Traffic Engineers and Transport Planners

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Our Reference: G19582R-02A

18 January 2019

Greater Shepparton City Council
Locked Bag 1000
SHEPPARTON VIC 3632

Attention: Mr Brett Keele

Dear Brett,

Balaclava Road / New Dookie Road / Verney Road / Hawdon Street – Intersection Analysis: Traffic Engineering Assessment

Introduction

Further to your instructions, please find following additional analysis of the Balaclava Road / New Dookie Road / Verney Road / Hawdon Street intersection in Shepparton.

Traffix Group was engaged in 2015 by Greater Shepparton City Council to undertake a traffic assessment on a number of intersection upgrade options at Balaclava Road / New Dookie Road / Verney Road / Hawdon Street in Shepparton including traffic signals and an upgraded roundabout (Our Ref: G19582R-01C dated 26/4/2016).

Each of the intersection options was assessed in a present scenario (2015) and a future scenario (2026 design year) and a functional layout plan was developed for the recommended traffic signal option.

We understand that Council is seeking additional SIDRA analysis to compare the performance of the recommended traffic signals with the existing roundabout. The following letter provides a comparison of existing roundabout layout and the proposed traffic signals to inform stakeholder consultation.

Comparison Scenarios

The following scenarios to compare the proposed traffic signals and the existing roundabout have been assessed:

- **Scenario 1:** existing roundabout ('0 years') compared to the existing roundabout ('10 years'), and
- **Scenario 2:** existing roundabout ('10 years') compared to the proposed traffic signals ('10 years').

Traffic Volume Data Sets

The traffic volumes utilised for this assessment were sourced from our previous report (Our Ref: G19582R-01C dated 26/4/2016). The key traffic volume scenarios are as follows:

- **'0 years' scenarios:** Turning movement count data collected at the intersection in 2015.
- **'10 years' scenarios:** Data set developed from the 2015 turning movement count data with additional volumes associated with likely developments in the area and a 2% growth factor for general growth on the road network. This data set represents a horizon year of 2026 (i.e. 10 years beyond 2015).

A full summary of the development of the future traffic volume data set can be found in our previous report.

Intersection Layouts

The SIDRA layouts adopted for this analysis are shown in Figure 1 and Figure 2.

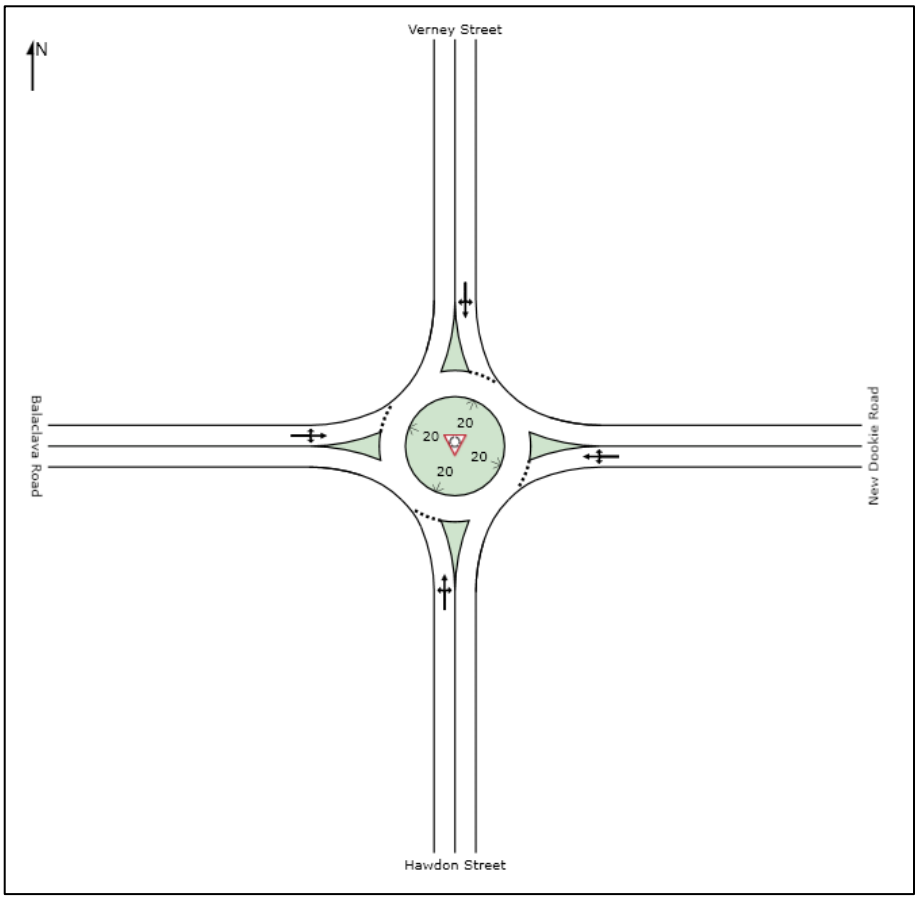


Figure 1: Existing Roundabout Layout

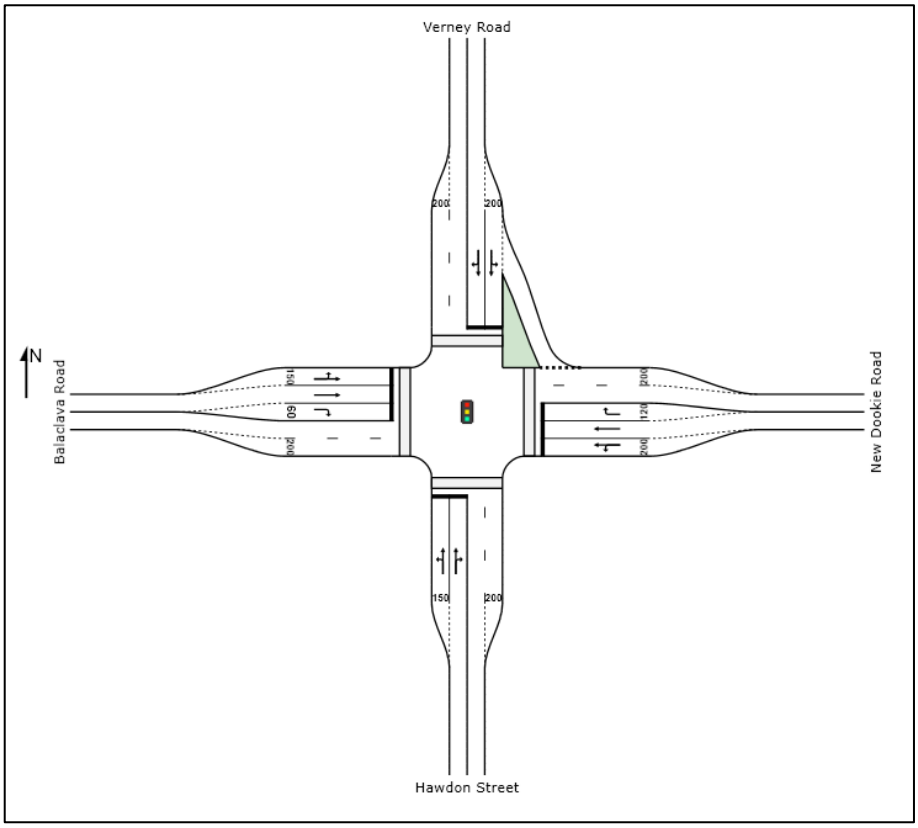


Figure 2: Proposed Traffic Signals

SIDRA Results - Scenario 1

Scenario 1 generally represents a 'Do Nothing' case where the existing roundabout layout is retained and the intersection is modelled with estimated traffic volumes ten (10) years into the future (i.e. 2026)

Table 1 below compares the existing roundabout at Balaclava Road / New Dookie Road / Verney Road under a '0 Year' scenario and a '10 Year' scenario.

Table 1: Scenario 1 Comparison

	AM Peak			PM Peak		
	Degree of Saturation	Average Delay (s)	Queue Length (m)	Degree of Saturation	Average Delay (s)	Queue Length (m)
South Approach: Hawdon Street						
0 Year	0.53	10	32	0.88	30	114
10 Year	1.41	394	1,206	1.30	291	1,086
Difference	**+0.88**	**+384**	**+1,174**	**+0.42**	**+261**	**+972**

	AM Peak			PM Peak		
	Degree of Saturation	Average Delay (s)	Queue Length (m)	Degree of Saturation	Average Delay (s)	Queue Length (m)
East Approach: New Dookie Road						
0 Year	0.58	12	40	0.94	37	167
10 Year	0.94	34	185	2.03	947	2,829
Difference	**+0.36**	**+22**	**+145**	**+1.09**	**+910**	**+2,662**
North Approach: Verney Street						
0 Year	0.71	13	60	0.71	12	58
10 Year	1.65	611	1,738	0.99	46	248
Difference	**+0.94**	**+598**	**+1,678**	**+0.28**	**+34**	**+190**
West Approach: Balaclava Road						
0 Year	0.57	11	42	0.97	64	158
10 Year	1.24	244	858	1.84	786	1,463
Difference	**+0.67**	**+233**	**+816**	**+0.87**	**+722**	**+1,035**

Table 1 shows that the performance of the existing roundabout severely deteriorates in the ten (10) year period following the existing conditions assessment with all of the approaches experiencing a degree of saturation above 1.0 in at least one peak period. This leads to SIDRA to estimate long delays and long queue lengths.

We note that the SIDRA estimates of delay and queue length can become less precise as the degree of saturation exceeds 1.0. On this basis, the specific delays and queue lengths are may not be representative of the actual intersection performance and should only be used as an indication that the intersection is operating well above capacity. Nevertheless, the SIDRA model clearly indicates that the existing roundabout layout will experience major traffic congestion prior to the 2026 design year with three of the four approaches experiencing average delays in excess of five minutes and maximum queues exceeding 500m.

A copy of the SIDRA results for Scenario 1 are provided in Appendix A and B.

SIDRA Results - Scenario 2

Scenario 2 compares the existing roundabout layout and the proposed traffic signal layout with the estimated traffic volumes ten (10) years into the future. Table 2 below summarises the SIDRA results for Scenario 2.

Table 2: Scenario 2 Comparison

	AM Peak			PM Peak		
	Degree of Saturation	Average Delay (s)	Queue Length (m)	Degree of Saturation	Average Delay (s)	Queue Length (m)
South Approach: Hawdon Street						
Roundabout	1.41	394	1,206	1.30	291	1,086
Signals	0.84	60	130	0.89	61	185
Difference	**-0.57**	**-334**	**-1,076**	**-0.41**	**-230**	**-901**
East Approach: New Dookie Road						
Roundabout	0.94	34	185	2.03	947	2,829
Signals	0.86	53	92	0.91	56	167
Difference	**-0.08**	**-19**	**-93**	**-1.12**	**-891**	**-2,662**
North Approach: Verney Street						
Roundabout	1.65	611	1,738	0.99	46	248
Signals	0.85	53	195	0.88	61	175
Difference	**-0.80**	**-558**	**-1,543**	**-0.11**	**+15**	**-73**
West Approach: Balaclava Road						
Roundabout	1.24	244	858	1.84	786	1,463
Signals	0.86	59	170	0.91	71	124
Difference	**-0.38**	**-185**	**-688**	**-0.93**	**-715**	**-1,339**

Table 2 above shows the in the '10 Year' scenario, the construction of the traffic signals results in significant improvements along all approaches from the existing roundabout layout.

As mentioned previously, SIDRA is less accurate as the degree of saturation exceeds 1.0. On this basis, it is difficult to quantify the exact improvements in maximum queue length and average delay, however, the 'Do Nothing' scenario will result in at least three of the four approaches experiencing major delays greater than five minutes and queue lengths that exceed 500m.

Under a '10 Year' scenario the traffic signals operate satisfactorily with a maximum queue length of 195m along the north approach in the AM peak and a maximum average delay of 71 seconds along the west approach in the PM peak.

A copy of the SIDRA results for Scenario 2 are provided in Appendix B and C.

SIDRA Detailed Outputs

The detailed SIDRA outputs for each option are provided in Appendix A to Appendix C. For each option the following summaries are provided:

- Intersection layout
- Movement summary
- Lane summary
- Phasing summary (where applicable – for traffic signal options only).

Conclusions

Based on the above assessments, the existing roundabout at Balaclava Road / New Dookie Road / Verney Road / Hawdon Street will continue to deteriorate and operate significantly above capacity in the future '10 Year' scenario. This will result in three of the four approaches experiencing major delays in excess of five minutes and queue lengths greater than 500m.

The construction of traffic signals will result in significantly improved performance of the intersection in the future scenario with a maximum average delays of 71 seconds and maximum queue lengths less than 200m.

Please contact myself at Traffix Group if you require any further information.

Yours faithfully,

TRAFFIX GROUP PTY LTD

WILL DE WAARD

Director

Appendix A – Roundabout '0 Years'

Appendix B – Roundabout '10 Years'

Appendix C – Traffic Signals '10 Years'

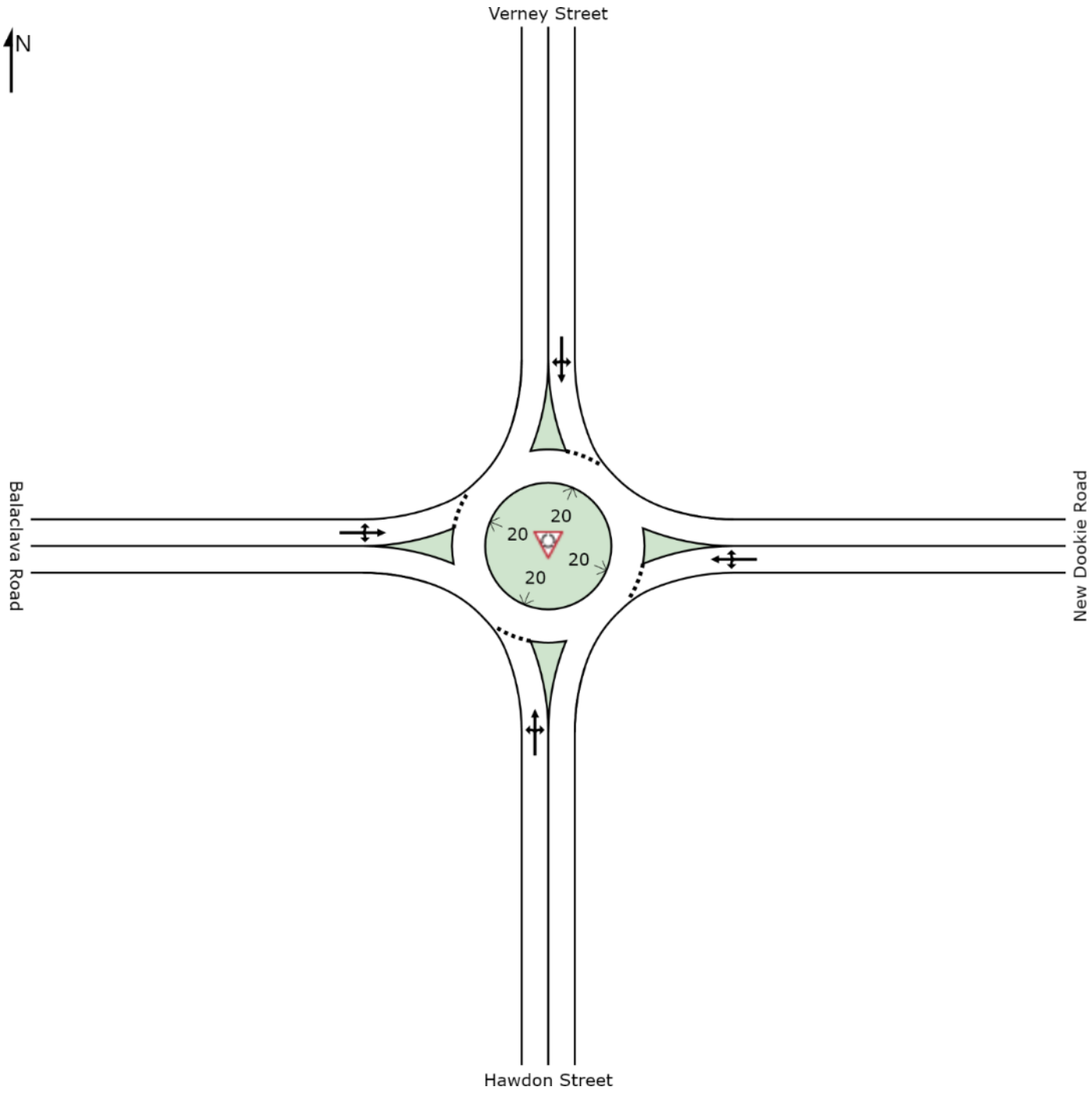
Appendix A: Roundabout '0 Years'

SITE LAYOUT

Site: Balaclava Road / New Dookie Road - AM Existing

Shepparton

Roundabout



MOVEMENT SUMMARY

Site: Balaclava Road / New Dookie Road - AM Existing

Shepparton

Roundabout

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Hawdon Street											
1	L2	66	1.6	0.530	9.0	LOS A	4.4	31.9	0.81	0.87	51.0
2	T1	266	5.5	0.530	9.4	LOS A	4.4	31.9	0.81	0.87	52.1
3	R2	66	3.2	0.530	13.9	LOS B	4.4	31.9	0.81	0.87	52.0
Approach		399	4.5	0.530	10.1	LOS B	4.4	31.9	0.81	0.87	51.9
East: New Dookie Road											
4	L2	67	6.3	0.582	9.8	LOS A	5.4	40.3	0.85	0.93	49.8
5	T1	236	8.9	0.582	10.2	LOS B	5.4	40.3	0.85	0.93	50.9
6	R2	148	8.5	0.582	14.8	LOS B	5.4	40.3	0.85	0.93	50.8
Approach		452	8.4	0.582	11.6	LOS B	5.4	40.3	0.85	0.93	50.7
North: Verney Street											
7	L2	168	5.6	0.713	12.2	LOS B	8.4	60.3	0.91	1.00	49.0
8	T1	308	2.7	0.713	12.2	LOS B	8.4	60.3	0.91	1.00	50.1
9	R2	78	2.7	0.713	16.9	LOS B	8.4	60.3	0.91	1.00	50.1
Approach		555	3.6	0.713	12.9	LOS B	8.4	60.3	0.91	1.00	49.8
West: Balaclava Road											
10	L2	111	27.6	0.571	10.4	LOS B	5.0	42.1	0.83	0.92	49.7
11	T1	231	14.6	0.571	10.0	LOS B	5.0	42.1	0.83	0.92	51.2
12	R2	94	37.1	0.571	15.7	LOS B	5.0	42.1	0.83	0.92	50.2
Approach		435	22.8	0.571	11.3	LOS B	5.0	42.1	0.83	0.92	50.6
All Vehicles		1840	9.5	0.713	11.6	LOS B	8.4	60.3	0.86	0.94	50.6

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.

LANE SUMMARY

Site: Balaclava Road / New Dookie Road - AM Existing

Shepparton

Roundabout

Lane Use and Performance													
	Demand Flows		Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	95% Back of Queue		Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	Total veh/h	HV %	veh/h	v/c	%	sec		Veh	Dist m		m	%	%
South: Hawdon Street													
Lane 1[d]	399	4.5	753	0.530	100	10.1	LOS B	4.4	31.9	Full	500	0.0	0.0
Approach	399	4.5		0.530		10.1	LOS B	4.4	31.9				
East: New Dookie Road													
Lane 1[d]	452	8.4	776	0.582	100	11.6	LOS B	5.4	40.3	Full	500	0.0	0.0
Approach	452	8.4		0.582		11.6	LOS B	5.4	40.3				
North: Verney Street													
Lane 1[d]	555	3.6	778	0.713	100	12.9	LOS B	8.4	60.3	Full	500	0.0	0.0
Approach	555	3.6		0.713		12.9	LOS B	8.4	60.3				
West: Balaclava Road													
Lane 1[d]	435	22.8	762	0.571	100	11.3	LOS B	5.0	42.1	Full	500	0.0	0.0
Approach	435	22.8		0.571		11.3	LOS B	5.0	42.1				
Intersection	1840	9.5		0.713		11.6	LOS B	8.4	60.3				

Level of Service (LOS) Method: Delay (HCM 2000).
Roundabout LOS Method: Same as Signalised Intersections.
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
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.

d Dominant lane on roundabout approach

MOVEMENT SUMMARY

Site: Balaclava Road / New Dookie Road - PM Existing

Shepparton

Roundabout

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Hawdon Street											
1	L2	84	2.5	0.883	28.9	LOS C	15.9	113.8	1.00	1.43	40.2
2	T1	396	1.6	0.883	29.0	LOS C	15.9	113.8	1.00	1.43	41.0
3	R2	52	14.3	0.883	34.5	LOS C	15.9	113.8	1.00	1.43	40.6
Approach		532	3.0	0.883	29.6	LOS C	15.9	113.8	1.00	1.43	40.8
East: New Dookie Road											
4	L2	75	1.4	0.940	34.8	LOS C	23.3	166.9	1.00	1.61	37.3
5	T1	315	4.0	0.940	35.2	LOS D	23.3	166.9	1.00	1.61	37.9
6	R2	258	1.2	0.940	39.6	LOS D	23.3	166.9	1.00	1.61	37.9
Approach		647	2.6	0.940	36.9	LOS D	23.3	166.9	1.00	1.61	37.9
North: Verney Street											
7	L2	155	0.0	0.705	11.3	LOS B	8.2	58.4	0.91	0.98	49.6
8	T1	328	1.3	0.705	11.6	LOS B	8.2	58.4	0.91	0.98	50.7
9	R2	69	9.1	0.705	16.6	LOS B	8.2	58.4	0.91	0.98	50.4
Approach		553	1.9	0.705	12.1	LOS B	8.2	58.4	0.91	0.98	50.3
West: Balaclava Road											
10	L2	67	3.1	0.971	62.3	LOS E	21.6	157.5	1.00	1.81	29.3
11	T1	226	7.4	0.971	63.0	LOS E	21.6	157.5	1.00	1.81	29.7
12	R2	121	0.0	0.971	66.9	LOS E	21.6	157.5	1.00	1.81	29.7
Approach		415	4.6	0.971	64.0	LOS E	21.6	157.5	1.00	1.81	29.6
All Vehicles		2146	2.9	0.971	33.9	LOS C	23.3	166.9	0.98	1.44	38.9

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.

LANE SUMMARY

Site: Balaclava Road / New Dookie Road - PM Existing

Shepparton

Roundabout

Lane Use and Performance													
	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Hawdon Street													
Lane 1[d]	532	3.0	602	0.883	100	29.6	LOS C	15.9	113.8	Full	500	0.0	0.0
Approach	532	3.0		0.883		29.6	LOS C	15.9	113.8				
East: New Dookie Road													
Lane 1[d]	647	2.6	689	0.940	100	36.9	LOS D	23.3	166.9	Full	500	0.0	0.0
Approach	647	2.6		0.940		36.9	LOS D	23.3	166.9				
North: Verney Street													
Lane 1[d]	553	1.9	784	0.705	100	12.1	LOS B	8.2	58.4	Full	500	0.0	0.0
Approach	553	1.9		0.705		12.1	LOS B	8.2	58.4				
West: Balaclava Road													
Lane 1[d]	415	4.6	427	0.971	100	64.0	LOS E	21.6	157.5	Full	500	0.0	0.0
Approach	415	4.6		0.971		64.0	LOS E	21.6	157.5				
Intersection	2146	2.9		0.971		33.9	LOS C	23.3	166.9				

Level of Service (LOS) Method: Delay (HCM 2000).
Roundabout LOS Method: Same as Signalised Intersections.
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
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.

d Dominant lane on roundabout approach

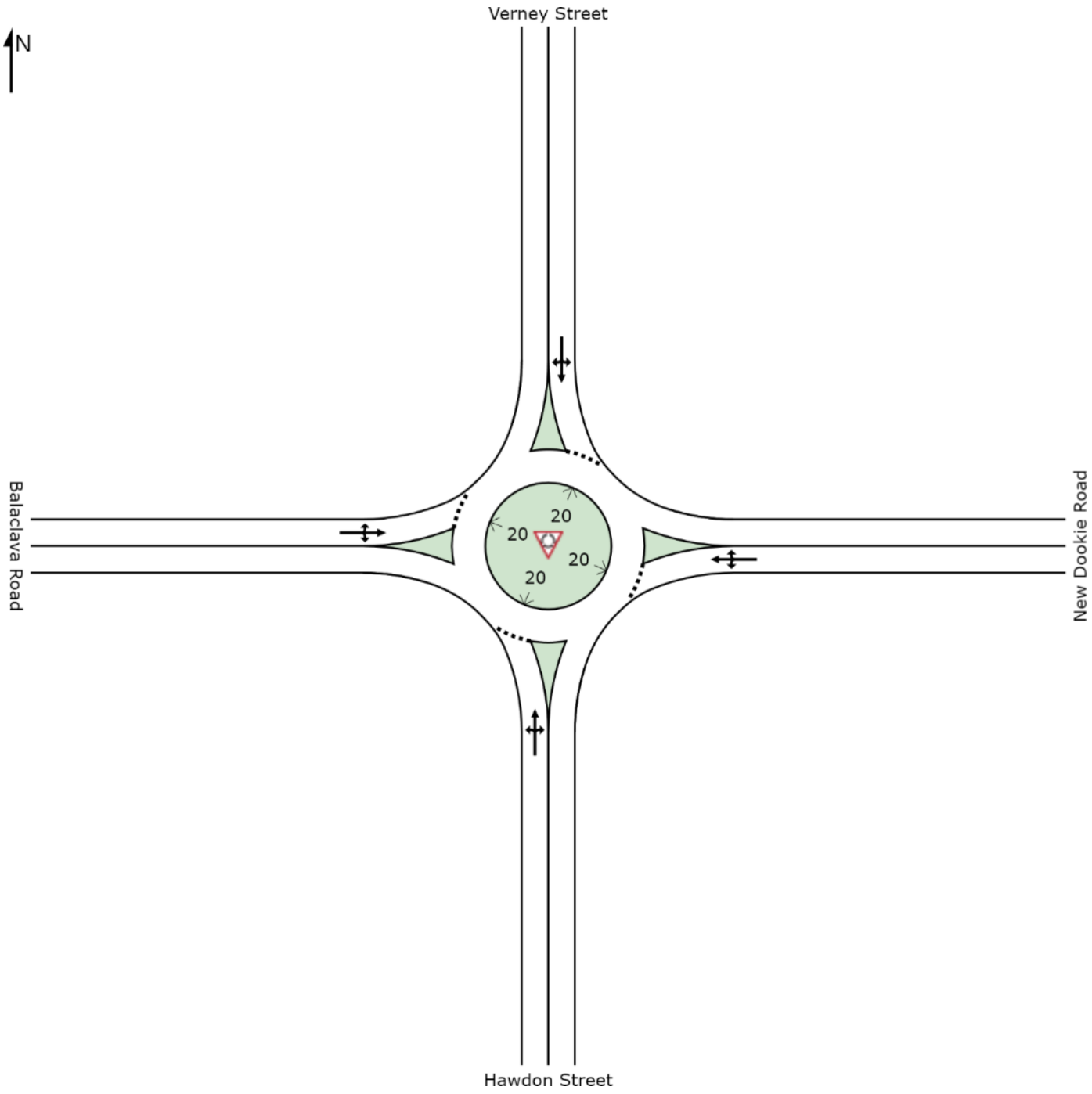
Appendix B:
Roundabout '10 Years'

SITE LAYOUT

Site: Balaclava Road / New Dookie Road - AM Future

Shepparton

Roundabout



MOVEMENT SUMMARY

Site: Balaclava Road / New Dookie Road - AM Future

Shepparton

Roundabout

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Hawdon Street											
1	L2	80	3.9	1.411	391.7	LOS F	166.0	1205.7	1.00	5.99	8.2
2	T1	369	4.6	1.411	392.0	LOS F	166.0	1205.7	1.00	5.99	8.2
3	R2	361	4.4	1.411	396.6	LOS F	166.0	1205.7	1.00	5.99	8.2
Approach		811	4.4	1.411	394.0	LOS F	166.0	1205.7	1.00	5.99	8.2
East: New Dookie Road											
4	L2	142	8.1	0.942	32.3	LOS C	24.7	185.3	1.00	1.58	38.4
5	T1	369	8.3	0.942	32.6	LOS C	24.7	185.3	1.00	1.58	39.1
6	R2	208	8.6	0.942	37.2	LOS D	24.7	185.3	1.00	1.58	39.0
Approach		720	8.3	0.942	33.9	LOS C	24.7	185.3	1.00	1.58	38.9
North: Verney Street											
7	L2	245	3.4	1.654	610.1	LOS F	240.8	1738.3	1.00	7.57	5.5
8	T1	523	3.6	1.654	610.3	LOS F	240.8	1738.3	1.00	7.57	5.5
9	R2	132	4.0	1.654	615.0	LOS F	240.8	1738.3	1.00	7.57	5.5
Approach		900	3.6	1.654	610.9	LOS F	240.8	1738.3	1.00	7.57	5.5
West: Balaclava Road											
10	L2	157	22.8	1.238	243.4	LOS F	102.6	857.7	1.00	4.68	12.1
11	T1	417	22.7	1.238	243.6	LOS F	102.6	857.7	1.00	4.68	12.1
12	R2	122	22.4	1.238	248.3	LOS F	102.6	857.7	1.00	4.68	12.1
Approach		696	22.7	1.238	244.4	LOS F	102.6	857.7	1.00	4.68	12.1
All Vehicles		3126	9.2	1.654	340.2	LOS F	240.8	1738.3	1.00	5.14	9.3

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.

LANE SUMMARY

Site: Balaclava Road / New Dookie Road - AM Future

Shepparton

Roundabout

Lane Use and Performance	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Hawdon Street													
Lane 1[d]	811	4.4	574	1.411	100	394.0	LOS F	166.0	1205.7	Full	500	0.0	46.6
Approach	811	4.4		1.411		394.0	LOS F	166.0	1205.7				
East: New Dookie Road													
Lane 1[d]	720	8.3	765	0.942	100	33.9	LOS C	24.7	185.3	Full	500	0.0	0.0
Approach	720	8.3		0.942		33.9	LOS C	24.7	185.3				
North: Verney Street													
Lane 1[d]	900	3.6	544	1.654	100	610.9	LOS F	240.8	1738.3	Full	500	0.0	100.0
Approach	900	3.6		1.654		610.9	LOS F	240.8	1738.3				
West: Balaclava Road													
Lane 1[d]	696	22.7	562	1.238	100	244.4	LOS F	102.6	857.7	Full	500	0.0	24.4
Approach	696	22.7		1.238		244.4	LOS F	102.6	857.7				
Intersection	3126	9.2		1.654		340.2	LOS F	240.8	1738.3				

Level of Service (LOS) Method: Delay (HCM 2000).
Roundabout LOS Method: Same as Signalised Intersections.
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
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.

d Dominant lane on roundabout approach

MOVEMENT SUMMARY

Site: Balaclava Road / New Dookie Road - PM Future

Shepparton

Roundabout

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Hawdon Street											
1	L2	101	3.1	1.299	289.8	LOS F	151.2	1085.5	1.00	5.50	10.5
2	T1	604	3.0	1.299	290.1	LOS F	151.2	1085.5	1.00	5.50	10.6
3	R2	203	3.1	1.299	294.7	LOS F	151.2	1085.5	1.00	5.50	10.6
Approach		908	3.0	1.299	291.1	LOS F	151.2	1085.5	1.00	5.50	10.6
East: New Dookie Road											
4	L2	260	2.4	2.031	945.1	LOS F	395.7	2829.0	1.00	9.47	3.7
5	T1	536	2.6	2.031	945.3	LOS F	395.7	2829.0	1.00	9.47	3.7
6	R2	384	2.5	2.031	949.9	LOS F	395.7	2829.0	1.00	9.47	3.7
Approach		1180	2.5	2.031	946.8	LOS F	395.7	2829.0	1.00	9.47	3.7
North: Verney Street											
7	L2	207	2.0	0.987	45.2	LOS D	34.8	247.9	1.00	1.84	34.1
8	T1	466	1.8	0.987	45.4	LOS D	34.8	247.9	1.00	1.84	34.7
9	R2	101	2.1	0.987	50.0	LOS D	34.8	247.9	1.00	1.84	34.6
Approach		775	1.9	0.987	45.9	LOS D	34.8	247.9	1.00	1.84	34.5
West: Balaclava Road											
10	L2	120	4.4	1.842	784.2	LOS F	201.2	1463.3	1.00	6.48	4.4
11	T1	369	4.6	1.842	784.5	LOS F	201.2	1463.3	1.00	6.48	4.4
12	R2	158	4.7	1.842	789.1	LOS F	201.2	1463.3	1.00	6.48	4.4
Approach		647	4.6	1.842	785.6	LOS F	201.2	1463.3	1.00	6.48	4.4
All Vehicles		3511	2.9	2.031	548.6	LOS F	395.7	2829.0	1.00	6.21	6.1

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

LANE SUMMARY

Site: Balaclava Road / New Dookie Road - PM Future

Shepparton

Roundabout

Lane Use and Performance													
	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Hawdon Street													
Lane 1[d]	908	3.0	699	1.299	100	291.1	LOS F	151.2	1085.5	Full	500	0.0	37.7
Approach	908	3.0		1.299		291.1	LOS F	151.2	1085.5				
East: New Dookie Road													
Lane 1[d]	1180	2.5	581	2.031	100	946.8	LOS F	395.7	2829.0	Full	500	0.0	100.0
Approach	1180	2.5		2.031		946.8	LOS F	395.7	2829.0				
North: Verney Street													
Lane 1[d]	775	1.9	785	0.987	100	45.9	LOS D	34.8	247.9	Full	500	0.0	0.0
Approach	775	1.9		0.987		45.9	LOS D	34.8	247.9				
West: Balaclava Road													
Lane 1[d]	647	4.6	351	1.842	100	785.6	LOS F	201.2	1463.3	Full	500	0.0	95.6
Approach	647	4.6		1.842		785.6	LOS F	201.2	1463.3				
Intersection	3511	2.9		2.031		548.6	LOS F	395.7	2829.0				

Level of Service (LOS) Method: Delay (HCM 2000).
Roundabout LOS Method: Same as Signalised Intersections.
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
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.
The results of iterative calculations indicate a somewhat unstable solution. See the Diagnostics section in the Detailed Output report.

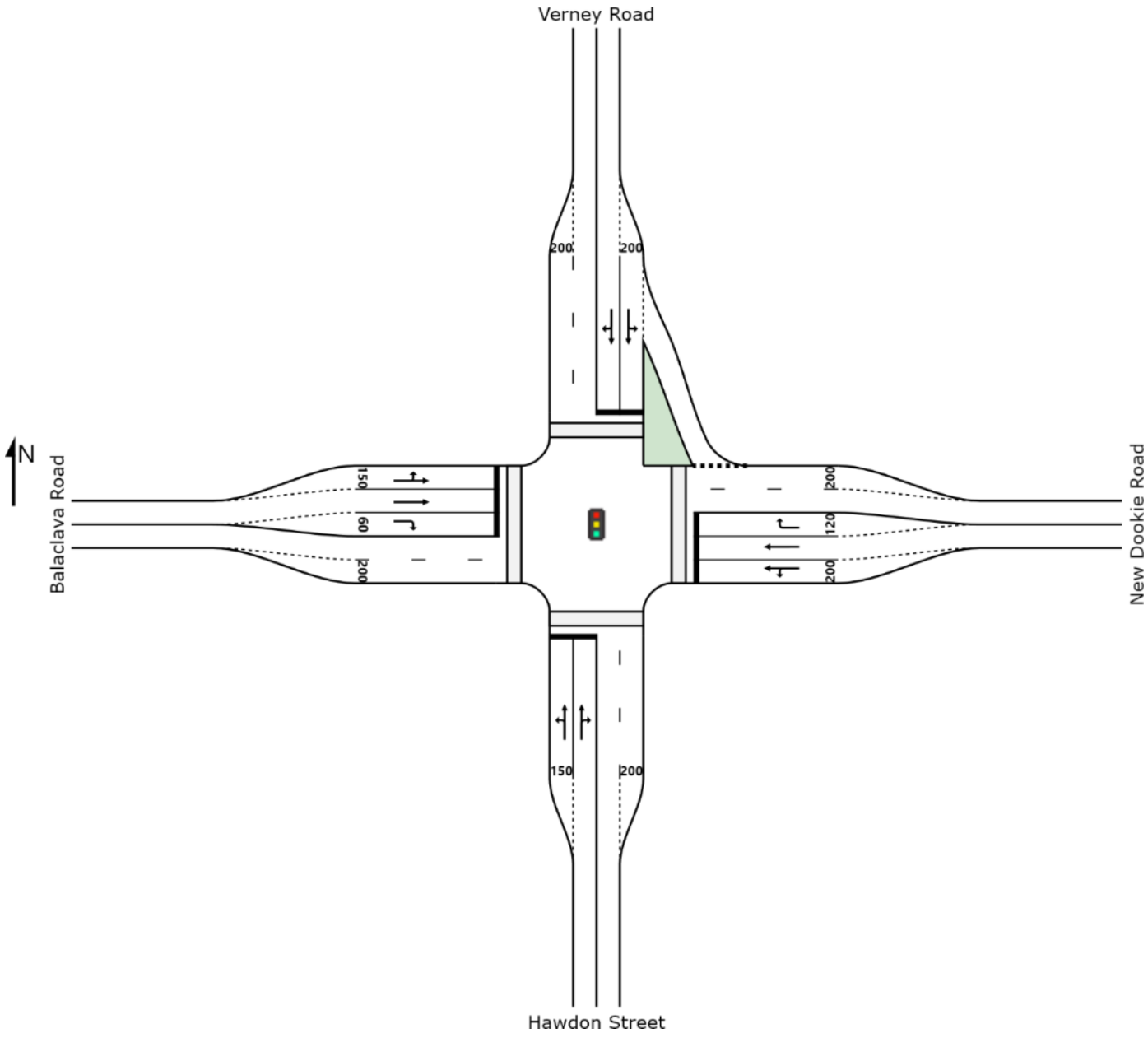
d Dominant lane on roundabout approach

Appendix C:
Traffic Signals ’10 Years’

SITE LAYOUT

Site: Traffic Signals - AM

New Site
Signals - Fixed Time Isolated



Organisation: TRAFFIX GROUP PTY LTD | Created: Tuesday, 15 January 2019 9:41:09 AM
Project: P:\Synergy\Projects\GRP1\GRP19582\07-Analysis\SIDRA\2019\Future Layout - Balaclava.sip6

MOVEMENT SUMMARY

Site: Traffic Signals - AM

New Site
Signals - Fixed Time Isolated Cycle Time = 120 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Hawdon Street											
1	L2	80	1.6	0.839	63.7	LOS E	17.9	130.3	1.00	0.97	29.9
2	T1	369	5.5	0.839	58.1	LOS E	17.9	130.3	1.00	0.97	30.3
3	R2	123	3.2	0.839	63.8	LOS E	17.8	129.4	1.00	0.97	29.7
Approach		573	4.5	0.839	60.1	LOS E	17.9	130.3	1.00	0.97	30.1
East: New Dookie Road											
4	L2	92	6.3	0.545	50.3	LOS D	11.6	86.9	0.94	0.80	33.3
5	T1	357	8.9	0.545	44.7	LOS D	11.8	88.9	0.94	0.79	34.4
6	R2	188	8.5	0.861	71.0	LOS E	12.3	92.1	1.00	0.94	27.3
Approach		637	8.4	0.861	53.3	LOS D	12.3	92.1	0.95	0.84	31.8
North: Verney Road											
7	L2	245	5.6	0.849	55.5	LOS E	26.9	195.2	1.00	1.05	32.0
8	T1	523	2.7	0.849	51.1	LOS D	26.9	195.2	1.00	1.01	32.1
9	R2	132	2.7	0.849	57.6	LOS E	26.2	187.6	1.00	0.97	31.5
Approach		900	3.5	0.849	53.2	LOS D	26.9	195.2	1.00	1.01	32.0
West: Balaclava Road											
10	L2	145	27.6	0.860	63.7	LOS E	20.7	170.0	1.00	0.99	29.4
11	T1	479	14.6	0.860	57.2	LOS E	20.7	170.0	0.99	1.00	30.7
12	R2	113	37.1	0.613	62.3	LOS E	6.6	60.6	1.00	0.81	28.9
Approach		737	20.6	0.860	59.2	LOS E	20.7	170.0	1.00	0.97	30.2
All Vehicles		2846	9.2	0.861	56.2	LOS E	26.9	195.2	0.99	0.95	31.1

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	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P1	South Full Crossing	53	44.3	LOS E	0.2	0.2	0.86	0.86
P2	East Full Crossing	53	42.6	LOS E	0.2	0.2	0.84	0.84
P3	North Full Crossing	53	44.3	LOS E	0.2	0.2	0.86	0.86
P4	West Full Crossing	53	51.5	LOS E	0.2	0.2	0.93	0.93
All Pedestrians		211	45.7	LOS E			0.87	0.87

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.

LANE SUMMARY

Site: Traffic Signals - AM

New Site
Signals - Fixed Time Isolated Cycle Time = 120 seconds (User-Given Cycle Time)

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Hawdon Street													
Lane 1	288	4.4	343	0.839	100	59.7	LOS E	17.9	130.3	Short	150	0.0	NA
Lane 2	285	4.5	340	0.839	100	60.6	LOS E	17.8	129.4	Full	500	0.0	0.0
Approach	573	4.5		0.839		60.1	LOS E	17.9	130.3				
East: New Dookie Road													
Lane 1	223	7.8	409	0.545	100	47.0	LOS D	11.6	86.9	Short	200	0.0	NA
Lane 2	226	8.9	415	0.545	100	44.7	LOS D	11.8	88.9	Full	500	0.0	0.0
Lane 3	188	8.5	219	0.861	100	71.0	LOS E	12.3	92.1	Short	120	0.0	NA
Approach	637	8.4		0.861		53.3	LOS D	12.3	92.1				
North: Verney Road													
Lane 1	473	4.2	557	0.849	100	52.7	LOS D	26.9	195.2	Short	200	0.0	NA
Lane 2	427	2.7	503	0.849	100	53.8	LOS D	26.2	187.6	Full	500	0.0	0.0
Approach	900	3.5		0.849		53.2	LOS D	26.9	195.2				
West: Balaclava Road													
Lane 1	323	20.4	376	0.860	100	60.5	LOS E	20.7	170.0	Short	150	0.0	NA
Lane 2	301	14.6	350[1]	0.860	100	56.8	LOS E	18.8	147.9	Full	500	0.0	0.0
Lane 3	113	37.1	184	0.613	100	62.3	LOS E	6.6	60.6	Short	60	0.0	NA
Approach	737	20.6		0.860		59.2	LOS E	20.7	170.0				
Intersection	2846	9.2		0.861		56.2	LOS E	26.9	195.2				

Level of Service (LOS) Method: Delay (HCM 2000).
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
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.

1 Reduced capacity due to a short lane effect. Short lane queues may extend into the adjacent full-length lanes. Some upstream delays at entry to short lanes are not included.

PHASING SUMMARY

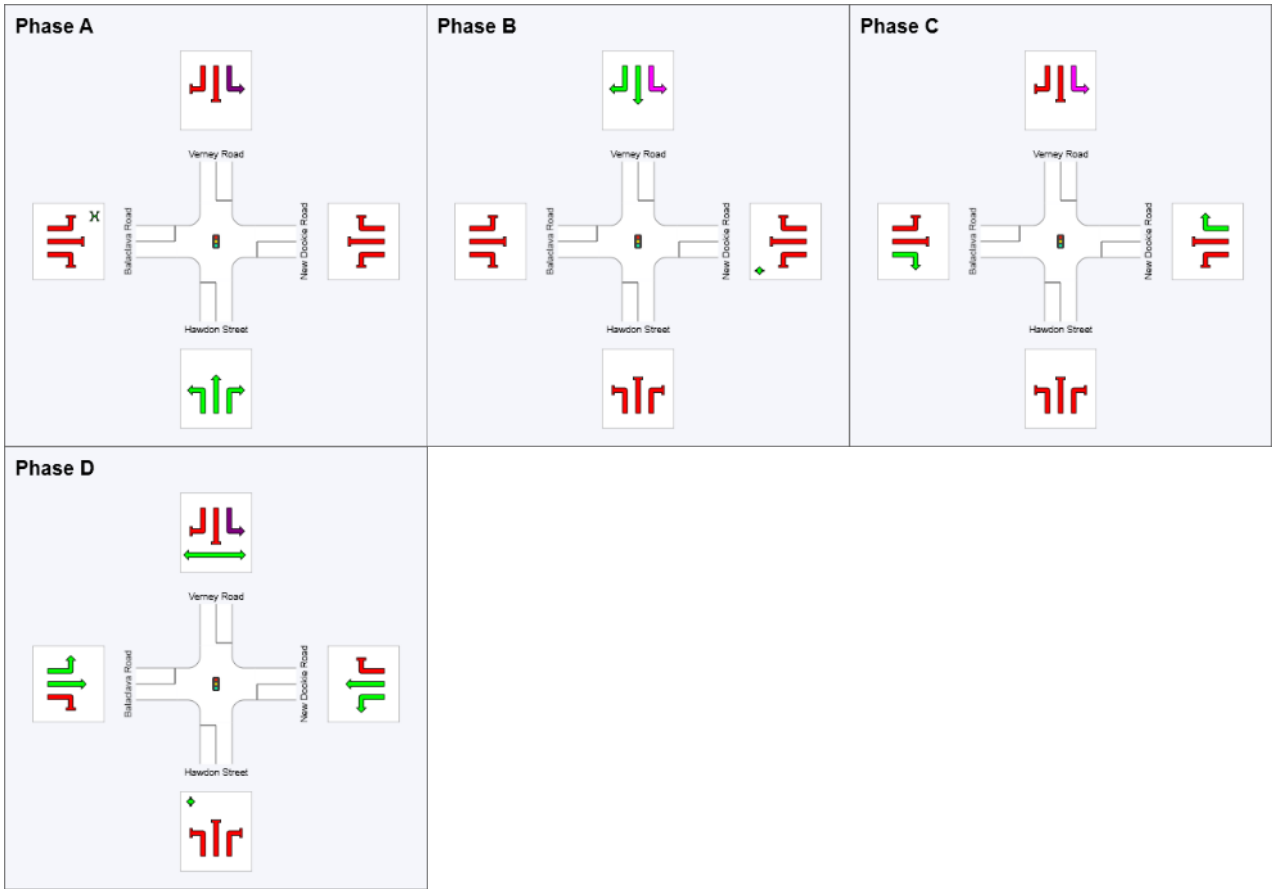
Site: Traffic Signals - AM

New Site
Signals - Fixed Time Isolated Cycle Time = 120 seconds (User-Given Cycle Time)

Phase times determined by the program
Sequence: Leading Right Turn (phase reduction applied)
Movement Class: All Movement Classes
Input Sequence: A, B, C, C1, D
Output Sequence: A, B, C, D

Phase Timing Results

Phase	A	B	C	D
Reference Phase	No	Yes	No	No
Phase Change Time (sec)	92	0	38	59
Green Time (sec)	22	32	15	27
Yellow Time (sec)	4	4	4	4
All-Red Time (sec)	2	2	2	2
Phase Time (sec)	28	38	21	33
Phase Split	23 %	32 %	18 %	28 %



MOVEMENT SUMMARY

Site: Traffic Signals - PM

New Site
Signals - Fixed Time Isolated Cycle Time = 120 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Hawdon Street											
1	L2	101	2.5	0.889	65.4	LOS E	25.9	184.0	1.00	1.03	29.5
2	T1	604	1.6	0.889	59.9	LOS E	25.9	184.0	1.00	1.04	30.0
3	R2	78	14.3	0.889	65.8	LOS E	25.6	185.3	1.00	1.04	29.5
Approach		783	3.0	0.889	61.2	LOS E	25.9	185.3	1.00	1.04	29.9
East: New Dookie Road											
4	L2	127	1.4	0.753	53.0	LOS D	19.2	137.9	0.99	0.88	32.6
5	T1	560	4.0	0.753	47.4	LOS D	19.4	140.6	0.99	0.88	33.5
6	R2	347	1.2	0.905	70.6	LOS E	23.6	167.1	1.00	0.98	27.4
Approach		1035	2.7	0.905	55.9	LOS E	23.6	167.1	0.99	0.92	31.1
North: Verney Road											
7	L2	201	4.1	0.875	64.1	LOS E	24.5	175.3	1.00	1.09	29.8
8	T1	466	1.3	0.875	58.8	LOS E	24.5	175.3	1.00	1.05	30.1
9	R2	101	0.0	0.875	64.7	LOS E	23.4	165.0	1.00	1.02	29.8
Approach		768	1.9	0.875	61.0	LOS E	24.5	175.3	1.00	1.05	30.0
West: Balaclava Road											
10	L2	114	3.1	0.914	76.4	LOS E	16.4	120.3	1.00	1.07	26.8
11	T1	365	7.4	0.914	70.8	LOS E	16.6	123.6	1.00	1.07	27.6
12	R2	145	0.0	0.722	65.1	LOS E	8.7	61.2	1.00	0.85	28.6
Approach		624	4.9	0.914	70.5	LOS E	16.6	123.6	1.00	1.02	27.7
All Vehicles		3211	3.0	0.914	61.2	LOS E	25.9	185.3	1.00	1.00	29.8

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	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P1	South Full Crossing	53	42.6	LOS E	0.2	0.2	0.84	0.84
P2	East Full Crossing	53	47.8	LOS E	0.2	0.2	0.89	0.89
P3	North Full Crossing	53	53.3	LOS E	0.2	0.2	0.94	0.94
P4	West Full Crossing	53	46.0	LOS E	0.2	0.2	0.88	0.88
All Pedestrians		211	47.4	LOS E			0.89	0.89

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.

LANE SUMMARY

Site: Traffic Signals - PM

New Site
Signals - Fixed Time Isolated Cycle Time = 120 seconds (User-Given Cycle Time)

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Hawdon Street													
Lane 1	394	1.8	444	0.889	100	61.3	LOS E	25.9	184.0	Short	150	0.0	NA
Lane 2	389	4.1	438	0.889	100	61.2	LOS E	25.6	185.3	Full	500	0.0	0.0
Approach	783	3.0		0.889		61.2	LOS E	25.9	185.3				
East: New Dookie Road													
Lane 1	342	3.0	454	0.753	100	49.5	LOS D	19.2	137.9	Short	200	0.0	NA
Lane 2	346	4.0	459	0.753	100	47.3	LOS D	19.4	140.6	Full	500	0.0	0.0
Lane 3	347	1.2	384	0.905	100	70.6	LOS E	23.6	167.1	Short	120	0.0	NA
Approach	1035	2.7		0.905		55.9	LOS E	23.6	167.1				
North: Verney Road													
Lane 1	406	2.7	464	0.875	100	61.2	LOS E	24.5	175.3	Short	200	0.0	NA
Lane 2	363	0.9	414	0.875	100	60.7	LOS E	23.4	165.0	Full	500	0.0	0.0
Approach	768	1.9		0.875		61.0	LOS E	24.5	175.3				
West: Balaclava Road													
Lane 1	238	5.3	261	0.914	100	73.5	LOS E	16.4	120.3	Short	150	0.0	NA
Lane 2	241	7.4	264	0.914	100	70.7	LOS E	16.6	123.6	Full	500	0.0	0.0
Lane 3	145	0.0	201	0.722	100	65.1	LOS E	8.7	61.2	Short	60	0.0	NA
Approach	624	4.9		0.914		70.5	LOS E	16.6	123.6				
Intersection	3211	3.0		0.914		61.2	LOS E	25.9	185.3				

Level of Service (LOS) Method: Delay (HCM 2000).
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

PHASING SUMMARY

Site: Traffic Signals - PM

New Site
Signals - Fixed Time Isolated Cycle Time = 120 seconds (User-Given Cycle Time)

Phase times determined by the program
Sequence: Leading Right Turn
Movement Class: All Movement Classes
Input Sequence: A, B, C, C1, D
Output Sequence: A, B, C, C1, D

Phase Timing Results

Phase	A	B	C	C1	D
Reference Phase	No	Yes	No	No	No
Phase Change Time (sec)	86	0	32	51	63
Green Time (sec)	28	26	13	6	17
Yellow Time (sec)	4	4	4	4	4
All-Red Time (sec)	2	2	2	2	2
Phase Time (sec)	34	32	19	12	23
Phase Split	28 %	27 %	16 %	10 %	19 %