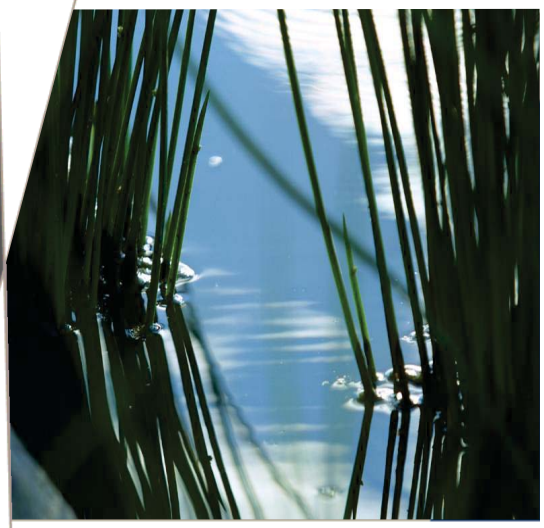
APPENDIX 4
Transport Assessment
& Addendum Memorandum

North Baldivis LSP

Transport Assessment

CEP02206



Prepared for
Upside Property Pty Ltd

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Cardno
Shaping the Future

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1 Introduction

1.1 Background

Cardno was commissioned by Upside Property Pty Ltd (a subsidiary of Cedar Woods Properties Ltd) to prepare a Transport Assessment of the proposed North Baldivis Local Structure Plan area.

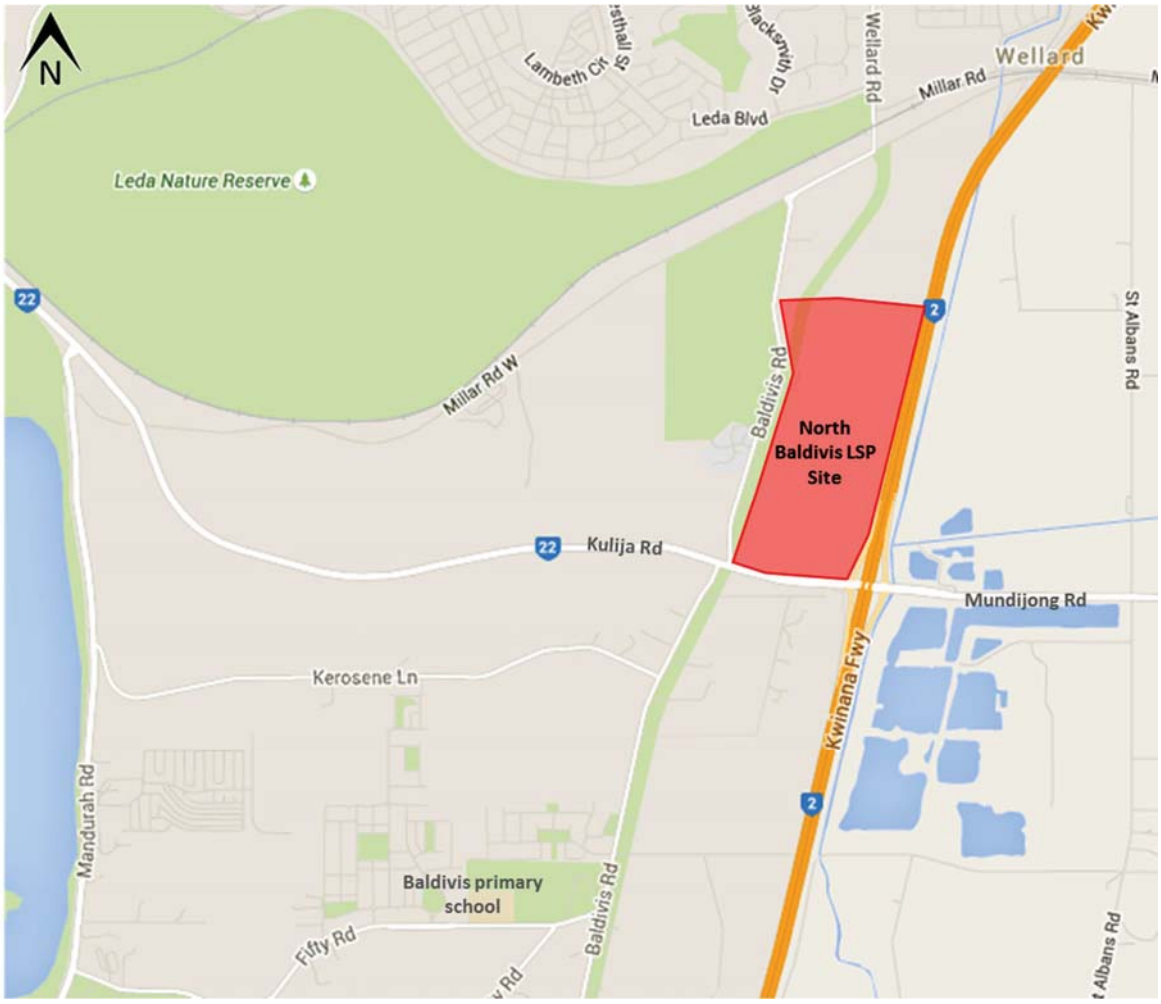
This report has been prepared in accordance with the Western Australian Planning Commission (WAPC) *Transport Impact Assessment Guidelines: Volume 2 – Planning Schemes, Structure Plans and Activity Centre Plans (2016);* the checklist is included at **Appendix A**. Specifically, this report aims to assess the internal operations of the proposed development and its access to the adjacent road network, with a focus on traffic volumes, intersection operation and accessibility.

This report also outlines the requirements and opportunities associated with traffic and transport within the development, referencing relevant City of Rockingham and WAPC policies and guidelines as well as best-practice planning within Western Australia.

1.2 Site Location

The site is bounded by Kwinana Freeway to the east, Baldivis Road to the west and Mundijong Road to the south, as indicated on **Figure 1-1**.

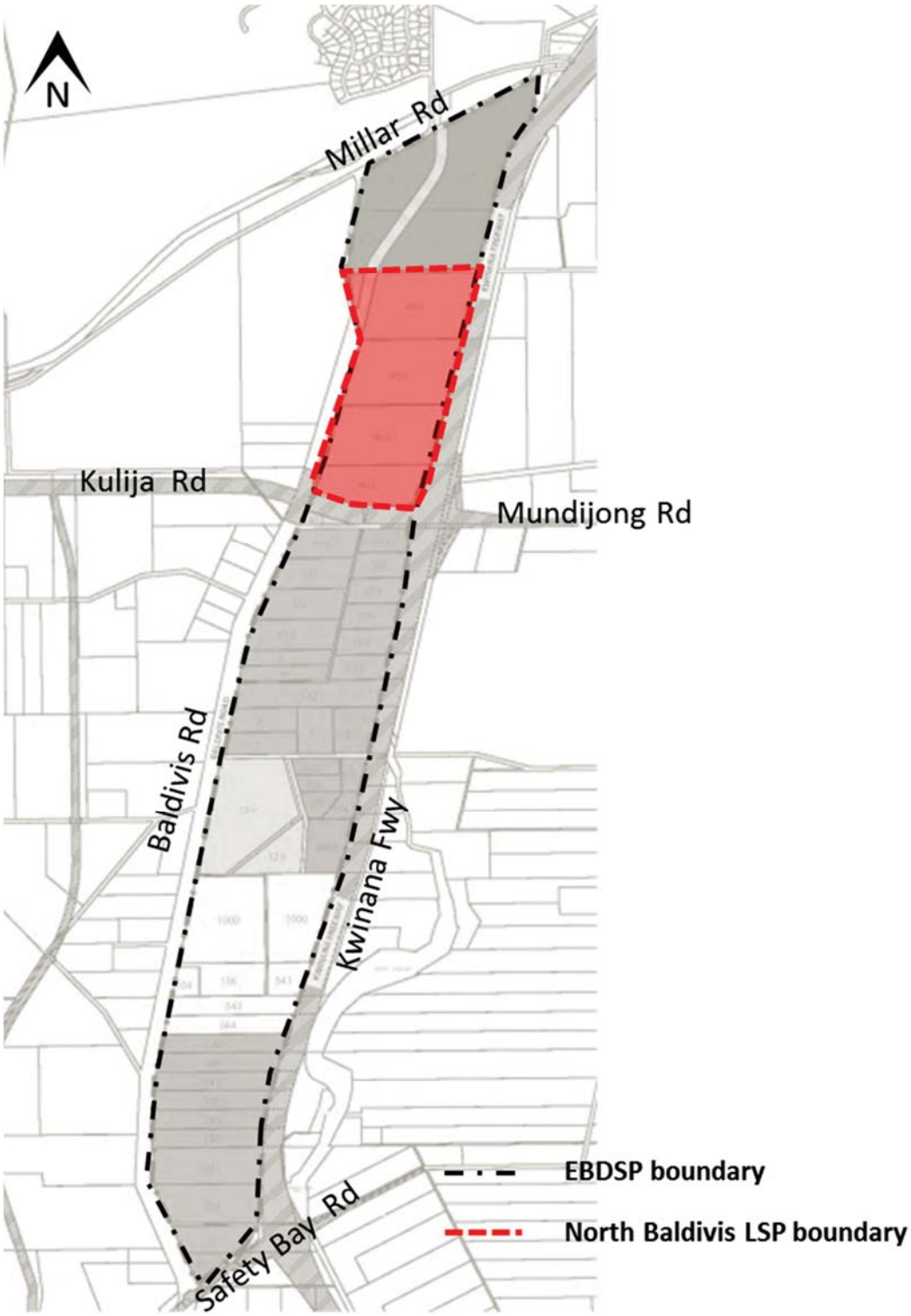
Figure 1-1 Site Location



(Source: Nearmaps, September, 2015)

The subject site is part of East Baldivis Structure Plan (EBDSP) that extends over a total area of approximately 376.5 ha (**Figure 1-2**).

Figure 1-2 EBDSP area

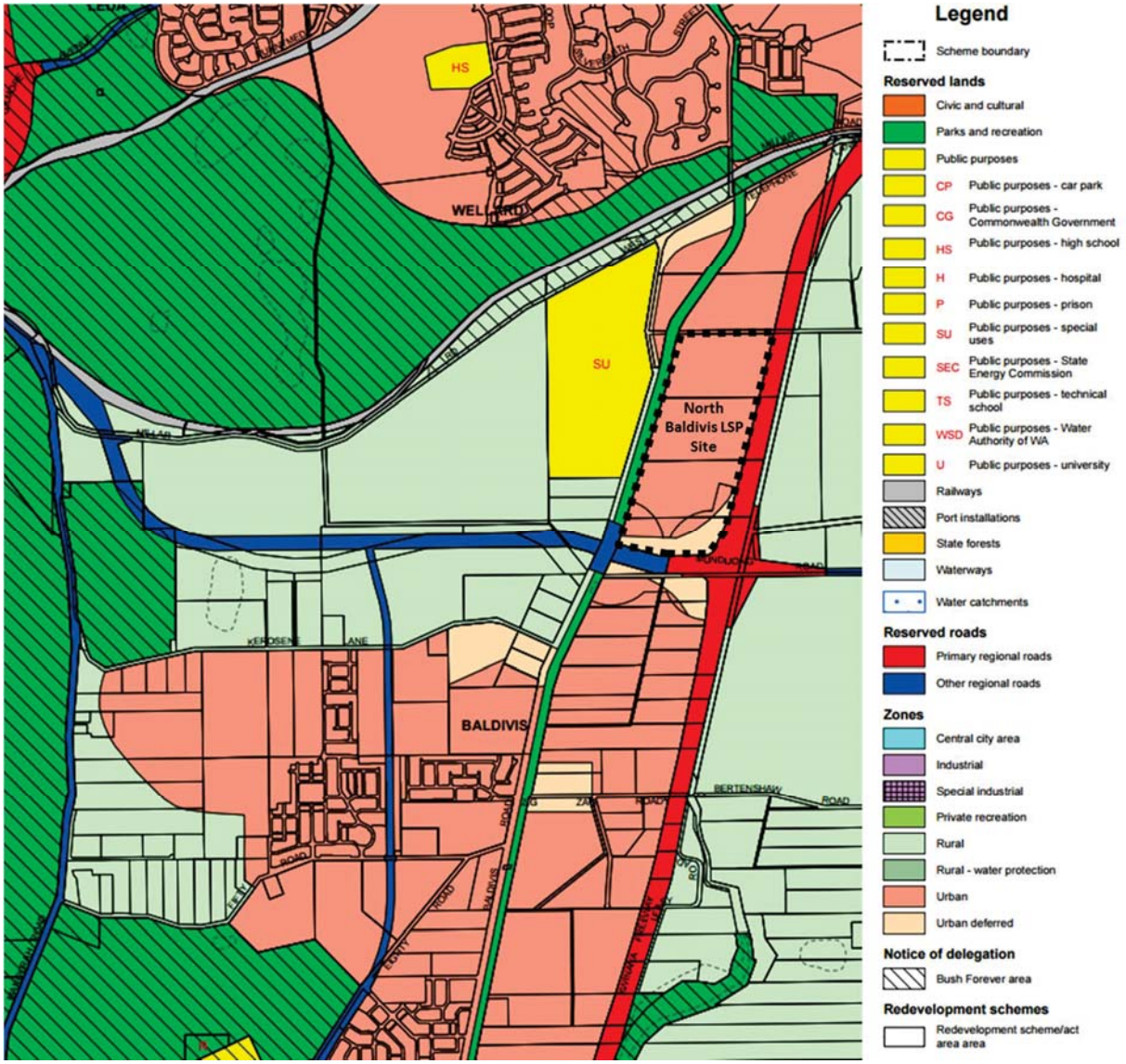


2 Existing Situation

2.1 General

The site is currently vacant land. The study area is generally zoned 'Urban' under the Metropolitan Region Scheme (MRS). Following **Figure 2-1** presents the MRS map with the subject site indicated. As shown, surrounding land uses predominantly consist of *urban*, *urban deferred*, waterways, special public and recreational uses.

Figure 2-1 Existing Surrounding Land Uses



Source: Metropolitan Regional Scheme Map, Department of Planning (extracted in September, 2015)

2.2 Existing Road network

The following discusses the characteristics of the surrounding road network:

> **Kwinana Freeway** is classified as a *Primary Distributor* according to MRWA *Metropolitan Functional Road Hierarchy* with a posted speed of 100km/h. It is a fully grade-separated four-lane dual carriageway with an approximately 20m wide median island. It is reserved as a Primary Regional Road under the Metropolitan Region Scheme and classified as 'Controlled Access Road' under the *Main Roads Act 1930*.

- **Mundijong Road** is classified as a *Regional Distributor* according to MRWA *Metropolitan Functional Road Hierarchy* with a posted speed of 70km/h. It is a two-lane dual carriageway for an approximately 365m in length for the section of road to the west of Kwinana Freeway Ramps/Mundijong Road intersection with an approximately 5.4m wide median island. Sealed shoulders are provided on both sides of the road at approximately 2.0m wide. This section of road is reserved as a *Primary Regional Road* under the Metropolitan Region Scheme. The rest of Mundijong Road is approximately 280m in length which intersects with Baldivis Road and is a single carriageway with one lane for each direction. This section of road is reserved as *Other Regional Road* under the Metropolitan Region Scheme and is approximately 7m wide plus 2m shoulders on each side of the road.
- **Kulija Road** is an extension of Mundijong Road to the west of Baldivis Road to connect with Mandurah Road. It has been constructed primarily to provide direct connectivity to Rockingham through Kwinana Freeway. It is a 4.5 km link to Dixon Road. The road was officially opened in August 2014. Kulija Road has a posted speed limit of 80km/hr and can be classified as a Regional Distributor based on its function. It is a single carriageway with one lane for each direction**.** This section of road is reserved as *Other Regional Road* under the Metropolitan Region Scheme and is approximately 7m wide plus 2m shoulders on each side of the road.
- **Baldivis Road** is classified as a *Regional Distributor* according to MRWA *Metropolitan Functional Road Hierarchy* with a posted speed of 80km/h. The road is a single carriageway with one lane for each direction. The road width is approximately 8.0m.

2.3 Existing Intersections

The following describes the existing intersections that are adjacent to the proposed development:

- **Baldivis Road/Mundijong Road/Kulija Road intersection** is located at the south-western corner of the site. The intersection is a right-left staggered T-intersection (**Figure 2-2**).
- **Kwinana Freeway Ramps/Mundijong Road intersection** is located at the south-eastern corner of the site. The intersection is a four-way signalised intersection comprising single approach and departure lanes for Mundijong Road with approximately 45m right turn pocket on Mundijong Road westbound and approximately 240m continuous left turn slip lane on Mundijong Road eastbound which will merge with the Kwinana Freeway northbound on ramp through lane. Kwinana Freeway northbound off ramp has an approximately 280m continuous left turn slip lane which will merge with Mundijong Road westbound through lane.

2.4 Existing Traffic Volumes

Existing weekday traffic volumes were obtained from Main Roads WA and other sources for key road sections in the vicinity of the site as shown in **Table 2-1**.

Table 2-1 Existing Weekday Traffic Volumes

Location	Weekday Traffic Volumes (two-way)		
	Daily	AM Peak (7am-8am)	PM Peak (4pm-5pm)
Baldivis Road, north of Mundijong Road	3,497	311	346
Baldivis Road, south of Mundijong Road	8,616	606	864
Mundijong Road, west of Kwinana Freeway	8,553	641	778
Kulija Road, west of Baldivis Road	6,263	426	625

Source: City of Rockingham Traffic Counts, September, 2014

2.5 Existing Intersection Operation

The existing site consists of vacant land. Recent upgrades to Mundijong Road and construction of Kulija Road (Mundijong Road extension) officially opened in September 2014 to include the creation of a right-left staggered T-intersection of the form shown below, **Figure 2-2**.

Figure 2-2 Modified Mundijong Road/Baldivis Road Intersection

Source: Nearmaps, September, 2015

Given that this extension has only recently been constructed, there is insufficient data to undertake an assessment of its existing operation.

2.6 Existing Pedestrian/Cycle Networks

The existing pedestrian/cycle networks are summarised as follows:

> Principal Shared Path (PSP) alongside of the Kwinana Freeway;
> Sealed shoulders of approximately 2.0m wide on both sides of Mundijong Road.

2.7 Existing Public Transport Services

There is currently no provision of public transport service in the vicinity of the site. The nearest viable public transport facility is Wellard Station, approximately 2.7km from the site. Public transport access is therefore currently only considered feasible via Park ‘n’ Ride.

2.8 Crash Assessment

Crash data for the five year period between January 2011 and December 2015 has been obtained from Main Roads WA (MRWA) for the section of Baldivis Road North of Mundijong Road including the Baldivis Road/Mundijong Road intersection.

These are summarised and presented in **Table 2-2** through **Table 2-3**.

It should be noted that the intersection form for the Mundijong Road/Baldivis Road intersection has been extensively modified and that there is insufficient evidence to support any conclusions regarding the safety of this intersection.

Table 2-2 Crash statistics at Baldivis Road/ Mundijong Road (2011-2015)

Type of Crash (RUM Code)	Fatal	Hospital	Medical	Major Property Damage	Minor Property Damage	Total Crashes
Rear End	-	-	3	3	4	**10**
Right Angle	-	1	1	6	1	**9**
Hit Object	-	-	-	2	-	**2**
Total	**-**	**1**	**4**	**11**	**5**	**21**

Table 2-3 Crash statistics along Baldivis Road (between Mundijong Road and Millar Road) 2011-2015

Type of Crash (RUM Code)	Fatal	Hospital	Medical	Major Property Damage	Minor Property Damage	Total Crashes
Head On	-	1	-	-	-	**1**
Right Angle	-	-	-	-	-	**-**
Hit Object	-	2	-	3	-	**5**
Rear End	-	-	-	-	1	**1**
Total	**-**	**3**	**-**	**3**	**1**	**7**

Table 2-4 Crash statistics at Baldivis Road/ Millar Road (2011-2015)

Type of Crash (RUM Code)	Fatal	Hospital	Medical	Major Property Damage	Minor Property Damage	Total Crashes
Hit Object	-	-	-	1	-	1
Total	**-**	**-**	**-**	**1**	**-**	**1**

In summary,

> No fatalities were recorded.
> There were 4 crashes that resulted in hospital admittance.
> There were 4 crashes that resulted in receiving medical treatment but not requiring hospital admittance.
> The majority of the crashes, including all of the Rear End crashes, occurred at the Baldivis Road/Mundijong Road intersection, which has subsequently been reconstructed.
> Rear End and Hit Object crashes are noted to be significantly over-represented, compared with network averages.

3 Background Information

As stated earlier, construction of Kulija Road has recently been completed between Baldivis Road and Mandurah Road, connecting to Nairn Road along its length. Due to the staggered-T intersection configuration created at Baldivis Road/Mundijong Road, the north-south route along Baldivis Road may become less attractive for vehicular access to/from Kwinana.

It is also noted that Mundijong Road east of Kwinana Freeway is planned to be widened to a 4-lane carriageway in the near future due to the proposed industrial development in that area (source: *WAPC Directions 2031 and Beyond*). This proposed road expansion has been identified in the Planning Framework for Perth and Peel at 3.5 million.

Future modification of the Kwinana Freeway/Mundijong Road interchange has been accommodated in the structure plan and identified as a 'Road Resumption' zone. The scale of this interchange design is likely to ultimately restrict access from Baldivis Road onto Mundijong Road, necessitating further modification of the existing staggered T-intersection to a flyover. It is expected that this will have a significant impact on distribution of traffic from the North Baldivis Development and across the nearby region.

3.1 Previous Reports

3.1.1 Baldivis Roads Needs Study: Traffic and Infrastructure Report

The Baldivis Roads Needs Study was originally prepared in 2005. This study considers the requirement for road network improvements to support long-term residential development of Baldivis.

The study proposed Baldivis Road as a Local Distributor with a maximum capacity of 10,000-12,000 vehicles and Mundijong Road as a District Distributor.

3.1.2 Review of Baldivis East District Structure Plan Transport Assessment

Transport Assessment for Baldivis East District Structure Plan, revised in February 2012, comprises a general review of traffic impacts and requirements for the proposed development in the East Baldivis area.

With respect to Baldivis Road, the report investigated two options.

- Option 1 considered Baldivis Road/ Mundijong Road intersection as a staggered T-intersection similar to the recent upgrade completed by Main Roads WA. Use of Baldivis Road north of Mundijong Road is projected to be in the order of 15% local traffic (internal-internal) and up to 10% destination traffic (internal-external). The remaining 75% of traffic is anticipated to be strategic through traffic (external-external), using Baldivis Road as a connection between the residential developments to the south and the Baldivis Town Centre.
  In this scenario, Mundijong Road is considered to have the capacity to carry 12,000 to 18,000 vehicles per day in the 20 to 25 year timeframe.
- Option 2 comprises the ultimate grade separation of Mundijong Road and Baldivis Road and removal of access to Mundijong Road via Baldivis Road (i.e. a flyover). This potentially creates a higher demand for Baldivis Road by development to the north and south of Mundijong Road, increasing traffic volumes to as much as 18,200 in this analysis.

The *Baldivis East DSP Transport Assessment* recommends upgrading Baldivis Road to a *District Distributor A* to be able to carry the extra traffic proposed by the upgrade of the Baldivis Road / Mundijong Road intersection.

3.2 Future Traffic Volumes

MRWA was consulted in order to obtain information on the likely future volumes on both Baldivis Road and Mundijong Road within close proximity of the proposed development.

MRWA's ROM24 modelling suggests that 2021 traffic volumes on Baldivis Road (north of Mundijong Road) is expected to be approximately 14,000 vehicles per day. MRWA suggests that for the 2031 scenario, traffic volumes on Baldivis Road is likely to reach 15,600 vehicles per day. It also suggests approximately 43,000 vehicles per day is expected in the ultimate condition (full development of Fremantle Outer Harbour, Latitude 32, KIA and IP14) however the timeframe is unknown. The *Baldivis East District Structure Plan – Revised Transport Assessment* suggests that in the ultimate condition, Baldivis Road is expected to have approximately 16,200 vehicles per day. This report adopted traffic volume of 16,200 vehicles per day (assumed to include traffic generation for the proposed development described in this report) for the year 2031 scenario along Baldivis Road and it aligns with information obtained from MRWA's ROM24 model.

MRWA's ROM24 modelling suggests that 2021 traffic volumes on Mundijong Road (west of Kwinana Freeway) is expected to be approximately 23,000 vehicles per day (not considering Fremantle Rockingham Constrained Access Highway). In the ultimate condition, Mundijong Road is expected to carry approximately 52,000 vehicles per day. The *Baldivis East District Structure Plan – Revised Transport Assessment* suggests that in the ultimate condition, Mundijong Road is expected to have approximately 19,500 vehicles per day.

4 Changes to Surrounding Transport Networks

4.1 Road Network

The Mundijong Road extension has recently been completed between Baldivis Road and Mandurah Road, connecting to Nairn Road along its length. Due to the staggered-T intersection configuration proposed for Baldivis Road/Mundijong Road, the north-south route along Baldivis Road may become less attractive for vehicular access to/from Kwinana.

It is also noted that Mundijong Road east of Kwinana Freeway is planned to be widened to a 4-lane carriageway in the near future due to the proposed industrial development in that area (source: WAPC *Directions 2031 and Beyond*).

Future modification of the Kwinana Freeway/Mundijong Road interchange has been accommodated in the structure plan and identified as a 'Road Resumption' zone. The scale of this interchange design is likely to ultimately restrict access from Baldivis Road onto Mundijong Road, necessitating further modification of the existing staggered T-intersection to a flyover. It is expected that this will have a significant impact on distribution of traffic from the North Baldivis Development and across the nearby region.

4.2 Changes to Pedestrian/Cycle Networks

Provision of pedestrian/cycle network within the adjacent Development Areas of the Baldivis Structure Plan and connection from these to the North Baldivis LSP are subject to further concept design.

4.3 Public Transport

As the site is located in a semi-rural area, it is expected that local residents will access services by private vehicle modes in the short-term. However, when residential precincts are fully developed, it is expected that improvement to the public transport network will be carried out by the Public Transport Authority.

It is noted that the *Baldivis Road Study Update – Traffic and Infrastructure Report*, dated January 2012, proposes a future bus route 569 which would run along Baldivis Road adjacent to the development site.

Recent discussions with PTA suggests that there are plans to operate Route 569 along Baldivis Road between Wellard and Warnbro Stations. PTA mentioned that these plans are subject to growth of residential area, road network and resource availability.

5 Proposed Development

5.1 Proposed Development Land Uses

According to the site plan and development yield information provided by the planners RPS Australia East Pty Ltd, the proposed development consists of the following elements:

- Total Site Area 67.78 ha
- Net Residential Area 32.9 ha, approximately 830 lots at an average of 375 sq.m per lot
- Total Open Space 8.5 ha
- Wetland 0.87 ha
- Commercial 0.65 ha (990m^2 GLA assumed)
- School 3.5 ha
- Balance Lot 1.08 ha
- Roadways (approximate) 14.19 ha

The land use areas, for the purposes of traffic generation, are summarised in **Table 5-1**.

Table 5-1 Land Use Traffic Generation

Land Use	Yield
Residential Lots	830 lots
Commercial	990m^2
School	3.5 ha

The proposed site plan is included at **Appendix B**.

5.2 Access arrangements

It is proposed that site access be entirely from Baldivis Road and will consist of:

> One full movement intersection via Pug Road to Baldivis Road; and
> One full movement intersection directly to the proposed development, referred to as the 'Southern Access' within the report.

5.3 Development Traffic Generation

To estimate traffic generation for the proposed development, trip generation rates were applied. Trip generation for the development has been estimated generally in accordance with *The Institute of Transportation Engineers (ITE): Trip Generation 7th Edition* and *RTA Guide for Traffic Generating Developments.*

For the purpose of determining potential trip generation rates, the proposed development has been assessed as per the following classifications (see **Table 5-2**):

Table 5-2 North Baldivis Development Classification

Land Use	Classification	ITE Classification Code
Residential Lots	ITE Single-Family Detached Housing	210
School	RTA (Primary School)	
Commercial	ITE Speciality Retail Centre	814

Table 5-3 summarises the ITE trip generation rates for each peak and daily time period.

Table 5-3 ITE Trip Generation Rates

ITE Land Use	ITE Land Use Code	Trip Generation Rates		
		AM Peak Hour	PM Peak Hour	Average Weekday
Residential Lots	210	0.77 trips/ dwelling unit	1.02 trips/ dwelling unit	9.57 trips/ dwelling unit
School	520	1 trips/ student	1 trips/ student	2 trips/ student
Commercial	814	6.84 trips/ 1,000sq.ft. GFA	5.02 trips/ 1,000sq.ft. GFA	44.32 trips/ 100 sqm GFA

5.4 Development Traffic Distribution

Inbound and outbound distribution for the development is expected to be as shown in **Table 5-4**.

Table 5-4 ITE Directionality Rates

ITE Land Use	AM Peak Hour		PM Peak Hour		Average Weekday	
	IN	OUT	IN	OUT	IN	OUT
Residential Lots	26%	74%	64%	36%	50%	50%
School	50%	50%	50%	50%	50%	50%
Commercial	48%	52%	56%	44%	50%	50%

Table 5-5 summarises the expected trip generation for the proposed development

Table 5-5 Development Trip Generation

ITE Land Use	Development Yields Up to	AM Peak Hour		PM Peak Hour		Average Weekday	
		IN	OUT	IN	OUT	IN	OUT
Residential Lots	830 dwellings	166 trips	473 trips	542 trips	305 trips	3,972 trips	3,972 trips
School	400 students	200 trips	200 trips	200 trips	200 trips	400 trips	400 trips
Commercial	990m^2	35 trips	38 trips	30 trips	24 trips	236 trips	236 trips

Generation by the primary school is expected to be local to the development. It is not expected to directly interact with Baldivis Road.

It should be noted that the student yield used for the assessment reflects the ultimate scenario where the entire EBDSP is developed. In the interim scenario, based on the staging of EBDSP the student enrolment to North Baldivis LSP primary school is expected to vary.

5.5 Vehicle Parking Provision

The statutory parking requirement for the proposed development is listed in **Table 5-6** in accordance with the City of Rockingham *Town Planning Scheme 2*.

Table 5-6 Car Parking Requirement

Land Use	City of Rockingham *TPS No. 2* Car Parking Rates
RESIDENTIAL USES	
Residential Dwelling Units (as per R-Code)	Single House: 2 spaces per dwelling
COMMERCIAL USES	
Store	6 spaces per 100sqm of NLA

The development concept plan included at **Appendix B** does not provide detail of car parking provision. Therefore, it is expected that the above rates will be used as a benchmark in further subdivision design works.

5.6 Bicycle Parking and End of Trip Facilities

The City of Rockingham *Planning Policy 3.3.14 – Bicycle Parking & End-of-Trip Facilities* provides requirements for bicycle parking provision and are summarise below in **Table 5-7**. This document does not have rates for school uses therefore bicycle parking provision rate has been taken from Austroads *Guide to Traffic Management Part 11 – Parking*.

Table 5-7 Bicycle Parking Requirements

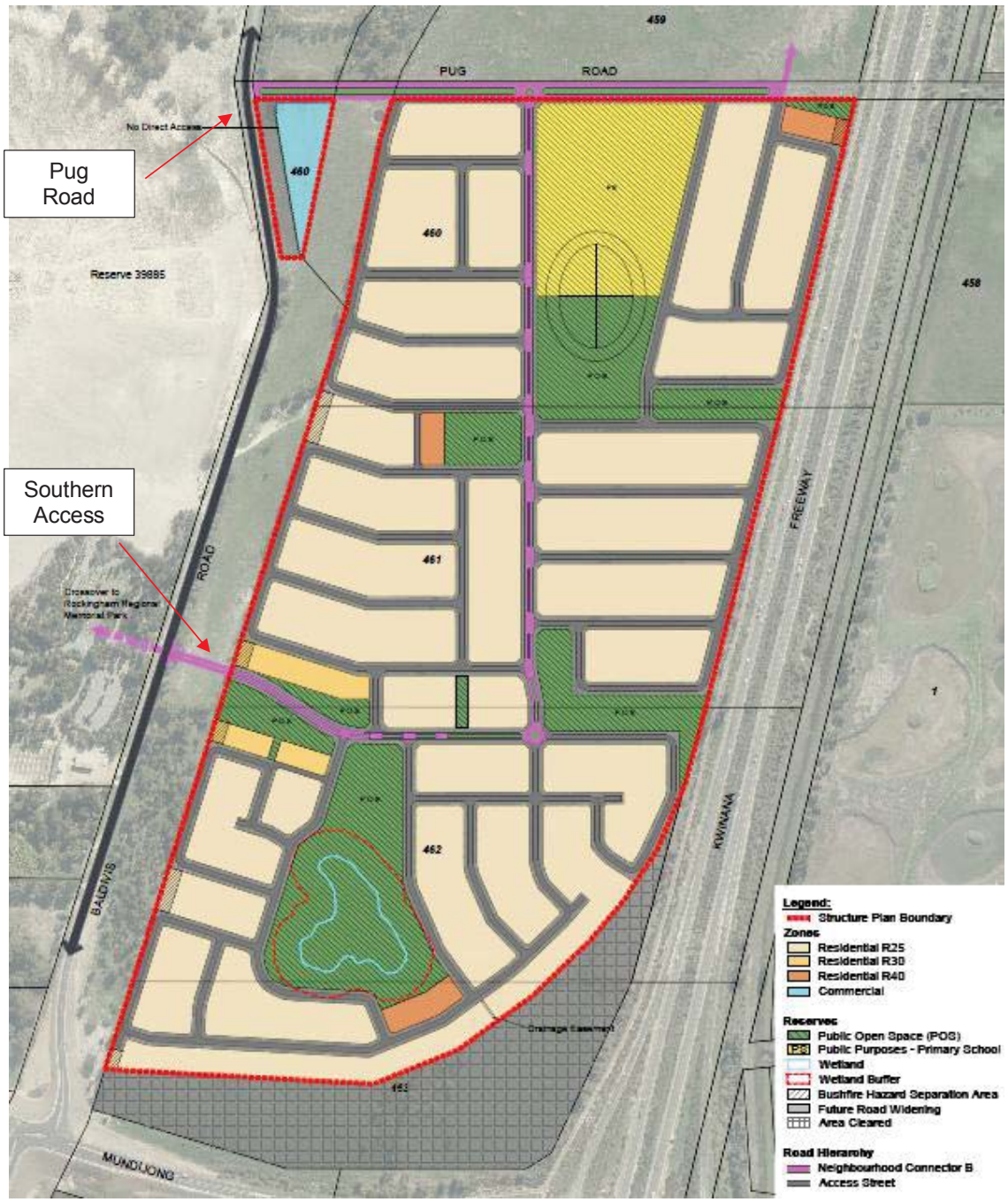
Land Use	Bicycle Parking Rates
RESIDENTIAL USES	
Residential Grouped and Multiple Dwelling Units (as per R-Code)	1 space per 3 dwellings for resident, plus 1 space per 10 dwelling for visitor
COMMERCIAL USES	
Local Shops (less than 1,000sqm NLA)	1 space per 250sqm NLA (long term), plus 1 space per 150sqm NLA (short term, minimum 2 spaces)
Neighbourhood Centres (between 1,001sqm to 4,999sqm NLA)	1 space per 500sqm NLA (long term, minimum 4 spaces), plus 1 space per 300sqm NLA (short term, minimum 6 spaces)
District Centres (greater than 5,000sqm NLA)	1 space per 1,500sqm NLA (long term, minimum 10 spaces), plus 1 space per 750sqm NLA (short term, minimum 16 spaces)
COMMUNITY USES	
School (from Austroads)	1 space per 5 pupils over year 4

The development plans included at **Appendix B** do not provide detail of bicycle parking provision. Therefore, it is expected that the above rates will be used as a benchmark in further subdivision design works.

5.7 Internal road layout

The development concept plans included at **Appendix B** show the proposed access arrangement for the development. It is noted that that all of the proposed internal roadways will accommodate two way circulation of traffic. **Figure 5-1** shows the access and internal road network for the proposed development.

Figure 5-1 Internal Road and Access Plan



An internal spine road (Neighbourhood Connector) is proposed within the site, which links the Southern Access Road to Pug Road. Traffic management at the intersection of Pug Road and the southern access road is shown to be via a roundabout treatment to reinforce lower speeds and control turning movements. Alternatively, a priority intersection may be retained to provide better pedestrian and cycling amenity.

All other roads are proposed to be constructed as Access Roads.

It should be noted that where possible, uncontrolled 4-way intersections have been avoided. Staggered T treatments have been used in place of 4 way intersections. It is noted that all the staggered T treatments will have a minimum separation distance or an island treatment to stay lane correct.

The geometry of the internal road network has been designed to spread traffic flows across the network. This feature will improve pedestrian and cycling amenity for crossing movements.

The hierarchy of roads within the LSP area is illustrated in **Figure 5-2** using the road hierarchy defined in *Liveable Neighbourhoods* (2007).

As illustrated, roads surrounding the primary school are proposed to be classified as Access Street B while other internal streets are proposed to be built as Access Street C and D profile roads.

Figure 5-2 Internal Road Hierarchy

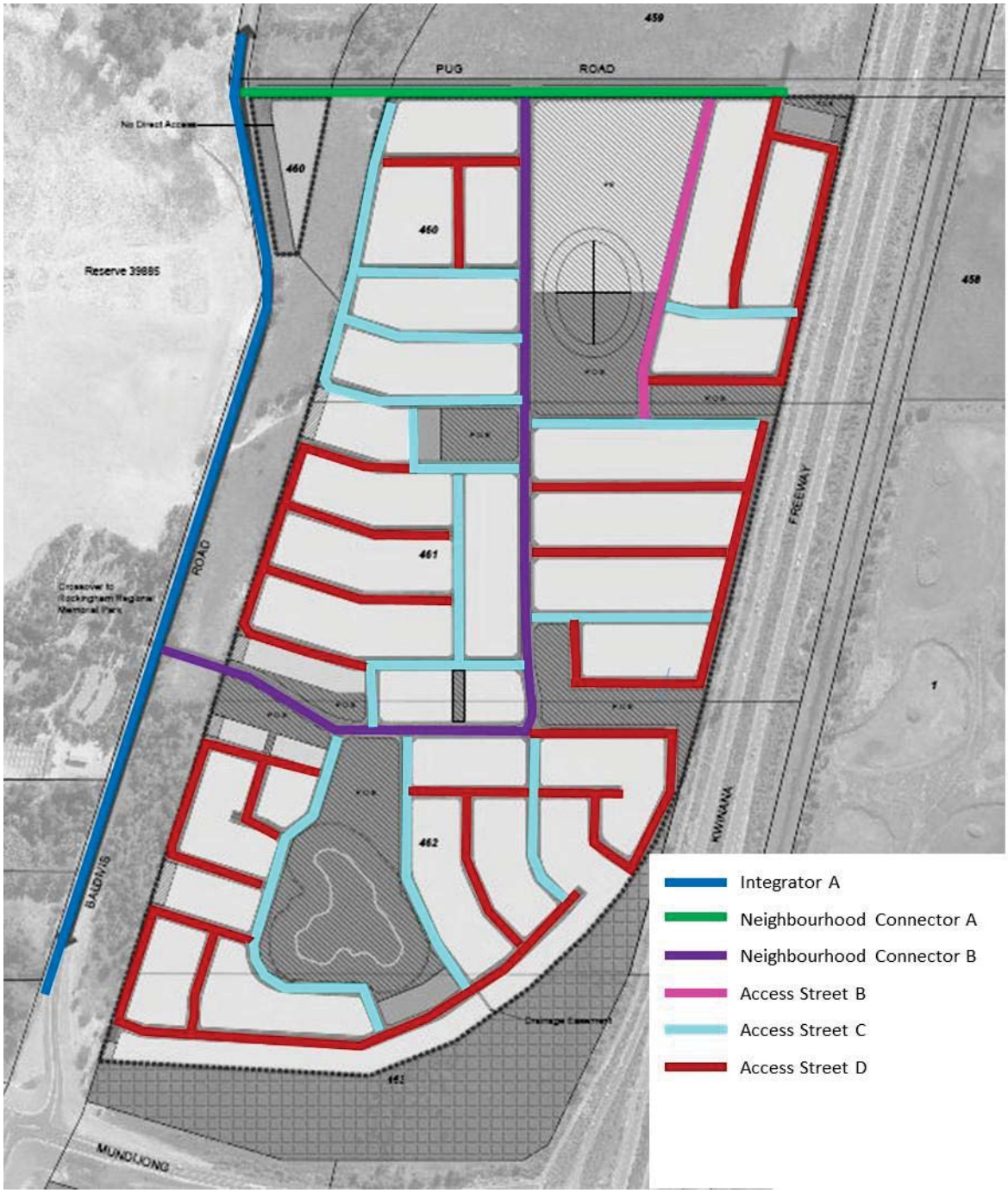


Figure 5-3 through to **Figure 5-7** present the road cross sections for different road hierarchies proposed for the LSP based on the guidelines set out by *Liveable Neighbourhoods (2007)*.

Figure 5-3 Neighbourhood Connector A

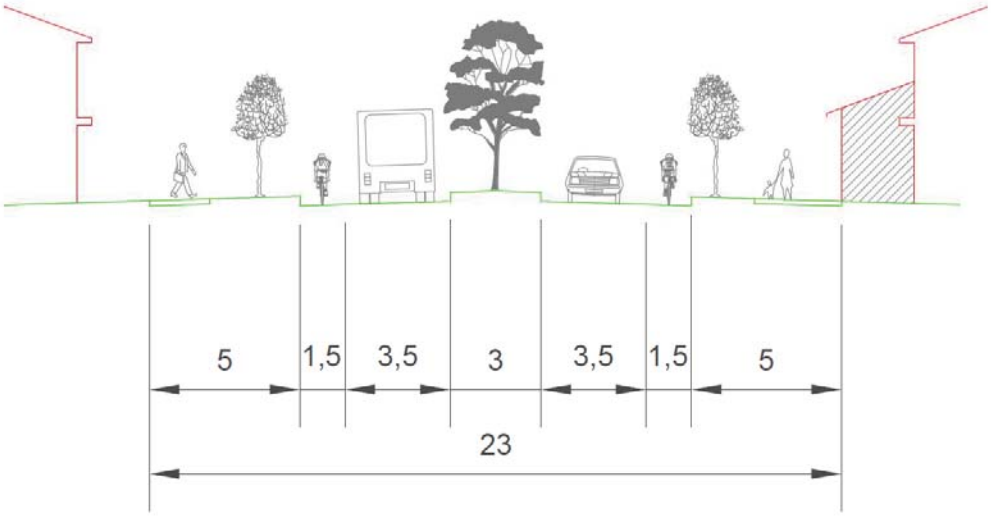


Figure 5-4 Neighbourhood Connector B

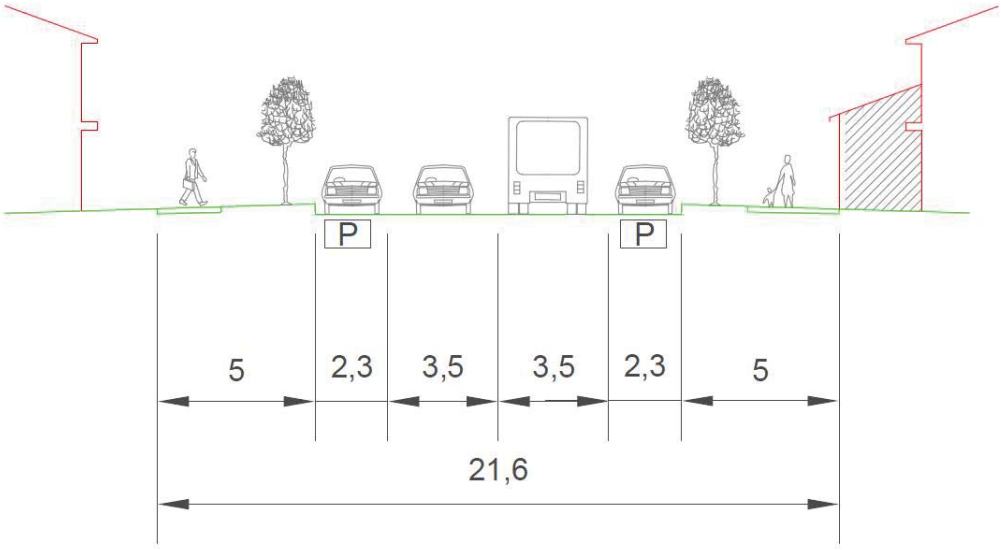


Figure 5-5 Access Street B

Figure 5-6 Access Street C

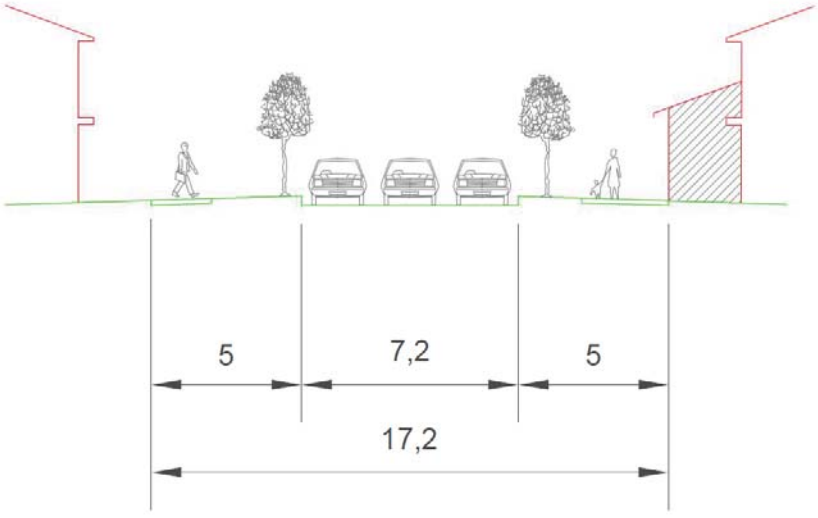
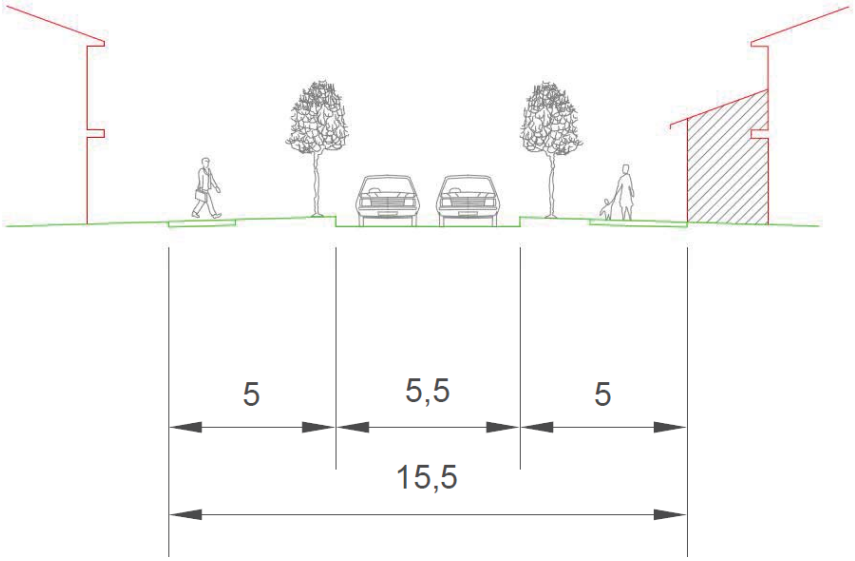


Figure 5-7 Access Street D



It should be noted that the road reserve widths associated with the road hierarchy classification are indicative and would be discussed in detail at sub-division stage.

Upgrades to Baldivis Road and Pug Road, where it abuts the Structure Plan, will be provided at subdivision stage. It is noted that Baldivis Road will require upgrade to permit retrofit to an Integrator 'A' profile road in the future.

5.8 Committed Development in the Area

It is also noted that Mundijong Road east of Kwinana Freeway is planned to be widened to a 4-lane carriageway in the near future due to the proposed industrial development in that area (source: WAPC *Directions 2031 and Beyond*).

The North Baldivis LSP is part of the larger residential development which extends south between Baldivis Road and the Kwinana Freeway to Safety Bay Road. The impact of this larger residential cell has been included in the assessment for future operation of the road network.

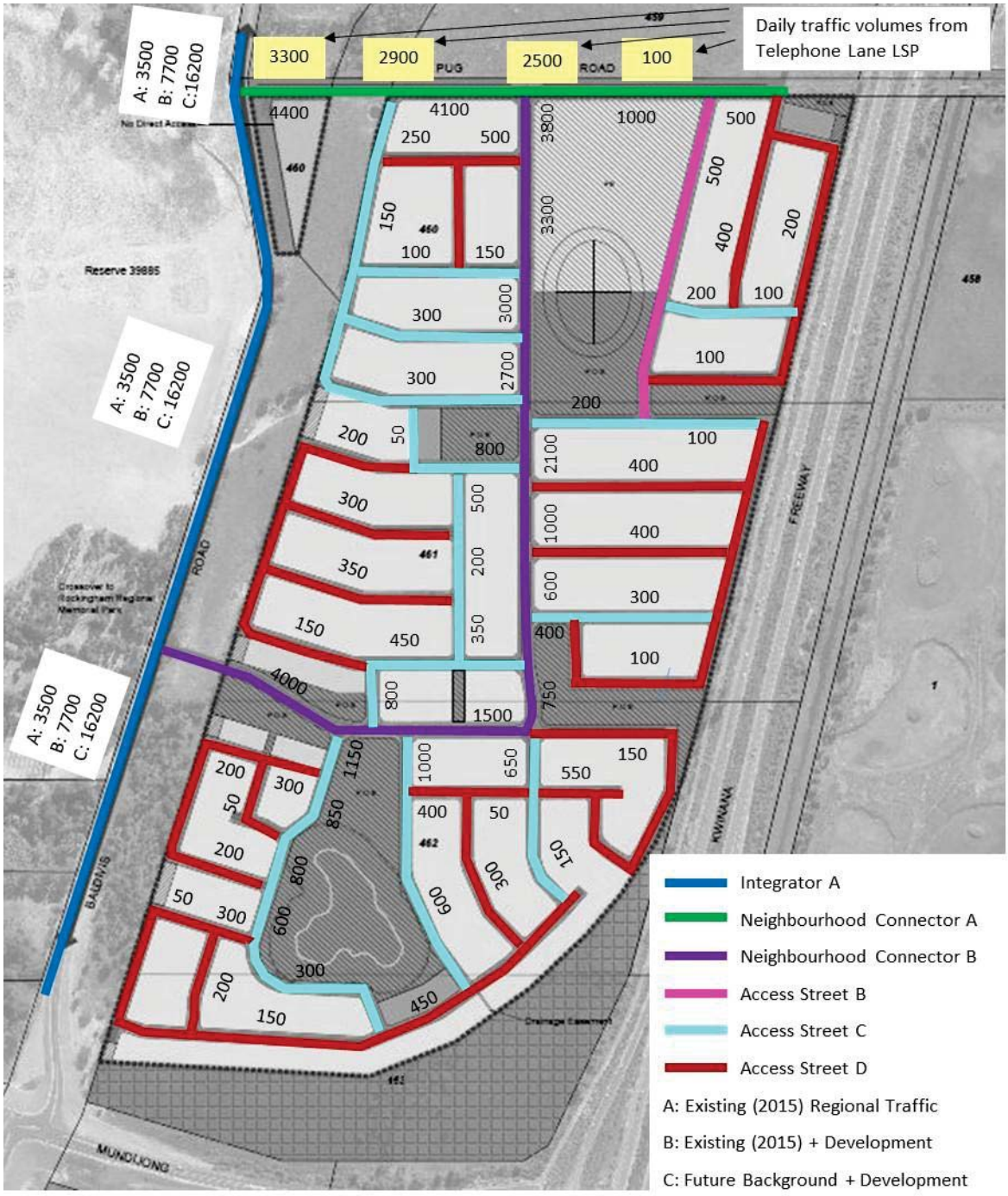
6 Analysis of Transport Network

6.1 Traffic flow forecasts

The future total daily traffic flows on the road network in and around the LSP area has been modelled for the future scenario of full development of this area as discussed above.

Figure 6-1 illustrates future total daily traffic flows anticipated on the road network of the LSP area.

Figure 6-1 Internal Traffic Flow Forecasting



6.2 Transport Assessment

Future traffic conditions have been analysed with the proposed development for the anticipated development year (2016) and a 15-year forecast year (2031). The assessment quantifies the effect that the additional development traffic has on the surrounding road network, specifically for the intersections listed below:

> Baldivis Road/Pug Road Intersection
> Baldivis Road/Internal Road Intersection (Southern Access).

The assessment undertaken in this study considers the weekday AM peak period 7:15am-8:15pm and the weekday PM peak period 4:15pm-5:15pm.

6.3 Growth Rates and Future Year traffic flows

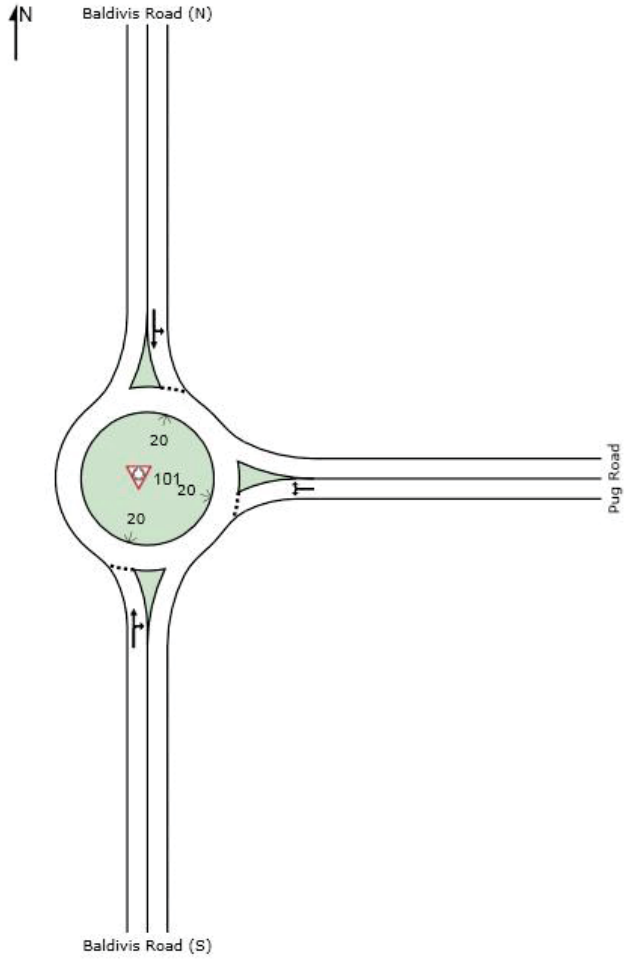
Based on the surrounding areas largely being newly developed or vacant land that will be developed in the near future, ultimate year traffic flows have been developed based on past studies of the area

6.4 2016 Intersection Performance (with Development)

6.4.1 Baldivis Road/Pug Road Intersection

The assessment below presents the analysis of the Baldivis Road/Pug Road intersection (proposed layout) for the year 2016 with the proposed development. **Figure 6-2** is a SIDRA layout representation of the proposed intersection at this location.

Figure 6-2 Baldivis Road/Pug Road Intersection Proposed Layout



The results of the assessment for this intersection are summarised in **Table 6-1** and **Table 6-2** below.

Table 6-1 Baldivis Road/Pug Road AM Peak Intersection Performance - 2016 with Development

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: Baldivis Road (S)											
2	T1	237	5.0	0.240	5.9	LOS A	1.6	12.0	0.34	0.52	59.3
3	R2	72	5.0	0.240	10.6	LOS B	1.6	12.0	0.34	0.52	53.6
Approach		309	5.0	0.240	7.0	LOS A	1.6	12.0	0.34	0.52	57.9
East: Pug Road											
4	L2	182	5.0	0.259	4.5	LOS A	1.6	12.0	0.50	0.59	50.6
6	R2	98	5.0	0.259	9.0	LOS A	1.6	12.0	0.50	0.59	51.4
Approach		280	5.0	0.259	6.0	LOS A	1.6	12.0	0.50	0.59	50.9
North: Baldivis Road (N)											
7	L2	41	5.0	0.206	5.3	LOS A	1.3	9.7	0.27	0.46	53.0
8	T1	236	5.0	0.206	5.7	LOS A	1.3	9.7	0.27	0.46	60.6
Approach		277	5.0	0.206	5.6	LOS A	1.3	9.7	0.27	0.46	59.3
All Vehicles		866	5.0	0.259	6.3	LOS A	1.6	12.0	0.37	0.53	55.8

Table 6-2 Baldivis Road/Pug Road PM Peak Intersection Performance - 2016 with Development

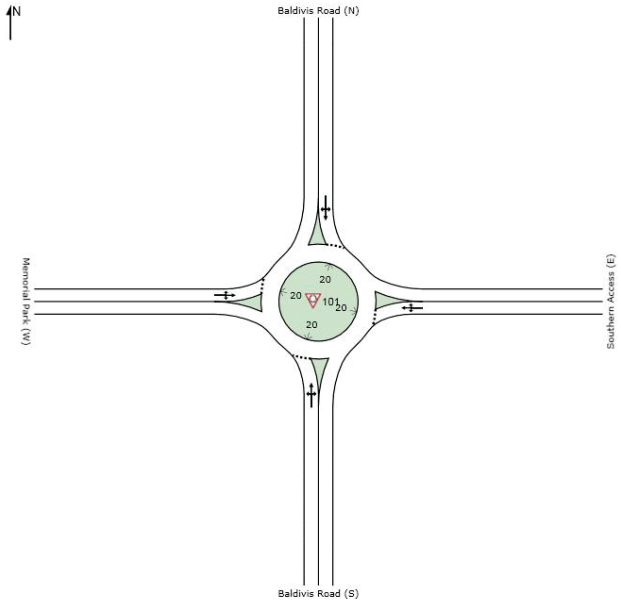
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Baldivis Road (S)											
2	T1	281	5.0	0.345	5.7	LOS A	2.7	19.7	0.29	0.54	58.9
3	R2	202	5.0	0.345	10.4	LOS B	2.7	19.7	0.29	0.54	53.2
Approach		483	5.0	0.345	7.7	LOS A	2.7	19.7	0.29	0.54	56.4
East: Pug Road											
4	L2	117	5.0	0.171	4.4	LOS A	1.1	7.7	0.50	0.58	50.6
6	R2	63	5.0	0.171	8.9	LOS A	1.1	7.7	0.50	0.58	51.4
Approach		180	5.0	0.171	6.0	LOS A	1.1	7.7	0.50	0.58	50.9
North: Baldivis Road (N)											
7	L2	108	5.0	0.312	6.3	LOS A	2.1	15.4	0.49	0.57	52.2
8	T1	245	5.0	0.312	6.7	LOS A	2.1	15.4	0.49	0.57	59.5
Approach		354	5.0	0.312	6.6	LOS A	2.1	15.4	0.49	0.57	57.1
All Vehicles		1017	5.0	0.345	7.0	LOS A	2.7	19.7	0.40	0.56	55.5

From the above it is noted that the proposed intersection layout will operate within acceptable capacity limits with the proposed development traffic.

6.4.2 Baldivis Road/Southern Access Intersection

The assessment below analyses the Baldivis Road/Southern Access intersection (proposed layout) for the year 2016 with the proposed development. **Figure 6-3** is a SIDRA layout representation of the proposed intersection layout at this location.

Figure 6-3 Baldivis Road/Southern Access Rd Intersection Proposed Layout



The results of this assessment for this intersection are summarised in **Table 6-3** and **Table 6-4** below.

Table 6-3 Baldivis Road/Southern Access Rd AM Peak Intersection Performance - 2016 with Development

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: Baldivis Road (S)											
1	L2	1	5.0	0.226	5.3	LOS A	1.4	10.5	0.30	0.51	52.3
2	T1	238	5.0	0.226	5.8	LOS A	1.4	10.5	0.30	0.51	59.6
3	R2	57	5.0	0.226	10.5	LOS B	1.4	10.5	0.30	0.51	53.9
Approach		296	5.0	0.226	6.7	LOS A	1.4	10.5	0.30	0.51	58.4
East: Southern Access (E)											
4	L2	162	5.0	0.265	5.6	LOS A	1.7	12.2	0.61	0.67	50.1
5	T1	1	5.0	0.265	5.5	LOS A	1.7	12.2	0.61	0.67	46.6
6	R2	87	5.0	0.265	10.1	LOS B	1.7	12.2	0.61	0.67	50.8
Approach		251	5.0	0.265	7.1	LOS A	1.7	12.2	0.61	0.67	50.3
North: Baldivis Road (N)											
7	L2	31	5.0	0.296	5.2	LOS A	1.9	13.8	0.23	0.46	53.1
8	T1	387	5.0	0.296	5.6	LOS A	1.9	13.8	0.23	0.46	60.7
9	R2	1	5.0	0.296	10.3	LOS B	1.9	13.8	0.23	0.46	54.7
Approach		419	5.0	0.296	5.6	LOS A	1.9	13.8	0.23	0.46	60.1
West: Memorial Park (W)											
10	L2	1	5.0	0.003	4.8	LOS A	0.0	0.1	0.52	0.49	50.3
11	T1	1	5.0	0.003	4.8	LOS A	0.0	0.1	0.52	0.49	46.9
12	R2	1	5.0	0.003	9.3	LOS A	0.0	0.1	0.52	0.49	51.1
Approach		3	5.0	0.003	6.3	LOS A	0.0	0.1	0.52	0.49	49.4
All Vehicles		968	5.0	0.296	6.3	LOS A	1.9	13.8	0.35	0.53	56.7

Table 6-4 Baldivis Road/ Southern Access Rd PM Peak Intersection Performance - 2016 with Development

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: Baldivis Road (S)											
1	L2	1	5.0	0.425	5.2	LOS A	3.4	24.8	0.28	0.52	52.1
2	T1	427	5.0	0.425	5.7	LOS A	3.4	24.8	0.28	0.52	59.3
3	R2	185	5.0	0.425	10.3	LOS B	3.4	24.8	0.28	0.52	53.6
Approach		614	5.0	0.425	7.1	LOS A	3.4	24.8	0.28	0.52	57.5
East: Southern Access (E)											
4	L2	104	5.0	0.155	4.5	LOS A	0.9	6.8	0.50	0.58	50.6
5	T1	1	5.0	0.155	4.5	LOS A	0.9	6.8	0.50	0.58	47.1
6	R2	56	5.0	0.155	9.0	LOS A	0.9	6.8	0.50	0.58	51.4
Approach		161	5.0	0.155	6.0	LOS A	0.9	6.8	0.50	0.58	50.8
North: Baldivis Road (N)											
7	L2	100	5.0	0.308	6.0	LOS A	1.9	14.0	0.43	0.55	52.4
8	T1	262	5.0	0.308	6.4	LOS A	1.9	14.0	0.43	0.55	59.8
9	R2	1	5.0	0.308	11.1	LOS B	1.9	14.0	0.43	0.55	53.9
Approach		363	5.0	0.308	6.3	LOS A	1.9	14.0	0.43	0.55	57.5
West: Memorial Park (W)											
10	L2	1	5.0	0.004	6.9	LOS A	0.0	0.2	0.68	0.55	49.2
11	T1	1	5.0	0.004	6.9	LOS A	0.0	0.2	0.68	0.55	45.9
12	R2	1	5.0	0.004	11.4	LOS B	0.0	0.2	0.68	0.55	49.9
Approach		3	5.0	0.004	8.4	LOS A	0.0	0.2	0.68	0.55	48.3
All Vehicles		1141	5.0	0.425	6.7	LOS A	3.4	24.8	0.36	0.54	56.4

From the above it is noted that the proposed intersection layout will operate within acceptable capacity limits with the proposed development traffic.

6.5 2031 Intersection Performance (with Future Development)

The performance of adjacent intersections has been assessed for the full build-out of the North Baldivis Structure Plan, including recent upgrade of the regional road network. These works involve an extension of Mundijong Road to Millar Road and will ultimately result in a redistribution of traffic to Baldivis Road. The results of previous assessment have been used as a basis for projected daily traffic volumes, with standard peak hour scaling factors to permit assessment of the peak hour operation of the development accesses under the future scenario.

It should be noted that the ultimate configuration of Baldivis Road/Mundijong Road, comprising a significant interchange upgrade at Kwinana Freeway/Mundijong Road and a flyover at Baldivis Road/Mundijong Road has not been assessed at this time. It is considered that there is insufficient data available to make an assessment of the operation and function of the local road network, in the absence of direction from State Government modelling outputs (STEM and ROM).

6.5.1 Baldivis Road/Pug Road Intersection

The assessment below analyses the Baldivis Road/Pug Road intersection (proposed layout) for the year 2031 with the proposed development. The access intersection geometry is retained from the 2016 scenario and defined in **Section 6.4**.

The results of this assessment for this intersection are summarised in **Table 6-5** and **Table 6-6** below.

Table 6-5 Baldivis Road/Pug Road AM Peak Intersection Performance - 2031 with Development

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: Baldivis Road (S)											
2	T1	483	5.0	0.423	6.0	LOS A	3.7	26.9	0.42	0.51	59.2
3	R2	76	5.0	0.423	10.7	LOS B	3.7	26.9	0.42	0.51	53.5
Approach		559	5.0	0.423	6.7	LOS A	3.7	26.9	0.42	0.51	58.4
East: Pug Road											
4	L2	182	5.0	0.309	6.0	LOS A	2.0	14.8	0.66	0.71	49.8
6	R2	98	5.0	0.309	10.5	LOS B	2.0	14.8	0.66	0.71	50.5
Approach		280	5.0	0.309	7.5	LOS A	2.0	14.8	0.66	0.71	50.1
North: Baldivis Road (N)											
7	L2	41	5.0	0.341	5.3	LOS A	2.6	18.9	0.32	0.47	52.7
8	T1	426	5.0	0.341	5.8	LOS A	2.6	18.9	0.32	0.47	60.3
Approach		467	5.0	0.341	5.8	LOS A	2.6	18.9	0.32	0.47	59.5
All Vehicles		1306	5.0	0.423	6.5	LOS A	3.7	26.9	0.43	0.54	56.7

Table 6-6 Baldivis Road/Pug Road PM Peak Intersection Performance - 2031 with Development

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: Baldivis Road (S)											
2	T1	496	5.0	0.490	5.8	LOS A	4.8	35.3	0.36	0.51	59.0
3	R2	202	5.0	0.490	10.5	LOS B	4.8	35.3	0.36	0.51	53.3
Approach		698	5.0	0.490	7.2	LOS A	4.8	35.3	0.36	0.51	57.2
East: Pug Road											
4	L2	117	5.0	0.207	5.8	LOS A	1.3	9.8	0.66	0.69	49.9
6	R2	63	5.0	0.207	10.3	LOS B	1.3	9.8	0.66	0.69	50.7
Approach		180	5.0	0.207	7.4	LOS A	1.3	9.8	0.66	0.69	50.2
North: Baldivis Road (N)											
7	L2	108	5.0	0.474	6.5	LOS A	3.8	28.0	0.58	0.59	51.7
8	T1	440	5.0	0.474	7.0	LOS A	3.8	28.0	0.58	0.59	59.0
Approach		548	5.0	0.474	6.9	LOS A	3.8	28.0	0.58	0.59	57.4
All Vehicles		1426	5.0	0.490	7.1	LOS A	4.8	35.3	0.48	0.57	56.3

From the above it is noted that the proposed intersection layout will operate within acceptable capacity limits with the increased background traffic.

6.5.2 Baldivis Road/Southern Access Rd Intersection

The assessment below analyses the Baldivis Road/Southern Access intersection (proposed layout) for the year 2031 with the proposed development. The access intersection geometry is retained from the 2016 scenario and defined in **Section 6.4**.

The results of this assessment for this intersection are summarised in **Table 6-7** and **Table 6-8** below.

Table 6-7 Baldivis Road/Southern Access Rd AM Peak Intersection Performance - 2031 with Development

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: Baldivis Road (S)											
1	L2	1	5.0	0.393	5.4	LOS A	3.1	22.8	0.36	0.50	52.2
2	T1	472	5.0	0.393	5.8	LOS A	3.1	22.8	0.36	0.50	59.6
3	R2	57	5.0	0.393	10.5	LOS B	3.1	22.8	0.36	0.50	53.8
Approach		529	5.0	0.393	6.4	LOS A	3.1	22.8	0.36	0.50	58.9
East: Southern Access (E)											
4	L2	162	5.0	0.315	7.3	LOS A	2.1	15.1	0.74	0.78	48.9
5	T1	1	5.0	0.315	7.3	LOS A	2.1	15.1	0.74	0.78	45.7
6	R2	87	5.0	0.315	11.8	LOS B	2.1	15.1	0.74	0.78	49.6
Approach		251	5.0	0.315	8.8	LOS A	2.1	15.1	0.74	0.78	49.2
North: Baldivis Road (N)											
7	L2	31	5.0	0.422	5.2	LOS A	3.2	23.5	0.27	0.46	52.9
8	T1	578	5.0	0.422	5.7	LOS A	3.2	23.5	0.27	0.46	60.5
9	R2	1	5.0	0.422	10.4	LOS B	3.2	23.5	0.27	0.46	54.5
Approach		609	5.0	0.422	5.6	LOS A	3.2	23.5	0.27	0.46	60.0
West: Memorial Park (W)											
10	L2	1	5.0	0.004	6.4	LOS A	0.0	0.2	0.66	0.54	49.4
11	T1	1	5.0	0.004	6.4	LOS A	0.0	0.2	0.66	0.54	46.1
12	R2	1	5.0	0.004	10.9	LOS B	0.0	0.2	0.66	0.54	50.2
Approach		3	5.0	0.004	7.9	LOS A	0.0	0.2	0.66	0.54	48.5
All Vehicles		1393	5.0	0.422	6.5	LOS A	3.2	23.5	0.39	0.53	57.3

Table 6-8 Baldivis Road/Southern Access Rd PM Peak Intersection Performance - 2031 with Development

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: Baldivis Road (S)											
1	L2	1	5.0	0.566	5.3	LOS A	5.8	42.6	0.36	0.50	52.0
2	T1	641	5.0	0.566	5.7	LOS A	5.8	42.6	0.36	0.50	59.2
3	R2	185	5.0	0.566	10.4	LOS B	5.8	42.6	0.36	0.50	53.5
Approach		827	5.0	0.566	6.8	LOS A	5.8	42.6	0.36	0.50	57.8
East: Southern Access (E)											
4	L2	104	5.0	0.188	5.9	LOS A	1.2	8.6	0.66	0.69	49.9
5	T1	1	5.0	0.188	5.8	LOS A	1.2	8.6	0.66	0.69	46.5
6	R2	56	5.0	0.188	10.4	LOS B	1.2	8.6	0.66	0.69	50.6
Approach		161	5.0	0.188	7.4	LOS A	1.2	8.6	0.66	0.69	50.1
North: Baldivis Road (N)											
7	L2	100	5.0	0.464	6.2	LOS A	3.5	25.3	0.51	0.57	52.0
8	T1	457	5.0	0.464	6.6	LOS A	3.5	25.3	0.51	0.57	59.3
9	R2	1	5.0	0.464	11.3	LOS B	3.5	25.3	0.51	0.57	53.5
Approach		558	5.0	0.464	6.6	LOS A	3.5	25.3	0.51	0.57	57.8
West: Memorial Park (W)											
10	L2	1	5.0	0.005	9.3	LOS A	0.0	0.3	0.80	0.60	47.7
11	T1	1	5.0	0.005	9.3	LOS A	0.0	0.3	0.80	0.60	44.6
12	R2	1	5.0	0.005	13.8	LOS B	0.0	0.3	0.80	0.60	48.4
Approach		3	5.0	0.005	10.8	LOS B	0.0	0.3	0.80	0.60	46.8
All Vehicles		1549	5.0	0.566	6.8	LOS A	5.8	42.6	0.44	0.54	56.9

From the above it is noted that the proposed intersection layout will operate within acceptable capacity limits with the increased background traffic.

7 Site Specific Issues

7.1 Commercial Development Access

The Commercial development at the north-western corner of the site is proposed to be directly accessed via Baldivis Road. This access location acknowledges the constraints associated with the tramway, and the proximity of alternative access locations to the primary intersections of Baldivis Road/Pug Road and Baldivis Road/Northern Access. It is therefore considered that access directly onto Baldivis Road offers the greatest level of operational and safety benefits.

7.2 Road Network (Northern Cell)

The Structure Plan shows a network of access roads in close proximity to the Northern Access intersection. The distance shown between these roads is relatively short and this configuration has therefore been reviewed in the context of traffic operation and safety. It is considered that due to the low expected volume of compound turning movements as well as the low speeds associated with this section of the network, the short intervals between intersections should not pose a safety concern.

8 Conclusions

Cardno was commissioned by Upside Property Group to prepare a Transport Assessment of the proposed North Baldivis Local Structure Plan area.

This report has been prepared in accordance with the Western Australian Planning Commission (WAPC) *Transport Impact Assessment Guidelines: Volume 2 – Planning Schemes, Structure Plans and Activity Centre Plans (2016);* the checklist is included at **Appendix A**.

The results of this assessment indicate that the proposed development will not significantly impact the adjoining road network, will consist of a safe and effective internal road system, and has adequate access to regional cycling facilities.

APPENDIX A
WAPC TRANSPORT STATEMENT CHECKLIST FOR DEVELOPMENT

Cardno
Shaping the Future

Checklist for a Transport Statement

Item	Status	Comments/Proposals
Summary	Included	
Introduction/Background		
name of applicant and consultant	Included	Discussed in Section 1.1
development location and context	Included	Discussed in Section 1.1
brief description of development proposal	Included	Discussed in Section 1.1
key issues	Included	Discussed in Section 1.1
Background information	Included	Discussed in Section 1.1
Development proposal		
regional context	Included	Discussed in Section 2.1
proposed land uses	Included	Discussed in Section 1.3
table of land uses and quantities	Included	Discussed in Section 1.5 and Included at Appendix B.
access arrangements	Included	Discussed in Section 1.4
parking provision	Included	Discussed in Section 1.7
end of trip facilities	Included	Discussed in Section 1.8
any specific issues	N/A	
Existing situation		
existing site uses (if any)	Included	Discussed in Section 2.1
existing parking and demand (if appropriate)	N/A	
existing access arrangements	Included	Discussed in Section 2.4
existing site traffic	Included	Discussed in Section 2.5
surrounding land uses	Included	Discussed in Section 2.1
surrounding road network	Included	Discussed in Section 2.3
traffic management on frontage roads	Included	Discussed in Section 2.3
traffic flows on surrounding roads (usually AM and PM peak hours)	Included	Included at Appendix C
traffic flows at major intersections (usually AM and PM peak hours)	Included	Discussed in Section 2.5
operation of surrounding intersections	N/A	
existing pedestrian / cycle networks	Included	Discussed in Section 2.6
existing public transport services	Included	Discussed in Section 2.7
crash data	Included	Discussed in Section 2.8
Changes to surrounding transport networks		
road network	Included	Discussed in Section 3.1
intersection layouts and controls	Included	Discussed in Section 3.1
pedestrian/cycle networks and crossing facilities	Included	Discussed in Section 3.2

public transport services	Included	Discussed in Section 3.3
Integration with surrounding area		
surrounding major attractors/generators	Included	Discussed in Section 4.1
proposed changes to land uses within 1200 metres	Included	Discussed in Section 4.2
travel desire lines from development to these attractors/generators	Included	Discussed in Section 4.1
adequacy of existing transport networks	Included	Discussed in Section 3.3
deficiencies in existing transport networks	Included	Discussed in Section 3.3
remedial measures to address deficiencies	Included	Discussed in Section 3.3
Analysis of transport networks		
assessment years	Included	Discussed in Section 5.1
time periods	Included	Discussed in Section 5.2
development generated traffic	Included	Discussed in Section 1.5
distribution of generated traffic	Included	Discussed in Section 1.5
parking supply & demand	Included	Discussed in Section 1.7
committed developments and transport proposals	Included	Discussed in Section 4.2
base and "with development" traffic flows	Included	Discussed in Section 5.2
analysis of development accesses	Included	Discussed in Section 1.4
impact on surrounding roads	Included	Discussed in Section 5.3
impact on intersections	Included	Discussed in Section 5.3
impact on neighbouring areas	Included	Discussed in Section 5.3
traffic noise and vibration	N/A	
road safety	Included	Discussed in Section 5.4
public transport access	Included	Discussed in Section 3.3
pedestrian access / amenity	Included	Discussed in Section 3.2
cycle access / amenity	Included	Discussed in Section 3.2
analysis of pedestrian / cycle networks	Included	Discussed in Section 3.2
safe walk/cycle to school (for residential and school site developments only)	Included	Discussed in Section 5.6
traffic management plan (where appropriate)	N/A	
Conclusions	Included	Discussed in Section 6

Proponent's name	Company	Signature	Date
Transport assessor's name	**Company**	**Signature**	**Date**

APPENDIX B
DEVELOPMENT PLAN

Cardno
Shaping the Future

REVISION A : xx/xx/20xx -	PROJECT **NORTH BALDIVIS**	CLIENT **CEDAR WOODS**	RPS Australia East Pty Ltd ACN 140 292 762 ABN 44 140 292 762 Level 2, 27-31 Troode Street West Perth, WA , Australia, 6005 PO Box 170, West Perth WA 6872 T +61 8 9211 1111 F +61 8 9211 1122 W rpsgroup.com.au
	Job Ref. 115795 / Date 22 NOVIEMBRE 2016 Comp By. LCFV / DWG Name. 115795-2-011i.dwg Checked By. SD / Locality BALDIVIS Local Authority CITY OF ROCKINGHAM	STRUCTURE PLAN	Scale 1:2000 / Sheet A1 / Plan Ref **115795-2** / Rev **I**

APPENDIX C
TRAFFIC COUNT DATA

Cardno
Shaping the Future

Weekly Volume by Hour

Traffic Flow:	**Both Directions**	Road Name:	**Mundijong Rd (1070010)**
Site No:	**5417**	Location Description:	**E of Baldivis Rd (SLK 5.43)**
Date Range:	**13 Sep 2012 to 16 Sep 2012**	Count Type:	**Classification Counts**

Average Vehicle Volume

Hour	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon - Fri	Mon - Sun
0000				18	10	34		14	14
0100				7	11	22		9	9
0200				10	14	11		12	12
0300				11	15	15		13	13
0400				41	33	27		37	37
0500				223	226	70		225	225
0600				394	404	128		399	399
0700				436	407	134		422	422
0800				361	346	223		354	354
0900				288	258	278		273	273
1000				242	256	293		249	249
1100				265	303	323		284	284
1200				263	282	309		273	273
1300				318	280	325		299	299
1400				348	354	332		351	351
1500				414	438	301		426	426
1600				484	422	295		453	453
1700				445	416	285		431	431
1800				291	312	187		302	302
1900				164	175	133		170	170
2000				99	100	86		100	100
2100				91	83	86		87	87
2200				47	70	80		59	59
2300				26	58	63		42	42
Total				5286	5273	4040		5284	5284

Peak Statistics

		Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon - Fri	Mon - Sun
AM	1/4 Hour				0715	0715	1115		0715	0800
	1/4 Hr Vol				116	116	86		116	93
	1/2 Hour				0715	0600	1100		0715	0745
	1/2 Hr Vol				228	215	170		222	177
	1 Hour				0715	0715	1130		0715	0715
	1 Hr Vol				450	417	325		434	347
	1 Hr Fact				.9698	.8987	.9129		.9353	.9362
	2 Hour				0615	0600	1145		0615	0615
	2 Hr Vol				851	811	648		826	652
PM	1/4 Hour				1645	1615	1430		1615	1615
	1/4 Hr Vol				130	121	94		123	107
	1/2 Hour				1715	1600	1415		1600	1600
	1/2 Hr Vol				247	231	182		236	209
	1 Hour				1645	1530	1245		1530	1530
	1 Hr Vol				485	460	332		454	401
	1 Hr Fact				.9327	.9504	.8925		.9265	.9369
	2 Hour				1545	1430	1245		1545	1545
	2 Hr Vol				940	867	661		892	788
Peak	12 Hour				0615	0600	0715		0600	0615
	12 Hr Vol				4265	4166	3306		4212	3892

Weekly Volume by Hour

Traffic Flow:	**Directional**	Road Name:	**Mundijong Rd (1070010)**
Site No:	**5417**	Location Description:	**E of Baldivis Rd (SLK 5.43)**
Date Range:	**13 Sep 2012 to 16 Sep 2012**	Count Type:	**Classification Counts**

Average Vehicle Volume

Hour	Mon		Tue		Wed		Thu		Fri		Sat		Sun		Mon - Fri		Mon - Sun	
	E	W	E	W	E	W	E	W	E	W	E	W	E	W	E	W	E	W
0000							8	10	2	8	9	25			5	9	5	9
0100							2	5	2	9	7	15			2	7	2	7
0200							6	4	7	7	1	10			7	6	7	6
0300							5	6	9	6	4	11			7	6	7	6
0400							29	12	24	9	20	7			27	11	27	11
0500							172	51	170	56	44	26			171	54	171	54
0600							260	134	271	133	84	44			266	134	266	134
0700							282	154	278	129	79	55			280	142	280	142
0800							205	156	174	172	111	112			190	164	190	164
0900							147	141	130	128	156	122			139	135	139	135
1000							118	124	132	124	134	159			125	124	125	124
1100							121	144	132	171	159	164			127	158	127	158
1200							120	143	139	143	149	160			130	143	130	143
1300							133	185	118	162	127	198			126	174	126	174
1400							136	212	155	199	137	195			146	206	146	206
1500							183	231	180	258	134	167			182	245	182	245
1600							192	292	177	245	121	174			185	269	185	269
1700							161	284	140	276	129	156			151	280	151	280
1800							99	192	101	211	90	97			100	202	100	202
1900							61	103	38	137	53	80			50	120	50	120
2000							39	60	39	61	39	47			39	61	39	61
2100							47	44	30	53	24	62			39	49	39	49
2200							17	30	23	47	41	39			20	39	20	39
2300							10	16	18	40	24	39			14	28	14	28
Total							2553	2733	2489	2784	1876	2164			2528	2766	2528	2766

Peak Statistics

		Mon		Tue		Wed		Thu		Fri		Sat		Sun		Mon - Fri		Mon - Sun	
		E	W	E	W	E	W	E	W	E	W	E	W	E	W	E	W	E	W
AM	1/4 Hour							0715	0645	0600	0800	1100	1115			0600	1145	0715	1145
	1/4 Hr Vol							80	48	87	51	44	50			79	48	57	44
	1/2 Hour							0715	0630	0545	0800	0900	1100			0715	0745	0715	1130
	1/2 Hr Vol							149	90	158	92	85	90			150	88	113	82
	1 Hour							0715	0715	0545	0800	1130	1030			0700	0745	0715	1100
	1 Hr Vol							284	166	283	172	161	174			280	165	214	160
	1 Hr Fact							.8875	.9432	.8132	.8431	.8564	.87			.9091	.8777	.9386	.9023
	2 Hour							0600	0630	0545	1130	1100	1145			0545	1145	0600	1145
	2 Hr Vol							542	322	557	316	308	354			549	317	418	329
PM	1/4 Hour							1515	1645	1530	1745	1215	1330			1515	1715	1515	1715
	1/4 Hr Vol							63	84	54	80	47	59			53	74	50	65
	1/2 Hour							1600	1715	1600	1745	1200	1415			1600	1715	1515	1715
	1/2 Hr Vol							105	159	101	146	82	110			103	146	92	126
	1 Hour							1515	1645	1530	1715	1200	1330			1515	1715	1515	1715
	1 Hr Vol							195	307	196	279	149	200			193	285	176	240
	1 Hr Fact							.7738	.9137	.9074	.8719	.7926	.8475			.9104	.9694	.8742	.9231
	2 Hour							1515	1615	1430	1615	1200	1245			1430	1615	1430	1600
	2 Hr Vol							378	583	373	530	276	395			372	557	336	476
Peak	12 Hour							0530	0630	0530	0745	0615	0745			0530	0645	0530	0715
	12 Hr Vol							2113	2273	2082	2241	1541	1787			2098	2250	1893	2092

Weekly Volume by Hour

Traffic Flow:	**Both Directions**	Road Name:	**Baldivis Rd (1070011)**
Site No:	**3929**	Location Description:	**S of Mundijong Rd (SLK 11.10)**
Date Range:	**18 Oct 2012 to 21 Oct 2012**	Count Type:	**Classification Counts**

Average Vehicle Volume

Hour	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon - Fri	Mon - Sun
0000				24	24	41		24	24
0100				20	19	23		20	20
0200				19	14	27		17	17
0300				11	17	14		14	14
0400				39	49	23		44	44
0500				267	265	111		266	266
0600				430	435	134		433	433
0700				472	465	197		469	469
0800				509	506	347		508	508
0900				357	409	376		383	383
1000				312	349	497		331	331
1100				325	340	494		333	333
1200				356	370	464		363	363
1300				342	396	427		369	369
1400				447	463	421		455	455
1500				580	597	428		589	589
1600				549	572	423		561	561
1700				582	614	403		598	598
1800				429	476	311		453	453
1900				241	258	192		250	250
2000				149	173	126		161	161
2100				121	113	119		117	117
2200				57	104	114		81	81
2300				32	65	91		49	49
Total				6670	7093	5803		6888	6888

Peak Statistics

		Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon - Fri	Mon - Sun
AM	1/4 Hour				0830	0815	1045		0800	0830
	1/4 Hr Vol				141	147	154		135	118
	1/2 Hour				0745	0800	1030		0800	0815
	1/2 Hr Vol				275	281	294		265	231
	1 Hour				0745	0730	1030		0745	0800
	1 Hr Vol				529	518	539		522	454
	1 Hr Fact				.9379	.881	.875		.9667	.9592
	2 Hour				0700	0630	1030		0700	0745
	2 Hr Vol				981	978	1023		976	850
PM	1/4 Hour				1530	1530	1245		1530	1530
	1/4 Hr Vol				164	161	130		163	143
	1/2 Hour				1700	1700	1200		1700	1700
	1/2 Hr Vol				308	312	235		310	277
	1 Hour				1515	1700	1200		1700	1500
	1 Hr Vol				586	614	464		598	535
	1 Hr Fact				.8933	.9534	.8923		.9614	.9353
	2 Hour				1530	1530	1200		1530	1530
	2 Hr Vol				1156	1191	891		1174	1067
Peak	12 Hour				0645	0630	0730		0630	0700
	12 Hr Vol				5282	5595	4813		5436	5202

Weekly Volume by Hour

Traffic Flow:	**Directional**	Road Name:	**Baldivis Rd (1070011)**
Site No:	**3929**	Location Description:	**S of Mundijong Rd (SLK 11.10)**
Date Range:	**18 Oct 2012 to 21 Oct 2012**	Count Type:	**Classification Counts**

Average Vehicle Volume

Hour	Mon		Tue		Wed		Thu		Fri		Sat		Sun		Mon - Fri		Mon - Sun	
	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S
0000							5	19	8	16	15	26			7	18	7	18
0100							6	14	1	18	5	18			4	16	4	16
0200							8	11	6	8	9	18			7	10	7	10
0300							8	3	9	8	8	6			9	6	9	6
0400							28	11	33	16	14	9			31	14	31	14
0500							218	49	207	58	84	27			213	54	213	54
0600							313	117	318	117	86	48			316	117	316	117
0700							333	139	325	140	105	92			329	140	329	140
0800							296	213	276	230	191	156			286	222	286	222
0900							199	158	229	180	204	172			214	169	214	169
1000							151	161	191	158	251	246			171	160	171	160
1100							174	151	164	176	237	257			169	164	169	164
1200							189	167	174	196	241	223			182	182	182	182
1300							159	183	194	202	205	222			177	193	177	193
1400							199	248	202	261	188	233			201	255	201	255
1500							255	325	242	355	190	238			249	340	249	340
1600							176	373	237	335	197	226			207	354	207	354
1700							195	387	234	380	190	213			215	384	215	384
1800							145	284	173	303	132	179			159	294	159	294
1900							79	162	97	161	92	100			88	162	88	162
2000							66	83	76	97	64	62			71	90	71	90
2100							48	73	37	76	57	62			43	75	43	75
2200							23	34	35	69	39	75			29	52	29	52
2300							15	17	19	46	27	64			17	32	17	32
Total							3288	3382	3487	3606	2831	2972			3394	3503	3394	3503

Peak Statistics

		Mon		Tue		Wed		Thu		Fri		Sat		Sun		Mon - Fri		Mon - Sun	
		N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S
AM	1/4 Hour							0800	0830	0700	0830	1030	1045			0700	0830	0800	1045
	1/4 Hr Vol							95	63	95	63	69	85			91	63	69	58
	1/2 Hour							0745	0815	0700	0815	1030	1030			0700	0815	0745	0830
	1/2 Hr Vol							184	119	175	123	138	156			170	121	135	107
	1 Hour							0715	0815	0630	0800	1000	1030			0700	0800	0745	1030
	1 Hr Vol							341	224	340	230	251	290			329	222	263	207
	1 Hr Fact							.8974	.8889	.8947	.9127	.9094	.8529			.9038	.881	.9529	.8974
	2 Hour							0615	0745	0630	0745	1015	1030			0615	0745	0700	1030
	2 Hr Vol							656	390	653	413	501	530			649	402	509	402
PM	1/4 Hour							1515	1700	1415	1530	1245	1500			1515	1730	1415	1530
	1/4 Hr Vol							69	106	70	102	75	71			68	101	61	85
	1/2 Hour							1515	1700	1500	1715	1245	1445			1515	1715	1515	1715
	1/2 Hr Vol							136	203	128	201	125	134			131	201	117	170
	1 Hour							1500	1645	1615	1700	1200	1415			1500	1700	1500	1700
	1 Hr Vol							255	391	246	380	241	251			249	384	229	327
	1 Hr Fact							.9239	.9222	.9762	.9314	.8033	.8838			.9222	.9505	.9703	.9618
	2 Hour							1415	1600	1500	1530	1200	1315			1500	1600	1500	1530
	2 Hr Vol							455	760	479	721	446	485			455	738	432	640
Peak	12 Hour							0515	0745	0530	0730	0730	0730			0530	0730	0530	0730
	12 Hr Vol							2678	2823	2808	2965	2341	2472			2741	2894	2580	2753

Weekly Volume by Hour

Traffic Flow:	**Both Directions**	Road Name:	**Baldivis Rd (1070011)**
Site No:	**3925**	Location Description:	**N of Mundijong Rd (SLK 11.40)**
Date Range:	**09 Aug 2011 to 15 Aug 2011**	Count Type:	**Axle Pairs**

Average Vehicle Volume

Hour	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon - Fri	Mon - Sun
0000	6	8	10	17	9	29	34	10	16
0100	5	4	6	3	3	7	11	4	6
0200	1	5	6	5	6	12	9	5	6
0300	4	3	7	2	4	11	13	4	6
0400	16	17	16	15	16	8	7	16	14
0500	60	72	67	74	64	25	13	67	54
0600	174	139	347	192	182	55	18	207	158
0700	252	248	732	331	276	101	55	368	285
0800	346	335	342	427	373	188	97	365	301
0900	228	226	215	266	268	222	167	241	227
1000	210	235	232	257	246	251	211	236	235
1100	213	215	224	282	284	238	225	244	240
1200	260	182	220	265	263	266	262	238	245
1300	207	230	245	245	260	254	203	237	235
1400	273	260	286	326	282	199	226	285	265
1500	330	383	344	386	405	244	267	370	337
1600	271	300	298	321	324	208	204	303	275
1700	235	285	285	267	260	182	156	266	239
1800	131	155	164	186	179	118	96	163	147
1900	82	91	81	95	107	84	59	91	86
2000	50	47	67	70	64	51	56	60	58
2100	41	39	45	58	64	39	25	49	44
2200	12	24	25	28	40	42	16	26	27
2300	5	12	12	15	30	34	5	15	16
Total	3412	3515	4276	4133	4009	2868	2435	3870	3522

Peak Statistics

		Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon - Fri	Mon - Sun
AM	1/4 Hour	0830	0830	0715	0830	0800	1030	1145	0715	0830
	1/4 Hr Vol	103	93	261	137	101	79	67	106	85
	1/2 Hour	0815	0815	0700	0815	0800	1015	1145	0815	0815
	1/2 Hr Vol	197	176	452	249	201	143	138	200	163
	1 Hour	0745	0745	0645	0745	0745	1015	1145	0745	0745
	1 Hr Vol	362	350	773	428	393	265	258	383	312
	1 Hr Fact	.8786	.9409	.7404	.781	.9728	.8386	.9085	.9189	.913
	2 Hour	0745	0745	0630	0700	0715	1130	1115	0700	0700
	2 Hr Vol	599	599	1192	758	677	521	491	732	586
PM	1/4 Hour	1515	1500	1530	1545	1530	1315	1515	1530	1500
	1/4 Hr Vol	99	109	107	116	108	85	75	94	85
	1/2 Hour	1500	1500	1530	1545	1530	1300	1515	1515	1530
	1/2 Hr Vol	176	201	193	208	206	145	141	186	169
	1 Hour	1445	1445	1530	1500	1500	1230	1500	1500	1500
	1 Hr Vol	335	391	346	386	405	272	267	370	337
	1 Hr Fact	.846	.8968	.8084	.8319	.9375	.8	.89	.984	.9962
	2 Hour	1445	1445	1430	1445	1445	1200	1400	1445	1445
	2 Hr Vol	618	692	660	726	732	520	493	685	623
Peak	12 Hour	0615	0630	0630	0630	0630	0730	0745	0630	0630
	12 Hr Vol	3007	3081	3804	3605	3458	2489	2189	3390	3078

Weekly Volume by Hour

Traffic Flow:	**Directional**	Road Name:	**Baldivis Rd (1070011)**
Site No:	**3925**	Location Description:	**N of Mundijong Rd (SLK 11.40)**
Date Range:	**09 Aug 2011 to 15 Aug 2011**	Count Type:	**Axle Pairs**

Average Vehicle Volume

Hour	Mon		Tue		Wed		Thu		Fri		Sat		Sun		Mon - Fri		Mon - Sun	
	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S
0000	5	1	3	5	5	5	10	7	8	1	11	18	12	22	6	4	8	8
0100	3	2	1	3	3	3	0	3	2	1	5	2	7	4	2	2	3	3
0200	1	0	3	2	3	3	4	1	5	1	5	7	5	4	3	1	4	3
0300	2	2	2	1	5	2	0	2	2	2	6	5	6	7	2	2	3	3
0400	9	7	5	12	9	7	4	11	9	7	4	4	4	3	7	9	6	7
0500	23	37	34	38	30	37	26	48	20	44	12	13	5	8	27	41	21	32
0600	70	104	49	90	50	297	74	118	68	114	34	21	9	9	62	145	51	108
0700	77	175	85	163	91	641	90	241	93	183	41	60	30	25	87	281	72	213
0800	151	195	136	199	124	218	166	261	164	209	94	94	48	49	148	216	126	175
0900	91	137	96	130	107	108	114	152	136	132	94	128	79	88	109	132	102	125
1000	96	114	114	121	120	112	127	130	109	137	112	139	94	117	113	123	110	124
1100	106	107	100	115	108	116	136	146	140	144	108	130	117	108	118	126	116	124
1200	134	126	79	103	100	120	127	138	134	129	131	135	114	148	115	123	117	128
1300	96	111	100	130	116	129	118	127	109	151	125	129	86	117	108	130	107	128
1400	113	160	120	140	131	155	164	162	130	152	99	100	109	117	132	154	124	141
1500	178	152	209	174	180	164	207	179	210	195	123	121	129	138	197	173	177	160
1600	149	122	170	130	172	126	178	143	180	144	104	104	94	110	170	133	150	126
1700	147	88	188	97	183	102	168	99	138	122	86	96	67	89	165	102	140	99
1800	79	52	80	75	88	76	107	79	113	66	64	54	33	63	93	70	81	66
1900	38	44	47	44	45	36	48	47	49	58	39	45	32	27	45	46	43	43
2000	26	24	24	23	27	40	32	38	31	33	26	25	23	33	28	32	27	31
2100	22	19	18	21	22	23	30	28	33	31	15	24	11	14	25	24	22	23
2200	7	5	15	9	15	10	14	14	21	19	17	25	11	5	14	11	14	12
2300	4	1	11	1	7	5	11	4	15	15	16	18	3	2	10	5	10	7
Total	1627	1785	1689	1826	1741	2535	1955	2178	1919	2090	1371	1497	1128	1307	1786	2085	1634	1889

Peak Statistics

		Mon		Tue		Wed		Thu		Fri		Sat		Sun		Mon - Fri		Mon - Sun	
		N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S	N	S
AM	1/4 Hour	0830	0815	0830	0800	0830	0715	0830	0715	0815	0800	1030	1030	1115	1000	0830	0715	0830	0715
	1/4 Hr Vol	54	56	46	58	44	242	64	78	50	73	32	47	38	39	51	89	41	65
	1/2 Hour	0815	0800	0815	0745	0815	0700	0815	0815	0815	0745	1145	1100	1100	1145	0815	0700	0815	0700
	1/2 Hr Vol	92	108	78	114	76	412	104	145	99	124	65	82	68	72	90	158	74	116
	1 Hour	0800	0745	0745	0745	0815	0645	0815	0745	0745	0745	1145	1030	1030	1145	0815	0700	0815	0700
	1 Hr Vol	151	212	138	212	132	688	175	266	171	222	139	162	127	142	150	281	131	213
	1 Hr Fact	.6991	.9464	.75	.9138	.75	.7107	.6836	.911	.855	.7603	.8688	.8617	.8355	.9342	.7296	.7911	.7905	.8192
	2 Hour	1130	0700	0745	0715	0815	0630	0815	0700	0800	0715	1130	0930	1030	1145	0815	0645	1045	0645
	2 Hr Vol	247	370	244	363	244	1015	287	502	300	401	262	294	239	265	261	505	234	390
PM	1/4 Hour	1515	1515	1530	1500	1700	1530	1545	1545	1530	1330	1215	1315	1200	1515	1530	1500	1530	1500
	1/4 Hr Vol	51	48	64	60	52	57	61	55	62	57	40	48	36	45	52	46	46	43
	1/2 Hour	1515	1500	1515	1445	1530	1515	1545	1545	1515	1500	1215	1300	1445	1515	1530	1500	1530	1500
	1/2 Hr Vol	98	92	118	102	96	97	112	96	114	101	74	76	66	78	101	89	90	82
	1 Hour	1515	1430	1445	1445	1615	1515	1545	1500	1515	1500	1200	1230	1445	1200	1500	1445	1500	1500
	1 Hr Vol	182	171	209	182	189	172	208	179	223	195	131	145	129	148	197	173	177	160
	1 Hr Fact	.8922	.8906	.8164	.7583	.9087	.7544	.8525	.8136	.8992	.8705	.8188	.7552	.9773	.8605	.9435	.9361	.965	.9365
	2 Hour	1515	1400	1445	1345	1530	1430	1445	1400	1500	1430	1200	1200	1430	1200	1445	1400	1445	1400
	2 Hr Vol	335	312	382	317	364	326	407	341	390	350	256	264	242	265	369	327	330	301
Peak	12 Hour	0630	0600	0645	0615	0645	0615	0630	0615	0645	0615	0730	0730	0730	0745	0645	0615	0645	0615
	12 Hr Vol	1427	1591	1482	1608	1525	2302	1713	1897	1671	1817	1194	1295	1013	1178	1561	1842	1426	1659

Traffic Memorandum

Title	**North Baldivis**		
Client	Upside Property Pty Ltd	**Project No**	CEP02206
Date	19/05/2017	**Status**	Revision A
Author	Danny Sriono, Traffic Engineer	**Discipline**	Traffic and Transport
Reviewer	Jacob Martin, Team Leader – Transport Planning	**Office**	Perth

Introduction

Cardno previously was commissioned by Upside Property Pty Ltd (a subsidiary of Cedar Woods Properties Ltd) to prepare a Transport Assessment for the North Baldivis Local Structure Plan (dated December 2016).

This report identified that the intersection of Baldivis Road/Mundijong Road/Kulija Road had not been assessed due to insufficient data, resulting from the fact that it was under construction at the time of reporting.

The purpose of this memo is to provide an update to the report and present the results of the intersection analysis, for the existing configuration shown below **Figure 1**.

1. Site Location

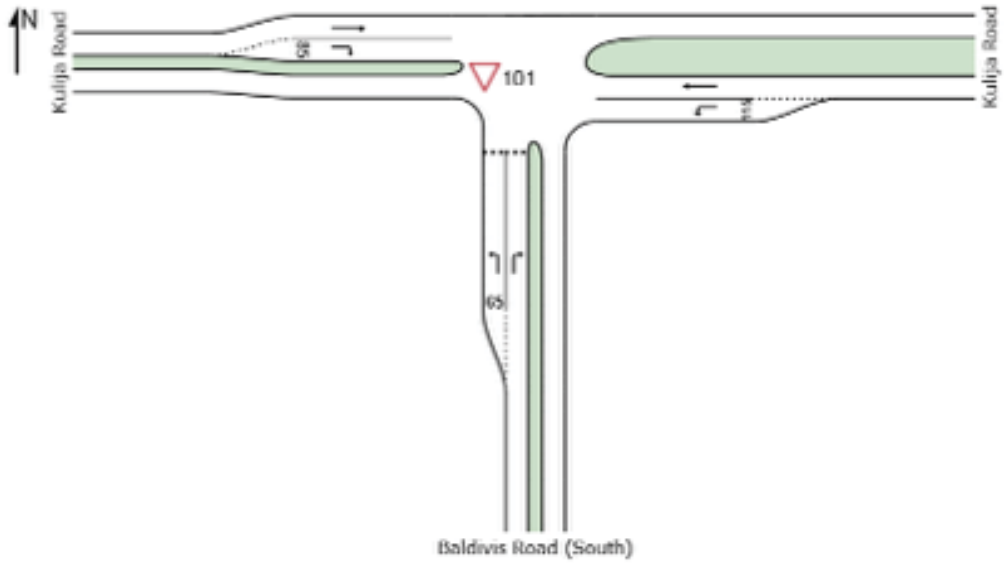
2. Intersection Operation

2.1. Existing

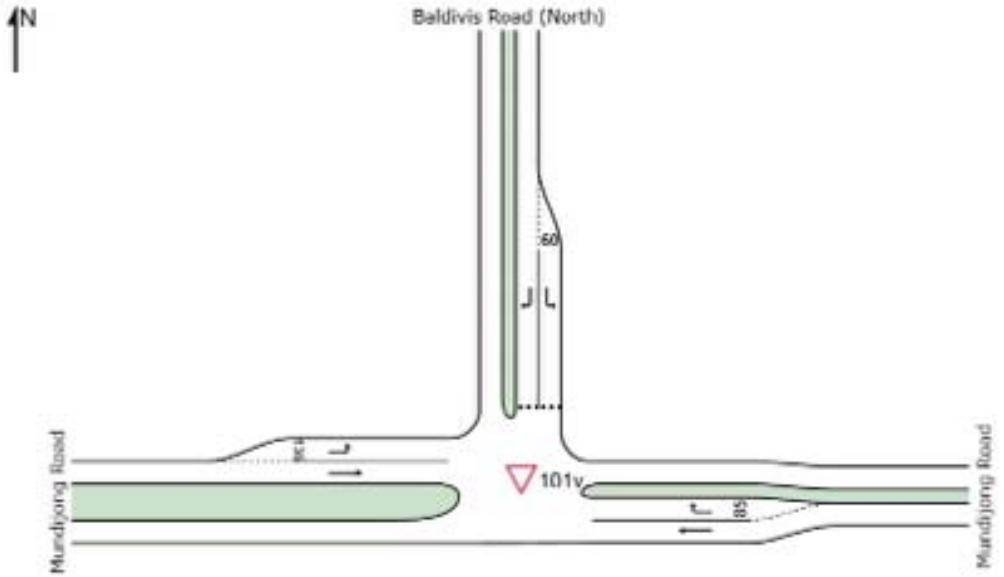
Analysis of the existing traffic volumes operation has been carried out for the intersection of Baldivis Road/Mundijong Road/Kulija Road by using the SIDRA analysis software. For the purpose of the SIDRA analysis, this staggered T-intersection has been separated into two 3-way priority intersections, with considerations regarding the interaction between these closely spaced intersections included in post-modelling analysis.

The SIDRA layout representation of the intersections are shown in **Figure 2** and **Figure 3**.

2. Baldivis Road/Kulija Road Intersection



3. Baldivis Road/Mundijong Road Intersection



Traffic survey was conducted on a typical weekday in May 2017 (outside of school holiday period) to determine turning movement volumes for this intersection. The existing turning movement volumes is shown in **Figure 4**

4. 2017 Existing Turning Movement Volumes (AM and PM Peak Hours)

The results of the SIDRA analysis in **Table 1** to **Table 4** quantify the existing intersection operations for both the AM peak period (7:15am-8:15am) and PM peak period (4:15pm-5:15pm).

1. Baldivis Road/Kulija Road Intersection Performance – 2017 AM Existing

Mov ID	ODMov	Demand Flows		Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
		Total	HV				Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Baldivis Road (South)											
1	L2	116	0	0.145	8.2	LOS A	0.5	3.7	0.49	0.74	51.6
3	R2	328	5	0.245	9.2	LOS A	1.2	8.8	0.53	0.71	52.8
Approach		444	3.7	0.245	7.5	LOS A	1.2	8.8	0.52	0.72	51.6
East: Kulija Road											
4	L2	104	2	0.057	5.6	LOS A	0	0	0	0.58	53.5
5	T1	429	4	0.226	0	LOS A	0	0	0	0	60
Approach		534	3.6	0.226	1.1	NA	0	0	0	0.11	58.6
West: Kulija Road											
11	T1	167	15	0.094	0	LOS A	0	0	0	0	60
12	R2	25	8	0.034	8.5	LOS A	0.1	0.9	0.52	0.69	50.9
Approach		193	14.1	0.094	1.1	NA	0.1	0.9	0.07	0.09	58.6
All Vehicles		1171	8.47	0.245	4.08	NA	1.2	8.8	0.33	0.54	89.05

2. Baldivis Road/Kulija Road Intersection Performance – 2017 PM Existing

Mov ID	ODMov	Demand Flows Total veh/h	Demand Flows 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: Baldivis Road (South)											
1	L2	88	2	0.119	8.5	LOS A	0.4	3	0.51	0.75	51.3
3	R2	211	3	0.162	9.8	LOS A	0.8	5.4	0.52	0.7	52.5
Approach		299	2.7	0.162	7.7	LOS A	0.8	5.4	0.52	0.72	51.6
East: Kulija Road											
4	L2	372	0	0.2	5.6	LOS A	0	0	0	0.58	53.6
5	T1	358	3	0.187	0	LOS A	0	0	0	0	60
Approach		729	1.5	0.2	2.8	NA	0	0	0	0.29	56.5
West: Kulija Road											
11	T1	379	3	0.198	0	LOS A	0	0	0	0	60
12	R2	193	2	0.304	11	LOS B	1.4	9.9	0.64	0.89	49.4
Approach		572	2.7	0.304	3.7	NA	1.4	9.9	0.22	0.3	55.9
All Vehicles		1600	2.74	0.304	4.39	NA	1.4	9.9	0.22	0.48	71.83

3. Baldivis Road/Mundijong Road Intersection Performance – 2017 AM Existing

Mov ID	ODMov	Demand Flows Total veh/h	Demand Flows 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
East: Mundijong Road											
5	T1	429	4	0.226	0	LOS A	0	0	0	0	60
6	R2	59	16	0.053	6.5	LOS A	0.2	1.7	0.3	0.58	51.8
Approach		488	5.4	0.226	0.8	NA	0.2	1.7	0.04	0.07	58.8
North: Baldivis Road (North)											
7	L2	43	12	0.041	6.5	LOS A	0.1	1.1	0.28	0.57	52.3
9	R2	63	7	0.046	8.7	LOS A	0.2	1.5	0.45	0.55	52.55
Approach		106	9	0.041	6.2	LOS A	0.2	1.2	0.27	0.56	52.3
West: Mundijong Road											
10	L2	1	0	0.001	5.5	LOS A	0	0	0	0.58	53.6
11	T1	166	15	0.094	0	LOS A	0	0	0	0	60
Approach		167	14.9	0.094	0	NA	0	0	0	0	59.9
All Vehicles		761	8.70	0.226	1.60	NA	0.2	1.7	0.08	0.13	63.20

4. Baldivis Road/Mundijong Road Intersection Performance – 2017 PM Existing

Mov ID	ODMov	Demand Flows Total veh/h	Demand Flows 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
East: Mundijong Road											
5	T1	358	3	0.187	0	LOS A	0	0	0	0	60
6	R2	56	0	0.058	7.3	LOS A	0.2	1.5	0.44	0.65	52.1
Approach		414	2.6	0.187	1	NA	0.2	1.5	0.06	0.09	58.8
North: Baldivis Road (North)											
7	L2	58	4	0.066	7.4	LOS A	0.2	1.7	0.42	0.66	52
9	R2	156	1	0.102	9	LOS A	0.5	3.3	0.43	0.63	52.9
Approach		214	1.8	0.102	6.8	LOS A	0.5	3.3	0.43	0.63	52.1
West: Mundijong Road											
10	L2	3	0	0.002	5.5	LOS A	0	0	0	0.58	53.6
11	T1	376	3	0.196	0	LOS A	0	0	0	0	60
Approach		379	3	0.196	0.1	NA	0	0	0	0	59.9
All Vehicles		1007	2.72	0.196	2.24	NA	0.5	3.3	0.12	0.18	61.40

From the above it is noted that the intersection is currently operating at an acceptable level of service.

2.2. Traffic Assessment

Future traffic conditions have been analysed with the proposed development for the anticipated development (2017) and conducting a design life analysis for the intersection (assuming 2% linear growth on Kulija Road and Mundijong Road) to determine when it would require upgrading. The assessment quantifies the effect that the additional development traffic has on the intersection of Baldivis Road/ Mundijong Road/Kulija Road.

The assessment undertaken in this study considers the weekday AM peak period (7:15am-8:15am) and the weekday PM peak period (4:15pm-5:15pm).

2.3. 2017 Intersection Performance (with Development)

The development traffic volumes for AM and PM peak hour is shown in **Figure 5**.

1. Proposed Development Trip Generation (AM and PM peak hour)

2.3.1. Baldivis Road/Kulija Road

The assessment below presents the analysis of the Baldivis Road/Kulija Road intersection for the year 2017 with the proposed development.

The results of the SIDRA analysis for this intersection is summarised below.

5. Baldivis Road/Kulija Road Intersection Performance – AM 2017 Existing (with development)

Mov ID	ODMov	Demand Flows		Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
		Total	HV				Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Baldivis Road (South)											
1	L2	116	0	0.145	8.2	LOS A	0.5	3.7	0.49	0.74	51.6
3	R2	374	5	0.279	9.3	LOS A	1.4	10.2	0.54	0.72	52.75
Approach		489	3.8	0.279	7.5	LOS A	1.4	10.2	0.53	0.72	51.6
East: Kulija Road											
4	L2	104	2	0.057	5.6	LOS A	0	0	0	0.58	53.5
5	T1	429	4	0.226	0	LOS A	0	0	0	0	60
Approach		534	3.6	0.226	1.1	NA	0	0	0	0.11	58.6
West: Kulija Road											
11	T1	193	15	0.108	0	LOS A	0	0	0	0	60
12	R2	25	8	0.034	8.5	LOS A	0.1	0.9	0.52	0.69	50.9
Approach		218	14.2	0.108	1	NA	0.1	0.9	0.06	0.08	58.8
All Vehicles		1241	8.48	0.279	4.21	NA	1.4	10.2	0.33	0.53	86.05

6. Baldivis Road/Kulija Road Intersection Performance – PM 2017 Existing (with development)

Mov ID	ODMov	Demand Flows		Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
		Total	HV				Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Baldivis Road (South)											
1	L2	88	2	0.151	10.2	LOS B	0.5	3.8	0.6	0.83	50.2
3	R2	323	3	0.301	12	LOS B	1.6	11.1	0.63	0.85	51.5
Approach		412	2.8	0.301	9	LOS A	1.6	11.1	0.62	0.84	50.8
East: Kulija Road											
4	L2	372	0	0.2	5.6	LOS A	0	0	0	0.58	53.6
5	T1	525	3	0.275	0	LOS A	0	0	0	0	59.9
Approach		897	1.8	0.275	2.3	NA	0	0	0	0.24	57.1
West: Kulija Road											
11	T1	542	3	0.283	0	LOS A	0	0	0	0	59.9
12	R2	193	2	0.396	14.4	LOS B	1.9	13.3	0.76	0.98	47.2
Approach		735	2.7	0.396	3.8	NA	1.9	13.3	0.2	0.26	56
All Vehicles		2044	3.12	0.396	4.72	NA	1.9	13.3	0.27	0.50	75.11

From the above it is noted that the intersection will operate at an acceptable level of service with both existing and proposed development.

2.3.2. Baldivis Road/Mundijong Road

The assessment below presents the analysis of the Baldivis Road/Mundijong Road intersection for the year 2017 with the proposed development.

The results of the SIDRA analysis for this intersection is summarised below.

7. Baldivis Road/Mundijong Road Intersection Performance – AM 2017 Existing (with development)

Mov ID	ODMov	Demand Flows		Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
		Total	HV				Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Mundijong Road											
5	T1	429	4	0.226	0	LOS A	0	0	0	0	60
6	R2	120	16	0.112	6.7	LOS A	0.5	3.7	0.33	0.6	51.7
Approach		549	6.6	0.226	1.5	NA	0.5	3.7	0.07	0.13	57.9
North: Baldivis Road (North)											
7	L2	174	12	0.167	6.7	LOS A	0.7	5.1	0.32	0.6	52.1
9	R2	277	7	0.201	9	LOS A	1	7.1	0.49	0.59	52.35
Approach		451	8.9	0.167	6.3	LOS A	0.8	5.9	0.31	0.58	52.2
West: Mundijong Road											
10	L2	26	0	0.014	5.5	LOS A	0	0	0	0.58	53.6
11	T1	166	15	0.094	0	LOS A	0	0	0	0	60
Approach		193	13	0.094	0.8	NA	0	0	0	0.08	59
All Vehicles		1193	9.47	0.226	3.86	NA	0.8	5.9	0.22	0.33	62.37

8. Baldivis Road/Mundijong Road Intersection Performance – PM 2017 Existing (with development)

Mov ID	ODMov	Demand Flows		Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
		Total	HV				Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Mundijong Road											
5	T1	358	3	0.187	0	LOS A	0	0	0	0	60
6	R2	167	0	0.209	8.6	LOS A	0.8	5.9	0.55	0.78	51.1
Approach		525	2	0.209	2.8	NA	0.8	5.9	0.18	0.25	56.8
North: Baldivis Road (North)											
7	L2	71	4	0.088	8	LOS A	0.3	2.3	0.47	0.7	51.7
9	R2	364	1	0.256	9.6	LOS A	1.3	9.1	0.51	0.69	52.7
Approach		435	1.5	0.256	7.2	LOS A	1.3	9.1	0.51	0.69	51.8
West: Mundijong Road											
10	L2	166	0	0.09	5.5	LOS A	0	0	0	0.58	53.6
11	T1	376	3	0.196	0	LOS A	0	0	0	0	60
Approach		542	2.1	0.196	1.7	NA	0	0	0	0.18	57.9
All Vehicles		1502	2.13	0.256	4.27	NA	1.3	9.1	0.23	0.40	63.16

From the above it is noted that the intersection will operate at an acceptable level of service with both existing and proposed development.

2.4. Design Life Intersection Performance (with Development)

2.4.1. Baldivis Road/Kulija Road

The assessment below presents the design life analysis of the Baldivis Road/Kulija Road intersection on when it would be required to upgraded (based on 2% linear growth annually). The results of the SIDRA analysis for this intersection is summarised below.

9. Baldivis Road/Kulija Road Intersection Performance – AM (Design Life > 20 years)

Mov ID	ODMov	Demand Flows		Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
		Total	HV				Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Baldivis Road (South)											
1	L2	169	0	0.289	11.1	LOS B	1.2	8.2	0.64	0.88	49.6
3	R2	818	5	0.786	17.3	LOS C	10.3	75.4	0.82	1.38	49.85
Approach		987	4.1	0.786	13.9	LOS B	10.3	75.4	0.79	1.29	47.4
East: Kulija Road											
4	L2	152	2	0.083	5.6	LOS A	0	0	0	0.58	53.5
5	T1	627	4	0.33	0	LOS A	0	0	0	0	59.9
Approach		779	3.6	0.33	1.1	NA	0	0	0	0.11	58.6
West: Kulija Road											
11	T1	247	15	0.139	0	LOS A	0	0	0	0	60
12	R2	37	8	0.071	11.3	LOS B	0.3	1.9	0.64	0.85	49
Approach		284	14.1	0.139	1.5	NA	0.3	1.9	0.08	0.11	58.3
All Vehicles		2050	7.66	0.786	8.44	NA	10.3	75.4	0.56	0.98	78.34

10. Baldivis Road/Kulija Road Intersection Performance – PM (Design Life – 17 years)

Mov ID	ODMov	Demand Flows		Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
		Total	HV				Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Baldivis Road (South)											
1	L2	118	2	0.204	10.4	LOS B	0.7	5.2	0.62	0.84	50
3	R2	841	3	0.789	20.6	LOS C	10.8	77.6	0.82	1.38	47.75
Approach		959	2.9	0.789	14	LOS B	10.8	77.6	0.79	1.32	47.4
East: Kulija Road											
4	L2	498	0	0.268	5.6	LOS A	0	0	0	0.58	53.6
5	T1	480	3	0.251	0	LOS A	0	0	0	0	59.9
Approach		977	1.5	0.268	2.9	NA	0	0	0	0.29	56.5
West: Kulija Road											
11	T1	526	3	0.275	0	LOS A	0	0	0	0	59.9
12	R2	258	2	0.583	18.4	LOS C	3.3	23.4	0.84	1.1	44.9
Approach		784	2.7	0.583	6.1	NA	3.3	23.4	0.28	0.36	54
All Vehicles		2720	2.81	0.789	9.59	NA	10.8	77.6	0.44	0.82	64.52

2.4.2. Baldivis Road/Mundijong Road

The assessment below presents the design life analysis of the Baldivis Road/Mundijong Road intersection on when it would be required to be upgraded (based on 2% linear growth annually). The results of the SIDRA analysis for this intersection is summarised below.

11. Baldivis Road/Mundijong Road Intersection Performance – AM (Design Life > 20 years)

Mov ID	ODMov	Demand Flows		Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
		Total	HV				Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Mundijong Road											
5	T1	1031	4	0.542	0.1	LOS A	0	0	0	0	59.8
6	R2	164	16	0.204	8.5	LOS A	0.8	6.6	0.52	0.75	50.7
Approach		1195	5.6	0.542	1.3	NA	0.8	6.6	0.07	0.1	58.4
North: Baldivis Road (North)											
7	L2	300	12	0.385	9.4	LOS A	2	15.4	0.56	0.85	50.4
9	R2	440	7	0.787	24.9	LOS C	6.3	46.4	0.93	1.35	44.35
Approach		740	9	0.385	8.1	LOS A	2	15.4	0.54	0.76	51.1
West: Mundijong Road											
10	L2	3	0	0.002	5.5	LOS A	0	0	0	0.58	53.6
11	T1	399	15	0.225	0	LOS A	0	0	0	0	59.9
Approach		402	14.9	0.225	0.1	NA	0	0	0	0	59.9
All Vehicles		2337	8.93	0.542	6.54	NA	2	15.4	0.30	0.45	59.21

12. Baldivis Road/Mundijong Road Intersection Performance – PM (Design Life > 20 years)

Mov ID	ODMov	Demand Flows		Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
		Total	HV				Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
East: Mundijong Road											
5	T1	981	3	0.958	3.5	LOS A	11.2	80.5	1	0	55.7
6	R2	296	0	0.978	68.1	LOS F	12.6	88.4	0.99	1.97	27.9
Approach		1276	2.3	0.978	18.5	NA	12.6	88.4	1	0.46	45.2
North: Baldivis Road (North)											
7	L2	179	4	0.655	26.9	LOS D	3	21.8	0.92	1.14	40.7
9	R2	482	1	0.771	32.4	LOS D	6.3	44.2	0.91	1.34	42.8
Approach		661	1.8	0.771	21.6	LOS C	6.3	44.2	0.91	1.28	43.3
West: Mundijong Road											
10	L2	17	0	0.009	5.5	LOS A	0	0	0	0.58	53.6
11	T1	1030	3	0.538	0.1	LOS A	0	0	0	0	59.8
Approach		1047	3	0.538	0.2	NA	0	0	0	0.01	59.7
All Vehicles		2984	2.69	0.978	14.81	NA	12.6	88.4	0.70	0.54	57.02

From the above it suggests that the intersection would require upgrading within 17 years or less. The critical movement appears to be traffic movements heading northbound on Baldivis Road from the east. The staggered-T formation effectively gives no priority to this movement under the current configuration.

It is important to note that the potential future failure of this intersection is as a result of background traffic increases along Mundijong Road and Baldivis Road, beyond the level expected for an intersection of this type. Modification of the intersection to a signalised form would provide capacity for minor movements. It is also understood that the ultimate form of this intersection is to be a flyover, with connection removed. This upgrade is associated with the construction of the FRCAH, and the timings for reconstruction dependent on funding for that link.

3. Summary

Cardno was commissioned by Upside Property Pty Ltd (a subsidiary of Cedar Woods Properties Ltd) to conduct a traffic analysis for the intersection of Baldivis Road/Mundijong Road/Kulija Road in the City of Rockingham as part of the North Baldivis Local Structure Plan Development Application process.

The following conclusions have been made in regards to the impact of the proposed development;

- The existing intersection currently operates at an acceptable level of service
- The existing intersection with the proposed development also operates at an acceptable level of service
- The intersection is expected to require upgrading within 17 years to cater for future growth of the area. (assuming full buildout of the proposed North Baldivis Structure Plan and a linear 2% growth rate).