

Proposed Child Care Centre

Oxford Falls

Traffic & Parking Report

Update

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1. Introduction

1.1 Background

In February 1998, Warringah Council granted consent for the establishment of an educational establishment (College of Natural Medicine), situated at N° 1039 Oxford Falls Road West. The site is situated on the southern side of Oxford Falls Road, as shown in **Appendix A**. The consent was subject to a number of conditions limiting the number of students to 75 and requiring the provision of 40 parking spaces. In 2002, the Academy for Natural Medicine proposed to expand some of the already approved facilities and the provision of a new hydrotherapy pool. The expanded facility was able to cater for up to 110 students. A traffic and parking report was then prepared by *Gennaoui Consulting Pty Ltd* (2002).

In 2004, Mr Russell Loel proposed to provide a Long Day Child Care facility operating between 6.00 am and 6.00 pm to accommodate up to 90 children with a staff of 15 persons. Some 40 parking spaces were also proposed. A traffic report was submitted with that application (Gennaoui, 2004).

Council rejected the application for the provision of 90 children facility. However, Mr Loel was advised that an application for a reduced number of children might be favourably considered.

Gennaoui Consulting Pty Ltd has now been asked to update the previous 2004 report and assess on traffic impacts and parking requirements of the latest proposed development.

1.2 Site Location and Study Area

Vehicular access to and from the proposed development will be from Oxford Falls Road West. The traffic implication of the proposed development was assessed along Oxford Falls Road West and Morgan Road and at their intersections with Wakehurst Parkway and with Forest Way respectively.

1.3 Scope of Report

This report summarises the findings, conclusions and recommendations with respect to the following two main areas of concerns:

- the traffic impacts of the proposed Child Care Centre with 60, 40 and 20 children;
- the parking and access requirements of the proposed development.

The road inventory, traffic counts and parking assessment carried out in conjunction with the previous report (Gennaoui, 2002) was adopted as the basis of this report.

2. Traffic Impact of Proposed Development

2.1 Approach Routes

All vehicles accessing the site would be travelling along Oxford Falls Road West. This local road connects Wakehurst Parkway, at Oxford Falls, to Forest Way at Belrose via Morgan Road.

Oxford Falls Road West has a two lane undivided carriageway; west of Spicer Road, it goes through a creek (water was flowing on day of survey). A three tonne weight limit restriction applies along this road. A "stop" sign controls traffic in Oxford Falls Road West at its intersection with the Wakehurst Parkway.

Morgan Road has a two lane undivided carriageway. Traffic signals controls its intersection with Forest Way.

The carriageway along the Oxford Falls Road West and Morgan Road route is mostly rural. At Oxford Creek, near Morgan Street, the carriageway reduces to one traffic lane.

2.2 Traffic Impact of Proposed Development

2.2.1 Traffic Counts

Traffic volumes at the intersections of Wakehurst Parkway with Oxford Falls Road West, and at the intersection of Forest Way with Morgan Road and Wyatt Avenue were counted on Tuesday 7 May 2002, in conjunction with the previous study (Gennaoui, 2002). These counts were carried out during the morning and afternoon periods between 8.00 and 10.00 am and 2.00 and 4.00 pm respectively. The results of these counts are included in **Appendix B**.

The time of survey was selected to coincide with the starting time in the morning (9.00 am) and the changeover of classes at 3.00 pm during the afternoon of the Academy for Natural Medicine proposal (Gennaoui, 2002). The overall morning and early afternoon peak hours at the two intersections occurred between 8.00 and 9.00 am, and from 3.00 to 4.00 pm respectively. The peak hour volumes along the different roads summarised in *Table 2.1*.

The proposed Child Care centre would operate till 6.00pm, thus coinciding with the on-street peak hour usually occurring between 4.00pm and 6.00pm. For the purpose of this assessment, it has been assumed that the afternoon peak would be about 30 percent higher than the early afternoon peak volumes, as noted in *Table 2.1*.

Wakehurst Parkway a regional road carries about 1,800 vehicles per hour during the morning peak hour increasing to about 2,050 vehicles during the afternoon peak hour. Forest Way functions as an arterial road and carries about 3,000 vehicles per hour during the morning peak hour increasing to over 3,600 vehicles during the afternoon peak hour. In comparison, Oxford Falls Road west and Morgan Road carry much lower volumes.

Table 2.1: Peak Hour Traffic Volumes without Proposed Development

ROADS	8.00-9.00 am		3.00-4.00 pm		4.30-5.30pm*	
	N/E	S/W	N/E	S/W	N/E	S/W
Wakehurst P'way, n of Oxford Falls Rd West	373	1,325	857	720	1,114	936
Wakehurst P'way, s of Oxford Falls Rd West	476	1,360	904	738	1,175	959
Oxford Falls Rd West, w of Wakehurst P'way	86	154	62	91	81	118
Morgan Rd, e of Forest Way	133	168	126	75	164	98
Forest Way, n of Morgan Road	1,654	1,326	1,619	1,205	2,105	1,567
Forest Way, s of Morgan Road	1,601	1,260	1,655	1,243	2,152	1,616

* Estimated volumes (30% higher than 3.0to4.0pm)

NB = Northbound SB = Southbound EB = Eastbound WB = Westbound

2.3 Trip Generation and Distribution

The proposed development will cater for up to 60 children and will be operated by a maximum of 12 staff, five days a week from 6.00 am to 6.00 pm.

The guidelines for traffic generation development published by the RTA (1995), included in *Table 2.2*, were used to estimate the number of trips likely to be generated by the proposed childcare centre.

Table 2.2: Trip Generation of Proposed Child Care Centre

Time Period	Peak Hourly Generation Rates *	Trip Generation		
		60 Children	40 Children	20 Children
7.00 to 9.00 am	0.8 vehicle trips/child	48	32	16
2.30 to 4.00 pm	0.3 vehicle trips/child	18	12	6
4.00 to 6.00 pm	0.7 vehicle trips/child	42	28	14

* source: RTA (1995)

A 60-children Child Care Centre is thus expected to generate up to 48 two-way trips. In comparison, a facility catering for 20 children would generate up to 16 two-way trips.

Based on the existing traffic pattern along the approach roads to the proposed development, and discussion with the developer of the site, it has been assumed vehicles arriving and departing the proposed development would do so in accordance with the distribution in *Table 2.3*.

Table 2.3: Trip Distribution for Proposed Developments

Routes		8:00-9:00 am		3:00-4.00 pm		4:30-5.30 pm	
		Arr	Dep	Arr	Dep	Arr	Dep
Facility with 60 Children							
Wakehurst P'way (n), Oxford Falls Rd W	20%	5	5	2	2	4	4
Wakehurst P'way (s), Oxford Falls Rd W	50%	12	12	5	5	11	11
Forest Way (n), Morgan Rd, Oxford Falls Rd w	20%	5	5	2	2	4	4
Forest Way (s), Morgan Rd, Oxford Falls Rd w	10%	2	2	1	1	2	2
Total	100%	24	24	10	10	21	21
Facility with 40 Children							
Wakehurst P'way (n), Oxford Falls Rd W	20%	3	3	1	1	3	3
Wakehurst P'way (s), Oxford Falls Rd W	50%	8	8	3	3	7	7
Forest Way (n), Morgan Rd, Oxford Falls Rd w	20%	3	3	1	1	3	3
Forest Way (s), Morgan Rd, Oxford Falls Rd w	10%	2	2	1	1	1	1
Total	100%	16	16	6	6	14	14
Facility with 20 Children							
Wakehurst P'way (n), Oxford Falls Rd W	20%	2	2	1	1	1	1
Wakehurst P'way (s), Oxford Falls Rd W	50%	4	4	2	2	4	4
Forest Way (n), Morgan Rd, Oxford Falls Rd w	20%	2	2	1	1	1	1
Forest Way (s), Morgan Rd, Oxford Falls Rd w	10%	1	1	0	0	1	1
Total	100%	9	9	4	4	7	7

2.4 Impact on Approach Roads

2.4.1 Impact on Carriageway Capacity

The traffic volumes generated by of the proposed development were then assigned to the road network in accordance to the distribution in *Table 2.3*. The resultant traffic volumes are summarised in *Table 2.4* together with their corresponding levels of service. The existing traffic volumes and corresponding levels of service are also included in *Table 2.4*. The concepts of carriageway capacity and Level of Service (LoS) are discussed in **Appendix C** together with the criteria for their assessment.

The volume of traffic generated by a 60, 40 or 20 child-care centre will have little effect on the current levels of service of all approach routes. The current Level of Service "A" along Oxford Falls Road west and Morgan Road will continue to prevail. Similarly, the Wakehurst Parkway and Forest Way will continue to operate at their current levels of service.

Table 2.4: Existing and Future Carriageway Volumes and Levels of Service *

Road	8:00-9:00 am				3:00-4:00 pm			4:30-5.30 pm		
	Lanes	N/E	S/W	LoS	N/E	S/W	LoS	N/E	S/W	LoS
Base Traffic Conditions										
Wakehurst P'way, n of Oxford Falls	2UCL	373	1,325	C	857	720	A	1,114	936	B
Wakehurst P'way, s of Oxford Falls	2UCL	476	1,360	C	904	738	A	1,175	959	B
Oxford Falls w of Wakehurst P'way	2U	86	154	A	62	91	A	81	118	A
Morgan Rd, e of Forest Way	2U	133	168	A	126	75	A	164	98	A
Forest Way, n of Morgan Rd	4DCL	1,654	1,326	A	1,619	1,205	A	2,105	1,567	A
Forest Way, s of Morgan Rd	4DC	1,601	1,260	B	1,655	1,243	B	2,152	1,616	D
With 60 Children Facility										
Wakehurst P'way, n of Oxford Falls	2UCL	378	1330	C	859	722	A	1118	940	B
Wakehurst P'way, s of Oxford Falls	2UCL	488	1372	C	909	743	A	1186	970	B
Oxford Falls w of Wakehurst P'way	2U	103	171	A	69	98	A	96	133	A
Morgan Rd, e of Forest Way	2U	140	175	A	129	78	A	170	104	A
Forest Way, n of Morgan Rd	4DCL	1659	1331	A	1621	1207	A	2109	1571	A
Forest Way, s of Morgan Rd	4DC	1603	1262	B	1656	1244	B	2154	1618	D
With 40 Children Facility										
Wakehurst P'way, n of Oxford Falls	2UCL	376	1328	C	858	721	A	1117	939	B
Wakehurst P'way, s of Oxford Falls	2UCL	484	1368	C	907	741	A	1182	966	B
Oxford Falls w of Wakehurst P'way	2U	97	165	A	66	95	A	91	128	A
Morgan Rd, e of Forest Way	2U	138	173	A	128	77	A	168	102	A
Forest Way, n of Morgan Rd	4DCL	1657	1329	A	1620	1206	A	2108	1570	A
Forest Way, s of Morgan Rd	4DC	1603	1262	B	1656	1244	B	2153	1617	D
With 20 Children Facility										
Wakehurst P'way, n of Oxford Falls	2UCL	375	1327	C	858	721	A	1115	937	B
Wakehurst P'way, s of Oxford Falls	2UCL	480	1364	C	906	740	A	1179	963	B
Oxford Falls w of Wakehurst P'way	2U	92	160	A	65	94	A	86	123	A
Morgan Rd, e of Forest Way	2U	136	171	A	127	76	A	166	100	A
Forest Way, n of Morgan Rd	4DCL	1656	1328	A	1620	1206	A	2106	1568	A
Forest Way, s of Morgan Rd	4DC	1602	1261	B	1655	1243	B	2153	1617	D

* Refer to Appendix C Uninterrupted flow conditions

2.4.2 Impact on Intersection Operation

An analysis of the operation of the following intersections, using the INTANAL (version 2004.1) computer-modelling program, was carried out to assess the effects of the proposed developments on their operation:

- Forest Way with Morgan Road and Wyatt Avenue (traffic signals)
- Wakehurst Parkway with Oxford Falls Road west (Stop sign)

The assessment of the level of service of traffic signals is based on the evaluation of the average delay (secs/veh) of vehicles on all approaches. The critical movement for the assessment of the level of service of a sign or a roundabout controlled intersection is the one with the highest average delay. The concepts of intersection capacity and level of service are discussed in **Appendix D** together with criteria for their assessment.

INTANAL is a software that allows comparisons between different forms of intersection control, and different forms of intersection configurations to be readily evaluated. The results of this analysis are summarised in *Table 2.5*.

Table 2.5: Operational Characteristic of Intersections

Intersections	8:00-9:00 am		3:00-4:00 pm		4:30-5.30 pm	
	D secs	LoS	D secs	LoS	D secs	LoS
Wakehurst P'way With Oxford Falls						
Existing (Stop sign)	18.3	B	21.2	B	33.5	C
With 20 children facility	18.6	B	21.3	B	34.0	C
With 40 children facility	18.8	B	21.4	B	34.5	C
With 60 children facility	19.1	B	21.5	B	35.0	C
Forest Way with Morgan Rd & Wyatt Av						
Existing (Traffic signals)	11.9	A	9.4	A	21.4	B
With 20 children facility	12.0	A	9.4	A	21.6	B
With 40 children facility	12.0	A	9.4	A	21.6	B
With 60 children facility	12.1	A	9.4	A	21.9	B

The intersection of Wakehurst Parkway with Oxford Falls Road west currently operates at a good level of service "C" reflecting the delays experienced by the right turning movement out of the later road. Similarly, the intersection of Forest Way with Morgan Road and Wyatt Avenue operates at very good level of service "B".

Traffic generated by a child-care centre with up to 60 children will not affect their operation. The two intersections will continue to operate at levels of service "C" or better.

3. Parking and Access Evaluation

The Warringah LEP (2000) requires the provision of 1 space per 4 children for Child Care Centre. Thus a maximum of 15 spaces would be necessary to meet the requirement for a 60 children childcare facility. Up to 40 spaces could be provided on-site at Council's discretion.

All vehicles will access the development from Oxford Falls Road west. The entry driveway will be situated about 125 metres west of Spicer Road.

It is understood that road advisory speed sign is in place along Oxford Falls west, thus a speed limit of 50 kmh has been assumed. Under guidelines developed by AUSTRROADS (1995), at least 45 metres of stopping sight distance should ideally be available for vehicles emerging from the driveway to oncoming vehicles, for vehicle approach speeds up to 50 km/h.

Whilst the sight distance from the west is close to the requirement, the sight distance from the east is well in excess the desirable minimum standard under the Austroads guidelines (1995).

It is recommended that the parking area and access be designed in accordance with the Australian Standard (2004).

4. Summary and Conclusions

4.1 Summary

The proposed childcare centre could accommodate up to 60 children. All vehicles will access the development from Oxford Falls Road West.

Up to 40 parking spaces could be provided on site thus satisfying Council's requirement for up to 15 spaces for a 60 children facility.

A Child Care facility for 60 children is expected to generate up to 48 and 42 two-way trips during the morning and afternoon peak hour respectively reducing to 16 and 14 two-way trips during the morning and afternoon peak hour for a 20 children facility.

The volume of traffic generated by the development will have little effect on the current levels of service of all approach routes.

Traffic generated by the proposed establishment will not affect their operation of the two surveyed intersections; they would continue to operate at levels of service "C" or better.

4.2 Conclusions

The proposed educational establishment will have a low impact and not likely to affect traffic conditions in the surrounding area. It could easily be accommodated by the existing road network without been construed as a nuisance both from a safety or traffic flow perspectives.

Therefore, subject that the parking area and access be designed in accordance with the Australian Standard (2004), there is no traffic or parking reasons why Council should not approve this development.

5. References

Austrroads (1995). *"Guide to Traffic Engineering Practice Part 5 Intersections at Grade."*

Gennaoui Consulting Pty Ltd (2002). *"Proposed Educational Facilities – Oxford Falls - Traffic and Parking Report"*. Australian Academy of Natural Medicine. May.

Gennaoui Consulting Pty Ltd (2004). *"Proposed Child Care Centre– Oxford Falls - Traffic and Parking Report"*. Russell Loel. September.

Roads and Traffic Authority of NSW (1995) *"Guide to Traffic Generating Developments"*. Issue 2.1. July.

Standard Australia (2004). *"AS 2890.1 - 2004, "Parking Facilities Part 1: Off-Street Car Parking"*.

Warringah Council (2000). *"Warringah LEP"*.

Appendix A

Site Location

Site Pl



Scale 1:300

Produced by GIS/IT

02/10/200

Subject Si

Parcel: 2739
Assessment: 49

POR 1039 OXFORD F
OXFORD FALL
NSW 2100

LOT 1039 DP 7
AREA: 2.089
MS AREA: 20992

Owner(s):
RUSSELL LOE

Postal Address:
P O BOX 10
FRENCHS FOREST NS



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Appendix B

Intersections Traffic Counts

09-May-02 10:15 C:\GennCons\UOBSU185Oxford Falls\Counts.xls\For-Mor
 PROJECT: Educational Facilities Oxford Falls
 LOCATION: Wakehurst Parkway with Oxford Falls Rd west INTERSECTION TYPE: T-Junction
 SURVEY DATE: Tuesday 5/12/2000 SURVEY PERIOD: 4.00 to 6.00pm
 Wednesday 6/12/2000 7.00 to 9.00am

APPROACH 1 = Oxford Falls Rd, west of Wakehurst Pwy
 APPROACH 2 = Wakehurst Pky, south of Oxford Falls Rd west
 APPROACH 3 =
 APPROACH 4 = Wakehurst Pkw, north of Oxford Falls Rd west

TIME PERIOD		15-MINUTE INTERVAL TURNING VOLUMES																TOTAL
		Oxford Falls Rd, west of Wakehurst Pky, south of Oxford Falls Rd								Wakehurst Pkw, north of Oxford Falls Rd								
		1L	1T	1R	1U	2L	2T	2R	2U	3L	3T	3R	3U	4L	4T	4R	4U	
08:00	- 08:15	5		17		23	90							300	8			443
08:15	- 08:30	6		22		48	68							342	9			495
08:30	- 08:45	3		11		22	80							322	12			450
08:45	- 09:00	6		16		30	115							330	2			499
09:00	- 09:15	4		14		11	105							266	3			403
09:15	- 09:30	9		6		6	68							266	6			361
09:30	- 09:45	7		8		5	74							215	2			311
09:45	- 10:00	3		5		4	57							192	3			264
14:00	- 14:15	4		11		8	126							139	1			289
14:15	- 14:30	2		7		5	164							160	4			342
14:30	- 14:45	3		12		10	178							189	5			397
14:45	- 15:00	3		5		10	155							144	6			323
15:00	- 15:15	1		12		35	201							194	9			452
15:15	- 15:30	6		13		8	189							174	4			394
15:30	- 15:45	8		11		8	240							161	8			436
15:45	- 16:00	3		8		14	209							165	5			404

		HOURLY TURNING VOLUMES PER MOVEMENT																TOTAL
TIME PERIOD		Oxford Falls Rd, west of Wakehurst Pky, south of Oxford Falls Rd								0	Wakehurst Pkw, north of Oxford Falls Rd							
		1L	1T	1R	1U	2L	2T	2R	2U	3L	3T	3R	3U	4L	4T	4R	4U	
08:00	- 09:00	20	0	66	0	123	353	0	0	0	0	0	0	0	1294	31	0	1887
08:15	- 09:15	19	0	63	0	111	368	0	0	0	0	0	0	0	1260	26	0	1847
08:30	- 09:30	22	0	47	0	69	368	0	0	0	0	0	0	0	1184	23	0	1713
08:45	- 09:45	26	0	44	0	52	362	0	0	0	0	0	0	0	1077	13	0	1574
09:00	- 10:00	23	0	33	0	26	304	0	0	0	0	0	0	0	939	14	0	1339
14:00	- 15:00	12	0	35	0	33	623	0	0	0	0	0	0	0	632	16	0	1351
14:15	- 15:15	9	0	36	0	60	698	0	0	0	0	0	0	0	687	24	0	1514
14:30	- 15:30	13	0	42	0	63	723	0	0	0	0	0	0	0	701	24	0	1566
14:45	- 15:45	18	0	41	0	61	785	0	0	0	0	0	0	0	673	27	0	1605
15:00	- 16:00	18	0	44	0	65	839	0	0	0	0	0	0	0	694	26	0	1686

TIME PERIOD		HOURLY TRAFFIC VOLUMES PER APPROACH											
		APPROACH 1			APPROACH 2			APPROACH 3			APPROACH 4		
		Oxford Falls Rd, west of Wakehurst Pky, south of Oxford Falls Rd			Wakehurst Pky, south of Oxford Falls Rd			0			Wakehurst Pkw, north of Oxford Falls Rd west		
		EB	WB	Total	NB	SB	Total	EB	WB	Total	NB	SB	Total
08:00	- 09:00	86	154	240	476	1360	1836	0	0	0	373	1325	1698
08:15	- 09:15	82	137	219	479	1323	1802	0	0	0	387	1286	1673
08:30	- 09:30	69	92	161	437	1231	1668	0	0	0	390	1207	1597
08:45	- 09:45	70	65	135	414	1121	1535	0	0	0	388	1090	1478
09:00	- 10:00	56	40	96	330	972	1302	0	0	0	327	953	1280
14:00	- 15:00	47	49	96	656	667	1323	0	0	0	635	648	1283
14:15	- 15:15	45	84	129	758	723	1481	0	0	0	707	711	1418
14:30	- 15:30	55	87	142	786	743	1529	0	0	0	736	725	1461
14:45	- 15:45	59	88	147	846	714	1560	0	0	0	803	700	1503
15:00	- 16:00	62	91	153	904	738	1642	0	0	0	857	720	1577

09-May-02 10:15		C:\GennCons\JOBS\185Oxford Falls\Counts.xls\For-Mor										APPROACH 1 = Wyatt Ave, west of Forest Way APPROACH 2 = Forest Way, south of Morgan Rd APPROACH 3 = Morgan Rd, east of Forest Way APPROACH 4 = Forest Way, north of Morgan Rd							
PROJECT:		Educational Facilities Oxford Falls																	
LOCATION:		Forest Way with Morgan Rd & Wyatt Ave										INTERSECTION TYPE :		4 way					
SURVEY DATE:		Tuesday 5/12/2000										SURVEY PERIOD :		4.00 to 6.00pm Wednesday 6/12/2000 7.00 to 9.00am					
15-MINUTE INTERVAL TURNING VOLUMES																			
TIME PERIOD		Wyatt Ave, west of Forest Way				Forest Way, south of Morgan Rd				Morgan Rd, east of Forest Way				Forest Way, north of Morgan Rd				TOTAL	
		1L	1T	1R	1U	2L	2T	2R	2U	3L	3T	3R	3U	4L	4T	4R	4U		
08:00	- 08:15	3	2	4		8	354	10		25	2	28		19	360	13		828	
08:15	- 08:30	3	2	3		13	436	10		3	3	15		15	307	12		822	
08:30	- 08:45	2	4	2		3	377	18		2	1	48		11	255	19		742	
08:45	- 09:00	4	6	2		1	345	26		1	1	39		10	296	9		740	
09:00	- 09:15	6	3	4		3	330	12		4	1	12		7	265	8		655	
09:15	- 09:30	3	4	1		1	283	13		3	1	4		9	234	6		562	
09:30	- 09:45	4	1	7		1	325	9		2	2	2		8	239	6		606	
09:45	- 10:00	1	2	2		2	322	7		1	1	1		8	217	8		572	
14:00	- 14:15	6	1	1		5	251	4		11	6	10		4	145	3		447	
14:15	- 14:30	7	1	5		5	340	14		13	7	10		5	148	5		560	
14:30	- 14:45	9	4	8		4	352	21		10	2	11		11	178	10		620	
14:45	- 15:00	8	8	7		5	387	22		21	9	4		13	197	13		694	
15:00	- 15:15	16	5	11		8	377	21		7	5	5		10	237	9		711	
15:15	- 15:30	12	11	19		10	346	24		19	3	13		7	291	7		762	
15:30	- 15:45	8	2	12		5	394	10		9	2	3		6	275	3		729	
15:45	- 16:00	9	2	10		7	432	21		4	1	4		7	349	4		850	
HOURLY TURNING VOLUMES PER MOVEMENT																			
TIME PERIOD		Wyatt Ave, west of Forest Way				Forest Way, south of Morgan Rd				Morgan Rd, east of Forest Way				Forest Way, north of Morgan Rd				TOTAL	
		1L	1T	1R	1U	2L	2T	2R	2U	3L	3T	3R	3U	4L	4T	4R	4U		
08:00	- 09:00	12	14	11	0	25	1512	64	0	31	7	130	0	55	1218	53	0	3132	
08:15	- 09:15	15	15	11	0	20	1488	66	0	10	6	114	0	43	1123	48	0	2959	
08:30	- 09:30	15	17	9	0	8	1335	69	0	10	4	103	0	37	1050	42	0	2699	
08:45	- 09:45	17	14	14	0	6	1283	60	0	10	5	57	0	34	1034	29	0	2563	
09:00	- 10:00	14	10	14	0	7	1260	41	0	10	5	19	0	32	955	28	0	2395	
14:00	- 15:00	30	14	21	0	19	1330	61	0	55	24	35	0	33	668	31	0	2321	
14:15	- 15:15	40	18	31	0	22	1456	78	0	51	23	30	0	39	760	37	0	2585	
14:30	- 15:30	45	28	45	0	27	1462	88	0	57	19	33	0	41	903	39	0	2787	
14:45	- 15:45	44	26	49	0	28	1504	77	0	56	19	25	0	36	1000	32	0	2896	
15:00	- 16:00	45	20	52	0	30	1549	76	0	39	11	25	0	30	1152	23	0	3052	
HOURLY TRAFFIC VOLUMES PER APPROACH																			
TIME PERIOD		APPROACH 1 Wyatt Ave, west of Forest Way			APPROACH 2 Forest Way, south of Morgan Rd			APPROACH 3 Morgan Rd, east of Forest Way			APPROACH 4 Forest Way, north of Morgan Rd								
		EB	WB	Total	NB	SB	Total	EB	WB	Total	NB	SB	Total						
08:00	- 09:00	37	85	122	1601	1260	2861	133	168	301	1654	1326	2980						
08:15	- 09:15	41	74	115	1574	1144	2718	124	130	254	1617	1214	2831						
08:30	- 09:30	41	54	95	1412	1069	2481	123	117	240	1453	1129	2582						
08:45	- 09:45	45	40	85	1349	1058	2407	108	72	180	1357	1097	2454						
09:00	- 10:00	38	40	78	1308	979	2287	83	34	117	1293	1015	2308						
14:00	- 15:00	65	74	139	1410	744	2154	108	114	222	1395	732	2127						
14:15	- 15:15	89	82	171	1556	842	2398	135	104	239	1526	836	2362						
14:30	- 15:30	118	85	203	1577	1005	2582	157	109	266	1540	983	2523						
14:45	- 15:45	119	79	198	1609	1105	2714	139	100	239	1573	1068	2641						
15:00	- 16:00	117	64	181	1655	1243	2898	126	75	201	1619	1205	2824						

Appendix C

Concept of Carriageway Capacity
and Level of Service

APPENDIX C**CONCEPT OF CARRIAGEWAY CAPACITY AND LEVEL OF SERVICE**

The capacity of major streets within an urban area can be based on an assessment of their operating Level of Service.

Level of service is defined by NAASRA (1988) as a "qualitative measure of the effects of a number of features, which include speed and travel time, traffic interruptions, freedom to manoeuvre, safety, driving comfort and convenience, and operating costs. Levels of service are designated from A to F from best (free flow conditions) to worst (forced flow with stop start operation, long queues and delays) as follows:

***LEVELS OF SERVICE**

- A - Free flow (almost no delays);
- B - Stable flow (slight delays);
- C - Stable flow (acceptable delays);
- D - Approaching unstable flow (tolerable delays);
- E - Unstable flow (congestion; intolerable delays); and
- F - Forced flow (jammed).

A service volume, as defined by NAASRA (1988), is the maximum number of vehicles that can pass over a given section of roadway in one direction during one hour while operating conditions are maintained at a specified level of service. It is suggested that ideally arterial and sub-arterial roads should not exceed service volumes at level of service C. At this level, whilst most drivers are restricted in their freedom to manoeuvre, operating speeds are still reasonable and acceptable delays experienced. However, in urban situations, arterial and sub-arterial roads operating at Level of Service D, are still considered adequate.

Traffic Volumes along urban roads with interrupted and uninterrupted flow conditions are included in *Tables C1 and C2* respectively.

**Table C1: Level of Service Interrupted Flow Conditions along Urban Roads
One Way Hourly Volumes**

		LEVEL OF SERVICE					
	Description	A	B	C	D	E	F
2U	2 Lane Undivided	540	630	710	810	900	F
							O
4U	4 Lane Undivided	900	1050	1200	1350	1500	R
							C
4UC	4 Lane Undivided with Clearways	1080	1260	1440	1620	1800	E
							D
4DC	4 Lane Divided with Clearways	1140	1330	1520	1710	1900	
6DC	6 Lane Divided with Clearway	1740	2030	2320	2610	2900	S

**Table C2: Level of Service Uninterrupted Flow Conditions Along Urban Roads
One Way Hourly Volumes**

	Description	LEVEL OF SERVICE					
		A	B	C	D	E	F
2UC	2 Lane Undivided with clearway	760	880	1000	1130	1260	F O
2UCL	2 Lane Undivided with clearway, limited access and limited intersections	1064	1232	1400	1582	1764	R C
4U	4 Lane Undivided	1260	1470	1680	1890	2100	E D
4UC	4 Lane Undivided with Clearways	1510	1760	2010	2270	2520	
4DC	4 Lane Divided with Clearways	1600	1860	2130	2400	2660	
4DCL	4 Lane Divided with Clearways, limited access and limited intersections	2250	2620	3000	3380	3740	F L
6U	6 Lane Undivided	2020	2350	2690	3020	3360	O W
6DC	6 Lane Divided with Clearway	2440	2840	3250	3660	4060	S
6DCL	6 Lane Divided with Clearways, limited access and limited intersections	3375	3930	4500	5070	5610	

Appendix D

Guidelines for Evaluation of Intersection Capacity

APPENDIX D

GUIDELINES FOR EVALUATION OF INTERSECTION CAPACITY

The RTA has included in the "Guide to Traffic Generating Developments" (Dec 1995, Issue 2) a section on the assessment of intersections. The assessment of the level of service of an intersection is based on the evaluation of the following Measures of Effectiveness:

- (a) average delay (secs/veh) (all forms of control);
- (b) delay to critical movement (secs/veh) (all forms of control);
- (c) degree of saturation (traffic signals and roundabouts); and
- (d) cycle length (traffic signals).

INTANAL was used to calculate the relevant intersection parameters. INTANAL is a software which allows comparisons between different forms of intersection control and different forms of intersection configurations to be readily evaluated. That is at each intersection the priority control, roundabout and signal control options will be examined to determine the most efficient form of control.

The best indicator of the level of service at an intersection is the average delay experienced by vehicles at that intersection. For traffic signals, the average delay over all movements should be taken. For roundabouts and priority control intersections (with Stop and Give Way signs or operating under the T-junction rule) the critical movement for level of service assessment should be that with the highest average delay.

With traffic signals, delays per approach tend to be equalised, subject to any over-riding requirements of signal co-ordination as well as to variations within individual movements. With roundabouts and priority controlled intersections, the critical criterion for assessment is the movement with the highest delay per vehicle. With this type of control the volume balance might be such that some movements suffer high levels of delay while other movements have minimal delay. An overall average delay for the intersection of 25 seconds might not be satisfactory if the average delay on one movement is 60 seconds.

The average delay for level of service E should be no more than 70 seconds. The accepted maximum practical cycle length for traffic signals under saturated conditions is 120 - 140 seconds. Under these conditions 120 seconds is near maximum for two and three phase intersections and 140 seconds near maximum for more complex phase designs. Drivers and pedestrians expect cycle lengths of these magnitudes and their inherent delays in peak hours. A cycle length of 140 seconds for an intersection that is almost saturated has an average vehicle delay of about 70 seconds, although this can vary. If the average vehicle delay is more than 70 seconds, the intersection is assumed to be at Level of Service F.

Table D1 sets out average delays for different levels of service. There is no consistent correlation between definitions of levels of service for road links as defined elsewhere in this section, and the ranges set out in *Table E1*. In assigning a level of service, the average delay to the motoring public needs to be considered, keeping in mind the location of the intersection. For example, drivers in inner-urban areas of Sydney have a higher tolerance of delay than drivers in country areas. *Table D1* provides a recommended baseline for assessment.

Table D1: Level of Service Criteria for Intersections

Level of Service	Average Delay per Vehicle (secs/veh)	Traffic Signals, Roundabout	Give Way & Stop Signs
A	less than 14	Good operation	Good operation
B	14 to 28	Good with acceptable delays & spare capacity	Acceptable delays & spare capacity
C	29 – 42	Satisfactory	Satisfactory, but accident study required
D	43 to 56	Operating near capacity	Near capacity & accident study required
E	57 to 70	At capacity; at signals, incidents will cause excessive delays	At capacity, required other control mode
		Roundabouts require other control mode	

Source: RTA (1995)

The figures in *Table D1* are intended as a guide only. Any particular assessment should take into account site-specific factors including maximum queue lengths (and their effect on lane blocking), the influence of nearby intersections and the sensitivity of the location to delays. In many situations, a comparison of the current and future average delay provides a better appreciation of the impact of a proposal, and not simply the change in the level of service.

The intersection degree of saturation (DS) can also be used to measure the performance of isolated intersections. At intersections controlled by traffic signals, both queue length and delays increase rapidly as DS approaches 1.0. An upper limit of 0.9 is appropriate. When DS exceeds 0.8 - 0.85, overflow queues start to become a problem. Satisfactory intersection operation is generally achieved with a DS of about 0.7 - 0.8. (Note that these figures are based on isolated signalised intersections with cycle lengths of 120 seconds. In co-ordinated signal systems DS might be actively maximised at key intersections). Although in some situations additional traffic does not alter the level of service, particularly where the level of service is E or F, additional capacity may still be required. This is particularly appropriate for service level F, where small increases in flow can cause disproportionately greater increases in delay. In this situation, it is advisable to consider means of control to maintain the existing level of absolute delay. Suggested criteria for the evaluation of the capacity of signalised intersections based on the Degree of Saturation are summarised in *Table D2*.

Table D2: Criteria for Evaluating Capacity of Signalised Intersections

LEVEL OF SERVICE	OPTIMUM CYCLE LENGTH (SECS) (CO)	VOLUME/SATURATION Y	INTERSECTION DEGREE OF SATURATION X
A/B Very good operation	< 90	< 0.70	< 0.80
C Satisfactory	90-120	0.70-0.80	0.80-0.85
D Poor but manageable	120-140	0.80-0.85	0.85-0.90
E/F Bad, extra capacity req'd	> 140	> 0.85	> 0.90

Source: RTA (1995)