6 TRAFFIC IMPACT ASSESSMENT

6.1 TRAFFIC GENERATION AND DISTRIBUTION

6.1.1 OVERVIEW

Trip generation in the precinct was based on actual traffic activity for the precinct, plus the incremental change between the present and future development profiles.

6.1.2 PPP COMPONENT

Traffic generation attributed to the PPP development is estimated on the basis of the future accommodation potential of the individual facilities. As there are no published guidelines on potential trip generation rates for facilities such as convention centre, exhibition centre or entertainment centre, trip generation is derived from the potential car parking demand of each facility, taking into account car mode share and expected turnover of the facility.

Trip generation is estimated based on the number of visitors at each facility. The worst scenario assumes occupancy of all key facilities at any one time. The visitor count is converted to vehicle trips by applying assumptions on mode split, turnover rates and inbound/outbound flow directional splits. Table 6-24 summarises the trip generation and distribution parameters applied to calculate total vehicle trips.

Table 6-24 PM Peak Traffic Generation for the PPP

PPP	Total Pax	Car Mode Share	Turnover Rate	Trips In	Trips Out	IN	OUT	Total Vehicle Trips
Convention Centre	7,250	20%	80%	20%	80%	232	928	1,160
ICC Exhibition Centre[1]	4,161	20%	80%	20%	80%	133	533	666
The Theatre	8,000	22.5%	25%	90%	10%	405	45	450
Total						770	1506	2,276

[1]Assumes 1 person per 10 square metres

For the purpose of this assessment, the following traffic distribution is assumed:

- 60% trips anticipated to arrive/depart from the north via Darling Drive north;
- 10% trips anticipated to arrive/depart from the east via Goulburn Street and George Street;
- 15% trips to arrive from the south via Darling Drive south;
- 25% trips to depart to the south via Darling Drive south;
- 10% trips to arrive from the north via Harbour Street north;
- 15% trips to depart to the north via Harbour Street north; and,
- 5% trips anticipated to arrive from east via George Street/Hay Street.

This traffic distribution follows the observed directional flows taken from Hyder's Sydney Strategic Model.

6.1.3 THE HAYMARKET PRECINCT

An indication of the peak hour traffic generation potential of the future development within The Haymarket Precinct has been based on the Roads and Traffic Authority *Guide to Traffic Generating Developments" (2002)*. The RTA's Guide provides a series of traffic generation rates for a variety of land uses based on generic surveys undertaken by the RTA. These rates are generally applied to the Gross Floor Area (GFA) or Gross Leasable Floor Area (GLFA).

The typical peak hour traffic generation rates applicable for the proposed land uses of The Haymarket Precinct are as follows:

- Residential evening peak vehicle trips: 0.24 vehicle trips per hour for each unit
- Retail evening peak hour vehicle trips: 0.56 vehicle trips per hour per 10sqm GLFA
- Commercial evening peak vehicle trips 2 vehicle trips per hour per 100sqm GFA

Application of the above traffic generation rates to the proposed development yields a weekday peak period total traffic generation potential of 372 vehicle trips per hour comprising 270 In / 102 Out during evening peak periods. These traffic generation projections have been based on an arrival/departure split of 80/20 for residential, 50/50 for retail and 20/80 for commercial during the evening peak period. The estimated peak hour traffic generation for the proposed future developments is shown in Table 6-25.

Table 6-25 Traffic Generation for The Haymarket

The Haymarket Divisions	IN (vtph)	OUT (vtph)	TOTAL (vtph)
North East and North	100	25	125
South East	75	19	94
South West	86	21	107
North West	9	37	46
Total	270	102	372

The above table assumes the following:

- Retail trips will mainly consist of non-car trips; and
- Office/Commercial trips would be capped with the available parking space allocation.

For the purpose of this assessment, the following traffic distribution is assumed:

- 30% trips anticipated to arrive from western suburbs via M4 Western Distributor;
- 10% trips anticipated to arrive from western suburbs via Great Western Highway/Parramatta Road;
- 30% trips anticipated to arrive from northern suburbs via M4 Western Distributor and then through Darling Drive and Ultimo Road;
- 20% trips anticipated to arrive from southern suburbs by using Eastern Distributor and then through north Darling Drive and Ultimo Road; and,

- 10% trips anticipated to arrive from southern suburbs by using Great Western Highway and then through Harris Street and Ultimo Road.

6.1.4 HOTEL

There are no guidelines for trip generation rates for hotel developments in the RMS Guide. However, it is suggested that analysis of trip generation for hotel developments be based on surveys of similar existing hotels. In the absence of survey data, reference is made to trip generation rates for Novotel Hotel Darling Harbour located along Harris Street[2]. It has been reported to be in the range of 0.08 – 0.15 vehicle trips per guest room. The rate provides indication of potential traffic generation for a hotel development in the vicinity of Darling Harbour.

However, it is anticipated that majority of the trips to the hotel will generate walking trips rather than vehicular trips. The majority of guests would arrive at the hotel via taxi, coach, mini bus or light rail. A relative small proportion would arrive by private car or hire car. Other hotel patrons who visit the hotel for functions or conferences may arrive by private vehicle but will be expected to find parking in the exhibition centre or public carparks near the vicinity of the site as no new parking will be provided as part of the hotel development. It is also anticipated that majority of the staff will be expected to use non-car modes for travel to work.

In summary, vehicle trip generation to the hotel will be minimal. For the purpose of this assessment, it is assumed that the trip generation rate for the hotel in the PM peak would be approximately 0.15 vehicle trips per guest room. Hence, a total of 137 vehicle trips during the PM peak are assumed. A 50/50 split in directional flow (inbound/outbound and northbound/southbound) is assumed. Main access to the hotel would be on Darling Drive.

6.1.5 STUDENT ACCOMMODATION

There are also no guidelines for trip generation rates for student accommodation in the RMS Guide. However, it is anticipated that majority of the trips for the student accommodation will comprise of walking trips and public transport trips during the peak hour. Vehicle trips for this land use are expected to be minimal and are anticipated to mostly occur outside the normal commuter peak. No parking will be provided for this land use but loading facilities will be incorporated in the design layout to allow for students moving in and moving out. In the absence of any guidelines, it is assumed that vehicle trip generation for student accommodation is not likely to exceed the vehicle trip generation for high density residential (0.24 vehicle trips per unit) and a high estimate could potentially be in the order of 0.12 vehicle trips per unit. Hence, for a total of 422 units, vehicle trip generation could be in the order of 50 vehicle trips.

6.2 INTERSECTION OPERATION

6.2.1 SIDRA INTERSECTION ANALYSIS

SIDRA Intersection modelling was undertaken to determine operational performance at key intersections.

The future network assumes the proposed road changes explained in Section 5.3 with one-way flow to and from the carparks. Access to the carpark entry is via the Darling Drive/Pier Street roundabout while exit from the carparks follow the one way road lane along Darling Drive

[2] Novotel Darling Harbor Traffic Impact Assessment, Arup

towards Ultimo Road. From Ultimo Road, vehicles with destinations north of the precinct will have to travel northbound either via Harbour Street or Harris Street.

The results of the modelling are presented in the following section. The tables below summarise the modelling results.

Table 6-26 Future Intersection Performance – (Friday Event)

Intersection	Intersection Control	Approach	Average Delay Approach (sec/veh)	Approach LoS	Overall Average Delay (sec/veh)	Overall LoS
(I-1) Darling Dr / Murray St / Pyrmont Bridge Rd	Signalised	Murray St North	44.7	D	40.9	C
		Darling Dr East	38.1	C		
		Murray St South	50.0	D		
		Pyrmont Bridge Rd West	40.3	C		
(I-2) Darling Dr / Pier street	Roundabout	Darling Dr North	4.0	A	9.4	A
		Pier St (off-ramp) East	9.4	A		
		Darling Drive South	8.9	A		
(I-3) Darling Dr / Car Park Access	Signalised	Darling Dr North	8.7	A	10.7	A
		Future Haymarket Car Park Access	71.7	F		
		Darling Dr South	7.9	A		
(I-4) Pier St / Harbour St / Goulburn St	Signalised	Harbour St North	40.7	C	33.8	C
		Goulburn St East	35.1	C		
		Harbour St South	38.7	C		
		Pier St West	23.0	B		
(I-5) Harbour St / Liverpool St	Signalised	Harbour St North	23.8	B	35.5	C
		Liverpool St East	45.0	D		
		Harbour St South	33.9	C		
		Car Park Exit (West)	70.8	F		

Table 6-27 Future Intersection Performance (Saturday Event)

Intersection	Intersection Control	Approach	Average Delay Approach (sec/veh)	Approach LoS	Overall Average Delay (sec/veh)	Overall LoS
(I-1) Darling Dr / Murray St / Pyrmont Bridge Rd	Signalised	Murray St North	54.4	D	61.2	E
		Darling Dr East	32.0	C		
		Murray St South	59.8	E		
		Pyrmont Bridge Rd West	85.9	F		
(I-2) Darling Dr / Pier street	Roundabout	Darling Dr North	4.3	A	9.8	A
		Pier St (off-ramp) East	9.7	A		
		Darling Drive South	20.5	B		

Intersection	Intersection Control	Approach	Average Delay Approach (sec/veh)	Approach LoS	Overall Average Delay (sec/veh)	Overall LoS
(I-3) Darling Dr / Car Park Access	Signalised	Darling Dr North	9.4	A	10.4	A
		Future Haymarket Car Park Access	62.6	E		
		Darling Dr South	6.9	A		
(I-4) Pier St / Harbour St / Goulburn St	Signalised	Harbour St North	49.6	D	38.4	C
		Goulburn St East	33.0	C		
		Harbour St South	44.7	D		
		Pier St West	24.1	B		
(I-5) Harbour St / Liverpool St	Signalised	Harbour St North	15.1	B	20.4	B
		Liverpool St East	29.9	C		
		Harbour St South	17.9	B		
		Car Park Exit (West)	33.5	C		

The results indicate that the impact of the SICEEP development does not impose conditions on the intersections worse than what would have otherwise occurred through existing traffic.

The results further indicate:

- Optimised signal settings at all intersections will improve intersection performance and maintain level of service at acceptable levels;
- Improved signal coordination at the intersection at Harbour Street/Pier Street/Goulburn Street; Goulburn Street/Sussex Street and Goulburn Street/George Street will minimise downstream effects;
- The overall performance of the intersections is maintained in 'status quo' with the one way scheme for the Friday event traffic. Hence, no adverse impact on intersection performance is expected from the development;
- Friday event traffic, the intersection of Pyrmont Bridge Road/Murray Street/Darling Drive intersection operates at "LoS C. With the one way exit lane, vehicles are diverted away from the Darling Drive/Pier Street roundabout and the Pyrmont Bridge Road/Murray Street/Darling Drive intersection;
- With the exception of Pyrmont Bridge Road/Murray Street/Darling Drive intersection, the operational performance of the key intersections are considered satisfactory for Saturday event traffic;
- The critical movements at the Pyrmont Bridge Road/Murray Street/Darling Drive intersection are the right turning movement from Pyrmont Bridge Road to Murray Street and the right turning movement from Darling Drive to Murray Street. It is noted that the RT bay from Pyrmont Bridge Road is only 40 metres. The 95% back of queue for that movement is 65 m. Similarly, the RT bay from Darling Drive East to Murray Street north is 50 m while the 95% back of queue is 86m.

The above critical movements indicate improvement measures are required to achieve satisfactory intersection performance. However, it should be noted that only the right turning movement from Darling Drive to Murray St is directly attributable to traffic movements generated

by the future SICEEP development. The right turn movements from Pyrmont Bridge Road to Murray Street represent vehicle movements outside the study cordon and have also manifested to be a critical movement in the existing intersection operations.

To achieve satisfactory intersection performance, the following improvement measures may be considered:

- Pyrmont Bridge Road eastbound right turning bay extension at intersection with Darling Drive and Murray Street.
- Darling Drive westbound right turning bay extension at intersection with Murray Street and Pyrmont Bridge Road.
- Goulburn St westbound right turning bay extension at intersection with Harbour Street. The RT bays are 30m and 28m while the 95% back of queue is observed to be 49m and 46m, respectively. Although this movement does not impact on the overall intersection operational performance, the modelling shows there are capacity issues in terms of lane queues and spillover to the adjacent through lane.

Detailed SIDRA Results are attached in Appendix C

6.2.2 AIMSUN INTERSECTION ANALYSIS

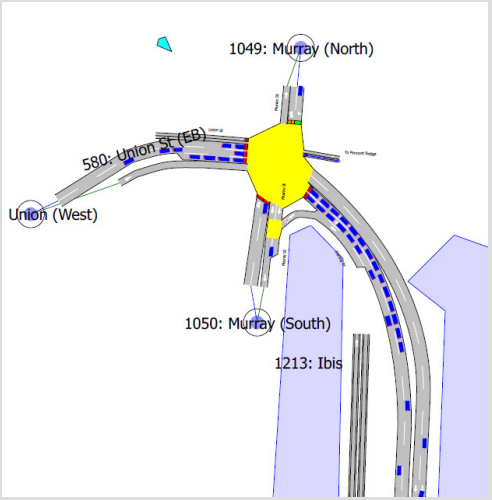
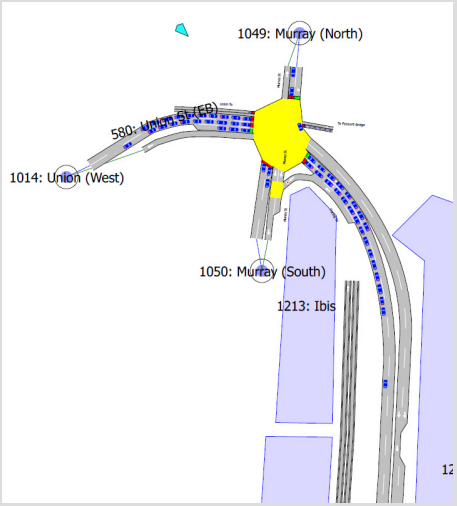
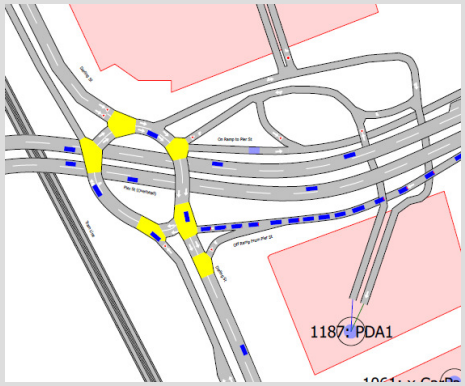
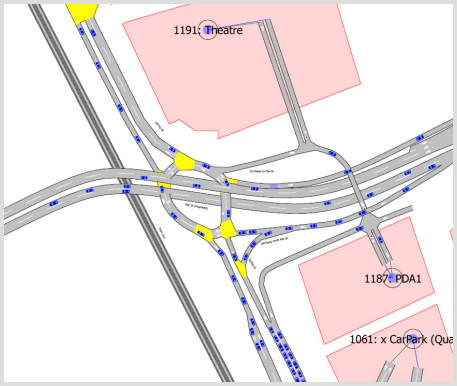
Intersection analysis, based on the AIMSUN assessment indicated some intersection related operational issues at following three intersections including:

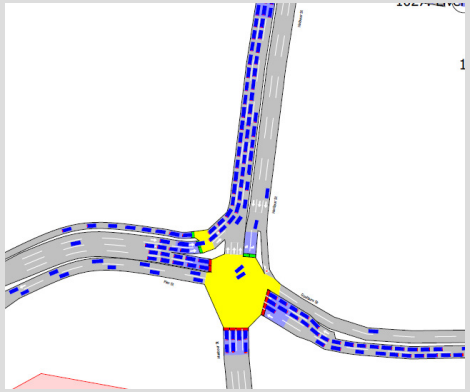
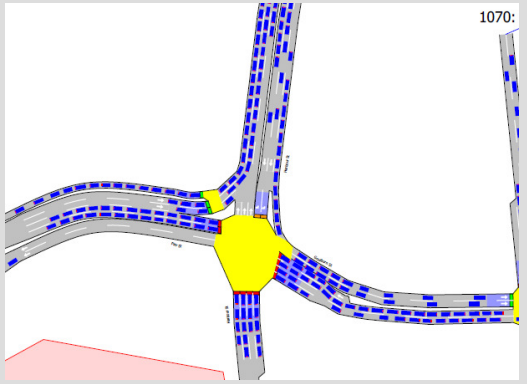
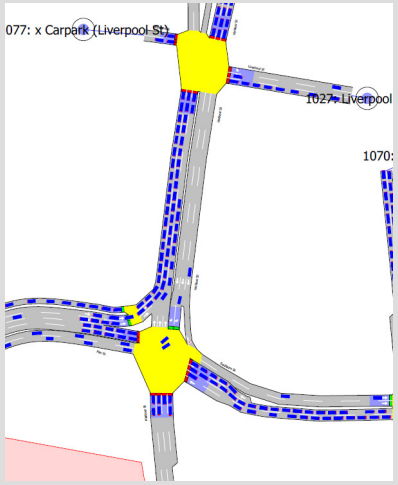
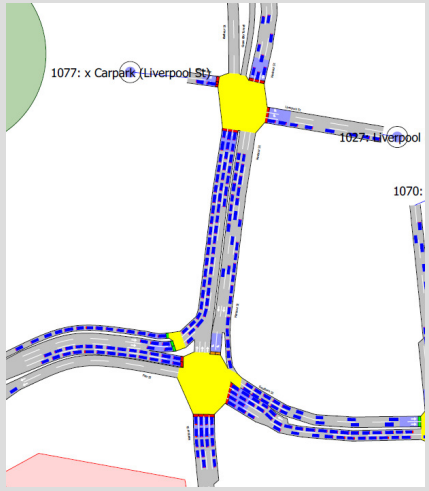
- Darling Drive/Pyrmont Bridge Road/Murray Street intersection
- Harbour Street/Pier Street/Goulburn Street intersection
- Harbour Street/Liverpool Street

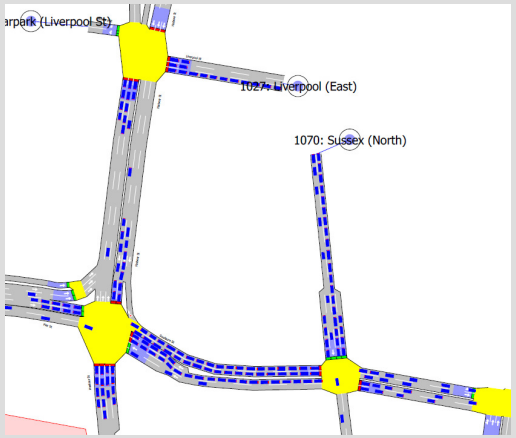
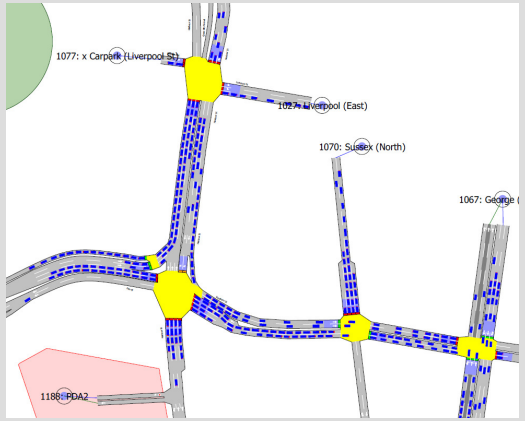
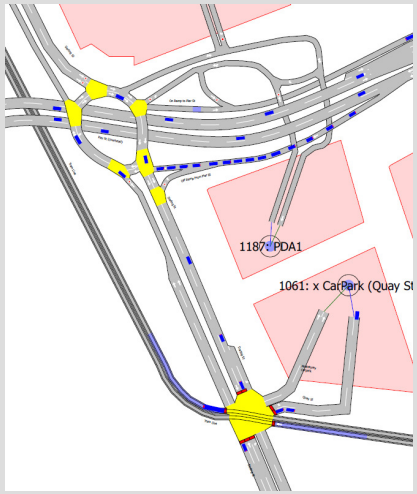
While some of these issues do not necessarily reflect an overcapacity situation for the entire intersection, any further increase on the demand from both future background and precinct development traffic at these locations will impact network capacity.

Key existing network issues identified for PM peak period are presented in Table 6-28. Screenshots from AIMSUN models are shown to illustrate the location and nature of each network issue. The level of service (LoS) results by each approach road is shown in Appendix D.

Table 6-28 Key Network Operational Issues in typical (Friday) PM Peak

ID	Location	Key Issues	AIMSUN Snapshot Existing	AIMSUN Snapshot Future
1	Pyrmont Bridge Road / Darling Drive/Murray Street Intersection (I-1)	Existing intersection layout has no exclusive left on Pyrmont Bridge Road west approach. There is one shared through-left at the intersection stopline. Existing and future scenario suggests occasional delays and queues along shared through-left turn lane on Pyrmont Bridge Road. The right turn movements from Pyrmont Bridge Road west approach and Darling Drive East approach may also experience delays and queues that spill-over the adjacent through lane. Future scenario mimics existing conditions.		
2	Darling Drive/Pier Street Roundabout (I-2)	Existing conditions show heavy westbound traffic on the off-ramp. Future scenario eliminates queueing on the Pier street off ramp approach to the roundabout		

ID	Location	Key Issues	AIMSUN Snapshot Existing	AIMSUN Snapshot Future
3	Harbour Street/Pier Street/Goulburn Street	Currently there are two exclusive right turning lanes (short lanes) at the intersection stopline on Goulburn Street. Model indicated for existing and future scenarios high right turn demand occasionally experiencing long queues exceeding the right turn bay lengths and spill backs to adjacent through lane.		
4	Harbour Street/ Pier Street/Goulburn Intersection and Harbour Street/Liverpool Intersection	Northbound traffic from Pier St turning left at Pier Street/Harbour Street intersection experiences long queues that extends back from Harbour Street /Liverpool intersection. Model indicated 907veh/hr turning left from Pier Street. This is observed for the existing scenario. The additional traffic from the development will experience extended queues on Pier Street. Future scenario show similar results.		

ID	Location	Key Issues	AIMSUN Snapshot Existing	AIMSUN Snapshot Future
5	Harbour Street/Pier Street/Goulburn Street	The existing scenario shows through traffic from Pier Street to Goulburn Street experiencing long queues extending back from Goulburn Street/Sussex Street intersection. Future scenario shows the same issues Southbound left turning traffic from Harbour St to Goulburn Street is impeded by extended queues from Sussex Street and Goulburn Street intersection spacing. For existing and future scenarios, heavy right turning volume from Goulburn Street to Harbour Street blocking the through lane.		
6	Darling Drive/Hay Street	For the existing scenario, the critical movement at the intersection is the exit flow from the SEC carpark. However, queuing tends to occur within the car park and hence, does not impact on the external road network. For the future scenario, the one way road lane forces vehicles to travel southbound. Queuing is experienced on the southbound lane of Darling Drive. However, intersection performance is acceptable.		

Source: AIMSUN model

6.3 SENSITIVITY OF GEORGE STREET LRT PROPOSAL ON SICEEP DEVELOPMENT

Although there is no firm proposal yet determined by NSW government on the extension of the Light Rail, a sensitivity test was undertaken to determine potential impact of the George Street LRT proposal on the network surrounding the SICEEP development. An indicative model run was carried out using Hyder's Sydney Strategic Model[3] to determine the likely impact on traffic flow on the surrounding network. The model indicated the shift of vehicle movements onto Harbour Street and increasing Harbour Street traffic volume by 10%.

A scenario run was undertaken by upscaling through traffic on Harbour Street by 10% to test the impact of the introduction of the LRT on George Street on the intersection performance at key intersections on Harbour Street.

Table 6-29 Impact of LRT Scenario on Intersection Performance (Friday Event + Additional 10% Thru Traffic on Harbour Street)

Intersection	Intersection Control	Approach	Average Delay Approach (sec/veh)	Approach LoS	Overall Average Delay (sec/veh)	Overall LoS
(I-4) Pier St / Harbour St / Goulburn St	Signalised	Harbour St North	40.7	C	33.8	C
		Goulburn St East	35.1	C		
		Harbour St South	40.7	C		
		Pier St West	23.0	B		
(I-5) Harbour St / Liverpool St	Signalised	Harbour St North	23.2	B	38.1	C
		Liverpool St East	52.5	D		
		Harbour St South	36.7	C		
		Car Park Exit (West)	76.8	F		

Table 6-30 Impact of LRT Scenario on Intersection Performance (Saturday Event + Additional 10% Thru Traffic on Harbour Street)

Intersection	Intersection Control	Approach	Average Delay Approach (sec/veh)	Approach LoS	Overall Average Delay (sec/veh)	Overall LoS
(I-4) Pier St / Harbour St / Goulburn St	Signalised	Harbour St North	49.6	D	38.5	C
		Goulburn St East	33.1	C		
		Harbour St South	44.5	D		
		Pier St West	24.1	B		
(I-5) Harbour St / Liverpool St	Signalised	Harbour St North	14.9	B	20.5	B
		Liverpool St East	31.9	C		

[3] Hyder's Sydney Strategic Model (SSTM) was built and operated in TransCAD Transportation GIS software. TransCAD provides a full complement of traffic assignment procedures that are used for modelling urban traffic. TransCAD is widely used in both the public and private sectors

Intersection	Intersection Control	Approach	Average Delay Approach (sec/veh)	Approach LoS	Overall Average Delay (sec/veh)	Overall LoS
		Harbour St South	17.7	B		
		Car Park Exit (West)	36.7	C		

SUMMARY

The above results indicate that there is no significant impact on the network adjoining the SICEEP development area. Both key intersections are performing at satisfactory LoS for future Friday Event and Saturday Event scenarios.

At the Pier Street/Harbour Street intersection, there is no change on intersection performance comparing future SICEEP Event models with and without the George Street LRT.

Similarly, there is no change on overall performance for the Liverpool Street/Harbour Street intersection with the additional 10% through traffic volume on Harbour Street although additional delay was observed on Liverpool Street (east) and car park exit (west).

It should be noted, however, that the above assessment is indicative and it would be expected that detailed modelling would be undertaken as part of the LRT project.

6.4 IMPACT ON THE WESTERN DISTRIBUTOR VIADUCT

There are no significant impacts anticipated on the Western Distributor viaduct during construction or operation of the SICEEP. An indicative model run of Hyder's Sydney Strategic model provided likely traffic distribution routes of the traffic movements to and from the precinct. The Western Distributor mainly carries traffic to and from the western and southern suburbs of Sydney. It is noted that 60% of the traffic movements would generally access the site via Pyrmont Bridge Road/Darling Drive corridor and 10-15% would take the Harbour Street corridor. The Western Distributor off-ramp at Harbour Street is likely to carry a marginal volume associated with the SICEEP development

In terms of pedestrian movements, the current Western Distributor pedestrian access to Parkside is to be maintained during the course of the initial onsite setup and other construction activities during the Development Phase. The existing stair from the flyover to the Exhibition Halls shall be maintained until relocation is required to allow the progress of construction activity. A temporary stair will be provided to maintain access to the existing ground level with the existing lift. Both shall be monitored and maintained to provide access to an overhead protective hoarding, delivering pedestrian flow through the construction area into the public domain. The existing public access to the eastern side of Parkside, adjacent to the stream shall be maintained during the course of construction but subject to realignment and relocation during the Public Realm works. On the overall, the pedestrian access routes on the Western Distributor will remain not be significantly impacted by the construction and operation of the SICEEP. Any minor impacts will be addressed through the pedestrian traffic management plan, to be further detailed prior to construction.

6.5 IMPACTS ON THE LIGHT RAIL CORRIDOR

The construction works on Darling Drive is expected to directly impact on the Light Rail corridor in terms of minor construction works on platforms and pedestrian pathways. However, the construction is not expected to impact on the operations of the Light Rail System. A Construction Traffic Management Plan (CTMP) for the proposed works has been prepared which assesses the construction traffic generated during the various stages and the likely impact to the road network and the surrounding areas. To eliminate impacts on the operations of the light rail, construction works that may encroach into the corridor and may hamper operations can be carried out during the period between the end hours of the operations in the late evening and prior to commencement of operations in the early morning. Pedestrian safety and amenity issues during the construction of the proposed works will be considered in the CTMP and impacts arising from the works will be appropriately managed.

6.6 CUMULATIVE IMPACTS FROM SURROUNDING CONSTRUCTION SITES

Known construction sites in the vicinity of the SICEEP construction site include, Barangaroo and Wynyard Walk. Although construction schedules are likely to coincide in the next two years from 2014 to 2015, it is anticipated that likely impacts will be minimal and can be managed via the detailed CTMPs to be prepared for the various stages of development of the SICEEP. The construction haulage routes for the SICEEP, Barangaroo and Wynyard Walk are likely to be similar as the vehicles exit the periphery of the Sydney CBD area. But within the CBD, access arrangements to the construction sites will vary. It is noted that construction at the Barangaroo site has the option to transport by sea transport via Darling Harbour.