892 – 990 Barwon Heads Road, Armstrong Creek
Traffic Impact Assessment
Prepared for: Newland Developers Pty Ltd

JULY 2015

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1 Introduction

1.1 Background

SMEC Australia Pty Ltd has been engaged by Newland Developers Pty Ltd to prepare a Traffic Impact Assessment (TIA) Report for the Clancy (Rainbow Rider) and Keirl properties in Armstrong Creek. The site is located at 892 - 990 Barwon Heads Road, Armstrong Creek south-east of Warralily Estate and is proposed for the development of 600 residential lots.

The purpose of this report is to support the planning application to rezone the land for residential development, as an extension of the Armstrong Creek Urban Growth Area.

1.2 Scope

This TIA report investigates all proposed access arrangements to the site and assesses the traffic and safety implications of its development on the existing surrounding area and transport network. The report also considers the internal road network and road cross sections within the site based on the Armstrong Creek East Precinct Structure Plan (PSP).

Trip generation rates have been obtained from the Armstrong Creek East PSP. Midblock and intersection assessments have been undertaken on Barwon Heads Road and the local road providing access to the site, to determine the capability of the existing road network to cater for the expected traffic generation of the site.

1.3 Aim of this Report

The aim of this report is to assess what impact the traffic generated from the proposed development will have on the existing road network. The report will also review the potential impact of local road connections to the adjoining Armstrong Waters/ Warralily Estate road network to identify any mitigation measures that may be required.

1.4 References

The following references were used to assist in the preparation of this report:

- Austroads Guide to Traffic Management, Part 12: Traffic Impacts of Development;
- Austroads Guide to Traffic Management, Part 3: Traffic Studies and Analysis;
- Austroads Guide to Road Design, Part 4A: Unsignalised and Signalised Intersections;
- Traffic Engineering and Management, K W Ogden and S Y Taylor, 1996;
- Department of Transport Guidelines for Land Use and Development: Public Transport, 2008;
- Armstrong Creek East Precinct Structure Plan, May 2010; and
- Armstrong Creek Eastern Precinct – Traffic Impact Assessment, 14 October 2009.

2 Development Proposal

2.1 Site Location

The proposed development site is located at 892-990 Barwon Heads Road in Armstrong Creek, refer to Figure 1. The site is bounded by Barwon Heads Road to the east, vacant land to the south and the Armstrong Creek Urban Growth Area to the north and west.

The site is located approximately 10km south of the Geelong town centre. In relation to Melbourne, the site is located approximately 70km south-west of the CBD.

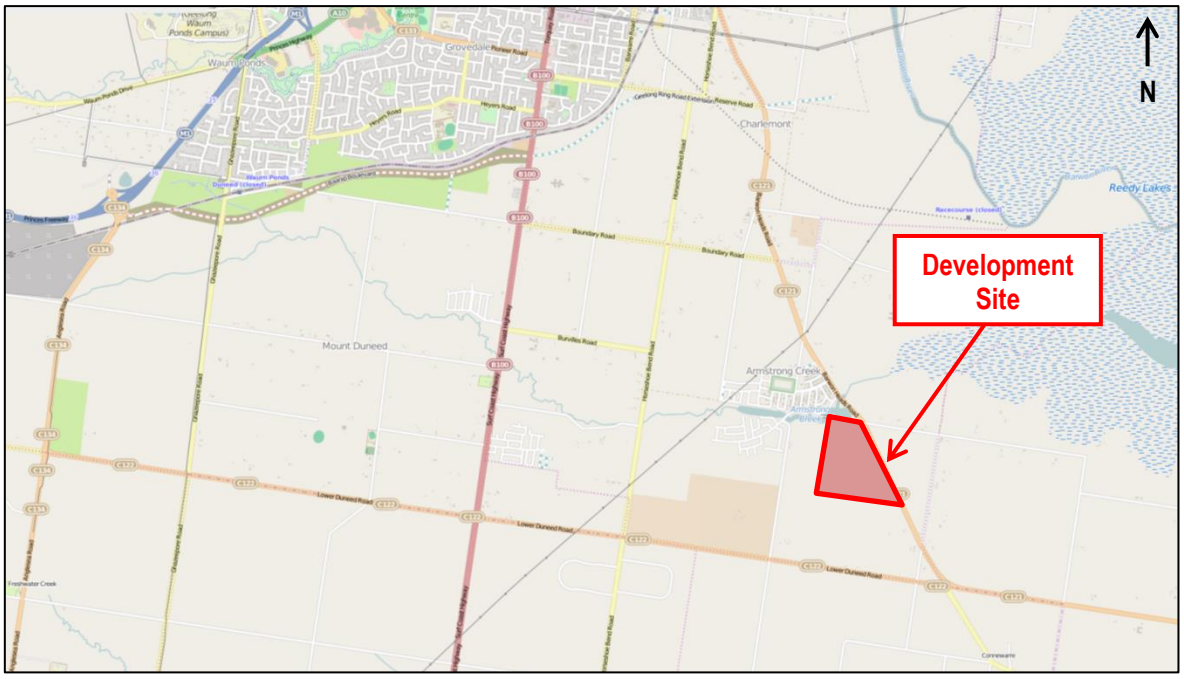


Figure 1: Locality plan (source: http://www.openstreetmap.org)

2.2 Site Plan

The residential development of the 52 hectare site is proposed to provide 600 lots. A copy of the concept site plan is provided in Appendix A.

Features of the development proposal include:

- Primary vehicular access point on Barwon Heads Road;
- Secondary vehicular access to the site provided via a local road connection to the adjacent development within the Armstrong Creek Urban Growth Area (i.e. Armstrong Waters); and
- Extension of the wetlands and open space areas adjacent to the north-west boundary of the site.

3 Existing Conditions Assessment

3.1 Greater Geelong Planning Scheme

Clause 21 of the Greater Geelong Planning Scheme defines the objectives, strategies and actions of the Municipal Strategic Statement (MSS) for guiding land use and development in Greater Geelong.

Clause 21.11 identifies the proposed development site as forming part of the rural break between the Armstrong Creek Urban Growth Area and the Surf Coast Shire. Refer to Appendix B for a copy of the Armstrong Creek Urban Growth Plan.

3.1.1 Armstrong Creek East Precinct Structure Plan

The Armstrong Creek Urban Growth Area is the primary growth area for Greater Geelong. It is expected to ultimately accommodate approximately 54,000 residents in 22,000 dwellings and provide 22,000 jobs.

A Precinct Structure Plan (PSP) has been developed for the Armstrong Creek Eastern Precinct to achieve the vision for urban development in the area set out in the Greater Geelong Planning Scheme. The PSP sets objectives and provides for their implementation in relation to eight key elements:

- Image and character;
- Subdivision and housing;
- Community facilities;
- Public open space, natural systems and biodiversity;
- Employment and activity centres;
- Transport and movement;
- Utilities and energy; and
- Drainage and floodplain management.

3.1.2 Transport and Movement

The Armstrong Creek East PSP identifies key road, public transport and walking and cycling infrastructure requirements to provide a permeable transport network suitable to cater for the expected future traffic demand. With regard to the proposed development site, the following transport network requirements have been considered:

- Barwon Heads Road is expected to be duplicated at some stage in the future, subject to traffic growth and consideration by VicRoads.
- Warralily Boulevard is shown as a Level 2 Connector with dedicated on-road cycle lanes. A secondary bus route is also recommended along Warralily Boulevard between Barwon Heads Road and Surf Coast Highway.
- Charlemont Road is shown as a Level 1 Connector. The section to the south of Warralily Boulevard is shown as a potential secondary bus route to Lower Duneed Road, and the section to the north of Warralily Boulevard (renamed as Carter Road) has a 3.0m wide shared path on one side of the road to cater for cyclists.
- Walking and cycling links are to be provided within the wetlands and open space areas to the north and west of the site.

3.2 Land Use

The proposed development site is located in a Farming Zone (FZ), refer to Figure 2. A Floodway Overlay (FO) and Land Subject to Inundation Overlay (LSIO) also apply to the site.

Key land uses surrounding the site include:

- Farming Zone (FZ) to the south and east;
- Urban Growth Zone (UGZ2) to the north and west (Armstrong Creek Urban Growth Area); and
- Road Zone (RDZ1) for Barwon Heads Road to the east.

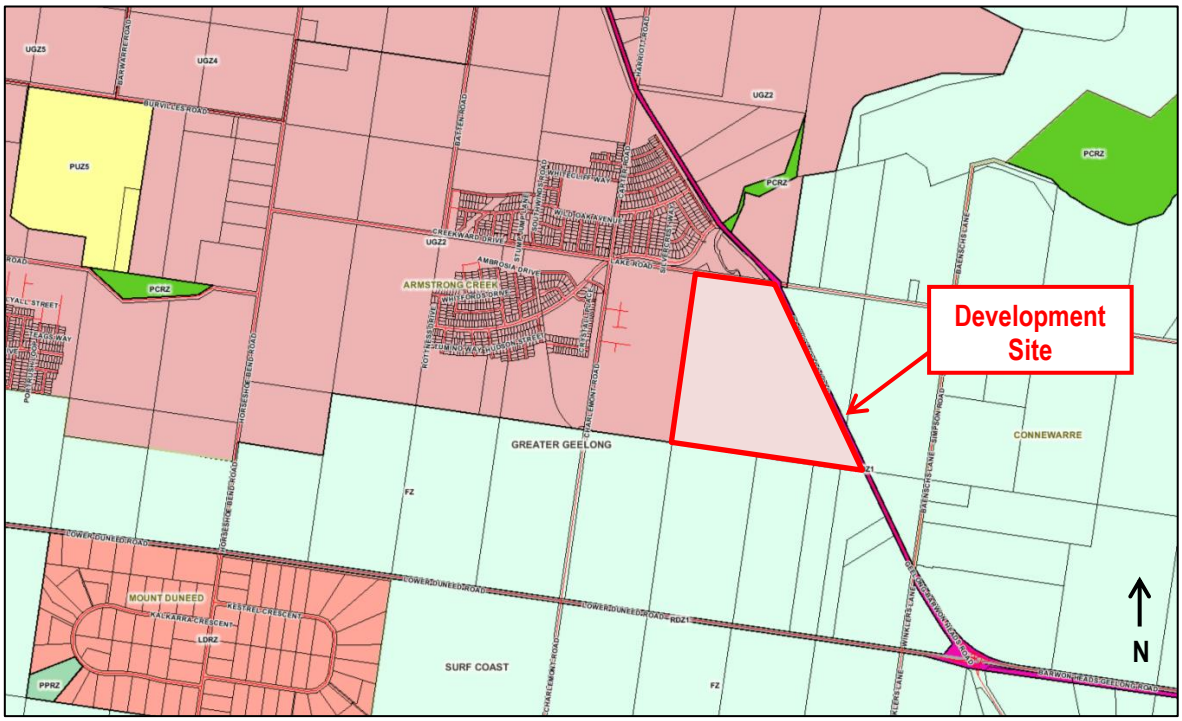


Figure 2: Land use plan (source: http://services.land.vic.gov.au/maps/pmo)

3.3 Road Network

3.3.1 Barwon Heads Road

Barwon Heads Road is an arterial road under the management and control of VicRoads. It provides a main road connection between Geelong and Barwon Heads/ Ocean Grove with access to Warralily Estate provided via a signalised intersection. Access to local roads and properties is also permitted via unsignalised intersections.

Barwon Heads Road is a two-lane, single carriageway road which runs in a mainly north-south direction between the Princes Highway in Geelong and Lower Duneed Road in Connewarre. Its orientation then changes to an east-west direction to Barwon Heads and Ocean Grove.

The posted speed limit on Barwon Heads Road varies along its length as the road travels through urban and rural areas. Adjacent to the site the posted speed limit is 100km/h, which decreases to 80km/h on both approaches to the Warralily Boulevard signalised intersection to the north of the site.

The alignment of Barwon Heads Road in the vicinity of the site is flat with some gentle horizontal curves. On both approaches to the proposed site access point, the road alignment is straight and flat providing adequate sight distance to the new intersection. Refer Photo 1 and Photo 2.

Photo 1: Barwon Heads Road, looking north

Photo 2: Barwon Heads Road, looking south

3.3.2 Warralily Boulevard

Warralily Boulevard is the main road through Warralily Estate, providing a connection between Barwon Heads Road to the east and Surf Coast Highway to the west of the estate. An urban default speed limit of 50km/h applies to the road.

Warralily Boulevard is a residential collector road which runs in a mainly east-west direction to the north of the site. The carriageway is 10.4m wide within a 24.4m wide road reserve. Indented on-street parking is provided adjacent to residential properties on both sides of the road.

The alignment of Warralily Boulevard is flat with gentle horizontal curves. Channelised right turn lanes are provided at its intersections with Charlemont Road and Carter Road; refer to Photo 3 and Photo 4 respectively.

Photo 3: Warralily Boulevard, west approach to Charlemont Road

Photo 4: Warralily Boulevard, east approach to Carter Road

3.3.3 Charlemont Road

Charlemont Road is a local road which runs in a mainly north-south direction to the west of the site. Its alignment comprises some gentle horizontal curves on the approaches to its intersection with Warralily Boulevard. An urban default speed limit of 50km/h applies to the road.

The section to the south of Warralily Boulevard comprises a sealed carriageway approximately 7.3m wide within a 20.0m wide road reserve, refer to Photo 5. On-street parking is permitted on both sides of the road. It is noted that this cross section is to be provided along the length of Charlemont Road within the estate. Refer to Appendix D.

To the north of Warralily Boulevard, Charlemont Road has been renamed as Carter Road and will ultimately provide access to the Armstrong Creek town centre. The carriageway is 7.0m wide within a 27.5m wide road reserve and on-street parking is permitted on both sides of the road. refer to Photo 6 and Appendix D.

Carter Road (previously Charlemont Road) connecting Warralily Boulevard and The Neighbourhood Activity Center is referred to in an earlier document, Armstrong Creek Eastern Precinct Report – Warralily Stage 1 to 11 by Cardno Grogan Richards and dated 3 May 2011.

Photo 5: Charlemont Road, looking north

Photo 6: Carter Road, looking north

3.4 Traffic Data

3.4.1 Casualty Accident Statistics

VicRoads' Crashstats database indicates that two casualty crashes have been recorded along Barwon Heads Road in the vicinity of the site, in the five-year period between January 2009 and December 2013.

One crash involved a car travelling north-west on Barwon Heads Road leaving the carriageway to the right and hitting a tree (DCA 173). The other crash involved a utility vehicle travelling south-east on Barwon Heads Road hitting a horse on the carriageway (DCA 167). Both crashes occurred south of Lake Road during night-time conditions and resulted in serious injury to the vehicle occupants.

It is noted that these crashes occurred prior to the development of Warralily Estate within the Armstrong Creek Urban Growth Area.

3.4.2 Traffic Volumes

The Armstrong Creek Eastern Precinct – Traffic Impact Assessment report indicates the following future traffic volumes on the road network in the vicinity of the site:

- Barwon Heads Road, south of Warralily Boulevard – 4,200 vehicles per day
- Warralily Boulevard, east of Charlemont Road – 6,000 vehicles per day
- Charlemont Road – 3,700 vehicles per day

Adopting a conservative approach, it is considered appropriate to assess the impact of the proposed development based on the volume of traffic expected to use these roads following full development of the precinct.

3.5 Public Transport Network

3.5.1 Rail

The closest train station to the proposed development site is Marshall Station, which is located 5.0km north-west of the site via Marshalltown Road.

VLine train services operate daily via Marshall Station between Melbourne and Geelong, and between Geelong and Warrnambool. There are 400 car parking spaces provided at the station as well as bicycle storage facilities.

3.5.2 Bus Routes

There is currently one bus route operating along Barwon Heads Road adjacent to the site. Route 80 runs between Geelong Station and Ocean Grove via Marshall Station and Barwon Heads, refer to Figure 3.

The closest bus stop is located at the Barwon Heads Road/ Warralily Boulevard intersection, which is approximately 400m from the northern boundary of the site.

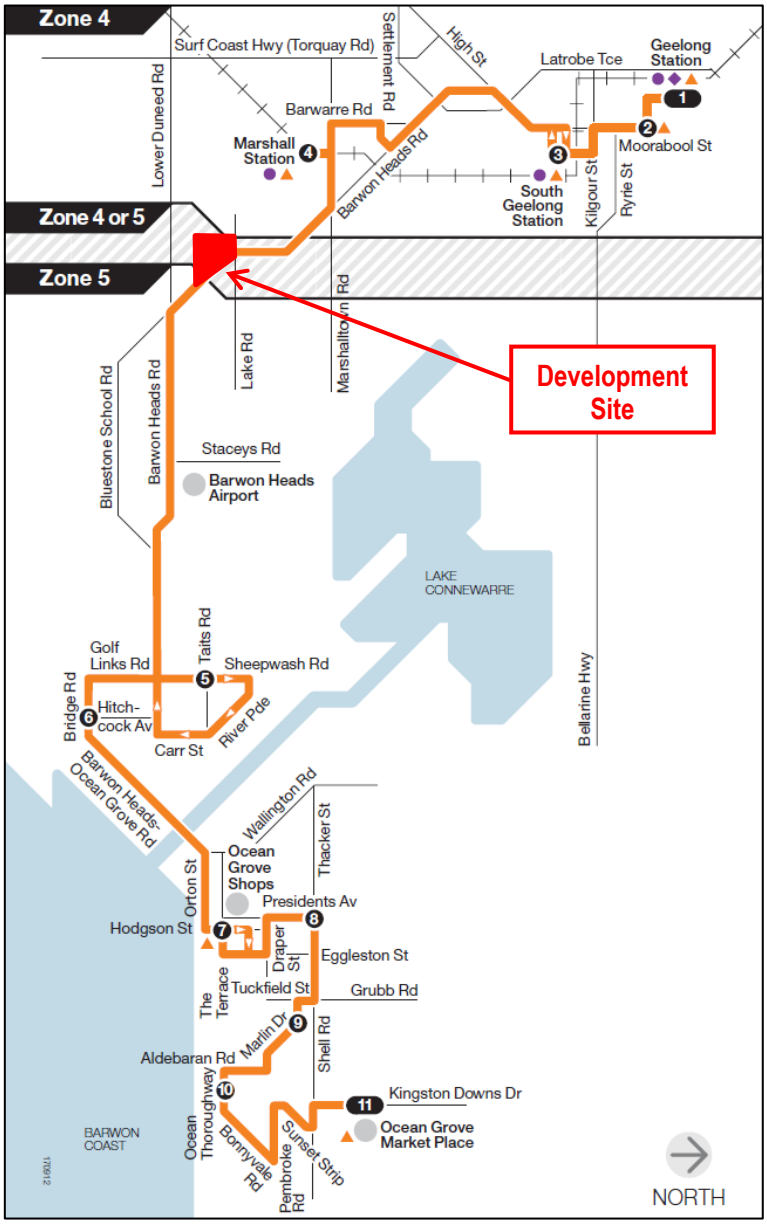


Figure 3: Bus Route 80 (source: http://ptv.vic.gov.au)

3.6 Walking and Cycling Facilities

On-road bicycle lanes are provided on Barwon Heads Road at its intersection with Warralily Boulevard, and along Warralily Boulevard through the estate. Cyclists are permitted to continue along Barwon Heads Road with sealed shoulders provided on both sides of the carriageway.

Along the south side of Warralily Boulevard there is a shared path network provided through the wetlands and open space areas, which continues under the bridge between Charlemont Road and Carter Road. Connections to the off-road shared path facilities in the wetlands area are also provided on both sides of Warralily Boulevard.

Footpaths are provided on both sides of Warralily Boulevard and Charlemont Road. Carter Road has a widened road reserve to maintain the trees within the verge and provide a 3.0m wide shared path on the west side of the road. A footpath is also provided on the east side of Carter Road.

4 Traffic Impact Assessment

4.1 Trip Generation

The Armstrong Creek Eastern Precinct – Traffic Impact Assessment report indicates that a trip generation rate of 8 vehicle movements per residential lot per day has been adopted for the precinct. As the proposed development site is considered an extension of the Armstrong Creek Urban Growth Area, the same rate will be adopted for the residential dwellings within this site.

Based on a 600 lot residential development, the proposed development site is expected to generate 4,800 vehicle trips per day. Assuming that 10% of daily vehicle trips are made in the peak hour; 480 vehicle trips would be expected to occur in the peak hour.

4.2 Trip Distribution

Generally, about 25% of trips generated by a new subdivision are internal trips made within the site. These internal trips include local shopping, school, recreation and local social visits. The remaining 75% of trips generated by the site are external trips made to/ from the site.

4.2.1 Internal Trips

For the proposed development site, it is expected that approximately 1,200 vehicle trips per day or 120 vehicle trips in the peak hour will be internal trips. Given the provision of local shopping, school and recreation facilities within Warralily Estate, these internal trips are expected to use the local road connection to the adjacent residential area (i.e. Armstrong Waters) and Charlemont Road to enter/ exit the site.

4.2.2 External Trips

The remaining 3,600 vehicle trips per day or 360 vehicle trips in the peak hour generated by the proposed development site are expected to be external trips. The majority of external vehicle trips generated by residential lots in the peak hour are home-to-work trips. Therefore, the distribution of traffic to/ from the site has been determined based on the location of the site in relation to the location of external employment areas.

It is therefore assumed that residents would use Barwon Heads Road to enter/ exit the site as follows:

- 90% of residents travel north towards Geelong and Melbourne; and
- 10% of residents travel south towards Torquay, Barwon Heads and Ocean Grove.

Figure 4 shows the distribution of generated traffic volumes from the site to the surrounding road network.

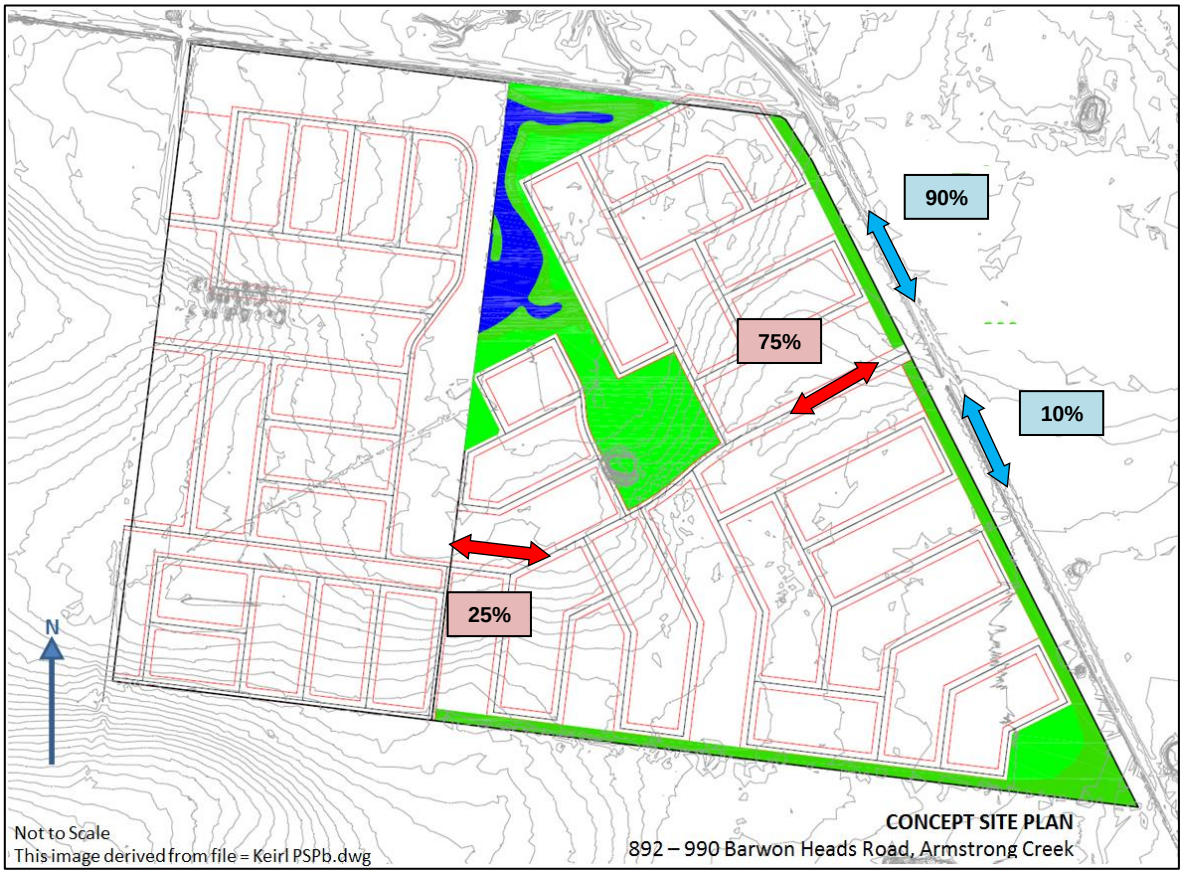


Figure 4: Distribution of site traffic

The directional distribution of traffic accessing the site is based on the assumption that 80% exit and 20% enter the site during the AM peak, and 40% exit and 60% enter the site during the PM peak (source: Traffic Engineering and Management, K W Ogden and S Y Taylor, 1996, Section 8.1).

4.2.3 Impact on Existing Traffic Movements

The proposed local road connection to the adjacent development (i.e. Armstrong Waters) would provide some residents of this development with an additional access point to Barwon Heads Road. As a result, it is expected that the new access point would re-distribute some traffic from Charlemont Road to the new access road. This is considered particularly relevant for the southern portion of the Armstrong Waters development area in the vicinity of the local road providing access to the site as it would provide a shorter route to Barwon Heads Road with less traffic expected in comparison to Warralily Boulevard (i.e. 6,000 vehicles per day from Section 3.4.2).

The number of trips that this new local road connection is expected to have an impact on is estimated at 1,200 vehicle trips per day (based on the daily external trip generation of the 200 residential lots within the southern portion of the Armstrong Waters development area). Therefore the total number of trips expected to use the new access point on Barwon Heads Road is 4,800 vehicles per day, and the total number of trips expected to use the local access road is approximately 2,400 vehicles per day.

Within Armstrong Waters, the nett effect on Charlemont Road would be zero as the number of trips diverted away from Charlemont Road is expected to be similar to the number of trips expected to use it to/ from the proposed development site. The local road providing access to the site however is expected to get busier with the addition of the internal trips generated by the proposed development site. Therefore the volume of traffic expected on this local access road is approximately 2,800

vehicles per day (based on the total daily trip generation of the 200 residential lots within the southern portion of the Armstrong Waters development area).

4.3 Trip Assignment

From the trip generation and distribution assumptions outlined above, traffic accessing the proposed development site can be assigned to Barwon Heads Road and the local road providing a secondary access point to the site.

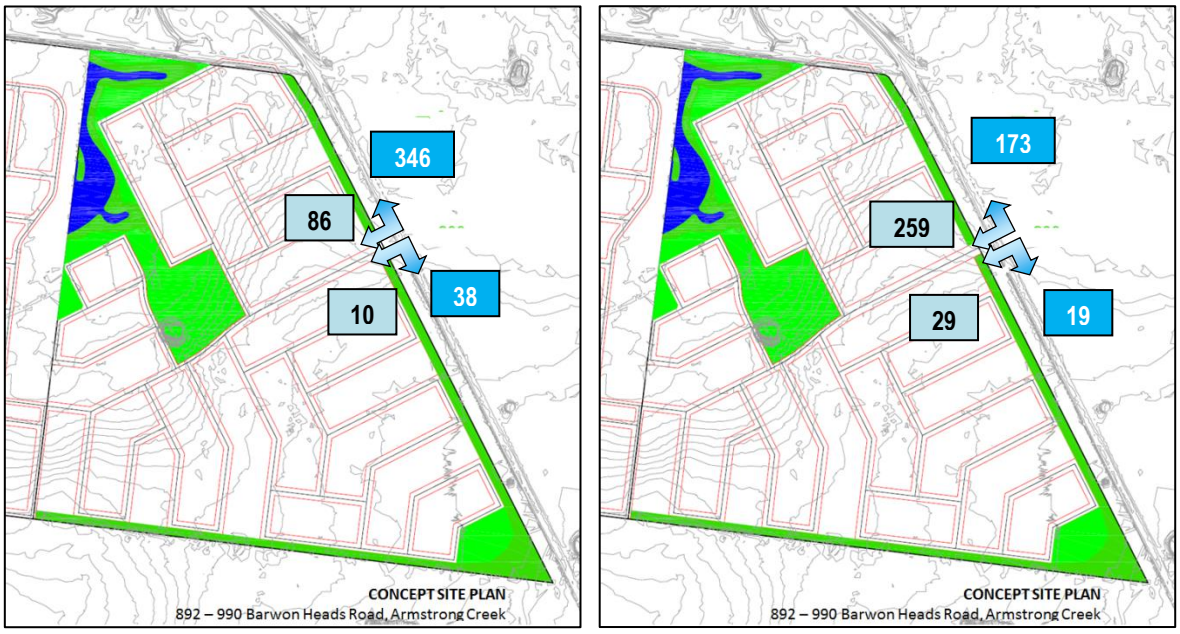
4.3.1 Barwon Heads Road

Table 1 summarises the predicted peak hour traffic movements on the primary access road following full development of the site.

Table 1: Peak hour private vehicle movements accessing the site

Access Road	AM Peak			PM Peak		
	Total Peak Hour Vehicle Trips	80% Exit	20% Enter	Total Peak Hour Vehicle Trips	40% Exit	60% Enter
Barwon Heads Road: North	**432**	346	86	**432**	173	259
Barwon Heads Road: South	**48**	38	10	**48**	19	29
Total	**480**	**384**	**96**	**480**	**192**	**288**

The assignment of traffic during the AM and PM peak hours accessing the site via Barwon Heads Road is presented in Figure 5.



AM Peak PM Peak

Figure 5: Assignment of traffic to Barwon Heads Road

4.3.2 Local Access Road

The predicted peak hour traffic movements on the local road providing access to the site, is presented in Figure 6. It is noted that the traffic volumes expected to move from the 892-990 Barwon Heads Road development westward to connect with Charlemont Road is slightly under a balance figure of vehicle trip exchanged between the two developments. The outcome of this slight imbalance is that a slight reduction in the peak hour operation of Charlemont Road can be expected.

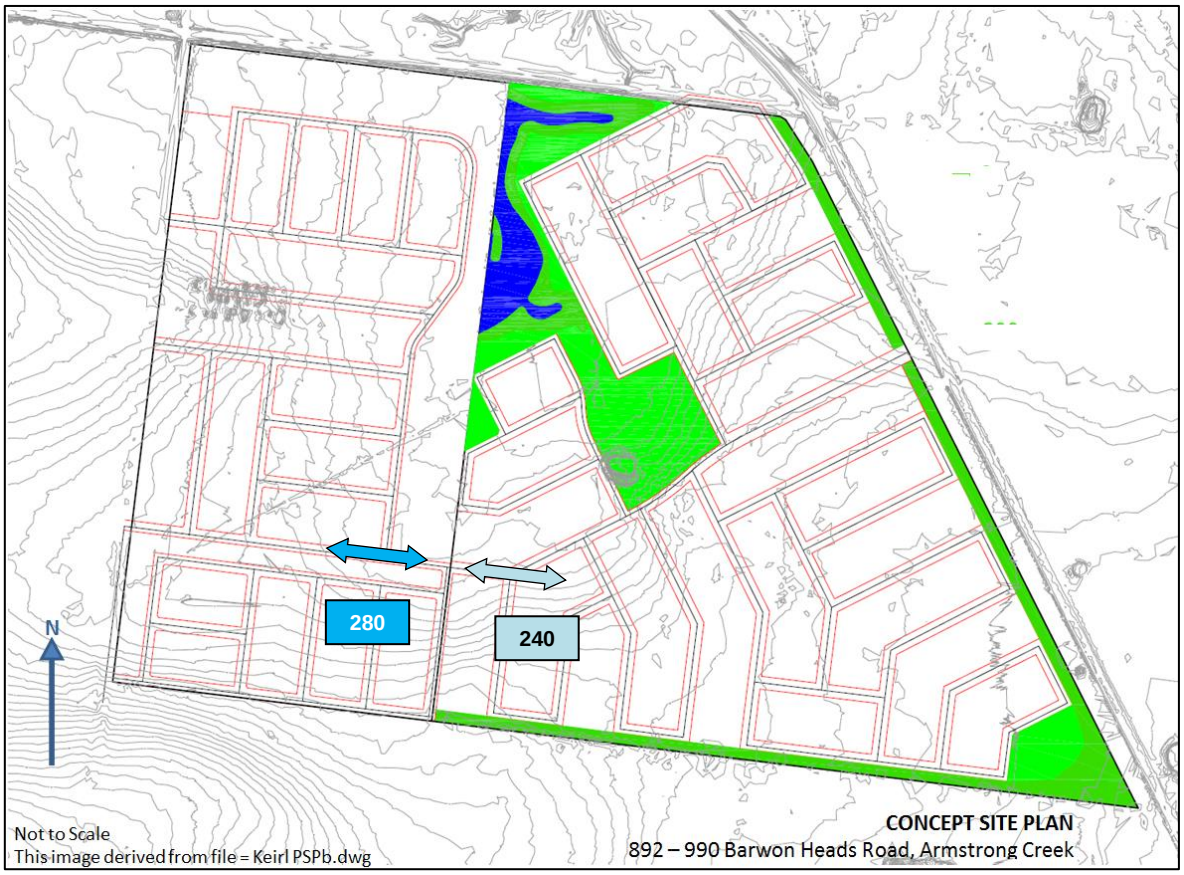


Figure 6: Assignment of traffic to local access road

4.4 Midblock Assessment

4.4.1 Existing Road Capacity

The one-way midblock capacity of a traffic lane on an undivided road with interrupted traffic flow is 900 vehicles per hour (source: Austroads Guide to Traffic Management, Part 3: Traffic Studies and Analysis, Section 5.2). This can be increased to 1,200 to 1,400 vehicles per hour when the following conditions are implemented:

- Adequate flaring at major upstream intersections;
- Uninterrupted flow from a wider carriageway upstream of an intersection approach and flowing at capacity;
- Control or absence of crossing or entering traffic at minor intersections by major road priority controls;
- Control or absence of parking;
- Control or absence of right turns by banning turning at difficult intersections;

- High volume flows of traffic from upstream intersections during more than one phase of a signal cycle; and
- Good co-ordination of traffic signals along the route.

4.4.1.1 Barwon Heads Road

Based on the proposed operating conditions of Barwon Heads Road in the Armstrong Creek East PSP, a one-way midblock capacity of 1,200 vehicles per hour has been adopted for this assessment.

The Armstrong Creek Eastern Precinct – Traffic Impact Assessment report indicates a peak one-way traffic flow on Barwon Heads Road adjacent to the site of 310 vehicles per hour in the AM peak travelling north towards Geelong and Melbourne. Therefore, Barwon Heads Road is expected to operate at approximately 26% of its theoretical capacity during the peak hour.

4.4.1.2 Local Access Road

A one-way midblock capacity of 900 vehicles per hour has been adopted for the local road providing access to the site. Based on the total daily trip generation of 200 residential lots within the adjacent development, it is estimated that approximately 1,600 vehicles per day would use this local access road. Assuming that 10% of vehicle trips occur in the peak hour, the peak traffic volume on this road equates to 160 vehicles per hour.

Adopting a worst case scenario whereby this traffic volume represents a one-way traffic flow, the local access road within Armstrong Waters is expected to operate at approximately 18% of its theoretical capacity during the peak hour.

4.4.2 Post Full Development Assessment

4.4.2.1 Barwon Heads Road

Following the development of the site, an additional 480 vehicle trips in the peak hour are expected along Barwon Heads Road. Assuming that 90% of traffic exiting the site in the AM peak would travel in a northbound direction along Barwon Heads Road, the development would contribute an extra 346 vehicles in the AM peak hour.

Therefore at full development of the site, the number of one-way vehicle trips in the peak hour along Barwon Heads Road to the north of the site would equate to 656 vehicles per hour. Barwon Heads Road would therefore operate at approximately 55% of its capacity during the AM peak hour. As a result, the traffic generated by the site would not have an adverse impact on the operating conditions of Barwon Heads Road when the development is fully constructed.

4.4.2.2 Local Access Road

Following the development of the site, an additional 120 vehicle trips in the peak hour are expected along the local road providing access to the site. Adopting a worst case scenario whereby this traffic volume represents a one-way traffic flow, the peak traffic volume on this local road would equate to 280 vehicles per hour. The local access road within Armstrong Waters would therefore operate at approximately 31% of its capacity during the peak hour.

As a result, the traffic generated by the site would not have an adverse impact on the operating conditions of the local road providing access to the site when the development is fully constructed.

4.5 Intersection Assessment

4.5.1 SIDRA Analysis

SIDRA Intersection 6.0 was used to assess the performance of the Barwon Heads Road/ New Access Road intersection under full development conditions. SIDRA is a key tool used for this type of assessment as it helps identify the "Level of Service" and "Degree of Saturation" of the intersection.

Level of Service (LOS) is defined as a qualitative measure for ranking "operating conditions", based on factors such as speed, travel time, freedom to manoeuvre, interruptions, comfort and convenience[1]. There are six levels of service, from A to F, with LOS A representing the best operating condition and LOS F the worst, ibid. LOS C or better is generally accepted as an appropriate level of operation.

The Degree of Saturation (DOS) is defined as the ratio of the arrival flow (demand) to the capacity of the approach during the same period[1]. The degree of saturation of an intersection approach ranges from close to zero for very low traffic flows and up to one for saturated flow or capacity, ibid. For signalised intersections, the "practical" DOS is around 0.90.

Table 2 sets out the DOS ranges that SIDRA uses when assessing the LOS. As can be seen, the lower the degree of saturation the better the level of service.

Table 2: LOS definition

Level of Service	Degree of Saturation
A	< = 0.60
B	0.60 – 0.70
C	0.70 – 0.90
D	0.90 – 0.95
E	0.95 – 1.00
F	> 1.00

[1] Austroads Guide to Traffic Management, Part 3: Traffic Studies and Analysis

4.5.2 Post Full Development Assessment – Single Carriageway

The main vehicular access point to the site is proposed on Barwon Heads Road via a new signalised T-intersection with all movements permitted. A performance assessment of the New Access Road intersection with Barwon Heads Road as a single carriageway has been undertaken for the AM and PM peak periods at full development. It is expected that Barwon Heads Road will remain a single carriageway until complete build out is achieved for the Armstrong Creek development area. Development input to the traffic volumes experienced on Barwon Heads Road have been incorporated into the intersection analysis. The volumes on Barwon Heads Road have been taken from the Armstrong Creek Eastern Precinct Traffic Impact Assessment report by Cardno dated 14 Oct 2009Cardno Report. Refer to the extract image, Figure 7 below.

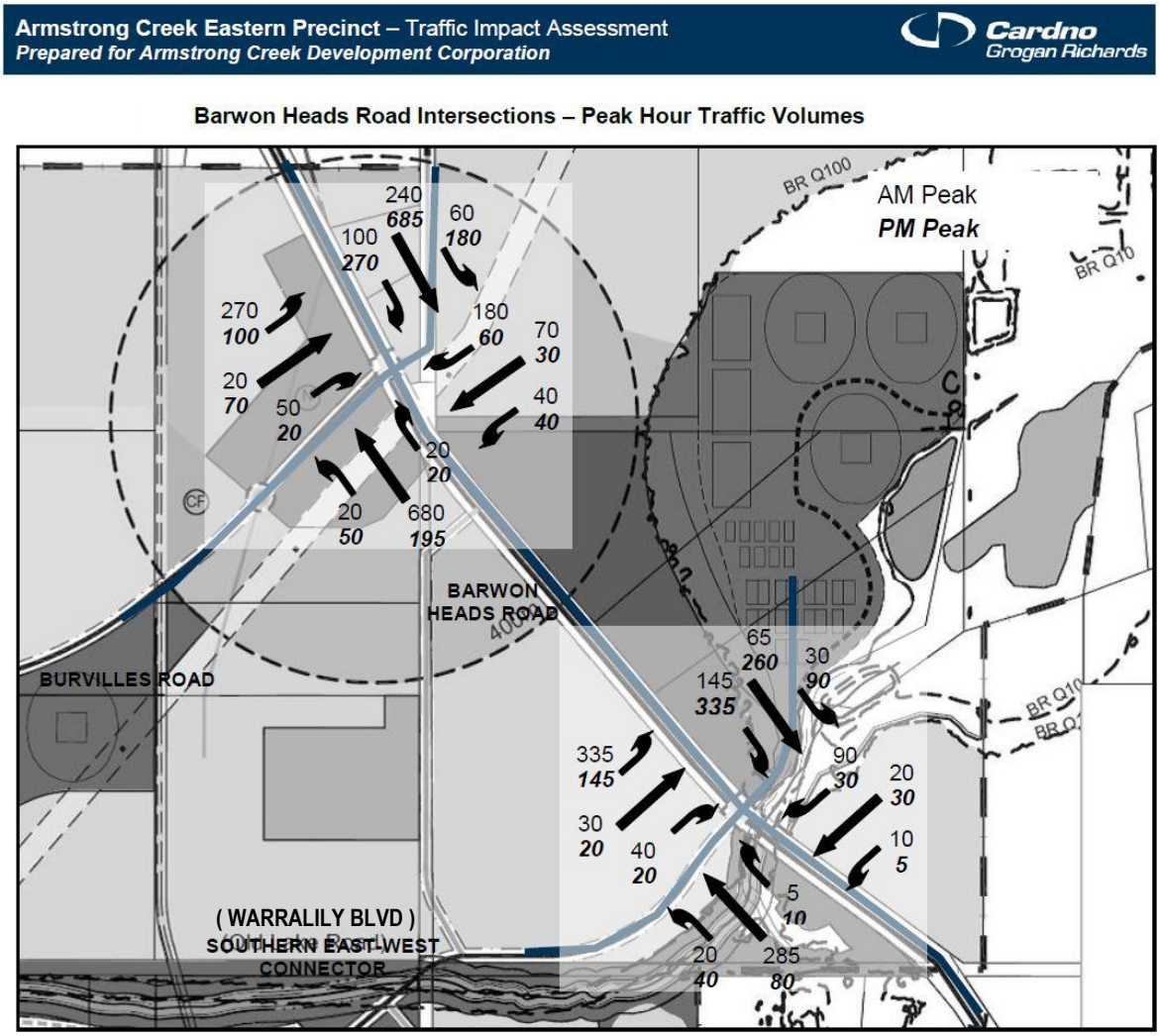


Figure 7: Barwon Heads Rd / Horseshoe Bend Rd at Full Build Out

The property at 892 - 990 Barwon Heads Road, Armstrong Creek has not been considered in the earlier Armstrong Creek Eastern Precinct Structure Planning or Traffic Impact Assessment reports produced to inform the PSP development process, therefore the traffic volumes to be considered at the property are additional to those full build out volumes displayed in Figure 7 at the Barwon Heads Road / Warralily Boulevard intersection. Two way (full build out) volumes in the AM and PM peaks have been extracted from the turning movements shown in Figure 7, these two way full build out volumes have then been considered in addition to the volumes generated by the proposed development. The north south two volumes extracted from Figure 7 indicate a 70 / 30 peak hour split The author has adopted this volume split as a conservative approach to this assessment. The

expected and reasonably considered volume split could be more in the region of a 90/10 volume split. The two way peak volumes extracted from Figure 7 are shown in Table 2a below.

PEAK PERIOD	NORTHBOUND	SOUTHBOUND
AM (hr)	310	115
PM (hr)	130	285

Table 2a: Two peak hour volumes across the frontage of 892 - 990 Barwon Heads Road

Below is a diagram of the Barwon Heads Road / New Access Road intersection, with Barwon Heads Road as a single carriageway. Refer to Figure 8 for the proposed intersection layout (based on the existing Barwon Heads Road/ Warralily Boulevard intersection).

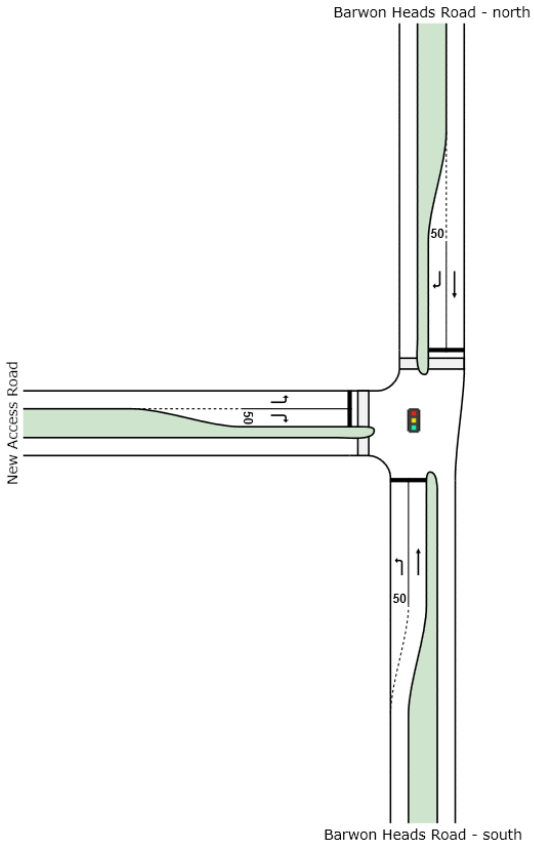


Figure 8: Proposed Barwon Heads Road/ New Access Road intersection- single carriageway

A summary of the queue length, average delay, degree of saturation and level of service of each intersection approach is provided in Table 3. Refer to Appendix C for the full results of SIDRA analysis.

Table 3: Summary of results at Barwon Heads Road (Single Carriageway) / New Access Road intersection

Approach	Barwon Heads Road – South approach	Barwon Heads Road – North approach	New Access Road
AM Peak			
95th %ile Queue (m)	95	20	94
Average Delay (sec)	24	8.6	25
Degree of Saturation	0.44	0.11	0.44
Level of Service	A	A	A
PM Peak			
95th %ile Queue (m)	25	62	20
Average Delay (sec)	20	34	13
Degree of Saturation	0.31	0.76	0.19
Level of Service	A	C	A

The results show that traffic generated by the proposed development site would create short queues, short delays and a low degree of saturation for each intersection approach during the AM and PM peak hours. They also show that, in general, the intersection would operate at LOS A with a LOS C expected on Barwon Heads Road north approach during the PM peak.

Therefore the volume of traffic generated by the site would not have an adverse impact on Barwon Heads Road as a two way two lane single carriageway.

4.5.3 Post Full Development Assessment – Dual Carriageway

Similar in operation to the Barwon Heads Road single carriageway, the ultimate dual carriageway configuration of Barwon Heads was tested using the ultimate build out volumes offered in the Armstrong Creek Eastern Precinct Traffic Impact Assessment report by Cardno dated 14 Oct 2009. Refer to the extract image, Figure 7. The Barwon Heads Road duplicated carriageway and intersection layout assessed is shown as Figure 9.

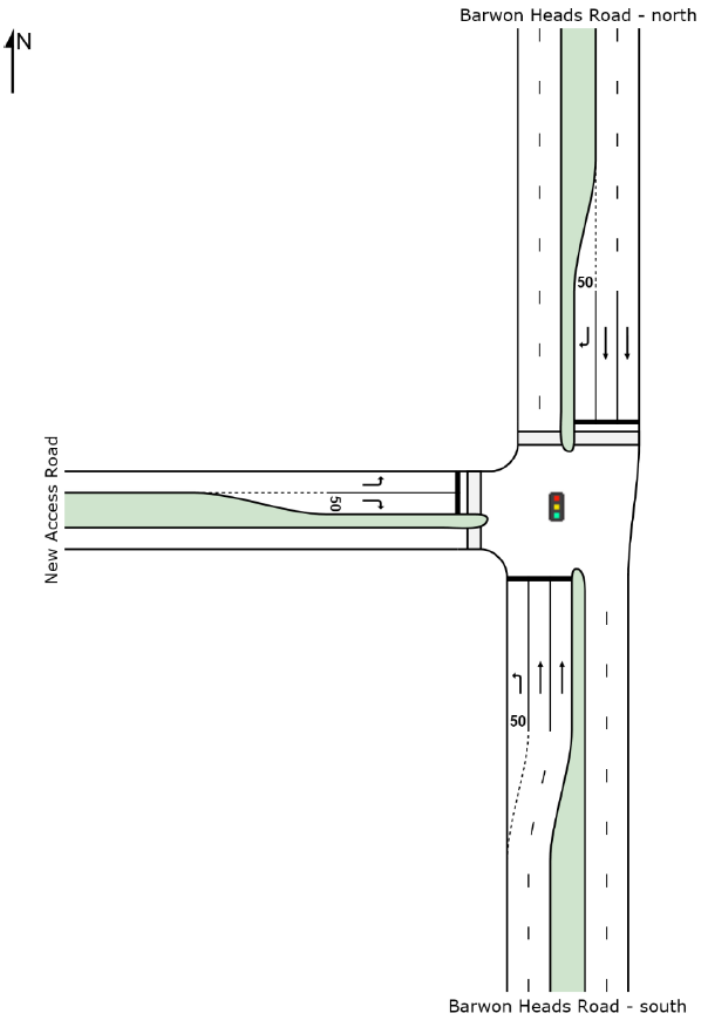


Figure 9: Proposed new Barwon Heads Road / New Access Road – dual carriageway

A summary of the queue length, average delay, degree of saturation and level of service of each intersection approach is provided in Table 4. Refer to Appendix C for the full results of SIDRA analysis.

Table 4: Summary of results at Barwon Heads Road (Dual Carriageway) / New Access Road intersection

Approach	Barwon Heads Road – South approach	Barwon Heads Road – North approach	New Access Road
AM Peak			
95th %ile Queue (m)	56	30	9.6
Average Delay (sec)	35	45.4	16
Degree of Saturation	0.33	0.21	0.33
Level of Service	A	A	A
PM Peak			
95th %ile Queue (m)	15	65	20
Average Delay (sec)	25	34	12
Degree of Saturation	0.18	0.67	0.17
Level of Service	A	B	A

The results shown in Table 4 indicate that traffic generated by the proposed development site would create short queues, short delays and a low degree of saturation for each intersection approach during the AM and PM peak hours. They also show that, in general, the intersection would generally operate at LOS A with a LOS B expected on Barwon Heads Road north approach during the PM peak.

Therefore the volume of traffic generated by the site would not have an adverse impact on Barwon Heads Road as a two way two lane duplicated carriageway.

4.6 Intersection Development

The proposed signalised intersection at the development access road will provide road operation, road safety and amenity benefits to future residents and road users, The benefits to the area resulting from the development include:

- The establishment of a threshold to the development and will also provide a threshold to Armstrong Creek on Barwon Heads Road, establishing a visible demarcation between the rural and urban environs;
- A signalised intersection at this location will slow and regulate Barwon Heads Road traffic flows and operating speeds at a location midway between Warralily Boulevard and Lower Duneed Road;
- Lane discipline offered at the signalised intersection will reinforce the bicycle and pedestrian friendly operation of the roadway and provide safe bicycle access to and from the development;
- The interim and ultimate signalised intersection layout is designed to fit the road reserve and land set aside by the PAO across the Barwon Heads Road frontage. The PAO is located at the west edge of the Barwon Heads Road.

5 Road Network Review

5.1 Charlemont Road

The Armstrong Creek East PSP sets out the road hierarchy and cross section configuration for each main road within the precinct, including Charlemont Road.

Given that the impact of the proposed development site on Charlemont Road is not expected to be significant, the current 20.0m cross section for Charlemont Road would be sufficient. Refer to Appendix D for a copy of the nominated cross section.

5.2 Main Access Road

The Armstrong Creek East PSP has also been used to determine the proposed cross section for the main access road into the site from Barwon Heads Road.

As can be seen in Figure 10 the concept layout of the site provides a dominant Connector Road leading into the proposed development parcel that reduces roadway functionality to a Key Local Access Street meeting the connectivity needs of those lots located in the southern portion of the site and the adjacent Armstrong Waters development area. The intention of the Key local Access Street is to facilitate a focussed connection to those areas deep within both development parcels whilst ensuring the road function and width remain in balance with the residential nature of this area.

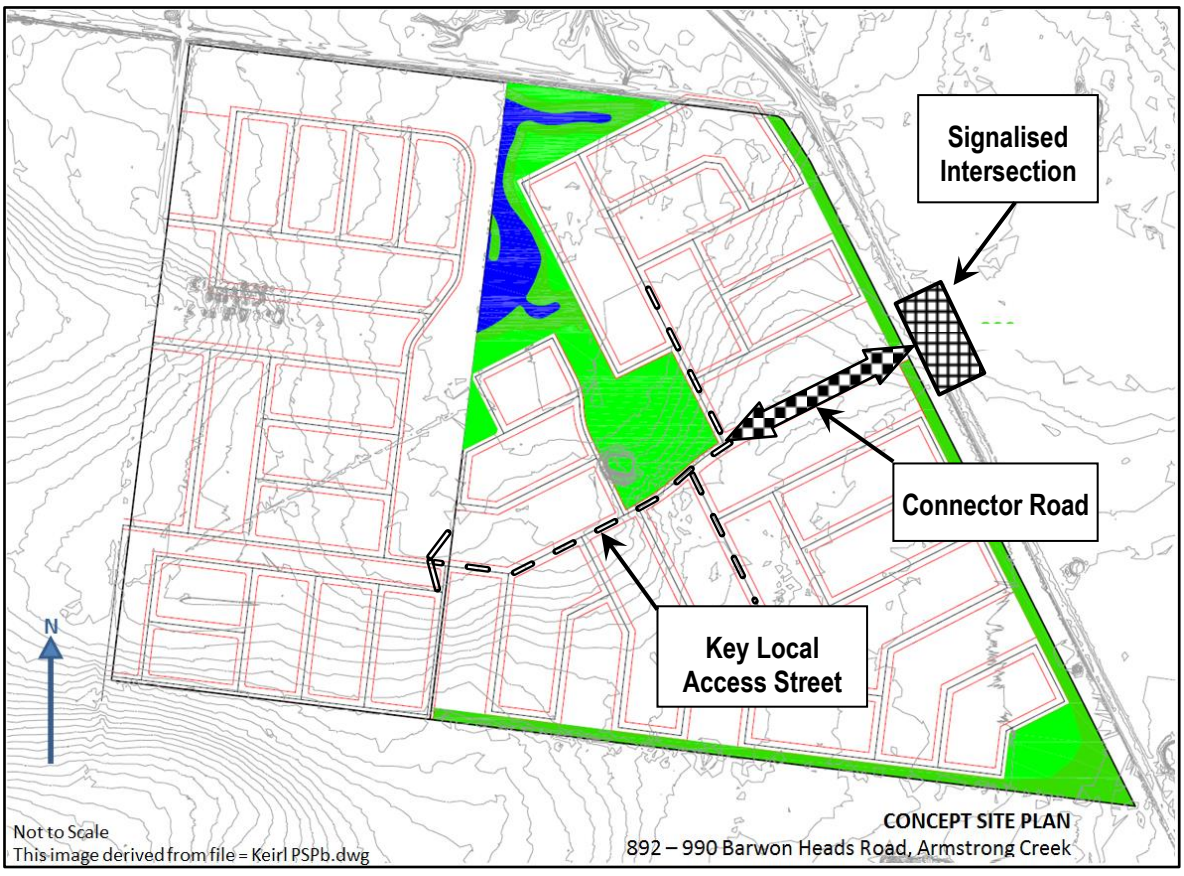


Figure 10: Connector Road and Key Local Streets

Based on the expected traffic volume of 4,800 vehicles per day and the function of the main access road as a connector street, it is proposed that a 21.6m wide cross section (based on Figure M and Figure N from the PSP) be provided with the following features:

- 3.5m wide traffic lanes, one in each direction;
- 2.3m wide on-street parking lanes; and
- 1.5m wide footpath on both sides of the road.

A copy of the nominated cross section is provided in Appendix D

5.3 Local Road Network

Clause 56.06 of the Greater Geelong Planning Scheme sets out the design requirements for the local road network within the municipality. The Armstrong Creek East PSP specifies the local road cross section configurations within the precinct based on these design requirements.

A summary of the PSP equivalent cross sections, indicative traffic volumes and road reservation widths for each local road type in the Planning Scheme is provided in Table 4.

Table 4: Classification of local roads

Clause 56.06 Classification	PSP Equivalent Road Cross Section	Indicative Vehicles Per Day	Road Reserve Width (m)
Access Lane	Access Lane (Figure U)	Up to 300	6.0 – 8.0
Access Place	Access Place (Figure V)	300 to 1,000	13.3
Access Street – Level 1	Typical Local Access Street – Beside Public Open Space (Figure S)	1,000 to 2,000	13.5
Access Street – Level 2	Typical Local Access Street (Figure R)	2,000 to 3,000	16.0

Based on the expected traffic volume of 2,400 vehicles per day using the local road connection to the adjacent development, it is proposed that a typical local access street cross section with a 16.0m wide road reserve be adopted. Refer to Appendix D for a copy of the nominated cross section.

It is also proposed that this cross section be extended to Charlemont Road along the local road providing access to the site through the Armstrong Waters development.

5.4 Barwon Heads Road

Barwon Heads Road as an interim condition is to operate as a two way two lane single carriageway until full build out of the Armstrong Creek Precinct. Ultimately Barwon Heads Road will be constructed as a two way four lane dual carriageway roadway, the timing of the implementation of the ultimate cross section will be determined by others.

SMEC has developed a Barwon Heads Road cross section to address issues of stormwater management and using the guidance offered in VicRoads drawing No 590540, shown in Appendix E as Figure 11. The SMEC developed cross section is shown in Appendix E as Figures 12

6 Integrated Transport Review

6.1 Accessibility to Bus Services

The majority of the proposed development site is located within the 400m walkable catchment of the existing bus route on Barwon Heads Road, as per the Department of Transport Guidelines for Land Use and Development: Public Transport, 2008.

It is noted however that an additional bus stop should be provided on Barwon Heads Road at the proposed signalised T-intersection with the New Access Road (similar to the existing Barwon Heads Road/ Warralily Boulevard intersection) to improve accessibility to this service.

6.2 Connectivity to Walking and Cycling Network

In keeping with the Armstrong Creek East PSP, shared path facilities should be considered in the wetlands and open space areas of the proposed development site with connections to the adjoining Warralily and Armstrong Waters shared path network.

The main access road into the site is proposed to have a footpath on both sides of the road. Footpaths are also proposed on both sides of the local road connection to the adjacent development, and one or both sides of the typical local access street and access place road cross sections to be provided within the site.

Connectivity between these facilities and the shared path network should be provided to create an integrated active transport network and encourage walking and cycling in the area.

7 Conclusion

In summary, this traffic impact assessment has identified the following:

- The proposed development site is expected to generate 4,800 vehicle trips per day or 480 vehicle trips in the peak hour.
- It is expected that 25% of trips (i.e. 1,200 vehicle trips per day) will be internal trips and use the local road connection to the adjacent residential area and Charlemont Road to enter/ exit the site. The remaining 75% of trips (i.e. 3,600 vehicle trips per day) will be external trips made to/ from the site via Barwon Heads Road.
- Within Armstrong Waters, the nett effect on Charlemont Road is expected be zero; however the local road providing access to the site is expected to get busier with the addition of the internal trips generated by the site. The volume of traffic expected on this local access road is 2,800 vehicles per day.
- The proposed local road connection to the adjacent development (i.e. Armstrong Waters) would provide some residents of this development with an additional access point to Barwon Heads Road. As a result, it is expected that the new access point would re-distribute some traffic from Charlemont Road to the new access road.
- The number of trips that this new local road connection is expected to have an impact on is 1,200 vehicle trips per day. Therefore the total number of trips expected to use the new access point on Barwon Heads Road is 4,800 vehicles per day, and the total number of trips expected to use the local access road is 2,400 vehicles per day.
- The results of SIDRA analysis show that, in general, the proposed Barwon Heads Road/ New Access Road signalised T-intersection at would operate at LOS A with a LOS C expected on Barwon Heads Road north approach during the PM peak.
- Traffic generated by the site would not have an adverse impact on the operating conditions of Barwon Heads Road and the local road providing access to the site when the development is fully constructed.
- The current 20.0m cross section for Charlemont Road is expected to be sufficient.
- A 21.6m wide cross section is proposed for the main access road into the site.
- A typical local access street cross section with a 16.0m wide road reserve is proposed for the local road connection to the adjacent development. It is expected that this cross section would be extended to Charlemont Road through the Armstrong Waters development.
- The majority of the site is located within the 400m walkable catchment of the existing bus route on Barwon Heads Road; however an additional bus stop should be provided on Barwon Heads Road to improve accessibility to this service.
- Shared path facilities should be considered in the wetlands and open space areas of the site with connections to the adjoining Warralily and Armstrong Waters shared path network. Connectivity with the proposed walking and cycling facilities within the road cross sections should also be provided to create an integrated active transport network and encourage walking and cycling in the area.

Based on the findings of this report, SMEC is of the opinion that the proposed rezoning of the site at 892 - 990 Barwon Heads Road in Armstrong Creek for residential development will not have an adverse impact on the operation of the road network adjacent to the site.

Rev No.	Date	Prepared by	Reviewed by	Approved by
A	16/02/15	C. Emmitt	M. De Marco	P. Ridgeway
B	02/04/15	C. Emmitt	M. De Marco	P. Ridgeway
C	19/05/15	P. Ridgeway	M. De Marco	P. Ridgeway
D	06/07/15	P. Ridgeway	M. De Marco	
E	08/07/15	P. Ridgeway	M. De Marco	

Our Reference:

30041825T

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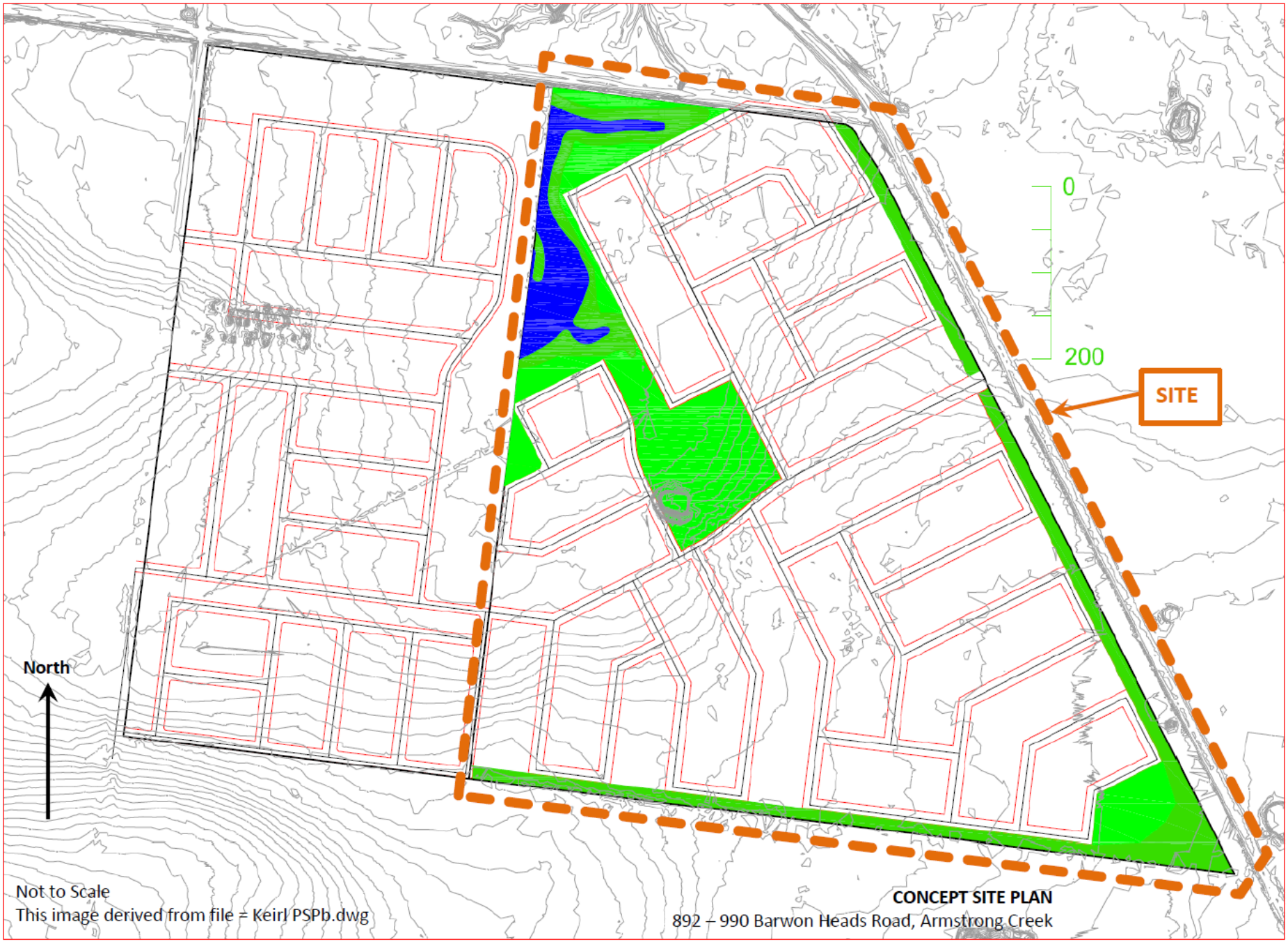
Appendix A – Concept Site Plan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200
SITE
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Not to Scale
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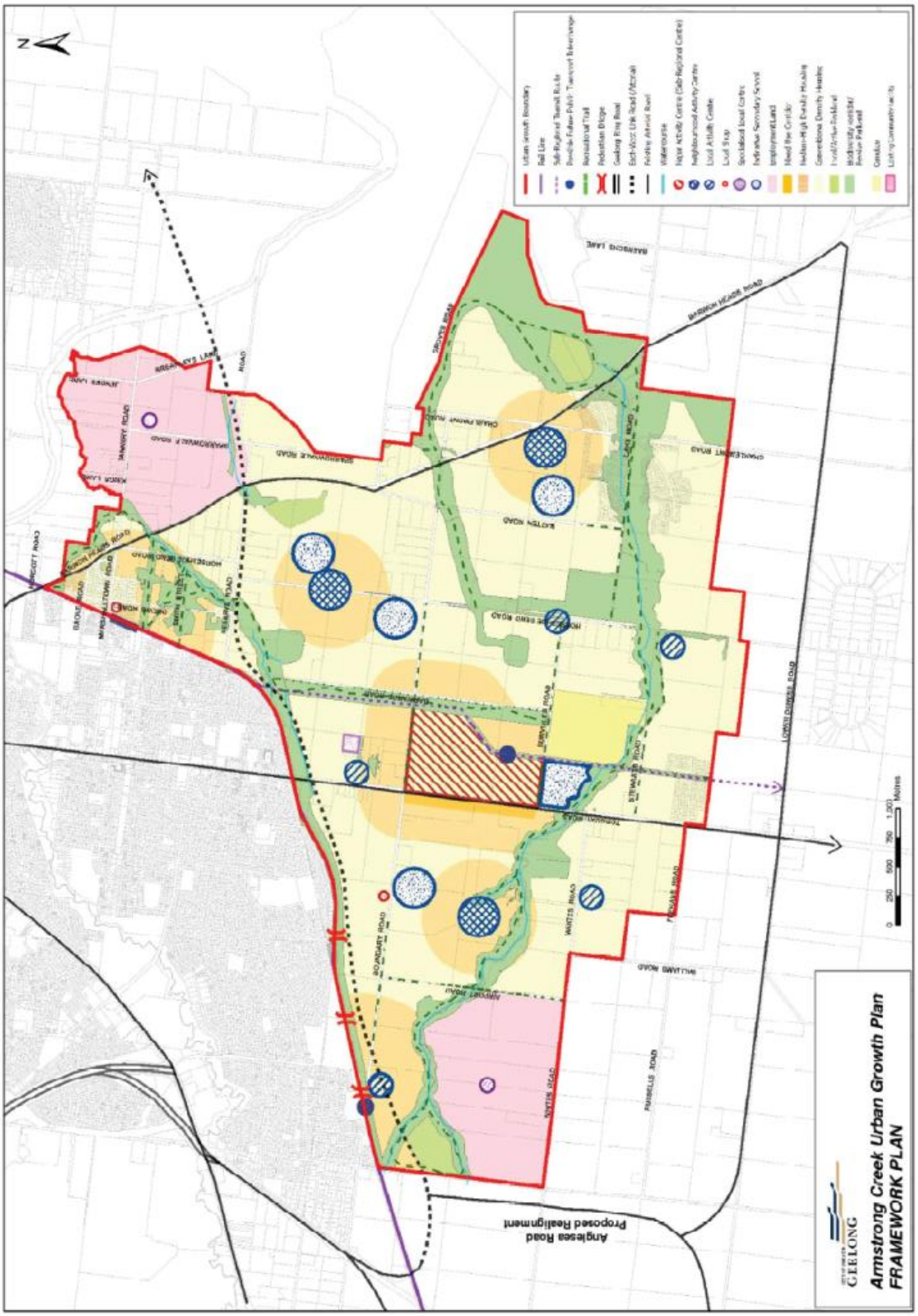
CONCEPT SITE PLAN
892 – 990 Barwon Heads Road, Armstrong Creek

Appendix B – Armstrong Creek Urban Growth Plan

21.11-4 Armstrong Creek Urban Growth Plan - Framework Plan map

23/10/2014
C267



Appendix C – SIDRA Movement and Phasing Summaries

MOVEMENT SUMMARY

Site: Warralily - AM Peak Sing Cwy App

Barwon Heads Road/ New Access Road
Signals - Fixed Time Cycle Time = 110 seconds (Optimum Cycle Time - Minimum Degree of Saturation)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Barwon Heads Road - south											
1	L2	11	5.0	0.014	24.3	LOS A	0.3	2.4	0.61	0.63	41.3
2	T1	343	5.0	0.436	24.3	LOS A	13.0	94.9	0.76	0.66	52.2
Approach		354	5.0	0.436	24.3	LOS A	13.0	94.9	0.76	0.66	51.8
North: Barwon Heads Road - north											
8	T1	127	5.0	0.108	8.6	LOS A	2.7	19.5	0.42	0.35	67.3
9	R2	91	5.0	0.327	52.5	LOS A	4.4	32.3	0.93	0.78	32.4
Approach		218	5.0	0.327	26.9	LOS A	4.4	32.3	0.63	0.53	46.5
West: New Access Road											
10	L2	364	5.0	0.436	25.1	LOS A	12.8	93.6	0.71	0.77	40.9
12	R2	40	5.0	0.085	37.3	LOS A	1.6	11.8	0.79	0.71	35.9
Approach		404	5.0	0.436	26.3	LOS A	12.8	93.6	0.72	0.77	40.3
All Vehicles		976	5.0	0.436	25.7	LOS A	13.0	94.9	0.71	0.67	45.3

Level of Service (LOS) Method: Degree of Saturation (SIDRA METHOD).
Vehicle movement LOS values are based on degree of saturation per movement
Intersection and Approach LOS values are based on worst degree of saturation for any vehicle movement.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P3	North Full Crossing	53	36.9	LOS D	0.1	0.1	0.82	0.82
P4	West Full Crossing	53	24.3	LOS C	0.1	0.1	0.67	0.67
All Pedestrians		105	30.6	LOS D			0.74	0.74

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: Warralily - PM Peak Sing Cwy App

Barwon Heads Road/ New Access Road
Signals - Fixed Time Cycle Time = 60 seconds (Practical Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Barwon Heads Road - south											
1	L2	31	5.0	0.068	24.4	LOS A	0.7	5.1	0.79	0.70	41.9
2	T1	144	5.0	0.305	20.3	LOS A	3.5	25.8	0.85	0.69	45.0
Approach		175	5.0	0.305	21.0	LOS A	3.5	25.8	0.84	0.69	44.4
North: Barwon Heads Road - north											
8	T1	316	5.0	0.304	7.9	LOS A	5.0	36.6	0.58	0.49	53.1
9	R2	273	5.0	0.760	33.8	LOS C	8.5	61.8	1.00	0.91	37.7
Approach		588	5.0	0.760	19.9	LOS C	8.5	61.8	0.77	0.69	44.6
West: New Access Road											
10	L2	182	5.0	0.185	12.9	LOS A	2.7	19.5	0.53	0.71	48.3
12	R2	20	5.0	0.045	24.2	LOS A	0.5	3.3	0.78	0.69	41.8
Approach		202	5.0	0.185	14.0	LOS A	2.7	19.5	0.56	0.71	47.5
All Vehicles		965	5.0	0.760	18.9	LOS C	8.5	61.8	0.74	0.69	45.2

Level of Service (LOS) Method: Degree of Saturation (SIDRA METHOD).
Vehicle movement LOS values are based on degree of saturation per movement
Intersection and Approach LOS values are based on worst degree of saturation for any vehicle movement.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P3	North Full Crossing	53	24.4	LOS C	0.1	0.1	0.90	0.90
P4	West Full Crossing	53	24.4	LOS C	0.1	0.1	0.90	0.90
All Pedestrians		105	24.4	LOS C			0.90	0.90

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: Warralily - AM Peak Ult Dup

Barwon Heads Road/ New Access Road
Signals - Fixed Time Cycle Time = 115 seconds (Optimum Cycle Time - Minimum Degree of Saturation)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Barwon Heads Road - south											
1	L2	11	5.0	0.021	36.5	LOS A	0.4	3.1	0.75	0.66	36.3
2	T1	343	5.0	0.326	35.5	LOS A	7.6	55.8	0.84	0.69	45.0
Approach		354	5.0	0.326	35.5	LOS A	7.6	55.8	0.84	0.69	44.7
North: Barwon Heads Road - north											
8	T1	127	5.0	0.060	11.8	LOS A	1.6	11.4	0.47	0.37	63.6
9	R2	91	5.0	0.215	45.4	LOS A	4.1	30.0	0.85	0.77	34.7
Approach		218	5.0	0.215	25.7	LOS A	4.1	30.0	0.63	0.54	47.2
West: New Access Road											
10	L2	364	5.0	0.329	15.8	LOS A	9.6	70.4	0.52	0.71	45.7
12	R2	40	5.0	0.068	32.6	LOS A	1.5	11.1	0.71	0.69	37.7
Approach		404	5.0	0.329	17.4	LOS A	9.6	70.4	0.53	0.71	44.7
All Vehicles		976	5.0	0.329	25.8	LOS A	9.6	70.4	0.67	0.66	45.2

Level of Service (LOS) Method: Degree of Saturation (SIDRA METHOD).
Vehicle movement LOS values are based on degree of saturation per movement
Intersection and Approach LOS values are based on worst degree of saturation for any vehicle movement.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P3	North Full Crossing	53	36.9	LOS D	0.1	0.1	0.80	0.80
P4	West Full Crossing	53	36.9	LOS D	0.1	0.1	0.80	0.80
All Pedestrians		105	36.9	LOS D			0.80	0.80

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: Warralily - PM Peak Ult Dup

Barwon Heads Road/ New Access Road
Signals - Fixed Time Cycle Time = 70 seconds (Practical Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Barwon Heads Road - south											
1	L2	31	5.0	0.079	29.7	LOS A	0.8	6.2	0.83	0.71	39.5
2	T1	144	5.0	0.178	24.8	LOS A	2.1	15.0	0.85	0.66	42.6
Approach		175	5.0	0.178	25.6	LOS A	2.1	15.0	0.85	0.67	42.0
North: Barwon Heads Road - north											
8	T1	316	5.0	0.158	9.1	LOS A	2.8	20.1	0.54	0.45	52.2
9	R2	273	5.0	0.665	33.7	LOS B	9.0	65.3	0.96	0.85	37.9
Approach		588	5.0	0.665	20.5	LOS B	9.0	65.3	0.74	0.63	44.4
West: New Access Road											
10	L2	182	5.0	0.165	11.8	LOS A	2.7	19.4	0.46	0.69	49.0
12	R2	20	5.0	0.037	24.3	LOS A	0.5	3.5	0.73	0.68	42.0
Approach		202	5.0	0.165	13.0	LOS A	2.7	19.4	0.48	0.69	48.2
All Vehicles		965	5.0	0.665	19.9	LOS B	9.0	65.3	0.70	0.65	44.7

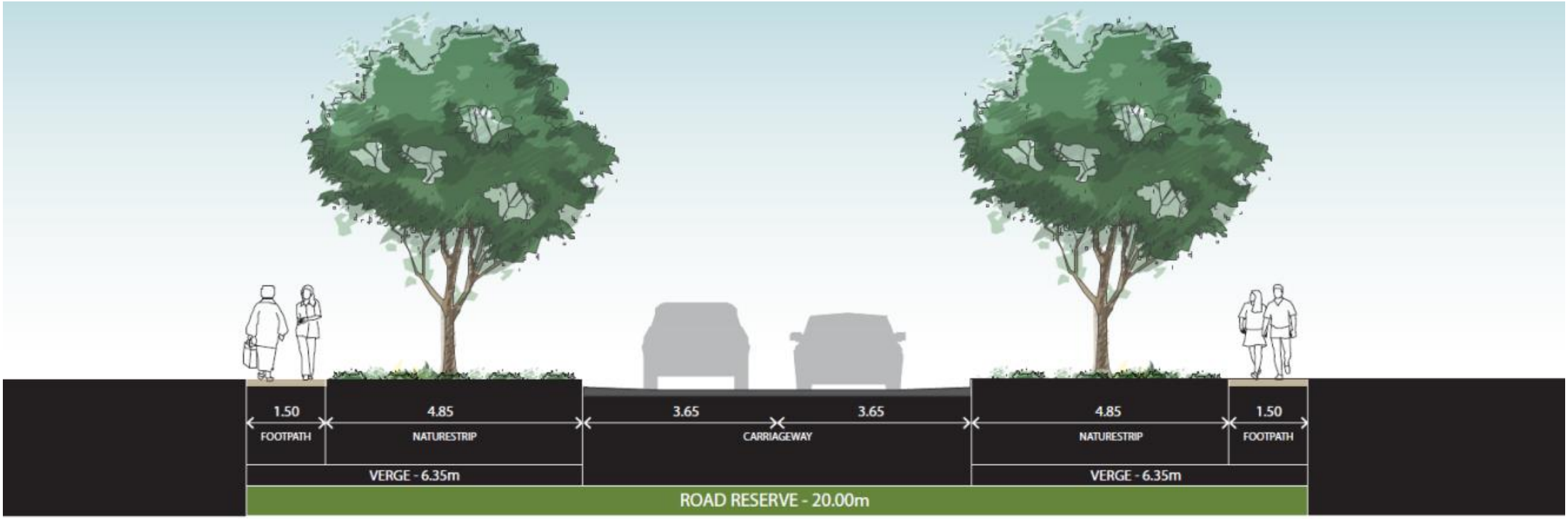
Level of Service (LOS) Method: Degree of Saturation (SIDRA METHOD).
Vehicle movement LOS values are based on degree of saturation per movement
Intersection and Approach LOS values are based on worst degree of saturation for any vehicle movement.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P3	North Full Crossing	53	29.3	LOS C	0.1	0.1	0.92	0.92
P4	West Full Crossing	53	29.3	LOS C	0.1	0.1	0.92	0.92
All Pedestrians		105	29.3	LOS C			0.92	0.92

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

Appendix D – Internal Road Cross Sections



Warralily
ARMSTRONG CREEK

CHARLEMONT ROAD NORTH AND SOUTH CROSS SECTION

WARRALILY, ARMSTRONG CREEK

SMEC
Local People. Global Experience.

Scale: 1:100 @ A4

0 1 2 3m

ref.: 3410503U
date: 23 Feb 2015
rev.: A
drawn: KD / HvR
checked: CD

please note:
This plan is based on preliminary information only and may be subject to change as a result of formal Council/Authority advice, detailed site investigations and confirmation by survey

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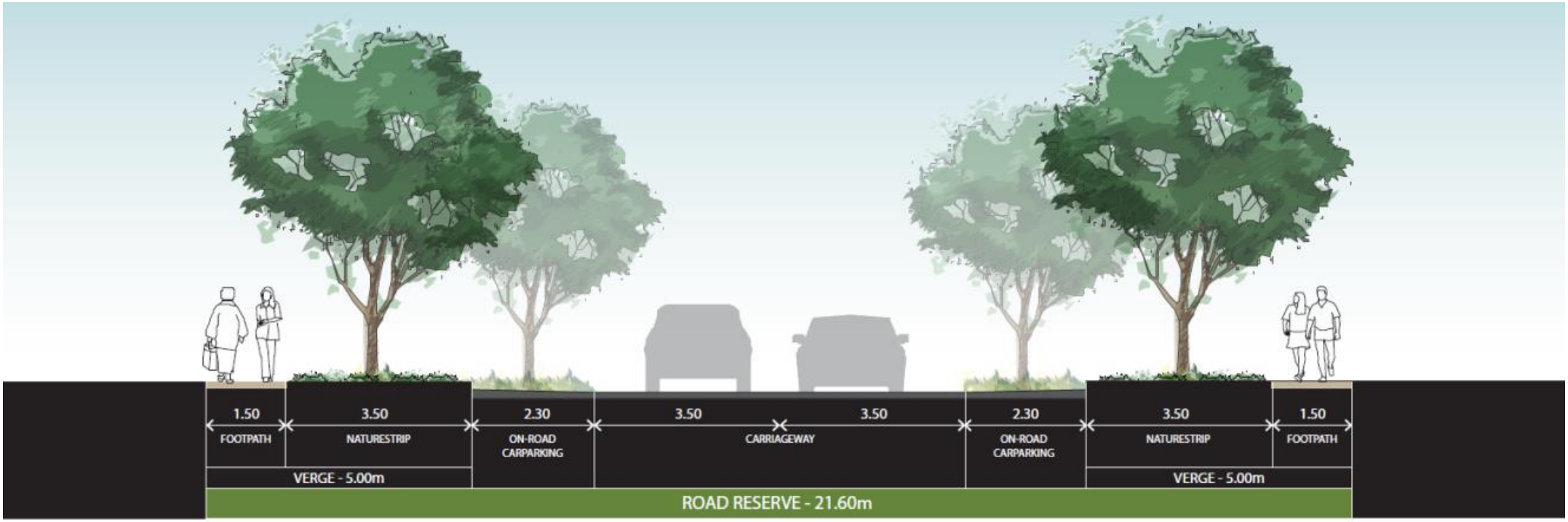
abn 47 065 475 149



Warralily
ARMSTRONG CREEK

SOUTH WEST CONNECTOR ROAD CROSS SECTION

WARRALILY, ARMSTRONG CREEK

SMEC
Local People. Global Experience.

Scale: 1:100 @ A4

0 1 2 3m

ref.: 3410503U
date: 19 Feb 2015
rev.: A
drawn: KD
checked: CD

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This plan is based on preliminary information only and may be subject to change as a result of formal Council/Authority advice, detailed site investigations and confirmation by survey

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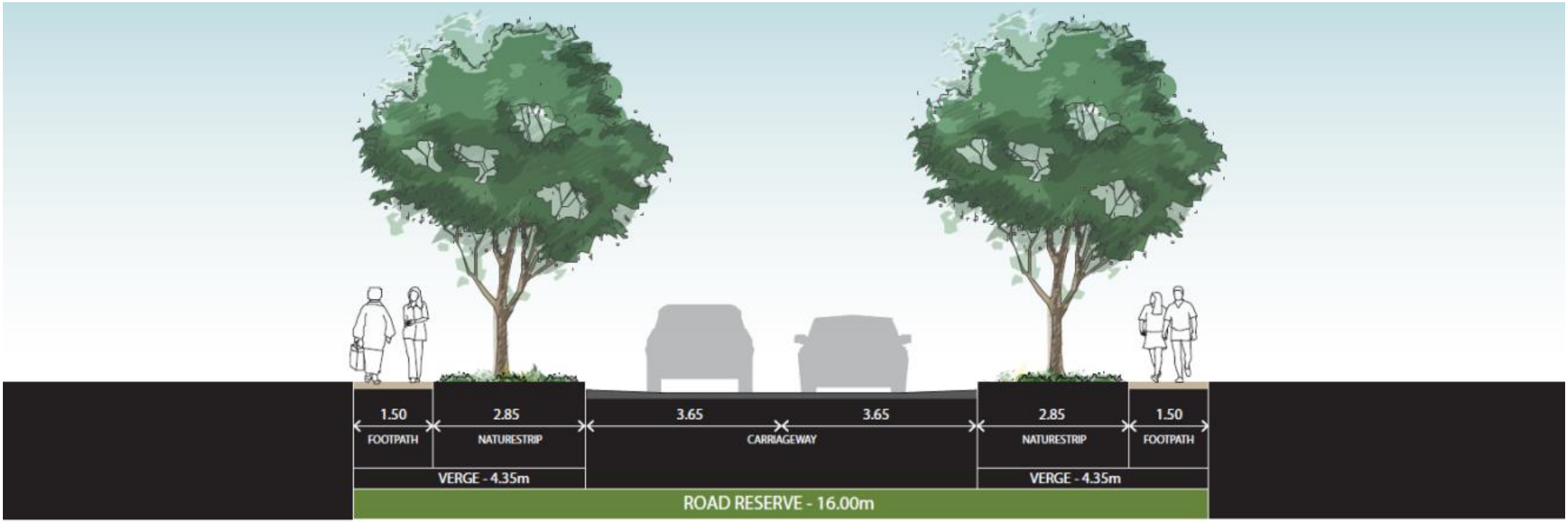

Warralily
ARMSTRONG CREEK

TYPICAL LOCAL ACCESS STREET CROSS SECTION

WARRALILY, ARMSTRONG CREEK

SMEC
Local People. Global Experience.

Scale: 1:100 @ A4

0 1 2 3m

ref.: 3410503U
date: 23 Feb 2015
rev.: A
drawn: KD / HvR
checked: CD

please note:
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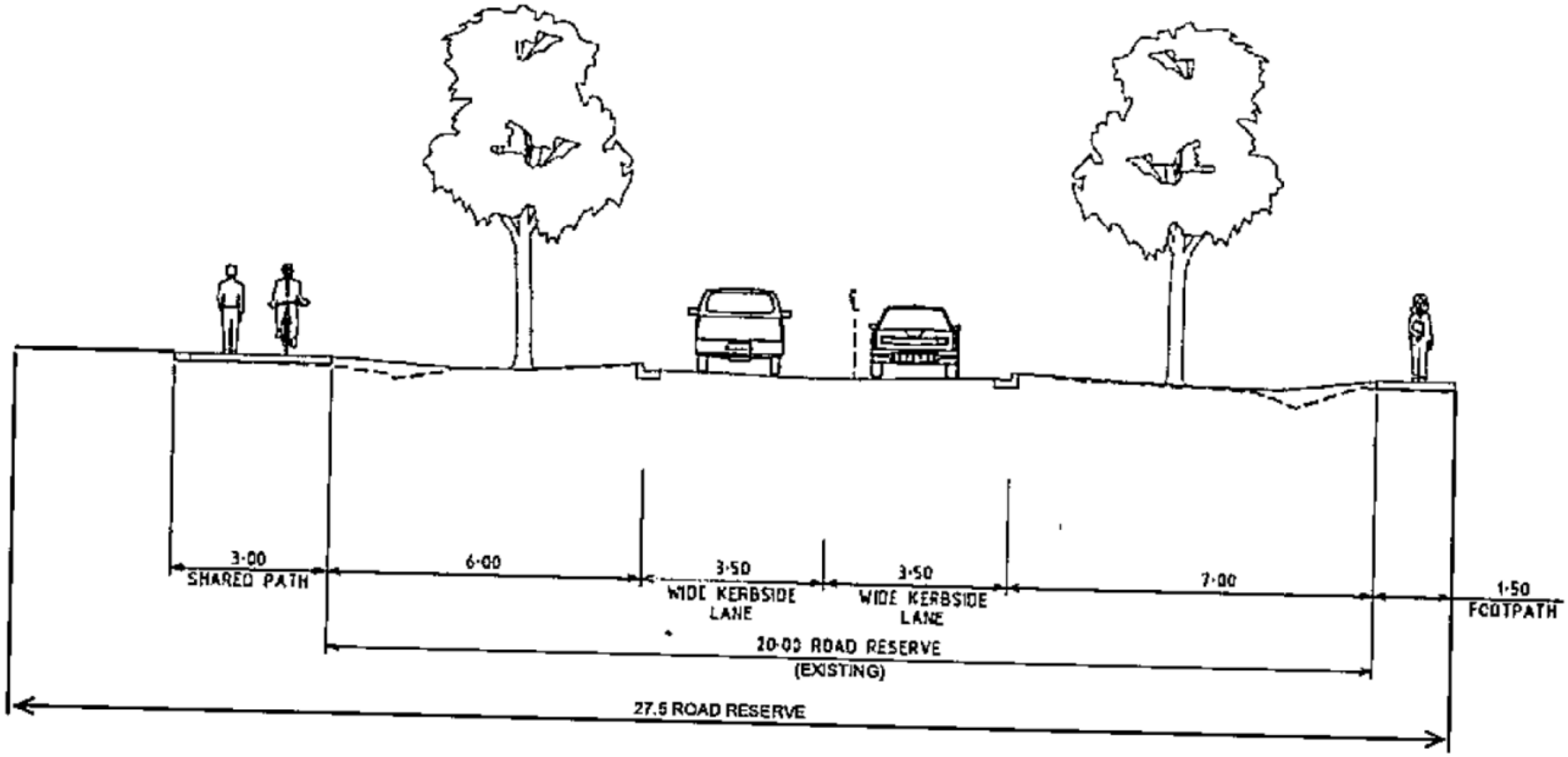
abn 47 065 475 149



CHARLEMONT ROAD (BETWEEN WARRALILY BOULEVARD AND NAC)
(27.5m ROAD RESERVE)

Note: Charlemont Road between Warralily Boulevard and The Neighborhood Activity Center now renamed Carter Road. Refer to Armstrong Creek Eastern Precinct Report – Warralily Stage 1 to 11 by Cardno Grogan Richards and dated 3 May 2011

Appendix D – External Road Cross Sections (Barwon Heads Road)

Figure 11: VicRoads Developed Barwon Heads Road Cross Sections

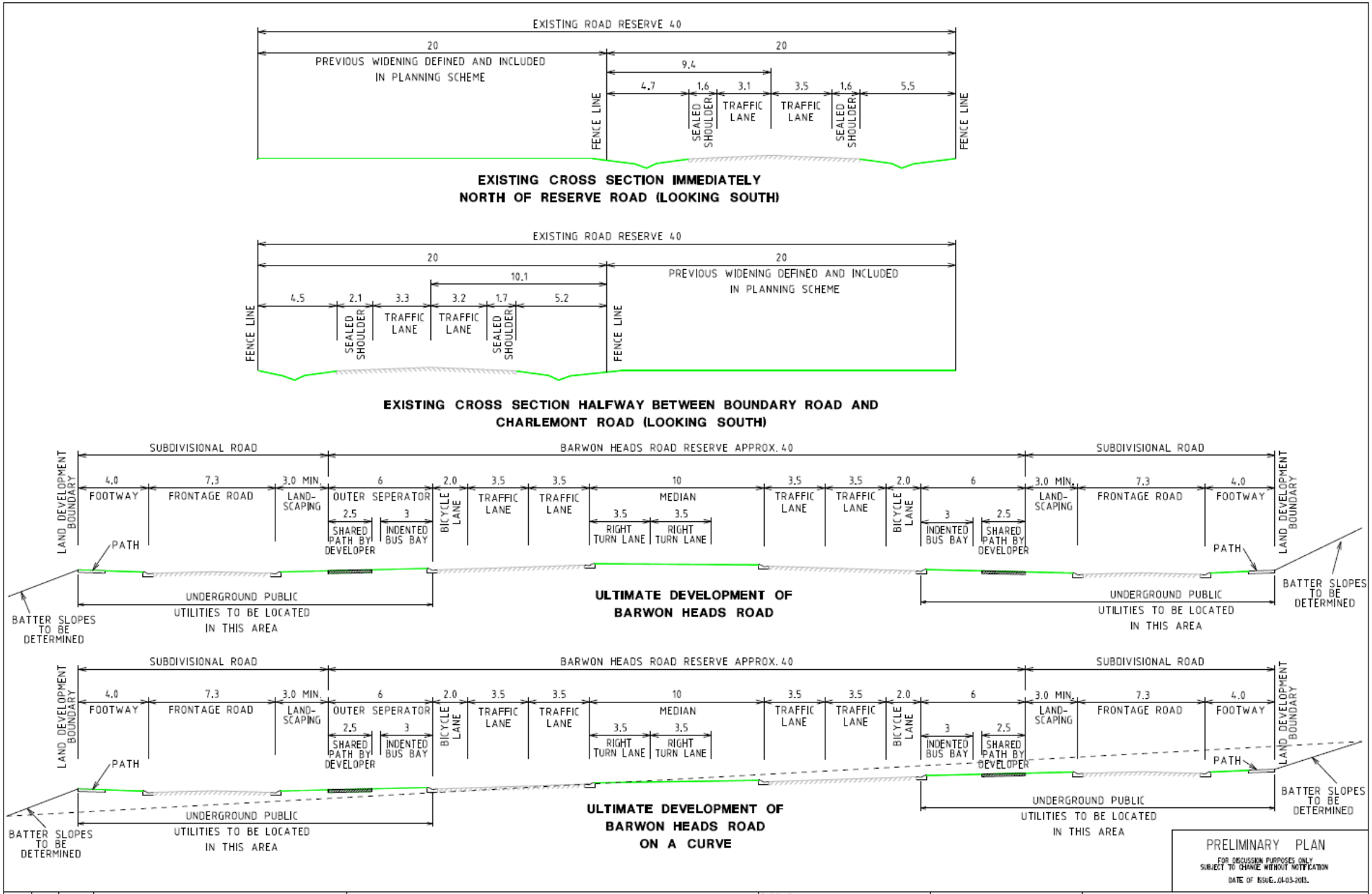
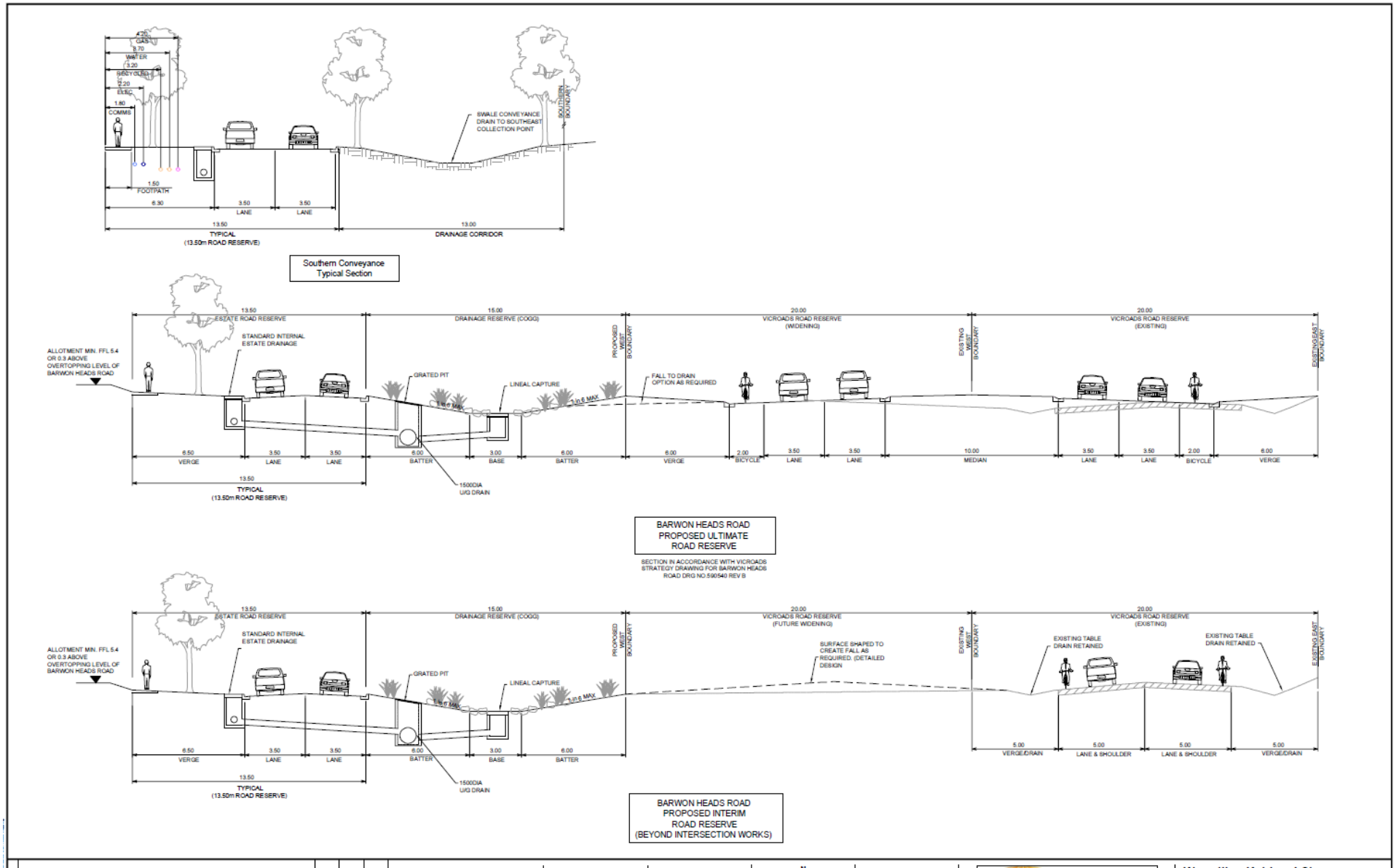


Figure 12: SMEC Developed Barwon Heads Road Cross Sections



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