aurecon

Project: Barangaroo Central Waterfront Promenade and Interim Public Domain - Development Application

Traffic Impact Assessment

Reference: 230341

Prepared for:
Baulderstone Pty Ltd

Revision: 4

30 October 2012

Barangaroo

Leading. Vibrant. Global.
www.aurecongroup.com

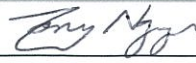
Document Control Record

Document prepared by:

Aurecon Australia Pty Ltd
ABN 54 005 139 873
Level 2, 116 Military Road
Neutral Bay NSW 2089
PO Box 538
Neutral Bay NSW 2089
Australia

T +61 2 9465 5599
F +61 2 9465 5598
E sydney@aurecongroup.com
W aurecongroup.com

Document control						aurecon
Report Title		Traffic Impact Assessment				
Document ID			**Project Number**		230341	
File Path		P:\CIV\230341\Barangaroo Central DA-TIA\Report\FINAL\Final-rev04\IN\Barangaroo_Central_TIA-FINAL-rev04.docx				
Client		Baulderstone Pty Ltd	**Client Contact**			
Rev	**Date**	**Revision Details/Status**	**Prepared by**	**Author**	**Verifier**	**Approver**
0	3 September 2012	Draft report	TN	TN	PS	CH
1	18 September 2012	Final draft report	TN	PS/TN	PS	CH
2	3 October 2012	Final	TN	TN	PS	CH
3	9 October 2012	Final – BDA comments	TN	TN	PS	CH
4	30 October 2012	Final - meeting at BDA	TN	TN	PS	CH
Current Revision		4				

Approval			
Author Signature		Approver Signature	
Name	Tony Nguyen	Name	Colin Henson
Title	Transport Planner/Modeller	Title	Senior Transport Planner

Executive Summary

This Traffic Impact Assessment report was prepared to address the traffic and transport implications of the proposed subject development at Barangaroo Central Waterfront Promenade and Interim Public Domain. The transport analyses for the potential works, in addition to the neighbouring construction works proposed to occur simultaneously, are presented. This report addresses the construction related impacts for Barangaroo Central, within the context of the operation of the proposed development in the overall Barangaroo scheme.

This assessment concluded that the impacts of the subject development are less than other peak construction and operational impacts and are therefore acceptable. The recommendations of this assessment include:

Construction

- Construction movements require appropriate management so that impacts are minimised, particularly during the morning peak period to the main entry/exit Gate No. 5 in addition to the Sussex Street/Napoleon Street/Hickson Road intersection. The use of Traffic Controllers with associated traffic control devices would aid in the management of construction activities along Hickson Road.
- Construction activities must be cognisant of major events throughout the year (such as Australia Day and New Year's Eve) to allow priority and safety for participants. Halting construction activities during special major events scheduled adjacent to Barangaroo would be recommended to minimise potential conflicts of construction vehicle movements with pedestrians.
- Any sections of the road, including kerb and footpaths, that are damaged by construction vehicles should be rectified at the cost of the contractor at the completion of the construction period. It is recommended that a survey of the existing conditions be undertaken prior to the commencement of construction works.
- Construction staff should be encouraged to use public transport by the provision of public transport information.

Operation

- The Sussex Street/Napoleon Street/Hickson Road intersection may require upgrading to traffic signals as part of the overall Barangaroo Scheme, with a minimal demand due to the subject development.
- A parking management scheme for special major events would be required to manage the expected influx of attendees.
- Promotion of public transport usage should be part of the scheme in addition to installing special event clearways along Hickson Road.

Contents

Appendices

List of Figures

List of Tables

List of Acronyms

AADT	Annual Average Daily Traffic
BDA	Barangaroo Delivery Authority
BHP	Barangaroo Headland Park
BPL	Baulderstone Pty Ltd
DGR	Director General's Requirements
LOS	Level of Service
RMS	Roads and Maritime Services
TIA	Traffic Impact Assessment
TMAP	Transport Management and Accessibility Plan

1. Introduction

Aurecon was engaged by Baulderstone Pty Ltd (BPL), on behalf of Barangaroo Delivery Authority (BDA), to undertake a Traffic Impact Assessment (TIA) for the proposed subject development of Barangaroo Central Waterfront Promenade and Interim Public Domain Works. The TIA is prepared in response to the Director General's Environmental Assessment Requirements (DGRs) to support a Development Application for Barangaroo Central.

1.1 Background

The Barangaroo area is envisioned to be developed into an actively diverse cultural and civic centre. For the purposes of development the Barangaroo site is divided into three distinct areas being Barangaroo Headland Park (BHP) at the northern end, Barangaroo Central and Barangaroo South.

The Barangaroo Central Waterfront Promenade and Interim Public Domain is the first phase in the development of the Barangaroo Central site and are scheduled to be completed in 2015.

1.2 Purpose of report

The TIA report is prepared to address the transport and accessibility requirements as outlined in the DGRs. The objective of the TIA report is to understand the potential traffic and transport implications, if any, arising from the construction and operation of the proposed development at Barangaroo Central. Furthermore, the identification of impacts would lead to recommendations of appropriate transport management measures to mitigate against those impacts identified.

This report provides the Traffic Impact Assessment for Barangaroo Central which aims to assist BPL, and ultimately BDA, in the planning approvals pathway. The TIA report will supplement Barangaroo Transport Management and Accessibility Plan (TMAP), September 2008.

1.3 Methodology

Aurecon's approach to this Traffic Impact Assessment is based on the expected activities for the construction and operation of Barangaroo Central, with information sourced from previous studies/reports and supplied data from BPL and/or BDA. The methodology that Aurecon has undertaken addresses the potential issues and outlines the corresponding mitigation measures. This was achieved through the following tasks:

- A site inspection to determine the existing traffic environment
- A review of relevant background documents
- The collection of traffic data through previously undertaken studies/reports
- The assessment of construction and operational vehicles and their potential impacts
- The proposal of traffic management measures to mitigate any impacts

1.4 Director General's Requirements

To set a clear structure for this TIA report and the transport and accessibility issues that are required to be addressed, the following reaffirms the DGRs which are assessed in this document. Prepare a Traffic Impact Assessment (TIA) that:

- Evaluates daily and peak traffic movements likely to be generated by the development (construction & operation), including peak traffic movements during special events.

- Provides network modelling that captures dynamic and co-ordinated traffic light operations to assess the impact on the surrounding road network. This modelling should include the interaction between pedestrian and vehicular traffic.
- Identifies upgrades to roads/intersections required to facilitate the proposal.
- Identifies pedestrian/cycle connections required to service the precinct, taking into consideration connections to external networks.
- Identifies the cumulative impacts associated with other construction and operational activities on the Barangaroo site.
- Details access arrangements for workers to/from the site, emergency vehicles and service vehicle movements.

1.5 Background documentation

To establish and investigate the potential implications arising from the Barangaroo Central development, an understanding of the relevant studies and reports published to date was required. A review of the supporting background documentation was undertaken to source relevant information for the purposes of this TIA, but more importantly to maintain a consistent approach with the data and assumptions adopted. The background documents reviewed as part of this TIA consisted of the following:

- *Barangaroo Integrated Transport Plan*, NSW Government-Transport for NSW, August 2012.
- *Barangaroo Central – Waterfront Promenade and Interim Public Domain Works, Request for Director-General's EIS Requirements*, MG Planning Pty Ltd, July 2012.
- *Barangaroo South – C3 Commercial Building Construction Traffic Management Plan*, Arup, Revision E, 19 July 2012.
- *Barangaroo South – C5 Commercial Building Construction Traffic Management Plan,* Arup, Revision D, 19 July 2012.
- *Submission to Barangaroo Review*, Lend Lease, 20th June 2011.
- *Sussex Street Pedestrian Bridge Transport Assessment*, Arup, Revision H, 31 May 2012.
- *Barangaroo Headland Park Main Works Traffic Impact Assessment and Construction Management Plan*, Halcrow, Revision 1.3, 26 October 2010.
- *Barangaroo Transport Management and Accessibility Plan for Request for Detailed Proposal – Stage 1*, NSW Government, September 2008. The following addendums are referenced:
  - Mod 4 Concept Plan TMAP – public document dated August 2010
  - Mod 1 – C4 TMAP – public document dated 12 October 2012
  - C3 TMAP – public document dated 18 Nov 2011 – Rev B
  - C5 TMAP – public document dated 8 Nov 2011 – Rev A

It is worth noting that the addendums to the TMAP report, those listed above, are available online from the NSW Government Planning & Infrastructure website and were sourced at the time of preparing this TIA report (August 2012). Furthermore, the information extracted from the abovementioned documents, for the purposes of this TIA, has been assumed to be valid and accurate.

2. Assessment criteria

In addition to the principles for transport and access that have been adopted for the Barangaroo development, the TIA for the proposal at Barangaroo Central has been developed with the following principles in mind to ensure:

- The provision of a safe road environment for road users and workers alike.
- The overall impact on other road users is kept to a minimum.
- Access is maintained for the local community, transport operators and various land uses.
- Road users and local communities are informed, as appropriate, in relation to any changed traffic conditions.

Performance criteria for the TIA have been devised to:

- Ensure safety for all road users is not reduced, particularly the more vulnerable users (pedestrians and cyclists). Where existing access is likely to be disrupted by construction traffic, measures should be put in place to provide reasonable alternative access (with a focus on safety and accessibility).
- Minimise major road closures during peak events, where practicable.
- Avoid detouring bus routes off their regular routes unless necessary construction works mean that a regular bus route cannot operate along a section of route. Where detours of bus routes are required, keep detours to a minimum with regard to distance of detour, number of missed stops, and duration the detour is required (avoid peak periods where possible).
- Ensure that heavy vehicles are not detoured onto local roads, but redirected onto alternative Regional or State Roads.
- Ensure routes for construction traffic (heavy vehicles in particular) to and from work sites avoid streets with sensitive land uses, where practicable.
- Avoid conflict in traffic movements between heavy vehicles for Barangaroo Central and other operating businesses in the area.

3. Proposed development

3.1 Site Context

The public domain in Barangaroo Central will be the connector between BHP and the urban precinct of Barangaroo South, and will contain elements common to both of these areas. It will extend the BHP Promenade along the harbour to Barangaroo South as well as providing significant spaces for public recreation and leisure, and for major events.

The Barangaroo Central Waterfront Promenade and Interim Public Domain is the first stage in the development of the Barangaroo Central site and are scheduled to be completed in 2015.

3.2 Location and layout

Barangaroo is a 22-hectare site that extends north-south along the foreshore of Sydney Harbour and is located west of the city's central business district. The proposed site of the Barangaroo Central Waterfront Promenade and Interim Public Domain works is located within the central portion of the Barangaroo site as outlined in Figure 3.1[1]. It can be seen to the north of Barangaroo Central will be the BHP and to the south will be the commercial, residential, retail and tourism precinct for Barangaroo.

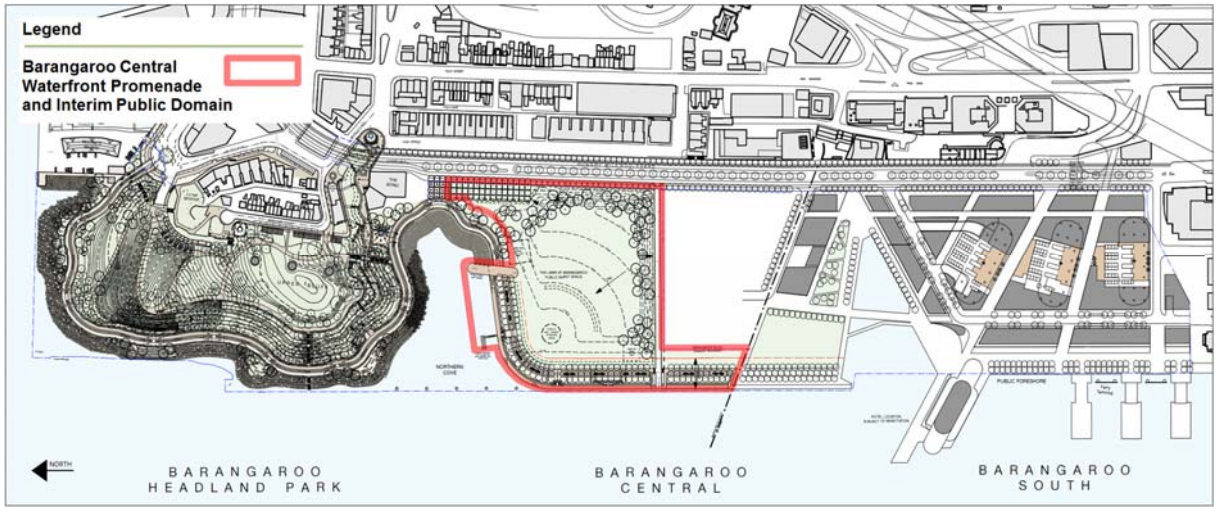


Figure 3.1[1] Barangaroo Central Waterfront Promenade and Interim Public Domain site area

The Barangaroo Central Waterfront Promenade and Interim Public Domain is located on the Barangaroo Central site, and is bounded by the Northern Cove and BHP to the north, the harbour to the west, Hickson Road to the east, and the Lend Lease Temporary Construction Staging Area to the south. Figure 3.2 further illustrates how the subject site is divided into two areas of works.

[1] Source: *Barangaroo Central – Waterfront Promenade and Interim Public Domain Works, Request for Director-General's EIS Requirements*, MG Planning Pty Ltd, July 2012

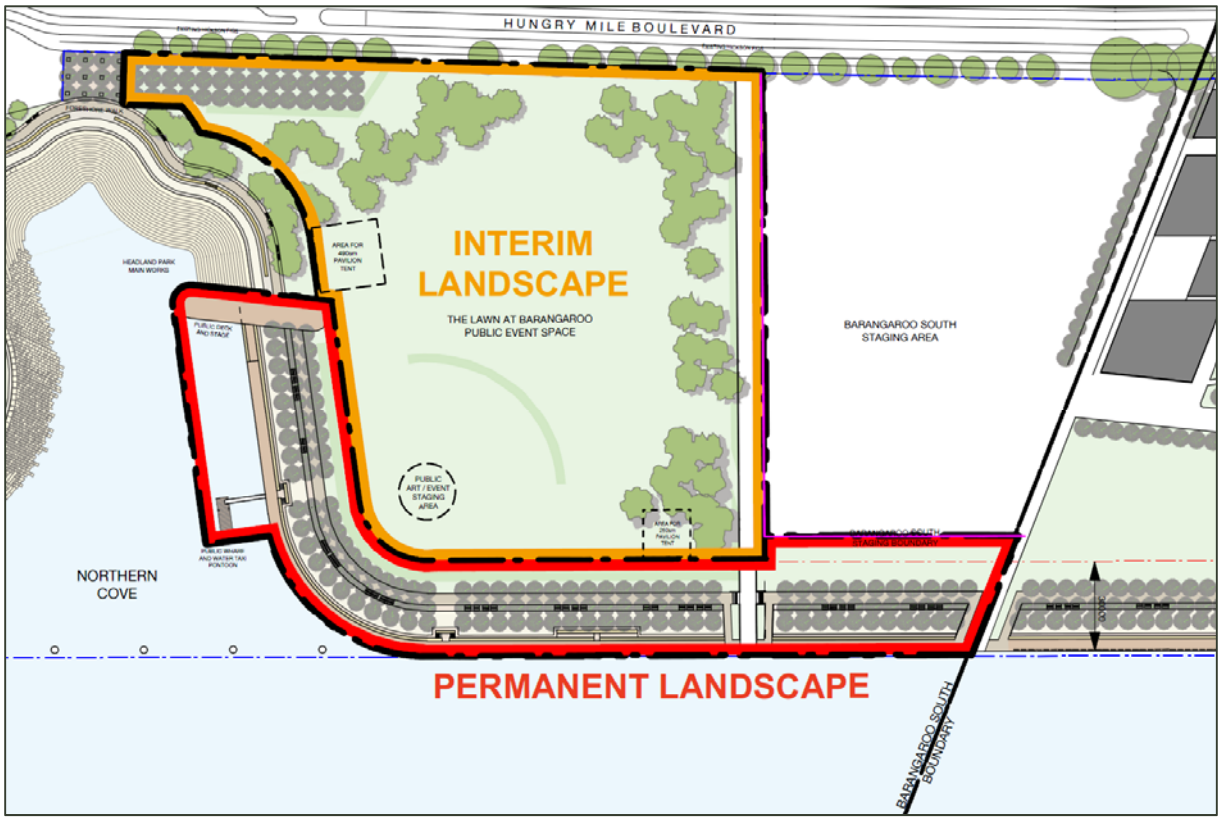


Figure 3.2[2] **Public Domain outline design plan**

The long term works area, shown above as the permanent landscape, consists of the Barangaroo Central Waterfront Promenade which covers the harbour frontage and extends the length between the public deck at the Northern Cove to the Barangaroo South staging area.

The interim works area, shown above as the temporary landscape, comprises of the remainder of the subject site for the Barangaroo Central Interim Public Domain, intended for recreation, leisure activities and future events.

3.3 Intended Use

The Barangaroo Central Waterfront Promenade and Interim Public Domain is the first stage in the development of the Barangaroo Central site and are scheduled for completion in 2015. The Barangaroo Central Waterfront Promenade and Interim Public Domain seek to deliver an active and connected waterfront that is in place at the time of completion of the BHP and partial completion of Barangaroo South.

The Barangaroo Central Waterfront Promenade will include a tree lined public promenade and a lower level boardwalk. The Promenade will provide public access along the harbour edge for pedestrians and cyclists. The lower level boardwalk will provide water edge access for pedestrians. A portion of the Promenade will accommodate deep water berthing and infrastructure for special events but not for long term stopping. A pontoon in the Northern Cove will provide small boat, drop-off access.

The Barangaroo Central Interim Public Domain comprises an interim lawn area that will accommodate major public gatherings, casual sports use and picnicking etc., as well as space for major and minor public and special events. The interim lawn includes two locations for future pavilions and potential

[2] Source: Barangaroo Outline Design Plan: Public Domain, PWP Landscape Architecture, August 31, 2012

public art and event staging areas. Major public and special events may include concerts, festivals, outdoor theatre and circuses.

It is envisaged that major events may be staged in the Interim Public Domain each year and attract up to 15,000 attendees per event per location.

3.4 Project description

The Barangaroo Central Waterfront Promenade covers the zone from the harbour edge approximately 30 m into the site, and extends along the full length of the Barangaroo Central site from the eastern side of the public deck in the Northern Cove to the Barangaroo South boundary.

The Barangaroo Central Waterfront Promenade will integrate with and continue the foreshore Promenade from BHP to Barangaroo South, whilst acknowledging the character of each precinct.

Key landscaping elements of the Promenade design will include:

- Planting including shade trees along the Promenade
- Paving and walls including pavements for pedestrians, cyclists and vehicular (emergency and maintenance) traffic, and sandstone block walls adjacent to the boardwalk
- Timber boardwalk along the lower level waterfront edge
- Furniture including seats, rubbish bins, drinking fountains, bike racks and life buoys along the Promenade and at key locations
- Signage
- Lighting

Where applicable, these elements will generally be based on the BHP design unless otherwise stated and will be permanent in nature.

The key structural elements include:

- Western Edge Treatment:
  - Ongoing use of the existing caissons as a seawall
  - New retaining walls inside the western edge to raise the levels of the western Promenade
  - Retain existing bollards and fenders for large vessel mooring
  - Timber boardwalk along the Promenade founded on the existing caissons, and associated stairs and ramps
- Northern Edge Treatment:
  - Structural concrete slab beneath boardwalk
  - Timber boardwalk along the Promenade founded on the new reinforced concrete retaining wall and adjacent fill , and associated stairs and ramps
- Water taxi pontoon and access ramp
- Public pier

  Note: the structural works required to form the Northern Cove are included in the BHP Main works and were included in planning approvals for the BHP.

The Barangaroo Central Interim Public Domain covers the remainder of the site. The Barangaroo Central Interim Public Domain will provide a flexible public space to address the various intended end uses.

Key landscaping elements of the Barangaroo Central Interim Public Domain designs will include:

- Planting including an interim lawn of a suitable quality to support the expected leisure and recreation activities such as touch football, and occasional major events

- Signage
- Provision of infrastructure for two future Pavilions and potential Public Art and Event Staging Areas including all necessary services to support the intended end use of these facilities.

These elements may differ from the Promenade unless otherwise stated due to the interim nature of this area.

The **civil works** comprises predominantly earthworks, pavements and road works. These works are located in both the permanent Barangaroo Central Waterfront Promenade and the Barangaroo Central Interim Public Domain, and should be designed to support the intended use and achieve the required design life in each area in the most cost effective manner.

The earthworks operation should seek to maximise the reuse of fill material from Barangaroo to reduce off-site disposal and fill importation. However all fill used on the Barangaroo Central site must be suitable for use and not contain unacceptable levels of contaminants.

The key civil elements include:

- Earthworks tore-profile the interim public domain area
- Filling to raise the levels along the Promenade by approximately 1m to 1.5m
- A permanent pavement along the Promenade
- A temporary access way connecting the Promenade to Hickson Road

All required services will be provided to support the intended use including stormwater, sewer, potable water irrigation, telecommunications, security, electrical and public lighting. This will include the provision of all services necessary to support the use of the future temporary pavilion areas and public art / event staging area, and to hold major public events, unless otherwise stated.

Generally permanent services should be provided to support the permanent Barangaroo Central Waterfront Promenade, and temporary services should be provided to support the Barangaroo Central Interim Public Domain unless otherwise stated. Regardless of this approach all services that are required in the Barangaroo Central Waterfront Promenade area for the future operation of the Barangaroo site will be installed. This will ensure that services works are not required in this area in the future.

3.5 Land use and zoning[3]

Under the State Environmental Planning Policy (Major Development) 2005, Barangaroo Central is partially zoned as both Public Recreation and Mix Use as illustrated in Figure 3.3[3].

The Barangaroo Central Waterfront Promenade will include a tree lined pathway and a lower level boardwalk providing public access along the harbour edge for pedestrians and cyclists. The Promenade will also provide deep water berthing and the associated facilities for special events, however no long term mooring/berthing will be allowed. A pontoon will be provided in the Northern Cove for small boats and drop-off access.

The Barangaroo Central Interim Public Domain will consist of a lawn area that will facilitate public gatherings for casual sports use and/or picnicking as well as for major public and special events. The lawn will include areas for temporary pavilions and a public art/event staging area, referring back to Figure 3.2[3]. It is envisaged that a number of major events may utilise the Interim Public Domain area of Barangaroo Central each year. Both the Barangaroo Central Waterfront Promenade and Interim Public Domain are intended to be accessible by the public on a full-time basis.

[3] Source: *Barangaroo Central – Waterfront Promenade and Interim Public Domain Works, Request for Director-General's EIS Requirements*, MG Planning Pty Ltd, July 2012

Figure 3.3[3] **Barangaroo Central land use and zoning**

3.6 Modal split[4]

The Concept Plan Approval documentation including the Transport Report has adopted mode split targets for the journey to work in the Barangaroo precinct. The targets have been retained in the Concept Plan Modification and the revised Transport Concept Plan.

The targets are:

- 83% by public transport (63% rail, 20% bus);
- 12% pedestrian/other;
- 4% car;
- 1% ferry.

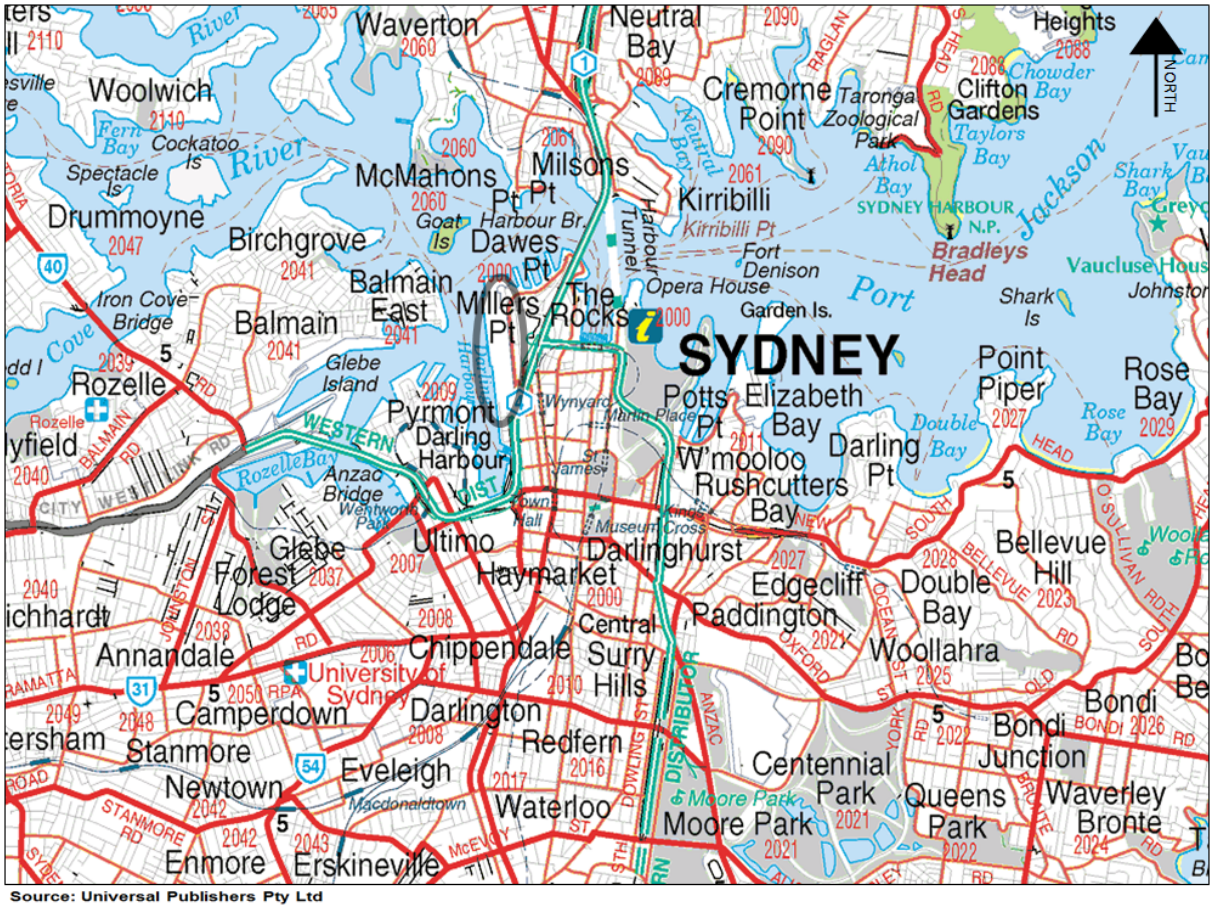
These targets have been adopted where applicable in this TIA report.

[4] *Barangaroo Transport Management and Accessibility Plan for Request for Detailed Proposal – Stage 1*, NSW Government, September 2008

4. Existing traffic situation

4.1 Location

The Barangaroo area is located along the foreshore of Sydney Harbour and is located west of the city's central business district as circled in Figure 4.1.



Source: Universal Publishers Pty Ltd

Figure 4.1 Barangaroo location

4.2 Road hierarchy[5]

Under the Roads Act 1993, roads are classified under a legal framework which divides them into three administrative categories. The categories include freeways, primary arterial roads, secondary or sub-arterial roads, Collector and local access roads. The NSW State, Regional and Local Road administrative system of road classification generally aligns to the following model hierarchy:

- State Roads – Freeways and primary arterials
- Regional Roads – Secondary or sub-arterials
- Local Roads – Collector and local access roads

[5] NSW Road Classification Review Panel – Final Report, August 2007, RMS

Figure 4.2 **Barangaroo Central study area of influence**

State Roads are defined as the primary network of roads providing links within urban centres of Sydney, Newcastle, Wollongong, the Central Coast, and throughout NSW. State Roads generally include roads classified as Freeways, National/State Highways (SH) and Main Roads (MR) under the Roads Act. State Roads are the responsibility of the NSW Roads and Maritime Services (RMS, formerly Roads and Traffic Authority, RTA) however the local governing council remains the owner, providing maintenance, for State Roads other than Freeways. The RMS only exercises authority for the function of the road as a State Road (such as road pavement and structures).

Regional Roads (RR) are defined as the secondary road network which, together with State Roads, provide for travel between towns and districts, performing a sub-arterial function within major urban centres. Regional Roads are the responsibility of the local governing council and generally include roads classified as Secondary Roads with some Main Roads.

Local Roads consist of those roads not classified under the Roads Act. Local Roads are collector and local access roads which provide linkages to State and Regional Roads as well as within developed areas. Local Roads are the responsibility of the local governing authority.

4.3 Study area of influence

The Barangaroo area is located within the suburb of Millers Point, which is under the local government authority of City of Sydney Council. However, the Barangaroo area is managed by the Barangaroo Delivery Authority (BDA), whose role is to oversee the waterfront development and to deliver a coordinated and financially responsible outcome that encompasses the highest of standards in urban design, public domain and sustainability.

For the purposes of this TIA, the identified study area of influence for the proposed Barangaroo Central Waterfront Promenade and Interim Public Domain is outlined in Figure 4.2 (note the internal roads of the Barangaroo site, as shown, do not exist and are featured as part of the mapping source). Note the boundary for the Barangaroo Central site, as illustrated, is an approximation of its location and footprint. The three identified intersections to be assessed for any impacts are circled. The existing

signalised intersection of Shelley Street with Sussex Street is not included in this analysis because the future of this area is subject to further discussions regarding the establishment of a Transport Interchange connecting the proposed ferry wharf with Margaret Street and Wynyard.

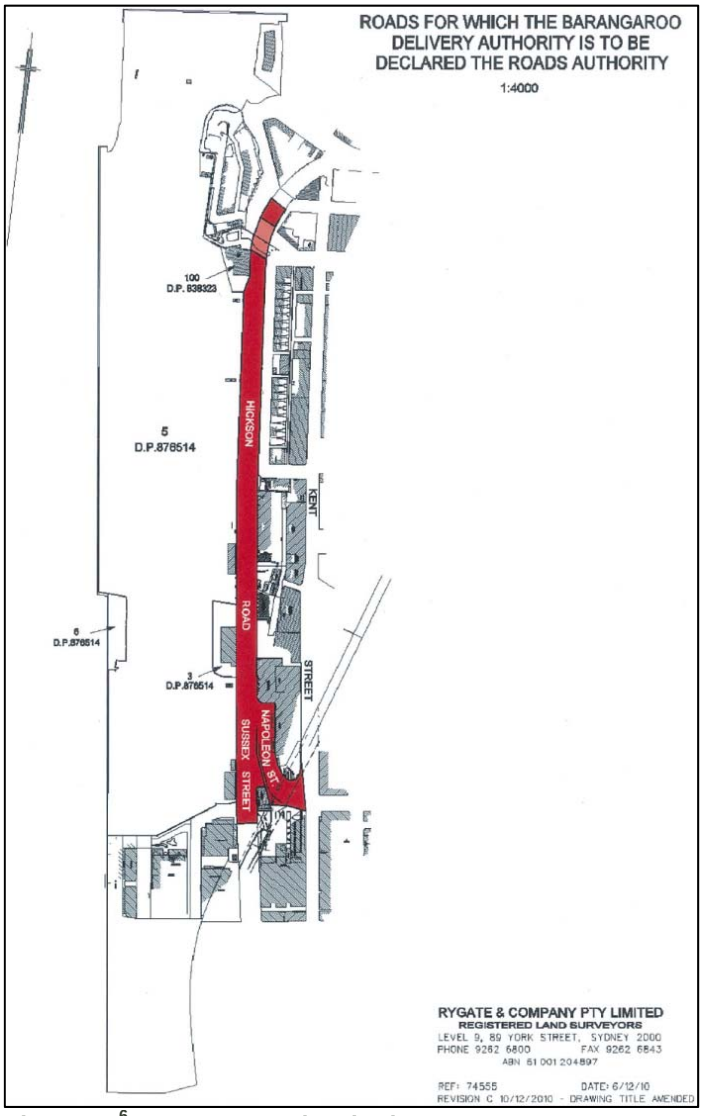


Figure 4.3[6] **BDA road authority extent**

4.4 Classified road

The following describes the general attributes of the key road that provides access to Barangaroo Central. Hickson Road is the only classified road that provides direct access to the Barangaroo area. The remaining roads within the vicinity would be classified as local roads.

4.4.1 Hickson Road

According to the Schedule of Classified Roads and State & Regional Roads (RMS, version 2011/1, as at 31 January 2011), Hickson Road together with Sussex Street, between the intersections of Erskine Street and Lower Fort Street, is classified as a Regional Road (MR7312) and is under the care and control of City of Sydney Council. However, for the purposes of the Barangaroo development area, BDA is declared as the road authority. Refer to Figure 4.3[6] for the limits of BDA's road authority along Hickson Road and Sussex Street (including Napoleon Street).

Hickson Road provides one traffic lane in each direction with a variety of restricted on-street angle and parallel parking on both sides of the roadway. The prevailing speed limit along Hickson Road is signposted at 50 km/h. There are four locations along Hickson Road where speed cushions are present.

There are no RMS count stations along Hickson Road and/or Sussex Street. The closest count station (Erskine Street/Kent Street intersection) recorded approximately 17,602 vehicles per day according to the RMS Traffic Volume Data in 2005. No further traffic volume data is available from RMS after 2005 for the location.

4.5 Heavy vehicle access

RMS has roads and zones throughout Sydney which are approved for Restricted Access Vehicles (RAV) as well as Higher Mass Limits (HML) for certain heavy vehicles to travel along. The heavy vehicle types for the approved operation consist of:

- Short combination vehicles (standard six-axle semi-trailers)
- B-doubles

[6] Source: http://www.barangaroo.com/media/57936/declared_road_area_map_6_%20dec_2009.pdf, accessed August 2012

- Road trains

The classified road section of Hickson Road (MR7312) is an approved RAV route which only permits 4.6 m high vehicles. Note B-doubles are not permitted to travel along Hickson Road. Moreover, there are no HML for heavy vehicles along MR7312.

4.6 Traffic volume data

4.6.1 RMS count station data

RMS collects and publishes traffic volume data at various count station sites located throughout Sydney and NSW. As the general governing road authority, RMS is known to collect traffic data at various sites for certain survey years (Sydney's survey years being 2005, 2008-2009). The collection of traffic data assists RMS with understanding any changing traffic volume trends on the road network.

As previously mentioned, the closest RMS count station site to Barangaroo is located at the intersection of Erskine Street and Kent Street (traffic control signal, TCS 307). According to RMS Traffic Volume Data for Sydney Region 2005, count stations record Annual Average Daily Traffic (AADT) volumes, among other traffic data, which indicate changing traffic volume trends. Table 4.1 provides AADT volumes for all the approaches of the Erskine Street/Kent Street intersection count station site.

Table 4.1 AADT volume for Erskine Street/Kent Street intersection count site

Station Number	Location	Annual Average Daily Traffic Volume (AADT)				
		1996	1999	2002	2005	Linear growth rate per annum (1996-2005)*
00.984*	Kent Street / Erskine Street intersection (TSC307)	17783	17591	17307	17602	-0.11%

*Sample station – consists of traffic volume data recorded for a brief survey period for the survey year.

Based on the historic traffic volume data from Table 4.1, it is evident that there was no significant change in AADT volumes between the periods of 1996 to 2005 for station 00.984. It was advised by RMS that the 2005 AADT volume data for station 00.984 is the latest available, with no further AADT traffic data collected thereafter in conjunction with any data available along Sussex Street and/or Hickson Road adjacent to the Barangaroo site.

4.6.2 Traffic survey data

Traffic survey data was sourced from various background documents previously prepared for the Barangaroo development, from those listed in Section 1.5, to determine the key traffic volumes at the three identified intersections and, more importantly, to help maintain a consistency with the data input for the analyses. The main background documents in which traffic survey data was extracted from are:

- *Barangaroo Headland Park Main Works Traffic Impact Assessment and Construction Management Plan*, Halcrow, Revision 1.3, 26 October 2010.
- *Barangaroo South – C3 Commercial Building Construction Traffic Management Plan*, Arup, Revision E, 19 July 2012.
- *Barangaroo South – C5 Commercial Building Construction Traffic Management Plan,* Arup, Revision D, 19 July 2012.

Figure 4.4[7] and Figure 4.5[8] illustrate the traffic survey data that has been adopted for the intersection analyses for the purposes of this TIA. The traffic survey data shown in Figure 4.4 for the Towns Place/Hickson Road intersection was collected in 2010 with the peak hour period as indicated. The traffic survey data in Figure 4.5 was collected by AECOM on Tuesday 8 November 2011 with no indication of what the morning and afternoon peak hour period was.

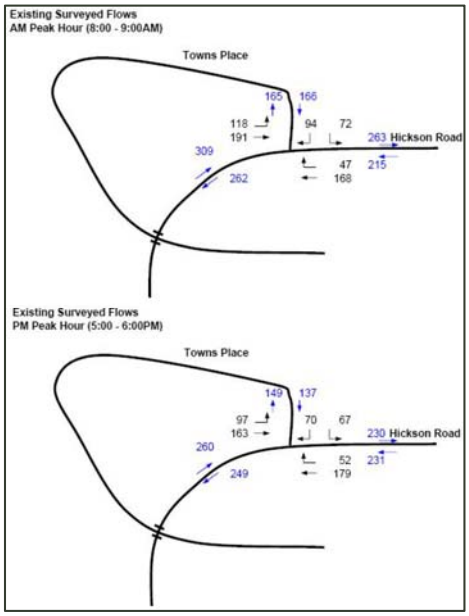


Figure 4.4[7] **AM-PM peak hour traffic volumes for Towns Place/Hickson Road intersection**

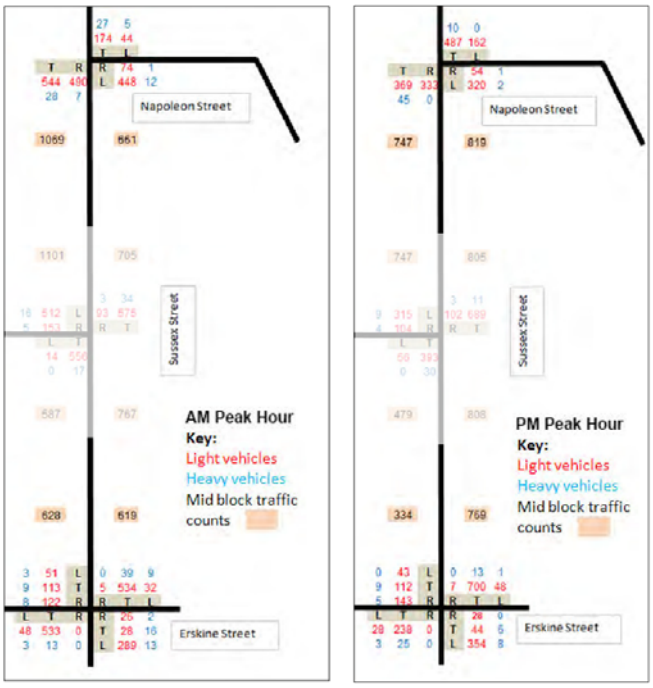


Figure 4.5[8] **AM-PM peak hour traffic volumes for Napoleon Street and Erskine Street intersections with Sussex Street**

[7] *Barangaroo Headland Park Main Works Traffic Impact Assessment and Construction Management Plan*, Halcrow, Revision 1.3, 26 October 2010

[8] *Barangaroo South – C3 Commercial Building Construction Traffic Management Plan*, Arup, Revision E, 19 July 2012
Barangaroo South – C5 Commercial Building Construction Traffic Management Plan, Arup, Revision D, 19 July 2012

4.7 Intersection analyses

The Director Generals Requirements include provision of network modelling that captures dynamic and co-ordinated traffic light operations to assess the impact on the surrounding road network. This modelling should include the interaction between pedestrian and vehicular traffic.

This TIA carefully considered the use of dynamic network modelling packages such as LinSig or Paramics. LinSig is a software tool which allows traffic engineers to model traffic signals and their effect on traffic capacities and queuing. As well as modelling the effects of traffic signals, LinSig also optimises signal timings to reduce delay or increase capacity at a junction or group of interlinked junctions. Paramics simulates the individual components of traffic flow and congestion, and presents its output as a real-time visual display for traffic management and road network design. Paramics represents the actions and inter-actions of individual vehicles as they travel through a road network. It models the detailed physical road layout, and includes features such as bus operations, traffic signal settings, driver behavioural characteristics and vehicle kinematics.

One of the key impediments to using these types of models for the subject development was the lack of detail and certainty in the future road layouts and development of other sites. There was no agreed layout for Hickson Road or the detail of the intersections along it, such as number of lanes, road location, and location of pedestrian crossings. There was no detail of how the Transport Square connecting Wynyard Walk to the new ferry terminal proposed in the Barangaroo Integrated Transport Plan[9] would be shaped to link with buses and light rail and pedestrian bridges, or how the Transport Square would be operated to manage pedestrian and vehicle flows along Hickson Road and Shelley Street. Speculation on these issues within the modelling for the subject TIA would have created far greater variability on the layout and modelling results than the relatively minor traffic impacts of the subject development at Barangaroo Central.

Other traffic and pedestrian management changes to Margaret Street and the wider Wynyard precinct traffic and bus flows would also have as yet undefined effects on the co-ordination of traffic signals and traffic flows.

Another key reason for not creating another dynamic transport model was that the future traffic generation of Barangaroo Central, in construction and operation scenarios, will be less than the level of increased traffic already modelled in detail in the Arup LinSig modelling for Barangaroo South and by Halcrow for the Barangaroo Headland Park. This issue of relatively lower and later traffic generation after the earlier peak activity years of other construction is described further in future impact assessments in the following sections 5.1 and 6.1 and Appendix B.

The existing and future intersection situations were therefore analysed using the SIDRA modelling package.

The peak hour traffic volumes for each intersection were analysed using SIDRA Intersection for the existing traffic situation. The intersection analysis will help determine the current operating performance of the intersections, which will form the basis to evaluate the potential impacts, if any, of the proposed Barangaroo Central development.

SIDRA Intersection is an advanced micro-analytical traffic evaluation tool that employs lane-by-lane and vehicle drive-cycle models coupled with an iterative approximation method to provide estimates of capacity and performance statistics (delay, queue length, level of service, etc).

The SIDRA Intersection software is for use as an aid for design and evaluation of signalised intersections (fixed-time/pre-time and actuated), signalised pedestrian crossings, single point

[9] BITP Figure 10

interchanges, roundabouts, two-way stop sign control, all-way stop sign control, and give-way sign control.

4.7.1 Intersection signal data

To analyse the signalised intersection of Sussex Street and Erskine Street using SIDRA, traffic signal data was sourced from the background document *Barangaroo South – C5 Commercial Building Construction Traffic Management Plan* prepared by Arup, in which signal timings were supplied.

4.7.2 Intersection analyses

To understand how each intersection operates under existing traffic conditions, the RMS Level of Service (LOS) criteria were used. The LOS parameter gives a good indication of how well an intersection operates. The *Austroads Guide to Traffic Management Part 12: Traffic Impacts of Development* in conjunction with the *RTA Guide to Traffic Generating Developments, October 2002* provides the criteria used to determine the Level of Service. Table 4.2 outlines the LOS criteria. Note that the LOS is determined by delay at an intersection, rather than the degree of saturation.

Table 4.2 RMS LOS criteria for intersections*

LOS	Average Delay per Vehicle (secs/veh)	Traffic Signals, Roundabout	Give Way & Stop signs
A	Less than 14	Good Operation	Good Operation
B	15 to 28	Good with acceptable delays & spare capacity	Acceptable delays & spare capacity
C	29 to 42	Satisfactory	Satisfactory, but accident study is required
D	43 to 56	Operating near capacity	Near capacity & accident study required
E	57 to 70	At capacity; at signals, incidents will cause excessive delays	At capacity, requires other control mode
F	> 70	Over capacity, unstable operation	Over capacity, unstable operation

* Note that the RMS LOS criteria differs from the Austroads Guide in terms of average delay per vehicle, as Austroads references the Highway Capacity Manual 2000.

Degree of Saturation (DS)

The degree of saturation value indicates the ratio of arrival volumes to capacity. Values above 1.0 represent oversaturated conditions (arrival volumes exceed capacity) whereas degrees of saturation below 1.0 represent under-saturated conditions (arrival volumes are below capacity).

Average Delay

The average delay is the amount of seconds that each vehicle, which arrives during the specified peak period, incurs in waiting to pass through the intersection.

Level of Service (LOS)

Level of service is an overall indication of the operational performance of traffic on any given intersection, traffic lane or roadway. The best indicator of LOS at a signalised intersection is the average delay in seconds experienced by vehicles over all movements whereas for a priority control intersections and roundabouts, the best LOS indicator is the maximum delay for the corresponding movement.

4.7.3 Results

For the purposes of this TIA, the existing traffic scenario shall be modelled for the current year 2012. It is worth nothing the traffic survey data sourced Table 4.3 outlines the summarised SIDRA results for the intersections from the traffic survey data extracted from the background documents.

Table 4.3 Existing traffic intersection performance results

		Existing traffic SIDRA results					
		AM			PM		
Intersection*	Control type	DS	Average Delay (secs/veh)	LOS	DS	Average Delay (secs/veh)	LOS
Towns Place/Hickson Road	Priority Give Way	0.214	8.9	A	0.166	8.6	A
Sussex Street/Napoleon Street/Hickson Road	Priority Stop	0.653	15.2	B	0.622	20.3	B
Sussex Street/Erskine Street	Signalised	0.455	23.5	B	0.535	29.6	C

* For priority control intersections, the maximum DS, delay and LOS are reported. Average values are reported for signal intersections.

It can be seen from Table 4.3 that the existing performance of the three identified intersections within the study area of influence results in good operation. The average delay per vehicle is minimal with the intersections having spare capacity. The above results demonstrate similar outcomes to those previously presented in Arup's Barangaroo South reports, as referenced in Section 1.5.

However, it should be noted that Arup's results reported a LOS F for the Sussex Street/Erskine Street intersection in the PM peak, in comparison to SIDRA resulting in LOS C as noted in Table 4.3. The difference in results is mainly due to the two through lanes on the northern approach, which in LINSIG comprises of saturation flows of 920 each, while SIDRA adopted basic saturation flows of 1950 vehicles per hour per lane. Manually altering the saturation flow in SIDRA to equal 920 for the same lanes-approach produces a LOS F.

Therefore the following observations are made for the Sussex Street/Erskine Street intersection in relation to the LINSIG modelling previously undertaken:

- The saturation flows for the through lanes are lower than the adjacent left and right turn lanes for the northern approach.
- The saturation flows adopted for the through lanes of the intersection are lower than the saturation flows of through lanes of other intersections in the modelling undertaken.

The inconsistent saturation flows used in each of the scenarios modelled in LINSIG, and also considering the inputs/outputs for the SIDRA analyses, would therefore support the modified approach adopted in this assessment.

For detailed results of the intersection analyses, refer to Appendix A.

4.7.4 Pedestrian analysis

With the absence of detailed pedestrian volume data for the purposes of this assessment, the intersection modelling for Erskine Street and Sussex Street was required to adopt some broad assumptions in attempting to determine the level of influence and interaction between pedestrians and vehicular traffic.

Referencing Arup's *Sussex Street Pedestrian Bridge Transport Assessment*, similar assumptions were adopted where applicable, to assist in the pedestrian analysis at the Erskine Street/Sussex Street intersection. Furthermore, pedestrian-related background reports undertaken within vicinity of the subject area for Barangaroo Pedestrian Link and other projects indicate pedestrian volumes for the Erskine Street/Kent Street intersection range between 600 – 1300 pedestrians in the morning and afternoon peak hour periods.

Therefore to simulate a potential worst case scenario for the existing Erskine Street/Sussex Street intersection in terms of pedestrian capacity, a volume of 1300 pedestrians was applied to each approach in the SIDRA models to determine the impact, if any, of pedestrians to vehicular traffic. The LOS results, taking into account the pedestrian and vehicular traffic interaction are as presented in Table 4.3.

4.8 Parking

The following on-street parking provisions are present as observed:

- Along Sussex Street, between Erskine Street and Shelly Street but mainly beneath the Western Distributor overpass, there is restricted parking for vehicles and motorbikes.
- Along Sussex Street, between Shelly Street and Napoleon Street, there is restricted parallel on-street parking available only.
- Along Hickson Road, between Napoleon Street and Towns Place, there is a combination of 90 degree rear to kerb and parallel restricted parking. Information available online from City of Sydney Council suggests there are 120 spaces for motorbikes.
- Towns Place provides 90 degree rear to kerb restricted parking (northern side) for vehicles under 6m only.

4.9 Pedestrian linkages

The following locations provide existing pedestrian facilities:

- Sussex Street/Erskine Street intersection provides signalised pedestrian crossings on all four approaches.
- Napoleon Street approach to Sussex Street/Hickson Road intersection provides a midblock pedestrian refuge.
- There is a marked pedestrian zebra crossing on Hickson Road, approximately 90 m north from Napoleon Street. Note that the marked crossing location is adjacent to a construction access gate for the current Barangaroo South civil works at the time of preparing this report.
- All approaches of the Towns Place/Hickson Road intersection provides marked pedestrian zebra crossings.

Generally, Sussex Street, Hickson Road, Napoleon Street and Towns Place provide footpaths on either side of the roadway.

4.10 Cycling

Figure 4.6[10] illustrates the existing cycle routes that surround the Barangaroo development site.

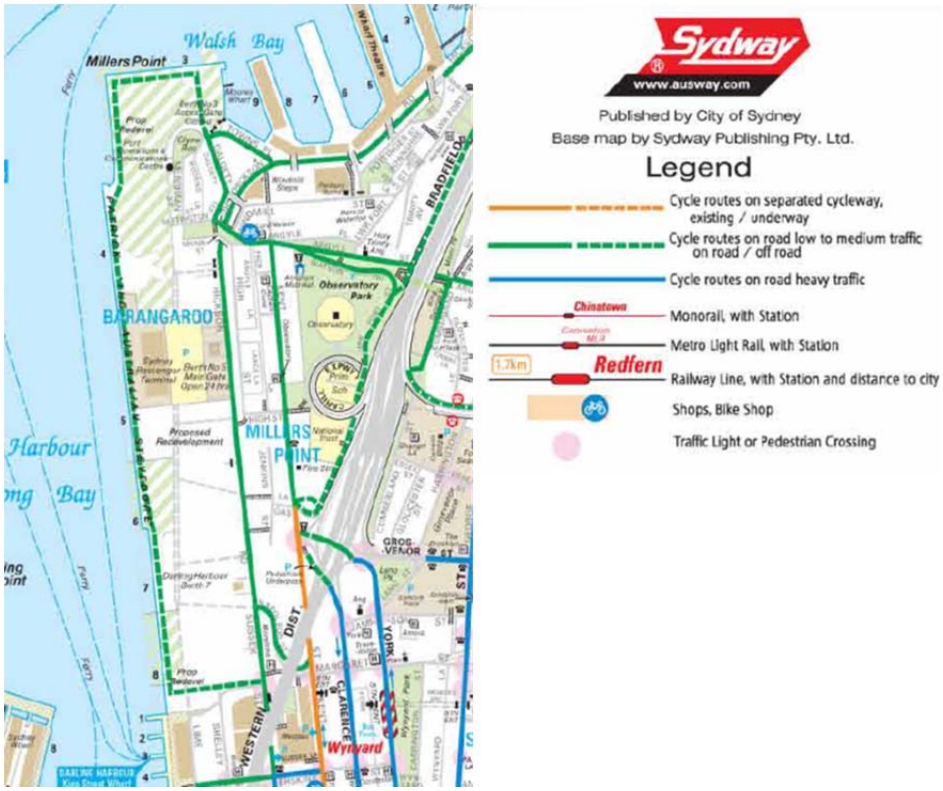


Figure 4.6[10] Existing cycle routes surrounding Barangaroo development site

Data on existing cycling at Barangaroo is limited. RMS has installed bicycle counters throughout Sydney since 2002 to monitor bicycle usage. The data from the bicycle counters reveals the following significant increases in bicycle usage: The average weekly daily count has increased by 68% from 2524 in 2002 to 4235 in 2007. Whilst there are no permanent counters at Barangaroo, the counter on the nearby Sydney Harbour Bridge Cycleway increased from 696 to 1023 cyclists. Since the completion of the first stage of the Kent Street cycleway in December 2010, bike counts[11] have increased by 95 per cent during the peak travel periods, from 778 riders to 1,518 cyclists per day.

[10] http://sydneycycleways.net/wp-content/uploads/Cycling-Map-Section-B.pdf, accessed August 2012

[11] City of Sydney Press Release, 8 February 2012

4.11 Public transport

4.11.1 Bus services

There are no operating bus routes along Sussex Street and the majority of Hickson Road according to the public transport information line (http://www.131500.com.au, accessed August 2012). However, as illustrated in Figure 4.7, there is a bus route (433 – Balmain & Glebe Point to City via Glebe) that traverses a short section of Hickson Road and Towns Place.

Figure 4.7 Bus route map

4.12 Taxis

There are existing taxi provisions located between Napoleon Street and Erskine Street along Sussex Street and further south, as illustrated in Figure 4.8[12]. The taxi rank locations are generally located on the western side of Sussex Street.

Figure 4.8[12] Existing taxi ranks near Barangaroo

[12] http://www.cityofsydney.nsw.gov.au/aboutsydney/parkingandtransport/LateNightTransport.asp, accessed August 2012

5. Construction impact assessment

5.1 Proposed construction details

Based on information provided by BPL, in addition to those sourced from the background documents, the following describes the proposed construction activities and associated movements with indicative durations that would be anticipated for the construction of Barangaroo Central. Furthermore, an assessment is presented as to the extent the construction related activities would impact on the study area of influence.

5.1.1 Construction timeframe

BDA suggests an indicative timeline for the development of the entire Barangaroo site as outlined in Table 5.1[13]. For the purposes of this TIA, the yearly scenarios are adopted as a general guide for the impact assessment assumptions. Table 5.1 suggests that 2013 would be the year with significant multiple construction activities occurring throughout the entire Barangaroo site.

Table 5.1 BDA indicative timeline

2012	2013	2014	2015	2016	2017-2020
Commence Bulk Excavation for basement construction and first commercial towers at Barangaroo South	Continue construction of commercial towers at Barangaroo South	Commence construction of hotel (subject to relocation negotiations)	**Barangaroo Headland Park complete**	Barangaroo Central works continue	**Barangaroo Central works continue and complete**
Barangaroo Headland Park construction continues	Temporary cruise passenger terminal closes and new terminal opens at White Bay	Barangaroo Central works commence	First two commercial buildings at Barangaroo South complete, as well as waterfront residential, promenade and Hickson Road commercial	Third commercial tower	**Barangaroo South works continue and complete**
Commence construction of Wynyard Barangaroo Pedestrian Link	Commence construction of Hickson Rd commercial buildings at Barangaroo South	Remediation of former Millers Point Gasworks continues and nears completion	Wynyard Walk and other pedestrian linkages complete	Hotel completed (subject to relocation negotiations).	
Remediation trial of former Millers Point Gasworks commences	Barangaroo Headland Park construction continues		**Barangaroo Central Waterfront Promenade and Interim Public Domain works complete to link South and Barangaroo Headland Park**		
	Remediation of former Millers Point Gasworks continues				

[13] http://www.barangaroo.com, accessed August 2012

In addition to the indicative construction timeline in Table 5.1, certain background documents presented an indicative combined construction program that sets out the estimated construction durations for key civil works relating to various Barangaroo developments. Figure 5.1[14] below reproduces the combined construction program which has been expanded to include the indicative works program in relation to Barangaroo Central Waterfront Promenade and Interim Public Domain.

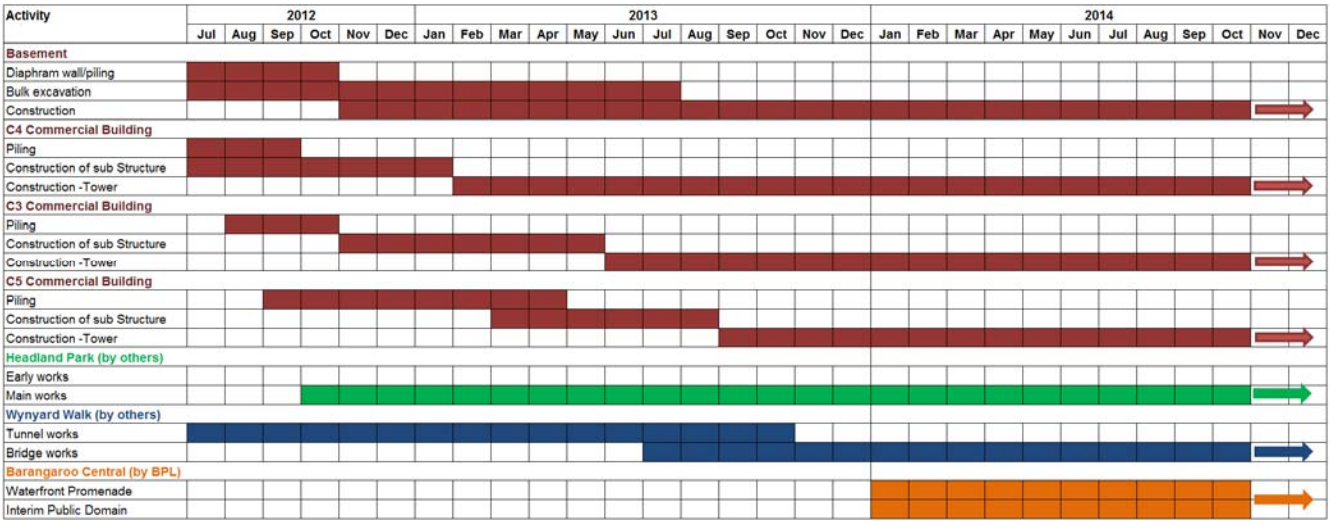


Figure 5.1[14] Indicative combined construction program for Barangaroo

Figure 5.1 originally illustrated indicative construction programs for the three commercial buildings (C3, C4 and C5) for Barangaroo South, BHP and Wynyard Walk. Following a meeting between Aurecon and BPL in August 2012, preliminary construction program details were supplied by BPL which suggested the timeframes for the expected civil works associated with Barangaroo Central Waterfront Promenade and Interim Public Domain. The preliminary works program for Barangaroo Central provided by BPL is presented in Appendix B.

In conjunction with Figure 5.1, Appendix D[14] replicates the table and graph of the anticipated construction traffic volumes from Arup which has been extended to incorporate the Barangaroo Central indicative program. Note that the peak in Barangaroo Central construction traffic occurs well after the peak of the other sites combined and is of lower overall traffic volumes. The associated construction traffic volumes are further explored in Section 5.1.3.

For the purposes of this TIA in addition to advice from BPL, the construction scenario is assumed for the year 2014, as this is when the intended civil works will occur in relation to Barangaroo Central Waterfront Promenade and Interim Public Domain.

5.1.2 Construction methodology

This section describes construction information relating to the development of Barangaroo Central as advised by BPL. Relevant construction details have also been adopted from previous background documents which tie in the scope of works for the overall Barangaroo site to help maintain a consistent approach in the information presented.

[14] *Barangaroo South – C3 Commercial Building Construction Traffic Management Plan*, Arup, Revision E, 19 July 2012
Barangaroo South – C5 Commercial Building Construction Traffic Management Plan, Arup, Revision D, 19 July 2012

Construction vehicles

BPL advises that construction vehicles and plant expected for Barangaroo Central would consist of, but not be limited to, the following:

- Concrete trucks
- Truck and dog trailers
- Flatbed trucks
- Oversized plant/machinery delivery

Construction personnel

BPL suggested that the number of on-site construction staff may possibly peak at approximately 40 personnel at any one time.

Construction hours of operation[14]

The proposed construction hours are:

- 7am – 6pm Monday to Friday
- 8am – 3pm Saturday
- No work on Sunday and public holidays

Works outside of these general hours would only be permitted in circumstances that include:

- Work that is inaudible at residential premises.
- The delivery of material outside of these hours as requested by police or other authorities for safety reasons.
- Emergency work to avoid the loss of lives, damage to property and/or to prevent environmental harm.
- Other works expressly approved by the Director-General of the Department of Planning and Infrastructure.
- Outside of standard hours identified in the Construction Noise and Vibration Management Plan approved by the Director General.

RMS has suggested that additional restriction times for trucks on York Street from 6am to 10am and from 2pm to 6pm on weekdays may be necessary to reduce potential adverse effects on bus services.

Construction vehicle access

BPL advises that the main access gate to be used for the construction of Barangaroo Central would be Gate No. 5 along Hickson Road, which is located approximately 470 m north of Napoleon Street. Emergency services such as ambulance and fire trucks would also use this access during this period. Furthermore, the proposed construction haulage routes proposed to/from the Barangaroo Central site match those previously proposed in Arup's reports[14]. Figure 5.2 to Figure 5.4 are extracts from Arup's report which outline the proposed construction vehicle access/egress routes.

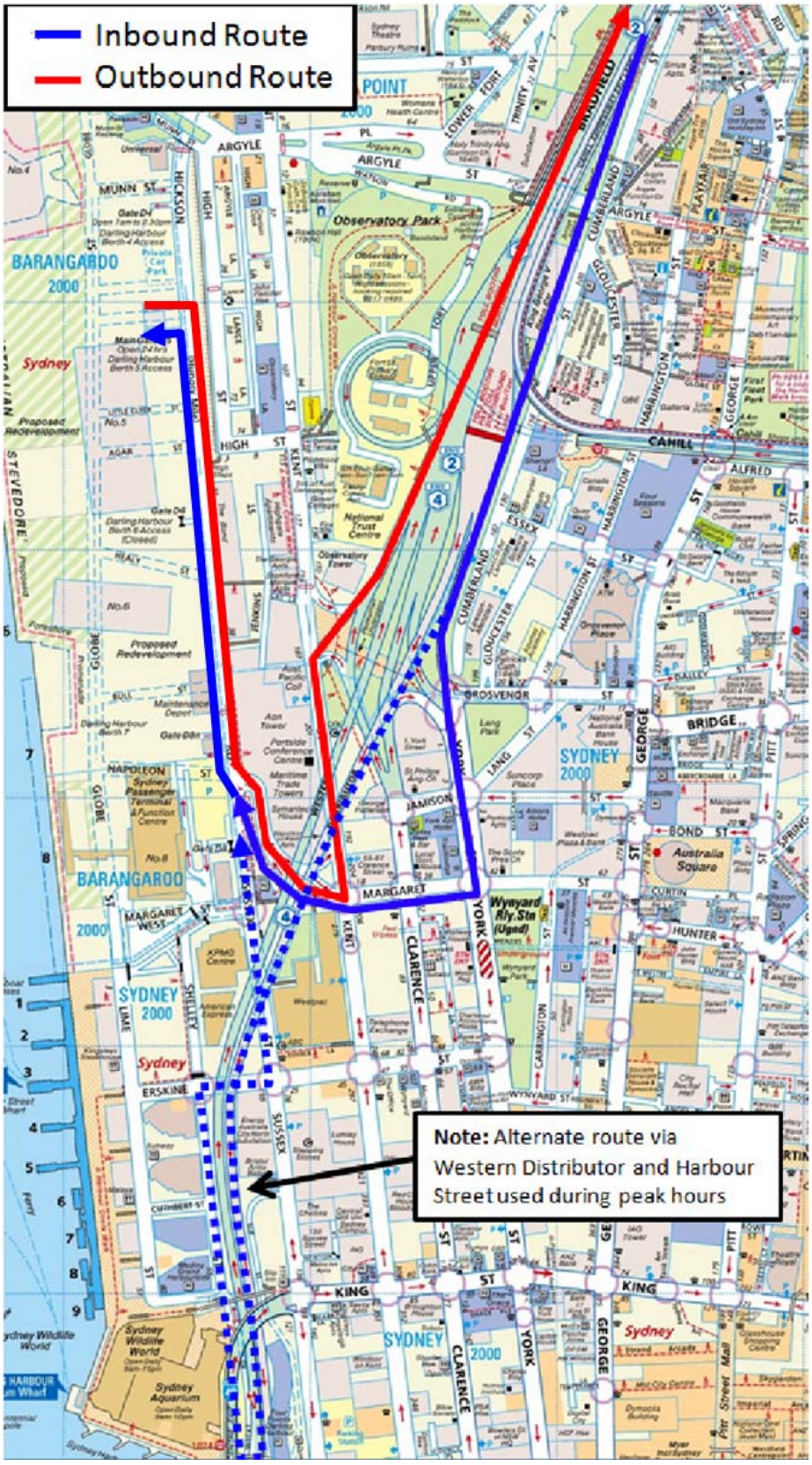


Figure 5.2[14] **Construction vehicle access route to/from the north**

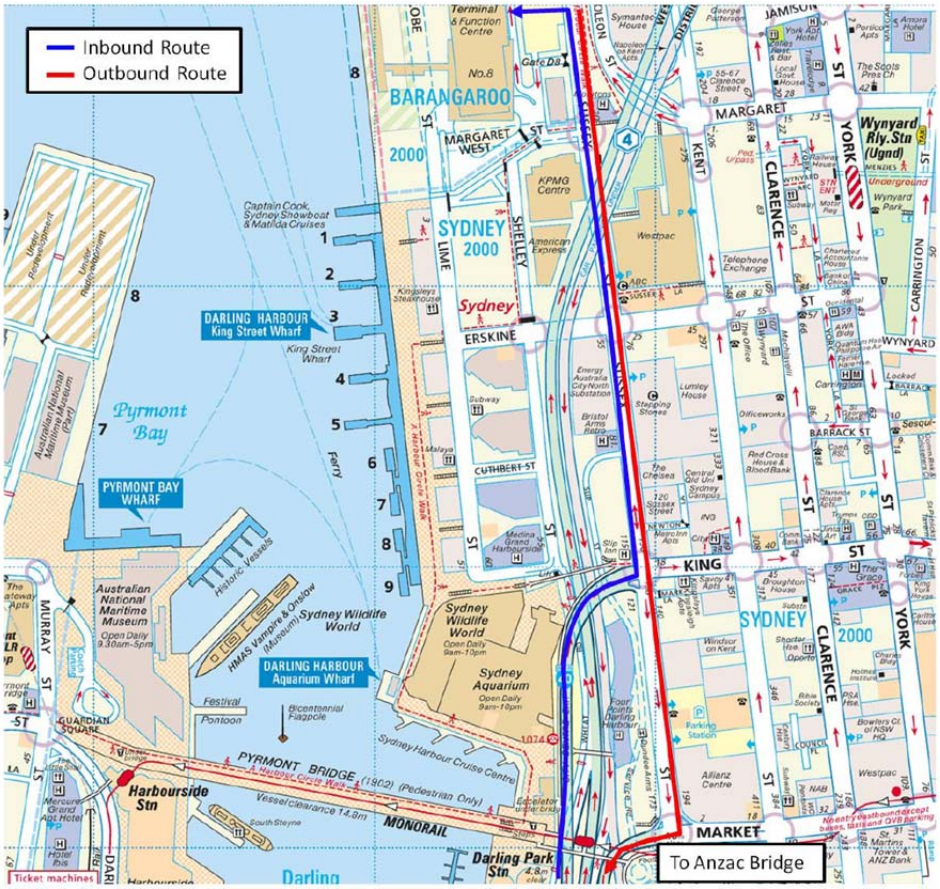


Figure 5.3[14] **Construction vehicle access route to/from the west (Anzac Bridge)**

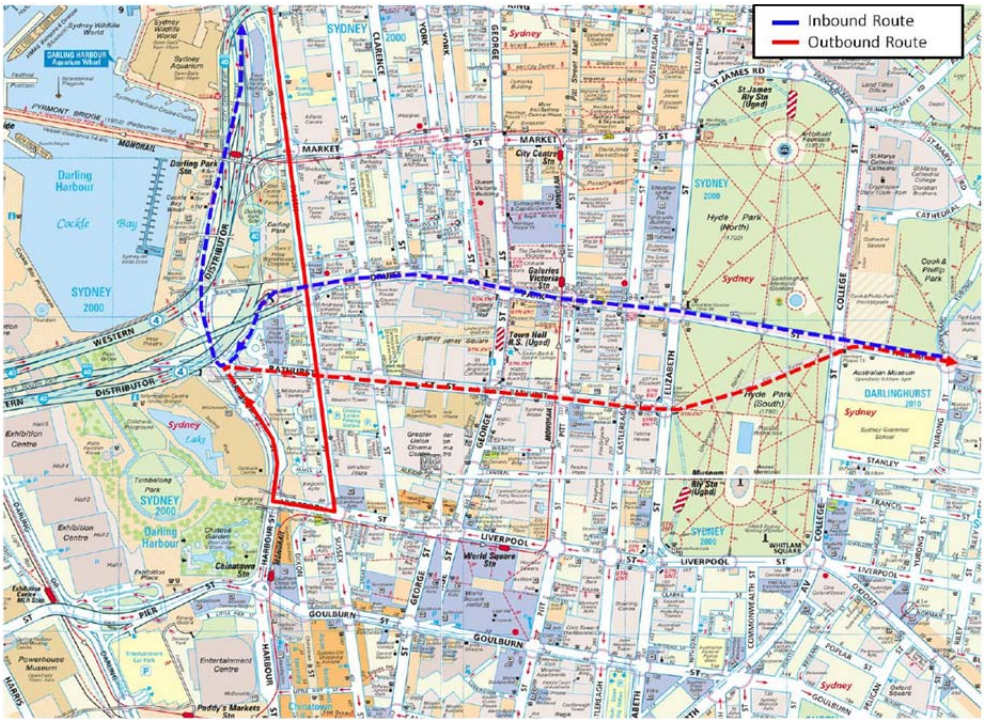


Figure 5.4[14] **Construction vehicle access route to/from the south and east**

5.1.3 Traffic generation

Estimated traffic generation from Barangaroo Central during construction

An estimate of construction-related vehicle movements would be required to understand the overall traffic volume generated by the construction of Barangaroo Central. At this stage of the preliminary construction program, BPL suggests that during the anticipated major works for Barangaroo Central, the following construction traffic movements are expected to occur during the morning peak period:

- Number of truck movements – 20 vehicles (in) and 20 vehicles (out)
- Number of light vehicle movements – 40 vehicles (in) and 20 vehicles (out)

A total of 80 (one way, or 160 two-way) heavy construction vehicle movements are expected to occur daily during the construction of Barangaroo Central. During the peak construction period, it is expected that approximately 40,000m^3 to 60,000m^3 of fill material will be transported to the site as advised by BPL.

Appendix D[15] replicates the table and graph of the anticipated construction traffic volumes which has been extended to incorporate Barangaroo Central. With reference to Figure 5.1, the table and graph in Appendix D presents the generated construction volumes for Barangaroo Central in conjunction with Arup's generated volumes. It should be noted that the 2014 construction volumes in Appendix D are those relating to Barangaroo Central only, as listed above, and does not include generated volumes from the surrounding construction activities, as no data is available beyond December 2013; only that advised by BPL.

In reality, it would be expected that the combination of surrounding construction activities would increase vehicle movements in addition to those from Barangaroo Central, however due to the absence of further construction information, it would be difficult to estimate the total cumulative amount of trucks and cars that would be generated.

Estimated traffic generation from other developments (excluding Barangaroo Central) during the construction period of Barangaroo Central

Based on the information obtained from the *Barangaroo South – C3 Commercial Building Construction Traffic Management Plan*, Arup, Revision E, 19 July 2012, the majority of vehicle movements from the Barangaroo South, BHP and Wynyard Walk work sites are expected to occur during the morning peak period. Therefore, assuming that the number of trucks and cars from December 2013 continues onto January 2014 (due to the absence of data), the following volumes would be expected:

- Number of truck movements – 46 vehicles (in) and 44 vehicles (out)
- Number of light vehicle movements – 188 vehicles (in) and 48 vehicles (out)

Estimated traffic generation from all developments (including Barangaroo Central) during the construction period of Barangaroo Central

The cumulative construction traffic movements for the Barangaroo South, BHP, Wynyard Walk work sites and including Barangaroo Central during the morning peak period from January 2014 onwards are as follows:

- Number of truck movements – 66 vehicles (in) and 64 vehicles (out)
- Number of light vehicle movements – 228 vehicles (in) and 68 vehicles (out)

[15] *Barangaroo South – C3 Commercial Building Construction Traffic Management Plan*, Arup, Revision E, 19 July 2012
Barangaroo South – C5 Commercial Building Construction Traffic Management Plan, Arup, Revision D, 19 July 2012

Estimated peak traffic generation from other developments prior to the construction of Barangaroo Central

The following peak traffic movements were estimated in the Arup report[14] for the Barangaroo South, BHP and Wynyard Walk work sites during the morning peak hour period in July 2013:

- Number of truck movements – 75 vehicles (in) and 72 vehicles (out)
- Number of light vehicle movements – 172 vehicles (in) and 50 vehicles (out)

Comparison between peak traffic generation prior to and during the construction of Barangaroo Central

The total number of peak truck movements during the construction of Barangaroo Central would be lower than the peak truck movements generated from the other construction sites prior to the construction of Barangaroo Central whilst, light vehicle movements are expected to increase by 56 (in) and 18 (out). The effect of these light vehicle movements are assessed and presented in the intersection analyses in the subsequent sections.

Refer to Appendix C for the traffic generation peak volumes for the estimated intersection volumes.

5.1.4 Traffic distribution

Considering the existing intersection performance of the identified intersections, the following traffic distribution assumptions have been adopted to minimise impacts on the intersections wherever possible:

- 60% of construction related traffic will arrive/depart to/from the Barangaroo Central site via Napoleon Street.
- 40% of construction related traffic will arrive/depart to/from the Sussex Street/Erskine Street intersection.

Therefore, as previously stated, 100% of construction related vehicles will be accessing/exiting the Barangaroo Central site via Gate No. 5 along Hickson Road.

5.2 Parking

BPL advises that no car parking will be supplied on site for the construction of Barangaroo Central. The majority of the construction personnel would arrive to the site using public transport with existing pedestrian linkages and the proposed pedestrian facilities from Wynyard Walk such as wider footpath along Margaret Street and temporary pedestrian bridge over Sussex Street.

5.3 Pedestrian linkages and cyclists

5.3.1 Sussex Street Pedestrian Bridge[16]

During the construction of Barangaroo Central, there are plans from Lend Lease to supply a future temporary pedestrian bridge over Sussex Street to provide a safer crossing location for the Barangaroo precinct. This pedestrian bridge provides the opportunity to improve access for construction site personnel to/from the Barangaroo site. Figure 5.5[16] is an extract that illustrates the proposed Sussex Street Pedestrian Bridge.

[16] *Sussex Street Pedestrian Bridge Transport Assessment*, Arup, Revision H, 31 May 2012.

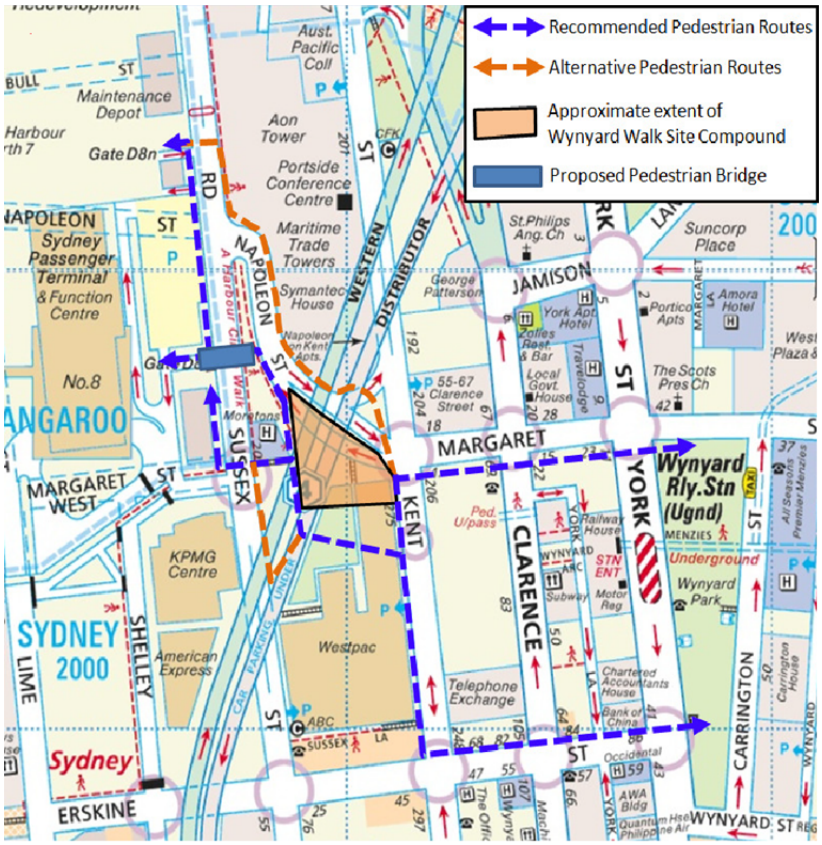


Figure 5.5[16] **Key routes for Sussex Street Pedestrian Bridge**

Arup's Sussex Street Pedestrian Bridge infers that a construction workforce of 1,584 movements per hour may be expected in relation to the proposed footbridge walkway.

For the purposes of this assessment, the worst case scenario would be presumed if all the construction staff movements traversed through the Sussex Street/Erskine Street intersection, however unrealistic. Therefore, including the anticipated Barangaroo Central construction personnel, a total of approximately 1,600 pedestrian movements per hour would potentially be opting to cross the Sussex Street/Erskine Street intersection crossings.

Realistically, pedestrians would be expected to seek the shortest route between origin and destination, based on factors such as familiarity and way-finding. This highlights that the key routes in Figure 5.5 would be the more likely adopted access paths for construction workers travelling to/from Barangaroo Central.

5.4 Public transport

No bus routes currently service Hickson Road adjacent to the Barangaroo Central site. There are no plans for BPL to shuttle construction personnel via bus to/from locations.

No cruise ship operations or land-side operations will remain at Barangaroo during the Barangaroo Central construction or operations periods. Note that up completion, it is intended that a length of 120 m waterfront at the western side of the site will be limited to restricted use for special events only. The area will accommodate deep water berthing for vessels such as cruise ships and naval vessels. In accordance with the Sydney Harbour Mooring Map issued by RMS, mooring is not permitted within the Barangaroo development site other than by permit at Barangaroo for special events such as naval vessel exhibition.

5.5 Construction Impacts – peak hour period

5.5.1 Intersection analyses

Once the existing year intersection performances were established, an assessment of the construction impacts may be ascertained by incorporating the data outlined previously and testing on the study area of influence intersections.

It is worth noting that the DGR in relation to traffic modelling states for the network assessment of dynamic and co-ordinated traffic light operations which should include the interaction between pedestrians and vehicular traffic. However, for the purposes of this TIA in terms of the expected developmental impacts from Barangaroo Central, the authors believe that utilising a traffic modelling software package, such as SIDRA Intersection, would be sufficient to assess the implications, if any, of the potential traffic, bicycle, and pedestrian volumes and future bus and light rail operations anticipated in light of the overall Barangaroo scheme.

Furthermore, extensive network modelling has been previously undertaken by AECOM and Arup using LinSig which includes detailed analyses for scenarios higher in truck and traffic volumes than forecast during the Barangaroo Central period, as featured in their background documents listed in Section 1.5. LinSig has the capability to model stand-alone junctions or multiple intersections which include road networks incorporating traffic signal pedestrian crossings, priority junctions as well as traffic signal intersections. The premise for LinSig is that it models the operation of traffic signal junctions in a similar way to how real traffic signal controllers at intersections would work.

Therefore, for the objectives of this TIA for Barangaroo Central, the use of SIDRA to analyse the intersections in the study area of influence deemed significant to the development would be sufficient to assess the associated impacts. The intersections in question are located some distance from one another, with only one key intersection (Sussex Street/Erskine Road) currently signalised.

5.5.2 Results

Table 5.2 outlines the summarised SIDRA analyses results for the intersections which incorporate the traffic generated/distributed from the construction activities. Refer to Appendix A for the comprehensive SIDRA analyses results.

Table 5.2 Construction SIDRA intersection performance results

	2014 SIDRA results					
	AM Peak			PM Peak		
Intersection*	DS	Average Delay (secs/veh)	LOS	DS	Average Delay (secs/veh)	LOS
Towns Place/Hickson Road	0.224	9.1	A	0.173	8.7	A
Hickson Road/Gate No. 5	0.526	58.5	E	0.351	24.2	B
Sussex Street/Napoleon Street/Hickson Road	0.832	69.0	E	0.649	61.5	E
Sussex Street/Erskine Street	0.523	26.3	B	0.539	29.1	C

* For priority control intersections, the maximum DS, delay and LOS are reported. Average values are reported for signal intersections.

From Table 5.2, the intersections for the construction assessment have been analysed and it is evident that the key intersections degrade in operational performance with the anticipated construction traffic movements for the peak periods with the addition of the growth in background traffic (taken as 3% linear growth per annum). Particularly, the intersections of Hickson Road/Gate No. 5 and Sussex Street/Napoleon Street/Hickson Road exhibited poor performance for their respective side roads

during the morning peak hour period. This may be as a result of the significant through movements passing each of these intersections, which in turn impedes the turning movements from the side access road of Gate No. 5 and Napoleon Street.

Similarly comparing the modelling outputs to Arup's results, the LOS for Sussex Street/Napoleon Street/Hickson Road intersection is reported as LOS A, as opposed to Table 5.2 showing LOS E. This is due to the average delay being presented for the worst movement. For unsignalised/priority controlled intersections, maximum delay should be reported as per the RMS Guide to Traffic Generating Developments; therefore SIDRA presents the worst result of LOS E for the right turn movement from Napoleon Street. The dominant flows at this intersection are from the southern approach, therefore the right turn movements from Sussex Street into Napoleon Street provides little opportunity for the right turn movements out from Napoleon Street onto Hickson Road.

To aid in the movement of the light vehicles (56 in, 18 out and vice versa), in addition to the anticipated construction vehicles, generally traffic controllers at the entry/exit points to the construction site would stop and provide the gap in through movements for turning traffic to move in or out.

Therefore, as a result of the poor intersection performances, it would be prudent to recommend that the bulk of construction vehicles movements should avoid coinciding with the morning peak period. This would aim to minimise the impact of construction vehicles on the road network, particularly the operational capacity of the intersections adjacent to the Barangaroo Central site, being Hickson Road/Gate No. 5 and Sussex Street/Napoleon Street/Hickson Road intersections.

5.5.3 Pedestrian analysis

As the anticipated construction workforce envisaged for Barangaroo Central is minimal in comparison to the surrounding Barangaroo works (Barangaroo South and Barangaroo Headland Park), assumptions from the Arup *Sussex Street Pedestrian Bridge Transport Assessment* have been adopted for consistency purposes for this assessment in relation to Barangaroo Central.

Incorporating the estimated 1,600 pedestrian movements into the SIDRA analyses for the Sussex Street/Erskine Street intersection resulted in acceptable average delays for all the approaches (LOS D or better). As the pedestrian phase times dictate the level of influence vehicular traffic is impeded by crossing pedestrians, another factor that is unaccounted for and should be considered are those pedestrians crossing (jaywalking) mid-block along Sussex Street, north of Erskine Street. This location is known to experience significant pedestrian volumes as previous studies have shown.

5.6 Parking

The expected impact on parking would be minimal during to the construction activities of Barangaroo Central due to the following reasons:

- Proposed construction activities will be confined to the designated site of Barangaroo Central. BPL advises that all major works would be related to the work site area with no major works envisaged to occur on Hickson Road. However, it is understood that minor road/landscape works is envisaged to occur along Hickson Road, but those details are yet to be confirmed and do not form part of the scope of works at this stage.
- Majority of the construction staff will be encouraged to arrive to the site using public transport.

5.7 Pedestrian and cyclists

The impact on pedestrian and cyclists movements would be minimal during the construction activities of Barangaroo Central due to proposed construction activities will be confined to the site and the scope of works do not include any construction works for Hickson Road in relation to Barangaroo Central will not be used for construction activities.

5.8 Public transport

The proposed construction activities are not expected have an impact on public transport operation since no public transport activities are expected to occur immediately adjacent to Barangaroo Central during the construction period.

5.9 Construction impacts – daily

Based on the peak hour traffic volumes along Hickson Road, it is estimated that Hickson Road currently carries approximately 15,000 vehicles movements daily. The proposed increase of construction vehicle movements to/from Barangaroo Central is estimated at 160 vehicles per day. The proportion of increased vehicle movements due to the construction is about 1% of the daily movements, which may be perceived as marginal.

The key issue for any associated construction impacts on a daily basis would be the appropriate scheduling of incoming/outgoing heavy vehicle movements so as to avoid coinciding with the general road network peak periods. Furthermore, the safe movement of other road users within vicinity to the construction access/egress location would require diligent considerations to ensure a safe environment is maintained.

5.10 Construction impacts – peak special events

During the construction period of Barangaroo Central, it is presumed that no special events will be scheduled at the Barangaroo Headland Park, as Table 5.1 suggests a completion year of 2015. However, major annual events such as Australia Day and New Year's Eve celebrations would be expected to occur at nearby sites.

Therefore, as a precautionary measure, it is recommended to temporarily stop construction activities at Barangaroo Central to minimise impacts on road users during scheduled major events, as these events are expected to generate high volumes of pedestrian movements along Hickson Road.

6. Operational impact assessment

6.1 Proposed operation details

6.1.1 Site operation

Based on information provided by BPL, in addition to what could be sourced from the background documents, the following sets out operational details that would be expected for Barangaroo Central. An assessment is undertaken and presented to determine the effects the operation of Barangaroo Central would have on the surrounding study area of influence.

The details of activities proposed for the Barangaroo Central development during the operation are provided below:

- Barangaroo Central Waterfront Promenade – This area would expect significant usage by visitors/tourists, with the Promenade extending the entire Barangaroo site; that is from Kings Street Wharf in the south of Darling Harbour, to BHP.
- Barangaroo Central Interim Public Domain – This area should see patronage (accumulation of persons, abbreviated as pax) by visitors/tourists for the following anticipated events as outlined in Table 6.1[17]:

Table 6.1 Proposed Event Type and Size Ranges to be held at Barangaroo Central

Event Type	Event Size Range
Cultural / Religious Events	3,000 to 4,000 pax Up to 8,000 pax depending on the nature and duration of the event
Arts/ Entertainment (small scale)	Up to 2,600 pax with moderate No. of structures. Up to 10,000 pax if transient crowd movement or part of another event
Arts / Entertainment (large scale)	Up to 12,000
Sporting / Outdoor/ Day-day Business	Up to 150 pax at any one time
Sporting / Outdoor (Event)	Up to 1,500 pax at any one time, depending on nature of event Up to 10,000 pax if transient movement of people
Political	500 to 1,000 pax
Filming &Media	Up to 50 pax
Private Event (small)	Up to 150 pax at any one location across the 5 locations
Private Event (medium)	Up to 500 pax at any one time across the 5 locations
Business Events / Corporate Functions (small)	Up to 150 pax at any one location across the 5 locations

[17] Barangaroo Delivery Authority, ESPA Table 2.0, 19 October 2012

Event Type	Event Size Range
Business Events / Corporate Functions (medium)	Up to 800 pax
Product Launches / Promotional / PR	200 to 1,000 pax
Fairs /Markets	5,000 to 10,000 pax
Live Site	10,000 – 12,000 pax Up to 15,000 pax if transient crowd movement or part of another event
Circuses	600 - 800 pax
Environmental Events	Up to 1,000 pax on site Up to 15,000 pax moving through site

A **typical event** does not exceed 1,000 pax.

From the above listed events, the following **special events** are expected to attract more than 1,000 pax but less than 15,000 pax:

- Cultural / Religious Events
- Arts / Entertainment
- Sporting / Outdoor
- Fairs / Markets
- Live Site
- Environmental Events

Based on the *Barangaroo Integrated Transport Plan*, transport management for **major events** attracting more than 15,000 pax such as Australia Day and New Year's Eve celebrations at Barangaroo would be expected to be similar to existing arrangements for major events in the CBD. Major events attracting more than 15,000 pax will most likely occur on weekends or public holidays. Barangaroo Central is located within walking distance to Wynyard and Circular Quay stations. For major events held at Barangaroo, road closures may be required with vehicle access to Barangaroo Headland Park be restricted to taxis, drivers with disabilities and pre-approved coaches. Special event parking restrictions will also apply during major events, and the public wharf and water taxi pontoon would be closed to public use.

6.1.2 Transport Mode split

It is difficult to gain data on the transport mode split to special events. The US Transport Research Board in 1991 noted that in the past few years, the scope and number of large special events, such as concerts and sporting events, have increased. Large special events are being viewed as a means of economic development, that is, as an attempt to bring in spectators from outside the region to obtain tourism dollars. Little published material is available applicable to the planning of large special events, especially in the areas of mode split (the mode of travel to the event). However, most of that information is for large events in outer areas and not located in the CBD of major cities. A number of methods were considered for Barangaroo Central as follows:

City of Sydney report Connecting our City of 2012 showed 60% of Weekday trips to Central Sydney by train bus and ferry trips and only 2% of trips within Central Sydney (93% were walk or cycle). It also showed that although 20% of Journey ToWork was by bus, this declined to less than 10% by bus off peak. This suggests that a primary bus and coach mode for off peak events of between 2% and 10%.

The Barangaroo Integrated Transport Plan by TfNSW in 2012 shows (Figure 2) peak hour JTW mode share targets of 18% by bus and 2% tram (or ferry in the meantime) and 1% taxis. These buses also include buses stopping in the Wynyard and northern CBD precincts and walk to the site – these buses do not have to come to Barangaroo.

Examples from the Sydney Olympics and legacy events include data for a 2002 event at Stadium Australia at Sydney Olympic Park that showed 28.7% by coach and bus. This mass coach operation was designed to specifically serve this relatively isolated location.

The Darling Harbour Visitor Snapshot by SHFA for December 2012 showed 25.7 million people movements in the year to December 2012. The Outdoor Events Technical manual of 2009 stated Darling Harbour has a range of event sites and outdoor areas catering for large crowds (e.g. The Sydney Entertainment Centre (SEC) is conveniently situated on the fringe of Chinatown, adjacent to Darling Harbour and a short walk to the CBD. The SEC caters for a variety of indoor performances ranging from small 500 to large 12,500 capacity performances.

This TIA has applied mode splits, based on the Barangaroo TMAP and the Barangaroo Integrated Transport Plan, as follows as these may vary according to the event size and type:

- Rail 63%
- Bus 18% -20% (estimate up to 5 percentage points of this to bus bays near the site frontage on Hickson Road, and the remainder walking from bus stops further away from the site)
- Walk 6%
- Car 4-5%
- Bike 4%
- LRT 2%
- Ferry 1% (4-6% may be achievable)
- Taxi 1%

6.2 Vehicular access to Barangaroo Central

A vehicular access will be provided via Hickson Road and this access will be limited to service, maintenance and emergency vehicles only. This vehicular access will be controlled by bollards to prevent other vehicles from entering into Barangaroo Central.

6.3 Parking

Based on the *Barangaroo Headland Park Main Works Traffic Impact Assessment and Construction Management Plan*, a total of 300 parking spaces are proposed to be constructed at an underground car park as part of the BHP works for visitor's usage in the area. It would be expected that some of the attendees to the events scheduled at Barangaroo Central will use this car park.

To cater for the special event parking, some on-street locations along Hickson Road would require temporary parking restrictions during major events to accommodate kiss and ride activities, taxi, bus/coach and emergency vehicle access.

Disabled parking spaces are also proposed on the west side of Hickson Road along the site frontage.

6.3.1 Traffic generation

Assuming that 4% of visitors arrive to Barangaroo using private cars, as stipulated in target mode splits in Section 3.6, it would be expected that major events could generate demand in the order of up to 600 vehicle movements to the Barangaroo precinct. These vehicles are expected to park at various

locations adjacent to the Barangaroo site due to the limited parking availability in the vicinity of the area. Furthermore, it is assumed that for special events scheduled for Barangaroo Central, the proposed parking station for BHP would be designated as preferred off-street parking. Therefore, a proportion of the anticipated vehicles would use the proposed BHP car park and the remainder will use other on-street and off-street car parks within the vicinity and further afield or alternatively opt for public transport.

6.3.2 Traffic distribution

It is assumed that 75% of BHP car park traffic would arrive from the south and the remainder arrive from the north. That is, vehicles that arrive from the north would be expected to access the BHP car park via Napoleon Street and/or Towns Place. Furthermore, the distribution of incoming/outgoing traffic has adopted a 90-10% split for the peak periods.

Figure 6.1[19] illustrates the possible routes vehicles could access the Barangaroo precinct.

Figure 6.1[19] Proposed traffic access

[19] *Barangaroo Integrated Transport Plan*, NSW Government-Transport for NSW, August 2012.

6.4 Pedestrian linkages and cyclists

Figure 6.2[19] illustrates the proposed pedestrian access routes for the Barangaroo precinct as provided in the *Barangaroo Integrated Transport Plan*.

Figure 6.2[19] Proposed pedestrian and bicycle access

The proposed pedestrian access to the Barangaroo area is provided from multiple transport interchanges/railway stations such as Wynyard railway station, Wynyard bus interchange, Martin Place railway station and Circular Quay railway station

The proposed Wynyard Walk that will provide direct high quality access between Wynyard Station and the Barangaroo area is understood to be in operation when the Barangaroo Central development is completed in 2015.

6.5 Public transport

6.5.1 Bus services

Figure 6.3[19] highlights the proposed bus services that will be extended to serve the Barangaroo area as provided in the *Barangaroo Integrated Transport Plan*.

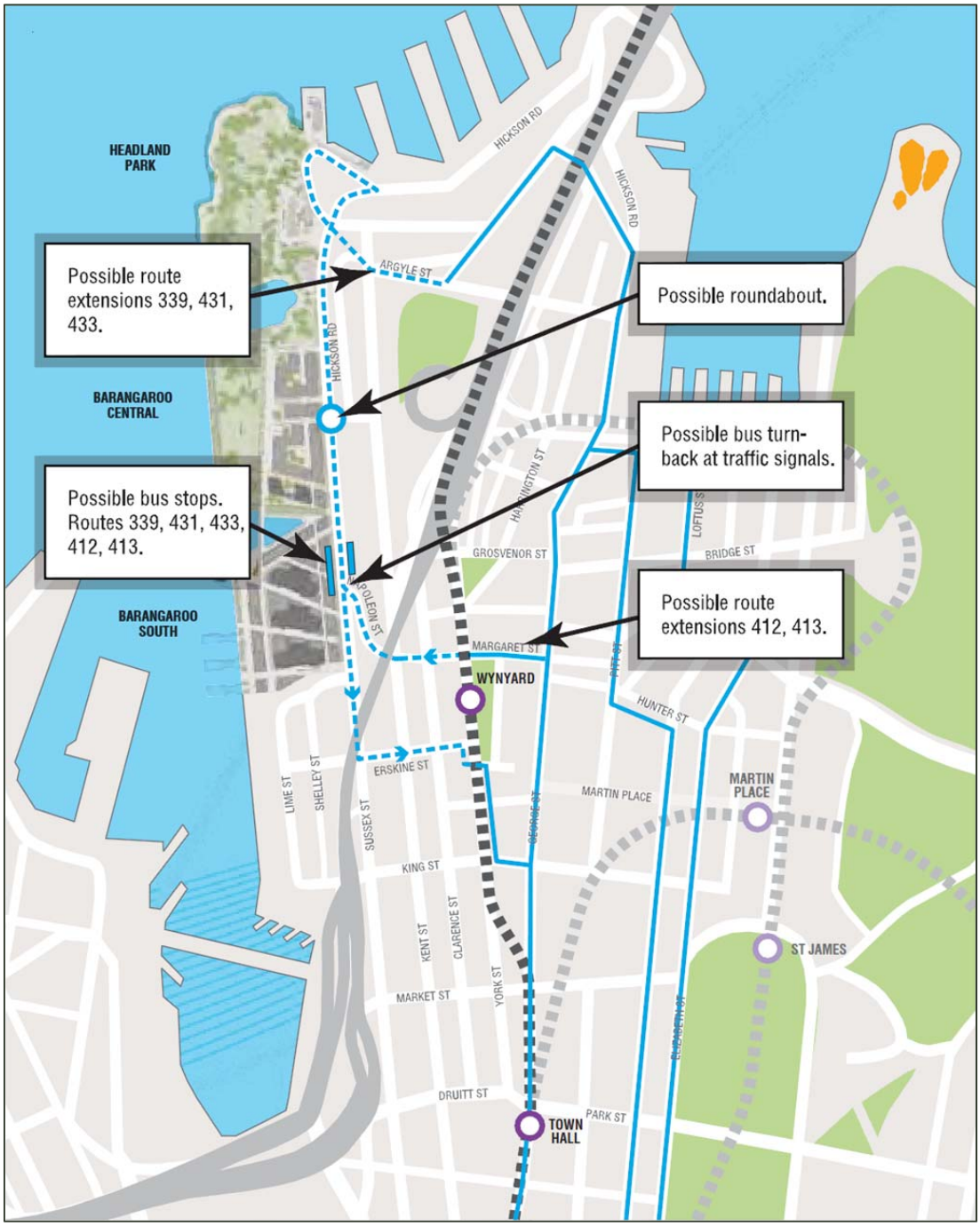


Figure 6.3[19] Proposed bus service extension under consideration

Bus route extensions would provide the benefit to commuters and visitors who are unable to walk from railway stations and bus interchanges. The proposed bus route extensions would provide opportunity to run bus services along Hickson Road to pick up and drop off visitors accessing Barangaroo Central.

RMS officers have expressed concerns about a bus turnaround or roundabout as shown in Figure 6.3 because of its effects on traffic flow and the ease of movement and safety of pedestrians and cyclists. The resolution of this issue is not material to this transport impact assessment of the subject development of Barangaroo Central.

6.5.2 Light rail

Figure 6.4[19] illustrates the proposed option for a light rail route along George Street that extends to Barangaroo as provided in the *Barangaroo Integrated Transport Plan*.

Figure 6.4[19] Proposed light rail option under consideration

When Barangaroo is envisaged to be completed, it is not expected that there will be any completed extension of the light rail into the CBD. The extension of the existing line from Lilyfield to Dulwich Hill will be operational and transporting passengers to the CBD and Barangaroo area. Note the locations and allowance of existing on-street parking along Hickson Road will come into question with the proposed light rail as an important factor would be available and/or useable road space.

6.6 Taxi

Figure 6.5[19] shows the locations of potential taxi ranks and access routes that are proposed to service the Barangaroo area as provided in the *Barangaroo Integrated Transport Plan*.

Figure 6.5[19] Proposed taxi ranks and access

Taxi ranks are proposed within and adjacent to the Barangaroo South development whilst no taxi ranks are shown for Barangaroo Central and the BHP development. The BHP TIA by Halcrow (Figure 3.5) showed a taxi rank on the west kerb of Hickson Road immediately north of the subject Barangaroo Central site. Therefore, it is recommended to provide a taxi rank for Barangaroo Central and BHP development. Based on the *Barangaroo Integrated Transport Plan,* vehicle access to BHP will be restricted to taxis, drivers with disabilities, and pre-approved coaches during major events. This would have the potential to provide temporary taxi ranks during major events immediately adjacent to the BHP/Barangaroo Central area.

6.7 Coaches

One of the actions in the *Barangaroo Integrated Transport Plan* advises to develop a Traffic Management Plan to manage coaches at Barangaroo. However the plan does provide any detail to the allocation of space for the management of coaches for Barangaroo Central and BHP.

While bus stops are proposed within and adjacent to the Barangaroo South development, no bus stops are shown or/and planned for Barangaroo Central and the BHP development. The BHP TIA by Halcrow Figure 3.6 showed two bus/coach stop sites, on the west kerb of Hickson Road north of the subject Barangaroo Central site, near Munn Street, and another on the north kerb of Towns Place, near Moores Wharf.

It is proposed to provide approximately 40m of permanent bus zone on the west kerb of Hickson Road on the site frontage, with fold-down signs to extend this to 100m if required for major events.

6.8 Service, maintenance and emergency vehicles

Service and maintenance vehicles would be required to access Barangaroo Central area during pedestrian off- peak periods to minimise vehicle-pedestrian conflicts. In the case where special events are scheduled, service vehicles delivering, as well as packing up, equipment would require appropriate management for the movement of goods and services, so as not to adversely impact on the surrounding operation of the area.

It is proposed that the interim public access and service lane, located between the Interim Landscape and Barangaroo South Staging Area as per Figure 3.2, could be used for service, maintenance and emergency vehicles. This would create a bump-in, bump-out arrangement for this location along Hickson Road, which is maintained separate from the proposed taxi and bus/coach locations.

6.9 Potential network changes

To maintain a consistent approach, in conjunction with the *Barangaroo Integrated Transport Plan*, the following network changes are proposed:

- Possible full or partial closure of Shelley Street to facilitate the proposed Transport Square between Wharf Plaza and Margaret Street. This Transport Square includes an interchange between various transport modes and a high quality public domain. Refer to Figure 6.6[19].
- Provision of a roundabout on Hickson Road opposite to Barangaroo Central.

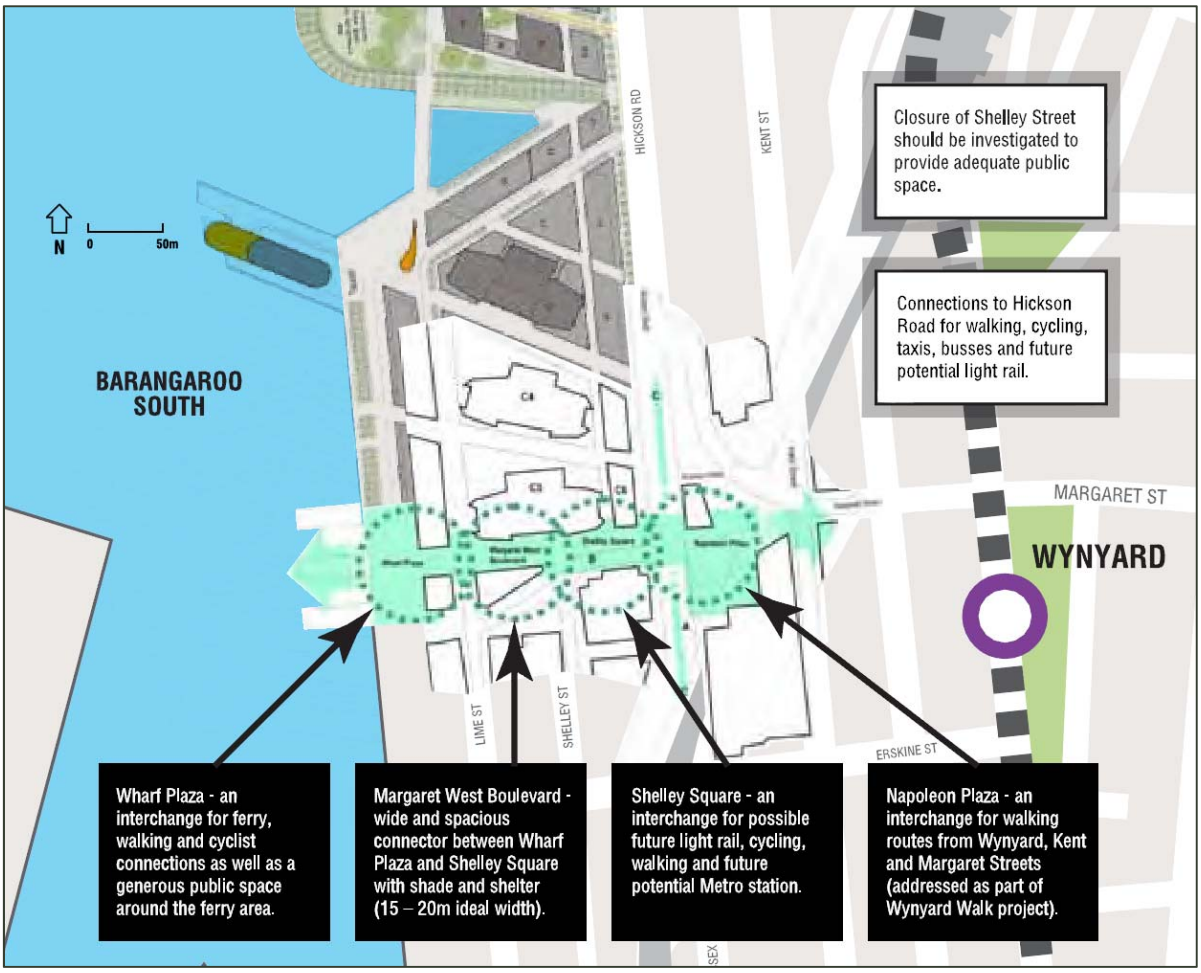


Figure 6.6[19] **Proposed Transport Square**

6.10 Operational impacts – peak hour period

6.10.1 Intersection analyses

Operation scenario

The intersection analyses have been undertaken based on the operational details, which account for the future year scenario of 2020, when then Barangaroo site is envisioned to be fully developed.

Background traffic growth

To analyse the operation scenario, a traffic growth factor was applied to the existing year traffic volumes. Considering the surrounding Barangaroo land use environs in conjunction with the limitations of the existing built environment, a general 3% linear growth factor per annum would be considered an appropriate projection of future year traffic demand.

Refer to Appendix C for the traffic generation peak volumes for the estimated intersection volumes.

6.10.2 Results

Table 6.2 outlines the summarised SIDRA results for the operation scenario of 2020 which incorporate the traffic generated/distributed from the operation activities in conjunction with the background traffic growth. Refer to Appendix A for the comprehensive SIDRA analyses results.

Table 6.2 2020 opening year SIDRA intersection performance results

	2020 SIDRA results					
	AM Peak			PM Peak		
Intersection*	DS	Average Delay (secs/veh)	LOS	DS	Average Delay (secs/veh)	LOS
Towns Place/Hickson Road	0.448	13.8	A	0.670	14.8	B
Sussex Street/Napoleon Street/Hickson Road (signalised)	1.177	128.0	F	1.963	222.0	F
Sussex Street/Erskine Street	0.787	28.6	C	0.736	31.0	C

* For priority control intersections, the maximum DS, delay and LOS are reported. Average values are reported for signal intersections.

From Table 6.2, the performance of the intersections that has been analysed results with acceptable operation (LOS B or better) during the morning and afternoon peak periods for 2020 only for the Towns Place/Hickson Road intersection. The performance of the Sussex Street/Napoleon Street/Hickson Street intersection is unacceptable (LOS F) with special event related traffic during both peak periods, even with the signalisation of this intersection.

Note in Table 6.2, the intersection of Sussex Street/Napoleon Street/Hickson Road has been upgraded to traffic signals to cope with the additional turning movements, as the existing STOP control priority intersection exhibited significant delays and operated at more than double the degree of saturation with excessive delays. Signals are also desirable to provide safer pedestrian crossing conditions at grade, regardless of the provision of pedestrian bridge over Sussex Street. RMS has indicated that these signals are expected to be installed as early as mid-2013.

It should be noted that the performance results are mostly determined by traffic generated from other developments and background growth in traffic, rather than the subject development. The operational performance of the Sussex Street/Erskine Street intersection remains at acceptable levels possibly due to this reason.

Furthermore, the flows through the intersection for this scenario show there is still capacity (LOS C), despite the dominant through movements from the north and south approaches. The phasing/cycle timings appear adequate for the flows, which in reality would potentially have the added benefit of coordination with the surrounding signals assisting in its operation. Similarly, it should be noted that using SIDRA to analyse the intersections may yield results, in terms of operational performance and capacity, which are more optimistic than in reality, as potentially in the case of the Sussex Street/Erskine Street intersection.

6.11 Operational impacts – typical events, special events and major events

6.11.1 Pedestrians

Estimates for special events with attendances of 15,000 people at Barangaroo Central were analysed. The Interim public use space of about 120m by 140m is an area of about 16,800 m^2 that equates to about 1.1 m^2 per person at a peak accumulation of 15,000 persons, which equates to an acceptable

Fruin Level of Service D with suitable crowd management practices. More than likely large events will occur on weekends or public holidays.

Using examples of peak arrival and departure flows for other events of up to 6% in the peak minute, various pedestrian flow assignment and distribution scenarios were analysed. The analyses suggested that footpaths would be adequate at acceptable Fruin Level of Service C/D or better with appropriate crowd management to ensure that arriving and departing crowds were encouraged to use alternative routes to take some pressure off the Hickson Road western footpath as the most direct link to the city and Wynyard. The foreshore path and boardwalk, over 10m wide to the north and south, provides an attractive alternative.

Estimates for typical events with attendances of up to 1,000 people at Barangaroo Central were analysed using examples of peak arrival and departure flows for other events[20]. Footpaths were estimated to be adequate at Fruin Level of service C/D or better.

Safe pedestrian crossing points of Hickson Road are proposed to be provided at major intersections and pedestrian bridges. Design of Hickson Road should consider the provision of safe crossings near intermediate pedestrian connections, as shown on Figure 6.2, such as the pedestrian steps up to High Street and Gas Lane footpath, and bus/LRT stops.

6.11.2 Cyclists

The estimated mode split of 4% by bike was analysed to be within the capacity of the proposed Hickson Road Bicycle Shoulders[21] and the shared foreshore path during typical events and special events.

6.11.3 Buses/coaches

The estimated mode split of 5% to bus and coach at the subject site frontage (i.e. not including those who walk to bus stops at Wynyard and elsewhere in the CBD) was analysed for typical events and is within the capacity of a stop for two buses.

For special events this should be expanded to a capacity of a stop for four buses.

This could be managed by a bus zone for at least two buses, with hinged signs to extend this during special events to a capacity of at least four buses.

6.11.4 General Traffic

Based on the results of the traffic analyses, the performance of the Sussex Street/Napoleon Street/Hickson Street intersection would deteriorate to an unacceptable level during special and major event scenarios. Therefore, signalisation of this intersection needs to be considered to minimise impact on this intersection. A signalised intersection at this location would provide the opportunity to include formalised pedestrian crossings for the approaches. RMS has indicated that these signals are expected to be installed as part of wider transport improvement programs as early as mid-2013.

By employing a combination of special event parking restrictions with selective vehicle access requirements to the Barangaroo area during special events, appropriate management measures may potentially alleviate the poor intersection performance of Sussex Street/Napoleon Street/Hickson Road as anticipated by the analyses.

[20] Sydney Olympic Park events
[21] Barangaroo Integrated Transport Plan

7. Traffic management measures

The following traffic management measures are proposed for consideration based on the information collated in this TIA report, the assessments undertaken and the results from the intersection analyses.

7.1 Construction

The following traffic management measures would have the potential to reduce the impact on the road network for the associated road users during the construction of Barangaroo Central:

- It is recommended that construction vehicle movements should be scheduled to avoid the morning peak period to minimise the impact on the road network, adjacent to the proposed Barangaroo Central development site, in particular to the Gate No. 5 and Napoleon Street intersection with Hickson Road.
- It is recommended to stop construction activities at Barangaroo Central to minimise impacts on road users and to minimise vehicle/pedestrian conflicts during major events (such as Australia Day, New Year's Eve), as these events are known to generate high volumes of pedestrian movements along Hickson Road.
- Access to properties located along Hickson Road should be maintained at all times during the construction of Barangaroo Central.
- Access for emergency vehicles should be maintained at all times.
- Pedestrian and bicycle movements need to be allowed along and across Hickson Road at all times.
- Pedestrians and cyclists require appropriate protection by RMS approved crash barriers (concrete jersey kerbs, water filled Triton barriers) when paths are diverted onto the roadway.
- There are existing footpaths on either side of Hickson Road, so if any construction works impede footpaths, adequate separation/protection is required where Traffic Controllers are to direct pedestrians to the designated walkway.
- It is important that no construction vehicles use streets that have not been approved for use by BDA and consequently RMS.
- Construction vehicles are to enter and leave in a forward direction.
- At least one Traffic Controller shall be used to assist and manage the movement of construction vehicles entering/exiting the construction site. The Traffic Controller shall be appropriately RMS qualified with the correct certification to manage traffic. The Traffic Controller must use discretion when stopping vehicles so queuing does not extend to the adjacent intersections.
- During construction, it is a requirement that all neighbouring properties are to remain accessible for both vehicle and pedestrian activities. It is unlikely that construction vehicles will block neighbouring properties, however, should this happen, the construction vehicles are to be moved immediately.
- Any sections of the road, including kerb and footpaths, that are damaged by construction vehicles are to be rectified at the cost of the contractor at the completion of the construction period. It is recommended that a survey of the existing conditions be undertaken prior to the commencement of construction works.

7.2 Operation

The following traffic management measures would have the potential to reduce the impact for all associated road users during the operation of Barangaroo Central:

- Signalise Sussex Street/Napoleon Street/Hickson Road intersection. RMS has indicated that these signals are expected to be installed as early as mid-2013.
- Create and manage a special event parking scheme that advises the public of the restricted parking arrangements in the area, encouraging the use of public transport to access the Barangaroo area during major events.
- Schedule special events during weekends and off-peak periods.
- Instate special event clearways along Hickson Road should the expected attendants for a special or major event is more than 1000 persons for example:
  - Cultural / Religious Events
  - Arts / Entertainment
  - Fairs / Markets
  - Live Site
- Provide designated kiss and ride, taxi parking and coach parking areas on Hickson Road.
- Schedule service and maintenance vehicles arrival/departure times to/from Barangaroo Central during the off- peak periods prior to and after the event to manage bump in and bump out activities on site.
- For major events such as Australia Day and New Year's Eve celebrations at Barangaroo, vehicle access to Headland Park/Barangaroo Central should be restricted to taxis, drivers with disabilities and pre-approved vehicle and coaches during major events.
- Access for emergency vehicles should be provided at all times.

8. Summary and conclusions

8.1 Summary

This Traffic Impact Assessment report has been prepared in response to the Director General's Requirements and as part of the Development Application process to address the traffic and transport implications of the proposed development at Barangaroo Central Waterfront Promenade and Interim Public Domain. The traffic analyses for the potential works, in addition to the neighbouring construction works proposed to occur simultaneously, are presented. This report not only addresses the construction related impacts for Barangaroo Central, it investigates the operation of the proposed development in the overall scheme.

The Barangaroo Central Waterfront Promenade and Interim Public Domain is the first stage in the development of the Barangaroo Central site and are scheduled for completion in 2015. The Barangaroo Central Waterfront Promenade and Interim Public Domain seek to deliver an active and connected waterfront that is in place at the time of completion of the Barangaroo Headland Park (BHP) and partial completion of Barangaroo South.

Parking is provided along Hickson Road. Some Cyclists and pedestrian facilities are provided along the road network located immediately adjacent to the Barangaroo area. No bus services are currently provided along Hickson Road.

BPL estimated that during the anticipated major works for Barangaroo Central, the following construction traffic movements are expected to occur during the morning peak hour period:

- Number of truck movements – 20 vehicles (in) and 20 vehicles (out)
- Number of light vehicle movements – 40 vehicles (in) and 20 vehicles (out)

A total of 80 (one way, or 160 two-way) truck and heavy construction vehicle movements are expected to occur daily during the peak construction of Barangaroo Central.

After the completion of construction, the activities proposed for the Barangaroo Central development during operation are:

- Barangaroo Central Waterfront Promenade – This area would expect significant usage by visitors/tourists, with the Promenade extending the entire Barangaroo site; that is from Kings Street Wharf in the south of Darling Harbour, to BHP.
- Barangaroo Central Interim Public Domain – Several events will be hosted at this area with the patronage figures of visitors/tourists up to 15,000 persons.

A vehicular access will be provided via Hickson Road and this access will be limited to service, maintenance and emergency vehicles only. This vehicular access will be controlled by bollards to prevent other vehicles from entering into Barangaroo Central.

8.2 Conclusion

The following conclusions have been drawn from this TIA:

- The existing performance of the intersections within the study area of influence results in good operation.
- Comparison between peak traffic generation prior to and during the construction of Barangaroo Central shows that the total number of peak truck movements during the construction of Barangaroo Central would be lower than the peak truck movements generated from the other construction sites prior to the construction of Barangaroo Central whilst, light vehicle movements are expected to increase by 56 (in) and 18 (out).

- Based on the peak hour traffic volumes along Hickson Road, it is estimated that Hickson Road, south of Napoleon Street, currently carries approximately 15,000 vehicles movements daily. The proposed increase of construction vehicle movements to/from Barangaroo Central is estimated at 160 vehicles per day. The proportion of increased vehicle movements due to the construction is about 1% of the daily movements, which may be perceived as marginal.
- Major annual events such as Australia Day and New Year's Eve celebrations would be expected occur at nearby sites. Therefore, as a precautionary measure, it is recommended to temporarily halt construction activities at Barangaroo Central to minimise impacts on road users during scheduled major events, as these events are expected to generate high volumes of pedestrian movements along Hickson Road.
- Based on the *Barangaroo Integrated Transport Plan*, transport management for major events such as Australia Day and New Year's Eve celebrations at Barangaroo would be expected to be similar to existing arrangements for major events in the CBD. Barangaroo Central is located within walking distance to Wynyard and Circular Quay stations. For major events held at Barangaroo, road closures may be required with vehicle access to Barangaroo Headland Park be restricted to taxis, drivers with disabilities and pre-approved coaches. Special event parking restrictions will also apply during major special events at Barangaroo Central.
- Based on the *Barangaroo Headland Park Main Works Traffic Impact Assessment and Construction Management Plan*, a total of 300 parking spaces are proposed to be constructed at an underground car park as part of the BHP works for visitor's usage in the area. It would be expected that some of the attendees to the events scheduled at Barangaroo Central will use this car park.
- The intersections of Hickson Road/Gate No. 5 and Sussex Street/Napoleon Street/Hickson Road are forecast to exhibit poor performance during the morning peak hour period during construction. Therefore, as a result of the poor intersection performances, it would be prudent to recommend that the bulk of construction vehicles movements should avoid coinciding with the morning peak period. This would aim to minimise the impact of construction vehicles on the road network, particularly the operational capacity of the intersections, adjacent to the proposed Barangaroo Central site.
- Assuming that up to 4% of visitors arrive to Barangaroo using private cars, it would be expected that major events would generate in the order of up to 600 vehicle movements to the Barangaroo precinct. These vehicles are expected to park at various locations due to the limited parking availability in the vicinity of the area. Furthermore, it is assumed that for special events scheduled for Barangaroo Central, the proposed parking station for Barangaroo Headland Park would be designated as preferred off-street parking. Therefore, some of the vehicles would use the proposed BHP car park and the remainder will use other on-street and off-street car parks within the vicinity and further afield.
- A comprehensive transport and access plan is proposed in the *Barangaroo Integrated Transport Plan* to provide pedestrian and cyclist linkages, bus services, light rail services, ferry services, taxi services and a potential Transport Square between Wharf Plaza and Margaret Street to Barangaroo area. However, no taxi ranks are planned for Barangaroo Central and BHP development.
- In order to minimise conflict between vehicle traffic, bikes and pedestrians, movements should be encouraged along the safe high capacity pedestrian promenade to mitigate conflict and congestion.
- One of the actions in the *Barangaroo Integrated Transport Plan* advises to develop a Traffic Management Plan to manage coaches at Barangaroo. However the plan does provide any detail to the allocation of space for the management of coaches for Barangaroo Central and BHP.
- The proposed construction and operation of the subject development does not prevent the ability to "future proof" the introduction of bus and light rail services along Hickson Road.

- Service and maintenance vehicles would be required to access Barangaroo Central area during pedestrian off- peak periods to minimise vehicle-pedestrian conflicts. In the case where special events are scheduled, service vehicles delivering, as well as packing up, equipment would require appropriate management for the movement of goods and services, so as not to adversely impact on the surrounding operation of the area.
- The performance of the Sussex Street/Napoleon Street/Hickson Street intersection is unacceptable (LOS F) with special event related traffic during both peak periods, even with the signalisation of this intersection. However, the existing STOP control priority intersection exhibited significant delays and operated at more than double the degree of saturation with excessive delays. This intersection would require upgrading to traffic signals; traffic signals are expected to be installed as early as mid-2013 as part of wider transport improvements.
- In summary, this assessment concluded that the impacts of the subject development are less than other peak construction and operational impacts and are therefore acceptable.

8.3 Summary of Recommendations

The recommendations of this assessment include:

Construction

- Construction movements require appropriate management so that impacts are minimised, particularly during the morning peak period to the main entry/exit Gate No. 5 in addition to the Sussex Street/Napoleon Street/Hickson Road intersection. The use of Traffic Controllers with associated traffic control devices would aid in the management of construction activities along Hickson Road.
- Construction activities must be cognisant of major events throughout the year (such as Australia Day and New Year's Eve) to allow priority and safety for participants. Halting construction activities during special major events scheduled adjacent to Barangaroo would be recommended to minimise potential conflicts of construction vehicle movements with pedestrians.
- Any sections of the road, including kerb and footpaths, that are damaged by construction vehicles should be rectified at the cost of the contractor at the completion of the construction period. It is recommended that a survey of the existing conditions be undertaken prior to the commencement of construction works.
- Construction staff should be encouraged to use public transport by the provision of public transport information.

Operation

- The Sussex Street/Napoleon Street/Hickson Road intersection may require upgrading to traffic signals as part of the overall scheme, with a minimal demand due to the subject development: traffic signals are expected to be installed as early as mid-2013 as part of wider transport improvements.
- A parking management scheme for special major events would be required to manage the expected influx of attendees.
- Promotion of public transport usage should be part of the scheme in addition to installing special event clearways along Hickson Road.

Appendix A
SIDRA Intersection analyses results

Existing traffic situation

Construction scenario (2014)

Operation scenario (2020)

Existing traffic situation

MOVEMENT SUMMARY

Site: Towns Pl / Hickson Rd-AM

Towns Place/Hickson Street intersection
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow 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
East: Hickson Road											
5	T	177	0.0	0.128	1.2	LOS A	1.0	7.0	0.43	0.00	44.7
6	R	49	0.0	0.128	7.3	LOS A	1.0	7.0	0.43	0.72	42.9
Approach		226	0.0	0.128	2.6	LOS A	1.0	7.0	0.43	0.16	44.3
North: Towns Place											
7	L	76	0.0	0.213	9.0	LOS A	1.1	7.8	0.48	0.67	29.3
9	R	99	0.0	0.214	8.9	LOS A	1.1	7.8	0.48	0.77	29.4
Approach		175	0.0	0.214	9.0	LOS A	1.1	7.8	0.48	0.72	29.3
West: Hickson Road											
10	L	124	0.0	0.170	6.4	LOS A	0.0	0.0	0.00	0.77	43.3
11	T	201	0.0	0.170	0.0	LOS A	0.0	0.0	0.00	0.00	50.0
Approach		325	0.0	0.170	2.4	LOS A	0.0	0.0	0.00	0.29	47.2
All Vehicles		726	0.0	0.214	4.1	NA	1.1	7.8	0.25	0.35	43.8

LOS (Aver. Int. Delay): NA. The average intersection delay is not a good LOS measure for two-way sign control due to zero delays associated with major road movements.
Level of Service (Worst Movement): LOS A. LOS Method for individual vehicle movements: Delay (RTA NSW).
Approach LOS values are based on the worst delay for any vehicle movement.

Processed: Thursday, 30 August 2012 9:09:15 AM
SIDRA INTERSECTION 5.0.5.1510
Project: C:\CW\230341-Barangaroo Central DA TIA\SIDRA\TIA-Towns-Napoleon-Erskine-Existing.sip
8001039, AURECON AUSTRALIA, ENTERPRISE

SIDRA INTERSECTION

MOVEMENT SUMMARY

Site: Napoleon St / Hickson Rd-AM

Napoleon Street/Hickson Road intersection
Stop (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow 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: Hickson Road											
2	T	602	4.9	0.259	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
3	R	523	1.4	0.378	9.5	LOS A	2.6	18.7	0.47	0.69	47.0
Approach		1125	3.3	0.378	4.4	LOS A	2.6	18.7	0.22	0.32	53.1
East: Napoleon Street											
4	L	484	2.6	0.653	15.2	LOS B	6.1	43.5	0.53	1.03	31.4
6	R	79	1.3	0.371	31.0	LOS C	1.7	11.9	0.88	1.05	20.5
Approach		563	2.4	0.653	17.4	LOS C	6.1	43.5	0.58	1.04	29.2
North: Hickson Road											
7	L	52	10.2	0.148	8.5	LOS A	0.0	0.0	0.00	0.98	49.0
8	T	212	13.4	0.148	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		263	12.8	0.148	1.7	LOS A	0.0	0.0	0.00	0.19	57.5
All Vehicles		1952	4.3	0.653	7.8	NA	6.1	43.5	0.29	0.51	48.0

LOS (Aver. Int. Delay): NA. The average intersection delay is not a good LOS measure for two-way sign control due to zero delays associated with major road movements.
Level of Service (Worst Movement): LOS C. LOS Method for individual vehicle movements: Delay (RTA NSW).
Approach LOS values are based on the worst delay for any vehicle movement.

Processed: Thursday, 30 August 2012 9:22:50 AM
SIDRA INTERSECTION 5.0.5.1510
Project: C:\CW\230341-Barangaroo Central DA TIA\SIDRA\TIA-Towns-Napoleon-Erskine-Existing.sip
8001039, AURECON AUSTRALIA, ENTERPRISE

SIDRA INTERSECTION

MOVEMENT SUMMARY

Site: Sussex St / Erskine St-AM

Sussex Street/Erskine Street intersection
Signals - Fixed Time Cycle Time = 110 seconds (User-Given Phase Times)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow 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: Sussex Street											
1	L	54	5.9	0.453	35.1	LOS C	14.2	101.8	0.81	0.86	27.9
2	T	575	2.4	0.453	28.6	LOS C	14.3	102.4	0.81	0.70	28.5
Approach		628	2.7	0.453	29.2	LOS C	14.3	102.4	0.81	0.71	28.4
East: Erskine Street											
4	L	318	4.3	0.422	30.7	LOS C	13.5	98.0	0.75	0.80	12.5
5	T	46	36.4	0.142	23.9	LOS B	3.8	32.2	0.69	0.55	13.5
6	R	29	7.1	0.142	30.1	LOS C	3.8	32.2	0.69	0.77	13.4
Approach		394	8.3	0.422	29.8	LOS C	13.5	98.0	0.74	0.77	12.7
North: Sussex Street											
7	L	43	22.0	0.333	23.5	LOS B	1.9	15.5	0.57	0.68	32.1
8	T	603	6.8	0.342	19.4	LOS B	11.7	86.7	0.67	0.58	32.9
9	R	5	0.0	0.045	60.4	LOS E	0.4	3.1	0.96	0.65	20.3
Approach		652	7.8	0.342	20.0	LOS B	11.7	86.7	0.67	0.59	32.7
West: Erskine Street											
10	L	57	5.6	0.237	27.9	LOS B	7.9	58.9	0.68	0.82	14.0
11	T	128	7.4	0.237	21.4	LOS B	7.9	58.9	0.68	0.56	14.4
12	R	137	6.2	0.426	40.8	LOS C	7.7	56.8	0.85	0.80	9.9
Approach		322	6.5	0.426	30.8	LOS C	7.9	58.9	0.75	0.71	12.0
All Vehicles		1996	6.1	0.453	26.6	LOS B	14.3	102.4	0.74	0.68	25.9

Level of Service (Aver. Int. Delay): LOS B. Based on average delay for all vehicle movements. LOS Method: Delay (RTA NSW).
Level of Service (Worst Movement): LOS E. LOS Method for individual vehicle movements: Delay (RTA NSW).
Approach LOS values are based on average delay for all vehicle movements.

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	Across S approach	1368	22.9	LOS C	2.8	2.8	0.65	0.65
P3	Across E approach	1368	27.0	LOS C	3.0	3.0	0.70	0.70
P5	Across N approach	1368	26.3	LOS C	3.0	3.0	0.69	0.69
P7	Across W approach	1368	28.4	LOS C	3.1	3.1	0.72	0.72
All Pedestrians		5472	26.1				0.69	0.69

Level of Service (Aver. Int. Delay): LOS C. Based on average delay for all pedestrian movements. LOS Method: Delay (HCM).
Level of Service (Worst Movement): LOS C. LOS Method for individual pedestrian movements: Delay (HCM).

MOVEMENT SUMMARY

Site: Towns Pl / Hickson Rd-PM

Towns Place/Hickson Street intersection
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow 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
East: Hickson Road											
5	T	188	0.0	0.136	1.0	LOS A	1.0	7.3	0.39	0.00	45.1
6	R	55	0.0	0.136	7.1	LOS A	1.0	7.3	0.39	0.70	42.9
Approach		243	0.0	0.136	2.4	LOS A	1.0	7.3	0.39	0.16	44.6
North: Towns Place											
7	L	71	0.0	0.166	8.6	LOS A	0.9	6.0	0.43	0.63	29.9
9	R	74	0.0	0.166	8.5	LOS A	0.9	6.0	0.43	0.73	30.0
Approach		144	0.0	0.166	8.5	LOS A	0.9	6.0	0.43	0.68	29.9
West: Hickson Road											
10	L	102	0.0	0.143	6.4	LOS A	0.0	0.0	0.00	0.77	43.3
11	T	172	0.0	0.143	0.0	LOS A	0.0	0.0	0.00	0.00	50.0
Approach		274	0.0	0.143	2.4	LOS A	0.0	0.0	0.00	0.29	47.3
All Vehicles		661	0.0	0.166	3.7	NA	1.0	7.3	0.24	0.33	44.1

LOS (Aver. Int. Delay): NA. The average intersection delay is not a good LOS measure for two-way sign control due to zero delays associated with major road movements.
Level of Service (Worst Movement): LOS A. LOS Method for individual vehicle movements: Delay (RTA NSW).
Approach LOS values are based on the worst delay for any vehicle movement.

MOVEMENT SUMMARY

Site: Napoleon St / Hickson Rd-PM

Napoleon Street/Hickson Road intersection
Stop (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow 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: Hickson Road											
2	T	436	10.9	0.194	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
3	R	351	0.0	0.423	13.2	LOS A	3.0	21.3	0.68	0.98	44.0
Approach		786	6.0	0.423	5.9	LOS A	3.0	21.3	0.30	0.44	51.6
East: Napoleon Street											
4	L	339	0.6	0.622	20.3	LOS B	4.9	34.6	0.76	1.19	27.0
6	R	58	1.8	0.285	30.3	LOS C	1.2	8.6	0.87	1.03	20.8
Approach		397	0.8	0.622	21.7	LOS C	4.9	34.6	0.78	1.17	25.9
North: Hickson Road											
7	L	171	0.0	0.364	8.2	LOS A	0.0	0.0	0.00	0.94	49.0
8	T	523	2.0	0.364	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		694	1.5	0.364	2.0	LOS A	0.0	0.0	0.00	0.23	56.9
All Vehicles		1877	3.3	0.622	7.8	NA	4.9	34.6	0.29	0.51	48.6

LOS (Aver. Int. Delay): NA. The average intersection delay is not a good LOS measure for two-way sign control due to zero delays associated with major road movements.
Level of Service (Worst Movement): LOS C. LOS Method for individual vehicle movements: Delay (RTA NSW).
Approach LOS values are based on the worst delay for any vehicle movement.

MOVEMENT SUMMARY

Site: Sussex St / Erskine St-PM

Sussex Street/Erskine Street intersection
Signals - Fixed Time Cycle Time = 110 seconds (User-Given Phase Times)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow 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: Sussex Street											
1	L	33	9.7	0.424	48.7	LOS D	9.0	68.4	0.92	0.82	23.7
2	T	277	9.5	0.424	42.1	LOS C	9.1	69.1	0.92	0.75	23.9
Approach		309	9.5	0.424	42.8	LOS D	9.1	69.1	0.92	0.76	23.9
East: Erskine Street											
4	L	381	2.2	0.395	23.0	LOS B	13.6	96.8	0.64	0.78	15.4
5	T	52	10.2	0.104	14.9	LOS B	3.2	23.9	0.55	0.44	18.4
6	R	29	0.0	0.104	21.0	LOS B	3.2	23.9	0.55	0.76	17.3
Approach		462	3.0	0.395	21.9	LOS B	13.6	96.8	0.62	0.74	15.8
North: Sussex Street											
7	L	52	2.0	0.408	30.8	LOS C	2.6	18.8	0.69	0.70	12.5
8	T	751	1.8	0.536	29.7	LOS C	17.1	121.5	0.84	0.73	15.9
9	R	7	0.0	0.045	54.3	LOS D	0.6	4.0	0.92	0.66	7.9
Approach		809	1.8	0.535	30.0	LOS C	17.1	121.5	0.83	0.73	15.6
West: Erskine Street											
10	L	45	0.0	0.174	20.2	LOS B	6.2	45.4	0.54	0.82	17.6
11	T	127	7.1	0.174	13.8	LOS A	6.2	45.4	0.54	0.45	19.1
12	R	156	3.4	0.380	31.5	LOS C	7.6	54.8	0.74	0.79	12.1
Approach		328	4.5	0.380	23.1	LOS B	7.6	54.8	0.64	0.66	14.8
All Vehicles		1909	3.8	0.535	28.9	LOS C	17.1	121.5	0.76	0.73	18.0

Level of Service (Aver. Int. Delay): LOS C. Based on average delay for all vehicle movements. LOS Method: Delay (RTA NSW).
Level of Service (Worst Movement): LOS D. LOS Method for individual vehicle movements: Delay (RTA NSW).
Approach LOS values are based on average delay for all vehicle movements.

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	Across S approach	1368	16.4	LOS B	2.3	2.3	0.55	0.55
P3	Across E approach	1368	41.0	LOS E	3.7	3.7	0.86	0.86
P5	Across N approach	1368	18.6	LOS B	2.5	2.5	0.58	0.58
P7	Across W approach	1368	43.7	LOS E	3.8	3.8	0.89	0.89
All Pedestrians		5472	29.9				0.72	0.72

Level of Service (Aver. Int. Delay): LOS C. Based on average delay for all pedestrian movements. LOS Method: Delay (HCM).
Level of Service (Worst Movement): LOS E. LOS Method for individual pedestrian movements: Delay (HCM).

Construction scenario (2014)

MOVEMENT SUMMARY

Site: Towns Pl / Hickson Rd-AM

Towns Place/Hickson Street intersection
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow 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
East: Hickson Road											
5	T	182	0.0	0.132	1.3	LOS A	1.0	7.3	0.44	0.00	44.6
6	R	51	0.0	0.132	7.4	LOS A	1.0	7.3	0.44	0.72	42.9
Approach		233	0.0	0.132	2.6	LOS A	1.0	7.3	0.44	0.16	44.2
North: Towns Place											
7	L	78	0.0	0.224	9.1	LOS A	1.2	8.2	0.49	0.67	29.1
9	R	102	0.0	0.224	9.0	LOS A	1.2	8.2	0.49	0.78	29.2
Approach		180	0.0	0.224	9.1	LOS A	1.2	8.2	0.49	0.73	29.2
West: Hickson Road											
10	L	128	0.0	0.175	6.4	LOS A	0.0	0.0	0.00	0.77	43.3
11	T	207	0.0	0.175	0.0	LOS A	0.0	0.0	0.00	0.00	50.0
Approach		336	0.0	0.175	2.5	LOS A	0.0	0.0	0.00	0.29	47.2
All Vehicles		748	0.0	0.224	4.1	NA	1.2	8.2	0.25	0.36	43.7

LOS (Aver. Int. Delay): NA. The average intersection delay is not a good LOS measure for two-way sign control due to zero delays associated with major road movements.
Level of Service (Worst Movement): LOS A. LOS Method for individual vehicle movements: Delay (RTA NSW).
Approach LOS values are based on the worst delay for any vehicle movement.

Processed: Wednesday, 5 September 2012 5:22:41 PM
SIDRA INTERSECTION 5.0.5.1510
Project: C:\CW\230341-Barangaroo Central DA TIA\SIDRA\TIA-Towns-Napoleon-Erskine-Construction.sip
8001039, AURECON AUSTRALIA, ENTERPRISE

SIDRA INTERSECTION

MOVEMENT SUMMARY

Site: Hickson Rd / Gate No. 5-AM

Hickson Road / Gate No. 5 intersection
Stop (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow 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: Hickson Road											
1	L	80	26.3	0.421	7.0	LOS A	0.0	0.0	0.00	0.90	43.3
2	T	702	4.5	0.422	0.0	LOS A	0.0	0.0	0.00	0.00	50.0
Approach		782	6.7	0.422	0.7	LOS A	0.0	0.0	0.00	0.09	49.2
North: Hickson Road											
8	T	314	9.4	0.172	5.3	LOS A	2.4	18.3	0.74	0.00	42.0
9	R	1	0.0	0.175	12.0	LOS A	2.4	18.3	0.74	1.01	40.8
Approach		315	9.4	0.172	5.3	LOS A	2.4	18.3	0.74	0.00	42.0
West: Gate No. 5											
10	L	1	0.0	0.526	58.5	LOS E	1.8	18.6	0.93	1.09	21.1
12	R	40	52.6	0.435	60.7	LOS E	1.8	18.6	0.93	1.08	21.1
Approach		41	51.3	0.434	60.6	LOS E	1.8	18.6	0.93	1.08	21.1
All Vehicles		1138	9.1	0.434	4.1	NA	2.4	18.6	0.24	0.10	44.9

LOS (Aver. Int. Delay): NA. The average intersection delay is not a good LOS measure for two-way sign control due to zero delays associated with major road movements.
Level of Service (Worst Movement): LOS E. LOS Method for individual vehicle movements: Delay (RTA NSW).
Approach LOS values are based on the worst delay for any vehicle movement.

Processed: Thursday, 6 September 2012 2:14:09 PM
SIDRA INTERSECTION 5.0.5.1510
Project: C:\CW\230341-Barangaroo Central DA TIA\SIDRA\TIA-Towns-Napoleon-Erskine-Construction.sip
8001039, AURECON AUSTRALIA, ENTERPRISE

SIDRA INTERSECTION

MOVEMENT SUMMARY

Site: Napoleon St / Hickson Rd-AM

Napoleon Street/Hickson Road intersection
Stop (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	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: Hickson Road											
2	T	655	6.3	0.284	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
3	R	539	1.4	0.419	10.2	LOS A	3.5	24.7	0.54	0.77	46.7
Approach		1194	4.1	0.419	4.6	LOS A	3.5	24.7	0.24	0.35	53.2
East: Napoleon Street											
4	L	498	2.5	0.686	16.4	LOS B	6.9	49.6	0.60	1.12	30.3
6	R	127	9.1	0.832	69.0	LOS E	5.4	40.8	0.97	1.31	11.1
Approach		625	3.9	0.831	27.1	LOS E	6.9	49.6	0.68	1.16	22.4
North: Hickson Road											
7	L	75	21.1	0.181	8.8	LOS A	0.0	0.0	0.00	0.97	49.0
8	T	236	17.0	0.181	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		311	18.0	0.181	2.1	LOS A	0.0	0.0	0.00	0.23	56.9
All Vehicles		2129	6.0	0.831	10.9	NA	6.9	49.6	0.33	0.57	44.6

LOS (Aver. Int. Delay): NA. The average intersection delay is not a good LOS measure for two-way sign control due to zero delays associated with major road movements.
Level of Service (Worst Movement): LOS E. LOS Method for individual vehicle movements: Delay (RTA NSW).
Approach LOS values are based on the worst delay for any vehicle movement.

SIDRA INTERSECTION

MOVEMENT SUMMARY

Site: Sussex St / Erskine St-AM

Sussex Street/Erskine Street intersection
Signals - Fixed Time Cycle Time = 111 seconds (User-Given Phase Times)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	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: Sussex Street											
1	L	55	5.8	0.443	32.8	LOS C	14.5	104.2	0.78	0.86	28.8
2	T	615	2.2	0.442	26.2	LOS B	14.7	104.8	0.78	0.67	29.5
Approach		669	2.5	0.442	26.8	LOS B	14.7	104.8	0.78	0.69	29.4
East: Erskine Street											
4	L	327	4.2	0.480	34.6	LOS C	14.8	107.6	0.81	0.82	11.4
5	T	47	35.6	0.161	26.7	LOS B	4.1	34.8	0.72	0.58	12.5
6	R	31	6.9	0.161	32.9	LOS C	4.1	34.8	0.72	0.77	12.5
Approach		405	8.1	0.480	33.6	LOS C	14.8	107.6	0.79	0.78	11.6
North: Sussex Street											
7	L	44	21.4	0.384	28.3	LOS B	2.2	18.0	0.64	0.69	17.7
8	T	639	8.2	0.330	16.2	LOS B	11.5	86.2	0.62	0.53	22.7
9	R	5	0.0	0.039	59.6	LOS E	0.4	3.0	0.95	0.65	10.2
Approach		688	9.0	0.384	17.3	LOS B	11.5	86.2	0.62	0.55	22.1
West: Erskine Street											
10	L	59	5.4	0.266	30.7	LOS C	8.6	63.7	0.72	0.82	13.1
11	T	132	7.2	0.266	24.1	LOS B	8.6	63.7	0.72	0.60	13.3
12	R	141	6.0	0.523	47.2	LOS D	8.5	62.9	0.92	0.81	8.8
Approach		332	6.3	0.523	35.1	LOS C	8.6	63.7	0.80	0.73	10.9
All Vehicles		2095	6.3	0.523	26.3	LOS B	14.8	107.6	0.73	0.67	22.0

Level of Service (Aver. Int. Delay): LOS B. Based on average delay for all vehicle movements. LOS Method: Delay (RTA NSW).
Level of Service (Worst Movement): LOS E. LOS Method for individual vehicle movements: Delay (RTA NSW).
Approach LOS values are based on average delay for all vehicle movements.

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	Across S approach	1684	26.7	LOS C	3.7	3.7	0.69	0.69
P3	Across E approach	1684	24.7	LOS C	3.5	3.5	0.67	0.67
P5	Across N approach	1684	30.3	LOS D	3.9	3.9	0.74	0.74
P7	Across W approach	1684	26.7	LOS C	3.7	3.7	0.69	0.69
All Pedestrians		6736	27.1				0.70	0.70

Level of Service (Aver. Int. Delay): LOS C. Based on average delay for all pedestrian movements. LOS Method: Delay (HCM).
Level of Service (Worst Movement): LOS D. LOS Method for individual pedestrian movements: Delay (HCM).

SIDRA INTERSECTION

MOVEMENT SUMMARY

Site: Towns Pl / Hickson Rd-PM

Towns Place/Hickson Street intersection
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow 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
East: Hickson Road											
5	T	194	0.0	0.140	1.1	LOS A	1.1	7.6	0.40	0.00	45.0
6	R	57	0.0	0.140	7.1	LOS A	1.1	7.6	0.40	0.71	42.9
Approach		251	0.0	0.140	2.4	LOS A	1.1	7.6	0.40	0.16	44.5
North: Towns Place											
7	L	73	0.0	0.173	8.7	LOS A	0.9	6.3	0.44	0.64	29.7
9	R	76	0.0	0.173	8.6	LOS A	0.9	6.3	0.44	0.74	29.8
Approach		148	0.0	0.173	8.6	LOS A	0.9	6.3	0.44	0.69	29.8
West: Hickson Road											
10	L	105	0.0	0.147	6.4	LOS A	0.0	0.0	0.00	0.77	43.3
11	T	177	0.0	0.147	0.0	LOS A	0.0	0.0	0.00	0.00	50.0
Approach		282	0.0	0.147	2.4	LOS A	0.0	0.0	0.00	0.29	47.3
All Vehicles		681	0.0	0.173	3.8	NA	1.1	7.6	0.24	0.33	44.0

LOS (Aver. Int. Delay): NA. The average intersection delay is not a good LOS measure for two-way sign control due to zero delays associated with major road movements.
Level of Service (Worst Movement): LOS A. LOS Method for individual vehicle movements: Delay (RTA NSW).
Approach LOS values are based on the worst delay for any vehicle movement.

MOVEMENT SUMMARY

Site: Hickson Rd / Gate No. 5-PM

Hickson Road / Gate No. 5 intersection
Stop (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow 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: Hickson Road											
1	L	40	52.6	0.308	7.5	LOS A	0.0	0.0	0.00	0.93	43.3
2	T	508	9.7	0.307	0.0	LOS A	0.0	0.0	0.00	0.00	50.0
Approach		548	12.9	0.307	0.5	LOS A	0.0	0.0	0.00	0.07	49.4
North: Hickson Road											
8	T	297	9.2	0.162	3.0	LOS A	1.8	13.3	0.62	0.00	43.1
9	R	1	0.0	0.175	9.8	LOS A	1.8	13.3	0.62	0.96	42.3
Approach		298	9.2	0.162	3.1	LOS A	1.8	13.3	0.62	0.00	43.1
West: Gate No. 5											
10	L	1	0.0	0.351	24.2	LOS B	1.5	12.5	0.80	1.05	32.2
12	R	80	26.3	0.309	25.2	LOS B	1.5	12.5	0.80	1.05	32.3
Approach		81	26.0	0.309	25.2	LOS B	1.5	12.5	0.80	1.05	32.3
All Vehicles		927	12.8	0.309	3.5	NA	1.8	13.3	0.27	0.13	45.2

LOS (Aver. Int. Delay): NA. The average intersection delay is not a good LOS measure for two-way sign control due to zero delays associated with major road movements.
Level of Service (Worst Movement): LOS B. LOS Method for individual vehicle movements: Delay (RTA NSW).
Approach LOS values are based on the worst delay for any vehicle movement.

MOVEMENT SUMMARY

Site: Napoleon St / Hickson Rd-PM

Napoleon Street/Hickson Road intersection
Stop (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow 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: Hickson Road											
2	T	471	12.5	0.212	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
3	R	361	0.0	0.512	15.4	LOS B	3.8	26.8	0.76	1.05	42.2
Approach		832	7.1	0.512	6.7	LOS B	3.8	26.8	0.33	0.46	50.7
East: Napoleon Street											
4	L	349	0.6	0.734	24.7	LOS B	6.5	45.5	0.85	1.30	24.0
6	R	78	14.9	0.649	61.5	LOS E	3.1	24.5	0.96	1.13	12.3
Approach		427	3.2	0.734	31.4	LOS E	6.5	45.5	0.87	1.27	20.5
North: Hickson Road											
7	L	221	4.8	0.423	8.3	LOS A	0.0	0.0	0.00	0.93	49.0
8	T	573	3.7	0.424	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		794	4.0	0.424	2.3	LOS A	0.0	0.0	0.00	0.26	56.5
All Vehicles		2053	5.1	0.734	10.1	NA	6.5	45.5	0.32	0.55	46.0

LOS (Aver. Int. Delay): NA. The average intersection delay is not a good LOS measure for two-way sign control due to zero delays associated with major road movements.
Level of Service (Worst Movement): LOS E. LOS Method for individual vehicle movements: Delay (RTA NSW).
Approach LOS values are based on the worst delay for any vehicle movement.

MOVEMENT SUMMARY

Site: Sussex St / Erskine St-PM

Sussex Street/Erskine Street intersection
Signals - Fixed Time Cycle Time = 110 seconds (User-Given Phase Times)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow 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: Sussex Street											
1	L	34	9.4	0.417	46.1	LOS D	9.6	73.9	0.90	0.82	24.4
2	T	307	12.3	0.417	39.5	LOS C	9.6	74.6	0.90	0.74	24.6
Approach		341	12.0	0.417	40.2	LOS C	9.6	74.6	0.90	0.75	24.6
East: Erskine Street											
4	L	393	2.1	0.429	25.1	LOS B	14.7	104.8	0.68	0.79	14.5
5	T	53	10.0	0.114	16.6	LOS B	3.5	25.7	0.58	0.46	17.2
6	R	31	0.0	0.114	22.7	LOS B	3.5	25.7	0.58	0.77	16.4
Approach		476	2.9	0.429	24.0	LOS B	14.7	104.8	0.66	0.75	14.9
North: Sussex Street											
7	L	53	2.0	0.506	42.9	LOS D	3.3	23.3	0.83	0.72	24.6
8	T	806	3.0	0.539	27.7	LOS B	17.8	127.7	0.83	0.72	16.6
9	R	7	0.0	0.045	54.3	LOS D	0.6	4.0	0.92	0.66	21.7
Approach		866	2.9	0.539	28.9	LOS C	17.8	127.7	0.83	0.72	17.6
West: Erskine Street											
10	L	46	0.0	0.188	21.9	LOS B	6.7	48.7	0.58	0.82	16.6
11	T	131	7.3	0.188	15.5	LOS B	6.7	48.7	0.58	0.48	17.8
12	R	160	3.3	0.432	35.7	LOS C	8.3	59.8	0.80	0.80	11.0
Approach		337	4.4	0.432	26.0	LOS B	8.3	59.8	0.68	0.68	13.7
All Vehicles		2020	4.7	0.539	29.1	LOS C	17.8	127.7	0.78	0.73	18.7

Level of Service (Aver. Int. Delay): LOS C. Based on average delay for all vehicle movements. LOS Method: Delay (RTA NSW).
Level of Service (Worst Movement): LOS D. LOS Method for individual vehicle movements: Delay (RTA NSW).
Approach LOS values are based on average delay for all vehicle movements.

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	Across S approach	1684	17.5	LOS B	3.0	3.0	0.56	0.56
P3	Across E approach	1684	38.5	LOS D	4.4	4.4	0.84	0.84
P5	Across N approach	1684	20.4	LOS C	3.2	3.2	0.61	0.61
P7	Across W approach	1684	40.2	LOS E	4.5	4.5	0.85	0.85
All Pedestrians		6736	29.1				0.72	0.72

Level of Service (Aver. Int. Delay): LOS C. Based on average delay for all pedestrian movements. LOS Method: Delay (HCM).
Level of Service (Worst Movement): LOS E. LOS Method for individual pedestrian movements: Delay (HCM).

Processed: Tuesday, 23 October 2012 4:05:07 PM
SIDRA INTERSECTION 5.0.5.1510
Project: C:\CW\230341-Barangaroo Central DA TIA\SIDRA\TIA-Towns-Napoleon-Erskine-Construction-rev01-peds.sip
8001039, AURECON AUSTRALIA, ENTERPRISE

SIDRA INTERSECTION

Operation scenario (2020)

MOVEMENT SUMMARY

Site: Towns Pl / Hickson Rd-AM

Towns Place/Hickson Street intersection
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow 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
East: Hickson Road											
5	T	224	0.0	0.210	4.0	LOS A	2.1	14.6	0.66	0.00	42.3
6	R	80	0.0	0.209	10.1	LOS A	2.1	14.6	0.66	0.90	41.3
Approach		304	0.0	0.209	5.6	LOS A	2.1	14.6	0.66	0.24	42.0
North: Towns Place											
7	L	104	0.0	0.447	13.9	LOS A	3.0	21.2	0.67	0.99	23.9
9	R	149	0.0	0.448	13.8	LOS A	3.0	21.2	0.67	0.97	24.0
Approach		254	0.0	0.447	13.8	LOS A	3.0	21.2	0.67	0.98	24.0
West: Hickson Road											
10	L	424	0.0	0.359	6.4	LOS A	0.0	0.0	0.00	0.70	43.3
11	T	255	0.0	0.359	0.0	LOS A	0.0	0.0	0.00	0.00	50.0
Approach		679	0.0	0.359	4.0	LOS A	0.0	0.0	0.00	0.44	45.6
All Vehicles		1237	0.0	0.447	6.4	NA	3.0	21.2	0.30	0.50	41.8

LOS (Aver. Int. Delay): NA. The average intersection delay is not a good LOS measure for two-way sign control due to zero delays associated with major road movements.
Level of Service (Worst Movement): LOS A. LOS Method for individual vehicle movements: Delay (RTA NSW).
Approach LOS values are based on the worst delay for any vehicle movement.

Processed: Friday, 7 September 2012 2:04:19 PM
SIDRA INTERSECTION 5.0.5.1510
Project: C:\CW\230341-Barangaroo Central DA TIA\SIDRA\TIA-Towns-Napoleon-Erskine-Operation.sip
8001039, AURECON AUSTRALIA, ENTERPRISE

SIDRA INTERSECTION

MOVEMENT SUMMARY

Site: Napoleon St / Hickson Rd-AM - Conversion

Napoleon Street/Hickson Road intersection
Signals - Fixed Time Cycle Time = 150 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow 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: Hickson Road											
2	T	976	3.8	0.687	19.5	LOS B	38.4	277.7	0.66	0.62	37.4
3	R	663	1.4	1.162	236.2	LOS F	104.0	736.8	1.00	1.40	8.0
Approach		1639	2.8	1.162	107.2	LOS F	104.0	736.8	0.81	0.94	15.0
East: Napoleon Street											
4	L	101	2.6	1.000[3]	66.3	LOS E	6.1	43.5	0.99	0.78	11.2
6	R	666	0.7	1.162	229.8	LOS F	95.1	677.7	1.00	1.32	3.7
Approach		766	2.2	1.162	208.3	LOS F	95.1	677.7	1.00	1.25	4.1
North: Hickson Road											
7	L	65	9.7	0.163	18.8	LOS B	6.4	48.8	0.45	0.87	40.6
8	T	292	12.3	0.163	12.2	LOS A	7.2	55.5	0.46	0.39	43.1
Approach		357	11.8	0.163	13.4	LOS A	7.2	55.5	0.46	0.47	42.6
All Vehicles		2762	3.8	1.162	123.2	LOS F	104.0	736.8	0.82	0.96	11.8

Level of Service (Aver. Int. Delay): LOS F. Based on average delay for all vehicle movements. LOS Method: Delay (RTA NSW).
Level of Service (Worst Movement): LOS F. LOS Method for individual vehicle movements: Delay (RTA NSW).
Approach LOS values are based on average delay for all vehicle movements.

3 x = 1.00 due to short lane. Refer to the Lane Summary report for information about excess flow and related conditions.

Processed: Friday, 7 September 2012 2:59:07 PM
SIDRA INTERSECTION 5.0.5.1510
Project: C:\CW\230341-Barangaroo Central DA TIA\SIDRA\TIA-Towns-Napoleon-Erskine-Operation.sip
8001039, AURECON AUSTRALIA, ENTERPRISE

SIDRA INTERSECTION

MOVEMENT SUMMARY

Site: Sussex St / Erskine St-AM

Sussex Street/Erskine Street intersection
Signals - Fixed Time Cycle Time = 110 seconds (User-Given Phase Times)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow 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: Sussex Street											
1	L	68	6.2	0.658	35.4	LOS C	22.6	161.6	0.87	0.88	27.9
2	T	941	1.8	0.658	28.8	LOS C	22.9	162.4	0.87	0.77	28.3
Approach		1009	2.1	0.658	29.3	LOS C	22.9	162.4	0.87	0.78	28.3
East: Erskine Street											
4	L	402	4.2	0.584	35.6	LOS C	18.3	132.4	0.85	0.83	11.2
5	T	58	36.4	0.216	28.3	LOS B	5.1	43.3	0.75	0.61	12.0
6	R	38	8.3	0.216	34.5	LOS C	5.1	43.3	0.75	0.78	12.1
Approach		498	8.2	0.584	34.7	LOS C	18.3	132.4	0.83	0.81	11.3
North: Sussex Street											
7	L	55	21.2	0.392	21.4	LOS B	2.2	18.2	0.53	0.69	33.2
8	T	787	6.6	0.413	17.9	LOS B	14.4	106.7	0.67	0.58	33.8
9	R	6	0.0	0.062	62.1	LOS E	0.5	3.7	0.97	0.65	20.0
Approach		848	7.4	0.413	18.4	LOS B	14.4	106.7	0.66	0.59	33.6
West: Erskine Street											
10	L	73	5.8	0.327	31.6	LOS C	10.4	77.3	0.74	0.83	12.8
11	T	162	7.1	0.328	25.0	LOS B	10.4	77.3	0.74	0.63	12.9
12	R	174	6.1	0.787	58.9	LOS E	11.6	85.8	1.00	0.93	7.3
Approach		408	6.4	0.787	40.6	LOS C	11.6	85.8	0.85	0.80	9.7
All Vehicles		2764	5.5	0.787	28.6	LOS C	22.9	162.4	0.80	0.73	25.4

Level of Service (Aver. Int. Delay): LOS C. Based on average delay for all vehicle movements. LOS Method: Delay (RTA NSW).
Level of Service (Worst Movement): LOS E. LOS Method for individual vehicle movements: Delay (RTA NSW).
Approach LOS values are based on average delay for all vehicle movements.

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	Across S approach	2632	25.6	LOS C	5.6	5.6	0.68	0.68
P3	Across E approach	2632	24.2	LOS C	5.5	5.5	0.66	0.66
P5	Across N approach	2632	29.1	LOS C	6.0	6.0	0.73	0.73
P7	Across W approach	2632	25.6	LOS C	5.6	5.6	0.68	0.68
All Pedestrians		10528	26.1				0.69	0.69

Level of Service (Aver. Int. Delay): LOS C. Based on average delay for all pedestrian movements. LOS Method: Delay (HCM).
Level of Service (Worst Movement): LOS C. LOS Method for individual pedestrian movements: Delay (HCM).

Processed: Tuesday, 23 October 2012 4:07:03 PM
SIDRA INTERSECTION 5.0.5.1510
Project: C:\CW\230341-Barangaroo Central DA TIA\SIDRA\TIA-Towns-Napoleon-Erskine-Operation-rev01-peds.sip
8001039, AURECON AUSTRALIA, ENTERPRISE

SIDRA INTERSECTION

MOVEMENT SUMMARY

Site: Towns Pl / Hickson Rd-PM

Towns Place/Hickson Street intersection
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow 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
East: Hickson Road											
5	T	239	0.0	0.180	1.6	LOS A	1.5	10.6	0.49	0.00	44.1
6	R	72	0.0	0.180	7.7	LOS A	1.5	10.6	0.49	0.75	42.8
Approach		311	0.0	0.180	3.0	LOS A	1.5	10.6	0.49	0.17	43.8
North: Towns Place											
7	L	160	0.0	0.669	14.9	LOS B	7.3	51.3	0.70	1.09	23.0
9	R	306	0.0	0.670	14.8	LOS B	7.3	51.3	0.70	1.12	23.1
Approach		466	0.0	0.671	14.8	LOS B	7.3	51.3	0.70	1.11	23.1
West: Hickson Road											
10	L	159	0.0	0.197	6.4	LOS A	0.0	0.0	0.00	0.76	43.3
11	T	217	0.0	0.197	0.0	LOS A	0.0	0.0	0.00	0.00	50.0
Approach		376	0.0	0.197	2.7	LOS A	0.0	0.0	0.00	0.32	46.9
All Vehicles		1153	0.0	0.671	7.7	NA	7.3	51.3	0.41	0.60	38.9

LOS (Aver. Int. Delay): NA. The average intersection delay is not a good LOS measure for two-way sign control due to zero delays associated with major road movements.
Level of Service (Worst Movement): LOS B. LOS Method for individual vehicle movements: Delay (RTA NSW).
Approach LOS values are based on the worst delay for any vehicle movement.

Processed: Friday, 7 September 2012 2:04:20 PM
SIDRA INTERSECTION 5.0.5.1510
Project: C:\CW\230341-Barangaroo Central DA TIA\SIDRA\TIA-Towns-Napoleon-Erskine-Operation.sip
8001039, AURECON AUSTRALIA, ENTERPRISE

SIDRA INTERSECTION

MOVEMENT SUMMARY

Site: Napoleon St / Hickson Rd-PM - Conversion

Napoleon Street/Hickson Road intersection
Signals - Fixed Time Cycle Time = 35 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow 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: Hickson Road											
2	T	576	10.4	0.528	6.7	LOS A	7.4	56.3	0.71	0.60	47.9
3	R	444	0.0	1.963	898.3	LOS F	97.9	685.4	1.00	4.94	2.3
Approach		1020	5.9	1.963	395.0	LOS F	97.9	685.4	0.83	2.49	5.0
East: Napoleon Street											
4	L	256	0.7	1.000[3]	24.8	LOS B	6.2	43.4	1.00	0.81	22.9
6	R	253	1.3	0.799	27.8	LOS B	6.6	46.9	1.00	0.98	21.3
Approach		508	0.8	1.000	26.3	LOS B	6.6	46.9	1.00	0.90	22.1
North: Hickson Road											
7	L	269	0.0	1.137	157.8	LOS F	81.1	574.0	1.00	2.75	11.4
8	T	823	1.7	1.137	149.6	LOS F	81.1	574.0	1.00	2.75	11.4
Approach		1093	1.3	1.137	151.6	LOS F	81.1	574.0	1.00	2.75	11.4
All Vehicles		2621	3.0	1.963	222.0	LOS F	97.9	685.4	0.94	2.29	7.6

Level of Service (Aver. Int. Delay): LOS F. Based on average delay for all vehicle movements. LOS Method: Delay (RTA NSW).
Level of Service (Worst Movement): LOS F. LOS Method for individual vehicle movements: Delay (RTA NSW).
Approach LOS values are based on average delay for all vehicle movements.

3 x = 1.00 due to short lane. Refer to the Lane Summary report for information about excess flow and related conditions.

Processed: Friday, 7 September 2012 2:35:05 PM
SIDRA INTERSECTION 5.0.5.1510
Project: C:\CW230341-Barangaroo Central DA TIA\SIDRA\TIA-Towns-Napoleon-Erskine-Operation.sip
8001039, AURECON AUSTRALIA, ENTERPRISE

SIDRA INTERSECTION

MOVEMENT SUMMARY

Site: Sussex St / Erskine St-PM

Sussex Street/Erskine Street intersection
Signals - Fixed Time Cycle Time = 110 seconds (User-Given Phase Times)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow 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: Sussex Street											
1	L	41	10.3	0.500	47.0	LOS D	11.4	86.5	0.92	0.83	24.1
2	T	375	9.0	0.500	40.4	LOS C	11.6	87.2	0.92	0.77	24.4
Approach		416	9.1	0.500	41.0	LOS C	11.6	87.2	0.92	0.77	24.3
East: Erskine Street											
4	L	482	2.2	0.527	26.4	LOS B	18.5	131.9	0.73	0.81	14.0
5	T	65	9.7	0.145	18.1	LOS B	4.4	32.3	0.61	0.49	16.3
6	R	37	0.0	0.145	24.2	LOS B	4.4	32.3	0.61	0.77	15.7
Approach		584	2.9	0.527	25.3	LOS B	18.5	131.9	0.71	0.77	14.3
North: Sussex Street											
7	L	65	1.6	0.492	28.9	LOS C	3.2	22.5	0.66	0.71	29.5
8	T	1111	1.5	0.736	30.7	LOS C	26.0	184.2	0.92	0.82	27.6
9	R	9	0.0	0.059	54.5	LOS D	0.7	5.1	0.92	0.67	21.6
Approach		1185	1.5	0.736	30.8	LOS C	26.0	184.2	0.90	0.81	27.6
West: Erskine Street											
10	L	57	0.0	0.231	22.3	LOS B	8.1	59.2	0.59	0.83	16.4
11	T	161	7.2	0.231	15.9	LOS B	8.1	59.2	0.59	0.50	17.5
12	R	197	3.2	0.648	42.3	LOS C	11.1	79.7	0.91	0.84	9.6
Approach		415	4.3	0.648	29.3	LOS C	11.1	79.7	0.74	0.71	12.5
All Vehicles		2600	3.5	0.736	31.0	LOS C	26.0	184.2	0.84	0.78	23.6

Level of Service (Aver. Int. Delay): LOS C. Based on average delay for all vehicle movements. LOS Method: Delay (RTA NSW).
Level of Service (Worst Movement): LOS D. LOS Method for individual vehicle movements: Delay (RTA NSW).
Approach LOS values are based on average delay for all vehicle movements.

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	Across S approach	2632	17.5	LOS B	4.6	4.6	0.56	0.56
P3	Across E approach	2632	38.5	LOS D	6.9	6.9	0.84	0.84
P5	Across N approach	2632	20.4	LOS C	5.0	5.0	0.61	0.61
P7	Across W approach	2632	40.2	LOS E	7.0	7.0	0.85	0.85
All Pedestrians		10528	29.1				0.72	0.72

Level of Service (Aver. Int. Delay): LOS C. Based on average delay for all pedestrian movements. LOS Method: Delay (HCM).
Level of Service (Worst Movement): LOS E. LOS Method for individual pedestrian movements: Delay (HCM).

Processed: Tuesday, 23 October 2012 4:07:32 PM
SIDRA INTERSECTION 5.0.5.1510
Project: C:\CW230341-Barangaroo Central DA TIA\SIDRA\TIA-Towns-Napoleon-Erskine-Operation-rev01-peds.sip
8001039, AURECON AUSTRALIA, ENTERPRISE

SIDRA INTERSECTION

Appendix B
BPL construction program

Barangaroo Central program

BARANGAROO SYDNEY AUSTRALIA

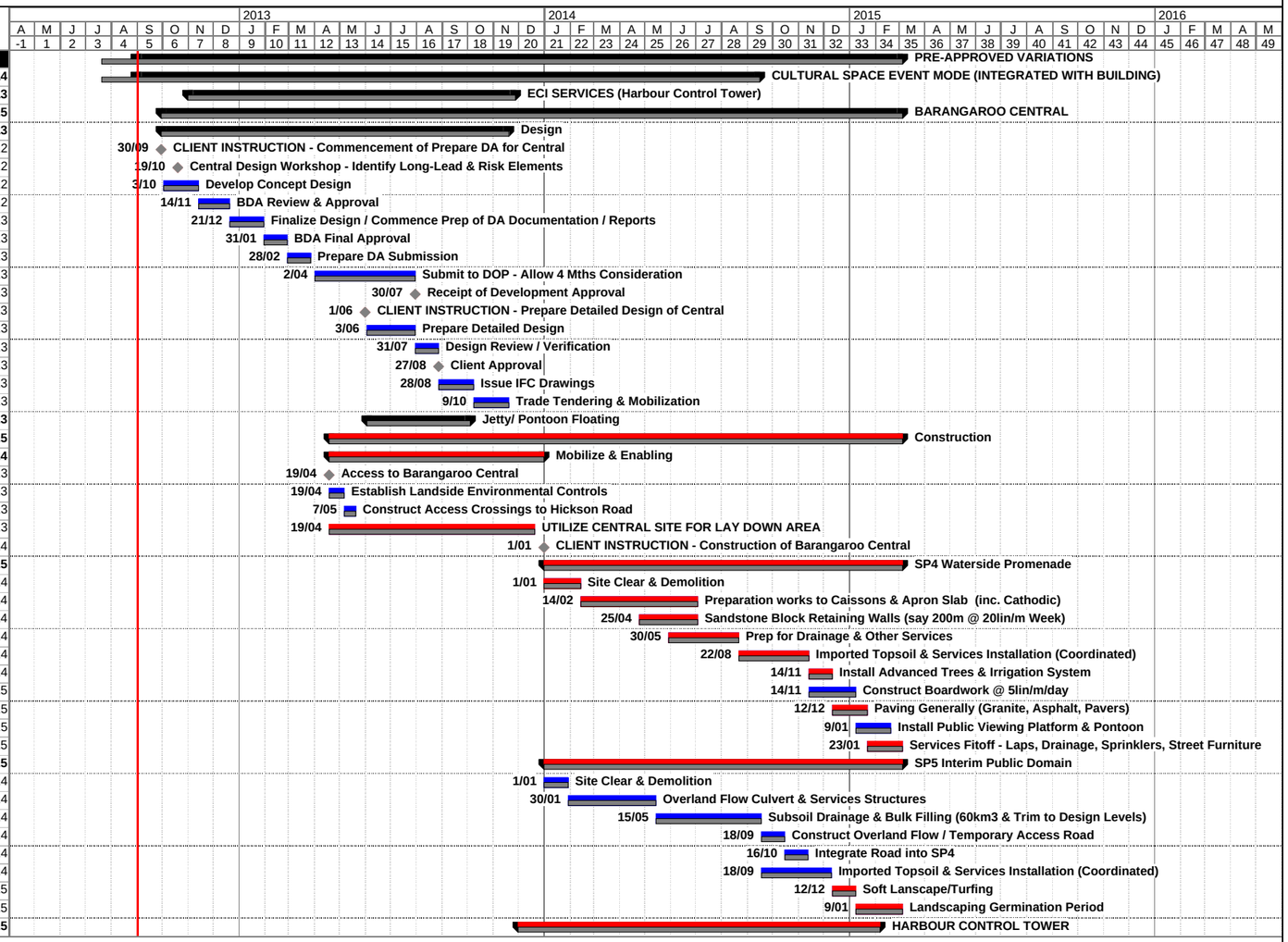
BARANGAROO PUBLIC DOMAIN MAIN WORKS

BARANGAROO CENTRAL PROGRAM

Revision 3 Status; 31/08/12

BAULDERSTONE

ID	Ref ID	%	Task Name	Duration	Start	Finish
1910	1888		**PRE-APPROVED VARIATIONS**			
1911	1889	0%	**CULTURAL SPACE EVENT MODE (INTEGRATED WITH BUILDING)**	**492 days**	**31/08/12**	**15/09/14**
1944	1922	0%	**ECI SERVICES (Harbour Control Tower)**	**280 days**	**1/11/12**	**27/11/13**
1948	1926	0%	**BARANGAROO CENTRAL**	**578 days**	**30/09/12**	**5/03/15**
1949	1927	0%	**Design**	**275 days**	**30/09/12**	**19/11/13**
1950	1928	0%	CLIENT INSTRUCTION - Commencement of Prepare DA for Central	0 days	30/09/12	30/09/12
1951	1929	0%	Central Design Workshop - Identify Long-Lead & Risk Elements	0 days	19/10/12	19/10/12
1952	1930	0%	Develop Concept Design	30 days	3/10/12	13/11/12
1953	1931	0%	BDA Review & Approval	25 days	14/11/12	20/12/12
1954	1932	0%	Finalize Design / Commence Prep of DA Documentation / Reports	20 days	21/12/12	30/01/13
1955	1933	0%	BDA Final Approval	20 days	31/01/13	27/02/13
1956	1934	0%	Prepare DA Submission	20 days	28/02/13	27/03/13
1957	1935	0%	Submit to DOP - Allow 4 Mths Consideration	82 days	2/04/13	30/07/13
1958	1936	0%	Receipt of Development Approval	0 days	30/07/13	30/07/13
1959	1937	0%	CLIENT INSTRUCTION - Prepare Detailed Design of Central	0 days	1/06/13	1/06/13
1960	1938	0%	Prepare Detailed Design	40 days	3/06/13	30/07/13
1961	1939	0%	Design Review / Verification	4 wks	31/07/13	27/08/13
1962	1940	0%	Client Approval	0 days	27/08/13	27/08/13
1963	1941	0%	Issue IFC Drawings	6 wks	28/08/13	8/10/13
1964	1942	0%	Trade Tendering & Mobilization	30 days	9/10/13	19/11/13
1965	1943	0%	**Jetty/ Pontoon Floating**	**90 days**	**3/06/13**	**4/10/13**
1970	1948	0%	**Construction**	**450 days**	**19/04/13**	**5/03/15**
1971	1949	0%	**Mobilize & Enabling**	**168 days**	**19/04/13**	**1/01/14**
1972	1950	0%	Access to Barangaroo Central	0 days	19/04/13	19/04/13
1973	1951	0%	Establish Landside Environmental Controls	10 days	19/04/13	6/05/13
1974	1952	0%	Construct Access Crossings to Hickson Road	10 days	7/05/13	20/05/13
1975	1953	0%	UTILIZE CENTRAL SITE FOR LAY DOWN AREA	168 days	19/04/13	20/12/13
1976	1954	0%	CLIENT INSTRUCTION - Construction of Barangaroo Central	0 days	1/01/14	1/01/14
1977	1955	0%	**SP4 Waterside Promenade**	**307 days**	**1/01/14**	**5/03/15**
1978	1956	0%	Site Clear & Demolition	32 days	1/01/14	13/02/14
1979	1957	0%	Preparation works to Caissons & Apron Slab (inc. Cathodic)	100 days	14/02/14	3/07/14
1980	1958	0%	Sandstone Block Retaining Walls (say 200m @ 20lin/m Week)	50 days	25/04/14	3/07/14
1981	1959	0%	Prep for Drainage & Other Services	60 days	30/05/14	21/08/14
1982	1960	0%	Imported Topsoil & Services Installation (Coordinated)	60 days	22/08/14	13/11/14
1983	1961	0%	Install Advanced Trees & Irrigation System	20 days	14/11/14	11/12/14
1984	1962	0%	Construct Boardwork @ 5lin/m/day	40 days	14/11/14	8/01/15
1985	1963	0%	Paving Generally (Granite, Asphalt, Pavers)	30 days	12/12/14	22/01/15
1986	1964	0%	Install Public Viewing Platform & Pontoon	30 days	9/01/15	19/02/15
1987	1965	0%	Services Fitoff - Laps, Drainage, Sprinklers, Street Furniture	30 days	23/01/15	5/03/15
1988	1966	0%	**SP5 Interim Public Domain**	**307 days**	**1/01/14**	**5/03/15**
1989	1967	0%	Site Clear & Demolition	21 days	1/01/14	29/01/14
1990	1968	0%	Overland Flow Culvert & Services Structures	75 days	30/01/14	14/05/14
1991	1969	0%	Subsoil Drainage & Bulk Filling (60km3 & Trim to Design Levels)	90 days	15/05/14	17/09/14
1992	1970	0%	Construct Overland Flow / Temporary Access Road	20 days	18/09/14	15/10/14
1993	1971	0%	Integrate Road into SP4	20 days	16/10/14	12/11/14
1994	1972	0%	Imported Topsoil & Services Installation (Coordinated)	60 days	18/09/14	10/12/14
1995	1973	0%	Soft Lanscape/Turfing	20 days	12/12/14	8/01/15
1996	1974	0%	Landscaping Germination Period	40 days	9/01/15	5/03/15
1997	1975	0%	**HARBOUR CONTROL TOWER**	**276 days**	**1/12/13**	**6/02/15**



Barangaroo - Contract Program Revision 3 - Updated

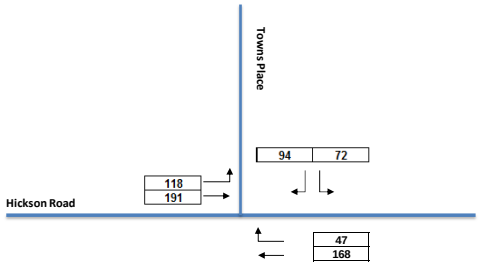
Task | Summary | Critical Summary | Completed Milstone | Rev1 - 30Jun12

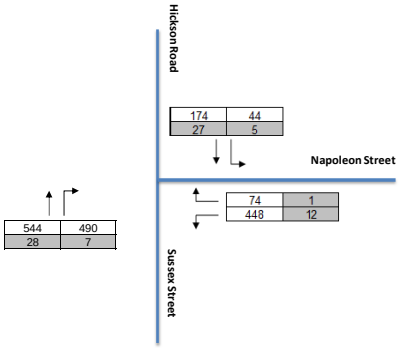
Milestone | Critical | Completed Task | Rev1 - 30Jun12 | Rev1 - 30Jun12

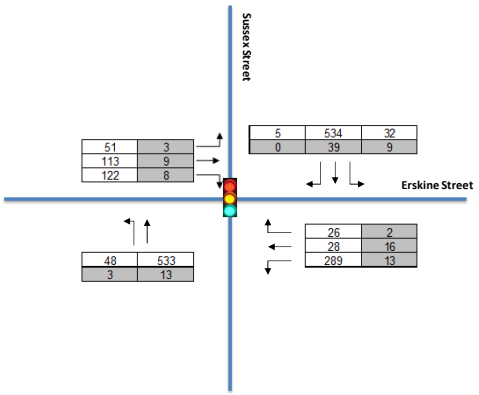
Data Date; 31/08/12

Appendix C
Traffic generation peak volumes

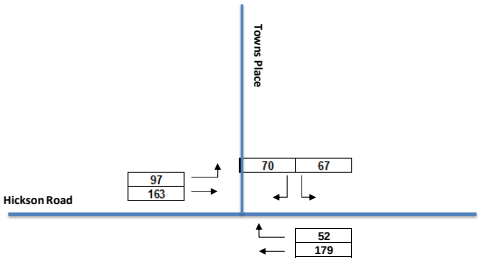
AM PEAK HOUR PERIOD

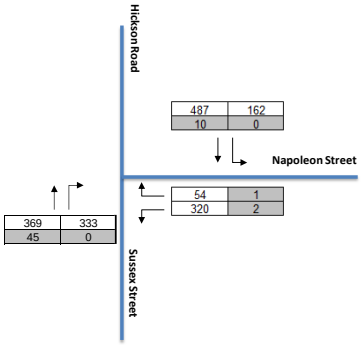


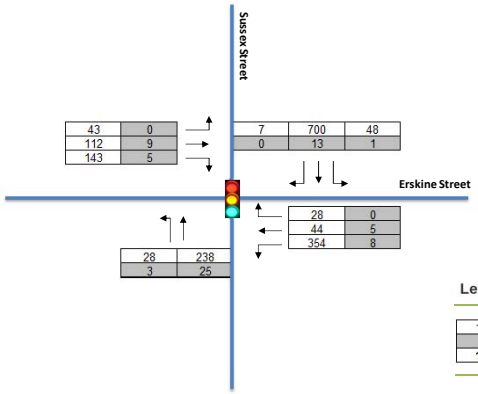




PM PEAK HOUR PERIOD







Legend

100	Light Vehicles
10	Heavy Vehicles
110	Total vehicles

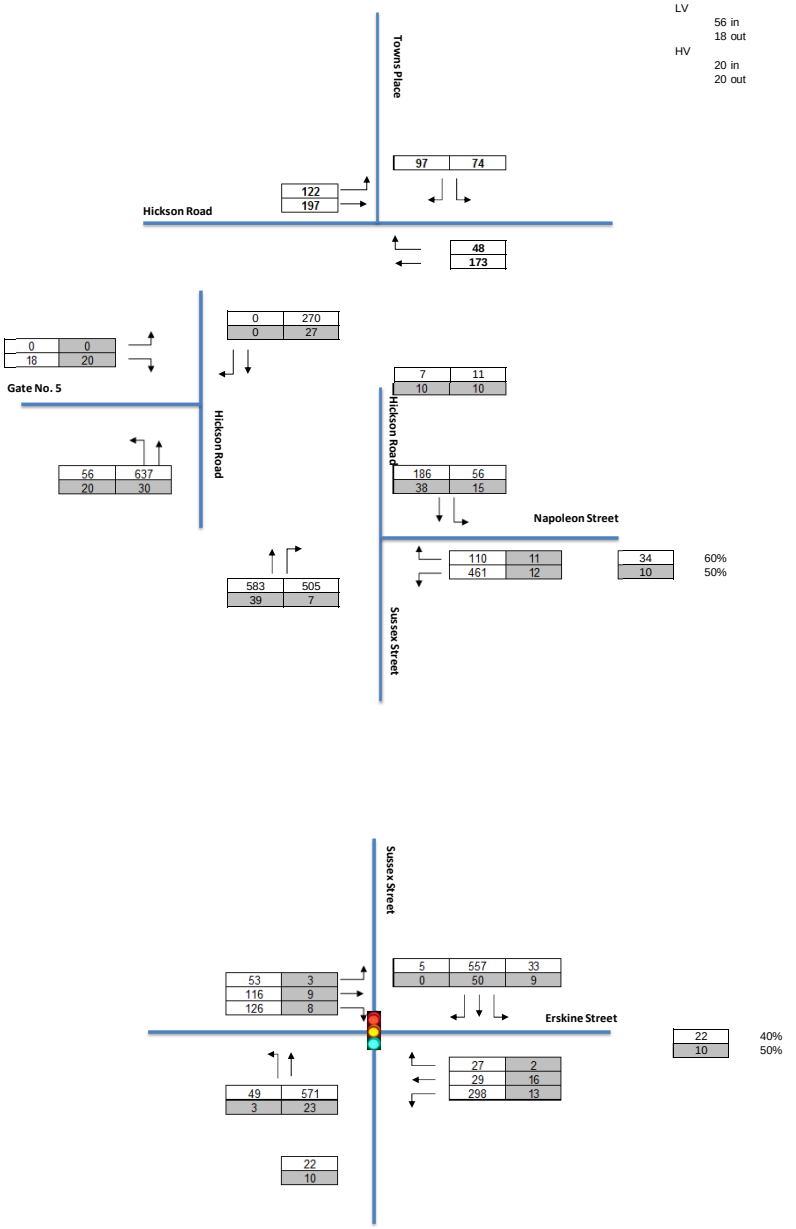
Note: Discrepancy with midblock traffic volumes between Napoleon Street and Erskine Street intersections is attributed to Shelly Street intersection located midway.

Towns Place/Hickson Road intersection traffic survey counts sourced from background document provide total volumes only.

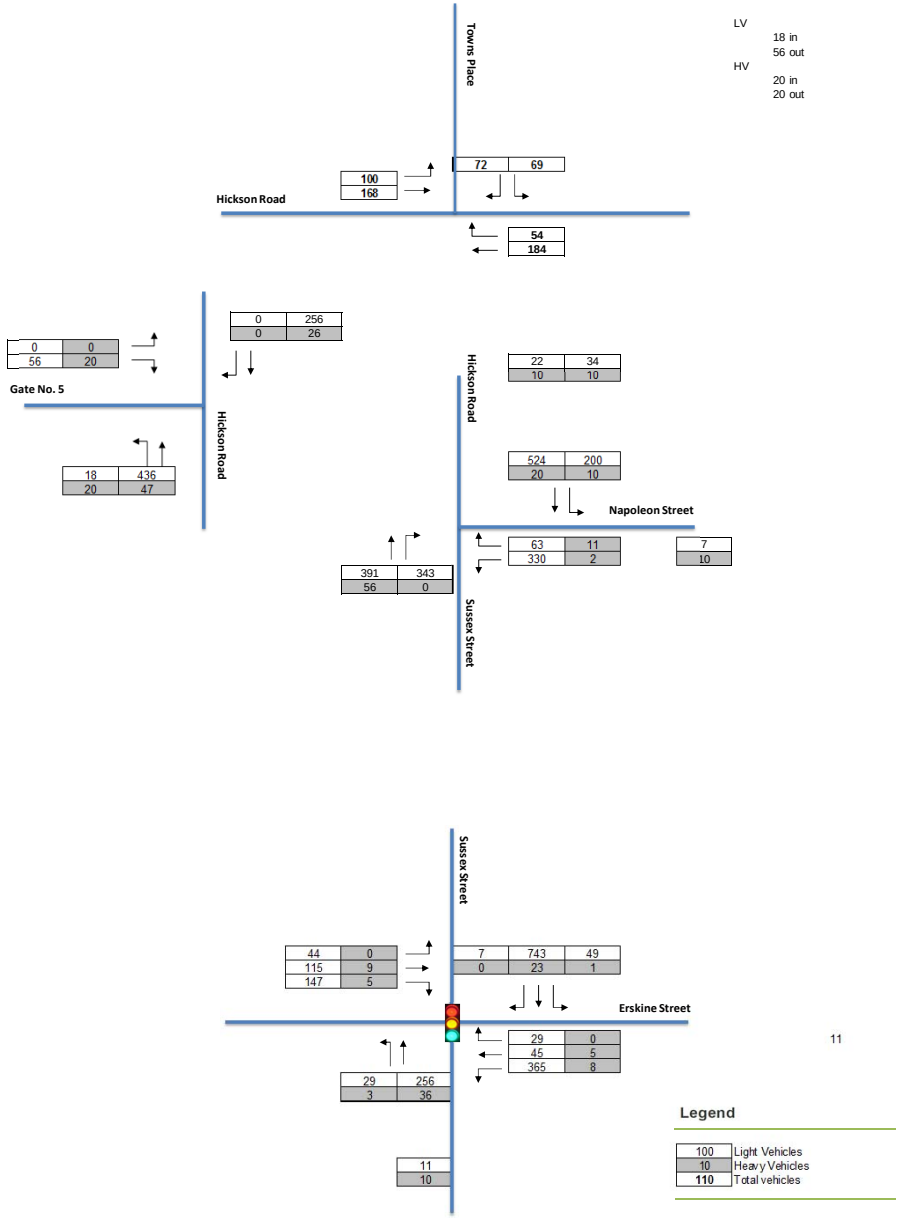
aurecon
Aurecon Australia Pty Ltd ABN 54 005 139 873
116 Military Road (PO Box 538) Neutral Bay
New South Wales 2089 Australia
Telephone: +61 2 9465 5599
Facsimile: +61 2 9465 5598
Email: sydney@ap.aurecongroup.com

FIGURE C-1: Existing Peak Hour Traffic Volumes

AM PEAK HOUR PERIOD



PM PEAK HOUR PERIOD



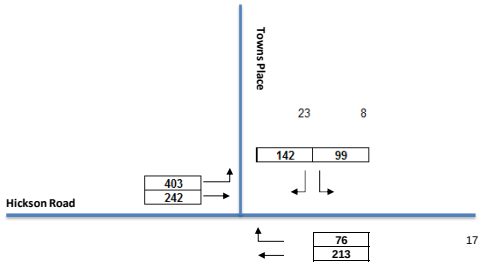
Note: Discrepancy with midblock traffic volumes between Napoleon Street and Erskine Street intersections is attributed to Shelly Street intersection located midway.

Towns Place/Hickson Road intersection traffic survey counts sourced from background document provide total volumes only.

aurecon
Aurecon Australia Pty Ltd ABN 54 005 139 873 Telephone: +61 2 9465 5599
116 Military Road (PO Box 538) Neutral Bay Facsimile: +61 2 9465 5598
New South Wales 2089 Australia Email: sydney@ap.aurecongroup.com

FIGURE C-2: Construction Peak Hour Traffic Volumes

AM PEAK HOUR PERIOD

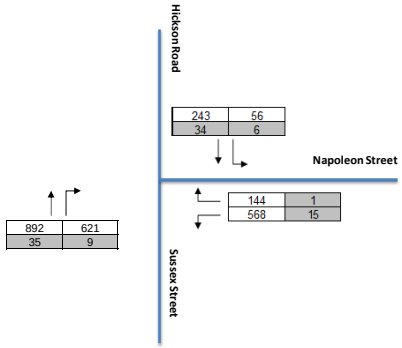


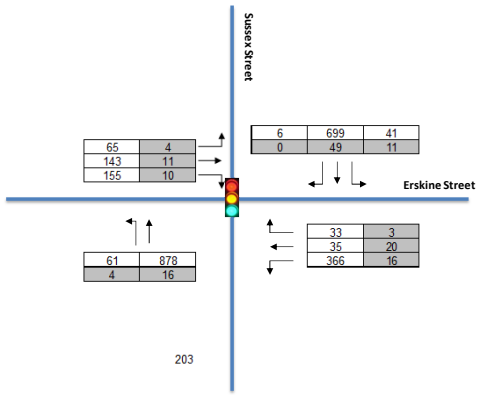
Special event

300 Headland Park

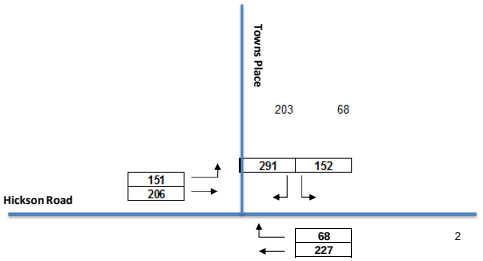
75% from the south
25% from the north

90% in 270
10% out 30



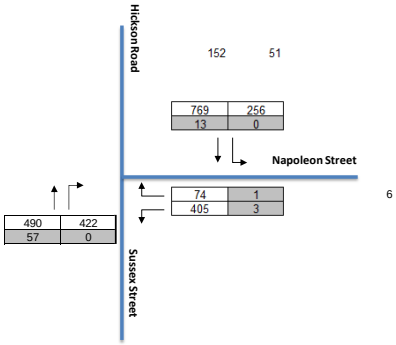


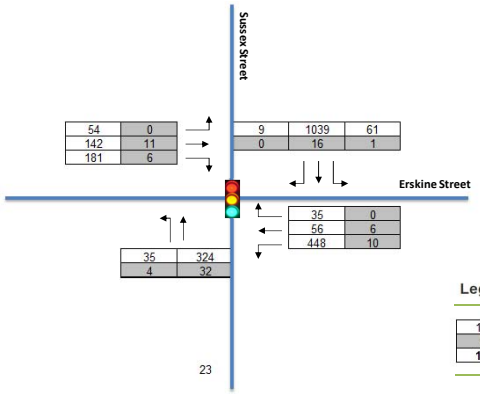
PM PEAK HOUR PERIOD



75% from the south
25% from the north

10% in 30
90% out 270





Legend

100	Light Vehicles
10	Heavy Vehicles
110	Total vehicles

Note: Discrepancy with midblock traffic volumes between Napoleon Street and Erskine Street intersections is attributed to Shelly Street intersection located midway.

Towns Place/Hickson Road intersection traffic survey counts sourced from background document provide total volumes only.

aurecon
Aurecon Australia Pty Ltd ABN 54 005 139 873
116 Military Road (PO Box 538) Neutral Bay
New South Wales 2089 Australia
Telephone: +61 2 9465 5599
Facsimile: +61 2 9465 5598
Email: sydney@ap.aurecongroup.com

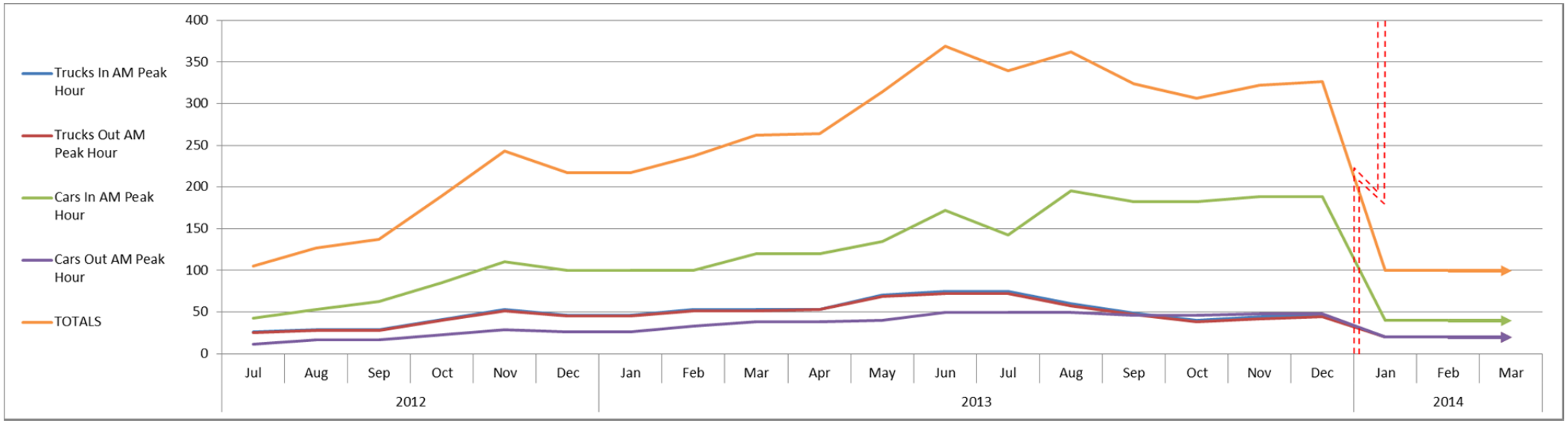
FIGURE C-3: Operation Peak Hour Traffic Volumes

Appendix D
Construction traffic numbers

Appendix D[22] replicates the table and graph of the anticipated construction traffic volumes which has been extended to incorporate Barangaroo Central. With reference to Figure 5.1, the following table and graph presents the generated construction volumes for Barangaroo Central in conjunction with Arup's generated volumes. It should be noted that the 2014 construction volumes are those relating to Barangaroo Central only, as advised by BPL, and does not include generated volumes from the surrounding construction activities, as no data is available beyond December 2013.

In reality, it would be expected that the combination of surrounding construction activities would increase vehicle movements in addition to those from Barangaroo Central, however due to the absence of further construction information, it would be difficult to estimate the total cumulative amount of trucks and cars that would be generated. As a result, the lines in the graph from January 2014 should be somewhat elevated to account for the addition of surrounding construction vehicle numbers from continuing works.

		2012						2013												2014		
		Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Trucks in	AM Peak Hour	26	29	29	41	53	46	46	53	53	53	70	75	75	60	49	40	44	46	20	20	20
Trucks out	AM Peak Hour	25	28	28	40	51	45	45	51	51	53	69	72	72	57	47	38	42	44	20	20	20
Cars In	AM Peak Hour	43	53	63	85	110	100	100	100	120	120	135	172	142	195	182	182	188	188	40	40	40
Cars out	AM Peak Hour	11	17	17	23	29	26	26	33	38	38	40	50	50	50	46	46	48	48	20	20	20
Total		**105**	**127**	**137**	**189**	**243**	**217**	**217**	**237**	**262**	**264**	**314**	**369**	**339**	**362**	**324**	**306**	**322**	**326**	**100**	**100**	**100**



[22] *Barangaroo South – C3 Commercial Building Construction Traffic Management Plan*, Arup, Revision E, 19 July 2012
Barangaroo South – C5 Commercial Building Construction Traffic Management Plan, Arup, Revision D, 19 July 2012

Aurecon Australia Pty Ltd
ABN 54 005 139 873
Level 2, 116 Military Road
Neutral Bay NSW 2089
PO Box 538
Neutral Bay NSW 2089
Australia
T +61 2 9465 5599
F +61 2 9465 5598
E sydney@aurecongroup.com
W aurecongroup.com