Lendlease

Commercial Building C1

Transport Assessment

Issue | 18 October 2017

Job number 222061-30

Arup
Arup Pty Ltd ABN 18 000 966 165

Arup
Level 10 201 Kent Street
PO Box 76 Millers Point
Sydney 2000
Australia
www.arup.com

ARUP

Contents

1 Introduction

The following report has been prepared by Arup for Lend Lease Millers Point Pty Ltd to support a State Significant Development Application (SSD 8529) seeking approval for construction of a commercial and retail building (known as Commercial Building C1) and associated works at Barangaroo South.

Commercial Building C1 will provide 11,748m^2 of floor space, with approximately 726m^2 of retail space and 11,022m^2 commercial space. The public domain to be provided around Building C1 will be constructed as part of the approved SSD Application (SSD_6303). Building C1 will incorporate signage zones and include a signage strategy for ground level signage in association with retail tenancies.

The Building C1 site is located on the eastern portion of the land identified in the approved Concept Plan as Block 3 (Refer to Figure 1). It is bound by Watermans Quay to the north, Scotch Row to the west, Hickson Road to the east and Shipwright Walk to the south.

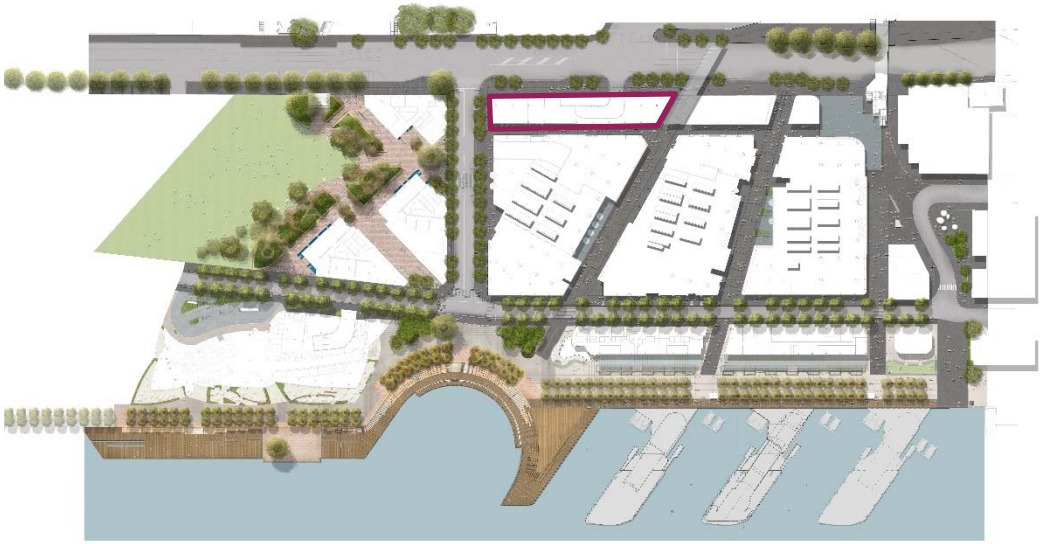


Figure 1 Site location

2 Study Background

2.1 Scope of the Report

This report assesses the forecast construction and operational traffic generated during all stages of the development of the site and its likely impact to the road network, as well as pedestrian safety and amenity issues during the construction and operation of the subject development. It assesses the cumulative traffic impacts associated with the construction of Building C1 and the following surrounding developments:

Works directly related to Barangaroo South

- Block 4 remediation works
- Block 5 remediation works
- Hickson Road remediation works
- Crown Sydney
- Stage 1B basement
- Stage 1B residential towers (buildings R4A, R4B, R5)
- Stage 1B public domain works
- Hickson Road upgrade

Works external to Barangaroo South

- Sydney Metro

With respect to construction work external to Barangaroo South, assumptions have been made regarding expected vehicular activity based on documents submitted as part of the planning applications for each of these works.

As the anticipated construction period (and level of vehicle activity) for the Barangaroo Central precinct is currently unclear, these works have been excluded from the analysis.

2.2 Study Objectives

Specific issues addressed in the report respond to the Secretary's Environmental Assessment Requirements (SEARs) in relation to traffic and transport for the planning application, those being:

In relation to operational traffic and transport:

- *accurate details of the current and proposed daily and peak hour vehicle, public transport, pedestrian and bicycle movements and existing traffic and transport facilities provided on the road network located adjacent to the proposed development*
- *assessment of road safety at key intersections and locations;*
- *details of on-street parking, loading zones, bicycle and pedestrian facilities including pedestrian crossings, bicycle parking, taxi facilities including taxi*

ranks proposed in the public domain and compliance with relevant Standards;

- *location of pedestrian and bicycle parking facilities in secure, convenient, accessible areas close to main entries incorporating lighting and passive surveillance;*
- *details of pedestrian and cycling connections/circulation and required upgrades to meet the likely future demand within Barangaroo and connections to the external network; and*
- *address provision of bicycle parking and changing facilities in accordance with the relevant guidelines and documents.*
- *Demonstrate the proposed development would not adversely impact on the Sydney Metro rail corridor and associated station at Barangaroo station.*
- *The EIS shall include an updated Transport Management and Accessibility Plan.*

In relation to construction traffic:

- *details of anticipated peak hour and daily truck movements to and from the site;*
- *assessment of cumulative traffic impacts associated with all other construction activities within the vicinity of the site, including construction of all other developments at the Barangaroo site, the Sydney Metro and the Sydney Light Rail project;*
- *assessment of road safety at key intersections and locations subject to heavy vehicle movements and high pedestrian activity;*
- *details of access arrangements for workers to/from the site, emergency vehicles and service vehicle movements;*
- *details of temporary pedestrian and cyclist access arrangements during construction, including measures to mitigate any associated pedestrian, cycleway, public transport or traffic impacts;*
- *details of proposed construction vehicle access arrangements at all stages of construction; and*
- *preparation of a Construction Pedestrian and Traffic Management Plan which includes vehicle routes, number of trucks, hours of operation, access arrangements and traffic control measures for all demolition/construction activities.*

3 Existing Traffic Conditions

3.1 Road Network

Sussex Street / Hickson Road forms a 4 lane wide road that runs along the western side of Sydney CBD, and bounds the east of the Barangaroo Stage 1A site. The Sussex Street section continues south from Napoleon Street to Hay Street. It is two-way north of King Street and one way southbound, south of King Street. Hickson Road forms the northern extension of Sussex Street and continues north from Napoleon Street to George Street at Dawes Point.

Napoleon Street provides a connection between Hickson Road and Kent Street / Margaret Street. It is a relatively wide road and has moderate downward slope from Kent Street to Hickson Road. Traffic signals were installed at the Hickson Road / Napoleon Street intersection in 2015, which provides for controlled vehicle movements out of the Barangaroo Stage 1A basement.

3.2 Pedestrian Conditions

There are a number of existing dedicated pedestrian facilities adjacent to the Barangaroo South site, including:

- Signal controlled pedestrian crossings across Sussex Street near Shelley Street
- Signal controlled pedestrian crossings across all approaches of Hickson Road / Napoleon Street intersection
- Adequate footpaths on both sides of Hickson Road
- Two grade separated crossings of Sussex Street (Wynyard Walk Bridge and Napoleon Bridge)
- Pedestrian access along the waterfront from King Street Wharf and Darling Harbour

3.3 Traffic Volumes

Traffic counts were undertaken in the Barangaroo precinct on Thursday 26 November 2015 and are presented in Table 1. These counts were compared with those undertaken by Arup on 25 July 2013 over the same time period.

Revised traffic counts were commissioned given the number of changes in the transport environment since the previous traffic counts were undertaken in July 2013, in particular the partial closure of George Street to accommodate the Sydney Light Rail construction. At the time of the traffic surveys, George Street was closed to general traffic between King Street and Market Street.

Other changes to the road environment since the previous July 2013 counts are as follows:

- Closure of Shelley Street north of Lime Street
- Opening of Barangaroo South Stage 1A public domain, including extension of Lime Street to connect with Watermans Quay and Hickson Road

- Signalisation of Hickson Road / Napoleon Street
- New bus routes on Hickson Road
- Occupation of Barangaroo South Stage 1A public domain and occupancy of commercial and residential buildings
- Opening of Barangaroo Reserve
- Changes to the CBD bus network associated with the construction of the light rail

Five signalised intersections in the vicinity of the Barangaroo worksite were surveyed. It should be noted that the survey was conducted on a Thursday outside of school holiday periods, and are therefore representative of traffic volumes in the precinct.

The locations of the intersections surveyed are displayed in Figure 2 below.

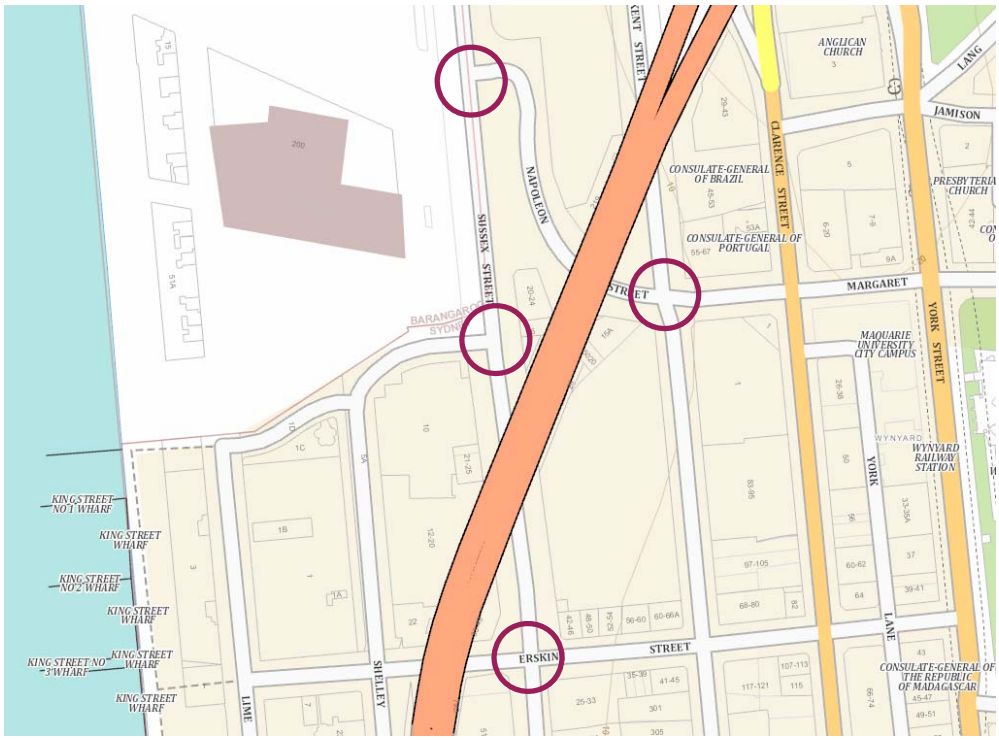


Figure 2 Traffic count locations

Table 1: Hickson Road / Sussex Traffic Volumes

Traffic Count Date	Road	Location	AM Peak Hour			PM Peak Hour		
			NB	SB	Total	NB	SB	Total
Nov 2015	Hickson Road	North of Napoleon Street	564	237	801	418	573	991
Jul 2013			601	254	855	380	606	986
% Change from 2013 to 2015			***-6%***	***-7%***	***-6%***	***10%***	***-5%***	***1%***
Nov 2015	Sussex Street	North of Shelley Street	698	474	1,172	512	569	1,081
Jul 2013			926	556	1,482	569	714	1,283
% Change from 2013 to 2015			***-25%***	***-15%***	***-21%***	***-10%***	***-20%***	***-16%***
Nov 2015	Sussex Street	North of Erskine Street	684	413	1,097	512	622	1,134
Jul 2013			650	518	1168	409	845	1,254
% Change from 2013 to 2015			***5%***	***-20%***	***-6%***	***25%***	***-26%***	***-10%***
Nov 2015	Sussex Street	South of Erskine Street	401	950	1,351	352	1,275	1,627
Jul 2013			578	907	1,485	316	1,364	1,680
% Change from 2013 to 2015			***-31%***	***5%***	***-9%***	***11%***	***-7%***	***-3%***

The results of the survey undertaken in November 2015 indicate that two-way traffic volumes in the Barangaroo precinct, specifically along Hickson Road, Napoleon Street and Sussex Street, have decreased compared to those surveyed in July 2013. This is the case for both the AM and PM commuter peak hours, and is illustrated in Figure 3 below.

When the directional traffic flows are reviewed, the northbound traffic along Sussex Street and Hickson Road has increased by between 10 and 25% in the PM peak but reduced in the AM Peak.

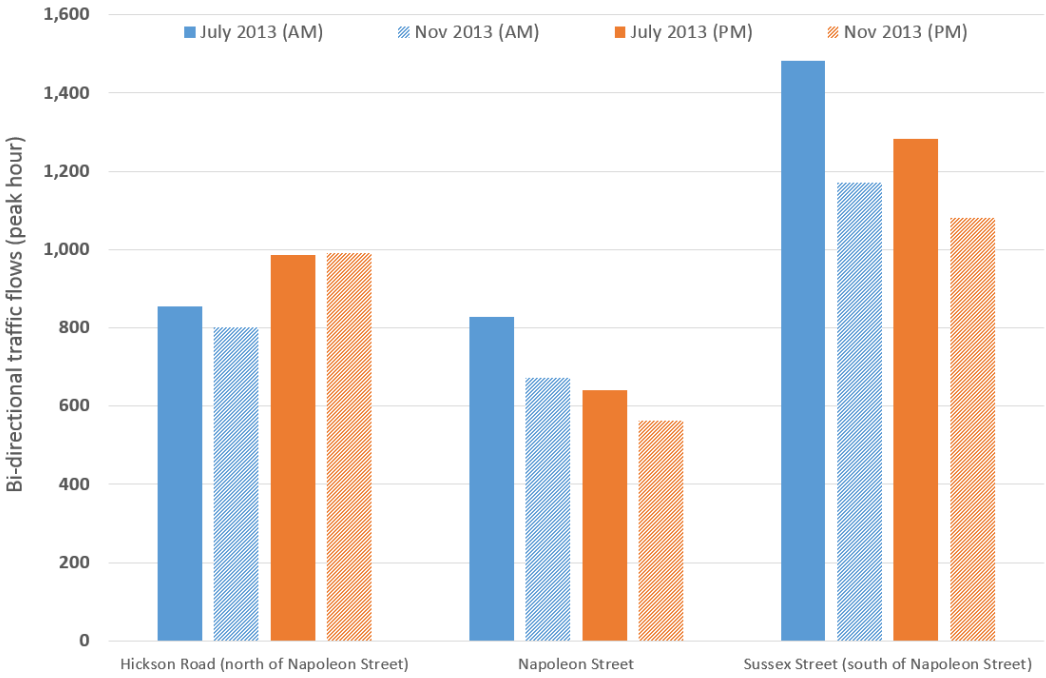


Figure 3 Changes in traffic volumes – 2013 vs 2015

The traffic surveys demonstrate that the partial closure of George Street (along with other changes in the road environment) has not resulted in any increases in traffic volumes along the Hickson Road corridor. Traffic volumes have instead declined in the key southbound direction – despite the reduced road capacity of George Street.

To ensure the traffic counts of November 2015 were reflective of current conditions, Arup undertook further traffic surveys on Wednesday 4 May 2016, coinciding with the closure of George Street between Bridge Street and Margaret Street. The results of the survey undertaken in May 2016 indicate traffic volumes in the Barangaroo precinct, specifically along Hickson Road, Napoleon Street and Sussex Street, have decreased compared to those surveyed in November 2015.

This is the case for both the AM and PM commuter peak hours, and is illustrated in Figure 3 below.

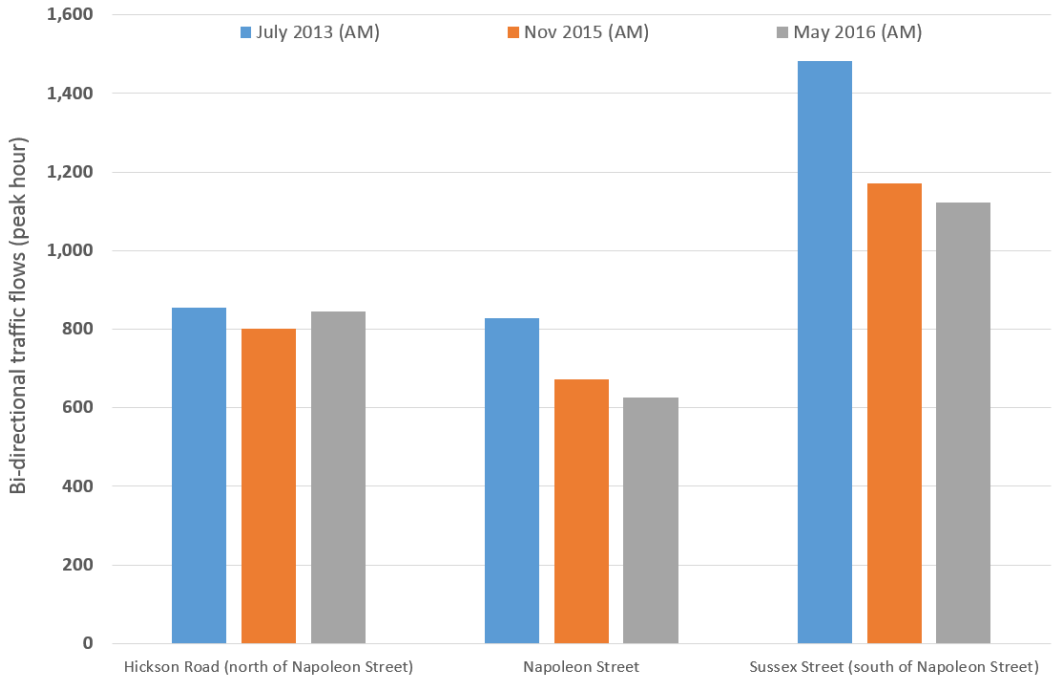


Figure 4 Changes in traffic volumes – AM Peak Hour

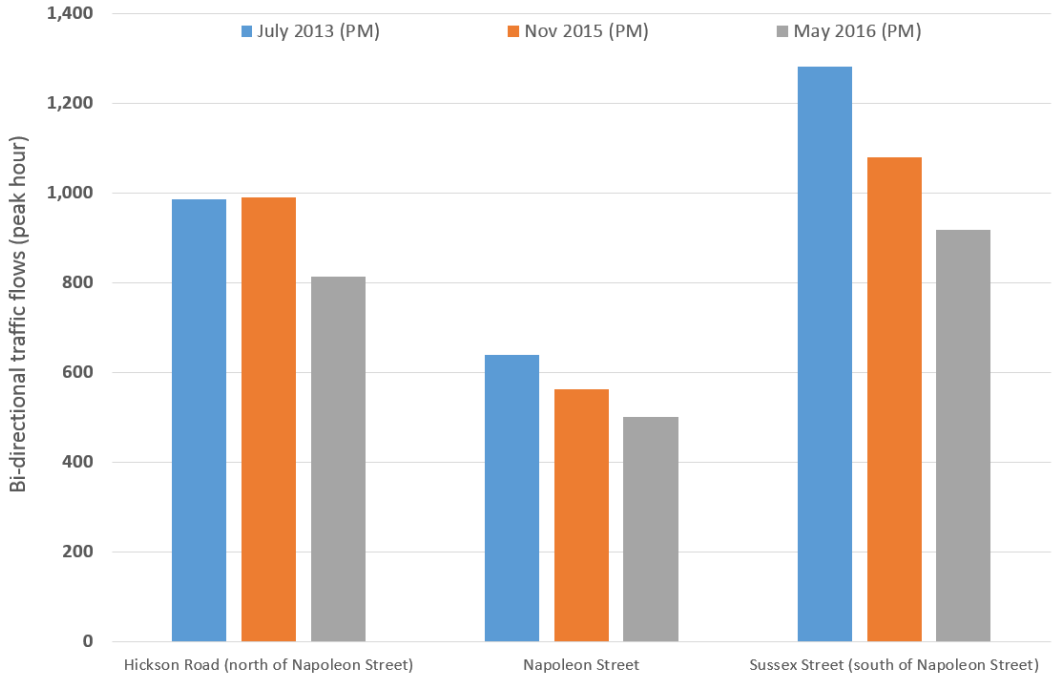


Figure 5 Changes in traffic volumes – PM Peak Hour

Significantly, since in the closure of the northern end of George Street in April 2016, traffic flows on Hickson Road have further declined compared to those recorded in November 2015. This indicates there has not been a redistribution of traffic away from George Street towards the Hickson Road corridor.

3.4 Existing Construction Activity

The typical profile of activity for vehicles generated by the Barangaroo site, over the course of a typical weekday in the three months between April and July 2017, is shown in Figure 6 below.

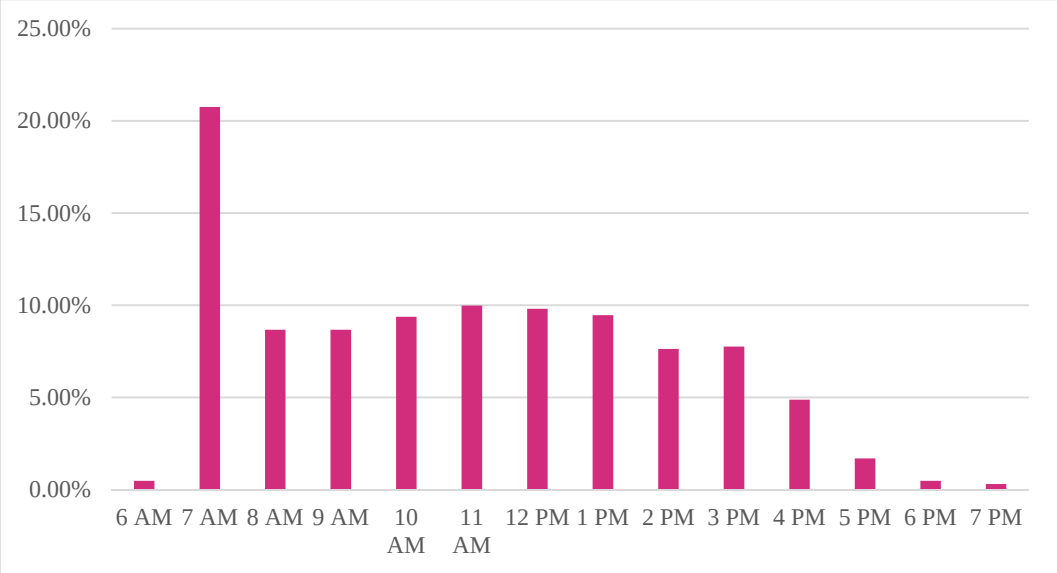


Figure 6: Existing Construction Activity for Barangaroo South

This existing profile demonstrates the majority of vehicle activity takes place outside the commuter peak hours of 8am-9am and 5pm-6pm. Most notably, construction activity dissipates significantly after 4pm, with only 2% of the day's total trucks arriving after this time.

This shows that the construction activity generated by Building C1 will have a relatively minor impact on the operation of nearby intersections during the critical PM peak period (4pm-7pm).

4 Construction Traffic Assessment

4.1 Construction program

4.1.1 Barangaroo South works

Table 2 below outlines the concurrent developments within the Barangaroo South site, noting the start and finish dates by annual quarters.

Table 2: Construction Details of Barangaroo South Works

Project	**Project Duration***		**Overlaps with C1 works?**
	Start	***Finish***	
C2 Building	Feb 2016	Jul 2017	✗
Block 4 Remediation Works	May 2016	Mar 2019	✓
Block 5 Remediation Works	Sep 2016	Mar 2019	✓
Crown Sydney	June 2016	Dec 2020	✓
Hickson Road upgrade works	May 2017	Oct 2018	✓
Hickson Road Remediation	Nov 2017	Jan 2020	✓
One Sydney Harbour basement	Jun 2017	Jan 2020	✓
One Sydney Harbour residential towers	Dec 2019	Jul 2023	✗
Stage 1B Public Domain works	June 2018	Dec 2020	✓
C1 Building	July 2018	Oct 2019	✓

** The above dates are indicative only and allow for future tenant fit out works within the individual buildings*

4.1.2 Works External to Barangaroo South

The construction staging for works external to the Barangaroo South site are outlined in Table 3 below.

Table 3: Construction Details of Works Adjacent to Barangaroo South

Project	**Project Duration**		**Overlaps with C1 Building Construction**
	Start	***Finish***	
Sydney Metro	Oct 2017*	Dec 2023*	✓

* Indicative only

4.2 Construction Traffic Principles

The overall construction traffic management principles will be to ensure:

- Construction access driveways are designed to allow trucks to enter and leave the site in a forward direction;
- Construction access driveways are managed and controlled by site personnel;
- Safety for works and the public in the vicinity of the worksite is maintained;
- Designated truck routes for all access points are developed which minimises the impacts on the local road network;
- A safe, convenient and appropriate environment is established for pedestrians and cyclists at all times; and
- Appropriate capacity for pedestrians along the Hickson Road footpath is maintained

4.3 Traffic Routes

The predominant traffic routes that construction vehicles utilise to Barangaroo are presented in the figures on the following pages, and summarised below.

From the north and north-west:

- Harbour Bridge – Western Distributor – Bathurst Street – Liverpool Street – Harbour Street – Shelley Street – Erskine Street – Sussex Street (inbound); and
- Hickson Road – Napoleon Street – Kent Street – Western Distributor – Harbour Bridge (outbound)

This southbound truck activity would occur during peak hours as there is no access for general traffic from the Harbour Bridge to York Street between 6.30am – 9.30am (Monday – Friday).

From the west and south-west:

- Anzac Bridge – Western Distributor – Sussex Street – Hickson Road (inbound); and
- Hickson Road – Sussex Street – Western Distributor – Anzac Bridge (outbound)

From the south and east:

- Eastern Distributor – Cross City Tunnel – Western Distributor – Wattle Street – Western Distributor – Sussex Street – Hickson Road (inbound); and
- Sussex Street – Harbour Street – Cross City Tunnel (outbound)

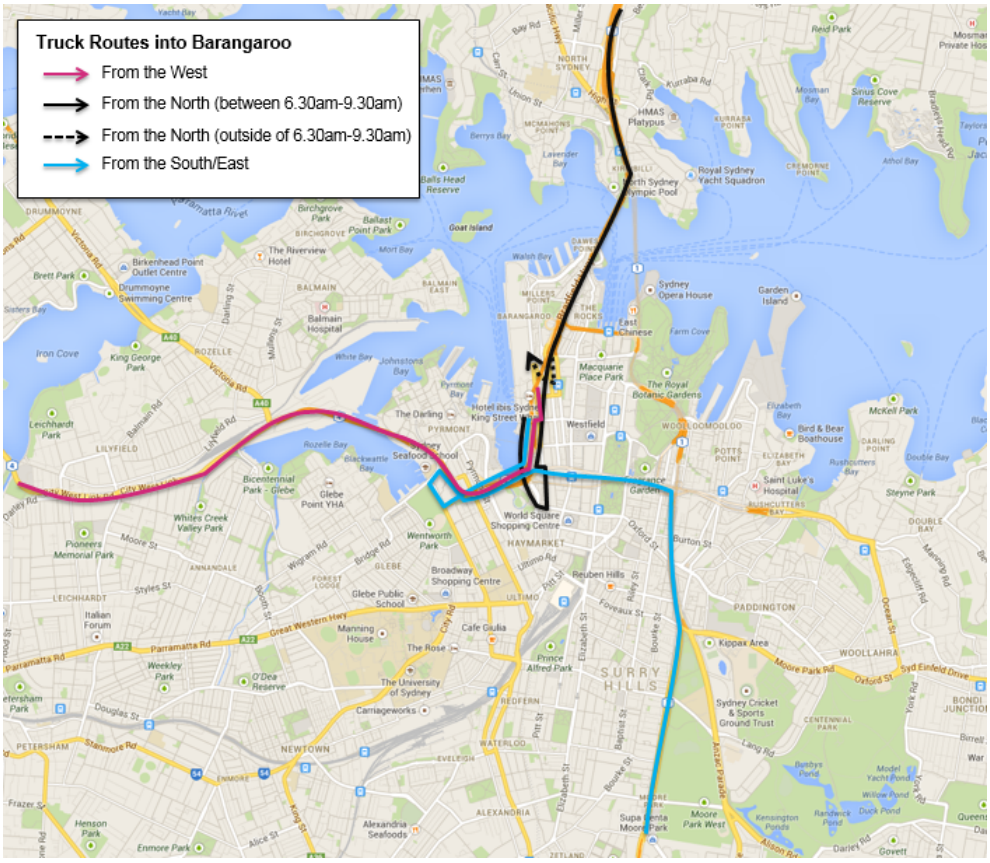


Figure 7: Inbound Traffic Routes to Barangaroo

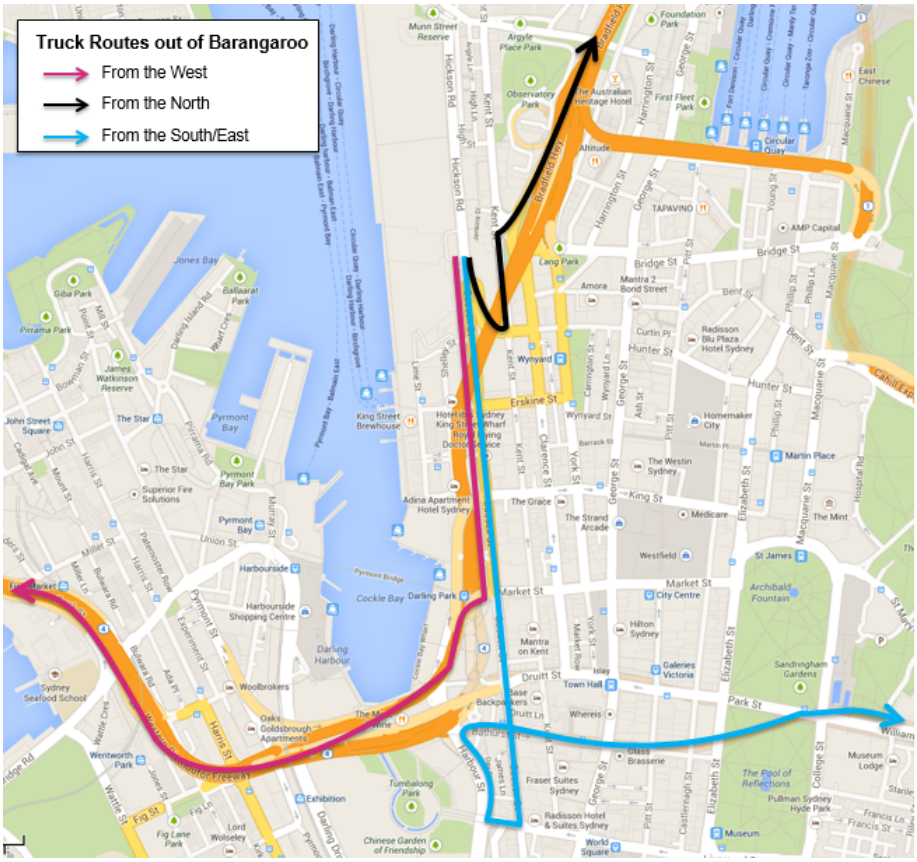


Figure 8: Outbound Traffic Routes from Barangaroo

4.4 Forecast Traffic Movements

An assessment has been made of the cumulative impacts of construction activities in the precinct, based on the works described in Section 4.1 of this report.

The construction of Building C1 overlaps with vehicle activity generated by the existing Barangaroo precinct, such as Barangaroo South Stage 1A and Barangaroo Reserve. As such, an assessment of the road network impact of these works during this time has also been undertaken.

4.4.1 C1 Construction

The works associated with the construction of Building C1 are expected to occur between July 2018 and October 2019. The stages and work, and expected duration, are summarised in the table below.

Table 4 C1 construction details

Construction Stage	Duration (months)
Construction Ground - L1 and Basement Services	3
Timber Structure L1 - L6	4
Façade L1 - L6	3
Services Rough In L1 - L6	4
Services Fitoff L1 - L6	4
Tenant Fitout	4
Building Commissioning and PC	2

4.4.2 Construction Traffic Movements

The number of construction vehicles generated by works within the Barangaroo South site is based on recent advice from Lend Lease. The number of vehicle movements[1] expected during the peak hours has been determined based on the existing activity profile for the Barangaroo South (Stage 1A) site. Construction vehicle activity generated by works external to Barangaroo South has been forecasted based on the supporting planning documents to each of the project applications.

[1] For the purposes of this report, a traffic movement is defined as the one-way flow of a single vehicle at a particular location. A vehicle entering the site, and departing some time later, is considered as two traffic movements.

4.4.3 Operational Traffic Movements

The proposed construction timeline for Commercial Building C1 coincides with the occupation of commercial and residential buildings within Barangaroo South, including all three commercial towers and associated retail buildings within Barangaroo South. In addition, the residential buildings are occupied and generate traffic movements. These buildings are completed and are estimated to generate in the order of 210 cars and 50 service vehicles during peak hours (including associated on-street parking).

4.4.4 Cumulative Traffic Movements

Table 5 on the following page provides a detailed summary of anticipated construction and development traffic movements associated with each project in the Barangaroo precinct. This demonstrates the peak traffic activity during the life of the project is anticipated to occur in July 2018, with 389 additional traffic movements during the AM peak hour (compared with the existing situation).

As illustrated in Figure 6, the majority of construction truck movements occur prior to the afternoon peak commuter period (5pm – 6pm). Therefore the analysis has considered the morning peak hour (8am – 9am) to determine the impacts arising from the construction of Building C1.

Barangaroo Construction Traffic Management Plan

Forecast Vehicle Activity - Vehicle Movements per Hour

Project	2015												2016												2017												2018											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Operational Traffic Movements																																															
T1 Commercial Building	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42
T2 Commercial Building	0	0	0	0	0	0	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52
T3 Commercial Building	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53
R8/R9 Residential Buildings	0	0	0	0	0	0	0	0	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24
C2 Building	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
R1 & R7 Buildings	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
On-Street Parking	0	0	0	0	0	0	0	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16
Barangaroo Reserve	0	0	0	0	0	0	0	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
Crown Sydney	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Car Movements	***0***	***0***	***0***	***0***	***0***	***0***	***52***	***80***	***104***	***104***	***104***	***104***	***104***	***104***	***104***	***104***	***157***	***157***	***157***	***157***	***157***	***199***	***199***	***199***	***199***	***199***	***199***	***206***	***210***	***210***	***210***	***210***	***210***	***210***	***210***	***210***	***210***	***210***	***210***	***210***	***210***	***210***	***210***	***210***	***210***	***210***	***210***
Service Vehicle Movements	0	0	0	0	0	0	0	25	25	25	25	25	25	25	25	25	40	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
Total Operational Traffic Movements	**0**	**0**	**0**	**0**	**0**	**0**	**52**	**105**	**129**	**129**	**129**	**129**	**129**	**129**	**129**	**129**	**197**	**207**	**207**	**207**	**207**	**249**	**249**	**249**	**249**	**249**	**249**	**256**	**260**	**260**	**260**	**260**	**260**	**260**	**260**	**260**	**260**	**260**	**260**	**260**	**260**	**260**	**260**	**260**	**260**	**260**	**260**
Construction Traffic Movements*																																															
Basement Construction	8	8	8	4	4	4	4	4	4	4	4	4	2	2	2	2	2	2	2	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T1 Commercial Building	4	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T2 Commercial Building	10	10	10	8	8	8	6	6	6	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T3 Commercial Building	8	8	8	6	6	6	6	6	6	4	4	4	2	2	2	2	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R8/R9 Residential Buildings	6	6	6	4	4	4	4	4	4	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Concrete Batch Plant Operation	6	6	6	7	8	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Block 4 Remediation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14
Block 5 Remediation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
Hickson Road Remediation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	4	4	4	10	10	10	10	10	10	10	5	5	5	4	4	4	4	10	10	10	5	5	5	0	0
Stage 1A Public Domain	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C2 Building	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C1 Building	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	6	6	6	6	6
R1 Building	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	2	2	2	2	2	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R7 Building	0	0	0	0	0	0	0	0	0	0	0	2	2	2	2	2	2	2	2	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Napoleon Bridge	2	2	2	2	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stage 1C remediation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	4	4	4	4	4	4	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	0	0	0	0	0	0
Crown Sydney	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	6	6	6	6	6	6	6	6	6	6	6	7	7	7	7	7	7	9	9	9	9	9	9	9	9	9	9	9	9	9
Stage 1B Basement	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	27	27	27	27	27	27	27	27	27	27	27	27	50	50	50	50	50	50	50
Building R4a	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Building R4b	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Building R5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stage 1B public domain	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	8	8	8	8	8
Barangaroo South Total	***48***	***48***	***48***	***35***	***36***	***36***	***24***	***24***	***24***	***22***	***16***	***14***	***10***	***13***	***13***	***13***	***27***	***33***	***33***	***33***	***41***	***37***	***43***	***43***	***43***	***43***	***49***	***47***	***44***	***72***	***72***	***72***	***72***	***67***	***67***	***69***	***68***	***68***	***68***	***68***	***74***	***97***	***105***	***100***	***100***	***100***	***95***	***95***
Wynyard Walk	16	16	16	16	16	16	16	16	16	16	16	16	0	0	0	0	0	0	0	0	0	16	16	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Barangaroo Reserve	6	6	6	6	6	6	6	6	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Barangaroo Ferry Wharf	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sydney Metro	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24
Total Construction Traffic Movements	***70***	***70***	***70***	***57***	***58***	***58***	***46***	***46***	***46***	***38***	***32***	***30***	***10***	***14***	***14***	***14***	***28***	***34***	***34***	***34***	***42***	***54***	***60***	***59***	***43***	***43***	***49***	***47***	***44***	***72***	***96***	***96***	***96***	***91***	***91***	***93***	***92***	***92***	***92***	***92***	***98***	***121***	***129***	***124***	***124***	***124***	***119***	***119***
Total Additional Traffic Movements	**70**	**70**	**70**	**57**	**58**	**58**	**98**	**151**	**175**	**167**	**161**	**159**	**139**	**143**	**143**	**143**	**225**	**241**	**241**	**241**	**249**	**303**	**309**	**308**	**292**	**292**	**298**	**303**	**304**	**332**	**356**	**356**	**356**	**351**	**351**	**353**	**352**	**352**	**352**	**352**	**358**	**381**	**389**	**384**	**384**	**384**	**379**	**379**

440

* Anticipated construction vehicle activity generated by Barangaroo South worksites are based on recent information provided to Arup by Lend Lease Buildings

2019

Project	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Operational Traffic Movements												
T1 Commercial Building	42	42	42	42	42	42	42	42	42	42	42	42
T2 Commercial Building	52	52	52	52	52	52	52	52	52	52	52	52
T3 Commercial Building	53	53	53	53	53	53	53	53	53	53	53	53
R8/R9 Residential Buildings	24	24	24	24	24	24	24	24	24	24	24	24
C2 Building	4	4	4	4	4	4	4	4	4	4	4	4
R1 & R7 Buildings	7	7	7	7	7	7	7	7	7	7	7	7
On-Street Parking	16	16	16	16	16	16	16	16	16	16	16	16
Barangaroo Reserve	12	12	12	12	12	12	12	12	12	12	12	12
Crown Sydney	0	0	0	0	0	0	0	0	0	0	0	0
Total Car Movements	*210*	*210*	*210*	*210*	*210*	*210*	*210*	*210*	*210*	*210*	*210*	*210*
Service Vehicle Movements	50	50	50	50	50	50	50	50	50	50	50	60
Total Operational Traffic Movements	**260**	**260**	**260**	**260**	**260**	**260**	**260**	**260**	**260**	**260**	**260**	**270**
Construction Traffic Movements*												
Basement Construction	0	0	0	0	0	0	0	0	0	0	0	0
T1 Commercial Building	0	0	0	0	0	0	0	0	0	0	0	0
T2 Commercial Building	0	0	0	0	0	0	0	0	0	0	0	0
T3 Commercial Building	0	0	0	0	0	0	0	0	0	0	0	0
R8/R9 Residential Buildings	0	0	0	0	0	0	0	0	0	0	0	0
Concrete Batch Plant Operation	0	0	0	0	0	0	0	0	0	0	0	0
Block 4 Remediation	14	14	14	0	0	0	0	0	0	0	0	0
Block 5 Remediation	8	8	8	0	0	0	0	0	0	0	0	0
Hickson Road Remediation	0	0	0	0	0	0	0	0	0	0	0	0
Stage 1A Public Domain	0	0	0	0	0	0	0	0	0	0	0	0
C2 Building	0	0	0	0	0	0	0	0	0	0	0	0
C1 Building	6	6	6	6	6	6	6	6	6	6	0	0
R1 Building	0	0	0	0	0	0	0	0	0	0	0	0
R7 Building	0	0	0	0	0	0	0	0	0	0	0	0
Napoleon Bridge	0	0	0	0	0	0	0	0	0	0	0	0
Stage 1C remediation	0	0	0	0	0	0	0	0	0	0	0	0
Crown Sydney	9	9	10	10	10	10	10	10	10	10	10	10
Stage 1B Basement	50	50	50	50	50	50	50	50	50	50	50	50
Building R4a	0	0	0	0	0	0	0	0	0	0	0	16
Building R4b	0	0	0	0	0	0	0	0	0	0	0	0
Building R5	0	0	0	0	0	0	0	0	0	0	0	0
Stage 1B public domain	8	8	8	8	8	8	8	8	8	8	8	8
Barangaroo South Total	*95*	*95*	*96*	*74*	*74*	*74*	*74*	*74*	*74*	*74*	*68*	*84*
Wynyard Walk	0	0	0	0	0	0	0	0	0	0	0	0
Barangaroo Reserve	0	0	0	0	0	0	0	0	0	0	0	0
Barangaroo Ferry Wharf	0	0	0	0	0	0	0	0	0	0	0	0
Sydney Metro	24	24	24	24	24	24	24	24	24	24	24	24
Total Construction Traffic Movements	*119*	*119*	*120*	*98*	*98*	*98*	*98*	*98*	*98*	*98*	*92*	*108*
Total Additional Traffic Movements	**379**	**379**	**380**	**358**	**358**	**358**	**358**	**358**	**358**	**358**	**352**	**378**

2020

Project	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Operational Traffic Movements												
T1 Commercial Building	42	42	42	42	42	42	42	42	42	42	42	42
T2 Commercial Building	52	52	52	52	52	52	52	52	52	52	52	52
T3 Commercial Building	53	53	53	53	53	53	53	53	53	53	53	53
R8/R9 Residential Buildings	24	24	24	24	24	24	24	24	24	24	24	24
C2 Building	4	4	4	4	4	4	4	4	4	4	4	4
R1 & R7 Buildings	7	7	7	7	7	7	7	7	7	7	7	7
On-Street Parking	16	16	16	16	16	16	16	16	16	16	16	16
Barangaroo Reserve	12	12	12	12	12	12	12	12	12	12	12	12
Crown Sydney	0	0	0	0	0	0	0	0	0	0	0	0
Total Car Movements	*210*	*210*	*210*	*210*	*210*	*210*	*210*	*210*	*210*	*210*	*210*	*210*
Service Vehicle Movements	60	60	60	60	60	60	60	60	60	60	60	60
Total Operational Traffic Movements	**270**	**270**	**270**	**270**	**270**	**270**	**270**	**270**	**270**	**270**	**270**	**270**
Construction Traffic Movements*												
Basement Construction	0	0	0	0	0	0	0	0	0	0	0	0
T1 Commercial Building	0	0	0	0	0	0	0	0	0	0	0	0
T2 Commercial Building	0	0	0	0	0	0	0	0	0	0	0	0
T3 Commercial Building	0	0	0	0	0	0	0	0	0	0	0	0
R8/R9 Residential Buildings	0	0	0	0	0	0	0	0	0	0	0	0
Concrete Batch Plant Operation	0	0	0	0	0	0	0	0	0	0	0	0
Block 4 Remediation	0	0	0	0	0	0	0	0	0	0	0	0
Block 5 Remediation	0	0	0	0	0	0	0	0	0	0	0	0
Hickson Road Remediation	0	0	0	0	0	0	0	0	0	0	0	0
Stage 1A Public Domain	0	0	0	0	0	0	0	0	0	0	0	0
C2 Building	0	0	0	0	0	0	0	0	0	0	0	0
C1 Building	0	0	0	0	0	0	0	0	0	0	0	0
R1 Building	0	0	0	0	0	0	0	0	0	0	0	0
R7 Building	0	0	0	0	0	0	0	0	0	0	0	0
Napoleon Bridge	0	0	0	0	0	0	0	0	0	0	0	0
Stage 1C remediation	0	0	0	0	0	0	0	0	0	0	0	0
Crown Sydney	10	10	10	10	10	10	10	10	10	10	10	10
Stage 1B Basement	50	50	50	50	50	50	50	50	50	50	50	50
Building R4a	16	16	16	16	16	16	16	16	16	16	16	16
Building R4b	0	0	0	0	0	0	0	0	0	0	0	0
Building R5	0	0	0	0	0	0	0	0	0	0	0	0
Stage 1B public domain	8	8	8	8	8	8	8	8	8	8	8	8
Barangaroo South Total	*84*	*84*	*84*	*84*	*84*	*84*	*84*	*84*	*84*	*84*	*84*	*84*
Wynyard Walk	0	0	0	0	0	0	0	0	0	0	0	0
Barangaroo Reserve	0	0	0	0	0	0	0	0	0	0	0	0
Barangaroo Ferry Wharf	0	0	0	0	0	0	0	0	0	0	0	0
Sydney Metro	24	24	24	24	24	24	24	24	24	24	24	24
Total Construction Traffic Movements	*108*	*108*	*108*	*108*	*108*	*108*	*108*	*108*	*108*	*108*	*108*	*108*
Total Additional Traffic Movements	**378**	**378**	**378**	**378**	**378**	**378**	**378**	**378**	**378**	**378**	**378**	**378**

2021

Project	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Operational Traffic Movements												
T1 Commercial Building	42	42	42	42	42	42	42	42	42	42	42	42
T2 Commercial Building	52	52	52	52	52	52	52	52	52	52	52	52
T3 Commercial Building	53	53	53	53	53	53	53	53	53	53	53	53
R8/R9 Residential Buildings	24	24	24	24	24	24	24	24	24	24	24	24
C2 Building	4	4	4	4	4	4	4	4	4	4	4	4
R1 & R7 Buildings	7	7	7	7	7	7	7	7	7	7	7	7
On-Street Parking	16	16	16	16	16	16	16	16	16	16	16	16
Barangaroo Reserve	12	12	12	12	12	12	12	12	12	12	12	12
Crown Sydney	91	91	91	91	91	91	91	91	91	91	91	91
Total Car Movements	*301*	*301*	*301*	*301*	*301*	*301*	*301*	*301*	*301*	*301*	*301*	*301*
Service Vehicle Movements	60	60	60	60	60	60	60	60	60	60	60	60
Total Operational Traffic Movements	**361**	**361**	**361**	**361**	**361**	**361**	**361**	**361**	**361**	**361**	**361**	**361**
Construction Traffic Movements*												
Basement Construction	0	0	0	0	0	0	0	0	0	0	0	0
T1 Commercial Building	0	0	0	0	0	0	0	0	0	0	0	0
T2 Commercial Building	0	0	0	0	0	0	0	0	0	0	0	0
T3 Commercial Building	0	0	0	0	0	0	0	0	0	0	0	0
R8/R9 Residential Buildings	0	0	0	0	0	0	0	0	0	0	0	0
Concrete Batch Plant Operation	0	0	0	0	0	0	0	0	0	0	0	0
Block 4 Remediation	0	0	0	0	0	0	0	0	0	0	0	0
Block 5 Remediation	0	0	0	0	0	0	0	0	0	0	0	0
Hickson Road Remediation	0	0	0	0	0	0	0	0	0	0	0	0
Stage 1A Public Domain	0	0	0	0	0	0	0	0	0	0	0	0
C2 Building	0	0	0	0	0	0	0	0	0	0	0	0
C1 Building	0	0	0	0	0	0	0	0	0	0	0	0
R1 Building	0	0	0	0	0	0	0	0	0	0	0	0
R7 Building	0	0	0	0	0	0	0	0	0	0	0	0
Napoleon Bridge	0	0	0	0	0	0	0	0	0	0	0	0
Stage 1C remediation	0	0	0	0	0	0	0	0	0	0	0	0
Crown Sydney	0	0	0	0	0	0	0	0	0	0	0	0
Stage 1B Basement	23	23	23	0	0	0	0	0	0	0	0	0
Building R4a	16	16	16	16	16	16	16	16	16	16	16	16
Building R4b	16	16	16	16	16	16	16	16	16	16	16	16
Building R5	0	0	0	0	16	0	0	16	16	16	16	16
Stage 1B public domain	0	0	0	0	0	0	0	0	0	0	0	0
Barangaroo South Total	*55*	*55*	*55*	*32*	*48*	*32*	*32*	*48*	*48*	*48*	*48*	*48*
Wynyard Walk	0	0	0	0	0	0	0	0	0	0	0	0
Barangaroo Reserve	0	0	0	0	0	0	0	0	0	0	0	0
Barangaroo Ferry Wharf	0	0	0	0	0	0	0	0	0	0	0	0
Sydney Metro	24	24	24	24	24	24	24	24	24	24	24	24
Total Construction Traffic Movements	*79*	*79*	*79*	*56*	*72*	*56*	*56*	*72*	*72*	*72*	*72*	*72*
Total Additional Traffic Movements	**440**	**440**	**440**	**417**	**433**	**417**	**417**	**433**	**433**	**433**	**433**	**433**

2022

Project	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Operational Traffic Movements												
T1 Commercial Building	42	42	42	42	42	42	42	42	42	42	42	42
T2 Commercial Building	52	52	52	52	52	52	52	52	52	52	52	52
T3 Commercial Building	53	53	53	53	53	53	53	53	53	53	53	53
R8/R9 Residential Buildings	24	24	24	24	24	24	24	24	24	24	24	24
C2 Building	4	4	4	4	4	4	4	4	4	4	4	4
R1 & R7 Buildings	7	7	7	7	7	7	7	7	7	7	7	7
On-Street Parking	16	16	16	16	16	16	16	16	16	16	16	16
Barangaroo Reserve	12	12	12	12	12	12	12	12	12	12	12	12
Crown Sydney	91	91	91	91	91	91	91	91	91	91	91	91
Total Car Movements	*301*	*301*	*301*	*301*	*301*	*301*	*301*	*301*	*301*	*301*	*301*	*301*
Service Vehicle Movements	60	60	60	60	60	60	60	60	60	60	60	60
Total Operational Traffic Movements	**361**	**361**	**361**	**361**	**361**	**361**	**361**	**361**	**361**	**361**	**361**	**361**
Construction Traffic Movements*												
Basement Construction	0	0	0	0	0	0	0	0	0	0	0	0
T1 Commercial Building	0	0	0	0	0	0	0	0	0	0	0	0
T2 Commercial Building	0	0	0	0	0	0	0	0	0	0	0	0
T3 Commercial Building	0	0	0	0	0	0	0	0	0	0	0	0
R8/R9 Residential Buildings	0	0	0	0	0	0	0	0	0	0	0	0
Concrete Batch Plant Operation	0	0	0	0	0	0	0	0	0	0	0	0
Block 4 Remediation	0	0	0	0	0	0	0	0	0	0	0	0
Block 5 Remediation	0	0	0	0	0	0	0	0	0	0	0	0
Hickson Road Remediation	0	0	0	0	0	0	0	0	0	0	0	0
Stage 1A Public Domain	0	0	0	0	0	0	0	0	0	0	0	0
C2 Building	0	0	0	0	0	0	0	0	0	0	0	0
C1 Building	0	0	0	0	0	0	0	0	0	0	0	0
R1 Building	0	0	0	0	0	0	0	0	0	0	0	0
R7 Building	0	0	0	0	0	0	0	0	0	0	0	0
Napoleon Bridge	0	0	0	0	0	0	0	0	0	0	0	0
Stage 1C remediation	0	0	0	0	0	0	0	0	0	0	0	0
Crown Sydney	0	0	0	0	0	0	0	0	0	0	0	0
Stage 1B Basement	0	0	0	0	0	0	0	0	0	0	0	0
Building R4a	16	16	16	16	0	0	0	0	0	0	0	0
Building R4b	16	16	16	16	16	16	16	16	16	16	16	16
Building R5	16	16	16	16	16	16	16	16	16	16	16	16
Stage 1B public domain	0	0	0	0	0	0	0	0	0	0	0	0
Barangaroo South Total	*48*	*48*	*48*	*48*	*32*	*32*	*32*	*32*	*32*	*32*	*32*	*32*
Wynyard Walk	0	0	0	0	0	0	0	0	0	0	0	0
Barangaroo Reserve	0	0	0	0	0	0	0	0	0	0	0	0
Barangaroo Ferry Wharf	0	0	0	0	0	0	0	0	0	0	0	0
Sydney Metro	24	24	24	24	24	24	24	24	24	24	24	24
Total Construction Traffic Movements	*72*	*72*	*72*	*72*	*56*	*56*	*56*	*56*	*56*	*56*	*56*	*56*
Total Additional Traffic Movements	**433**	**433**	**433**	**433**	**417**	**417**	**417**	**417**	**417**	**417**	**417**	**417**

4.5 Road Network Impacts

The impacts of the additional traffic movements on the local road network generated by the construction and operation of the Barangaroo site are described in the sections below.

Construction Traffic

Consistent with the forecasts adopted in previous construction traffic management plans for Barangaroo South works, 70% of construction vehicles are forecast to approach the worksite from the southern and western parts of Sydney. The remainder would approach from the northern direction (i.e. via the Harbour Bridge, Western Distributor and Harbour Street). For trucks returning to the north, they would utilise Napoleon Street and then turn left onto Kent Street to approach the Harbour Bridge. Margaret Street would not be used as a construction route during peak hours.

Development Traffic.

Traffic associated with the new development has been distributed across the road network based on Journey to Work Census data, consistent with the assumptions outlined in the MWT Modified Concept Plan – Transport Report, July 2008. This is summarised in Table 6 below. This includes traffic related to the Stage 1A precinct.

Table 6: Development Traffic Distribution

Direction	Route	Distribution
North	Harbour Bridge	40.7%
East	Eastern Distributor	22.9%
	William Street	1.5%
	Oxford Street	4.1%
South	Harbour Street	8.6%
West	Western Distributor	21.8%
Sydney Inner	-	0.4%
Total		**100%**

George Street future diversion traffic

Although traffic surveys previously conducted by Arup have demonstrated that the partial closure of George Street (along with other changes in the road environment) has not resulted in any increases in traffic volumes along the Hickson Road corridor, TfNSW have indicated that up to 300 vehicles could be redirected onto study area as a result of the northern closure on George Street. Background traffic has been increased with traffic distributed proportionately according to existing flows.

4.5.1 Traffic Modelling

This report examines in detail the future stage traffic operations of the five nearest and most relevant intersections to Barangaroo South construction site, namely:

- Hickson Road & Watermans Quay, **Priority Controlled (Future)**
- Napoleon Street & Hickson Road, **Traffic Signals**
- Sussex Street & Erskine Street, **Traffic Signals**
- Napoleon Street, Margaret Street & Kent Street, **Traffic Signals**

4.5.2 Modelling Assumptions

Existing models were calibrated to the observed situation and then forecasted to two additional scenarios for the AM and PM peak period: the future case excluding Building C1 and the future case including Building C1. The following points describe the key modelling assumptions made:

- A global heavy vehicle average of 4.57% was assumed across the network, as an equivalent passenger car unit (PCU) of 2.
- Coordination of intersection phasing was optimised by LinSig
- Dead green time was used in LinSig to model certain locations to incorporate the impacts of a heavily congested or restricted movement – specifically queue spillback from upstream and downstream intersections
- Base saturation flows were input based on the Austroads Guide to Traffic Management (AGTM03-09 Traffic Studies and Analysis)
    - Environment Class C assumed due to high activity nature in the CBD area surrounding the site
    - All dedicated left and right turn movements classified as a restricted turning lane (Type 3) due to high activity nature in the CBD area surrounding the site. Type 3 refers to restricted turning lanes in the Austroads Guide to Traffic Management (AGTM03-09 Traffic Studies and Analysis, pg. 75)

It should be noted that the mean-maximum queues were also assessed across the models. AM scenarios recorded queues at the Sussex Street pedestrian crossing, exceeding the section lengths of approximately 1 PCU. It was assumed that the queue-back can be accommodated by the adjacent upstream and downstream intersections.

Similarly, the PM models were found to model queues extending further than the storage on the western approach of the Erskine Street /Sussex Street intersection. It was found that the queues extended in both the future base and future model with the Crown development were estimated as 5 PCU over the 8PCU storage length. As this queue was observed at the Shelley Street /Erskine Street intersection, the congested effects were modelled with incorporated dead-green time for the southern leg right turn movement.

4.5.3 Intersection Operation

The effect of the estimated additional peak hour traffic during (for the combined construction and operational activities) has been investigated for each of the affected intersections during the AM peak hour. Negligible construction traffic movements are anticipated during the PM peak hour and therefore this has not been considered in the analysis. The modelling results for the future peak hour traffic movements are summarised in Table 7.

Table 7: Intersection Analysis

Peak	Intersection	Future Traffic Peak, 2020 (Excluding C1 Building works)			Future Traffic Peak, 2020, (Including C1 Building works)		
		LOS	DOS	AVD (sec)	LOS	DOS	AVD (sec)
AM	Sussex St / Erskine St	C	0.91	37	C	0.91	36
	Hickson Rd / Napoleon St	E	0.94	58	E	0.95	61
	Kent St / Margaret St	B	0.61	21	B	0.62	21
	Hickson Rd / Globe St	A	0.49	2	A	0.51	2

LOS - Intersection Traffic Level of Service, DOS - Degree of Saturation, AVD - Average Delay per vehicle

The results of the LinSig intersection analysis forecast minimal changes in the operation of key intersections as a result of the construction of Building C1 when compared with the base case scenario. The additional construction vehicles associated with Commercial Building C1 works has a negligible impact on forecast road network performance.

During the AM peak hour, when construction vehicles attributable to Commercial Building C1 are expected to access the site, the road network generally operates satisfactorily. The addition of construction traffic movements associated with the Commercial Building C1 works does not impact the overall operation of the local road network, and requires no further works to accommodate the levels of construction traffic anticipated.

4.5.4 Hickson Road upgrade works

In 2017 work commenced to upgrade Hickson Road and Sussex Street between Watermans Quay and Shelley Street to provide a streetscape that will interface with Barangaroo South and also provide a safe environment that reduces and caters for major stormwater overland flows.

This is a separate project, with traffic impacts previously outlined by Arup as part of the Review of Environmental Factors for the project. It is important to note that all times during construction, the current road configuration on Hickson Road will be maintained, that is:

- One northbound through lane
- One right turn bay
- Two southbound lanes

4.5.5 Movement During Peak Hours

As previously indicated in Figure 6, the number of construction vehicle movements generated during the AM and PM peak hours is relatively low when compared to overall daily movements. This is reflective of the overall policy to minimise (as far as practicable) construction vehicle movements during these times to avoid periods of higher traffic flows on CBD streets. This would be continued during Commercial Building C1 works.

4.6 Access arrangements

In the design of the C1 building, investigations were undertaken to modify the existing Hickson Road / Napoleon Street intersection, which provides egress for vehicles departing the Barangaroo South 1A car park. A safety audit was undertaken to investigate moving the traffic signals to improve pedestrian crossing movements. The audit found that moving the signals west will increase risk of accidents between exiting vehicles and pedestrian(s) which is not acceptable. It is imperative we ensure the design maximises safety to pedestrians by reducing conflict points with vehicles. The current location of the signalised pedestrian crossing maximises sight lines and minimises walk through possibilities. The approved intersection layout is adopted for the design and is shown in the figure below.

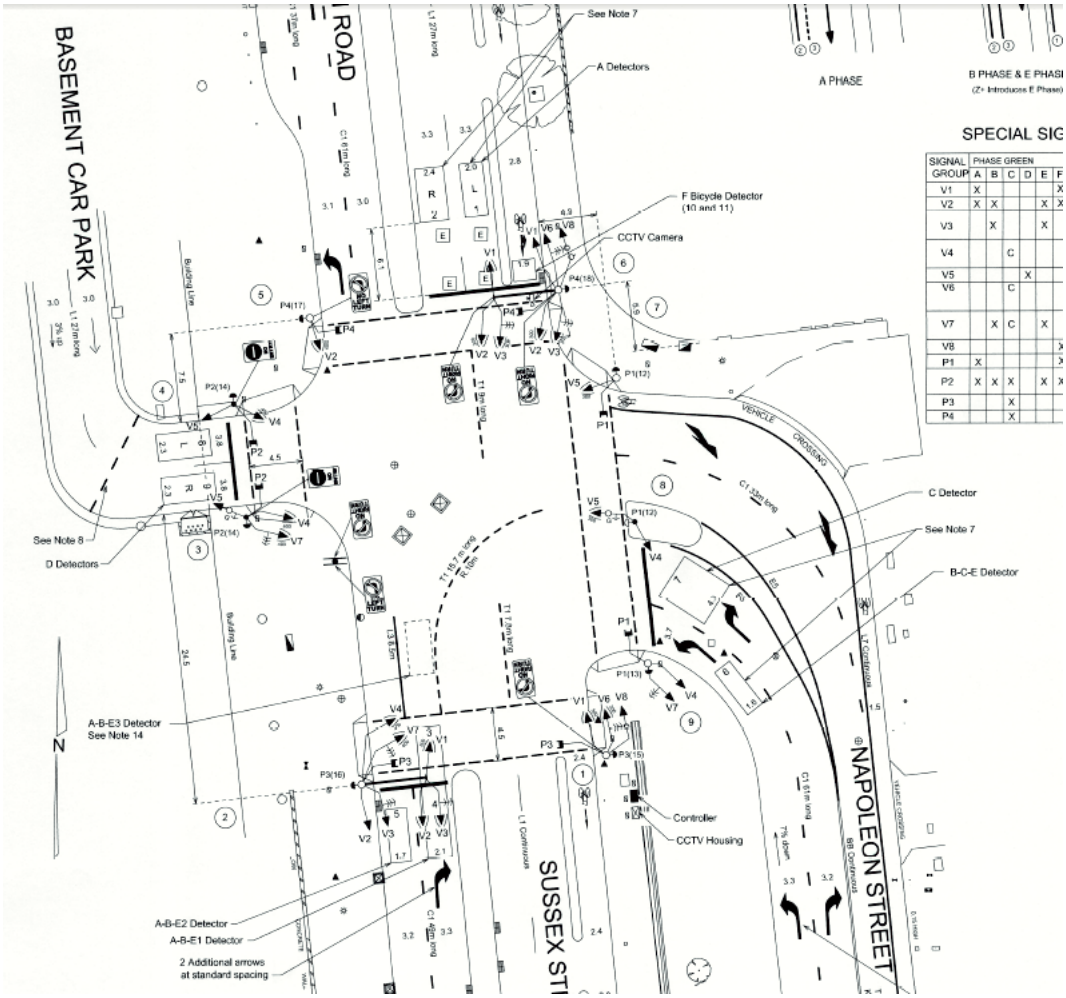


Figure 9 Approved intersection layout – Hickson Road / Napoleon Street

4.7 Construction Vehicle Management

4.7.1 Hours of Operation

The proposed site hours of operation will be similar to the existing project approvals for Barangaroo South. These hours assist the site traffic movements being generated mainly outside the normal commuter peak traffic periods, such that their impacts on the surrounding road network are minimised.

4.7.2 Restriction to Construction Routes

As per current approvals for Barangaroo, which restricts trucks using York Street between 2pm and 8pm, trucks are also not able to use York Street or Clarence Street in the AM peak between 6am and 10am due to existing restrictions.

4.7.3 Emergency Vehicle Access

Site entries are to be clearly signposted for the benefit of all approaching site traffic, in particular emergency services vehicles.

4.7.4 Access for Construction Workers

To reduce the impact on the local road network associated with construction work, no on-site parking is to be provided for construction workers. In this manner it is being treated like any other CBD construction project. The constrained parking environment surrounding the site, coupled with the relatively high cost of long term parking, will ensure the majority of construction workers arrive to the site via public transport.

Construction workers through their site inductions will be provided with travel advice about public transport, walking and cycling routes to the site.

4.7.5 Traffic Control Recommendations

The site traffic control recommendations for each worksite gate entry or exit point (including all appropriate signage) will be determined by means of a Traffic Control Plan to be prepared by an RMS accredited contractor closer to construction commencement.

Truck movements are to be staged and coordinated to prevent trucks circulating CBD streets whilst awaiting access to the site.

Construction vehicles will approach the site from areas outside the CBD using major arterial routes such as the M4, M5 etc.

The size of trucks proposed to access the site will be in accordance with Clause 300-3 of the Australian Road Rules in terms of lengthy vehicle restrictions.

The vehicular traffic movements at each of the site entry or exit gates for traffic to and from Hickson Road will potentially need to be controlled by a flagman to ensure no potential traffic safety conflicts occur between the site truck traffic and pedestrians on the adjacent footpath.

Personnel will not be permitted to use stop/slow signage in Hickson Road or Sussex Street on weekdays between 7am and 9am and 4pm to 7pm. However, personnel using stop/slow signage will be permitted on Hickson Road, north of the intersection of Hickson Road and Napoleon Street, when it is required to ensure safe truck access at designated site access points, provided that vehicles queue lengths generated as a result of the traffic control do not exceed more than six vehicles in either direction.

Any activity likely to impact the operational efficiency of the state road network and/or for works within 100m of traffic lights would be the subject of an application to the Transport Management Centre for a road occupancy licence.

4.8 Vehicle Site Access

Temporary loading zones will be in place along Hickson Road / Sussex Street during the construction of Commercial Building C1. This is similar to the arrangements previously in place during the construction of the C2 building, also fronting Sussex Street.

4.9 Pedestrian Access

In July 2015 two major improvements to the pedestrian network in the Barangaroo precinct were opened to the public, those being:

- The Napoleon Bridge – providing a grade separated pedestrian connection from Napoleon Street, across Sussex Street into the Barangaroo site
- Signalisation of the Hickson Road / Napoleon Street intersection providing controlled pedestrian crossing movements across all four legs of the intersection.

In 2016 site access for construction workers were further improved through the completion of the Wynyard Walk development. This provides a safe and efficient access for construction workers walking across Hickson Road and Sussex Street.

These arrangements are shown in Figure 10

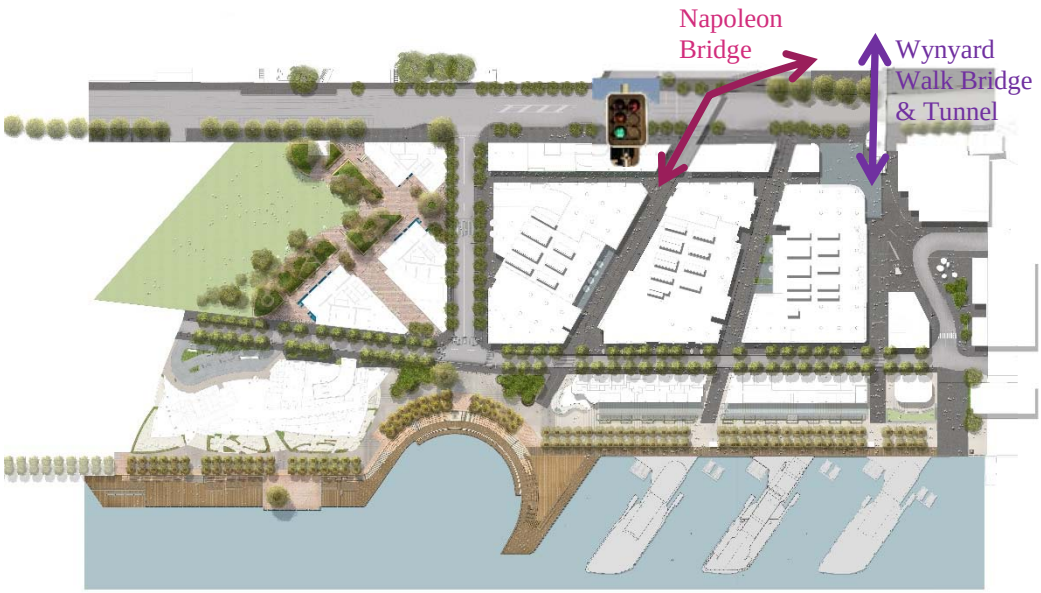


Figure 10 Pedestrian access routes

5 Operational Stage Assessment

5.1 Site Access Arrangements

Vehicular access to the Building C1 basement car park and loading dock is proposed to be via the existing driveway into the Stage 1A precinct via Watermans Quay. The primary vehicular access route into and out of the site will be via Sussex Street, Hickson Road and Watermans Quay.

By the completion of the development planned within the Stage 1B development, traffic signals will be installed at the Hickson Road / Watermans Quay intersection (subject to separate approval). This will manage traffic circulation and efficiency. The detailed design of the intersection, including the phasing and lane arrangements, will take place closer to the construction date and be subject to consultation with the Road Authority and RMS.

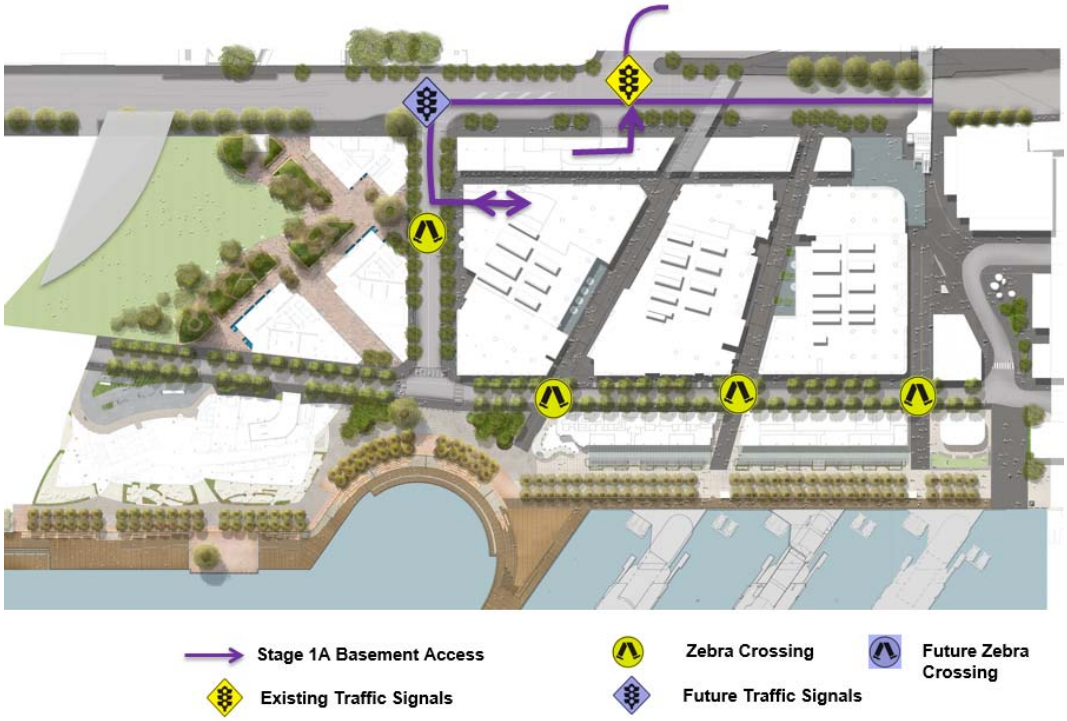


Figure 11 Vehicle access arrangements

A number of formal pedestrian crossing facilities are to be provided within the Barangaroo precinct. These crossings, including two zebra crossings on Barangaroo Avenue, will provide good accessibility for pedestrians to and from Commercial Building C1.

5.2 Car Parking

5.2.1 Commercial Car Parking

Commercial parking is provided at 1/600m2 GFA in accordance with the Barangaroo Concept Plan. 10,886m^2 of commercial office space is proposed within Commercial Building C1, which results in a parking provision of 17 spaces. These 17 spaces are already located within the existing Barangaroo South Stage 1A car park, however are currently unoccupied.

5.2.2 Retail Car Parking

1 retail car parking space is proposed for Building C1.

5.3 Loading and Servicing

Loading and servicing for the building will be via the existing loading dock servicing the Stage 1A precinct. This dock contains 68 spaces which can be pre-booked via a smartphone application. The dock is managed to ensure there is sufficient capacity to accommodate loading requirements of the various buildings and tenants.

5.4 Future Road Operations

5.4.1 Traffic generation

Traffic generation rates for Commercial Building C1 have been adopted based on those utilised in the Masson Wilson Twiney Modified Concept Plan (July 2008) and most recent TMAP developed for the Barangaroo Concept Plan. A peak hour vehicle trip rate of 0.40 vehicles / car space for the retail component and 0.26 vehicles / car space for the commercial component has been utilised – **equating to only 5 cars during peak hours**. This traffic increase is considered negligible in the context of future traffic volumes in the CBD precinct and would not result in any additional impacts on surrounding intersections.

5.4.2 Road network impacts

A full assessment of future road network operations following the full development of the Barangaroo precinct has recently been outlined in the approved Concept Plan Modification for the site (MP06_0162 Mod 8). This assessment included the provision of Commercial Building C1. The results of the modelling undertaken for this study forecast minimal changes in the operation of key intersections surrounding the site as a result of the concept plan modification (including Commercial Building C1), compared with that forecast (and subsequently approved) in the Barangaroo TMAP Stage 1 published by the NSW Government in September 2008.

5.5 Pedestrian Accessibility

The site will be well serviced by a number of pedestrian routes which link with the wider Barangaroo precinct. A number of zebra crossings are proposed which are located on major pedestrian desire lines to facilitate the safe movement of pedestrians to and from the site.

The main pedestrian desire lines for residents of Building C1 will be to/from the commercial development in the southern end of the site and Wynyard public transport hub. Appropriate at-grade pedestrian crossing facilities (either pedestrian signals or zebra crossings) are planned throughout the precinct to ensure pedestrians are provided with safe and efficient road crossing opportunities along key desire lines as shown in Figure 12.

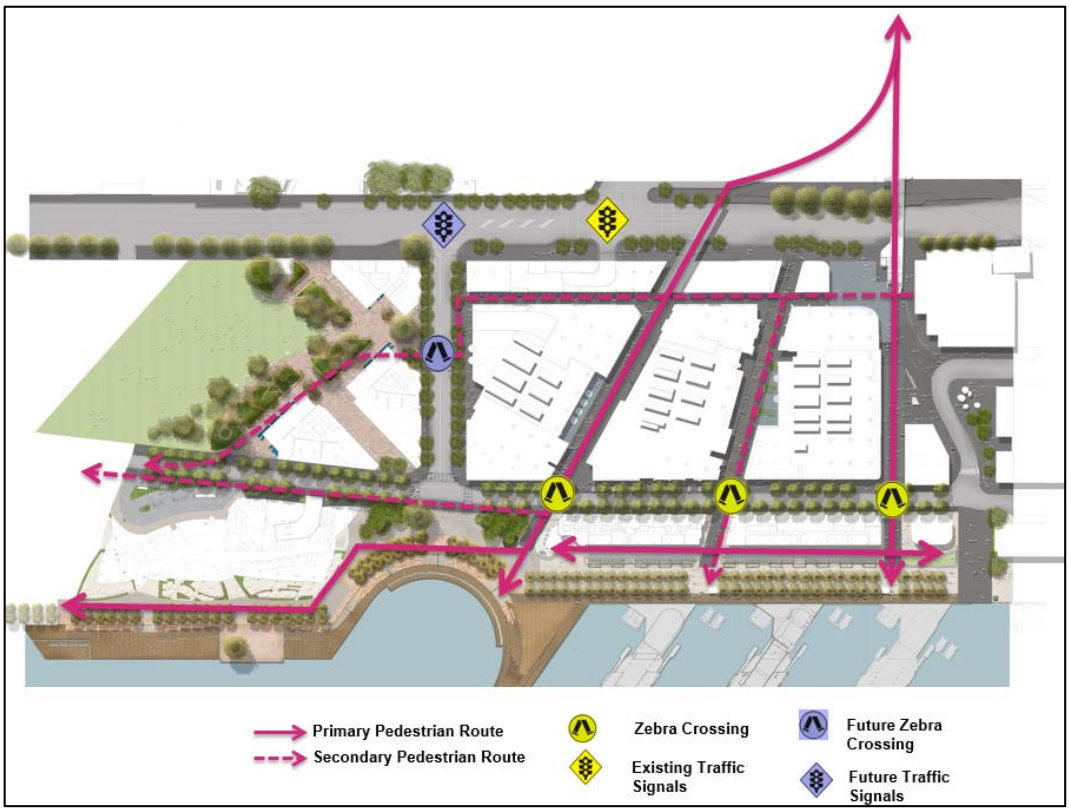


Figure 12 Major Pedestrian Routes

5.6 Cycling

The primary route for riders travelling to Building C1 from the north (via the Sydney Harbour Bridge cycleway) will be via Napoleon Street. This is consistent with the City of Sydney Cycle Strategy and Action Plan. An alternative route exists via Argyle Street, Dalgety Road and Hickson Road. Many cyclists will find this route attractive given the low traffic volumes and the available road space.

Napoleon Street will form a link for cyclists travelling between the Building C1 and the existing separated cycleway on Kent Street. An on-road bicycle lane has recently been installed for eastbound riders (uphill), with a mixed traffic environment in the westbound direction.

Cycling within Barangaroo will be confined to the internal road network, i.e. along Watermans Quay and Barangaroo Avenue. These will function as mixed traffic streets given the relatively low levels of vehicular traffic and anticipated 40km/h speed limit.

The foreshore promenade will primarily act as a pedestrian pathway however cycling will not be prohibited. A low speed environment will be promoted where cyclists will be required to give way to pedestrians at all times. This will be similar to the operation of the adjacent King Street Wharf and Darling Harbour.

Access for cyclists to Building C1 will be via the dedicated bike entry ramp accessed via Hickson Road. The planned internal cycle network is outlined in Figure 13.

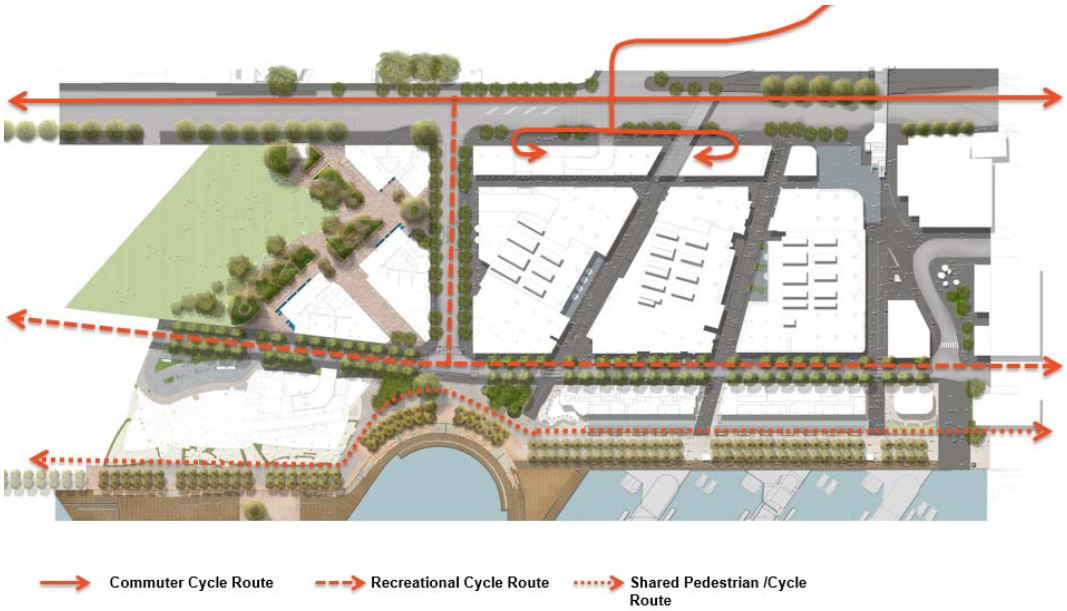


Figure 13 Internal Bicycle Network

Future tenants of Commercial Building C1 will have access to a dedicated end of trip facilities room, including lockers, showers and change rooms. A total of 96 lockers and 35 bicycle parking spaces are proposed as part of the development, as shown in Figure 14. This quantum of bicycle parking is approximately 5% of the commercial population of Commercial Building C1. This rate is consistent with that recommended by the Green Building Council of Australia in their Green Star requirements, although is not necessarily required to be satisfied to achieve a green star rating.

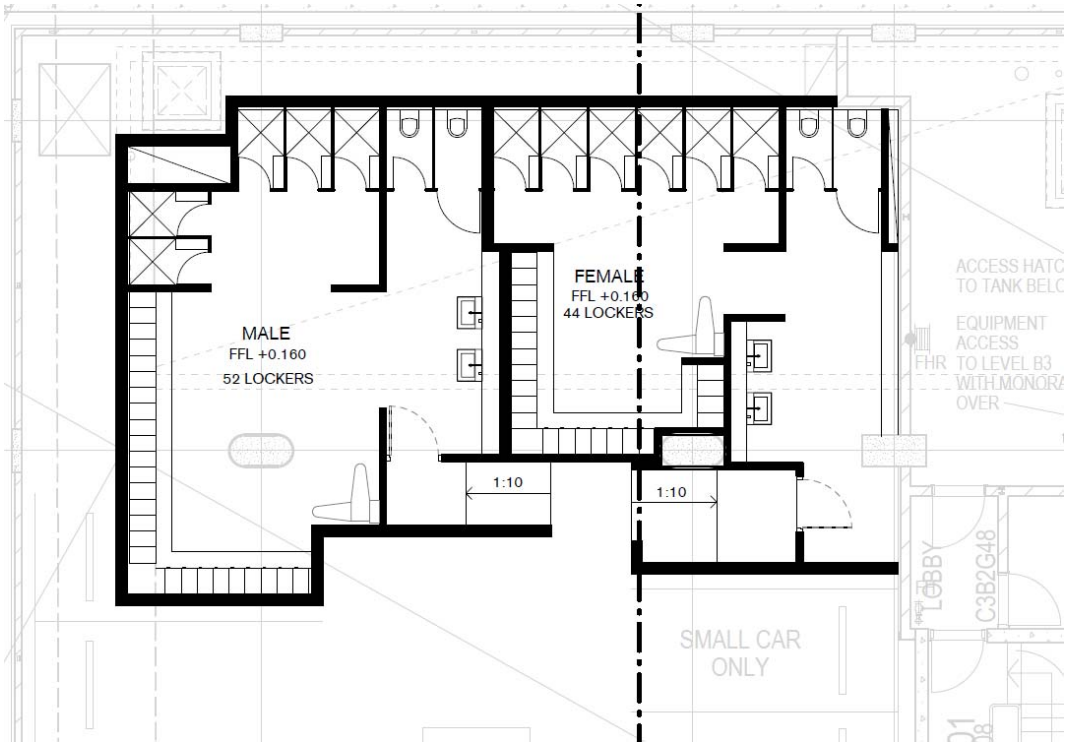


Figure 14 Commercial Building C1 end of trip facilities room

5.7 Public Transport Accessibility

5.7.1 Heavy Rail

The NSW Long Term Transport Masterplan released in December 2012 outlines a 20 year plan and includes the following rail projects for Sydney:

- North West and South West Rail Lines
- Sydney Metro
- Wynyard Station improvement works

Wynyard Station

A significant number of work trips into Barangaroo are anticipated to occur by rail, with Wynyard Station to act as the major transport hub. Recent upgrades to Wynyard Station have included:

- New, premium fixtures and finishes, such as lighting, tiling and painting;
- Widened paid concourse and ticket gates;
- Reduced clutter on the concourse and platforms;
- Upgraded existing and new platform stairs to improve pedestrian circulation and reduce queuing;
- New wayfinding and signage to make it easier for customers to move in and around the Station;
- Improving operational reliability through upgraded services and removal of redundant services; and
- Renovated back of house areas, including new and relocated Station Manager's office.

Sydney Metro

Sydney Metro is the next major rail project identified in Sydney's Rail Future. Sydney Metro scope has been developed to meet the Project objectives and deliver key elements of Stages 4 and 5 of Sydney's Rail Future.

In June 2014 the NSW Government announced the Sydney Metro concept, including the Sydney Harbour Crossing and Western Extension to Bankstown proposals. The project would extend rapid transit under Sydney Harbour, through the central business district (CBD) of Sydney and west to Bankstown, with capacity to run up to 30 trains per hour in each direction through the city on the new line.

The Project represents a major increase in the capacity of Sydney's rail network, providing a 60 per cent increase in the number of trains in the peak periods and catering for an extra 100,000 customers per hour. Sydney Metro would significantly improve reliability across the rail network by addressing current and emerging constraints such as train crowding, platform and station crowding, and network complexity.

Sydney Metro Northwest is currently under construction and includes eight new fully accessible railway stations and 4,000 commuter car parking spaces. Metro services will start in the first half of 2019 with a train every four minutes in the peak, or 15 trains an hour.

In June 2015 the NSW Government announced a new station would be constructed at Barangaroo as part of the Sydney Metro project. Based on patronage modelling undertaken by Sydney Metro, delivery a new station at Barangaroo will in the morning peak, reduce entries and exits at both Wynyard Station and Martin Place station by approximately 5,000 passengers. This station will significantly improve public transport access for people traveling to and from the Barangaroo precinct.

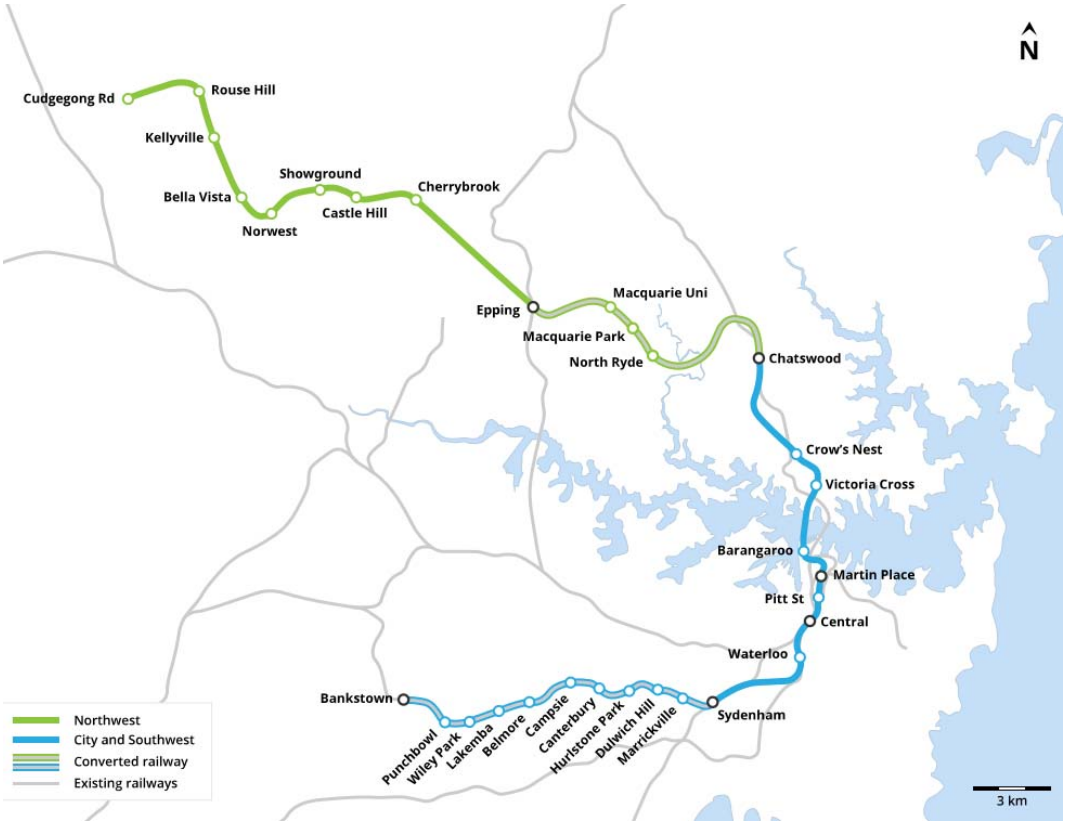


Figure 15 Sydney Metro Project

Source: Transport for NSW

5.7.2 Bus Services

In July 2015 the NSW Government announced a series of bus routes will directly service the Barangaroo precinct. These services all run along Hickson Road adjacent to Barangaroo South, terminating at Walsh Bay, and include:

- Route 311
- Route 324
- Route 325

These services are illustrated in Figure 16 below.

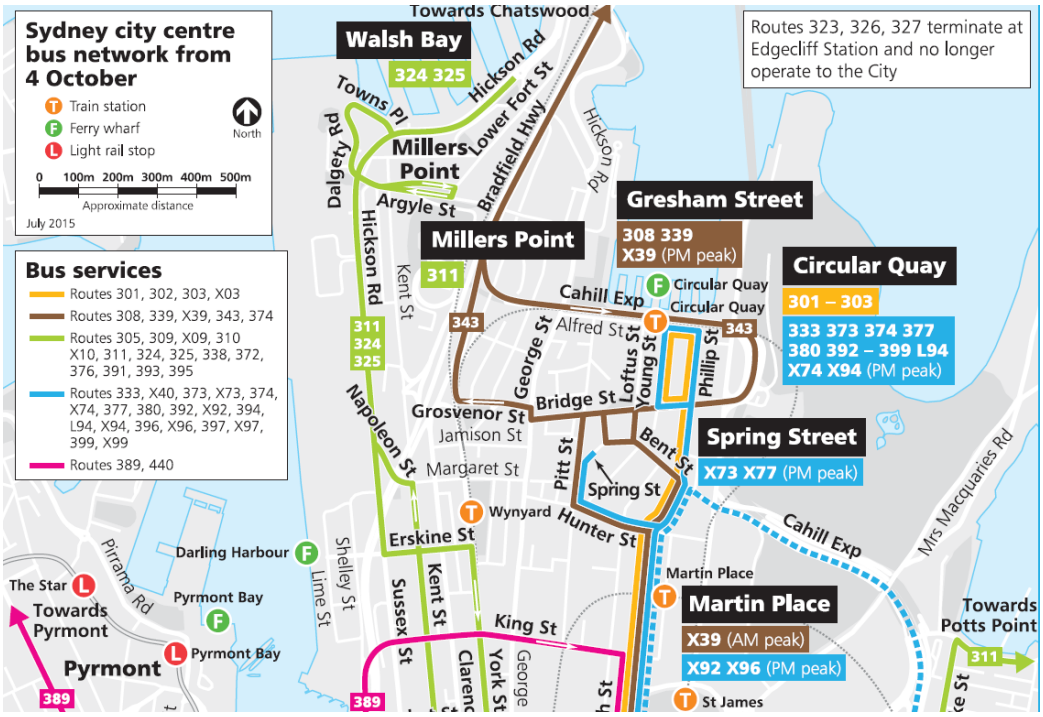


Figure 16 Bus services

5.7.3 Ferry

The Barangaroo Ferry Hub opened to the public in June 2017. The new ferry hub will service the C1 Commercial Building and connect ferry users to the western and midtown parts of the city centre via the Wynyard Walk link. It reduces capacity constraints on the Circular Quay terminal and will bring additional ferry services and routes directly to Barangaroo.

5.7.4 Light Rail

In December 2012, the NSW Government released 'Sydney's Light Rail Future'. This document details plans for expanding the existing light rail network to the Sydney CBD and South Eastern Sydney as well as the completion of the Inner West Light Rail extension. It could be expected that public transport patronage to Barangaroo from the inner west would shift mode from bus and rail as a result of these extensions.

Inner West Light Rail Extension (completed)

The first stage of the inner-west light rail extension is a 5.6km extension running between Lilyfield and Dulwich Hill as shown in Figure 17. It runs from the current light rail terminus at Lilyfield, along the disused freight rail corridor, to Dulwich Hill. The extension opened in March 2014.

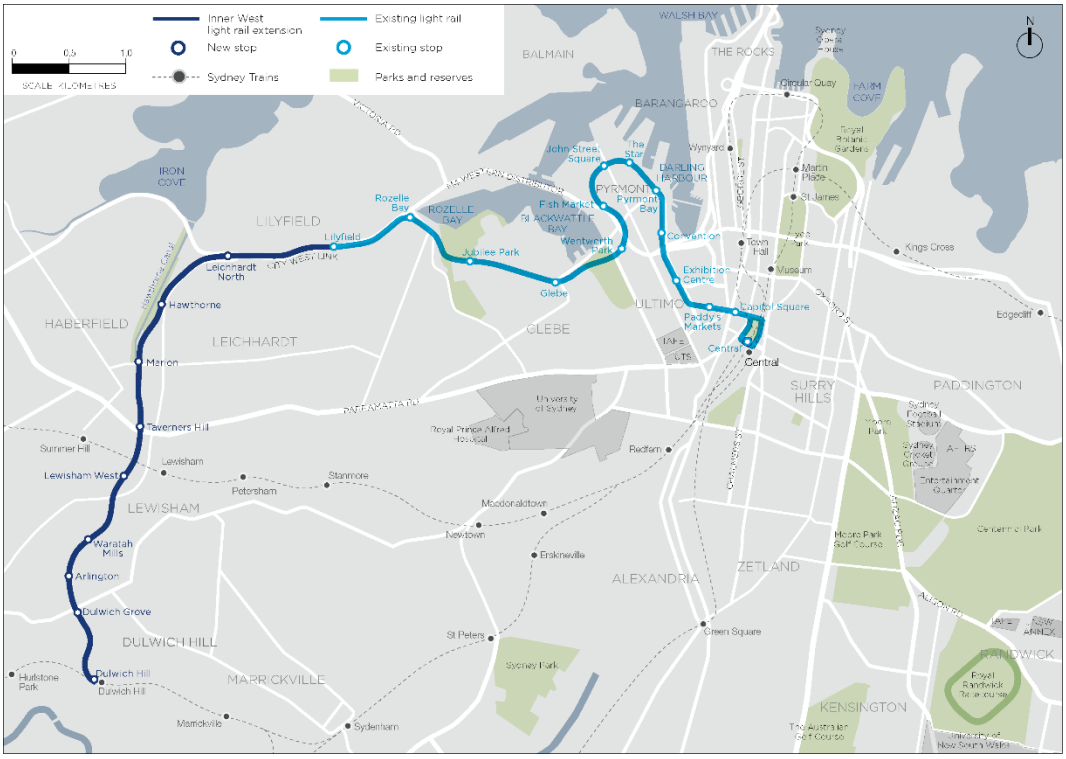


Figure 17 Inner-West Light rail extensions

CBD and South East Light Rail The CBD and South East Light Rail link will connect Circular Quay to the University of New South Wales via Anzac Parade and Alison Road. The integration of existing and planned light rail networks would further enhance patronage by this mode to Barangaroo. This link will include the pedestrianisation of a 1 kilometre section of George Street, between Bathurst and Hunter Streets. Construction commenced in 2015.

Figure 18 CBD and South East Light Rail Route Map

6 Travel Demand Management

This Travel Demand Management Plan specific for the C1 Commercial Building needs to address the following issues:

- What are the **objectives** for tenants in terms of travel journeys to and from work, during work hours and other travel to and from the office.
- How are the set objectives going to be met? What **measures** are going to be implemented and encouraged?
- Who is going to be responsible for the management, implementation and administration of the measures?

These matters are addressed in the following sections.

6.1 Travel Demand Management Plan Objectives

The main objectives of the Travel Demand Management Plan are to reduce the need to travel and promotion of sustainable means of transport.

The more specific objectives include:

- High modal share for public transport, cycling and walking to work journeys;
- To ensure adequate facilities are provided at the site to enable staff and visitors to commute by sustainable transport modes;
- To reduce the number of car journeys associated with business travel by staff and visitors;
- To facilitate the sustainable and safe travel of new employees;
- To reduce the need to travel for work-related activities, particularly air travel; and
- To raise awareness of sustainable transport amongst staff and visitors.

6.2 Travel Demand Management Plan Measures

The measures proposed to achieve the above objectives have been separated into the following categories:

1. Those to be implemented / considered to be implemented by Lendlease
2. Those to be promoted / considered promoting to tenants of C1

These measures are discussed in detail in the sections below.

6.2.1 Implemented by Lendlease

Cycling

The C1 Commercial Building will have good access to the cycling network and will provide onsite facilities for cyclists (i.e. easily accessible bike room/shelter, changing rooms and showers, lockers and good access from those facilities to the office). In order to activate and promote cycling the following measures should be considered:

- Supply a bicycle repair station-this can consist of puncture repair equipment, a bike pump, a spare lock and lights;
- Come to an arrangement with a local cycle retailer for cheap servicing of staff bikes. If staff buy enough bikes from the retailer, they may agree to service them for free;
- Provide Sydney cycle maps to staff;

Public Transport

- Provide a minimal number of parking spaces for employees within Commercial Building C1 basement to encourage the use of public transport travel – in line with the approved Barangaroo Concept Plan;
- Provide a public transport website to contain useful links to journey planning websites in Sydney;
- Provide useful public transport maps and promotional items

Walking

- Participate in Walk to Work day and look into holding a ‘healthy breakfast’ as a reward to all those who participate.

Wayfinding

As an entirely new precinct Barangaroo South will need a careful wayfinding strategy. The strategy will include Commercial Building C1 as part of the precinct plan. Key civic nodes, Wynyard train station, ferry terminal and other public spaces will need to be located quickly. A number of wayfinding measures would be implemented through Barangaroo South precinct planning process rather than independently by individual tenants. The way finding measures could be introduced to improve connectivity and enhance access to the C1 Commercial Building.

Shuttle Bus

Consider the introduction of a shuttle bus service between Sydney Airport and Barangaroo South

6.2.2 Promoted to C1 Tenants

General Promotion and Marketing

The objectives of the Travel Demand Management Plan will only be achieved with the support of tenants within Commercial Building C1. Marketing the benefits and promoting the sustainable alternatives available are therefore crucial in encouraging staff to adopt the Travel Demand Management Plan measures. It is important that at an early stage, staff are made aware of the need for the Travel Demand Management Plan, and that it is emphasised that the measures are being introduced to support and encourage people to use cars more wisely.

In addition to raising general awareness, any successes achieved will be fully publicised to staff in order to motivate them to use sustainable modes of transport.

- Support and promote events such as National Bike Week, Bike2Work Days, walk to work day, to staff, through lunch time presentations, notice board posters, websites and email.
- A dedicated webpage for employees has been created to include a travel information section containing information on cycle parking and useful links to public transport websites specific to the C1 office location (see Figure 19 and Figure 20).

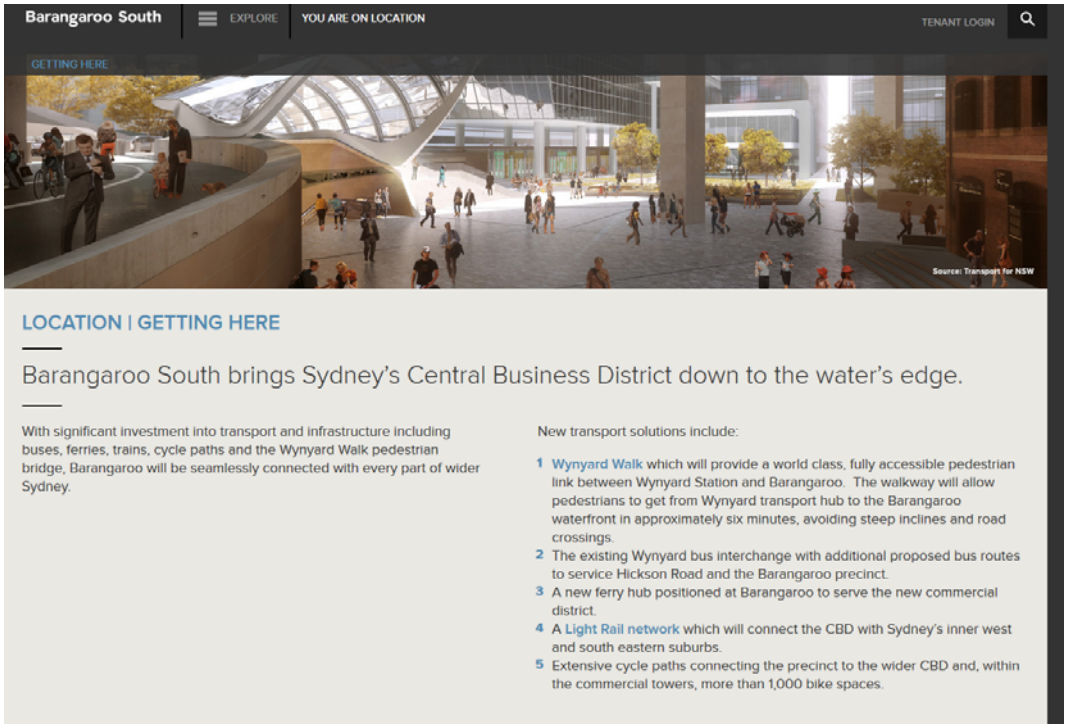


Figure 19 Travel information – International Towers website

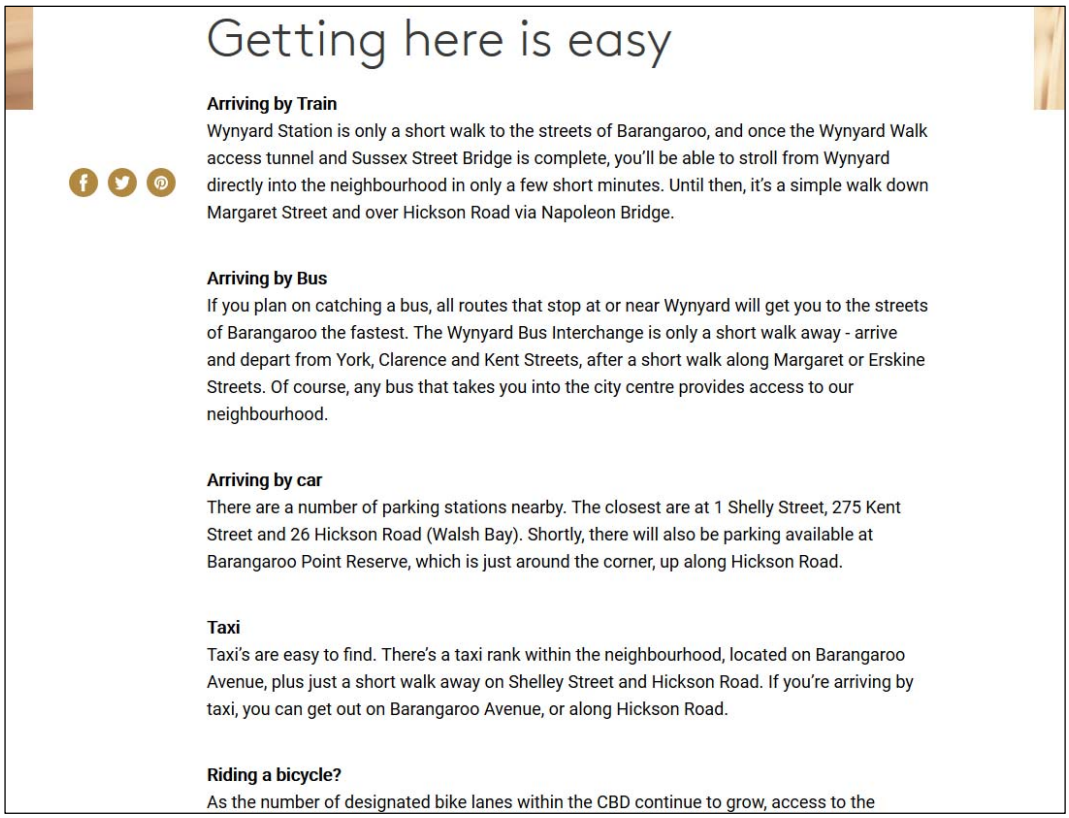


Figure 20 Travel information – Streets of Barangaroo website

Reducing The Need To Travel

To ensure that sustainable transport options are promoted to staff when making journeys for work purposes, and to reduce the need to travel, the following measures can be implemented. These measures require implementation by staff members across the building.

- Active promotion of the office teleconferencing facilities as an alternative to face to face meetings. This can be achieved by placing 'reducing the need to travel' as an item on internal group meeting agendas;
- Include teleconference meetings as a standard option in client proposals in preference to face to face meetings where practical; and
- Promote telecommuting policy to all existing and new staff.

Travel During the Working Day

To provide staff with a choice of convenient sustainable transport options for work related travel during the working day, the following initiatives should be promoted:

- Use of the Sydney Trains network to travel to places that are on or near a train line;
- Walk to places that are close by rather than taking the taxi;

Cycling

- Participate in annual events such as 'Ride to Work Day';

- Notice boards in staff areas and public area notifications could have news of events promoting cycling
- The office could have information available detailing 'Cycling to work' details including details of storage areas, shower facilities and links on the intranet containing useful links to journey planning websites in Sydney
- Make staff aware of public transport cycling carriage policies and cycle storage facilities at rail stations
- Staff who cycle to work should be encouraged to form a Bicycle User Group in order to provide a body of regular cyclists who can discuss on issues relating to the provision of on-site cycling facilities and the maintenance of off-site cycle routes

Public Transport

- Provide notice boards in staff areas and include news of events / generic posters promoting public transport.

Walking

- Produce walking related articles focussing on 'walking champions' to highlight best practise in walking to business meetings;
- Create and maintain an intranet 'useful walking routes' containing useful routes to key parts of the Sydney CBD, including public transport terminals at Wynyard, Circular Quay, Martin Place and Town Hall rail stations;
- Promote smart phone apps that monitor walking and cycling usage (e.g. Strava)
- Promote walking mobile applications to staff (e.g. 'Map My Walk')

Staff Induction

To ensure new members of staff are aware of the Travel Demand Management Plan, all new staff members should be made aware of the Plan as part of their induction process. The Travel Demand Management Plan section of the induction should provide new starters with the following:

- A brief introduction to the Travel Demand Management Plan and its purpose;
- Tour of the office to include a visit to the bicycle parking areas and shower and changing facilities; and
- Provision of a Travel Demand Management Plan information package which would include information on incentives to use sustainable means of transport e.g. pool bikes and car/taxi share system.

Visitor Travel / Site Access Information

- For internal site access information, consider developing an interactive map to show useful walking route, nearby public transport terminals and popular cycling routes to work, expanded to include additional local information useful to staff such as nearby shops and services or locations for recreational activities

6.3 Scheme Administration

6.3.1 Administration

Lendlease and/or the C1 property management team are recommended to appoint a Travel Demand Management Plan co-ordinator to liaise with tenant representatives responsible for various C1 tenant Travel Demand Management Plans. The role/s should be undertaken by an enthusiastic and high quality communicator in order to promote measures that will encourage employees to think about travel other than as a single occupancy car user. The role will involve coordination with the travel representative from the City of Sydney Council.

He/she will need to be an enthusiastic and respected member of staff who is keen to champion the cause of the Travel Plan. Other qualities that may be appropriate include the capability of dealing with all types of people within Barangaroo and external organisations, the ability to lead by example, the ability to approach issues with a practical and balanced perspective and the capability for original and innovative thinking to raise awareness of the Travel Plan at a local level.

6.3.2 Consultation

The Travel Demand Management Plan co-ordinator will be responsible for all liaisons with outside bodies, including local transport operators, planning and highway authorities.

Liaison with officers of the Council (e.g. those responsible for cycling and public transport) will be undertaken as required. The co-ordinator will also seek to join and attend meetings with any local travel forums as appropriate in order to exchange ideas with other like minded organisations.

6.3.3 Promotion

All employees will be made aware of the details of the Travel Demand Management Plan, its objectives in enhancing the environment and the role of individuals in achieving its objectives at its launch. Job applicants will be made aware of the Travel Demand Management Plan at the interview stage and be directed to the dedicated online page for more information.

Other promotional material will take a variety of forms and will be issued either to individual employees, displayed in a prominent location in the office or provided in the form of ‘one off’ marketing initiatives. This would include outlining the benefits for staff in participating in government travel surveys to both improve public transport services and promote the use of public transport.

The promotional material will advise employees wishing to raise specific transport-related matters to discuss them with the appropriate nominated Travel Plan co-ordinator who in turn would liaise with the Travel Demand Management Plan management team, transport operators and the local authority as required.

6.4 Updating, reviewing and monitoring

The Travel Demand Management Plan is a strategy that will evolve over time. Although the objectives of the Plan to ‘educate’ employees and to facilitate travel by sustainable modes will not change, it may be possible over time to define or re-define specific targets. Target setting should reflect an ambition for continued progress year on year and there should be a mechanism to review targets in light of monitoring surveys. The monitoring measures could include collecting data on employee travel patterns for journeys to work and also during the work. The recorded data would inform modes of transport and distance travelled by each mode, from which energy consumption and emissions could be estimated.

Following the implementation to the Travel Demand Management Plan, meetings should be held periodically to undertake a review of the Travel Plan measures in place. The objective will be to measure their success and to identify the potential for refinements. The management team will further engage with City of Sydney Council and State Government to assist in designing and operating services which best support the needs to the workers and therefore promote high levels of sustainable transport modes.

The Travel Demand Management Plan management team will then compile a review report outlining the results of the review. The report will also incorporate the results of on-going monitoring processes throughout each of the preceding periods.

7 Summary

The following report has been prepared by Arup for Lend Lease Pty Ltd to support a State Significant Development Application (SSD 8529) seeking approval for construction of a commercial and retail building (known as Commercial Building C1) and associated works at Barangaroo South.

The cumulative impacts of construction and development traffic activity associated with all works currently planned in the Barangaroo precinct have been assessed. The assessment concludes that the traffic impacts arising from the works proposed under the Stage Significant Development Application can be appropriately managed.

A number of travel demand management measures are recommended for consideration to promote use of sustainable modes of transport from residents of Building C1. These measures include the distribution of resident travel packs, general marketing and promotion, provision of car share spaces and incentives for walking, cycling and public transport use.

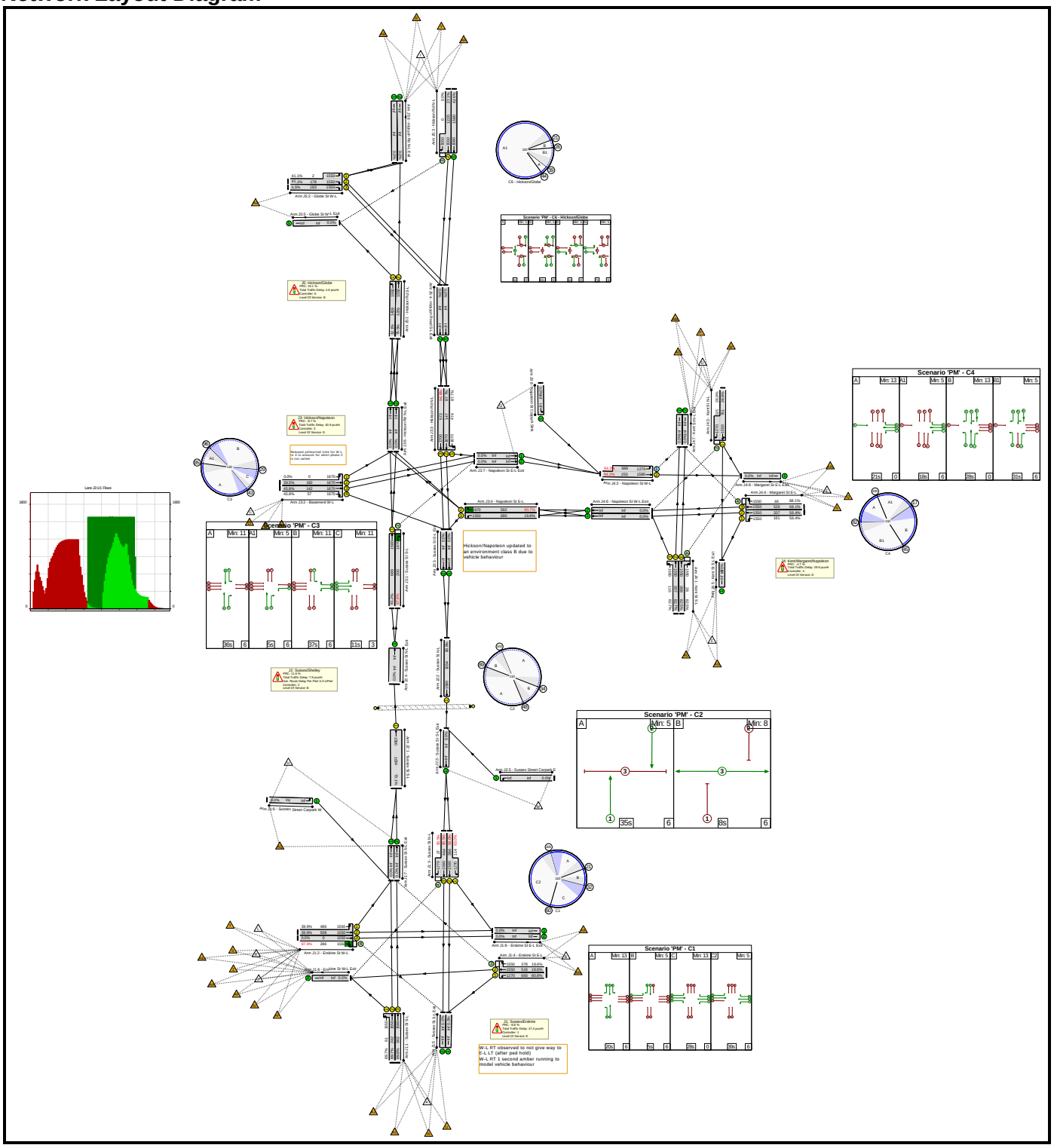
Appendix A

LinSig Modelling Outputs

Basic Results Summary

Scenario 1: 'PM' (FG1: 'Flow Group 1', Plan 1: 'Network Control Plan 1')

Network Layout Diagram



Basic Results Summary

Network Results

Item	Lane Description	Lane Type	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Deg Sat (%)	Av. Delay Per PCU (s/pcu)	Mean Max Queue (pcu)
Network	-	-	-	-	**97.9%**	-	-
J1: Sussex/Erskine	-	-	-	-	**97.9%**	-	-
1/2+1/1	Sussex St S-L Left Ahead	U	272	1550:1550	89.7 : 89.7%	90.5	11.4
1/3	Sussex St S-L Ahead	U	271	1580	89.8%	91.1	11.6
2/2+2/1	Erskine St W-L Left Ahead	U	397	1550:1550	39.9 : 39.9%	11.9	5.2
2/3+2/4	Erskine St W-L Right Ahead	U+O	280	1550:1550	0.0 : 97.9%	134.5	15.5
3/2+3/1	Sussex St N-L Ahead Left	U	463	1580:1270	93.0 : 93.0%	69.9	16.4
3/3+3/4	Sussex St N-L Ahead Right	U+O	426	1580:1270	90.5 : 90.5%	59.9	15.5
4/1	Erskine St E-L Left	U	560	1270	80.8%	33.5	15.9
4/2+4/3	Erskine St E-L Ahead Right	U+O	175	1550:1550	19.6 : 19.6%	12.9	1.6
J2: Sussex/Shelley	-	-	-	-	**80.6%**	-	-
1/1	Sussex St S-L Ahead	U	756	1580	73.1%	16.1	7.8
2/1	Sussex St N-L Ahead	U	834	1580	80.6%	19.5	18.6
Ped Link: P1	Shelley	-	0	-	0.0%	Inf	Inf
J3: Hickson/Napoleon	-	-	-	-	**97.8%**	-	-
1/1	Sussex St S-L Ahead	U	560	1580	81.2%	34.1	18.5
1/2	Sussex St S-L Right	O	196	1670	97.8%	154.5	12.0
2/2+2/1	Basement W-L Left Ahead	U	72	1670:1670	39.5 : 0.0%	61.9	2.4
2/3+2/4	Basement W-L Right Ahead	U	91	1670:1670	45.8 : 45.8%	62.0	2.8
3/2+3/1	Hickson Rd N-L Ahead Left	U	545	1670:1670	87.7 : 87.7%	40.5	15.1
3/3	Hickson Rd N-L Ahead	U	542	1700	94.8%	76.8	22.5
4/1	Napoleon St E-L Left	U	137	1550	19.8%	16.9	1.8
4/2	Napoleon St E-L Right	U	537	1670	90.7%	40.4	19.8
J4: Kent/Margaret/Napoleon	-	-	-	-	**94.3%**	-	-
1/2+1/1	Kent St S-L Left Ahead	U	349	1550:1550	82.7 : 82.7%	58.5	11.9
1/3+1/4	Kent St S-L Ahead Right	U+O	343	1550:1550	82.5 : 82.5%	60.8	12.0
2/2+2/1	Napoleon St W-L Left Ahead	U+O	795	1580:1270	94.3 : 94.3%	45.4	27.6
3/1+3/2	Kent St N-L Ahead Right Left	U+O	233	1550:1270	26.9 : 26.9%	17.6	3.4

Basic Results Summary

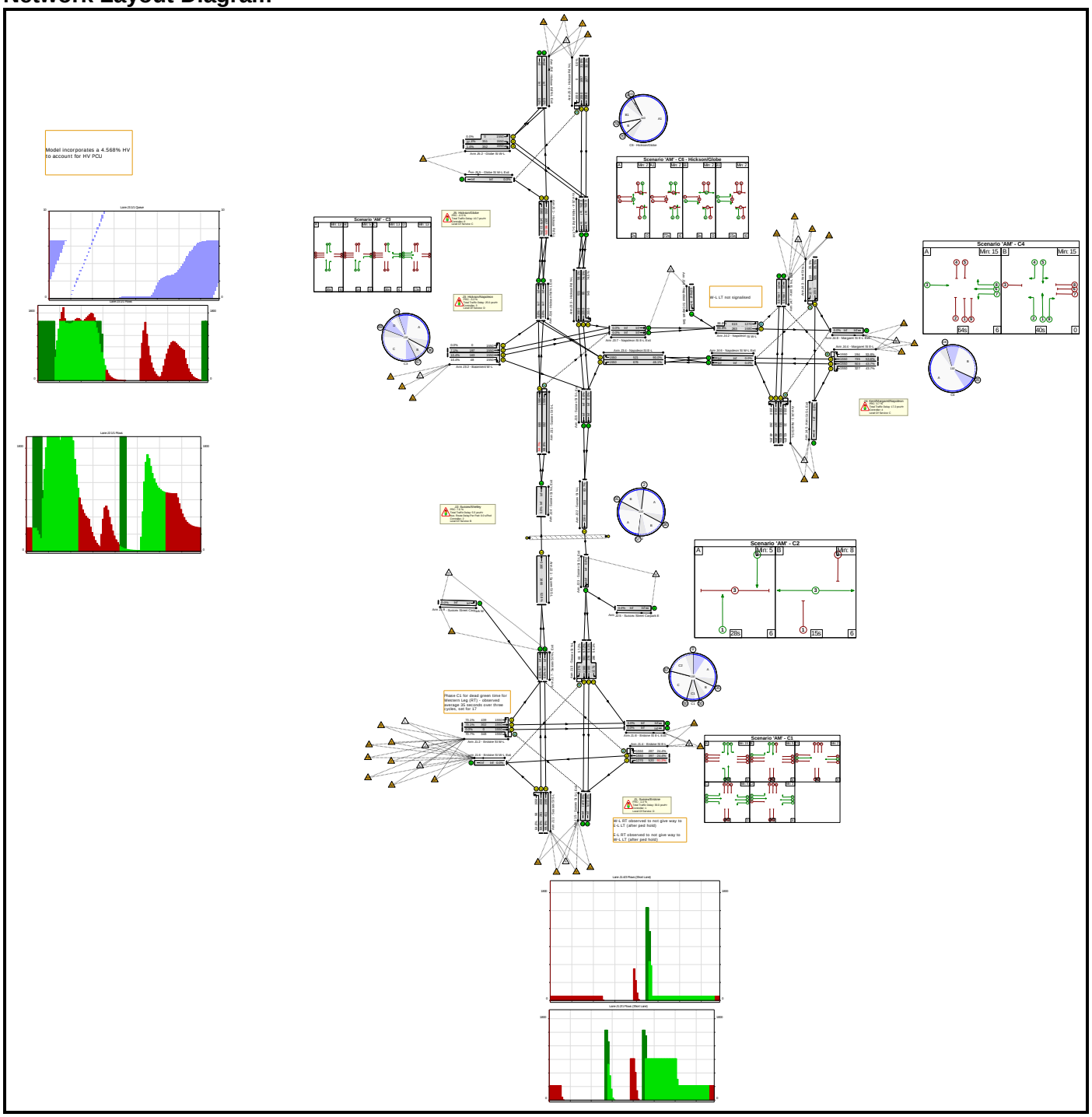
4/2+4/1	Margaret St E-L Left Ahead	U	281	1550:1550	56.4 : 56.4%	38.7	7.5
4/3+4/4	Margaret St E-L Ahead Right	U+O	389	1550:1550	68.1 : 68.1%	39.6	10.9
J5: Hickson/Globe	**-**	**-**	**-**	**-**	**75.5%**	**-**	**-**
1/1	Hickson Rd S-L Left	U	171	1550	12.1%	1.5	0.1
1/2	Hickson Rd S-L Ahead	U	926	1550	75.5%	9.6	6.5
2/2+2/1	Globe St W-L Right Left	U	74	1550:1550	41.1 : 41.1%	61.8	2.4
2/3	Globe St W-L Right	U	10	1550	5.5%	53.6	0.3
3/1	Hickson Rd N-L Ahead	U	673	1580	42.6%	2.0	0.4
3/2+3/3	Hickson Rd N-L Ahead Right	U+O	331	1550:1550	27.1 : 0.0%	5.1	2.9

C1	PRC for Signalled Lanes (%):	-8.8	Total Delay for Signalled Lanes (pcuHr):	47.39	Cycle Time (s): 110
C2	PRC for Signalled Lanes (%):	11.6	Total Delay for Signalled Lanes (pcuHr):	7.88	Cycle Time (s): 110
C3	PRC for Signalled Lanes (%):	-8.7	Total Delay for Signalled Lanes (pcuHr):	40.88	Cycle Time (s): 110
C4	PRC for Signalled Lanes (%):	-4.7	Total Delay for Signalled Lanes (pcuHr):	29.93	Cycle Time (s): 110
C5	PRC for Signalled Lanes (%):	0.0	Total Delay for Signalled Lanes (pcuHr):	0.00	Cycle Time (s): 110
C6 - Hickson/Globe	PRC for Signalled Lanes (%):	19.1	Total Delay for Signalled Lanes (pcuHr):	4.43	Cycle Time (s): 110
	PRC Over All Lanes (%):	-8.8	Total Delay Over All Lanes(pcuHr):	130.88	

Basic Results Summary

Scenario 1: 'AM' (FG1: 'Flow Group 1', Plan 1: 'Network Control Plan 1')

Network Layout Diagram



Basic Results Summary

Network Results

Item	Lane Description	Lane Type	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Deg Sat (%)	Av. Delay Per PCU (s/pcu)	Mean Max Queue (pcu)
Network	-	-	-	-	**94.7%**	-	-
J1: Sussex/Erskine	-	-	-	-	**91.2%**	-	-
1/2+1/1	Sussex St S-L Left Ahead	U	243	1550:1550	64.0 : 64.0%	49.2	7.1
1/3	Sussex St S-L Ahead	U	297	1580	68.9%	49.1	9.2
2/2+2/1	Erskine St W-L Left Ahead	U	542	1550:1550	73.1 : 73.1%	29.9	13.1
2/3+2/4	Erskine St W-L Right Ahead	U+O	246	1550:1550	0.0 : 70.7%	55.5	7.9
3/2+3/1	Sussex St N-L Ahead Left	U	257	1580:1270	54.1 : 54.1%	34.7	2.9
3/3+3/4	Sussex St N-L Ahead Right	U+O	377	1580:1270	57.2 : 57.2%	24.2	5.2
4/1	Erskine St E-L Left	U	474	1270	91.2%	63.8	17.9
4/2+4/3	Erskine St E-L Ahead Right	U+O	167	1550:1550	24.4 : 24.4%	21.1	2.6
J2: Sussex/Shelley	-	-	-	-	**83.7%**	-	-
1/1	Sussex St S-L Ahead	U	882	3160	52.9%	7.6	2.9
2/1	Sussex St N-L Ahead	U	697	1580	83.7%	18.5	11.4
Ped Link: P1	Shelley	-	0	-	0.0%	Inf	Inf
J3: Hickson/Napoleon	-	-	-	-	**94.7%**	-	-
1/1	Sussex St S-L Ahead	U	653	1580	94.7%	47.4	18.6
1/2	Sussex St S-L Right	O	229	1550	68.9%	36.8	6.8
2/2+2/1	Basement W-L Left Ahead	U	14	1550:1550	7.1 : 0.0%	52.1	0.4
2/3+2/4	Basement W-L Right Ahead	U	22	1550:1550	10.4 : 10.4%	51.9	0.5
3/2+3/1	Hickson Rd N-L Ahead Left	U	475	1550:1550	74.5 : 74.5%	17.5	7.6
3/3	Hickson Rd N-L Ahead	U	309	1580	58.1%	31.5	8.4
4/1	Napoleon St E-L Left	U	312	1550	46.1%	18.5	5.3
4/2	Napoleon St E-L Right	U	469	1550	90.0%	53.0	17.5
J4: Kent/Margaret/Napoleon	-	-	-	-	**86.8%**	-	-
1/2+1/1	Kent St S-L Left Ahead	U	228	1550:1550	48.8 : 48.8%	38.1	5.4
1/3+1/4	Kent St S-L Ahead Right	U+O	373	1550:1550	63.8 : 63.8%	36.8	10.1
2/2+2/1	Napoleon St W-L Left Ahead	U+O	762	1580:1270	86.8 : 86.8%	22.4	29.6
3/1+3/2	Kent St N-L Ahead Right Left	U+O	219	1550:1270	35.5 : 35.5%	31.8	4.2

Basic Results Summary

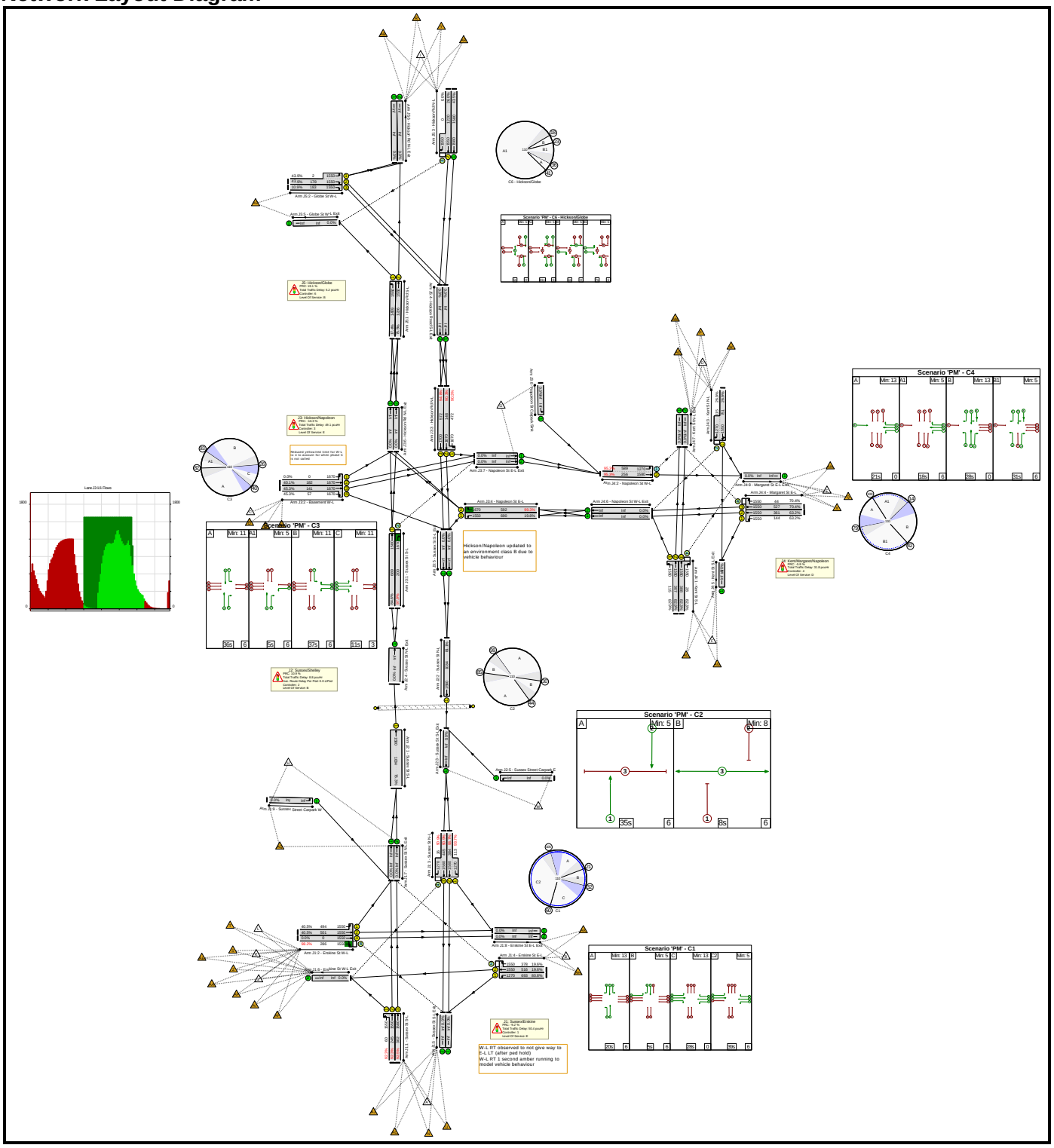
4/2+4/1	Margaret St E-L Left Ahead	U	363	1550:1550	43.7 : 43.7%	18.6	6.4
4/3+4/4	Margaret St E-L Ahead Right	U+O	498	1550:1550	53.6 : 53.6%	17.6	9.2
J5: Hickson/Globe	**-**	**-**	**-**	**-**	**90.5%**	**-**	**-**
1/1	Hickson Rd S-L Left	U	166	1580	11.2%	1.4	0.1
1/2	Hickson Rd S-L Ahead	U	956	1550	90.5%	28.6	30.8
2/2+2/1	Globe St W-L Right Left	U	96	1550:1550	27.4 : 0.0%	42.1	2.6
2/3	Globe St W-L Right	U	5	1550	1.4%	38.4	0.1
3/1	Hickson Rd N-L Ahead	U	346	1580	32.1%	9.6	4.5
3/2+3/3	Hickson Rd N-L Ahead Right	U+O	337	1550:1550	31.9 : 0.0%	9.6	4.4

C1	PRC for Signalled Lanes (%):	-1.4	Total Delay for Signalled Lanes (pcuHr):	30.05	Cycle Time (s): 110
C2	PRC for Signalled Lanes (%):	7.6	Total Delay for Signalled Lanes (pcuHr):	5.45	Cycle Time (s): 110
C3	PRC for Signalled Lanes (%):	-5.2	Total Delay for Signalled Lanes (pcuHr):	24.99	Cycle Time (s): 110
C4	PRC for Signalled Lanes (%):	3.7	Total Delay for Signalled Lanes (pcuHr):	17.20	Cycle Time (s): 110
C5	PRC for Signalled Lanes (%):	0.0	Total Delay for Signalled Lanes (pcuHr):	0.00	Cycle Time (s): 110
C6 - Hickson/Globe	PRC for Signalled Lanes (%):	-0.5	Total Delay for Signalled Lanes (pcuHr):	10.66	Cycle Time (s): 110
	PRC Over All Lanes (%):	-5.2	Total Delay Over All Lanes(pcuHr):	88.35	

Basic Results Summary

Scenario 1: 'PM' (FG1: 'Flow Group 1', Plan 1: 'Network Control Plan 1')

Network Layout Diagram



Basic Results Summary

Network Results

Item	Lane Description	Lane Type	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Deg Sat (%)	Av. Delay Per PCU (s/pcu)	Mean Max Queue (pcu)
Network	-	-	-	-	**99.3%**	-	-
J1: Sussex/Erskine	-	-	-	-	**98.2%**	-	-
1/2+1/1	Sussex St S-L Left Ahead	U	281	1550:1550	92.3 : 92.3%	99.9	12.5
1/3	Sussex St S-L Ahead	U	279	1580	92.5%	100.9	12.8
2/2+2/1	Erskine St W-L Left Ahead	U	403	1550:1550	40.5 : 40.5%	11.9	5.3
2/3+2/4	Erskine St W-L Right Ahead	U+O	281	1550:1550	0.0 : 98.2%	137.1	15.7
3/2+3/1	Sussex St N-L Ahead Left	U	466	1580:1270	93.7 : 93.7%	73.3	17.6
3/3+3/4	Sussex St N-L Ahead Right	U+O	428	1580:1270	90.9 : 90.9%	62.1	16.6
4/1	Erskine St E-L Left	U	560	1270	80.8%	33.5	15.9
4/2+4/3	Erskine St E-L Ahead Right	U+O	175	1550:1550	19.6 : 19.6%	12.9	1.6
J2: Sussex/Shelley	-	-	-	-	**81.1%**	-	-
1/1	Sussex St S-L Ahead	U	779	1580	75.3%	18.8	7.7
2/1	Sussex St N-L Ahead	U	839	1580	81.1%	20.2	18.1
Ped Link: P1	Shelley	-	0	-	0.0%	Inf	Inf
J3: Hickson/Napoleon	-	-	-	-	**99.3%**	-	-
1/1	Sussex St S-L Ahead	U	583	1580	84.6%	33.2	19.4
1/2	Sussex St S-L Right	O	196	1670	97.9%	151.1	12.0
2/2+2/1	Basement W-L Left Ahead	U	73	1670:1670	40.1 : 0.0%	62.1	2.4
2/3+2/4	Basement W-L Right Ahead	U	90	1670:1670	45.3 : 45.3%	61.9	2.8
3/2+3/1	Hickson Rd N-L Ahead Left	U	560	1670:1670	90.3 : 90.3%	46.9	17.2
3/3	Hickson Rd N-L Ahead	U	542	1700	94.8%	76.8	22.5
4/1	Napoleon St E-L Left	U	137	1550	19.8%	16.9	1.8
4/2	Napoleon St E-L Right	U	588	1670	99.3%	80.8	29.0
J4: Kent/Margaret/Napoleon	-	-	-	-	**95.3%**	-	-
1/2+1/1	Kent St S-L Left Ahead	U	350	1550:1550	82.9 : 82.9%	58.8	11.9
1/3+1/4	Kent St S-L Ahead Right	U+O	342	1550:1550	82.3 : 82.3%	60.5	11.9
2/2+2/1	Napoleon St W-L Left Ahead	U+O	805	1580:1270	95.3 : 95.3%	49.5	28.4
3/1+3/2	Kent St N-L Ahead Right Left	U+O	233	1550:1270	26.9 : 26.9%	17.6	3.4

Basic Results Summary

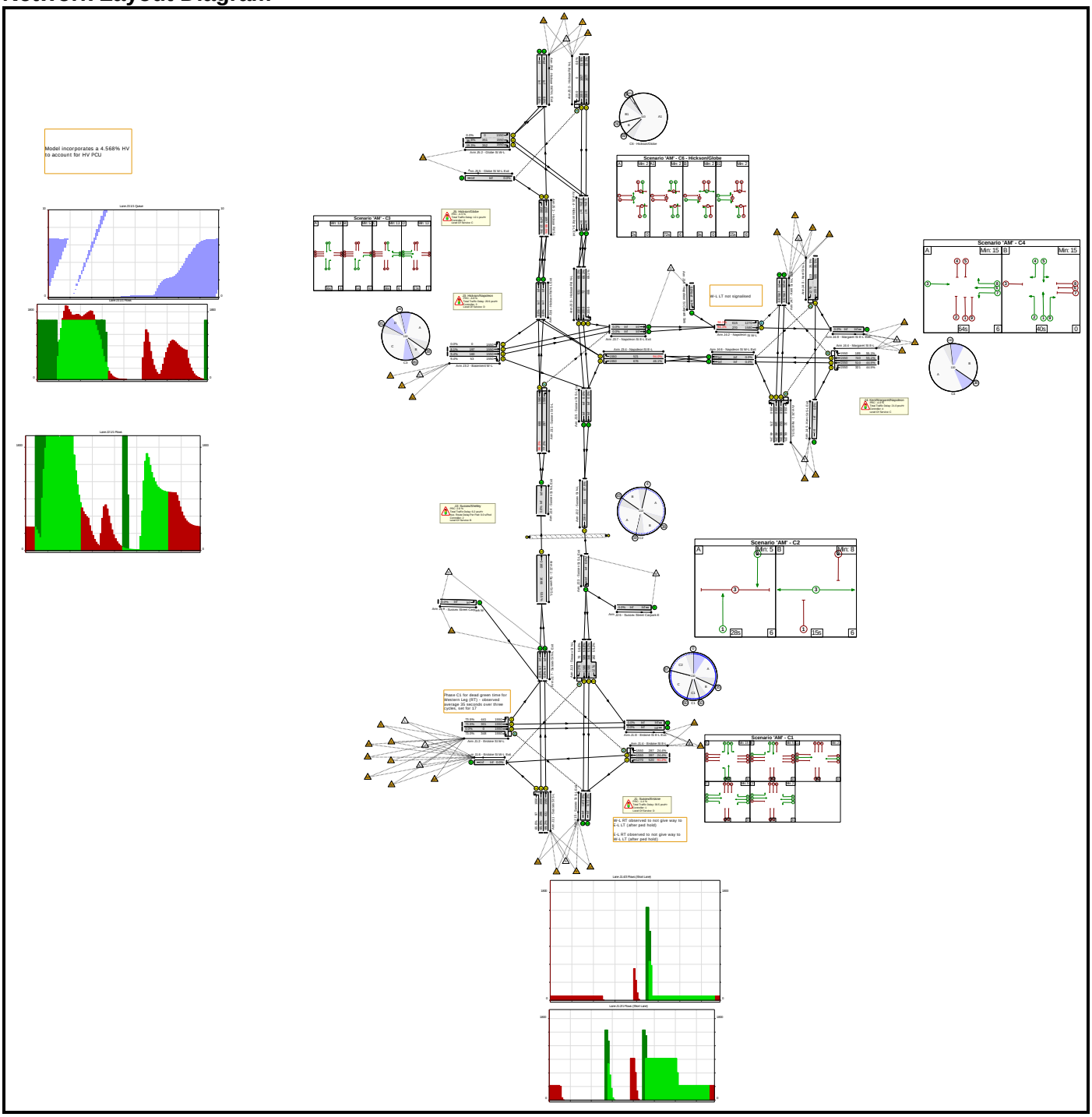
4/2+4/1	Margaret St E-L Left Ahead	U	319	1550:1550	63.2 : 63.2%	40.6	8.9
4/3+4/4	Margaret St E-L Ahead Right	U+O	402	1550:1550	70.4 : 70.4%	40.7	11.5
J5: Hickson/Globe	**-**	**-**	**-**	**-**	**75.5%**	**-**	**-**
1/1	Hickson Rd S-L Left	U	245	1550	17.4%	1.6	0.2
1/2	Hickson Rd S-L Ahead	U	926	1550	75.5%	9.9	7.6
2/2+2/1	Globe St W-L Right Left	U	79	1550:1550	43.9 : 43.9%	62.8	2.6
2/3	Globe St W-L Right	U	20	1550	10.9%	54.4	0.6
3/1	Hickson Rd N-L Ahead	U	687	1580	43.5%	2.0	0.4
3/2+3/3	Hickson Rd N-L Ahead Right	U+O	317	1550:1550	26.0 : 0.0%	5.0	2.6

C1	PRC for Signalled Lanes (%):	-9.2	Total Delay for Signalled Lanes (pcuHr):	50.35	Cycle Time (s):	110
C2	PRC for Signalled Lanes (%):	10.9	Total Delay for Signalled Lanes (pcuHr):	8.79	Cycle Time (s):	110
C3	PRC for Signalled Lanes (%):	-10.3	Total Delay for Signalled Lanes (pcuHr):	49.12	Cycle Time (s):	110
C4	PRC for Signalled Lanes (%):	-5.9	Total Delay for Signalled Lanes (pcuHr):	31.80	Cycle Time (s):	110
C5	PRC for Signalled Lanes (%):	0.0	Total Delay for Signalled Lanes (pcuHr):	0.00	Cycle Time (s):	110
C6 - Hickson/Globe	PRC for Signalled Lanes (%):	19.1	Total Delay for Signalled Lanes (pcuHr):	4.78	Cycle Time (s):	110
	PRC Over All Lanes (%):	-10.3	Total Delay Over All Lanes(pcuHr):	145.22		

Basic Results Summary

Scenario 1: 'AM' (FG1: 'Flow Group 1', Plan 1: 'Network Control Plan 1')

Network Layout Diagram



Basic Results Summary

Network Results

Item	Lane Description	Lane Type	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Deg Sat (%)	Av. Delay Per PCU (s/pcu)	Mean Max Queue (pcu)
Network	-	-	-	-	**96.2%**	-	-
J1: Sussex/Erskine	-	-	-	-	**91.2%**	-	-
1/2+1/1	Sussex St S-L Left Ahead	U	249	1550:1550	65.0 : 65.0%	49.5	7.4
1/3	Sussex St S-L Ahead	U	298	1580	69.2%	49.2	9.2
2/2+2/1	Erskine St W-L Left Ahead	U	545	1550:1550	73.5 : 73.5%	30.1	13.2
2/3+2/4	Erskine St W-L Right Ahead	U+O	254	1550:1550	0.0 : 73.0%	57.1	8.4
3/2+3/1	Sussex St N-L Ahead Left	U	297	1580:1270	55.2 : 55.2%	33.1	3.3
3/3+3/4	Sussex St N-L Ahead Right	U+O	369	1580:1270	56.0 : 56.0%	22.7	4.9
4/1	Erskine St E-L Left	U	474	1270	91.2%	63.8	17.9
4/2+4/3	Erskine St E-L Ahead Right	U+O	167	1550:1550	24.4 : 24.4%	21.1	2.6
J2: Sussex/Shelley	-	-	-	-	**87.5%**	-	-
1/1	Sussex St S-L Ahead	U	892	3160	53.5%	7.1	3.0
2/1	Sussex St N-L Ahead	U	729	1580	87.5%	22.0	12.2
Ped Link: P1	Shelley	-	0	-	0.0%	Inf	Inf
J3: Hickson/Napoleon	-	-	-	-	**96.2%**	-	-
1/1	Sussex St S-L Ahead	U	663	1580	96.2%	54.2	20.4
1/2	Sussex St S-L Right	O	229	1550	77.2%	48.8	8.3
2/2+2/1	Basement W-L Left Ahead	U	16	1550:1550	8.1 : 0.0%	52.3	0.5
2/3+2/4	Basement W-L Right Ahead	U	20	1550:1550	9.4 : 9.4%	51.7	0.5
3/2+3/1	Hickson Rd N-L Ahead Left	U	525	1550:1550	69.1 : 69.1%	14.3	7.9
3/3	Hickson Rd N-L Ahead	U	362	1580	68.1%	36.6	10.8
4/1	Napoleon St E-L Left	U	312	1550	46.1%	18.4	5.3
4/2	Napoleon St E-L Right	U	490	1550	94.0%	65.6	20.2
J4: Kent/Margaret/Napoleon	-	-	-	-	**94.1%**	-	-
1/2+1/1	Kent St S-L Left Ahead	U	214	1550:1550	46.1 : 46.1%	37.7	5.0
1/3+1/4	Kent St S-L Ahead Right	U+O	387	1550:1550	66.3 : 66.3%	37.7	10.7
2/2+2/1	Napoleon St W-L Left Ahead	U+O	833	1580:1270	94.1 : 94.1%	35.6	33.2
3/1+3/2	Kent St N-L Ahead Right Left	U+O	219	1550:1270	35.5 : 35.5%	32.0	4.2

Basic Results Summary

4/2+4/1	Margaret St E-L Left Ahead	U	370	1550:1550	44.5 : 44.5%	18.6	6.6
4/3+4/4	Margaret St E-L Ahead Right	U+O	512	1550:1550	55.1 : 55.1%	17.9	9.6
J5: Hickson/Globe	**-**	**-**	**-**	**-**	**90.5%**	**-**	**-**
1/1	Hickson Rd S-L Left	U	197	1580	13.3%	1.5	0.1
1/2	Hickson Rd S-L Ahead	U	956	1550	90.5%	29.3	31.9
2/2+2/1	Globe St W-L Right Left	U	136	1550:1550	38.8 : 0.0%	44.4	3.8
2/3	Globe St W-L Right	U	68	1550	19.3%	40.7	1.8
3/1	Hickson Rd N-L Ahead	U	347	1580	32.2%	9.6	4.5
3/2+3/3	Hickson Rd N-L Ahead Right	U+O	336	1550:1550	31.8 : 0.0%	9.6	4.3

C1	PRC for Signalled Lanes (%):	-1.4	Total Delay for Signalled Lanes (pcuHr):	30.52	Cycle Time (s): 110
C2	PRC for Signalled Lanes (%):	2.9	Total Delay for Signalled Lanes (pcuHr):	6.21	Cycle Time (s): 110
C3	PRC for Signalled Lanes (%):	-6.8	Total Delay for Signalled Lanes (pcuHr):	29.88	Cycle Time (s): 110
C4	PRC for Signalled Lanes (%):	-4.6	Total Delay for Signalled Lanes (pcuHr):	20.95	Cycle Time (s): 110
C5	PRC for Signalled Lanes (%):	0.0	Total Delay for Signalled Lanes (pcuHr):	0.00	Cycle Time (s): 110
C6 - Hickson/Globe	PRC for Signalled Lanes (%):	-0.5	Total Delay for Signalled Lanes (pcuHr):	12.12	Cycle Time (s): 110
	PRC Over All Lanes (%):	-6.8	Total Delay Over All Lanes(pcuHr):	99.68	