Vraj Sydney Pty Ltd

Proposed Development, 682 Castlereagh Road, Agnes Bank.

Transport Impact Study

February 2018

Henson Consulting

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1 Introduction

1.1 Scope of Report

Henson Consulting was commissioned by Vraj Sydney Pty Ltd in 2017 to undertake a traffic and transport assessment and advice for the proposed development of a site at 682 Castlereagh Road, Agnes Bank, about sixty kilometres east of the Sydney city centre.

This report was prepared to address the issues being considered in the planning stage of the project, to support a Development Application (DA) to the Penrith City Council (Council), and meets the requirement of the traffic and parking report required by the Penrith Development Control Plan (DCP).

This Transport Impact Study (TIS) and report was prepared with reference to traffic impact assessment as required by the RMS NSW Guide to Traffic Generating Developments, and other relevant Australian Standards and controls.

1.2 Existing Studies and Reports and Guidelines

Existing studies and reports include area studies by Council and the RMS NSW on some nearby roads, and a range of NSW Government departments. The key transport guidelines taken into account in this study include:

- Austroads Guidelines
- Guidelines to Traffic Generating Developments, RMS NSW
- Australian Standard AS/NZS 2890.1 – 2004 Parking facilities Part 1: Off-street car parking
- Australian Standard AS 2890.2 – 2002 Off-Street Parking Part 2: Commercial vehicle facilities.
- Australian Standard AS 2890.3 – 2013 Parking Facilities Part 3: Bicycle Parking Facilities
- Australian Standard AS 2890.5 – 1993 On Street Parking
- Australian Standard AS 2890.6 – 1993 Off Street Parking Facilities for people with disabilities.
- Penrith DCP 2014, particularly C10 Transport Access and Parking
- NSW Environmental Planning and Assessments Act, 1979 and SEPPs.
- ‘Planning Guidelines for Walking and Cycling’, Department of Infrastructure, Planning and Natural Resources December 2004.

1.3 Key Issues and Objectives

This TIS specifically considered the following issues and recognises the role of traffic within a broader transport system that includes public transport, walking and cycling:

(a) The accessibility of the site by a range of transport modes including car, public transport, walking and cycling;

(b) The ability of the public transport network to service the site in the peak and off peak and weekend periods;

(c) Mode share targets;

(d) Means of minimising travel demand by car and maximising the share of travel by other modes including public transport, cycling and walking, or car share;

(e) Compliance with the requirements of the LEP and DCP;

(f) A justification of car parking provision and site servicing arrangements in accordance with the objectives of the LEP and DCP;

(g) The proposed allocation of parking;

(h) Access for the mobility impaired;

(i) Estimates of trip generation by the development and the impacts of trips generated by the development on the road network and other movement systems;

(j) Means of accommodating and integrating trips generated by the development including necessary improvements to public transport services, pedestrian systems, bicycle routes, and the road network;

(k) Means of mitigating any adverse impacts of the development on movement systems;

(l) Means of improving access to the site having regard to vehicular, pedestrian, cycle and public transport access;

(m) Impacts on and means of improving pedestrian accessibility to public transport, shops, schools, open spaces, community centres and the like.

(n) Means of improving access to public transport include the provision of subsidised public transport, improving the quality and safety pedestrian access to public transport, improving bus shelters and the like;

(o) Impacts on and means of improving pedestrian safety;

(p) Availability of on street parking and potential on street parking controls to discourage commuting and parking demand generated by the development.

1.4 Penrith DCP

The Penrith DCP 2014 specifically refers to:

A. Objectives

a) To provide safe and efficient travel routes for all vehicles in the Penrith LGA;

b) To reduce the number of vehicle and pedestrian accidents per capita;

c) To ensure the safety of cyclists, pedestrians and passing traffic during construction of development;

d) To cater for current and future growth of vehicle traffic usage;

e) To encourage the orderly and economic provision of road and intersection works;

f) To ensure that existing roads and intersections are upgraded to provide a satisfactory level of service consistent with the volume and nature of traffic generated by the proposed development; and

g) To avoid new direct access to and from arterial, sub-arterial and other major roads.

B. Controls

1) Traffic Studies

a) Development applications for major development proposals should be accompanied by an appropriate Traffic Report (see Appendix F3 – Submission Requirements). The Traffic Report should detail the assessed impact of projected pedestrian and vehicular traffic associated with the proposal, with recommendations on the extent and nature of the traffic facilities necessary to preserve or improve the safety and efficiency of the adjacent road system.

b) A Traffic Report must be provided for applications required to be referred to the Roads and Maritime Services (RMS) under Column 2 and a Traffic Impact Statement for Column 3 of SEPP (Infrastructure) 2007.

c) Depending on the scale, type and nature of the use proposed, Council may determine that a Traffic Report or Traffic Impact Statement is required for certain development which is not listed under Column 2 or 3 of SEPP (Infrastructure) 2007.

d) Any Traffic Report or Traffic Impact Statement is required to address the following issues:

i) The objectives of this section relating to transport and land use;

ii) The objectives of this section relating to traffic management and safety;

iii) The objectives and controls of this section relating to traffic generating developments; and

iv) The issues set out in Appendix F3 – Submission Requirements of this DCP.

e) Any development identified in Schedule 3 of State Environmental Planning Policy (Infrastructure) 2007 is either referred to RMS (Column 2 developments) or Council's Local Traffic Development Committee (Column 3 developments) for assessment and conditions as required.

2) Road Safety

a) Each development should demonstrate how it will:

i) Provide safe entry and exit for vehicles and pedestrians which reflect the proposed land use, and the operating speed and character of the road;

ii) Minimise the potential for vehicular/pedestrian conflicts, providing protection for pedestrians where necessary;

iii) Not restrict traffic flow or create a hazard to traffic on roads in the vicinity of the development;

iv) Provide suitable off-street parking facilities to accommodate vehicles generated by the development; and

v) Identify the need, where apparent, for any additional on-street traffic facilities or road works which may be required to maintain the safe and efficient movement of vehicles and pedestrians.

b) Where feasible, vehicle access for developments should be from service roads/lanes.

c) The design of direct vehicular access to developments should consider the traffic impacts on the surrounding road network. This may require the provision of deceleration, acceleration, right turn lanes and road widening, as necessary.

d) Provision must be made for all vehicles to enter and leave properties in a forward direction other than for single dwellings.

e) The layout and design of parking areas must minimise vehicle to pedestrian impacts, especially where heavy vehicle access to loading docks is proposed.

3) Traffic Generating Development

a) New access points off arterial, sub arterial or other major roads is to be avoided where alternate access opportunities exist.

b) Any development identified in Schedule 3 of State Environmental Planning Policy (Infrastructure) 2007 is either referred to RMS (Column 2 developments) or Council's Local Traffic Development Committee (Column 3 developments) for assessment and conditions as required.

2 Existing Conditions

2.1 Site Location

The 5-hectare site is located in Agnes Bank, approximately 70 kilometres by road west of the Sydney CBD, 8kilometres south of Richmond centre, and 16 kilometres north of Penrith centre, as shown in the following figures. Agnes Banks is near a boundary between Penrith Council to the south and Hawkesbury Council to the north.

Figure 1: Regional location

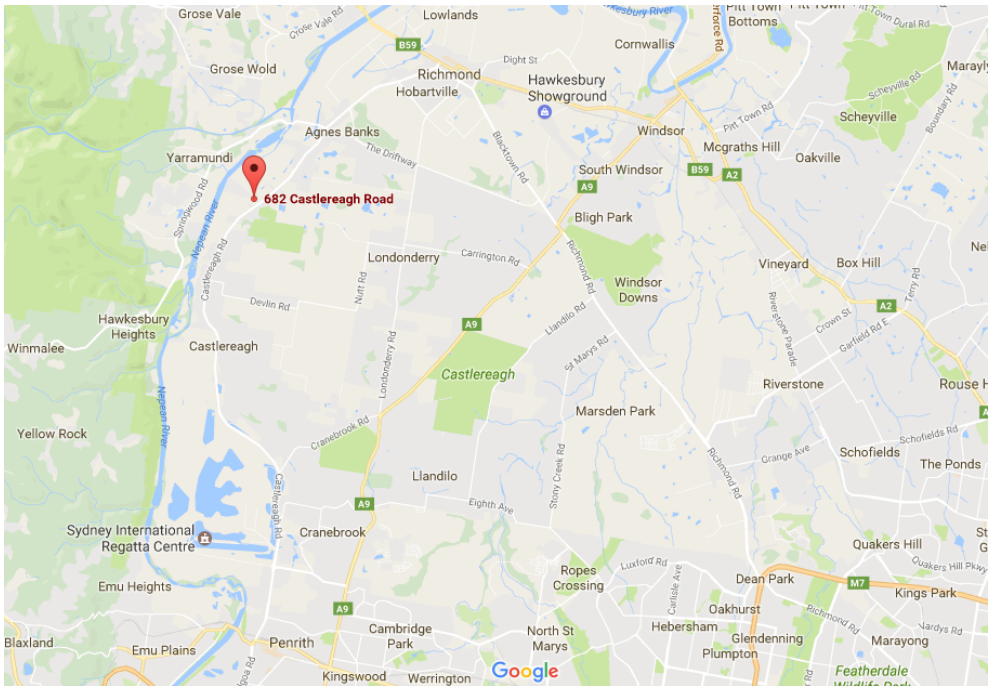
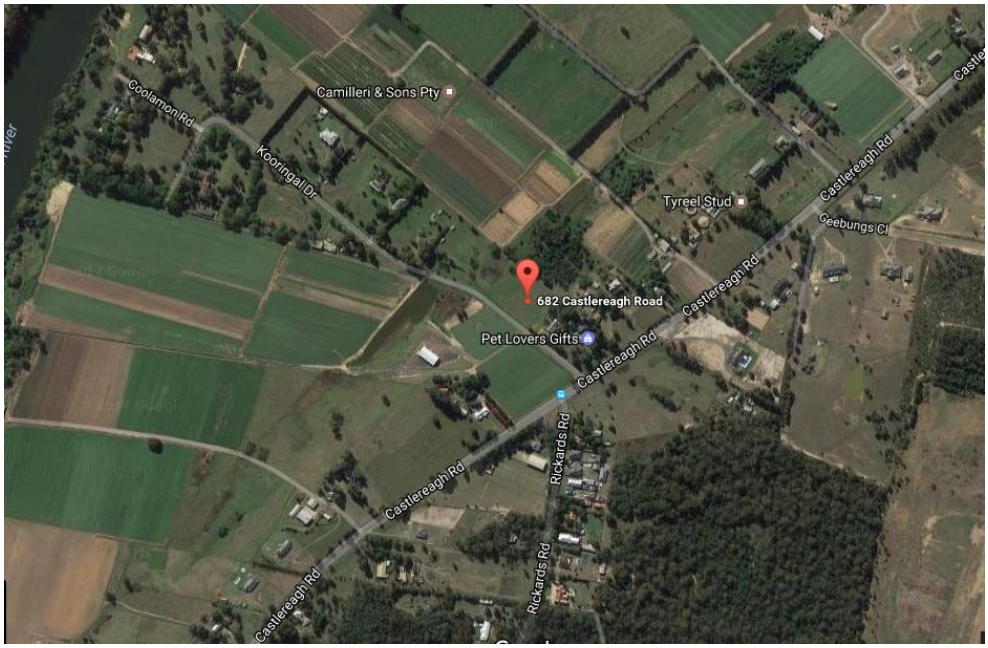


Figure 2: Site Location



2.2 Description of the Site

The approximately rectangular site fronts Castlereagh Road to the east, Kooringal Drive to the south, rural property to the north and west, with the Hawkesbury River to the west. The site is predominantly rural uses, with a house and associated buildings, that has previously been used as base for pet supplies business.

Surrounding land uses are generally semi-rural, with horse studs, turf farms, agriculture and small holdings. Penrith Lakes and Sydney International Regatta Centre are to the south and Agnes Banks and Richmond township to the north. Nepean Raceway is located at 112 Rickards Road to the east.

2.3 Road Hierarchy

Classified roads[1] are roads that, although owned by the City, are under the control of the NSW RMS because of their function as part of the Regional and/or State traffic network.

- Castlereagh Road (Main Road) 80km/h
- Kooringal Drive (Local) 60km/h
- Rickards Road (Major Local) 60km/h

2.4 Roads

Castlereagh Road (Main Road No. 630) is a two-lane road with some widenings at intersections, classified in part south of Cranebrook Road as a State Road. Regional Road 2109 from Cranebrook Road (MR630) at Cranebrook via Castlereagh Road Deviation and Castlereagh Road to Springwood Road (MR570) at Agnes Banks. State Road 630: from Jane Street (Great Western Highway HW5) at Penrith via Castlereagh Road, then via second ramp to Cranebrook Road, and Cranebrook Road to The Northern Road (MR154) at Llandilo, then from the Northern Road at Llandilo via Londonderry Road and Paget Street to Lennox Street (MR537) at Richmond. State Roads are managed and financed by RMS NSW.

The road is one lane in each direction with a marked centreline and edge lines on an approximately 7m wide pavement with up to 2m wide unpaved shoulders that are used for parking and run-off for passing right turning vehicles near driveways and intersections. There are bus stops south of the subject site. There is localised street lighting at intersections.

[1] DCP figure 2.1

Figure 3: looking south, from Castlereagh Road fronting the subject site, Kooringal Drive on to the west and Rickards Road to the east.

Kooringal Drive is a local road approximately 6m wide pavement with one traffic lanes in each direction, no road markings and a grassed shoulder on each side.

Rickards Road is a local road approximately 5 m wide pavement with no road markings is one lane in each direction.

2.5 Intersections

The intersection of Castlereagh Road and Kooringal Drive is a T junction, with implied priority to the through road. There are no Stop or Give Way signs currently in place.

The intersection of Castlereagh Road and Rickards Road is a T junction staggered 58m south of Kooringal Drive, with signed Give Way priority to the through road.

The subject site has a major driveway 123 m west of Castlereagh Road, and two minor residential driveways off Castlereagh Road 48m and 88m m north of the Kooringal Road.

2.6 Demographics and Mode Split

Figure 4: Existing Mode Share[2]

Mode/ Percentage Split	Penrith LGA	Hawkesbury LGA	Greater Sydney Average
Car, as driver	55	61	54%
Car, as passenger	25	25	5%
Walked only	12	7	4%
Bicycle/other mode			1%
Bus	3	3	5%
Train	4	3	9%
Other	1	1	22%
Total	100%	100%	100%

[2] Source: BTS, Key Transport Indicators1 by Local Government Area of Residence (LGA) and Subregion, 2011/12

The data suggest that the proportion of workers driving or as passengers to work is higher than Sydney averages. The walked-only mode share is higher than average and public transport usage is lower than average.

2.7 Transport and Traffic conditions

Typical traffic flows are reproduced in the following table.

Figure 5: Existing Weekday Vehicle Volumes[3]

Annual Average Daily Traffic	**AADT**	**AADT**	**AADT**	**AADT**	**ADT[4]**
Year/intersection	1993	1999	2005	2008	2017
Castlereagh Road north of Devlins Road		5543	5618	-	
Castlereagh Road MR155, Agnes Banks south of the Driftway	4484	6194	8605	9108	
Rickards Road , north of Devlins Road	243			-	
Castlereagh Road north of Kooringal Drive					7044
Kooringal Drive west of Castlereagh Road					149

Vehicular traffic growth in the local area appears relatively modest. The following data shows that the predominant peaks on Castlereagh Road are northbound in the mornings and southbound in the afternoons. Traffic flows on Kooringal Drive are less than 200 vehicles per day. There are less than one percent heavy vehicles on these roads. The 85th percentile speed on Castlereagh Road is approximately 83km/h and on Kooringal Drive is approximately 55km/h, slightly above the posted speed limits. The weekday morning vehicular peak hour occurs between 8am and 9am and the weekday evening vehicular peak hour occurs between 5pm and 6pm.

[3] Source: RMS

[4] Matrix Traffic Counts for Henson Consulting, March 2017

Figure 6: Traffic Data for Castlereagh Road and Kooringal Drive

Job No	N3044
Client	Henson Consulting
Site	Castelreagh Rd - north of Kooringal Drv
Location	Castlereagh
Site No	2
Start Date	1-Mar-17
Description	Volume Summary
Direction	NB

Menu

MATRIX Traffic and Transport Data

Hour Starting	Day of Week							W'Day Ave	7 Day Ave
	Mon	Tue	Wed	Thu	Fri	Sat	Sun		
	6-Mar	7-Mar	1-Mar	2-Mar	3-Mar	4-Mar	5-Mar		
AM Peak	378	426	406	406	380	300	276		
PM Peak	265	253	238	271	260	251	251	**3678**	**3450**
0:00	9	8	9	10	15	15	20	10	12
1:00	2	5	2	7	4	13	13	4	7
2:00	8	5	4	2	5	9	7	5	6
3:00	13	17	14	16	18	5	13	16	14
4:00	54	47	48	43	44	17	7	47	37
5:00	124	132	139	127	110	43	20	126	99
6:00	250	261	228	235	246	68	36	244	189
7:00	378	426	406	406	380	126	50	399	310
8:00	370	376	385	378	352	196	139	372	314
9:00	244	233	263	287	277	238	212	261	251
10:00	200	183	215	211	239	291	249	210	227
11:00	187	215	212	204	209	300	276	205	229
12:00	178	189	198	200	208	251	245	195	210
13:00	178	211	164	180	189	242	251	184	202
14:00	225	253	225	230	260	212	222	239	232
15:00	250	235	238	271	227	187	201	244	230
16:00	265	248	236	254	215	169	169	244	222
17:00	233	220	202	258	209	172	153	224	207
18:00	146	146	160	181	166	156	118	160	153
19:00	90	94	98	118	92	114	74	98	97
20:00	74	78	71	83	69	84	72	75	76
21:00	60	86	42	44	61	83	51	59	61
22:00	29	31	37	27	57	65	33	36	40
23:00	16	21	12	18	37	54	20	21	25
Total	3583	3720	3608	3790	3689	3110	2651	3678	3450

7-19	2854	2935	2904	3060	2931	2540	2285	2937	2787
6-22	3328	3454	3343	3540	3399	2889	2518	3413	3210
6-24	3373	3506	3392	3585	3493	3008	2571	3470	3275
0-24	3583	3720	3608	3790	3689	3110	2651	3678	3450

Job No	N3044
Client	Henson Consulting
Site	Castelreagh Rd - north of Kooringal Drv
Location	Castlereagh
Site No	2
Start Date	1-Mar-17
Description	Volume Summary
Direction	SB

Menu

MATRIX Traffic and Transport Data

Hour Starting	Day of Week							W'Day Ave	7 Day Ave
	Mon	Tue	Wed	Thu	Fri	Sat	Sun		
	6-Mar	7-Mar	1-Mar	2-Mar	3-Mar	4-Mar	5-Mar		
AM Peak	212	198	232	233	214	253	196		
PM Peak	453	440	453	447	402	310	282	**3838**	**3594**
0:00	10	13	14	10	18	32	58	13	22
1:00	9	7	4	6	7	8	20	7	9
2:00	1	3	8	4	5	17	14	4	7
3:00	3	6	6	6	9	13	7	6	7
4:00	16	18	10	15	17	6	4	15	12
5:00	58	62	48	62	58	24	19	58	47
6:00	137	134	114	115	117	35	28	123	97
7:00	192	198	156	175	193	68	54	183	148
8:00	212	197	232	233	213	92	64	217	178
9:00	169	187	170	169	169	157	116	173	162
10:00	181	172	163	176	166	174	153	172	169
11:00	184	180	187	180	214	253	196	189	199
12:00	189	221	208	228	220	270	264	213	229
13:00	216	227	238	210	267	310	282	232	250
14:00	255	262	297	273	344	288	263	286	283
15:00	367	341	380	338	402	306	266	366	343
16:00	453	378	379	421	402	283	272	407	370
17:00	434	440	453	447	391	246	216	433	375
18:00	264	277	263	293	249	159	126	269	233
19:00	149	172	123	192	137	132	89	155	142
20:00	119	122	96	151	111	97	81	120	111
21:00	64	102	109	143	83	119	74	100	99
22:00	47	57	46	70	93	87	37	63	62
23:00	27	21	29	40	61	78	15	36	39
Total	3756	3797	3733	3957	3946	3254	2718	3838	3594

7-19	3116	3080	3126	3143	3230	2606	2272	3139	2939
6-22	3585	3610	3568	3744	3678	2989	2544	3637	3388
6-24	3659	3688	3643	3854	3832	3154	2596	3735	3489
0-24	3756	3797	3733	3957	3946	3254	2718	3838	3594

Job No	N3044
Client	Henson Consulting
Site	Kooringal Drv - west of Castelreagh Rd
Location	Castlereagh
Site No	1
Start Date	1-Mar-17
Description	Volume Summary
Direction	WB

Menu

MATRIX Traffic and Transport Data

Hour Starting	Day of Week							W'Day Ave	7 Day Ave
	Mon	Tue	Wed	Thu	Fri	Sat	Sun		
	6-Mar	7-Mar	1-Mar	2-Mar	3-Mar	4-Mar	5-Mar		
AM Peak	8	5	7	6	8	6	8		
PM Peak	10	13	9	9	12	9	6	**80**	**75**
0:00	0	0	0	0	2	2	3	0	1
1:00	0	0	0	1	0	0	0	0	0
2:00	0	0	0	0	0	0	0	0	0
3:00	0	0	0	0	0	0	0	0	0
4:00	1	1	0	1	4	0	0	1	1
5:00	0	0	1	0	0	0	1	0	0
6:00	1	1	1	0	0	0	0	1	0
7:00	2	2	2	2	2	0	0	2	1
8:00	7	3	2	0	3	2	2	3	3
9:00	6	3	7	5	1	6	1	4	4
10:00	8	1	7	5	7	4	2	6	5
11:00	8	5	3	6	8	4	8	6	6
12:00	9	3	5	6	11	9	6	7	7
13:00	10	4	2	8	5	4	6	6	6
14:00	9	7	6	5	2	8	6	6	6
15:00	5	6	8	6	7	8	4	6	6
16:00	3	7	5	4	3	5	4	4	4
17:00	8	13	9	8	12	3	4	10	8
18:00	5	7	9	9	5	0	1	7	5
19:00	3	4	4	4	3	0	3	4	3
20:00	4	1	2	4	6	2	2	3	3
21:00	3	2	0	4	1	5	1	2	2
22:00	0	3	2	0	0	2	3	1	1
23:00	0	0	0	1	0	0	0	0	0
Total	92	73	75	79	82	64	57	80	75

7-19	80	61	65	64	66	53	44	67	62
6-22	91	69	72	76	76	60	50	77	71
6-24	91	72	74	77	76	62	53	78	72
0-24	92	73	75	79	82	64	57	80	75

Job No	N3044
Client	Henson Consulting
Site	Kooringal Drv - west of Castelreagh Rd
Location	Castlereagh
Site No	1
Start Date	1-Mar-17
Description	Volume Summary
Direction	EB

Menu

MATRIX Traffic and Transport Data

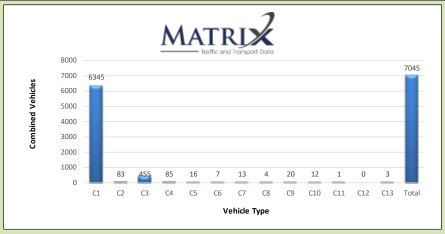
Hour Starting	Day of Week							W'Day Ave	7 Day Ave
	Mon	Tue	Wed	Thu	Fri	Sat	Sun		
	6-Mar	7-Mar	1-Mar	2-Mar	3-Mar	4-Mar	5-Mar		
AM Peak	13	15	12	10	9	8	5		
PM Peak	8	11	11	11	8	10	7	**80**	**74**
0:00	0	0	0	0	0	0	2	0	0
1:00	0	0	0	0	0	0	0	0	0
2:00	0	0	0	0	0	0	0	0	0
3:00	0	0	0	0	0	0	0	0	0
4:00	2	2	1	2	3	0	0	2	1
5:00	2	1	1	2	4	2	0	2	2
6:00	8	5	6	3	7	1	2	6	5
7:00	6	5	3	9	4	3	4	5	5
8:00	8	15	12	10	9	3	5	11	9
9:00	3	3	5	5	5	8	2	4	4
10:00	6	0	9	2	4	6	4	4	4
11:00	13	3	7	6	9	8	5	8	7
12:00	8	2	3	4	3	5	5	4	4
13:00	6	5	3	8	8	4	4	6	5
14:00	5	11	11	11	3	1	5	8	7
15:00	5	1	4	6	6	7	1	4	4
16:00	5	4	3	2	2	10	3	3	4
17:00	2	4	2	5	6	2	1	4	3
18:00	3	6	0	2	1	1	3	2	2
19:00	5	6	1	3	3	4	7	4	4
20:00	3	0	1	2	2	0	2	2	1
21:00	0	0	1	1	1	1	0	1	1
22:00	0	0	0	0	0	0	0	0	0
23:00	0	0	0	0	0	0	0	0	0
Total	90	73	73	83	80	66	55	80	74

7-19	70	59	62	70	60	58	42	64	60
6-22	86	70	71	79	73	64	53	76	71
6-24	86	70	71	79	73	64	53	76	71
0-24	90	73	73	83	80	66	55	80	74

Job No N3044
Client Henson Consulting
Site Castelreagh Rd - north of Kooringal Drv
Location Castlereagh
Site No 2
Start Date 1-Mar-17
Day 7 Day Ave
Description Class Summary
Classification AustRoads94
Select Site
2. Castelreagh Rd - north of Kooringal Drv
Select Day
7 Day Ave

Menu

Class Summary		C	NB	SB
Light	Class 1	90%	91%	89%
	Class 2	1%	1%	1%
Medium	Class 3	6%	6%	7%
	Class 4	1%	1%	2%
	Class 5	0%	0%	0%
Heavy	Class 6	0%	0%	0%
	Class 7	0%	0%	0%
	Class 8	0%	0%	0%
	Class 9	0%	0%	0%
	Class 10	0%	0%	0%
	Class 11	0%	0%	0%
	Class 12	0%	0%	0%
U/C	Class 13	0%	0%	0%



NB

Hour Starting	C1 Short	C2 Short Towing	C3 2 axle Truck or bus	C4 3 Axle Truck or Bus	C5 4 or 5 Axle Truck	C6 3 axle Articulated	C7 4 Axle Articulated	C8 5 Axle Articulated	C9 6 Axle Articulated	C10 B Double	C11 Double Road Train	C12 Triple Road Train	C13 Unclassifiable	Total
0:00	11	0	1	0	0	0	0	0	0	0	0	0	0	12
1:00	6	0	1	0	0	0	0	0	0	0	0	0	0	7
2:00	5	0	1	0	0	0	0	0	0	0	0	0	0	6
3:00	11	0	2	0	0	0	0	0	0	0	0	0	0	14
4:00	29	1	4	1	0	0	0	0	1	0	0	0	0	37
5:00	84	2	10	2	0	0	0	0	1	0	0	0	0	99
6:00	167	2	16	1	1	1	1	0	0	0	0	0	0	189
7:00	287	4	16	1	0	0	1	0	0	0	0	0	0	310
8:00	286	5	18	1	1	1	0	0	1	1	0	0	0	314
9:00	226	5	15	1	1	0	0	1	1	0	0	0	0	251
10:00	207	4	14	1	0	0	0	0	0	0	0	0	0	227
11:00	210	2	14	2	0	0	0	0	0	0	0	0	0	229
12:00	188	2	14	3	1	0	0	0	2	0	0	0	0	210
13:00	183	3	13	1	1	0	0	0	1	0	0	0	0	202
14:00	213	2	13	2	0	0	1	0	0	1	0	0	0	232
15:00	209	3	14	1	0	0	0	0	1	0	0	0	0	230
16:00	201	3	15	1	0	0	0	0	1	0	0	0	0	222
17:00	191	3	11	1	0	0	1	0	0	0	0	0	0	207
18:00	143	2	7	1	0	0	1	0	0	0	0	0	0	153
19:00	91	1	4	0	0	0	0	0	0	0	0	0	0	97
20:00	72	1	2	0	0	0	0	0	0	0	0	0	0	76
21:00	56	0	4	0	1	0	0	0	0	0	0	0	0	61
22:00	38	0	1	0	0	0	0	0	0	0	0	0	0	40
23:00	24	0	1	0	0	0	0	0	0	0	0	0	0	25
Total	3136	45	210	21	7	4	7	3	11	4	1	0	2	3450

SB

Hour Starting	C1 Short	C2 Short Towing	C3 2 axle Truck or bus	C4 3 Axle Truck or Bus	C5 4 or 5 Axle Truck	C6 3 axle Articulated	C7 4 Axle Articulated	C8 5 Axle Articulated	C9 6 Axle Articulated	C10 B Double	C11 Double Road Train	C12 Triple Road Train	C13 Unclassifiable	Total
0:00	21	0	1	0	0	0	0	0	0	0	0	0	0	22
1:00	8	0	1	0	0	0	0	0	0	0	0	0	0	9
2:00	7	0	1	0	0	0	0	0	0	0	0	0	0	7
3:00	6	0	1	0	0	0	0	0	0	0	0	0	0	7
4:00	11	0	1	0	0	0	0	0	0	0	0	0	0	12
5:00	41	0	4	1	0	0	0	0	0	0	0	0	0	47
6:00	79	1	10	3	1	0	1	0	0	1	0	0	0	97
7:00	128	2	12	3	1	0	0	0	0	1	0	0	1	148
8:00	157	2	13	3	1	0	0	0	1	0	0	0	0	178
9:00	142	3	12	2	1	0	0	0	0	1	0	0	0	162
10:00	145	3	15	3	0	0	1	0	1	1	0	0	0	169
11:00	176	4	15	2	1	0	0	0	1	0	0	0	0	199
12:00	203	3	16	4	1	1	0	0	1	0	0	0	0	229
13:00	224	3	17	4	0	0	0	0	1	1	0	0	0	250
14:00	250	3	20	7	1	0	1	0	1	1	0	0	0	283
15:00	307	3	23	6	0	0	1	0	0	1	0	0	0	343
16:00	335	4	22	6	0	0	1	0	1	0	0	0	0	370
17:00	341	3	23	5	1	0	1	0	1	1	0	0	0	375
18:00	215	1	13	3	0	0	0	0	0	0	0	0	0	233
19:00	127	1	10	2	0	0	0	0	0	0	0	0	0	142
20:00	102	0	5	3	0	0	0	0	0	0	0	0	0	111
21:00	90	1	6	3	0	0	0	0	0	0	0	0	0	99
22:00	58	0	2	2	0	0	0	0	0	0	0	0	0	62
23:00	36	0	1	1	0	0	0	0	0	0	0	0	0	39
Total	3209	38	244	64	9	4	6	1	9	8	1	0	1	3594

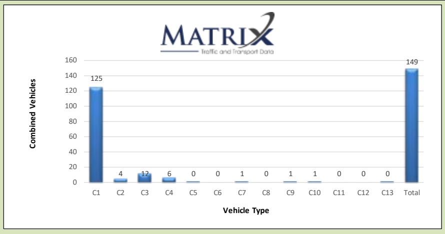
COMBINED

Hour Starting	C1 Short	C2 Short Towing	C3 2 axle Truck or bus	C4 3 Axle Truck or Bus	C5 4 or 5 Axle Truck	C6 3 axle Articulated	C7 4 Axle Articulated	C8 5 Axle Articulated	C9 6 Axle Articulated	C10 B Double	C11 Double Road Train	C12 Triple Road Train	C13 Unclassifiable	Total
0:00	32	0	2	0	0	0	0	0	0	0	0	0	0	34
1:00	13	0	2	0	0	0	0	0	0	0	0	0	0	15
2:00	11	0	1	0	0	0	0	0	0	0	0	0	0	13
3:00	18	0	3	0	0	0	0	0	0	0	0	0	0	21
4:00	39	1	5	2	1	0	0	0	2	0	0	0	0	49
5:00	125	2	14	3	1	0	0	0	1	1	0	0	0	147
6:00	246	3	26	4	2	1	1	0	1	1	0	0	0	286
7:00	415	6	29	4	1	0	1	0	0	1	0	0	1	458
8:00	442	7	31	4	1	1	0	1	2	1	0	0	0	491
9:00	368	8	28	3	1	1	1	1	1	1	0	0	0	413
10:00	352	7	29	3	1	0	1	0	1	1	0	0	0	396
11:00	386	6	29	4	1	0	0	0	1	1	0	0	0	428
12:00	391	4	30	7	2	1	1	0	2	0	0	0	0	438
13:00	406	6	29	5	1	0	1	0	1	1	0	0	0	452
14:00	463	6	33	9	1	0	1	0	1	1	0	0	0	516
15:00	517	6	38	7	0	0	1	0	2	1	0	0	0	573
16:00	536	7	37	7	1	1	1	0	2	0	0	0	0	592
17:00	531	6	34	6	1	0	1	1	1	1	0	0	0	582
18:00	358	3	20	3	0	0	1	0	0	0	0	0	0	386
19:00	218	3	14	3	0	1	0	0	0	0	0	0	0	239
20:00	174	1	8	3	0	0	0	0	0	0	0	0	0	187
21:00	146	1	9	3	1	0	0	0	0	0	0	0	0	160
22:00	96	1	4	2	0	0	0	0	0	0	0	0	0	102
23:00	60	0	3	1	0	0	0	0	0	0	0	0	0	64
Total	6345	83	455	85	16	7	13	4	20	12	1	0	3	7045

Job No N3044
Client Henson Consulting
Site Kooringal Drv - west of Castelreagh Rd
Location Castlereagh
Site No 1
Start Date 1-Mar-17
Day 7 Day Ave
Description Class Summary
Classification AustRoads94
Select Site
1. Kooringal Drv - west of Castelreagh Rd
Select Day
7 Day Ave

Menu

Class Summary		C	EB	WB
Light	Class 1	84%	83%	84%
	Class 2	3%	3%	3%
Medium	Class 3	8%	9%	7%
	Class 4	4%	3%	4%
	Class 5	0%	0%	0%
Heavy	Class 6	0%	0%	0%
	Class 7	1%	1%	1%
	Class 8	0%	0%	0%
	Class 9	0%	0%	0%
	Class 10	0%	0%	0%
	Class 11	0%	0%	0%
	Class 12	0%	0%	0%
U/C	Class 13	0%	0%	0%



EB

Hour Starting	C1 Short	C2 Short Towing	C3 2 axle Truck or bus	C4 3 Axle Truck or Bus	C5 4 or 5 Axle Truck	C6 3 axle Articulated	C7 4 Axle Articulated	C8 5 Axle Articulated	C9 6 Axle Articulated	C10 B Double	C11 Double Road Train	C12 Triple Road Train	C13 Unclassifiable	Total
0:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:00	1	0	0	0	0	0	0	0	0	0	0	0	0	1
5:00	1	0	0	0	0	0	0	0	0	0	0	0	0	2
6:00	4	0	1	0	0	0	0	0	0	0	0	0	0	5
7:00	4	0	1	0	0	0	0	0	0	0	0	0	0	5
8:00	8	1	0	0	0	0	0	0	0	0	0	0	0	9
9:00	4	0	0	0	0	0	0	0	0	0	0	0	0	4
10:00	4	0	0	0	0	0	0	0	0	0	0	0	0	4
11:00	6	0	1	1	0	0	0	0	0	0	0	0	0	7
12:00	4	0	0	0	0	0	0	0	0	0	0	0	0	4
13:00	4	0	0	0	0	0	0	0	0	0	0	0	0	5
14:00	5	0	1	0	0	0	0	0	0	0	0	0	0	7
15:00	3	0	1	0	0	0	0	0	0	0	0	0	0	4
16:00	3	0	0	0	0	0	0	0	0	0	0	0	0	4
17:00	3	0	0	0	0	0	0	0	0	0	0	0	0	3
18:00	2	0	0	0	0	0	0	0	0	0	0	0	0	2
19:00	3	0	1	0	0	0	0	0	0	0	0	0	0	4
20:00	1	0	0	0	0	0	0	0	0	0	0	0	0	1
21:00	1	0	0	0	0	0	0	0	0	0	0	0	0	1
22:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	62	2	6	3	0	0	0	0	0	0	0	0	0	74

WB

Hour Starting	C1 Short	C2 Short Towing	C3 2 axle Truck or bus	C4 3 Axle Truck or Bus	C5 4 or 5 Axle Truck	C6 3 axle Articulated	C7 4 Axle Articulated	C8 5 Axle Articulated	C9 6 Axle Articulated	C10 B Double	C11 Double Road Train	C12 Triple Road Train	C13 Unclassifiable	Total
0:00	1	0	0	0	0	0	0	0	0	0	0	0	0	1
1:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:00	1	0	0	0	0	0	0	0	0	0	0	0	0	1
5:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:00	1	0	0	0	0	0	0	0	0	0	0	0	0	1
8:00	2	0	0	0	0	0	0	0	0	0	0	0	0	3
9:00	4	0	0	0	0	0	0	0	0	0	0	0	0	4
10:00	4	0	0	0	0	0	0	0	0	0	0	0	0	5
11:00	5	1	0	0	0	0	0	0	0	0	0	0	0	6
12:00	5	0	0	1	0	0	0	0	0	0	0	0	0	7
13:00	5	0	0	0	0	0	0	0	0	0	0	0	0	6
14:00	5	0	1	0	0	0	0	0	0	0	0	0	0	6
15:00	5	0	1	0	0	0	0	0	0	0	0	0	0	6
16:00	4	0	0	0	0	0	0	0	0	0	0	0	0	4
17:00	7	0	0	0	0	0	0	0	0	0	0	0	0	8
18:00	5	0	1	0	0	0	0	0	0	0	0	0	0	5
19:00	3	0	0	0	0	0	0	0	0	0	0	0	0	3
20:00	3	0	0	0	0	0	0	0	0	0	0	0	0	3
21:00	2	0	0	0	0	0	0	0	0	0	0	0	0	2
22:00	1	0	0	0	0	0	0	0	0	0	0	0	0	1
23:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	63	2	5	3	0	0	0	0	0	0	0	0	0	75

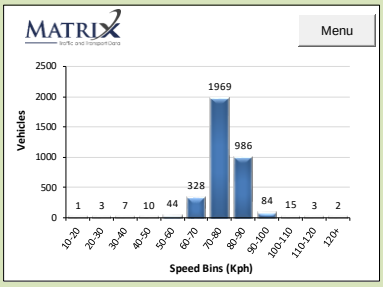
COMBINED

Hour Starting	C1 Short	C2 Short Towing	C3 2 axle Truck or bus	C4 3 Axle Truck or Bus	C5 4 or 5 Axle Truck	C6 3 axle Articulated	C7 4 Axle Articulated	C8 5 Axle Articulated	C9 6 Axle Articulated	C10 B Double	C11 Double Road Train	C12 Triple Road Train	C13 Unclassifiable	Total
0:00	1	0	0	0	0	0	0	0	0	0	0	0	0	1
1:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:00	2	0	0	1	0	0	0	0	0	0	0	0	0	2
5:00	1	0	0	0	0	0	0	0	0	0	0	0	0	2
6:00	4	0	1	0	0	0	0	0	0	0	0	0	0	5
7:00	5	0	1	0	0	0	0	0	0	0	0	0	0	6
8:00	10	1	1	0	0	0	0	0	0	0	0	0	0	12
9:00	8	0	0	0	0	0	0	0	0	0	0	0	0	9
10:00	8	0	0	1	0	0	0	0	0	0	0	0	0	9
11:00	11	1	1	1	0	0	0	0	0	0	0	0	0	13
12:00	9	1	0	1	0	0	0	0	0	0	0	0	0	11
13:00	9	0	1	1	0	0	0	0	0	0	0	0	0	11
14:00	11	0	1	0	0	0	0	0	0	0	0	0	0	13
15:00	8	0	2	0	0	0	0	0	0	0	0	0	0	11
16:00	7	0	1	0	0	0	0	0	0	0	0	0	0	9
17:00	10	0	0	0	0	0	0	0	0	0	0	0	0	11
18:00	6	0	1	0	0	0	0	0	0	0	0	0	0	7
19:00	6	0	1	0	0	0	0	0	0	0	0	0	0	7
20:00	4	0	0	0	0	0	0	0	0	0	0	0	0	4
21:00	3	0	0	0	0	0	0	0	0	0	0	0	0	3
22:00	1	0	0	0	0	0	0	0	0	0	0	0	0	1
23:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	125	4	12	6	0	0	1	0	1	1	0	0	0	149

Job No	N3044
Client	Henson Consulting
Site	Castelreagh Rd - north of Kooringal Drv
Location	Castlereagh
Site No	2
Start Date	1-Mar-17
Day	7 Day Ave
Direction	NB
Description	Speed Summary

Select Site: 2. Castelreagh Rd - north of Kooringal Drv

Select Day: 7 Day Ave Select Direction: NB



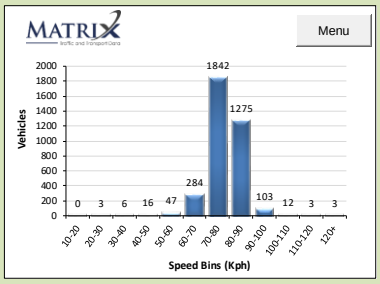
Bin Summary	
10-20	0.0%
20-30	0.1%
30-40	0.2%
40-50	0.3%
50-60	1.3%
60-70	9.5%
70-80	57.1%
80-90	28.6%
90-100	2.4%
100-110	0.4%
110-120	0.1%
120+	0.0%
77.3	**83.0**

Hour	Vehicle Speed Bins (kph)												Speed	
Starting	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	100-110	110-120	120+	Ave	85%ile
0:00	0	0	0	0	0	2	6	4	0	0	0	0	77.9	83.2
1:00	0	0	0	0	0	1	4	1	0	0	0	0	78.5	78.3
2:00	0	0	0	0	0	1	2	3	1	0	0	0	81.4	0
3:00	0	0	0	0	0	2	5	5	1	0	0	0	78.9	87.3
4:00	0	0	0	0	0	1	14	17	3	1	0	0	80.7	88.5
5:00	0	0	0	0	0	4	40	47	7	2	0	0	81.1	87.3
6:00	0	0	0	0	0	9	107	66	6	1	1	0	79.3	84.9
7:00	0	0	1	1	2	13	183	103	5	2	0	0	78.2	83.6
8:00	0	0	2	1	2	25	188	92	4	1	0	0	77.2	82.6
9:00	0	1	0	1	2	22	152	68	4	1	0	0	77.2	82.4
10:00	0	0	0	1	3	19	139	61	3	0	0	0	76.8	82.4
11:00	0	0	0	1	4	24	141	55	4	0	0	0	76.3	82.0
12:00	0	0	1	1	3	17	124	58	5	1	0	0	77.1	82.7
13:00	0	0	0	1	1	18	124	52	5	1	0	0	77.2	82.5
14:00	0	0	0	1	3	27	138	58	4	0	0	0	76.3	82.1
15:00	0	0	0	0	4	30	132	58	4	0	0	0	76.3	82.6
16:00	0	0	1	0	5	33	126	51	5	0	0	0	75.6	81.6
17:00	0	0	0	1	6	26	113	55	5	1	0	0	76.5	82.5
18:00	0	0	0	0	1	14	78	52	7	1	0	0	78.7	84.4
19:00	0	0	0	0	2	11	50	29	4	0	0	0	77.4	83.8
20:00	0	0	0	0	2	11	42	18	3	1	0	0	76.4	82.7
21:00	0	0	0	0	2	8	33	16	2	0	0	0	76.4	83.5
22:00	0	0	0	0	1	8	19	9	2	0	0	0	77.1	83.1
23:00	0	0	0	0	1	2	12	8	2	0	0	0	79.7	85.4
Total	1	3	7	10	44	328	1969	986	84	15	3	2	77.3	83.0

Job No	N3044
Client	Henson Consulting
Site	Castelreagh Rd - north of Kooringal Drv
Location	Castlereagh
Site No	2
Start Date	1-Mar-17
Day	7 Day Ave
Direction	SB
Description	Speed Summary

Select Site: 2. Castelreagh Rd - north of Kooringal Drv

Select Day: 7 Day Ave Select Direction: SB



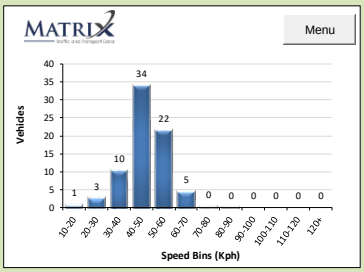
Bin Summary	
10-20	0.0%
20-30	0.1%
30-40	0.2%
40-50	0.5%
50-60	1.3%
60-70	7.9%
70-80	51.2%
80-90	35.5%
90-100	2.9%
100-110	0.3%
110-120	0.1%
120+	0.1%
78.1	**83.9**

Hour	Vehicle Speed Bins (kph)												Speed	
Starting	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	100-110	110-120	120+	Ave	85%ile
0:00	0	0	0	0	0	1	9	10	1	1	0	0	82.4	89.1
1:00	0	0	0	0	0	1	4	3	0	0	0	0	80.5	85.3
2:00	0	0	0	0	0	1	2	3	1	1	0	0	86.2	90.0
3:00	0	0	0	0	0	1	3	3	0	0	0	0	77.7	88.6
4:00	0	0	0	0	0	1	3	5	2	0	0	0	78.4	90.7
5:00	0	0	0	0	1	3	17	22	3	0	0	0	79.7	86.2
6:00	0	0	1	0	2	10	40	38	5	1	0	0	77.6	85.7
7:00	0	0	1	1	3	10	64	61	7	1	0	0	78.9	85.7
8:00	0	0	1	2	4	14	84	65	7	0	0	0	77.7	84.0
9:00	0	0	1	0	2	11	82	62	4	0	0	0	77.9	83.8
10:00	0	0	0	1	2	13	87	60	4	1	0	0	77.9	83.8
11:00	0	1	0	2	4	16	104	68	4	0	0	0	77.3	83.5
12:00	0	0	0	1	2	15	126	79	5	0	0	0	78.3	83.4
13:00	0	0	0	2	3	19	137	83	6	0	0	0	77.6	83.3
14:00	0	0	0	1	3	20	157	96	4	0	0	0	77.9	83.2
15:00	0	0	1	2	5	21	196	113	5	1	0	0	77.7	83.2
16:00	0	0	0	1	5	45	190	121	7	0	0	0	77.3	82.8
17:00	0	0	0	1	3	33	195	138	5	1	0	0	78.1	83.1
18:00	0	0	0	0	1	11	108	102	9	1	0	0	79.8	85.2
19:00	0	0	0	1	2	12	73	47	6	1	0	0	78.4	84.4
20:00	0	0	0	0	1	9	62	33	4	1	0	0	78.3	84.1
21:00	0	0	0	1	3	10	46	34	3	1	0	0	77.8	84.1
22:00	0	0	0	0	0	5	33	18	4	1	0	0	79.5	85.7
23:00	0	0	0	0	0	2	18	11	5	1	1	0	82.4	91.4
Total	0	3	6	16	47	284	1842	1275	103	12	3	3	78.1	83.9

Job No	N3044
Client	Henson Consulting
Site	Kooringal Drv - west of Castlereagh Rd
Location	Castlereagh
Site No	1
Start Date	1-Mar-17
Day	7 Day Ave
Direction	WB
Description	Speed Summary

Select Site: 1. Kooringal Drv - west of Castlereagh Rd

Select Day: 7 Day Ave Select Direction: WB



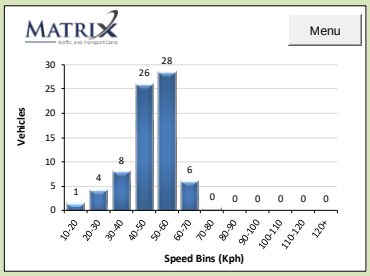
Bin Summary	
10-20	1.1%
20-30	3.6%
30-40	13.8%
40-50	45.6%
50-60	28.9%
60-70	6.1%
70-80	0.6%
80-90	0.2%
90-100	0.0%
100-110	0.0%
110-120	0.0%
120+	0.0%
46.6	**52.0**

Hour Starting	Vehicle Speed Bins (kph)												Speed	
	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	100-110	110-120	120+	Ave	85%ile
0:00	0	0	0	0	0	0	0	0	0	0	0	0	53.3	0
1:00	0	0	0	0	0	0	0	0	0	0	0	0	68.7	0
2:00	0	0	0	0	0	0	0	0	0	0	0	0		0
3:00	0	0	0	0	0	0	0	0	0	0	0	0		0
4:00	0	0	0	0	1	0	0	0	0	0	0	0	53.2	0
5:00	0	0	0	0	0	0	0	0	0	0	0	0	55.2	0
6:00	0	0	0	0	0	0	0	0	0	0	0	0	48.7	0
7:00	0	0	0	1	0	0	0	0	0	0	0	0	47.1	0
8:00	0	0	1	1	1	0	0	0	0	0	0	0	44.5	0
9:00	0	0	1	1	2	0	0	0	0	0	0	0	48.1	0
10:00	0	0	1	2	1	0	0	0	0	0	0	0	46.1	0
11:00	0	0	1	2	2	0	0	0	0	0	0	0	46.2	0
12:00	0	0	1	3	1	0	0	0	0	0	0	0	42.2	47.9
13:00	0	0	1	3	2	0	0	0	0	0	0	0	45.0	0
14:00	0	0	1	2	2	1	0	0	0	0	0	0	47.6	0
15:00	0	0	1	3	2	0	0	0	0	0	0	0	46.6	0
16:00	0	0	0	2	1	0	0	0	0	0	0	0	47.0	0
17:00	0	0	1	5	2	0	0	0	0	0	0	0	47.6	55.5
18:00	0	0	0	2	2	0	0	0	0	0	0	0	46.2	0
19:00	0	0	0	1	1	0	0	0	0	0	0	0	45.9	0
20:00	0	0	0	1	1	0	0	0	0	0	0	0	47.5	0
21:00	0	0	0	1	1	0	0	0	0	0	0	0	47.8	0
22:00	0	0	0	1	1	0	0	0	0	0	0	0	50.4	0
23:00	0	0	0	0	0	0	0	0	0	0	0	0	60.5	0
Total	1	3	10	34	22	5	0	0	0	0	0	0	46.6	52.0

Job No	N3044
Client	Henson Consulting
Site	Kooringal Drv - west of Castlereagh Rd
Location	Castlereagh
Site No	1
Start Date	1-Mar-17
Day	7 Day Ave
Direction	EB
Description	Speed Summary

Select Site: 1. Kooringal Drv - west of Castlereagh Rd

Select Day: 7 Day Ave Select Direction: EB



Bin Summary	
10-20	1.9%
20-30	5.8%
30-40	10.6%
40-50	34.8%
50-60	38.3%
60-70	8.1%
70-80	0.6%
80-90	0.0%
90-100	0.0%
100-110	0.0%
110-120	0.0%
120+	0.0%
47.6	**55.8**

Hour Starting	Vehicle Speed Bins (kph)												Speed	
	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	100-110	110-120	120+	Ave	85%ile
0:00	0	0	0	0	0	0	0	0	0	0	0	0	53.1	0
1:00	0	0	0	0	0	0	0	0	0	0	0	0		0
2:00	0	0	0	0	0	0	0	0	0	0	0	0		0
3:00	0	0	0	0	0	0	0	0	0	0	0	0		0
4:00	0	0	0	0	1	0	0	0	0	0	0	0	53.4	0
5:00	0	0	0	0	1	1	0	0	0	0	0	0	55.0	0
6:00	0	0	0	2	1	0	0	0	0	0	0	0	48.6	0
7:00	0	0	0	2	2	1	0	0	0	0	0	0	50.9	0
8:00	0	1	1	4	3	1	0	0	0	0	0	0	46.9	55.8
9:00	0	0	1	1	2	0	0	0	0	0	0	0	48.6	0
10:00	0	0	1	1	2	0	0	0	0	0	0	0	45.6	0
11:00	0	1	1	2	3	1	0	0	0	0	0	0	46.8	56.9
12:00	0	0	0	1	2	0	0	0	0	0	0	0	50.6	0
13:00	0	0	1	2	2	0	0	0	0	0	0	0	44.1	0
14:00	0	1	1	2	3	1	0	0	0	0	0	0	49.3	54.7
15:00	0	0	1	2	1	0	0	0	0	0	0	0	37.3	0
16:00	0	0	0	2	1	0	0	0	0	0	0	0	47.1	0
17:00	0	0	0	1	1	0	0	0	0	0	0	0	47.3	0
18:00	0	0	0	1	1	0	0	0	0	0	0	0	44.6	0
19:00	0	0	0	1	1	1	0	0	0	0	0	0	51.3	0
20:00	0	0	0	1	1	0	0	0	0	0	0	0	51.7	0
21:00	0	0	0	1	0	0	0	0	0	0	0	0	46.8	0
22:00	0	0	0	0	0	0	0	0	0	0	0	0		0
23:00	0	0	0	0	0	0	0	0	0	0	0	0		0
Total	1	4	8	26	28	6	0	0	0	0	0	0	47.6	55.8

2.8 Existing traffic generation

The existing site comprises two detached dwellings with up to 4 cars observed parked on the property. There is no nearby kerbside parking. By observation, the subject site currently generates up to 4 car trips in the peak hour.

Figure 7: Subject site existing vehicle traffic flows on typical weekday

Hour starting:	Vehicles in	Vehicles out	Total Vehicles
8.00 a.m.	1	3	4
17.00 p.m.	3	1	4

2.9 Bus and Taxi

There are bus stops on Castlereagh Road approximately 60m south of the subject site. The majority of the buses in the area operate along Castlereagh Road including service #678 Penrith to Richmond, approximately 30 minutes from Penrith Railway Station and 20 minutes from Richmond Railway Station.

Figure 8: Bus Services [5]

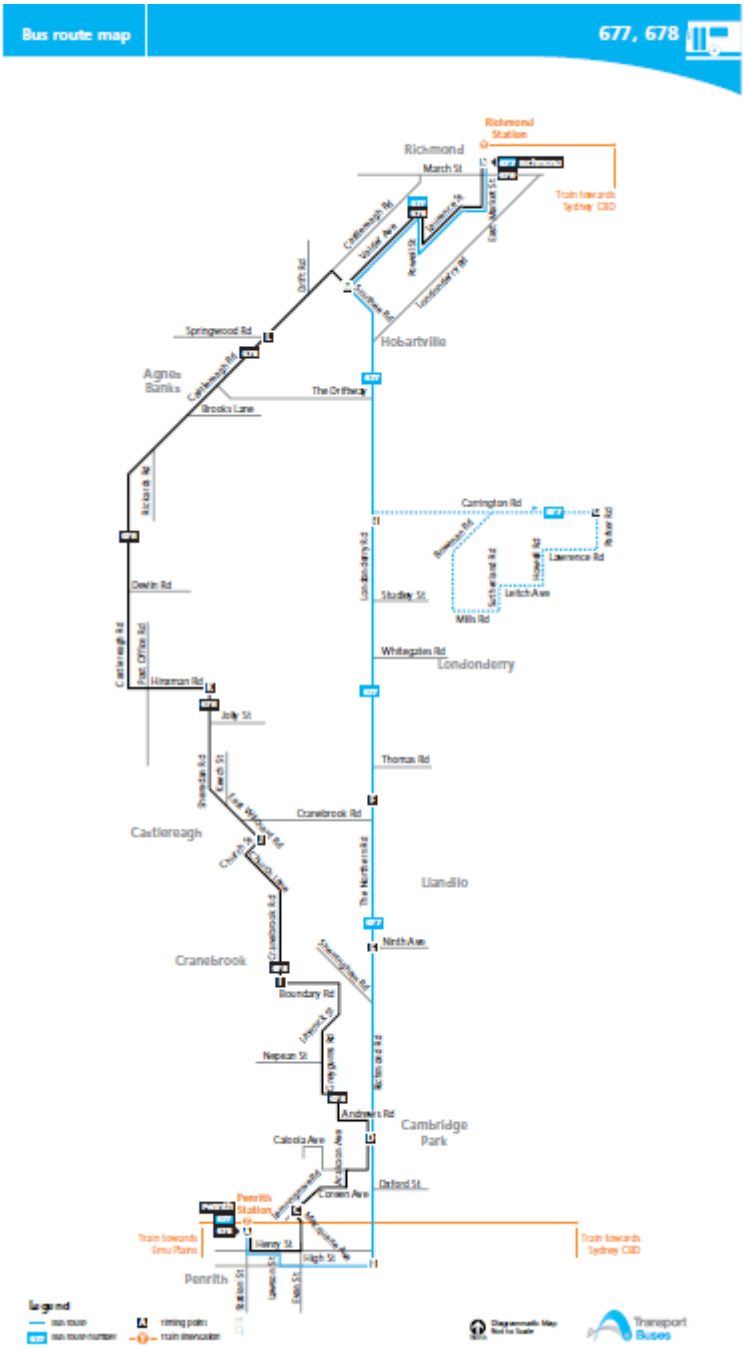
	Weekdays	Saturday
First Bus		
Penrith Interchange	06:40	08:19
Last Bus		
Penrith Interchange	17:25	15:49
Frequency		
peak	30-60 mins	2 trips
off peak	1 trip	

Weekday peak hour bus frequency is between 30 - 60 minutes depending on the direction of travel. Frequency is poor off-peak and during the weekends and public holidays. The Figure below illustrates the bus routes in the area.

Taxis are not widely available in the area.

[5] Extract from TfNSW bus website

Figure 9: Bus routes near the subject site



2.10 Train

Rail Stations are also shown in the above map. The site is outside walking distance and easy cycling distance of stations, but is within kiss-and–ride or park-and–ride distance of good frequent metropolitan train services at Penrith station and 10 minute /8km drive to Richmond station.

2.11 Pedestrians

Pedestrian path connections in the area are not provided. Walking is along the carriageway, the shoulder or verge.

2.12 Bicycles

Bicycles were not observed to be widely used to and within the relatively flat site and surrounds. The area and subject site are outside the catchment of the Penrith Bike Plan[6]. The Hawkesbury Mobility Plan [7] concentrates on the urban areas of Richmond and other centres. The local area is however reasonably flat and conducive to cycling for keen cyclists.

2.13 On-street car parking

There is no significant on-street parking observed along roads near the subject site.

2.14 Road Safety

RMS records[8] indicate that there is no unusual concentration of crashes around the subject site.

[6] Sub Regional Bike Planning Study – Penrith; GTA 2009
[7] GTA 2010
[8] Crashstats 2010 -2013

3 Proposed Development

3.1 The Development

The DA is seeking approval for a proposed cultural centre including:

- Excavation and site preparation works
- Addition to existing residential building
- Monument Landscape Feature and viewing platform
- At-grade on-site car parking accessed via a two-way level driveway off Kooringal Drive 150m west of Castlereagh Road, and at grade car parking for cars accessed via a two-way driveway off Kooringal Drive 60m west of Castlereagh Road. This is a total of 64 car spaces and 1 minibus space (including visitor spaces, two of which are accessible disabled parking spaces).
- Two upgraded paved driveways a minimum of 5.5m wide off Kooringal Drive to the parking areas
- No dedicated delivery truck and coach/bus parking is provided, but there is space for up to one 12.5m long standard Heavy Rigid Vehicle truck/bus to be provided within the car park at off-peak delivery times when the car park is underutilised.
- Additional parking exists for overflow parking on open space within the site. This overflow parking is not expected to be required to be used. No overflow parking will be required on-street.
- Footpaths and pedestrian accesses.
- Associated landscaping and open space.

The subject proposal is described in scheme drawings by Intercapital Consultants. The proposed driveways are designed to suit the road frontage, and is a beneficial reduction from the existing site driveway/crossovers on the busier and higher speed Castlereagh Road.

The driveways have less than 1 in 20 grades for at least the first 6m before the property line, have adequate queueing within the site, and are wide enough to provide adequate sight distance triangles from the driver's eye to vehicles and to pedestrians on the footpath.

Service vehicle access would be via the car parks mainly for utilities and small vans is envisaged to be relatively minor and associated with repairs and cleaning. and an occasional truck or bus up to a heavy goods vehicle.

Pedestrian and bike access to the building is via the perimeter public road and crossings to the parking areas.

3.2 Hours of operation

The car parks will be open at all times but will mostly be used in daylight hours.

3.3 Design vehicles

The design vehicle for the car park is the Australian Standards AS2890.1 Off Street Car Parking B99 vehicle (99th percentile vehicle represented by a very large car or Ford Transit Van medium wheelbase van) to public parking. The design vehicle to service waste is likely to be the AS2890.2 Medium Rigid Vehicle (MRV garbage truck 8.8 m long) and occasional HRV Truck/Bus (12.5m long). The driveways and parking areas will accommodate these vehicles and turning paths.

3.4 Analysis of projected queuing at entrances

Sufficient parking and traffic management elements are provided on site to avoid queuing at the entrance. There will not be key card/intercom access control and will be no expected delay to vehicles including bicycles entering the site.

All parking spaces and circulation aisles generally comply with AS 2890.1 – 2004 off street car parking, bike parking, and other standards.

3.5 Other local development

Cumulative traffic impact assessment addressed in Section 4 considered some 5 percent traffic growth from nearby future development, such as site redevelopments and the Penrith Lakes proposals. No major redevelopment that will significantly affect local traffic in the short term has been identified.

3.6 Current and proposed road works and transport management works

Discussions with Council and RMS officers did not indicate any major proposed immediate transport network works. In the longer-term transport in the area will be influenced by the development over wider areas.

4 Assessment of Proposed Development

4.1 Managing Transport Demand

The DCP emphasises managing the transport demand that is generated by a development to encourage more sustainable transport options. 'Managing Transport Demand' refers to the measures taken which minimise the need to travel and the length of trips, particularly by cars, and also encourages travel by more sustainable modes of transport (DIPNR, Integrating Land Use and Transport, 2001).

4.2 Traffic generation during design periods

Based on discussions and data[9] provided by the proponent, the following representative scenarios were developed as a basis for traffic analysis:

Non-event Day: Administrative duties staff will be attending the site during the week, and their work hours: Mon-Fri - 5 people (max.) Sat/Sun -7 people (max.); timings – any time during the day. Community site uses attend the site: Mon-Fri - 15 persons between 5pm-7 pm. Sat-Sun - 50 to100 people between noon-7 pm.

Event Day: is represented by a regular fortnightly event - 200 persons attending fortnightly, approximately 25 times per year, with peak arrivals and departures outside the am and pm on-road peak hours.

There are no traffic generation data on these types of events in the Sydney area. The following traffic generation rates are therefore estimated from first principles and in discussion with the proposed operators of the development. They are based on conservative (worst case) estimates as follows:

- a car occupancy of 1.0 staff member per car
- 3.0 people per car for events[10], based on Henson Consulting experience of sporting events, and the likely attendance of families with children in their car.
- 100% of staff arrive in morning peak hour and depart in the evening peak hour
- 100% of event attendees arrive in one hour before the event and depart in one hour after the event.

Note these vehicle occupancy data allow for some mini-buses/passenger vehicles and the occasional bus in the overall mix of traffic attending special events. Two representative scenarios have been analysed as follows:

- the busiest **Non-event Day**, effectively the busiest non-event day on a Friday, when background weekday traffic is higher than weekend background traffic; and

[9] Emails from Mr. Rick Shah of 30 January 2017 and 30 March 2017, and 27 October 2017

[10] RMS Guide to Traffic Generating Developments specify 2.3 persons per car for markets and 2.2 persons per car for restaurants.

- **Event Day** when the Event Day traffic is overlaid on a Friday when background weekday traffic is higher than weekend background traffic.

(Note that event traffic generally arrives and departs outside the on-street peak hours but have been very conservatively (worst case) assumed to coincide with the on-street peak hours and factored by a multiple of 2.5 safety factor to allow for short-term 5-minute peaks within the peak hour for Sidra analysis purposes.)

Figure 10: Subject site traffic generation (peak hour)

		Staff				Other attendees				Total
		persons	car occup	prop peak	cars/h	persons	car opp	prop peak	cars/h	veh/h
Non-event day										
arrival peak	in	5	1	1	5	15	3	1	5	10
	out	0	1	1	0	0	3	1	0	0
departure peak	in	0	1	1	0	0	3	1	0	0
	out	5	1	1	5	15	3	1	5	10
Event day										
arrival peak	in	7	1	1	7	200	3	1	67	74
	out	0	1	1	0	0	3	1	0	0
departure peak	in	0	1	1	0	0	3	1	0	0
	out	7	1	1	7	200	3	1	67	74
Event day with 2.5 safety factor to allow for short term 5-minute peaks within the peak hour										
arrival peak	in	7	1	1	7	200			167	174
	out	0	1	1	0	0			0	0
departure peak	in	0	1	1	0	0			0	0
	out	7	1	1	7	200			167	174

4.3 Pedestrian generation and movements

Pedestrian generation from the development will be able to circulate within the extensive pathways that exist within the site.

4.4 Traffic Distribution and Assignment

The distribution of traffic as shown in the Appendix to and from the site to surrounding areas of Sydney was estimated from a range of sources. The study was on the basis of 25% of traffic distributed to each of the north, south, east and west based on Journey to Work Census data and data from the NSWTI Transport Data Centre. That equates to a 50% split each way along Castlereagh Road.

4.5 Background Traffic Growth

Traffic in Sydney has been growing in recent years at less than 2% per year, and passengers through Sydney Airport[11] at 2.9% per year and 4.2% to 2029. The surface transport task in Sydney is projected to grow passenger kilometres at a compound annual growth rate of 0.9 per cent per year from 2010 to 2056. Combined with local site developments outlined above, a background growth factor of 5% was added to all existing background traffic flows as a basis for analysing the future traffic flows with the subject development.

[11] Sydney Airport Master Plan, SACL

4.6 Impact of Generated Traffic

The vehicular trips generated by the development during the on-street peak hours will distribute across the access network. The peak hour levels of traffic generated, and the inter-peak arrival and departure of vehicles to the site will be well provided for by the grid network and its connections to the main road access system, supplemented by walking, cycling and public transport facilities.

Intersections were analysed by the Sidra intersection modelling program. The results of the intersection modelling for vehicles and pedestrians are tabulated below. Summary SIDRA outputs and Explanatory Notes are attached in the Appendices.

The very small deterioration of intersection performance was mostly related to the assumed growth in background traffic, not related to the subject development - the additional traffic from the subject development had a negligible effect. Intersections are calculated to operate at acceptable levels of service in future with background growth and the proposed development. Pedestrian levels of service will not be changed.

Thus, the road network and pedestrian network is capable of accommodating the proposed development and cumulative traffic impacts are acceptable.

Figure 11: Summary of Intersection Analysis – Vehicles

Intersection	Peak hour	Level of Service Existing	Level of Service with subject development on Non -event Day	Level of Service with subject development on Event Day
Castlereagh Road/Kooringal Drive[12]	a.m.	A	A	A
	p.m.	A	A	A
Site Driveway/Kooringal Drive[13]	a.m.	A	A	A
	p.m.	A	A	A

[12] Sidra Analysis - see Appendix for summary files

[13] By inspection

4.7 Intersection Control

The warrants for upgrading the intersection of Castlereagh Road and Kooringal Drive were considered.

Physical road improvements should be built to accommodate traffic during the 30th busiest hour of a facility. This 30th hour typically occurs during the weekday evening peak hour. Since the site would mostly be used in Non-event Day mode most days, event traffic would not extend to the 30th busiest hour. This means temporary traffic control measures would be sufficient and should be used to manage traffic at the site's access if required, not physical and permanent measures such as traffic signals or turn lanes.

A decision as to whether a STOP sign or a GIVE WAY sign is required is based on sight distance requirements for drivers on the minor road approach as shown in Austroads Figure 3.2, reproduced from AS1742.2:

STOP signs should normally be installed only where justified on the basis of sight distance requirements, otherwise the signs will lose 'credibility' and their effectiveness in general will be compromised.

Austroads Figure 3.2 shows sight distance restrictions requiring the use of Stop signs. For a major road speed of 80km/h, a clear sight distance with no permanent sight obstruction requires a distance along the major road of 65m from a viewpoint 3m back from the edge of the through lane. This is satisfied on the subject site, and therefore a STOP sign is not warranted.

Austroads Road Design Guide Part 4a[14] with a design speed less than 100km/h in areas including urban fringe and slower rural roads is shown in Figure 4.9(b) for a major road volume of 600 v/h in peak and a right or left turn volume less than 5 v/h shows that a basic urban right (BAR) or left turn (BAL) arrangement is acceptable. No auxiliary lanes or channelization is needed.

AUL and CHL auxiliary lane treatments may cause dangerous misunderstandings between the nearby staggered junctions with Rickards Road and bus stops: drivers using auxiliary lanes to pass at speed turning vehicle drivers may be confused with drivers slowing to turn left at the next T junction or stop. It is considered safer to leave the junction as existing.

4.8 Parking policy

The car parking rates are not specified for a festival use. The Penrith DCP for places of worship requires one car parking space per 4 seats. On that basis, an Event Day attendance of 200 people requires 50 car spaces. This is considered adequate.

[14] ARDG 4A 2010.

Figure 12: Parking Space Demand and Provision and compliance

Activity on site	People Attending	Car Parking required	Car parking provided on-site[15]	Overflow car parking
Non-event Day	30	30	64	0
Event Day	200	50	64	0
Complies?			Yes	Yes

4.9 Effects on Public Transport, walking and cycling

The subject site and locality is served by public transport via bus services that stop near the site, within an easy walk to the site. The proposal will have no adverse impact on existing railway stations, bus stops and operation of buses in the area, and will act to potentially increase public transport patronage.

The subject site and locality is accessible by foot walking along roadsides if required.

Bike parking[16] will be available at the subject site. Streets in the adjacent street network are suited to cycling, although some cyclists may be deterred from using some roads that carry higher traffic volumes.

4.10 Safety

The design provides adequate sight distances and circulation for the safe access and movement of residents and visitors, and passing pedestrians, cyclists, and vehicular traffic.

[15] Including accessible/disabled parking spaces

[16] Penrith DCP bike parking rates refer to the NSW Guidelines for Walking and Cycling 2004: Table 1 for Place of assembly or worship requires long term parking for 3%-5% of staff and short-term parking for 5%-10% of staff. With 5 staff, this requires less than one bike parking space.

5 Conclusions

The key conclusions of this Transport Impact Study are:

- A range of events and transport scenarios were considered. The busiest day during a typical Non-event Day and typical Event Day were analysed. Since the site only hosts a limited number of events per year, and most event traffic is outside the on-road peak hours, event traffic would not extend to the 30th busiest hour. No physical and permanent measures or upgrades such as such as traffic signals or turn lanes are required.
- Event operations could, if required, be monitored and video recorded during events to evaluate the need for further control. If considered necessary, traffic control services could be provided by the venue to erect temporary advance warning signs, manage parking and monitor traffic during events.
- The site is suited to the proposed use from a transport perspective.
- Parking provision and layout, circulation and access are generally designed in accordance with the relevant Australian Standards and traffic engineering principles.
- Traffic generated by the proposed development can be accommodated at acceptable levels of service without adversely affecting traffic, pedestrian, bicycle or bus network efficiency on the existing road and path network.
- Access points for pedestrians, cyclists, and vehicles are suitable and concentrated on the Kooringal Drive local side road in accordance with road hierarchy considerations. The proposed operation can be appropriately managed and have no significant impact on amenity.
- There will be no adverse effects on the safety of any road users including public transport, pedestrians and cyclists.

The proposed development is in accordance with Penrith DCP, including:

i) Provide safe entry and exit for vehicles and pedestrians which reflect the proposed land use, and the operating speed and character of the road;

ii) Minimise the potential for vehicular/pedestrian conflicts, providing protection for pedestrians where necessary;

iii) Not restrict traffic flow or create a hazard to traffic on roads in the vicinity of the development;

iv) Provide suitable off-street parking facilities to accommodate vehicles generated by the development; and

v) Not require any additional on-street traffic facilities or road works to maintain the safe and efficient movement of vehicles and pedestrians.

a) New access points off arterial, sub arterial or other major roads is avoided.

b) Vehicle access for developments is from service roads/lanes.

c) The design of direct vehicular access to developments has considered the traffic impacts on the surrounding road network. This does not require the provision of deceleration, acceleration, right turn lanes and road widening.

d) Provision is made for all vehicles to enter and leave properties in a forward direction.

e) The layout and design of parking areas minimises vehicle to pedestrian impacts, including where heavy vehicle access is proposed.

6 Appendix: Traffic Analysis

6.1 Turning Movements

Intersection name	Existing a.m.					Base					Generated by Development					Future = Base + Gen by Development				
Non-event day						5 % total growth over existing					25% each of NSEW									
Kooringal/Castlereagh Road			1	216	0			0	1	227	0	0			5			0	6	227	0	0
		5				0		5	0	0	0	0						5	0	0	0	0
		0				0		0	0	0	0	0						0	0	0	0	0
		6				0		6	0	0	0	0						6	0	0	0	0
			2	367	0			0	2	385	0	0			5			0	7	385	0	0
Kooringal /Subject site Driveway			0	0	3			0	0	0	3	0						0	0	0	3	0
	0					1		0	0	0	0	1					10	0	0	0	0	11
	8					2		8	0	0	0	2						8	0	0	0	2
	0					0		0	0	0	0	0						0	0	0	0	0
			0	0	0			0	0	0	0	0						0	0	0	0	0
Event day x 2.5 factor																						
Kooringal/Castlereagh Road			1	216	0			0	1	227	0	0			87			0	88	227	0	0
		5				0		5	0	0	0	0						5	0	0	0	0
		0				0		0	0	0	0	0						0	0	0	0	0
		6				0		6	0	0	0	0						6	0	0	0	0
			2	367	0			0	2	385	0	0			87			0	89	385	0	0
Kooringal /Subject site Driveway			0	0	3			0	0	0	3	0						0	0	0	3	0
	0					1		0	0	0	0	1					174	0	0	0	0	175
	8					2		8	0	0	0	2						8	0	0	0	2
	0					0		0	0	0	0	0						0	0	0	0	0
			0	0	0			0	0	0	0	0						0	0	0	0	0
Key to turns (north approach to top of page)		Right		Through	Left																	
	Left					Right																
	Through					Through																
	Right					Left																
		Left		Through	Right																	

Intersection name	Existing p.m.					Base					Generated by Development					Future = Base + Gen by Development				
Non-event day						5 % total growth over existing					25% each of NSEW									
Kooringal/Castlereagh Road			5	428	0			0	5	449	0	0						0	5	449	0	0
		2				0		2	0	0	0	0			5			7	0	0	0	0
		0				0		0	0	0	0	0						0	0	0	0	0
		2				0		2	0	0	0	0			5			7	0	0	0	0
			5	242	0			0	5	254	0	0						0	5	254	0	0
Kooringal /Subject site Driveway			0	0	1			0	0	0	1	0					10	0	0	0	11	0
	0					3		0	0	0	0	3						0	0	0	0	3
	3					7		3	0	0	0	7						3	0	0	0	7
	0					0		0	0	0	0	0						0	0	0	0	0
			0	0	0			0	0	0	0	0						0	0	0	0	0
Event Day x 2.5 factor																						
Kooringal/Castlereagh Road			5	428	0			0	5	449	0	0						0	5	449	0	0
		2				0		2	0	0	0	0			87			89	0	0	0	0
		0				0		0	0	0	0	0						0	0	0	0	0
		2				0		2	0	0	0	0			87			89	0	0	0	0
			5	242	0			0	5	254	0	0						0	5	254	0	0
Kooringal /Subject site Driveway			0	0	1			0	0	0	1	0					174	0	0	0	175	0
	0					3		0	0	0	0	3						0	0	0	0	3
	3					7		3	0	0	0	7						3	0	0	0	7
	0					0		0	0	0	0	0						0	0	0	0	0
			0	0	0			0	0	0	0	0						0	0	0	0	0
Key to turns (north approach to top of page)		Right		Through	Left																	
	Left					Right																
	Through					Through																
	Right					Left																
		Left		Through	Right																	

6.2 SIDRA Analysis

LANE LEVEL OF SERVICE

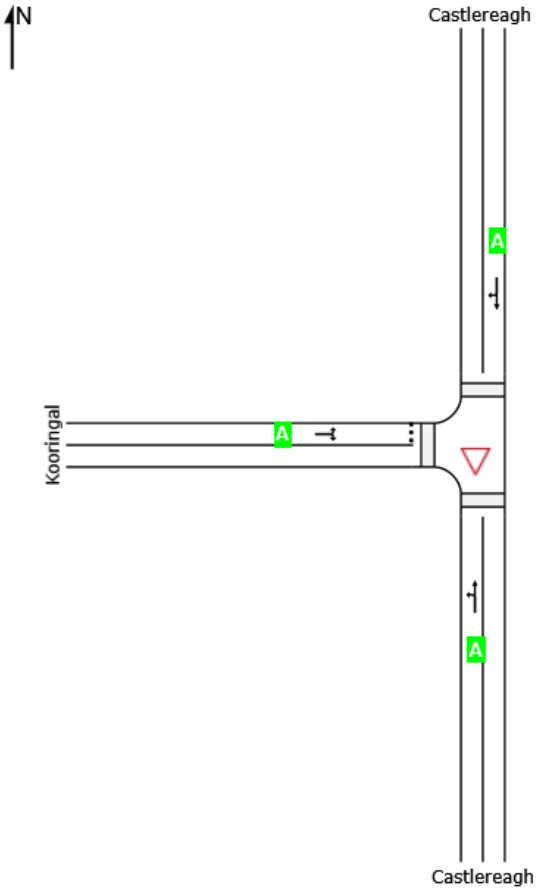
Lane Level of Service

Site: 101 [Castlereagh Road /Kooringal Drive a.m. Existing]

Existing
Giveway / Yield (Two-Way)

All Movement Classes

	South	North	West	Intersection
LOS	NA	NA	A	NA



Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Lane LOS values are based on average delay per lane.
Minor Road Approach LOS values are based on average delay for all lanes.
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 lanes.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

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Project: E:\HC\Projects\2017154 Castlereagh Road\SIDRA\Castlereagh-Kooringal Nov 2017.sip7

MOVEMENT SUMMARY

Site: 101 [Castlereagh Road /Kooringal Drive a.m. Existing]

Existing
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Castlereagh											
1	L2	2	5.0	0.207	9.5	LOS A	0.0	0.2	0.01	0.00	72.3
2	T1	386	5.0	0.207	0.0	LOS A	0.0	0.2	0.01	0.00	79.9
Approach		388	5.0	0.207	0.1	NA	0.0	0.2	0.01	0.00	79.8
North: Castlereagh											
8	T1	227	5.0	0.121	0.0	LOS A	0.0	0.1	0.01	0.00	79.9
9	R2	1	5.0	0.121	8.4	LOS A	0.0	0.1	0.01	0.00	71.7
Approach		228	5.0	0.121	0.1	NA	0.0	0.1	0.01	0.00	79.9
West: Kooringal											
10	L2	5	5.0	0.014	7.0	LOS A	0.0	0.3	0.45	0.65	51.7
12	R2	6	5.0	0.014	8.5	LOS A	0.0	0.3	0.45	0.65	51.2
Approach		12	5.0	0.014	7.8	LOS A	0.0	0.3	0.45	0.65	51.4
All Vehicles		628	5.0	0.207	0.2	NA	0.0	0.3	0.02	0.02	79.0

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

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

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

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

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

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

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

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LANE LEVEL OF SERVICE

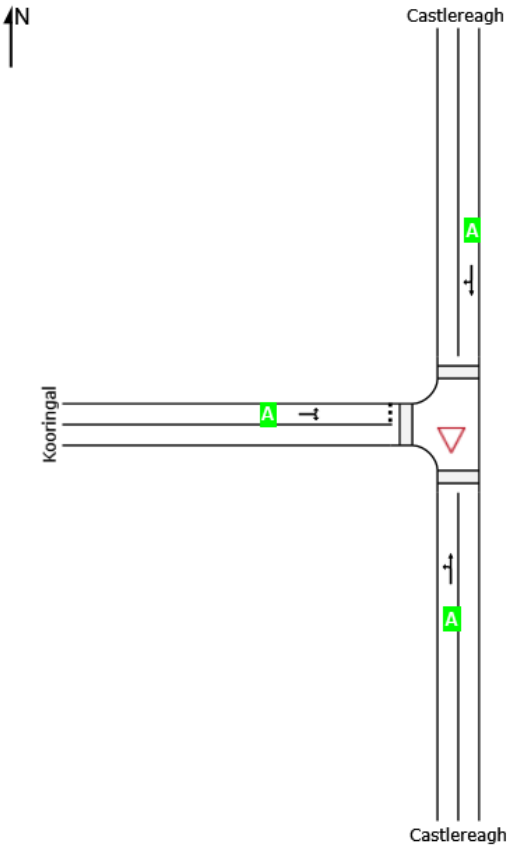
Lane Level of Service

Site: 101 [Castlereagh Road /Kooringal Drive a.m. Non Event day]

Existing plus non event traffic
Giveway / Yield (Two-Way)

All Movement Classes

	South	North	West	Intersection
LOS	NA	NA	A	NA



Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Lane LOS values are based on average delay per lane.
Minor Road Approach LOS values are based on average delay for all lanes.
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 lanes.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

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MOVEMENT SUMMARY

Site: 101 [Castlereagh Road /Kooringal Drive a.m. Non Event day]

Existing plus non event traffic
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	OD Mov	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: Castlereagh											
1	L2	7	5.0	0.223	9.8	LOS A	0.1	0.8	0.03	0.01	72.1
2	T1	405	5.0	0.223	0.1	LOS A	0.1	0.8	0.03	0.01	79.5
Approach		413	5.0	0.223	0.3	NA	0.1	0.8	0.03	0.01	79.4
North: Castlereagh											
8	T1	239	5.0	0.132	0.1	LOS A	0.1	0.5	0.03	0.02	79.4
9	R2	6	5.0	0.132	8.6	LOS A	0.1	0.5	0.03	0.02	71.3
Approach		245	5.0	0.132	0.3	NA	0.1	0.5	0.03	0.02	79.2
West: Kooringal											
10	L2	5	5.0	0.015	7.1	LOS A	0.0	0.4	0.46	0.66	51.6
12	R2	6	5.0	0.015	8.8	LOS A	0.0	0.4	0.46	0.66	51.1
Approach		12	5.0	0.015	8.0	LOS A	0.0	0.4	0.46	0.66	51.3
All Vehicles		669	5.0	0.223	0.4	NA	0.1	0.8	0.04	0.02	78.6

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

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LANE LEVEL OF SERVICE

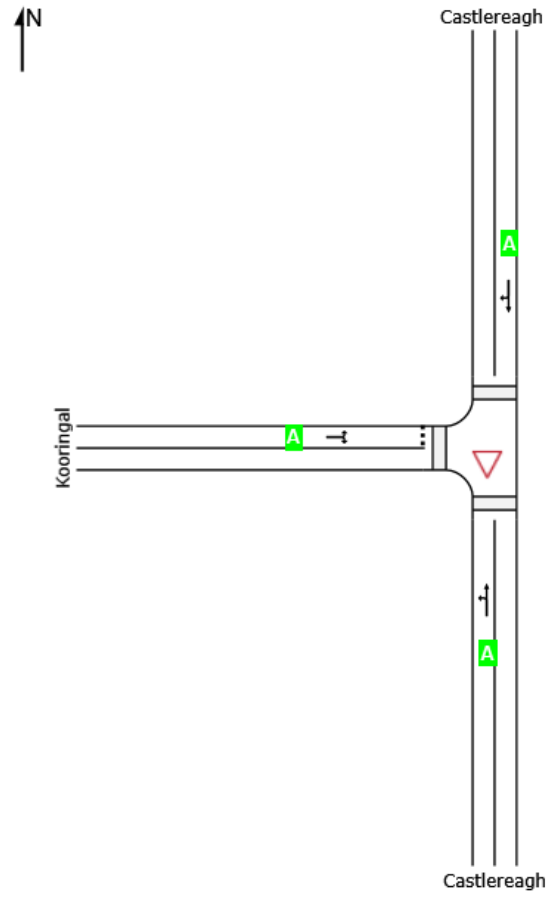
Lane Level of Service

Site: 101 [Castlereagh Road /Kooringal Drive a.m. Event Day factored by 2.5]

Existing plus Event Day factored by 2.5
Giveway / Yield (Two-Way)

All Movement Classes

	South	North	West	Intersection
LOS	NA	NA	A	NA



Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Lane LOS values are based on average delay per lane.
Minor Road Approach LOS values are based on average delay for all lanes.
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 lanes.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

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MOVEMENT SUMMARY

Site: 101 [Castlereagh Road /Kooringal Drive a.m. Event Day factored by 2.5]

Existing plus Event Day factored by 2.5
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Castlereagh											
1	L2	94	5.0	0.322	10.1	LOS A	1.4	10.2	0.27	0.14	68.7
2	T1	405	5.0	0.322	1.1	LOS A	1.4	10.2	0.27	0.14	75.4
Approach		499	5.0	0.322	2.8	NA	1.4	10.2	0.27	0.14	74.0
North: Castlereagh											
8	T1	239	5.0	0.219	1.3	LOS A	1.0	7.1	0.37	0.21	74.1
9	R2	93	5.0	0.219	9.4	LOS A	1.0	7.1	0.37	0.21	67.0
Approach		332	5.0	0.219	3.6	NA	1.0	7.1	0.37	0.21	71.9
West: Kooringal											
10	L2	5	5.0	0.017	7.1	LOS A	0.1	0.4	0.49	0.68	51.1
12	R2	6	5.0	0.017	9.9	LOS A	0.1	0.4	0.49	0.68	50.6
Approach		12	5.0	0.017	8.6	LOS A	0.1	0.4	0.49	0.68	50.8
All Vehicles		842	5.0	0.322	3.2	NA	1.4	10.2	0.31	0.17	72.7

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

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

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

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

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

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

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

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LANE LEVEL OF SERVICE

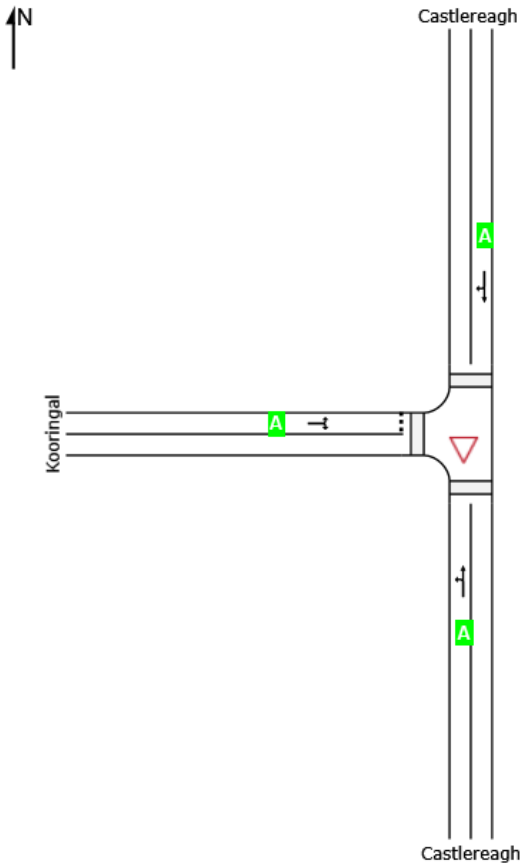
Lane Level of Service

Site: 101 [Castlereagh Road /Kooringal Drive p.m. Existing]

Existing
Giveway / Yield (Two-Way)

All Movement Classes

	South	North	West	Intersection
LOS	NA	NA	A	NA



Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Lane LOS values are based on average delay per lane.
Minor Road Approach LOS values are based on average delay for all lanes.
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 lanes.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

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MOVEMENT SUMMARY

Site: 101 [Castlereagh Road /Kooringal Drive p.m. Existing]

Existing
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Castlereagh											
1	L2	5	5.0	0.140	8.4	LOS A	0.1	0.4	0.02	0.01	72.1
2	T1	255	5.0	0.140	0.0	LOS A	0.1	0.4	0.02	0.01	79.6
Approach		260	5.0	0.140	0.2	NA	0.1	0.4	0.02	0.01	79.4
North: Castlereagh											
8	T1	451	5.0	0.243	0.0	LOS A	0.1	0.4	0.01	0.01	79.8
9	R2	5	5.0	0.243	7.9	LOS A	0.1	0.4	0.01	0.01	71.6
Approach		456	5.0	0.243	0.1	NA	0.1	0.4	0.01	0.01	79.7
West: Kooringal											
10	L2	2	5.0	0.005	6.4	LOS A	0.0	0.1	0.40	0.60	51.7
12	R2	2	5.0	0.005	9.2	LOS A	0.0	0.1	0.40	0.60	51.2
Approach		4	5.0	0.005	7.8	LOS A	0.0	0.1	0.40	0.60	51.5
All Vehicles		720	5.0	0.243	0.2	NA	0.1	0.4	0.02	0.01	79.3

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

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LANE LEVEL OF SERVICE

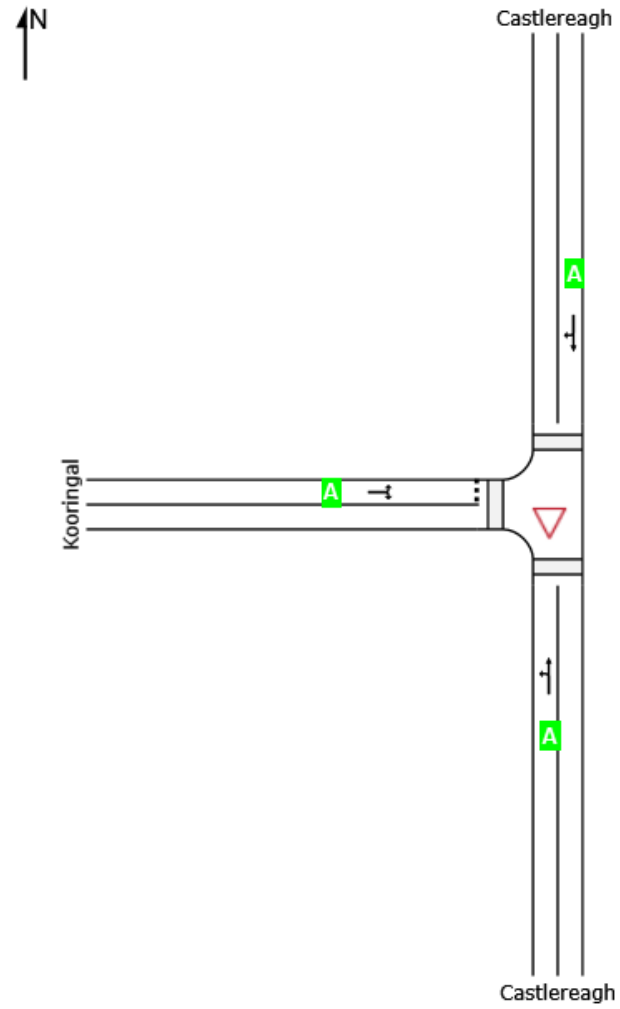
Lane Level of Service

Site: 101 [Castlereagh Road /Kooringal Drive p.m. Non Event]

Existing plus non-event traffic
Giveway / Yield (Two-Way)

All Movement Classes

	South	North	West	Intersection
LOS	NA	NA	A	NA



Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
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Minor Road Approach LOS values are based on average delay for all lanes.
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SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

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MOVEMENT SUMMARY

Site: 101 [Castlereagh Road /Kooringal Drive p.m. Non Event]

Existing plus non-event traffic
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Castlereagh											
1	L2	5	5.0	0.147	8.5	LOS A	0.1	0.4	0.02	0.01	72.1
2	T1	267	5.0	0.147	0.0	LOS A	0.1	0.4	0.02	0.01	79.6
Approach		273	5.0	0.147	0.2	NA	0.1	0.4	0.02	0.01	79.4
North: Castlereagh											
8	T1	473	5.0	0.254	0.0	LOS A	0.1	0.4	0.01	0.01	79.8
9	R2	5	5.0	0.254	8.0	LOS A	0.1	0.4	0.01	0.01	71.6
Approach		478	5.0	0.254	0.1	NA	0.1	0.4	0.01	0.01	79.7
West: Kooringal											
10	L2	7	5.0	0.019	6.5	LOS A	0.1	0.5	0.41	0.64	51.5
12	R2	7	5.0	0.019	9.7	LOS A	0.1	0.5	0.41	0.64	51.0
Approach		15	5.0	0.019	8.1	LOS A	0.1	0.5	0.41	0.64	51.3
All Vehicles		765	5.0	0.254	0.3	NA	0.1	0.5	0.02	0.02	78.7

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

Organisation: HENSON CONSULTING | Processed: Wednesday, 1 November 2017 10:50:16 AM
Project: E:\HC\Projects\2017154 Castlereagh Road\SIDRA\Castlereagh-Kooringal Nov 2017.sip7

LANE LEVEL OF SERVICE

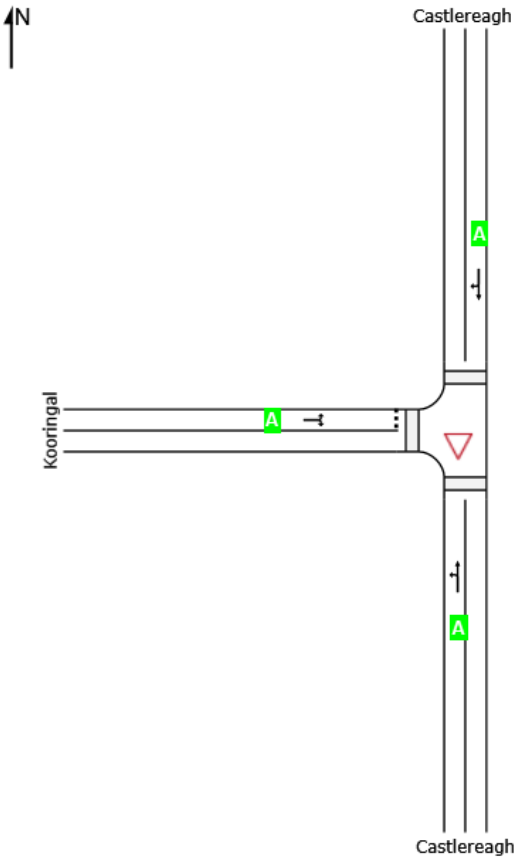
Lane Level of Service

Site: 101 [Castlereagh Road /Kooringal Drive p.m. Event Day factored by 2.5]

Existing plus Event Day factored by 2.5
Giveway / Yield (Two-Way)

All Movement Classes

	South	North	West	Intersection
LOS	NA	NA	A	NA



Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Lane LOS values are based on average delay per lane.
Minor Road Approach LOS values are based on average delay for all lanes.
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MOVEMENT SUMMARY

Site: 101 [Castlereagh Road /Kooringal Drive p.m. Event Day factored by 2.5]

Existing plus Event Day factored by 2.5
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Castlereagh											
1	L2	5	5.0	0.147	8.5	LOS A	0.1	0.4	0.02	0.01	72.1
2	T1	267	5.0	0.147	0.0	LOS A	0.1	0.4	0.02	0.01	79.6
Approach		273	5.0	0.147	0.2	NA	0.1	0.4	0.02	0.01	79.4
North: Castlereagh											
8	T1	473	5.0	0.254	0.0	LOS A	0.1	0.4	0.01	0.01	79.8
9	R2	5	5.0	0.254	8.0	LOS A	0.1	0.4	0.01	0.01	71.6
Approach		478	5.0	0.254	0.1	NA	0.1	0.4	0.01	0.01	79.7
West: Kooringal											
10	L2	94	5.0	0.244	6.7	LOS A	0.9	6.6	0.46	0.71	51.1
12	R2	94	5.0	0.244	10.6	LOS A	0.9	6.6	0.46	0.71	50.6
Approach		187	5.0	0.244	8.7	LOS A	0.9	6.6	0.46	0.71	50.9
All Vehicles		938	5.0	0.254	1.8	NA	0.9	6.6	0.10	0.15	71.5

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

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7 Appendix: Explanatory notes

Description and Classification Methods

Glossary and descriptions are generally in accordance with the recommendations of Australian Standards AS 1348-1986.

Term	Definition
access control control of access	1. Preventing vehicles and people crossing property lines by means of barriers or regulations. 2. Arranging matters so that vehicles and people have access at predetermined locations.
amenity	That element in the layout and operation of town and country which makes for a comfortable and pleasant life rather than a mere existence. It relates also to the preservation of such characteristics of a neighbourhood as make it pleasing in appearance to both the passer-by as well as to the resident and those across the road.
assignment traffic assignment	Process of allocating trips onto existing or planned routes available on the road or public transport network. Assignment may be based on one or more factors known to influence route selection, e.g. Travel time, distance, cost.
at-grade crossing level crossing	Crossing at the same level, such as a railway crossing which is at the same level as a road, or a normal road intersection.
base case	System that would exist without the introduction of the changes proposed in the project being analysed.
calibration	Process of determining the parameters of the mathematical travel models so that these models simulate observed travel patterns as accurately as possible.
capacity	Maximum flow of trains, vehicles, passengers or goods that can be accommodated in a transport system in a specified period.
road capacity	Maximum number of vehicles or pedestrians that can pass over a given section of a lane, road or footpath in one direction (or in both directions for a two-lane or three-lane road) during a given time period under prevailing road and traffic conditions. It is the maximum rate of flow that has a reasonable expectation of occurring. In the absence of a time modifier, capacity is an hourly volume. The capacity would not normally be exceeded without changing one or more of the conditions that prevail. In expressing capacity, it is essential to state the prevailing road and traffic conditions under which the capacity is applicable.
census collector's district (abbreviation **CCD**)	Unit of area for which each census collector is responsible for collecting information. CCDs are the smallest individual areas for which basic land use and population data are available in Australia.
central business district (abbreviation **CBD**)	Dominant area of business and commercial activity within a given area. CBDs are characterised by high density office and retail development, large numbers of pedestrians and vehicles, and a heavy demand for parking. Also known as central activities district (CAD).
centroid	Assumed point in a traffic zone that represents the origin or destination of all trips to or from the zone. Generally, the weighted centre of trip ends rather than a geometric centre of the zonal area.
commercial vehicle	Road vehicle constructed specifically to convey goods, passengers or burden in the course of trade or business.
cordon	Imaginary line drawn around a given study area at which traffic counts and interviews may be taken.
desire line	Straight line joining two centroids and showing the desired direction of travel.
distribution	Process by which the number of trips between zones is estimated. The distribution may be measured or be estimated by a growth factor process or by a synthetic model such as a gravity model.
85th Percentile	Value of variable characteristic of individuals in a population, possessed by at or below 85 per cent of that population.
elasticity	Ratio of the change in demand for a commodity to the change in price of that commodity. In transport, a high ratio is termed elastic while a low ratio is termed inelastic.
grade separation	The separation of road, rail or other traffic so that crossing movements which would otherwise conflict are effected at different elevations.
journey	Movement involving one or more trips, e.g.: (a) a 'journey-to-work', which could involve a direct trip to work or an intermediate stop for some other but secondary purpose; (b) an 'origin-to-origin' journey, which could involve several trips, each for a particular purpose. Home-to-home journeys have also been termed 'tours'.
model	Mathematical description of a situation which uses data on past and present conditions to make predictions about the effects of changes.
passenger car unit equivalent car unit	Measure involving the conversion of different types of vehicles into their equivalent passenger cars in terms of operating characteristics.
public transport	Service by bus, rail, taxi or other means which provides transport to the public on a regular basis for payment of a prescribed fare.

Term	Definition
road hierarchy	Grading of roads according to increasing or decreasing importance of their traffic carrying or other function.
screenline	Imaginary line which splits a study area into two parts. Usually located along railway lines or rivers to minimise the number of crossing points.
sight distance	The distance measured along the carriageway over which objects of defined height are visible to a driver.
traffic	movement between locations of persons, goods and information by means of mechanical, electrical or personal methods.
base traffic	That traffic already present on a facility, or that traffic unlikely to be affected by design changes.
by-passable traffic	That traffic which can be diverted from a particular road or area because drivers do not wish to stop on that road or in that area.
local by-passable traffic	Term normally used to refer to short distance traffic that can be diverted, usually at the expense of increased distance, not increased time.
through by-passable traffic	Term normally used to refer to longer distance traffic that can be diverted without significant time or distance penalties.
converted traffic	Component of traffic which has changed its mode of travel, e.g. from train to car.
diverted traffic	Component of traffic which has changed its route but not its origin, destination, or mode of travel.
generated traffic	1. Traffic created by a new or improved facility as distinct from traffic which is diverted to a facility and normal traffic increase. 2. Traffic created by changes in land use.
induced traffic	Additional traffic resulting from some improvement in a road or in traffic arrangements.
potential traffic	Total volume which would move between two terminals assuming ideal travelling conditions.
shifted traffic	Component of traffic whose desire lines have been shifted because of change of origin or destination.
suppressed traffic	Reduction in traffic volume resulting from a change in traffic arrangements.
trip	1. One-way movement from one place to another for a particular purpose (*see also* **journey**). Note: Care is required in applying this general definition. In particular, the definition of 'purpose' will affect the way in which person, vehicle or commodity movements are classified into trips. In travel surveys, the 'purpose' set often includes 'change mode' and 'serve passenger', thus making a trip correspond to a movement by only one mode. Movements for these purposes have been varyingly called 'legs', 'segments', or 'unlinked trips', in transport planning practice. For analyses, trips are often 'linked', thus making a trip embrace more than one mode and/or lower order purpose. 2. In public vehicle operations: the movement by one vehicle or unit in one direction from the start of a route to the end of it.
external trip	Trip which starts or ends outside the study area.
through trip	Trip which starts and ends outside the study area, but which passes through the study area.
internal trip`	Trip which starts and ends in the study area.
linked trip	One-way movement from one place to another for a specific purpose, involving more than one mode of travel.
trip distribution	1. The geographical distribution of trips. 2. Process by which the total number of trips is converted to individual zone-to-zone movements.
vehicle hours of travel (abbreviation **VHT**)	Total vehicle hours of travel over a road segment or number of road segments for a certain period, usually a specified year.
vehicle kilometres of travel (abbreviation **VKT**)	Total vehicle kilometres of travel over a road segment or number of road segments for a certain period, usually a specified year.
volume	Number of persons, vehicles or pedestrians passing a given point in a specified period of time.

Field surveys have been used to assess conditions. Unless specifically stated otherwise, these assessments have been transferred directly to the record sheets and not modified. Field descriptions may therefore be used as an independent estimate of conditions which can be correlated with other data.

AUSTROADS Design Vehicle Classification (AUSTROADS/SAA, 1995)

Bicycles		see Austroads Part 13	
Motorcycles		see Austroads Part 13	
Car/van - 85th percentile car,	99th percentile car	5.0 metres long	2 axles
Service vehicle		8.8 metres long	2 axles
Single unit truck/bus		12.5 metres long	3 axles
Long rigid bus		14.5 metres long	3 axles
Articulated bus		19.0 metres long	4 axles
Prime mover and semi-trailer		19.0 metres long	6 axles
Prime mover and long semi-trailer		25.0 metres long	6 axles
B-Double		25.0 metres long	9 axles
Road train		36.0 – 53.0 metres long	11-16 axles

Levels of Service

- **Level of Service A** is a condition of free flow in which individual drivers are virtually unaffected by the presence of others in the traffic stream. Freedom to select desired speeds and to manoeuvre within the traffic stream is extremely high, and the general level of comfort and convenience provided is excellent.
- **Level of Service B** is in the zone of stable flow and drivers still have reasonable freedom to select their desired speed and to manoeuvre within the traffic stream, although the general level of comfort and convenience is a little less than with level of service A.
- **Level of Service C** is also in the zone of stable flow, but most drivers are restricted to some extent in their freedom to select their desired speed and to manoeuvre within the traffic stream. The general level of comfort and convenience declines noticeably at this level.
- **Level of Service D** is close to the limit of stable flow and is approaching unstable flow. All drivers are severely restricted in their freedom to select their desired speed and to manoeuvre within the traffic stream. The general level of comfort and convenience is poor, and small increases in traffic flow will generally cause operational problems.
- **Level of Service E** occurs when traffic volumes are at or close to capacity, and there is virtually no freedom to select desired speeds or to manoeuvre within the traffic stream. Flow is unstable and minor disturbances within the traffic stream will cause break-down.
- **Level of Service F** is the zone of forced flow. With it, the amount of traffic approaching the point under consideration exceeds that which can pass it. Flow break-down occurs, and queuing and delays result.

Degree of Saturation: The DS is another measure of the operational performance of individual intersections. As both queue length and delay increase rapidly as DS approaches 1.0, it is usual to attempt to keep DS to less than 0.9. Values of DS in the order of 0.7 generally represent satisfactory intersection operation. When DS exceeds 0.9 residual queues can be anticipated.

Road Classification

Broad Classification

Arterial Roads	Freeways	Those roads with full access control and grade separated intersections, whose primary function is to service large traffic movements.
	Primary Arterial Roads	Those arterial roads whose main function is to form the principal avenue of communication for metropolitan traffic movement not catered for by freeways.
	Secondary Arterial Roads	Those roads which supplement the Primary Arterial Roads in providing for through traffic movement, to an individually determined limit that is sensitive to both roadway characteristics and abutting land users.
Local Roads	Collector Roads	Those non arterial or 'intermediate' roads which distribute traffic between the arterial roads and the local street system, which provide local connection between arterial roads and which provide access to abutting property. It is the collector road, which mixes the basic functions of carrying traffic – often at excessive speed – and serving as a local residential street, that is the generator of many of the problems encountered in traffic management in Local Traffic Areas.
	Local Access Streets	Those streets, not being arterials or collectors, whose main (traffic) function is to provide access to abutting property.

Source: Austroads Part 10, 1988

Classification of Residential Streets

Access Street	Access Place	The lowest order of street providing access to sites without any traffic generated by sites in other streets. Target maximum speed 15 km/h. Indicative traffic volume 300 vpd.

	Local Street	Access streets are generally streets where the residential environment is dominant, traffic is subservient, speed and volume are low and pedestrians and cycle movements are facilitated. Target maximum speed 40 km/h. Indicative traffic volume <200 vpd.
Collector Streets	Minor Collector	The collector street collects traffic from access streets and carries higher volumes of traffic. A reasonable level of residential amenity and safety is maintained by restricting traffic volumes and vehicle speeds. Vehicle speeds are controlled by street alignment, intersection design and, in some cases, by speed control measures. Target maximum speed 50 km/h. Indicative traffic volume <3000 vpd.
	Major Collector	The major collector is generally short and connects the collector street with the road corridor network. Fronting development should still be encouraged, but with siting conditions which ensure acceptable amenity and safety. Target maximum speed 60 km/h. Indicative traffic volume <6000 vpd.

Source: AMCORD 1995, Element 1.3 Street Networks

Road management between Roads and Maritime Services (replacing Roads and Traffic Authority) and councils in NSW provides for three categories of road: State, Regional and Local. Refer to NSW Road Management Arrangements for more details. **Legal Class** The Roads Act 1993 provides for roads to be classified as Freeways, Controlled Access Roads, Tollways, State Highways, Main Roads, Secondary Roads, Tourist Roads, Transitways and State Works. The classification of a road empowers Roads and Maritime Services (replacing Roads and Traffic Authority) to exercise broad authority over some, or all, aspects of legally classified roads and to provide financial assistance to councils. **Administrative Class To** simplify administration of the various legal road classes, the roads in which Roads and Maritime Services (replacing Roads and Traffic Authority) has an interest and council roads are grouped into a three tier administrative classification system of State, Regional and Local Roads. The schedule of roads classified under the Roads Act 1993 and of State and Regional Roads is on the RMS website.