onemilegrid
TRAFFIC ENGINEERING

Carr Street Closure

Traffic & Parking Impact Assessment

190728TIA001C-F.docx

23 January 2024

onemile**grid**

ABN: 79 168 115 679

(03) 9939 8250
56 Down Street

COLLINGWOOD, VIC 3066
www.onemilegrid.com.au

DOCUMENT INFORMATION

Prepared for	Greater Geelong City Council		
File Name	190728TIA001C-F.docx	**Report Date**	23 January 2024
Prepared by	JD	**Reviewed by**	SV

CONTENTS

1 INTRODUCTION 5
2 EXISTING CONDITIONS 5
2.1 Site Location 5
2.2 Planning Zones and Overlays 6
2.3 Road Network 7
2.3.1 Carr Street 7
2.3.2 Lonsdale Street 7
2.3.3 Yarra Street 8
2.3.4 Bellerine Street 9
2.3.5 Swanston Street 9
2.4 Crash History 10
2.5 Sustainable Transport 11
2.5.1 Bicycle Accessibility 13
3 DEVELOPMENT PROPOSAL 14
4 TRAFFIC ANALYSIS 15
4.1 Existing Traffic 15
4.2 Traffic Generation 18
4.2.1 Residential 18
4.2.2 Supermarket & Retail 18
4.2.3 Anticipated Traffic Generation 19
4.3 Traffic Distribution 19
4.4 Generated Traffic Volumes 19
4.5 Future Traffic Volumes 22
4.6 Traffic Impact 22
4.6.1 Scenario 1 23
4.6.2 Scenario 2 24
4.6.3 Scenario 3 25
4.6.4 Scenario 4 26
4.6.5 Summary 27
5 CAR PARKING 28
5.1 Existing Conditions 28
5.2 Future Conditions 28

TABLES

Table 1 Public Transport Provision 12
Table 2 SIDRA Intersection Parameters 17
Table 3 Carr Street / Lonsdale Street – Existing Conditions 17
Table 4 Carr Street / Swanston Street – Existing Conditions 17
Table 5 Lonsdale Street / Swanston Street – Existing Conditions 18
Table 6 Anticipated Traffic Generation 19
Table 7 Adopted Directional Traffic Distribution 19
Table 8 Carr Street / Lonsdale Street – Scenario 1 Future Conditions 23
Table 9 Carr Street / Swanston Street – Scenario 1 Future Conditions 23
Table 10 Lonsdale Street / Swanston Street – Scenario 1 Future Conditions 23
Table 11 Carr Street / Lonsdale Street – Scenario 2 Future Conditions 24
Table 12 Carr Street / Swanston Street – Scenario 2 Future Conditions 24
Table 13 Lonsdale Street / Swanston Street – Scenario 2 Future Conditions 24
Table 14 Carr Street / Lonsdale Street – Scenario 3 Future Conditions 25
Table 15 Carr Street / Swanston Street – Scenario 3 Future Conditions 25
Table 16 Lonsdale Street / Swanston Street – Scenario 3 Future Conditions 25
Table 17 Carr Street / Lonsdale Street – Scenario 4 Future Conditions 26

Table 18 Carr Street / Swanston Street – Scenario 4 Future Conditions 26
Table 19 Lonsdale Street / Swanston Street – Scenario 4 Future Conditions 26

FIGURES

Figure 1 Site Location 5
Figure 2 Site Context (18/11/2019) 6
Figure 3 Planning Scheme Zones 6
Figure 4 Carr Street, looking south-east from the subject site 7
Figure 5 Lonsdale Street, looking west from the subject site 8
Figure 6 Yarra Street, looking north from the Carr Street 8
Figure 7 Bellerine Street, looking north from Lonsdale Street 9
Figure 8 Swanston Street, looking north from the subject site 10
Figure 9 Active Travel Map 11
Figure 10 Public Transport Provision 12
Figure 11 Bicycle Accessibility of Site 13
Figure 12 Analysis Scenarios 14
Figure 13 Existing Peak-hour Traffic Volumes - AM 15
Figure 14 Existing Peak-hour Traffic Volumes - PM 16
Figure 15 Generated Traffic Volumes 20
Figure 16 Traffic Redistribution 22
Figure 17 Carr Street Parking Occupancy Profile - Thursday 21/11/19 28

1 INTRODUCTION

onemile**grid** has been requested by Greater Geelong City Council to undertake a Traffic Impact Assessment of redevelopment of the former Barwon Water site on Carr Street, and identify a preferred access arrangement considering the partial or full closure of Carr Street.

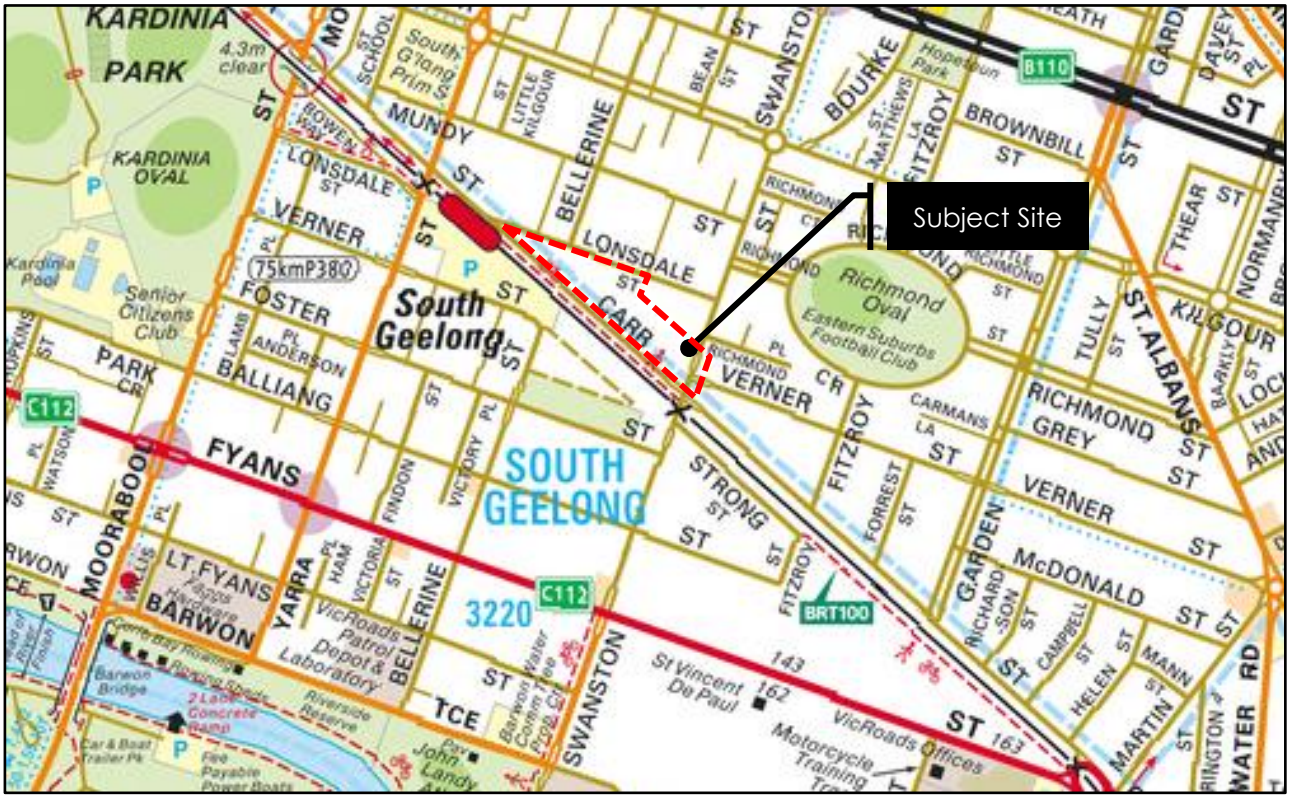
As part of this assessment the subject site has been inspected with due consideration of the development proposal, traffic data has been sourced and relevant background information has been reviewed.

2 EXISTING CONDITIONS

2.1 Site Location

The subject site is located at Carr Street Closure, as shown in Figure 1. The site is irregular in shape with a total area of 19,230m^2. It has frontages to Carr Street, Lonsdale Street and Swanston Street of approximately 315m, 185m and 50m respectively.

Figure 1 Site Location



Copyright Melway Publishing

The site is currently unoccupied excepting two dwellings spanning the Swanston Street face of the site.

Land use in the immediate vicinity of the site is largely residential in nature. It includes South Geelong Station and a dedicated station-user carpark to the south-west, Richmond oval to the east, GMHBA Stadium and Kardinia Park to the west.

An aerial view of the subject site is provided in Figure 2.

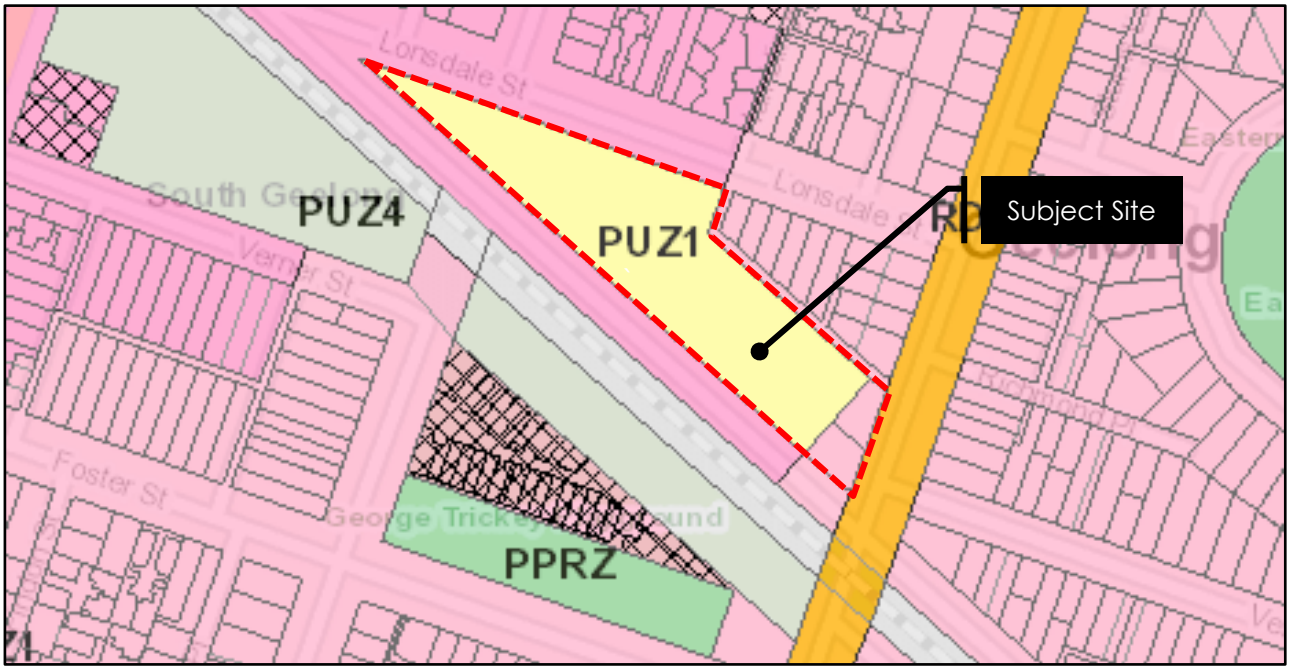
Figure 2 Site Context (18/11/2019)

Copyright Nearmap

2.2 Planning Zones and Overlays

It is shown in Figure 3 that the site is largely located within a Public Use Zone (PUZ) with the two residences abutting Swanston Street located within a General Residential Zone (GRZ). Additionally, the site abuts Swanston Street which is within a Road Zone (RDZ).

Figure 3 Planning Scheme Zones



2.3 Road Network

2.3.1 Carr Street

Carr Street is a local road running south-east from Kilgour Street to its intersection with Boundary Road.

Carr Street provides a single marked traffic lane in each direction adjacent to the site. Unrestricted kerbside parking is provided on both sides of the road, with kerbside parallel parking along the north side, and indented angled parking adjacent to the railway line.

A 60km/h speed limit applies to Carr Street in the vicinity of the site.

The cross-section of Carr Street at the frontage of the site is shown in Figure 4.

Figure 4 Carr Street, looking south-east from the subject site

Carr Street is identified in Council's Road Register as a "Secondary Distributor".

2.3.2 Lonsdale Street

Lonsdale Street is a local road running between Swanston Street in the east, and Carr Street in the west.

Lonsdale Street provides for two-way traffic and parking on both sides.

At the eastern end, car parking is parallel to the kerbside, within an 11 metre wide carriageway, transitioning to indented angle parking further west within a carriageway of approximately 21 metres width.

Car parking is generally unrestricted on the south side, and largely restricted to 2-hour parking between 9:00am and 5:30pm, Monday to Friday on the north side of the road.

The default 50km/h speed limit applies to Lonsdale Street in the vicinity of the site.

The cross-section of Lonsdale Street at the frontage of the site is shown in Figure 5.

Figure 5 Lonsdale Street, looking west from the subject site

Lonsdale Street is identified in Council's Road Register as a "Local Access" street.

2.3.3 Yarra Street

Yarra Street is a local road running between Eastern Beach Road in the North, and Barwon Terrace in the south.

Yarra Street provides a single traffic lane and a bike lane in each direction in the vicinity of the site, with centrally located turn lanes. Kerbside parking is provided on both sides of the road, generally restricted to 4-hour parking between 9:00am and 5:30pm, Monday to Friday.

A 60km/h speed limit applies to Yarra Street in the vicinity of the site.

The cross-section of Yarra Street at the frontage of the site is shown in Figure 6.

Figure 6 Yarra Street, looking north from the Carr Street

Yarra Street is identified in Council's Road Register as a "Secondary Distributor".

2.3.4 Bellerine Street

Bellerine Street is a local road running between Eastern Beach Road in the north, and Lonsdale Street in the south.

Bellerine Street provides for two-way traffic and kerbside parallel parking on both sides of the road, generally restricted to 2-hour parking between 9:00am and 5:30pm, Monday to Friday, with some unrestricted kerbside parking north of Mundy Street. The carriageway measures approximately 18 metres width.

The default 50km/h speed limit applies to Bellerine Street in the vicinity of the site.

The cross-section of Bellerine Street at the frontage of the site is shown in Figure 7.

Figure 7 Bellerine Street, looking north from Lonsdale Street

Bellarine Street is identified in Council's Road Register as a "Local Access" street.

2.3.5 Swanston Street

Swanston Street is an arterial road running between Eastern Beach Road in the North, and Barwon Terrace in the South.

Swanston Street provides a single traffic lane and a bike lane in each direction adjacent to the site, with centrally located turn lanes. Unrestricted kerbside parking is provided on both sides of the road.

A 60km/h speed limit applies to Swanston Street in the vicinity of the site.

The cross-section of Swanston Street at the frontage of the site is shown in Figure 8.

Figure 8 Swanston Street, looking north from the subject site

Swanston Street is identified in Council's Road Register as a "Secondary Distributor".

2.4 Crash History

Crash history information for the intersections surrounding the site were obtained through VicRoads CrashStats (the Victorian accident statistics and mapping program) for the latest 5-year period (2011 – 2016 inclusive).

A total of two accidents were recorded over the 5-year period. One occurred at the intersection of Lonsdale Street and Swanston Street and involved a serious injury. The other occurred at the intersection of Carr Street and Yarra Street and involved an injury which was not serious.

2.5 Sustainable Transport

An extract of the Active Travel Map for the City of Greater Geelong is shown in Figure 9, highlighting the public transport, bicycle and pedestrian facilities in the area.

Figure 9 Active Travel Map

The full public transport provision in the vicinity of the site is shown in Figure 10 and detailed in Table 1.

The site has very good public transport accessibility, with a variety of transport modes and services servicing the vicinity of the site. The public transport in the vicinity of the site is very good, with a train line and large variety of bus routes servicing the site.

Figure 10 Public Transport Provision

Table 1 Public Transport Provision

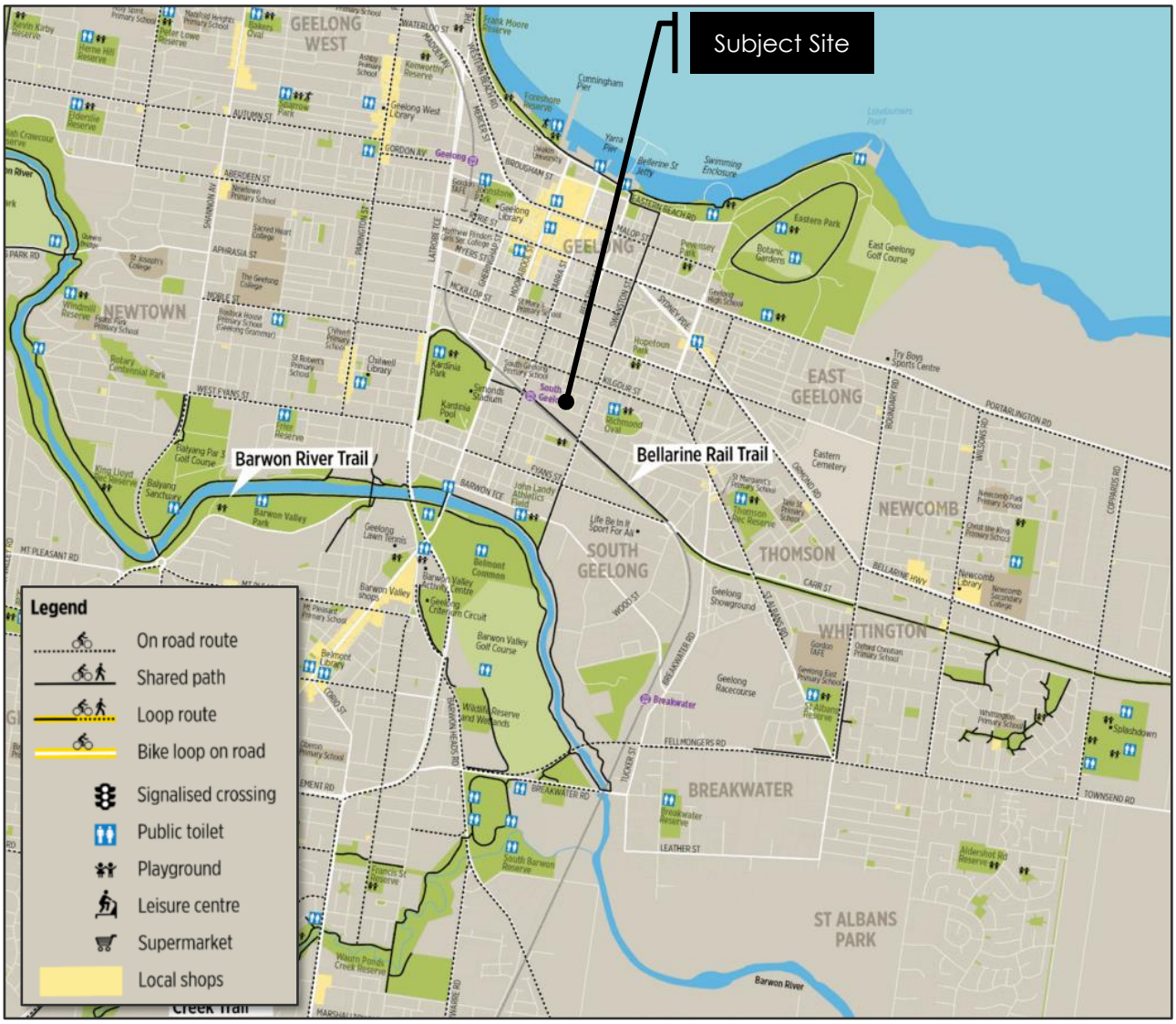
Mode	Route No	Route Description	Nearest Stop/Station
Train		Warnambool Line	South Geelong (200m)
Bus	1	North Shore Station – Deakin University	South Geelong Station (250m)
	24	Geelong Station – North Geelong Station	Cardinia Park (450m)
	30	Geelong – Whittington (via Newcomb)	Geelong Hospital (950m)
	31	Geelong – St Albans Park	Swanston Street (350m)
	32	Geelong – Leopold	Geelong Hospital (950m)
	40	Geelong to Deakin (via Breakwater)	Geelong Hospital (950m)
	41	Geelong to Deakin (via Grovedale)	Cardinia Park (450m)
	42	Geelong to Deakin (via South Valley Road)	Cardinia Park (450m)
	50	Geelong to Jan Juc (via Wombah Park)	Cardinia Park (450m)
	51	Geelong to Jan Juc (via Torquay)	Cardinia Park (450m)
	55	Geelong to Ocean Grove (via Barwon Heads)	Cardinia Park (450m)
	56	Geelong to Queenscliff (via Ocean Grove)	Geelong Hospital (950m)
	60	Geelong to St Leonards	Geelong Hospital (950m)
	61	Geelong to Drysdale (via Leopold, Clifton Springs)	Geelong Hospital (950m)
	101	Geelong to Lorne	Lonsdale Street (450m)

2.5.1 Bicycle Accessibility

In addition to on road bicycle lanes, there are a number of off-road bicycle and pedestrian shared paths in the vicinity of the site. These routes are shown in Figure 11 below.

The Bellarine Rail Trail runs adjacent to the site between the railway line and Carr St. It begins at South Geelong Station and extends to Queenscliff following the railway line. The Barwon River Trail runs approximately 20km along Barwon River in a loop. It can be accessed by travelling approximately 850 metres south along Swanston Street and can connect cyclists to the Waurn Ponds Creek Trail. A small unnamed trail exists north of the site, spanning a small segment of the bay.

Figure 11 Bicycle Accessibility of Site



3 DEVELOPMENT PROPOSAL

We understand that Barwon Water intends to rezone and redevelop the site for a mixed-use comprising a combination of residential apartments, a small supermarket, and specialty retail. Preliminary estimates indicate in the order of 200-300 dwellings, a 1,500m^2 supermarket and approximately 1,000m^2 retail uses.

Pertinent to this review is the preference of Barwon Water to close part -or all- of Carr Street to facilitate improved urban design outcomes. This would impact on both the distribution of existing traffic flows in the precinct, and the distribution of traffic generated to and from the development.

It is envisioned that the site will be self-sufficient for car parking, providing dedicated on-site parking within a podium or basement car park. The location of the car park access (or accesses) are not known at this stage, but would be located on either Carr Street, or Lonsdale Street.

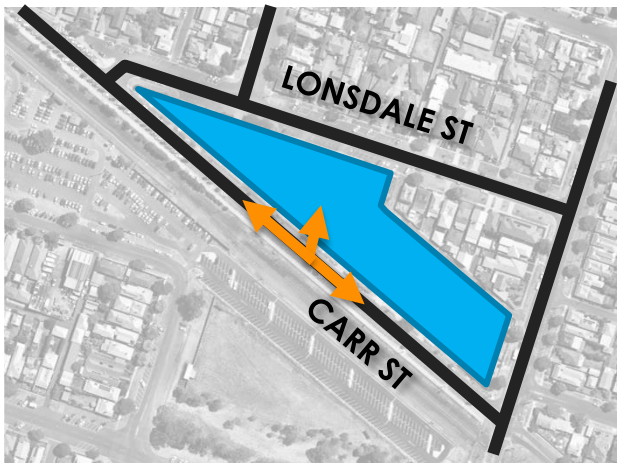
For the purposes of this assessment, four scenarios will be considered:

1. Carr Street remains open – Development is accessed from Carr Street
2. Carr Street closed at the west end - Development accessed from the east end of Carr Street
3. Carr Street closed at the east end - Development accessed from the west end of Carr Street
4. Carr street fully closed – Development access from Lonsdale Street

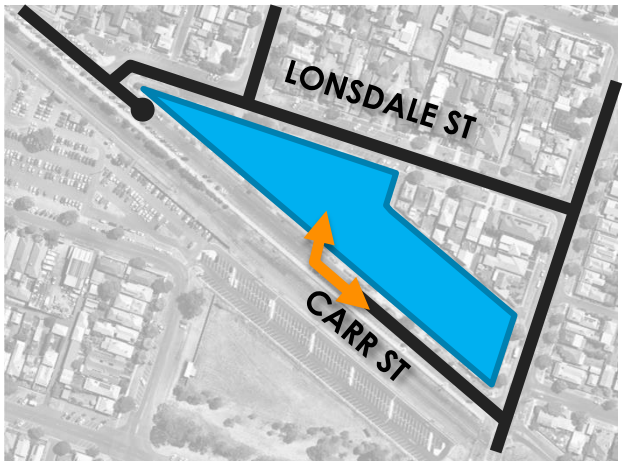
These are depicted conceptually in Figure 12 below.

Figure 12 Analysis Scenarios

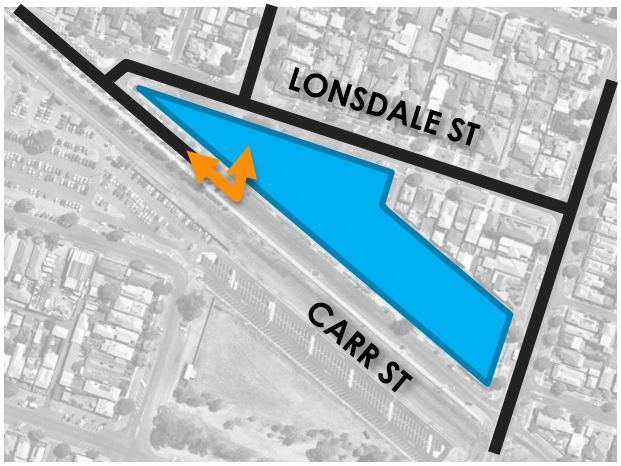
Scenario 1



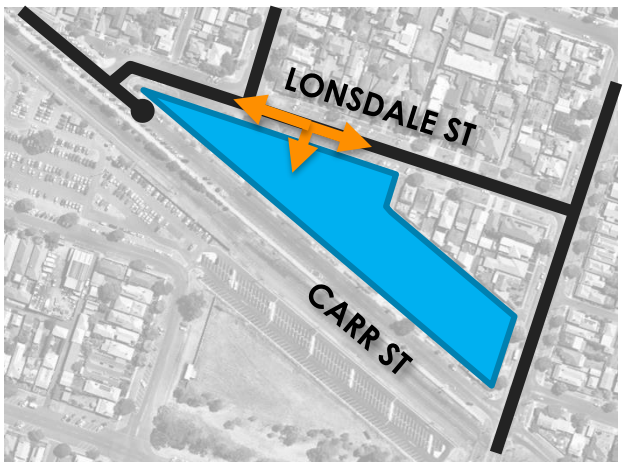
Scenario 2



Scenario 3



Scenario 4



4 TRAFFIC ANALYSIS

4.1 Existing Traffic

In order to establish existing traffic conditions in the site's vicinity, and provide a "base-case" from which to compare each scenario, **one**mile**grid** commissioned peak-hour turning movement surveys on Thursday 21st November 2019 from 6:30AM-9:30AM and 3:30PM-7:30PM at the following intersections:

- Carr Street / Lonsdale Street;
- Carr Street / Swanston Street; and
- Lonsdale Street / Swanston Street.

In addition, **one**mile**grid** commissioned a traffic volume, speed and classification survey along Carr Street mid-block.

The peak-hour traffic volumes are presented in Figure 13 and Figure 14 below. The combined peak periods were found to be from 8:00AM-9:00AM and 4:00PM-5:00PM.

Figure 13 Existing Peak-hour Traffic Volumes - AM

Figure 14 Existing Peak-hour Traffic Volumes - PM

The traffic data suggests that the surveyed roads carry the following approximate daily traffic volumes

- Carr Street West – 900 vehicles per day
- Carr Street East -900 vehicles per day
- Lonsdale Street -- 250 vehicles per day
- Swanston Street – 6,000 vehicles per day

Both Local Access streets (Carr Street, Lonsdale Street) fall within their indicative capacities (2,000 vehicles per day) as defined by Council's Road Management Plan, while Swanston Street is above it's capacity of 3,000-5,000 vehicles per day.

To assess the operation of each of the surveyed intersections, the traffic volumes have been input into SIDRA Intersection, a traffic modelling software package.

The SIDRA Intersection software package has been developed to provide information on the capacity of an intersection with regard to a number of parameters. Those parameters considered relevant are, Degree of Saturation (DoS), 95th Percentile Queue, and Average Delay as described below.

Table 2 SIDRA Intersection Parameters

Parameter	Description
Degree of Saturation (DoS)	The DoS represents the ratio of the traffic volume making a particular movement compared to the maximum capacity for that particular movement. The value of the DoS has a corresponding rating depending on the ratio as shown below.

Degree of Saturation	Rating
Up to 0.60	Excellent
0.61 – 0.70	Very Good
0.71 – 0.80	Good
0.81 – 0.90	Fair
0.91 – 1.00	Poor
Above 1.00	Very Poor

It is noted that whilst the range of 0.91 – 1.00 is rated as 'poor', it is acceptable for critical movements at an intersection to be operating within this range during high peak periods, reflecting actual conditions in a significant number of suburban signalised intersections.

Average Delay (seconds)	Average delay is the time delay that can be expected for all vehicles undertaking a particular movement in seconds.
95th Percentile (95%ile) Queue	95%ile queue represents the maximum queue length in metres that can be expected in 95% of observed queue lengths in the peak hour

The results of the analysis are provided in Table 3, Table 4 and Table 5 below.

Table 3 Carr Street / Lonsdale Street – Existing Conditions

Approach	DoS	Avg. Delay (sec)	Queue (m)
AM Peak			
Carr Street (S)	0.020	0.7	0.2
Lonsdale Street (E)	0.012	5.7	0.3
Carr Street (N)	0.029	2.2	0.0
PM Peak			
Carr Street (S)	0.021	0.6	0.2
Lonsdale Street (E)	0.009	5.7	0.2
Carr Street (N)	0.028	1.1	0.0

Table 4 Carr Street / Swanston Street – Existing Conditions

Approach	DoS	Avg. Delay (sec)	Queue (m)
AM Peak			
Swanston Street (S)	0.165	0.4	0.0
Carr Street (E)	0.161	13.7	0.6
Swanston Street (N)	0.118	1.1	0.0
Carr Street (W)	0.165	2.5	0.2
PM Peak			
Swanston Street (S)	0.131	1.1	0.2
Carr Street (E)	0.234	16.9	0.9
Swanston Street (N)	0.146	1.0	0.0
Carr Street (W)	0.127	15.1	0.5

Table 5 Lonsdale Street / Swanston Street – Existing Conditions

Approach	DoS	Avg. Delay (sec)	Queue (m)
AM Peak			
Swanston Street (S)	0.177	0.1	0.0
Swanston Street (N)	0.123	0.2	0.3
Lonsdale Street (W)	0.018	7.1	0.5
PM Peak			
Swanston Street (S)	0.137	0.1	0.0
Swanston Street (N)	0.173	0.1	0.3
Lonsdale Street (W)	0.012	7.0	0.3

The Carr Street / Lonsdale Street intersection is operating under "excellent" conditions in both AM and PM peaks, with minimal queues and delays, as anticipated for its modest traffic volumes.

The Carr Street / Swanston Street intersection is operating under "excellent" conditions during both peak periods, with movements from the eastern leg (Carr Street) experiencing slightly limited capacity as through movements on Swanston Street increase, providing fewer gaps for crossing traffic.

The Lonsdale Street / Swanston Street intersection also operates under "excellent" conditions during both peak periods due to the reduced number of turning movements to/from, and only three legs, significantly reducing the number of movements competing for gaps on Swanston Street.

It is noted that this analysis does not consider the impacts to traffic flows, positive or negative, of closure of the boom gate at the Swanston Street railway crossing. A review of current timetables suggests there are a total of six services during the peak traffic periods, (three inbound, three outbound). It is not anticipated that this will materially impact on the above analysis.

4.2 Traffic Generation

4.2.1 Residential

Surveys undertaken by other traffic engineering firms at residential dwellings have shown that the daily traffic generation rates vary depending on the size, location and type of the dwelling, the parking provision and proximity to local facilities and public transport.

Medium to high density dwellings in inner areas generate traffic with rates between 3.0 and 6.0 movements per dwelling. Considering the location of the subject site, the excellent access to public transport, and its proximity to the Geelong CBD, it is expected that the development will generate traffic at a daily rate of in the order of 5.0 movements per day per dwelling with 10% of daily traffic occurring during the peak hours.

Adopting the upper estimate of 300 dwellings on-site, equates to a projected 1,500 daily vehicle movements, inclusive of 150 during the peak hours.

It is estimated that 80% of the residential traffic will be outbound during the AM peak, while during the afternoon peak, 60% of the residential traffic will be inbound.

4.2.2 Supermarket & Retail

The New South Wales Roads and Traffic Authority (now the Department of Transport, Roads and Maritime Services) produced the document "Guide to Traffic Generating Developments" dated October 2002, which aims to assist with the assessment and preparation of development applications. The guide identifies peak traffic rates for a variety of land uses based on surveys of

existing facilities. While there is no Victorian equivalent of this document, it is widely accepted that the findings are relevant in the Victorian context.

For supermarket uses, the guide identifies a PM peak-hour traffic generation rate of 15 movements per 100m^2, and for specialty retail, a rate of 4.6 movements per 100m^2.

In the absence of any specific information on the prospective tenants or ultimate land uses, these values will be adopted for further analysis.

No traffic generation rates are given within the guide for the AM peak, however noting that generation rates for these uses are typically considerably lower, it is assumed that the AM rate represents only 20% of the peak PM period.

Applying the above traffic generation estimates to the 1,500m^2 supermarket and 1,000m^2 retail floor areas, gives an estimated 55 movements during the AM peak, and 272 movements in the PM peak hour. Traffic is assumed the be evenly split between inbound and outbound vehicles.

It is noted that this assessment is considered conservative as it does not consider the generation of linked or diverted trips from vehicles already on the surrounding roads.

4.2.3 Anticipated Traffic Generation

Based on the above survey results, the anticipated traffic generated by the proposed development is shown in Table 6.

Table 6 Anticipated Traffic Generation

Period	*Inbound*	*Outbound*	*Total*
AM Peak	68	137	205
PM Peak	226	196	422

4.3 Traffic Distribution

Considering the location of the site in relation to the arterial road network, and key land uses and employment areas, the directional distribution shown in Table 7 has been adopted.

Table 7 Adopted Directional Traffic Distribution

Origin/Destination	*Percentage*
North East – Swanston Street	30%
North West – Yarra Street	30%
South East – Swanston Street	15%
South West – Yarra Street	25%

4.4 Generated Traffic Volumes

Local distribution of traffic generated by the site's development to the surrounding roads will differ based on the access location and arrangement of Carr Street. A summary of development-generated traffic volumes for the following scenarios is provided in Figure 15 below.

1. Carr Street remains open – Development is accessed from Carr Street
2. Carr Street closed at the west end - Development accessed from the east end of Carr Street
3. Carr Street closed at the east end - Development accessed from the west end of Carr Street
4. Carr street fully closed – Development access from Lonsdale Street

Figure 15 Generated Traffic Volumes

Scenario 1

AM Peak

Scenario 1

PM Peak

Scenario 2

AM Peak

Scenario 2

PM Peak

Scenario 3

AM Peakl

Scenario 3

PM Peakl

Scenario 4

AM Peak

Scenario 4

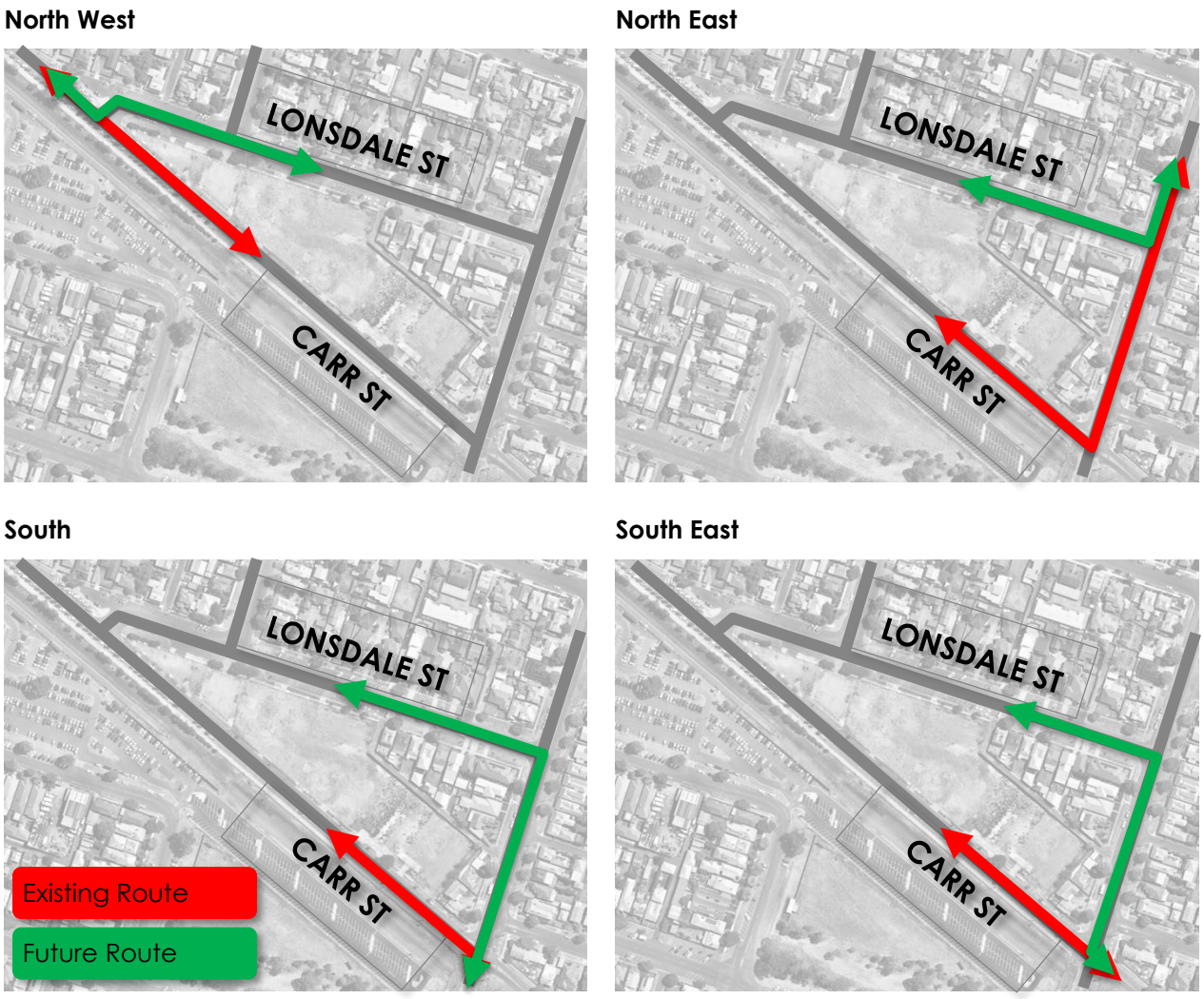
AM Peak

4.5 Future Traffic Volumes

Superimposing the above traffic volumes onto surveyed volumes presented in Figure 13 and Figure 14 allows a review of ultimate traffic volumes following the site's redevelopment.

In order to assess traffic impacts of Scenarios 2, 3 and 4, existing traffic volumes have been re-routed to reflect the changes in access routes to the precinct, as shown in Figure 16.

Figure 16 Traffic Redistribution



It is noted that the Carr Street closure is likely to result in the loss of a number of parking spaces currently used for commuter parking. Removal of these spaces may therefore result in a reduction in traffic generated to/from the precinct which was not been considered in this analysis.

4.6 Traffic Impact

These traffic volumes have been input into SIDRA and re-analysed. A summary of the results of each scenario are provided in the sections below.

4.6.1 Scenario 1

Table 8 Carr Street / Lonsdale Street – Scenario 1 Future Conditions

Approach	DoS		Avg. Delay (sec)		Queue (m)	
	Existing	Future	Existing	Future	Existing	Future
AM Peak						
Carr Street (S)	0.020	0.061	0.7	0.2	0.2	0.2
Lonsdale Street (E)	0.012	0.013	5.7	5.8	0.3	0.3
Carr Street (N)	0.029	0.049	2.2	1.3	0.0	0.0
PM Peak						
Carr Street (S)	0.021	0.081	0.6	0.2	0.2	0.2
Lonsdale Street (E)	0.009	0.011	5.7	6.3	0.2	0.3
Carr Street (N)	0.028	0.096	1.1	0.3	0.0	0.0

Table 9 Carr Street / Swanston Street – Scenario 1 Future Conditions

Approach	DoS		Avg. Delay (sec)		Queue (m)	
	Existing	Future	Existing	Future	Existing	Future
AM Peak						
Swanston Street (S)	0.165	0.170	0.4	0.6	0.0	0.0
Carr Street (E)	0.161	0.172	13.7	14.4	0.6	0.6
Swanston Street (N)	0.118	0.118	1.1	1.5	0.0	0.1
Carr Street (W)	0.165	0.178	2.5	13.5	0.2	0.7
PM Peak						
Swanston Street (S)	0.131	0.151	1.1	1.6	0.2	0.2
Carr Street (E)	0.234	0.291	16.9	21.0	0.9	1.2
Swanston Street (N)	0.146	0.147	1.0	2.0	0.0	0.3
Carr Street (W)	0.127	0.346	15.1	16.9	0.5	1.6

Table 10 Lonsdale Street / Swanston Street – Scenario 1 Future Conditions

Approach	DoS		Avg. Delay (sec)		Queue (m)	
	Existing	Future	Existing	Future	Existing	Future
AM Peak						
Swanston Street (S)	0.177	0.177	0.1	0.1	0.0	0.0
Swanston Street (N)	0.123	0.123	0.2	0.2	0.3	0.0
Lonsdale Street (W)	0.018	0.018	7.1	7.1	0.5	0.1
PM Peak						
Swanston Street (S)	0.137	0.137	0.1	0.1	0.0	0.0
Swanston Street (N)	0.173	0.173	0.1	0.1	0.3	0.0
Lonsdale Street (W)	0.012	0.012	7.0	7.0	0.3	0.0

In this scenario, where Carr Street access is maintained in both directions and the development is primarily accessed from Carr Street, the post-development intersection operation remains comparable to existing, with all intersections operating under "excellent" conditions.

Queues and delays increase only marginally, with the most significant impacts occurring at the western approach of the Carr Street / Swanston Street intersection, where average delays will increase by 11 seconds in the AM peak.

4.6.2 Scenario 2

Table 11 Carr Street / Lonsdale Street – Scenario 2 Future Conditions

Approach	DoS		Avg. Delay (sec)		Queue (m)	
	Existing	Future	Existing	Future	Existing	Future
AM Peak						
Carr Street (S)	0.020	0.001	0.7	2.9	0.2	0.0
Lonsdale Street (E)	0.012	0.049	5.7	5.6	0.3	0.2
Carr Street (N)	0.029	0.037	2.2	5.5	0.0	0.0
PM Peak						
Carr Street (S)	0.021	0.001	0.6	2.9	0.2	0.0
Lonsdale Street (E)	0.009	0.062	5.7	5.6	0.2	0.2
Carr Street (N)	0.028	0.051	1.1	5.5	0.0	0.0

Table 12 Carr Street / Swanston Street – Scenario 2 Future Conditions

Approach	DoS		Avg. Delay (sec)		Queue (m)	
	Existing	Future	Existing	Future	Existing	Future
AM Peak						
Swanston Street (S)	0.165	0.176	0.4	0.6	0.0	0.0
Carr Street (E)	0.161	0.216	13.7	16.6	0.6	0.8
Swanston Street (N)	0.118	0.119	1.1	1.9	0.0	0.2
Carr Street (W)	0.165	0.295	2.5	14.2	0.2	1.3
PM Peak						
Swanston Street (S)	0.131	0.173	1.1	2.1	0.2	0.2
Carr Street (E)	0.234	0.420	16.9	30.8	0.9	1.7
Swanston Street (N)	0.146	0.148	1.0	2.9	0.0	0.6
Carr Street (W)	0.127	0.494	15.1	19.5	0.5	3.0

Table 13 Lonsdale Street / Swanston Street – Scenario 2 Future Conditions

Approach	DoS		Avg. Delay (sec)		Queue (m)	
	Existing	Future	Existing	Future	Existing	Future
AM Peak						
Swanston Street (S)	0.177	0.239	0.1	0.8	0.0	0.0
Swanston Street (N)	0.123	0.147	0.2	0.6	0.3	0.2
Lonsdale Street (W)	0.018	0.068	7.1	8.3	0.5	0.2
PM Peak						
Swanston Street (S)	0.137	0.217	0.1	0.9	0.0	0.0
Swanston Street (N)	0.173	0.242	0.1	0.4	0.3	0.2
Lonsdale Street (W)	0.012	0.172	7.0	9.8	0.3	0.6

Similar to the first scenario, this scenario (Carr Street closed at the west end - Development accessed from the east end of Carr Street) results in only minor increases to queues and delays. All intersections will continue operating under "excellent" conditions.

Impacts are greatest at the Carr Street / Swanston Street intersection, where average delays on the western approach increase by nearly 12 seconds during the AM peak, and 14 seconds during the PM peak.

4.6.3 Scenario 3

Table 14 Carr Street / Lonsdale Street – Scenario 3 Future Conditions

Approach	DoS		Avg. Delay (sec)		Queue (m)	
	Existing	Future	Existing	Future	Existing	Future
AM Peak						
Carr Street (S)	0.020	0.082	0.7	2.4	0.2	0.3
Lonsdale Street (E)	0.012	0.052	5.7	6.0	0.3	0.2
Carr Street (N)	0.029	0.052	2.2	3.1	0.0	0.0
PM Peak						
Carr Street (S)	0.021	0.122	0.6	2.7	0.2	0.5
Lonsdale Street (E)	0.009	0.110	5.7	6.4	0.2	0.4
Carr Street (N)	0.028	0.105	1.1	1.5	0.0	0.0

Table 15 Carr Street / Swanston Street – Scenario 3 Future Conditions

Approach	DoS		Avg. Delay (sec)		Queue (m)	
	Existing	Future	Existing	Future	Existing	Future
AM Peak						
Swanston Street (S)	0.165	0.169	0.4	0.3	0.0	0.0
Carr Street (E)	0.161	0.178	13.7	14.4	0.6	0.6
Swanston Street (N)	0.118	0.125	1.1	1.0	0.0	0.0
Carr Street (W)	0.165	0.008	2.5	14.4	0.2	0.0
PM Peak						
Swanston Street (S)	0.131	0.143	1.1	1.1	0.2	0.2
Carr Street (E)	0.234	0.259	16.9	18.3	0.9	1.0
Swanston Street (N)	0.146	0.156	1.0	1.2	0.0	0.0
Carr Street (W)	0.127	0.009	15.1	15.2	0.5	0.0

Table 16 Lonsdale Street / Swanston Street – Scenario 3 Future Conditions

Approach	DoS		Avg. Delay (sec)		Queue (m)	
	Existing	Future	Existing	Future	Existing	Future
AM Peak						
Swanston Street (S)	0.177	0.191	0.1	0.7	0.0	0.0
Swanston Street (N)	0.123	0.144	0.2	1.3	0.3	0.3
Lonsdale Street (W)	0.018	0.098	7.1	7.3	0.5	0.4
PM Peak						
Swanston Street (S)	0.137	0.155	0.1	1.0	0.0	0.0
Swanston Street (N)	0.173	0.231	0.1	1.9	0.3	0.8
Lonsdale Street (W)	0.012	0.157	7.0	7.6	0.3	0.6

This scenario considers Carr Street closed at the east end, and development accessed from the west end of Carr Street.

As shown above, all intersections continue to operate under "excellent" conditions during both the morning and afternoon peak hours, with minimal changes to queues and delays experienced by motorists.

4.6.4 Scenario 4

Table 17 Carr Street / Lonsdale Street – Scenario 4 Future Conditions

Approach	DoS		Avg. Delay (sec)		Queue (m)	
	Existing	Future	Existing	Future	Existing	Future
AM Peak						
Carr Street (S)	0.020	0.001	0.7	3.0	0.2	0.0
Lonsdale Street (E)	0.012	0.095	5.7	5.6	0.3	0.3
Carr Street (N)	0.029	0.052	2.2	5.5	0.0	0.0
PM Peak						
Carr Street (S)	0.021	0.001	0.6	3.2	0.2	0.0
Lonsdale Street (E)	0.009	0.132	5.7	5.8	0.2	0.5
Carr Street (N)	0.028	0.101	1.1	5.5	0.0	0.0

Table 18 Carr Street / Swanston Street – Scenario 4 Future Conditions

Approach	DoS		Avg. Delay (sec)		Queue (m)	
	Existing	Future	Existing	Future	Existing	Future
AM Peak						
Swanston Street (S)	0.165	0.171	0.4	0.3	0.0	0.0
Carr Street (E)	0.161	0.182	13.7	14.7	0.6	0.7
Swanston Street (N)	0.118	0.129	1.1	1.0	0.0	0.0
Carr Street (W)	0.165	0.008	2.5	14.6	0.2	0.0
PM Peak						
Swanston Street (S)	0.131	0.150	1.1	1.1	0.2	0.2
Carr Street (E)	0.234	0.271	16.9	19.2	0.9	1.1
Swanston Street (N)	0.146	0.162	1.0	1.2	0.0	0.0
Carr Street (W)	0.127	0.009	15.1	15.7	0.5	0.0

Table 19 Lonsdale Street / Swanston Street – Scenario 4 Future Conditions

Approach	DoS		Avg. Delay (sec)		Queue (m)	
	Existing	Future	Existing	Future	Existing	Future
AM Peak						
Swanston Street (S)	0.177	0.194	0.1	0.7	0.0	0.0
Swanston Street (N)	0.123	0.144	0.2	1.3	0.3	0.3
Lonsdale Street (W)	0.018	0.111	7.1	7.4	0.5	0.4
PM Peak						
Swanston Street (S)	0.137	0.163	0.1	1.2	0.0	0.0
Swanston Street (N)	0.173	0.232	0.1	1.9	0.3	0.8
Lonsdale Street (W)	0.012	0.176	7.0	7.8	0.3	0.7

This scenario considers full closure of Carr Street, and development accessed from Lonsdale Street.

Minimal impacts to intersection performance result, with all intersections continuing to operate under "excellent" conditions.

4.6.5 Summary

All development scenarios assessed will result in acceptable intersection performance, with all surveyed and analysed intersections expected to operate a comparable level of performance to existing conditions.

It is noted though, that Scenarios 2-4 will effectively result in Lonsdale Street operating as the main east-west link between Yarra and Swanston Streets.

Carr Street is identified in Council's Road Register as a "Secondary Distributor", which broadly has the function of carrying significant volumes of traffic and provide access, by linking residential areas to arterial roads.

Lonsdale Street in contrast is classified as a "Local Access" street which is intended for short distance travel to higher level roads, and a target of less than 2,000 vehicles per day. Noting this, and the residential nature of the street (at least on the northern side), traffic volumes to Lonsdale Street would ideally be minimised.

Scenarios 3 and 4 would both result in daily traffic volumes greater than 2,000 vehicles per day on Lonsdale Street, which is not preferred.

In light of the above, **it is recommended, based on traffic engineering grounds, that Scenarios 1 and 2 be pursued** as a priority.

Should the ultimate access strategy, development composition, or road closure arrangement differ materially from what has been contemplated above, traffic analysis should be reviewed and the impacts re-assessed.

5 CAR PARKING

5.1 Existing Conditions

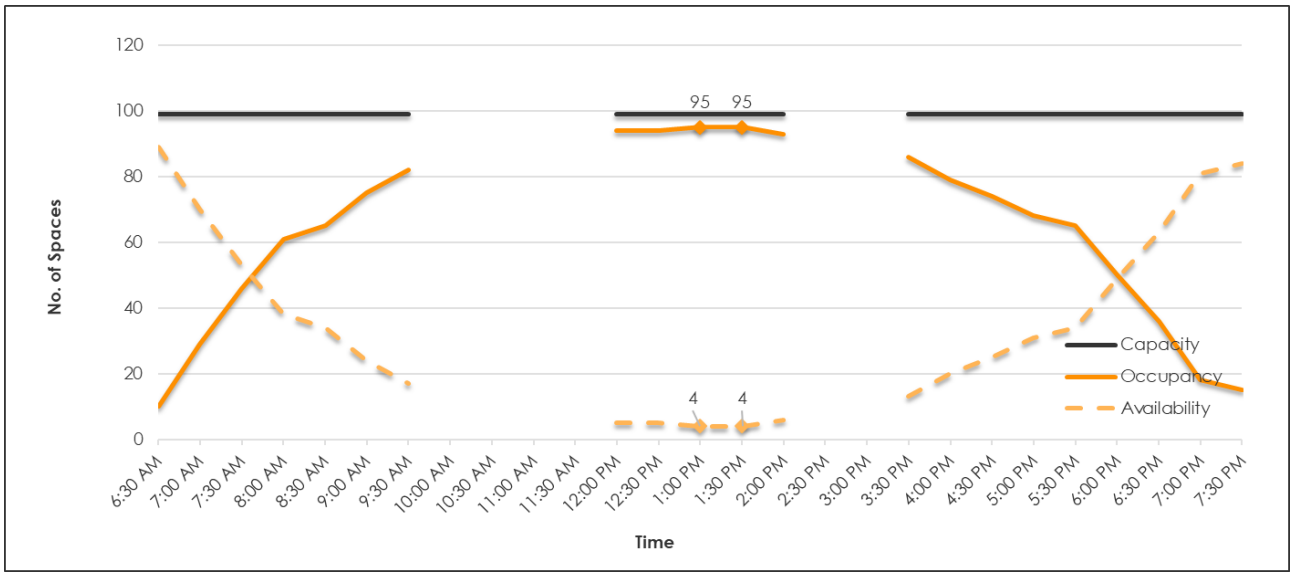
In addition to traffic surveys, **one**mile**grid** commissioned parking inventory and occupancy surveys of the Carr Street (between Lonsdale Street and Swanston Street) on Thursday 21st November 2019 from 6:30AM-9:30AM, 12:00PM-2:00PM and 3:30PM-7:30PM at 30 minute intervals.

The surveys identified a supply of 99 parking spaces on Carr Street. Peak occupancy occurred during the middle of the day at 1:00PM and 1:30PM when 95 spaces were occupied, leaving no fewer than 4 spaces available for use. Parking utilisation varied between 96% and 10% of capacity.

It is noted that all car parking surveyed was unrestricted.

The result of the survey is presented in Figure 17 below.

Figure 17 Carr Street Parking Occupancy Profile - Thursday 21/11/19



The above data clearly suggests that on-street car parking is heavily utilised, and occupancy patterns (and proximity to South Geelong station) suggest that car parking is utilised by commuters.

5.2 Future Conditions

Should Carr Street be partially or fully closed, up to 99 unrestricted parking spaces may be removed, and demand for up to 95 parking spaces may be redistributed to the surrounding streets and car parks.

Observations on-site, and from historical aerial photography suggest that formalised commuter parking at the station (including the south-eastern railway car park that was expanded in early 2019) is heavily utilised, and is unlikely to have sufficient capacity to accommodate any redistribution of demands. As a result, parking demands are likely to pushed into the surrounding residential streets.

The majority of car parking on Lonsdale Street and Bellarine Street is time restricted, so parking demands may be redistributed more widely to streets without parking restrictions if not replaced.

Should Council wish to replace lost car parking, and assuming that all spaces on Carr Street between Swanston Street and Lonsdale Street are lost, it is estimated that approximately 70 new spaces would be required to accommodate all existing demands.

Given the wide carriageway of Bellarine Street, additional on-street car parking may be provided by establishing angled kerbside parking (in lieu of existing parallel parking). This would yield between a 230% (60 degree) and 270% (90 degree) increase in parking per linear metre, excluding impacts of driveway crossovers on efficiency. The existing carriageway width (18 metres) is sufficient to accommodate even 90 degree angled parking.

Additionally, opportunity exists to provide new car parking along the northern Barwon Water site frontage, noting that driveway crossovers which serviced the previous use may no longer be required.

It is noted that the Australian Standard for On-Street Parking (AS2890.5) requires a minimum roadway width of 25 metres to facilitate central angle parking (and kerbside parallel parking on both sides). As a result, no roads surrounding the site are suitable.

It is noted that the supply of freely available parking has a significant impact on travel mode choice when accessing a destination. Where there is a large supply of free car parking, such as the subject site, there is little incentive to utilise alternative transport modes. In contrast, if the supply of car parking is limited, or users are charged a fee, it creates incentive (scarcity, and cost) to travel to the station by walking, cycling or feeder public transport routes. The site is well-located in this regard, with a large walkable catchment, excellent bicycle access, and multiple bus routes in the vicinity.

Consideration should also be given to the amenity impacts of new car parking on existing residential streets, which may include increases to traffic volumes, and impacts on property access.