
# Kelso Traffic Access Study

## Bathurst Regional Council

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## Traffic and Transport Assessment Report

aurecon

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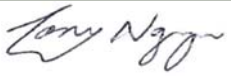
| Author Signature |  | Approver Signature |  |
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# Executive Summary

Aurecon Australia was engaged by Bathurst Regional Council (BRC) and Roads and Maritime Services (Roads and Maritime) to prepare a traffic access study for the future developments in the Kelso area, located to the east of the Bathurst Town Centre and north of the Great Western Highway.

It is proposed that, over a 30 year time frame, 4,810 new dwellings would be constructed increasing the population by approximately 10,000 people at Kelso. Associated with this increase in population is a need for school facilities, community centre, employment opportunities, recreational facilities and, of course, an efficient transport system to link these activities at Kelso, and Bathurst. The majority of the traffic generated from these developments will need to use either the Great Western Highway or Hereford Street to access workplaces, shops along the highway at Kelso and Bathurst CBD. The identified developments at Kelso would have the potential to increase the traffic and parking demand at Kelso as well as Bathurst CBD.

The assessment of the potential traffic and transport requirements for these future developments needs to be modelled to identify potential traffic management and other measures to facilitate traffic, cycling, pedestrian and public transport access. In this regard, the development of a micro-simulation model was undertaken to assess these measures and provide council with the opportunity to test various scenarios.

The existing land uses located within Kelso are mainly residential, with rural land uses on the eastern and northern boundaries. A review of the information published in the Bathurst Regional Council website, based on the 2011 census, indicates that the population of Kelso was approximately 7,667 in 2011, living in approximately 2,930 dwellings with an average house hold size of 2.6.

As part of the assessment of the travel patterns of the existing Kelso and Bathurst Regional Council area, an analysis of the mode of travel was carried out. This highlighted that the primary mode of transport is private vehicles (approximately 83% and 76% respectively) and the public transport usage is minimal (0.1%-0.6%) within the Kelso area as well as in the Bathurst Regional Council area. 2.8% of residents use active transport modes (bicycle/walking) to travel to work from the Kelso area compared to 5.3% in the BRC area. A significant number of residents either worked at home or did not go to work on the Census day.

Based on these current modes of travel patterns, the majority of the residents of the future developments proposed in the Kelso area are expected to travel using private cars. The usage of public transport and other forms of transport by the residents of the proposed developments is expected to be minimal. However, this report supports Council's aim to encourage increased walking, cycling and public transport use (new/ amended bus routes into the Kelso Development area (KDA), and future expanded services) as a way of reducing current and future traffic congestion, so is recommending the provision of shared paths or footpaths along all collector and local roads to facilitate walking, cycling and bus use.

As part of the study a number of traffic surveys were carried out to assess the existing travel patterns and volumes of traffic on some of the key roads in the area. These surveys included peak hour intersection counts, seven day speed and classification counts, origin-destination (OD) surveys, travel time and queue lengths at key intersections. This information was used in conjunction with data provided by Roads and Maritime on Average Annual Daily Traffic (AADT) for roads in the study area.

Based on the surveys the following information was determined:

- The majority of the vehicles (86%-89%) travelling east of the Macquarie River on Hereford Street have an origin/destination in Kelso, within the study area, or Gilmour Street (MR54) north of Eltham Drive.
- The majority of the vehicles (79%-82%) travelling along Gilmour Street (MR54) (south of Eltham Drive) have an origin/destination in Kelso, within the study area, or west of the Macquarie River on Hereford Street.
- 10-12% of the vehicles travelling along Gilmour Street (MR54) (south of Eltham Drive) have an origin/destination to the west of the Macquarie River bridge on the Highway.
- 15% of the vehicles travelling along Littlebourne Street (MR253) (south of the Great Western Highway) have an origin/destination in Kelso, within the study area.
- A total of 74% of the vehicles travelling along Littlebourne Street (MR253) (south of the Great Western Highway) have an origin/destination either to the east of Littlebourne Street (MR253) on the highway or west of Macquarie River Bridge on the highway.
- The overall traffic distribution showed that approximately 70% of the traffic that has an origin/destination in Kelso, is to/from the west, 10% to/from the east and 20% to/from the north/south.
- The queue lengths at the surveyed intersections are similar during both the morning and evening peak periods with the observed queue lengths generally being less than 100 metres, except for the intersections of the Great Western Highway/George Street and Great Western highway/Littlebourne Street (MR253) intersections. The queues on these intersections can extend up to 140m.
- The mid-block traffic counts identified that most of the roads in the study area operate at an acceptable level of service except for the Great Western Highway, east of Littlebourne Street (MR253), and Hereford Street.
- The intersection counts indicated that the intersections within the study area operate at a good level of service during the peak periods, except for the intersections of the Great Western highway/George Street and the Great Western Highway/William Street intersections.

According to the Bathurst Community Access and Cycling Plan 2011, in 2010 Bathurst had a total of approximately 73.3 kilometres of footpaths and 13.4 kilometres of cycleways. Footpaths in Bathurst Regional Council area are generally a 3.8m wide sealed path (Class 1) in the Bathurst CBD, and a 1.2m wide sealed path (Class 2) in the suburbs, villages, and low-traffic areas.

Currently bus services for Kelso are provided by Buslines, who operate three bus routes between Kelso and the Bathurst CBD.

### Proposed land use developments

The following land use scenarios will be assessed as part of the study as shown in the figure on the following page.

- Short term scenario - 2016
- Medium term scenario - 2025
- Long term scenario – 2035

Land use scenarios for short, medium and long term residential developments are proposed based on the Stage 1 and Stage 2 developments shown in the Draft Bathurst Regional Development Control Plan 2013 Map No 4. The figure on the following page shows the land use scenarios that will be adopted for the modelling exercise.

**Proposed residential land areas for short, medium and long term scenarios**

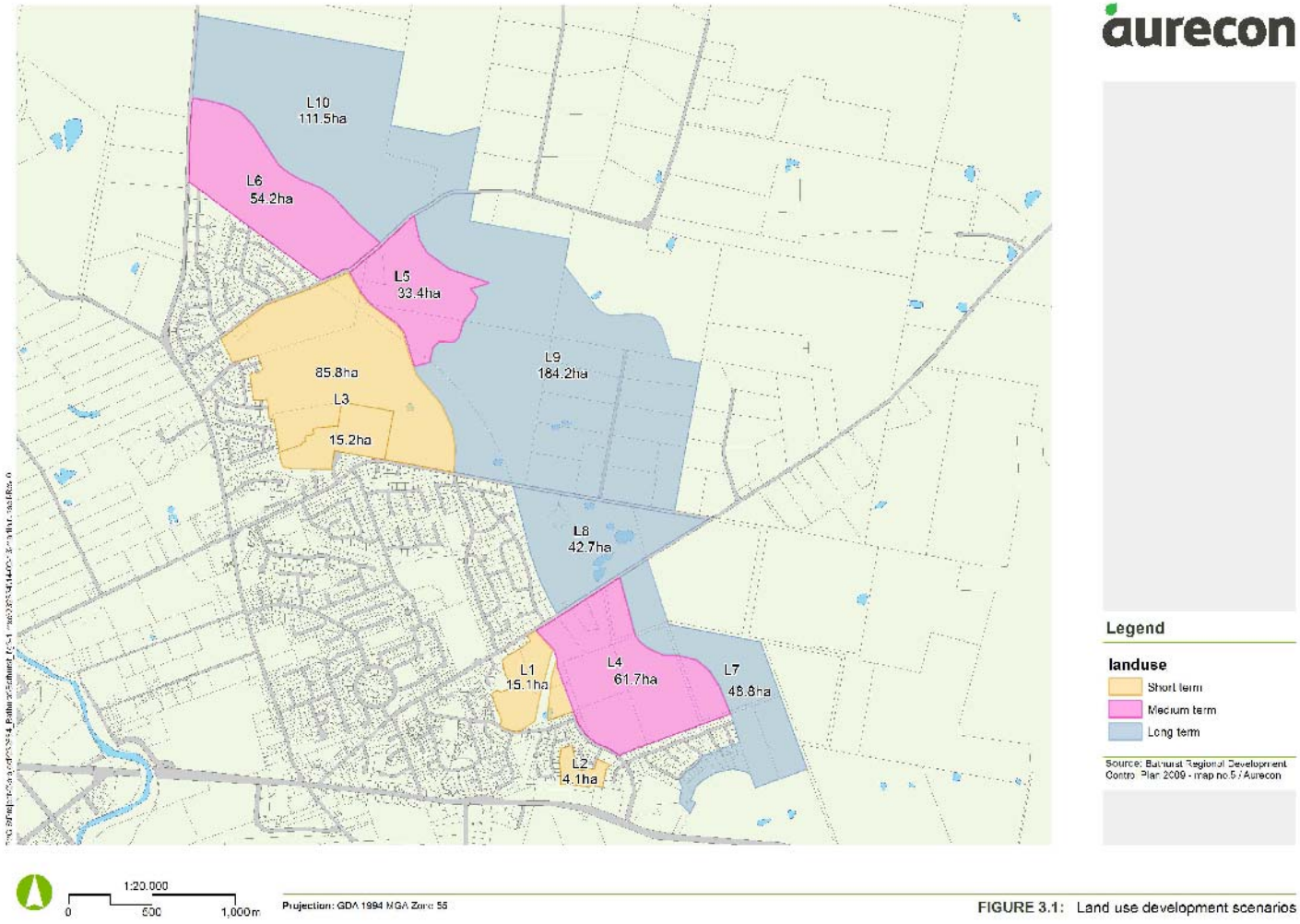



FIGURE 3.1: Land use development scenarios

The details of the proposed residential developments are provided in the following table. It is estimated that 1ha of developable land would be able to accommodate 7.5 dwellings, based on the *Bathurst Region Urban Strategy* prepared by Bathurst Regional Council.

**Details of proposed land use developments**

| Land use development | Number of dwellings | Peak hour traffic generation (veh/h) | Daily traffic generation (veh/day) |
|---|---|---|---|
| **Short term scenario – 2016** | | | |
| L1 | 113 | 96 | 1,019 |
| L2 | 31 | 26 | 277 |
| L3 | 644 | 547 | 5,792 |
| **Total** | **788** | **669** | **7,088** |
| **Medium term scenario – 2025** | | | |
| L1, L2 & L3 | 788 | 669 | 7,088 |
| L4 | 463 | 393 | 4,165 |
| L5 | 251 | 213 | 2,255 |
| L6 | 404 | 344 | 3,642 |
| **Total** | **1,906** | **1,620** | **17,150** |
| **Long term scenario – 2035** | | | |
| L1, L2, L3, L4 L5 & L6 | 1,906 | 1,620 | 17,150 |
| L7 | 366 | 311 | 3,295 |
| L8 | 320 | 272 | 2,882 |
| L9 | 1,382 | 1,174 | 12,435 |
| L10 | 836 | 711 | 7,528 |
| **Total** | **4,810** | **4,088** | **43,290** |

A new retail development of potentially 7,000m$^2$ in size and a public school are proposed for the residents of the future Kelso development.

### Future collector/local road network and shared path network

The internal roads will be provided to service the proposed land use developments for short term, medium term and long term scenarios. The details of the roads that are proposed during each scenario are provided in **Figure 4.2** and provided below:

- Short term scenario (2016) – Roads A, B, C, and E
- Medium term scenario (2025) – Road D
- Long term scenario (2035) – Roads F, G, H, I, J and K

According to the NSW road classification administrative hierarchy, local roads consist of those not classified under the *Roads Act 1993*. Local roads are collector and local access roads which provide linkages to State and Regional Roads as well as within developed areas. For the purposes of discussion, roads A to H will be known as “local roads” and roads I to K as “collector roads”, as they will form the base network to which local streets will connect. This has been determined following discussion with BRC on the potential uses of the roads. Collector roads will provide a traffic lane and

sealed shoulder in each direction with no dwellings fronting the road. Local roads will provide a traffic lane and parking lane in each direction with dwellings fronting the road and access.

The alignment of the roads shown on the following page (and **Figure 4.2**) is conceptual only. It is recommended that the principle guiding the alignment of roads in the proposed new development area should be for a grid pattern, for local roads as much as possible. Circuitous streets and cul-de-sacs should be avoided, as these street patterns considerably reduce the ability of bus services (present or future) to efficiently serve the area, and can compromise route-directness or route-legibility for pedestrians and cyclists or motorists unfamiliar with the area. Where cul-de-sacs are necessary, safe pedestrian and cyclist 'cut-throughs' are recommended to improve permeability. 'Cut-throughs' are connections between the end of a cul-de-sac and the street beyond, to provide pedestrians and cyclists with a direct, connected route.

It is also recommended that shared paths of 2.5 m wide be provided on at least one side of collector roads and along proposed bus routes, with a standard footpath being provided on the other side of the collector road. This provision would serve the dual purpose of providing an effective pedestrian and cycle network through the new redevelopment area, as well as providing an accessible path of travel for residents to access the bus stops. The wider shared path provision would accommodate the increasing use of electric wheelchairs and mobility scooters by the population, and thereby minimise the need to widen paths in future.

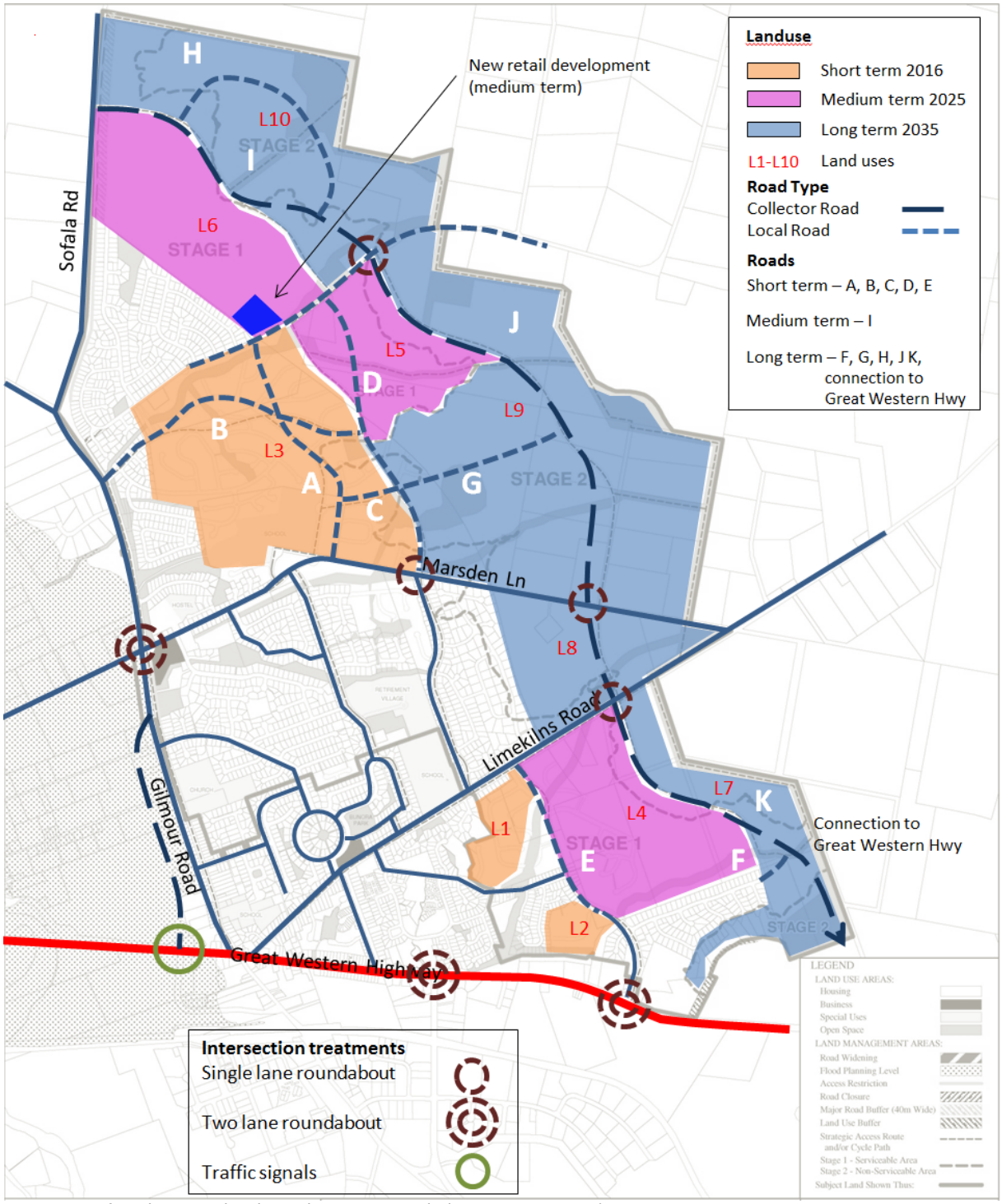
The alignment of roads in the next figure (and in **Figure 4.2**) also indicates the proposed readjustment of Gilmour Street, at Great Western Highway. At the time of preparing this report, it is worth noting that Roads and Maritime have started upgrading sections of the Great Western Highway at Kelso to four lanes, improving intersections and separating opposing traffic directions. The 2.4 km upgrade extends from just west of Stockland Drive to just east of Ashworth Drive. Currently, early works have started to install new traffic signals and a U-turn bay at Stockland Drive, upgrading kerbs at Gilmour Street, utility adjustments (communication cables) and road surfacing between Stockland Drive and Gilmour Street as advised on the Roads and Maritime Road Projects website[1].

The signalised intersections of Gilmour Street and Boyd Street with the Great Western Highway are located within close proximity to one another (approximately 100 m) and now with the addition of Stockland Drive. The concept of realigning Gilmour Street (to parallel east of Raglan Creek) so that its traffic signal is relocated with Stockland Drive would provide some distance between the Gilmour and Boyd Street intersections at Great Western Highway. This increased separation may assist in the networks efficiency when accommodating the KDA, particularly from a safety perspective in terms of reducing the potential overflow queuing impacts from the closely located intersections.

Gilmour Street is classified as a State Road, under the care and control of Roads and Maritime, so funding and approval for the realignment of Gilmour Street would require the appropriate consent and approvals process. The realignment of Gilmour Street would be subject to the appropriate environmental impact assessment process that addresses the statutory planning considerations. The scale and land use proposed for the KDA would be one key consideration that contributes to the feasibility/determination of realigning Gilmour Street, however there would be additional issues to consider such as socio-economic and other environmental issues which is beyond the scope of this study and should be explored in further detail at the appropriate stage.

[1] http://www.rms.nsw.gov.au/projects/western-nsw/kelso/index.html, December 2014

**Proposed road network within Kelso**




Source – Draft Bathurst Regional Development Control Plan 2013 Map No 4/Aurecon

Council has identified a good network of on-road cycle routes along most of the main collector roads through Kelso (Hereford Street/ Marsden Lane, Limekilns Road, Gilmour Street (MR54)/ Eleven Mile Drive) and some key local connector roads (Tadora Street, Ilumba Way, and Hughes Street). Shared paths are proposed along the, approximately, east-west running drainage corridors, linked to cycle routes; as well as a north-south path linking Marsden Lane and Laffing Waters Lane; and some short

cut-throughs off Gilmour Street (MR54). Footpaths are proposed along some key local connector streets.

Therefore, it will increasingly be important to plan for more extensive provision of footpaths to provide a basic level of access for all residents. In addition, footpath/ shared path provision could provide the opportunity for increased physical activity for all residents. It is understood that while the provision of footpaths on both sides of the road is not BRC's current practice, it is considered that they provide encouragement and opportunity for residents to consider alternative transport options such as walking, cycling or public transport.

The KDA is estimated to generate 43,290 vehicle movements daily and 4,088 movement during the morning and afternoon peak periods from 4,810 dwellings.

### Future intersection performance

The future performance of the key intersections in the study area has been assessed for the morning and afternoon peak periods using the PARAMICS output for the following:

- Baseline growth taking into consideration the existing residential zoned land. The model includes the proposed Eglinton Village expansion, proposed service business development located south of Great Western Highway, proposed upgrade along the Great Western Highway at Kelso by Roads and Maritime and the land use developments (L1-L3) assumed for short term scenario.
- With proposed developments for all land use scenarios in 2016, 2025 and 2035. The model includes the proposed Eglinton Village expansion, proposed service business development located south of Great Western Highway, proposed upgrade along the Great Western Highway at Kelso by Roads and Maritime and the land use developments for corresponding land use scenarios.

The results from the modelling without the Kelso development identified that the following works would be required by 2035 to accommodate the background traffic growth and the already planned developments:

- Provision of dual left turns from Durham Street (South) to Stewart Street at the Durham Street/Stewart Street intersection.
- Traffic signals at the Great Western Highway/Rankin Street intersection.
- Proposed upgrade along the Great Western Highway by Roads and Maritime.
- Provision of two (2) approach lanes on the George Street (east) approach at the Great Western Highway/George Street intersection with the removal of parking during the morning and afternoon peak periods.

The above road network improvements included in the model would have the potential to provide Level of Service (LOS) 'C' or better at all key intersections except the Great Western Highway/Littlebourne Street (MR253) intersection. The performance of the Great Western Highway/Littlebourne Street (MR253) intersection is predicted to be unsatisfactory (LOS 'F') during the afternoon peak period.

The future performance of the key intersections in the study area for the morning and afternoon peak periods has been assessed using the PARAMICS output for the long term scenario - 2035. The model included the following items, compared to the base case:

- Future land use developments proposed for the long term scenario
- Signalise Great Western Highway (Durham Street)/Rankin Street intersection
- Proposed upgrade along the Great Western Highway by Roads and Maritime
- Provision of 1-lane circulating roundabout at the Marsden Lane/Hughes Street intersection
- Provision of 1-lane circulating roundabout at the Marsden Lane/New Link A intersection

- Upgrading from 1-lane circulating roundabout to 2-lane circulating roundabout at the Gilmour Street (MR54)/Hereford Street/Marsden Lane and Hereford Street/Stanley Street intersections
- Widening of Hereford Street from Gilmour Street (MR54) to Stanley Street from 2 lanes to 4 lanes including widening of the bridge over the Macquarie River
- Widening of George Street from Stanley Street to the Great Western Highway (Durham Street) to provide three (3) travel lanes in both directions.
- Provision of four (4) approach lanes including a short right lane on George Street (east) at the Great Western Highway/George Street intersection.
- Traffic signal adjustments at the Great Western Highway (Durham Street)/George Street intersection
- Line marking and civil works along George Street to provide four (4) approach lanes (including short right turn lane) and two (2) departure lanes.
- Provision of dual left turns from Durham Street (South) to Stewart Street at the Durham Street/Stewart Street intersection.
- Provision of two (2) lane approach (50m) with modification to the existing parking arrangements on Rankin Street (west).

The performance of the intersections is expected to be satisfactory (LOS 'D' or better) with the above road network improvements, except the performance of the Boyd Street, George Street, Stewart Street intersections with the Great Western Highway.The modelling also suggests that, should Gilmour Street be realigned with Stockland Drive at the Great Western Highway, the intersection would operate near capacity during the long term scenario (2035). This may be largely due to the dominant flows along Great Western Highway where Gilmour Street receives less priority, as the predicted traffic volumes for the Gilmour Street approach range between 5 – 6% of the total traffic volume through the intersection.

### Draft Section 94 contributions

A Draft Section 94 Contribution Plan will be prepared by BRC based on the Section 94 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).The costs per lot by catchment area are provided in the table below to assist BRC in developing the contribution plan. Detailed breakdown of the contribution per lot is provided in the relevant section of this report. It should be noted that these amounts are to be taken as indicative relative amounts, due to the following developing issues:

- ***Hereford Street Bridge*** – This report recommends the duplication of the low level bridge on Hereford Street (over the Macquarie River) to meet the aims of this traffic study, and this cost has been included in the infrastructure cost estimates. However, Bathurst Regional Council is considering the feasibility of also raising the level of the Hereford Street Bridge to accommodate flood events. Roads and Maritime suggest that if raised, the bridge height should be increased to above the level of a 1:20 flood event (as a minimum), to avoid losing this crucial road link (Hereford Road) and thereby potentially causing significant traffic congestion on the Great Western Highway (which is the only other alternative river crossing route in Bathurst). Council recognise that it is its responsibility to undertake further investigations as to the proposed design and works required to raise the bridge and its approaches to accommodate the flood event required, and to estimate the cost of the works required.
- ***State Government funding*** – The State Government, through a form of special infrastructure contribution (SIC) agreement, is also likely to contribute funds towards traffic and transport infrastructure works associated with growth resulting from the Kelso Development area (KDA) and general traffic/ transport growth in Bathurst city. However, the final scope of works and funding amount to be supported, and timeframe for the works, are currently being discussed so while this report assumes some State Government funding contribution, the assumptions are subject to change.

**Indicative Relative s94 contribution per lot by catchment areas**

| KDA Catchment area | Relative s94 contribution per lot |
|---|---|
| **Residential contribution** | |
| L1 | $4,665 |
| L2 | $4,665 |
| L3 | $6,795 |
| L4 | $3,953 |
| L5 | $11,506 |
| L6 | $5,561 |
| L7 | $3,953 |
| L8 | $3,377 |
| L9 | $3,071 |
| L10 | $5,561 |
| **Retail area contribution** | |
| Retail | $456,763* |

Note: * Total contribution for retail area

# 1. Introduction

## 1.1 Background to the study

Aurecon Australia was engaged by Bathurst Regional Council to prepare a traffic access study for the future developments in the Kelso area, located to the east of the Bathurst Town Centre and north of the Great Western Highway. Based on the Bathurst Urban Strategy (2007), the following residential growth options have been developed by Bathurst Regional Council to accommodate the population growth in Bathurst:

- Eglinton Village Expansion for population of 1,500 – rezoning of land is based on the Eglinton Village Expansion, which has been gazetted.
- Development east of Bathurst (Kelso) for a population of 10,000
- Development north of Bathurst for a population of 8,750
- Development west of Bathurst for a population of 9,000
- Perthville Expansion for a population of 1,150
- Development at Morrisett Street for a population of 75

This report has been prepared as part of a traffic and transport assessment for the proposed Development east of Bathurst at Kelso to assess the required infrastructure upgrades to accommodate the traffic generated from over 4,800 dwellings proposed for the development at Kelso.

It is proposed that, over a 30 year time frame, 4,810 new dwellings would be constructed increasing the population by approximately 10,000 people at Kelso. Associated with this increase in population is a need for school facilities, community centre, employment opportunities, recreational facilities and, of course, an efficient transport system to link these activities at Kelso, and Bathurst. The majority of the traffic generated from these developments will need to use the Great Western Highway to access workplaces, shops along the highway at Kelso and Bathurst CBD. The identified developments at Kelso would have the potential to increase the traffic and parking demand at Kelso as well as Bathurst CBD.

The assessment of the potential traffic and transport requirements for these future developments needs to be modelled to identify potential traffic management and other measures to facilitate traffic, cycling, pedestrian and public transport access. In this regard, it is considered that the development of a micro-simulation model is required to assess these measures and provide council with the opportunity to test various scenarios. This is proposed to be undertaken using Paramics, to develop the future scenarios and identify potential management measures and facilities required.

Roads and Maritime is currently undertaking a detailed design for the section of the Great Western Highway section at Kelso and the traffic assessment undertaken for this project included some of the future land use developments. However, the Roads and Maritime traffic model does not include the proposed development east of Bathurst (Kelso). Therefore, the traffic study is required to assess the necessary transport infrastructure upgrades in addition to the proposed Roads and Maritime infrastructure upgrades along the Great Western Highway. Funding arrangements between Roads and Maritime and Council for infrastructure upgrades and a section 94 contribution plan need to be prepared for the proposed development as part of this traffic study.

## 1.2 Study objectives

Based on Council's brief, the objectives of the study are to:

- Evaluate the current constraints and performance of the network and assessing the latent capacity. While the Study is to be principally concerned with vehicular traffic, the evaluation is also to include cyclist, pedestrian and public transport needs.
- Assess the impact of planned (approved) and future potential development on the existing network and the level of impact attributable to each potential dwelling.
- Provide a concept plan, with an indicative road hierarchy, for the Kelso area to cater for future urban expansion.
- Determine key network infrastructure requirements for vehicles, cyclists, pedestrians and public transport based on predicted growth.
- Assess the actual impacts of nominated recent developments in Kelso, in conjunction with the expected impacts of future expansion.
- Detail trigger points for network improvements to be carried out to accommodate the urban expansion, and providing an infrastructure staging plan.
- Recommend a means of developer contributions to the road infrastructure required to accommodate the urban development.
- Subject to the recommendations made in accordance with the above point, prepare indicative cost estimates for input and guidance to BRC Draft Section 94 Contributions Plan, including a comprehensive schedule of works and estimated costs.
- Clearly establish the roles and responsibilities of Bathurst Regional Council and the Roads and Maritime Services to program, fund and undertake works.

## 1.3 Study methodology

The following general study methodology has been adopted to examine the traffic and transport issues associated with the Kelso development:

- Analysis of existing traffic and transport conditions (Section 2)
  - This section of the study describes the existing road network and provides an analysis of historical traffic growth along the highway. Details of existing traffic volumes along the road located within the study area including heavy vehicle movements and through traffic are provided based on traffic surveys carried out in October 2012. Based on the traffic information and the Roads and Maritime Services road classification guidelines, the existing road hierarchy is identified. An assessment of the existing performance (levels of service) of the midblock sections and intersections is included and existing travel times are discussed. The results of an analysis of the historical crash data for the study area are also presented and details are provided in relation to the existing public transport, pedestrian and cyclist movements within the study area.
- Proposed land use developments and infrastructure upgrades (Section 3)
  - The details of the proposed land use developments relevant to this traffic study are provided in this section, followed by the development of the recommended infrastructure provision for the short-, medium-, and long-term development stages of the Kelso development area.
- Proposed traffic and transport measures for Kelso Development area (Section 4)
  - This section outlines the principles for encouraging alternate methods of travel to the private car, including the provision of suitable pedestrian access and public transport services for the Kelso development area.
  - This section also includes principles for encouraging greater walking, cycling and bus use, and how they can be applied for the Kelso development area.

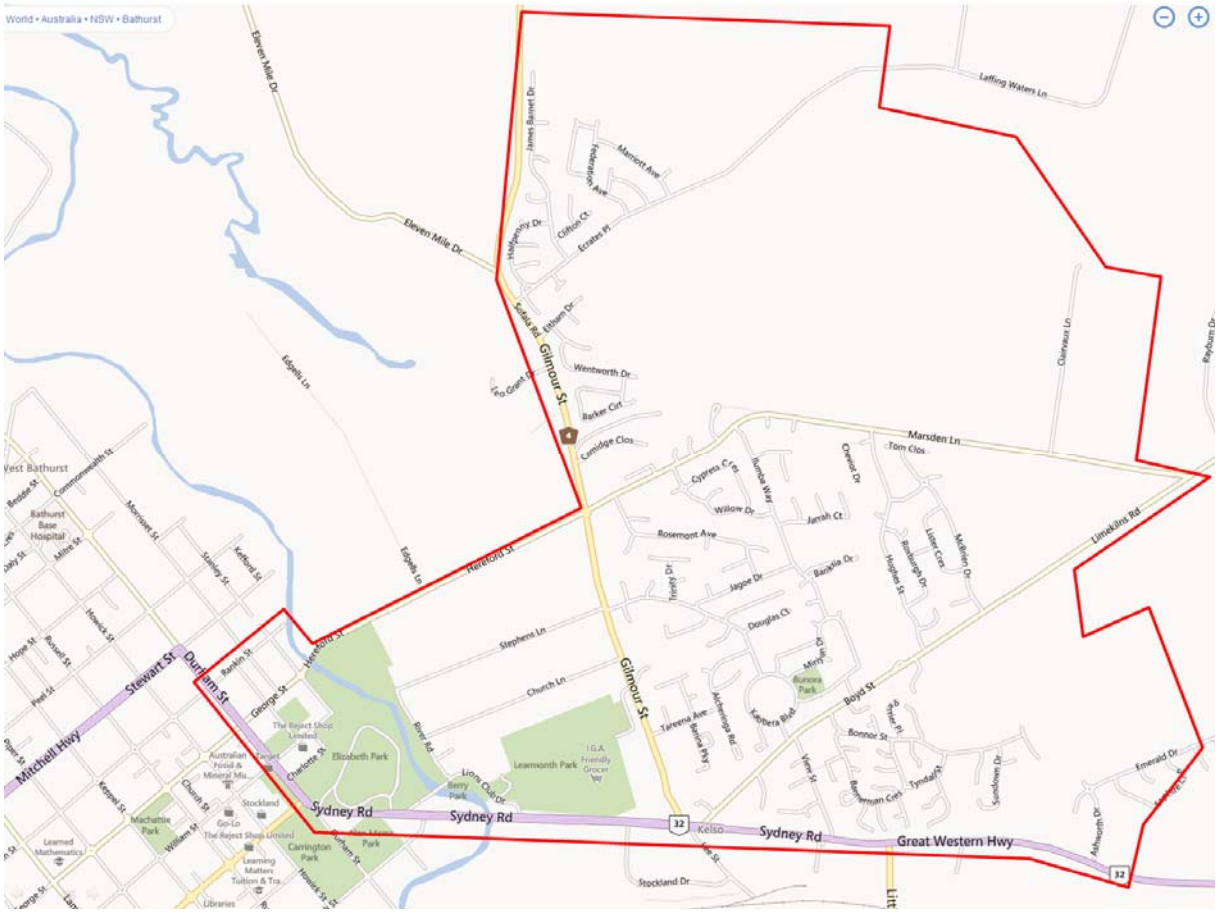
- Future traffic and transport conditions (Section 5)
  - This section provides details of the future land use developments proposed within and adjacent to the study area and provides an analysis of the associated traffic generation. Based on the future traffic information and the Roads and Maritime road classification guidelines, the future road hierarchy is identified. It outlines the methodology adopted for the prediction of future traffic volumes and provides the traffic forecasts along the roads located within the study area. An assessment of the future operational performance of the highway based on these forecasts is provided for short term, medium term and long term infrastructure and land use developments, and the future traffic and transport conditions are examined. Also included is an assessment of the future public transport, pedestrian, and cyclist conditions in the area.
- Costing of infrastructure upgrades (Section 6)
  - This section provides preliminary cost estimates based on either unit costs for upgrades provided by Bathurst Regional Council or similar projects undertaken by Aurecon using the Rawlinsons Australian Construction Handbook 2014.
- Funding responsibility (Section 7)
  - This section identifies the timing and indicative costs of the infrastructure upgrades. The section also provides the details of funding responsibilities for Bathurst Regional Council and Roads and Maritime Services based on the criteria agreed by both organisations.
- Input into Draft Section 94 Contribution Plan (Section 8)
  - The section provides the suggested portion of s94 contributions per lot resulting from the recommended traffic infrastructure.
- Summary and conclusions (Section 9)
  - Information from the preceding sections and the proposed facilities is summarised in this section.

# 2. Existing traffic and transport situation

## 2.1 Study area

**Figure 2.12.1** shows the study area which covers the Kelso area and part of the Bathurst area.

**Figure 2.1 Study Area**




Source: Bing map

## 2.2 Existing road network

### Roads

The details of the key roads that are located within and adjacent to the study area are provided below:

**Great Western Highway A32 (Sydney Road/Durham Street)** – The Great Western Highway is classified as a State Road and is under the care and control of Roads and Maritime Services. The Great Western Highway connects Sydney and the regional centres that are located in the Western NSW. In the study area the Great Western Highway varies from a four lane divided road west of Boyd Street to a two lane undivided road in the eastern section and carries approximately 27,600 vehicles movements daily at Macquarie River Bridge. The section of the Great Western Highway that is located within the study area, provides direct access to retail and commercial properties.

**Gilmour Street (MR54)** – Gilmour Street is classified as a State Road (MR54) and is under the care and control of Roads and Maritime Services. Gilmour Street connects Sofala and the Great Western Highway at Kelso. Gilmour Street is a two lane, two way road and carries approximately 5,100 vehicle

movements per day north of the Great Western Highway. Gilmour Street provides access to Trinity Heights shops and Kelso Public School.

**Littlebourne Street (MR 253)/O'Connell Road** – This road is classified as a State Road, is part of the MR253 and is maintained by Roads and Maritime Services. Littlebourne Street/O'Connell Road connects Kelso and Oberon. This road is a two lane, two way road and carries approximately 10,000 vehicle movements per day south of the Great Western Highway. This road also provides access to the service business area located south of the highway.

**Boyd Street/Limekilns Road** – Boyd Street/Limekilns Road is a Collector Road and is under the care and control of Bathurst Regional Council. This road connects Kelso and Wattle Flat (via Limekilns Road). This section of the road is a two lane, two way section and carries approximately 5,000 vehicle movements daily north of the Great Western Highway. This road provides access to Kelso Shops and Kelso High School campus. It is constructed to an urban standard between the highway and McBrien Drive with the eastern section constructed as a two lane rural standard road with gravel shoulders.

**Marsden Lane** – Marsden Lane is a Collector Road and is maintained by Bathurst Regional Council. This road connects Gilmour Street (MR54) and Limekilns Road/Boyd Street. Marsden Lane is a two lane, two way road and carries approximately 7,000 vehicle movements daily east of Gilmour Street (MR54). Marsden Lane provides access to Trinity Heights Shops and Holy Family Primary School. The section between Gilmour Street (MR54) and Billabong Close is constructed as an urban standard road with a traffic lane in each direction and parking lane with kerb and gutter on both sides of the road. The kerb and gutter continues on the southern side of the road to Hughes Street. East of Hughes Street it is constructed as a two lane rural standard road with narrow shoulders.

**Halfpenny Drive/Ecrates Place/Laffing Waters Lane** – Halfpenny Drive/Ecrates Place/Laffing Waters Lane is classified as a local road and is under the care and control of Bathurst Regional Council. The road operates as a collector road providing access for the residential development at the northern end of Kelso to Gilmour Street (MR54). The western section of the road (Halfpenny Drive/Ecrates Place) is generally constructed as an urban standard road with a two lane undivided pavement with parking on both sides between Gilmour Street (MR54) and James Barnet Drive, with kerb and gutter on the northern side only and an unsealed shoulder between James Barnet Drive and just east of Marriott Avenue. The section east of this is generally constructed as a two lane rural road with unsealed shoulders. The section of road near Gilmour Street (MR54) carries approximately 2,500 vehicles per day.

**Hereford Street** – Hereford Street is a Collector Road and provides alternative access between Kelso and the Bathurst Town Centre. The road is a two lane undivided road with kerb provided on the southern side and bicycle lanes marked in both directions. It is maintained by Bathurst Regional Council and a low level bridge is located on this road where it crosses the Macquarie River and connects to George Street. Hereford Street carries approximately 12,000 vehicles per day west of Gilmour Street (MR54).

### Intersections

The following key intersections are located within the study area.

- Great Western Highway/Ashworth Drive
- Great Western Highway/Littlebourne Street (MR253)
- Great Western Highway/View Street
- Great Western Highway/Boyd Street
- Great Western Highway/Gilmour Street (MR54)
- Great Western Highway/Havannah Street
- Great Western Highway/Bentinck Street

- Great Western Highway/William Street
- Great Western Highway/George Street
- Great Western Highway/Rankin Street
- Sofala Road/Eleven Mile Drive
- Gilmore Street/Halfpenny Drive
- Gilmore Street/Marsden Lane
- Gilmore Street/Tandora Street
- Gilmore Street/Tareena Avenue
- Hereford Street/Stanley Street/George Street
- Marsden Lane/Ilumba Way
- Marsden Lane/Hughes Street
- Marsden Lane/Limekilns Road
- Limekilns Road/Allambie Boulevard
- Boyd Street/Bonnor Street
- Limekilns Road/Morang Avenue
- Limekilns Road/Hughes Street

All movements are currently allowed at the above intersections except for the Great Western Highway/Boyd Street intersection. Right turning movements from the Great Western Highway onto Boyd Street are banned at the intersection. Traffic wishing to access the Boyd Street precinct can access it via either Ashworth Drive or View Street.

### Existing road hierarchy

Under the Roads Act 1993, roads are classified under a legal framework which divides them into three administrative categories. The categories include freeways, primary arterial roads, secondary or sub-arterial roads, Collector and local access roads. The NSW State, Regional and Local Road administrative system of road classification generally aligns to the following model hierarchy:

- State Roads – Freeways and primary arterials
- Regional Roads – Secondary or sub-arterials
- Local Roads – Collector and local access roads

State Roads are defined as the primary network of roads providing links within urban centres of Sydney, Newcastle, Wollongong, the Central Coast, and throughout NSW. State Roads generally include roads classified as Freeways, National/State Highways (SH) and Main Roads (MR) under the Roads Act. State Roads are the responsibility of the NSW Roads and Maritime Services (formerly Roads and Traffic Authority, RTA) however the local governing council remains the owner, providing maintenance for State Roads other than Freeways. Roads and Maritime only exercises authority for the function of the road as a State Road (such as road pavement and structures).

Regional Roads (RR) are defined as the secondary road network which, together with State Roads, provide for travel between towns and districts, performing a sub-arterial function within major urban centres. Regional Roads are the responsibility of the local governing council and generally include roads classified as Secondary Roads, and some Main Roads.

Local Roads consist of those roads not classified under the Roads Act. Local Roads are collector and local access roads which provide linkages to State and Regional Roads as well as within developed areas. Local Roads are the responsibility of the local governing authority.

The following roads that are classified as State Roads are located within and immediately adjacent to the study area:

- Great Western Highway (A32)
- Gilmour Street/Sofala Road (MR54)

- Littlebourne Street/ O'Connell Road (MR253)

No Regional Roads are provided within the study area. All other roads are located within the study area are Local Roads (Collector and local access roads).

## 2.3 Existing land uses

The land uses located within the study area are mainly residential, with rural land uses on the eastern and northern boundaries. A review of the information published in the Bathurst Regional Council website, based on the 2011 census, indicates that the population of Kelso was approximately 7,667 in 2011, living in approximately 2,930 dwellings with an average house hold size of 2.6.

The following traffic generating developments are currently available to serve Kelso population:

- Kelso Public School
- Kelso High Campus
- Trinity Heights Primary School
- Trinity Heights Shopping Centre at the corner of Marsden Lane and Gilmour Street (MR54)
- Kelso Centrepoint Shopping Centre on Boyd Road
- Shops along Great Western Highway

## 2.4 Travel pattern and transport modes

### Journey to work

A review of journey to work data was carried out to undertake an analysis on current employment/residential locations of the BRC workers/residents. **Table 2.1** shows journey to work data obtained from the Census Statistics-2011 for Bathurst Regional Council.

**Table 2.1 Journey to work statistics**

| | Employment location of BRC residents | | Residential location of BRC workers | |
|---|---|---|---|---|
| | Number | % | Number | % |
| Live and work in the area | 13,598 | 77.6 | 13,598 | 89.3 |
| Work in the area, but live outside | - | - | 1,626 | 10.7 |
| Live in the area, but work outside | 2,090 | 11.9 | - | - |
| Work location unknown | 1,840 | 10.5 | - | - |
| Total employed residents/workers | 17,528 | 100 | 15,224 | 100 |

Source – ABS Census statistics, 2011

From **Table 2.1**, the majority of the residents (78%) of BRC area live and work within the Council area and majority of workers (89%) of BRC area reside in the Council area. Approximately 12% of BRC residents work outside the Council area. Residents working outside the BRC area travel to Orange (542 – 3.1%), Lithgow/Blue Mountains (420 – 2.4%), Oberon (294 – 1.7%), Blayney (215 - 0.6%), Cabonne (104 – 0.6%), other regional towns (183 – 1.0%) and Sydney (30 - 0.2%).

Approximately 11% of BRC area workers live outside the Council area. Workers living outside the BRC area travel from Oberon (344 – 2.3%), Lithgow/Blue Mountains (328 – 2.1%), Blayney (262 - 1.7%), Orange (230 – 1.5%), Cabonne (49 – 0.3%), other regional towns (68 – 0.4%).

Assuming that the current journey to work pattern will continue, the majority of the residents of the future developments within the KDA are expected to work within the BRC area. The majority of the workers of any new employment developments proposed within KDA are expected to live in the BRC area.

### Mode of travel

As part of the assessment of the travel patterns of the existing Kelso and Bathurst Regional Council area, an analysis of the mode of travel was carried out. **Table 2.2** shows the mode of travel to work data for the Kelso area and the Bathurst Regional Council obtained from the Census Statistics - 2011.

**Table 2.2** **Mode of travel**

| Mode of travel | Kelso area | | BRC area |
|---|---|---|---|
| | Number | % | % |
| Car - as driver | 2,458 | 73.4 | 67.3 |
| Car - as passenger | 235 | 7.0 | 6.4 |
| Truck | 53 | 1.6 | 1.4 |
| Motorbike | 16 | 0.5 | 0.5 |
| Bus | 3 | 0.1 | 0.5 |
| Train | 0 | 0.0 | 0.1 |
| Taxi | 0 | 0.0 | 0.3 |
| Bicycle | 8 | 0.2 | 0.6 |
| Walked only | 88 | 2.6 | 4.7 |
| Worked at home | 85 | 2.5 | 4.3 |
| Did not go to work | 312 | 9.3 | 11.2 |
| Other | 42 | 1.3 | 1.0 |
| Not stated | 44 | 1.3 | 1.5 |
| **Total** | **3,348** | **100** | **100** |

Source – ABS Census statistics, 2011

From Table 2.2, the primary mode of transport for Kelso and Bathurst Regional Council residents is private vehicles (approximately 83% and 76% respectively) and the public transport usage is minimal (0.1%-0.6%) within the Kelso area as well as in the Bathurst Regional Council area. 2.8% of residents use active transport modes (bicycle/walking) to travel to work in the Kelso area compared to 5.3% in the BRC area. A significant number of residents either worked at home or did not go to work on the Census day.

Based on the current mode of travel pattern, the majority of the residents of the future developments proposed in the KDA are expected to travel using private cars. The usage of public transport and other forms of transport by the residents of the KDA is expected to be minimal. However, this report will support Council's aim to encourage increased walking, cycling and public transport use (new/ amended bus routes into the KDA, and future expanded services) as a way of reducing current and future traffic congestion.

## 2.5 Historical traffic volumes and growth rates

Roads and Maritime collects and publishes traffic volume data at various count station sites located throughout NSW. As the general governing road authority, Roads and Maritime is known to collect traffic data at various sites for certain survey years (Western Region's survey years are 1992, 1996, 1999, 2002 & 2005). The collection of traffic data assists Roads and Maritime with understanding any changing traffic volume trends on the road network.

### Traffic volumes along the Great Western Highway

**Table 2.3** shows the historical annual average daily traffic volumes at Roads and Maritime count sites along the Great Western Highway adjacent to the study area, based on the Roads and Maritime *Traffic Volume Data for Western Region* publication. Note that all values are reported in axle pairs; the actual volume of vehicles is estimated to be approximately 10%-20% lower (depending on the location) due to a proportion of the vehicles recorded having more than 2 axles.

**Table 2.3 Annual average daily traffic volumes – Great Western Highway (axle pairs)**

| Station Number | Location along Great Western Highway | Annual Average Daily Traffic Volume (AADT) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 1992 | 1996 | 1999 | 2002 | 2005 | 2008 | 2011 |
| 99.887 | Bathurst – East of Littlebourne Street (MR253) | 12,901 | 14,479 | 15,034 | 14,805 | 14,955 | 17,291 | 18,282 |
| 99.709 | Bathurst – East of Boyd Street | 14,024 | 19,491 | 18,801 | 19,713 | 20,422 | 22,340 | 23,609 |
| 99.337 | Bathurst – West of Gilmour St (MR54) | 18,965 | 26,881 | 27,891 | 22,242 | 24,378 | 27,690 | 29,013 |

Source – Roads and Maritime Traffic Volume Data for Western Region, 2005

From **Table 2.3** it is evident that the traffic volumes along the highway, west of Gilmour Street (MR54), increased from 1992 to 1999 and from 2002 to 2011 although they decreased substantially between 1999 and 2002 (approximately 20%). Traffic volumes increased from 1992 to 1996 and from 2005 to 2011 on the Great Western Highway, east of Boyd Street, although, no significant increase in traffic volumes occurred between 1996 and 2005 on the highway east of Boyd Street.

### Traffic growth along the Great Western Highway

**Table 2.4** shows the historical traffic growth in axle pairs for the long-term (1992-2005) and short term (2002-2005) scenarios at points within and adjacent to the study area, calculated from the Roads and Maritime traffic volume data provided in Table 2.3.

**Table 2.4 Historical traffic growth**

| Station Number | Location along Great Western Highway | Traffic Growth (in axle pairs) per annum (axle prs/day/year) | |
|---|---|---|---|
| | | Long term (1992-2011) | Short term (2002-2011) |
| 99.887 | Bathurst – East of Littlebourne Street (MR253) | 283 | 386 |
| 99.709 | Bathurst – East of Boyd Street | 504 | 433 |
| 99.337 | Bathurst – West of Gilmour St (MR54) | 529 | 752 |

*Note – growth between 1992 and 1999

From **Table 2.4**, it is evident that traffic growth along the highway has been higher at locations closer to Bathurst compared to east of Littlebourne Street (MR253). The Great Western Highway, west of Gilmour Street (MR54) includes a significant amount of local traffic in addition to the through traffic at this location, while the traffic volume east of Littlebourne Street (MR253) primarily comprises through traffic. The difference in growth reflects the impact of urban development on local traffic generation in the study area, with the growth in local traffic occurring at a faster rate than the growth in through traffic.

Based on the long term traffic growth on the Great Western Highway east of Littlebourne Street (MR253), traffic grows 283 axle pairs/day/year which equates to 252 veh/day/year after applying the axle pair correction factor of 0.89, based on the AADT information published in the Roads and Maritime website.

### Traffic volumes along other roads

**Table 2.5** shows the historical annual average daily traffic volumes at Roads and Maritime count sites along the roads (other than Great Western Highway) located within and adjacent to the study area, based on the Roads and Maritime *Traffic Volume Data for Western Region* publication. Note that all values are reported in axle pairs; the actual volume of vehicles is estimated to be approximately 5%-10% lower (depending on the location) due to a proportion of the vehicles recorded having more than 2 axles.

**Table 2.5 Annual average daily traffic volumes – other roads (axle pairs)**

| Station Number | Location | Annual Average Daily Traffic Volume (AADT) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 1992 | 1996 | 1999 | 2002 | 2005 | 2008 | 2011 |
| 97.712 | Bathurst – Gilmour St, North of Sydney Rd | 3,543 | 4,908 | | 4,311 | 4,877 | 6,137 | 6,524 |
| 99.310 | Bathurst – Lee St, South of Sydney Road | 143 | 6,445 | 569 | 878 | 343 | | |
| 99.925 | Bathurst – Littlebourne St (MR253), South of Lee St | | 2,424 | | 2,750 | 9,039 | 5,481 | 5,984 |

Source – Roads and Maritime Traffic Volume Data for Western Region, 2005

From **Table 2.5**, no particular pattern is observed in relation to the increase/decrease in traffic volumes along Gilmour Street (MR54), Lee Street and Littlebourne Street (MR253). Overall, Gilmour Street (MR54) traffic increased by 2,981 axle pairs/day over a 19 year period (approximately 157 axle pairs/day/year). This reflects the residential development that has occurred in the Kelso area over this period. There was a significant increase in traffic volumes on Littlebourne Street (MR253) from 2002 to 2005.

## 2.6 Existing traffic volumes at midblock locations

The existing traffic volumes are reported in this section based on the results of the traffic surveys. The results of the traffic surveys are attached in Appendix A.

### Daily traffic volumes

**Table 2.6** shows the existing (2012) annual average daily traffic volumes (vehicles/day) within the study area. These volumes were derived from vehicle classification surveys that were conducted at selected locations for a one week period during October and November 2012.

Table 2.6 Existing Annual Average Daily Traffic Volumes (2012)

| Location | Annual Average Daily Traffic Volume – AADT (veh/day) |
|---|---|
| Great Western Highway at Macquarie River Bridge | 27,613 |
| Great Western Highway - East of Littlebourne Street (MR253) | 15,325 |
| Hereford Street – West of Edgells Lane | 11,219 |
| Gilmour Street (MR54) – North of Great Western Highway | 5,089 |
| Boyd Street – North of Great Western Highway | 4,714 |

## Peak hour traffic volumes

**Table 2.7** shows the existing (2012) peak hour traffic volumes along the highway. These volumes were derived from the intersection surveys undertaken on Wednesday 10 October 2012.

Table 2.7 Existing Peak Hour Traffic Volumes (2012)

| Location | Direction | Peak hour traffic volumes (veh/h) | | | |
|---|---|---|---|---|---|
| | | AM peak | | PM peak | |
| **Great Western Highway** | | | | | |
| Great Western Highway – East of Littebourne Street | EB | 433 | 1,108 | 638 | 1,286 |
| | WB | 675 | | 648 | |
| Great Western Highway – West of Gilmour Street (MR54) | EB | 825 | 2,221 | 1,147 | 2,430 |
| | WB | 1,396 | | 1,283 | |
| Great Western Highway – West of Havannah Street | EB | 556 | 1,366 | 851 | 1,770 |
| | WB | 810 | | 919 | |
| Great Western Highway – West of George Street | EB | 702 | 1,411 | 757 | 1,745 |
| | WB | 709 | | 988 | |
| Great Western Highway – West of Rankine Street | EB | 1,047 | 1,741 | 923 | 2,034 |
| | WB | 694 | | 1,111 | |
| **Sofala Road/Gilmour Street (MR54)** | | | | | |
| Sofala Road – North of Eleven Mile Drive | NB | 68 | 163 | 95 | 150 |
| | SB | 95 | | 55 | |
| Gilmour Street (MR54) – North of Marsden Lane | NB | 215 | 710 | 469 | 768 |
| | SB | 495 | | 299 | |
| Gilmour Street (MR54) – South of Marsden Lane | NB | 285 | 632 | 343 | 647 |
| | SB | 347 | | 304 | |
| Gilmour Street (MR54) – North of Great Western Highway | NB | 175 | 482 | 266 | 494 |
| | SB | 307 | | 228 | |
| **Marsden Lane/Hereford Street** | | | | | |
| Marsden Lane – West of Limekilns Road | EB | 18 | 64 | 57 | 78 |

| Location | Direction | Peak hour traffic volumes (veh/h) | | | |
|---|---|---|---|---|---|
| | | AM peak | | PM peak | |
| | WB | 46 | | 21 | |
| Marsden Lane – East of Gilmour Street (MR54) | EB | 291 | 667 | 379 | 710 |
| | WB | 376 | | 331 | |
| Hereford Street – East of Stanley Street | EB | 381 | 1,161 | 697 | 1,215 |
| | WB | 780 | | 518 | |
| **Limekilns Road/Boyd Street** | | | | | |
| Limekilns Road – North of Marsden Lane | NB | 26 | 119 | 80 | 116 |
| | SB | 93 | | 36 | |
| Boyd Street – North of Great Western Highway | NB | 140 | 482 | 290 | 546 |
| | SB | 342 | | 256 | |
| **Littlebourne Street (MR253)** | | | | | |
| Littlebourne Street (MR253) – South of Great Western Highway | NB | 502 | 990 | 566 | 964 |
| | SB | 488 | | 398 | |

## 2.7 Origin-Destination (OD) survey

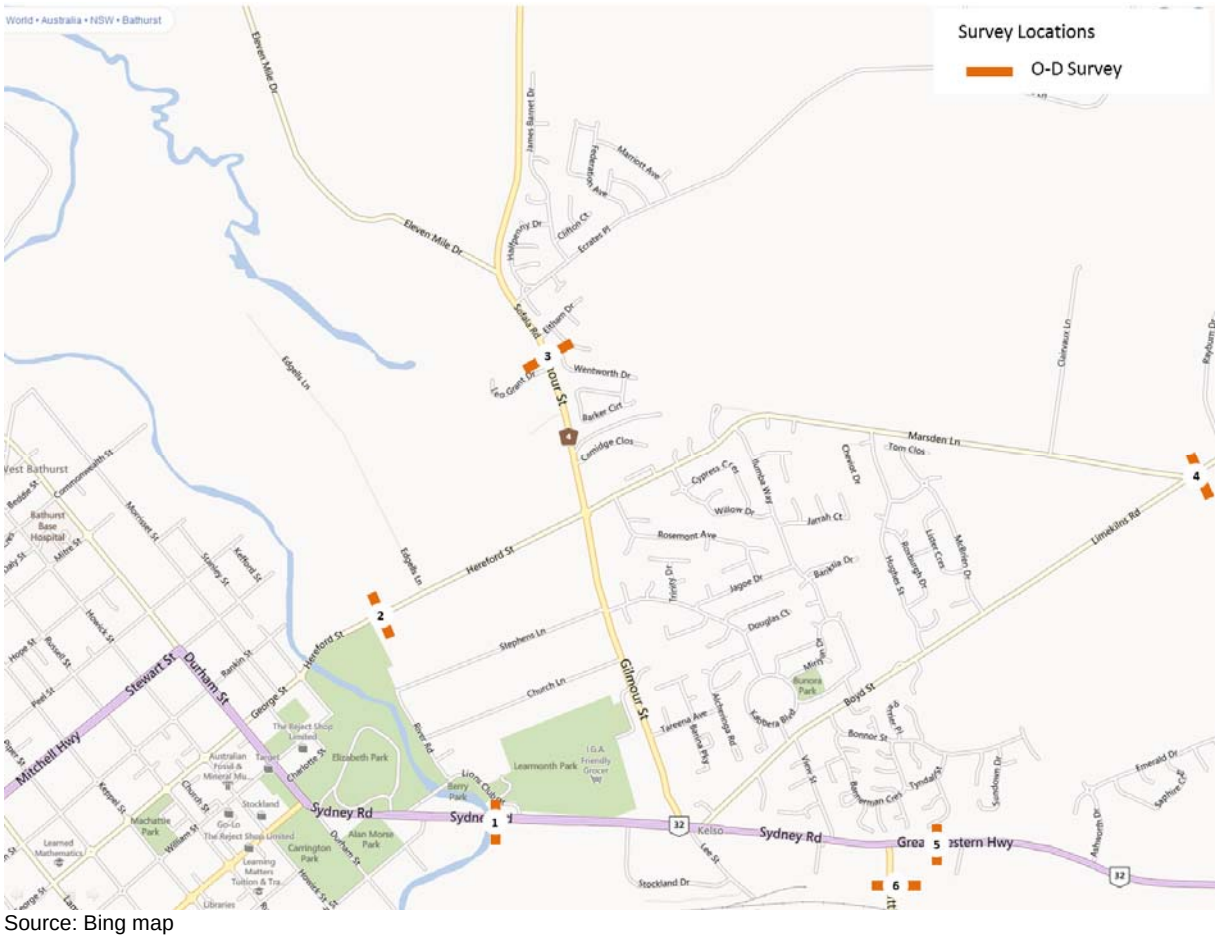
In order to gain an understanding of where traffic is travelling to and from through the study area at the present time, an OD survey was carried out through the observation of vehicles entering and leaving the study area.

The number plates of light vehicles (Austroads Classes 1-2) and all heavy vehicles (Austroads Classes 3-12) were recorded for each direction of travel as they passed each location (survey station), along with the time at which they were observed. The number plates recorded at each station were subsequently matched to determine the number of vehicles that passed both stations (i.e. 'through' vehicles in the context of trips along the study area) during specific time intervals (otherwise known as trip duration limits). The results were calculated for trip duration limits of 15 minutes and 30 minutes to be observed. The details of the survey locations are provided below:

- Survey location 1 – Great Western Hwy at Macquarie River Bridge
- Survey location 2 – Hereford St – East of Macquarie River
- Survey location 3 – Gilmour St (MR54) – South of Eltham Drive
- Survey location 4 – Limekilns Road – East of Marsden Lane
- Survey location 5 – Great Western Hwy – East of Littlebourne Street (MR253)
- Survey location 6 - Littlebourne St (MR253) – South of Great Western Hwy

The details of the OD locations are shown in Figure 2.2.

**Figure 2.2** **OD survey locations**




Source: Bing map

The results of the OD surveys are shown in **Table 2.8** and **Table 2.9** for the morning and afternoon peak periods.

**Table 2.8** **Results of Origin Destination surveys - Morning peak period - 8.30am-9.30am**

| | | Destination | | | | | | Total traffic at survey locations | Trips with an origin/ destination in Kelso within the study area |
|---|---|---|---|---|---|---|---|---|---|
| | | 1WB | 2WB | 3NB | 4NB | 5EB | 6SB | | |
| Origin | 1EB | 0 | 11 | 23 | 6 | 297 | 227 | 885 | 321 |
| | 2EB | 23 | 0 | 59 | 6 | 14 | 6 | 381 | 273 |
| | 3SB | 46 | 220 | 0 | 1 | 17 | 52 | 469 | 133 |
| | 4SB | 38 | 31 | 6 | 0 | 2 | 11 | 93 | 5 |
| | 5WB | 478 | 12 | 12 | 1 | 0 | 68 | 675 | 104 |
| | 6NB | 334 | 12 | 12 | 3 | 40 | 0 | 502 | 100 |
| Total traffic at survey locations | | 1,377 | 780 | 215 | 26 | 433 | 488 | | |
| Trips with an origin/destination in Kelso within the study area | | 457 | 495 | 103 | 8 | 63 | 124 | | |

Table 2.9 Results of Origin Destination surveys - Afternoon peak period - 3.30pm-4.30pm

| | | Destination | | | | | | Total traffic at survey locations | Trips with an origin/ destination in Kelso within the study area |
|---|---|---|---|---|---|---|---|---|---|
| | | 1WB | 2WB | 3NB | 4NB | 5EB | 6SB | | |
| Origin | 1EB | 0 | 33 | 44 | 12 | 441 | 223 | 1,224 | 471 |
| | 2EB | 22 | 0 | 206 | 33 | 23 | 20 | 697 | 394 |
| | 3SB | 34 | 108 | 0 | 5 | 18 | 14 | 299 | 119 |
| | 4SB | 9 | 15 | 1 | 0 | 4 | 3 | 38 | 6 |
| | 5WB | 457 | 22 | 41 | 1 | 0 | 63 | 648 | 65 |
| | 6NB | 380 | 17 | 33 | 10 | 44 | 0 | 566 | 82 |
| Total traffic at survey locations | | 1,323 | 518 | 495 | 80 | 638 | 398 | | |
| Trips with an origin/destination in Kelso within the study area | | 420 | 334 | 191 | 28 | 131 | 59 | | |

Note - Survey location 1 – Great Western Hwy at Macquarie River Bridge
Survey location 2 – Hereford St – East of Macquarie River
Survey location 3 – Gilmour St (MR54) – South of Eltham Drive
Survey location 4 – Limekilns Road – East of Marsden Lane
Survey location 5 – Great Western Hwy – East of Littlebourne Street (MR253)
Survey location 6 - Littlebourne St (MR253) – South of Great Western Hwy

## 2.8 Existing trip patterns and trip distributions

### Existing trip pattern along the Great Western Highway

Based on the results of the origin destination surveys, the details of current trip distributions along the Great Western Highway are provided in **Table 2.10**.

Table 2.10 Trips pattern along the Great Western Highway.

| Location | Trip type | AM Peak Period (8.30am-9.30am) | PM Peak Period (3.30PM-4.30PM) |
|---|---|---|---|
| Great Western Highway at Macquarie River Bridge | Origin/destination in Kelso, within the study area | 899 (41%) | 891 (35%) |
| | Through traffic travelling along the highway between Macquarie River Bridge and east of Littlebourne Street (MR253) | 735 (33%) | 898 (35%) |
| | Origin/destination in Littlebourne Street (MR253) | 410 (19%) | 603 (24%) |
| | Remaining trips | 155 (7%) | 155 (6%) |
| Great Western Hwy – East of Littlebourne Street (MR253) | Origin/destination in Kelso, within the study area | 250 (23%) | 196 (15%) |
| | Through traffic travelling along the highway between Macquarie River Bridge and east of Littlebourne Street | 735 (68%) | 898 (70%) |

| Location | Trip type | AM Peak Period (8.30am-9.30am) | PM Peak Period (3.30PM-4.30PM) |
|---|---|---|---|
| | (MR253) | | |
| | Origin/destination in Littlebourne Street (MR253) | 65 (6%) | 107 (8%) |
| | Remaining trips | 29 (3%) | 85 (7%) |

Based on **Table 2.10**, more than 90% of the morning and afternoon peak period trips on the Great Western Highway comprised of:

- Trips with the origin/destination in the study area
- Through traffic travelling along the highway
- Trips with the origin/destination in Littlebourne Street (MR253) which include through trips to/from Oberon

### Existing trip pattern along Hereford Street, Gilmour Street (MR54) and Littlebourne Street (MR253)

Based on the results of the origin destination surveys, the details of current trip distributions along Hereford Street, Gilmour Street (MR54), and Littlebourne Street (MR253) are provided in **Table 2.11**.

**Table 2.11 Trip distributions for Hereford Street, Gilmour Street (MR54) and Littlebourne Street (MR253)**

| Location | Trip type | AM Peak Period* (8.30am-9.30am) | PM Peak Period (3.30PM-4.30PM) |
|---|---|---|---|
| Hereford St – East of Macquarie River | Origin/destination in Kelso, within the study area | 713 (68%) | 726 (60%) |
| | Origin/destination to Gilmour Street (MR54) south of Eltham Drive | 225 (21%) | 314 (26%) |
| | Origin/destination to the Highway east of Littlebourne Street (MR253) | 27 (3%) | 45 (4%) |
| | Remaining trips | 86 (8%) | 130 (10%) |
| Gilmour St (MR54) – South of Eltham Dr | Origin/destination in Kelso, within the study area | 285 (44%) | 196 (39%) |
| | Origin/destination to Hereford Street west of Macquarie River | 245 (38%) | 314 (40%) |
| | Origin/destination to the Highway east of Littlebourne Street (MR253) | 29 (4%) | 59 (7%) |
| | Origin/destination to the Highway west of Macquarie River Bridge | 81 (12%) | 78 (10%) |
| | Remaining trips | 10 (2%) | 33 (4%) |
| Littlebourne St (MR253) – South of Great Western Hwy | Origin/destination in Kelso, within the study area | | 141 (15%) |
| | Origin/destination to Hereford Street west of Macquarie River | | 37 (4%) |
| | Origin/destination to Gilmour Street (MR54) north of Eltham Drive | | 47 (5%) |

| Location | Trip type | AM Peak Period* (8.30am-9.30am) | PM Peak Period (3.30PM-4.30PM) |
|---|---|---|---|
| | Origin/destination to the Highway east of Littlebourne Street (MR253) | | 107 (11%) |
| | Origin/destination to the Highway west of Macquarie River Bridge | | 603 (62%) |
| | Remaining trips | | 29 (3%) |

Note * survey errors were noted for AM peak numbers for Littlebourne St – South of Great Western Hwy so that data has been excluded.

From **Table 2.11**, the following observations are made in relation to traffic distribution during peak periods:

- The majority of the vehicles (86%-89%) travelling east of Macquarie River on Hereford Street have an origin/destination in Kelso, within the study area, or Gilmour Street (MR54) north of Eltham Drive.
- The majority of the vehicles (79%-82%) travelling along Gilmour Street (MR54) (south of Eltham Drive) have an origin/destination in Kelso, within the study area, or west of the Macquarie River on Hereford Street.
- 10-12% of the vehicles travelling along Gilmour Street (MR54) (south of Eltham Drive) have an origin/destination to the west of the Macquarie River bridge on the Highway
- 15% of the vehicles travelling along Littlebourne Street (MR253) (south of the Great Western Highway) have an origin/destination in Kelso, within the study area.
- A total of 74% of the vehicles travelling along Littlebourne Street (MR253) (south of the Great Western Highway) have an origin destination either to the east of Littlebourne Street (MR253)on the highway or west of Macquarie River Bridge on the highway

### Existing directional distribution of trips with origin/destination to the study area

**Table 2.12** shows the distribution of trips that have an origin/destination in Kelso, within the study area, at each of the OD survey locations during the afternoon peak period.

**Table 2.12 Distribution of trips with origin/destination in Kelso study area – PM Peak period**

| Location | Number of trips that have origin/destination in Kelso, within the study area | Percentage of trips |
|---|---|---|
| Great Western Highway at Macquarie River Bridge | 891 | 39% |
| Hereford St – East of Macquarie River | 728 | 32% |
| Gilmour St (MR54) – South of Eltham Drive | 310 | 13% |
| Limekilns Road – East of Marsden Lane | 34 | 1% |
| Great Western Hwy – East of Littlebourne Street (MR253) | 196 | 9% |
| Littlebourne St – South of Great Western Highway | 141 | 6% |
| Total | 2,300 | 100% |

From **Table 2.12**, approximately 70% of the traffic that has an origin/destination in Kelso, within the study area, is to/from the west with approximately 10% of the traffic to/from the east and 20% of the traffic to/from the north/south. Based on the results of the OD survey results on Gilmour Street (MR54)

south of Eltham Drive, the land uses located in the northern part of the study area are likely to use Hereford Street rather than the Highway to access the Bathurst CBD.

### Existing directional distribution to Eglinton village development

Traffic distribution at the OD stations located on Hereford Street and Gilmour Street (MR54) were used to estimate traffic distributions for Eglinton village expansion. **Table 2.13** shows the existing directional traffic distributions on Hereford Street east of Macquarie River and on Gilmour Street (MR54) south of Eltham Drive.

**Table 2.13 Existing directional distribution of trips at Hereford and Gilmour Streets (MR54)**

| Location (to/from) | Existing directional distribution | |
|---|---|---|
| | AM Peak | PM Peak |
| **Hereford St – East of Macquarie River** | | |
| Kelso within the study area | 68% | 60% |
| Gilmour St (MR54) – South of Eltham Drive | 21% | 26% |
| Great Western Hwy – East of Littlebourne Street | 3% | 4% |
| Remaining trips | 8% | 10% |
| **Gilmour St (MR54)– South of Eltham Dr** | | |
| Kelso within the study area | 44% | 39% |
| Hereford St – East of Macquarie River | 38% | 40% |
| Great Western Hwy – East of Littlebourne Street (MR253) | 4% | 7% |
| Great Western Highway at Macquarie River Bridge | 12% | 10% |
| Remaining trips | 2% | 4% |

From **Table 2.13**, it can be seen that a high level of trips, that have an origin/destination in the study area, are currently occurring from the north and west.

## 2.9 Queue lengths at intersections

To gain a further appreciation of traffic conditions in the study area, queue length surveys were undertaken during the same periods as the turning movement counts. The queue length data was collected for every phase at each of the signalised intersections. Queue length surveys were undertaken at the following intersections from 6.30am to 9.30am and from 3.30pm to 6.30pm on Wednesday 10 October 2012.

- Great Western Highway/George Street
- Great Western Highway/Bentinck Street
- Great Western Highway/Gilmour Street (MR54)
- Great Western Highway/Boyd Street
- Great Western Highway/Littlebourne Street (MR253)
- Gilmour Street (MR54)/Marsden Lane/Hereford Street

**Table 2.14** provides the results of the queue length survey for the morning and afternoon peak periods.

**Table 2.14 Queue length survey results**

| Intersection | Approach | Observed 95th percentile queue length (Number of vehicles) | |
|---|---|---|---|
| | | AM Peak (8.15am-9.15am) | PM Peak Period (3.30pm-4.30pm) |
| Great Western Highway/George Street | NW (GWH) | 15 | 15 |
| | NE (George St) | 19 | 9 |
| | SE (GWH) | 11 | 11 |
| | SW (George St) | 7 | 12 |
| Great Western Highway/Bentinck Street | NW (GWH) | 3 | 4 |
| | SE (GWH) | 8 | 7 |
| | SW (Bentinck St) | 8 | 12 |
| Great Western Highway/Gilmour Street (MR54) | N (Gilmour St) | 10 | 8 |
| | E (GWH) | 8 | 6 |
| | W (GWH) | 9 | 9 |
| Great Western Highway/Boyd Street | N (Boyd St) | 9 | 11 |
| | E (GWH) | 9 | 9 |
| | W (GWH) | 7 | 7 |
| Great Western Highway/Littlebourne Street (MR253) | E (GWH) | 15 | 12 |
| | S (L'bourne St) | 9 | 15 |
| | W (GWH) | 20 | 20 |
| Gilmour Street (MR54)/Marsden Lane/ Hereford Street | N (Gilmour St) | 7 | 5 |
| | E (Marsden Ln) | 5 | 7 |
| | S (Gilmour St) | 5 | 4 |
| | W (Hereford St) | 4 | 9 |

Based on **Table 2.14**, the queue lengths are similar during the morning and afternoon peak periods. The observed queue lengths (95th percentile) at the approaches of the intersections are less than 100m at all intersections except for the following:

- Great Western Highway and George Street intersection
- Great Western Highway and Littlebourne Street (MR253) intersection

The queues at some of the approaches of the above intersections extend up to 140m.

## 2.10 Journey time within the study area

In parallel with the queue length surveys, journey time surveys were undertaken for selected routes, in both directions, from 6.30am to 9.30am and from 3.30pm to 6.30pm on Wednesday 10 October 2012. The details of the survey routes are provided below and the survey results presented in Table 2.15:

- Route 1 – Great Western Highway – between Peel Street and Ashworth Drive
- Route 2 – Gilmour Street (MR54) – between Eleven Mile Drive and Great Western Highway

**Table 2.15 Journey time within the study area**

| Route name | Travel time (min) | | | | | |
|---|---|---|---|---|---|---|
| | AM peak | | | PM peak | | |
| | Min | Mean | Max | Min | Mean | Max |
| R1 – Great Western Hwy Eastbound | 5:03 | 6:21 | 8:01 | 4:56 | 6:38 | 8:48 |
| R1 – Great Western Hwy Westbound | 4:44 | 6:43 | 9:14 | 5:12 | 6:11 | 8:02 |
| R2 – Gilmour St (MR54) Southbound | 3:28 | 3:38 | 4:08 | 3:30 | 3:42 | 3:50 |
| R2 – Gilmour St (MR54) Northbound | 3:39 | 3:51 | 5:38 | 3:30 | 3:42 | 3:50 |

**Figure 2.3 Journey Time routes**

## 2.11 Existing performance of midblock sections

The performance of the midblock sections has been assessed based on the Roads and Maritime *Guide to Traffic Generating Developments* as shown in **Table 2.16**

**Table 2.16** **Urban road peak hour flows per direction**

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

**Table 2.17** shows the existing performance of midblock sections of roads located within the study area.

**Table 2.17** **Performance of midblock sections**

| Location | Direction | Maximum peak hour traffic volumes (veh/h) | Level of service (LOS) |
|---|---|---|---|
| **Great Western Highway** | | | |
| Great Western Highway – East of Littlebourne Street (MR253) | EB | 638 | D |
| | WB | 675 | D |
| Great Western Highway – West of Gilmour Street (MR54) | EB | 1147 | B |
| | WB | 1396 | B |
| Great Western Highway – West of Havannah Street | EB | 851 | A |
| | WB | 919 | B |
| Great Western Highway – West of George Street | EB | 757 | A |
| | WB | 988 | B |
| Great Western Highway – West of Rankin Street | EB | 1047 | B |
| | WB | 1111 | B |
| **Sofala Road/Gilmour Street (MR54)** | | | |
| Sofala Road – North of Eleven Mile Drive | NB | 95 | A |
| | SB | 95 | A |
| Gilmour Street (MR54) – North of Marsden Lane | NB | 469 | C |
| | SB | 495 | C |
| Gilmour Street (MR54) – South of Marsden Lane | NB | 343 | B |
| | SB | 347 | B |
| Gilmour Street (MR54) – North of Great Western Highway | NB | 266 | B |
| | SB | 307 | B |
| **Marsden Lane/Hereford Street** | | | |
| Marsden Lane – West of Limekilns Road | EB | 57 | A |
| | WB | 46 | A |
| Marsden Lane – East of Gilmour Street (MR54) | EB | 379 | B |
| | WB | 376 | B |
| Hereford Street – East of Stanley Street | EB | 697 | D |
| | WB | 780 | D |
| **Limekilns Road/Boyd Street** | | | |
| Limekilns Road – North of Marsden Lane | NB | 80 | A |

| Location | Direction | Maximum peak hour traffic volumes (veh/h) | Level of service (LOS) |
|---|---|---|---|
| | SB | 93 | A |
| Boyd Street – North of Great Western Highway | NB | 290 | B |
| | SB | 342 | B |
| **Littlebourne Street (MR253)** | | | |
| Littlebourne Street (MR253)– South of Great Western Highway | NB | 566 | C |
| | SB | 488 | C |

From **Table 2.17**, the existing performance of midblock sections is acceptable (LOS 'C' or better) for all road sections except on the Great Western Highway, east of Littlebourne Street (MR253), and Hereford Street.

## 2.12 Existing intersection performance

### Intersection performance criteria

The Roads and Maritime Level of Service (LoS) criteria has been used to assess the performance of intersections. The LoS parameter gives a good indication of how well an intersection operates. The Roads and Maritime Guide to Traffic Generating Developments, October 2002 provides the criteria used to determine the LoS. **Table 2.18** below shows the Roads and Maritime LoS criteria.

**Table 2.18 Level of Service Criteria for Intersections**

| LoS | Average delay per vehicle (secs/veh) | Traffic signals, Roundabout | Give Way & Stop signs |
|---|---|---|---|
| A | Less than 14 | Good operation | Good operation |
| B | 15 to 28 | Good with acceptable delays & spare capacity | Acceptable delays & spare capacity |
| C | 29 to 42 | Satisfactory | Satisfactory, but accident study is required |
| D | 43 to 56 | Operating near capacity | Near capacity & accident study required |
| E | 57 to 70 | At capacity; at signals, incidents will cause excessive delays | At capacity, requires other control mode |
| F | Greater than 70 | Over capacity; at signals, incidents will cause excessive delays | Over capacity, requires other control mode or increasing road capacity |

The Roads and Maritime guidelines recommend performance standards for all major roads. The performance standard during the peak hour should be LoS 'C' or better on weekdays.

### Existing intersection operation

The existing performance of the key intersections in the study area for the morning and afternoon peak periods has been assessed using the PARAMICS output for the 2012 base case. The results of the analysis are summarised in **Table 2.19** and the detailed results are provided in **Appendix A**.

**Table 2.19 Existing performance of intersections - 2012**

| Intersection | Control | Morning peak period | | Afternoon peak period | |
|---|---|---|---|---|---|
| | | Average delay* | Level of Service (LoS) | Average delay* | Level of Service (LoS) |
| **Great Western Highway** | | | | | |
| Rankin St | Signal | 7.2 | A | 10.9 | A |
| George St | Signal | 36.1 | C | 38.9 | C |
| William St | Signal | 21.6 | B | 33.4 | C |
| Bentinck St | Signal | 15.5 | B | 20.4 | B |
| Havannah St | Signal | 19.5 | B | 19.4 | B |
| Gilmour St (MR54) | Signal | 12.5 | A | 13.1 | A |
| Boyd St | Signal | 13.6 | A | 13.1 | A |
| Littlebourne St | Signal | 16.9 | B | 20.4 | B |
| **Gilmour Street (MR54)** | | | | | |
| Eleven Mile Drive | Priority | 6.1 | A | 6.5 | A |
| Halfpenny Drive | Priority | 5.0 | A | 7.5 | A |
| Hereford St | 1 lane circulating roundabout | 7.5 | A | 13.4 | A |
| **Hereford Street/Marsden Lane** | | | | | |
| Stanley St | 1 lane circulating roundabout | 6.7 | A | 8.3 | A |
| Hughes Street | Priority | 10.1 | A | 8.3 | A |
| **Boyd Street/Limekilns Road** | | | | | |
| Hughes Street | Priority | 0.8 | A | 0.8 | A |
| Hereford St | Priority | 11.7 | A | 12.0 | A |

Note: For roundabout and priority control intersections, the maximum delay and LoS for a particular movement is reported. *Average delay in secs/veh

From **Table 2.19**, the performance of the intersections located within the study area is good (LOS 'A' or 'B') except for the following intersections:

- Great Western Highway and George Street during the morning and afternoon peak periods
- Great Western Highway and William Street during the afternoon peak period

The performance of the above intersections is satisfactory (LOS 'C' or better).

## 2.13 Historical crash analysis

An historical crash analysis was undertaken for the 5 year period from January 2007 to December 2011 for the crashes that occurred within the study area in Kelso. The majority of the crashes were reported to occur on the Great Western Highway. A separate crash analysis was undertaken for the

crashes that occurred along the Great Western Highway and for the other roads located within the study area in Kelso. The results of the crash analysis are provided below:

### Crashes occurring along the Great Western Highway

**Table 2.20** and **Table 2.21** show the number of crashes and crash types for the crashes occurred at intersection and midblock location along the Great Western Highway.

**Table 2.20 Intersection crashes on Great Western Highway**

| Intersection with Great Western Highway | Total crashes | Number of crashes/crash type | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Rear end | Movement between opposite /adjacent approaches | Lane change/ Side swipe | Leave parking/ Reversing | Off road | Pedestrian | Hit an object on road |
| Ashworth Dr | 6 | 1 | 4 | 1 | | | | |
| Pat O'Leary Dr | 9 | 8 | | | 1 | | | |
| Littlebourne St | 8 | 4 | 2 | 1 | | 1 | | |
| View St | 3 | 2 | 1 | | | | | |
| Boyd St | 7 | | 4 | 1 | 1 | 1 | | |
| Gilmour St (MR54) | 5 | 1 | 1 | | | 2 | 1 | |
| Stockland Dr | 1 | | 1 | | | | | |
| Lions Club Dr | 2 | 1 | | | | | | 1 |
| **Total crashes** | **41** | **17** | **13** | **3** | **2** | **4** | **1** | **1** |

**Table 2.21 Midblock crashes on Great Western Highway**

| Road section on the Great Western Highway | | Total crashes | Number of crashes/crash type | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| From | To | | Rear end | Lane change | Leave parking | Off road | U-turn | Emerging from driveway | Pedestrian |
| Ashworth Dr | Pat O'Leary Dr | 5 | 5 | | | | | | |
| Pat O'Leary Dr | Littlebourne St | 19 | 18 | | | 1 | | | |
| Littlebourne St | View St | 3 | 2 | | | 1 | | | |
| View St | Boyd St | 9 | 5 | 1 | 1 | | 1 | 1 | |
| Boyd St | Gilmour St (MR54) | 1 | | | | | | | 1 |
| Gilmour St (MR54) | Stockland Dr | 2 | 2 | | | | | | |
| Stockland Dr | Lions Club Dr | 2 | | 1 | | 1 | | | |
| **Total crashes** | | **41** | **32** | **2** | **1** | **3** | **1** | **1** | **1** |

From **Table 2.20** and **Table 2.21** the majority of the crashes (49 crashes out of 82 crashes) were recorded as rear end type crashes. The rear end type crashes are over represented in the two-way, two-lane section (east of View Street) of the highway. This may be due to vehicles turning into properties along this section of road.

### Crashes on the Kelso road network (excl. Great Western Highway)

**Table 2.22** and **Table 2.23** show the number of crashes and crash types for the crashes occurred at intersection and midblock location along the Kelso road network (except Great Western Highway):

Table 2.22 Intersection crashes on Kelso road network (excl. GWH)

| Intersection | Total crashes | Number of crashes/crash type | | | | |
|---|---|---|---|---|---|---|
| | | Rear end | Movement between adjacent approaches | Off road | Pedestrian | U-turn |
| Boyd St/Wayside Cl | 2 | | | | 1 | 1 |
| Gilmour St/Eltham Dr | 1 | 1 | | | | |
| Marsden Ln/Rosemont Ave | 1 | 1 | | | | |
| Ashworth Dr/Emerald Dr | 1 | | | 1 | | |
| Bannerman Cr/Bonner St | 1 | | | 1 | | |
| Boyd St/Bonner St | 1 | | | 1 | | |
| Crips Pl/Bannerman Cr | 1 | | | | 1 | |
| Halfpenny Dr/James Barnet Dr | 1 | | | | 1 | |
| Jagoe Dr/Tandora St | 1 | | 1 | | | |
| Miriyan Dr/Morang Ave | 1 | | | 1 | | |
| Tandora St/Arnold Ct | 1 | | | 1 | | |
| **Total crashes** | **12** | **2** | **1** | **5** | **3** | **1** |

Table 2.23 Midblock crashes on Kelso road network (excl. GWH)

| Road | Total crashes | Number of crashes/crash type | | | |
|---|---|---|---|---|---|
| | | Rear end | Off road | Emerging from driveway | Overtaking |
| Boyd St | 6 | 2 | 3 | 1 | |
| Gilmour St (MR54) | 3 | 2 | 1 | | |
| Marsden Ln | 3 | | 2 | | 1 |
| Hereford St | 3 | 2 | | 1 | |
| Limekilns Rd | 1 | | 1 | | |
| Bonner St | 1 | | 1 | | |
| James Barnet Dr | 1 | | 1 | | |
| Lions Club Dr | 1 | | 1 | | |
| McBrien Dr | 1 | | 1 | | |
| McMenamin Pl | 1 | | 1 | | |
| Spofforth Pl | 1 | | 1 | | |
| Tandora Street | 1 | | 1 | | |
| Tyndall Street | 1 | | 1 | | |
| Wentworth Drive | 1 | | 1 | | |
| **Total crashes** | **25** | **6** | **16** | **2** | **1** |

From **Table 2.22** and **Table 2.23**, the majority of the crashes (21 crashes out of 37 crashes) were recorded as off-road type crashes. Off road crashes generally occur on rural roads with high posted speed limits. There is a safety concern that a high number of off road crashes occurred on a road network that primarily serves residential land uses and the road network is currently signposted for 50/60 km/h.

It is also observed that a total of three (3) pedestrian crashes were reported to occur on the road network that serves the residential community of Kelso.

## 2.14 Pedestrians and cyclists

Section 2.4 shows that, based on Census data, only 2.8% of journeys to work from Kelso were made by walking or cycling, compared to 5.3% across the BRC area. Given that the existing Kelso area is within a comfortable cycling distance to the main employment area of Bathurst CBD, the low active transport (walking and cycling) mode share could be a target for improvement.

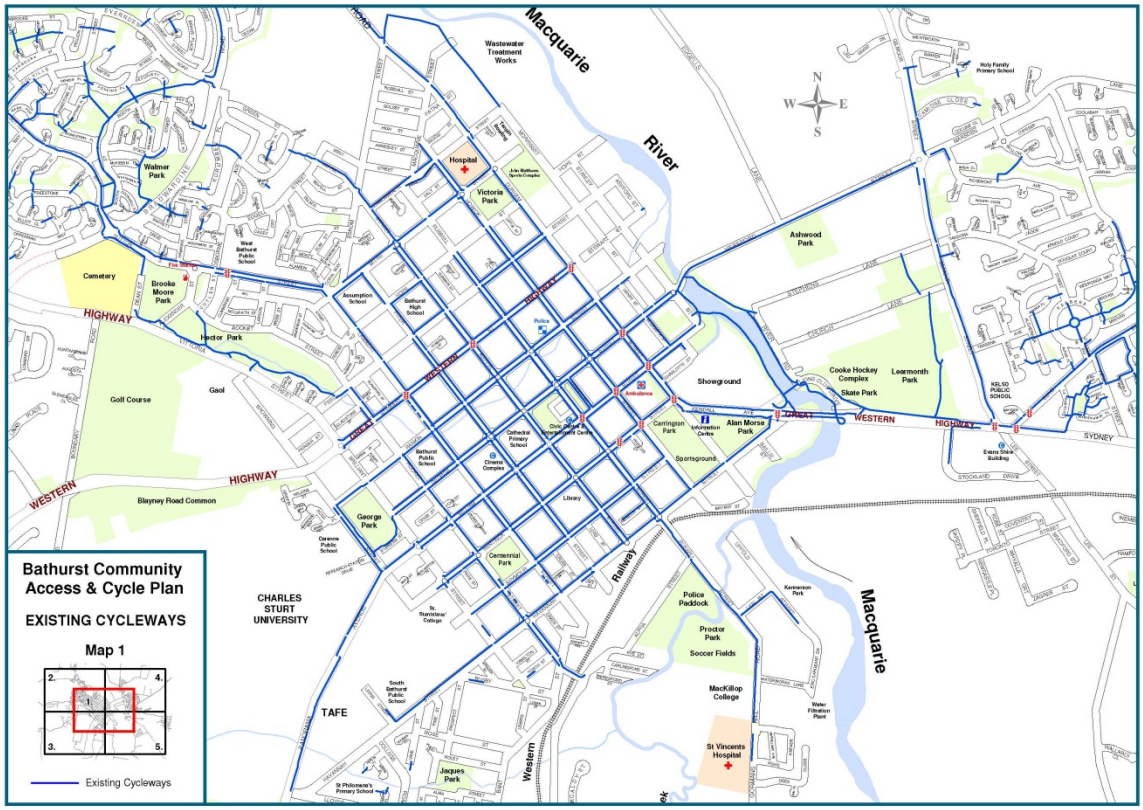
Section 2.4 concluded that assuming that the current journey to work pattern will continue, the majority of the residents of the future developments proposed within the KDA are expected to work within the BRC area. The majority of the workers of any new employment developments proposed within the KDA are expected to live in the BRC area. A large proportion of the employment in the BRC is provided in Bathurst CBD, and given that the new Kelso redevelopment area will be within 1-4 km of Bathurst CBD, it is expected that a large proportion of new working residents in the Kelso redevelopment area would work in Bathurst CBD. The expanding Kelso industrial area and new service business development just south of the Great Western Highway will provide additional nearby employment opportunities, and is similarly within 1-4 km of the new Kelso redevelopment area.

Given the proximity of the Bathurst CBD and Kelso industrial area, there is a significant opportunity to encourage a higher mode split to cycling for the journey to work for the residents of the new Kelso redevelopment area working at those locations. This study will aim to provide cycleway links to facilitate this opportunity.

According to the Bathurst Community Access and Cycling Plan 2011, in 2010 Bathurst had a total of approximately 73.3 kilometres of footpaths and 13.4 kilometres of cycleways. Footpaths in Bathurst Regional Council area are generally a 3.8m wide sealed path (Class 1) in the Bathurst CBD, and a 1.2m wide sealed path (Class 2) in the suburbs, villages, and low-traffic areas. Cycle paths provided within the BRC area are generally 2.5m wide.

As can be seen from **Figure 2.4**, there is an extensive network of wide (3.8m) footpaths on both sides of most streets in Bathurst CBD. This encourages walking trips within the CBD, and provides good continuous accessibility for people with mobility impairments, as well as the elderly, children, parents with prams, people with shopping trolleys, and people in mobility scooters. However, just outside the Bathurst CBD, footpath provision and continuity rapidly diminishes, with subsequent diminished benefits for accessibility: lack of path continuity in even a small section of, say, a wheelchair user's route, can render that whole route inaccessible.

**Figure 2.4 Bathurst CBD footpaths and cycleways (shared paths)**




*Source: Bathurst Community Access and Cycling Plan 2011, Bathurst Regional Council.*

Linking Bathurst CBD and Kelso, there are two main pedestrian and cycle routes:

- shared (bicycle and pedestrian) path along the southern side of Hereford Street
- mix of shared path and Class 2 footpath along the northern side of the Great Western Highway, from View Street in Kelso, into Bathurst CBD.

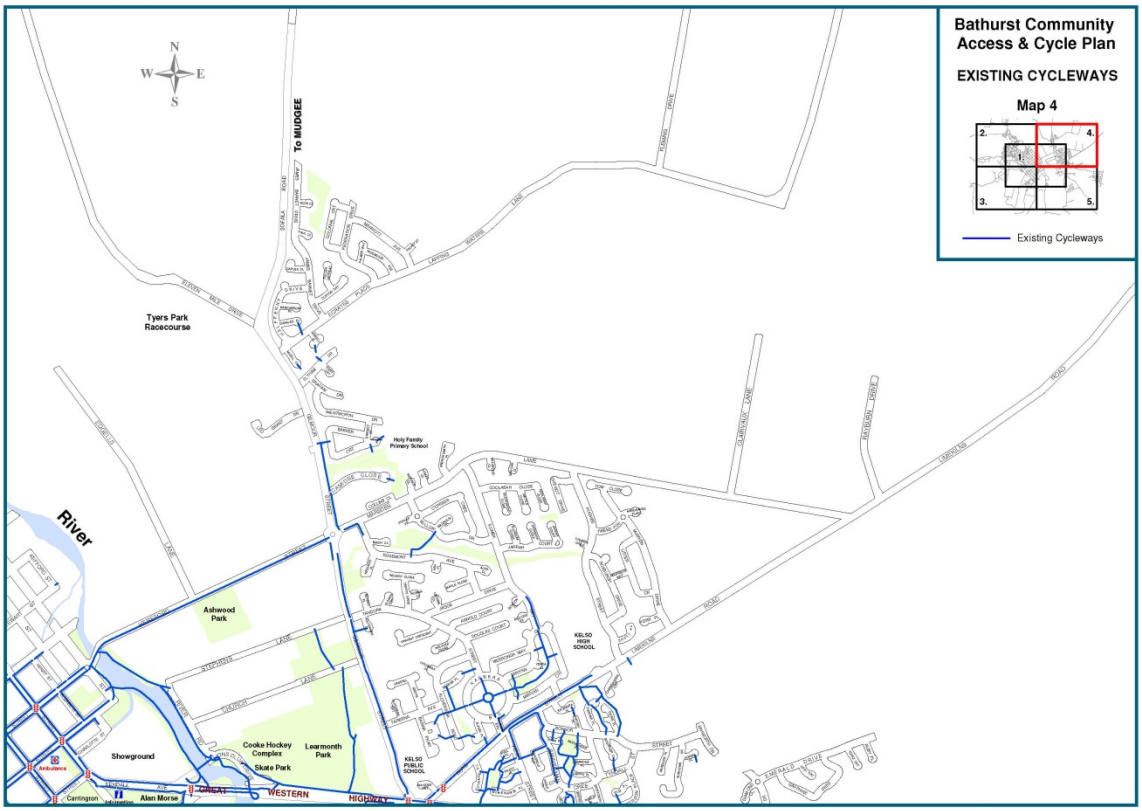
In addition, there are three approximately north-south routes, which are:

- Gilmour Street (MR54) between the Great Western Highway and St Patricks Sportsground (north of Hereford Street).
- Shared path along Raglan Creek approximately 100m west of Gilmour Street (MR54) between the Great Western Highway and Stephens Lane.
- Shared path along both sides of the Macquarie River between the Great Western Highway and Hereford Street.

The key features of the pedestrian and cycleway network in the established part of Kelso are:

- Around Boyd Street - a reasonably extensive (Class 2) footpath network in a number of streets around the south-western section of Boyd Street, which provide some local access to the small parks and reserves in that area.
- Along Gilmour Street (MR54) – there is a footpath between the Great Western Highway and Hereford Street, which then becomes a shared path northwards to Barker Circuit.
- Throughout Kelso – there are a number of short pedestrian access paths linking cul-de-sacs with adjacent roads or reserves.

**Figure 2.5** **Kelso existing footpaths and cycleways**




However, there are large parts of central and northern Kelso that do not have any pedestrian footpaths or shared paths. There is also no correlation between provision of pedestrian paths and bus route and stop locations, which means that it is difficult for residents to access the bus stops if they have mobility impairments or are pushing prams. Both these factors would contribute to residents' isolation and car dependence.

With an ageing population, and therefore the likelihood of an increasing prevalence of mobility limitations in residents, it will be important to plan for more extensive provision of footpaths to provide a basic level of access for all residents. In addition, footpath/ shared path provision could provide the opportunity for increased physical activity for all residents.

## 2.15 Public transport

Kelso area is currently being served by buses, taxis and community transport services. This section provides the details of public transport operation for Kelso area.

### Bus services

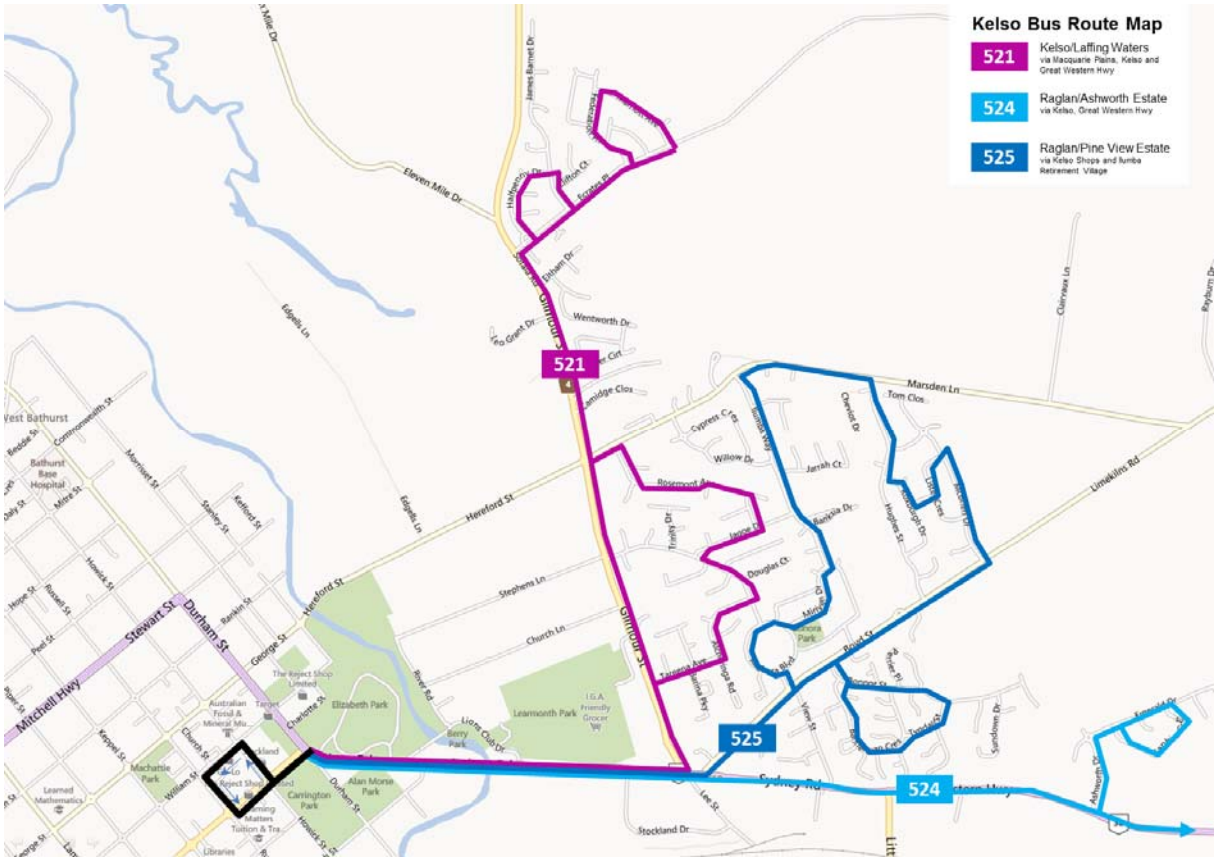
Local bus services

Bathurst is a major regional town in New South Wales. A total of nine (9) bus routes serve the Bathurst area, and are operated by Bathurst Buslines. Three out of the nine (9) routes serve Kelso via Great Western Highway, Gilmour Street (MR54) and Boyd Street.

Table 2.24 Bus Services

| Route | Description | Peak Frequency |
|---|---|---|
| 521 | Kelso / Laffing Waters via Macquarie Plains, Kelso and Great Western Highway | 1 hour |
| 524 | Raglan / Ashworth Estate via (Kelso) Great Western Highway | 1 hour |
| 525 | Kelso / Pine View Estate via Kelso Shops and Ilumba Retirement Village | 1 hour |

Figure 2.6 Kelso existing bus routes




Based on the discussion with Bathurst Buslines, the following information is provided in relation to bus services in Kelso:

- Buslines Bus Company is currently contracted to service Bathurst area by TfNSW, since April 2012, following the purchase of Jones Bros. Bus Company
- Given the current road network arrangement, it is not possible to run efficient bus services e.g Medical Centre at IGA Trinity Shopping Centre is highly popular. However, some bus services are not directly servicing this shopping centre
- The current bus timetables was planned to be reviewed in March 2013.
- Ticketing data is not available
- Through routes along the major collector roads in the new development area would help to run efficient services.

### Taxis

There are currently no specific taxi ranks in the Kelso area. Residents are required to contact the taxi operator to book a taxi for journeys from Kelso. Taxi ranks are provided in the Bathurst Town Centre for people wishing to travel from there to Kelso.

### Community Transport

Community transport services in the Bathurst region are provided by the Bathurst Community Transport. The service provides transport services, on a pre-booked system, to enable those without alternative transport options such as the aged, persons with disabilities and others who are transport disadvantaged and who are living independently to access medical services, shopping, social group outings or other appointments. These services are effectively door to door services. The service operates Monday to Friday only, excluding public holidays.

The service receives funding from the Commonwealth Department of Health & Ageing, the NSW Ageing, Disability and Home Care Department and Transport for NSW, however this does not cover all of the costs involved in providing the service. The service currently operates with eight vehicles.

## 2.16 Flood Events

The flooding events that occur along Macquarie River and Raglan Creek cause disruptions to traffic movements on Hereford Street and the Great Western Highway. Major flood events cause significant delays for residents of Kelso to access Bathurst area during the major flood events.

### Bridge over Macquarie River on Hereford Street

The details of flooding events at the Bridge over Macquarie River on Hereford Street are provided below:

- A low level bridge is provided across the Macquarie River on Hereford Street.
- Hereford Street Bridge is operable until 1 in 5 ARI or greater flooding events.
- The latest flooding that caused closure of the Hereford Street Bridge lasted 3.5 days.

The flooding also occurs along Hereford Street due to Raglan Creek. Works on a diversion channel for Raglan Creek commenced in April 2013. These works are to provide access along Hereford Street up to a 1 in 20 ARI flooding event, with the exception of the low-level bridge closures.

### Bridge over Macquarie River on the Great Western Highway

The Great Western Highway Bridge currently operates with flooding events between 1 in10 and 1 in 20. While the bridge over the Macquarie River is above the 1:20 flood level, the flooding of Raglan Creek, where it crosses the highway, results in the highway itself being closed at the lesser flood level. However, works currently underway at Raglan Creek will allow the highway to operate up to a 1 in 20 flood event.

Based on the above information, the low level Hereford Street Bridge would have the potential to disrupt traffic movements along Hereford Street every five (5) years and force Kelso residents to use Great Western Highway.

# 3. Proposed land use developments and infrastructure upgrades

## 3.1 Details of future residential developments in Kelso

The following land use scenarios have been assessed as part of the study as shown in **Figure 3.1**

- Short term scenario - 2016
- Medium term scenario - 2025
- Long term scenario – 2035

Land use scenarios for short, medium and long term residential developments are proposed based on the Stage 1 and Stage 2 developments shown in the Draft Bathurst Regional Development Control Plan 2013 Map No 4. **Figure 3.1** shows the land use scenarios that will be adopted for the modelling exercise. The staging shown on this map relates to the likely availability of water infrastructure.

**Figure 3.1** **Proposed residential land areas for short, medium and long term scenarios**

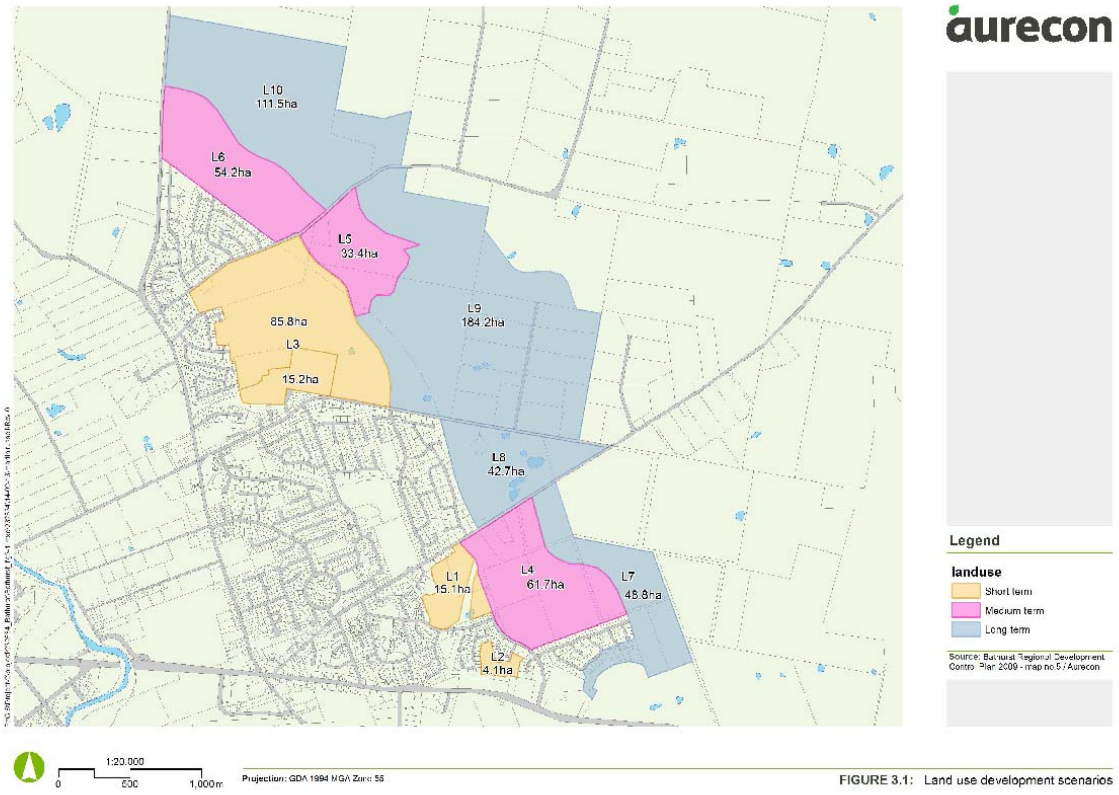



FIGURE 3.1: Land use development scenarios

The details of the proposed residential developments are provided in Table 3.1. It is estimated that 1 ha of developable land would be able to accommodate 7.5 dwellings, based on the *Bathurst Region Urban Strategy* prepared by Bathurst Regional Council.

Table 3.1 Details of proposed land use developments

| Land use development | Number of dwellings | Peak hour traffic generation (veh/h) | Daily traffic generation (veh/day) |
|---|---|---|---|
| **Short term scenario – 2016** | | | |
| L1 | 113 | 96 | 1,019 |
| L2 | 31 | 26 | 277 |
| L3 | 644 | 547 | 5,792 |
| **Total** | **788** | **669** | **7,088** |
| **Medium term scenario – 2025** | | | |
| L1, L2 & L3 | 788 | 669 | 7,088 |
| L4 | 463 | 393 | 4,165 |
| L5 | 251 | 213 | 2,255 |
| L6 | 404 | 344 | 3,642 |
| **Total** | **1,906** | **1,620** | **17,150** |
| **Long term scenario – 2035** | | | |
| L1, L2, L3, L4 L5 & L6 | 1,906 | 1,620 | 17,150 |
| L7 | 366 | 311 | 3,295 |
| L8 | 320 | 272 | 2,882 |
| L9 | 1,382 | 1,174 | 12,435 |
| L10 | 836 | 711 | 7,528 |
| **Total** | **4,810** | **4,088** | **43,290** |

A new retail development of potentially 7,000m$^2$ GLA in size and a public school are proposed for the residents of the KDA. The retail development site has also been identified for the provision of future neighbourhood centre activities.

## 3.2 Industrial or service business developments – South of Great Western Highway

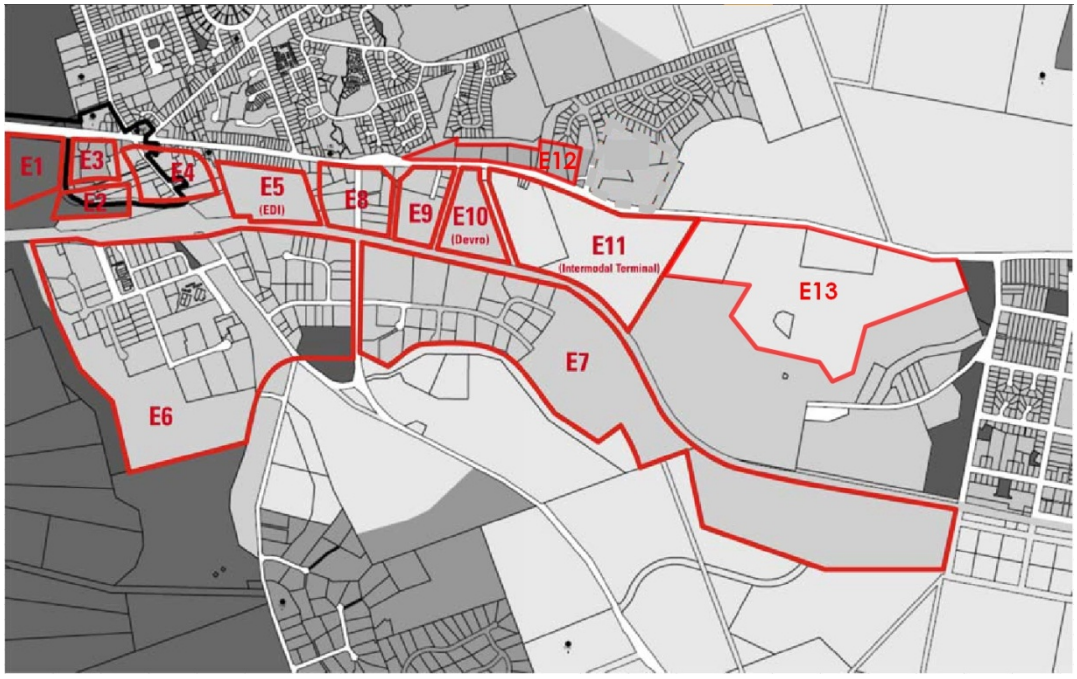
The proposed industrial or business service developments are located south of the Great Western Highway at Kelso which is outside the study area. The information in relation to the proposed industrial or service business development has been obtained from *Great Western Highway Upgrade, Kelso, Traffic Assessment, Final Draft Report*, prepared by Cardno for Roads and Maritime. The details of employment precincts are provided below, although it should be noted that there is no development potential within area E1, as the land is flood prone:

- Precinct E1 – Vacant land on western side of Stockland Drive
- Precinct E2 – Vacant land on the southern portion of Stockland Drive
- Precinct E3 – Redevelopment of existing sites off Stockland Drive
- Precinct E4 – Redevelopment of existing Sites off Lee Street
- Precinct E5 – EDI site
- Precinct E6 – Hampden Park Road industrial area west of Littlebourne Street (MR253)

- Precinct E7 – Hampden Park Road industrial area east of Littlebourne Street (MR253)
- Precinct E8 – Regional growth of Littlebourne Street (MR253)
- Precinct E9 – Pat O'Leary Drive mixed use retail development
- Precinct E10 – Devro
- Precinct E11 – Intermodal terminal
- Precinct E12 – Sydney Road (North) Bulky Goods
- Precinct E13 – Raglan Business Park

**Figure 3.23.2** shows the proposed industrial development precincts.

**Figure 3.2 Proposed industrial precincts south of Great Western Highway**




Source: Great Western Highway Upgrade, Kelso Traffic Assessment, Final Draft Report and Bathurst Regional Council

Council is currently considering a Planning Proposal for the E11 site to zone the land 3(b) - Service Business. Up to 13 hectares of the land is proposed to be made available for bulky goods development.

The Kelso precinct is developing as the City's bulky goods (retail) precinct with pressure for additional land for bulky goods (retail) development within this area evident from development applications approved by Council in this locality on both industrial zoned and rural zoned land.

## 3.3 Eglinton village expansion

The number of additional lots that could be provided with the Eglinton village, is in the range of 153 – 768 lots based on the *Eglinton Village Expansion LES*. The following assumption has been made in relation to land use scenarios:

- Short term scenario (2016) – 153 lots
- Medium term scenario (2022) – 425 lots
- Long term scenario (2035) – 768 lots

## 3.4 Great Western Highway upgrade at Kelso

At the time of this report, Roads and Maritime is currently upgrading 2.4 km of Great Western Highway. The project extends from west of the Stockland Drive intersection to east of Ashworth Drive.

The project will widen the highway to four lanes with improvements to intersections. The layout of the preferred concept option was used for future modelling.

## 3.5 Bathurst Community Access and Cycling Plan 2011

The *Bathurst Regional Community Access and Cycling Plan 2011* prepared by Bathurst Council provides a comprehensive footpath and cycleway plan for the Bathurst region, including outlying townships. An extract from the plan states:

*The primary aim of the plan is to provide a holistic and planned approach to improving the pedestrian and cycle environment within the Bathurst Region for its community and visitors to the Region by:*

*a) Identifying opportunities for upgrading and improving the existing access network;*
*b) Identifying additional access linkages that:*
- *i) support connectivity of existing linkages,*
- *ii) complement popular and high use routes, and*
- *iii) extend the network to, and within, the Region's rural villages;*

*c) Identifying opportunities for cycling tourism;*
*d) Identifying associated facilities and access aids that are required to support the network; and*
*e) Adopting a network that:*
- *i) encourages cycling and walking as an alternative to the motor vehicle;*
- *ii) integrates walking and cycling into the transport network; and*
- *iii) removes barriers to walking and cycling and improves access to all members of the community.*

The following figures from the *Bathurst Regional Community Access and Cycling Plan 2011* show the proposed footpaths and cycleways for Bathurst CBD and Kelso, overlaid on the existing network.

**Figure 3.3 Existing and proposed cycleways and footpaths for Bathurst CBD**

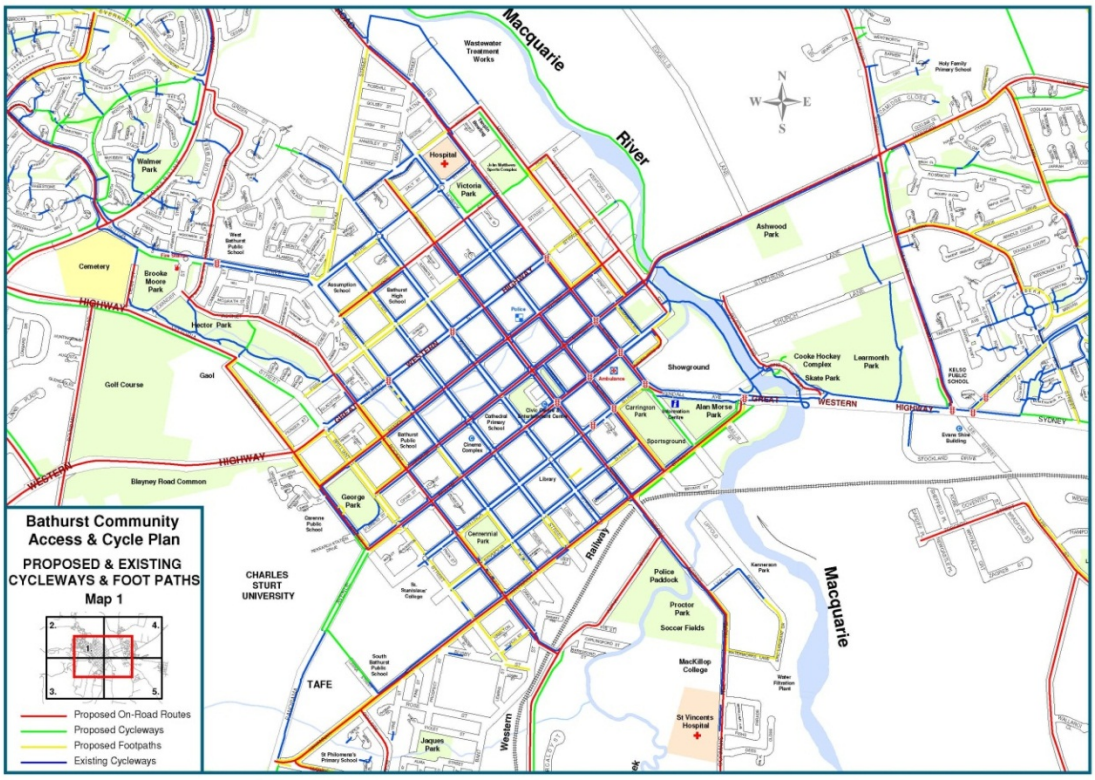


**Figure 3.4** **Existing and proposed cycleways and footpaths in Kelso**

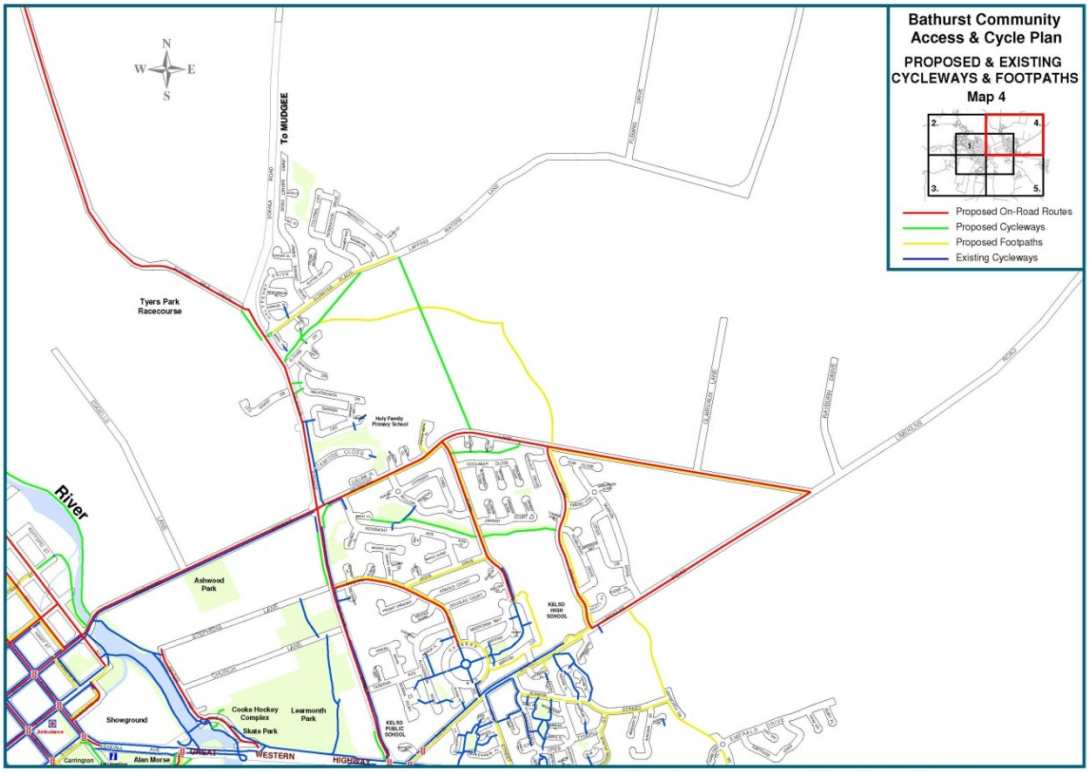



**Figure 3.5** **Proposed footpath priority in Kelso**

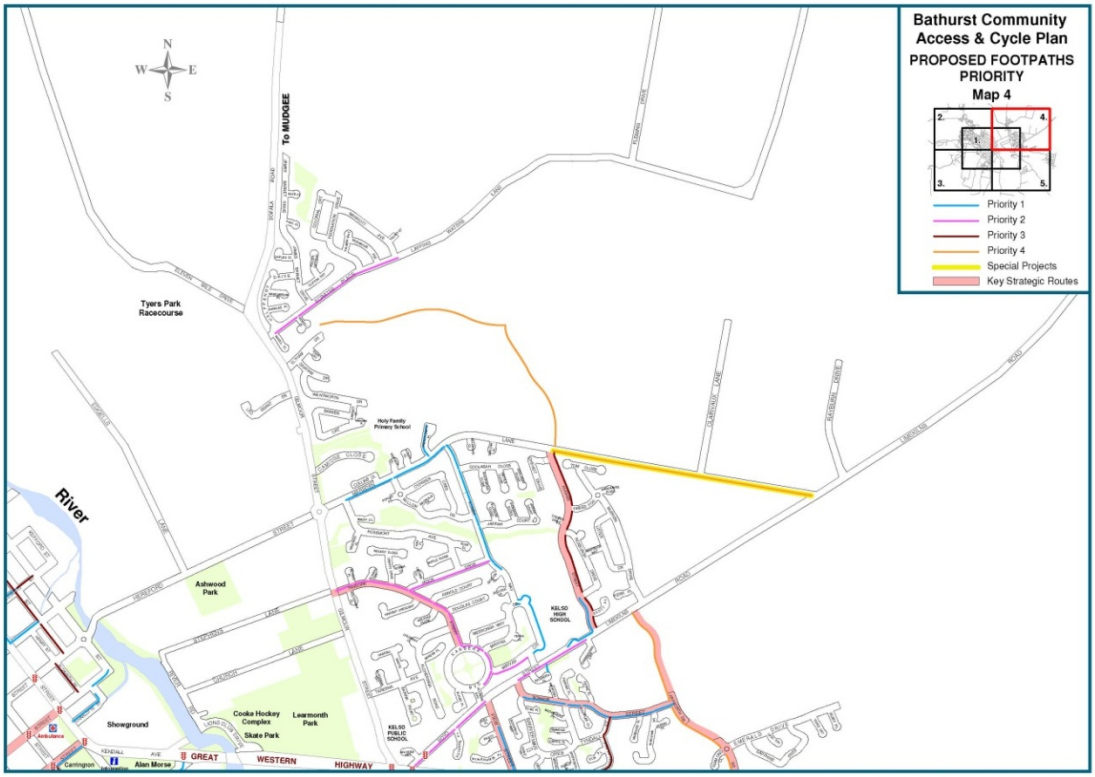


**Figure 3.6 Proposed (off-road) cycleway priority**

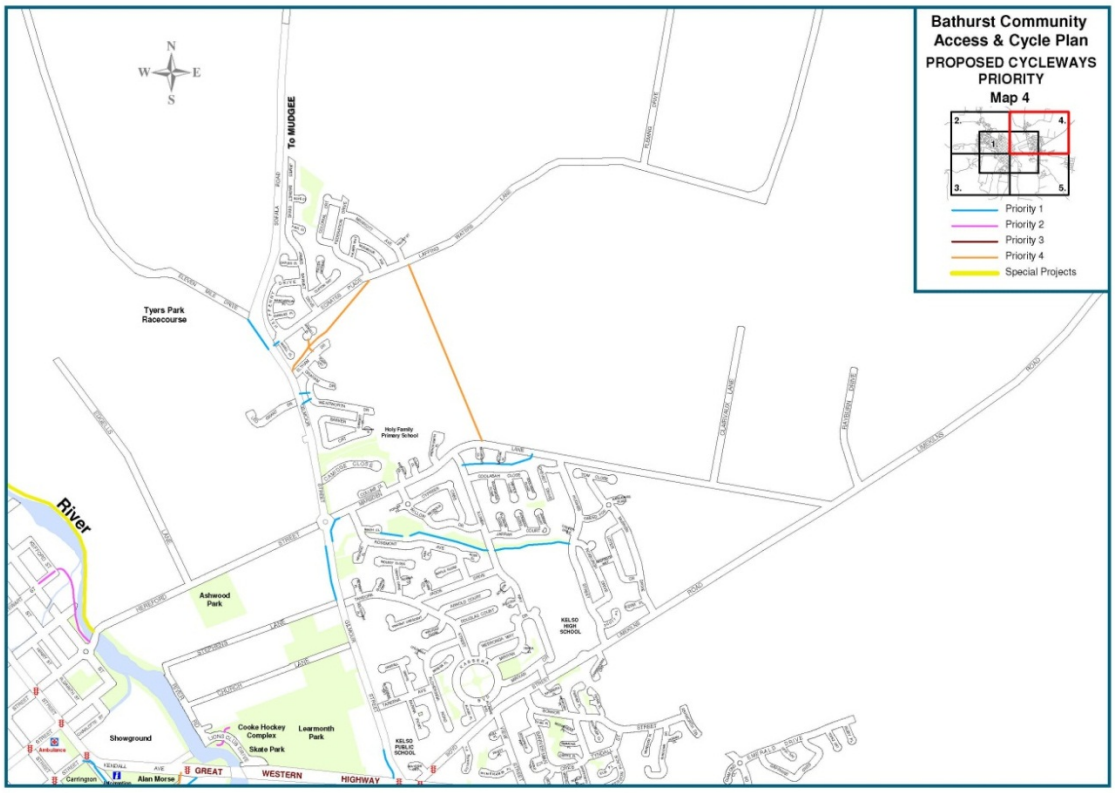
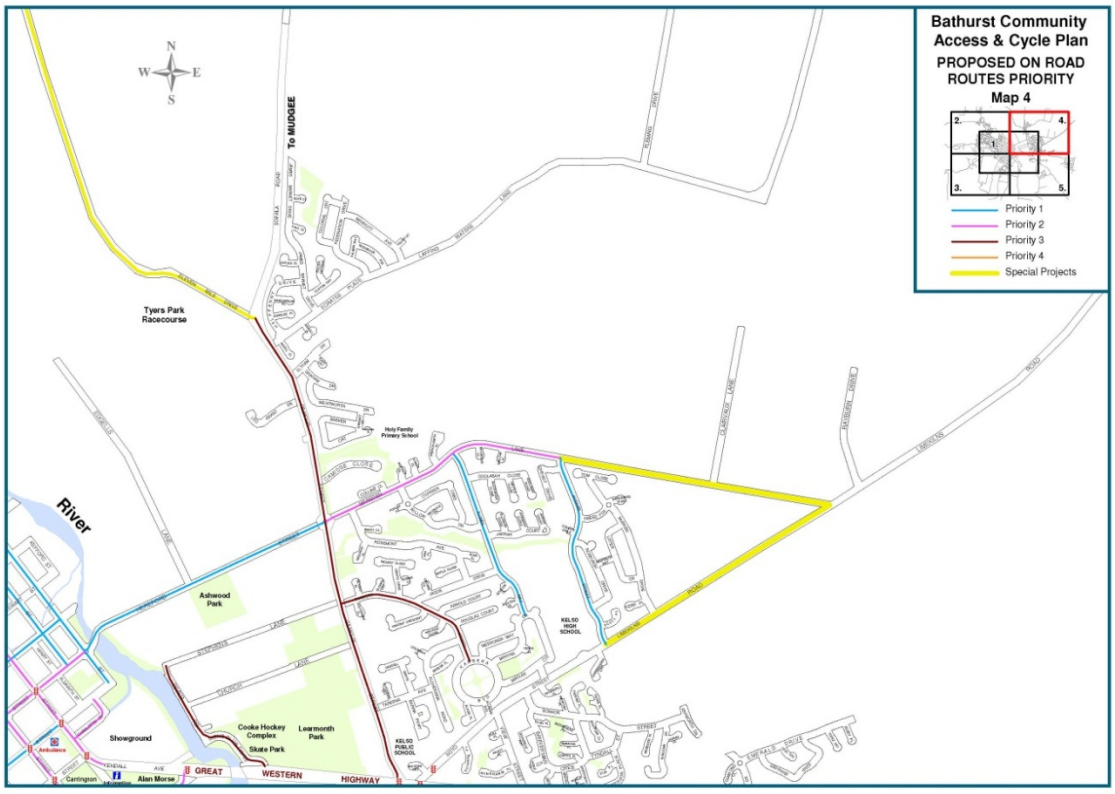



**Figure 3.7 Proposed on-road cycle routes priority**



As can be seen from the above figures, Council has identified a good network of on-road cycle routes along most of the main collector roads through Kelso (Hereford Street/ Marsden Lane, Limekilns Road, Gilmour Street (MR54)/ Eleven Mile Drive) and some key local connector roads (Tadora Street, Ilumba Way, and Hughes Street). Shared paths are proposed along the, approximately, east-west running drainage corridors, linked to cycle routes; as well as a north-south path linking Marsden Lane and Laffing Waters Lane; and some short cut-throughs off Gilmour Street (MR54). Footpaths are proposed along some key local connector streets.

The *Bathurst Regional Community Access and Cycling Plan 2011* quotes the Department of Planning's forecasts for Bathurst LGA that "*the percentage of the population aged over 65 is expected to double over the next 30 years. In 2031 it is projected that approximately 1 in 4 persons will be aged over 65 years.*" With an ageing population, there is a likelihood of an increasing prevalence of mobility limitations in residents, which will limit their ability to drive. In addition, the proportion of the population 0-14 years old (hence, unable to legally drive) is expected to be 16% by 2031. So assuming that a third of this age group is within the say 10-14 year age group that could independently walk, cycle or catch buses to their destinations, it means there could be approximately 30% of the population who will rely on transport other than a private car.

Therefore, it will increasingly be important to plan for more extensive provision of footpaths to provide a basic level of access for all residents. In addition, footpath/ shared path provision could provide the opportunity for increased physical activity for all residents.

## 3.6 Long Term Transport Master Plan 2013

The NSW State Government's *Long Term Transport Master Plan* (released in early 2013) includes specific walking and cycling actions for regional communities, which are relevant for the Kelso redevelopment area:

***"Action: Invest in local cycleways in partnership with local councils***

*Cycling provides greater travel choice to regional communities and delivers health and environmental benefits. In addition to statewide initiatives to promote cycling, we will invest in better information and infrastructure to support cycling in conjunction with regional local councils.* ***As part of the Cycling Investment Program*** *we will prioritise opportunities for regional tourism in the assessment criteria and seek to connect cycling networks around major regional towns and centres.*

***Many regional roads were built without suitable space for cycling. In some cases, these roads now carry high levels of vehicle traffic that deter young or inexperienced cyclists from riding****. We will work with councils to improve and enhance paths and cycling routes in regional centres to increase the number of people who choose to cycle. All new road projects or road network upgrades will be required to examine the feasibility of providing for cycling as an essential component of the project.*

***Action: Invest in regional footpaths in partnership with local councils***

*Walking is an important element for mobility. In addition to statewide initiatives to promote walking, we will invest in better information and infrastructure to support walking in conjunction with regional local councils.*

*Many regional roads were built without suitable footpaths or space for walking. We will work to improve and enhance walking paths in regional centres to increase the number of people who walk."* [p239]

"*Transport networks will be developed to serve new greenfield residential and employment areas within growth areas. We will ensure appropriate infrastructure is in place to support walking, cycling, public transport and vehicle movements*" [p323]

These actions and discussion present a clear position that Government considers walking and cycling to be key transport modes to be supported in regional councils, and in all new developments. Following from the actions identified in the *Long Term Transport Master Plan*, Transport for NSW subsequently released in December 2013 two reports *Sydney's Walking Future, Connecting People and Places* and *Sydney's Cycling Future, Cycling for Everyday Transport*.

# 4. Proposed traffic and transport measures for Kelso Development area

This section outlines the principles guiding the development of the traffic and transport infrastructure identified for the Kelso Development Area (KDA), then details the infrastructure proposed.

Principles for the development of traffic & transport management measures:

***Social equity – Not all residents have access to a car for many reasons, therefore the design of new residential areas needs to take into account provision for non-car based travel, including walking, cycling and public transport.***

Reasons for not having access to a car can include: age (under 17 years, or elderly); temporary or permanent mobility impairment, intellectual or cognitive impairment; inability to afford the costs. With an increasingly ageing population and people living longer, a greater proportion of the population is likely to be unable to drive in future years. Retrofitting existing areas with footpaths and cycleways will generally be more expensive that providing the facilities 'up front' when development is taking place. Council would also be more likely to be able to levy Section 94 contributions 'up front' rather than retrospectively. New residential areas therefore need to provide facilities for walking (including wheelchairs, mobility scooters, prams), cycling (including off-road for children), and public transport.

Footpaths alongside all roadways should be provided as a basic standard for access: people should not have to push a pram or wheelchair in a roadway. Footpaths can provide all residents with an accessible path of travel to potential future transport facilities such as cycleways, bus stops, hail and ride stops, even car share pods.

Key design principles could include:

1. Provide a Class 2 footpath on at least one side (but preferably both sides, particularly within 400m of proposed bus stops) of all new roadways, so that it can accommodate prams, wheelchairs, mobility scooters, etc. Consider providing wider footpaths in areas where greater pedestrian activity would be expected (such as near village/ shopping centres, schools).
2. Footpaths should be designed and constructed, where practicable, to satisfy DDA design requirements (particularly regarding gradients, width, continuity, crossing points), and consideration of the increasing size and width of mobility scooters.
3. Extend the on-road cycle routes and off-road cycleway network through the new development areas at the same time roads are constructed, and link these routes and cycleways to the existing network. As a minimum, all collector roads in the new development areas should include either an on-road cycle route, or an adjacent cycleway, that is connected to the existing cycle network.
4. Footpaths and cycleways/ cycle routes should link from residential areas to schools, shops, employment areas (eg. Bathurst CBD, Kelso Industrial Park), and other key land uses, with appropriate end-of-trip facilities (such as secure bicycle parking, public toilets, water stations) and en route provision (such as good lighting and way-finding). For the Kelso release areas, this means strong links to the proposed new shopping centre and new primary school.
5. Public transport stops should include sealed paths and ramps to the kerbside to allow prams and wheelchairs access onto/off the bus.

***Relative grid-based local road network – This provides the greatest flexibility and efficiency with regard to longer-term traffic management, and provision of community transport services and regular bus route services.***

In the short-term, the collector road network identified in this study should allow for future development of bus routes that can achieve good coverage of residential areas (that is, within 400m walk of most residences), and directly connect key land uses (such as shopping centres, schools, employment areas, community/ recreational facilities). Where buses are operating along collector streets, good connections between the surrounding residential streets and the bus stop locations are important. Development Control Plans should identify the location of bus stops and how these are connected to the surrounding area, being located near to side streets or pedestrian pathways.

In particular, potential bus routes should be developed as early as possible for each of the identified stages, in order that the bus operator can initiate routes at the earliest time and provide residents with a public transport network in place when they move in. Where bus routes are required to operate along streets other than the collector road network (as will be required in some locations) then these should provide a direct route with identified locations for bus stops near cross streets or pedestrian pathways providing good access to the surrounding area.

A relative grid-based road network with roads that are not circuitous or create long loops will also make it easier to manage longer-term traffic growth, as it provides options for alternative relief routes to be identified and expanded, and for a finer-grained traffic/ transport network to be introduced (for example, by through-block connections).

Key design principles include:

6. Design the road network for the new development areas in a grid-based pattern, with particular consideration for optimising existing and future bus or community transport routes.
7. Consider medium-long-term alternative collector routes from the new development area into Bathurst CBD (such as along Marsden Lane?), and intra-village routes (such as between Kelso and Eglinton).

The following traffic management measures are proposed to improve the performance of the intersections in the short term (5 years), medium term (10 years) and long term (20 years) and to accommodate generated traffic from new developments proposed in the KDA.

***Future travel mode splits – Plan growth in Bathurst to become a regional city by providing for non-car modes of travel for all trips.***

Bathurst has identified itself as an “Evocity”, so to maintain its characteristics of a “…*city with less traffic, a great lifestyle, a welcoming and safe community*…” traffic growth should be managed early, rather than when congestion is a major problem.

Facilities such as walking paths and cycleways greatly enhance the liveability of a city by providing a healthier way to get around, recreational opportunities, delaying the need for road expansions, and reduced traffic congestion and resulting pollution. Continued population growth, coupled with the same level of car use would, over time, diminish the attractiveness of a town like Bathurst.

To put in place the infrastructure and mindset to continue to be a “city with less traffic, (and) a great lifestyle”, all major developments/ tenants should be encouraged (by incentives) or be required to provide some or all of the following:

8. Front-end provision of bus services to new release areas before car use becomes entrenched.
9. Encourage employment areas to minimise traffic generation by providing lunchtime and personal business facilities within walking distance in the area.

## 4.1 Pedestrians and cyclists

Apply principles discussed at the beginning of this section:

- Provide a Class 2 footpath on at least one side (but preferably both sides) of any new roadway, so that it can accommodate wheelchairs, mobility scooters, prams, etc. Footpaths should be designed and constructed to satisfy DDA design requirements (particularly regarding gradients, width, continuity, crossing points).
- Extend the on-road cycle routes and off-road cycleway network through the new development areas at the same time roads are constructed, and link these routes and cycleways to the existing network. As a minimum, all collector roads in the new development areas should include either an on-road cycle route, or an adjacent cycleway, that is connected to the existing cycle network.
- Footpaths and cycleways./ cycle routes should link from residential areas to schools, shops, employment areas (eg. Bathurst CBD, Kelso Industrial Park), and other key land uses, with appropriate end-of-trip facilities (such as secure bicycle parking, public toilets, water stations) and en route provision (such as good lighting and wayfinding). For the Kelso release areas, this means strong links to the proposed new shopping centre and new primary school.

## 4.2 Public transport

Apply principles discussed at the beginning of this section:

- The location of bus stops is dependent on a number of factors with regard to location. Where it is determined that bus stops will be provided on a proposed route, as an alternative to the current system that operates generally in the Kelso area of hail and ride, they would generally be located approximately 200-350 metres apart, near to any access points from the surrounding area (street access or pedestrian links) and able to provide good visibility to the approaching bus.
- Design the road network for the new development areas in a grid-based pattern, with particular consideration for optimising existing and future bus or community transport routes.
- Public transport stops should include sealed paths and ramps to the kerbside to allow prams and wheelchairs access onto/off the bus.

Also:

- Consider Hereford Street for future bus route(s) as an alternative to using Great Western Highway into Bathurst CBD.
- Front-end provision of bus services in new release areas.

The provision of bus services into the new development areas of Kelso is an important aspect for the future planning and development of the suburb. Existing bus routes are somewhat constrained by an incomplete road network resulting in bus routes operating in a circuitous network in order to provide services to the existing population. The development of the study area needs to be carried out in such a way that bus routes can be implemented at the earliest opportunity and that these can be easily extended as development progresses.

A draft future bus route network has been prepared for the KDA to provide good coverage of the area, connections to local shopping centres and to Bathurst town centre. One of the other aims of the network is to try and reduce the circuitousness of the routes in order to reduce journey time. This is not always possible, particularly in those areas where buses need to service the existing residential areas of Kelso.

**Figure 4.1** provides for four bus routes operating in the area, with each operating in both directions and centred on the Bathurst Town Centre. It is also identified that at least one of the routes would access the Bathurst Town Centre along Hereford Street/George Street, as well as along the Highway.

While hail and ride will most likely operate in the future, as the bus fleet is fully accessible facilities such as concrete pads will be required to enable mobility impaired people to easily board or alight from the bus. This would be best achieved through the provision of identified bus stops at locations along the routes. This does not preclude the operation of hail and ride but provides a presence of the bus route to the local community.

In addition it would be opportune to provide facilities such as a bus shelter with timetable display/noticeboard at key waiting destinations such as at the Trinity Heights shopping centre, and the proposed new shopping centre on Laffing Waters Lane and potentially other bus stops along the route.

### Route A

This route principally services the new development to the south of Limekilns Road/Boyd Street and the existing residential area around Kabbera Boulevard/Miriyan Drive/Ilumba Way including the aged care facility and Trinity Heights shopping centre. It would operate in both directions with access to Bathurst Town Centre being provided along the Great Western Highway and Hereford Street.

### Route B

This route would operate along the great Western Highway from Bathurst to Boyd Street and service the existing residential area around Bonner Street and Ashworth Drive, Hughes Street to Marsden Lane to the intersection with Limekilns Road, returning along the same route.

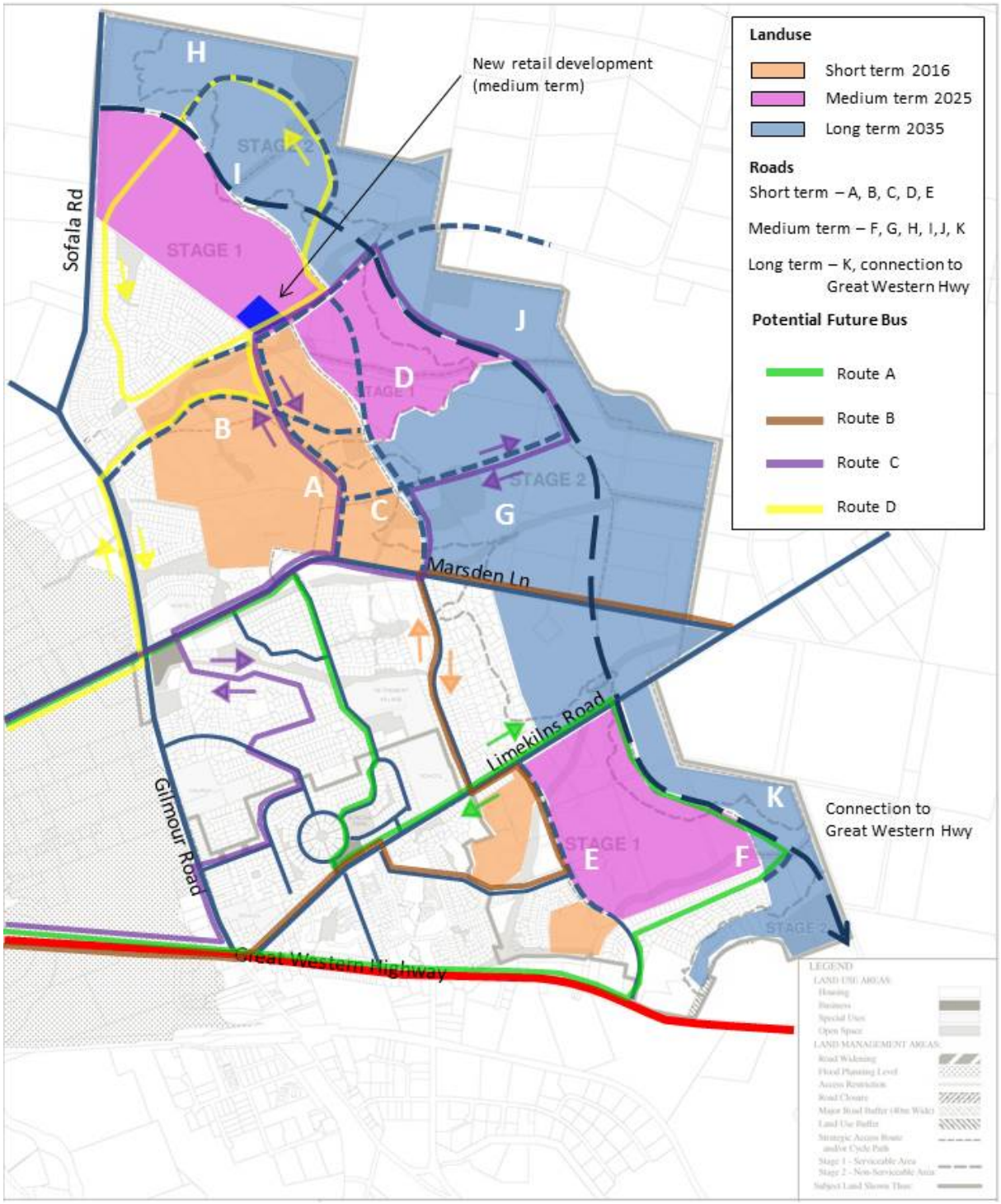
### Route C

This route services both the existing Kelso residential area between Boyd Street and Marsden Lane along Tareena Avenue, Alcheringa Road, Tandora Street, Jagoe Drive and Rosemont Avenue and along Marsden Lane to service the central area of the new development. It operates as a loop through the new residential area providing a link to the proposed shopping centre on Laffing Waters Lane and returning to Bathurst via Hereford Street.

### Route D

This route services the northern area of the existing and new development area around Eltham Drive and Laffing Waters Lane. It is proposed that this service operate via Hereford Street on both the inward and outward journeys from the Bathurst town centre. This route is proposed to make use of some streets below the collector road network in order to service the northern area better than if restricted to the collector road network.

**Figure 4.1 Proposed Bus Network**



## 4.3 Proposed road network within KDA

The internal roads will be provided to service the proposed land use developments for short term, medium term and long term scenarios. The details of the roads that are proposed during each scenario are provided in **Figure 4.2** and provided below:

- Short term scenario (2016) – Roads A, B, C, part D and E
- Medium term scenario (2025) – Roads D and I
- Long term scenario (2035) – Roads F, H, J and K

According to the NSW road classification administrative hierarchy, local roads consist of those not classified under the *Roads Act 1993*. Local roads are collector and local access roads which provide linkages to State and Regional Roads as well as within developed areas. For the purposes of discussion, roads A to H will be known as “local roads” and roads I to K as “collector roads”, as they will form the base network to which local streets will connect.

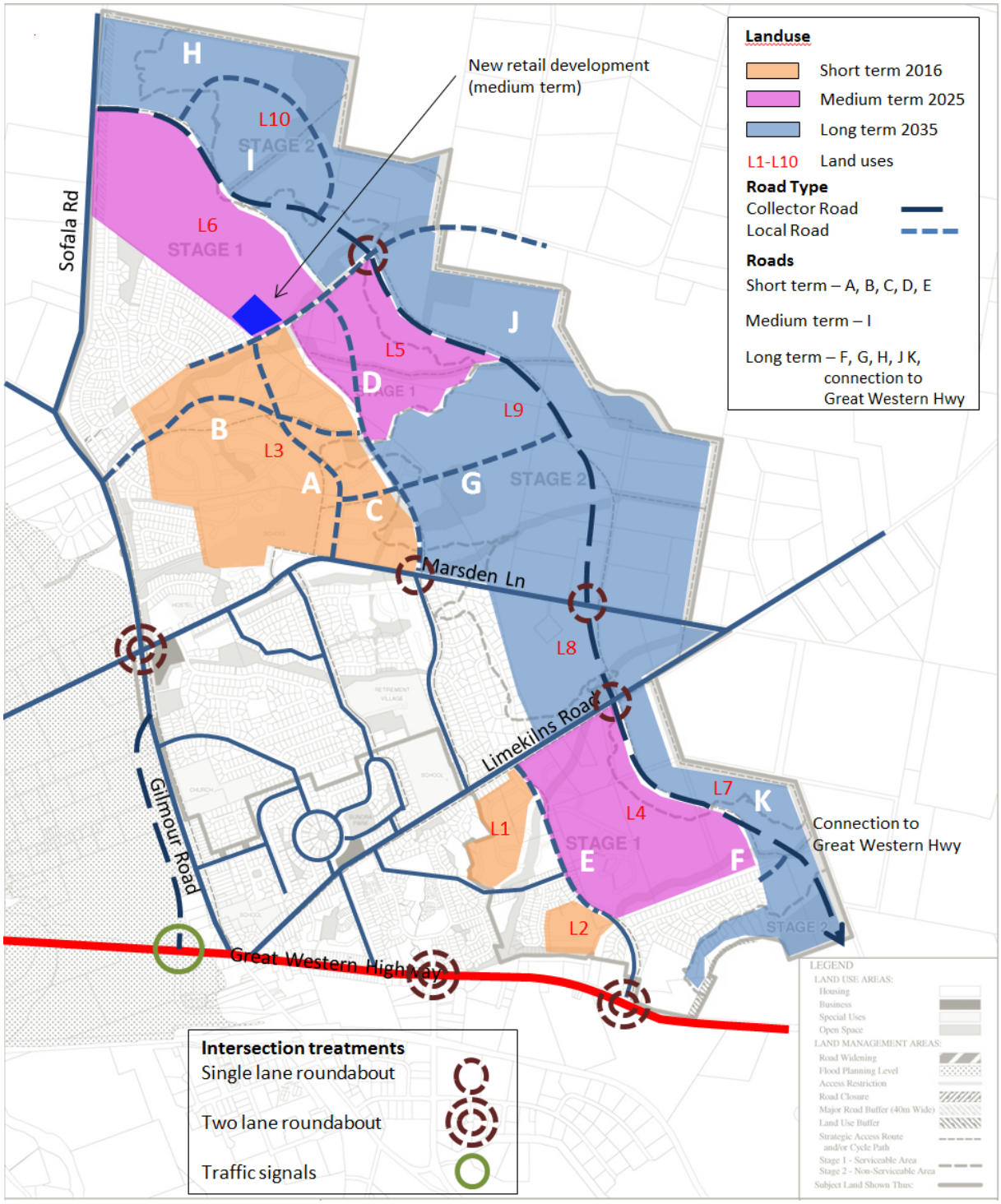
The alignment of the roads shown in **Figure 4.2** is conceptual only. It is recommended that the principle guiding the alignment of roads in the KDA should be for a grid pattern for local roads, as much as possible. Circuitous streets and cul-de-sacs should be avoided, as these street patterns considerably reduce the ability of bus services (present or future) to efficiently serve the area, and can compromise route-directness or route-legibility for pedestrians and cyclists or motorists unfamiliar with the area. Where cul-de-sacs are necessary, safe pedestrian and cyclist ‘cut-throughs’ are recommended to improve permeability. 'Cut-throughs' are connections between the end of a cul-de-sac and the street beyond, to provide pedestrians and cyclists with a direct, connected route.

It is also recommended that shared paths of 2.5 wide be provided on at least one side of collector roads and along proposed bus routes, with a standard footpath being provided on the other side of the collector road. This provision would serve the dual purpose of providing an effective pedestrian and cycle network through the new redevelopment area, as well as providing an accessible path of travel for residents to access the bus stops. The wider shared path provision would accommodate the increasing use of electric wheelchairs and mobility scooters by the population, and thereby minimise the need to widen paths in future. The Australian Model Code for Residential Development (AMCORD) provides that collector roads (with > 2,000 vehicles per day) should have footpaths on both sides of the street.

A higher level of street lighting would also be provided along these collector and bus route roads (and adjacent shared paths) compared to local streets. Providing facilities such as benches or shelters at the bus stops would also serve the dual purpose of providing a comfortable waiting area for bus patrons, as well as rest stops for pedestrians.

Concentrating pedestrian, cyclist, and public transport activity and facilities (such as lighting, directional signage, seating) along these routes would also generally improve the overall perception of safety and accessibility along these routes, and could in turn encourage greater walking, cycling, and public transport use.

**Figure 4.2** **Proposed road network within KDA**




Source – Draft Bathurst Regional Development Control Plan 2013 Map No 4/Aurecon

The alignment of roads in **Figure 4.2** above also indicates the proposed readjustment of Gilmour Street, at Great Western Highway. At the time of preparing this report, it is worth noting that Roads and Maritime were in the process of upgrading sections of the Great Western Highway at Kelso to four lanes, improving intersections and separating opposing traffic directions. The 2.4 km upgrade extends from just west of Stockland Drive to just east of Ashworth Drive. The works involve new traffic signals and a U-turn bay at Stockland Drive, upgrading kerbs at Gilmour Street, utility adjustments

(communication cables) and road surfacing between Stockland Drive and Gilmour Street as advised on the Roads and Maritime Road Projects website[2].

The signalised intersections of Gilmour Street and Boyd Street with the Great Western Highway are located within close proximity to one another (approximately 100 m) and now with the addition of Stockland Drive. The concept of realigning Gilmour Street (to parallel east of Raglan Creek) so that its traffic signal is relocated with Stockland Drive would provide some distance between the Gilmour and Boyd Street intersections with Great Western Highway. This increased separation may assist in the networks efficiency when accommodating the KDA, particularly from a safety perspective in terms of reducing the potential overflow queuing impacts from the closely located intersections.

Gilmour Street is classified as a State Road, under the care and control of Roads and Maritime, so funding and approval for the realignment of Gilmour Street would be undertaken separately by Roads and Maritime. The realignment of Gilmour Street would be subject to the appropriate environmental impact assessment process to obtain development/planning approval. The scale and land use proposed for the KDA would be one key consideration that contributes to the feasibility/determination of realigning Gilmour Street, however there would be additional issues to consider such as socio-economic and other environmental issues. This assessment is outside the scope of this study and should be explored in further detail at the appropriate stage.

[2] http://www.rms.nsw.gov.au/projects/western-nsw/kelso/index.html, December 2014

# 5. Future traffic and transport conditions

## 5.1 Proposed traffic patterns and directional distribution

### Trip distribution along the Great Western Highway

Based on the existing traffic distribution, future traffic volumes along the highway from the KDA would be estimated as follows:

- Trips with an origin destination in Kelso, within study area – Traffic generation from the proposed land use developments within the study area will be estimated based on the Roads and Maritime *Guide to Traffic Generating Developments* and distributed based on the origin – destination survey results.
- Through trip travelling along the highway – Based on Table 2.10, approximately 70% of the traffic on the highway east of Littlebourne Street (MR253) is through traffic travelling along the highway. Therefore, 176 veh/day/year (252 x 0.7) will be adopted for through trip increase along the Great Western Highway. The increase in peak hour traffic volume would be 26 veh/hour/year (equivalent to 2% per annum), assuming that 15% of the daily through traffic travels during peak periods.
- Trips with an origin or destination in Littlebourne Street (MR253) – Estimated traffic generation from the proposed industrial land use developments located south of Great Western Highway based on the *Great Western Highway Upgrade, Kelso Traffic Assessment, Final Draft Report* prepared by CARDNO for Roads and Maritime. Traffic distribution is based on the origin destination survey results at Littlebourne Street (MR253) .
- The through traffic increase on Littlebourne Street (MR253) is estimated at 10 veh/hour/year based on the journey to work data.
- Trips to/from the proposed industrial developments along the highway - Estimated traffic generation from the proposed industrial land use developments located south of Great Western Highway based on the *Great Western Highway Upgrade, Kelso Traffic Assessment, Final Draft Report* prepared by CARDNO for Roads and Maritime. Traffic distribution is based on the origin destination survey results recorded at Littlebourne Street (MR253) .
- Trips from the proposed Eglinton Village Expansion - Traffic generation from the proposed land use developments within the study area will be estimated based on the Roads and Maritime Guide to Traffic Generating Developments and distributed based on the origin – destination survey results recorded at Gilmour Street (MR54) and Hereford Street.

### Directional distribution of trips with an origin/destination in Kelso, within the study area

Based on the existing directional distribution of trips with an origin/destination in Kelso, within the study area, **Table 5.1** shows the traffic distribution for the proposed residential developments.

**Table 5.1 Proposed trip distribution for the KDA, within the study area**

| Location (to/from) | Proposed traffic distribution | |
|---|---|---|
| | Developments south of Marsden Lane | Developments north of Marsden Lane |
| Great Western Highway at Macquarie River Bridge | 40% | 10% |
| Hereford St – East of Macquarie River | 30% | 60% |
| Gilmour St (MR54)– South of Eltham Drive | 10% | 10% |

| Location (to/from) | Proposed traffic distribution | |
|---|---|---|
| | Developments south of Marsden Lane | Developments north of Marsden Lane |
| Great Western Hwy – East of Littlebourne Street (MR253) | 10% | 10% |
| Littlebourne St – South of Great Western Highway | 10% | 10% |

### Directional distribution to commercial developments south of the highway

Traffic distribution at the OD station located on Littlebourne Street (MR253) will be used to assess the traffic distributions for commercial developments located south of the Great Western Highway as shown in **Table 5.2**.

**Table 5.2 Proposed trip distribution for commercial development, south of the highway**

| Location (to/from) | The percentage of generated traffic from commercial developments |
|---|---|
| Kelso within the study area | 15% |
| Great Western Highway at Macquarie River Bridge | 62% |
| Hereford St – East of Macquarie River | 4% |
| Gilmour St (MR54) – South of Eltham Drive | 5% |
| Great Western Hwy – East of Littlebourne Street (MR253) | 11% |
| Oberon (outside the study area) | 3% |

### Proposed directional distribution to Eglinton village development

Based on the existing traffic pattern at the northern OD stations, the traffic distribution shown in **Table 5.3** is proposed to be adopted for Eglinton Village expansion area assuming that majority of the trips generated from this area will access Bathurst CBD for employment and other daily requirements.

**Table 5.3 Proposed trip distribution for Eglinton village development**

| Location (to/from) | Directional distribution of generated traffic from Eglinton village |
|---|---|
| Bathurst CBD (outside the study area) | 30% |
| Bathurst CBD (to the study area via Eglinton Road/Great Western Highway) | 30% |
| Study area via Hereford Street | 20% |
| Study area via Eleven Mile Drive | 5% |
| Great Western Hwy – East of Littlebourne Street (MR253) via Gilmour Street (MR54) | 5% |
| Local traffic within Eglinton (outside the study area) | 10% |

## 5.2 Estimation of traffic generation

### Residential developments within the study area

The traffic generation estimation has been undertaken based on the Roads and Maritime *Guide to Traffic Generating Developments*. The following traffic generation rates have been applied to estimate the future peak hour and daily traffic volumes:

- Daily vehicle trips – 9 per dwelling
- Weekday peak hour trip – 0.85 per dwelling

**Table 5.4** shows the estimated traffic generation from the proposed residential developments within the study area.

**Table 5.4 Estimated traffic generation – Residential developments within the study area**

| Land use development | Number of dwellings | Peak hour traffic generation (veh/h) | Daily traffic generation (veh/day) |
|---|---|---|---|
| **Short term scenario – 2016** | | | |
| L1 | 113 | 96 | 1,019 |
| L2 | 31 | 26 | 277 |
| L3 | 644 | 547 | 5,792 |
| **Total** | **788** | **669** | **7,088** |
| **Medium term scenario – 2025** | | | |
| L1, L2 & L3 | 788 | 669 | 7,088 |
| L4 | 463 | 393 | 4,165 |
| L5 | 251 | 213 | 2,255 |
| L6 | 404 | 344 | 3,642 |
| **Total** | **1,906** | **1,620** | **17,150** |
| **Long term scenario – 2035** | | | |
| L1, L2, L3, L4 L5 & L6 | 1,906 | 1,620 | 17,150 |
| L7 | 366 | 311 | 3,295 |
| L8 | 320 | 272 | 2,882 |
| L9 | 1,382 | 1,174 | 12,435 |
| L10 | 836 | 711 | 7,528 |
| **Total** | **4,810** | **4,088** | **43,290** |

A new retail development of potentially 7,000m$^2$ in size, community facilities, and a public school are proposed for the residents of the future KDA. This will reduce the pressure on existing facilities when the new release area is in place. This would have the potential to reduce the external trips outside the Kelso area. It is assumed that 10% of trips generated by the KDA would be internal trips to the study area. **Table 5.5** shows the internal and external trips to study area.

Table 5.5 Internal and external trips (two-way) to the study area

| Land use Development | Peak period trips (veh/h) | | Daily trips (veh/day) | | Routes that would be used to/from proposed developments |
|---|---|---|---|---|---|
| | Internal | External | Internal | External | |
| **Short term scenario – 2016** | | | | | |
| L1 | 10 | 86 | 102 | 917 | Limekilns Road (100%) |
| L2 | 3 | 23 | 28 | 249 | Great Western Highway (100%) |
| L3 | 55 | 492 | 579 | 5,213 | Marsden Lane (50%), Halfpenny Drive/Laffing Waters Lane (50%) |
| **Total** | **67** | **602** | **709** | **6,379** | |
| **Medium term scenario – 2025** | | | | | |
| L1, L2 & L3 | 67 | 602 | 709 | 6,379 | |
| L4 | 39 | 354 | 417 | 3,749 | Limekilns Road (50%), Great Western Highway (50%) |
| L5 | 21 | 192 | 226 | 2,030 | Halfpenny Drive/Laffing Waters Lane (50%), Marsden Lane (50%) |
| L6 | 34 | 310 | 364 | 3,278 | Sofala Road (50%), Halfpenny Drive/Laffing Waters Lane (50%) |
| **Total** | **162** | **1458** | **1715** | **15435** | |
| **Long term scenario – 2035** | | | | | |
| L1, L2, L3, L4 L5 & L6 | 162 | 1,458 | 1,715 | 15,435 | |
| L7 | 31 | 280 | 330 | 2,966 | Limekilns Road (100%) |
| L8 | 27 | 245 | 288 | 2,594 | Limekilns Road (50%), Marsden Lane (50%) |
| L9 | 117 | 1,057 | 1,244 | 11,192 | Halfpenny Drive/Laffing Waters Lane (50%), Marsden Lane (50%) |
| L10 | 71 | 640 | 753 | 6,775 | Sofala Road (50%), Halfpenny Drive/Laffing Waters Lane (50%) |
| **Total** | **409** | **3,679** | **4,329** | **38,961** | |

The following assumptions are made in relation to arrival and departure pattern of the proposed residential developments located within the KDA:

- 80% of total generated traffic would leave the study area and 20% of total generated traffic would arrive in study area during the morning peak period.
- 80% of total generated traffic would arrive in the study area and 20% of total generated traffic would leave the study area during the afternoon peak period.

### Industrial & service business developments – South of Great Western Highway

**Table 5.6** shows the summary of the traffic generation assumed for each of the employment precincts as provided in the Final Draft Report for the Great Western Highway Upgrade, Kelso Traffic Assessment.

**Table 5.6 2011 to 2035 additional employment traffic generation (veh/h)**

| Employment Precinct | | Trips (veh/h) | | Timing | | |
|---|---|---|---|---|---|---|
| | | AM Peak | PM Peak | 2016 | 2025 | 2035 |
| E1 | Stockland Drive – Western Side | 0 | 0 | - | - | - |
| E2 | Southern part of Stockland Drive | 15 | 15 | 100% | | |
| E3 | Existing sites off Stockland Drive | 29 | 47 | 100% | | |
| E4 | Existing sites off Lee Street | 5 | 8 | 100% | | |
| E5 | EDI | 16 | 16 | 100% | | |
| E6 | Hampden Park Road West | 0 | 0 | - | - | - |
| E7 | Hampden Park Road East | 118 | 118 | 35% | 60% | 100% |
| E8 | Existing Littlebourne Street (MR253) | 0 | 0 | - | - | - |
| E9 | Pat O'Leary Dr Mixed Retail | 712 | 712 | 75% | 100% | |
| E10 | Devro | 12 | 12 | 100% | | |
| E11 | Intermodal Terminal* | 252 | 354 | 20% | 50% | 100% |
| E12 | Sydney Road (North) Bulky Goods | 73 | 73 | 75% | 100% | |
| E13 | Raglan Business Park | 932 | 932 | - | 20% | 50% |
| **Total** | | **2,163** | **2,287** | | | |

Note: * Excludes 120 vehicles per hour passing trade (60 in and 60 out)
Source: Great Western Highway Upgrade, Kelso Traffic Assessment, Final Draft Report & Aurecon

**Table 5.7** provides the arrival and departure pattern of the proposed industrial developments located south of the Great Western Highway.

**Table 5.7 Arrival and departure patterns**

| Employment precinct | | AM peak | | PM peak | |
|---|---|---|---|---|---|
| | | In | Out | In | Out |
| E1 | Stockland Drive – Western Side | 60% | 40% | 41% | 59% |
| E2 | Southern part of Stockland Drive | 60% | 40% | 41% | 59% |
| E3 | Existing sites off Stockland Drive | 60% | 40% | 41% | 59% |
| E4 | Existing sites off Lee Street | 37% | 63% | 41% | 59% |
| E5 | EDI | 32% | 68% | 38% | 62% |
| E6 | Hampden Park Road West | 55% | 45% | 32% | 68% |
| E7 | Hampden Park Road East | 69% | 31% | 16% | 84% |

| Employment precinct | | AM peak | | PM peak | |
|---|---|---|---|---|---|
| | | In | Out | In | Out |
| E8 | Existing Littlebourne Street (MR253) | 43% | 57% | 44% | 56% |
| E9 | Pat O'Leary Dr Mixed Retail | 58% | 42% | 50% | 50% |
| E10 | Devro | 57% | 43% | 7% | 93% |
| E11 | Intermodal Terminal* | 50% | 50% | 50% | 50% |
| E12 | Ashworth North Bulky Goods | 53% | 47% | 36% | 64% |

Source: Great Western Highway Upgrade, Kelso Traffic Assessment, Final Draft Report

## 5.3 Eglinton Village expansion

Traffic generation estimation has been undertaken based on the Roads and Maritime *Guide to Traffic Generating Developments*. The following traffic generation rates have been applied to estimate the future peak hour and daily traffic volumes:

- Daily vehicle trips – 9 per dwelling
- Weekday peak hour trip – 0.85 per dwelling

**Table 5.8** shows the estimated traffic generation for the proposed developments.

**Table 5.8 Estimated traffic generation – Eglinton village expansion**

| Land use development scenario | Number of dwellings | Peak hour traffic generation (veh/h) | Daily traffic generation (veh/day) |
|---|---|---|---|
| Short term scenario (2012) | 153 | 130 | 1,377 |
| Medium term scenario (2025) | 425 | 361 | 3,825 |
| Long term scenario (2035) | 768 | 653 | 6,912 |

The following assumptions are made in relation to the arrival and departure pattern of the proposed residential developments located in the Eglinton area:

- 80% of total generated traffic would leave Eglinton Village and 20% of total generated traffic would arrive in the Eglinton Village during the morning peak period.
- 80% of total generated traffic would arrive in the Eglinton Village and 20% of total generated traffic would leave Eglinton Village during the afternoon peak period.

## 5.4 Future performance of intersections

The future performance of the key intersections in the study area has been assessed for the morning and afternoon peak periods using the PARAMICS output for the following:

- Baseline growth to 2035, taking into consideration the existing residential zoned land. The model includes the proposed Eglinton Village expansion, proposed industrial or service business developments located south of Great Western Highway, proposed upgrade along the Great Western Highway at Kelso by Roads and Maritime and the land use developments (L1-L3) assumed for short term scenario.
- With proposed developments for all land use scenarios in 2016, 2025 and 2035. The model includes the proposed Eglinton Village expansion, proposed industrial or service business developments located south of Great Western Highway, proposed upgrade along the Great

Western Highway at Kelso by Roads and Maritime and the land use developments for corresponding land use scenarios.

The results of the analysis are summarised in this section and the detailed results are included in Appendix B.

### Future performance of intersections – without proposed developments (2035)

The future performance of the key intersections in the study area for the morning and afternoon peak periods has been assessed using the PARAMICS output without the KDA for 2035, in order to ascertain what base works will be required on the network. The modelling identified that some works would be required in the future to accommodate the increased background traffic growth on the road network. This included the following road network improvements compared to the base case:

- Provision of dual left turns from Durham Street (South) to Stewart Street at the Durham Street/Stewart Street intersection.
- Traffic signals at the Great Western Highway/Rankin Street intersection.
- Provision of three (3) approach lanes on the George Street both directions at the Great Western Highway/George Street intersection.

The results of the analysis are summarised in **Table 5.9**. Refer to Appendix B for detailed results.

**Table 5.9 Future performance of intersections – without Kelso developments (L4-10) - 2035**

| Intersection | Control | Morning peak period | | Afternoon peak period | |
|---|---|---|---|---|---|
| | | Average delay* | Level of Service (LoS) | Average delay* | Level of Service (LoS) |
| **Great Western Highway** | | | | | |
| Stewart St | Signal | 22.9 | B | 19.1 | B |
| Rankin St | Signal | 31.7 | C | 39.2 | C |
| George St | Signal | 34.4 | C | 40.4 | C |
| William St | Signal | 24.7 | B | 37.0 | C |
| Bentinck St | Signal | 22.2 | B | 39.2 | C |
| Havannah St | Signal | 24.1 | B | 30.7 | C |
| Gilmour St (MR54) | Signal | 18.1 | B | 21.8 | B |
| Boyd St | Signal | 23.8 | B | 27.0 | B |
| Littlebourne St (MR253) | 2 lane circulating roundabout | 26.4 | B | 93.2 | F |
| Ashworth St | 2 lane circulating roundabout | 10.5 | A | 13.1 | A |
| **Gilmour Street (MR54)** | | | | | |
| Eleven Mile Drive | Priority | 9.0 | A | 11.8 | A |
| Halfpenny Drive | Priority | 5.8 | A | 8.9 | A |
| Hereford St | 1 lane circulating roundabout | 18.1 | B | 16.3 | B |

| Intersection | Control | Morning peak period | | Afternoon peak period | |
|---|---|---|---|---|---|
| | | Average delay* | Level of Service (LoS) | Average delay* | Level of Service (LoS) |
| **Hereford Street/Marsden Lane** | | | | | |
| Stanley St | 1 lane circulating roundabout | 10.6 | A | 11.8 | A |
| Hughes Street | Priority | 13.5 | A | 10.9 | A |
| New Link A | Priority | 9.0 | A | 12.0 | A |
| **Boyd Street/Limekilns Road** | | | | | |
| Hughes Street | Priority | 4.8 | A | 5.7 | A |
| Marsden Lane | Priority | 10.9 | A | 11.0 | A |
| New Link E | Priority | 5.7 | A | 4.2 | A |

Note: For roundabout and priority control intersections, the maximum delay and LoS for a particular movement is reported. *Average delay in secs/veh

From **Table 5.9**, the road network improvements included in the model would have the potential to provide Level of Service (LOS) C or better at all key intersections except the Great Western Highway/Littlebourne Street (MR253) intersection. The performance of the Great Western Highway/Littlebourne Street (MR253) intersection is predicted to be over-capacity (LOS F) during the afternoon peak period. As the intersection LOS is reported for the worst movement, the westbound Great Western Highway traffic experiences the most delay. This is primarily due to the heavy right turn volume from Great Western Highway into Littlebourne Street.

### Future performance of intersections – Short term scenario (2016)

The future performance of the key intersections in the study area for the morning and afternoon peak periods has been assessed using the PARAMICS output for the short term scenario -2016. The model included the following compared to the base case:

- Future land use developments proposed for the short term scenario.
- Proposed upgrade along the Great Western Highway by Roads and Maritime.
- Traffic signals at the Great Western Highway/Rankin Street intersection.

The results of the analysis are summarised in **Table 5.10**. Refer to Appendix B for detailed results.

Table 5.10 Future performance of intersections - 2016

| Intersection | Control | Morning peak period | | Afternoon peak period | |
|---|---|---|---|---|---|
| | | Average delay* | Level of Service (LoS) | Average delay* | Level of Service (LoS) |
| **Great Western Highway** | | | | | |
| Stewart St | Signal | 18.1 | B | 28.7 | C |
| Rankin St | Signal | 8.2 | A | 11.3 | A |
| George St | Signal | 30.6 | C | 48.8 | D |
| William St | Signal | 21.2 | B | 30.8 | C |
| Bentinck St | Signal | 18.2 | B | 21.4 | B |
| Havannah St | Signal | 17.5 | B | 23.2 | B |
| Gilmour St (MR54) | Signal | 19.7 | B | 21.4 | B |
| Boyd St | Signal | 23.2 | B | 19.3 | B |
| Littlebourne St | 2 lane roundabout | 13.4 | A | 15.1 | A |
| Ashworth St | 2 lane roundabout | 9.0 | A | 10.0 | A |
| **Gilmour Street (MR54)** | | | | | |
| Eleven Mile Dr | Priority | 9.9 | A | 6.6 | A |
| Halfpenny Drive | Priority | 5.4 | A | 10.0 | A |
| Hereford St | 1 lane roundabout | 18.0 | B | 16.7 | B |
| **Hereford Street/Marsden Lane** | | | | | |
| Stanley St | 1 lane roundabout | 8.0 | A | 10.4 | A |
| Hughes Street | Priority | 13.1 | A | 11.1 | A |
| New Link A | Priority | 7.9 | A | 12.5 | A |
| **Boyd Street/Limekilns Road** | | | | | |
| Hughes Street | Priority | 4.9 | A | 5.2 | A |
| Marsden Lane | Priority | 10.4 | A | 11.1 | A |
| New Link E | Priority | 4.7 | A | 4.3 | A |

Note: For roundabout and priority control intersections, the maximum delay and LoS for a particular movement is reported. *Average delay in secs/veh

From **Table 5.10**, the performance of the intersections located within the study area is acceptable (LOS 'C' or better) except for the Great Western Highway and George Street intersection. The performance of the Great Western Highway and George Street is unacceptable (LOS 'D' or worse) during the afternoon peak period.

### Future performance of intersections – Medium term scenario (2025)

The future performance of the key intersections in the study area for the morning and afternoon peak periods has been assessed using the PARAMICS output for the medium term scenario (2025). The models included the following compared to the base case:

- Future land use developments proposed for the medium term scenario.

- Proposed upgrade along the Great Western Highway by Roads and Maritime.
- Traffic signals at the Great Western Highway/Rankin Street intersection.
- Widening of George Street (east) to provide three approach lanes (including short right turn lane).
- Traffic signal adjustments at the Great Western Highway (Durham Street)/George Street intersection.
- Line marking and civil works along George Street (west) to provide three approach lanes (including short right turn lane).

The results of the analysis are summarised in **Table 5.11**. Refer to Appendix B for detailed results.

**Table 5.11 Future performance of intersections – 2025**

| Intersection | Control | Morning peak period | | Afternoon peak period | |
|---|---|---|---|---|---|
| | | Average delay* | Level of Service (LoS) | Average delay* | Level of Service (LoS) |
| **Great Western Highway** | | | | | |
| Stewart St | Signal | 23.1 | B | 25.6 | B |
| Rankin St | Signal | 27.2 | B | 31.6 | C |
| George St | Signal | 51.6 | D | 54.4 | D |
| William St | Signal | 21.4 | B | 35.6 | C |
| Bentinck St | Signal | 22.3 | B | 35.6 | C |
| Havannah St | Signal | 23.6 | B | 26.9 | B |
| Gilmour St (MR54) | Signal | 17.2 | B | 19.5 | B |
| Boyd St | Signal | 37.0 | C | 26.7 | B |
| Littlebourne St (MR253) | 2 lane roundabout | 32.9 | C | 28.3 | B |
| Ashworth St | 2 lane roundabout | 9.1 | A | 10.0 | A |
| **Gilmour Street (MR54)** | | | | | |
| Eleven Mile Drive | Priority | 10.9 | A | 11.8 | A |
| Halfpenny Drive | Priority | 7.2 | A | 7.5 | A |
| Hereford St | 1 lane roundabout | 58.5 | E | 69.5 | E |
| **Hereford Street/Marsden Lane** | | | | | |
| Stanley St | 1 lane roundabout | 9.9 | A | 12.5 | A |
| Hughes Street | Priority | 11.4 | A | 11.4 | A |
| New Link A | Priority | 12.7 | A | 11.8 | A |
| **Boyd Street/Limekilns Road** | | | | | |
| Hughes Street | Priority | 7.1 | A | 8.3 | A |

| Intersection | Control | Morning peak period | | Afternoon peak period | |
|---|---|---|---|---|---|
| | | Average delay* | Level of Service (LoS) | Average delay* | Level of Service (LoS) |
| Marsden Lane | Priority | 10.8 | A | 11.2 | A |
| New Link E | Priority | 5.4 | A | 5.4 | A |

Note: For roundabout and priority control intersections, the maximum delay and LoS for a particular movement is reported. *Average delay in secs/veh

From **Table 5.11**, the performance of the intersections located within the study area is satisfactory (LOS 'C' or better) except for the following intersections:

- Great Western Highway and George Street intersection during the morning and afternoon peak periods. There is the potential to convert the existing parking lane on the Great Western Highway in each direction to a traffic lane, providing three lanes in each direction along the highway.
- Gilmour Street (MR54) and Hereford Street intersection during both peak periods. Gilmour Street (MR54) and Hereford Street intersection would need to be upgraded to either a 2-lane circulating roundabout or traffic signals. Traffic signals would require significant construction and widening of approach streets and the site is not expected to generate sufficient traffic volumes to meet the warrants for traffic signals. In this regard the 2-lane roundabout would be the preferred intersection option.

### Future performance of intersections – Long Term Scenario (2035)

The future performance of the key intersections in the study area for the morning and afternoon peak periods has been assessed using the PARAMICS output for the long term scenario (2035). The model included the following changes to the network compared to the base case:

- Future land use developments proposed for the long term scenario
- Signalise Great Western Highway (Durham Street)/Rankin Street intersection
- Proposed upgrade along the Great Western Highway by Roads and Maritime
- Provision of 1-lane circulating roundabout at the Marsden Lane/Hughes Street intersection
- Provision of 1-lane circulating roundabout at the Marsden Lane/New Link A intersection
- Upgrading from 1-lane circulating roundabout to 2-lane circulating roundabout at the Gilmour Street (MR54)/Hereford Street/Marsden Lane and Hereford Street/Stanley Street intersections
- Realignment of Gilmour Street (MR54) at Great Western Highway with Stockland Drive.
- Widening of Hereford Street from Gilmour Street (MR54) to Stanley Street from 2 lanes to 4 lanes including widening of bridge over Macquarie River
- Widening of George Street from Stanley Street to Great Western Highway (Durham Street) to provide three (3) approach lanes and two (2) exit lanes.
- Provision of four (4) approach lanes and two (2) exit lanes on the George Street (east) at the Great Western Highway/George Street intersection.
- Traffic signal adjustments at the Great Western Highway (Durham Street)/George Street intersection
- Line marking and civil works along George Street to provide four (4) approach lanes (including short right turn lane) and two (2) departure lanes.
- Provision of dual left turns from Durham Street (South) to Stewart Street at the Durham Street/Stewart Street intersection.

- Provision of two (2) lane approach (50m) with modification to the existing parking arrangements on Rankin Street (west).
- In order to improve the operation of the intersection along the Great Western Highway between Bentinck Street and Stewart Street, the use of the existing parking lane along the highway through this section was assessed, providing three through lanes in each direction, with the kerb lane operating as a shared left/through lane at the intersections. Currently Durham Street/ Great Western Highway is already wide enough to accommodate a third traffic lane on both directions with only requiring removal of parking, or implementation of clearways during peak hours. Parking loss should not be a major issue, as all businesses that need parking already have off-street parking on site.

The results of the analysis are summarised in **Table 5.12**. Refer to Appendix B for detailed results.

**Table 5.12 Future performance of intersections – 2035 (with realigned Gilmour Street)**

| Intersection | Control | Morning peak period | | Afternoon peak period | |
|---|---|---|---|---|---|
| | | Average delay* | Level of Service (LoS) | Average delay* | Level of Service (LoS) |
| **Great Western Highway** | | | | | |
| Stewart St | Signal | 22.2 | B | 26.8 | B |
| Rankin St | Signal | 38.8 | C | 40.0 | C |
| George St | Signal | 51.1 | D | 57.2 | E |
| William St | Signal | 22.9 | B | 37.8 | C |
| Bentinck St | Signal | 25.7 | B | 38.2 | C |
| Havannah St | Signal | 36.0 | C | 29.2 | C |
| Gilmour St (MR54) | Signal | 27.6 | B | 46.0 | D |
| Boyd St | Signal | 43.5 | D | 37.1 | C |
| Littlebourne St | 2 lane roundabout | 65.4 | E | 82.6 | F |
| Ashworth St | 2 lane roundabout | 10.7 | A | 13.7 | A |
| **Gilmour Street (MR54)** | | | | | |
| Eleven Mile Drive | Priority | 15.1 | B | 20.9 | B |
| Halfpenny Drive | Priority | 24.2 | B | 21.6 | B |
| Hereford St | 2 lane roundabout | 30.8 | C | 32.1 | C |
| **Hereford Street/Marsden Lane** | | | | | |
| Stanley St | 2 lane roundabout | 9.2 | A | 17.8 | B |
| Hughes Street | 1 lane roundabout | 6.4 | A | 8.5 | A |
| New Link A | 1 lane roundabout | 56.2 | D | 24.0 | B |
| **Boyd Street/Limekilns Road** | | | | | |
| Hughes Street | Priority | 13.3 | A | 19.7 | B |
| Marsden Lane | Priority | 10.5 | A | 13.4 | A |
| New Link E | Priority | 7.2 | A | 11.5 | A |

Note: For roundabout and priority control intersections, the maximum delay and LoS for a particular movement is reported. *Average delay in secs/veh

From **Table 5.12**, the performance of the intersections located within the study area is satisfactory (LOS 'C' or better) except for the following intersections:

- Great Western Highway and George Street intersection during both peak periods.
- Great Western Highway and Gilmour Street (MR54) intersection during the afternoon peak period.
- Great Western Highway and Boyd Street intersection during the morning peak period.
- Great Western Highway and Littlebourne Street (MR253) intersection during the both peak periods.
- Marsden Lane and New Link A intersection during the morning peak period.

Based on the above, the performance of the George Street, Gilmour Street, Boyd Street and New Link A intersections with the Great Western Highway would operate near or at capacity (LOS D or E) whereas the Littlebourne Street intersection would deteriorate to an unacceptable level.

However, it is worth noting that the intersection of Gilmour Street with Great Western Highway, for the long term scenario of 2035, incorporates the realigned Gilmour Street with Stockland Drive. The Gilmour Street approach for this intersection exhibited LOS D and F for the morning and afternoon periods respectively (refer to Appendix B). This may be largely due to the dominant flows along Great Western Highway where Gilmour Street receives less priority. However, from a modelling perspective, despite the overall intersection performance operating near capacity, the poor LOS performance for the Gilmour Street approach volumes represents only 5 – 6% of the total traffic volume through the intersection. As expected, the Great Western Highway approaches carry the dominant volumes which perform better in terms of LOS as it is assigned more priority, hence exhibiting satisfactory performance of no more than LOS C for both peak periods.

In reality, as the traffic signal system (known as SCATS, Sydney Coordinated Adaptive Traffic System) optimises the signal timings based on the changing traffic flows, various movements/approaches may experience reduced priority to accommodate the dominant flows during different peak periods.

### Future performance of intersections – Long Term Scenario (2035) without Gilmour Street realignment

To identify and assess whether the Gilmour Street realignment option provides any significant benefits, an additional modelling scenario was tested for the long term scenario 2035. As a comparative assessment, the 2035 scenario was modelled with the full KDA however without the realigned Gilmour Street to Stockland Drive at Great Western Highway. The results of the analysis are summarised in **Table 5.13**. Refer to Appendix B for detailed results.

**Table 5.13 Future performance of intersections – 2035 (without realigned Gilmour Street)**

| Intersection | Control | Morning peak period | | Afternoon peak period | |
|---|---|---|---|---|---|
| | | Average delay* | Level of Service (LoS) | Average delay* | Level of Service (LoS) |
| **Great Western Highway** | | | | | |
| Stewart St | Signal | 51.5 | D | 49.3 | D |
| Rankin St | Signal | 36.9 | C | 41.5 | C |
| George St | Signal | 72.2 | F | 87.7 | F |
| William St | Signal | 31.1 | C | 56.2 | D |
| Bentinck St | Signal | 27.2 | B | 25.9 | B |
| Havannah St | Signal | 27.0 | B | 24.3 | B |
| Gilmour St | Signal | 20.8 | B | 32.0 | C |

| Intersection | Control | Morning peak period | | Afternoon peak period | |
|---|---|---|---|---|---|
| | | Average delay* | Level of Service (LoS) | Average delay* | Level of Service (LoS) |
| (MR54) | | | | | |
| Boyd St | Signal | 48.0 | D | 145.5 | F |
| Littlebourne St | 2 lane roundabout | 73.7 | F | 219.8 | F |
| Ashworth St | 2 lane roundabout | 10.6 | A | 15.5 | B |
| **Gilmour Street (MR54)** | | | | | |
| Eleven Mile Drive | Priority | 14.1 | A | 21.7 | B |
| Halfpenny Drive | Priority | 21.1 | B | 37.5 | C |
| Hereford St | 2 lane roundabout | 37.7 | C | 50.2 | D |
| **Hereford Street/Marsden Lane** | | | | | |
| Stanley St | 2 lane roundabout | 36.0 | C | 18.8 | B |
| Hughes Street | 1 lane roundabout | 21.9 | B | 17.1 | B |
| New Link A | 1 lane roundabout | 23.0 | B | 26.4 | B |
| **Boyd Street/Limekilns Road** | | | | | |
| Hughes Street | Priority | 17.5 | B | 41.0 | C |
| Marsden Lane | Priority | 9.9 | A | 11.0 | A |
| New Link E | Priority | 13.9 | A | 75.1 | F |

Note: For roundabout and priority control intersections, the maximum delay and LoS for a particular movement is reported. *Average delay in secs/veh

When comparing the results from **Table 5.12** and **Table 5.13**, it is evident that, in the long term scenario without the Gilmour Street realignment, there are key intersections in Bathurst, Kelso and particularly for the KDA that degrade further in intersection performance, specifically:

- Great Western Highway and Stewart Street intersection during both peak periods (LOS B to D).
- Great Western Highway and George Street intersection during both peak periods (LOS D to F for the morning and LOS E to F for the afternoon).
- Great Western Highway and William Street intersection during the afternoon peak period (LOS C to D).
- Great Western Highway and Boyd Street intersection during afternoon peak period (LOS C to F).
- Great Western Highway and Littlebourne Street intersection during the morning peak period (LOS E to F).
- Gilmour Street and Hereford Street intersection during the afternoon peak period (LOS C to D).
- Limekilns Road and New Link E intersection during the afternoon peak period (LOS A to F).

The most significant degrade in intersection performance, in terms of average delay, should be highlighted for the Boyd Street and Littlebourne Street intersections with the Great Western Highway where the afternoon peak period results with significant delays (both increasing more than 100 seconds in average delay).

The Boyd Street and New Link E intersections with Great Western Highway exhibit the greatest reduction in intersection performance, from operating satisfactorily (LOS C and A respectively) to over-capacity (both LOS F). This suggests that the realigned Gilmour Street provides potentially significant intersection performance improvements for Boyd Street which may be contributed by the increased distance between the two intersections.

It should be acknowledged that the Gilmour Street realignment would require further detailed assessment in terms of the cost, benefits and other considerations, such as community and environmental issues, as the results outlined for the merits of the Gilmour Street realignment pertain to a traffic modelling perspective only.

Therefore based on the results of the traffic modelling and as a result of the proposed KDA, the realignment of Gilmour Street would provide some benefit to the immediate road network for the future performance of the intersections.

## 5.5 Future car parking situation

The proposed Kelso development would increase on-street and off-street car parking demand in Kelso as well as Bathurst CBD. Since the number of retail outlets, office facilities and employment opportunities are limited in Kelso, it is expected that the Kelso residents would use the major retail and office facilities in Bathurst CBD. This would have the potential to increase parking demand in the Bathurst CBD.

## 5.6 Traffic and parking impacts

Traffic and transport management measures, as detailed in Section 5, need to be developed to reduce private car trips between Kelso and Bathurst by promoting active and public transport to improve the performance along the Great Western Highway and minimise the parking impacts on Bathurst CBD.

## 5.7 Road Safety

Based on the crashes recorded between January 2007 and December 2011, it is evident that the following issues need to addressed, with the KDA, which will increase traffic movements substantially within Kelso. The following comments are provided in relation to the road safety with the KDA:

- The rear end type crashes are over represented in the two-way, two-lane section (east of View street) of the highway. The proposed Roads and Maritime upgrade of the highway with widening of the carriageway to four (4) lanes would provide overtaking opportunity for motorists and has the potential to reduce the number of rear end type crashes.
- There is a safety concern that a high number of off-road crashes occurred on the existing road network which primarily serves the residential land uses and the road network is currently signposted 50/60 km/h.
- A total of three (3) pedestrian crashes were reported to occur on a road network that serves the residential community of Kelso. The future Kelso development area needs to provide shared paths, footpaths and pedestrian refuges to provide improved pedestrian safety.

# 6. Draft Costing and Staging Plan

With the development of the new residential development of Kelso there is a need to identify the costs for implementing various aspects of infrastructure in order to provide appropriate facilities for the future residents. Developers of the land will provide infrastructure as part of the development approval process and construction of the development. For the purposes of this study this will include road and footpath development, among other things, up to and including collector roads (works-in-kind).

Other aspects, such as improvements to existing traffic facilities, will require a contribution from the developer to Bathurst Regional Council or Roads and Maritime Services for the upgrading of facilities such as intersection improvements (traffic signals, roundabouts, road widening), the provision of off-road pedestrian pathways/cycleways or other works to accommodate the additional traffic that will be generated by the development.

The following summary of works and who will most likely be responsible for the expenditure of funds provided by developers has been identified for the progressive development of the Kelso area. As highlighted above, developers may provide some of this as works-in-kind rather than pay a contribution to Council.

Table 6.1 summarises the identified infrastructure requirements for the three scenarios of the KDA, and identifies:

- **KDA req'd?**– whether the infrastructure is required wholly/ largely as a result of the KDA (Y = "Yes"), or whether the works would have been required wholly/ largely by general traffic growth, even if the KDA did not occur (N = "No").
- **Local/ State works** – whether the works are on local roads or State roads. It should be noted that the local/ State designation does not imply funding responsibility by that party: that is, not all "Local" road works would necessarily be the funding responsibility of Council, nor "State" road works the funding responsibility of the State government. Funding responsibilities would be negotiated at a later stage.

It is worth noting that the following cost estimates in

Table 6.1 have been calculated using the Rawlinsons Australian Construction Handbook 2014, Edition 32. The calculations behind the cost estimates are based on the following inputs and provisions from the handbook:

- Unit prices have been extracted from the handbook under the relevant sections of Detailed Prices.
- The Detailed Prices are indicative average prices for reasonable quantities of work and would apply to projects in excess of $1,500,000 and having average site conditions.
- Prices, unless otherwise described, are for the completely installed item of work including Builders' overheads and profit normally applying at the commencement of 2014. Whilst including for site allowance at the average rate per hour, they do not included any other special allowances such as structural and height allowances etc.
- The majority of the unit prices used to determine the cost estimates are considered under Civil Engineering Road works and Bridgeworks. Road works prices include minimal cut and fill with in-situ concrete kerbs but exclude lighting and drainage. Bridgeworks prices are for reinforced concrete single span bridges including safety rails, balustrades but exclude approach works, abutments and piling.
- Prices exclude GST.

From previous cost estimates undertaken in 2013, the presented values in **Table 6.1** have adopted 2014 unit rates where the most significant reduction in cost relates to roadwork prices. Therefore, the following cost estimates are to be taken as indicative relative amounts where detailed calculations

would be required by an appropriate cost estimator to consider the required construction and resourcing factors.

**Table 6.1 KDA Infrastructure requirements by development scenarios**

| Item no. | Infrastructure requirement | Cost estimate ($) | KDA req'd ? | Local/ State works |
|---|---|---|---|---|
| | **Short term (2016 – L1, L2, L3)** | | | |
| 1 | ***KDA Local Roads*** – A, B, C, part D and E. | 4,962 K | Y | Local |
| 2 | ***Rural sections of Halfpenny Drive, Marsden Lane and Limekilns Road*** to be upgraded to urban condition with footpaths up to built-up areas. | 3,701 K | Y | Local |
| 3 | Signalise ***Great Western Highway (Durham Street)/Rankin Street intersection***. | 325 K | N | State |
| | **Medium term (2025 – L1-L6)** | | | |
| 4 | ***KDA Local Road*** – remainder of D. | 746 K | Y | Local |
| 5 | ***KDA Collector Road*** – I. | 1,712 K | Y | Local |
| 6 | ***Great Western Highway (Durham Street)/George Street intersection*** – Widening of George Street (east) to provide three approach lanes (including short right turn lane) and two departure lanes. | 26 K | Y | Local |
| 7 | ***Great Western Highway (Durham Street)/George Street intersection*** – Line marking and civil works along George Street (west) to provide three approach lanes (including short right turn lane) and two departure lanes. | 32.5 K | N | Local |
| 8 | ***Great Western Highway (Durham Street)/George Street intersection*** – Traffic signal adjustments at the Great Western Highway (Durham Street)/George Street intersection. | 28 K | Y | State |
| | **Long term (2035 – L1-L10)** | | | |
| 9 | ***KDA Local Roads*** – F G, and H. | 13,246 K | Y | Local |
| 10 | ***KDA Collector Roads*** – J and K (excluding intersection at Great Western Highway). | 11,112 K | Y | Local |
| 11 | ***Collector Road K intersection at Great Western Highway – extension of Road K to GWH, and 2-lane roundabout at GWH.*** | 1,250 K | Y | Local & State |
| 12 | ***Between Great Western Highway (Durham Street) and Gilmour Street (MR54) on Hereford Street and George Street*** – Upgrading from 1-lane circulating roundabout to 2-lane circulating roundabout at the Gilmour Street (MR54)/Hereford Street/Marsden Lane and Hereford Street/Stanley Street intersections. | 750 K | Y | Local |
| 13 | ***Between Great Western Highway (Durham Street) and Gilmour Street (MR54) on Hereford Street and George Street*** – Widening of Hereford Street from Gilmour Street (MR54) to Stanley Street from 2 lanes to 4 lanes including | 3,041 K | Y | Local |

| Item no. | Infrastructure requirement | Cost estimate ($) | KDA req'd ? | Local/ State works |
|---|---|---|---|---|
| | widening of bridge over Macquarie River. | | | |
| 14 | ***Between Great Western Highway (Durham Street) and Gilmour Street (MR54) on Hereford Street and George Street*** – Widening of George Street from Stanley Street to Great Western Highway (Durham Street) to provide four approach lanes (including short right turn lane) and three departure lanes. | 425 K | Y | Local |
| 15 | ***Between Great Western Highway (Durham Street) and Stanley Street on George Street*** – Bicycle lane/shared path between Great Western Highway (Durham Street) and Stanley Street along George Street. | 49 K | Y | Local |
| 16 | Provision of dual left turns from Durham Street (South) to Stewart Street at the ***Durham Street/Stewart Street intersection***. | 33 K | N | State |
| 17 | ***Marsden Lane/Hughes Street and Marsden Lane/New Link A intersections*** - Provision of 1-lane circulating roundabout | 273 K | Y | Local |

# 7. Input into Draft Section 94 Contribution Plan

Section 94 of the Environmental Planning and Assessment Act 1979 provides that where development consent is being sought for a development which is likely to require the provision of new facilities or an increase in demand on existing public facilities or services, then Council provide a condition where a monetary contribution or dedication of land, or both, is required for the development of the facilities.

The fundamental principles that are required to be considered in the application of Section 94 contributions include:

- ***Reasonableness*** - in that there is a connection between the KDA and the need for the new and/or additional facilities needed to be implemented to accommodate the additional impacts of the development. This can include, in the instance of the Roads Contribution Plan, the need to provide additional traffic facilities, amplification of the existing road network or the provision of new roads, traffic management or pedestrian/cycling facilities for the increased traffic.
- ***Accountability*** – that the contributions made under the provisions of S94 are monitored to ensure that the Plan remains relevant and that the delivery of the identified facilities occurs in accordance with the plan

A Draft Section 94 Contribution Plan will be prepared by BRC based on the Section 94 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). A summary of the identified costs per lot by catchment area for roads and associated traffic facilities are provided in Table 7.1**.** It should be noted that these amounts are to be taken as indicative relative amounts, to be used to assist BRC in developing the contributions plan, due to the following developing issues:

- ***Hereford Street Bridge*** – This report recommends the duplication of the low-level bridge on Hereford Street (over the Macquarie River) to meet the aims of this traffic study, and this cost has been included in the infrastructure cost estimates. However, Bathurst Regional Council is considering the feasibility of also raising the level of the Hereford Street Bridge to accommodate flood events. Roads and Maritime suggest that if raised, the bridge height should be increased to above the level of a 1:20 flood event (as a minimum), to avoid losing this crucial road link (Hereford Road) and thereby potentially causing significant traffic congestion on the Great Western Highway (which is the only other alternative river crossing route in Bathurst). Council recognise that it is its responsibility to undertake further investigations as to the proposed design and works required to raise the bridge and its approaches to accommodate the flood event required, and to estimate the cost of the works required.
- ***State Government funding*** – The State Government, through a form of special infrastructure contribution (SIC) agreement, is also likely to contribute funds towards traffic and transport infrastructure works associated with growth resulting from the Kelso Development area (KDA) and general traffic/ transport growth in Bathurst city. However, the final scope of works and funding amount to be supported, and timeframe for the works, are currently being discussed so while this report assumes some State Government funding contribution, the assumptions are subject to change.

The calculation of contribution rates is determined based on the following formulae, where all rates are determined to the nearest dollar:

$$C_{proj} = \frac{TC}{Sum(T_{lots})}$$

$$C_{lot} = Sum(C_{proj}\ per\_catchment)$$

$C_{proj}$ = the contribution rate per project.
TC = the total cost to Bathurst Regional Council (less any grant or reserve funds).

$T_{lot}$ = the total estimated existing and proposed residential lots within the benefiting contribution area(s).
$C_{lot}$ = the contribution rate per lot.

Table 7.1 presents the indicative totals for each lot contribution, whereas

Table 7.2 shows a detailed breakdown of the contributions.

**Table 7.1** **Indicative Relative s94 contribution per lot (by KDA catchment area)**

| KDA Catchment area | Relative s94 contribution per lot |
|---|---|
| **Residential contribution** | |
| L1 | $4,665 |
| L2 | $4,665 |
| L3 | $6,795 |
| L4 | $3,953 |
| L5 | $11,506 |
| L6 | $5,561 |
| L7 | $3,953 |
| L8 | $3,377 |
| L9 | $3,071 |
| L10 | $5,561 |
| **Retail area contribution** | |
| Retail | $456,763* |

Note: * Total contribution for retail area

**Table 7.2 Indicative detailed relative s94 contribution per lot (by KDA catchment area)**

| | AREA | TOTAL | CONTRIBUTION | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| COST | WHICH | NO. OF | L1 | L2 | L3 | L4 | L5 | L6 | L7 | L8 | L9 | L10 | Retail area |
| | BENEFITS | LOTS | $ PER LOT | $ PER LOT | $ PER LOT | $ PER LOT | $ PER LOT | $ PER LOT | $ PER LOT | $ PER LOT | $ PER LOT | $ PER LOT | |
| $1,985,433 | L3 | 614 | | | $3,234 | | | | | | | | |
| $1,740,534 | L3 | 614 | | | $2,835 | | | | | | | | |
| $446,066 | L3 | 614 | | | $726 | | | | | | | | |
| $2,386,018 | L5, L9, retail | 444 | | | | | $5,376 | | | | $538 | | $293,492 |
| $2,567,943 | L1, L2, L4 | 607 | 4665 | 4665 | | | | | | | | | |
| $2,567,943 | L4 & L7 | 829 | | | | $3,098 | | | $3,098 | | | | |
| $2,090,390 | L6 , L10, retail | 1295 | | | | | | $1,615 | | | | $1,615 | $88,144 |
| $1,486,888 | L8 & L9+retail | 1618 | | | | | | | | $919 | $827 | | $50,153 |
| $2,737,623 | L6, L10 | 1038 | | | | | | $2,404 | | | | $2,404 | |
| $4,478,157 | L5, L8, L9 | 1386 | | | | | $4,586 | | | | | | |
| $3,778,445 | L4, L7, L8, L9 | 822 | | | | | | | | | | | |
| $983,244 | L4, L7 & L8 | 1149 | | | | $856 | | | $856 | $856 | | | |
| $1,070,886 | L8 & L9 | 1011 | | | | | | | | $1,059 | $530 | | |
| $833,520 | L5, L6, L9, L10 & retail | 1822 | | | | | $457 | $457 | | | $91 | $457 | $24,973 |
| $1,982,100 | L5, L6, L8, L9 & L10 | 3033 | | | | | $654 | $654 | | $327 | $654 | $654 | |
| $39,257 | L5, L6, L8, L9 & L10 | 3033 | | | | | $13 | $13 | | $6 | $13 | $13 | |
| $308,945 | L5, L6, L8, L9 & L10 | 3033 | | | | | $102 | $102 | | $51 | $102 | $102 | |
| $13,000 | L5, L6, L8, L9 & L10 | 3033 | | | | | $4 | $4 | | $2 | $4 | $4 | |
| $53,367 | L5, L6, L8, L9 & L10 | 3033 | | | | | $18 | $18 | | $9 | $18 | $18 | |
| $53,367 | L5, L6, L8, L9 & L10 | 3033 | | | | | $18 | $18 | | $9 | $18 | $18 | |
| $42,049 | L5, L6, L8, L9 & L10 | 3033 | | | | | $14 | $14 | | $7 | $14 | $14 | |
| $800,788 | L5, L6, L8, L9 & L10 | 3033 | | | | | $264 | $264 | | $132 | $264 | $264 | |
| **$28,273,929** | | | **$4,665** | **$4,665** | **$6,795** | **$3,953** | **$11,506** | **$5,561** | **$3,953** | **$3,377** | **$3,071** | **$5,561** | **$456,763** |
| **Lots/area** | | | **113** | **31** | **614** | **463** | **251** | **404** | **366** | **320** | **1382** | **836** | **55** |

# 8. Summary and conclusions

The following summary and conclusions are drawn from this study:

1. Assuming that the current journey to work pattern will continue, the majority of the residents of the KDA are expected to work within the BRC area. The majority of the workers of any new employment developments proposed within the KDA are expected to live in the BRC area.
2. Based on the current mode of travel patterns, the majority of the residents of the future KDA are expected to travel using private cars. The usage of public transport and other forms of transport by the residents of the KDA is expected to be minimal.
3. The existing performance of the intersections located within the study area is good (LOS 'A' or 'B') except for the Great Western Highway and George Street intersection during the morning and afternoon peak periods and, the Great Western Highway and William Street during the afternoon peak period. The performance of these intersections is satisfactory (LOS 'C' or better).
4. The majority of the crashes recorded on the Great Western Highway were rear end type crashes. The rear end type crashes are over represented in the two way, two lane section (east of view street) of the highway.
5. The majority of the crashes were recorded as off-road type crashes for the roads (other than the Great Western Highway) located within Kelso. Off road crashes generally occur on rural roads with high posted speed limits. There is a safety concern that the high number of off road crashes occurred on road network which primarily serves residential land uses and the road network is currently signposted for a 50/60 km/h speed limit. It was also observed that a total of three (3) pedestrian crashes were reported to occur on a road network that serves the residential community of Kelso.
6. The pedestrian and cycleway network in the established part of Kelso are around Boyd Street, along Gilmour Street (MR54) and a number of short pedestrian access paths linking cul-de-sacs with adjacent roads or reserves. However, there are large parts of central and northern Kelso that do not have any pedestrian footpaths or shared paths. There is also no correlation between provision of pedestrian paths and bus route and stop locations, which means that it is difficult for residents to access the bus stops if they have a mobility impairment or are pushing prams. Both these factors would contribute to residents' isolation and car dependence.
7. Kelso area is currently being served by buses only. Bathurst is a major regional town in New South Wales. A total of nine (9) bus routes serve the Bathurst area, and are operated by Bathurst Buslines. Three out of nine (9) services serve Kelso via Great Western Highway, Gilmour Street (MR54) and Boyd Street.
8. The flooding events that occur along Macquarie River and Raglan Creek cause disruptions to traffic movements on Hereford Street and the Great Western Highway. Major flood events cause significant delays for residents of Kelso to access the Bathurst area.
9. The KDA is estimated to generate 43,290 vehicle movements daily and 4,088 movements during morning and afternoon peak periods from 4,810 dwellings.
10. The future performance of the key intersections in the study area for the morning and afternoon peak periods has been assessed using the PARAMICS micro-simulation modelling program output without proposed developments in 2035 in order to assess the works required to accommodate future background traffic growth. The model included the following road network improvements compared to the base case:
    - Provision of dual left turns from Durham Street (South) to Stewart Street at the Durham Street/Stewart Street intersection.
    - Traffic signals at the Great Western Highway/Rankin Street intersection.
    - Proposed upgrade along the Great Western Highway by Roads and Maritime

- Provision of three (3) approach lanes on the George Street both directions at the Great Western Highway/George Street intersection.

The above road network improvements included in the model would have the potential to provide Level of Service (LOS) 'C' or better at all key intersections except the Great Western Highway/Littlebourne Street (MR253) intersection. The performance of the Great Western Highway/Littlebourne Street (MR253) intersection is predicted to be unsatisfactory (LOS 'D') during the afternoon peak period.

11. The future performance of the key intersections in the study area for the morning and afternoon peak periods has been assessed using the PARAMICS output for the long term scenario - 2035. The model included the following items, compared to the base case:
    - Future land use developments proposed for the long term scenario
    - Signalise Great Western Highway (Durham Street)/Rankin Street intersection
    - Proposed upgrade along the Great Western Highway by Roads and Maritime
    - Provision of 1-lane circulating roundabout at the Marsden Lane/Hughes Street intersection
    - Provision of 1-lane circulating roundabout at the Marsden Lane/New Link A intersection
    - Upgrading from 1-lane circulating roundabout to 2-lane circulating roundabout at the Gilmour Street (MR54)/Hereford Street/Marsden Lane and Hereford Street/Stanley Street intersections
    - Realignment of Gilmour Street (MR54) at Great Western Highway with Stockland Drive.
    - Widening of Hereford Street from Gilmour Street (MR54) to Stanley Street from 2 lanes to 4 lanes including widening of the bridge over the Macquarie River
    - Widening of George Street from Stanley Street to the Great Western Highway (Durham Street) to provide three (3) approach lanes in and two (2) exit lanes.
    - Provision of four (4) approach lanes including a short right lane on George Street (east) at the Great Western Highway/George Street intersection.
    - Traffic signal adjustments at the Great Western Highway (Durham Street)/George Street intersection
    - Line marking and civil works along George Street to provide four (4) approach lanes (including short right turn lane) and two (2) departure lanes.
    - Provision of dual left turns from Durham Street (South) to Stewart Street at the Durham Street/Stewart Street intersection.
    - Provision of two (2) lane approach (50m) with modification to the existing parking arrangements on Rankin Street (west).
    - In order to improve the operation of the intersection along the Great Western Highway between Bentinck Street and Stewart Street, the use of the existing parking lane along the highway through this section was assessed, providing three through lanes in each direction, with the kerb lane operating as a shared left/through lane at the intersections.

    The performance of the intersections is expected to be satisfactory with the above road network improvements, except the performance of the Boyd Street, George Street, Stewart Street intersections with the Great Western Highway. Based on the results of the traffic modelling and as a result of the proposed KDA, the realignment of Gilmour Street would provide some benefit to the immediate road network for the future performance of the intersections.

# Appendix A
# Existing Performance of Intersections

## Kelso Modelling Performance Summary - Future Short Term Scenario

| 2016 Traffic Volume with Development | | AM | | | | | | PM | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Approach | | | Intersection | | | Approach | | | Intersection | | |
| Intersection | Approach | Volume | Delay | LOS | Volume | Delay | LOS | Volume | Delay | LOS | Volume | Delay | LOS |
| GWH/Stewart St | N | 68 | 18.82 | B | 1880 | 18.1 | B | 30 | 22.05 | B | 2589 | 28.7 | C |
| | S | 763 | 11.54 | A | | | | 1368 | 9.52 | A | | | |
| | W | 1049 | 22.78 | B | | | | 1191 | 50.81 | D | | | |
| GWH/Rankin St | NW | 1101 | 8.91 | A | 2053 | 8.2 | A | 1186 | 9.87 | A | 2810 | 11.3 | A |
| | NE | 39 | 45.15 | D | | | | 40 | 32.07 | C | | | |
| | SE | 809 | 4.51 | A | | | | 1275 | 8.81 | A | | | |
| | SW | 104 | 15.79 | B | | | | 309 | 24.47 | B | | | |
| GWH/George St | NW | 798 | 32.39 | C | 2479 | 30.6 | C | 930 | 48.28 | D | 3140 | 48.8 | D |
| | NE | 709 | 34.67 | C | | | | 467 | 50.09 | D | | | |
| | SE | 669 | 24.33 | B | | | | 1153 | 32.91 | C | | | |
| | SW | 303 | 30.43 | C | | | | 590 | 79.43 | F | | | |
| GWH/William | NW | 825 | 19.85 | B | 1762 | 21.2 | B | 964 | 26.2 | B | 2623 | 30.8 | C |
| | NE | 79 | 27.69 | B | | | | 146 | 35.74 | C | | | |
| | SE | 712 | 19.05 | B | | | | 1125 | 30.31 | C | | | |
| | SW | 146 | 35.94 | C | | | | 388 | 41.91 | C | | | |
| GWH/Bentinck St | NW | 838 | 7.3 | A | 1807 | 18.2 | B | 1011 | 7.51 | A | 2762 | 23.2 | B |
| | SE | 814 | 27.07 | B | | | | 1120 | 24.88 | B | | | |
| | SW | 155 | 31.12 | C | | | | 631 | 45.51 | D | | | |
| GWH/Havannah St | E | 1334 | 24.21 | B | 2292 | 19.7 | B | 1607 | 26.44 | B | 3086 | 21.4 | B |
| | S | 236 | 32.06 | C | | | | 366 | 35.65 | C | | | |
| | W | 722 | 7.37 | A | | | | 1113 | 9.45 | A | | | |
| GWH/Gilmour St | N | 239 | 58.62 | E | 2430 | 17.5 | B | 247 | 75.91 | F | 3251 | 19.3 | B |
| | E | 1304 | 11.75 | A | | | | 1554 | 12.9 | A | | | |
| | W | 887 | 14.84 | B | | | | 1450 | 16.62 | B | | | |
| GWH/Boyd St | N | 253 | 59.16 | E | 2215 | 23.2 | B | 238 | 87.95 | F | 2785 | 21.4 | B |
| | E | 1093 | 22.29 | B | | | | 1374 | 19.43 | B | | | |
| | W | 869 | 13.78 | A | | | | 1173 | 10.25 | A | | | |
| GWH/Littlebourne St | E | 804 | 13.02 | A | 2254 | 13.4 | A | 992 | 14.79 | B | 2857 | 15.1 | B |
| | S | 459 | 9.95 | A | | | | 636 | 13.07 | A | | | |
| | W | 991 | 13.39 | A | | | | 1229 | 15.12 | B | | | |
| GWH/Ashworth | N | 63 | 5.72 | A | 1071 | 9.0 | A | 83 | 6.16 | A | 1548 | 10.0 | A |
| | E | 599 | 7.36 | A | | | | 748 | 7.54 | A | | | |
| | S | 25 | 5.42 | A | | | | 41 | 5.99 | A | | | |
| | W | 384 | 8.96 | A | | | | 676 | 10.02 | A | | | |
| Gilmour St/Halfpenny Dr | N | 215 | 1.24 | A | 597 | 5.4 | A | 268 | 1.3 | A | 796 | 6.6 | A |
| | E | 243 | 5.35 | A | | | | 108 | 6.6 | A | | | |
| | S | 139 | 1.84 | A | | | | 420 | 4.2 | A | | | |
| Gilmore St/ElevenMile Dr | N | 130 | 0.88 | A | 438 | 9.9 | A | 155 | 1.0 | A | 574 | 10.0 | A |
| | S | 209 | 0.24 | A | | | | 296 | 0.3 | A | | | |
| | W | 99 | 9.92 | A | | | | 123 | 10.0 | A | | | |
| Marsden Ln/Hughes St | N | 21 | 6.53 | A | 406 | 13.1 | A | 42 | 6.1 | A | 541 | 11.1 | A |
| | E | 41 | 0.86 | A | | | | 16 | 1.7 | A | | | |
| | S | 184 | 4.33 | A | | | | 242 | 4.1 | A | | | |
| | W | 160 | 13.1 | A | | | | 241 | 11.1 | A | | | |
| Limeklins Rd/Marsden Ln | NE | 105 | 5.5 | A | 138 | 10.4 | A | 48 | 4.1 | A | 158 | 11.1 | A |
| | SW | 25 | 0.48 | A | | | | 53 | 0.7 | A | | | |
| | W | 8 | 10.39 | A | | | | 57 | 11.1 | A | | | |
| Limelins Rd/Hughes St | N | 219 | 4.9 | A | 506 | 4.9 | A | 296 | 5.2 | A | 627 | 5.2 | A |
| | E | 78 | 2.4 | A | | | | 87 | 4.3 | A | | | |
| | S | 77 | 4.1 | A | | | | 31 | 4.1 | A | | | |
| | W | 132 | 0.96 | A | | | | 213 | 1.2 | A | | | |
| George St/Stanley St | NW | 65 | 4.6 | A | 1328 | 8.0 | A | 115 | 6.7 | A | 1541 | 10.4 | A |
| | NE | 945 | 8.02 | A | | | | 603 | 5.2 | A | | | |
| | SE | 60 | 7 | A | | | | 255 | 7.4 | A | | | |
| | SW | 258 | 5.99 | A | | | | 568 | 10.4 | A | | | |
| Hereford St/Gilmour | N | 346 | 8.16 | A | 1566 | 18.0 | B | 234 | 9.0 | A | 1798 | 16.7 | B |
| | E | 716 | 15.33 | B | | | | 399 | 7.3 | A | | | |
| | S | 156 | 18 | B | | | | 278 | 10.1 | A | | | |
| | W | 348 | 7.63 | A | | | | 887 | 16.7 | B | | | |
| Halfpenny Dr/NewLink D | N | 0 | 0 | A | 0 | 0.0 | A | 0 | 0.0 | A | 6 | 1.2 | A |
| | E | 0 | 0 | A | | | | 0 | 0.0 | A | | | |
| | S | 0 | 0 | A | | | | 0 | 0.0 | A | | | |
| | W | 0 | 0 | A | | | | 6 | 1.2 | A | | | |
| Marsden Ln/NewLink A | N | 465 | 6.31 | A | 810 | 7.9 | A | 229 | 7.5 | A | 881 | 12.5 | A |
| | E | 211 | 7.91 | A | | | | 240 | 12.5 | A | | | |
| | W | 134 | 0.34 | A | | | | 412 | 0.4 | A | | | |
| Limeklins Rd/NewLink E | E | 64 | 2.96 | A | 182 | 4.7 | A | 32 | 1.9 | A | 292 | 4.3 | A |
| | S | 30 | 4.65 | A | | | | 78 | 3.9 | A | | | |
| | W | 88 | 4.45 | A | | | | 182 | 4.3 | A | | | |

## Kelso Modelling Performance Summary - Future Medium Term Scenario

| 2025 Traffic Volume with Development | | AM | | | | | | PM | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Approach | | | Intersection | | | Approach | | | Intersection | | |
| Intersection | Approach | Volume | Delay | LOS | Volume | Delay | LOS | Volume | Delay | LOS | Volume | Delay | LOS |
| GWH/Stewart St | N | 208 | 35.31 | C | 2536 | 23.1 | B | 83 | 39.2 | C | 3159 | 25.6 | B |
| | S | 1075 | 25.33 | B | | | | 1670 | 33.04 | C | | | |
| | W | 1253 | 19.13 | B | | | | 1406 | 16 | B | | | |
| GWH/Rankin St | NW | 1406 | 25.75 | B | 2748 | 27.2 | B | 1429 | 30.53 | C | 3404 | 31.6 | C |
| | NE | 83 | 57 | E | | | | 178 | 52.27 | D | | | |
| | SE | 1117 | 25.22 | B | | | | 1445 | 25.59 | B | | | |
| | SW | 142 | 39.54 | C | | | | 352 | 50.09 | D | | | |
| GWH/George St | NW | 1057 | 45.92 | D | 3403 | 51.6 | D | 1179 | 42.77 | D | 4009 | 54.4 | D |
| | NE | 950 | 39.75 | C | | | | 528 | 60.36 | E | | | |
| | SE | 990 | 66.03 | E | | | | 1394 | 57.81 | E | | | |
| | SW | 406 | 58.94 | E | | | | 908 | 60.73 | E | | | |
| GWH/William | NW | 1072 | 16.65 | B | 2406 | 21.4 | B | 1308 | 10.89 | A | 3369 | 35.6 | C |
| | NE | 96 | 39.37 | C | | | | 158 | 34.34 | C | | | |
| | SE | 1077 | 20.62 | B | | | | 1421 | 57.43 | E | | | |
| | SW | 161 | 47.96 | D | | | | 482 | 38.97 | C | | | |
| GWH/Bentinck St | NW | 1091 | 10.37 | A | 2508 | 22.3 | B | 1421 | 12.2 | A | 3560 | 37.4 | C |
| | SE | 1214 | 30.34 | C | | | | 1428 | 43.56 | D | | | |
| | SW | 203 | 38.22 | C | | | | 711 | 75.35 | F | | | |
| GWH/Havannah St | E | 1840 | 30.15 | C | 3139 | 23.6 | B | 1959 | 33.81 | C | 3969 | 26.9 | B |
| | S | 267 | 32.19 | C | | | | 462 | 45.85 | D | | | |
| | W | 1032 | 9.71 | A | | | | 1548 | 12.38 | A | | | |
| GWH/Gilmour St | N | 282 | 59.63 | E | 3373 | 17.2 | B | 266 | 69.45 | E | 4187 | 19.5 | B |
| | E | 1841 | 13.35 | A | | | | 1948 | 14.22 | A | | | |
| | W | 1250 | 13.4 | A | | | | 1973 | 17.93 | B | | | |
| GWH/Boyd St | N | 421 | 116 | F | 3107 | 37.0 | C | 268 | 115.49 | F | 3417 | 26.7 | B |
| | E | 1465 | 31.54 | C | | | | 1725 | 25.12 | B | | | |
| | W | 1221 | 16.32 | B | | | | 1424 | 12.01 | A | | | |
| GWH/Littlebourne St | E | 1180 | 32.93 | C | 3051 | 32.9 | C | 1319 | 28.25 | B | 3459 | 28.3 | B |
| | S | 452 | 12.45 | A | | | | 651 | 15.41 | B | | | |
| | W | 1419 | 24.41 | B | | | | 1489 | 23.97 | B | | | |
| GWH/Ashworth | N | 148 | 6.62 | A | 1675 | 9.1 | A | 99 | 8.25 | A | 2106 | 10.0 | A |
| | E | 850 | 7.63 | A | | | | 1026 | 7.96 | A | | | |
| | S | 62 | 5.86 | A | | | | 86 | 9 | A | | | |
| | W | 615 | 9.09 | A | | | | 895 | 9.97 | A | | | |
| Gilmour St/Halfpenny Dr | N | 455 | 1.18 | A | 1013 | 7.2 | A | 320 | 1.2 | A | 1077 | 7.5 | A |
| | E | 369 | 7.23 | A | | | | 130 | 7.5 | A | | | |
| | S | 189 | 1.66 | A | | | | 627 | 4.1 | A | | | |
| Gilmore St/ElevenMile Dr | N | 352 | 1.16 | A | 778 | 10.9 | A | 230 | 2.0 | A | 860 | 11.8 | A |
| | S | 275 | 0.27 | A | | | | 491 | 0.3 | A | | | |
| | W | 151 | 10.88 | A | | | | 139 | 11.8 | A | | | |
| Marsden Ln/Hughes St | N | 133 | 6.68 | A | 620 | 11.4 | A | 95 | 5.8 | A | 738 | 11.4 | A |
| | E | 29 | 11.37 | A | | | | 30 | 11.3 | A | | | |
| | S | 286 | 4.87 | A | | | | 435 | 5.1 | A | | | |
| | W | 172 | 10.87 | A | | | | 178 | 11.4 | A | | | |
| Limeklins Rd/Marsden Ln | NE | 97 | 4.04 | A | 123 | 10.8 | A | 58 | 3.2 | A | 192 | 11.2 | A |
| | SW | 21 | 0.24 | A | | | | 96 | 0.3 | A | | | |
| | W | 5 | 10.83 | A | | | | 38 | 11.2 | A | | | |
| Limelins Rd/Hughes St | N | 337 | 7.07 | A | 920 | 7.1 | A | 320 | 8.3 | A | 1113 | 8.3 | A |
| | E | 307 | 3 | A | | | | 258 | 6.1 | A | | | |
| | S | 85 | 5.66 | A | | | | 32 | 6.8 | A | | | |
| | W | 191 | 1.05 | A | | | | 503 | 1.0 | A | | | |
| George St/Stanley St | NW | 71 | 5.16 | A | 1636 | 9.9 | A | 134 | 8.9 | A | 1970 | 12.5 | A |
| | NE | 1171 | 9.85 | A | | | | 822 | 6.5 | A | | | |
| | SE | 61 | 8.17 | A | | | | 255 | 8.0 | A | | | |
| | SW | 333 | 7.15 | A | | | | 759 | 12.5 | A | | | |
| Hereford St/Gilmour | N | 677 | 10.83 | A | 1946 | 58.5 | E | 302 | 8.3 | A | 2264 | 69.5 | E |
| | E | 672 | 58.47 | E | | | | 564 | 11.5 | A | | | |
| | S | 179 | 29.3 | C | | | | 354 | 14.9 | B | | | |
| | W | 418 | 8.96 | A | | | | 1044 | 69.5 | E | | | |
| Halfpenny Dr/NewLink D | E | 63 | 0.15 | A | 122 | 4.3 | A | 61 | 4.3 | A | 150 | 4.8 | A |
| | S | 53 | 4 | A | | | | 70 | 1.3 | A | | | |
| | W | 6 | 4.3 | A | | | | 19 | 4.8 | A | | | |
| Marsden Ln/NewLink A | N | 462 | 5.25 | A | 911 | 12.7 | A | 231 | 11.8 | A | 1077 | 11.8 | A |
| | E | 267 | 12.72 | A | | | | 375 | 5.9 | A | | | |
| | W | 182 | 5.3 | A | | | | 471 | 2.4 | A | | | |
| Limeklins Rd/NewLink E | E | 71 | 2.58 | A | 510 | 5.4 | A | 45 | 4.5 | A | 725 | 5.4 | A |
| | S | 258 | 4.32 | A | | | | 243 | 5.4 | A | | | |
| | W | 181 | 5.36 | A | | | | 437 | 0.0 | A | | | |

## Kelso Modelling Performance Summary - Future Long Term Scenario

| 2035 Traffic Volumes without Development L4-L10 | | AM | | | | | | PM | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Approach | | | Intersection | | | Approach | | | Intersection | | |
| Intersection | Approach | Volume | Delay | LOS | Volume | Delay | LOS | Volume | Delay | LOS | Volume | Delay | LOS |
| GWH/Stewart St | N | 423 | 28.97 | C | 3022 | 38.7 | C | 130 | 37.8 | C | 3587 | 18.0 | B |
| | S | 1164 | 11.1 | A | | | | 1937 | 17.37 | B | | | |
| | W | 1435 | 63.94 | E | | | | 1520 | 17.05 | B | | | |
| GWH/Rankin St | NW | 1725 | 34.75 | C | 3135 | 37.5 | C | 1558 | 37.84 | C | 3764 | 38.4 | C |
| | NE | 181 | 44.34 | D | | | | 169 | 79.67 | F | | | |
| | SE | 1058 | 41.37 | C | | | | 1684 | 34.5 | C | | | |
| | SW | 171 | 33.31 | C | | | | 353 | 39.39 | C | | | |
| GWH/George St | NW | 1393 | 24.87 | B | 3498 | 37.1 | C | 1301 | 32.89 | C | 4151 | 36.8 | C |
| | NE | 661 | 24.15 | B | | | | 423 | 74.26 | F | | | |
| | SE | 1036 | 53.88 | D | | | | 1620 | 21.25 | B | | | |
| | SW | 408 | 57.55 | E | | | | 807 | 54.47 | D | | | |
| GWH/William | NW | 1361 | 22.13 | B | 2774 | 23.8 | B | 1362 | 14.35 | A | 3631 | 37.0 | C |
| | NE | 90 | 32.44 | C | | | | 153 | 37.25 | C | | | |
| | SE | 1156 | 20.76 | B | | | | 1625 | 52.78 | D | | | |
| | SW | 167 | 54.12 | D | | | | 491 | 47.78 | D | | | |
| GWH/Bentinck St | NW | 1399 | 10.01 | A | 2990 | 22.2 | B | 1495 | 15.73 | B | 3799 | 40.5 | C |
| | SE | 1366 | 33.65 | C | | | | 1630 | 52.75 | D | | | |
| | SW | 225 | 29.05 | C | | | | 674 | 65.62 | E | | | |
| GWH/Havannah St | E | 1975 | 34.14 | C | 3604 | 24.6 | B | 2181 | 35.72 | C | 4247 | 30.4 | C |
| | S | 299 | 30.54 | C | | | | 481 | 36.32 | C | | | |
| | W | 1330 | 9.12 | A | | | | 1585 | 21.25 | B | | | |
| GWH/Gilmour St | N | 313 | 92.25 | F | 3872 | 19.5 | B | 250 | 63.59 | E | 4453 | 20.0 | B |
| | E | 1984 | 11.25 | A | | | | 2193 | 14.61 | B | | | |
| | W | 1575 | 15.46 | B | | | | 2010 | 20.53 | B | | | |
| GWH/Boyd St | N | 295 | 51.68 | D | 3636 | 25.0 | B | 238 | 80.94 | F | 3926 | 21.4 | B |
| | E | 1735 | 29.07 | C | | | | 2004 | 25.67 | B | | | |
| | W | 1606 | 15.67 | B | | | | 1684 | 7.94 | A | | | |
| GWH/Littlebourne St | E | 1376 | 21.04 | B | 3586 | 24.7 | B | 1595 | 51.29 | D | 4055 | 51.3 | D |
| | S | 478 | 17.03 | B | | | | 727 | 19.41 | B | | | |
| | W | 1732 | 24.74 | B | | | | 1733 | 26.15 | B | | | |
| GWH/Ashworth | N | 117 | 7.97 | A | 2231 | 10.2 | A | 110 | 8.42 | A | 2712 | 11.46 | A |
| | E | 1050 | 7.86 | A | | | | 1223 | 8.54 | A | | | |
| | S | 110 | 6.86 | A | | | | 172 | 7.93 | A | | | |
| | W | 954 | 10.23 | A | | | | 1207 | 11.46 | A | | | |
| Gilmour St/Halfpenny Dr | N | 350 | 1.37 | A | 758 | 6.1 | A | 280 | 1.2 | A | 987 | 7.0 | A |
| | E | 219 | 6.1 | A | | | | 157 | 7.0 | A | | | |
| | S | 189 | 1.83 | A | | | | 550 | 4.7 | A | | | |
| Gilmore St/ElevenMile Dr | N | 220 | 1.46 | A | 691 | 9.8 | A | 216 | 2.2 | A | 750 | 9.7 | A |
| | S | 262 | 0.31 | A | | | | 412 | 0.3 | A | | | |
| | W | 209 | 9.78 | A | | | | 122 | 9.7 | A | | | |
| Marsden Ln/Hughes St | N | 41 | 7.08 | A | 468 | 13.1 | A | 38 | 6.5 | A | 649 | 11.2 | A |
| | E | 36 | 0.89 | A | | | | 18 | 1.0 | A | | | |
| | S | 168 | 4.15 | A | | | | 368 | 4.8 | A | | | |
| | W | 223 | 13.1 | A | | | | 225 | 11.2 | A | | | |
| Limeklins Rd/Marsden Ln | NE | 100 | 4.33 | A | 126 | 10.5 | A | 54 | 4.3 | A | 173 | 11.3 | A |
| | SW | 14 | 1.13 | A | | | | 77 | 0.3 | A | | | |
| | W | 12 | 10.54 | A | | | | 42 | 11.3 | A | | | |
| Limelins Rd/Hughes St | N | 284 | 4.73 | A | 540 | 4.7 | A | 282 | 6.4 | A | 804 | 6.8 | A |
| | E | 83 | 2.53 | A | | | | 201 | 6.8 | A | | | |
| | S | 76 | 4.56 | A | | | | 34 | 5.8 | A | | | |
| | W | 97 | 0.87 | A | | | | 287 | 1.4 | A | | | |
| George St/Stanley St | NW | 65 | 5.16 | A | 1364 | 9.4 | A | 100 | 6.3 | A | 1632 | 12.1 | A |
| | NE | 923 | 6.63 | A | | | | 705 | 6.3 | A | | | |
| | SE | 102 | 9.35 | A | | | | 226 | 7.2 | A | | | |
| | SW | 274 | 7.52 | A | | | | 601 | 12.1 | A | | | |
| Hereford St/Gilmour | N | 418 | 8.76 | A | 1682 | 13.2 | A | 251 | 9.4 | A | 2041 | 20.0 | B |
| | E | 710 | 13.24 | A | | | | 527 | 9.9 | A | | | |
| | S | 195 | 11.79 | A | | | | 363 | 14.9 | B | | | |
| | W | 359 | 8.48 | A | | | | 900 | 20.0 | B | | | |
| Halfpenny Dr/NewLink D | N | 0 | 0 | A | 3 | 1.6 | A | 0 | 0.0 | A | 4 | 0.9 | A |
| | E | 0 | 0 | A | | | | 0 | 0.0 | A | | | |
| | S | 0 | 0 | A | | | | 0 | 0.0 | A | | | |
| | W | 3 | 1.57 | A | | | | 4 | 0.9 | A | | | |
| Marsden Ln/NewLink A | N | 488 | 6.59 | A | 831 | 8.5 | A | 218 | 7.7 | A | 1016 | 11.7 | A |
| | E | 195 | 8.46 | A | | | | 357 | 11.7 | A | | | |
| | W | 148 | 0.31 | A | | | | 441 | 0.4 | A | | | |
| Limeklins Rd/NewLink E | E | 67 | 2.56 | A | 233 | 5.5 | A | 39 | 2.6 | A | 435 | 4.6 | A |
| | S | 39 | 4.98 | A | | | | 193 | 4.6 | A | | | |
| | W | 127 | 5.54 | A | | | | 203 | 4.1 | A | | | |

# Kelso Modelling Performance Summary - Future Long Term Scenario with 3 through lanes on GWH with New Link K to GWH

| 2035 with Full Dev | | AM | | | | | | PM | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Approach | | | Intersection | | | Approach | | | Intersection | | |
| Intersection | Approach | Volume | Delay | LOS | Volume | Delay | LOS | Volume | Delay | LOS | Volume | Delay | LOS |
| GWH/Stewart St | N | 381 | 36.21 | C | 3498 | 21.5 | B | 137 | 37.71 | C | 4192 | 34.0 | C |
| | S | 1568 | 18.96 | B | | | | 2071 | 23.46 | B | | | |
| | W | 1549 | 20.5 | B | | | | 1984 | 44.71 | D | | | |
| GWH/Rankin St | NW | 1823 | 39.8 | C | 3805 | 37.6 | C | 2028 | 48.24 | D | 4572 | 41.7 | C |
| | NE | 212 | 34.01 | C | | | | 218 | 34.3 | C | | | |
| | SE | 1567 | 34.8 | C | | | | 1849 | 28.98 | C | | | |
| | SW | 203 | 44.12 | D | | | | 477 | 66.31 | E | | | |
| GWH/George St | NW | 1442 | 55.8 | D | 5186 | 56.5 | D | 1580 | 66.39 | E | 5722 | 57.7 | E |
| | NE | 1855 | 52.79 | D | | | | 932 | 78 | F | | | |
| | SE | 1276 | 66.85 | E | | | | 1609 | 43.19 | D | | | |
| | SW | 613 | 47.7 | D | | | | 1601 | 51.9 | D | | | |
| GWH/William | NW | 1433 | 20.22 | B | 3112 | 24.6 | B | 1661 | 22.77 | B | 3986 | 45.9 | D |
| | NE | 89 | 41.11 | C | | | | 224 | 42.81 | D | | | |
| | SE | 1387 | 23.81 | B | | | | 1593 | 54.24 | D | | | |
| | SW | 203 | 53.88 | D | | | | 508 | 96.75 | F | | | |
| GWH/Bentinck St | NW | 1461 | 12.55 | A | 3222 | 24.5 | B | 1812 | 14.61 | B | 4088 | 43.0 | D |
| | SE | 1500 | 35.31 | C | | | | 1552 | 64.92 | E | | | |
| | SW | 261 | 29.14 | C | | | | 724 | 66.87 | E | | | |
| GWH/Havannah St | E | 2159 | 39.38 | C | 3894 | 28.5 | C | 2131 | 42.91 | D | 4667 | 32.8 | C |
| | S | 317 | 33.56 | C | | | | 557 | 60.78 | E | | | |
| | W | 1418 | 10.93 | A | | | | 1979 | 13.98 | A | | | |
| GWH/Gilmour St | N | 266 | 62.38 | E | 4280 | 29.1 | C | 243 | 131.2 | F | 5018 | 46.9 | D |
| | E | 2248 | 24.63 | B | | | | 2237 | 40.86 | C | | | |
| | S | 7 | 43.11 | | | | | 81 | 72.56 | | | | |
| | W | 1759 | 29.69 | C | | | | 2457 | 43.13 | D | | | |
| GWH/Boyd St | N | 614 | 68.63 | E | 3777 | 38.2 | C | 304 | 89.13 | F | 3939 | 34.5 | C |
| | E | 1588 | 38.3 | C | | | | 1899 | 43.26 | D | | | |
| | W | 1575 | 26.14 | B | | | | 1736 | 15.3 | B | | | |
| GWH/Littlebourne St | E | 1309 | 62.43 | E | 3562 | 62.4 | E | 1525 | 47.02 | D | 4035 | 47.0 | D |
| | S | 466 | 14.28 | A | | | | 698 | 22.7 | B | | | |
| | W | 1787 | 27.33 | B | | | | 1812 | 23.88 | B | | | |
| GWH/Ashworth | N | 215 | 9.1 | A | 2322 | 10.2 | A | 101 | 10.29 | A | 2746 | 12.4 | A |
| | E | 1006 | 8.81 | A | | | | 1147 | 8.31 | A | | | |
| | S | 134 | 7.47 | A | | | | 247 | 8.07 | A | | | |
| | W | 967 | 10.2 | A | | | | 1251 | 12.38 | A | | | |
| Gilmour St/Halfpenny Dr | N | 917 | 1.28 | A | 1603 | 25.4 | B | 576 | 1.44 | A | 1817 | 25.1 | B |
| | E | 356 | 25.4 | B | | | | 159 | 25.06 | B | | | |
| | S | 330 | 2.07 | A | | | | 1082 | 13.46 | A | | | |
| Gilmore St/ElevenMile Dr | N | 746 | 1.67 | A | 1518 | 17.3 | B | 421 | 3.35 | A | 1546 | 24.1 | B |
| | S | 486 | 0.36 | A | | | | 862 | 0.3 | A | | | |
| | W | 286 | 17.27 | B | | | | 263 | 24.09 | B | | | |
| Marsden Ln/Hughes St | N | 440 | 6.28 | A | 1198 | 6.3 | A | 221 | 6.54 | A | 1278 | 7.1 | A |
| | E | 281 | 5.35 | A | | | | 240 | 4.89 | A | | | |
| | S | 338 | 5.5 | A | | | | 580 | 7.14 | A | | | |
| | W | 139 | 4.66 | A | | | | 237 | 5.23 | A | | | |
| Limeklins Rd/Marsden Ln | NE | 103 | 3.52 | A | 129 | 11.3 | A | 48 | 3.28 | A | 162 | 11.4 | A |
| | SW | 21 | 0.33 | A | | | | 87 | 0.52 | A | | | |
| | W | 5 | 11.33 | A | | | | 27 | 11.43 | A | | | |
| Limelins Rd/Hughes St | N | 477 | 13.1 | A | 1387 | 13.1 | A | 333 | 17.73 | B | 1614 | 17.7 | B |
| | E | 527 | 3.28 | A | | | | 383 | 15.98 | B | | | |
| | S | 72 | 10.66 | A | | | | 17 | 11.06 | A | | | |
| | W | 311 | 0.85 | A | | | | 881 | 1.18 | A | | | |
| George St/Stanley St | NW | 114 | 5.52 | A | 3006 | 12.6 | A | 360 | 25.47 | B | 3480 | 25.5 | B |
| | NE | 2301 | 12.46 | A | | | | 1359 | 6.41 | A | | | |
| | SE | 56 | 12.61 | A | | | | 269 | 9.8 | A | | | |
| | SW | 535 | 7.8 | A | | | | 1492 | 18.88 | B | | | |
| Hereford St/Gilmour | N | 1025 | 15.57 | B | 3398 | 30.1 | C | 515 | 26.66 | B | 3948 | 29.7 | C |
| | E | 1556 | 14.45 | A | | | | 971 | 7.35 | A | | | |
| | S | 190 | 30.06 | C | | | | 454 | 18.54 | B | | | |
| | W | 627 | 8.26 | A | | | | 2008 | 29.71 | C | | | |
| Halfpenny Dr/NewLink D | E | 230 | 4.34 | A | 358 | 11.3 | A | 102 | 0.19 | A | 261 | 4.2 | A |
| | S | 105 | 3.46 | A | | | | 106 | 4.18 | A | | | |
| | W | 23 | 11.32 | A | | | | 53 | 1.83 | A | | | |
| Marsden Ln/NewLink A | N | 1053 | 32.4 | C | 1887 | 32.4 | C | 415 | 6.13 | A | 2076 | 22.4 | B |
| | E | 506 | 6.62 | A | | | | 595 | 6.94 | A | | | |
| | W | 328 | 2.63 | A | | | | 1066 | 22.43 | B | | | |
| Limeklins Rd/NewLink E | E | 341 | 6.54 | A | 925 | 7.5 | A | 166 | 2.73 | A | 1216 | 17.1 | B |
| | S | 320 | 5.98 | A | | | | 408 | 17.1 | B | | | |
| | W | 264 | 7.46 | A | | | | 642 | 4.88 | A | | | |
| GWH/NewLink K | N | 111 | 1.26 | A | 1672 | 4.3 | A | 76 | 10.59 | A | 2070 | 10.6 | A |
| | E | 880 | 0.59 | A | | | | 1107 | 4.1 | A | | | |
| | W | 681 | 4.31 | A | | | | 887 | 0.6 | A | | | |
| Halfpenny Dr/NewLink J | N | 315 | 0 | A | 579 | 7.3 | A | 256 | 2.84 | A | 511 | 4.0 | A |
| | E | 0 | 0.55 | A | | | | 0 | 0 | A | | | |
| | S | 148 | 4.12 | A | | | | 113 | 0.46 | A | | | |
| | W | 116 | 7.26 | A | | | | 142 | 4.03 | A | | | |
| Marsden Ln/NewLink J | N | 172 | 0.81 | A | 587 | 12.3 | A | 98 | 5.8 | A | 629 | 10.4 | A |
| | E | 25 | 5.35 | A | | | | 13 | 1.66 | A | | | |
| | S | 311 | 12.28 | A | | | | 363 | 5.34 | A | | | |
| | W | 79 | 0 | A | | | | 155 | 10.44 | A | | | |

# Appendix B
# Future Intersection Performance

## Kelso Modelling Performance Summary - Future Short Term Scenario

| 2016 Traffic Volume with Development | | AM | | | | | | PM | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Approach | | | Intersection | | | Approach | | | Intersection | | |
| Intersection | Approach | Volume | Delay | LOS | Volume | Delay | LOS | Volume | Delay | LOS | Volume | Delay | LOS |
| GWH/Stewart St | N | 68 | 18.82 | B | 1880 | 18.1 | B | 30 | 22.05 | B | 2589 | 28.7 | C |
| | S | 763 | 11.54 | A | | | | 1368 | 9.52 | A | | | |
| | W | 1049 | 22.78 | B | | | | 1191 | 50.81 | D | | | |
| GWH/Rankin St | NW | 1101 | 8.91 | A | 2053 | 8.2 | A | 1186 | 9.87 | A | 2810 | 11.3 | A |
| | NE | 39 | 45.15 | D | | | | 40 | 32.07 | C | | | |
| | SE | 809 | 4.51 | A | | | | 1275 | 8.81 | A | | | |
| | SW | 104 | 15.79 | B | | | | 309 | 24.47 | B | | | |
| GWH/George St | NW | 798 | 32.39 | C | 2479 | 30.6 | C | 930 | 48.28 | D | 3140 | 48.8 | D |
| | NE | 709 | 34.67 | C | | | | 467 | 50.09 | D | | | |
| | SE | 669 | 24.33 | B | | | | 1153 | 32.91 | C | | | |
| | SW | 303 | 30.43 | C | | | | 590 | 79.43 | F | | | |
| GWH/William | NW | 825 | 19.85 | B | 1762 | 21.2 | B | 964 | 26.2 | B | 2623 | 30.8 | C |
| | NE | 79 | 27.69 | B | | | | 146 | 35.74 | C | | | |
| | SE | 712 | 19.05 | B | | | | 1125 | 30.31 | C | | | |
| | SW | 146 | 35.94 | C | | | | 388 | 41.91 | C | | | |
| GWH/Bentinck St | NW | 838 | 7.3 | A | 1807 | 18.2 | B | 1011 | 7.51 | A | 2762 | 23.2 | B |
| | SE | 814 | 27.07 | B | | | | 1120 | 24.88 | B | | | |
| | SW | 155 | 31.12 | C | | | | 631 | 45.51 | D | | | |
| GWH/Havannah St | E | 1334 | 24.21 | B | 2292 | 19.7 | B | 1607 | 26.44 | B | 3086 | 21.4 | B |
| | S | 236 | 32.06 | C | | | | 366 | 35.65 | C | | | |
| | W | 722 | 7.37 | A | | | | 1113 | 9.45 | A | | | |
| GWH/Gilmour St | N | 239 | 58.62 | E | 2430 | 17.5 | B | 247 | 75.91 | F | 3251 | 19.3 | B |
| | E | 1304 | 11.75 | A | | | | 1554 | 12.9 | A | | | |
| | W | 887 | 14.84 | B | | | | 1450 | 16.62 | B | | | |
| GWH/Boyd St | N | 253 | 59.16 | E | 2215 | 23.2 | B | 238 | 87.95 | F | 2785 | 21.4 | B |
| | E | 1093 | 22.29 | B | | | | 1374 | 19.43 | B | | | |
| | W | 869 | 13.78 | A | | | | 1173 | 10.25 | A | | | |
| GWH/Littlebourne St | E | 804 | 13.02 | A | 2254 | 13.4 | A | 992 | 14.79 | B | 2857 | 15.1 | B |
| | S | 459 | 9.95 | A | | | | 636 | 13.07 | A | | | |
| | W | 991 | 13.39 | A | | | | 1229 | 15.12 | B | | | |
| GWH/Ashworth | N | 63 | 5.72 | A | 1071 | 9.0 | A | 83 | 6.16 | A | 1548 | 10.0 | A |
| | E | 599 | 7.36 | A | | | | 748 | 7.54 | A | | | |
| | S | 25 | 5.42 | A | | | | 41 | 5.99 | A | | | |
| | W | 384 | 8.96 | A | | | | 676 | 10.02 | A | | | |
| Gilmour St/Halfpenny Dr | N | 215 | 1.24 | A | 597 | 5.4 | A | 268 | 1.3 | A | 796 | 6.6 | A |
| | E | 243 | 5.35 | A | | | | 108 | 6.6 | A | | | |
| | S | 139 | 1.84 | A | | | | 420 | 4.2 | A | | | |
| Gilmore St/ElevenMile Dr | N | 130 | 0.88 | A | 438 | 9.9 | A | 155 | 1.0 | A | 574 | 10.0 | A |
| | S | 209 | 0.24 | A | | | | 296 | 0.3 | A | | | |
| | W | 99 | 9.92 | A | | | | 123 | 10.0 | A | | | |
| Marsden Ln/Hughes St | N | 21 | 6.53 | A | 406 | 13.1 | A | 42 | 6.1 | A | 541 | 11.1 | A |
| | E | 41 | 0.86 | A | | | | 16 | 1.7 | A | | | |
| | S | 184 | 4.33 | A | | | | 242 | 4.1 | A | | | |
| | W | 160 | 13.1 | A | | | | 241 | 11.1 | A | | | |
| Limeklins Rd/Marsden Ln | NE | 105 | 5.5 | A | 138 | 10.4 | A | 48 | 4.1 | A | 158 | 11.1 | A |
| | SW | 25 | 0.48 | A | | | | 53 | 0.7 | A | | | |
| | W | 8 | 10.39 | A | | | | 57 | 11.1 | A | | | |
| Limelins Rd/Hughes St | N | 219 | 4.9 | A | 506 | 4.9 | A | 296 | 5.2 | A | 627 | 5.2 | A |
| | E | 78 | 2.4 | A | | | | 87 | 4.3 | A | | | |
| | S | 77 | 4.1 | A | | | | 31 | 4.1 | A | | | |
| | W | 132 | 0.96 | A | | | | 213 | 1.2 | A | | | |
| George St/Stanley St | NW | 65 | 4.6 | A | 1328 | 8.0 | A | 115 | 6.7 | A | 1541 | 10.4 | A |
| | NE | 945 | 8.02 | A | | | | 603 | 5.2 | A | | | |
| | SE | 60 | 7 | A | | | | 255 | 7.4 | A | | | |
| | SW | 258 | 5.99 | A | | | | 568 | 10.4 | A | | | |
| Hereford St/Gilmour | N | 346 | 8.16 | A | 1566 | 18.0 | B | 234 | 9.0 | A | 1798 | 16.7 | B |
| | E | 716 | 15.33 | B | | | | 399 | 7.3 | A | | | |
| | S | 156 | 18 | B | | | | 278 | 10.1 | A | | | |
| | W | 348 | 7.63 | A | | | | 887 | 16.7 | B | | | |
| Halfpenny Dr/NewLink D | N | 0 | 0 | A | 0 | 0.0 | A | 0 | 0.0 | A | 6 | 1.2 | A |
| | E | 0 | 0 | A | | | | 0 | 0.0 | A | | | |
| | S | 0 | 0 | A | | | | 0 | 0.0 | A | | | |
| | W | 0 | 0 | A | | | | 6 | 1.2 | A | | | |
| Marsden Ln/NewLink A | N | 465 | 6.31 | A | 810 | 7.9 | A | 229 | 7.5 | A | 881 | 12.5 | A |
| | E | 211 | 7.91 | A | | | | 240 | 12.5 | A | | | |
| | W | 134 | 0.34 | A | | | | 412 | 0.4 | A | | | |
| Limeklins Rd/NewLink E | E | 64 | 2.96 | A | 182 | 4.7 | A | 32 | 1.9 | A | 292 | 4.3 | A |
| | S | 30 | 4.65 | A | | | | 78 | 3.9 | A | | | |
| | W | 88 | 4.45 | A | | | | 182 | 4.3 | A | | | |

## Kelso Modelling Performance Summary - Future Medium Term Scenario

| 2025 Traffic Volume with Development | | AM | | | | | | PM | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Approach | | | Intersection | | | Approach | | | Intersection | | |
| Intersection | Approach | Volume | Delay | LOS | Volume | Delay | LOS | Volume | Delay | LOS | Volume | Delay | LOS |
| GWH/Stewart St | N | 208 | 35.31 | C | 2536 | 23.1 | B | 83 | 39.2 | C | 3159 | 25.6 | B |
| | S | 1075 | 25.33 | B | | | | 1670 | 33.04 | C | | | |
| | W | 1253 | 19.13 | B | | | | 1406 | 16 | B | | | |
| GWH/Rankin St | NW | 1406 | 25.75 | B | 2748 | 27.2 | B | 1429 | 30.53 | C | 3404 | 31.6 | C |
| | NE | 83 | 57 | E | | | | 178 | 52.27 | D | | | |
| | SE | 1117 | 25.22 | B | | | | 1445 | 25.59 | B | | | |
| | SW | 142 | 39.54 | C | | | | 352 | 50.09 | D | | | |
| GWH/George St | NW | 1057 | 45.92 | D | 3403 | 51.6 | D | 1179 | 42.77 | D | 4009 | 54.4 | D |
| | NE | 950 | 39.75 | C | | | | 528 | 60.36 | E | | | |
| | SE | 990 | 66.03 | E | | | | 1394 | 57.81 | E | | | |
| | SW | 406 | 58.94 | E | | | | 908 | 60.73 | E | | | |
| GWH/William | NW | 1072 | 16.65 | B | 2406 | 21.4 | B | 1308 | 10.89 | A | 3369 | 35.6 | C |
| | NE | 96 | 39.37 | C | | | | 158 | 34.34 | C | | | |
| | SE | 1077 | 20.62 | B | | | | 1421 | 57.43 | E | | | |
| | SW | 161 | 47.96 | D | | | | 482 | 38.97 | C | | | |
| GWH/Bentinck St | NW | 1091 | 10.37 | A | 2508 | 22.3 | B | 1421 | 12.2 | A | 3560 | 37.4 | C |
| | SE | 1214 | 30.34 | C | | | | 1428 | 43.56 | D | | | |
| | SW | 203 | 38.22 | C | | | | 711 | 75.35 | F | | | |
| GWH/Havannah St | E | 1840 | 30.15 | C | 3139 | 23.6 | B | 1959 | 33.81 | C | 3969 | 26.9 | B |
| | S | 267 | 32.19 | C | | | | 462 | 45.85 | D | | | |
| | W | 1032 | 9.71 | A | | | | 1548 | 12.38 | A | | | |
| GWH/Gilmour St | N | 282 | 59.63 | E | 3373 | 17.2 | B | 266 | 69.45 | E | 4187 | 19.5 | B |
| | E | 1841 | 13.35 | A | | | | 1948 | 14.22 | A | | | |
| | W | 1250 | 13.4 | A | | | | 1973 | 17.93 | B | | | |
| GWH/Boyd St | N | 421 | 116 | F | 3107 | 37.0 | C | 268 | 115.49 | F | 3417 | 26.7 | B |
| | E | 1465 | 31.54 | C | | | | 1725 | 25.12 | B | | | |
| | W | 1221 | 16.32 | B | | | | 1424 | 12.01 | A | | | |
| GWH/Littlebourne St | E | 1180 | 32.93 | C | 3051 | 32.9 | C | 1319 | 28.25 | B | 3459 | 28.3 | B |
| | S | 452 | 12.45 | A | | | | 651 | 15.41 | B | | | |
| | W | 1419 | 24.41 | B | | | | 1489 | 23.97 | B | | | |
| GWH/Ashworth | N | 148 | 6.62 | A | 1675 | 9.1 | A | 99 | 8.25 | A | 2106 | 10.0 | A |
| | E | 850 | 7.63 | A | | | | 1026 | 7.96 | A | | | |
| | S | 62 | 5.86 | A | | | | 86 | 9 | A | | | |
| | W | 615 | 9.09 | A | | | | 895 | 9.97 | A | | | |
| Gilmour St/Halfpenny Dr | N | 455 | 1.18 | A | 1013 | 7.2 | A | 320 | 1.2 | A | 1077 | 7.5 | A |
| | E | 369 | 7.23 | A | | | | 130 | 7.5 | A | | | |
| | S | 189 | 1.66 | A | | | | 627 | 4.1 | A | | | |
| Gilmore St/ElevenMile Dr | N | 352 | 1.16 | A | 778 | 10.9 | A | 230 | 2.0 | A | 860 | 11.8 | A |
| | S | 275 | 0.27 | A | | | | 491 | 0.3 | A | | | |
| | W | 151 | 10.88 | A | | | | 139 | 11.8 | A | | | |
| Marsden Ln/Hughes St | N | 133 | 6.68 | A | 620 | 11.4 | A | 95 | 5.8 | A | 738 | 11.4 | A |
| | E | 29 | 11.37 | A | | | | 30 | 11.3 | A | | | |
| | S | 286 | 4.87 | A | | | | 435 | 5.1 | A | | | |
| | W | 172 | 10.87 | A | | | | 178 | 11.4 | A | | | |
| Limeklins Rd/Marsden Ln | NE | 97 | 4.04 | A | 123 | 10.8 | A | 58 | 3.2 | A | 192 | 11.2 | A |
| | SW | 21 | 0.24 | A | | | | 96 | 0.3 | A | | | |
| | W | 5 | 10.83 | A | | | | 38 | 11.2 | A | | | |
| Limelins Rd/Hughes St | N | 337 | 7.07 | A | 920 | 7.1 | A | 320 | 8.3 | A | 1113 | 8.3 | A |
| | E | 307 | 3 | A | | | | 258 | 6.1 | A | | | |
| | S | 85 | 5.66 | A | | | | 32 | 6.8 | A | | | |
| | W | 191 | 1.05 | A | | | | 503 | 1.0 | A | | | |
| George St/Stanley St | NW | 71 | 5.16 | A | 1636 | 9.9 | A | 134 | 8.9 | A | 1970 | 12.5 | A |
| | NE | 1171 | 9.85 | A | | | | 822 | 6.5 | A | | | |
| | SE | 61 | 8.17 | A | | | | 255 | 8.0 | A | | | |
| | SW | 333 | 7.15 | A | | | | 759 | 12.5 | A | | | |
| Hereford St/Gilmour | N | 677 | 10.83 | A | 1946 | 58.5 | E | 302 | 8.3 | A | 2264 | 69.5 | E |
| | E | 672 | 58.47 | E | | | | 564 | 11.5 | A | | | |
| | S | 179 | 29.3 | C | | | | 354 | 14.9 | B | | | |
| | W | 418 | 8.96 | A | | | | 1044 | 69.5 | E | | | |
| Halfpenny Dr/NewLink D | E | 63 | 0.15 | A | 122 | 4.3 | A | 61 | 4.3 | A | 150 | 4.8 | A |
| | S | 53 | 4 | A | | | | 70 | 1.3 | A | | | |
| | W | 6 | 4.3 | A | | | | 19 | 4.8 | A | | | |
| Marsden Ln/NewLink A | N | 462 | 5.25 | A | 911 | 12.7 | A | 231 | 11.8 | A | 1077 | 11.8 | A |
| | E | 267 | 12.72 | A | | | | 375 | 5.9 | A | | | |
| | W | 182 | 5.3 | A | | | | 471 | 2.4 | A | | | |
| Limeklins Rd/NewLink E | E | 71 | 2.58 | A | 510 | 5.4 | A | 45 | 4.5 | A | 725 | 5.4 | A |
| | S | 258 | 4.32 | A | | | | 243 | 5.4 | A | | | |
| | W | 181 | 5.36 | A | | | | 437 | 0.0 | A | | | |

**Kelso Modelling Performance Summary - Future Long Term Scenario**

| 2035 Traffic Volumes without Development L4-L10 | | AM | | | | | | PM | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Approach | | | Intersection | | | Approach | | | Intersection | | |
| Intersection | Approach | Volume | Delay | LOS | Volume | Delay | LOS | Volume | Delay | LOS | Volume | Delay | LOS |
| GWH/Stewart St | N | 367 | 26.21 | B | 2947 | 22.9 | B | 139 | 37.63 | C | 3619 | 19.1 | B |
| | S | 1120 | 10.48 | A | | | | 1891 | 16.69 | B | | | |
| | W | 1460 | 31.61 | C | | | | 1589 | 20.31 | B | | | |
| GWH/Rankin St | NW | 1716 | 26.54 | B | 3130 | 31.7 | C | 1629 | 37.96 | C | 3794 | 39.2 | C |
| | NE | 206 | 27.04 | B | | | | 241 | 65.84 | E | | | |
| | SE | 1038 | 40.97 | C | | | | 1590 | 36.25 | C | | | |
| | SW | 170 | 32.68 | C | | | | 334 | 40.57 | C | | | |
| GWH/George St | NW | 1421 | 22.77 | B | 3419 | 34.4 | C | 1384 | 34.24 | C | 4104 | 40.4 | C |
| | NE | 591 | 25.68 | B | | | | 403 | 77.06 | F | | | |
| | SE | 1033 | 54.47 | D | | | | 1504 | 31.45 | C | | | |
| | SW | 374 | 36.77 | C | | | | 813 | 49.34 | D | | | |
| GWH/William | NW | 1356 | 22.17 | B | 2799 | 24.7 | B | 1456 | 17.21 | B | 3592 | 37.0 | C |
| | NE | 86 | 30.86 | C | | | | 155 | 35.22 | C | | | |
| | SE | 1169 | 22.88 | B | | | | 1506 | 48.66 | D | | | |
| | SW | 188 | 51.48 | D | | | | 475 | 61.53 | E | | | |
| GWH/Bentinck St | NW | 1403 | 11 | A | 2945 | 22.2 | B | 1555 | 12.2 | A | 3786 | 39.2 | C |
| | SE | 1305 | 32.44 | C | | | | 1560 | 57.04 | E | | | |
| | SW | 237 | 31.85 | C | | | | 671 | 60.48 | E | | | |
| GWH/Havannah St | E | 1902 | 33.63 | C | 3538 | 24.1 | B | 2151 | 40.07 | C | 4252 | 30.7 | C |
| | S | 306 | 31.71 | C | | | | 407 | 33.82 | C | | | |
| | W | 1330 | 8.6 | A | | | | 1694 | 18.13 | B | | | |
| GWH/Gilmour St | N | 308 | 81.11 | F | 3740 | 18.1 | B | 267 | 65.66 | E | 4516 | 21.8 | B |
| | E | 1862 | 10.86 | A | | | | 2169 | 19.11 | B | | | |
| | W | 1570 | 14.31 | A | | | | 2080 | 18.88 | B | | | |
| GWH/Boyd St | N | 275 | 56.33 | D | 3502 | 23.8 | B | 231 | 83.65 | F | 3974 | 27.0 | B |
| | E | 1631 | 28.15 | B | | | | 1986 | 37.11 | C | | | |
| | W | 1596 | 13.72 | A | | | | 1757 | 8.21 | A | | | |
| GWH/Littlebourne St | E | 1369 | 21.76 | B | 3504 | 26.4 | B | 1582 | 22.71 | B | 4086 | 93.2 | F |
| | S | 416 | 19.03 | B | | | | 706 | 93.15 | F | | | |
| | W | 1719 | 26.41 | B | | | | 1798 | 25.73 | B | | | |
| GWH/Ashworth | N | 104 | 9.72 | A | 2205 | 10.5 | A | 93 | 8.93 | A | 2732 | 13.09 | A |
| | E | 1061 | 8.26 | A | | | | 1242 | 8.44 | A | | | |
| | S | 111 | 7.65 | A | | | | 146 | 7.93 | A | | | |
| | W | 929 | 10.54 | A | | | | 1251 | 13.09 | A | | | |
| Gilmour St/Halfpenny Dr | N | 358 | 1.41 | A | 745 | 5.8 | A | 342 | 1.4 | A | 1034 | 8.9 | A |
| | E | 210 | 5.77 | A | | | | 169 | 8.9 | A | | | |
| | S | 177 | 2.21 | A | | | | 523 | 5.1 | A | | | |
| Gilmore St/ElevenMile Dr | N | 201 | 1.25 | A | 654 | 9.0 | A | 244 | 2.5 | A | 824 | 11.8 | A |
| | S | 230 | 0.25 | A | | | | 411 | 0.3 | A | | | |
| | W | 223 | 9.01 | A | | | | 169 | 11.8 | A | | | |
| Marsden Ln/Hughes St | N | 50 | 6.08 | A | 474 | 13.5 | A | 39 | 5.7 | A | 621 | 10.9 | A |
| | E | 28 | 0.9 | A | | | | 23 | 1.8 | A | | | |
| | S | 188 | 4.16 | A | | | | 344 | 4.7 | A | | | |
| | W | 208 | 13.53 | A | | | | 215 | 10.9 | A | | | |
| Limeklins Rd/Marsden Ln | NE | 116 | 3.42 | A | 140 | 10.9 | A | 51 | 3.8 | A | 180 | 11.0 | A |
| | SW | 19 | 0.39 | A | | | | 77 | 0.7 | A | | | |
| | W | 5 | 10.87 | A | | | | 52 | 11.0 | A | | | |
| Limelins Rd/Hughes St | N | 289 | 4.84 | A | 609 | 4.8 | A | 307 | 5.7 | A | 803 | 5.7 | A |
| | E | 107 | 2.25 | A | | | | 184 | 5.5 | A | | | |
| | S | 92 | 4.76 | A | | | | 24 | 4.0 | A | | | |
| | W | 121 | 1.02 | A | | | | 288 | 1.4 | A | | | |
| George St/Stanley St | NW | 56 | 4.53 | A | 1345 | 10.6 | A | 101 | 7.3 | A | 1643 | 11.8 | A |
| | NE | 917 | 7.05 | A | | | | 717 | 6.8 | A | | | |
| | SE | 111 | 10.62 | A | | | | 254 | 8.5 | A | | | |
| | SW | 261 | 8.01 | A | | | | 571 | 11.8 | A | | | |
| Hereford St/Gilmour | N | 425 | 8.82 | A | 1655 | 18.1 | B | 309 | 10.6 | A | 2023 | 16.3 | B |
| | E | 679 | 18.12 | B | | | | 481 | 9.3 | A | | | |
| | S | 200 | 9.93 | A | | | | 389 | 15.5 | B | | | |
| | W | 351 | 8.72 | A | | | | 844 | 16.3 | B | | | |
| Halfpenny Dr/NewLink D | N | 0 | 0 | A | 2 | 0.8 | A | 0 | 0.0 | A | 4 | 1.0 | A |
| | E | 0 | 0 | A | | | | 0 | 0.0 | A | | | |
| | S | 0 | 0 | A | | | | 0 | 0.0 | A | | | |
| | W | 2 | 0.82 | A | | | | 4 | 1.0 | A | | | |
| Marsden Ln/NewLink A | N | 462 | 7.17 | A | 818 | 9.0 | A | 221 | 6.5 | A | 938 | 12.0 | A |
| | E | 205 | 8.95 | A | | | | 332 | 12.0 | A | | | |
| | W | 151 | 0.28 | A | | | | 385 | 0.4 | A | | | |
| Limeklins Rd/NewLink E | E | 87 | 2.74 | A | 262 | 5.7 | A | 38 | 2.3 | A | 409 | 4.2 | A |
| | S | 44 | 4.32 | A | | | | 172 | 4.2 | A | | | |
| | W | 131 | 5.67 | A | | | | 199 | 3.9 | A | | | |

## Kelso Modelling Performance Summary - 2035 Future Base Scenario

| 2035 Traffic Volumes with Full Development | | AM | | | | | | PM | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Approach | | | Intersection | | | Approach | | | Intersection | | |
| Intersection | Approach | Volume | Delay | LOS | Volume | Delay | LOS | Volume | Delay | LOS | Volume | Delay | LOS |
| GWH/Stewart St | N | 379 | 30.03 | C | 3369 | 51.5 | D | 146 | 40.88 | C | 3960 | 49.3 | D |
| | S | 1467 | 12.24 | A | | | | 1944 | 18.59 | B | | | |
| | W | 1523 | 94.63 | F | | | | 1870 | 81.95 | F | | | |
| GWH/Rankin St | NW | 1779 | 36.95 | C | 3697 | 36.9 | C | 1925 | 40.93 | C | 4292 | 41.5 | C |
| | NE | 169 | 37.97 | C | | | | 240 | 40.21 | C | | | |
| | SE | 1563 | 35.79 | C | | | | 1678 | 35.87 | C | | | |
| | SW | 186 | 43.82 | D | | | | 449 | 66.05 | E | | | |
| GWH/George St | NW | 1244 | 80.43 | F | 4869 | 72.2 | F | 1624 | 43.7 | D | 5506 | 87.7 | F |
| | NE | 1815 | 63.11 | E | | | | 794 | 159.86 | F | | | |
| | SE | 1231 | 74.71 | F | | | | 1444 | 46.78 | D | | | |
| | SW | 579 | 77.41 | F | | | | 1644 | 132.1 | F | | | |
| GWH/William | NW | 1213 | 18.57 | B | 2889 | 31.1 | C | 1710 | 22.91 | B | 3789 | 56.2 | D |
| | NE | 175 | 35.01 | C | | | | 191 | 140.23 | F | | | |
| | SE | 1313 | 32.87 | C | | | | 1367 | 32.09 | C | | | |
| | SW | 188 | 95.47 | F | | | | 521 | 197.82 | F | | | |
| GWH/Bentinck St | NW | 1305 | 8.9 | A | 3055 | 27.2 | B | 1819 | 20.18 | B | 3851 | 25.9 | B |
| | SE | 1526 | 42.11 | C | | | | 1301 | 26.54 | B | | | |
| | SW | 224 | 32.51 | C | | | | 731 | 38.82 | C | | | |
| GWH/Havannah St | E | 2162 | 38.28 | C | 3834 | 27.0 | B | 1799 | 26.97 | B | 4242 | 24.3 | B |
| | S | 300 | 30.53 | C | | | | 490 | 53.25 | D | | | |
| | W | 1372 | 8.33 | A | | | | 1953 | 14.56 | B | | | |
| GWH/Gilmour St | N | 288 | 101.64 | F | 4119 | 20.8 | B | 278 | 95.13 | F | 4411 | 32.0 | C |
| | E | 2235 | 15.75 | B | | | | 1742 | 29.89 | C | | | |
| | W | 1596 | 13.31 | A | | | | 2391 | 26.24 | B | | | |
| GWH/Boyd St | N | 647 | 141.56 | F | 3787 | 48.0 | D | 230 | 782.23 | F | 3366 | 145.5 | F |
| | E | 1635 | 40.3 | C | | | | 1547 | 192.16 | F | | | |
| | W | 1505 | 16.19 | B | | | | 1589 | 7.83 | A | | | |
| GWH/Littlebourne St | E | 1289 | 73.73 | F | 3522 | 73.7 | F | 1352 | 79.86 | F | 3650 | 219.8 | F |
| | S | 491 | 12.78 | A | | | | 608 | 219.79 | F | | | |
| | W | 1742 | 23.65 | B | | | | 1690 | 19.65 | B | | | |
| GWH/Ashworth | N | 421 | 9.12 | A | 2526 | 10.6 | A | 224 | 9.56 | A | 3036 | 15.5 | B |
| | E | 1049 | 8.84 | A | | | | 1346 | 9.08 | A | | | |
| | S | 133 | 7.28 | A | | | | 221 | 7.51 | A | | | |
| | W | 923 | 10.57 | A | | | | 1245 | 15.51 | B | | | |
| Gilmour St/Halfpenny Dr | N | 867 | 1.12 | A | 1480 | 21.1 | B | 502 | 1.5 | A | 1742 | 37.5 | C |
| | E | 271 | 21.09 | B | | | | 183 | 37.5 | C | | | |
| | S | 342 | 4.54 | A | | | | 1057 | 26.0 | B | | | |
| Gilmore St/ElevenMile Dr | N | 755 | 1.88 | A | 1407 | 14.1 | A | 351 | 2.7 | A | 1426 | 21.7 | B |
| | S | 400 | 0.38 | A | | | | 816 | 0.4 | A | | | |
| | W | 252 | 14.07 | A | | | | 259 | 21.7 | B | | | |
| Marsden Ln/Hughes St | N | 357 | 6.27 | A | 1857 | 21.9 | B | 308 | 7.2 | A | 2153 | 17.1 | B |
| | E | 830 | 14.22 | A | | | | 455 | 6.1 | A | | | |
| | S | 404 | 21.85 | B | | | | 750 | 13.1 | A | | | |
| | W | 266 | 5.67 | A | | | | 640 | 17.1 | B | | | |
| Limeklins Rd/Marsden Ln | NE | 104 | 4.14 | A | 133 | 9.9 | A | 48 | 4.3 | A | 171 | 11.0 | A |
| | SW | 22 | 0.61 | A | | | | 91 | 0.4 | A | | | |
| | W | 7 | 9.89 | A | | | | 32 | 11.0 | A | | | |
| Limelins Rd/Hughes St | N | 480 | 17.45 | B | 1552 | 17.5 | B | 426 | 34.9 | C | 1946 | 41.0 | C |
| | E | 711 | 5.53 | A | | | | 437 | 41.0 | C | | | |
| | S | 80 | 15.72 | B | | | | 23 | 17.7 | B | | | |
| | W | 281 | 1.07 | A | | | | 1060 | 1.2 | A | | | |
| George St/Stanley St | NW | 237 | 6.29 | A | 3128 | 36.0 | C | 267 | 11.1 | A | 3373 | 18.8 | B |
| | NE | 2193 | 35.99 | C | | | | 1380 | 10.9 | A | | | |
| | SE | 132 | 14.39 | A | | | | 292 | 18.8 | B | | | |
| | SW | 566 | 7.03 | A | | | | 1434 | 18.3 | B | | | |
| Hereford St/Gilmour | N | 948 | 13.05 | A | 3330 | 37.7 | C | 463 | 50.2 | D | 3853 | 50.2 | D |
| | E | 1532 | 10.99 | A | | | | 1104 | 8.2 | A | | | |
| | S | 185 | 37.72 | C | | | | 326 | 20.7 | B | | | |
| | W | 665 | 7.75 | A | | | | 1960 | 22.0 | B | | | |
| Halfpenny Dr/NewLink D | N | 290 | 1.27 | A | 661 | 4.4 | A | 297 | 3.3 | A | 746 | 4.0 | A |
| | E | 141 | 4.35 | A | | | | 71 | 4.0 | A | | | |
| | S | 162 | 0.2 | A | | | | 221 | 0.2 | A | | | |
| | W | 68 | 1.35 | A | | | | 157 | 1.4 | A | | | |
| Marsden Ln/NewLink A | N | 506 | 6.46 | A | 1837 | 23.0 | B | 286 | 12.5 | A | 2054 | 26.4 | B |
| | E | 1012 | 22.96 | B | | | | 817 | 18.0 | B | | | |
| | W | 319 | 7.92 | A | | | | 951 | 26.4 | B | | | |
| Limeklins Rd/NewLink E | E | 612 | 2.51 | A | 1356 | 13.9 | A | 256 | 2.7 | A | 1641 | 75.1 | F |
| | S | 395 | 13.86 | A | | | | 596 | 75.1 | F | | | |
| | W | 349 | 10.23 | A | | | | 789 | 6.2 | A | | | |

# Kelso Modelling Performance Summary - Future Long Term Scenario with 3 through lanes on GWH with New Link K to GWH

| 2035 with Full Dev Gilmore St realiagnment | | AM | | | | | | PM | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Approach | | | Intersection | | | Approach | | | Intersection | | |
| Intersection | Approach | Volume | Delay | LOS | Volume | Delay | LOS | Volume | Delay | LOS | Volume | Delay | LOS |
| GWH/Stewart St | N | 369 | 39.31 | C | 3437 | 22.2 | B | 147 | 38.55 | C | 4228 | 26.8 | B |
| | S | 1571 | 19.69 | B | | | | 2118 | 22.46 | B | | | |
| | W | 1497 | 20.68 | B | | | | 1963 | 30.53 | C | | | |
| GWH/Rankin St | NW | 1758 | 42.29 | C | 3739 | 38.8 | C | 2016 | 43.38 | D | 4576 | 40.0 | C |
| | NE | 204 | 37.97 | C | | | | 226 | 36.25 | C | | | |
| | SE | 1573 | 35 | C | | | | 1849 | 31.16 | C | | | |
| | SW | 204 | 39.24 | C | | | | 485 | 61.68 | E | | | |
| GWH/George St | NW | 1421 | 45.92 | D | 5209 | 51.1 | D | 1577 | 52.04 | D | 5789 | 57.2 | E |
| | NE | 1870 | 42.97 | D | | | | 907 | 96.38 | F | | | |
| | SE | 1287 | 67.85 | E | | | | 1660 | 43.16 | D | | | |
| | SW | 631 | 52.83 | D | | | | 1645 | 54.59 | D | | | |
| GWH/William | NW | 1393 | 19.37 | B | 3092 | 22.9 | B | 1703 | 19.24 | B | 4024 | 37.8 | C |
| | NE | 98 | 36.16 | C | | | | 211 | 52.46 | D | | | |
| | SE | 1426 | 22.91 | B | | | | 1616 | 53.78 | D | | | |
| | SW | 175 | 42.78 | D | | | | 494 | 43.01 | D | | | |
| GWH/Bentinck St | NW | 1426 | 12.1 | A | 3251 | 25.7 | B | 1826 | 14.89 | B | 4165 | 38.2 | C |
| | SE | 1577 | 36.84 | C | | | | 1618 | 54.4 | D | | | |
| | SW | 248 | 32.42 | C | | | | 721 | 60.82 | E | | | |
| GWH/Havannah St | E | 2229 | 52.02 | D | 3938 | 36.0 | C | 2135 | 38.77 | C | 4685 | 29.2 | C |
| | S | 344 | 31.67 | C | | | | 543 | 45.71 | D | | | |
| | W | 1365 | 11.05 | A | | | | 2007 | 14.45 | A | | | |
| GWH/Gilmour St | N | 254 | 45.25 | D | 4291 | 27.6 | B | 227 | 158 | F | 5016 | 46.0 | D |
| | E | 2315 | 23.8 | B | | | | 2220 | 38.43 | C | | | |
| | S | 11 | 44.29 | D | | | | 84 | 94 | F | | | |
| | W | 1711 | 30.1 | C | | | | 2485 | 40.83 | C | | | |
| GWH/Boyd St | N | 621 | 71.77 | F | 3852 | 43.5 | D | 312 | 132.95 | F | 3927 | 37.1 | C |
| | E | 1642 | 49.18 | D | | | | 1874 | 40.16 | C | | | |
| | W | 1589 | 26.47 | B | | | | 1741 | 16.64 | B | | | |
| GWH/Littlebourne St | E | 1318 | 65.42 | E | 3622 | 65.4 | E | 1536 | 82.58 | F | 4044 | 82.6 | F |
| | S | 501 | 13.88 | A | | | | 680 | 20.78 | B | | | |
| | W | 1803 | 26.77 | B | | | | 1828 | 24.97 | B | | | |
| GWH/Ashworth | N | 211 | 8.9 | A | 2319 | 10.7 | A | 92 | 8.85 | A | 2791 | 13.7 | A |
| | E | 1031 | 8.35 | A | | | | 1219 | 9.28 | A | | | |
| | S | 121 | 6.86 | A | | | | 228 | 6.97 | A | | | |
| | W | 956 | 10.74 | A | | | | 1252 | 13.65 | A | | | |
| Gilmour St/Halfpenny Dr | N | 852 | 1.07 | A | 1506 | 24.2 | B | 568 | 1.45 | A | 1766 | 21.6 | B |
| | E | 301 | 24.19 | B | | | | 140 | 21.57 | B | | | |
| | S | 353 | 3.44 | A | | | | 1058 | 8.61 | A | | | |
| Gilmore St/ElevenMile Dr | N | 730 | 1.73 | A | 1407 | 15.1 | B | 410 | 3.69 | A | 1539 | 20.9 | B |
| | S | 445 | 0.31 | A | | | | 860 | 0.35 | A | | | |
| | W | 232 | 15.1 | B | | | | 269 | 20.87 | B | | | |
| Marsden Ln/Hughes St | N | 378 | 6.37 | A | 1144 | 6.4 | A | 224 | 6.56 | A | 1276 | 8.5 | A |
| | E | 263 | 4.95 | A | | | | 231 | 4.94 | A | | | |
| | S | 370 | 5.81 | A | | | | 594 | 8.46 | A | | | |
| | W | 133 | 4.99 | A | | | | 227 | 5.27 | A | | | |
| Limeklins Rd/Marsden Ln | NE | 102 | 2.42 | A | 139 | 10.5 | A | 50 | 2.99 | A | 158 | 13.4 | A |
| | SW | 24 | 0.29 | A | | | | 81 | 0.47 | A | | | |
| | W | 13 | 10.51 | A | | | | 27 | 13.43 | A | | | |
| Limelins Rd/Hughes St | N | 462 | 13.27 | A | 1395 | 13.3 | A | 348 | 19.74 | B | 1635 | 19.7 | B |
| | E | 568 | 4.18 | A | | | | 373 | 16.86 | B | | | |
| | S | 72 | 10.84 | A | | | | 39 | 18.84 | B | | | |
| | W | 293 | 1.65 | A | | | | 875 | 1.17 | A | | | |
| George St/Stanley St | NW | 109 | 5.55 | A | 3045 | 9.2 | A | 306 | 11.32 | A | 3423 | 17.8 | B |
| | NE | 2319 | 9.16 | A | | | | 1375 | 6.47 | A | | | |
| | SE | 74 | 8.77 | A | | | | 243 | 8.51 | A | | | |
| | SW | 543 | 8 | A | | | | 1499 | 17.78 | B | | | |
| Hereford St/Gilmour | N | 946 | 13.35 | A | 3415 | 30.8 | C | 485 | 28.72 | C | 3908 | 32.1 | C |
| | E | 1603 | 10.77 | A | | | | 1012 | 7.81 | A | | | |
| | S | 218 | 30.8 | C | | | | 412 | 20.83 | B | | | |
| | W | 648 | 8.17 | A | | | | 1999 | 32.1 | C | | | |
| Halfpenny Dr/NewLink D | E | 188 | 3.89 | A | 290 | 12.5 | A | 111 | 0.21 | A | 282 | 4.2 | A |
| | S | 83 | 2.74 | A | | | | 93 | 4.23 | A | | | |
| | W | 19 | 12.47 | A | | | | 78 | 1.85 | A | | | |
| Marsden Ln/NewLink A | N | 1129 | 56.16 | D | 1893 | 56.2 | D | 487 | 6.57 | A | 2146 | 24.0 | B |
| | E | 434 | 7.04 | A | | | | 581 | 8.87 | A | | | |
| | W | 330 | 2.67 | A | | | | 1078 | 23.96 | B | | | |
| Limeklins Rd/NewLink E | E | 381 | 7.16 | A | 929 | 7.2 | A | 154 | 2.54 | A | 1202 | 11.5 | A |
| | S | 322 | 4.61 | A | | | | 405 | 11.54 | A | | | |
| | W | 226 | 6.91 | A | | | | 643 | 4.56 | A | | | |
| GWH/NewLink K | N | 139 | 1.39 | A | 1744 | 4.6 | A | 99 | 8.35 | A | 2147 | 8.4 | A |
| | E | 959 | 0.68 | A | | | | 1142 | 4.81 | A | | | |
| | W | 646 | 4.55 | A | | | | 906 | 0.51 | A | | | |
| Halfpenny Dr/NewLink J | N | 268 | 0 | A | 501 | 5.3 | A | 262 | 3.06 | A | 546 | 4.2 | A |
| | E | 0 | 0.41 | A | | | | 0 | 0 | A | | | |
| | S | 139 | 4.26 | A | | | | 124 | 0.48 | A | | | |
| | W | 94 | 5.25 | A | | | | 160 | 4.17 | A | | | |
| Marsden Ln/NewLink J | N | 149 | 1.46 | A | 571 | 11.2 | A | 108 | 6.03 | A | 623 | 11.1 | A |
| | E | 17 | 4.88 | A | | | | 9 | 0.69 | A | | | |
| | S | 320 | 11.18 | A | | | | 353 | 5.56 | A | | | |
| | W | 85 | 0 | A | | | | 153 | 11.14 | A | | | |

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