Transport Assessment

Berwick Health and Education Precinct

CG140608

Prepared for
Metropolitan Planning Authority

9 October 2015

Cardno
Shaping the Future

Document Information

Prepared for	Metropolitan Planning Authority
Project Name	Berwick Health and Education Precinct
File Reference	CG140608REP002F02.docx
Job Reference	CG140608
Date	9 October 2015

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Document Control

Version	Date	Author	Author Initials	Reviewer	Reviewer Initials
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Executive Summary

Cardno has been engaged by the Metropolitan Planning Authority (MPA) to determine the traffic and transport impacts associated with the Berwick Health and Education Comprehensive Development Plan.

The Plan allows for the intensification of existing land uses within the Precinct to enable it to cater up to 16,000 additional students, 360 hospital beds, 25,500sqm of commercial floor area and 250 dwellings.

The assessment of the traffic demand indicates that the additional land uses are anticipated to generate up to some 4,620 and 3,950 vehicles per hour during the AM and PM road network peak hours respectively.

The assessment also indicates that pedestrian volumes will increase from some 320 (existing) to 1,000 (ultimately) across Clyde Road in the vicinity of the Berwick Rail Station.

In order to gain an understanding of the impacts likely to be generated by the development of the Precinct, Cardno completed traffic modelling for key intersections on Clyde Road. The results of this assessment indicate that the Clyde Road/Enterprise Avenue intersection and the Clyde Road/Kangan Drive/Sir Gustav Nossal Boulevard intersection are currently approaching capacity under existing conditions, prior to the addition of any development generated traffic volumes.

In this regard, it is clear that additional works will be required to accommodate the traffic volumes anticipated to be generated by the development of the Precinct.

The modelling undertaken by Cardno, and summarised within this report, indicates that east-west connectivity to the Monash University/Nossal High School site and the Chisholm Institute site from Clyde Road is the primary driver in the road networks ability to accommodate the increased land use density envisaged by the Plan.

Specifically, the assessment indicates that while there is some scope to increase the capacity of the existing Clyde Road/Kangan Drive/Sir Gustav Nossal Boulevard intersection and the Clyde Road/Enterprise Avenue intersection, the upgrade works are not sufficient to accommodate the level of traffic accessing the Monash University/Nossal High School site or Chisholm Institute site from Clyde Road.

In this regard, the assessment indicates that the provision of an additional four leg signalised intersection on Clyde Road south of the Kangan Drive intersection is warranted to cater for the anticipated traffic generation.

In addition to the road network upgrades, a key finding of the investigation is the requirement to support and increase the level of sustainable travel to and from the Precinct including walking, cycling and public transport.

The assessment indicates that additional provisions will be required to increase pedestrian accessibility between Berwick Rail Station and the Monash University/Nossal High School area. It is however noted that the existing level crossing on Clyde Road adjacent to the station is earmarked for grade separation within the next eight years as part of the State Government's Level Crossing Removal Project. The existing large volumes of pedestrians currently exiting the station and crossing Clyde Road warrants the provision of a grade separated facility across Clyde Road and it is envisaged that a suitable facility will be provided as part of the Level Crossing Removal Project.

In conclusion the assessment undertaken and summarised within this report indicates that the intensification proposed as part of the Comprehensive Development Plan can be accommodated subject to the provision of increased road network capacity improvements and improvements to public transport, pedestrian and cyclist provisions.

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1 Introduction

1.1 Background

The Berwick Health and Education Comprehensive Development Plan (CDP) is currently being developed by the Metropolitan Planning Authority (MPA) for incorporation into the Casey Planning Scheme by way of a Planning Scheme Amendment process.

The Precinct which is irregular in shape, is bound by the Princes Highway to the north, the Princes Freeway to the south and incorporates Monash University (Berwick campus), the Chisholm Institute and Casey Hospital sites.

While the majority of the Precinct area is currently developed, the CDP proposes to intensify the on-site uses, particularly on the Monash University and the Chisholm Institute sites.

The Berwick Health and Education CDP is being prepared in consultation with relevant stakeholders including Monash University, Chisholm Institute, VicRoads, Casey and St John of God Hospitals and the City of Casey.

1.2 Purpose of this Report

Cardno was engaged by the MPA to assess the traffic and transport impacts of the additional land uses proposed as part of the CDP. The assessment is divided into two sections:

- **Stage One** of the study included a review of existing conditions within the Precinct including vehicle, public transport and active travel conditions and infrastructure. The assessment identified existing issues and opportunities in the transport network. A copy of this assessment is provided at Appendix A.
- **Stage Two** of the study entailed a detailed review of the road network and its ability to accommodate future traffic, pedestrian and cyclist volumes likely to be generated by the development outlined in the CDP. As part of the Stage Two works, Cardno undertook traffic modelling for the purpose of identifying road and intersection upgrades required to accommodate the development of the CDP area.

1.3 Reference Documents

In the course of preparing this assessment, reference has been made to the following:

- The Draft Urban Structure Plan, prepared by MPA;
- Traffic surveys completed by Nationwide Traffic Surveys;
- SCATS data provided by VicRoads;
- Public transport patronage data, provided by Public Transport Victoria; and
- Other documents as nominated throughout this report.

1.4 Strategic Context – Plan Melbourne

Plan Melbourne, developed by the State Government and adopted in May 2014, is an integrated land use and transport plan aimed at guiding the way the city will grow and change over the next 40 years. It is a strategy to house, employ and connect more people to jobs and services closer to where they live. In this regard *Plan Melbourne* outlines the development of an Integrated Economic Triangle model for the future development of the city to be delivered by 2050.

Plan Melbourne aims to align employment centres with an improved public transport network creating employment clusters and industrial precincts. Ultimately, *Plan Melbourne* aims to increase and improve investment and employment options within the existing and future transport corridors. Figure 1-1 shows the existing key activity nodes and transport links, and shows how these are anticipated to change by 2050.

Figure 1-1 Plan Melbourne Integrated Transport Model (Melbourne Today)

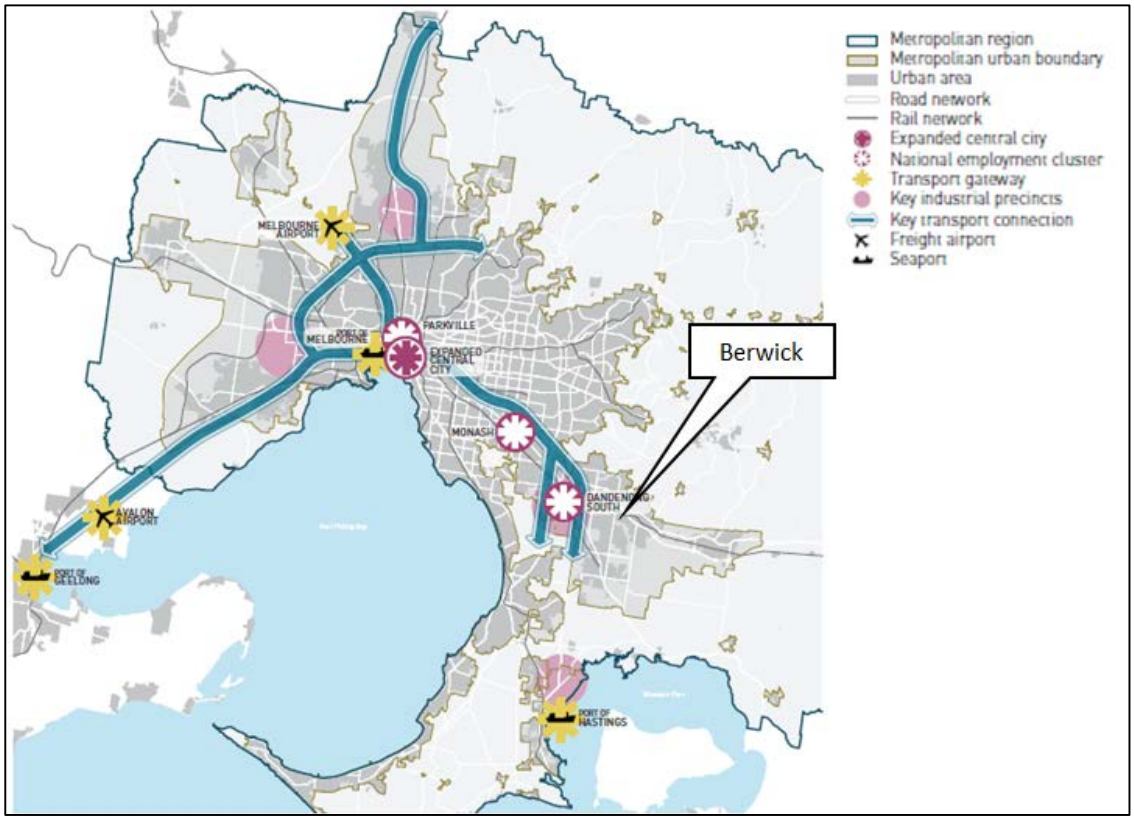
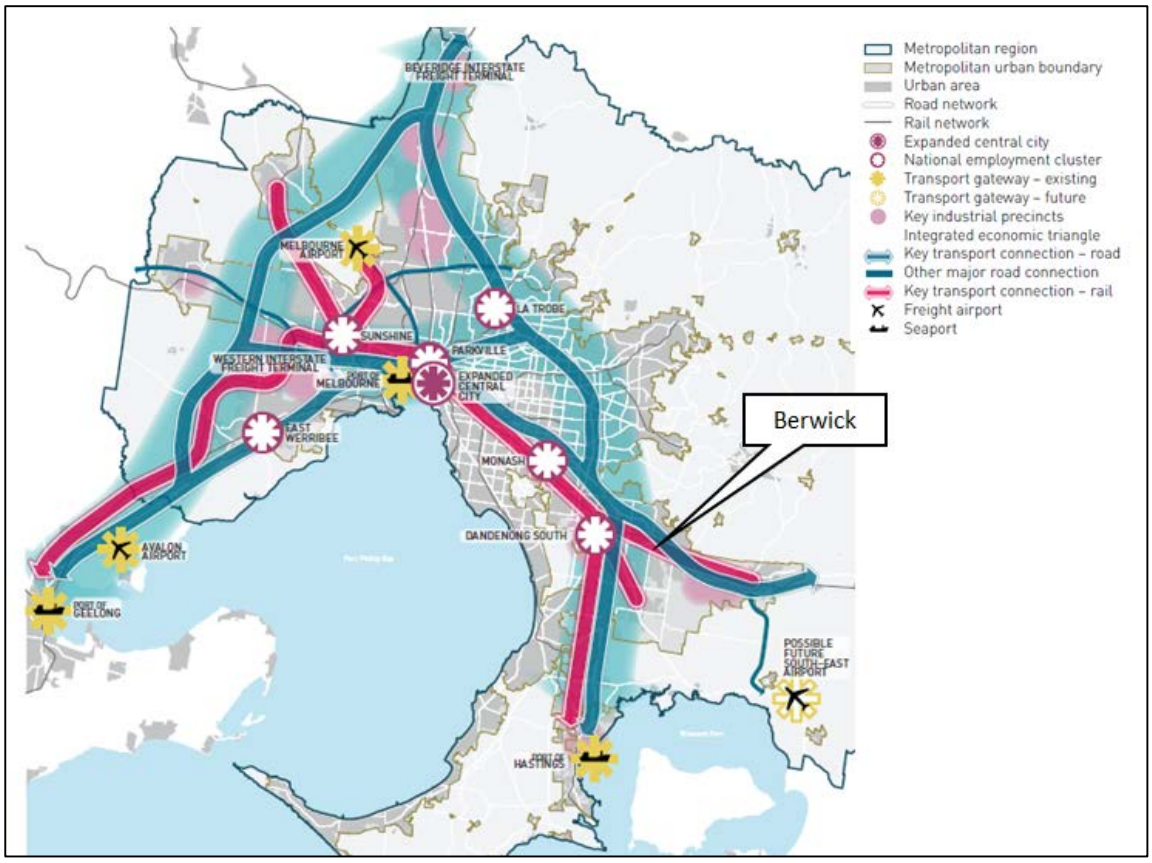


Figure 1-2 Plan Melbourne Integrated Transport Model (Melbourne 2050)

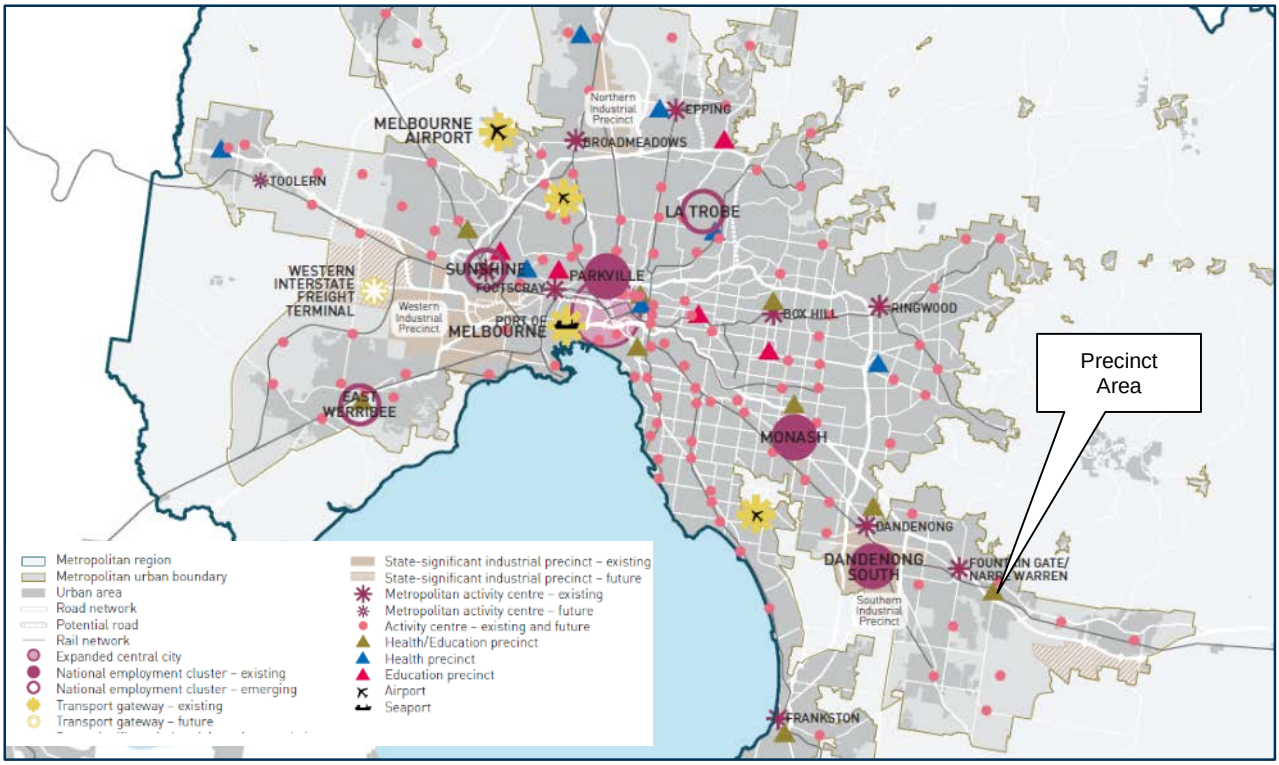


In terms of transport related objectives, *Plan Melbourne* indicates that it will "*provide an integrated transport system connecting people to jobs and services, and goods to market*". As such, the development and improvement of the transport network will be closely linked to the success of *Plan Melbourne.* Key Transport directions outlined in *Plan Melbourne* are as follows:

- Transform the transport system to support a more productive central city;
- Improve access to job-rich areas across Melbourne and strengthen transport networks in existing suburbs;
- Improve transport infrastructure, services and affordability in Melbourne's newer suburbs;
- Improve local travel options to increase social and economic participation;
- Improve the efficiency of freight networks while protecting urban amenity; and
- Increase the capacity of ports, interstate rail terminals and airports and improve landside transport access to these gateways.

Figure 1-3 shows the Precinct area in the context of surrounding activity areas, outlined in *Plan Melbourne*.

Figure 1-3 Activity Centre Locations



The CDP area is identified in *Plan Melbourne* as a Health/Education Precinct, as such, the development of the transport network within and around the Precinct will play a pivotal role in the development of the area and the ultimate visions and aims of *Plan Melbourne*.

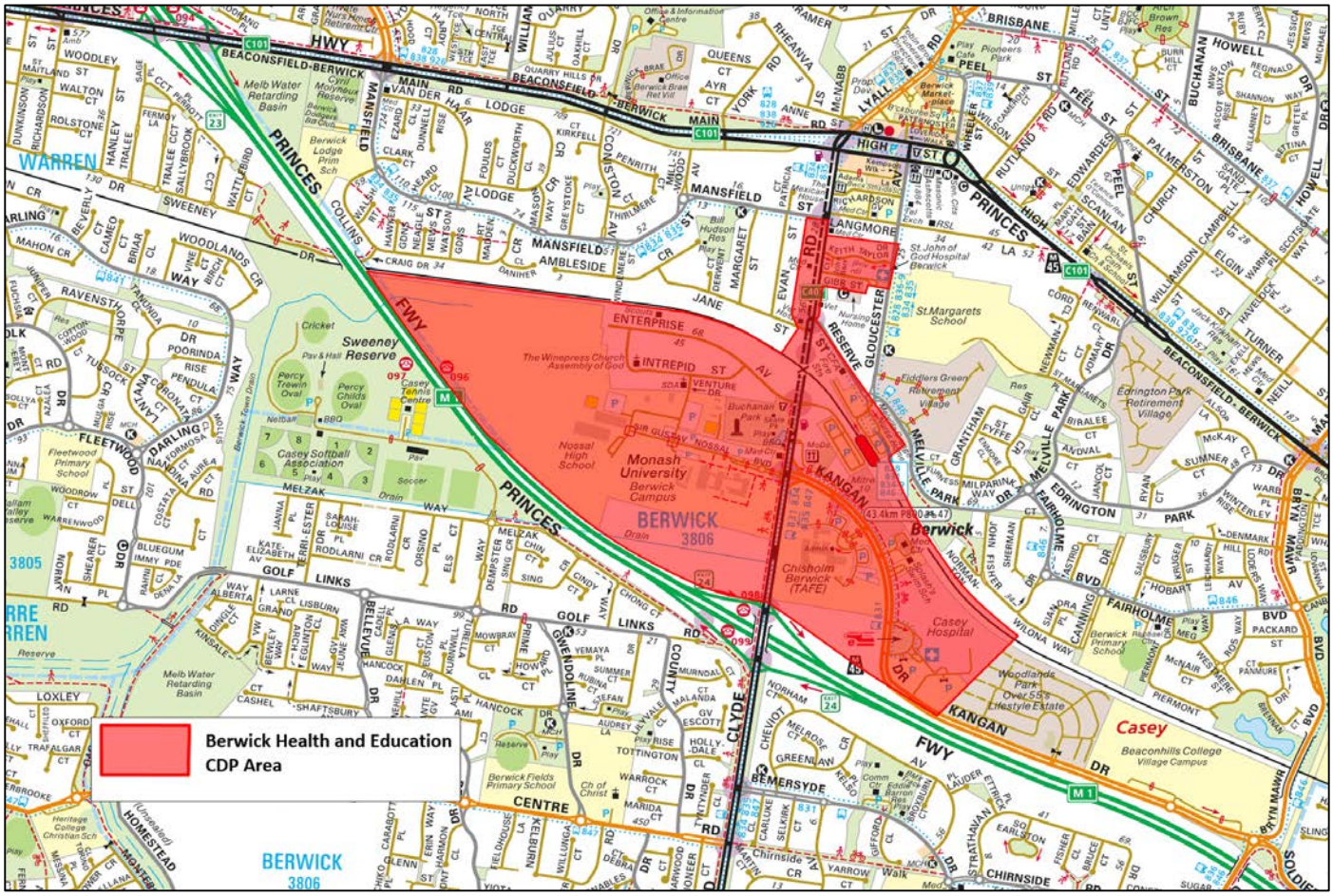
2 Study Area

2.1 Site Location

The overall study area is located in Berwick and is bound by the Princes Highway to the north, the Princes Freeway to the south and is bisected by Clyde Road.

The CDP area is shown in Figure 2-1.

Figure 2-1 CDP Area



2.2 Existing Land Uses

The study area incorporates a number of key land uses including education and health facilities. Notably, Monash University (Berwick Campus) and Nossal High School are located on the south-west land parcel sharing a single access point to Clyde Road.

The Chisholm Institute is also located within the Precinct opposite the Monash University Campus and is accessed via Kangan Drive. Casey Hospital is located to the west of the Chisholm Institute and also accessed via Kangan Drive. St John of God Hospital is located in the northern portion of the study area, east of Clyde Road, however a new St John of God Hospital is being constructed opposite Casey Hospital, on Kangan Drive. An industrial area is also located to the north of Monash University and accessed via Enterprise Avenue.

These key existing land uses are identified in Figure 2-2.

Figure 2-2 Existing Key Land Uses

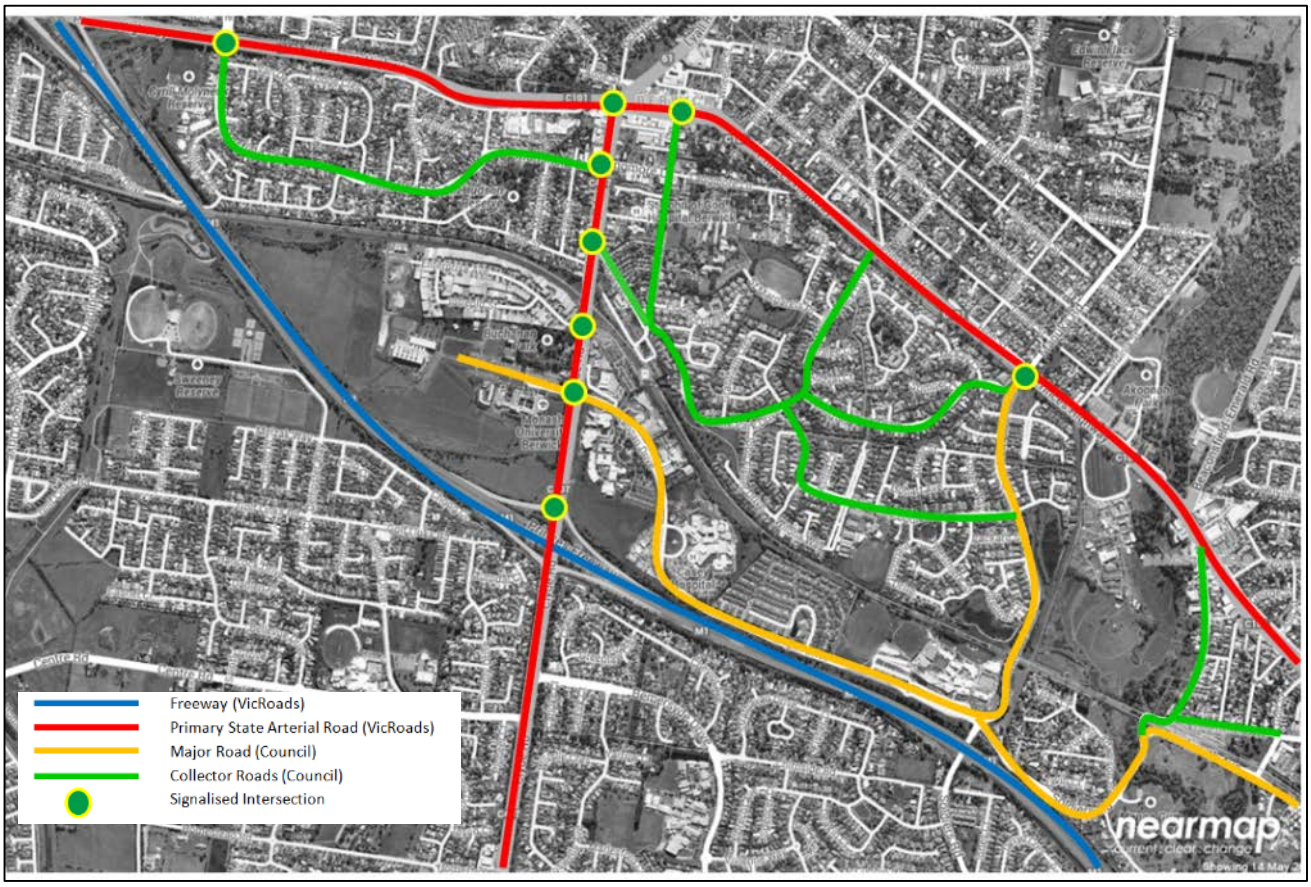
3 Existing Conditions and Background

3.1 Road Network

3.1.1 Road Hierarchy

The existing road hierarchy within the study area is shown in Figure 3-1. The study area is bisected by Clyde Road, an arterial road which provides convenient vehicle access to the north and south boundaries of the study area. In addition a network of connector streets and local access streets provide convenient east to west connectivity within the CDP area.

Figure 3-1 Road Hierarchy



The existing volumes on the road network have been assessed against the road classifications and associated daily volumes outlined in the former Growth Areas Authority CDP Note '*Our Roads Connecting Our People*'. Table 3-1 summarises this assessment.

Table 3-1 Road Network Analysis

Road Name	Configuration	Classification	Approximate Vehicles per day for Classification	Existing Daily Volume
Clyde Road	Four Lane	Secondary Arterial	12,000-40,000vpd	25,550vpd
Kangan Drive	Two - Four Lanes	Connector Street	3,000-7,000vpd	8,150vpd
Sir Gustav Nossal Boulevard	Two lane	Connector Street	3,000 7,000vpd	3,200vpd
Enterprise Avenue	Two lane	Connector Street	3,000-7,000vpd	5,500vpd
Reserve Street	Two lane	Connector Street	3,000-7,000vpd	6,050vpd
Gloucester Avenue	Two lane	Connector Street	3,000-7,000vpd	4,100vpd

Table 3-1 indicates that the key roads in the Precinct area generally operate within capacity with the exception of Kangan Drive. This highlights that in order to facilitate growth within the CDP area on the west side of Clyde Road additional access provisions on Clyde Road would be beneficial for site access purposes and to provide an alternate access point to the existing Clyde Road/Kangan Drive/Sir Gustav Nossal Boulevard intersection.

3.1.2 Clyde Road

Clyde Road is classified as a Primary State Arterial Road (controlled by VicRoads) and is generally aligned in a north-south direction. It is a four lane median divided road and generally incorporates pedestrian paths and bicycle lanes on both sides of the carriageway. A level crossing is located on Clyde Road, north of Enterprise Avenue which is listed on the Department of Economic Development, Jobs, Transport and Resources' (DEDJTR) list of 50 level crossings to be removed over the next eight years as part of the Level Crossing Removal Project.

Clyde Road carries approximately 25,550 vehicles per day[1], and north and south facing photos of Clyde Road at Enterprise Avenue are shown in Figure 3-2 and Figure 3-3.

[1] *Source: VicRoads SCATS data*

Figure 3-2 Clyde Road (facing North at Enterprise Avenue)

Figure 3-3 Clyde Road (facing South at Enterprise Avenue)

3.1.3 Kangan Drive

Kangan Drive is classified as a Major Road (Council controlled) and is generally aligned in a north-west to south-east direction in the vicinity of the Precinct area. It is a two lane median divided road and generally incorporates pedestrian paths on both sides of the carriageway. Kangan Drive provides access to Chisolm Institute and Casey Hospital.

Kangan Drive also provides a link between the two freeway overpasses on the southern boundary of the study area. Kerbside parking is permitted on both sides of the carriageway in the vicinity of the education and health uses.

Kangan Drive carries approximately 8,150 vehicles per day[2] and photos in both directions to the east of its intersection with Clyde Road are shown in Figure 3-4 and Figure 3-5.

Figure 3-4 Kangan Drive (facing east)

Figure 3-5 Kangan Drive (facing west)

[2] *Source: VicRoads SCATS data*

3.1.4 Sir Gustav Nossal Boulevard

Sir Gustav Nossal Boulevard is classified as a Collector Street (Council controlled) and provides access to Monash University and Nossal High School. It is a two-way, two lane road aligned in an east-west direction. Kerbside parking is not permitted on either side the carriageway.

Sir Gustav Nossal Boulevard carries approximately 3,200 vehicles per day[3] and photos of it in both directions to the east of its intersection with Clyde Road are shown in Figure 3-6 and Figure 3-7.

Figure 3-6 Sir Gustav Nossal Boulevard (facing east)

Figure 3-7 Sir Gustav Nossal Boulevard (facing west)

[3] *Source: VicRoads SCATS data*

3.1.5 Enterprise Avenue

Enterprise Avenue is classified as a Local Road (Council controlled) and provides access to the industrial precinct to the west of Clyde Road. It is a two-way two lane road aligned in an east-west direction. Kerbside parking is permitted on both sides of the carriageway.

Enterprise Avenue carries approximately 5,500 vehicles per day[4] with photos of its layout in both directions to the west of Clyde Road shown in Figure 3-8 and Figure 3-9.

Figure 3-8 Enterprise Avenue (facing east)

Figure 3-9 Enterprise Avenue (facing west)

[4] *Source: VicRoads SCATS data*

3.1.6 Reserve Road

Reserve Road is classified as a Collector Street (Council controlled). It is a two-way two lane road and generally aligned in a north-west to south-east direction. It provides a key connection to Berwick Rail Station. Kerbside parking is permitted on the north side of the carriageway only with minimal parking available on the southern side of the carriageway.

Reserve Road carries approximately 6,050 vehicles per day[5] with photos in both directions immediately to the east of Clyde Road shown in Figure 3-10 and Figure 3-11.

Figure 3-10 Reserve Road (facing east)

Figure 3-11 Reserve Road (facing west)

[5] *Source: VicRoads SCATS data*

3.2 Road Network Operation

In order to gain an understanding of existing traffic volumes in the vicinity of the site, Cardno obtained traffic volume data from VicRoads SCATS data for the weeklong period from Wednesday 30 July to Tuesday 5 August 2014. The average AM and PM peak hour traffic volumes for the Wednesday, Thursday and Tuesday are provided in Figure 3-12 and Figure 3-13.

Figure 3-12 Existing Traffic Volumes – AM Peak Hour

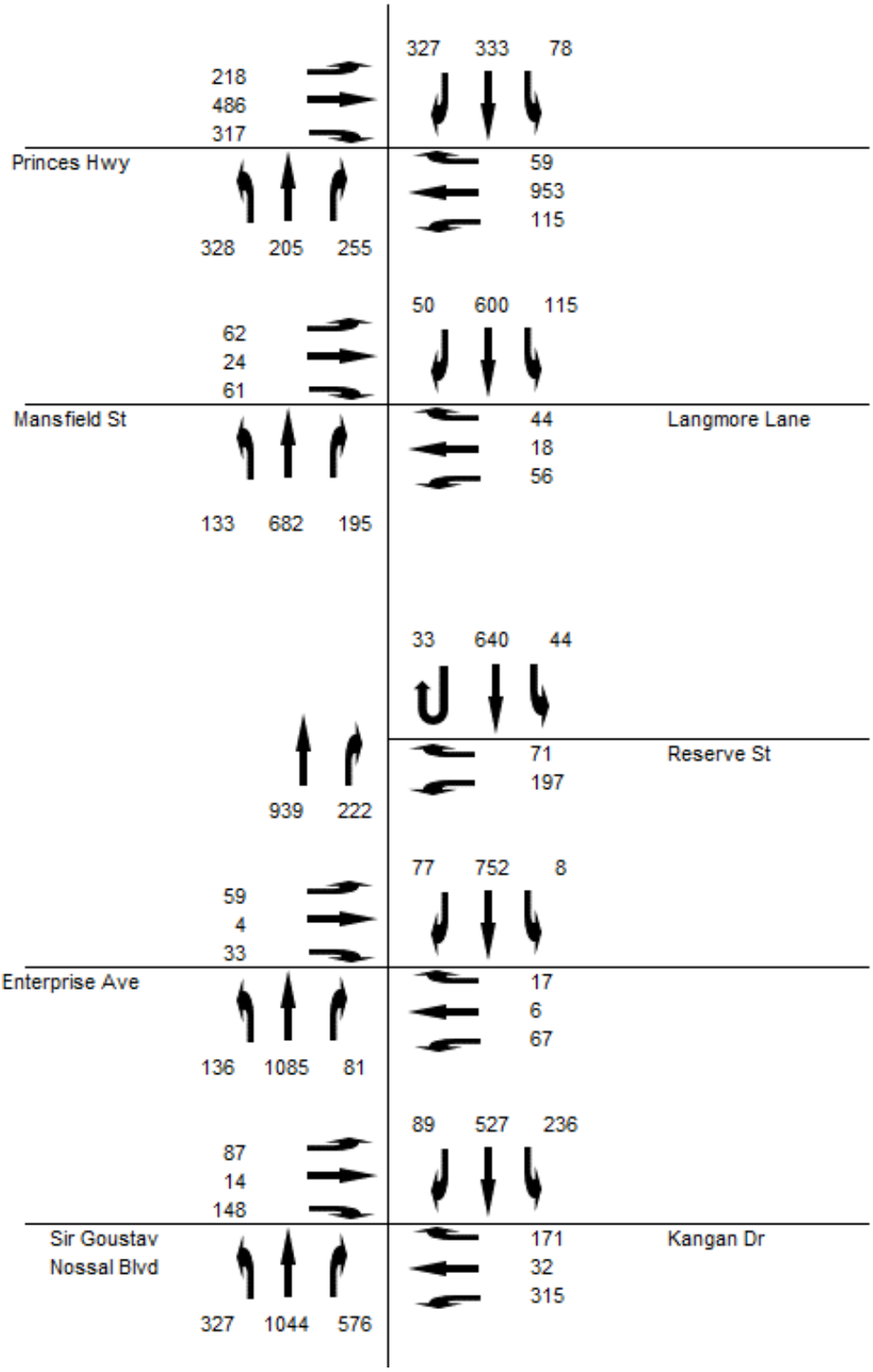
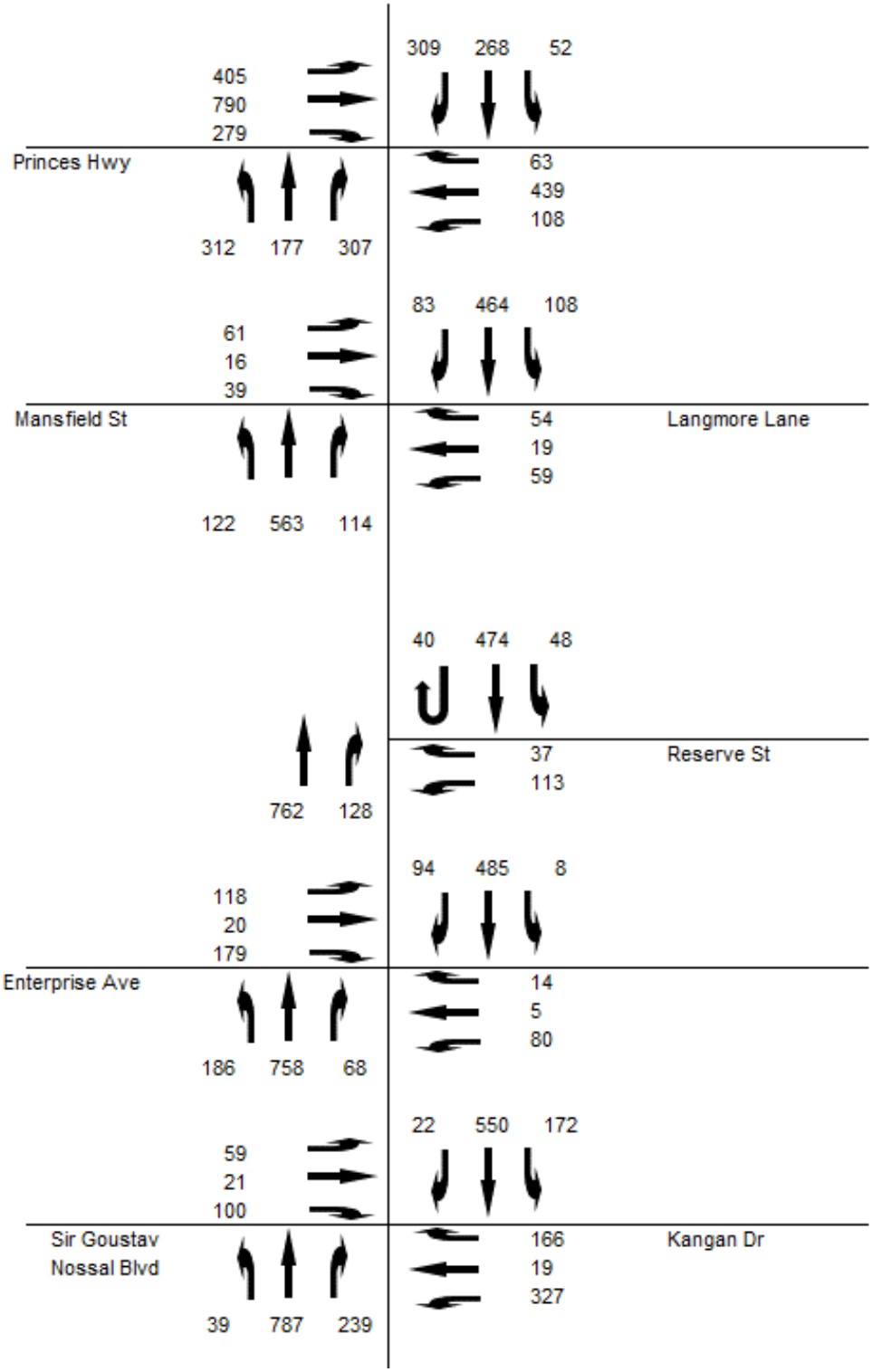


Figure 3-13 Existing Traffic Volumes – PM Peak Hour



3.3 Existing Intersection Operation

The operation of key intersections in the CDP area has been assessed using Sidra Network Intersection software SIDRA 6.1, making use of the network modelling capabilities which allows multiple intersections to be modelled together.

The networking capabilities in SIDRA account for additional considerations beyond a stand-alone intersection operation, such as the effect of upstream and downstream capacity constraints on the performance of the intersection. Specifically, the two fundamental elements are considered together in the SIDRA Network Intersection software, these are:

- The determination of the backward spread of congestion, as queues on downstream lanes block upstream lanes; and
- Application of capacity constraint to oversaturated upstream lanes for determining exit flow rates, thus limiting the flows entering downstream lanes.

It should be recognised that in networked SIDRA models, queue lengths in excess of the available storage distance will be passed on to upstream traffic lanes. That is queue blockage from a downstream intersection can apply to intersections further upstream, affecting both queue length and capacity at the upstream intersection. The model also considers the effects that signal coordination and platoon dispersion have on the performance of the network.

In addition it is highlighted that observed pedestrian movements were in the modelling. A summary of the SIDRA intersection results is provided in Table 3-2 with full results provided at Appendix B.

Table 3-2 Existing Conditions Intersection Operation

Intersection	Peak Hour	DOS	Average Delay	95th Percentile Queue
Clyde Road/Enterprise Avenue/Railway Access Intersection	AM	0.54	11sec	80m
	PM	0.86	28sec	148m
Clyde Road/Kangan Drive/Sir Gustav Nossal Boulevard Intersection	AM	0.91	40sec	299m
	PM	0.60	31sec	144m

Based on the above and site observations (see Appendix A), the assessed intersections within the CDP area were found to be currently operating with some spare capacity. However, the following is noted:

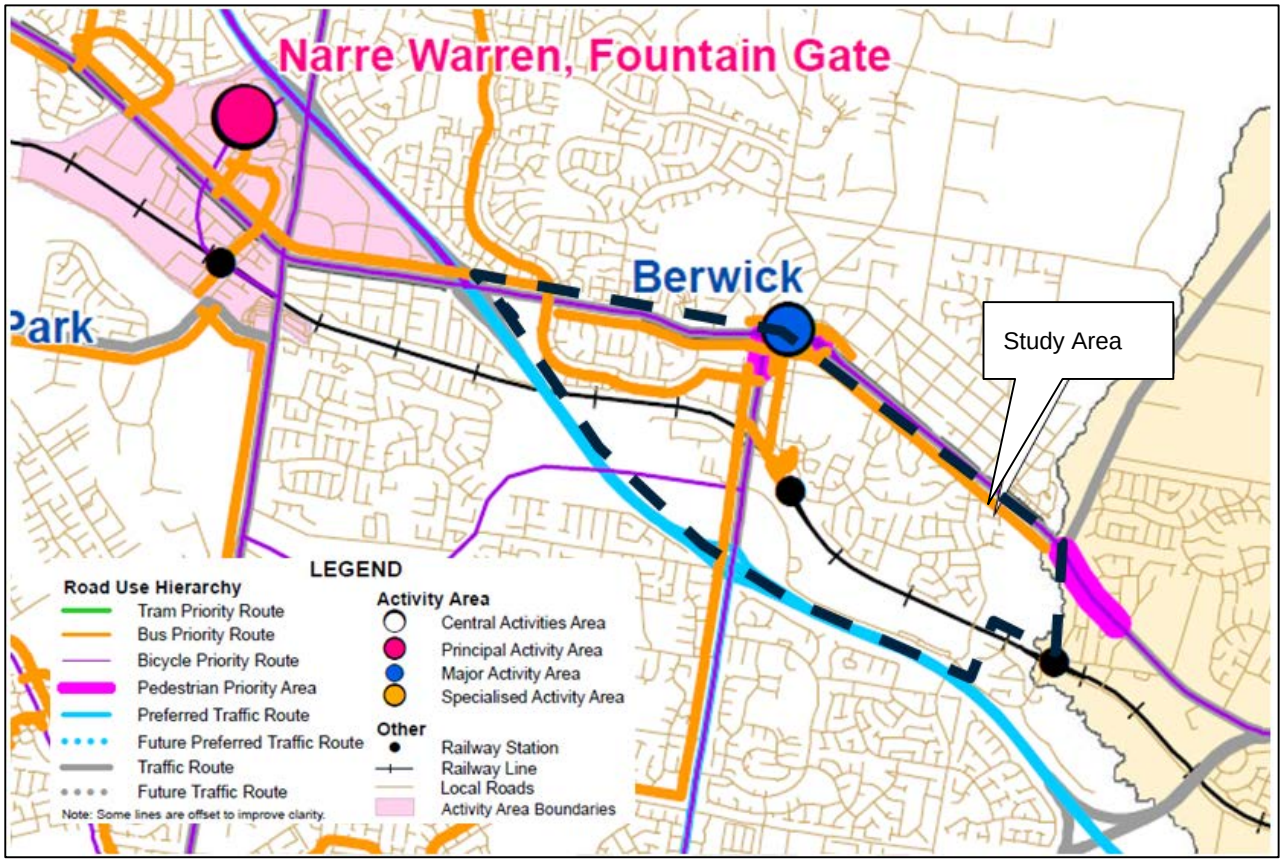
- Queuing on Clyde Road was found to exceed 100m at the Enterprise Avenue intersection (PM peak) and at the Kangan Drive/Sir Gustav Nossal Boulevard intersection (both AM and PM peak), however the associated average delays indicate that these queues clear regularly.
- Kangan Drive currently experiences delays during peak hours as a result of vehicles are trying to access Clyde Road. It is noted that Kangan Drive currently operates with a single lane in each direction, east of the pedestrian crossing, due to constraints resulting from on-street parking, which is permitted on both sides of the carriageway.
- Queueing was observed back from the Monash Freeway interchange (southbound), although it was found that the flow on queues at the signalised intersections on Clyde Road within the Precinct did clear regularly during the PM peak.
- The existing level crossing on Clyde Road impacts on through movements causing queues and delays.

3.4 SmartRoads

SmartRoads is a road network management approach developed by VicRoads which seeks to prioritise use of roads to different transport modes at particular times of day. While the initiative continues to allow access to all users, certain routes are managed to facilitate the use of sustainable modes across the network.

The SmartRoads road use hierarchy for the study area is illustrated in Figure 3-14.

Figure 3-14 VicRoads SmartRoads Road Use Hierarchy



As illustrated in Figure 3-14, a number of roads within the study area are designated as bus priority routes. The hierarchy also indicates a pedestrian priority area at the Clyde Road/Princes Highway intersection.

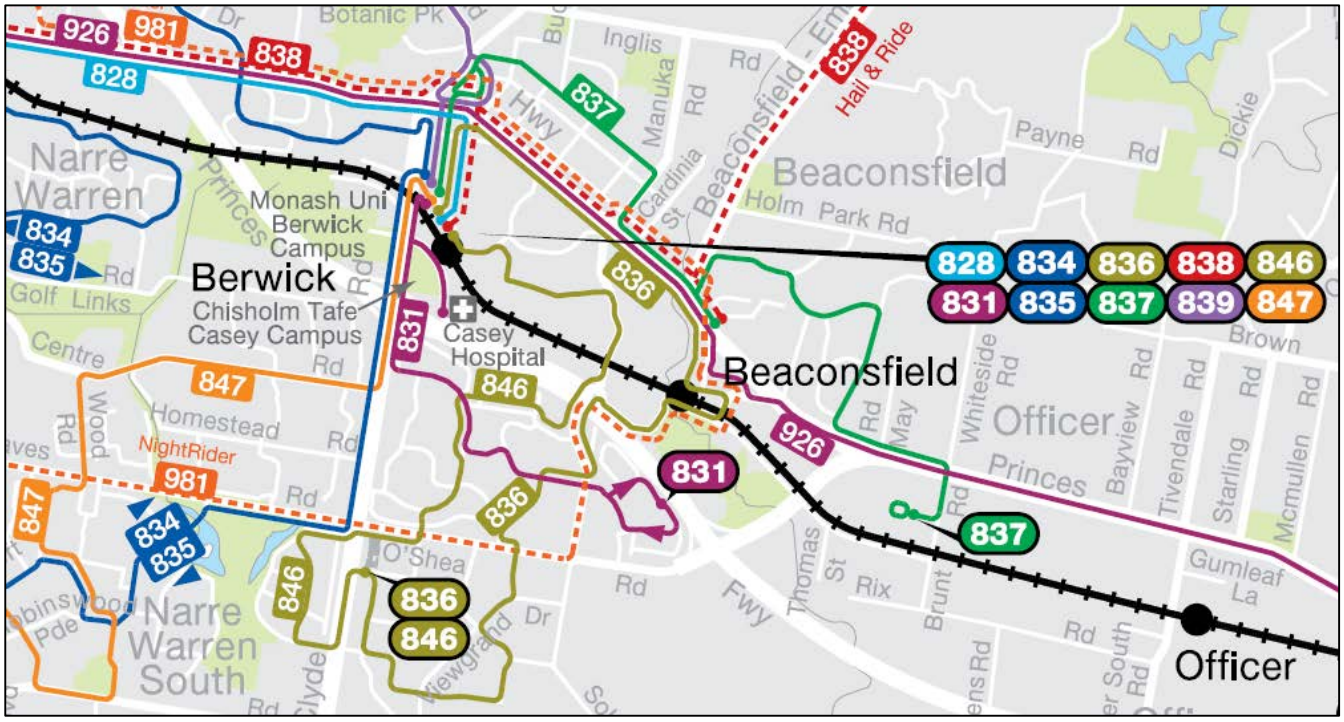
In addition the SmartRoads Road Use Hierarchy includes a yet to be developed bicycle priority route from Clyde Road through Monash University to the west and across the Princes Freeway to the south.

3.5 Sustainable Transport Modes

3.5.1 Public Transport

As the CDP area is within an already existing activity area, it is well connected by public transport. The public transport network within the vicinity of the study area is illustrated in Figure 3-15. Berwick Rail Station, on the Dandenong Pakenham line is within the CDP area and a number of bus routes provide a convenient connection to the station.

Figure 3-15 Public Transport Services



Source: Public Transport Victoria

3.5.2 Bicycle Network and Facilities

On-road bicycle lanes are provided on Clyde Road north of Kangan Drive and continue across the Princes Highway. Cyclists currently ride on-road throughout the remainder of the precinct.

In addition to the above, Clyde Road, Princes Highway, Reserve Street, Sir Gustav Nossal Boulevard and Bryn Mawr Boulevard form part of Melbourne's Principal Bicycle Network (PBN), a network of existing and proposed cycle routes that is intended to facilitate a higher number of cycle trips in a safer environment. The PBN aims to provide access to major destinations in the Melbourne metropolitan area. An extract from VicRoads' Principal Bicycle Network map for the study area is shown in Figure 3-16.

Figure 3-16 Principal Bicycle Network

Source: VicRoads

It is noted that the PBN does not distinguish between existing and proposed bicycle links.

An inspection of the site indicates that no connection is currently provided to Sweeney Reserve limiting bike accessibility to the area from west of the Princes Freeway. Furthermore, on-road bike lanes on Clyde Road do not extend south of Kangan Drive across the Princes Freeway interchange.

A number of bicycle parking facilities are also located within the study area including:

- 15 storage lockers, 3 u-racks and a storage cage at Berwick Rail Station;
- 3 sets of u-racks within the retail precinct;
- Cycle racks at Monash University;
- Cycle racks at Chisholm Institute; and
- Cycle racks at Casey Hospital.

Cardno was advised by the Chisholm Institute that bicycle parking facilities are provided on-site for staff and students in a conveniently accessible location. Bicycle parking provided at Casey Hospital is located adjacent to hospital car park and ticket parking area and has a high level of surveillance.

3.5.3 Pedestrian Routes

Pedestrian paths are typically located on both sides of roads within the study area. Key roads incorporating paths on both sides of the carriageway include Clyde Road, Kangan Drive, Melville Park Drive, Canning Drive, Edrington Park Drive and Bryn Mawr Boulevard.

A portion of lower order residential roads incorporate a pedestrian path on one side of the road reserve. It is noted that Reserve Road (which provides a key connection to the Berwick Rail Station) incorporates a pedestrian path on the northern side of the carriageway only. Within the existing business park, Enterprise Avenue only has a pedestrian path along the northern side, and Intrepid Street does not incorporate pedestrian paths on either side of the carriageway.

A pedestrian connection is also provided between Berwick Rail Station and Kangan Drive providing public transport users with a link to the education and health uses on Kangan Drive.

It is noted that pedestrian surveys completed by Cardno (refer to Appendix A for more detail) indicate that in the order of 320 pedestrians currently access the Monash University/Nossal High School area during the AM peak hour.

3.6 Existing Conditions Summary

It is clear that the Precinct currently incorporates a reasonable level of pedestrian, cyclist and public transport infrastructure. However as development of the area progresses, it is anticipated that the demands on these facilities will increase.

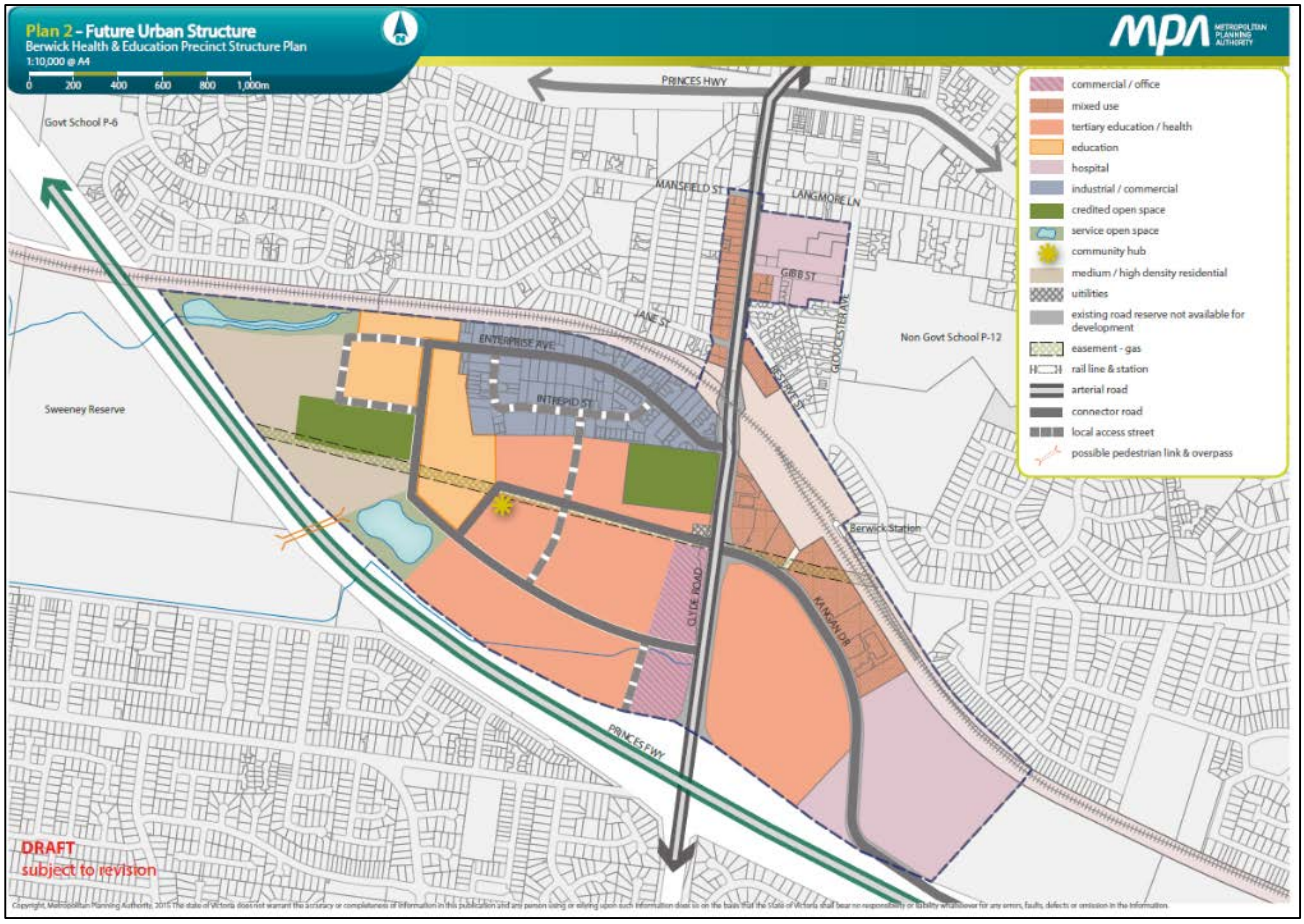
While the Precinct is accessible via private vehicle, the ability of key roads within the Precinct to accommodate existing levels of traffic is approaching capacity. As such, a greater reliance on sustainable transport modes should be a key focus throughout further development of the CDP area.

4 CDP Overview

4.1 Draft Urban Structure

The Berwick Health and Education Precinct currently provides for a significant concentration of health and education facilities servicing Melbourne's outer south east. The CDP will assist the Precinct in building upon the existing infrastructure to facilitate the further development of a vibrant and attractive employment, health, education and mixed use precinct that will become a more connected, walkable and attractive area to live, work and study. The CDP area and the proposed land use structure is shown in Figure 4-1.

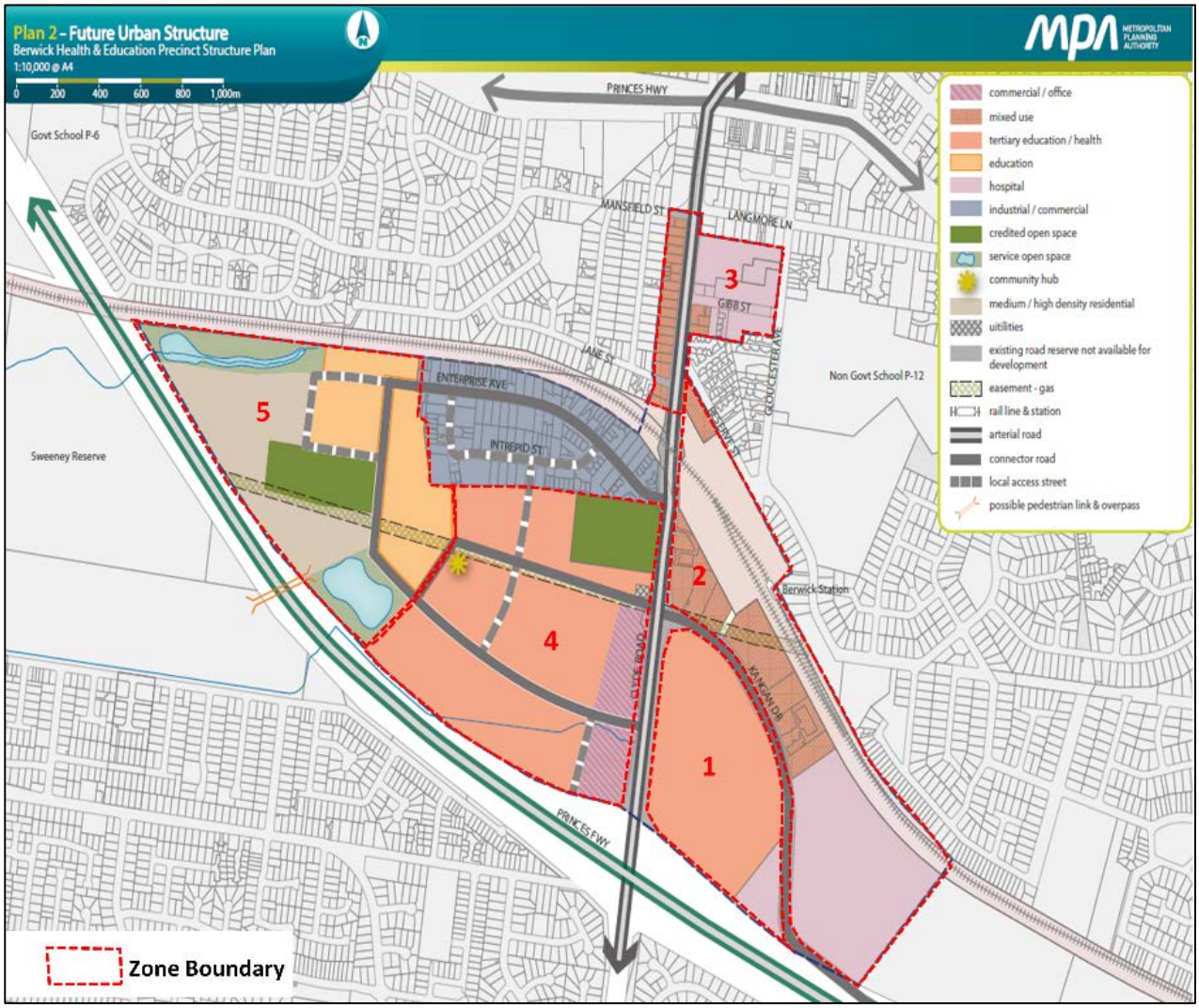
Figure 4-1 Draft Urban Structure



As shown in Figure 4-1, the CDP includes additional commercial and mixed-use developments in the vicinity of Berwick Rail Station and along the Clyde Road corridor. Commercial floor area is also proposed within the Monash University campus adding to the provision of around 2,000 commercial and research jobs in the CDP area. There will also be the provision for additional students at both the Monash University campus and the Chisholm Institute Campus. In order to ensure sufficient access is provided, additional connector and local access streets will be provided within the Monash University Campus and the Chisholm Institute Campus. A new signalised intersection is also proposed on Clyde Road to service these areas.

For the purposes of this assessment the CDP has been broken into five zones as shown in Figure 4-2.

Figure 4-2 Precinct Zone Map



4.2 Proposed Land Uses

As discussed, the land uses within the CDP area are primarily education, medical and commercial. The proposed land use increases envisaged by the CDP build upon these existing land uses. The proposed additional land uses are summarised in Table 4-1.

Table 4-1 Additional Land Uses

Zone	Zone Description	Use	Additional Size/No.
1	Chisholm Institute and St John of God Hospital Expansion	Education	10,000 students
		Medical	300 beds
			125 practitioners
2	Casey Hospital and Commercial area Expansion	Medical	161 beds
		Commercial	500sqm
3	Clyde Road Health and Commercial Area	Commercial	15,000sqm
4	Monash University Expansion	Commercial	10,000sqm
		Education	5,000 students
5	Nossal High School Expansion	Education	1,079 students
		Residential Dwellings	250 dwellings

4.3 Proposed Transport Network Provisions

4.3.1 Road Network Provisions

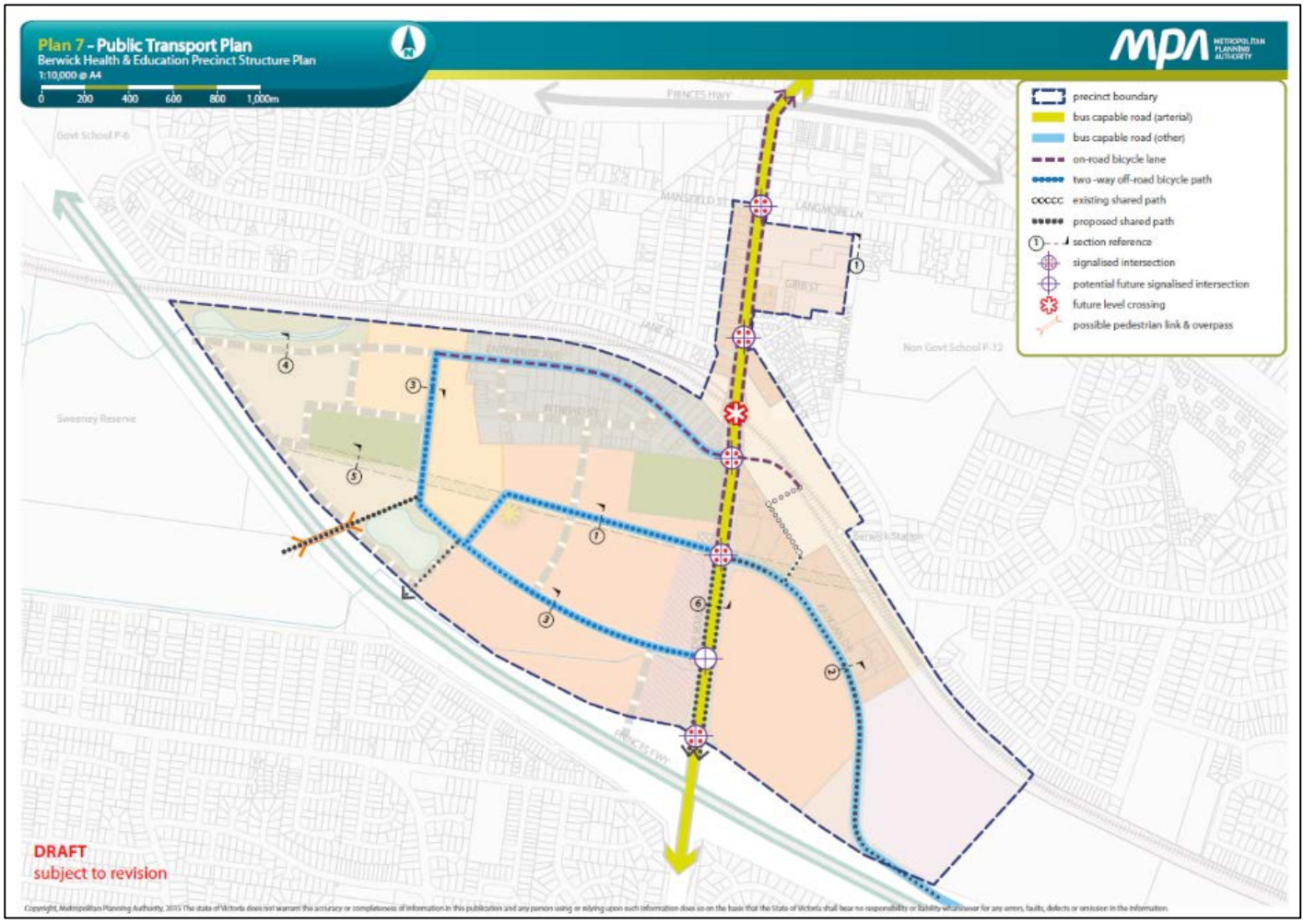
The CDP will utilise the existing roadwork including Clyde Road, Kangan Drive, Sir Gustav Nossal Boulevard and Enterprise Avenue. However additional connector and local access streets are proposed within Zone 1 (Chisholm Institute) and Zones 4-5 (Monash University and Nossal High School) to accommodate the additional traffic volumes.

It is noted that under ultimate (2046) conditions, Clyde Road is expected to be upgraded to incorporate three lanes in each direction, and in addition to the level crossing on Clyde Road is expected to be grade separated.

Furthermore, in the interim (2026) intersection upgrades will be undertaken at the Clyde Road/Kangan Drive/Sir Gustav Nossal Boulevard intersection and the Clyde Road/Enterprise Avenue/Railway Access intersection to increase the capacity at these intersections and facilitate development of the CDP area. Car parking on Kangan Drive is also proposed to be removed, providing two traffic lanes in each direction. In addition, the level crossing on Clyde Road will be removed.

The provision of an additional four leg signalised intersection on Clyde Road south of the Kangan Drive intersection is also considered warranted to cater for the anticipated traffic generation as discussed in Section 5 of this report. The proposed road network hierarchy for the CDP area is shown in Figure 4-3.

Figure 4-3 Proposed Road Network

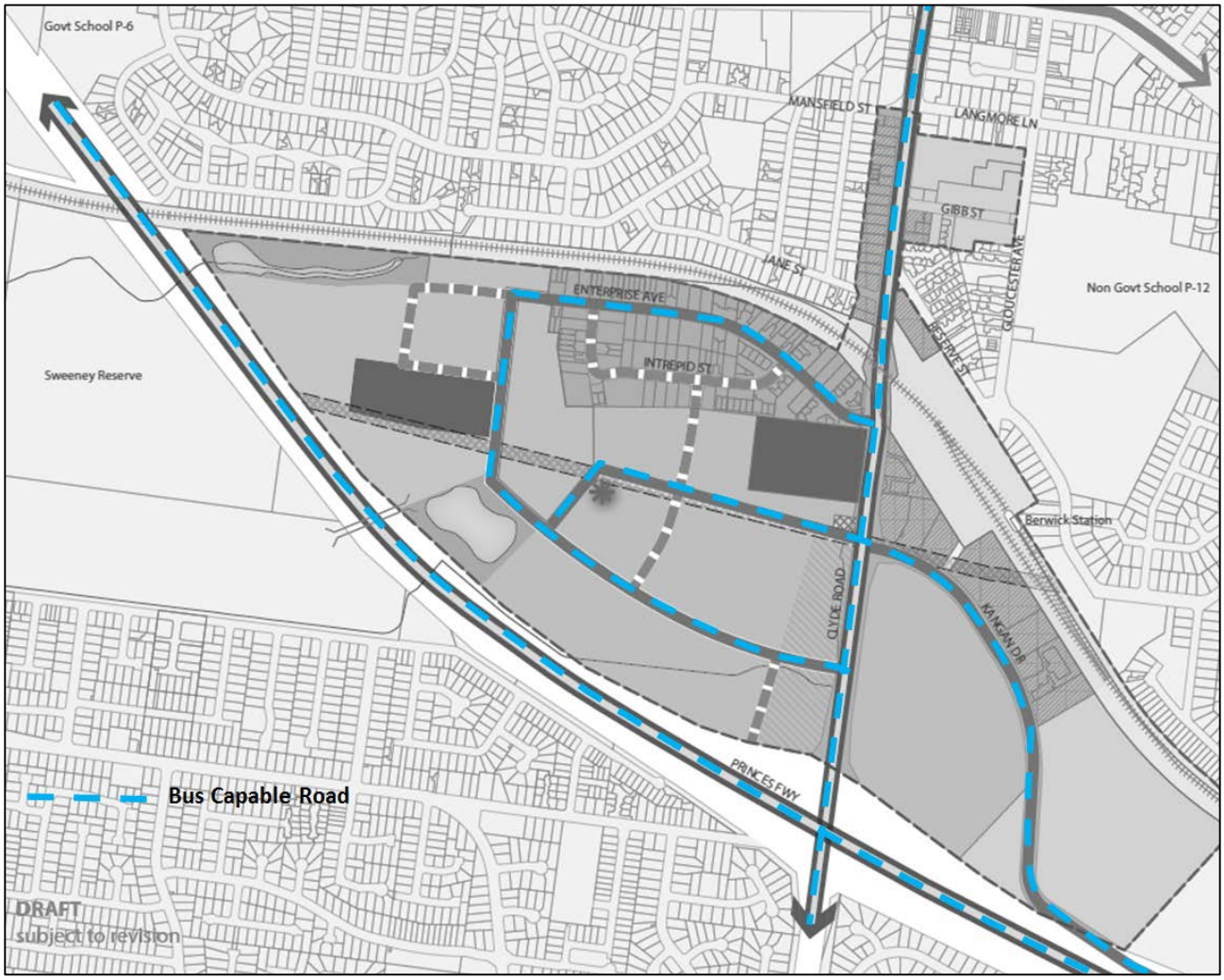


An internal ring road is proposed within Zone 4 and 5 which will connect in the south into the Chisholm Institute area. In addition, Sir Gustav Nossal Boulevard is to be upgraded to a boulevard connector street. Standard local access roads are also proposed within the Chisholm Institute site and the Monash University/Nossal High School areas.

4.4 Public Transport Provisions

As highlighted in Section 3, existing bus routes 834/835, 847 and 831 travel along Clyde Road running north-south through the CDP area, with route 831 branching into Casey Hospital. With the further development of the CDP area, the network of connector streets have been specified to be “bus capable”. These streets must be constructed to allow for the future provision of ultra-low floor buses, in accordance with the Public Transport Guidelines for Land Use and Development. Figure 4.4 highlights the existing and proposed bus network provision within the CDP area.

Figure 4-4 Proposed Public Transport Provision

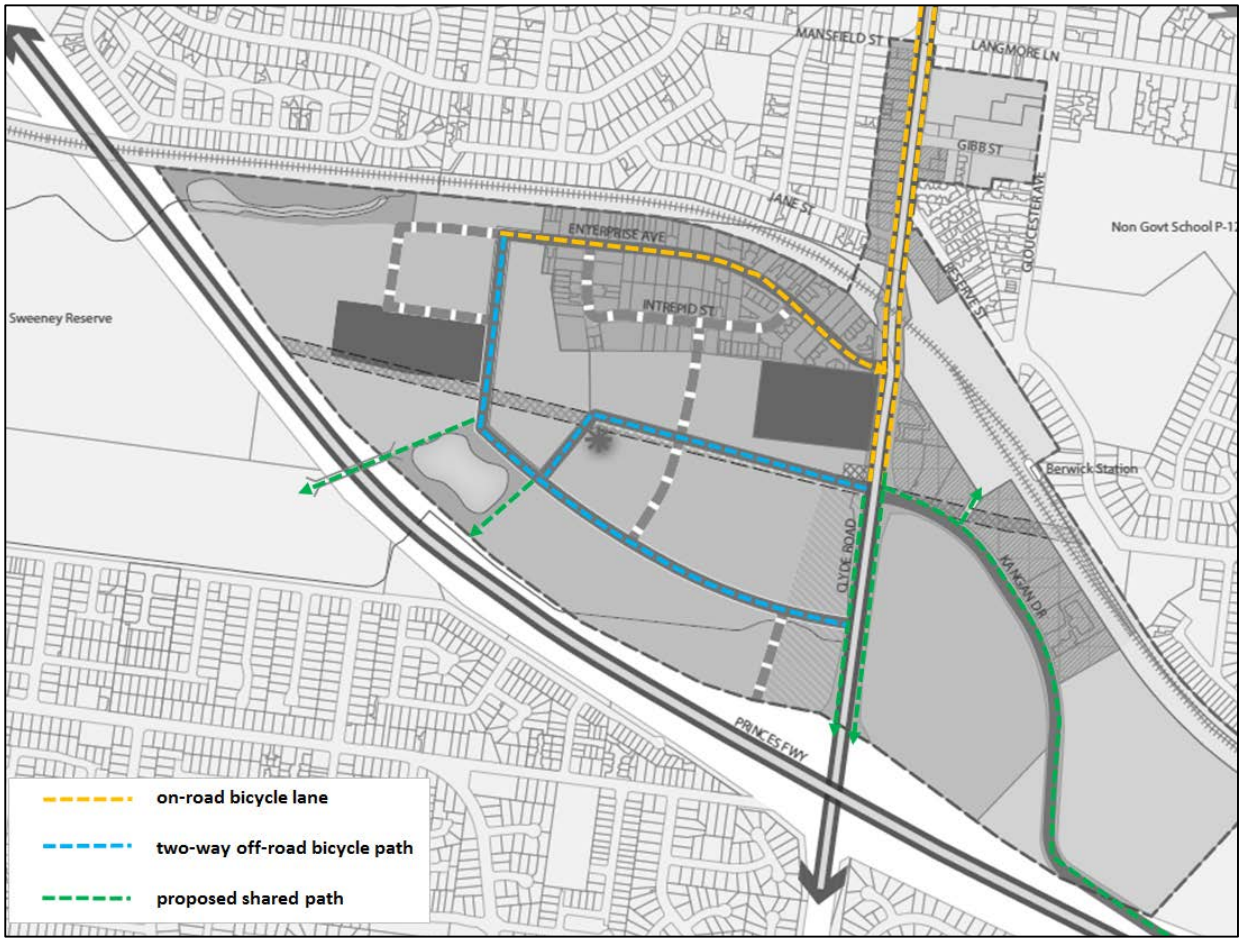


4.5 Bicycle Network

The Principle Bike Network (PBN) through the CDP area was identified in Section 3, however site inspections also confirmed that sections of the network are yet to be implemented. The draft CDP Transport & Movement Plan recognises the missing sections and incorporates them into its cycle and shared path network. The Plan specifies off road cycle paths along all proposed connector streets west of Clyde Road, with the exception of Enterprise Avenue along the northern boundary of the CDP area.

The Plan also recognises the existing on-road cycle lanes along Clyde Rd extending north from the Kangan Drive intersection, and further also specifies that there be a dedicated on-road cycle lane along the access road to the Berwick Rail Station car park. The draft CDP also specifies that there should be safe transition between on and off road cycle networks and that appropriate cycle facilities be provided by developers at key destination points. Figure 4.5 identifies the existing bicycle facilities and those proposed under the CDP.

Figure 4-5 Proposed Cycle Network



4.6 Pedestrian and Shared Path Provisions

The draft CDP Transport & Movement Plan recognises the proposed extension of the off road shared path connection along Sir Gustav Nossal Boulevard, that extends further west and over the Princes Freeway, connecting to Sweeney Reserve sports precinct as shown on the PBN. The Plan also recognises the provision of shared paths along each side of Clyde Road extending from the Sir Gustav Nossal Blvd intersection south over the Freeway. It also specifies an additional shared path along the northern side of Kangan Drive from Clyde Road with a connection into Berwick Rail Station car park. The draft CDP also specifies that there be the provision of a minimum 1.5m footpath on both side of all streets unless there is a provision of shared paths as identified in the plan. Pedestrians are also to be given priority on all slip lanes. Figure 4.5 highlights the shared paths under the Plan.

The full draft integrated Transport & Movement Plan as proposed by the MPA is included as Appendix C.

The existing level rail crossing on Clyde Road within the CDP area is earmarked for grade separation within the next eight years as part of the State Government's Level Crossing Removal Project. It is envisaged that the grade separation of the level rail crossing on Clyde Road will include a separated pedestrian crossing facility across Clyde Road between the railway station and the CDP area to the west of Clyde Road. The provision of a separated pedestrian crossing facility will ensure that the benefits of the level crossing removal to traffic flow on Clyde Road are maximised. The CDP therefore does not include this separated Clyde Road pedestrian crossing provision.

5 Traffic Modelling

5.1 CDP Ultimate Traffic Volumes

5.1.1 Trip Generation

The expected peak hour trip generation within the Berwick Health and Education CDP area for each of the five zones as outlined in Section 4 of this report has been calculated. The assumed AM and PM in/out split for each of the land uses as generally accepted are summarised in Table 5-1.

Table 5-1 Land Use In/Out Distribution Splits

Land Use	AM Peak		PM Peak	
	In	Out	In	Out
Education	80%	20%	20%	80%
Commercial	90%	10%	10%	90%
Medical	50%	50%	50%	50%
Dwelling	20%	80%	60%	40%
Aged care	50%	50%	40%	50%
School	80%	20%	20%	80%

In order to gain an understanding of the likely traffic generation rates for the land uses within the CDP area, reference has been made to the Road and Transport Authority's *Guide to Traffic Generating Developments* and other survey data sources. Reference to the RTA document indicates that following traffic generation rates are appropriate for the CDP area:

- Medical: 0.5 trips per bed and 4.7 trips per practitioner.
- Commercial: 2 trips per 100sqm.
- Dwellings: 0.85 trips per dwelling.

With regards to the education use, reference has been made to traffic survey data collected by Cardno for the Monash University Clayton Campus which indicates that a traffic generation rate of 0.15 trips per student currently exists. Furthermore, a traffic generation rate of 0.35 trips per student for the Nossal High School use has been adopted based on traffic survey data collected as part of the existing conditions assessment.

In addition to traffic generation rates, the RTA guide indicates that in the order of 25% of trips generated by the Precinct are anticipated to be internal to the network. As such a 25% discount has been applied to the relevant dwellings in zone 5.

Table 5-2 has been prepared to summarise the traffic volumes generated by each zone.

Table 5-2 Anticipated CDP Traffic Generation

Zone	Land Use	Size	Generation Rate	AM In	AM Out	PM In	PM Out
1	Education	10,000 students	0.15 trips per student	1,200vph	300vph	300vph	1,200vph
	Medical	300 beds	0.5 trips per bed	75vph	75vph	75vph	75vph
	Medical	125 practitioners	4.7 trips per practitioner	294vph	294vph	294vph	294vph
2	Commercial	500sqm	2 trips per 100sqm	9vph	1vph	1vph	9vph
	Medical	161 beds	0.5 trips per bed	40vph	40vph	40vph	40vph
3	Commercial	15,000sqm	2 trips per 100sqm	270vph	30vph	30vph	270vph
4	Commercial	10,000sqm	2 trips per 100sqm	180vph	20vph	20vph	180vph
	Education	6,425 students[1]	0.15 trips per student	771vph	193vph	193vph	771vph
5	Education	1,900 students[2]	0.35 trips per student	532vph	133vph	Nil	Nil
	Dwellings	250 dwellings	0.85 trips per dwelling[3]	32vph	128vph	96vph	64vph
			Total	**3,403vph**	**1,213vph**	**1,048vph**	**2,903vph**

[1] Includes 1,425 existing enrolments. It is noted that the existing trips generated by Monash University were removed from the post development network model to avoid double-counting for the trips.
[2] Includes 821 existing enrolments. It is noted that the existing trips generated by Nossal High School were removed from the post development network model to avoid double counting of the trips.
[3] It is considered that approximately 25% of trips would be generated internally within the CDP area.
Note: vph denotes vehicles per hour.

5.1.2 Anticipated Background Traffic Growth

In order to gain an understanding of the existing background traffic and forecast growth along Clyde Road, existing SCATS traffic data was sourced from VicRoads, and anticipated ultimate (2046) traffic volumes were obtained from MPA's South-East Growth Corridor version of the Victorian Integrated Transport Model (VITM).

A comparison of the two sets of data for three locations around the Clyde Road / Kanga Drive intersection is provided in Table 5-3.

Table 5-3 Existing and Anticipated Ultimate (2046) Background Traffic Volumes

Road	Existing Conditions			VITM 2046		
	AM Peak Hour	PM Peak Hour	Daily	AM Peak Hour [1]	PM Peak Hour [1]	Daily
Clyde Road (north of Kangan Drive)	2,160vph	2,160vph	25,560vph	1,840vph	2,420vph	17,400vph
Clyde Road (south of Kangan Drive)	2,940vph	2,440vph	30,710vph	-	-	-
Kangan Drive (east of Clyde Road)	1,340vph	950vph	12,230vph	500vph	500vph	3,650vph

[1] VITM outputs 2-hour commuter peak volumes and daily volumes, the 2-hour peak VITM output volumes were converted to 1-hour peak volumes by applying a factor of 0.55 to the 2-hour peak volumes.

Table 5-3 shows that the existing traffic volumes are higher than the 2046 VITM projections for Clyde Road and Kangan Drive. This can be attributed to VITM including a freeway interchange at Beaconsfield and

greater levels of public transport use than current conditions. As such, the existing background traffic volumes were adopted for this analysis to present a conservative assessment.

5.1.3 Trip Distribution

It is assumed that zones 4 and 5, located to the west of Clyde Road, will gain access to the wider road network via Clyde Road given that this area is constrained with regards to alternatives for vehicle access by the Princess Freeway and the existing railway line corridor.

In order to gain an understanding of likely traffic distributions on Clyde Road, consideration was given to existing SCATS volume distribution data which indicated the following:

- AM Peak: 66% northbound and 34% southbound split in through traffic; and
- PM Peak: 45% northbound and 55% southbound split in through traffic.

It was noted that the VITM daily plots also indicated a 60% northbound and a 40% southbound split on Clyde Road. On that basis, a 60% northbound and 40% southbound split was adopted for the purposes of this analysis.

The proportion of trips accessing each zone from Kangan Drive is summarised below:

- Zone 1: 20% of trips travelling to/from the east.
- Zone 2: 10% of trips travelling to/from the east.
- Zone 3: Nil.
- Zone 4: 30% of trips travelling to/from the east.
- Zone 5: 30% of trips travelling to/from the east.

It is noted that the variance in the distribution on Kangan Drive was adopted to produce a conservative assessment, ensuring that a higher proportion of trips crossed Kangan Drive to get to the Monash University and Nossal High School Zones. Similarly, this distribution was reduced to Zone 1 (Chisholm Institute) and Zone 2, to increase the level of traffic passing through the Clyde Road intersections.

By adding the CDP development generated traffic to existing traffic volumes, the future post-development road network volumes were derived and are in Figure 5-1 and Figure 5-2 for the AM and PM peak hours respectively.

Figure 5-1 Post Development Traffic Volumes – AM Peak Hour

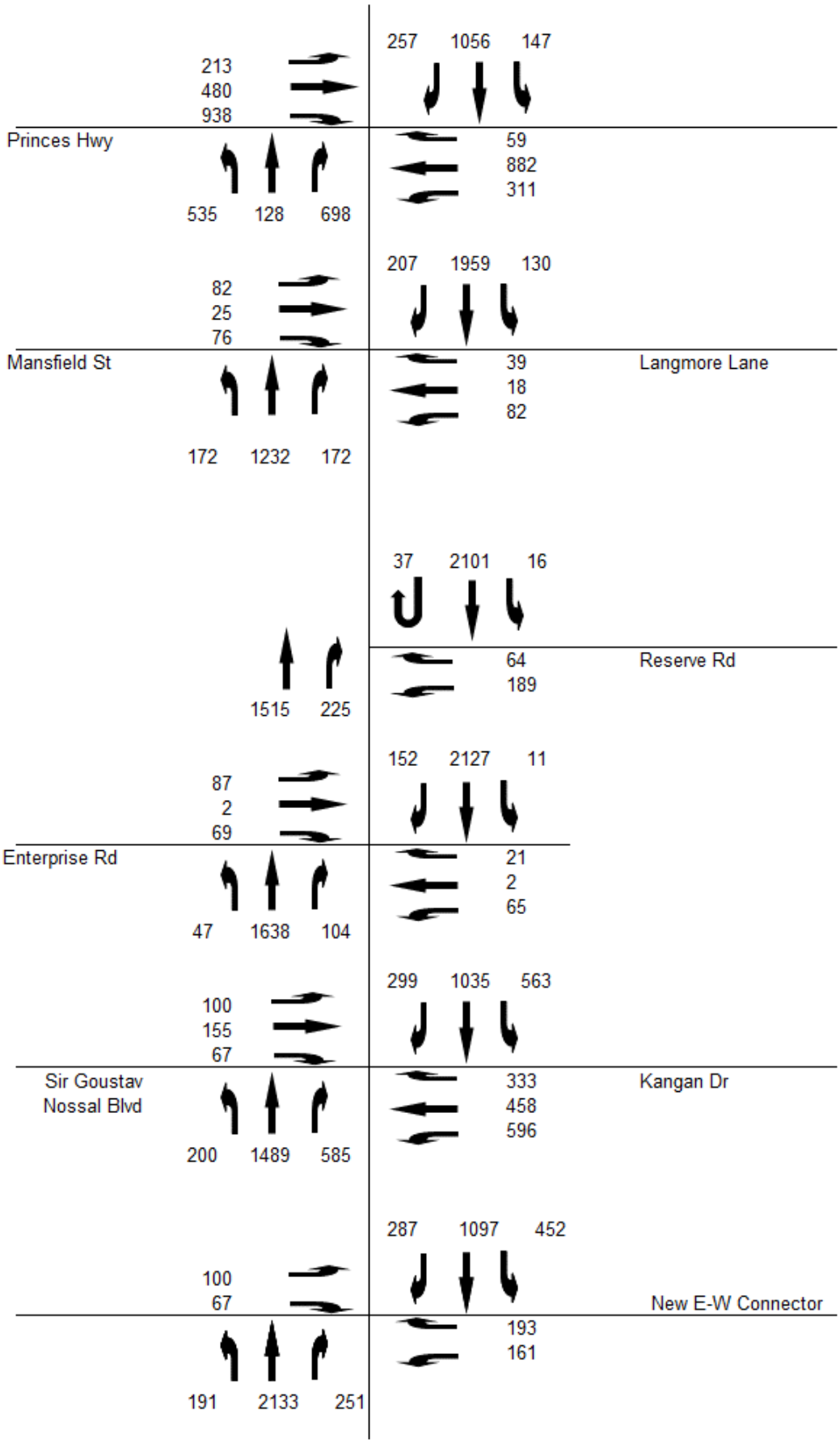
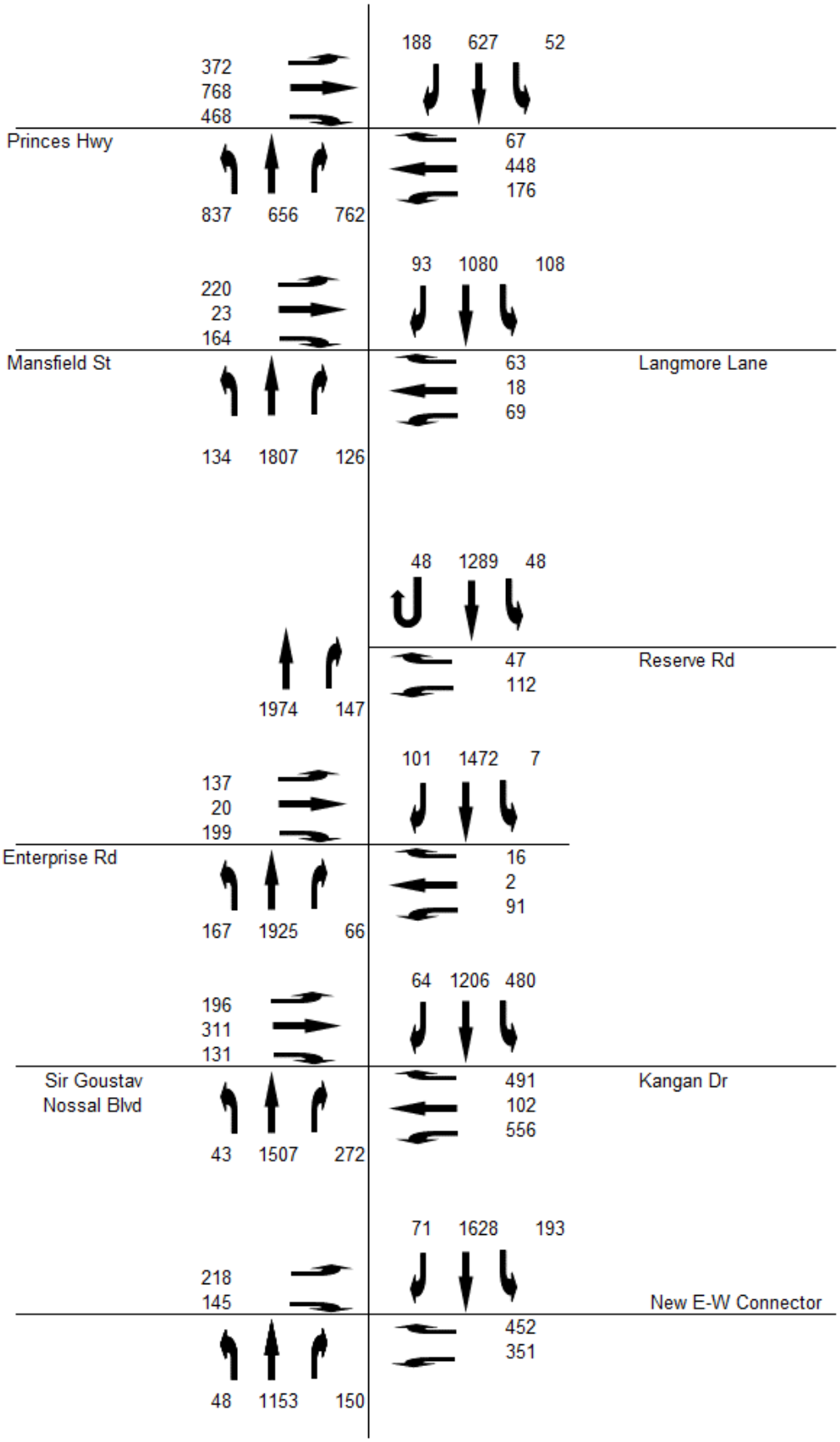


Figure 5-2 Post Development Traffic Volumes – PM Peak Hour



5.2 Road Network Operation

It is noted that approximately 90% of the CDP traffic generated during the AM and PM peak hours[6] will gain access to the area via the Enterprise Avenue/ Clyde Road, Kangan Drive/Sir Gustav Nossal Boulevard/Clyde Road or the Clyde Road/new east-west connector street intersections. As such, the following assessment has focused on the ability of these intersections to accommodate the additional traffic generated by the CDP.

The operation of these key signalised intersections, has been assessed using SIDRA 6.1, making use of the network modelling capabilities provided by this software package.

The commonly used measure of intersection performance is referred to as the *Degree of Saturation (DOS)*. The *DOS* represents the flow-to-capacity ratio for the most critical movement on each leg of the intersection.

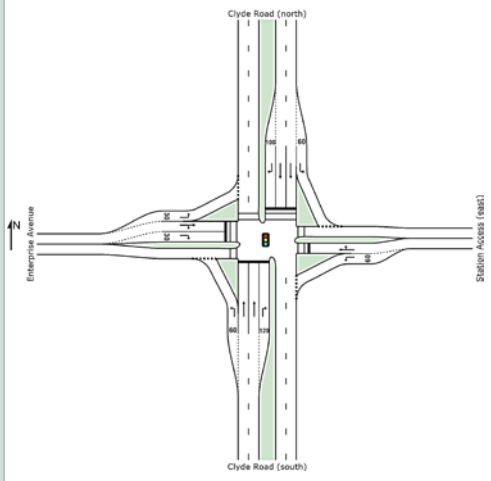
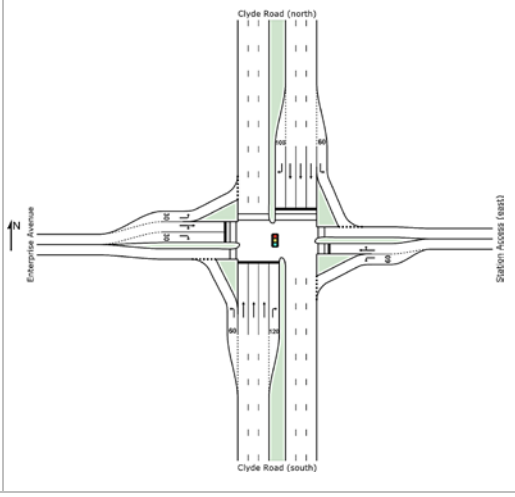
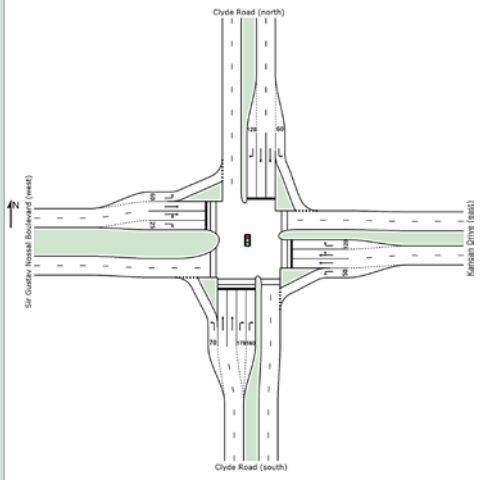
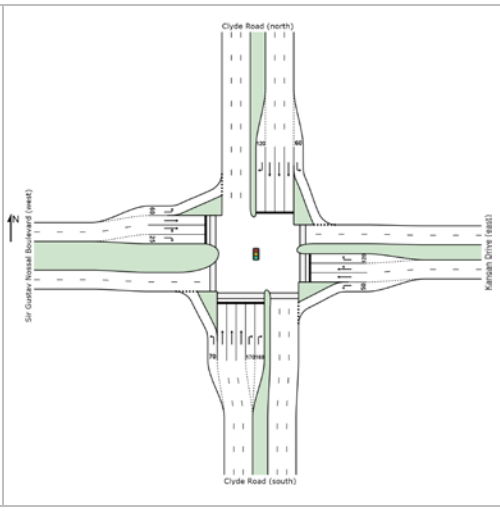
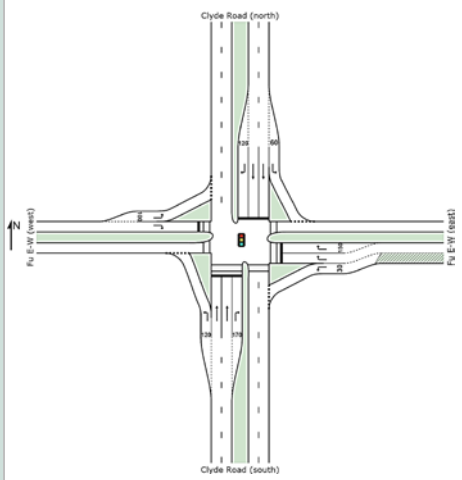
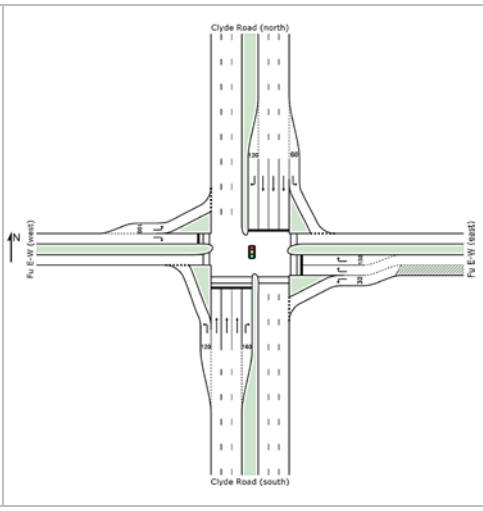
For signalised intersections, a DOS of around 0.95 has been typically considered the 'ideal' limit, beyond which queues and delays increase disproportionately. In addition, for signalised intersections, the SIDRA models were run with a 120-150 second cycle time and incorporated a leading right-turn arrangement in accordance with VicRoads requirements.

5.3 Interim and Ultimate Intersection Requirements

Based on the outcomes of SIDRA modelling, the interim (Clyde Road in its existing Secondary Arterial form) and ultimate (Clyde Road upgraded to a 6-lane Primary Arterial Road) intersection layouts for the assessed intersections is shown in Table 5-4.

[6] *Including existing Monash University and Nossal High School enrolments.*

Table 5-4 Interim and Ultimate Intersection Layout Configurations

Intersection	Interim	Ultimate
Clyde Road/Enterprise Avenue/Railway Access Intersection		
	Turn lane capacity will be increased in the interim with provision of an additional through lane in each direction under ultimate conditions.	
Clyde Road/Kangan Drive/Sir Gustav Nossal Boulevard Intersection		
	East-west capacity will be increased in the interim with provision of an additional through lane in each direction under ultimate conditions.	
Clyde Road/East-West Connector Street		
	East-west approaches will be provided in the interim with provision of an additional through lane in each direction under ultimate conditions.	

5.4 Ultimate Road Network Operation

A summary of the ultimate scenario SIDRA outputs is provided in Table 5-5 with full results provided in Appendix D of this report.

Table 5-5 Ultimate Intersection Operation

Intersection	Peak Hour	DOS	Average Delay	95th Percentile Queue
Clyde Road/Enterprise Avenue/Railway Access Intersection	AM	0.71	34 sec	279m
	PM	0.92	24 sec	221m
Clyde Road/Kangan Drive/Sir Gustav Nossal Boulevard Intersection	AM	0.88	43 sec	278m
	PM	0.88	39 sec	195m
Clyde Road/East-West Connector Street	AM	0.84	25 sec	237m
	PM	0.88	22 sec	117m

As outlined in Table 5-5, the road network is anticipated to be operating at an acceptable level of service following the full development of the CDP.

Specifically, the results indicate that queue lengths on Clyde Road are anticipated to remain under 300m with associated delay times indicating that the intersections are clearing each cycle.

Based on the above, while the intersections are anticipated to operate within their theoretical capacities, it is clear that an increase in pedestrian, cyclist and public transport trips should be encouraged to reduce the queuing impact on the road network as the CDP develops.

Noting that student numbers in the Monash University/Nossal High School areas (Zones 4 and 5) are anticipated to increase from 2,246 students to 8,325 students as part of the CDP, the level of pedestrians crossing Clyde Road (currently up to 320 per hour) is anticipated to almost triple. As such, the provision of grade separated pedestrian links will be required to ensure a safe pedestrian connection between the rail station and the areas on the western side of Clyde Road. It is anticipated that the separated pedestrian crossing will be provided in conjunction with the Clyde Road level crossing removal (discussed in Section 3.1.2.).

5.5 Interim Road Network Operation

In order to gain an understanding of interim operating requirements, Cardno has completed a trigger assessment to determine the level of CDP development which could be accommodated prior to the upgrade of Clyde Road (i.e. to provide three through lanes in each direction), using the intersection layouts depicted in Table 5-4. The results of this SIRDA assessment, included in Appendix E, indicate that up to 47% of the additional land uses proposed by the CDP can be developed prior to the interim intersection layouts reaching capacity.

A summary of the interim development yields is provided in Table 5-6.

Table 5-6 Interim Development Yield Traffic Generation

Zone	Land Use	Size	Generation Rate	AM In	AM Out	PM In	PM Out
1	Education	4,200 students	0.15 trips per student	504vph	126vph	126vph	504vph
	Medical	126 beds	0.5 trips per bed	32vph	32vph	32vph	32vph
	Medical	53 practitioners	4.7 trips per practitioner	123vph	123vph	123vph	123vph
2	Commercial	210sqm	2 trips per 100sqm	4vph	Nil	Nil	4vph
	Medical	68 beds	0.5 trips per bed	17vph	17vph	17vph	17vph
3	Commercial	6,300sqm	2 trips per 100sqm	113vph	13vph	13vph	113vph
4	Commercial	4,200sqm	2 trips per 100sqm	76vph	8vph	8vph	76vph
	Education	2,700 students[1]	0.15 trips per student	324vph	81vph	81vph	324vph
5	Education	821 students[2]	0.35 trips per student	230vph	57vph	Nil	Nil
	Dwellings	105 dwellings	0.85 trips per dwelling[3]	13vph	54vph	40vph	27vph
			Total	**1,436vph**	**511vph**	**440vph**	**1,220vph**

[1] Includes 1,425 existing enrolments. It is noted that the existing trips generated by Monash University were removed from the post development network model to avoid double counting.
[2] Includes 821 existing enrolments. It is noted that the existing trips generated by Nossal High School were removed from the post development network model to avoid double counting.
[3] It is considered that approximately 25% of trips would be generated internally within the CDP area.
Note: vph denotes vehicles per hour.

The traffic volumes for the trigger assessment are shown in Figure 5-3 and Figure 5-4.

Figure 5-3 Trigger Assessment Volumes – AM Peak Hour

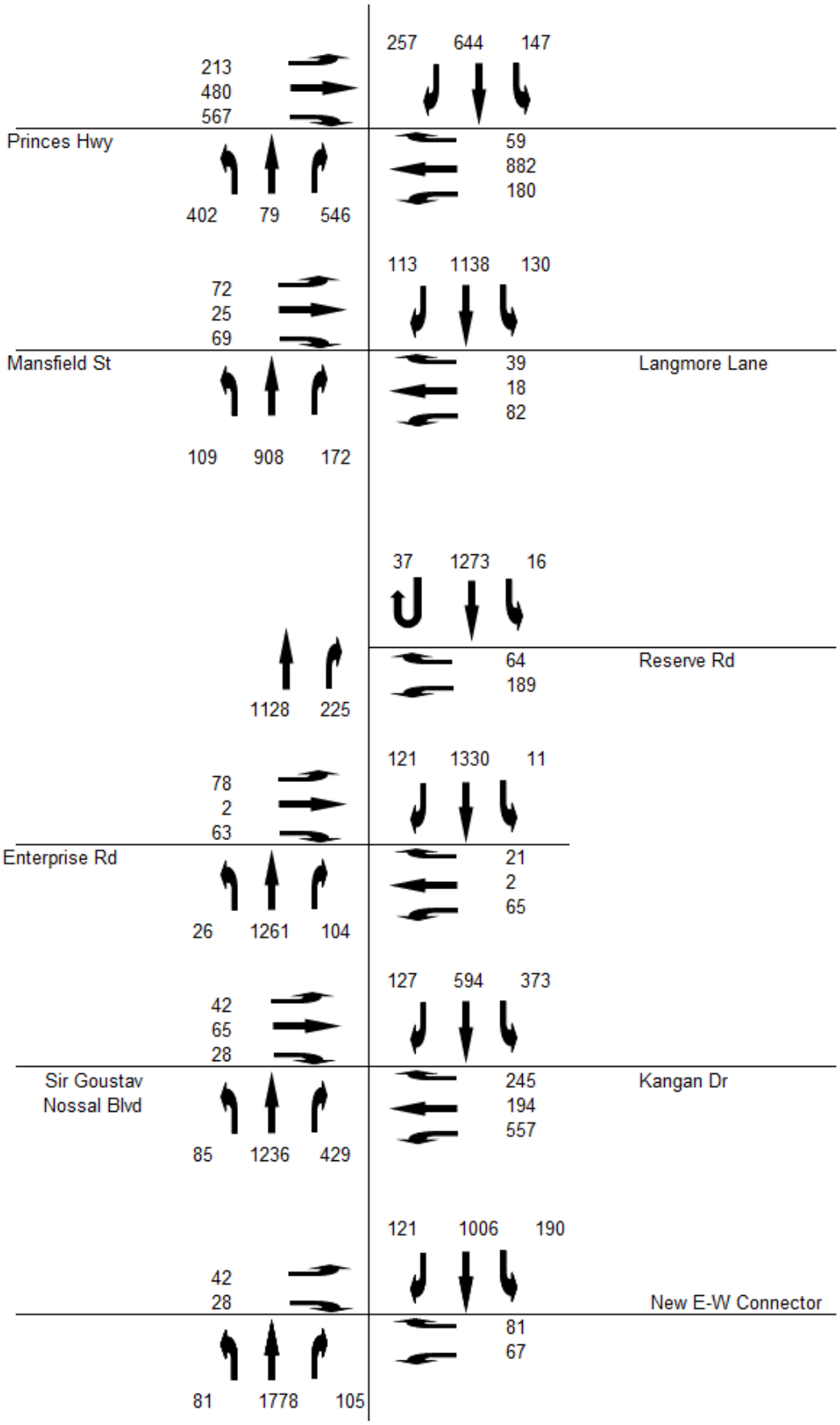
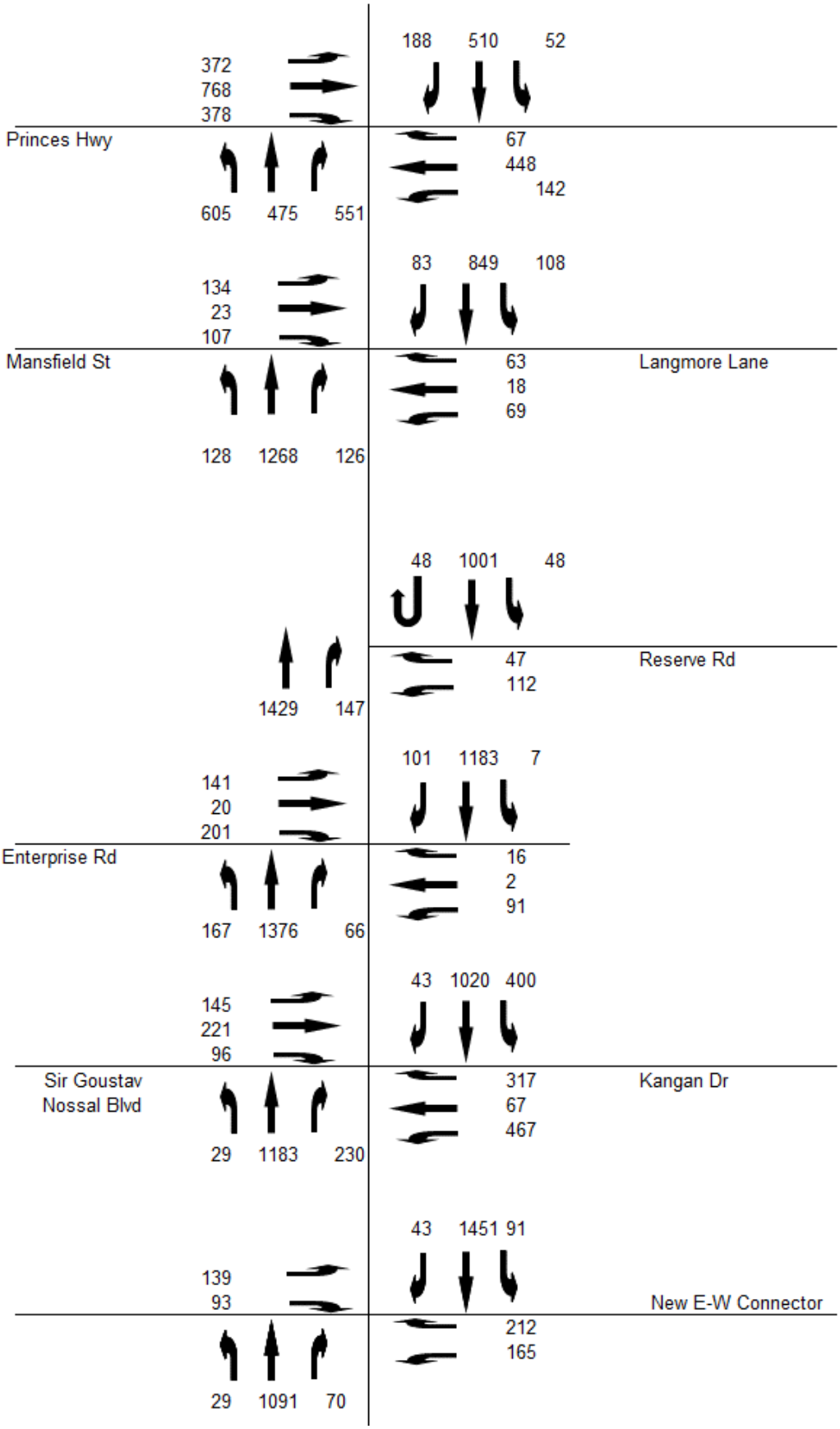


Figure 5-4 Trigger Assessment Volumes – PM Peak Hour



5.6 Proposed Concept Plans – Ultimate Configuration

Noting that intersection works are required on Clyde Road to accommodate the additional traffic volumes likely to be generated by the CDP, Cardno has prepared concept plans to show the extent of works required at the following intersections:

- Clyde Road/Enterprise Avenue/Railway Access
- Clyde Road/Kangan Drive/Sir Gustav Nossal Boulevard
- Clyde Road/New East-West Connector Street.

A copy of the concept plans is provided at Appendix F of this report.

6 Conclusion

This report has been prepared to address the traffic and transport impacts which are likely to be generated by the development of the Berwick Health and Education Comprehensive Development Plan. Based on the analysis and assessment within this report, the following conclusions are made:

Sustainable and Active Travel Modes:

- As development of the CDP area progresses, and particularly the Monash University/Nossal High School area, additional pedestrian connectivity will be required, including the provision of a grade separated pedestrian facility across Clyde Road connecting Berwick Rail Station to these uses.
- It is envisaged that a suitable separated pedestrian provision will be provided in association with the Clyde Road rail level crossing removal which is included in the DEDJTR's Level Crossing Removal Project.
- The CDP incorporates additional cyclist links to the external road network which will encourage the use of cycling to access the CDP area.
- Public transport patronage is anticipated to increase as the CDP area develops. As such, a high level of connectivity between these services and the key trip generators (i.e. Monash University and Chisholm Institute) will be required.
- An increased reliance on sustainable travel (i.e. public transport, walking, cycling) must be a key focus of the CDP to reduce the impact to the road network.

Road Network:

- The existing conditions assessment indicates that key intersections within the CDP area are currently approaching capacity during peak times.
- The CDP area is anticipated to ultimately generate up to 4,616 vehicle movements during the AM peak hour and up to 3,951 vehicle movements during the PM peak hour.
- Road network upgrades, including the provision of a new east-west connector street intersection to Clyde Road will be required to accommodate traffic volumes generated by the development envisaged by the CDP.
- It is anticipated that the proposed intersection upgrades will enable 47% of the development envisaged by the CDP to be constructed prior to the upgrade of Clyde Road (to provide an additional through traffic lane in each direction) being required.
- Following the upgrade of Clyde Road, the modelling for the proposed intersections indicates that the assessed intersections will operate at an acceptable level during peak times following full development of the CDP area.

Berwick Health and Education Precinct

APPENDIX A

EXISTING CONDITIONS ASSESSMENT

Cardno
Shaping the Future

Existing Conditions Transport Assessment

Berwick Health and Education Precinct

CG140608

Prepared for
Metropolitan Planning Authority

15 August 2014

Cardno
Shaping the Future

Document Information

Prepared for	Metropolitan Planning Authority
Project Name	Berwick Health and Education Precinct
File Reference	CG140608REP01F01.docx
Job Reference	CG140608
Date	15 August 2014

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Document Control

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Tables

Figures

1 Introduction

1.1 Purpose of the Report

Cardno has been engaged the Metropolitan Planning Authority (MPA) to undertake a transport assessment for the proposed Berwick Health and Education Precinct (The Precinct). The transport assessment will assist in the development of a Precinct Structure Plan (PSP) for the Precinct.

Stage One of the transport assessment entailed reviewing existing conditions within the Precinct including vehicle, public transport and active travel conditions and infrastructure. Furthermore, the existing conditions assessment identified existing gaps in the network for all modes.

1.2 Location and Land Use

The overall study area is located in Berwick and is bound by the Princes Highway to the north, the Princes Freeway to the south and Kangan Drive/Haileybury College to the east. The area is bisected by the Pakenham rail line.

The Precinct Structure Plan (PSP) area lies within a wider study area and focuses on the key education and health uses within the southern portion of the wider study area. The wider study area and PSP boundaries are illustrated in Figure 1-1.

The study area incorporates a number of key land uses including education and health uses. Notably, Monash University (Berwick Campus) and Nossal High School are located on the south-west land parcel sharing a single access point to Clyde Road.

In addition, Chisholm TAFE is located within the Precinct opposite the Monash University Campus and accessed via Kangan Drive. Casey Hospital is located to the west of Chisholm TAFE and also accessed via Kangan Drive while St John of God Hospital is located in the northern portion of the study area, east of Clyde Road. An industrial precinct is located to the north of Monash University and accessed via Enterprise Avenue.

Key land uses are identified in Figure 1-2.

Figure 1-1 Subject Site and Surrounds

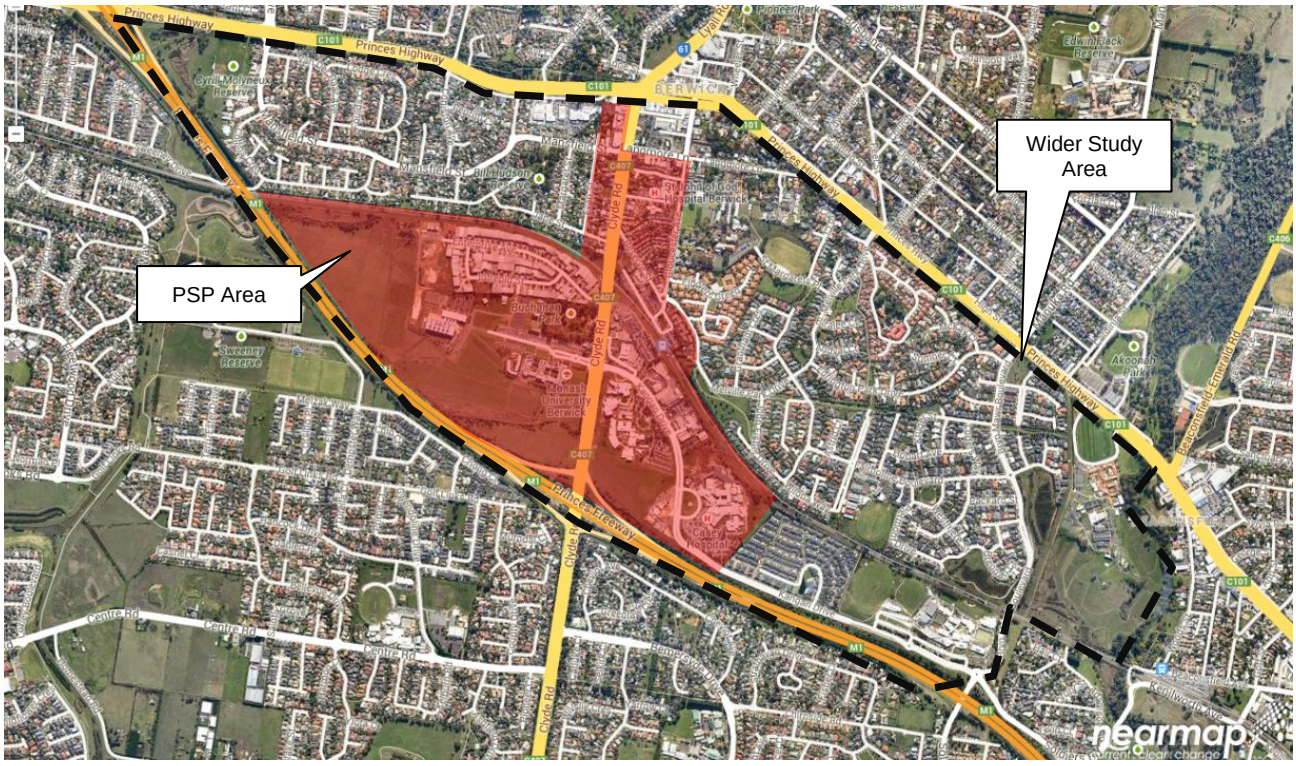
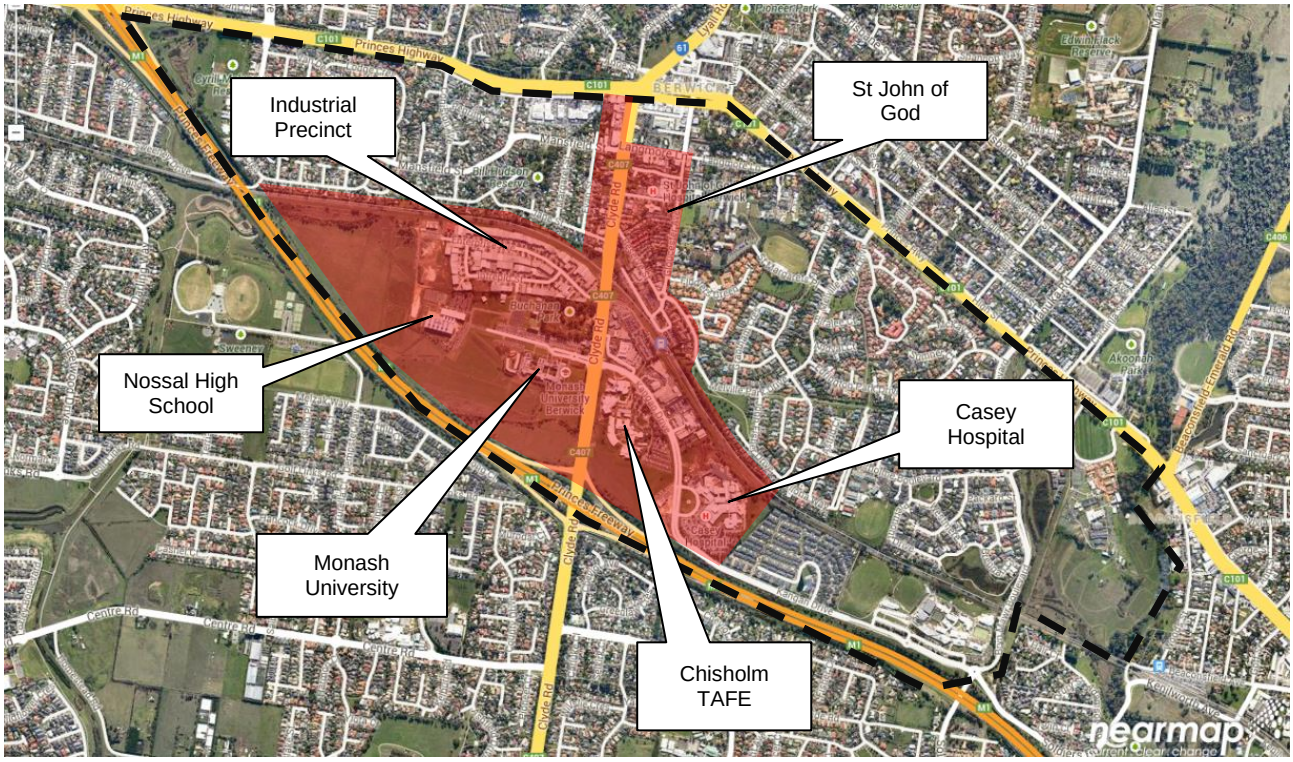


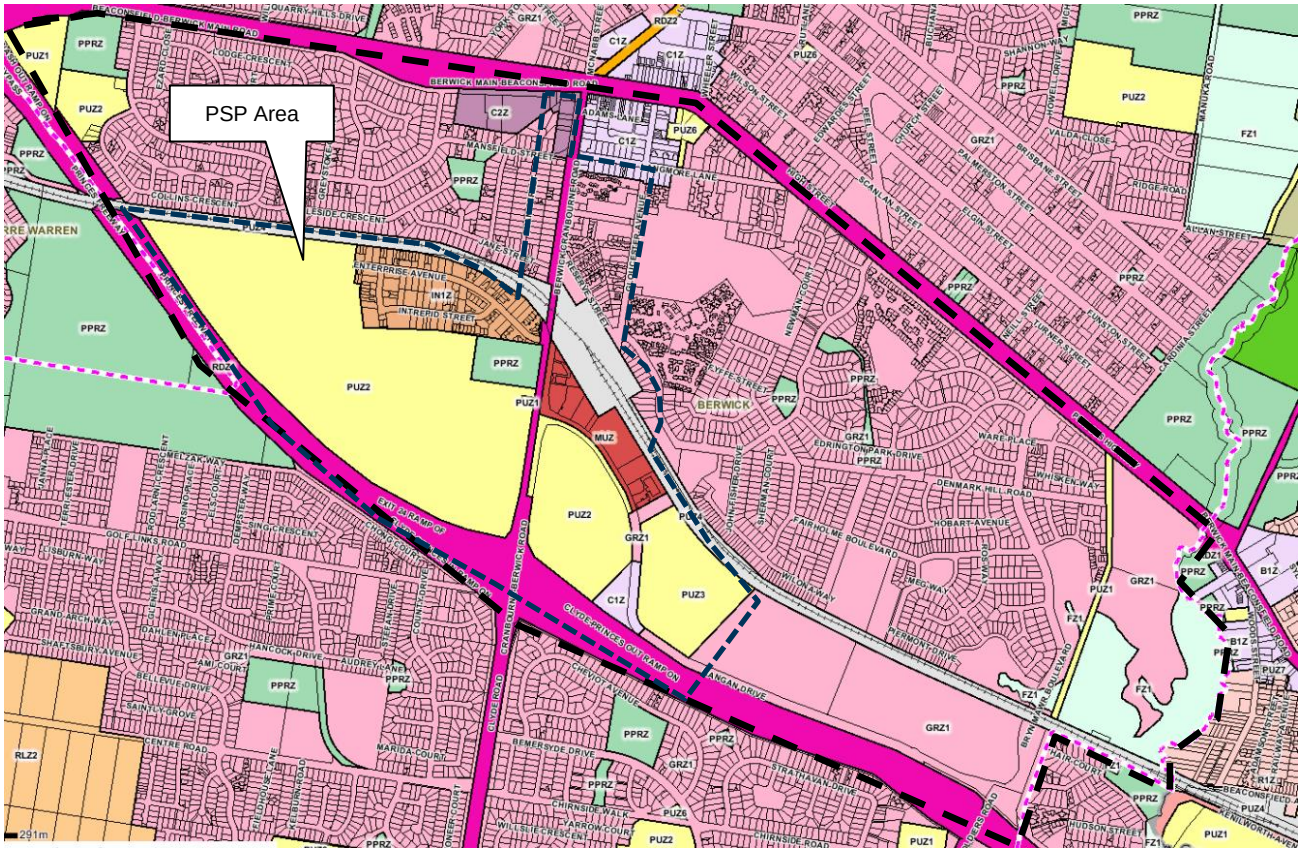
Figure 1-2 Key Land Uses



1.3 Existing Planning Zones

The existing land zoning for the Precinct is illustrated in Figure 1-3.

Figure 1-3 Land Zoning



2 Document Review

2.1 Plan Melbourne

Plan Melbourne, adopted in May 2014, is an integrated land use and transport plan developed by the Victorian Government. It focuses on the development of an Integrated Economic Triangle model for the future development of the city to be delivered by 2050.

Plan Melbourne aims to align employment centres with an improved public transport network creating employment clusters and industrial precincts. Ultimately, Plan Melbourne aims to increase and improve investment and employment options within the existing and future transport corridors. Figure 2-1 shows the existing key activity nodes and transport links, and Figure 2-2 shows how these are anticipated to change by 2050.

Figure 2-1 Plan Melbourne Integrated Transport Model (Melbourne Today)

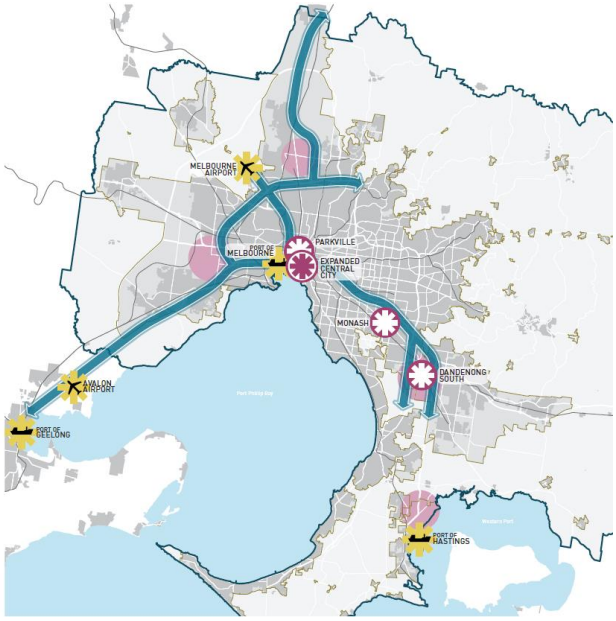
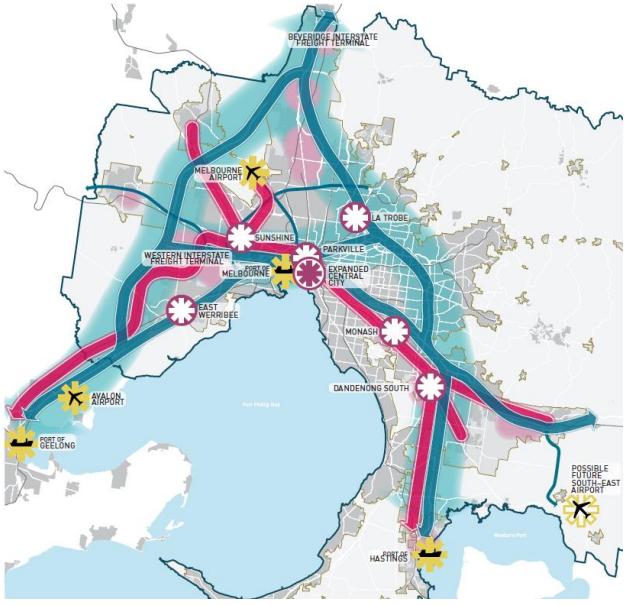


Figure 2-2 Plan Melbourne Integrated Transport Model (Melbourne 2050)

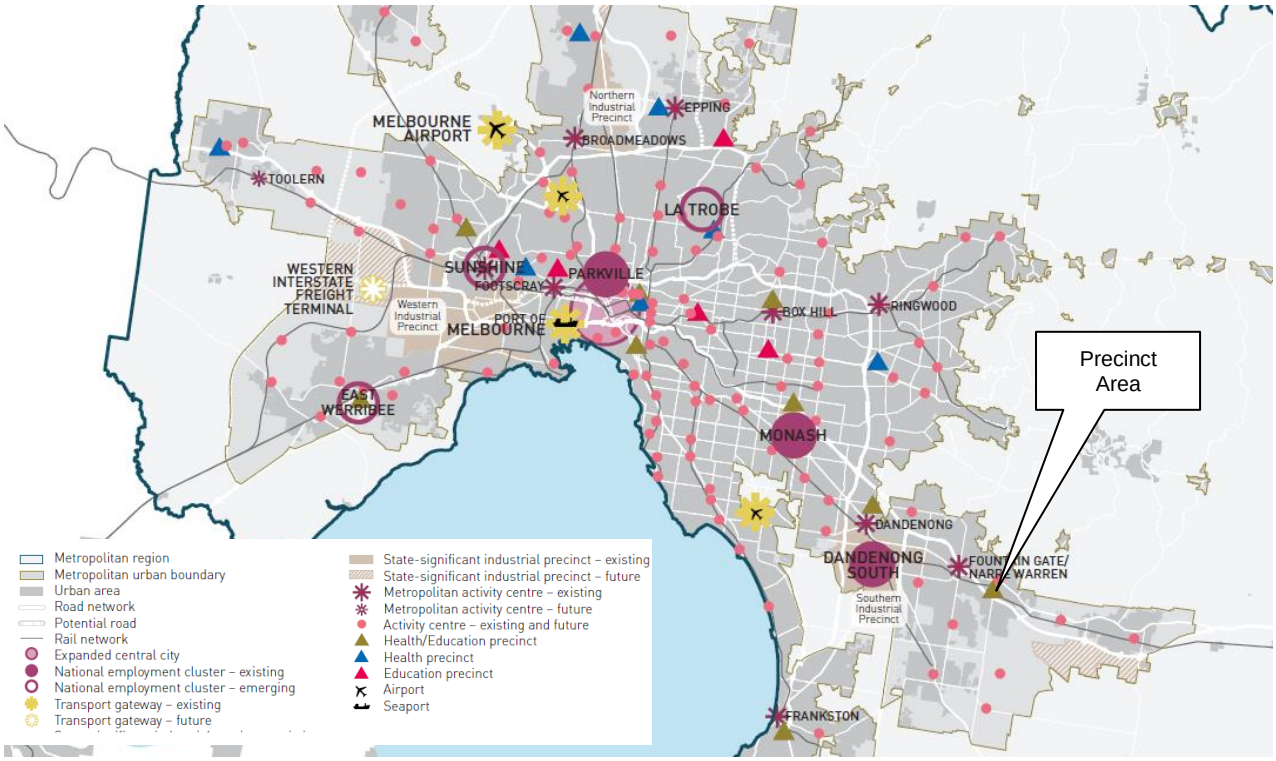


In terms of transport related objectives, Plan Melbourne indicates that it will "provide an integrated transport system connecting people to jobs and services, and goods to market". Consequentially, the development and improvement of the transport network will be closely linked to the success of Plan Melbourne. Key Transport directions outlined in Plan Melbourne are as follows:

- Transform the transport system to support a more productive central city;
- Improve access to job-rich areas across Melbourne and strengthen transport networks in existing suburbs;
- Improve transport infrastructure, services and affordability in Melbourne's newer suburbs;
- Improve local travel options to increase social and economic participation;
- Improve the efficiency of freight networks while protecting urban amenity; and
- Increase the capacity of ports, interstate rail terminals and airports and improve landside transport access to these gateways.

Figure 2-3 shows the Precinct area in the context of surrounding activity areas, outlined in Plan Melbourne.

Figure 2-3 Activity Centre Locations



The Precinct is identified in Plan Melbourne as an Activity Centre with Monash University and Casey Hospital identified as Health and Education Precincts. As such, the development of the transport network within and around the Precinct will play a pivotal role in the development of the area and the ultimate visions and aims of Plan Melbourne.

2.2 Casey Planning Scheme

The Casey Planning Scheme states that planning should ensure an integrated and sustainable transport system that provides access to social and economic opportunities, facilitates economic prosperity, contributes to environmental sustainability, coordinates reliable movements of people and goods and is safe.

Key transport strategies outlined by the Planning Scheme include:

- Coordinating improvements to public transport, walking and cycling networks with the ongoing development and redevelopment of urban area;

- Providing routing, bus stop and interchange arrangements for public transport services in new development areas; and
- Providing safe, convenient and direct pedestrian and cycling access to activity centres, public transport interchanges and other strategic redevelopment sites.

Given the Precinct is located on an arterial transport corridor and is classified as an activity centre, an opportunity exists to develop a Precinct which aligns with Council's visions and strategic aims.

A key element of this existing conditions assessment is to highlight transport issues and opportunities within the Precinct as they relate to various modes and through this identification. The potential therefore exists to develop a coordinated transport network which allows users to access key locations within the Precinct.

2.3 Berwick Village Structure Plan

The Berwick Village Structure Plan was prepared by Casey City Council in September of 2011. Figure 2-4 shows the extent of the Berwick Village. The Structure Plan sets out framework for the use, development and enhancement of the Berwick Village activity centre for a 20 year period.

Figure 2-4 Berwick Village Structure Plan Area

Source: Berwick Structure Plan, prepared by the City of Casey, dated September 2011

The Structure Plan sets out Council's vision for the centre noting that it is to 'accommodate necessary growth and expansion through appropriate development on identified strategic sites and within the education, medical and mixed use precinct'. The 2011 version of the plan superseded the Berwick Village Commercial Centre Strategy prepared in 2006.

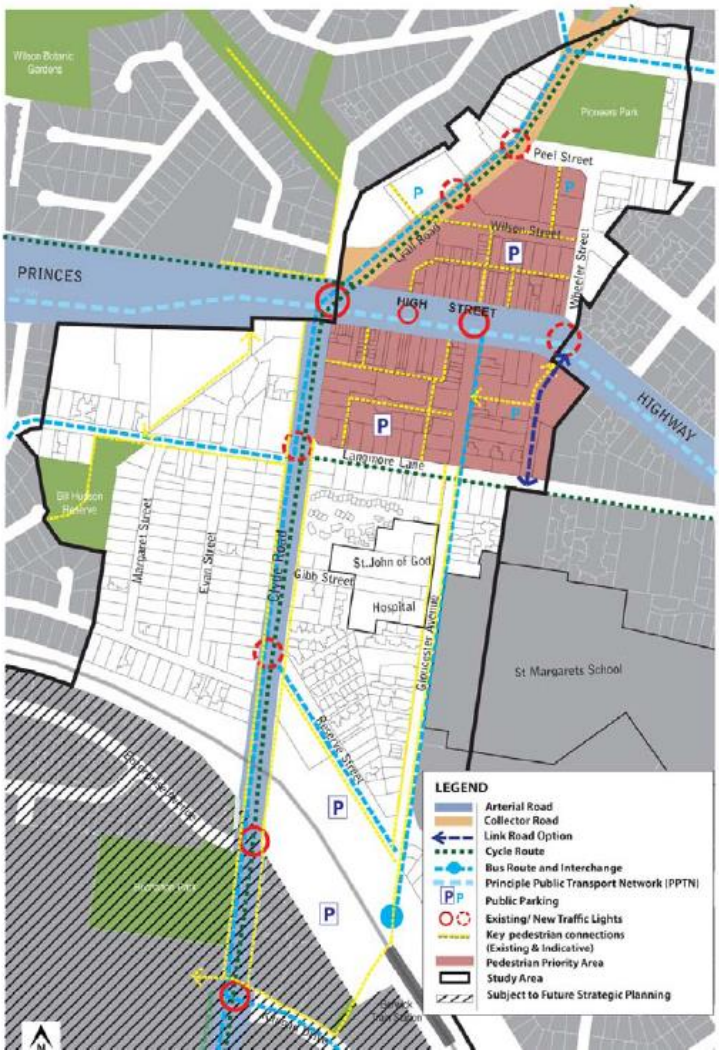
The Structure Plan identified a number of opportunities to improve and enhance accessibility in the area with a key objective being to 'improve accessibility into and around the centre by minimising traffic congestion, improving parking management and by promoting the use of more sustainable transport modes such as walking, cycling and public transport'.

A key item identified within the Structure Plan is a need to provide dedicated cyclist routes and end of trip parking facilities at key locations within the Precinct, and to enhance pedestrian connections and signage to strategic sites through walkways, laneways and arcades.

Noting that a Monash University and TAFE campuses are located within the Precinct, pedestrian and cyclist facilities between these facilities, the nearby railway station, and retail uses is a key item which will be addressed in this review.

Figure 2-5 shows the Access Plan included in the Berwick Village Structure Plan.

Figure 2-5 Berwick Village Structure Plan – Access



Source: Berwick Structure Plan, prepared by the City of Casey, dated September 2011

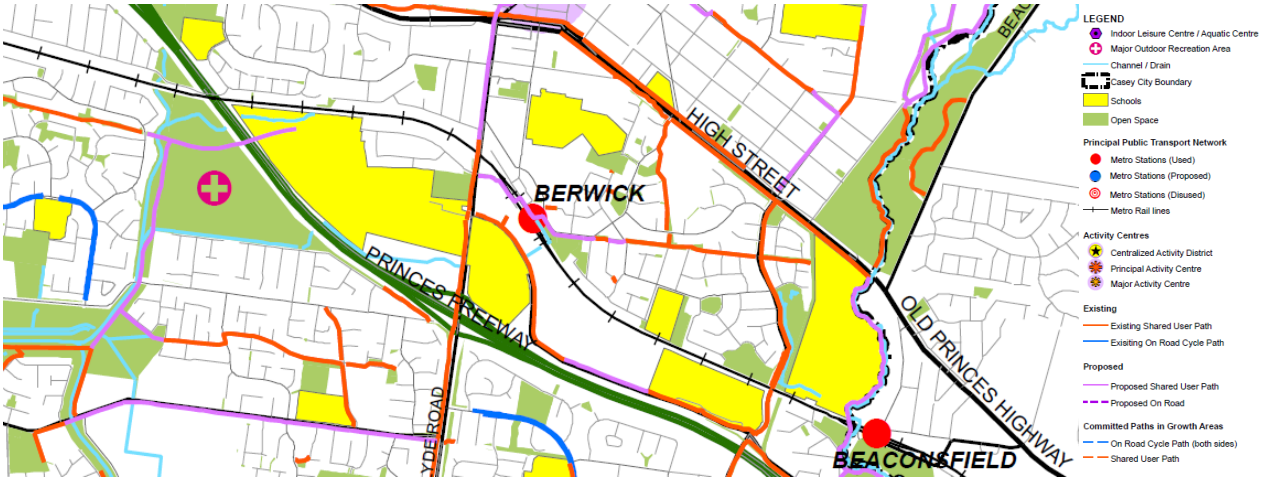
2.4 Paths and Trails Strategy

The City of Casey Paths and Trail Strategy, dated May 2012 and prepared by Aecom, aims to encourage the use of active transport within the municipality of Casey for local trips and in conjunction with public transport services.

A number of objectives are identified within the strategy which aims at increasing participation in active travel modes and also improving and enhancing the quality, connectivity and safety of the pedestrian and cyclist network.

Figure 2-6 shows the strategy for the North Section of Casey surrounding the Precinct.

Figure 2-6 City of Casey Paths and Trails Strategy (North Section)



Source: City of Casey

The Strategy outlines a need to review and plan for new components of the network.

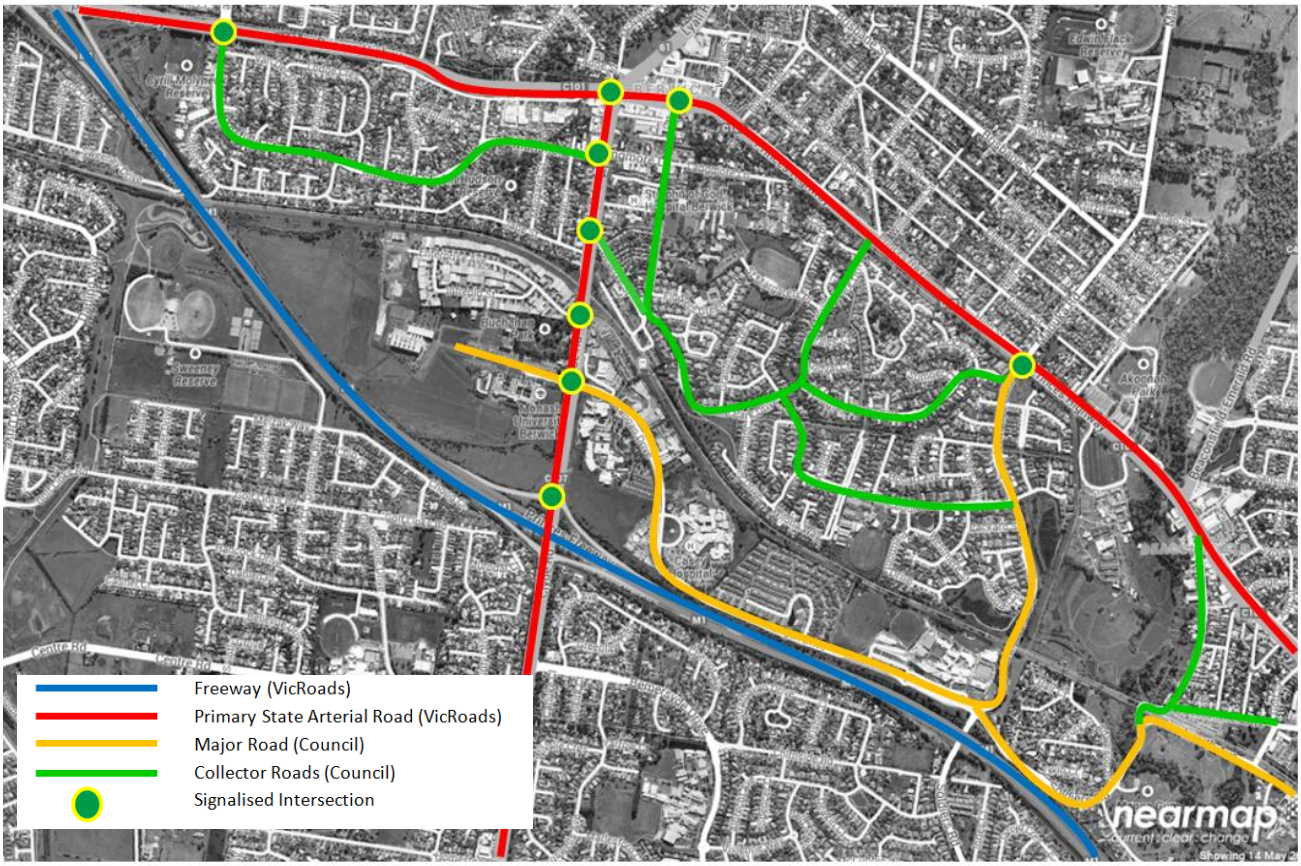
3 Road Network

3.1 Existing Road Network

3.1.1 Road Hierarchy

The existing road hierarchy within the study area is shown in Figure 3-1. The study area is bisected by an arterial road which provides convenient vehicle access to the north and south boundaries of the study area. A network of connector and major roads provides convenient east to west connectivity within the area.

Figure 3-1 Road Hierarchy



The existing volumes on the road network have been assessed against the road classifications and associated daily volumes outlined in the Growth Areas Authority PSP Note 'Our Roads Connecting Our People'. Table 3-1 summarises this assessment.

Table 3-1 Road Network Analysis

Road Name	Configuration	Classification	Approximate Vehicles per day for Classification	Existing Daily Volume
Clyde Road	Four Lane	Secondary Arterial	12,000-40,000vpd	25,550vpd
Kangan Drive	Two - Four Lanes	Connector Street	3,000-7,000vpd	8,150vpd
Sir Gustav Nossal Boulevard	Two lane	Connector Street	3,000 7,000vpd	3,200vpd
Enterprise Avenue	Two lane	Connector Street	3,000-7,000vpd	5,500vpd
Reserve Street	Two lane	Connector Street	3,000-7,000vpd	6,050vpd
Gloucester Avenue	Two lane	Connector Street	3,000-7,000vpd	4,100vpd

Table 3.1 indicates that the key roads in the Precinct area operate within capacity with the exception of Kangan Drive. This indicates that in order to facilitate growth on the west side of Clyde Road an additional signalised access point onto Clyde Road is already required.

3.1.2 Clyde Road

Clyde Road is classified as a Primary State Arterial road (controlled by VicRoads) and is generally aligned in a north-south direction. It is a four lane median divided road and generally incorporates pedestrian paths and bicycle lanes on both sides of the carriageway. A level crossing is located on Clyde Road, north of Enterprise Avenue.

Clyde Road carries approximately 25,550 vehicles per day[1] and is shown in Figure 3-2 and Figure 3-3.

Figure 3-2 Clyde Road (facing North at Enterprise Avenue)

[1] *Source: VicRoads SCATS data*

Figure 3-3 Clyde Road (Facing South at Enterprise Avenue)

3.1.3 Kangan Drive

Kangan Drive is classified as a Major Road (Council controlled) and is generally aligned in a north-west to south-east direction in the vicinity of the Precinct area. It is a two lane median divided road and generally incorporates pedestrian paths on both sides of the carriageway. Kangan Drive provides access to Chisolm TAFE and Casey Hospital.

Kangan Drive also provides a link between the two freeway overpasses on the southern boundary of the study area. Kerbside parking is permitted on both sides of the carriageway in the vicinity of the education and health uses.

Kangan Drive carries approximately 8,150 vehicles per day[2] and is shown in Figure 3-4 and Figure 3-5.

Figure 3-4 Kangan Drive (facing east)

[2] *Source: VicRoads SCATS data*

Figure 3-5 Kangan Drive (facing west)

3.1.4 Sir Gustav Nossal Boulevard

Sir Gustav Nossal Boulevard is classified as a Collector Road (Council controlled) and provides access to Monash University and Nossal High School. It is a two-way two lane road aligned in an east-west direction. Kerbside parking is not permitted on either side the carriageway.

Sir Gustav Nossal Boulevard carries approximately 3,200 vehicles per day[3] and is shown in Figure 3-8 and Figure 3-9.

Figure 3-6 Sir Gustav Nossal Boulevard (facing east)

[3] *Source: VicRoads SCATS data*

Figure 3-7 Sir Gustav Nossal Boulevard (facing west)

3.1.5 Enterprise Avenue

Enterprise Avenue is classified as a Local Road (Council controlled) and provides access to the industrial precinct to the west of Clyde Road. It is a two-way two lane road aligned in an east-west direction. Kerbside parking is permitted on both sides of the carriageway.

Enterprise Avenue carries approximately 5,500 vehicles per day[4] and is shown in Figure 3-8 and Figure 3-9.

Figure 3-8 Enterprise Avenue (facing east)

[4] *Source: VicRoads SCATS data*

Figure 3-9 Enterprise Avenue (facing west)

3.1.6 Reserve Road

Reserve Road is classified as a Collector Road (Council controlled). It is a two-way two lane road and generally aligned in a north-west to south-east direction. It provides a key connection to Berwick railway station. Kerbside parking is permitted on the north side of the carriageway with minimal parking available on the southern side of the carriageway.

Reserve Road carries approximately 6,050 vehicles per day[5] and is shown in Figure 3-10 and Figure 3-11.

Figure 3-10 Reserve Road (facing east)

[5] *Source: VicRoads SCATS data*

Figure 3-11 Reserve Road (Facing west)

3.1.7 Gloucester Avenue

Gloucester Avenue is classified as a Collector Road (Council controlled). It is a two-way two lane road and is generally aligned in a north-south direction. It provides a key connection to Berwick railway station and the Princes Highway. Kerbside parking is generally permitted on both sides of the carriageway.

Gloucester Avenue carries approximately 4,100 vehicles per day[6] and is shown in Figure 3-12.

Figure 3-12 Gloucester Avenue (facing north)

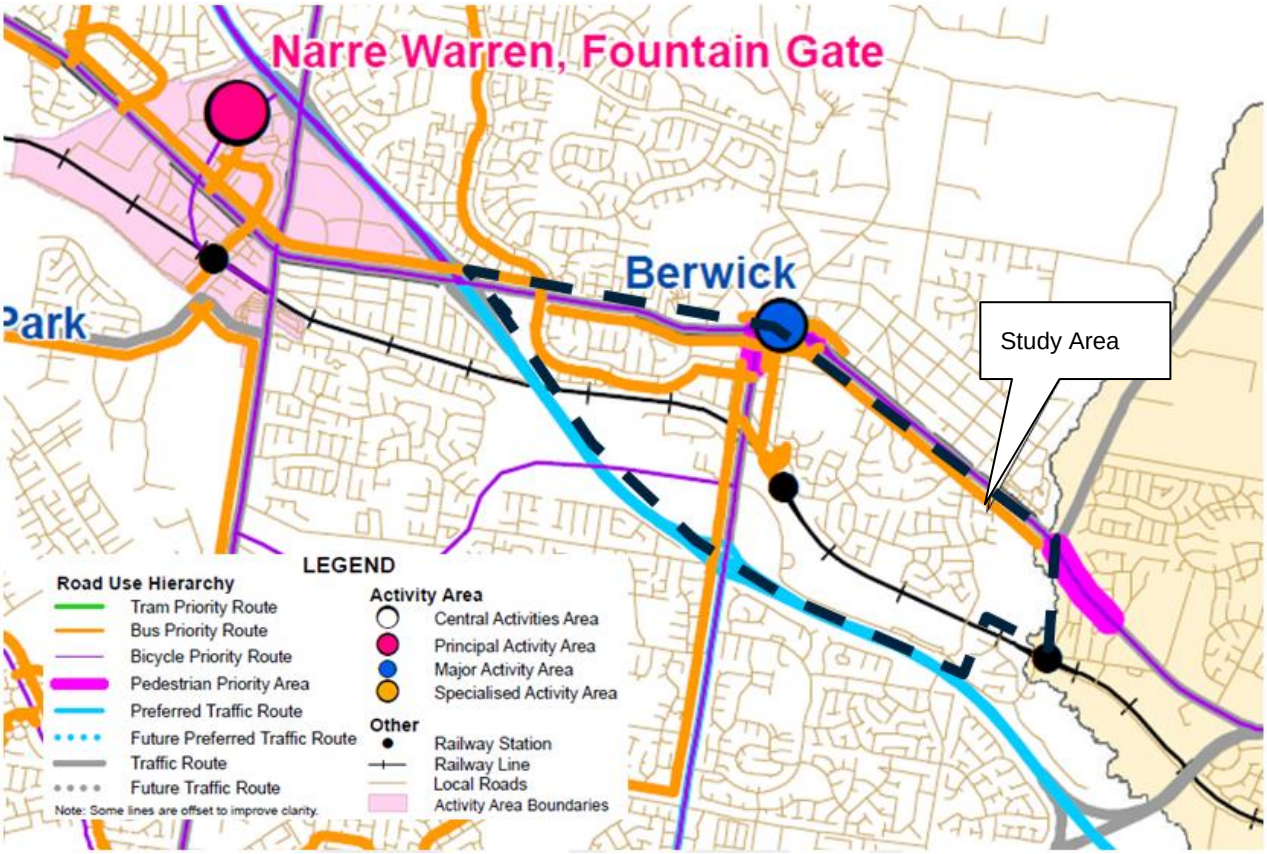
3.2 SmartRoads

SmartRoads is a road network management approach developed by VicRoads which seeks to prioritise use of roads to different transport modes at particular times of day. While the initiative continues to allow access to all users, certain routes are managed to work better for certain user types across the network.

The SmartRoads road use hierarchy for the study area is illustrated in Figure 3-13.

[6] *Source: VicRoads SCATS data*

Figure 3-13 SmartRoads Road Use Hierarchy



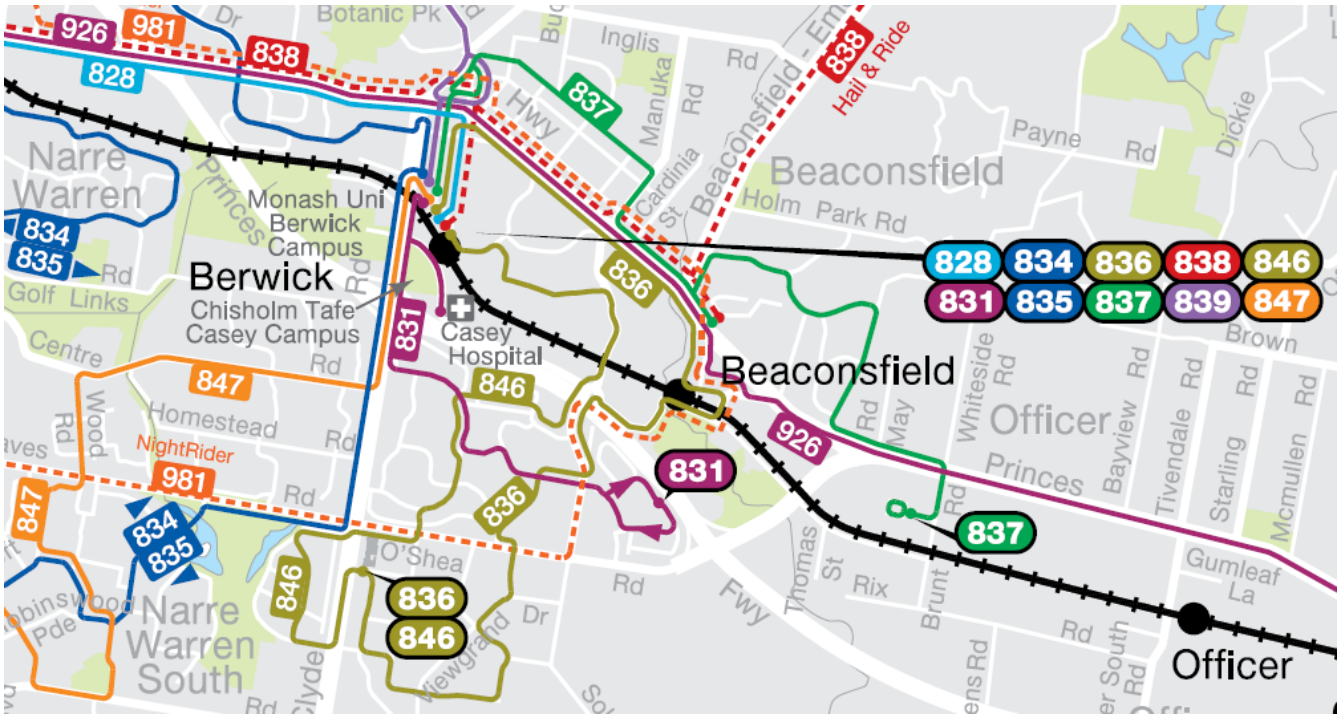
As illustrated in Figure 3-13, a number of roads within the study area are designated at bus priority routes. The hierarchy also indicates a pedestrian priority area at the Clyde Road/Princes Highway intersection and a bicycle priority route from Clyde Road through Monash University and across the Freeway.

4 Public Transport Provisions

4.1 Existing Public Transport Services

A number of public transport services operate in the vicinity of the study area as illustrated in Figure 4-1. It is noted that a number of bus routes provide a convenient connection to Berwick railway station.

Figure 4-1 Public Transport Services



Source: Public Transport Victoria

Details regarding the route and frequency of the public transport services in the study area is summarised in Table 4-1.

Table 4-1 Public Transport Services Summary

Service Type	Route Name/ No.	Service Summary	Hours Operation						Frequency
			Weekday		Saturday		Sunday		
			Inbound	Outbound	Inbound	Outbound	Inbound	Outbound	
Bus	828	Berwick Station via Dandenong	5:30am to 10:00pm	5:30am to 10:30pm	6:00am to 10:00pm	6:30am to 10:00pm	8:00am to 10:00pm	8:00am to 10:00pm	20 mins peak / 30 mins off peak
	831	Kingsmere Estate via Casey Hospital	6:00am to 9:00pm	6:30am to 9:30pm	8:00am to 9:00pm	8:30am to 10:00pm	8:30am to 9:00pm	8:30am to 10:00pm	40 mins peak / 60 mins off peak
	834/ 835	Berwick Station via Berwick North, Narre Warren South	5:00am to 10:30pm	5:00am to 10:30pm	7:00am to 10:00pm	7:00am to 10:30pm	9:00am to 10:00pm	9:00am to 10:30pm	20 mins peak / 40 mins off peak
	836	Berwick Station via Bridgewater Estate	5:30am to 10:00pm	6:30am to 10:00pm	8:00am to 9:30pm	8:00am to 9:30pm	8:30am to 9:30pm	9:30am to 9:30pm	Hourly
	837	Berwick Station via Brisbane Street	5:30am to 9:00pm	6:00am to 9:30pm	7:00am to 9:00pm	7:30am to 9:30pm	9:00am to 9:00pm	9:00am to 9:30pm	Hourly

	838	Fountain Gate SC via Beaconsfield	6:30am to 1:00pm	12:22pm to 5:12pm	n/a	n/a	n/a	n/a	Three services daily in each direction
	839	Berwick Station via Telford Drive	6:00am to 9:30pm	6:30am to 9:30am	7:30am to 9:00pm	7:30am to 9:30pm	8:30am to 8:30pm	9:30am to 9:30pm	40 mins weekdays / hourly on weekends
	846	Berwick Station via Bryn Mawr Blvd	6:00am to 9:00pm	7:00am to 9:30pm	7:00am to 9:00pm	8:00am to 10:00pm	8:30am to 9:00pm	9:00am to 10:00pm	Hourly
	847	Casey Central SC via Glasscocks Road	6:00am to 9:00pm	6:00am to 9:30pm	7:00am to 9:00pm	8:00am to 9:30pm	8:30am to 9:00pm	9:00am to 9:30pm	30 mins peak / hourly off peak
Train	Pakenham Line	Pakenham Station to Southern Cross	4:00am to midnight	4:30am to 12:30am	4:00am to 1:00am	5:00am to 1:30am	6:30am to midnight	8:00am to 12:30am	10 mins peak / 20 mins off peak

Note: Inbound/Outbound refers to the Precinct.
834 noted as inbound, 835 summarised as outbound

4.2 Patronage Data

4.2.1 Buses

In order to gain an understanding of existing bus patronage in the vicinity of the Precinct, Cardno obtained patronage data from Public Transport Victoria (PTV).

A review of the bus data for bus stops at the Berwick railway station indicates an average weekday touch on rate of 900 patrons during March 2014 with an average weekday touch off rate of 820. The data also indicates that the majority of patrons arrived or departed from the Berwick railway bus stop between 7:00am and 8:00am and 3:00pm to 5:00pm.

The data for stops near the Casey Hospital and Monash University indicate a relatively low patronage rate with the Casey Hospital bus stop recording an average daily weekday touch on of five patrons and touch off of nine patrons.

Similarly, the Monash University stops recorded an average daily weekday touch on and touch off rate of 105 and 38 respectively. It is however noted, that a review of the Monash University bus stops indicated a high level of 'touch ons' between 3:00pm and 4:00pm and a general peak period range from 2:00pm to 4:00pm. These timeframes would suggest that there is a high level of trips generated by Nossal High School, located to the west of Monash University.

It is noted that Cardno has been advised that touch on and touch offs represent approximately 61.8% of public transport trips. As such Berwick railway station stops could be expected to have generated 1,456 outbound trips and 1,327 inbound trips on an average weekday.

Casey Hospital could therefore be expected to have generated 8 and 15 outbound and inbound average daily trips respectively; while Monash University could be expected to generate 170 and 61 outbound and inbound average daily trips trips respectively.

Table 4-2 summarises the average daily bus patronage for key routes within the Precinct.

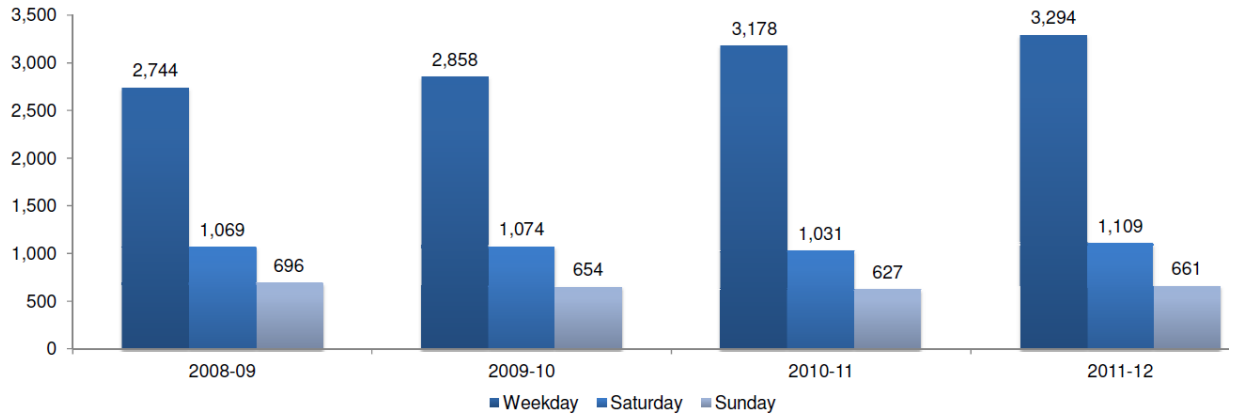
Table 4-2 Average Daily Patronage (March 2014)

Route No.	Service Description	Average Daily Patronage		
		Weekday	Saturday	Sunday
831	Kingsmere Estate via Casey Hospital	235	73	49
834	Berwick Station via Berwick North, Narre Warren South	996	512	267
835	Berwick Station via Narre Warren South, Berwick North	1,687	651	315
836	Berwick Station via Bridgewater Estate	312	116	110
837	Berwick Station via Brisbane Street	97	37	28
839	Berwick Station via Telford Drive	219	71	23
846	Berwick Station via Bryn Mawr Blvd	184	94	72
847	Casey Central SC via Glasscocks Road	584	122	72

4.2.2 Trains

Reference to 2008 - 2012 patronage data from PTV for Berwick railway station indicates that patronage has increased from 2008 to 2012 with weekday, Saturday and Sunday boardings increasing by 3.7%, 7.6% and 5.4% respectively. The estimated average daily boardings from 2008 to 2012 is illustrated in Figure 4-2.

Figure 4-2 Estimated Average Daily Boarding Numbers



4.3 Berwick Rail Station Upgrades

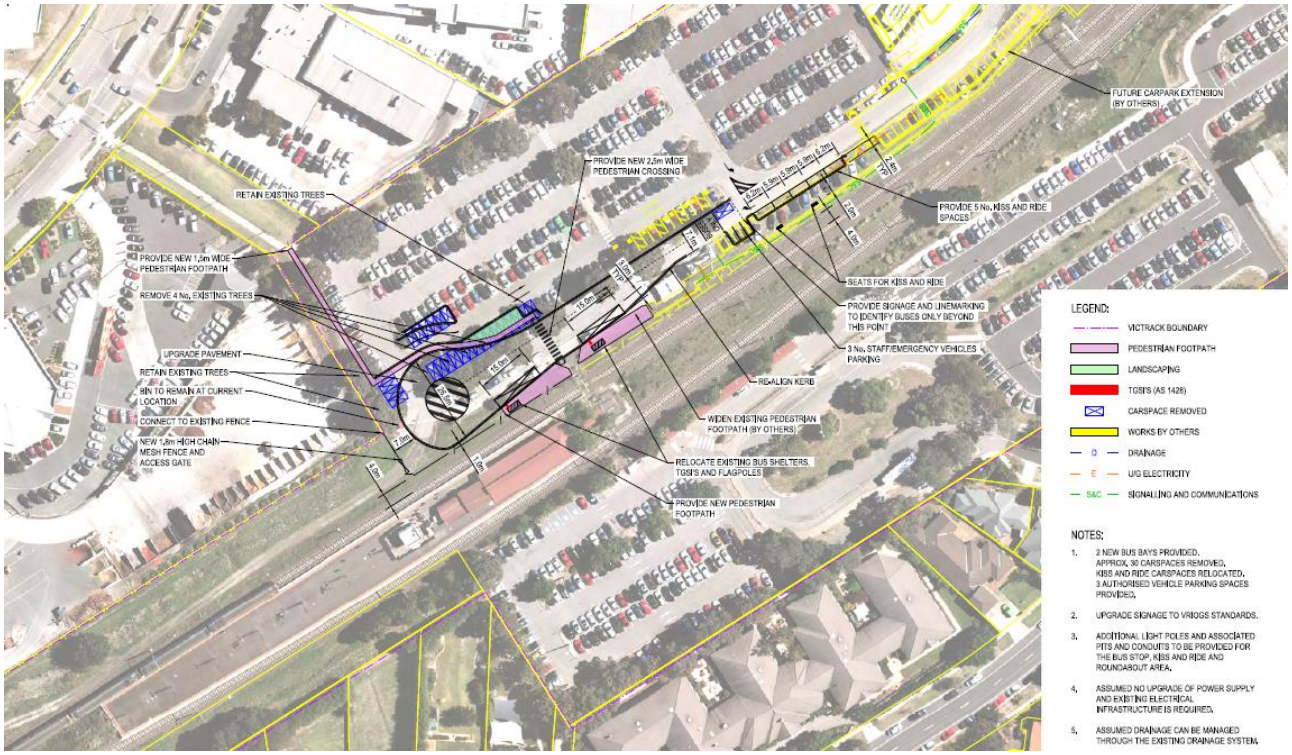
Cardno has been advised that upgrade works are proposed at Berwick railway station. This work will include the provision of additional at-grade car parking, pedestrian and shared path facilities at the railway access road from Clyde Road (south of the rail line).

Sealed paths are proposed on both sides of the carriageway and will incorporate 1.5m and 2.5m widths which are appropriate to cater for pedestrian and shared (pedestrian and cyclists) use respectively.

PTV is also proposing to incorporate two additional bus stops at Berwick railway station, south of the rail line. The stops will be located adjacent to the station with buses arriving and departing via Clyde Road. The project is aimed at increasing efficiency of existing bus routes at the station.

Figure 4-3 shows the proposed upgrade.

Figure 4-3 Proposed Berwick Rail Station Upgrade



4.4 Bus – Train Passenger Transfer Surveys

In order to gain an understanding of existing transfers between Berwick railway station train and bus services, Cardno commissioned surveys on Tuesday 5 August 2014 to ascertain the level of transfer between train services and bus services at the station between 7:00am and 10:00am and 4:00pm to 7:00pm. The results of these surveys are summarised in Table 4-3 and Table 4-4.

Table 4-3 Berwick Station Rail and Bus Transfer Survey Summary (AM Peak)

Hour Period	Train to Bus (patrons)	Bus to Train (patrons)	Total
7:00am to 8:00am	32	124	**156**
7:15am to 8:15am	41	108	**149**
7:30am to 8:30am	39	88	**127**
7:45am to 8:45am	36	155	**191**
8:00am to 9:00am	28	121	**149**
8:15am to 9:15am	28	128	**156**
8:30am to 9:30am	27	110	**137**
8:45am to 9:45am	30	45	**75**
9:00am to 10:00am	25	42	**67**

Table 4-4 Berwick Station Rail and Bus Transfer Survey Summary (PM Peak)

Hour Period	Train to Bus (patrons)	Bus to Train (patrons)	Total
4:00pm to 5:00pm	72	24	**96**
4:15pm to 5:15pm	63	21	**84**
4:30pm to 5:30pm	88	13	**101**
4:45pm to 5:45pm	69	4	**73**
5:00pm to 6:00pm	77	3	**80**
5:15pm to 6:15pm	97	2	**99**
5:30pm to 6:30pm	80	5	**85**
5:45pm to 6:45pm	80	9	**89**
6:00pm to 7:00pm	86	11	**97**

The above results indicate that a number of patrons currently transfer between transport modes at the station with peak periods occurring between 7:45am and 8:45am in the AM peak period and 4:30pm to 5:30pm in the PM peak period.

5 Bicycle Facilities

5.1 Bicycle Network

On-road bicycle lanes are provided on Clyde Road north of Kangan Drive and continue across the Princes Highway. Cyclists currently ride on-road throughout the remainder of the precinct.

In addition to the above, Clyde Road, Princes Highway, Reserve Street, Sir Gustav Nossal Boulevard and Bryn Mawr Boulevard form part of Melbourne's Principal Bicycle Network (PBN), a network of proposed and existing cycle routes that help people cycle for transport. The PBN aims to provide access to major destinations in the Melbourne metropolitan area.

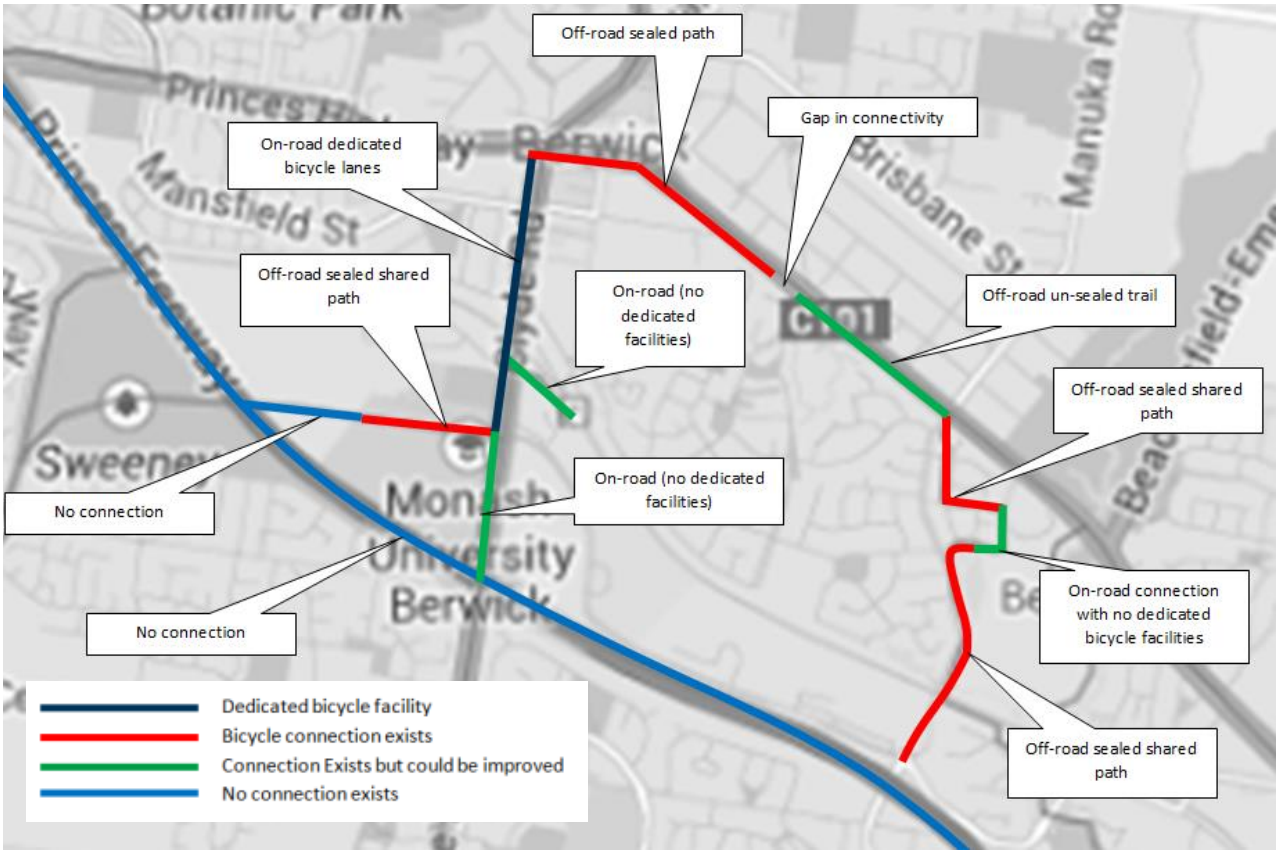
An extract from VicRoads' Principal Bicycle Network map for the study area is shown in Figure 5-1.

Figure 5-1 Principal Bicycle Network

Source: VicRoads

It is noted that the PBN does not distinguish between existing and proposed bicycle links. As such, Figure 5-2 has been prepared to illustrate which of the connections internal to the study area are existing and which are proposed.

Figure 5-2 Existing vs Proposed PBN Facilities



It is noted that no connection is currently provided to Sweeney Reserve limiting bike accessibility to the area from the west. A reasonable level of passive surveillance is provided along Clyde Road and Princes Highway for cyclists given the arterial nature of the road.

Within the study area, east of Clyde Road, a number of improvements could be made to the existing facilities including sealing the unsealed sections of path, and completing the existing gaps (shown in Figure 5-2) in the network. Passive surveillance along the off-road sections of existing network is also limited.

5.2 End of Trip Facilities

A number of bicycle parking facilities are also located within the study area including:

- 15 storage lockers, 3 u-racks and a storage cage at Berwick railway station
- 3 sets of u-racks within the retail precinct
- racks at Monash University
- racks at Chisholm TAFE
- racks at Casey Hospital.

The bicycle parking provided at Berwick railway station is highly visible from the car parking areas and the station itself providing a high level of passive surveillance. The facilities are also aligned with pedestrian access points to the station making their location highly notable to patrons of the station which may increase usage.

The u-racks within the retail precinct are greatly dispersed ensuring cyclists are not required to park in one location but rather can park bicycles in the most suitable location applicable. Furthermore, the racks are typically located along shop fronts providing a high level of surveillance and awareness of location.

The racks provided at Monash University are positioned between in the central median of Sir Gustav Nossal Boulevard and allow for a high level of visibility for surveillance. They are however, unprotected in terms of weather which may limit bicycle usage at times.

Cardno was advised by Chisholm TAFE that bicycle parking facilities are provided on-site for staff and students in a conveniently accessible location. Bicycle parking provided at Casey Hospital is located adjacent to hospital car park and ticket parking area and has a high level of surveillance.

The bicycle parking facilities provided in these key locations is illustrated in the following figures.

Figure 5-3 Berwick Railway Station – lockers and racks

Figure 5-4 Berwick Railway Station – storage cage

As illustrated above, Berwick railway station currently incorporates a high level of bicycle parking facilities for cyclists including secure facilities in close proximity to the station.

Figure 5-5 Princes Highway Bike Parking (east of Gloucester Avenue)

Figure 5-6 Princes Highway Bike Parking (west of Gloucester Avenue)

Figure 5-7 Clyde Road Bike Parking (South of Princes Highway)

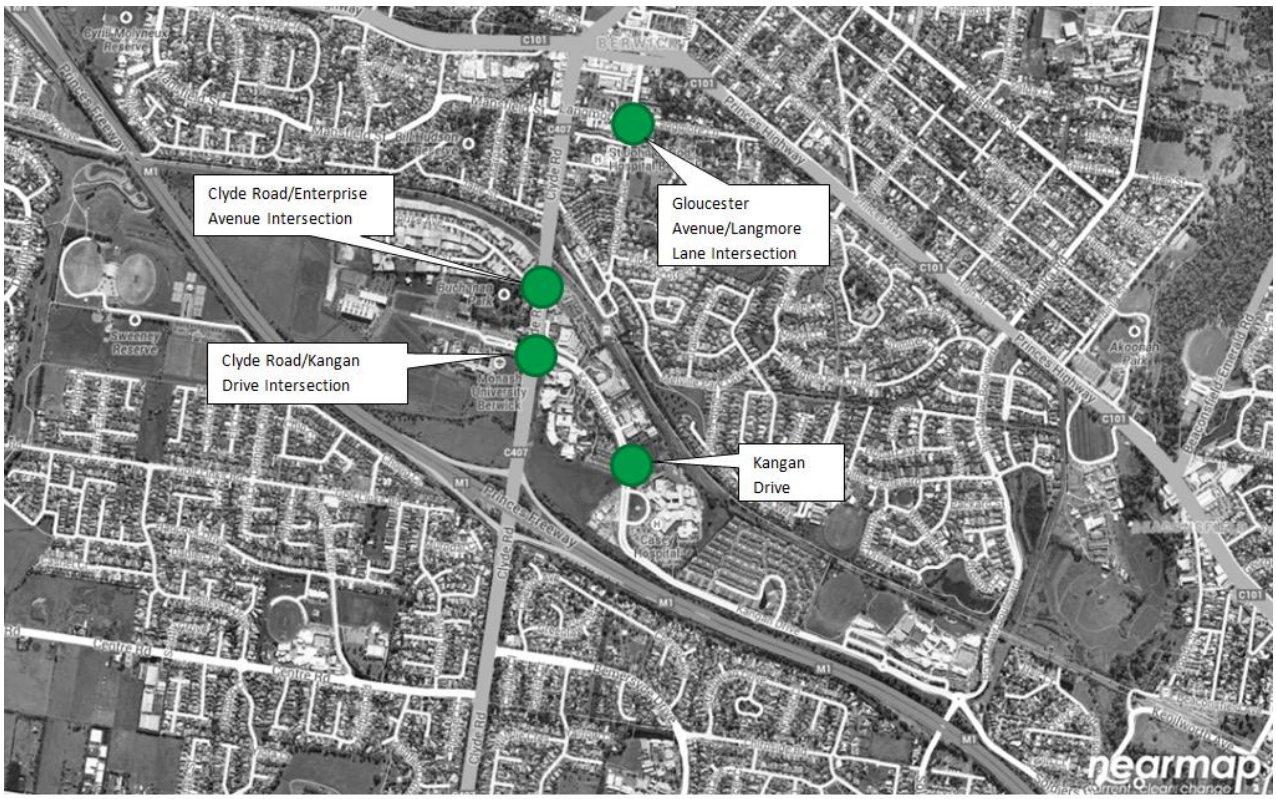
Figure 5-8 Monash University Bicycle Parking

Figure 5-9 Casey Hospital Bicycle Parking

5.3 Cyclist Surveys

Cardno commissioned cyclist activity surveys on Tuesday 5 August from 7:00am to 9:00am and 4:00pm to 6:00pm at key locations throughout the Precinct. The location of the surveys is illustrated in Figure 5-10.

Figure 5-10 Cyclist Survey Locations



The results of the surveys are summarised in Table 5-1.

Table 5-1 Cyclist Surveys

Intersection	Peak Hour	East-West Cyclist Volumes	North-South Cyclist Volumes
Clyde Road/Enterprise Avenue Intersection	AM Peak	0	4
	PM Peak	1	6
Clyde Road/Kangan Drive/Sir Gustav Nossal Boulevard	AM Peak	5	1
	PM Peak	4	3
Kangan Drive (adjacent to reserve)	AM Peak	0 [1]	2
	PM Peak	0 [1]	2
Gloucester Avenue/Langmore Lane Intersection	AM Peak	0	2
	PM Peak	1	3

[1] North-south refers to Kangan Drive cyclist while east-west refers to entry/exit to the hospital.

The above results indicate that cyclist activity is relatively low throughout the Precinct, particularly in the vicinity of Monash University and Chisholm TAFE.

6 Pedestrian and Shared Path Network

6.1 Pedestrian Routes

Pedestrian paths are typically located on both sides of roads within the study area. Key roads incorporating paths on both sides of the carriageway include Clyde Road, Kangan Drive, Melville Park Drive, Canning Drive, Edrington Park Drive and Bryn Mawr Boulevard.

A portion of lower order residential roads incorporate a pedestrian path on one-side of the road. It is noted that Reserve Road (which provides a key connection to the Berwick railway station) incorporates a pedestrian path on the northern side of the carriageway only. Enterprise Avenue does not incorporate pedestrian paths on either side of the carriageway.

A pedestrian connection is also provided between Berwick railway station and Kangan Drive providing commuters with a link to the education and health uses on Kangan Drive as illustrated below in Figure 6-1 to Figure 6-3. It is however noted that a number of pedestrians were observed to walk within circulation roads of the station car park to access the pedestrian routes.

Figure 6-1 Berwick Railway Station Pedestrian Connection through Car Park

Figure 6-2 Berwick Railway Station Pedestrian Connection to Kangan Drive

Figure 6-3 Berwick Railway Station Pedestrian Connection to Clyde Road (adjacent to level crossing)

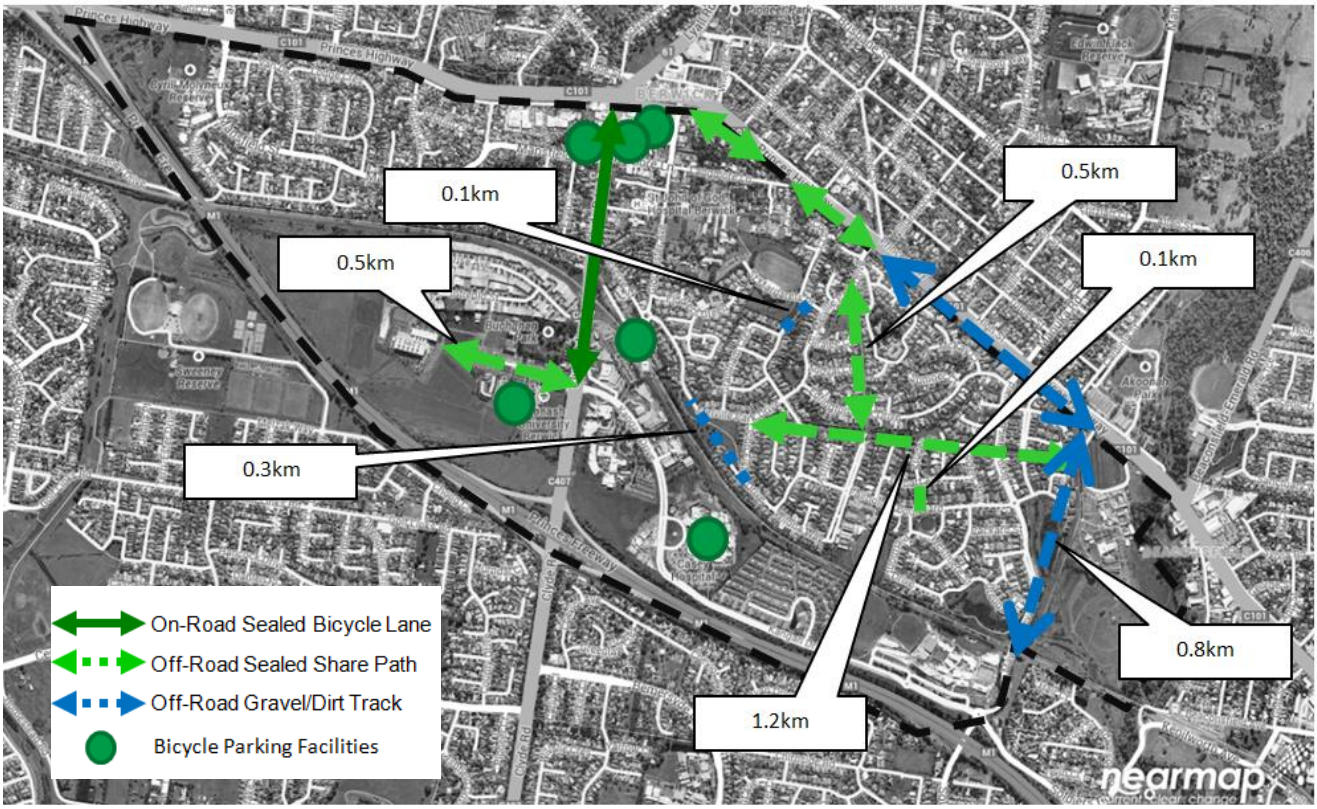
6.2 Off-Road Trails

A number of off-road routes also exist within the study area including an internal east-west link between Haileybury School and Melville Park Drive. A north south connection also operates between Canning Drive and Melville Park Drive while a dirt trail was also observed between Princes Highway and the rail line. The trails are typically provided on one side of the road and run parallel to a carriageway.

A sealed share path exists on the southern side of the Princes Highway, however a portion of the path to the east was unsealed, while a portion adjacent to thick tree growth did not incorporate a path.

The extent of the off-road trail network is illustrated in Figure 6-4.

Figure 6-4 Key Trail Links and Distances



Some of the key off-road trails are illustrated in the Figure 6-5 to Figure 6-10.

Figure 6-5 East-West Sealed Path (1.2km between Whisken Way Access & Melville Park Drive)

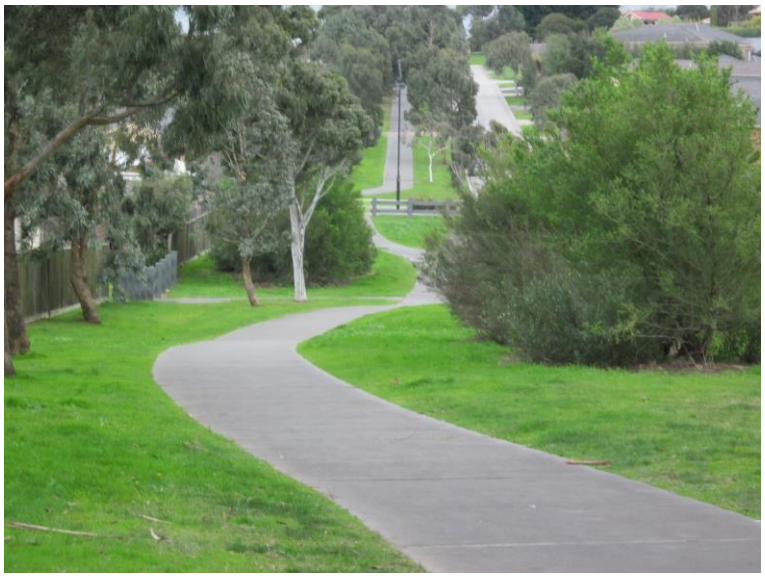


Figure 6-6 North-South Sealed Path (0.1km between Fairholme Boulevard & Hobart Avenue)

Figure 6-7 North-South Sealed Path (0.5km between Canning Drive & Melville Park Drive)

Figure 6-8 North-South Unsealed Path (0.1km between Gair Close & St Margaret Place)

Figure 6-9 Monash Uni Sealed Shared Path (0.5km between Clyde Road & Nossal High School)

Figure 6-10 East-West Dirt Track Adjacent to Rail line (0.3km between John Fisher Drive & Melville Park Drive)

6.3 Walking Distance to Key Destinations

Based on the Berwick railway station patronage data it is clear that a number of patrons travel to the Precinct via Berwick railway station and walk to various key destinations in the study area.

A summary of walking distances between Berwick railway station and key land use destinations is summarised below:

- Casey Hospital via Kangan Drive: 650m
- Chisholm TAFE via Kangan Drive: 450m
- Monash University via Kangan Drive and Sir Gustav Nossal Boulevard: 500m
- Nossal High School via Kangan Drive and Sir Gustav Nossal Boulevard: 850m
- Industrial Precinct via Berwick Rail Station car park access: 400m
- Retail Precinct via Gloucester Avenue: 850m.

6.4 Pedestrian Surveys

In addition to the Bus/Train transfer pedestrian surveys outlined in Section 4.3, Cardno commissioned pedestrian activity surveys at key locations throughout the Precinct. The location of the surveys are illustrated in Figure 6-11, and Table 6-1 summarises the results of the surveys.

Figure 6-11 Pedestrian Survey Locations

Table 6-1 Clyde Road/Kangan Drive/Sir Gustav Nossal Drive Intersection

Intersection	Peak Hour	East-West Pedestrian Volumes	North-South Pedestrian Volumes
Clyde Road/Enterprise Avenue Intersection	AM Peak	9	11
	PM Peak	25	22
Clyde Road/Kangan Drive/Sir Gustav Nossal Boulevard	AM Peak	320	2
	PM Peak	80	22
Kangan Drive (adjacent to reserve)	AM Peak	3 [1]	22
	PM Peak	14 [1]	29
Gloucester Avenue/Langmore Lane Intersection	AM Peak	17	48
	PM Peak	6	40

[1] North-south refers to Kangan Drive pedestrians while east-west refers to entry/exit to the hospital

The above results indicate that there is a notable number of pedestrians travelling between Monash University and Nossal High School and the railway station. The results also suggested that a number of staff arriving at the industrial precinct travel to the site via public transport.

The surveys also indicate a reasonable level of activity at the Gloucester Avenue/Langmore Lane intersection in the vicinity of the existing town centre.

7 Site Analysis

Following a review of relevant background material and an inspection of the study area and surrounds an issues and opportunities analysis was completed for each transport mode. The purpose of this assessment is to identify the existing gaps, constraints and observed issues for each mode type and to identify potential solutions to improve on the network.

7.1 Private Vehicles

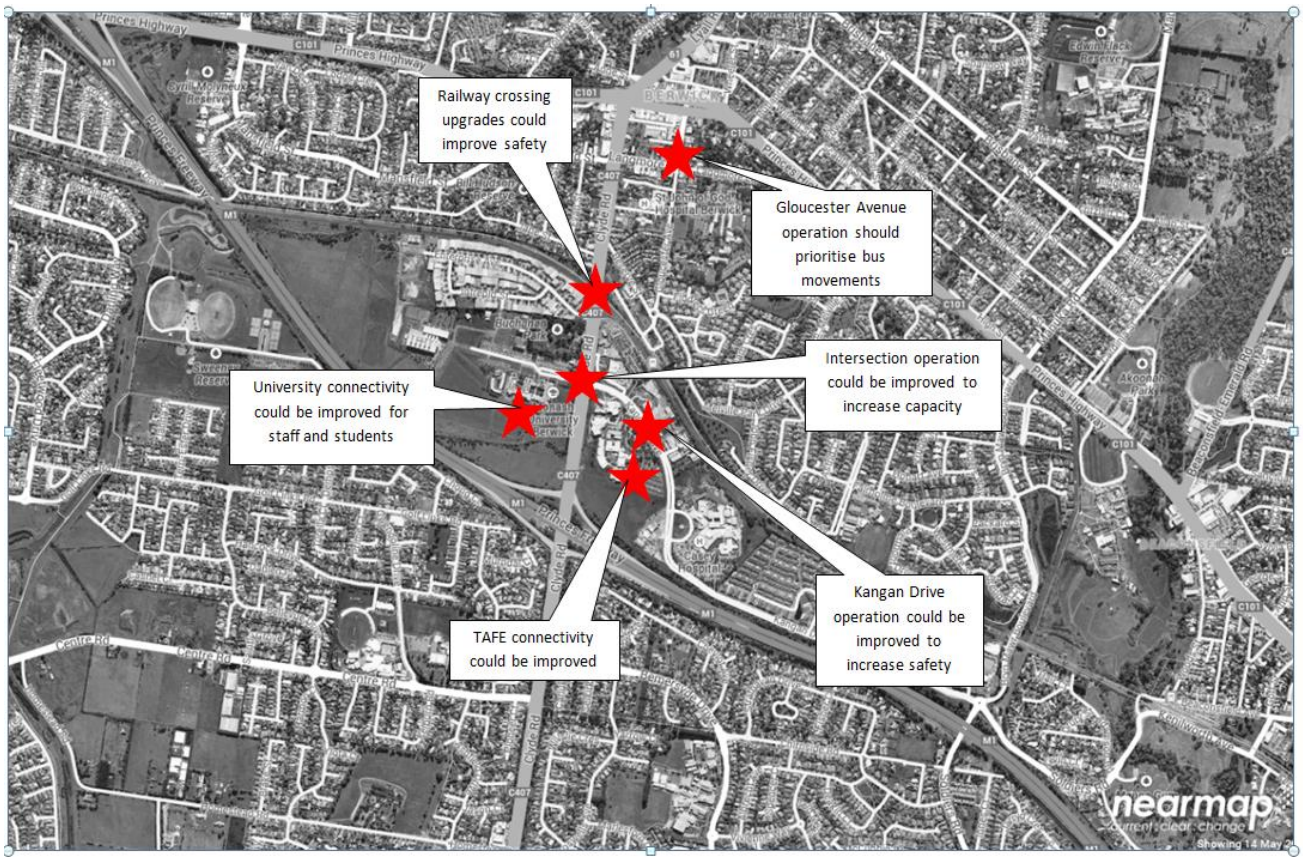
A summary of existing private vehicle issues and associated opportunities is provided in Table 7-1 and illustrated in Figure 7-1.

Table 7-1 Private Vehicles Issues and Opportunities

Item	Issue	Opportunity
▪ Road Network Capacity	▪ Kangan Drive and the intersection of Clyde Road/Kangan Drive currently experiences high levels of congestion during the weekday peak hours with staff and students accessing the various health and education uses in the southern portion of the Precinct. ▪ This issue is compounded by the existing level crossing associated with the railway line. ▪ It is noted that access to/from the TAFE is provided via a single access point to Kangan Drive. ▪ It is understood that both Monash University and TAFE has is ultimately seeking to expand enrollment numbers on-site, while additional development is currently underway adjacent to the hospital.	▪ An assessment of the Clyde Road/Kangan Drive intersection may identify potential operational changes which could improve efficiency and support future growth. ▪ Consideration should also be given to an additional signalised intersection on Clyde Road (between Kangan Drive and the Freeway interchange to enhance accessibility and facilitate the development of the health/education land uses and provide permeability for pedestrians across Clyde Road.
▪ Kangan Drive Operation	▪ A number of site access driveways and median breaks currently exist on Kangan Drive. During peak hours a number of conflicting movements occur resulting in a potential safe hazard. ▪ The merging of two lanes to one to the east of Clyde Road appears to be a safety concern. ▪ On-street car parking on Kangan Drive in the vicinity of the TAFE site access inhibits the ability for exiting vehicles to view oncoming traffic.	▪ A safety assessment could be completed to identify if any safety concerns exist. ▪ Some of the car parking in the vicinity of the site access could be removed in conjunction with improved efforts to promote sustainable modes of transport by staff and students of the education and health uses.
▪ Gloucester Avenue	▪ Gloucester Avenue currently incorporates a narrow carriageway with one lane in each direction. The roadway currently accommodates bus routes accessing the railway station from the Princes Highway as well as other traffic. On-street car parking is also permitted on both sides of the carriageway. ▪ On-site observations indicate that the ability of Gloucester Avenue to accommodate bus, vehicle and parking movements is limited with buses frequently queuing behind parking vehicles.	▪ Car parking could potentially be removed on one side of the carriageway to improve the usable carriageway width. This item could also be addressed in conjunction with promotion of sustainable transport modes.
▪ North/South Connectivity	▪ Clyde Road provides the primary rail crossing through the precinct with the only other	▪ The provision of rail/road grade separation on Clyde Road would improve

	crossing being Bryn Mawr Boulevard. In this regard, the operation and efficiency of Clyde Road is paramount to the overall performance of the road network in the precinct.	safety for all user types.
▪ Educational Uses Connectivity	▪ Monash University and Chisholm TAFE incorporate one access point per campus.	▪ As noted under *Road Network Capacity*, Consideration should also be given to an additional signalised intersection on Clyde Road (between Kangan Drive and the Freeway interchange to enhance accessibility and facilitate the development of the health/education land uses and provide permeability for pedestrians across Clyde Road.
▪ Private Vehicle Reliance	▪ Site inspections indicate that the Precinct has a high reliance on private vehicles	▪ Staff and students in particular could be encouraged to utilize sustainable transport modes.

Figure 7-1 Private Vehicles Issues Summary



7.2 Public Transport

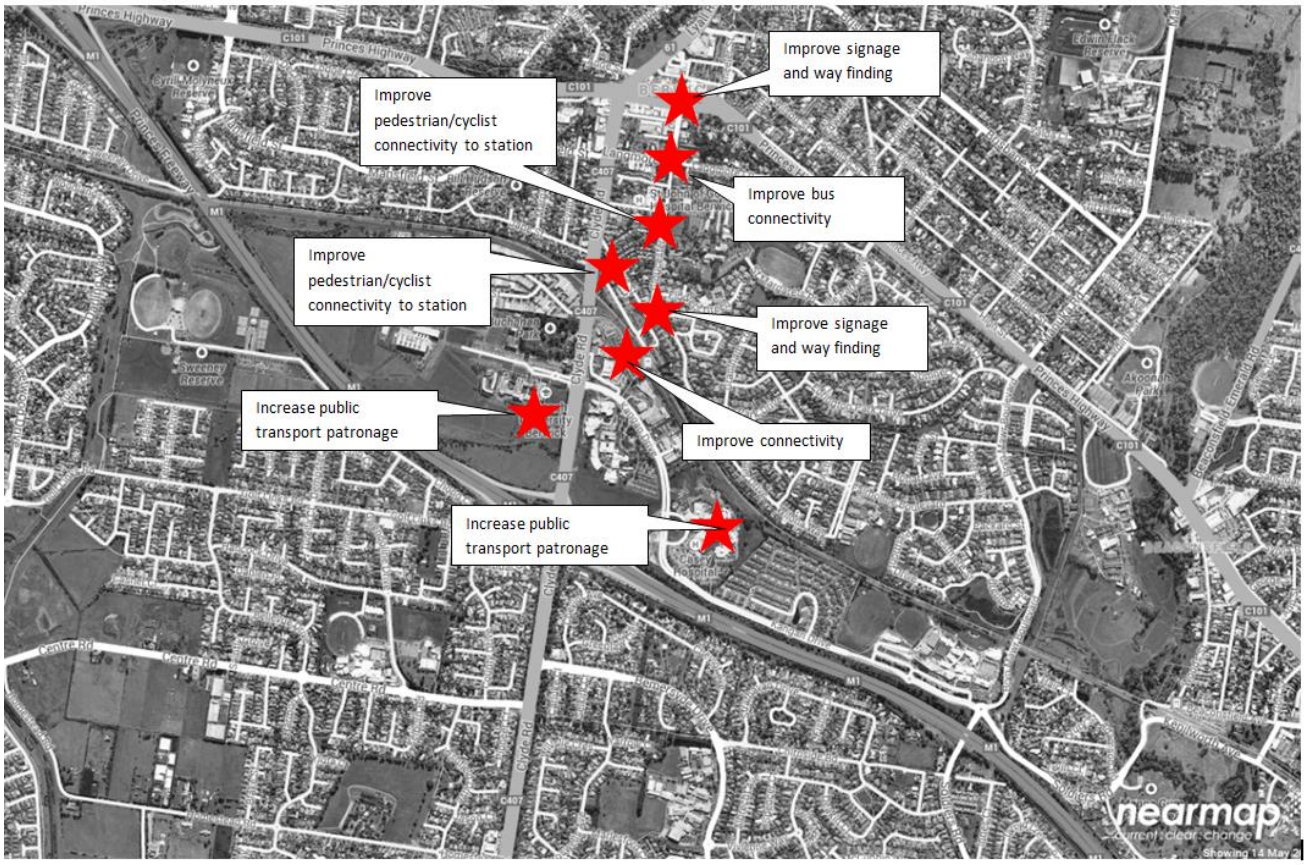
A summary of existing public transport issues and associated opportunities is provided in Table 7-2 and illustrated in Figure 7-2.

Table 7-2 Public Transport Issues and Opportunities

Item	Issue	Opportunity
▪ Gloucester Avenue Priority	▪ Gloucester Avenue is a Bus Priority Route under SmartRoads but parking vehicles and the narrow carriageway restrict bus movements.	▪ Consideration could be given to improving the operation of Gloucester Avenue for buses but also pedestrians and bicycles.

▪ Signage and Wayfinding	▪ Signage identifying the location of Berwick railway station is minimal. In addition, signage at the Reserve Street/Gloucester Avenue roundabout is incorrectly orientated.	▪ The potential exists to improve signage and wayfinding within the Precinct which may improve patronage. ▪ Consideration could also be given to additional signage on Clyde Road and Princes Highway/Gloucester Avenue alerting pedestrians/cyclists of the station location.
▪ Patronage	▪ Patronage data indicates that bus patronage is low at the Monash University stops and Casey Hospital.	▪ Restriction parking could be used on these sites to further encourage public transport patronage.
▪ Accessibility	▪ Reserve Road provides a key connection to Berwick railway station however only incorporates a pedestrian path on one side of the road and does not incorporate bicycle facilities. ▪ Gloucester Avenue also does not incorporate bicycle facilities. ▪ The connection to the southern station car park (south of the rail line on Clyde Road does not incorporate pedestrian paths or bicycle lanes	▪ Improvements could be made to increase the accessibility to Berwick railway station of all user types to further encourage patronage. (It is noted that some improvements are planned at the station as outlined in Section 4.3).
▪ Safety	▪ Connections to Berwick railway station do not incorporate high levels of passive surveillance. The path from Kangan Drive is closed off from adjacent uses.	▪ Connections could be improved to enhance the level of safety, particularly for students/staff travelling late at night.
▪ Bus Services to from Monash University	▪ There is currently no bus route connecting the full east-west extent of the University site to the nearby train station.	▪ Given that the University is understood to be growing, consideration could be given to a bus service that connects the University (full east-west length of the site) and other land uses on the west site of Clyde Road to the train station to encourage public transport use.

Figure 7-2 Public Transport Issues Summary



7.3 Bicycles and Pedestrians

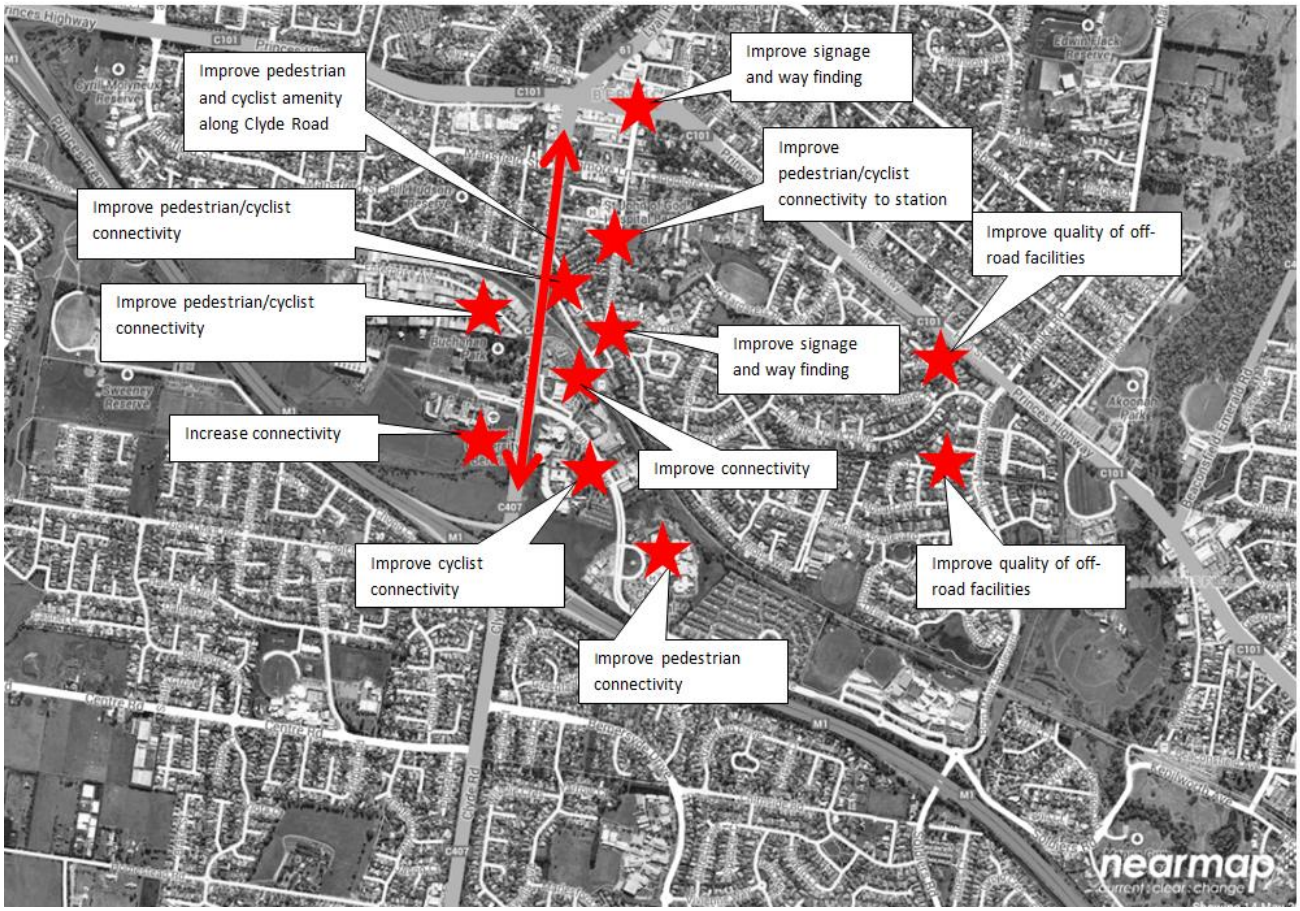
A summary of existing pedestrian/cyclist issues and associated opportunities is provided in Table 7-3 and illustrated in Figure 7-3.

Table 7-3 Bicycles and Pedestrians Issues and Opportunities

Item	Issue	Opportunity
▪ Amenity of Clyde Road	▪ Amenity of Clyde Road for pedestrians and cyclist is limited given the Primary Arterial nature of the road resulting in it being an unattractive connection between the existing town centre near Princes Highway and the health and education uses further to the south.	▪ Consider reducing speed limits on Clyde Road to enhance amenity. ▪ Consider providing additional signalised crossing points on Clyde Road to improve east-west permeability. ▪ Consider urban amenity improvements (street furniture and landscaping) to enhance the walking/cycling experience along Clyde Road.
▪ Lack of On-Road Bicycle Facilities	▪ Clyde Road incorporates the only on-road bicycle lanes in the precinct.	▪ Consideration should be given to additional on-road bicycle routes particularly east-west on Kangan Drive or Reserve Road and north-south on Gloucester Avenue
▪ Railway Connectivity	▪ Clyde Road provides the only pedestrian/cyclist connection over the railway in the western portion of the study area	▪ An additional connection could be considered in the vicinity of Monash University. ▪ Consider providing a shared path adjacent to the rail line connecting the station and Clyde Road.
▪ Land Use	▪ Limited infrastructure exists (particularly for	▪ Consideration could be given to

Connectivity	cyclists) connecting Monash University, Chisholm TAFE and Casey hospital to the land uses on the northern side of the rail line. ▪ No pedestrian paths or cycle lanes are provided on Enterprise Avenue and the industrial area. No pedestrian facilities are incorporated (at present) on the access to Berwick railway station southern car park. ▪ No pedestrian connection is provided at Casey Hospital from Kangan Drive when approaching from the west.	improving connections including bicycle lanes and passive surveillance on Reserve Road. ▪ Pedestrian paths should be provided on at least one side of Enterprise Avenue.
▪ Precinct Accessibility/ ▪ wayfinding	▪ Limited signage exists identifying the location of key land uses including Casey Hospital or Berwick railway station.	▪ Additional signage could be incorporated within the precinct with 'you are here' maps to identify key uses and encourage walking/cycling.
▪ Quality of Facilities	▪ A number of off-road paths are provided throughout the broader study area providing convenient connections to the east-west and north-south. The width of these paths is quite narrow or in some cases unsealed. It is also disjointed in sections including interfaces with the road network. ▪ Limited passive surveillance on some off-road paths.	▪ Consideration could be given to reviewing these facilities and providing widths and surfaces which are consistent with industry guidelines for shared paths. ▪ Opportunities to enhance passive surveillance should also be explored.

Figure 7-3 Pedestrian and Cyclists Issues and Opportunities



8 Summary

Based on the findings and discussion contained within this report, the following conclusions are made:

- The study area has a high reliance on private motor vehicles which leads to increased congestion, particularly around key land uses.
- A number of roadways including Gloucester Avenue are currently experiencing high demands from multiple transport modes.
- Monash University and Chisholm TAFE are currently investigating options for secondary vehicle connections potentially due to congestion related issues on Clyde Road.
- The site currently incorporates a high level of public transport connectivity although not necessarily a high level of patronage.
- Patronage data indicates that a number of uses within the Precinct have a low reliance on bus services within the area.
- Pedestrian and bicycle facilities allow for accessibility to key areas however the quality of some of these connections could be improved.
- A number of bicycle parking facilities are located within the study area, however improvements are required to address the lack of dedicated bicycle lanes within the study area.
- Additional signage and wayfinding information would provide residents, students and staff within the study area with detailed knowledge of public transport services. At present, signage is minimal and at times incorrect.

Berwick Health and Education Precinct

APPENDIX B

SIDRA INTERSECTION RESULTS – EXISTING CONDITIONS

Cardno
Shaping the Future

Clyde Road/Enterprise Avenue Intersection

MOVEMENT SUMMARY

Site: Clyde / Enterprise Ex AM

Network: Ex AM

Clyde / Enterprise
Signals - Fixed Time Coordinated Cycle Time = 120 seconds (Network Cycle Time)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	Demand Flows HV	Arrival Flows Total	Arrival Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Clyde Road (south)													
1	L2	143	5.0	143	5.0	0.538	7.4	LOS A	3.4	25.1	0.11	0.23	54.8
2	T1	1142	5.0	1142	5.0	0.538	1.2	LOS A	3.4	25.1	0.08	0.13	54.4
3	R2	85	5.0	85	5.0	0.519	68.7	LOS A	5.2	37.8	1.00	0.78	22.7
Approach		1371	5.0	1371	5.0	0.538	6.0	LOS A	5.2	37.8	0.14	0.18	46.2
East: Station Access (east)													
4	L2	71	5.0	71	5.0	0.092	7.8	LOS A	0.7	5.0	0.28	0.62	48.1
5	T1	6	5.0	6	5.0	0.114	50.3	LOS A	1.3	9.3	0.91	0.70	31.7
6	R2	18	5.0	18	5.0	0.114	55.9	LOS A	1.3	9.3	0.91	0.70	22.7
Approach		95	5.0	95	5.0	0.114	19.8	LOS A	1.3	9.3	0.44	0.64	37.6
North: Clyde Road (north)													
7	L2	8	5.0	8	5.0	0.339	15.8	LOS A	10.7	78.0	0.51	0.46	43.9
8	T1	792	5.0	792	5.0	0.339	11.3	LOS A	10.9	79.6	0.51	0.46	16.7
9	R2	81	5.0	81	5.0	0.493	62.6	LOS A	4.7	34.5	0.99	0.77	20.8
Approach		881	5.0	881	5.0	0.493	16.1	LOS A	10.9	79.6	0.55	0.49	18.8
West: Enterprise Avenue													
10	L2	62	5.0	62	5.0	0.296	27.1	LOS A	3.3	24.3	0.81	0.76	22.3
11	T1	4	5.0	4	5.0	0.296	21.5	LOS A	3.3	24.3	0.81	0.76	41.7
12	R2	35	5.0	35	5.0	0.296	27.1	LOS A	3.3	24.3	0.81	0.76	32.3
Approach		101	5.0	101	5.0	0.296	26.9	LOS A	3.3	24.3	0.81	0.76	25.6
All Vehicles		2447	5.0	2447	5.0	0.538	11.0	LOS A	10.9	79.6	0.33	0.33	35.2

PHASING SUMMARY

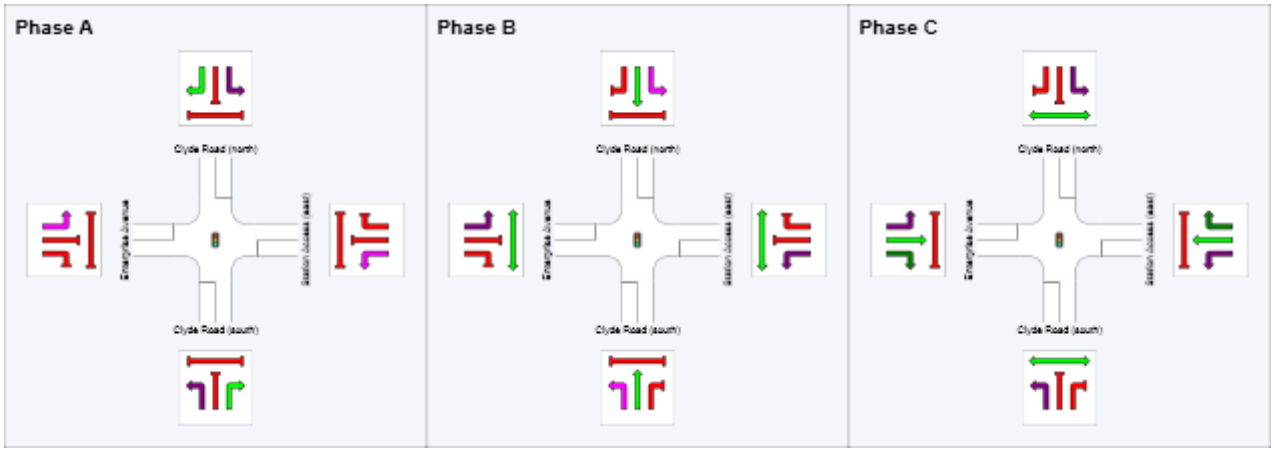
Site: Clyde / Enterprise Ex AM

Network: Ex AM

Clyde / Enterprise
Signals - Fixed Time Coordinated Cycle Time = 120 seconds (Network Cycle Time)
Phase times determined by the program
Sequence: Leading Right Turn
Movement Class: All Movement Classes
Input Sequence: A, B, C
Output Sequence: A, B, C

Phase Timing Results

Phase	A	B	C
Reference Phase	No	Yes	No
Phase Change Time (sec)	103	0	81
Green Time (sec)	11	75	16
Yellow Time (sec)	4	4	4
All-Red Time (sec)	2	2	2
Phase Time (sec)	17	81	22
Phase Split	14 %	68 %	18 %



MOVEMENT SUMMARY

Network: Ex PM

Site: Clyde / Enterprise Ex PM

Clyde / Enterprise
Signals - Fixed Time Coordinated Cycle Time = 120 seconds (Network Cycle Time)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	Demand Flows HV	Arrival Flows Total	Arrival Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Clyde Road (south)													
1	L2	196	5.0	196	5.0	0.460	18.9	LOS A	17.4	127.3	0.89	0.81	43.4
2	T1	798	5.0	798	5.0	0.460	17.8	LOS A	20.0	145.8	0.85	0.76	28.2
3	R2	72	5.0	72	5.0	0.599	68.2	LOS A	4.4	31.8	1.00	0.78	22.8
Approach		1065	5.0	1065	5.0	0.599	21.4	LOS A	20.0	145.8	0.87	0.77	31.0
East: Station Access (east)													
4	L2	84	5.0	84	5.0	0.111	10.8	LOS A	1.3	9.2	0.42	0.66	44.8
5	T1	5	5.0	5	5.0	0.067	42.1	LOS A	1.0	7.0	0.84	0.68	34.1
6	R2	15	5.0	15	5.0	0.067	47.7	LOS A	1.0	7.0	0.84	0.68	24.9
Approach		104	5.0	104	5.0	0.111	17.6	LOS A	1.3	9.2	0.50	0.66	39.1
North: Clyde Road (north)													
7	L2	8	5.0	8	5.0	0.235	16.6	LOS A	6.9	50.0	0.51	0.46	43.1
8	T1	511	5.0	511	5.0	0.235	12.5	LOS A	7.2	52.4	0.51	0.45	15.6
9	R2	99	5.0	99	5.0	0.828	72.3	LOS C	6.4	46.8	1.00	0.91	18.9
Approach		618	5.0	618	5.0	0.828	22.1	LOS C	7.2	52.4	0.59	0.52	18.0
West: Enterprise Avenue													
10	L2	124	5.0	124	5.0	0.863	63.1	LOS C	20.3	147.9	1.00	1.02	16.1
11	T1	21	5.0	21	5.0	0.863	57.4	LOS C	20.3	147.9	1.00	1.02	29.6
12	R2	188	5.0	188	5.0	0.863	63.0	LOS C	20.3	147.9	1.00	1.02	19.9
Approach		334	5.0	334	5.0	0.863	62.7	LOS C	20.3	147.9	1.00	1.02	18.9
All Vehicles		2121	5.0	2121	5.0	0.863	27.9	LOS C	20.3	147.9	0.79	0.73	25.0

PHASING SUMMARY

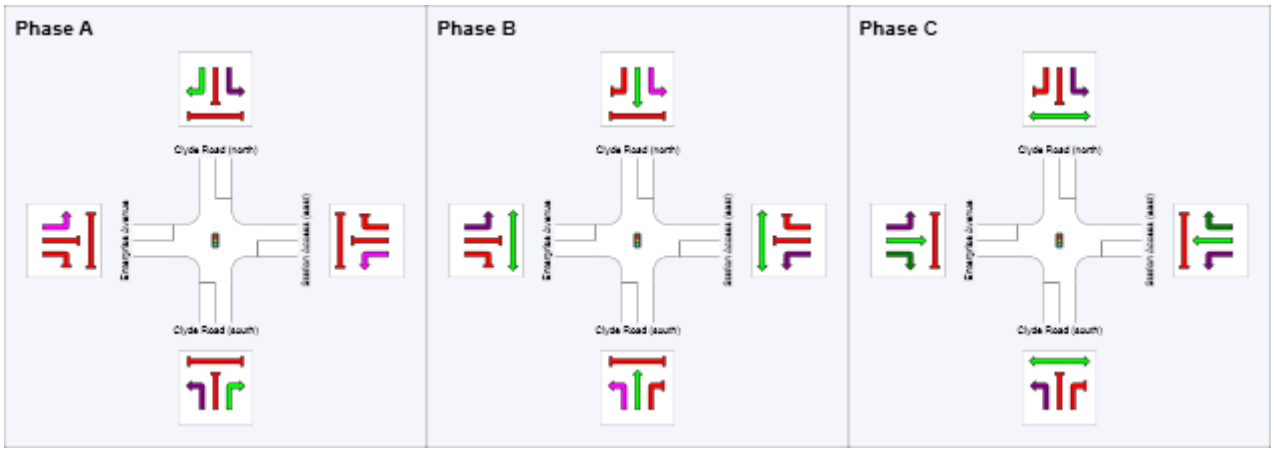
Network: Ex PM

Site: Clyde / Enterprise Ex PM

Clyde / Enterprise
Signals - Fixed Time Coordinated Cycle Time = 120 seconds (Network Cycle Time)
Phase times determined by the program
Sequence: Leading Right Turn
Movement Class: All Movement Classes
Input Sequence: A, B, C
Output Sequence: A, B, C

Phase Timing Results

Phase	A	B	C
Reference Phase	No	Yes	No
Phase Change Time (sec)	106	0	76
Green Time (sec)	8	70	24
Yellow Time (sec)	4	4	4
All-Red Time (sec)	2	2	2
Phase Time (sec)	14	76	30
Phase Split	12 %	63 %	25 %



Clyde Road/Kangan Drive/Sir Gustav Nossal Boulevard Intersection

MOVEMENT SUMMARY

Site: Clyde / Kangan Ex AM

Network: Ex AM

Clyde / Kangan
Signals - Fixed Time Coordinated Cycle Time = 120 seconds (Network Cycle Time)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	Demand Flows HV	Arrival Flows Total	Arrival Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Clyde Road (south)													
1	L2	344	5.0	344	5.0	0.240	6.8	LOS A	2.8	20.6	0.21	0.61	52.4
2	T1	1099	5.0	1099	5.0	0.903	52.2	LOS D	41.0	299.1	0.96	1.03	19.2
3	R2	606	5.0	606	5.0	0.882	68.2	LOS C	20.0	145.7	1.00	0.97	26.3
Approach		2049	5.0	2049	5.0	0.903	49.3	LOS D	41.0	299.1	0.85	0.94	26.1
East: Kangan Drive (east)													
4	L2	332	5.0	332	5.0	0.272	7.9	LOS A	4.1	29.7	0.29	0.64	51.5
5	T1	34	5.0	34	5.0	0.093	43.0	LOS A	1.6	11.9	0.86	0.64	35.3
6	R2	180	5.0	180	5.0	0.908	77.2	LOS D	12.3	89.8	1.00	1.00	17.2
Approach		545	5.0	545	5.0	0.908	32.9	LOS D	12.3	89.8	0.56	0.76	35.1
North: Clyde Road (north)													
7	L2	248	5.0	248	5.0	0.513	9.9	LOS A	8.2	59.6	0.42	0.54	50.6
8	T1	555	5.0	555	5.0	0.513	14.9	LOS A	10.9	79.3	0.56	0.56	41.6
9	R2	94	5.0	94	5.0	0.418	64.0	LOS A	5.5	40.1	1.00	0.78	23.7
Approach		897	5.0	897	5.0	0.513	18.7	LOS A	10.9	79.3	0.57	0.58	40.3
West: Sir Gustav Nossal Boulevard (west)													
10	L2	92	5.0	92	5.0	0.138	23.4	LOS A	3.4	25.1	0.62	0.67	34.9
11	T1	15	5.0	15	5.0	0.138	17.8	LOS A	3.4	25.1	0.62	0.67	43.8
12	R2	156	5.0	156	5.0	0.745	65.1	LOS C	9.4	68.9	1.00	0.87	27.2
Approach		262	5.0	262	5.0	0.745	47.9	LOS C	9.4	68.9	0.85	0.79	29.6
All Vehicles		3754	5.0	3754	5.0	0.908	39.5	LOS D	41.0	299.1	0.74	0.82	30.2

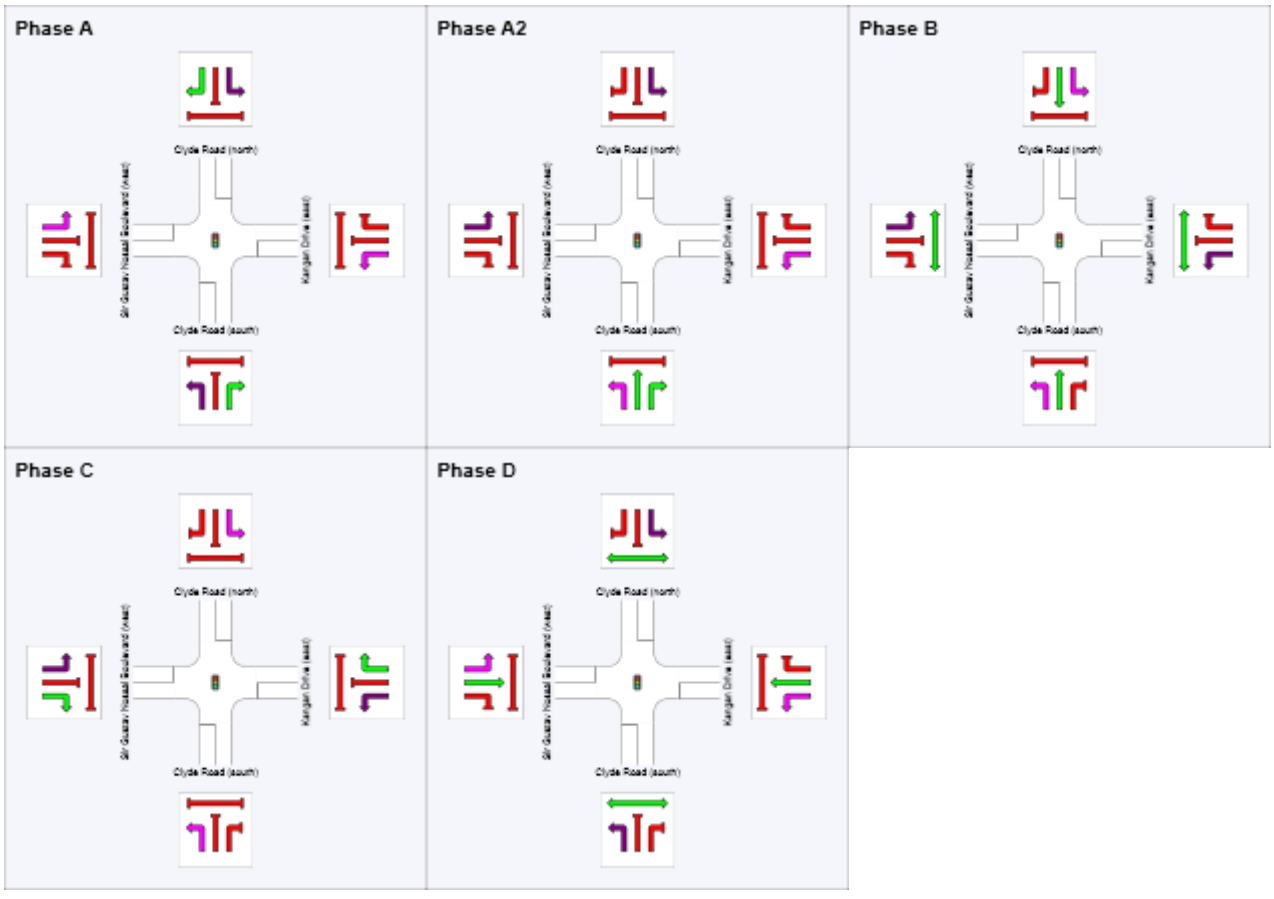
PHASING SUMMARY

Site: Clyde / Kangan Ex AM

Network: Ex AM

Clyde / Kangan
Signals - Fixed Time Coordinated Cycle Time = 120 seconds (Network Cycle Time)
Phase times determined by the program
Sequence: Leading Right Turn
Movement Class: All Movement Classes
Input Sequence: A, A2, B, C, D
Output Sequence: A, A2, B, C, D
Phase Timing Results

Phase	A	A2	B	C	D
Reference Phase	No	No	Yes	No	No
Phase Change Time (sec)	91	112	0	42	62
Green Time (sec)	15	2	36	14	23
Yellow Time (sec)	4	4	4	4	4
All-Red Time (sec)	2	2	2	2	2
Phase Time (sec)	21	8	42	20	29
Phase Split	18 %	7 %	35 %	17 %	24 %



MOVEMENT SUMMARY

Site: Clyde / Kangan Ex PM

Network: Ex PM

Clyde / Kangan
Signals - Fixed Time Coordinated Cycle Time = 120 seconds (Network Cycle Time)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	HV	Arrival Flows Total	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Clyde Road (south)													
1	L2	41	5.0	41	5.0	0.027	6.1	LOS A	0.2	1.2	0.13	0.57	53.0
2	T1	828	5.0	828	5.0	0.603	33.0	LOS B	19.8	144.4	0.87	0.76	25.6
3	R2	252	5.0	252	5.0	0.601	61.9	LOS B	7.3	53.0	1.00	0.80	27.7
Approach		1121	5.0	1121	5.0	0.603	38.5	LOS B	19.8	144.4	0.87	0.76	27.3
East: Kangan Drive (east)													
4	L2	344	5.0	344	5.0	0.326	11.8	LOS A	7.1	52.2	0.44	0.69	48.6
5	T1	20	5.0	20	5.0	0.071	47.4	LOS A	1.0	7.4	0.89	0.64	33.9
6	R2	175	5.0	175	5.0	0.600	56.4	LOS B	9.7	70.5	0.97	0.81	21.3
Approach		539	5.0	539	5.0	0.600	27.6	LOS B	9.7	70.5	0.63	0.73	37.6
North: Clyde Road (north)													
7	L2	181	5.0	181	5.0	0.443	15.3	LOS A	11.6	84.8	0.79	0.75	46.2
8	T1	579	5.0	579	5.0	0.443	20.7	LOS A	12.2	89.1	0.76	0.68	37.7
9	R2	23	5.0	23	5.0	0.111	57.7	LOS A	1.3	9.5	0.97	0.72	25.1
Approach		783	5.0	783	5.0	0.443	20.5	LOS A	12.2	89.1	0.77	0.70	38.9
West: Sir Gustav Nossal Boulevard (west)													
10	L2	62	5.0	62	5.0	0.145	20.8	LOS A	2.2	15.9	0.71	0.68	37.2
11	T1	22	5.0	22	5.0	0.145	15.2	LOS A	2.2	15.9	0.71	0.68	45.7
12	R2	105	5.0	105	5.0	0.352	54.2	LOS A	5.6	40.5	0.93	0.78	29.9
Approach		189	5.0	189	5.0	0.352	38.7	LOS A	5.6	40.5	0.83	0.73	33.0
All Vehicles		2633	5.0	2633	5.0	0.603	30.9	LOS B	19.8	144.4	0.79	0.73	33.0

PHASING SUMMARY

Site: Clyde / Kangan Ex PM

Network: Ex PM

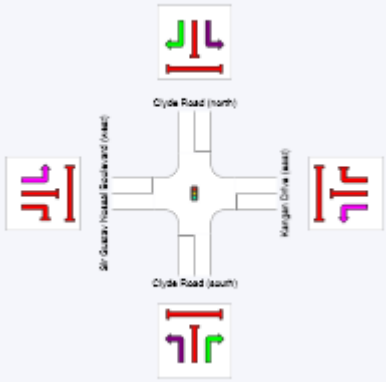
Clyde / Kangan
Signals - Fixed Time Coordinated Cycle Time = 120 seconds (Network Cycle Time)

Phase times determined by the program
Sequence: Leading Right Turn (phase reduction applied)
Movement Class: All Movement Classes
Input Sequence: A, A2, B, C, D
Output Sequence: A, B, C, D

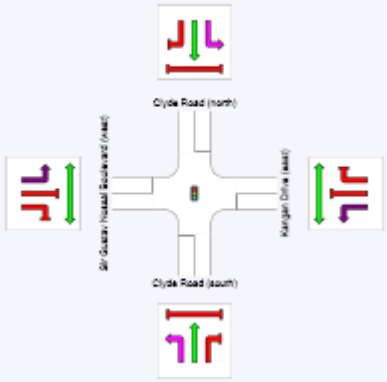
Phase Timing Results

Phase	A	B	C	D
Reference Phase	No	Yes	No	No
Phase Change Time (sec)	50	70	0	26
Green Time (sec)	14	44	20	18
Yellow Time (sec)	4	4	4	4
All-Red Time (sec)	2	2	2	2
Phase Time (sec)	20	50	26	24
Phase Split	17 %	42 %	22 %	20 %

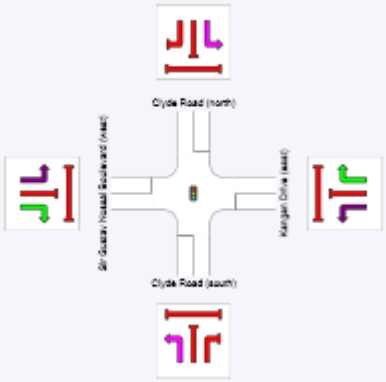
Phase A



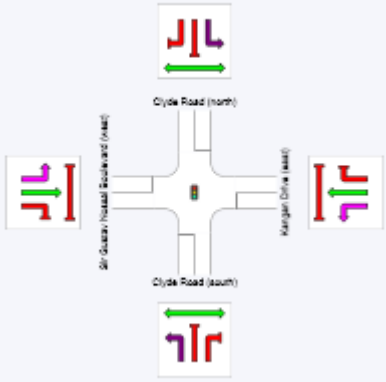
Phase B



Phase C



Phase D



Berwick Health and Education Precinct

APPENDIX C

DRAFT URBAN STRUCTURE PLAN

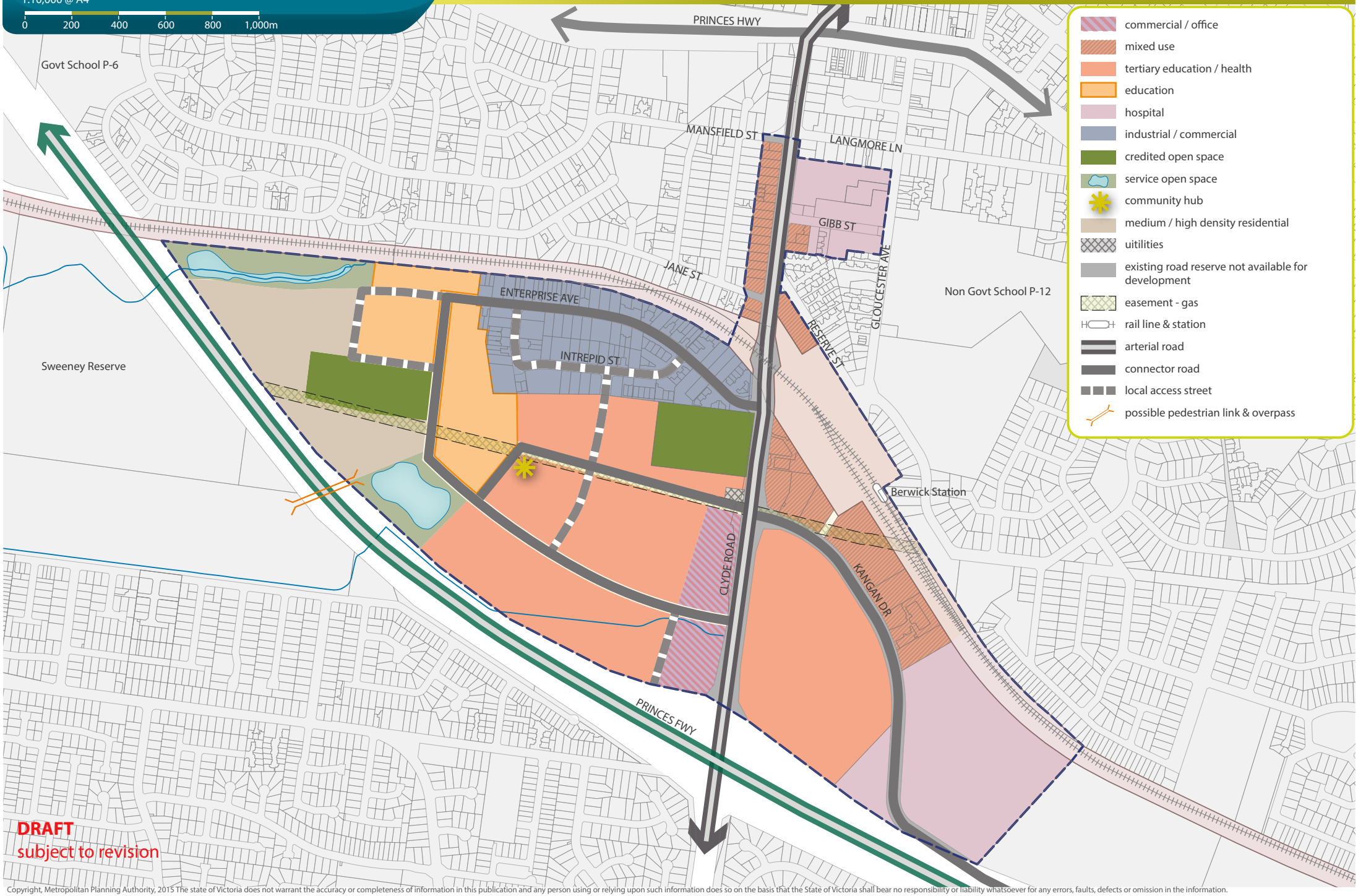
Plan 2 - Future Urban Structure

Berwick Health & Education Precinct Structure Plan

1:10,000 @ A4

0 200 400 600 800 1,000m

METROPOLITAN PLANNING AUTHORITY

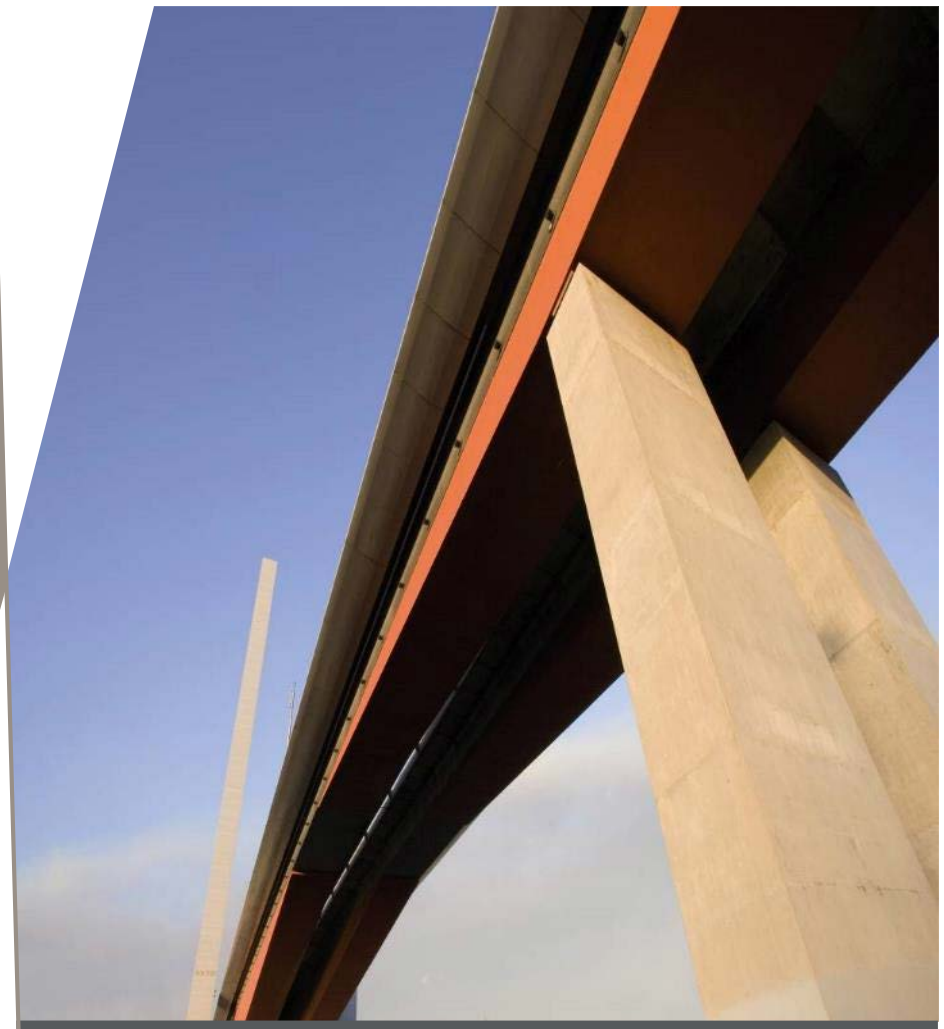


DRAFT
subject to revision

Berwick Health and Education Precinct

APPENDIX D

SIDRA INTERSECTION RESULTS – ULTIMATE CONDITIONS



MOVEMENT SUMMARY

Site: Clyde / Enterprise Fu PM

Network: Fu PM

Clyde / Enterprise
Signals - Fixed Time Coordinated Cycle Time = 140 seconds (Network Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Arrival Flows Total veh/h	Arrival Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Clyde Road (south)													
1	L2	167	5.0	167	5.0	0.100	7.8	LOS A	3.1	22.5	0.40	0.65	49.6
2	T1	1925	5.0	1925	5.0	0.603	21.3	LOS B	30.2	220.8	0.72	0.65	33.4
3	R2	66	5.0	66	5.0	0.598	76.0	LOS A	4.6	33.4	1.00	0.77	21.4
Approach		2158	5.0	2158	5.0	0.603	22.0	LOS B	30.2	220.8	0.70	0.65	33.8
East: Station Access (east)													
4	L2	91	5.0	91	5.0	0.152	10.2	LOS A	1.6	11.9	0.32	0.64	45.3
5	T1	2	5.0	2	5.0	0.221	73.9	LOS A	1.3	9.2	1.00	0.70	26.3
6	R2	16	5.0	16	5.0	0.221	79.5	LOS A	1.3	9.2	1.00	0.70	21.6
Approach		109	5.0	109	5.0	0.221	21.5	LOS A	1.6	11.9	0.43	0.65	36.6
North: Clyde Road (north)													
7	L2	7	5.0	7	5.0	0.004	6.3	LOS A	0.0	0.3	0.13	0.57	51.6
8	T1	1472	5.0	1472	5.0	0.430	17.9	LOS A	18.9	137.7	0.61	0.55	27.1
9	R2	101	5.0	101	5.0	0.915	92.4	LOS D	8.0	58.5	1.00	1.04	19.5
Approach		1580	5.0	1580	5.0	0.915	22.6	LOS D	18.9	137.7	0.63	0.58	25.6
West: Enterprise Avenue													
10	L2	137	5.0	137	5.0	0.190	16.0	LOS A	4.8	34.9	0.56	0.73	43.2
11	T1	20	5.0	20	5.0	0.284	46.5	LOS A	6.2	45.4	0.88	0.75	32.7
12	R2	199	5.0	199	5.0	0.284	52.1	LOS A	6.2	45.4	0.88	0.76	22.7
Approach		356	5.0	356	5.0	0.284	37.9	LOS A	6.2	45.4	0.76	0.75	30.0
All Vehicles		4203	5.0	4203	5.0	0.915	23.6	LOS D	30.2	220.8	0.67	0.63	30.9

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

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P2	East Full Crossing	50	64.3	LOS F	0.2	0.2	0.96	0.96
P3	North Full Crossing	50	64.3	LOS F	0.2	0.2	0.96	0.96
P4	West Full Crossing	50	64.3	LOS F	0.2	0.2	0.96	0.96
All Pedestrians		150	64.3	LOS F			0.96	0.96

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.

PHASING SUMMARY

Site: Clyde / Enterprise Fu PM

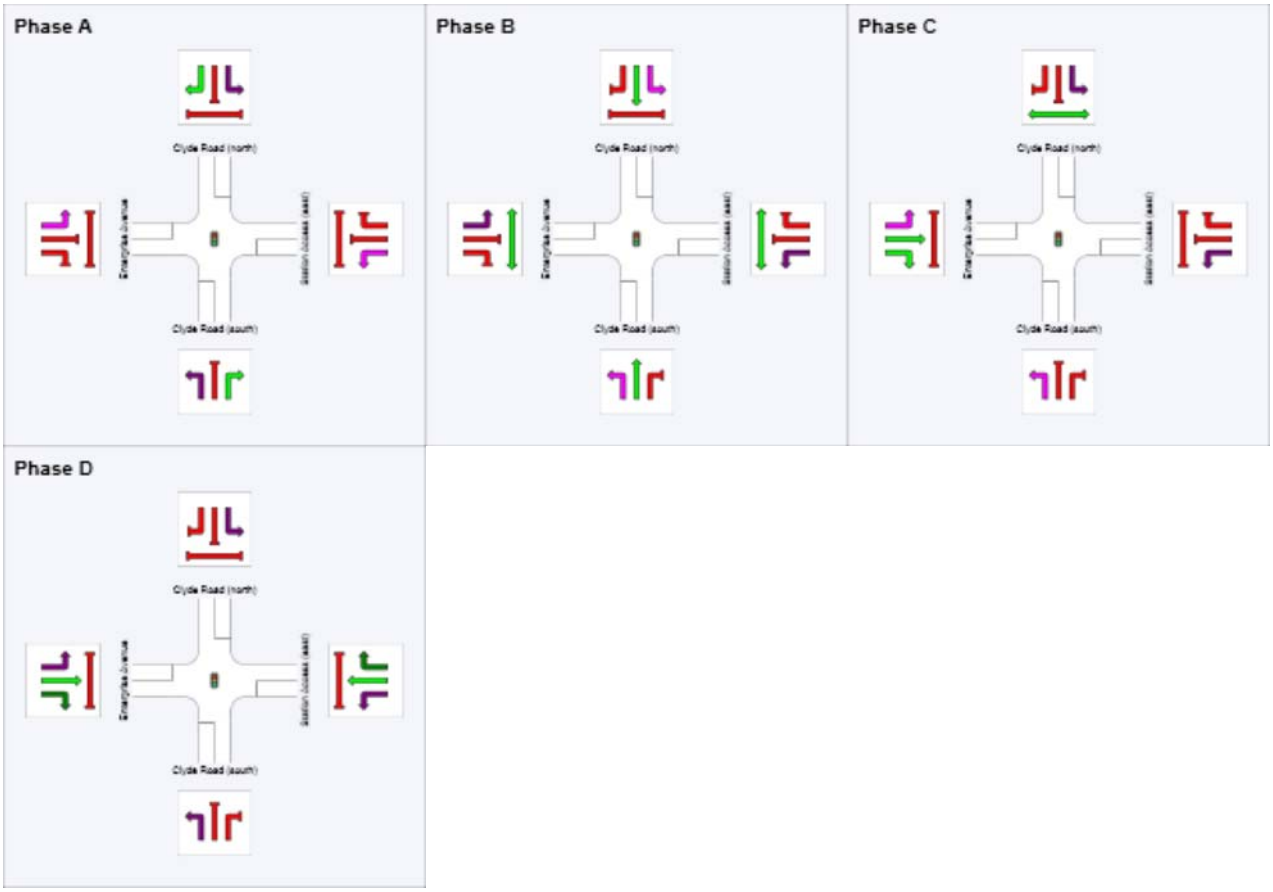
Network: Fu PM

Clyde / Enterprise
Signals - Fixed Time Coordinated Cycle Time = 140 seconds (Network Cycle Time)

Phase times determined by the program
Sequence: Split Phasing (phase reduction applied)
Movement Class: All Movement Classes
Input Sequence: A, A2, B, C, D
Output Sequence: A, B, C, D

Phase Timing Results

Phase	A	B	C	D
Reference Phase	No	Yes	No	No
Phase Change Time (sec)	40	54	0	28
Green Time (sec)	8	80	22	6
Yellow Time (sec)	4	4	4	4
All-Red Time (sec)	2	2	2	2
Phase Time (sec)	14	86	28	12
Phase Split	10 %	61 %	20 %	9 %



Normal Movement
Slip/Bypass-Lane Movement
Stopped Movement
Other Movement Class Running
Mixed Running & Stopped Movement Classes
Undetected Movement
Permitted/Opposed
Opposed Slip/Bypass-Lane
Turn On Red
Other Movement Class Stopped
Phase Transition Applied

MOVEMENT SUMMARY

Site: Clyde / Kangan Fu PM

Network: Fu PM

Clyde / Kangan
Signals - Fixed Time Coordinated Cycle Time = 140 seconds (Network Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Arrival Flows Total veh/h	Arrival Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Clyde Road (south)													
1	L2	43	5.0	43	5.0	0.028	6.6	LOS A	0.3	2.1	0.14	0.58	50.7
2	T1	1507	5.0	1507	5.0	0.544	20.5	LOS A	23.1	168.9	0.59	0.53	22.0
3	R2	272	5.0	272	5.0	0.519	67.3	LOS A	9.0	65.7	1.00	0.80	22.8
Approach		1822	5.0	1822	5.0	0.544	27.1	LOS A	23.1	168.9	0.64	0.57	23.1
East: Kangan Drive (east)													
4	L2	556	5.0	556	5.0	0.608	26.1	LOS B	24.3	177.5	0.79	0.90	32.8
5	T1	102	5.0	102	5.0	0.305	55.7	LOS A	6.2	45.0	0.92	0.73	31.6
6	R2	491	5.0	491	5.0	0.873	78.8	LOS C	19.1	139.2	1.00	0.97	17.1
Approach		1149	5.0	1149	5.0	0.873	51.3	LOS C	24.3	177.5	0.89	0.92	24.0
North: Clyde Road (north)													
7	L2	480	5.0	480	5.0	0.371	12.8	LOS A	15.1	110.1	0.60	0.75	45.4
8	T1	1206	5.0	1206	5.0	0.511	41.5	LOS A	26.7	194.8	0.94	0.83	14.6
9	R2	64	5.0	64	5.0	0.516	77.3	LOS A	4.5	32.6	1.00	0.76	21.4
Approach		1750	5.0	1750	5.0	0.516	34.9	LOS A	26.7	194.8	0.85	0.80	23.5
West: Sir Gustav Nossal Boulevard (west)													
10	L2	196	5.0	196	5.0	0.361	18.9	LOS A	6.6	48.4	0.57	0.73	37.5
11	T1	311	5.0	311	5.0	0.879	77.8	LOS C	13.5	98.7	1.00	1.00	26.6
12	R2	131	5.0	131	5.0	0.879	83.9	LOS C	10.0	72.7	1.00	1.00	16.5
Approach		638	5.0	638	5.0	0.879	60.9	LOS C	13.5	98.7	0.87	0.92	25.9
All Vehicles		5359	5.0	5359	5.0	0.879	38.9	LOS C	26.7	194.8	0.79	0.76	24.0

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

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P1	South Full Crossing	50	64.3	LOS F	0.2	0.2	0.96	0.96
P2	East Full Crossing	50	64.3	LOS F	0.2	0.2	0.96	0.96
P4	West Full Crossing	50	64.3	LOS F	0.2	0.2	0.96	0.96
All Pedestrians		150	64.3	LOS F			0.96	0.96

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.

PHASING SUMMARY

Site: Clyde / Kangan Fu PM

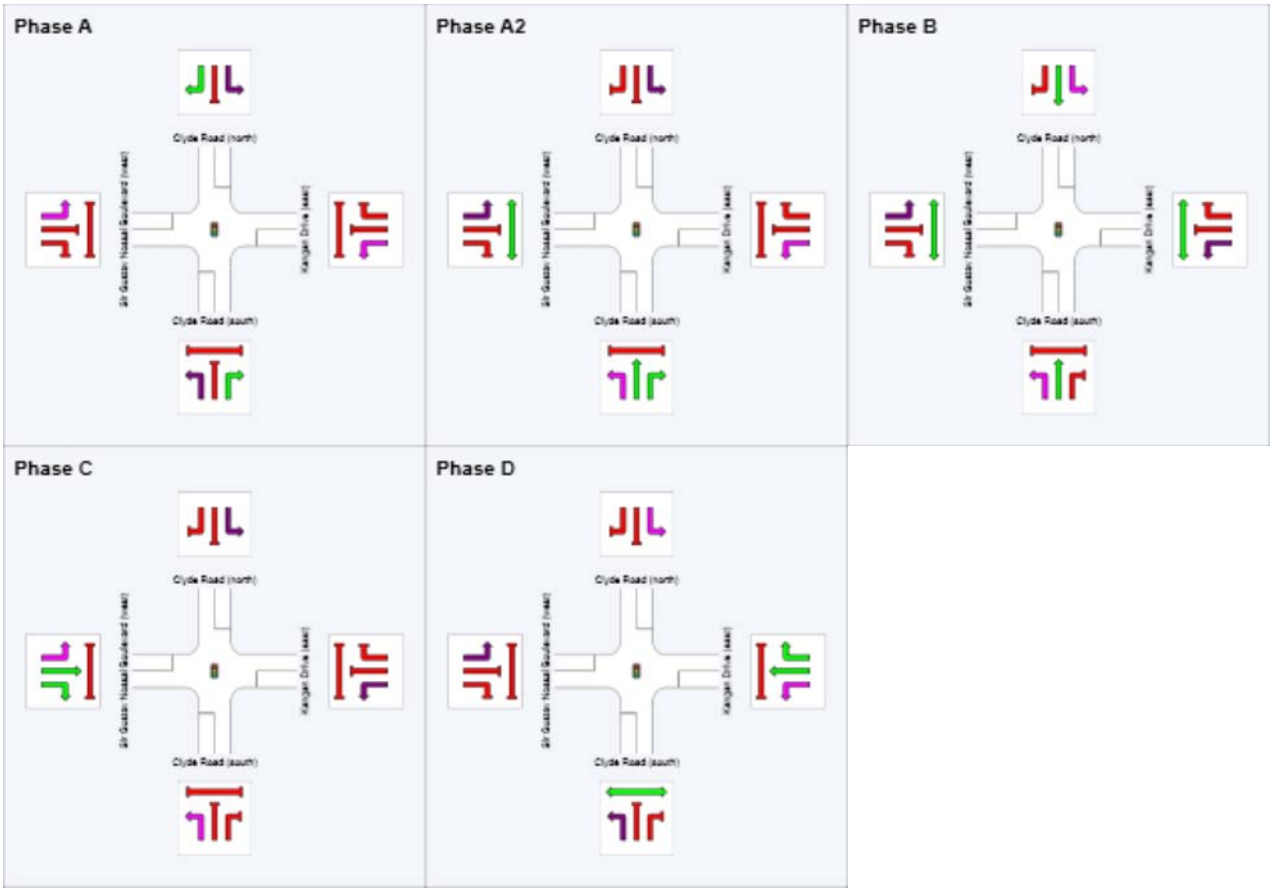
Network: Fu PM

Clyde / Kangan
Signals - Fixed Time Coordinated Cycle Time = 140 seconds (Network Cycle Time)

Phase times determined by the program
Sequence: Split Phasing
Movement Class: All Movement Classes
Input Sequence: A, A2, B, C, D
Output Sequence: A, A2, B, C, D

Phase Timing Results

Phase	A	A2	B	C	D
Reference Phase	No	No	Yes	No	No
Phase Change Time (sec)	130	5	15	81	101
Green Time (sec)	9	4	60	14	23
Yellow Time (sec)	4	4	4	4	4
All-Red Time (sec)	2	2	2	2	2
Phase Time (sec)	15	10	66	20	29
Phase Split	11 %	7 %	47 %	14 %	21 %



Normal Movement
Permitted/Opposed
Slip/Bypass-Lane Movement
Opposed Slip/Bypass-Lane
Stopped Movement
Turn On Red
Other Movement Class Running
Other Movement Class Stopped
Mixed Running & Stopped Movement Classes
Undetected Movement
Phase Transition Applied

MOVEMENT SUMMARY

Site: Clyde / Fu E-W Fu PM

Network: Fu PM

Clyde / Fu E-W Fu
Signals - Fixed Time Coordinated Cycle Time = 140 seconds (Network Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Clyde Road (south)													
1	L2	48	0.0	48	0.0	0.027	6.2	LOS A	0.3	1.8	0.12	0.58	51.3
2	T1	1153	5.0	1153	5.0	0.319	15.0	LOS A	12.9	93.8	0.54	0.47	26.0
3	R2	150	0.0	150	0.0	0.875	84.5	LOS C	11.4	79.5	1.00	0.97	19.7
Approach		1351	4.3	1351	4.3	0.875	22.4	LOS C	12.9	93.8	0.58	0.53	24.8
East: Fu E-W (east)													
4	L2	351	0.0	351	0.0	0.533	19.4	LOS A	16.2	113.3	0.85	0.89	40.5
6	R2	452	0.0	452	0.0	0.586	61.3	LOS A	14.1	98.9	0.96	0.82	20.3
Approach		803	0.0	803	0.0	0.586	43.0	LOS A	16.2	113.3	0.91	0.85	27.2
North: Clyde Road (north)													
7	L2	193	0.0	193	0.0	0.112	5.8	LOS A	0.2	1.6	0.02	0.56	51.8
8	T1	1628	5.0	1628	5.0	0.450	9.5	LOS A	16.0	117.1	0.33	0.30	41.9
9	R2	71	0.0	71	0.0	0.414	77.8	LOS A	4.9	34.6	1.00	0.77	20.7
Approach		1892	4.3	1892	4.3	0.450	11.7	LOS A	16.0	117.1	0.33	0.34	40.6
West: Fu E-W (west)													
10	L2	218	0.0	218	0.0	0.200	8.1	LOS A	2.3	16.2	0.30	0.64	47.6
12	R2	145	0.0	145	0.0	0.534	67.3	LOS A	9.4	65.7	0.98	0.80	22.8
Approach		363	0.0	363	0.0	0.534	31.8	LOS A	9.4	65.7	0.57	0.70	31.5
All Vehicles		4409	3.2	4409	3.2	0.875	22.3	LOS C	16.2	117.1	0.53	0.52	31.6

Level of Service (LOS) Method: Degree of Saturation (SIDRA METHOD).
Vehicle movement LOS values are based on degree of saturation per movement
Intersection and Approach LOS values are based on worst degree of saturation for any vehicle movement.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
The results of iterative calculations indicate a somewhat unstable solution. See the Diagnostics section in the Detailed Output report.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P1	South Full Crossing	50	64.3	LOS F	0.2	0.2	0.96	0.96
P2	East Full Crossing	50	64.3	LOS F	0.2	0.2	0.96	0.96
P4	West Full Crossing	50	64.3	LOS F	0.2	0.2	0.96	0.96
All Pedestrians		150	64.3	LOS F			0.96	0.96

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.

PHASING SUMMARY

Site: Clyde / Enterprise Fu PM

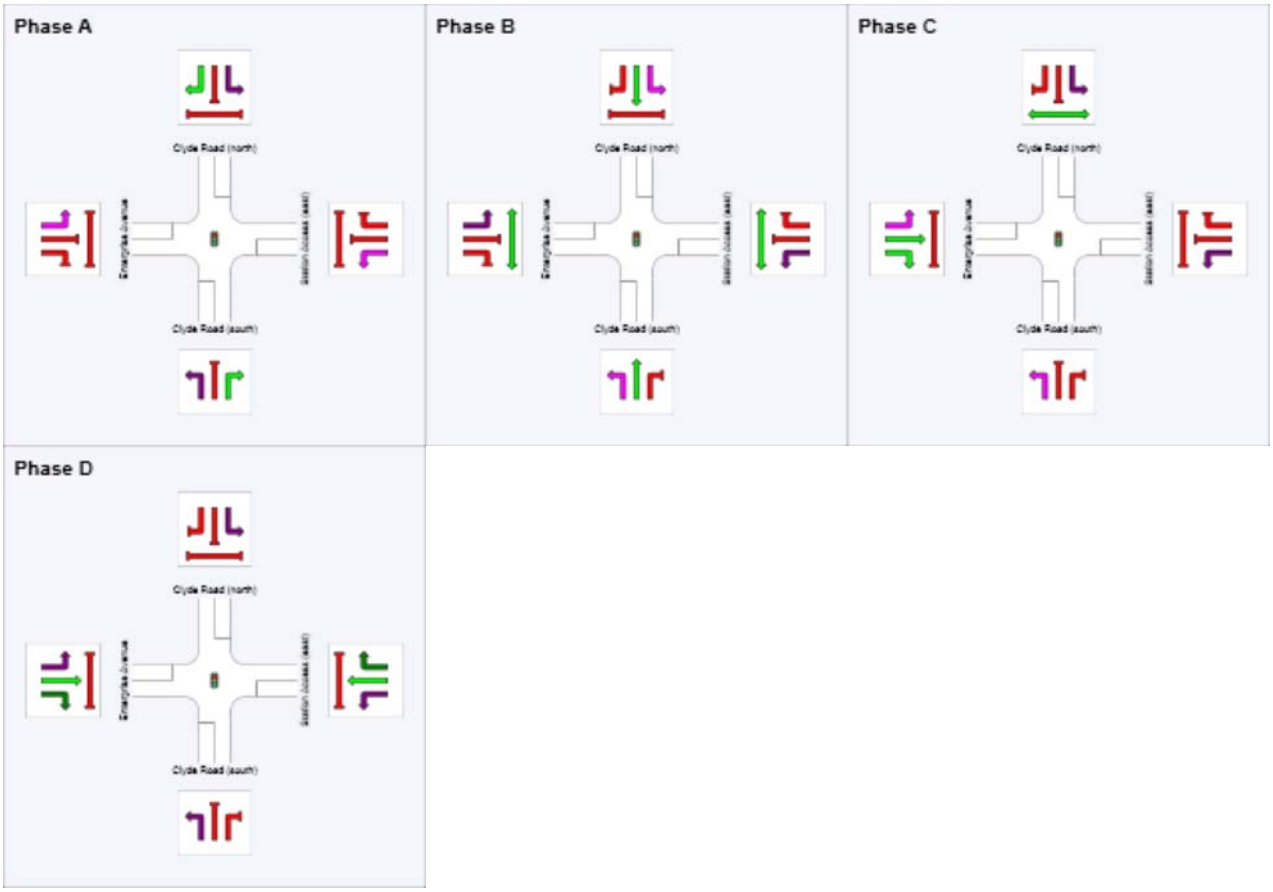
Network: Fu PM

Clyde / Enterprise
Signals - Fixed Time Coordinated Cycle Time = 140 seconds (Network Cycle Time)

Phase times determined by the program
Sequence: Split Phasing (phase reduction applied)
Movement Class: All Movement Classes
Input Sequence: A, A2, B, C, D
Output Sequence: A, B, C, D

Phase Timing Results

Phase	A	B	C	D
Reference Phase	No	Yes	No	No
Phase Change Time (sec)	40	54	0	28
Green Time (sec)	8	80	22	6
Yellow Time (sec)	4	4	4	4
All-Red Time (sec)	2	2	2	2
Phase Time (sec)	14	86	28	12
Phase Split	10 %	61 %	20 %	9 %



Normal Movement
Slip/Bypass-Lane Movement
Stopped Movement
Other Movement Class Running
Mixed Running & Stopped Movement Classes
Undetected Movement
Permitted/Opposed
Opposed Slip/Bypass-Lane
Turn On Red
Other Movement Class Stopped
Phase Transition Applied

MOVEMENT SUMMARY

Site: Clyde / Enterprise Fu AM

Network: Fu AM

Clyde / Enterprise
Signals - Fixed Time Coordinated Cycle Time = 140 seconds (Network Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Arrival Flows Total veh/h	Arrival Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Clyde Road (south)													
1	L2	47	5.0	47	5.0	0.029	7.8	LOS A	0.8	5.5	0.33	0.62	49.7
2	T1	1683	5.0	1683	5.0	0.560	38.8	LOS A	35.4	258.4	0.95	0.85	24.5
3	R2	104	5.0	104	5.0	0.471	73.8	LOS A	7.1	51.5	1.00	0.79	21.8
Approach		1834	5.0	1834	5.0	0.560	40.0	LOS A	35.4	258.4	0.94	0.84	24.7
East: Station Access (east)													
4	L2	65	5.0	65	5.0	0.097	15.1	LOS A	1.6	11.9	0.43	0.66	40.5
5	T1	2	5.0	2	5.0	0.279	74.2	LOS A	1.6	11.8	1.00	0.71	26.2
6	R2	21	5.0	21	5.0	0.279	79.9	LOS A	1.6	11.8	1.00	0.71	21.5
Approach		88	5.0	88	5.0	0.279	31.9	LOS A	1.6	11.9	0.58	0.67	31.4
North: Clyde Road (north)													
7	L2	11	5.0	11	5.0	0.007	6.4	LOS A	0.1	0.5	0.14	0.57	51.4
8	T1	2127	5.0	2127	5.0	0.711	26.9	LOS C	38.2	279.0	0.81	0.74	21.3
9	R2	152	5.0	152	5.0	0.689	72.4	LOS B	10.4	75.7	1.00	0.83	22.8
Approach		2290	5.0	2290	5.0	0.711	29.8	LOS C	38.2	279.0	0.82	0.74	21.7
West: Enterprise Avenue													
10	L2	87	5.0	87	5.0	0.108	15.0	LOS A	2.4	17.5	0.45	0.68	44.0
11	T1	2	5.0	2	5.0	0.091	44.2	LOS A	1.9	13.7	0.84	0.71	33.2
12	R2	69	5.0	69	5.0	0.091	49.9	LOS A	1.9	13.7	0.84	0.71	23.2
Approach		158	5.0	158	5.0	0.108	30.6	LOS A	2.4	17.5	0.63	0.69	33.4
All Vehicles		4370	5.0	4370	5.0	0.711	34.1	LOS C	38.2	279.0	0.86	0.78	24.0

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

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P2	East Full Crossing	50	64.3	LOS F	0.2	0.2	0.96	0.96
P3	North Full Crossing	50	64.3	LOS F	0.2	0.2	0.96	0.96
P4	West Full Crossing	50	64.3	LOS F	0.2	0.2	0.96	0.96
All Pedestrians		150	64.3	LOS F			0.96	0.96

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.

PHASING SUMMARY

Site: Clyde / Enterprise Fu AM

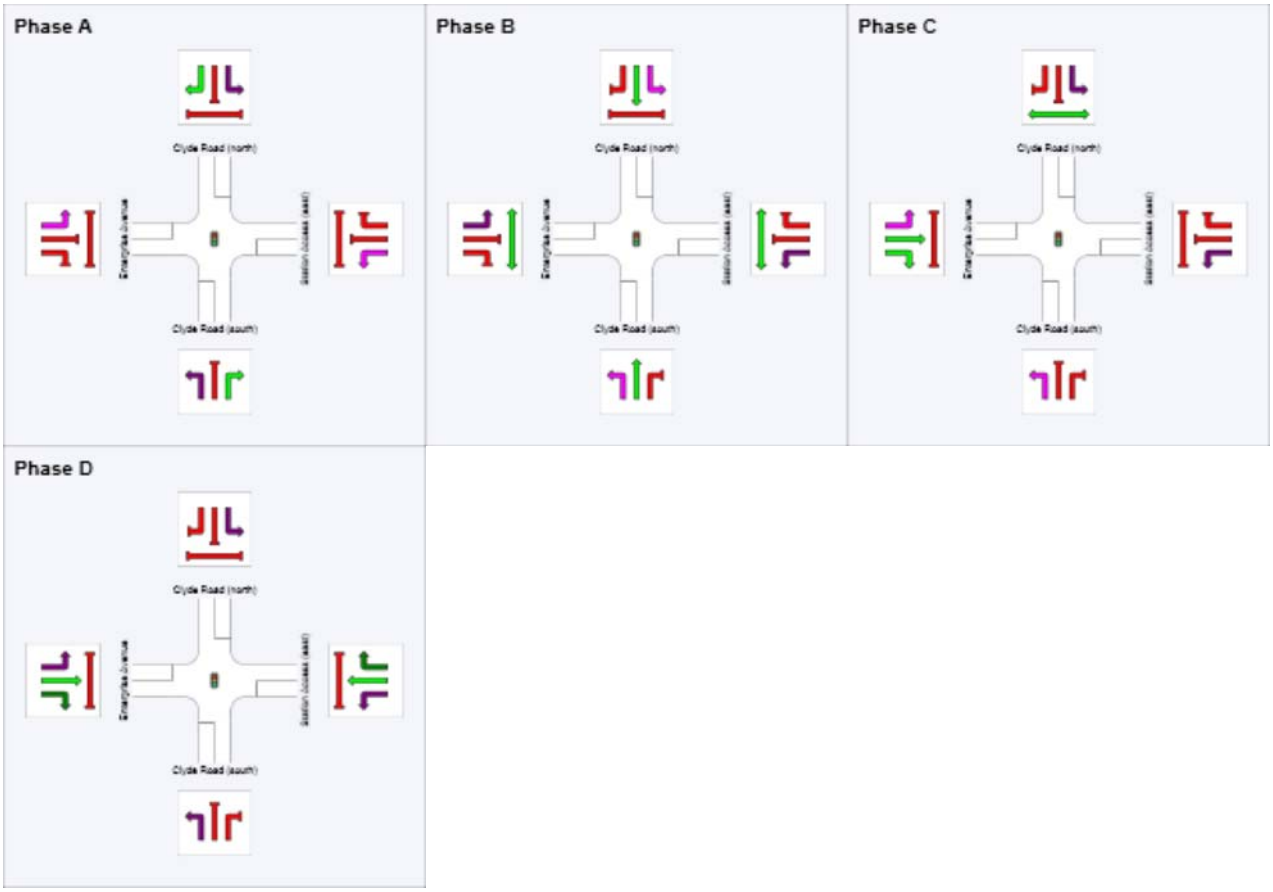
Network: Fu AM

Clyde / Enterprise
Signals - Fixed Time Coordinated Cycle Time = 140 seconds (Network Cycle Time)

Phase times determined by the program
Sequence: Split Phasing (phase reduction applied)
Movement Class: All Movement Classes
Input Sequence: A, A2, B, C, D
Output Sequence: A, B, C, D

Phase Timing Results

Phase	A	B	C	D
Reference Phase	No	Yes	No	No
Phase Change Time (sec)	50	72	10	38
Green Time (sec)	16	72	22	6
Yellow Time (sec)	4	4	4	4
All-Red Time (sec)	2	2	2	2
Phase Time (sec)	22	78	28	12
Phase Split	16 %	56 %	20 %	9 %



Normal Movement
Slip/Bypass-Lane Movement
Stopped Movement
Other Movement Class Running
Mixed Running & Stopped Movement Classes
Undetected Movement
Permitted/Opposed
Opposed Slip/Bypass-Lane
Turn On Red
Other Movement Class Stopped
Phase Transition Applied

MOVEMENT SUMMARY

Site: Clyde / Kangan Fu AM

Network: Fu AM

Clyde / Kangan
Signals - Fixed Time Coordinated Cycle Time = 140 seconds (Network Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Arrival Flows Total veh/h	Arrival Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Clyde Road (south)													
1	L2	200	5.0	200	5.0	0.175	14.9	LOS A	5.3	38.4	0.44	0.68	43.4
2	T1	1489	5.0	1489	5.0	0.836	45.0	LOS C	38.1	278.3	0.94	0.91	12.5
3	R2	585	5.0	585	5.0	0.544	40.4	LOS A	14.4	105.1	0.77	0.78	30.2
Approach		2274	5.0	2274	5.0	0.836	41.2	LOS C	38.1	278.3	0.86	0.86	20.9
East: Kangan Drive (east)													
4	L2	596	5.0	596	5.0	0.503	17.3	LOS A	19.3	140.7	0.60	0.81	38.8
5	T1	458	5.0	458	5.0	0.877	70.3	LOS C	23.3	170.3	0.98	1.01	28.0
6	R2	333	5.0	333	5.0	0.877	77.6	LOS C	23.3	170.3	1.00	0.98	17.5
Approach		1387	5.0	1387	5.0	0.877	49.3	LOS C	23.3	170.3	0.82	0.92	27.5
North: Clyde Road (north)													
7	L2	563	5.0	563	5.0	0.429	6.6	LOS A	2.3	16.8	0.08	0.57	51.0
8	T1	1035	5.0	1035	5.0	0.633	49.7	LOS B	25.6	186.8	0.99	0.85	12.7
9	R2	299	5.0	299	5.0	0.834	45.6	LOS C	18.3	133.6	0.92	0.84	28.9
Approach		1897	5.0	1897	5.0	0.834	36.2	LOS C	25.6	186.8	0.71	0.77	25.4
West: Sir Gustav Nossal Boulevard (west)													
10	L2	67	5.0	67	5.0	0.132	27.0	LOS A	2.5	18.2	0.62	0.71	32.3
11	T1	155	5.0	155	5.0	0.858	81.1	LOS C	6.6	48.3	1.00	0.94	25.9
12	R2	100	5.0	100	5.0	0.858	87.2	LOS C	6.5	47.8	1.00	0.94	16.1
Approach		322	5.0	322	5.0	0.858	71.7	LOS C	6.6	48.3	0.92	0.89	23.5
All Vehicles		5880	5.0	5880	5.0	0.877	43.2	LOS C	38.1	278.3	0.80	0.84	24.3

Level of Service (LOS) Method: Degree of Saturation (SIDRA METHOD).
Vehicle movement LOS values are based on degree of saturation per movement
Intersection and Approach LOS values are based on worst degree of saturation for any vehicle movement.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
The results of iterative calculations indicate a somewhat unstable solution. See the Diagnostics section in the Detailed Output report.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P1	South Full Crossing	50	64.3	LOS F	0.2	0.2	0.96	0.96
P2	East Full Crossing	50	64.3	LOS F	0.2	0.2	0.96	0.96
P4	West Full Crossing	50	64.3	LOS F	0.2	0.2	0.96	0.96
All Pedestrians		150	64.3	LOS F			0.96	0.96

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.

PHASING SUMMARY

Site: Clyde / Kangan Fu AM

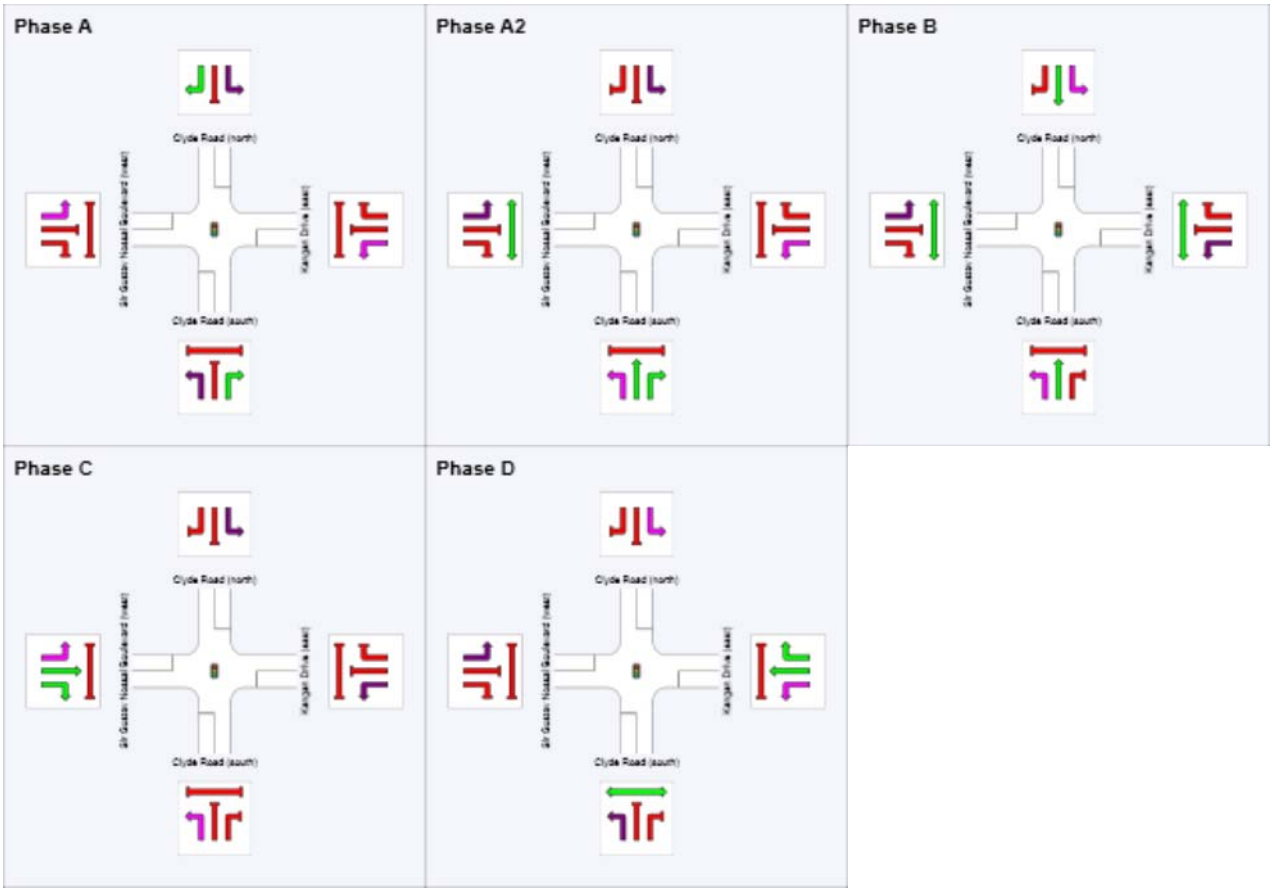
Network: Fu AM

Clyde / Kangan
Signals - Fixed Time Coordinated Cycle Time = 140 seconds (Network Cycle Time)

Phase times determined by the program
Sequence: Split Phasing
Movement Class: All Movement Classes
Input Sequence: A, A2, B, C, D
Output Sequence: A, A2, B, C, D

Phase Timing Results

Phase	A	A2	B	C	D
Reference Phase	No	No	Yes	No	No
Phase Change Time (sec)	95	127	0	50	63
Green Time (sec)	26	7	44	7	26
Yellow Time (sec)	4	4	4	4	4
All-Red Time (sec)	2	2	2	2	2
Phase Time (sec)	32	13	50	13	32
Phase Split	23 %	9 %	36 %	9 %	23 %



Normal Movement
Permitted/Opposed
Slip/Bypass-Lane Movement
Opposed Slip/Bypass-Lane
Stopped Movement
Turn On Red
Other Movement Class Running
Other Movement Class Stopped
Mixed Running & Stopped Movement Classes
Undetected Movement
Phase Transition Applied

The results of iterative calculations indicate a somewhat unstable solution. See the Diagnostics section in the Detailed Output report.

MOVEMENT SUMMARY

Site: Clyde / Fu E-W Fu AM

Network: Fu AM

Clyde / Fu E-W Fu AM
Signals - Fixed Time Coordinated Cycle Time = 140 seconds (Network Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Clyde Road (south)													
1	L2	191	0.0	191	0.0	0.122	8.7	LOS A	2.8	19.7	0.26	0.61	48.8
2	T1	2133	5.0	2133	5.0	0.786	13.1	LOS C	32.5	236.9	0.59	0.54	28.1
3	R2	251	0.0	251	0.0	0.732	66.6	LOS C	16.7	116.9	1.00	0.86	22.9
Approach		2575	4.1	2575	4.1	0.786	18.0	LOS C	32.5	236.9	0.60	0.58	28.8
East: Fu E-W (east)													
4	L2	161	0.0	161	0.0	0.193	10.3	LOS A	3.0	21.2	0.37	0.66	47.4
6	R2	193	0.0	193	0.0	0.750	78.4	LOS C	7.6	52.9	1.00	0.88	17.2
Approach		354	0.0	354	0.0	0.750	47.4	LOS C	7.6	52.9	0.71	0.78	25.8
North: Clyde Road (north)													
7	L2	452	0.0	452	0.0	0.283	8.2	LOS A	6.3	43.9	0.25	0.62	49.3
8	T1	1097	5.0	1097	5.0	0.300	26.2	LOS A	22.6	165.0	0.85	0.75	27.4
9	R2	287	0.0	287	0.0	0.837	77.0	LOS C	20.3	141.9	1.00	0.88	20.8
Approach		1836	3.0	1836	3.0	0.837	29.7	LOS C	22.6	165.0	0.73	0.74	29.9
West: Fu E-W (west)													
10	L2	100	5.0	100	5.0	0.080	14.1	LOS A	2.3	16.7	0.41	0.66	41.4
12	R2	67	0.0	67	0.0	0.782	84.7	LOS C	5.0	34.8	1.00	0.86	19.7
Approach		167	3.0	167	3.0	0.782	42.4	LOS C	5.0	34.8	0.65	0.74	27.3
All Vehicles		4932	3.4	4932	3.4	0.837	25.3	LOS C	32.5	236.9	0.66	0.66	28.8

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

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P1	South Full Crossing	50	64.3	LOS F	0.2	0.2	0.96	0.96
P2	East Full Crossing	50	64.3	LOS F	0.2	0.2	0.96	0.96
P4	West Full Crossing	50	64.3	LOS F	0.2	0.2	0.96	0.96
All Pedestrians		150	64.3	LOS F			0.96	0.96

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.

PHASING SUMMARY

Site: Clyde / Fu E-W Fu AM

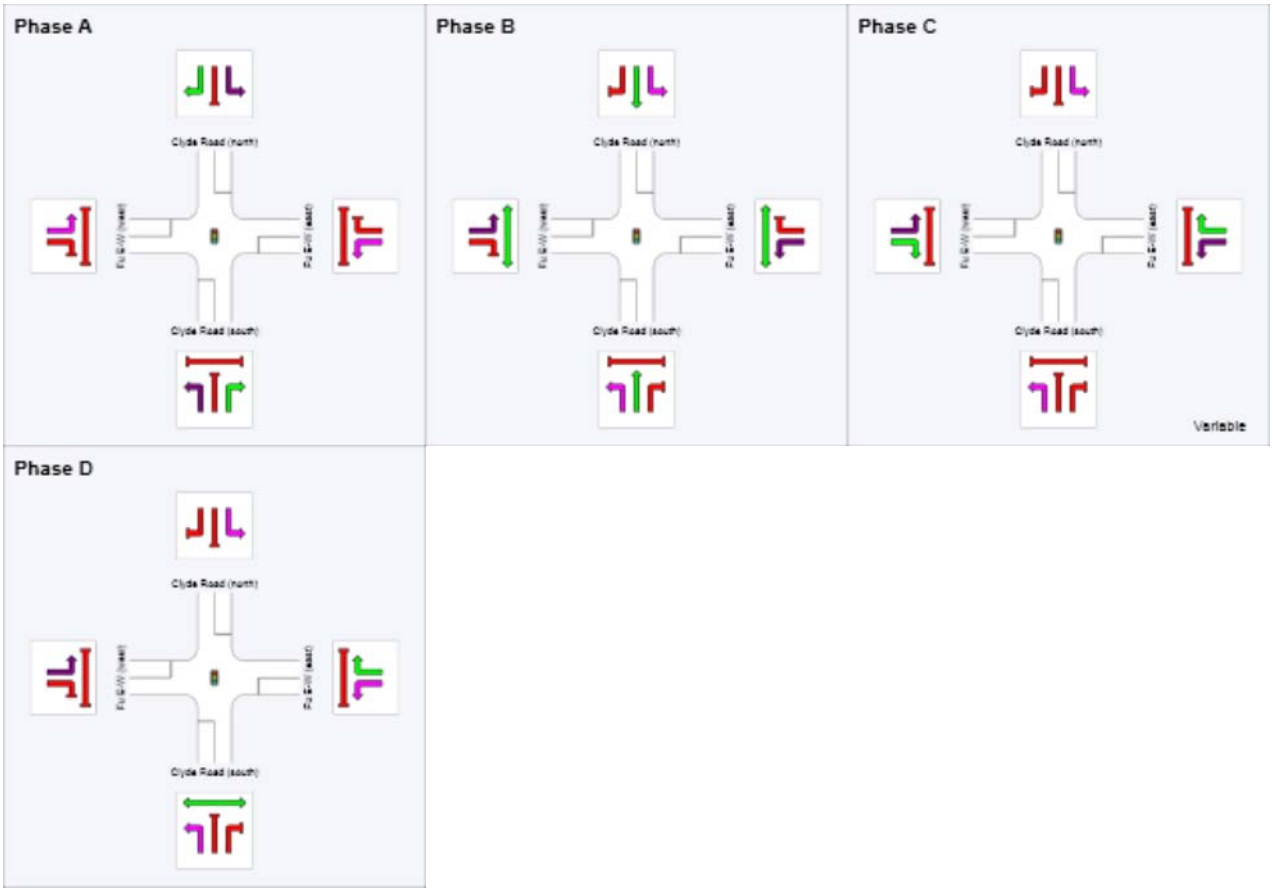
Network: Fu AM

Clyde / Fu E-W Fu AM
Signals - Fixed Time Coordinated Cycle Time = 140 seconds (Network Cycle Time)

Phase times determined by the program
Sequence: Leading Right Turn
Movement Class: All Movement Classes
Input Sequence: A, B, C, D
Output Sequence: A, B, C, D

Phase Timing Results

Phase	A	B	C	D
Reference Phase	No	Yes	No	No
Phase Change Time (sec)	40	70	20	32
Green Time (sec)	24	84	6	2
Yellow Time (sec)	4	4	4	4
All-Red Time (sec)	2	2	2	2
Phase Time (sec)	30	90	12	8
Phase Split	21 %	64 %	9 %	6 %

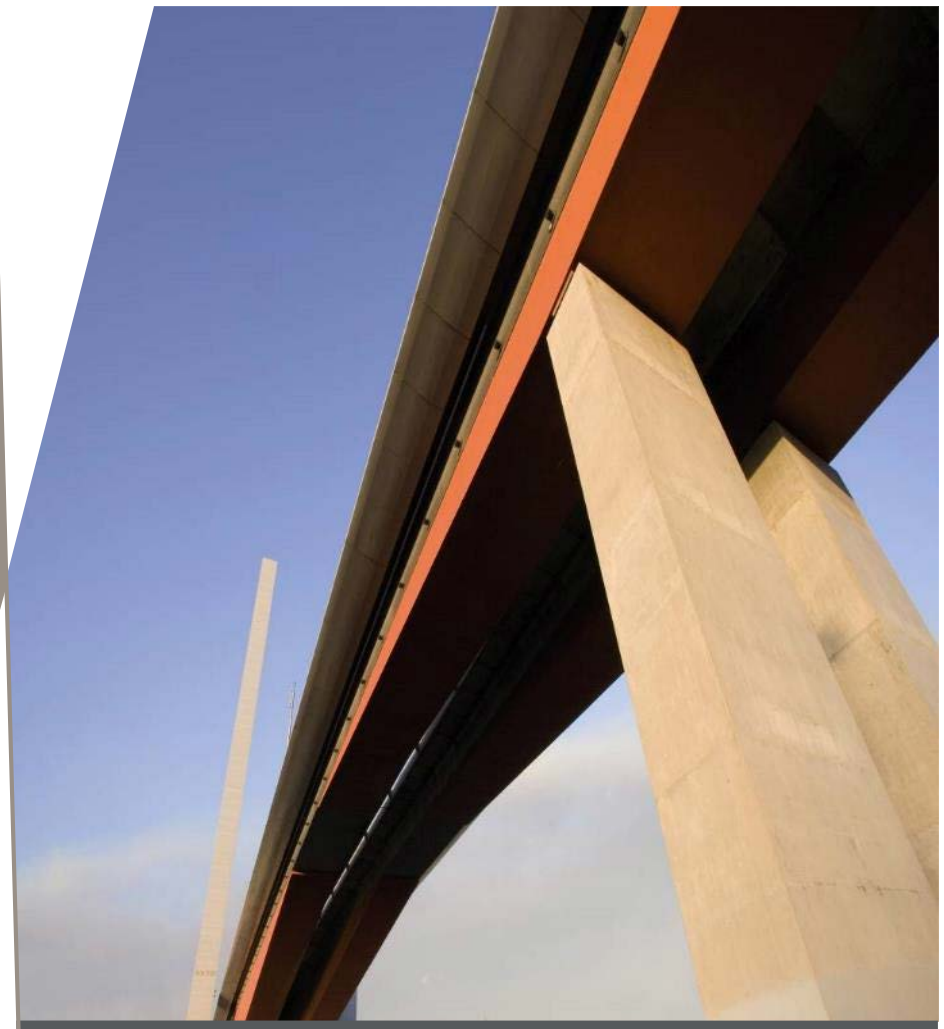


Normal Movement		Permitted/Opposed	
Slip/Bypass-Lane Movement		Opposed Slip/Bypass-Lane	
Stopped Movement		Turn On Red	
Other Movement Class Running		Other Movement Class Stopped	
Mixed Running & Stopped Movement Classes			
Undetected Movement		Phase Transition Applied	

Berwick Health and Education Precinct

APPENDIX E

SIDRA INTERSECTION RESULTS – INTERIM CONDITIONS



MOVEMENT SUMMARY

Site: Clyde / Enterprise Interim PM

Network: Fu PM

Clyde / Enterprise - Trigger Assessment
Signals - Fixed Time Coordinated Cycle Time = 140 seconds (Network Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Clyde Road (south)													
1	L2	167	5.0	167	5.0	0.100	6.8	LOS A	1.7	12.4	0.22	0.61	50.7
2	T1	1376	5.0	1376	5.0	0.631	18.9	LOS B	33.3	242.9	0.72	0.65	35.2
3	R2	66	5.0	66	5.0	0.598	73.1	LOS A	4.5	32.8	0.98	0.76	21.8
Approach		1609	5.0	1609	5.0	0.631	19.9	LOS B	33.3	242.9	0.68	0.65	35.6
East: Station Access (east)													
4	L2	91	5.0	91	5.0	0.157	11.4	LOS A	1.8	13.5	0.36	0.65	44.0
5	T1	2	5.0	2	5.0	0.221	73.9	LOS A	1.3	9.2	1.00	0.70	26.2
6	R2	16	5.0	16	5.0	0.221	79.5	LOS A	1.3	9.2	1.00	0.70	21.5
Approach		109	5.0	109	5.0	0.221	22.5	LOS A	1.8	13.5	0.46	0.66	35.9
North: Clyde Road (north)													
7	L2	7	5.0	7	5.0	0.004	6.3	LOS A	0.0	0.3	0.13	0.57	51.6
8	T1	1183	5.0	1183	5.0	0.480	16.0	LOS A	21.9	160.0	0.60	0.54	28.8
9	R2	101	5.0	101	5.0	0.915	92.4	LOS D	8.0	58.5	1.00	1.03	19.4
Approach		1291	5.0	1291	5.0	0.915	21.9	LOS D	21.9	160.0	0.63	0.58	26.4
West: Enterprise Avenue													
10	L2	141	5.0	141	5.0	0.202	15.7	LOS A	4.4	32.1	0.51	0.71	43.5
11	T1	20	5.0	20	5.0	0.340	51.4	LOS A	6.6	48.4	0.92	0.76	31.3
12	R2	201	5.0	201	5.0	0.340	57.0	LOS A	6.6	48.4	0.92	0.77	21.3
Approach		362	5.0	362	5.0	0.340	40.6	LOS A	6.6	48.4	0.76	0.75	28.9
All Vehicles		3371	5.0	3371	5.0	0.915	23.0	LOS D	33.3	242.9	0.66	0.63	31.6

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

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P2	East Full Crossing	50	64.3	LOS F	0.2	0.2	0.96	0.96
P3	North Full Crossing	50	64.3	LOS F	0.2	0.2	0.96	0.96
P4	West Full Crossing	50	64.3	LOS F	0.2	0.2	0.96	0.96
All Pedestrians		150	64.3	LOS F			0.96	0.96

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.

PHASING SUMMARY

Site: Clyde / Enterprise Interim PM

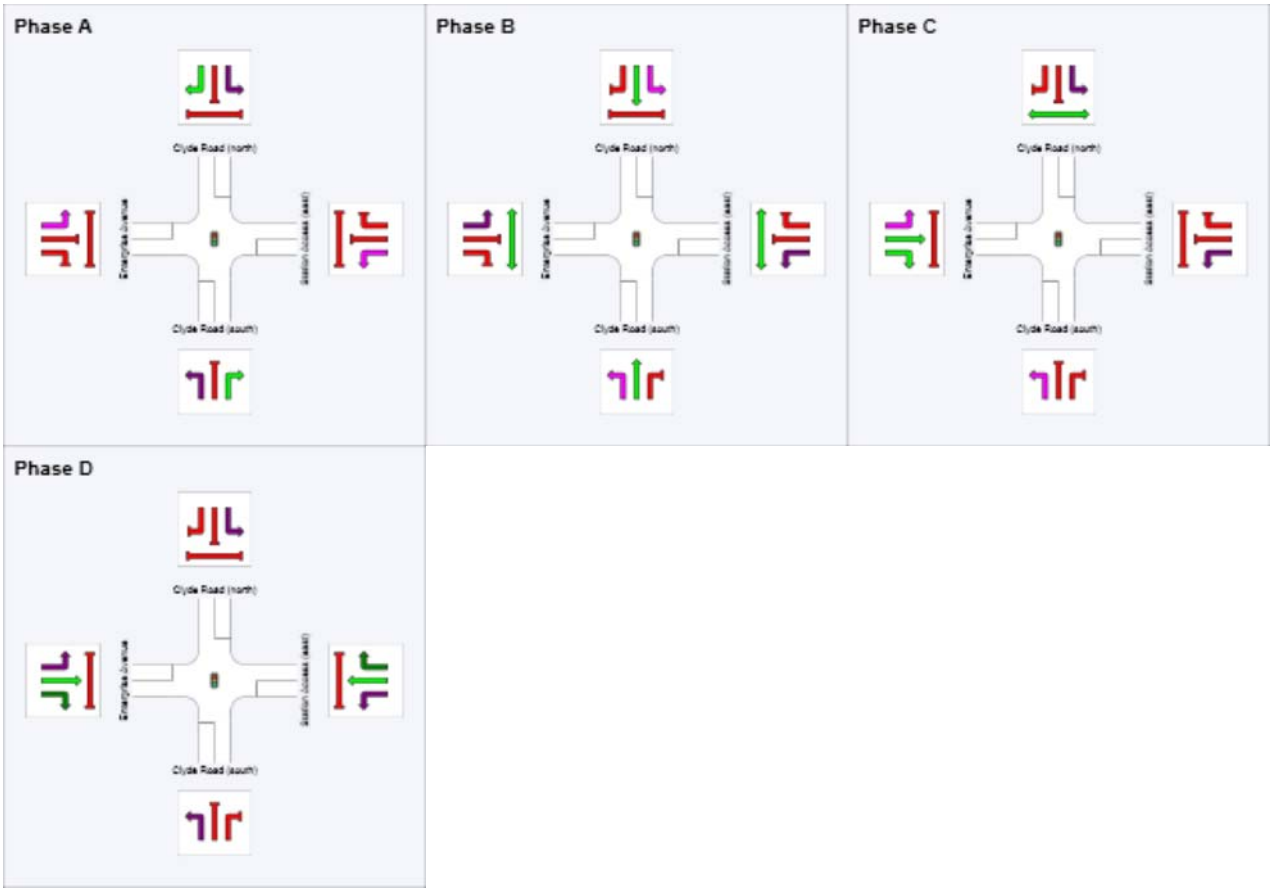
Network: Fu PM

Clyde / Enterprise - Trigger Assessment
Signals - Fixed Time Coordinated Cycle Time = 140 seconds (Network Cycle Time)

Phase times determined by the program
Sequence: Split Phasing (phase reduction applied)
Movement Class: All Movement Classes
Input Sequence: A, A2, B, C, D
Output Sequence: A, B, C, D

Phase Timing Results

Phase	A	B	C	D
Reference Phase	No	Yes	No	No
Phase Change Time (sec)	35	49	0	23
Green Time (sec)	8	85	17	6
Yellow Time (sec)	4	4	4	4
All-Red Time (sec)	2	2	2	2
Phase Time (sec)	14	91	23	12
Phase Split	10 %	65 %	16 %	9 %



Normal Movement
Slip/Bypass-Lane Movement
Stopped Movement
Other Movement Class Running
Mixed Running & Stopped Movement Classes
Undetected Movement
Permitted/Opposed
Opposed Slip/Bypass-Lane
Turn On Red
Other Movement Class Stopped
Phase Transition Applied

MOVEMENT SUMMARY

Site: Clyde / Kangan Interim PM

Network: Fu PM

Clyde / Kangan Trigger Assessment
Signals - Fixed Time Coordinated Cycle Time = 140 seconds (Network Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Clyde Road (south)													
1	L2	29	5.0	29	5.0	0.018	6.3	LOS A	0.1	1.1	0.11	0.57	51.0
2	T1	1183	5.0	1183	5.0	0.583	18.3	LOS A	24.0	175.3	0.60	0.54	23.7
3	R2	230	5.0	230	5.0	0.595	72.6	LOS A	7.9	57.6	1.00	0.79	21.7
Approach		1442	5.0	1442	5.0	0.595	26.7	LOS A	24.0	175.3	0.65	0.58	23.4
East: Kangan Drive (east)													
4	L2	467	5.0	467	5.0	0.583	27.0	LOS A	22.5	164.2	0.83	0.89	32.3
5	T1	67	5.0	67	5.0	0.243	58.8	LOS A	4.1	30.1	0.93	0.72	30.7
6	R2	317	5.0	317	5.0	0.704	70.9	LOS C	11.8	86.2	1.00	0.85	18.4
Approach		851	5.0	851	5.0	0.704	45.9	LOS C	22.5	164.2	0.90	0.86	25.4
North: Clyde Road (north)													
7	L2	400	5.0	400	5.0	0.262	8.2	LOS A	5.5	39.9	0.27	0.63	49.4
8	T1	1020	5.0	1020	5.0	0.607	23.0	LOS B	24.6	179.9	0.71	0.64	22.1
9	R2	43	5.0	43	5.0	0.520	81.3	LOS A	3.1	22.6	1.00	0.74	20.6
Approach		1463	5.0	1463	5.0	0.607	20.7	LOS B	24.6	179.9	0.60	0.64	31.0
West: Sir Gustav Nossal Boulevard (west)													
10	L2	145	5.0	145	5.0	0.304	15.7	LOS A	4.1	30.1	0.49	0.70	40.0
11	T1	221	5.0	221	5.0	0.933	89.5	LOS D	9.9	72.0	1.00	1.08	24.4
12	R2	96	5.0	96	5.0	0.933	98.1	LOS D	8.4	61.2	1.00	1.08	14.6
Approach		462	5.0	462	5.0	0.933	68.1	LOS D	9.9	72.0	0.84	0.96	24.1
All Vehicles		4218	5.0	4218	5.0	0.933	33.0	LOS D	24.6	179.9	0.70	0.70	26.1

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

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P1	South Full Crossing	50	64.3	LOS F	0.2	0.2	0.96	0.96
P2	East Full Crossing	50	64.3	LOS F	0.2	0.2	0.96	0.96
P4	West Full Crossing	50	64.3	LOS F	0.2	0.2	0.96	0.96
All Pedestrians		150	64.3	LOS F			0.96	0.96

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.

PHASING SUMMARY

Site: Clyde / Kangan Interim PM

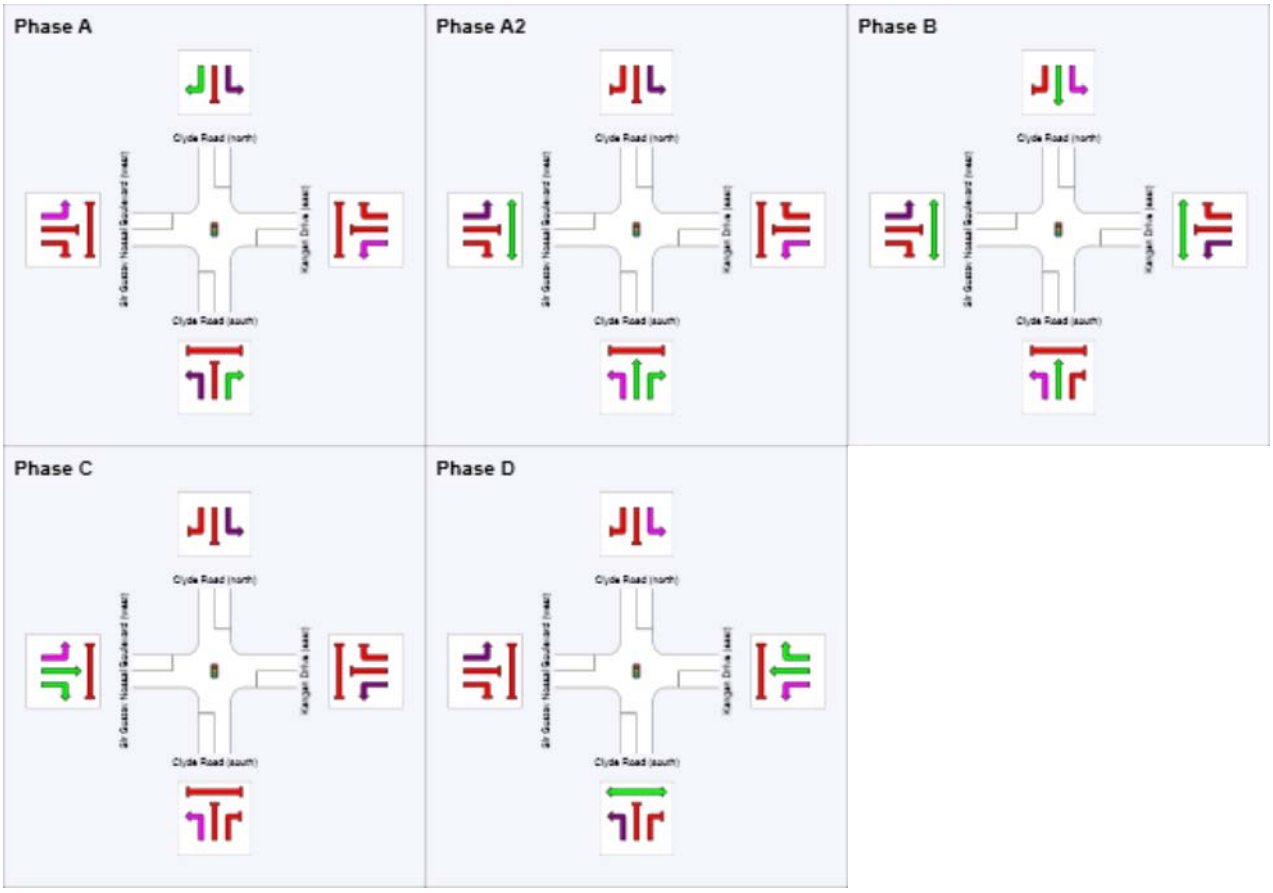
Network: Fu PM

Clyde / Kangan Trigger Assessment
Signals - Fixed Time Coordinated Cycle Time = 140 seconds (Network Cycle Time)

Phase times determined by the program
Sequence: Split Phasing
Movement Class: All Movement Classes
Input Sequence: A, A2, B, C, D
Output Sequence: A, A2, B, C, D

Phase Timing Results

Phase	A	A2	B	C	D
Reference Phase	No	No	Yes	No	No
Phase Change Time (sec)	135	7	15	95	110
Green Time (sec)	6	2	74	9	19
Yellow Time (sec)	4	4	4	4	4
All-Red Time (sec)	2	2	2	2	2
Phase Time (sec)	12	8	80	15	25
Phase Split	9 %	6 %	57 %	11 %	18 %



Normal Movement
Slip/Bypass-Lane Movement
Stopped Movement
Other Movement Class Running
Mixed Running & Stopped Movement Classes
Undetected Movement
Permitted/Opposed
Opposed Slip/Bypass-Lane
Turn On Red
Other Movement Class Stopped
Phase Transition Applied

MOVEMENT SUMMARY

Site: Clyde / Fu E-W Interim PM

Network: Fu PM

Clyde / Fu E-W Trigger Assessment
Signals - Fixed Time Coordinated Cycle Time = 140 seconds (Network Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Clyde Road (south)													
1	L2	29	0.0	29	0.0	0.016	6.0	LOS A	0.1	0.9	0.11	0.57	51.5
2	T1	1091	5.0	1091	5.0	0.435	14.4	LOS A	19.0	138.6	0.56	0.50	26.6
3	R2	70	0.0	70	0.0	0.817	85.8	LOS C	5.3	36.8	1.00	0.89	19.4
Approach		1190	4.6	1190	4.6	0.817	18.4	LOS C	19.0	138.6	0.57	0.53	25.8
East: Fu E-W (east)													
4	L2	165	0.0	165	0.0	0.256	14.4	LOS A	4.9	34.2	0.54	0.72	44.0
6	R2	212	0.0	212	0.0	0.258	55.5	LOS A	6.1	42.7	0.88	0.77	21.6
Approach		377	0.0	377	0.0	0.258	37.5	LOS A	6.1	42.7	0.73	0.75	29.2
North: Clyde Road (north)													
7	L2	91	0.0	91	0.0	0.050	5.7	LOS A	0.1	0.6	0.02	0.55	51.9
8	T1	1451	5.0	1451	5.0	0.601	13.9	LOS B	28.0	204.6	0.54	0.50	36.8
9	R2	43	0.0	43	0.0	0.502	82.7	LOS A	3.1	21.7	1.00	0.73	19.8
Approach		1585	4.6	1585	4.6	0.601	15.3	LOS B	28.0	204.6	0.53	0.51	36.3
West: Fu E-W (west)													
10	L2	139	0.0	139	0.0	0.065	8.8	LOS A	1.7	11.9	0.30	0.63	46.9
12	R2	93	0.0	93	0.0	0.814	83.6	LOS C	6.9	48.2	1.00	0.90	19.8
Approach		232	0.0	232	0.0	0.814	38.8	LOS C	6.9	48.2	0.58	0.74	28.5
All Vehicles		3384	3.8	3384	3.8	0.817	20.5	LOS C	28.0	204.6	0.57	0.56	31.3

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

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P1	South Full Crossing	50	64.3	LOS F	0.2	0.2	0.96	0.96
P2	East Full Crossing	50	64.3	LOS F	0.2	0.2	0.96	0.96
P4	West Full Crossing	50	64.3	LOS F	0.2	0.2	0.96	0.96
All Pedestrians		150	64.3	LOS F			0.96	0.96

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.

PHASING SUMMARY

Site: Clyde / Fu E-W Interim PM

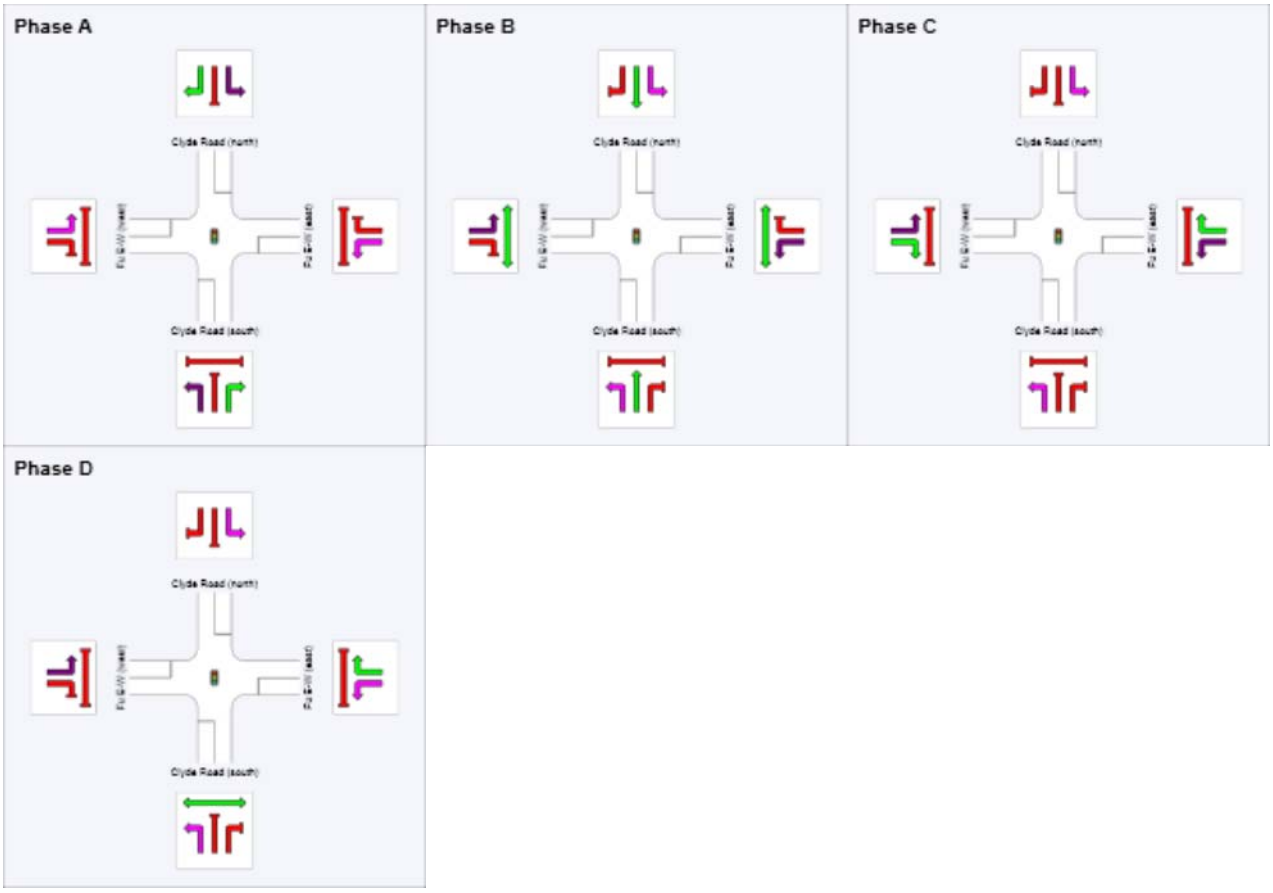
Network: Fu PM

Clyde / Fu E-W Trigger Assessment
Signals - Fixed Time Coordinated Cycle Time = 140 seconds (Network Cycle Time)

Phase times determined by the program
Sequence: Leading Right Turn
Movement Class: All Movement Classes
Input Sequence: A, B, C, D
Output Sequence: A, B, C, D

Phase Timing Results

Phase	A	B	C	D
Reference Phase	No	Yes	No	No
Phase Change Time (sec)	18	30	123	137
Green Time (sec)	6	87	8	15
Yellow Time (sec)	4	4	4	4
All-Red Time (sec)	2	2	2	2
Phase Time (sec)	12	93	14	21
Phase Split	9 %	66 %	10 %	15 %



Normal Movement
Slip/Bypass-Lane Movement
Stopped Movement
Other Movement Class Running
Mixed Running & Stopped Movement Classes
Undetected Movement
Permitted/Opposed
Opposed Slip/Bypass-Lane
Turn On Red
Other Movement Class Stopped
Phase Transition Applied

MOVEMENT SUMMARY

Site: Clyde / Enterprise Interim AM

Network: Fu AM

Clyde / Enterprise - Trigger Assessment
Signals - Fixed Time Coordinated Cycle Time = 140 seconds (Network Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Arrival Flows Total veh/h	Arrival Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Clyde Road (south)													
1	L2	27	5.0	27	5.0	0.017	7.1	LOS A	0.3	2.3	0.24	0.59	50.4
2	T1	1303	5.0	1303	5.0	0.617	29.9	LOS B	37.9	276.4	0.89	0.81	28.4
3	R2	109	5.0	109	5.0	0.567	72.3	LOS A	7.4	54.2	1.00	0.79	22.0
Approach		1440	5.0	1440	5.0	0.617	32.7	LOS B	37.9	276.4	0.89	0.80	27.8
East: Station Access (east)													
4	L2	68	5.0	68	5.0	0.104	13.7	LOS A	1.6	11.6	0.40	0.66	41.8
5	T1	2	5.0	2	5.0	0.294	74.3	LOS A	1.7	12.4	1.00	0.71	26.1
6	R2	22	5.0	22	5.0	0.294	80.0	LOS A	1.7	12.4	1.00	0.71	21.4
Approach		93	5.0	93	5.0	0.294	30.9	LOS A	1.7	12.4	0.56	0.67	31.8
North: Clyde Road (north)													
7	L2	12	5.0	12	5.0	0.007	6.4	LOS A	0.1	0.5	0.14	0.57	51.4
8	T1	1415	5.0	1415	5.0	0.666	22.2	LOS B	35.0	255.6	0.74	0.67	24.0
9	R2	127	5.0	127	5.0	0.660	73.6	LOS B	8.7	63.7	1.00	0.81	22.4
Approach		1554	5.0	1554	5.0	0.666	26.3	LOS B	35.0	255.6	0.75	0.68	23.9
West: Enterprise Avenue													
10	L2	80	5.0	80	5.0	0.106	15.3	LOS A	2.2	15.8	0.45	0.67	43.8
11	T1	2	5.0	2	5.0	0.101	47.9	LOS A	1.9	13.6	0.87	0.71	32.1
12	R2	65	5.0	65	5.0	0.101	53.5	LOS A	1.9	13.6	0.87	0.71	22.1
Approach		147	5.0	147	5.0	0.106	32.7	LOS A	2.2	15.8	0.64	0.69	32.4
All Vehicles		3234	5.0	3234	5.0	0.666	29.6	LOS B	37.9	276.4	0.80	0.74	26.7

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

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P2	East Full Crossing	53	64.3	LOS F	0.2	0.2	0.96	0.96
P3	North Full Crossing	53	64.3	LOS F	0.2	0.2	0.96	0.96
P4	West Full Crossing	53	64.3	LOS F	0.2	0.2	0.96	0.96
All Pedestrians		158	64.3	LOS F			0.96	0.96

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.

PHASING SUMMARY

Site: Clyde / Enterprise Interim AM

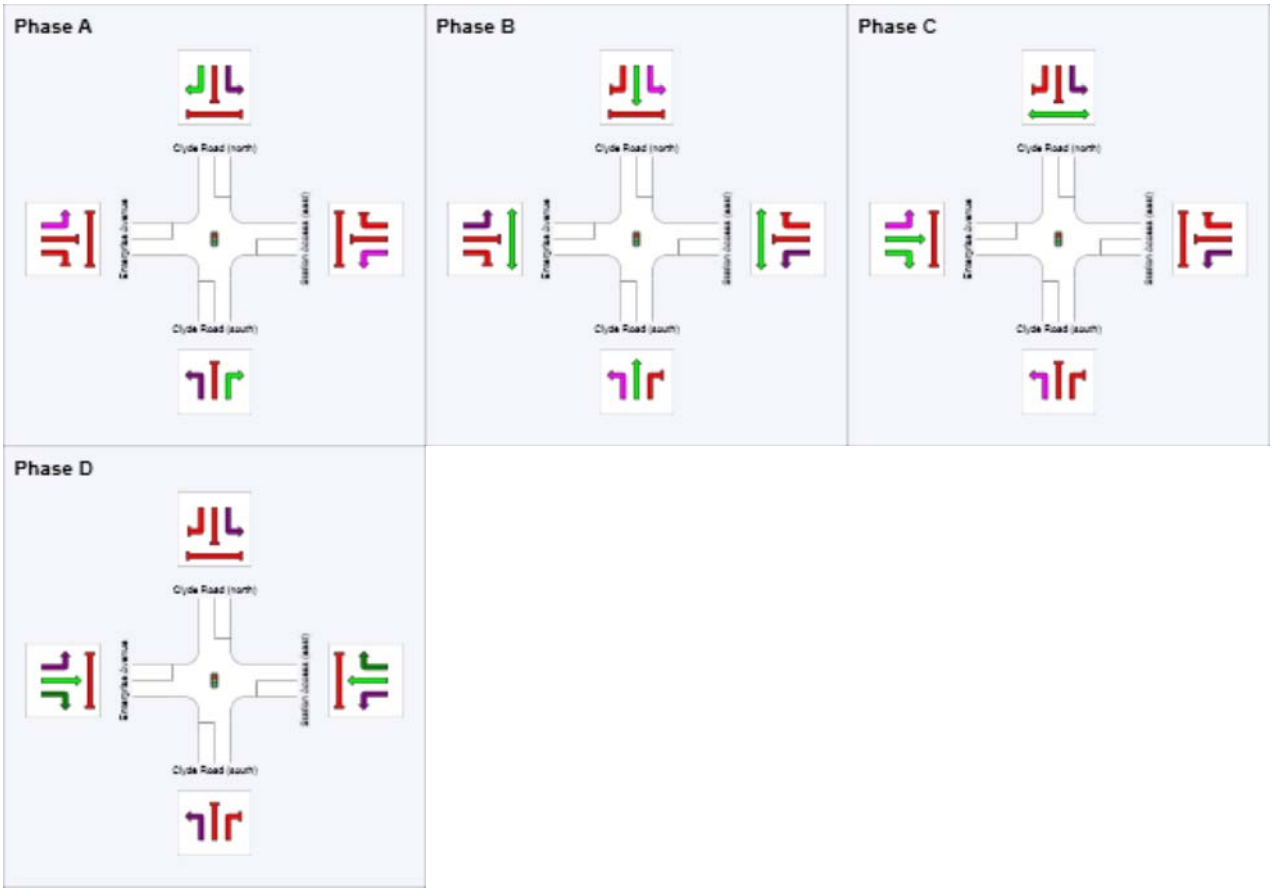
Network: Fu AM

Clyde / Enterprise - Trigger Assessment
Signals - Fixed Time Coordinated Cycle Time = 140 seconds (Network Cycle Time)

Phase times determined by the program
Sequence: Split Phasing (phase reduction applied)
Movement Class: All Movement Classes
Input Sequence: A, A2, B, C, D
Output Sequence: A, B, C, D

Phase Timing Results

Phase	A	B	C	D
Reference Phase	No	Yes	No	No
Phase Change Time (sec)	46	66	10	34
Green Time (sec)	14	78	18	6
Yellow Time (sec)	4	4	4	4
All-Red Time (sec)	2	2	2	2
Phase Time (sec)	20	84	24	12
Phase Split	14 %	60 %	17 %	9 %



Normal Movement
Slip/Bypass-Lane Movement
Stopped Movement
Other Movement Class Running
Mixed Running & Stopped Movement Classes
Undetected Movement
Permitted/Opposed
Opposed Slip/Bypass-Lane
Turn On Red
Other Movement Class Stopped
Phase Transition Applied

MOVEMENT SUMMARY

Site: Clyde / Kangan Interim AM

Network: Fu AM

Clyde / Kangan - Trigger Assessment
Signals - Fixed Time Coordinated Cycle Time = 140 seconds (Network Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Clyde Road (south)													
1	L2	87	5.0	87	5.0	0.061	8.5	LOS A	1.0	7.1	0.20	0.60	48.8
2	T1	1291	5.0	1291	5.0	0.828	27.6	LOS C	38.0	277.4	0.80	0.76	18.1
3	R2	452	5.0	452	5.0	0.455	52.6	LOS A	11.9	86.9	0.82	0.79	26.2
Approach		1829	5.0	1829	5.0	0.828	32.8	LOS C	38.0	277.4	0.78	0.76	23.0
East: Kangan Drive (east)													
4	L2	586	5.0	586	5.0	0.504	13.2	LOS A	18.2	132.9	0.55	0.74	42.2
5	T1	199	5.0	199	5.0	0.808	68.3	LOS C	10.7	77.9	0.99	0.91	28.2
6	R2	258	5.0	258	5.0	0.808	76.8	LOS C	11.6	84.6	1.00	0.92	17.5
Approach		1043	5.0	1043	5.0	0.808	39.4	LOS C	18.2	132.9	0.74	0.82	29.1
North: Clyde Road (north)													
7	L2	393	5.0	393	5.0	0.278	6.5	LOS A	1.7	12.6	0.09	0.58	51.1
8	T1	643	5.0	643	5.0	0.457	44.6	LOS A	22.1	161.5	0.95	0.82	13.9
9	R2	131	5.0	131	5.0	0.789	66.6	LOS C	8.8	64.6	0.99	0.82	23.4
Approach		1166	5.0	1166	5.0	0.789	34.2	LOS C	22.1	161.5	0.67	0.74	26.2
West: Sir Gustav Nossal Boulevard (west)													
10	L2	31	5.0	31	5.0	0.087	24.6	LOS A	1.1	7.8	0.58	0.68	33.7
11	T1	46	5.0	46	5.0	0.266	73.9	LOS A	1.6	11.8	1.00	0.70	27.3
12	R2	20	5.0	20	5.0	0.242	79.6	LOS A	1.4	10.2	1.00	0.70	17.0
Approach		97	5.0	97	5.0	0.266	59.5	LOS A	1.6	11.8	0.87	0.70	26.1
All Vehicles		4136	5.0	4136	5.0	0.828	35.5	LOS C	38.0	277.4	0.74	0.77	25.9

Level of Service (LOS) Method: Degree of Saturation (SIDRA METHOD).
Vehicle movement LOS values are based on degree of saturation per movement
Intersection and Approach LOS values are based on worst degree of saturation for any vehicle movement.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
The results of iterative calculations indicate a somewhat unstable solution. See the Diagnostics section in the Detailed Output report.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P1	South Full Crossing	53	64.3	LOS F	0.2	0.2	0.96	0.96
P2	East Full Crossing	53	64.3	LOS F	0.2	0.2	0.96	0.96
P4	West Full Crossing	53	64.3	LOS F	0.2	0.2	0.96	0.96
All Pedestrians		158	64.3	LOS F			0.96	0.96

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.

PHASING SUMMARY

Site: Clyde / Kangan Interim AM

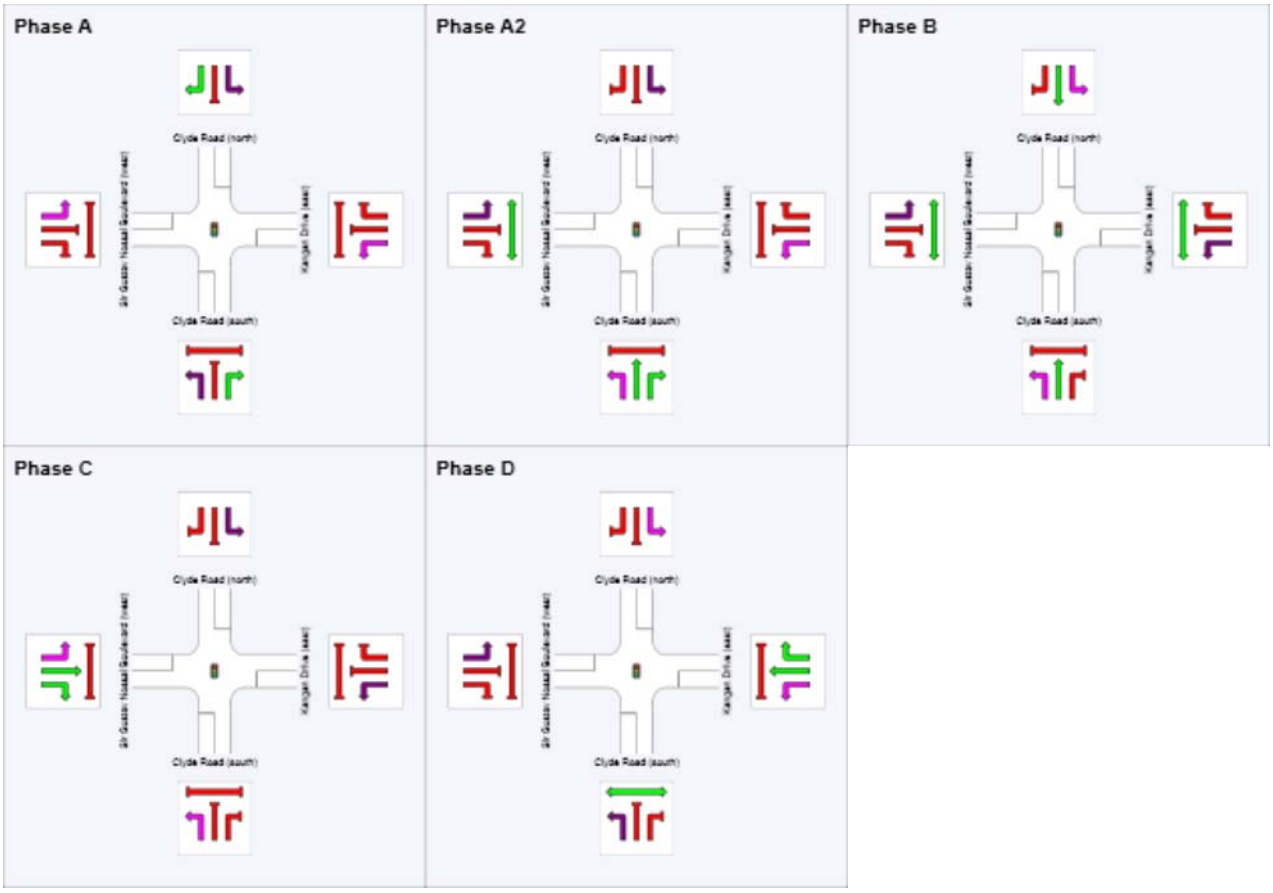
Network: Fu AM

Clyde / Kangan - Trigger Assessment
Signals - Fixed Time Coordinated Cycle Time = 140 seconds (Network Cycle Time)

Phase times determined by the program
Sequence: Split Phasing
Movement Class: All Movement Classes
Input Sequence: A, A2, B, C, D
Output Sequence: A, A2, B, C, D

Phase Timing Results

Phase	A	A2	B	C	D
Reference Phase	No	No	Yes	No	No
Phase Change Time (sec)	98	116	0	61	73
Green Time (sec)	12	18	55	6	19
Yellow Time (sec)	4	4	4	4	4
All-Red Time (sec)	2	2	2	2	2
Phase Time (sec)	18	24	61	12	25
Phase Split	13 %	17 %	44 %	9 %	18 %



The results of iterative calculations indicate a somewhat unstable solution. See the Diagnostics section in the Detailed Output report.

MOVEMENT SUMMARY

Site: Clyde / Fu E-W Interim AM

Network: Fu AM

Clyde / Fu E-W - Trigger Assessment
Signals - Fixed Time Coordinated Cycle Time = 140 seconds (Network Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	Demand Flows HV %	Arrival Flows Total veh/h	Arrival Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Clyde Road (south)													
1	L2	82	0.0	82	0.0	0.047	6.5	LOS A	0.6	4.1	0.15	0.58	51.0
2	T1	1875	5.0	1875	5.0	0.922	17.7	LOS D	38.5	280.7	0.46	0.51	23.6
3	R2	111	0.0	111	0.0	0.774	80.1	LOS C	8.0	55.9	1.00	0.86	20.3
Approach		2067	4.5	2067	4.5	0.922	20.6	LOS D	38.5	280.7	0.48	0.53	24.5
East: Fu E-W (east)													
4	L2	71	0.0	71	0.0	0.094	7.9	LOS A	0.9	6.0	0.24	0.62	49.6
6	R2	85	0.0	85	0.0	0.323	72.3	LOS A	3.2	22.7	0.97	0.75	18.1
Approach		156	0.0	156	0.0	0.323	43.2	LOS A	3.2	22.7	0.64	0.69	27.2
North: Clyde Road (north)													
7	L2	200	0.0	200	0.0	0.115	6.1	LOS A	0.7	5.2	0.08	0.57	51.4
8	T1	1071	5.0	1071	5.0	0.401	9.0	LOS A	18.0	131.3	0.47	0.42	42.6
9	R2	124	0.0	124	0.0	0.869	85.6	LOS C	9.2	64.2	1.00	0.87	19.3
Approach		1395	3.8	1395	3.8	0.869	15.4	LOS C	18.0	131.3	0.46	0.48	37.7
West: Fu E-W (west)													
10	L2	28	5.0	28	5.0	0.024	13.7	LOS A	0.6	4.5	0.41	0.63	41.8
12	R2	19	0.0	19	0.0	0.221	79.2	LOS A	1.3	9.3	1.00	0.70	20.5
Approach		47	3.0	47	3.0	0.221	39.9	LOS A	1.3	9.3	0.64	0.66	28.1
All Vehicles		3665	4.1	3665	4.1	0.922	19.8	LOS D	38.5	280.7	0.48	0.52	30.1

Level of Service (LOS) Method: Degree of Saturation (SIDRA METHOD).
Vehicle movement LOS values are based on degree of saturation per movement
Intersection and Approach LOS values are based on worst degree of saturation for any vehicle movement.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
The results of iterative calculations indicate a somewhat unstable solution. See the Diagnostics section in the Detailed Output report.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P1	South Full Crossing	53	64.3	LOS F	0.2	0.2	0.96	0.96
P2	East Full Crossing	53	64.3	LOS F	0.2	0.2	0.96	0.96
P4	West Full Crossing	53	64.3	LOS F	0.2	0.2	0.96	0.96
All Pedestrians		158	64.3	LOS F			0.96	0.96

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.

PHASING SUMMARY

Site: Clyde / Fu E-W Interim AM

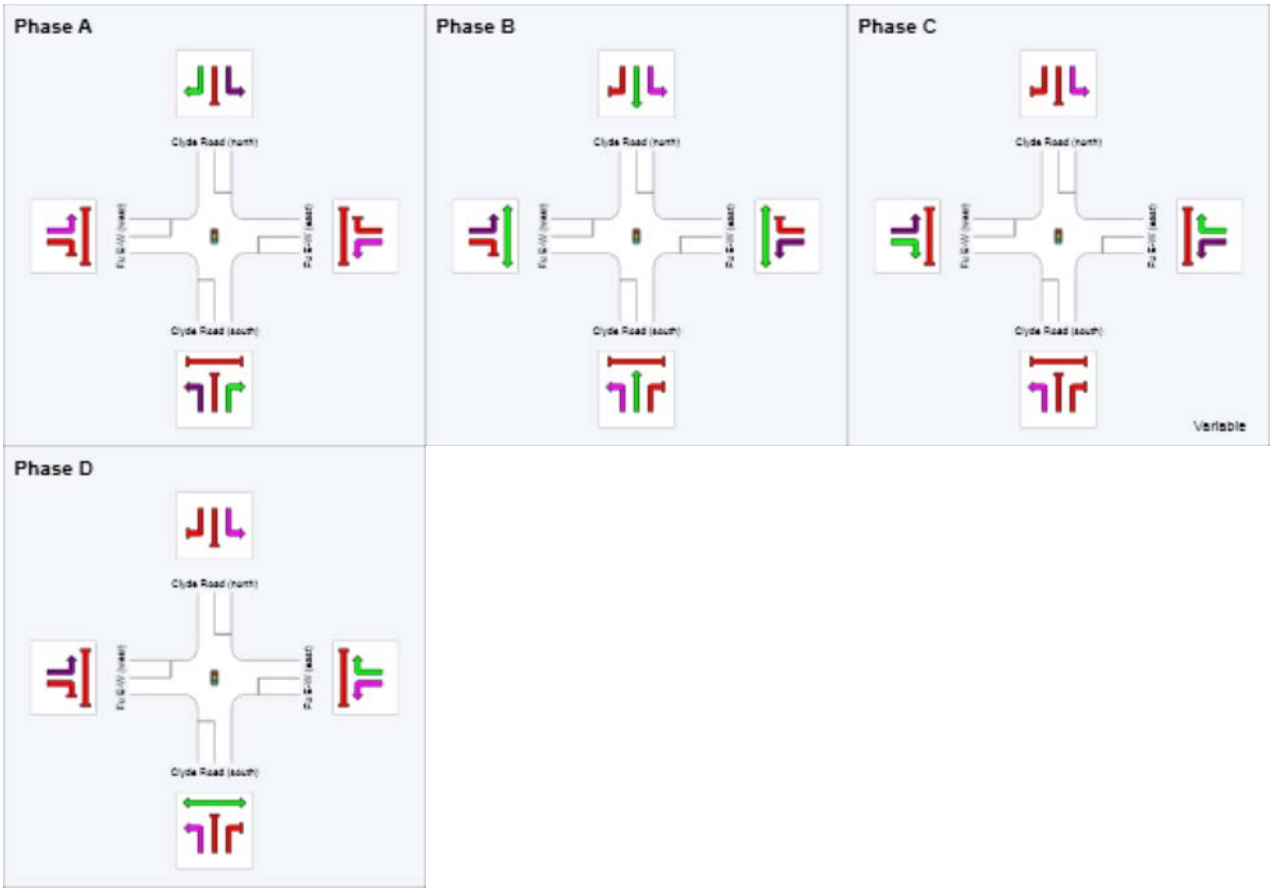
Network: Fu AM

Clyde / Fu E-W - Trigger Assessment
Signals - Fixed Time Coordinated Cycle Time = 140 seconds (Network Cycle Time)

Phase times determined by the program
Sequence: Leading Right Turn
Movement Class: All Movement Classes
Input Sequence: A, B, C, D
Output Sequence: A, B, C, D

Phase Timing Results

Phase	A	B	C	D
Reference Phase	No	Yes	No	No
Phase Change Time (sec)	54	70	35	47
Green Time (sec)	10	99	6	1
Yellow Time (sec)	4	4	4	4
All-Red Time (sec)	2	2	2	2
Phase Time (sec)	16	105	12	7
Phase Split	11 %	75 %	9 %	5 %



Normal Movement		Permitted/Opposed	
Slip/Bypass-Lane Movement		Opposed Slip/Bypass-Lane	
Stopped Movement		Turn On Red	
Other Movement Class Running		Other Movement Class Stopped	
Mixed Running & Stopped Movement Classes			
Undetected Movement		Phase Transition Applied	

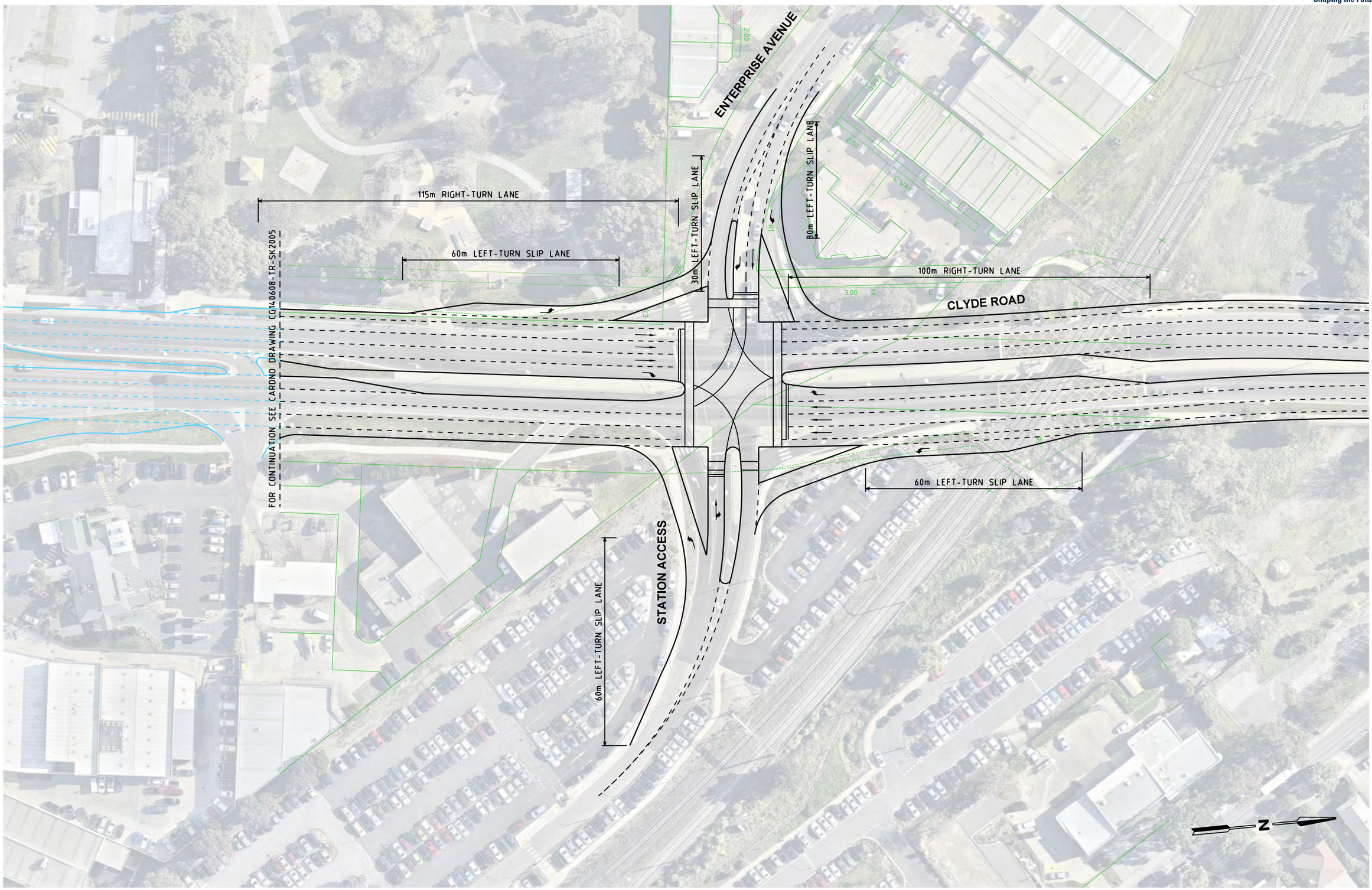
The results of iterative calculations indicate a somewhat unstable solution. See the Diagnostics section in the Detailed Output report.

Berwick Health and Education Precinct

APPENDIX F

ULTIMATE INTERSECTION LAYOUT – CONCEPT PLANS

Cardno
Shaping the Future



CG140608 SK2004 - CLYDE ROAD FUTURE PLANNING LAYOUTS - CLYDE ROAD, BERWICK
CONCEPT LAYOUT PLAN
SCALE - 1:1000 @ A3 DATE - 12.08.2015

Cardno
Shaping the Future

155m OUTER RIGHT-TURN LANE

120m INNER RIGHT-TURN LANE

70m LEFT-TURN SLIP LANE

SIR GUSTAV NOSSAL BOULEVARD

30m TURN LANES

130m RIGHT-TURN LANE

CLYDE ROAD

FOR CONTINUATION SEE CARDNO DRAWING CG140608-TR-SK2006

FOR CONTINUATION SEE CARDNO DRAWING CG140608-TR-SK2004

40m LEFT-TURN SLIP LANE

105m RIGHT-TURN LANE

KANGAN DRIVE

N

CG140608 SK2005 - CLYDE ROAD FUTURE PLANNING LAYOUTS - CLYDE ROAD, BERWICK
CONCEPT LAYOUT PLAN
SCALE - 1:1000 @ A3 DATE - 12.08.2015

DATE PLOTTED 8/13/2015 12:06:12 PM

CAD FILES\FILES

Cardno
Shaping the Future

MONASH FREEWAY OFF-RAMP

170m RIGHT-TURN LANE

120m LEFT-TURN SLIP LANE

CLYDE ROAD

PROPOSED ROAD

50m LEFT-TURN SLIP LANE

MONASH FREEWAY ON-RAMP

2.00

2.00

16.00

FOR CONTINUATION SEE CARDNO DRAWING CG140608-TR-SK2005

115m RIGHT-TURN LANE

60m LEFT-TURN SLIP LANE

PROPOSED ROAD

N

CG140608 SK2006 - CLYDE ROAD FUTURE PLANNING LAYOUTS - CLYDE ROAD, BERWICK
CONCEPT LAYOUT PLAN
SCALE - 1:1000 @ A3 DATE - 12.08.2015