



# **Traffic and** transport study:

Fern Bay and North Stockton

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# Fern Bay & North Stockton Traffic & Transport Study

Port Stephens Council / Newcastle City Council

June 2018



## Traffic & Transport Study: Fern Bay & North Stockton

Author: Sean Morgan

Client: Port Stephens Council & Newcastle City Council

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# SECA solution >>>>

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## Contents

1.	Execut	ive Summary	. iii
2.	Introdu	iction	. 1
	2.1	Background	. 1
	2.2	Methodology Overview	.1
	2.3	Reference Documents	. 2
	2.4	Consultation	. 2
3.	Existin	g Situation	. 3
	3.1	Study Area	. 3
	3.2	Road Hierarchy	.4
	3.3	Traffic Data Collection	. 8
	3.4	Road Safety and Crash History	15
	3.5	Pedestrian and Bicycle Facilities	15
	3.6	Public Transport	18
	3.7	Parking	24
4.	Trip G	eneration & Distribution	25
	4.1	Future Design Year Assessment	25
	4.2	Trip Generation	27
	4.3	Traffic Distribution	28
	4.4	Access Arrangements	29
5.	Assess	sment Criteria	30
	5.1	Road Capacity Assessment Criteria	30
	5.2	Intersection Capacity Standards	32
6.	Baselii	ne Assessment	33
	6.1	Road Capacity	34
	6.2	Intersection Capacity	35
	6.3	Deficiency Analysis	37
7.	2021 F	Road Capacity and Intersection Analysis	38
	7.1	Road Capacity	38
	7.2	Intersection Analysis	39
	7.3	Summary of Road and Intersection Upgrades	41
8.	2026 F	Road Capacity and Intersection Analysis	43
	8.1	Road Capacity	43
	8.2	Intersection Analysis	44
	8.3	Summary of Road and Intersection Upgrades for 2026 design year	48
9.	2036 F	Road Capacity and Intersection Analysis	49
	9.1	Road Capacity	49

9.2	Intersection Analysis	. 50
9.3	Summary of Road and Intersection Upgrades 2036	. 55
9.4	Future Road Link	. 55
10. Backg	round Growth Only	. 57
10.1	Intersection of Nelson Bay Road / Fullerton Street	. 57
10.2	Intersection of Nelson Bay Road / Vardon Road	. 58
11. Future	Public Transport, Pedestrian and Cycling	. 59
11.1	Bicycle and Pedestrian Facilities	. 59
11.2	Pedestrian Crossing	. 60
11.3	Bus Facilities	. 62
11.4	Park and Ride	. 65
12. Conce	pt Plans and Associated Cost Estimates	. 66
12.1	Introduction	. 66
12.2	Conceptual Designs	. 66
12.3	Land Acquisition	. 66
12.4	Criteria for Concept Level Engineering Estimates	. 66
12.5	Basis of Applied Unit Rates for Construction	. 66
12.6	Basis of Concept Level Engineering Estimates	. 66
12.7	Engineering Cost Estimates	. 67
12.8	Prioritising and Staging of Improvements	. 67
12.9	Concepts and Bills of Quantities	.71
13. Recon	nmendation	.77
Appendix	A: Accident Data	. 78
Appendix	B: Dune Drive Strategic Layout (Source: RMS)	. 84
Appendix	C: Forecast 2021 Traffic Volumes	. 86
Appendix	D: Forecast 2026 Traffic Volumes	. 88
Appendix	E: Forecast 2036 Traffic Volumes	. 91
Appendix	F: Sidra Results	94

### 1. Executive Summary

Seca Solution Pty Ltd has been jointly commissioned by Port Stephens Council and Newcastle City Council to prepare a traffic and transport study to inform the development of a future land use strategy for Fern Bay and North Stockton.

The purpose of this study is to assess the current and future performance of the road network and provide recommendations for upgrades to support the planned growth identified within the study area. The recommendations will also allow for funding through the Port Stephens and Newcastle S94 Development Contribution Plans.

A key theme of this study is the review of opportunities to promote active travel alternatives (walking, cycling and public transport) through upgrades to the existing facilities, and encourage a shift away from private vehicle use. This includes identifying opportunities to ease car parking congestions around Stockton Ferry Terminal and the feasibility of a park and ride scheme operating out of Corroba Oval.

In summary, the objectives of this traffic and transport study are to:

- Assess the capacity of the existing road network to support future commercial and residential development proposed within the study area.
- Maintain the function of Nelson Bay Road as a regional connection from Newcastle to Newcastle Airport, Williamtown RAAF Base and through to Nelson Bay.
- Improve opportunities for residents to participate in active transport including walking and cycling.
- Promote the safe passage of residents from existing and proposed residential areas to a new commercial centre within the study area.
- Prioritise the movement of pedestrians, cyclists and public transport ahead of single occupancy vehicles.

#### Approach and Methodology

Traffic surveys were undertaken to determine the existing traffic flows particularly as they relate to various connection points with Nelson Bay Road. Nelson Bay Road provides an arterial connection with Newcastle to the south and Nelson Bay to the north. It carries significant traffic flows as it services the employment lands associated with Kooragang Island, the RAAF Base-Williamtown, Tomago and Newcastle Airport and is anticipated to carry ongoing growth in traffic throughout the study period.

Key future residential developments have been identified and traffic generation determined based on applying trip rates per the RMS Guide to Traffic Generating Developments. Additional traffic associated with contained trips has been allowed for by applying suitable trip rates for the proposed retail/commercial element proposed by 2036. In the meantime the application of single dwelling rates for all developments, whether seniors living or medium density (manufactured home estates) has provided sufficient to allow for additional trips associated with these demands.

Sidra Intersection Modelling was applied to a series of intersections to assess their existing level of performance as well as to cater for background growth and future development traffic. Allowing for the separation of these intersections and the minimal impact they have one each other there was no requirement to allow for a network model, nor for micro-simulation of the study area.

#### **Key Recommendations**

The existing roads and intersections, pedestrian / bicycle facilities and public transport facilities were assessed through the study area. The capacity and suitability of these services was assessed, taking into account the need to accommodate future development opportunities as identified during 2021, 2026 and 2036.

The key constraints identified through the study area relate to Nelson Bay Road where single lanes of travel restrict traffic flows during the peak hours to a level already at LoS D-E. Nelson Bay Road has been duplicated in varying sections along its length however discussions with the RMS indicate that although the corridor has been modelled there are no timeframes for future upgrades within the study area.

In addition to the need to duplicate Nelson Bay Road to increase capacity by providing two lanes of travel in each direction, the flows along this corridor impact on the performance of the various intersections with the capacity for right turns out of side roads as well as right turns in off Nelson Bay Road hampered by the lack of suitable gaps in traffic flows. It has been this need to provide safe connection that has driven the recommendation to provide a signalised intersection at Nelson Bay Road and Vardon Road to allow for future development by 2026.

Overall the assessment proposes a number of upgrades to roads and intersections, pedestrian / bicycle facilities and public transport facilities, to ensure these services maintain an adequate level of operation in the long term (2036 design horizon). The recommended upgrades are outlined in Table 1.1 and shown in Figure 1.1 with the prioritisation and timing of these works determined based on the predicted timeframes for the implementation of proposed developments in the study area.



Table 1.1 - Prioritisations and staging of recommended works

Ref #	Facility Name	Description of Works	Priority / Staging		
Road	s and Intersections				
R1	Nelson Bay Road / Vardon Road	Realignment of kerbs and median to restrict right turns onto Nelson Bay Road. Remove and infill U-turn lane.	2021		
R3	Nelson Bay Road / Taylor Road	Realignment of kerbs and median to restrict right turns onto Nelson Bay Road. Remove and infill U-turn lane.	2021		
R1	Nelson Bay Road / Vardon Road	Installation of traffic signal controls.	2026		
R2	Vardon Road	Widening of Vardon Road between Nelson Bay Road / Popplewell Road.	2026		
R3	Nelson Bay Road / Taylor Road	Remove and infill central median to restrict access to left in / left out onto Nelson Bay Road.	2026		
Pede	strian / Bicycle Facilities				
P1	Shared Path on eastern side of Nelson	n Bay Road (between Braid Road / Bayway Village). Approx. 1,475m.	2 / 2026		
P2	Shared Path on western side of Nelso	n Bay Road (between Vardon Road and Palm Lakes Resort), Approx. 950m.	3 / 2026		
P3	Shared Path (between Seaside Boule	vard and Popplewell Road). Approx. 2,200m.	4 / 2026		
P4	Shared Path (between Popplewell Roa	ad and Fullerton Street) - indicative only. Approx. 2,500m.	5 / 2036		
P5	Pedestrian refuge on Fullerton Street for access between Fort Wallace development and Stockton Cycleway.				
P6	Upgrades to existing pedestrian (zebra	a) crossing on Fullerton Street.	4 / 2026		
Publi	c Transport Facilities				
B1	Relocate existing bus stop on Seaside	Boulevard. Upgrade to provide seating and shelter.	1 / 2021		
B2	Upgrade existing bus stop to provide s	seating and shelter (timed to coincide with development of Fort Wallace).	2 / 2021		
B3	Upgrade existing bus stop to provide s	seating and shelter.	3 / 2021		
B4	Bus route diverted on Vardon Road to	connect with Rifle Range site (timed to coincide with installation of traffic signals at Vardon Road).	4 / 2026		
B5	Relocate existing southbound bus sto Vardon Road).	p near Vardon Road. Upgrade to provide seating and shelter (timed to coincide with installation of traffic signals at	5 / 2026		
B6	Provide new northbound bus stop nea	r Vardon Road with seating and shelter (timed to coincide with installation of traffic signals at Vardon Road).	5 / 2026		
B7	Upgrade existing bus stop to provide s	seating and shelter (timed to coincide with development of Caravan Park).	6 / 2026		
B8	Upgrade existing bus stop to provide s	seating and shelter (timed to coincide with development of Caravan Park).	6 / 2026		
B9	Relocate the existing northbound bus stop (located to the immediate north of the Stockton Bridge) to be further north of the roundabout. Upgrade to provide seating and shelter. A pedestrian refuge will also be constructed on Nelson Bay Road to facilitate access to development on the eastern side of the road (timed to coincide with development of the preferred site for mixed use centre).				
B10		seating and shelter (timed to coincide with development of the preferred site for mixed use centre).	7 / 2026		
B11		posite existing bus stop to front of Stockton Centre. Upgrade to provide seating and shelter (timed to coincide with	7 / 2026		



Figure 1.1 - Summary of upgrades and improvements.

## 2. Introduction

#### 2.1 Background

Seca Solution Pty Ltd has been jointly commissioned by Port Stephens Council and Newcastle City Council to prepare a traffic and transport study to inform the development of a future land use strategy for Fern Bay and North Stockton. The purpose of this study is to assess the current and future performance of the road network and provide recommendations for upgrades to support the planned growth identified within the study area. The recommendations provided by this study will also provide recommendations to funding through the Port Stephens and Newcastle S94 Development Contribution Plans.

A key theme of this study reviews the opportunities to promote active travel alternatives (walking, cycling and public transport) through upgrades to the existing facilities, and to encourage a shift away from private vehicle use. This includes identifying opportunities to ease car parking congestion around Stockton Ferry Terminal and the feasibility of a park and ride scheme operating out of Corroba Oval.

In summary, the objectives of this traffic and transport study are as follows:

- Assess the capacity of the existing road network to support future commercial and residential development proposed within the study area.
- Maintain the function of Nelson Bay Road as a regional connection from Newcastle to Newcastle Airport, Williamtown RAAF Base and through to Nelson Bay.
- Improve opportunities for residents to participate in active transport including walking and cycling.
- Promote the safe passage of residents from existing and proposed residential areas to a new commercial centre within the strategy area.
- Prioritise the movement of pedestrians, cyclists and public transport ahead of single occupancy vehicles.

#### 2.2 Methodology Overview

The traffic study has applied the following methodology in determining the traffic impact and appropriate future level traffic volumes in the local road network:

- A review of existing traffic and transport systems along the Nelson Bay Road corridor was undertaken and deficiencies in the road network identified;
- Traffic counts have been completed that the key intersections along Nelson Bay Road to determine the existing traffic volumes;
- The trip generation associated with approved and proposed developments has been identified to determine the traffic volumes at each future design horizon years of 2026 and 2036;
- A trip generation and trip distribution analysis has been undertaken for each development to allocate traffic to the road network;
- Mid-block analysis has been undertaken to establish whether the existing and proposed road network has sufficient link capacity;
- The analysis of individual intersections has been undertaken using *Sidra Intersection 7* for the 2018, 2026 and 2036 design years with key performance parameters i.e. Level of Service (LoS) determined;
- Mitigation measures have been proposed for Nelson Bay Road corridor to identify the required upgrades to support the forecast traffic volumes at each future design year.

Further to this, the following methodology has also been adopted to identify upgrades to pedestrian and cycling facilities, bus stops and car parking at the Stockton Ferry Terminal:

- Review the existing pedestrian and cycling facilities within the study area to identify any deficiencies or constraints;
- Review the location of bus stops and accessibility to/from nearby residential development. Determine the availability of seating and shelter at each bus stop;



- Assess the potential demands for walking, cycling or public transport associated with existing and future development;
- Identify the opportunities to improve access to existing facilities and encourage active travel such as walking or cycling;
- Assess the benefits of relocating or providing additional bus stops to satisfy the future demands for these services;
- Observe car parking demands in the area surrounding Stockton Ferry Terminal to assess the current parking demands during the morning and afternoon associated with commuter trips to Newcastle;
- Assess the merits of providing a park and ride scheme out of Corroba Oval and identify other opportunities to relieve car parking congestion around Stockton Ferry Terminal.

#### 2.3 Reference Documents

In preparing this document, the following guides and publications have been reviewed:

- RMS Guide to Traffic Generating Developments, Version 2.2 Dated October 2002;
- Port Stephens Development Contributions Plan
- Newcastle Development Contributions Plan
- Various Traffic Impact Assessments for developments within the study area provided by each Council

#### 2.4 Consultation

As part of the study work, consultation has been held with Port Stephens Council and Newcastle City Council through consultation meetings. As part of this process the Roads and Maritime Services (RMS) has also been involved, due to the potential impact of the works identified in the study area on Nelson Bay Road, forming part of the Regional road network.

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### 3. Existing Situation

#### 3.1 Study Area



Figure 3.1 - Road network assessed in the study area, showing location of key intersections



#### 3.2 Road Hierarchy

The main road through the locality is Nelson Bay Road which provides a major connection between Nelson Bay to the north and Kooragang to the south. It forms part of the regional road network (B63) and accordingly carries a high volume of traffic between Newcastle and the Port Stephens LGA, including Newcastle Airport and the Williamtown RAAF base. Along its length it varies between a dual and single lane carriageway and contains a number of key intersections between North Stockton and Fullerton Cove that are within the study area.

To the north of the Stockton Bridge, Nelson Bay Road connects with Fullerton Street at an offset roundabout junction with three legs (Figure 3.2). This intersection provides the only vehicle access into and out of Stockton. The intersection layout allows for northbound through movements to occur separate to the roundabout, with two through lanes provided in this location. An additional northbound lane is provided for right turn movements off Nelson Bay Road into Fullerton Street at the roundabout. The posted speed limit for northbound travel is 80km/hr passing this intersection.



Figure 3.2 - Aerial view of the roundabout intersection of Nelson Bay Road and Fullerton Street (source: Nearmap)

There are two lanes on the southbound approach to the roundabout, one allowing for left turns into Fullerton Street as well as through movements and the other allowing for through movements as well as the U-turn movement around the roundabout to travel back towards the north along Nelson Bay Road. The posted speed limit southbound in this location is 70km/hr.

On the Fullerton Street approach there is a channelised left turn treatment allowing these movements to occur separate to the roundabout. An acceleration lane is provided on Nelson Bay Road to allow efficient merging of left turning vehicles with the southbound through traffic. Right turn movements out of Fullerton Street onto Nelson Bay Road occur at the roundabout, with an acceleration lane provided for this movement for vehicles joining the northbound through traffic.



Fullerton Street provides the only vehicle route connecting the Stockton Peninsula to the external road network. It operates as a two-way road with one lane in each direction and has a sealed pavement providing no kerb or guttering between Nelson Bay Road and Meredith Street. It has a pavement width in the order of 9-11 metres along this stretch of road and operates under the posted speed limit of 70km/hr.

To the north of this roundabout, Nelson Bay Road operates as a dual carriageway with sheltered right turn lanes provided at intersections for northbound vehicles, including into Taylor Road, Vardon Road and Newcastle Links Hotel. There are sheltered right turn lanes provided for southbound vehicles to undertake a U-turn, which are located at the intersections with Taylor Road and Vardon Road. Prior to Taylor Road the northbound speed limit on Nelson Bay Road reduces to 70km/hr, in line with the southbound speed limit.

The intersection of Taylor Road with Nelson Bay Road allows for all turning movements (Photo 1). Taylor Road is a local street which primarily services residential development in the area, operating under the posted speed limit of 50km/hr. It provides a sealed pavement in the order of 6 metres wide allowing for one lane of travel in each direction. It has no kerb and guttering nor footpaths however does have lighting along its length.



Photo 1 - Intersection of Nelson Bay Road and Taylor Road

Similarly, the intersection of Vardon Road with Nelson Bay Road allows for all turning movements. Vardon Road is a local street providing the primary access to a range of developments including Fern Bay Public School, the Newcastle Golf Club, Fern Bay Community Hall, as well as residential properties. It operates with one lane in each direction and provides kerb and guttering along the northern roadside only (Photo 2). It has a posted speed limit of 50km/hr with a school zone present in the vicinity of the public school, limiting vehicle speeds to 40km/hr during the typical school pick up and drop off times (8-9:30am and 2:30-4pm). Street lighting is provided along Vardon Road.



Photo 2 - Cross section of Vardon Road looking to the east

Between the intersections of Taylor Road and Vardon Road, Nelson Bay Road intersects with Rankin Road. Rankin Road allows for left in / left out turning movements only onto Nelson Bay Road, with a central median preventing right turns in this location. Rankin Road operates in the same manner as Taylor Road, under the speed limit of 50km/hr servicing residential developments. It allows for one lane of travel in each direction, with a narrow sealed pavement width in the order of 4.5 metres.

Nelson Bay Road continues as a dual carriageway to the north of Vardon Road for 450 metres before merging to provide one lane of travel in each direction, with no central median.

A left turn deceleration lane is provided for northbound vehicles to enter the Palm Lakes Resort development (Photo 3). There is also a sheltered right turn lane provided for southbound vehicles to turn at this intersection. Left turn movements only are permitted out of the Palm Lakes onto Nelson Bay Road, with the right turn out restricted by a paved median.



Photo 3 - Access to Palm Lakes Resort for vehicles northbound along Nelson Bay Road

A further sheltered right turn lane is provided for access to Bayway Village for northbound vehicles, with a left turn deceleration lane also provided for southbound movements turning into this development. Turning movements onto Nelson Bay Road are available in both directions, with short acceleration lanes (45 metres) provided to assist both right and left turn movements back onto Nelson Bay Road.

Nelson Bay Road continues as a single carriageway to the north of Bayway Village until reaching the roundabout intersection with Fullerton Cove Road / Seaside Boulevard (Figure 3.2). Nelson Bay Road widens to provide two lanes of travel in each direction on both the northern and southern legs, before returning to a single lane in each direction to the north of the roundabout. Both approaches provide a through and left turn lane, and a through and right turn lane.



Figure 3.2 - Aerial view of the roundabout intersection of Nelson Bay Road and Fullerton Cove Road / Seaside Boulevard (Source Nearmap)

The western leg of the roundabout connects Nelson Bay Road to Fullerton Cove Road. Fullerton Cove Road is a local collector road which provides access to residential developments in the area and operates under the speed limit of 70km/hr. The road loops around to the west before reconnecting with Nelson Bay Road approximately 5 kilometres north of the roundabout, at a priority controlled T-intersection (Nelson Bay Road having priority) allowing for all turning movements including a sheltered right turn lane on Nelson Bay Road.

The eastern leg of the roundabout connects Seaside Boulevard with Nelson Bay Road. Seaside Boulevard currently provides the only vehicle access to the ongoing Seaside Estate development. It provides one lane of travel in each direction with a central median between Nelson Bay Road and Ironbark Drive and operates under the posted speed limit of 60km/hr for this section. At the roundabout the road widens to allow for two lanes, including a designated left turn lane and a combined through and right turn lane.

#### 3.3 Traffic Data Collection

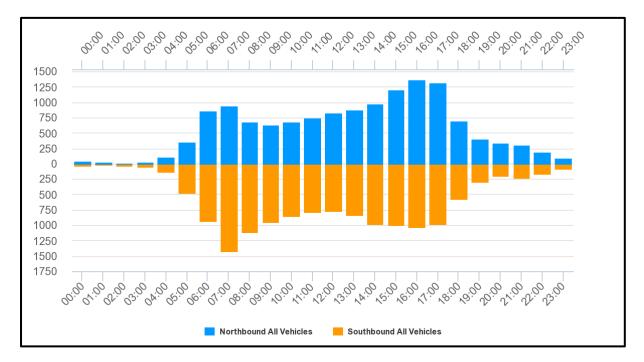
#### 3.3.1 Traffic Counts

As part of the project work, Seca Solution has completed traffic surveys at the following intersections to determine the current traffic demands and review their current operation:

- Nelson Bay Road / Fullerton Street
- Nelson Bay Road / Vardon Road
- Nelson Bay Road / Seaside Boulevard / Fullerton Cove Road

These surveys were completed concurrently on Wednesday 7<sup>th</sup> February 2017 during morning (6:30am to 8:30am) and evening (3:00pm to 5:30pm) with these times coinciding with the typical peak commuter periods along Nelson Bay Road.

Figure 3.3 shows the typical daily traffic profile along Nelson Bay Road determined by the permanent counter located on Stockton Bridge, south of the Fullerton Street intersection (ID 05962).



#### Figure 3.3 - 2017 daily traffic profile on Nelson Bay Road (source: RMS web page, 2018).

During the morning traffic survey, an accident occurred on Nelson Bay Road (south of Fullerton Street) slightly before 8am which impacted on traffic flows in both directions. Surveys also recorded a decrease in northbound traffic on Nelson Bay Road between 6:45am-7:15am, although the cause of this was not determined.

To overcome the loss of data and ensure that reliability of the observed traffic volumes, follow up traffic surveys were completed on Tuesday 12<sup>th</sup> February 2018 at the following locations:

- Nelson Bay Road / Fullerton Street (7:30am 8:30am)
- Nelson Bay Road / Vardon Road (7:00am 9:00am)

Traffic counts were also completed at the following intersections to determine the demands for turn movements into and out of the minor roads:

- Nelson Bay Road / Taylor Road (8:30am 8:45am)
- Nelson Bay Road / Rankin Road (8:30am 8:45am)

#### 3.3.2 Intersection Traffic Demands

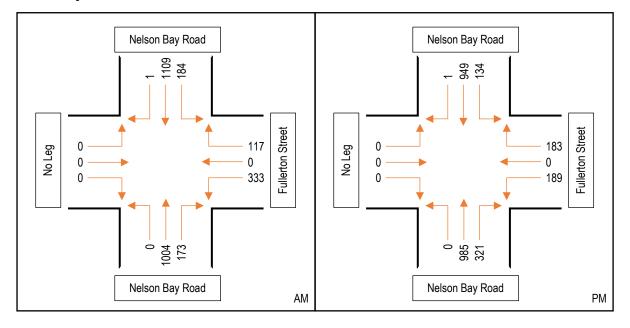
From the various surveys completed, the current peak hour traffic volumes were then determined for each intersection. Several adjustments have been applied to the raw data to correct for inconsistencies, particularly associated with the accident noted above. These are summarised below:

- Surveys completed on Wednesday 7<sup>th</sup> February showed the morning peak hour on Nelson Bay Road as 7:15am to 8:15am. Follow up surveys completed on Tuesday 12 February showed the morning peak hour on Nelson Bay Road as 7:00am to 8:00am. The later peak time for this earlier survey is influenced by the decreased demands for northbound traffic observed prior to 7:15am. The peak hour has therefore been taken as 7:00am to 8:00am, which is consistent with the typical demand profile for Nelson Bay Road.
- To reduce errors associated with the accident on Nelson Bay Road and earlier reduction in northbound traffic, the peak flows have been taken as the 45 minute peak demands from 7:15am to 8:00am, adjusted to a 1 hour equivalent. This provides a satisfactory value for the traffic demands, which compares with

the secondary surveys completed at the Nelson Bay Road / Vardon Road intersection. By adopting this approach, consistency is also maintained between the flows at the various intersections.

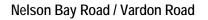
The evening peak hour on Nelson Bay Road has been taken as 3:45pm to 4:45pm (based on Fullerton Street), however flows remain mostly consistent throughout the afternoon until 5:30pm. The peak hour recorded at Vardon Road and Seaside Boulevard was noted as being 4:30pm to 5:30pm although flows at this time are comparable to the earlier peak. The highest demands for the critical right turn movements at Vardon Road occur in this earlier peak, which is therefore the more critical period.

The adjusted peak hour flows for each intersection are summarised to follow in Figure 3.4, Figure 3.5 and Figure 3.6.

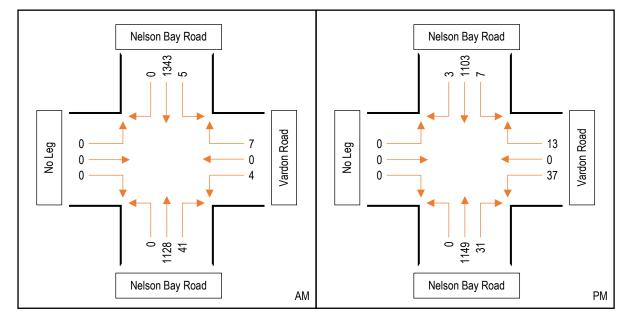


Nelson Bay Road / Fullerton Street



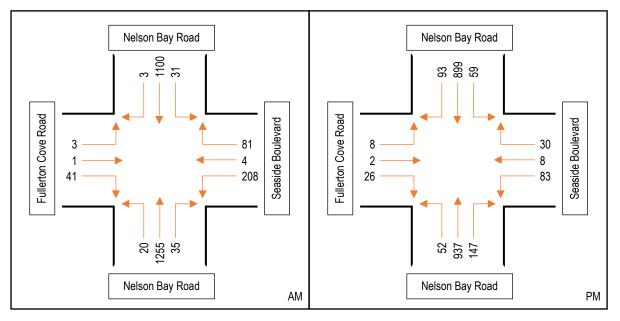


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#### Nelson Bay Road / Seaside Boulevard / Fullerton Cove Road





#### 3.3.3 Local Road Network Traffic Demands

For each of the local roads within the Fern Bay / North Stockton Study Area, the current mid-block traffic demands have been determined for both the morning and afternoon peak periods. These are summarised below in Table 3.1.

Road (location)	Peak	Two Way Flows	Eastbound / Northbound	Westbound / Southbound
Nelson Bay Road	AM	2,619	1,177	1,442
(south of Fullerton Street)	PM	2,444	1,306	1,138
Nelson Bay Road	AM	2,483	1,135	1,348
(north of Vardon Street)	PM	2,278	1,165	1,113
Nelson Bay Road	AM	2,473	1,339	1,134
(north of Seaside Boulevard)	PM	2,026	975	1,051
Fullerton Street	AM	807	357	450
(east of Nelson Bay Road)	PM	827	455	372
Vardon Road	AM	57	46	11
(east of Nelson Bay Road) <sup>1</sup>	PM	88	38	50
Seaside Boulevard	AM	356	67	289
(east of Nelson Bay Road)	PM	221	208	113
Fullerton Cove Road	AM	72	45	27
(west of Nelson Bay Road)	PM	189	36	153

Table 3.1 - Summary of local traffic demands

Notes: <sup>1</sup> Peak flows on Vardon Road are influenced by the school drop off / pick up associated with Fern Bay Public School which occur outside of the typical peak hour for the Nelson Bay Road corridor. Peak traffic demands during this time were 112 vehicles during the morning school drop off and 116 vehicles during the evening school pick up period.



#### 3.3.4 Travel Time Surveys

Travel time surveys were completed along Nelson Bay Road with various surveys undertaken throughout the morning and afternoon survey periods on Wednesday 7<sup>th</sup> February 2018. These surveys recorded the travel times over two sections, extending from the base of Stockton Bridge (approximately 200 metres south of Fullerton Street) to the roundabout intersection at Seaside Boulevard and then north to the future road connection at Dune Drive (Figure 3.7).



The results of these surveys are outlined in Table 3.2 and Table 3.3 following.

Figure 3.7 - Travel Time Survey Checkpoint Locations

Survey Time	Travel Time (Stockton Bridge to Seaside Boulevard)	Travel Time (Seaside Boulevard to Dune Drive)			
Morning Peak					
6:40am	3:23	0:39			
7:25am	3:18	0:40			
Evening Peak					
3:05pm	3:28	0:40			
4:10pm	3:23	0:42			
5:05pm	3:23	0:40			

Table 3.2 - Nelson Bay Road Travel Time Surveys (northbound)

Table 3.3 - Nelson Bay Road Travel Time Surveys (southbound)

Survey Time	Travel Time (Seaside Boulevard to Stockton Bridge)	Travel Time (Dune Drive to Seaside Boulevard)				
	Morning Peak					
6:30am	3:35	0:42				
7:30am	3:57	0:46				
8:00am	5:58 <sup>1</sup>	0:40				
Evening Peak						
3:10pm	3:26	0:41				
3:25pm	3:25	0:41				
4:05pm	3:37	0:40				

Notes: <sup>1</sup> Increased travel time due to accident on Nelson Bay Road (south of Fullerton Street). Queues at this time extended back through the roundabout intersection at Fullerton Street.

The above results show that travel times for northbound traffic on Nelson Bay Road are consistent throughout the morning and afternoon. Excluding the roundabout intersection at Seaside Boulevard / Fullerton Cove Road, where delays are typically less than 10 seconds, there are no delays for northbound traffic along Nelson Bay Road which has priority through the various intersections.

For southbound traffic, vehicles can be delayed by the various intersections including the two roundabouts at Seaside Boulevard / Fullerton Cove Road and Fullerton Street, however these delays are again typically less than 10 seconds.

Drivers are typically able to travel at their desired speed along Nelson Bay Road, however in the area to the north of Vardon Road, where Nelson Bay Road becomes a single lane of travel in each direction, there is a near constant stream of traffic with speeds determined by any slower moving vehicle as there are no opportunities to overtake. Travel speeds through this section of Nelson Bay Road are typically less than the posted speed limit of 70 km/hr during the peak hours.

#### 3.3.5 Additional Traffic Observations

In addition to the traffic counts and travel time surveys, additional observations were completed at each of the intersections to determine the typical queues lengths and delays. These were undertaken at various times throughout the peak hours (morning and afternoon) with the following observations noted:

#### Nelson Bay Road / Fullerton Street

- Queues for the right turn into and out of Fullerton Street are typically less than 1-2 vehicles. Longer queues
  of up to 5 vehicles were observed on Fullerton Street during the peak hours when groups of vehicles
  arrived at the intersection within a short period. Any queues which formed cleared quickly (typically within
  20 seconds) due to regular gaps in the southbound traffic or when southbound traffic was stopped due to
  a vehicle turning right into Fullerton Street.
- Queues for southbound traffic on Nelson Bay Road only occur when a vehicle turns right into Fullerton Street. Due to the high demands for southbound traffic in both the morning and evening, queues of around 4-7 vehicles were not uncommon. Any queues which form clear very quickly once flows resume.
- Overall, the observations on site indicate that this intersection currently operates to an acceptable standard with no significant delays or queuing.

#### Nelson Bay Road / Vardon Road

- Overall this intersection works well with the only delays observed for the right turn into Vardon Road off Nelson Bay Road and the right turn out of Vardon Road onto Nelson Bay Road
- For the right turn from Nelson Bay Road, there is a sheltered right turn lane for traffic to prop and wait for an appropriate gap in the southbound traffic movement. The maximum queue observed was 2 vehicles in this turn lane. Several vehicles were also observed completing a U-turn from this bay to obtain access to the Fern Bay Store to the south of this intersection.
- Several vehicles park up on the left-hand side of Nelson Bay Road in this location enabling the driver to cross the road to access the Fern Bay Store.
- At this location there is also a sheltered right turn lane to permit U-turns for traffic southbound on Nelson Bay Road. There was a very low demand for this movement (less than 5 per hour) and these vehicles had minimal delays.
- For the right turn out, the observations showed that the typical delays were less than one minute. A driver was observed pulling into the central lane area to complete this right turn in two separate movements with the balance of drivers completing this right turn in one movement.

#### Nelson Bay Road / Seaside Boulevard / Fullerton Cove Road

- There is a reasonable demand for turning traffic at this intersection which creates regular delays for opposing movements.
- Due to the relatively lower traffic movements out of the side roads, queues on Seaside Boulevard or Fullerton Cove Road are low, with typically only 1-2 vehicles. Regular gaps in the through traffic streams allow for vehicles to exit these side roads with minimal delay, with most vehicles having departed within 10-15 seconds.
- Delays for the through traffic on Nelson Bay Road are minimal due to the relatively low demands for traffic entering / exiting the side roads.
- Queues of around 5-10 vehicles on the Nelson Bay Road approaches were observed during the peak periods, when through traffic was delayed by turning movements into/out of the side roads. Any queues which form clear quickly once the opposing vehicle had cleared.
- Overall, the observations on site indicate that this intersection currently operates to a good standard with no significant delays or queuing.

Traffic observations were also completed at the following locations:

- Nelson Bay Road / Taylor Road
- Nelson Bay Road / Rankin Road
- Nelson Bay Road / Bayway Village Access

The intersection of Nelson Bay Road / Taylor Road operates to a very similar standard to the intersection with Vardon Road. Both intersection provide a similar layout allowing for all turn movements with a southbound U-turn facility on Nelson Bay Road.

The intersection of Nelson Bay Road / Rankin Road allows for left turn into and out of Rankin Road only. These movements experience minimal delays, with gaps in the southbound traffic permitting the left turn onto Nelson Bay Road.

Access to Bayway Village currently allows for all turning movements, with Nelson Bay Road in this location providing a single lane of travel in each direction, which reduces the opportunity for drivers to turn into or out of this site. Although a sheltered turn lane allows for a staged right turn onto Nelson Bay Road, the high traffic volumes in this location require drivers to accept smaller gaps and increases the potential for an accident. Similarly, drivers must choose smaller gaps when turning right into the site.

#### 3.4 Road Safety and Crash History

Accident data along the length of the road network through the study area has been provided by the Transport for New South Wales Centre for Road Safety, with the detailed outputs included in Appendix A. A review of this data shows there have been 33 accidents recorded in the study area over the 5 year period from July 2012 to July 2017.

A review of the detailed data shows the majority of these accidents have occurred in the proximity of intersections, with 12 at the intersection of Nelson Bay Road and Fullerton Cove Road / Seaside Boulevard. These accidents included a range of different crash types with vehicles going off road and rear ends being the most common, with 6 accidents occurring during wet conditions. A further 5 accidents occurred at the intersection of Nelson Bay Road and Fullerton Street, including 4 different crash types, the only repeating cause being vehicles off road to the left (2 recorded). Considering the high volume of traffic through these intersections and there being no clear trend of repeating causes for accidents, it is considered they operate at a good level of safety.

The remaining accidents included a mix of crash types and were distributed along Nelson Bay Road. Of particular note, there have been 2 recorded pedestrian collisions resulting in injury during the past five years. One occurred 600m north of Varden Road at 7pm with the other at 1.15pm during the daytime near the Fern Bay Store. It is also noted in the period since the finalised crash data there has been a further pedestrian injured after being struck by a vehicle whilst crossing Nelson Bay Road.

There is currently no controlled provision for pedestrians to cross Nelson Bay Road in the study area.

#### 3.5 Pedestrian and Bicycle Facilities

#### 3.5.1 Bicycle Routes

There are a number of existing bicycle routes identified in the Newcastle Cycling Strategy and Action Plan (March 2012), including on road and off road paths as part of local and regional routes. The key routes within the study area are:

**Regional Routes:** 

#### R1 Adamstown Heights to Fern Bay

This route currently forms part of the NSW Coastline Cycleway. It commences at the Lake Macquarie LGA boundary on the Fernleigh Track, travelling off road to Adamstown. From near Victoria Street, Adamstown it travels on road via mostly quiet local streets to the ferry terminal at the Newcastle foreshore. A ferry trip is required to Stockton, then the route travels off road to the boundary with Port Stephens LGA. An alternative to off road route is on road on Fullerton Street from Stockton ferry terminal to the Port Stephens LGA boundary. The route is marked in its entirety.

#### R13 R2 (Industrial Drive at Tourle Street) to Port Stephens

This route is primarily on road from the Tourle Street intersection with Industrial Drive (R2 Newcastle to Maitland) on Tourle Street, Cormorant Road, Teal Street, pedestrian footway on Stockton Bridge and Nelson Bay Road. Short off road sections are proposed to be constructed to connect the service roads on approaches to the bridge to the pedestrian stairway, and wheel ramps constructed on the stairs. The duplication of Cormorant Road to the



north-east of the Tourle Street Bridge will provide shoulder widening to cater for on-road cyclists, with these works to be completed in 2018.

Other Routes:

L20 Stockton

This is a local route which is an on road connector from the ferry terminal to Route R1 (Adamstown Heights to Fern Bay) at the northern end of Fullerton Street, on Mitchell Street, Barrie Crescent, Griffith Avenue, Eames Avenue and Meredith Street.

S2 Stockton Foreshore - Breakwall to Port Stephens

A scenic / recreational route, incorporating the Stockton Cycleway.

#### 3.5.2 Footpaths and Shared Paths

The existing footpaths and shared paths through the study area are marked on Figure 3.8 to follow, including the shared path through to Stockton. The Seaside Estate and Stockton residential areas have a well-established network of footpaths.

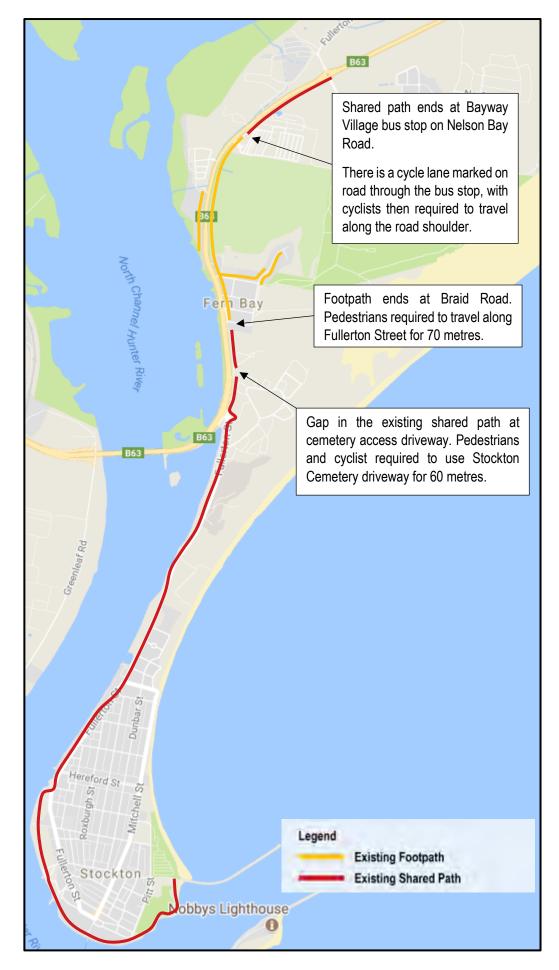


Figure 3.8 - Existing footpaths and shared paths along Nelson Bay Road and Fern Bay residential, including Stockton cycleway

#### 3.6 Public Transport

#### 3.6.1 Bus Services

Hunter Valley Buses provide two services through the Fern Bay and Stockton area, being routes 136 and 138 as shown in Figure 3.9.

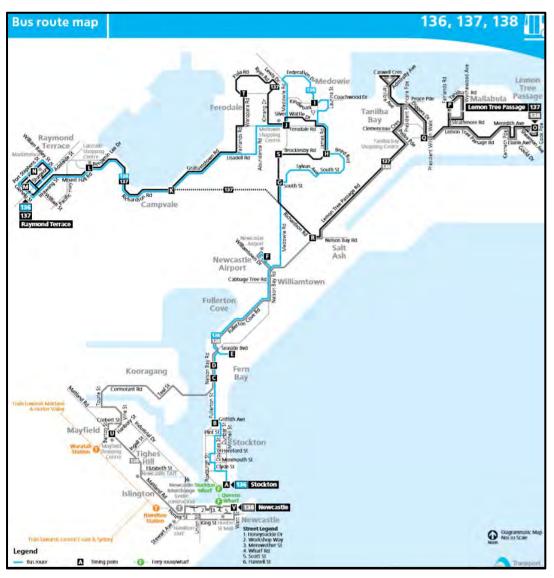


Figure 3.9 - Bus routes through the Fern Bay / Stockton area provided by Hunter Valley Buses

Route 136: Raymond Terrace to Stockton, via Medowie, Newcastle Airport and Fern Bay.

Service operates daily with regular services:

- Monday to Friday: between 6am 9pm with hourly services on average in each direction. Additional services between Seaside Village and Stockton Wharf throughout the day.
- Saturday: hourly services on Average between 8am 7pm
- Sunday and Public Holidays: 4 services in each direction throughout the day

Route 138: Newcastle to Lemon Tree Passage, via Fern Bay, Newcastle Airport and Salt Ash.

Service operates Monday to Friday with limited services, including:

- Two morning services from Lemon Tree Passage to Newcastle
- Two afternoon services from Newcastle to Lemon Tree Passage
- Two shortened services in each direction during the day between Bay Way Village and Mayfield shops



Port Stephens Coaches provides two services along Nelson Bay Road passing Fern Bay, being routes 130 and 131 as shown in Figure 3.10.

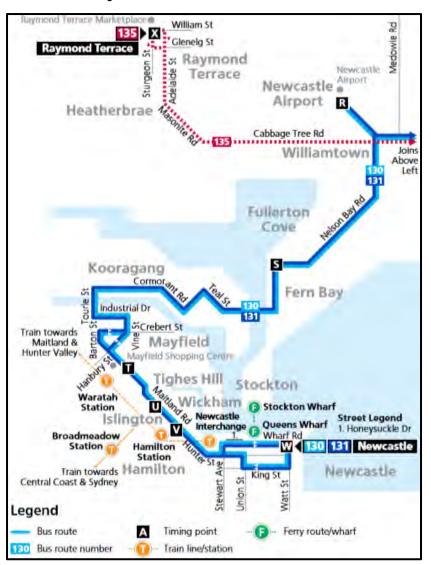


Figure 3.10 - Bus routes through the Fern Bay area provided by Port Stephens Coaches

Route 130: Newcastle to Newcastle Airport / Newcastle to Port Stephens, via Anna Bay.

- Monday to Friday: Regular services between Newcastle and Newcastle Airport passing Fern Bay, with extended routes through to Port Stephens. Operates every hour on average between 4:30am – 11pm
- Saturday, Sunday and Public Holidays: Less frequent services every 1-2 hours throughout the day

Route 131: Newcastle to Newcastle Airport / Newcastle to Port Stephens, via Taylors Beach.

Service operates Monday to Friday with limited services, including:

- Three daily services from Newcastle to Port Stephens
- One full service per day from Port Stephens to Newcastle





Newcastle Transport (Keolis Downer) operates a ferry service between Newcastle and Stockton, as well as a bus route (118). These services are shown in Figure 3.11.

Figure 3.11 - Bus and ferry services provided by Newcastle transport

Bus route 118 operates on Friday and Saturday nights only from Newcastle to Stockton, leaving at 2:46am.

Ferry services operate as below:

- Monday to Friday: Services every 30 minutes on average from 5:10 00:05, with extended breaks from 9:15 – 10:10 and 18:30 – 19:25
- Saturday: As per Monday Friday, from 5:15 00.05
- Sunday / Public Holidays: Runs every 30 minutes on average from 8:30 22:00



#### **School Services**

There are a number of school bus services that pick up / set down in the study area. Services provided by Hunter Valley Buses are shown in Table 3.5.

Table 3.5 - School Services in the study area provided by Hunter Valley Buses
---

	АМ
138*	Along Nelson Bay Road, pick up at Fern Bay Shop
1341	Along Nelson Bay Road, Fern Bay pick up
1372	Enters Seaside Estate, Bay Way Village and Fern Bay local roads through to Stockton Primary School
1391	Along Nelson Bay Road, pick up on Fern Bay near Taylor Road
1421	Seaside Estate pick up, transfer at Bayway Village or continue to Stockton Wharf
1431	Stockton area pick up
1461	Seaside Village pick up, terminates at Bayway Village (transfer to other services)
1651	Along Nelson Bay Road, pick up at Bayway Village
1671	Along Nelson Bay Road, Fern Bay pick up
	PM
1001	Along Fullerton Street through to Stockton Wharf
1402	Stockton area loop, passes Fern Bay, through to Seaside Estate and continues north through Fullerton Cove
1245	Nelson Bay Road through to Seaside Estate, continues north through Fullerton Cove
1251	Fern Bay Shops, to Seaside Estate, north to Fullerton Cove
1672	Fern Bay local roads drop off, continues along Nelson Bay Road to the north
2204	Fern Bay local roads, to Seaside Estate, continues north to Fullerton Cove
2555	Fern Bay Primary School pick up, enters Bayway Village, Seaside Estate, continues north
ublic bus	servicing school students

Further school services are provided by Port Stephens Coaches shown below in Table 3.6, all of which pick up and set down at Fern Bay.

AM	PM
S551	S561
S552	S562
S553	S563
S554	S564
	S565
	S566

#### 3.6.2 Bus Stops and Associated Facilities

Table 3.7 below describes the various bus stops within the study area. The location of these stops is also indicated on Figure 3.12 following.

Location	Map Ref	Description	Seating	Shelter
Fullerton Cove Road	1	There are bus stops on both sides of Fullerton Cove Road, with bus zones 110 metres to the west of the roundabout intersection with Nelson Bay Road.	NO	NO
Seaside Boulevard	2	There is one bus stop provided internal to the Seaside Estate Development, with a bus zone located prior to the roundabout intersection of Seaside Boulevard and Ironbark Drive. This stop caters for both northbound and southbound travel with buses undertaking a U-turn at the roundabout.	NO	NO
	3	There are bus stops on Nelson Bay Road approximately 750 metres to the north of the roundabout intersection with Seaside Boulevard.	NO	NO
	4	There is a bus stop for southbound travel, to the north of the roundabout intersection of Nelson Bay Road and Seaside Boulevard. There is also a bus stop for northbound travel to the south of this intersection. Both of these stops include a bus zone clear of the through lanes.	NO	NO
Nelson Bay	5	There are bus stops located on both sides of Nelson Bay Road to the north of the Bayway Village access for northbound and southbound travel. There is a further bus stop provided internal to Bayway Village for northbound travel, with drivers entering Bayway Village on request for bus route 136.	YES	YES
Road	6	There is a bus stop located in the bus only lane to the immediate north of the Palm Lakes Resort access, for northbound travel.	NO	NO
	7	There is a bus stop located 330 metres to the south of the access to Pacific Palms Resort for southbound travel.	YES	YES
	8	There is a bus stop located within the road shoulder of Nelson Bay Road (parking lane) 50 metres to the north of Vardon Road, for southbound travel.	NO	NO
	9	There are bus stops located on both sides of Nelson Bay Road near Taylor Road, for northbound and southbound travel.	YES	YES
	10	There is a bus stop prior to the Stockton Cemetery access for southbound travel.	NO	NO
	11	There is a bus stop prior to the roundabout intersection of Nelson Bay Road and Fullerton Street for northbound travel.	NO	NO
North Stockton	12	There is a bus stop on Fullerton Street to the south of the Stockton Centre access, for southbound travel.	YES	YES
	13	There is a bus stop on Fullerton Street to the north of the Fort Wallace access, for southbound travel.	NO	NO

Table 3.7 - Bus stops and facilities within the study area



Figure 3.12 - Location of existing bus stops



#### Stockton

There are a number of bus stops throughout the Stockton area, serviced by Hunter Valley Buses route 136 which travels along the local roads in the area including; Fullerton Street, Griffiths Avenue, Dunbar Street, Flint Street, Douglas Street, Hereford Street, Roxburgh Street, Monmouth Street, Lamond Street, Clyde Street, Roxburgh Street, Monmouth Street to Ferry Wharf. The stop located at Stockton Wharf provides a dedicated bus zone with seating and shelter as shown in Photo 4, for the key connection to the ferry terminal.



Photo 4 - Bus stop at Stockton Wharf

#### 3.7 Parking

A parking beat survey of the Council car park adjacent to Stockton Wharf was conducted as part of the project work. There is a total of 121 marked parking spaces in this area, of which 4 are designated as accessible parking. This survey was undertaken on Wednesday 7<sup>th</sup> February 2018 with the result outlined below in Table 3.8.

Time	Car Park <sup>1</sup>
7:05am	33
8:20am	118 (+3)
2:10pm	116 (+5)
4:45pm	80 (+1)
5:25pm	46

Table 3.8 - Parking demand at Stockton Ferry terminal car park and surrounds

Notes: <sup>1</sup> Numbers in brackets denote vehicles informally parked (not in marked bays)

In addition to parking within the existing Council car park, there was also a strong demand for parking along the surrounding roads including Hunter Street, Mitchell Street and Wharf Crescent, as well as for informal parking on the grass area to the north of the carpark. As the carpark fills up during the morning, the demands spill over into the surrounding area with more than 100 vehicles observed to park in the area surrounding Stockton Ferry throughout the day.

## 4. Trip Generation & Distribution

#### 4.1 Future Design Year Assessment

As outlined in the project brief, analysis has been completed for three future design scenarios including the 2018 existing situation, 2021, 2026 and 2036 future design years. Forecasts of the future traffic volumes at these design horizons has been calculated by applying the trips generated by the various development opportunities identified by Council, which have been calculated using standard RMS rates with consideration to the nature of each development and its expected staging.

A summary of the existing, approved and future development within the study area and their expected timing has been provided by Council and are summarised below in Table 4.1.

Location	Existing Dwellings	Approved Dwellings	Proposed Dwellings
Seaside Estate	Approx. 550	850 (including existing)	-
The Cove Village	219	-	-
Palm Lakes Resort	279	-	-
Bayway Village	531	-	-
Original Fern Bay	202	-	42 (infill development)
Fort Wallace	0	-	100
Rifle Range	0	-	300
Preferred site for mixed use centre	0	-	750
Golf Course	0	-	80
Caravan Park	0	-	145
Total	Approx. 1,781	850	1,417

Table 4.1 - Existing, approved and proposed dwelling numbers.

The above indicates that there are currently 2,081 existing or approved dwellings within the Fern Bay and North Stockton study area (including 300 dwellings left to be constructed within the final stages of Seaside Estate). Council has indicated future development opportunities which could see an additional 1,417 dwellings within the study area by 2036, representing an increase of 68% over the current housing supply.

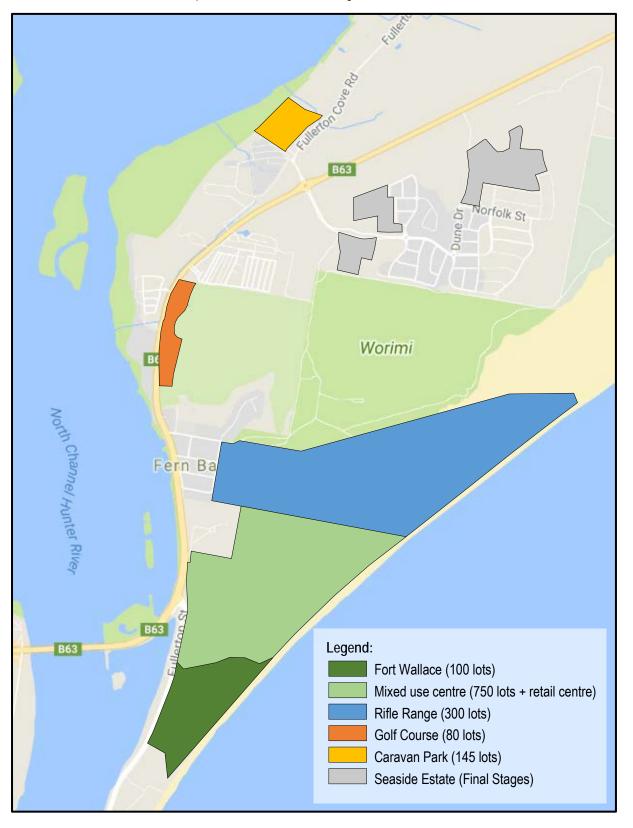
In addition to this, Port Stephens Council together with Newcastle City Council have identified the preferred site location for a new 5,000 m<sup>2</sup> retail centre and shopping precinct at the southern end of the study area in North Stockton. This development is referred to as the "Preferred site for mixed use centre" in this document, with this reference also incorporating the residential development adjacent to this, associated with land currently occupied by the Stockton Centre. Estimated timings for the release of future dwellings have been provided by Council and are summarised below in Table 4.2 for each design horizon.

Table 4.2- Staging of future residential developmer	ıt.
---	-----

Development	Sub-Catchment	Number of Dwellings			
		2021	2026	2036	Total
Fort Wallace	North Stockton	100	-	-	100
Rifle Range	Fern bay	-	120	180	300
Preferred site for mixed use centre	North Stockton	-	-	750	750
Golf Course	Fern Bay	-	-	80	80
Caravan Park	Fullerton Cove	-	100	45	145
Fern Bay Infill	Fern Bay	42	-	-	42
Total		142	220	1,055	1,417



Staging for the proposed retail centre and shopping precinct as part of the preferred site for the mixed use centre, is assumed to align with the estimated release of future residential dwellings as part of this development by 2036.



The location of these future developments is shown below in Figure 4.2.

Figure 4.2 - Location of approved and future development.

Under local government regulations, approved developments cannot be levied for additional funds as part of subsequent development contributions plans. It is therefore assumed that development contributions associated with the final stages of Seaside Estate would have been accounted for within the current Port Stephens Development Contributions Plan 2007.

Accordingly, it is the impact of these future developments (1,417 dwellings and 5,000 m<sup>2</sup> shopping centre) that provide the basis for assessing the required road and intersection upgrades within the Nelson Bay Road corridor. To determine these impacts, a baseline assessment has been prepared which allows for the 2018 existing traffic volumes together with the approved final stages of Seaside Estate that have yet to be constructed.

It is also important to distinguish between the impacts of future development within the study area and the impacts of background growth along Nelson Bay Road associated with ongoing development external to the study area. To account for this, the future design years have been assessed for the following scenarios:

- Background Growth Only allowing background growth only along Nelson Bay Road with no development.
- Background Growth and Development allowing for future development associated with the study along with background growth on Nelson Bay Road.

The difference between the baseline assessment and 'background growth and development' will provide the basis for identifying the necessary road and intersection upgrades to support the future traffic demands. Comparisons of the results both with and without background growth will assist in determining the proportion of costs associated with the required upgrades to be funded under future development contributions.

Background growth along Nelson Bay Road has been taken as 2% per annum based on advice provided by Roads and Maritime Services (RMS).

#### 4.2 Trip Generation

Traffic generated by the various residential developments have been calculated as per the RMS Guide to Traffic Generating Developments. This guide specifies the following traffic generation rates for low density residential dwellings located in regional New South Wales:

- Weekday Morning Peak Hour Vehicle Trips 0.71 per dwelling
- Weekday Evening Peak Hour Vehicle Trips 0.78 per dwelling

The above rates for residential do not include contained trips within a subdivision, which may be an additional 25%. These are typically trips associated with school runs and visits to local shops etc.

For the proposed 5,000 m<sup>2</sup> retail centre at the preferred site for the mixed use centre, the RTA Guide provides the following traffic generation rates, based upon the rates for shopping centres:

• Weekday Evening Peak Hour Vehicle Trips - 12.5 per 100 m<sup>2</sup> gross leasable floor area.

No traffic generation rates are provided for the morning peak hour, reflective of the much lower demands during this time, with most retail stores opening towards the end of the morning commuter peak. To ensure a robust assessment, a rate of 20% of the evening peak traffic generation has been applied for the assessment of the morning peak, equating to 2.5 trips per 100 m<sup>2</sup> gross leasable floor area.

Applying these rates, the additional trips generated by each future development are summarised in Table 4.3, Table 4.4 and Table 4.5 to follow. The demands for contained trips associated with future dwellings would be offset by the demands created by the proposed retail centre and therefore have not been included to avoid double counting.

#### Table 4.3 - Trip generation of future residential development (AM).

Dovelonment	2021		2026		20	2036	
Development	Dwellings	Trips	Dwellings	Trips	Dwellings	Trips	
Fort Wallace	100	71	-	-	-	-	
Rifle Range	-	-	120	86	180	127	
Preferred site for mixed							
use centre	-	-	-	-	750	533	
(residential component)							
Golf Course	-	-	-	-	80	57	
Caravan Park	-	-	100	71	45	32	
Fern Bay Infill	42	30	-	-	-	-	
Total	142	101	220	157	1,055	749	
Cumulative Total	142	101	262	258	1,417	1,007	

Table 4.4 - Trip generation of future residential development (PM).

Dovelopment	202	21	2026		2036	
Development	Dwellings	Trips	Dwellings	Trips	Dwellings	Trips
Fort Wallace	100	78	-	-	-	-
Rifle Range	-	-	120	94	180	140
Preferred site for mixed use centre (residential component)	-	-	-	-	750	585
Golf Course	-	-	-	-	80	63
Caravan Park	-	-	100	78	45	36
Fern Bay Infill	42	33	-	-	-	-
Total	142	111	220	172	1,055	824
Cumulative Total	142	111	262	283	1,417	1,107

#### Table 4.5 - Trip generation of future retail centre at preferred site for the mixed use centre (AM/PM).

Development	GLFA	Peak	2021	2026	2036
Preferred site for mixed		AM	-	-	125
use centre (retail component)	5,000 m <sup>2</sup>	PM	-	-	625

It should be noted that future development at the 'Golf Course' and 'Caravan Park' sites have been earmarked for over 55's housing and a manufactured homes site respectively. The developments typically appeal to retirees and attract a lower trip rate compared to low density residential. Allowing for the increased rates associated with low density residential however, ensures a robust assessment of the traffic impacts associated with these developments, and further offsets any additional demands associated with trips external to the various subdivisions.

# 4.3 Traffic Distribution

The trip distribution for each future development will be dependent upon its location with respect to Nelson Bay Road. It is anticipated that most of the demands will have an origin/destination towards Newcastle, with demands north towards Newcastle Airport and Williamtown RAAF Base, or west towards industrial lands at Tomago. Local shops and the Stockton Ferry Terminal also provide a nexus for trips to the Stockton Town Centre, which are expected to remain consistent into the future.

Surveys completed at the intersections of Nelson Bay Road / Fullerton Street and Nelson Bay Road / Seaside Boulevard / Fullerton Cove Road suggest the following distribution of traffic for existing residential development:

- 55% south towards Newcastle;
- 30% north towards Williamtown and Nelson Bay;
- 15% south towards Stockton.

The distribution of traffic associated with the future residential development is expected to remain consistent with the existing traffic patterns, and therefore the above allocation of trips is appropriate. To ensure consistency, this distribution has been applied to all future residential development, irrespective of their potential demographic.

During the morning peak, around 80% of trips associated with the residential lands are expected to be outbound, with the reverse expected during the evening peak.

Trips associated with the proposed retail/commercial centre have been assumed to be equally distributed between the existing residential area at Stockton and the residential areas (existing and proposed) throughout Fern Bay. No discounts have been provided for passing trade.

Due to the high turnover of demands associated with a shopping centre, traffic flows associated with this use are expected to be reasonably balanced inbound and outbound throughout the day, with a slight bias in inbound traffic prior to opening and the reverse when shops close during the late afternoon.

The allocation of these trips within the road network is assumed to reflect the distribution of dwellings in each location. Accordingly, trips have been distributed within the road network according to the number of dwellings accessed from each road.

### 4.4 Access Arrangements

Access to future residential developments is not currently known for all future development and may be subject to change depending upon the detailed design. The following assumptions outlined in Table 4.6 have been applied when allocating trips associated with these developments to the local road network.

Development	Access Arrangements
Fort Wallace	Access to Fullerton Street.
Rifle Range	Access to Popplewell Road. Vehicles travelling north use Vardon Road to connect Nelson Bay Road, vehicles travelling south use Taylor Road (consistent with Traffic Impact Assessment lodged to Port Stephens Council).
Preferred site for mixed use centre	Council have indicated a preference for access via a fourth leg at the roundabout intersection of Nelson Bay Road / Fullerton Street with secondary access off Fullerton Street. Modelling for this scenario has been undertaken to assess the feasibility of providing access via this roundabout, with access also assessed off Fullerton Street only.
Golf Course	Access to Nelson Bay Road.
Caravan Park	Access to Fullerton Cove Road.
Fern Bay Infill	Access via Vardon Road.

Table 4.6 - Access of future development sites to external i	road network
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# 5. Assessment Criteria

# 5.1 Road Capacity Assessment Criteria

Capacity assessments are fundamental to planning, design and operation of roads as they provide quantitative techniques for assessing the traffic carrying capacity and efficiency of a road. These standards are based on maximum sustainable hourly traffic volumes which can be reasonably expected to traverse a section of road under the prevailing traffic conditions.

The Austroads Guide to Traffic Management Part 3: Traffic Studies and Analysis recommends Level of Service (LoS) is an appropriate technique for assessing the capacity and operating conditions for all types of road facilities. Level of Service is a qualitative measure describing the operational conditions within a traffic stream such the general efficiency and comfort, travel speeds and ability of a driver to select their desired speed and manoeuvre within the traffic stream. There are six different level of service classifications defined by the Austroads Guide which are summarised below:

### Level of Service A

This, the top level is a condition of free flow in which individual drivers are virtually unaffected by the presence of others in the traffic stream. Freedom to select desired speeds and to manoeuvre within the traffic stream is extremely high, and the general level of comfort and convenience provided is excellent.

### Level of Service B

This level is in the zone of stable flow and drivers still have reasonable freedom to select their desired speed and to manoeuvre within the traffic stream, although the general level of comfort and convenience is little less than that of the level of Service A.

### Level of Service C

This service level is also in the zone of stable flow, but most drivers are restricted to some extent in their freedom to select their desired speed and to manoeuvre within the traffic stream. The general level of comfort and convenience declines noticeably at this level.

### Level of Service D

This level is close to the limit of stable flow but is approaching unstable flow. All drivers are severely restricted in their freedom to select their desired speed and to manoeuvre within the traffic stream. The general level of comfort and convenience is poor, and small increases in traffic flow will generally cause operational problems.

### Level of Service E

This occurs when traffic volumes are at or close to capacity and there is virtually no freedom to select desired speeds or to manoeuvre within the traffic stream. Flow is unstable and minor disturbances within the traffic stream will cause a traffic-jam.

### Level of Service F

This service level is in the zone of forced flow. With it, the amount of traffic approaching the point under consideration exceeds that which can pass it. Flow break-down occurs and queuing and delays result.

### 5.1.1 Urban Roads

For an urban road, level of service is the appropriate performance standard for assessing its capacity. The peak mid-block traffic flows (per direction) corresponds to each level of service classification are summarised below in Table 5.1.

Level of Service	One Lane (veh/hr)	Two Lanes (veh/hr)
A	200	900
В	380	1,400
С	600	1,800
D	900	2,200
E	1,400	2,800

Table 5.1- Level of Service for Various Mid-Block Flows (Source: RMS Guide to Traffic Generating Developments, Table 4.4)

### 5.1.2 Residential Streets

The RMS Guide to Traffic Generating Developments describes the need to reduce traffic volumes on residential streets such as Vardon Road, where pedestrian safety and amenity is of primary concern. It provides advice for assessing the capacity of a residential street, based on "Environmental Capacity" performance standards which are summarised below in Table 5.2.

Table 5.2 - Environmental Standards for Residential Street (Source: RMS Guide to Traffic Generating Developments, Table 4.6)

Road Class	Road Type	Maximum Speed (km/hr)	Maximum Peak Hour Volume (veh/hr)
	Access Way	25	100
Local	Local Street		200 environmental goal
	Street	40	300 maximum
Collector	Street	50	300 environmental goal
Collector	Sueel	50	500 maximum

### 5.1.3 Application of Performance Standards

Nelson Bay Road, forms part of a major arterial route connecting Newcastle to Williamtown and Nelson Bay, and Fullerton Street operates as a major collector road providing the only road access through to Stockton. Therefore, the capacity of these roads has been determined applying the level of service criteria above. Level of Service has also been used to assess the capacity of Seaside Boulevard and Fullerton Cove Road, each of which provides a collector road function to residential development on either side of Nelson Bay Road.

The Austroads Guide to Traffic Management Part 3: Traffic Studies and Analysis indicated a typical mid-block capacity of 900 vph per lane for urban roads with interrupted flow conditions. This may increase to 1,200-1,400 vph per lane when the following conditions exist or can be implemented:

- Adequate flaring at 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 intersection
- High volume flows of traffic from upstream intersections occurs during more than one phase of a signal cycle
- Good co-ordination of traffic signals along the route

There are many examples within the Hunter and Newcastle areas where lane flows of up to 1,400 vph are regularly observed. Throughout this assessment however, the capacity of an urban road has been taken as the upper limit of Level of Service (LoS) D, or 900 vph per direction for a single travel lane and 2,200 vph per direction where there are two travel lanes in each direction. This has been agreed with the study team.

For Vardon Road, which operates as a local collector street providing access to several residences as well as Fern Bay Public School, the environmental capacity based on the above standards would be 500 vehicles per hour during the peak periods.

# 5.2 Intersection Capacity Standards

The capacity of an urban road is typically limited by the overall performance of the various intersections. The RMS Guide to Traffic Generating Developments specifies delays and queuing as the key performance measures for assessing the effectiveness of both signalised and unsignalised intersections. Degree of saturation is also recommended for assessing the performance of roundabouts and traffic signals.

A summary of the key criteria for assessing the operation of signalised and unsignalised intersections is provided below.

### 5.2.1 Average Delays

The level of service criteria for each intersection type is outlined in Table 5.3 below.

Level of Service	Average Delay per Vehicle (secs)	Traffic Signals, Roundabouts	Give Way & Stop Signs
A	d ≤ 14.5	Good operation.	Good operation.
В	14.5 ≤ d ≤ 28.5	Good with acceptable delays and spare capacity.	Acceptable delays and spare capacity.
С	$28.5 \le d \le 42.5$	Satisfactory.	Satisfactory, accident study required.
D	$42.5 \le d \le 56.5$	Operating near capacity.	Near capacity, accident study required.
E	56.5 ≤ d ≤ 70.5	At capacity; at signals, incidents will cause excessive delays. Roundabout requires other control mode.	At capacity, requires other control mode.
F	70.5 < d	Failure.	Failure.

Table 5.3 - Level of Service (LoS) criteria for intersections

### 5.2.2 Degree of Saturation

Degree of Saturation (DoS) is another measure for assessing the performance of an intersection. It is usually calculated based on as the highest ratio of traffic volumes on an approach to its theoretical capacity and is a measure of the utilisation of available green time at traffic signals.

For intersections controlled by traffic signals, both queues and delays increase rapidly as the DoS approaches 1.0, with overflow queuing starting to become a problem at around 0.8-0.85. A satisfactory level of operation is generally achieved when DoS is kept below 0.75.

# 6. Baseline Assessment

To assess the operation of the existing road network conditions, a baseline assessment has been prepared allowing for the existing 2018 traffic volumes together with demands associated with the approved final stages of the Seaside Estate. It assumes that construction of Dune Drive has been finalised, creating a new access onto Nelson Bay Road from Seaside Estate.

Predicted baseline traffic volumes are summarised in Figures 6.1-6.4 to follow.

### Nelson Bay Road / Fullerton Street

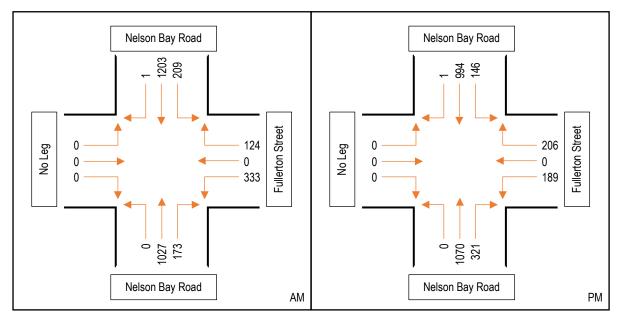
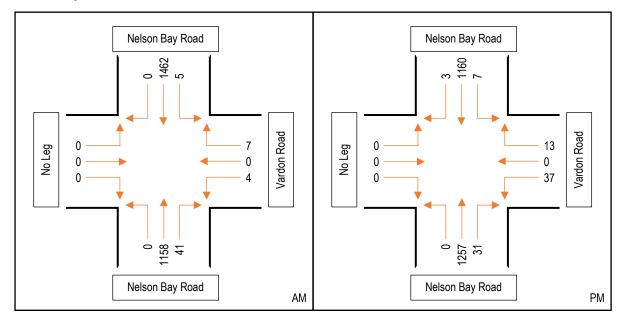


Figure 6.1 - Baseline 2018 traffic volumes at the intersection of Nelson Bay Road / Fullerton Street (AM/PM)



### Nelson Bay Road / Vardon Road

Figure 6.2 - Baseline 2018 traffic volumes at the intersection of Nelson Bay Road / Vardon Road (AM/PM)

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## Nelson Bay Road / Seaside Boulevard / Fullerton Cove Road

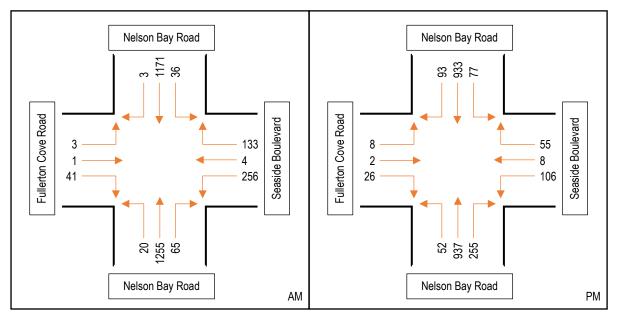


Figure 6.3 - Baseline 2018 traffic volumes at the intersection of Nelson Bay Road / Seaside Boulevard / Fullerton Cove Road (AM/PM)

# Nelson Bay Road / Dune Drive

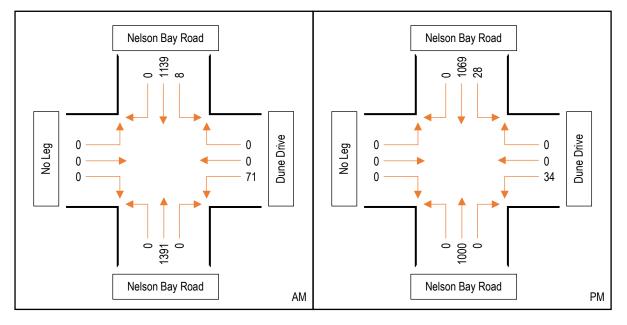


Figure 6.4 - Baseline 2018 traffic volumes at the intersection of Nelson Bay Road / Seaside Boulevard / Fullerton Cove Road (AM/PM)

# 6.1 Road Capacity

Mid-block capacity analysis has been completed for Nelson Bay Road and the various local connections, to assess their operation under the baseline traffic conditions. For Nelson Bay Road, several locations have been considered to account for changes in the overall road geometry. For each of these roads, the theoretical capacity has been taken as the upper threshold for LoS D, consistent with recommendations by the study team and the results are shown below in Table 6.5 and Table 6.6.

Road (location)	Peak	Maximum Traffic Volumes (vph/direction)	Level of Service	Capacity (vph/direction)	Volume / Capacity
Nelson Bay Road	AM	1,536	С	2,200	0.70
(south of Fullerton Street) Two Lanes	PM	1,391	В	2,200	0.63
Nelson Bay Road	AM	1,467	F	900	1.63
(north of Vardon Street) Single Lane	PM	1,270	E	900	1.41
Nelson Bay Road (north of Seaside Boulevard) Single Lane	AM	1,391	E	900	1.55
	PM	1,103	E	900	1.23
Fullerton Street	AM	457	С	900	0.51
(east of Nelson Bay Road) Single Lane	PM	467	С	900	0.52
Seaside Boulevard	AM	393	С	900	0.44
(east of Nelson Bay Road) Single Lane	PM	334	В	900	0.37
Fullerton Cove Road	AM	45	А	900	0.05
(west of Nelson Bay Road) Single Lane	PM	153	А	900	0.17

#### Table 6.4 - Level of Service and Degree of Saturation (V/C) of Roads - 2018 Baseline Assessment

Table 6.5 - Baseline Level of Service and Volume/Capacity Ratios for Vardon Road

Road (location)	Peak	Maximum Traffic Volumes (vph, two way)	Level of Service	Capacity (vph, two way)	Volume / Capacity
Vardon Road	AM	112	-	500	0.22
(east of Nelson Bay Road) Residential Street	PM	116	-	500	0.23

Note - Peak flows on Vardon Road occur outside of the typical commuter peaks, due to the demands associated with Fern Bay Public School at the beginning and end of the school day. To ensure a robust assessment of the impacts to Vardon Road associated with future development, the forecast trip generation for future developments have been assumed to be consistent in both the school and commuter peak periods.

The sections of Nelson Bay Road which provide for two lanes of travel in each direction, currently operate at less than 70% of the theoretical capacity during the morning and afternoon peaks. However, to the north of Vardon Road (and further north of Seaside Boulevard), where Nelson Bay Road provides only a single lane of travel in each direction, the volume to capacity ratio exceeds 1.0 indicating that the road is operating above capacity, with level of service decreasing to LoS F during the morning peak (associated with high demands for southbound traffic towards Newcastle).

Traffic volumes on Nelson Bay Road are expected to exceed 1,400 vph during the morning peak, which is higher than the upper capacity threshold indicated by the RMS Guide. At this point, delays and queuing is expected to occur at the point where the road merges into a single lane, which will be highly susceptible to minor disruptions in the downstream traffic streams.

## 6.2 Intersection Capacity

Intersection modelling has been completed for each of the key intersection identified within the study area. This has been completed using, *Sidra Intersection 7* lane based modelling software package. The results of this assessment are provided below in Table 6.7-6.10 to follow, for the morning and evening commuter peak periods.

### Nelson Bay Road / Fullerton Street

Approach	Movement	Level of Service (LoS)	Average Delay (seconds)	95% Back of Queue (metres)
Nelson Bay Road (northbound)	Right Turn	A/A	11.0 / 11.5	6.1 / 12.9
Fullerton Street	Right Turn	A / A	12.2 / 11.7	5.1 / 7.9
Nelson Bay Road (southbound)	Approach	A / A	6.7 / 7.5	33.0 / 28.4

Table 6.6 - Sidra Results - Intersection of Nelson Bay Road / Fullerton Street - 2018 Baseline (AM/PM)

# Nelson Bay Road / Vardon Road

Table 6.7 - Sidra Results - Intersection of Nelson Bay Road / Vardon Road - 2018 Baseline (AM/PM)

Approach	Movement	Level of Service (LoS)	Average Delay (seconds)	95% Back of Queue (metres)
Nelson Bay Road (northbound)	Right Turn	C / B	32.9 / 18.0	6.3 / 2.5
Vardon Road	Right Turn	F/F	1007.1 / 1678.9	25.2 / 68.7
Nelson Bay Road (southbound)	U-turn	C/C	33.9 / 42.1	0.2/0.7
	Approach	A / A	0.2 / 0.3	0.2 / 0.7

## Nelson Bay Road / Seaside Boulevard / Fullerton Cove Road

Table 6.8 - Sidra Results - Intersection of Nelson Bay Road / Seaside Boulevard - 2018 Baseline (AM/PM)

Approach	Movement	Level of Service (LoS)	Average Delay (seconds)	95% Back of Queue (metres)
Nelson Bay Road (northbound)	Approach	A/A	5.4 / 6.5	38.3 / 29.7
Seaside Boulevard	Approach	A/A	9.6 / 8.6	12.6 / 5.1
Nelson Bay Road (southbound)	Approach	A/A	5.0 / 6.4	33.3 / 33.6
Fullerton Cove Road	Approach	A/A	14.2 / 10.9	3.8 / 1.7

## Nelson Bay Road / Dune Drive

Table 6.9 - Sidra Results - Intersection of Nelson Bay Road / Dune Drive - 2018 Baseline (AM/PM)

Approach	Movement	Level of Service (LoS)	Average Delay (seconds)	95% Back of Queue (metres)
Nelson Bay Road (northbound)	Approach	A/A	0.6 / 0.2	0.0 / 0.0
Dune Drive	Approach	B / B	20.5 / 14.8	6.9 / 2.4

Nelson Bay Road (southbound)	Approach	A / A	0.2 / 0.3	0.0 / 0.0
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### 6.3 Deficiency Analysis

The above results show that each intersection (excluding Vardon Road) currently operates well within their capacity, with only minor delays and LoS A or B on each approach.

Results for the intersection of Nelson Bay Road / Vardon Road show that the intersection currently experiences significant delays for vehicles turning right out of Vardon Road onto Nelson Bay Road. The strong southbound demands on Nelson Bay Road provide a near continuous stream of traffic with drivers being required to accept smaller gaps when completing this movement. Observations on site indicate that some drivers complete this as a staged movement, holding within the central median and U-turn lane before merging into the northbound traffic stream.

This reduces the overall safety and increases the risk of crashes at this intersection, warranting restrictions to the right turn onto Nelson Bay Road. Traffic demands on Nelson Bay Road are similar at both Vardon Road and Taylor Road, highlighting that right turn restrictions also required at the Taylor Road intersection.

The road capacity assessment also indicates the need for the duplication of Nelson Bay Road in both directions between Seaside Boulevard and Vardon Road, as well as to the north of Fullerton Cove Road (Seaside Boulevard). Nelson Bay Road currently provides for a single lane of travel in each direction through these sections of road, with current traffic volumes being well in excess of the capacity (900 vph per direction).

# 7. 2021 Road Capacity and Intersection Analysis

# 7.1 Road Capacity

Forecasts of the traffic demands at the 2021 design horizon have been determined as the summation of the demands generated by future development (Table 4.3-4.5) together with their expected trip distribution and applying these to the 2018 baseline traffic flows in Figures 6.1-6.4. Background growth of 2% per annum has also been added to the traffic volumes on Nelson Bay Road, consistent with advice from the RMS.

Traffic volumes at each intersection for the 2021 design year are summarised in Appendix B.

It has been assumed that there are no changes to the existing road geometry along Nelson Bay Road although restrictions have been placed on the right turns out of both Vardon Road and Taylor Road. Allowing for this, an assessment of the road capacity along Nelson Bay Road has been completed with a summary of the results provided below in Table 7.1 and 7.2.

Road (location)	Peak	Maximum Traffic Volumes (vph/direction)	Level of Service	Capacity (vph/direction)	Volume / Capacity
Nelson Bay Road	AM	1,656	С	2,200	0.75
(south of Fullerton Street) Two Lanes	PM	1,503	В	2,200	0.68
Nelson Bay Road	AM	1,561	F	900	1.73
(north of Vardon Street) Single Lane	PM	1,352	Е	900	1.50
Nelson Bay Road	AM	1,490	F	900	1.65
(north of Seaside Boulevard) Single Lane	PM	1,186	Е	900	1.32
Fullerton Street	AM	506	С	900	0.56
(east of Nelson Bay Road) Single Lane	PM	521	С	900	0.58
Seaside Boulevard	AM	393	С	900	0.44
(east of Nelson Bay Road) Single Lane	PM	334	В	900	0.37
Fullerton Cove Road	AM	45	А	900	0.05
(west of Nelson Bay Road) Single Lane	PM	153	А	900	0.17

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Table 7.1 - Level of Service a	nd Dogroo of Saturation	(V/C) of Poads 202	1 docian voar
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Table 7.2 - Environmental Capacity and Degree of Saturation (V/C) of Vardon Road (School Peak) - 2021

Road (location)	Peak	Maximum Traffic Volumes (vph, two way)	Level of Service	Capacity (vph, two way)	Volume / Capacity
Vardon Road	AM	142	-	500	0.17
(east of Nelson Bay Road) Residential Street	PM	149	-	500	0.24

The above results show that the section of Nelson Bay Road with only a single lane of travel in each direction will continue to experience traffic volumes exceeding its capacity during both the morning and afternoon peak hours. To ensure the capacity of the road network to accommodate the future traffic demands, Nelson Bay Road will require widening to provide for two lanes of travel in each direction along its full length between Fullerton Street and Dune Drive.

The sections of Nelson Bay Road with two lanes of travel provides adequate capacity to accommodate the traffic demands in 2021, with all other roads operating within their capacity.

# 7.2 Intersection Analysis

The intersections within the study area have been analysed using Sidra Intersection to assess their operation with the forecast traffic demands at the 2021 design horizon. The results of this assessment are provided below.

### 7.2.1 Nelson Bay Road / Fullerton Street

The results of the Sidra modelling for the intersection of Nelson Bay Road / Fullerton Street, allowing for the forecast traffic demands, are outlined in Table 7.3 below.

Table 7.3 - Sidra Results - Intersection of Nelson Bay Road / Fullerton Street - 2021 Predicted AM/PM)

Approach	Movement	Level of Service (LoS)	Average Delay (seconds)	95% Back of Queue (metres)
Nelson Bay Road (northbound)	Right Turn	A / A	11.1 / 11.5	6.6 / 14.8
Fullerton Street	Right Turn	A / A	12.4 / 11.9	6.4 / 9.2
Nelson Bay Road (southbound)	Approach	A / A	6.9 / 8.2	37.6 / 34.3

The above results show the intersection of Nelson Bay Road / Fullerton Street has been assessed allowing for the forecast traffic demands, with Sidra modelling showing that the intersection will continue to operate within its capacity beyond the 2021 design year. Each approach will continue to experience low overall delays and queuing with no upgrades required to this intersection.

### 7.2.2 Nelson Bay Road / Vardon Road

The results of the Sidra modelling for the intersection of Nelson Bay Road / Vardon Road are outlined in Table 7.4 below.

Approach	Movement	Level of Service (LoS)	Average Delay (seconds)	95% Back of Queue (metres)
Nelson Bay Road (northbound)	Right Turn	D / B	42.7 / 21.5	8.7 / 4.9
Vardon Road	Approach	A/A	10.8 / 8.7	1.8 / 2.4
Nelson Bay Road (southbound)	U-turn	C / D	42.0 / 52.4	0.2/0.9
	Approach	A / A	0.3 / 0.3	0.2 / 0.8

The intersection of Nelson Bay Road / Vardon Road will continue to provide an acceptable level of operation to 2021. At this time however, the critical U-turn movement on Nelson Bay Road will be operating close to capacity and will require another method of control to ensure these movements can continue to occur safely in future years.

Although no intersection modelling has been completed at Taylor Road, through traffic volumes on Nelson Bay Road in this location are the same as those at Vardon Road, indicating that the U-turn in this location will also be approaching its capacity.

At this time, it is recommended that U-turns in these locations be removed, with the roundabout at Fullerton Street located around 800 metres to the south being able to provide for these demands safely and appropriately.

Intersection modelling for the intersection of Nelson Bay Road / Vardon Road has been revised with U-turns removed, with the revised Sidra results provided in Table 7.5 to follow.

Approach	Movement	Level of Service (LoS)	Average Delay (seconds)	95% Back of Queue (metres)
Nelson Bay Road (northbound)	Right Turn	D / B	42.7 / 21.5	8.7 / 4.9
Vardon Road	Approach	A/A	10.8 / 8.7	1.8 / 2.4
Nelson Bay Road (southbound)	Approach	A / A	0.2 / 0.2	0.0 / 0.0

Table 7.5 - Sidra Results - Intersection of Nelson Bay Road / Vardon Road (No U-turns) - 2021 Predicted (AM/PM)

The above results confirm that with U-turn prohibited, the intersection can operate to an appropriate standard during both the morning and evening peaks.

The intersection of Nelson Bay Road and Fullerton Street was also reassessed to allow for the inclusion of the Uturn traffic, with the results confirming that the redistribution of vehicles will have a negligible impact upon the overall operation of this intersection.

Table 7.6 - Sidra Results - Intersection of Nelson Bay Road / Fullerton Street - 2021 Predicted with additional U-turn volumes (AM/PM)

Approach	Movement	Level of Service (LoS)	Average Delay (seconds)	95% Back of Queue (metres)
Nelson Bay Road (northbound)	Right Turn	A / A	11.3 / 11.7	6.6 / 15.0
Fullerton Street	Right Turn	A/A	12.5 / 11.9	6.5 / 9.4
Nelson Bay Road (southbound)	Approach	A/A	7.0 / 8.4	39.1 / 36.5

### 7.2.3 Nelson Bay Road / Seaside Boulevard / Fullerton Cove Road

The results of the Sidra modelling for the intersection of Nelson Bay Road / Seaside Boulevard / Fullerton Cove Road are outlined in Table 7.7 below.

Table 7.7 - Sidra Results - Intersection of Nelson Bay Road / Seaside Boulevard - 2021 Predicted (AM/PM)

Approach	Movement	Level of Service (LoS)	Average Delay (seconds)	95% Back of Queue (metres)
Nelson Bay Road (northbound)	Approach	A/A	5.5 / 6.5	43.5 / 32.4
Seaside Boulevard	Approach	A/A	10.1 / 9.0	13.6 / 5.6
Nelson Bay Road (southbound)	Approach	A/A	5.0 / 6.5	37.0 / 37.9
Fullerton Cove Road	Approach	B / A	14.9 / 11.2	4.3 / 1.8

The intersection of Nelson Bay Road / Seaside Boulevard / Fullerton Cove Road has been assessed allowing for the forecast traffic demands, with Sidra modelling showing that the intersection will continue to operate within its capacity beyond the 2021 design year. Each approach will continue to experience low overall delays and queuing with no upgrades required to this intersection.

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### 7.2.4 Nelson Bay Road / Dune Drive

The results of the Sidra modelling for the intersection of Nelson Bay Road / Dune Drive are outlined in Table 7.8 below.

Tahle 7.8 - Sidra Results	- Intersection of Nelson F	lav Road / Dune Drive .	- 2021 Predicted (AM/PM)
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Approach	Movement	Level of Service (LoS)	Average Delay (seconds)	95% Back of Queue (metres)
Nelson Bay Road (northbound)	Approach	A/A	0.8 / 0.2	0.0 / 0.0
Dune Drive	Approach	B / B	26.7 / 18.3	8.8 / 3.0
Nelson Bay Road (southbound)	Approach	A / A	0.2 / 0.3	0.0 / 0.0

The intersection of Nelson Bay Road / Dune Drive has been assessed allowing for the forecast traffic demands, with Sidra modelling showing that the intersection will continue to operate within its capacity beyond the 2021 design year. Each approach will continue to experience low overall delays and queuing with no upgrades required to this intersection.

## 7.3 Summary of Road and Intersection Upgrades

The analysis of the impacts of traffic forecasts for the 2021 design year indicate the following road and intersection upgrades, which are required to ensure adequate capacity within the road corridor to support future development and background growth:

- Widening of Nelson Bay Road to provide two lanes of travel in each direction between Vardon Road and Seaside Boulevard, with extension of the acceleration lane at Dune Drive to provide two lanes of travel southbound to Seaside Boulevard. Left turn out of Dune Drive will operate as a slip before permitting through traffic to the south (See Figure 7.1 to follow).
- Removal of U-turns at both Vardon Road and Taylor Road. These movements can be provided for at the roundabout intersection of Nelson Bay Road / Fullerton Street to the south.

Nelson Bay Road will also require duplication northbound to the north of Fullerton Cove Road, however this would need to be considered in conjunction with widening of Nelson Bay Road further north of the study area to ensure that existing bottlenecks are removed and not relocated along the road corridor i.e. Coxs Lane where there is a single lane bridge on Nelson Bay Road. These upgrades are outside the scope of this assessment and therefore have not been considered.

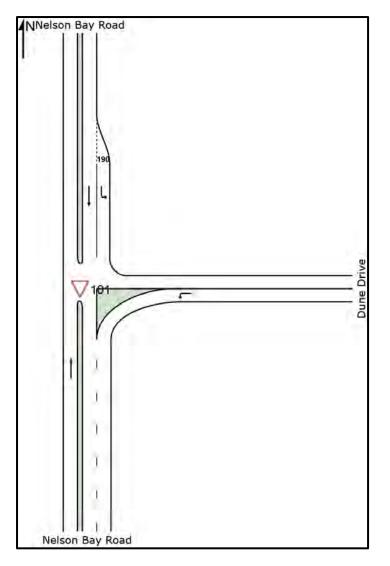


Figure 7.1 - Layout of Nelson Bay Road / Dune Drive, Nelson Bay Road duplicated southbound.

# 8. 2026 Road Capacity and Intersection Analysis

### 8.1 Road Capacity

Forecasts of the 2026 traffic demands have been determined in the same way as those for the 2021 design year and are summarised in Appendix D. It has been assumed that all road and intersection upgrades identified in 2021 have been completed with no other changes to the road layout.

An assessment of the road capacity for the 2026 design year is presented below in Table 8.1 and Table 8.2.

Road (location)	Peak	Maximum Traffic Volumes (vph/direction)	Level of Service	Capacity (vph/direction)	Volume / Capacity
Nelson Bay Road	AM	1,779	С	2,200	0.81
(south of Fullerton Street) Two Lanes	PM	1,685	С	2,200	0.77
Nelson Bay Road	AM	1,752	С	2,200	0.80
(north of Vardon Street) Two Lanes	PM	1,548	С	2,200	0.70
Nelson Bay Road	AM	1,412	С	2,200	0.64
(north of Seaside Boulevard) Two Lanes Southbound	PM	1,321	В	2,200	0.60
Nelson Bay Road	AM	1,654	F	900	1.84
(north of Seaside Boulevard) Single Lane Northbound	PM	1,168	E	900	1.30
Fullerton Street	AM	511	С	900	0.57
(east of Nelson Bay Road) Single Lane	PM	526	С	900	0.58
Seaside Boulevard	AM	393	С	900	0.44
(east of Nelson Bay Road) Single Lane	PM	334	В	900	0.37
Fullerton Cove Road	AM	102	А	900	0.11
(west of Nelson Bay Road) Single Lane	PM	215	В	900	0.24

Table 8.1 - Level of Service and Degree of Saturation (V/C) of Roads - 2026 design year

#### Table 8.2 - Environmental Capacity and Degree of Saturation (V/C) of Vardon Road (School Peak) - 2026

Road (location)	Peak	Maximum Traffic Volumes (vph, two way)	Level of Service	Capacity (vph, two way)	Volume / Capacity
Vardon Road (east of Nelson Bay Road) Residential Street	AM	148	-	500	0.17
	PM	172	-	500	0.24

Note - As no right turns are permitted out of Vardon Road, all outbound traffic associated with the Rifle Range development is expected to turn left out of Taylor Road and complete a U-Turn via the roundabout at Fullerton Street. Inbound traffic from the north is predicted to return to the site via a left turn off Nelson Bay Road into Vardon Road.

The above results show that with the recommended duplication of Nelson Bay Road, mid-block traffic volumes on Nelson Bay Road will remain well within the capacity of the road network at the 2026 design year. However, flows within a single lane of travel northbound to the north of Fullerton Cove Road will exceed the theoretical upper capacity threshold during the morning peak. At these volumes, breakdown of flows is likely to occur at the point where Nelson Bay Road merges to a single lane, creating delays and congestion which could potentially impact upon the roundabout intersection at Seaside Boulevard / Fullerton Cove Road.

A collaborative approach and consultation between both RMS and Port Stephens Council will be required to assess the potential mitigation measures to improve the road capacity in this location as upstream factors such as the two lane bridge at Coxs Lane represent key constraints along the road corridor.

## 8.2 Intersection Analysis

For the 2026 forecasted traffic demands, Sidra modelling of the key intersection along the road corridor has been completed to assess their performance under the future traffic conditions, with the results provided below.

### 8.2.1 Nelson Bay Road / Fullerton Street

The results of the Sidra modelling for the intersection of Nelson Bay Road / Fullerton Street are outlined in Table 8.3 below.

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Table 9.2 Sidra Desults Intersection of Nolcon Pay Dead / Fullerton Street 2026 Dredicted (AM/DM)

Approach	Movement	Level of Service (LoS)	Average Delay (seconds)	95% Back of Queue (metres)
Nelson Bay Road (northbound)	Right Turn	A / A	11.4 / 12.0	6.8 / 15.9
Fullerton Street	Right Turn	A/A	13.2 / 12.5	8.6 / 12.5
Nelson Bay Road (southbound)	Approach	A/A	7.3 / 9.4	52.3 / 48.9

The intersection of Nelson Bay Road / Fullerton Street has been assessed allowing for the forecast traffic demands, with Sidra modelling showing that the intersection will continue to operate within its capacity beyond the 2026 design year. Each approach will continue to experience low overall delays and queuing with no upgrades required to this intersection.

## 8.2.2 Nelson Bay Road / Vardon Road

The results of the Sidra modelling for the intersection of Nelson Bay Road / Vardon Road are outlined in Table 8.4 below.

Table 8.4 - Sidra Results - Intersection of Nelson Bay Road / Vardon Road - 2026 Predicted (AM/PM)

Approach	Movement	Level of Service (LoS)	Average Delay (seconds)	95% Back of Queue (metres)
Nelson Bay Road (northbound)	Right Turn	F/C	<mark>84.1</mark> / 29.1	14.3 / 6.7
Vardon Road	Approach	A / A	12.5 / 9.4	2.1 / 2.6
Nelson Bay Road (southbound)	Approach	A / A	0.3 / 0.3	0.0 / 0.0

At the 2026 design year, this intersection will experience significant delays for the right turn into Vardon Road, which will operate at a LoS F in the morning peak. This indicates a point of failure, with drivers being required to accept smaller gaps to turn right into Vardon Road, creating a safety concern for drivers.

Through traffic volumes on Nelson Bay Road are similar at both Vardon Road and Taylor Road, however demands for right turns off Nelson Bay Road into Taylor Road are expected to be higher due to the Rifle Range development off Popplewell Road. As such, right turns at this intersection would also fail during the morning peak.

To ensure that suitable access is maintained to the residential areas off Vardon Road, Rankin Road and Taylor Road, the intersection at either Vardon Road or Taylor Road should be upgraded to provide traffic signal control. The provision of traffic signals ensures that right turns into and out of the existing residential area are preserved,

minimising the impacts to existing residents. Traffic signals will also facilitate improved pedestrian connectivity to bus stops and residences on the western side of Nelson Bay Road.

In selecting a location for the traffic signals, either at Vardon Road or Taylor Road, the respective advantages and disadvantages have been compared and are summarised in Table 8.5 below.

Location of Traffic Signals	Advantages	Disadvantages
Vardon Road	<ul> <li>Supports safe and appropriate access to Fern Bay Public School and Newcastle Golf Club</li> <li>Provides improved pedestrian connectivity for existing residences on the western side of Nelson Bay Road, which are located north of Vardon Road.</li> <li>Provides improved access for future development at Newcastle Golf Club should access be off Vardon Road instead of Nelson Bay Road.</li> <li>Provides adequate road width along much of its length to support two-way traffic movements</li> </ul>	• Traffic demands for existing residences and future development are primarily to the south, towards Stockton and Fern Bay. Residents would need to travel additional distances when returning home from destinations to the south.
Taylor Road	<ul> <li>Supports safe and appropriate control for right turns, minimising the distance travelled for vehicles approaching from the south.</li> </ul>	<ul> <li>Reduced pedestrian connectivity for residences on the western side of Nelson Bay Road being further south.</li> <li>Increases traffic on the local roads associated with vehicles accessing Fern Bay Public School.</li> <li>Queues on Taylor Road are likely to impact on access and egress from Fullerton Street (~10m from Nelson Bay Road).</li> <li>Width of Taylor Road is not sufficient for 2-way traffic movements, requiring significant upgrades</li> </ul>

Table 8.5 - Comparison of Advantages and Disadvantages associated with Traffic Signal Location

Based on the above, it is recommended that traffic signals be provided at Vardon Road, with this option providing the most desirable outcomes for pedestrian access and the Fern Bay Public School. The increased distance for vehicles travelling from the south (<1km) is minimal and will be offset by reduced delays and improved access for vehicles turning right onto Nelson Bay Road.

The operation of a future signal-controlled intersection at Vardon Road has been assessed based on the Sidra output in Figure 8.1. This layout allows for all turning movements into and out of Vardon Road with pedestrian facilities on each leg. Signal phasing has been based on a simple three phase layout.

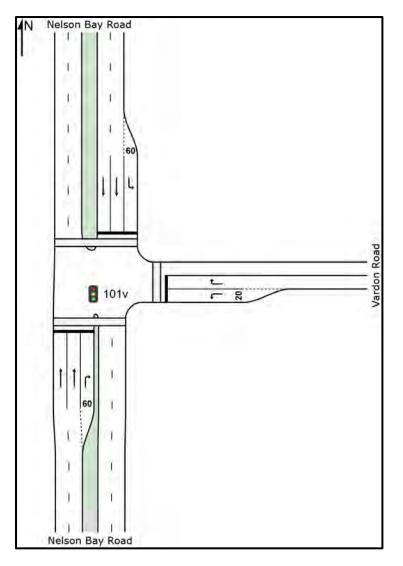


Figure 8.1 - Sidra layout for signalised intersection at Vardon Road.

This intersection will provide for all right turn movements into and out of the existing Fern Bay residential area, with these movements to be restricted at Taylor Road to left in/left out only. This will see a reallocation of traffic within the local road system, with increased demands on Vardon Road. A summary of the revised traffic demands is provided within Appendix D. Sidra results for the revised intersection control (traffic signals) are summarised in Table 8.6 below.

Table 8.6 - Sidra Results - Intersection of Nelson Bay Road / Vardon Road	1 - 2026 Predicted (AM/PM) - Upgrade to Traffic Signals
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Approach	Movement	Level of Service (LoS)	Average Delay (seconds)	95% Back of Queue (metres)
Nolson Roy Road (porthbound)	Right Turn	D / D	54.5 / 47.4	34.0 / 40.9
Nelson Bay Road (northbound)	Approach	A/A	6.5 / 7.0	71.3 / 82.4
Vardon Road	Right Turn	D / D	50.9 / 47.7	13.9 / 10.5
	Approach	D / C	45.7 / 38.2	13.9 / 10.5
Nelson Bay Road (southbound)	Approach	A / A	10.9 / 11.7	190.3 / 136.9

These results demonstrate that the provision of traffic signal control at the intersection of Nelson Bay Road / Vardon Road will provide sufficient capacity to ensure an appropriate level of operation for all turn movements, including the critical right turn both into and out of Vardon Road.

The increased traffic demands on Vardon Road are expected to remain well within its environmental capacity as described in Table 8.7 below.

Table 0.7 Environmental Conc	alty and Degree of Caturation	(V/C) of Vardon Dood	(Cohool Dook) 2026
Table 8.7 - Environmental Capa	CITV AND DEGREE OF SATURATION	$(V/C) \cup Valuon Road$	ISCHOOL PEAKL - 2020
		(	(

Road (location)	Peak	Maximum Traffic Volumes (vph, two way)	Level of Service	Capacity (vph, two way)	Volume / Capacity
Vardon Road (east of Nelson Bay Road) Residential Street	AM	228	-	500	0.35
	PM	274	-	500	0.49

Note - All right turns for existing and future development in the original Fern Bay residential area provided for off Vardon Road. No right turn at Taylor Road.

### 8.2.3 Nelson Bay Road / Seaside Boulevard / Fullerton Cove Road

The results of the Sidra modelling for the intersection of Nelson Bay Road / Seaside Boulevard / Fullerton Cove Road are outlined in Table 8.8 below.

Table 8.8 - Sidra Results - Intersection of Nelson Ba	v Road / Seaside Boulevard -	2026 Predicted (AM/PM)

Approach	Movement	Level of Service (LoS)	Average Delay (seconds)	95% Back of Queue (metres)
Nelson Bay Road (northbound)	Approach	A/A	5.5 / 6.5	52.1 / 39.9
Seaside Boulevard	Approach	A/A	8.8 / 8.1	11.5 / 4.8
Nelson Bay Road (southbound)	Approach	A/A	5.3 / 6.6	31.5 / 31.6
Fullerton Cove Road	Approach	B / A	15.3 / 11.8	9.5 / 3.1

The intersection of Nelson Bay Road / Seaside Boulevard / Fullerton Cove Road has been assessed allowing for the forecast traffic demands, with Sidra modelling showing that the intersection will continue to operate within its capacity beyond the 2026 design year. Each approach will continue to experience low overall delays and queuing with no upgrades required to this intersection.

### 8.2.4 Nelson Bay Road / Dune Drive

The results of the Sidra modelling for the intersection of Nelson Bay Road / Dune Drive are outlined in Table 8.9 below.

Table & O Sidra Deculte	Intercection of Nelson Ray I	Road / Dune Drive - 2026 Predicted (AM/PM)
Table 0.7 - Siula Nesulis	- IIIICI SECIIUII UI NEISUII DAY I	Abau / Dune Drive - 2020 Fredicieu (Alvi/Fivi)

Approach	Movement	Level of Service (LoS)	Average Delay (seconds)	95% Back of Queue (metres)
Nelson Bay Road (northbound)	Approach	A / A	1.9 / 0.3	0.0 / 0.0
Dune Drive	Approach	A / A	4.4 / 4.4	0.0 / 0.0
Nelson Bay Road (southbound)	Approach	A / A	0.3 / 0.4	0.0 / 0.0

The intersection of Nelson Bay Road / Dune Drive has been assessed allowing for the forecast traffic demands, with Sidra modelling showing that the intersection will continue to operate within its capacity beyond the 2026 design year. Each approach will continue to experience low overall delays and queuing with no upgrades required to this intersection.

# 8.3 Summary of Road and Intersection Upgrades for 2026 design year

The analysis of the impacts of traffic forecasts for the 2026 design year indicate the following road and intersection upgrades, which are required to ensure adequate capacity within the road corridor to support future development and background growth:

- Installation of traffic signal control at Vardon Road, which will allow for all turning movements.
- Restrict Taylor Road to left in/left out only

If not already completed by this stage, Nelson Bay Road will still require duplication northbound to the north of Fullerton Cove Road, however this would need to be considered in conjunction with widening of Nelson Bay Road further north of the study area to ensure that existing bottlenecks are removed and not relocated along the road corridor i.e. Coxs Lane. These upgrades are outside the scope of this assessment and therefore not considered further.

# 9. 2036 Road Capacity and Intersection Analysis

## 9.1 Road Capacity

Forecasts of the 2036 traffic demands have been determined in the same way as those for the 2021 and 2026 design years and are summarised in Appendix E. It has been assumed that all road and intersection upgrades identified in 2026 have been completed with no other changes to the road layout.

An assessment of the road capacity for the 2036 design year is presented below in Table 9.1 and Table 9.2.

Road (location)	Peak	Maximum Traffic Volumes (vph/direction)	Level of Service	Capacity (vph/direction)	Volume / Capacity
Nelson Bay Road	AM	2,460	E	2,200	1.12
(south of Fullerton Street) Two Lanes	PM	2,262	E	2,200	1.03
Nelson Bay Road	AM	2,150	D	2,200	0.98
(north of Vardon Street) Two Lanes	PM	2,016	D	2,200	0.92
Nelson Bay Road	AM	1,694	С	2,200	0.77
(north of Seaside Boulevard) Two Lanes Southbound	PM	1,714	С	2,200	0.78
Nelson Bay Road	AM	2,085	F	900	2.32
(north of Seaside Boulevard) Single Lane Northbound	PM	1,404	F	900	1.56
Fullerton Street	AM	910	E	900	1.01
(east of Nelson Bay Road) Single Lane	PM	1,086	E	900	1.21
Seaside Boulevard	AM	401	С	900	0.45
(east of Nelson Bay Road) Single Lane	PM	384	С	900	0.43
Fullerton Cove Road	AM	131	А	900	0.15
(west of Nelson Bay Road) Single Lane	PM	265	В	900	0.29

Table 9.1 - Level of Service and Degree of Saturation (V/C) of Roads - 2036

Table 9.2- Environmental Capacity and Degree of Saturation (V/C) of Vardon Road (School Peak) - 2036

Road (location)	Peak	Maximum Traffic Volumes (vph, two way)	Level of Service	Capacity (vph, two way)	Volume / Capacity
Vardon Road	AM	283	-	500	0.57
(east of Nelson Bay Road) Residential Street	PM	397	-	500	0.79

By 2036, traffic demands on Nelson Bay Road will be approaching the capacity of the road corridor, particularly if the full rate of background growth is realised. Flows within the single lane of travel (northbound) to the north of Seaside Estate, will be oversaturated, with modelling results indicating an average travel speed of below 20 km/hr. Significant congestion at the northbound merge will be problematic, with queues likely to impact on downstream intersections if required capacity improvements have not been implemented.

Forecast traffic volumes on Fullerton Street (east of Nelson Bay Road) see this road operating close to capacity between Nelson Bay Road and the access to the future residential component of the preferred site for the mixed use centre. Further south of this point, flows on Fullerton Street will be significantly lower and are well within the road capacity with no mitigation required. All other roads in the study area will continue to operate to an acceptable level.

# 9.2 Intersection Analysis

The intersections within the study area have been analysed using Sidra Intersection to assess their operation with the forecast traffic demands at the 2036 design horizon. The results of this assessment are provided below.

It should be noted that by 2036, Nelson Bay Road is forecast to be operating close to capacity and this is likely to see a change in the travel patterns for motorists who will tend to travel earlier or later to avoid delays and congestion during the absolute peak. This is likely to see the traditional road peak occurring over a longer duration with more consistent demands across each 15 minute time interval i.e. peak hour spread.

## 9.2.1 Nelson Bay Road / Fullerton Street

The results of the Sidra modelling for the intersection of Nelson Bay Road / Fullerton Street are outlined in Table 9.3 below.

Approach	Movement	Level of Service (LoS)	Average Delay (seconds)	95% Back of Queue (metres)
Nelson Bay Road (northbound)	Right Turn	A / B	12.0 / 15.1	10.7 / 48.2
Fullerton Street	Right Turn	B / B	21.9 / 17.6	36.0 / 41.3
Nelson Bay Road (southbound)	Approach	A / F	11.1 / <mark>204.1</mark>	115.5 / <mark>1030.9</mark>

By 2036, the roundabout intersection at Nelson Bay Road / Fullerton Street may experience an unacceptable level of operation during the evening peak should the full rate of background growth and development be realised. The high demands for right turn movements into Fullerton Street associated with development at the preferred site for the mixed use centre and Fort Wallace release areas will reduce the gaps for southbound traffic, resulting in long delays and queuing on this approach.

Several options have been considered to mitigate this and ensure continued operation of this intersection. This included changes to the intersection geometry or control (traffic signals), provision of additional turning lanes and opportunities to provide flow metering. Given the geometric constraints in this location and without introducing disruption to northbound traffic, it is considered desirable to maintain the current roundabout control.

A concept layout for an upgraded roundabout intersection is provided in Figure 9.1, with the following changes put forward to improve capacity:

- Provision of dual right turn lanes into Fullerton Street (requires extension of the dual circulating lanes anticlockwise to the southern approach).
- Right turn lanes will also need to be extended to ensure sufficient length for deceleration and queue storage. Given the geometric constraints associated with Stockton Bridge, the intersection will need to be relocated further north with the Fullerton Street approach realigned as required.
- Queue metering on Nelson Bay Road (southbound), with traffic signals to stop right turns into Fullerton Street (during the evening peak) when queues exceed the specified distance. Metering shall not be required at other times of the day with normal roundabout operation being sufficient.

# SECA solution >>>>

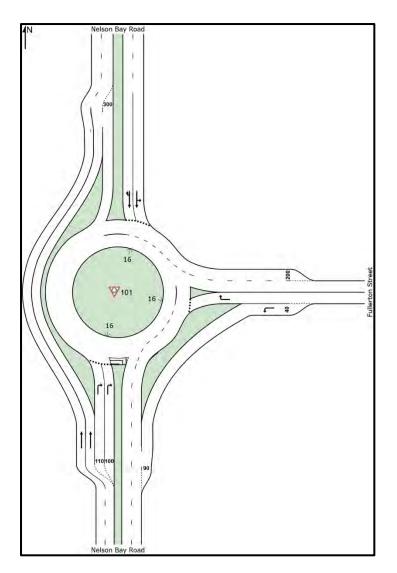


Figure 9.1 - Sidra layout for upgraded roundabout at Nelson Bay Road / Fullerton Street

Sidra results for the revised intersection layout are summarised in Table 9.4 below, demonstrating an acceptable level of operation for each approach.

Table 9.4 Sidra Results - Intersection of Nelson Bay Road / Fullerton Street - 2036 Predicted (AM/PM) - Upgraded Roundabout

Approach	Movement	Level of Service (LoS)	Average Delay (seconds)	95% Back of Queue (metres)
Nelson Bay Road (northbound)	Right Turn	A / B	11.6 / 9.9	4.8 / 77.2
Fullerton Street	Right Turn	B / B	23.6 / 12.0	38.6 / 37.7
Nelson Bay Road (southbound)	Approach	A / B	11.4 / 17.4	118.6 / 129.2

Council have indicated a preference to provide access to the preferred site for the mixed use centre via a new leg at the roundabout intersection at Nelson Bay Road / Fullerton Street. Sidra modelling has been completed to assess the feasibility of this option, based on the conceptual design in Figure 9.2 following.

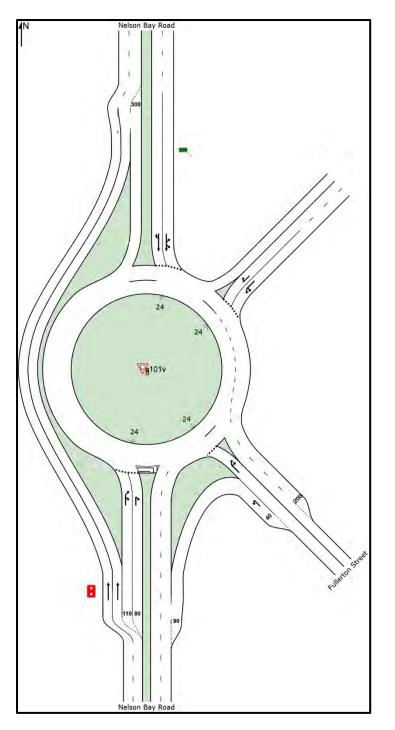


Figure 9.2 - Sidra layout including additional leg at the Nelson Bay Road / Fullerton Street roundabout

To ensure adequate capacity to cater for the traffic demands, and consistent with the roundabout in Figure 9.1, dual right turns shall be required on Nelson Bay Road for right turns into Fullerton Street, with queue metering on Nelson Bay Road (southbound) linked to traffic signals to control right turns movements during the evening peak. The new leg to the north-east of the roundabout would require a single departure lane with two approach lanes to ensure a satisfactory level of operation.

Sidra results for the above intersection layout are summarised in Table 9.5 below.

Level of Service Average Delay 95% Back of Queue Movement Approach (LoS) (seconds) (metres) A/B 4.3/48.9 Nelson Bay Road (northbound) **Right Turn** 11.4 / 15.5 **Fullerton Street** B/A 21.1 / 13.9 21.8 / 19.4 **Right Turn** New Leg Approach C/B 40.4 / 15.0 45.6 / 16.4 Nelson Bay Road (southbound) A/B 12.3 / 14.6 Approach 138.6 / 103.9

Table 9.5 - Sidra Results - Intersection of Nelson Bay Road / Fullerton Street - 2036 Predicted (AM/PM) - Upgraded Roundabout with Access to the mixed use centre.

The provision of a fourth leg at the roundabout to provide for access to the preferred site for the mixed use centre will relieve traffic on Fullerton Street which will be operating close to capacity during the morning and at capacity in the evening. A revised capacity assessment for Fullerton Street is provided below in Table 9.6.

Table 9.6 – Revised capacity assessment for Fullerton Street allowing for access to the preferred site for the mixed use centre via additional leg off roundabout.

Road (location)	Peak	Maximum Traffic Volumes (vph/direction)	Level of Service	Capacity (vph/direction)	Volume / Capacity
Fullerton Street	AM	522	С	900	0.58
(east of Nelson Bay Road) Single Lane	PM	538	С	900	0.60

Should the full rate of background growth or future development not be realised, or if there is a change in travel patterns leading to a spread in the typical peak hour, the existing intersection control will provide sufficient capacity without mitigation. Similarly, the provision of an internal road link connecting the existing Fern Bay Residential area to Fullerton Street via the Rifle Range, preferred site for the mixed use centre and Fort Wallace development sites could further reduce demands through this roundabout, potentially seeing improvements to its overall operation and reducing the extent of any mitigation requirements.

It is recommended that the operation of this roundabout be reviewed prior to the development of the preferred site for the mixed use centre, to determine the actual level of growth within the road corridor and assess the need for capacity improvements.

## 9.2.2 Nelson Bay Road / Vardon Road

The results of the Sidra modelling for the intersection of Nelson Bay Road / Vardon Road are outlined in Table 9.7 below.

Table 9.7 - Sidra Results - Intersection of Nelson Bay Road / Vardon Road - 2036 Predicted (AM/PM) -	Traffic Signals
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Approach	Movement	Level of Service (LoS)	Average Delay (seconds)	95% Back of Queue (metres)
Nelson Bay Road	Right Turn	E/E	66.2 / 58.8	49.7 / 94.9
(northbound)	Approach	A/A	7.2 / 9.6	105.1 / 156.3
Vorden Dood	Right Turn	E/E	62.6 / 60.9	28.3 / 16.1
Vardon Road	Approach	<mark>E</mark> / D	<mark>58.0</mark> / 47.7	28.3 / 16.1
Nelson Bay Road (southbound)	Approach	A / B	12.5 / 17.3	283.1 / 274.0

By 2036, the proposed traffic signals at Vardon Road will continue to provide an acceptable standard of operation during the critical morning and evening peak commuter periods. Whilst there will be delays for drivers turning out of or right into Vardon Road, these are mostly inherent to the phasing of the traffic signals and the long green time required to support the high through traffic demands associated with Nelson Bay Road.

The right turn lane on Nelson Bay Road will need to be designed to ensure it has adequate length to accommodate the increased queues expected by 2036 due to the completion of the Rifle Range development.

### 9.2.3 Nelson Bay Road / Seaside Boulevard / Fullerton Cove Road

The results of the Sidra modelling for the intersection of Nelson Bay Road / Seaside Boulevard / Fullerton Cove Road are outlined in Table 9.8 below.

Approach	Level of Service (LoS)	Average Delay (seconds)	95% Back of Queue (metres)
Nelson Bay Road (northbound)	A/A	5.7 / 6.7	85.3 / 55.3
Seaside Boulevard	A/A	9.7 / 9.0	14.1 / 9.0
Nelson Bay Road (southbound)	A / A	5.6 / 8.6	40.8 / 57.3
Fullerton Cove Road	B / A	23.4 / 14.0	19.5 / 5.9

Table 9.8 - Sidra Results - Intersection of Nelson Bay Road / Seaside Boulevard - 2036 Predicted (AM/PM)

The intersection of Nelson Bay Road / Seaside Boulevard / Fullerton Cove Road has been assessed allowing for the forecast traffic demands, with Sidra modelling showing that the intersection will continue to operate within its capacity beyond the 2036 design year. Each approach will continue to experience low overall delays and queuing with no upgrades required to this intersection.

### 9.2.4 Nelson Bay Road / Dune Drive

The results of the Sidra modelling for the intersection of Nelson Bay Road / Dune Drive are outlined in Table 9.9 below.

Table 9.9- Sidra Results - Intersection of Nelson Bay Road / Dune Drive - 2036 Predicted (AM/PM)

Approach	Level of Service (LoS)	Average Delay (seconds)	95% Back of Queue (metres)
Nelson Bay Road (northbound)	F/A	<mark>202.9</mark> / 0.5	0.0 / 0.0
Dune Drive	A / A	4.4 / 4.4	0.0 / 0.0
Nelson Bay Road (southbound)	A / A	0.5 / 0.7	0.0 / 0.0

By 2036, the intersection of Nelson Bay Road / Dune Drive will continue to provide an acceptable standard of operation with minimal delays for the left turn movements into and out of Dune Drive. Whilst the Sidra results above show long delays for northbound traffic during the morning peak, these are reflective of the high levels of congestion expected for the single lane of travel northbound. Whilst the Sidra results above show long delays for northbound traffic during the morning peak, these are reflective of the single lane of travel northbound. Whilst the Sidra results above show long delays for northbound traffic during the morning peak, these are reflective of the single lane of travel northbound.

No upgrades are required at this intersection to improve capacity although Nelson Bay Road will require duplication northbound to provide for two lanes of travel due to the continual background growth for traffic flows along this arterial road.

# 9.3 Summary of Road and Intersection Upgrades 2036

The analysis of the impacts of traffic forecasts for the 2036 design year indicate the following road and intersection upgrades, which are required to ensure adequate capacity within the road corridor to support future development and background growth:

- The roundabout intersection of Nelson Bay Road / Fullerton Street may require upgrades to improve capacity including the provision of dual right turn lanes into Fullerton Street and introduction of queue metering in the evening peak period.
- A review of the operation of this intersection should be completed prior to development of the preferred site for the mixed use centre to determine the need for capacity improvements, which may not be required if the predicted level of background growth or future development is not realised.
- Upgrades to Nelson Bay Road (north of Seaside Estate) have been described in Section 7.

# 9.4 Future Road Link

Council have indicated an opportunity to provide a future road link connecting the existing Fern Bay residential area through to North Stockton (Fullerton Street), potentially connecting the Rifle Range, preferred site for the mixed use centre and Fort Wallace development areas as shown in Figure 9.2.

The new road link would be expected to provide for trips to/from Stockton (~15%) associated with the existing and future residential development on the eastern side of Nelson Bay Road (~624 dwellings) as well as trips to/from the preferred commercial centre.

Assuming 100% utilisation, the potential demands for this new road link would be in the order of 80 vehicles during the morning peak (two way) and 150 vehicles during the evening peak. The removal of these flows from the intersection of Nelson Bay Road / Fullerton Street are insignificant in terms of the future traffic volumes through this location and as such, the provision of a future road link through these sites will not see significant improvements to the operation of this intersection.

Although not justified on capacity grounds there are other benefits to the community for providing this connection including:

- Providing local access to the preferred commercial site
- Enabling community connectivity
- Opportunity for connection to the beachfront
- Opportunity for a spine road to cater for bus travel
- Opportunity for quality cycling and pedestrian connectivity





Figure 9.2 - Indicative location of future road link.

# 10. Background Growth Only

For the intersections of Nelson Bay Road / Fullerton Street and Nelson Bay Road / Vardon Road, Sidra modelling has been completed at each design year to determine the impacts associated with background growth only. The results of this assessment provide a benchmark for the existing road network to accommodate future growth and the extent at which future development impacts on the surrounding road network. This will also influence the apportionment of costs associated with infrastructure upgrades under development contributions.

No assessment has been provided for the intersections of Nelson Bay Road / Seaside Boulevard / Fullerton Cove Road or Nelson Bay Road / Dune Drive, as these intersections do not require upgrades to support the forecast traffic demands.

The need for widening on Nelson Bay Road to provide for two lanes of travel between Vardon Road and Dune Drive has been identified as an existing deficiency in the road corridor, with existing traffic volumes exceeding the recommended capacity of this section of road.

Results presented below are for the existing intersection layout (without upgrades).

## 10.1 Intersection of Nelson Bay Road / Fullerton Street

The results of the Sidra modelling for the intersection of Nelson Bay Road / Fullerton Street for the 2021, 2026 and 2036 design horizons are outlined in Tables 10.1-10.3 below.

Table 10.1- Sidra Results - Intersection of Nelson Bay Road / Fullerton Street - 2021 Background Growth Only (AM/PM)

Approach	Movement	Level of Service (LoS)	Average Delay (seconds)	95% Back of Queue (metres)
Nelson Bay Road (northbound)	Right Turn	A / A	11.0 / 11.5	6.2 / 12.9
Fullerton Street	Right Turn	A / A	12.3 / 11.8	5.4 / 8.4
Nelson Bay Road (southbound)	Approach	A/A	6.8 / 7.6	36.0 / 30.7

Table 10.2 - Sidra Results - Intersection of Nelson Bay Road / Fullerton Street - 2026 Background Growth Only (AM/PM)

Approach	Movement	Level of Service (LoS)	Average Delay (seconds)	95% Back of Queue (metres)
Nelson Bay Road (northbound)	Right Turn	A / A	11.0 / 11.5	6.3 / 13.1
Fullerton Street	Right Turn	A / A	12.6 / 12.0	6.0 / 9.1
Nelson Bay Road (southbound)	Approach	A / A	6.9 / 7.9	41.6 / 35.6

Table 10.3 - Sidra Results - Intersection of Nelson Bay Road / Fullerton Street - 2036 Background Growth Only (AM/PM)

Approach	Movement	Level of Service (LoS)	Average Delay (seconds)	95% Back of Queue (metres)
Nelson Bay Road (northbound)	Right Turn	A/A	11.0 / 11.5	6.4 / 13.3
Fullerton Street	Right Turn	A/A	13.4 / 12.6	7.7 / 11.3
Nelson Bay Road (southbound)	Approach	A/A	7.3 / 8.9	57.2 / 50.8

The above results show that without the additional trips associated with the proposed developments, the intersection of Nelson Bay Road / Fullerton Street will continue to operate to an acceptable standard with only minor increases in the delays and queuing on each approach.

The key factor driving the need for future upgrades at this intersection is the increased demands for right turns off Nelson Bay Road associated with development at Fort Wallace, as well as the residential and commercial components of the preferred site for the mixed use centre.

# 10.2 Intersection of Nelson Bay Road / Vardon Road

The results of the Sidra modelling for the intersection of Nelson Bay Road / Vardon Road for the 2021 and 2026 design horizons are outlined in Table 10.4 and Table 10.5 below. Due to the results no further assessment was undertaken.

The critical right turn out of Vardon Road onto Nelson Bay Road is operating at LoS F during the 2018 baseline assessment. With restrictions on the right turns out of Vardon Road, the intersection will continue to provide an acceptable level of operation to 2021. By 2026 however, both the U-turn on Nelson Bay Road and right turn into Vardon Road will be operating beyond capacity. To maintain right turn access for dwellings in the residential area off Vardon Road, Rankin Road or Taylor Road, the intersection will need to be upgraded to provide traffic signal control.

Table 10.4 - Sidra Results - Intersection of Nelson Bay Road / Vardon Road - 2021 Background Growth Only (AM/PM)

Approach	Movement	Level of Service (LoS)	Average Delay (seconds)	95% Back of Queue (metres)
Nelson Bay Road (northbound)	Right Turn	C / B	41.0 / 19.7	7.7 / 2.8
Vardon Road	Approach	A / A	10.5 / 8.6	0.6 / 2.1
Nelson Bay Road (southbound)	U-turn	C / D	40.0 / 51.8	0.2 / 0.8
	Approach	A / A	0.3 / 0.3	

Table 10.5 - Sidra Results - Intersection of Nelson Bay Road / Vardon Road - 2026 Background Growth Only (AM/PM)

Approach	Movement	Level of Service (LoS)	Average Delay (seconds)	95% Back of Queue (metres)
Nelson Bay Road (northbound)	Right Turn	E / B	65.4 / 23.6	11.2 / 3.5
Vardon Road	Approach	A/A	11.8 / 9.3	0.6 / 2.3
Nelson Bay Road (southbound)	U-turn	D / F	52.6 / 71.7	0.3 / 1.2
	Approach	A/A	0.3 / 0.3	

# 11. Future Public Transport, Pedestrian and Cycling

# 11.1 Bicycle and Pedestrian Facilities

The Newcastle Cycling Strategy and Action Plan (March 2012) identifies the goals of The City of Newcastle in the promotion of cycling as a viable mode of transport and the strategic initiatives being developed to achieve these goals. A critical component of this is the development of a comprehensive bicycle network comprising of on road and off road paths as part of local and regional routes. The Port Stephens Pathways Plan (2015) identifies existing footpaths and shared paths, as well as identifying locations for future infrastructure when funding becomes available.

The existing network of footpaths and shared paths in the study area, outlined previously in Section 3.5.2, have been reviewed with reference to the above Council strategies. This assessment has outlined the missing links in the existing network of footpaths and shared paths and has also identified the location of future infrastructure, to provide active travel opportunities for both existing and future residents in the study area. The proposed upgrades are identified on Figure 11.1 to follow. These have been designed in accordance with the Austroads Guide to Road Design Part 6A: Pedestrian and Cyclist Paths, which nominates a desirable minimum width of 2.5 metres for shared paths providing local access.

Shared path widths allow suitable opportunity for mobility devices as well as cyclists and pedestrians. To allow for two wheelchairs to pass a lesser width of 1.8 metres is required, however a narrower width of 1.2 metres can be tolerated for short distances if required in constrained situations.

It is noted that this nominated Austroads width is greater than that required under the Port Stephens Council design guidelines, which allow for shared paths to have a minimum width of 2.0 metres.

P1 - Upgrade the existing footpath along the eastern side of Nelson Bay Road, between Bayway Village and Braid Road, to provide a shared path (2.5 metres) along the length of Nelson Bay Road in this locality. Cyclists are able to travel on road for 70 metres between the proposed and existing shared path located at the southern end of Fullerton Street. This is consistent with the current situation, which is adequate given the very low traffic flows along Fullerton Street which provides a no through road in this location, south of Braid Street. The provision of an off-road extension however would allow for both pedestrians and cyclists.

This upgrade would include the removal of the dated bus seating and shelter on the existing footpath (located 330 metres south of the Palm Lakes Resort access) with the proposed shared paths to provide improved connectivity to surrounding bus stops, in locations that encourage safer pedestrian crossing.

P2 - Provide a shared path along the western side of Nelson Bay Road, from the Palm Lakes Resort access south to Vardon Road providing connection for pedestrians to cross safely at the future signalised intersection of Nelson Bay Road and Vardon Road. This shared path would replace the existing footpath along the frontage of the residential developments on the western side of Nelson Bay Road.

P3 - Provide a shared path from Seaside Boulevard, along the access trail to the east of Newcastle Golf Club, through to Popplewell Road then link up with the existing shared path to the east of Nelson Bay Road. This could also include a link to the rear of Bayway Village.

P4 - Indicative shared path providing a link between future development of the Rifle Range, preferred site for the mixed use centre and Fort Wallace sites. The location of this path would be determined pending detailed design of these developments.

# 11.2 Pedestrian Crossing

### 11.2.1 Nelson Bay Road

The road layout and pedestrian demand has been assessed to determine a suitable location and treatment for pedestrians to cross Nelson Bay Road. Based on the existing and future development in the area, the section of Nelson Bay Road adjacent to the Newcastle Golf Club has been identified as the preferred location for a pedestrian treatment. This should be incorporated as part of an upgrade of the intersection of Nelson Bay Road and Vardon Road to provide traffic signals which would include a pedestrian crossing on all legs. This will provide for the safe crossing of pedestrians across Nelson Bay Road.

A pedestrian refuge should also be considered to allow for crossing of Nelson Bay Road near the access to Stockton Cemetery. This upgrade would be completed in conjunction with the upgrade of bus stops in this location (discussed further in Section 11.3 below), to allow for northbound bus travellers to cross Nelson Bay Road in this location.

### 11.2.2 Fullerton Street

A means for pedestrians to cross Fullerton Street in the vicinity of the existing access to the Fort Wallace development has been considered, with the future development in this location to generate pedestrian demands across Fullerton Street between the development and the Stockton Cycleway. It is appropriate for the speed limit in this area to be reviewed in conjunction with the future development, to allow for a reduction to 50km/hr (currently 70km/hr).

It is proposed to provide a pedestrian refuge crossing near the site access for this development, which shall provide for safe crossing in this location given the straight road alignment and low speed limit. This would be staged in conjunction with the Fort Wallace development. This upgrade is identified as P5 on Figure 11.1.

There is also an existing pedestrian (zebra) crossing to the north near the site access for the future preferred site for the mixed use centre. Upgrades to this crossing in this location (including lighting and further works) shall allow for increased safety for pedestrians. This upgrade is identified as P6 on Figure 11.1.

# SECA solution >>>>>



Figure 11.1 - Existing and proposed footpaths and shared paths in the study area

# SECA solution >>>>

### 11.3 Bus Facilities

The Port Stephens Council Infrastructure Design Guide states:

"Bus routes will normally be identified by Council. It is important that the road hierarchy adequately caters for buses. The main criteria in determining the location of bus routes is that no more than 5% of residents should have to walk in excess of 400 metres to catch a bus."

Further to the above, bus routes are typically identified through consultation with the local bus providers as well as Transport for NSW, in conjunction with Council. Infrastructure upgrades to bus stop facilities can be funded via Section 94 contributions to Council.

The existing bus stops along Nelson Bay Road provide adequate connection for the residential developments in the study area. There are bus stops located within or adjacent to the Seaside Estate, Bayway Village and Palm Lakes Resort. It is noted the bus stop for Seaside Estate currently has no seating or shelter. The Fern Bay residential area is serviced by bus stops on Nelson Bay Road, which are located within 400 metres of the majority of development in the area, with the exception of Popplewell Road (north of Vardon Road) and Nagle Close.

From discussions with the key bus provider in this location (Hunter Valley Buses) it has been indicated there is consideration for relocating the Seaside Village bus stop further inside the development, to provide greater connectivity for local residents. This would also include an upgrade to provide seating and shelter. Any changes to Hunter Valley Buses services and facilities are reviewed as part of the Growth Bus Programme, which determines the need and feasibility of any upgrades. It is recommended the above upgrades are considered in this location in order to provide better connection and facilities for existing and future public transport users in the area, the following upgrades are recommended which the locations marked on Figure 11.2 to follow.

For this assessment B1 has been assigned as the most immediate priority, through to B11 representing the lowest. The prioritising of the outlined recommendations should be further considered as future development in the area progresses and certainty around timelines is obtained.

B1 - Relocate the existing Seaside Estate bus stop further east along Seaside Boulevard to provide greater connectivity for local residents. This upgrade should include provision of seating and shelter.

B2 - Upgrade the existing bus stop on the eastern side of Fullerton Street, adjacent to the Fort Wallace access, to provide seating and shelter.

B3 - Upgrade the existing bus stop on the western side of Nelson Bay Road, adjacent to the Palm Lakes Resort access, to provide seating and shelter.

B4 - Provide an internal bus stop as part of the future development of the Rifle Range Site. Consideration should be given to providing bus services through the existing Fern Bay residential area, to service the adjacent Rifle Range site. Existing bus routes along Nelson Bay Road could divert to loop through the area, entering at the proposed signalised intersection with Vardon Road from both directions. The route could then proceed along Vardon Road onto Popplewell Road to link with the future access for the Rifle Range development, with this indicative route also outlined in Figure 11.2. A suitable area would be required for set down, as well as a turn-around area or roundabout to allow for a bus to exit via the same route (similar to that of Seaside Estate).

B5 - Relocate the existing bus stop on the eastern side of Nelson Bay Road, north of Vardon Road, to the south of Vardon Road. This relocation will allow for sufficient area to provide a bus stop with seating and shelter located in close proximity to the future signalised intersection of Nelson Bay Road and Vardon Road allowing for pedestrian phases on the signals.

B6 - Provide a bus stop with seating and shelter along the western side of Nelson Bay Road, to the north of Vardon Road, to encourage safe crossing at the future signalised intersection.

B7/B8 - Provide seating and shelter on both sides of Fullerton Cove Road in the location of the existing bus zones.



**B9** - Remove the signage for the bus stop to the immediate north of the Stockton Bridge. Provide a new bus stop with seating and shelter on the western roadside opposite the Stockton Cemetery access. This would be developed in conjunction with a pedestrian refuge to be provided in this location, discussed previously in Section 11.2.1.

B10 - Upgrade the existing bus stop on the eastern side of Nelson Bay Road, adjacent to the Stockton Cemetery access, to provide seating and shelter.

B11 – Provide a bus stop with seating and shelter along the western side of Fullerton Street, opposite the access to the preferred site for the mixed use centre. Encouraging safe crossing of Fullerton Street at the existing pedestrian (zebra) crossing in this location.

In regard to the upgrade detailed in B1, discussions with the key bus provider in this location (Hunter Valley Buses) have indicated this relocation is currently under consideration. Any changes to Hunter Valley Buses services and facilities are reviewed as part of the Growth Bus Programme, which determines the need and feasibility of any upgrades. Discussion with Port Stephens Coaches, who also provide public and school bus services through the area, have determined there is currently no alteration of services planned through the area.

It is recognised that the existing local roads in the Fern Bay residential area proposed for a new bus route as part of B4 (Vardon Road and Popplewell Road) are narrow and not suited to regular bus services. These roads would need to be upgraded in line with Council design requirements. Upgrades for these roads are discussed further in Section 11. Further to the above recommendations it is noted in the longer term that there is also the potential for a road link between Popplewell Road and Fullerton Street, through the future development sites to the south. The opportunity for providing enhanced bus services through this area should be considered pending the extent of future development in this area.



Figure 11.2 - Proposed upgrades to bus services and facilities

#### 11.4 Park and Ride

The suitability of a Park and Ride scheme to service the Stockton ferry terminal has been considered, in order to reduce the parking demand in the precinct surrounding the terminal. The potential to incorporate this scheme into the future redevelopment of Corroba oval and associated parking in this area has been examined.

When considering the validity of the Park and Ride scheme, the key considerations were:

- Will the scheme improve travel times for commuters?
- What is the existing availability of parking in the area being serviced? (Surrounding the ferry terminal)

The Stockton Ferry council car park is heavily utilised, as observed during the parking beat surveys undertaken. There is also a high demand for parking in the locality, both on street and in informal areas surrounding the terminal and the adjacent Griffith Park. Based on observations there is however excess parking available in this area throughout the day, within 400 metres walking distance of the ferry terminal. Whilst parking is relatively easily available commuters are unlikely to drive to Corroba Oval, change to a shuttle bus or similar and then change again to cross to the city by ferry. Therefore, a Park and Ride scheme such as that proposed would be perceived by commuters as being less efficient than parking as close to the terminal as possible and walking.

In order to make a Park and Ride scheme feasible, the parking within easy walking distance of the terminal would need to be restricted / time controlled or have suitable payment associated with it. Such parking controls would impact however on other people accessing this area. A detailed assessment of this is beyond the scope of this study but would be required to understand more fully the feasibility of a local parking scheme.

Given the above, it is not considered a Park and Ride scheme operating out of Corroba Oval, or any other location, is feasible to service the Stockton Ferry Terminal at this time.

The use of an E-bike (electric bike) sharing service operating between Corroba oval and the Stockton ferry terminal was also considered. This would involve commuters parking at Corroba Oval and traveling via e-bike along the Stockton Cycleway to the terminal. Bike sharing schemes generally require a critical mass to make them viable and rely on a turn over of bikes with ongoing demand throughout a day rather than being a one use point to point service. The operation of this service requires the balancing of bikes (pick up and return to a critical hub) to ensure a suitable number are available for commuters who need to then ride from the terminal back to Corroba Oval at the end of the working day. Otherwise users who may park at Corroba Oval in the morning and ride to the terminal are not guaranteed to have a bike available for the return journey. Further investigation as to the feasibility of such a scheme would be required however it is considered that this is unlikely to be feasible in the short term.

There is however an opportunity to improve cycling facilities for commuters at the Ferry Terminal. As there is an increased interest in e-bikes it is anticipated that the provision of a quality bike hub, providing weatherproof and secure storage along with suitable charging facilities for electric bikes, could see an increase in demand for residents of the study area to ride to the ferry terminal and securely store their bikes and charge through the day as required. The provision of quality end of trip facilities which allow for both e-bikes and regular bicycles in this location would serve to encourage this mode of travel for commuters. Its location within close proximity to the terminal can allow for adequate lighting and passive surveillance.

The encouragement of alternative modes of travel to the ferry terminal, other than by private vehicle, would minimise the high demand for parking currently observed in this location.

## 12. Concept Plans and Associated Cost Estimates

### 12.1 Introduction

For the recommended road and intersection works, improvements to pedestrian and cycling facilities and upgrades to bus infrastructure described throughout this document, cost estimates have been prepared to inform future planning and apportionment of funding as part of the development contributions plan for the area. These costings have been prepared based on the conceptual designs with consideration to the standard costs provided by Council.

### 12.2 Conceptual Designs

Throughout this study, a concept design has been defined as an engineering concept plan which provides sufficient detail to allow for calculation of concept stage engineering estimates based on standard costing parameters provided by Council (where applicable) or as otherwise determined from a Schedule of Rates for Civil Engineering Work. The conceptual designs and associated costings have not allowed for any detailed consideration of the ground conditions, interactions with underground or overhead services or geometric design. Rather, to account for these elements, provisional allowances have been included where appropriate.

### 12.3 Land Acquisition

Conceptual designs prepared by Seca Solution Pty Ltd have endeavoured to contain all works within the existing road reserve to minimise the costs and impacts on adjacent land owners. Where land acquisitions are required to facilitate the construction of the recommended works, the approximate area of land required has been identified and summarised in Table 12.1 to follow. The costings do not allow for the cost of the land acquisition.

All pedestrian and cycling facilities, and public transport infrastructure on Nelson Bay Road is contained within the existing road reserve with no land acquisition required for these elements of the strategy.

### 12.4 Criteria for Concept Level Engineering Estimates

The criteria for development concept level engineering cost estimates relies on initial considerations such as the planning capacity and functional requirements, with costs often based on strategic estimates or typical unit costs for comparable works. At this stage of the design process, there is often deficiencies in the available information such as site conditions, geology, underground services and geotechnical requirements which can all have a significant impact upon the overall construction costs.

As such, the confidence limits for engineering cost estimates at the concept stage are typically in the order of +40% to -20%. The accuracy of these estimates continually improves throughout the design process, as detailed design information becomes increasingly available and there is better appreciation of the overall site conditions.

### 12.5 Basis of Applied Unit Rates for Construction

Port Stephens Council has provided a schedule of unit rates which covers a range of construction activities including kerb and guttering, footpaths, crossings and other pedestrian facilities etc. Where unit costs are available, these have been applied when preparing the cost estimates associate with elements of the recommended works.

Final costs may be slightly higher or lower depending on the prevailing site conditions although these would be expected to reflect the average unit costs overall.

### 12.6 Basis of Concept Level Engineering Estimates

Where unit costs are not available, costings have been derived from similar projects completed by Seca Solution Pty Ltd. These have been converted to unit costs which together with a bill of quantities for the construction works have been applied to determine the incremental costs associated with each construction task.

In the case of required kerb and median works, allowance has been made for the overall cost of the works to be based on advice from Council regarding the typical budget required for such works, in lieu of a bill of quantities.



### 12.7 Engineering Cost Estimates

A summary of the engineering cost estimates for the various road and intersection improvements, pedestrian, bicycle and public transport infrastructure upgrades is provided in Table 12.2.

Where land acquisition has been identified as part of the design process, Council's Property Services Departments will provide land valuations to enable land costs to be incorporated into the relevant works schedules and contributions calculations.

Costings have not been provided for the duplication of Nelson Bay Road between Vardon Road and Dune Drive. Nelson Bay Road forms part of the regional road network, with these upgrades required to support the existing traffic demands along this road corridor as well as future growth to the north of the study area. These upgrades are not required solely due to the future development within the study area and as such funding will need to be confirmed with the RMS.

Similarly, upgrades to the intersection at Nelson Bay Road / Vardon Road and Nelson Bay Road / Taylor Road are also required to support the increased demands on the road corridor which are not solely due to development within the study area. The proportion of costs attributed to future development in the study area will need to be negotiated with the RMS prior to inclusion as part of a future development contributions plan.

### 12.8 Prioritising and Staging of Improvements

The priority and timing of the recommended improvements is summarised in Table 12.3. These reflect the staging of development throughout the study area and the need for improvements due to the changing travel demands associated with this development. Changes in the pattern of development could see a change in the priority and timing of key upgrades, particularly those relating to road improvements and public transport infrastructure as these are largely timed to coincide with developments coming online.

The progression of development within the study area should be subject to regular monitoring and revised with the timings for key improvements revised as required.

With regards to pedestrian and bicycle facilities, priority should be given to infilling gaps within the existing pathways prior to upgrading the existing footpath to a shared footway / cycling way.

#### Table 12.1- Engineering cost estimates for recommended civil works.

Ref #	Facility Name	Description of Works	Capital Cost Estimate
Roads	s and Intersections		
R1	Nelson Bay Road / Vardon Road	Realignment of kerbs and median to restrict right turns onto Nelson Bay Road. Remove and infill U-turn lane.	\$200,000
κı	Nelson Bay Roau / Valuon Roau	Installation of traffic signal controls.	\$1,057,000 <sup>A</sup>
R2	Vardon Road	Widening of Vardon Road between Nelson Bay Road / Popplewell Road.	\$697,000
<b>D</b> 2	Noloon Doy Dood / Toylor Dood	Realignment of kerbs and median to restrict right turns onto Nelson Bay Road. Remove and infill U-turn lane.	\$200,000
R3	Nelson Bay Road / Taylor Road	Remove and infill central median to restrict access to left in / left out onto Nelson Bay Road.	\$200,000
	·	Sub-total	\$2,354,000
		Contingencies (20%)	\$471,000
Dodos	strian / Bicycle Facilities	Sub-total including contingencies	\$2,825,000
P1		son Bay Road (between Braid Road / Bayway Village). Approx. 1,475m.	\$579,000 <sup>в</sup>
P2	Shared Path on western side of Ne	Ison Bay Road (between Vardon Road and Palm Lakes Resort), Approx. 950m.	\$336,000 <sup>в</sup>
P3	Shared Path (between Seaside Bo	ulevard and Popplewell Road). Approx. 2,200m.	\$725,000 <sup>c</sup>
P4	Shared Path (between Popplewell	Road and Fullerton Street) - indicative only. Approx. 2,500m.	\$823,000 <sup>c</sup>
P5	Pedestrian refuge on Fullerton Stre	et for access between Fort Wallace development and Stockton Cycleway.	\$200,000
P6	Upgrades to existing pedestrian (ze		\$100,000
Dubli	c Transport Facilities	Sub-total	\$2,763,000
B1			
to B11	Relocate, replace, upgrade or remo	ove existing bus shelters (x11).	\$275,000
B9	Pedestrian refuge on Nelson Bay R	Road for access to relocated bus stop (B9)	\$200,000
		Sub-total	\$475,000
		Total	\$6,063,000

<sup>A</sup>Proportion of costs to be funded as part of the development contributions plan to be negotiated with RMS. <sup>B</sup> May incur additional costs above that quoted associated with Worimi supervision

<sup>c</sup> Estimate includes additional costs associated with Worimi supervision



Table 12.2 - Summary of land acquisition requirements for recommended civil works

Ref #	Facility Name	Description of Works	Land Area to be Acquired (m <sup>2</sup> )
Roads and	d Intersections		
R1	Nelson Bay Road / Vardon	Realignment of kerbs and median to restrict right turns onto Nelson Bay Road. Remove and infill U-turn lane.	None
	Road	Installation of traffic signal controls.	None
R2	Vardon Road	Widening of Vardon Road between Nelson Bay Road / Popplewell Road.	None
R3	Nelson Day Dood / Taylor Dood	Realignment of kerbs and median to restrict right turns onto Nelson Bay Road. Remove and infill U-turn lane.	None
K3	Nelson Bay Road / Taylor Road	Remove and infill central median to restrict access to left in / left out onto Nelson Bay Road.	None
		Sub-total	None
Pedestria	n / Bicycle Facilities		
P1	Shared Path on eastern side of N	lelson Bay Road (between Braid Road / Bayway Village). Approx. 1,475m.	TBC to allow for 70m connection
P2	Shared Path on western side of N	lelson Bay Road (between Vardon Road and Palm Lakes Resort), Approx. 950m.	None
P3	Shared Path (between Seaside B	oulevard and Popplewell Road). Approx. 2,200m.	TBC
P4	Shared Path (between Popplewe	II Road and Fullerton Street) - indicative only. Approx. 2,500m	None
P5	Pedestrian refuge on Fullerton St	reet for access between Fort Wallace development and Stockton Cycleway	None
P6	Upgrades to existing pedestrian (	zebra) crossing on Fullerton Street.	None
		Sub-total	None
Public Tra	ansport Facilities		
B1 to B11	Relocate, replace, upgrade or rer	nove existing bus shelters (x11).	None
B9	Pedestrian refuge on Nelson Bay	Road for access to relocated bus stop (B9)	None
		Sub-total	None
		Total	TBC

#### Table 12.3 - Prioritisations and staging of recommended works

Ref #	Facility Name	Description of Works	Priority / Staging
Road	s and Intersections		
R1	Nelson Bay Road / Vardon Road	Realignment of kerbs and median to restrict right turns onto Nelson Bay Road. Remove and infill U-turn lane.	2021
R3	Nelson Bay Road / Taylor Road	Realignment of kerbs and median to restrict right turns onto Nelson Bay Road. Remove and infill U-turn lane.	2021
R1	Nelson Bay Road / Vardon Road	Installation of traffic signal controls.	2026
R2	Vardon Road	Widening of Vardon Road between Nelson Bay Road / Popplewell Road.	2026
R3	Nelson Bay Road / Taylor Road	Remove and infill central median to restrict access to left in / left out onto Nelson Bay Road.	2026
Pedes	strian / Bicycle Facilities		
P1	Shared Path on eastern side of Nelson Ba	y Road (between Braid Road / Bayway Village). Approx. 1,475m.	2 / 2026
P2	Shared Path on western side of Nelson Ba	y Road (between Vardon Road and Palm Lakes Resort), Approx. 950m.	3 / 2026
P3	Shared Path (between Seaside Boulevard	and Popplewell Road). Approx. 2,200m.	4 / 2026
P4	Shared Path (between Popplewell Road a	nd Fullerton Street) - indicative only. Approx. 2,500m.	5 / 2036
P5	Pedestrian refuge on Fullerton Street for a	ccess between Fort Wallace development and Stockton Cycleway.	1 / 2021
P6	Upgrades to existing pedestrian (zebra) cro	ossing on Fullerton Street.	4 / 2026
Publi	c Transport Facilities		
B1	Relocate existing bus stop on Seaside Bou	Ilevard. Upgrade to provide seating and shelter.	1 / 2021
B2	Upgrade existing bus stop to provide seating	ng and shelter (timed to coincide with development of Fort Wallace).	2 / 2021
B3	Upgrade existing bus stop to provide seating	ng and shelter.	3 / 2021
B4	Bus route diverted on Vardon Road to con	nect with Rifle Range site (timed to coincide with installation of traffic signals at Vardon Road).	4 / 2026
B5		ar Vardon Road. Upgrade to provide seating and shelter (timed to coincide with installation of traffic signals at	5 / 2026
B6	Provide new northbound bus stop near Va	rdon Road with seating and shelter (timed to coincide with installation of traffic signals at Vardon Road).	5 / 2026
B7	Upgrade existing bus stop to provide seating	ng and shelter (timed to coincide with development of Caravan Park).	6 / 2026
B8	Upgrade existing bus stop to provide seating	ng and shelter (timed to coincide with development of Caravan Park).	6 / 2026
B9	Relocate the existing northbound bus stop	(located to the immediate north of the Stockton Bridge) to be further north of the roundabout. Upgrade to provide ill also be constructed on Nelson Bay Road to facilitate access to development on the eastern side of the road (timed	7 / 2026
B10	· · · · · · · · · · · · · · · · · · ·	ng and shelter (timed to coincide with development of the preferred site for mixed use centre).	7 / 2026
B11		existing bus stop to front of Stockton Centre. Upgrade to provide seating and shelter (timed to coincide with	7 / 2026

### 12.9 Concepts and Bills of Quantities

### 12.9.1 Nelson Bay Road and Vardon Road 2021 (R1)

Description of Works: Realignment of kerbs and median to restrict right turns onto Nelson Bay Road. Remove and infill U-turn lane.

Cost Estimate:

An allowance of \$200,000.00 has been made to complete these works. This figure has been advised by Council and reflects the typical budget required to complete works of this nature.

# SECA solution >>>>>

### 12.9.2 Nelson Bay Road and Vardon Road 2026 (R1)

Description of Works: Installation of traffic signal controls.



Figure 12.1 - Concept design for Nelson Bay Road and Vardon Road upgrade to traffic control signals

### Quantity Schedule: (Concept only)

Table 12.4 - Nelson Bay Road and Vardon Road 2026: Bill of Quantities

Description	Quantity	Unit	Unit Cost	Cost
General				
Site Establishment and supervision	1	Item	\$150,000.00	\$150,000.00
Site Amenities	1	Item	\$10,500.00	\$10,500.00
Setout Survey	1	Item	\$25,000.00	\$25,000.00
Geotechnical Testing (Compaction and Concrete)	1	Item	\$12,000.00	\$12,000.00
Location of Services	1	Item	\$10,000.00	\$10,000.00
Traffic Control	1	Item	\$150,000.00	\$150,000.00
Site Destablishment	1	Item	\$5,000.00	\$5,000.00
Subtotal			+-,	\$362,500.00
Demolition		1	II	<i>+••=</i> / <i>•••</i>
Remove Existing Kerb and Gutter	14	m	\$25.00	\$350.00
Remove Existing Concrete Footpath	8	m <sup>2</sup>	\$16.50	\$132.00
Remove Existing pavement and earthworks	465	m <sup>2</sup>	\$5.00	\$2,325.00
Waste Classification Assessment	1	Item	\$10,000	\$10,000.00
Tipping Fees (If contaminated tipping fees could be higher)	1	Item	\$50,000	\$50,000.00
Subtotal		m <sup>2</sup>		\$62,807.00
Earthworks				<i>+02,007.00</i>
Bulk earthworks including trim and compact batters	465	m <sup>2</sup>	\$15.00	\$6,975.00
Trim and Compact Road Subgrade, Vardon Road	260	m <sup>2</sup>	\$6.50	\$1,690.00
Trim and Compact Subgrade, Nelson Bay Road (West Side)	205	m <sup>2</sup>	\$6.50	\$1,332.50
Trim and Compact Footpath/Cycleway, Nelson Bay Road (West Side)	525	m²	\$6.00	\$3,150.00
Subtotal				\$13,147.50
Flexible Pavement				· · ·
Supply, Place and Compact 200mm Moderately Stabilised Sub-Base Course	202	m²	\$56.00	\$11,312.00
Supply, Place and Compact 200mm Heavily Bound Base Course	202	m²	\$56.00	\$11,312.00
Supply and Place 7mm Primer Seal	202	m <sup>2</sup>	\$7.90	\$1,595.80
Supply and Place 80mm AC20 (AR450)	202	m <sup>2</sup>	\$50.00	\$10,100.00
Supply and Place HD 80mm AC20 (AR450)	202	m <sup>2</sup>	\$50.00	\$10,100.00
Supply and Place HD 42mm AC14 (AR450)	202	m <sup>2</sup>	\$30.00	\$6,060.00
Supply and Place Tack Coat along exist/new pavement interfaces	1	Item	\$1,200.00	\$1,200.00
Resheet 42mm ac14 across the intersection	1160	m²	\$30.00	\$34,800.00
Subtotal			,	\$86,479.80
Concrete Works				
Upright Kerb and Gutter RMS SA Type. Vardon Road	57	m	\$110.00	\$6,270.00
Upright Kerb and Gutter RMS SA Type. Nelson Bay Road (West Side)	51	m	\$110.00	\$5,610.00
RMS SF Type Kerb. Nelson Bay Road, raised median	58	m	\$110.00	\$6,380.00
Pedestrian Pram Ramps	5	Item	\$750.00	\$3,750.00
Concrete infill median. Nelson Bay Road	111	m <sup>2</sup>	\$80.00	\$8,800.00
Subtotal	111		ψ00.00	\$30,810.00
Utility Services				<i>400,010.00</i>



Relocate power pole, Vardon Road / Nelson Bay Road	1	Item	\$30,000.00	\$30,000.00
Subtotal				\$30,000.00
Subsoil Drainage				
Subsoil Drainage per Council Std Drwg	108	m	\$65.00	\$7,020.00
Install Subsoil Drainage Flushing Points	4	Item	\$175.00	\$700.00
Connection to Existing Subsoil Drains	2	Item	\$500.00	\$1000.00
Subtotal				\$8,720.00
Linemarking and Signage				
Linemarkings and Symbols	1	Item	\$15,000.00	\$15,000.00
Signage	1	Item	\$5,000.00	\$5,000.00
Subtotal				\$20,000.00
Landscaping, Turfing, Vegetation Works				
Topsoil and Turf behind kerbs (1 strip)	330	m <sup>2</sup>	\$17.50	\$5,775.00
Topsoil and grass seed to batters	100	m <sup>2</sup>	\$5.00	\$500.00
Subtotal				\$6,275.00
Sediment and Erosion Control				
Allowance for Sediment & Erosion Control	1	Item	\$10,000	\$10,000.00
Subtotal				\$10,000.00
Traffic Control Signals				
Upgrade to Traffic Control Signals	1	Item	\$330,000.00	\$330,000.00
Subtotal				\$330,000.00
Total Excluding GST				\$960,739.30
GST (10%)				\$96,073.93
Total Including GST				\$1,056,813.23

#### 12.9.3 Vardon Road 2026 (R2)

Description of Works: Widening of Vardon Road between Nelson Bay Road / Popplewell Road.

### Quantity Schedule: (Concept only)

Table 12.5 - Vardon Road widening 2026: Bill of Quantities

Description	Quantity	Unit	Unit Cost	Cost
General				
Setout Survey	1	Item	\$25,000.00	\$25,000.00
Geotechnical Testing (Compaction and Concrete)	1	Item	\$12,000.00	\$12,000.00
Location of Services	1	Item	\$10,000.00	\$10,000.00
Subtotal				\$47,000.00
Demolition				
Remove Existing pavement and earthworks	285	m <sup>2</sup>	\$5.00	\$1,425.00
Waste Classification Assessment	1	Item	\$10,000	\$10,000.00
Tipping Fees (If contaminated tipping fees could be higher)	1	Item	\$50,000	\$50,000.00
Subtotal		m <sup>2</sup>	+,	\$61,425.00
Earthworks				,,
Bulk earthworks including trim and compact batters	1,283	m <sup>2</sup>	\$15.00	\$19,237.50
Trim and Compact Road Subgrade, Vardon Road	1,283	m <sup>2</sup>	\$6.50	\$8,336.25
Subtotal	1,200		φ0.00	\$27,573.75
Flexible Pavement				φ21,515.15
Supply, Place and Compact 200mm Moderately Stabilised	1140	m <sup>2</sup>	\$56.00	\$63,840.00
Sub-Base Course				. ,
Supply, Place and Compact 200mm Heavily Bound Base Course	1140	m <sup>2</sup>	\$56.00	\$63,840.00
Supply and Place 7mm Primer Seal	1140	m <sup>2</sup>	\$7.90	\$9,006.00
Supply and Place 80mm AC20 (AR450)	1140	m <sup>2</sup>	\$50.00	\$57,000.00
Supply and Place HD 80mm AC20 (AR450)	1140	m <sup>2</sup>	\$50.00	\$57,000.00
Supply and Place HD 42mm AC14 (AR450)	1140	m²	\$30.00	\$34,200.00
Supply and Place Tack Coat along exist/new pavement interfaces	1	Item	\$1,200.00	\$1,200.00
Subtotal				\$286,086.00
Concrete Works				
Upright Kerb and Gutter RMS SA Type. Vardon Road	285	m	\$110.00	\$31,350.00
Upright Kerb and Gutter RMS SA Type. Popplewell Road Intersection	18	m	\$110.00	\$1,980.00
Subtotal				\$33,330.00
Utility Services				
Provision Allowance for Relocation of U/G Services	1	Item	\$150,000.00	\$150,000.00
Subtotal			. ,	\$150,000.00
Subsoil Drainage				
Subsoil Drainage per Council Std Drwg	285	m	\$65.00	\$18,525.00
Install Subsoil Drainage Flushing Points	10	Item	\$175.00	\$1,750.00
Connection to Existing Subsoil Drains	2	Item	\$500.00	\$1,000.00
Subtotal	<u> </u>		<i>\</i> 000.00	\$21,275.00
Landscaping, Turfing, Vegetation Works				<i>\$21,270.00</i>
Topsoil and Turf behind kerbs (1 strip)	303	m <sup>2</sup>	\$17.50	\$5,302.00
Topsoil and grass seed to batters	303	m <sup>2</sup>	\$5.00	\$1,515.00
Subtotal	000	- 111	ψ0.00	\$6,817.50
Total Excluding GST				\$633,507.25
9				
GST (10%) Total Including CST				\$63,350.73
Total Including GST lote: These works will occur in conjunction with the upgrade of Nelson Bay		lan Daad	to traffic control size	\$696,857.98

Note: These works will occur in conjunction with the upgrade of Nelson Bay Road and Vardon Road to traffic control signals. It is assumed costs related to general construction site establishment and traffic control will be shared between these works.

#### 12.9.4 Nelson Bay Road and Taylor Road 2021 (R3)

Description of Works: Realignment of kerbs and median to restrict right turns onto Nelson Bay Road. Remove and infill U-turn lane.

#### Cost Estimate:

An allowance of \$200,000.00 has been made to complete these works. This figure has been advised by Council and reflects the typical budget required to complete works of this nature.

#### 12.9.5 Nelson Bay Road and Taylor Road 2026 (R3)

Description of Works: Remove and infill central median to restrict access to left in / left out onto Nelson Bay Road.

#### Cost Estimate:

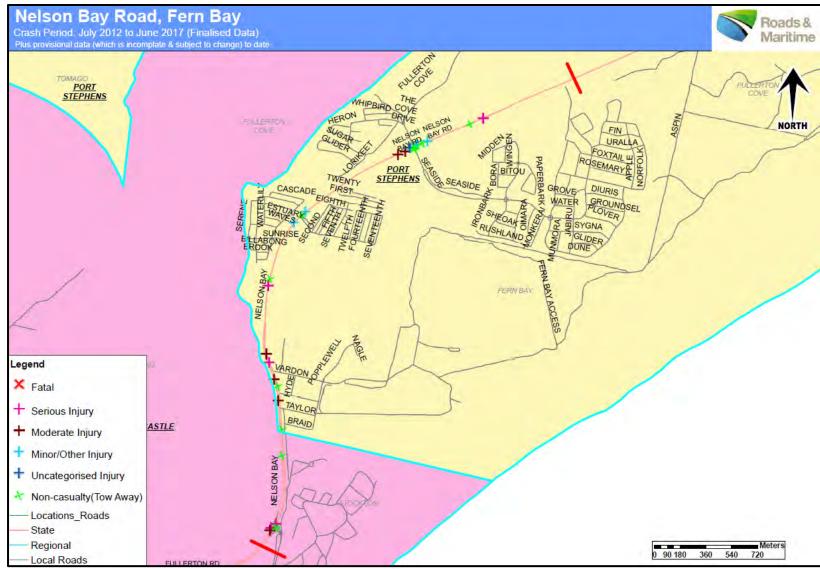
An allowance of \$200,000.00 has been made to complete these works. This figure has been advised by Council and reflects the typical budget required to complete works of this nature.

## 13. Recommendation

From the study work the following works are put forward for implementation:

- Control U-turns and right turn movements at Nelson Bay Road and Vardon Road and Nelson Bay Road and Taylor Road.
- Upgrade intersection of Nelson Bay Road and Vardon Road to traffic signal control. This will allow for safe pedestrian movements and control right turn movements in a safe manner with acceptable delays and congestion
- Duplicate Nelson Bay Road full length between Vardon Road and the roundabout at Seaside Boulevarde
- Provide a footway / cycleway along the western side of Nelson Bay Road from the traffic signals at Vardon Road to connect to the existing footpath adjacent to the residential dwellings in this location. Upgrade existing footpath from this location to Palm Lake development site to allow for both cyclists and mobility aids.
- Upgrade Vardon Road with kerb and gutter and footpaths to both sides
- Provide a footway / cycleway to connect between Seaside Boulevard and the intersection of Vardon Road
   / Popplewell Road
- Allow for upgrade of the footpath along the eastern side of Nelson Bay Road to provide a continual footway / cycleway to connect to the roundabout at Fullerton Street

### Appendix A: Accident Data



						Summary Crash Rep	port					NS	for N	
# Crash Type	1.0		Contributing	Factor	s	Crash Moveme	nt		CRASHE	s	33	CASUA	LTIES	20
Car Crash	30	90.9%	Speeding	6	18.2%	Intersection, adjacent approaches	3	9.1%	Fatal		0 0.0%	Killed	1	0.0%
Light Truck Crash	5	15.2%	Fatigue	4	12.1%	Head-on (not overtaking)	0	0.0%	Serious inj.		5 15.2%	Seriously inj.	1	5 25.0%
Rigid Truck Crash	0	0.0%			1	Opposing vehicles; turning	0	0.0%	Moderate inj.		7 21.2%	Moderately inj.	3	9 45.0%
Articulated Truck Crash	0	0.0%				U-turn	0	0.0%	Minor/Other inj.		5 15.2%	Minor/Other inj.	1	5 25.0%
'Heavy Truck Crash	(0)	(0.0%)	Weathe	r		Rear-end	11	33.3%	Uncategorised inj.		1 3.0%	Uncategorised inj		1 5.0%
Bus Crash	0	0.0%	Fine	23	69.7%	Lane change	1	3.0%	Non-casualty	1	5 45.5%	* Unrestrained	1	0.0%
"Heavy Vehicle Crash	(0)	(0.0%)	Rain	8	24.2%	Parallel lanes; turning	0	0.0%	Self Reported Crash		5 15.15%	^ Belt fitted but not w		
Emergency Vehicle Crash	0	0.0%	Overcast	2	6.1%	Vehicle leaving driveway	0	0.0%	Sen Reported Crash		3 15,15%	fitted to position OR I	to neimet	wom
Motorcycle Crash	3	9.1%	Fog or mist	0	0.0%	Overtaking; same direction	0	0.0%	Time Group	0/-	of Day	Crashes	Cas	ualties
Pedal Cycle Crash	0	0.0%	Other	0	0.0%	Hit parked vehicle	0	0.0%					2017	1
Pedestrian Crash	2	6.1%	Road Surface	Condit	ion	Hit railway train	0	0.0%	00:01 - 02:59		0.0% 12.5%	/	2016	6
Rigid or Artic. Truck " Heavy Tru			the second desired of			Hit pedestrian	2	6.1%	03:00 - 04:59		i.1% 8.3%	5	2015	- 4
# These categories are NOT mut	ually ex	clusive	Wet	11	33.3%	Permanent obstruction on road	0	0.0%	05:00 - 05:59		.0% 4.2%	8	2014	3
Location Typ	e	1	Dry	22	66.7%	Hit animal	0	0.0%	06:00 - 06:59 07:00 - 07:59	-	.1% 4.2%	0	2013	3
*Intersection	12	36.4%	Snow or ice	0	0.0%	Off road, on straight	3	9.1%	07:00 - 07:59	-	2% 4.2%	5	2012	3
Non intersection	21	63.6%	Natural Lig	htina	-	Off road on straight, hit object	8	24.2%	09:00 - 09:59		0.0% 4.2%			
* Up to 10 metres from an interse	ction		1.			Out of control on straight	0	0.0%	10:00 - 10:59		.0% 4.2%			
			Dawn	3	9.1%	Off road, on curve	1	3.0%	11:00 - 11:59		.0% 4.2% i.1% 4.2%			
Collision Typ		(in a d	Daylight	21	63.6%	Off road on curve, hit object	3	9.1%	12:00 - 12:59		0.0% 4.2%			
Single Vehicle	11	33.3%	Dusk	1	3.0%	Out of control on curve	0	0.0%	13:00 - 13:59	6.00	1% 4.2%	1.575 C		Alam X
Multi Vehicle	22	66.7%	Darkness	8	24.2%	Other crash type	1	3.0%	14:00 - 14:59	5 6	1% 4.2%	McLean Periods	1	Week
Road Classifica	ation	-				Speed Limit			15:00 - 15:59		.1% 4.2%	A 10	1000	
	0	0.0%	40 km/h or less	1	3.09	% 80 km/h zone 7	21.2%		16:00 - 16:59		0% 4.2%	B 3		
Freeway/Motorway State Highway	0	0.0%	50 km/h zone	0	0.09	% 90 km/h zone 1	3.0%		17:00 - 17:59	2 6	.1% 4.2%	C 6		
Other Classified Road	33	100.0%	60 km/h zone	2	6.19	% 100 km/h zone 3	9.1%		18:00 - 18:59	-	.1% 4.2%	D		
Unclassified Road	0	0.0%	70 km/h zone	19	57.69	% 110 km/h zone 0	0.0%		19:00 - 19:59		.1% 4.2%	E 2		
				_				-	20:00 - 21:59		.1% 8.3%	F 5		
~ 07:30-09:30 or 14:30-17:00 o	on scho	ol days	~ 40km/h or less	0	0.0%	~ School Travel Time Involvement	7	21.2%	22:00 - 24:00		.0% 8.3%	G 5		
			Day of the	Week								н		
Monday 6 18.2%	Wedn	esday	4 12.1% Friday		7 21.2	% Sunday 4 12.1% WEEK	END 5	15.2%	Street Lighting Off/Nil	% 0	of Dark	0		
Tuesday 5 15.2%	Thurs	day	6 18.2% Saturday		1 3.0	% WEEKDAY 28 84.8%			1 of 8	in Darl	k 12.5%	J 2	. 6.1%	10.79
	-	-		#H	Ioliday Pe	eriods		_	1					
New Year 1 3	.0% E	aster	0 0.0%	Queer		0 0.0% Christmas	0 0.0%	Easter	SH 0 0.0%	Sent/	Oct. SH	2 6.1%		

						91	Detailed	Crash	Repo	rt-se	orted					rans or NS	port SW	
Crash No. Data Source Date	Day of Week	Time	Distance	ID Feature	Loc Type	Alignment	Weather	Surface Condition	Speed Limit No. of Tus	ž	Age/Sex	Street Travelling	Speed Travelling	Manoeuvre	Degree of Crash	Killed	Injured	Factors
			Natural Lighti	ng								100 C						SF
Hunter Region 803563 P 12/07/2012 E48579703	Thu		rt Stephens LGA 5 m N NUMBE Darkness	R 1024 HN	2WY RUM:	CRV	n Bay Raining ear end	Wet	70 3	CAR CAR CAR	M36	Nelson Bay Rd S in NELSON BAY RD S in NELSON BAY RD S in NELSON BAY RD	50 Veering righ 0 Stationary 50 Proceeding		,	0	1	s
Hunter Region 811519 P 12/08/2012 E48423235	Sun		rt Stephens LGA at FULLEF Daylight	RTON COVE RD	RDB RUM:	STR	Fine Fine	Wet	80 1		M58 c island	Nelson Bay Rd W in NELSON BAY RD I etc	70 Proceeding	in lane	Ν	0	0	
Hunter Region 812323 P 18/09/2012 E48804417	Tue		rt Stephens LGA at SEASID Darkness	DE BVD	RDB RUM:	STR	n Bay Raining ff road to left	Wet	80 1	CAR	F19	Nelson Bay Rd N in NELSON BAY RD	40 Proceeding	in lane	N	0	0	
Hunter Region 814382 P 22/10/2012 E49768258	Mon		rt Stephens LGA 650 m N VARDO Daylight	N RD	2WY RUM:	STR	n Bay Fine ear end	Dry	70 2	TRK TRK		Nelson Bay Rd N in NELSON BAY RD N in NELSON BAY RD	60 Proceeding 0 Stationary	in lane	N	0	0	
Hunter Region 816890 P 13/11/2012 E96336002	Tue		rt Stephens LGA at NUMBE Daylight	R 1018 HN	DIV RUM:	STR	n Bay Fine ffrd left => o	Dry	70 2	WAG	M74	Nelson Bay Rd S in NELSON BAY RD S in NELSON BAY RD	70 Proceeding 0 Parked	in lane	Ê	0	2	F
Hunter Region 822681 P 01/01/2013 E49746825	Tue		rt Stephens LGA 70 m W FULLEF Dawn	RTON COVE RD	2WY RUM:	STR	lerton Cov Fine ff rd rght => (	Dry	90 1	VAN Tree/		Nelson Bay Rd E in NELSON BAY RD	80 Proceeding	in lane	1	0	1	
Hunter Region 829475 P 09/01/2013 E52941186	Wed		rt Stephens LGA 50 m N RANKIN Daylight	NRD	DIV RUM:	CRV	n Bay Fine ff left/rt bnd=	Dry >obj	70 2	CAR UTE	M57	Nelson Bay Rd S in NELSON BAY RD S in NELSON BAY RD	70 Proceeding 0 Parked foots		N	0	0	SF
Hunter Region 834635 P 14/03/2013 E50693032	Thu		rt Stephens LGA 100 m E SEASID Daylight	DE BVD	2WY RUM:	STR	n Bay Fine ear end	Dry	70 2			Nelson Bay Rd W in NELSON BAY RD W in NELSON BAY RD	20 Proceeding 20 Proceeding		i.	0	1	
Hunter Region 833321 P 12/04/2013 E51561779	Fri		rt Stephens LGA 50 m N BAYWA Daylight	Y VILLAGE ENT	DIV RUM:	CRV	n Bay Fine earend	Dry	70 2			Nelson Bay Rd S in NELSON BAY RD S in NELSON BAY RD	60 Proceeding 60 Proceeding		Ē	0	1	
Hunter Region 836620 P 15/05/2013 E51252036	Wed		wcastle LGA at FULLEF Daylight	RTON ST	RDB RUM:	Sto CRV	Fine Fine	Dry	70 2	CAR	M62	Nelson Bay Rd W in FULLERTON ST S in NELSON BAY RD	30 Proceeding 50 Proceeding	in lane	N	0	0	

		0					Detailed	Crash	Repo	rt - se	ortec	i				rans or NS	W	
Crash No. Data Source Date	Day of Week	Time	Distance	ID Feature	Loc Type	Alignment	Weather	Surface Condition	Speed Limit No. of Tus	Tu Type/Obj	Age/Sex	Street Travelling	Speed Travelling	Manoeuvre	Degree of Crash	Killed	Injured	Factors
1000		1.000	Natural Li	ghting														SF
Hunter Region 854063 P 01/10/2013 E186125096	Tue		rt Stephens L( at SE Daylig	ASIDE BVD	RDB RUM:	STR	rn Bay Raining Off road to left	Wet	80 1	CAR	M18	Nelson Bay Rd W in NELSON BAY RD	60 Proceed	ling in lane	Ν	0	0	
Hunter Region 1009025 P 24/01/2014 E460723191	Fri		wcastle LGA at FU Darkne	LLERTON ST ess	TJN RUM:	CRV	ockton Overcast Off lft/lft bnd=:	Wet >obj	70 1	CAR		Nelson Bay Rd N in NELSON BAY RD	80 Proceed	ling in lane	1	0	1	s
Hunter Region 1018975 P 26/03/2014 E55192816	Wed		rt Stephens LO at BA Daylig	Y WAY VILLAGE ENT	2WY RUM:	CRV	rn Bay / Fine Right rear	Dry	40 2			Nelson Bay Rd E in NELSON BAY RD E in NELSON BAY RD	60 Proceed 0 Wait tur	-	Ň	0	0	s
Hunter Region 1028158 P 19/05/2014 E55632639	Mon		rt Stephens LO 400 m E SE Davlid	ASIDE BVD	2WY RUM:	STR	rn Bay Fine Offrd left => o	Dry	100 1	CAR Tree/		Nelson Bay Rd N in NELSON BAY RD	100 Proceed	ling in lane	N	0	0	F
Hunter Region 1034828 P 04/07/2014 E55554049	Fri	Po 06:58	rt Stephens LO 60 m S FIF Daw	RST AVE	2WY RUM:	STR	rn Bay Fine Rear end	Dry	70 2			Nelson Bay Rd N in NELSON BAY RD N in NELSON BAY RD	70 Proceed 0 Stationa		1	0	1	
Hunter Region 1033284 P 14/07/2014 E219181195	Mon		rt Stephens L( 40 m E FU Daylig	LLERTON COVE RD	2WY RUM:	STR	rn Bay Raining ⊃ffrd left ⇒ c	Wet	70 1		M18 /culver	Nelson Bay Rd N in NELSON BAY RD t	30 Proceed	fing in lane	N	0	0	
Hunter Region 1040932 P 05/09/2014 E237865894	Fri		rt Stephens LO at SE Darkne	ASIDE BVD	RDB RUM:	CRV	rn Bay / Raining Off left/left ber	Wet	70 1	4WD	M18	Nelson Bay Rd N in NELSON BAY RD	40 Proceed	ding in lane	N	0	0	s
Hunter Region 1041839 P 07/09/2014 E56227779	Sun		rt Stephens LO 150 m S TA Darkne	YLOR RD	DIV RUM:	STR	rn Bay Raining Off rd left => c	Wet	70 2	UTE CAR	υU	Nelson Bay Rd S in NELSON BAY RD S in NELSON BAY RD	70 Proceed 0 Parked 1		N	0	0	F
Hunter Region 1046069 P 04/10/2014 E56053257	Sat		rt Stephens LO 50 m N TA Daw	YLOR RD	2WY RUM:	CRV	rn Bay ∕Fine ⊃fflft/lftbnd≕	Dry >obj	70 1		M34	Nelson Bay Rd N in NELSON BAY RD	Unk Proceed	ding in lane	1	٥	1	
Hunter Region 1073326 P 18/05/2015 E57670105	Mon		rt Stephens L(	GA IMBER 1006 HN	DIV RUM:	Fe	rn Bay	Dry	70 2	CAR	F46	Nelson Bay Rd N in NELSON BAY RD W in NELSON BAY RD		ding in lane oss carriageway	1	0	1	1

# 

							Detailed	Crash	Repo	rt-so	orted	6			Centro for 1	12 2.2	port SW	
Crash No. Data Source Date	Day of Week	Time	Distance	ID Feature	Loc Type	Alignment	Weather	Surface Condition	Speed Limit No. of Tus	Tu Type/Obj	Age/Sex	Street Travelling	Speed Travelling	Manoeuvre	Degree of Crash	Killed	Injured	Factors
1.			Natural Light	ing			_		-									SF
Hunter Region 1072660 S 06/07/2015 E58249513	Mon		rt Stephens LGA at SEASII Daylight	DE BVD	RDB RUM:	STR	rn Bay Fine Rear end	Dry	70 2			Nelson Bay Rd S in NELSON BAY RD S in NELSON BAY RD	Unk Proceedi 0 Stationar	-	-10	0	1	
Hunter Region 1076486 P 08/07/2015 E58885628	Wed		rt Stephens LGA 500 m N FULLE Daylight	RTON COVE RD	2WY RUM:	STR	rn Bay Fine Rear end	Wet	100 2			Nelson Bay Rd N in NELSON BAY RD N in NELSON BAY RD	90 Proceedii 80 Proceedii	-	I	0	1	
Hunter Region 1077915 S 06/08/2015 E58440732	Thu		rt Stephens LGA at SEASII Daylight	DE BVD	RDB RUM:	STR	rn Bay Fine Rear end	Dry	60 2			Nelson Bay Rd N in SEASIDE BVD N in SEASIDE BVD	Unk Proceedi 0 Stationar	-	N	0	0	
Hunter Region 1079824 P 13/09/2015 E58781922	Sun		wcastle LGA 30 m S FULLE Daylight	RTON ST	2WY RUM:	STR	ockton Fine Offrd rght =>	Dry	80 2	WAG	M18	Nelson Bay Rd N in NELSON BAY RD N in NELSON BAY RD	40 Proceedii 0 Parked o	-	1	0	1	
Hunter Region 1093996 P 19/02/2016 E62279787	Fri	Po 08:15	rt Stephens LGA 500 m E SEASII Daylight	DE BVD	2WY RUM:	Fe	rn Bay	Dry	100 3	4WD WAG	M62	Nelson Bay Rd W in NELSON BAY RD W in NELSON BAY RD W in NELSON BAY RD	80 Proceedii 20 Proceedii 30 Proceedii	ng in lane ng in lane	1	0	1	
Hunter Region 1094405 S 22/02/2016 E60174244	Mon		wcastle LGA 500 m N FULLE Daylight	RTON ST	DIV RUM:	STR	Fine Recident	Dry	80 3	TRK CAR TRK	M33	Nelson Bay Rd N in NELSON BAY RD N in NELSON BAY RD N in NELSON BAY RD	Unk Proceedi 0 Broken d Unk Proceedi	own	N	0	0	
Hunter Region 1096112 S 04/03/2016 E218191997	Fri	Poi 15:20	rt Stephens LGA 100 m W FULLE Daylight	RTON ST	2WY RUM:	STR	rn Bay Fine Off rd left => c	Dry	70 1		M32 /culvert	Nelson Bay Rd E in NELSON BAY RD	Unk Proceedir	ng in lane	Ξ.	0	1	
Hunter Region 1097900 P 05/04/2016 E60375937	Tue		wcastle LGA 50 m S FULLE Darkness	RTON ST	DIV RUM:	CRV	Fine Fine	Dry right	80 2	OMV M/C	1.1	Nelson Bay Rd N in NELSON BAY RD N in NELSON BAY RD	80 Veering r 80 Proceedi		Î.	0	1	
Hunter Region 1109229 P 17/06/2016 E61933049	Fri	Poi 19:05	rt Stephens LGA 600 m N VARDO Darkness	ON RD	2WY RUM:	STR	rn Bay Overcast Ped nearside	Dry	60 2	CAR		Nelson Bay Rd N in NELSON BAY RD E in NELSON BAY RD	60 Proceedii Walk acro	ng in lane oss carriageway	.t	0	2	

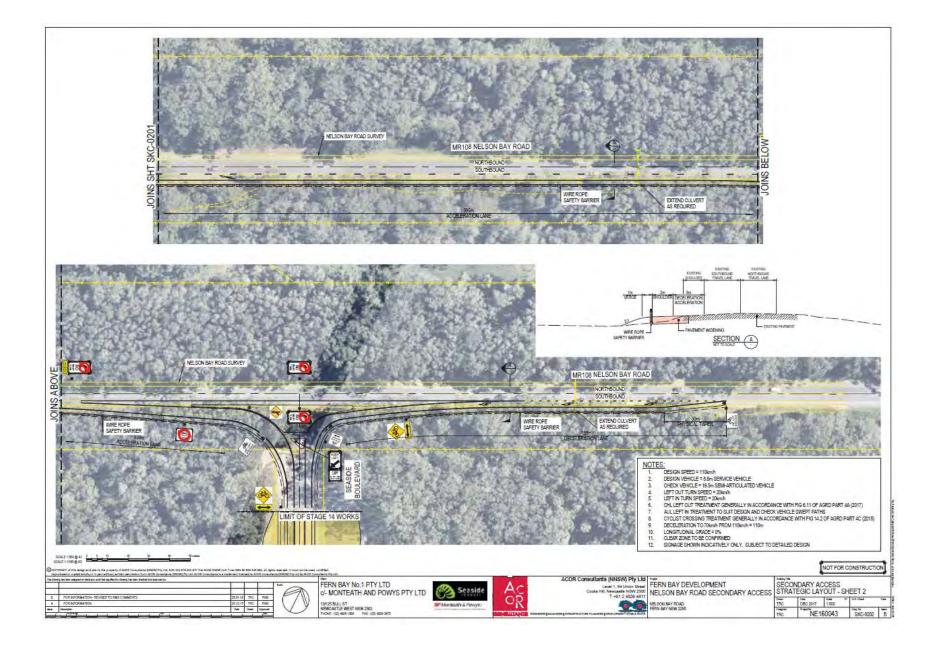
							Detailed C	rash	Repo	rt - s	orted	I			Centre for	ransp or NS	W	
Crash No. Data Source	Day of Week	Time	Distance	ID Feature	Loc Type	Alignment	Weather	Surface Condition	Speed Limit		Age/Sex	Street Travelling	Speed Travelling	Manoeuvre	Degree of Crash	Killed	Injured	Factors
	-		Natural I	Lighting													-	SF
Hunter Region 1117814 S 23/1 E61933870	Sun	Por 11:50		LGA FULLERTON COVE RD ylight	RDB RUM:		Fern Bay TR Fine Rear end	Dry	70 2	CAR		Nelson Bay Rd E in NELSON BAY RD E in NELSON BAY RD	Unk Proceed 0 Stationa		1	0	1	
Hunter Region 1123789 P 15/1 E63331376	Thu	New 17:10		A FULLERTON ST usk	RDB RUM:		Stockton RV Raining Cross traffic	Wet	70 2			Nelson Bay Rd N in FULLERTON ST W in NELSON BAY RD	10 Proceed 20 Proceed	ding in lane ding in lane	N	0	0	1
Hunter Region 1128128 P 19/0 E62998217	Thu	Por 14:20		LGA SEASIDE BVD ylight	RDB RUM:		Fern Bay TR Fine Off road to left	Dry	80 1	CAR	M20	Nelson Bay Rd E in NELSON BAY RD	40 Proceed	ding in lane	Ν	0	0	1
Hunter Region 1145002 P 26/0	Thu	Por 22:08	Stephens	LGA SEASIDE BVD	RDB		Fern Bay FR Raining	Wet	70 2	2 4WD	0.77	Nelson Bay Rd W in SEASIDE BVD	Unk Turning		1	0	1	s
E64115868 Report Totals:	То	tal Crash	Dan les: 33	kness Fatal Crash	RUM: es: 0	12	Left far Injury C	rashes:	18	TRK	F18	N in NELSON BAY RD Killed: 0	10 Proceed Injured	ding in lane d: 20				

## 

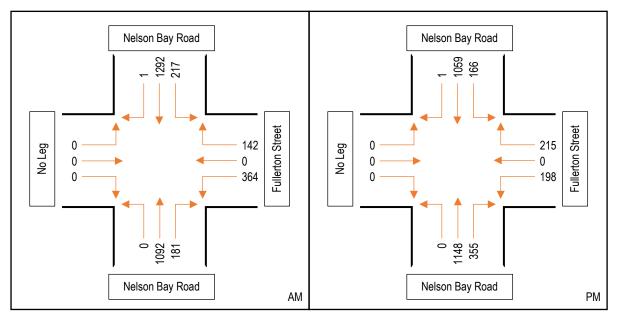


### Appendix B: Dune Drive Strategic Layout (Source: RMS)

## 



## Appendix C: Forecast 2021 Traffic Volumes



### Nelson Bay Road / Fullerton Street



### Nelson Bay Road / Vardon Road

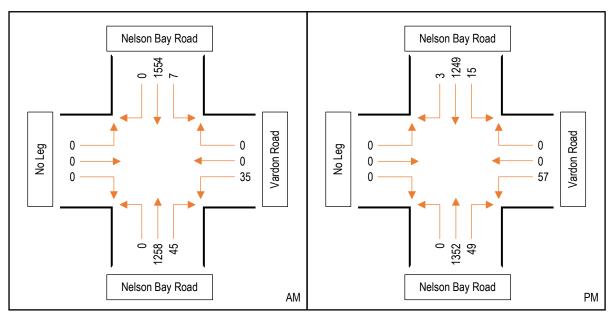
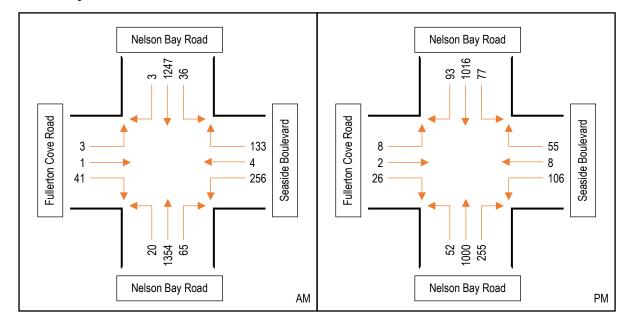


Figure C-2 - Forecast 2021 traffic volumes at the intersection of Nelson Bay Road / Vardon Road (AM/PM)





#### Nelson Bay Road / Seaside Boulevard / Fullerton Cove Road



### Nelson Bay Road / Dune Drive

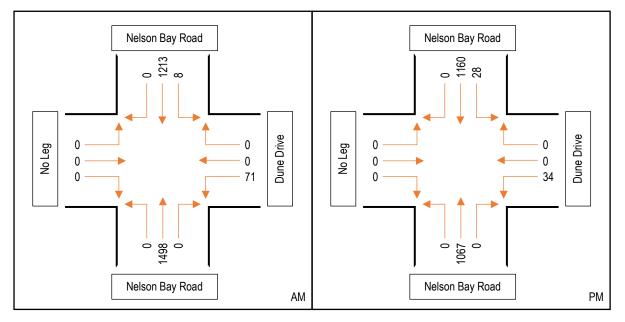
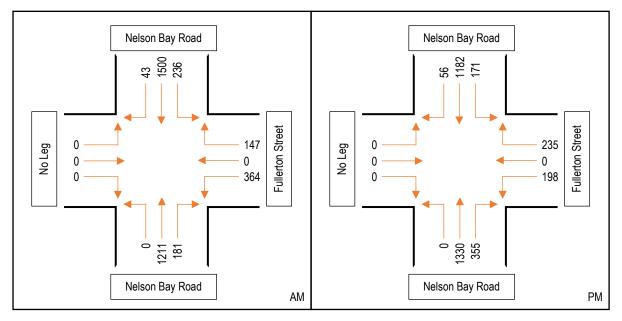


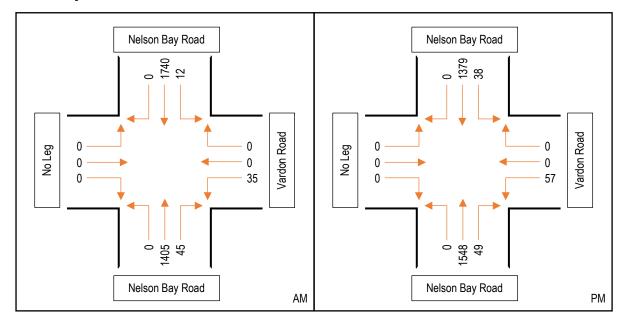
Figure C-4 - Forecast 2021 traffic volumes at the intersection of Nelson Bay Road / Seaside Boulevard / Fullerton Cove Road (AM/PM)

### Appendix D: Forecast 2026 Traffic Volumes



#### Nelson Bay Road / Fullerton Street

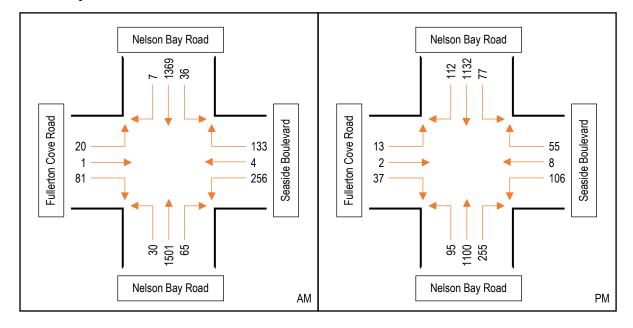
Figure D-1 - Forecast 2026 traffic volumes at the intersection of Nelson Bay Road / Fullerton Street (AM/PM)



### Nelson Bay Road / Vardon Road

Figure D-2 - Forecast 2026 traffic volumes at the intersection of Nelson Bay Road / Vardon Road (AM/PM)





#### Nelson Bay Road / Seaside Boulevard / Fullerton Cove Road



### Nelson Bay Road / Dune Drive

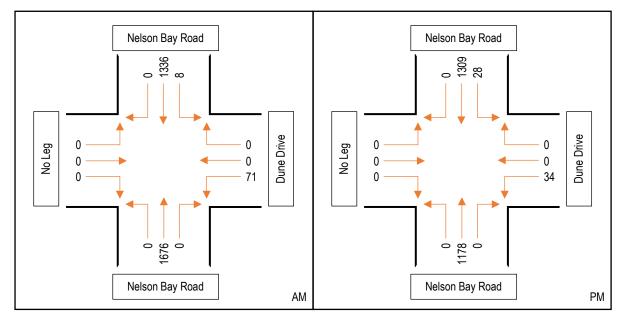
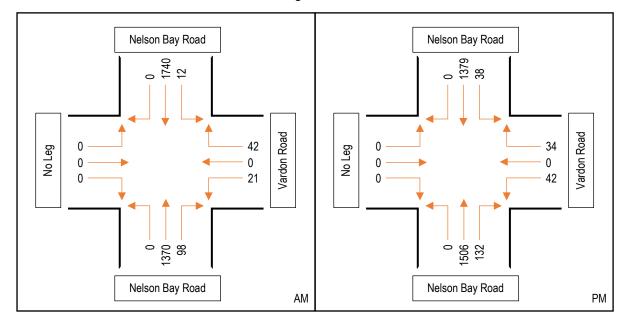


Figure D-4 - Forecast 2026 traffic volumes at the intersection of Nelson Bay Road / Seaside Boulevard / Fullerton Cove Road (AM/PM)

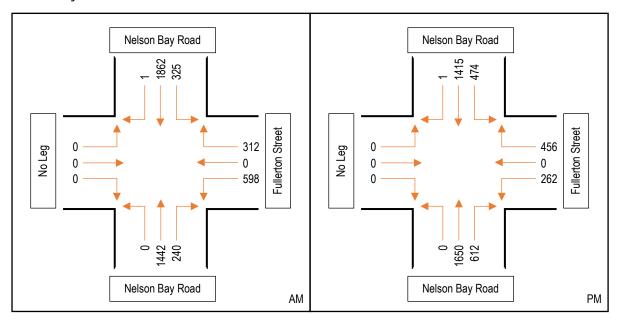


### Forecast demands due to installation of traffic signals at Vardon Road





### Appendix E: Forecast 2036 Traffic Volumes



Nelson Bay Road / Fullerton Street - Preferred site for mixed use centre accessed from Fullerton Street.

Figure E-1 - Forecast 2026 traffic volumes at the intersection of Nelson Bay Road / Fullerton Street (AM/PM)

Nelson Bay Road / Fullerton Street - Preferred site for mixed use centre accessed via 4th leg at roundabout.

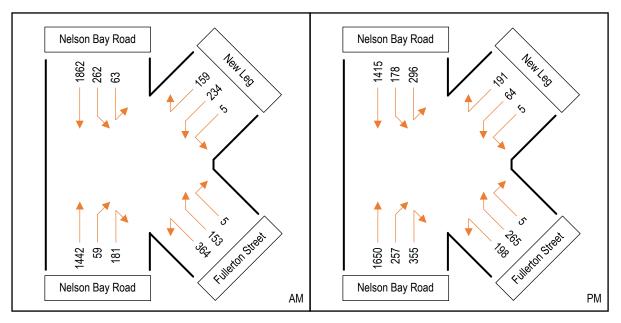


Figure E-2 - Forecast 2036 traffic volumes at the intersection of Nelson Bay Road / Fullerton Street (AM/PM)

Note - Secondary access located on Fullerton Street to cater for demands to/from Stockton.

### Nelson Bay Road / Vardon Road

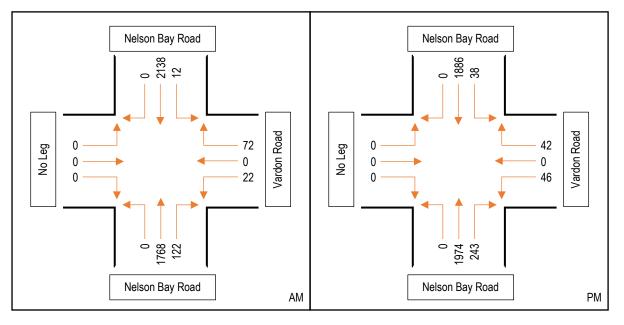
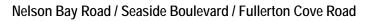


Figure E-3 - Forecast 2036 traffic volumes at the intersection of Nelson Bay Road / Vardon Road (AM/PM)



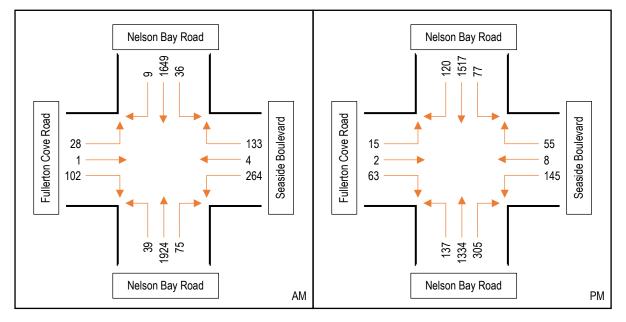


Figure E-4 - Forecast 2036 traffic volumes at the intersection of Nelson Bay Road / Seaside Boulevard / Fullerton Cove Road (AM/PM)

### Nelson Bay Road / Dune Drive

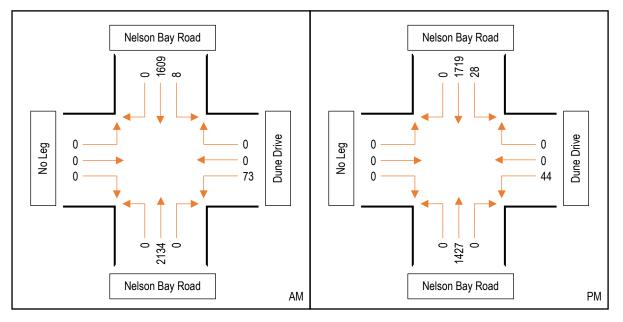


Figure E-5 - Forecast 2036 traffic volumes at the intersection of Nelson Bay Road / Seaside Boulevard / Fullerton Cove Road (AM/PM)

### Appendix F: Sidra Results

2018 Baseline Assessment

### **MOVEMENT SUMMARY**

### Site: 101 [2018 AM Fullerton Street]

Nelson Bay Road / Fullerton Street 2018 AM - Existing Situation Roundabout

Move	ment Pe	erformance	- Vel	nicles							
Mov	OD	Demand F	lows	Deg.	Average	Level of	95% Back	of Queue	Prop.	Effective	Average
ID	Mov	Total	ΗV	Satn	Delay	Service	Vehicles	Distance	Queued	Stop Rate	Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South:	Nelson	Bay Road									
2	T1	1081	3.9	0.278	6.4	LOS A	0.0	0.0	0.00	0.53	71.6
3	R2	182	6.4	0.141	11.0	LOS A	0.8	6.1	0.34	0.64	57.8
Approa	ach	1263	4.3	0.278	7.1	LOS A	0.8	6.1	0.05	0.55	70.0
East: F	Fullerton	Street									
4	L2	351	1.5	0.178	4.8	LOS A	0.0	0.0	0.00	0.53	61.9
6	R2	131	4.0	0.167	12.2	LOS A	0.7	5.1	0.64	0.87	60.1
Approa	ach	481	2.2	0.178	6.8	LOS A	0.7	5.1	0.17	0.62	61.2
North:	Nelson	Bay Road									
7	L2	220	1.9	0.553	6.4	LOS A	4.6	33.0	0.50	0.57	61.8
8	T1	1266	5.1	0.553	6.8	LOS A	4.6	33.0	0.52	0.58	62.2
9u	U	1	0.0	0.553	13.0	LOS A	4.4	32.4	0.54	0.58	65.0
Approa	ach	1487	4.6	0.553	6.7	LOS A	4.6	33.0	0.52	0.58	62.2
All Veh	nicles	3232	4.1	0.553	6.9	LOS A	4.6	33.0	0.28	0.57	64.9

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

Roundabout Capacity Model: SIDRA Standard.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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# Site: 101 [2018 PM Fullerton Street]

Nelson Bay Road / Fullerton Street 2018 PM - Existing Situation Roundabout

Movement Performance - Vehicles												
Mov	OD	Demand F	lows	Deg.	Average	Level of	95% Back	of Queue	Prop.	Effective	Average	
ID	Mov	Total	ΗV	Satn	Delay	Service	Vehicles	Distance	Queued	Stop Rate	Speed	
		veh/h	%	v/c	sec		veh	m		per veh	km/h	
South:	Nelson	Bay Road										
2	T1	1126	2.5	0.288	6.4	LOS A	0.0	0.0	0.00	0.53	71.7	
3	R2	338	2.2	0.274	11.5	LOS A	1.8	12.9	0.47	0.68	58.5	
Approa	ach	1464	2.4	0.288	7.6	LOS A	1.8	12.9	0.11	0.56	69.2	
East: F	Fullerton	Street										
4	L2	199	2.6	0.102	4.8	LOS A	0.0	0.0	0.00	0.53	61.5	
6	R2	217	1.9	0.257	11.7	LOS A	1.1	7.9	0.63	0.84	60.2	
Approa	ach	416	2.3	0.257	8.4	LOS A	1.1	7.9	0.33	0.69	60.7	
North:	Nelson	Bay Road										
7	L2	154	3.4	0.509	7.2	LOS A	4.0	28.4	0.64	0.66	61.0	
8	T1	1046	2.6	0.509	7.6	LOS A	4.0	28.4	0.65	0.67	62.2	
9u	U	1	0.0	0.509	13.9	LOS A	3.8	27.0	0.66	0.69	64.6	
Approa	ach	1201	2.7	0.509	7.5	LOS A	4.0	28.4	0.65	0.67	62.1	
All Veh	nicles	3081	2.5	0.509	7.7	LOS A	4.0	28.4	0.35	0.62	65.0	

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

Roundabout Capacity Model: SIDRA Standard.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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### ▽Site: 101 [2018 AM Vardon Road]

Nelson Bay Road / Vardon Road 2018 AM - Existing Situation Giveway / Yield (Two-Way)

Movement Performance - Vehicles												
Mov	OD	Demand	Flows	Deg.	Average	Level of	95% Back	of Queue	Prop.	Effective	Average	
ID	Mov	Total	ΗV	Satn	Delay	Service	Vehicles	Distance	Queued	Stop Rate	Speed	
		veh/h	%	v/c	sec		veh	m		per veh	km/h	
South:	Nelson	Bay Road										
2	T1	1219	3.5	0.316	0.1	LOS A	0.0	0.0	0.00	0.00	69.9	
3	R2	43	0.0	0.277	32.9	LOS C	0.9	6.3	0.92	0.99	44.3	
Approa	ach	1262	3.4	0.316	1.2	NA	0.9	6.3	0.03	0.03	69.3	
East: \	/ardon F	Road										
4	L2	4	0.0	0.008	9.7	LOS A	0.0	0.2	0.62	0.71	56.5	
6	R2	7	0.0	1.228	1007.1	LOS F	3.6	25.2	1.00	1.13	5.4	
Approa	ach	12	0.0	1.228	644.4	LOS F	3.6	25.2	0.86	0.98	7.2	
North:	Nelson	Bay Road										
7	L2	5	40.0	0.404	7.1	LOS A	0.0	0.0	0.00	0.00	41.9	
8	T1	1539	4.4	0.404	0.2	LOS A	0.0	0.0	0.00	0.00	69.8	
9u	U	1	0.0	0.008	33.9	LOS C	0.0	0.2	0.88	0.94	57.6	
Approa	ach	1545	4.5	0.404	0.2	NA	0.0	0.2	0.00	0.00	69.7	
All Veh	nicles	2819	4.0	1.228	3.3	NA	3.6	25.2	0.02	0.02	68.1	

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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### ▽Site: 101 [2018 PM Vardon Road]

Nelson Bay Road / Vardon Road 2018 PM - Existing Situation Giveway / Yield (Two-Way)

Movement Performance - Vehicles												
Mov	OD	Demand	Flows	Deg.	Average	Level of	95% Back	of Queue	Prop.	Effective	Average	
ID	Mov	Total	ΗV	Satn	Delay	Service	Vehicles	Distance	Queued	Stop Rate	Speed	
		veh/h	%	v/c	sec		veh	m		per veh	km/h	
South:	Nelson	Bay Road										
2	T1	1323	2.4	0.341	0.1	LOS A	0.0	0.0	0.00	0.00	69.9	
3	R2	33	0.0	0.109	18.0	LOS B	0.4	2.5	0.81	0.93	52.4	
Approa	ach	1356	2.3	0.341	0.5	NA	0.4	2.5	0.02	0.02	69.6	
East: \	/ardon F	Road										
4	L2	39	2.7	0.060	8.2	LOS A	0.2	1.5	0.53	0.73	57.4	
6	R2	14	0.0	2.281	1678.9	LOS F	9.8	68.7	1.00	1.28	3.1	
Approa	ach	53	2.0	2.281	442.6	LOS F	9.8	68.7	0.65	0.87	8.2	
North:	Nelson	Bay Road										
7	L2	7	14.3	0.317	6.7	LOS A	0.0	0.0	0.00	0.01	42.3	
8	T1	1221	2.2	0.317	0.1	LOS A	0.0	0.0	0.00	0.00	69.9	
9u	U	3	0.0	0.032	42.1	LOS C	0.1	0.7	0.91	0.97	55.4	
Approa	ach	1232	2.2	0.317	0.3	NA	0.1	0.7	0.00	0.01	69.6	
All Veh	nicles	2640	2.3	2.281	9.2	NA	9.8	68.7	0.02	0.03	64.8	

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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# Site: 101 [2018 AM Seaside Boulevard]

Nelson Bay Road / Seaside Boulevard / Fullerton Cove Road 2018 AM - Existing Situation Roundabout

Move	ment Po	erformand	ce - Vel	hicles							
Mov	OD	Demand		Deg.	Average	Level of	95% Back	of Queue	Prop.	Effective	Average
ID	Mov	Total	ΗV	Satn	Delay	Service	Vehicles	Distance	Queued	Stop Rate	Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South	: Nelson	Bay Road									
1	L2	21	5.0	0.412	5.2	LOS A	3.1	22.5	0.45	0.46	64.2
2	T1	1321	3.9	0.558	5.1	LOS A	5.3	38.3	0.48	0.47	67.1
3	R2	68	10.8	0.558	11.8	LOS A	5.3	38.3	0.49	0.47	64.3
Appro	ach	1411	4.3	0.558	5.4	LOS A	5.3	38.3	0.48	0.47	66.9
East:	Seaside	Boulevard									
4	L2	269	2.0	0.315	7.2	LOS A	1.8	12.6	0.77	0.86	63.3
5	T1	4	25.0	0.234	8.7	LOS A	1.1	8.1	0.73	0.90	25.0
6	R2	140	3.0	0.234	14.3	LOS A	1.1	8.1	0.73	0.90	58.0
Appro	ach	414	2.5	0.315	9.6	LOS A	1.8	12.6	0.76	0.87	61.5
North:	Nelson	Bay Road									
7	L2	38	19.4	0.303	5.3	LOS A	1.9	13.7	0.35	0.45	61.9
8	T1	1233	3.8	0.541	5.0	LOS A	4.6	33.3	0.39	0.44	67.4
9	R2	3	33.3	0.541	12.1	LOS A	4.6	33.3	0.40	0.44	33.0
Appro	ach	1274	4.3	0.541	5.0	LOS A	4.6	33.3	0.39	0.44	67.2
West:	Fullertor	n Cove Roa	ad								
10	L2	3	0.0	0.097	7.4	LOS A	0.4	3.8	0.71	0.88	56.4
11	T1	1	100.0	0.097	10.3	LOS A	0.4	3.8	0.71	0.88	42.3
12	R2	43	41.5	0.097	14.9	LOS B	0.4	3.8	0.71	0.88	59.3
Appro	ach	47	40.0	0.097	14.2	LOS A	0.4	3.8	0.71	0.88	59.0
All Ve	hicles	3145	4.6	0.558	5.9	LOS A	5.3	38.3	0.48	0.52	66.4

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

Roundabout Capacity Model: SIDRA Standard.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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# Site: 101 [2018 PM Seaside Boulevard]

Nelson Bay Road / Seaside Boulevard / Fullerton Cove Road 2018 PM - Existing Situation Roundabout

Move	ment Pe	erformanc	e - Vel	nicles							
Mov	OD	Demand		Deg.	Average	Level of	95% Back	of Queue	Prop.	Effective	Average
ID	Mov	Total	ΗV	Satn	Delay	Service	Vehicles	Distance	Queued	Stop Rate	Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South	: Nelson	Bay Road									
1	L2	55	3.8	0.380	5.3	LOS A	2.5	18.2	0.42	0.47	64.4
2	T1	986	2.8	0.513	5.1	LOS A	4.1	29.7	0.44	0.51	66.9
3	R2	268	2.4	0.513	11.7	LOS A	4.1	29.7	0.45	0.53	64.7
Appro	ach	1309	2.7	0.513	6.5	LOS A	4.1	29.7	0.44	0.51	66.5
East:	Seaside	Boulevard									
4	L2	112	4.7	0.131	6.2	LOS A	0.7	5.1	0.71	0.75	63.5
5	T1	8	62.5	0.109	8.7	LOS A	0.5	3.9	0.70	0.84	25.2
6	R2	58	3.6	0.109	13.1	LOS A	0.5	3.9	0.70	0.84	58.7
Appro	ach	178	7.1	0.131	8.6	LOS A	0.7	5.1	0.70	0.78	60.9
North:	Nelson	Bay Road									
7	L2	81	1.3	0.312	6.0	LOS A	2.0	13.9	0.53	0.55	61.5
8	T1	982	1.6	0.558	5.9	LOS A	4.7	33.6	0.60	0.55	66.7
9	R2	98	1.1	0.558	12.5	LOS A	4.7	33.6	0.62	0.55	32.8
Appro	ach	1161	1.5	0.558	6.4	LOS A	4.7	33.6	0.60	0.55	63.8
West:	Fullertor	n Cove Roa	d								
10	L2	8	12.5	0.055	6.5	LOS A	0.2	1.7	0.64	0.79	57.9
11	T1	2	0.0	0.055	6.0	LOS A	0.2	1.7	0.64	0.79	46.3
12	R2	27	7.7	0.055	12.6	LOS A	0.2	1.7	0.64	0.79	62.6
Appro	ach	38	8.3	0.055	10.9	LOS A	0.2	1.7	0.64	0.79	61.4
All Ve	hicles	2686	2.6	0.558	6.7	LOS A	4.7	33.6	0.53	0.55	64.9

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

Roundabout Capacity Model: SIDRA Standard.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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## Site: 101 [2018 AM Dune Drive]

Nelson Bay Road / Dune Drive 2018 AM - Base Giveway / Yield (Two-Way)

Mover	nent Pe	erformance	- Vel	nicles							
Mov ID	OD Mov	Demand F Total veh/h	lows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back Vehicles veh	of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South:	Nelson	Bay Road									
2	T1	1464	3.8	0.762	0.6	LOS A	0.0	0.0	0.00	0.00	98.6
Approa	ach	1464	3.8	0.762	0.6	NA	0.0	0.0	0.00	0.00	98.6
East: Dune Drive											
4	L2	75	0.0	0.296	20.5	LOS B	1.0	6.9	0.89	0.98	59.4
Approa	ach	75	0.0	0.296	20.5	LOS B	1.0	6.9	0.89	0.98	59.4
North:	Nelson I	Bay Road									
7	L2	8	0.0	0.005	7.8	LOS A	0.0	0.0	0.00	0.66	65.7
8	T1	1199	4.6	0.627	0.1	LOS A	0.0	0.0	0.00	0.00	99.2
Approa	ach	1207	4.5	0.627	0.2	NA	0.0	0.0	0.00	0.00	99.1
All Veh	icles	2746	4.0	0.762	1.0	NA	1.0	6.9	0.02	0.03	97.4

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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## ∇Site: 101 [2018 PM Dune Drive]

Nelson Bay Road / Dune Drive 2018 PM - Base Giveway / Yield (Two-Way)

Mover	nent Pe	erformance	- Vel	nicles							
Mov ID	OD Mov	Demand F Total veh/h	lows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back Vehicles veh	of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South:	Nelson	Bay Road									
2	T1	1053	2.9	0.544	0.2	LOS A	0.0	0.0	0.00	0.00	99.5
Approa	ach	1053	2.9	0.544	0.2	NA	0.0	0.0	0.00	0.00	99.5
East: D	Dune Dri	ve									
4	L2	36	0.0	0.110	14.8	LOS B	0.3	2.4	0.82	0.91	63.9
Approa	ach	36	0.0	0.110	14.8	LOS B	0.3	2.4	0.82	0.91	63.9
North:	Nelson I	Bay Road									
7	L2	29	0.0	0.016	7.8	LOS A	0.0	0.0	0.00	0.66	65.7
8	T1	1125	1.6	0.577	0.1	LOS A	0.0	0.0	0.00	0.00	99.4
Approa	ach	1155	1.5	0.577	0.3	NA	0.0	0.0	0.00	0.02	98.8
All Veh	icles	2243	2.2	0.577	0.5	NA	0.3	2.4	0.01	0.02	98.4

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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2021 Intersection Analysis

### **MOVEMENT SUMMARY**

## Site: 101 [2021 AM Fullerton Street]

Nelson Bay Road / Fullerton Street 2021 Forecast Roundabout

Movement Performance - Vehicles Mov OD Demand Flows Deg. Average Level of 95% Back of Queue Prop. Effective Average												
Mov	OD			Deg.	Average	Level of			Prop.	Effective	Average	
ID	Mov	Total	ΗV	Satn	Delay	Service	Vehicles	Distance	Queued	Stop Rate	Speed	
		veh/h	%	v/c	sec		veh	m		per veh	km/h	
South:	Nelson	Bay Road										
2	T1	1149	3.7	0.296	6.4	LOS A	0.0	0.0	0.00	0.53	71.6	
3	R2	191	6.1	0.151	11.1	LOS A	0.9	6.6	0.36	0.65	57.8	
Approa	ach	1340	4.0	0.296	7.1	LOS A	0.9	6.6	0.05	0.55	70.0	
East: Fullerton Street		Street										
4	L2	383	1.4	0.194	4.8	LOS A	0.0	0.0	0.00	0.53	61.9	
6	R2	149	3.5	0.202	12.4	LOS A	0.9	6.4	0.68	0.89	60.0	
Approa	ach	533	2.0	0.202	6.9	LOS A	0.9	6.4	0.19	0.63	61.2	
North:	Nelson	Bay Road										
7	L2	228	1.8	0.595	6.5	LOS A	5.2	37.6	0.54	0.58	61.6	
8	T1	1360	4.7	0.595	6.9	LOS A	5.2	37.6	0.56	0.59	62.1	
9u	U	1	0.0	0.595	13.2	LOS A	5.1	36.8	0.58	0.60	64.9	
Approa	ach	1589	4.3	0.595	6.9	LOS A	5.2	37.6	0.56	0.59	62.1	
All Veh	nicles	3462	3.8	0.595	7.0	LOS A	5.2	37.6	0.31	0.58	64.8	

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

Roundabout Capacity Model: SIDRA Standard.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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# Site: 101 [2021 PM Fullerton Street]

Nelson Bay Road / Fullerton Street 2021 Forecast Roundabout

Move	lovement Performance - Vehicles Mov OD Demand Flows Deg. Average Level of 95% Back of Queue Prop. Effective Average													
Mov	OD	Demand F	lows	Deg.	Average	Level of	95% Back	of Queue	Prop.	Effective	Average			
ID	Mov	Total	ΗV	Satn	Delay	Service	Vehicles	Distance	Queued	Stop Rate	Speed			
		veh/h	%	v/c	sec		veh	m		per veh	km/h			
South:	Nelson	Bay Road												
2	T1	1208	2.4	0.308	6.4	LOS A	0.0	0.0	0.00	0.53	71.7			
3	R2	374	2.0	0.305	11.5	LOS A	2.1	14.8	0.49	0.68	58.4			
Approa	ach	1582	2.3	0.308	7.6	LOS A	2.1	14.8	0.12	0.57	69.1			
East: F	Fullerton	Street												
4	L2	208	2.5	0.106	4.8	LOS A	0.0	0.0	0.00	0.53	61.6			
6	R2	226	1.9	0.284	11.9	LOS A	1.3	9.2	0.67	0.85	60.1			
Approa	ach	435	2.2	0.284	8.5	LOS A	1.3	9.2	0.35	0.70	60.7			
North:	Nelson	Bay Road												
7	L2	175	3.0	0.564	7.7	LOS A	4.8	34.3	0.70	0.70	60.9			
8	T1	1115	2.5	0.564	8.2	LOS A	4.8	34.3	0.71	0.73	62.0			
9u	U	1	0.0	0.564	14.8	LOS B	4.8	34.1	0.72	0.75	64.4			
Approa	ach	1291	2.5	0.564	8.2	LOS A	4.8	34.3	0.71	0.72	61.9			
All Veh	nicles	3307	2.4	0.564	7.9	LOS A	4.8	34.3	0.38	0.65	64.9			

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

Roundabout Capacity Model: SIDRA Standard.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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## ▽Site: 101 [2021 AM Vardon Road]

Nelson Bay Road / Vardon Road 2021 Forecast Giveway / Yield (Two-Way)

Mover	nent Po	erformance	e - Vel	nicles							
Mov ID	OD Mov	Demand Total	Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back Vehicles	of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South:	Nelson	Bay Road									
2	T1	1324	3.3	0.343	0.1	LOS A	0.0	0.0	0.00	0.00	69.9
3	R2	47	0.0	0.378	42.7	LOS D	1.2	8.7	0.94	1.01	40.1
Approa	ach	1372	3.1	0.378	1.6	NA	1.2	8.7	0.03	0.04	69.1
East: V	/ardon F	Road									
4	L2	37	0.0	0.079	10.8	LOS A	0.3	1.8	0.67	0.84	55.7
Approa	ach	37	0.0	0.079	10.8	LOS A	0.3	1.8	0.67	0.84	55.7
North:	Nelson	Bay Road									
7	L2	7	28.6	0.430	7.0	LOS A	0.0	0.0	0.00	0.01	42.0
8	T1	1636	4.1	0.430	0.2	LOS A	0.0	0.0	0.00	0.00	69.8
9u	U	1	0.0	0.011	42.0	LOS C	0.0	0.2	0.91	0.97	55.4
Approa	ach	1644	4.2	0.430	0.3	NA	0.0	0.2	0.00	0.00	69.7
All Veh	icles	3053	3.7	0.430	1.0	NA	1.2	8.7	0.02	0.03	69.3

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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## Site: 101 [2021 PM Vardon Road]

Nelson Bay Road / Vardon Road 2021 Forecast Giveway / Yield (Two-Way)

Move	ment P	erformance	e - Vel	nicles							
Mov	OD	Demand F	Flows	Deg.	Average	Level of	95% Back	of Queue	Prop.	Effective	Average
ID	Mov	Total	ΗV	Satn	Delay	Service	Vehicles	Distance	Queued	Stop Rate	Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South:	Nelson	Bay Road									
2	T1	1423	2.2	0.366	0.1	LOS A	0.0	0.0	0.00	0.00	69.9
3	R2	52	0.0	0.207	21.5	LOS B	0.7	4.9	0.86	0.96	50.0
Approa	ach	1475	2.1	0.366	0.9	NA	0.7	4.9	0.03	0.03	69.4
East: \	East: Vardon Road										
4	L2	60	1.8	0.098	8.7	LOS A	0.3	2.4	0.56	0.78	57.1
Approa	ach	60	1.8	0.098	8.7	LOS A	0.3	2.4	0.56	0.78	57.1
North:	Nelson	Bay Road									
7	L2	16	6.7	0.343	6.6	LOS A	0.0	0.0	0.00	0.01	42.3
8	T1	1315	2.0	0.343	0.1	LOS A	0.0	0.0	0.00	0.01	69.8
9u	U	3	0.0	0.042	52.4	LOS D	0.1	0.8	0.93	0.98	52.9
Approa	ach	1334	2.1	0.343	0.3	NA	0.1	0.8	0.00	0.01	69.4
All Veh	nicles	2868	2.1	0.366	0.8	NA	0.7	4.9	0.03	0.04	69.3

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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# Site: 101 [2021 AM Seaside Boulevard]

Nelson Bay Road / Seaside Boulevard / Fullerton Cove Road 2021 Forecast Roundabout

Move	ment Po	erformanc	e - Vel	nicles							
Mov	OD	Demand	Flows	Deg.	Average	Level of	95% Back	of Queue	Prop.	Effective	Average
ID	Mov	Total	ΗV	Satn	Delay	Service	Vehicles	Distance	Queued	Stop Rate	Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South	Nelson	Bay Road									
1	L2	21	5.0	0.442	5.3	LOS A	3.5	25.1	0.47	0.47	64.1
2	T1	1425	3.6	0.598	5.1	LOS A	6.0	43.5	0.50	0.47	67.0
3	R2	68	10.8	0.598	11.9	LOS A	6.0	43.5	0.52	0.47	64.2
Appro	ach	1515	4.0	0.598	5.5	LOS A	6.0	43.5	0.50	0.47	66.9
East:	Seaside	Boulevard									
4	L2	269	2.0	0.331	7.7	LOS A	1.9	13.6	0.80	0.88	63.1
5	T1	4	25.0	0.247	9.3	LOS A	1.2	8.7	0.76	0.91	24.8
6	R2	140	3.0	0.247	14.9	LOS B	1.2	8.7	0.76	0.91	57.7
Appro	ach	414	2.5	0.331	10.1	LOS A	1.9	13.6	0.78	0.89	61.2
North:	Nelson	Bay Road									
7	L2	38	19.4	0.321	5.3	LOS A	2.0	14.9	0.35	0.45	61.9
8	T1	1313	3.5	0.574	5.0	LOS A	5.1	37.0	0.40	0.44	67.4
9	R2	3	33.3	0.574	12.2	LOS A	5.1	37.0	0.42	0.44	32.9
Appro	ach	1354	4.0	0.574	5.0	LOS A	5.1	37.0	0.40	0.45	67.2
West:	Fullertor	n Cove Roa	d								
10	L2	3	0.0	0.106	8.1	LOS A	0.5	4.3	0.74	0.89	55.8
11	T1	1	100.0	0.106	11.3	LOS A	0.5	4.3	0.74	0.89	41.6
12	R2	43	41.5	0.106	15.7	LOS B	0.5	4.3	0.74	0.89	58.9
Appro	ach	47	40.0	0.106	14.9	LOS B	0.5	4.3	0.74	0.89	58.6
All Vel	nicles	3329	4.3	0.598	6.0	LOS A	6.0	43.5	0.50	0.52	66.4

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

Roundabout Capacity Model: SIDRA Standard.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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# Site: 101 [2021 PM Seaside Boulevard]

Nelson Bay Road / Seaside Boulevard / Fullerton Cove Road 2021 Forecast Roundabout

Move	ment Pe	erformanc	e - Vel	nicles							
Mov	OD	Demand		Deg.	Average	Level of	95% Back	of Queue	Prop.	Effective	Average
ID	Mov	Total	ΗV	Satn	Delay	Service	Vehicles	Distance	Queued	Stop Rate	Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South	: Nelson	Bay Road									
1	L2	55	3.8	0.399	5.3	LOS A	2.7	19.6	0.43	0.47	64.3
2	T1	1053	2.6	0.539	5.2	LOS A	4.5	32.4	0.45	0.51	66.9
3	R2	268	2.4	0.539	11.8	LOS A	4.5	32.4	0.46	0.53	64.7
Appro	ach	1376	2.6	0.539	6.5	LOS A	4.5	32.4	0.45	0.51	66.5
East:	Seaside	Boulevard									
4	L2	112	4.7	0.140	6.5	LOS A	0.8	5.6	0.74	0.78	63.4
5	T1	8	62.5	0.117	9.3	LOS A	0.6	4.3	0.73	0.86	25.0
6	R2	58	3.6	0.117	13.6	LOS A	0.6	4.3	0.73	0.86	58.5
Appro	ach	178	7.1	0.140	9.0	LOS A	0.8	5.6	0.74	0.81	60.7
North:	Nelson	Bay Road									
7	L2	81	1.3	0.336	6.0	LOS A	2.2	15.3	0.54	0.55	61.4
8	T1	1069	1.5	0.600	5.9	LOS A	5.4	37.9	0.62	0.55	66.6
9	R2	98	1.1	0.600	12.6	LOS A	5.4	37.9	0.65	0.55	32.7
Appro	ach	1248	1.4	0.600	6.5	LOS A	5.4	37.9	0.62	0.55	63.9
West:	Fullertor	n Cove Roa	d								
10	L2	8	12.5	0.057	6.8	LOS A	0.2	1.8	0.66	0.81	57.7
11	T1	2	0.0	0.057	6.2	LOS A	0.2	1.8	0.66	0.81	45.9
12	R2	27	7.7	0.057	12.9	LOS A	0.2	1.8	0.66	0.81	62.4
Appro	ach	38	8.3	0.057	11.2	LOS A	0.2	1.8	0.66	0.81	61.2
All Ve	hicles	2840	2.4	0.600	6.7	LOS A	5.4	37.9	0.55	0.55	65.0

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

Roundabout Capacity Model: SIDRA Standard.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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## Site: 101 [2021 AM Dune Drive]

Nelson Bay Road / Dune Drive 2021 Forecast Giveway / Yield (Two-Way)

Mover	nent Pe	erformance	- Vel	nicles							
Mov ID	OD Mov	Demand F Total veh/h	lows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back Vehicles veh	of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South:	Nelson	Bay Road									
2	T1	1577	3.5	0.819	0.8	LOS A	0.0	0.0	0.00	0.00	98.0
Approa	ich	1577	3.5	0.819	0.8	NA	0.0	0.0	0.00	0.00	98.0
East: D	Dune Dri	ve									
4	L2	75	0.0	0.379	26.7	LOS B	1.3	8.8	0.92	1.02	55.1
Approa	ich	75	0.0	0.379	26.7	LOS B	1.3	8.8	0.92	1.02	55.1
North:	Nelson I	Bay Road									
7	L2	8	0.0	0.005	7.8	LOS A	0.0	0.0	0.00	0.66	65.7
8	T1	1277	4.3	0.666	0.2	LOS A	0.0	0.0	0.00	0.00	99.1
Approa	ich	1285	4.3	0.666	0.2	NA	0.0	0.0	0.00	0.00	99.0
All Veh	icles	2937	3.8	0.819	1.2	NA	1.3	8.8	0.02	0.03	96.8

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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## ∇Site: 101 [2021 PM Dune Drive]

Nelson Bay Road / Dune Drive 2021 Forecast Giveway / Yield (Two-Way)

Mover	ment Pe	erformance	- Vel	nicles							
Mov	OD	Demand F	lows	Deg.	Average	Level of	95% Back	of Queue	Prop.	Effective	Average
ID	Mov	Total	ΗV	Satn	Delay	Service	Vehicles	Distance	Queued	Stop Rate	Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South:	Nelson	Bay Road									
2	T1	1123	2.7	0.580	0.2	LOS A	0.0	0.0	0.00	0.00	99.4
Approa	ach	1123	2.7	0.580	0.2	NA	0.0	0.0	0.00	0.00	99.4
East: D	Dune Dri	ve									
4	L2	36	0.0	0.143	18.3	LOS B	0.4	3.0	0.87	0.94	61.0
Approa	ach	36	0.0	0.143	18.3	LOS B	0.4	3.0	0.87	0.94	61.0
North:	Nelson I	Bay Road									
7	L2	29	0.0	0.016	7.8	LOS A	0.0	0.0	0.00	0.66	65.7
8	T1	1221	1.5	0.626	0.1	LOS A	0.0	0.0	0.00	0.00	99.3
Approa	ach	1251	1.4	0.626	0.3	NA	0.0	0.0	0.00	0.02	98.7
All Veh	nicles	2409	2.0	0.626	0.6	NA	0.4	3.0	0.01	0.02	98.3

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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### 2021 Intersection Analysis (Upgrades)

### **MOVEMENT SUMMARY**

## $\nabla$ Site: 101 [2021 AM Vardon Road - No U-turn]

Nelson Bay Road / Vardon Road 2021 Forecast Giveway / Yield (Two-Way)

Mover	ment Pe	erformance	e - Vel	nicles							
Mov	OD	Demand	Flows	Deg.	Average	Level of	95% Back	of Queue	Prop.	Effective	Average
ID	Mov	Total	ΗV	Satn	Delay	Service	Vehicles	Distance	Queued	Stop Rate	Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South:	Nelson	Bay Road									
2	T1	1324	3.3	0.343	0.1	LOS A	0.0	0.0	0.00	0.00	69.9
3	R2	47	0.0	0.378	42.7	LOS D	1.2	8.7	0.94	1.01	40.1
Approa	ach	1372	3.1	0.378	1.6	NA	1.2	8.7	0.03	0.04	69.1
East: \	East: Vardon Road										
4	L2	37	0.0	0.079	10.8	LOS A	0.3	1.8	0.67	0.84	55.7
Approa	ach	37	0.0	0.079	10.8	LOS A	0.3	1.8	0.67	0.84	55.7
North:	Nelson	Bay Road									
7	L2	7	28.6	0.430	7.0	LOS A	0.0	0.0	0.00	0.01	42.0
8	T1	1636	4.1	0.430	0.2	LOS A	0.0	0.0	0.00	0.00	69.8
Approa	ach	1643	4.2	0.430	0.2	NA	0.0	0.0	0.00	0.00	69.7
All Veh	nicles	3052	3.7	0.430	1.0	NA	1.2	8.7	0.02	0.03	69.3

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akcelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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## ▽Site: 101 [2021 PM Vardon Road - No U-turn]

Nelson Bay Road / Vardon Road 2021 Forecast Giveway / Yield (Two-Way)

Mover	nent Pe	erformance	- Vel	hicles							
Mov ID	OD Mov	Demand F Total	ΗV	Deg. Satn	Average Delay	Level of Service	95% Back Vehicles	Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South:	Nelson	Bay Road									
2	T1	1423	2.2	0.366	0.1	LOS A	0.0	0.0	0.00	0.00	69.9
3	R2	52	0.0	0.207	21.5	LOS B	0.7	4.9	0.86	0.96	50.0
Approa	ach	1475	2.1	0.366	0.9	NA	0.7	4.9	0.03	0.03	69.4
East: Vardon Road											
4	L2	60	1.8	0.098	8.7	LOS A	0.3	2.4	0.56	0.78	57.1
Approa	ach	60	1.8	0.098	8.7	LOS A	0.3	2.4	0.56	0.78	57.1
North:	Nelson	Bay Road									
7	L2	16	6.7	0.343	6.6	LOS A	0.0	0.0	0.00	0.01	42.3
8	T1	1315	2.0	0.343	0.1	LOS A	0.0	0.0	0.00	0.01	69.8
Approa	ach	1331	2.1	0.343	0.2	NA	0.0	0.0	0.00	0.01	69.5
All Veh	icles	2865	2.1	0.366	0.7	NA	0.7	4.9	0.03	0.04	69.3

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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2026 Intersection Analysis

### **MOVEMENT SUMMARY**

## Site: 101 [2026 AM Fullerton Street]

Nelson Bay Road / Fullerton Street 2026 Forecast Roundabout

Move	ment Pe	erformance	- Vel	hicles							
Mov	OD	Demand F	lows	Deg.	Average	Level of	95% Back	of Queue	Prop.	Effective	Average
ID	Mov	Total	ΗV	Satn	Delay	Service	Vehicles	Distance	Queued	Stop Rate	Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South:	Nelson	Bay Road									
2	T1	1275	3.3	0.327	6.4	LOS A	0.0	0.0	0.00	0.53	71.6
3	R2	191	6.1	0.157	11.4	LOS A	0.9	6.8	0.41	0.66	57.6
Approa	ach	1465	3.7	0.327	7.1	LOS A	0.9	6.8	0.05	0.55	70.1
East: F	ullerton	Street									
4	L2	383	1.4	0.194	4.8	LOS A	0.0	0.0	0.00	0.53	61.9
6	R2	155	3.4	0.250	13.2	LOS A	1.2	8.6	0.77	0.93	59.6
Approa	ach	538	2.0	0.250	7.2	LOS A	1.2	8.6	0.22	0.65	61.0
North:	Nelson I	Bay Road									
7	L2	248	1.7	0.698	6.8	LOS A	7.2	51.9	0.64	0.60	61.3
8	T1	1579	4.1	0.698	7.2	LOS A	7.2	52.3	0.66	0.62	61.8
9u	U	45	0.0	0.698	13.6	LOS A	7.2	52.3	0.68	0.63	64.4
Approa	ach	1873	3.7	0.698	7.3	LOS A	7.2	52.3	0.66	0.61	61.9
All Veh	nicles	3876	3.4	0.698	7.2	LOS A	7.2	52.3	0.37	0.59	64.6

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

Roundabout Capacity Model: SIDRA Standard.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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# Site: 101 [2026 PM Fullerton Street]

Nelson Bay Road / Fullerton Street 2026 Forecast Roundabout

Move	ment Pe	erformance	- Vel	nicles							
Mov	OD	Demand F	lows	Deg.	Average	Level of	95% Back	of Queue	Prop.	Effective	Average
ID	Mov	Total	ΗV	Satn	Delay	Service	Vehicles	Distance	Queued	Stop Rate	Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South:	Nelson	Bay Road									
2	T1	1400	2.0	0.356	6.4	LOS A	0.0	0.0	0.00	0.53	71.7
3	R2	374	2.0	0.327	12.0	LOS A	2.2	15.9	0.57	0.72	58.2
Approa	ach	1774	2.0	0.356	7.6	LOS A	2.2	15.9	0.12	0.57	69.3
East: F	Fullerton	Street									
4	L2	208	2.5	0.106	4.8	LOS A	0.0	0.0	0.00	0.53	61.6
6	R2	247	1.7	0.352	12.5	LOS A	1.8	12.5	0.75	0.90	59.9
Approa	ach	456	2.1	0.352	8.9	LOS A	1.8	12.5	0.41	0.73	60.5
North:	Nelson	Bay Road									
7	L2	180	2.9	0.650	8.6	LOS A	6.8	48.9	0.77	0.76	60.6
8	T1	1244	2.2	0.650	9.2	LOS A	6.8	48.9	0.78	0.79	61.6
9u	U	59	0.0	0.650	15.9	LOS B	6.7	47.9	0.79	0.82	63.9
Approa	ach	1483	2.2	0.650	9.4	LOS A	6.8	48.9	0.78	0.79	61.6
All Veh	nicles	3713	2.1	0.650	8.5	LOS A	6.8	48.9	0.42	0.68	64.9

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

Roundabout Capacity Model: SIDRA Standard.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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## ▽Site: 101 [2026 AM Vardon Road]

Nelson Bay Road / Vardon Road 2026 Forecast Giveway / Yield (Two-Way)

Mover	nent Pe	erformance	e - Vel	nicles							
Mov	OD	Demand	Flows	Deg.	Average	Level of	95% Back	of Queue	Prop.	Effective	Average
ID	Mov	Total	ΗV	Satn	Delay	Service	Vehicles	Distance	Queued	Stop Rate	Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South:	Nelson	Bay Road									
2	T1	1479	2.9	0.382	0.1	LOS A	0.0	0.0	0.00	0.00	69.9
3	R2	47	0.0	0.617	84.1	LOS F	2.0	14.3	0.98	1.06	28.9
Approa	ach	1526	2.8	0.617	2.7	NA	2.0	14.3	0.03	0.03	68.5
East: V	/ardon F	Road									
4	L2	37	0.0	0.095	12.5	LOS A	0.3	2.1	0.73	0.87	54.4
Approa	ach	37	0.0	0.095	12.5	LOS A	0.3	2.1	0.73	0.87	54.4
North:	Nelson	Bay Road									
7	L2	13	16.7	0.481	6.8	LOS A	0.0	0.0	0.00	0.01	42.1
8	T1	1832	3.7	0.481	0.3	LOS A	0.0	0.0	0.00	0.00	69.8
Approa	ach	1844	3.8	0.481	0.3	NA	0.0	0.0	0.00	0.00	69.6
All Veh	icles	3407	3.3	0.617	1.5	NA	2.0	14.3	0.02	0.03	69.0

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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## Site: 101 [2026 PM Vardon Road]

Nelson Bay Road / Vardon Road 2026 Forecast Giveway / Yield (Two-Way)

Mover	nent Po	erformance	e - Vel	nicles							
Mov	OD	Demand F	lows	Deg.	Average	Level of	95% Back	of Queue	Prop.	Effective	Average
ID	Mov	Total	ΗV	Satn	Delay	Service	Vehicles	Distance	Queued	Stop Rate	Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South:	Nelson	Bay Road									
2	T1	1629	1.9	0.419	0.1	LOS A	0.0	0.0	0.00	0.00	69.8
3	R2	52	0.0	0.283	29.1	LOS C	1.0	6.7	0.91	0.99	45.9
Approa	ach	1681	1.9	0.419	1.0	NA	1.0	6.7	0.03	0.03	69.4
East: V	/ardon F	Road									
4	L2	60	1.8	0.107	9.4	LOS A	0.4	2.6	0.60	0.81	56.6
Approa	ach	60	1.8	0.107	9.4	LOS A	0.4	2.6	0.60	0.81	56.6
North:	Nelson	Bay Road									
7	L2	40	2.6	0.385	6.6	LOS A	0.0	0.0	0.00	0.03	42.3
8	T1	1452	1.8	0.385	0.2	LOS A	0.0	0.0	0.00	0.02	69.8
Approa	ach	1492	1.8	0.385	0.3	NA	0.0	0.0	0.00	0.02	69.0
All Veh	icles	3233	1.9	0.419	0.9	NA	1.0	6.7	0.03	0.04	69.1

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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# Site: 101 [2026 AM Seaside Boulevard]

Nelson Bay Road / Seaside Boulevard / Fullerton Cove Road 2026 Forecast Roundabout

Move	ment Po	erformand	ce - Vel	hicles							
Mov	OD	Demand		Deg.	Average	Level of	95% Back	of Queue	Prop.	Effective	Average
ID	Mov	Total	ΗV	Satn	Delay	Service	Vehicles	Distance	Queued	Stop Rate	Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South	: Nelson	Bay Road									
1	L2	32	3.3	0.489	5.3	LOS A	4.0	29.0	0.49	0.47	64.1
2	T1	1580	3.3	0.662	5.3	LOS A	7.2	52.1	0.54	0.48	66.9
3	R2	68	10.8	0.662	12.0	LOS A	7.2	52.1	0.57	0.48	64.1
Appro	ach	1680	3.6	0.662	5.5	LOS A	7.2	52.1	0.54	0.48	66.8
East:	Seaside	Boulevard									
4	L2	269	2.0	0.316	6.4	LOS A	1.6	11.5	0.75	0.77	63.4
5	T1	4	25.0	0.243	8.0	LOS A	1.1	7.7	0.73	0.90	25.2
6	R2	140	3.0	0.243	13.6	LOS A	1.1	7.7	0.73	0.90	58.5
Appro	ach	414	2.5	0.316	8.8	LOS A	1.6	11.5	0.74	0.82	61.7
North:	Nelson	Bay Road									
7	L2	38	19.4	0.515	5.5	LOS A	4.4	31.5	0.47	0.46	61.3
8	T1	1441	3.2	0.515	5.2	LOS A	4.4	31.5	0.49	0.47	67.1
9	R2	7	14.3	0.515	12.3	LOS A	4.2	30.4	0.51	0.48	32.9
Appro	ach	1486	3.7	0.515	5.3	LOS A	4.4	31.5	0.49	0.47	66.9
West:	Fullertor	n Cove Roa	ad								
10	L2	21	0.0	0.239	9.7	LOS A	1.2	9.5	0.82	0.93	55.6
11	T1	1	100.0	0.239	13.7	LOS A	1.2	9.5	0.82	0.93	41.0
12	R2	85	21.0	0.239	16.7	LOS B	1.2	9.5	0.82	0.93	59.6
Appro	ach	107	17.6	0.239	15.3	LOS B	1.2	9.5	0.82	0.93	58.9
All Vel	hicles	3687	3.9	0.662	6.1	LOS A	7.2	52.1	0.55	0.53	66.2

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

Roundabout Capacity Model: SIDRA Standard.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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# Site: 101 [2026 PM Seaside Boulevard]

Nelson Bay Road / Seaside Boulevard / Fullerton Cove Road 2026 Forecast Roundabout

Move	ment P	erformanc	e - Vel	nicles							
Mov	OD	Demand		Deg.	Average	Level of	95% Back	of Queue	Prop.	Effective	Average
ID	Mov	Total	ΗV	Satn	Delay	Service	Vehicles	Distance	Queued	Stop Rate	Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South	: Nelson	Bay Road									
1	L2	100	2.1	0.449	5.5	LOS A	3.3	23.3	0.48	0.50	64.2
2	T1	1158	2.4	0.607	5.4	LOS A	5.6	39.9	0.51	0.52	66.8
3	R2	268	2.4	0.607	12.0	LOS A	5.6	39.9	0.53	0.54	64.5
Appro	ach	1526	2.3	0.607	6.5	LOS A	5.6	39.9	0.52	0.52	66.3
East:	Seaside	Boulevard									
4	L2	112	4.7	0.135	5.7	LOS A	0.7	4.8	0.70	0.69	63.5
5	T1	8	62.5	0.117	8.5	LOS A	0.5	3.8	0.70	0.88	25.3
6	R2	58	3.6	0.117	12.7	LOS A	0.5	3.8	0.70	0.88	59.0
Appro	ach	178	7.1	0.135	8.1	LOS A	0.7	4.8	0.70	0.76	61.0
North:	Nelson	Bay Road									
7	L2	81	1.3	0.534	5.9	LOS A	4.5	31.6	0.62	0.53	61.0
8	T1	1192	1.3	0.534	6.0	LOS A	4.5	31.6	0.64	0.56	66.6
9	R2	118	0.9	0.534	13.0	LOS A	4.2	29.9	0.66	0.61	32.7
Appro	ach	1391	1.3	0.534	6.6	LOS A	4.5	31.6	0.64	0.57	63.7
West:	Fullertor	n Cove Roa	d								
10	L2	14	7.7	0.091	7.5	LOS A	0.4	3.1	0.72	0.86	57.4
11	T1	2	0.0	0.091	7.0	LOS A	0.4	3.1	0.72	0.86	45.2
12	R2	39	5.4	0.091	13.6	LOS A	0.4	3.1	0.72	0.86	62.2
Appro	ach	55	5.8	0.091	11.8	LOS A	0.4	3.1	0.72	0.86	60.9
All Ve	hicles	3149	2.2	0.607	6.8	LOS A	5.6	39.9	0.58	0.56	64.8

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

Roundabout Capacity Model: SIDRA Standard.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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## Site: 101 [2026 AM Dune Drive]

Nelson Bay Road / Dune Drive 2026 Forecast Giveway / Yield (Two-Way)

Mover	nent Pe	erformance	- Vel	nicles							
Mov ID	OD Mov	Demand F Total veh/h	lows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back Vehicles veh	of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South:	Nelson	Bay Road									
2	T1	1764	3.2	0.914	1.9	LOS A	0.0	0.0	0.00	0.00	95.5
Approa	ach	1764	3.2	0.914	1.9	NA	0.0	0.0	0.00	0.00	95.5
East: D	Dune Dri	ve									
4	L2	75	0.0	0.040	4.4	LOS A	0.0	0.0	0.00	0.47	48.3
Approa	ach	75	0.0	0.040	4.4	NA	0.0	0.0	0.00	0.47	48.3
North:	Nelson I	Bay Road									
7	L2	8	0.0	0.005	7.8	LOS A	0.0	0.0	0.00	0.66	65.7
8	T1	1406	3.9	0.732	0.2	LOS A	0.0	0.0	0.00	0.00	98.8
Approa	ach	1415	3.9	0.732	0.3	NA	0.0	0.0	0.00	0.00	98.6
All Veh	icles	3254	3.4	0.914	1.2	NA	0.0	0.0	0.00	0.01	95.1

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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## ∇Site: 101 [2026 PM Dune Drive]

Nelson Bay Road / Dune Drive 2026 Forecast Giveway / Yield (Two-Way)

Mover	ment Pe	erformance	- Vel	nicles							
Mov ID	OD Mov	Demand F Total veh/h	lows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back Vehicles veh	of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South:	Nelson	Bay Road									
2	T1	1240	2.5	0.639	0.3	LOS A	0.0	0.0	0.00	0.00	99.2
Approa	ach	1240	2.5	0.639	0.3	NA	0.0	0.0	0.00	0.00	99.2
East: D	Dune Dri	ve									
4	L2	36	0.0	0.019	4.4	LOS A	0.0	0.0	0.00	0.47	48.3
Approa	ach	36	0.0	0.019	4.4	NA	0.0	0.0	0.00	0.47	48.3
North:	Nelson I	Bay Road									
7	L2	29	0.0	0.016	7.8	LOS A	0.0	0.0	0.00	0.66	65.7
8	T1	1378	1.3	0.705	0.2	LOS A	0.0	0.0	0.00	0.00	98.9
Approa	ach	1407	1.3	0.705	0.4	NA	0.0	0.0	0.00	0.01	98.5
All Veh	nicles	2683	1.8	0.705	0.4	NA	0.0	0.0	0.00	0.01	97.7

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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### 2026 Intersection Analysis (Upgrades)

### **MOVEMENT SUMMARY**

## Site: 101v [2026 AM Vardon Road - Signals]

Nelson Bay Road / Vardon Road

2026 Forecast

Signals - Fixed Time Isolated Cycle Time = 90 seconds (Optimum Cycle Time - Minimum Delay)

Move	ment Pe	erformance	e - Vel	nicles							
Mov	OD	Demand	Flows	Deg.	Average	Level of	95% Back	of Queue	Prop.	Effective	Average
ID	Mov	Total	ΗV	Satn	Delay	Service	Vehicles	Distance	Queued	Stop Rate	Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South:	Nelson	Bay Road									
2	T1	1442	3.0	0.466	3.0	LOS A	9.9	71.3	0.35	0.32	68.5
3	R2	103	0.0	0.707	54.5	LOS D	4.9	34.0	1.00	0.84	36.2
Approa	ach	1545	2.8	0.707	6.5	LOS A	9.9	71.3	0.39	0.35	66.7
East: \	Vardon F	Road									
4	L2	22	0.0	0.056	35.2	LOS C	0.8	5.5	0.83	0.69	42.3
6	R2	44	0.0	0.353	50.9	LOS D	2.0	13.9	0.99	0.73	43.4
Approa	ach	66	0.0	0.353	45.7	LOS D	2.0	13.9	0.94	0.72	43.1
North:	Nelson I	Bay Road									
7	L2	13	16.7	0.011	12.2	LOS A	0.2	1.5	0.36	0.65	59.7
8	T1	1832	3.7	0.730	10.9	LOS A	26.4	190.3	0.71	0.66	65.0
Approa	ach	1844	3.8	0.730	10.9	LOS A	26.4	190.3	0.71	0.66	65.0
All Veh	nicles	3456	3.3	0.730	9.6	LOS A	26.4	190.3	0.57	0.52	65.3

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

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.

Move	ement Performance -	Pedestrians						
Mov		Demand	Average	Level of	Average Back c	f Queue	Prop.	Effective
ID	Description	Flow	Delay	Service	Pedestrian	Distance	Queued	Stop Rate
		ped/h	sec		ped	m		per ped
P1	South Full Crossing	21	36.5	LOS D	0.0	0.0	0.90	0.90
P2	East Full Crossing	21	8.5	LOS A	0.0	0.0	0.43	0.43
P3	North Full Crossing	21	39.2	LOS D	0.1	0.1	0.93	0.93
All Pe	edestrians	63	28.1	LOS C			0.76	0.76

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.

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## Site: 101v [2026 PM Vardon Road - Signals]

### Nelson Bay Road / Vardon Road

2026 Forecast

Signals - Fixed Time Isolated Cycle Time = 85 seconds (Optimum Cycle Time - Minimum Delay)

Mover	ment P	erformanc	e - Vel	hicles							
Mov	OD	Demand	Flows	Deg.	Average	Level of	95% Back	of Queue	Prop.	Effective	Average
ID	Mov	Total	ΗV	Satn	Delay	Service	Vehicles	Distance	Queued	Stop Rate	Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South:	Nelson	Bay Road									
2	T1	1585	2.0	0.517	3.4	LOS A	11.6	82.4	0.39	0.35	68.3
3	R2	139	0.0	0.629	47.4	LOS D	5.8	40.9	1.00	0.82	38.5
Approa	ach	1724	1.8	0.629	7.0	LOS A	11.6	82.4	0.44	0.39	66.5
East: V	/ardon F	Road									
4	L2	44	2.4	0.093	30.5	LOS C	1.4	10.0	0.79	0.71	44.2
6	R2	36	0.0	0.270	47.7	LOS D	1.5	10.5	0.98	0.72	44.4
Approa	ach	80	1.3	0.270	38.2	LOS C	1.5	10.5	0.88	0.71	44.3
North:	Nelson	Bay Road									
7	L2	40	2.6	0.036	13.7	LOS A	0.7	4.8	0.43	0.67	59.2
8	T1	1452	1.8	0.627	11.6	LOS A	19.3	136.9	0.69	0.63	64.7
Approa	ach	1492	1.8	0.627	11.7	LOS A	19.3	136.9	0.68	0.63	64.6
All Veh	nicles	3296	1.8	0.629	9.8	LOS A	19.3	136.9	0.56	0.51	65.1

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

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.

Move	ement Performance -	Pedestrians						
Mov		Demand	Average	Level of	Average Back o	f Queue	Prop.	Effective
ID	Description	Flow	Delay	Service	Pedestrian	Distance	Queued	Stop Rate
		ped/h	sec		ped	m		per ped
P1	South Full Crossing	21	34.0	LOS D	0.0	0.0	0.89	0.89
P2	East Full Crossing	21	10.4	LOS B	0.0	0.0	0.49	0.49
P3	North Full Crossing	21	36.7	LOS D	0.0	0.0	0.93	0.93
All Pe	destrians	63	27.0	LOS C			0.77	0.77

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.

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### **MOVEMENT SUMMARY**

## Site: 101 [2036 AM Fullerton Street - Access via Fullerton Street]

Nelson Bay Road / Fullerton Street 2036 Forecast Roundabout

Move	ment Pe	erformance	- Vel	nicles							
Mov	OD	Demand F	lows	Deg.	Average	Level of	95% Back	of Queue	Prop.	Effective	Average
ID	Mov	Total	ΗV	Satn	Delay	Service	Vehicles	Distance	Queued	Stop Rate	Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South:	Nelson	Bay Road									
2	T1	1442	2.8	0.369	6.4	LOS A	0.0	0.0	0.00	0.53	71.7
3	R2	240	4.6	0.221	12.0	LOS A	1.5	10.7	0.57	0.70	57.4
Approa	ach	1682	3.0	0.369	7.2	LOS A	1.5	10.7	0.08	0.55	70.0
East: F	Fullerton	Street									
4	L2	598	0.8	0.302	4.8	LOS A	0.0	0.0	0.00	0.53	62.0
6	R2	312	1.6	0.712	21.9	LOS B	5.1	36.0	0.95	1.09	54.9
Approa	ach	910	1.1	0.712	10.6	LOS A	5.1	36.0	0.33	0.73	58.5
North:	Nelson	Bay Road									
7	L2	325	1.2	0.854	10.1	LOS A	15.9	113.6	0.91	0.77	60.3
8	T1	1862	3.3	0.854	11.2	LOS A	16.1	115.5	0.94	0.81	60.6
9u	U	1	0.0	0.854	18.2	LOS B	16.1	115.5	0.97	0.85	63.2
Approa	ach	2188	3.0	0.854	11.1	LOS A	16.1	115.5	0.93	0.81	60.6
All Veh	nicles	4780	2.6	0.854	9.6	LOS A	16.1	115.5	0.52	0.70	63.3

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

Roundabout Capacity Model: SIDRA Standard.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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# Site: 101 [2036 PM Fullerton Street - Access via Fullerton Street]

Nelson Bay Road / Fullerton Street 2036 Forecast Roundabout

Move	ment Pe	erformance	e - Vel	nicles							
Mov	OD	Demand F	-lows	Deg.	Average	Level of	95% Back	of Queue	Prop.	Effective	Average
ID	Mov	Total	ΗV	Satn	Delay	Service	Vehicles	Distance	Queued	Stop Rate	Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South:	Nelson	Bay Road									
2	T1	1650	1.6	0.419	6.4	LOS A	0.0	0.0	0.00	0.53	71.7
3	R2	612	1.1	0.630	15.1	LOS B	6.8	48.2	0.88	0.88	56.3
Approa	ach	2262	1.5	0.630	8.8	LOS A	6.8	48.2	0.24	0.62	68.1
East: F	ullerton	Street									
4	L2	262	1.9	0.133	4.8	LOS A	0.0	0.0	0.00	0.53	61.7
6	R2	456	0.9	0.746	17.6	LOS B	5.9	41.3	0.93	1.09	57.2
Approa	ach	718	1.3	0.746	12.9	LOS A	5.9	41.3	0.59	0.88	58.3
North:	Nelson	Bay Road									
7	L2	474	1.1	1.097	202.1	LOS F	145.4	1030.9	1.00	4.95	20.0
8	T1	1415	1.8	1.097	204.7	LOS F	145.4	1030.9	1.00	4.72	20.0
9u	U	1	0.0	1.097	212.6	LOS F	119.4	848.9	1.00	4.57	24.6
Approa	ach	1890	1.6	1.097	204.1	LOS F	145.4	1030.9	1.00	4.78	20.0
All Veh	nicles	4870	1.5	1.097	85.2	LOS F	145.4	1030.9	0.59	2.27	33.7

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

Roundabout Capacity Model: SIDRA Standard.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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## Site: 101v [2036 AM Vardon Road - Signals]

### Nelson Bay Road / Vardon Road

2036 Forecast

Signals - Fixed Time Isolated Cycle Time = 110 seconds (Optimum Cycle Time - Minimum Delay)

Mover	ment Pe	erformance	e - Vel	nicles							
Mov	OD	Demand	Flows	Deg.	Average	Level of	95% Back	of Queue	Prop.	Effective	Average
ID	Mov	Total	ΗV	Satn	Delay	Service	Vehicles	Distance	Queued	Stop Rate	Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South:	Nelson	Bay Road									
2	T1	1768	2.3	0.551	3.2	LOS A	14.7	105.1	0.35	0.32	68.5
3	R2	122	0.0	0.795	66.2	LOS E	7.1	49.7	1.00	0.89	33.0
Approa	ach	1890	2.2	0.795	7.2	LOS A	14.7	105.1	0.39	0.36	66.4
East: V	/ardon F	Road									
4	L2	22	0.0	0.059	42.9	LOS D	1.0	6.7	0.84	0.69	39.3
6	R2	72	0.0	0.603	62.6	LOS E	4.0	28.3	1.00	0.79	40.2
Approa	ach	94	0.0	0.603	58.0	LOS E	4.0	28.3	0.96	0.77	40.0
North:	Nelson	Bay Road									
7	L2	12	16.7	0.010	12.1	LOS A	0.2	1.6	0.32	0.64	59.8
8	T1	2138	3.0	0.806	12.5	LOS A	39.4	283.1	0.76	0.71	64.3
Approa	ach	2150	3.1	0.806	12.5	LOS A	39.4	283.1	0.75	0.71	64.3
All Veh	nicles	4134	2.6	0.806	11.1	LOS A	39.4	283.1	0.59	0.55	64.7

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

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.

Move	ement Performance -	Pedestrians						
Mov		Demand	Average	Level of	Average Back o	f Queue	Prop.	Effective
ID	Description	Flow	Delay	Service	Pedestrian	Distance	Queued	Stop Rate
		ped/h	sec		ped	m		per ped
P1	South Full Crossing	20	46.4	LOS E	0.1	0.1	0.92	0.92
P2	East Full Crossing	20	8.0	LOS A	0.0	0.0	0.38	0.38
P3	North Full Crossing	20	49.2	LOS E	0.1	0.1	0.95	0.95
All Pe	destrians	60	34.5	LOS D			0.75	0.75

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.

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## Site: 101v [2036 PM Vardon Road - Signals]

### Nelson Bay Road / Vardon Road

2036 Forecast

Signals - Fixed Time Isolated Cycle Time = 110 seconds (Optimum Cycle Time - Minimum Delay)

Mover	ment P	erformanc	e - Vel	hicles							
Mov	OD	Demand	Flows	Deg.	Average	Level of	95% Back	of Queue	Prop.	Effective	Average
ID	Mov	Total	ΗV	Satn	Delay	Service	Vehicles	Distance	Queued	Stop Rate	Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South:	Nelson	Bay Road									
2	T1	1974	1.5	0.612	3.5	LOS A	18.1	128.5	0.38	0.36	68.3
3	R2	243	0.0	0.791	58.8	LOS E	13.6	94.9	1.00	0.89	34.9
Approa	ach	2217	1.4	0.791	9.6	LOS A	18.1	128.5	0.45	0.41	65.1
East: V	/ardon F	Road									
4	L2	46	2.2	0.088	35.7	LOS C	1.8	12.9	0.77	0.71	42.0
6	R2	42	0.0	0.352	60.9	LOS E	2.3	16.1	0.99	0.73	40.6
Approa	ach	88	1.1	0.352	47.7	LOS D	2.3	16.1	0.88	0.72	41.2
North:	Nelson	Bay Road									
7	L2	38	2.6	0.034	15.4	LOS B	0.8	5.7	0.42	0.67	58.3
8	T1	1886	1.3	0.805	17.3	LOS B	38.7	274.0	0.82	0.76	62.3
Approa	ach	1924	1.4	0.805	17.3	LOS B	38.7	274.0	0.82	0.76	62.3
All Veh	nicles	4229	1.3	0.805	13.9	LOS A	38.7	274.0	0.62	0.58	63.3

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

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.

Move	ement Performance -	Pedestrians						
Mov		Demand	Average	Level of	Average Back o	of Queue	Prop.	Effective
ID	Description	Flow	Delay	Service	Pedestrian	Distance	Queued	Stop Rate
		ped/h	sec		ped	m		per ped
P1	South Full Crossing	20	46.4	LOS E	0.1	0.1	0.92	0.92
P2	East Full Crossing	20	11.8	LOS B	0.0	0.0	0.46	0.46
P3	North Full Crossing	20	49.2	LOS E	0.1	0.1	0.95	0.95
All Pe	destrians	60	35.8	LOS D			0.78	0.78

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.

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# Site: 101 [2036 AM Seaside Boulevard]

Nelson Bay Road / Seaside Boulevard / Fullerton Cove Road 2036 Forecast Roundabout

Move	ment Po	erformanc	e - Vel	hicles							
Mov	OD	Demand	Flows	Deg.	Average	Level of	95% Back	of Queue	Prop.	Effective	Average
ID	Mov	Total	ΗV	Satn	Delay	Service	Vehicles	Distance	Queued	Stop Rate	Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South	: Nelson	Bay Road									
1	L2	39	2.6	0.588	5.5	LOS A	5.6	40.1	0.56	0.49	63.8
2	T1	1924	2.5	0.796	5.5	LOS A	11.9	85.3	0.65	0.50	66.6
3	R2	75	9.3	0.796	12.4	LOS A	11.9	85.3	0.70	0.50	63.7
Appro	ach	2038	2.8	0.796	5.7	LOS A	11.9	85.3	0.65	0.50	66.5
East:	Seaside	Boulevard									
4	L2	264	1.9	0.353	7.3	LOS A	2.0	14.1	0.82	0.90	63.2
5	T1	4	25.0	0.268	9.0	LOS A	1.2	8.9	0.78	0.92	24.9
6	R2	133	3.0	0.268	14.5	LOS A	1.2	8.9	0.78	0.92	57.9
Appro	ach	401	2.5	0.353	9.7	LOS A	2.0	14.1	0.81	0.91	61.4
North:	Nelson	Bay Road									
7	L2	36	19.4	0.598	5.7	LOS A	5.7	40.8	0.56	0.48	60.9
8	T1	1649	2.7	0.598	5.5	LOS A	5.7	40.8	0.58	0.49	66.8
9	R2	9	11.1	0.598	12.6	LOS A	5.5	39.3	0.60	0.51	32.8
Appro	ach	1694	3.1	0.598	5.6	LOS A	5.7	40.8	0.58	0.49	66.6
West:	Fullertor	n Cove Roa	d								
10	L2	28	0.0	0.416	17.8	LOS B	2.5	19.5	0.92	1.04	50.5
11	T1	1	100.0	0.416	23.8	LOS B	2.5	19.5	0.92	1.04	34.2
12	R2	102	16.7	0.416	25.0	LOS B	2.5	19.5	0.92	1.04	55.7
Appro	ach	131	13.7	0.416	23.4	LOS B	2.5	19.5	0.92	1.04	54.7
All Vel	hicles	4264	3.2	0.796	6.6	LOS A	11.9	85.3	0.64	0.55	65.9

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

Roundabout Capacity Model: SIDRA Standard.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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# Site: 101 [2036 PM Seaside Boulevard]

Nelson Bay Road / Seaside Boulevard / Fullerton Cove Road 2036 Forecast Roundabout

Move	ment P	erformanc	e - Vel	hicles							
Mov	OD	Demand	Flows	Deg.	Average	Level of	95% Back	of Queue	Prop.	Effective	Average
ID	Mov	Total	ΗV	Satn	Delay	Service	Vehicles	Distance	Queued	Stop Rate	Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South	: Nelson	Bay Road									
1	L2	137	1.5	0.523	5.6	LOS A	4.3	30.3	0.54	0.51	64.0
2	T1	1334	1.9	0.707	5.5	LOS A	7.8	55.3	0.59	0.53	66.6
3	R2	305	2.0	0.707	12.2	LOS A	7.8	55.3	0.63	0.55	64.3
Appro	ach	1776	1.9	0.707	6.7	LOS A	7.8	55.3	0.59	0.53	66.1
East:	Seaside	Boulevard									
4	L2	145	3.4	0.224	7.0	LOS A	1.2	9.0	0.83	0.85	63.2
5	T1	8	62.5	0.148	10.1	LOS A	0.7	5.2	0.79	0.92	24.9
6	R2	55	3.6	0.148	14.0	LOS A	0.7	5.2	0.79	0.92	58.2
Appro	ach	208	5.8	0.224	9.0	LOS A	1.2	9.0	0.82	0.87	61.0
North:	Nelson	Bay Road									
7	L2	77	1.3	0.691	7.6	LOS A	8.1	57.3	0.79	0.72	60.2
8	T1	1517	1.0	0.691	8.1	LOS A	8.1	57.3	0.80	0.76	66.1
9	R2	120	0.8	0.691	15.5	LOS B	8.0	56.8	0.83	0.82	32.4
Appro	ach	1714	1.0	0.691	8.6	LOS A	8.1	57.3	0.80	0.76	63.7
West:	Fullertor	n Cove Roa	d								
10	L2	15	6.7	0.161	9.2	LOS A	0.8	5.9	0.81	0.93	56.0
11	T1	2	0.0	0.161	8.7	LOS A	0.8	5.9	0.81	0.93	42.8
12	R2	63	3.2	0.161	15.3	LOS B	0.8	5.9	0.81	0.93	61.0
Appro	ach	80	3.8	0.161	14.0	LOS A	0.8	5.9	0.81	0.93	60.1
All Ve	hicles	3778	1.7	0.707	7.8	LOS A	8.1	57.3	0.71	0.66	64.7

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

Roundabout Capacity Model: SIDRA Standard.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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## Site: 101 [2036 AM Dune Drive]

Nelson Bay Road / Dune Drive 2026 Forecast Giveway / Yield (Two-Way)

Mover	nent Pe	erformance	- Vel	nicles							
Mov ID	OD Mov	Demand F Total veh/h	lows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back Vehicles veh	of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South:	Nelson	Bay Road									
2	T1	2134	2.5	1.101	202.9	LOS F	0.0	0.0	0.00	0.00	16.5
Approa	ach	2134	2.5	1.101	202.9	NA	0.0	0.0	0.00	0.00	16.5
East: D	Dune Dri	ve									
4	L2	73	0.0	0.040	4.4	LOS A	0.0	0.0	0.00	0.47	48.3
Approa	ach	73	0.0	0.040	4.4	NA	0.0	0.0	0.00	0.47	48.3
North:	Nelson I	Bay Road									
7	L2	8	0.0	0.004	7.8	LOS A	0.0	0.0	0.00	0.66	65.7
8	T1	1609	3.2	0.834	0.4	LOS A	0.0	0.0	0.00	0.00	97.8
Approa	ach	1617	3.2	0.834	0.5	NA	0.0	0.0	0.00	0.00	97.7
All Veh	icles	3824	2.7	1.101	113.5	NA	0.0	0.0	0.00	0.01	25.8

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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## Site: 101 [2036 PM Dune Drive]

Nelson Bay Road / Dune Drive 2036 Forecast Giveway / Yield (Two-Way)

Mover	nent Pe	erformance	- Vel	nicles							
Mov	OD	Demand F	lows	Deg.	Average	Level of	95% Back	of Queue	Prop.	Effective	Average
ID	Mov	Total	ΗV	Satn	Delay	Service	Vehicles	Distance	Queued	Stop Rate	Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South:	Nelson	Bay Road									
2	T1	1427	2.0	0.734	0.5	LOS A	0.0	0.0	0.00	0.00	98.8
Approa	ach	1427	2.0	0.734	0.5	NA	0.0	0.0	0.00	0.00	98.8
East: D	Dune Dri	ve									
4	L2	44	0.0	0.024	4.4	LOS A	0.0	0.0	0.00	0.47	48.3
Approa	ach	44	0.0	0.024	4.4	NA	0.0	0.0	0.00	0.47	48.3
North:	Nelson I	Bay Road									
7	L2	28	0.0	0.015	7.8	LOS A	0.0	0.0	0.00	0.66	65.7
8	T1	1719	1.0	0.878	0.6	LOS A	0.0	0.0	0.00	0.00	96.9
Approa	ach	1747	1.0	0.878	0.7	NA	0.0	0.0	0.00	0.01	96.6
All Veh	icles	3218	1.4	0.878	0.7	NA	0.0	0.0	0.00	0.01	96.4

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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2036 Intersection Analysis (Upgrades)

### **MOVEMENT SUMMARY**

## Site: 101 [2036 AM Fullerton Street - Access via Fullerton Street - Dual Right Turn]

Nelson Bay Road / Fullerton Street 2036 Forecast Roundabout

Move	ment Pe	erformance	- Vel	hicles							
Mov	OD	Demand F	lows	Deg.	Average	Level of	95% Back	of Queue	Prop.	Effective	Average
ID	Mov	Total	ΗV	Satn	Delay	Service	Vehicles	Distance	Queued	Stop Rate	Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South:	Nelson	Bay Road									
2	T1	1442	2.8	0.369	6.4	LOS A	0.0	0.0	0.00	0.53	71.7
3	R2	240	4.6	0.101	11.6	LOS A	0.7	4.8	0.52	0.67	57.6
Approa	ach	1682	3.0	0.369	7.2	LOS A	0.7	4.8	0.07	0.55	70.0
East: F	ullerton	Street									
4	L2	598	0.8	0.302	4.8	LOS A	0.0	0.0	0.00	0.53	62.0
6	R2	312	1.6	0.733	23.6	LOS B	5.4	38.6	0.96	1.11	54.0
Approa	ach	910	1.1	0.733	11.2	LOS A	5.4	38.6	0.33	0.73	58.1
North:	Nelson I	Bay Road									
7	L2	325	1.2	0.898	10.8	LOS A	16.4	117.3	0.92	0.85	60.1
8	T1	1862	3.3	0.898	11.6	LOS A	16.5	118.6	0.94	0.88	60.5
9u	U	1	0.0	0.898	18.1	LOS B	16.5	118.6	0.95	0.90	63.2
Approa	ach	2188	3.0	0.898	11.4	LOS A	16.5	118.6	0.93	0.88	60.4
All Veh	nicles	4780	2.6	0.898	9.9	LOS A	16.5	118.6	0.52	0.73	63.1

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

Roundabout Capacity Model: SIDRA Standard.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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### Site: 101v [2036 PM Fullerton Street - Access via Fullerton Street - Metering - Dual **Right Turn**]

Nelson Bay Road / Fullerton Street 2036 Forecast **Roundabout Metering** 

Movement Performance - Vehicles Mov OD Demand Flows Deg. Average Level of 95% Back of Queue Prop. Effective Average												
Mov ID	OD Mov	Demand F Total	lows HV	Deg. Satn	Average Delay	Level of Service	95% Back Vehicles	of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed	
		veh/h	%	v/c	sec		veh	m		per veh	km/h	
South:	Nelson	Bay Road										
2	T1	1650	1.6	0.419	6.4	LOS A	0.0	0.0	0.00	0.53	71.7	
3	R2	612	1.1	0.442	19.1	LOS B	10.9	77.2	0.88	0.76	53.2	
Approa	ach	2262	1.5	0.442	9.9	LOS A	10.9	77.2	0.24	0.59	67.2	
East: F	Fullerton	Street										
4	L2	262	1.9	0.133	4.8	LOS A	0.0	0.0	0.00	0.53	61.7	
6	R2	456	0.9	0.700	16.2	LOS B	5.3	37.7	0.91	1.06	58.0	
Approa	ach	718	1.3	0.700	12.0	LOS A	5.3	37.7	0.58	0.87	58.9	
North:	Nelson I	Bay Road										
7	L2	474	1.1	0.904	16.3	LOS B	18.2	129.2	1.00	1.15	56.9	
8	T1	1415	1.8	0.904	17.7	LOS B	18.2	129.2	1.00	1.18	57.0	
9u	U	1	0.0	0.904	24.7	LOS B	17.7	125.7	1.00	1.21	60.0	
Approa	ach	1890	1.6	0.904	17.4	LOS B	18.2	129.2	1.00	1.17	57.0	
All Veh	nicles	4870	1.5	0.904	13.1	LOS A	18.2	129.2	0.58	0.86	61.4	

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

Roundabout Capacity Model: SIDRA Standard.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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# Site: 101 [2036 AM Fullerton Street - Stockton Centre Access via Roundabout - Dual Right Turn]

Nelson Bay Road / Fullerton Street 2036 Forecast Roundabout

Move	ment P	erformance	- Vel	hicles							
Mov	OD	Demand F	lows	Deg.	Average	Level of	95% Back	of Queue	Prop.	Effective	Average
ID	Mov	Total	ΗV	Satn	Delay	Service	Vehicles	Distance	Queued	Stop Rate	Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South	: Nelson	Bay Road									
2	T1	1518	2.8	0.388	6.1	LOS A	0.0	0.0	0.00	0.49	72.8
3a	R1	62	0.0	0.098	8.8	LOS A	0.6	4.3	0.47	0.63	38.3
3b	R3	191	6.1	0.098	11.4	LOS A	0.6	4.3	0.48	0.65	51.9
Appro	ach	1771	3.0	0.388	6.8	LOS A	0.6	4.3	0.07	0.51	69.7
South	East: Fu	llerton Street									
21b	L3	383	1.4	0.222	3.5	LOS A	0.0	0.0	0.00	0.48	55.9
23a	R1	161	3.3	0.464	20.0	LOS B	3.0	21.8	0.96	1.05	50.0
23	R2	5	0.0	0.464	21.1	LOS B	3.0	21.8	0.96	1.05	38.2
Appro	ach	549	1.9	0.464	8.5	LOS A	3.0	21.8	0.29	0.65	53.2
North	East: Sto	ockton Centre	;								
24	L2	5	0.0	0.773	33.0	LOS C	6.5	45.6	1.00	1.23	32.0
24a	L1	246	0.0	0.773	32.6	LOS C	6.5	45.6	1.00	1.23	32.6
26b	R3	167	0.0	0.813	52.0	LOS D	5.7	39.7	0.98	1.23	36.0
Appro	ach	419	0.0	0.813	40.4	LOS C	6.5	45.6	0.99	1.23	34.5
North:	Nelson	Bay Road									
7b	L3	66	0.0	0.924	11.3	LOS A	19.3	138.6	0.96	0.91	55.7
7a	L1	276	1.5	0.924	11.0	LOS A	19.3	138.6	0.96	0.91	57.9
8	T1	1960	3.3	0.924	12.5	LOS A	19.3	138.6	0.98	0.95	60.3
9u	U	1	0.0	0.924	20.7	LOS B	19.2	138.1	1.00	0.98	63.3
Appro	ach	2303	3.0	0.924	12.3	LOS A	19.3	138.6	0.98	0.94	59.9
All Ve	hicles	5042	2.6	0.924	12.3	LOS A	19.3	138.6	0.59	0.79	60.1

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

Roundabout Capacity Model: SIDRA Standard.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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# Site: 101v [2036 PM Fullerton Street - Stockton Centre Access via Roundabout - Dual Right Turns]

Nelson Bay Road / Fullerton Street 2036 Forecast Roundabout Metering

Move	ment P	erformance	- Vel	nicles							
Mov	OD	Demand F	lows	Deg.	Average	Level of	95% Back	of Queue	Prop.	Effective	Average
ID	Mov	Total	ΗV	Satn	Delay	Service	Vehicles	Distance	Queued	Stop Rate	Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South	: Nelson	Bay Road									
2	T1	1650	1.6	0.419	6.1	LOS A	0.0	0.0	0.00	0.49	72.9
3a	R1	257	0.0	0.354	12.7	LOS A	7.0	48.9	0.78	0.70	36.9
3b	R3	355	2.0	0.354	15.5	LOS B	7.0	48.9	0.79	0.74	49.9
Appro	ach	2262	1.5	0.419	8.3	LOS A	7.0	48.9	0.21	0.56	65.9
South	East: Fu	llerton Street									
21b	L3	198	2.5	0.115	3.5	LOS A	0.0	0.0	0.00	0.48	55.8
23a	R1	265	1.5	0.448	12.8	LOS A	2.7	19.4	0.86	0.99	53.3
23	R2	5	0.0	0.448	13.9	LOS A	2.7	19.4	0.86	0.99	43.3
Appro	ach	468	1.9	0.448	8.9	LOS A	2.7	19.4	0.50	0.77	54.0
North	East: Sto	ockton Centre	;								
24	L2	5	0.0	0.206	10.7	LOS A	0.9	6.4	0.83	0.90	46.5
24a	L1	64	0.0	0.206	10.3	LOS A	0.9	6.4	0.83	0.90	47.9
26b	R3	191	0.0	0.394	16.7	LOS B	2.3	16.4	0.90	1.00	50.3
Appro	ach	260	0.0	0.394	15.0	LOS B	2.3	16.4	0.88	0.97	49.9
North:	Nelson	Bay Road									
7b	L3	296	0.0	0.896	13.5	LOS A	14.7	103.9	0.94	1.15	53.1
7a	L1	178	2.8	0.896	13.1	LOS A	14.7	103.9	0.94	1.15	55.7
8	T1	1415	1.8	0.896	15.0	LOS B	14.7	103.9	0.95	1.19	58.5
9u	U	1	0.0	0.896	23.5	LOS B	14.1	100.5	0.96	1.21	62.0
Appro	ach	1890	1.6	0.896	14.6	LOS B	14.7	103.9	0.95	1.18	57.5
All Ve	hicles	4880	1.5	0.896	11.2	LOS A	14.7	103.9	0.56	0.84	60.3

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

Roundabout Capacity Model: SIDRA Standard.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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### Background Growth Only 2021

### **MOVEMENT SUMMARY**

## Site: 101 [AM Fullerton Street - 2021 Background Only]

Nelson Bay Road / Fullerton Street Roundabout Design Life Analysis (Final Year): Results for 3 years

Move	Iovement Performance - Vehicles Nov OD Demand Flows Deg. Average Level of 95% Back of Queue Prop. Effective Average													
Mov	OD	Demand F	lows	Deg.	Average	Level of	95% Back	of Queue	Prop.	Effective	Average			
ID	Mov	Total	ΗV	Satn	Delay	Service	Vehicles	Distance	Queued	Stop Rate	Speed			
		veh/h	%	v/c	sec		veh	m		per veh	km/h			
South:	Nelson	Bay Road												
2	T1	1146	3.9	0.295	6.5	LOS A	0.0	0.0	0.00	0.53	71.6			
3	R2	182	6.4	0.141	11.0	LOS A	0.8	6.2	0.34	0.64	57.8			
Approa	ach	1328	4.2	0.295	7.1	LOS A	0.8	6.2	0.05	0.54	70.0			
East: F	Fullerton	Street												
4	L2	351	1.5	0.178	4.8	LOS A	0.0	0.0	0.00	0.53	61.9			
6	R2	131	4.0	0.174	12.3	LOS A	0.7	5.4	0.66	0.88	60.0			
Approa	ach	481	2.2	0.178	6.8	LOS A	0.7	5.4	0.18	0.63	61.2			
North:	Nelson	Bay Road												
7	L2	220	1.9	0.581	6.5	LOS A	5.0	36.0	0.52	0.57	61.7			
8	T1	1342	5.1	0.581	6.8	LOS A	5.0	36.0	0.54	0.58	62.2			
9u	U	1	0.0	0.581	13.1	LOS A	4.8	35.4	0.56	0.59	64.9			
Approa	ach	1563	4.6	0.581	6.8	LOS A	5.0	36.0	0.54	0.58	62.1			
All Veh	nicles	3372	4.1	0.581	6.9	LOS A	5.0	36.0	0.29	0.57	64.9			

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

Roundabout Capacity Model: SIDRA Standard.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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# Site: 101 [PM Fullerton Street - 2021 Background Only]

### Nelson Bay Road / Fullerton Street

Roundabout Design Life Analysis (Final Year): Results for 3 years

Move	ment Pe	erformance	e - Vel	nicles							
Mov	OD	Demand F	lows	Deg.	Average	Level of	95% Back	of Queue	Prop.	Effective	Average
ID	Mov	Total	ΗV	Satn	Delay	Service	Vehicles	Distance	Queued	Stop Rate	Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South:	Nelson	Bay Road									
2	T1	1194	2.5	0.305	6.4	LOS A	0.0	0.0	0.00	0.53	71.7
3	R2	338	2.2	0.274	11.5	LOS A	1.8	12.9	0.47	0.68	58.5
Approa	ach	1532	2.4	0.305	7.5	LOS A	1.8	12.9	0.10	0.56	69.3
East: F	ullerton	Street									
4	L2	199	2.6	0.102	4.8	LOS A	0.0	0.0	0.00	0.53	61.5
6	R2	217	1.9	0.266	11.8	LOS A	1.2	8.4	0.65	0.85	60.2
Approa	ach	416	2.3	0.266	8.4	LOS A	1.2	8.4	0.34	0.70	60.7
North:	Nelson	Bay Road									
7	L2	154	3.4	0.536	7.3	LOS A	4.3	30.7	0.65	0.66	60.9
8	T1	1109	2.6	0.536	7.7	LOS A	4.3	30.7	0.67	0.68	62.1
9u	U	1	0.0	0.536	14.1	LOS A	4.2	29.7	0.68	0.70	64.6
Approa	ach	1264	2.7	0.536	7.6	LOS A	4.3	30.7	0.66	0.68	62.0
All Veh	nicles	3211	2.5	0.536	7.7	LOS A	4.3	30.7	0.35	0.63	65.0

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

Roundabout Capacity Model: SIDRA Standard.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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## ▽Site: 101 [AM Vardon Road - 2021 Background Only]

#### Nelson Bay Road / Vardon Road Giveway / Yield (Two-Way) Design Life Analysis (Final Year): Results for 3 years

Mover	nent Pe	erformance	e - Vel	nicles							
Mov ID	OD Mov	Demand Total	Flows HV	Deg. Satn	Average Delav	Level of Service	95% Back Vehicles	of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
	NIC V	veh/h	%	v/c	sec	0011100	venicies	m	Queucu	per veh	km/h
South:	Nelson	Bay Road									
2	T1	1300	3.5	0.337	0.1	LOS A	0.0	0.0	0.00	0.00	69.9
3	R2	43	0.0	0.341	41.0	LOS C	1.1	7.7	0.94	1.01	40.7
Approa	ach	1343	3.4	0.341	1.4	NA	1.1	7.7	0.03	0.03	69.2
East: V	/ardon F	Road									
4	L2	12	0.0	0.025	10.5	LOS A	0.1	0.6	0.66	0.80	55.9
Approa	ach	12	0.0	0.025	10.5	LOS A	0.1	0.6	0.66	0.80	55.9
North:	Nelson	Bay Road									
7	L2	5	40.0	0.429	7.1	LOS A	0.0	0.0	0.00	0.00	41.9
8	T1	1631	4.4	0.429	0.2	LOS A	0.0	0.0	0.00	0.00	69.8
9u	U	1	0.0	0.010	40.0	LOS C	0.0	0.2	0.90	0.97	55.9
Approa	ach	1638	4.5	0.429	0.3	NA	0.0	0.2	0.00	0.00	69.7
All Veh	icles	2992	4.0	0.429	0.8	NA	1.1	7.7	0.02	0.02	69.4

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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## ablaSite: 101 [PM Vardon Road - 2021 Background Only]

#### Nelson Bay Road / Vardon Road Giveway / Yield (Two-Way) Design Life Analysis (Final Year): Results for 3 years

Mover	nent P	erformance	e - Ve	hicles							
Mov ID	OD Mov	Demand F Total	lows <sup>-</sup> HV	Deg. Satn	Average Delay	Level of Service	95% Back Vehicles	of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South:	Nelson	Bay Road									
2	T1	1417	2.4	0.365	0.1	LOS A	0.0	0.0	0.00	0.00	69.9
3	R2	33	0.0	0.125	19.7	LOS B	0.4	2.8	0.84	0.94	51.0
Approa	ach	1450	2.3	0.365	0.5	NA	0.4	2.8	0.02	0.02	69.6
East: V	/ardon F	Road									
4	L2	53	2.0	0.085	8.6	LOS A	0.3	2.1	0.55	0.77	57.1
Approa	ach	53	2.0	0.085	8.6	LOS A	0.3	2.1	0.55	0.77	57.1
North:	Nelson	Bay Road									
7	L2	7	14.3	0.336	6.7	LOS A	0.0	0.0	0.00	0.01	42.2
8	T1	1294	2.2	0.336	0.1	LOS A	0.0	0.0	0.00	0.00	69.9
9u	U	3	0.0	0.041	51.8	LOS D 11	0.1	0.8	0.93	0.98	53.0
Approa	ach	1305	2.2	0.336	0.3	NA	0.1	0.8	0.00	0.01	69.6
All Veh	icles	2807	2.3	0.365	0.6	NA	0.4	2.8	0.02	0.03	69.5

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

11 Level of Service is worse than the Level of Service Target specified in the Parameter Settings dialog.

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### Background Growth Only 2026

### **MOVEMENT SUMMARY**

## Site: 101 [AM Fullerton Street - 2026 Background Only]

Nelson Bay Road / Fullerton Street Roundabout Design Life Analysis (Final Year): Results for 8 years

Move	ovement Performance - Vehicles lov OD Demand Flows Deg. Average Level of 95% Back of Queue Prop. Effective Average												
Mov		Demand F	lows	Deg.			95% Back	of Queue	Prop.	Effective	0		
ID	Mov	Total	ΗV	Satn	Delay	Service	Vehicles	Distance	Queued	Stop Rate	Speed		
		veh/h	%	v/c	sec		veh	m		per veh	km/h		
South:	Nelson	Bay Road											
2	T1	1254	3.9	0.323	6.5	LOS A	0.0	0.0	0.00	0.53	71.6		
3	R2	182	6.4	0.141	11.0	LOS A	0.8	6.3	0.34	0.64	57.8		
Approa	ach	1436	4.2	0.323	7.0	LOS A	0.8	6.3	0.04	0.54	70.1		
East: F	ullerton	Street											
4	L2	351	1.5	0.178	4.8	LOS A	0.0	0.0	0.00	0.53	61.9		
6	R2	131	4.0	0.187	12.6	LOS A	0.8	6.0	0.70	0.91	59.9		
Approa	ach	481	2.2	0.187	6.9	LOS A	0.8	6.0	0.19	0.63	61.1		
North:	Nelson	Bay Road											
7	L2	220	1.9	0.627	6.6	LOS A	5.7	41.6	0.56	0.58	61.6		
8	T1	1469	5.1	0.627	6.9	LOS A	5.7	41.6	0.58	0.59	62.0		
9u	U	1	0.0	0.627	13.2	LOS A	5.6	40.9	0.59	0.60	64.8		
Approa	ach	1690	4.7	0.627	6.9	LOS A	5.7	41.6	0.57	0.59	62.0		
All Veh	nicles	3607	4.1	0.627	7.0	LOS A	5.7	41.6	0.31	0.58	64.9		

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

Roundabout Capacity Model: SIDRA Standard.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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# Site: 101 [PM Fullerton Street - 2026 Background Only]

### Nelson Bay Road / Fullerton Street

Roundabout Design Life Analysis (Final Year): Results for 8 years

d Flows	<b>Novement Performance - Vehicles</b> Mov OD Demand Flows Deg. Average Level of 95% Back of Queue Prop. Effective Average													
	$-\overline{\mathcal{D}\mathcal{C}\mathcal{Q}}$	Average_	Level of	95% Ba <u>ck</u>	of Queue	Prop.	Effective	Average						
HV	Satn	Delay	Service	Vehicles	Distance	Queued	Stop Rate	Speed						
%	v/c	sec		veh	m		per veh	km/h						
2.5	0.334	6.4	LOS A	0.0	0.0	0.00	0.53	71.7						
2.2	0.275	11.5	LOS A	1.8	13.1	0.48	0.68	58.4						
2.5	0.334	7.5	LOS A	1.8	13.1	0.10	0.56	69.4						
2.6	0.102	4.8	LOS A	0.0	0.0	0.00	0.53	61.5						
1.9	0.283	12.0	LOS A	1.3	9.1	0.69	0.86	60.1						
5 2.3	0.283	8.5	LOS A	1.3	9.1	0.36	0.71	60.6						
3.4	0.579	7.4	LOS A	5.0	35.5	0.68	0.68	60.8						
2.6	0.579	8.0	LOS A	5.0	35.6	0.69	0.70	62.0						
0.0	0.579	14.5	LOS B	5.0	35.6	0.71	0.73	64.5						
3 2.7	0.579	7.9	LOS A	5.0	35.6	0.69	0.70	61.9						
								65.1						
	1.9       2.3       3.4       2.6       0.0       3       2.7	1.9       0.283         2.3       0.283         3.4       0.579         2.6       0.579         0.0       0.579         3       2.7         0.579	1.9       0.283       12.0         5       2.3       0.283       8.5         4       3.4       0.579       7.4         4       2.6       0.579       8.0         0.0       0.579       14.5         3       2.7       0.579       7.9	7       1.9       0.283       12.0       LOS A         6       2.3       0.283       8.5       LOS A         4       3.4       0.579       7.4       LOS A         4       2.6       0.579       8.0       LOS A         4       0.0       0.579       14.5       LOS B         3       2.7       0.579       7.9       LOS A	7       1.9       0.283       12.0       LOS A       1.3         6       2.3       0.283       8.5       LOS A       1.3         4       3.4       0.579       7.4       LOS A       5.0         4       2.6       0.579       8.0       LOS A       5.0         0.0       0.579       14.5       LOS B       5.0         3       2.7       0.579       7.9       LOS A       5.0	7       1.9       0.283       12.0       LOS A       1.3       9.1         6       2.3       0.283       8.5       LOS A       1.3       9.1         4       3.4       0.579       7.4       LOS A       5.0       35.5         4       2.6       0.579       8.0       LOS A       5.0       35.6         0.0       0.579       14.5       LOS B       5.0       35.6         3       2.7       0.579       7.9       LOS A       5.0       35.6	7       1.9       0.283       12.0       LOS A       1.3       9.1       0.69         6       2.3       0.283       8.5       LOS A       1.3       9.1       0.36         4       3.4       0.579       7.4       LOS A       5.0       35.5       0.68         4       2.6       0.579       8.0       LOS A       5.0       35.6       0.69         0.0       0.579       14.5       LOS B       5.0       35.6       0.71         3       2.7       0.579       7.9       LOS A       5.0       35.6       0.69	7         1.9         0.283         12.0         LOS A         1.3         9.1         0.69         0.86           5         2.3         0.283         8.5         LOS A         1.3         9.1         0.36         0.71           4         3.4         0.579         7.4         LOS A         5.0         35.5         0.68         0.68           4         2.6         0.579         8.0         LOS A         5.0         35.6         0.69         0.70           0.0         0.579         14.5         LOS B         5.0         35.6         0.71         0.73						

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

Roundabout Capacity Model: SIDRA Standard.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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## ▽Site: 101 [AM Vardon Road - 2026 Background Only]

#### Nelson Bay Road / Vardon Road Giveway / Yield (Two-Way) Design Life Analysis (Final Year): Results for 8 years

Move	ment P	erformanc	e - Ve	hicles							
Mov	OD	Demand I	Flows	Deg.	Average	Level of	95% Back	of Queue	Prop.	Effective	Average
ID	Mov	Total	ΗV	Satn	Delay	Service	Vehicles	Distance	Queued	Stop Rate	Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South:	Nelson	Bay Road									
2	T1	1423	3.5	0.369	0.1	LOS A	0.0	0.0	0.00	0.00	69.9
3	R2	43	0.0	0.497	65.4	LOS E 11	1.6	11.2	0.97	1.03	33.0
Approa	ach	1466	3.4	0.497	2.0	NA	1.6	11.2	0.03	0.03	68.9
East: \	/ardon F	Road									
4	L2	12	0.0	0.029	11.8	LOS A	0.1	0.6	0.71	0.85	54.9
Approa	ach	12	0.0	0.029	11.8	LOS A	0.1	0.6	0.71	0.85	54.9
North:	Nelson	Bay Road									
7	L2	5	40.0	0.469	7.2	LOS A	0.0	0.0	0.00	0.00	41.9
8	T1	1785	4.4	0.469	0.2	LOS A	0.0	0.0	0.00	0.00	69.8
9u	U	1	0.0	0.014	52.6	LOS D 11	0.0	0.3	0.93	0.98	52.8
Approa	ach	1791	4.5	0.469	0.3	NA	0.0	0.3	0.00	0.00	69.7
All Veh	nicles	3269	4.0	0.497	1.1	NA	1.6	11.2	0.02	0.02	69.3

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

11 Level of Service is worse than the Level of Service Target specified in the Parameter Settings dialog.

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## ablaSite: 101 [PM Vardon Road - 2026 Background Only]

#### Nelson Bay Road / Vardon Road Giveway / Yield (Two-Way) Design Life Analysis (Final Year): Results for 8 years

Move	ment P	erformanc	e - Ve	hicles							
Mov	OD	Demand	Flows	Deg.	Average	Level of	95% Back	of Queue	Prop.	Effective	Average
ID	Mov	Total	ΗV	Satn	Delay	Service	Vehicles	Distance	Queued	Stop Rate	Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South:	Nelson	Bay Road									
2	T1	1551	2.4	0.400	0.1	LOS A	0.0	0.0	0.00	0.00	69.9
3	R2	33	0.0	0.157	23.6	LOS B	0.5	3.5	0.88	0.95	48.8
Approa	ach	1583	2.3	0.400	0.6	NA	0.5	3.5	0.02	0.02	69.6
East: \	/ardon F	Road									
4	L2	53	2.0	0.094	9.3	LOS A	0.3	2.3	0.60	0.81	56.6
Approa	ach	53	2.0	0.094	9.3	LOS A	0.3	2.3	0.60	0.81	56.6
North:	Nelson	Bay Road									
7	L2	7	14.3	0.368	6.7	LOS A	0.0	0.0	0.00	0.01	42.2
8	T1	1416	2.2	0.368	0.2	LOS A	0.0	0.0	0.00	0.00	69.9
9u	U	3	0.0	0.060	71.7	LOS F 11	0.2	1.2	0.95	0.99	48.7
Approa	ach	1427	2.2	0.368	0.3	NA	0.2	1.2	0.00	0.01	69.6
All Veh	nicles	3063	2.3	0.400	0.6	NA	0.5	3.5	0.02	0.03	69.5

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

11 Level of Service is worse than the Level of Service Target specified in the Parameter Settings dialog.

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### Background Growth Only 2036

### **MOVEMENT SUMMARY**

## Site: 101 [AM Fullerton Street - 2036 Background Only]

Nelson Bay Road / Fullerton Street Roundabout Design Life Analysis (Final Year): Results for 18 years

Mover	ment P	erformance	- Vel	hicles							
Mov	OD	Demand F	lows	Deg.	Average	Level of	95% Back	of Queue	Prop.	Effective	Average
ID	Mov	Total	ΗV	Satn	Delay	Service	Vehicles	Distance	Queued	Stop Rate	Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South:	Nelson	Bay Road									
2	T1	1470	3.9	0.379	6.5	LOS A	0.0	0.0	0.00	0.53	71.6
3	R2	182	6.4	0.142	11.0	LOS A	0.9	6.4	0.35	0.64	57.8
Approa	ach	1652	4.2	0.379	7.0	LOS A	0.9	6.4	0.04	0.54	70.3
East: F	ullerton	Street									
4	L2	351	1.5	0.178	4.8	LOS A	0.0	0.0	0.00	0.53	61.9
6	R2	131	4.0	0.223	13.4	LOS A	1.1	7.7	0.78	0.93	59.5
Approa	ach	481	2.2	0.223	7.1	LOS A	1.1	7.7	0.21	0.64	60.9
North:	Nelson	Bay Road									
7	L2	220	1.9	0.720	6.8	LOS A	7.6	55.5	0.64	0.59	61.3
8	T1	1722	5.1	0.720	7.3	LOS A	7.8	57.2	0.66	0.61	61.7
9u	U	1	0.0	0.720	13.8	LOS A	7.8	57.2	0.69	0.63	64.5
Approa	ach	1943	4.7	0.720	7.3	LOS A	7.8	57.2	0.66	0.61	61.7
All Veh	nicles	4077	4.2	0.720	7.1	LOS A	7.8	57.2	0.36	0.59	64.8

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

Roundabout Capacity Model: SIDRA Standard.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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# Site: 101 [PM Fullerton Street - 2036 Background Only]

#### Nelson Bay Road / Fullerton Street

Roundabout Design Life Analysis (Final Year): Results for 18 years

Move	ment Pe	erformance	e - Vel	nicles							
Mov	OD	Demand F	Flows	Deg.	Average	Level of	95% Back	of Queue	Prop.	Effective	Average
ID	Mov	Total	ΗV	Satn	Delay	Service	Vehicles	Distance	Queued	Stop Rate	Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South:	Nelson	Bay Road									
2	T1	1532	2.5	0.391	6.4	LOS A	0.0	0.0	0.00	0.53	71.7
3	R2	338	2.2	0.276	11.5	LOS A	1.9	13.3	0.48	0.68	58.4
Approa	ach	1870	2.5	0.391	7.4	LOS A	1.9	13.3	0.09	0.56	69.7
East: F	Fullerton	Street									
4	L2	199	2.6	0.102	4.8	LOS A	0.0	0.0	0.00	0.53	61.5
6	R2	217	1.9	0.324	12.6	LOS A	1.6	11.3	0.76	0.91	59.9
Approa	ach	416	2.3	0.324	8.8	LOS A	1.6	11.3	0.39	0.73	60.5
North:	Nelson	Bay Road									
7	L2	154	3.4	0.667	8.4	LOS A	7.1	50.8	0.75	0.73	60.6
8	T1	1423	2.6	0.667	9.0	LOS A	7.1	50.8	0.76	0.76	61.8
9u	U	1	0.0	0.667	15.6	LOS B	7.1	50.5	0.78	0.78	64.3
Approa	ach	1578	2.7	0.667	8.9	LOS A	7.1	50.8	0.76	0.76	61.7
All Veł	nicles	3863	2.5	0.667	8.2	LOS A	7.1	50.8	0.40	0.66	65.1

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Vehicle movement LOS values are based on average delay per movement.

Intersection and Approach LOS values are based on average delay for all vehicle movements.

Roundabout Capacity Model: SIDRA Standard.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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