REGIONAL ROADS VICTORIA

MAY 2021

BEAUFORT BYPASS ENVIRONMENT EFFECTS STATEMENT

TRAFFIC AND TRANSPORT IMPACT ASSESSMENT

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Beaufort Bypass Environment Effects Statement
Traffic and Transport Impact Assessment

Regional Roads Victoria

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TABLE OF CONTENTS

CONTENTS (Continued)

CONTENTS (Continued)

LIST OF TABLES

LIST OF TABLES (CONTINUED)

LIST OF TABLES (CONTINUED)

LIST OF FIGURES

LIST OF FIGURES (CONTINUED)

LIST OF FIGURES (CONTINUED)

LIST OF APPENDICES

ABBREVIATIONS

AADT	Annual Average Daily Traffic
ADT	Annual Daily Traffic
ATC/ICs	Automatic Tube Counts/Intersection Counts
DELWP	Department of Environment, Land, Water and Planning
DoS	Degree of Saturation
DOTARS	Department of Transport and Regional Services
EES	Environment Effects Statement
EPA	Environment Protection Authority
ERA	Environmental risk assessment
HV	Heavy Vehicles
LoS	Level of Service
LV	Light Vehicles
OD	Origin-destination
RRV	Regional Roads Victoria (formerly VicRoads)
SVITM	State-wide Victorian Integrated Transport Model
VKT	Vehicle Kilometres Travelled
vpd	vehicles per day
vph	vehicles per hour

EXECUTIVE SUMMARY

Regional Roads Victoria (RRV) has engaged WSP Australia Pty Ltd (WSP) to undertake a traffic and transport impact assessment for the Beaufort Bypass project. As part of the Environment Effects Statement (EES), traffic and transport impacts resulting from construction and operation of the bypass road are required to be assessed.

An assessment of the existing conditions was established by conducting and assessing the results of traffic including traffic volumes (automatic traffic surveys), intersection counts, origin-destination count and travel time surveys. The surveys were generally completed with differing survey periods in the 7-day period between Thursday 26 October 2017 to Wednesday 1 November 2017. It was noted that there were survey issues with the automatic tube count site on Western Highway between King Street & Beaufort-Lexton Road, where the tube was damaged. As such, the site was resurveyed the following week between Thursday 2 November 2017 to Wednesday 8 November 2017. As this period occurred during the Melbourne Cup public holiday, factoring was completed to account for potential traffic volume variations due to the holiday period. The existing conditions also included an assessment of crash history of the study area, along with existing conditions for public transport, walking and cycling.

The existing conditions review showed that highest proportion of traffic movements within the study area was the east-west movement on the Western Highway travelling through Beaufort, based on origin-destination survey results. Within the study area, the Western Highway had the highest daily traffic volume, with volumes peaking in Beaufort town centre at 11,063 vehicles per day (based on weekday average) for the survey period. For the travel time survey, the results show that travel times on the Western Highway in the eastbound direction were largely consistent across the midday (12:00 pm – 1:00 pm) and PM (2:30 pm – 5:30 pm) survey periods, with only a 3 second difference in average time. For westbound direction, the midday run was slightly faster (25 seconds) compared to the PM period. A total of nine serious injury or fatal crashes occurred in the study area for the period of 2016–2020 inclusive, with the one fatality crash occurring at a midblock location on the Western Highway. The existing public transport services primarily consists of V-Line services with limited walking and cycling infrastructure present.

The impact assessment was undertaken by developing a spreadsheet model to understand the change in traffic volumes due to the Beaufort Bypass. SIDRA intersection analysis was undertaken to assess the impact on delays to traffic at intersections within Beaufort. The impact on travel times was assessed by using survey data and calculations. It was noted that the choice of option alignment did not affect the outcomes of the spreadsheet and intersection modelling, and as such, two scenarios were considered for the modelling – a "project' and "no-project" case.

The spreadsheet modelling showed that by 2031 in the "no-project" case, traffic volumes on the Western Highway between King Street and Beaufort-Lexton Road (centre of Beaufort) are forecast to be over 14,000 vehicles per day for a Thursday with over 2,500 heavy vehicles per day. At this volume the centre of town is likely to be experiencing congestion leading to safety issues, and accessibility issues.

With the implementation of the bypass, the assessment shows a reduction in east-west traffic through the town thereby extending the functional life of the cross intersections along the route, with 2031 "project" daily traffic volumes forecast to be approximately 7,500 vehicles per day with approximately 500 heavy vehicles per day for a Thursday. This is particularly noted at the Havelock Street and Livingstone Street intersection, where signalisation may be required in 2031 if the bypass is not implemented. The reduced traffic will also improve safety outcomes and increase amenity, particularly with creating greater opportunity for active transport. The SIDRA results for the assessed intersections (along the Western Highway/Neill Street at Havelock Street/Livingstone Street, Lawrence Street and Racecourse Road) also show results which generally suggest good capacity, low delays, good level of service and reasonable queue lengths in each scenario. However, there are generally clear improvements in all results for the 'project' case compared to the 'no project' case due to the reduced main line volumes.

The forecast traffic volume on the proposed bypass is between 7,000 and 10,000 vehicles by 2031. Comparing travel time with alignment options, there is a 21 seconds difference in total travel times between each of the options and as such, this is not likely to be a significant factor in determining the alignment preference.

Negative transport impacts on the receiving environment will predominantly be received during the construction phase and related to impacts on road users and access. Operational impacts on transport networks and road users would be positive through improvements to capacity, accessibility, safety and amenity within Beaufort.

1 INTRODUCTION

Regional Roads Victoria (RRV), formerly VicRoads, proposes to construct a new freeway section of the Western Highway to bypass the town of Beaufort (the project), linking completed sections of the Western Highway duplication to the east and west of Beaufort.

On 22 July 2015, the Minister for Planning determined an Environment Effects Statement (EES) would be required under the *Environment Effects Act 1978* (EE Act) to assess the potential environmental effects of the project. The EES includes consideration of four alternative alignments and selection of a preferred bypass alignment which identifies the land to be reserved for the future construction. The EES process provides for identification and analysis of the potential environment effects of the project and the means of avoiding, minimising and managing adverse effects. It includes public involvement and allows stakeholders to understand the likely environmental effects of the project and how they will be managed.

1.1 PROJECT BACKGROUND

The Western Highway is the primary road link between Melbourne and Adelaide. It serves interstate trade between Victoria and South Australia and is a key transport corridor through Victoria's west. Over 6,500 vehicles utilise the Western Highway, west of Ballarat each day. Of these 6,500 vehicles, 1,500 are classed as commercial heavy vehicles. These traffic volumes are expected to increase to approximately 7,500 by 2025 and 9,500 by 2040.

RRV have identified the need to upgrade the Western Highway from Ballarat to Stawell to:

- improve road safety at intersections
- improve safety of access to adjoining properties
- enhance road freight efficiency
- reduce travel time
- provide better access to local facilities
- improve roadside facilities.

As part of planning studies commissioned by the Commonwealth and State Governments, bypass route options around the town of Beaufort have been considered to meet the objectives identified by RRV and the National Land Transport Network's Nation Building Program.

The project would include construction of a dual carriageway, connections to major intersecting roads, interchanges to connect Beaufort to the Western Highway at the eastern and western tie-in points, several waterway crossings, an overpass of the Melbourne-Ararat rail line, and intersection upgrades at local roads and provision for service roads as required.

1.2 PROJECT OBJECTIVES

The objectives of the project are to:

- improve road safety and maintain the functionality of Beaufort's road network
- improve freight movement and efficiency across the road network
- improve Beaufort's amenity by removing heavy vehicles
- improve access to markets and the competitiveness of local industries.

1.3 PURPOSE OF THE REPORT

This report assesses the potential traffic and transport impacts associated with the construction and operation of the project, based on the concept designs for the four alignments. It also identifies any opportunities to address traffic and transport impacts.

This traffic and transport assessment report has been prepared for the EES in:

- accordance with the scoping requirements (dated December 2016) released by the Department of Environment, Land, Water and Planning (DELWP) on 4 January 2017
- consultation with the community and stakeholders in parallel with the concept designs for the project.

1.4 STUDY OBJECTIVES

The objective of the traffic and transport assessment is to outline the key traffic and transport issues in Beaufort, describe the existing conditions and traffic patterns, describe the likely effects of the introduction of the bypass, and identify any required mitigations.

2 PROJECT DESCRIPTION

The project would comprise of an 11 km freeway standard bypass to the north of the township of Beaufort, connecting the two recently duplicated sections of the Western Highway to the east and west of Beaufort. The project would be constructed under a Design and Construct or Construct only contract administered by a superintendent at RRV/Major Road Projects Victoria (MRPV), following a competitive tender process. Department of Transport would manage and maintain the asset.

2.1 FREEWAY STANDARD BYPASS

The project would connect the duplicated sections of the Western Highway to the east and west of Beaufort via the Option C2 bypass to the north of Beaufort that avoids Snowgums Bushland Reserve and cuts through Camp Hill. The bypass would include the following key components:

- designed as a freeway standard bypass
- approximately 11 km long
- designed to 120 km/hr and sign posted to 110 km/hr for its entirety
- two tie-in interchanges
- one road over rail bridge
- waterway crossings
- diamond interchange to connect with the local road network
- four overpass bridge structures over the local road network.

2.2 INTERCHANGES

The project would have interchanges at the following locations:

- tie-in points to existing Western Highway at the eastern and western ends of the bypass
- diamond interchange at existing local road network connection (Beaufort-Lexton Road).

2.3 BRIDGES AND CULVERTS

The route option would have bridge structures at the following locations:

- road over rail bridge structure for the Melbourne-Ararat rail line
- several waterway bridge structures over Yam Holes Creek
- overpass bridge structures for the existing local road network:
  - Main Lead Road
  - Beaufort-Lexton Road (diamond interchange)
  - Racecourse Road
  - Back Raglan Road.

2.4 ALIGNMENT DESCRIPTIONS

Four alignment options, referred to as Options A0, A1, C0 and C2, were assessed in order to identify a preferred bypass (see Figure 2.1). Following extensive community consultation and technical assessments, Option C2 was selected as the preferred route.

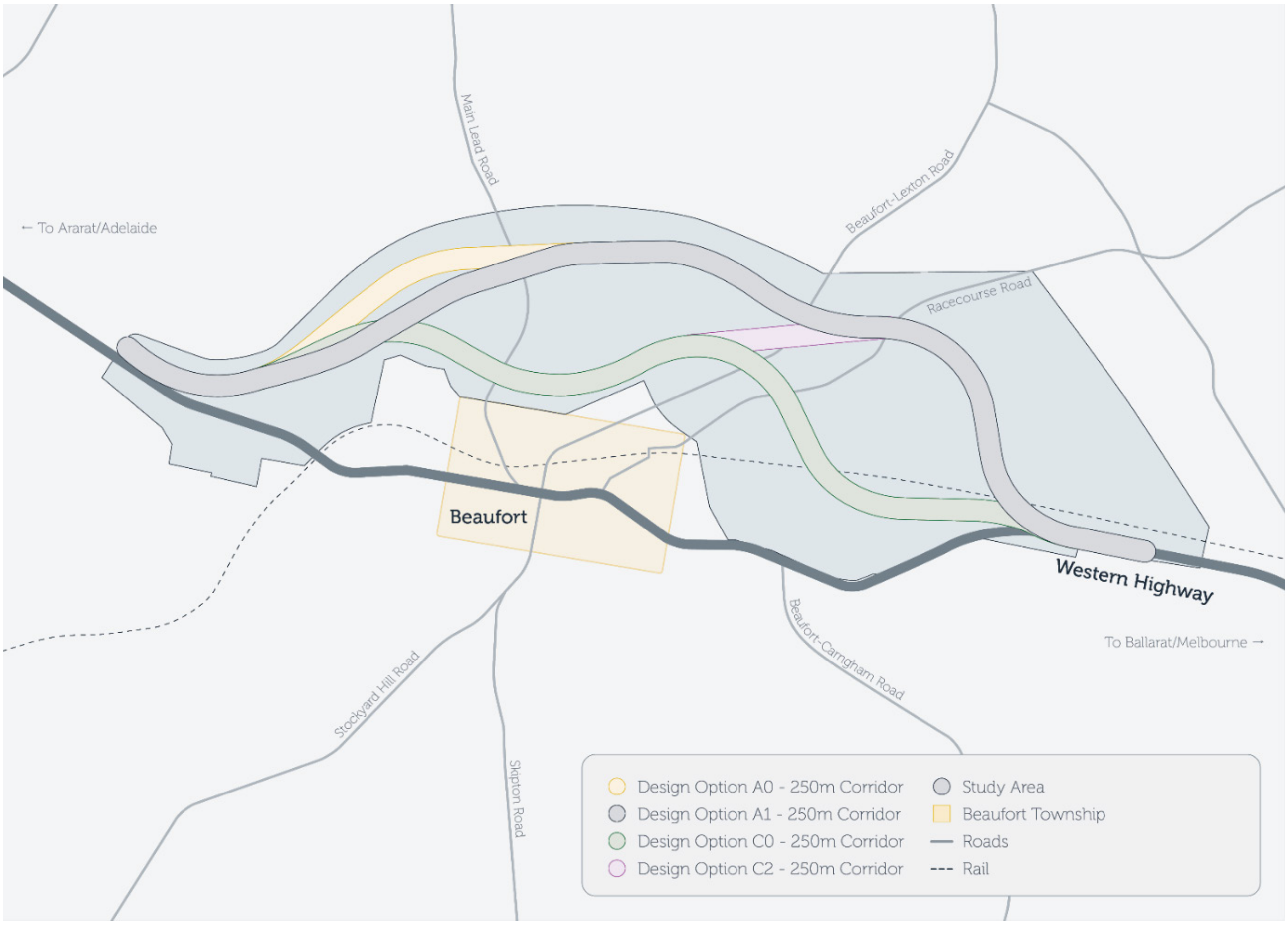


Figure 2.1 Beaufort Bypass alignment options and study area

2.4.1 OPTIONS ASSESSED

2.4.1.1 OPTION A0

The A0 bypass alignment is 11.2 km in length and is the northern most bypass option (see Figure 2.2). From the western tie-in point, approximately 3 km from the Beaufort township, this alignment curves north – north east, where there will be a west-facing, half diamond interchange to maintain access to private properties and the township via the existing Western Highway. The alignment passes over Main Lead Road then climbs through the State Forest north of Camp Hill. From here it descends to a full diamond interchange at Beaufort-Lexton Road, which will provide access to the north and south of the township, before re-joining the Western Highway at its eastern extent, approximately 4.5 km from Beaufort. An outbound exit ramp at the eastern interchange will allow for eastern access to Beaufort via the existing Western Highway. Bridges will pass over Main Lead and Racecourse Roads, as well as over the Melbourne-Ararat train line. The main areas of fill occur at bridge and interchange locations with a large cut section north of Camp Hill.

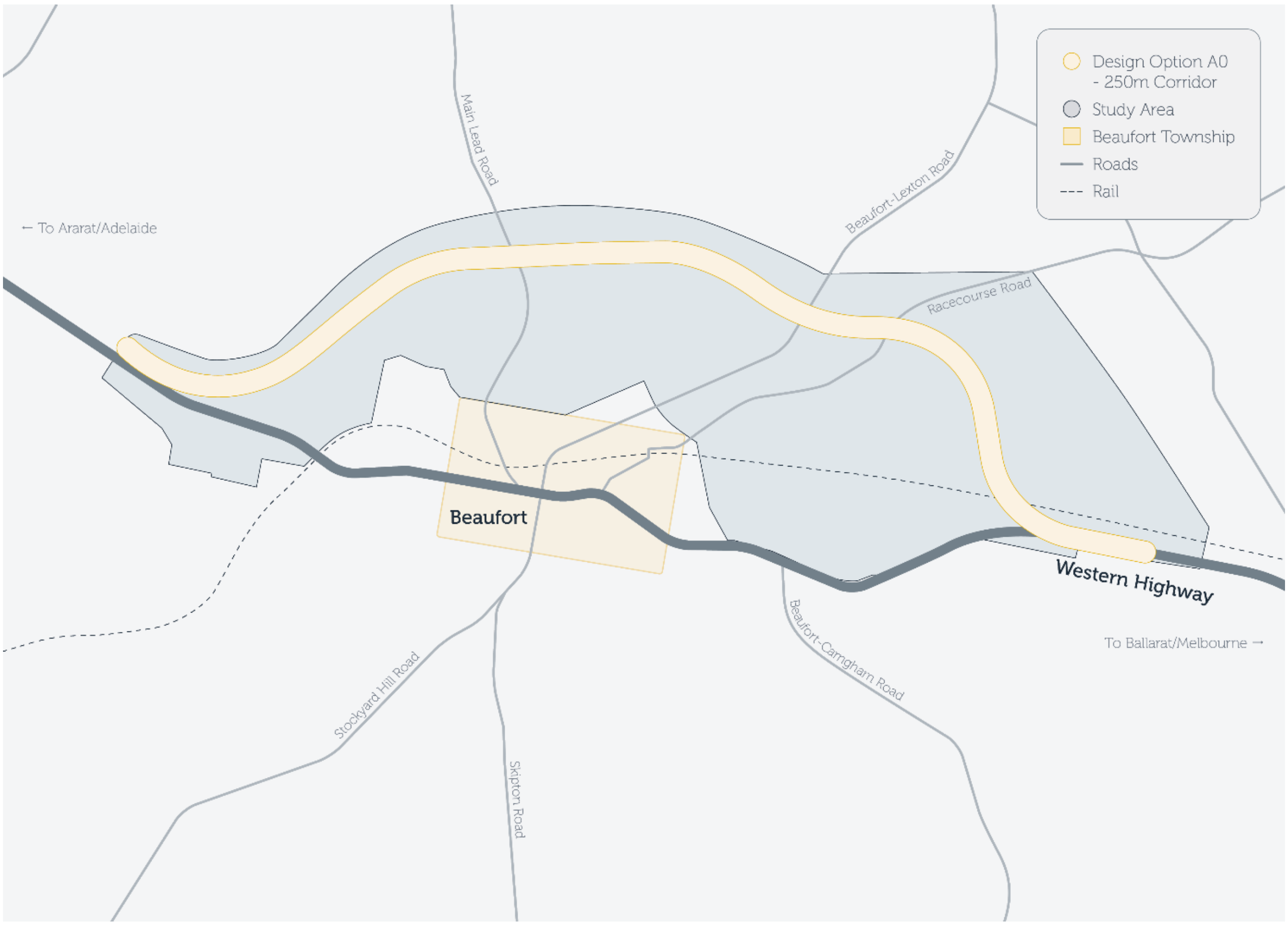


Figure 2.2 Beaufort Bypass A0 alignment option

2.4.1.2 OPTION A1

The A1 bypass alignment option is 11.1 km in length (see Figure 2.3). Approximately 3 km from the Beaufort township, this alignment deviates north-east from the Western Highway, staying slightly south of option A0 until a point east of Main Lead Road, where it re-joins the A0 alignment. There will be a west-facing, half diamond interchange at the western tie-in to maintain access to private properties and the township of Beaufort via the existing Western Highway, and a full diamond interchange at Beaufort-Lexton Road to maintain north-south access. The A1 alignment will re-join the Western Highway approximately 4.5 km to the east of the township. An outbound exit ramp at the eastern interchange will allow for eastern access to Beaufort via the existing Western Highway. Bridges will pass over Main Lead and Racecourse Roads, as well as over the Melbourne-Ararat train line. The main areas of fill occur at bridge and interchange locations, with cuts north-east of Back Raglan Road, and north of Camp Hill.

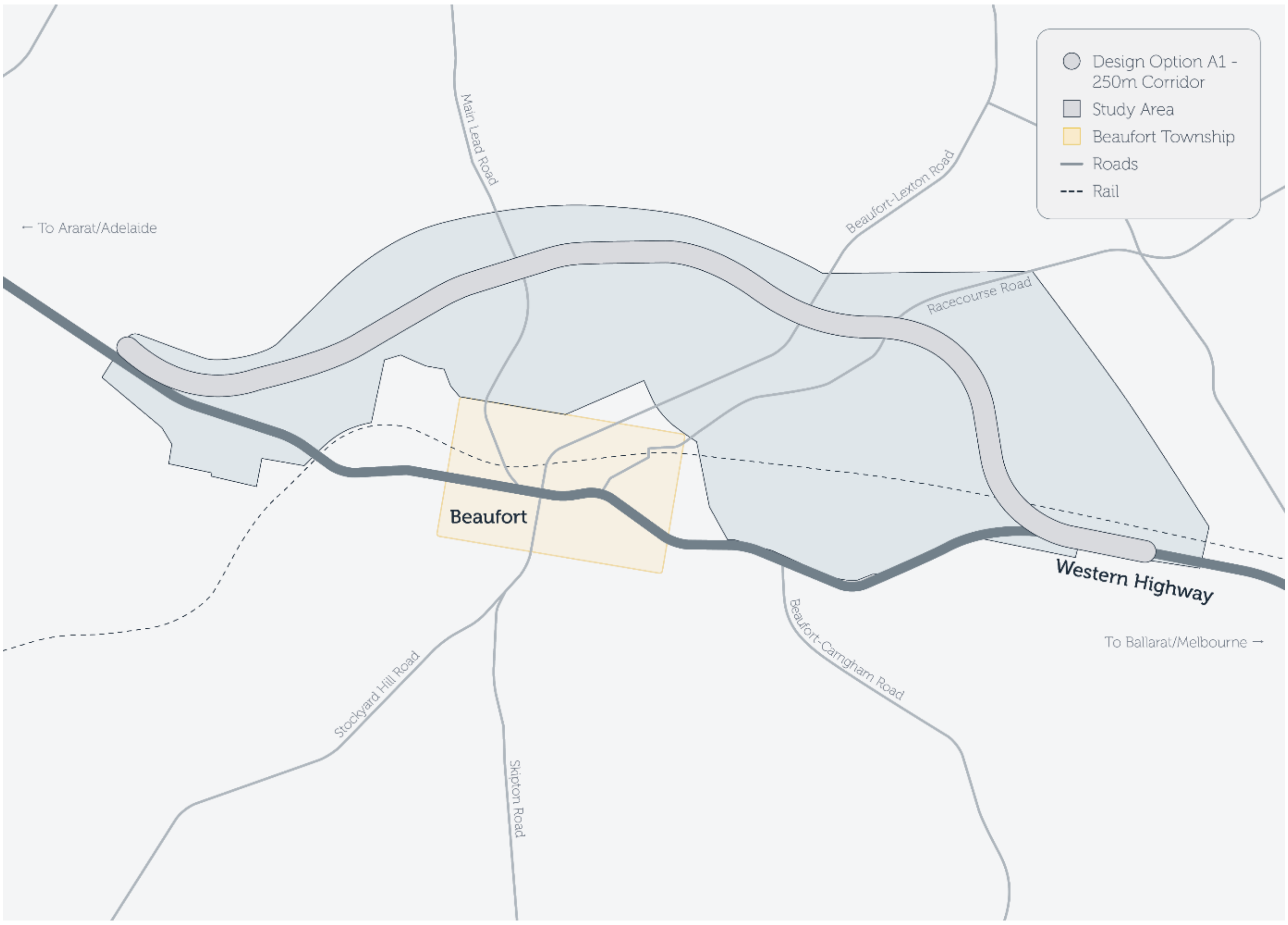


Figure 2.3 Beaufort Bypass A1 alignment option

2.4.1.3 OPTION C0

The southernmost option, C0, is approximately 10.6 km in length from the west to east tie-in points of the Western Highway (see Figure 2.4). Access to the Beaufort township via the existing Western Highway will be maintained by a west-facing, half diamond interchange in the west. The C0 option follows the A0 option from the western tie-in point, approximately 3 km from the Beaufort township, before deviating at Back Raglan Road in a more easterly direction almost parallel to the existing Western Highway. This option passes close to the north of Camp Hill, with some cut and fill required in this section, before curving south-east to a full diamond interchange at Beaufort-Lexton Road, providing north-south access. The C0 alignment will re-join the Western Highway approximately 4.5 km to the east of the township. Bridges will pass over Main Lead and Racecourse Roads, as well as over the Melbourne-Ararat train line. The main areas of fill occur at bridge and interchange locations, with the largest cut and fill areas north and north-east of Camp Hill.

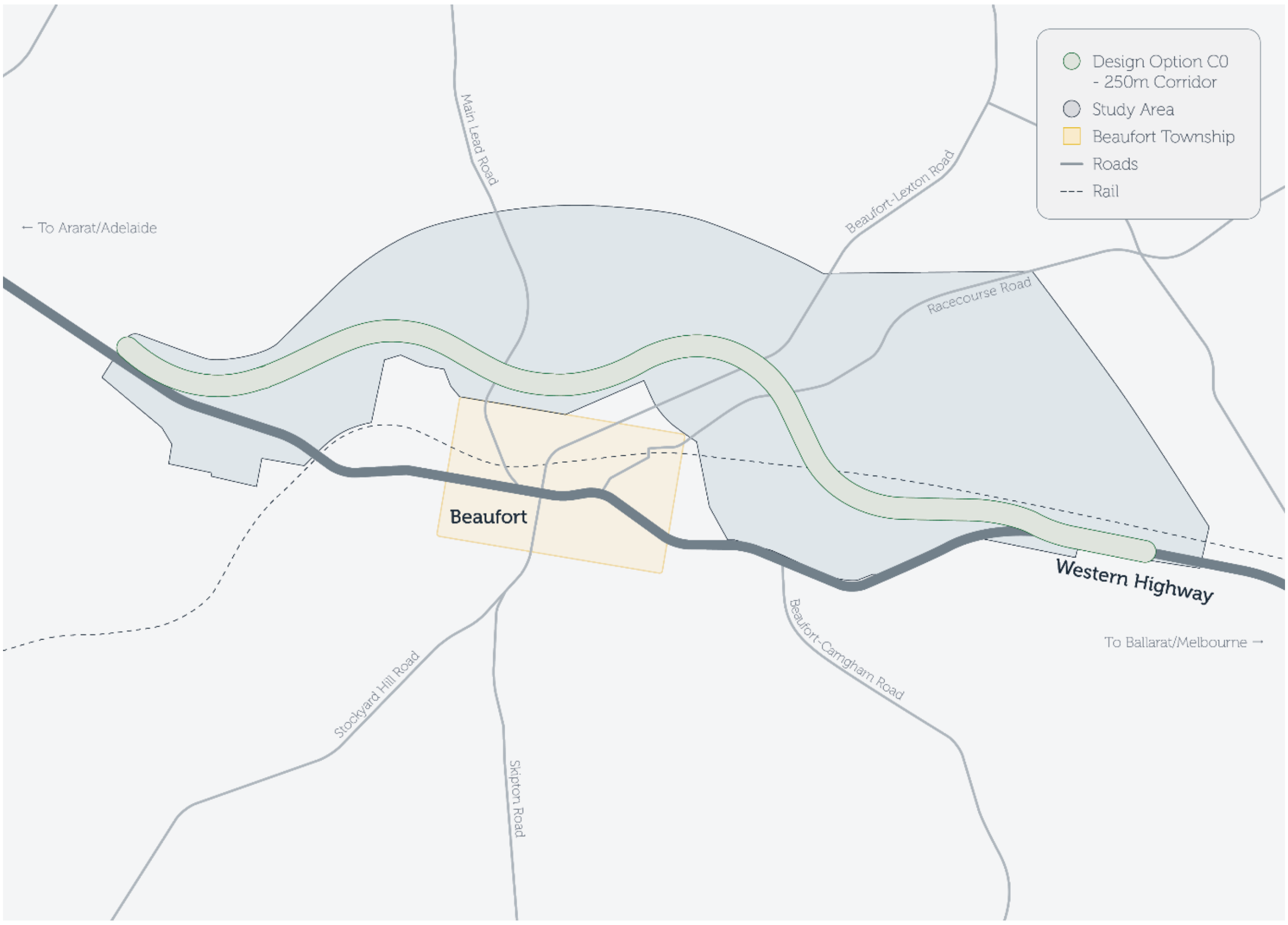


Figure 2.4 Beaufort Bypass C0 alignment option

2.4.2 PREFERRED ALIGNMENT

2.4.2.1 OPTION C2

Option C2 is 11 km in length and is a hybrid between the A0 and the C0 options (see Figure 2.5). It follows the C0 option from the western tie-in point (approximately 3 km from the Beaufort township) until Beaufort-Lexton Road, where it continues in an easterly direction and joins the A0 alignment near Racecourse Road. The C2 alignment will re-join the existing Western Highway at the eastern tie-it point, approximately 4.5 km from the township. At the western extent, access to Beaufort via the existing Western Highway will be maintained by a half diamond interchange, and there will be a full diamond interchange over Beaufort-Lexton Road. Access to Beaufort via the existing Western Highway at the eastern approach will be maintained by an outbound exit ramp at the eastern interchange. Again, bridges will pass over Main Lead and Racecourse Roads, as well as over the Melbourne-Ararat train line. The main areas of fill occur at bridge and interchange locations, with the largest cut and fill areas north and north east of Camp Hill.

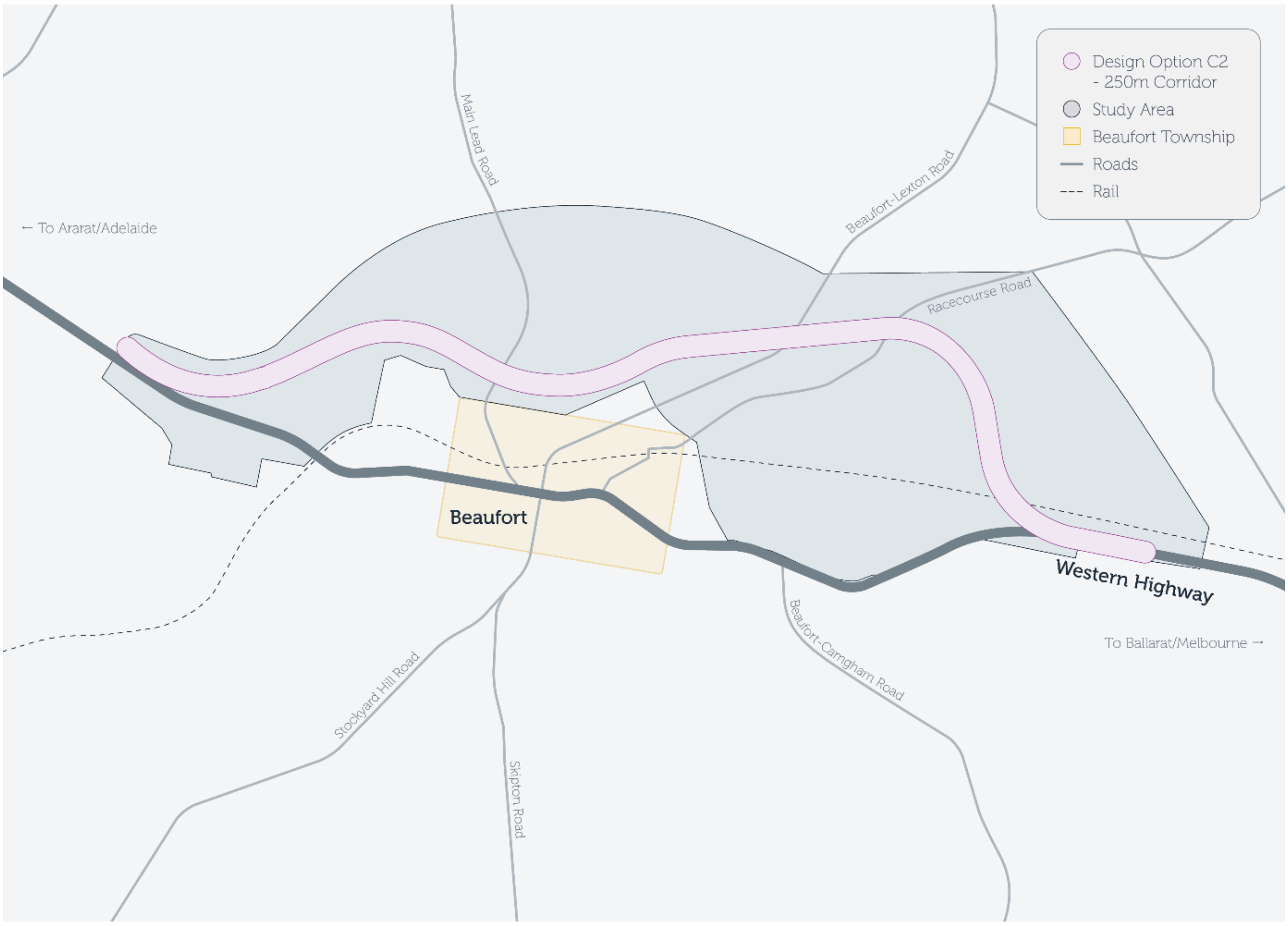


Figure 2.5 Beaufort Bypass C2 alignment option

2.5 PROJECT CONSTRUCTION

The following construction sub-sections describe the construction activities for the project. Construction of the bypass is expected to take two years and commence once construction funding and approvals are obtained.

2.5.1 CONSTRUCTION ACTIVITIES

Construction activities would include:

- preconstruction site delineation and compound setup, which may include (but not be limited to) tree clearance and vegetation lopping/removal, and establishment of construction site(s) and access tracks
- establishment of environmental and traffic controls
- route clearance and relocation and/or protection of utilities
- construction drainage and sediment and erosion control mitigation
- general earthworks:
  - excavation of a cut including stripping of topsoil and placement of fill
  - import, export and stockpiling of fill
  - treatment of contaminated soil or removal of hazardous material, if required
- development of structures, interchanges, batters, drainage and pavement
- development of ancillary infrastructure:
  - noise barriers
  - lighting
  - safety barriers
  - line marking
- landscaping and site reinstatement.

2.6 OPERATIONS AND MAINTENANCE

Operations and maintenance of the project would be consistent with current practices and standards, including the VicRoads' *Roadside Management Strategy* (2011). Key objectives include:

- asset management of:
  - landscaped areas
  - stormwater drains
  - bridges and culverts
  - road pavement
  - signage
  - barriers
  - line marking
- enhancement of transport safety, efficiency and access
- protection of environmental and cultural heritage values
- management of fire risk
- preservation and enhancement of roadside amenity
- routine and life cycle maintenance activities throughout operations
- monitoring and management of areas of environmental sensitivity such as water bodies and wildlife corridors.

3 EES SCOPING REQUIREMENTS

The *Scoping Requirements for Beaufort Bypass Project Environment Effects Statement* (DELWP 2016) (Scoping Requirements) have been prepared by DELWP on behalf of the Minister for Planning. The Scoping Requirements set out the specific environmental matters to be investigated and documented in the EES, which informs the scope of the EES technical studies.

The following matters of the Scoping Requirements are relevant to the traffic and transport impact assessment:

EES EVALUATION OBJECTIVE

Road efficiency, capacity and safety: To provide for an effective Western Highway bypass of Beaufort, to improve travel efficiency, road safety, and capacity, as well as improve amenity and local transport network in Beaufort.

Table 3.1 EES scoping requirements – Traffic and transport

SCOPING REQUIREMENTS SUB-SECTION	MATTER TO BE ADDRESSED	RELEVANT ASSESSMENT	ADDRESSED IN THIS ASSESSMENT
Key issues	Impacts from through traffic (including heavy vehicles) in Beaufort.	Traffic and transport	✓
	Effective integration of the proposed project with local transport networks including public transport.	Traffic and transport	✓
	Identify and compare expected or modelled transport performance of identified alignment alternatives, in terms of travel times, capacity, traffic volumes, road safety and accessibility.	Traffic and transport	✓
Priorities for characterising the existing environment	Characterise traffic and road conditions (times, capacity, volumes, road safety) for the "no project scenario."	Traffic and transport	✓
	Characterise existing transport patterns —private vehicles, commercial/freight heavy vehicles, pedestrians, bicycles and public transport— to identify influences on capacity, travel times, safety and accessibility and planned future land uses.	Traffic and transport	✓
Design and mitigation measures	Potential design solutions, appropriate for a rural town such as Beaufort, to optimise linkages with the existing local road network and maintain or enhance access (or vehicles, pedestrians, bicycle and public transport).	Traffic and transport	✓
	Address potential risk areas to road safety, such as wildlife corridors, and outline any specific measures to avoid, minimise and mitigate road safety issues.	Traffic and transport	✓
	Identify proposed north-south road access to public and private land.	Traffic and transport	✓
		Planning and land use	EES Chapter 15 (Land use and planning)

SCOPING REQUIREMENTS SUB-SECTION	MATTER TO BE ADDRESSED	RELEVANT ASSESSMENT	ADDRESSED IN THIS ASSESSMENT
		Social impact assessment	EES Chapter 14 (Social impact assessment)
	Identify proposed access to public land in the event of wildfire, should existing access tracks be severed.	Traffic and transport	✓
		Planning and land use	EES Chapter 15 (Land use and planning)
		Social impact assessment	EES Chapter 14 (Social impact assessment)
Assessment of likely effects	Assessment, including modelling projections, of the effects on traffic volumes and travel time outcomes.	Traffic and transport	✓
	Assessment of the effects on the accessibility, safety and connectivity for commercial vehicles, local car users, public transport, pedestrians and cyclists.	Traffic and transport	✓
		Social impact assessment	EES Chapter 14 (Social impact assessment)
	Assessment of the possible timing and implications of the bypass on traffic network performance.	Traffic and transport	✓
	Describe the implications of each alternative in meeting the proposed project's transport objectives.	Traffic and transport	✓

4 METHODOLOGY

4.1 STUDY AREA

The terminology utilised throughout the current technical assessment relating to the study area and alignment options is defined below.

Study area: The study area for the Beaufort Bypass EES project includes approximately 1,800 ha of land north of the Beaufort township, which contains the four bypass options assessed in this report. During the development stages of the alignment options, the study area was assessed to determine potential environmental impacts and constraints to individual alignment options.

Alignment options: Alignment options (A0, A1, C0 and C2) refer to the four selected bypass options assessed within the study area. Each alignment option consists of a 250 m corridor in which the specific bypass option has been designed. Each alignment option, unless otherwise stipulated, is the area assessed for direct and indirect impacts resulting from the construction, operation and maintenance of the project.

4.2 EXISTING CONDITIONS ASSESSMENT

Existing conditions were established by conducting traffic surveys and by assessing the results of the surveys. Surveys were undertaken including traffic volumes, intersection counts, origin-destination count and travel time surveys. The crash history of the study area was established, along with existing conditions for public transport, walking and cycling.

4.3 RISK ASSESSMENT

An environmental risk assessment (ERA) has been utilised in the Beaufort Bypass EES to identify environmental impacts associated with the construction and operation phases of the project. The risk assessment process is consistent with the guidance provided in Sections 3.1 and 4 of the *Scoping Requirements for the Beaufort Bypass Project EES* (DELWP 2016) and the *Ministerial guidelines for assessment of the environmental effects under the Environment Effects Act 1978* (DSE 2006).

The purpose of the ERA was to provide a systematic approach to the identification and further assessment of potential impacts resulting from the project, whether they be environmental, social or economic. The ERA articulates the probability of an incident with environmental, social or economic effects occurring and the consequence of that impact to the environment. Identified impacts with a medium or higher initial risk are subject to detailed impact assessment and mitigation treatments, detailed within each discipline impact assessment

RRV defines risk and impact as:

- "*Environmental risk reflects the potential for negative change, injury or loss with respect to environmental assets*" (DSE 2006). This approach is consistent with ISO 31000: 2018, which defines risk as "*the effect of uncertainty of [environmental] objectives*". Both definitions reflect the fact that risk is typically expressed in terms of the likelihood of a change occurring and the consequence of that change.
- Environmental impact is described as any change to the environment as a result of project activities.

The risk assessment is a critical part of the EES process as it guides the level and range of impact assessment for the EES and facilitates a consistent approach to risk assessment across the various disciplines.

4.3.1 RISK ASSESSMENT PROCESS

The ERA has guided the environmental impact assessment for the project. The objectives of the ERA are to:

- identify primary environmental risks that relate to the construction and operation of the project
- guide the level and extent of investigation and data gathering necessary for accurately characterising the existing environment and assessing the project's environmental impact
- help identify mitigation measures to avoid, minimise and mitigate environmental risks
- inform assessment of likely residual effects that are expected to be experienced after standard controls and proposed mitigations have been implemented.

The risk assessment process for the EES adopts a risk management framework as detailed in the VicRoads Environmental Sustainability toolkit. The process includes:

- an approach to environmental management which is aligned with ISO 31000: 2018
- systems used to manage environmental risk and protect the environment, and how these are implemented at different stages of road construction, operation and maintenance
- tools and reporting requirements which provide guidance in managing environmental issues throughout the project.

The ERA identifies impact events for each relevant element of the environment, details the primary risks and has informed the level and range of technical reporting required to address predicted impacts. The ERA utilises a risk matrix approach where the likelihood and consequence of an event occurring are considered (Table 4.1, Table 4.2 and Table 4.3). All risks are reassessed at regular intervals during all phases of the project, from the development of the EES to operation and maintenance, to ensure they are still applicable, that controls are appropriate and effective, and that they reflect most recent outcomes of specialist technical studies.

Table 4.1 Risk assessment matrix

			LIKELIHOOD				
	Risk categories		**Rare (A)**	**Unlikely (B)**	**Possible (C)**	**Likely (D)**	**Almost Certain (E)**
CONSEQUENCE	**Catastrophic**	**5**	Medium	High	High	Extreme	Extreme
	Major	**4**	Medium	Medium	High	High	Extreme
	Moderate	**3**	Low	Medium	Medium	High	High
	Minor	**2**	Negligible	Low	Low	Medium	Medium
	Insignificant	**1**	Negligible	Negligible	Negligible	Low	Low

The risk evaluation criteria were adapted from the risk matrix set out in the VicRoads Environmental Sustainability toolkit.

All risks should be reassessed at regular intervals during all phases of the project, from the development of the EES to Operation and Maintenance, to ensure they are still applicable, that controls are appropriate and effective and that they reflect most recent outcomes of specialist technical studies.

Based on the project objectives and context, a draft set of project-specific and appropriate assessment, likelihood and consequence criteria were developed.

The likelihood categories are used as a guide for evaluating risk shown below in Table 4.2.

Table 4.2 Likelihood categories

RARE (A)	UNLIKELY (B)	POSSIBLE (C)	LIKELY (D)	ALMOST CERTAIN (E)
Less than once in 12 months during operation OR 5% chance of recurrence during the construction phase.	About once in 6 months during operation OR 10% chance of recurrence during the construction phase.	About once in 4 months during operation OR 30% chance of recurrence during the construction phase.	About once in 2 months during operation OR 50% chance of recurrence during the construction phase.	About once in a month during operation OR 100% chance of recurrence during the construction phase.
The event may occur only in exceptional circumstances.	The event could occur but is not expected.	The event could occur.	The event will probably occur in most circumstances.	The event is expected to occur in most circumstances.

Consequence criteria have been developed for the project in consultation with technical specialists. The result is a discipline and aspect-specific set of consequence descriptors used to define what would be considered an Insignificant, Minor, Moderate, Major and Catastrophic consequence associated with a risk event.

Table 4.3 Traffic and transport environmental risk assessment consequences descriptors

ASPECTS	INSIGNIFICANT	MINOR	MODERATE	MAJOR	CATASTROPHIC
Construction results in decline in road safety	No occurrence of road accidents during construction period.	Occurrence of property damage only road accidents increase by less than 5% OR Minor injury due to road accident during construction period.	Occurrence of property damage only road accidents increase by 5-10% OR Major injury due to road accident during construction period.	Occurrence of property damage only road accidents increase by 10-20% OR Multiple major injuries or fatality due to road accident during construction period.	Occurrence of property damage only road accidents increase by greater than 20% OR Multiple fatalities due to road accident during construction period.
Operations show decline in road safety	No occurrence of road accidents during a 5-year period.	Occurrence of property damage only road accidents increase by less than 5% OR Minor injury due to road accident during operation period.	Occurrence of property damage only road accidents increase by 5-10% OR Major injury due to road accident during operation period.	Occurrence of property damage only road accidents increase by 10-20% OR Multiple major injuries due to road accident during operation period.	Occurrence of property damage only road accidents increase by greater than 20%. OR Multiple fatalities due to road accident during operation period.
Construction adversely impacts traffic conditions	Negligible adverse impact on traffic and transport conditions.	Detectable adverse changes in traffic and transport condition (decrease in Level of Service) at one or two locations at any one point in time during the construction period.	Detectable adverse change in traffic and transport conditions (decrease in Level of Service) at multiple locations.	Traffic and transport congestion and delays exceed acceptable levels at multiple locations.	Traffic and transport congestion and delays severely restrict the safe operation and efficiency of the transport network.
Operation of network performing below expectation (compared to 'no road' option)	Network performs according to design.	Detectable underperformance in traffic and transport condition (decrease in Level of Service) at one or two locations at any one point in time during the operation period.	Detectable underperformance in traffic and transport conditions (decrease in Level of Service) at multiple locations.	Traffic and transport congestion and delays exceed acceptable levels at multiple locations.	Traffic and transport congestion and delays severely restrict the safe operation and efficiency of the transport network.

ASPECTS	INSIGNIFICANT	MINOR	MODERATE	MAJOR	CATASTROPHIC
Construction impacts on traffic access	Negligible impact on access routes during construction OR No changes to access routes.	Less than 5 routes with access temporarily compromised OR Minor diversions required (up to 250 m).	Greater than 5 and less than 10 routes with access temporarily compromised OR Diversions of up to 1,000 m required.	Greater than 10 and less than 30 routes with access temporarily compromised OR Diversions of more than 1,000 m required.	Greater than 30 routes with access temporarily compromised OR Properties inaccessible for an extended period (greater than two weeks).
Operation impacts on traffic access	Negligible impact on access routes during operation OR No changes to access routes.	Less than 5 routes with access permanently compromised OR Minor diversions required (up to 250 m) and less than 5,000 vehicles per day affected.	Greater than 5 and less than 10 routes with access permanently compromised OR Diversions of up to 1,000 m required; or between 5,000 and 20,000 vpd affected.	Greater than 10 and less than 30 routes with access permanently compromised OR Diversions of more than 1,000 m required; or more than 20,000 vpd affected.	Greater than 30 routes with access permanently compromised OR Properties inaccessible for an extended period (greater than two weeks).

The risk assessment was undertaken for each discrete alignment option as each option had a distinct profile, type and extent of environmental impacts. The assessment of these impacts is detailed within Sections 7 and 9 of this report.

4.4 IMPACT ASSESSMENT

The impact assessment for the project has utilised the environmental risk assessment to inform the areas for further investigation. Impacts assessed within this assessment have typically been identified as having a medium or higher initial risk within the risk assessment when standard controls were applied. Impact assessments were prepared in two stages, initially to inform the options assessment and following the selection of the preferred alignment, impact assessments were revised to report impacts and mitigations specifically on the preferred alignment. The project describes and assesses impacts in terms of the following:

- description of impact
- identification of whether impacts are direct or indirect
- prediction of the magnitude, extent and duration of impact
- overall rating of impact (without mitigation)
- residual rating of impact (with mitigation).

To inform the transport network aspects of the impact assessment a project specific transport spreadsheet model was developed to understand the change in traffic volumes due to the Beaufort Bypass. SIDRA intersection analysis was also undertaken to assess the impact on delays to traffic at intersections within Beaufort. The impact on travel times was assessed by using survey data and calculations.

4.4.1 FUTURE TRAFFIC ASSESSMENT

To assess traffic conditions with and without the project, a simple spreadsheet model was developed as well as intersection models at key locations. The spreadsheet model was primarily focussed on quantifying the volume of traffic that might stay on the proposed bypass, as well as estimating changed turning movements for the intersection modelling options. This approach does have limitations and in this case, did not forecast the traffic on Beaufort-Lexton Road particularly well. The model also does not account for trips with an origin or destination within Beaufort.

4.4.2 INTERSECTION PERFORMANCE ASSESSMENT

The software modelling package SIDRA Intersection 7.0 was used to assess the impact on delays to traffic at intersections within Beaufort. Modelling was completed on two scenarios – a ‘project’ scenario and ‘no project’ scenario for the 2021 and 2031 AM and PM peak hours using the outputs from the spreadsheet model. The intersection performance measures from the SIDRA modelling are outlined in Section 9.1.2.1 with performance targets outlined in Section 9.1.2.2.

4.4.3 MODEL DEVELOPMENT

Two models were developed – a simple spreadsheet network model of the major roads in Beaufort and SIDRA models of the intersections along the Western Highway at Havelock Street/Livingstone Street, Lawrence Street and Racecourse Road for the survey identified AM and PM peak period.

The spreadsheet model, as outlined in Section 4.4.1, was developed using a combination of the origin-destination, intersection and automatic traffic (tube) surveys. Results for the intersection and automatic traffic (tube) surveys for the same time period (7:00 am to 7:00 pm on Thursday 26/10/17) were plotted into the existing network diagram as the base case. A project case was then developed based on the implementation of the Beaufort Bypass to the north of the town. An assessment was made of the likely route choice changes with the bypass based on the results of the origin-destination survey, with traffic volumes adjusted accordingly. The mid-block changes in traffic volumes between survey locations were used to verify the project case model and to ensure that volume totals remained consistent (i.e. total traffic volumes in the network were not increasing or decreasing as a result of the bypass implementation).

A subsequent peak hour spreadsheet network model was created for the AM and PM peak hours based on the surveyed peak hours across both intersections on Western Highway (Havelock Street/Livingstone Street and Lawrence Street).

SIDRA modelling was completed for the AM and PM peak hours based on the developed peak hour volumes. Google Maps satellite imagery was used to determine the lane arrangement/lengths and the most recent traffic signal operation sheet (dated 10/03/06) used to develop the signal phasing.

4.4.3.1 ASSUMPTIONS

The following assumptions were made in the development of the spreadsheet network model:

- The total traffic volumes in the study area network remain the same between the project and no project scenarios.
- In the project case, the following route choice changes have been made based on the origin-destination surveys:
  - vehicles travelling between Western Highway, west of Martins Lane (site 1) and Western Highway, west of Smiths Lane (site 4) in both directions would change routes and use the bypass
  - vehicles travelling between Western Highway, west of Martins Lane (site 1) and Beaufort-Lexton Road (site 3) in both directions would change routes and use the bypass and diamond interchange on Beaufort-Lexton Road
  - vehicles travelling between Western Highway, west of Smiths Lane (site 4) and Beaufort-Lexton Road (site 3) in both directions would change routes and use the bypass and diamond interchange on Beaufort-Lexton Road.
- No other route changes were assumed and factors such as induced traffic demands were not considered.
- For traffic that had an origin or destination on Beaufort-Lexton Road (site 3), it was assumed that in the project case, the origin-destination of these vehicles would be north of Beaufort i.e. the traffic utilising the interchange at Beaufort-Lexton Road would not have an origin-destination in Beaufort town centre. It is noted that the tube count location is south of the proposed interchange, and due to this assumption, would not capture the diverted traffic.
- For Origin-Destination (OD) data, only the percentage data from OD surveys was used – the volumes were not assessed and compared with ATC/ICs.
- The OD surveys were completed on the Thursday, as agreed by the project team. It was assumed that these OD movements represented a typical week day.
- To develop the traffic volumes for the intersection of Western Highway and Racecourse Road, it was assumed that that there was no volume difference between Racecourse Road and Lawrence Street on Western Highway. The volume difference would only occur between Western Highway (west of Smith St) and Racecourse Road.
- At Racecourse Road intersection, directional split is 50:50 for traffic entering/exiting Racecourse Road.
- Assumed that the traffic volumes at Racecourse Road automatic traffic (tube) counts is the sum total volume of traffic entering/exiting Racecourse Road at Western Highway.

The following assumptions were made in the development of SIDRA models:

- SIDRA Intersection 7.0 (Network) was the modelling package selected for this assessment. The default model parameters were generally adopted for all intersection models.
- A forecast pedestrian demand of 20 pedestrians per hour in 2021 and 20 pedestrians per hour in 2031 per crossing has been assumed for the models. This was conservative estimate compared to 2017 surveyed pedestrian volumes.
- Where peak hour volumes for certain movements had an hourly volume of 0 vehicles per hour (vph), for the purposes of SIDRA modelling a total volume of 1 was assumed.
- Where the peak hour volume from the spreadsheet model was a negative value, for the purposes of SIDRA modelling a volume of 1 was assumed.
- From the spreadsheet modelling results for peak hour volumes, a small number of movements resulted in a negative vehicle volume per hour. The largest of these was approximately -5 vph. Due to the nature of the spreadsheet modelling, such results indicate that a very low volume of vehicles will make this movement in the peak hour. In the SIDRA modelling, such movements were assumed to have a total volume of 1 vph.

4.4.3.2 MODEL LIMITATIONS

All traffic forecasts are subject to uncertainties. Inevitably, some assumptions used to develop the forecasts will not be realised, and unanticipated events/circumstances may occur. Therefore, no assurance can be provided that the reported forecasts will be achieved. The actual outcomes may vary from those forecasts and the variations may be material.

4.4.3.3 GROWTH RATES

The surveyed volumes were for 2017 traffic volumes. To develop 2021 and 2031 forecast volumes, a standard growth rate was assumed for the entire network.

The following data sources are available for determining growth rates:

- Traffic Data from VicRoads, permanent count station 2 km west of Beaufort. Between the period of 2004 and 2008 growth rates recorded were -0.4% for all vehicles and +0.9% for commercial vehicles.
- Department of Transport and Regional Services (DOTARS), 2007, Melbourne – Adelaide Corridor Strategy, growth rates for Horsham to Ballarat were 1.52% and 1.76% for light and heavy vehicles respectively, with all vehicle growth rate at 1.59%.
- Analysis of intersection volumes at the Western Highway/Lawrence Street intersections indicate a 3.9% growth rate between 2015 and 2016, and 6.0% between 2016 and 2017. This rate includes growth within Beaufort, as opposed to the other forecasts which are for highway traffic.
- VicRoads open data traffic information, where traffic growth along the Western Highway is stated to be between 2% to 3%.
- Analysis of the Statewide Victorian Integrated Transport Model (SVITM), indicates two-way traffic volume growth on the Western Highway for the AM and PM peak periods would be between 0.75% and 1.11% per annum between 2015 and 2031.

Previous analysis undertaken in the *Western Highway Project-Section 3: Ararat to Stawell* report applied the DOTARS 2007 Adelaide Corridor Strategy growth rate 1.59% for projecting future growth.

In addition to this information, further assessment on the historic and forecast population growth, economic growth information, VicRoads data on traffic growth and VicRoads Culway monitor (heavy vehicle types and loads) was completed. This assessment is provided in Appendix B.

Following the above review, a conservative growth rate of 2.0% was adopted for the network model to develop 2021 and 2031 forecast volumes.

4.4.4 ACCESS ASSESSMENTS

Qualitative assessment of access impacts are based on the functional design access arrangements and general construction methods proposed for the project (defined within *EES Chapter 4: Project description*). Construction and operation access impacts are considered within this assessment.

4.5 MITIGATION

Mitigations for identified impacts were developed by discipline specialists in consultation with RRV. All identified mitigations developed for the project have been informed by specialist experience with proven feasible control measures for major civil infrastructure projects, industry best practice measures and regulatory measures defined by State, Commonwealth and International Government agencies.

Mitigations for the project were developed throughout the impact assessment process to inform the residual impacts of the preferred alignment, which are detailed in Section 11.

4.6 OPTIONS ASSESSMENT

The alignment refinement for the Beaufort Bypass has been undertaken in three distinct phases since project inception. These are discussed in the EES Attachment IV: *Options assessment (RRV 2019)* as:

- Phase 1 – Concept alignment development
- Phase 2 – Option development and assessment
- Phase 3 – Identification of preferred alignment.

This options assessment method section considers the Phase 3 assessment and details the process for selection of the preferred alignment.

The Phase 3 assessment considered four alignment options to select the preferred alignment, utilising a customised comparative options assessment to rank each option against the following areas:

- Biodiversity
- Catchment values and hydrology
- Cultural heritage (Aboriginal and Historic)
- Social and Community
- Amenity
- Landscape and Visual.

Multiple scoring scenarios and sensitivity testings were undertaken against each option to ensure the environmental, social, heritage and economic assessment criteria aligned with the EES evaluation objectives. The scoring framework developed sought to ensure a wholistic decision-making process was undertaken, and that no single scoring or sensitivity scenario would be the primary determining factor in the identification and selection of the preferred alignment.

Weightings for the assessment included the application of six scenarios and sensitivity tests to eliminate bias of specific environmental constraints. These scenarios included:

- Scenario 1: Apply a score of 1 to 4 from least to highest impact.
- Scenario 2: Alignment with highest number of least impact scores.
- Scenario 3: Apply a score of 1 to the highest impact and the subtract the percentage difference between alignments.
- Scenario 4: Apply a score of 1 to least impact and then add the percentage difference between remaining alignments.
- Scenario 5: As per Scenario 3, but minus criteria that can be mitigated.
- Scenario 6: As per Scenario 4, but minus criteria that can be mitigated.

The sensitivity tests included:

- Scoring sensitivity scenario 1:
  - Options with the lowest impact and other options within 5% of the lowest impact are apportioned a score of one point and a green light.
  - Options within 5–20% of the lowest impact option are apportioned a score of zero points and an amber light.
  - Options with an impact of 20% or greater than the lowest impact option are apportioned a score of minus one and a red light.
- Scoring sensitivity scenario 2:
  - Options with the lowest impact and other options within 5% of the lowest impact are apportioned a score of one point and a green light.
  - Options within 5–25% of the lowest impact option are apportioned a score of zero points and an amber light.
  - Options with an impact of 25% or greater than the lowest impact option are apportioned a score of minus one and a red light.

- Scoring sensitivity scenario 3:
  - Options with the lowest impact and other options within 5% of the lowest impact are apportioned a score of one point and a green light.
  - Options within 5–15% of the lowest impact option are apportioned a score of zero points and an amber light.
  - Options with an impact of 15% or greater than the lowest impact option are apportioned a score of minus one and a red light.

The assessment process included an iterative process with RRV, the Technical Reference Group (TRG), legal and discipline specialists to refine the assessment environmental risk workshops and develop a customised assessment matrix. The suite of assessment criteria are detailed within the EES Attachment IV: *Options assessment.*

5 LEGISLATION

This section assesses the project against the Commonwealth and State legislation, policies and guidelines relevant to the traffic and transport assessment.

5.1 STATE LEGISLATION, REGULATION AND POLICY

Key State legislation relevant to the traffic and transport assessment for the Beaufort Bypass are outlined in Table 5.1 below.

Table 5.1 Relevant Victorian legislation and policy

LEGISLATION	DESCRIPTION	RELEVANCE TO PROJECT
Transport Integration Act 2010	The *Transport Integration Act 2010* establishes a legislated policy framework for the provision of an integrated and sustainable transport system in Victoria that contributes to an inclusive and environmentally responsible State. The Act establishes a set of objectives that contribute to addressing the above, they include: — social and economic inclusion — economic prosperity — environmental sustainability — integration of transport and land use — efficiency, coordination and reliability — safety, health and wellbeing.	Sets out the following seven decision-making principles to be considered for the Beaufort Bypass. — integrated decision making — triple bottom line assessment — equity — transport system user perspective — precautionary principle — stakeholder engagement and community participation — transparency.
Road Management Act 2004	The *Road Management Act 2004* (RM Act) sets out the regulations and requirements of working within the road reserve and specifies the relevant road manager for arterial roads and local roads within Victoria. The purpose of this Act is to reform the law relating to road management in Victoria and to make related amendments to certain Acts. In outline this Act: — establishes a new statutory framework for the management of the road network which facilitates the coordination of the various uses of road reserves for roadways, pathways, infrastructure and similar purposes — sets out certain rights and duties of road users — establishes the general principles which apply to road management — provides for the role, functions and powers of a road authority — provides for the making of Codes of Practice to provide practical guidance in relation to road management — facilitates the making of road management plans as part of the management system to be implemented by a road authority in the performance of road management functions	Provides the statutory framework for RRV to manage the Beaufort Bypass and is applicable throughout the whole of life cycle of the project, including planning and development, constructions, operations and asset management. Code of practices are set out under the RM Act to provide guidance for road authorities, works and infrastructure managers.

LEGISLATION	DESCRIPTION	RELEVANCE TO PROJECT
	— enables the declaration and discontinuance of roads — provides a new process for the declaration and classification of roads and the re-allocation of management responsibility for roads — provides for a road authority to keep a register of public roads in respect of which the road authority is the coordinating road authority — provides for the construction, inspection, maintenance and repair of public roads — sets out the road management functions of road authorities — sets out the road management functions of infrastructure managers and works managers in providing infrastructure or conducting works — provides for issues relating to civil liability arising out of road management — provides for mechanisms to enforce and administer provisions of the Act — makes related amendments to the *Transport Act 1983*, the *Road Safety Act 1986*, *the Local Government Act 1989* and certain other Acts. Sets out powers, functions and responsibilities of road authorities.	
Environment Effects Act 1978	The *Environment Effects Act 1978* provides a framework for the assessment of the potential environmental impacts of a proposed development to allow statutory decision-makers to determine whether a project with potentially significant environmental effects should proceed. If the Minister for Planning decides that an Environment Effects Statement (EES) is required under the Act, the project proponent is responsible for undertaking the necessary investigations and preparing the EES. Once the EES is completed and released for public comment, the Minister provides an assessment to relevant decision-makers. The Act also provides for opportunities for community involvement at various stages in the process.	The Minister for Planning has determined that an assessment through an Environment Effects Statement under the Act is required for the project.
Planning and Environment Act 1987	The *Planning & Environment Act 1987* (P&E Act) establishes the framework for planning the use, development and protection of land in Victoria, in the present and long-term interest of all Victorians. The P&E Act sets out the structure and administration of land use in Victoria and provides for the preparation, approval and adoption of planning schemes as subordinate instruments to govern use and development of land in specific detail. These requirements are to be considered in transport planning decision-making.	Sets out framework of land use planning requirements to be adopted for the planning of the Beaufort Bypass.

5.2 GUIDELINES

Other policies and plans relevant to the Beaufort Bypass traffic and transport assessment are outlined in Table 5.2 below.

Table 5.2 Other relevant policies and plans

POLICY / PLAN	DESCRIPTION	RELEVANCE TO PROJECT
Strategic Plan 2019-23: Simple, connected journeys (Department of Transport 2019)	In July 2019, VicRoads and Public Transport Victoria were integrated to form the Department of Transport (DoT). The department portfolio includes RRV. The *Strategic Plan 2019-23* released by DoT outlines the vision and focus of DoT, including transport priorities, initiatives and outcomes.	Key priorities in the DoT Strategic Plan relevant to the Beaufort Bypass are to: — operate a safe and inclusive system, with an objective to create a road network that is well maintained, efficient and safe to use — optimise the system for sustainable and reliable travel, with an objective to make freight more efficient — design and plan a people-focused system, with an initiative to continue to upgrade regional roads through RRV.
Victorian Road Safety Strategy 2021–2030	The *Victorian Road Safety Strategy 2021–2030* is the state road safety strategy aimed at creating a safer road environment and reducing the opportunity for poor decision making. The strategy commits the Victorian Government to initially halve road deaths and progressively reduce serious injury by 2030 before ultimately eliminating death and serious injury from roads by 2050. The strategy will be delivered via a series of short-term action plans over the life of the strategy which may include measures such as policy, innovation and technology, infrastructure improvements, public information campaigns, education programs, enforcement and other mechanisms available to government.	Key goals in the Victorian Road Safety Strategy that are relevant to the Beaufort Bypass are: — make remote and rural roads safer for all road users — reduce fatalities and serious injuries where speed is a contributing factor — ensure unprotected and vulnerable road users are supported by the road system, not impacted by it.
Victorian Freight Plan: Delivering the Goods (Transport for Victoria 2018)	The *Victorian Freight Plan: Delivering the Goods* is a state-wide plan for freight that builds on previous Victorian government freight strategies. The Plan sets out long-term directions for the freight network in Victoria to create an efficient, safe and sustainable freight and logistics system that enhances the economic prosperity and liveability of the State. A key objective of the *Victorian Freight Plan* is to improve the efficiency of moving freight while minimising adverse impacts.	— Identifies reducing the impact of congestion on supply chain costs and communities as a key priority area. — Identifies importance of regional Victoria freight networks and supply chains.

POLICY / PLAN	DESCRIPTION	RELEVANCE TO PROJECT
Central Highlands Regional Transport Strategy (Central Highlands Councils 2014)	The *Central Highlands Regional Transport Strategy* provides a tool for implementing established transport frameworks, and for planning and policy development for future projects. The purpose of the Strategy is to identify priority transport projects of regional significance and align the transport directions of the Central Highlands with state, regional and local policy. The objectives of the *Central Highlands Regional Transport Strategy* are to: — improve the capacity and functioning of the region's transport networks — ensure access and connectivity between settlements within and external to the region — provide for a safe, reliable and resilient transport network — consider technological advances in the transport provision mix — ensure amenity and useability — develop freight precincts as places to collect and distribute goods — understand and ensure efficient ways to transport products between producers and markets.	— Identifies regional corridors. — Connectivity of Beaufort to other centres. — Amenity considerations for Beaufort centre. — Safe, reliable, resilient network.
Central Highlands Regional Growth Plan (Victorian Government 2014)	The *Central Highlands Regional Growth Plan* (Victorian Government 2014) has been developed in a partnership between local government and state authorities. The Plan provides an approach to land use planning in the Central Highlands, which covers the municipalities of Ararat, Ballarat, Golden Plains, Hepburn, Moorabool and Pyrenees. The Plan identifies opportunities to accommodate and encourage growth over the next 30 years, and key regional priorities for future infrastructure planning and investment to support growth. Future directions identified in the Plan in relation to transport networks include: — improve the capacity and functioning of the region's transport networks — ensure access and connectivity between settlements within and external to the region — provide for a safe, reliable and resilient transport network — ensure amenity and useability — understand and ensure efficient ways to transport products between producers and markets (supply chains).	— Identifies the Western Highway and rail corridors linking Melbourne and Adelaide as significant transport networks, which service freight and passenger requirements and are vital to the local economy. — Identifies the issue of managing the amenity impacts of freight in high amenity areas to reduce potential conflicts in townships, such as Beaufort.

POLICY / PLAN	DESCRIPTION	RELEVANCE TO PROJECT

Plan Melbourne 2017-2050 (DELWP 2017)	*Plan Melbourne 2017-2050* is a long-term plan which accommodates for the city's forecasted future population growth. The 35-year blueprint ensures that Melbourne and Victoria are more liveable, sustainable and productive as the population grows to approximately 8 million by 2050. *Plan Melbourne* aims to guide planners, councils and developers towards these goals. Regional Victoria is included within the Plan, focusing on several directions and policies to stimulate employment and growth, and improve transport connections through regional centres. Principle 3 is of particular significance, aiming to create a 'city of centres' linked to regional Victoria. This principle places emphasis on creating economic and social opportunities across the state by forging better linkages between Greater Melbourne and regional Victoria.
	
	Relevant Outcomes, Directions and Policies to Regional Victoria and the traffic and transport assessment are as follows:
	
	Outcome 7 – Regional Victoria is productive, sustainable and supports jobs and economic growth.
	
	— *Direction 7.2* – Improve connections between cities and regions:
	  — Policy 7.2.1 – Improve transport and digital connectivity for regional Victoria
	  — Policy 7.2.2- Strengthen transport links of national networks for the movement of commodities.
	
	Regional cities and towns are to be connected by safe and efficient road and rail transport corridors. This will ensure infrastructure and services are available to support economic and population growth in rural areas. Corridors of state significance, such as the Western Highway, are critical for the support of rural economies, as well as connection to Melbourne. Improvement and upgrading of these corridors are of the utmost important to cater for a growing population and economy in Melbourne and rural cities and towns.
		— Supporting policy for improved corridor between Melbourne and Adelaide and all the regional centres along the Western Highway.
		— Identifies importance of connections from within Beaufort to the proposed bypass.
		— Identifies importance of transport connections between Beaufort and other regional centres.

6 EXISTING CONDITIONS

6.1 TRAFFIC AND TRANSPORT

6.1.1 REGIONAL CONTEXT AND STUDY AREA

The Western Highway provides the main connection between Melbourne and Adelaide and caters for interstate traffic and freight supporting agriculture, manufacturing, tourism and other industries. Beaufort is located along the Western Highway between Ballarat and Ararat. The RRV arterial highway is a two lane, two-way road typically undivided with a divided section though the township of Beaufort. Furthermore, the lanes are partially divided by a painted hatched median between Beaufort-Carngham Road and Smiths Lane. It is noted that the Western Highway is a divided highway either side of the study area. An overtaking lane is located on the west side of Beaufort for westbound traffic.

One four leg signalised intersection exists in the centre of Beaufort between the Western Highway and Lawrence Street, which has protected right hand turning lanes and a slip lane on the eastern leg. The current intersection has signalised pedestrian crossings on all four legs. Operating speed limits along the Western Highway vary between 50 km/h and 100 km/h for the study area considered, with speed restrictions of 40 km/h applicable on school days along Skipton Road and surrounding residential streets.

The following roads provide routes for traffic in the Beaufort area:

- Smiths Lane is a single lane two-way unsealed council road with the main function of providing access to rural properties.
- Racecourse Road is a local two lane, two-way undivided road between Western Highway and the railway after which is a narrow one lane wide two-way road. Racecourse Road provides access to rural properties and caters for traffic flows from Black Bottom Road and Trawalla-Waterloo Road. Operating speed limits along Racecourse Road vary between 50 km/h and 100 km/h.
- Beaufort-Lexton Road is a RRV two lane, two-way undivided road connecting Beaufort and Lexton townships and providing access to rural properties. Operating speed limits along this road vary between 50 km/h and 100 km/h.
- Main Lead Road is a council owned two-way two lane undivided road connecting the Beaufort and Main Lead areas. Operating speed limits along this road vary between 50 km/h and 100 km/h within the study area.
- Back Raglan Road is a local council road one lane two way which provides access to rural properties and caters for traffic from Eurambeen-Streatham Road. Operating speed limits along this road vary between 50 km/h and 80 km/h.

The Beaufort railway station is located just north of the town centre on Pratt Street. There are several rail level crossings on roads within the study area these include:

- King Street
- Lawrence Street (Beaufort-Lexton Road)
- Racecourse Road.

The Western Highway crosses the railway on the western side of Beaufort via a road bridge.

The proposed Beaufort Bypass options with entry points are shown in Figure 6.1.

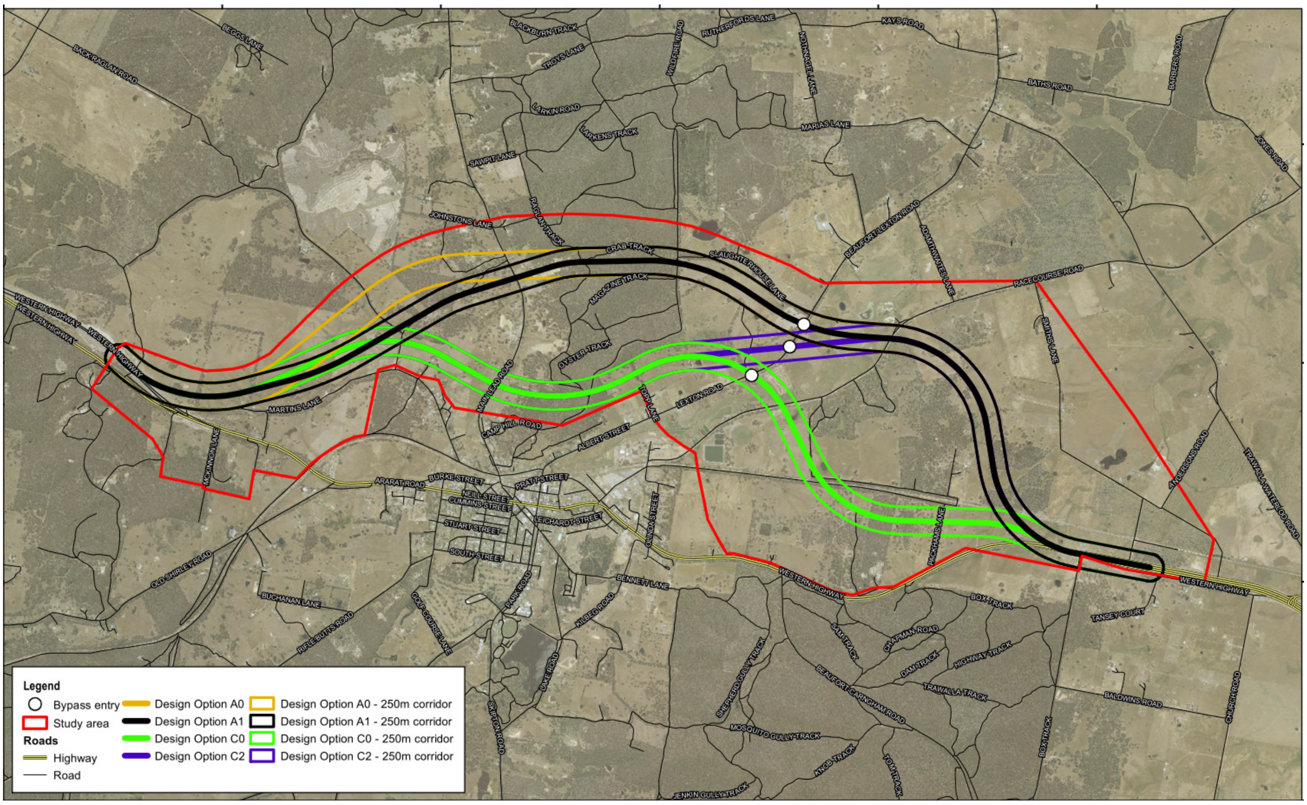


Figure 6.1 Proposed Beaufort Bypass options with entry points

6.1.2 SURVEY OVERVIEW

Four different surveys were commissioned within the study area of Beaufort. These included automatic traffic (tube) counts, intersection counts, origin-destination surveys and travel time surveys. Intersection counts, origin-destination surveys and travel time surveys were completed on Thursday 26 October 2017 only whilst automatic traffic counts surveys were completed for a 7-day period between Thursday 26 October 2017 to Wednesday 1 November 2017 (apart from Western Highway between King Street & Beaufort-Lexton Road, where the tubes were damaged. This site was resurveyed the following week, Thursday 2 November 2017 to Wednesday 8 November 2017). Weather conditions were reported to be fine and surveys were conducted during the school term, on a Thursday as agreed with the project team. The survey locations within the study area is highlighted in Figure 6.2 below.

Intersection counts were conducted at two locations along the Western Highway – at Livingstone Street/Havelock Street and Lawrence Street. The counts were completed for a 12-hour period between 7:00 am and 7:00 pm and included pedestrian counts.

Origin-Destination surveys were completed at five different stations for a 12-hour period between 7:00 am and 7:00 pm. Listed below are the locations of the origin-destination survey stations:

1. Western Highway, west of Martins Lane
2. Main Lead Road, near of 125 Main Lead Road
3. Beaufort-Lexton Road
4. Western Highway, west of Smiths Lane
5. Skipton Road, north of Stockyard Hill Road.

Travel time surveys were measured for two sessions – a midday session (12:00 pm – 1:00 pm) and a PM session (2:30 pm – 5:30 pm). The survey was conducted along the Western Highway in both directions between Olinda Street and an unnamed lane.

Automatic traffic (tube) counts were completed at eight different locations for a 7-day period as listed below:

1 Western Highway, west of Martins Lane
2 Main Lead Road, near 125 Main Lead Road
3 Beaufort-Lexton Road
4 Western Highway, west of Smiths Lane
5 Skipton Road, north of Stockyard Hill Road
6 Back Raglan Road, north of Martins Lane
7 Racecourse Road, near 125 Racecourse Road
8 Western Highway, between King Street & Beaufort-Lexton Road.

With regards to results for site 4 (Western Highway, west of Smiths Lane), westbound volumes on Monday, Tuesday and Wednesday were omitted as part of the analysis as traffic volumes appear to be low during the evening, possibly due to road works or a closed lane. For site 8 (Western Highway, between King Street & Beaufort-Lexton Road), the count failed and a recount was done the following week. The effects of the recount are further detailed in Section 6.1.2.1.

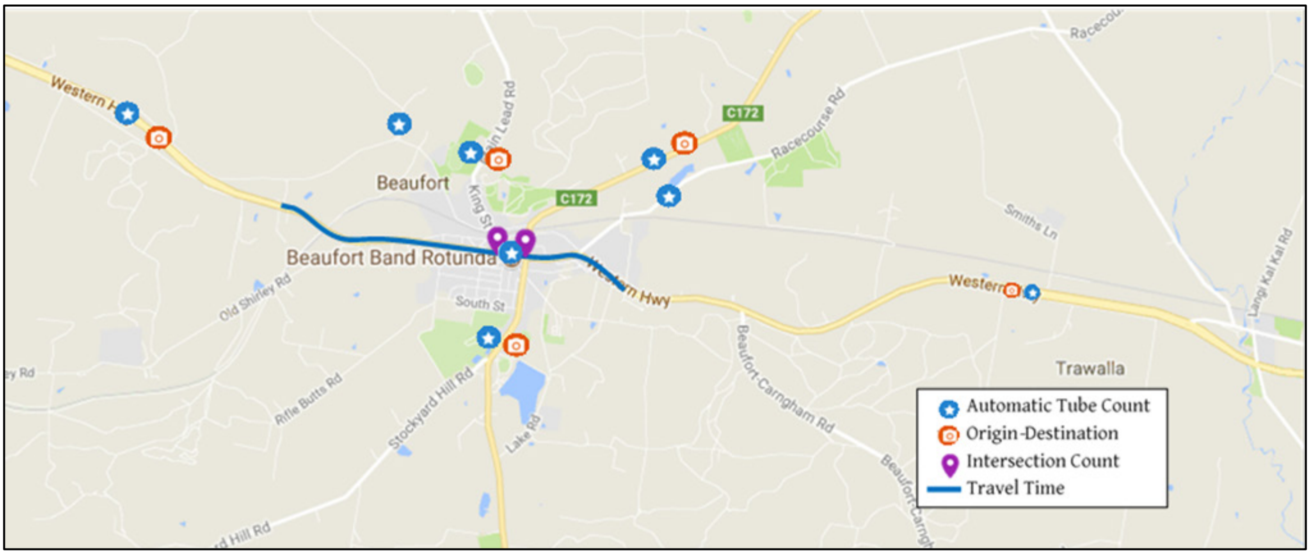


Figure 6.2 Survey locations

6.1.2.1 WESTERN HIGHWAY (BETWEEN KING STREET & BEAUFORT-LEXTON ROAD) SURVEY FACTORS

As previously outlined, the automatic traffic (tube) counts for site 8 failed and a recount was done the following week (from Thursday 2 November 2017 to Wednesday 8 November 2017). This coincided with the Melbourne Cup public holiday, which may have affected the results of the count.

To account for the effect of this public holiday in Melbourne, an assessment was completed on the difference in traffic volumes recorded on SCATS at the intersection of Western Highway, Beaufort-Lexton Road and Lawrence Street (Site 5330). The assessment was completed on westbound and eastbound traffic only.

From this, Table 6.1 below details the conversion factors developed to adjust the collected tube count data, based on the volume difference in the SCATS traffic volumes between the two weeks.

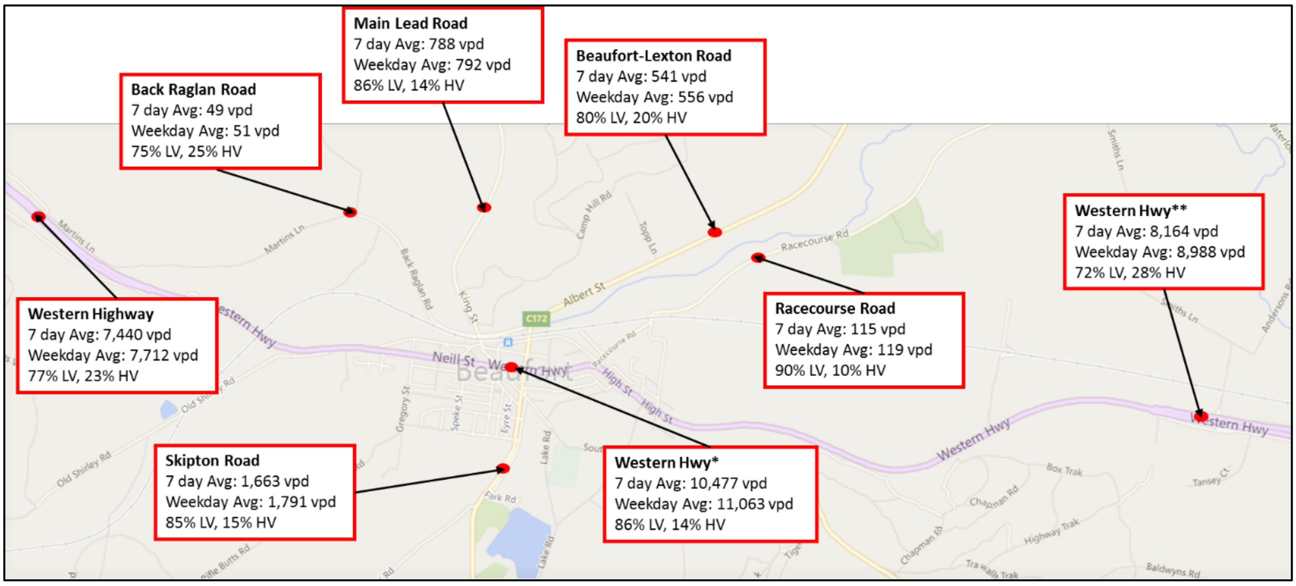
Table 6.1 Western Highway (between King Street & Beaufort-Lexton Road) conversion factors

DAY OF THE WEEK	WESTBOUND FACTOR	EASTBOUND FACTOR
Friday	0.778	1.021
Saturday	0.621	0.889
Sunday	0.873	1.005
Monday	1.042	0.830
Tuesday	1.287	0.662
Wednesday	0.937	0.939
Thursday	1.072	1.044
Weekday average	0.987	0.881
7-day average	0.906	0.898

The results show significant variation in traffic volumes across different days. However, across the full week, the traffic volumes were only slightly higher during the Melbourne Cup survey week compared to the proceeding week, and for Thursday, the "Cup Week" traffic volumes were lower than the preceding week. For the purposes of this report, the factored results were used for the analysis and calculations.

6.1.3 TRAFFIC VOLUMES

The results from the automatic traffic (tube) surveys are summarised below in Figure 6.3.



*Volumes have been factored as detailed in Section 6.1.2.1

**Only Thursday to Sunday data was summarised due to possible inaccuracies with data collected for Monday to Wednesday.

Figure 6.3 Two-way traffic volumes summary (Surveyed data in Beaufort – October 2017)

The collected survey data shows traffic volumes of 11,063 vehicles on the Western Highway in central Beaufort per day (based on the weekday average) during the survey period. Within the study area, the Western Highway, Skipton Road, Main Lead Road and Beaufort-Lexton Road show the highest average traffic volumes. From these roads, only Main Lead Road is managed by Pyrenees Shire Council, with the other roads managed by RRV.

As a comparison, the latest available VicRoads open traffic data for Beaufort is shown in Figure 6.4 and includes Annual Average Daily Traffic (AADT), the percentage of vehicle and annual growth rates. Only data for RRV managed roads are available.

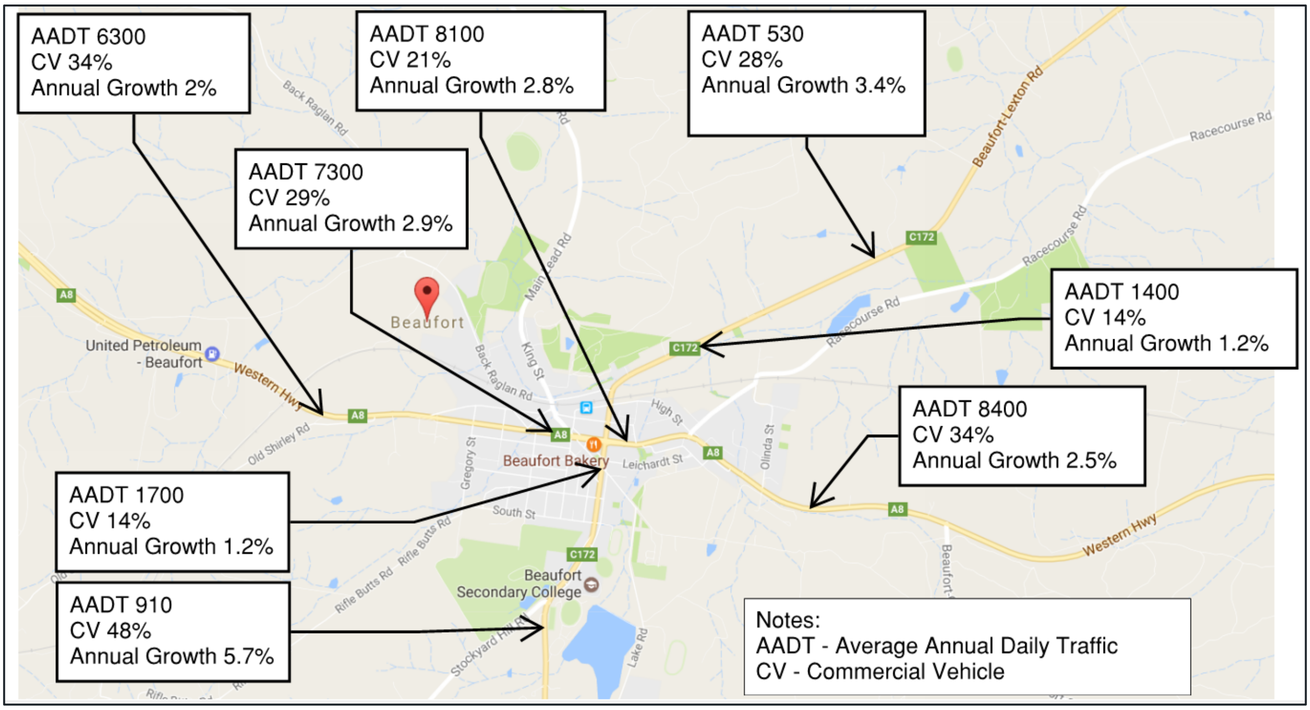
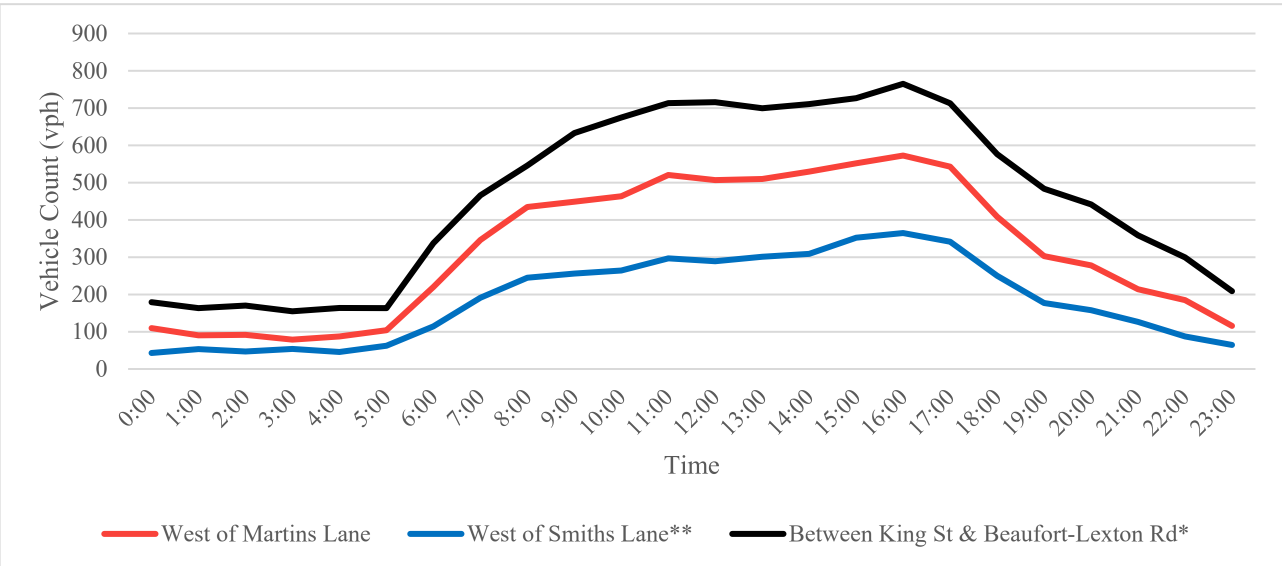


Figure 6.4 Summarised Beaufort traffic data (sourced from VicRoads-Open Data 2017)

6.1.3.1 TRAFFIC PROFILES

Figure 6.5 below shows the average weekday traffic profile for the automatic traffic (tube) count sites along the Western Highway.



*Volumes have been factored as detailed in Section 6.1.2.1

**Only Thursday to Sunday data was summarised due to possible inaccuracies with data collected for Monday to Wednesday.

Figure 6.5 Average weekday traffic volumes along Western Highway

The results show that traffic volume along Western Highway has a relatively flat profile. Traffic volumes are largely consistent throughout the day with minor peaking in the evening between 3:00 pm and 5:00 pm. The traffic volumes within Beaufort town centre are significantly higher than the sites on the approaches into town. Figure 6.6 below shows the average weekday traffic profiles for the other automatic traffic (tube) count sites within the study area.

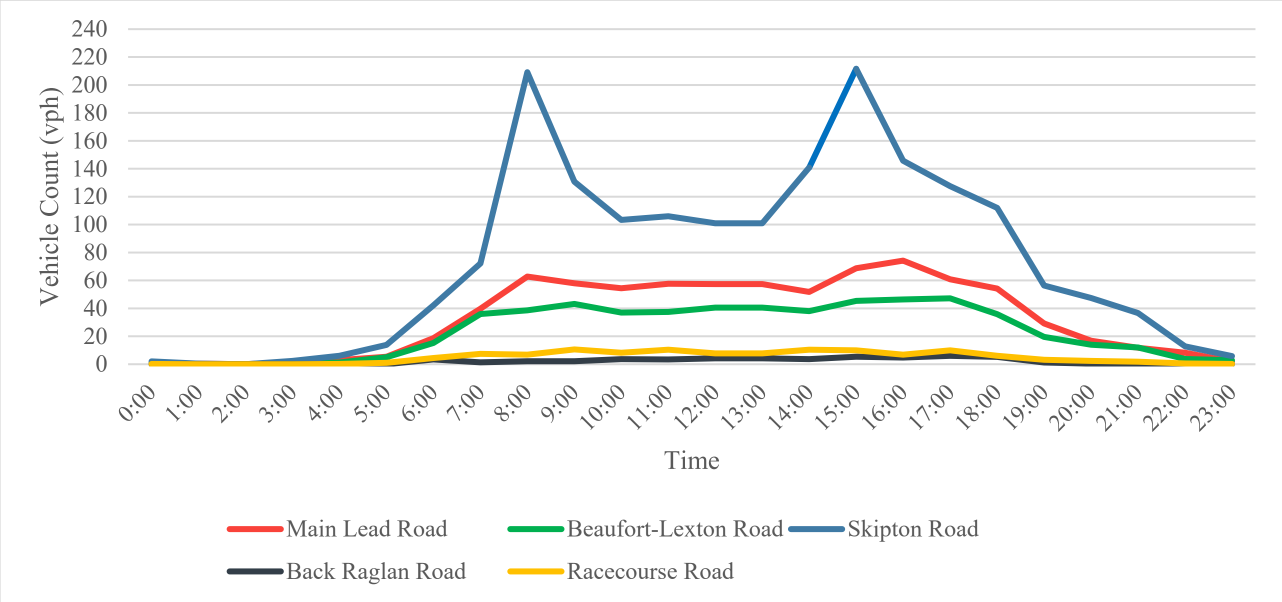
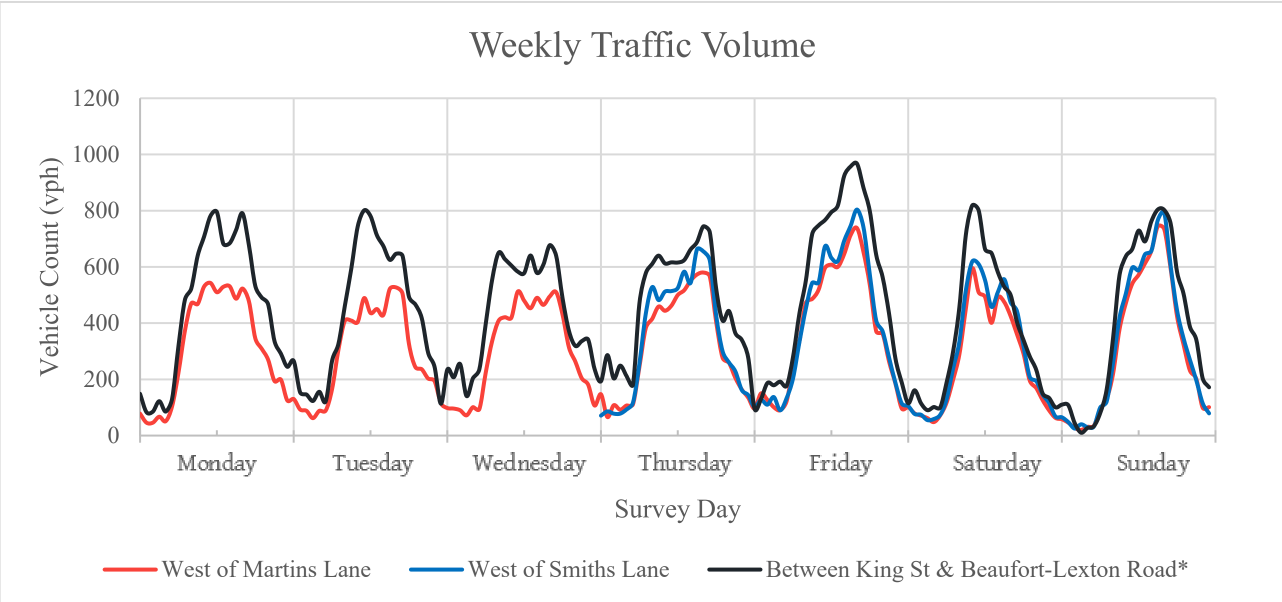


Figure 6.6 Average weekday traffic volumes along other roads within the study area

Main Lead Road, Beaufort-Lexton Road, Back Raglan Road and Racecourse Road all show a similar traffic profile to the Western Highway, with a relatively flat profile across the day and minor peaking in the PM period. Skipton Road exhibits distinct peak periods in the AM (7:30 am to 8:30 am) and PM (2:30 pm to 3:30 pm) peak periods. It is noted that Beaufort Secondary College is located on Skipton Road.

Figure 6.7 below shows the weekly traffic profile for the automatic traffic (tube) count sites along the Western Highway. Results for Western Highway, west of Smiths Lane, westbound volumes on Monday, Tuesday and Wednesday were omitted. Overall across the three sites, there was a peak in traffic volumes on Friday, particularly in Beaufort town centre.



*Volumes have been factored as detailed in Section 6.1.2.1

Figure 6.7 Weekly traffic profile along Western Highway

Figure 6.8 below shows the weekly traffic profiles for the other automatic traffic (tube) count sites within the study area. The traffic volumes and profiles for the other roads remain largely consistent throughout week days.

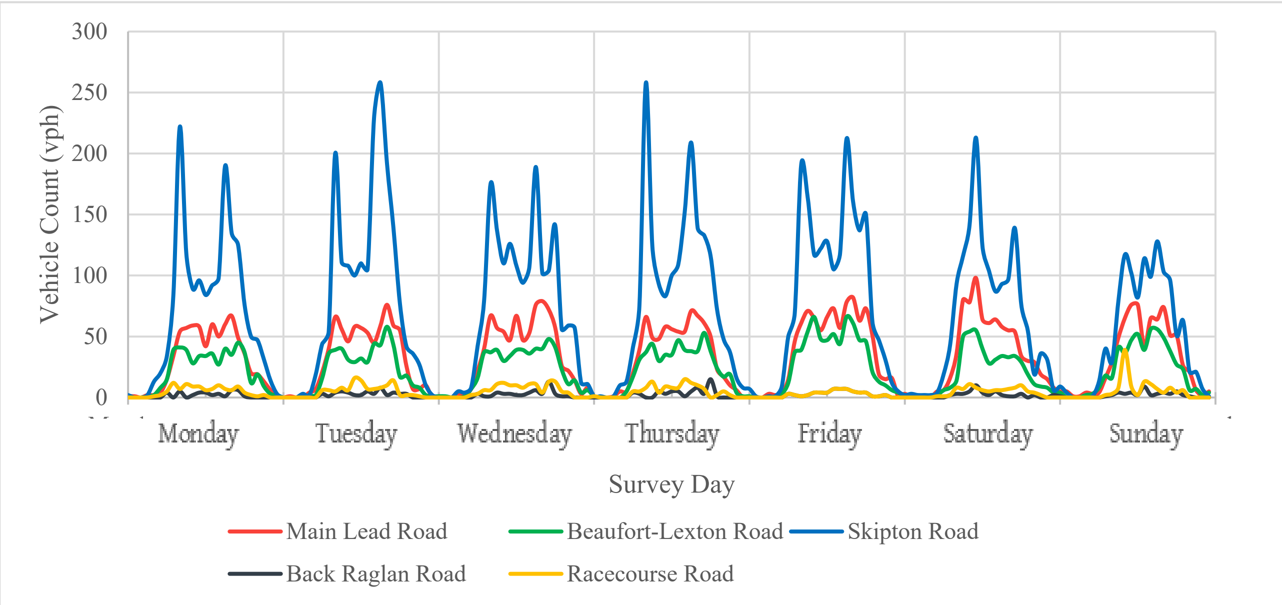


Figure 6.8 Weekly traffic profile along other roads within the study area

6.1.4 INTERSECTION COUNTS

Intersection Counts were completed at two intersections along Western Highway – Havelock Street/Livingstone Street and Lawrence Street. Both were collected on Thursday 26 October 2017, between 7:00 am and 7:00 pm. The results for AM and PM peak hours are summarised in Figure 6.9 and Figure 6.10 below.

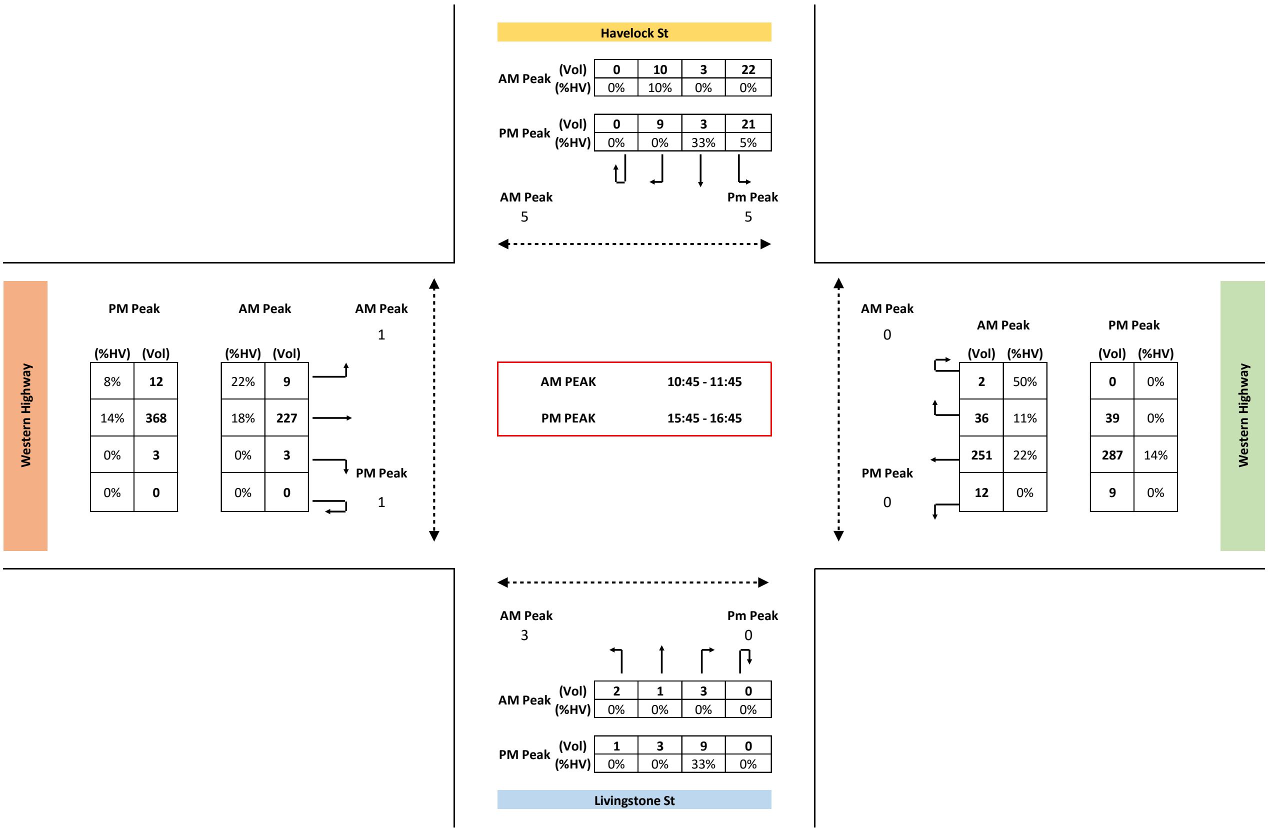


Figure 6.9 Havelock Street/Livingstone Street/Western Highway peak hour intersection summary

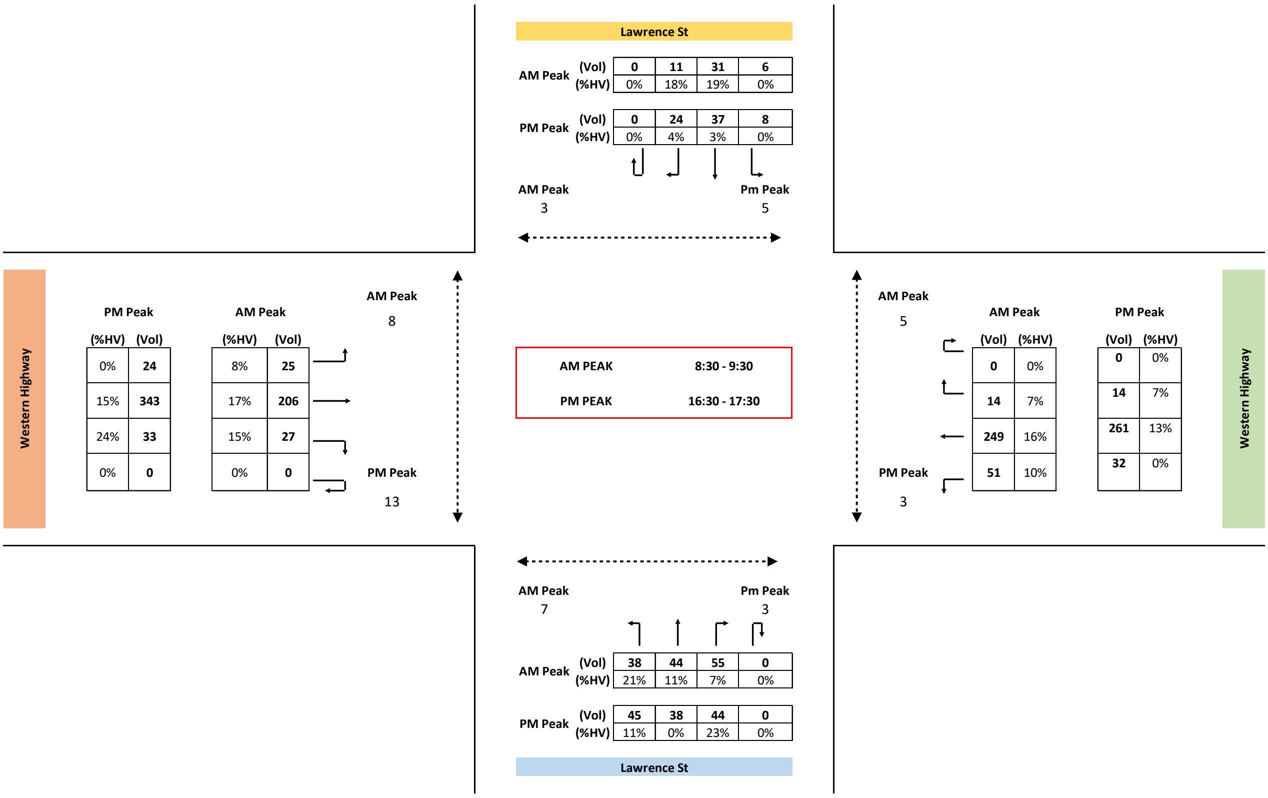


Figure 6.10 Lawrence Street/Western Highway peak hour intersection summary

6.1.5 ORIGIN-DESTINATION SURVEYS

Origin-Destination surveys were conducted between 7:00 am and 7:00 pm on Thursday 26 October 2017. The surveys stations included Western Highway (west of Martins Lane, between Kings Road and Beaufort-Lexton Road and West of Smiths Lane), Main Lead Road, Beaufort-Lexton Road and Skipton Road as shown in Figure 6.11.

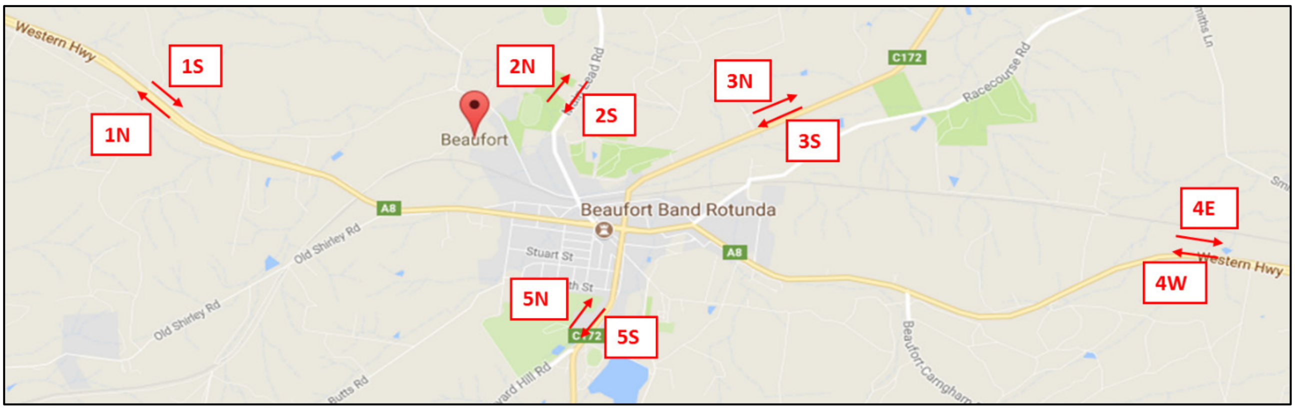


Figure 6.11 Origin-Destination survey station location summary

The average match rates for the origin-destination surveys across all stations was approximately 67% based on a match time of 30 minutes. This could be due to the numerous local roads in the study area that were not captured as part of the survey, or to the number of trips with an origin or destination within Beaufort.

Summary tables for light vehicles, heavy vehicles and all vehicles for the full survey period are presented in Table 6.2 to Table 6.4, with result diagrams for all vehicles presented in Figure 6.12 to Figure 6.26.

Table 6.2 Origin-destination match table for 7:00 am to 7:00 pm – Light vehicles

DESTINATION STATION		1N	2N	3N	4E	5S	TOTAL	PERCENTAGE MATCHED
Origin station	**Volume**	2161	305	204	2756	655	6081	
1S	2408	14	11	18	1696	71	1810	75%
2S	312	6	26	1	77	39	149	48%
3S	211	17	3	9	11	53	93	44%
4W	2568	1508	48	7	24	117	1704	66%
5N	658	86	29	45	99	64	323	49%
Total	6157	1631	117	80	1907	344	4079	66%
Percentage Matched		75%	38%	39%	69%	53%	67%	

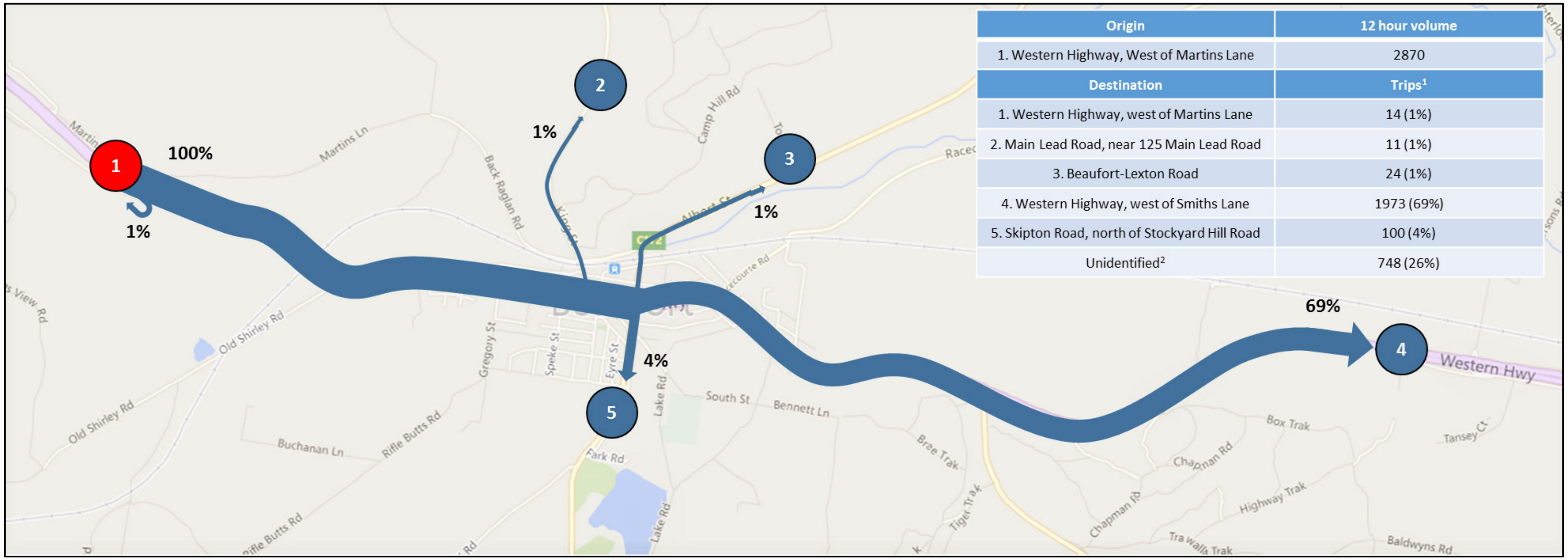
Table 6.3 Origin-destination match table for 7:00 am to 7:00 pm – Heavy vehicles

DESTINATION STATION		1N	2N	3N	4E	5S	TOTAL	PERCENTAGE MATCHED
Origin station	**Volume**	517	27	31	456	115	1146	
1S	462	0	0	6	277	29	312	68%
2S	24	0	1	0	1	2	4	17%
3S	20	1	0	0	0	8	9	45%
4W	508	358	4	0	3	28	393	77%
5N	113	17	2	9	24	4	56	50%
Total	1127	376	7	15	305	71	774	69%
Percentage Matched		73%	26%	48%	67%	62%	68%	

Table 6.4 Origin-destination match table for 7:00 am to 7:00 pm – All vehicles

DESTINATION STATION		1N	2N	3N	4E	5S	TOTAL	PERCENTAGE MATCHED
Origin station	**Volume**	2678	332	235	3212	770	7227	
1S	2870	14	11	24	1973	100	2122	74%
2S	336	6	27	1	78	41	153	46%
3S	231	18	3	9	11	61	102	44%
4W	3076	1866	52	7	27	145	2097	68%
5N	771	103	31	54	123	68	379	49%
Total	7284	2007	124	95	2212	415	4853	67%
Percentage Matched		75%	37%	40%	69%	54%	67%	

Figure 6.12 shows that throughout the 12-hour survey period, 69% of eastbound traffic from the Western Highway, west of Martins Lane travels east through Beaufort, 4% travels to Skipton Road and 1% travels north on Main Lead Road, north on Beaufort-Lexton Road and west on Western Highway.



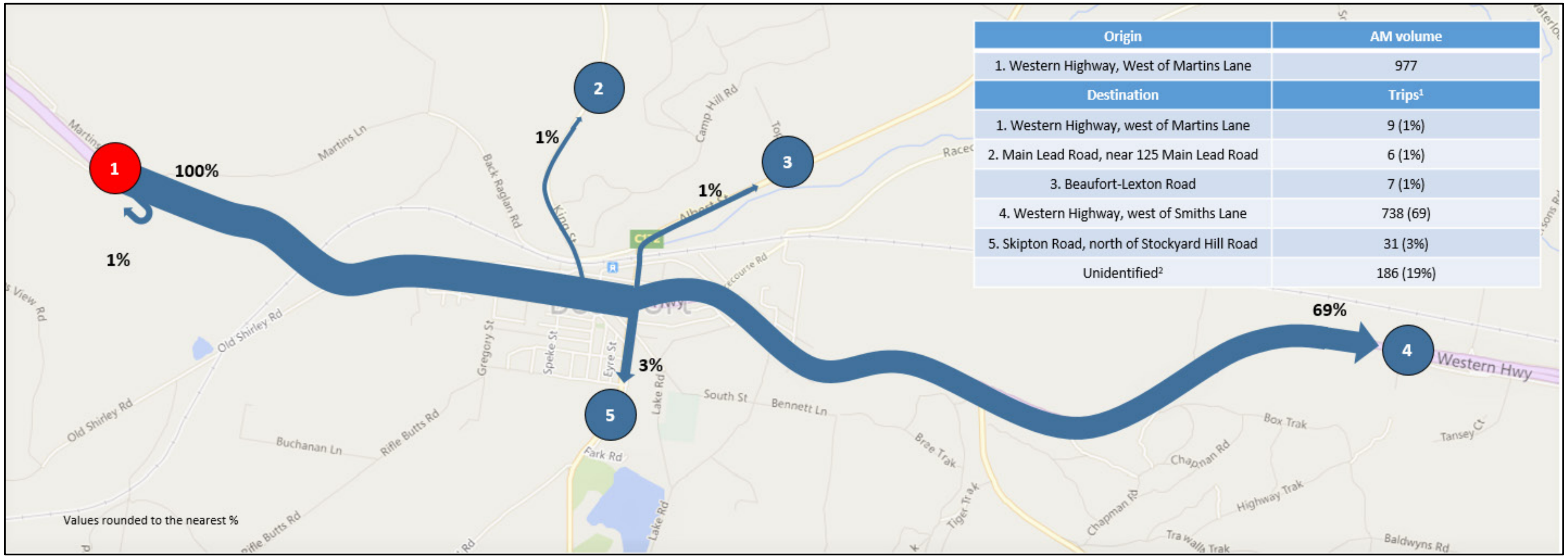
Origin	12 hour volume
1. Western Highway, West of Martins Lane	2870
Destination	**Trips[1]**
1. Western Highway, west of Martins Lane	14 (1%)
2. Main Lead Road, near 125 Main Lead Road	11 (1%)
3. Beaufort-Lexton Road	24 (1%)
4. Western Highway, west of Smiths Lane	1973 (69%)
5. Skipton Road, north of Stockyard Hill Road	100 (4%)
Unidentified[2]	748 (26%)

(1) Percentages have been rounded to the nearest whole figure and may not add up to 100% due to rounding errors

(2) Unidentified trips are vehicles that were only recorded at one origin-destination station (entering or exiting the study area). It's assumed that they have an origin/destination within the study or have entered/exited the study area through a local road.

Figure 6.12 Origin-Destination 12-hour survey – eastbound traffic on Western Highway, west of Martins Lane

Figure 6.13 shows that during the AM survey period, 69% of eastbound traffic from the Western Highway, west of Martins Lane travels through Beaufort eastbound along Western Highway, 3% travels south on Skipton Road and 1% travels north on Main Lead Road, north on Beaufort-Lexton Road and west on Western Highway.



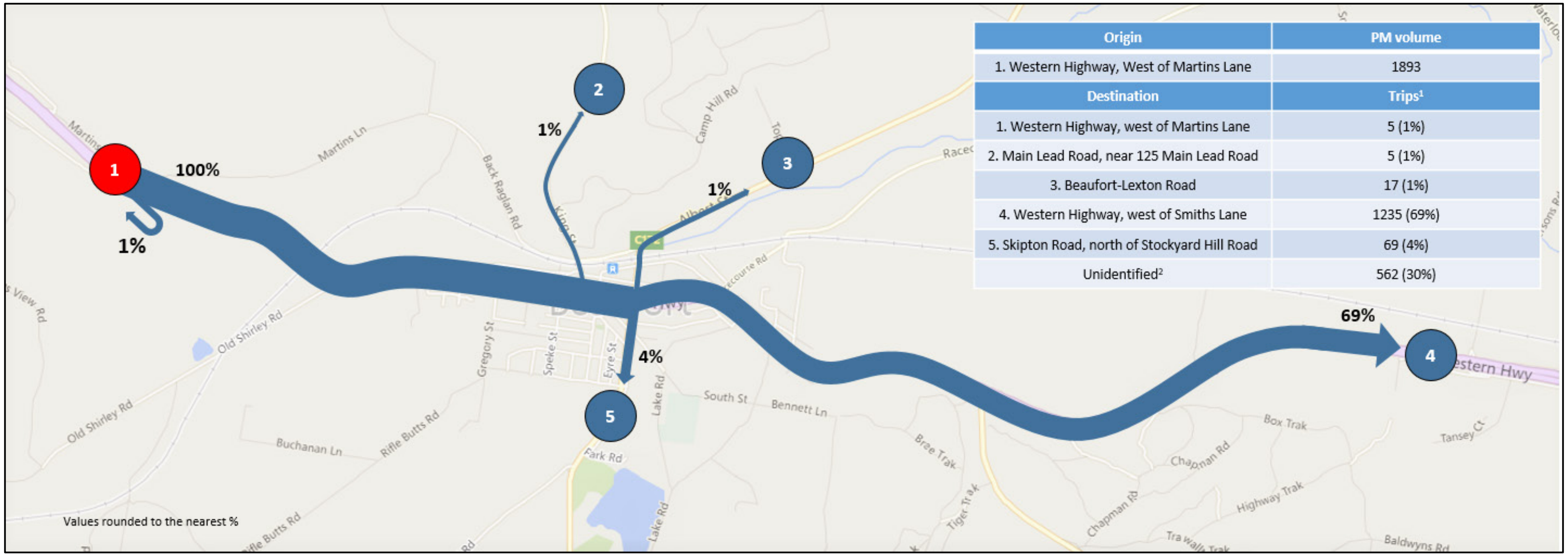
Origin	AM volume
1. Western Highway, West of Martins Lane	977
Destination	**Trips[1]**
1. Western Highway, west of Martins Lane	9 (1%)
2. Main Lead Road, near 125 Main Lead Road	6 (1%)
3. Beaufort-Lexton Road	7 (1%)
4. Western Highway, west of Smiths Lane	738 (69)
5. Skipton Road, north of Stockyard Hill Road	31 (3%)
Unidentified[2]	186 (19%)

(1) Percentages have been rounded to the nearest whole figure and may not add up to 100% due to rounding errors

(2) Unidentified trips are vehicles that were only recorded at one origin-destination station (entering or exiting the study area). It’s assumed that they have an origin/destination within the study or have entered/exited the study area through a local road.

Figure 6.13 Origin/Destination AM survey – eastbound traffic on Western Highway, west of Martins Lane

Figure 6.14 shows that during the PM survey period, 69% of eastbound traffic from the Western Highway, west of Martins Lane travels through Beaufort east along Western Highway, 4% travels south on Skipton Road and 1% travels north on Main Lead Road, north on Beaufort-Lexton Road and west on Western Highway.



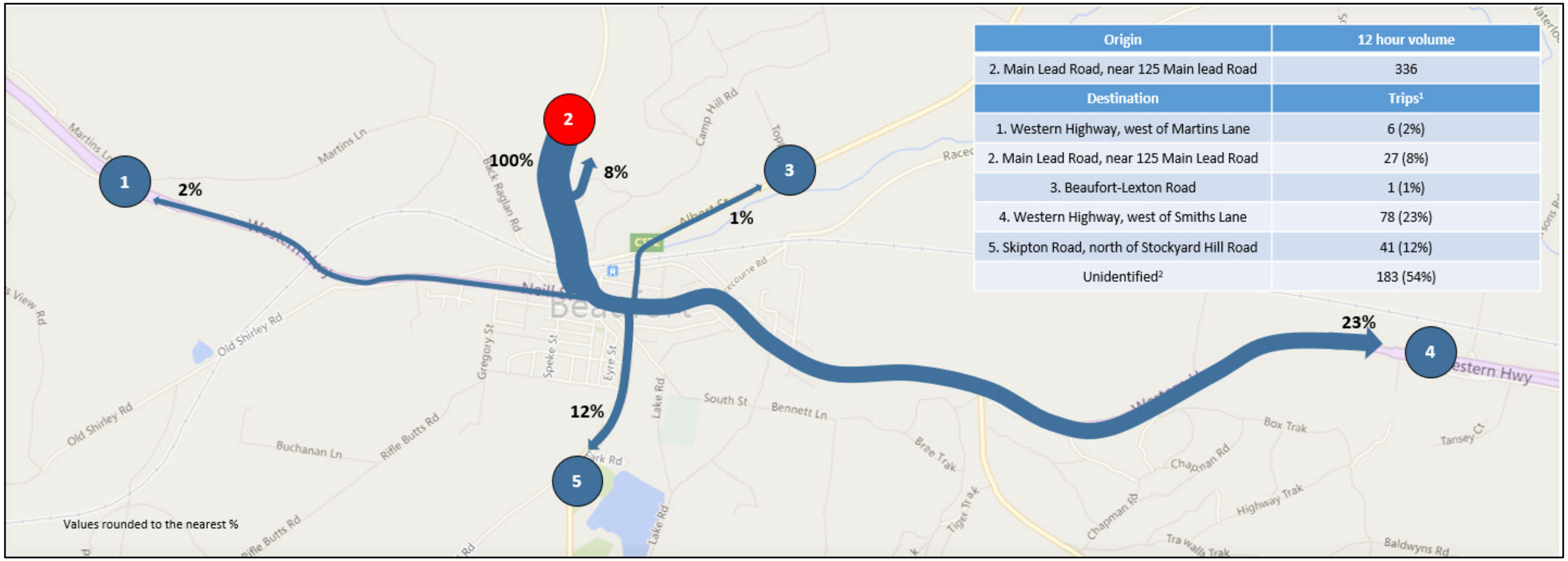
Origin	PM volume
1. Western Highway, West of Martins Lane	1893
Destination	**Trips[1]**
1. Western Highway, west of Martins Lane	5 (1%)
2. Main Lead Road, near 125 Main Lead Road	5 (1%)
3. Beaufort-Lexton Road	17 (1%)
4. Western Highway, west of Smiths Lane	1235 (69%)
5. Skipton Road, north of Stockyard Hill Road	69 (4%)
Unidentified[2]	562 (30%)

(1) Percentages have been rounded to the nearest whole figure and may not add up to 100% due to rounding errors

(2) Unidentified trips are vehicles that were only recorded at one origin-destination station (entering or exiting the study area). It's assumed that they have an origin/destination within the study or have entered/exited the study area through a local road.

Figure 6.14 Origin/Destination PM survey – eastbound traffic on Western Highway, west of Martins Lane

Figure 6.15 show that throughout the 12-hour survey period, 23% of southbound traffic from Main Lead Road travels east along Western Highway, 12% of traffic travels south on Skipton Road, 8% travels north up Main Lead Road, 2% travels west on Western Highway and 1% travels north on Beaufort-Lexton Road.

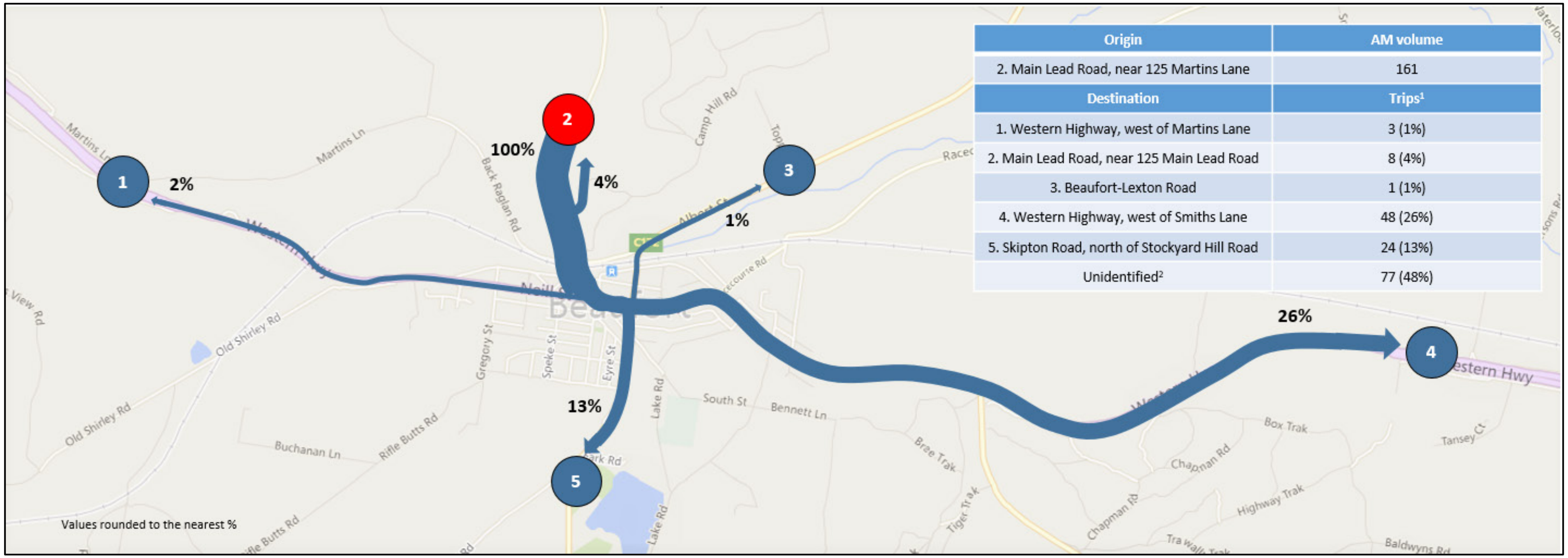


(1) Percentages have been rounded to the nearest whole figure and may not add up to 100% due to rounding errors

(2) Unidentified trips are vehicles that were only recorded at one origin-destination station (entering or exiting the study area). It's assumed that they have an origin/destination within the study or have entered/exited the study area through a local road.

Figure 6.15 Origin/Destination 12-hour survey – southbound traffic on Main Lead Road

Figure 6.16 shows that during the AM survey period, 26% of southbound traffic on Main Lead Road travels east on Western Highway, 13% travels south on Skipton Road, 4% travels north on Main Lead Road, 2% travels west on Western Highway and 1% travels north on Beaufort-Lexton Road.



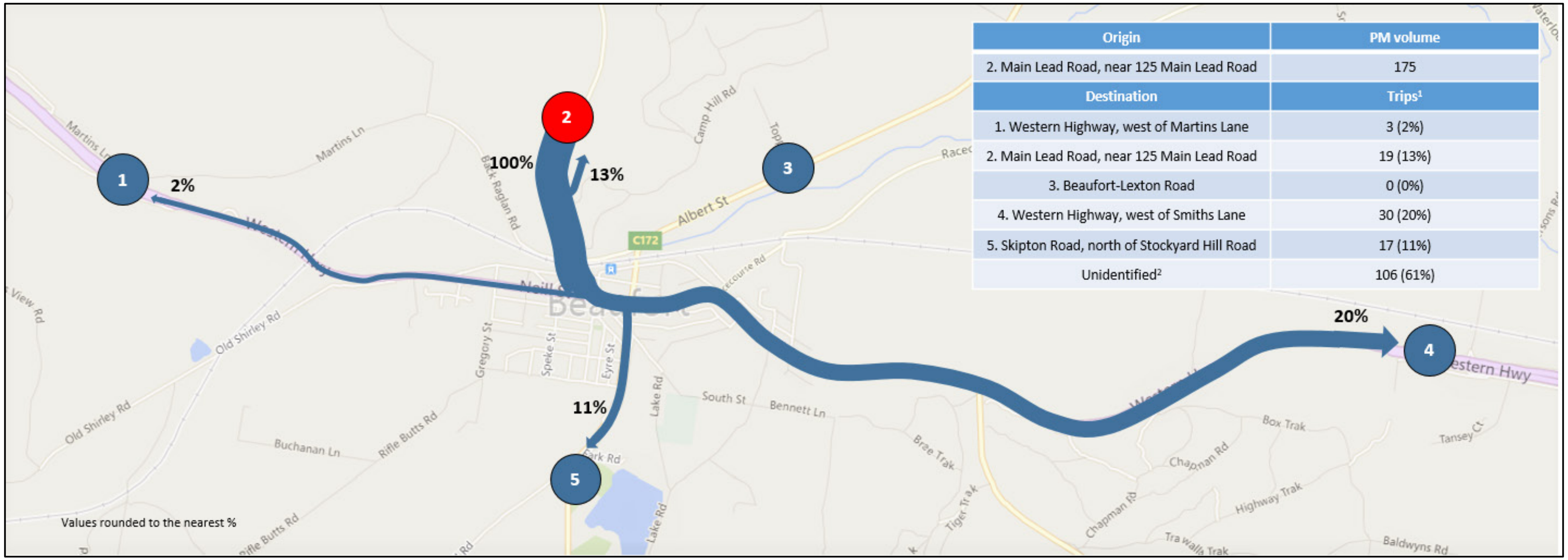
Origin	AM volume
2. Main Lead Road, near 125 Martins Lane	161
Destination	**Trips[1]**
1. Western Highway, west of Martins Lane	3 (1%)
2. Main Lead Road, near 125 Main Lead Road	8 (4%)
3. Beaufort-Lexton Road	1 (1%)
4. Western Highway, west of Smiths Lane	48 (26%)
5. Skipton Road, north of Stockyard Hill Road	24 (13%)
Unidentified[2]	77 (48%)

(1) Percentages have been rounded to the nearest whole figure and may not add up to 100% due to rounding errors

(2) Unidentified trips are vehicles that were only recorded at one origin-destination station (entering or exiting the study area). It's assumed that they have an origin/destination within the study or have entered/exited the study area through a local road.

Figure 6.16 Origin/Destination AM survey – southbound traffic on Main Lead Road

Figure 6.17 shows that during the PM survey period, 20% of southbound traffic on Main Lead Road travels east along Western Highway, 13% travels north on Main Lead Road, 11% travels south on Skipton Road and 2% travels west on Western Highway. No traffic movements were recorded for vehicles travelling to Beaufort-Lexton Road.



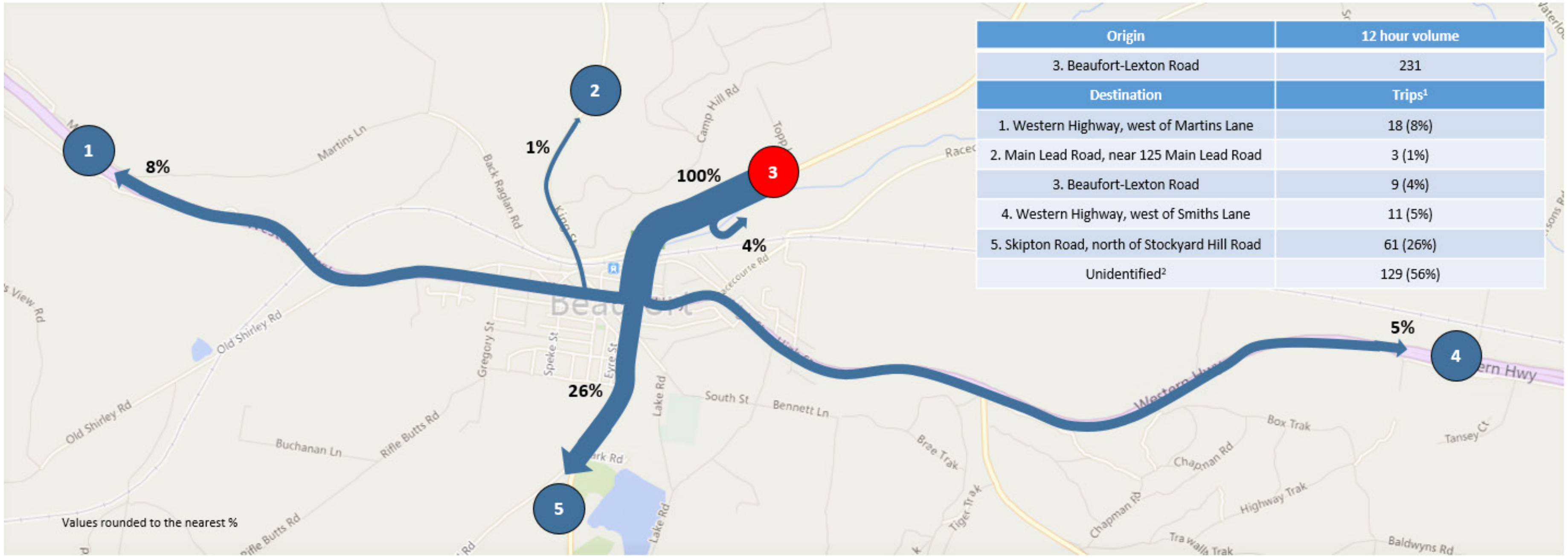
Origin	PM volume
2. Main Lead Road, near 125 Main Lead Road	175
Destination	**Trips[1]**
1. Western Highway, west of Martins Lane	3 (2%)
2. Main Lead Road, near 125 Main Lead Road	19 (13%)
3. Beaufort-Lexton Road	0 (0%)
4. Western Highway, west of Smiths Lane	30 (20%)
5. Skipton Road, north of Stockyard Hill Road	17 (11%)
Unidentified[2]	106 (61%)

(1) Percentages have been rounded to the nearest whole figure and may not add up to 100% due to rounding errors

(2) Unidentified trips are vehicles that were only recorded at one origin-destination station (entering or exiting the study area). It’s assumed that they have an origin/destination within the study or have entered/exited the study area through a local road.

Figure 6.17 Origin/Destination PM survey – southbound traffic on Main Lead Road

Figure 6.18 shows that throughout the 12-hour survey period, 26% of southbound traffic from Beaufort-Lexton Road continues south onto Skipton Road, 8% travels west on the Western Highway, 5% travels east on the Western Highway, 4% travels north on Beaufort-Lexton Road and 1% travels north on Main Lead Road.

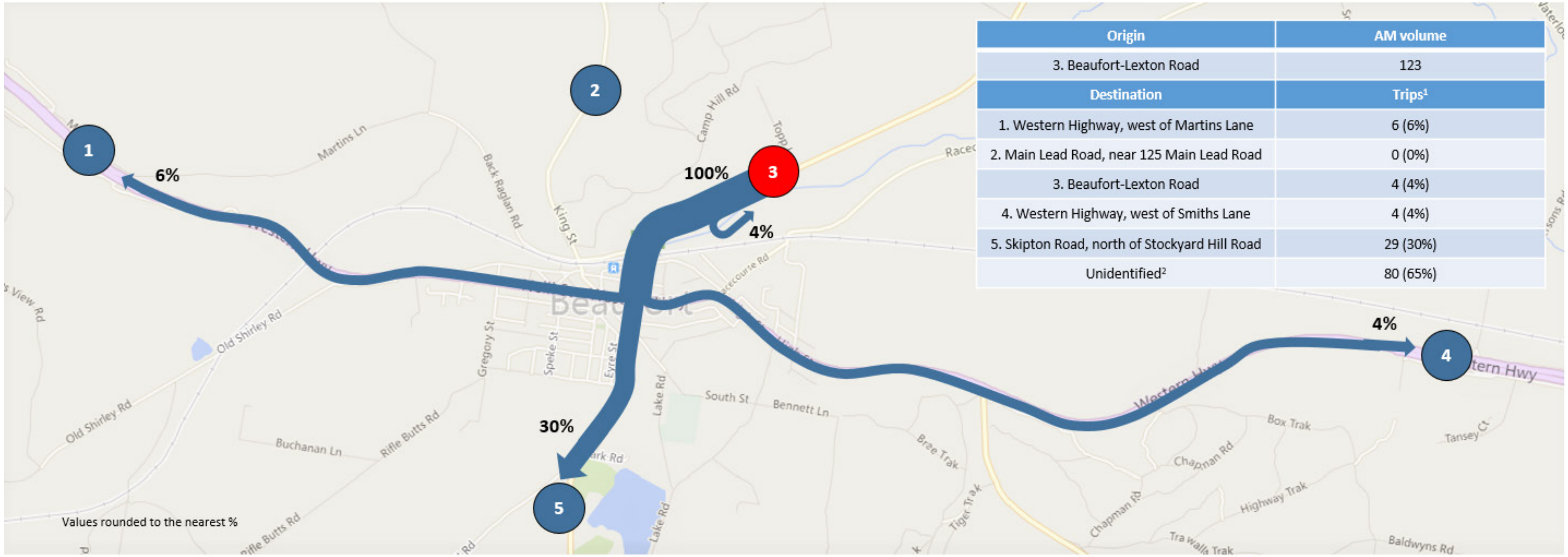


(1) Percentages have been rounded to the nearest whole figure and may not add up to 100% due to rounding errors

(2) Unidentified trips are vehicles that were only recorded at one origin-destination station (entering or exiting the study area). It's assumed that they have an origin/destination within the study or have entered/exited the study area through a local road.

Figure 6.18 Origin/Destination 12-hour survey – southbound traffic on Beaufort-Lexton Road

Figure 6.19 show that during the AM survey period, 30% southbound traffic from Beaufort-Lexton Road continues south onto Skipton Road, 6% travels west on the Western Highway, 4% travels east on Western Highway and 4% travels north on Beaufort-Lexton Road. No traffic movements were recorded for vehicles travelling to Main Lead Road.



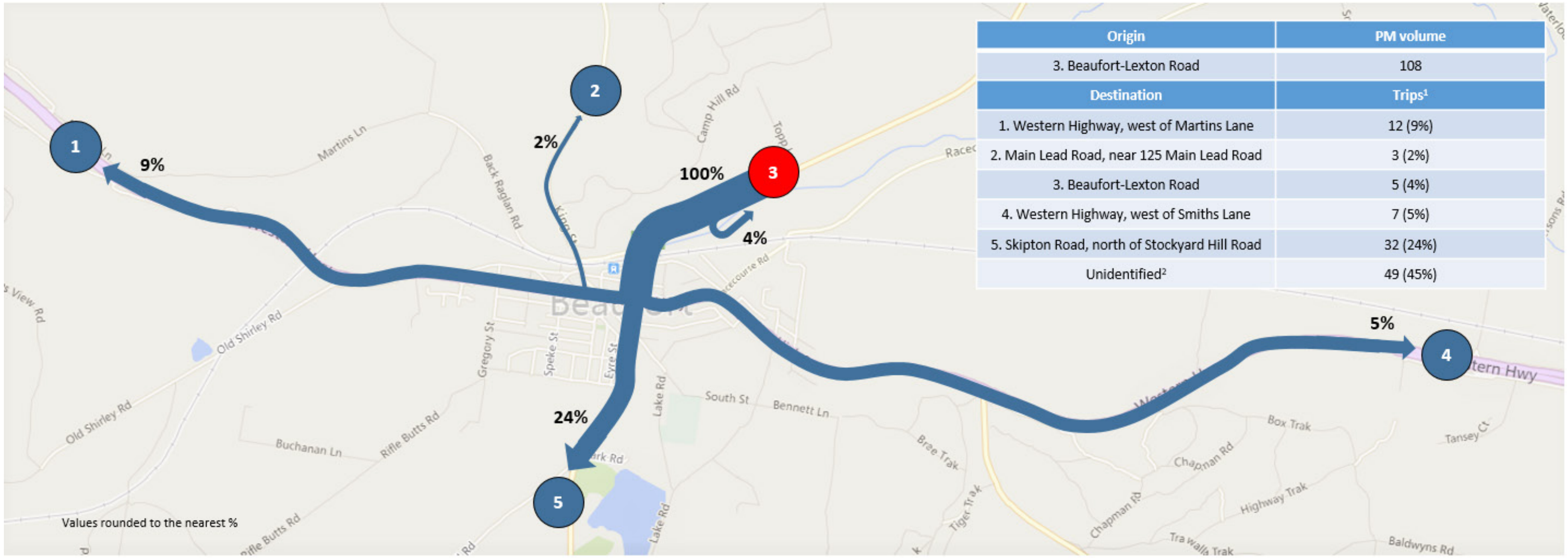
Origin	AM volume
3. Beaufort-Lexton Road	123
Destination	**Trips[1]**
1. Western Highway, west of Martins Lane	6 (6%)
2. Main Lead Road, near 125 Main Lead Road	0 (0%)
3. Beaufort-Lexton Road	4 (4%)
4. Western Highway, west of Smiths Lane	4 (4%)
5. Skipton Road, north of Stockyard Hill Road	29 (30%)
Unidentified[2]	80 (65%)

(1) Percentages have been rounded to the nearest whole figure and may not add up to 100% due to rounding errors

(2) Unidentified trips are vehicles that were only recorded at one origin-destination station (entering or exiting the study area). It's assumed that they have an origin/destination within the study or have entered/exited the study area through a local road.

Figure 6.19 Origin/Destination AM survey – southbound traffic on Beaufort-Lexton Road

Figure 6.20 shows that during the PM survey period, 24% of southbound traffic from Beaufort-Lexton Road continues south onto Skipton Road, 9% travels west on Western Highway, 5% travels east on Western Highway, 4% travels north on Beaufort-Lexton Road and 2% on Main Lead Road.



Origin	PM volume
3. Beaufort-Lexton Road	108
Destination	**Trips[1]**
1. Western Highway, west of Martins Lane	12 (9%)
2. Main Lead Road, near 125 Main Lead Road	3 (2%)
3. Beaufort-Lexton Road	5 (4%)
4. Western Highway, west of Smiths Lane	7 (5%)
5. Skipton Road, north of Stockyard Hill Road	32 (24%)
Unidentified[2]	49 (45%)

(1) Percentages have been rounded to the nearest whole figure and may not add up to 100% due to rounding errors

(2) Unidentified trips are vehicles that were only recorded at one origin-destination station (entering or exiting the study area). It's assumed that they have an origin/destination within the study or have entered/exited the study area through a local road.

Figure 6.20 Origin/Destination PM survey – southbound traffic on Beaufort-Lexton Road

Figure 6.21 shows that throughout the 12-hour survey period, 61% of westbound traffic from the Western Highway west of Smiths Lane continues to travel west, 5% travels south on Skipton Road, 2% travels north on Main Lead Road and 1% travels east on Western Highway and north on Beaufort-Lexton Road.

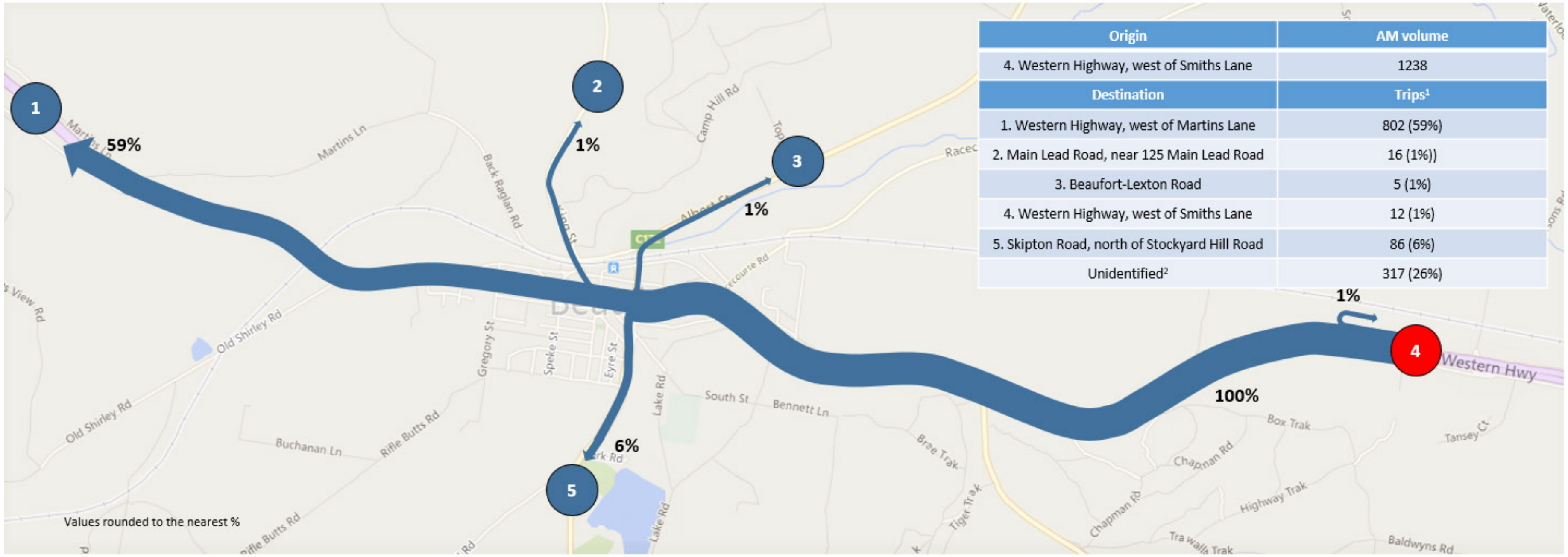
Origin	12 hour volume
4. Western Highway, west of Smiths Lane	3076
Destination	**Trips[1]**
1. Western Highway, west of Martins Lane	1866 (61%)
2. Main Lead Road, near 125 Main Lead Road	52 (2%)
3. Beaufort-Lexton Road	7 (1%)
4. Western Highway, west of Smiths Lane	27 (1%)
5. Skipton Road, north of Stockyard Hill Road	145 (5%)
Unidentified[2]	979 (32%)

(1) Percentages have been rounded to the nearest whole figure and may not add up to 100% due to rounding errors

(2) Unidentified trips are vehicles that were only recorded at one origin-destination station (entering or exiting the study area). It's assumed that they have an origin/destination within the study or have entered/exited the study area through a local road.

Figure 6.21 Origin/Destination 12-hour survey – westbound on Western Highway

Figure 6.22 shows that during the AM survey period, 59% of westbound traffic from the Western Highway west of Smiths Lane continues to travel west, 6% travels south on Skipton Road, 1% travels north on Main Lead Road, 1% travels north on Beaufort-Lexton Road and 1% travels east on Western Highway.



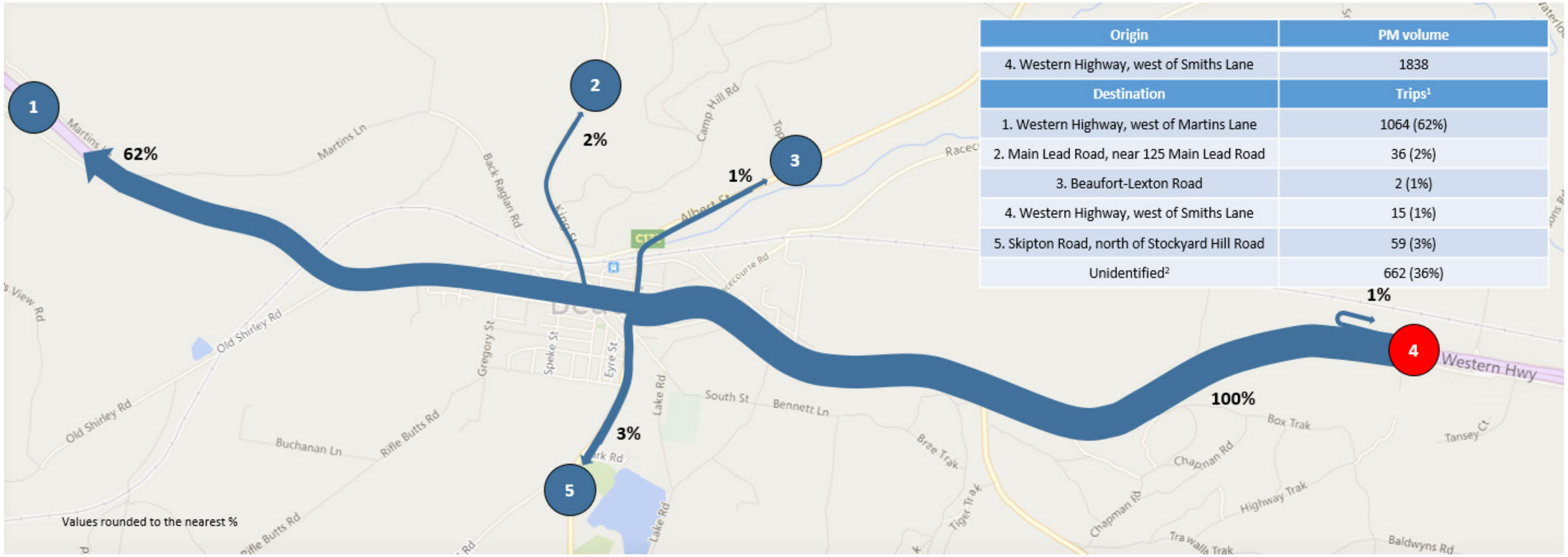
Origin	AM volume
4. Western Highway, west of Smiths Lane	1238
Destination	**Trips[1]**
1. Western Highway, west of Martins Lane	802 (59%)
2. Main Lead Road, near 125 Main Lead Road	16 (1%))
3. Beaufort-Lexton Road	5 (1%)
4. Western Highway, west of Smiths Lane	12 (1%)
5. Skipton Road, north of Stockyard Hill Road	86 (6%)
Unidentified[2]	317 (26%)

(1) Percentages have been rounded to the nearest whole figure and may not add up to 100% due to rounding errors

(2) Unidentified trips are vehicles that were only recorded at one origin-destination station (entering or exiting the study area). It's assumed that they have an origin/destination within the study or have entered/exited the study area through a local road.

Figure 6.22 Origin/Destination AM survey – westbound on Western Highway

Figure 6.23 shows that during the PM survey period, 62% of westbound traffic from the Western Highway west of Smiths Lane continues to travel west, 3% travels south onto Skipton Road, 2% travels north on Main Lead Road and 1% travels north on Beaufort-Lexton Road and west on Western Highway.



(1) Percentages have been rounded to the nearest whole figure and may not add up to 100% due to rounding errors

(2) Unidentified trips are vehicles that were only recorded at one origin-destination station (entering or exiting the study area). It's assumed that they have an origin/destination within the study or have entered/exited the study area through a local road.

Figure 6.23 Origin/Destination PM survey – westbound on Western Highway

Figure 6.24 shows that throughout the 12-hour survey period, 16% of northbound traffic from Skipton Road travels east on Western Highway, 13% travels west on Western Highway, 9% travels south on Skipton Road, 7% travels north on Beaufort-Lexton Road and 4% travels north on Main Lead Road.

Origin	12 hour volume
5. Skipton Road, north of Stockyard Hill Road	771
Destination	**Trips[1]**
1. Western Highway, west of Martins Lane	103 (13%)
2. Main Lead Road, near 125 Main Lead Road	31 (4%)
3. Beaufort-Lexton Road	54 (7%)
4. Western Highway, west of Smiths Lane	123 (16%)
5. Skipton Road, north of Stockyard Hill Road	68 (9%)
Unidentified[2]	392 (51%)

(1) Percentages have been rounded to the nearest whole figure and may not add up to 100% due to rounding errors

(2) Unidentified trips are vehicles that were only recorded at one origin-destination station (entering or exiting the study area). It's assumed that they have an origin/destination within the study or have entered/exited the study area through a local road.

Figure 6.24 Origin/Destination 12-hour survey – northbound on Skipton Road

Figure 6.25 shows that during the AM survey period, 18% of northbound traffic from Skipton Road travels east on Western Highway, 13% travels west on Western Highway respectively, 8% travels south on Skipton Road, 7% continues north on Beaufort-Lexton Road and 4% travels north on Main Lead road.

Origin	12 hour volume
5. Skipton Road, north of Stockyard Hill Road	316
Destination	**Trips[1]**
1. Western Highway, west of Martins Lane	44 (13%)
2. Main Lead Road, near 125 Main Lead Road	12 (4%)
3. Beaufort-Lexton Road	22 (7%)
4. Western Highway, west of Smiths Lane	61 (18%)
5. Skipton Road, north of Stockyard Hill Road	28 (8%)
Unidentified[2]	149 (47%)

(1) Percentages have been rounded to the nearest whole figure and may not add up to 100% due to rounding errors

(2) Unidentified trips are vehicles that were only recorded at one origin-destination station (entering or exiting the study area). It's assumed that they have an origin/destination within the study or have entered/exited the study area through a local road.

Figure 6.25 Origin/Destination AM survey – northbound on Skipton Road

Figure 6.26 shows that during the PM survey period, 14% of traffic from Skipton Road travels east and west on Western Highway respectively, 9% travels south on Skipton Road, 7% continues north on Beaufort-Lexton Road and 4% travels north on Main Lead Road.

Origin	12 hour volume
5. Skipton Road, north of Stockyard Hill Road	455
Destination	**Trips[1]**
1. Western Highway, west of Martins Lane	59 (14%)
2. Main Lead Road, near 125 Main Lead Road	19 (4%)
3. Beaufort-Lexton Road	32 (7%)
4. Western Highway, west of Smiths Lane	62 (14%)
5. Skipton Road, north of Stockyard Hill Road	40 (9%)
Unidentified[2]	243 (53%)

(1) Percentages have been rounded to the nearest whole figure and may not add up to 100% due to rounding errors

(2) Unidentified trips are vehicles that were only recorded at one origin-destination station (entering or exiting the study area). It's assumed that they have an origin/destination within the study or have entered/exited the study area through a local road.

Figure 6.26 Origin/Destination PM survey – northbound on Skipton Road

6.1.6 TRAVEL TIME SURVEYS

Travel time surveys were conducted along the Western Highway between the unnamed road adjacent to 4932 Western Highway (United Petroleum service station) and Olinda Street in both directions. Surveys were completed for two sessions – a midday session (12:00 pm – 1:00 pm) and a PM session (2:30 pm – 5:30 pm). Five runs were completed in each direction for the midday session whilst 15 runs and 18 runs were completed in the PM session for westbound and eastbound respectively.

During the midday runs, the eastbound run took an average of 4 minutes and 16 seconds to complete, with an average speed of 50 km/h whilst the westbound run took an average of 4 minutes and 30 seconds to complete, travelling at an average speed of 53 km/h.

During the PM runs, the eastbound run took an average of 4 minutes and 19 seconds to complete whilst travelling at an average speed of 52 km/h. The westbound runs on the other hand, took an average of 4 minutes and 5 seconds to complete whilst travelling at an average speed of 55 km/hr.

The surveys show that the travel times along the Western Highway in the eastbound direction were largely consistent across the two survey periods, with only a 3 second difference in average time. For westbound direction, the midday run was slightly faster (25 seconds) compared to the PM period.

The results of the runs are summarised in Figure 6.27 to Figure 6.30. The speed limits along the road in the direction of travel are also shown in the graphs in red.

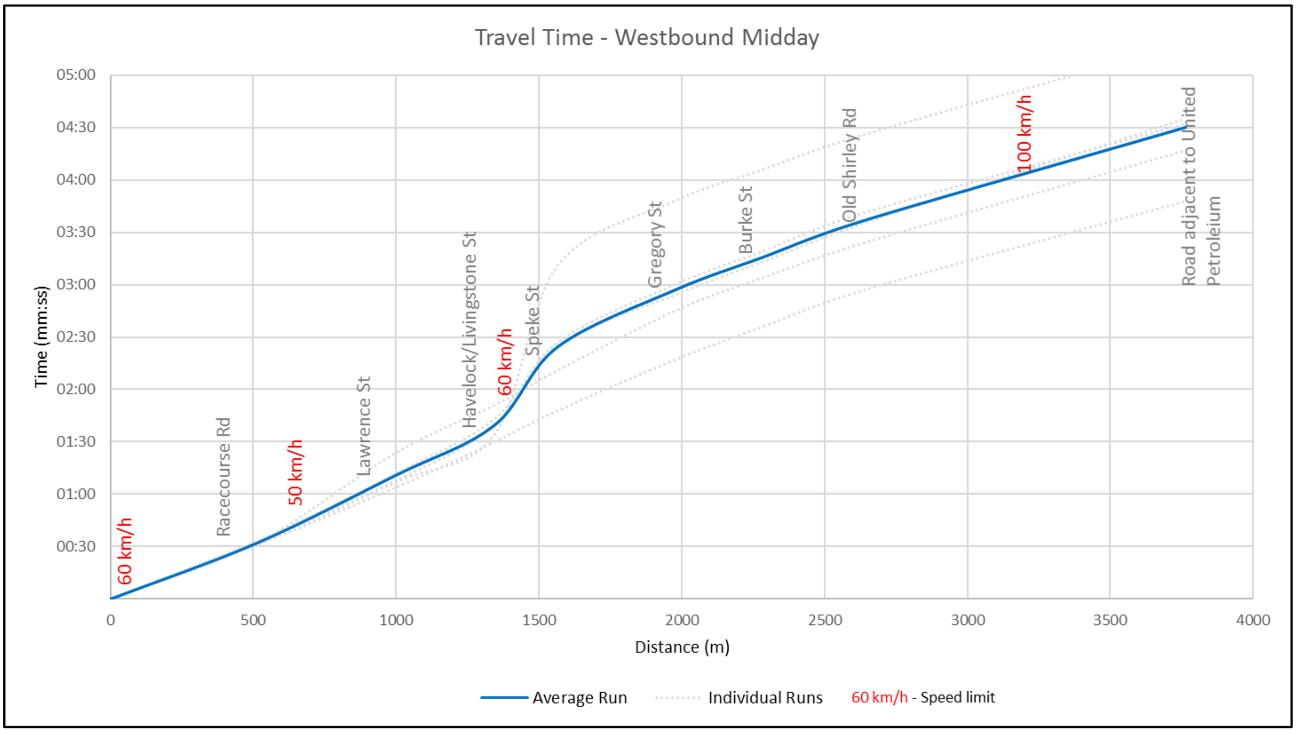


Figure 6.27 Midday westbound travel time survey

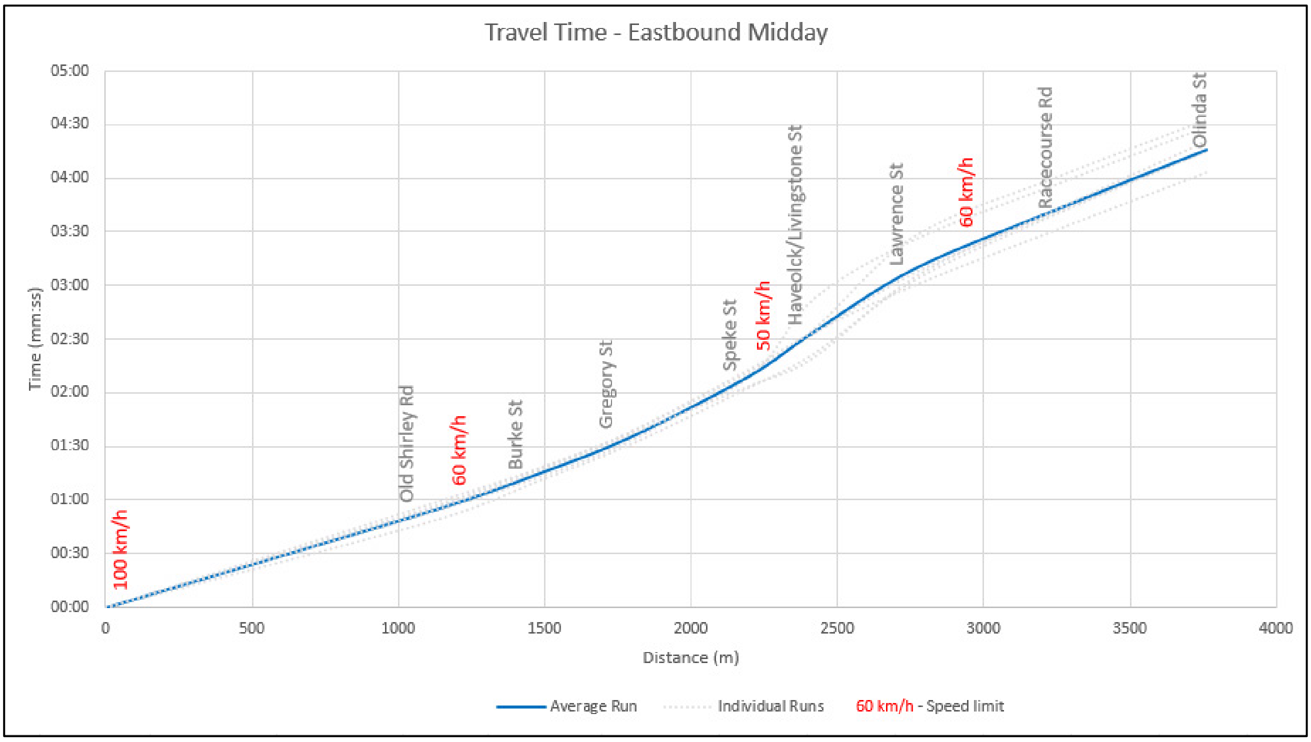


Figure 6.28 Midday eastbound travel time survey

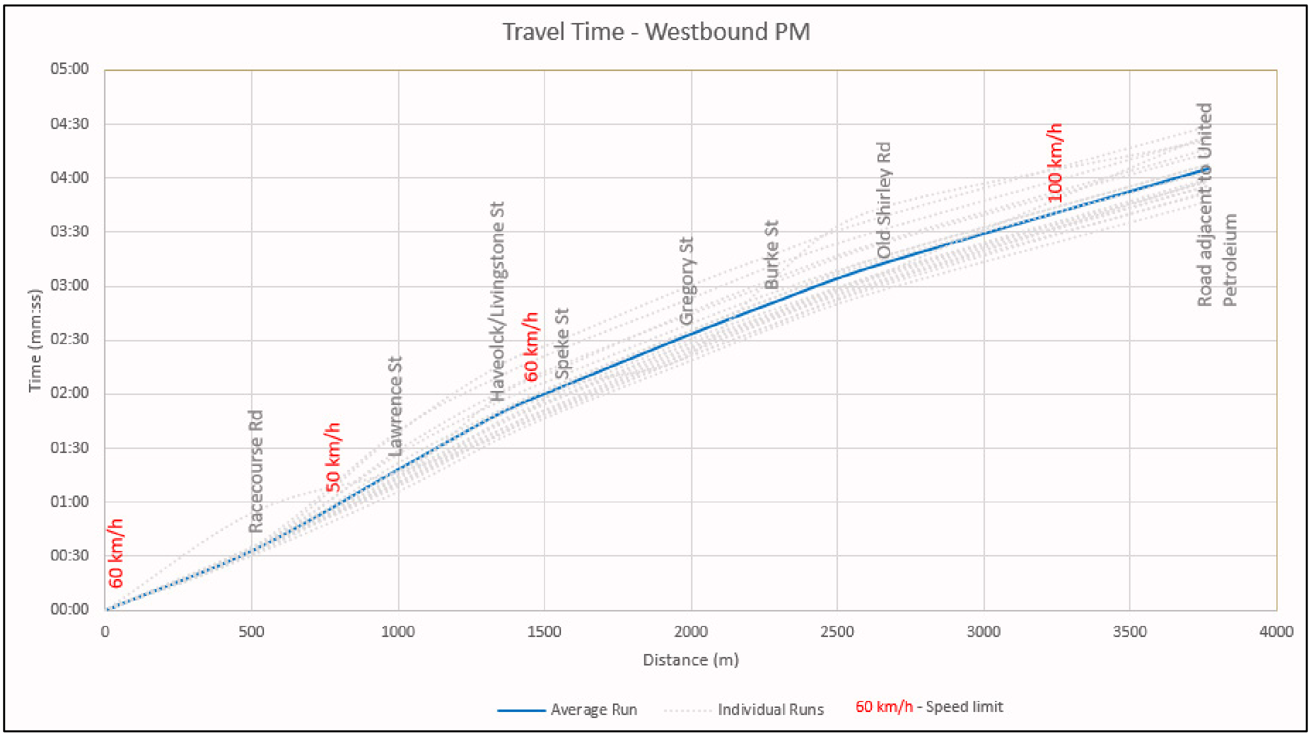


Figure 6.29 PM westbound travel time survey

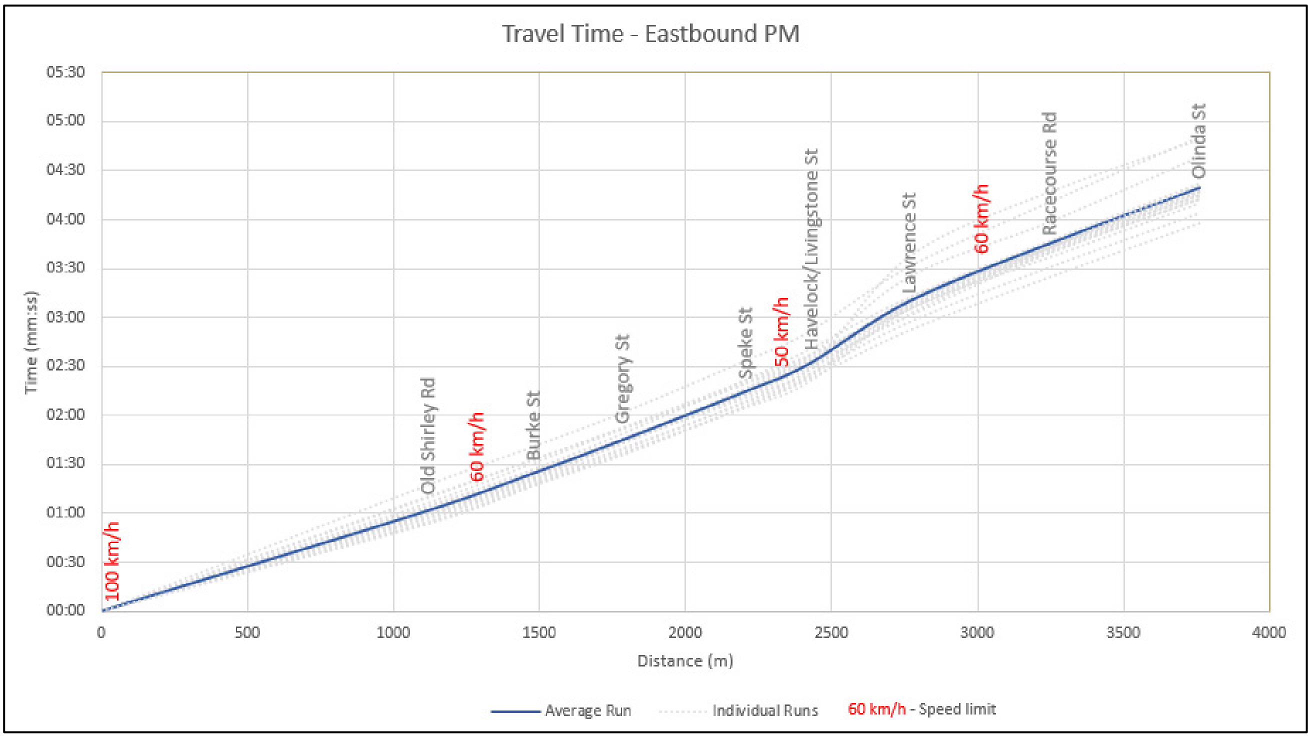


Figure 6.30 PM eastbound travel time survey

6.1.7 CRASH HISTORY

Crash statistics for the five-year period 2016–2020 (inclusive) were provided by RRV for the Beaufort study area, with a 9.9 km section of the Western Highway between Smiths Lane to Martins Lane used to determine crash rates. Figure 6.31 shows the extents of the crash history search area.

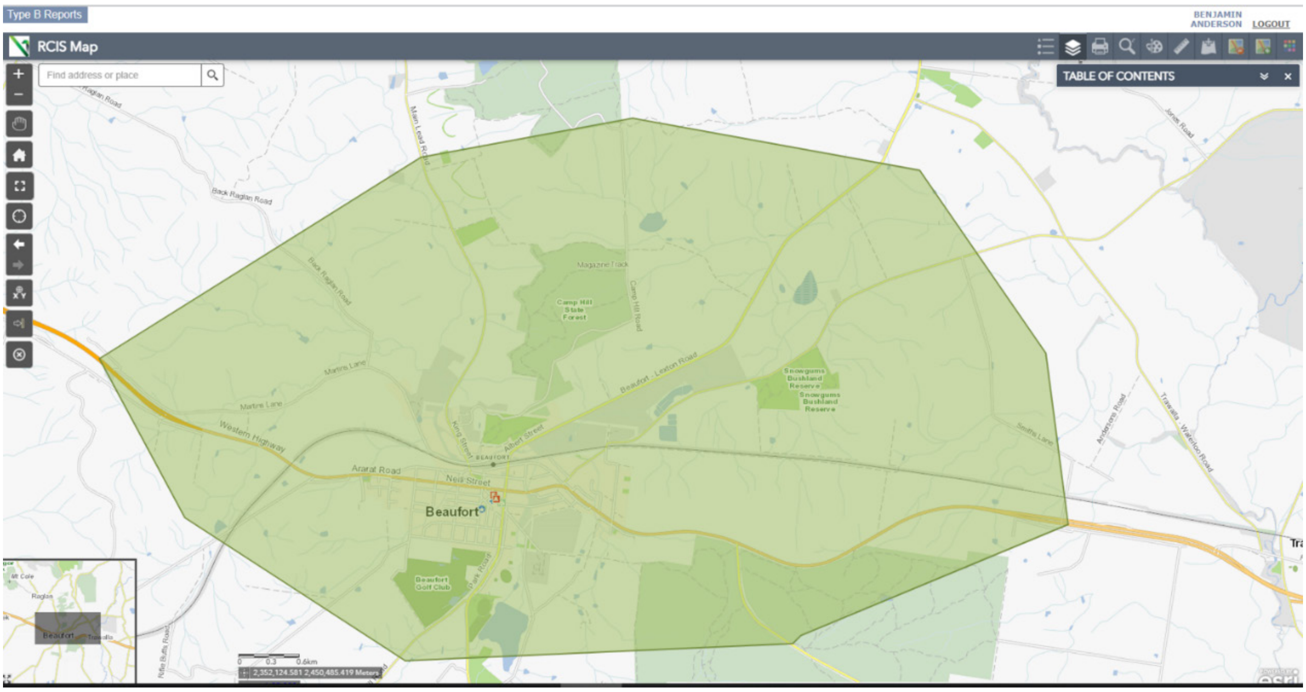


Figure 6.31 Crash history search area

Over this period a total of nine serious injury or fatal crashes have occurred, of which there were:

- seven crashes on the Western Highway and two crashes at other locations within the study area
- one fatality crash at a midblock location on the Western highway
- eight serious injury accidents with seven at midblock locations one at an intersection
- three crashes were run off road type crashes whilst six crashes occurred between vehicles
- no serious injury or fatal crashes involved pedestrians, cyclists or motorcyclists.

Summarised in Table 6.5 below are crash event statistics for the Western Highway on the 9.9 km section from Smiths Lane to Martins Lane only. This table disaggregates crashes by two road types – within the built-up area in Beaufort, and in non-built up areas. The table shows the annual Vehicle Kilometres Travelled (VKT) and crash rate for the two road types.

Table 6.5 Beaufort Study Area Western Highway casualty crash rates

AREA	APPROX. AADT*	LENGTH (km)	ANNUAL VKT (PER 100 MILLION VKT)	CRASH RATE (SERIOUS INJURY / FATAL PER YEAR)	CRASH RATE (CASUALTY PER 100 MILLION VKT)
Non-built up areas	7350	7.3	0.20	1	5.11
Built up areas	7700	2.6	0.07	0.4	5.71

*AADT volumes are from VicRoads Open Data Traffic Volumes last updated May 2020

Table 6.6 provides national and state average casualty rates for rural roads. The crash rate for built up areas should be compared to the 'urban' road stereotype, with non-built up areas compared to the rural stereotype.

Crash rates within non-built up and built up areas of 5.11 and 5.71 crashes per 100 million VKT respectively are low in comparison with both state and national averages shown in Table 6.6.

Table 6.6 Nationally weighted mean road section casualty crash rates (sourced from Austroads, 2010)

ROAD STEREOTYPE	CRASH RATE (CASUALTY CRASHES PER 100 MILLION VKT)	
	Australia	Victoria
Rural	14.76	16.31
Rural undivided/single	16.26	18.57
Urban	23.69	23.22
Urban undivided/single	29.44	32.12

The one intersection serious injury within the study area did not occur on the Western Highway and instead occurred at the Havelock Street and Lawrence Street intersection. No AADT data was available at this location for Havelock Street, and as such, comparisons with any intersection benchmarks cannot be made.

6.1.8 PUBLIC TRANSPORT

Public transport provided to the Beaufort area includes one rail and three coach services providing access to Melbourne, Ballarat, Horsham, Ararat and Ouyen.

V-Line provides a train service from Beaufort Train Station via the Melbourne-Ararat service through Ballarat. This provides five services to and from Melbourne during weekdays and three services to and from Melbourne during weekends.

V-Line also provides coach services from Beaufort Train Station with the following routes:

- Ouyen – Melbourne via Hopetoun and Ballarat
- Nhill – Melbourne via Horsham.

6.1.9 WALKING AND CYCLING

Currently there is only a short section of pedestrian footpath provided within the central township of Beaufort. There is limited provision for pedestrians wanting to cross the Western Highway in Beaufort as only one signalised pedestrian crossing is available in town located at the intersection with Lawrence Street. With increased traffic flows through Beaufort there will be decreased opportunities for pedestrians to cross Western Highway. No designated bike lanes exist on roads, however, generally there are cycling opportunities around the Beaufort area. The Pyrenees Shire have created a Beaufort Walkability Plan which is focused on improving accessibility and infrastructure for pedestrians and cyclists in the Beaufort area. From this, the council was awarded funding in 2017 as part of the Federal Government's Building Better Regions Fund Infrastructure Projects stream for the "construction of walking and cycling paths that link community, recreation, education, transport and business precincts. Establishment of additional supportive infrastructure such as way finding signage, seats, bike racks and pram ramps, and disability access to the railway station" (Department of Industry, Innovation and Science, 2019). The project is currently underway (Pyrenees Shire Council, 2019).

7 IMPACT ASSESSMENT – FOUR ALIGNMENT OPTIONS

A high-level comparison of network and construction impacts between the alignment options are provided below.

7.1 NETWORK IMPACT ASSESSMENT

The impact assessment focused on the assessment of future traffic volumes with two separate models being used – a spreadsheet model to quantify the volume that would utilise the bypass and intersection models to assess the performance of intersections at key locations. The different bypass alignment options displayed no difference in impact between models, as such, the models were developed to simulate two scenarios to assess impact – a project scenario (where the bypass was built) and a no project scenario. The impact assessment outcomes presented in Section 9 are applicable to all alignment options.

7.1.1 CAPACITY

Each option has been designed with the same cross-section and the same interchange arrangements, and therefore there is no difference in capacity between the options. The introduction of any of the options will improve capacity within Beaufort to the same degree.

As such, the overall impact of the bypass will be to increase the capacity of Western Highway to accommodate future traffic growth when compared to existing conditions.

7.1.2 SAFETY

Each option has been designed with the same cross-section and the same interchange arrangements, and therefore there is minimal difference in safety between the options. There is potential during construction for an increase of vehicle collisions with wildlife crossing. This has been included in the Risk Register and applies to all alignment options.

The overall impact of the bypass on safety will be to improve safety when compared to existing conditions, particularly in the town centre for active transport modes, by reducing traffic volumes through the town and therefore reducing the likelihood of crashes.

7.1.3 ACCESSIBILITY

There is no difference in levels of accessibility between the four options. Each option provides the same interchange locations and the implementation of all options will have a positive impact on the Beaufort traffic network by improving crossing conditions and supporting conditions for the future implementation of pedestrian and cyclist improvements.

The overall impact of the project will be improved accessibility, especially for active transport, when compared to existing conditions by removing through traffic volumes from the road network within the town centre.

Specific impacts to access for private properties are discussed in the EES Appendix J: *Social impact assessment* (WSP 2021).

7.1.4 TRAVEL TIME COMPARISON

A comparison of the travel time between the eastern and western bypass interchanges was made, comparing the bypass to current travel times along the full length of the existing Western Highway.

The travel time surveys covered a section of road approximately 3.75 km in length between the United Petroleum service station (west of the Beaufort township) and Olinda Street (east of the Beaufort township). The total section of Western Highway that will be bypassed by the project is approximately 10–11 km in length.

As the travel time survey did not cover the entire bypassed section of Western Highway (through the town centre), in order to enable the comparison, the travel time of the missing sections was approximated. The missing sections are outside the town centre, and due to the rural nature of the road, the vehicles were assumed to travel at free flow speed i.e. the speed limit. Speed zone and speed sign data was obtained from RRV through the Victorian Government Open Data portal.

The section of road between the western interchange of the bypass and the western end of the travel time survey (unnamed road adjacent to 4932 Western Highway) is approximately 1.55 km in length. Eastbound from the interchange there is a section 810 m in length with a speed limit of 110 km/h, followed by a 740 m section with a speed limit of 100 km/h. Westbound from the end of travel time survey, there is a section 140 m in length with a speed limit of 100 km/h, followed by a 1.41 km section with a speed limit of 110 km/h.

The section of road between the eastern interchange of the bypass and the eastern end of the travel time survey is approximately 4.75 km in length. From the interchange there is a 4.62 km section with a speed limit of 100 km/h in both directions, and a 130 m section with a speed limit of 60 km/h in both directions.

Average travel times on the non-surveyed sections of Western Highway/Neill Street were calculated as a function of speed and distance. The average estimated travel time for each period between the proposed bypass interchange locations is summarised in Table 7.1.

Separate calculations are shown for heavy vehicles, assuming they travel at the speed for heavy vehicles of 100 km/h on the 110 km/h sections.

Table 7.1 Existing condition travel times by time period and direction

DIRECTION	SESSION	AVERAGE SURVEYED TRAVEL TIME (MM:SS) (3.75 km SECTION)	CALCULATED AVERAGE TRAVEL TIME (MM:SS) (10 km SECTION) LIGHT VEHICLES	CALCULATED AVERAGE TRAVEL TIME (MM:SS) (10 km SECTION) HEAVY VEHICLES
Noon (Westbound)	12:00-13:00	04:30	08:15	08:20
Noon (Eastbound)	12:00-13:00	04:16	08:03	08:06
PM (Westbound)	14:30-17:30	04:05	07:50	07:55
PM (Eastbound)	14:30-17:30	04:19	08:06	08:09

There are four current options for the bypass as shown in Figure 2.1. Based on the assumption that the travel time is a function of the speed and distance (neglecting any potential sources of delay) and a speed limit of 110 km/hr, the travel times for each bypass option is shown in Table 7.2.

Table 7.2 Bypass calculated travel time (110 km/h speed limit for light vehicles, 100 km/h speed limit for heavy vehicles)

BYPASS ROUTE OPTION	DISTANCE (km)	CALCULATED TRAVEL TIME (MM:SS) LIGHT VEHICLES	CALCULATED TRAVEL TIME (MM:SS) HEAVY VEHICLES
A0	11.2	06:07	06:43
A1	11.1	06:03	06:40
C0	10.6	05:47	06:22
C2	11.0	06:00	06:36

These results show that based on 2017 surveyed travel times, for general through traffic on the Western Highway, a potential travel time saving of between 1:44 (PM westbound on Option A0) and 2:28 (noon westbound on Option C0) can be achieved.

The results show that based on 2017 surveyed travel times, for heavy vehicle through traffic on the Western Highway assuming a speed limit of 100 km/h, a potential travel time saving of between 1:12 (PM westbound on Option A0) and 1:58 (noon westbound on Option C0) can be achieved.

As the estimated average travel times of the options fall within a range of 21 seconds per trip, this is not considered a significant differentiator between the alignments.

Overall any of the alignment options for the bypass will improve travel times when compared to existing conditions.

7.2 CONSTRUCTION TRAFFIC IMPACTS

At the time of this report, detailed information regarding the construction was not available. As such, only a high-level overview of the construction impacts and impact management strategies has been provided.

The project is expected to have an overall construction timeframe of two years with works likely happening during standard construction work hours, as dictated in the Environment Protection Authority (EPA) Publication 1834: *Civil construction, building and demolition guide* (2020) unless prior approval has been sought from the RRV superintendent and EPA. The standard construction hours are:

- 7:00 am to 6:00 pm Monday to Friday
- 7:00 am to 1:00 pm Saturdays.

The proposed alignment largely covers greenfield areas, meaning construction works will predominantly remain off existing roads other than where the bypass interchanges are proposed. The potential construction traffic impacts will be the increased usage of the existing road network by construction vehicles, particularly heavy vehicles along haulage routes. Other potential traffic impacts include construction worker trips to and from the site as well as access impacts on the road network to and from the sites for local landowners and road users. Specific impacts to access for private properties are discussed in the EES Appendix J: *Social impact assessment* (WSP 2021).

An overall traffic management strategy with detailed traffic management plans and traffic guidance schemes is required to be developed to manage potential disruptions post the approval of the EES for the project. These need to ensure safety and network operation outcomes are achieved to the satisfaction of relevant the governing agencies. The objectives for the management of traffic should be to:

- minimise the impact on traffic
- provide a safe environment for the travelling public and construction personnel
- cater for the needs of all traffic
- communicate the purpose of the proposed traffic event
- communicate the arrangements for and impacts of any event affecting traffic.

Figure 7.1 below shows the estimated cut and fill for each route option. The graph shows that all options have a higher amount of fill compared to cut, and as such, additional fill must be imported to the construction site.

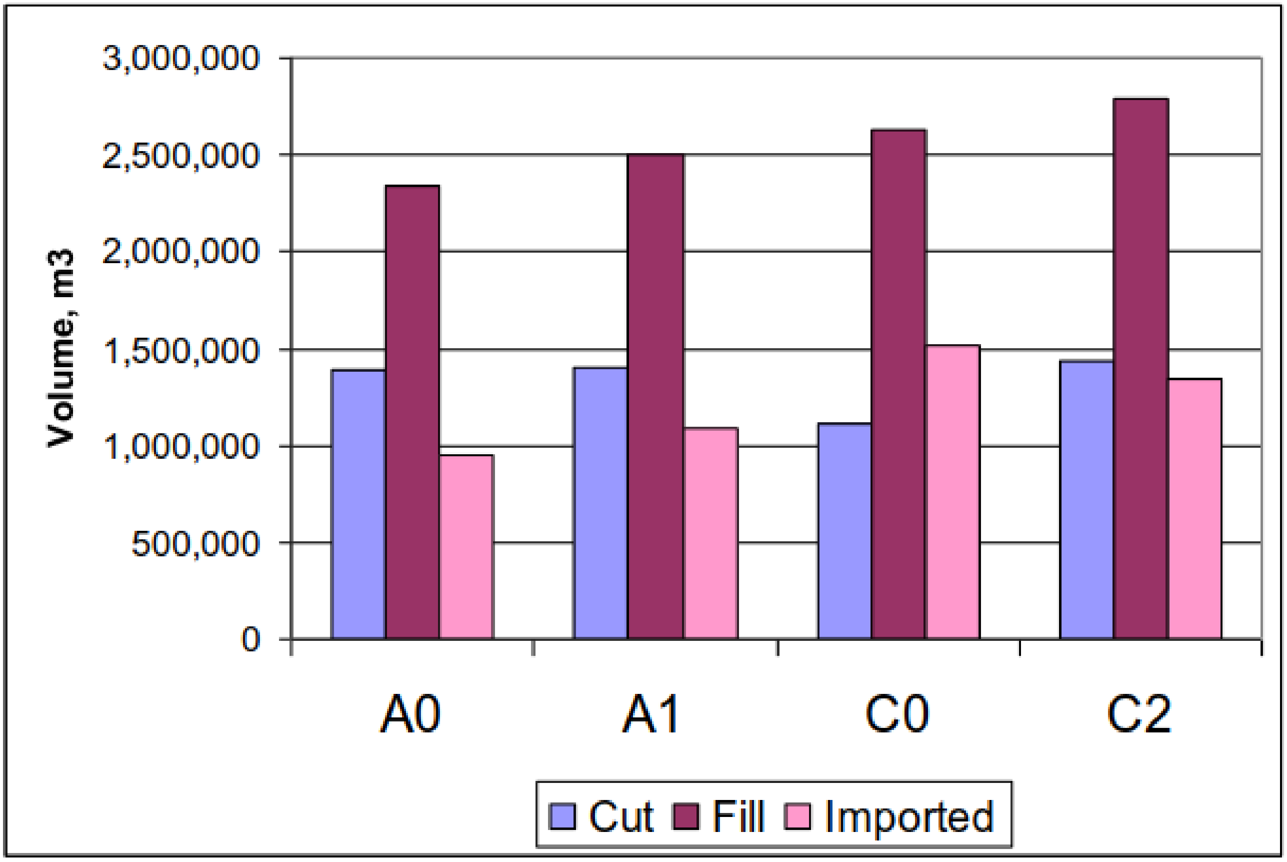


Figure 7.1 Estimated cut and fill for route options (EES Appendix B*: Air quality impact assessment* (CEE October 2021))

Table 7.3 below shows the potential equipment that may be used for construction, based on observations of the construction fleet used for other sections of the Western Highway (from EES Appendix B: *Air quality impact assessment*), consisting of a number of light and heavy vehicles.

A high-level estimation was also completed on the additional peak hour construction vehicle volumes due to haulage of earthworks required for construction. This was based on the assumptions below:

- construction works would occur over 2 years
- 300 days of work per year
- the use of the common three axle rigid tuck and three axle dog trailer (42.5t) as outlined by the National Heavy Vehicle Regulator
- truck movements over 11 hours per day (7:00 am to 6:00 pm).

The results outlined in Table 7.4 indicate minimal impacts for all potential alignment options.

Table 7.3 Equipment used in excavation stage and fill stage (EES Appendix B: *Air quality impact assessment*)

EXCAVATION STAGE	NUMBER	FILLING STAGE	NUMBER
Bulldozers	2		
Scrapers	2	Graders	2
Dump trucks	6	Dump trucks	6
Excavators	6	Excavators	4
Truck/trailer	12	Truck/trailer	16
Rollers/compactors	1	Rollers/compactors	3
Water trucks	2	Water trucks	2
Light trucks	7	Light trucks	7
Utes/vans	20	Utes/vans	20
Cars	20	Cars	20

Table 7.4 Estimated earthworks material quantities and haulage numbers

OPTION	A0	A1	C0	C2
Earthworks material to be transported (m^3)	900000	1100000	1200000	1700000
Construction vehicles per day	71	86	94	133
Construction vehicles per hour	7	8	9	13

Note: Figures have been rounded to the nearest thousandth

8 OPTIONS ASSESSMENT AND PREFERRED ALIGNMENT SELECTION

As the four alignment options involved the same potential impacts with regard to traffic and transport, the options assessment has not relied on the outcomes of this impact assessment. The information within this section is provided as context for the process utilised to select the preferred alignment.

The options assessment completed for the project assessed alignment options A0, A1, C0 and C2 against the customised set of criteria summarised in section 4.6. The results of the options assessment and sensitivity testing are detailed in Table 8.1. As well as the score for each alignment under each scenario, a colour coding has been applied to rank the performance of the options under each scenario as follows:

- best performing alignment option: Green
- second performing alignment option: Yellow
- third performing alignment option: Orange
- worst performing alignment option: Red.

Table 8.1 Combined alignment option scenario scoring

SCENARIO	ALIGNMENT A0	ALIGNMENT A1	ALIGNMENT C0	ALIGNMENT C2
Scenario 1	128	123	126	111
Scenario 2	18	22	20	27
Scenario 3	45.85	44.89	50.01	43.95
Scenario 4	81.03	77.59	93.98	74.12
Scenario 5	24.16	22.70	27.03	19.44
Scenario 6	47.74	42.69	56.16	35.49
Sensitivity Scenario 1	-6	-3	-5	9
Sensitivity Scenario 2	-3	2	-4	11
Sensitivity Scenario 3	-11	-6	-9	5

The alignment scoring scenarios outlined in Table 8.1 show that the best performing option is the C2 Alignment, while the worst performing options are the A0 and C0 Alignments. The primary drivers for this outcome were due to the C2 alignment having:

- the lowest amount of total native vegetation clearance
- the least impact on threatened vegetation communities identified under *the Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and *Flora and Fauna Guarantee Act 1988* (FFG Act)
- the least impact on wildlife corridors, particularly the core habitat areas
- the lowest amount of native vegetation with high conditions to be removed by Ecological Vegetation Class (EVC) Conservation Status
- the lowest potential impacts on known or registered sites of Aboriginal and historic heritage significance
- the smallest number of dwellings within 100 m, 200 m and 300 m of the alignment corridor.

Further detail on the options assessment process is provided in the EES Attachment IV: *Options assessment*.

9 IMPACT ASSESSMENT – PREFERRED ALIGNMENT

9.1 OPERATIONAL NETWORK PERFORMANCE IMPACT

As outlined in Section 4.4, two separate models were developed – a spreadsheet model to understand the change in traffic volumes due to the Beaufort Bypass and SIDRA intersection analysis to assess the impact on delays to traffic at intersections within Beaufort. The results are presented below in the following sections.

9.1.1 SPREADSHEET NETWORK MODEL

For the spreadsheet network model, both Average Daily Traffic (ADT) volumes and peak hour volumes were developed. The results of the spreadsheet network model and intersection modelling for the project are presented below.

9.1.1.1 AVERAGE DAILY TRAFFIC

As previously outlined, in Section 4.4.3, the spreadsheet model was developed using a combination of the origin-destination, intersection and automatic traffic (tube) surveys. Intersection counts and origin-destination (OD) surveys were only conducted on a Thursday as directed by RRV. As such, the spreadsheet model was initially only developed for a Thursday.

From the weekly traffic volume profile shown in Figure 6.7, Friday was identified as the peak daily traffic volume. Therefore, to provide further information for the identified peak day, Friday results were assessed using available data and assumptions outlined in Section 4.4.3. As OD and intersection counts were not completed on the Friday, results were not able to be produced at all locations such as at Beaufort-Lexton Road and Western Highway between King St and Beaufort-Lexton Road. Results for the 7-day average has also been produced with a similar methodology as potential inputs for other discipline assessments.

The no project scenario volumes (light vehicle (LV), heavy vehicle (HV) and total traffic volumes) are outlined below in Table 9.1 to Table 9.3.

Table 9.1 Thursday 24-hour traffic volumes – no project

SITE LOCATION	SEGMENT LOCATION	DIRECTION	2017 THURSDAY (VEHICLES)			2021 THURSDAY (VEHICLES)			2031 THURSDAY (VEHICLES)		
			LV	HV	Total	LV	HV	Total	LV	HV	Total
Western Highway	West of Martins Lane Entrance (West of Beaufort)	East Bound	2966	1051	4017	3210	1138	4348	3914	1387	5300
		West Bound	2691	1058	3749	2913	1145	4058	3551	1396	4947
Main Lead Road	Near 125 Main Lead Road, next to Beaufort Trotting Training Track	North Bound	328	52	380	355	56	411	433	69	501
		South Bound	329	52	381	356	56	412	434	69	503
Beaufort-Lexton Road	Between Topp Lane and Action lane	East Bound	219	66	285	237	71	308	289	87	376
		West Bound	218	50	268	236	54	290	288	66	354
Western Highway	West of Smiths Lane (East of Beaufort)	East Bound	3132	1141	4273	3390	1235	4625	4133	1506	5638
		West Bound	2758	1320	4078	2985	1429	4414	3639	1742	5381
Skipton Road	Between Stockyard Hill Road and Park Road	North Bound	765	133	898	828	144	972	1009	175	1185
		South Bound	801	139	940	867	150	1017	1057	183	1240
Back Raglan Road	North of Martins Lane and Back Raglan Road intersection	North Bound	20	9	29	22	10	31	26	12	38
		South Bound	22	7	29	24	8	31	29	9	38
Racecourse Road	Adjacent Yam Holes Creek	East Bound	49	14	63	53	15	68	65	18	83
		West Bound	48	3	51	52	3	55	63	4	67
Western Highway*	Between King St & Beaufort-Lexton Road	East Bound	5132	869	6000	5555	940	6495	6771	1146	7917
		West Bound	4050	1061	5110	4383	1148	5532	5343	1400	6743

*Volumes have been factored as detailed in Section 6.1.2.1

It is notable that by 2031 in the "no-project" case, traffic volumes on the Western Highway between King Street and Beaufort-Lexton Road are forecast to be over 14,000 vehicles per day (vpd) with over 2,500 heavy vpd for a Thursday in 2031. At this volume the centre of town is likely to be experiencing congestion leading to safety issues, and accessibility issues.

All other roads in the study area have forecast daily volumes of less than 2,000 vpd and would be below the usual amenity thresholds for local streets.

Table 9.2 Friday 24-hour traffic volumes – no project

SITE LOCATION	SEGMENT LOCATION	DIRECTION	2017 FRIDAY (VEHICLES)			2021 FRIDAY (VEHICLES)			2031 FRIDAY (VEHICLES)		
			LV	HV	Total	LV	HV	Total	LV	HV	Total
Western Highway	West of Martins Lane Entrance (West of Beaufort)	East Bound	3497	1035	4532	3785	1120	4906	4614	1366	5980
		West Bound	3634	941	4575	3934	1019	4952	4795	1242	6037
Main Lead Road	Near 125 Main Lead Road, next to Beaufort Trotting Training Track	North Bound	411	63	474	445	68	513	542	83	625
		South Bound	376	66	442	407	71	478	496	87	583
Beaufort-Lexton Road	Between Topp Lane and Action lane	East Bound	284	67	351	307	73	380	375	88	463
		West Bound	267	60	327	289	65	354	352	79	431
Western Highway	West of Smiths Lane (East of Beaufort)	East Bound	3848	1090	4938	4165	1180	5345	5077	1438	6516
		West Bound	3523	1154	4677	3813	1249	5063	4649	1523	6171
Skipton Road	Between Stockyard Hill Road and Park Road	North Bound	784	162	946	849	175	1024	1034	214	1248
		South Bound	804	149	953	870	161	1032	1061	197	1257
Back Raglan Road	North of Martins Lane and Back Raglan Road intersection	North Bound	19	11	30	21	12	32	25	15	40
		South Bound	22	6	28	24	6	30	29	8	37
Racecourse Road	Adjacent Yam Holes Creek	East Bound	61	4	65	66	4	70	80	5	86
		West Bound	59	5	64	64	5	69	78	7	84
Western Highway*	Between King St & Beaufort-Lexton Road	East Bound	6335	641	6977	6858	694	7552	8359	846	9206
		West Bound	4828	802	5630	5226	868	6094	6370	1059	7429

*Volumes have been factored as detailed in Section 6.1.2.1

Table 9.3 7 day average 24-hour traffic volumes – no project

SITE LOCATION	SEGMENT LOCATION	DIRECTION	2017 7 DAY AVG (VEHICLES)			2021 7 DAY AVG (VEHICLES)			2031 7 DAY AVG (VEHICLES)		
			LV	HV	Total	LV	HV	Total	LV	HV	Total
Western Highway	West of Martins Lane Entrance (West of Beaufort)	East Bound	2903	871	3774	3142	943	4085	3830	1149	4979
		West Bound	2826	839	3665	3059	908	3967	3728	1107	4836
Main Lead Road	Near 125 Main Lead Road, next to Beaufort Trotting Training Track	North Bound	347	44	392	376	48	424	458	59	517
		South Bound	348	48	396	376	52	428	459	64	522
Beaufort-Lexton Road	Between Topp Lane and Action lane	East Bound	224	51	275	243	55	298	296	67	363
		West Bound	221	45	266	239	49	288	292	59	351
Western Highway	West of Smiths Lane (East of Beaufort)	East Bound	3375	841	4216	3653	910	4564	4454	1110	5563
		West Bound	3075	870	3945	3328	941	4270	4057	1148	5205
Skipton Road	Between Stockyard Hill Road and Park Road	North Bound	717	106	823	776	115	891	946	140	1086
		South Bound	720	120	839	779	130	909	950	158	1108
Back Raglan Road	North of Martins Lane and Back Raglan Road intersection	North Bound	18	7	25	19	8	27	24	9	33
		South Bound	20	5	24	21	5	26	26	6	32
Racecourse Road	Adjacent Yam Holes Creek	East Bound	52	5	56	56	5	61	68	6	74
		West Bound	54	5	59	58	5	64	71	6	77
Western Highway*	Between King St & Beaufort-Lexton Road	East Bound	5077	515	5592	5495	557	6053	6699	679	7378
		West Bound	4070	718	4788	4406	777	5183	5371	948	6318

*Volumes have been factored as detailed in Section 6.1.2.1

The project scenario volumes are shown below in Table 9.4 to Table 9.6.

Table 9.4 Thursday 24-hour traffic volumes – project

SITE LOCATION	SEGMENT LOCATION	DIRECTION	2017 THURSDAY (VEHICLES)			2021 THURSDAY (VEHICLES)			2031 THURSDAY (VEHICLES)		
			LV	HV	Total	LV	HV	Total	LV	HV	Total
Western Highway	West of Martins Lane Entrance (West of Beaufort)	East Bound	902	320	1222	977	346	1323	1190	422	1612
		West Bound	1001	253	1254	1083	274	1358	1321	334	1655
Main Lead Road	Near 125 Main Lead Road, next to Beaufort Trotting Training Track	North Bound	328	52	380	355	56	411	433	69	501
		South Bound	329	52	381	356	56	412	434	69	503
Beaufort-Lexton Road#	Between Topp Lane and Action lane	East Bound	188	54	242	203	59	262	248	72	319
		West Bound	191	44	234	206	47	254	252	58	309
Western Highway	West of Smiths Lane (East of Beaufort)	East Bound	1083	416	1499	1172	450	1622	1428	549	1978
		West Bound	1079	516	1595	1168	559	1726	1423	681	2104
Skipton Road	Between Stockyard Hill Road and Park Road	North Bound	765	133	898	828	144	972	1009	175	1185
		South Bound	801	139	940	867	150	1017	1057	183	1240
Back Raglan Road	North of Martins Lane and Back Raglan Road intersection	North Bound	20	9	29	22	10	31	26	12	38
		South Bound	22	7	29	24	8	31	29	9	38
Racecourse Road	Adjacent Yam Holes Creek	East Bound	49	14	63	53	15	68	65	18	83
		West Bound	48	3	51	52	3	55	63	4	67
Western Highway*#	Between King St & Beaufort-Lexton Road	East Bound	3068	137	3205	3321	149	3470	4048	181	4229
		West Bound	2359	256	2616	2554	277	2831	3113	338	3451
Beaufort Bypass	West of Beaufort-Lexton Road Interchange	East Bound	2064	731	2795	2234	792	3026	2723	965	3688
		West Bound	1690	805	2495	1829	871	2700	2230	1062	3292
Beaufort Bypass	East of Beaufort-Lexton Road Interchange	East Bound	2049	725	2774	2218	785	3003	2704	956	3661
		West Bound	3779	990	4769	4091	1072	5162	4986	1306	6293

*Volumes have been factored as detailed in Section 6.1.2.1

#These locations only reported for the Thursday model

In the 'project' scenario, the daily traffic volumes on the Western Highway within Beaufort could be expected to fall to approximately 7,500 vpd with heavy vehicle volumes reducing to approximately 500 vpd in 2031. This represents almost half the daily traffic volumes and approximately one-fifth of the daily heavy vehicle volumes when compared to the 'no project' case (Table 9.1), leading to significant improvements in congestion, safety and amenity in the town area.

BEAUFORT-LEXTON ROAD

The forecast volumes for Beaufort-Lexton Road are considered low given its future function as a direct connection to the new interchange. Low forecast volumes are likely due to the spreadsheet model under-reporting these volumes due to very low existing volumes in comparison with the mainline flows on the highway. With the introduction of a new interchange, it is likely that these volumes would increase. There is also a possibility that traffic from Back Raglan Road and Main Lead Road could transfer to Beaufort-Lexton Road to access the bypass rather than continuing along Havelock Street and Neill Street. There is not sufficient data to accurately predict this possibility. It is noted that total forecast traffic for 2031 on Main Lead Road, Back Raglan Road and Beaufort-Lexton Road, is less than 2,000 vpd which is well within the carrying capacity of a two-lane road.

The shift of traffic onto Beaufort-Lexton Road could lead to increases in traffic on Albert Street or Willoby Street. Additionally, there may be an impact to amenity on Beaufort-Lexton Road due to the increase in traffic.

Table 9.5 Friday 24-hours traffic volume – project

SITE LOCATION	SEGMENT LOCATION	DIRECTION	2017 FRIDAY (VEHICLES)			2021 FRIDAY (VEHICLES)			2031 FRIDAY (VEHICLES)		
			LV	HV	Total	LV	HV	Total	LV	HV	Total
Western Highway	West of Martins Lane Entrance (West of Beaufort)	East Bound	1064	315	1379	1151	341	1492	1404	415	1819
		West Bound	1476	236	1712	1598	256	1853	1948	312	2259
Main Lead Road	Near 125 Main Lead Road, next to Beaufort Trotting Training Track	North Bound	411	63	474	445	68	513	542	83	625
		South Bound	376	66	442	407	71	478	496	87	583
Western Highway	West of Smiths Lane (East of Beaufort)	East Bound	1431	376	1807	1549	407	1956	1889	496	2384
		West Bound	1378	451	1829	1491	489	1980	1818	596	2414
Skipton Road	Between Stockyard Hill Road and Park Road	North Bound	784	162	946	849	175	1024	1034	214	1248
		South Bound	804	149	953	870	161	1032	1061	197	1257
Back Raglan Road	North of Martins Lane and Back Raglan Road intersection	North Bound	19	11	30	21	12	32	25	15	40
		South Bound	22	6	28	24	6	30	29	8	37
Racecourse Road	Adjacent Yam Holes Creek	East Bound	61	4	65	66	4	70	80	5	86
		West Bound	59	5	64	64	5	69	78	7	84
Beaufort Bypass	West of Beaufort-Lexton Road Interchange	East Bound	2433	720	3153	2634	780	3413	3211	950	4161
		West Bound	2158	705	2863	2336	763	3099	2847	930	3777
Beaufort Bypass	East of Beaufort-Lexton Road Interchange	East Bound	2417	714	3131	2616	773	3389	3189	943	4131
		West Bound	2145	703	2848	2322	761	3083	2831	927	3758

Table 9.6 7 day average 24-hours traffic volume – project

SITE LOCATION	SEGMENT LOCATION	DIRECTION	2017 7 DAY AVG (VEHICLES)			2021 7 DAY AVG (VEHICLES)			2031 7 DAY AVG (VEHICLES)		
			LV	HV	Total	LV	HV	Total	LV	HV	Total
Western Highway	West of Martins Lane Entrance (West of Beaufort)	East Bound	883	265	1148	956	287	1243	1165	350	1515
		West Bound	943	308	1251	1021	333	1354	1245	406	1651
Main Lead Road	Near 125 Main Lead Road, next to Beaufort Trotting Training Track	North Bound	347	44	392	376	48	424	458	59	517
		South Bound	348	48	396	376	52	428	459	64	522
Western Highway	West of Smiths Lane (East of Beaufort)	East Bound	1369	240	1609	1482	260	1742	1807	317	2123
		West Bound	1203	340	1543	1302	368	1670	1587	449	2036
Skipton Road	Between Stockyard Hill Road and Park Road	North Bound	717	106	823	776	115	891	946	140	1086
		South Bound	720	120	839	779	130	909	950	158	1108
Back Raglan Road	North of Martins Lane and Back Raglan Road intersection	North Bound	18	7	25	19	8	27	24	9	33
		South Bound	20	5	24	21	5	26	26	6	32
Racecourse Road	Adjacent Yam Holes Creek	East Bound	52	5	56	56	5	61	68	6	74
		West Bound	54	5	59	58	5	64	71	6	77
Beaufort Bypass	West of Beaufort-Lexton Road Interchange	East Bound	2020	606	2626	2186	656	2842	2665	800	3465
		West Bound	1882	531	2414	2038	575	2613	2484	701	3185
Beaufort Bypass	East of Beaufort-Lexton Road Interchange	East Bound	2006	601	2607	2171	650	2822	2647	793	3440
		West Bound	1872	530	2402	2027	573	2600	2470	699	3169

9.1.1.2 PEAK HOUR VOLUMES

As intersection and OD surveys were only completed on Thursday, only Thursday peak hour volumes could be developed. For the AM peak, the identified network peak hour times were 8:30 am to 9:30 am.

The 2021 AM peak intersection turn volumes – no project are shown below in Figure 9.1.

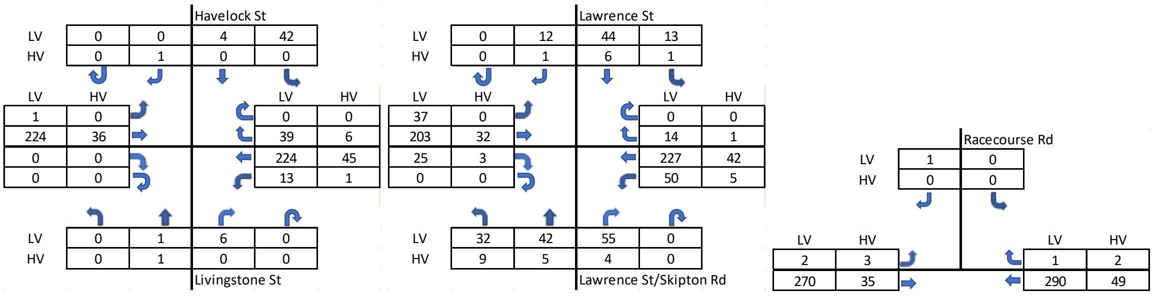


Figure 9.1 2021 AM peak intersection turn volumes – no project

The 2021 AM peak intersection turn volumes – project are shown below in Figure 9.2.

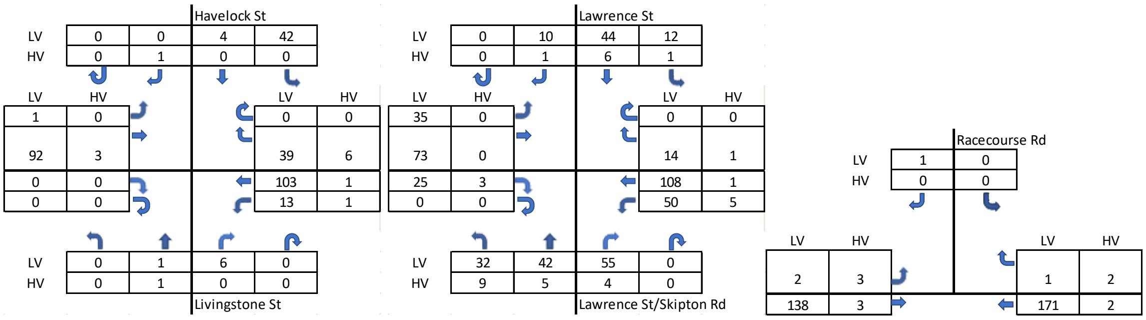


Figure 9.2 2021 AM peak intersection turn volumes – project

The 2031 AM peak intersection turn volumes – no project are shown below in Figure 9.3.

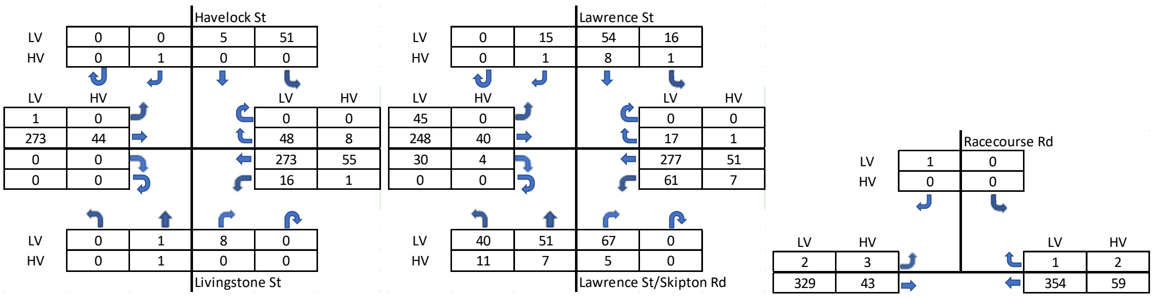


Figure 9.3 2031 AM peak intersection turn volumes – no project

The 2031 AM peak intersection turn volumes – project are shown below in Figure 9.4.

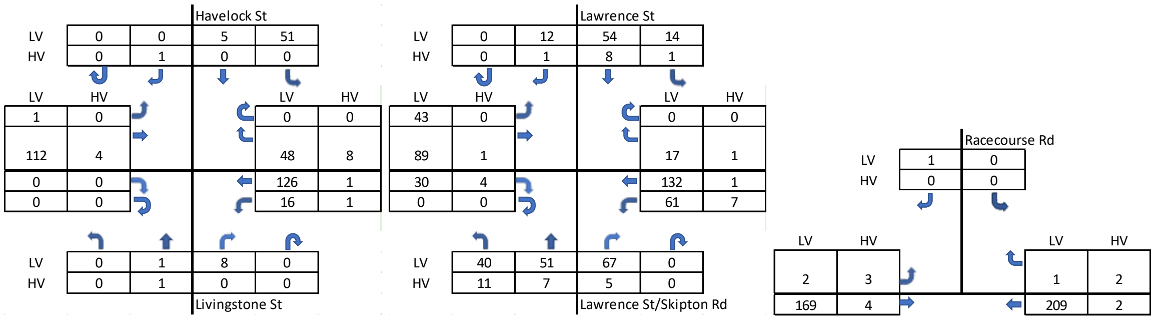


Figure 9.4 2031 AM peak intersection turn volumes – project

For the PM peak, the identified network peak hour times were 4:30 pm to 5:30 pm.

The 2021 PM peak intersection turn volumes – no project are shown below in Figure 9.5.

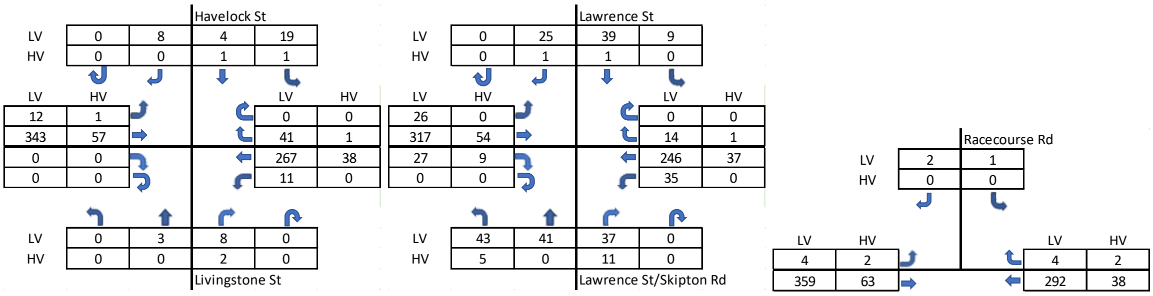


Figure 9.5 2021 PM peak intersection turn volumes – no project

The 2021 PM peak intersection turn volumes – project are shown below in Figure 9.6.

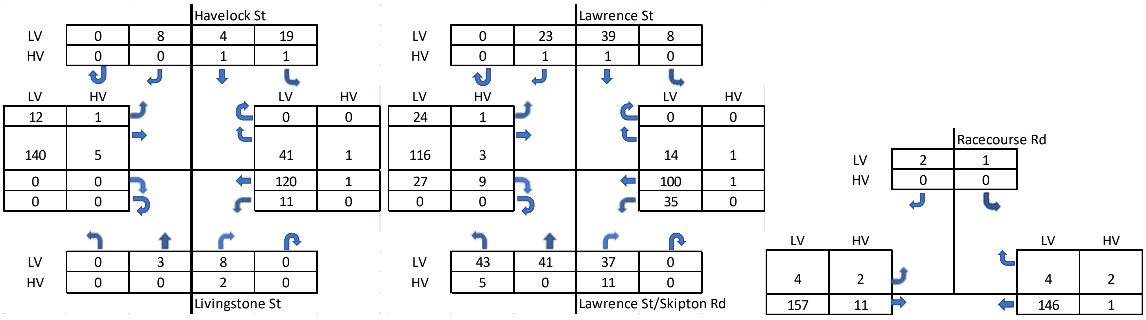


Figure 9.6 2021 PM peak intersection turn volumes – project

The 2031 PM peak intersection turn volumes – no project are shown below in Figure 9.7.

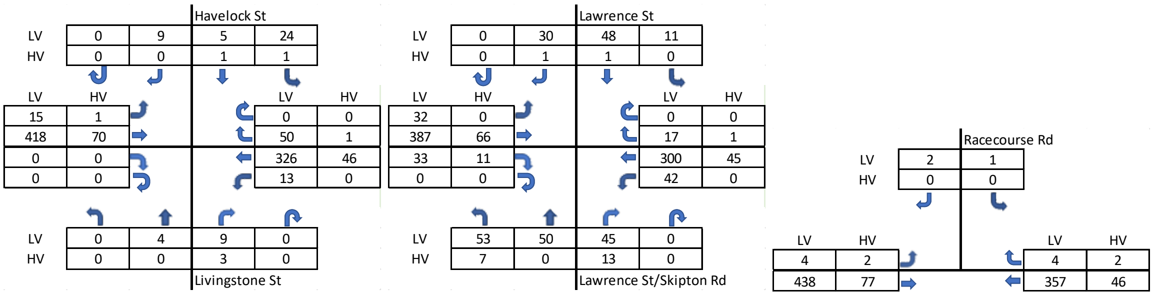


Figure 9.7 2031 PM peak intersection turn volumes – no project

The 2031 PM peak intersection turn volume – project are shown below in Figure 9.8.

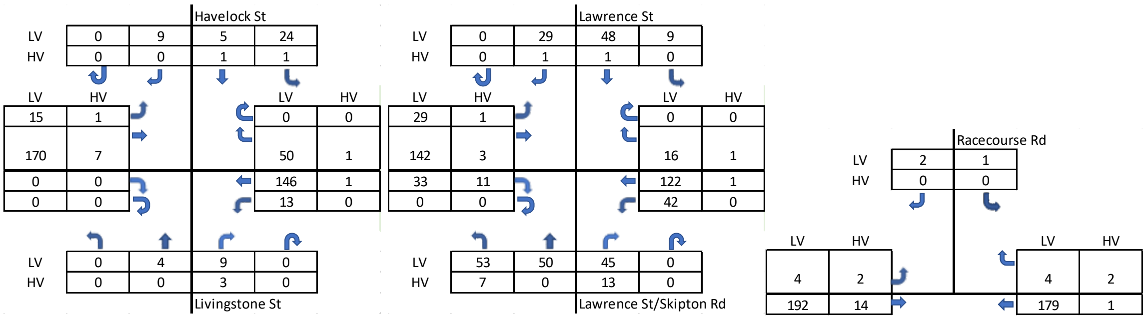


Figure 9.8 2031 PM peak intersection turn volumes – project

9.1.2 SIDRA MODEL

SIDRA modelling was completed for the AM and PM peak hours based on the developed peak hour volumes. Google Maps satellite imagery was used to determine the lane arrangement/lengths and the most recent traffic signal operation sheet (dated 10/03/06) used to develop the signal phasing. Detailed results are provided in Appendix C.

9.1.2.1 INTERSECTION PERFORMANCE MEASURES

The definitions for the key outputs from the SIDRA modelling are provided below, where they are used to evaluate intersection performance.

- Degree of Saturation (DoS): the ratio of demand to capacity for a turning movement with the overall intersection DoS defined as the largest of the degrees of saturation for individual turning movements at the intersection. Where the intersection DoS is less than 1, the intersection is said to be under-saturated and where the intersection DoS is equal to 1, the intersection is saturated or operating at capacity. When the intersection DoS exceeds 1 (often taken as 0.9 for a signalised site and 0.85 for a sign-controlled site in practice), the intersection is described as oversaturated and both queue length and delays would be expected to increase rapidly as additional demand occurs.
- Level of Service (LoS): a measure of the average delay per vehicle completing movements at the intersection and can be calculated for a movement, an approach or for all vehicles. A LoS A to F is assigned based on the criteria shown below in Table 9.7.
- 95th percentile queues: the queue length (in vehicles or metres) expected to be exceeded 5% of the time for a particular intersection configuration and traffic demands. The 95th percentile queue is often interpreted as the maximum queue and used in determining the required turn lane lengths and other design characteristics.

Table 9.7 Level of Service criteria (Source: SIDRA Intersection)

LEVEL OF SERVICE (LOS)	SIGNALISED INTERSECTION AVERAGE DELAY PER VEHICLE (SECONDS) CRITERIA	SIGN CONTROLLED INTERSECTION AVERAGE DELAY PER VEHICLE (SECONDS) CRITERIA
A	delay < or = 10	delay < or = 10
B	10 < delay <= 20	10 < delay <= 15
C	20 < delay <= 35	15 < delay <= 25
D	35< delay <= 55	25< delay <= 35
E	55< delay <= 80	35< delay <= 50
F	80 < delay	50 < delay

9.1.2.2 TRAFFIC PERFORMANCE TARGETS

The intersection traffic performance targets used for this assessment include:

- a degree of saturation (DoS) less than the practical DoS of 0.9 for a signalised site or less than 0.85 for a sign controlled site
- an overall intersection level of service (LoS) D or better
- 95th percentile queue lengths that are generally contained within the proposed turn lanes.

9.1.2.3 MODEL COVERAGE

A traffic assessment was undertaken for the following intersections along Western Highway – Havelock Street/ Livingstone Street, Lawrence Street and Racecourse Road. Table 9.8 below summarises the key intersections and their traffic controls assessed.

Table 9.8 Intersection traffic controls

WESTERN HIGHWAY, INTERSECTION WITH	TRAFFIC CONTROL
Havelock Street/Livingstone Street	Give Way
Lawrence Street (Beaufort-Lexton Road)	Signals
Racecourse Road	Give Way

9.1.2.4 HAVELOCK STREET/LIVINGSTONE STREET

The intersection layout for the intersection in SIDRA is shown below in Figure 9.9.

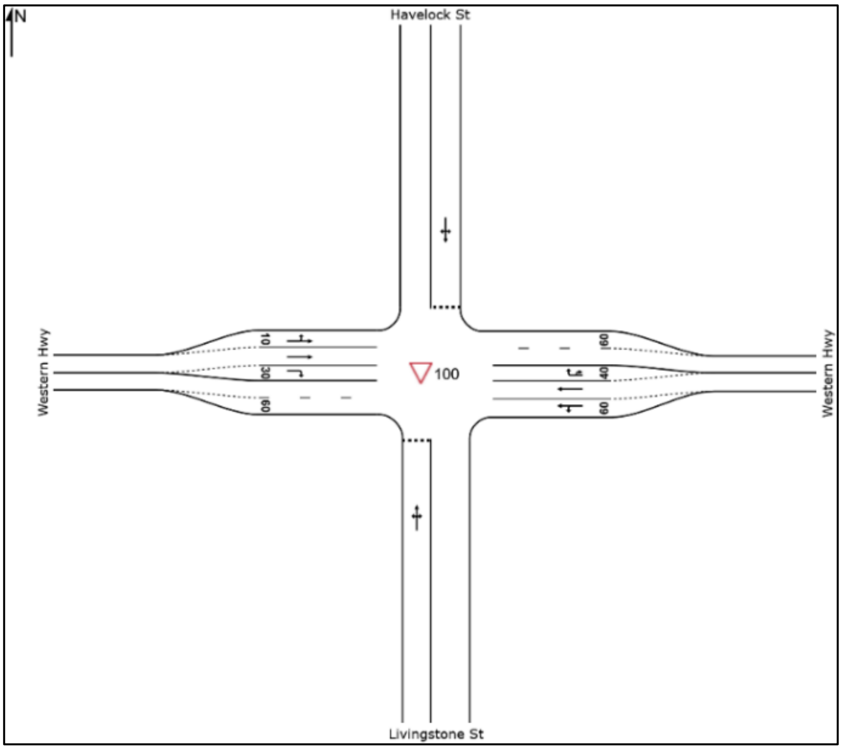


Figure 9.9 Intersection layout for Western Highway, Havelock Street and Livingstone Street

2021 SIDRA RESULTS

Table 9.9 and Table 9.10 summarise the intersection performance during the 2021 AM and PM peaks respectively.

Table 9.9 Havelock Street/Livingstone Street intersection analysis – 2021 AM peak

APPROACH	DEMAND (VPH)		DOS		DELAY (S)		LOS		95% QUEUE (M)	
	No project	Project	No project	Project	No project	Project	No project	Project	No project	Project
South	9	9	0.037	0.018	16.1	7.8	C	A	0.9	0.5
East	328	163	0.133	0.051	1.0	1.8	–	–	1.4	1.1
North	47	47	0.057	0.043	6.3	5.0	A	A	1.4	1.1
West	262	97	0.106	0.036	1.2	1.3	–	–	0.0	0.0
Intersection	**646**	**316**	**0.133**	**0.051**	**1.7**	**2.3**	**–**	**–**	**1.4**	**1.1**

Table 9.10 Havelock Street/Livingstone Street intersection analysis – 2021 PM peak

APPROACH	DEMAND (VPH)		DOS		DELAY (S)		LOS		95% QUEUE (M)	
	No project	Project	No project	Project	No project	Project	No project	Project	No project	Project
South	14	14	0.089	0.033	25.1	9.1	D	A	2.1	0.9
East	358	174	0.144	0.056	0.9	1.5	–	–	1.3	1.0
North	33	33	0.090	0.044	12.1	6.2	B	A	2.1	1.1
West	414	159	0.168	0.061	1.4	1.6	–	–	0.0	0.0
Intersection	**819**	**380**	**0.168**	**0.061**	**2.0**	**2.2**	–	–	**2.1**	**1.1**

2031 SIDRA RESULTS

Table 9.11 and Table 9.12 summarise the intersection performance during the 2031 AM and PM peaks respectively.

Table 9.11 Havelock Street/Livingstone Street intersection analysis – 2031 AM peak

APPROACH	DEMAND (VPH)		DOS		DELAY (S)		LOS		95% QUEUE (M)	
	No project	Project	No project	Project	No project	Project	No project	Project	No project	Project
South	11	11	0.062	0.025	22.1	8.9	B	A	1.4	0.6
East	401	200	0.162	0.062	1.1	1.8	–	–	1.8	1.5
North	57	57	0.078	0.053	7.0	5.1	A	A	1.9	1.4
West	319	118	0.129	0.045	1.2	1.2	–	–	0	0.0
Intersection	**788**	**386**	**0.162**	**0.062**	**1.9**	**2.3**	–	–	**1.9**	**1.5**

Table 9.12 Havelock Street/Livingstone Street intersection analysis – 2031 PM peak

APPROACH	DEMAND (VPH)		DOS		DELAY (S)		LOS		95% QUEUE (M)	
	No Project	Project	No Project	Project	No Project	Project	No Project	Project	No Project	Project
South	17	17	0.180	0.047	42.0	10.9	E	B	4.3	1.3
East	436	211	0.176	0.068	1.0	1.6	–	–	1.7	1.2
North	40	40	0.146	0.056	15.8	6.6	C	A	3.3	1.4
West	505	194	0.205	0.074	1.4	1.6	–	–	0.0	0.0
Intersection	**998**	**462**	**0.205**	**0.074**	**2.5**	**2.3**	–	–	**4.3**	**1.4**

The intersection performance results are generally acceptable with low Degree of Saturation (less than 0.85 for non-signalised intersections as defined in targets detailed in Section 9.1.2.2), good level of service (Level of service (LoS) of D or better as defined in targets detailed in Section 9.1.2.2), low delays (less than 35 seconds) and insignificant queuing (queuing length less than 5 metres) in both the no project and project case. The exception is the southern approach in the no project case which reaches an unacceptable delay of 42 seconds by 2031 during the PM peak. A delay of more than 35 seconds (LoS E) at an unsignalised intersection is considered likely to lead to unsafe manoeuvres as drivers take higher risks to enter or cross the major traffic stream. As can be seen in Table 9.12 above, the introduction of the bypass will have a significantly positive impact on this issue, reducing the delay to 10.9 seconds during the PM peak. If the bypass is not implemented before 2031, it is likely that signalisation of this intersection could be required.

PEDESTRIAN RESULTS

There was no change in pedestrian delays and level of service between the no project and project scenarios for both 2021 and 2031 with average pedestrian delay at 9.6 seconds and a LoS A. However, the project scenario shows significantly reduced traffic through east-west vehicles volumes, particularly heavy vehicle volumes. This reduction in traffic will assist with the implementation of local improvements for pedestrians and cyclists as planned by the Pyrenees Shire as outlined in the Beaufort Walkability Plan, outlined in Section 6.1.9.

9.1.2.5 LAWRENCE STREET

The intersection layout for the intersection in SIDRA is shown below in Figure 9.10.

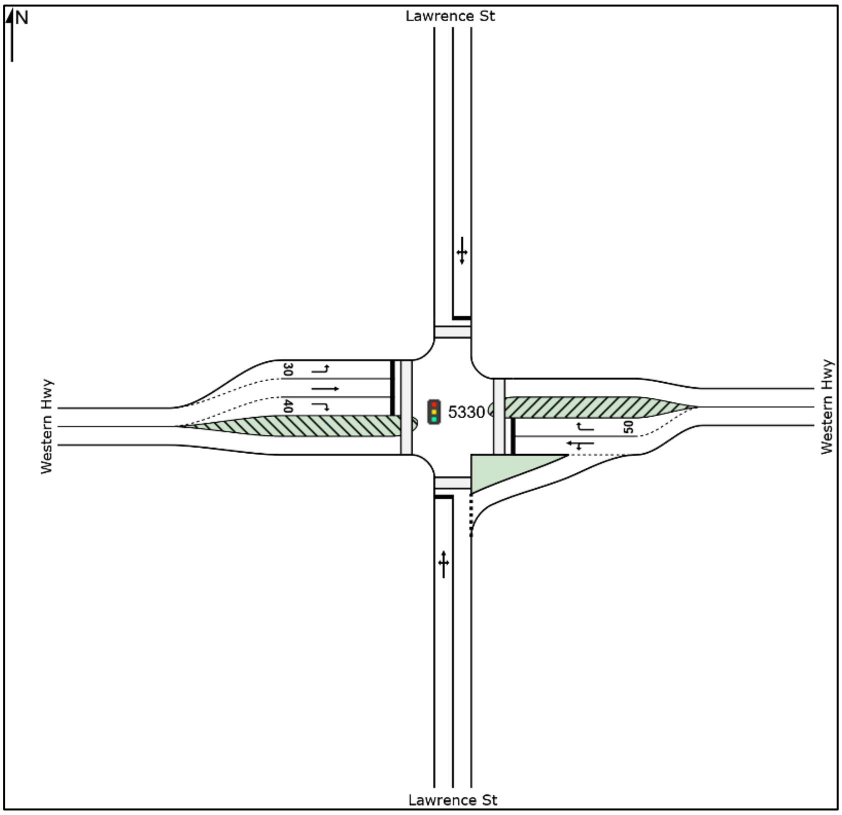


Figure 9.10 Intersection layout for Western Highway and Lawrence Street

2021 SIDRA RESULTS

Table 9.13 and Table 9.14 summarise the intersection performance during the 2021 AM and PM peaks respectively.

Table 9.13 Lawrence St/Western Highway intersection analysis – 2021 AM peak

APPROACH	DEMAND (VPH)		DOS		DELAY (S)		LOS		95% QUEUE (M)	
	No project	Project	No project	Project	No project	Project	No project	Project	No project	Project
South	147	147	0.481	0.321	15.9	12.6	B	B	16.4	13.9
East	339	179	0.467	0.262	6.0	6.2	A	A	20.5	8.2
North	77	74	0.232	0.147	13.5	10.3	B	B	7.9	6.4
West	300	136	0.358	0.140	8.8	11.6	A	B	20.8	6.0
Intersection	**863**	**536**	**0.481**	**0.321**	**9.3**	**9.9**	**A**	**A**	**20.8**	**13.9**

Table 9.14 Lawrence St/Western Highway intersection analysis – 2021 PM peak

APPROACH	DEMAND (VPH)		DOS		DELAY (S)		LOS		95% QUEUE (M)	
	No project	Project	No project	Project	No project	Project	No project	Project	No project	Project
South	137	137	0.432	0.289	15.8	12.6	B	B	15.0	12.7
East	333	151	0.467	0.229	7.2	6.5	A	A	23.4	7.1
North	75	72	0.226	0.144	14.0	10.8	B	B	7.2	5.9
West	433	179	0.568	0.233	9.3	11.3	A	B	36.5	10.4
Intersection	**978**	**539**	**0.568**	**0.289**	**9.8**	**10.2**	**A**	**B**	**36.5**	**12.7**

2031 SIDRA RESULTS

Table 9.15 and Table 9.16 summarise the intersection performance during the 2031 AM and PM peaks respectively.

Table 9.15 Lawrence St/Western Highway intersection analysis – 2031 AM peak

APPROACH	DEMAND (VPH)		DOS		DELAY (S)		LOS		95% QUEUE (M)	
	No project	Project	No project	Project	No project	Project	No project	Project	No project	Project
South	181	181	0.614	0.425	17.0	13.1	B	B	21.7	18.0
East	414	219	0.569	0.319	6.8	6.4	A	A	28.6	10.4
North	95	90	0.301	0.184	13.7	10.4	B	B	10.0	8.0
West	367	167	0.439	0.174	9.2	12.1	A	B	26.5	7.6
Intersection	**1057**	**657**	**0.614**	**0.425**	**10.0**	**10.2**	**B**	**B**	**28.6**	**18.0**

Table 9.16 Lawrence St/Western Highway intersection analysis – 2031 PM peak

APPROACH	DEMAND (VPH)		DOS		DELAY (S)		LOS		95% QUEUE (M)	
	No project	Project	No project	Project	No project	Project	No project	Project	No project	Project
South	168	168	0.589	0.381	16.9	13.0	B	B	19.8	16.3
East	405	182	0.568	0.283	8.0	6.5	A	A	31.4	8.7
North	91	88	0.289	0.182	14.2	11.0	B	B	8.9	7.3
West	529	219	0.694	0.283	10.9	11.8	B	B	50.9	12.8
Intersection	**1193**	**657**	**0.694**	**0.381**	**11.0**	**10.5**	**B**	**B**	**50.9**	**16.3**

The SIDRA results show good capacity, low delays, good level of service and reasonable queue lengths in each scenario, however, there is a clear improvement in all results for the "project" case due to the reduced main line volumes. As noted above, the spreadsheet model is underreporting forecast volumes on Lawrence Street for the project case. The DoS of less than 0.5 and LoS B indicates that this intersection has capacity to cater for considerably higher volumes of traffic.

9.1.2.6 RACECOURSE ROAD

The intersection layout for the intersection in SIDRA is shown below in Figure 9.11.

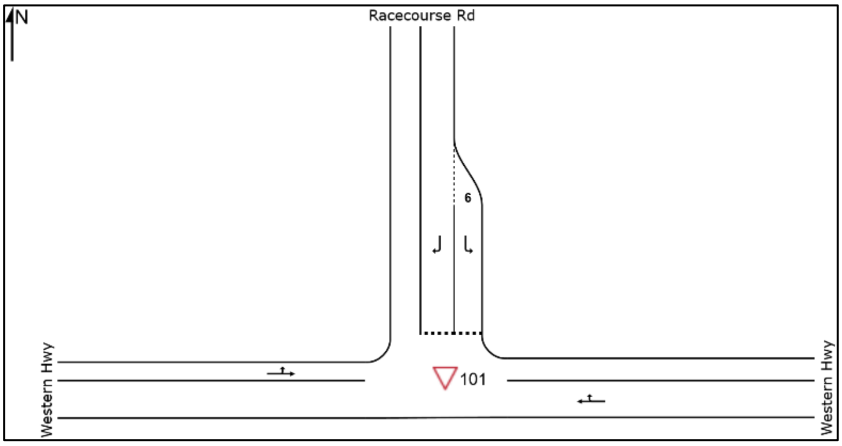


Figure 9.11 Intersection layout for Western Highway and Racecourse Road

2021 SIDRA RESULTS

Table 9.17 and Table 9.18 summarise the intersection performance during the 2021 AM and PM peaks respectively.

Table 9.17 Racecourse Rd/Western Highway intersection analysis – 2021 AM peak

APPROACH	DEMAND (VPH)		DOS		DELAY (S)		LOS		95% QUEUE (M)	
	No project	Project	No project	Project	No project	Project	No project	Project	No project	Project
East	342	176	0.179	0.086	0.1	0.1	–	–	0.4	0.2
North	2	2	0.002	0.001	6.6	5.3	A	A	0.0	0.0
West	310	324	0.172	0.077	0.1	0.2	–	–	0.0	0.2
Intersection	**654**	**324**	**0.179**	**0.086**	**0.1**	**0.2**	–	–	**0.4**	**0.2**

Table 9.18 Racecourse Rd/Western Highway intersection analysis – 2021 PM peak

APPROACH	DEMAND (VPH)		DOS		DELAY (S)		LOS		95% QUEUE (M)	
	No project	Project	No project	Project	No project	Project	No project	Project	No project	Project
East	336	153	0.174	0.075	0.3	0.3	–	–	0.7	0.4
North	3	3	0.004	0.002	7.8	5.5	A	A	0.1	0.0
West	428	174	0.241	0.094	0.1	0.2	–	–	0.0	0.0
Intersection	**767**	**330**	**0.241**	**0.094**	**0.2**	**0.3**	–	–	**0.7**	**0.4**

2031 SIDRA RESULTS

Table 9.19 and Table 9.20 summarise the intersection performance during the 2031 AM and PM peaks respectively.

Table 9.19 Racecourse Rd/Western Highway intersection analysis – 2031 AM peak

APPROACH	DEMAND (VPH)		DOS		DELAY (S)		LOS		95% QUEUE (M)	
	No project	Project	No project	Project	No project	Project	No project	Project	No project	Project
East	416	214	0.217	0.104	0.1	0.1	–	–	0.5	0.3
North	2	2	0.002	0.001	7.3	5.5	A	A	0.0	0.0
West	377	177	0.209	0.093	0.1	0.2	–	–	0.0	0.0
Intersection	**795**	**393**	**0.217**	**0.104**	**0.1**	**0.2**	–	–	**0.5**	**0.3**

Table 9.20 Racecourse Rd/Western Highway intersection analysis – 2031 PM peak

APPROACH	DEMAND (VPH)		DOS		DELAY (S)		LOS		95% QUEUE (M)	
	No project	Project	No project	Project	No project	Project	No project	Project	No project	Project
East	409	186	0.212	0.091	0.3	0.3	–	–	0.9	0.4
North	3	3	0.005	0.002	9.2	5.7	A	A	0.1	0.0
West	521	212	0.294	0.114	0.1	0.2	–	–	0.0	0.0
Intersection	**933**	**401**	**0.294**	**0.114**	**0.2**	**0.3**	–	–	**0.9**	**0.4**

The SIDRA outputs show no performance issues for this intersection in all scenarios. As such, the ‘project’ scenario will generally have a net positive impact on the transport network due to the reduced traffic demand through the town. This is noted particularly at the Havelock Street/Livingstone Street intersection.

9.1.3 TRAVEL TIME CALCULATIONS

9.1.3.1 TRAVEL TIME

A comparison was made between the surveyed current delays and modelled future delays for the through movements on the Western Highway/Neill Street. Simplistic travel time comparisons were also made between the surveyed travel times and expected travel times on the bypass for through traffic on the Western Highway.

9.1.3.2 DELAY COMPARISON

Three intersections were assessed as part of the modelling. However, only the Lawrence Street signalised intersection would affect through vehicles heading eastbound or westbound on Western Highway/Neill Street, as this is the only intersection where through vehicles would be required to stop. The intersections at Livingstone Street/Havelock Street and Racecourse Road are sign controlled intersections, where the through movement has priority. A comparison between the surveyed delays and modelled delays for eastbound and westbound through traffic on Western Highway/Neill Street at Lawrence Street is made below in Table 9.21.

Note that only a comparison of PM travel times could be completed, as models were only completed for PM peak periods.

Table 9.21 Delay comparison at Western Highway/Neill Street and Lawrence Street

DIRECTION	SESSION	SURVEYED DELAY (S)	SIDRA 2017 (S)	SIDRA 2021 (S)		SIDRA 2031 (S)	
				No project	Project	No project	Project
Noon (Westbound)	12:00-13:00	5	–	–	–	–	–
Noon (Eastbound)	12:00-13:00	7	–	–	–	–	–
PM (Westbound)	14:30-17:30	8	6	6.3	4.4	7.1	4.5
PM (Eastbound)	14:30-17:30	9	8.5	8.7	9.9	10.5	10

The results show that the SIDRA models under represented delays at the intersection compared to the surveyed data. It also showed that generally, the project scenario has lower delays for through traffic. The exception to this is the PM eastbound SIDRA results for 2021 and this would be a function of SIDRA's signal phase time allocation method, where the DoS on all approaches and movements are equalised to ensure the most optimal overall performance of the intersection. With the introduction of the Bypass and the effective functional downgrade of the Western Highway through Beaufort, the signal reallocation of phase time to side road movements (i.e. north-south movements) would be appropriate at this intersection. The impact of this would be positive for particularly local road users, as delays associated with through traffic movements travelling through the site would be reduced.

9.1.4 PUBLIC TRANSPORT

The proposed bypass will not specifically provide public transport improvements with low to negligible impacts expected. However, the reduction of traffic within Beaufort could ensure that access to the rail station for the existing coach services is not subject to congestion. Currently the coaches do not cross any rail level crossings, so if the routes are altered to use the interchange at Beaufort-Lexton Road, there will be an additional impact introduced to these services. This is low impact given the low number of services.

9.1.5 WALKING AND CYCLING

The significant reduction in traffic volumes through Beaufort as shown in Table 9.4 will provide additional capacity to allow the Pyrenees Shire to implement the Beaufort Walkability Plan which is focused on improving accessibility and infrastructure for pedestrians and cyclists in the Beaufort area.

With the potential reduction in traffic through Beaufort there is potential to remodel the signals at the Lawrence Street intersection to provide a more urban, pedestrian friendly layout by removing the left turn slip lane. This would improve conditions for pedestrians and cyclists in the centre of town. The reduction of heavy vehicle traffic as shown in Table 9.4 through the town will also enable a reduction in road cross-section requirements and could facilitate future implementation of medians, narrower lanes, cycle lanes which would provide an enhanced urban environment and better multi-modal outcomes. As such, this would result in positive impacts for active transport modes within Beaufort, particularly through the town centre.

9.2 OPERATIONAL ACCESS IMPACT

9.2.1 NETWORK ACCESS IMPACT

In general, the preferred Option C2 alignment option is not expected to have any permanent negative network access impacts or restrictions at the arterial or freeway level. The operation of the bypass would provide network benefits through a new link, with grade separated overpasses provided at junctions of the bypass with existing routes on the transport network including Main Lead Road, Beaufort-Lexton Road, Racecourse Road, Back Raglan Road and the Melbourne-Ararat rail line.

9.2.2 LOCAL ACCESS IMPACT

The majority of local road accesses will be retained through the design of road overpasses. The project will create permanent changes to access from dwellings to the local road network at the following locations:

- Parcel 3\PS727373 and 9E\PP2605 (66 and 124 Martins Lane, Beaufort) is accessed from Martins Lane. Direct access to Martins Lane from the Western Highway will be redirected to Martin Lane access from the unnamed road adjacent to 4932 Western Highway (United Petroleum service station).
- Parcel 1\TP531530 (4126 Western Highway, Trawalla) will remove the existing dwelling access, however other informal access points to the local road network is currently available.
- Parcel 10~Q\PP2096 (Camp Hill State Forest) contains a fire track that will require realignment to ensure access for fire management vehicles. The listed access changes are permanent but localised in nature. The impacts will not isolate landholders or managers from accessing parcels. The impacts to fire management access would inhibit fire management processes. This permanent change in function, resulting from access impacts is a low impact without mitigation.

9.3 CONSTRUCTION TRAFFIC IMPACTS

A high-level summary of the construction traffic impacts from the project has previously been detailed in Section 7.2, where it was noted that the proposed alignment largely covers greenfield areas, meaning construction works will predominantly remain off existing roads other than where the bypass interchanges are proposed. The key potential construction traffic impact will be the increased usage of the existing road network by construction vehicles, particularly heavy vehicles along haulage routes. Other potential traffic impacts include construction worker trips to and from the site as well as access impacts on the road network to and from the sites for local landowners and road users.

The initial assessment for Option C2 found that additional fill would need to be imported for the project, as noted in Figure 7.1, due to Option C2 having a higher amount of fill compared to cut. As such, the identification of potential pits/quarries where the imported fill would be sourced is one of the key initial steps, as this would dictate haulage routes. The potential haulage routes to the project would likely consist of:

- Western Highway
- Beaufort-Lexton Road
- Main Lead Road
- Skipton Road.

Of particular note is the haulage route of Western Highway, where there may be potential impacts to Beaufort town centre (Neill Street) depending on the location quarry/pit site and the specific site of construction at the time of delivery. As such, these need to be identified and outlined early to ensure that impacts can either be minimised or managed.

Overall, Table 7.4 showed that Option C2 had 1,700,000 m^3 of earthworks material to be transported. This results in Option C2 necessitating 133 construction vehicles per day or 13 construction vehicles per hour of demand on the road network associated with earthwork haulages based on the assessment methodology in Section 7.2.

Modelling detailed in Section 9.1.2 identifies the local road network currently operates within capacity. The addition of 133 construction vehicles per day, plus worker trips, will cause a medium impact to the local road network without mitigation. Construction traffic plans and strategies discussed in Section 10.3 will need to be implemented to ensure the co-ordination, resident notification and safety of construction traffic.

9.4 CONSTRUCTION ACCESS IMPACTS

Temporary access changes will occur at discrete locations during the construction phase. As the siting of construction access is yet to occur, specific locations of temporary local access changes cannot be specified. Construction access points may result in temporary impacts to private property access from private tracks and the public road network, road/lane closures, changes in road environment (including speed or alignment) and implementation of diversions/detours. Impacts to local access will be temporary and localised in nature to areas where construction access and egress is determined. Impacts to access during construction will be medium without mitigation. The detailed design phase will confirm whether any permanent existing access arrangements need to be removed and alternative access arrangements will be negotiated with affected landholders. This may include measures such as the provision of alternate access or the acquisition of a parcel of land where severance causes land to become unviable from the project, during the construction phase. The measures taken should be reviewed on an individual case basis, with allowances made as part of the design process where appropriate.

Impacts to access for private properties is also discussed in the EES Appendix J*: Social impact assessment* (WSP 2021).

10 MITIGATION

The mitigations proposed to manage potential impacts to traffic and transport are summarised into two categories; Transport network impacts and access impacts. The mitigations proposed below apply to both construction and operation phases. The mitigations have then been structured to respond to the outlined impacts from Section 9.

10.1 OPERATIONAL NETWORK PERFORMANCE MITIGATION

Initial impacts identified for network performance are considered to be net positive in terms of the network performance resulting from the bypass, when compared with the no project scenario. The listed mitigations are to reinforce the functional design layout into the detailed design adopting relevant design standards to ensure these net positive impacts are realised. The mitigation measures identified relate to ensuring the design follows the relevant latest standards and guidelines (as per the approving road authority), including but not limited to:

- Austroads Guide to Road Design (AGRD)
- Austroads Guide to Traffic Management (AGTM)
- AS1742 - Manual of uniform traffic control devices
- VicRoads Traffic Engineering Manual (TEM) Volume 1, 2 and 3
- Road Safety Audits/Safe System Assessments.

As part of the design process, it is understood the road design will need to be reviewed and approved by the approving road authority and may undergo additional assessments such as third-party peer reviews to ensure the suitability of the design.

It was further noted from the modelling results that there was a potential shift of traffic onto Beaufort-Lexton Road, which could lead to increases in traffic on Albert Street or Willoby Street. Local traffic management measures may be required to mitigate the impacts of these changes at the intersections with King Street and Beaufort Lexton Road.

10.2 OPERATIONAL ACCESS MITIGATION

Permanent access changes to the local road network will occur at two locations based on the functional design. Alternative access is already available at one of these locations (Parcel 3\PS727373 (66 Martins Lane, Beaufort)). A vehicle turnaround has been incorporated into the design for vehicles that can no longer proceed to the Western Highway via Martins Lane. Access to the Western Highway from Martins Lane can still occur through the existing unnamed road adjacent to 4932 Western Highway (United Petroleum service station).

For the impact to parcel 1\TP531530 (4126 Western Highway, Trawalla) and the fire track within the Camp Hill State Forest, new access tracks will be required to maintain dwelling access and connectivity for fire management activities. The new fire track has been incorporated into the functional design and has been considered in the assessment of related vegetation impacts within EES Appendix C: *Flora and fauna impact assessment (WSP 2021)*. The mitigation measures identified relate to ensuring that the relevant standards are applied and appropriate process are followed with the approving road authority. An appropriate community consultation or advertisement of works is also required. Measures include:

- ensuring alternative access is provided during detailed design, construction and operational phases, where removal of existing access results from the project, through an access management strategy
- ensuring there is a thorough community consultation process and/or public advertisement of works
- ensure that a traffic management strategy is implemented which follows relevant standards and guidelines, including but not limited to:
  - AS1742.3 – Manual of uniform traffic control devices
  - TEM Vol 2 Part 2.03 – Traffic control devices for works on roads
- preparation of TMPs and appropriate sign off by authority.

10.3 CONSTRUCTION TRAFFIC MITIGATIONS

An overall traffic management strategy with detailed traffic management plans and traffic guidance schemes need to be developed to manage potential disruptions post the approval of the EES for the project. This is particularly important as detailed information regarding the construction staging and methodology was not available at the time of this report. The development of the strategy and plans need to be conducted with the appropriate amount of stakeholder and community in line with the strategy objectives outlined in Section 7.2. This is particularly critical when temporary local or network access changes need to be implemented, where alternative detour routes or access to properties need to be identified and provided as part of any traffic management plans.

During the detailed design phase a detailed construction traffic management strategy should be developed that is guided by the following standards and key objectives, to the satisfaction of the approving road authority. Measures include:

- ensuring there is a thorough community consultation process and/or public advertisement of works
- ensure that a traffic management strategy is implemented which follows relevant standards and guidelines, including but not limited to:
  - AS1742.3 – Manual of uniform traffic control devices, Part 3: Traffic control for works on roads
  - TEM Vol 2 Part 2.03 – Traffic control devices for works on roads
- preparation of traffic management plans (TMPs) and appropriate sign off by the responsible authority.

10.4 CONSTRUCTION ACCESS MITIGATION

During the detailed design phase and confirmation of site egress and access, existing access arrangements will likely need to be removed or altered at discrete locations. Mitigations to manage these localised impacts will involve consultation and negotiation for the provision of suitable alternative access arrangements with affected landholders. This will include measures such as the provision of alternate access or the acquisition or lease of land by negotiation for parcels where severance causes land to become temporarily unviable from the project during construction.

The mitigation measures identified relate to ensuring that the relevant standards are applied and appropriate processes are followed with the approving road authority. An appropriate community consultation or advertisement of works is also required. Measures include:

- ensuring there is a thorough community consultation process and/or public advertisement of works
- ensure that an access management strategy is implemented which follows relevant standards and guidelines, including but not limited to:
  - AS1742.3 – Manual of uniform traffic control devices
  - TEM Vol 2 Part 2.03 – Traffic control devices for works on roads.

10.5 SUMMARY OF MITIGATIONS

The table below summarises the mitigations proposed to manage transport impacts resulting from the project. The listed mitigations will be incorporated into the project EMF as a part of the EES process.

Table 10.1 Summary of mitigations

NO.	MITIGATION	PROJECT PHASE
TR1	Ensure the detailed design maintains the functional design layout and follows the relevant latest standards and guidelines (as per the approving road authority), to meet the project transport demands.	Design
TR2	Ensure alternative access (where permanent access is removed) is incorporated into the design to maintain access for land owners and land managers to properties.	Design
TR3	Prepare and implement a traffic management strategy for construction that includes: — Traffic Management Plans (TMP) in line with the relevant guidelines to that satisfaction of the relevant authority — community consultation and procedures to address complaints — co-ordination of heavy vehicle movements with other projects in the region — access arrangements during construction including detours and re-directions.	Pre-construction and construction
TR4	Develop an access strategy that accounts for alternate access arrangements where temporary changes to access occur during construction.	Design, pre-construction and construction

11 RESIDUAL IMPACTS

Following incorporation of mitigations outlined in Section 10, the following residual impacts will apply for the project.

11.1 OPERATIONAL NETWORK PERFORMANCE IMPACT

A net positive impact on network performance will result from the bypass, when compared with the no project scenario which will apply to local road users and bypass traffic. This assessment assumes the bypass is built to the specifications discussed in Section 10.

11.2 OPERATIONAL ACCESS IMPACT

Where permanent access changes are required as a result of the project, alternative access arrangements have been incorporated into the design. The residual impact with regard to access to parcels is low. Consultation with affected landholders will ensure changes to access are understood and provided alternatives are adequate for land owner and land manager requirements through the access strategy.

11.3 CONSTRUCTION TRAFFIC IMPACT

The residual impact for impacts to road users during construction is rated as medium following implementation of mitigations related to:

- changed road environment during construction (construction traffic/site access/variable speeds/unfamiliar conditions/ additional roadside hazards) leads to potential for increased incidence of accidents
- changed road environment during construction (construction traffic/site access/variable speeds/unfamiliar conditions/ additional roadside hazards) leads to potential for increased traffic on local roads decreasing amenity to road users and residents/businesses.

11.4 CONSTRUCTION ACCESS IMPACT

With the implementation of a project access strategy, access impacts resulting from construction traffic will be co-ordinated to ensure construction access impacts are minimised. Where temporary impacts to adjacent land holders occurs, consultation and alternative access arrangements will be provided. With the implementation of prescribed mitigations, the temporary impacts to localised landholders will be medium due to potential increased travel times, decreased amenity.

12 CONCLUSION

A traffic and transport impact assessment has been carried out for the proposed Beaufort Bypass project. The purpose of the impact assessment is to address the scoping requirements for the development of an Environment Effect Statement (EES).

The existing conditions review and traffic surveys showed that the majority of traffic within the study area was east-west traffic on the Western Highway travelling through Beaufort. Within the study area, the Western Highway had the highest daily traffic volume, with volumes peaking in Beaufort town centre.

The impact assessment shows that the implementation of the bypass should lead to a reduction in east-west traffic through Beaufort as outlined in Section 9.1.1. This will positively impact the town and enable a range of multi-modal projects to be introduced as detailed in Sections 9.1.4 and 9.1.5. At a very minimum, the future reduction in east-west traffic will extend the life of the cross intersections along the route. This is particularly noted at the intersection of Havelock Street and Livingstone Street, where it may be possible to avoid the upgrade of the existing traffic signals until after 2031, if the bypass is implemented. There are also additional road safety benefits with the reduction in east-west traffic. The reduced east-west traffic will mitigate potential future safety issues caused by excessive delays to vehicles entering and exiting side streets. As crash risk is proportional to exposure, the reduction in traffic will likely result in less crashes and vehicle related incidents, thereby improving safety within Beaufort. There will also be benefits to other road users, particularly for vulnerable road users such as cyclists and pedestrians, where there will be reduced safety risks due to the decrease in vehicles. In particular, the bypass of the majority of long haul heavy vehicles will improve safety and amenity of all road users.

The traffic volume utilising the proposed bypass was forecast to be between 7,000 and 10,000 vehicles per day and is well within the capacity of a freeway. As such, the bypass is not likely to exhibit significant congestion or safety issues. The bypass options proposed are very similar in terms of traffic operations all being to the north side of the town, and with a common interchange location at the Beaufort-Lexton Road. The only real difference is in length which has a direct impact on travel time and accident rates. However, as there is only 21 seconds difference in total travel times between each of the options, this is not likely to be a significant factor in determining a preferred option.

With regards to construction impacts, the project is expected to have an overall construction timeframe of two years with works likely to occur during standard construction work hours. The proposed alignment is noted to largely cover greenfield areas, meaning construction works will predominantly remain off existing roads other than where the bypass interchanges are proposed. The potential construction traffic impacts include the increased usage of the existing road network by construction vehicles (particularly heavy vehicles along haulage routes), construction worker trips to and from the site and access impacts on the road network to and from the sites for local landowners and road users.

The project overall would have a positive impact on capacity, accessibility, safety and amenity within Beaufort.

13 LIMITATIONS

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APPENDIX A

RISK REGISTER

AO ALIGNMENT

Table A.1 Traffic and transport environmental risk assessment register – A0 alignment

RISK ID	IMPACT PATHWAY	RISK DESCRIPTION	STANDARD CONTROLS	INITIAL RISK			ADDITIONAL MITIGATION / CONTROLS	RESIDUAL RISK		
				Consequence	Likelihood	Rating		Consequence	Likelihood	Rating
T1a	Design does not sufficiently cater for traffic demands	Bypass does not provide an attractive alternative to using the existing road. Insignificant reduction in traffic on existing route	Ensure design follows relevant standards and guidelines, including but not limited to: — Austroads Guide to Road Design (AGRD) — Austroads Guide to Traffic Management (AGTM) — AS1742 — VicRoads Traffic Engineering Manual (TEM) Volume 1, 2 and 3	Minor	Unlikely	Low	Not required	Minor	Unlikely	Low
T2a	Design does not sufficiently cater for traffic demands	Further works required to increase capacity. This would require further work and design, and potentially further land requirements	Ensure design follows relevant standards and guidelines, including but not limited to: — Austroads Guide to Road Design (AGRD) — Austroads Guide to Traffic Management (AGTM) — AS1742 — VicRoads Traffic Engineering Manual (TEM) Volume 1, 2 and 3	Minor	Unlikely	Low	Not required	Minor	Unlikely	Low

RISK ID	IMPACT PATHWAY	RISK DESCRIPTION	STANDARD CONTROLS	INITIAL RISK			ADDITIONAL MITIGATION / CONTROLS	RESIDUAL RISK		
				Consequence	Likelihood	Rating		Consequence	Likelihood	Rating
T3a	Design does not sufficiently cater for traffic demands	Increased incidence of accidents due to traffic congestion	Ensure design follows relevant standards and guidelines, including but not limited to: — Austroads Guide to Road Design (AGRD) — Austroads Guide to Traffic Management (AGTM) — AS1742 — VicRoads Traffic Engineering Manual (TEM) Volume 1, 2 and 3	Minor	Unlikely	Low	Not required	Minor	Unlikely	Low
T4a	Design does not sufficiently cater for traffic demands	New routes may increase traffic on some roads, which may be at odds with the road hierarchy - decreasing amenity to road users and residents/businesses	Ensure the signage, route management and local area traffic management follows relevant standards and guidelines, including but not limited to: — Austroads Guide to Road Design (AGRD) — Austroads Guide to Traffic Management (AGTM) — AS1742 — VicRoads Traffic Engineering Manual (TEM) Volume 1, 2 and 3 Ensure stakeholder consultation is carried out, particularly with Council, to manage any potential issues	Minor	Possible	Low	Not required	Minor	Possible	Low

RISK ID	IMPACT PATHWAY	RISK DESCRIPTION	STANDARD CONTROLS	INITIAL RISK			ADDITIONAL MITIGATION / CONTROLS	RESIDUAL RISK		
				Consequence	Likelihood	Rating		Consequence	Likelihood	Rating
T5a	Design does not sufficiently cater for traffic demands	Potential for decreased road safety due to inadequate design Increased incidence of accidents	Ensure design follows relevant standards and guidelines, including but not limited to: — Austroads Guide to Road Design (AGRD) — Austroads Guide to Traffic Management (AGTM) — AS1742 — VicRoads Traffic Engineering Manual (TEM) Volume 1, 2 and 3 — Road safety Audits	Moderate	Rare	Low	Not required	Moderate	Rare	Low
T6a	Construction impacts on road users	Changed road environment during construction (construction traffic / site access / variable speeds / unfamiliar conditions / additional roadside hazards) leads to increased incidence of accidents	Ensure there is a thorough community consultation process Ensure that a traffic management strategy is implemented which follows relevant standards and guidelines, including but not limited to: — AS1742.3 – Manual of uniform traffic control devices — TEM Vol 2 Part 2.03 – Traffic control devices for works on roads Preparation of traffic management plans (TMPs) and appropriate sign off by authority	Moderate	Unlikely	Medium	None identified	Moderate	Unlikely	Medium

RISK ID	IMPACT PATHWAY	RISK DESCRIPTION	STANDARD CONTROLS	INITIAL RISK			ADDITIONAL MITIGATION / CONTROLS	RESIDUAL RISK		
				Consequence	Likelihood	Rating		Consequence	Likelihood	Rating
T7a	Impacts on road users during construction	Changed road environment during construction (construction traffic / site access / variable speeds / unfamiliar conditions / additional roadside hazards) leads to increased traffic on local roads decreasing amenity to road users and residents/businesses	Ensure there is a thorough community consultation process Ensure that a traffic management strategy is implemented which follows relevant standards and guidelines, including but not limited to: — AS1742.3 - Manual of uniform traffic control devices — TEM Vol 2 Part 2.03 - Traffic control devices for works on roads Preparation of traffic management plans (TMPs) and appropriate sign off by authority	Minor	Almost Certain	Medium	None identified	Minor	Almost Certain	Medium
T8a	Land access issues for local land users during construction	Increased travel times, decreased amenity	Ensure there is a thorough community consultation process Ensure that a traffic management strategy is implemented which follows relevant standards and guidelines, including but not limited to: — AS1742.3 - Manual of uniform traffic control devices — TEM Vol 2 Part 2.03 - Traffic control devices for works on roads Preparation of traffic management plans (TMPs) and appropriate sign off by authority	Minor	Likely	Medium	None identified	Minor	Likely	Medium

RISK ID	IMPACT PATHWAY	RISK DESCRIPTION	STANDARD CONTROLS	INITIAL RISK			ADDITIONAL MITIGATION / CONTROLS	RESIDUAL RISK		
				Consequence	Likelihood	Rating		Consequence	Likelihood	Rating
T9a	Land access issues for local land users during construction	Land becomes inaccessible	Ensure there is a thorough community consultation process Ensure that a traffic management strategy is implemented which follows relevant standards and guidelines, including but not limited to: — AS1742.3 - Manual of uniform traffic control devices — TEM Vol 2 Part 2.03 - Traffic control devices for works on roads Preparation of traffic management plans (TMPs) and appropriate sign off by authority	Minor	Likely	Medium	Provide alternate access to inaccessible land	Insignificant	Rare	Negligible
T10a	Land access issues for local land users during operation	Increased travel times, decreased amenity	Ensure there is a thorough community consultation process Ensure that a traffic management strategy is implemented which follows relevant standards and guidelines, including but not limited to: — AS1742.3 - Manual of uniform traffic control devices — TEM Vol 2 Part 2.03 - Traffic control devices for works on roads Preparation of traffic management plans (TMPs) and appropriate sign off by authority	Minor	Possible	Low	Not required	Minor	Possible	Low

RISK ID	IMPACT PATHWAY	RISK DESCRIPTION	STANDARD CONTROLS	INITIAL RISK			ADDITIONAL MITIGATION / CONTROLS	RESIDUAL RISK		
				Consequence	Likelihood	Rating		Consequence	Likelihood	Rating
T11a	Land access issues for local land users during operation	Land becomes inaccessible	Ensure there is a thorough community consultation process Ensure that a traffic management strategy is implemented which follows relevant standards and guidelines, including but not limited to: — AS1742.3 - Manual of uniform traffic control devices — TEM Vol 2 Part 2.03 - Traffic control devices for works on roads Preparation of traffic management plans (TMPs) and appropriate sign off by authority	Minor	Unlikely	Low	Provide temporary access to inaccessible land where possible	Minor	Unlikely	Low

A1 ALIGNMENT

Table A.2 Traffic and transport environmental risk assessment register – A1 alignment

RISK ID	IMPACT PATHWAY	RISK DESCRIPTION	STANDARD CONTROLS	INITIAL RISK			ADDITIONAL MITIGATION / CONTROLS	RESIDUAL RISK		
				Consequence	Likelihood	Rating		Consequence	Likelihood	Rating
T1b	Design does not sufficiently cater for traffic demands	Bypass does not provide an attractive alternative to using the existing road. Insignificant reduction in traffic on existing route	Ensure design follows relevant standards and guidelines, including but not limited to: — Austroads Guide to Road Design (AGRD) — Austroads Guide to Traffic Management (AGTM) — AS1742 — VicRoads Traffic Engineering Manual (TEM) Volume 1, 2 and 3	Minor	Unlikely	Low	Not required	Minor	Unlikely	Low
T2b	Design does not sufficiently cater for traffic demands	Further works required to increase capacity. This would require further work and design, and potentially further land requirements	Ensure design follows relevant standards and guidelines, including but not limited to: — Austroads Guide to Road Design (AGRD) — Austroads Guide to Traffic Management (AGTM) — AS1742 — VicRoads Traffic Engineering Manual (TEM) Volume 1, 2 and 3	Minor	Unlikely	Low	Not required	Minor	Unlikely	Low

RISK ID	IMPACT PATHWAY	RISK DESCRIPTION	STANDARD CONTROLS	INITIAL RISK			ADDITIONAL MITIGATION / CONTROLS	RESIDUAL RISK		
				Consequence	Likelihood	Rating		Consequence	Likelihood	Rating
T3b	Design does not sufficiently cater for traffic demands	Increased incidence of accidents due to traffic congestion	Ensure design follows relevant standards and guidelines, including but not limited to: — Austroads Guide to Road Design (AGRD) — Austroads Guide to Traffic Management (AGTM) — AS1742 — VicRoads Traffic Engineering Manual (TEM) Volume 1, 2 and 3	Moderate	Rare	Low	Not required	Moderate	Rare	Low
T4b	Design does not sufficiently cater for traffic demands	New routes may increase traffic on some roads, which may be at odds with the road hierarchy - decreasing amenity to road users and residents/businesses	Ensure the signage, route management and local area traffic management follows relevant standards and guidelines, including but not limited to: — Austroads Guide to Road Design (AGRD) — Austroads Guide to Traffic Management (AGTM) — AS1742 — VicRoads Traffic Engineering Manual (TEM) Volume 1, 2 and 3 Ensure stakeholder consultation is carried out, particularly with Council, to manage any potential issues	Minor	Possible	Low	Not required	Minor	Possible	Low

RISK ID	IMPACT PATHWAY	RISK DESCRIPTION	STANDARD CONTROLS	INITIAL RISK			ADDITIONAL MITIGATION / CONTROLS	RESIDUAL RISK		
				Consequence	Likelihood	Rating		Consequence	Likelihood	Rating
T5b	Design does not sufficiently cater for traffic demands	Potential for decreased road safety due to inadequate design Increased incidence of accidents	Ensure design follows relevant standards and guidelines, including but not limited to: — Austroads Guide to Road Design (AGRD) — Austroads Guide to Traffic Management (AGTM) — AS1742 — VicRoads Traffic Engineering Manual (TEM) Volume 1, 2 and 3 — Road safety Audits	Moderate	Rare	Low	Not required	Moderate	Rare	Low
T6b	Construction impacts on road users	Changed road environment during construction (construction traffic / site access / variable speeds / unfamiliar conditions / additional roadside hazards) leads to increased incidence of accidents	Ensure that a traffic management strategy is implemented which follows relevant standards and guidelines, including but not limited to: — AS1742.3 - Manual of uniform traffic control devices — TEM Vol 2 Part 2.03 - Traffic control devices for works on roads Ensure there is a thorough community consultation process Request relevant assistance when issues (e.g. enforcement of temporary traffic conditions) arise Preparation of traffic management plans (TMPs) and appropriate sign off by authority	Moderate	Unlikely	Medium	None identified	Moderate	Unlikely	Medium

RISK ID	IMPACT PATHWAY	RISK DESCRIPTION	STANDARD CONTROLS	INITIAL RISK			ADDITIONAL MITIGATION / CONTROLS	RESIDUAL RISK		
				Consequence	Likelihood	Rating		Consequence	Likelihood	Rating
T7b	Impacts on road users during construction	Changed road environment during construction (construction traffic / site access / variable speeds / unfamiliar conditions / additional roadside hazards) leads to increased traffic on local roads decreasing amenity to road users and residents/businesses	Ensure that a traffic management strategy is implemented which follows relevant standards and guidelines, including but not limited to: — AS1742.3 - Manual of uniform traffic control devices — TEM Vol 2 Part 2.03 - Traffic control devices for works on roads Ensure there is a thorough community consultation process Request relevant assistance when issues (e.g. enforcement of temporary traffic conditions) arise Preparation of traffic management plans (TMPs) and appropriate sign off by authority	Minor	Almost Certain	Medium	None identified	Minor	Almost Certain	Medium

RISK ID	IMPACT PATHWAY	RISK DESCRIPTION	STANDARD CONTROLS	INITIAL RISK			ADDITIONAL MITIGATION / CONTROLS	RESIDUAL RISK		
				Consequence	Likelihood	Rating		Consequence	Likelihood	Rating
T8b	Land access issues for local land users during construction	Increased travel times, decreased amenity	Ensure that a traffic management strategy is implemented which follows relevant standards and guidelines, including but not limited to: — AS1742.3 - Manual of uniform traffic control devices — TEM Vol 2 Part 2.03 - Traffic control devices for works on roads Ensure there is a thorough community consultation process Request relevant assistance when issues (e.g. enforcement of temporary traffic conditions) arise Preparation of traffic management plans (TMPs) and appropriate sign off by authority	Minor	Likely	Medium	None identified	Minor	Likely	Medium

RISK ID	IMPACT PATHWAY	RISK DESCRIPTION	STANDARD CONTROLS	INITIAL RISK			ADDITIONAL MITIGATION / CONTROLS	RESIDUAL RISK		
				Consequence	Likelihood	Rating		Consequence	Likelihood	Rating
T9b	Land access issues for local land users during construction	Land becomes inaccessible	Ensure there is a thorough community consultation with impacted land holders process to minimise and manage land access impacts Ensure that a traffic management strategy is implemented which follows relevant standards and guidelines, including but not limited to: — AS1742.3 - Manual of uniform traffic control devices — TEM Vol 2 Part 2.03 - Traffic control devices for works on roads Preparation of traffic management plans (TMPs) and appropriate sign off by authority	Minor	Likely	Medium	Provide alternate access to stranded land	Insignificant	Rare	Negligible

RISK ID	IMPACT PATHWAY	RISK DESCRIPTION	STANDARD CONTROLS	INITIAL RISK			ADDITIONAL MITIGATION / CONTROLS	RESIDUAL RISK		
				Consequence	Likelihood	Rating		Consequence	Likelihood	Rating
T10b	Land access issues for local land users during operation	Increased travel times, decreased amenity	Ensure there is a thorough community consultation with impacted land holders process to minimise and manage land access impacts Ensure that a traffic management strategy is implemented which follows relevant standards and guidelines, including but not limited to: — AS1742.3 - Manual of uniform traffic control devices — TEM Vol 2 Part 2.03 - Traffic control devices for works on roads Preparation of traffic management plans (TMPs) and appropriate sign off by authority	Minor	Possible	Low	Not required	Minor	Possible	Low

RISK ID	IMPACT PATHWAY	RISK DESCRIPTION	STANDARD CONTROLS	INITIAL RISK			ADDITIONAL MITIGATION / CONTROLS	RESIDUAL RISK		
				Consequence	Likelihood	Rating		Consequence	Likelihood	Rating
T11b	Land access issues for local land users during operation	Land becomes inaccessible	Ensure there is a thorough community consultation with impacted land holders process to minimise and manage land access impacts Ensure that a traffic management strategy is implemented which follows relevant standards and guidelines, including but not limited to: — AS1742.3 - Manual of uniform traffic control devices — TEM Vol 2 Part 2.03 - Traffic control devices for works on roads Preparation of traffic management plans (TMPs) and appropriate sign off by authority	Minor	Unlikely	Low	Provide temporary access to inaccessible land where possible	Minor	Unlikely	Low

C0 ALIGNMENT

Table A.3 Traffic and transport environmental risk assessment register – C0 alignment

RISK ID	IMPACT PATHWAY	RISK DESCRIPTION	STANDARD CONTROLS	INITIAL RISK			ADDITIONAL MITIGATION / CONTROLS	RESIDUAL RISK		
				Consequence	Likelihood	Rating		Consequence	Likelihood	Rating
T1c	Design does not sufficiently cater for traffic demands	Bypass does not provide an attractive alternative to using the existing road. Insignificant reduction in traffic on existing route	Ensure design follows relevant standards and guidelines, including but not limited to: — Austroads Guide to Road Design (AGRD) — Austroads Guide to Traffic Management (AGTM) — AS1742 — VicRoads Traffic Engineering Manual (TEM) Volume 1, 2 and 3	Minor	Unlikely	Low	Not required	Minor	Unlikely	Low
T2c	Design does not sufficiently cater for traffic demands	Further works required to increase capacity. This would require further work and design, and potentially further land requirements	Ensure design follows relevant standards and guidelines, including but not limited to: — Austroads Guide to Road Design (AGRD) — Austroads Guide to Traffic Management (AGTM) — AS1742 — VicRoads Traffic Engineering Manual (TEM) Volume 1, 2 and 3	Minor	Unlikely	Low	Not required	Minor	Unlikely	Low

RISK ID	IMPACT PATHWAY	RISK DESCRIPTION	STANDARD CONTROLS	INITIAL RISK			ADDITIONAL MITIGATION / CONTROLS	RESIDUAL RISK		
				Consequence	Likelihood	Rating		Consequence	Likelihood	Rating
T3c	Design does not sufficiently cater for traffic demands	Increased incidence of accidents due to traffic congestion	Ensure design follows relevant standards and guidelines, including but not limited to: — Austroads Guide to Road Design (AGRD) — Austroads Guide to Traffic Management (AGTM) — AS1742 — VicRoads Traffic Engineering Manual (TEM) Volume 1, 2 and 3	Moderate	Rare	Low	Not required	Moderate	Rare	Low
T4c	Design does not sufficiently cater for traffic demands	New routes may increase traffic on some roads, which may be at odds with the road hierarchy - decreasing amenity to road users and residents/businesses	Ensure the signage, route management and local area traffic management follows relevant standards and guidelines, including but not limited to: — Austroads Guide to Road Design (AGRD) — Austroads Guide to Traffic Management (AGTM) — AS1742 — VicRoads Traffic Engineering Manual (TEM) Volume 1, 2 and 3 Ensure stakeholder consultation is carried out, particularly with Council, to manage any potential issues	Minor	Possible	Low	Not required	Minor	Possible	Low

RISK ID	IMPACT PATHWAY	RISK DESCRIPTION	STANDARD CONTROLS	INITIAL RISK			ADDITIONAL MITIGATION / CONTROLS	RESIDUAL RISK		
				Consequence	Likelihood	Rating		Consequence	Likelihood	Rating
T5c	Design does not sufficiently cater for traffic demands	Potential for decreased road safety due to inadequate design Increased incidence of accidents	Ensure design follows relevant standards and guidelines, including but not limited to: — Austroads Guide to Road Design (AGRD) — Austroads Guide to Traffic Management (AGTM) — AS1742 — VicRoads Traffic Engineering Manual (TEM) Volume 1, 2 and 3 — Road safety Audits	Moderate	Rare	Low	Not required	Moderate	Rare	Low
T6c	Construction impacts on road users	Changed road environment during construction (construction traffic / site access / variable speeds / unfamiliar conditions / additional roadside hazards) leads to increased incidence of accidents	Ensure that a traffic management strategy is implemented which follows relevant standards and guidelines, including but not limited to: — AS1742.3 - Manual of uniform traffic control devices — TEM Vol 2 Part 2.03 - Traffic control devices for works on roads Ensure there is a thorough community consultation process Request relevant assistance when issues (e.g. enforcement of temporary traffic conditions) arise Preparation of traffic management plans (TMPs) and appropriate sign off by authority	Moderate	Unlikely	Medium	None identified	Moderate	Unlikely	Medium

RISK ID	IMPACT PATHWAY	RISK DESCRIPTION	STANDARD CONTROLS	INITIAL RISK			ADDITIONAL MITIGATION / CONTROLS	RESIDUAL RISK		
				Consequence	Likelihood	Rating		Consequence	Likelihood	Rating
T7c	Impacts on road users during construction	Changed road environment during construction (construction traffic / site access / variable speeds / unfamiliar conditions / additional roadside hazards) leads to increased traffic on local roads decreasing amenity to road users and residents/businesses	Ensure that a traffic management strategy is implemented which follows relevant standards and guidelines, including but not limited to: — AS1742.3 - Manual of uniform traffic control devices — TEM Vol 2 Part 2.03 - Traffic control devices for works on roads Ensure there is a thorough community consultation process Request relevant assistance when issues (e.g. enforcement of temporary traffic conditions) arise Preparation of traffic management plans (TMPs) and appropriate sign off by authority	Minor	Almost Certain	Medium	None identified	Minor	Almost Certain	Medium

RISK ID	IMPACT PATHWAY	RISK DESCRIPTION	STANDARD CONTROLS	INITIAL RISK			ADDITIONAL MITIGATION / CONTROLS	RESIDUAL RISK		
				Consequence	Likelihood	Rating		Consequence	Likelihood	Rating
T8c	Land access issues for local land users during construction	Increased travel times, decreased amenity	Ensure that a traffic management strategy is implemented which follows relevant standards and guidelines, including but not limited to: — AS1742.3 - Manual of uniform traffic control devices — TEM Vol 2 Part 2.03 - Traffic control devices for works on roads Ensure there is a thorough community consultation process Request relevant assistance when issues (e.g. enforcement of temporary traffic conditions) arise Preparation of traffic management plans (TMPs) and appropriate sign off by authority	Minor	Likely	Medium	None identified	Minor	Likely	Medium

RISK ID	IMPACT PATHWAY	RISK DESCRIPTION	STANDARD CONTROLS	INITIAL RISK			ADDITIONAL MITIGATION / CONTROLS	RESIDUAL RISK		
				Consequence	Likelihood	Rating		Consequence	Likelihood	Rating
T9c	Land access issues for local land users during construction	Land becomes inaccessible	Ensure there is a thorough community consultation with impacted land holders process to minimise and manage land access impacts Ensure that a traffic management strategy is implemented which follows relevant standards and guidelines, including but not limited to: — AS1742.3 - Manual of uniform traffic control devices — TEM Vol 2 Part 2.03 - Traffic control devices for works on roads Preparation of traffic management plans (TMPs) and appropriate sign off by authority	Minor	Likely	Medium	Provide alternate access to stranded land	Insignificant	Rare	Negligible

RISK ID	IMPACT PATHWAY	RISK DESCRIPTION	STANDARD CONTROLS	INITIAL RISK			ADDITIONAL MITIGATION / CONTROLS	RESIDUAL RISK		
				Consequence	Likelihood	Rating		Consequence	Likelihood	Rating
T10c	Land access issues for local land users during operation	Increased travel times, decreased amenity	Ensure there is a thorough community consultation with impacted land holders process to minimise and manage land access impacts Ensure that a traffic management strategy is implemented which follows relevant standards and guidelines, including but not limited to: — AS1742.3 - Manual of uniform traffic control devices — TEM Vol 2 Part 2.03 - Traffic control devices for works on roads Preparation of traffic management plans (TMPs) and appropriate sign off by authority	Minor	Possible	Low	Not required	Minor	Possible	Low

RISK ID	IMPACT PATHWAY	RISK DESCRIPTION	STANDARD CONTROLS	INITIAL RISK			ADDITIONAL MITIGATION / CONTROLS	RESIDUAL RISK		
				Consequence	Likelihood	Rating		Consequence	Likelihood	Rating
T11c	Land access issues for local land users during operation	Land becomes inaccessible	Ensure there is a thorough community consultation with impacted land holders process to minimise and manage land access impacts Ensure that a traffic management strategy is implemented which follows relevant standards and guidelines, including but not limited to: — AS1742.3 - Manual of uniform traffic control devices — TEM Vol 2 Part 2.03 - Traffic control devices for works on roads Preparation of traffic management plans (TMPs) and appropriate sign off by authority	Minor	Unlikely	Low	Provide temporary access to inaccessible land where possible	Minor	Unlikely	Low

C2 ALIGNMENT

Table A.4 Traffic and transport environmental risk assessment register – C2 alignment

RISK ID	IMPACT PATHWAY	RISK DESCRIPTION	STANDARD CONTROLS	INITIAL RISK			ADDITIONAL MITIGATION / CONTROLS	RESIDUAL RISK		
				Consequence	Likelihood	Rating		Consequence	Likelihood	Rating
T1d	Design does not sufficiently cater for traffic demands	Bypass does not provide an attractive alternative to using the existing road. Insignificant reduction in traffic on existing route	Ensure design follows relevant standards and guidelines, including but not limited to: — Austroads Guide to Road Design (AGRD) — Austroads Guide to Traffic Management (AGTM) — AS1742 — VicRoads Traffic Engineering Manual (TEM) Volume 1, 2 and 3	Minor	Unlikely	Low	Not required	Minor	Unlikely	Low
T2d	Design does not sufficiently cater for traffic demands	Further works required to increase capacity. This would require further work and design, and potentially further land requirements	Ensure design follows relevant standards and guidelines, including but not limited to: — Austroads Guide to Road Design (AGRD) — Austroads Guide to Traffic Management (AGTM) — AS1742 — VicRoads Traffic Engineering Manual (TEM) Volume 1, 2 and 3	Minor	Unlikely	Low	Not required	Minor	Unlikely	Low

RISK ID	IMPACT PATHWAY	RISK DESCRIPTION	STANDARD CONTROLS	INITIAL RISK			ADDITIONAL MITIGATION / CONTROLS	RESIDUAL RISK		
				Consequence	Likelihood	Rating		Consequence	Likelihood	Rating
T3d	Design does not sufficiently cater for traffic demands	Increased incidence of accidents due to traffic congestion	Ensure design follows relevant standards and guidelines, including but not limited to: — Austroads Guide to Road Design (AGRD) — Austroads Guide to Traffic Management (AGTM) — AS1742 — VicRoads Traffic Engineering Manual (TEM) Volume 1, 2 and 3	Moderate	Rare	Low	Not required	Minor	Unlikely	Low
T4d	Design does not sufficiently cater for traffic demands	New routes may increase traffic on some roads, which may be at odds with the road hierarchy - decreasing amenity to road users and residents/businesses	Ensure the signage, route management and local area traffic management follows relevant standards and guidelines, including but not limited to: — Austroads Guide to Road Design (AGRD) — Austroads Guide to Traffic Management (AGTM) — AS1742 — VicRoads Traffic Engineering Manual (TEM) Volume 1, 2 and 3 Ensure stakeholder consultation is carried out, particularly with Council, to manage any potential issues	Minor	Possible	Low	Not required	Minor	Possible	Low

RISK ID	IMPACT PATHWAY	RISK DESCRIPTION	STANDARD CONTROLS	INITIAL RISK			ADDITIONAL MITIGATION / CONTROLS	RESIDUAL RISK		
				Consequence	Likelihood	Rating		Consequence	Likelihood	Rating
T5d	Design does not sufficiently cater for traffic demands	Potential for decreased road safety due to inadequate design Increased incidence of accidents	Ensure design follows relevant standards and guidelines, including but not limited to: — Austroads Guide to Road Design (AGRD) — Austroads Guide to Traffic Management (AGTM) — AS1742 — VicRoads Traffic Engineering Manual (TEM) Volume 1, 2 and 3 — Road safety Audits	Moderate	Rare	Low	Not required	Minor	Rare	Low
T6d	Construction impacts on road users	Changed road environment during construction (construction traffic / site access / variable speeds / unfamiliar conditions / additional roadside hazards) leads to increased incidence of accidents	Ensure that a traffic management strategy is implemented which follows relevant standards and guidelines, including but not limited to: — AS1742.3 - Manual of uniform traffic control devices — TEM Vol 2 Part 2.03 - Traffic control devices for works on roads Ensure there is a thorough community consultation process Request relevant assistance when issues (e.g. enforcement of temporary traffic conditions) arise Preparation of traffic management plans (TMPs) and appropriate sign off by authority	Moderate	Unlikely	Medium	None identified	Moderate	Unlikely	Medium

RISK ID	IMPACT PATHWAY	RISK DESCRIPTION	STANDARD CONTROLS	INITIAL RISK			ADDITIONAL MITIGATION / CONTROLS	RESIDUAL RISK		
				Consequence	Likelihood	Rating		Consequence	Likelihood	Rating
T7d	Impacts on road users during construction	Changed road environment during construction (construction traffic / site access / variable speeds / unfamiliar conditions / additional roadside hazards) leads to increased traffic on local roads decreasing amenity to road users and residents/businesses	Ensure that a traffic management strategy is implemented which follows relevant standards and guidelines, including but not limited to: — AS1742.3 - Manual of uniform traffic control devices — TEM Vol 2 Part 2.03 - Traffic control devices for works on roads Ensure there is a thorough community consultation process Request relevant assistance when issues (e.g. enforcement of temporary traffic conditions) arise Preparation of traffic management plans (TMPs) and appropriate sign off by authority	Minor	Almost Certain	Medium	None identified	Moderate	Unlikely	Medium

RISK ID	IMPACT PATHWAY	RISK DESCRIPTION	STANDARD CONTROLS	INITIAL RISK			ADDITIONAL MITIGATION / CONTROLS	RESIDUAL RISK		
				Consequence	Likelihood	Rating		Consequence	Likelihood	Rating
T8d	Land access issues for local land users during construction	Increased travel times, decreased amenity	Ensure that a traffic management strategy is implemented which follows relevant standards and guidelines, including but not limited to: — AS1742.3 - Manual of uniform traffic control devices — TEM Vol 2 Part 2.03 - Traffic control devices for works on roads Ensure there is a thorough community consultation process Request relevant assistance when issues (e.g. enforcement of temporary traffic conditions) arise Preparation of traffic management plans (TMPs) and appropriate sign off by authority	Minor	Likely	Medium	None identified	Minor	Likely	Medium
T9d	Land access issues for local land users during construction	Land becomes inaccessible	Ensure there is a thorough community consultation with impacted land holders process to minimise and manage land access impacts Ensure that a traffic management strategy is implemented which follows relevant standards and guidelines, including but not limited to: — AS1742.3 - Manual of uniform traffic control devices — TEM Vol 2 Part 2.03 - Traffic control devices for works on roads Preparation of traffic management plans (TMPs) and appropriate sign off by authority	Minor	Likely	Medium	Provide alternate access to stranded land	Insignificant	Rare	Negligible

RISK ID	IMPACT PATHWAY	RISK DESCRIPTION	STANDARD CONTROLS	INITIAL RISK			ADDITIONAL MITIGATION / CONTROLS	RESIDUAL RISK		
				Consequence	Likelihood	Rating		Consequence	Likelihood	Rating
T10d	Land access issues for local land users during operation	Increased travel times, decreased amenity	Ensure there is a thorough community consultation with impacted land holders process to minimise and manage land access impacts Ensure that a traffic management strategy is implemented which follows relevant standards and guidelines, including but not limited to: — AS1742.3 - Manual of uniform traffic control devices — TEM Vol 2 Part 2.03 - Traffic control devices for works on roads Preparation of traffic management plans (TMPs) and appropriate sign off by authority	Minor	Possible	Low	Not required	Minor	Possible	Low
T11d	Land access issues for local land users during operation	Land becomes inaccessible	Ensure there is a thorough community consultation with impacted land holders process to minimise and manage land access impacts Ensure that a traffic management strategy is implemented which follows relevant standards and guidelines, including but not limited to: — AS1742.3 - Manual of uniform traffic control devices — TEM Vol 2 Part 2.03 - Traffic control devices for works on roads Preparation of traffic management plans (TMPs) and appropriate sign off by authority	Minor	Unlikely	Low	Provide temporary access to inaccessible land where possible	Minor	Unlikely	Low

APPENDIX B

GROWTH RATE REVIEW

From:	Winn, Ray
Sent:	Monday, 19 March 2018 11:39 AM
To:	Foo, Wilson
Cc:	McDonald, Kate
Subject:	RE: Beaufort growth rates

Hi Wilson,

I am responding to your request for me to review the growth rates section of the Traffic and Transport Existing Conditions Report.

Below I comment on current basis for estimate and suggest some additional evidence that is relevant to setting growth assumptions.

Happy to discuss.

Summary

Based on past and forecast population changes and past traffic growth trends, it would be reasonable to apply a growth range of 1% to 2% for the traffic currently using the Western Highway through Beaufort.

This is a judgement based on the available information summarised below and is driven by the following considerations:

- It's likely that trend traffic growth on this part of the Western Highway will be positive given:
  - Past growth despite relatively stable and sometimes declining population growth on the rural sections of the corridor
  - Freight volumes have grown over time and there is some evidence of a greater increase in the use of smaller vehicles
- Beaufort's vicinity to those parts of the corridor that is growing fastest:
  - is likely to mean population and employment is likely to increase by a small proportion and this will generate traffic
  - however, some of this is likely to be orientated to travel to the east and not across the entire length of the by-pass

Overall a range of 1% to 2% seems reasonable although this might not fully incorporate the impact of journey time savings inducing travel from west of Beaufort to major destinations such as Ballarat.

It is for the team to decide whether the journey time savings are likely to be significant enough to induce traffic growth across the bypass in excess of 2%.

Below I summarise:

- the basis for the growth predictions
- review of current material used to estimate growth
- additional material that might help you set a growth range.

Basis for growth predictions

Likely drivers of change

Changes in traffic volumes on the Western Highway are likely to be related to changes in:

- Corridor population (both in terms of the number of people and their characteristics e.g. age distribution etc)
- Economic activity along the parts of the corridor affecting the section through Beaufort (including factors driving long-distance freight)
- Levels of service where improved or worsening travel conditions may impact on the frequency and type of travel
- Travel patterns and behaviours:
  - freight industry trends e.g. moving to larger trucks for long-distance freight and maybe smaller vehicles for local distribution
  - changing travel propensities and modes with population changes e.g. ageing population may change travel frequencies.

Practical approach

The factors driving future travel are multiple and complex and our understanding is constrained by the availability of relevant and comprehensive data.

A practical but defensible approach to setting forecast growth (and potentially a growth range) should involve:

- accessing available, relevant and recent data (on past traffic, population and economic growth) relevant to this section of the Western Highway
- considering state-sanctioned and relevant forecasts of population and economic activity
- logically and transparently linking this evidence to traffic growth estimates.

Additional material to inform growth forecasts

I have summarised additional material relevant to forecasting traffic growth in the vicinity of Beaufort from work on the Western Highway Background including:

- Historic and forecast population growth
- Economic growth information.
- VicRoads data on traffic growth
- VicRoads Culway monitor (CV types and loads).

Summarise key aspects of each below.

Population

The table below shows growth for the Western Highway corridor LGAs between 2011 and 2016 and the Victoria in the Future forecasts for 2011-2031.

(note 2011 census and VIF are not meant to match as we used census community profile)

In summary:

- Significant past growth has been focused on the eastern end of the corridor between Melbourne and Ballarat
- Pyrenees shire population grew by 9% between 2011 and 2016
- Forecast growth is also focused on the eastern end of the corridor
- Pyrenees shire population is expected to grow at 8% but LGAs to the west, except for Horsham, are expected to experience stable or declining populations.

LGA growth from Victoria in the Future

Council	Census Community Profile				Victoria in the Future						
	2011	2016	Growth 2011-16 People	%	2011	2016	Growth 2011-16 People	%	2031	Growth 2016-31 People	%
Brimbank	182,735	194,319	11,584	6	191,496	201,429	9,933	5	227,544	26,116	13
Melton	109,259	135,443	26,184	24	112,643	138,181	25,538	23	266,008	127,827	93
Moorabool	28,124	31,818	3,694	13	28,670	32,126	3,456	12	46,124	13,998	44
Ballarat	93,501	101,686	8,185	9	95,185	103,249	8,064	8	136,873	33,623	33
Pyrenees	6,669	7,238	569	9	6,759	6,867	108	2	7,419	551	8
Ararat	11,183	11,600	417	4	11,326	10,952	-374	-3	10,614	-339	-3
Northern Grampians	11,845	11,439	-406	-3	12,054	11,420	-634	-5	10,820	-600	-5
Horsham	19,279	19,642	363	2	19,523	19,887	364	2	21,793	1,906	10
Yarriambiack	7,088	6,674	-414	-6	7,183	6,645	-538	-7	5,618	-1,026	-15
Hindmarsh	5,798	5,721	-77	-1	5,856	5,393	-463	-8	4,641	-752	-14
West Wimmera	4,251	3,903	-348	-8	4,287	3,811	-476	-11	2,988	-823	-22
Total	479,732	529,483	49,751	10	494,982	539,961	44,979	9	740,441	200,480	37

Most of the projected growth in Pyrenees shire is expected in or around Beaufort.

Economic growth

The major engine of economic growth for the Western Highway corridor is at the eastern end between Ballarat and Melbourne.

Between 2011 and 2016 the number of employed persons between the Ararat and West Wimmera LGAs fell by between 1% and 9%.

The number of employed persons in LGAs between Ballarat and Brimbank increased by between 5% and 18% with the greatest growth in Melton and Moorabool.

For the Pyrenees shire the number of employed persons increased by 3% or 65 people and probably reflects the proximity of areas to the east experiencing more rapid economic growth.

If this is the case then direct journey to work trips would be generated going east from Beaufort without necessarily using the bypass.

However, stable or increasing employment is likely to also generate non-work trips.

VicRoads information

The sources of VicRoads information on traffic growth include:

- Published AADT and CV estimates for numerous locations by direction along the Western Highway
- Data from four continuous count sites along the Western Highway
- A single VicRoads Culway monitor (that can detect vehicle type and weight by direction).

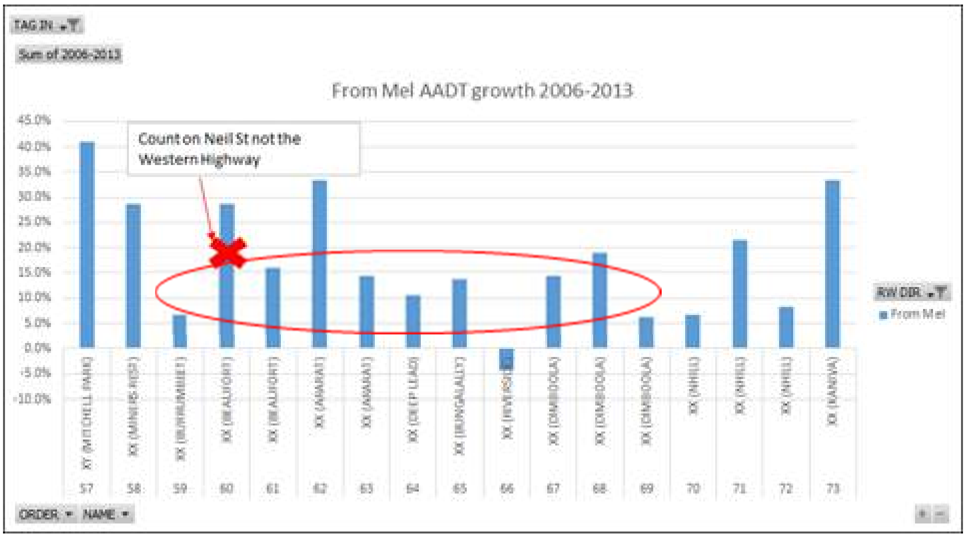
VicRoads historic traffic data-publicly available AADT

These data include AADT directional figures and also an equivalent figure for commercial vehicles and are:

- Estimated from a range of traffic inputs including partial link and intersection counts.
- Provided for 2006 and then 2013-2016.

Growth estimates for the relevant sections of the Western Highway are shown below by direction:

- The nature of these estimates (not full count sites) probably explains some of the patterns and variations shown
- It's difficult to get a definitive and consistent read on growth with some variation hard to explain
- Overall the results for the rural sections to the west of Ballarat is that:
  - For 2006-2013 two-way traffic growth was positive and I have taken a range for Beaufort type locations of between 10% and 15% (1.4% to 2% per annum)
  - For 2013-2016 two-way traffic growth was again overall positive and have allowed a range of between 3% and 8% (1.0% to 2.6% per annum) – the Beaufort W Highway sites were at the lower end of thisrange
- Relying on these data alone would set the growth range per annum as between 1% and 2%.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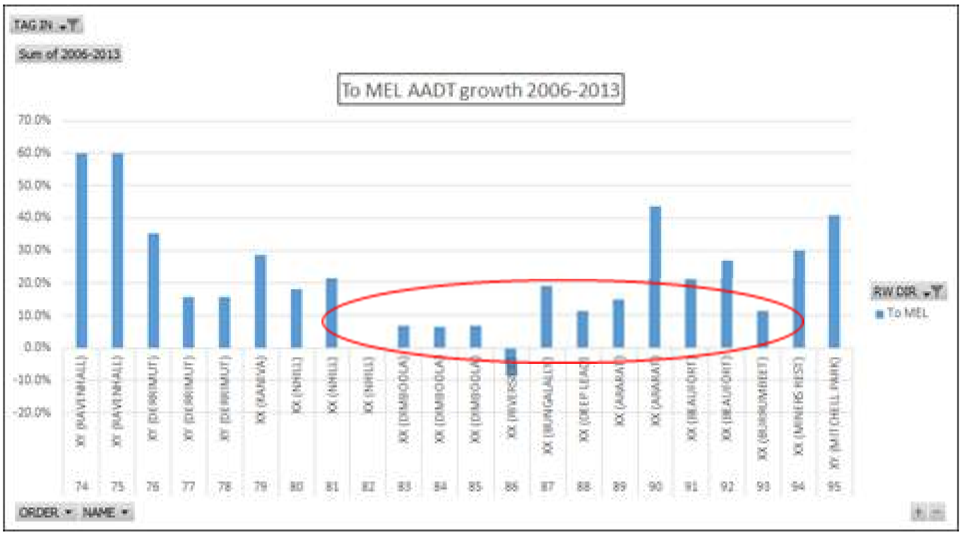
From Mel AADT growth 2006-2013
Count on Neil St not the Western Highway
RW DIR
From Mel
ORDER
NAME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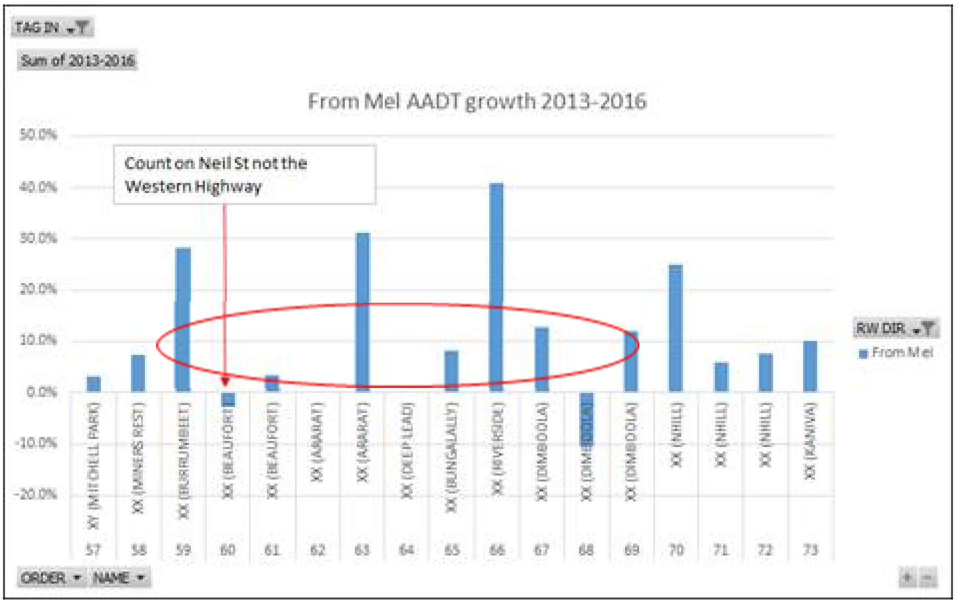
To MEL
ORDER
NAME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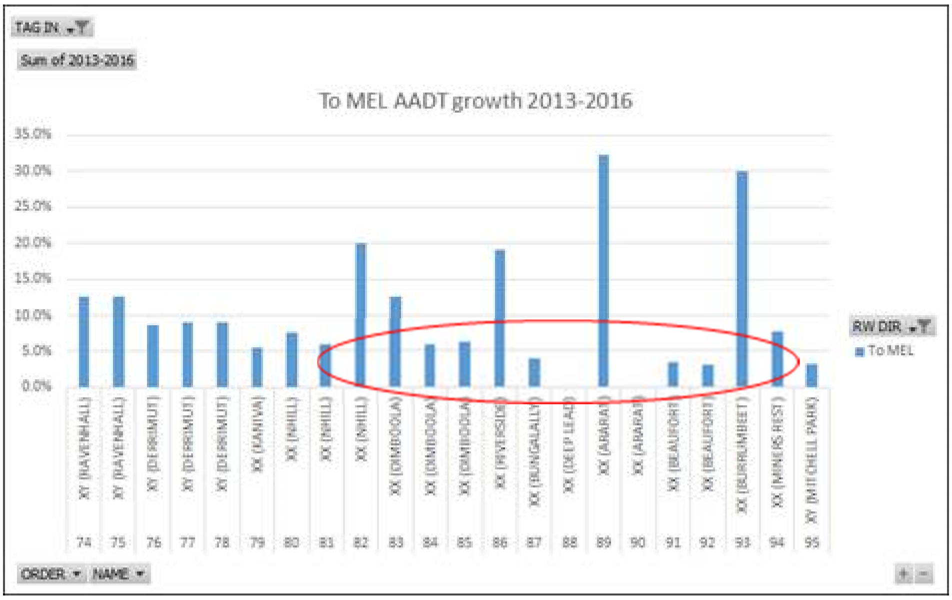
RW DIR
From Mel
ORDER
NAME



VicRoads provided us with a short, internal analysis paper on CV changes based essentially on the same data.

Given the smaller numbers and measurement challenges it was hard to draw meaningful conclusions from the analysis.

VicRoads analysis of Culway data from a site at Beaufort

VicRoads previously provided us with a report Western Highway Heavy Vehicle Weight Analysis (2006-2014).

This reported on changes in heavy goods vehicles at Beaufort which is the only location on the Western Highway with a culway installation

http://tca.gov.au/documents/pdfs/Presentation-20170911-WIMForum-VicRoads-Trumper-Sping.pdf (slide 2 shows location on W highway between Beaufort and Ararat)

The work reported between 2006 and 2014:

- An increase in average freight vehicles per day from 525 to 664
- This is a 26.5% increase equivalent to 3% per year over the period
- Over the same period the average weight per vehicle has fallen and the weight of freight carried has not increased at the same rate as the number of vehicles
- There has also been a shift to using smaller vehicle classes
- The paper’s initial observations included the possibility that the growth of online shopping freight might explain some of these trends.

Freight often makes up 20% to 30% of traffic (and sometimes more) on the more rural sections of the Western Highway corridor.

Regards

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APPENDIX C

SIDRA MODEL RESULTS

MOVEMENT SUMMARY

Site: 5330 [Lawrence St 2021 AM - 2% No Proj]

Beaufort Bypass
Signals - Fixed Time Isolated   Cycle Time = 30 seconds (Practical Cycle Time)

Movement Performance - Vehicles												
Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Lawrence St											
1	L2	41	22.0	0.481	17.5	LOS B	2.1	16.4	0.93	0.77	37.7
2	T1	47	10.6	0.481	12.7	LOS B	2.1	16.4	0.93	0.77	41.1
3	R2	59	6.8	0.481	17.4	LOS B	2.1	16.4	0.93	0.77	40.5
Approach		147	12.2	0.481	15.9	LOS B	2.1	16.4	0.93	0.77	40.1
East: Western Hwy											
4	L2	55	9.1	0.467	9.5	LOS A	2.6	20.5	0.77	0.68	46.4
5	T1	269	15.6	0.467	4.9	LOS A	2.6	20.5	0.77	0.68	45.1
6	R2	15	6.7	0.035	13.0	LOS B	0.2	1.2	0.73	0.66	41.6
Approach		339	14.2	0.467	6.0	LOS A	2.6	20.5	0.77	0.68	45.1
North: Lawrence St											
7	L2	14	7.1	0.232	16.5	LOS B	1.0	7.9	0.87	0.69	41.8
8	T1	50	12.0	0.232	11.8	LOS B	1.0	7.9	0.87	0.69	42.2
9	R2	13	7.7	0.232	16.5	LOS B	1.0	7.9	0.87	0.69	39.3
Approach		77	10.4	0.232	13.5	LOS B	1.0	7.9	0.87	0.69	41.7
West: Western Hwy											
10	L2	37	0.0	0.054	11.4	LOS B	0.4	2.5	0.67	0.67	40.6
11	T1	235	13.6	0.358	7.9	LOS A	2.7	20.8	0.77	0.63	43.4
12	R2	28	10.7	0.064	13.2	LOS B	0.3	2.4	0.74	0.68	38.9
Approach		300	11.7	0.358	8.8	LOS A	2.7	20.8	0.75	0.64	42.6
All Vehicles		863	12.6	0.481	9.3	LOS A	2.7	20.8	0.80	0.68	42.9

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians								
Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P1	South Full Crossing	20	9.6	LOS A	0.0	0.0	0.80	0.80
P2	East Full Crossing	20	9.6	LOS A	0.0	0.0	0.80	0.80
P3	North Full Crossing	20	9.6	LOS A	0.0	0.0	0.80	0.80
P4	West Full Crossing	20	9.6	LOS A	0.0	0.0	0.80	0.80
All Pedestrians		80	9.6	LOS A			0.80	0.80

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

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MOVEMENT SUMMARY

Site: 5330 [Lawrence St 2021 PM - 2% No Proj]

Beaufort Bypass
Signals - Fixed Time Isolated Cycle Time = 30 seconds (Practical Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Lawrence St											
1	L2	48	10.4	0.432	17.2	LOS B	1.9	15.0	0.92	0.76	38.0
2	T1	41	0.0	0.432	12.5	LOS B	1.9	15.0	0.92	0.76	41.2
3	R2	48	22.9	0.432	17.3	LOS B	1.9	15.0	0.92	0.76	40.5
Approach		137	11.7	0.432	15.8	LOS B	1.9	15.0	0.92	0.76	40.0
East: Western Hwy											
4	L2	35	0.0	0.467	10.8	LOS B	3.0	23.4	0.79	0.69	45.8
5	T1	283	13.1	0.467	6.3	LOS A	3.0	23.4	0.79	0.69	44.2
6	R2	15	6.7	0.044	14.9	LOS B	0.2	1.3	0.80	0.67	40.8
Approach		333	11.4	0.467	7.2	LOS A	3.0	23.4	0.79	0.69	44.2
North: Lawrence St											
7	L2	9	0.0	0.226	16.4	LOS B	1.0	7.2	0.87	0.70	41.6
8	T1	40	2.5	0.226	11.8	LOS B	1.0	7.2	0.87	0.70	42.0
9	R2	26	3.8	0.226	16.4	LOS B	1.0	7.2	0.87	0.70	39.1
Approach		75	2.7	0.226	14.0	LOS B	1.0	7.2	0.87	0.70	41.1
West: Western Hwy											
10	L2	26	0.0	0.038	11.3	LOS B	0.3	1.8	0.67	0.66	40.7
11	T1	371	14.6	0.568	8.7	LOS A	4.6	36.5	0.85	0.72	42.8
12	R2	36	25.0	0.092	13.5	LOS B	0.4	3.5	0.75	0.70	38.6
Approach		433	14.5	0.568	9.3	LOS A	4.6	36.5	0.83	0.72	42.3
All Vehicles		978	12.2	0.568	9.8	LOS A	4.6	36.5	0.83	0.71	42.4

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P1	South Full Crossing	20	9.6	LOS A	0.0	0.0	0.80	0.80
P2	East Full Crossing	20	9.6	LOS A	0.0	0.0	0.80	0.80
P3	North Full Crossing	20	9.6	LOS A	0.0	0.0	0.80	0.80
P4	West Full Crossing	20	9.6	LOS A	0.0	0.0	0.80	0.80
All Pedestrians		80	9.6	LOS A			0.80	0.80

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

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MOVEMENT SUMMARY

Site: 5330 [Lawrence St 2021 AM - 2% Proj]

Beaufort Bypass
Signals - Fixed Time Isolated   Cycle Time = 30 seconds (Practical Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Lawrence St											
1	L2	41	22.0	0.321	14.2	LOS B	1.8	13.9	0.81	0.72	39.6
2	T1	47	10.6	0.321	9.4	LOS A	1.8	13.9	0.81	0.72	42.7
3	R2	59	6.8	0.321	14.1	LOS B	1.8	13.9	0.81	0.72	42.1
Approach		147	12.2	0.321	12.6	LOS B	1.8	13.9	0.81	0.72	41.7
East: Western Hwy											
4	L2	55	9.1	0.262	8.5	LOS A	1.1	8.2	0.71	0.62	46.5
5	T1	109	0.9	0.262	4.0	LOS A	1.1	8.2	0.71	0.62	45.2
6	R2	15	6.7	0.034	13.8	LOS B	0.2	1.3	0.76	0.66	41.3
Approach		179	3.9	0.262	6.2	LOS A	1.1	8.2	0.71	0.62	45.3
North: Lawrence St											
7	L2	13	7.7	0.147	13.4	LOS B	0.8	6.4	0.76	0.63	43.4
8	T1	50	12.0	0.147	8.8	LOS A	0.8	6.4	0.76	0.63	43.8
9	R2	11	9.1	0.147	13.4	LOS B	0.8	6.4	0.76	0.63	41.3
Approach		74	10.8	0.147	10.3	LOS B	0.8	6.4	0.76	0.63	43.4
West: Western Hwy											
10	L2	35	0.0	0.071	13.9	LOS B	0.4	2.8	0.77	0.68	39.1
11	T1	73	0.0	0.140	9.5	LOS A	0.9	6.0	0.79	0.60	42.3
12	R2	28	10.7	0.066	14.0	LOS B	0.3	2.5	0.77	0.69	38.4
Approach		136	2.2	0.140	11.6	LOS B	0.9	6.0	0.78	0.64	40.6
All Vehicles		536	6.7	0.321	9.9	LOS A	1.8	13.9	0.77	0.65	42.8

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P1	South Full Crossing	20	9.6	LOS A	0.0	0.0	0.80	0.80
P2	East Full Crossing	20	9.6	LOS A	0.0	0.0	0.80	0.80
P3	North Full Crossing	20	9.6	LOS A	0.0	0.0	0.80	0.80
P4	West Full Crossing	20	9.6	LOS A	0.0	0.0	0.80	0.80
All Pedestrians		80	9.6	LOS A			0.80	0.80

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

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MOVEMENT SUMMARY

Site: 5330 [Lawrence St 2021 PM - 2% Proj]

Beaufort Bypass
Signals - Fixed Time Isolated   Cycle Time = 30 seconds (Practical Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Lawrence St											
1	L2	48	10.4	0.289	14.0	LOS B	1.7	12.7	0.80	0.72	39.9
2	T1	41	0.0	0.289	9.3	LOS A	1.7	12.7	0.80	0.72	42.8
3	R2	48	22.9	0.289	14.1	LOS B	1.7	12.7	0.80	0.72	42.0
Approach		137	11.7	0.289	12.6	LOS B	1.7	12.7	0.80	0.72	41.6
East: Western Hwy											
4	L2	35	0.0	0.229	8.9	LOS A	1.0	7.1	0.73	0.61	46.5
5	T1	101	1.0	0.229	4.4	LOS A	1.0	7.1	0.73	0.61	45.1
6	R2	15	6.7	0.038	14.7	LOS B	0.2	1.3	0.80	0.67	40.8
Approach		151	1.3	0.229	6.5	LOS A	1.0	7.1	0.73	0.62	44.9
North: Lawrence St											
7	L2	8	0.0	0.144	13.3	LOS B	0.8	5.9	0.76	0.64	43.2
8	T1	40	2.5	0.144	8.8	LOS A	0.8	5.9	0.76	0.64	43.6
9	R2	24	4.2	0.144	13.4	LOS B	0.8	5.9	0.76	0.64	41.0
Approach		72	2.8	0.144	10.8	LOS B	0.8	5.9	0.76	0.64	42.8
West: Western Hwy											
10	L2	24	0.0	0.048	13.8	LOS B	0.3	1.9	0.77	0.67	39.2
11	T1	119	2.5	0.233	9.9	LOS A	1.5	10.4	0.82	0.64	42.1
12	R2	36	25.0	0.090	14.3	LOS B	0.4	3.6	0.78	0.70	38.2
Approach		179	6.7	0.233	11.3	LOS B	1.5	10.4	0.80	0.66	40.8
All Vehicles		539	5.9	0.289	10.2	LOS B	1.7	12.7	0.78	0.66	42.4

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P1	South Full Crossing	20	9.6	LOS A	0.0	0.0	0.80	0.80
P2	East Full Crossing	20	9.6	LOS A	0.0	0.0	0.80	0.80
P3	North Full Crossing	20	9.6	LOS A	0.0	0.0	0.80	0.80
P4	West Full Crossing	20	9.6	LOS A	0.0	0.0	0.80	0.80
All Pedestrians		80	9.6	LOS A			0.80	0.80

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

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PHASING SUMMARY

Site: 5330 [Lawrence St 2021 AM - 2% No Proj]

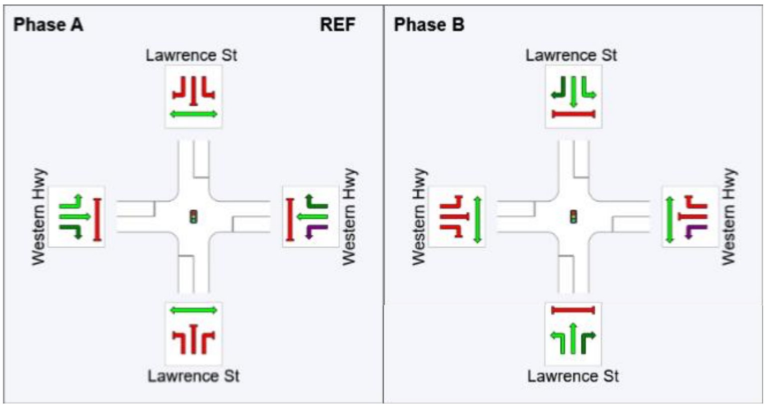
Beaufort Bypass
Signals - Fixed Time Isolated   Cycle Time = 30 seconds (Practical Cycle Time)

Phase Times determined by the program
Phase Sequence: Two-Phase
Reference Phase: Phase A
Input Phase Sequence: A, B
Output Phase Sequence: A, B

Phase Timing Results

Phase	A	B
Phase Change Time (sec)	0	18
Green Time (sec)	11	6
Phase Time (sec)	17	13
Phase Split	57%	43%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.



REF: Reference Phase
VAR: Variable Phase

Normal Movement	Permitted/Opposed
Slip/Bypass-Lane Movement	Opposed Slip/Bypass-Lane
Stopped Movement	Turn On Red
Other Movement Class Running	Other Movement Class Stopped
Mixed Running & Stopped Movement Classes	
Undetected Movement	Phase Transition Applied

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PHASING SUMMARY

Site: 5330 [Lawrence St 2021 PM - 2% No Proj]

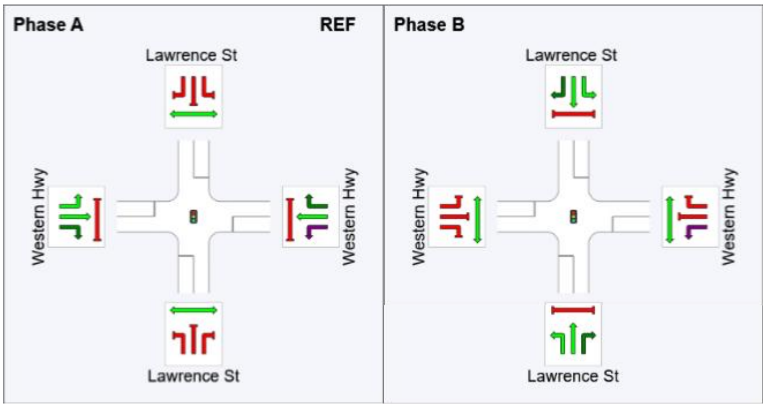
Beaufort Bypass
Signals - Fixed Time Isolated   Cycle Time = 30 seconds (Practical Cycle Time)

Phase Times determined by the program
Phase Sequence: Two-Phase
Reference Phase: Phase A
Input Phase Sequence: A, B
Output Phase Sequence: A, B

Phase Timing Results

Phase	A	B
Phase Change Time (sec)	0	18
Green Time (sec)	11	6
Phase Time (sec)	17	13
Phase Split	57%	43%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.



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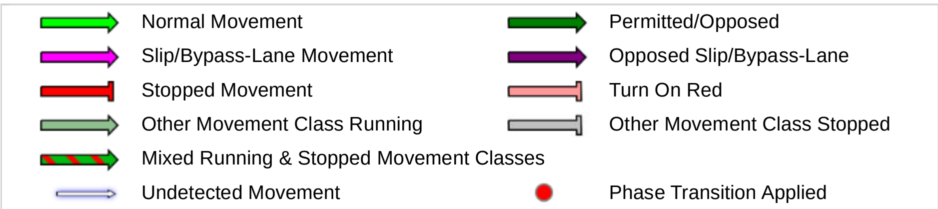
VAR: Variable Phase



PHASING SUMMARY

Site: 5330 [Lawrence St 2021 AM - 2% Proj]

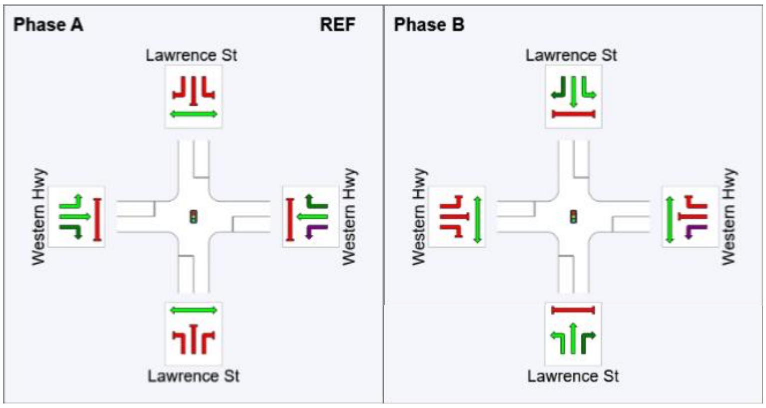
Beaufort Bypass
Signals - Fixed Time Isolated   Cycle Time = 30 seconds (Practical Cycle Time)

Phase Times determined by the program
Phase Sequence: Two-Phase
Reference Phase: Phase A
Input Phase Sequence: A, B
Output Phase Sequence: A, B

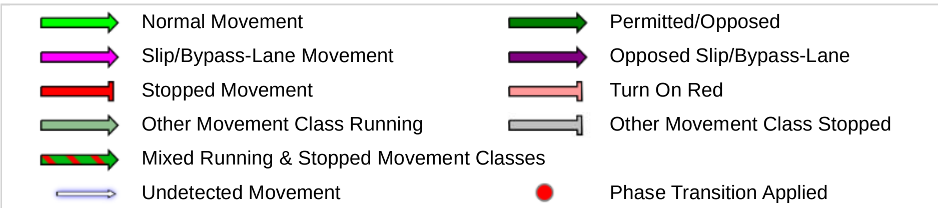
Phase Timing Results

Phase	A	B
Phase Change Time (sec)	0	15
Green Time (sec)	8	9
Phase Time (sec)	14	16
Phase Split	47%	53%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.



REF: Reference Phase
VAR: Variable Phase



PHASING SUMMARY

Site: 5330 [Lawrence St 2021 PM - 2% Proj]

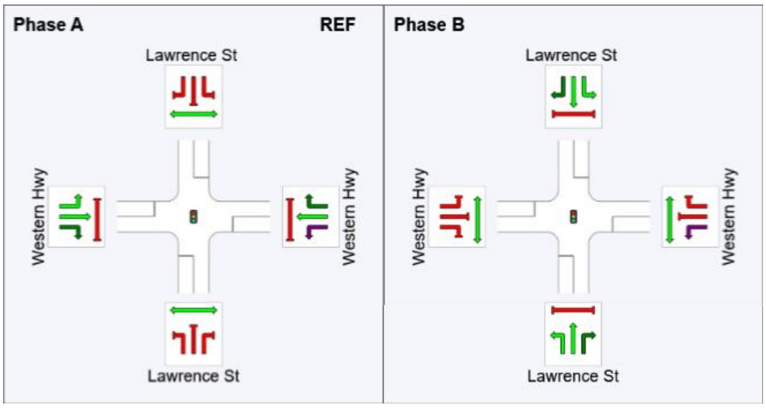
Beaufort Bypass
Signals - Fixed Time Isolated   Cycle Time = 30 seconds (Practical Cycle Time)

Phase Times determined by the program
Phase Sequence: Two-Phase
Reference Phase: Phase A
Input Phase Sequence: A, B
Output Phase Sequence: A, B

Phase Timing Results

Phase	A	B
Phase Change Time (sec)	0	15
Green Time (sec)	8	9
Phase Time (sec)	14	16
Phase Split	47%	53%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.



REF: Reference Phase
VAR: Variable Phase

Normal Movement	Permitted/Opposed
Slip/Bypass-Lane Movement	Opposed Slip/Bypass-Lane
Stopped Movement	Turn On Red
Other Movement Class Running	Other Movement Class Stopped
Mixed Running & Stopped Movement Classes	
Undetected Movement	Phase Transition Applied

Organisation: PARSONS BRINCKERHOFF AUSTRALIA | Processed: Thursday, 14 June 2018 2:21:51 PM
Project: \\APMELFIL01\proj\V\VicRoads\2270290A_BEAUFORT_BYPASS_EES\05_WrkPapers\WP\Draft\Specialist Studies and Risk\Traffic & Transport\Variation Analysis\Western Hwy, Beaufort_sl.sip7

MOVEMENT SUMMARY

▽ Site: 101 [Racecourse Rd 2021 AM - 2% No Proj]

Giveway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Western Hwy											
5	T1	339	14.5	0.179	0.0	LOS A	0.0	0.4	0.01	0.00	59.9
6	R2	3	66.7	0.179	8.9	LOS A	0.0	0.4	0.01	0.00	55.7
Approach		342	14.9	0.179	0.1	NA	0.0	0.4	0.01	0.00	59.9
North: Racecourse Rd											
7	L2	1	0.0	0.001	5.5	LOS A	0.0	0.0	0.36	0.49	48.8
9	R2	1	0.0	0.002	7.6	LOS A	0.0	0.0	0.50	0.58	47.9
Approach		2	0.0	0.002	6.6	LOS A	0.0	0.0	0.43	0.54	48.3
West: Western Hwy											
10	L2	5	60.0	0.172	6.2	LOS A	0.0	0.0	0.00	0.01	55.4
11	T1	305	11.5	0.172	0.0	LOS A	0.0	0.0	0.00	0.01	59.9
Approach		310	12.3	0.172	0.1	NA	0.0	0.0	0.00	0.01	59.8
All Vehicles		654	13.6	0.179	0.1	NA	0.0	0.4	0.01	0.01	59.8

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

▽ Site: 101 [Racecourse Rd 2021 PM - 2% No Proj]

Giveway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Western Hwy											
5	T1	330	11.5	0.174	0.1	LOS A	0.1	0.7	0.03	0.01	59.8
6	R2	6	33.3	0.174	9.0	LOS A	0.1	0.7	0.03	0.01	57.1
Approach		336	11.9	0.174	0.3	NA	0.1	0.7	0.03	0.01	59.7
North: Racecourse Rd											
7	L2	1	0.0	0.001	6.1	LOS A	0.0	0.0	0.44	0.52	48.6
9	R2	2	0.0	0.004	8.6	LOS A	0.0	0.1	0.57	0.65	47.2
Approach		3	0.0	0.004	7.8	LOS A	0.0	0.1	0.52	0.60	47.7
West: Western Hwy											
10	L2	6	33.3	0.241	5.9	LOS A	0.0	0.0	0.00	0.01	56.6
11	T1	422	14.9	0.241	0.0	LOS A	0.0	0.0	0.00	0.01	59.9
Approach		428	15.2	0.241	0.1	NA	0.0	0.0	0.00	0.01	59.8
All Vehicles		767	13.7	0.241	0.2	NA	0.1	0.7	0.02	0.01	59.7

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Organisation: PARSONS BRINCKERHOFF AUSTRALIA | Processed: Wednesday, 21 March 2018 3:09:41 PM
Project: U:\Projects\PS102347_2270290A\05_WrkPapers\WP\Draft\Specialist Studies and Risk\Traffic & Transport\Variation Analysis\Western Hwy, Beaufort.sip7

MOVEMENT SUMMARY

▽ Site: 101 [Racecourse Rd 2021 AM - 2% Proj]

Giveway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Western Hwy											
5	T1	173	1.2	0.086	0.0	LOS A	0.0	0.2	0.02	0.01	59.9
6	R2	3	66.7	0.086	7.2	LOS A	0.0	0.2	0.02	0.01	55.7
Approach		176	2.3	0.086	0.1	NA	0.0	0.2	0.02	0.01	59.8
North: Racecourse Rd											
7	L2	1	0.0	0.001	4.9	LOS A	0.0	0.0	0.23	0.48	49.2
9	R2	1	0.0	0.001	5.7	LOS A	0.0	0.0	0.33	0.51	49.0
Approach		2	0.0	0.001	5.3	LOS A	0.0	0.0	0.28	0.49	49.1
West: Western Hwy											
10	L2	5	60.0	0.077	6.2	LOS A	0.0	0.0	0.00	0.02	55.4
11	T1	141	2.1	0.077	0.0	LOS A	0.0	0.0	0.00	0.02	59.9
Approach		146	4.1	0.077	0.2	NA	0.0	0.0	0.00	0.02	59.7
All Vehicles		324	3.1	0.086	0.2	NA	0.0	0.2	0.01	0.02	59.7

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101 [Racecourse Rd 2021 PM - 2% Proj]

Giveway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Western Hwy											
5	T1	147	0.7	0.075	0.1	LOS A	0.1	0.4	0.03	0.02	59.7
6	R2	6	33.3	0.075	6.8	LOS A	0.1	0.4	0.03	0.02	57.0
Approach		153	2.0	0.075	0.3	NA	0.1	0.4	0.03	0.02	59.6
North: Racecourse Rd											
7	L2	1	0.0	0.001	5.0	LOS A	0.0	0.0	0.25	0.48	49.1
9	R2	2	0.0	0.002	5.7	LOS A	0.0	0.0	0.34	0.52	48.9
Approach		3	0.0	0.002	5.5	LOS A	0.0	0.0	0.31	0.50	49.0
West: Western Hwy											
10	L2	6	33.3	0.094	5.9	LOS A	0.0	0.0	0.00	0.02	56.6
11	T1	168	6.5	0.094	0.0	LOS A	0.0	0.0	0.00	0.02	59.8
Approach		174	7.5	0.094	0.2	NA	0.0	0.0	0.00	0.02	59.7
All Vehicles		330	4.8	0.094	0.3	NA	0.1	0.4	0.02	0.03	59.5

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

▽ Site: 100 [Livingstone St 2021 AM - 2% No Proj]

Giveway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Livingstone St											
1	L2	1	0.0	0.037	5.7	LOS A	0.1	0.9	0.67	0.80	43.1
2	T1	2	50.0	0.037	20.2	LOS C	0.1	0.9	0.67	0.80	40.6
3	R2	6	0.0	0.037	16.5	LOS C	0.1	0.9	0.67	0.80	39.3
Approach		9	11.1	0.037	16.1	LOS C	0.1	0.9	0.67	0.80	40.1
East: Western Hwy											
4	L2	14	7.1	0.027	4.6	LOS A	0.0	0.0	0.00	0.16	47.9
5	T1	269	16.7	0.133	0.0	LOS A	0.0	0.0	0.00	0.02	49.8
6	R2	45	13.3	0.045	6.0	LOS A	0.2	1.4	0.37	0.56	44.1
Approach		328	15.9	0.133	1.0	NA	0.2	1.4	0.05	0.10	48.9
North: Havelock St											
7	L2	42	0.0	0.057	4.8	LOS A	0.2	1.4	0.18	0.51	44.1
8	T1	4	0.0	0.057	13.4	LOS B	0.2	1.4	0.18	0.51	46.1
9	R2	1	100.0	0.057	39.2	LOS E	0.2	1.4	0.18	0.51	47.3
Approach		47	2.1	0.057	6.3	LOS A	0.2	1.4	0.18	0.51	44.4
West: Western Hwy											
10	L2	1	0.0	0.039	5.5	LOS A	0.0	0.0	0.00	0.20	57.3
11	T1	260	13.8	0.106	1.2	LOS A	0.0	0.0	0.00	0.20	59.3
12	R2	1	0.0	0.001	6.7	LOS A	0.0	0.0	0.37	0.52	49.0
Approach		262	13.7	0.106	1.2	NA	0.0	0.0	0.00	0.20	59.3
All Vehicles		646	13.9	0.133	1.7	NA	0.2	1.4	0.05	0.18	52.0

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

▽ Site: 100 [Livingstone St 2021 PM - 2% No Proj]

Giveway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Livingstone St											
1	L2	1	0.0	0.089	5.9	LOS A	0.3	2.1	0.79	0.88	39.0
2	T1	3	0.0	0.089	18.5	LOS C	0.3	2.1	0.79	0.88	37.3
3	R2	10	20.0	0.089	29.1	LOS D	0.3	2.1	0.79	0.88	33.6
Approach		14	14.3	0.089	25.1	LOS D	0.3	2.1	0.79	0.88	35.0
East: Western Hwy											
4	L2	11	0.0	0.029	4.6	LOS A	0.0	0.0	0.00	0.11	48.4
5	T1	305	12.5	0.144	0.0	LOS A	0.0	0.0	0.00	0.02	49.8
6	R2	42	2.4	0.047	6.7	LOS A	0.2	1.3	0.46	0.63	43.9
Approach		358	10.9	0.144	0.9	NA	0.2	1.3	0.05	0.09	49.0
North: Havelock St											
7	L2	20	5.0	0.090	5.0	LOS A	0.3	2.1	0.36	0.57	40.2
8	T1	5	20.0	0.090	23.7	LOS C	0.3	2.1	0.36	0.57	42.8
9	R2	8	0.0	0.090	22.4	LOS C	0.3	2.1	0.36	0.57	45.5
Approach		33	6.1	0.090	12.1	LOS B	0.3	2.1	0.36	0.57	42.1
West: Western Hwy											
10	L2	13	7.7	0.062	5.6	LOS A	0.0	0.0	0.00	0.24	56.5
11	T1	400	14.3	0.168	1.2	LOS A	0.0	0.0	0.00	0.21	59.2
12	R2	1	0.0	0.001	6.8	LOS A	0.0	0.0	0.39	0.53	48.9
Approach		414	14.0	0.168	1.4	NA	0.0	0.0	0.00	0.21	59.0
All Vehicles		819	12.3	0.168	2.0	NA	0.3	2.1	0.05	0.18	52.7

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

▽ Site: 100 [Livingstone St 2021 AM - 2% Proj]

Giveway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Livingstone St											
1	L2	1	0.0	0.018	4.9	LOS A	0.1	0.5	0.40	0.57	47.8
2	T1	2	50.0	0.018	8.3	LOS A	0.1	0.5	0.40	0.57	44.8
3	R2	6	0.0	0.018	8.1	LOS A	0.1	0.5	0.40	0.57	44.8
Approach		9	11.1	0.018	7.8	LOS A	0.1	0.5	0.40	0.57	45.2
East: Western Hwy											
4	L2	14	7.1	0.010	4.6	LOS A	0.0	0.0	0.00	0.40	46.2
5	T1	104	1.0	0.051	0.0	LOS A	0.0	0.0	0.00	0.02	49.9
6	R2	45	13.3	0.037	5.1	LOS A	0.1	1.1	0.20	0.50	44.7
Approach		163	4.9	0.051	1.8	NA	0.1	1.1	0.06	0.18	48.0
North: Havelock St											
7	L2	42	0.0	0.043	4.6	LOS A	0.2	1.1	0.07	0.50	45.1
8	T1	4	0.0	0.043	6.6	LOS A	0.2	1.1	0.07	0.50	46.9
9	R2	1	100.0	0.043	12.4	LOS B	0.2	1.1	0.07	0.50	48.1
Approach		47	2.1	0.043	5.0	LOS A	0.2	1.1	0.07	0.50	45.4
West: Western Hwy											
10	L2	1	0.0	0.013	5.5	LOS A	0.0	0.0	0.00	0.22	57.2
11	T1	95	3.2	0.036	1.2	LOS A	0.0	0.0	0.00	0.20	59.4
12	R2	1	0.0	0.001	5.9	LOS A	0.0	0.0	0.22	0.51	49.4
Approach		97	3.1	0.036	1.3	NA	0.0	0.0	0.00	0.21	59.2
All Vehicles		316	4.1	0.051	2.3	NA	0.2	1.1	0.05	0.25	50.4

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

▽ Site: 100 [Livingstone St 2021 PM - 2% Proj]

Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Livingstone St											
1	L2	1	0.0	0.033	5.0	LOS A	0.1	0.9	0.46	0.62	47.0
2	T1	3	0.0	0.033	7.4	LOS A	0.1	0.9	0.46	0.62	44.6
3	R2	10	20.0	0.033	10.0	LOS A	0.1	0.9	0.46	0.62	42.2
Approach		14	14.3	0.033	9.1	LOS A	0.1	0.9	0.46	0.62	43.2
East: Western Hwy											
4	L2	11	0.0	0.011	4.6	LOS A	0.0	0.0	0.00	0.28	47.3
5	T1	121	0.8	0.056	0.0	LOS A	0.0	0.0	0.00	0.02	49.8
6	R2	42	2.4	0.034	5.2	LOS A	0.1	1.0	0.26	0.51	44.7
Approach		174	1.1	0.056	1.5	NA	0.1	1.0	0.06	0.16	48.3
North: Havelock St											
7	L2	20	5.0	0.044	4.7	LOS A	0.2	1.1	0.10	0.51	44.1
8	T1	5	20.0	0.044	8.5	LOS A	0.2	1.1	0.10	0.51	45.9
9	R2	8	0.0	0.044	8.6	LOS A	0.2	1.1	0.10	0.51	49.0
Approach		33	6.1	0.044	6.2	LOS A	0.2	1.1	0.10	0.51	45.8
West: Western Hwy											
10	L2	13	7.7	0.022	5.6	LOS A	0.0	0.0	0.00	0.32	55.8
11	T1	145	3.4	0.061	1.2	LOS A	0.0	0.0	0.00	0.22	59.1
12	R2	1	0.0	0.001	6.0	LOS A	0.0	0.0	0.23	0.51	49.4
Approach		159	3.8	0.061	1.6	NA	0.0	0.0	0.00	0.23	58.6
All Vehicles		380	3.2	0.061	2.2	NA	0.2	1.1	0.06	0.24	51.6

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 5330 [Lawrence St 2031 AM - 2% No Proj]

Beaufort Bypass
Signals - Fixed Time Isolated Cycle Time = 30 seconds (Practical Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Lawrence St											
1	L2	51	21.6	0.614	18.5	LOS B	2.8	21.7	0.96	0.85	37.2
2	T1	58	12.1	0.614	13.8	LOS B	2.8	21.7	0.96	0.85	40.6
3	R2	72	6.9	0.614	18.4	LOS B	2.8	21.7	0.96	0.85	40.1
Approach		181	12.7	0.614	17.0	LOS B	2.8	21.7	0.96	0.85	39.6
East: Western Hwy											
4	L2	68	10.3	0.569	10.3	LOS B	3.6	28.6	0.82	0.73	45.9
5	T1	328	15.5	0.569	5.7	LOS A	3.6	28.6	0.82	0.73	44.5
6	R2	18	5.6	0.046	13.9	LOS B	0.2	1.5	0.77	0.67	41.2
Approach		414	14.3	0.569	6.8	LOS A	3.6	28.6	0.81	0.72	44.6
North: Lawrence St											
7	L2	17	5.9	0.301	16.7	LOS B	1.3	10.0	0.89	0.71	41.7
8	T1	62	12.9	0.301	12.1	LOS B	1.3	10.0	0.89	0.71	42.1
9	R2	16	6.3	0.301	16.7	LOS B	1.3	10.0	0.89	0.71	39.2
Approach		95	10.5	0.301	13.7	LOS B	1.3	10.0	0.89	0.71	41.6
West: Western Hwy											
10	L2	45	0.0	0.073	12.2	LOS B	0.5	3.3	0.71	0.68	40.1
11	T1	288	13.9	0.439	8.2	LOS A	3.4	26.5	0.80	0.67	43.2
12	R2	34	11.8	0.086	14.2	LOS B	0.4	3.1	0.78	0.70	38.4
Approach		367	12.0	0.439	9.2	LOS A	3.4	26.5	0.79	0.67	42.3
All Vehicles		1057	12.9	0.614	10.0	LOS B	3.6	28.6	0.84	0.73	42.5

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P1	South Full Crossing	50	9.6	LOS A	0.0	0.0	0.80	0.80
P2	East Full Crossing	50	9.6	LOS A	0.0	0.0	0.80	0.80
P3	North Full Crossing	50	9.6	LOS A	0.0	0.0	0.80	0.80
P4	West Full Crossing	50	9.6	LOS A	0.0	0.0	0.80	0.80
All Pedestrians		200	9.6	LOS A			0.80	0.80

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.

Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: 5330 [Lawrence St 2031 PM - 2% No Proj]

Beaufort Bypass
Signals - Fixed Time Isolated   Cycle Time = 30 seconds (Practical Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Lawrence St											
1	L2	60	11.7	0.589	18.3	LOS B	2.6	19.8	0.95	0.84	37.4
2	T1	50	0.0	0.589	13.6	LOS B	2.6	19.8	0.95	0.84	40.7
3	R2	58	22.4	0.589	18.4	LOS B	2.6	19.8	0.95	0.84	40.0
Approach		168	11.9	0.589	16.9	LOS B	2.6	19.8	0.95	0.84	39.5
East: Western Hwy											
4	L2	42	0.0	0.568	11.6	LOS B	4.1	31.4	0.83	0.73	45.4
5	T1	345	13.0	0.568	7.1	LOS A	4.1	31.4	0.83	0.73	43.6
6	R2	18	5.6	0.061	16.8	LOS B	0.2	1.8	0.87	0.68	39.9
Approach		405	11.4	0.568	8.0	LOS A	4.1	31.4	0.83	0.73	43.6
North: Lawrence St											
7	L2	11	0.0	0.289	16.6	LOS B	1.2	8.9	0.89	0.71	41.5
8	T1	49	2.0	0.289	12.1	LOS B	1.2	8.9	0.89	0.71	41.9
9	R2	31	3.2	0.289	16.7	LOS B	1.2	8.9	0.89	0.71	39.0
Approach		91	2.2	0.289	14.2	LOS B	1.2	8.9	0.89	0.71	41.0
West: Western Hwy											
10	L2	32	0.0	0.052	12.1	LOS B	0.3	2.3	0.70	0.67	40.2
11	T1	453	14.6	0.694	10.5	LOS B	6.5	50.9	0.90	0.86	41.7
12	R2	44	25.0	0.125	14.5	LOS B	0.5	4.5	0.79	0.71	38.0
Approach		529	14.6	0.694	10.9	LOS B	6.5	50.9	0.88	0.83	41.2
All Vehicles		1193	12.2	0.694	11.0	LOS B	6.5	50.9	0.87	0.79	41.7

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P1	South Full Crossing	50	9.6	LOS A	0.0	0.0	0.80	0.80
P2	East Full Crossing	50	9.6	LOS A	0.0	0.0	0.80	0.80
P3	North Full Crossing	50	9.6	LOS A	0.0	0.0	0.80	0.80
P4	West Full Crossing	50	9.6	LOS A	0.0	0.0	0.80	0.80
All Pedestrians		200	9.6	LOS A			0.80	0.80

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.

Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: 5330 [Lawrence St 2031 AM - 2% Proj]

Beaufort Bypass
Signals - Fixed Time Isolated   Cycle Time = 30 seconds (Practical Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Lawrence St											
1	L2	51	21.6	0.425	14.6	LOS B	2.3	18.0	0.84	0.75	39.4
2	T1	58	12.1	0.425	9.9	LOS A	2.3	18.0	0.84	0.75	42.5
3	R2	72	6.9	0.425	14.5	LOS B	2.3	18.0	0.84	0.75	41.9
Approach		181	12.7	0.425	13.1	LOS B	2.3	18.0	0.84	0.75	41.5
East: Western Hwy											
4	L2	68	10.3	0.319	8.7	LOS A	1.4	10.4	0.73	0.64	46.4
5	T1	133	0.8	0.319	4.1	LOS A	1.4	10.4	0.73	0.64	45.1
6	R2	18	5.6	0.045	14.8	LOS B	0.2	1.6	0.80	0.67	40.8
Approach		219	4.1	0.319	6.4	LOS A	1.4	10.4	0.73	0.64	45.1
North: Lawrence St											
7	L2	15	6.7	0.184	13.6	LOS B	1.0	8.0	0.77	0.64	43.3
8	T1	62	12.9	0.184	8.9	LOS A	1.0	8.0	0.77	0.64	43.8
9	R2	13	7.7	0.184	13.6	LOS B	1.0	8.0	0.77	0.64	41.2
Approach		90	11.1	0.184	10.4	LOS B	1.0	8.0	0.77	0.64	43.4
West: Western Hwy											
10	L2	43	0.0	0.099	14.9	LOS B	0.5	3.7	0.81	0.70	38.6
11	T1	90	1.1	0.174	9.7	LOS A	1.1	7.6	0.80	0.62	42.2
12	R2	34	11.8	0.095	15.1	LOS B	0.4	3.2	0.81	0.70	37.8
Approach		167	3.0	0.174	12.1	LOS B	1.1	7.6	0.81	0.66	40.3
All Vehicles		657	7.2	0.425	10.2	LOS B	2.3	18.0	0.79	0.67	42.6

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P1	South Full Crossing	50	9.6	LOS A	0.0	0.0	0.80	0.80
P2	East Full Crossing	50	9.6	LOS A	0.0	0.0	0.80	0.80
P3	North Full Crossing	50	9.6	LOS A	0.0	0.0	0.80	0.80
P4	West Full Crossing	50	9.6	LOS A	0.0	0.0	0.80	0.80
All Pedestrians		200	9.6	LOS A			0.80	0.80

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.

Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: 5330 [Lawrence St 2031 PM - 2% Proj]

Beaufort Bypass
Signals - Fixed Time Isolated Cycle Time = 30 seconds (Practical Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Lawrence St											
1	L2	60	11.7	0.381	14.4	LOS B	2.1	16.3	0.83	0.74	39.7
2	T1	50	0.0	0.381	9.7	LOS A	2.1	16.3	0.83	0.74	42.6
3	R2	58	22.4	0.381	14.5	LOS B	2.1	16.3	0.83	0.74	41.8
Approach		168	11.9	0.381	13.0	LOS B	2.1	16.3	0.83	0.74	41.4
East: Western Hwy											
4	L2	42	0.0	0.283	9.0	LOS A	1.2	8.7	0.75	0.63	46.4
5	T1	123	0.8	0.283	4.5	LOS A	1.2	8.7	0.75	0.63	45.0
6	R2	17	5.9	0.043	14.8	LOS B	0.2	1.5	0.80	0.67	40.8
Approach		182	1.1	0.283	6.5	LOS A	1.2	8.7	0.75	0.64	44.9
North: Lawrence St											
7	L2	9	0.0	0.182	13.5	LOS B	1.0	7.3	0.77	0.66	43.1
8	T1	49	2.0	0.182	8.9	LOS A	1.0	7.3	0.77	0.66	43.5
9	R2	30	3.3	0.182	13.5	LOS B	1.0	7.3	0.77	0.66	40.9
Approach		88	2.3	0.182	11.0	LOS B	1.0	7.3	0.77	0.66	42.7
West: Western Hwy											
10	L2	30	3.3	0.071	14.8	LOS B	0.4	2.6	0.81	0.68	38.6
11	T1	145	2.1	0.283	10.0	LOS B	1.8	12.8	0.83	0.66	41.9
12	R2	44	25.0	0.129	15.4	LOS B	0.6	4.7	0.82	0.71	37.5
Approach		219	6.8	0.283	11.8	LOS B	1.8	12.8	0.83	0.67	40.5
All Vehicles		657	5.9	0.381	10.5	LOS B	2.1	16.3	0.80	0.68	42.2

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P1	South Full Crossing	50	9.6	LOS A	0.0	0.0	0.80	0.80
P2	East Full Crossing	50	9.6	LOS A	0.0	0.0	0.80	0.80
P3	North Full Crossing	50	9.6	LOS A	0.0	0.0	0.80	0.80
P4	West Full Crossing	50	9.6	LOS A	0.0	0.0	0.80	0.80
All Pedestrians		200	9.6	LOS A			0.80	0.80

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.

Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

▽ Site: 101 [Racecourse Rd 2031 AM - 2% No Proj]

Giveway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Western Hwy											
5	T1	413	14.3	0.217	0.1	LOS A	0.1	0.5	0.01	0.00	59.9
6	R2	3	66.7	0.217	9.9	LOS A	0.1	0.5	0.01	0.00	55.7
Approach		416	14.7	0.217	0.1	NA	0.1	0.5	0.01	0.00	59.9
North: Racecourse Rd											
7	L2	1	0.0	0.001	5.8	LOS A	0.0	0.0	0.41	0.50	48.7
9	R2	1	0.0	0.002	8.8	LOS A	0.0	0.0	0.58	0.63	47.1
Approach		2	0.0	0.002	7.3	LOS A	0.0	0.0	0.49	0.57	47.9
West: Western Hwy											
10	L2	5	60.0	0.209	6.3	LOS A	0.0	0.0	0.00	0.01	55.4
11	T1	372	11.6	0.209	0.0	LOS A	0.0	0.0	0.00	0.01	59.9
Approach		377	12.2	0.209	0.1	NA	0.0	0.0	0.00	0.01	59.9
All Vehicles		795	13.5	0.217	0.1	NA	0.1	0.5	0.01	0.01	59.8

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

▽ Site: 101 [Racecourse Rd 2031 PM - 2% No Proj]

Giveway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Western Hwy											
5	T1	403	11.4	0.212	0.1	LOS A	0.1	0.9	0.03	0.01	59.7
6	R2	6	33.3	0.212	10.3	LOS B	0.1	0.9	0.03	0.01	57.0
Approach		409	11.7	0.212	0.3	NA	0.1	0.9	0.03	0.01	59.7
North: Racecourse Rd											
7	L2	1	0.0	0.001	6.6	LOS A	0.0	0.0	0.49	0.54	48.5
9	R2	2	0.0	0.005	10.5	LOS B	0.0	0.1	0.66	0.72	46.2
Approach		3	0.0	0.005	9.2	LOS A	0.0	0.1	0.60	0.66	46.9
West: Western Hwy											
10	L2	6	33.3	0.294	6.0	LOS A	0.0	0.0	0.00	0.01	56.6
11	T1	515	15.0	0.294	0.0	LOS A	0.0	0.0	0.00	0.01	59.9
Approach		521	15.2	0.294	0.1	NA	0.0	0.0	0.00	0.01	59.8
All Vehicles		933	13.6	0.294	0.2	NA	0.1	0.9	0.02	0.01	59.7

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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MOVEMENT SUMMARY

▽ Site: 101 [Racecourse Rd 2031 AM - 2% Proj]

Giveway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Western Hwy											
5	T1	211	0.9	0.104	0.0	LOS A	0.0	0.3	0.01	0.01	59.9
6	R2	3	66.7	0.104	7.4	LOS A	0.0	0.3	0.01	0.01	55.7
Approach		214	1.9	0.104	0.1	NA	0.0	0.3	0.01	0.01	59.8
North: Racecourse Rd											
7	L2	1	0.0	0.001	5.0	LOS A	0.0	0.0	0.25	0.48	49.1
9	R2	1	0.0	0.001	6.0	LOS A	0.0	0.0	0.37	0.52	48.9
Approach		2	0.0	0.001	5.5	LOS A	0.0	0.0	0.31	0.50	49.0
West: Western Hwy											
10	L2	5	60.0	0.093	6.2	LOS A	0.0	0.0	0.00	0.02	55.4
11	T1	172	2.3	0.093	0.0	LOS A	0.0	0.0	0.00	0.02	59.9
Approach		177	4.0	0.093	0.2	NA	0.0	0.0	0.00	0.02	59.8
All Vehicles		393	2.8	0.104	0.2	NA	0.0	0.3	0.01	0.01	59.7

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Organisation: PARSONS BRINCKERHOFF AUSTRALIA | Processed: Wednesday, 21 March 2018 12:30:30 PM
Project: U:\Projects\PS102347_2270290A\05_WrkPapers\WP\Draft\Specialist Studies and Risk\Traffic & Transport\Variation Analysis\Western Hwy, Beaufort.sip7

MOVEMENT SUMMARY

▽ Site: 101 [Racecourse Rd 2031 PM - 2% Proj]

Giveway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Western Hwy											
5	T1	180	0.6	0.091	0.1	LOS A	0.1	0.4	0.03	0.02	59.7
6	R2	6	33.3	0.091	7.0	LOS A	0.1	0.4	0.03	0.02	57.0
Approach		186	1.6	0.091	0.3	NA	0.1	0.4	0.03	0.02	59.6
North: Racecourse Rd											
7	L2	1	0.0	0.001	5.1	LOS A	0.0	0.0	0.29	0.48	49.0
9	R2	2	0.0	0.002	6.0	LOS A	0.0	0.0	0.38	0.53	48.8
Approach		3	0.0	0.002	5.7	LOS A	0.0	0.0	0.35	0.52	48.9
West: Western Hwy											
10	L2	6	33.3	0.114	5.9	LOS A	0.0	0.0	0.00	0.02	56.6
11	T1	206	6.8	0.114	0.0	LOS A	0.0	0.0	0.00	0.02	59.9
Approach		212	7.5	0.114	0.2	NA	0.0	0.0	0.00	0.02	59.8
All Vehicles		401	4.7	0.114	0.3	NA	0.1	0.4	0.02	0.02	59.6

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

PHASING SUMMARY

Site: 5330 [Lawrence St 2031 AM - 2% No Proj]

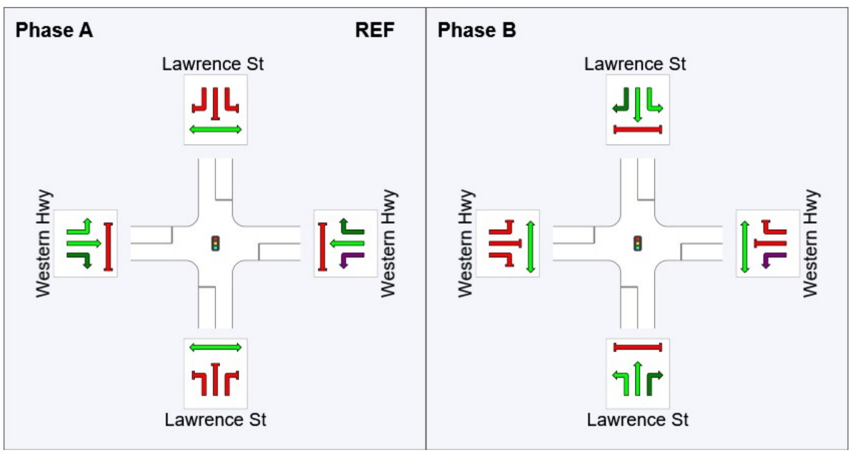
Beaufort Bypass
Signals - Fixed Time Isolated   Cycle Time = 30 seconds (Practical Cycle Time)

Phase Times determined by the program
Phase Sequence: Two-Phase
Reference Phase: Phase A
Input Phase Sequence: A, B
Output Phase Sequence: A, B

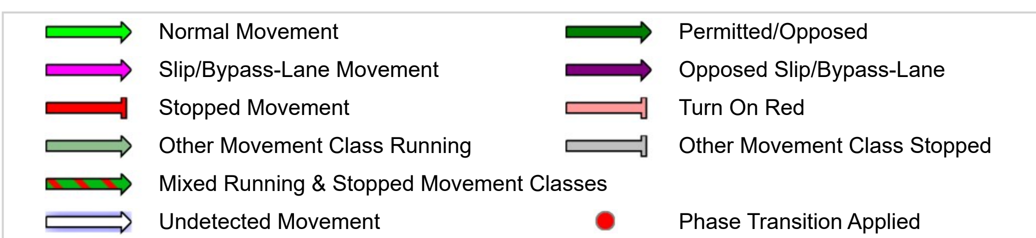
Phase Timing Results

Phase	A	B
Phase Change Time (sec)	0	18
Green Time (sec)	11	6
Phase Time (sec)	17	13
Phase Split	57%	43%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.



REF: Reference Phase
VAR: Variable Phase



PHASING SUMMARY

Site: 5330 [Lawrence St 2031 PM - 2% No Proj]

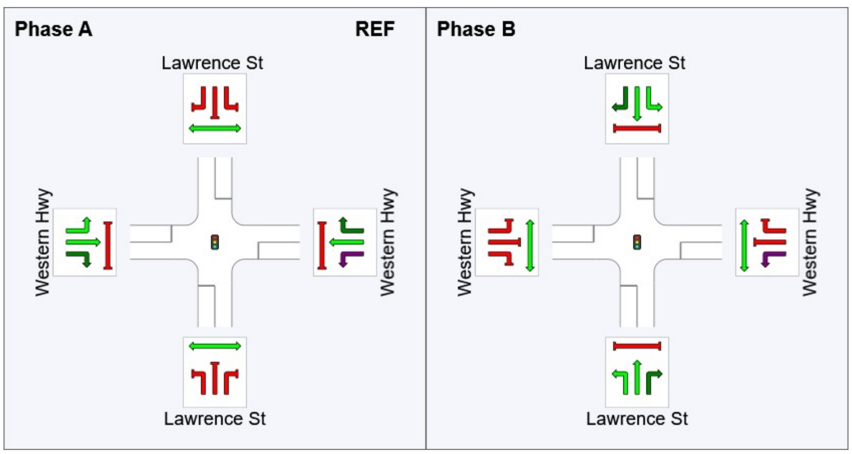
Beaufort Bypass
Signals - Fixed Time Isolated   Cycle Time = 30 seconds (Practical Cycle Time)

Phase Times determined by the program
Phase Sequence: Two-Phase
Reference Phase: Phase A
Input Phase Sequence: A, B
Output Phase Sequence: A, B

Phase Timing Results

Phase	A	B
Phase Change Time (sec)	0	18
Green Time (sec)	11	6
Phase Time (sec)	17	13
Phase Split	57%	43%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.



REF: Reference Phase
VAR: Variable Phase

Normal Movement	Permitted/Opposed
Slip/Bypass-Lane Movement	Opposed Slip/Bypass-Lane
Stopped Movement	Turn On Red
Other Movement Class Running	Other Movement Class Stopped
Mixed Running & Stopped Movement Classes	
Undetected Movement	Phase Transition Applied

Organisation: PARSONS BRINCKERHOFF AUSTRALIA | Processed: Wednesday, 21 March 2018 12:08:09 PM
Project: U:\Projects\PS102347_2270290A\05_WrkPapers\WP\Draft\Specialist Studies and Risk\Traffic & Transport\Variation Analysis\Western Hwy, Beaufort.sip7

PHASING SUMMARY

Site: 5330 [Lawrence St 2031 AM - 2% Proj]

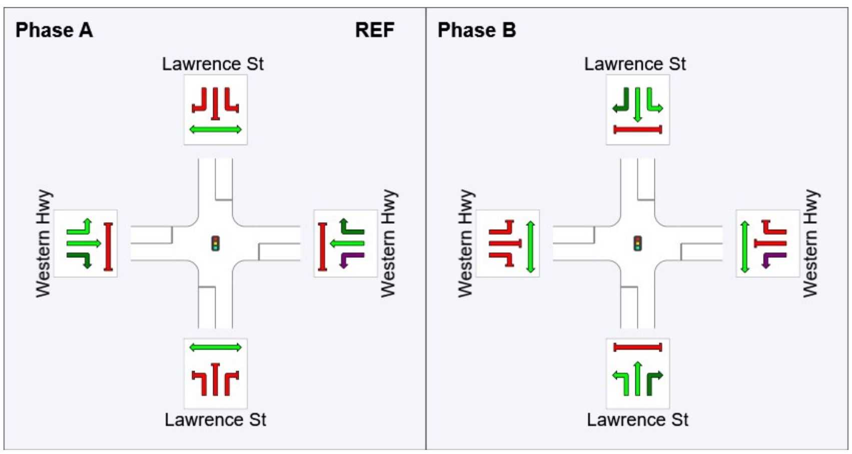
Beaufort Bypass
Signals - Fixed Time Isolated   Cycle Time = 30 seconds (Practical Cycle Time)

Phase Times determined by the program
Phase Sequence: Two-Phase
Reference Phase: Phase A
Input Phase Sequence: A, B
Output Phase Sequence: A, B

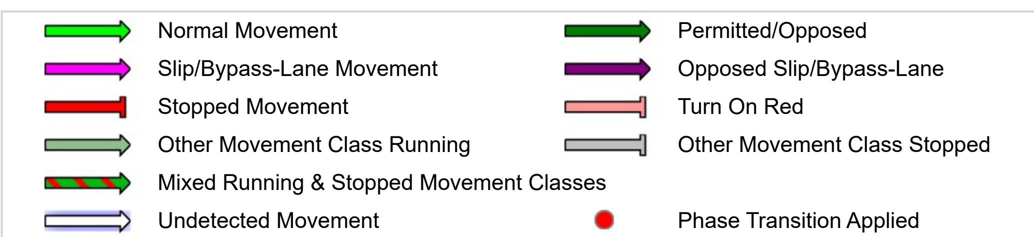
Phase Timing Results

Phase	A	B
Phase Change Time (sec)	0	15
Green Time (sec)	8	9
Phase Time (sec)	14	16
Phase Split	47%	53%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.



REF: Reference Phase
VAR: Variable Phase



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PHASING SUMMARY

Site: 5330 [Lawrence St 2031 PM - 2% Proj]

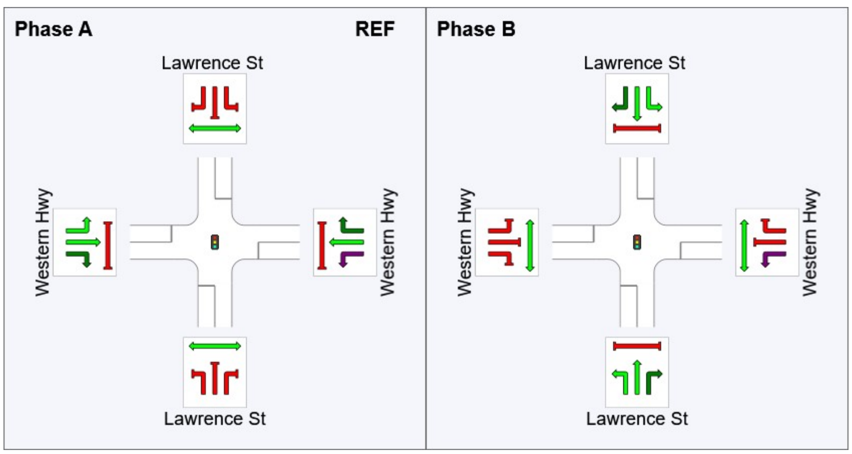
Beaufort Bypass
Signals - Fixed Time Isolated   Cycle Time = 30 seconds (Practical Cycle Time)

Phase Times determined by the program
Phase Sequence: Two-Phase
Reference Phase: Phase A
Input Phase Sequence: A, B
Output Phase Sequence: A, B

Phase Timing Results

Phase	**A**	**B**
Phase Change Time (sec)	0	15
Green Time (sec)	8	9
Phase Time (sec)	14	16
Phase Split	47%	53%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.



REF: Reference Phase
VAR: Variable Phase

- Normal Movement
- Permitted/Opposed
- Slip/Bypass-Lane Movement
- Opposed Slip/Bypass-Lane
- Stopped Movement
- Turn On Red
- Other Movement Class Running
- Other Movement Class Stopped
- Mixed Running & Stopped Movement Classes
- Undetected Movement
- Phase Transition Applied

Organisation: PARSONS BRINCKERHOFF AUSTRALIA | Processed: Wednesday, 21 March 2018 12:31:25 PM
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MOVEMENT SUMMARY

▽ Site: 100 [Livingstone St 2031 AM - 2% No Proj]

Giveway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Livingstone St											
1	L2	1	0.0	0.062	6.1	LOS A	0.2	1.4	0.77	0.86	40.3
2	T1	2	50.0	0.062	28.6	LOS D	0.2	1.4	0.77	0.86	38.1
3	R2	8	0.0	0.062	22.5	LOS C	0.2	1.4	0.77	0.86	36.1
Approach		11	9.1	0.062	22.1	LOS C	0.2	1.4	0.77	0.86	37.0
East: Western Hwy											
4	L2	17	5.9	0.032	4.6	LOS A	0.0	0.0	0.00	0.16	47.9
5	T1	328	16.8	0.162	0.0	LOS A	0.0	0.0	0.00	0.02	49.8
6	R2	56	14.3	0.060	6.4	LOS A	0.2	1.8	0.42	0.60	44.0
Approach		401	16.0	0.162	1.1	NA	0.2	1.8	0.06	0.11	48.8
North: Havelock St											
7	L2	51	0.0	0.078	4.9	LOS A	0.3	1.9	0.22	0.51	43.6
8	T1	5	0.0	0.078	17.9	LOS C	0.3	1.9	0.22	0.51	45.7
9	R2	1	100.0	0.078	61.2	LOS F	0.3	1.9	0.22	0.51	46.9
Approach		57	1.8	0.078	7.0	LOS A	0.3	1.9	0.22	0.51	43.9
West: Western Hwy											
10	L2	1	0.0	0.047	5.5	LOS A	0.0	0.0	0.00	0.20	57.3
11	T1	317	13.9	0.129	1.2	LOS A	0.0	0.0	0.00	0.20	59.3
12	R2	1	0.0	0.001	7.0	LOS A	0.0	0.0	0.41	0.53	48.9
Approach		319	13.8	0.129	1.2	NA	0.0	0.0	0.00	0.20	59.3
All Vehicles		788	14.0	0.162	1.9	NA	0.3	1.9	0.06	0.18	51.8

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

▽ Site: 100 [Livingstone St 2031 PM - 2% No Proj]

Giveway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Livingstone St											
1	L2	1	0.0	0.180	7.4	LOS A	0.5	4.3	0.88	0.94	33.1
2	T1	4	0.0	0.180	27.8	LOS D	0.5	4.3	0.88	0.94	31.9
3	R2	12	25.0	0.180	49.7	LOS E	0.5	4.3	0.88	0.94	27.5
Approach		17	17.6	0.180	42.0	LOS E	0.5	4.3	0.88	0.94	29.0
East: Western Hwy											
4	L2	13	0.0	0.035	4.6	LOS A	0.0	0.0	0.00	0.11	48.4
5	T1	372	12.4	0.176	0.0	LOS A	0.0	0.0	0.00	0.02	49.8
6	R2	51	2.0	0.064	7.3	LOS A	0.2	1.7	0.51	0.68	43.4
Approach		436	10.8	0.176	1.0	NA	0.2	1.7	0.06	0.10	49.0
North: Havelock St											
7	L2	25	4.0	0.146	5.1	LOS A	0.5	3.3	0.46	0.60	38.1
8	T1	6	16.7	0.146	34.2	LOS D	0.5	3.3	0.46	0.60	41.1
9	R2	9	0.0	0.146	33.1	LOS D	0.5	3.3	0.46	0.60	43.5
Approach		40	5.0	0.146	15.8	LOS C	0.5	3.3	0.46	0.60	39.9
West: Western Hwy											
10	L2	16	6.3	0.075	5.6	LOS A	0.0	0.0	0.00	0.24	56.5
11	T1	488	14.3	0.205	1.2	LOS A	0.0	0.0	0.00	0.21	59.2
12	R2	1	0.0	0.001	7.2	LOS A	0.0	0.0	0.43	0.54	48.8
Approach		505	14.1	0.205	1.4	NA	0.0	0.0	0.00	0.21	59.0
All Vehicles		998	12.3	0.205	2.5	NA	0.5	4.3	0.06	0.19	52.2

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Organisation: PARSONS BRINCKERHOFF AUSTRALIA | Processed: Wednesday, 21 March 2018 12:09:42 PM
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MOVEMENT SUMMARY

▽ Site: 100 [Livingstone St 2031 AM - 2% Proj]

Giveway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Livingstone St											
1	L2	1	0.0	0.025	5.0	LOS A	0.1	0.6	0.45	0.61	47.1
2	T1	2	50.0	0.025	9.6	LOS A	0.1	0.6	0.45	0.61	44.2
3	R2	8	0.0	0.025	9.2	LOS A	0.1	0.6	0.45	0.61	44.0
Approach		11	9.1	0.025	8.9	LOS A	0.1	0.6	0.45	0.61	44.3
East: Western Hwy											
4	L2	17	5.9	0.012	4.6	LOS A	0.0	0.0	0.00	0.40	46.3
5	T1	127	0.8	0.062	0.0	LOS A	0.0	0.0	0.00	0.02	49.8
6	R2	56	14.3	0.047	5.2	LOS A	0.2	1.5	0.23	0.50	44.6
Approach		200	5.0	0.062	1.8	NA	0.2	1.5	0.06	0.19	47.9
North: Havelock St											
7	L2	51	0.0	0.053	4.7	LOS A	0.2	1.4	0.09	0.50	45.0
8	T1	5	0.0	0.053	7.4	LOS A	0.2	1.4	0.09	0.50	46.8
9	R2	1	100.0	0.053	15.0	LOS C	0.2	1.4	0.09	0.50	48.1
Approach		57	1.8	0.053	5.1	LOS A	0.2	1.4	0.09	0.50	45.3
West: Western Hwy											
10	L2	1	0.0	0.016	5.5	LOS A	0.0	0.0	0.00	0.21	57.2
11	T1	116	3.4	0.045	1.2	LOS A	0.0	0.0	0.00	0.20	59.4
12	R2	1	0.0	0.001	6.0	LOS A	0.0	0.0	0.24	0.51	49.3
Approach		118	3.4	0.045	1.2	NA	0.0	0.0	0.00	0.21	59.2
All Vehicles		386	4.1	0.062	2.3	NA	0.2	1.5	0.06	0.25	50.3

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
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Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

▽ Site: 100 [Livingstone St 2031 PM - 2% Proj]

Giveway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Livingstone St											
1	L2	1	0.0	0.047	5.1	LOS A	0.2	1.3	0.51	0.68	46.0
2	T1	4	0.0	0.047	8.5	LOS A	0.2	1.3	0.51	0.68	43.7
3	R2	12	25.0	0.047	12.2	LOS B	0.2	1.3	0.51	0.68	40.6
Approach		17	17.6	0.047	10.9	LOS B	0.2	1.3	0.51	0.68	41.8
East: Western Hwy											
4	L2	13	0.0	0.014	4.6	LOS A	0.0	0.0	0.00	0.27	47.3
5	T1	147	0.7	0.068	0.0	LOS A	0.0	0.0	0.00	0.02	49.8
6	R2	51	2.0	0.043	5.3	LOS A	0.2	1.2	0.30	0.53	44.6
Approach		211	0.9	0.068	1.6	NA	0.2	1.2	0.07	0.16	48.3
North: Havelock St											
7	L2	25	4.0	0.056	4.7	LOS A	0.2	1.4	0.12	0.51	43.8
8	T1	6	16.7	0.056	9.7	LOS A	0.2	1.4	0.12	0.51	45.7
9	R2	9	0.0	0.056	9.9	LOS A	0.2	1.4	0.12	0.51	48.8
Approach		40	5.0	0.056	6.6	LOS A	0.2	1.4	0.12	0.51	45.4
West: Western Hwy											
10	L2	16	6.3	0.027	5.6	LOS A	0.0	0.0	0.00	0.32	55.8
11	T1	177	4.0	0.074	1.2	LOS A	0.0	0.0	0.00	0.22	59.1
12	R2	1	0.0	0.001	6.1	LOS A	0.0	0.0	0.26	0.51	49.3
Approach		194	4.1	0.074	1.6	NA	0.0	0.0	0.00	0.23	58.6
All Vehicles		462	3.2	0.074	2.3	NA	0.2	1.4	0.06	0.24	51.5

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

ABOUT US

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