SECA solution
ACN: 164611652
Suite 10, 265 King Street
Newcastle NSW 2300
Ph: (02) 4925 7795
admin@secasolution.com.au

20 August 2014

P0250 SNL Whitebridge Addendum Ver02

SNL Building Constructions
22 Pendlebury Road,
Cardiff NSW 2285

Attn: Mr Wade Morris

Dear Wade,

Proposed residential subdivision, Whitebridge, NSW - Addendum to Traffic Study

Further to our recent discussions, we have reviewed the current plans and the traffic study prepared by Better Transport Futures (July 2013) as well as undertaking traffic surveys in the afternoon of 11th June 2014 at the intersections of Dudley Road and Lonus Avenue (roundabout) and Lonus Avenue and Kopa Street. We have also reviewed the comments by Council and the Roads and Maritime Services Newcastle (RMS) in their letter of 13th January 2014 issued by Lake Macquarie City Council with regard to the current development application (DA/1774/2013).

Traffic Data
Seca Solution completed traffic surveys at the roundabout controlled intersection of Dudley Road, Lonus Avenue, Waran Road and Bulls Garden Road on Wednesday 11th June 2014. This afternoon was selected following a review of the school calendar which showed that there were no extraordinary activities running on this day. Similarly it was not a school sports afternoon which may have influenced traffic flows along Lonus Avenue. These surveys were completed between 3.00-6.000 PM. During the surveys the following was noted:

- During this period, the roundabout operated very well, with minimal queues on all approaches.
- During the afternoon school period 3.30-3.45pm delays occurred along Lonus Avenue. These queues reflected the higher flows exiting Lonus Avenue but also being impacted upon by higher flows from Waran Road combining with steady flows eastbound along Dudley Road and eastbound turning from Bulls Garden Road. These queues cleared as opportunities arose and weren't replicated in any other time period.
- During the afternoon period, particularly around 5pm, occasional queuing was observed back into the roundabout associated with vehicles manoeuvring in the carpark on the northern side of the shopping centre. At one time this queue was observed to stretch back towards Dudley Road eastbound effectively gridlocking the roundabout as movements in and out of Waran Road and Lonus Avenue were blocked, as was exit movements into Dudley Road east. This was made worse by vehicles wishing to complete a U-turn at the roundabout from Dudley Road westbound.
- The afternoon peak period was between 3.00 and 4.00 associated with the school traffic with a second, slightly lighter peak between 4.30-5.30pm

The summary of the traffic survey is provided below in Figure 1.

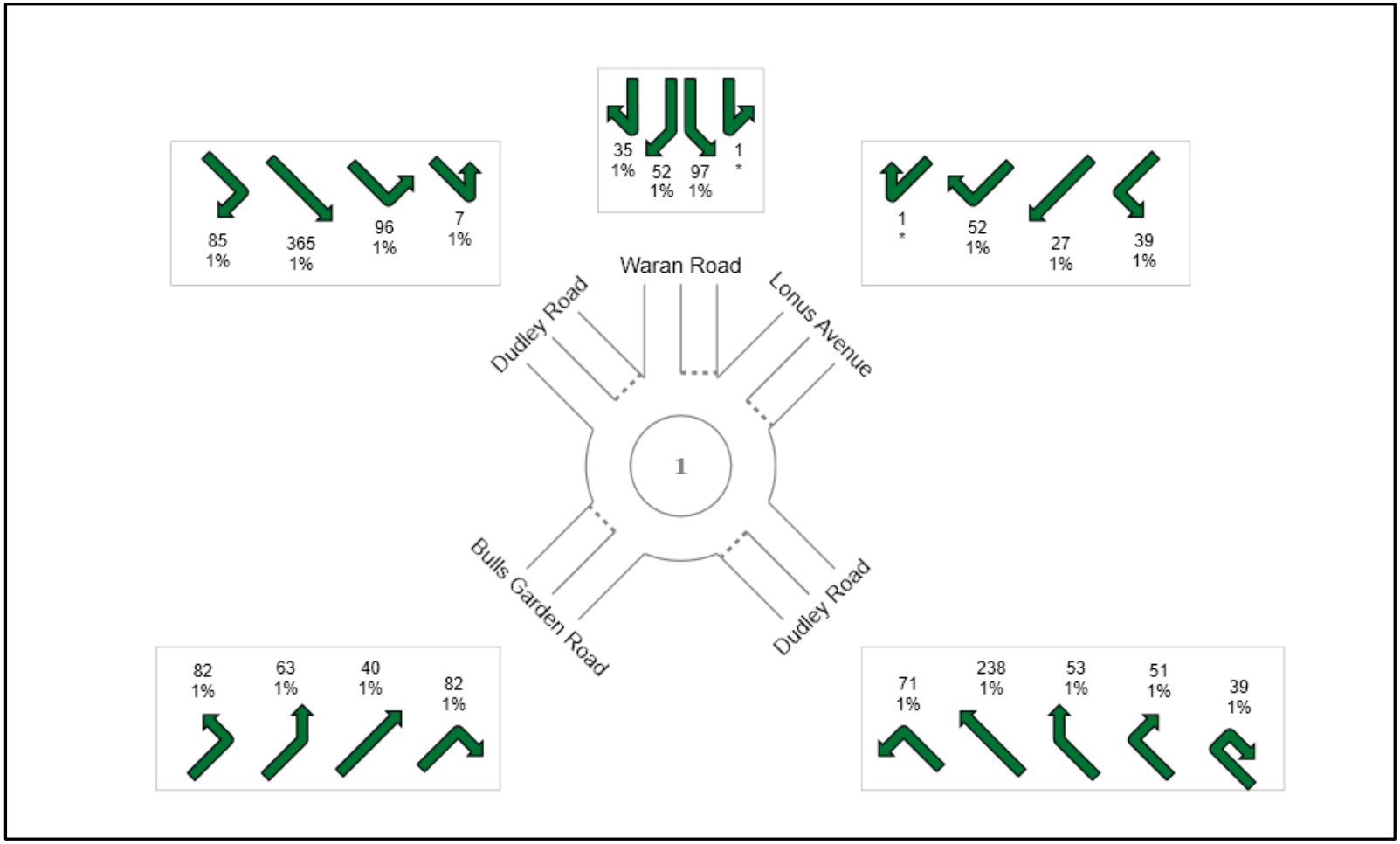

Figure 1 Traffic Survey Results at roundabout controlled intersection of Dudley Road and Bulls Garden Road, June 2014

Seca Solution also completed traffic surveys at the intersection of Lonus Avenue and Kopa Street. This intersection provides a single access to the subject site on the eastern leg of Kopa Street. These surveys were also completed between 3.00-6.000 PM. The straight alignment of this intersection provides for visibility in excess of the 80m required for the design speed and as such complies with the RMS Road Design Guide. A review of the RMS accident data included in the BTF report shows that there were no accidents in this location for the period July 2007 to June 2012.

During the surveys the following was noted:

- Between the Dudley Road roundabout and this intersection there is the Birralee Long Day Care Centre which operates between the hours of 7.30am and 6pm. It caters for all pre-school aged infants and children. Vehicles were observed completing U-turns in Lonus Avenue in the vicinity of the centre if parking was not readily available with vehicles then parking on the opposite side of the street.
- On the south west corner of this intersection there are two tennis courts on which tennis lessons were being undertaken during the period of the surveys.
- During the survey period 6 vehicles were observed turning right into Kopa Street (east) to complete a U-turn and then complete their journey outbound along Lonus Avenue. Some of these movements were associated with having dropped children off at the tennis courts.

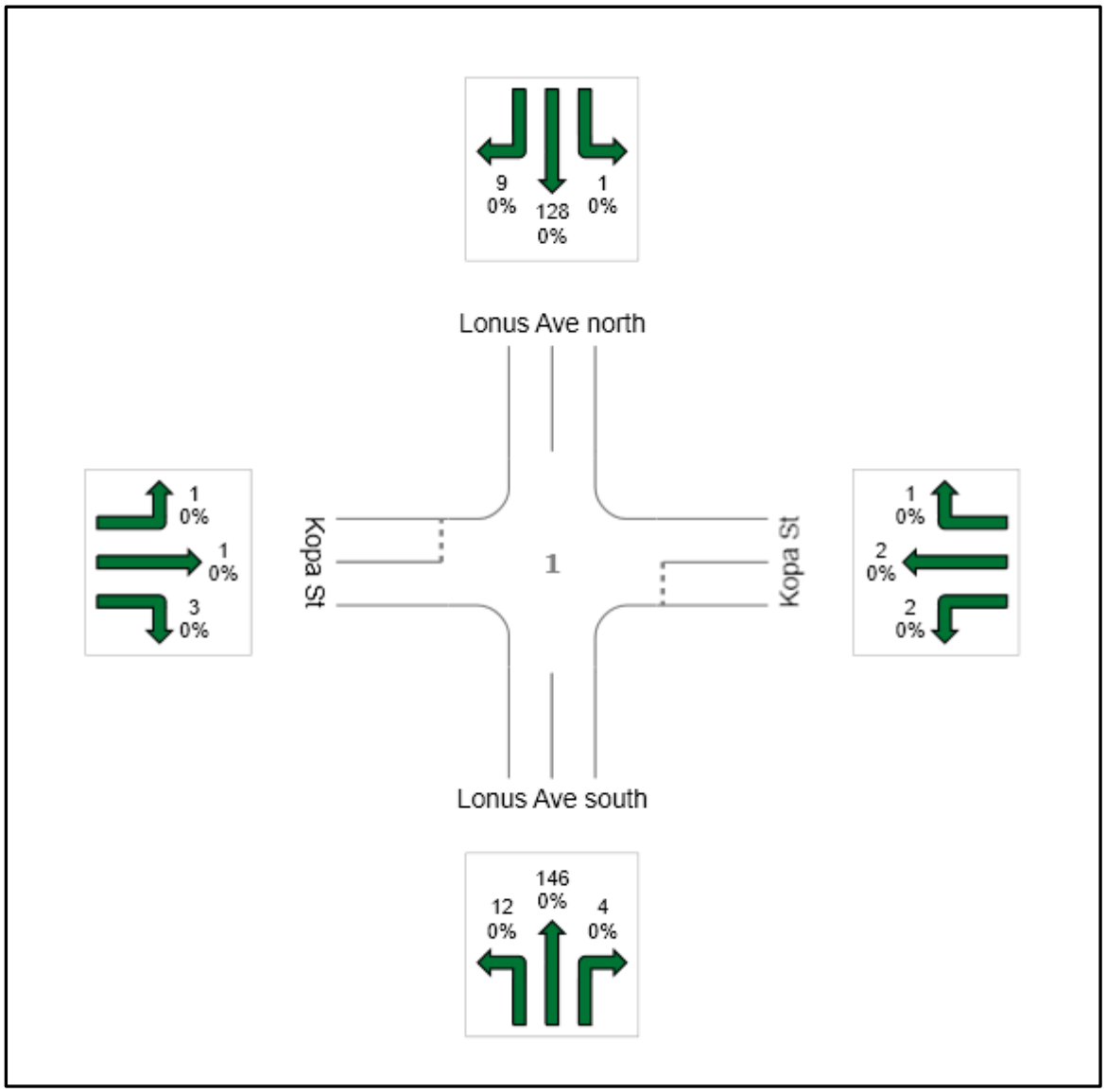

Figure 2 Traffic Survey at 4-way intersection of Lonus Avenue and Kopa Street, June 2014

A review of the survey data shows that the traffic associated with the school afternoon peak period is distinct with the absolute peak being between 3.15 and 3.30 where vehicles are both approaching and leaving the Whitebridge High School. During the peak hour between 3pm and 4pm the two way flows on Lonus Avenue south of the Kopa Street intersection are 297vph. After the school peak, finishing by 3.45pm, the average volumes through the intersection are consistently much lower with two way flows averaging 116vph .

Table 1 Total flows through Lonus Avenue/Kopa Street intersection by 15minute increments and accumulated for the hour

3:00	60	
3:15	143	
3:30	68	
3:45	36	307
4:00	26	273
4:15	31	161
4:30	39	132
4:45	29	125
5:00	23	122
5:15	29	120
5:30	43	124
5:45	23	118

Retail Development

The traffic assessment has been expanded since the initial BTF report was completed to now include the proposed retail element. This retail area adjoins the existing shopping area on the northern side of Dudley Road and provides for a total of 351m^2 retail space. The existing retail element provides for approximately 1000m^2 GFA on this side of Dudley Road.

The parking requirements for the commercial/shop element of the development has been reviewed by Council and found to be satisfactory.

Dudley Road is serviced by Newcastle Buses Route 322 which runs between Belmont-Redhead-Charlestown-Newcastle. The provision of a bus shelter on Dudley Road, immediately adjacent to the development provides for the public transport needs of the site. As there is no proposed further discount to the parking supply this existing facility is considered adequate with no additional shelters required.

Photo 1 Bus facilities on Dudley Road with subject site to the rear of the photo.

Although the RMS Guide to Traffic Generating Developments provides a series of trip rates for shopping centres the critical factor for this development is the incidence of linked and multi-purpose trips. Linked trips being those taken as a side-track from an existing trip such as a person calling in to the centre on the way home from work whilst multi-purpose trips are those where a person is visiting more than one shop within the centre. The location of the Whitebridge shopping centre is such that it services the needs of the local community. The provision of these new shops will be to complement the existing facilities and are unlikely to create a nexus for additional trips in their own right.

Given the volume of passing traffic and high number of existing shoppers it is considered that the new shops will be very low generators of additional traffic in their own right. The Guide provides for a rate of 12 trips per 100m2 GLFA where as a general guide, 100 m2 gross floor area equals 75 m2 gross leasable floor area. This rate has been discounted to provide for the high level of linked and multi-purpose trips by 50%.

The GFA of 315m2 equates to a GLFA of 236m2. Applying a discounted trip rate of 6 vehicles per 100m2 in the peak hour results in a potential increase in traffic of 14 vehicles in the peak hour, giving some 7 vehicles inbound and 7 outbound per hour. This would be a worst case scenario as it is expected that the actual additional trips generated by the new shops could be much lower than this.

Sidra Analysis

The operation of the two intersections in the vicinity of the subject site have been assessed using the Sidra intersection modelling package. For the roundabout at Dudley Road and Bulls Garden Road, the Sidra analysis was completed for the existing 2014 base conditions, based upon the traffic data collected by Seca Solution in June 2014. The intersection was then assessed with the additional traffic movements associated with the development of the subject site. This was based upon the current masterplan with 92 dwellings and the same distribution assignment of trips form the BTF report. The results of the analysis are presented in Table 2 below.

Table 2 Roundabout controlled Intersection of Dudley Road / Waran Road / Bulls Garden Road

Approach	Level of Service	Delay (seconds)	Queue (metres)
Dudley Road (east)	A / A	6.6 / 7.0	28.5 / 31.4
Lonus Avenue	A / A	12.4 / 12.4	13.6 / 15.2
Waran Road	B / B	15.9 / 19.3	26.3 / 31.7
Dudley Road (west)	A / A	11.1 / 13.4	60.9/ 76.5
Bulls Garden Road	A / A	9.4 / 10.0	20.6 / 23.8

Results: Existing PM peak / PM peak plus development

The Sidra analysis confirms that the roundabout currently operates well with low delays and congestion. The level of service provided by the roundabout control is A for the majority of users, indicating that there is plenty of spare capacity for additional traffic movements. The roundabout control was then assessed with the additional traffic movements associated with the development, which shows that there will be a minor increase in delays and congestion but these will still remain well within acceptable limits.

Table 3 4-way Give Way controlled intersection of Kopa Street / Lonus Avenue

Approach	Level of Service	Delay (seconds)	Queue (metres)
Lonus Avenue south	A / A	1.0 / 2.2	3.2 / 4.3
Kopa Street east	A / A	6.5 / 6.4	0.2 / 0.4
Lonus Avenue north	A / A	0.9 / 0.9	2.8 / 2.8
Kopa Street west	A / A	6.9 / 7.3	0.2 / 0.8

The above Sidra analysis demonstrates that the 4-way intersection operates well with minimal delays and congestion, based upon the traffic data collected by Seca Solution in June 2014. With the additional traffic movements associated with the subject development site, the intersection will continue to operate well with minimal delays and congestion, which are well within acceptable limits.

Summary

Traffic data has been collected for the afternoon peak period in June 2014 on a day when there was no sport in the locality and the Sidra analysis has been updated over the previous analysis completed by BTF. This analysis has allowed for the current masterplan which allows for 92 residential dwellings and the commercial element fronting Dudley Road. The Sidra analysis demonstrates that the proposed development will have a minimal impact upon the operation of the roundabout on Dudley Road as well as the 4-way give way controlled intersection of Lomus Avenue and Kopa Street.

Please feel free to contact me on 4925 7795, or 0499 196 100, should you have any further queries.

Yours sincerely

Sean Morgan

Director

Attachment A – Sidra output

Attachment B – Site plan

Attachment A – Sidra Results

Criteria for interpreting results of SIDRA (source: Roads and Maritime Services)

1-Level of Service (LoS)

LoS	Traffic Signals and Roundabouts	Give Way and Stop Signs
A	Good	Good
B	Good, with acceptable delays and spare capacity	Acceptable delays and spare capacity
C	Satisfactory	Satisfactory, but requires accident study
D	Operating near capacity	Near capacity and requires accident study
E	At capacity, excessive delay: roundabout requires other control method	At capacity, requires other control mode
F	Unsatisfactory, requires other control mode or additional capacity	Unsatisfactory, requires other control mode

2-Average Vehicle Delay (AVD)

The AVD is a measure of operational performance of an intersection relating to its LoS. The average delay should be taken as a guide only for an average intersection. Longer delays may be tolerated at some intersections where delays are expected by motorists (e.g. those in inner city areas or major arterial roads).

LoS	Average Delay / Vehicle (secs)	Traffic Signals and Roundabouts	Give Way and Stop Signs
A	Less than 15	Good operation	Good operation
B	15 to 28	Good with acceptable delays and spare capacity	Acceptable delays and spare capacity
C	28 to 42	Satisfactory	Satisfactory but accident study required
D	42 to 56	Operating near capacity	Near capacity, accident study required
E	56 to 70	At capacity, excessive delays: roundabout requires other control mode	At capacity; requires other control mode
F	Exceeding 70	Unsatisfactory, requires additional capacity	Unsatisfactory, requires other control mode

3-Degree of Saturation (D/S)

The D/S of an intersection is usually taken as the highest ratio of traffic volumes on an approach to an intersection compared with the theoretical capacity, and is a measure of the utilisation of available green time. For intersections controlled by traffic signals, both queues and delays increase rapidly as DS approaches 1.0. An intersection operates satisfactorily when its D/S is kept below 0.75. When D/S exceeds 0.9, queues are expected.

INTERSECTION SUMMARY

Site: 2014 PM Whitebridge Roundabout base

Dudley Road / Lonus Avenue / Bulls Garden Road
PM peak base flows
Roundabout
Design Life Analysis (Practical Capacity): Results for 10 years

Intersection Performance - Hourly Values				
Performance Measure	Vehicles		Persons	
Travel Speed (Average)	48.6	km/h	48.6	km/h
Travel Distance (Total)	2059.1	veh-km/h	2470.9	pers-km/h
Travel Time (Total)	42.4	veh-h/h	50.8	pers-h/h
Demand Flows (Total)	1991	veh/h	2389	pers/h
Percent Heavy Vehicles (Demand)	1.0	%		
Degree of Saturation	0.709			
Practical Spare Capacity	19.9	%		
Effective Intersection Capacity	2808	veh/h		
Control Delay (Total)	5.64	veh-h/h	6.77	pers-h/h
Control Delay (Average)	10.2	sec	10.2	sec
Control Delay (Worst Lane)	15.9	sec		
Control Delay (Worst Movement)	19.7	sec	19.7	sec
Geometric Delay (Average)	4.9	sec		
Stop-Line Delay (Average)	5.3	sec		
Idling Time (Average)	1.3	sec		
Intersection Level of Service (LOS)	LOS A			
95% Back of Queue - Vehicles (Worst Lane)	8.6	veh		
95% Back of Queue - Distance (Worst Lane)	60.9	m		
Queue Storage Ratio (Worst Lane)	0.05			
Total Effective Stops	1665	veh/h	1998	pers/h
Effective Stop Rate	0.84	per veh	0.84	per pers
Proportion Queued	0.81		0.81	
Performance Index	121.0		121.0	
Cost (Total)	1120.16	$/h	1120.16	$/h
Fuel Consumption (Total)	175.1	L/h		
Carbon Dioxide (Total)	412.6	kg/h		
Hydrocarbons (Total)	0.033	kg/h		
Carbon Monoxide (Total)	0.420	kg/h		
NOx (Total)	0.294	kg/h		

Level of Service (LOS) Method: Delay (RTA NSW).
Intersection LOS value for Vehicles is based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

MOVEMENT SUMMARY

Site: 2014 PM Whitebridge Roundabout base

Dudley Road / Lonus Avenue / Bulls Garden Road
PM peak base flows
Roundabout
Design Life Analysis (Practical Capacity): Results for 10 years

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
SouthEast: Dudley Road											
21	L2	90	1.0	0.528	5.2	LOS A	4.0	28.5	0.66	0.65	48.4
22	T1	301	1.0	0.528	5.2	LOS A	4.0	28.5	0.66	0.65	49.5
23a	R1	67	1.0	0.528	8.7	LOS A	4.0	28.5	0.66	0.65	49.0
23	R2	64	1.0	0.528	9.7	LOS A	4.0	28.5	0.66	0.65	46.6
23u	U	49	1.0	0.528	11.5	LOS A	4.0	28.5	0.66	0.65	50.3
Approach		571	1.0	0.528	6.6	LOS A	4.0	28.5	0.66	0.65	49.0
NorthEast: Lonus Avenue											
24	L2	49	1.0	0.275	10.4	LOS A	1.9	13.6	0.90	0.90	42.9
25	T1	34	1.0	0.275	10.3	LOS A	1.9	13.6	0.90	0.90	46.5
26	R2	66	1.0	0.275	14.9	LOS B	1.9	13.6	0.90	0.90	46.5
26b	R3	1	0.0	0.275	15.8	LOS B	1.9	13.6	0.90	0.90	46.8
Approach		150	1.0	0.275	12.4	LOS A	1.9	13.6	0.90	0.90	45.2
North: Waran Road											
7b	L3	1	0.0	0.451	14.0	LOS A	3.7	26.3	0.97	1.03	44.1
7a	L1	123	1.0	0.451	13.7	LOS A	3.7	26.3	0.97	1.03	45.0
9a	R1	66	1.0	0.451	17.6	LOS B	3.7	26.3	0.97	1.03	47.8
9b	R3	44	1.0	0.451	19.7	LOS B	3.7	26.3	0.97	1.03	48.6
Approach		234	1.0	0.451	15.9	LOS B	3.7	26.3	0.97	1.03	46.4
NorthWest: Dudley Road											
27b	L3	9	1.0	0.709	10.4	LOS A	8.6	60.9	0.87	0.92	49.9
27	L2	121	1.0	0.709	10.2	LOS A	8.6	60.9	0.87	0.92	50.3
28	T1	461	1.0	0.709	10.4	LOS A	8.6	60.9	0.87	0.92	48.1
29	R2	107	1.0	0.709	15.1	LOS B	8.6	60.9	0.87	0.92	51.4
Approach		699	1.0	0.709	11.1	LOS A	8.6	60.9	0.87	0.92	49.0
SouthWest: Bulls Garden Road											
30	L2	104	1.0	0.414	7.9	LOS A	2.9	20.6	0.79	0.82	51.4
30a	L1	80	1.0	0.414	7.8	LOS A	2.9	20.6	0.79	0.82	52.2
31	T1	51	1.0	0.414	8.2	LOS A	2.9	20.6	0.79	0.82	49.1
32	R2	104	1.0	0.414	12.8	LOS A	2.9	20.6	0.79	0.82	49.3
Approach		337	1.0	0.414	9.4	LOS A	2.9	20.6	0.79	0.82	50.6
All Vehicles		1991	1.0	0.709	10.2	LOS A	8.6	60.9	0.81	0.84	48.6

Level of Service (LOS) Method: Delay (RTA NSW).
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.

SIDRA INTERSECTION 6

INTERSECTION SUMMARY

Site: 2014 PM Lonus Kopa 4-way

New Site
Giveway / Yield (Two-Way)

Intersection Performance - Hourly Values				
Performance Measure	Vehicles		Persons	
Travel Speed (Average)	58.2	km/h	58.2	km/h
Travel Distance (Total)	329.7	veh-km/h	395.6	pers-km/h
Travel Time (Total)	5.7	veh-h/h	6.8	pers-h/h
Demand Flows (Total)	326	veh/h	392	pers/h
Percent Heavy Vehicles (Demand)	0.0	%		
Degree of Saturation	0.074			
Practical Spare Capacity	1220.7	%		
Effective Intersection Capacity	4398	veh/h		
Control Delay (Total)	0.10	veh-h/h	0.13	pers-h/h
Control Delay (Average)	1.2	sec	1.2	sec
Control Delay (Worst Lane)	6.9	sec		
Control Delay (Worst Movement)	7.2	sec	7.2	sec
Geometric Delay (Average)	0.6	sec		
Stop-Line Delay (Average)	0.5	sec		
Idling Time (Average)	0.0	sec		
Intersection Level of Service (LOS)	NA			
95% Back of Queue - Vehicles (Worst Lane)	0.5	veh		
95% Back of Queue - Distance (Worst Lane)	3.2	m		
Queue Storage Ratio (Worst Lane)	0.00			
Total Effective Stops	22	veh/h	26	pers/h
Effective Stop Rate	0.07	per veh	0.07	per pers
Proportion Queued	0.22		0.22	
Performance Index	5.8		5.8	
Cost (Total)	123.42	$/h	123.42	$/h
Fuel Consumption (Total)	21.3	L/h		
Carbon Dioxide (Total)	50.0	kg/h		
Hydrocarbons (Total)	0.004	kg/h		
Carbon Monoxide (Total)	0.063	kg/h		
NOx (Total)	0.012	kg/h		

Level of Service (LOS) Method: Delay (RTA NSW).
NA: Intersection LOS for Vehicles is Not Applicable for two-way sign control since the average intersection 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.

MOVEMENT SUMMARY

Site: 2014 PM Lonus Kopa 4-way

New Site
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Lonus Ave south											
1	L2	13	0.0	0.015	5.5	LOS A	0.0	0.0	0.00	0.26	56.1
2	T1	154	0.0	0.074	0.5	LOS A	0.5	3.2	0.22	0.04	58.7
3	R2	4	0.0	0.074	6.0	LOS A	0.5	3.2	0.25	0.02	56.6
Approach		171	0.0	0.074	1.0	NA	0.5	3.2	0.21	0.06	58.4
East: Kopa St											
4	L2	2	0.0	0.006	7.0	LOS A	0.0	0.2	0.31	0.54	52.9
5	T1	2	0.0	0.006	5.8	LOS A	0.0	0.2	0.31	0.54	53.2
6	R2	1	0.0	0.006	6.9	LOS A	0.0	0.2	0.31	0.54	52.6
Approach		5	0.0	0.006	6.5	LOS A	0.0	0.2	0.31	0.54	52.9
North: Lonus Ave north											
7	L2	1	0.0	0.013	5.5	LOS A	0.0	0.0	0.00	0.03	58.1
8	T1	135	0.0	0.065	0.5	LOS A	0.4	2.8	0.23	0.04	58.7
9	R2	9	0.0	0.065	6.1	LOS A	0.4	2.8	0.28	0.05	56.3
Approach		145	0.0	0.065	0.9	NA	0.4	2.8	0.23	0.04	58.5
West: Kopa St											
10	L2	1	0.0	0.007	7.2	LOS A	0.0	0.2	0.34	0.57	52.5
11	T1	1	0.0	0.007	6.0	LOS A	0.0	0.2	0.34	0.57	52.8
12	R2	3	0.0	0.007	7.1	LOS A	0.0	0.2	0.34	0.57	52.3
Approach		5	0.0	0.007	6.9	LOS A	0.0	0.2	0.34	0.57	52.5
All Vehicles		326	0.0	0.074	1.2	NA	0.5	3.2	0.22	0.07	58.2

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

Processed: Friday, 27 June 2014 11:36:32 AM
SIDRA INTERSECTION 6.0.22.4722

SIDRA INTERSECTION 6

Project: C:\Sidra folders\SNL Whitebridge.sip6
8002653, SECA SOLUTION, NETWORK / 1PC

INTERSECTION SUMMARY

Site: 2014 PM Whitebridge Roundabout base +dev

Dudley Road / Lonus Avenue / Bulls Garden Road
PM peak base flows plus development
Roundabout
Design Life Analysis (Practical Capacity): Results for 10 years

Intersection Performance - Hourly Values				
Performance Measure	Vehicles		Persons	
Travel Speed (Average)	47.8	km/h	47.8	km/h
Travel Distance (Total)	2141.2	veh-km/h	2569.5	pers-km/h
Travel Time (Total)	44.8	veh-h/h	53.8	pers-h/h
Demand Flows (Total)	2070	veh/h	2484	pers/h
Percent Heavy Vehicles (Demand)	1.0	%		
Degree of Saturation	0.766			
Practical Spare Capacity	10.9	%		
Effective Intersection Capacity	2702	veh/h		
Control Delay (Total)	6.66	veh-h/h	7.99	pers-h/h
Control Delay (Average)	11.6	sec	11.6	sec
Control Delay (Worst Lane)	19.3	sec		
Control Delay (Worst Movement)	23.1	sec	23.1	sec
Geometric Delay (Average)	4.9	sec		
Stop-Line Delay (Average)	6.7	sec		
Idling Time (Average)	1.8	sec		
Intersection Level of Service (LOS)	LOS A			
95% Back of Queue - Vehicles (Worst Lane)	10.8	veh		
95% Back of Queue - Distance (Worst Lane)	76.5	m		
Queue Storage Ratio (Worst Lane)	0.06			
Total Effective Stops	1861	veh/h	2233	pers/h
Effective Stop Rate	0.90	per veh	0.90	per pers
Proportion Queued	0.85		0.85	
Performance Index	137.6		137.6	
Cost (Total)	1193.81	$/h	1193.81	$/h
Fuel Consumption (Total)	184.1	L/h		
Carbon Dioxide (Total)	434.0	kg/h		
Hydrocarbons (Total)	0.035	kg/h		
Carbon Monoxide (Total)	0.439	kg/h		
NOx (Total)	0.310	kg/h		

Level of Service (LOS) Method: Delay (RTA NSW).
Intersection LOS value for Vehicles is based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

MOVEMENT SUMMARY

Site: 2014 PM Whitebridge Roundabout base +dev

Dudley Road / Lonus Avenue / Bulls Garden Road
PM peak base flows plus development
Roundabout
Design Life Analysis (Practical Capacity): Results for 10 years

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
SouthEast: Dudley Road											
21	L2	90	1.0	0.552	5.5	LOS A	4.4	31.4	0.68	0.69	48.3
22	T1	301	1.0	0.552	5.4	LOS A	4.4	31.4	0.68	0.69	49.3
23a	R1	67	1.0	0.552	9.0	LOS A	4.4	31.4	0.68	0.69	48.9
23	R2	87	1.0	0.552	9.9	LOS A	4.4	31.4	0.68	0.69	46.5
23u	U	49	1.0	0.552	11.8	LOS A	4.4	31.4	0.68	0.69	50.1
Approach		594	1.0	0.552	7.0	LOS A	4.4	31.4	0.68	0.69	48.7
NorthEast: Lonus Avenue											
24	L2	53	1.0	0.301	10.5	LOS A	2.1	15.2	0.91	0.91	42.8
25	T1	37	1.0	0.301	10.4	LOS A	2.1	15.2	0.91	0.91	46.4
26	R2	71	1.0	0.301	14.9	LOS B	2.1	15.2	0.91	0.91	46.4
26b	R3	1	0.0	0.301	15.8	LOS B	2.1	15.2	0.91	0.91	46.8
Approach		162	1.0	0.301	12.4	LOS A	2.1	15.2	0.91	0.91	45.2
North: Waran Road											
7b	L3	1	0.0	0.504	17.4	LOS B	4.5	31.7	1.00	1.09	42.4
7a	L1	123	1.0	0.504	17.0	LOS B	4.5	31.7	1.00	1.09	43.3
9a	R1	66	1.0	0.504	21.0	LOS B	4.5	31.7	1.00	1.09	45.8
9b	R3	44	1.0	0.504	23.1	LOS B	4.5	31.7	1.00	1.09	46.6
Approach		234	1.0	0.504	19.3	LOS B	4.5	31.7	1.00	1.09	44.6
NorthWest: Dudley Road											
27b	L3	9	1.0	0.766	12.7	LOS A	10.8	76.5	0.94	1.03	48.4
27	L2	150	1.0	0.766	12.5	LOS A	10.8	76.5	0.94	1.03	48.8
28	T1	461	1.0	0.766	12.7	LOS A	10.8	76.5	0.94	1.03	46.8
29	R2	107	1.0	0.766	17.3	LOS B	10.8	76.5	0.94	1.03	49.8
Approach		728	1.0	0.766	13.4	LOS A	10.8	76.5	0.94	1.03	47.6
SouthWest: Bulls Garden Road											
30	L2	104	1.0	0.447	8.6	LOS A	3.4	23.8	0.82	0.86	51.0
30a	L1	80	1.0	0.447	8.5	LOS A	3.4	23.8	0.82	0.86	51.8
31	T1	67	1.0	0.447	8.8	LOS A	3.4	23.8	0.82	0.86	48.8
32	R2	104	1.0	0.447	13.5	LOS A	3.4	23.8	0.82	0.86	49.0
Approach		354	1.0	0.447	10.0	LOS A	3.4	23.8	0.82	0.86	50.1
All Vehicles		2070	1.0	0.766	11.6	LOS A	10.8	76.5	0.85	0.90	47.8

Level of Service (LOS) Method: Delay (RTA NSW).
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.

SIDRA INTERSECTION 6

INTERSECTION SUMMARY

Site: 2014 PM Lonus Kopa 4-way+dev

Lonus and Kopa 4-way plus development traffic
Giveway / Yield (Two-Way)

Intersection Performance - Hourly Values				
Performance Measure	Vehicles		Persons	
Travel Speed (Average)	57.0	km/h	57.0	km/h
Travel Distance (Total)	413.8	veh-km/h	496.6	pers-km/h
Travel Time (Total)	7.3	veh-h/h	8.7	pers-h/h
Demand Flows (Total)	409	veh/h	491	pers/h
Percent Heavy Vehicles (Demand)	0.0	%		
Degree of Saturation	0.112			
Practical Spare Capacity	772.4	%		
Effective Intersection Capacity	3645	veh/h		
Control Delay (Total)	0.25	veh-h/h	0.30	pers-h/h
Control Delay (Average)	2.2	sec	2.2	sec
Control Delay (Worst Lane)	7.3	sec		
Control Delay (Worst Movement)	8.2	sec	8.2	sec
Geometric Delay (Average)	1.6	sec		
Stop-Line Delay (Average)	0.6	sec		
Idling Time (Average)	0.0	sec		
Intersection Level of Service (LOS)	NA			
95% Back of Queue - Vehicles (Worst Lane)	0.6	veh		
95% Back of Queue - Distance (Worst Lane)	4.3	m		
Queue Storage Ratio (Worst Lane)	0.00			
Total Effective Stops	71	veh/h	85	pers/h
Effective Stop Rate	0.17	per veh	0.17	per pers
Proportion Queued	0.23		0.23	
Performance Index	7.8		7.8	
Cost (Total)	163.97	$/h	163.97	$/h
Fuel Consumption (Total)	28.0	L/h		
Carbon Dioxide (Total)	65.9	kg/h		
Hydrocarbons (Total)	0.005	kg/h		
Carbon Monoxide (Total)	0.083	kg/h		
NOx (Total)	0.017	kg/h		

Level of Service (LOS) Method: Delay (RTA NSW).
NA: Intersection LOS for Vehicles is Not Applicable for two-way sign control since the average intersection 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.

MOVEMENT SUMMARY

Site: 2014 PM Lonus Kopa 4-way+dev

Lonus and Kopa 4-way plus development traffic
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Lonus Ave south											
1	L2	13	0.0	0.022	5.5	LOS A	0.0	0.0	0.00	0.17	56.9
2	T1	154	0.0	0.112	0.5	LOS A	0.6	4.3	0.21	0.19	57.5
3	R2	61	0.0	0.112	6.0	LOS A	0.6	4.3	0.26	0.19	55.2
Approach		227	0.0	0.112	2.2	NA	0.6	4.3	0.21	0.19	56.8
East: Kopa St											
4	L2	12	0.0	0.018	6.7	LOS A	0.1	0.4	0.27	0.55	52.9
5	T1	4	0.0	0.018	5.6	LOS A	0.1	0.4	0.27	0.55	53.2
6	R2	1	0.0	0.018	6.7	LOS A	0.1	0.4	0.27	0.55	52.7
Approach		17	0.0	0.018	6.4	LOS A	0.1	0.4	0.27	0.55	53.0
North: Lonus Ave north											
7	L2	1	0.0	0.013	5.5	LOS A	0.0	0.0	0.00	0.03	58.1
8	T1	135	0.0	0.065	0.5	LOS A	0.4	2.8	0.23	0.04	58.7
9	R2	9	0.0	0.065	6.1	LOS A	0.4	2.8	0.28	0.05	56.3
Approach		145	0.0	0.065	0.9	NA	0.4	2.8	0.23	0.04	58.5
West: Kopa St											
10	L2	1	0.0	0.029	8.2	LOS A	0.1	0.8	0.45	0.61	52.3
11	T1	16	0.0	0.029	7.0	LOS A	0.1	0.8	0.45	0.61	52.6
12	R2	3	0.0	0.029	8.2	LOS A	0.1	0.8	0.45	0.61	52.1
Approach		20	0.0	0.029	7.3	LOS A	0.1	0.8	0.45	0.61	52.5
All Vehicles		409	0.0	0.112	2.2	NA	0.6	4.3	0.23	0.17	57.0

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

SIDRA INTERSECTION 6

Project: C:\Sidra folders\SNL Whitebridge.sip6
8002653, SECA SOLUTION, NETWORK / 1PC

Attachment B – Site Plans