	247	61	51	235	184
8:00	234	262	257	249	249	102	64	250	202
9:00	207	228	227	259	241	144	82	232	198
10:00	222	232	205	200	211	192	147	214	201
11:00	212	185	213	242	254	184	143	221	205
12:00	243	215	265	226	251	177	143	240	217
13:00	233	247	247	268	281	206	169	255	236
14:00	256	275	283	269	293	152	121	275	236
15:00	280	311	306	282	303	144	134	296	251
16:00	247	249	260	284	291	132	123	266	227
17:00	261	282	293	281	309	161	161	285	250
18:00	166	193	188	177	225	119	122	190	170
19:00	78	96	84	105	84	77	57	89	83
20:00	45	63	59	69	73	44	44	62	57
21:00	49	46	52	60	52	48	19	52	47
22:00	25	24	38	43	43	32	25	35	33
23:00	16	12	15	17	35	22	9	19	18
Total	3768	3979	4071	4097	4264	2282	1784	4036	3464
% Heavies	7.9%	8.5%	10.0%	8.4%	8.9%	4.7%	4.4%	8.8%	8.1%



Road	Denman Rd		
Location	south of Racecourse Rd		
Site No.	7		
Start Date	Saturday	28-Apr-07	
Direction	Northbound		

Average Weekday	3460
7 Day Average	2860
Weekday Heavy's	11.8%
7 Day Heavy's	11.0%

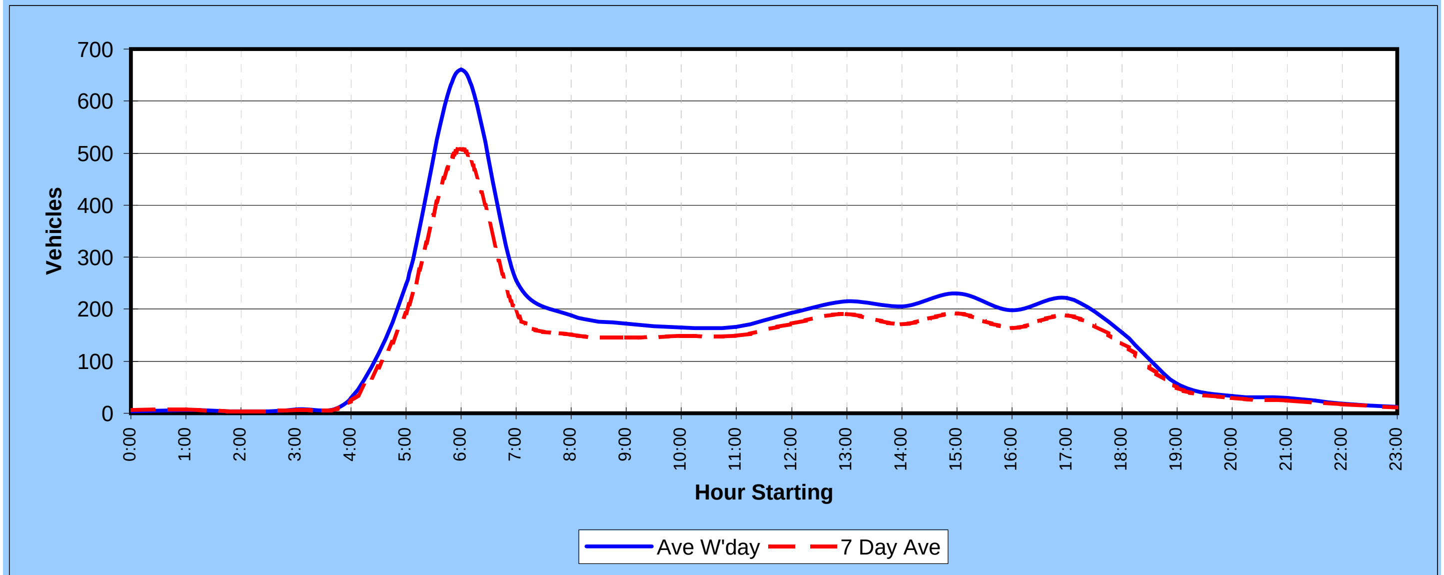
Time	Mon 30-Apr	Tue 1-May	Wed 2-May	Thu 3-May	Fri 4-May	Sat 28-Apr	Sun 29-Apr	Ave W'day	7 Day Ave
AM Peak	222	228	222	227	224	158	87		
PM Peak	491	482	541	509	547	116	138		
0:00	2	9	12	9	12	5	16	9	9
1:00	3	10	8	13	8	5	8	8	8
2:00	1	6	7	6	4	3	3	5	4
3:00	7	9	7	4	6	3	3	7	6
4:00	9	9	9	15	19	12	5	12	11
5:00	28	34	41	36	37	19	20	35	31
6:00	149	145	129	141	150	97	61	143	125
7:00	209	202	222	212	216	56	49	212	167
8:00	195	228	218	227	213	91	49	216	174
9:00	196	192	202	189	204	149	70	197	172
10:00	159	169	160	208	224	158	87	184	166
11:00	222	177	187	194	179	148	77	192	169
12:00	202	181	182	219	236	115	83	204	174
13:00	198	180	203	214	257	116	138	210	187
14:00	228	239	244	306	295	98	95	262	215
15:00	491	482	541	509	547	82	81	514	390
16:00	357	446	410	422	338	67	79	395	303
17:00	295	320	314	314	222	76	97	293	234
18:00	145	142	173	152	147	108	75	152	135
19:00	109	109	107	103	75	44	55	101	86
20:00	37	47	35	49	30	12	34	40	35
21:00	23	21	28	24	33	23	14	26	24
22:00	21	29	28	33	28	16	4	28	23
23:00	12	17	17	12	23	14	2	16	14
Total	3298	3403	3484	3611	3503	1517	1205	3460	2860
% Heavies	11.0%	12.0%	12.3%	11.9%	11.4%	6.9%	6.1%	11.8%	11.0%



Road	Denman Rd		
Location	south of Racecourse Rd		
Site No.	7		
Start Date	Saturday	28-Apr-07	
Direction	Southbound		

Average Weekday	3474
7 Day Average	2880
Weekday Heavy's	13.2%
7 Day Heavy's	12.3%

Time	Day of Week Mon 30-Apr	Tue 1-May	Wed 2-May	Thu 3-May	Fri 4-May	Sat 28-Apr	Sun 29-Apr	Ave W'day	7 Day Ave
AM Peak	638	665	695	656	647	171	103		
PM Peak	225	241	225	244	261	135	136		
0:00	3	1	5	6	4	12	8	4	6
1:00	3	11	7	6	5	6	10	6	7
2:00	1	4	5	3	6	5	5	4	4
3:00	5	7	6	11	5	4	3	7	6
4:00	24	36	27	29	29	13	8	29	24
5:00	247	247	251	247	247	66	38	248	192
6:00	638	665	695	656	647	171	83	660	508
7:00	240	241	255	278	264	50	28	256	194
8:00	182	197	197	186	179	69	47	188	151
9:00	157	164	163	202	178	100	56	173	146
10:00	164	173	149	179	162	114	103	165	149
11:00	176	143	160	165	188	111	95	166	148
12:00	203	182	189	198	194	135	106	193	172
13:00	192	197	201	244	244	122	136	216	191
14:00	199	203	214	190	223	100	70	206	171
15:00	225	241	225	214	247	100	92	230	192
16:00	181	179	198	209	226	73	83	199	164
17:00	190	220	210	224	261	109	104	221	188
18:00	140	146	149	136	201	96	79	154	135
19:00	45	58	53	77	49	32	28	56	49
20:00	20	37	33	41	34	23	18	33	29
21:00	32	30	26	36	24	14	12	30	25
22:00	9	13	21	24	25	17	14	18	18
23:00	13	12	10	6	18	13	4	12	11
Total	3289	3407	3449	3567	3660	1555	1230	3474	2880
% Heavies	12.5%	13.3%	14.5%	13.1%	12.4%	7.5%	6.7%	13.2%	12.3%



Appendix B

Proposed 5-year Works Program

Proposed 5-year Works Program (2008 to 2013)

Location	LOS existing 2007 (Table 4-7)	LoS S4 2037 with natural traffic growth and no development/bypass (Table 8-1)	LoS S5 2037 with future development on the 2037 network with no Bypass (Table 8-2)	LoS S6 2037 with future development on the 2037 network with Bypass (Table 8-4)	Description of works (see Table 8-5 for capacity and Table 9-1 safety improvements)	Comments	Estimated project cost	Suggested priority based on capacity and safety concerns
INTERSECTION UPGRADE PROJECTS								
Rutherford Rd/New England Hwy	F	F	F	F	▪ New signals (see Figure 8-2)	▪ Council has advised that traffic signals will be installed in 2008-2009. ▪ Time separation for traffic in major road and minor road ▪ Signals could accommodate the pedestrian desire line between shops across the intersection ▪ Increase pedestrian and cyclist safety ▪ Reduce traffic speeds through increased delay on main road ▪ Reduce crashes+ (reduce opposing vehicle turning and rear-end crash types, but may migrate crashes to other, less serious, types, e.g. crashes involving adjacent approaches at intersection) ▪ High installation costs ▪ Requires RTA approval ▪ Needs to meet RTA warrants	▪ >$500,000	High
Rutherford Rd/Acacia Dr	A	A	F	F	▪ New roundabout (see Figure 8-2)	▪ On capacity grounds, a roundabout is not required immediately, however, consideration should be given to bringing forward a roundabout for the future LATM study ▪ The installation of a roundabout can reduce more serious crash types significantly+ ▪ Need to ensure that pedestrian and cyclist safety is not reduced. ▪ Relatively high construction cost, but low maintenance cost (depending on the type of landscaping treatment adopted)	▪ >$300,000	Medium

Rutherford Rd/Ironbark Rd	A	A	E	D	▪ New roundabout (see Figure 8-3)
					▪ Edgeline marking on Ironbark Road approaching Rutherford Road intersection
						▪ On capacity grounds, a roundabout is not required immediately, however, consideration should be given to bringing forward a roundabout for the future LATM study
						▪ Roundabouts:
						  ▸ Reduce serious crash types significantly+, but need to consider pedestrian safety
						  ▸ Relatively high construction cost, but low maintenance cost (depending on the type of landscape treatment)
						▪ Edgeline markings
						  ▸ Reduce various crash types significantly+
						  ▸ Reduce traffic speeds
						  ▸ Provide protection and delineation for parked cars
						  ▸ Low installation cost but adds to future maintenance burden
						  ▸ May restrict commercial vehicle access
						  ▸ May introduce squeeze points for cyclists
							▪ >$300,000 for roundabout
							▪ $6,000 ($10/m linemarking)
								Medium

Location	LOS existing 2007 (Table 4-7)	LoS S4 2037 with natural traffic growth and no development/bypass (Table 8-1)	LoS S5 2037 with future development on the 2037 network with no Bypass (Table 8-2)	LoS S6 2037 with future development on the 2037 network with Bypass (Table 8-4)	Description of works (see Table 8-5 for capacity and Table 9-1 safety improvements)	Comments	Estimated project cost	Suggested priority based on capacity and safety concerns
Thompson Street/New England Hwy	F	F	F	F	▪ New signals (see Figure 8-5)	▪ The proposed signalisation accords with RTA requirements ▪ Time separation for traffic in major road and minor road ▪ Increase pedestrian and cyclist safety ▪ Reduce traffic speeds through increased delay on main road ▪ Reduce crashes+ (reduce opposing vehicle turning and rear-end crash types, but may migrate crashes to other types, e.g. crashes involving adjacent approaches at intersection) ▪ High installation costs ▪ Design requires RTA approval and project must meet RTA warrants	▪ >$500,000	High
Haydon Street/Maitland Road/New England Hwy	F	F	F	F	▪ Give-way and raised median (see Figure 8-8A)	Option 1: Modify this intersection to left-in-left-out arrangement. ▪ Reduce the number of conflict points by providing a median in the Highway and restricting the right turn movements at the intersection ▪ The give-way, median closure and turn ban control can reduce crashes at the intersection+ ▪ Restricts residential access ▪ May divert traffic onto surrounding streets (i.e. New England Highway and Haydon Street) ▪ Turns may divert to less safe locations	▪ $30,000 to $50,000	High
					▪ Short right turn bay and a pedestrian refuge island on New England Highway (Figure 8-8B)	Option 2: Provide a short right turn lane and pedestrian refuge island. ▪ Insufficient capacity on the one-lane section on the Highway ▪ Potential right to left merge problem on approach to the right turn bay ▪ Improve pedestrian access across the Highway ▪ PB recommended the Council to consider the provision of suitable signs and linemarking, and roadway lighting.	▪ Greater than $150,000	High
New England Hwy/Hunter Street	F	E	F	F	▪ New seagull (see Figure 8-12)	▪ Increase traffic efficiency and provide staged right turn from Hunter Street ▪ Reduce serious crash risks significantly+	▪ >$500,000	High
Brecht Street/Brentwood Street	A	A	A	A	▪ Provide pedestrian refuge islands ▪ Provide a roundabout to slow down traffic on Brecht Street	▪ Increases pedestrian safety and connectivity at refuge islands ▪ Refuge islands: ▸ Reduce traffic speed ▸ May restrict commercial vehicle access ▸ Increase pedestrian safety and connectivity ▪ Roundabout: ▸ Reduce high speed travel in Brecht Street ▸ Minimise crash severity from side impact events ▸ Reduce various crash types significantly+	▪ $10,000 for pedestrian refuge island ▪ $>$300,000 for roundabout	High

Location	LOS existing 2007 (Table 4-7)	LoS S4 2037 with natural traffic growth and no development/bypass (Table 8-1)	LoS S5 2037 with future development on the 2037 network with no Bypass (Table 8-2)	LoS S6 2037 with future development on the 2037 network with Bypass (Table 8-4)	Description of works (see Table 8-5 for capacity and Table 9-1 safety improvements)	Comments	Estimated project cost	Suggested priority based on capacity and safety concerns
						▸ Relatively high construction cost, but low maintenance cost (depending on the type of landscaping treatment)		
New England Highway/ Aberdeen Street	-	-	-	-	▪ Review linemarking (turn lanes) and intersection control ▪ Review crash history in the vicinity of the intersection ▪ Prepare plans to address crash problems	▪ Improve intersection safety and reduce crash risks	▪ Further investigation in a separate study	High
ROAD PROJECTS								
Acacia Drive	-	-	-	-	▪ Provide edgeline marking between Rutherford Road and Bloodwood Road ▪ Provide 4 roundabouts along Acacia Drive intersections	▪ Reduce travel speed by introducing edgeline on either side of the road ▪ Edgeline markings ▸ Reduce various crash types significantly+ ▸ Reduce traffic speeds ▸ Provide protection and delineation for parked cars ▸ Low installation cost ▸ May restrict commercial vehicle access ▸ May introduce squeeze points for cyclists ▪ Roundabout: ▸ Prevent the acceleration of vehicles up Acacia Drive, which would dramatically reduce speed ▸ Reduce various crash types significantly+ ▸ Need to consider pedestrian safety ▸ Relatively high construction cost, but low maintenance cost (depending on the type of landscaping treatment)	▪ $17,200 ($10/m linemarking) ▪ $>$300,000 for each roundabout	High
Bloodwood Road	-	-	-	-	▪ Provide edgeline marking between Bimbadeen Drive and Acacia Drive ▪ Provide raised pavement within intersection as constructed in the new road Osborn Avenue	▪ Reduce travel speed by introducing edgeline and threshold treatments ▪ Edgeline markings: ▸ Reduce various crash types significantly+ ▸ Reduce traffic speeds ▸ Provide protection and delineation for parked cars ▸ Low installation cost ▸ May restrict commercial vehicle access ▸ May introduce squeeze points for cyclists ▪ Raised pavement within intersection ▸ Reduce traffic speeds ▸ Signals a change in the road environment ▸ Reduce crash risk ▸ Minor inconvenience to motorists	▪ $4,300 ($10/m linemarking) ▪ $20,000 for raised intersection threshold treatment	High

Location	LOS existing 2007 (Table 4-7)	LoS S4 2037 with natural traffic growth and no development/bypass (Table 8-1)	LoS S5 2037 with future development on the 2037 network with no Bypass (Table 8-2)	LoS S6 2037 with future development on the 2037 network with Bypass (Table 8-4)	Description of works (see Table 8-5 for capacity and Table 9-1 safety improvements)	Comments	Estimated project cost	Suggested priority based on capacity and safety concerns
						▸ Can increase noise levels depending on the use of the material ▸ Can require drainage alterations ▸ Requires line-marking and adequate illumination ▸ Often an expensive treatment ▸ Visually attractive		
Hakea Drive	-	-	-	-	▪ Provide consistent treatment between Weemala Place and Acacia Drive, as with Bloodwood Road	▪ Reduce travel speed by introducing edgeline and threshold treatment ▪ Edgeline marking can reduce various crash types significantly[+] ▪ Edgeline marking also: ▸ Reduces traffic speeds ▸ Provides protection and delineation for parked cars ▸ Low installation cost ▸ May restrict commercial vehicle access ▸ May introduce squeeze points for cyclists ▪ Raised pavement within intersection ▸ Reduce traffic speeds ▸ Reduce crash risk ▸ Minor inconvenience to motorists ▸ Can increase noise levels depending on the use of the material ▸ Can require drainage alterations ▸ Requires line-marking and adequate illumination ▸ Often an expensive treatment ▸ Visually attractive	▪ $5,000 ($10/m linemarking) ▪ $20,000 for raised intersection threshold treatment	High
Beech Street	-	-	-	-	▪ Provide edgeline marking between Acacia Drive and Calgaroo Avenue ▪ Review pedestrian connectivity in a LATM study	▪ Reduce travel speed by introducing edgeline on either side of the road ▪ Improve pedestrian accessibility ▪ Edgeline marking can reduce various crash types significantly[+] ▪ Reduces traffic speeds ▪ Provides protection and delineation for parked cars ▪ Low installation cost ▪ May restrict commercial vehicle access ▪ May introduce squeeze points for cyclists	▪ $6,600 ($10/m linemarking)	High

Location	LOS existing 2007 (Table 4-7)	LoS S4 2037 with natural traffic growth and no development/bypass (Table 8-1)	LoS S5 2037 with future development on the 2037 network with no Bypass (Table 8-2)	LoS S6 2037 with future development on the 2037 network with Bypass (Table 8-4)	Description of works (see Table 8-5 for capacity and Table 9-1 safety improvements)	Comments	Estimated project cost	Suggested priority based on capacity and safety concerns
Rutherford Road	-	-	-	-	▪ Provide pedestrian crossing facilities (for example zebra crossing)	▪ Accommodate pedestrian desire lines to/from shops ▪ Increased driver awareness of pedestrians for safety ▪ Increase pedestrian convenience ▪ Reduced potential for jaywalking ▪ Reduced collision risk with pedestrians ▪ Proper signposting and marking are of critical importance ▪ Require adequate sight distance and pedestrian visibility ▪ Require high quality and distinctive lighting at night ▪ Cannot be provided where RTA warrant is not met ▪ Loss of on-street parking ▪ Can be costly if drainage pits need adjustment (spot treatment).	▪ $10,000 for zebra crossing	High
Calgaroo Avenue	-	-	-	-	▪ Provide roundabout at the Beech Street intersection	▪ The roundabout would prevent the acceleration of vehicles up Calgaroo Avenue which would dramatically reduce speed ▪ This treatment is consistent with the roundabout at the Grevillea Street intersection ▪ The installation of a roundabout can reduce various crash types significantly+ ▪ Consider pedestrian safety ▪ Relatively high construction cost, but low maintenance cost (depending on the type of landscaping treatment)	▪ >$300,000 for roundabout	High
Ironbark Road/Skellatar Stock Route	-	-	-	-	▪ Road reconstruction to urban standards	▪ Currently the road does not meet the RTA standard as an urban road. Upgrade road by widening to the standard lane width with gains in road capacity	▪ Cost to be determined upon final design	Medium
Lorne Street/ Mitchell Street route	-	-	-	-	▪ Prepare an area-wide LATM plan to address rat-running issues. Limitation of area to be defined by Council.	▪ Reduce through traffic in local streets	▪ Further investigation in a separate study	Medium
Adams Street	-	-	-	-	▪ Provide roundabout at Thompson Street/ Adams Street intersection ▪ Provide pedestrian refuge along pedestrian desire lines	▪ Roundabout: ▸ Prevent the acceleration of vehicles up Acacia Drive which would dramatically reduce speed ▸ Reduce various crash types significantly+ ▸ Need to consider pedestrian safety ▸ Relatively high construction cost, but low maintenance cost (depending on the type of landscape treatment) ▪ Pedestrian refuge island ▸ Reduce traffic speed ▸ May restrict commercial vehicle access ▸ Increase pedestrian safety and connectivity	▪ >$300,000 for roundabout ▪ $10,000 for pedestrian refuge	Medium

Location	LOS existing 2007 (Table 4-7)	LoS S4 2037 with natural traffic growth and no development/bypass (Table 8-1)	LoS S5 2037 with future development on the 2037 network with no Bypass (Table 8-2)	LoS S6 2037 with future development on the 2037 network with Bypass (Table 8-4)	Description of works (see Table 8-5 for capacity and Table 9-1 safety improvements)	Comments	Estimated project cost	Suggested priority based on capacity and safety concerns
Shaw Crescent	-	-	-	-	▪ Provide edgeline marking along Shaw Crescent ▪ Remove trees on the roadside around the bends	▪ Reduce travel speed by introducing edgeline markings ▪ Edgeline markings: ‣ Reduce various crash types significantly+ ‣ Reduce traffic speeds ‣ Provide protection and delineation for parked cars ‣ Low installation cost ‣ May restrict commercial vehicle access ‣ May introduce squeeze points for cyclists ▪ Remove trees on the roadside to improve better sight line around bends	▪ $3,000 ($10/m linemarking) ▪ $8,000 ($2,000/ tree)	Medium
Access from urban areas to Denman Road	-	-	-	-	▪ Provide type of intersections for connecting roads from local developments	▪ The design of intersections connecting with rural roads should be in accord with RTA/ AUSTROADS guidelines	▪ Further investigation in a separate study	Low
Access from urban areas to the northern approach of the New England Highway	-	-	-	-	▪ Provide type of intersections for connecting roads from local developments	▪ The design of intersections connecting with rural roads should be in accord with RTA/ AUSTROADS guidelines	▪ Further investigation in a separate study	Low
Access from urban areas to the southern approach of the New England Highway	-	-	-	-	▪ Provide type of intersections for connecting roads from local developments	▪ The design of intersections connecting with rural roads should be in accord with RTA/ AUSTROADS guidelines	▪ Further investigation in a separate study	Low
Narrow bridge immediately south of No. 15 George Street	-	-	-	-	▪ Muswellbrook Shire Council has proposed to improve traffic and pedestrian safety by providing for one lane traffic only across the bridge with a Give Way sign against southbound traffic travelling downhill from Hill Street. It is proposed to reduce the width of the trafficable lane and include a pedestrian path across the bridge. The separation of vehicular and pedestrian traffic across the bridge could by using a section of New Jersey kerb or an equivalent.	▪ PB advised Council to consider the following in the detailed design: ‣ Enhance drivers' awareness of the one-lane bridge, New Jersey kerb and pedestrian path, particularly during night time and adverse weather conditions. ‣ Provide delineation on approach to and on the bridge along George Street. These include edge line and centreline. ‣ Provide signage including pedestrian warning signs and hazard markers on the New Jersey kerb ‣ Provide the required signage for the one-lane bridge in accordance with AS 1742.2-2009. ‣ Provide appropriate treatment to the roadside hazards located within the clear zone. ▪ Undertake design stage and pre-opening stage road safety audits.	▪ Further investigation in a separate study	Medium

Note: cost estimates are approximate and require to be finalised following a detailed design (i.e. underground utility, relocation of kerb lines, re-pavement, lighting and traffic control etc.)

+ Source: Appendix C, Accident Reduction Guide Part 1, Roads and Traffic Authority, August 2005

Appendix C

RTA's comments on the draft Muswellbrook Traffic Study report

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MUSWELLBROOK
SHIRE COUNCIL
- 7 JUL 2008
File 600.000 Name NWP.
Complete........... Date..............

Fwd to K.RS.
7/7.

The General Manager
Muswellbrook Shire Council
PO Box 122
MUSWELLBROOK NSW 2333

Attention: Mr Neil Pope

DRAFT MUSWELLBROOK TRAFFIC STUDY AND PLAN 2008, MUSWELLBROOK SHIRE COUNCIL

Dear Mr Pope

I refer to the meeting held on 22 May 2008 between RTA and Muswellbrook representatives where it was requested that comments be provided from the Roads and Traffic Authority with regard to the draft traffic study submitted by Parsons Brinckerhoff Pty Ltd.

The RTA's primary interests are in the road network, traffic and broader transport issues, particularly in relation to the efficiency and safety of the classified road system, the security of property assets and the integration of land use and transport.

In accordance with the *Roads Act 1993*, the RTA has powers in relation to road works, traffic control facilities, connections to roads and other works on the classified road network. The New England Highway (HW9) and Denman Road/Sydney Street (MR 209) are classified (State) roads and RTA concurrence is required road works under section 138 of the Act. Council is the roads authority for this road and all other public roads in the area.

It is noted the traffic study investigates the future traffic scenarios of 2020 and 2037 with growth in the Muswellbrook area estimated at approximately 4000 residential lots and 35,000m^2 of commercial/retail space. The study reports on intersection and mid-block performance and provides options for future potential upgrades.

The RTA has reviewed the draft traffic study and offers the following comments for Council's consideration:

- Figure 7-6 on Page 105 of the study shows the mid-block degree of saturation for all major roads within the Muswellbrook township with the proposed Muswellbrook bypass in place. Despite the implementation of the bypass, the model results indicate that by 2037, there are three road sections approaching or are over the practical degree of saturation as follows:
    - Bridge Street south of Market Street.
    - Sydney Street between Skellatar Stock Route and Mitchell Line Road.
    - At the intersection of the New England Highway and Rutherford Road.

An upgrade of the mid-block road sections on Bridge and Sydney Streets to two lanes in each direction should be undertaken within a suitable timeframe to ensure the efficiency of the classified road network is maintained. The intersection of the New England Highway and Rutherford Road will need to be upgraded to accommodate future predicted traffic flows.

- Pages 117 to 120 of the study lists the proposed intersection improvements based on providing an acceptable level of service up to the 2037 horizon. It is noted that the upgraded intersections have been modelled based on the Muswellbrook bypass not being implemented. A number of intersections have been modelled with the proposed upgrades, but have resulted in 95^{th} percentile queue lengths of up to and exceeding 300 metres. It is considered the following intersections require further investigation to determine a lane configuration that will accommodate predicted future traffic flows:

    - New England Highway/Rutherford Road
    - New England Highway/Thompson Street
    - New England Highway/Bell Street
    - Maitland Street/Sydney Street

  Options to be considered include increasing capacity via additional lanes, turning restrictions or grade separation. Additionally, the study recommends the intersection of the New England Highway and Thompson Street should be upgraded to a seagull intersection by 2016. There is a current development application for a retail centre on Thompson Street that includes an upgrade of the intersection to traffic control signals, which has been conditionally supported by the RTA.

- The intersection of the New England Highway and Hunter Street is proposed to be upgraded to a seagull. Concerns are raised with regard to sight distance to the north and potential bridge works that may be required to ensure the proposed design complies with the RTA Road Design Guide and relevant Australian Standards. Also, restrictions to the intersection of Hunter Street and Manning Street may be necessary to ensure vehicles do not queue back onto the New England Highway.

- Any traffic and transport infrastructure required as a result of developments should be funded through a Council Section 94 Contributions Plan or direct developer funding. This would be considered the most fair and equitable manner in which to apportion any upgrade works required. The RTA will not fund any transport infrastructure works as a direct result of future development of the area.

Please contact me on (02) 4924 0240 if you have any queries.

Yours sincerely

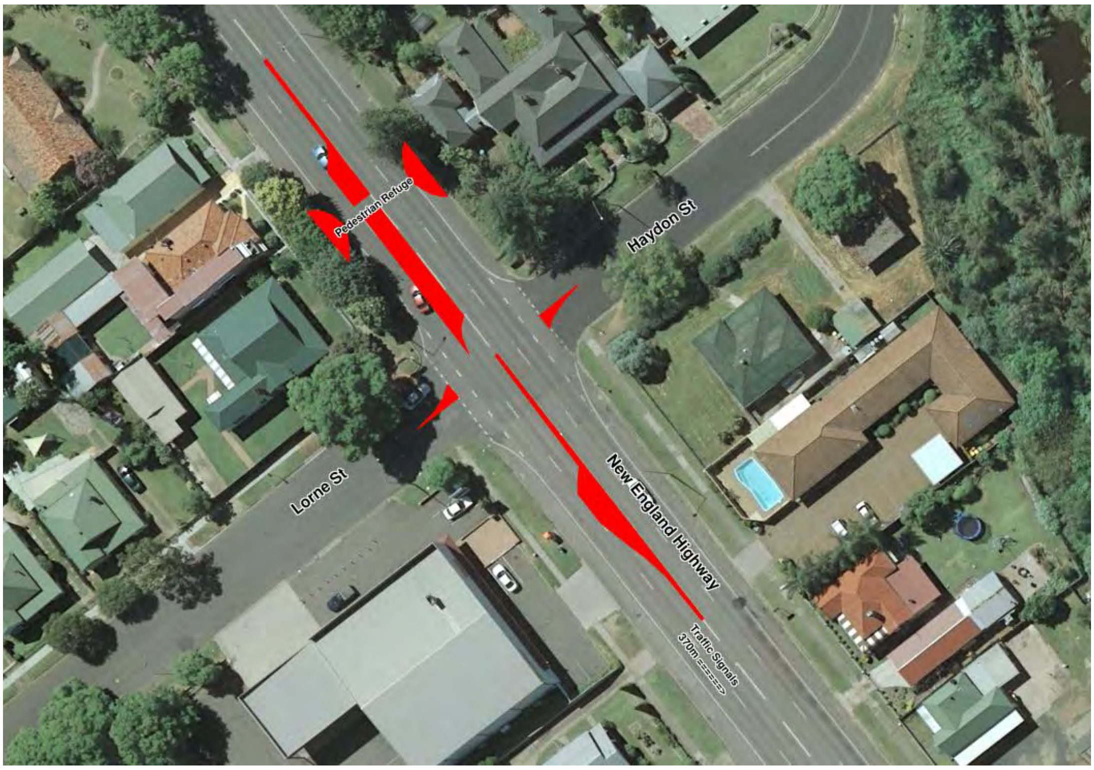
John Farrell
A/Manager, Land Use Development
Hunter Operations & Engineering Services

3 July 2008

Appendix D

Council's preliminary design of a short right turn lane and pedestrian refuge at the Haydon Street/Lorne Street/New England Hwy

As shown in the figure below, the Council prepared a preliminary design of a short right turn lane and pedestrian refuge (Option 2) at the Haydon Street/Lorne Street/New England Highway intersection (I-13).



PB advised the Council to consider the following recommendations in the detailed design as a minimum:

- Based on RTA's Technical Direction TDT 2002/10 Pedestrian Refuges:
  - Provide Refuge Island warning signs (W6-1 and W8-25) on both approaches to the refuge island.
  - Provide a No Stopping zone on both approaches to the refuge island. The length of the No Stopping zone depends on the width of the kerb extension.
  - Provide a hazard maker (G9-208) on the kerb extension facing the approaching traffic.
- Provide Keep Left signs (R2-3) on the traffic island facing the approaching traffic.
- Ensure illumination is adequate at the refuge island to increase motorists' awareness of pedestrians at night.
- Provide sufficient warning (i.e. signs and linemarking) to motorists that the right lane is about to end and that they must merge into the through lane.
- Consider provision of refuge islands on Lorne Street and Haydon Street at the intersection to increase accessibility for wheelchairs and prams.
- Undertake design stage and pre-opening stage road safety audits.

PB has also undertaken the following capacity analyses for the preliminary design:

- Intersection capacity analysis
- Mid-block capacity analysis.

Intersection capacity analysis

The intersection capacity performance in 2037 (S5) is summarised below.

Peak hour	DoS	Delays (sec)	LoS	Queue (m)
AM peak	1.00	271	F	38
PM peak	0.52	55	D	5

A review of the intersection performance indicated that during the AM peak hour, the left turning traffic from Lorne Street would experience the highest delay of 271 seconds due to the less available traffic gaps on the Highway. There would be one through lane only on the Highway (north-westbound), reducing the number of traffic gaps for the entering traffic from Lorne Street. This would increase traffic delay on Lorne Street, resulting in an unsatisfactory LoS F. The design traffic volume has reached the intersection's capacity resulting in DoS 1.00 during the AM peak hour.

During the PM peak hour, the left turning traffic from Haydon Street would experience the highest delay of 55 second. The intersection would operate at LoS D. The DoS of 0.52 is adequate during the PM peak hour.

Mid-block capacity analysis

The mid-block capacity analysis has been undertaken for New England Highway in the vicinity of the subject intersection, in accord with RTA's *Guide to Traffic Generating Developments 2002*.

Urban road peak hour flows per direction

Level of Service	One Lane (veh/hr)	Two Lanes (veh/hr)
A	200	900
B	380	1400
C	600	1800
D	900	2200
E	1400	2800

Source: RTA's *Guide to Traffic Generating Developments 2002*

The mid-block capacity performance in 2037 (S5) is summarised below.

Location	Direction	No. of lanes	Traffic volume (veh/hr)		LoS	
			AM peak	PM peak	AM peak	PM peak
East of Haydon Street/Lorne Street	South-eastbound	2-lane section	832	1,730	A	C
	North-westbound	1-lane section	1,470	1,004	F	E
		2-lane section	1,482	1,026	C	B
West of Haydon Street/Lorne Street	South-eastbound	2-lane section	825	1,719	A	C
	North-westbound	1-lane section	1,459	983	F	E
		2-lane section	1,459	983	C	B

In year 2037, the two-lane sections on New England Highway would have sufficient spare capacity to accommodate the future traffic volume. The one-lane section where a right turn bay and a pedestrian refuge facility are incorporated would become a bottleneck, as the traffic volume would exceed the available lane capacity on the one-lane section, resulting in an unsatisfactory LoS E to F.

Appendix E

Council's preliminary design of the one-lane bridge on George Street

muswellbrook shire council

George St. Proposed Works

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Appendix F

AS 1742.2 specifications for one-lane bridge

4.6.2 Bridges

4.6.2.1 *Bridges with more than one lane*

(a) *Full formation width or greater*

Where the full formation width is provided on a bridge either unkerbed or between kerbs no special treatment is warranted, i.e. pavement markings and delineation provided on the approach pavement shall be continued across the bridge. An exception is where the width between the kerbs is less than 8.6 m in which case the treatment specified in Item (b) shall be used.

(b) *Less than formation width*

At bridges less than the full formation width, including those where there is a reduction in pavement width, the treatment is illustrated in Figure 4.10, and shall be as follows:

(i) Edge lines shall be provided on the bridge and in advance of the bridge as shown in Figure 4.10, if practicable.

(ii) Bridge width markers shall be provided in accordance with Clause 4.6.7.2(c) at or near the bridge abutments on each approach to delineate the width of the bridge.

(iii) The Narrow Bridge sign (W4-1) shall be provided where the conditions in Clause 4.6.6.3(a) apply. On two-way roadways the NO OVERTAKING ON BRIDGE sign (R6-2) shall also be provided where the conditions in Clause 4.6.6.1(c) apply.

Raised retroreflective pavement markers should be considered for use in accordance with Clause 5.6.5.2 on the dividing line or lane line on approach to, and across the bridge, and on edge lines on each approach.

4.6.2.2 *One-lane bridges on two-way roadways*

One-lane bridges are those where the width between bridge kerbs is either less than 5.0 m, or less than 5.5 m if the proportion of trucks and buses is greater than one third of the traffic using the bridge, or the approach alignment is poor.

Treatment depends on traffic volumes, bridge length, visibility, grade and the possible need to regulate driver action by signs or traffic signals.

Treatment for one-lane bridges on two-way roadways without use of traffic signals shall be as follows:

(a) *Bridges 60 m or more in length*

(i) Edge lines and bridge width markers shall be provided as specified in Clause 4.6.2.1(b). The maximum width between edge lines shall be 4.0 m.

(ii) On each approach the Narrow Bridge sign (W4-1) shall be provided in conjunction with the ONE LANE sign (W8-16) followed by the NO OVERTAKING OR PASSING sign (R6-1) (see Figure 4.11).

(iii) Where it is desired to indicate which direction of traffic is to give way, the NO OVERTAKING OR PASSING sign (R6-1) shall be used only on one approach. The GIVE WAY sign (R1-2) (see Clause 4.6.6.1(a)) shall be used on the other approach (see Figure 4.12), the Give Way Sign Ahead sign (W3-2) may also be used.

Priority is usually given to the approach with the lesser sight distance, i.e. the one on which the driver is less able to see whether a suitable crossing gap is available in the opposing traffic stream, but on steep grades it may be desirable to give the downgrade traffic priority over the upgrade traffic or, where traffic on one approach is markedly faster than on the other, it may be desirable to give the faster approach priority.

(b) *Bridges less than 60 m in length*

On bridges less than about 60 m long, the treatments given in Items (a)(i) and (a)(ii) are usually adequate. The treatment given in Item (a)(iii) is not required unless traffic volumes are high or both points of entry to the bridge are not visible from each approach.

NOTE: High traffic volumes in this case could be regarded as in excess of 200 vpd.

4.6.2.3 *Signalization of one-lane bridges*

Signalized control of traffic flow may be used on one-lane bridges. The main factors influencing a decision regarding the installation are—

(a) length of the bridge;

(b) sight distance between drivers approaching the bridge in opposing directions;

(c) 85^{th} percentile speed of vehicles on the bridge approaches and on the bridge itself; and

(d) volume and distribution of traffic throughout the day and proportion of heavy vehicles.

A typical treatment of signs and signals is shown in Figure 4.13. The types of traffic signals that should be used for particular situations are detailed as follows:

(i) The following treatments are generally appropriate on bridges where the distance between stop lines is up to 200 m and the surface conditions permit all vehicles to maintain an average speed of 30 km/h:

   (A) Where vehicle volumes are low and approximately equal in each direction: Fixed time signals with a fixed 'all red' period.

   (B) Where vehicle volumes are low and opposing flows are significantly different: Vehicle-actuated signals with a fixed 'all red' period.

   (C) Where vehicle volumes are medium with little variation in opposing flows, and only small variations in travel time over the controlled length: Vehicle-actuated signals with a fixed 'all red' period.

(ii) Vehicle-actuated signals with variable 'all red' periods are suitable for use on bridges where the distance between stop lines is greater than 200 m or where there are—

   (A) high or near-capacity vehicle volumes;

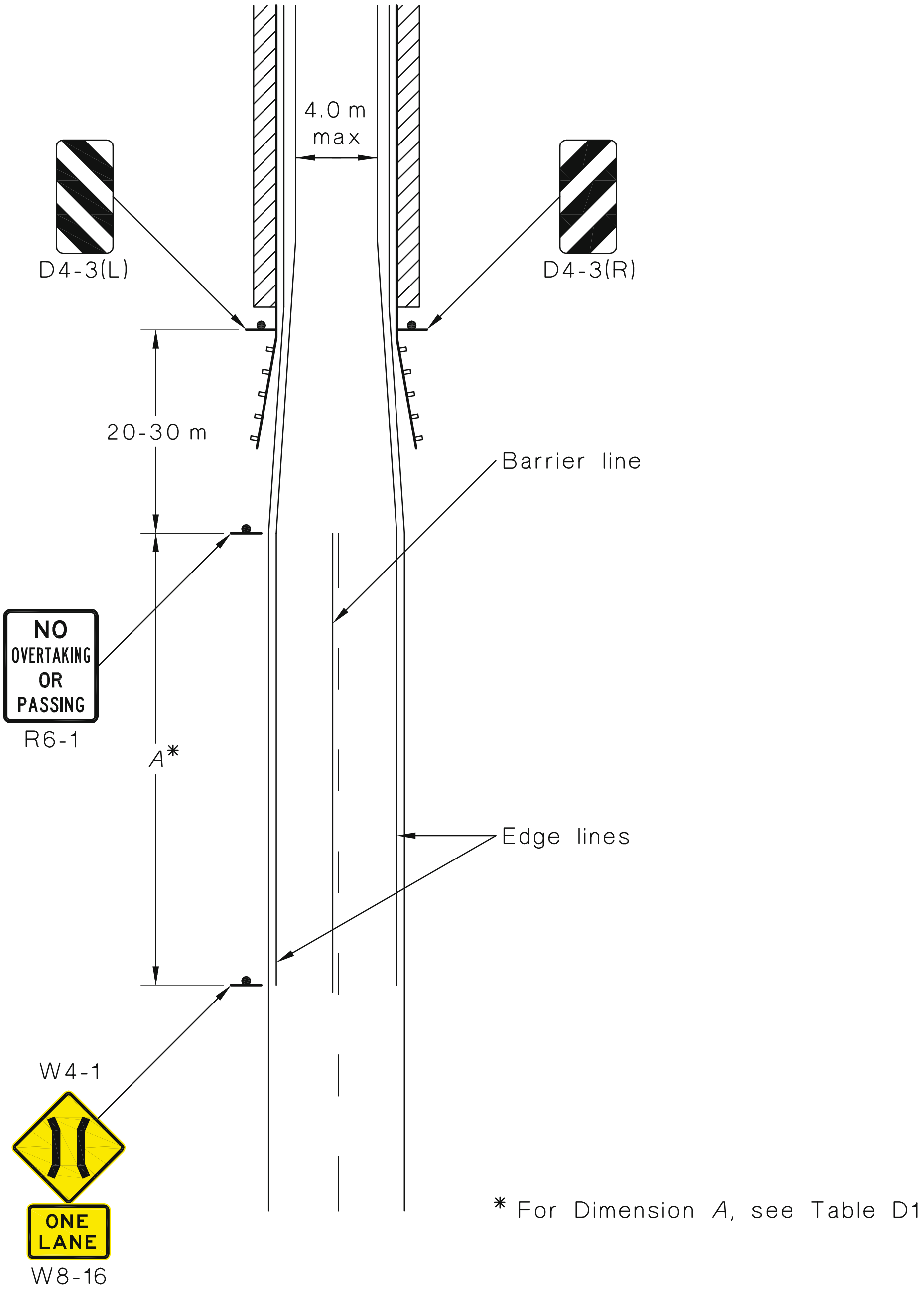
   (B) medium vehicle volumes and the opposing flow is significantly different; or

   (C) large variations in travel time over the controlled length.

In these cases detectors should be placed at intervals along the controlled length, e.g. every 60 m, to detect the passage of the last vehicle in a platoon and to extend the period accordingly.

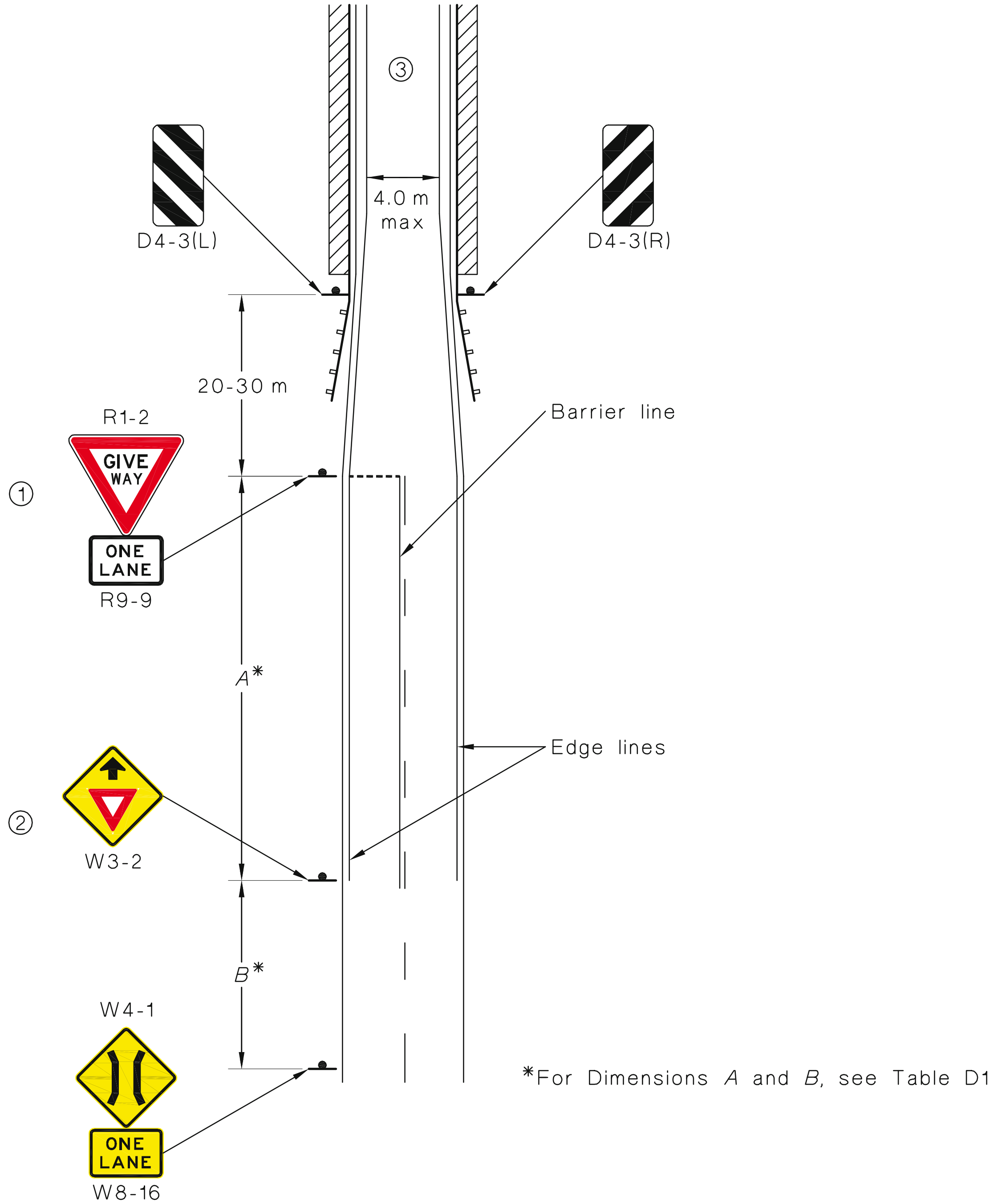
NOTE: As a guide, low volumes could be taken as less than 50% of the calculated hourly capacity of the one-lane section (both directions) in the peak hour, medium volumes as between 50% and 75% and high or near-capacity volumes, greater than 75%.

For temporary installations, e.g. where works are in progress on a bridge, additional warning signs may be required (see AS 1742.3).



NOTE: A one-lane bridge is one that meets the width limitations specified in Clause 4.6.2.2. The maximum width between edge lines is 4.0 m.

FIGURE 4.11 ONE-LANE BRIDGE



NOTES:

1 The approach on which this treatment is used should be selected in accordance with the priorities recommended in Clause 4.6.2.2 (a)(iii). The other approach is treated as shown in Figure 4.11.

2 Used only if sight distance to the R1-2 sign is less than the lower limit for Dimension A.

3 A one-lane bridge is one that meets the width limitations specified in Clause 4.6.2.2. The maximum width between edge lines is 4.0 m.

FIGURE 4.12 ONE-LANE BRIDGE WITH GIVE WAY SIGN

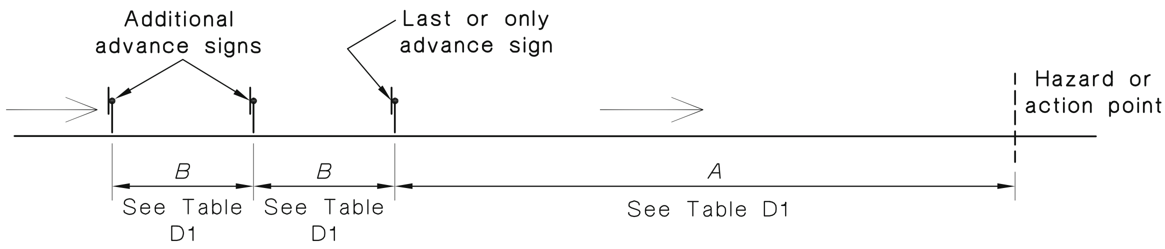


FIGURE D1 ADVANCE SIGN DISTANCES

TABLE D1

LOCATION OF WARNING SIGNS IN ADVANCE OF A HAZARD

metres

Dimension	**Situation**	**V_{85}, km/h**			**Typical examples**
		<75	**75–90**	**>90**	
Dimension *A*	(i) Must or may need to stop	80–120	120–180	180–250	W3-2 Give Way Sign Ahead W3-1 Stop sign Ahead W2-3 T junction (sign on minor road) W5-7 FLOODWAY W4-8 LOW CLEARANCE _·_ m
	(ii) Significant speed reduction required	60–80	80–120	120–180	Signs in the Turn Sign Zone in Figure 4.5 W5-20 Slippery W2-7 Roundabout ahead
	(iii) Low to moderate speed reduction required – or no speed reduction	40–60	60–80	80–120	Signs in the Curve Sign Zone in Figure 4.5 W5-3 Aircraft W4-4 Divided road Intersection warning signs located on straight major road
Dimension *B*	Position of any additional warning sign in advance of sign at Dimension *A*.	50	60	70	

NOTE: Values for Dimensions *A* and *B* in this Table are to be used unless a different value is specified elsewhere in this Standard in a particular case.

D2.3 Lateral placement and height

D2.3.1 *General*

The following are general requirements for the lateral location of roadside signs and overhead sign structure supports, and for the mounting heights of roadside and overhead signs. The lateral placement shall be measured from the edge of the sign nearest the road, and the height from the underside of the sign or the lowest sign in an assembly of signs.

The requirements apply to signs of a permanent nature, and include signs for roadworks and special purposes where these are mounted on posts set into the ground. Any variation in these requirements for a particular sign is given in the Clause relating to that sign.

There may, however, be exceptions where conditions do not permit these requirements to be applied. In these cases the placement or height shall be adjusted to meet these special conditions, e.g. the height of a sign may be increased or decreased to avoid obstructing sight distance at an intersection.

Lateral clearance and mounting height details for various situations are shown in Figure D2.