



# **Proposed McDonald's Restaurant, Thomas Road and Kardan Boulevard, Byford**

## **Transport Impact Assessment**

**PREPARED FOR:  
McDonald's Australia Ltd**

**June 2017**

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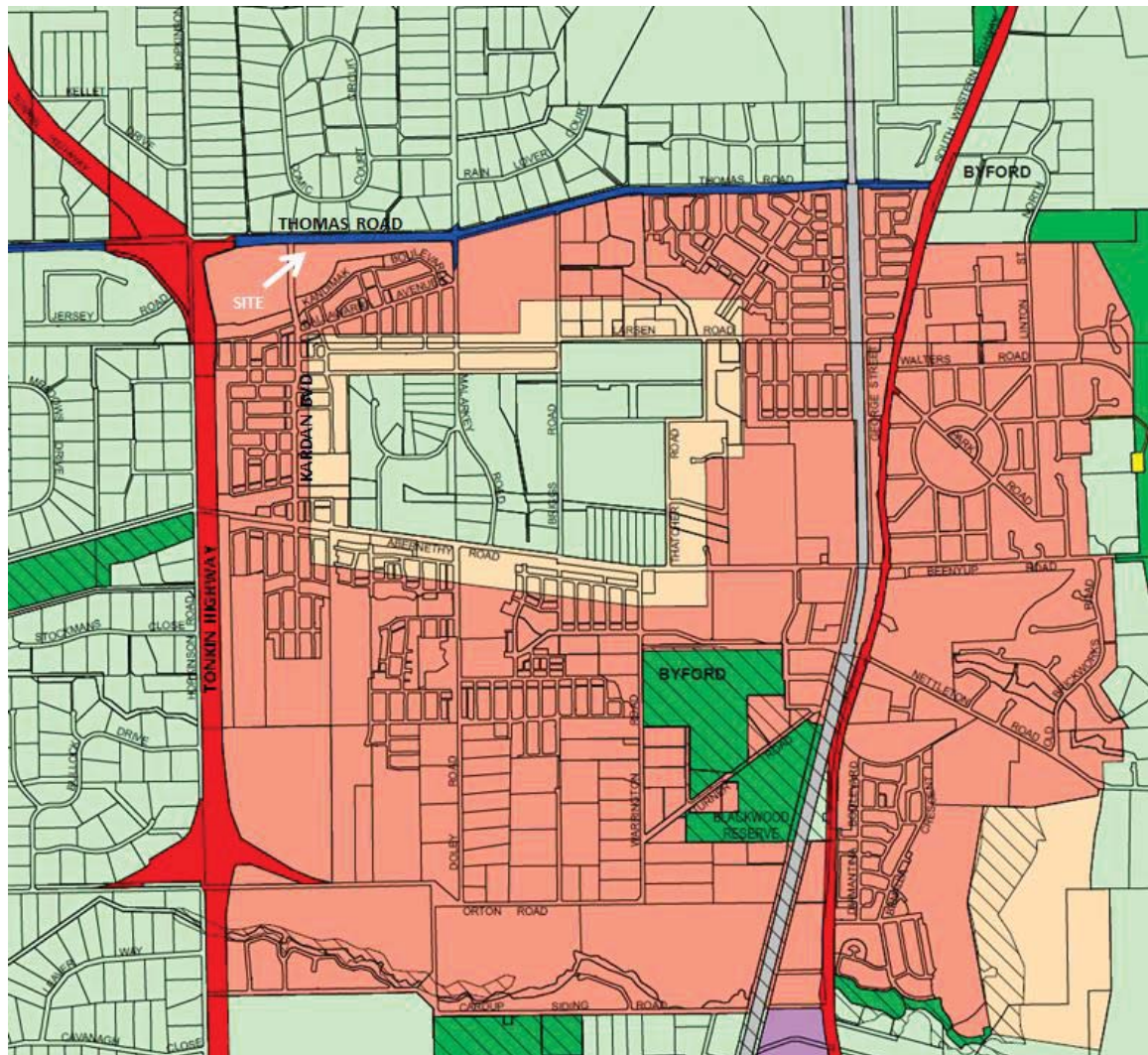
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## 1.0 Introduction

This Transport Assessment report has been prepared by Transcore on behalf of McDonald's Australia Ltd. The subject of this report is a proposed McDonald's restaurant development at Byford in the Shire of Serpentine-Jarrahdale.

The subject site is located at the south-eastern corner of Thomas Road and Kardan Boulevard, as shown in **Figure 1**.



**Figure 1: Site location**

Key issues that will be addressed in this report include the traffic generation and distribution of the proposed development, parking supply and demand, and on-site circulation arrangements. Future intersection requirements at the intersection of Thomas Rd / Kardan Bvd and the Kardan Bvd / Kalyang Loop roundabout immediately southwest of the site are assessed in this report.

## 2.0 Existing Situation

### 2.1 Existing Land Use

The subject site shown in **Figure 2** is currently vacant land.



**Figure 2: Subject site**

The site is bounded by Thomas Road to the north, Kardan Boulevard to the west, Pingaring Court to the south and Pindipindi Loop to the west.

The subject site is within the Redgum Brook Estate North Local Structure Plan (LSP) area, which includes the cleared areas and new residential subdivision visible on **Figure 2** north of the watercourse that angles across the middle of that figure. The residential subdivision west of Kardan Boulevard contains approximately 130 residential lots and 16 larger lots to the west identified as “composite residential / light industrial” in the LSP. The LSP indicates a residential subdivision for approximately 85 dwellings east of Kardan Boulevard (south and east of the subject site).

The subject site is indicated as a mixed use site on the LSP and a second mixed use site of similar size is indicated directly opposite it at the southwest corner of Thomas

Road and Kardan Boulevard. That western site has recently been developed for a service station, fast food outlet and 24-hour gym.

Pingaring Court, on the south side of the subject site, provides the only road access to the 85-lot residential development east of Kardan Boulevard, south and east of the subject site.

## 2.2 Existing Road Network

**Thomas Road** is classified as a district distributor A road in the Main Roads WA functional road hierarchy and is covered by an Other Regional Roads reservation (a Blue road) in the Metropolitan Region Scheme, as shown in **Figure 1**. It is constructed as a single carriageway rural road (one lane each way), generally 7.0-7.4m carriageway width with 1.0-1.2m sealed shoulders. It is widened to provide a 3m wide right turn lane approximately 80m long and a left turn slip lane approximately 70m long at the Kardan Boulevard intersection, as shown in **Figure 3**.



Figure 3: Existing roads and intersections adjacent to the site

A traffic count by Main Roads WA recorded average weekday traffic flows of 7,540 vehicles per day (vpd) on Thomas Rd east of Hopkinson Rd in June 2010, with 14.5% of this traffic classified as heavy vehicles. Thomas Rd has a posted speed limit of 70km/h in this vicinity.

This section of Thomas Road (east of Tonkin Hwy) is identified as a primary freight road (local government control) in State Planning Policy 5.4.

**Kardan Boulevard** is constructed to Integrator B standard within a 30m road reserve in this vicinity. It has two single-lane, 5m carriageways (i.e. a 3.5m traffic lane and 1.5m cycle lane each way) with a 10m-wide landscaped median. A 50 km/h speed limit applies.

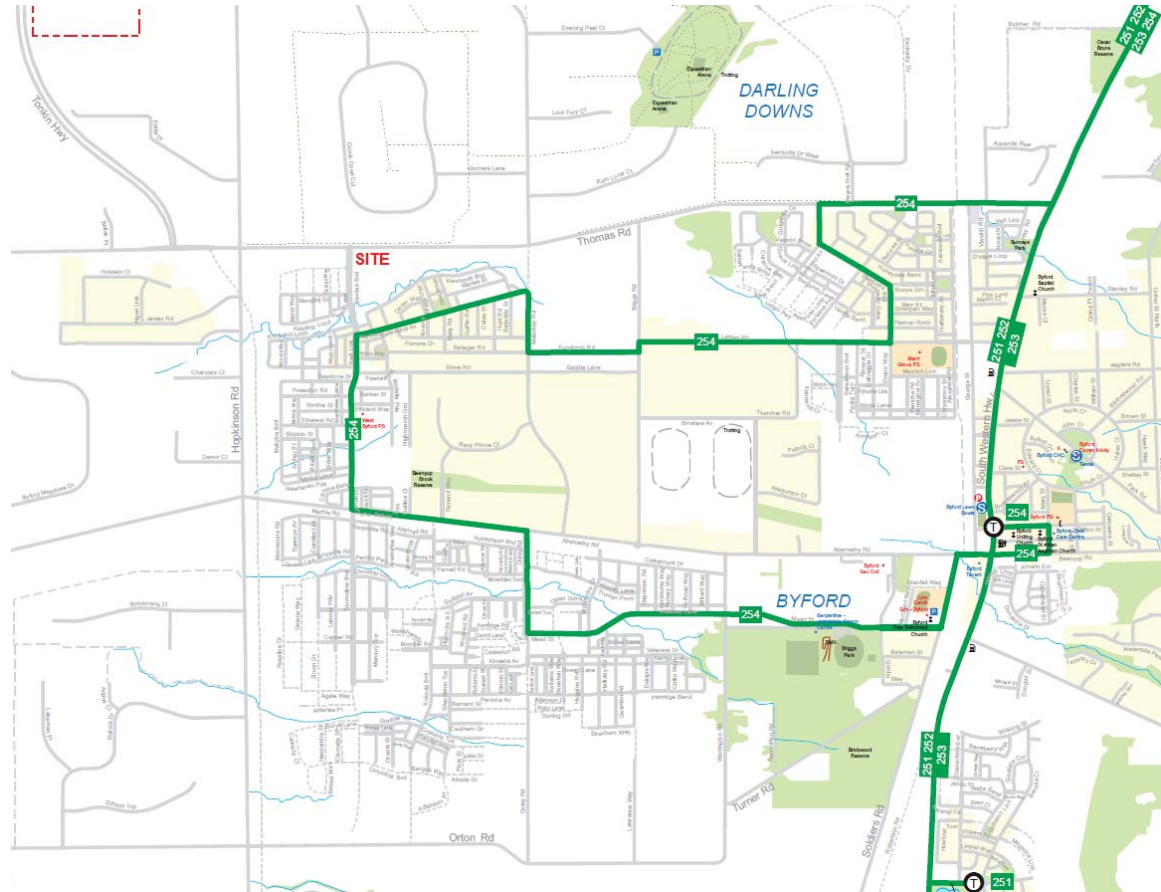
**Pingaring Court** and **Pindipindi Loop** are constructed as Access Streets within a 15m road reserve. They have a 6m-wide two-lane road carriageway. The default 50 km/h built-up area speed limit applies.

The Kardan Bvd / Kalyang Loop / Pingaring Ct intersection has been constructed as a 4-way, single-lane roundabout, as shown in **Figure 3**.



### 2.3 Public Transport

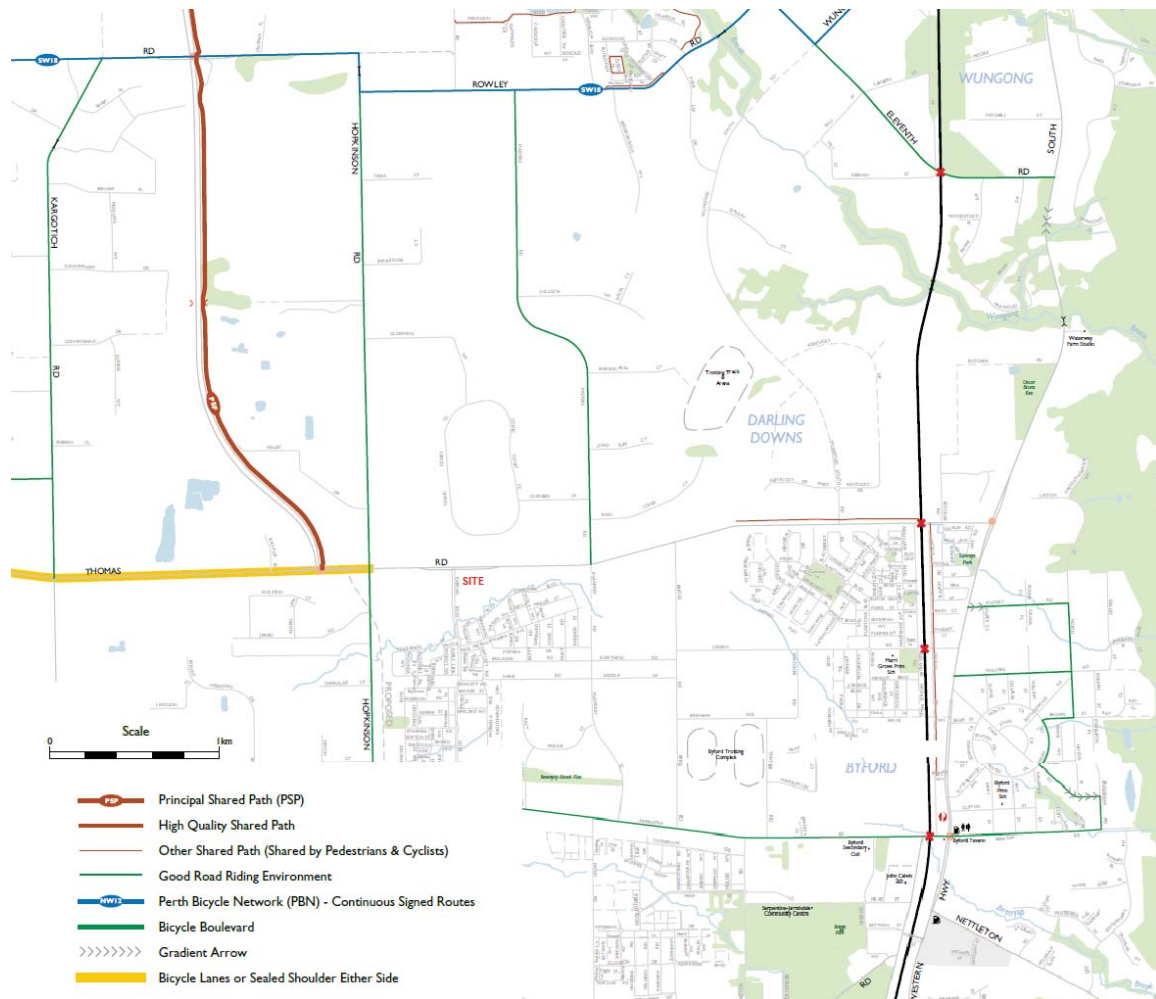
Existing bus routes in this area are shown in **Figure 4**. The closest existing bus route is route 254 (from Byford Town Centre to Armadale Station), which passes within 400m of the site on Kardan Boulevard and Ballawarra Avenue.



**Figure 4: Existing bus routes**

## 2.4 Pedestrian and Cyclist Facilities

The Department of Transport's Perth Bike Map series (see **Figure 5**) shows the existing Principal Shared Path along the eastern side of Tonkin Highway.



**Figure 5: Perth Bike Map**

Although not shown on this Bike Map (last updated October 2016), Kardan Boulevard has been constructed with 5m road carriageways (i.e. 3.5m traffic lane and 1.5m bike lane in each direction), with a 2.5m path on the western side north of the watercourse and a 1.5m path on the east side of Kardan Boulevard including the section abutting the subject site. Pingaring Court has a 1.5m path on the south side opposite the subject site and Pindipindi Loop has a 1.5m path on the east side opposite the subject site.

## **2.5 *Changes to Surrounding Road Network***

As shown in **Figure 1** Tonkin Highway is planned to be extended south of Thomas Road in future and will ultimately have a grade-separated interchange at the Thomas Road intersection.

Consultants have previously prepared road design concept plans for future upgrading of Thomas Road on behalf of the Shire of Serpentine-Jarrahdale in consultation with Main Roads WA (MRWA) and the Department of Planning (DoP). This involves future upgrading of Thomas Road to dual carriageway standard with a two-lane roundabout at the Kardan Boulevard intersection. Current advice is that this roundabout design will not require any additional land take from the subject site.

## **2.6 *Integration with Surrounding Area***

The proposed McDonald's restaurant proposed for the subject site is appropriate for the mixed use land use designation of this site as part of the planned activity centre either side of Kardan Boulevard as shown in the LSP.

### 3.0 Development Proposal

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As detailed in the proposed site plan provided by Hindley & Associates (Drawing DA02), which is included at Appendix A, the development proposal is for a McDonald's restaurant (547m<sup>2</sup> GLA).

The proposed restaurant will have a drive through facility consisting of two lane entry with two Customer Order Booths (COBs). This facility merges into a single lane for payment and pickup.

The proposed McDonald's restaurant will include 58 marked parking bays, 2 drive-thru wait bays, drive-thru stacking space for 14 cars and a separate loading bay for delivery vehicles.

Vehicle access to the site will be obtained via a full movement driveway crossover on Pingaring Court on the southern side of the site. The location of this driveway crossover is in accordance with the local development plan (detailed area plan) for this site approved by the Shire in 2016.

As indicated on drawing DA03 at Appendix A, a 12.5m delivery vehicle (the largest size of vehicle anticipated to service this development for deliveries and rubbish collection) is able to access the site via the crossover on Pingaring Court and manoeuvre in and out of the loading bay located between the restaurant and the drive through lanes.

## 4.0 Traffic Assessment

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### 4.1 Assessment Period

This traffic analysis is based upon and updates the traffic analysis undertaken by Transcore in 2015 for the service station / fast food development that has recently been constructed at the southwest corner of Thomas Road and Kardan Boulevard, directly opposite the proposed McDonald's restaurant site.

The assessment period for this transport impact assessment considers the weekday AM and PM peak periods which will continue to be the overall peak periods of traffic flows on the adjacent road network after completion of the proposed development.

An assessment year of 2031 has been used for this analysis to coincide with 2031 traffic forecasts provided by Main Roads WA for that previous report. This more than satisfies the assessment period of ten years after completion of development, in accordance with the WAPC *Transport Impact Assessment Guidelines*.

### 4.2 Trip Generation

Traffic generation rates used in the traffic analysis are based on information sourced from the NSW Roads and Traffic Authority *Guide to Traffic Generating Developments* (2002), the Institute of Transportation Engineers *Trip Generation Manual* (9<sup>th</sup> Edition, 2012) and the WAPC *Transport Impact Assessment Guidelines* (2016).

Peak hour traffic flows for traffic generated in the whole Redgum Brook Estate North Local Structure Plan area were calculated for each land use component (i.e. west of Kardan Bvd includes 130 residential lots, 16 composite residential / light industrial lots and the service station / fast food / gym development; east of Kardan Bvd includes approximately 85 dwellings and the proposed McDonald's restaurant).

The traffic generated by these land uses (excluding the subject site) is as follows:

 West of Kardan Bvd:

- AM peak hour: 112 in / 143 out
- PM peak hour: 117 in / 116 out

 East of Kardan Bvd:

- AM peak hour: 21 in / 47 out
- PM peak hour: 47 in / 21 out

The traffic volume likely to be generated by the proposed McDonald's restaurant has been calculated based on recent sales transaction data provided for a comparable McDonald's restaurant in Bicton.

Transaction data provided for the week beginning 22 May 2017 was analysed and the weekday average AM, PM and daily transactions are summarised in Table 1.

**Table 1: Average weekday customer patronage**

Period	Total	Drive Thru	Front Counter
8am to 9am	71	58	13
4.30pm to 5.30pm	60	44	16
Daily	1154	862	292

The above patronage data was adopted for estimating the trip generation of the proposed McDonald's restaurant.

Drive through transactions generate one trip into the site and one trip out of the site.

Front counter transactions are composed of customers who drive and park at the site, walk-ins from the nearby locality and some multiple customers who travelled to the site in the same vehicle. Therefore, to derive a trip generation rate for front counter sales, Transcore reviewed previous traffic surveys undertaken at a McDonald's restaurant in Morley and compared with patronage data for that restaurant.

Review of trip generation and customer patronage data for McDonald's Morley derived the following trip generation rate for front counter sales:

- ✚ AM Peak Hour: 1.7 trips per transaction (two-way);
- ✚ PM Peak Hour: 0.57 trips per transaction (two-way); and,
- ✚ Daily: averaged 1.14 trips per transaction (two-way).

It is assumed that there will be a 50/50 inbound/outbound traffic split during the peak hour and throughout the day.

Based on the above assumptions, it is estimated that the proposed McDonald's restaurant would attract traffic flows of approximately 2,057 vehicles per day (vpd), 138 vph (69 in / 69 out) during the weekday AM peak period and 98 vph (49 in / 49 out) during the weekday AM peak period.

Another factor to be taken into consideration is the concept of passing trade.

Some of the customers visiting this development during weekday peak hours would be drivers already passing the site, mainly on Thomas Road or Kardan Boulevard, who will stop in at this site as a minor deviation from their existing journey. For example, this would typically include drivers who stop in on their way from home to work or vice versa. The WAPC *Transport Impact Assessment Guidelines* recommends

use of 50% passing traffic for fast food restaurants. These pass-by or diverted trips would be trips already on the nearby road network, not completely new trips generated by the proposed development. The other 50% are treated as primary trips (i.e. trips solely for that purpose). This has been taken into consideration in the traffic flows modelled for this transport impact assessment.

### **4.3 Trip Distribution**

Trip distribution from the other land uses in the Redgum Brook Estate North LSP area was modelled in the 2015 transport assessment report for the service station / fast food development and has been adopted as the base traffic for the current transport impact assessment. Similar assumptions are utilised for the trip distribution for the proposed McDonald's restaurant. In particular the primary trips will be mostly generated by the local residential catchment and are assumed to be distributed 77% south (to/from Byford, etc.) and 23% north (i.e. to/from Thomas Rd), based on the 2031 distribution shown in MRWA modelling previously undertaken for this area. The diverted or pass-by trips have been distributed in proportion to the traffic flows on Kardan Boulevard and Thomas Road adjacent to this site. Approximately 50% of the pass-by or diverted trips are assumed to already be travelling on Kardan Boulevard past the site and the other 50% of pass-by or diverted trips would already be passing by on Thomas Road.

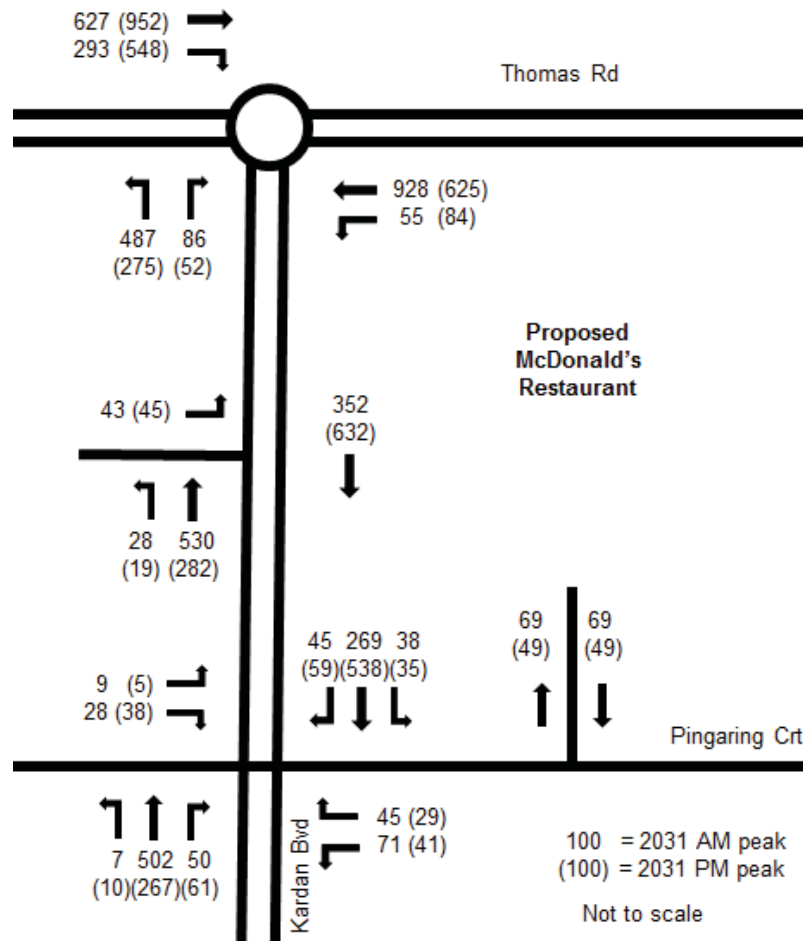
### **4.4 Traffic Flows**

The 2015 transport assessment report for the service station / fast food development utilised 2031 traffic modelling previously undertaken for this area by Main Roads WA that was provided for use as the base traffic flows for that transport assessment. That modelling included the Redgum Brook Estate North LSP area and modelled the equivalent of 300m<sup>2</sup> retail floor area on both mixed use sites southeast and southwest of the Thomas Rd / Kardan Bvd intersection.

Peak hour traffic flows of through traffic on these roads was calculated by applying peak hour factors and typical directional splits from existing traffic counts in this area (eg. Thomas Rd AM peak = 8.5% of AWT, PM peak = 8.6% of AWT, typical directional split about 60/40). Kardan Bvd peak hour characteristics were modelled on existing Hopkinson Rd traffic patterns (AM peak = 8.6% of AWT with 63% northbound, PM peak = 9.1% of AWT with 33% northbound).

An AM peak hour manual traffic count of turn movements to/from Kardan Boulevard at the Thomas Road intersection on 28 June 2017 indicated a slightly higher than anticipated proportion of traffic turning left from Thomas Rd and right out from Kardan Boulevard than was previously modelled, so the previously calculated 2031 turn traffic flows have been increased on those movements to reflect those observations. This adjustment results in an overall minor increase in traffic flows at this intersection and on Kardan Boulevard and is considered an appropriately conservative approach to ensure future traffic flows are not underestimated.

The resultant total 2031 weekday peak hour traffic flows with the proposed McDonald's restaurant and full development of the surrounding area are shown in **Figure 6**.



**Figure 6: 2031 traffic flows with full development**

#### 4.5 Intersection Analysis

The operation of two key intersections has been assessed for the future (2031) full development traffic flows shown in **Figure 6**. The intersections assessed are:

- ✚ Thomas Rd / Kardan Bvd dual lane roundabout
- ✚ Kardan Bvd / Kalyang Loop / Pingaring Ct 4-way roundabout

In addition, the existing Thomas Rd / Kardan Bvd T-intersection has been assessed for existing AM and PM peak hour traffic plus the traffic flows associated with the proposed McDonald's restaurant.

Capacity analysis of these intersections has been undertaken using the SIDRA computer software package. SIDRA is an intersection modelling tool commonly



used by traffic engineers for all types of intersections. SIDRA outputs are presented in the form of Degree of Saturation, Level of Service, Average Delay and 95% Queue. These characteristics are defined as follows:

- ✚ Degree of Saturation is the ratio of the arrival traffic flow to the capacity of the approach during the same period. The Degree of Saturation ranges from close to zero for infrequent traffic flow up to one for saturated flow or capacity.
- ✚ Level of Service is the qualitative measure describing operational conditions within a traffic stream and the perception by motorists and/or passengers. In general, there are 6 levels of service, designated from A to F, with Level of Service A representing the best operating condition (i.e. free flow) and Level of Service F the worst (i.e. forced or breakdown flow).
- ✚ Average Delay is the average of all travel time delays for vehicles through the intersection.
- ✚ 95% Queue is the queue length below which 95% of all observed queue lengths fall.

The results of the SIDRA analysis are summarised in Appendix B.

The SIDRA analysis in Tables B1a & B1b indicates that the existing Thomas Rd / Kardan Bvd T-intersection would be at 31% and 27% of capacity in the AM and PM peak periods with the proposed McDonald's restaurant traffic added to existing traffic flows. Most movements will operate at level of service A except the right turn out from Kardan Boulevard which would operate at level of service B and C in the AM and PM peak periods, respectively.

The SIDRA analysis in Tables B2a & B2b indicates that the planned Thomas Rd / Kardan Bvd dual-lane roundabout would be at 65% and 47% of capacity under the 2031 AM and PM peak hour traffic flows. All movements will operate at level of service A or B, which indicates the proposed roundabout would operate very smoothly under these modelled 2031 traffic flows.

The SIDRA analysis in Tables B3a & B3b indicates that the 4-way roundabout at the Kardan Bvd / Kalyang Loop / Pingaring Court intersection would be at 42% to 47% of capacity with all movements at level of service A or B under the modelled 2031 traffic flows with the proposed development. Average delays across all movements are 4.5 seconds per vehicle in the AM peak hour and 4.6 seconds per vehicle in the PM peak. The longest queues on any approach would be no more than three or four vehicles (north approach in the PM peak hour).

#### **4.6 Impact on Surrounding Roads**

The WAPC *Transport Assessment Guidelines* (2016) provides guidance on the assessment of traffic impacts:

*“As a general guide, an increase in traffic of less than 10 percent of capacity would not normally be likely to have a material impact on any particular section of road, but increases over 10 percent may. All sections of road with an increase greater than 10 percent of capacity should therefore be included in the analysis. For ease of assessment, an increase of 100 vehicles per hour for any lane can be considered as equating to around 10 percent of capacity. Therefore any section of road where the development traffic would increase flows by more than 100 vehicles per hour for any lane should be included in the analysis.”*

The proposed development will not increase traffic flows anywhere near the quoted WAPC threshold to warrant further analysis. The proposed development will not increase traffic on any lanes on Thomas Road or Kardan Boulevard or Pingaring Court by more than 100vph, therefore the impact on the surrounding road network is considered to be insignificant.

#### **4.7 Impact on Neighbouring Areas**

The traffic generated by the proposed development is not excessive and is not expected to have a significant effect on neighbouring areas. These traffic flows are consistent with the mixed-use land use designation of this site in the Redgum Brook Estate North LSP.

## 5.0 Parking

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The subject site is situated within the Shire of Serpentine-Jarrahdale and as such the Shire's *Town Planning Scheme No. 2* and *Local Planning Policy No 56: Fast Food Premises* are applicable to the proposed development. Refer to the planning report prepared for this development application for analysis of the scheme requirements for this development.

The current development application proposes 58 marked parking bays (including two disabled bays), a loading bay, two drive-through wait bays and queuing space for 14 cars in the drive-through facility.

Section 5.8.1 of the *NSW Guide to Traffic Generating Developments*<sup>[1]</sup> provides useful guidance on the parking requirements for drive-in, take-away food outlets.

This clause advises that:

*An exclusive area for queuing of cars for a drive through is required (queue length of 5 to 12 cars measured from pick up point). There should also be a minimum of four car spaces for cars queued from the ordering point.*

The McDonald's restaurant proposes a two-lane drive through facility with two Customer Order Booths (COBs). This facility merges into a single lane for payment and pickup.

The proposed drive through facility includes provision of 7 car stacking capacity within the drive through facility after the COBs with a combined stacking space for 7 cars at the COBs resulting in a total of 14 car stacking capacity within the drive through facility.

Accordingly, the proposed drive through facility meets the RTA recommended drive through queuing area provisions.

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<sup>[1]</sup> Guide to Traffic Generating Developments, Version 2.2, October 2002, RTA, NSW.

## 6.0 Pedestrians and Cyclists

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Pedestrian access to the proposed development will be accommodated by the footpath connection to Pingaring Court that is shown on the proposed site plan at Appendix A.

A bicycle parking rack is indicated at the front of the restaurant on the site plan at Appendix A

## 7.0 Conclusions

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This transport impact assessment relates to a proposed McDonald's restaurant development in the Shire of Serpentine-Jarrahdale.

The subject site is located at the south-eastern corner of Thomas Road and Kardan Boulevard in Byford.

Traffic generation has been assessed and full development of the site is anticipated to attract traffic flows turning in and out of the site of approximately 138 vehicles per hour (69 in / 69 out) during the weekday AM peak hour and 98vph (49 in / 49 out) during the weekday PM peak hour of the adjacent road network. A significant proportion of this traffic (at least 50%) will be passing trade already travelling on the adjacent road network.

The traffic modelling and analysis undertaken indicates that the existing T-intersection at the adjacent Thomas Rd / Kardan Bvd intersection currently has sufficient capacity to accommodate the traffic movements generated by the proposed development. The future roundabout planned as part of the future upgrade of Thomas Road to dual carriageway standard will be more than sufficient to accommodate forecast 2031 traffic flows with this proposed restaurant and full development of the surrounding area.

The intersection analysis of the existing Kardan Bvd / Kalyang Loop / Pingaring Court roundabout adjacent to the southeast corner of the site indicates that this roundabout will also operate satisfactorily under the forecast 2031 traffic flows with this proposed restaurant and full development of the surrounding area.

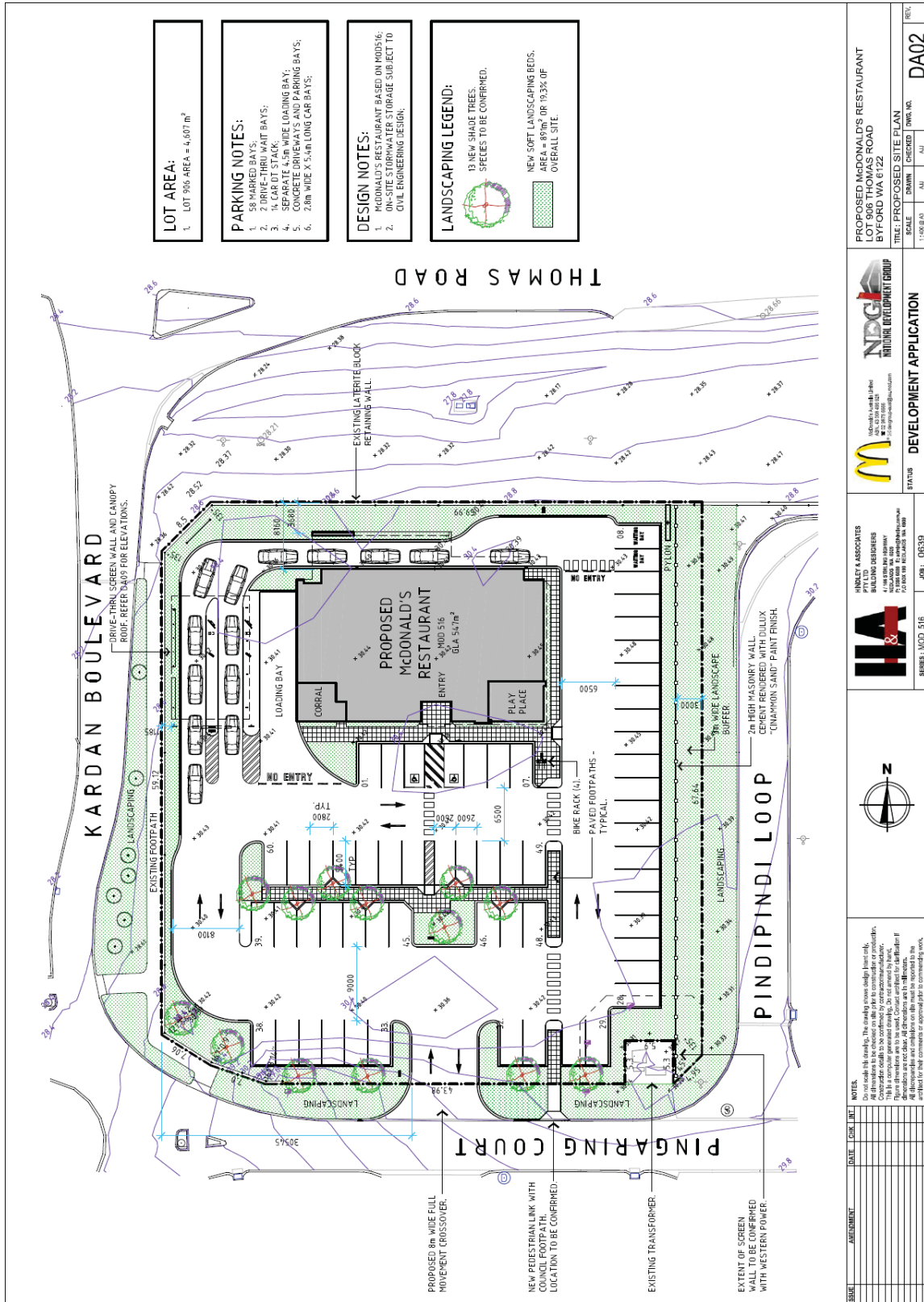
The proposed site plan shows that 58 parking spaces will be provided on site plus a loading bay for delivery vehicles and a drive-through facility with queuing space for 14 vehicles and two drive through waiting bays. Satisfactory service vehicle access is demonstrated by the turn path plan provided with the development application.

Pedestrian access is provided from Pingaring Court and bicycle parking will be provided at the front of the store as shown on the proposed site plan.

# Appendix A

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## PROPOSED DEVELOPMENT PLANS



**LOT AREA:**  
1. LOT 906 AREA = 4,407 m<sup>2</sup>

**PARKING NOTES:**  
1. 58 MARKED BAYS;  
2. DRIVE-THRU WAIT BAYS;  
3. SEPARATE STACK;  
4. CONCRETE DRIVEWAYS AND PARKING BAYS;  
5. 2.8m WIDE X 5.4m LONG CAR BAYS;

**DESIGN NOTES:**  
1. MCDONALD'S RESTAURANT BASED ON MOD 316;  
2. ALL UTILITIES TO BE REVEALED FOR ADEQUATE SUBJECT TO CIVIL ENGINEERING DESIGN.

**LANDSCAPING LEGEND:**  
13 NEW SHADE TREES SPECIES TO BE COVERED.  
NEW SOFT LANDSCAPING BEDS. AREA = 48.8m<sup>2</sup> OR 10.3% OF OVERALL SITE.

ISSUE	AMENDMENT	DATE	CODE	INT.	NOTES



PROPOSED MCDONALD'S RESTAURANT LOT 906 THOMAS ROAD BYFORD WA 6122				
TITLE: PROPOSED SITE PLAN				
SCALE	DRAWN	CHECKED	REV. NO.	REV.
1:100 @ A3	AU	AU	DA02	

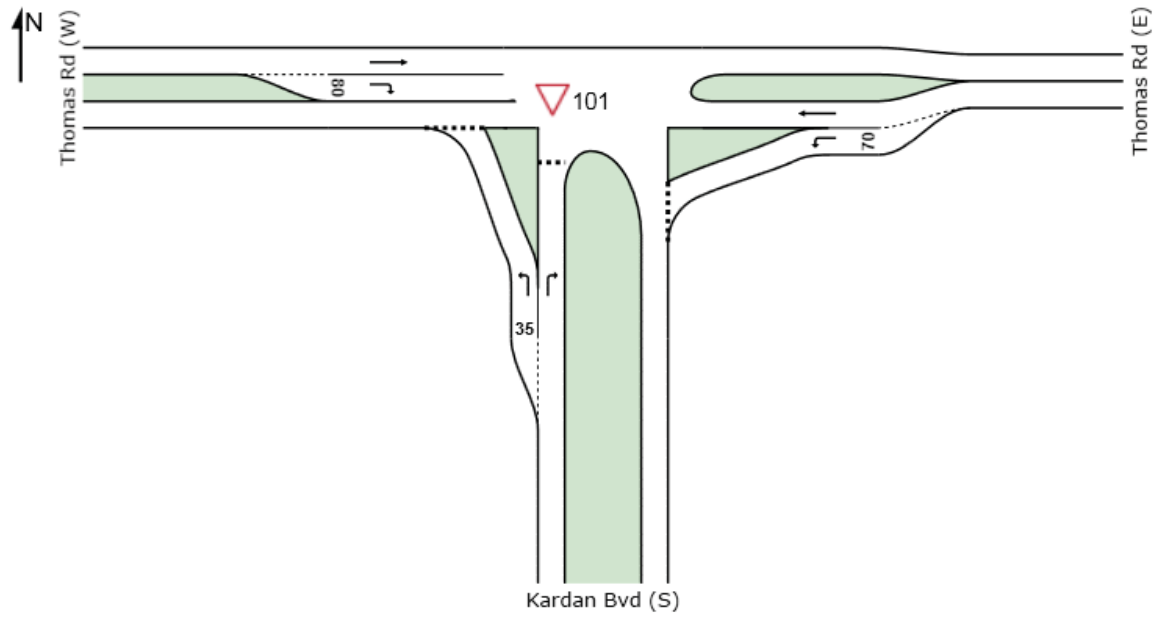




# Appendix B

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## SIDRA INTERSECTION ANALYSIS



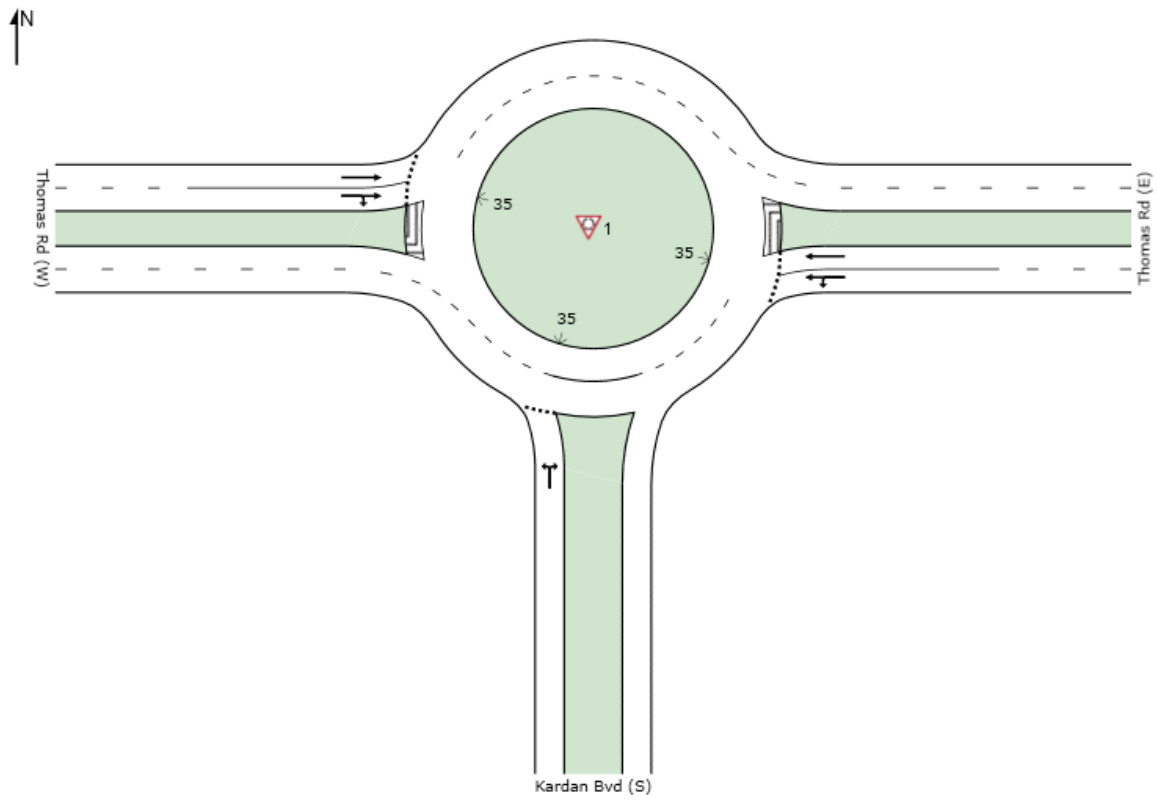
**Figure B1. Thomas Rd / Kardan Bvd existing T-intersection layout analysed in SIDRA**

**Table B1a. SIDRA results – Thomas Rd / Kardan Bvd intersection – 2017 AM peak with proposed development**

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Total veh/h	Flows 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: Kardan Bvd (S)											
1	L2	347	2.0	0.310	5.5	LOS A	1.4	10.0	0.34	0.55	51.3
3	R2	86	2.0	0.221	13.1	LOS B	0.8	6.0	0.69	0.87	46.1
Approach		433	2.0	0.310	7.0	LOS A	1.4	10.0	0.41	0.61	50.2
East: Thomas Rd (E)											
4	L2	55	2.0	0.037	6.9	LOS A	0.1	1.1	0.20	0.55	52.4
5	T1	163	15.0	0.091	0.0	LOS A	0.0	0.0	0.00	0.00	70.0
Approach		218	11.7	0.091	1.8	LOS A	0.1	1.1	0.05	0.14	64.5
West: Thomas Rd (W)											
11	T1	379	15.0	0.211	0.0	LOS A	0.0	0.0	0.00	0.00	69.9
12	R2	111	2.0	0.073	6.9	LOS A	0.3	2.4	0.29	0.58	51.5
Approach		490	12.1	0.211	1.6	NA	0.3	2.4	0.07	0.13	64.7
All Vehicles		1141	8.2	0.310	3.7	NA	1.4	10.0	0.19	0.32	58.2

**Table B1b. SIDRA results – Thomas Rd / Kardan Bvd intersection – 2017 PM peak with proposed development**

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Total veh/h	Flows 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: Kardan Bvd (S)											
1	L2	107	2.0	0.116	6.2	LOS A	0.4	3.0	0.41	0.61	51.0
3	R2	52	2.0	0.197	18.2	LOS C	0.7	4.9	0.79	0.91	43.3
Approach		159	2.0	0.197	10.1	LOS B	0.7	4.9	0.54	0.71	48.2
East: Thomas Rd (E)											
4	L2	84	2.0	0.072	7.8	LOS A	0.3	2.0	0.40	0.63	51.8
5	T1	326	15.0	0.182	0.0	LOS A	0.0	0.0	0.00	0.00	69.9
Approach		410	12.3	0.182	1.6	LOS A	0.3	2.0	0.08	0.13	65.2
West: Thomas Rd (W)											
11	T1	230	15.0	0.128	0.0	LOS A	0.0	0.0	0.00	0.00	70.0
12	R2	342	2.0	0.269	7.9	LOS A	1.3	9.6	0.48	0.69	51.0
Approach		572	7.2	0.269	4.7	NA	1.3	9.6	0.29	0.41	57.2
All Vehicles		1141	8.3	0.269	4.4	NA	1.3	9.6	0.25	0.35	58.3



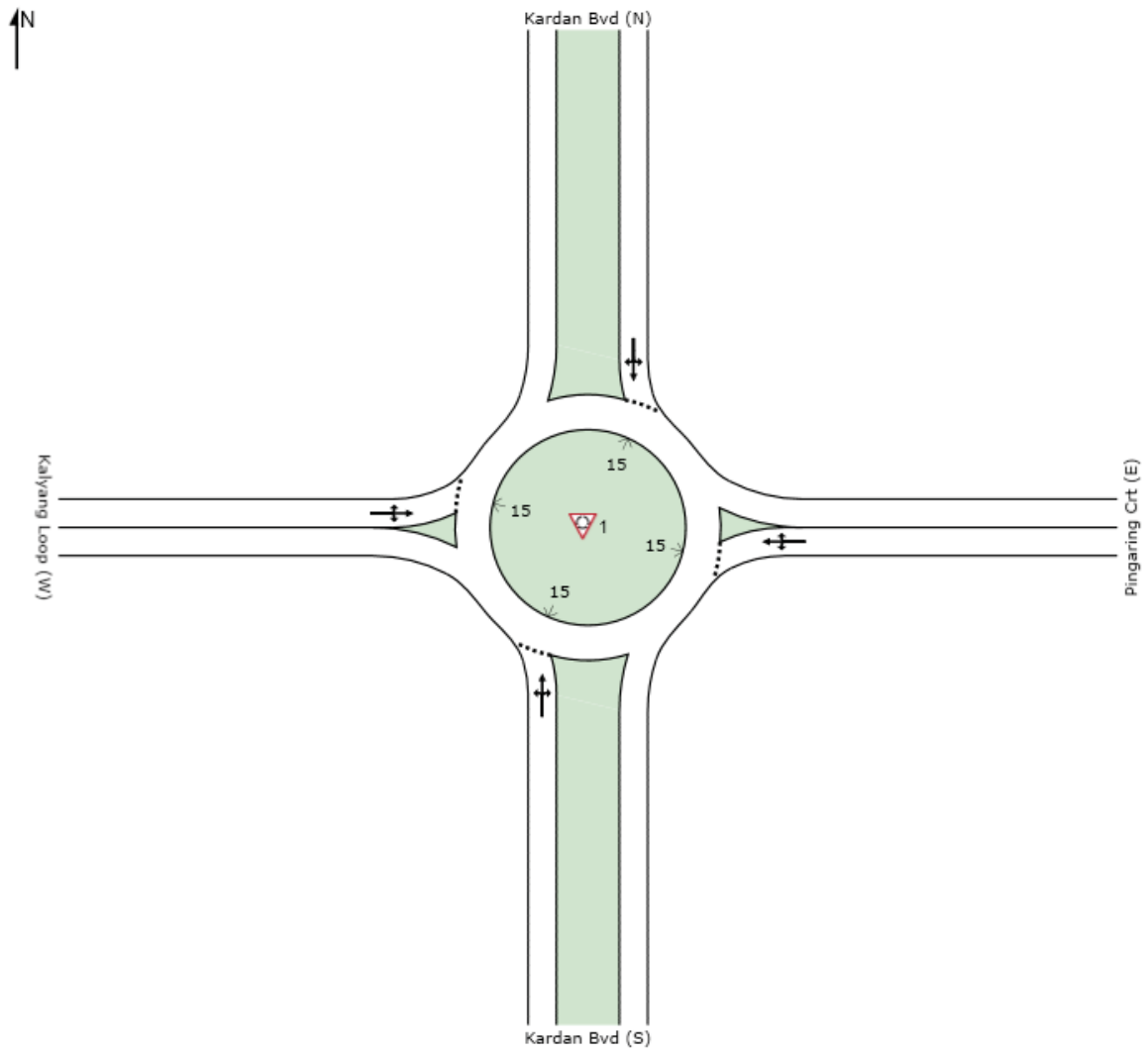
**Figure B2. Thomas Rd / Kardan Bvd roundabout layout analysed in SIDRA**

**Table B2a. SIDRA results – Thomas Rd / Kardan Bvd roundabout – 2031 AM peak with proposed development**

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Total veh/h	Flows 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: Kardan Bvd (S)											
1	L2	487	2.0	0.645	5.9	LOS A	4.0	28.5	0.73	0.91	52.0
3	R2	86	2.0	0.645	11.3	LOS B	4.0	28.5	0.73	0.91	53.5
Approach		573	2.0	0.645	6.7	LOS A	4.0	28.5	0.73	0.91	52.2
East: Thomas Rd (E)											
4	L2	55	2.0	0.382	5.7	LOS A	2.7	20.3	0.52	0.52	53.0
5	T1	928	10.0	0.382	6.2	LOS A	2.7	20.3	0.54	0.54	61.8
Approach		983	9.6	0.382	6.2	LOS A	2.7	20.3	0.54	0.54	61.3
West: Thomas Rd (W)											
11	T1	627	10.0	0.299	5.0	LOS A	2.2	17.0	0.30	0.44	62.7
12	R2	293	2.0	0.299	11.3	LOS B	2.2	15.7	0.31	0.58	54.4
Approach		920	7.5	0.299	7.0	LOS A	2.2	17.0	0.30	0.49	59.8
All Vehicles		2476	7.0	0.645	6.6	LOS A	4.0	28.5	0.50	0.60	58.4

**Table B2b. SIDRA results – Thomas Rd / Kardan Bvd roundabout – 2031 PM peak with proposed development**

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Total veh/h	Flows 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: Kardan Bvd (S)											
1	L2	275	2.0	0.328	3.4	LOS A	1.3	9.5	0.51	0.55	53.0
3	R2	52	2.0	0.328	8.8	LOS A	1.3	9.5	0.51	0.55	54.6
Approach		327	2.0	0.328	4.3	LOS A	1.3	9.5	0.51	0.55	53.3
East: Thomas Rd (E)											
4	L2	84	2.0	0.328	6.8	LOS A	2.3	17.4	0.67	0.63	52.4
5	T1	625	10.0	0.328	7.6	LOS A	2.3	17.4	0.68	0.66	60.9
Approach		709	9.1	0.328	7.5	LOS A	2.3	17.4	0.68	0.66	59.8
West: Thomas Rd (W)											
11	T1	952	10.0	0.466	5.0	LOS A	4.1	30.8	0.26	0.42	63.1
12	R2	548	2.0	0.466	11.2	LOS B	4.0	28.8	0.28	0.58	54.1
Approach		1500	7.1	0.466	7.2	LOS A	4.1	30.8	0.27	0.48	59.4
All Vehicles		2536	7.0	0.466	6.9	LOS A	4.1	30.8	0.41	0.54	58.7



**Figure B3. Kardan Bvd / Kalyang Loop roundabout layout analysed in SIDRA**

**Table B3a. SIDRA results – Kardan Bvd / Kalyang Loop roundabout – 2031 AM peak with proposed development**

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Total veh/h	Flows 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: Kardan Bvd (S)											
1	L2	7	2.0	0.421	3.7	LOS A	2.7	19.6	0.30	0.43	46.5
2	T1	502	2.0	0.421	3.7	LOS A	2.7	19.6	0.30	0.43	47.4
3	R2	50	2.0	0.421	7.7	LOS A	2.7	19.6	0.30	0.43	47.4
Approach		559	2.0	0.421	4.1	LOS A	2.7	19.6	0.30	0.43	47.4
East: Pingaring Crt (E)											
4	L2	71	2.0	0.118	4.9	LOS A	0.6	4.0	0.45	0.61	45.7
5	T1	1	2.0	0.118	4.8	LOS A	0.6	4.0	0.45	0.61	46.6
6	R2	45	2.0	0.118	8.8	LOS A	0.6	4.0	0.45	0.61	46.6
Approach		117	2.0	0.118	6.4	LOS A	0.6	4.0	0.45	0.61	46.1
North: Kardan Bvd (N)											
7	L2	38	2.0	0.268	3.6	LOS A	1.5	10.3	0.24	0.43	46.6
8	T1	269	2.0	0.268	3.6	LOS A	1.5	10.3	0.24	0.43	47.6
9	R2	45	2.0	0.268	7.5	LOS A	1.5	10.3	0.24	0.43	47.6
Approach		352	2.0	0.268	4.1	LOS A	1.5	10.3	0.24	0.43	47.5
West: Kalyang Loop (W)											
10	L2	9	2.0	0.047	6.2	LOS A	0.2	1.7	0.59	0.68	44.3
11	T1	1	2.0	0.047	6.2	LOS A	0.2	1.7	0.59	0.68	45.2
12	R2	28	2.0	0.047	10.1	LOS B	0.2	1.7	0.59	0.68	45.2
Approach		38	2.0	0.047	9.1	LOS A	0.2	1.7	0.59	0.68	45.0
All Vehicles		1066	2.0	0.421	4.5	LOS A	2.7	19.6	0.31	0.46	47.2

**Table B3b. SIDRA results – Kardan Bvd / Kalyang Loop roundabout – 2031 PM peak with proposed development**

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Total veh/h	Flows 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: Kardan Bvd (S)											
1	L2	10	2.0	0.262	3.7	LOS A	1.4	10.0	0.25	0.44	46.5
2	T1	267	2.0	0.262	3.6	LOS A	1.4	10.0	0.25	0.44	47.4
3	R2	61	2.0	0.262	7.6	LOS A	1.4	10.0	0.25	0.44	47.4
Approach		338	2.0	0.262	4.3	LOS A	1.4	10.0	0.25	0.44	47.4
East: Pingaring Crt (E)											
4	L2	41	2.0	0.091	6.5	LOS A	0.5	3.4	0.62	0.70	44.8
5	T1	1	2.0	0.091	6.5	LOS A	0.5	3.4	0.62	0.70	45.7
6	R2	29	2.0	0.091	10.4	LOS B	0.5	3.4	0.62	0.70	45.7
Approach		71	2.0	0.091	8.1	LOS A	0.5	3.4	0.62	0.70	45.1
North: Kardan Bvd (N)											
7	L2	35	2.0	0.471	3.8	LOS A	3.2	23.0	0.32	0.44	46.4
8	T1	536	2.0	0.471	3.8	LOS A	3.2	23.0	0.32	0.44	47.4
9	R2	59	2.0	0.471	7.7	LOS A	3.2	23.0	0.32	0.44	47.4
Approach		632	2.0	0.471	4.1	LOS A	3.2	23.0	0.32	0.44	47.3
West: Kalyang Loop (W)											
10	L2	9	2.0	0.039	4.8	LOS A	0.2	1.3	0.44	0.62	45.0
11	T1	1	2.0	0.039	4.8	LOS A	0.2	1.3	0.44	0.62	45.9
12	R2	28	2.0	0.039	8.7	LOS A	0.2	1.3	0.44	0.62	45.9
Approach		38	2.0	0.039	7.7	LOS A	0.2	1.3	0.44	0.62	45.7
All Vehicles		1079	2.0	0.471	4.6	LOS A	3.2	23.0	0.32	0.46	47.1