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DATE 28 May 2015  
FILE 6-XT177.62/305DC  
SUBJECT Traffic Modelling of SH6A/ Ballarat Street  
Intersection

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## 1 Introduction

Opus have been commissioned to investigate options for addressing congestion problems at the State Highway 6A (SH6A)/ Ballarat Street intersection in Queenstown.

The intersection is currently a single lane roundabout, with a zebra crossing on its south-eastern approach. The zebra crossing is part of a busy pedestrian route into central Queenstown, and during busy times the high pedestrian volumes restrict traffic flow through the roundabout, leading to vehicle delays and long queues which impact upstream intersections.

The congestion is serious enough that manual traffic control is employed during the Christmas/ New Year period.

## 2 Traffic Volumes

Traffic count data from the 1<sup>st</sup> December 2014 to the 23<sup>rd</sup> January 2015 was analysed from the nearby State Highway count station. Using this data it was determined that the 24<sup>th</sup> December was the most representative of the holiday peak days. Traffic counts for this day were then obtained from pre-recorded video surveillance.

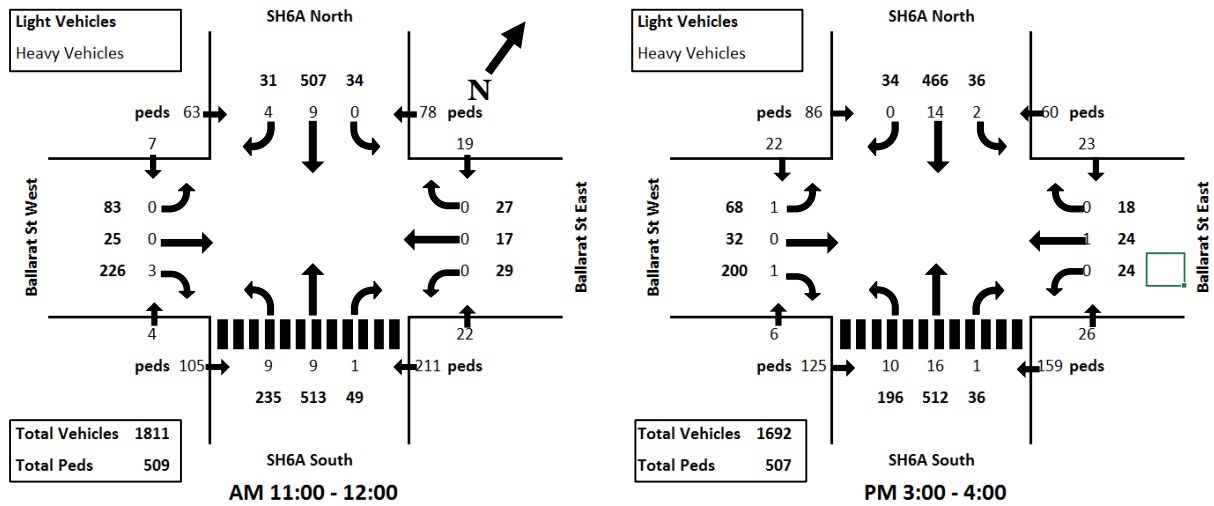
Traffic and pedestrian volumes through the intersection were recorded on Wednesday 24 December 2014 to represent summer holiday conditions, and on Thursday 23 April to represent non-holiday conditions.

The non-holiday surveys found the morning peak hour to be 8:15 - 9:15am and the afternoon peak hour to be 5:00 - 6:00pm.

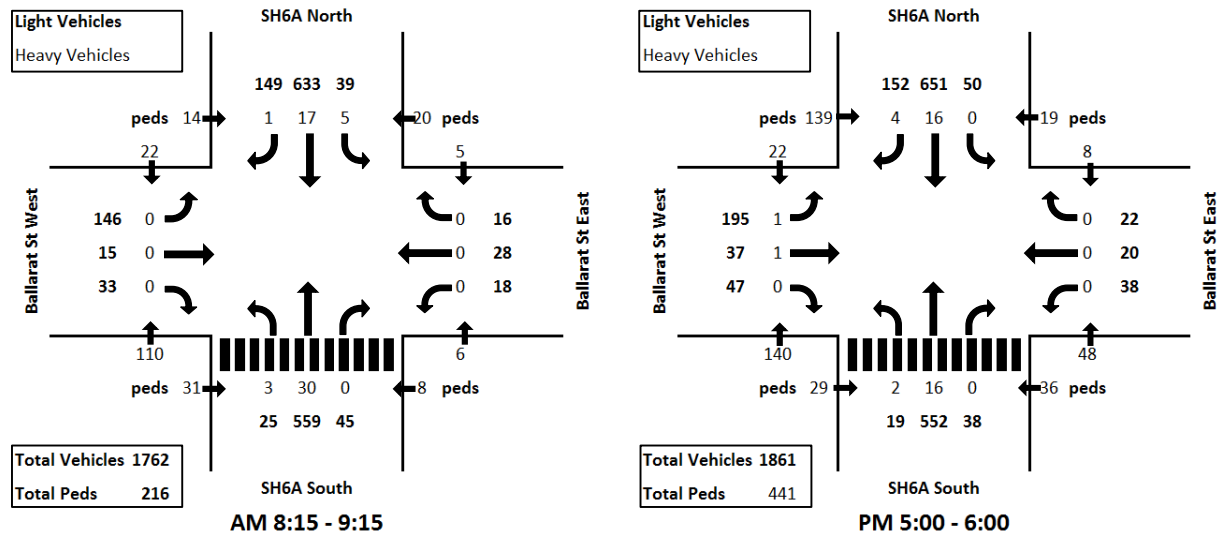
Based on traffic volumes from the State Highway count station, the holiday surveys used a morning peak hour of 11:00 - 12:00am and an afternoon peak hour of 3:00 - 4:00pm.

The results are shown in Figure 1 and Figure 2.





**Figure 1 - Traffic and pedestrian volumes at SH6A/ Ballarat Street roundabout (Wednesday 24/12/2014)**



**Figure 2 - Traffic and pedestrian volumes at SH6A/ Ballarat Street roundabout (Thursday 23/04/2015)**

The total number of vehicles passing through the intersection is relatively similar in all four time periods, differing by only 9% between the lowest (December PM) and the highest (April PM). The pedestrian numbers differ more, with the highest peak period (December AM) being 77% higher than the lowest peak period (April AM).

The existing intersection has been modelled for all four peak periods. A range of different options has then been tested for the December AM peak period only. This is because the December AM peak period has a similar number of vehicles to the other 3 peak periods, while it has a greater number of pedestrians, which are shown later in this report to have a significant impact on the operation of the intersection. The preferred option has then been tested in all four peak periods.

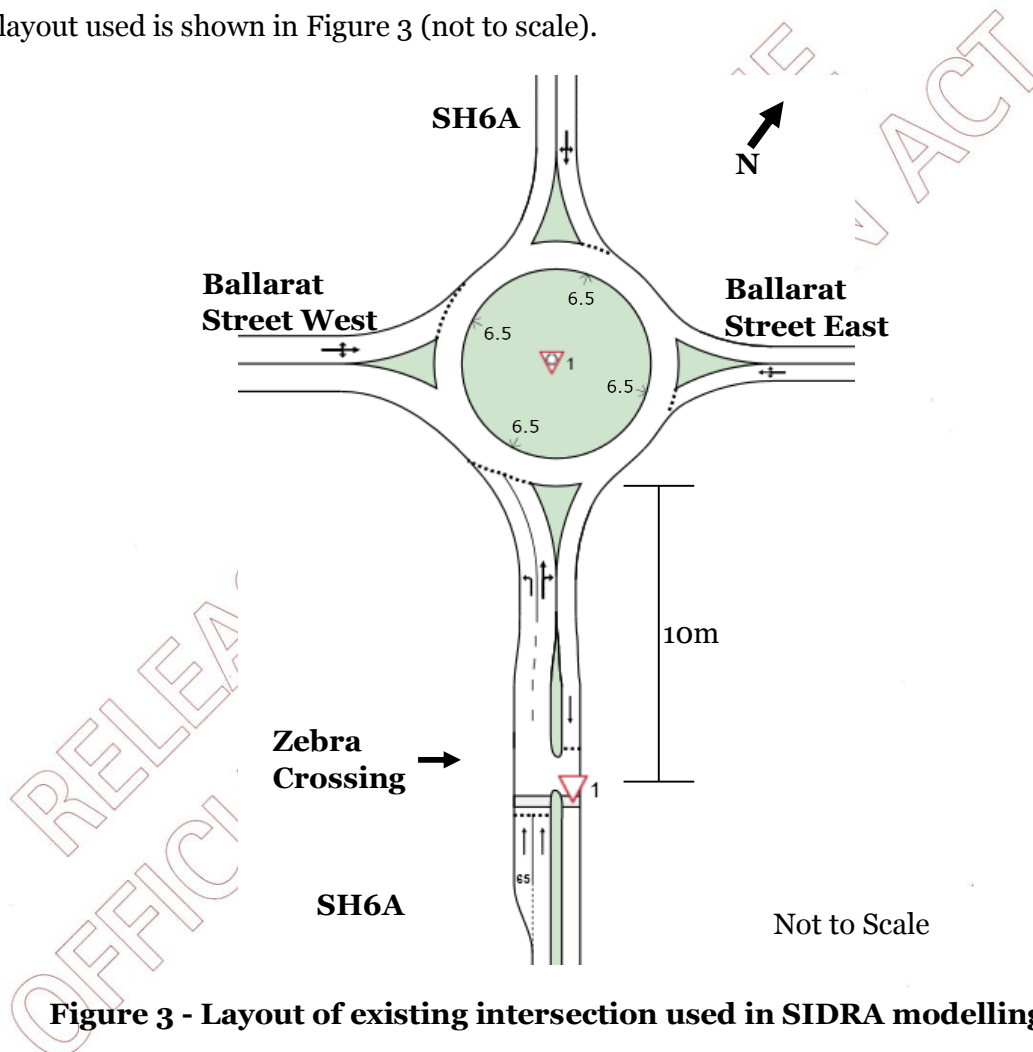
### 3 Existing Intersection Performance

The existing roundabout was modelled using SIDRA INTERSECTION 6.1. It was set up as a network consisting of two linked intersections:

1. The roundabout; and
2. The pedestrian crossing.

Queues on the SH6A approaches have been observed to extend back to adjacent intersections, beyond which they branch off to different routes and merge into the surrounding transport activity. It is therefore difficult to quantify queue lengths at the intersection, so queue lengths were not recorded during the surveys. Therefore the model has not been calibrated and is based on default parameters.

The layout used is shown in Figure 3 (not to scale).



**Figure 3 - Layout of existing intersection used in SIDRA modelling**

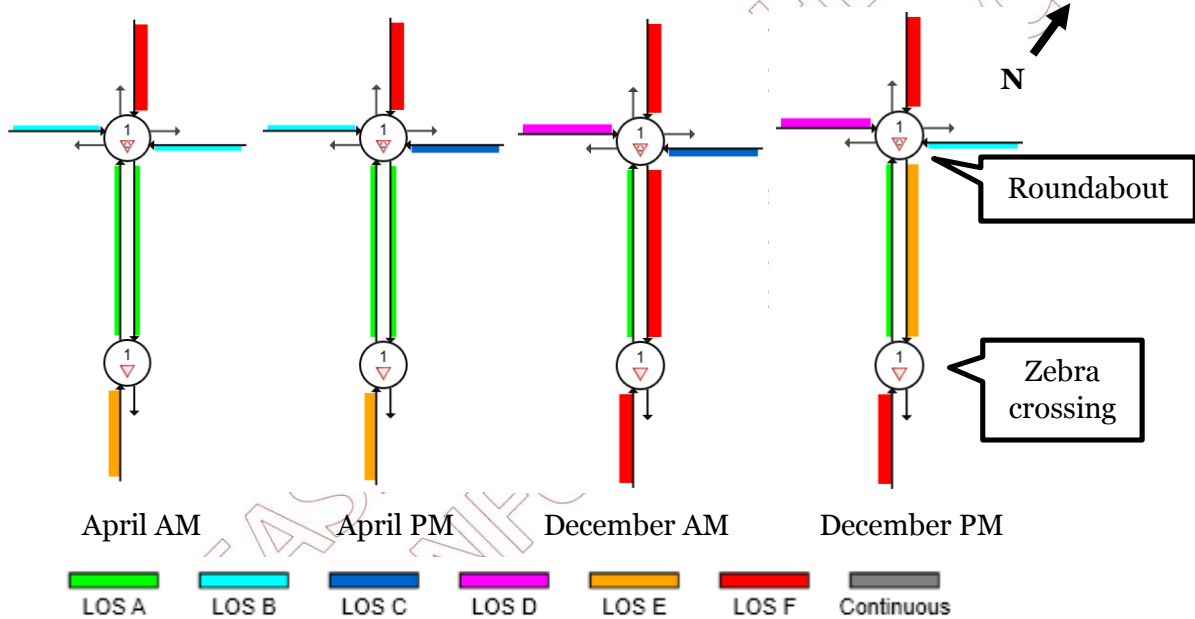
The results for the existing roundabout are included in detail in Appendix A. The network summary, roundabout summary, and zebra crossing summary are included for each time period. These are summarised in Table 1. Queue lengths on the south approach are measured from the zebra crossing, whereas queue lengths on the other approaches are measured from the roundabout limit line.



	23 April 2015		24 December 2014	
	AM	PM	AM	PM
Intersection level of service	F	F	F	E
Average Vehicle Delay (s)	113	127	92	59
95% Queue Length South (m)	137	138	275	234
95% Queue Length East (m)	9	14	11	10
95% Queue Length North (m)	1730	1860	742	602
95% Queue Length West (m)	15	23	85	61

**Table 1 - Modelling results for existing layout**

The levels of service on each approach are shown diagrammatically for the 4 time periods in Figure 4.



**Figure 4 - Levels of service of existing roundabout and crossing**

The results show that the northern approach experiences the longest queues and poorest level of service in all periods. This approach is particularly poor in the April time periods when there are greater southbound traffic volumes.

The pedestrian crossing has a greater impact on the intersection in the December time periods when there are higher pedestrian numbers.

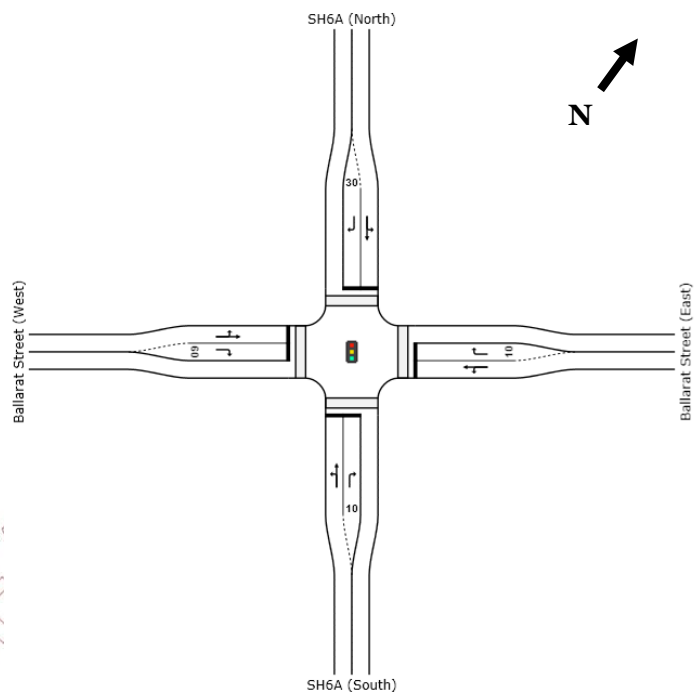
The Ballarat Street approaches are performing at higher levels of service than the SH6A approaches in all time periods.

## 4 Testing of Options

The following options were tested in SIDRA INTERSECTION 6.1:

- A. Existing roundabout with pedestrian crossing removed
- B. Existing roundabout with pedestrian crossing relocated 50m south
- C. Existing roundabout with pedestrian crossing signalised
- D. Existing roundabout with pedestrian crossing relocated 50m south and signalised
- E. Signalised intersection
  - 1. Two phases
  - 2. Two phases with Barnes dance pedestrian phase
  - 3. Single diamond (SH6A)
  - 4. Four split-phases

The layout used for the signalised intersection is shown in Figure 5.



**Figure 5 - Layout of signalised intersection used in modelling**

Diagrams showing the phase sequences used are shown in Figure 6.

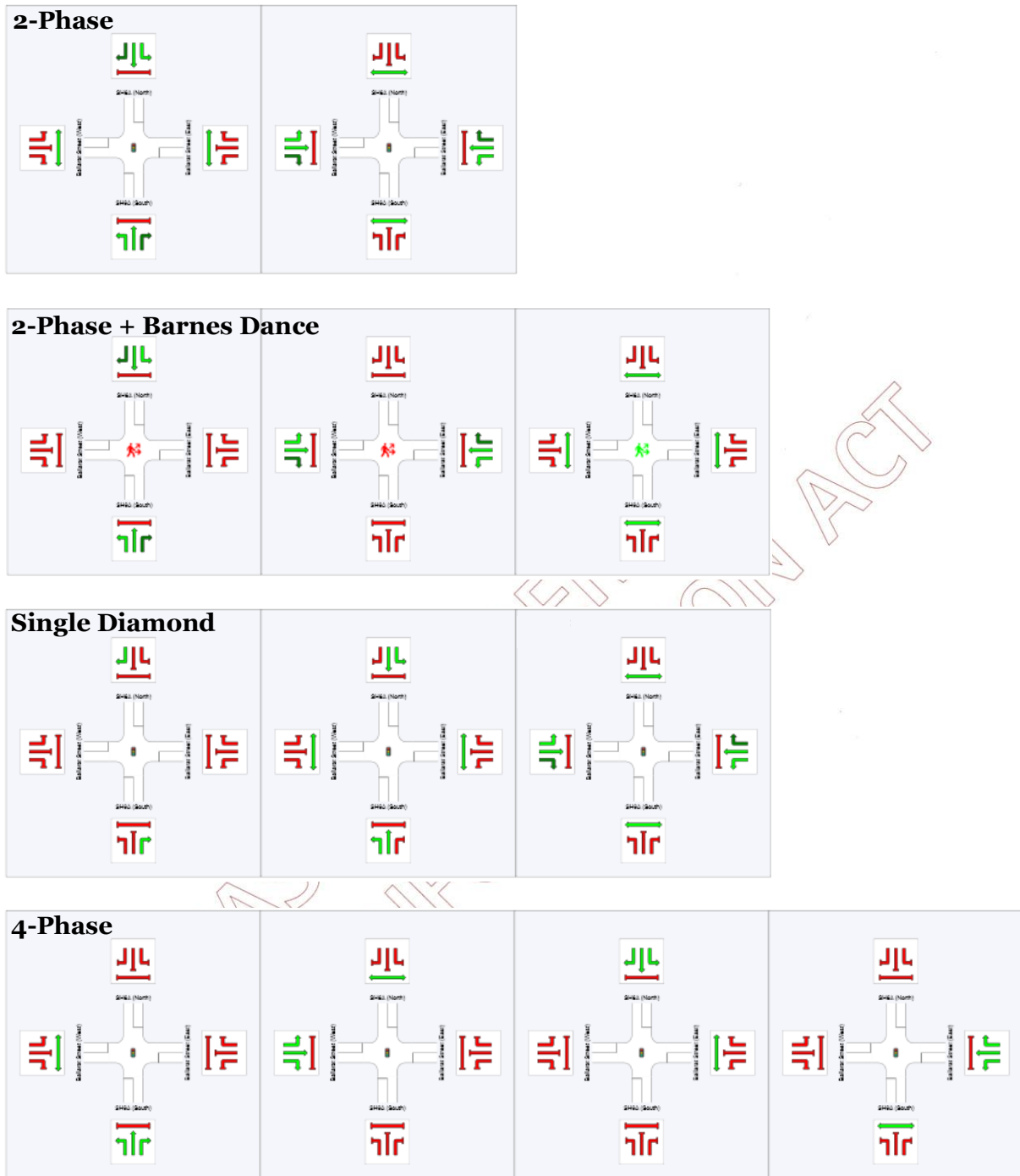


Figure 6 - Phase sequences used in options for signalised intersection



Each option was tested for the critical December AM peak period. The detailed results are included in Appendix B, and summarised in Table 2.

	Existing Intersection	Option							
		A	B	C	D	E1	E2	E3	E4
		Crossing removed	Crossing relocated	Crossing Signalised	Crossing signalised and relocated	2-phase	Barnes dance	Diamond	4-phase
Average Vehicle LoS	F	A	E	E	E	B	C	C	F
Average Vehicle Delay (s)	92	7	82	52	52	18	32	34	314
Average Pedestrian LoS	-	-	-	E	E	C	E	D	E
Average Pedestrian Delay (s)	-	-	-	55	55	23	55	32	53
95% Queue Length South (m)	275	22	23 (42)	77	21 (52)	150	272	282	1020
95% Queue Length East (m)	11	7	11	11	11	9	17	13	19
95% Queue Length North (m)	742	32	742	753	752	75	149	128	718
95% Queue Length West (m)	85	18	85	99	96	53	108	87	192

**Table 2 - Comparison of intersection performance under each option**

The high level of performance for Option A (roundabout with no pedestrian crossing) shows that, in the December AM peak period, the high pedestrian volumes rather than the traffic volumes are the primary reason for the high vehicle delays and queues of the existing intersection.

Option B (pedestrian crossing relocated 50m south) would result in a minor improvement in intersection performance. Queue lengths on the southern approach are reported for both the roundabout limit line (top number) and the upstream zebra crossing (bottom number). These would both reduce considerably from the existing situation, although queue lengths on other approaches would remain unchanged.

Option C (pedestrian crossing signalised) uses a pedestrian phase of 16 seconds and a cycle time of 120 seconds. It would result in a more substantial improvement in intersection delays than Option B. Queue lengths would reduce on the southern approach, but remain almost unchanged on the other three approaches.

Option D (pedestrian crossing signalised and relocated 50m south) would result in the same delays as under Option C (pedestrian crossing signalised), and a negligible reduction in queue lengths. Option D was modelled using a range of cycle times, with the results summarised in Table 3 and detailed in Appendix C.



<b>Cycle Time (s)</b>	<b>60</b>	<b>90</b>	<b>120</b>	<b>150</b>
Average Vehicle LoS	E	E	E	E
Average Vehicle Delay (s)	56	53	52	51
Average Pedestrian LoS	C	E	E	F
Average Pedestrian Delay (s)	25	40	55	71
95% Queue Length South (m)	20 (54)	20 (53)	21 (52)	21 (52)
95% Queue Length East (m)	11	11	11	11
95% Queue Length North (m)	761	755	752	750
95% Queue Length West (m)	114	102	96	93

**Table 3 – Option D performance using different cycle times**

The results show that a longer cycle time will reduce delays and queues for vehicles, while increasing delays for pedestrians; however the variation from the 120 second cycle time in Option D is minimal.

All Option E variants were modelled using the optimum cycle time with a maximum of 120 seconds. They all include pedestrian protection from turning vehicles.

Option E1 (signalised intersection, 2-phase) would result in substantial reductions to vehicle delays and queue lengths on all approaches. Compared to the other signalised options, it would provide a high pedestrian level of service.

Option E2 (signalised intersection, 2-phase + Barnes dance) would result in substantial reductions to vehicle delays and queue lengths on SH6A, although not as substantial as those predicted under Option E1. Delays and queue lengths on all approaches would be higher than Option E1, as would pedestrian delays.

Option E3 (signalised intersection, single diamond overlap) would again result in reductions in delays and queue lengths compared to the existing roundabout, although not as substantially as Option E1. This is because the volume of right-turning traffic is not large, making the diamond phase relatively inefficient.

Option E4 (signalised intersection, 4 split phases) would result in degradation of intersection performance. Split phasing is most efficient when there is significant right-turning traffic from all approaches, whereas this intersection has relatively low volumes of right-turning traffic. Queues and delays would be worse than they are with the existing roundabout.

## 5 Preferred Option

The SIDRA modelling shows Option E1 (signalised intersection, 2-phase sequence) would have the lowest vehicle delays and shortest queues. It would also have the lowest pedestrian delays of the options which include signalised pedestrian movements.

It would formalise pedestrian crossing movements on all approaches. This would be an improvement for pedestrians crossing the east, north and west approaches, although it would introduce delays to pedestrians who currently use the zebra crossing.



Option E1 has been tested further, running it in all four time periods. The results are summarised in Table 4, with the results for the existing roundabout repeated for ease of comparison.

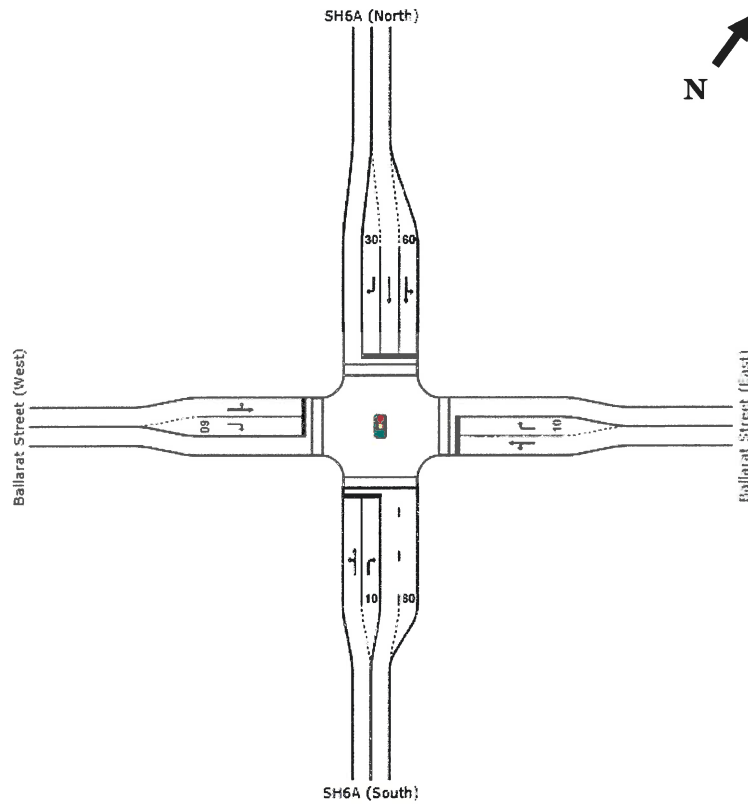
Intersection Layout	Measure	23 April 2015		24 December 2014		
		AM	PM	AM	PM	
Existing roundabout and zebra crossing	Intersection level of service	F	F	F	E	
	95 percentile queue length (m)	South	137	138	275	234
		East	9	14	11	10
		North	1730	1860	742	602
		West	15	23	85	61
Option E1 (signals, 2-phase)	Intersection level of service	B	B	B	B	
	95 percentile queue length (m)	South	91	83	150	130
		East	11	12	9	9
		North	111	145	75	70
		West	44	58	53	45

**Table 4 - Results of modelling for Option E1 (signals, 2-phase)**

The results show that the signalised intersection would operate with the same overall level of service B in all time periods. The option would result in substantial improvements in levels of service and queue lengths in all time periods compared to the existing intersection.

## 5.1 Alternative Preferred Option

In the April peak periods, queue lengths on the north approach would be long enough to affect performance at the upstream intersection with Shotover Street, which is approximately 115m away. These queue lengths could be further reduced if an additional southbound lane was included in the layout. This has been modelled as Option E1.1 using the layout shown in Figure 7, with the results summarised in Table 5 and detailed in Appendix D.



**Figure 7 - Option E1.1 Layout**

Intersection Layout	Measure	23 April 2015		24 December 2014		
		AM	PM	AM	PM	
Existing roundabout and zebra crossing	Intersection level of service	B	B	B	B	
	95 percentile queue length (m)	South	103	94	155	136
		East	8	10	10	11
		North	70	72	55	52
		West	33	46	62	52

**Table 5 - Results of Modelling for Option E1.1 (additional southbound lane)**

The addition of a second southbound through lane would reduce queues on the northern approach significantly. Minor changes to other queue lengths would occur as a result of associated changes to the optimum phase and cycle times.

Preliminary measurements off aerial photographs suggest Option E1 would likely be able to be accommodated within the existing road reserve, although it would require changes to on-street parking, medians and kerbs. Option E1.1 would require more investigation, as it would have more significant impacts on parking, medians, kerbs, accesses and potentially adjacent intersections.



## 6 Conclusions and Recommendation

The existing roundabout controlled intersection is operating at a low level of service with long queues, particularly on the northern approach, which have a significant impact on the wider network.

Several potential options for improving the intersection were tested using SIDRA INTERSECTION 6.1. This showed that the most effective option was to signalise the intersection, and operate it using a simple 2-phase sequence.

A lane configuration consisting of a single left-through lane and a short right-turn lane on each approach could be used, although queuing on the northern approach would still encroach on the upstream intersection with Shotover Street. This queuing could be reduced to a level where it would not encroach on the upstream intersection by adding a second southbound through lane. However this would have more significant impacts on parking, medians and accesses.

It is recommended that the preferred signalised 2-phase option is investigated further.

# **Appendix A**

## **Detailed SIDRA Outputs for Existing Roundabout**

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## NETWORK SUMMARY

Network: Existing April AM

New Network

Network Performance - Hourly Values			
Performance Measure	Vehicles	Per Unit Distance	Persons
Network Level of Service (LOS)	LOS F		
Travel Time Index	1.88		
Speed Efficiency	0.27		
Congestion Coefficient	3.71		
Travel Speed (Average)	13.5 km/h		13.5 km/h
Travel Distance (Total)	1906.0 veh-km/h		2287.2 pers-km/h
Travel Time (Total)	141.4 veh-h/h		169.7 pers-h/h
Desired Speed	50.0 km/h		
Demand Flows (Total)	3289 veh/h		3930 pers/h
Arrival Flows (Total)	3275 veh/h		3930 pers/h
Percent Heavy Vehicles (Demand)	3.4 %		
Percent Heavy Vehicles (Arrival)	3.4 %		
Degree of Saturation	1.133		
Control Delay (Total)	102.84 veh-h/h		123.41 pers-h/h
Control Delay (Average)	113.0 sec		
Control Delay (Worst Lane)	376.1 sec		
Control Delay (Worst Movement)	378.2 sec		
Geometric Delay (Average)	2.9 sec		
Stop-Line Delay (Average)	110.2 sec		
Queue Storage Ratio (Worst Lane)	1.39		
Total Effective Stops	3183 veh/h		3820 pers/h
Effective Stop Rate	0.97 per veh	1.7 per km	0.97 per pers
Proportion Queued	0.65		
Performance Index	759.2		
Cost (Total)	3836.14 \$/h	2.01 \$/km	3836.14 \$/h
Fuel Consumption (Total)	320.9 L/h	168.3 mL/km	
Fuel Economy	16.8 L/100km		
Carbon Dioxide (Total)	758.7 kg/h	398.1 g/km	
Hydrocarbons (Total)	0.136 kg/h	0.071 g/km	
Carbon Monoxide (Total)	1.197 kg/h	0.628 g/km	
NOx (Total)	0.896 kg/h	0.470 g/km	

Network Model Accuracy Level (largest change in degree of saturation for any lane): 2.5 %

Number of Iterations: 10

Network Level of Service (LOS) Method: SIDRA Speed Efficiency.

Model used: New Zealand.

Network Performance - Annual Values		
Performance Measure	Vehicles	Persons
Demand Flows (Total)	1,578,947 veh/y	1,886,387 pers/y
Delay	49,363 veh-h/y	59,236 pers-h/y
Effective Stops	1,527,887 veh/y	1,833,464 pers/y
Travel Distance	914,876 veh-km/y	1,097,851 pers-km/y
Travel Time	67,879 veh-h/y	81,455 pers-h/y
Cost	1,841,348 \$/y	1,841,348 \$/y
Fuel Consumption	154,010 L/y	
Carbon Dioxide	364,197 kg/y	
Hydrocarbons	65 kg/y	
Carbon Monoxide	574 kg/y	
NOx	430 kg/y	

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# MOVEMENT SUMMARY

Site: Existing April AM roundabout

Network: Existing April AM

New Site  
Roundabout

Movement Performance - Vehicles													
Mov ID	OD Mov	Total veh/h	Demand Flows HV %	Total veh/h	Arrival Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: SH6A (South)													
1	L2	29	10.7	29	10.7	0.038	3.7	LOS A	0.2	1.5	0.44	0.54	43.4
2	T1	620	5.1	620	5.1	0.507	2.9	LOS A	3.4	24.9	0.57	0.54	45.6
3	R2	47	0.0	47	0.0	0.507	5.0	LOS A	3.4	24.9	0.57	0.54	45.2
Approach		697	5.0	697	5.0	0.507	3.1	LOS A	3.4	24.9	0.57	0.54	45.4
East: Ballarat Street (East)													
4	L2	19	0.0	19	0.0	0.170	17.0	LOS B	1.4	9.5	0.99	0.88	34.0
5	T1	29	0.0	29	0.0	0.170	16.7	LOS B	1.4	9.5	0.99	0.88	40.2
6	R2	17	0.0	17	0.0	0.170	19.5	LOS B	1.4	9.5	0.99	0.88	40.0
Approach		65	0.0	65	0.0	0.170	17.5	LOS B	1.4	9.5	0.99	0.88	38.9
North: SH6A (North)													
7	L2	46	11.4	46	11.4	1.133	376.7	LOS F	241.5	1729.7	1.00	2.25	8.1
8	T1	684	2.6	684	2.6	1.133	375.6	LOS F	241.5	1729.7	1.00	2.25	4.5
9	R2	158	0.7	158	0.7	1.133	378.2	LOS F	241.5	1729.7	1.00	2.25	8.1
Approach		888	2.7	888	2.7	1.133	376.1	LOS F	241.5	1729.7	1.00	2.25	5.4
West: Ballarat Street (West)													
10	L2	154	0.0	154	0.0	0.310	11.5	LOS B	2.1	14.9	0.83	0.85	42.3
11	T1	16	0.0	16	0.0	0.310	10.9	LOS B	2.1	14.9	0.83	0.85	42.9
12	R2	35	0.0	35	0.0	0.310	13.6	LOS B	2.1	14.9	0.83	0.85	37.9
Approach		204	0.0	204	0.0	0.310	11.8	LOS B	2.1	14.9	0.83	0.85	41.9
All Vehicles		1855	3.2	1855	3.2	1.133	183.2	LOS F	241.5	1729.7	0.82	1.40	9.9

Level of Service (LOS) Method: Delay (HCM 2000).

Roundabout LOS Method: Same as Signalised Intersections.

Vehicle movement LOS values are based on average delay per movement

Intersection and Approach LOS values are based on average delay for all vehicle movements.

Roundabout Capacity Model: SIDRA Standard.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.



## MOVEMENT SUMMARY

Site: Existing April AM zebra crossing

Network: Existing April AM

Unsignalised pedestrian (Zebra) crossing across two-way road  
Giveway / Yield (Two-Way)

Movement Performance - Vehicles													
Mov ID	OD Mov	Total veh/h	Demand Flows HV %	Total veh/h	Arrival Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: SH6A South													
2	T1	697	5.0	697	5.0	0.606	41.6	LOS E	18.8	137.2	0.41	0.43	23.4
Approach		697	5.0	697	5.0	0.606	41.6	LOS E	18.8	137.2	0.41	0.43	23.4
North: SH6A North													
8	T1	738	2.4	723	2.4	0.779	1.9	LOS A	3.5	24.9	0.43	0.39	46.8
Approach		738	2.4	723 <sup>N1</sup>	2.4	0.779	1.9	LOS A	3.5	24.9	0.43	0.39	46.8
All Vehicles		1435	3.7	1420 <sup>N1</sup>	3.7	0.779	21.4	NA	18.8	137.2	0.42	0.41	31.5

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: Akçelik M1.

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

The results of iterative calculations indicate a somewhat unstable solution. See the Diagnostics section in the Detailed Output report.

<sup>N1</sup> Arrival Flow value is reduced due to capacity constraint at oversaturated upstream lanes.

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## NETWORK SUMMARY

Network: Existing April PM

New Network

Network Performance - Hourly Values			
Performance Measure	Vehicles	Per Unit Distance	Persons
Network Level of Service (LOS)	LOS F		
Travel Time Index	1.68		
Speed Efficiency	0.25		
Congestion Coefficient	3.98		
Travel Speed (Average)	12.6 km/h		12.6 km/h
Travel Distance (Total)	1986.4 veh-km/h		2383.7 pers-km/h
Travel Time (Total)	158.1 veh-h/h		189.7 pers-h/h
Desired Speed	50.0 km/h		
Demand Flows (Total)	3411 veh/h		4017 pers/h
Arrival Flows (Total)	3347 veh/h		4017 pers/h
Percent Heavy Vehicles (Demand)	2.3 %		
Percent Heavy Vehicles (Arrival)	2.3 %		
Degree of Saturation	1.218		
Control Delay (Total)	117.89 veh-h/h		141.47 pers-h/h
Control Delay (Average)	126.8 sec		126.8 sec
Control Delay (Worst Lane)	420.0 sec		
Control Delay (Worst Movement)	422.2 sec		422.2 sec
Geometric Delay (Average)	3.0 sec		
Stop-Line Delay (Average)	123.8 sec		
Queue Storage Ratio (Worst Lane)	1.50		
Total Effective Stops	4077 veh/h		4893 pers/h
Effective Stop Rate	1.22 per veh	2.1 per km	1.22 per pers
Proportion Queued	0.66		0.66
Performance Index	726.9		726.9
Cost (Total)	4257.46 \$/h	2.14 \$/km	4257.46 \$/h
Fuel Consumption (Total)	342.1 L/h	172.2 mL/km	
Fuel Economy	17.2 L/100km		
Carbon Dioxide (Total)	807.5 kg/h	406.5 g/km	
Hydrocarbons (Total)	0.142 kg/h	0.071 g/km	
Carbon Monoxide (Total)	1.218 kg/h	0.613 g/km	
NOx (Total)	0.757 kg/h	0.381 g/km	

Network Model Accuracy Level (largest change in degree of saturation for any lane): 10.5 %

Number of Iterations: 10

Network Level of Service (LOS) Method: SIDRA Speed Efficiency.

Model used: New Zealand.

Network Performance - Annual Values		
Performance Measure	Vehicles	Persons
Demand Flows (Total)	1,637,052 veh/y	1,927,981 pers/y
Delay	56,589 veh-h/y	67,907 pers-h/y
Effective Stops	1,957,000 veh/y	2,348,401 pers/y
Travel Distance	953,489 veh-km/y	1,144,186 pers-km/y
Travel Time	75,879 veh-h/y	91,055 pers-h/y
Cost	2,043,582 \$/y	2,043,582 \$/y
Fuel Consumption	164,214 L/y	
Carbon Dioxide	387,600 kg/y	
Hydrocarbons	68 kg/y	
Carbon Monoxide	585 kg/y	
NOx	363 kg/y	

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# MOVEMENT SUMMARY

Site: Existing April PM roundabout

Network: Existing April PM

New Site  
Roundabout

Movement Performance - Vehicles														
Mov ID	OD Mov	Total veh/h	Demand Flows HV %	Total veh/h	Arrival Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h	
South: SH6A (South)														
1	L2	22	9.5	22	9.5	0.028	3.6	LOS A	0.1	1.1	0.43	0.53	43.5	
2	T1	598	2.8	598	2.8	0.477	2.8	LOS A	3.5	24.9	0.55	0.53	45.7	
3	R2	40	0.0	40	0.0	0.477	4.9	LOS A	3.5	24.9	0.55	0.53	45.3	
Approach		660	2.9	660	2.9	0.477	3.0	LOS A	3.5	24.9	0.54	0.53	45.6	
East: Ballarat Street (East)														
4	L2	40	0.0	40	0.0	0.243	21.2	LOS C	2.0	14.3	1.00	0.91	31.5	
5	T1	21	0.0	21	0.0	0.243	21.0	LOS C	2.0	14.3	1.00	0.91	38.4	
6	R2	23	0.0	23	0.0	0.243	23.7	LOS C	2.0	14.3	1.00	0.91	38.2	
Approach		84	0.0	84	0.0	0.243	21.8	LOS C	2.0	14.3	1.00	0.91	35.8	
North: SH6A (North)														
7	L2	53	0.0	53	0.0	1.218	420.0	LOS F	260.6	1860.2	1.00	3.07	7.4	
8	T1	702	2.4	702	2.4	1.218	419.5	LOS F	260.6	1860.2	1.00	3.07	4.1	
9	R2	164	2.6	164	2.6	1.218	422.2	LOS F	260.6	1860.2	1.00	3.07	7.4	
Approach		919	2.3	919	2.3	1.218	420.0	LOS F	260.6	1860.2	1.00	3.07	4.9	
West: Ballarat Street (West)														
10	L2	206	0.5	206	0.5	0.433	12.5	LOS B	3.3	23.5	0.86	0.91	41.8	
11	T1	40	2.6	40	2.6	0.433	12.0	LOS B	3.3	23.5	0.86	0.91	42.4	
12	R2	49	0.0	49	0.0	0.433	14.6	LOS B	3.3	23.5	0.86	0.91	37.1	
Approach		296	0.7	296	0.7	0.433	12.8	LOS B	3.3	23.5	0.86	0.91	41.4	
All Vehicles		1959	2.1	1959	2.1	1.218	200.9	LOS F	260.6	1860.2	0.82	1.79	9.4	

Level of Service (LOS) Method: Delay (HCM 2000).

Roundabout LOS Method: Same as Signalised Intersections.

Vehicle movement LOS values are based on average delay per movement

Intersection and Approach LOS values are based on average delay for all vehicle movements.

Roundabout Capacity Model: SIDRA Standard.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

## MOVEMENT SUMMARY

Site: Existing April PM zebra crossing

Network: Existing April PM

Unsignalised pedestrian (Zebra) crossing across two-way road  
Giveway / Yield (Two-Way)

Movement Performance - Vehicles													
Mov ID	OD Mov	Total veh/h	Demand Flows HV %	Total veh/h	Arrival Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: SH6A South													
2	T1	660	2.9	660	2.9	0.556	44.7	LOS E	19.3	138.3	0.40	0.43	22.5
Approach		660	2.9	660	2.9	0.556	44.7	LOS E	19.3	138.3	0.40	0.43	22.5
North: SH6A North													
8	T1	792	2.1	728	2.1	0.783	1.9	LOS A	3.5	24.9	0.44	0.39	46.8
Approach		792	2.1	728 <sup>N1</sup>	2.1	0.783	1.9	LOS A	3.5	24.9	0.44	0.39	46.8
All Vehicles		1452	2.5	1388 <sup>N1</sup>	2.6	0.783	22.2	NA	19.3	138.3	0.42	0.41	31.0

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: Akçelik M1.

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

The results of iterative calculations indicate a somewhat unstable solution. See the Diagnostics section in the Detailed Output report.

<sup>N1</sup> Arrival Flow value is reduced due to capacity constraint at oversaturated upstream lanes.

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## NETWORK SUMMARY

Network: Existing December AM

SH6A / Ballarat Street

Network Performance - Hourly Values			
Performance Measure	Vehicles	Per Unit Distance	Persons
Network Level of Service (LOS)	LOS F		
Travel Time Index	2.22		
Speed Efficiency	0.30		
Congestion Coefficient	3.33		
Travel Speed (Average)	15.0 km/h		15.0 km/h
Travel Distance (Total)	1970.2 veh-km/h		2364.3 pers-km/h
Travel Time (Total)	131.4 veh-h/h		157.7 pers-h/h
Desired Speed	50.0 km/h		
Demand Flows (Total)	3580 veh/h		4296 pers/h
Arrival Flows (Total)	3580 veh/h		4296 pers/h
Percent Heavy Vehicles (Demand)	1.9 %		
Percent Heavy Vehicles (Arrival)	1.9 %		
Degree of Saturation	1.128		
Control Delay (Total)	91.54 veh-h/h		109.85 pers-h/h
Control Delay (Average)	92.1 sec		92.1 sec
Control Delay (Worst Lane)	247.4 sec		
Control Delay (Worst Movement)	250.6 sec		250.6 sec
Geometric Delay (Average)	2.9 sec		
Stop-Line Delay (Average)	89.2 sec		
Queue Storage Ratio (Worst Lane)	1.00		
Total Effective Stops	7905 veh/h		9486 pers/h
Effective Stop Rate	2.21 per veh	4.0 per km	2.21 per pers
Proportion Queued	0.83		
Performance Index	436.4		
Cost (Total)	3425.55 \$/h	1.74 \$/km	3425.55 \$/h
Fuel Consumption (Total)	314.3 L/h	159.5 mL/km	
Fuel Economy	16.0 L/100km		
Carbon Dioxide (Total)	741.7 kg/h	376.4 g/km	
Hydrocarbons (Total)	0.226 kg/h	0.115 g/km	
Carbon Monoxide (Total)	1.673 kg/h	0.849 g/km	
NOx (Total)	0.813 kg/h	0.413 g/km	

Network Model Accuracy Level (largest change in degree of saturation for any lane): 2.3 %

Number of Iterations: 10

Network Level of Service (LOS) Method: SIDRA Speed Efficiency.

Model used: New Zealand.

Network Performance - Annual Values		
Performance Measure	Vehicles	Persons
Demand Flows (Total)	1,718,400 veh/y	2,062,080 pers/y
Delay	43,939 veh-h/y	52,727 pers-h/y
Effective Stops	3,794,447 veh/y	4,553,336 pers/y
Travel Distance	945,711 veh-km/y	1,134,854 pers-km/y
Travel Time	63,072 veh-h/y	75,687 pers-h/y
Cost	1,644,264 \$/y	1,644,264 \$/y
Fuel Consumption	150,884 L/y	
Carbon Dioxide	355,996 kg/y	
Hydrocarbons	109 kg/y	
Carbon Monoxide	803 kg/y	
NOx	390 kg/y	

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Project: G:\NZTA\Reg 13\6-XT177.62.305DC SH6A Ballarat St Intersection\500 Technical\Modelling\SH6A\_Ballarat.sip6

# MOVEMENT SUMMARY

Site: Existing December AM roundabout

Network: Existing December AM

New Site  
Roundabout

Movement Performance - Vehicles													
Mov ID	OD Mov	Total veh/h	Demand Flows HV %	Total veh/h	Arrival Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: SH6A (South)													
1	L2	257	3.7	257	3.7	0.224	2.7	LOS A	1.4	10.4	0.31	0.51	44.6
2	T1	549	1.7	549	1.7	0.395	2.1	LOS A	3.2	22.9	0.33	0.43	46.3
3	R2	53	2.0	53	2.0	0.395	4.3	LOS A	3.2	22.9	0.33	0.43	45.8
Approach		859	2.3	859	2.3	0.395	2.4	LOS A	3.2	22.9	0.32	0.45	45.8
East: Ballarat Street (East)													
4	L2	31	0.0	31	0.0	0.194	19.4	LOS B	1.6	10.9	0.99	0.89	32.4
5	T1	18	0.0	18	0.0	0.194	19.1	LOS B	1.6	10.9	0.99	0.89	39.0
6	R2	28	0.0	28	0.0	0.194	21.9	LOS C	1.6	10.9	0.99	0.89	38.9
Approach		77	0.0	77	0.0	0.194	20.3	LOS C	1.6	10.9	0.99	0.89	37.0
North: SH6A (North)													
7	L2	36	0.0	36	0.0	1.104	247.7	LOS F	104.1	742.4	1.00	3.55	11.4
8	T1	543	1.7	543	1.7	1.104	247.2	LOS F	104.1	742.4	1.00	3.55	6.5
9	R2	37	11.4	37	11.4	1.104	250.6	LOS F	104.1	742.4	1.00	3.55	11.4
Approach		616	2.2	616	2.2	1.104	247.4	LOS F	104.1	742.4	1.00	3.55	7.2
West: Ballarat Street (West)													
10	L2	87	0.0	87	0.0	0.692	45.2	LOS D	12.0	84.8	1.00	1.40	30.2
11	T1	26	0.0	26	0.0	0.692	44.6	LOS D	12.0	84.8	1.00	1.40	30.5
12	R2	241	1.3	241	1.3	0.692	47.4	LOS D	12.0	84.8	1.00	1.40	22.2
Approach		355	0.9	355	0.9	0.692	46.7	LOS D	12.0	84.8	1.00	1.40	25.5
All Vehicles		1906	1.9	1906	1.9	1.104	90.5	LOS F	104.1	742.4	0.69	1.65	15.7

Level of Service (LOS) Method: Delay (HCM 2000).

Roundabout LOS Method: Same as Signalised Intersections.

Vehicle movement LOS values are based on average delay per movement

Intersection and Approach LOS values are based on average delay for all vehicle movements.

Roundabout Capacity Model: SIDRA Standard.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.



## MOVEMENT SUMMARY

Site: Existing December AM zebra crossing

Network: Existing December AM

Unsignalised pedestrian (Zebra) crossing across two-way road  
Giveaway / Yield (Two-Way)

Movement Performance - Vehicles													
Mov ID	OD Mov	Total veh/h	Demand Flows HV %	Total veh/h	Arrival Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: SH6A South													
2	T1	859	2.3	859	2.3	0.786	53.3	LOS F	38.6	275.3	0.95	1.84	20.4
Approach		859	2.3	859	2.3	0.786	53.3	LOS F	38.6	275.3	0.95	1.84	20.4
North: SH6A North													
8	T1	815	1.6	815	1.6	1.128	136.5	LOS F	3.5	24.9	1.00	3.90	10.7
Approach		815	1.6	815	1.6	1.128	136.5	LOS F	3.5	24.9	1.00	3.90	10.7
All Vehicles		1674	1.9	1674	1.9	1.128	93.8	NA	38.6	275.3	0.98	2.85	14.1

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: Akçelik M1.

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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## NETWORK SUMMARY

Network: Existing December PM

New Network

Network Performance - Hourly Values			
Performance Measure	Vehicles	Per Unit Distance	Persons
Network Level of Service (LOS)	LOS E		
Travel Time Index	3.33		
Speed Efficiency	0.40		
Congestion Coefficient	2.50		
Travel Speed (Average)	20.0 km/h		20.0 km/h
Travel Distance (Total)	1841.7 veh-km/h		2210.1 pers-km/h
Travel Time (Total)	92.2 veh-h/h		110.6 pers-h/h
Desired Speed	50.0 km/h		
Demand Flows (Total)	3337 veh/h		4004 pers/h
Arrival Flows (Total)	3337 veh/h		4004 pers/h
Percent Heavy Vehicles (Demand)	2.8 %		
Percent Heavy Vehicles (Arrival)	2.8 %		
Degree of Saturation	1.006		
Control Delay (Total)	54.95 veh-h/h		65.94 pers-h/h
Control Delay (Average)	59.3 sec		59.3 sec
Control Delay (Worst Lane)	195.0 sec		
Control Delay (Worst Movement)	197.3 sec		197.3 sec
Geometric Delay (Average)	2.8 sec		
Stop-Line Delay (Average)	56.4 sec		
Queue Storage Ratio (Worst Lane)	1.00		
Total Effective Stops	5392 veh/h		6470 pers/h
Effective Stop Rate	1.62 per veh	2.9 per km	1.62 per pers
Proportion Queued	0.80		0.80
Performance Index	334.7		334.7
Cost (Total)	2412.73 \$/h	1.31 \$/km	2412.73 \$/h
Fuel Consumption (Total)	253.2 L/h	137.5 mL/km	
Fuel Economy	13.7 L/100km		
Carbon Dioxide (Total)	598.7 kg/h	325.1 g/km	
Hydrocarbons (Total)	0.148 kg/h	0.080 g/km	
Carbon Monoxide (Total)	1.280 kg/h	0.695 g/km	
NOx (Total)	0.834 kg/h	0.453 g/km	

Network Model Accuracy Level (largest change in degree of saturation for any lane): 2.2 %

Number of Iterations: 10

Network Level of Service (LOS) Method: SIDRA Speed Efficiency.

Model used: New Zealand.

Network Performance - Annual Values		
Performance Measure	Vehicles	Persons
Demand Flows (Total)	1,601,684 veh/y	1,922,021 pers/y
Delay	26,374 veh-h/y	31,649 pers-h/y
Effective Stops	2,588,105 veh/y	3,105,727 pers/y
Travel Distance	884,023 veh-km/y	1,060,828 pers-km/y
Travel Time	44,259 veh-h/y	53,111 pers-h/y
Cost	1,158,108 \$/y	1,158,108 \$/y
Fuel Consumption	121,538 L/y	
Carbon Dioxide	287,382 kg/y	
Hydrocarbons	71 kg/y	
Carbon Monoxide	614 kg/y	
NOx	400 kg/y	

# MOVEMENT SUMMARY

Site: Existing December PM roundabout

Network: Existing December PM

New Site  
Roundabout

Movement Performance - Vehicles													
Mov ID	OD Mov	Total veh/h	Demand Flows HV %	Total veh/h	Arrival Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: SH6A (South)													
1	L2	217	4.9	217	4.9	0.199	2.7	LOS A	1.2	9.1	0.30	0.51	44.6
2	T1	556	3.0	556	3.0	0.393	2.1	LOS A	3.2	22.8	0.33	0.43	46.4
3	R2	39	2.7	39	2.7	0.393	4.3	LOS A	3.2	22.8	0.33	0.43	45.9
Approach		812	3.5	812	3.5	0.393	2.4	LOS A	3.2	22.8	0.32	0.45	45.8
East: Ballarat Street (East)													
4	L2	25	0.0	25	0.0	0.173	18.2	LOS B	1.4	9.7	0.97	0.87	33.1
5	T1	26	4.0	26	4.0	0.173	18.2	LOS B	1.4	9.7	0.97	0.87	39.6
6	R2	19	0.0	19	0.0	0.173	20.6	LOS C	1.4	9.7	0.97	0.87	39.4
Approach		71	1.5	71	1.5	0.173	18.9	LOS B	1.4	9.7	0.97	0.87	37.9
North: SH6A (North)													
7	L2	40	5.3	40	5.3	1.006	195.5	LOS F	84.0	602.4	1.00	2.86	13.6
8	T1	505	2.9	505	2.9	1.006	194.8	LOS F	84.0	602.4	1.00	2.86	8.0
9	R2	36	0.0	36	0.0	1.006	197.3	LOS F	84.0	602.4	1.00	2.86	13.6
Approach		581	2.9	581	2.9	1.006	195.0	LOS F	84.0	602.4	1.00	2.86	8.8
West: Ballarat Street (West)													
10	L2	73	1.4	73	1.4	0.608	35.8	LOS D	8.6	60.7	1.00	1.24	32.8
11	T1	34	0.0	34	0.0	0.608	35.1	LOS D	8.6	60.7	1.00	1.24	33.1
12	R2	212	0.5	212	0.5	0.608	37.8	LOS D	8.6	60.7	1.00	1.24	25.1
Approach		318	0.7	318	0.7	0.608	37.1	LOS D	8.6	60.7	1.00	1.24	28.4
All Vehicles		1781	2.7	1781	2.7	1.006	72.1	LOS E	84.0	602.4	0.69	1.39	18.3

Level of Service (LOS) Method: Delay (HCM 2000).

Roundabout LOS Method: Same as Signalised Intersections.

Vehicle movement LOS values are based on average delay per movement

Intersection and Approach LOS values are based on average delay for all vehicle movements.

Roundabout Capacity Model: SIDRA Standard.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

## MOVEMENT SUMMARY

Site: Existing December PM zebra crossing

Network: Existing December PM

Unsignalised pedestrian (Zebra) crossing across two-way road  
Giveway / Yield (Two-Way)

Movement Performance - Vehicles													
Mov ID	OD Mov	Total veh/h	Demand Flows HV %	Total veh/h	Arrival Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: SH6A South													
2	T1	812	3.5	812	3.5	0.705	41.1	LOS E	32.4	233.7	0.85	1.43	23.6
Approach		812	3.5	812	3.5	0.705	41.1	LOS E	32.4	233.7	0.85	1.43	23.6
North: SH6A North													
8	T1	744	2.4	744	2.4	1.005	48.5	LOS E	3.5	24.9	1.00	2.35	21.6
Approach		744	2.4	744	2.4	1.005	48.5	LOS E	3.5	24.9	1.00	2.35	21.6
All Vehicles		1556	3.0	1556	3.0	1.005	44.7	NA	32.4	233.7	0.92	1.87	22.6

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: Akçelik M1.

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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## **Appendix B**

### **Detailed SIDRA Outputs for Options**

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## MOVEMENT SUMMARY

Site: Option A (Ex roundabout with no crossing) December AM

New Site  
Roundabout

Movement Performance - Vehicles											
Mov ID	OD Mov	Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: SH6A (South)											
1	L2	257	3.7	0.226	5.5	LOSA	1.4	10.3	0.31	0.56	45.2
2	T1	549	1.7	0.398	4.3	LOSA	3.2	22.4	0.33	0.48	46.2
3	R2	53	2.0	0.398	7.0	LOSA	3.2	22.4	0.33	0.48	45.9
Approach		859	2.3	0.398	4.9	LOSA	3.2	22.4	0.32	0.51	45.9
East: Ballarat Street (East)											
4	L2	31	0.0	0.140	11.5	LOS B	0.9	6.5	0.84	0.83	42.2
5	T1	18	0.0	0.140	11.0	LOS B	0.9	6.5	0.84	0.83	42.6
6	R2	28	0.0	0.140	13.6	LOS B	0.9	6.5	0.84	0.83	42.4
Approach		77	0.0	0.140	12.1	LOS B	0.9	6.5	0.84	0.83	42.4
North: SH6A (North)											
7	L2	36	0.0	0.579	7.0	LOSA	4.5	32.0	0.65	0.71	44.9
8	T1	543	1.7	0.579	6.2	LOSA	4.5	32.0	0.65	0.71	45.4
9	R2	37	11.4	0.579	9.0	LOSA	4.5	32.0	0.65	0.71	45.0
Approach		616	2.2	0.579	6.4	LOSA	4.5	32.0	0.65	0.71	45.4
West: Ballarat Street (West)											
10	L2	87	0.0	0.416	8.4	LOSA	2.6	18.0	0.70	0.84	43.4
11	T1	26	0.0	0.416	7.6	LOSA	2.6	18.0	0.70	0.84	44.0
12	R2	241	1.3	0.416	10.2	LOS B	2.6	18.0	0.70	0.84	43.7
Approach		355	0.9	0.416	9.6	LOSA	2.6	18.0	0.70	0.84	43.7
All Vehicles		1906	1.9	0.579	6.5	LOSA	4.5	32.0	0.52	0.65	45.1

Level of Service (LOS) Method: Delay (HCM 2000).

Roundabout LOS Method: Same as Signalised Intersections.

Vehicle movement LOS values are based on average delay per movement

Intersection and Approach LOS values are based on average delay for all vehicle movements.

Roundabout Capacity Model: SIDRA Standard.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.



## NETWORK SUMMARY

Network: Option B December AM

New Network

Network Performance - Hourly Values			
Performance Measure	Vehicles	Per Unit Distance	Persons
Network Level of Service (LOS)	LOS E		
Travel Time Index	2.59		
Speed Efficiency	0.33		
Congestion Coefficient	3.00		
Travel Speed (Average)	16.6 km/h		16.6 km/h
Travel Distance (Total)	2053.9 veh-km/h		2464.7 pers-km/h
Travel Time (Total)	123.4 veh-h/h		148.1 pers-h/h
Desired Speed	50.0 km/h		
Demand Flows (Total)	3580 veh/h		4296 pers/h
Arrival Flows (Total)	3580 veh/h		4296 pers/h
Percent Heavy Vehicles (Demand)	1.9 %		
Percent Heavy Vehicles (Arrival)	1.9 %		
Degree of Saturation	1.128		
Control Delay (Total)	81.76 veh-h/h		98.11 pers-h/h
Control Delay (Average)	82.2 sec		82.2 sec
Control Delay (Worst Lane)	247.4 sec		
Control Delay (Worst Movement)	250.6 sec		250.6 sec
Geometric Delay (Average)	3.8 sec		
Stop-Line Delay (Average)	78.4 sec		
Queue Storage Ratio (Worst Lane)	1.00		
Total Effective Stops	7090 veh/h		8508 pers/h
Effective Stop Rate	1.98 per veh	3.5 per km	1.98 per pers
Proportion Queued	0.75		
Performance Index	420.9		
Cost (Total)	3295.89 \$/h	1.60 \$/km	3295.89 \$/h
Fuel Consumption (Total)	321.7 L/h	156.6 mL/km	
Fuel Economy	15.7 L/100km		
Carbon Dioxide (Total)	758.9 kg/h	369.5 g/km	
Hydrocarbons (Total)	0.211 kg/h	0.103 g/km	
Carbon Monoxide (Total)	1.680 kg/h	0.818 g/km	
NOx (Total)	0.852 kg/h	0.415 g/km	

Network Model Accuracy Level (largest change in degree of saturation for any lane): 2.3 %

Number of Iterations: 10

Network Level of Service (LOS) Method: SIDRA Speed Efficiency.

Model used: New Zealand.

Network Performance - Annual Values		
Performance Measure	Vehicles	Persons
Demand Flows (Total)	1,718,400 veh/y	2,062,080 pers/y
Delay	39,244 veh-h/y	47,093 pers-h/y
Effective Stops	3,403,110 veh/y	4,083,732 pers/y
Travel Distance	985,880 veh-km/y	1,183,056 pers-km/y
Travel Time	59,237 veh-h/y	71,084 pers-h/y
Cost	1,582,029 \$/y	1,582,029 \$/y
Fuel Consumption	154,408 L/y	
Carbon Dioxide	364,290 kg/y	
Hydrocarbons	101 kg/y	
Carbon Monoxide	806 kg/y	
NOx	409 kg/y	

# MOVEMENT SUMMARY

Site: Option B (mid-block zebra) December AM roundabout

Network: Option B December AM

New Site  
Roundabout

Movement Performance - Vehicles													
Mov ID	OD Mov	Total veh/h	Demand Flows HV %	Total veh/h	Arrival Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: SH6A (South)													
1	L2	257	3.7	257	3.7	0.224	5.3	LOS A	1.4	10.4	0.31	0.56	42.3
2	T1	549	1.7	549	1.7	0.395	4.0	LOS A	3.2	22.9	0.33	0.47	44.2
3	R2	53	2.0	53	2.0	0.395	6.8	LOS A	3.2	22.9	0.33	0.47	43.8
Approach		859	2.3	859	2.3	0.395	4.5	LOS A	3.2	22.9	0.32	0.50	43.6
East: Ballarat Street (East)													
4	L2	31	0.0	31	0.0	0.194	19.4	LOS B	1.6	10.9	0.99	0.89	32.4
5	T1	18	0.0	18	0.0	0.194	19.1	LOS B	1.6	10.9	0.99	0.89	39.0
6	R2	28	0.0	28	0.0	0.194	21.9	LOS C	1.6	10.9	0.99	0.89	38.9
Approach		77	0.0	77	0.0	0.194	20.3	LOS C	1.6	10.9	0.99	0.89	37.0
North: SH6A (North)													
7	L2	36	0.0	36	0.0	1.104	247.7	LOS F	104.1	742.4	1.00	3.55	11.4
8	T1	543	1.7	543	1.7	1.104	247.2	LOS F	104.1	742.4	1.00	3.55	6.5
9	R2	37	11.4	37	11.4	1.104	250.6	LOS F	104.1	742.4	1.00	3.55	11.4
Approach		616	2.2	616	2.2	1.104	247.4	LOS F	104.1	742.4	1.00	3.55	7.2
West: Ballarat Street (West)													
10	L2	87	0.0	87	0.0	0.692	45.2	LOS D	12.0	84.8	1.00	1.40	30.2
11	T1	26	0.0	26	0.0	0.692	44.6	LOS D	12.0	84.8	1.00	1.40	30.5
12	R2	241	1.3	241	1.3	0.692	47.4	LOS D	12.0	84.8	1.00	1.40	22.2
Approach		355	0.9	355	0.9	0.692	46.7	LOS D	12.0	84.8	1.00	1.40	25.5
All Vehicles		1906	1.9	1906	1.9	1.104	91.5	LOS F	104.1	742.4	0.69	1.67	16.0

Level of Service (LOS) Method: Delay (HCM 2000).

Roundabout LOS Method: Same as Signalised Intersections.

Vehicle movement LOS values are based on average delay per movement

Intersection and Approach LOS values are based on average delay for all vehicle movements.

Roundabout Capacity Model: SIDRA Standard.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

## MOVEMENT SUMMARY

Site: Option B (mid-block zebra) December AM zebra crossing

Network: Option B December AM

Unsignalised pedestrian (Zebra) crossing across two-way road  
Giveway / Yield (Two-Way)

Movement Performance - Vehicles													
Mov ID	OD Mov	Total veh/h	Demand Flows HV %	Total veh/h	Arrival Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: SH6A South													
2	T1	859	2.3	859	2.3	0.598	8.5	LOS A	5.9	42.2	0.63	0.85	40.6
Approach		859	2.3	859	2.3	0.598	8.5	LOS A	5.9	42.2	0.63	0.85	40.6
North: SH6A North													
8	T1	815	1.6	815	1.6	1.128	138.3	LOS F	21.0	149.1	1.00	3.90	11.4
Approach		815	1.6	815	1.6	1.128	138.3	LOS F	21.0	149.1	1.00	3.90	11.4
All Vehicles		1674	1.9	1674	1.9	1.128	71.7	NA	21.0	149.1	0.81	2.34	17.5

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: Akçelik M1.

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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## NETWORK SUMMARY

Network: Option C December AM

New Network

Network Performance - Hourly Values				
Performance Measure	Vehicles	Per Unit Distance	Pedestrians	Persons
Network Level of Service (LOS)	LOS E			
Travel Time Index	3.69			
Speed Efficiency	0.43			
Congestion Coefficient	2.32			
Travel Speed (Average)	21.6 km/h		1.5 km/h	19.8 km/h
Travel Distance (Total)	1970.2 veh-km/h		17.1 ped-km/h	2381.4 pers-km/h
Travel Time (Total)	91.2 veh-h/h		11.0 ped-h/h	120.5 pers-h/h
Desired Speed	50.0 km/h			
Demand Flows (Total)	3580 veh/h		481 ped/h	4296 pers/h
Arrival Flows (Total)	3580 veh/h		481 ped/h	4296 pers/h
Percent Heavy Vehicles (Demand)	1.9 %			
Percent Heavy Vehicles (Arrival)	1.9 %			
Degree of Saturation	1.104			
Control Delay (Total)	51.55 veh-h/h		7.38 ped-h/h	69.24 pers-h/h
Control Delay (Average)	51.8 sec		55.3 sec	58.0 sec
Control Delay (Worst Lane)	250.7 sec			
Control Delay (Worst Movement)	253.9 sec			
Geometric Delay (Average)	1.8 sec			
Stop-Line Delay (Average)	50.0 sec			
Queue Storage Ratio (Worst Lane)	1.00			
Total Effective Stops	3685 veh/h		466 ped/h	4888 pers/h
Effective Stop Rate	1.03 per veh	1.9 per km	0.97 per ped	1.14 per pers
Proportion Queued	0.54			
Performance Index	366.8			
Cost (Total)	2304.16 \$/h	1.17 \$/km	191.97 \$/h	2496.14 \$/h
Fuel Consumption (Total)	238.0 L/h	120.8 mL/km		
Fuel Economy	12.1 L/100km			
Carbon Dioxide (Total)	561.8 kg/h	285.1 g/km		
Hydrocarbons (Total)	0.051 kg/h	0.026 g/km		
Carbon Monoxide (Total)	0.442 kg/h	0.224 g/km		
NOx (Total)	0.517 kg/h	0.262 g/km		

Network Model Accuracy Level (largest change in degree of saturation for any lane): 2.3 %

Number of Iterations: 10

Network Level of Service (LOS) Method: SIDRA Speed Efficiency.

Model used: New Zealand.

Network Performance - Annual Values			
Performance Measure	Vehicles	Pedestrians	Persons
Demand Flows (Total)	1,718,400 veh/y	230,905 ped/y	2,062,080 pers/y
Delay	24,742 veh-h/y	3,544 ped-h/y	33,234 pers-h/y
Effective Stops	1,768,646 veh/y	223,847 ped/y	2,346,222 pers/y
Travel Distance	945,711 veh-km/y	8,197 ped-km/y	1,143,051 pers-km/y
Travel Time	43,798 veh-h/y	5,296 ped-h/y	57,854 pers-h/y
Cost	1,105,998 \$/y	92,146 \$/y	1,198,145 \$/y
Fuel Consumption	114,217 L/y		
Carbon Dioxide	269,646 kg/y		
Hydrocarbons	25 kg/y		
Carbon Monoxide	212 kg/y		
NOx	248 kg/y		

# MOVEMENT SUMMARY

Site: Option C (sig ped crossing) December AM roundabout

Network: Option C December AM

New Site  
Roundabout

Movement Performance - Vehicles													
Mov ID	OD Mov	Total veh/h	Demand Flows HV %	Total veh/h	Arrival Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: SH6A (South)													
1	L2	257	3.7	257	3.7	0.224	2.7	LOS A	1.3	9.4	0.27	0.51	44.6
2	T1	549	1.7	549	1.7	0.395	2.1	LOS A	2.9	20.5	0.29	0.43	46.5
3	R2	53	2.0	53	2.0	0.395	4.3	LOS A	2.9	20.5	0.29	0.43	45.9
Approach		859	2.3	859	2.3	0.395	2.4	LOS A	2.9	20.5	0.28	0.45	45.9
East: Ballarat Street (East)													
4	L2	31	0.0	31	0.0	0.195	19.5	LOS B	1.6	10.9	0.99	0.89	32.3
5	T1	18	0.0	18	0.0	0.195	19.2	LOS B	1.6	10.9	0.99	0.89	39.0
6	R2	28	0.0	28	0.0	0.195	21.9	LOS C	1.6	10.9	0.99	0.89	38.8
Approach		77	0.0	77	0.0	0.195	20.3	LOS C	1.6	10.9	0.99	0.89	37.0
North: SH6A (North)													
7	L2	36	0.0	36	0.0	1.104	251.0	LOS F	105.6	753.3	1.00	3.53	11.2
8	T1	543	1.7	543	1.7	1.104	250.5	LOS F	105.6	753.3	1.00	3.53	6.5
9	R2	37	11.4	37	11.4	1.104	253.9	LOS F	105.6	753.3	1.00	3.53	11.3
Approach		616	2.2	616	2.2	1.104	250.7	LOS F	105.6	753.3	1.00	3.53	7.1
West: Ballarat Street (West)													
10	L2	87	0.0	87	0.0	0.681	51.5	LOS D	14.0	98.8	1.00	1.32	28.7
11	T1	26	0.0	26	0.0	0.681	50.9	LOS D	14.0	98.8	1.00	1.32	29.0
12	R2	241	1.3	241	1.3	0.681	53.7	LOS D	14.0	98.8	1.00	1.32	20.7
Approach		355	0.9	355	0.9	0.681	52.9	LOS D	14.0	98.8	1.00	1.32	23.9
All Vehicles		1906	1.9	1906	1.9	1.104	92.7	LOS F	105.6	753.3	0.68	1.63	15.5

Level of Service (LOS) Method: Delay (HCM 2000).

Roundabout LOS Method: Same as Signalised Intersections.

Vehicle movement LOS values are based on average delay per movement

Intersection and Approach LOS values are based on average delay for all vehicle movements.

Roundabout Capacity Model: SIDRA Standard.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

# MOVEMENT SUMMARY

Site: Option C (sig ped crossing) December AM crossing

Network: Option C December AM

New Site

Pedestrian Crossing (Signals) - Fixed Time Isolated Cycle Time = 120 seconds (User-Given Phase Times)

Movement Performance - Vehicles													
Mov ID	OD Mov	Total veh/h	Demand Flows HV %	Total veh/h	Arrival Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: RoadName													
2	T1	859	2.3	859	2.3	0.349	4.7	LOS A	9.4	67.0	0.34	0.31	44.3
Approach		859	2.3	859	2.3	0.349	4.7	LOS A	9.4	67.0	0.34	0.31	44.3
North: RoadName													
8	T1	815	1.6	815	1.6	0.531	5.8	LOS A	2.3	16.3	0.43	0.39	43.3
Approach		815	1.6	815	1.6	0.531	5.8	LOS A	2.3	16.3	0.43	0.39	43.3
All Vehicles		1674	1.9	1674	1.9	0.531	5.2	LOS A	9.4	67.0	0.38	0.35	43.8

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians										
Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped		
P1	South Full Crossing	481	55.3	LOS E	1.6	1.6	0.97	0.97		
All Pedestrians		481	55.3	LOS E			0.97	0.97		

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

Pedestrian movement LOS values are based on average delay per pedestrian movement.

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

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## NETWORK SUMMARY

Network: Option D December AM

New Network

Network Performance - Hourly Values				
Performance Measure	Vehicles	Per Unit Distance	Pedestrians	Persons
Network Level of Service (LOS)	LOS E			
Travel Time Index	3.78			
Speed Efficiency	0.44			
Congestion Coefficient	2.27			
Travel Speed (Average)	22.0 km/h		1.5 km/h	20.2 km/h
Travel Distance (Total)	2053.9 veh-km/h		17.1 ped-km/h	2481.8 pers-km/h
Travel Time (Total)	93.3 veh-h/h		11.0 ped-h/h	123.0 pers-h/h
Desired Speed	50.0 km/h			
Demand Flows (Total)	3580 veh/h		481 ped/h	4296 pers/h
Arrival Flows (Total)	3580 veh/h		481 ped/h	4296 pers/h
Percent Heavy Vehicles (Demand)	1.9 %			
Percent Heavy Vehicles (Arrival)	1.9 %			
Degree of Saturation	1.104			
Control Delay (Total)	51.80 veh-h/h		7.38 ped-h/h	69.54 pers-h/h
Control Delay (Average)	52.1 sec		55.3 sec	58.3 sec
Control Delay (Worst Lane)	250.4 sec			
Control Delay (Worst Movement)	253.5 sec		55.3 sec	253.5 sec
Geometric Delay (Average)	2.4 sec			
Stop-Line Delay (Average)	49.7 sec			
Queue Storage Ratio (Worst Lane)	1.00			
Total Effective Stops	3709 veh/h		466 ped/h	4917 pers/h
Effective Stop Rate	1.04 per veh	1.8 per km	0.97 per ped	1.14 per pers
Proportion Queued	0.54		0.97	0.64
Performance Index	381.1		13.6	394.7
Cost (Total)	2385.42 \$/h	1.16 \$/km	191.97 \$/h	2577.40 \$/h
Fuel Consumption (Total)	252.0 L/h	122.7 mL/km		
Fuel Economy	12.3 L/100km			
Carbon Dioxide (Total)	594.9 kg/h	289.6 g/km		
Hydrocarbons (Total)	0.055 kg/h	0.027 g/km		
Carbon Monoxide (Total)	0.476 kg/h	0.232 g/km		
NOx (Total)	0.556 kg/h	0.271 g/km		

Network Model Accuracy Level (largest change in degree of saturation for any lane): 2.3 %

Number of Iterations: 10

Network Level of Service (LOS) Method: SIDRA Speed Efficiency.

Model used: New Zealand.

Network Performance - Annual Values			
Performance Measure	Vehicles	Pedestrians	Persons
Demand Flows (Total)	1,718,400 veh/y	230,905 ped/y	2,062,080 pers/y
Delay	24,864 veh-h/y	3,544 ped-h/y	33,381 pers-h/y
Effective Stops	1,780,306 veh/y	223,847 ped/y	2,360,214 pers/y
Travel Distance	985,880 veh-km/y	8,197 ped-km/y	1,191,253 pers-km/y
Travel Time	44,773 veh-h/y	5,296 ped-h/y	59,024 pers-h/y
Cost	1,145,003 \$/y	92,146 \$/y	1,237,150 \$/y
Fuel Consumption	120,972 L/y		
Carbon Dioxide	285,555 kg/y		
Hydrocarbons	26 kg/y		
Carbon Monoxide	228 kg/y		
NOx	267 kg/y		

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# MOVEMENT SUMMARY

Site: Option D (shifted sig ped crossing) December AM roundabout

Network: Option D December AM

New Site  
Roundabout

Movement Performance - Vehicles													
Mov ID	OD Mov	Total veh/h	Demand Flows HV %	Total veh/h	Arrival Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: SH6A (South)													
1	L2	257	3.7	257	3.7	0.224	5.3	LOS A	1.3	9.6	0.28	0.56	42.4
2	T1	549	1.7	549	1.7	0.395	4.0	LOS A	2.9	20.9	0.29	0.47	44.3
3	R2	53	2.0	53	2.0	0.395	6.8	LOS A	2.9	20.9	0.29	0.47	43.9
Approach		859	2.3	859	2.3	0.395	4.5	LOS A	2.9	20.9	0.29	0.50	43.7
East: Ballarat Street (East)													
4	L2	31	0.0	31	0.0	0.195	19.5	LOS B	1.6	10.9	0.99	0.89	32.3
5	T1	18	0.0	18	0.0	0.195	19.2	LOS B	1.6	10.9	0.99	0.89	39.0
6	R2	28	0.0	28	0.0	0.195	21.9	LOS C	1.6	10.9	0.99	0.89	38.8
Approach		77	0.0	77	0.0	0.195	20.3	LOS C	1.6	10.9	0.99	0.89	37.0
North: SH6A (North)													
7	L2	36	0.0	36	0.0	1.104	250.6	LOS F	105.4	751.8	1.00	3.53	11.3
8	T1	543	1.7	543	1.7	1.104	250.1	LOS F	105.4	751.8	1.00	3.53	6.5
9	R2	37	11.4	37	11.4	1.104	253.5	LOS F	105.4	751.8	1.00	3.53	11.3
Approach		616	2.2	616	2.2	1.104	250.4	LOS F	105.4	751.8	1.00	3.53	7.1
West: Ballarat Street (West)													
10	L2	87	0.0	87	0.0	0.683	50.4	LOS D	13.7	96.3	1.00	1.34	29.0
11	T1	26	0.0	26	0.0	0.683	49.7	LOS D	13.7	96.3	1.00	1.34	29.2
12	R2	241	1.3	241	1.3	0.683	52.6	LOS D	13.7	96.3	1.00	1.34	21.0
Approach		355	0.9	355	0.9	0.683	51.8	LOS D	13.7	96.3	1.00	1.34	24.2
All Vehicles		1906	1.9	1906	1.9	1.104	93.4	LOS F	105.4	751.8	0.68	1.65	15.8

Level of Service (LOS) Method: Delay (HCM 2000).

Roundabout LOS Method: Same as Signalised Intersections.

Vehicle movement LOS values are based on average delay per movement

Intersection and Approach LOS values are based on average delay for all vehicle movements.

Roundabout Capacity Model: SIDRA Standard.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

# MOVEMENT SUMMARY

Site: Option D (shifted sig ped crossing) December AM crossing

Network: Option D December AM

New Site

Pedestrian Crossing (Signals) - Fixed Time Isolated Cycle Time = 120 seconds (User-Given Phase Times)

Movement Performance - Vehicles													
Mov ID	OD Mov	Total veh/h	Demand Flows HV %	Total veh/h	Arrival Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: RoadName													
2	T1	859	2.3	859	2.3	0.453	4.4	LOS A	7.3	52.4	0.32	0.28	44.7
Approach		859	2.3	859	2.3	0.453	4.4	LOS A	7.3	52.4	0.32	0.28	44.7
North: RoadName													
8	T1	815	1.6	815	1.6	0.531	5.8	LOS A	13.8	97.9	0.43	0.39	43.8
Approach		815	1.6	815	1.6	0.531	5.8	LOS A	13.8	97.9	0.43	0.39	43.8
All Vehicles		1674	1.9	1674	1.9	0.531	5.1	LOS A	13.8	97.9	0.37	0.34	44.2

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians										
Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped		
P1	South Full Crossing	481	55.3	LOS E	1.6	1.6	0.97	0.97		
All Pedestrians		481	55.3	LOS E			0.97	0.97		

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

Pedestrian movement LOS values are based on average delay per pedestrian movement.

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

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Project: G:\NZTA\Reg 13\6-XT177.62.305DC SH6A Ballarat St Intersection\500 Technical\Modelling\SH6A\_Ballarat.sip6

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## MOVEMENT SUMMARY

Site: Option E1 (signals 2phase) April AM

New Site

Signals - Fixed Time Isolated Cycle Time = 75 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles											
Mov ID	OD Mov	Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: SH6A (South)											
1	L2	29	10.7	0.589	12.0	LOS B	12.5	91.2	0.57	0.52	44.8
2	T1	620	5.1	0.589	7.3	LOS A	12.5	91.2	0.57	0.52	45.3
3	R2	47	0.0	0.115	17.6	LOS B	1.0	7.2	0.60	0.69	39.9
Approach		697	5.0	0.589	8.2	LOS A	12.5	91.2	0.57	0.53	44.9
East: Ballarat Street (East)											
4	L2	17	0.0	0.159	34.8	LOS C	1.5	10.6	0.90	0.69	34.6
5	T1	29	0.0	0.159	30.2	LOS C	1.5	10.6	0.90	0.69	34.8
6	R2	19	0.0	0.096	38.6	LOS D	0.7	4.6	0.93	0.69	32.4
Approach		65	0.0	0.159	33.8	LOS C	1.5	10.6	0.91	0.69	34.0
North: SH6A (North)											
7	L2	46	11.4	0.752	13.3	LOS B	15.5	111.3	0.60	0.57	44.0
8	T1	684	2.6	0.752	8.6	LOS A	15.5	111.3	0.60	0.57	44.6
9	R2	158	0.7	0.331	17.9	LOS B	3.7	25.8	0.66	0.74	39.7
Approach		888	2.7	0.752	10.5	LOS B	15.5	111.3	0.61	0.60	43.6
West: Ballarat Street (West)											
10	L2	154	0.0	0.661	39.7	LOS D	6.3	44.2	0.99	0.85	32.3
11	T1	16	0.0	0.661	35.2	LOS D	6.3	44.2	0.99	0.85	32.5
12	R2	35	0.0	0.155	37.8	LOS D	1.2	8.3	0.93	0.72	32.7
Approach		204	0.0	0.661	39.1	LOS D	6.3	44.2	0.98	0.83	32.4
All Vehicles		1855	3.2	0.752	13.6	LOS B	15.5	111.3	0.65	0.60	42.0

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians										
Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped		
P1	South Full Crossing	333	32.2	LOS D	0.7	0.7	0.93	0.93		
P2	East Full Crossing	43	7.7	LOS A	0.0	0.0	0.45	0.45		
P3	North Full Crossing	148	31.9	LOS D	0.3	0.3	0.93	0.93		
P4	West Full Crossing	12	7.7	LOS A	0.0	0.0	0.45	0.45		
All Pedestrians		536	29.6	LOS C			0.88	0.88		

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

Pedestrian movement LOS values are based on average delay per pedestrian movement.

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

## MOVEMENT SUMMARY

Site: Option E1 (signals 2phase) April PM

New Site

Signals - Fixed Time Isolated Cycle Time = 65 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles											
Mov ID	OD Mov	Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: SH6A (South)											
1	L2	22	9.5	0.593	12.9	LOS B	11.6	83.4	0.63	0.57	44.3
2	T1	598	2.8	0.593	8.3	LOS A	11.6	83.4	0.63	0.57	44.8
3	R2	40	0.0	0.117	20.4	LOS C	0.9	6.2	0.70	0.70	38.7
Approach		660	2.9	0.593	9.2	LOS A	11.6	83.4	0.64	0.58	44.4
East: Ballarat Street (East)											
4	L2	40	0.0	0.209	31.6	LOS C	1.8	12.4	0.91	0.72	35.2
5	T1	21	0.0	0.209	27.0	LOS C	1.8	12.4	0.91	0.72	35.4
6	R2	23	0.0	0.127	35.5	LOS D	0.7	5.0	0.95	0.70	33.4
Approach		84	0.0	0.209	31.5	LOS C	1.8	12.4	0.92	0.71	34.7
North: SH6A (North)											
7	L2	53	0.0	0.840	21.3	LOS C	20.3	145.0	0.71	0.78	40.2
8	T1	702	2.4	0.840	16.8	LOS B	20.3	145.0	0.71	0.78	40.5
9	R2	164	2.6	0.369	19.2	LOS B	3.7	26.7	0.73	0.76	39.2
Approach		919	2.3	0.840	17.5	LOS B	20.3	145.0	0.71	0.77	40.2
West: Ballarat Street (West)											
10	L2	206	0.5	0.750	35.3	LOS D	8.2	58.0	1.00	0.92	33.7
11	T1	40	2.6	0.750	30.7	LOS C	8.2	58.0	1.00	0.92	34.0
12	R2	49	0.0	0.193	32.6	LOS C	1.5	10.2	0.92	0.73	34.3
Approach		296	0.7	0.750	34.2	LOS C	8.2	58.0	0.99	0.89	33.8
All Vehicles		1959	2.1	0.840	17.8	LOS B	20.3	145.0	0.74	0.72	40.1

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians									
Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped	
P1	South Full Crossing	333	27.2	LOS C	0.6	0.6	0.92	0.92	
P2	East Full Crossing	43	8.9	LOS A	0.0	0.0	0.52	0.52	
P3	North Full Crossing	148	26.9	LOS C	0.3	0.3	0.91	0.91	
P4	West Full Crossing	12	8.9	LOS A	0.0	0.0	0.52	0.52	
All Pedestrians		536	25.2	LOS C			0.88	0.88	

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

Pedestrian movement LOS values are based on average delay per pedestrian movement.

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

## MOVEMENT SUMMARY

Site: Option E1 (signals 2phase) December AM

New Site

Signals - Fixed Time Isolated Cycle Time = 60 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles											
Mov ID	OD Mov	Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: SH6A (South)											
1	L2	257	3.7	0.817	19.9	LOS B	21.0	150.2	0.81	0.85	40.3
2	T1	549	1.7	0.817	15.3	LOS B	21.0	150.2	0.81	0.85	40.7
3	R2	53	2.0	0.117	17.8	LOS B	1.0	7.3	0.68	0.70	39.8
Approach		859	2.3	0.817	16.8	LOS B	21.0	150.2	0.80	0.84	40.5
East: Ballarat Street (East)											
4	L2	31	0.0	0.139	27.4	LOS C	1.2	8.6	0.87	0.70	36.7
5	T1	18	0.0	0.139	22.9	LOS C	1.2	8.6	0.87	0.70	37.0
6	R2	28	0.0	0.081	27.1	LOS C	0.7	5.0	0.86	0.70	36.1
Approach		77	0.0	0.139	26.3	LOS C	1.2	8.6	0.87	0.70	36.5
North: SH6A (North)											
7	L2	36	0.0	0.573	13.3	LOS B	10.5	74.7	0.66	0.60	44.1
8	T1	543	1.7	0.573	8.7	LOS A	10.5	74.7	0.66	0.60	44.5
9	R2	37	11.4	0.149	24.7	LOS C	0.9	6.8	0.81	0.72	36.9
Approach		616	2.2	0.573	9.9	LOS A	10.5	74.7	0.67	0.61	44.0
West: Ballarat Street (West)											
10	L2	87	0.0	0.312	27.6	LOS C	3.0	20.7	0.89	0.75	36.4
11	T1	26	0.0	0.312	23.0	LOS C	3.0	20.7	0.89	0.75	36.7
12	R2	241	1.3	0.755	33.9	LOS C	7.5	53.3	1.00	0.92	33.8
Approach		355	0.9	0.755	31.6	LOS C	7.5	53.3	0.97	0.86	34.6
All Vehicles		1906	1.9	0.817	17.7	LOS B	21.0	150.2	0.79	0.76	40.1

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians										
Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped		
P1	South Full Crossing	333	24.6	LOS C	0.5	0.5	0.91	0.91		
P2	East Full Crossing	43	9.7	LOS A	0.0	0.0	0.57	0.57		
P3	North Full Crossing	148	24.5	LOS C	0.2	0.2	0.91	0.91		
P4	West Full Crossing	12	9.6	LOS A	0.0	0.0	0.57	0.57		
All Pedestrians		536	23.1	LOS C			0.88	0.88		

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

Pedestrian movement LOS values are based on average delay per pedestrian movement.

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

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Project: G:\NZTA\Reg 1316-XT177.62.305DC SH6A Ballarat St Intersection\500 Technical\Modelling\SH6A\_Ballarat.sip6

## MOVEMENT SUMMARY

Site: Option E1 (signals 2phase) December PM

New Site

Signals - Fixed Time Isolated Cycle Time = 60 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles											
Mov ID	OD Mov	Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: SH6A (South)											
1	L2	216	4.9	0.769	16.9	LOS B	18.0	130.1	0.79	0.79	41.8
2	T1	556	3.0	0.769	12.3	LOS B	18.0	130.1	0.79	0.79	42.2
3	R2	39	2.7	0.083	16.9	LOS B	0.7	5.2	0.65	0.68	40.2
Approach		811	3.5	0.769	13.8	LOS B	18.0	130.1	0.78	0.78	41.9
East: Ballarat Street (East)											
4	L2	25	0.0	0.142	26.6	LOS C	1.3	9.2	0.86	0.68	37.3
5	T1	26	4.0	0.142	22.0	LOS C	1.3	9.2	0.86	0.68	37.5
6	R2	19	0.0	0.057	27.0	LOS C	0.5	3.3	0.85	0.68	36.2
Approach		71	1.5	0.142	25.0	LOS C	1.3	9.2	0.86	0.68	37.1
North: SH6A (North)											
7	L2	40	5.3	0.534	13.1	LOS B	9.7	69.8	0.65	0.59	44.1
8	T1	505	2.9	0.534	8.5	LOS A	9.7	69.8	0.65	0.59	44.6
9	R2	36	0.0	0.124	22.6	LOS C	0.8	5.7	0.77	0.71	37.8
Approach		581	2.9	0.534	9.7	LOS A	9.7	69.8	0.66	0.59	44.1
West: Ballarat Street (West)											
10	L2	72	0.0	0.282	27.4	LOS C	2.7	19.0	0.89	0.74	36.7
11	T1	34	0.0	0.282	22.8	LOS C	2.7	19.0	0.89	0.74	36.9
12	R2	214	1.5	0.680	32.3	LOS C	6.4	45.4	0.99	0.86	34.3
Approach		319	1.0	0.680	30.2	LOS C	6.4	45.4	0.96	0.82	35.1
All Vehicles		1781	2.8	0.769	15.8	LOS B	18.0	130.1	0.77	0.72	40.9

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians									
Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped	
P1	South Full Crossing	333	24.6	LOS C	0.5	0.5	0.91	0.91	
P2	East Full Crossing	43	9.7	LOS A	0.0	0.0	0.57	0.57	
P3	North Full Crossing	148	24.5	LOS C	0.2	0.2	0.91	0.91	
P4	West Full Crossing	12	9.6	LOS A	0.0	0.0	0.57	0.57	
All Pedestrians		536	23.1	LOS C			0.88	0.88	

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

Pedestrian movement LOS values are based on average delay per pedestrian movement.

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



## MOVEMENT SUMMARY

Site: Option E2 (signals Barnes) December AM

New Site

Signals - Fixed Time Isolated Cycle Time = 120 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles											
Mov ID	OD Mov	Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: SH6A (South)											
1	L2	257	3.7	0.842	29.5	LOS C	38.0	271.7	0.83	0.82	36.5
2	T1	549	1.7	0.842	24.9	LOS C	38.0	271.7	0.83	0.82	36.8
3	R2	53	2.0	0.133	31.3	LOS C	2.0	14.5	0.69	0.71	34.7
Approach		859	2.3	0.842	26.7	LOS C	38.0	271.7	0.82	0.81	36.5
East: Ballarat Street (East)											
4	L2	31	0.0	0.145	49.9	LOS D	2.4	16.9	0.88	0.71	29.9
5	T1	18	0.0	0.145	45.4	LOS D	2.4	16.9	0.88	0.71	30.1
6	R2	28	0.0	0.126	55.7	LOS E	1.5	10.6	0.92	0.72	28.1
Approach		77	0.0	0.145	51.0	LOS D	2.4	16.9	0.90	0.71	29.3
North: SH6A (North)											
7	L2	36	0.0	0.604	22.2	LOS C	21.0	148.9	0.68	0.62	39.8
8	T1	543	1.7	0.604	17.7	LOS B	21.0	148.9	0.68	0.62	40.1
9	R2	37	11.4	0.193	45.1	LOS D	1.8	13.7	0.83	0.74	30.6
Approach		616	2.2	0.604	19.6	LOS B	21.0	148.9	0.69	0.63	39.4
West: Ballarat Street (West)											
10	L2	87	0.0	0.342	51.9	LOS D	5.9	41.4	0.92	0.77	29.3
11	T1	26	0.0	0.342	47.4	LOS D	5.9	41.4	0.92	0.77	29.5
12	R2	241	1.3	0.842	65.3	LOS E	15.2	107.9	1.00	0.94	26.2
Approach		355	0.9	0.842	60.7	LOS E	15.2	107.9	0.98	0.88	27.1
All Vehicles		1906	1.9	0.842	31.7	LOS C	38.0	271.7	0.81	0.76	34.8

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians										
Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped		
P1	South Full Crossing	322	54.9	LOS E	1.1	1.1	0.96	0.96		
P2	East Full Crossing	33	54.2	LOS E	0.1	0.1	0.95	0.95		
P3	North Full Crossing	138	54.5	LOS E	0.4	0.4	0.96	0.96		
P4	West Full Crossing	1	54.2	LOS E	0.0	0.0	0.95	0.95		
PD	Diagonal Crossing	42	54.2	LOS E	0.1	0.0	0.95	0.95		
All Pedestrians		536	54.7	LOS E			0.96	0.96		

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

Pedestrian movement LOS values are based on average delay per pedestrian movement.

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

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## MOVEMENT SUMMARY

Site: Option E3 (signals diamond) December AM

New Site

Signals - Fixed Time Isolated Cycle Time = 90 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles											
Mov ID	OD Mov	Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: SH6A (South)											
1	L2	257	3.7	0.903	40.0	LOS D	39.4	281.6	0.94	1.02	33.0
2	T1	549	1.7	0.903	35.4	LOS D	39.4	281.6	0.94	1.02	33.2
3	R2	53	2.0	0.427	51.4	LOS D	2.4	17.0	1.00	0.74	29.1
Approach		859	2.3	0.903	37.8	LOS D	39.4	281.6	0.94	1.00	32.9
East: Ballarat Street (East)											
4	L2	31	0.0	0.162	40.0	LOS D	1.9	13.1	0.89	0.71	32.6
5	T1	18	0.0	0.162	35.4	LOS D	1.9	13.1	0.89	0.71	32.8
6	R2	28	0.0	0.102	40.4	LOS D	1.1	7.7	0.89	0.71	31.9
Approach		77	0.0	0.162	39.1	LOS D	1.9	13.1	0.89	0.71	32.4
North: SH6A (North)											
7	L2	36	0.0	0.632	21.8	LOS C	18.1	128.1	0.77	0.69	40.0
8	T1	543	1.7	0.632	17.2	LOS B	18.1	128.1	0.77	0.69	40.3
9	R2	37	11.4	0.319	51.1	LOS D	1.7	12.8	0.99	0.73	29.1
Approach		616	2.2	0.632	19.5	LOS B	18.1	128.1	0.78	0.69	39.4
West: Ballarat Street (West)											
10	L2	87	0.0	0.370	41.5	LOS D	4.6	32.0	0.93	0.77	32.0
11	T1	26	0.0	0.370	36.9	LOS D	4.6	32.0	0.93	0.77	32.2
12	R2	241	1.3	0.882	56.0	LOS E	12.3	87.0	1.00	1.01	28.1
Approach		355	0.9	0.882	51.0	LOS D	12.3	87.0	0.98	0.93	29.2
All Vehicles		1906	1.9	0.903	34.4	LOS C	39.4	281.6	0.89	0.88	33.9

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians										
Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped		
P1	South Full Crossing	333	33.4	LOS D	0.7	0.7	0.87	0.87		
P2	East Full Crossing	43	15.6	LOS B	0.1	0.1	0.59	0.59		
P3	North Full Crossing	148	33.1	LOS D	0.3	0.3	0.86	0.86		
P4	West Full Crossing	12	15.6	LOS B	0.0	0.0	0.59	0.59		
All Pedestrians		536	31.5	LOS D			0.84	0.84		

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

Pedestrian movement LOS values are based on average delay per pedestrian movement.

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

## MOVEMENT SUMMARY

Site: Option E4 (signals 4-phase) December AM

New Site

Signals - Fixed Time Isolated Cycle Time = 120 seconds (Practical Cycle Time)

Movement Performance - Vehicles											
Mov ID	OD Mov	Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: SH6A (South)											
1	L2	257	3.7	1.355	392.7	LOS F	142.9	1020.3	1.00	2.40	7.9
2	T1	549	1.7	1.355	388.2	LOS F	142.9	1020.3	1.00	2.40	7.9
3	R2	53	2.0	0.085	33.7	LOS C	2.1	14.9	0.72	0.71	33.9
Approach		859	2.3	1.355	367.8	LOS F	142.9	1020.3	0.98	2.30	8.3
East: Ballarat Street (East)											
4	L2	31	0.0	0.312	61.7	LOS E	2.8	19.3	0.97	0.74	27.3
5	T1	18	0.0	0.312	57.1	LOS E	2.8	19.3	0.97	0.74	27.5
6	R2	28	0.0	0.130	56.7	LOS E	1.5	10.7	0.93	0.71	27.9
Approach		77	0.0	0.312	58.8	LOS E	2.8	19.3	0.96	0.73	27.6
North: SH6A (North)											
7	L2	36	0.0	1.351	392.7	LOS F	101.1	718.0	1.00	2.55	7.9
8	T1	543	1.7	1.351	388.1	LOS F	101.1	718.0	1.00	2.55	7.9
9	R2	37	11.4	0.091	43.4	LOS D	1.7	13.0	0.82	0.71	31.1
Approach		616	2.2	1.351	367.7	LOS F	101.1	718.0	0.99	2.44	8.3
West: Ballarat Street (West)											
10	L2	87	0.0	0.682	65.1	LOS E	6.9	48.0	1.00	0.84	26.5
11	T1	26	0.0	0.682	60.6	LOS E	6.9	48.0	1.00	0.84	26.6
12	R2	241	1.3	1.111	184.4	LOS F	27.1	191.8	1.00	1.38	14.1
Approach		355	0.9	1.111	145.8	LOS F	27.1	191.8	1.00	1.21	16.6
All Vehicles		1906	1.9	1.355	314.0	LOS F	142.9	1020.3	0.99	2.08	9.4

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians										
Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped		
P1	South Full Crossing	333	54.9	LOS E	1.1	1.1	0.96	0.96		
P2	East Full Crossing	43	41.7	LOS E	0.1	0.1	0.83	0.83		
P3	North Full Crossing	148	54.5	LOS E	0.5	0.5	0.96	0.96		
P4	West Full Crossing	12	32.3	LOS D	0.0	0.0	0.73	0.73		
All Pedestrians		536	53.2	LOS E			0.95	0.95		

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

Pedestrian movement LOS values are based on average delay per pedestrian movement.

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

## **Appendix C**

### **Detailed SIDRA Outputs for Option D using Different Cycle Times**

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# MOVEMENT SUMMARY

Site: Option D (shifted sig ped crossing) December AM crossing

Network: Option D December AM

New Site

Pedestrian Crossing (Signals) - Fixed Time Isolated Cycle Time = 60 seconds (User-Given Phase Times)

Movement Performance - Vehicles													
Mov ID	OD Mov	Total veh/h	Demand Flows HV %	Total veh/h	Arrival Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: RoadName													
2	T1	859	2.3	859	2.3	0.651	9.1	LOS A	7.6	54.4	0.64	0.55	40.0
Approach		859	2.3	859	2.3	0.651	9.1	LOS A	7.6	54.4	0.64	0.55	40.0
North: RoadName													
8	T1	815	1.6	815	1.6	0.764	13.4	LOS B	13.8	97.9	0.85	0.80	37.7
Approach		815	1.6	815	1.6	0.764	13.4	LOS B	13.8	97.9	0.85	0.80	37.7
All Vehicles		1674	1.9	1674	1.9	0.764	11.2	LOS B	13.8	97.9	0.74	0.67	38.8

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians										
Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped		
P1	South Full Crossing	481	24.8	LOS C	0.8	0.8	0.92	0.92		
All Pedestrians		481	24.8	LOS C			0.92	0.92		

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

Pedestrian movement LOS values are based on average delay per pedestrian movement.

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

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Project: G:\NZTA\Reg 13\6-XT177.62.305DC SH6A Ballarat St Intersection\500 Technical\Modelling\SH6A\_Ballarat.sip6

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# MOVEMENT SUMMARY

Site: Option D (shifted sig ped crossing) December AM roundabout

Network: Option D December AM

New Site  
Roundabout

Movement Performance - Vehicles														
Mov ID	OD Mov	Total veh/h	Demand Flows HV %	Total veh/h	Arrival Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h	
South: SH6A (South)														
1	L2	257	3.7	257	3.7	0.224	5.3	LOS A	1.2	8.9	0.24	0.57	42.5	
2	T1	549	1.7	549	1.7	0.395	4.0	LOS A	2.9	20.4	0.25	0.47	44.5	
3	R2	53	2.0	53	2.0	0.395	6.8	LOS A	2.9	20.4	0.25	0.47	44.1	
Approach		859	2.3	859	2.3	0.395	4.5	LOS A	2.9	20.4	0.25	0.50	43.8	
East: Ballarat Street (East)														
4	L2	31	0.0	31	0.0	0.195	19.5	LOS B	1.6	10.9	0.99	0.89	32.3	
5	T1	18	0.0	18	0.0	0.195	19.2	LOS B	1.6	10.9	0.99	0.89	39.0	
6	R2	28	0.0	28	0.0	0.195	21.9	LOS C	1.6	10.9	0.99	0.89	38.8	
Approach		77	0.0	77	0.0	0.195	20.3	LOS C	1.6	10.9	0.99	0.89	37.0	
North: SH6A (North)														
7	L2	36	0.0	36	0.0	1.103	253.0	LOS F	106.7	761.0	1.00	3.50	11.2	
8	T1	543	1.7	543	1.7	1.103	252.6	LOS F	106.7	761.0	1.00	3.50	6.4	
9	R2	37	11.4	37	11.4	1.103	256.0	LOS F	106.7	761.0	1.00	3.50	11.2	
Approach		616	2.2	616	2.2	1.103	252.8	LOS F	106.7	761.0	1.00	3.50	7.0	
West: Ballarat Street (West)														
10	L2	87	0.0	87	0.0	0.672	57.9	LOS E	16.1	113.8	1.00	1.22	27.3	
11	T1	26	0.0	26	0.0	0.672	57.3	LOS E	16.1	113.8	1.00	1.22	27.6	
12	R2	241	1.3	241	1.3	0.672	60.1	LOS E	16.1	113.8	1.00	1.22	19.3	
Approach		355	0.9	355	0.9	0.672	59.3	LOS E	16.1	113.8	1.00	1.22	22.5	
All Vehicles		1906	1.9	1906	1.9	1.103	95.6	LOS F	106.7	761.0	0.66	1.62	15.6	

Level of Service (LOS) Method: Delay (HCM 2000).

Roundabout LOS Method: Same as Signalised Intersections.

Vehicle movement LOS values are based on average delay per movement

Intersection and Approach LOS values are based on average delay for all vehicle movements.

Roundabout Capacity Model: SIDRA Standard.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

## NETWORK SUMMARY

Network: Option D December AM

New Network

Network Performance - Hourly Values				
Performance Measure	Vehicles	Per Unit Distance	Pedestrians	Persons
Network Level of Service (LOS)	LOS E			
Travel Time Index	3.58			
Speed Efficiency	0.42			
Congestion Coefficient	2.37			
Travel Speed (Average)	21.1 km/h		2.5 km/h	20.1 km/h
Travel Distance (Total)	2053.9 veh-km/h		17.1 ped-km/h	2481.8 pers-km/h
Travel Time (Total)	97.3 veh-h/h		7.0 ped-h/h	123.7 pers-h/h
Desired Speed	50.0 km/h			
Demand Flows (Total)	3580 veh/h		481 ped/h	4296 pers/h
Arrival Flows (Total)	3580 veh/h		481 ped/h	4296 pers/h
Percent Heavy Vehicles (Demand)	1.9 %			
Percent Heavy Vehicles (Arrival)	1.9 %			
Degree of Saturation	1.103			
Control Delay (Total)	55.82 veh-h/h		3.31 ped-h/h	70.30 pers-h/h
Control Delay (Average)	56.1 sec		24.8 sec	58.9 sec
Control Delay (Worst Lane)	252.8 sec			
Control Delay (Worst Movement)	256.0 sec		24.8 sec	256.0 sec
Geometric Delay (Average)	2.4 sec			
Stop-Line Delay (Average)	53.8 sec			
Queue Storage Ratio (Worst Lane)	1.00			
Total Effective Stops	4210 veh/h		442 ped/h	5494 pers/h
Effective Stop Rate	1.18 per veh	2.0 per km	0.92 per ped	1.28 per pers
Proportion Queued	0.70		0.92	0.80
Performance Index	394.6		9.4	404.0
Cost (Total)	2562.16 \$/h	1.25 \$/km	121.15 \$/h	2683.31 \$/h
Fuel Consumption (Total)	269.3 L/h	131.1 mL/km		
Fuel Economy	13.1 L/100km			
Carbon Dioxide (Total)	635.7 kg/h	309.5 g/km		
Hydrocarbons (Total)	0.059 kg/h	0.029 g/km		
Carbon Monoxide (Total)	0.512 kg/h	0.249 g/km		
NOx (Total)	0.609 kg/h	0.297 g/km		

Network Model Accuracy Level (largest change in degree of saturation for any lane): 2.3 %

Number of Iterations: 10

Network Level of Service (LOS) Method: SIDRA Speed Efficiency.

Model used: New Zealand.

Network Performance - Annual Values			
Performance Measure	Vehicles	Pedestrians	Persons
Demand Flows (Total)	1,718,400 veh/y	230,905 ped/y	2,062,080 pers/y
Delay	26,794 veh-h/y	1,590 ped-h/y	33,743 pers-h/y
Effective Stops	2,021,027 veh/y	212,065 ped/y	2,637,298 pers/y
Travel Distance	985,880 veh-km/y	8,197 ped-km/y	1,191,253 pers-km/y
Travel Time	46,686 veh-h/y	3,342 ped-h/y	59,365 pers-h/y
Cost	1,229,836 \$/y	58,151 \$/y	1,287,987 \$/y
Fuel Consumption	129,280 L/y		
Carbon Dioxide	305,123 kg/y		
Hydrocarbons	29 kg/y		
Carbon Monoxide	246 kg/y		
NOx	292 kg/y		



## NETWORK SUMMARY

Network: Option D December AM

New Network

Network Performance - Hourly Values				
Performance Measure	Vehicles	Per Unit Distance	Pedestrians	Persons
Network Level of Service (LOS)	LOS E			
Travel Time Index	3.72			
Speed Efficiency	0.43			
Congestion Coefficient	2.30			
Travel Speed (Average)	21.7 km/h		1.9 km/h	20.3 km/h
Travel Distance (Total)	2053.9 veh-km/h		17.1 ped-km/h	2481.8 pers-km/h
Travel Time (Total)	94.4 veh-h/h		9.0 ped-h/h	122.3 pers-h/h
Desired Speed	50.0 km/h			
Demand Flows (Total)	3580 veh/h		481 ped/h	4296 pers/h
Arrival Flows (Total)	3580 veh/h		481 ped/h	4296 pers/h
Percent Heavy Vehicles (Demand)	1.9 %			
Percent Heavy Vehicles (Arrival)	1.9 %			
Degree of Saturation	1.104			
Control Delay (Total)	52.98 veh-h/h		5.35 ped-h/h	68.92 pers-h/h
Control Delay (Average)	53.3 sec		40.0 sec	57.8 sec
Control Delay (Worst Lane)	251.1 sec			
Control Delay (Worst Movement)	254.3 sec		40.0 sec	254.3 sec
Geometric Delay (Average)	2.4 sec			
Stop-Line Delay (Average)	50.9 sec			
Queue Storage Ratio (Worst Lane)	1.00			
Total Effective Stops	3871 veh/h		458 ped/h	5104 pers/h
Effective Stop Rate	1.08 per veh	1.9 per km	0.95 per ped	1.19 per pers
Proportion Queued	0.59			
Performance Index	385.1			
Cost (Total)	2439.69 \$/h	1.19 \$/km	156.50 \$/h	2596.19 \$/h
Fuel Consumption (Total)	257.5 L/h	125.4 mL/km		
Fuel Economy	12.5 L/100km			
Carbon Dioxide (Total)	607.8 kg/h	295.9 g/km		
Hydrocarbons (Total)	0.056 kg/h	0.027 g/km		
Carbon Monoxide (Total)	0.487 kg/h	0.237 g/km		
NOx (Total)	0.573 kg/h	0.279 g/km		

Network Model Accuracy Level (largest change in degree of saturation for any lane): 2.3 %

Number of Iterations: 10

Network Level of Service (LOS) Method: SIDRA Speed Efficiency.

Model used: New Zealand.

Network Performance - Annual Values			
Performance Measure	Vehicles	Pedestrians	Persons
Demand Flows (Total)	1,718,400 veh/y	230,905 ped/y	2,062,080 pers/y
Delay	25,431 veh-h/y	2,566 ped-h/y	33,083 pers-h/y
Effective Stops	1,858,164 veh/y	219,920 ped/y	2,449,717 pers/y
Travel Distance	985,880 veh-km/y	8,197 ped-km/y	1,191,253 pers-km/y
Travel Time	45,334 veh-h/y	4,317 ped-h/y	58,718 pers-h/y
Cost	1,171,052 \$/y	75,120 \$/y	1,246,172 \$/y
Fuel Consumption	123,599 L/y		
Carbon Dioxide	291,742 kg/y		
Hydrocarbons	27 kg/y		
Carbon Monoxide	234 kg/y		
NOx	275 kg/y		

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# MOVEMENT SUMMARY

Site: Option D (shifted sig ped crossing) December AM roundabout

Network: Option D December AM

New Site  
Roundabout

Movement Performance - Vehicles													
Mov ID	OD Mov	Total veh/h	Demand Flows HV %	Total veh/h	Arrival Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: SH6A (South)													
1	L2	257	3.7	257	3.7	0.224	5.3	LOS A	1.3	9.3	0.26	0.56	42.4
2	T1	549	1.7	549	1.7	0.395	4.0	LOS A	2.9	20.4	0.28	0.47	44.4
3	R2	53	2.0	53	2.0	0.395	6.8	LOS A	2.9	20.4	0.28	0.47	44.0
Approach		859	2.3	859	2.3	0.395	4.5	LOS A	2.9	20.4	0.28	0.50	43.8
East: Ballarat Street (East)													
4	L2	31	0.0	31	0.0	0.195	19.5	LOS B	1.6	10.9	0.99	0.89	32.3
5	T1	18	0.0	18	0.0	0.195	19.2	LOS B	1.6	10.9	0.99	0.89	39.0
6	R2	28	0.0	28	0.0	0.195	21.9	LOS C	1.6	10.9	0.99	0.89	38.8
Approach		77	0.0	77	0.0	0.195	20.3	LOS C	1.6	10.9	0.99	0.89	37.0
North: SH6A (North)													
7	L2	36	0.0	36	0.0	1.104	251.4	LOS F	105.8	754.7	1.00	3.52	11.2
8	T1	543	1.7	543	1.7	1.104	250.9	LOS F	105.8	754.7	1.00	3.52	6.4
9	R2	37	11.4	37	11.4	1.104	254.3	LOS F	105.8	754.7	1.00	3.52	11.2
Approach		616	2.2	616	2.2	1.104	251.1	LOS F	105.8	754.7	1.00	3.52	7.1
West: Ballarat Street (West)													
10	L2	87	0.0	87	0.0	0.680	52.7	LOS D	14.4	101.6	1.00	1.31	28.5
11	T1	26	0.0	26	0.0	0.680	52.1	LOS D	14.4	101.6	1.00	1.31	28.7
12	R2	241	1.3	241	1.3	0.680	54.9	LOS D	14.4	101.6	1.00	1.31	20.4
Approach		355	0.9	355	0.9	0.680	54.1	LOS D	14.4	101.6	1.00	1.31	23.6
All Vehicles		1906	1.9	1906	1.9	1.104	94.1	LOS F	105.8	754.7	0.67	1.64	15.7

Level of Service (LOS) Method: Delay (HCM 2000).

Roundabout LOS Method: Same as Signalised Intersections.

Vehicle movement LOS values are based on average delay per movement

Intersection and Approach LOS values are based on average delay for all vehicle movements.

Roundabout Capacity Model: SIDRA Standard.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

# MOVEMENT SUMMARY

Site: Option D (shifted sig ped crossing) December AM crossing

Network: Option D December AM

New Site

Pedestrian Crossing (Signals) - Fixed Time Isolated Cycle Time = 90 seconds (User-Given Phase Times)

Movement Performance - Vehicles													
Mov ID	OD Mov	Total veh/h	Demand Flows HV %	Total veh/h	Arrival Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: RoadName													
2	T1	859	2.3	859	2.3	0.504	5.9	LOS A	7.4	53.0	0.43	0.37	43.1
Approach		859	2.3	859	2.3	0.504	5.9	LOS A	7.4	53.0	0.43	0.37	43.1
North: RoadName													
8	T1	815	1.6	815	1.6	0.591	7.8	LOS A	13.8	97.9	0.57	0.52	42.0
Approach		815	1.6	815	1.6	0.591	7.8	LOS A	13.8	97.9	0.57	0.52	42.0
All Vehicles		1674	1.9	1674	1.9	0.591	6.8	LOS A	13.8	97.9	0.50	0.44	42.5

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians										
Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped		
P1	South Full Crossing	481	40.0	LOS E	1.2	1.2	0.95	0.95		
All Pedestrians		481	40.0	LOS E			0.95	0.95		

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

Pedestrian movement LOS values are based on average delay per pedestrian movement.

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

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## NETWORK SUMMARY

Network: Option D December AM

New Network

Network Performance - Hourly Values				
Performance Measure	Vehicles	Per Unit Distance	Pedestrians	Persons
Network Level of Service (LOS)	LOS E			
Travel Time Index	3.78			
Speed Efficiency	0.44			
Congestion Coefficient	2.27			
Travel Speed (Average)	22.0 km/h		1.5 km/h	20.2 km/h
Travel Distance (Total)	2053.9 veh-km/h		17.1 ped-km/h	2481.8 pers-km/h
Travel Time (Total)	93.3 veh-h/h		11.0 ped-h/h	123.0 pers-h/h
Desired Speed	50.0 km/h			
Demand Flows (Total)	3580 veh/h		481 ped/h	4296 pers/h
Arrival Flows (Total)	3580 veh/h		481 ped/h	4296 pers/h
Percent Heavy Vehicles (Demand)	1.9 %			
Percent Heavy Vehicles (Arrival)	1.9 %			
Degree of Saturation	1.104			
Control Delay (Total)	51.80 veh-h/h		7.38 ped-h/h	69.54 pers-h/h
Control Delay (Average)	52.1 sec		55.3 sec	58.3 sec
Control Delay (Worst Lane)	250.4 sec			
Control Delay (Worst Movement)	253.5 sec		55.3 sec	253.5 sec
Geometric Delay (Average)	2.4 sec			
Stop-Line Delay (Average)	49.7 sec			
Queue Storage Ratio (Worst Lane)	1.00			
Total Effective Stops	3709 veh/h		466 ped/h	4917 pers/h
Effective Stop Rate	1.04 per veh	1.8 per km	0.97 per ped	1.14 per pers
Proportion Queued	0.54		0.97	0.64
Performance Index	381.1		13.6	394.7
Cost (Total)	2385.42 \$/h	1.16 \$/km	191.97 \$/h	2577.40 \$/h
Fuel Consumption (Total)	252.0 L/h	122.7 mL/km		
Fuel Economy	12.3 L/100km			
Carbon Dioxide (Total)	594.9 kg/h	289.6 g/km		
Hydrocarbons (Total)	0.055 kg/h	0.027 g/km		
Carbon Monoxide (Total)	0.476 kg/h	0.232 g/km		
NOx (Total)	0.556 kg/h	0.271 g/km		

Network Model Accuracy Level (largest change in degree of saturation for any lane): 2.3 %

Number of Iterations: 10

Network Level of Service (LOS) Method: SIDRA Speed Efficiency.

Model used: New Zealand.

Network Performance - Annual Values			
Performance Measure	Vehicles	Pedestrians	Persons
Demand Flows (Total)	1,718,400 veh/y	230,905 ped/y	2,062,080 pers/y
Delay	24,864 veh-h/y	3,544 ped-h/y	33,381 pers-h/y
Effective Stops	1,780,306 veh/y	223,847 ped/y	2,360,214 pers/y
Travel Distance	985,880 veh-km/y	8,197 ped-km/y	1,191,253 pers-km/y
Travel Time	44,773 veh-h/y	5,296 ped-h/y	59,024 pers-h/y
Cost	1,145,003 \$/y	92,146 \$/y	1,237,150 \$/y
Fuel Consumption	120,972 L/y		
Carbon Dioxide	285,555 kg/y		
Hydrocarbons	26 kg/y		
Carbon Monoxide	228 kg/y		
NOx	267 kg/y		

# MOVEMENT SUMMARY

Site: Option D (shifted sig ped crossing) December AM roundabout

Network: Option D December AM

New Site  
Roundabout

Movement Performance - Vehicles													
Mov ID	OD Mov	Total veh/h	Demand Flows HV %	Total veh/h	Arrival Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: SH6A (South)													
1	L2	257	3.7	257	3.7	0.224	5.3	LOS A	1.3	9.6	0.28	0.56	42.4
2	T1	549	1.7	549	1.7	0.395	4.0	LOS A	2.9	20.9	0.29	0.47	44.3
3	R2	53	2.0	53	2.0	0.395	6.8	LOS A	2.9	20.9	0.29	0.47	43.9
Approach		859	2.3	859	2.3	0.395	4.5	LOS A	2.9	20.9	0.29	0.50	43.7
East: Ballarat Street (East)													
4	L2	31	0.0	31	0.0	0.195	19.5	LOS B	1.6	10.9	0.99	0.89	32.3
5	T1	18	0.0	18	0.0	0.195	19.2	LOS B	1.6	10.9	0.99	0.89	39.0
6	R2	28	0.0	28	0.0	0.195	21.9	LOS C	1.6	10.9	0.99	0.89	38.8
Approach		77	0.0	77	0.0	0.195	20.3	LOS C	1.6	10.9	0.99	0.89	37.0
North: SH6A (North)													
7	L2	36	0.0	36	0.0	1.104	250.6	LOS F	105.4	751.8	1.00	3.53	11.3
8	T1	543	1.7	543	1.7	1.104	250.1	LOS F	105.4	751.8	1.00	3.53	6.5
9	R2	37	11.4	37	11.4	1.104	253.5	LOS F	105.4	751.8	1.00	3.53	11.3
Approach		616	2.2	616	2.2	1.104	250.4	LOS F	105.4	751.8	1.00	3.53	7.1
West: Ballarat Street (West)													
10	L2	87	0.0	87	0.0	0.683	50.4	LOS D	13.7	96.3	1.00	1.34	29.0
11	T1	26	0.0	26	0.0	0.683	49.7	LOS D	13.7	96.3	1.00	1.34	29.2
12	R2	241	1.3	241	1.3	0.683	52.6	LOS D	13.7	96.3	1.00	1.34	21.0
Approach		355	0.9	355	0.9	0.683	51.8	LOS D	13.7	96.3	1.00	1.34	24.2
All Vehicles		1906	1.9	1906	1.9	1.104	93.4	LOS F	105.4	751.8	0.68	1.65	15.8

Level of Service (LOS) Method: Delay (HCM 2000).

Roundabout LOS Method: Same as Signalised Intersections.

Vehicle movement LOS values are based on average delay per movement

Intersection and Approach LOS values are based on average delay for all vehicle movements.

Roundabout Capacity Model: SIDRA Standard.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

# MOVEMENT SUMMARY

Site: Option D (shifted sig ped crossing) December AM crossing

Network: Option D December AM

New Site

Pedestrian Crossing (Signals) - Fixed Time Isolated Cycle Time = 120 seconds (User-Given Phase Times)

Movement Performance - Vehicles													
Mov ID	OD Mov	Total veh/h	Demand Flows HV %	Total veh/h	Arrival Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: RoadName													
2	T1	859	2.3	859	2.3	0.453	4.4	LOS A	7.3	52.4	0.32	0.28	44.7
Approach		859	2.3	859	2.3	0.453	4.4	LOS A	7.3	52.4	0.32	0.28	44.7
North: RoadName													
8	T1	815	1.6	815	1.6	0.531	5.8	LOS A	13.8	97.9	0.43	0.39	43.8
Approach		815	1.6	815	1.6	0.531	5.8	LOS A	13.8	97.9	0.43	0.39	43.8
All Vehicles		1674	1.9	1674	1.9	0.531	5.1	LOS A	13.8	97.9	0.37	0.34	44.2

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians										
Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped		
P1	South Full Crossing	481	55.3	LOS E	1.6	1.6	0.97	0.97		
All Pedestrians		481	55.3	LOS E			0.97	0.97		

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

Pedestrian movement LOS values are based on average delay per pedestrian movement.

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

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## NETWORK SUMMARY

Network: Option D December AM

New Network

Network Performance - Hourly Values				
Performance Measure	Vehicles	Per Unit Distance	Pedestrians	Persons
Network Level of Service (LOS)	LOS E			
Travel Time Index	3.82			
Speed Efficiency	0.44			
Congestion Coefficient	2.25			
Travel Speed (Average)	22.2 km/h		1.3 km/h	20.0 km/h
Travel Distance (Total)	2053.9 veh-km/h		17.1 ped-km/h	2481.8 pers-km/h
Travel Time (Total)	92.6 veh-h/h		13.1 ped-h/h	124.2 pers-h/h
Desired Speed	50.0 km/h			
Demand Flows (Total)	3580 veh/h		481 ped/h	4296 pers/h
Arrival Flows (Total)	3580 veh/h		481 ped/h	4296 pers/h
Percent Heavy Vehicles (Demand)	1.9 %			
Percent Heavy Vehicles (Arrival)	1.9 %			
Degree of Saturation	1.104			
Control Delay (Total)	51.11 veh-h/h		9.43 ped-h/h	70.76 pers-h/h
Control Delay (Average)	51.4 sec		70.5 sec	59.3 sec
Control Delay (Worst Lane)	249.9 sec			
Control Delay (Worst Movement)	253.1 sec		70.5 sec	253.1 sec
Geometric Delay (Average)	2.4 sec			
Stop-Line Delay (Average)	49.0 sec			
Queue Storage Ratio (Worst Lane)	1.00			
Total Effective Stops	3609 veh/h		471 ped/h	4802 pers/h
Effective Stop Rate	1.01 per veh	1.8 per km	0.98 per ped	1.12 per pers
Proportion Queued	0.50		0.98	0.61
Performance Index	378.7		15.7	394.4
Cost (Total)	2353.42 \$/h	1.15 \$/km	227.49 \$/h	2580.91 \$/h
Fuel Consumption (Total)	248.8 L/h	121.1 mL/km		
Fuel Economy	12.1 L/100km			
Carbon Dioxide (Total)	587.2 kg/h	285.9 g/km		
Hydrocarbons (Total)	0.054 kg/h	0.026 g/km		
Carbon Monoxide (Total)	0.469 kg/h	0.228 g/km		
NOx (Total)	0.546 kg/h	0.266 g/km		

Network Model Accuracy Level (largest change in degree of saturation for any lane): 2.3 %

Number of Iterations: 10

Network Level of Service (LOS) Method: SIDRA Speed Efficiency.

Model used: New Zealand.

Network Performance - Annual Values			
Performance Measure	Vehicles	Pedestrians	Persons
Demand Flows (Total)	1,718,400 veh/y	230,905 ped/y	2,062,080 pers/y
Delay	24,535 veh-h/y	4,524 ped-h/y	33,966 pers-h/y
Effective Stops	1,732,479 veh/y	226,203 ped/y	2,305,178 pers/y
Travel Distance	985,880 veh-km/y	8,197 ped-km/y	1,191,253 pers-km/y
Travel Time	44,447 veh-h/y	6,276 ped-h/y	59,612 pers-h/y
Cost	1,129,640 \$/y	109,195 \$/y	1,238,835 \$/y
Fuel Consumption	119,405 L/y		
Carbon Dioxide	281,865 kg/y		
Hydrocarbons	26 kg/y		
Carbon Monoxide	225 kg/y		
NOx	262 kg/y		



# MOVEMENT SUMMARY

Site: Option D (shifted sig ped crossing) December AM roundabout

Network: Option D December AM

New Site  
Roundabout

Movement Performance - Vehicles														
Mov ID	OD Mov	Total veh/h	Demand Flows HV %	Total veh/h	Arrival Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h	
South: SH6A (South)														
1	L2	257	3.7	257	3.7	0.224	5.3	LOS A	1.4	9.8	0.28	0.56	42.4	
2	T1	549	1.7	549	1.7	0.395	4.0	LOS A	3.0	21.4	0.30	0.47	44.3	
3	R2	53	2.0	53	2.0	0.395	6.8	LOS A	3.0	21.4	0.30	0.47	43.9	
Approach		859	2.3	859	2.3	0.395	4.5	LOS A	3.0	21.4	0.30	0.50	43.7	
East: Ballarat Street (East)														
4	L2	31	0.0	31	0.0	0.194	19.4	LOS B	1.6	10.9	0.99	0.89	32.3	
5	T1	18	0.0	18	0.0	0.194	19.2	LOS B	1.6	10.9	0.99	0.89	39.0	
6	R2	28	0.0	28	0.0	0.194	21.9	LOS C	1.6	10.9	0.99	0.89	38.8	
Approach		77	0.0	77	0.0	0.194	20.3	LOS C	1.6	10.9	0.99	0.89	37.0	
North: SH6A (North)														
7	L2	36	0.0	36	0.0	1.104	250.2	LOS F	105.2	750.2	1.00	3.54	11.3	
8	T1	543	1.7	543	1.7	1.104	249.7	LOS F	105.2	750.2	1.00	3.54	6.5	
9	R2	37	11.4	37	11.4	1.104	253.1	LOS F	105.2	750.2	1.00	3.54	11.3	
Approach		616	2.2	616	2.2	1.104	249.9	LOS F	105.2	750.2	1.00	3.54	7.1	
West: Ballarat Street (West)														
10	L2	87	0.0	87	0.0	0.685	49.1	LOS D	13.2	93.4	1.00	1.36	29.3	
11	T1	26	0.0	26	0.0	0.685	48.5	LOS D	13.2	93.4	1.00	1.36	29.5	
12	R2	241	1.3	241	1.3	0.685	51.3	LOS D	13.2	93.4	1.00	1.36	21.3	
Approach		355	0.9	355	0.9	0.685	50.5	LOS D	13.2	93.4	1.00	1.36	24.5	
All Vehicles		1906	1.9	1906	1.9	1.104	93.0	LOS F	105.2	750.2	0.68	1.65	15.8	

Level of Service (LOS) Method: Delay (HCM 2000).

Roundabout LOS Method: Same as Signalised Intersections.

Vehicle movement LOS values are based on average delay per movement

Intersection and Approach LOS values are based on average delay for all vehicle movements.

Roundabout Capacity Model: SIDRA Standard.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

# MOVEMENT SUMMARY

Site: Option D (shifted sig ped crossing) December AM crossing

Network: Option D December AM

New Site

Pedestrian Crossing (Signals) - Fixed Time Isolated Cycle Time = 150 seconds (User-Given Phase Times)

Movement Performance - Vehicles													
Mov ID	OD Mov	Total veh/h	Demand Flows HV %	Total veh/h	Arrival Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: RoadName													
2	T1	859	2.3	859	2.3	0.427	3.5	LOS A	7.3	52.1	0.26	0.23	45.7
Approach		859	2.3	859	2.3	0.427	3.5	LOS A	7.3	52.1	0.26	0.23	45.7
North: RoadName													
8	T1	815	1.6	815	1.6	0.501	4.6	LOS A	13.8	97.9	0.34	0.32	45.0
Approach		815	1.6	815	1.6	0.501	4.6	LOS A	13.8	97.9	0.34	0.32	45.0
All Vehicles		1674	1.9	1674	1.9	0.501	4.0	LOS A	13.8	97.9	0.30	0.27	45.3

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians										
Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped		
P1	South Full Crossing	481	70.5	LOS F	2.0	2.0	0.98	0.98		
All Pedestrians		481	70.5	LOS F			0.98	0.98		

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

Pedestrian movement LOS values are based on average delay per pedestrian movement.

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

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## Appendix D

### Detailed SIDRA Outputs for Option E1.1

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## MOVEMENT SUMMARY

Site: Option E1.1 (signals+lane 2phase) April AM

New Site

Signals - Fixed Time Isolated Cycle Time = 65 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles											
Mov ID	OD Mov	Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: SH6A (South)											
1	L2	29	10.7	0.688	15.3	LOS B	14.0	102.8	0.73	0.66	43.0
2	T1	620	5.1	0.688	10.6	LOS B	14.0	102.8	0.73	0.66	43.5
3	R2	47	0.0	0.115	18.1	LOS B	1.0	6.8	0.66	0.69	39.8
Approach		697	5.0	0.688	11.3	LOS B	14.0	102.8	0.72	0.66	43.2
East: Ballarat Street (East)											
4	L2	17	0.0	0.109	26.3	LOS C	1.2	8.3	0.82	0.65	37.6
5	T1	29	0.0	0.109	21.7	LOS C	1.2	8.3	0.82	0.65	37.9
6	R2	19	0.0	0.056	28.6	LOS C	0.5	3.6	0.85	0.68	35.8
Approach		65	0.0	0.109	24.9	LOS C	1.2	8.3	0.83	0.66	37.2
North: SH6A (North)											
7	L2	46	11.4	0.214	12.5	LOS B	3.6	26.0	0.54	0.50	44.1
8	T1	684	2.6	0.599	9.1	LOS A	9.7	69.8	0.62	0.55	44.4
9	R2	158	0.7	0.441	24.2	LOS C	4.1	29.2	0.83	0.78	37.2
Approach		888	2.7	0.599	11.9	LOS B	9.7	69.8	0.65	0.59	42.9
West: Ballarat Street (West)											
10	L2	154	0.0	0.412	28.3	LOS C	4.7	33.2	0.90	0.78	36.0
11	T1	16	0.0	0.412	23.7	LOS C	4.7	33.2	0.90	0.78	36.2
12	R2	35	0.0	0.100	28.9	LOS C	0.9	6.6	0.86	0.71	35.5
Approach		204	0.0	0.412	28.0	LOS C	4.7	33.2	0.89	0.77	35.9
All Vehicles		1855	3.2	0.688	13.9	LOS B	14.0	102.8	0.71	0.64	41.9

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians									
Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped	
P1	South Full Crossing	333	27.2	LOS C	0.6	0.6	0.92	0.92	
P2	East Full Crossing	43	10.5	LOS B	0.0	0.0	0.57	0.57	
P3	North Full Crossing	148	26.9	LOS C	0.3	0.3	0.91	0.91	
P4	West Full Crossing	12	10.5	LOS B	0.0	0.0	0.57	0.57	
All Pedestrians		536	25.4	LOS C			0.88	0.88	

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

Pedestrian movement LOS values are based on average delay per pedestrian movement.

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

## MOVEMENT SUMMARY

Site: Option E1.1 (signals+lane 2phase) April PM

New Site

Signals - Fixed Time Isolated Cycle Time = 60 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles											
Mov ID	OD Mov	Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: SH6A (South)											
1	L2	22	9.5	0.684	15.9	LOS B	13.1	93.9	0.77	0.68	42.8
2	T1	598	2.8	0.684	11.2	LOS B	13.1	93.9	0.77	0.68	43.3
3	R2	40	0.0	0.109	19.3	LOS B	0.8	5.7	0.71	0.70	39.3
Approach		660	2.9	0.684	11.9	LOS B	13.1	93.9	0.76	0.68	43.0
East: Ballarat Street (East)											
4	L2	40	0.0	0.138	24.7	LOS C	1.5	10.2	0.83	0.69	37.7
5	T1	21	0.0	0.138	20.1	LOS C	1.5	10.2	0.83	0.69	38.0
6	R2	23	0.0	0.076	28.1	LOS C	0.6	4.1	0.87	0.69	36.0
Approach		84	0.0	0.138	24.5	LOS C	1.5	10.2	0.84	0.69	37.3
North: SH6A (North)											
7	L2	53	0.0	0.238	13.2	LOS B	3.8	27.1	0.58	0.54	43.8
8	T1	702	2.4	0.666	9.9	LOS A	10.1	72.3	0.68	0.60	43.9
9	R2	164	2.6	0.480	24.1	LOS C	4.2	29.7	0.86	0.79	37.2
Approach		919	2.3	0.666	12.7	LOS B	10.1	72.3	0.70	0.63	42.5
West: Ballarat Street (West)											
10	L2	206	0.5	0.548	26.5	LOS C	6.5	46.0	0.92	0.80	36.7
11	T1	40	2.6	0.548	21.9	LOS C	6.5	46.0	0.92	0.80	37.0
12	R2	49	0.0	0.123	25.5	LOS C	1.2	8.4	0.84	0.72	36.7
Approach		296	0.7	0.548	25.7	LOS C	6.5	46.0	0.91	0.79	36.8
All Vehicles		1959	2.1	0.684	14.9	LOS B	13.1	93.9	0.76	0.67	41.4

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians									
Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped	
P1	South Full Crossing	333	24.6	LOS C	0.5	0.5	0.91	0.91	
P2	East Full Crossing	43	11.4	LOS B	0.0	0.0	0.62	0.62	
P3	North Full Crossing	148	24.5	LOS C	0.2	0.2	0.91	0.91	
P4	West Full Crossing	12	11.4	LOS B	0.0	0.0	0.62	0.62	
All Pedestrians		536	23.2	LOS C			0.88	0.88	

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

Pedestrian movement LOS values are based on average delay per pedestrian movement.

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

## MOVEMENT SUMMARY

Site: Option E1.1 (signals+lane 2phase) December AM

New Site

Signals - Fixed Time Isolated Cycle Time = 70 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles											
Mov ID	OD Mov	Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: SH6A (South)											
1	L2	257	3.7	0.792	18.4	LOS B	21.7	154.7	0.77	0.78	41.0
2	T1	549	1.7	0.792	13.8	LOS B	21.7	154.7	0.77	0.78	41.4
3	R2	53	2.0	0.098	15.8	LOS B	1.0	7.2	0.58	0.68	40.8
Approach		859	2.3	0.792	15.3	LOS B	21.7	154.7	0.76	0.78	41.2
East: Ballarat Street (East)											
4	L2	31	0.0	0.136	30.0	LOS C	1.4	9.8	0.86	0.69	35.8
5	T1	18	0.0	0.136	25.5	LOS C	1.4	9.8	0.86	0.69	36.0
6	R2	28	0.0	0.079	29.6	LOS C	0.8	5.6	0.84	0.70	35.4
Approach		77	0.0	0.136	28.8	LOS C	1.4	9.8	0.85	0.70	35.7
North: SH6A (North)											
7	L2	36	0.0	0.136	11.5	LOS B	2.3	16.5	0.48	0.46	44.6
8	T1	543	1.7	0.382	8.0	LOS A	7.7	54.7	0.55	0.49	44.9
9	R2	37	11.4	0.145	25.7	LOS C	1.0	7.6	0.78	0.72	36.5
Approach		616	2.2	0.382	9.2	LOS A	7.7	54.7	0.56	0.50	44.3
West: Ballarat Street (West)											
10	L2	87	0.0	0.289	30.1	LOS C	3.4	23.5	0.88	0.75	35.5
11	T1	26	0.0	0.289	25.6	LOS C	3.4	23.5	0.88	0.75	35.8
12	R2	241	1.3	0.761	38.3	LOS D	8.7	61.6	1.00	0.91	32.5
Approach		355	0.9	0.761	35.3	LOS D	8.7	61.6	0.96	0.86	33.4
All Vehicles		1906	1.9	0.792	17.6	LOS B	21.7	154.7	0.74	0.70	40.1

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians									
Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped	
P1	South Full Crossing	333	29.7	LOS C	0.6	0.6	0.93	0.93	
P2	East Full Crossing	43	9.8	LOS A	0.0	0.0	0.53	0.53	
P3	North Full Crossing	148	29.4	LOS C	0.3	0.3	0.92	0.92	
P4	West Full Crossing	12	9.8	LOS A	0.0	0.0	0.53	0.53	
All Pedestrians		536	27.6	LOS C			0.88	0.88	

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

Pedestrian movement LOS values are based on average delay per pedestrian movement.

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

## MOVEMENT SUMMARY

Site: Option E1.1 (signals+lane 2phase) December PM

New Site

Signals - Fixed Time Isolated Cycle Time = 70 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles											
Mov ID	OD Mov	Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: SH6A (South)											
1	L2	216	4.9	0.745	16.0	LOS B	18.8	135.6	0.75	0.73	42.2
2	T1	556	3.0	0.745	11.4	LOS B	18.8	135.6	0.75	0.73	42.6
3	R2	39	2.7	0.070	15.0	LOS B	0.7	5.1	0.56	0.66	41.2
Approach		811	3.5	0.745	12.8	LOS B	18.8	135.6	0.74	0.73	42.4
East: Ballarat Street (East)											
4	L2	25	0.0	0.139	30.0	LOS C	1.5	10.6	0.86	0.69	36.0
5	T1	26	4.0	0.139	25.4	LOS C	1.5	10.6	0.86	0.69	36.3
6	R2	19	0.0	0.051	29.3	LOS C	0.5	3.7	0.84	0.68	35.5
Approach		71	1.5	0.139	28.1	LOS C	1.5	10.6	0.85	0.68	36.0
North: SH6A (North)											
7	L2	40	5.3	0.128	11.5	LOS B	2.1	15.3	0.47	0.47	44.5
8	T1	505	2.9	0.358	7.9	LOS A	7.2	51.9	0.54	0.48	45.0
9	R2	36	0.0	0.120	23.7	LOS C	0.9	6.3	0.74	0.71	37.4
Approach		581	2.9	0.358	9.1	LOS A	7.2	51.9	0.55	0.50	44.4
West: Ballarat Street (West)											
10	L2	72	0.0	0.262	29.9	LOS C	3.1	21.6	0.87	0.74	35.7
11	T1	34	0.0	0.262	25.4	LOS C	3.1	21.6	0.87	0.74	36.0
12	R2	214	1.5	0.678	36.2	LOS D	7.4	52.1	0.99	0.86	33.1
Approach		319	1.0	0.678	33.6	LOS C	7.4	52.1	0.95	0.82	34.0
All Vehicles		1781	2.8	0.745	16.0	LOS B	18.8	135.6	0.72	0.67	40.9

Level of Service (LOS) Method: Delay (HCM 2000).

Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

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HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians									
Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped	
P1	South Full Crossing	333	29.7	LOS C	0.6	0.6	0.93	0.93	
P2	East Full Crossing	43	9.8	LOS A	0.0	0.0	0.53	0.53	
P3	North Full Crossing	148	29.4	LOS C	0.3	0.3	0.92	0.92	
P4	West Full Crossing	12	9.8	LOS A	0.0	0.0	0.53	0.53	
All Pedestrians		536	27.6	LOS C			0.88	0.88	

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)

Pedestrian movement LOS values are based on average delay per pedestrian movement.

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