TRANSIT NEW ZEALAND
ARARAU AOTEAROA

BASIN RESERVE AT-GRADE INTERSECTION PROPOSAL

Basin Reserve At-Grade Intersection Proposals

Prepared By
Andrew Martindale
Graduate Civil Engineer

Reviewed By
Roger Burra
Senior Transport Planner

Opus International Consultants Limited
Wellington Office
Level 9, Majestic Centre
100 Willis Street, PO Box 12-003
Wellington, New Zealand

Telephone: +64 4 471 7000
Facsimile: +64 4 471 1397

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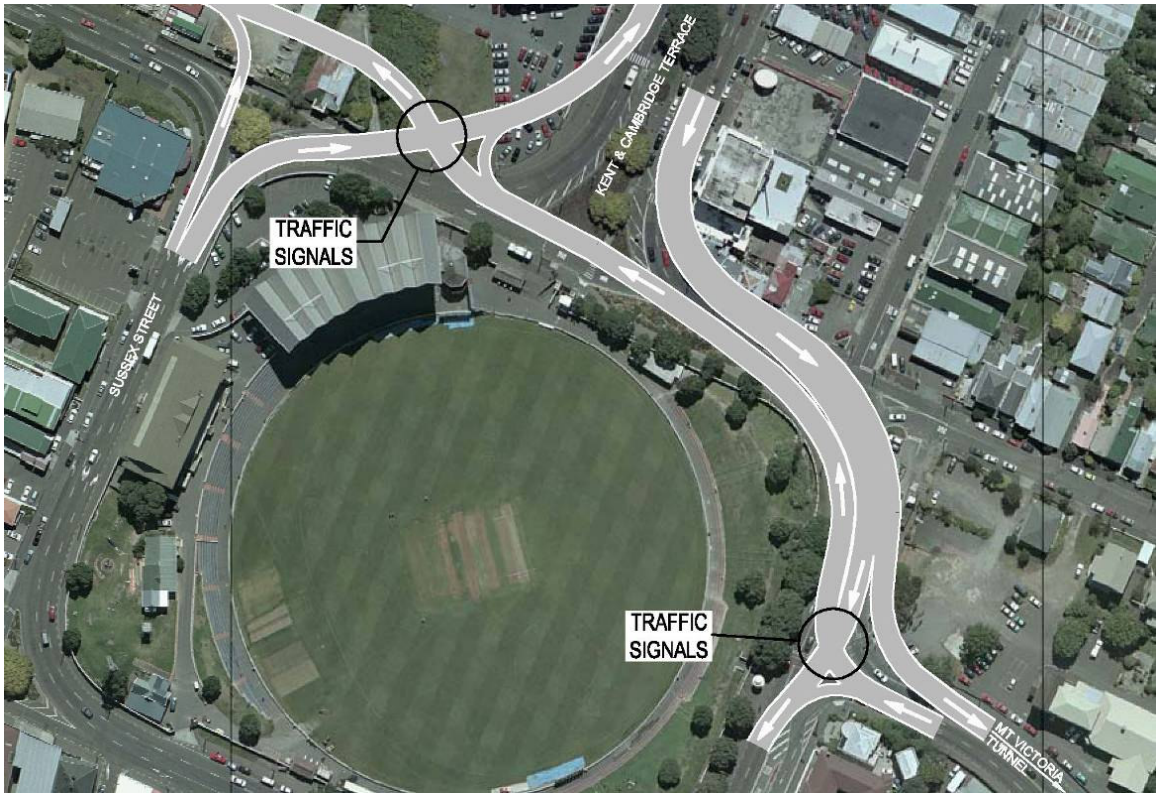
1 Introduction

Opus International Consultants have been commissioned by Transit NZ Wellington Region to assess at-grade changes to the Basin Reserve gyratory. The aim of the study was to determine whether at-grade improvements of State Highway 1 (SH1) at the Basin Reserve could improve the operating performance and / or accommodate the increased traffic volumes in the next ten years. Various at-grade improvement options tested using the as-built Wellington Inner City Bypass (WICB) model. Later work to assess with grade separated options has also been included as an addendum to this report.

1.1 Background

An alternative at-grade roading arrangement around the Basin Reserve is shown in Figure 1.1. This option was first tested as a part of Package 5 of the Ngauranga to Airport Strategic Study using SATURN modelling software. Assessment of the SATURN results indicated that an at-grade revision to the Basin Reserve roading arrangement would operate with a satisfactory level of performance.

Figure 1.1 - Basic Arrangement for At-Grade Proposal



Ngauranga to Airport Study: Package 5 also included measures that reduced the capacity of Adelaide Road and increased the capacity of the parallel Wallace Street and Taranaki Street. The effect of these measures was that fewer local trips from Adelaide Road pass around the Basin Reserve gyratory.

In order to provide greater confidence in the forecast performance of an at-grade solution, this study has assessed at-grade improvements in isolation from other schemes included in Package 5 using the WICB Paramics model.

1.2 Wellington Inner City Bypass "As-built" Paramics Model

The Paramics model originally developed as a design aid for the Wellington Inner City Bypass (WICB) project was recently updated (Nov 2007) following completion of the inner city bypass to reflect changes to SH1 and local roads within the city. This was completed using SCATS data (turning counts) and travel time data collected in post-construction surveys. Queue length surveys, undertaken at the Basin Reserve were also used to determine whether the model was adequately representing present day traffic conditions. The calibrated model is known as the as-built WICB model.

The results of the validation process indicate that the AM peak as-built model adequately represents prevailing traffic flows. A significant amount of work was undertaken to validate the PM peak as-built model and to calibrate it by balancing discrepancies in travel times with those for forecast and recorded traffic flows.

Although it is less representative than the AM peak model, it is considered fit-for purpose. The level of confidence provided by the model is adequate for an assessment of the operation of the gyratory and constituent intersections to be made. In comparison to observed conditions the PM peak as-built model forecasts:

- 18.5% more trips leaving Mt Victoria tunnel;
- 16% too many trips on Adelaide Road;
- Taranaki Street northbound travel times are 25% too fast;
- Willis Street northbound travel times are 23% too slow;
- Victoria Street southbound travel times are 23% too fast;

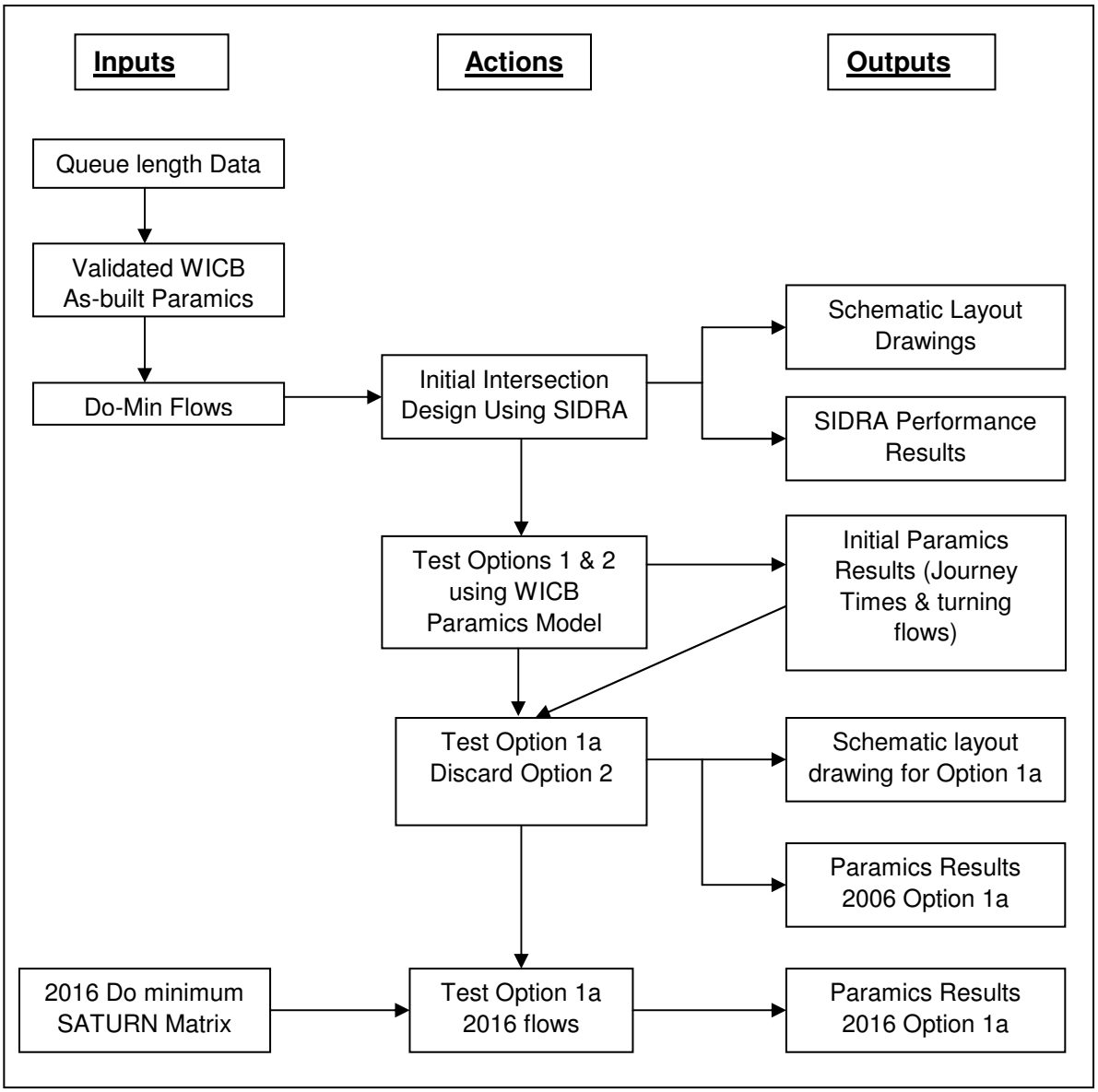
An option to test changes to the Basin Reserve gyratory using a cordoned model was considered. This option was discounted because the cordoned model would need to be re-validated and re-calibrated using a substantial amount of new survey data. It was agreed that use of a cordoned WICB model would be more expensive than using the WICB model and would pose a potential risk to the project programme.

2 Methodology

2.1 Overview

Figure 2.1 shows the study methodology. The following text explains the activities undertaken at each stage in the process.

Figure 2.1 - Project Methodology



2.2 Queue Length Survey

A queue length survey was completed on the 29th of November 2007. Queue lengths were recorded between 07:00 - 09:00; 12:00 - 14:00 and 16:00 - 18:00. Queue length data was

used to calibrate the as-built WICB model. The survey results are presented in Appendix A with plan showing the queue locations.

2.3 Option Design & SIDRA Analysis of Options

2007 Do-nothing traffic demands at the Basin Reserve were extracted from the validated as-built WICB model. Turning flows derived from these demands are presented in Appendix B. The turning flows were then used in an initial assessment of the improvement options illustrated schematically in Figures 4 & 5. Intersections forming each option were tested in isolation using SIDRA modelling software.

SIDRA model outputs were used to confirm that the proposed intersection layouts could accommodate the forecast traffic flows in isolation. The number of lanes at each intersection was adjusted according to the outputs from the SIDRA models until adequate performance was achieved.

SIDRA is only able to model intersections in isolation; Paramics is used to identify the interaction between intersections. The layouts and phase splits confirmed using SIDRA were incorporated within the Paramics model and optimised to ensure the intersections could be well co-ordinated.

2.3.1 Option Layouts

Figure 2.2 and Figure 2.3 schematically show the options tested first in SIDRA and then in Paramics. The key characteristics of the options are also described below.

Option 1:

- Three signal controlled intersections at Sussex Street / Buckle Street; Ellice Street / Kent Terrace; Paterson Street / Dufferin Street.
- SH1 northbound passes around the northern side of the Basin Reserve providing a more direct link between the Mount Victoria Tunnel and Buckle Street (WICB).
- SH1 southbound traffic passes from Kent Terrace around the northern side of the Basin Reserve to the Mount Victoria Tunnel.
- a diverge to a single slip lane allows SH1 southbound traffic to travel to Mt Victoria Tunnel without stopping at the Paterson Street / Dufferin Street Signals
- Slip lanes are provided for traffic to make right turns to and from Cambridge & Kent Terrace respectively.
- Motorists travelling from Adelaide Road to the WICB will give way to northbound SH1 traffic at a new signalised intersection.

Figure 2.2 - Option 1 Layout

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Figure 2.3 - Option 2 Layout

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Option 2:

- Two signal controlled intersections at Sussex Street / Buckle Street and Paterson Street / Dufferin Street.
- SH1 northbound passes around the northern part of the Basin Reserve providing a more direct link between the Mount Victoria Tunnel and Buckle Street (WICB).
- SH1 southbound passes from Kent Terrace around the northern side of the Basin Reserve to the Mount Victoria Tunnel.
- A diverge to a single slip lane allows SH1 southbound traffic to travel to Mt Victoria Tunnel without stopping at the Paterson Street / Dufferin Street Signals.
- Motorists travelling from Paterson Street to Cambridge Terrace must drive around the southern side of the Basin as at present.
- Traffic from Kent Terrace wishing to access the WICB has to travel clockwise around the Basin as at present.
- Motorists travelling from Adelaide Road to the WICB will give way to northbound SH1 traffic at a new signalised intersection.

2.4 Paramics Option Modelling

The WICB as-built model base network coding was adjusted to reflect the two options developed from the SIDRA option testing and design process. As well as optimising the combined performance of these two intersections it was necessary to make changes to the performance of other intersections on Vivian and Ghuznee Street to optimise the performance of the modelled network.

The as-built WICB model does not include future year matrices. To forecast the future traffic flows in the WICB model, growth factors for zones in the Saturn Model were derived for the period between 2001 and 2016. The growth factors were then applied geographically to the zones in the 2007 Paramics model to forecast trips in 2016. In the absence of a Saturn model validated to 2006/07 conditions this is the best was to forecast future demand.

3 Sidra Results

This section presents the results of tests using SIDRA intersection models. The demand flows used within the models were extracted from the 2007 As-built Paramics model.

3.1 Option 1

The three intersections proposed within Option 1 performed better than those included within Option 2. The SIDRA layout and performance for Option 1 intersections are reported below.

3.1.1 Option 1: Dufferin / Patterson Street Intersection

Figure 3.1 shows the layout and phasing arrangement for the Dufferin / Patterson Street intersection in Option1. It was found that the intersection performed to an acceptable level of service (LOS) no lower than B on all approaches in each modelled period when run in a two phase arrangement. Table 3.1 and Table 3.2 show that all of the intersection approaches operated within their theoretical capacity. For the full SIDRA performance outputs refer to Appendix C.

Figure 3.1 - Option 1: Dufferin / Patterson Street Layout & Phase Arrangement

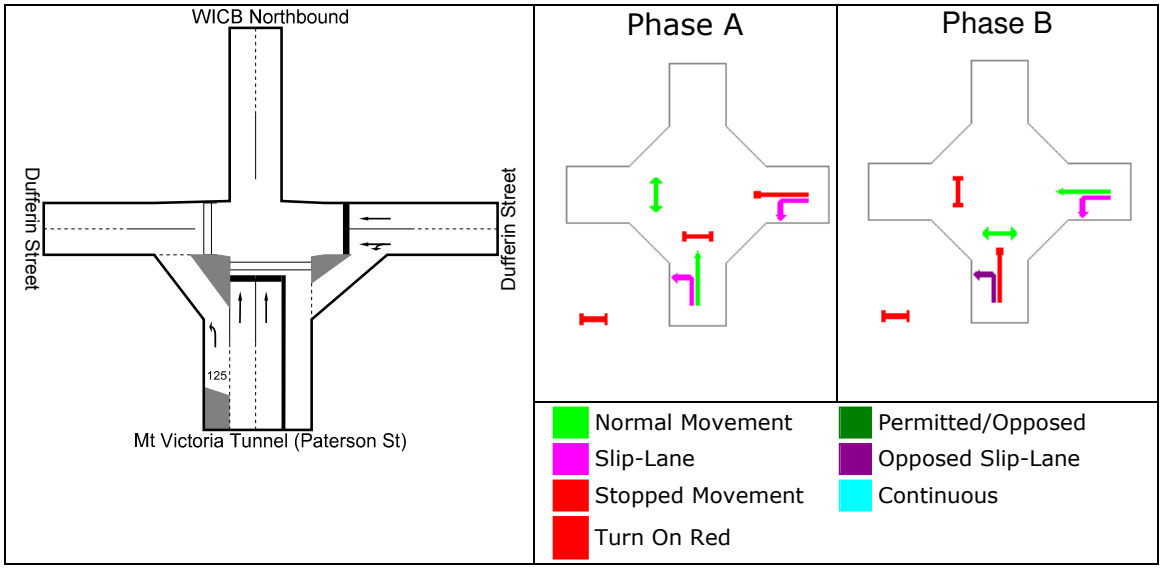


Table 3.1 - AM Option 1 Dufferin / Patterson Intersection

Cycle Time (sec)		50					
Time	**Approach**	**Move**	**Dem. Flow (veh/h)**	**Deg. of Sat. (v/c)**	**95% Back of Queue (m)**	**Ave. Delay (Sec)**	**LOS**
AM	Mt Vic Tunnel	Left	55	0.05	5	8.4	A
		Through	1457	0.772	127	13.7	B
	Kent Terrace	Left	404	0.749	85	18.1	B
		Through	489	0.748	85	19	B

Table 3.2 - PM Option 1 Dufferin / Patterson Intersection

Cycle Time (sec)		40					
Time	**Approach**	**Move**	**Dem. Flow (veh/h)**	**Deg. of Sat. (v/c)**	**95% Back of Queue (m)**	**Ave. Delay (Sec)**	**LOS**
PM	Mt Vic Tunnel	Left	118	0.121	10	8.9	A
		Through	1186	0.785	99	15	B
	Kent Terrace	Left	511	0.712	68	12.5	B
		Through	513	0.712	70	13.6	B

3.1.2 Option 1: Kent Terrace / Ellis Street Intersection

It was found that the Kent Terrace intersection in the above layout performed to an acceptable LOS B or C on both approaches during AM and PM peak periods when run in a two phase arrangement. Figure 3.2 shows the proposed layout and phasing arrangement.

Figure 3.2 - Option 1: Kent Terrace / Ellis Street Intersection Layout & Phase Arrangement

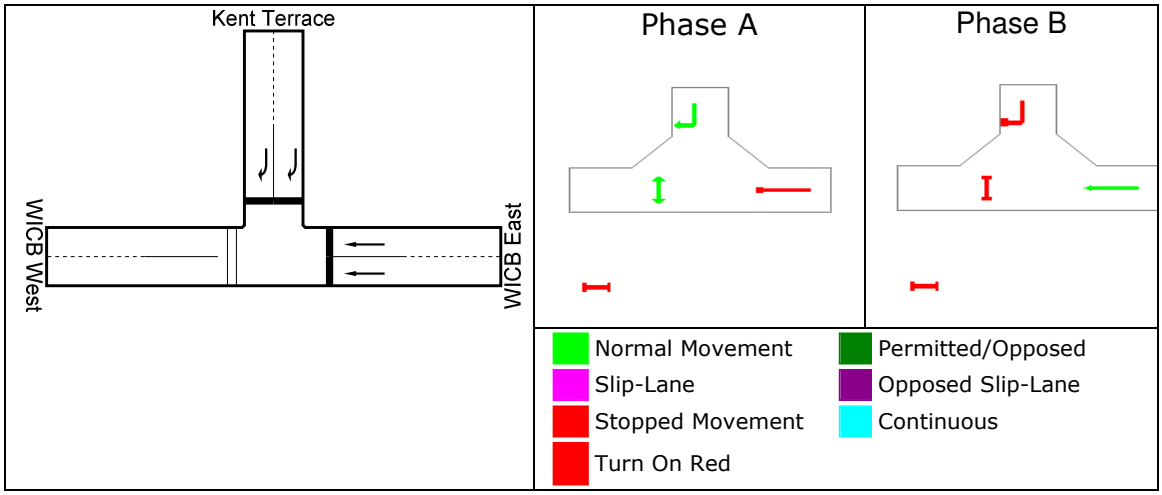


Table 3.3 and Table 3.4 show that all of the intersection approaches operated within their theoretical capacity. However, the queue lengths from WICB east had the potential in the AM peak to queue into the previous set of signals at Dufferin / Patterson. This was only able to be confirmed in Paramics analysis. For the full SIDRA outputs, refer to Appendix C.

Table 3.3 - AM Option 1 Kent Terrace / Ellis Street Intersection

Cycle Time (sec)		40					
Time	**Approach**	**Move**	**Dem. Flow (veh/h)**	**Deg. of Sat. (v/c)**	**95% Back of Queue (m)**	**Ave. Delay (Sec)**	**LOS**
AM	WICB	Through	1457	0.857	132	18.4	B
	Kent Terrace	Right	756	0.843	77	29.5	C

Table 3.4 - PM Option 1 Kent Terrace / Ellis Street Intersection

Cycle Time (sec)		40					
Time	**Approach**	**Move**	**Dem. Flow (veh/h)**	**Deg. of Sat. (v/c)**	**95% Back of Queue (m)**	**Ave. Delay (Sec)**	**LOS**
PM	WICB	Through	1186	0.739	91	12.6	B
	Kent Terrace	Right	765	0.776	72	25.6	C

3.1.3 Option 1: Buckle Street Intersection

Figure 3.3 shows the proposed layout and phasing arrangement for the Buckle Street intersection. It was found that the Buckle Street intersection performed to an acceptable LOS B & C during the AM and PM peak periods when run in a two phase arrangement.

Figure 3.3 - Option 1 Buckle Street Intersection Layout & Phase Arrangement

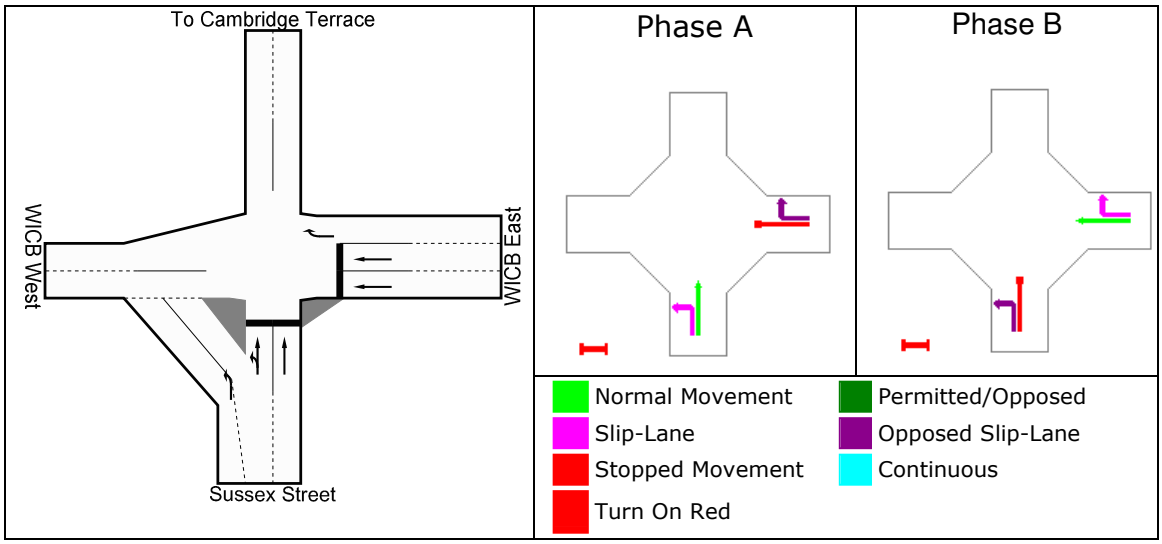


Table 3.5 and Table 3.6 show that each of the intersection approaches operated within their theoretical capacity. However, the northbound queues had the potential in the AM and PM peaks to queue into the previous set of signals at Kent Terrace. This was only able to be confirmed in Paramics analysis. For the full SIDRA analysis refer to Appendix C.

Table 3.5 - AM Option 1 Buckle Street Intersection

Cycle Time (sec)		40					
Time	**Approach**	**Move**	**Dem. Flow (veh/h)**	**Deg. of Sat. (v/c)**	**95% Back of Queue (m)**	**Ave. Delay (Sec)**	**LOS**
AM	Sussex St	Left	878	0.777	71	19.5	B
		Through	408	0.777	65	18.5	B
	WICB	Through	1525	0.85	134	17.2	B
		Right	687	0.655	54	12.3	B

Table 3.6 - PM Option 1 Buckle Street Intersection

Cycle Time (sec)		40					
Time	**Approach**	**Move**	**Dem. Flow (veh/h)**	**Deg. of Sat. (v/c)**	**95% Back of Queue (m)**	**Ave. Delay (Sec)**	**LOS**
PM	Sussex St	Left	667	0.789	71	21.1	C
		Through	468	0.789	60	19.7	B
	WICB	Through	1568	0.83	130	15	B
		Right	383	0.35	28	10.2	B

3.2 Option 2

Option 2 which included only two intersections on the northern side of the Basin Reserve did not perform as well as Option 1. Details of the intersection layouts, phasing and performance outputs are presented in Appendix C. The majority of movements at each intersection were forecast to operate with LOS D – E as a result of traffic volumes that were too high for lane capacities.

The reason Option 1 did not perform as well as Option 2 was because of the limited turning movements that were provided between SH1 to and from Cambridge and Kent Terraces respectively. In Option 2, motorists wishing to turn right from SH1 northbound to Cambridge Terrace must travel around the southern side of the Basin Reserve and through a new intersection between Sussex Street / Buckle Street and Cambridge Terrace. The volumes of traffic making this movement reduce the green time that is given to SH1 northbound traffic, resulting in queues.

Similarly, motorists wishing to turn right from Kent Terrace to SH1 northbound must travel around the southern side of the Basin Reserve. This forces them through the Patterson / Dufferin Interchange and results in queues both for SH1 northbound and for local traffic from Kent Terrace.

4 Paramics Results

4.1 Paramics Overview

The performance and interaction of the proposed intersections at the Basin Reserve were assessed by comparing travel times forecast using the WICB Paramics model. Turning movements were also reviewed to assess the number of motorists affected and to determine whether changes resulted in re-routing. The following options were tested:

- Option 1 – three intersection arrangement; and
- Option 2 – two intersection arrangement.

Following initial tests a variation of Option 1 was developed and tested using Paramics. Option 1a (see Figure 4.2) provides for pedestrian movements at the Basin Reserve Gyratory and promotes better lane utilisation, both within the gyratory, but also on its approaches.

Option 1a introduces a signalised pedestrian phase across the slip lane to SH1 Mt Victoria Tunnel. Should this option be implemented it is intended that the pedestrian phase would operate only when called. In the absence of any data relating to pedestrian demand across this traffic movement, the intersection is modelled as if the pedestrian stage were called in every cycle. Other pedestrian movements at this interchange would occur when motorised traffic is stopped.

It was found that the proportion of trips entering and exiting from each of the approaches to the Basin Reserve gyratory did not change significantly between the 2006 and 2016 forecast matrices. On this basis only the Option 1a which performed most satisfactorily in 2006 was assessed for future year traffic conditions.

4.2 Design Issues

During the modelling process, the following issues were identified. Each of these will need to be considered in more detail and solutions develop should the options be progressed further:

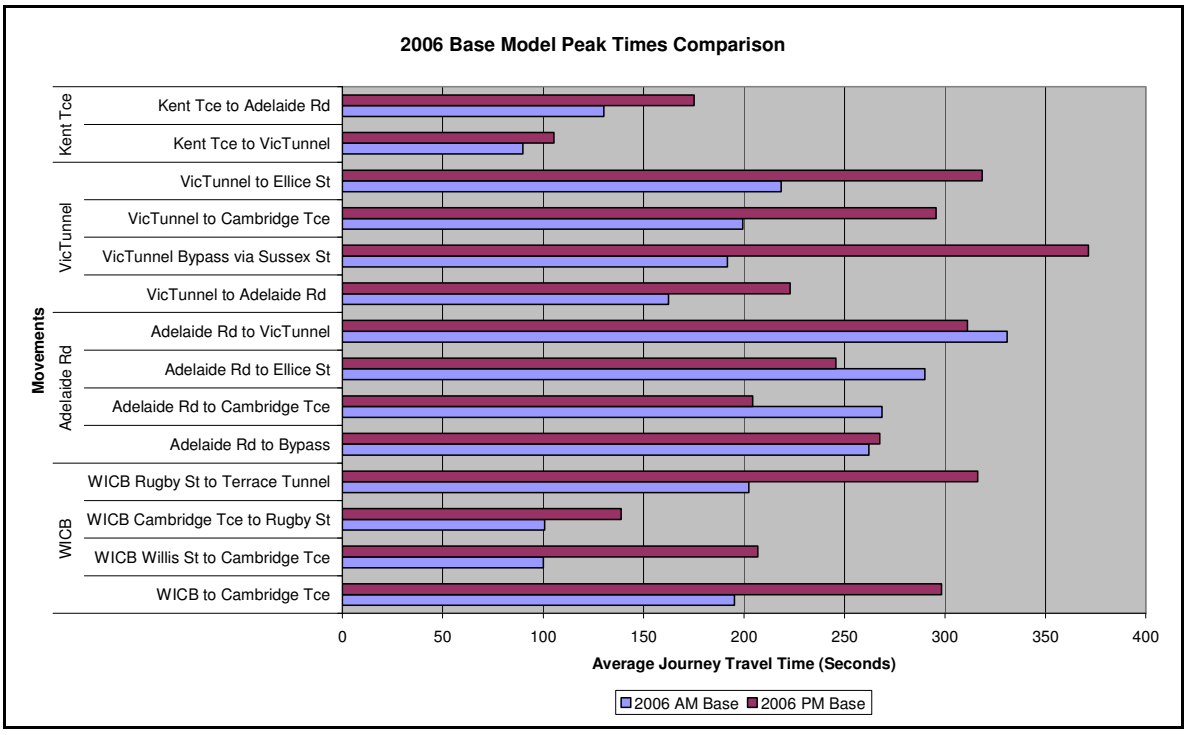
- Pedestrian access across Ellice Street to the Basin Reserve (i.e. on the northern side) will be difficult and will need further consideration should options be developed further.
- Maintaining vehicular access to Ellice Street from the Basin Reserve gyratory affects its performance, however closing this intersection puts too much pressure on the Vivian / Pirie / Kent intersection further to the north.
- The at-grade improvement layouts (based on those presented as part of Package 5 of the Ngauranga to Airport Study) require land-take immediately north of Paterson Street at its intersection with Dufferin Street.
- Land-take would also be required to the North of Buckle Street at its intersection with Cambridge Terrace.
- The physical separation that is required between opposing directions on SH1 around the northern side of the Basin Reserve.
- Safety at the Patterson / Dufferin intersection.

4.3 Base Year Review

Average travel times were forecast for the 2006 do-minimum and the 2006 do-something options were compared in order to assess the degree to which proposed changes would affect traffic flows through the Basin Reserve gyratory. The routes to which the travel times relate are shown in Appendix D.

An assessment of do-minimum travel times found that 11 of the 14 travel times tested were greater in the PM peak than in the AM. This is shown in Figure 4.1. In the 2006 do-minimum scenario, motorists travelling northbound coming from the Mt Victoria Tunnel experience travel times over 240 seconds during the PM peak. During the AM period, motorists travelling through the Basin Reserve from Adelaide Road experience the longest travel times of more than 250 seconds for any destination.

Figure 4.1 - Base Year AM Vs. PM Results



4.4 2006 Do Minimum and Options Comparison

Comparison of the performance of the do-minimum against Options 1, 1a and 2 for traffic demand forecast in 2006 demand shows that there are few positive changes in the network's performance in either the AM and PM or PM peak periods. The results are shown in Figure 4.3 and Figure 4.4. The movements can be grouped into four movement areas relating to movements into the gyratory from:

- Adelaide Road,
- Kent Terrace,
- Victoria Tunnel, and
- WICB.

Figure 4.2 – Option 1a

NOTE A3 FOLDOUT

Figure 4.3 - 2006 AM Peak Comparison

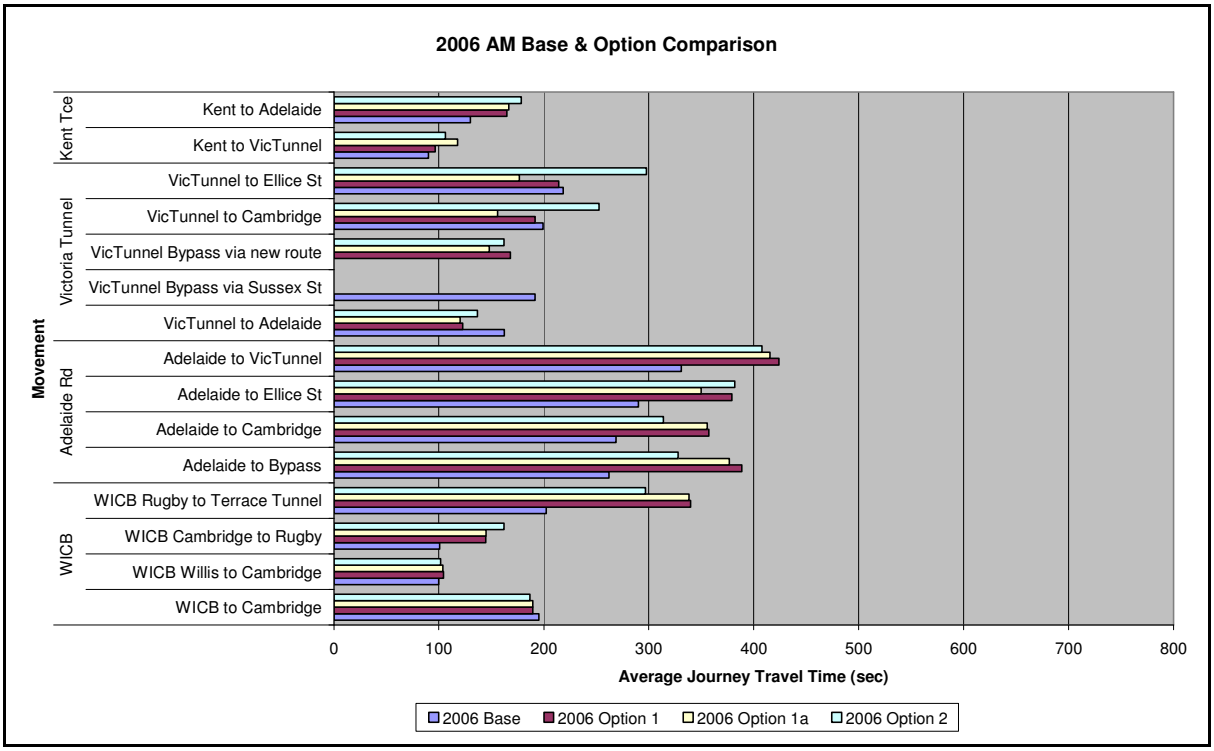
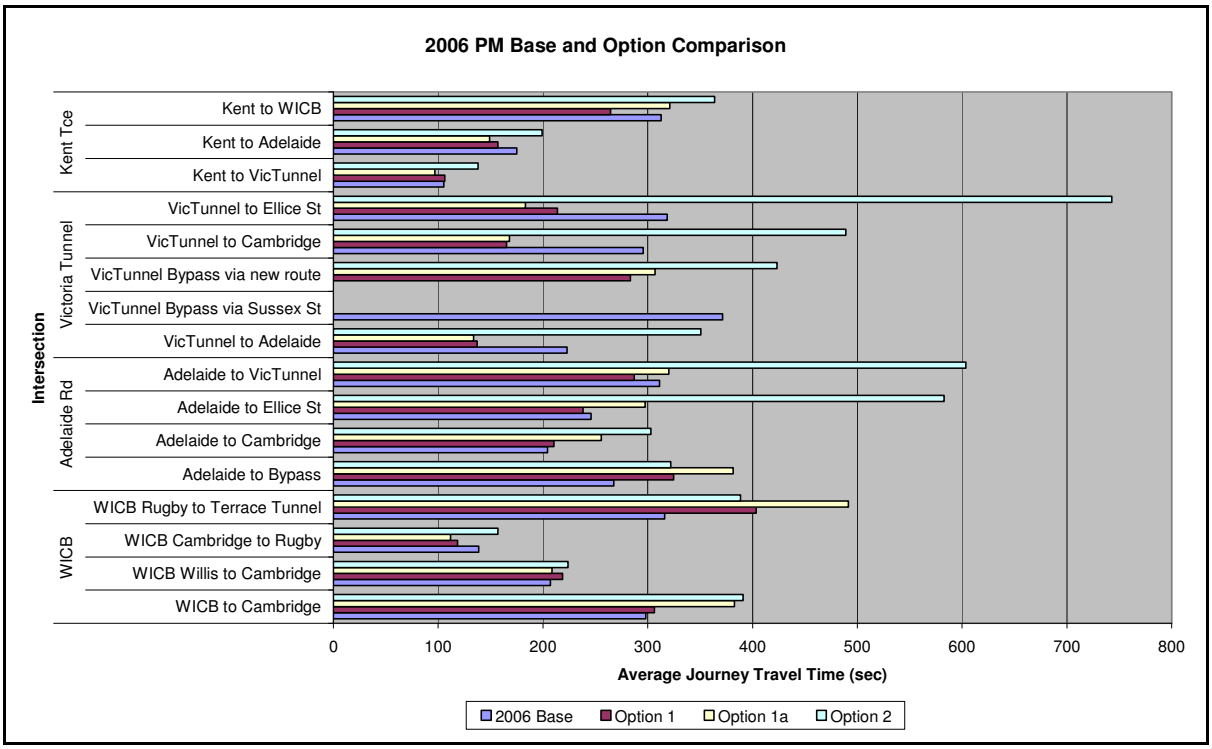


Figure 4.4 - 2006 PM Peak Comparison



4.4.1 Kent Terrace

During both the AM and PM peak periods, average journey travel times from Kent Terrace for Option 1, were similar or less than those forecast for the do-minimum option. The reduced travel times resulted from the un-signalised slip lane from the Basin Reserve gyratory to Paterson Street and the Mount Victoria Tunnel. Option 1a, which introduces a signalised crossing on the slip lane to Mount Victoria, results in slightly longer travel times than either Option 1 or the Do-minimum scenario.

During the AM peak period all of the proposed options lead to an increase in the average journey travel times, with Option 1 consistently being the best performer of the options. As the travel time increase was no greater than 50 seconds for Options 1 or 1a.

During the PM peak period, Option 1 and 1a were either consistent with or less than the do-minimum travel times for all movements from this approach. While these options saw a decrease in the travel times, they were not large enough to consider the changes significant.

One of the most poignant changes resulting from Option 1a is the relocation of queues. Currently two lanes of traffic heading into the Mount Victoria Tunnel merge on Patterson Street resulting in queues that tail back into the Basin Reserve gyratory. Option 1a has a continuous single lane from Kent Terrace around the Basin Reserve and into the Tunnel. In Option 1a the traffic merge occurs on Kent Terrace, thus relocating the queue.

4.4.2 Mount Victoria Tunnel / SH1 Northbound

The improvement options considerably reduced the average journey travel time for traffic movements from the Mt Victoria Tunnel during both the AM and PM peak periods. Option 1a was most effective at reducing journey times for movements onto Cambridge Terrace and onto the WICB (SH1 northbound) which, according to the 2006 base flows are the major flows from this approach.

Option 2 was the worst performing in both peak periods leading to increases in the travel time at two of three movements in the AM peak and all three movements in the PM peak from this area.

4.4.3 Adelaide Road

For most movements from Adelaide Road, higher travel times than in the do-minimum option are forecast as a result of changes to the Basin Reserve gyratory. During the AM peak period, the travel times were increased by all of the proposed improvement options with the lowest increase being approximately 50 seconds. Option 2 while still significantly higher than the do-minimum, had the lowest increase in journey travel time for the majority of movements from Adelaide Road

During the PM period, the travel times from Adelaide Road were also increased by the proposed improvement options. However, in this period Option 1 was relatively consistent with the do minimum option. Option 1a performed slightly worse than Option 1 and Option

2 performed so badly that for some of the movements, the journey time more than doubled the do-minimum.

Should Option 1 or 1a be implemented, it would be possible to give priority to traffic from Adelaide over that from Rugby Road using a priority intersection rather than signal control as at present. This would effectively provide bus priority. The modelling undertaken has not tested priority control at this intersection as it is not expected to change the results of the analysis given the low numbers of motorists that will make this manoeuvre (ahead on Rugby Road).

4.4.4 WICB (Destinations from Vivian Street)

Each of the improvement options were either consistent or greater than the travel times forecast for the do-minimum. This was dependent on the movement or time period being analysed.

During the AM peak, all the movements in any of the improvement options apart from WICB Rugby to Terrace Tunnel were very consistent with the do-minimum. The WICB Rugby to Terrace Tunnel movement saw increases to the travel times by over 100 seconds when the improvement options were used. Options 1 & 1a performing the worst of the improvement options.

In the PM peak, the WICB Rugby to Terrace Tunnel movement saw increases to the travel times of over 100 seconds when the improvement options were used. Option 1a was the worst performing at this movement with an increase of nearly 200 seconds when compared to the do-minimum.

Based on the results for movements from these approaches, at-grade improvement option will not significantly reduce the journey travel times.

4.5 2006 Summary

On the basis of an assessment for 2006 traffic demand, at-grade solutions that are implemented in isolation from schemes to re-route local traffic away from the Basin Reserve gyratory will not improve performance or reduce traffic congestion. The improvement options primarily only see significant benefit for travel time savings at the northbound Mt Victoria Tunnel movements. In both the AM and PM peak periods, other movements are either maintained at do-minimum travel times or worsened. Option 2 was the worst performing and was not tested for 2016 forecast traffic demand.

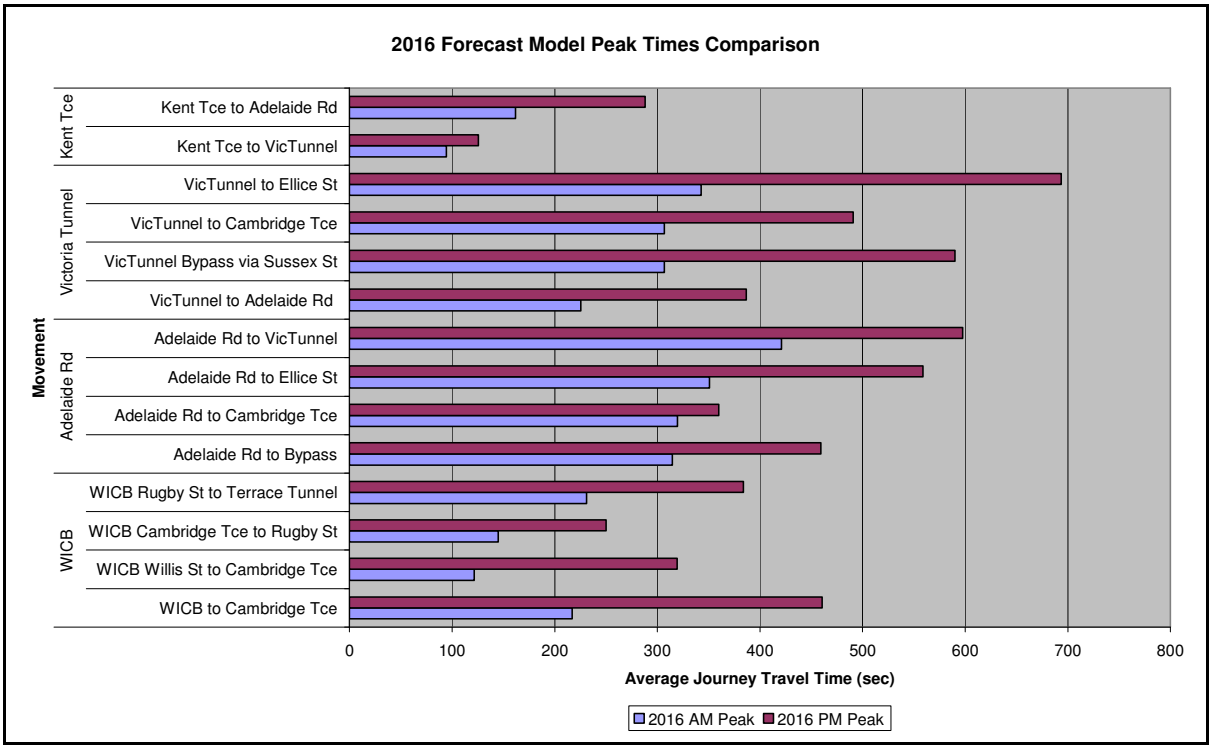
Although for some movements in Option 1 performed better than Option 1a, it is not considered realistic to expect an option that does not adequately cater for pedestrians to be progressed.

4.6 2016 Do-minimum

The forecast 2016 do-minimum traffic travel times are substantially greater than those forecast for 2006 for each traffic movement. A further change is that travel times for journeys from Adelaide Road would be worse in the PM peak than in the AM peak; a

reversal of the trend in 2006. The 2016 do minimum travel times are shown in Figure 4.5. Northbound vehicles coming out of Mt Victoria Tunnel experience the worst delays of approximately 700 seconds in the PM peak when trying to get to Cambridge Terrace.

Figure 4.5 - 2016 AM Vs. PM Results



4.6.1 Comparison of 2016 Do minimum & Option 1a

Tests using the 2006 traffic demands found that Option 2 performed the worst of the three options developed. Realistically the provision of a link from the Basin Reserve Gyratory cannot be provided without accommodating pedestrian crossing movements. Therefore only Option 1a was modelled for 2016 traffic demands.

A comparison between the 2016 do-minimum and Option 1a are shown in Figure 4.6 and Figure 4.7. The figures show similar results to the 2006 tests, where northbound traffic on SH1 receives a benefit from the proposed changes, but other movements are delayed by the changes.

As in section 4.3, the movements for the 2016 comparison can be grouped into four movement areas relating to movements out of: Adelaide Road, Kent Terrace, Victoria Tunnel and WICB.

Figure 4.6 – 2016 AM Peak Comparison

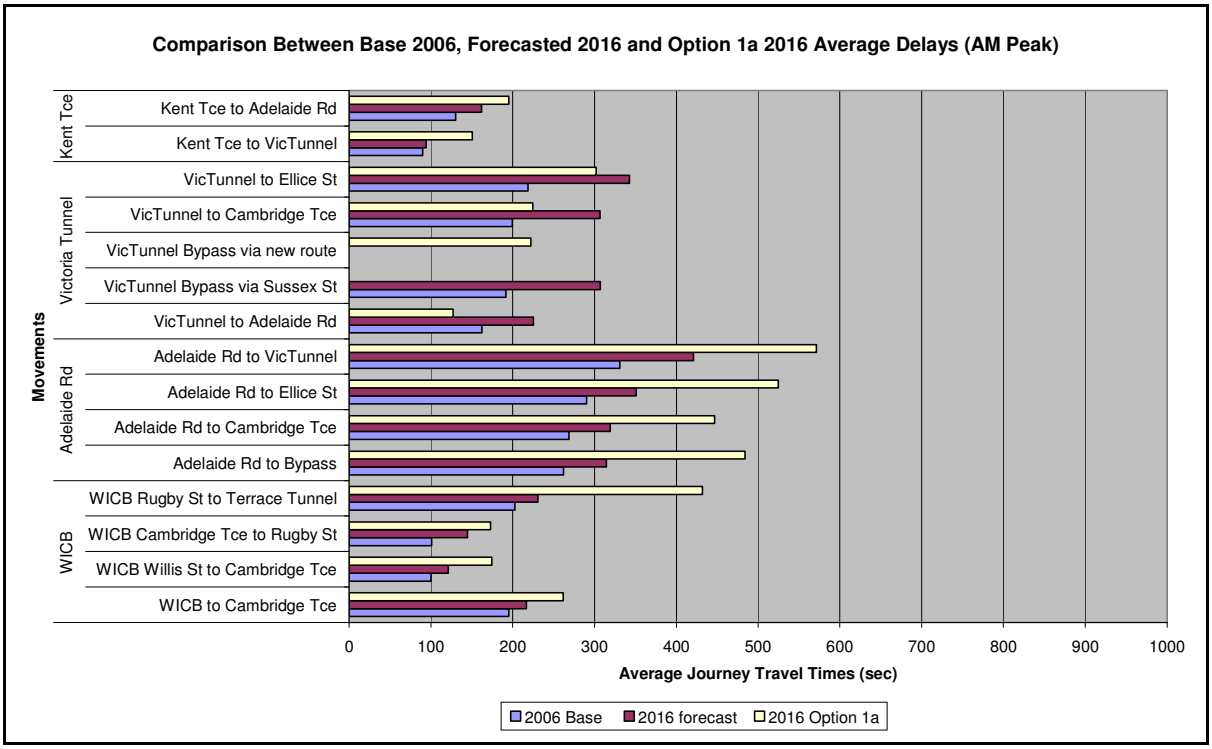
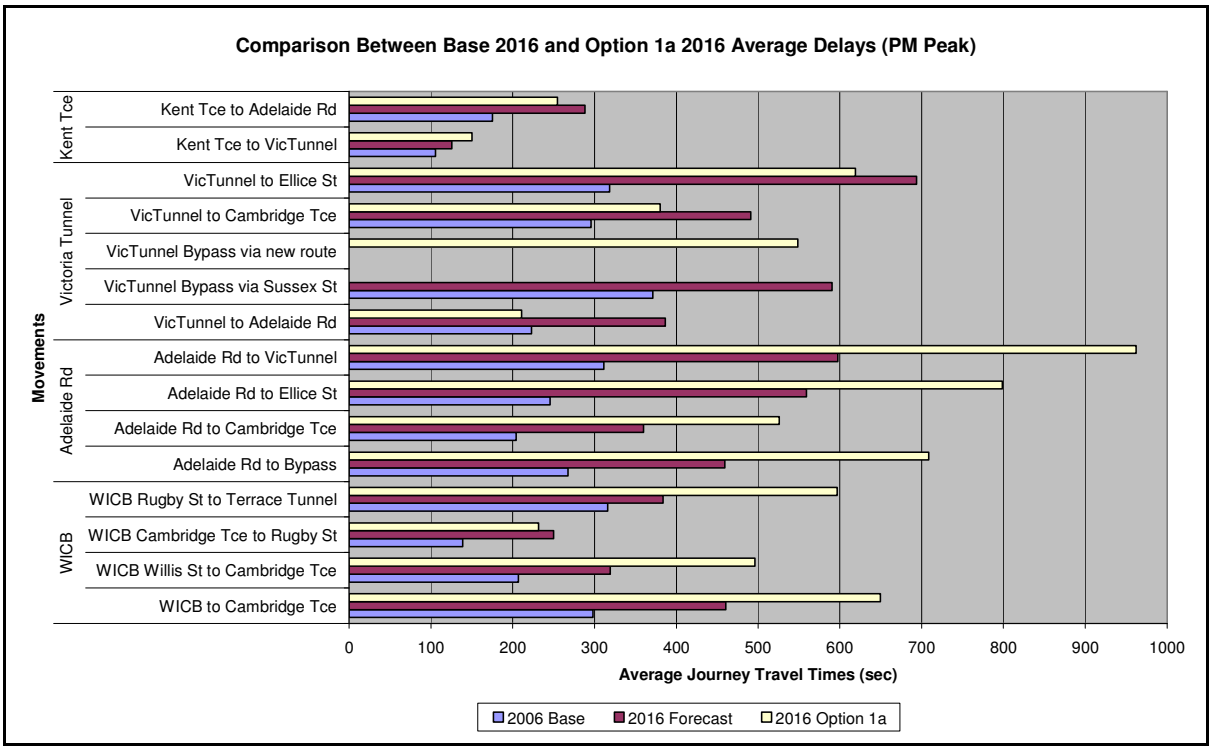


Figure 4.7 – 2016 PM Peak Comparison



4.6.2 Kent Terrace

The average delay for the forecast 2016 flow was found to be the lowest at the Kent Terrace movement area during both the AM and PM peak periods. The do-minimum travel times in both peak periods have only seen slight increases from 2006 to 2016 to between 20-50 seconds, which is relatively minor considering the increases forecast for other movements.

Option 1a is forecast to result in higher travel times for all movements compared to the 2016 do-minimum apart from the PM Kent Terrace to Adelaide Road movement which decreased when the option was tested. Because Option 1a has seen increased average journey travel times, it can not be considered a viable alternative to the do-minimum.

4.6.3 Victoria Tunnel / SH1 northbound

For both the AM and PM peak periods Option 1a results in improvements to average journey times when compared to the do-minimum option. When Option 1a was used AM peak travel time savings on the major movements onto Cambridge Terrace and into the WICB were well over 100 seconds. This reduced the journey travel times close to those forecast for the 2006 do-minimum. During the PM peak, travel time savings were found to be between 50 - 100 seconds on both Cambridge Terrace and into the WICB. Option 1a can be considered to improve the movements originating from this area over the next ten years.

4.6.4 Adelaide Road

Figure 4.6 and Figure 4.7 show that the do-minimum travel times significantly increase between 2006 and 2016. This would be expected given the forecast increase in traffic demand. In both peak periods, travel times for movements from Adelaide Road are significantly increased by Option 1a. By using the proposed option, travel times are between 150-200 seconds higher than the 2016 do-minimum. The at-grade improvement option has made this movement worse during both peak periods.

4.6.5 WICB / SH1 Southbound from Vivian Street

The average travel times consistently increased between the do-minimum and the at-grade improvement option for both the AM and PM peak periods. When comparing the do-minimum of 2006 and 2016, the travel times have significantly increased, particularly during the PM peak by approximately 100 seconds.

Option 1a increases to travel time from the 2016 do-minimum in both the AM and PM peak periods. The AM increases were no greater than 50 seconds while the PM times were closer to a 100 second increase. Based on the results for movements at this area, any at-grade improvement options will not reduce the travel times.

4.7 2016 Summary

The improvement option results in significant benefits for motorists travelling north from the Mount Victoria Tunnel. On average in both the AM and PM peak periods, the other

movement areas only worsen in terms of average journey travel time. As can be seen by this analysis the travel times still increase significantly between the 2006 and 2016 do-minimum results.

5 Recommendations

The results for both the 2006 and 2016 forecast years show that the at-grade changes to the Basin Reserve gyratory presented in this report are not expected to reduce congestion or travel times. This analysis has concluded that at-grade improvement options will not make any significant improvement to travel times except for those from at the Mt Victoria Tunnel approach. On the basis of the analysis presented in this report it is recommended that:

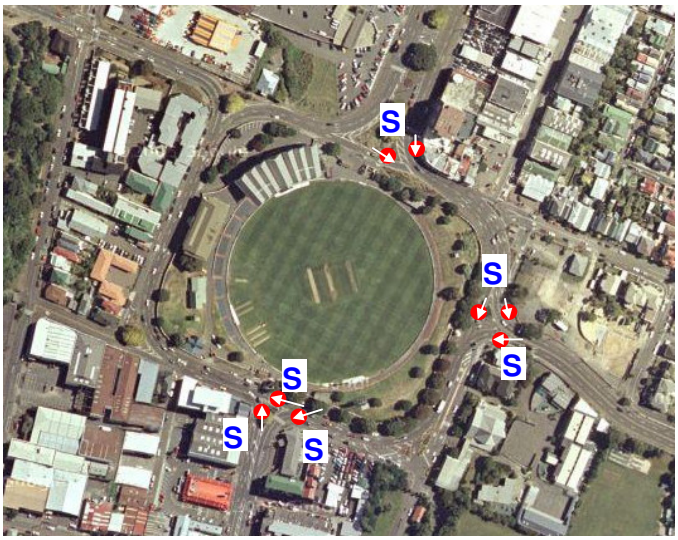
(a) Improvement options for an at-grade solution permitting all existing movements are not progressed any further;

(b) An alternative solution that either addresses the traffic conflict at the Basin Reserve or encourages greater use of Passenger transport is developed in order to address the traffic congestion forecast for 2016 (do-minimum); and

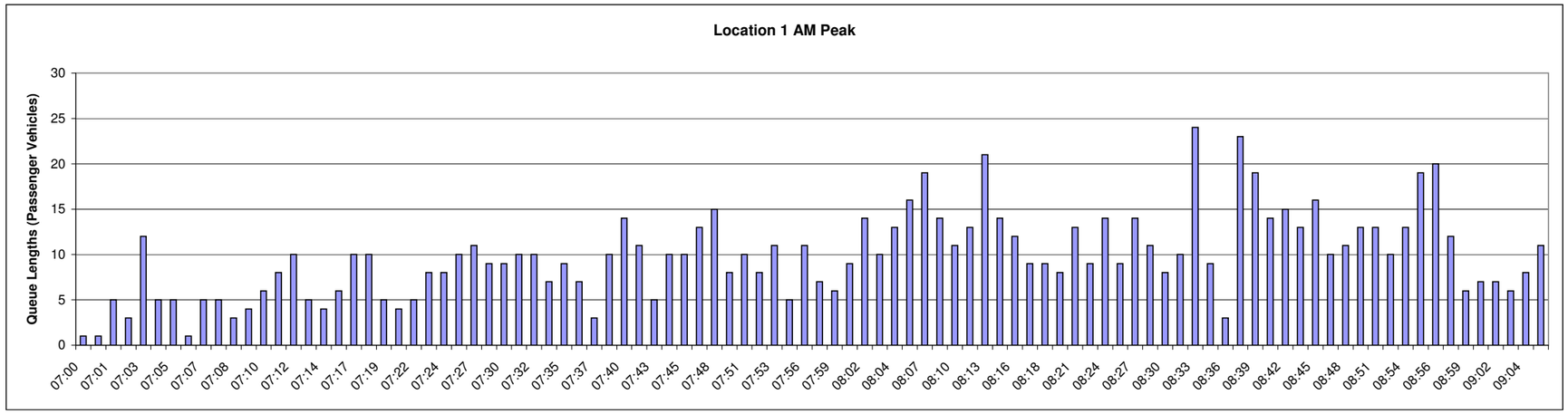
(c) Passenger transport measures and facilities for pedestrians and cyclists are considered in any options that are developed further.

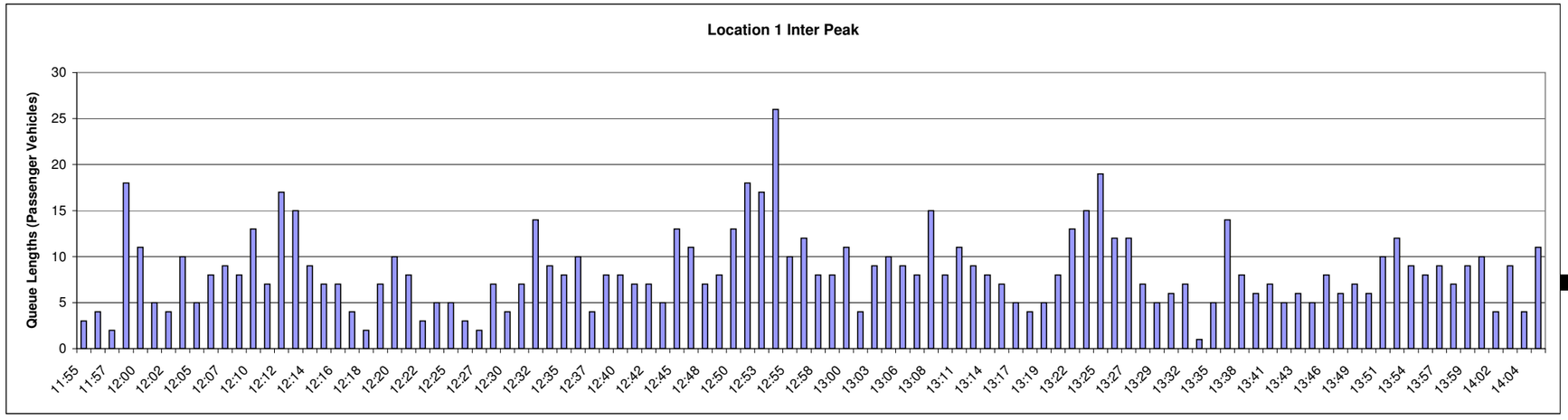
APPENDIX A

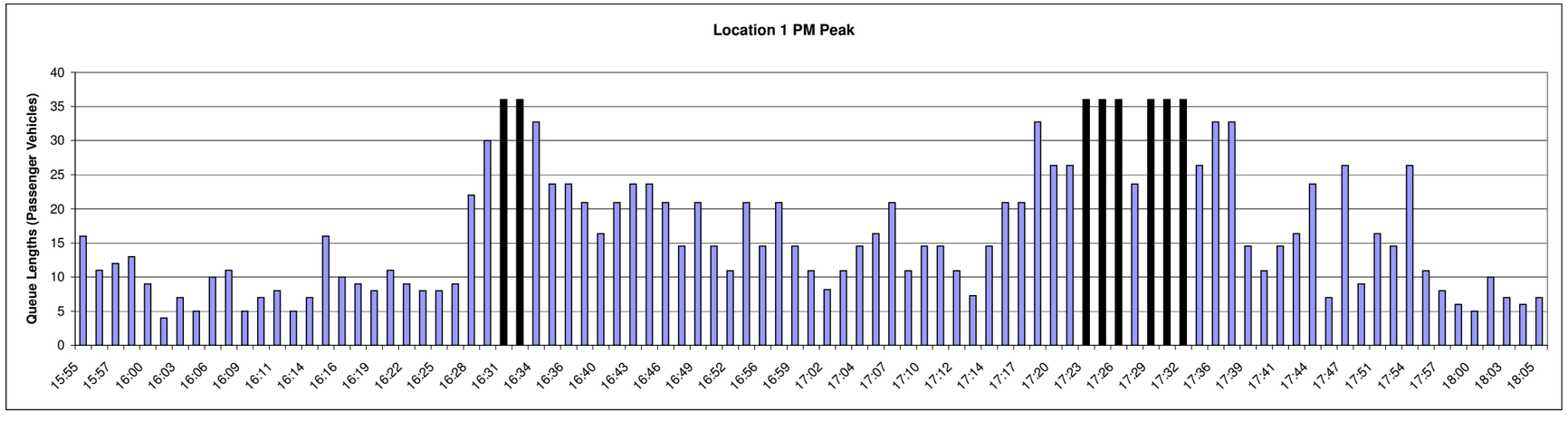
Queue Length Survey Results



Queue Length Survey 29 November 2007 Location 1 (Adelaide Road Stop Line)



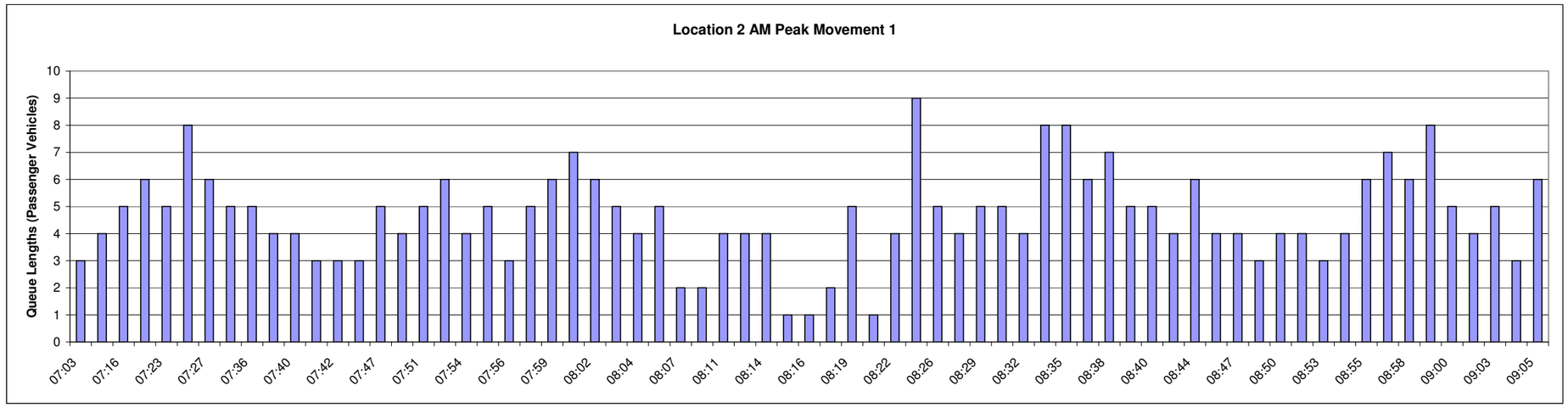


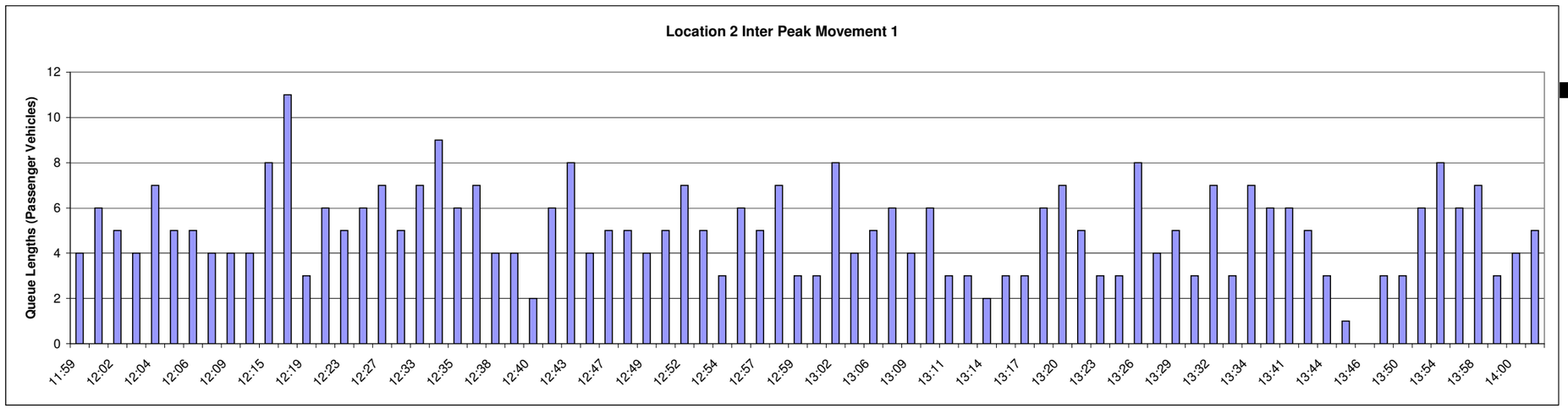


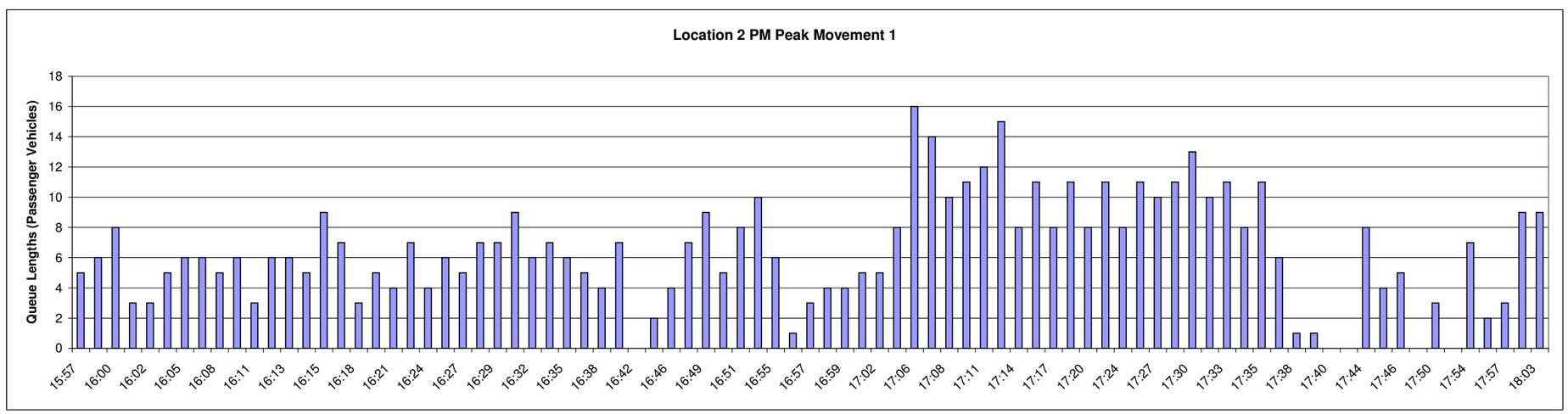
KEY:

Darkened bar indicates maximum queue length

Queue Length Survey 29 November 2007 Location 2 Movement 1 (Left Filter to Adelaide Road)



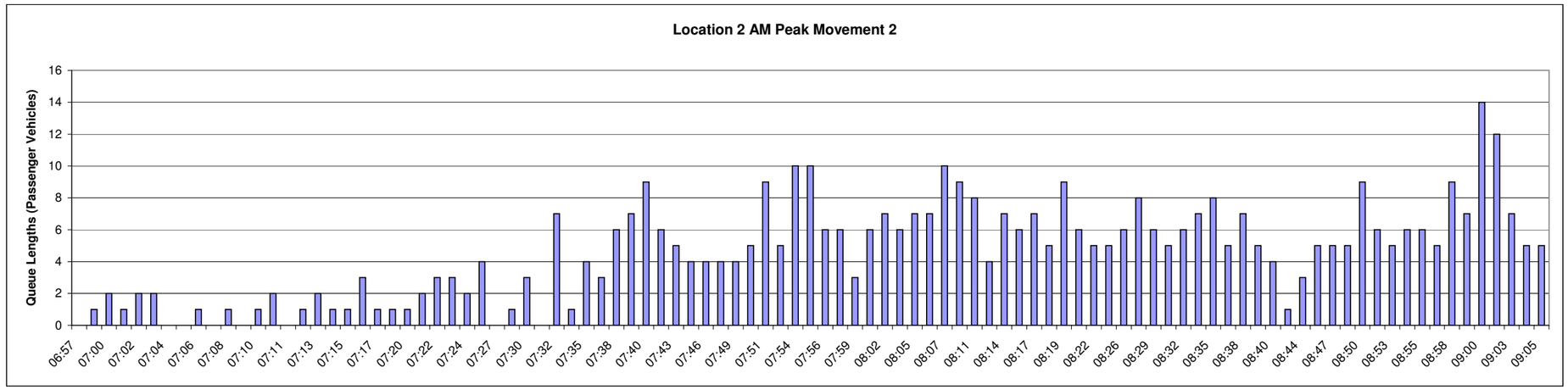


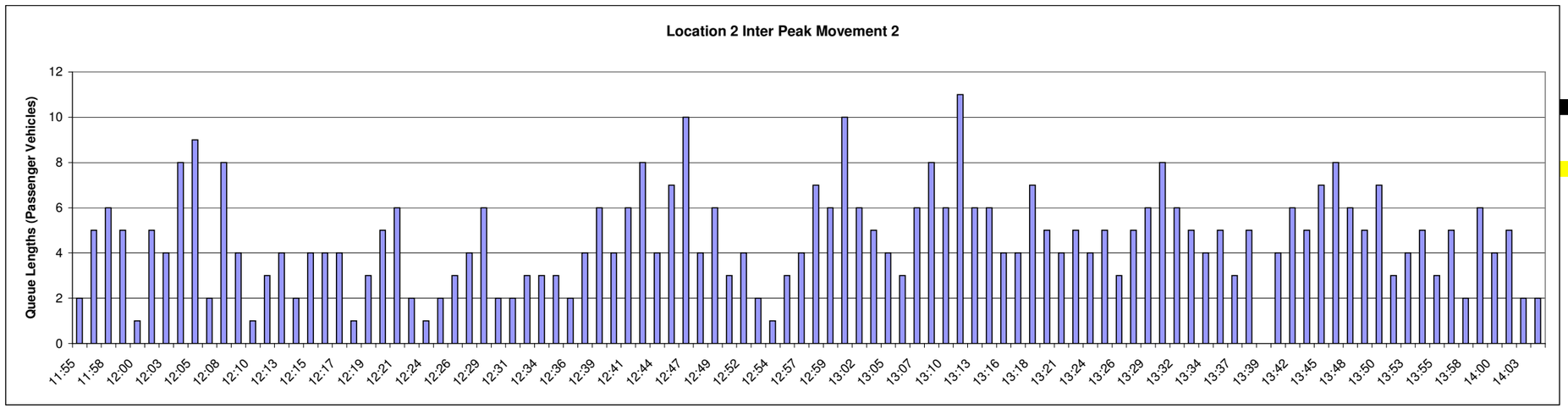


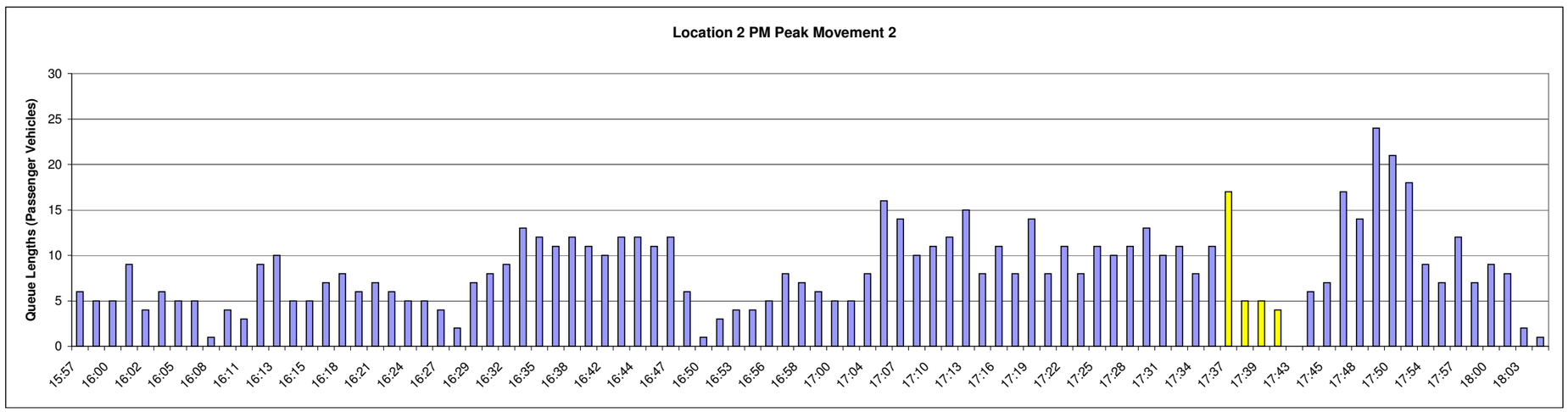
KEY:

Darkened bar indicates maximum queue length

Queue Length Survey 29 November 2007 Location 2 Movement 2 (Ahead around Basin Reserve)





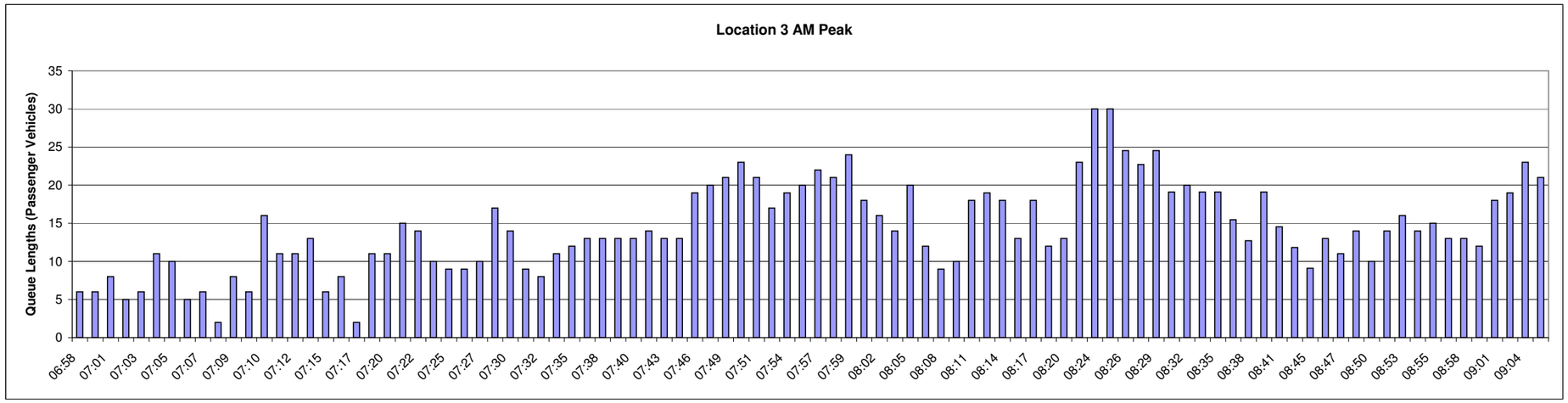


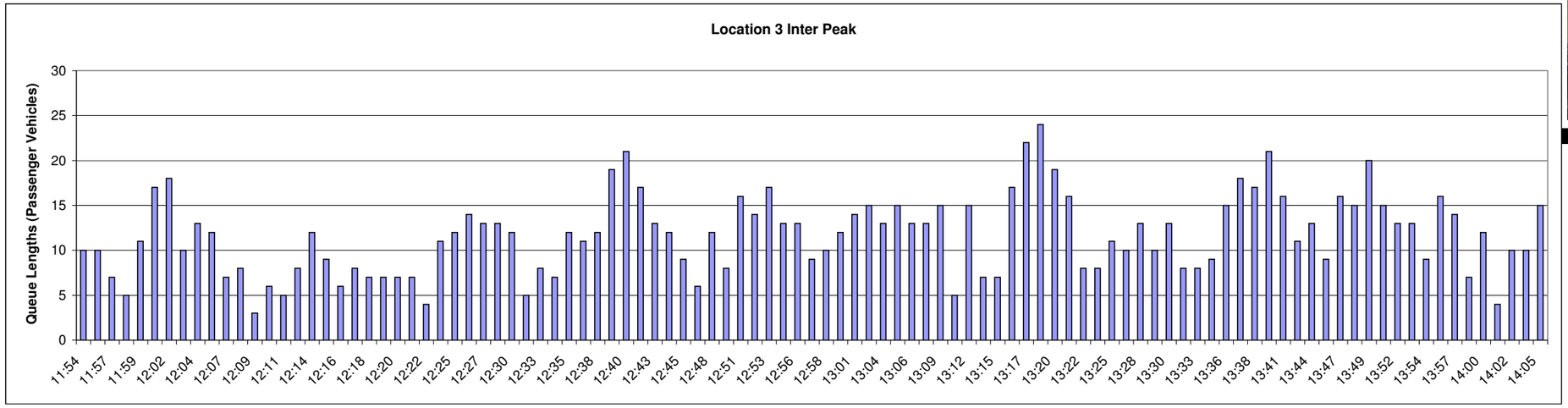
KEY:

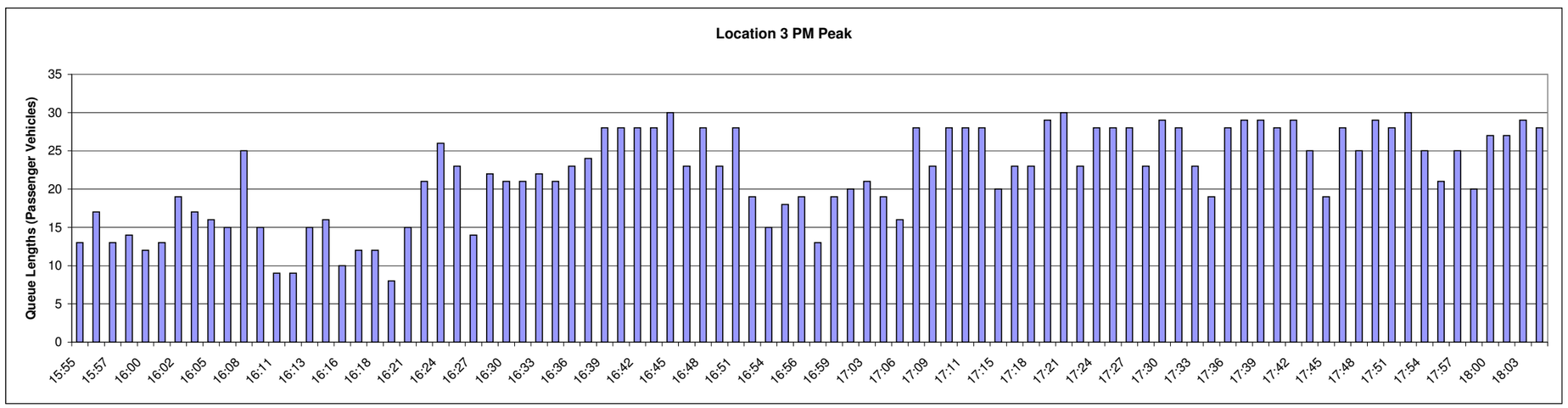
Darkened bar indicates maximum queue length

Yellow bar indicates queue affected by derailed tram

Queue Length Survey 29 November 2007 Location 3 (Paterson Street)



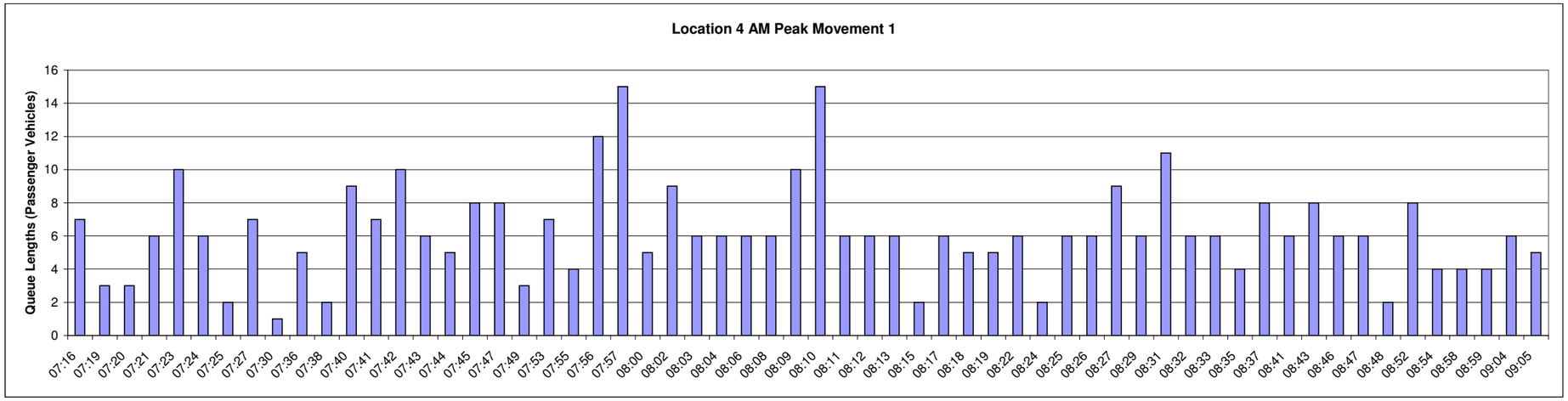


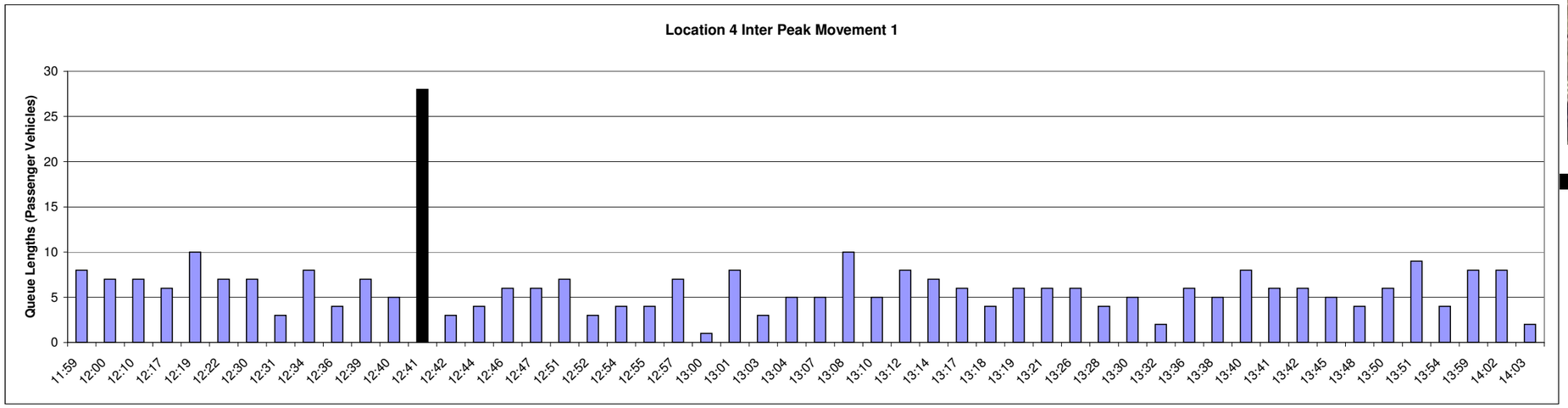


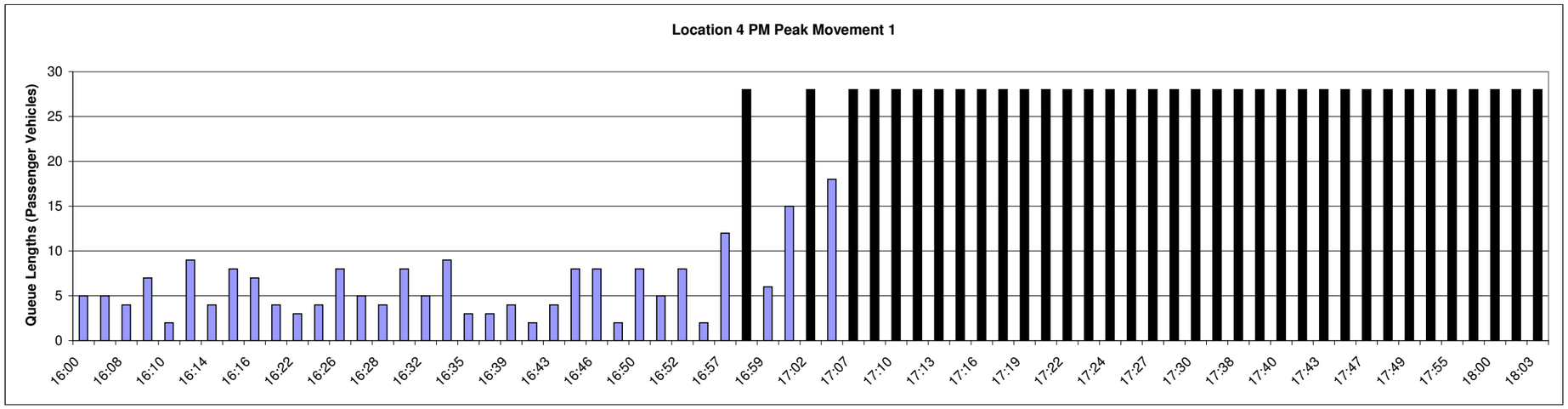
KEY:

Darkened bar indicates maximum queue length (Paterson Street)

Queue Length Survey 29 November 2007 Location 4 Movement 1 (Left turn to Paterson Street)







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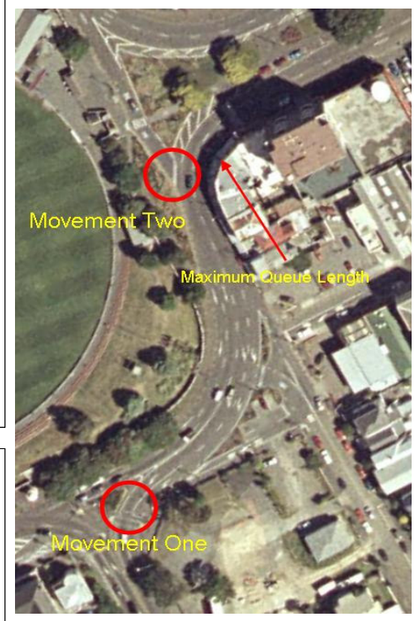
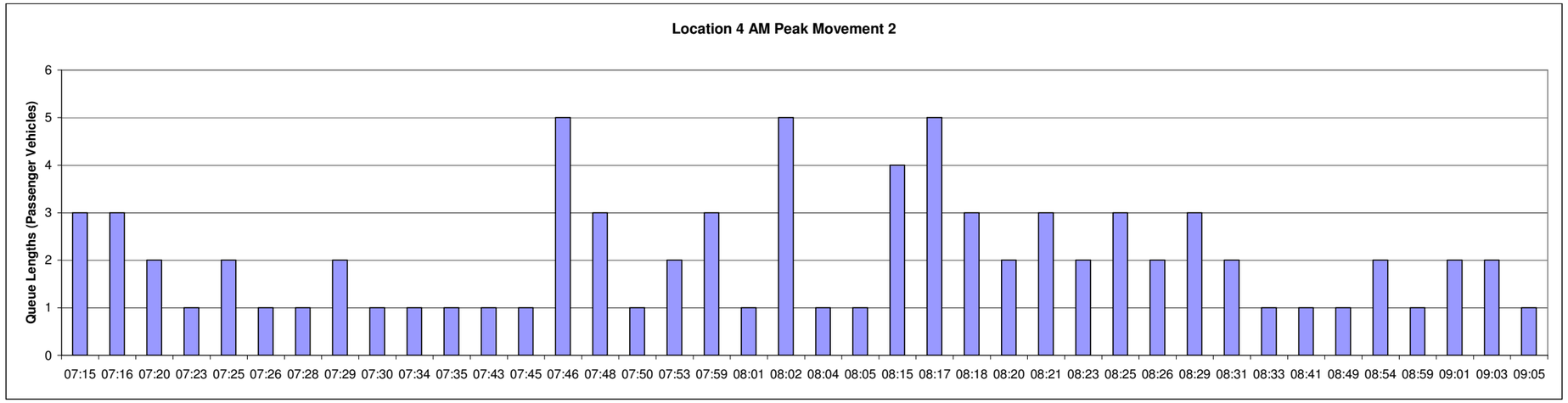
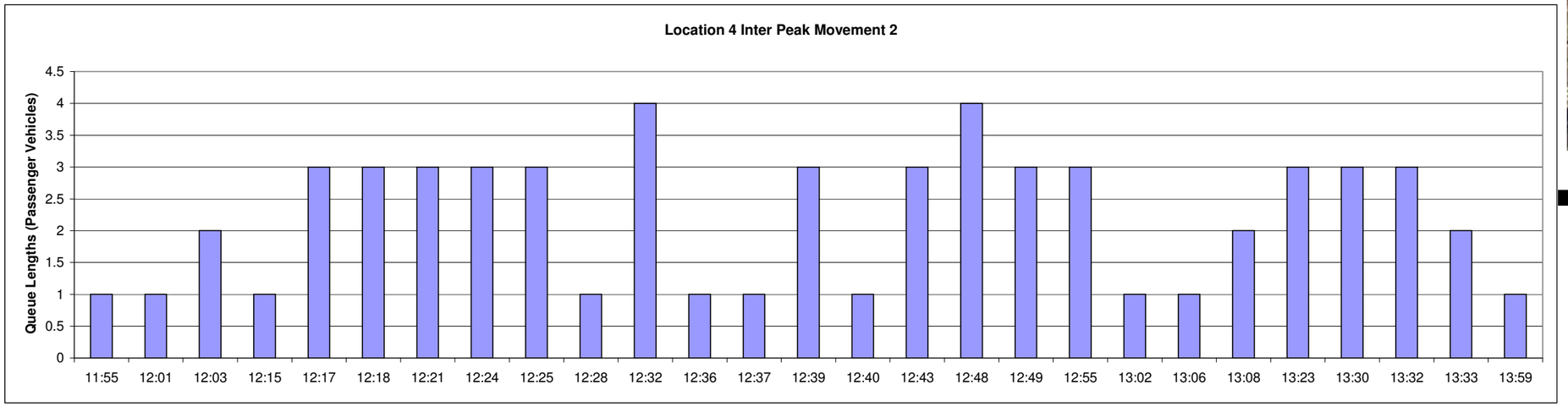
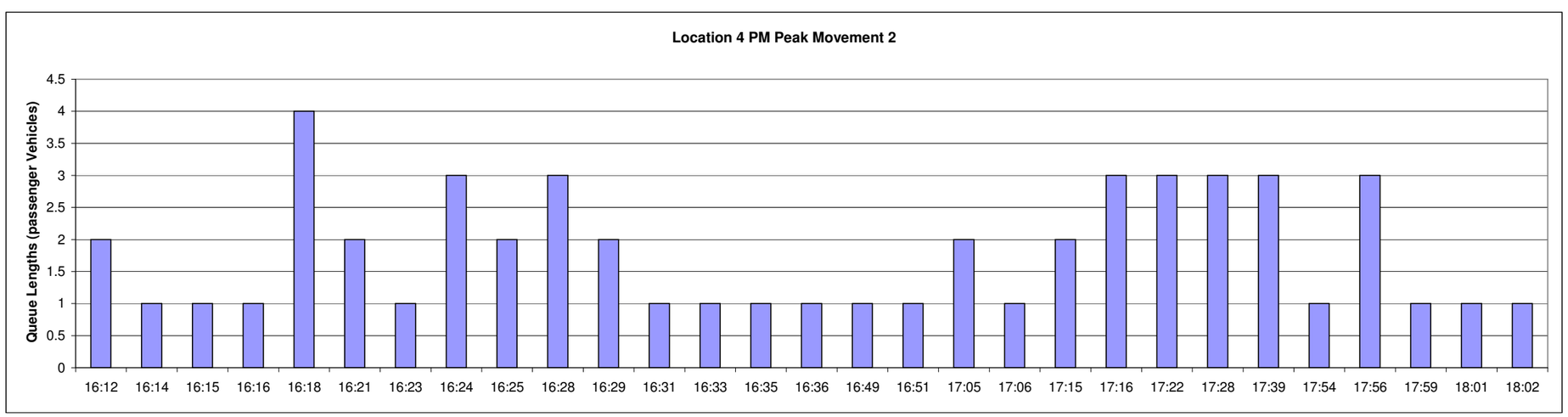


Darkened bar indicates maximum queue length

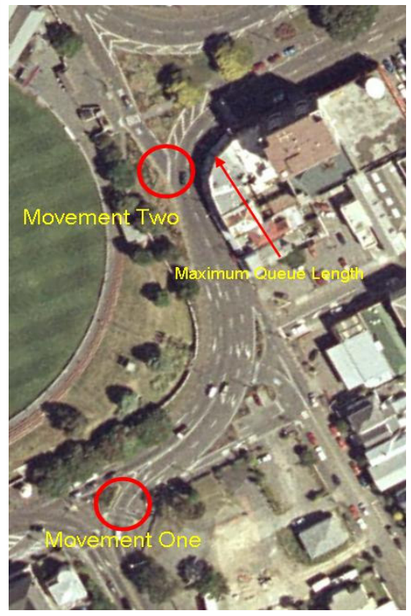
Queue Length Survey 29 November 2007 Location 4 Movement 2 (give-way markings)





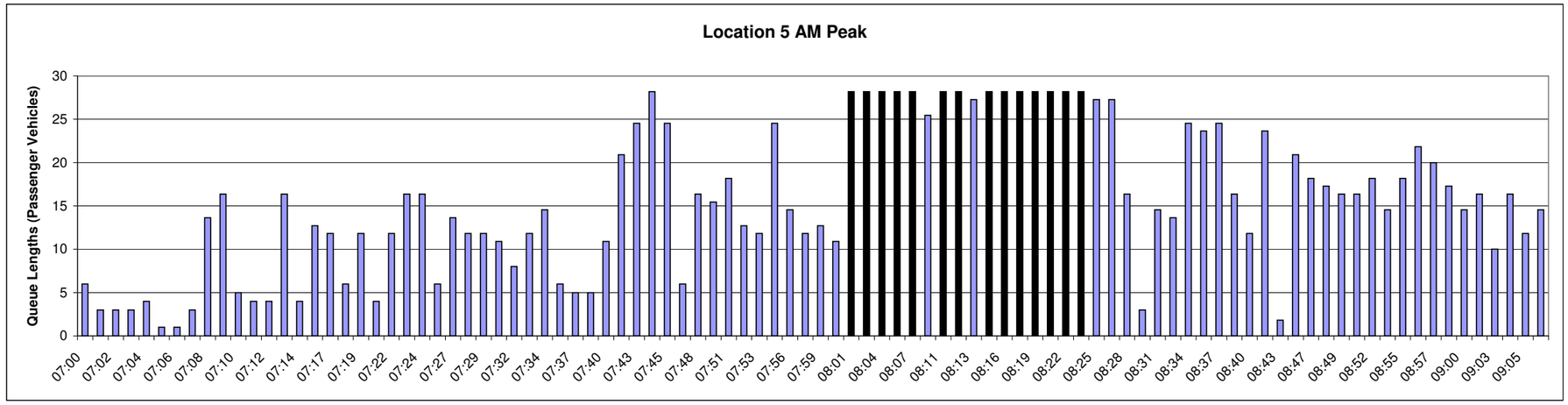


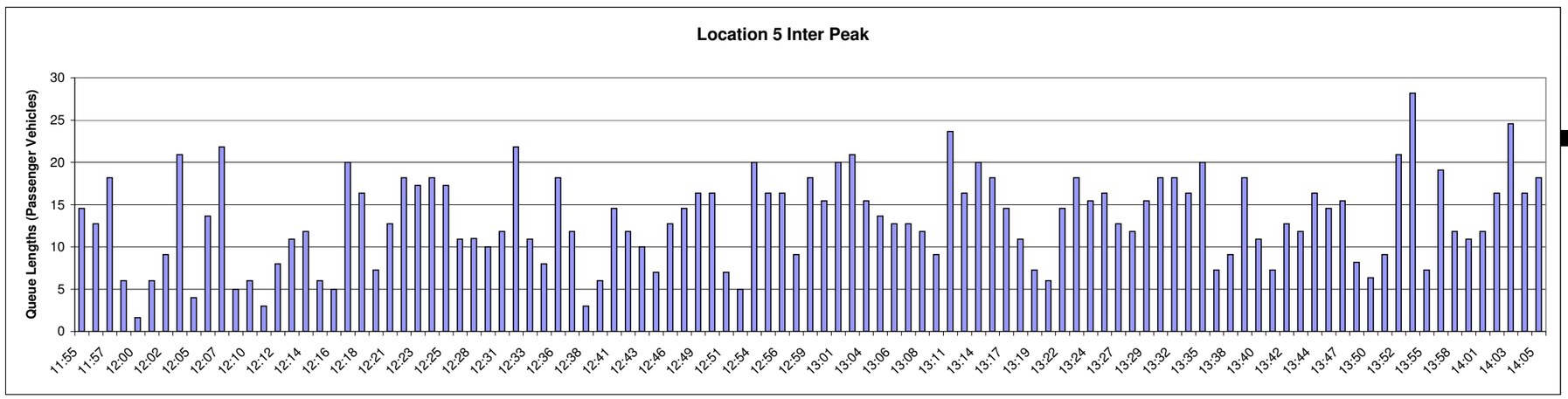
KEY:

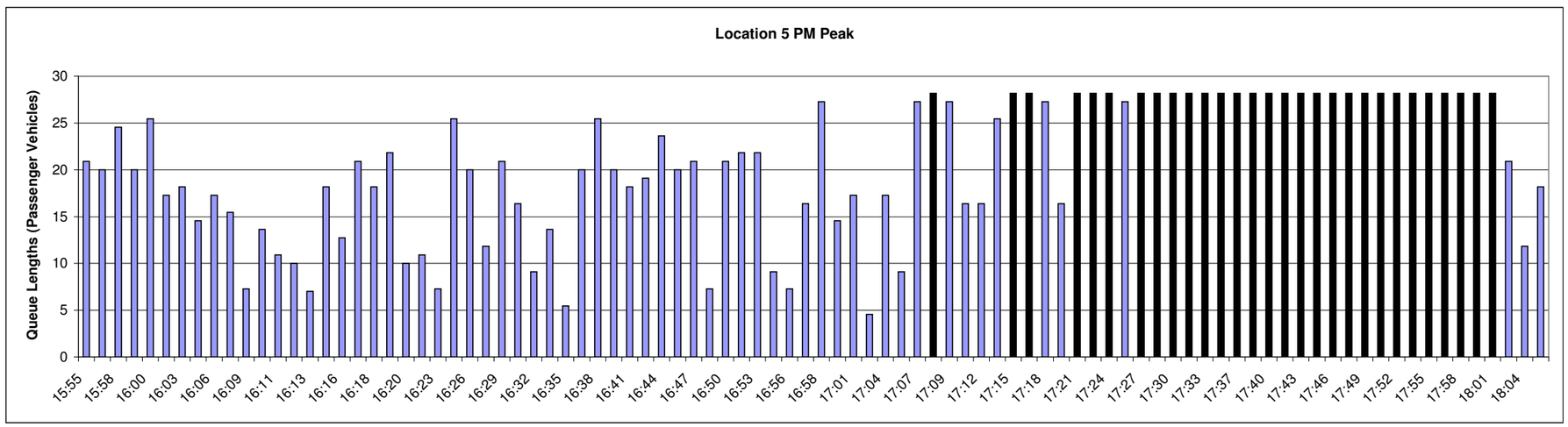


Darkened bar indicates maximum queue length

Queue Length Survey 29 November 2007 Location 5 (Ahead Movement at Paterson Street intersection)



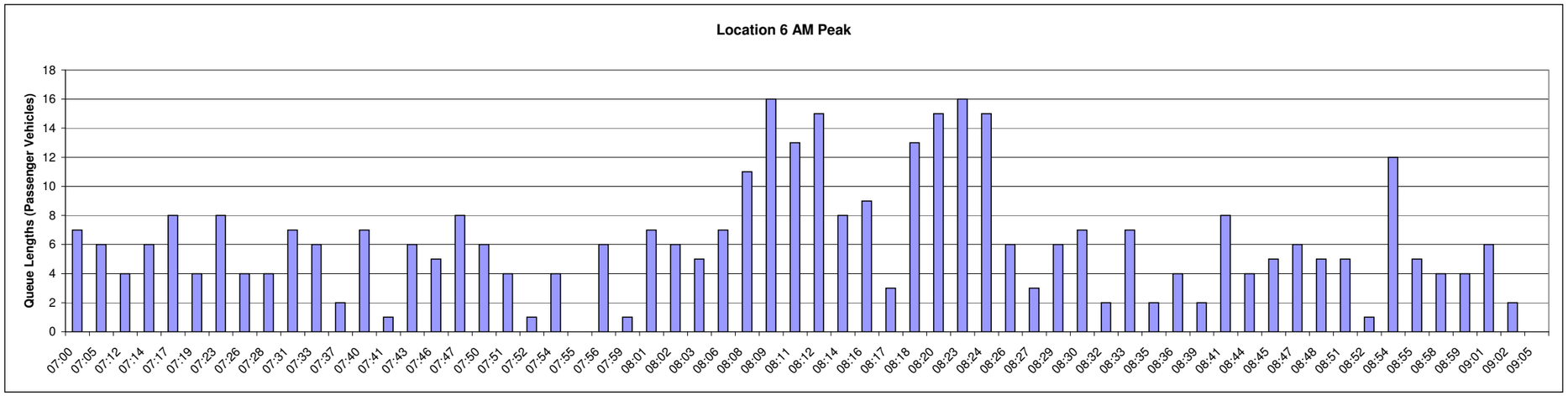


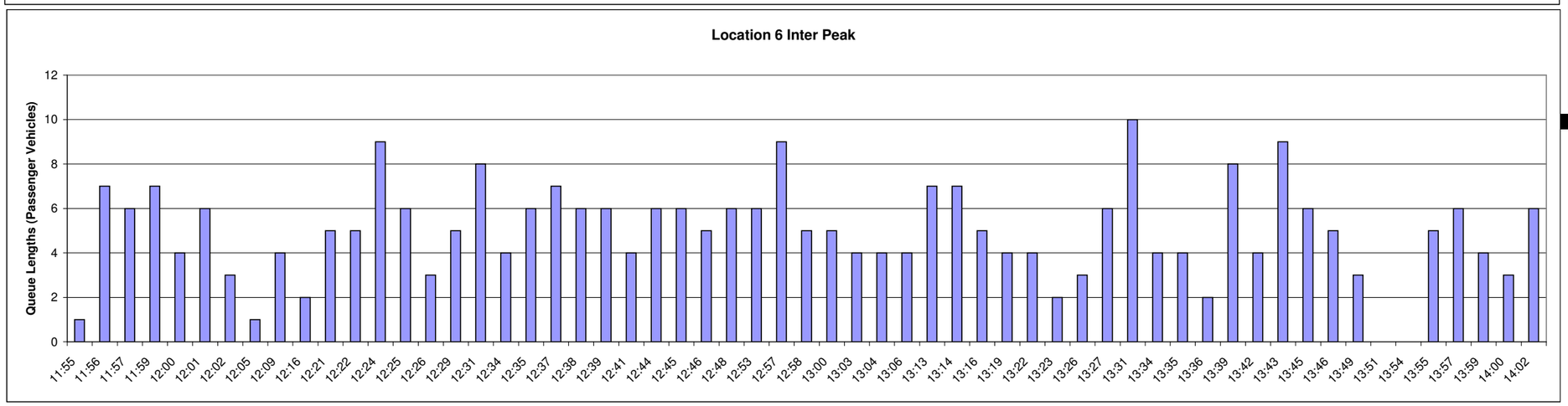


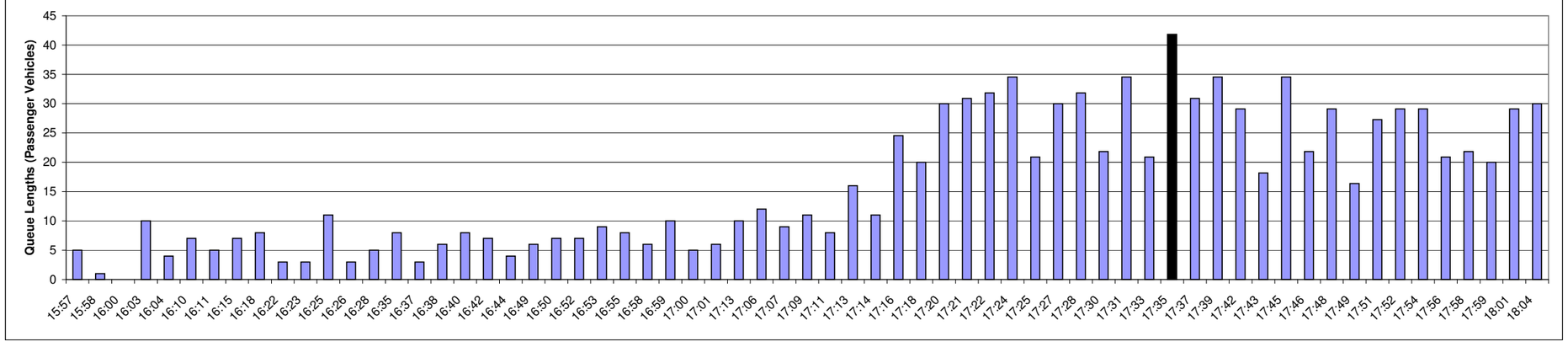
KEY:

Darkened bar indicates maximum queue length

Queue Length Survey 29 November 2007 Location 6 (signalised pedestrian crossing on Kent Terrace)







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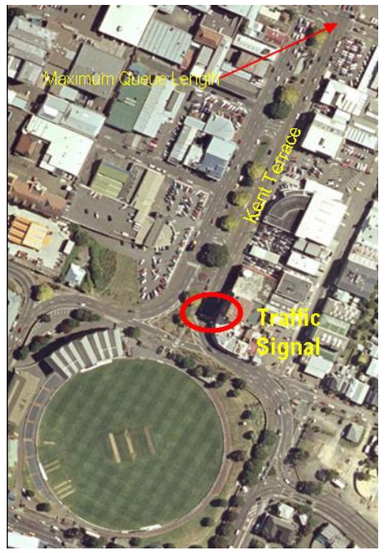


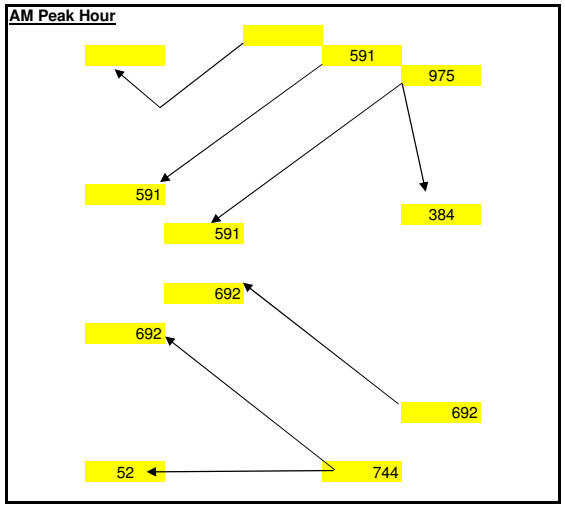
Darkened bar indicates maximum queue length

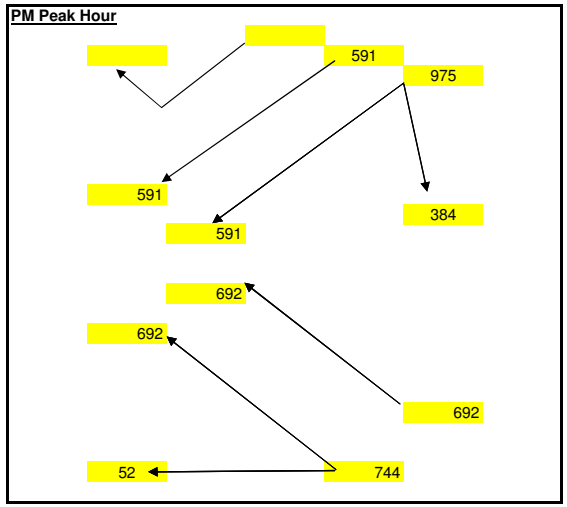
APPENDIX B

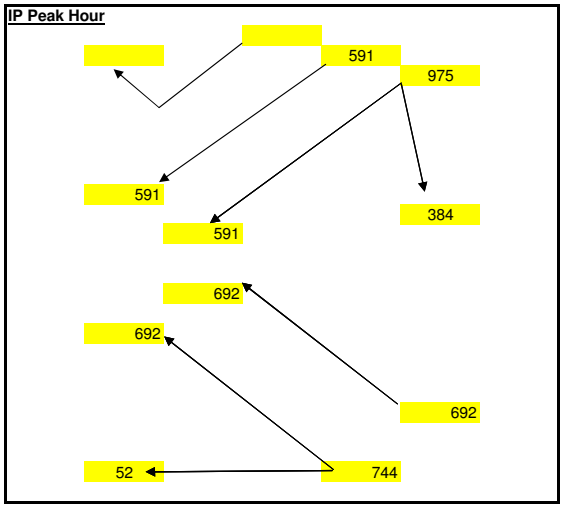
2006 Turning Flows Forecast Using the As-built WICB Model

Lane Utilisation - Option 1 & 1A

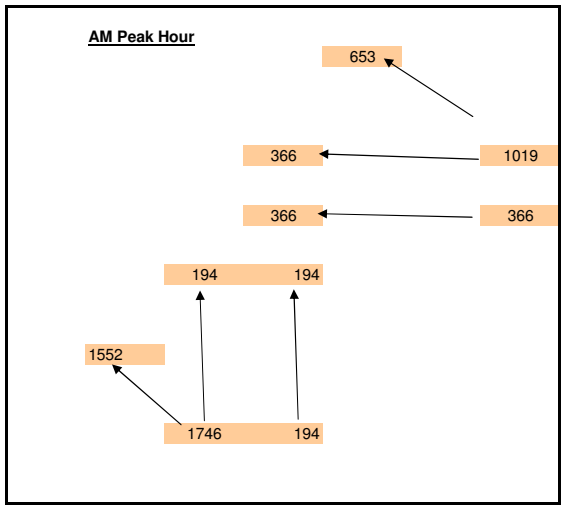
Mt Victoria Signals

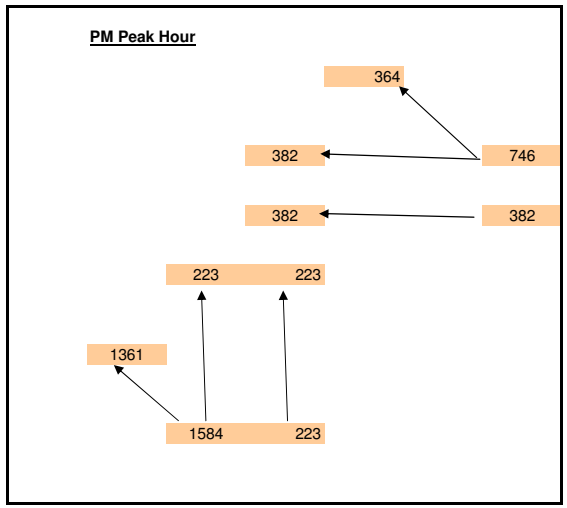


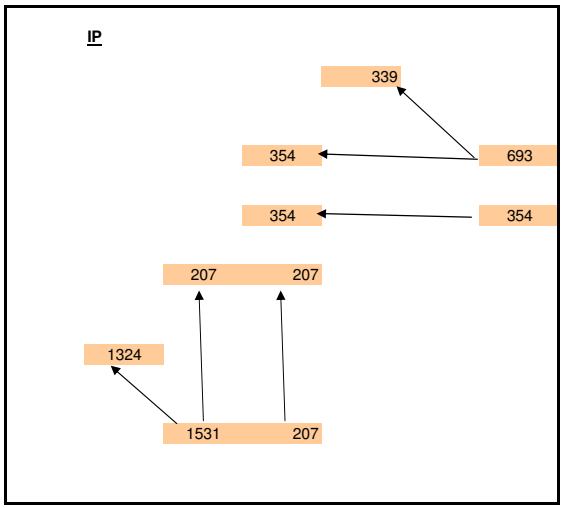




Buckle St Signals







APPENDIX C

SIDRA MODEL OUTPUTS

SIDRA INTERSECTION

Output Tables

Buckle St Signalised Intersection

PM peak flow

Run Information

```
Cycle Time =   30  (Practical Cycle Time)

* Basic Parameters:
  Intersection Type: Signalised - Fixed Time
  Driving on the left-hand side of the road
  "New Zealand" give way rule applied when input data was set up for this run
  Input data specified in Metric units
  Model Defaults: New Zealand
  Peak Flow Period (for performance): 30 minutes
  Unit time (for volumes): 60 minutes.
  Delay definition: Control delay
                    Geometric delay included
  SIDRA Standard Delay model used
  SIDRA Standard Queue model used
  Level of Service based on: Delay (HCM method)
  Queue definition: Back of queue, 95th Percentile

* Iteration Data:
  No. of Main (Timing-Capacity) Iterations =  1
  Comparison of last two iterations:
    Difference in intersection degree of satn =  0.0 %
    Largest difference in eff. green times =  0 secs
    (max. value for stopping = 0 secs)
```

Table B.1 - Movement Definitions and Flow Rates (Origin-Destination)

```
Buckle St Signalised Intersection
PM peak flow
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  30 (Practical Cycle Time)

-------------------------------------------------------------------
 From      To          Mov          Flow Rate   Flow   Peak Flow
 Approach  Approach    ID    Turn     LV    HV   Scale    Factor
-------------------------------------------------------------------
 South: Sussex Street
           North         2   Thru    445    23    1.00     0.95
           West          1   Left   1361    72    1.00     0.95
-------------------------------------------------------------------
 East: WICB East
           North         6   Right   364    19    1.00     0.95
           West          5   Thru    764    40    1.00     0.95
-------------------------------------------------------------------
Unit Time for Volumes =  60 minutes
Peak Flow Period =  30 minutes
Flow Rates include effects of Flow Scale and Peak Flow Factor
```

Table B.2A - Flow Rates (Separate Light and Heavy Vehicles)

```
Buckle St Signalised Intersection
PM peak flow
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  30 (Practical Cycle Time)

-----------------------------------------------
  Mov          Left       Through       Right
  ID        ---------    ---------    ---------
             LV    HV     LV    HV     LV    HV
-----------------------------------------------
Demand flows in veh/hour as used by the program
South: Sussex Street
    1 L    1361    72      0     0      0     0
    2 T       0     0    445    23      0     0
-----------------------------------------------
East: WICB East
    5 T       0     0    764    40      0     0
    6 R       0     0      0     0    364    19
-----------------------------------------------
Unit Time for Volumes =  60 minutes
Peak Flow Period =  30 minutes
Flow Rates include effects of Flow Scale and Peak Flow Factor
```

Table B.2B - Flow Rates (Total Vehicles and Percent Heavy)

```
Buckle St Signalised Intersection
PM peak flow
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  30 (Practical Cycle Time)

-------------------------------------------------
  Mov          Left        Through        Right
  ID        ----------    ----------    ----------
            Total  %HV    Total  %HV    Total  %HV
-------------------------------------------------
Demand flows in veh/hour as used by the program
South: Sussex Street
    1 L     1433   5.0       0   0.0       0   0.0
    2 T        0   0.0     468   4.9       0   0.0
-------------------------------------------------
East: WICB East
    5 T        0   0.0     804   5.0       0   0.0
    6 R        0   0.0       0   0.0     383   5.0
-------------------------------------------------
Unit Time for Volumes =  60 minutes
Peak Flow Period =  30 minutes
Flow Rates include effects of Flow Scale and Peak Flow Factor
```

Table S.1 - Movement Phase and Timing Parameters

```
Buckle St Signalised Intersection
PM peak flow
Intersection ID: 0
```

```
Fixed-Time Signals, Cycle Time =  30 (Practical Cycle Time)

-------------------------------------------------------------------------------------------
 Mov     Mov           P H A S E  M A T R I X          Lost Tim  Req.Mov.Time     Eff. Grn
 ID      Typ      First Green          Second Green     --------  ------------     --------
                 -------------------  -------------------  1st  2nd  1st      2nd     1st  2nd
                  Fr    To    Op Pr    Fr    To    Op Pr   Grn  Grn  Grn      Grn     Grn  Grn
-------------------------------------------------------------------------------------------
South: Sussex Street
   1 L  (Slp)*A      B             B      A      Y       6   11   15.8     13.1     10    3
   2 T        A      B                                    6        14.3              10
-------------------------------------------------------------------------------------------
East: WICB East
   5 T       *B      A                                    6        13.1               8
   6 R  (Slp) A      B      Y      B      A             12    6   12.3     12.8      4    8
-------------------------------------------------------------------------------------------
-------------------------------------------------------------------------------------------
  Current Phase Sequence: Two-phase
  Input phase sequence: A B
  Output phase sequence: A B
-------------------------------------------------------------------------------------------
  *  Critical Movement/Green Period

Movement Types:                              Under heading 'Op':
  Slp  Slip Lane Movement                      Y   If opposed turn
  Ped  Pedestrian
  Dum  Dummy
```

Table S.2 - Movement Capacity Parameters

```
Buckle St Signalised Intersection
PM peak flow
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  30 (Practical Cycle Time)

-------------------------------------------------------------------------------
 Mov      Dem           Satn Flow   Flow Ratio  Total Prac. Prac. Lane   Deg.
 ID       Flow         -----------  ---------   Cap. Deg.  Spare Util   Satn
          (veh    HV    1st   2nd    1st   2nd  (veh  Satn  Cap.
           /h)    (%)   Grn   Grn    Grn   Grn   /h)   xp    (%)   (%)     x
-------------------------------------------------------------------------------
South: Sussex Street
   1 L    1433    5.0  3586  5978  0.295 0.063  1793  0.90    13   100  0.799*
   2 T     468    4.9  1890        0.248         630  0.90    21    93  0.743
-------------------------------------------------------------------------------
East: WICB East
   5 T     804    5.0  3778        0.213        1007  0.90    13   100  0.798
   6 R     383    5.0  2059  1794  0.009 0.203   753  0.90    77   100  0.509
-------------------------------------------------------------------------------
```

Table S.3 - Intersection Parameters

```
Buckle St Signalised Intersection
PM peak flow
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  30 (Practical Cycle Time)

-------------------------------------------------------------------------
   Crit App.  Green   Phases   Adjusted    Adjusted   Required   Required
   Mov  and   Period  ------     Lost        Flow     Grn Time   Movement
   ID   Turn          Fr  To     Time        Ratio     Ratio       Time
```

```
-------------------------------------------------------------------------
     1  S_L    1st   A    B        6        0.295      0.328       15.8
     5  E_T          B    A        6        0.213      0.236       13.1
                                  ----       ------     ------     ------
                          Total:   12        0.508      0.564       28.9
-------------------------------------------------------------------------

   Cycle Time:
     Minimum   Maximum   Practical   Chosen
        24       150         28         30


   Intersection Level of Service             =         B
   Worst movement Level of Service           =         B
   Average intersection delay (s/pers)       =      13.8
   Largest average movement delay (s)        =      15.1
   Largest back of queue, 95% (m)            =        66
   Performance Index                         =     87.77
   Degree of saturation (highest)            =     0.799
   Practical Spare Capacity (lowest)         =        13 %
   Effective intersection capacity, (veh/h)  =      3864
   Total vehicle flow (veh/h)                =      3088
   Total person flow (pers/h)                =      4632
   Total vehicle delay (veh-h/h)             =     11.83
   Total person delay (pers-h/h)             =     17.75
   Total effective vehicle stops (veh/h)     =      2949
   Total effective person stops (pers/h)     =      4423
   Total vehicle travel (veh-km/h)           =    1788.6
   Total cost ($/h)                          =   1436.60
   Total fuel (L/h)                          =     219.8
   Total CO2 (kg/h)                          =    550.48
```

Table S.4 - Phase Information

```
Buckle St Signalised Intersection
PM peak flow
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  30 (Practical Cycle Time)

-------------------------------------------------------------------------
Phase  Change  Starting  Green  Displayed  Green  Terminating  Phase  Phase
       Time    Intgrn   Start    Green     End     Intgrn     Time   Split
-------------------------------------------------------------------------
 A        0       6        6       10       16        6         16    53%
 B       16       6       22        8       30        6         14    47%
-------------------------------------------------------------------------
  Current Phase Sequence: Two-phase
  Input phase sequence: A B
  Output phase sequence: A B
```

Table S.5 - Movement Performance

```
-------------------------------------------------------------------------
  Mov      Total    Total   Aver.  Prop.  Eff. Longest Queue  Perf.  Aver.
  ID       Delay    Delay   Delay Queued  Stop   95% Back     Index  Speed
        (veh-h/h)(pers-h/h)(sec)         Rate  (vehs)  (m)          (km/h)
-------------------------------------------------------------------------
South: Sussex Street
    1 L     5.60     8.41    14.1   0.89  0.96    9.1    66   39.15   37.5
    2 T     1.58     2.37    12.1   0.94  0.93    8.9    65   13.77   38.6
-------------------------------------------------------------------------
East: WICB East
    5 T     3.38     5.07    15.1   0.99  1.03    8.5    62   25.56   36.6
    6 R     1.27     1.91    11.9   0.79  0.80    4.4    32    9.29   38.9
```

Table S.6 - Intersection Performance

Buckle St Signalised Intersection
PM peak flow
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 30 (Practical Cycle Time)

Total Flow (veh/h)	Deg. Satn x	Total Delay (veh-h/h)	Total Delay (pers-h/h)	Aver. Delay (sec)	Prop. Queued	Eff. Stop Rate	Longest Queue (m)	Perf. Index	Aver. Speed (km/h)
South: Sussex Street									
1901	0.799	7.18	10.77	13.6	0.90	0.96	66	52.92	37.8
East: WICB East									
1187	0.798	4.65	6.97	14.1	0.92	0.95	62	34.85	37.3
ALL VEHICLES:									
3088	0.799	11.83	17.75	13.8	0.91	0.95	66	87.77	37.6
INTERSECTION (persons):									
4632	0.799		17.75	13.8	0.91	0.95		87.77	37.6

Queue values in this table are 95% back of queue (metres).

Table S.7 - Lane Performance

Buckle St Signalised Intersection
PM peak flow
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 30 (Practical Cycle Time)

Lane No.	Effective Green Times (sec) R1	G1	R2	G2	Dem Flow (veh/h)	Cap (veh/h)	Deg. Satn x	Aver. Delay (sec)	Eff. Stop Rate	Queue 95% Back (vehs)	(m)	Lane Length (m)
South: Sussex Street												
1 L	6	10	11	3	717	897	0.799	14.1	0.96	9.1	66.4	500.0
2 L	6	10	11	3	717	897	0.799	14.1	0.96	9.1	66.4	500.0
3 T	20	10	0	0	468	630	0.743	12.1	0.93	8.9	64.8	500.0
East: WICB East												
1 T	22	8	0	0	402	504	0.798	15.1	1.03	8.5	62.2	500.0
2 T	22	8	0	0	402	504	0.798	15.1	1.03	8.5	62.2	500.0
3 R	12	4	6	8	383	753	0.509	11.9	0.80	4.4	31.9	500.0

Table S.8 - Lane Flow and Capacity Information

Buckle St Signalised Intersection
PM peak flow

```
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  30 (Practical Cycle Time)

--------------------------------------------------------------------------
                                  Saturation Flow  End  Tot
 Lane     Dem Flow (veh/h)   Lane   Adj. Aver Aver  Cap  Cap  Deg.  Lane
 No.    -------------------  Width Basic 1st  2nd  (veh (veh  Satn  Util
         Lef Thru  Rig  Tot   (m)  (tcu) (veh)(veh)  /h)  /h)   x     %
--------------------------------------------------------------------------
 South: Sussex Street
 1 L     717    0    0  717  3.30  1950 1793  2989  299  897 0.799  100
 2 L     717    0    0  717  3.30  1950 1793  2989  299  897 0.799  100
 3 T       0  468    0  468  3.30  1950 1890     0    0  630 0.743   93P
--------------------------------------------------------------------------
 East: WICB East
 1 T       0  402    0  402  3.30  1950 1889     0    0  504 0.798  100
 2 T       0  402    0  402  3.30  1950 1889     0    0  504 0.798  100
 3 R       0    0  383  383  3.30  1950 2059  1794  263  753 0.509  100
--------------------------------------------------------------------------
  P  Lane under-utilisation found by the "Program".  This includes cases where
     the value of lane under-utilisation due to downstream effects has been
     modified by the program during lane flow calculations (e.g. a de facto
     exclusive lane has been found).

  Basic Saturation Flow in this table is adjusted for lane width, approach
  grade, parking manoeuvres and number of buses stopping.  Saturation flow
  scale applies if specified.
```

Table S.9 - Signal Timing Diagram

```
Buckle St Signalised Intersection
PM peak flow
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  30 (Practical Cycle Time)

Displayed (Phase) Green Times

              Phase A                              Phase B

0                                   16                                   30
I-----------------------------------I-----------------------------------I
..............GGGGGGGGGGGGGGGGGGGGG..............GGGGGGGGGGGGGGGGGG.
             6                                     22


Effective (Movement) Green Times


 South: Sussex Street

Mov.     1 (L)
I                                   I                                    I
GGGGGGG..............GGGGGGGGGGGGGGGGGGGGG.........................G
      3             9                       19                        30

Mov.     2 (T)
I                                   I                                    I
......................GGGGGGGGGGGGGGGGGGGGG.........................
                     9                       19


 East: WICB East

Mov.     5 (T)
I                                   I                                    I
GGGGGG.................................................GGGGGGGGGGGG
      3                                                   25

Mov.     6 (R)
I                                   I                                    I
GGGGGGG............................GGGGGGGG..............GGGGGGGGGGGGG
      3                           15       19             25
```

```
I-----I------I------I------I------I------I------I------I------I------I----->
0      3      6      9     12     15     18     21     24     27     30

                              T I M E  (s)
```

Table S.10 - Movement Capacity and Performance Summary

```
Buckle St Signalised Intersection
PM peak flow
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  30 (Practical Cycle Time)

--------------------------------------------------------------------------------
 Mov     Mov  Dem   Total  Lane  Deg.  Eff. Grn  Aver.  Eff.    95%    Perf.
 ID      Typ  Flow   Cap.  Util  Satn  --------  Delay  Stop  Back of  Index
              (veh  (veh               1st  2nd         Rate   Queue
               /h)   /h)   (%)     x   Grn  Grn  (sec)         (veh)
--------------------------------------------------------------------------------
South: Sussex Street
   1 L  (Slp) 1433  1793   100  0.799*  10*   3   14.1  0.96    9.1   39.15
   2 T         468   630    93  0.743   10        12.1  0.93    8.9   13.77
--------------------------------------------------------------------------------
East: WICB East
   5 T         804  1007   100  0.798    8*       15.1  1.03    8.5   25.56
   6 R  (Slp)  383   753   100  0.509    4    8   11.9  0.80    4.4    9.29
--------------------------------------------------------------------------------
  *  Maximum degree of saturation, or critical green periods
```

Table S.12A - Fuel Consumption, Emissions and Cost (TOTAL)

```
Buckle St Signalised Intersection
PM peak flow
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  30 (Practical Cycle Time)

------------------------------------------------------------
  Mov            Fuel    Cost     HC      CO     NOX     CO2
  ID             Total   Total   Total   Total   Total   Total
                  L/h    $/h     kg/h    kg/h    kg/h    kg/h
------------------------------------------------------------
South: Sussex Street
    1 L          101.8   671.40   0.411   18.70   0.553   255.0
    2 T           32.9   211.87   0.135    6.23   0.180    82.3
                 ------------------------------------------
                 134.7   883.27   0.546   24.94   0.733   337.3
------------------------------------------------------------
East: WICB East
    5 T           58.5   381.97   0.243   11.25   0.321   146.5
    6 R           26.6   171.36   0.109    5.03   0.146    66.6
                 ------------------------------------------
                  85.1   553.33   0.351   16.28   0.467   213.1
------------------------------------------------------------
 INTERSECTION:  219.8  1436.60   0.897   41.22   1.200   550.5
------------------------------------------------------------


PARAMETERS USED IN COST CALCULATIONS
------------------------------------

   Pump price of fuel ($/L)                 =     1.600
   Fuel resource cost factor                =      0.60
   Ratio of running cost to fuel cost       =       2.5
```

```
   Average income ($/h)                      =     21.00
   Time value factor                         =      0.60
   Light vehicle mass (1000 kg)              =       1.4
   Heavy vehicle mass (1000 kg)              =      11.0
   Light vehicle idle fuel rate (L/h)        =     1.350
   Heavy vehicle idle fuel rate (L/h)        =     2.000
```

Table S.12B - Fuel Consumption, Emissions and Cost (RATE)

```
Buckle St Signalised Intersection
PM peak flow
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  30 (Practical Cycle Time)

-------------------------------------------------------------
  Mov            Fuel    Cost     HC      CO     NOX     CO2
  ID             Rate    Rate    Rate    Rate    Rate    Rate
              L/100km  $/km     g/km    g/km    g/km    g/km
-------------------------------------------------------------
South: Sussex Street
    1 L          12.1     0.80   0.489   22.28   0.659   303.8
    2 T          12.2     0.79   0.502   23.23   0.669   306.8
               ----------------------------------------------
                 12.2     0.80   0.492   22.51   0.661   304.5
-------------------------------------------------------------
East: WICB East
    5 T          12.7     0.83   0.526   24.40   0.697   317.8
    6 R          12.1     0.78   0.494   22.91   0.663   303.4
               ----------------------------------------------
                 12.5     0.81   0.516   23.92   0.686   313.1
-------------------------------------------------------------
 INTERSECTION:   12.3     0.80   0.501   23.05   0.671   307.8
-------------------------------------------------------------
```

Table S.14 - Summary of Input and Output Data

```
Buckle St Signalised Intersection
PM peak flow
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  30 (Practical Cycle Time)

-------------------------------------------------------------------------------
 Lane   Demand Flow (veh/h)       Adj.  Eff Grn   Deg   Aver. Longest Shrt
 No.   --------------------  %HV  Basic  (secs)   Sat   Delay  Queue  Lane
         L    T    R   Tot       Satf. 1st 2nd    x    (sec)   (m)    (m)
-------------------------------------------------------------------------------
 South: Sussex Street
1 L     717             717    5  1949   10   3  0.799   14.1    66   500
2 L     717             717    5  1950   10   3  0.799   14.1    66   500
3 T          468        468    5  1950   10      0.743   12.1    65   500
       ---------------------------------------------------------------------
      1433  468    0  1901    5                 0.799   13.6    66
-------------------------------------------------------------------------------
 East: WICB East
1 T          402        402    5  1949    8      0.798   15.1    62   500
2 T          402        402    5  1949    8      0.798   15.1    62   500
3 R               383   383    5  1949    4   8  0.509   11.9    32   500
       ---------------------------------------------------------------------
         0  804  383  1187    5                 0.798   14.1    62
===============================================================================
 ALL VEHICLES          Total   %       Cycle      Max   Aver.   Max
                       Flow   HV       Time        X    Delay  Queue
                       3088    5         30      0.799   13.8    66
===============================================================================
```

```
Peak flow period = 30 minutes.

Queue values in this table are 95% back of queue (metres).

Note: Basic Saturation Flows (in through car units) have been adjusted for
      grade, lane widths, parking manoeuvres and bus stops.
```

Table S.15 - Capacity and Level of Service

```
Buckle St Signalised Intersection
PM peak flow
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  30 (Practical Cycle Time)
```

Mov ID	Mov Typ	Green Time Ratio (g/C) 1st grn	2nd grn	Total Flow (veh /h)	Total Cap. (veh /h)	Deg. of Satn (v/c)	Aver. Delay (sec)	LOS	Longest Queue 95% Back (vehs)	(m)
South: Sussex Street										
1	L (Slp)	0.333*	0.100	1433	1793	0.799*	14.1	B	9.1	66
2	T	0.333		468	630	0.743	12.1	B	8.9	65
East: WICB East										
5	T	0.267*		804	1007	0.798	15.1	B	8.5	62
6	R (Slp)	0.133	0.267	383	753	0.509	11.9	B	4.4	32
ALL VEHICLES:				3088		0.799	13.8	B	9.1	66
INTERSECTION (persons):				4632			13.8		9.1	66

```
     Level of Service calculations are based on
     average control delay including geometric delay (HCM criteria),
     independent of the current delay definition used.
     For the criteria, refer to the "Level of Service" topic in the
     SIDRA Output Guide or the Output section of the on-line help.
  *  Maximum v/c ratio, or critical green periods
  "  Movement Level of service has been determined using adjacent lane
     v/c ratio rather than short lane v/c ratio (v/c=1.0)
```

Table S.16 - SCATS MF Parameter

```
Buckle St Signalised Intersection
PM peak flow
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  30 (Practical Cycle Time)
```

Lane No.	Stopline Flow (veh/h)	Capacity (veh/h)	SCATS Satn Flow	SCATS MF	Deg. Satn x	Lane Util. %
South: Sussex Street						
1 L	717	897	1857	NA	0.799	100
2 L	717	897	1857	NA	0.799	100
3 T	468	630	1950	1219	0.743	93P
East: WICB East						
1 T	402	504	1950	1114	0.798	100
2 T	402	504	1950	1114	0.798	100
3 R	383	753	1857	NA	0.509	100

```
  NA Not Applicable - SCATS MF was not calculated for this lane due to one
     of the following reasons:
      - the lane is not controlled by signals (slip or continuous lane)
      - two movements share this lane and do not run in the same phases
  P  Lane under-utilisation found by the "Program".  This includes cases where
     the value of lane under-utilisation due to downstream effects has been
     modified by the program during lane flow calculations (e.g. a de facto
     exclusive lane has been found).

  STOPLINE FLOW: Departure flow rate in veh/h as measured at the stop line.
  This cannot exceed capacity.

  SCATS SATURATION FLOW: This allows for lane width, approach grade and
  turning vehicles.  Saturation flow scale applies if specified.
  The effects of heavy vehicles, parking manoeuvres, number of buses
  stopping and conflicting pedestrian volume are not included.

  SCATS MF: This emulates the MF (Maximum Flow) parameter used in the SCATS
  control system. It is calculated from the SCATS SATURATION FLOW parameter.

  DEG. SATN: The Demand (Arrival) Flow Rate may exceed the Stopline Flow
  Rate, therefore x > 1 is possible.
```

Table D.0 - Geometric Delay Data

```
Buckle St Signalised Intersection
PM peak flow
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  30 (Practical Cycle Time)

-------------------------------------------------------------------------------
                          Negn  Negn   Negn   Appr.   Downstream  Distance
 From      To             Radius Speed  Dist.  Dist.   ---------------------
 Approach  Approach  Turn    (m)  (km/h)  (m)    (m)       (m)      User Spec?
-------------------------------------------------------------------------------
 South: Sussex Street
             North   Thru       S   50.0   13.2    500      76          No
              West   Left    20.0   26.2   31.4    500      88          No
-------------------------------------------------------------------------------
 East: WICB East
             North   Right    5.0   15.5   10.0    500      76          No
              West   Thru       S   50.0   13.2    500      76          No
-------------------------------------------------------------------------------

  Downstream distance is distance travelled from the stopline until exit
  cruise speed is reached (includes negotiation distance).  Acceleration
  distance is weighted for light and heavy vehicles.  The same distance
  applies for both stopped and unstopped vehicles.
```

Table D.1 - Lane Delays

```
Buckle St Signalised Intersection
PM peak flow
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  30 (Practical Cycle Time)

-------------------------------------------------------------------------
                    ----------  Delay (seconds/veh)  ----------------
         Deg.   Stop-line Delay  Acc.   Queuing   Stopd
 Lane    Satn   1st   2nd Total  Dec.  Total MvUp (Idle) Geom Control
 No.       x     d1    d2   dSL   dn    dq   dqm    di    dig   dic
-------------------------------------------------------------------------
 South: Sussex Street
 1 L    0.799   5.0   3.4   8.4   4.4   4.0   1.9   2.1   5.7   14.1
```

2 L	0.799	5.0	3.4	8.4	4.4	4.0	1.9	2.1	5.7	14.1
3 T	0.743	10.2	1.9	12.1	7.3	4.9	1.5	3.4	0.0	12.1
East: WICB East										
1 T	0.798	12.0	3.2	15.1	7.6	7.5	2.5	5.0	0.0	15.1
2 T	0.798	12.0	3.2	15.1	7.6	7.5	2.5	5.0	0.0	15.1
3 R	0.509	4.5	0.0	4.5	2.6	1.9	0.0	1.9	7.4	11.9

dn is average stop-start delay for all vehicles queued and unqueued

Table D.2 - Lane Stops

Buckle St Signalised Intersection
PM peak flow
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 30 (Practical Cycle Time)

Lane No.	Deg. Satn x	-- Effective Stop Rate -- he1	he2	Geom. hig	Overall h	Prop. Queued pq	Queue Move-up Rate hqm
South: Sussex Street							
1 L	0.799	0.76	0.14	0.06	0.96	0.885	0.31
2 L	0.799	0.76	0.14	0.06	0.96	0.885	0.31
3 T	0.743	0.81	0.12	0.00	0.93	0.942	0.22
East: WICB East							
1 T	0.798	0.83	0.19	0.00	1.03	0.987	0.39
2 T	0.798	0.83	0.19	0.00	1.03	0.987	0.39
3 R	0.509	0.66	0.00	0.15	0.80	0.787	0.00

hig is the average value for all movements in a shared lane
hqm is average queue move-up rate for all vehicles queued and unqueued

Table D.3A - Lane Queues (veh)

Buckle St Signalised Intersection
PM peak flow
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 30 (Practical Cycle Time)

Lane No.	Deg. Satn x	Ovrfl. Queue No	Average (veh) Nb1	Nb2	Nb	Percentile (veh) 70%	85%	90%	95%	98%	Queue Stor. Ratio
South: Sussex Street											
1 L	0.799	0.8	3.4	1.1	4.5	5.6	6.9	7.7	9.1	10.5	0.13
2 L	0.799	0.8	3.4	1.1	4.5	5.6	6.9	7.7	9.1	10.5	0.13
3 T	0.743	0.3	4.0	0.4	4.4	5.5	6.7	7.5	8.9	10.2	0.13
East: WICB East											
1 T	0.798	0.4	3.6	0.5	4.2	5.2	6.4	7.2	8.5	9.8	0.12
2 T	0.798	0.4	3.6	0.5	4.2	5.2	6.4	7.2	8.5	9.8	0.12
3 R	0.509	0.0	1.9	0.0	1.9	2.4	3.1	3.5	4.4	5.2	0.06

Values printed in this table are back of queue (vehicles).

Table D.3B - Lane Queues (metres)

Buckle St Signalised Intersection
PM peak flow
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 30 (Practical Cycle Time)

Lane No.	Deg. Satn x	Ovrfl. Queue No	Average (metres) Nb1	Nb2	Nb	Percentile (metres) 70%	85%	90%	95%	98%	Queue Stor. Ratio
South: Sussex Street											
1 L	0.799	5.6	24.8	8.3	33.1	41.1	50.4	56.4	66.4	76.4	0.13
2 L	0.799	5.6	24.8	8.3	33.1	41.1	50.4	56.4	66.4	76.4	0.13
3 T	0.743	2.2	29.0	3.2	32.2	40.0	49.1	55.0	64.8	74.7	0.13
East: WICB East											
1 T	0.798	2.9	26.6	4.0	30.6	38.0	46.8	52.5	62.2	71.8	0.12
2 T	0.798	2.9	26.6	4.0	30.6	38.0	46.8	52.5	62.2	71.8	0.12
3 R	0.509	0.0	14.0	0.0	14.0	17.8	22.5	25.8	31.9	38.1	0.06

Values printed in this table are back of queue (metres).

Table D.4 - Movement Speeds (km/h) and Geometric Delay

Buckle St Signalised Intersection
PM peak flow
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 30 (Practical Cycle Time)

Mov ID	App. Speeds Cruise	Negn	Exit Speeds Negn	Cruise	Queue Move-up 1st Grn	2nd Grn	Av. Section Spd Running	Overall	Geom Delay (sec)
South: Sussex Street									
1 L	50.0	26.2	26.2	50.0	23.4	16.5	39.0	37.5	5.7
2 T	50.0	50.0	50.0	50.0	24.0	0.0	41.2	38.6	0.0
East: WICB East									
5 T	50.0	50.0	50.0	50.0	21.5		40.1	36.6	0.0
6 R	50.0	15.5	15.5	50.0			40.3	38.9	7.4

"Running Speed" is the average speed excluding stopped periods.

Table D.5 - Progression Factors and Actuated Signal Parameters

Buckle St Signalised Intersection
PM peak flow
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 30 (Practical Cycle Time)

Mov ID	Control	Coord.	Arrival Type	Delay Prog. Factor	Queue Prog. Factor	Disp. Grn. Settings 1st Grn Gmin	Gmax	2nd Grn Gmin	Gmax

South: Sussex Street									
1	L	FT	No	3	1.000	1.000	6	NA	6 NA
2	T	FT	No	3	1.000	1.000	6	NA	
East: WICB East									
5	T	FT	No	3	1.000	1.000	6	NA	
6	R	FT	No	3	1.000	1.000	6	NA	6 NA

Table D.6 - Gap Acceptance Parameters

Buckle St Signalised Intersection
PM peak flow
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 30 (Practical Cycle Time)

Mov ID	Mov Type	Opng Flow (pcu/h)	Critical Gap Hdwy (s)	Critical Gap Dist (m)	Foll-up Headway (s)	Entry HV Equiv
South: Sussex Street						
1 L	Slip	807	4.01	55.8	2.41	2.00
East: WICB East						
6 R	Slip	469	4.51	62.7	2.61	2.00

Values in this table are adjusted for heavy vehicles in the entry stream.

SIDRA INTERSECTION

Output Tables

Buckle St Signalised Intersection

PM peak flow

Run Information

```
Cycle Time =   40  (Practical Cycle Time)

* Basic Parameters:
  Intersection Type: Signalised - Fixed Time
  Driving on the left-hand side of the road
  "New Zealand" give way rule applied when input data was set up for this run
  Input data specified in Metric units
  Model Defaults: New Zealand
  Peak Flow Period (for performance): 30 minutes
  Unit time (for volumes): 60 minutes.
  Delay definition: Control delay
                    Geometric delay included
  SIDRA Standard Delay model used
  SIDRA Standard Queue model used
  Level of Service based on: Delay (HCM method)
  Queue definition: Back of queue, 95th Percentile

* Iteration Data:
  No. of Main (Timing-Capacity) Iterations =  2
  Comparison of last two iterations:
    Difference in intersection degree of satn =  0.0 %
    Largest difference in eff. green times =  0 secs
    (max. value for stopping = 0 secs)
```

Table B.1 - Movement Definitions and Flow Rates (Origin-Destination)

```
Buckle St Signalised Intersection
PM peak flow
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  40 (Practical Cycle Time)

-------------------------------------------------------------------
 From      To          Mov          Flow Rate   Flow   Peak Flow
 Approach  Approach    ID    Turn     LV    HV   Scale    Factor
-------------------------------------------------------------------
 South: Sussex Street
           North         2   Thru    445    23    1.00     0.95
           West          1   Left    634    33    1.00     0.95
-------------------------------------------------------------------
 East: WICB East
           North         6   Right   364    19    1.00     0.95
           West          5   Thru   1490    78    1.00     0.95
-------------------------------------------------------------------
Unit Time for Volumes =  60 minutes
Peak Flow Period =  30 minutes
Flow Rates include effects of Flow Scale and Peak Flow Factor
```

Table B.2A - Flow Rates (Separate Light and Heavy Vehicles)

```
Buckle St Signalised Intersection
PM peak flow
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  40 (Practical Cycle Time)

-----------------------------------------------
  Mov          Left       Through       Right
  ID        ---------    ---------    ---------
             LV    HV     LV    HV     LV    HV
-----------------------------------------------
Demand flows in veh/hour as used by the program
South: Sussex Street
    1 L     634    33      0     0      0     0
    2 T       0     0    445    23      0     0
-----------------------------------------------
East: WICB East
    5 T       0     0   1490    78      0     0
    6 R       0     0      0     0    364    19
-----------------------------------------------
Unit Time for Volumes =  60 minutes
Peak Flow Period =  30 minutes
Flow Rates include effects of Flow Scale and Peak Flow Factor
```

Table B.2B - Flow Rates (Total Vehicles and Percent Heavy)

```
Buckle St Signalised Intersection
PM peak flow
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  40 (Practical Cycle Time)

-------------------------------------------------
  Mov          Left        Through        Right
  ID        ----------    ----------    ----------
            Total  %HV    Total  %HV    Total  %HV
-------------------------------------------------
Demand flows in veh/hour as used by the program
South: Sussex Street
    1 L      667   4.9       0   0.0       0   0.0
    2 T        0   0.0     468   4.9       0   0.0
-------------------------------------------------
East: WICB East
    5 T        0   0.0    1568   5.0       0   0.0
    6 R        0   0.0       0   0.0     383   5.0
-------------------------------------------------
Unit Time for Volumes =  60 minutes
Peak Flow Period =  30 minutes
Flow Rates include effects of Flow Scale and Peak Flow Factor
```

Table S.1 - Movement Phase and Timing Parameters

```
Buckle St Signalised Intersection
PM peak flow
Intersection ID: 0
```

Fixed-Time Signals, Cycle Time = 40 (Practical Cycle Time)

Mov ID	Mov Typ	PHASE MATRIX First Green Fr	To	Op Pr	Second Green Fr	To	Op Pr	Lost Tim 1st Grn	2nd Grn	Req.Mov.Time 1st Grn	2nd Grn	Eff. Grn 1st Grn	2nd Grn
South: Sussex Street													
1 L	(Slp)*A		B		B	A	Y	6	20	13.7	24.4	8	6
2 T	A		B					6		13.0		8	
East: WICB East													
5 T	*B		A					6		24.4		20	
6 R	(Slp) A		B	Y	B	A		11	6	12.0Min	14.0	3	20

Current Phase Sequence: Two-phase
Input phase sequence: A B
Output phase sequence: A B

* Critical Movement/Green Period

Movement Types:
Slp Slip Lane Movement
Ped Pedestrian
Dum Dummy

Under heading 'Op':
Y If opposed turn

Table S.2 - Movement Capacity Parameters

Buckle St Signalised Intersection
PM peak flow
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 40 (Practical Cycle Time)

Mov ID	Dem Flow (veh /h)	HV (%)	Satn Flow 1st Grn	2nd Grn	Flow Ratio 1st Grn	2nd Grn	Total Cap. (veh /h)	Prac. Deg. Satn xp	Prac. Spare Cap. (%)	Lane Util (%)	Deg. Satn x
South: Sussex Street											
1 L	667	4.9	2627	2130	0.173	0.100	845	0.90	14	100	0.789
2 T	468	4.9	2964		0.158		593	0.90	14	100	0.789
East: WICB East											
5 T	1568	5.0	3778		0.415		1889	0.90	8	100	0.830*
6 R	383	5.0	2631	1794	0.022	0.180	1094	0.90	157	100	0.350

Table S.3 - Intersection Parameters

Buckle St Signalised Intersection
PM peak flow
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 40 (Practical Cycle Time)

Crit Mov ID	App. and Turn	Green Period	Phases Fr	To	Adjusted Lost Time	Adjusted Flow Ratio	Required Grn Time Ratio	Required Movement Time

```
-------------------------------------------------------------------------
     1  S_L    1st   A    B        6        0.173      0.192       13.7
     5  E_T          B    A        6        0.415      0.461       24.4
                                  ----       ------     ------     ------
                           Total:   12        0.588      0.653       38.1
-------------------------------------------------------------------------

   Cycle Time:
     Minimum   Maximum   Practical   Chosen
        24       150         35         40


   Intersection Level of Service             =         B
   Worst movement Level of Service           =         C
   Average intersection delay (s/pers)       =      16.4
   Largest average movement delay (s)        =      21.1
   Largest back of queue, 95% (m)            =       130
   Performance Index                         =    101.50
   Degree of saturation (highest)            =     0.830
   Practical Spare Capacity (lowest)         =         8 %
   Effective intersection capacity, (veh/h)  =      3718
   Total vehicle flow (veh/h)                =      3086
   Total person flow (pers/h)                =      4629
   Total vehicle delay (veh-h/h)             =     14.08
   Total person delay (pers-h/h)             =     21.13
   Total effective vehicle stops (veh/h)     =      3029
   Total effective person stops (pers/h)     =      4543
   Total vehicle travel (veh-km/h)           =    1777.9
   Total cost ($/h)                          =   1487.17
   Total fuel (L/h)                          =     223.9
   Total CO2 (kg/h)                          =    560.81
```

Table S.4 - Phase Information

```
Buckle St Signalised Intersection
PM peak flow
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  40 (Practical Cycle Time)

-------------------------------------------------------------------------
Phase  Change  Starting  Green  Displayed  Green  Terminating  Phase  Phase
        Time    Intgrn   Start    Green     End     Intgrn     Time   Split
-------------------------------------------------------------------------
 A         0       6        6        8       14        6         14    35%
 B        14       6       20       20       40        6         26    65%
-------------------------------------------------------------------------
  Current Phase Sequence: Two-phase
  Input phase sequence: A B
  Output phase sequence: A B
```

Table S.5 - Movement Performance

```
-------------------------------------------------------------------------
  Mov      Total    Total   Aver.  Prop.  Eff. Longest Queue  Perf.  Aver.
  ID       Delay    Delay   Delay Queued  Stop   95% Back     Index  Speed
        (veh-h/h)(pers-h/h)(sec)         Rate  (vehs)  (m)          (km/h)
-------------------------------------------------------------------------
South: Sussex Street
    1 L     3.91     5.86    21.1   0.97  1.03    9.8    71   22.48   33.4
    2 T     2.56     3.84    19.7   1.00  1.02    8.3    60   16.36   33.9
-------------------------------------------------------------------------
East: WICB East
    5 T     6.53     9.79    15.0   0.92  1.00   17.8   130   53.88   36.7
    6 R     1.09     1.63    10.2   0.54  0.77    3.9    28    8.79   40.1
```

```
------------------------------------------------------------------------
```

Table S.6 - Intersection Performance

```
Buckle St Signalised Intersection
PM peak flow
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  40 (Practical Cycle Time)

------------------------------------------------------------------------
 Total   Deg.   Total    Total   Aver.  Prop.  Eff. Longest Perf.   Aver.
 Flow    Satn   Delay    Delay   Delay Queued  Stop  Queue  Index   Speed
(veh/h)   x   (veh-h/h)(pers-h/h)(sec)         Rate   (m)          (km/h)
------------------------------------------------------------------------
South: Sussex Street
 1135   0.789    6.46     9.70    20.5   0.98  1.02    71   38.84    33.6
------------------------------------------------------------------------
East: WICB East
 1951   0.830    7.62    11.43    14.1   0.84  0.96   130   62.66    37.3
------------------------------------------------------------------------
ALL VEHICLES:
 3086   0.830   14.08    21.13    16.4   0.89  0.98   130  101.50    35.8
------------------------------------------------------------------------
INTERSECTION (persons):
 4629   0.830            21.13    16.4   0.89  0.98        101.50    35.8
------------------------------------------------------------------------
Queue values in this table are 95% back of queue (metres).
```

Table S.7 - Lane Performance

```
Buckle St Signalised Intersection
PM peak flow
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  40 (Practical Cycle Time)

------------------------------------------------------------------------
        Effective Red and   Dem                          Q u e u e
        Green Times (sec)  Flow  Cap  Deg.  Aver.  Eff.   95% Back     Lane
 Lane   -----------------  (veh (veh  Satn  Delay  Stop  -----------  Length
 No.     R1  G1   R2  G2     /h)  /h)   x   (sec)  Rate  (vehs) (m)    (m)
------------------------------------------------------------------------
 South: Sussex Street
 1 L      6   8   20   6    472  598 0.789   20.0  1.01   9.8   71.2   500.0
 2 LT     9   8   20   3    364  461 0.789   21.1  1.05   7.8   56.9   500.0
 3 T     32   8    0   0    298  378 0.789   20.6  1.00   8.3   60.3   500.0
------------------------------------------------------------------------
 East: WICB East
 1 T     20  20    0   0    784  944 0.830   15.0  1.00  17.8  129.9    70.0
 2 T     20  20    0   0    784  944 0.830   15.0  1.00  17.8  129.9    70.0
 3 R     11   3    6  20    383 1094 0.350   10.2  0.77   3.9   28.3    50.0
------------------------------------------------------------------------
```

Table S.8 - Lane Flow and Capacity Information

```
Buckle St Signalised Intersection
PM peak flow
```

```
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  40 (Practical Cycle Time)

--------------------------------------------------------------------------
                                  Saturation Flow  End  Tot
 Lane     Dem Flow (veh/h)   Lane   Adj. Aver Aver  Cap  Cap  Deg.  Lane
 No.    -------------------  Width Basic 1st  2nd  (veh (veh  Satn  Util
         Lef Thru  Rig  Tot   (m)  (tcu) (veh)(veh)  /h)  /h)   x     %
--------------------------------------------------------------------------
 South: Sussex Street
 1 L     472    0    0  472  3.30  1950 1794  1598  162  598 0.789  100
 2 LT    195  170    0  364  3.30  1950 1837  1253  162  461 0.789  100
 3 T       0  298    0  298  3.30  1950 1890     0    0  378 0.789  100
--------------------------------------------------------------------------
 East: WICB East
 1 T       0  784    0  784  3.30  1950 1889     0    0  944 0.830  100
 2 T       0  784    0  784  3.30  1950 1889     0    0  944 0.830  100
 3 R       0    0  383  383  3.30  1950 2631  1794  197 1094 0.350  100
--------------------------------------------------------------------------

  Basic Saturation Flow in this table is adjusted for lane width, approach
  grade, parking manoeuvres and number of buses stopping.  Saturation flow
  scale applies if specified.
```

Table S.9 - Signal Timing Diagram

```
Buckle St Signalised Intersection
PM peak flow
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  40 (Practical Cycle Time)

Displayed (Phase) Green Times

        Phase A                           Phase B

0                      14                                              40
I----------------------I-----------------------------------------------I
...........GGGGGGGGGGG.............GGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGG.
          6                        20


Effective (Movement) Green Times


 South: Sussex Street

Mov.     1 (L)
I                      I                                               I
GGGGG...........GGGGGGGGGGGGG.....................................GGGGGG
    3          9             17                                  37

Mov.     2 (T)
I                      I                                               I
................GGGGGGGGGGGGG.......................................
               9             17


 East: WICB East

Mov.     5 (T)
I                      I                                               I
GGGG.....................................GGGGGGGGGGGGGGGGGGGGGGGGGGGGGG
    3                                   23

Mov.     6 (R)
I                      I                                               I
GGGGG....................GGGG..........GGGGGGGGGGGGGGGGGGGGGGGGGGGGGG
    3                    14   17         23


I-----I------I------I------I------I------I------I------I------I------I---->
0     4      8      12     16     20     24     28     32     36     40
```

T I M E (s)

Table S.10 - Movement Capacity and Performance Summary

Buckle St Signalised Intersection
PM peak flow
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 40 (Practical Cycle Time)

Mov ID	Mov Typ	Dem Flow (veh /h)	Total Cap. (veh /h)	Lane Util (%)	Deg. Satn x	Eff. Grn 1st Grn	Eff. Grn 2nd Grn	Aver. Delay (sec)	Eff. Stop Rate	95% Back of Queue (veh)	Perf. Index
South: Sussex Street											
1 L	(Slp)	667	845	100	0.789	8*	6	21.1	1.03	9.8	22.48
2 T		468	593	100	0.789	8		19.7	1.02	8.3	16.36
East: WICB East											
5 T		1568	1889	100	0.830*	20*		15.0	1.00	17.8	53.88
6 R	(Slp)	383	1094	100	0.350	3	20	10.2	0.77	3.9	8.79

* Maximum degree of saturation, or critical green periods

Table S.12A - Fuel Consumption, Emissions and Cost (TOTAL)

Buckle St Signalised Intersection
PM peak flow
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 40 (Practical Cycle Time)

Mov ID	Fuel Total L/h	Cost Total $/h	HC Total kg/h	CO Total kg/h	NOX Total kg/h	CO2 Total kg/h
South: Sussex Street						
1 L	49.6	342.48	0.204	8.94	0.264	124.1
2 T	34.8	235.29	0.146	6.57	0.188	87.3
	84.4	577.77	0.349	15.51	0.452	211.4
East: WICB East						
5 T	113.3	742.39	0.469	21.58	0.618	283.8
6 R	26.2	167.01	0.106	4.95	0.144	65.6
	139.5	909.40	0.575	26.53	0.762	349.4
INTERSECTION:	223.9	1487.17	0.924	42.04	1.214	560.8

PARAMETERS USED IN COST CALCULATIONS

Pump price of fuel ($/L)	=	1.600
Fuel resource cost factor	=	0.60
Ratio of running cost to fuel cost	=	2.5
Average income ($/h)	=	21.00
Time value factor	=	0.60
Light vehicle mass (1000 kg)	=	1.4
Heavy vehicle mass (1000 kg)	=	11.0

```
   Light vehicle idle fuel rate (L/h)        =     1.350
   Heavy vehicle idle fuel rate (L/h)        =     2.000
```

Table S.12B - Fuel Consumption, Emissions and Cost (RATE)

```
Buckle St Signalised Intersection
PM peak flow
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  40 (Practical Cycle Time)

-------------------------------------------------------------
  Mov            Fuel    Cost     HC      CO      NOX     CO2
  ID             Rate    Rate    Rate    Rate    Rate    Rate
              L/100km  $/km     g/km    g/km    g/km    g/km
-------------------------------------------------------------
South: Sussex Street
    1 L          12.7    0.88   0.521   22.89   0.676   317.7
    2 T          13.0    0.88   0.543   24.48   0.700   325.1
               ---------------------------------------------
                 12.8    0.88   0.530   23.53   0.686   320.7
-------------------------------------------------------------
East: WICB East
    5 T          12.6    0.83   0.521   24.00   0.687   315.6
    6 R          11.9    0.76   0.484   22.53   0.654   298.8
               ---------------------------------------------
                 12.5    0.81   0.514   23.71   0.681   312.3
-------------------------------------------------------------
 INTERSECTION:   12.6    0.84   0.520   23.64   0.683   315.4
-------------------------------------------------------------
```

Table S.14 - Summary of Input and Output Data

```
Buckle St Signalised Intersection
PM peak flow
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  40 (Practical Cycle Time)

-------------------------------------------------------------------------
 Lane   Demand Flow (veh/h)        %HV  Adj.  Eff Grn   Deg   Aver. Longest Shrt
 No.   --------------------        %   Basic  (secs)    Sat   Delay  Queue  Lane
         L    T    R   Tot             Satf. 1st 2nd    x    (sec)   (m)    (m)
-------------------------------------------------------------------------
 South: Sussex Street
1 L     472              472     5  1949    8   6  0.789   20.0    71    500
2 LT    195  170         364     5  1950    8   3  0.789   21.1    57    500
3 T          298         298     5  1950    8      0.789   20.6    60    500
        ---------------------------------------------------------------
        667  468    0  1135     5                 0.789   20.5    71
-------------------------------------------------------------------------
 East: WICB East
1 T          784         784     5  1949   20      0.830   15.0   130     70
2 T          784         784     5  1949   20      0.830   15.0   130     70
3 R               383    383     5  1949    3  20  0.350   10.2    28     50
        ---------------------------------------------------------------
          0 1568  383  1951     5                 0.830   14.1   130
=========================================================================
 ALL VEHICLES          Total    %       Cycle       Max    Aver.   Max
                       Flow    HV       Time        X     Delay  Queue
                       3086     5         40      0.830   16.4   130
=========================================================================
Peak flow period = 30 minutes.

Queue values in this table are 95% back of queue (metres).
```

```
Note: Basic Saturation Flows (in through car units) have been adjusted for
      grade, lane widths, parking manoeuvres and bus stops.
```

Table S.15 - Capacity and Level of Service

```
Buckle St Signalised Intersection
PM peak flow
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  40 (Practical Cycle Time)

--------------------------------------------------------------------------------
 Mov     Mov    Green Time  Total  Total    Deg.   Aver.   LOS  Longest Queue
 ID      Typ    Ratio (g/C) Flow    Cap.     of    Delay          95% Back
               ------------ (veh   (veh     Satn                (vehs)  (m)
                1st   2nd     /h)    /h)    (v/c)  (sec)
                grn   grn
--------------------------------------------------------------------------------
South: Sussex Street
   1 L  (Slp) 0.200* 0.150    667    845   0.789    21.1    C       9.8     71
   2 T        0.200           468    593   0.789    19.7    B       8.3     60
--------------------------------------------------------------------------------
East: WICB East
   5 T        0.500*         1568   1889   0.830*   15.0    B      17.8    130
   6 R  (Slp) 0.075  0.500    383   1094   0.350    10.2    B       3.9     28
--------------------------------------------------------------------------------
  ALL VEHICLES:              3086          0.830    16.4    B      17.8    130
--------------------------------------------------------------------------------
  INTERSECTION (persons):    4629                   16.4           17.8    130
--------------------------------------------------------------------------------
     Level of Service calculations are based on
     average control delay including geometric delay (HCM criteria),
     independent of the current delay definition used.
     For the criteria, refer to the "Level of Service" topic in the
     SIDRA Output Guide or the Output section of the on-line help.
  *  Maximum v/c ratio, or critical green periods
  "  Movement Level of service has been determined using adjacent lane
     v/c ratio rather than short lane v/c ratio (v/c=1.0)
```

Table S.16 - SCATS MF Parameter

```
Buckle St Signalised Intersection
PM peak flow
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  40 (Practical Cycle Time)

-----------------------------------------------------
 Lane   Stopline Capacity  SCATS  SCATS   Deg.  Lane
 No.      Flow   (veh/h)   Satn    MF     Satn  Util.
        (veh/h)           Flow             x     %
-----------------------------------------------------
 South: Sussex Street
 1 L       472     598     1857     NA   0.789   100
 2 LT      364     461     1899     NA   0.789   100
 3 T       298     378     1950   1114   0.789   100
-----------------------------------------------------
 East: WICB East
 1 T       784     944     1950   1500   0.830   100
 2 T       784     944     1950   1500   0.830   100
 3 R       383    1094     1857     NA   0.350   100
-----------------------------------------------------
  NA Not Applicable - SCATS MF was not calculated for this lane due to one
     of the following reasons:
      - the lane is not controlled by signals (slip or continuous lane)
      - two movements share this lane and do not run in the same phases
```

STOPLINE FLOW: Departure flow rate in veh/h as measured at the stop line. This cannot exceed capacity.

SCATS SATURATION FLOW: This allows for lane width, approach grade and turning vehicles. Saturation flow scale applies if specified. The effects of heavy vehicles, parking manoeuvres, number of buses stopping and conflicting pedestrian volume are not included.

SCATS MF: This emulates the MF (Maximum Flow) parameter used in the SCATS control system. It is calculated from the SCATS SATURATION FLOW parameter.

DEG. SATN: The Demand (Arrival) Flow Rate may exceed the Stopline Flow Rate, therefore x > 1 is possible.

Table D.0 - Geometric Delay Data

Buckle St Signalised Intersection
PM peak flow
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 40 (Practical Cycle Time)

From Approach	To Approach	Turn	Negn Radius (m)	Negn Speed (km/h)	Negn Dist. (m)	Appr. Dist. (m)	Downstream (m)	Distance User Spec?
South: Sussex Street								
	North	Thru	S	50.0	13.2	500	76	No
	West	Left	20.0	26.2	31.4	500	88	No
East: WICB East								
	North	Right	5.0	15.5	10.0	500	76	No
	West	Thru	S	50.0	13.2	500	76	No

Downstream distance is distance travelled from the stopline until exit cruise speed is reached (includes negotiation distance). Acceleration distance is weighted for light and heavy vehicles. The same distance applies for both stopped and unstopped vehicles.

Table D.1 - Lane Delays

Buckle St Signalised Intersection
PM peak flow
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 40 (Practical Cycle Time)

		Delay (seconds/veh)								
Lane No.	Deg. Satn x	Stop-line Delay 1st d1	2nd d2	Total dSL	Acc. Dec. dn	Queuing Total dq	MvUp dqm	Stopd (Idle) di	Geom dig	Control dic
South: Sussex Street										
1 L	0.789	10.7	3.6	14.3	4.8	9.5	2.4	7.1	5.7	20.0
2 LT	0.789	14.6	3.5	18.1	6.2	11.9	3.1	8.7	3.0	21.1
3 T	0.789	17.7	2.9	20.6	7.7	12.9	2.2	10.6	0.0	20.6
East: WICB East										
1 T	0.830	9.5	5.5	15.0	7.1	7.9	1.8	6.1	0.0	15.0
2 T	0.830	9.5	5.5	15.0	7.1	7.9	1.8	6.1	0.0	15.0
3 R	0.350	2.8	0.0	2.8	1.8	1.1	0.0	1.1	7.4	10.2

dn is average stop-start delay for all vehicles queued and unqueued

Table D.2 - Lane Stops

Buckle St Signalised Intersection
PM peak flow
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 40 (Practical Cycle Time)

Lane No.	Deg. Satn x	-- Effective Stop Rate -- he1	he2	Geom. hig	Overall h	Prop. Queued pq	Queue Move-up Rate hqm
South: Sussex Street							
1 L	0.789	0.82	0.17	0.02	1.01	0.960	0.40
2 LT	0.789	0.83	0.22	0.00	1.05	0.988	0.63
3 T	0.789	0.83	0.17	0.00	1.00	1.000	0.34
East: WICB East							
1 T	0.830	0.82	0.18	0.00	1.00	0.918	0.25
2 T	0.830	0.82	0.18	0.00	1.00	0.918	0.25
3 R	0.350	0.45	0.00	0.32	0.77	0.541	0.00

hig is the average value for all movements in a shared lane
hqm is average queue move-up rate for all vehicles queued and unqueued

Table D.3A - Lane Queues (veh)

Buckle St Signalised Intersection
PM peak flow
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 40 (Practical Cycle Time)

Lane No.	Deg. Satn x	Ovrfl. Queue No	Average (veh) Nb1	Nb2	Nb	Percentile (veh) 70%	85%	90%	95%	98%	Queue Stor. Ratio
South: Sussex Street											
1 L	0.789	0.5	4.2	0.8	4.9	6.1	7.5	8.3	9.8	11.2	0.14
2 LT	0.789	0.4	3.2	0.6	3.8	4.7	5.8	6.5	7.8	9.1	0.11
3 T	0.789	0.3	3.7	0.4	4.0	5.0	6.2	7.0	8.3	9.6	0.12
East: WICB East											
1 T	0.830	1.3	8.3	2.0	10.3	12.5	14.8	16.1	17.8	19.5	1.86
2 T	0.830	1.3	8.3	2.0	10.3	12.5	14.8	16.1	17.8	19.5	1.86
3 R	0.350	0.0	1.7	0.0	1.7	2.1	2.7	3.1	3.9	4.6	0.57

Values printed in this table are back of queue (vehicles).

Table D.3B - Lane Queues (metres)

Buckle St Signalised Intersection
PM peak flow
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 40 (Practical Cycle Time)

Lane No.	Deg. Satn x	Ovrfl. Queue No	Average (metres) Nb1	Nb2	Nb	Percentile (metres) 70%	85%	90%	95%	98%	Queue Stor. Ratio
South: Sussex Street											
1 L	0.789	4.0	30.3	5.8	36.1	44.7	54.6	60.9	71.2	81.5	0.14
2 LT	0.789	3.0	23.3	4.1	27.5	34.2	42.3	47.6	56.9	66.1	0.11
3 T	0.789	2.0	26.7	2.8	29.5	36.7	45.2	50.7	60.3	69.8	0.12
East: WICB East											
1 T	0.830	9.6	60.5	14.7	75.2	91.2	108.2	117.6	129.9	142.2	1.86
2 T	0.830	9.6	60.5	14.7	75.2	91.2	108.2	117.6	129.9	142.2	1.86
3 R	0.350	0.0	12.2	0.0	12.2	15.5	19.7	22.7	28.3	33.9	0.57

Values printed in this table are back of queue (metres).

Table D.4 - Movement Speeds (km/h) and Geometric Delay

Buckle St Signalised Intersection
PM peak flow
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 40 (Practical Cycle Time)

Mov ID	App. Speeds Cruise	Negn	Exit Speeds Negn	Cruise	Queue Move-up 1st Grn	2nd Grn	Av. Section Spd Running	Overall	Geom Delay (sec)
South: Sussex Street									
1 L	50.0	26.2	26.2	50.0	21.0	15.2	38.2	33.4	5.7
2 T	50.0	50.0	50.0	50.0	21.4	0.0	38.6	33.9	0.0
East: WICB East									
5 T	50.0	50.0	50.0	50.0	34.0		41.1	36.7	0.0
6 R	50.0	15.5	15.5	50.0			41.0	40.1	7.4

"Running Speed" is the average speed excluding stopped periods.

Table D.5 - Progression Factors and Actuated Signal Parameters

Buckle St Signalised Intersection
PM peak flow
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 40 (Practical Cycle Time)

Mov ID	Control	Coord.	Arrival Type	Delay Prog. Factor	Queue Prog. Factor	Disp. Grn. Settings 1st Grn Gmin	Gmax	2nd Grn Gmin	Gmax
South: Sussex Street									
1 L	FT	No	3	1.000	1.000	6	NA	6	NA
2 T	FT	No	3	1.000	1.000	6	NA		
East: WICB East									

```
    5 T      FT       No        3      1.000   1.000     6   NA
    6 R      FT       No        3      1.000   1.000     6   NA     6   NA
--------------------------------------------------------------------------
```

Table D.6 - Gap Acceptance Parameters

```
Buckle St Signalised Intersection
PM peak flow
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  40 (Practical Cycle Time)

-----------------------------------------------------------
                          Critical Gap
                  Opng    ------------   Foll-up   Entry
  Mov     Mov     Flow    Hdwy    Dist   Headway    HV
  ID      Type   (pcu/h)   (s)    (m)      (s)     Equiv
-----------------------------------------------------------
 South: Sussex Street
    1 L   Slip      1573   4.01    55.7     2.41     2.00
-----------------------------------------------------------
 East: WICB East
    6 R   Slip       469   4.51    62.7     2.61     2.00
-----------------------------------------------------------

  Values in this table are adjusted for heavy vehicles in the entry stream.
```

SIDRA SOLUTIONS

Site: Buckle St Signals PM peak - kent terrace east
G:\Transport\Transit\Proj\5C1353.00_Basin_Reserve_At-grade_Improvements\03_Sidra\Proposed_Intersections\Buckle St.aap
Processed Feb 11, 2008 05:00:28p.m.

A0101, Opus International Consultants Ltd, Large Office
Produced by SIDRA Intersection 3.2.0.1455

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SIDRA INTERSECTION

Output Tables

Buckle St Signalised Intersection

AM peak flow

Unsettled Results

Solution for this case has some uncertainty. Review the iteration data in the RUN INFORMATION section to assess the acceptability of the solution.

Run Information

```
Cycle Time =   50  (Practical Cycle Time)

* Basic Parameters:
  Intersection Type: Signalised - Fixed Time
  Driving on the left-hand side of the road
  "New Zealand" give way rule applied when input data was set up for this run
  Input data specified in Metric units
  Model Defaults: New Zealand
  Peak Flow Period (for performance): 30 minutes
  Unit time (for volumes): 60 minutes.
  Delay definition: Control delay
                    Geometric delay included
  SIDRA Standard Delay model used
  SIDRA Standard Queue model used
  Level of Service based on: Delay (HCM method)
  Queue definition: Back of queue, 95th Percentile

* Iteration Data:
  No. of Main (Timing-Capacity) Iterations =  4
  Comparison of last two iterations:
    Difference in intersection degree of satn = 16.2 %
    Largest difference in eff. green times = 12 secs
    (max. value for stopping = 1 secs)
  Information on Previous Iteration:
    Cycle Time =  40
    Phase Times: 0,  18
    Critical Movements:     1(1st),     6(2nd)

* Forced stop due to oscillating results at iteration 4
```

Table B.1 - Movement Definitions and Flow Rates (Origin-Destination)

```
Buckle St Signalised Intersection
AM peak flow
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  50 (Practical Cycle Time)

-------------------------------------------------------------------
 From      To          Mov           Flow Rate   Flow   Peak Flow
 Approach  Approach    ID    Turn     LV    HV   Scale    Factor
-------------------------------------------------------------------
```

```
 South: Sussex Street
           North         2   Thru    388    20    1.00     0.95
           West          1   Left   1552    82    1.00     0.95
-------------------------------------------------------------------
 East: WICB East
           North         6   Right   653    34    1.00     0.95
           West          5   Thru    731    38    1.00     0.95
-------------------------------------------------------------------
Unit Time for Volumes =  60 minutes
Peak Flow Period =  30 minutes
Flow Rates include effects of Flow Scale and Peak Flow Factor
```

Table B.2A - Flow Rates (Separate Light and Heavy Vehicles)

```
Buckle St Signalised Intersection
AM peak flow
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  50 (Practical Cycle Time)

-----------------------------------------------
  Mov          Left       Through       Right
  ID        ---------    ---------    ---------
             LV    HV     LV    HV     LV    HV
-----------------------------------------------
Demand flows in veh/hour as used by the program
South: Sussex Street
    1 L    1552    82      0     0      0     0
    2 T       0     0    388    20      0     0
-----------------------------------------------
East: WICB East
    5 T       0     0    731    38      0     0
    6 R       0     0      0     0    653    34
-----------------------------------------------
Unit Time for Volumes =  60 minutes
Peak Flow Period =  30 minutes
Flow Rates include effects of Flow Scale and Peak Flow Factor
```

Table B.2B - Flow Rates (Total Vehicles and Percent Heavy)

```
Buckle St Signalised Intersection
AM peak flow
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  50 (Practical Cycle Time)

-------------------------------------------------
  Mov          Left        Through        Right
  ID        ----------    ----------    ----------
            Total  %HV    Total  %HV    Total  %HV
-------------------------------------------------
Demand flows in veh/hour as used by the program
South: Sussex Street
    1 L     1634   5.0       0   0.0       0   0.0
    2 T        0   0.0     408   4.9       0   0.0
-------------------------------------------------
East: WICB East
    5 T        0   0.0     769   4.9       0   0.0
    6 R        0   0.0       0   0.0     687   4.9
-------------------------------------------------
Unit Time for Volumes =  60 minutes
Peak Flow Period =  30 minutes
Flow Rates include effects of Flow Scale and Peak Flow Factor
```

Table S.1 - Movement Phase and Timing Parameters

Buckle St Signalised Intersection
AM peak flow
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 50 (Practical Cycle Time)

Mov ID	Mov Typ	First Green Fr	First Green To	First Green Op Pr	Second Green Fr	Second Green To	Second Green Op Pr	Lost Tim 1st Grn	Lost Tim 2nd Grn	Req.Mov.Time 1st Grn	Req.Mov.Time 2nd Grn	Eff. Grn 1st Grn	Eff. Grn 2nd Grn
South: Sussex Street													
1	L (Slp)*A	B			B	A	Y	6	15	18.0	26.5	24	5
2	T A	B						6		18.0		24	
East: WICB East													
5	T B	A						6		17.3		14	
6	R (Slp) A	B	Y		*B	A		13	6	14.1	26.5	17	14

Current Phase Sequence: Two-phase
Input phase sequence: A B
Output phase sequence: A B

* Critical Movement/Green Period

Movement Types:
Slp Slip Lane Movement
Ped Pedestrian
Dum Dummy

Under heading 'Op':
Y If opposed turn

Table S.2 - Movement Capacity Parameters

Buckle St Signalised Intersection
AM peak flow
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 50 (Practical Cycle Time)

Mov ID	Dem Flow (veh /h)	HV (%)	Satn Flow 1st Grn	Satn Flow 2nd Grn	Flow Ratio 1st Grn	Flow Ratio 2nd Grn	Total Cap. (veh /h)	Prac. Deg. Satn xp	Prac. Spare Cap. (%)	Lane Util (%)	Deg. Satn x
South: Sussex Street											
1 L	1634	5.0	3586	4140	0.216	0.208	2135	0.90	18	100	0.765*
2 T	408	4.9	1890		0.216		907	0.90	100	59	0.450
East: WICB East											
5 T	769	4.9	3779		0.203		1058	0.90	24	100	0.727
6 R	687	4.9	1192	1794	0.020	0.370	908	0.90	19	100	0.757

Table S.3 - Intersection Parameters

Buckle St Signalised Intersection
AM peak flow
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 50 (Practical Cycle Time)

Crit Mov ID	App. and Turn	Green Period	Phases Fr	Phases To	Adjusted Lost Time	Adjusted Flow Ratio	Required Grn Time Ratio	Required Movement Time
1	S_L	1st	A	B	6	0.216	0.240	18.0
6	E_R	2nd	B	A	6	0.370	0.411	26.5
				Total:	12	0.586	0.651	44.5

Cycle Time:

Minimum	Maximum	Practical	Chosen
24	150	34	50

Intersection Level of Service	=	B
Worst movement Level of Service	=	B
Average intersection delay (s/pers)	=	15.5
Largest average movement delay (s)	=	19.9
Largest back of queue, 95% (m)	=	101
Performance Index	=	110.11
Degree of saturation (highest)	=	0.765
Practical Spare Capacity (lowest)	=	18 %
Effective intersection capacity, (veh/h)	=	4571
Total vehicle flow (veh/h)	=	3498
Total person flow (pers/h)	=	5247
Total vehicle delay (veh-h/h)	=	15.03
Total person delay (pers-h/h)	=	22.55
Total effective vehicle stops (veh/h)	=	3094
Total effective person stops (pers/h)	=	4640
Total vehicle travel (veh-km/h)	=	2026.2
Total cost ($/h)	=	1651.94
Total fuel (L/h)	=	247.2
Total CO2 (kg/h)	=	619.20

Table S.4 - Phase Information

Buckle St Signalised Intersection
AM peak flow
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 50 (Practical Cycle Time)

Phase	Change Time	Starting Intgrn	Green Start	Displayed Green	Green End	Terminating Intgrn	Phase Time	Phase Split
A	0	6	6	24	30	6	30	60%
B	30	6	36	14	50	6	20	40%

Current Phase Sequence: Two-phase
Input phase sequence: A B
Output phase sequence: A B

Table S.5 - Movement Performance

Mov ID	Total Delay (veh-h/h)	Total Delay (pers-h/h)	Aver. Delay (sec)	Prop. Queued	Eff. Stop Rate	Longest Queue 95% Back (vehs)	(m)	Perf. Index	Aver. Speed (km/h)
South: Sussex Street									
1 L	6.76	10.13	14.9	0.80	0.93	13.1	95	48.48	37.0
2 T	1.07	1.61	9.5	0.71	0.61	8.4	61	11.26	40.7
East: WICB East									
5 T	4.26	6.39	19.9	0.96	0.90	11.0	80	28.42	33.7
6 R	2.95	4.42	15.4	0.86	0.93	13.8	101	21.95	36.5

Table S.6 - Intersection Performance

Buckle St Signalised Intersection
AM peak flow
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 50 (Practical Cycle Time)

Total Flow (veh/h)	Deg. Satn x	Total Delay (veh-h/h)	Total Delay (pers-h/h)	Aver. Delay (sec)	Prop. Queued	Eff. Stop Rate	Longest Queue (m)	Perf. Index	Aver. Speed (km/h)
South: Sussex Street									
2042	0.765	7.83	11.74	13.8	0.78	0.87	95	59.74	37.7
East: WICB East									
1456	0.757	7.20	10.81	17.8	0.91	0.91	101	50.37	35.0
ALL VEHICLES:									
3498	0.765	15.03	22.55	15.5	0.83	0.88	101	110.11	36.5
INTERSECTION (persons):									
5247	0.765		22.55	15.5	0.83	0.88		110.11	36.5

Queue values in this table are 95% back of queue (metres).

Table S.7 - Lane Performance

Buckle St Signalised Intersection
AM peak flow
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 50 (Practical Cycle Time)

Lane No.	Effective Green Times (sec) R1	G1	R2	G2	Dem Flow (veh /h)	Cap (veh /h)	Deg. Satn x	Aver. Delay (sec)	Eff. Stop Rate	Queue 95% Back (vehs)	(m)	Lane Length (m)
South: Sussex Street												
1 L	6	24	15	5	816	1066	0.765	14.9	0.93	13.1	95.5	500.0
2 L	6	24	15	5	818	1069	0.765	14.8	0.93	13.0	94.9	500.0
3 T	26	24	0	0	408	907	0.450	9.5	0.61	8.4	61.3	500.0
East: WICB East												
1 T	36	14	0	0	385	529	0.727	19.9	0.90	11.0	80.5	500.0
2 T	36	14	0	0	385	529	0.727	19.9	0.90	11.0	80.5	500.0
3 R	13	17	6	14	687	907	0.757	15.4	0.93	13.8	100.7	500.0

Table S.8 - Lane Flow and Capacity Information

```
Buckle St Signalised Intersection
AM peak flow
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  50 (Practical Cycle Time)

--------------------------------------------------------------------------
                                  Saturation Flow  End  Tot
 Lane     Dem Flow (veh/h)   Lane   Adj. Aver Aver  Cap  Cap  Deg.  Lane
 No.    -------------------  Width Basic 1st  2nd  (veh (veh  Satn  Util
         Lef Thru  Rig  Tot   (m)  (tcu) (veh)(veh)  /h)  /h)   x     %
--------------------------------------------------------------------------
 South: Sussex Street
 1 L     816    0    0  816  3.30  1950 1793  2051  179 1066 0.765  100
 2 L     818    0    0  818  3.30  1950 1793  2088  179 1069 0.765  100
 3 T       0  408    0  408  3.30  1950 1890     0    0  907 0.450   59P
--------------------------------------------------------------------------
 East: WICB East
 1 T       0  385    0  385  3.30  1950 1889     0    0  529 0.727  100
 2 T       0  385    0  385  3.30  1950 1889     0    0  529 0.727  100
 3 R       0    0  687  687  3.30  1950 1192  1794  158  907 0.757  100
--------------------------------------------------------------------------
  P  Lane under-utilisation found by the "Program".  This includes cases where
     the value of lane under-utilisation due to downstream effects has been
     modified by the program during lane flow calculations (e.g. a de facto
     exclusive lane has been found).

  Basic Saturation Flow in this table is adjusted for lane width, approach
  grade, parking manoeuvres and number of buses stopping.  Saturation flow
  scale applies if specified.
```

Table S.9 - Signal Timing Diagram

```
Buckle St Signalised Intersection
AM peak flow
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  50 (Practical Cycle Time)

Displayed (Phase) Green Times

                Phase A                           Phase B

0                                        30                           50
I----------------------------------------I----------------------------I
........GGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGG.........GGGGGGGGGGGGGGGGGGG.
        6                                        36


Effective (Movement) Green Times


 South: Sussex Street

Mov.     1 (L)
I                                        I                            I
GGGG.........GGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGG.....................GGGG
   3         9                                33                   48

Mov.     2 (T)
I                                        I                            I
............GGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGG.........................
           9                                33
```

```
 East: WICB East

Mov.     5 (T)
I                                        I                           I
GGG.....................................................GGGGGGGGGGGGGGG
   3                                                    39

Mov.     6 (R)
I                                        I                           I
GGGG..................GGGGGGGGGGGGGGGGGGGGGGG.........GGGGGGGGGGGGGGGG
   3                 16                      33        39


I-----I------I------I------I------I------I------I------I------I------I---->
0      5     10     15     20     25     30     35     40     45     50

                                T I M E  (s)
```

Table S.10 - Movement Capacity and Performance Summary

```
Buckle St Signalised Intersection
AM peak flow
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  50 (Practical Cycle Time)

--------------------------------------------------------------------------------
 Mov     Mov  Dem   Total  Lane  Deg.  Eff. Grn  Aver.  Eff.    95%    Perf.
 ID      Typ  Flow   Cap.  Util  Satn  --------  Delay  Stop  Back of  Index
              (veh  (veh               1st  2nd         Rate   Queue
               /h)   /h)   (%)     x   Grn  Grn  (sec)         (veh)
--------------------------------------------------------------------------------
South: Sussex Street
   1 L   (Slp) 1634  2135   100  0.765*  24*   5   14.9  0.93   13.1   48.48
   2 T         408   907    59  0.450   24         9.5  0.61    8.4   11.26
--------------------------------------------------------------------------------
East: WICB East
   5 T         769  1058   100  0.727   14        19.9  0.90   11.0   28.42
   6 R   (Slp) 687   908   100  0.757   17   14*  15.4  0.93   13.8   21.95
--------------------------------------------------------------------------------
  *  Maximum degree of saturation, or critical green periods
```

Table S.12A - Fuel Consumption, Emissions and Cost (TOTAL)

```
Buckle St Signalised Intersection
AM peak flow
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  50 (Practical Cycle Time)

------------------------------------------------------------
  Mov            Fuel     Cost      HC       CO      NOX      CO2
  ID             Total    Total    Total    Total    Total    Total
                  L/h     $/h      kg/h     kg/h     kg/h     kg/h
------------------------------------------------------------
South: Sussex Street
    1 L          115.8    771.43   0.467    20.99    0.623    290.1
    2 T           25.8    171.55   0.102     4.30    0.131     64.7
                 ------------------------------------------------
                 141.6    942.98   0.569    25.29    0.754    354.8
------------------------------------------------------------
East: WICB East
    5 T           56.4    385.18   0.235    10.39    0.300    141.4
    6 R           49.1    323.78   0.203     9.27    0.267    123.0
                 ------------------------------------------------
                 105.6    708.96   0.438    19.67    0.567    264.4
```

```
-------------------------------------------------------------
 INTERSECTION:  247.2  1651.94   1.007   44.96   1.322   619.2
-------------------------------------------------------------


PARAMETERS USED IN COST CALCULATIONS
------------------------------------

   Pump price of fuel ($/L)                 =     1.600
   Fuel resource cost factor                =      0.60
   Ratio of running cost to fuel cost       =       2.5
   Average income ($/h)                     =     21.00
   Time value factor                        =      0.60
   Light vehicle mass (1000 kg)             =       1.4
   Heavy vehicle mass (1000 kg)             =      11.0
   Light vehicle idle fuel rate (L/h)       =     1.350
   Heavy vehicle idle fuel rate (L/h)       =     2.000
```

Table S.12B - Fuel Consumption, Emissions and Cost (RATE)

```
Buckle St Signalised Intersection
AM peak flow
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  50 (Practical Cycle Time)

-------------------------------------------------------------
  Mov            Fuel    Cost     HC      CO      NOX     CO2
  ID             Rate    Rate    Rate    Rate    Rate    Rate
              L/100km  $/km     g/km    g/km    g/km    g/km
-------------------------------------------------------------
South: Sussex Street
    1 L          12.1    0.81   0.488   21.93   0.651   303.0
    2 T          11.0    0.73   0.436   18.38   0.560   276.6
               ---------------------------------------------
                 11.9    0.79   0.478   21.23   0.633   297.8
-------------------------------------------------------------
East: WICB East
    5 T          12.8    0.87   0.534   23.57   0.680   320.6
    6 R          12.5    0.82   0.514   23.54   0.679   312.3
               ---------------------------------------------
                 12.6    0.85   0.525   23.55   0.680   316.7
-------------------------------------------------------------
 INTERSECTION:   12.2    0.82   0.497   22.19   0.652   305.6
-------------------------------------------------------------
```

Table S.14 - Summary of Input and Output Data

```
Buckle St Signalised Intersection
AM peak flow
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  50 (Practical Cycle Time)

-----------------------------------------------------------------------------
 Lane   Demand Flow (veh/h)        Adj.  Eff Grn   Deg   Aver. Longest Shrt
 No.   --------------------  %HV  Basic  (secs)    Sat   Delay  Queue  Lane
         L    T    R   Tot        Satf. 1st 2nd    x    (sec)   (m)    (m)
-----------------------------------------------------------------------------
 South: Sussex Street
1 L     816             816    5  1949   24   5  0.765   14.9    95   500
2 L     818             818    5  1950   24   5  0.765   14.8    95   500
3 T          408        408    5  1950   24      0.450    9.5    61   500
       ---------------------------------------------------------------------
       1634  408    0  2042    5                0.765   13.8    95
-----------------------------------------------------------------------------
```

```
 East: WICB East
1 T          385        385    5  1949   14      0.727   19.9    80   500
2 T          385        385    5  1949   14      0.727   19.9    80   500
3 R               687   687    5  1949   17  14  0.757   15.4   101   500
        ------------------------------------------------------------------
          0  769  687  1456    5                  0.757   17.8   101
================================================================================
 ALL VEHICLES          Total   %       Cycle      Max   Aver.   Max
                       Flow   HV       Time        X    Delay  Queue
                       3498    5         50      0.765   15.5   101
================================================================================
Peak flow period = 30 minutes.

Queue values in this table are 95% back of queue (metres).

Note: Basic Saturation Flows (in through car units) have been adjusted for
      grade, lane widths, parking manoeuvres and bus stops.
```

Table S.15 - Capacity and Level of Service

```
Buckle St Signalised Intersection
AM peak flow
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  50 (Practical Cycle Time)

--------------------------------------------------------------------------------
 Mov     Mov    Green Time  Total  Total    Deg.   Aver.   LOS  Longest Queue
 ID      Typ    Ratio (g/C) Flow    Cap.     of    Delay          95% Back
               ------------ (veh   (veh     Satn                (vehs)  (m)
                1st   2nd     /h)    /h)    (v/c)  (sec)
                grn   grn
--------------------------------------------------------------------------------
South: Sussex Street
   1 L  (Slp) 0.480* 0.100   1634   2135   0.765*   14.9    B     13.1     95
   2 T        0.480           408    907   0.450     9.5    A      8.4     61
--------------------------------------------------------------------------------
East: WICB East
   5 T        0.280           769   1058   0.727    19.9    B     11.0     80
   6 R  (Slp) 0.340  0.280*   687    908   0.757    15.4    B     13.8    101
--------------------------------------------------------------------------------
  ALL VEHICLES:              3498          0.765    15.5    B     13.8    101
--------------------------------------------------------------------------------
  INTERSECTION (persons):    5247                   15.5          13.8    101
--------------------------------------------------------------------------------
     Level of Service calculations are based on
     average control delay including geometric delay (HCM criteria),
     independent of the current delay definition used.
     For the criteria, refer to the "Level of Service" topic in the
     SIDRA Output Guide or the Output section of the on-line help.
  *  Maximum v/c ratio, or critical green periods
  "  Movement Level of service has been determined using adjacent lane
     v/c ratio rather than short lane v/c ratio (v/c=1.0)
```

Table S.16 - SCATS MF Parameter

```
Buckle St Signalised Intersection
AM peak flow
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  50 (Practical Cycle Time)

--------------------------------------------------
 Lane   Stopline Capacity  SCATS  SCATS   Deg.  Lane
 No.      Flow   (veh/h)   Satn    MF     Satn  Util.
        (veh/h)           Flow            x     %
```

South: Sussex Street						
1 L	816	1066	1857	NA	0.765	100
2 L	818	1069	1857	NA	0.765	100
3 T	408	907	1950	1560	0.450	59P
East: WICB East						
1 T	385	529	1950	1365	0.727	100
2 T	385	529	1950	1365	0.727	100
3 R	687	907	1857	NA	0.757	100

NA Not Applicable - SCATS MF was not calculated for this lane due to one of the following reasons:
- the lane is not controlled by signals (slip or continuous lane)
- two movements share this lane and do not run in the same phases

P Lane under-utilisation found by the "Program". This includes cases where the value of lane under-utilisation due to downstream effects has been modified by the program during lane flow calculations (e.g. a de facto exclusive lane has been found).

STOPLINE FLOW: Departure flow rate in veh/h as measured at the stop line. This cannot exceed capacity.

SCATS SATURATION FLOW: This allows for lane width, approach grade and turning vehicles. Saturation flow scale applies if specified. The effects of heavy vehicles, parking manoeuvres, number of buses stopping and conflicting pedestrian volume are not included.

SCATS MF: This emulates the MF (Maximum Flow) parameter used in the SCATS control system. It is calculated from the SCATS SATURATION FLOW parameter.

DEG. SATN: The Demand (Arrival) Flow Rate may exceed the Stopline Flow Rate, therefore x > 1 is possible.

Table D.0 - Geometric Delay Data

Buckle St Signalised Intersection
AM peak flow
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 50 (Practical Cycle Time)

From Approach	To Approach	Turn	Negn Radius (m)	Negn Speed (km/h)	Negn Dist. (m)	Appr. Dist. (m)	Downstream Distance (m)	User Spec?
South: Sussex Street								
	North	Thru	S	50.0	13.2	500	76	No
	West	Left	20.0	26.2	31.4	500	88	No
East: WICB East								
	North	Right	5.0	15.5	10.0	500	76	No
	West	Thru	S	50.0	13.2	500	76	No

Downstream distance is distance travelled from the stopline until exit cruise speed is reached (includes negotiation distance). Acceleration distance is weighted for light and heavy vehicles. The same distance applies for both stopped and unstopped vehicles.

Table D.1 - Lane Delays

Buckle St Signalised Intersection
AM peak flow

```
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  50 (Practical Cycle Time)

------------------------------------------------------------------------
                     ----------  Delay (seconds/veh)  ----------------
         Deg.   Stop-line Delay  Acc.   Queuing   Stopd
 Lane    Satn   1st   2nd Total  Dec.  Total MvUp (Idle) Geom Control
 No.       x     d1    d2   dSL   dn    dq   dqm    di    dig   dic
------------------------------------------------------------------------
 South: Sussex Street
 1 L    0.765   7.1   2.1   9.2   4.0   5.3   1.4   3.9   5.7   14.9
 2 L    0.765   7.1   2.1   9.1   4.0   5.2   1.4   3.8   5.7   14.8
 3 T    0.450   9.5   0.0   9.5   5.5   4.0   0.0   4.0   0.0    9.5
------------------------------------------------------------------------
 East: WICB East
 1 T    0.727  18.3   1.6  19.9   7.4  12.5   0.9  11.6   0.0   19.9
 2 T    0.727  18.3   1.6  19.9   7.4  12.5   0.9  11.6   0.0   19.9
 3 R    0.757   5.4   2.6   8.0   2.8   5.2   0.7   4.4   7.4   15.4
------------------------------------------------------------------------
  dn is average stop-start delay for all vehicles queued and unqueued
```

Table D.2 - Lane Stops

```
Buckle St Signalised Intersection
AM peak flow
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  50 (Practical Cycle Time)

-------------------------------------------------------
                                                 Queue
        Deg.  -- Effective Stop Rate --   Prop. Move-up
 Lane   Satn              Geom. Overall  Queued  Rate
 No.      x    he1   he2   hig     h       pq     hqm
-------------------------------------------------------
 South: Sussex Street
 1 L   0.765  0.71  0.11  0.11   0.93    0.798   0.22
 2 L   0.765  0.71  0.11  0.11   0.93    0.796   0.22
 3 T   0.450  0.61  0.00  0.00   0.61    0.707   0.00
-------------------------------------------------------
 East: WICB East
 1 T   0.727  0.82  0.08  0.00   0.90    0.960   0.13
 2 T   0.727  0.82  0.08  0.00   0.90    0.960   0.13
 3 R   0.757  0.77  0.06  0.10   0.93    0.860   0.10
-------------------------------------------------------
  hig is the average value for all movements in a shared lane
  hqm is average queue move-up rate for all vehicles queued and unqueued
```

Table D.3A - Lane Queues (veh)

```
Buckle St Signalised Intersection
AM peak flow
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  50 (Practical Cycle Time)

------------------------------------------------------------------------------------
        Deg.  Ovrfl.   Average (veh)              Percentile (veh)            Queue
 Lane   Satn  Queue ------------------  ---------------------------------  Stor.
 No.      x    No      Nb1    Nb2     Nb     70%    85%    90%    95%    98%  Ratio
------------------------------------------------------------------------------------
 South: Sussex Street
 1 L   0.765    0.6     6.2    0.9    7.1     8.7   10.5   11.5   13.1   14.6   0.19
 2 L   0.765    0.6     6.1    0.9    7.1     8.6   10.4   11.4   13.0   14.6   0.19
 3 T   0.450    0.0     4.1    0.0    4.1     5.1    6.3    7.1    8.4    9.7   0.12
```

East: WICB East											
1 T	0.727	0.2	5.4	0.3	5.8	7.1	8.6	9.5	11.0	12.5	0.16
2 T	0.727	0.2	5.4	0.3	5.8	7.1	8.6	9.5	11.0	12.5	0.16
3 R	0.757	0.6	6.6	1.0	7.6	9.3	11.1	12.2	13.8	15.4	0.20

Values printed in this table are back of queue (vehicles).

Table D.3B - Lane Queues (metres)

Buckle St Signalised Intersection
AM peak flow
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 50 (Practical Cycle Time)

Lane No.	Deg. Satn x	Ovrfl. Queue No	Average (metres) Nb1	Nb2	Nb	Percentile (metres) 70%	85%	90%	95%	98%	Queue Stor. Ratio
South: Sussex Street											
1 L	0.765	4.1	45.1	6.7	51.8	63.4	76.3	84.0	95.5	106.9	0.19
2 L	0.765	4.1	44.8	6.7	51.5	63.0	75.8	83.5	94.9	106.4	0.19
3 T	0.450	0.0	30.1	0.0	30.1	37.4	46.0	51.7	61.3	70.9	0.12
East: WICB East											
1 T	0.727	1.6	39.7	2.3	42.0	51.7	62.8	69.6	80.5	91.3	0.16
2 T	0.727	1.6	39.7	2.3	42.0	51.7	62.8	69.6	80.5	91.3	0.16
3 R	0.757	4.3	48.4	6.9	55.4	67.7	81.2	89.1	100.7	112.4	0.20

Values printed in this table are back of queue (metres).

Table D.4 - Movement Speeds (km/h) and Geometric Delay

Buckle St Signalised Intersection
AM peak flow
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 50 (Practical Cycle Time)

Mov ID	App. Speeds Cruise	Negn	Exit Speeds Negn	Cruise	Queue Move-up 1st Grn	2nd Grn	Av. Section Spd Running	Overall	Geom Delay (sec)
South: Sussex Street									
1 L	50.0	26.2	26.2	50.0	36.2	17.8	39.7	37.0	5.7
2 T	50.0	50.0	50.0	50.0	37.2	0.0	44.2	40.7	0.0
East: WICB East									
5 T	50.0	50.0	50.0	50.0	28.4		41.6	33.7	0.0
6 R	50.0	15.5	15.5	50.0	24.9	27.7	39.6	36.5	7.4

"Running Speed" is the average speed excluding stopped periods.

Table D.5 - Progression Factors and Actuated Signal Parameters

Buckle St Signalised Intersection
AM peak flow
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 50 (Practical Cycle Time)

Mov ID	Control	Coord.	Arrival Type	Delay Prog. Factor	Queue Prog. Factor	Disp. Grn. Settings 1st Grn Gmin	1st Grn Gmax	2nd Grn Gmin	2nd Grn Gmax
South: Sussex Street									
1 L	FT	No	3	1.000	1.000	6	NA	6	NA
2 T	FT	No	3	1.000	1.000	6	NA		
East: WICB East									
5 T	FT	No	3	1.000	1.000	6	NA		
6 R	FT	No	3	1.000	1.000	6	NA	6	NA

Table D.6 - Gap Acceptance Parameters

Buckle St Signalised Intersection
AM peak flow
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 50 (Practical Cycle Time)

Mov ID	Mov Type	Opng Flow (pcu/h)	Critical Gap Hdwy (s)	Critical Gap Dist (m)	Foll-up Headway (s)	Entry HV Equiv
South: Sussex Street						
1 L	Slip	771	4.01	55.8	2.41	2.00
East: WICB East						
6 R	Slip	409	4.51	62.7	2.61	2.00

Values in this table are adjusted for heavy vehicles in the entry stream.

SIDRA INTERSECTION

Output Tables

Buckle St Signalised Intersection

AM peak flow

Run Information

```
Cycle Time =   40  (Practical Cycle Time)

* Basic Parameters:
  Intersection Type: Signalised - Fixed Time
  Driving on the left-hand side of the road
  "New Zealand" give way rule applied when input data was set up for this run
  Input data specified in Metric units
  Model Defaults: New Zealand
  Peak Flow Period (for performance): 30 minutes
  Unit time (for volumes): 60 minutes.
  Delay definition: Control delay
                    Geometric delay included
  SIDRA Standard Delay model used
  SIDRA Standard Queue model used
  Level of Service based on: Delay (HCM method)
  Queue definition: Back of queue, 95th Percentile

* Iteration Data:
  No. of Main (Timing-Capacity) Iterations =  2
  Comparison of last two iterations:
    Difference in intersection degree of satn =  0.0 %
    Largest difference in eff. green times =  0 secs
    (max. value for stopping = 0 secs)
```

Table B.1 - Movement Definitions and Flow Rates (Origin-Destination)

```
Buckle St Signalised Intersection
AM peak flow
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  40 (Practical Cycle Time)

-------------------------------------------------------------------
 From      To          Mov           Flow Rate   Flow   Peak Flow
 Approach  Approach    ID    Turn     LV    HV   Scale    Factor
-------------------------------------------------------------------
 South: Sussex Street
           North         2   Thru    388    20    1.00     0.95
           West          1   Left    834    44    1.00     0.95
-------------------------------------------------------------------
 East: WICB East
           North         6   Right   653    34    1.00     0.95
           West          5   Thru   1449    76    1.00     0.95
-------------------------------------------------------------------
Unit Time for Volumes =  60 minutes
Peak Flow Period =  30 minutes
Flow Rates include effects of Flow Scale and Peak Flow Factor
```

Table B.2A - Flow Rates (Separate Light and Heavy Vehicles)

```
Buckle St Signalised Intersection
AM peak flow
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  40 (Practical Cycle Time)

-----------------------------------------------
  Mov          Left       Through       Right
  ID        ---------    ---------    ---------
             LV    HV     LV    HV     LV    HV
-----------------------------------------------
Demand flows in veh/hour as used by the program
South: Sussex Street
    1 L     834    44      0     0      0     0
    2 T       0     0    388    20      0     0
-----------------------------------------------
East: WICB East
    5 T       0     0   1449    76      0     0
    6 R       0     0      0     0    653    34
-----------------------------------------------
Unit Time for Volumes =  60 minutes
Peak Flow Period =  30 minutes
Flow Rates include effects of Flow Scale and Peak Flow Factor
```

Table B.2B - Flow Rates (Total Vehicles and Percent Heavy)

```
Buckle St Signalised Intersection
AM peak flow
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  40 (Practical Cycle Time)

-------------------------------------------------
  Mov          Left        Through        Right
  ID        ----------    ----------    ----------
            Total  %HV    Total  %HV    Total  %HV
-------------------------------------------------
Demand flows in veh/hour as used by the program
South: Sussex Street
    1 L      878   5.0       0   0.0       0   0.0
    2 T        0   0.0     408   4.9       0   0.0
-------------------------------------------------
East: WICB East
    5 T        0   0.0    1525   5.0       0   0.0
    6 R        0   0.0       0   0.0     687   4.9
-------------------------------------------------
Unit Time for Volumes =  60 minutes
Peak Flow Period =  30 minutes
Flow Rates include effects of Flow Scale and Peak Flow Factor
```

Table S.1 - Movement Phase and Timing Parameters

```
Buckle St Signalised Intersection
AM peak flow
Intersection ID: 0
```

Fixed-Time Signals, Cycle Time = 40 (Practical Cycle Time)

Mov ID	Mov Typ	First Green Fr	First Green To	First Green Op Pr	Second Green Fr	Second Green To	Second Green Op Pr	Lost Tim 1st Grn	Lost Tim 2nd Grn	Req.Mov.Time 1st Grn	Req.Mov.Time 2nd Grn	Eff. Grn 1st Grn	Eff. Grn 2nd Grn
South: Sussex Street													
1 L	(Slp)*A		B		B	A	Y	6	20	14.1	23.9	9	5
2 T	A		B					6		13.8		9	
East: WICB East													
5 T	*B		A					6		23.9		19	
6 R	(Slp) A		B	Y	B	A		12	6	12.7	22.0	3	19

Current Phase Sequence: Two-phase
Input phase sequence: A B
Output phase sequence: A B

* Critical Movement/Green Period

Movement Types:
Slp Slip Lane Movement
Ped Pedestrian
Dum Dummy

Under heading 'Op':
Y If opposed turn

Table S.2 - Movement Capacity Parameters

Buckle St Signalised Intersection
AM peak flow
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 40 (Practical Cycle Time)

Mov ID	Dem Flow (veh /h)	HV (%)	Satn Flow 1st Grn	Satn Flow 2nd Grn	Flow Ratio 1st Grn	Flow Ratio 2nd Grn	Total Cap. (veh /h)	Prac. Deg. Satn xp	Prac. Spare Cap. (%)	Lane Util (%)	Deg. Satn x
South: Sussex Street											
1 L	878	5.0	3206	3273	0.183	0.089	1130	0.90	16	100	0.777
2 T	408	4.9	2335		0.175		525	0.90	16	100	0.777
East: WICB East											
5 T	1525	5.0	3778		0.404		1795	0.90	6	100	0.850*
6 R	687	4.9	2631	1794	0.016	0.360	1049	0.90	37	100	0.655

Table S.3 - Intersection Parameters

Buckle St Signalised Intersection
AM peak flow
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 40 (Practical Cycle Time)

Crit Mov ID	App. and Turn	Green Period	Phases Fr	Phases To	Adjusted Lost Time	Adjusted Flow Ratio	Required Grn Time Ratio	Required Movement Time

```
-------------------------------------------------------------------------
     1  S_L    1st   A    B        6        0.183      0.204       14.1
     5  E_T          B    A        6        0.404      0.449       23.9
                                  ----       ------     ------     ------
                          Total:   12        0.587      0.652       38.1
-------------------------------------------------------------------------

   Cycle Time:
     Minimum   Maximum   Practical   Chosen
        24       150         35         40


   Intersection Level of Service             =         B
   Worst movement Level of Service           =         B
   Average intersection delay (s/pers)       =      17.0
   Largest average movement delay (s)        =      19.5
   Largest back of queue, 95% (m)            =       134
   Performance Index                         =    114.86
   Degree of saturation (highest)            =     0.850
   Practical Spare Capacity (lowest)         =         6 %
   Effective intersection capacity, (veh/h)  =      4116
   Total vehicle flow (veh/h)                =      3498
   Total person flow (pers/h)                =      5247
   Total vehicle delay (veh-h/h)             =     16.47
   Total person delay (pers-h/h)             =     24.71
   Total effective vehicle stops (veh/h)     =      3493
   Total effective person stops (pers/h)     =      5240
   Total vehicle travel (veh-km/h)           =    2016.8
   Total cost ($/h)                          =   1699.72
   Total fuel (L/h)                          =     255.5
   Total CO2 (kg/h)                          =    639.98
```

Table S.4 - Phase Information

```
Buckle St Signalised Intersection
AM peak flow
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  40 (Practical Cycle Time)

-------------------------------------------------------------------------
Phase  Change  Starting  Green  Displayed  Green  Terminating  Phase  Phase
       Time    Intgrn   Start    Green     End     Intgrn     Time   Split
-------------------------------------------------------------------------
 A        0       6        6        9       15        6         15    38%
 B       15       6       21       19       40        6         25    63%
-------------------------------------------------------------------------
  Current Phase Sequence: Two-phase
  Input phase sequence: A B
  Output phase sequence: A B
```

Table S.5 - Movement Performance

```
-------------------------------------------------------------------------
  Mov      Total    Total   Aver.  Prop.  Eff. Longest Queue  Perf.  Aver.
  ID       Delay    Delay   Delay Queued  Stop   95% Back     Index  Speed
        (veh-h/h)(pers-h/h)(sec)         Rate  (vehs)  (m)          (km/h)
-------------------------------------------------------------------------
South: Sussex Street
    1 L     4.76     7.14    19.5   0.95  1.00    9.7    71   28.53   34.2
    2 T     2.10     3.14    18.5   0.99  0.98    9.0    65   14.13   34.5
-------------------------------------------------------------------------
East: WICB East
    5 T     7.27    10.91    17.2   0.95  1.07   18.4   134   55.19   35.3
    6 R     2.34     3.51    12.3   0.72  0.85    7.4    54   17.02   38.6
```

Table S.6 - Intersection Performance

Buckle St Signalised Intersection
AM peak flow
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 40 (Practical Cycle Time)

Total Flow (veh/h)	Deg. Satn x	Total Delay (veh-h/h)	Total Delay (pers-h/h)	Aver. Delay (sec)	Prop. Queued	Eff. Stop Rate	Longest Queue (m)	Perf. Index	Aver. Speed (km/h)
South: Sussex Street									
1286	0.777	6.86	10.28	19.2	0.96	1.00	71	42.66	34.3
East: WICB East									
2212	0.850	9.62	14.42	15.6	0.87	1.00	134	72.20	36.3
ALL VEHICLES:									
3498	0.850	16.47	24.71	17.0	0.91	1.00	134	114.86	35.5
INTERSECTION (persons):									
5247	0.850		24.71	17.0	0.91	1.00		114.86	35.5

Queue values in this table are 95% back of queue (metres).

Table S.7 - Lane Performance

Buckle St Signalised Intersection
AM peak flow
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 40 (Practical Cycle Time)

Lane No.	Effective Green Times (sec) R1	G1	R2	G2	Dem Flow (veh/h)	Cap (veh/h)	Deg. Satn x	Aver. Delay (sec)	Eff. Stop Rate	Queue 95% Back (vehs)	Queue 95% Back (m)	Lane Length (m)
South: Sussex Street												
1 L	6	9	20	5	496	638	0.777	19.1	0.99	9.7	70.6	500.0
2 LT	7	9	20	4	460	592	0.777	19.0	1.01	9.0	65.4	500.0
3 T	31	9	0	0	330	425	0.777	19.5	0.98	8.8	64.3	500.0
East: WICB East												
1 T	21	19	0	0	763	897	0.850	17.2	1.07	18.4	134.0	70.0
2 T	21	19	0	0	763	897	0.850	17.2	1.07	18.4	134.0	70.0
3 R	12	3	6	19	687	1049	0.655	12.3	0.85	7.4	54.1	50.0

Table S.8 - Lane Flow and Capacity Information

Buckle St Signalised Intersection
AM peak flow

```
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  40 (Practical Cycle Time)

--------------------------------------------------------------------------
                                    Saturation Flow  End  Tot
 Lane     Dem Flow (veh/h)   Lane    Adj. Aver Aver  Cap  Cap  Deg.  Lane
 No.    -------------------  Width Basic 1st  2nd  (veh (veh  Satn  Util
         Lef Thru  Rig  Tot    (m)  (tcu) (veh)(veh)  /h)  /h)   x     %
--------------------------------------------------------------------------
 South: Sussex Street
 1 L     496    0    0  496  3.30  1950 1793  1878  201  638 0.777  100
 2 LT    382   78    0  460  3.30  1950 1809  1855  201  592 0.777  100
 3 T       0  330    0  330  3.30  1950 1890     0    0  425 0.777  100
--------------------------------------------------------------------------
 East: WICB East
 1 T       0  763    0  763  3.30  1950 1889     0    0  897 0.850  100
 2 T       0  763    0  763  3.30  1950 1889     0    0  897 0.850  100
 3 R       0    0  687  687  3.30  1950 2631  1794  197 1049 0.655  100
--------------------------------------------------------------------------

  Basic Saturation Flow in this table is adjusted for lane width, approach
  grade, parking manoeuvres and number of buses stopping.  Saturation flow
  scale applies if specified.
```

Table S.9 - Signal Timing Diagram

```
Buckle St Signalised Intersection
AM peak flow
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  40 (Practical Cycle Time)

Displayed (Phase) Green Times

         Phase A                           Phase B

0                        15                                            40
I------------------------I---------------------------------------------I
...........GGGGGGGGGGGGG.............GGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGG.
          6                         21


Effective (Movement) Green Times


 South: Sussex Street

Mov.     1 (L)
I                        I                                             I
GGGGG...........GGGGGGGGGGGGGGG.................................GGGG
    3         9              18                                  38

Mov.     2 (T)
I                        I                                             I
................GGGGGGGGGGGGGGG.....................................
              9               18


 East: WICB East

Mov.     5 (T)
I                        I                                             I
GGGG.....................................GGGGGGGGGGGGGGGGGGGGGGGGGGGGGG
    3                                    24

Mov.     6 (R)
I                        I                                             I
GGGGG.....................GGGGG..........GGGGGGGGGGGGGGGGGGGGGGGGGGGGG
    3                    15    18         24


I-----I------I------I------I------I------I------I------I------I------I---->
0      4      8     12     16     20     24     28     32     36     40
```

T I M E (s)

Table S.10 - Movement Capacity and Performance Summary

Buckle St Signalised Intersection
AM peak flow
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 40 (Practical Cycle Time)

Mov ID	Mov Typ	Dem Flow (veh /h)	Total Cap. (veh /h)	Lane Util (%)	Deg. Satn x	Eff. Grn 1st Grn	Eff. Grn 2nd Grn	Aver. Delay (sec)	Eff. Stop Rate	95% Back of Queue (veh)	Perf. Index
South: Sussex Street											
1 L	(Slp)	878	1130	100	0.777	9*	5	19.5	1.00	9.7	28.53
2 T		408	525	100	0.777	9		18.5	0.98	9.0	14.13
East: WICB East											
5 T		1525	1795	100	0.850*	19*		17.2	1.07	18.4	55.19
6 R	(Slp)	687	1049	100	0.655	3	19	12.3	0.85	7.4	17.02

* Maximum degree of saturation, or critical green periods

Table S.12A - Fuel Consumption, Emissions and Cost (TOTAL)

Buckle St Signalised Intersection
AM peak flow
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 40 (Practical Cycle Time)

Mov ID	Fuel Total L/h	Cost Total $/h	HC Total kg/h	CO Total kg/h	NOX Total kg/h	CO2 Total kg/h
South: Sussex Street						
1 L	64.6	441.84	0.264	11.69	0.345	161.7
2 T	30.1	201.86	0.126	5.67	0.163	75.4
	94.6	643.70	0.390	17.36	0.508	237.1
East: WICB East						
5 T	113.0	746.97	0.472	21.74	0.619	283.0
6 R	47.8	309.05	0.195	9.05	0.262	119.9
	160.8	1056.02	0.667	30.79	0.881	402.9
INTERSECTION:	255.5	1699.72	1.057	48.15	1.388	640.0

PARAMETERS USED IN COST CALCULATIONS

Pump price of fuel ($/L)	=	1.600
Fuel resource cost factor	=	0.60
Ratio of running cost to fuel cost	=	2.5
Average income ($/h)	=	21.00
Time value factor	=	0.60
Light vehicle mass (1000 kg)	=	1.4
Heavy vehicle mass (1000 kg)	=	11.0

```
   Light vehicle idle fuel rate (L/h)        =     1.350
   Heavy vehicle idle fuel rate (L/h)        =     2.000
```

Table S.12B - Fuel Consumption, Emissions and Cost (RATE)

```
Buckle St Signalised Intersection
AM peak flow
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  40 (Practical Cycle Time)

------------------------------------------------------------
  Mov            Fuel    Cost     HC      CO     NOX     CO2
  ID             Rate    Rate    Rate    Rate    Rate    Rate
              L/100km  $/km     g/km    g/km    g/km    g/km
------------------------------------------------------------
South: Sussex Street
    1 L          12.6    0.86   0.514   22.72   0.671   314.4
    2 T          12.9    0.86   0.536   24.25   0.695   322.1
               ---------------------------------------------
                 12.6    0.86   0.521   23.20   0.679   316.8
------------------------------------------------------------
East: WICB East
    5 T          12.9    0.85   0.539   24.86   0.708   323.7
    6 R          12.1    0.78   0.496   22.96   0.665   304.2
               ---------------------------------------------
                 12.7    0.83   0.526   24.27   0.694   317.6
------------------------------------------------------------
 INTERSECTION:   12.7    0.84   0.524   23.87   0.688   317.3
------------------------------------------------------------
```

Table S.14 - Summary of Input and Output Data

```
Buckle St Signalised Intersection
AM peak flow
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  40 (Practical Cycle Time)

-------------------------------------------------------------------------
 Lane   Demand Flow (veh/h)        %HV  Adj.  Eff Grn   Deg   Aver. Longest Shrt
 No.    --------------------           Basic  (secs)    Sat   Delay  Queue  Lane
          L    T    R   Tot            Satf. 1st 2nd    x    (sec)   (m)    (m)
-------------------------------------------------------------------------
 South: Sussex Street
1 L     496         496     5  1949    9   5  0.777   19.1    71    500
2 LT    382   78    460     5  1950    9   4  0.777   19.0    65    500
3 T         330     330     5  1950    9      0.777   19.5    64    500
        ---------------------------------------------------------------
        878  408    0  1286     5                 0.777   19.2    71
-------------------------------------------------------------------------
 East: WICB East
1 T         763     763     5  1949   19      0.850   17.2   134     70
2 T         763     763     5  1949   19      0.850   17.2   134     70
3 R              687   687     5  1949    3  19  0.655   12.3    54     50
        ---------------------------------------------------------------
          0 1525  687  2212     5                 0.850   15.6   134
=========================================================================
 ALL VEHICLES          Total    %       Cycle       Max    Aver.   Max
                       Flow    HV       Time         X     Delay  Queue
                       3498     5         40       0.850   17.0   134
=========================================================================
Peak flow period = 30 minutes.

Queue values in this table are 95% back of queue (metres).
```

```
Note: Basic Saturation Flows (in through car units) have been adjusted for
      grade, lane widths, parking manoeuvres and bus stops.
```

Table S.15 - Capacity and Level of Service

```
Buckle St Signalised Intersection
AM peak flow
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  40 (Practical Cycle Time)

--------------------------------------------------------------------------------
 Mov     Mov    Green Time  Total  Total    Deg.   Aver.   LOS  Longest Queue
 ID      Typ    Ratio (g/C) Flow    Cap.     of    Delay          95% Back
               ------------ (veh   (veh     Satn                (vehs)  (m)
                1st   2nd     /h)    /h)    (v/c)  (sec)
                grn   grn
--------------------------------------------------------------------------------
South: Sussex Street
   1 L  (Slp) 0.225* 0.125    878   1130   0.777    19.5    B      9.7     71
   2 T        0.225           408    525   0.777    18.5    B      9.0     65
--------------------------------------------------------------------------------
East: WICB East
   5 T        0.475*         1525   1795   0.850*   17.2    B     18.4    134
   6 R  (Slp) 0.075  0.475    687   1049   0.655    12.3    B      7.4     54
--------------------------------------------------------------------------------
  ALL VEHICLES:              3498          0.850    17.0    B     18.4    134
--------------------------------------------------------------------------------
  INTERSECTION (persons):    5247                   17.0          18.4    134
--------------------------------------------------------------------------------
     Level of Service calculations are based on
     average control delay including geometric delay (HCM criteria),
     independent of the current delay definition used.
     For the criteria, refer to the "Level of Service" topic in the
     SIDRA Output Guide or the Output section of the on-line help.
  *  Maximum v/c ratio, or critical green periods
  "  Movement Level of service has been determined using adjacent lane
     v/c ratio rather than short lane v/c ratio (v/c=1.0)
```

Table S.16 - SCATS MF Parameter

```
Buckle St Signalised Intersection
AM peak flow
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  40 (Practical Cycle Time)

-----------------------------------------------------
 Lane   Stopline Capacity  SCATS  SCATS   Deg.  Lane
 No.      Flow   (veh/h)   Satn    MF     Satn  Util.
        (veh/h)           Flow             x     %
-----------------------------------------------------
 South: Sussex Street
 1 L       496     638     1857     NA   0.777   100
 2 LT      460     592     1872     NA   0.777   100
 3 T       330     425     1950   1170   0.777   100
-----------------------------------------------------
 East: WICB East
 1 T       763     897     1950   1482   0.850   100
 2 T       763     897     1950   1482   0.850   100
 3 R       687    1049     1857     NA   0.655   100
-----------------------------------------------------
  NA Not Applicable - SCATS MF was not calculated for this lane due to one
     of the following reasons:
      - the lane is not controlled by signals (slip or continuous lane)
      - two movements share this lane and do not run in the same phases
```

STOPLINE FLOW: Departure flow rate in veh/h as measured at the stop line. This cannot exceed capacity.

SCATS SATURATION FLOW: This allows for lane width, approach grade and turning vehicles. Saturation flow scale applies if specified. The effects of heavy vehicles, parking manoeuvres, number of buses stopping and conflicting pedestrian volume are not included.

SCATS MF: This emulates the MF (Maximum Flow) parameter used in the SCATS control system. It is calculated from the SCATS SATURATION FLOW parameter.

DEG. SATN: The Demand (Arrival) Flow Rate may exceed the Stopline Flow Rate, therefore x > 1 is possible.

Table D.0 - Geometric Delay Data

Buckle St Signalised Intersection
AM peak flow
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 40 (Practical Cycle Time)

From Approach	To Approach	Turn	Negn Radius (m)	Negn Speed (km/h)	Negn Dist. (m)	Appr. Dist. (m)	Downstream Distance (m)	User Spec?
South: Sussex Street								
	North	Thru	S	50.0	13.2	500	76	No
	West	Left	20.0	26.2	31.4	500	88	No
East: WICB East								
	North	Right	5.0	15.5	10.0	500	76	No
	West	Thru	S	50.0	13.2	500	76	No

Downstream distance is distance travelled from the stopline until exit cruise speed is reached (includes negotiation distance). Acceleration distance is weighted for light and heavy vehicles. The same distance applies for both stopped and unstopped vehicles.

Table D.1 - Lane Delays

Buckle St Signalised Intersection
AM peak flow
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 40 (Practical Cycle Time)

		Delay (seconds/veh)								
Lane No.	Deg. Satn x	Stop-line Delay 1st d1	2nd d2	Total dSL	Acc. Dec. dn	Queuing Total dq	MvUp dqm	Stopd (Idle) di	Geom dig	Control dic
South: Sussex Street										
1 L	0.777	10.5	3.0	13.4	4.7	8.7	2.2	6.5	5.7	19.1
2 LT	0.777	11.4	3.0	14.3	5.2	9.1	2.4	6.7	4.7	19.0
3 T	0.777	16.8	2.7	19.5	7.7	11.8	1.9	9.9	0.0	19.5
East: WICB East										
1 T	0.850	10.3	6.9	17.2	7.3	9.9	2.3	7.6	0.0	17.2
2 T	0.850	10.3	6.9	17.2	7.3	9.9	2.3	7.6	0.0	17.2
3 R	0.655	4.8	0.0	4.8	2.4	2.5	0.5	2.0	7.4	12.3

dn is average stop-start delay for all vehicles queued and unqueued

Table D.2 - Lane Stops

Buckle St Signalised Intersection
AM peak flow
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 40 (Practical Cycle Time)

Lane No.	Deg. Satn x	-- Effective Stop Rate -- he1	he2	Geom. hig	Overall h	Prop. Queued pq	Queue Move-up Rate hqm
South: Sussex Street							
1 L	0.777	0.80	0.16	0.03	0.99	0.944	0.37
2 LT	0.777	0.81	0.18	0.02	1.01	0.956	0.43
3 T	0.777	0.83	0.15	0.00	0.98	0.993	0.29
East: WICB East							
1 T	0.850	0.84	0.22	0.00	1.07	0.945	0.31
2 T	0.850	0.84	0.22	0.00	1.07	0.945	0.31
3 R	0.655	0.62	0.03	0.20	0.85	0.717	0.09

hig is the average value for all movements in a shared lane
hqm is average queue move-up rate for all vehicles queued and unqueued

Table D.3A - Lane Queues (veh)

Buckle St Signalised Intersection
AM peak flow
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 40 (Practical Cycle Time)

Lane No.	Deg. Satn x	Ovrfl. Queue No	Average (veh) Nb1	Nb2	Nb	Percentile (veh) 70%	85%	90%	95%	98%	Queue Stor. Ratio
South: Sussex Street											
1 L	0.777	0.5	4.2	0.7	4.9	6.1	7.4	8.3	9.7	11.1	0.14
2 LT	0.777	0.4	3.8	0.6	4.5	5.5	6.8	7.6	9.0	10.3	0.13
3 T	0.777	0.3	4.0	0.4	4.4	5.4	6.7	7.5	8.8	10.2	0.13
East: WICB East											
1 T	0.850	1.6	8.3	2.4	10.7	13.0	15.3	16.7	18.4	20.1	1.91
2 T	0.850	1.6	8.3	2.4	10.7	13.0	15.3	16.7	18.4	20.1	1.91
3 R	0.655	0.0	3.5	0.0	3.5	4.4	5.5	6.2	7.4	8.6	1.08

Values printed in this table are back of queue (vehicles).

Table D.3B - Lane Queues (metres)

Buckle St Signalised Intersection
AM peak flow
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 40 (Practical Cycle Time)

Lane No.	Deg. Satn x	Ovrfl. Queue No	Average (metres) Nb1	Nb2	Nb	Percentile (metres) 70%	85%	90%	95%	98%	Queue Stor. Ratio
South: Sussex Street											
1 L	0.777	3.5	30.6	5.2	35.7	44.2	54.1	60.3	70.6	80.9	0.14
2 LT	0.777	3.2	27.8	4.7	32.5	40.3	49.5	55.4	65.4	75.3	0.13
3 T	0.777	2.1	29.0	2.9	31.9	39.6	48.7	54.5	64.3	74.2	0.13
East: WICB East											
1 T	0.850	11.4	60.7	17.3	78.0	94.6	112.0	121.6	134.0	146.4	1.91
2 T	0.850	11.4	60.7	17.3	78.0	94.6	112.0	121.6	134.0	146.4	1.91
3 R	0.655	0.0	25.8	0.0	25.9	32.3	40.0	45.1	54.1	63.0	1.08

Values printed in this table are back of queue (metres).

Table D.4 - Movement Speeds (km/h) and Geometric Delay

Buckle St Signalised Intersection
AM peak flow
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 40 (Practical Cycle Time)

Mov ID	App. Speeds Cruise	Negn	Exit Speeds Negn	Cruise	Queue Move-up 1st Grn	2nd Grn	Av. Section Spd Running	Overall	Geom Delay (sec)
South: Sussex Street									
1 L	50.0	26.2	26.2	50.0	22.2	16.1	38.5	34.2	5.7
2 T	50.0	50.0	50.0	50.0	22.7	0.0	39.9	34.5	0.0
East: WICB East									
5 T	50.0	50.0	50.0	50.0	33.1		40.6	35.3	0.0
6 R	50.0	15.5	15.5	50.0	15.5	32.2	40.1	38.6	7.4

"Running Speed" is the average speed excluding stopped periods.

Table D.5 - Progression Factors and Actuated Signal Parameters

Buckle St Signalised Intersection
AM peak flow
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 40 (Practical Cycle Time)

Mov ID	Control	Coord.	Arrival Type	Delay Prog. Factor	Queue Prog. Factor	Disp. Grn. Settings 1st Grn Gmin	Gmax	2nd Grn Gmin	Gmax
South: Sussex Street									
1 L	FT	No	3	1.000	1.000	6	NA	6	NA
2 T	FT	No	3	1.000	1.000	6	NA		
East: WICB East									

```
    5 T      FT       No        3      1.000   1.000     6   NA
    6 R      FT       No        3      1.000   1.000     6   NA     6   NA
--------------------------------------------------------------------------
```

Table D.6 - Gap Acceptance Parameters

```
Buckle St Signalised Intersection
AM peak flow
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  40 (Practical Cycle Time)

-----------------------------------------------------------
                          Critical Gap
                  Opng    ------------   Foll-up   Entry
  Mov     Mov     Flow    Hdwy    Dist   Headway    HV
  ID      Type   (pcu/h)   (s)    (m)      (s)     Equiv
-----------------------------------------------------------
 South: Sussex Street
    1 L   Slip      1530   4.01    55.8     2.41     2.00
-----------------------------------------------------------
 East: WICB East
    6 R   Slip       409   4.51    62.7     2.61     2.00
-----------------------------------------------------------

  Values in this table are adjusted for heavy vehicles in the entry stream.
```

SIDRA INTERSECTION

Output Tables

Mt Victoria Tunnel Signalised Intersection

Victoria - Peak PM

Run Information

```
Cycle Time =   50  (Practical Cycle Time)

* Basic Parameters:
  Intersection Type: Signalised - Fixed Time
  Driving on the left-hand side of the road
  "New Zealand" give way rule applied when input data was set up for this run
  Input data specified in Metric units
  Model Defaults: New Zealand
  Peak Flow Period (for performance): 30 minutes
  Unit time (for volumes): 60 minutes.
  Delay definition: Control delay
                    Geometric delay included
  SIDRA Standard Delay model used
  SIDRA Standard Queue model used
  Level of Service based on: Delay (HCM method)
  Queue definition: Back of queue, 95th Percentile

* Iteration Data:
  No. of Main (Timing-Capacity) Iterations =  1
  Comparison of last two iterations:
    Difference in intersection degree of satn =  0.0 %
    Largest difference in eff. green times =  0 secs
    (max. value for stopping = 0 secs)

  Degree of saturation of non-critical movement    2  is
  greater than the critical movement degrees of saturation
  because of one or more of the following reasons:
  - critical movement green times are at minimum
  - adjustment has been applied to the required time of
    a critical movement with two green periods
  - there is insufficient green time available in the cycle.
```

Table B.1 - Movement Definitions and Flow Rates (Origin-Destination)

```
Mt Victoria Tunnel Signalised Intersection
Victoria - Peak PM
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  50 (Practical Cycle Time)

-------------------------------------------------------------------
 From      To          Mov           Flow Rate   Flow   Peak Flow
 Approach  Approach    ID    Turn     LV    HV   Scale    Factor
-------------------------------------------------------------------
 South: Mt Victoria Tunnel
           North         2   Thru   1127    59    1.00     0.95
           West          1   Left    112     6    1.00     0.95
-------------------------------------------------------------------
 East: Kent Terrace
```

```
            South          4   Left    485    26    1.00     0.95
            North          6   Right   727    38    1.00     0.95
            West           5   Thru    487    26    1.00     0.95
-------------------------------------------------------------------
Unit Time for Volumes =  60 minutes
Peak Flow Period =  30 minutes
Flow Rates include effects of Flow Scale and Peak Flow Factor
```

Table B.2A - Flow Rates (Separate Light and Heavy Vehicles)

```
Mt Victoria Tunnel Signalised Intersection
Victoria - Peak PM
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  50 (Practical Cycle Time)

-----------------------------------------------
  Mov          Left       Through       Right
  ID        ---------    ---------    ---------
             LV    HV     LV    HV     LV    HV
-----------------------------------------------
Demand flows in veh/hour as used by the program
South: Mt Victoria Tunnel
    1 L     112     6      0     0      0     0
    2 T       0     0   1127    59      0     0
-----------------------------------------------
East: Kent Terrace
    4 L     485    26      0     0      0     0
    5 T       0     0    487    26      0     0
    6 R       0     0      0     0    727    38
-----------------------------------------------
Unit Time for Volumes =  60 minutes
Peak Flow Period =  30 minutes
Flow Rates include effects of Flow Scale and Peak Flow Factor
```

Table B.2B - Flow Rates (Total Vehicles and Percent Heavy)

```
Mt Victoria Tunnel Signalised Intersection
Victoria - Peak PM
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  50 (Practical Cycle Time)

-------------------------------------------------
  Mov          Left        Through        Right
  ID        ----------    ----------    ----------
            Total  %HV    Total  %HV    Total  %HV
-------------------------------------------------
Demand flows in veh/hour as used by the program
South: Mt Victoria Tunnel
    1 L      118   5.1       0   0.0       0   0.0
    2 T        0   0.0    1186   5.0       0   0.0
-------------------------------------------------
East: Kent Terrace
    4 L      511   5.1       0   0.0       0   0.0
    5 T        0   0.0     513   5.1       0   0.0
    6 R        0   0.0       0   0.0     765   5.0
-------------------------------------------------
Unit Time for Volumes =  60 minutes
Peak Flow Period =  30 minutes
Flow Rates include effects of Flow Scale and Peak Flow Factor
```

Table B.3 - Pedestrian Flow Rates

Mt Victoria Tunnel Signalised Intersection
Victoria - Peak PM
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 50 (Practical Cycle Time)

Mov ID	Stage	Flow Rate (ped/h)	Flow Scale	Peak Flow Factor
Across South Approach				
P1		53	1.00	0.95
Across West Approach				
P7		53	1.00	0.95

Unit Time for Volumes = 60 minutes
Peak Flow Period = 30 minutes
Flow Rates include effects of Flow Scale and Peak Flow Factor

Table S.1 - Movement Phase and Timing Parameters

Mt Victoria Tunnel Signalised Intersection
Victoria - Peak PM
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 50 (Practical Cycle Time)

Mov ID	Mov Typ	PHASE MATRIX First Green Fr	To	Op Pr	Second Green Fr	To	Op Pr	Lost Tim 1st Grn	Lost Tim 2nd Grn	Req.Mov.Time 1st Grn	Req.Mov.Time 2nd Grn	Eff. Grn 1st Grn	Eff. Grn 2nd Grn
South: Mt Victoria Tunnel													
1 L	(Slp) A		B		B	A	Y	6	13	15.0Min	18.0Min	19	12
2 T	A		B					6		23.4		19	
East: Kent Terrace													
4 L	(Slp)*A		B		B	A		6	6	23.4	22.4	19	19
5 T	B		A					6		22.7		19	
6 R	*B		A					6		22.7		19	
Pedestrian Movements													
P1	(Ped) B		A					12		18.0Min		13	
P7	(Ped) A		B					9		15.0Min		16	

Current Phase Sequence: Two-phase
Input phase sequence: A B
Output phase sequence: A B

* Critical Movement/Green Period

Movement Types:
Slp Slip Lane Movement
Ped Pedestrian
Dum Dummy

Under heading 'Op':
Y If opposed turn

Table S.2 - Movement Capacity Parameters

Mt Victoria Tunnel Signalised Intersection
Victoria - Peak PM
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 50 (Practical Cycle Time)

Mov ID	Dem Flow (veh /h)	HV (%)	Satn Flow 1st Grn	Satn Flow 2nd Grn	Flow Ratio 1st Grn	Flow Ratio 2nd Grn	Total Cap. (veh /h)	Prac. Deg. Satn xp	Prac. Spare Cap. (%)	Lane Util (%)	Deg. Satn x
South: Mt Victoria Tunnel											
1 L	118	5.1	1488<	1398	0.079	0.000	901	0.90	587	100	0.131
2 T	1186	5.0	3778		0.314		1436	0.90	9	100	0.826*
East: Kent Terrace											
4 L	511	5.1	462	1239	0.314	0.295	646	0.90	14	100	0.791
5 T	513	5.1	1708		0.300		649	0.90	14	100	0.790
6 R	765	5.0	2547		0.300		968	0.90	14	100	0.790
Pedestrian Movements											
P1	53		12000		0.004		3120	0.90		0	0.017
P7	53		12000		0.004		3840	0.90		0	0.014

Degree of saturation of non-critical movement 2 is greater than the critical movement degrees of saturation because of one or more of the following reasons:
- critical movement green times are at minimum
- adjustment has been applied to the required time of a critical movement with two green periods
- there is insufficient green time available in the cycle.

Table S.3 - Intersection Parameters

Mt Victoria Tunnel Signalised Intersection
Victoria - Peak PM
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 50 (Practical Cycle Time)

Crit Mov ID	App. and Turn	Green Period	Phases Fr	Phases To	Adjusted Lost Time	Adjusted Flow Ratio	Required Grn Time Ratio	Required Movement Time
4	E_L	1st	A	B	6	0.314	0.349	23.4
6	E_R		B	A	6	0.300	0.334	22.7
				Total:	12	0.614	0.683	46.1

Cycle Time:

Minimum	Maximum	Practical	Chosen
33	150	38	50

Intersection Level of Service	=	C
Worst movement Level of Service	=	C
Average intersection delay (s/pers)	=	20.1
Largest average movement delay (s)	=	26.3
Largest back of queue, 95% (m)	=	124
Performance Index	=	115.88
Degree of saturation (highest)	=	0.826
Practical Spare Capacity (lowest)	=	9 %
Effective intersection capacity, (veh/h)	=	3744
Total vehicle flow (veh/h)	=	3093

```
   Total pedestrian flow (ped/h)             =       106
   Total person flow (pers/h)                =      4746
   Total vehicle delay (veh-h/h)             =     17.40
   Total pedestrian delay (ped-h/h)          =      0.37
   Total person delay (pers-h/h)             =     26.47
   Total effective vehicle stops (veh/h)     =      3001
   Total effective pedestrian stops (ped/h)  =        75
   Total effective person stops (pers/h)     =      4576
   Total vehicle travel (veh-km/h)           =    1779.0
   Total cost ($/h)                          =   1575.50
   Total fuel (L/h)                          =     229.4
   Total CO2 (kg/h)                          =    574.61
```

Table S.4 - Phase Information

```
Mt Victoria Tunnel Signalised Intersection
Victoria - Peak PM
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  50 (Practical Cycle Time)

--------------------------------------------------------------------------------
Phase  Change  Starting  Green  Displayed  Green  Terminating  Phase  Phase
        Time    Intgrn   Start    Green     End     Intgrn     Time   Split
--------------------------------------------------------------------------------
 A         0       6        6       19       25        6         25    50%
 B        25       6       31       19       50        6         25    50%
--------------------------------------------------------------------------------
  Current Phase Sequence: Two-phase
  Input phase sequence: A B
  Output phase sequence: A B
```

Table S.5 - Movement Performance

```
--------------------------------------------------------------------------------
  Mov      Total    Total   Aver.  Prop.  Eff. Longest Queue  Perf.  Aver.
  ID       Delay    Delay   Delay Queued  Stop   95% Back     Index  Speed
        (veh-h/h)(pers-h/h)(sec)         Rate  (vehs)  (m)          (km/h)
--------------------------------------------------------------------------------
South: Mt Victoria Tunnel
    1 L     0.27     0.40     8.2   0.43  0.64    1.3    10    2.61   41.7
    2 T     6.85    10.28    20.8   0.97  1.02   17.0   124   46.64   33.3
--------------------------------------------------------------------------------
East: Kent Terrace
    4 L     2.41     3.62    17.0   0.89  0.94   14.3   104   16.81   35.6
    5 T     2.27     3.41    16.0   0.93  0.93   15.2   111   17.96   36.0
    6 R     5.60     8.39    26.3   0.95  0.99   15.2   111   30.42   30.6
--------------------------------------------------------------------------------
Pedestrian Movements
   P1       0.20     0.20    13.7   0.74  0.74    0.1     0    0.76    2.9
   P7       0.17     0.17    11.6   0.68  0.68    0.1     0    0.67    3.0
--------------------------------------------------------------------------------
```

Table S.6 - Intersection Performance

```
Mt Victoria Tunnel Signalised Intersection
Victoria - Peak PM
```

Intersection ID: 0
Fixed-Time Signals, Cycle Time = 50 (Practical Cycle Time)

Total Flow (veh/h)	Deg. Satn x	Total Delay (veh-h/h)	Total Delay (pers-h/h)	Aver. Delay (sec)	Prop. Queued	Eff. Stop Rate	Longest Queue (m)	Perf. Index	Aver. Speed (km/h)
South: Mt Victoria Tunnel									
1304	0.826	7.12	10.68	19.7	0.92	0.99	124	49.25	33.9
East: Kent Terrace									
1789	0.791	10.28	15.42	20.7	0.92	0.96	111	65.20	33.4
Pedestrians:									
0	0.000	0.00	0.00	13.7-NaN		0.74	0	0.00	2.9
ALL VEHICLES:									
3093	0.826	17.40	26.10	20.3	0.92	0.97	124	114.45	33.6
INTERSECTION (persons):									
4746	0.826		26.47	20.1	0.92	0.96		115.88	33.2

Queue values in this table are 95% back of queue (metres).

Table S.7 - Lane Performance

Mt Victoria Tunnel Signalised Intersection
Victoria - Peak PM
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 50 (Practical Cycle Time)

Lane No.	Effective Green Times (sec) R1	G1	R2	G2	Dem Flow (veh /h)	Cap (veh /h)	Deg. Satn x	Aver. Delay (sec)	Eff. Stop Rate	Queue 95% Back (vehs)	(m)	Lane Length (m)
South: Mt Victoria Tunnel												
1 L	6	19	13	12	118	901	0.131	8.2	0.64	1.3	9.7	50.0T
2 T	31	19	0	0	593	718	0.826	20.8	1.02	17.0	123.8	500.0
3 T	31	19	0	0	593	718	0.826	20.8	1.02	17.0	123.8	500.0
East: Kent Terrace												
1 LT	6	6	19	19	695	879	0.791	15.4	0.92	14.3	104.2	500.0
2 TR	31	19	0	0	555	702	0.791	21.8	0.97	15.2	111.3	500.0
3 R	31	19	0	0	539	682	0.791	26.4	0.99	14.9	108.9	500.0

T Short lane due to specification of Turn Slot

Table S.8 - Lane Flow and Capacity Information

Mt Victoria Tunnel Signalised Intersection
Victoria - Peak PM
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 50 (Practical Cycle Time)

Lane No.	Dem Flow (veh/h) Lef	Thru	Rig	Tot	Lane Width (m)	Saturation Flow Adj. Basic (tcu)	Aver 1st (veh)	Aver 2nd (veh)	End Cap (veh /h)	Tot Cap (veh /h)	Deg. Satn x	Lane Util %
South: Mt Victoria Tunnel												

```
 1 L     118    0    0  118  3.30  1950 1488< 1398  179  901 0.131  100
 2 T       0  593    0  593  3.30  1950 1889     0    0  718 0.826  100
 3 T       0  593    0  593  3.30  1950 1889     0    0  718 0.826  100
--------------------------------------------------------------------------
 East: Kent Terrace
 1 LT    511  184    0  695  3.30  1950 1575  1816    0  879 0.791  100
 2 TR      0  329  226  555  3.30  1950 1848     0    0  702 0.791  100
 3 R       0    0  539  539  3.30  1950 1794     0    0  682 0.791  100
--------------------------------------------------------------------------
  <  Reduced saturation flow due to a short lane effect

  Basic Saturation Flow in this table is adjusted for lane width, approach
  grade, parking manoeuvres and number of buses stopping.  Saturation flow
  scale applies if specified.
```

Table S.9 - Signal Timing Diagram

```
Mt Victoria Tunnel Signalised Intersection
Victoria - Peak PM
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  50 (Practical Cycle Time)

Displayed (Phase) Green Times

             Phase A                              Phase B

0                                  25                                    50
I----------------------------------I-----------------------------------I
........GGGGGGGGGGGGGGGGGGGGGGGGG.........GGGGGGGGGGGGGGGGGGGGGGGGG.
        6                                  31


Effective (Movement) Green Times


 South: Mt Victoria Tunnel

Mov.     1 (L)
I                                  I                                     I
GGGG.........GGGGGGGGGGGGGGGGGGGGGGG..................GGGGGGGGGGGGGG
   3         9                         28                41

Mov.     2 (T)
I                                  I                                     I
.............GGGGGGGGGGGGGGGGGGGGGGG.............................
            9                         28


 East: Kent Terrace

Mov.     4 (L)
I                                  I                                     I
GGGG.........GGGGGGGGGGGGGGGGGGGGGGGG.........GGGGGGGGGGGGGGGGGGGGGGG
   3         9                         28        34

Mov.     5 (T)
I                                  I                                     I
GGG.............................................GGGGGGGGGGGGGGGGGGGGG
   3                                             34

Mov.     6 (R)
I                                  I                                     I
GGG.............................................GGGGGGGGGGGGGGGGGGGGG
   3                                             34


 Pedestrian Movements

Mov.    P1
I                                  I                                     I
.............................................GGGGGGGGGGGGGGGG.......
                                          33                46
```

```
Mov.    P7
I                                I                                  I
...........GGGGGGGGGGGGGGGGGGGGG.....................................
          8                     24


I-----I------I------I------I------I------I------I------I------I------I---->
0      5     10     15     20     25     30     35     40     45     50

                                T I M E  (s)
```

Table S.10 - Movement Capacity and Performance Summary

```
Mt Victoria Tunnel Signalised Intersection
Victoria - Peak PM
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  50 (Practical Cycle Time)

--------------------------------------------------------------------------------
 Mov     Mov  Dem   Total  Lane  Deg.  Eff. Grn  Aver.  Eff.    95%    Perf.
 ID      Typ  Flow   Cap.  Util  Satn  -------- Delay  Stop  Back of  Index
              (veh  (veh               1st  2nd        Rate   Queue
               /h)   /h)   (%)     x   Grn  Grn  (sec)         (veh)
--------------------------------------------------------------------------------
South: Mt Victoria Tunnel
   1 L  (Slp)  118   901<  100  0.131   19   12    8.2  0.64    1.3    2.61
   2 T        1186  1436   100  0.826*  19        20.8  1.02   17.0   46.64
--------------------------------------------------------------------------------
East: Kent Terrace
   4 L  (Slp)  511   646   100  0.791   19*  19   17.0  0.94   14.3   16.81
   5 T         513   649   100  0.790   19        16.0  0.93   15.2   17.96
   6 R         765   968   100  0.790   19*       26.3  0.99   15.2   30.42
--------------------------------------------------------------------------------
Pedestrian Movements
  P1    (Ped)   53  3120   100  0.017   13        13.7  0.74    0.1    0.76
  P7    (Ped)   53  3840   100  0.014   16        11.6  0.68    0.1    0.67
--------------------------------------------------------------------------------
  <  Reduced capacity due to a short lane effect
  *  Maximum degree of saturation, or critical green periods
```

Table S.12A - Fuel Consumption, Emissions and Cost (TOTAL)

```
Mt Victoria Tunnel Signalised Intersection
Victoria - Peak PM
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  50 (Practical Cycle Time)

------------------------------------------------------------
  Mov            Fuel    Cost     HC      CO     NOX     CO2
  ID             Total   Total   Total   Total   Total   Total
                  L/h    $/h     kg/h    kg/h    kg/h    kg/h
------------------------------------------------------------
South: Mt Victoria Tunnel
    1 L           7.7    50.04   0.030    1.35   0.041    19.3
    2 T          89.2   606.03   0.375   16.85   0.481   223.5
               ---------------------------------------------
                 96.9   656.07   0.405   18.19   0.522   242.8
------------------------------------------------------------
East: Kent Terrace
    4 L          36.9   247.45   0.151    6.76   0.199    92.3
    5 T          36.8   244.36   0.152    6.85   0.198    92.1
    6 R          58.8   414.87   0.249   10.86   0.312   147.3
               ---------------------------------------------
```

	132.4	906.68	0.552	24.47	0.708	331.8
Pedestrian Movements						
P1		6.81				
P7		5.94				
		12.75				
ALL VEHICLES:	229.4	1562.75	0.956	42.66	1.230	574.6
INTERSECTION:	229.4	1575.50	0.956	42.66	1.230	574.6

PARAMETERS USED IN COST CALCULATIONS

Pump price of fuel ($/L)	= 1.600
Fuel resource cost factor	= 0.60
Ratio of running cost to fuel cost	= 2.5
Average income ($/h)	= 21.00
Time value factor	= 0.60
Light vehicle mass (1000 kg)	= 1.4
Heavy vehicle mass (1000 kg)	= 11.0
Light vehicle idle fuel rate (L/h)	= 1.350
Heavy vehicle idle fuel rate (L/h)	= 2.000

Table S.12B - Fuel Consumption, Emissions and Cost (RATE)

Mt Victoria Tunnel Signalised Intersection
Victoria - Peak PM
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 50 (Practical Cycle Time)

Mov ID		Fuel Rate L/100km	Cost Rate $/km	HC Rate g/km	CO Rate g/km	NOX Rate g/km	CO2 Rate g/km
South: Mt Victoria Tunnel							
1	L	11.2	0.72	0.436	19.47	0.593	279.8
2	T	13.1	0.89	0.551	24.77	0.707	328.6
		12.9	0.88	0.540	24.28	0.697	324.1
East: Kent Terrace							
4	L	12.4	0.83	0.507	22.78	0.670	311.0
5	T	12.5	0.83	0.516	23.30	0.672	313.1
6	R	13.4	0.95	0.568	24.75	0.710	335.8
		12.9	0.88	0.536	23.77	0.688	322.2
Pedestrian Movements							
P1			4.29				
P7			4.21				
			4.26				
ALL VEHICLES:		12.9	0.88	0.538	23.98	0.691	323.0
INTERSECTION:		12.9	0.88	0.538	23.98	0.691	323.0

Table S.14 - Summary of Input and Output Data

```
Mt Victoria Tunnel Signalised Intersection
Victoria - Peak PM
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  50 (Practical Cycle Time)

--------------------------------------------------------------------------------
 Lane   Demand Flow (veh/h)       Adj.  Eff Grn   Deg   Aver. Longest Shrt
 No.   --------------------  %HV  Basic  (secs)   Sat   Delay  Queue  Lane
         L    T    R   Tot       Satf. 1st 2nd    x    (sec)   (m)    (m)
--------------------------------------------------------------------------------
 South: Mt Victoria Tunnel
1 L     118             118    5  1949   19  12  0.131    8.2    10    50
2 T          593        593    5  1949   19      0.826   20.8   124   500
3 T          593        593    5  1949   19      0.826   20.8   124   500
        ------------------------------------------------------------------
        118 1186    0  1304    5                 0.826   19.7   124
--------------------------------------------------------------------------------
 East: Kent Terrace
1 LT    511  184        695    5  1950    6  19  0.791   15.4   104   500
2 TR         329  226   555    5  1950   19      0.791   21.8   111   500
3 R               539   539    5  1950   19      0.791   26.4   109   500
        ------------------------------------------------------------------
        511  513  765  1789    5                 0.791   20.7   111
--------------------------------------------------------------------------------
 Pedestrians
  Across S approach      53              13      0.017   13.7   0.1
  Across W approach      53              16      0.014   11.6   0.1
================================================================================
 ALL VEHICLES          Total   %       Cycle      Max   Aver.   Max
                       Flow   HV       Time        X    Delay  Queue
                       3093    5         50      0.826   20.3   124
================================================================================
Peak flow period = 30 minutes.

Queue values in this table are 95% back of queue (metres).

Note: Basic Saturation Flows (in through car units) have been adjusted for
      grade, lane widths, parking manoeuvres and bus stops.
```

Table S.15 - Capacity and Level of Service

```
Mt Victoria Tunnel Signalised Intersection
Victoria - Peak PM
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  50 (Practical Cycle Time)

--------------------------------------------------------------------------------
 Mov     Mov    Green Time  Total  Total    Deg.   Aver.   LOS  Longest Queue
 ID      Typ    Ratio (g/C) Flow    Cap.     of    Delay          95% Back
               ------------ (veh   (veh     Satn                (vehs)  (m)
                1st   2nd    /h)    /h)    (v/c)  (sec)
                grn   grn
--------------------------------------------------------------------------------
South: Mt Victoria Tunnel
   1 L  (Slp) 0.380  0.240    118    901<  0.131     8.2    A      1.3     10
   2 T        0.380          1186   1436   0.826*   20.8    C     17.0    124
--------------------------------------------------------------------------------
East: Kent Terrace
   4 L  (Slp) 0.380* 0.380    511    646   0.791    17.0    B     14.3    104
   5 T        0.380           513    649   0.790    16.0    B     15.2    111
   6 R        0.380*          765    968   0.790    26.3    C     15.2    111
--------------------------------------------------------------------------------
Pedestrian Movements
  P1    (Ped) 0.260            53   3120   0.017    13.7    B      0.1      0
  P7    (Ped) 0.320            53   3840   0.014    11.6    B      0.1      0
--------------------------------------------------------------------------------
  ALL VEHICLES:              3093          0.826    20.3    C     17.0    124
--------------------------------------------------------------------------------
  INTERSECTION (persons):    4746                   20.1          17.0    124
--------------------------------------------------------------------------------
     Level of Service calculations are based on
     average control delay including geometric delay (HCM criteria),
```

```
     independent of the current delay definition used.
     For the criteria, refer to the "Level of Service" topic in the
     SIDRA Output Guide or the Output section of the on-line help.
     Intersection capacity is calculated considering vehicle movements only.
  <  Reduced capacity due to a short lane effect
  *  Maximum v/c ratio, or critical green periods
  "  Movement Level of service has been determined using adjacent lane
     v/c ratio rather than short lane v/c ratio (v/c=1.0)
```

Table S.16 - SCATS MF Parameter

```
Mt Victoria Tunnel Signalised Intersection
Victoria - Peak PM
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  50 (Practical Cycle Time)

-----------------------------------------------------
 Lane   Stopline Capacity  SCATS  SCATS   Deg.  Lane
 No.      Flow   (veh/h)   Satn    MF     Satn  Util.
        (veh/h)           Flow            x     %
-----------------------------------------------------
 South: Mt Victoria Tunnel
 1 L       118     901     1857     NA   0.131   100
 2 T       593     718     1950   1482   0.826   100
 3 T       593     718     1950   1482   0.826   100
-----------------------------------------------------
 East: Kent Terrace
 1 LT      695     879     1881     NA   0.791   100
 2 TR      555     702     1911   1452   0.791   100
 3 R       539     682     1857   1411   0.791   100
-----------------------------------------------------
  NA Not Applicable - SCATS MF was not calculated for this lane due to one
     of the following reasons:
      - the lane is not controlled by signals (slip or continuous lane)
      - two movements share this lane and do not run in the same phases

  STOPLINE FLOW: Departure flow rate in veh/h as measured at the stop line.
  This cannot exceed capacity.

  SCATS SATURATION FLOW: This allows for lane width, approach grade and
  turning vehicles.  Saturation flow scale applies if specified.
  The effects of heavy vehicles, parking manoeuvres, number of buses
  stopping and conflicting pedestrian volume are not included.

  SCATS MF: This emulates the MF (Maximum Flow) parameter used in the SCATS
  control system. It is calculated from the SCATS SATURATION FLOW parameter.

  DEG. SATN: The Demand (Arrival) Flow Rate may exceed the Stopline Flow
  Rate, therefore x > 1 is possible.
```

Table D.0 - Geometric Delay Data

```
Mt Victoria Tunnel Signalised Intersection
Victoria - Peak PM
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  50 (Practical Cycle Time)

-------------------------------------------------------------------------------
                           Negn  Negn   Negn   Appr.   Downstream  Distance
 From      To              Radius Speed Dist.  Dist.   ----------
 Approach  Approach  Turn    (m)  (km/h)  (m)    (m)      (m)     User Spec?
-------------------------------------------------------------------------------
 South: Mt Victoria Tunnel
            North   Thru       S   50.0   13.2    500      76         No
```

West	Left	20.0	26.2	31.4	500	88	No
East: Kent Terrace							
South	Left	15.0	23.5	23.6	500	83	No
North	Right	5.0	15.5	10.0	500	76	No
West	Thru	S	50.0	16.5	500	76	No

Downstream distance is distance travelled from the stopline until exit cruise speed is reached (includes negotiation distance). Acceleration distance is weighted for light and heavy vehicles. The same distance applies for both stopped and unstopped vehicles.

Table D.1 - Lane Delays

Mt Victoria Tunnel Signalised Intersection
Victoria - Peak PM
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 50 (Practical Cycle Time)

		Delay (seconds/veh)								
	Deg.	Stop-line Delay		Acc.	Queuing		Stopd			
Lane	Satn	1st	2nd	Total	Dec.	Total	MvUp	(Idle)	Geom	Control
No.	x	d1	d2	dSL	dn	dq	dqm	di	dig	dic
South: Mt Victoria Tunnel										
1 L	0.131	2.5	0.0	2.5	2.2	0.6	0.0	0.6	5.7	8.2
2 T	0.826	15.6	5.2	20.8	7.5	13.3	1.7	11.6	0.0	20.8
3 T	0.826	15.6	5.2	20.8	7.5	13.3	1.7	11.6	0.0	20.8
East: Kent Terrace										
1 LT	0.791	7.3	3.6	10.9	4.8	6.1	0.9	5.2	4.5	15.4
2 TR	0.791	15.3	3.5	18.8	5.6	13.2	1.3	11.9	3.0	21.8
3 R	0.791	15.3	3.6	18.9	3.1	15.8	1.3	14.5	7.4	26.4

dn is average stop-start delay for all vehicles queued and unqueued

Table D.2 - Lane Stops

Mt Victoria Tunnel Signalised Intersection
Victoria - Peak PM
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 50 (Practical Cycle Time)

		-- Effective Stop Rate --					Queue
	Deg.			Geom.	Overall	Prop.	Move-up
Lane	Satn					Queued	Rate
No.	x	he1	he2	hig	h	pq	hqm
South: Mt Victoria Tunnel							
1 L	0.131	0.35	0.00	0.30	0.64	0.433	0.00
2 T	0.826	0.85	0.17	0.00	1.02	0.967	0.24
3 T	0.826	0.85	0.17	0.00	1.02	0.967	0.24
East: Kent Terrace							
1 LT	0.791	0.79	0.09	0.05	0.92	0.889	0.14
2 TR	0.791	0.83	0.12	0.01	0.97	0.947	0.18
3 R	0.791	0.83	0.13	0.04	0.99	0.947	0.18

hig is the average value for all movements in a shared lane
hqm is average queue move-up rate for all vehicles queued and unqueued

Table D.3A - Lane Queues (veh)

Mt Victoria Tunnel Signalised Intersection
Victoria - Peak PM
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 50 (Practical Cycle Time)

Lane No.	Deg. Satn x	Ovrfl. Queue No	Average (veh) Nb1	Nb2	Nb	Percentile (veh) 70%	85%	90%	95%	98%	Queue Stor. Ratio
South: Mt Victoria Tunnel											
1 L	0.131	0.0	0.5	0.0	0.5	0.7	0.9	1.0	1.3	1.6	0.19
2 T	0.826	0.9	8.3	1.4	9.7	11.8	14.0	15.3	17.0	18.6	0.25
3 T	0.826	0.9	8.3	1.4	9.7	11.8	14.0	15.3	17.0	18.6	0.25
East: Kent Terrace											
1 LT	0.791	0.8	6.6	1.3	7.9	9.6	11.5	12.7	14.3	15.9	0.21
2 TR	0.791	0.6	7.6	1.0	8.6	10.4	12.5	13.6	15.2	16.9	0.22
3 R	0.791	0.6	7.4	0.9	8.3	10.2	12.2	13.3	14.9	16.5	0.22

Values printed in this table are back of queue (vehicles).

Table D.3B - Lane Queues (metres)

Mt Victoria Tunnel Signalised Intersection
Victoria - Peak PM
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 50 (Practical Cycle Time)

Lane No.	Deg. Satn x	Ovrfl. Queue No	Average (metres) Nb1	Nb2	Nb	Percentile (metres) 70%	85%	90%	95%	98%	Queue Stor. Ratio
South: Mt Victoria Tunnel											
1 L	0.131	0.0	3.9	0.0	3.9	5.0	6.5	7.6	9.7	11.9	0.19
2 T	0.826	6.9	60.5	10.6	71.0	86.2	102.5	111.6	123.8	135.9	0.25
3 T	0.826	6.9	60.5	10.6	71.0	86.2	102.5	111.6	123.8	135.9	0.25
East: Kent Terrace											
1 LT	0.791	5.8	48.5	9.2	57.7	70.4	84.3	92.5	104.2	115.9	0.21
2 TR	0.791	4.5	55.6	7.0	62.5	76.2	90.9	99.4	111.3	123.2	0.22
3 R	0.791	4.5	54.0	6.9	60.9	74.2	88.7	97.1	108.9	120.7	0.22

Values printed in this table are back of queue (metres).

Table D.4 - Movement Speeds (km/h) and Geometric Delay

Mt Victoria Tunnel Signalised Intersection
Victoria - Peak PM
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 50 (Practical Cycle Time)

Mov ID	App. Speeds Cruise	App. Speeds Negn	Exit Speeds Negn	Exit Speeds Cruise	Queue Move-up 1st Grn	Queue Move-up 2nd Grn	Av. Section Spd Running	Av. Section Spd Overall	Geom Delay (sec)
South: Mt Victoria Tunnel									
1 L	50.0	26.2	26.2	50.0			42.2	41.7	5.7
2 T	50.0	50.0	50.0	50.0	33.1		40.9	33.3	0.0
East: Kent Terrace									
4 L	50.0	23.5	23.5	50.0	17.0	32.5	39.6	35.6	6.1
5 T	50.0	50.0	50.0	50.0	27.1	0.0	40.7	36.0	0.0
6 R	50.0	15.5	15.5	50.0	32.4		38.9	30.6	7.4

"Running Speed" is the average speed excluding stopped periods.

Table D.5 - Progression Factors and Actuated Signal Parameters

Mt Victoria Tunnel Signalised Intersection
Victoria - Peak PM
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 50 (Practical Cycle Time)

Mov ID	Control	Coord.	Arrival Type	Delay Prog. Factor	Queue Prog. Factor	Disp. Grn. Settings 1st Grn Gmin	1st Grn Gmax	2nd Grn Gmin	2nd Grn Gmax
South: Mt Victoria Tunnel									
1 L	FT	No	3	1.000	1.000	6	NA	6	NA
2 T	FT	No	3	1.000	1.000	6	NA		
East: Kent Terrace									
4 L	FT	No	3	1.000	1.000	6	NA	6	NA
5 T	FT	No	3	1.000	1.000	6	NA		
6 R	FT	No	3	1.000	1.000	6	NA		
Pedestrians									
P1	FT	No	3	1.000	1.000				
P7	FT	No	3	1.000	1.000				

Table D.6 - Gap Acceptance Parameters

Mt Victoria Tunnel Signalised Intersection
Victoria - Peak PM
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 50 (Practical Cycle Time)

Mov ID	Mov Type	Opng Flow (pcu/h)	Critical Gap Hdwy (s)	Critical Gap Dist (m)	Foll-up Headway (s)	Entry HV Equiv
South: Mt Victoria Tunnel						
1 L	Slip	515	4.02	55.8	2.41	2.00
East: Kent Terrace						
No opposed movements on this approach						

Values in this table are adjusted for heavy vehicles in the entry stream.

Site: Mt Victoria PM Peak - right turn at signals
G:\Transport\Transit\Proj\5C1353.00_Basin_Reserve_At-grade_Improvements\03_Sidra\Proposed_Intersections\Mt Victoria.aap
Processed Feb 07, 2008 11:30:17a.m.

A0101, Opus International Consultants Ltd, Large Office

SIDRA INTERSECTION

Output Tables

Mt Victoria Tunnel Signalised Intersection

Victoria - Peak AM

Run Information

```
Cycle Time =   50  (Practical Cycle Time)

* Basic Parameters:
  Intersection Type: Signalised - Fixed Time
  Driving on the left-hand side of the road
  "New Zealand" give way rule applied when input data was set up for this run
  Input data specified in Metric units
  Model Defaults: New Zealand
  Peak Flow Period (for performance): 30 minutes
  Unit time (for volumes): 60 minutes.
  Delay definition: Control delay
                    Geometric delay included
  SIDRA Standard Delay model used
  SIDRA Standard Queue model used
  Level of Service based on: Delay (HCM method)
  Queue definition: Back of queue, 95th Percentile

* Iteration Data:
  No. of Main (Timing-Capacity) Iterations =  2
  Comparison of last two iterations:
    Difference in intersection degree of satn =  0.0 %
    Largest difference in eff. green times =  0 secs
    (max. value for stopping = 0 secs)
```

Table B.1 - Movement Definitions and Flow Rates (Origin-Destination)

```
Mt Victoria Tunnel Signalised Intersection
Victoria - Peak AM
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  50 (Practical Cycle Time)

-------------------------------------------------------------------
 From      To          Mov           Flow Rate   Flow   Peak Flow
 Approach  Approach    ID    Turn     LV    HV   Scale    Factor
-------------------------------------------------------------------
 South: Mt Victoria Tunnel
           North         2   Thru   1384    73    1.00     0.95
           West          1   Left     52     3    1.00     0.95
-------------------------------------------------------------------
 East: Kent Terrace
           South         4   Left    384    20    1.00     0.95
           West          5   Thru    465    24    1.00     0.95
-------------------------------------------------------------------
Unit Time for Volumes =  60 minutes
Peak Flow Period =  30 minutes
Flow Rates include effects of Flow Scale and Peak Flow Factor
```

Table B.2A - Flow Rates (Separate Light and Heavy Vehicles)

```
Mt Victoria Tunnel Signalised Intersection
Victoria - Peak AM
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  50 (Practical Cycle Time)

-----------------------------------------------
  Mov          Left       Through       Right
  ID        ---------    ---------    ---------
             LV    HV     LV    HV     LV    HV
-----------------------------------------------
Demand flows in veh/hour as used by the program
South: Mt Victoria Tunnel
    1 L      52     3      0     0      0     0
    2 T       0     0   1384    73      0     0
-----------------------------------------------
East: Kent Terrace
    4 L     384    20      0     0      0     0
    5 T       0     0    465    24      0     0
-----------------------------------------------
Unit Time for Volumes =  60 minutes
Peak Flow Period =  30 minutes
Flow Rates include effects of Flow Scale and Peak Flow Factor
```

Table B.2B - Flow Rates (Total Vehicles and Percent Heavy)

```
Mt Victoria Tunnel Signalised Intersection
Victoria - Peak AM
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  50 (Practical Cycle Time)

-------------------------------------------------
  Mov          Left        Through        Right
  ID        ----------    ----------    ----------
            Total  %HV    Total  %HV    Total  %HV
-------------------------------------------------
Demand flows in veh/hour as used by the program
South: Mt Victoria Tunnel
    1 L       55   5.5       0   0.0       0   0.0
    2 T        0   0.0    1457   5.0       0   0.0
-------------------------------------------------
East: Kent Terrace
    4 L      404   5.0       0   0.0       0   0.0
    5 T        0   0.0     489   4.9       0   0.0
-------------------------------------------------
Unit Time for Volumes =  60 minutes
Peak Flow Period =  30 minutes
Flow Rates include effects of Flow Scale and Peak Flow Factor
```

Table B.3 - Pedestrian Flow Rates

```
Mt Victoria Tunnel Signalised Intersection
Victoria - Peak AM
Intersection ID: 0
```

```
Fixed-Time Signals, Cycle Time =  50 (Practical Cycle Time)

----------------------------------------
 Mov        Flow Rate   Flow   Peak Flow
 ID   Stage  (ped/h)    Scale   Factor
----------------------------------------
Across South Approach
  P1            53       1.00    0.95
----------------------------------------
Across West Approach
  P7            53       1.00    0.95
----------------------------------------
Unit Time for Volumes =  60 minutes
Peak Flow Period =  30 minutes
Flow Rates include effects of Flow Scale and Peak Flow Factor
```

Table S.1 - Movement Phase and Timing Parameters

```
Mt Victoria Tunnel Signalised Intersection
Victoria - Peak AM
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  50 (Practical Cycle Time)

-------------------------------------------------------------------------------------------------
 Mov     Mov           P H A S E  M A T R I X          Lost Tim  Req.Mov.Time     Eff. Grn
 ID      Typ      First Green          Second Green     --------  ------------     --------
              -------------------  -------------------  1st  2nd  1st      2nd     1st  2nd
               Fr    To    Op Pr    Fr    To    Op Pr   Grn  Grn  Grn      Grn     Grn  Grn
-------------------------------------------------------------------------------------------------
South: Mt Victoria Tunnel
   1 L  (Slp) A      B             B      A      Y       6   14   15.0Min  18.0Min  25    5
   2 T       *A      B                                   6        27.4              25
-------------------------------------------------------------------------------------------------
East: Kent Terrace
   4 L  (Slp) A      B             B      A              6    6   23.2     18.0Min  25   13
   5 T       *B      A                                   6        18.0Min           13
-------------------------------------------------------------------------------------------------
Pedestrian Movements
  P1    (Ped) B      A                                  12        18.0Min            7
  P7    (Ped) A      B                                   9        15.0Min           22
-------------------------------------------------------------------------------------------------
  Current Phase Sequence: Two-phase
  Input phase sequence: A B
  Output phase sequence: A B
-------------------------------------------------------------------------------------------------
  *  Critical Movement/Green Period

Movement Types:                            Under heading 'Op':
  Slp  Slip Lane Movement                    Y   If opposed turn
  Ped  Pedestrian
  Dum  Dummy
```

Table S.2 - Movement Capacity Parameters

```
Mt Victoria Tunnel Signalised Intersection
Victoria - Peak AM
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  50 (Practical Cycle Time)

-------------------------------------------------------------------------------
```

Mov ID	Dem Flow (veh /h)	HV (%)	Satn Flow 1st Grn	Satn Flow 2nd Grn	Flow Ratio 1st Grn	Flow Ratio 2nd Grn	Total Cap. (veh /h)	Prac. Deg. Satn xp	Prac. Spare Cap. (%)	Lane Util (%)	Deg. Satn x
South: Mt Victoria Tunnel											
1 L	55	5.5	1787	1994	0.000	0.028	1093	0.90	1688	100	0.050
2 T	1457	5.0	3777		0.386		1889	0.90	17	100	0.772*
East: Kent Terrace											
4 L	404	5.0	419	1270	0.309	0.216	540	0.90	20	100	0.749
5 T	489	4.9	2514		0.195		654	0.90	20	100	0.748
Pedestrian Movements											
P1	53		12000		0.004		1680	0.90		0	0.032
P7	53		12000		0.004		5280	0.90		0	0.010

Table S.3 - Intersection Parameters

Mt Victoria Tunnel Signalised Intersection
Victoria - Peak AM
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 50 (Practical Cycle Time)

Crit Mov ID	App. and Turn	Green Period Fr	Phases To	Adjusted Lost Time	Adjusted Flow Ratio	Required Grn Time Ratio	Required Movement Time
2	S_T	A	B	6	0.386	0.429	27.4
5	E_T	B	A	18	-	-	18.0Min
			Total:	24	0.386	0.429	45.4

\- Flow ratio not used for cycle time calculations and the adjusted lost time equals the required movement time (=Min or Max as shown in Table S.1)

Cycle Time:

Minimum	Maximum	Practical	Chosen
33	150	42	50

Intersection Level of Service	=	B
Worst movement Level of Service	=	B
Average intersection delay (s/pers)	=	15.3
Largest average movement delay (s)	=	19.0
Largest back of queue, 95% (m)	=	127
Performance Index	=	83.19
Degree of saturation (highest)	=	0.772
Practical Spare Capacity (lowest)	=	17 %
Effective intersection capacity, (veh/h)	=	3117
Total vehicle flow (veh/h)	=	2405
Total pedestrian flow (ped/h)	=	106
Total person flow (pers/h)	=	3714
Total vehicle delay (veh-h/h)	=	10.27
Total pedestrian delay (ped-h/h)	=	0.39
Total person delay (pers-h/h)	=	15.79
Total effective vehicle stops (veh/h)	=	2100
Total effective pedestrian stops (ped/h)	=	75
Total effective person stops (pers/h)	=	3225
Total vehicle travel (veh-km/h)	=	1382.9
Total cost ($/h)	=	1145.42
Total fuel (L/h)	=	170.0
Total CO2 (kg/h)	=	425.76

Table S.4 - Phase Information

Mt Victoria Tunnel Signalised Intersection
Victoria - Peak AM
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 50 (Practical Cycle Time)

Phase	Change Time	Starting Intgrn	Green Start	Displayed Green	Green End	Terminating Intgrn	Phase Time	Phase Split
A	0	6	6	25	31	6	31	62%
B	31	6	37	13	50	6	19	38%

Current Phase Sequence: Two-phase
Input phase sequence: A B
Output phase sequence: A B

Table S.5 - Movement Performance

Mov ID	Total Delay (veh-h/h)	Total Delay (pers-h/h)	Aver. Delay (sec)	Prop. Queued	Eff. Stop Rate	Longest Queue 95% Back (vehs)	Longest Queue 95% Back (m)	Perf. Index	Aver. Speed (km/h)
South: Mt Victoria Tunnel									
1 L	0.13	0.19	8.4	0.43	0.62	0.7	5	1.22	41.5
2 T	5.53	8.29	13.7	0.87	0.86	17.4	127	49.25	37.6
East: Kent Terrace									
4 L	2.03	3.05	18.1	0.91	0.90	11.7	85	13.52	35.0
5 T	2.58	3.87	19.0	0.96	0.90	11.7	85	17.76	34.2
Pedestrian Movements									
P1	0.27	0.27	18.5	0.86	0.86	0.1	0	0.86	2.6
P7	0.12	0.12	7.8	0.56	0.56	0.0	0	0.58	3.4

Table S.6 - Intersection Performance

Mt Victoria Tunnel Signalised Intersection
Victoria - Peak AM
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 50 (Practical Cycle Time)

Total Flow (veh/h)	Deg. Satn x	Total Delay (veh-h/h)	Total Delay (pers-h/h)	Aver. Delay (sec)	Prop. Queued	Eff. Stop Rate	Longest Queue (m)	Perf. Index	Aver. Speed (km/h)
South: Mt Victoria Tunnel									
1512	0.772	5.66	8.49	13.5	0.86	0.85	127	50.47	37.7
East: Kent Terrace									
893	0.749	4.61	6.92	18.6	0.94	0.90	85	31.28	34.5
Pedestrians:									
0	0.000	0.00	0.00	18.5-NaN		0.86	0	0.00	2.6
ALL VEHICLES:									
2405	0.772	10.27	15.40	15.4	0.89	0.87	127	81.74	36.5
INTERSECTION (persons):									

```
 3714   0.772            15.79    15.3   0.88  0.87         83.19    35.9
-------------------------------------------------------------------------
Queue values in this table are 95% back of queue (metres).
```

Table S.7 - Lane Performance

```
Mt Victoria Tunnel Signalised Intersection
Victoria - Peak AM
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  50 (Practical Cycle Time)

-------------------------------------------------------------------------
        Effective Red and   Dem                            Q u e u e
        Green Times (sec)  Flow  Cap  Deg.  Aver.  Eff.   95% Back     Lane
 Lane   -----------------  (veh (veh  Satn  Delay  Stop  -----------  Length
 No.     R1  G1   R2  G2     /h)  /h)   x    (sec)  Rate  (vehs) (m)    (m)
-------------------------------------------------------------------------
 South: Mt Victoria Tunnel
 1 L      6  25   14   5     55 1093 0.050    8.4  0.62   0.7    4.8   125.0T
 2 T     25  25    0   0    729  944 0.772   13.7  0.86  17.4  126.8   125.0
 3 T     25  25    0   0    729  944 0.772   13.7  0.86  17.4  126.8   500.0
-------------------------------------------------------------------------
 East: Kent Terrace
 1 LT     6   7   24  13    525  702 0.748   16.7  0.89  11.7   85.5   500.0
 2 T     37  13    0   0    368  491 0.748   21.3  0.93  10.9   79.6   500.0
-------------------------------------------------------------------------
  T  Short lane due to specification of Turn Slot
```

Table S.8 - Lane Flow and Capacity Information

```
Mt Victoria Tunnel Signalised Intersection
Victoria - Peak AM
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  50 (Practical Cycle Time)

-------------------------------------------------------------------------
                                  Saturation Flow  End  Tot
 Lane     Dem Flow (veh/h)   Lane   Adj. Aver Aver  Cap  Cap  Deg.  Lane
 No.    -------------------  Width Basic 1st  2nd  (veh (veh  Satn  Util
         Lef Thru  Rig  Tot   (m)  (tcu) (veh)(veh)  /h)  /h)   x     %
-------------------------------------------------------------------------
 South: Mt Victoria Tunnel
 1 L      55    0    0   55  3.30  1950 1787  1994  179 1093 0.050  100
 2 T       0  729    0  729  3.30  1950 1888     0    0  944 0.772  100
 3 T       0  729    0  729  3.30  1950 1888     0    0  944 0.772  100
-------------------------------------------------------------------------
 East: Kent Terrace
 1 LT    404  121    0  525  3.30  1950 1646  1815    0  702 0.748  100
 2 T       0  368    0  368  3.30  1950 1890     0    0  491 0.748  100
-------------------------------------------------------------------------

  Basic Saturation Flow in this table is adjusted for lane width, approach
  grade, parking manoeuvres and number of buses stopping.  Saturation flow
  scale applies if specified.
```

Table S.9 - Signal Timing Diagram

```
Mt Victoria Tunnel Signalised Intersection
Victoria - Peak AM
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  50 (Practical Cycle Time)

Displayed (Phase) Green Times

                Phase A                              Phase B

0                                        31                          50
I----------------------------------------I---------------------------I
........GGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGG..........GGGGGGGGGGGGGGGGG.
        6                                        37


Effective (Movement) Green Times


 South: Mt Victoria Tunnel

Mov.     1 (L)
I                                        I                           I
GGGG.........GGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGG...................GGGG
   3         9                                34                  48

Mov.     2 (T)
I                                        I                           I
............GGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGG.....................
            9                                34


 East: Kent Terrace

Mov.     4 (L)
I                                        I                           I
GGGG.........GGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGGG........GGGGGGGGGGGGGGG
   3         9                                34        40

Mov.     5 (T)
I                                        I                           I
GGG.....................................................GGGGGGGGGGGGGG
   3                                                     40


 Pedestrian Movements

Mov.    P1
I                                        I                           I
.....................................................GGGGGGGG.......
                                                    39         46

Mov.    P7
I                                        I                           I
...........GGGGGGGGGGGGGGGGGGGGGGGGGGGGGG.............................
           8                                30


I-----I------I------I------I------I------I------I------I------I------I---->
0     5      10     15     20     25     30     35     40     45     50

                                T I M E  (s)
```

Table S.10 - Movement Capacity and Performance Summary

```
Mt Victoria Tunnel Signalised Intersection
Victoria - Peak AM
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  50 (Practical Cycle Time)

--------------------------------------------------------------------------------
 Mov     Mov  Dem   Total  Lane  Deg.  Eff. Grn  Aver.  Eff.    95%    Perf.
 ID      Typ  Flow   Cap.  Util  Satn  --------  Delay  Stop  Back of  Index
```

	(veh /h)	(veh /h)	(%)	x	1st Grn	2nd Grn	(sec)	Rate	Queue (veh)	
South: Mt Victoria Tunnel										
1 L (Slp)	55	1093	100	0.050	25	5	8.4	0.62	0.7	1.22
2 T	1457	1889	100	0.772*	25*		13.7	0.86	17.4	49.25
East: Kent Terrace										
4 L (Slp)	404	540	100	0.749	25	13	18.1	0.90	11.7	13.52
5 T	489	654	100	0.748	13*		19.0	0.90	11.7	17.76
Pedestrian Movements										
P1 (Ped)	53	1680	100	0.032	7		18.5	0.86	0.1	0.86
P7 (Ped)	53	5280	100	0.010	22		7.8	0.56	0.0	0.58

* Maximum degree of saturation, or critical green periods

Table S.12A - Fuel Consumption, Emissions and Cost (TOTAL)

Mt Victoria Tunnel Signalised Intersection
Victoria - Peak AM
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 50 (Practical Cycle Time)

Mov ID	Fuel Total L/h	Cost Total $/h	HC Total kg/h	CO Total kg/h	NOX Total kg/h	CO2 Total kg/h
South: Mt Victoria Tunnel						
1 L	3.6	23.39	0.014	0.63	0.019	9.0
2 T	101.4	668.64	0.415	18.61	0.542	254.1
	105.0	692.03	0.429	19.24	0.561	263.1
East: Kent Terrace						
4 L	29.2	198.01	0.119	5.30	0.156	73.1
5 T	35.7	242.43	0.149	6.61	0.191	89.5
	64.9	440.44	0.268	11.90	0.347	162.6
Pedestrian Movements						
P1	7.70					
P7	5.25					
	12.95					
ALL VEHICLES:	170.0	1132.47	0.697	31.14	0.908	425.8
INTERSECTION:	170.0	1145.42	0.697	31.14	0.908	425.8

PARAMETERS USED IN COST CALCULATIONS

Pump price of fuel ($/L)	= 1.600
Fuel resource cost factor	= 0.60
Ratio of running cost to fuel cost	= 2.5
Average income ($/h)	= 21.00
Time value factor	= 0.60
Light vehicle mass (1000 kg)	= 1.4
Heavy vehicle mass (1000 kg)	= 11.0
Light vehicle idle fuel rate (L/h)	= 1.350
Heavy vehicle idle fuel rate (L/h)	= 2.000

Table S.12B - Fuel Consumption, Emissions and Cost (RATE)

```
Mt Victoria Tunnel Signalised Intersection
Victoria - Peak AM
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  50 (Practical Cycle Time)

------------------------------------------------------------
  Mov            Fuel    Cost     HC      CO     NOX     CO2
  ID             Rate    Rate    Rate    Rate    Rate    Rate
              L/100km  $/km     g/km    g/km    g/km    g/km
------------------------------------------------------------
South: Mt Victoria Tunnel
    1 L          11.2     0.73   0.437   19.45   0.592   280.0
    2 T          12.1     0.80   0.496   22.28   0.649   304.1
             ----------------------------------------------
                 12.1     0.80   0.494   22.17   0.647   303.2
------------------------------------------------------------
East: Kent Terrace
    4 L          12.4     0.84   0.508   22.57   0.666   311.5
    5 T          12.7     0.86   0.530   23.56   0.680   319.2
             ----------------------------------------------
                 12.6     0.86   0.520   23.11   0.673   315.7
------------------------------------------------------------
Pedestrian Movements
   P1                     4.86
   P7                     3.72
             ----------------------------------------------
                          4.32
------------------------------------------------------------
 ALL VEHICLES:   12.3     0.82   0.504   22.52   0.657   307.9
------------------------------------------------------------
 INTERSECTION:   12.3     0.83   0.504   22.52   0.657   307.9
------------------------------------------------------------
```

Table S.14 - Summary of Input and Output Data

```
Mt Victoria Tunnel Signalised Intersection
Victoria - Peak AM
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  50 (Practical Cycle Time)

-------------------------------------------------------------------------------
 Lane   Demand Flow (veh/h)        Adj.  Eff Grn   Deg   Aver. Longest Shrt
 No.   --------------------  %HV  Basic  (secs)   Sat   Delay  Queue  Lane
         L    T    R   Tot       Satf. 1st 2nd    x    (sec)   (m)    (m)
-------------------------------------------------------------------------------
 South: Mt Victoria Tunnel
1 L      55              55     5  1949   25   5  0.050    8.4     5   125
2 T          729         729     5  1949   25      0.772   13.7   127   125
3 T          729         729     5  1949   25      0.772   13.7   127   500
        ---------------------------------------------------------------------
         55 1457    0  1512     5                 0.772   13.5   127
-------------------------------------------------------------------------------
 East: Kent Terrace
1 LT     404  121         525     5  1950    7  13  0.748   16.7    85   500
2 T          368         368     5  1950   13      0.748   21.3    80   500
        ---------------------------------------------------------------------
        404  489    0    893     5                 0.748   18.6    85
-------------------------------------------------------------------------------
 Pedestrians
  Across S approach       53               7       0.032   18.5   0.1
  Across W approach       53              22       0.010    7.8   0.0
===============================================================================
 ALL VEHICLES          Total    %       Cycle      Max   Aver.   Max
                       Flow    HV       Time        X    Delay  Queue
                       2405     5         50      0.772   15.4   127
===============================================================================
Peak flow period = 30 minutes.

Queue values in this table are 95% back of queue (metres).
```

```
Note: Basic Saturation Flows (in through car units) have been adjusted for
      grade, lane widths, parking manoeuvres and bus stops.
```

Table S.15 - Capacity and Level of Service

```
Mt Victoria Tunnel Signalised Intersection
Victoria - Peak AM
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  50 (Practical Cycle Time)

--------------------------------------------------------------------------------
 Mov     Mov    Green Time  Total  Total    Deg.   Aver.   LOS  Longest Queue
 ID      Typ    Ratio (g/C) Flow    Cap.     of    Delay          95% Back
               ------------ (veh   (veh     Satn                (vehs)  (m)
                1st   2nd     /h)    /h)    (v/c)  (sec)
                grn   grn
--------------------------------------------------------------------------------
South: Mt Victoria Tunnel
   1 L  (Slp) 0.500  0.100     55   1093   0.050     8.4    A      0.7       5
   2 T        0.500*         1457   1889   0.772*   13.7    B     17.4     127
--------------------------------------------------------------------------------
East: Kent Terrace
   4 L  (Slp) 0.500  0.260    404    540   0.749    18.1    B     11.7      85
   5 T        0.260*          489    654   0.748    19.0    B     11.7      85
--------------------------------------------------------------------------------
Pedestrian Movements
  P1    (Ped) 0.140            53   1680   0.032    18.5    B      0.1       0
  P7    (Ped) 0.440            53   5280   0.010     7.8    A      0.0       0
--------------------------------------------------------------------------------
  ALL VEHICLES:              2405          0.772    15.4    B     17.4     127
--------------------------------------------------------------------------------
  INTERSECTION (persons):    3714                   15.3          17.4     127
--------------------------------------------------------------------------------
     Level of Service calculations are based on
     average control delay including geometric delay (HCM criteria),
     independent of the current delay definition used.
     For the criteria, refer to the "Level of Service" topic in the
     SIDRA Output Guide or the Output section of the on-line help.
     Intersection capacity is calculated considering vehicle movements only.
  *  Maximum v/c ratio, or critical green periods
  "  Movement Level of service has been determined using adjacent lane
     v/c ratio rather than short lane v/c ratio (v/c=1.0)
```

Table S.16 - SCATS MF Parameter

```
Mt Victoria Tunnel Signalised Intersection
Victoria - Peak AM
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  50 (Practical Cycle Time)

-------------------------------------------------
 Lane   Stopline Capacity  SCATS  SCATS   Deg.  Lane
 No.      Flow   (veh/h)   Satn    MF     Satn  Util.
        (veh/h)           Flow            x     %
-------------------------------------------------
 South: Mt Victoria Tunnel
 1 L        55    1093     1857    NA   0.050   100
 2 T       729     944     1950  1573   0.772   100
 3 T       729     944     1950  1573   0.772   100
-------------------------------------------------
 East: Kent Terrace
 1 LT      525     702     1878    NA   0.748   100
 2 T       368     491     1950  1334   0.748   100
```

```
------------------------------------------------
  NA Not Applicable - SCATS MF was not calculated for this lane due to one
     of the following reasons:
      - the lane is not controlled by signals (slip or continuous lane)
      - two movements share this lane and do not run in the same phases

  STOPLINE FLOW: Departure flow rate in veh/h as measured at the stop line.
  This cannot exceed capacity.

  SCATS SATURATION FLOW: This allows for lane width, approach grade and
  turning vehicles.  Saturation flow scale applies if specified.
  The effects of heavy vehicles, parking manoeuvres, number of buses
  stopping and conflicting pedestrian volume are not included.

  SCATS MF: This emulates the MF (Maximum Flow) parameter used in the SCATS
  control system. It is calculated from the SCATS SATURATION FLOW parameter.

  DEG. SATN: The Demand (Arrival) Flow Rate may exceed the Stopline Flow
  Rate, therefore x > 1 is possible.
```

Table D.0 - Geometric Delay Data

```
Mt Victoria Tunnel Signalised Intersection
Victoria - Peak AM
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  50 (Practical Cycle Time)

-------------------------------------------------------------------------------
                            Negn  Negn   Negn   Appr.   Downstream  Distance
 From      To               Radius Speed  Dist.  Dist.   -------------------
 Approach  Approach  Turn     (m)  (km/h)  (m)    (m)       (m)      User Spec?
-------------------------------------------------------------------------------
 South: Mt Victoria Tunnel
             North   Thru       S   50.0   10.0    500       76          No
              West   Left    20.0   26.2   31.4    500       88          No
-------------------------------------------------------------------------------
 East: Kent Terrace
             South   Left    15.0   23.5   23.6    500       83          No
              West   Thru       S   50.0   16.5    500       76          No
-------------------------------------------------------------------------------

  Downstream distance is distance travelled from the stopline until exit
  cruise speed is reached (includes negotiation distance).  Acceleration
  distance is weighted for light and heavy vehicles.  The same distance
  applies for both stopped and unstopped vehicles.
```

Table D.1 - Lane Delays

```
Mt Victoria Tunnel Signalised Intersection
Victoria - Peak AM
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  50 (Practical Cycle Time)

-------------------------------------------------------------------------
                    ----------  Delay (seconds/veh)  ----------------
         Deg.   Stop-line Delay  Acc.   Queuing   Stopd
 Lane    Satn   1st   2nd Total  Dec.  Total MvUp (Idle) Geom Control
 No.       x     d1    d2   dSL   dn    dq   dqm    di    dig   dic
-------------------------------------------------------------------------
 South: Mt Victoria Tunnel
 1 L    0.050   2.8   0.0   2.8   2.1   0.9   0.0   0.9   5.7    8.4
 2 T    0.772  11.2   2.5  13.7   6.8   6.9   0.7   6.2   0.0   13.7
 3 T    0.772  11.2   2.5  13.7   6.8   6.9   0.7   6.2   0.0   13.7
-------------------------------------------------------------------------
```

```
 East: Kent Terrace
 1 LT   0.748   9.9   2.1  12.0   4.8   7.3   0.8   6.5   4.7   16.7
 2 T    0.748  19.2   2.1  21.3   7.5  13.8   1.2  12.6   0.0   21.3
-------------------------------------------------------------------------
  dn is average stop-start delay for all vehicles queued and unqueued
```

Table D.2 - Lane Stops

```
Mt Victoria Tunnel Signalised Intersection
Victoria - Peak AM
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  50 (Practical Cycle Time)

-------------------------------------------------------
                                                  Queue
        Deg.  -- Effective Stop Rate --   Prop. Move-up
 Lane   Satn              Geom. Overall  Queued  Rate
 No.      x    he1   he2   hig     h       pq     hqm
-------------------------------------------------------
 South: Mt Victoria Tunnel
 1 L   0.050  0.32  0.00  0.30   0.62    0.428   0.00
 2 T   0.772  0.78  0.08  0.00   0.86    0.875   0.10
 3 T   0.772  0.78  0.08  0.00   0.86    0.875   0.10
-------------------------------------------------------
 East: Kent Terrace
 1 LT  0.748  0.78  0.07  0.04   0.89    0.907   0.12
 2 T   0.748  0.83  0.10  0.00   0.93    0.975   0.17
-------------------------------------------------------
  hig is the average value for all movements in a shared lane
  hqm is average queue move-up rate for all vehicles queued and unqueued
```

Table D.3A - Lane Queues (veh)

```
Mt Victoria Tunnel Signalised Intersection
Victoria - Peak AM
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  50 (Practical Cycle Time)

-------------------------------------------------------------------------------------
        Deg.  Ovrfl.   Average (veh)              Percentile (veh)            Queue
 Lane   Satn  Queue ------------------  ---------------------------------  Stor.
 No.      x    No      Nb1    Nb2     Nb     70%    85%    90%    95%    98%  Ratio
-------------------------------------------------------------------------------------
 South: Mt Victoria Tunnel
 1 L   0.050    0.0     0.3    0.0    0.3     0.3    0.4    0.5    0.7    0.8   0.04
 2 T   0.772    0.6     9.1    0.9   10.0    12.1   14.4   15.7   17.4   19.0   1.01
 3 T   0.772    0.6     9.1    0.9   10.0    12.1   14.4   15.7   17.4   19.0   0.25
-------------------------------------------------------------------------------------
 East: Kent Terrace
 1 LT  0.748    0.4     5.6    0.6    6.2     7.6    9.2   10.2   11.7   13.2   0.17
 2 T   0.748    0.3     5.3    0.4    5.7     7.0    8.5    9.4   10.9   12.4   0.16
-------------------------------------------------------------------------------------

     Values printed in this table are back of queue (vehicles).
```

Table D.3B - Lane Queues (metres)

Mt Victoria Tunnel Signalised Intersection
Victoria - Peak AM
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 50 (Practical Cycle Time)

Lane No.	Deg. Satn x	Ovrfl. Queue No	Average (metres) Nb1	Nb2	Nb	Percentile (metres) 70%	85%	90%	95%	98%	Queue Stor. Ratio
South: Mt Victoria Tunnel											
1 L	0.050	0.0	1.9	0.0	1.9	2.4	3.2	3.7	4.8	5.9	0.04
2 T	0.772	4.3	66.2	6.9	73.1	88.7	105.3	114.5	126.8	139.0	1.01
3 T	0.772	4.3	66.2	6.9	73.1	88.7	105.3	114.5	126.8	139.0	0.25
East: Kent Terrace											
1 LT	0.748	2.8	40.9	4.3	45.2	55.6	67.2	74.4	85.5	96.5	0.17
2 T	0.748	1.9	38.7	2.8	41.4	51.0	62.0	68.8	79.6	90.4	0.16

Values printed in this table are back of queue (metres).

Table D.4 - Movement Speeds (km/h) and Geometric Delay

Mt Victoria Tunnel Signalised Intersection
Victoria - Peak AM
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 50 (Practical Cycle Time)

Mov ID	App. Speeds Cruise	Negn	Exit Speeds Negn	Cruise	Queue Move-up 1st Grn	2nd Grn	Av. Section Spd Running	Overall	Geom Delay (sec)
South: Mt Victoria Tunnel									
1 L	50.0	26.2	26.2	50.0			42.2	41.5	5.7
2 T	50.0	50.0	50.0	50.0	38.0		42.3	37.6	0.0
East: Kent Terrace									
4 L	50.0	23.5	23.5	50.0	18.8	26.8	39.6	35.0	6.1
5 T	50.0	50.0	50.0	50.0	25.2	0.0	40.6	34.2	0.0

"Running Speed" is the average speed excluding stopped periods.

Table D.5 - Progression Factors and Actuated Signal Parameters

Mt Victoria Tunnel Signalised Intersection
Victoria - Peak AM
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 50 (Practical Cycle Time)

Mov ID	Control	Coord.	Arrival Type	Delay Prog. Factor	Queue Prog. Factor	Disp. Grn. Settings 1st Grn Gmin	Gmax	2nd Grn Gmin	Gmax
South: Mt Victoria Tunnel									
1 L	FT	No	3	1.000	1.000	6	NA	6	NA
2 T	FT	No	3	1.000	1.000	6	NA		
East: Kent Terrace									
4 L	FT	No	3	1.000	1.000	6	NA	6	NA

```
    5 T     FT       No        3      1.000   1.000     6   NA
--------------------------------------------------------------------------
 Pedestrians
   P1        FT       No        3      1.000   1.000
   P7        FT       No        3      1.000   1.000
--------------------------------------------------------------------------
```

Table D.6 - Gap Acceptance Parameters

```
Mt Victoria Tunnel Signalised Intersection
Victoria - Peak AM
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  50 (Practical Cycle Time)

-----------------------------------------------------------
                          Critical Gap
                  Opng    ------------   Foll-up   Entry
  Mov     Mov     Flow    Hdwy    Dist   Headway    HV
  ID      Type   (pcu/h)   (s)     (m)      (s)     Equiv
-----------------------------------------------------------
 South: Mt Victoria Tunnel
    1 L   Slip       491   4.03    55.9     2.42     2.00
-----------------------------------------------------------
 East: Kent Terrace
  No opposed movements on this approach
-----------------------------------------------------------

  Values in this table are adjusted for heavy vehicles in the entry stream.
```

SIDRA SOLUTIONS

Site: Mt Victoria AM Peak - no kent terrace traffic
G:\Transport\Transit\Proj\5C1353.00_Basin_Reserve_At-grade_Improvements\03_Sidra\Proposed_Intersections\Mt Victoria.aap
Processed Jun 13, 2008 03:12:42p.m.

A0101, Opus International Consultants Ltd, Large Office
Produced by SIDRA Intersection 3.2.0.1455

www.sidrasolutions.com

SIDRA INTERSECTION

Output Tables

Mt Victoria Tunnel Signalised Intersection

Victoria - Peak AM

Run Information

```
Cycle Time =   60  (Practical Cycle Time)

* Basic Parameters:
  Intersection Type: Signalised - Fixed Time
  Driving on the left-hand side of the road
  "New Zealand" give way rule applied when input data was set up for this run
  Input data specified in Metric units
  Model Defaults: New Zealand
  Peak Flow Period (for performance): 30 minutes
  Unit time (for volumes): 60 minutes.
  Delay definition: Control delay
                    Geometric delay included
  SIDRA Standard Delay model used
  SIDRA Standard Queue model used
  Level of Service based on: Delay (HCM method)
  Queue definition: Back of queue, 95th Percentile

* Iteration Data:
  No. of Main (Timing-Capacity) Iterations =  2
  Comparison of last two iterations:
    Difference in intersection degree of satn =  0.0 %
    Largest difference in eff. green times =  0 secs
    (max. value for stopping = 0 secs)
```

Table B.1 - Movement Definitions and Flow Rates (Origin-Destination)

```
Mt Victoria Tunnel Signalised Intersection
Victoria - Peak AM
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  60 (Practical Cycle Time)

-------------------------------------------------------------------
 From      To          Mov           Flow Rate   Flow   Peak Flow
 Approach  Approach    ID    Turn     LV    HV   Scale    Factor
-------------------------------------------------------------------
 South: Mt Victoria Tunnel
           North         2   Thru   1384    73    1.00     0.95
           West          1   Left     52     3    1.00     0.95
-------------------------------------------------------------------
 East: Kent Terrace
           South         4   Left    384    20    1.00     0.95
           North         6   Right   718    38    1.00     0.95
           West          5   Thru    465    24    1.00     0.95
-------------------------------------------------------------------
Unit Time for Volumes =  60 minutes
Peak Flow Period =  30 minutes
Flow Rates include effects of Flow Scale and Peak Flow Factor
```

Table B.2A - Flow Rates (Separate Light and Heavy Vehicles)

```
Mt Victoria Tunnel Signalised Intersection
Victoria - Peak AM
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  60 (Practical Cycle Time)

-----------------------------------------------
  Mov          Left        Through       Right
  ID        ---------    ---------    ---------
             LV    HV     LV    HV     LV    HV
-----------------------------------------------
Demand flows in veh/hour as used by the program
South: Mt Victoria Tunnel
    1 L      52     3      0     0      0     0
    2 T       0     0   1384    73      0     0
-----------------------------------------------
East: Kent Terrace
    4 L     384    20      0     0      0     0
    5 T       0     0    465    24      0     0
    6 R       0     0      0     0    718    38
-----------------------------------------------
Unit Time for Volumes =  60 minutes
Peak Flow Period =  30 minutes
Flow Rates include effects of Flow Scale and Peak Flow Factor
```

Table B.2B - Flow Rates (Total Vehicles and Percent Heavy)

```
Mt Victoria Tunnel Signalised Intersection
Victoria - Peak AM
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  60 (Practical Cycle Time)

-------------------------------------------------
  Mov          Left         Through        Right
  ID        ----------    ----------    ----------
           Total  %HV    Total  %HV    Total  %HV
-------------------------------------------------
Demand flows in veh/hour as used by the program
South: Mt Victoria Tunnel
    1 L       55   5.5       0   0.0       0   0.0
    2 T        0   0.0    1457   5.0       0   0.0
-------------------------------------------------
East: Kent Terrace
    4 L      404   5.0       0   0.0       0   0.0
    5 T        0   0.0     489   4.9       0   0.0
    6 R        0   0.0       0   0.0     756   5.0
-------------------------------------------------
Unit Time for Volumes =  60 minutes
Peak Flow Period =  30 minutes
Flow Rates include effects of Flow Scale and Peak Flow Factor
```

Table B.3 - Pedestrian Flow Rates

```
Mt Victoria Tunnel Signalised Intersection
```

```
Victoria - Peak AM
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  60 (Practical Cycle Time)

---------------------------------------
 Mov        Flow Rate   Flow   Peak Flow
 ID   Stage  (ped/h)    Scale   Factor
---------------------------------------
Across South Approach
  P1            53       1.00    0.95
---------------------------------------
Across West Approach
  P7            53       1.00    0.95
---------------------------------------
Unit Time for Volumes =  60 minutes
Peak Flow Period =  30 minutes
Flow Rates include effects of Flow Scale and Peak Flow Factor
```

Table S.1 - Movement Phase and Timing Parameters

```
Mt Victoria Tunnel Signalised Intersection
Victoria - Peak AM
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  60 (Practical Cycle Time)

-------------------------------------------------------------------------------------------------
 Mov     Mov           P H A S E  M A T R I X          Lost Tim  Req.Mov.Time     Eff. Grn
 ID      Typ      First Green          Second Green     --------  ------------     --------
                 -------------------  -------------------  1st  2nd  1st      2nd     1st  2nd
                  Fr    To    Op Pr    Fr    To    Op Pr  Grn  Grn  Grn      Grn     Grn  Grn
-------------------------------------------------------------------------------------------------
South: Mt Victoria Tunnel
   1 L  (Slp) A     B            B     A     Y       6   14   15.0Min  18.0Min  28   12
   2 T        A     B                                  6        31.7              28
-------------------------------------------------------------------------------------------------
East: Kent Terrace
   4 L  (Slp)*A     B            B     A              6    6   32.5     24.9     28   20
   5 T       *B     A                                  6        24.9              20
   6 R        B     A                                  6        24.9              20
-------------------------------------------------------------------------------------------------
Pedestrian Movements
  P1    (Ped) B     A                                 12        18.0Min           14
  P7    (Ped) A     B                                  9        15.0Min           25
-------------------------------------------------------------------------------------------------
  Current Phase Sequence: Two-phase
  Input phase sequence: A B
  Output phase sequence: A B
-------------------------------------------------------------------------------------------------
  *  Critical Movement/Green Period

Movement Types:                          Under heading 'Op':
  Slp  Slip Lane Movement                  Y   If opposed turn
  Ped  Pedestrian
  Dum  Dummy
```

Table S.2 - Movement Capacity Parameters

```
Mt Victoria Tunnel Signalised Intersection
Victoria - Peak AM
Intersection ID: 0
```

Fixed-Time Signals, Cycle Time = 60 (Practical Cycle Time)

Mov ID	Dem Flow (veh /h)	HV (%)	Satn Flow 1st Grn	Satn Flow 2nd Grn	Flow Ratio 1st Grn	Flow Ratio 2nd Grn	Total Cap. (veh /h)	Prac. Deg. Satn xp	Prac. Spare Cap. (%)	Lane Util (%)	Deg. Satn x
South: Mt Victoria Tunnel											
1 L	55	5.5	1305<	1453	0.000	0.038	900	0.90	1372	100	0.061
2 T	1457	5.0	3777		0.386		1763	0.90	9	100	0.827
East: Kent Terrace											
4 L	404	5.0	226	1106	0.397	0.284	474	0.90	6	100	0.852*
5 T	489	4.9	1721		0.284		574	0.90	6	100	0.852*
6 R	756	5.0	2661		0.284		887	0.90	6	100	0.852*
Pedestrian Movements											
P1	53		12000		0.004		2800	0.90		0	0.019
P7	53		12000		0.004		5000	0.90		0	0.011

Table S.3 - Intersection Parameters

Mt Victoria Tunnel Signalised Intersection
Victoria - Peak AM
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 60 (Practical Cycle Time)

Crit Mov ID	App. and Turn	Green Period	Phases Fr	Phases To	Adjusted Lost Time	Adjusted Flow Ratio	Required Grn Time Ratio	Required Movement Time
4	E_L	1st	A	B	6	0.397	0.441	32.5
5	E_T		B	A	6	0.284	0.316	24.9
				Total:	12	0.681	0.757	57.4

Cycle Time:

Minimum	Maximum	Practical	Chosen
33	150	49	60

Intersection Level of Service	=	C
Worst movement Level of Service	=	D
Average intersection delay (s/pers)	=	25.0
Largest average movement delay (s)	=	35.5
Largest back of queue, 95% (m)	=	163
Performance Index	=	136.81
Degree of saturation (highest)	=	0.852
Practical Spare Capacity (lowest)	=	6 %
Effective intersection capacity, (veh/h)	=	3708
Total vehicle flow (veh/h)	=	3161
Total pedestrian flow (ped/h)	=	106
Total person flow (pers/h)	=	4848
Total vehicle delay (veh-h/h)	=	22.20
Total pedestrian delay (ped-h/h)	=	0.41
Total person delay (pers-h/h)	=	33.71
Total effective vehicle stops (veh/h)	=	3199
Total effective pedestrian stops (ped/h)	=	72
Total effective person stops (pers/h)	=	4870
Total vehicle travel (veh-km/h)	=	1816.4
Total cost ($/h)	=	1714.52
Total fuel (L/h)	=	242.7
Total CO2 (kg/h)	=	607.92

Table S.4 - Phase Information

Mt Victoria Tunnel Signalised Intersection
Victoria - Peak AM
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 60 (Practical Cycle Time)

Phase	Change Time	Starting Intgrn	Green Start	Displayed Green	Green End	Terminating Intgrn	Phase Time	Phase Split
A	0	6	6	28	34	6	34	57%
B	34	6	40	20	60	6	26	43%

Current Phase Sequence: Two-phase
Input phase sequence: A B
Output phase sequence: A B

Table S.5 - Movement Performance

Mov ID		Total Delay (veh-h/h)	Total Delay (pers-h/h)	Aver. Delay (sec)	Prop. Queued	Eff. Stop Rate	Longest Queue 95% Back (vehs)	Longest Queue (m)	Perf. Index	Aver. Speed (km/h)
South: Mt Victoria Tunnel										
1	L	0.12	0.18	7.9	0.36	0.61	0.6	5	1.20	42.0
2	T	8.24	12.36	20.4	0.93	0.97	22.4	163	59.62	33.5
East: Kent Terrace										
4	L	3.01	4.51	26.8	0.97	1.04	18.5	135	17.09	30.5
5	T	3.37	5.05	24.8	0.99	1.05	18.5	135	21.23	31.2
6	R	7.46	11.19	35.5	1.00	1.08	18.4	135	36.22	26.9
Pedestrian Movements										
P1		0.26	0.26	17.6	0.77	0.77	0.1	0	0.82	2.6
P7		0.15	0.15	10.2	0.58	0.58	0.1	0	0.62	3.1

Table S.6 - Intersection Performance

Mt Victoria Tunnel Signalised Intersection
Victoria - Peak AM
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 60 (Practical Cycle Time)

Total Flow (veh/h)	Deg. Satn x	Total Delay (veh-h/h)	Total Delay (pers-h/h)	Aver. Delay (sec)	Prop. Queued	Eff. Stop Rate	Longest Queue (m)	Perf. Index	Aver. Speed (km/h)
South: Mt Victoria Tunnel									
1512	0.827	8.36	12.55	19.9	0.91	0.96	163	60.83	33.7
East: Kent Terrace									
1649	0.852	13.84	20.75	30.2	0.99	1.06	135	74.54	29.0
Pedestrians:									
0	0.000	0.00	0.00	17.6-NaN		0.77	0	0.00	2.6

```
ALL VEHICLES:
 3161   0.852   22.20    33.30    25.3   0.95  1.01   163  135.36    31.1
--------------------------------------------------------------------------
INTERSECTION (persons):
 4848   0.852            33.71    25.0   0.95  1.00        136.81    30.7
--------------------------------------------------------------------------
Queue values in this table are 95% back of queue (metres).
```

Table S.7 - Lane Performance

```
Mt Victoria Tunnel Signalised Intersection
Victoria - Peak AM
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  60 (Practical Cycle Time)

--------------------------------------------------------------------------------
        Effective Red and   Dem                              Q u e u e
        Green Times (sec)  Flow  Cap  Deg.  Aver.  Eff.   95% Back     Lane
 Lane   -----------------  (veh (veh  Satn  Delay  Stop  -----------  Length
 No.     R1  G1   R2  G2     /h)  /h)   x    (sec)  Rate  (vehs) (m)    (m)
--------------------------------------------------------------------------------
 South: Mt Victoria Tunnel
 1 L      6  28   14  12     55  899 0.061    7.9  0.61   0.6    4.7    50.0T
 2 T     32  28    0   0    729  881 0.827   20.4  0.97  22.4  163.3   500.0
 3 T     32  28    0   0    729  881 0.827   20.4  0.97  22.4  163.3   500.0
--------------------------------------------------------------------------------
 East: Kent Terrace
 1 LT     6   4   30  20    616  723 0.852   24.7  1.03  18.5  134.8   500.0
 2 TR    40  20    0   0    524  614 0.852   31.4  1.08  18.4  134.6   500.0
 3 R     40  20    0   0    509  598 0.852   35.6  1.08  18.1  132.0   500.0
--------------------------------------------------------------------------------
  T  Short lane due to specification of Turn Slot
```

Table S.8 - Lane Flow and Capacity Information

```
Mt Victoria Tunnel Signalised Intersection
Victoria - Peak AM
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  60 (Practical Cycle Time)

--------------------------------------------------------------------------------
                                    Saturation Flow  End  Tot
 Lane     Dem Flow (veh/h)   Lane   Adj. Aver Aver  Cap  Cap  Deg.  Lane
 No.    -------------------  Width Basic 1st  2nd  (veh (veh  Satn  Util
         Lef Thru  Rig  Tot   (m)  (tcu) (veh)(veh)  /h)  /h)   x     %
--------------------------------------------------------------------------------
 South: Mt Victoria Tunnel
 1 L      55    0    0   55  3.30  1950 1305< 1453  149  899 0.061  100
 2 T       0  729    0  729  3.30  1950 1888     0    0  881 0.827  100
 3 T       0  729    0  729  3.30  1950 1888     0    0  881 0.827  100
--------------------------------------------------------------------------------
 East: Kent Terrace
 1 LT    404  212    0  616  3.30  1950 1711  1826    0  723 0.852  100
 2 TR      0  277  247  524  3.30  1950 1843     0    0  614 0.852  100
 3 R       0    0  509  509  3.30  1950 1793     0    0  598 0.852  100
--------------------------------------------------------------------------------
  <  Reduced saturation flow due to a short lane effect

  Basic Saturation Flow in this table is adjusted for lane width, approach
  grade, parking manoeuvres and number of buses stopping.  Saturation flow
  scale applies if specified.
```

Table S.9 - Signal Timing Diagram

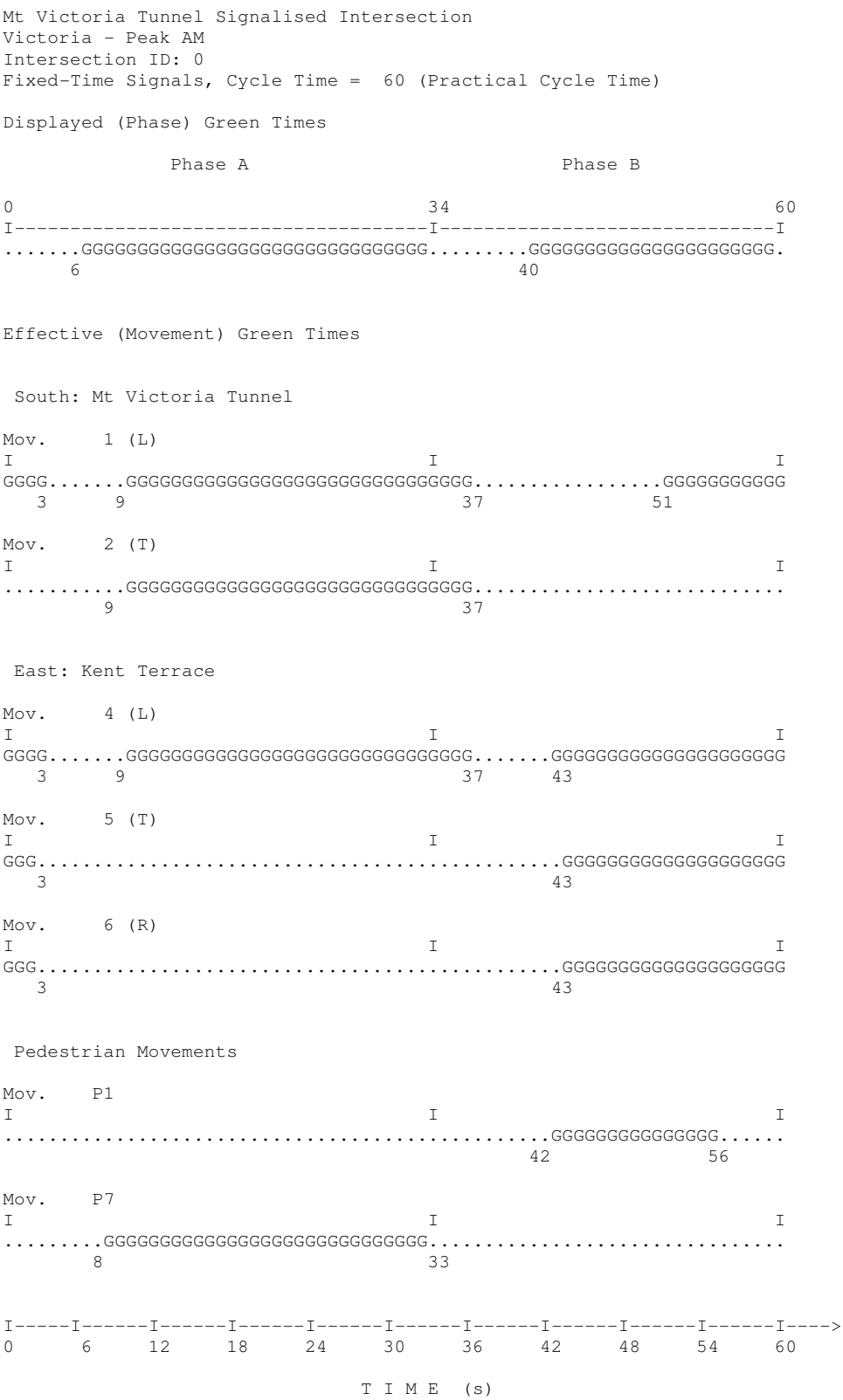

Table S.10 - Movement Capacity and Performance Summary

Mt Victoria Tunnel Signalised Intersection
Victoria - Peak AM
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 60 (Practical Cycle Time)

Mov ID	Mov Typ	Dem Flow (veh /h)	Total Cap. (veh /h)	Lane Util (%)	Deg. Satn x	Eff. Grn 1st Grn	Eff. Grn 2nd Grn	Aver. Delay (sec)	Eff. Stop Rate	95% Back of Queue (veh)	Perf. Index
South: Mt Victoria Tunnel											
1 L	(Slp)	55	900<	100	0.061	28	12	7.9	0.61	0.6	1.20
2 T		1457	1763	100	0.827	28		20.4	0.97	22.4	59.62
East: Kent Terrace											
4 L	(Slp)	404	474	100	0.852*	28*	20	26.8	1.04	18.5	17.09
5 T		489	574	100	0.852*	20*		24.8	1.05	18.5	21.23
6 R		756	887	100	0.852*	20		35.5	1.08	18.4	36.22
Pedestrian Movements											
P1	(Ped)	53	2800	100	0.019	14		17.6	0.77	0.1	0.82
P7	(Ped)	53	5000	100	0.011	25		10.2	0.58	0.1	0.62

< Reduced capacity due to a short lane effect
* Maximum degree of saturation, or critical green periods

Table S.12A - Fuel Consumption, Emissions and Cost (TOTAL)

Mt Victoria Tunnel Signalised Intersection
Victoria - Peak AM
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 60 (Practical Cycle Time)

Mov ID	Fuel Total L/h	Cost Total $/h	HC Total kg/h	CO Total kg/h	NOX Total kg/h	CO2 Total kg/h
South: Mt Victoria Tunnel						
1 L	3.6	23.16	0.014	0.62	0.019	8.9
2 T	108.4	737.71	0.453	20.21	0.580	271.4
	111.9	760.87	0.467	20.83	0.599	280.4
East: Kent Terrace						
4 L	31.2	221.91	0.131	5.66	0.165	78.2
5 T	37.8	262.79	0.160	7.11	0.202	94.8
6 R	61.7	455.73	0.266	11.23	0.321	154.5
	130.8	940.42	0.558	23.99	0.688	327.5
Pedestrian Movements						
P1	7.54					
P7	5.69					
	13.23					
ALL VEHICLES:	242.7	1701.29	1.025	44.82	1.287	607.9
INTERSECTION:	242.7	1714.52	1.025	44.82	1.287	607.9

PARAMETERS USED IN COST CALCULATIONS

Pump price of fuel ($/L) = 1.600
Fuel resource cost factor = 0.60

```
   Ratio of running cost to fuel cost        =       2.5
   Average income ($/h)                      =     21.00
   Time value factor                         =      0.60
   Light vehicle mass (1000 kg)              =       1.4
   Heavy vehicle mass (1000 kg)              =      11.0
   Light vehicle idle fuel rate (L/h)        =     1.350
   Heavy vehicle idle fuel rate (L/h)        =     2.000
```

Table S.12B - Fuel Consumption, Emissions and Cost (RATE)

```
Mt Victoria Tunnel Signalised Intersection
Victoria - Peak AM
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  60 (Practical Cycle Time)

------------------------------------------------------------
  Mov            Fuel    Cost     HC      CO      NOX     CO2
  ID             Rate    Rate    Rate    Rate    Rate    Rate
              L/100km   $/km    g/km    g/km    g/km    g/km
------------------------------------------------------------
South: Mt Victoria Tunnel
    1 L          11.1    0.72   0.432   19.16   0.585   277.6
    2 T          13.0    0.88   0.543   24.19   0.694   324.9
               ---------------------------------------------
                 12.9    0.88   0.539   24.00   0.690   323.1
------------------------------------------------------------
East: Kent Terrace
    4 L          13.3    0.95   0.558   24.10   0.704   333.3
    5 T          13.5    0.94   0.572   25.35   0.722   337.9
    6 R          14.2    1.05   0.615   25.90   0.740   356.4
               ---------------------------------------------
                 13.8    0.99   0.588   25.29   0.725   345.3
------------------------------------------------------------
Pedestrian Movements
   P1                    4.76
   P7                    4.04
               ---------------------------------------------
                         4.42
------------------------------------------------------------
 ALL VEHICLES:   13.4    0.94   0.564   24.68   0.709   334.7
------------------------------------------------------------
 INTERSECTION:   13.4    0.94   0.564   24.68   0.709   334.7
------------------------------------------------------------
```

Table S.14 - Summary of Input and Output Data

```
Mt Victoria Tunnel Signalised Intersection
Victoria - Peak AM
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  60 (Practical Cycle Time)

-------------------------------------------------------------------------------
 Lane   Demand Flow (veh/h)        Adj.  Eff Grn   Deg   Aver. Longest Shrt
 No.   --------------------  %HV  Basic  (secs)   Sat   Delay  Queue  Lane
         L    T    R   Tot       Satf. 1st 2nd    x    (sec)   (m)    (m)
-------------------------------------------------------------------------------
 South: Mt Victoria Tunnel
1 L      55              55    5  1949   28  12  0.061    7.9     5    50
2 T          729        729    5  1949   28      0.827   20.4   163   500
3 T          729        729    5  1949   28      0.827   20.4   163   500
        ---------------------------------------------------------------------
         55 1457    0  1512    5                0.827   19.9   163
-------------------------------------------------------------------------------
 East: Kent Terrace
```

```
1 LT    404  212        616    5  1950    4  20  0.852   24.7   135   500
2 TR         277  247   524    5  1950   20      0.852   31.4   135   500
3 R               509   509    5  1950   20      0.852   35.6   132   500
        ------------------------------------------------------------------
        404  489  756  1649    5                 0.852   30.2   135
--------------------------------------------------------------------------
 Pedestrians
  Across S approach      53              14      0.019   17.6   0.1
  Across W approach      53              25      0.011   10.2   0.1
==========================================================================
 ALL VEHICLES          Total   %       Cycle      Max   Aver.   Max
                       Flow   HV       Time        X    Delay  Queue
                       3161    5         60      0.852   25.3   163
==========================================================================
Peak flow period = 30 minutes.

Queue values in this table are 95% back of queue (metres).

Note: Basic Saturation Flows (in through car units) have been adjusted for
      grade, lane widths, parking manoeuvres and bus stops.
```

Table S.15 - Capacity and Level of Service

```
Mt Victoria Tunnel Signalised Intersection
Victoria - Peak AM
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  60 (Practical Cycle Time)

--------------------------------------------------------------------------------
 Mov     Mov    Green Time  Total  Total    Deg.   Aver.   LOS  Longest Queue
 ID      Typ    Ratio (g/C) Flow    Cap.     of    Delay          95% Back
               ------------ (veh    (veh     Satn                (vehs)  (m)
                1st   2nd     /h)    /h)    (v/c)  (sec)
                grn   grn
--------------------------------------------------------------------------------
South: Mt Victoria Tunnel
   1 L  (Slp) 0.467  0.200     55    900<  0.061     7.9    A      0.6       5
   2 T        0.467          1457   1763   0.827    20.4    C     22.4     163
--------------------------------------------------------------------------------
East: Kent Terrace
   4 L  (Slp) 0.467* 0.333    404    474   0.852*   26.8    C     18.5     135
   5 T        0.333*          489    574   0.852*   24.8    C     18.5     135
   6 R        0.333           756    887   0.852*   35.5    D     18.4     135
--------------------------------------------------------------------------------
Pedestrian Movements
  P1    (Ped) 0.233            53   2800   0.019    17.6    B      0.1       0
  P7    (Ped) 0.417            53   5000   0.011    10.2    B      0.1       0
--------------------------------------------------------------------------------
  ALL VEHICLES:               3161          0.852    25.3    C     22.4     163
--------------------------------------------------------------------------------
  INTERSECTION (persons):     4848                   25.0          22.4     163
--------------------------------------------------------------------------------
     Level of Service calculations are based on
     average control delay including geometric delay (HCM criteria),
     independent of the current delay definition used.
     For the criteria, refer to the "Level of Service" topic in the
     SIDRA Output Guide or the Output section of the on-line help.
     Intersection capacity is calculated considering vehicle movements only.
  <  Reduced capacity due to a short lane effect
  *  Maximum v/c ratio, or critical green periods
  "  Movement Level of service has been determined using adjacent lane
     v/c ratio rather than short lane v/c ratio (v/c=1.0)
```

Table S.16 - SCATS MF Parameter

Mt Victoria Tunnel Signalised Intersection
Victoria - Peak AM
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 60 (Practical Cycle Time)

Lane No.	Stopline Flow (veh/h)	Capacity (veh/h)	SCATS Satn Flow	SCATS MF	Deg. Satn x	Lane Util. %
South: Mt Victoria Tunnel						
1 L	55	899	1857	NA	0.061	100
2 T	729	881	1950	1606	0.827	100
3 T	729	881	1950	1606	0.827	100
East: Kent Terrace						
1 LT	616	723	1888	NA	0.852	100
2 TR	524	614	1905	1465	0.852	100
3 R	509	598	1857	1429	0.852	100

NA Not Applicable - SCATS MF was not calculated for this lane due to one of the following reasons:
- the lane is not controlled by signals (slip or continuous lane)
- two movements share this lane and do not run in the same phases

STOPLINE FLOW: Departure flow rate in veh/h as measured at the stop line. This cannot exceed capacity.

SCATS SATURATION FLOW: This allows for lane width, approach grade and turning vehicles. Saturation flow scale applies if specified. The effects of heavy vehicles, parking manoeuvres, number of buses stopping and conflicting pedestrian volume are not included.

SCATS MF: This emulates the MF (Maximum Flow) parameter used in the SCATS control system. It is calculated from the SCATS SATURATION FLOW parameter.

DEG. SATN: The Demand (Arrival) Flow Rate may exceed the Stopline Flow Rate, therefore x > 1 is possible.

Table D.0 - Geometric Delay Data

Mt Victoria Tunnel Signalised Intersection
Victoria - Peak AM
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 60 (Practical Cycle Time)

From Approach	To Approach	Turn	Negn Radius (m)	Negn Speed (km/h)	Negn Dist. (m)	Appr. Dist. (m)	Downstream Distance (m)	User Spec?
South: Mt Victoria Tunnel								
	North	Thru	S	50.0	13.2	500	76	No
	West	Left	20.0	26.2	31.4	500	88	No
East: Kent Terrace								
	South	Left	15.0	23.5	23.6	500	83	No
	North	Right	5.0	15.5	10.0	500	76	No
	West	Thru	S	50.0	16.5	500	76	No

Downstream distance is distance travelled from the stopline until exit cruise speed is reached (includes negotiation distance). Acceleration distance is weighted for light and heavy vehicles. The same distance applies for both stopped and unstopped vehicles.

Table D.1 - Lane Delays

Mt Victoria Tunnel Signalised Intersection
Victoria - Peak AM
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 60 (Practical Cycle Time)

Lane No.	Deg. Satn x	Stop-line Delay 1st d1	2nd d2	Total dSL	Acc. Dec. dn	Queuing Total dq	MvUp dqm	Stopd (Idle) di	Geom dig	Control dic
South: Mt Victoria Tunnel										
1 L	0.061	2.3	0.0	2.3	1.8	0.7	0.0	0.7	5.7	7.9
2 T	0.827	15.2	5.2	20.4	7.2	13.2	1.1	12.0	0.0	20.4
3 T	0.827	15.2	5.2	20.4	7.2	13.2	1.1	12.0	0.0	20.4
East: Kent Terrace										
1 LT	0.852	13.2	7.5	20.7	5.5	15.2	1.7	13.5	4.0	24.7
2 TR	0.852	20.7	7.3	27.9	5.6	22.3	2.1	20.3	3.5	31.4
3 R	0.852	20.7	7.4	28.1	3.3	24.9	2.1	22.7	7.4	35.6

dn is average stop-start delay for all vehicles queued and unqueued

Table D.2 - Lane Stops

Mt Victoria Tunnel Signalised Intersection
Victoria - Peak AM
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 60 (Practical Cycle Time)

Lane No.	Deg. Satn x	-- Effective Stop Rate -- he1	he2	Geom. hig	Overall h	Prop. Queued pq	Queue Move-up Rate hqm
South: Mt Victoria Tunnel							
1 L	0.061	0.28	0.00	0.34	0.61	0.361	0.00
2 T	0.827	0.84	0.13	0.00	0.97	0.934	0.16
3 T	0.827	0.84	0.13	0.00	0.97	0.934	0.16
East: Kent Terrace							
1 LT	0.852	0.86	0.17	0.01	1.03	0.974	0.25
2 TR	0.852	0.87	0.21	0.00	1.08	0.995	0.28
3 R	0.852	0.87	0.21	0.00	1.08	0.995	0.29

hig is the average value for all movements in a shared lane
hqm is average queue move-up rate for all vehicles queued and unqueued

Table D.3A - Lane Queues (veh)

Mt Victoria Tunnel Signalised Intersection
Victoria - Peak AM
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 60 (Practical Cycle Time)

Lane No.	Deg. Satn x	Ovrfl. Queue No	Average (veh) Nb1	Nb2	Nb	Percentile (veh) 70%	85%	90%	95%	98%	Queue Stor. Ratio

South: Mt Victoria Tunnel											
1 L	0.061	0.0	0.3	0.0	0.3	0.3	0.4	0.5	0.6	0.8	0.09
2 T	0.827	1.2	11.5	1.9	13.4	16.2	19.0	20.6	22.4	24.2	0.33
3 T	0.827	1.2	11.5	1.9	13.4	16.2	19.0	20.6	22.4	24.2	0.33
East: Kent Terrace											
1 LT	0.852	1.4	8.6	2.1	10.8	13.0	15.4	16.8	18.5	20.2	0.27
2 TR	0.852	1.1	9.0	1.7	10.7	13.0	15.4	16.7	18.4	20.1	0.27
3 R	0.852	1.1	8.8	1.7	10.5	12.7	15.1	16.4	18.1	19.8	0.26

Values printed in this table are back of queue (vehicles).

Table D.3B - Lane Queues (metres)

Mt Victoria Tunnel Signalised Intersection
Victoria - Peak AM
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 60 (Practical Cycle Time)

Lane No.	Deg. Satn x	Ovrfl. Queue No	Average (metres) Nb1	Nb2	Nb	Percentile (metres) 70%	85%	90%	95%	98%	Queue Stor. Ratio
South: Mt Victoria Tunnel											
1 L	0.061	0.0	1.8	0.0	1.8	2.4	3.1	3.6	4.7	5.8	0.09
2 T	0.827	8.4	84.3	13.6	97.8	118.1	139.0	150.1	163.3	176.4	0.33
3 T	0.827	8.4	84.3	13.6	97.8	118.1	139.0	150.1	163.3	176.4	0.33
East: Kent Terrace											
1 LT	0.852	10.1	62.9	15.7	78.6	95.2	112.7	122.4	134.8	147.2	0.27
2 TR	0.852	8.3	65.9	12.6	78.4	95.0	112.5	122.2	134.6	147.0	0.27
3 R	0.852	8.2	64.2	12.4	76.6	92.9	110.1	119.6	132.0	144.4	0.26

Values printed in this table are back of queue (metres).

Table D.4 - Movement Speeds (km/h) and Geometric Delay

Mt Victoria Tunnel Signalised Intersection
Victoria - Peak AM
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 60 (Practical Cycle Time)

Mov ID	App. Speeds Cruise	Negn	Exit Speeds Negn	Cruise	Queue Move-up 1st Grn	2nd Grn	Av. Section Spd Running	Overall	Geom Delay (sec)
South: Mt Victoria Tunnel									
1 L	50.0	26.2	26.2	50.0			42.5	42.0	5.7
2 T	50.0	50.0	50.0	50.0	40.2		41.6	33.5	0.0
East: Kent Terrace									
4 L	50.0	23.5	23.5	50.0	14.4	33.4	38.7	30.5	6.1
5 T	50.0	50.0	50.0	50.0	25.3	0.0	37.1	31.2	0.0
6 R	50.0	15.5	15.5	50.0	33.2		38.3	26.9	7.4

"Running Speed" is the average speed excluding stopped periods.

Table D.5 - Progression Factors and Actuated Signal Parameters

Mt Victoria Tunnel Signalised Intersection
Victoria - Peak AM
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 60 (Practical Cycle Time)

Mov ID	Control	Coord.	Arrival Type	Delay Prog. Factor	Queue Prog. Factor	Disp. Grn. Settings 1st Grn Gmin	1st Grn Gmax	2nd Grn Gmin	2nd Grn Gmax
South: Mt Victoria Tunnel									
1 L	FT	No	3	1.000	1.000	6	NA	6	NA
2 T	FT	No	3	1.000	1.000	6	NA		
East: Kent Terrace									
4 L	FT	No	3	1.000	1.000	6	NA	6	NA
5 T	FT	No	3	1.000	1.000	6	NA		
6 R	FT	No	3	1.000	1.000	6	NA		
Pedestrians									
P1	FT	No	3	1.000	1.000				
P7	FT	No	3	1.000	1.000				

Table D.6 - Gap Acceptance Parameters

Mt Victoria Tunnel Signalised Intersection
Victoria - Peak AM
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 60 (Practical Cycle Time)

Mov ID	Mov Type	Opng Flow (pcu/h)	Critical Gap Hdwy (s)	Critical Gap Dist (m)	Foll-up Headway (s)	Entry HV Equiv
South: Mt Victoria Tunnel						
1 L	Slip	491	4.03	55.9	2.42	2.00
East: Kent Terrace						
No opposed movements on this approach						

Values in this table are adjusted for heavy vehicles in the entry stream.

SIDRA INTERSECTION

Output Tables

Mt Victoria Tunnel Signalised Intersection

Victoria - Peak PM

Run Information

```
Cycle Time =   40  (Practical Cycle Time)

* Basic Parameters:
  Intersection Type: Signalised - Fixed Time
  Driving on the left-hand side of the road
  "New Zealand" give way rule applied when input data was set up for this run
  Input data specified in Metric units
  Model Defaults: New Zealand
  Peak Flow Period (for performance): 30 minutes
  Unit time (for volumes): 60 minutes.
  Delay definition: Control delay
                    Geometric delay included
  SIDRA Standard Delay model used
  SIDRA Standard Queue model used
  Level of Service based on: Delay (HCM method)
  Queue definition: Back of queue, 95th Percentile

* Iteration Data:
  No. of Main (Timing-Capacity) Iterations =  2
  Comparison of last two iterations:
    Difference in intersection degree of satn =  0.0 %
    Largest difference in eff. green times =  0 secs
    (max. value for stopping = 0 secs)
```

Table B.1 - Movement Definitions and Flow Rates (Origin-Destination)

```
Mt Victoria Tunnel Signalised Intersection
Victoria - Peak PM
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  40 (Practical Cycle Time)

-------------------------------------------------------------------
 From      To          Mov           Flow Rate   Flow   Peak Flow
 Approach  Approach    ID    Turn     LV    HV   Scale    Factor
-------------------------------------------------------------------
 South: Mt Victoria Tunnel
           North         2   Thru   1127    59    1.00     0.95
           West          1   Left    112     6    1.00     0.95
-------------------------------------------------------------------
 East: Kent Terrace
           South         4   Left    485    26    1.00     0.95
           West          5   Thru    487    26    1.00     0.95
-------------------------------------------------------------------
Unit Time for Volumes =  60 minutes
Peak Flow Period =  30 minutes
Flow Rates include effects of Flow Scale and Peak Flow Factor
```

Table B.2A - Flow Rates (Separate Light and Heavy Vehicles)

```
Mt Victoria Tunnel Signalised Intersection
Victoria - Peak PM
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  40 (Practical Cycle Time)

-----------------------------------------------
  Mov          Left       Through       Right
  ID        ---------    ---------    ---------
             LV    HV     LV    HV     LV    HV
-----------------------------------------------
Demand flows in veh/hour as used by the program
South: Mt Victoria Tunnel
    1 L     112     6      0     0      0     0
    2 T       0     0   1127    59      0     0
-----------------------------------------------
East: Kent Terrace
    4 L     485    26      0     0      0     0
    5 T       0     0    487    26      0     0
-----------------------------------------------
Unit Time for Volumes =  60 minutes
Peak Flow Period =  30 minutes
Flow Rates include effects of Flow Scale and Peak Flow Factor
```

Table B.2B - Flow Rates (Total Vehicles and Percent Heavy)

```
Mt Victoria Tunnel Signalised Intersection
Victoria - Peak PM
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  40 (Practical Cycle Time)

-------------------------------------------------
  Mov          Left        Through        Right
  ID        ----------    ----------    ----------
            Total  %HV    Total  %HV    Total  %HV
-------------------------------------------------
Demand flows in veh/hour as used by the program
South: Mt Victoria Tunnel
    1 L      118   5.1       0   0.0       0   0.0
    2 T        0   0.0    1186   5.0       0   0.0
-------------------------------------------------
East: Kent Terrace
    4 L      511   5.1       0   0.0       0   0.0
    5 T        0   0.0     513   5.1       0   0.0
-------------------------------------------------
Unit Time for Volumes =  60 minutes
Peak Flow Period =  30 minutes
Flow Rates include effects of Flow Scale and Peak Flow Factor
```

Table B.3 - Pedestrian Flow Rates

```
Mt Victoria Tunnel Signalised Intersection
Victoria - Peak PM
Intersection ID: 0
```

```
Fixed-Time Signals, Cycle Time =  40 (Practical Cycle Time)

----------------------------------------
 Mov        Flow Rate   Flow   Peak Flow
 ID   Stage  (ped/h)    Scale   Factor
----------------------------------------
Across South Approach
  P1            53       1.00    0.95
----------------------------------------
Across West Approach
  P7            53       1.00    0.95
----------------------------------------
Unit Time for Volumes =  60 minutes
Peak Flow Period =  30 minutes
Flow Rates include effects of Flow Scale and Peak Flow Factor
```

Table S.1 - Movement Phase and Timing Parameters

```
Mt Victoria Tunnel Signalised Intersection
Victoria - Peak PM
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  40 (Practical Cycle Time)

-------------------------------------------------------------------------------------------------
 Mov     Mov           P H A S E  M A T R I X          Lost Tim  Req.Mov.Time     Eff. Grn
 ID      Typ      First Green          Second Green     --------  ------------     --------
              -------------------  -------------------  1st  2nd  1st      2nd     1st  2nd
               Fr    To    Op Pr    Fr    To    Op Pr   Grn  Grn  Grn      Grn     Grn  Grn
-------------------------------------------------------------------------------------------------
South: Mt Victoria Tunnel
   1 L  (Slp) A      B             B      A      Y       6   13   15.0Min  18.0Min  16    5
   2 T       *A      B                                   6        20.0              16
-------------------------------------------------------------------------------------------------
East: Kent Terrace
   4 L  (Slp) A      B             B      A              6    6   15.0Min  18.0Min  16   12
   5 T       *B      A                                   6        18.0Min           12
-------------------------------------------------------------------------------------------------
Pedestrian Movements
  P1    (Ped) B      A                                  12        18.0Min            6
  P7    (Ped) A      B                                   9        15.0Min           13
-------------------------------------------------------------------------------------------------
  Current Phase Sequence: Two-phase
  Input phase sequence: A B
  Output phase sequence: A B
-------------------------------------------------------------------------------------------------
  *  Critical Movement/Green Period

Movement Types:                          Under heading 'Op':
  Slp  Slip Lane Movement                  Y   If opposed turn
  Ped  Pedestrian
  Dum  Dummy
```

Table S.2 - Movement Capacity Parameters

```
Mt Victoria Tunnel Signalised Intersection
Victoria - Peak PM
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  40 (Practical Cycle Time)

-------------------------------------------------------------------------------
```

Mov ID	Dem Flow (veh /h)	HV (%)	Satn Flow 1st Grn	Satn Flow 2nd Grn	Flow Ratio 1st Grn	Flow Ratio 2nd Grn	Total Cap. (veh /h)	Prac. Deg. Satn xp	Prac. Spare Cap. (%)	Lane Util (%)	Deg. Satn x
South: Mt Victoria Tunnel											
1 L	118	5.1	1792	2057	0.000	0.057	974	0.90	643	100	0.121
2 T	1186	5.0	3778		0.314		1511	0.90	15	100	0.785*
East: Kent Terrace											
4 L	511	5.1	762	1376	0.183	0.270	718	0.90	26	100	0.712
5 T	513	5.1	2402		0.214		721	0.90	26	100	0.712
Pedestrian Movements											
P1	53		12000		0.004		1800	0.90		0	0.029
P7	53		12000		0.004		3900	0.90		0	0.014

Table S.3 - Intersection Parameters

Mt Victoria Tunnel Signalised Intersection
Victoria - Peak PM
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 40 (Practical Cycle Time)

Crit Mov ID	App. and Turn	Green Period Fr	Phases To	Adjusted Lost Time	Adjusted Flow Ratio	Required Grn Time Ratio	Required Movement Time
2	S_T	A	B	6	0.314	0.349	20.0
5	E_T	B	A	18	-	-	18.0Min
				24			
			Total:		0.314	0.349	38.0

- Flow ratio not used for cycle time calculations and the adjusted lost time equals the required movement time (=Min or Max as shown in Table S.1)

Cycle Time:

Minimum	Maximum	Practical	Chosen
33	150	37	40

Intersection Level of Service	=	B
Worst movement Level of Service	=	B
Average intersection delay (s/pers)	=	13.8
Largest average movement delay (s)	=	15.0
Largest back of queue, 95% (m)	=	99
Performance Index	=	73.51
Degree of saturation (highest)	=	0.785
Practical Spare Capacity (lowest)	=	15 %
Effective intersection capacity, (veh/h)	=	2966
Total vehicle flow (veh/h)	=	2328
Total pedestrian flow (ped/h)	=	106
Total person flow (pers/h)	=	3598
Total vehicle delay (veh-h/h)	=	8.93
Total pedestrian delay (ped-h/h)	=	0.35
Total person delay (pers-h/h)	=	13.75
Total effective vehicle stops (veh/h)	=	2082
Total effective pedestrian stops (ped/h)	=	81
Total effective person stops (pers/h)	=	3204
Total vehicle travel (veh-km/h)	=	1340.3
Total cost ($/h)	=	1089.97
Total fuel (L/h)	=	164.2
Total CO2 (kg/h)	=	411.38

Table S.4 - Phase Information

```
Mt Victoria Tunnel Signalised Intersection
Victoria - Peak PM
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  40 (Practical Cycle Time)

-------------------------------------------------------------------------
Phase  Change  Starting  Green  Displayed  Green  Terminating  Phase  Phase
        Time    Intgrn   Start    Green     End     Intgrn     Time   Split
-------------------------------------------------------------------------
 A         0       6       6       16       22        6         22    55%
 B        22       6      28       12       40        6         18    45%
-------------------------------------------------------------------------
  Current Phase Sequence: Two-phase
  Input phase sequence: A B
  Output phase sequence: A B
```

Table S.5 - Movement Performance

```
-------------------------------------------------------------------------
  Mov      Total    Total   Aver.  Prop.  Eff. Longest Queue  Perf.  Aver.
  ID       Delay    Delay   Delay Queued  Stop   95% Back     Index  Speed
        (veh-h/h)(pers-h/h)(sec)         Rate  (vehs)  (m)          (km/h)
-------------------------------------------------------------------------
South: Mt Victoria Tunnel
    1 L     0.29     0.44     8.9   0.53  0.66    1.3    10    2.64   41.1
    2 T     4.94     7.41    15.0   0.93  0.95   13.5    99   39.60   36.7
-------------------------------------------------------------------------
East: Kent Terrace
    4 L     1.77     2.66    12.5   0.83  0.86    9.3    68   13.98   38.6
    5 T     1.93     2.90    13.6   0.92  0.85    9.5    70   15.86   37.5
-------------------------------------------------------------------------
Pedestrian Movements
   P1       0.21     0.21    14.4   0.85  0.85    0.1     0    0.80    2.9
   P7       0.13     0.13     9.1   0.68  0.68    0.0     0    0.63    3.2
-------------------------------------------------------------------------
```

Table S.6 - Intersection Performance

```
Mt Victoria Tunnel Signalised Intersection
Victoria - Peak PM
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  40 (Practical Cycle Time)

-------------------------------------------------------------------------
 Total   Deg.   Total    Total   Aver.  Prop.  Eff. Longest Perf.   Aver.
 Flow    Satn   Delay    Delay   Delay Queued  Stop  Queue  Index   Speed
(veh/h)   x   (veh-h/h)(pers-h/h)(sec)         Rate   (m)          (km/h)
-------------------------------------------------------------------------
South: Mt Victoria Tunnel
 1304   0.785    5.23     7.84    14.4   0.90  0.93    99   42.24    37.1
-------------------------------------------------------------------------
East: Kent Terrace
 1024   0.712    3.71     5.56    13.0   0.87  0.85    70   29.84    38.0
-------------------------------------------------------------------------
Pedestrians:
    0   0.000    0.00     0.00    14.4-NaN     0.85     0    0.00     2.9
-------------------------------------------------------------------------
ALL VEHICLES:
 2328   0.785    8.93    13.40    13.8   0.89  0.89    99   72.08    37.5
-------------------------------------------------------------------------
INTERSECTION (persons):
```

```
 3598   0.785            13.75    13.8   0.88  0.89         73.51    36.9
-------------------------------------------------------------------------
Queue values in this table are 95% back of queue (metres).
```

Table S.7 - Lane Performance

```
Mt Victoria Tunnel Signalised Intersection
Victoria - Peak PM
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  40 (Practical Cycle Time)

-------------------------------------------------------------------------
        Effective Red and   Dem                            Q u e u e
        Green Times (sec)  Flow  Cap  Deg.  Aver.  Eff.   95% Back     Lane
 Lane   -----------------  (veh (veh  Satn  Delay  Stop  -----------  Length
 No.     R1  G1   R2  G2     /h)  /h)   x    (sec)  Rate  (vehs) (m)    (m)
-------------------------------------------------------------------------
 South: Mt Victoria Tunnel
 1 L      6  16   13   5    118  974 0.121    8.9  0.66   1.3    9.7   125.0T
 2 T     24  16    0   0    593  756 0.785   15.0  0.95  13.5   98.6   125.0
 3 T     24  16    0   0    593  756 0.785   15.0  0.95  13.5   98.6   500.0
-------------------------------------------------------------------------
 East: Kent Terrace
 1 LT     6   8   14  12    621  872 0.712   11.4  0.83   9.3   67.7   500.0
 2 T     28  12    0   0    403  566 0.712   15.5  0.88   9.5   69.7   500.0
-------------------------------------------------------------------------
  T  Short lane due to specification of Turn Slot
```

Table S.8 - Lane Flow and Capacity Information

```
Mt Victoria Tunnel Signalised Intersection
Victoria - Peak PM
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  40 (Practical Cycle Time)

-------------------------------------------------------------------------
                                  Saturation Flow  End  Tot
 Lane     Dem Flow (veh/h)   Lane   Adj. Aver Aver  Cap  Cap  Deg.  Lane
 No.    -------------------  Width Basic 1st  2nd  (veh (veh  Satn  Util
         Lef Thru  Rig  Tot   (m)  (tcu) (veh)(veh)  /h)  /h)   x     %
-------------------------------------------------------------------------
 South: Mt Victoria Tunnel
 1 L     118    0    0  118  3.30  1950 1792  2057  224  974 0.121  100
 2 T       0  593    0  593  3.30  1950 1889     0    0  756 0.785  100
 3 T       0  593    0  593  3.30  1950 1889     0    0  756 0.785  100
-------------------------------------------------------------------------
 East: Kent Terrace
 1 LT    511  110    0  621  3.30  1950 1649  1808    0  872 0.712  100
 2 T       0  403    0  403  3.30  1950 1888     0    0  566 0.712  100
-------------------------------------------------------------------------

  Basic Saturation Flow in this table is adjusted for lane width, approach
  grade, parking manoeuvres and number of buses stopping.  Saturation flow
  scale applies if specified.
```

Table S.9 - Signal Timing Diagram

```
Mt Victoria Tunnel Signalised Intersection
Victoria - Peak PM
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  40 (Practical Cycle Time)

Displayed (Phase) Green Times

               Phase A                            Phase B

0                                    22                                  40
I------------------------------------I-----------------------------------I
..........GGGGGGGGGGGGGGGGGGGGGGGGG.....GGGGGGGGGGGGGGGGGGGG.
          6                                    28


Effective (Movement) Green Times


 South: Mt Victoria Tunnel

Mov.     1 (L)
I                                    I                                   I
GGGGG.....GGGGGGGGGGGGGGGGGGGGGGGGGGGGGG.....................GGGG
    3         9                            25                    38

Mov.     2 (T)
I                                    I                                   I
..............GGGGGGGGGGGGGGGGGGGGGGGGGGGGG.........................
              9                             25


 East: Kent Terrace

Mov.     4 (L)
I                                    I                                   I
GGGGG.....GGGGGGGGGGGGGGGGGGGGGGGGGGGGGG.....GGGGGGGGGGGGGGGGGG
    3         9                            25         31

Mov.     5 (T)
I                                    I                                   I
GGGG.................................................GGGGGGGGGGGGGGGGG
    3                                                 31


 Pedestrian Movements

Mov.    P1
I                                    I                                   I
.....................................................GGGGGGGGG........
                                                    30         36

Mov.    P7
I                                    I                                   I
.............GGGGGGGGGGGGGGGGGGGGG.................................
            8                      21


I-----I------I------I------I------I------I------I------I------I------I---->
0     4      8     12     16     20     24     28     32     36     40

                                T I M E  (s)
```

Table S.10 - Movement Capacity and Performance Summary

```
Mt Victoria Tunnel Signalised Intersection
Victoria - Peak PM
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  40 (Practical Cycle Time)

--------------------------------------------------------------------------------
 Mov     Mov  Dem   Total  Lane  Deg.  Eff. Grn  Aver.  Eff.    95%    Perf.
 ID      Typ  Flow   Cap.  Util  Satn  --------  Delay  Stop  Back of  Index
```

		(veh /h)	(veh /h)	(%)	x	1st Grn	2nd Grn	(sec)	Rate	Queue (veh)	
South: Mt Victoria Tunnel											
1	L (Slp)	118	974	100	0.121	16	5	8.9	0.66	1.3	2.64
2	T	1186	1511	100	0.785*	16*		15.0	0.95	13.5	39.60
East: Kent Terrace											
4	L (Slp)	511	718	100	0.712	16	12	12.5	0.86	9.3	13.98
5	T	513	721	100	0.712	12*		13.6	0.85	9.5	15.86
Pedestrian Movements											
P1	(Ped)	53	1800	100	0.029	6		14.4	0.85	0.1	0.80
P7	(Ped)	53	3900	100	0.014	13		9.1	0.68	0.0	0.63

* Maximum degree of saturation, or critical green periods

Table S.12A - Fuel Consumption, Emissions and Cost (TOTAL)

Mt Victoria Tunnel Signalised Intersection
Victoria - Peak PM
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 40 (Practical Cycle Time)

Mov ID		Fuel Total L/h	Cost Total $/h	HC Total kg/h	CO Total kg/h	NOX Total kg/h	CO2 Total kg/h
South: Mt Victoria Tunnel							
1	L	7.8	50.70	0.031	1.37	0.042	19.6
2	T	85.0	559.12	0.351	16.03	0.461	213.0
		92.8	609.81	0.382	17.41	0.503	232.5
East: Kent Terrace							
4	L	35.5	231.76	0.143	6.51	0.193	88.9
5	T	35.9	235.96	0.147	6.65	0.193	90.0
		71.4	467.73	0.290	13.16	0.386	178.8
Pedestrian Movements							
P1		6.95					
P7		5.49					
		12.43					
ALL VEHICLES:		164.2	1077.54	0.672	30.56	0.888	411.4
INTERSECTION:		164.2	1089.97	0.672	30.56	0.888	411.4

PARAMETERS USED IN COST CALCULATIONS

Pump price of fuel ($/L)	= 1.600
Fuel resource cost factor	= 0.60
Ratio of running cost to fuel cost	= 2.5
Average income ($/h)	= 21.00
Time value factor	= 0.60
Light vehicle mass (1000 kg)	= 1.4
Heavy vehicle mass (1000 kg)	= 11.0
Light vehicle idle fuel rate (L/h)	= 1.350
Heavy vehicle idle fuel rate (L/h)	= 2.000

Table S.12B - Fuel Consumption, Emissions and Cost (RATE)

Mt Victoria Tunnel Signalised Intersection
Victoria - Peak PM
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 40 (Practical Cycle Time)

Mov ID		Fuel Rate L/100km	Cost Rate $/km	HC Rate g/km	CO Rate g/km	NOX Rate g/km	CO2 Rate g/km
South: Mt Victoria Tunnel							
1	L	11.3	0.73	0.444	19.89	0.602	283.1
2	T	12.5	0.82	0.516	23.57	0.678	313.1
		12.4	0.81	0.509	23.23	0.671	310.4
East: Kent Terrace							
4	L	12.0	0.78	0.481	21.93	0.649	299.4
5	T	12.2	0.80	0.500	22.59	0.656	305.8
		12.1	0.79	0.490	22.26	0.652	302.6
Pedestrian Movements							
P1			4.38				
P7			3.89				
			4.15				
ALL VEHICLES:		12.3	0.80	0.501	22.80	0.663	306.9
INTERSECTION:		12.3	0.81	0.501	22.80	0.663	306.9

Table S.14 - Summary of Input and Output Data

Mt Victoria Tunnel Signalised Intersection
Victoria - Peak PM
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 40 (Practical Cycle Time)

Lane No.		Demand Flow (veh/h) L	T	R	Tot	%HV	Adj. Basic Satf.	Eff Grn (secs) 1st	2nd	Deg Sat x	Aver. Delay (sec)	Longest Queue (m)	Shrt Lane (m)
South: Mt Victoria Tunnel													
1	L	118			118	5	1949	16	5	0.121	8.9	10	125
2	T		593		593	5	1949	16		0.785	15.0	99	125
3	T		593		593	5	1949	16		0.785	15.0	99	500
		118	1186	0	1304	5				0.785	14.4	99	
East: Kent Terrace													
1	LT	511	110		621	5	1950	8	12	0.712	11.4	68	500
2	T		403		403	5	1950	12		0.712	15.5	70	500
		511	513	0	1024	5				0.712	13.0	70	
Pedestrians													
Across S approach			53				6			0.029	14.4	0.1	
Across W approach			53				13			0.014	9.1	0.0	

ALL VEHICLES	Total Flow	% HV	Cycle Time	Max X	Aver. Delay	Max Queue
	2328	5	40	0.785	13.8	99

Peak flow period = 30 minutes.

Queue values in this table are 95% back of queue (metres).

```
Note: Basic Saturation Flows (in through car units) have been adjusted for
      grade, lane widths, parking manoeuvres and bus stops.
```

Table S.15 - Capacity and Level of Service

```
Mt Victoria Tunnel Signalised Intersection
Victoria - Peak PM
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  40 (Practical Cycle Time)

--------------------------------------------------------------------------------
 Mov     Mov    Green Time  Total  Total    Deg.   Aver.   LOS  Longest Queue
 ID      Typ    Ratio (g/C) Flow    Cap.     of    Delay          95% Back
               ------------ (veh   (veh     Satn                (vehs)  (m)
                1st   2nd     /h)    /h)    (v/c)  (sec)
                grn   grn
--------------------------------------------------------------------------------
South: Mt Victoria Tunnel
   1 L  (Slp) 0.400  0.125    118    974   0.121     8.9    A      1.3      10
   2 T        0.400*         1186   1511   0.785*   15.0    B     13.5      99
--------------------------------------------------------------------------------
East: Kent Terrace
   4 L  (Slp) 0.400  0.300    511    718   0.712    12.5    B      9.3      68
   5 T        0.300*          513    721   0.712    13.6    B      9.5      70
--------------------------------------------------------------------------------
Pedestrian Movements
  P1    (Ped) 0.150             53   1800   0.029    14.4    B      0.1       0
  P7    (Ped) 0.325             53   3900   0.014     9.1    A      0.0       0
--------------------------------------------------------------------------------
  ALL VEHICLES:              2328          0.785    13.8    B     13.5      99
--------------------------------------------------------------------------------
  INTERSECTION (persons):    3598                   13.8          13.5      99
--------------------------------------------------------------------------------
     Level of Service calculations are based on
     average control delay including geometric delay (HCM criteria),
     independent of the current delay definition used.
     For the criteria, refer to the "Level of Service" topic in the
     SIDRA Output Guide or the Output section of the on-line help.
     Intersection capacity is calculated considering vehicle movements only.
  *  Maximum v/c ratio, or critical green periods
  "  Movement Level of service has been determined using adjacent lane
     v/c ratio rather than short lane v/c ratio (v/c=1.0)
```

Table S.16 - SCATS MF Parameter

```
Mt Victoria Tunnel Signalised Intersection
Victoria - Peak PM
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  40 (Practical Cycle Time)

--------------------------------------------------
 Lane   Stopline Capacity  SCATS  SCATS   Deg.  Lane
 No.      Flow   (veh/h)   Satn    MF     Satn  Util.
        (veh/h)           Flow            x     %
--------------------------------------------------
 South: Mt Victoria Tunnel
 1 L       118     974     1857     NA   0.121   100
 2 T       593     756     1950   1418   0.785   100
 3 T       593     756     1950   1418   0.785   100
--------------------------------------------------
 East: Kent Terrace
 1 LT      621     872     1873     NA   0.712   100
 2 T       403     566     1950   1300   0.712   100
```

```
--------------------------------------------------
  NA Not Applicable - SCATS MF was not calculated for this lane due to one
     of the following reasons:
      - the lane is not controlled by signals (slip or continuous lane)
      - two movements share this lane and do not run in the same phases

  STOPLINE FLOW: Departure flow rate in veh/h as measured at the stop line.
  This cannot exceed capacity.

  SCATS SATURATION FLOW: This allows for lane width, approach grade and
  turning vehicles.  Saturation flow scale applies if specified.
  The effects of heavy vehicles, parking manoeuvres, number of buses
  stopping and conflicting pedestrian volume are not included.

  SCATS MF: This emulates the MF (Maximum Flow) parameter used in the SCATS
  control system. It is calculated from the SCATS SATURATION FLOW parameter.

  DEG. SATN: The Demand (Arrival) Flow Rate may exceed the Stopline Flow
  Rate, therefore x > 1 is possible.
```

Table D.0 - Geometric Delay Data

```
Mt Victoria Tunnel Signalised Intersection
Victoria - Peak PM
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  40 (Practical Cycle Time)

-------------------------------------------------------------------------------
                            Negn  Negn   Negn   Appr.   Downstream  Distance
 From      To               Radius Speed  Dist.  Dist.   --------------------
 Approach  Approach  Turn     (m)  (km/h)  (m)    (m)       (m)      User Spec?
-------------------------------------------------------------------------------
 South: Mt Victoria Tunnel
             North   Thru       S   50.0   10.0    500       76          No
              West   Left    20.0   26.2   31.4    500       88          No
-------------------------------------------------------------------------------
 East: Kent Terrace
             South   Left    15.0   23.5   23.6    500       83          No
              West   Thru       S   50.0   16.5    500       76          No
-------------------------------------------------------------------------------

  Downstream distance is distance travelled from the stopline until exit
  cruise speed is reached (includes negotiation distance).  Acceleration
  distance is weighted for light and heavy vehicles.  The same distance
  applies for both stopped and unstopped vehicles.
```

Table D.1 - Lane Delays

```
Mt Victoria Tunnel Signalised Intersection
Victoria - Peak PM
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  40 (Practical Cycle Time)

-------------------------------------------------------------------------
                    ----------  Delay (seconds/veh)  ----------------
         Deg.   Stop-line Delay  Acc.   Queuing   Stopd
 Lane    Satn   1st   2nd Total  Dec.  Total MvUp (Idle) Geom Control
 No.       x     d1    d2   dSL   dn    dq   dqm    di    dig   dic
-------------------------------------------------------------------------
 South: Mt Victoria Tunnel
 1 L    0.121   3.2   0.0   3.2   2.6   0.8   0.0   0.8   5.7    8.9
 2 T    0.785  11.8   3.2  15.0   7.2   7.8   1.5   6.3   0.0   15.0
 3 T    0.785  11.8   3.2  15.0   7.2   7.8   1.5   6.3   0.0   15.0
-------------------------------------------------------------------------
```

```
 East: Kent Terrace
 1 LT   0.712   5.1   1.3   6.4   4.2   2.3   0.4   1.8   5.0   11.4
 2 T    0.712  14.2   1.4  15.5   7.3   8.2   1.0   7.3   0.0   15.5
-------------------------------------------------------------------------
  dn is average stop-start delay for all vehicles queued and unqueued
```

Table D.2 - Lane Stops

```
Mt Victoria Tunnel Signalised Intersection
Victoria - Peak PM
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  40 (Practical Cycle Time)

-------------------------------------------------------
                                                  Queue
        Deg.  -- Effective Stop Rate --   Prop. Move-up
 Lane   Satn              Geom. Overall  Queued  Rate
 No.      x    he1   he2   hig     h       pq     hqm
-------------------------------------------------------
 South: Mt Victoria Tunnel
 1 L   0.121  0.41  0.00  0.25   0.66    0.529   0.00
 2 T   0.785  0.82  0.13  0.00   0.95    0.935   0.20
 3 T   0.785  0.82  0.13  0.00   0.95    0.935   0.20
-------------------------------------------------------
 East: Kent Terrace
 1 LT  0.712  0.71  0.04  0.08   0.83    0.825   0.08
 2 T   0.712  0.80  0.08  0.00   0.88    0.945   0.14
-------------------------------------------------------
  hig is the average value for all movements in a shared lane
  hqm is average queue move-up rate for all vehicles queued and unqueued
```

Table D.3A - Lane Queues (veh)

```
Mt Victoria Tunnel Signalised Intersection
Victoria - Peak PM
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  40 (Practical Cycle Time)

-------------------------------------------------------------------------------------
        Deg.  Ovrfl.   Average (veh)              Percentile (veh)            Queue
 Lane   Satn  Queue ------------------  ---------------------------------  Stor.
 No.      x    No      Nb1    Nb2     Nb     70%    85%    90%    95%    98%  Ratio
-------------------------------------------------------------------------------------
 South: Mt Victoria Tunnel
 1 L   0.121    0.0     0.5    0.0    0.5     0.7    0.9    1.0    1.3    1.6   0.08
 2 T   0.785    0.6     6.5    0.9    7.4     9.0   10.9   11.9   13.5   15.1   0.79
 3 T   0.785    0.6     6.5    0.9    7.4     9.0   10.9   11.9   13.5   15.1   0.20
-------------------------------------------------------------------------------------
 East: Kent Terrace
 1 LT  0.712    0.3     4.2    0.4    4.6     5.8    7.0    7.9    9.3   10.6   0.14
 2 T   0.712    0.2     4.5    0.3    4.8     6.0    7.3    8.1    9.5   10.9   0.14
-------------------------------------------------------------------------------------

     Values printed in this table are back of queue (vehicles).
```

Table D.3B - Lane Queues (metres)

Mt Victoria Tunnel Signalised Intersection
Victoria - Peak PM
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 40 (Practical Cycle Time)

Lane No.	Deg. Satn x	Ovrfl. Queue No	Average (metres) Nb1	Nb2	Nb	Percentile (metres) 70%	85%	90%	95%	98%	Queue Stor. Ratio
South: Mt Victoria Tunnel											
1 L	0.121	0.0	3.9	0.0	3.9	5.0	6.5	7.6	9.7	11.9	0.08
2 T	0.785	4.5	47.2	6.7	53.9	66.0	79.2	87.1	98.6	110.1	0.79
3 T	0.785	4.5	47.2	6.7	53.9	66.0	79.2	87.1	98.6	110.1	0.20
East: Kent Terrace											
1 LT	0.712	2.0	30.8	3.1	33.9	42.0	51.5	57.6	67.7	77.7	0.14
2 T	0.712	1.4	33.1	2.1	35.2	43.5	53.3	59.5	69.7	79.9	0.14

Values printed in this table are back of queue (metres).

Table D.4 - Movement Speeds (km/h) and Geometric Delay

Mt Victoria Tunnel Signalised Intersection
Victoria - Peak PM
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 40 (Practical Cycle Time)

Mov ID	App. Speeds Cruise	Negn	Exit Speeds Negn	Cruise	Queue Move-up 1st Grn	2nd Grn	Av. Section Spd Running	Overall	Geom Delay (sec)
South: Mt Victoria Tunnel									
1 L	50.0	26.2	26.2	50.0			41.8	41.1	5.7
2 T	50.0	50.0	50.0	50.0	30.4		41.3	36.7	0.0
East: Kent Terrace									
4 L	50.0	23.5	23.5	50.0	20.1	25.7	40.2	38.6	6.1
5 T	50.0	50.0	50.0	50.0	25.0	0.0	41.9	37.5	0.0

"Running Speed" is the average speed excluding stopped periods.

Table D.5 - Progression Factors and Actuated Signal Parameters

Mt Victoria Tunnel Signalised Intersection
Victoria - Peak PM
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 40 (Practical Cycle Time)

Mov ID	Control	Coord.	Arrival Type	Delay Prog. Factor	Queue Prog. Factor	Disp. Grn. Settings 1st Grn Gmin	Gmax	2nd Grn Gmin	Gmax
South: Mt Victoria Tunnel									
1 L	FT	No	3	1.000	1.000	6	NA	6	NA
2 T	FT	No	3	1.000	1.000	6	NA		
East: Kent Terrace									
4 L	FT	No	3	1.000	1.000	6	NA	6	NA

```
    5 T     FT       No        3      1.000   1.000     6   NA
--------------------------------------------------------------------------
 Pedestrians
   P1        FT       No        3      1.000   1.000
   P7        FT       No        3      1.000   1.000
--------------------------------------------------------------------------
```

Table D.6 - Gap Acceptance Parameters

```
Mt Victoria Tunnel Signalised Intersection
Victoria - Peak PM
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  40 (Practical Cycle Time)

-----------------------------------------------------------
                          Critical Gap
                  Opng    ------------   Foll-up   Entry
  Mov     Mov     Flow    Hdwy    Dist   Headway    HV
  ID      Type    (pcu/h)  (s)    (m)      (s)     Equiv
-----------------------------------------------------------
 South: Mt Victoria Tunnel
    1 L   Slip       515   4.02    55.8     2.41     2.00
-----------------------------------------------------------
 East: Kent Terrace
  No opposed movements on this approach
-----------------------------------------------------------

  Values in this table are adjusted for heavy vehicles in the entry stream.
```

SIDRA SOLUTIONS

Site: Mt Victoria PM Peak - no kent terrace traffic
G:\Transport\Transit\Proj\5C1353.00_Basin_Reserve_At-grade_Improvements\03_Sidra\Proposed_Intersections\Mt Victoria.aap
Processed Jun 13, 2008 03:11:10p.m.

A0101, Opus International Consultants Ltd, Large Office
Produced by SIDRA Intersection 3.2.0.1455

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SIDRA INTERSECTION

Output Tables

Kent Terrace Signals

PM Peak

Run Information

```
Cycle Time =   40  (Practical Cycle Time)

* Basic Parameters:
  Intersection Type: Signalised - Fixed Time
  Driving on the left-hand side of the road
  "New Zealand" give way rule applied when input data was set up for this run
  Input data specified in Metric units
  Model Defaults: New Zealand
  Peak Flow Period (for performance): 30 minutes
  Unit time (for volumes): 60 minutes.
  Delay definition: Control delay
                    Geometric delay included
  SIDRA Standard Delay model used
  SIDRA Standard Queue model used
  Level of Service based on: Delay (HCM method)
  Queue definition: Back of queue, 95th Percentile

* Iteration Data:
  No. of Main (Timing-Capacity) Iterations =  2
  Comparison of last two iterations:
    Difference in intersection degree of satn =  0.0 %
    Largest difference in eff. green times =  0 secs
    (max. value for stopping = 0 secs)
```

Table B.1 - Movement Definitions and Flow Rates (Origin-Destination)

```
Kent Terrace Signals
PM Peak
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  40 (Practical Cycle Time)

-------------------------------------------------------------------
 From      To          Mov           Flow Rate   Flow   Peak Flow
 Approach  Approach    ID    Turn     LV    HV   Scale    Factor
-------------------------------------------------------------------
 East: WICB East
           West          5   Thru   1127    59    1.00     0.95
-------------------------------------------------------------------
 North: Kent Terrace
           West          9   Right   727    38    1.00     0.95
-------------------------------------------------------------------
Unit Time for Volumes =  60 minutes
Peak Flow Period =  30 minutes
Flow Rates include effects of Flow Scale and Peak Flow Factor
```

Table B.2A - Flow Rates (Separate Light and Heavy Vehicles)

```
Kent Terrace Signals
PM Peak
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  40 (Practical Cycle Time)

------------------------------------------------
  Mov          Left       Through       Right
  ID        ---------    ---------    ---------
             LV    HV     LV    HV     LV    HV
------------------------------------------------
Demand flows in veh/hour as used by the program
East: WICB East
    5 T       0     0   1127    59      0     0
------------------------------------------------
North: Kent Terrace
    9 R       0     0      0     0    727    38
------------------------------------------------
Unit Time for Volumes =  60 minutes
Peak Flow Period =  30 minutes
Flow Rates include effects of Flow Scale and Peak Flow Factor
```

Table B.2B - Flow Rates (Total Vehicles and Percent Heavy)

```
Kent Terrace Signals
PM Peak
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  40 (Practical Cycle Time)

--------------------------------------------------
  Mov          Left        Through        Right
  ID        ----------    ----------    ----------
           Total  %HV    Total  %HV    Total  %HV
--------------------------------------------------
Demand flows in veh/hour as used by the program
East: WICB East
    5 T       0   0.0    1186   5.0       0   0.0
--------------------------------------------------
North: Kent Terrace
    9 R       0   0.0       0   0.0     765   5.0
--------------------------------------------------
Unit Time for Volumes =  60 minutes
Peak Flow Period =  30 minutes
Flow Rates include effects of Flow Scale and Peak Flow Factor
```

Table B.3 - Pedestrian Flow Rates

```
Kent Terrace Signals
PM Peak
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  40 (Practical Cycle Time)

----------------------------------------
 Mov        Flow Rate   Flow   Peak Flow
 ID   Stage  (ped/h)    Scale   Factor
----------------------------------------
Across West Approach
```

```
  P7            53       1.00    0.95
----------------------------------------
Unit Time for Volumes =  60 minutes
Peak Flow Period =  30 minutes
Flow Rates include effects of Flow Scale and Peak Flow Factor
```

Table S.1 - Movement Phase and Timing Parameters

```
Kent Terrace Signals
PM Peak
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  40 (Practical Cycle Time)

-------------------------------------------------------------------------------------------------
 Mov     Mov           P H A S E  M A T R I X          Lost Tim  Req.Mov.Time     Eff. Grn
 ID      Typ      First Green          Second Green     --------  ------------     --------
              -------------------  -------------------  1st  2nd  1st      2nd     1st  2nd
               Fr    To    Op Pr    Fr    To    Op Pr   Grn  Grn  Grn      Grn     Grn  Grn
-------------------------------------------------------------------------------------------------
East: WICB East
   5 T       *B      A                                    6        20.0              17
-------------------------------------------------------------------------------------------------
North: Kent Terrace
   9 R       *A      B                                    6        15.5              11
-------------------------------------------------------------------------------------------------
Pedestrian Movements
  P7    (Ped) A      B                                    9        15.0Min            8
-------------------------------------------------------------------------------------------------
  Current Phase Sequence: Two-phase
  Input phase sequence: A B
  Output phase sequence: A B
-------------------------------------------------------------------------------------------------
  *  Critical Movement/Green Period

Movement Types:                              Under heading 'Op':
  Slp  Slip Lane Movement                      Y   If opposed turn
  Ped  Pedestrian
  Dum  Dummy
```

Table S.2 - Movement Capacity Parameters

```
Kent Terrace Signals
PM Peak
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  40 (Practical Cycle Time)

-------------------------------------------------------------------------------
 Mov      Dem           Satn Flow   Flow Ratio  Total Prac. Prac. Lane   Deg.
 ID       Flow          ----------   ----------   Cap. Deg.  Spare Util   Satn
          (veh    HV    1st   2nd    1st   2nd  (veh  Satn  Cap.
           /h)    (%)   Grn   Grn    Grn   Grn   /h)   xp    (%)   (%)     x
-------------------------------------------------------------------------------
East: WICB East
   5 T    1186    5.0  3778        0.314        1606  0.90    22   100  0.739
-------------------------------------------------------------------------------
North: Kent Terrace
   9 R     765    5.0  3587        0.213         986  0.90    16   100  0.776*
-------------------------------------------------------------------------------
Pedestrian Movements
  P7        53        12000        0.004        2400  0.90           0  0.022
```

Table S.3 - Intersection Parameters

Kent Terrace Signals
PM Peak
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 40 (Practical Cycle Time)

Crit Mov ID	App. and Turn	Green Period	Phases Fr	Phases To	Adjusted Lost Time	Adjusted Flow Ratio	Required Grn Time Ratio	Required Movement Time
9	N_R		A	B	6	0.213	0.237	15.5
5	E_T		B	A	6	0.314	0.349	20.0
				Total:	12	0.527	0.586	35.4

Cycle Time:

Minimum	Maximum	Practical	Chosen
27	150	29	40

Intersection Level of Service	=	B
Worst movement Level of Service	=	C
Average intersection delay (s/pers)	=	17.6
Largest average movement delay (s)	=	25.6
Largest back of queue, 95% (m)	=	91
Performance Index	=	66.10
Degree of saturation (highest)	=	0.776
Practical Spare Capacity (lowest)	=	16 %
Effective intersection capacity, (veh/h)	=	2516
Total vehicle flow (veh/h)	=	1951
Total pedestrian flow (ped/h)	=	53
Total person flow (pers/h)	=	2980
Total vehicle delay (veh-h/h)	=	9.60
Total pedestrian delay (ped-h/h)	=	0.19
Total person delay (pers-h/h)	=	14.58
Total effective vehicle stops (veh/h)	=	1788
Total effective pedestrian stops (ped/h)	=	42
Total effective person stops (pers/h)	=	2725
Total vehicle travel (veh-km/h)	=	1118.8
Total cost ($/h)	=	954.31
Total fuel (L/h)	=	140.7
Total CO2 (kg/h)	=	352.56

Table S.4 - Phase Information

Kent Terrace Signals
PM Peak
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 40 (Practical Cycle Time)

Phase	Change Time	Starting Intgrn	Green Start	Displayed Green	Green End	Terminating Intgrn	Phase Time	Phase Split
A	0	6	6	11	17	6	17	43%
B	17	6	23	17	40	6	23	58%

Current Phase Sequence: Two-phase
Input phase sequence: A B

```
  Output phase sequence: A B
```

Table S.5 - Movement Performance

```
------------------------------------------------------------------------------
  Mov      Total    Total   Aver.  Prop.  Eff. Longest Queue  Perf.  Aver.
  ID       Delay    Delay   Delay Queued  Stop   95% Back     Index  Speed
        (veh-h/h)(pers-h/h)(sec)         Rate  (vehs)  (m)          (km/h)
------------------------------------------------------------------------------
East: WICB East
    5 T     4.15     6.22    12.6   0.90  0.87   12.5    91   36.95   38.3
------------------------------------------------------------------------------
North: Kent Terrace
    9 R     5.45     8.17    25.6   0.98  0.99    9.8    72   28.43   30.9
------------------------------------------------------------------------------
Pedestrian Movements
   P7       0.19     0.19    12.8   0.80  0.80    0.0     0    0.73    2.9
------------------------------------------------------------------------------
```

Table S.6 - Intersection Performance

```
Kent Terrace Signals
PM Peak
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  40 (Practical Cycle Time)

------------------------------------------------------------------------------
 Total   Deg.   Total    Total   Aver.  Prop.  Eff. Longest Perf.   Aver.
 Flow    Satn   Delay    Delay   Delay Queued  Stop  Queue  Index   Speed
(veh/h)   x   (veh-h/h)(pers-h/h)(sec)         Rate   (m)          (km/h)
------------------------------------------------------------------------------
East: WICB East
 1186   0.739    4.15     6.22    12.6   0.90  0.87    91   36.95    38.3
------------------------------------------------------------------------------
North: Kent Terrace
  765   0.776    5.45     8.17    25.6   0.98  0.99    72   28.43    30.9
------------------------------------------------------------------------------
Pedestrians:
    0   0.000    0.00     0.00    25.6-NaN     0.99     0    0.00    30.9
------------------------------------------------------------------------------
ALL VEHICLES:
 1951   0.776    9.60    14.40    17.7   0.93  0.92    91   65.38    35.0
------------------------------------------------------------------------------
INTERSECTION (persons):
 2980   0.776            14.58    17.6   0.93  0.91         66.10    34.7
------------------------------------------------------------------------------
Queue values in this table are 95% back of queue (metres).
```

Table S.7 - Lane Performance

```
Kent Terrace Signals
PM Peak
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  40 (Practical Cycle Time)

------------------------------------------------------------------------------
```

Lane No.	Effective Green Times (sec) R1	G1	R2	G2	Dem Flow (veh /h)	Cap (veh /h)	Deg. Satn x	Aver. Delay (sec)	Eff. Stop Rate	Q u e u e 95% Back (vehs)	(m)	Lane Length (m)
East: WICB East												
1 T	23	17	0	0	593	803	0.739	12.6	0.87	12.5	91.5	150.0
2 T	23	17	0	0	593	803	0.739	12.6	0.87	12.5	91.5	150.0
North: Kent Terrace												
1 R	29	11	0	0	383	493	0.776	25.6	0.99	9.8	71.8	500.0
2 R	29	11	0	0	383	493	0.776	25.6	0.99	9.8	71.8	500.0

Table S.8 - Lane Flow and Capacity Information

Kent Terrace Signals
PM Peak
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 40 (Practical Cycle Time)

Lane No.	Dem Flow (veh/h) Lef	Thru	Rig	Tot	Lane Width (m)	Saturation Flow Adj. Basic (tcu)	Aver 1st (veh)	Aver 2nd (veh)	End Cap (veh /h)	Tot Cap (veh /h)	Deg. Satn x	Lane Util %
East: WICB East												
1 T	0	593	0	593	3.30	1950	1889	0	0	803	0.739	100
2 T	0	593	0	593	3.30	1950	1889	0	0	803	0.739	100
North: Kent Terrace												
1 R	0	0	383	383	3.30	1950	1794	0	0	493	0.776	100
2 R	0	0	383	383	3.30	1950	1794	0	0	493	0.776	100

Basic Saturation Flow in this table is adjusted for lane width, approach grade, parking manoeuvres and number of buses stopping. Saturation flow scale applies if specified.

Table S.9 - Signal Timing Diagram

Kent Terrace Signals
PM Peak
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 40 (Practical Cycle Time)

Displayed (Phase) Green Times

```
          Phase A                          Phase B

0                         17                                      40
I-------------------------I---------------------------------------I
...........GGGGGGGGGGGGGGGG............GGGGGGGGGGGGGGGGGGGGGGGGGGGG.
          6                           23
```

Effective (Movement) Green Times

East: WICB East

```
Mov.     5 (T)
I                         I                                       I
```

```
GGGG.....................................GGGGGGGGGGGGGGGGGGGGGGGG
    3                                     26


 North: Kent Terrace

Mov.     9 (R)
I                          I                                     I
.............GGGGGGGGGGGGGGGGG.................................
             9                 20


 Pedestrian Movements

Mov.    P7
I                          I                                     I
............GGGGGGGGGGGGG.....................................
            8             16


I-----I------I------I------I------I------I------I------I------I------I---->
0      4      8     12     16     20     24     28     32     36     40

                                T I M E  (s)
```

Table S.10 - Movement Capacity and Performance Summary

```
Kent Terrace Signals
PM Peak
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  40 (Practical Cycle Time)

--------------------------------------------------------------------------------
 Mov     Mov  Dem   Total  Lane  Deg.  Eff. Grn  Aver.  Eff.    95%    Perf.
 ID      Typ  Flow   Cap.  Util  Satn  --------  Delay  Stop  Back of  Index
              (veh  (veh              1st  2nd          Rate   Queue
               /h)   /h)   (%)     x   Grn  Grn  (sec)         (veh)
--------------------------------------------------------------------------------
East: WICB East
   5 T        1186  1606   100  0.739   17*       12.6  0.87   12.5   36.95
--------------------------------------------------------------------------------
North: Kent Terrace
   9 R         765   986   100  0.776*  11*       25.6  0.99    9.8   28.43
--------------------------------------------------------------------------------
Pedestrian Movements
  P7    (Ped)   53  2400   100  0.022    8        12.8  0.80    0.0    0.73
--------------------------------------------------------------------------------
  *  Maximum degree of saturation, or critical green periods
```

Table S.12A - Fuel Consumption, Emissions and Cost (TOTAL)

```
Kent Terrace Signals
PM Peak
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  40 (Practical Cycle Time)

------------------------------------------------------------
  Mov            Fuel    Cost     HC      CO     NOX     CO2
  ID             Total   Total   Total   Total   Total   Total
                  L/h    $/h     kg/h    kg/h    kg/h    kg/h
------------------------------------------------------------
East: WICB East
    5 T          82.3   536.95   0.336   15.25   0.443   206.2
               ---------------------------------------------
```

```
                82.3   536.95   0.336   15.25   0.443   206.2
-------------------------------------------------------------
North: Kent Terrace
    9 R         58.4   411.19   0.247   10.77   0.310   146.4
               ----------------------------------------------
                58.4   411.19   0.247   10.77   0.310   146.4
-------------------------------------------------------------
Pedestrian Movements
   P7                    6.17
              -----------------------------------------------
                         6.17
-------------------------------------------------------------
 ALL VEHICLES:  140.7   948.14   0.583   26.02   0.753   352.6
-------------------------------------------------------------
 INTERSECTION:  140.7   954.31   0.583   26.02   0.753   352.6
-------------------------------------------------------------


PARAMETERS USED IN COST CALCULATIONS
------------------------------------

   Pump price of fuel ($/L)                 =     1.600
   Fuel resource cost factor                =      0.60
   Ratio of running cost to fuel cost       =       2.5
   Average income ($/h)                     =     21.00
   Time value factor                        =      0.60
   Light vehicle mass (1000 kg)             =       1.4
   Heavy vehicle mass (1000 kg)             =      11.0
   Light vehicle idle fuel rate (L/h)       =     1.350
   Heavy vehicle idle fuel rate (L/h)       =     2.000
```

Table S.12B - Fuel Consumption, Emissions and Cost (RATE)

```
Kent Terrace Signals
PM Peak
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  40 (Practical Cycle Time)

-------------------------------------------------------------
  Mov            Fuel    Cost     HC      CO      NOX     CO2
  ID             Rate    Cost    Rate    Rate    Rate    Rate
              L/100km   $/km    g/km    g/km    g/km    g/km
-------------------------------------------------------------
East: WICB East
    5 T         12.1     0.79   0.494   22.42   0.651   303.1
               ----------------------------------------------
                12.1     0.79   0.494   22.42   0.651   303.1
-------------------------------------------------------------
North: Kent Terrace
    9 R         13.3     0.94   0.563   24.55   0.706   333.7
               ----------------------------------------------
                13.3     0.94   0.563   24.55   0.706   333.7
-------------------------------------------------------------
Pedestrian Movements
   P7                    4.38
              -----------------------------------------------
                         4.38
-------------------------------------------------------------
 ALL VEHICLES:   12.6     0.85   0.521   23.25   0.673   315.1
-------------------------------------------------------------
 INTERSECTION:   12.6     0.85   0.521   23.25   0.673   315.1
-------------------------------------------------------------
```

Table S.14 - Summary of Input and Output Data

Kent Terrace Signals
PM Peak
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 40 (Practical Cycle Time)

Lane No.	Demand Flow (veh/h) L	T	R	Tot	%HV	Adj. Basic Satf.	Eff Grn (secs) 1st	2nd	Deg Sat x	Aver. Delay (sec)	Longest Queue (m)	Shrt Lane (m)
East: WICB East												
1 T		593		593	5	1949	17		0.739	12.6	91	150
2 T		593		593	5	1949	17		0.739	12.6	91	150
	0	1186	0	1186	5				0.739	12.6	91	
North: Kent Terrace												
1 R			383	383	5	1949	11		0.776	25.6	72	500
2 R			383	383	5	1949	11		0.776	25.6	72	500
	0	0	765	765	5				0.776	25.6	72	
Pedestrians												
Across W approach			53			8			0.022	12.8	0.0	

ALL VEHICLES	Total Flow	% HV	Cycle Time	Max X	Aver. Delay	Max Queue
	1951	5	40	0.776	17.7	91

Peak flow period = 30 minutes.

Queue values in this table are 95% back of queue (metres).

Note: Basic Saturation Flows (in through car units) have been adjusted for grade, lane widths, parking manoeuvres and bus stops.

Table S.15 - Capacity and Level of Service

Kent Terrace Signals
PM Peak
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 40 (Practical Cycle Time)

Mov ID	Mov Typ	Green Time Ratio (g/C) 1st grn	2nd grn	Total Flow (veh /h)	Total Cap. (veh /h)	Deg. of Satn (v/c)	Aver. Delay (sec)	LOS	Longest Queue 95% Back (vehs)	(m)
East: WICB East										
5 T		0.425*		1186	1606	0.739	12.6	B	12.5	91
North: Kent Terrace										
9 R		0.275*		765	986	0.776*	25.6	C	9.8	72
Pedestrian Movements										
P7	(Ped)	0.200		53	2400	0.022	12.8	B	0.0	0
ALL VEHICLES:				1951		0.776	17.7	B	12.5	91
INTERSECTION (persons):				2980			17.6		12.5	91

Level of Service calculations are based on
average control delay including geometric delay (HCM criteria),
independent of the current delay definition used.
For the criteria, refer to the "Level of Service" topic in the
SIDRA Output Guide or the Output section of the on-line help.
Intersection capacity is calculated considering vehicle movements only.
* Maximum v/c ratio, or critical green periods

Table S.16 - SCATS MF Parameter

Kent Terrace Signals
PM Peak
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 40 (Practical Cycle Time)

Lane No.	Stopline Flow (veh/h)	Capacity (veh/h)	SCATS Satn Flow	SCATS MF	Deg. Satn x	Lane Util. %
East: WICB East						
1 T	593	803	1950	1441	0.739	100
2 T	593	803	1950	1441	0.739	100
North: Kent Terrace						
1 R	383	493	1857	1202	0.776	100
2 R	383	493	1857	1202	0.776	100

STOPLINE FLOW: Departure flow rate in veh/h as measured at the stop line. This cannot exceed capacity.

SCATS SATURATION FLOW: This allows for lane width, approach grade and turning vehicles. Saturation flow scale applies if specified. The effects of heavy vehicles, parking manoeuvres, number of buses stopping and conflicting pedestrian volume are not included.

SCATS MF: This emulates the MF (Maximum Flow) parameter used in the SCATS control system. It is calculated from the SCATS SATURATION FLOW parameter.

DEG. SATN: The Demand (Arrival) Flow Rate may exceed the Stopline Flow Rate, therefore x > 1 is possible.

Table D.0 - Geometric Delay Data

Kent Terrace Signals
PM Peak
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 40 (Practical Cycle Time)

From Approach	To Approach	Turn	Negn Radius (m)	Negn Speed (km/h)	Negn Dist. (m)	Appr. Dist. (m)	Downstream Distance (m)	User Spec?
East: WICB East								
	West	Thru	S	50.0	10.0	500	76	No
North: Kent Terrace								
	West	Right	5.0	15.5	10.0	500	76	No

Downstream distance is distance travelled from the stopline until exit cruise speed is reached (includes negotiation distance). Acceleration distance is weighted for light and heavy vehicles. The same distance applies for both stopped and unstopped vehicles.

Table D.1 - Lane Delays

Kent Terrace Signals
PM Peak
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 40 (Practical Cycle Time)

Lane No.	Deg. Satn x	Stop-line Delay 1st d1	2nd d2	Total dSL	Acc. Dec. dn	Queuing Total dq	MvUp dqm	Stopd (Idle) di	Geom dig	Control dic
East: WICB East										
1 T	0.739	10.8	1.8	12.6	6.9	5.7	0.9	4.8	0.0	12.6
2 T	0.739	10.8	1.8	12.6	6.9	5.7	0.9	4.8	0.0	12.6
North: Kent Terrace										
1 R	0.776	15.3	2.9	18.2	3.2	15.0	1.8	13.2	7.4	25.6
2 R	0.776	15.3	2.9	18.2	3.2	15.0	1.8	13.2	7.4	25.6

Delay (seconds/veh)

dn is average stop-start delay for all vehicles queued and unqueued

Table D.2 - Lane Stops

Kent Terrace Signals
PM Peak
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 40 (Practical Cycle Time)

Lane No.	Deg. Satn x	Effective Stop Rate Geom. he1	he2	Overall hig	h	Prop. Queued pq	Queue Move-up Rate hqm
East: WICB East							
1 T	0.739	0.79	0.08	0.00	0.87	0.896	0.12
2 T	0.739	0.79	0.08	0.00	0.87	0.896	0.12
North: Kent Terrace							
1 R	0.776	0.83	0.15	0.02	0.99	0.978	0.26
2 R	0.776	0.83	0.15	0.02	0.99	0.978	0.26

hig is the average value for all movements in a shared lane
hqm is average queue move-up rate for all vehicles queued and unqueued

Table D.3A - Lane Queues (veh)

Kent Terrace Signals
PM Peak
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 40 (Practical Cycle Time)

Lane No.	Deg. Satn x	Ovrfl. Queue No	Average (veh) Nb1	Nb2	Nb	Percentile (veh) 70%	85%	90%	95%	98%	Queue Stor. Ratio
East: WICB East											
1 T	0.739	0.4	6.2	0.6	6.7	8.3	10.0	11.0	12.5	14.1	0.61
2 T	0.739	0.4	6.2	0.6	6.7	8.3	10.0	11.0	12.5	14.1	0.61

North: Kent Terrace										
1 R	0.776	0.4	4.5	0.5	5.0	6.2	7.5	8.4	9.8	11.3	0.14
2 R	0.776	0.4	4.5	0.5	5.0	6.2	7.5	8.4	9.8	11.3	0.14

Values printed in this table are back of queue (vehicles).

Table D.3B - Lane Queues (metres)

Kent Terrace Signals
PM Peak
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 40 (Practical Cycle Time)

Lane No.	Deg. Satn x	Ovrfl. Queue No	Average (metres) Nb1	Nb2	Nb	Percentile (metres) 70%	85%	90%	95%	98%	Queue Stor. Ratio
East: WICB East											
1 T	0.739	2.7	45.1	4.1	49.2	60.3	72.7	80.2	91.5	102.8	0.61
2 T	0.739	2.7	45.1	4.1	49.2	60.3	72.7	80.2	91.5	102.8	0.61
North: Kent Terrace											
1 R	0.776	2.6	32.8	3.7	36.5	45.1	55.1	61.4	71.8	82.1	0.14
2 R	0.776	2.6	32.8	3.7	36.5	45.1	55.1	61.4	71.8	82.1	0.14

Values printed in this table are back of queue (metres).

Table D.4 - Movement Speeds (km/h) and Geometric Delay

Kent Terrace Signals
PM Peak
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 40 (Practical Cycle Time)

Mov ID	App. Speeds Cruise	Negn	Exit Speeds Negn	Cruise	Queue Move-up 1st Grn	2nd Grn	Av. Section Spd Running	Overall	Geom Delay (sec)
East: WICB East									
5 T	50.0	50.0	50.0	50.0	31.3		42.1	38.3	0.0
North: Kent Terrace									
9 R	50.0	15.5	15.5	50.0	24.5		38.5	30.9	7.4

"Running Speed" is the average speed excluding stopped periods.

Table D.5 - Progression Factors and Actuated Signal Parameters

Kent Terrace Signals

PM Peak
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 40 (Practical Cycle Time)

Mov ID	Control	Coord.	Arrival Type	Delay Prog. Factor	Queue Prog. Factor	Disp. Grn. Settings 1st Grn Gmin	1st Grn Gmax	2nd Grn Gmin	2nd Grn Gmax
East: WICB East									
5 T	FT	No	3	1.000	1.000	6	NA		
North: Kent Terrace									
9 R	FT	No	3	1.000	1.000	6	NA		
Pedestrians									
P7	FT	No	3	1.000	1.000				

Table D.6 - Gap Acceptance Parameters

Kent Terrace Signals
PM Peak
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 40 (Practical Cycle Time)

No opposed movements at this intersection

SIDRA SOLUTIONS

Site: Kent Terrace PM Peak
G:\Transport\Transit\Proj\5C1353.00_Basin_Reserve_At-grade_Improvements\03_Sidra\Proposed_Intersections\Potential Kent Terrace Intersection.aap
Processed Jun 13, 2008 09:44:42a.m.

A0101, Opus International Consultants Ltd, Large Office

SIDRA INTERSECTION

Output Tables

Kent Terrace Signals

AM Peak

Run Information

```
Cycle Time =   40  (Practical Cycle Time)

* Basic Parameters:
  Intersection Type: Signalised - Fixed Time
  Driving on the left-hand side of the road
  "New Zealand" give way rule applied when input data was set up for this run
  Input data specified in Metric units
  Model Defaults: New Zealand
  Peak Flow Period (for performance): 30 minutes
  Unit time (for volumes): 60 minutes.
  Delay definition: Control delay
                    Geometric delay included
  SIDRA Standard Delay model used
  SIDRA Standard Queue model used
  Level of Service based on: Delay (HCM method)
  Queue definition: Back of queue, 95th Percentile

* Iteration Data:
  No. of Main (Timing-Capacity) Iterations =  1
  Comparison of last two iterations:
    Difference in intersection degree of satn =  0.0 %
    Largest difference in eff. green times =  0 secs
    (max. value for stopping = 0 secs)
```

Table B.1 - Movement Definitions and Flow Rates (Origin-Destination)

```
Kent Terrace Signals
AM Peak
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  40 (Practical Cycle Time)

-------------------------------------------------------------------
 From      To          Mov           Flow Rate   Flow   Peak Flow
 Approach  Approach    ID    Turn     LV    HV   Scale    Factor
-------------------------------------------------------------------
 East: WICB East
           West          5   Thru   1384    73    1.00     0.95
-------------------------------------------------------------------
 North: Kent Terrace
           West          9   Right   718    38    1.00     0.95
-------------------------------------------------------------------
Unit Time for Volumes =  60 minutes
Peak Flow Period =  30 minutes
Flow Rates include effects of Flow Scale and Peak Flow Factor
```

Table B.2A - Flow Rates (Separate Light and Heavy Vehicles)

```
Kent Terrace Signals
AM Peak
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  40 (Practical Cycle Time)

-----------------------------------------------
  Mov          Left       Through       Right
  ID        ---------    ---------    ---------
             LV    HV     LV    HV     LV    HV
-----------------------------------------------
Demand flows in veh/hour as used by the program
East: WICB East
    5 T       0     0   1384    73      0     0
-----------------------------------------------
North: Kent Terrace
    9 R       0     0      0     0    718    38
-----------------------------------------------
Unit Time for Volumes =  60 minutes
Peak Flow Period =  30 minutes
Flow Rates include effects of Flow Scale and Peak Flow Factor
```

Table B.2B - Flow Rates (Total Vehicles and Percent Heavy)

```
Kent Terrace Signals
AM Peak
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  40 (Practical Cycle Time)

-------------------------------------------------
  Mov          Left        Through        Right
  ID        ----------    ----------    ----------
            Total  %HV    Total  %HV    Total  %HV
-------------------------------------------------
Demand flows in veh/hour as used by the program
East: WICB East
    5 T       0   0.0    1457   5.0       0   0.0
-------------------------------------------------
North: Kent Terrace
    9 R       0   0.0       0   0.0     756   5.0
-------------------------------------------------
Unit Time for Volumes =  60 minutes
Peak Flow Period =  30 minutes
Flow Rates include effects of Flow Scale and Peak Flow Factor
```

Table B.3 - Pedestrian Flow Rates

```
Kent Terrace Signals
AM Peak
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  40 (Practical Cycle Time)

---------------------------------------
 Mov        Flow Rate   Flow   Peak Flow
 ID   Stage  (ped/h)    Scale   Factor
---------------------------------------
Across West Approach
```

```
  P7            53       1.00    0.95
----------------------------------------
Unit Time for Volumes =  60 minutes
Peak Flow Period =  30 minutes
Flow Rates include effects of Flow Scale and Peak Flow Factor
```

Table S.1 - Movement Phase and Timing Parameters

```
Kent Terrace Signals
AM Peak
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  40 (Practical Cycle Time)

-------------------------------------------------------------------------------------------------
 Mov     Mov           P H A S E  M A T R I X          Lost Tim  Req.Mov.Time     Eff. Grn
 ID      Typ      First Green          Second Green     --------  ------------     --------
              -------------------  -------------------  1st  2nd  1st      2nd     1st  2nd
               Fr    To    Op Pr    Fr    To    Op Pr   Grn  Grn  Grn      Grn     Grn  Grn
-------------------------------------------------------------------------------------------------
East: WICB East
   5 T       *B      A                                    6        23.1              18
-------------------------------------------------------------------------------------------------
North: Kent Terrace
   9 R       *A      B                                    6        15.4              10
-------------------------------------------------------------------------------------------------
Pedestrian Movements
  P7    (Ped) A      B                                    9        15.0Min            7
-------------------------------------------------------------------------------------------------
  Current Phase Sequence: Two-phase
  Input phase sequence: A B
  Output phase sequence: A B
-------------------------------------------------------------------------------------------------
  *  Critical Movement/Green Period

Movement Types:                              Under heading 'Op':
  Slp  Slip Lane Movement                      Y   If opposed turn
  Ped  Pedestrian
  Dum  Dummy
```

Table S.2 - Movement Capacity Parameters

```
Kent Terrace Signals
AM Peak
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  40 (Practical Cycle Time)

-------------------------------------------------------------------------------
 Mov      Dem           Satn Flow   Flow Ratio  Total Prac. Prac. Lane   Deg.
 ID       Flow          ----------   ----------   Cap. Deg.  Spare Util   Satn
          (veh    HV    1st   2nd    1st   2nd  (veh  Satn  Cap.
           /h)    (%)   Grn   Grn    Grn   Grn   /h)   xp    (%)   (%)     x
-------------------------------------------------------------------------------
East: WICB East
   5 T    1457    5.0  3777        0.386        1700  0.90     5   100  0.857*
-------------------------------------------------------------------------------
North: Kent Terrace
   9 R     756    5.0  3586        0.211         897  0.90     7   100  0.843
-------------------------------------------------------------------------------
Pedestrian Movements
  P7        53        12000        0.004        2100  0.90           0  0.025
```

```
------------------------------------------------------------------------------
```

Table S.3 - Intersection Parameters

```
Kent Terrace Signals
AM Peak
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  40 (Practical Cycle Time)

------------------------------------------------------------------------------
   Crit App.  Green   Phases   Adjusted    Adjusted   Required   Required
   Mov  and   Period  ------     Lost        Flow     Grn Time   Movement
   ID   Turn          Fr  To     Time        Ratio     Ratio       Time
------------------------------------------------------------------------------
     9  N_R          A    B        6        0.211      0.234       15.4
     5  E_T          B    A        6        0.386      0.429       23.1
                                 ----       ------     ------     ------
                         Total:   12        0.597      0.663       38.5
------------------------------------------------------------------------------

   Cycle Time:
     Minimum   Maximum   Practical   Chosen
        27       150         36         40


   Intersection Level of Service             =         C
   Worst movement Level of Service           =         C
   Average intersection delay (s/pers)       =      22.0
   Largest average movement delay (s)        =      29.5
   Largest back of queue, 95% (m)            =       132
   Performance Index                         =     85.19
   Degree of saturation (highest)            =     0.857
   Practical Spare Capacity (lowest)         =         5 %
   Effective intersection capacity, (veh/h)  =      2582
   Total vehicle flow (veh/h)                =      2213
   Total pedestrian flow (ped/h)             =        53
   Total person flow (pers/h)                =      3373
   Total vehicle delay (veh-h/h)             =     13.64
   Total pedestrian delay (ped-h/h)          =      0.20
   Total person delay (pers-h/h)             =     20.65
   Total effective vehicle stops (veh/h)     =      2424
   Total effective pedestrian stops (ped/h)  =        44
   Total effective person stops (pers/h)     =      3680
   Total vehicle travel (veh-km/h)           =    1269.1
   Total cost ($/h)                          =   1159.47
   Total fuel (L/h)                          =     168.8
   Total CO2 (kg/h)                          =    422.87
```

Table S.4 - Phase Information

```
Kent Terrace Signals
AM Peak
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  40 (Practical Cycle Time)

------------------------------------------------------------------------------
Phase  Change  Starting  Green  Displayed  Green  Terminating  Phase  Phase
       Time    Intgrn    Start    Green     End     Intgrn     Time   Split
------------------------------------------------------------------------------
 A        0       6        6       10       16        6         16    40%
 B       16       6       22       18       40        6         24    60%
------------------------------------------------------------------------------
  Current Phase Sequence: Two-phase
  Input phase sequence: A B
```

Output phase sequence: A B

Table S.5 - Movement Performance

Mov ID	Total Delay (veh-h/h)	Total Delay (pers-h/h)	Aver. Delay (sec)	Prop. Queued	Eff. Stop Rate	Longest Queue 95% Back (vehs)	Longest Queue 95% Back (m)	Perf. Index	Aver. Speed (km/h)
East: WICB East									
5 T	7.45	11.17	18.4	0.96	1.10	18.1	132	54.04	34.6
North: Kent Terrace									
9 R	6.19	9.28	29.5	1.00	1.09	10.6	77	30.40	29.2
Pedestrian Movements									
P7	0.20	0.20	13.6	0.82	0.82	0.0	0	0.74	2.8

Table S.6 - Intersection Performance

Kent Terrace Signals
AM Peak
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 40 (Practical Cycle Time)

Total Flow (veh/h)	Deg. Satn x	Total Delay (veh-h/h)	Total Delay (pers-h/h)	Aver. Delay (sec)	Prop. Queued	Eff. Stop Rate	Longest Queue (m)	Perf. Index	Aver. Speed (km/h)
East: WICB East									
1457	0.857	7.45	11.17	18.4	0.96	1.10	132	54.04	34.6
North: Kent Terrace									
756	0.843	6.19	9.28	29.5	1.00	1.09	77	30.40	29.2
Pedestrians:									
0	0.000	0.00	0.00	29.5-NaN		1.09	0	0.00	29.2
ALL VEHICLES:									
2213	0.857	13.64	20.45	22.2	0.97	1.10	132	84.44	32.6
INTERSECTION (persons):									
3373	0.857		20.65	22.0	0.97	1.09		85.19	32.3

Queue values in this table are 95% back of queue (metres).

Table S.7 - Lane Performance

Kent Terrace Signals
AM Peak
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 40 (Practical Cycle Time)

Lane No.	Effective Green Times (sec) R1	G1	R2	G2	Dem Flow (veh /h)	Cap (veh /h)	Deg. Satn x	Aver. Delay (sec)	Eff. Stop Rate	Queue 95% Back (vehs)	(m)	Lane Length (m)
East: WICB East												
1 T	22	18	0	0	729	850	0.857	18.4	1.10	18.1	132.0	150.0
2 T	22	18	0	0	729	850	0.857	18.4	1.10	18.1	132.0	150.0
North: Kent Terrace												
1 R	30	10	0	0	378	448	0.843	29.5	1.09	10.6	77.4	500.0
2 R	30	10	0	0	378	448	0.843	29.5	1.09	10.6	77.4	500.0

Table S.8 - Lane Flow and Capacity Information

Kent Terrace Signals
AM Peak
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 40 (Practical Cycle Time)

Lane No.	Dem Flow (veh/h) Lef	Thru	Rig	Tot	Lane Width (m)	Saturation Flow Adj. Basic (tcu)	Aver 1st (veh)	Aver 2nd (veh)	End Cap (veh /h)	Tot Cap (veh /h)	Deg. Satn x	Lane Util %
East: WICB East												
1 T	0	729	0	729	3.30	1950	1888	0	0	850	0.857	100
2 T	0	729	0	729	3.30	1950	1888	0	0	850	0.857	100
North: Kent Terrace												
1 R	0	0	378	378	3.30	1950	1793	0	0	448	0.843	100
2 R	0	0	378	378	3.30	1950	1793	0	0	448	0.843	100

Basic Saturation Flow in this table is adjusted for lane width, approach grade, parking manoeuvres and number of buses stopping. Saturation flow scale applies if specified.

Table S.9 - Signal Timing Diagram

Kent Terrace Signals
AM Peak
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 40 (Practical Cycle Time)

Displayed (Phase) Green Times

```
          Phase A                          Phase B

0                         16                                        40
I-------------------------I-----------------------------------------I
...........GGGGGGGGGGGGGGG.............GGGGGGGGGGGGGGGGGGGGGGGGGGGG.
          6                           22
```

Effective (Movement) Green Times

East: WICB East

```
Mov.     5 (T)
I                         I                                         I
```

```
GGGG.....................................GGGGGGGGGGGGGGGGGGGGGGGGGG
    3                                     25


 North: Kent Terrace

Mov.     9 (R)
I                         I                                       I
.............GGGGGGGGGGGGGGG.....................................
             9               19


 Pedestrian Movements

Mov.    P7
I                         I                                       I
............GGGGGGGGGG.....................................------>
            8          15

I-----I------I------I------I------I------I------I------I------I------I---->
0      4      8     12     16     20     24     28     32     36     40

                                T I M E  (s)
```

Table S.10 - Movement Capacity and Performance Summary

```
Kent Terrace Signals
AM Peak
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  40 (Practical Cycle Time)

--------------------------------------------------------------------------------
 Mov     Mov  Dem   Total  Lane  Deg.  Eff. Grn  Aver.  Eff.    95%    Perf.
 ID      Typ  Flow   Cap.  Util  Satn  --------  Delay  Stop  Back of  Index
              (veh  (veh              1st  2nd          Rate   Queue
               /h)   /h)   (%)     x   Grn  Grn  (sec)         (veh)
--------------------------------------------------------------------------------
East: WICB East
   5 T        1457  1700   100  0.857*  18*       18.4  1.10   18.1   54.04
--------------------------------------------------------------------------------
North: Kent Terrace
   9 R         756   897   100  0.843   10*       29.5  1.09   10.6   30.40
--------------------------------------------------------------------------------
Pedestrian Movements
  P7    (Ped)   53  2100   100  0.025    7        13.6  0.82    0.0    0.74
--------------------------------------------------------------------------------
  *  Maximum degree of saturation, or critical green periods
```

Table S.12A - Fuel Consumption, Emissions and Cost (TOTAL)

```
Kent Terrace Signals
AM Peak
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  40 (Practical Cycle Time)

------------------------------------------------------------
  Mov            Fuel    Cost     HC      CO     NOX     CO2
  ID             Total   Total   Total   Total   Total   Total
                  L/h    $/h     kg/h    kg/h    kg/h    kg/h
------------------------------------------------------------
East: WICB East
    5 T         109.3   726.73   0.458   21.11   0.599   273.8
               ---------------------------------------------
```

```
                109.3   726.73   0.458   21.11   0.599   273.8
-------------------------------------------------------------
North: Kent Terrace
    9 R          59.5   426.42   0.254   10.97   0.314   149.0
                ------------------------------------------------
                 59.5   426.42   0.254   10.97   0.314   149.0
-------------------------------------------------------------
Pedestrian Movements
   P7                    6.32
                ------------------------------------------------
                         6.32
-------------------------------------------------------------
 ALL VEHICLES:  168.8  1153.15   0.712   32.07   0.913   422.9
-------------------------------------------------------------
 INTERSECTION:  168.8  1159.47   0.712   32.07   0.913   422.9
-------------------------------------------------------------


PARAMETERS USED IN COST CALCULATIONS
------------------------------------

   Pump price of fuel ($/L)                  =     1.600
   Fuel resource cost factor                 =      0.60
   Ratio of running cost to fuel cost        =       2.5
   Average income ($/h)                      =     21.00
   Time value factor                         =      0.60
   Light vehicle mass (1000 kg)              =       1.4
   Heavy vehicle mass (1000 kg)              =      11.0
   Light vehicle idle fuel rate (L/h)        =     1.350
   Heavy vehicle idle fuel rate (L/h)        =     2.000
```

Table S.12B - Fuel Consumption, Emissions and Cost (RATE)

```
Kent Terrace Signals
AM Peak
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  40 (Practical Cycle Time)

-------------------------------------------------------------
  Mov            Fuel    Cost     HC      CO      NOX     CO2
  ID             Rate    Rate    Rate    Rate    Rate    Rate
              L/100km   $/km    g/km    g/km    g/km    g/km
-------------------------------------------------------------
East: WICB East
    5 T          13.1    0.87   0.548   25.26   0.717   327.8
                ------------------------------------------------
                 13.1    0.87   0.548   25.26   0.717   327.8
-------------------------------------------------------------
North: Kent Terrace
    9 R          13.7    0.98   0.586   25.29   0.724   343.8
                ------------------------------------------------
                 13.7    0.98   0.586   25.29   0.724   343.8
-------------------------------------------------------------
Pedestrian Movements
   P7                    4.48
                ------------------------------------------------
                         4.48
-------------------------------------------------------------
 ALL VEHICLES:   13.3    0.91   0.561   25.27   0.719   333.2
-------------------------------------------------------------
 INTERSECTION:   13.3    0.91   0.561   25.27   0.719   333.2
-------------------------------------------------------------
```

Table S.14 - Summary of Input and Output Data

```
Kent Terrace Signals
AM Peak
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  40 (Practical Cycle Time)

--------------------------------------------------------------------------------
 Lane   Demand Flow (veh/h)       Adj.  Eff Grn   Deg   Aver. Longest Shrt
 No.   -------------------- %HV  Basic  (secs)   Sat   Delay  Queue  Lane
         L    T    R   Tot       Satf. 1st 2nd    x    (sec)   (m)    (m)
--------------------------------------------------------------------------------
 East: WICB East
1 T          729        729    5  1949   18      0.857   18.4   132   150
2 T          729        729    5  1949   18      0.857   18.4   132   150
       ------------------------------------------------------------------------
         0 1457    0  1457    5                 0.857   18.4   132
--------------------------------------------------------------------------------
 North: Kent Terrace
1 R              378   378    5  1949   10      0.843   29.5    77   500
2 R              378   378    5  1949   10      0.843   29.5    77   500
       ------------------------------------------------------------------------
         0    0  756   756    5                 0.843   29.5    77
--------------------------------------------------------------------------------
 Pedestrians
  Across W approach      53               7      0.025   13.6   0.0
================================================================================
 ALL VEHICLES          Total   %       Cycle      Max   Aver.   Max
                       Flow   HV       Time       X    Delay  Queue
                       2213    5         40      0.857   22.2   132
================================================================================
Peak flow period = 30 minutes.

Queue values in this table are 95% back of queue (metres).

Note: Basic Saturation Flows (in through car units) have been adjusted for
      grade, lane widths, parking manoeuvres and bus stops.
```

Table S.15 - Capacity and Level of Service

```
Kent Terrace Signals
AM Peak
Intersection ID: 0
Fixed-Time Signals, Cycle Time =  40 (Practical Cycle Time)

--------------------------------------------------------------------------------
 Mov     Mov    Green Time  Total  Total    Deg.   Aver.   LOS  Longest Queue
 ID      Typ    Ratio (g/C) Flow    Cap.     of    Delay          95% Back
               ------------ (veh   (veh     Satn                (vehs)  (m)
                1st   2nd     /h)    /h)    (v/c)  (sec)
                grn   grn
--------------------------------------------------------------------------------
East: WICB East
   5 T        0.450*         1457   1700   0.857*   18.4    B     18.1    132
--------------------------------------------------------------------------------
North: Kent Terrace
   9 R        0.250*          756    897   0.843    29.5    C     10.6     77
--------------------------------------------------------------------------------
Pedestrian Movements
  P7    (Ped) 0.175            53   2100   0.025    13.6    B      0.0      0
--------------------------------------------------------------------------------
  ALL VEHICLES:              2213          0.857    22.2    C     18.1    132
--------------------------------------------------------------------------------
  INTERSECTION (persons):    3373                   22.0          18.1    132
--------------------------------------------------------------------------------
     Level of Service calculations are based on
     average control delay including geometric delay (HCM criteria),
     independent of the current delay definition used.
     For the criteria, refer to the "Level of Service" topic in the
     SIDRA Output Guide or the Output section of the on-line help.
     Intersection capacity is calculated considering vehicle movements only.
  *  Maximum v/c ratio, or critical green periods
```

Table S.16 - SCATS MF Parameter

Kent Terrace Signals
AM Peak
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 40 (Practical Cycle Time)

Lane No.	Stopline Flow (veh/h)	Capacity (veh/h)	SCATS Satn Flow	SCATS MF	Deg. Satn x	Lane Util. %
East: WICB East						
1 T	729	850	1950	1462	0.857	100
2 T	729	850	1950	1462	0.857	100
North: Kent Terrace						
1 R	378	448	1857	1161	0.843	100
2 R	378	448	1857	1161	0.843	100

STOPLINE FLOW: Departure flow rate in veh/h as measured at the stop line. This cannot exceed capacity.

SCATS SATURATION FLOW: This allows for lane width, approach grade and turning vehicles. Saturation flow scale applies if specified. The effects of heavy vehicles, parking manoeuvres, number of buses stopping and conflicting pedestrian volume are not included.

SCATS MF: This emulates the MF (Maximum Flow) parameter used in the SCATS control system. It is calculated from the SCATS SATURATION FLOW parameter.

DEG. SATN: The Demand (Arrival) Flow Rate may exceed the Stopline Flow Rate, therefore x > 1 is possible.

Table D.0 - Geometric Delay Data

Kent Terrace Signals
AM Peak
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 40 (Practical Cycle Time)

From Approach	To Approach	Turn	Negn Radius (m)	Negn Speed (km/h)	Negn Dist. (m)	Appr. Dist. (m)	Downstream Distance (m)	User Spec?
East: WICB East								
	West	Thru	S	50.0	10.0	500	76	No
North: Kent Terrace								
	West	Right	5.0	15.5	10.0	500	76	No

Downstream distance is distance travelled from the stopline until exit cruise speed is reached (includes negotiation distance). Acceleration distance is weighted for light and heavy vehicles. The same distance applies for both stopped and unstopped vehicles.

Table D.1 - Lane Delays

Kent Terrace Signals
AM Peak
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 40 (Practical Cycle Time)

Lane No.	Deg. Satn x	Stop-line Delay 1st d1	2nd d2	Total dSL	Acc. Dec. dn	Queuing Total dq	MvUp dqm	Stopd (Idle) di	Geom dig	Control dic
East: WICB East										
1 T	0.857	11.0	7.4	18.4	7.4	11.0	2.5	8.5	0.0	18.4
2 T	0.857	11.0	7.4	18.4	7.4	11.0	2.5	8.5	0.0	18.4
North: Kent Terrace										
1 R	0.843	16.4	5.6	22.0	3.3	18.7	3.1	15.6	7.4	29.5
2 R	0.843	16.4	5.6	22.0	3.3	18.7	3.1	15.6	7.4	29.5

dn is average stop-start delay for all vehicles queued and unqueued

Table D.2 - Lane Stops

Kent Terrace Signals
AM Peak
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 40 (Practical Cycle Time)

Lane No.	Deg. Satn x	-- Effective Stop Rate -- Geom. he1	he2	hig	Overall h	Prop. Queued pq	Queue Move-up Rate hqm
East: WICB East							
1 T	0.857	0.85	0.24	0.00	1.10	0.960	0.35
2 T	0.857	0.85	0.24	0.00	1.10	0.960	0.35
North: Kent Terrace							
1 R	0.843	0.85	0.25	0.00	1.09	1.000	0.46
2 R	0.843	0.85	0.25	0.00	1.09	1.000	0.46

hig is the average value for all movements in a shared lane
hqm is average queue move-up rate for all vehicles queued and unqueued

Table D.3A - Lane Queues (veh)

Kent Terrace Signals
AM Peak
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 40 (Practical Cycle Time)

Lane No.	Deg. Satn x	Ovrfl. Queue No	Average (veh) Nb1	Nb2	Nb	Percentile (veh) 70%	85%	90%	95%	98%	Queue Stor. Ratio
East: WICB East											
1 T	0.857	1.6	8.1	2.4	10.5	12.7	15.1	16.4	18.1	19.8	0.88
2 T	0.857	1.6	8.1	2.4	10.5	12.7	15.1	16.4	18.1	19.8	0.88

North: Kent Terrace										
1 R	0.843	0.6	4.6	0.9	5.5	6.8	8.2	9.1	10.6	12.1	0.15
2 R	0.843	0.6	4.6	0.9	5.5	6.8	8.2	9.1	10.6	12.1	0.15

Values printed in this table are back of queue (vehicles).

Table D.3B - Lane Queues (metres)

Kent Terrace Signals
AM Peak
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 40 (Practical Cycle Time)

Lane No.	Deg. Satn x	Ovrfl. Queue No	Average (metres) Nb1	Nb2	Nb	Percentile (metres) 70%	85%	90%	95%	98%	Queue Stor. Ratio
East: WICB East											
1 T	0.857	11.6	59.2	17.5	76.7	92.9	110.1	119.7	132.0	144.4	0.88
2 T	0.857	11.6	59.2	17.5	76.7	92.9	110.1	119.7	132.0	144.4	0.88
North: Kent Terrace											
1 R	0.843	4.6	33.6	6.4	40.0	49.3	60.0	66.7	77.4	88.0	0.15
2 R	0.843	4.6	33.6	6.4	40.0	49.3	60.0	66.7	77.4	88.0	0.15

Values printed in this table are back of queue (metres).

Table D.4 - Movement Speeds (km/h) and Geometric Delay

Kent Terrace Signals
AM Peak
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 40 (Practical Cycle Time)

Mov ID	App. Speeds Cruise	Negn	Exit Speeds Negn	Cruise	Queue Move-up 1st Grn	2nd Grn	Av. Section Spd Running	Overall	Geom Delay (sec)
East: WICB East									
5 T	50.0	50.0	50.0	50.0	32.2		40.3	34.6	0.0
North: Kent Terrace									
9 R	50.0	15.5	15.5	50.0	23.4		37.5	29.2	7.4

"Running Speed" is the average speed excluding stopped periods.

Table D.5 - Progression Factors and Actuated Signal Parameters

Kent Terrace Signals

AM Peak
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 40 (Practical Cycle Time)

Mov ID	Control	Coord.	Arrival Type	Delay Prog. Factor	Queue Prog. Factor	Disp. Grn. Settings 1st Grn Gmin	1st Grn Gmax	2nd Grn Gmin	2nd Grn Gmax
East: WICB East									
5 T	FT	No	3	1.000	1.000	6	NA		
North: Kent Terrace									
9 R	FT	No	3	1.000	1.000	6	NA		
Pedestrians									
P7	FT	No	3	1.000	1.000				

Table D.6 - Gap Acceptance Parameters

Kent Terrace Signals
AM Peak
Intersection ID: 0
Fixed-Time Signals, Cycle Time = 40 (Practical Cycle Time)

No opposed movements at this intersection

APPENDIX D

PARAMICS TRAVEL TIME PATHS


7. WICB to Cambridge
8. WICB Willis to Cambridge
9. WICB Cambridge to Rugby
10. WICB Rugby to Terrace Tunnel
10
8
9
Wellington
Wellington.govt.nz
New Zealand
Epuni St
Ohiro Rd
Nairn St
Thompson St
Victoria St
Cuba St
Torrens Tce
Hopper St
Taranaki St
Tasman St
Sussex St
Cambridge Tce
Kent Tce
Brougham St
Hawker St
Willis St
The Terrace
Boulcott St
Wellington Urban Motorway
Salamanca Rd
Clermont Tce
Clifton Tce
Aurora Tce
Bolton St
Bowen St
Lambton Quay
Customhouse Quay
Featherston St
Willis St
Jervois Quay
Queens Wharf
Waterloo Quay
Thorndon Quay
Hobson St
Murphy St
Molesworth St
Mulgrave St
Pipitea St
Aitken St
Ballance St
Whitmore St
Stout St
Tinakori Rd
Grant Rd
Hill St
Harriett St
Poplar Gr
George St
Park St
Hawkestone St
Webb St
Abel Smith St
Ghuznee St
Cuba Mall
Manners St
Manners Mall
Bond St
Mercer St
Willeston St
Hunter St
Grey St
Panama St
Brandon St
Johnston St
Harris St
Wakefield St
Dixon St
Courtenay Pl
Haining St
Frederick St
Jessie St
College St
Lorne St
Tennyson St
Allen St
Blair St
Cable St
Herd St
Oriental Pde
Roxburgh St
Majoribanks St
Elizabeth St
Pirie St
Ellice St
Paterson St
Douglas St
Rugby St
Arthur St
Aro St
Karo Dr
Marion St


18. Adelaide to Bypass
19. Adelaide to Cambridge
20. Adelaide to Ellice St
18
19
21
Wellington
Wellington.govt.nz New Zealand
Salamanca Rd
Clermont Tce
Bowen St
Tinakori Rd
Wellington Urban Motorway
Grant Rd
Harriett St
Poplar Gr
George St
Park St
Hawkestone St
Molesworth St
Murphy St
Hobson St
Thorndon Quay
Pipitea St
Aitken St
Mulgrave St
Featherston St
Hill St
Bolton St
Aurora Tce
Clifton Tce
The Terrace
Boulcott St
Lambton Quay
Customhouse Quay
Ballance St
Stout St
Whitmore St
Grey St
Panama St
Brandon St
Johnston St
Hunter St
Willis St
Mercer St
Bond St
Manners St
Manners Mall
Dixon St
Victoria St
Cuba St
Cuba Mall
Ghuznee St
Vivian St
Webb St
Karo Dr
Aro St
Ohiro Rd
Epuni St
Nairn St
Thompson St
Torrens Tce
Hopper St
Arthur St
Abel Smith St
Marion St
Taranaki St
Haining St
Frederick St
Jessie St
Tory St
Tasman St
Douglas St
College St
Lorne St
Tennyson St
Courtenay Pl
Allen St
Blair St
Wakefield St
Cable St
Herd St
Queens Wharf
Jervois Quay
Harris St
Williston St
Waterloo Quay
Kent Tce
Oriental Pde
Roxburgh St
Majoribanks St
Hawker St
Dufferin St
Pirie St
Elizabeth St
Brougham St
Paterson St


21. Adelaide to Victoria Tunnel
22. Victoria Tunnel to Adelaide
23. Victoria Tunnel to Bypass
Wellington
Wellington.govt.nz New Zealand
Salamanca Rd
Clermont Tce
Bowen St
Tinakori Rd
Wellington Urban Motorway
Grant Rd
Epuni St
Bolton St
Clifton Tce
Aurora Tce
Hill St
Molesworth St
Murphy St
Hobson St
Thorndon Quay
The Terrace
Boulcott St
Lambton Quay
Customhouse Quay
Featherston St
Waterloo Quay
Ohiro Rd
Aro St
Karo Dr
Willis St
Victoria St
Nairn St
Thompson St
Webb St
Vivian St
Ghuznee St
Dixon St
Manners St
Bond St
Mercer St
Willeston St
Hunter St
Harris St
Wakefield St
Jervois Quay
Queens Wharf
Cuba St
Cuba Mall
Torrens Tce
Hopper St
Arthur St
Abel Smith St
Marion St
Taranaki St
Haining St
Frederick St
Jessie St
Courtenay Pl
Tory St
Tasman St
Sussex St
College St
Lorne St
Tennyson St
Allen St
Blair St
Cable St
Herd St
Kent Tce
Oriental Pde
Roxburgh St
Pirie St
Elizabeth St
Majoribanks St
Brougham St
Hawker St
Douglas St
Ellice St
Grey St
Panama St
Brandon St
Johnston St
Ballance St
Whitmore St
Stout St
Aitken St
Mulgrave St
Pipitea St
Hawkestone St
Park St
George St
Poplar Gr
Harriett St
22
23
23


27. Kent to Victoria Tunnel
28. Kent to Adelaide
29. Kent to WICB
25
27
28
Wellington
Wellington.govt.nz
New Zealand
Salamanca Rd
Clermont Tce
Bolton St
Bowen St
Hill St
Harriett St
Poplar Gr
George St
Park St
Grant Rd
Tinakori Rd
Wellington Urban Motorway
Hawkestone St
Molesworth St
Murphy St
Hobson St
Thorndon Quay
Pipitea St
Aitken St
Mulgrave St
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Kent Tce
Oriental Pde
Roxburgh St
Majoribanks St
Pirie St
Elizabeth St
Ellice St
Brougham St
Hawker St
Douglas St

ADDENDUM 1

GRADE SEPARATION TESTS

Wellington Office
Level 9, Majestic Centre
100 Willis Street, PO Box 12-003
Wellington, New Zealand

Tel +64 4 471 7000
Fax +64 4 471 1397

TO	Ngauranga to Airport Steering Group
COPY	Wayne Stewart
FROM	Roger Burra
DATE	30 April 2008
FILE	
SUBJECT	Grade Separation of Basin Reserve: Paramics Modelling Results

This note presents the results of modelling tests for an option to grade separate SH1 from local traffic at the Basin Reserve in Wellington CBD. The note also documents the assumptions used in developing the tests and the methods applied during the modelling.

The decision to undertake the tests using Paramics was made on the basis that the SATURN CBD trip matrices are based upon the 2001 Emme/2 regional mode choice model. The Paramics model is considered more current because it has recently been calibrated for 2007 conditions.

Future Year Matrices

A future year matrix was developed from the 2016 emme/2 regional model. Given the time available, a relatively coarse method was used to assign the trips contained in the emme/2 matrices to the Paramics matrices. Comparison of the Paramics 2006 base matrices against the 2016 matrices shows a 17% and 16% increase in the total number of trips in the model for the AM and PM peak periods respectively. It is expected that the method used to develop the Paramics matrices results in slightly higher numbers of trips using the modelled network than is likely.

Future Year Network

The figures overleaf show the grade separated option that was modelled. The following road arrangement was modelled:

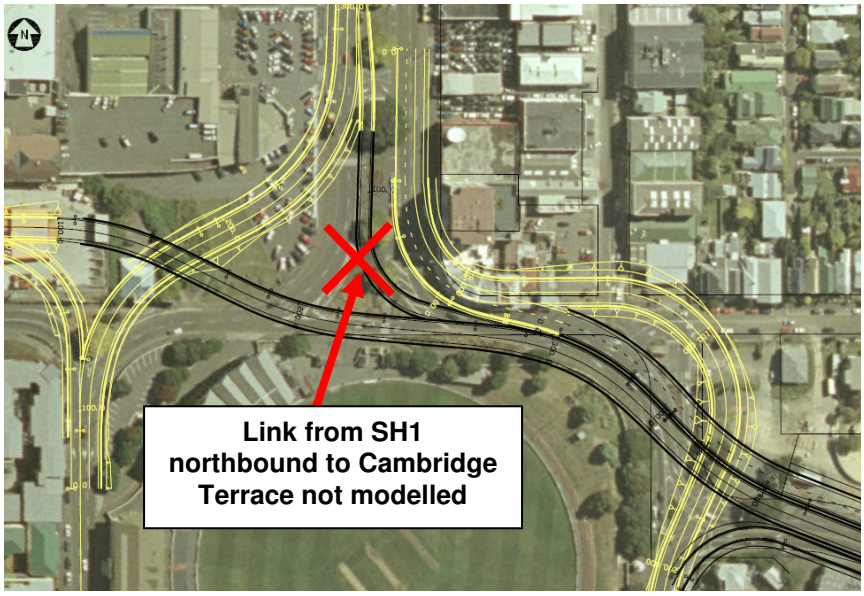
- Grade separation for SH1 northbound
- Local traffic travelling from Kent Terrace to Adelaide Road (Dufferin Street) passes beneath both directions of SH1.
- Local traffic travelling from Adelaide Road to Cambridge Terrace (Sussex Street) passes beneath SH1 Northbound.
- No exit-slip from SH1 northbound to Cambridge Terrace
- Maintain the pedestrian crossing facilities and bus pre-signal immediately north of the Basin Reserve on Kent and Cambridge Terraces.
- Signalised intersection between Patterson Street exit slip and the Basin Reserve (Dufferin Street)
- Adelaide Road has a single north and southbound lane for general traffic and a passenger transport lane in each direction.
- One lane in each direction through the Mount Victoria Tunnel.

A number of variations have been tested. Initially U-turns from Cambridge to Kent Terrace were banned in order to improve traffic efficiency on Kent Terrace. However this was found to increase pressure on the Vivian Street / Kent Terrace intersection such that motorists using SH1 were significant delayed. U-turns were therefore re-instated.

Initially the intersection between Sussex Street (the Basin Reserve) and Buckle Street (SH1 NB) was coded as a merge. This was found to cause severe delays for traffic from Adelaide Road to SH1 northbound. Following consultation with the steering group this was coded as a merging lane so that Buckle Street has three lanes from the merge until it flares to four lanes (as at present) at the Taranaki Street intersection.

Tests found that even when the third "merging" lane is added, SH1 traffic is interrupted as vehicles merge to the right in advance of turns into Tory Street and Taranaki Street from SH1. In order to resolve this issue, additional tests were undertaken for the AM peak hour where turns to Taranaki and Tasman Streets are banned. This change represents a potential outcome of Buckle Street National Memorial project.

Figure 1: Potential Alignment for Grade Separated Option at the Basin Reserve



For the do-minimum scenario, it was assumed there are no changes to the existing road network.

Signal Optimisation

It is possible using Paramics, to optimise adjacent signalised intersections so that specified traffic movements receive a green wave. This process must be undertaken manually for each intersection. Due to time constraints it has not been possible to optimise all intersections on SH1 within the model.

Results

Results have been prepared for the 2016 Forecast Year. The outputs presented in this report are traffic flows for selected movements and travel times for defined paths within the model. Results are presented either as the difference between Do-minimum and Do-something scenarios for 2016.

Table 1 below shows that the 2016 AM peak hour demand flows. The values represent the numbers of vehicles would make each movement if there were sufficient road capacity.

Table 1: 2016 AM Peak Demand Flows

Location	One Hour Demand Flows (Vehicles)
From Mt Victoria Tunnel	1622
Mt Victoria Tunnel to Cambridge Terrace	871
Mt Victoria Tunnel to Adelaide Road	101
Mt Victoria Tunnel to Buckle Street	645
From Adelaide Road to Buckle Street	662
From Adelaide Rd to Cambridge Terrace	434
Kent Terrace to Adelaide Road	1091
Kent Terrace to Mt Victoria Tunnel	593

There are however some locations where vehicles could not pass into the model because of road network capacity constraints. The number of unreleased vehicles in 2016 for each modelling scenario is presented in the table below.

Table 2 shows that the proposed changes increase the numbers of vehicles which may enter the model from the Mount Victoria Tunnel and Adelaide Road, however fewer vehicles enter the model from Kent Terrace (southbound), the Terrace Tunnel and Taranaki Street (northbound). Significantly, the results show that grade separating the Basin Reserve reduces the number of vehicles which cannot pass into the model in the AM peak hour.

Table 2: 2016 AM Peak Unreleased Traffic

Location	Do Minimum	Grade Separation Only		Grade Separation with Tory / Tasman Intersection	
	No. Vehs.	No. Vehs.	Diff. from DM	No. Vehs.	Diff. from DM
From Mt Vic Tunnel	205	26	179	72	133
From Adelaide Road	457	232	225	283	174
From Kent Terrace	0	79	-79	82	-82
From Terrace Tunnel	963	965	-2	1003	-40
From Taranaki Street	113	184	-71	242	-129

Table 3 shows the numbers of vehicles making specified movements in each modelled scenario. The table shows that in the 2016 AM peak hour, the number of vehicles passing through the Mount Victoria Tunnel is forecast to increase, but by less than 100 vehicles per hour.

The option to grade separate without implementing changes to the Tory / Tasman Street intersection performed better than if intersection improvements are made.

Table 3: 2016 AM Peak Forecast Turning Movements

Location	DM	Grade Separation Only	Grade Separation with Tory St
From Mt Victoria Tunnel	1470	1547	1544
Mt Victoria Tunnel to Buckle Street via Grade Separation	N/A	975	828
Sussex Street to Buckle Street	1605	750	713
Left Turn from Mt Victoria Tunnel to Dufferin Street	1453	578	695
Left Turn from Kent Terrace to Mt Victoria Tunnel	825	1076	996
Left Turn from Dufferin Street to Adelaide Road	516	573	547
Left Turn from Adelaide Road to Rugby Road	883	922	926
Sussex Street to Cambridge Terrace	786	1502	1570

Travel Times

Table 4 shows the differences between the forecast travel times for the 2016 minimum (DM), 2016 Grade separation only and 2016 grade separation with turns from Buckle Street to Tasman and Tory Streets closed. The table presents the results for the AM period only.

Table 4: 2016 AM Peak Forecast Travel Times for Selected Journeys

Ref	Route	No. of runs	2016 DM	Grade-Separation Only		Grade-Separation + Tory / Tasman	
				Time (Secs)	Diff.	Time (Secs)	Diff.
1	*Taranaki Street Southbound*	**12**	162	159	**-3**	167	5
2	*Taranaki Street Northbound*	**12**	152	185	**34**	232	**80**
4	*Willis Street Northbound*	**12**	253	270	17	268	16
5	*Victoria Street Southbound*	**12**	173	145	**-28**	151	**-22**
7	*Vivian Street - Terrace Tunnel to Cambridge Terrace*	**12**	192	315	**123**	342	**151**
8	*Vivian Street - Willis Street to Cambridge Terrace*	**12**	105	228	**122**	251	**145**
9	*Kent Terrace – Pirie Street to Adelaide Road*	**12**	109	117	8	121	12

				Grade-Separation Only		Grade-Separation + Tory / Tasman	
18	*Adelaide Road to Taranaki Street*	**12**	300	296	**-4**	313	13
19	*Adelaide Road to Cambridge Terrace*	**12**	303	245	**-57**	267	**-36**
22	*Mt Victoria Tunnel to Adelaide Road*	**12**	216	141	**-74**	222	6
23	*Mt Victoria Tunnel to Taranaki Street*	**12**	247	143	**-103**	162	**-85**
					0		0
25	*Mt Victoria Tunnel to Cambridge Terrace*	**12**	253	196	**-57**	268	15
					0		0
27	*Kent Terrace – Vivian Street to Mt Victoria Tunnel*	**12**	91	91	0	91	0
28	*Kent Terrace – Vivian Street to Adelaide Road*	**12**	132	143	10	145	12

The table shows that motorists travelling on SH1 from the Terrace Tunnel are forecast to have faster travel times from the Mount Victoria Tunnel to Taranaki Street. The table shows that on average motorist making this movement will save 103 seconds if all movements are permitted at the Tory / Tasman intersection. A smaller reduction in travel times is forecast where changes to the Tory / Tasman intersection are made.

The table also shows that motorists travelling along Vivian Street would experience longer travel times than the do minimum option for each grade separation scenario. Comparison of journeys 7, 8 and 9 indicates that the majority of the additional travel time is experienced between Willis Street and Cambridge Terrace.

The results also show that journeys from Adelaide Road are forecast to improve. Again the savings are greatest for the scenario where the Tory / Tasman intersection remains unchanged.

Conclusion

The intersection between Patterson Street and Dufferin Street on the Basin Reserve Gyratory, currently limits the amount of traffic that uses SH1 NB (Buckle Street). Enabling northbound traffic on SH1 to pass over this intersection brings travel time benefits to motorists making this journey. The results also show, that as well as improving travel times, the improvements allow a greater number of vehicles to pass though the Mount Victoria Tunnel. It should however be noted, that the forecast increase is relatively low, indicating that the Mount Victoria Tunnel also has a limiting effect on the numbers of northbound vehicles using SH1.

There are however wider impacts affecting the efficiency of the network. Accommodating higher traffic volumes on SH1 northbound, requires a greater proportion of the intersection cycle time to be assigned to this movement. This results in queuing on local roads which intersect with SH1.

Currently a significant amount of traffic moves from SH1 northbound to Cambridge Terrace in order to access locations between Buckle Street, Vivian Street, Cambridge Terrace and Taranaki Street. Grade separating SH1 without providing for this movement forces

motorists to re-route, either by leaving SH1 immediately after passing through the Mount Victoria Tunnel and travelling around the Basin Reserve, or by turning right into Tory or Taranaki Street. The modelling work, undertaken thus far, indicates that this increases pressure at intersections on the SH1 both on Buckle Street, but more significantly on Vivian Street. The delays on Vivian Street are in part associated with the increased numbers of vehicles making the right turn from Taranaki Street to Vivian Street. This change in assignment not only means that green time is taken away from Vivian Street traffic but also increases the numbers of vehicles using Vivian Street resulting in more delay and congestion.