HARRINGTON ESTATES (NSW) PTY LTD

TRAFFIC IMPACT REVIEW OF PROPOSED CATHERINE PARK STAGES 1-3 SUBDIVISION

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1.0 INTRODUCTION

Harrington Estates (NSW) Pty Ltd propose to develop the first three stages of the Catherine Park residential subdivision. These stages are part of the wider Catherine Field (part) Precinct. Transport planning for this area has been undertaken by AECOM, with the most recent report being *Catherine Field (part) Precinct – Post Exhibition Transport and Access Review (Addendum).* Figure 1 reproduces Figure 4 from this report, showing the *Indicative Layout Plan for Catherine Field (part) Precinct.*

The initial stage of subdivision currently proposed is immediately north of the purple schools precinct, just north of Oran Park Drive. Figure 1 provides an indicative structure plan for the area, with locations of open space, a neighbourhood centre and various housing densities indicated, within the framework of an indicative road network.

As part of the planning of this residential area, Harrington Estates (NSW) Pty Ltd commissioned Development Planning Strategies to review residential road design standards. Their report of 11 April 2013 is part of the background material for this current traffic study, and is discussed in Section 2.

Christopher Hallam & Associates Pty Ltd were commissioned by Harrington Estates (NSW) Pty Ltd to review the proposed road hierarchy within the proposed Stages 1-3 subdivisions, provide advice and prepare a traffic impact assessment. We have set out our study findings in the following Sections:

- Section 2 reviews road hierarchy and design standards;
- Section 3 describes the proposed road hierarchy, the projected traffic flows and assesses the proposed subdivision and intersections, and
- Section 4 sets out our conclusions.

2.0 ROAD HIERARCHY STANDARDS

The AECOM report *Catherine Field (part) Precinct – Post Exhibition Transport and Access Review (Addendum)* (1 July 2013), sets out recommended road cross-sections for different road classes. Of particular interest are the Collector Roads, the Local roads and the Access Streets.

The DPS report *Catherine Park Residential Roads Review* 11 April 2013, reviewed these standards, other standards and examples of good practice and recommended a Desired Road Hierarchy. Following a further design assessment, a revised Design Road Hierarchy was developed. Table 2.1 sets out this Design Road Hierarchy that has been adopted for the design of Stages 1-3 of Catherine Park.

TABLE 2.1 Desired Road Hierarchy for Catherine Park

Road Type	Verge	Carriageway	Verge	Reserve
Transit Boulevard	4.5m	7m + 4m median + 7m	4.5m	27m
Collector Street– Bus Route	3.5m	2.1m + 7m + 2.1m	3.5m	18.2m
Collector Street– Bus Capable	3.5m	2.1m + 6.4m + 2.1m	3.5m	17.6m
Local Street	3.5m	7.2m	3.5m	14.2m
Access Street	3.5m	5.5m	3.5m	12.5m
Laneway	-	6.4m	-	6.4m

Table 2.2 sets out a comparison of the key elements of the original AECOM road hierarchy and the road hierarchy adopted for Catherine Park, Stages 1-3.

TABLE 2.2 Road Hierarchy Standards Comparison

Road Type	AECOM Daily Flow (vpd)	AECOM Carriageway (metres)	AECOM Reserve (metres)	DPS Daily Flow (vpd)	DPS Carriageway (metres)	DPS Reserve (metres)
Collector road	3,000-10,000	11.0	20.0	3,000-7,000	10.6-11.2	17.6-18.2
Local street	1,000-3,000	9.0	16.0	1,000-3,000	7.2	14.2
Access street	-	-	-	< 1,000	5.5	12.5

For Collector Roads, the AECOM guide goes a little higher with the maximum daily traffic flows, and comparable with the carriageway width. The DPS carriageway for Collector Streets includes kerbside parking lanes on each side, at 2.1m each, plus the central carriageway of 6.4-7.0m. With Local

Streets, the volume ranges are the same. The DPS carriageway width is narrower. The DPS report provides an additional category, for Access Streets, with less than 1,000 vehicles per day (vpd).

Before reviewing the carriageway widths, a review of environmental capacity performance standards is relevant. Table 2.3 reproduces the relevant table from the Roads & Traffic Authority's (RMS) *Guide to Traffic Generating Developments.*

TABLE 2.3 Environmental Capacity Performance Standards on Residential Streets

Road class	Road type	Max. Speed (km/hr)	Max.peak hour flow (veh/hr)
Local	Access way	25	100
	Street	40	200 environmental goal
		40	300 maximum
Collector	Street	50	300 environmental goal
		50	500 maximum

There are four traffic flow thresholds, 100 veh/hr, 200 veh/hr, 300 veh/hr and 500 veh/hr. For the equivalent daily traffic flows, these are approximately ten times the peak hour, so 1,000 vpd, 2,000 vpd, 3,000 vpd and 5,000 vpd. The Local Access Way corresponds with the DPS Access Street, in traffic volume terms. The 300 veh/hr, or 3,000 vpd threshold is the environmental capacity maximum for a Local Street. This is appropriate and consistent with the figures in Table 2.2. The upper limits for Collector Roads in Table 2.2 are both higher than the maximum of 500 veh/hr (5,000 vpd) in Table 2.3. This figure of 500 veh/hr was derived from studies of accident potential for pedestrians crossing the road, traffic noise, perceptions of traffic impact and other factors. In this regard, we prefer the DPS threshold of 7,000 vpd rather than the AECOM threshold of 10,000 vpd. Note that the research into environmental capacity for the (then) Traffic Authority of NSW (by Christopher Hallam & Associates Pty Ltd) that resulted in Table 2.3 found benefits of restricting carriageway widths so that the distance a pedestrian had to cross the road was reduced. This was also identified in the major research design report *The Streets Where We Live.* In traffic safety terms, narrower is better. A residential street with occasional kerbside parking requires drivers to slow down and manoeuvre between parked cars. This is good, not bad.

A particularly good reference report is the *Australian Model Code for Residential Development* (AMCORD), published in 1995. This provides a more extensive breakdown of street types than set out in Table 2.2. Table 2.4 summarises the AMCORD recommendations, with the full reference provided in Annexure A.

TABLE 2.4 AMCORD Road Hierarchy Guidelines

Road Type	Daily Flows (vpd)	Carriageway width (m)	Reserve width (m)
Major Collector	3,000-6,000	Performance based	Performance based
Minor Collector	1,000-3,000	7.0-7.5	16.5
Access Street	1,000-2,000	5.5 or 7.0	13.5
Access Street	300-1,000	5.0-5.5	13.0
Access Street	0 - 300	5.0	12.0

For Major Collectors, AMCORD does not have a specific recommendation. We consider that the DPS proposed total carriageway widths for Collector Roads, of 10.6-11.2m are appropriate for the design traffic flows. The carriageway width for Minor Collector fits the DPS recommended width of 7.2m for Local Streets, with the same traffic volume range, of 1,000-3,000 vpd. The AMCORD figures for Access Street (300-1,000 vpd) of 5.0-5.5m or 7.0m are consistent with the DPS recommended widths. In the AMCORD table reproduced in Annexure A , Note 14 states: *"Width is limited to 5.5 m to deter vehicles parking opposite each other and blocking traffic".* The DPS recommended carriageway width of 5.5m for Access Streets is consistent.

We consider that the road hierarchy standards recommended in the DPS report are appropriate and reasonable for application in Catherine Park.

3.0 CATHERINE PARK STAGES 1-3 SUBDIVISION

3.1 Road Hierarchy

The proposed subdivisions will have the following lot yields:

Stage	Standard Lots	Superlots (dwellings)		Total Dwellings
1	162	3	(19)	181
2	111	8	(60)	171
3	66	7	(53)	119
Total	339	18	(132)	471

The AECOM report (1 July 2013) set out its *Catherine Field (part) Precinct Proposed Road Hierarchy and Mid-Block Flows,* which is reproduced here as Figure 2. This establishes what is now to be known as Catherine Park Drive (Rickard Road Extension) as a Transit Boulevard. This will form the eastern boundary of the proposed Stage 1 subdivision. The Collector Road running west from Catherine Park Drive will form the northern boundary of the Stage 1. This is seen in Figure 3, which is the proposed *Catherine Park Stages 1-3 Road Hierarchy.*

Comparing Figures 2 and 3, Graham's Drive is the northern east-west Collector Road. Figure 2 shows the east-west road north of the Catholic Schools precinct as a "Local with transit function", reflecting the future use of this road by school buses. Figure 3 classifies this road as a Local Street, with a 7.2m wide carriageway, as appropriate for a local street.

Figure 3 also shows a connecting Local Street between the schools precinct and the Graham's Drive Collector Road, with a carriageway width of 7.2m.

Figure 3 provides a further breakdown into Local Streets (7.2m wide), Access Streets (5.5m wide), Laneways (6.4m wide) and Accessways (5.0m wide).

In summary, Figure 3 follows Figure 2, with more detail of the local street network, and with additional roads classified as Collector.

Figure 2 shows projected peak hour flows. Along Catherine Park Drive, the two-way peak hour flows are 1050 veh/hr (AM) and 700 veh/hr (PM) north of Oran Park Drive, and 950 veh/hr (AM) and 850 veh/hr (PM) north of Graham's Drive. Converted to daily traffic flows by multiplying one peak hour by ten, the daily flows would be about 9,000 vpd. With Catherine Park Drive proposed as a two-plus-two lane divided carriageway, there will be ample capacity, based on these projected flows, for it to function as a Transit Boulevarde.

On Graham's Drive, Figure 2 shows two-way peak hour flows of 450 veh/hr (AM) and 400 veh/hr (PM), equating to a daily flow of about 4,250 vpd. This fits into the middle of the Collector Road flow range of 3,000-7,000 vpd.

We conclude that the Collector and Transit Boulevarde roads will have traffic flows less than their maximums, and hence are appropriate.

3.2 Traffic Flows

We have reviewed the details of the proposed Stages 1-3 subdivisions by first estimating the weekday daily flows. We have used the RTA's *Guide to Traffic Generating Developments* rate of 0.85 veh/hr and 9 vpd per dwelling, and have taken into account the road network connections to the major road network. The daily traffic generation rate is just above the approximation of Peak x 10 = Daily, but are used to be consistent with RTA guidelines. Variations in the traffic distribution could occur, but as is discussed, the traffic flow projections are so far within the road hierarchy limits, the precise traffic distribution is not critical. We have set out on Figure 4 the projected two-way peak hour traffic flows for Stages 1-3. Figure 4 shows the detailed subdivision design proposed. It should be noted that these projected traffic flows are for residential subdivision traffic only, and do not include any school traffic from the two Catholic schools to the immediate South.

The current development consent for these schools is for vehicular access off Oran Park Drive. It is the intention that when a "rear access" opens up, access from the North would be provided, to not only reduce traffic loads along Oran Park Drive, and its intersections, but also to provide a shorter and safer path of travel from residential development in Catherine Park and Catherine Field. The roundabout at the north-west corner of the schools precinct will provide ultimate access between this precinct and the residential area. This will clearly load up the east-west road along the schools boundary, and the north-south connector to Graham's Drive. These Local Streets could alternatively be classified as *Local road with Transit Function*.

3.3 Subdivision Layout Review

Traffic Flows

Looking at Figure 4, the east-west Local Street along the northern side of the schools precinct has flows of up to 85 veh/hr, at the eastern end, being traffic from 100 dwellings. This is equivalent to a daily flow of about 900 vpd, based on the RTA rates. This is well under the limit for a Local Street. The north-south Local Street link road up to Graham's Drive has a maximum of 111 veh/hr at its northern end, where it meets Graham's Drive. At the RTA rates, this is 1,170 vpd. Note that the traffic flows shown on Figure 4 include traffic from Stages 1-3. These flows are below the DPS Local Street maximum of 3,000 vpd, and provide adequate scope for the addition of school traffic. The volume of additional school traffic will depend on whether the approved schools access on Oran

Park Drive is retained when the rear (northern) access is opened up. As a minimum, left turn in and out to the schools off Oran Park Drive would be anticipated.

The other Local Streets identified on Figure 3 have a maximum projected peak hour flow of 51 veh/hr, which is equivalent to approximately 540 vpd. These flows classify as Access Streets, at less than 1,000 vpd, and hence these roads designated as Local Roads will have very satisfactory levels of traffic movements.

The Access Streets identified on Figure 3 have maximum projected peak hour flows of 22 veh/hr, which is equivalent to approximately 230 vpd. These flows are all substantially less than the limit of 1,000 vpd for Access Streets.

We have also assessed the incremental impact of the addition of schools traffic, when they have an access through the roundabout on their boundary. We have used the projected traffic generation of the schools, generally as set out in the Christopher Hallam & Associates Pty Ltd report of 18th November 2011 titled *St Justins Catholic Primary School and St Benedicts Catholic College, Oran Park – Traffic Study for Proposed Ultimate School Development.* This report provided figures for the peak hour flows, in the periods 7.30-8.30am and 2.30-3.30pm. The AM peak hour would correspond to the commuter peak hour in Oran Park, but the 2.30-3.30pm period would not. The AECOM study used the average hourly flows in the periods 7-9am and 4-6pm. In the mid-period of 4.30-5.30pm, the schools would have a substantially lower traffic generation. The 2011 report sets out some details over time of the traffic movements at Magdalene College, Smeaton Grange. The traffic flows in the latest hour surveyed, 4-5pm, were only 20% of the flows in the period 2.30-3.30pm, the school PM peak hour. In this analysis of Catherine Park, for the 4.30-5.30pm commuter peak hour, we have assumed the schools generate 20% of their peak afternoon (2.30-3.30pm) figures. The resulting figures for ultimate development of both schools, during the commuter peak hours are:

Period	In	Out	Total
AM	519	359	878
PM	36	64	100

For this assessment, we have assumed that left turns into and out of the schools off Oran Park Drive will be permitted, but no right turns. In reassigning the traffic, we have assumed that two-thirds of the school traffic will be from south, east or west of the schools, and one-third from north (Catherine Field and adjoining areas.) We have taken the proposed road network into account in our traffic reassignment.

On the north-south link road between the school roundabout and Graham's Drive, the highest flows will occur just south of Graham's Drive, in the AM peak hour. The total hourly flow will be about 320 veh/hr. It however reduces just to the South, below where the Local Street on the eastern side joins, reducing to approximately 260 veh/hr in the AM. In the PM peak hour the respective total hourly flows are projected to be 135 veh/hr just south of Grahams Drive and 80 veh/hr further to the south.

Projecting the daily school traffic from the peak hour traffic is different to the residential pattern, because school traffic is concentrated in the two peak hours with limited after hours traffic. In

August 2007 we undertook a seven day automatic count on the access off Narellan Road into Mount Annan Christian Collage. Looking at the average weekday hourly flows at this location, the AM peak hour flow of 415 veh/hr compared with the 24 weekday flow of 1130 veh/day. The multiplication factor is thus 2.72. Using this factor, the daily school traffic using the north-south link road is 564 veh/day. Thus, the total weekday traffic flow just south of Grahams Drive would be about 1740 veh/day, and 1140 veh/day further to the south below the adjoining local road. These flows fit within the road hierarchy guidelines.

On the east-west Local Street along the northern school boundary, just west of Catherine Park Drive, the AM peak hour flow will be about 140 veh/hr, including both residential and school traffic, which calculates out to be approximately 1030 vpd , a figure substantially less than the maximum of 3,000vpd. Figure 4 also shows the Stages 2 & 3 subdivision layouts and projected peak hour flows. West of the Schools Precinct, the east-west Local Street is projected to carry flows of less than 50 veh/hr for the residential traffic, which is substantially less than the environmental capacity limit. For the Local roads, projected flows also do not exceed 50 veh/hr, still substantially less than the environmental goal of a Local street, of 200 veh/hr.

In traffic volume and road hierarchy terms, the proposed subdivision pattern and road hierarchy for the Stages 1-3 subdivision are acceptable and have projected traffic flows within the threshold levels identified in Table 2.1.

Bus Routes

Figure 15 of the AECOM report of 1 July 2013 sets out the *Possible Catherine Field Bus Strategy.* Clearly, the Transit Boulevarde of Catherine Park Drive will be a bus route. Graham's Drive and the east-west Local Street along the northern boundary of the Catholic schools precinct are shown as "Bus capable roads". Along Graham's Drive, at bus stops, kerbside parking will need to be prohibited opposite the stop if continuous two-way movement is desired, or left unrestricted if the occasional parked car is accepted, in which case drivers might need to slow down passing the stopped bus, if there is any oncoming traffic. Along the east-west Local Street , kerbside parking will need to be prohibited opposite the stop. This will permit one direction of traffic flow when a bus is stopped.

3.4 Intersections

The intersections internal to the subdivision are predicted to have very minor traffic flow levels, as shown on Figure 4, and hence simple Priority control will be satisfactory.

The design of a one-lane roundabout at the north-west corner of the Catholic schools precinct will provide for flexibility in catering for the connection between this schools precinct and the residential area. A one-lane roundabout will provide good capacity. The base traffic flows through this roundabout from the Stages 1-3 residential development are relatively modest, as shown on Figure 4. The schools traffic has been added, and a SIDRA analysis undertaken. The results are set out in Annexure B. In reviewing intersection capacity, guidance can be found in the RTA *Guide to Traffic Generating Developments.* Table 3.1 reproduces the applicable table from this Guide.

TABLE 3.1 Level Of Service Criteria For Intersections

Level of Service	Average Delay per Vehicle (secs/veh)	Traffic Signals, Roundabouts	Give Way & Stop signs
A	<14	Good operation	Good operation
B	15 to 28	Good with acceptable delays & spare capacity	Acceptable delays & spare capacity
C	29 to 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 Roundabouts require other control mode	At capacity, requires other control mode

As shown in the results in Annexure B – "Site: School Access to Northern Link Road" – all movements will have a level of service of A, in both peak periods, and the overall intersection average delay is predicted to be approximately 4 seconds. A simple priority-junction, with the East-West road having priority, will thus provide ample capacity, subject to "No Stopping" restrictions on all approaches and departures.

Where the east-west Local Street along the school's northern boundary meets Catherine Park Drive, movements will be restricted to left turn in and out only, and hence there will be no conflicts.

The North—South Local Street from the school's roundabout to Graham's Drive will intersect with Graham's Drive in a priority-controlled junction, with Graham's Drive traffic having priority. With the proposed road hierarchy carriageway widths, Graham's Drive will have 10.4m wide carriageway width. This will allow the provision of a short right-turn bay in Grahams Drive, with ancillary "No Stopping" restrictions. The North-South Local Street, with its 7.2m carriageway, will require "No Stopping" restrictions on both sides on the approach to Graham's Drive. Annexure B shows the intersection layout modelled in SIDRA, plus the outputs. Table 3.2 sets out the results of this analysis. As indicated, this includes school traffic.

TABLE 3.2 SIDRA Analysis of Graham's Drive & Link Road – Year 2036

Approach	Move	AM Avg Delay (secs/veh)	AM Level Of Service	AM 95% Queue(m)	PM Avg Delay (secs/veh)	PM Level Of Service	PM 95% Queue(m)
Link road	Left	7	A	3	7	A	1
(South)	Right	7	A	3	7	A	1
Grahams Dr	Left	6	A	0	6	A	0
(East)	Thru	0	A	0	0	A	0
Grahams Dr	Thru	0	A	0	0	A	0
(West)	Right	8	A	3	7	A	1
All	All	3.1	(A)	(3)	1.8	(A)	(1)

Table 3.2 indicates very satisfactory operation of a simple priority-junction, in both peak periods. As a sensitivity test, all of the traffic flows were increased by 50%. All movements in both peak periods remained at a level of service of A, with the intersection average delay less than 4 seconds. The predicted "95%ile Back of Queue" for the right turn bay on Graham's Drive was a maximum of 5m. Hence, the construction of this intersection with a carriageway width of 10.4m will allow linemarking for a priority-control junction that will operate in a satisfactory manner.

Stages 2 and 3 will see Local roads intersecting with "Road No. 2", an east-west Collector road. With the projected two-way flows of 30-35 veh/hr on these Local roads, simple priority controls will be satisfactory.

The junction of Catherine Park Drive and Graham's Drive will be controlled by a roundabout. In our review, we have assumed a one-lane roundabout. For the base year 2036 traffic flows, we have used the detailed traffic flow projections set out in AECOM's report of 1 July 2013, with assumptions made about turning movement distributions. We have also added the school traffic through this intersection, although it is probable that this has already been taken into account in AECOM's analysis. The roundabout layout and SIDRA results are set out in Annexure B. Table 3.3 sets out the results:

TABLE 3.3 SIDRA Analysis of Catherine Park Drive & Graham's Drive – Year 2036

Approach	Move	AM Avg Delay (secs/veh)	AM Level Of Service	AM 95% Queue(m)	PM Avg Delay (secs/veh)	PM Level Of Service	PM 95% Queue(m)
Cath Park	Left	6	A	26	5	A	11
Dr South	Thru	5	A	26	4	A	11
Cath Park	Thru	4	A	21	4	A	19
Dr North	Right	9	A	21	10	A	19
Graham's	Left	7	A	6	6	A	7
Drive	Right	11	A	6	10	A	7
All	All	5.6	A	(26)	5.3	A	(19)

Table 3.3 indicates very satisfactory roundabout operation, with a level of service of A on all movements, and low delay levels. This intersection has spare capacity to handle additional traffic movements, should the current traffic projections be low over time.

We conclude that all of the intersections within and on the perimeter of these Stages 1-3 Catherine Park subdivisions will have ample capacity to handle the future Year 2036 peak hour flows.

4.0 CONCLUSIONS

1. The Stages 1-3 Subdivision Plan for Catherine Park has been planned from the broader road network planning undertaken by AECOM as set out in their *Catherine Field (part) Precinct – Post Exhibition Transport and Access Review (Addendum).* The road network and hierarchical classification has been followed.
2. A main consideration in the planning of this subdivision is the widths of roads. A detailed review was undertaken by Development Planning Strategies, resulting in the recommendation for revised carriageway and road reserve widths. These revised widths are concurred with.
3. An analysis has been undertaken to see if the projected traffic flows fit into the road hierarchy volume ranges for specific street types. They all do, generally being at the lower end of the volume range, for the traffic situation with just the residential development. School traffic has also been taken into account, and the projected future daily flows remain well within the road hierarchy limits.
4. The analysis has taken into account the future connection of the Catholic schools precinct. The proposed priority-controlled junction at the northern school entrance will provide adequate capacity for all movements, with appropriate "No Stopping" restrictions. The intersection on Graham's Drive and the north-south link road from the schools roundabout will have priority control. The traffic analysis found that priority control at this intersection will provide adequate capacity, with appropriate "No Stopping" restrictions.
5. Finally, the proposed roundabout intersection at the junction of Catherine Park Drive and Graham's Drive has been reviewed for the year 2036 traffic flows. A one-lane roundabout will provide ample capacity.
6. In conclusion, the traffic implications of the proposed Stages 1-3 subdivisions are satisfactory.

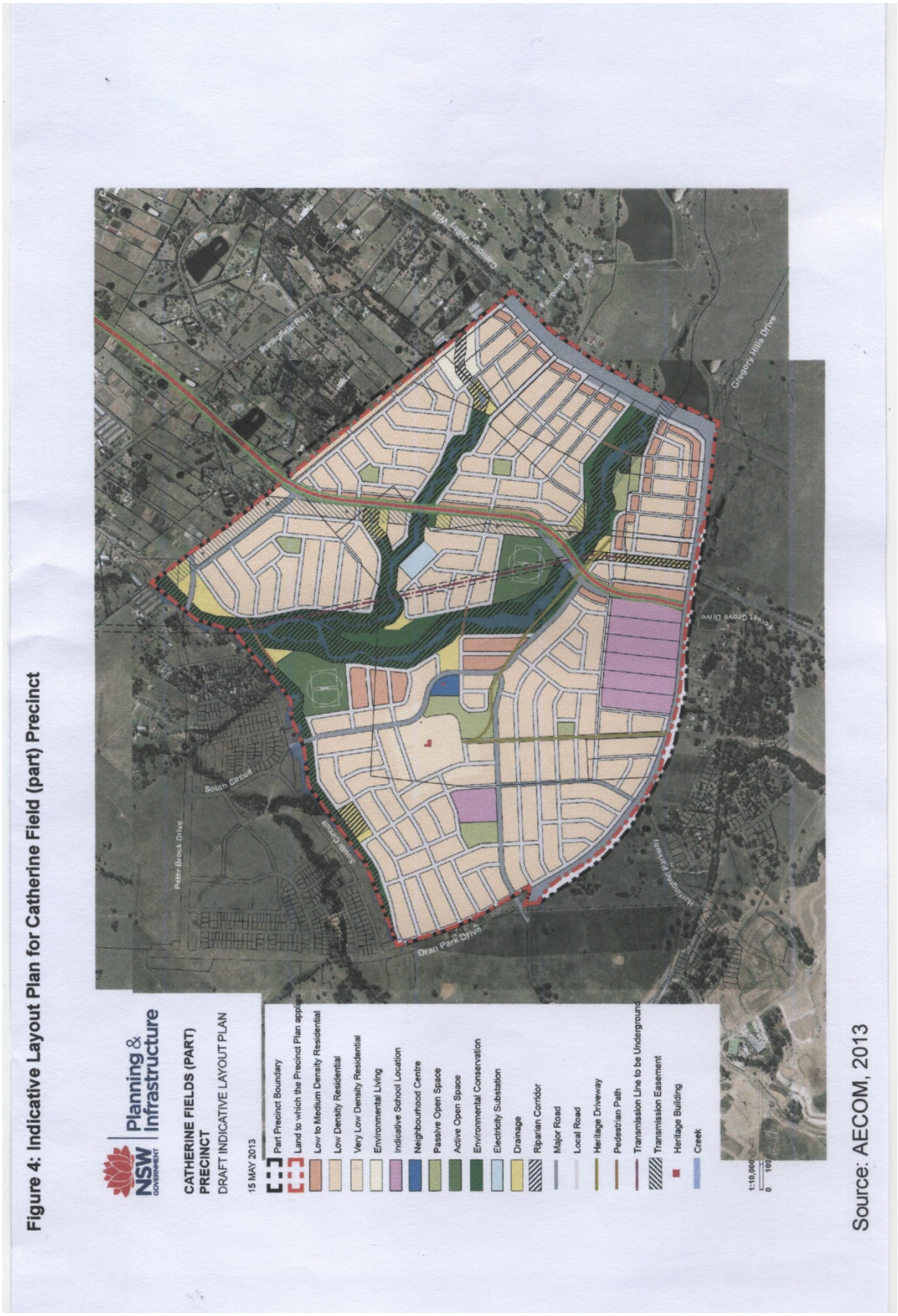

FIGURE 1 LAYOUT PLAN FOR CATHERINE FIELD (part) PRECINCT

FIGURE 2 CATHERINE FIELD (part) PRECINCT ROAD HIERARCHY and TRAFFIC FLOWS

FIGURE 3 CATHERINE PARK STAGES 1-3 ROAD HIERARCHY

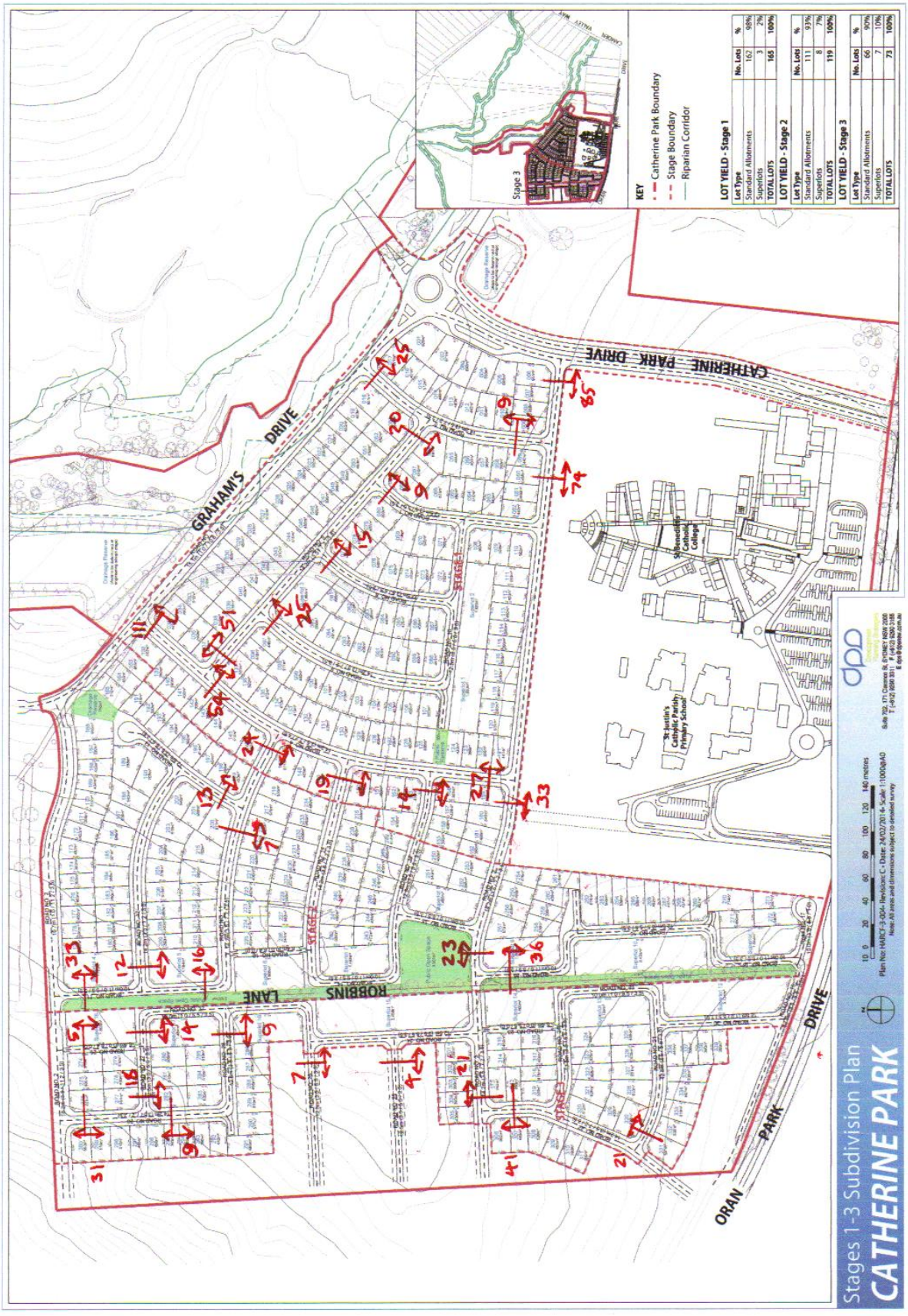

FIGURE 4 STAGES 1-3 SUBDIVISION PLAN and TRAFFIC FLOWS

Element 2.1
Street Design and On-street Carparking (continued)

Table 1
Characteristics of street types

Street type	Indicative maximum traffic volume range (vpd)(1)	Target speed & design speed (km/h)(2)	Street reserve width minimum (m)(3)	Carriageway width (m)(4)	Verge width minimum (m) each side (5)	Parking provision within street reserve	Kerb type (20)	Entrance kerb return minimum (m)	Propert access	Street longitu-dinal gradient maximum%	Footpath	Cycles
ACCESS STREETS												
Access lane	100	15	varies	See note (6)	Not specified	No	Not required	NA	Rear	NA	No	Share with vehicles
Access place(7)	0-300	15	10.0	Single-lane 3.5-3.7(8)	See note (9)	1 Hard standing verge space per 2 dw. with scope for extra space	Layback flush	5(10)	Access to all sites (21)	17(11)	No	Share with vehicles
Access street	0–300(11)	40	12.0	5.0 only	3.5	Carriageway	Layback	4	Access to all sites (21)	15(11)	No(12)	Share with vehicles
Access street	300–1000	40	13.0	5.0–5.5 only(14)	4.0	Carriageway	Layback	5	Access to all sites (21)	12	No	Share with vehicles
Access street	1000–2000	40	13.5	5.5 or 7.0	4.0	Carriageway	Layback	5	Access to all sites (21)	10	1.2 m wide one side (13)	Share with vehicles
COLLECTOR STREET												
Minor collector	1000–3000	50 (20 at desig-nated ped–cyc. crossing)	16.50	7.0–7.5 or 6.0–6.5 plus indented parking	4.5	Carriageway or indented	Layback (15)	6	Access to all sites(17)	8(16)	1.2 m wide both sides located away from kerb	Provide within street pavement (22)
Major collector	3000–6000	Design using the performance criteria									1.2 m wide located away from kerb (18)	Provide within street pavement (22)

1 For single dwelling allotments apply a traffic generation rate of 10 vpd or a rate based on local data. For multi-unit dwellings apply a traffic generation rate of 6 vpd or a rate based on local data.

2 Streets are to be designed to achieve the target speed, and sight distances to accord with design speed.

3 The minimum street reserve widths apply after satisfying the other criteria within this table and other site-specific requirements.

4 The carriageway width is measured from kerb invert at outer edge of edge strip. Widening is required at bends to allow for wider vehicle paths (using AUSTROADS Turning Templates).

5 Each verge must be of sufficient width to accommodate relevant services, landscaping and, unless other noise attenuation methods are used, to ensure a total setback to residential dwellings which satisfies prescribed traffic noise exposure levels at the facade.

6 Lane width is determined by requirements for access to garages (Table 6). Minimum width is 3.0 m.

7 An integrated design of street and building layout is necessary for speed control and to achieve the optimum result. Appropriate considerations are required for the collection of waste.

8 This requires parking provision and provision for widening to 5.0 m if necessary in the future. Maximum length is 100 m. A passing bay is required if length is greater than 80 m.

9 See Acceptable Solutions for Street Design for minimum verge width for different speeds or provide minimum for services - whichever is the greater.

10 A minimum kerb radius is desirable for pedestrian safety and control of vehicle speeds. A threshold treatment may be used at the intersection entry.

11 The maximum grade is based on the equivalent maximum grade permitted for driveways across the verge. Grades greater than 12% require special design considerations for pedestrians, cyclists, waste collection vehicles and street layout (eg grade on curves, grade for turning vehicles at the street turning head).

12 Includes traditional cul-de-sac-type streets.

13 Footpaths are to be provided on both sides of streets serving as bus routes. Footpaths are to be provided adjacent to multi-unit dwellings.

14 Width is limited to 5.5 m to deter vehicles parking opposite each other and blocking traffic.

15 Upright kerb may be considered for drainage without reducing the carriageway width, but layback is preferred for safety reasons.

16 Short lengths for bus routes at 10% are acceptable. Collectors not serving as bus routes are permitted to have a maximum longitudinal grade of 10%.

17 Minimum lot frontage of 11 m unless rear access for vehicles is provided.

18 One footpath may need to be combined as a dual footpath/cycleway and the width increased to 1.8 m.

19 Refer to cycleway routes in Development Plan.

20 Upright kerbs are preferred adjacent to public reserves and when needed for drainage.

21 Particular attention needs to be given to vehicle access to allotments in streets with narrow pavements.

22 Refer to Austroads (Part 14: Bicycles).

ANNEXURE A AMCORD ROAD HIERARCHY GUIDELINES

MOVEMENT SUMMARY

▽ Site: School Access to Northern Link Road

Year 2036 AM
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: School Access											
1	L2	147	2.0	0.114	4.5	LOS A	0.5	3.3	0.03	0.48	36.9
2	T1	76	2.0	0.114	3.2	LOS A	0.5	3.3	0.03	0.48	36.9
3	R2	23	2.0	0.114	5.0	LOS A	0.5	3.3	0.03	0.48	36.9
Approach		246	2.0	0.114	4.2	LOS A	0.5	3.3	0.03	0.48	36.9
East: East											
4	L2	27	2.0	0.023	4.5	LOS A	0.1	0.7	0.06	0.43	37.0
5	T1	8	2.0	0.023	0.0	LOS A	0.1	0.7	0.06	0.43	37.0
6	R2	8	2.0	0.023	5.0	LOS A	0.1	0.7	0.06	0.43	37.0
Approach		44	2.0	0.023	3.7	NA	0.1	0.7	0.06	0.43	37.0
North: North											
7	L2	5	2.0	0.087	4.6	LOS A	0.2	1.7	0.08	0.41	37.2
8	T1	142	2.0	0.087	3.3	LOS A	0.2	1.7	0.08	0.41	37.2
9	R2	9	2.0	0.087	5.0	LOS A	0.2	1.7	0.08	0.41	37.2
Approach		157	2.0	0.087	3.4	LOS A	0.2	1.7	0.08	0.41	37.2
West: West											
10	L2	5	2.0	0.024	4.6	LOS A	0.1	0.9	0.11	0.46	36.6
11	T1	8	2.0	0.024	0.1	LOS A	0.1	0.9	0.11	0.46	36.6
12	R2	38	2.0	0.024	5.0	LOS A	0.1	0.9	0.11	0.46	36.6
Approach		52	2.0	0.024	4.1	NA	0.1	0.9	0.11	0.46	36.6
All Vehicles		499	2.0	0.114	3.9	NA	0.5	3.3	0.06	0.45	37.0

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

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ANNEXURE B SIDRA RESULTS

MOVEMENT SUMMARY

▽ Site: School Access to Northern Link Road

Year 2036 PM
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: School Access											
1	L2	25	2.0	0.020	4.5	LOS A	0.1	0.5	0.03	0.48	36.8
2	T1	14	2.0	0.020	3.2	LOS A	0.1	0.5	0.03	0.48	36.8
3	R2	4	2.0	0.020	4.9	LOS A	0.1	0.5	0.03	0.48	36.8
Approach		43	2.0	0.020	4.1	LOS A	0.1	0.5	0.03	0.48	36.8
East: East											
4	L2	2	2.0	0.009	4.5	LOS A	0.0	0.3	0.06	0.34	37.7
5	T1	8	2.0	0.009	0.0	LOS A	0.0	0.3	0.06	0.34	37.7
6	R2	8	2.0	0.009	4.9	LOS A	0.0	0.3	0.06	0.34	37.7
Approach		19	2.0	0.009	2.7	NA	0.0	0.3	0.06	0.34	37.7
North: North											
7	L2	5	2.0	0.012	4.5	LOS A	0.0	0.3	0.04	0.49	36.8
8	T1	9	2.0	0.012	3.2	LOS A	0.0	0.3	0.04	0.49	36.8
9	R2	9	2.0	0.012	5.0	LOS A	0.0	0.3	0.04	0.49	36.8
Approach		24	2.0	0.012	4.2	LOS A	0.0	0.3	0.04	0.49	36.8
West: West											
10	L2	5	2.0	0.009	4.5	LOS A	0.0	0.3	0.05	0.30	37.9
11	T1	8	2.0	0.009	0.0	LOS A	0.0	0.3	0.05	0.30	37.9
12	R2	3	2.0	0.009	4.9	LOS A	0.0	0.3	0.05	0.30	37.9
Approach		17	2.0	0.009	2.3	NA	0.0	0.3	0.05	0.30	37.9
All Vehicles		103	2.0	0.020	3.6	NA	0.1	0.5	0.04	0.43	37.2

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

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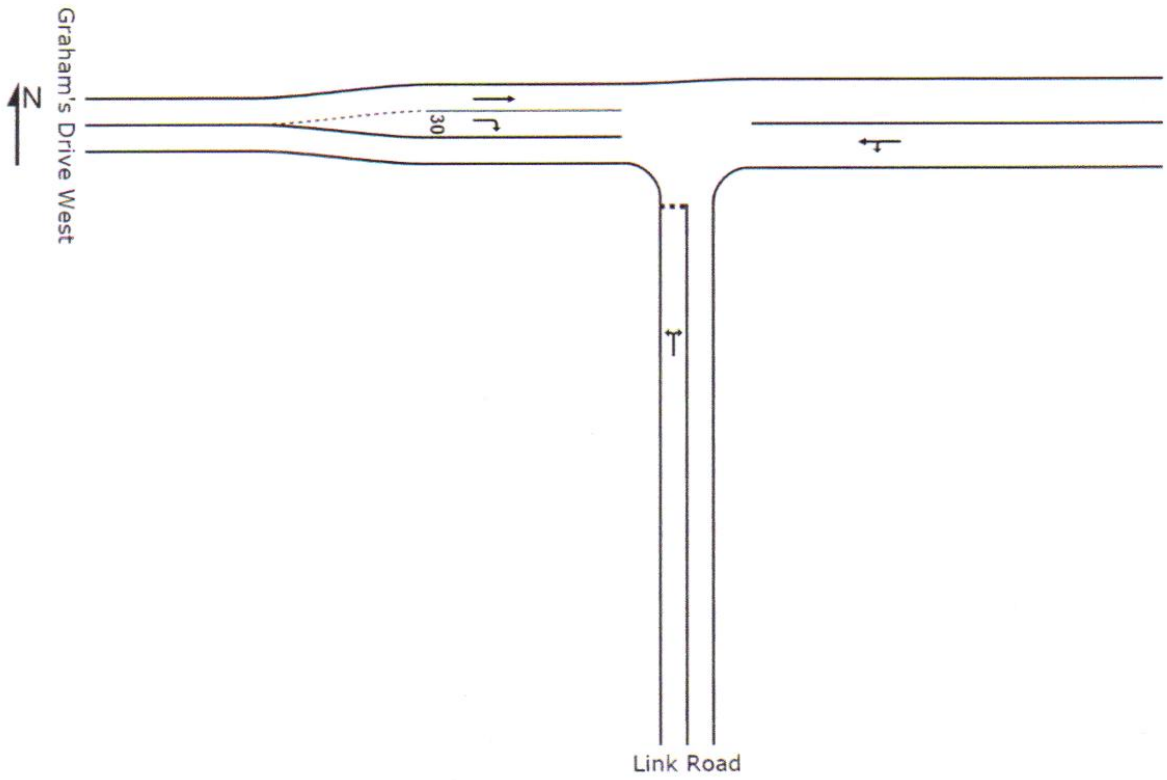
SITE LAYOUT

Site: Grahams Drive & Link Road

Priority
Year 2036 AM
Giveway / Yield (Two-Way)



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SIDRA INTERSECTION 6

MOVEMENT SUMMARY

▽ Site: Grahams Drive & Link Road

Priority
Year 2036 AM
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	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Link Road											
1	L2	128	2.0	0.089	7.3	LOS A	0.4	3.0	0.39	0.61	41.9
3	R2	26	2.0	0.089	7.4	LOS A	0.4	3.0	0.39	0.61	41.9
Approach		155	2.0	0.089	7.3	LOS A	0.4	3.0	0.39	0.61	41.9
East: Grahams Drive East											
4	L2	39	2.0	0.178	6.4	LOS A	0.0	0.0	0.00	0.09	49.2
5	T1	332	2.0	0.178	0.0	LOS A	0.0	0.0	0.00	0.09	49.2
Approach		371	2.0	0.178	0.7	NA	0.0	0.0	0.00	0.09	49.2
West: Graham's Drive West											
11	T1	105	2.0	0.055	0.0	LOS A	0.0	0.0	0.00	0.00	50.0
12	R2	123	2.0	0.072	7.9	LOS A	0.4	2.7	0.45	0.64	41.5
Approach		228	2.0	0.072	4.2	NA	0.4	2.7	0.24	0.34	45.0
All Vehicles		754	2.0	0.178	3.1	NA	0.4	3.0	0.15	0.28	46.2

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

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MOVEMENT SUMMARY

▽ Site: Grahams Drive & Link Road

Priority
Year 2036 PM
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: Link Road											
1	L2	31	2.0	0.021	7.0	LOS A	0.1	0.7	0.30	0.57	42.2
3	R2	8	2.0	0.021	7.2	LOS A	0.1	0.7	0.30	0.57	42.2
Approach		39	2.0	0.021	7.1	LOS A	0.1	0.7	0.30	0.57	42.2
East: Grahams Drive East											
4	L2	35	2.0	0.119	6.4	LOS A	0.0	0.0	0.00	0.12	48.9
5	T1	213	2.0	0.119	0.0	LOS A	0.0	0.0	0.00	0.12	48.9
Approach		247	2.0	0.119	0.9	NA	0.0	0.0	0.00	0.12	48.9
West: Graham's Drive West											
11	T1	197	2.0	0.103	0.0	LOS A	0.0	0.0	0.00	0.00	50.0
12	R2	66	2.0	0.034	7.4	LOS A	0.2	1.3	0.35	0.59	41.8
Approach		263	2.0	0.103	1.9	NA	0.2	1.3	0.09	0.15	47.6
All Vehicles		549	2.0	0.119	1.8	NA	0.2	1.3	0.06	0.17	47.8

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

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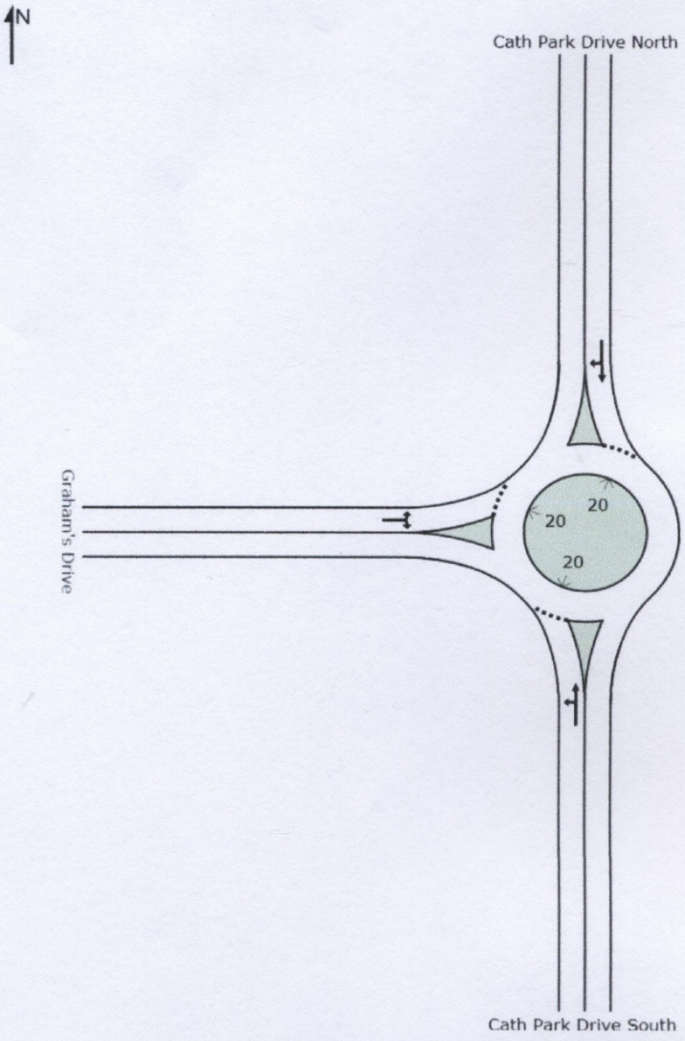
SITE LAYOUT

Site: Catherine Park Drive & Graham's Drive

Year 2036 AM



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SIDRA INTERSECTION 6

MOVEMENT SUMMARY

Site: Catherine Park Drive & Graham's Drive

Year 2036 AM
Roundabout

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Cath Park Drive South											
1	L2	189	2.0	0.485	5.9	LOS A	3.6	25.9	0.50	1.03	43.1
2	T1	408	2.0	0.485	4.8	LOS A	3.6	25.9	0.50	1.03	43.1
Approach		598	2.0	0.485	5.1	LOS A	3.6	25.9	0.50	0.52	43.1
North: Cath Park Drive North											
8	T1	386	2.0	0.383	3.7	LOS A	3.0	21.3	0.24	0.93	43.4
9	R2	181	2.0	0.383	9.4	LOS A	3.0	21.3	0.24	0.93	43.4
Approach		567	2.0	0.383	5.5	LOS A	3.0	21.3	0.24	0.47	43.4
West: Graham's Drive											
10	L2	85	2.0	0.139	6.7	LOS A	0.8	5.7	0.57	1.31	41.4
12	R2	46	2.0	0.139	11.3	LOS A	0.8	5.7	0.57	1.31	41.4
Approach		132	2.0	0.139	8.3	LOS A	0.8	5.7	0.57	0.65	41.4
All Vehicles		1297	2.0	0.485	5.6	LOS A	3.6	25.9	0.39	0.51	43.1

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

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MOVEMENT SUMMARY

Site: Catherine Park Drive & Graham's Drive

Year 2036 PM
Roundabout

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Cath Park Drive South											
1	L2	122	2.0	0.258	5.2	LOS A	1.6	11.0	0.32	0.86	44.0
2	T1	211	2.0	0.258	4.1	LOS A	1.6	11.0	0.32	0.86	44.0
Approach		333	2.0	0.258	4.5	LOS A	1.6	11.0	0.32	0.43	44.0
North: Cath Park Drive North											
8	T1	406	2.0	0.368	3.9	LOS A	2.7	18.9	0.27	0.90	43.6
9	R2	117	2.0	0.368	9.5	LOS A	2.7	18.9	0.27	0.90	43.6
Approach		523	2.0	0.368	5.1	LOS A	2.7	18.9	0.27	0.45	43.6
West: Graham's Drive											
10	L2	137	2.0	0.180	5.7	LOS A	1.0	7.1	0.41	1.14	42.1
12	R2	66	2.0	0.180	10.2	LOS A	1.0	7.1	0.41	1.14	42.1
Approach		203	2.0	0.180	7.2	LOS A	1.0	7.1	0.41	0.57	42.1
All Vehicles		1059	2.0	0.368	5.3	LOS A	2.7	18.9	0.32	0.47	43.4

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

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