



# North Sydney CBD Transport Masterplan

## Final Report



**3 August 2018**



## Document Control

**Document:** North Sydney CBD Transport Masterplan  
0650  
Final Report

**This document has been prepared for:**



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## Revision History

VERSION	DATE	DETAILS	AUTHOR	AUTHORISATION
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**LIST OF ACRONYMS**


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AM	Morning
BRT	Bus Rapid Transit
CBD	Central Business District
EIS	Environmental Impact Statement
HPAA	High Pedestrian Activity Areas
ITPS	Integrated Traffic and Parking Strategy
LGA	Local Government Area
NSC	North Sydney Council
NSW	New South Wales
PM	Afternoon
PSA	PSA Consulting (Australia)
SOJ	Singe Occupant Journey

# 1 INTRODUCTION

## 1.1 STUDY PURPOSE

PSA Consulting (Australia) Pty Ltd (PSA) was engaged by North Sydney Council (NSC) to prepare the North Sydney CBD Transport Masterplan. The announcement of the Victoria Cross Station as a part of the Sydney Metro project has provided NSC with an opportunity to capitalise on the proposed changes to the public transport network within the North Sydney CBD. The positive impact that Metro will have on the North Sydney CBD by accommodating population led growth in travel demand and encouraging mode shift to public transport must be met with interventions to the surrounding transport system to ensure that it does not create a downstream impact on the existing transport infrastructure, particularly the amenity and safety of shared spaces and footpaths.

The objectives of this Transport Masterplan as defined by NSC are to:

- Ensure that growth of the North Sydney Centre and Sydney Metro are complimented by transport infrastructure that improves the safety, amenity, vibrancy and overall appeal of the Centre for workers, residents, visitors and investors; and
- Facilitate significant increases in walking, cycling and public transport mode share and minimise the negative impacts of traffic within the North Sydney Centre.

This study seeks to achieve these objectives, through the analysis of several multi-modal infrastructure strategies that have the potential to enhance the vibrancy and viability of the centre, with a particular focus on achieving best practice outcomes for pedestrian accessibility throughout the centre.

This CBD Transport Masterplan will provide an informed, justified and consistent approach to Council's input to the Victoria Cross "Interchange Access Plan" process. This will be done through evidence based pedestrian modelling and problem identification, alignment with the criteria outlined in the North Sydney Transport Strategy (NSTS) using a Multi-Criteria Analysis process. In order to achieve this, NSC will utilise this document, the North Sydney CBD Transport Masterplan. This document provides the basis for future stakeholder and community engagement and forms the basis for:

- a) internal development of Council's North Sydney CBD capital works program;
- b) internal development of the North Sydney CBD Public Domain Strategy;
- c) Council's input to the Victoria Cross "Interchange Access Plan" process; and
- d) Council's North Sydney CBD transport advocacy program to TfNSW and RMS.

This Masterplan has been prepared using Council and NSW government planning documents, particularly the North Sydney Transport Strategy, the North Sydney Centre Traffic and Pedestrian Study (2014) and the Sydney Metro Chatswood to Sydenham Environmental Impact Statement (EIS). The Masterplan addresses the community priorities identified in the NSTS. Identified NSTS priorities provide the basis for the following CBD Masterplan "Vision":

*By 2036, public realm, accessibility, travel safety and amenity will be improved to create a more vibrant, active and flourishing North Sydney CBD*

This is achieved by:

- Prioritising the delivery of walking infrastructure that best accommodates significant local trip growth
- Minimising local traffic growth
- Creating slow speed traffic environments on roads within the CBD
- Encouraging regional traffic to use alternative routes to by-pass the CBD

## 1.2 KEY TRANSPORT NETWORK CHALLENGES

Due to North Sydney's influential economic centre, high employment rate and position within the metropolitan Sydney transport network, North Sydney is an important part of Global Sydney. It's position at the confluence of significant transport infrastructure to the north of the Sydney Harbour crossings makes it, at once, one of the most accessible parts of the City as well as one of the worst effected by the negative impacts of travel in the vicinity of the Sydney CBD. The key

transport network considerations for the North Sydney CBD Transport Masterplan have been identified by PSA as follows:

### **Pedestrians**

Every journey to, from and within the North Sydney CBD involves a local walking component. As well as the 7% of journeys to work that will be made by walking alone, PSA modelling suggests that walking journeys to North Sydney Rail Stations will grow by +13% by 2036 with 15,593 additional pedestrian movements entering / exiting the southern Victoria Cross portal and a significant proportion, approximately 40% of these entering / exiting Miller Street in the AM peak. This report identifies locations where existing walking infrastructure will not provide for adequate levels of safety and amenity under this growth scenario as well as opportunities for improving public domain and walking infrastructure to the benefit of the growing North Sydney community

### **Cyclists**

Cycling trips into and within the North Sydney CBD equate to only approximately 3% of all journeys to work in 2035.

Lower speed, local cycling access will be encouraged through the design and delivery of slow speed traffic environments in the North Sydney CBD.

Higher speed, regional cycling activity will be encouraged for access into, out of and around the North Sydney CBD by providing high quality separated cycling infrastructure via CBD by-pass route on classified roads. This will assist in minimizing conflict between local walking movements and regional cycling movements within the CBD core.

### **Public Transport**

While Metro is expected to encourage significant mode shift to rail for trips to/from the CBD, a corresponding reduction in demand for north-west bus services is also expected. Declining bus demand offers opportunities to re-allocate road space in the heart of the CBD (Miller Street) to higher priority road users. Scenarios that include alternative bus interchange locations have been identified that minimise bus/pedestrian conflict within the CBD while still allowing the opportunity for bus/Metro interchange, recognizing that the majority of bus/Metro interchange will occur at Crow's Nest. This will ensure a more equitable distribution of benefits from the introduction of Metro on other North Sydney public transport options.

### **Local Deliveries**

The accommodation of local delivery services is critical to ongoing economic activity within the North Sydney CBD. In order to minimise the impact of deliveries on safety and amenity in the CBD, this report has investigated opportunities for alternative delivery methodologies including: alternative kerb space allocation, shared delivery facilities, out of hours servicing and encouraging freight haulers to use alternative routes to by-pass the CBD.

### **Parking and Traffic**

To support walking, cycling and public transport growth in the CBD and minimise the negative impacts of traffic, this report recommends targeted application of parking policy and demand management initiatives to support reduced car ownership and use, provide more equitable access to parking and reduce traffic volumes in the North Sydney CBD.

There is a clear link between parking supply and traffic generation. In order to maintain current levels of local traffic within the North Sydney CBD, parking rates for new development must deliver similar parking supply and traffic generation rates to those currently accommodated within the North Sydney CBD. To provide clear guidance for developers and ensure no net increase in local traffic generation with new development, North Sydney CBD parking rates should be modified to reflect the rates applicable to St Leonard's Precincts 2&3, which were introduced to reflect resident's access to local shops, services and public transport.

Reallocating regional traffic from local roads and creating a low speed and pedestrian friendly environment within the CBD is critical to achieving the Masterplan vision.

## **1.3 BACKGROUND AND CONTEXT**

North Sydney is home to the telecommunications and the finance and insurance sectors, each of which are major generators of growth in the modern services economy.

The location for this study is the area bound by St Leonard's Park to the north, Warringah Freeway to the east and Blue Street to the south. The Pacific Highway runs through the Centre, preventing easy and convenient connection to a number of different areas within the CBD, particularly by pedestrians. A number of different land uses and precincts are identified in CBD boundary for this masterplan as shown in Figure 1.

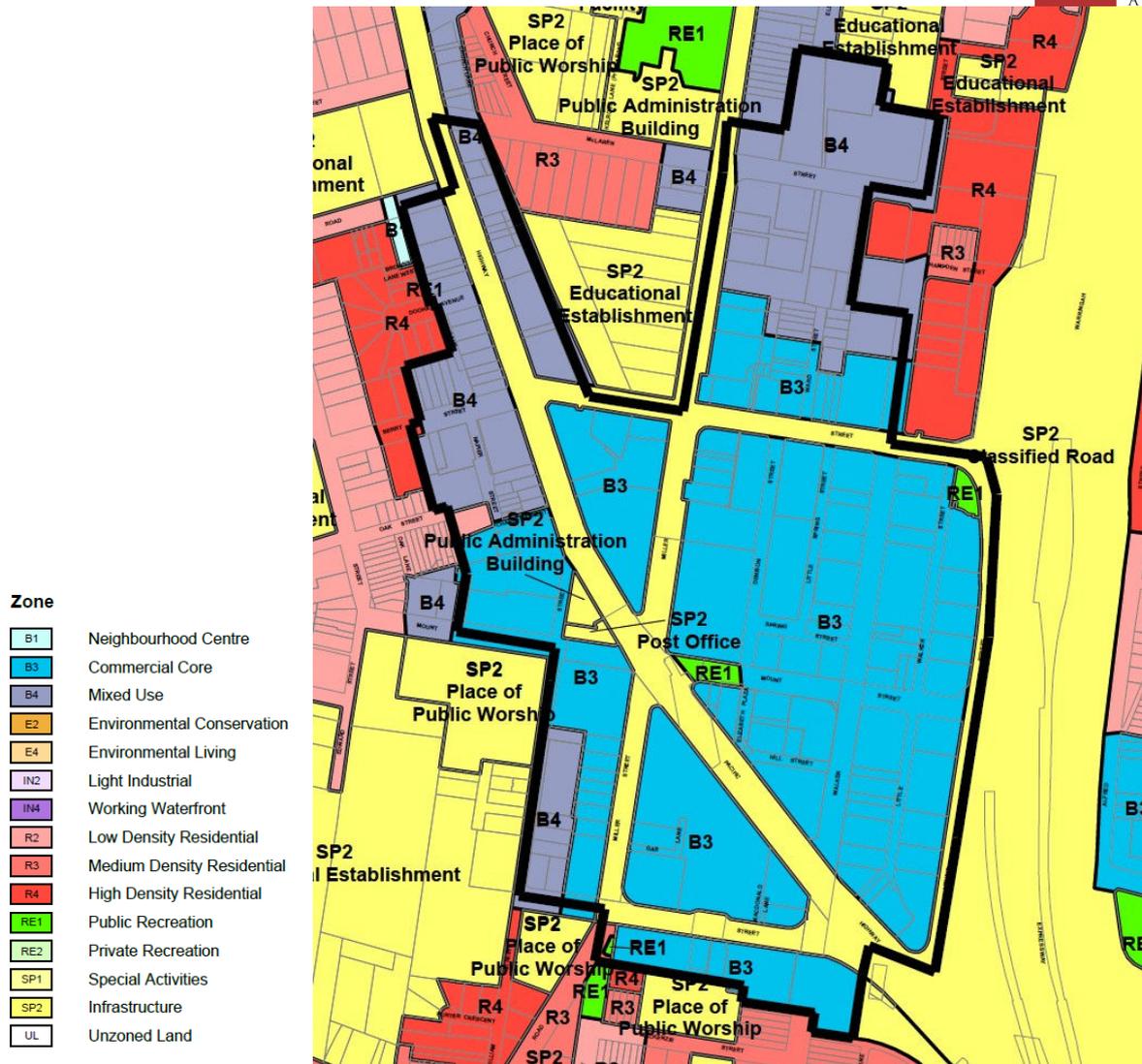


Figure 1 : Context Map of Study Area (North Sydney Council, PSA Consulting (Australia))

The Sydney Metro is a NSW State Government project which will deliver new railway infrastructure for the city. The Sydney Metro City and Southwest phase of the project was announced in 2015 and has an expected completion and operational date by 2024. The project proposes the construction of two new Metro stations within the North Sydney Local Government Area (LGA). The proposed station locations are in Crows Nest and Victoria Cross (North Sydney CBD). The Victoria Cross Station is located within the Study Area.

Sydney Metro will connect Sydney’s north-western suburbs to the Bankstown Line via Chatswood, Crows Nest, North Sydney and the Sydney CBD and is expected to accommodate 20-30,000 trips in the peak hour with potential to accommodate approximately 40% of the road based trips that currently utilise the Metro corridor. This has the potential to deliver a paradigm shift in the way Sydney’s residents and workers travel to, from and through North Sydney.

## 2 DEFICIENCY APPRAISAL OF TRANSPORT NETWORK

### 2.1 FUTURE DEMANDS

As a key centre for commerce, the Centre has a much higher workforce than resident population. The NSC Traffic and Pedestrian Study estimated that there were 36,000 inbound workers and 1,500 outbound residents during a typical weekday in 2014. These figures, and the Journey to Work 2011 data establish the mode split presented in Table 1.

Table 1: Mode Split, 2014 (Source: ARUP, PSA)

MODE	INBOUND WORKERS		OUTBOUND RESIDENTS		COMBINED	
	Mode Split	Number of Persons	Mode Split	Number of Persons	Mode Split	Number of Persons
Train	48%	17,280	27%	405	47%	17,685
Bus	12%	4,320	16%	240	12%	4,560
Single Occupant Vehicle Journey (SOJ)	29%	10,440	26%	390	29%	10,830
Ride-share	3%	1,080	3%	45	3%	1,125
Other Mode	2%	720	3%	45	2%	765
Walk Only	6%	2,160	25%	375	7%	2,535
Total	100%	36,000	100%	1,500	100%	37,500

Several sources were consulted to establish a global growth rate for the North Sydney CBD as shown in Table 2. A conservative estimate has been derived from these three sources as a growth estimate of 28.6% between 2014 and 2036, which equates to 1.3% per annum.

Table 2: Employment Growth Predictions (Source: North Sydney Council, Greater Sydney Commission, TfNSW)

SOURCE	PREDICTED GROWTH RATE (%)	ANNUAL LINEAR GROWTH RATE (%)	COMMENT
Economic Development Strategy, North Sydney Council (2016)	24%	0.96%	Prediction is from 2016 to 2041
Draft North District Plan, Greater Sydney Commission (2016)	26% to 36%	1.3% - 1.75%	Prediction is from 2016 to 2036
Land Use Planner – Employment, TfNSW (2017)	32%	1.28%	Prediction is from 2011 to 2036

In 2024, the Sydney Metro Victoria Cross Station will commence operations. This new station will make train travel a viable travel mode for many more North Sydney workers, particularly those travelling from the north-western growth areas. Due to the introduction of the Metro in these areas, there is a high proportion of shift expected from private vehicle to public transport as there has not been a viable public transport option in the past. In the Metro project EIS it is predicted that Victoria Cross Station will see a peak hour AM patronage of 15,593 passengers in 2036. It is predicted that North Sydney Station will see a 43% reduction in ridership as many passengers migrate to the new Metro service. Table 3 presents the predicted mode split in 2036, having taken these expected changes into account along with the 1.3% per annum growth. The growth in cycling as a mode share is based on the extrapolation of the current cycling mode share based on the NSC policy direction, while the walk only mode share is expected to be maintained due to the growth in residential dwellings in close proximity to the CBD.

Table 3: Mode Split, 2036 (Source: PSA)

MODE	COMBINED	
	Mode Split	Number of Persons
Train	60%	28,953
Bus	8%	3,858
SOJ	20%	9,645
Ride-share	2%	946
Other Mode (incl Cycling)	3%	1,447
Walk Only	7%	3,376
Total	100.00%	48,225

Table 4: Change in Mode Split, 2014 to 2036 (Source: PSA)

MODE	Number of Persons			Mode Share		
	2014	2036	Change	2014	2036	Change
Train	17,685	28,953	11,268	47%	60%	+13%
Bus	4,560	3,858	-702	12%	8%	-4%
SOJ	10,830	9,645	-1,185	29%	20%	-9%
Ride-share	1,125	946	-179	3%	2%	-1%
Other Mode (incl Cycling)	765	1,447	682	2%	3%	+1%
Walk Only	2,535	3,376	841	7%	7%	-
<b>Total</b>	<b>37,500</b>	<b>48,225</b>	<b>10,725</b>	<b>100%</b>	<b>100%</b>	<b>28.6%</b>

The introduction of the Metro to the Centre will invoke a shift in commuter behaviour, particularly for commuters currently traveling by train. As shown in

Table 4, train utilisation will increase by approximately 13% when compared with other modes. There will be a reduction in bus patronage, as commuters likely shift to the Metro services. Single occupant vehicle journeys will see a reduction in mode share, significant enough to result in a slight reduction of approximately 1,000 trips per day with origins and destinations of the North Sydney CBD.

Across North Sydney active, public and private transport options help move residents, employees and visitors into / out of / within and through the LGA. Deficiencies and issues within the North Sydney CBD have been identified and are outlined below by transport mode.

## 2.2 WALKING

### 2.2.1 Existing Deficiencies

Active health is a community priority of the North Sydney Transport Strategy. The strategy seeks to promote active transport and increase the number of walking trips through infrastructure that encourages active and healthy travel choices. The built environment is the primary obstacle to walking routes in North Sydney, in particular the Warringah Freeway corridor and the Pacific Highway Corridor.

The Warringah Freeway corridor bisects North Sydney and separates the eastern and western halves of the LGA. This physical and psychological barrier restricts movements between the two halves of the city. There are a handful of freeway crossings adjacent to the study area: the High Street Overpass, the Mount Street Overpass and the Ridge Street Pedestrian Bridge. These links have poor pedestrian amenity and are rarely used as a result.

The North Sydney Transport Strategy also identified safe travel as a community priority. Currently, the configuration of roads and intersection within the CBD draw large volumes of regional traffic through the CBD, resulting in congestion while also increasing the risk of conflicts between pedestrians and vehicles.

The frequent nature of crashes involving pedestrians is highlighted by Figure 2. These graphs demonstrate that over the last five years, approximately one in ten crashes within the North Sydney CBD involved a pedestrian, accounting for a total of 119 crashes.



### Crashes by RUM Code group - North Sydney

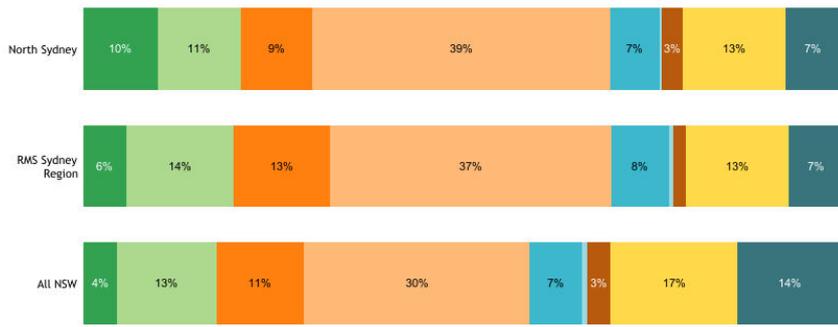
Select your LGAs:  
North Sydney

Reporting year:  
All

Degree of crash:  
All

Type of crash:  
All

Road classification:  
All

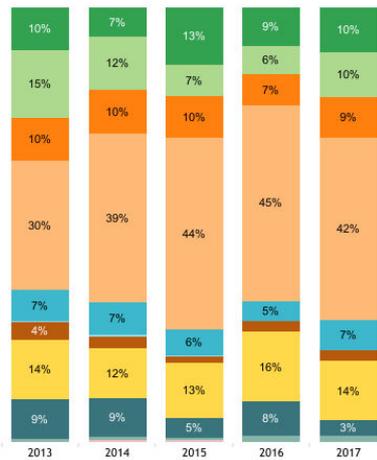


Display By  
RUM Code group

DATA AVAILABILITY  
Finalised data is available for the 4 year period 2013 to 2016. 2017 data is preliminary and subject to change.  
Data refreshed date: 25 June 2018

### Trend Graph - North Sydney

- Pedestrian
- Vehicles from Adjacent...
- Vehicles from Opposin...
- Vehicles from Same Dir...
- Manoeuvring
- Overtaking
- On Path
- Off Path, On Straight
- Off Path, On Curve or ...
- Miscellaneous
- Unknown



### Trend Table - North Sydney

	2013	2014	2015	2016	2017	Total
Pedestrian	32	18	29	19	21	119
Vehicles from Adjacent Directi...	50	33	16	14	21	134
Vehicles from Opposing Directi...	32	27	21	16	19	115
Vehicles from Same Direction	96	104	97	97	85	479
Manoeuvring	23	20	13	10	14	80
Overtaking	1	1	1	0	0	3
On Path	13	7	3	5	5	33
Off Path, On Straight	44	31	28	35	28	166
Off Path, On Curve or Turning	30	24	10	17	7	88
Miscellaneous	2	2	1	3	3	11
Unknown	0	1	1	0	0	2
<b>Total</b>	<b>323</b>	<b>268</b>	<b>220</b>	<b>216</b>	<b>203</b>	<b>1,230</b>

Figure 2: Crash Types by Category (Source: Interactive Crash Statistics)

There were a total of 119 crashes that involved pedestrians over the five year period, with the highest number occurring at the intersections of the Pacific Highway / Miller Street, the Pacific Highway / Blue Street and Blue Street Miller Street. Each of these intersections operate with heavy vehicle volumes that increase the risk of conflict between pedestrians and vehicles. Figure 3 shows the location of crashes involving pedestrians.

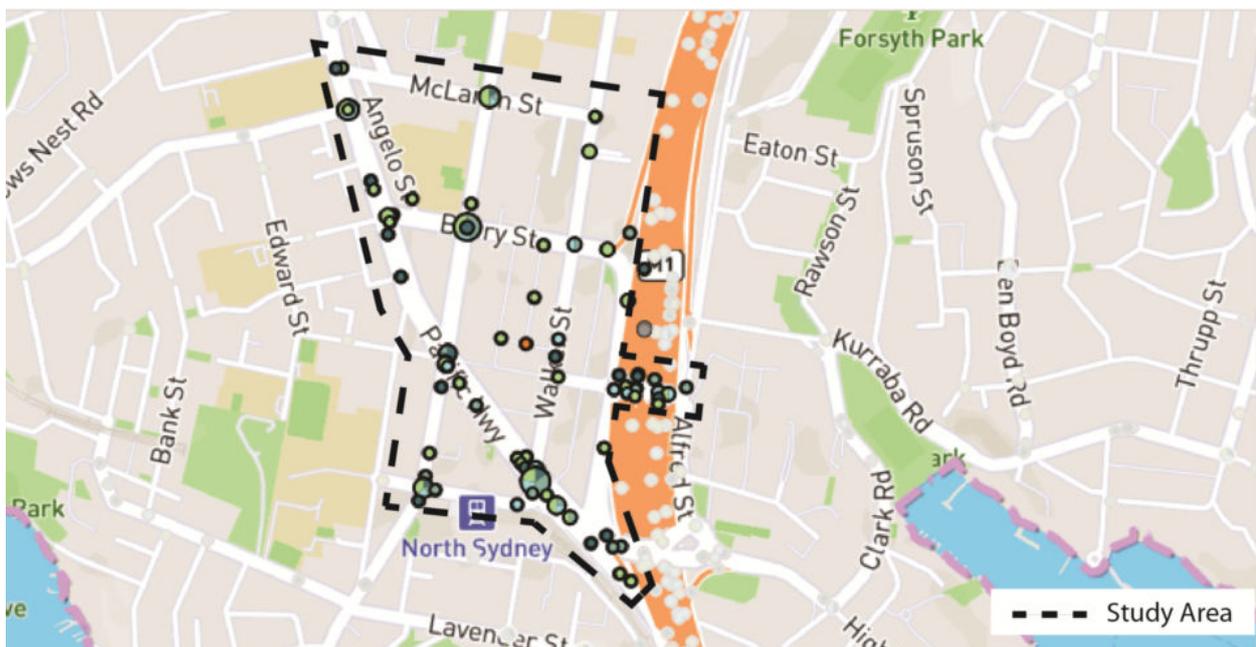


Figure 3: Crash Investigation (Source: Interactive Crash Statistics)

This risk is exacerbated at the intersections of Pacific Highway / Miller Street and Pacific Highway / Walker Street where slip lanes and small pedestrian islands bring pedestrians and vehicles into conflict. The small refuge islands, of

approximately 10m<sup>2</sup> each, are often observed overflowing with pedestrians.

Pedestrian congestion is also present on the footpaths within the CBD. The western footpath of Miller Street experiences very low levels of service during the PM peak when passengers queueing for bus services restrict the flow of pedestrians to single file. Similar congestion was also observed on the eastern footpath, near the intersection with the Pacific Highway, although not to the same degree. The implementation of the Metro will likely replace many of the bus services that use Miller Street. However, analysis indicated that the reduction in bus passengers is unlikely to alleviate the problems due to the footpath widths near the bus stops.

Observations have confirmed that the current configuration of North Sydney's pedestrian crossings is insufficient to cater for pedestrian desire lines and therefore additional mid-block crossings are required to address the existing desire lines and the desire lines expected following the introduction of the Metro and Ward Street Precinct. Strong desire lines have been observed mid-block on Miller Street between the Pacific Highway and Berry Street, and crossing Berry Street, adjacent to Berry Square. These desire lines are anticipated to increase in popularity following the launch of Victoria Cross Station, with pedestrians crossing near Berry Square to access the Ward Street Precinct and Miller Street to access Northpoint.

### 2.2.2 Future Demands

The existing pedestrian movements throughout the city were captured as a part of the North Sydney Council Traffic and Pedestrian Study and are shown in Figure 4.

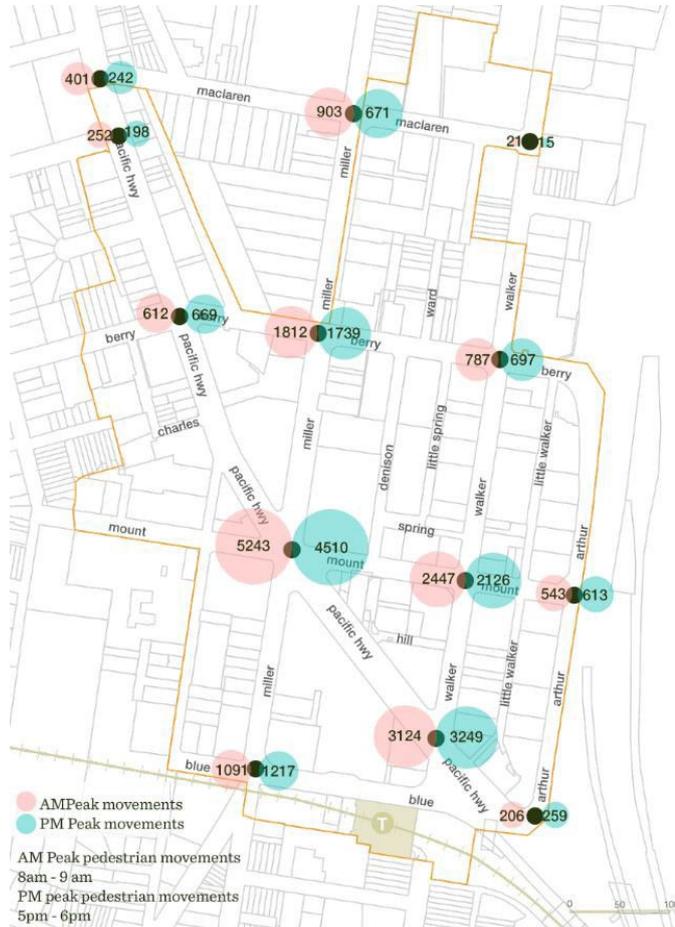


Figure 4: Existing Pedestrian Demand (Source: ARUP 2014 North Sydney Centre Traffic And Pedestrian Study)

Figure 4 shows a concentration of pedestrian activity in the southern section of the Centre. This activity is generated by commuters from the North Sydney Station, located in the south of the Centre. The construction of the Victoria Cross Metro Station, which will be located in the middle of the Centre, will alter the distribution of pedestrians in the Centre.

The Sydney Metro Chatswood to Sydenham Environmental Impact Statement (EIS) Summary May-June 2016 outlined a forecast passenger demand at the Victoria Cross Station of 2,600 entering the station and 12,550 customers exiting the station in the AM peak hour. It is estimated that that the 67% of the arrivals at the station would be as pedestrians, with 1% cyclists, 26% by bus and 6% by kiss-and ride. This indicates that while the majority of bus interchange will not occur in North Sydney, there will still be a demand for some interchange in close proximity to the Metro.

The EIS figures can be augmented by those presented in the Victoria Cross and Artamon Substation Modification Report (Modification Report) June 2017. The Modification Report, which confirms the location of a northern portal to Victoria Cross Station, proposes that the increase in coverage area will result in a five percent increase in Metro ridership.

As boarding passengers who arrive to the station by modes other than walking will have a minimal the effect on the pedestrian network, they have been excluded. Table 5 shows the distribution of Metro passengers in the Centre. The full methodology and results from this assessment are presented in Appendix 1.

Table 5: Metro Passenger Pedestrian Distribution, 2036 (Source: PSA)

DIRECTION	EXIT		ENTER	
	Percent	Number of Pedestrians	Percent	Number of Pedestrians
Denison St South	54%	6,947	23%	421
Denison St North	6%	772	7%	128

Miller St South	12%	1,544	18%	329
Miller St North, East FP	2%	258	-	-
Berry St East	2%	258	-	-
Berry St West, South FP	12%	1,544	7. %	128
North Portal, South	7%	901	-	-
North Portal, West	5%	644	28%	512
Northern Portal, North	-	-	17%	311
Total:	100%	12,863	100%	1,829

Table 6 presents an estimate of pedestrian movements at key intersections in the Centre. These figures were informed by both the passenger distributions shown in Table 5 and the pedestrian desire lines published in the NSC Traffic and Pedestrian Study.

**Table 6: Pedestrian Movements at Key Intersections, 2036 (Source: PSA)**

INTERSECTIONS	NUMBER OF PEDESTRIANS	WORST LOS
Pacific/Arthur	181	A
Pacific/Walker	3,160	C
Pacific/Miller	6,471	F
Blue/Miller	2,115	A
Pacific/Berry	2,210	A
Miller/Berry	3,648	B
Walker/Berry	1,849	B
Walker/Mount	4,369	C
Arthur/Mount	1,119	A
Walker/McLaren	18	A
Miller/McLaren	3,105	C
Pacific/Bay	221	A
Pacific/McLaren	352	A
Total:	28,819	-

Table 6 also shows the Level of Service for each intersection. Should existing queuing capacity be maintained as part of future walking and infrastructure design, only the Pacific Hwy / Miller St intersection will have insufficient capacity in 2036. This is due to the small splitter islands / pedestrian refuges located in the north and south of the intersection. These islands, as shown in Figure 9, have an area of 10m<sup>2</sup> each.

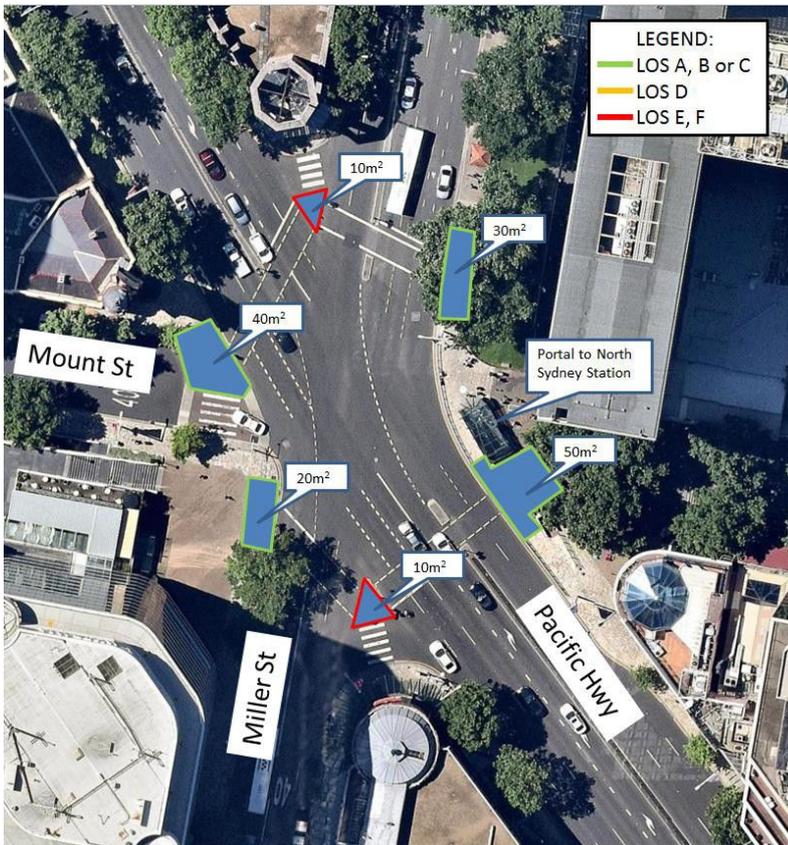


Figure 5: Pedestrian Level of Service - Pacific Hwy / Miller St Intersection, 2036 (Source: Nearmap, PSA )

The increase in pedestrian activity within the CBD as a result of the Metro will result in a direct increase in demand on existing footpaths within the CBD. Figure 6 shows the Pedestrian Level of Service on key footpaths in the Centre. The southern section of Denison Street, which is currently a shared zone, will experience a LoS D. However, should vehicles restrict the flow of pedestrians, this section would experience a LoS of E. Mount Street will experience a LoS E with the current footpath configuration. While Miller Street has sufficient footpath width to convey the expected demand, the effective width of the western footpath is restricted to single file around the bus stops near the Berry St / Miller St intersections due to the queuing bus passengers. This obstruction results in a LoS E. Similar restriction to pedestrian flow also occurs on the eastern footpath, where the bus shelters near the Pacific Highway / Miller Street intersection restrict pedestrian movements, although not to the same degree.

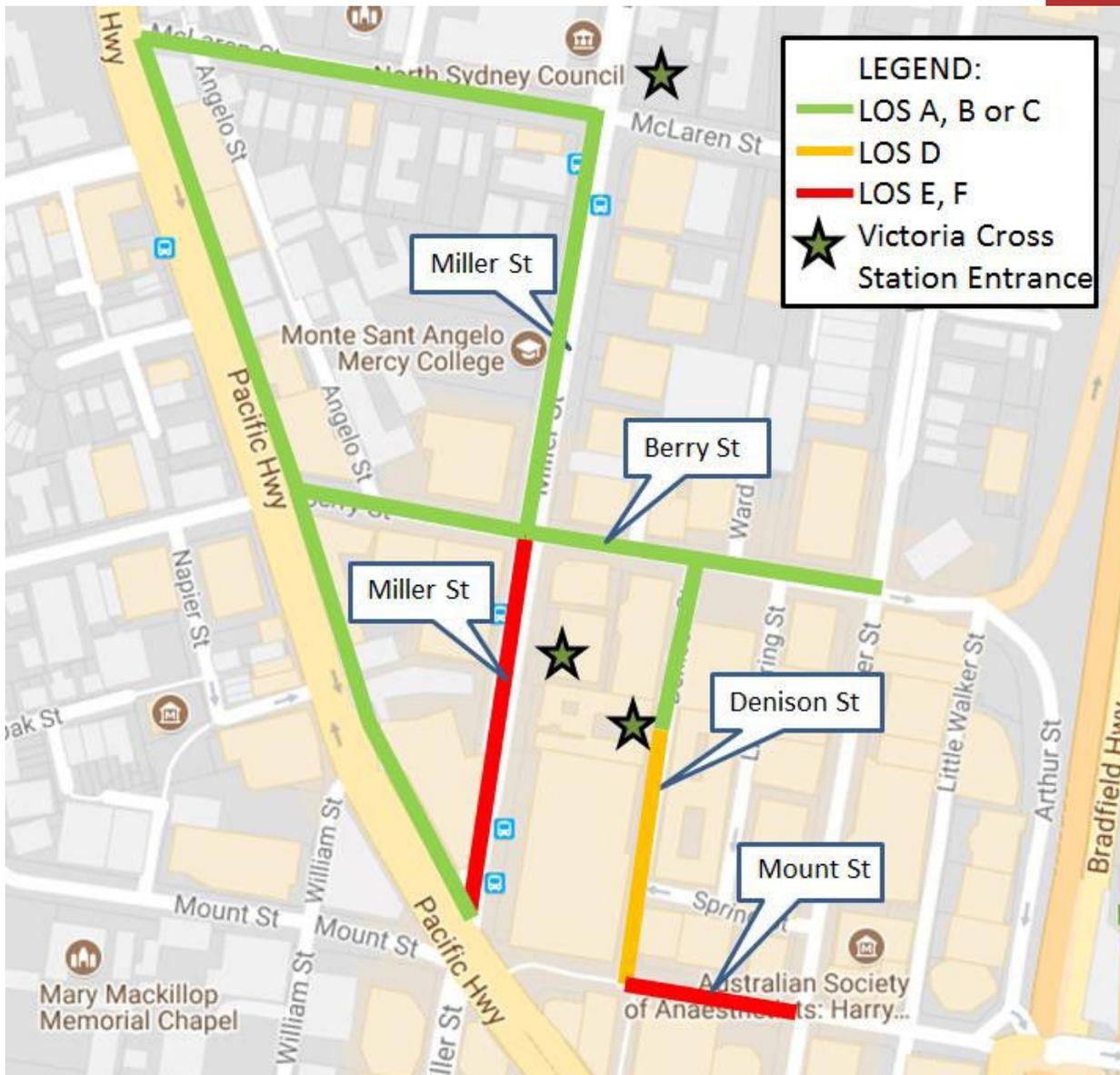


Figure 6: Pedestrian Level of Service on Footpaths, 2036 (Source: Google Maps, PSA)

## 2.3 CYCLING

### 2.3.1 Existing Deficiencies

Based on 2011 Journey to Work data for the North Sydney LGA, cyclists represent a low mode share of less than 2%. In order to reduce the private vehicle mode share, the North Sydney Community Strategic Plan sets a goal for NSC to encourage sustainable, safe, healthy and socially enriching transport, with an objective to provide 'a network of accessible, safe and linked cycle paths throughout North Sydney'. Through the development of the North Sydney Integrated Cycling Strategy, NSC has declared the following goals:

- Deliver an accessible, safe and connected cycle network by 2020;
- Make cycling an attractive choice for short trips within the LGA; and
- Increase and diversify participation in cycling (people of all ages and abilities will view cycling as a safe, everyday transport option).

The North Sydney Transport Strategy outlines the following guiding principle for walking and cycling infrastructure design. 'Council will identify and prioritise improvements to walking and cycling infrastructure within the walking and cycling catchments of commercial, mixed use and neighbourhood centres that also offer access to high quality public transport services.'

The North Sydney Integrated Cycling Strategy identified that in direct conflict to the goal for a 'linked network' set out the 2020 Vision, the existing cycling network is missing key connections and incorporates sections that are difficult to

negotiate. The Strategy highlights the following gaps and difficult sections in the network which have a significant impact on the amenity and safety of cyclist as:

- cyclists are forced to ride along high volume roads and negotiate busy intersections without formal bicycle facilities;
- cyclists encounter pinch points where road space is suddenly lessened and they are forced to merge with fast moving traffic;
- cyclists encounter situations which compromise the mobility advantages gained from riding (such as wheel ramps up steps); and
- cyclists ride on the footpath to avoid difficult or dangerous sections, increasing the for potential conflict with pedestrians.

The gaps in the network and difficult sections have a negative impact on cycling participation as poor amenity or potentially dangerous sections of road are a disincentive for those who might otherwise take up cycling.

Lower speed, local cycling access will be encouraged through the design and delivery of slow speed traffic environments in the North Sydney CBD.

Higher speed, regional cycling activity will be encouraged for access into, out of and around the North Sydney CBD by providing high quality separated cycling infrastructure via CBD by-pass on the Pacific Highway. This will assist in minimizing conflict between local walking movements and regional cycling movements within the CBD core.

### 2.3.2 Future Demands

Cycling is increasing in popularity in North Sydney. The Journey to Work 2011 data set showed that 1.4% of all journeys to work from North Sydney LGA were on bicycle. This represents a considerable increase from 2006, when only 0.8% of journeys to work were on bicycle.

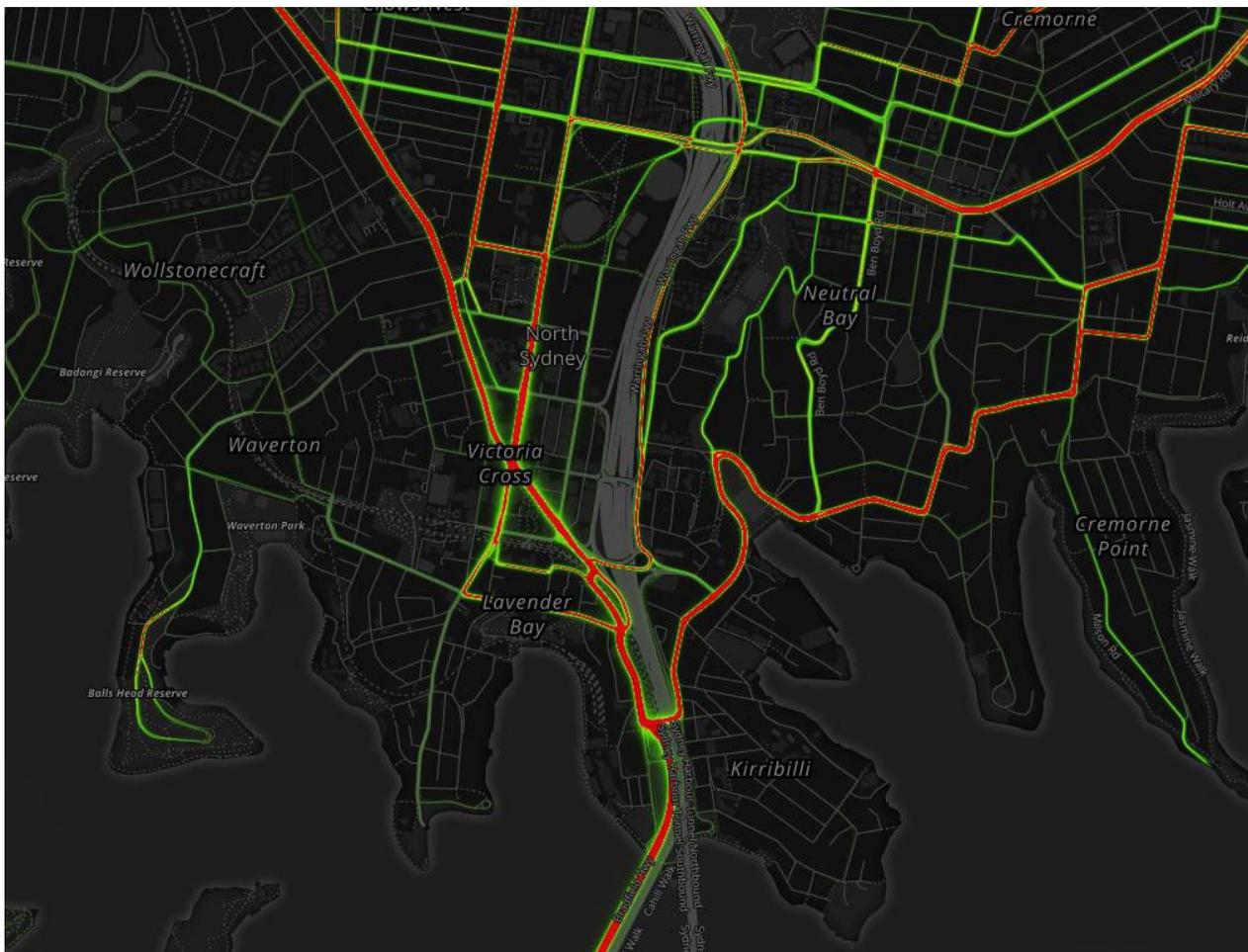


Figure 7: Bicycle Heatmap of North Sydney 2015 (Source: Strava)

The heatmap in Figure 7 shows high demand on the Pacific Highway and the Sydney Harbour Bridge, as well as Miller Street and West Street. The routes shown on the heatmap indicate that the majority of the cycling trips in North Sydney are regional, meaning that most cyclists travelling in the CBD do not have origins or destinations within the CBD. This suggests that these cyclists could be redirected away from conflicts with vehicles and pedestrians on the congested CBD streets footpaths and directed towards a network of cycling by-passes. This includes through the provision of separation along the Pacific Highway or Ridge Street to connect those travelling to / from the north-west and the Alfred Street eastern cycling link to the Sydney Harbour Bridge.

The heatmap also shows the extent to which the Warringah Freeway acts as a barrier to east-west movements in North Sydney. While the High Street Overpass appears to show moderate usage, the Mount Street Overpass and the Ridge Street Overpass show very low utilization at present due to the lack of connection.

While the number of cyclist is increasing in the North Sydney LGA, there are likely many potential cyclists not utilising this mode. The North Sydney Integrated Cycling Strategy recognises that many potential cyclist do not ride in the North Sydney LGA due to safety concerns over road conditions. Should road conditions improve for cyclists, it is likely that this mode would see further increases in the future. One such improvement to the road conditions would be to lower the speed environment roads within and throughout the North Sydney CBD to improve safety for pedestrians and cyclists, particularly on the Pacific Highway where crossings are common.

## 2.4 PUBLIC TRANSPORT

### 2.4.1 Existing Deficiencies

#### **Bus**

Buses are currently the third most popular mode for journey to work trips to and from the Centre with a 12% mode share with bus stops on the Pacific Highway, Miller Street and Blue Street. The stops on Blue Street provide an interchange opportunity with the T1 line and those on Miller Street will provide an interchange with the future Victoria Cross Metro Station. Although the key interchange for bus/Metro will be at Crow's Nest as identified in the Metro EIS, the provision for interchange at each station provides improved connectivity for all public transport journeys.

Currently, there is considerable bus congestion on Miller Street. The lack of dedicated bicycle infrastructure forces cyclists to ride in the traffic lanes between Blue Street and McLaren Street which exacerbates this congestion, particularly in the PM peak. The steep grade on this section of Miller Street slows cyclists and, in turn, the bus services.

The existing bus congestion on Miller Street also impacts pedestrians. The high number of buses on Miller Street between the Pacific Highway and Berry Street presents a safety risk for pedestrians performing a midblock crossing of Miller Street. This crossing follows a strong desire line that will further increase in demand once the Metro becomes operational. Currently 12% of Journey to Work trips are made by bus, however, with the implementation of Metro, this is expected to decrease to 8% by 2036. The increase in those travelling by train from 47% to 60% will result in an increase in pedestrians crossing Miller Street and will further increase demand for pedestrian space on Miller Street.

The storage of pedestrians at bus stops is also an issue, particularly at the northbound bus stops on Miller Street near Berry Street. The boarding passengers restrict the limited footpath space to such a degree that bi-directional pedestrian movements are impossible and pedestrians must skirt the stored passengers in a single file. The same problem also occurs, although to a lesser extent, at the other bus stops on Miller Street.

The B-Line is a bus rapid transit (BRT) service that connects Mona Vale and Wynyard. Currently, based on journey to work and census data 20 to 25% of those residents living in LGAs on the B-Line corridor that travel to the Sydney and North Sydney CBDs have origins / destinations within the North Sydney CBD. However, the services does not stop in North Sydney as the circuitous route required to access the CBD would add approximately eight minutes to the journey and not align with the principles of BRT. This highlights deficiencies in the bus infrastructure and road layout in the east of the Centre, particularly around the Warringah Freeway Corridor as well as opportunity to provide bus interchange facilities within the Warringah Freeway corridor to significantly improve access for bus services that currently by-pass the North Sydney CBD.

#### **Heavy Rail**

North Sydney is currently serviced by the North Sydney Railway Station (shown in Figure 8), located on Blue Street, between Miller Street and the Pacific Highway. The Station is serviced by the following lines:

- T1 North Shore Line;
- T1 Northern Line;
- T1 Western Line;

- T6 Carlingford Line; and
- Central Coast and Newcastle Line.

Services operate on a three minute frequency during peak periods. There are five bus stops located on Blue Street to cater for connecting bus services. There is also a taxi rank on the eastern end of Blue Street, however, it does not have sufficient capacity to meet demand.

Pedestrians can access North Sydney Rail Station either from street level (Blue Street), underground via the Greenwood Plaza, or via the Greenwood Plaza rooftop gardens and the Elizabeth Plaza pedestrian bridge which provides a grade separated connection between Blue Street and Mount Street, over the Pacific Highway. Despite the provision of these grade separated route, the Pacific Highway/Miller Street and Pacific Highway/Walker Street intersections still carry a significant number of pedestrian movements. Due to the limited capacity provided by splitter lane islands at these junctions (particularly the north-western and south-eastern corners), current issues can be observed with pedestrians overflowing from the refuge islands, restricting opportunities for uncontrolled left turns off of and on to the Pacific Highway during the morning and afternoon peaks. Removal of the slip lanes for left-turning traffic at these signalised intersections will provide a safer environment for pedestrians and result in more reliable traffic outcomes during peak periods.

The nearest train stations to North Sydney Station are Waverton Station and Milsons Point Station. Waverton Station is accessed via Bay Road, approximately 850m west of the Centre and approximately 1km south of North Sydney Station. Milsons Point station is accessed via Alfred Street South, approximately 1km from the Centre and approximately 700m north of North Sydney Station.

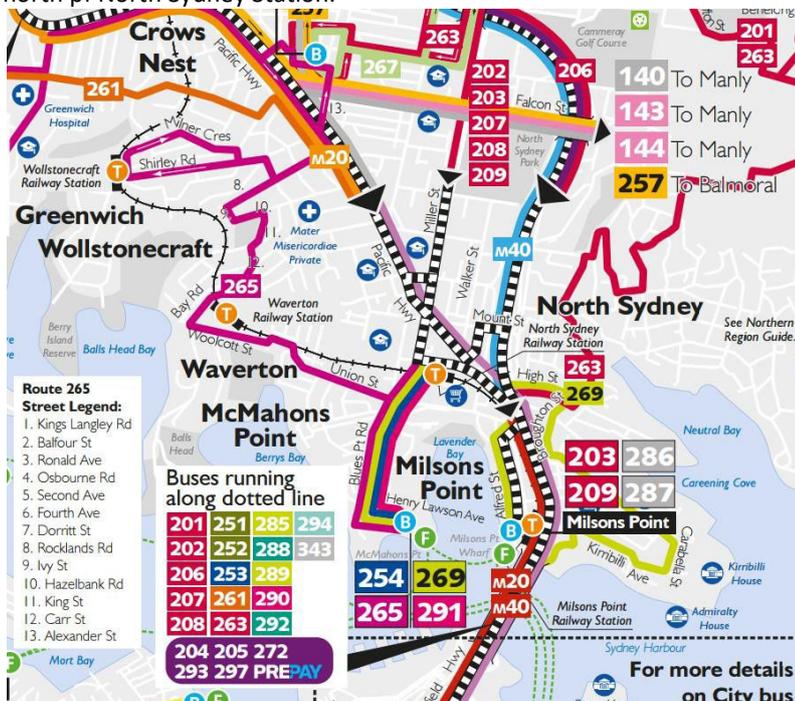


Figure 8: Public Transport Map (Source: TfNSW)

## 2.4.2 Future Demands

### Heavy Rail

The Journey to Work 2011 data shows that train travel is the most popular mode of travel to and from the Centre, with 47% of all journeys by this mode. Currently, this demand is met through the North Sydney Station by the T1 line. The North Sydney Station is one of the busiest in Sydney with average barrier counts in 2014 of 57,220 customers per day and an estimated morning peak period patronage of 17,685.

Demand for the T1 line is expected to fall once the Metro is operational. The EIS predicts a 43% drop in North Sydney Station customers in 2036 as passengers migrate to the new service.

### Metro

The Sydney Metro Chatswood to Sydenham Environmental Impact Statement (EIS) Summary May-June 2016 outlined a forecast passenger demand at the Victoria Cross Station of 2,600 entering the station and 12,550 customers exiting the station in the AM peak hour. When these figures are augmented by the Modification Report, passenger demand increases to 2,730 entering the station and 12,863 customers exiting the station in the AM peak hour. Afternoon peak

demand is predicted to be slightly less than morning peak demand.

### **Bus**

At present, approximately 6 services travel along the Pacific Highway and are considered to largely replicate the Metro route. This suggests that the introduction of Metro will result in some level of passenger transfer from buses to Metro within the Metro project corridor. Within the Metro EIS it is outlined that under a 'do-minimum' network change approach, 18 southbound and 17 northbound bus services will be able to be removed from the congested Harbour Bridge during the one-hour AM peak as a result of the introduction of Sydney Metro City & Southwest. It will also be possible to remove an additional 12 inbound buses along other key locations on the M2 corridor. A preliminary assessment indicates that approximately one third of bus services using the Pacific Highway may be superseded by the Metro. This will have a flow on effect for the bus routes that use Miller Street.

A full bus network review that considers the patronage/demand impacts of Metro on parallel bus services should be undertaken to determine relative demand for bus and traffic facilities compared to walking and cycling facilities.

Consideration should be given to re-allocating obsolete services, stops and interchange facilities to new Metro feeder routes rather than duplicating Metro service alignments.

Regardless of the exact route and service changes implemented by Transport for New South Wales as a result of the Metro, the changes are expected to result in modifications to the nature of the bus stops on Miller Street. There will be a requirement to provide a level of interchange between the bus services and the Metro services. However, the reduction in bus services also presents an opportunity to improve the public domain and pedestrian environment in the heart of the North Sydney CBD while relocating the interchange to Blues Point Road, less than 150m south of Victoria Cross Station.

Maintaining bus interchange in Miller Street provides accessibility for the 8% bus JTW post-Metro, however, given that approximately 15% of the 60% of those travelling to work by rail (close to 2,000 pedestrians in the peak period) will cross Miller Street as a part of their walking journey, this will negatively impact more pedestrians than it is likely to benefit.

Delivering bus stops at satellite bus interchanges at the Pacific Highway/Miller Street intersection and Mount Street overpass provides lower levels of accessibility for the 8% of those travelling to work by bus, however, it will allow NSC to provide significant benefits in terms of Miller Street walkability for those that use the rail and Miller Street for their local walking journey. This also increases the opportunity for bus services that currently by-pass the CBD along the Warringah Freeway to stop at the Mount Street overpass bus interchange and provide significant opportunities for public domain improvements in the heart of the North Sydney CBD.

## **2.5 LOCAL DELIVERIES**

### **2.5.1 Existing Deficiencies**

Addressing the transport needs of businesses was identified as a community priority in the North Sydney Transport Strategy and local deliveries play a pivotal role in the day-to-day function of many businesses in North Sydney. Minimising the impact of these deliveries on safety and amenity in the CBD is an important challenge for North Sydney.

The North Sydney CBD has approximately 11km of kerbside, of which approximately 5km is utilised for loading, parking, bus, taxi, and mail zones. Of this, approximately 500m is dedicated as loading zones. As shown in Figure 9, these loading zones are distributed throughout the CBD. Despite this, there is high demand for these spaces. Optimising the delivery of freight in the CBD will be a challenging task. Possible solutions to optimize the delivery of freight in the CBD include the retiming of freight deliveries such that non-critical deliveries take place outside of peak periods, more significant enforcement or introduction of permits for and there is higher utilisation of off-street deliveries. These policies should be explored further in a dedicated freight plan. Similar plans include the Last Kilometre Freight Plan – City of Melbourne and City Freight Plan – City of Gold Coast. These recently developed Freight Plans provide kerbside allocation rates and preferred out of hours operations specific to each precinct.



Figure 9: Kerbside Utilisation (Source: North Sydney Council Traffic and Pedestrian Study, Arup 2014)

The City of Melbourne have developed the Last Kilometre Freight Plan as a proactive policy tool developed to address the challenges posed by the last kilometre of a freight delivery in a changing metropolitan area. City of Melbourne's plan identifies the responsible partners in freight delivery, including the City of Melbourne, building managers, businesses and receivers of freight, residents and other agencies. The plan explores five themes: local area planning, public transport, freight initiatives, technology and communication and regulation, and draws from these themes actions for the City of Melbourne. Key actions from the plan include:

- Investigate opportunities to reclaim unused or underutilised space for freight and logistics;
- Encourage and support the piloting of new and innovative technologies (including vehicles) and processes;
- Work with State Government, industry and the community to overcome barriers (regulatory and other) to quiet out of hours delivery in the central city;
- Investigate new opportunities for gathering and using freight data to improve freight efficiency; and
- Ensure new buildings are equipped to meet the freight requirements for receiving and dispensing goods and services.

Many of the actions revolve around communication and collaboration between the responsible partners. Innovations such as out of hours delivery or cargo bikes are not considered a silver bullet and will not be effective without the participation of all responsible partners. Most importantly, the plan acknowledges that there are no off the shelf solutions to last kilometre freight management. The development of a solution will involve collaboration with sister cities in Australia and globally.

## 2.5.2 Future Demands

There is high demand and competition for the 500 metres of available kerb space in the Centre. Currently, there are no restrictions on the times which freight can be delivered in the Centre, beyond those stipulated on the on-street signage. As a result, both low and high priority freight compete for the limited spaces.

The City of Melbourne are seeking to better understand freight movements through their Last Kilometre Freight Plan by:

- Identifying the principles of out of hours deliveries which could reduce the number of heavy vehicles (such as those larger than a medium rigid) driving through the CBD during peak periods and lunch peak;

- Collecting data and surveying loading zones to evaluate their efficiency and determine if they are achieving the desired occupancy at peak loading times;
- Developing tools to understand the freight generation rates for different land uses;
- Integrating council's technology and information with platforms and systems used by stakeholders; and
- Investigating the development of a freight journey planner.

These, and several other supporting actions, will work in concert to understand and predict how local deliveries function in the City of Melbourne. Similar actions should be explored in the North Sydney Local Deliveries and Freight Action Plan suggested in the North Sydney Transport Strategy.

## 2.6 PRIVATE TRANSPORT

### 2.6.1 Existing Deficiencies

A VISSIM microsimulation model has been developed for the North Sydney CBD Transport Masterplan. In 2014, Arup was commissioned by the North Sydney Council to develop a VISSIM microsimulation model as part of the North Sydney Traffic and Pedestrian Management Study. The 2014 VISSIM model covers the commercial and retail core of North Sydney, and approximately bounded by:

- The education precinct at the west
- The Northshore Railway Line at the south
- The Warringah Freeway to the east
- The inner North Sydney residential areas around McLaren Street to the north

Detailed model coverage of the Arup VISSIM model is shown in the Figure 10 below.



Figure 10: 2014 VISSIM Model Coverage (Source: Model Development Report, Arup 2014)

The model was well calibrated and validated to the traffic counts and travel time surveys undertaken in 2014, and therefore adopted by the North Sydney Council for option assessment in the study. As part of the development of this

North Sydney CBD Transport Masterplan, a wider VISSIM model has been developed to evaluate various intervention measures developed during the study.

Utilising the existing 2014 VISSIM model as the basis for the Masterplan model was the most cost-effective methodology. To develop a wider area model for option testing in the later project stage, the existing 2014 model was expanded to include the following roads and intersections:

#### Roads:

- Falcon Street between Pacific Highway and Merlin Street
- Pacific Highway between McHatton Street and Falcon Street
- Warringah Freeway between Pacific Highway and Falcon Street

#### Intersections:

- Pacific Highway/Falcon Street
- Pacific Highway/Alexander Street
- Pacific Highway/Rocklands Road
- Pacific Highway/Hazelbank Road
- Falcon Street/Alexander Street intersection
- Falcon Street/West Street intersection
- Falcon Street/Miller Street intersection
- Falcon Street/Lytton Street intersection
- Falcon Street/Moodie Street intersection
- Falcon Street (Military Road) motorway interchange (both eastern and western interchange)
- Warringah Freeway northbound entry ramp from Arthur Street
- Mount Street (Arthur Street) interchange (both eastern and western interchange)

It is understood the existing 2014 model was well calibrated to the Base Year data. Therefore, traffic demands for the expanded model were developed based on the following steps:

- The existing 2014 model demand be adjusted to cater for the traffic growth between 2014 and 2017. This is subject to the comparison of 2014 and 2017 counts.
- The adjusted model demand and patterns be maintained for the 2014 model area.
- Additional traffic demand matrix estimation be undertaken for the new roads and intersections only.

Compared to the development of a new model using new traffic data, this approach would make use of the existing calibrated model, and deliver the most cost-effective outcomes.

One of the main objectives of the model expansion is to analyse the feasibility/impacts of reducing through traffic volumes in North Sydney to improve walking. An example of this is prioritising traffic between the Pacific Highway and the Warringah Freeway via Falcon Street, which saw transfer of regional trips away from the CBD and onto Falcon Street. The removal of regional traffic from the CBD was identified as a strategic principal for the project based on internal and external consultation. Therefore the following roads were not required so as to achieve the study objectives:

- Bradfield Highway
- Alfred Street North
- Merlin Street
- High Street
- Other minor alleyways connecting to Falcon Street
- Other internal roads between the existing model boundary, Pacific Highway, and Falcon Street

Coverage of the expanded modelled area is shown in the Figure 11 below:

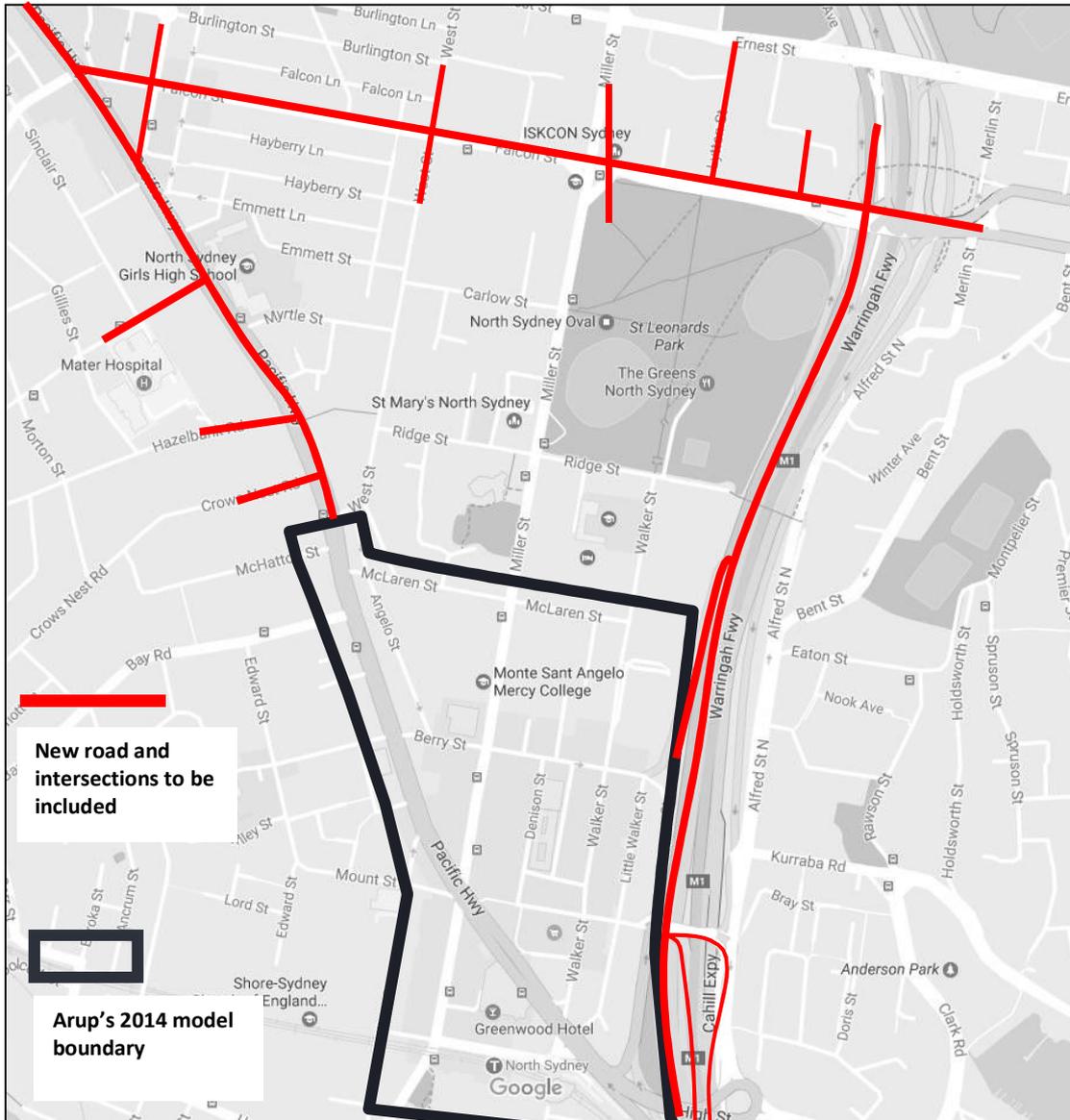


Figure 11: Adopted Model Boundary (Background image source: Google Map)

## 2.6.2 Base Model Observations

Several observations were made during the base model simulation runs, and compared against the current congestion in the network. Observations indicated that much of the network functioned well considering the CBD environment, with most intersections operating under capacity. However, the following locations were observed to be at, or close to, capacity:

- Some weaving issues on the westbound Pacific Highway between Walker Street and Arthur Street with queuing sometimes extending towards the freeway exit;
- High pedestrian activities in the CBD resulted in delays to vehicle traffic, particularly at the left turn from the Pacific Highway into Miller Street where long queues of traffic back down the highway towards Walker Street were observed;
- Significant drop-off activities on Walker Street between the highway and Mount Street resulted in congestion during peak periods. Right turning traffic from the Pacific Highway experienced difficulties in turning into Walker Street because of the downstream congestion on this road section;
- The right turn from Blue Street to the Pacific Highway. This movement was observed to be operating at capacity, with queues extending back towards the kerb build outs opposite the train station; and
- Pacific Highway/Falcon Street intersection operated at capacity, with southbound traffic on the highway sometimes extended beyond Oxley Street, and westbound traffic on Falcon Street queued beyond Alexander

Lane.

These observations generally match the existing congestion in the area, and hence the model is considered a good representation of the current on-site operations.

### **2.6.3 Future Demands**

Many roadways within the study area serve both a place and movement function. This duality of function leads to poor public domain outcomes and/or slower travel speeds due to increased conflict between local and regional journeys. This is particularly prevalent on both the Pacific Highway and Berry Street. Currently, Berry Street acts as a thoroughfare for vehicles travelling to destinations south of the harbour during the AM peak, while the Pacific Highway performs a similar function in the PM peak. This high demand impinges on those roads' ability to provide efficient private vehicle access to the North Sydney CBD.

Encouraging regional traffic away from routes that are critical to the pedestrian connectivity of the North Sydney CBD is critical to achieving the Masterplan vision. This has been considered through reassigning regional traffic from Berry Street and the Pacific Highway via a northern bypass along Falcon Street and a southern bypass (approximately 40%) as outlined further in the options investigated.

## 3 STRATEGY DEVELOPMENT

### 3.1 STRATEGIES AND INITIATIVES

The “Vision” for the CBD Masterplan is informed by the priorities outlined in the NSTS:

*By 2036, public realm, accessibility, travel safety and amenity will be improved to create a more vibrant, active and flourishing North Sydney CBD*

This is achieved by the following objectives:

- Prioritising the delivery of walking infrastructure that best accommodates significant local trip growth
  - *Target:* improved pedestrian safety and amenity to encourage pedestrian activity through provision of appropriate pedestrian infrastructure along key desire lines.
- Minimising local traffic growth
  - *Target:* reduction in mode share by private vehicle for trips ending within the CBD by reducing the parking provision, particularly for new developments following the implementation of the Metro.
- Creating slow speed traffic environments on roads within the CBD
  - *Target:* reduction in the speed of vehicles travelling within the CBD to improve the safety and appeal for people within the CBD to encourage more walking and activity.
- Encouraging regional traffic to use alternative routes to by-pass the CBD
  - *Target:* reduction in the volume of traffic using the CBD for regional movements through provision of sufficient infrastructure and operational modifications to encourage the use of key external traffic routes.

The actions presented in this section seek to achieve the studies objectives through two underlying strategies:

- Ensure that growth of the North Sydney Centre and Sydney Metro are complimented by transport infrastructure that improves the safety, amenity, vibrancy and overall appeal of the CBD for workers, residents, visitors and investors; and
- Facilitate significant increases in walking, cycling and public transport mode share and minimise the negative impacts of traffic within the North Sydney CBD.

A suite of interventions have been identified through internal and stakeholder consultation to address issues resulting from the introduction of the Sydney Metro. Opportunities for delivering supplementary interventions that further improve the safety and amenity of the North Sydney CBD are also identified. The below lists range of intervention actions and their related NSTS priority, the associated problem as identified in Section 2 along with the objectives and opportunities that can be achieved through implementation in the four intervention scenarios. These intervention actions are represented graphically in Figure 12 to Figure 15 below.

#### 3.1.2 Minimalist Intervention Scenario

- Pacific Highway / Falcon Street Signal modifications
  - **NSTS Priority:**
    - Walking Safety and Amenity
  - **Problem:**
    - Under current traffic network operations, increased conflict between pedestrians and traffic will negatively impact upon all NSTS priorities.
  - **Objective:**
    - Remove regional traffic from the CBD core to minimise the negative road safety and amenity impacts of increasing traffic volumes.
  - **Opportunity:**
    - Open a general traffic link between the Military Road/ Falcon Street intersection on ramp and the Alfred Street North slip lane (potentially, as part of the WHT/BL Warringah Freeway re-design) and encourage trips to the North Sydney CBD to be made via this route.





- Restriction to Bus only on Miller Street between Pacific Highway and Berry Street; or
  - Creation of a Miller Street Pedestrian Plaza creating amenity, safety and capacity improvements for pedestrians.
- **Restricting Movements at Walker Street**
  - **NSTS Priority:**
    - Private Transport Amenity
  - **Problem:**
    - Traffic weaving between the Warringah Freeway slip lane and right turn lanes from Pacific Highway to Walker Street
  - **Objective:**
    - Provide an alternative to traffic weaving to access parking infrastructure at the southern end of Walker Street.
  - **Opportunity:**
    - Opportunity to simplify movements on the Pacific Highway in order to be able to remove general traffic from Miller Street.
- **Simplify Traffic Operations at the Pacific Highway / Walker Street / Blue Street intersection**
  - **NSTS Priority:**
    - Private Transport Amenity
  - **Problem:**
    - Traffic queueing/ congestion/ delays due to significant demand for right turns out of Blue Street on to the Pacific Highway
  - **Objective:**
    - Optimise traffic operations and re- allocate road space/ phase time to higher priority mode groups and regional traffic movements.
  - **Opportunity:**
    - Significant opportunity for public domain and walking improvements associated with simplification of the Pacific Highway/Walker Street/Blue Street intersection by closure to general traffic and restriction of buses to left-in / right-out.
- **The Western Cycling By-pass**
  - **NSTS Priority:**
    - Walking Safety and Amenity
  - **Problem:**
    - While pedestrian/ vehicle conflict has the greatest negative impact on safety and amenity outcomes in the CBD, pedestrian/ cyclist conflict and associated safety and amenity issues will also grow in line with pedestrian/cyclin g volumes
  - **Objective:**
    - Increase priority for pedestrians in the CBD core by providing alternate routes for regional cycling outside of the CBD core.
  - **Opportunity:**
    - Reallocation of carriageway space on Pacific Highway to provide separate northbound and southbound one-way separated cycle lanes. This includes the provision of a single right turn lane from the Pacific Highway into Miller Street (south).
- **The Eastern Cycling By-pass**
  - **NSTS Priority:**
    - Walking Safety and Amenity
  - **Problem:**
    - While pedestrian/ vehicle conflict has the greatest negative impact on safety and amenity outcomes in the CBD, pedestrian/ cyclist conflict and associated safety and amenity issues will also grow in line with pedestrian/cyclin g volumes
  - **Objective:**

- Increase priority for pedestrians in the CBD core by providing alternate routes for regional cycling outside of the CBD core.
  - **Opportunity:**
    - Re-allocation of Alfred Street North road space to separated (bi-directional) cycling infrastructure (potentially, as part of the WHT/BL Warringah Freeway re-design)
- **Ridge Street Cycling Facilities**
  - **NSTS Priority:**
    - Cycling Safety and Amenity
  - **Problem:**
    - Interaction with pedestrians in a high pedestrian activity area, interaction with buses, road design that prioritises the movement of regional traffic and a notable lack of formal cycling facilities results in low levels of safety and amenity for cyclists accessing the North Sydney CBD
  - **Objective:**
    - Provide a connection between the Pacific Highway and Eastern Cycling facilities.
- **Mount Street Overpass Cycling Facilities**
  - **NSTS Priority:**
    - Cycling Safety and Amenity
  - **Problem:**
    - Interaction with pedestrians in a high pedestrian activity area, interaction with buses, road design that prioritises the movement of regional traffic and a notable lack of formal cycling facilities results in low levels of safety and amenity for cyclists accessing the North Sydney CBD
  - **Objective:**
    - Provide for more direct access between higher priority regional cycling links such as the eastern cycling bypass and the CBD core.

### 3.1.4 Miller Street Plaza Scenario

- **Pacific Highway/ Miller Street Bus Interchange**
  - **NSTS Priority:**
    - Public Transport Amenity
  - **Problem:**
    - Re-allocating road space to provide higher levels of safety/ amenity for Metro passengers at the Miller Street Metro portal will result in relatively poorer CBD access outcomes for bus passengers, however bus passengers equate to only 8% of Journey to work trips in comparison to 60% by train.
  - **Objective:**
    - Maintaining relative/ appropriate levels of bus amenity for bus passengers under the “Miller Street Pedestrian Plaza” scenario
- **Mount Street Overpass Bus Interchange**
  - **NSTS Priority:**
    - Public Transport Amenity
  - **Problem:**
    - Re-allocating road space to provide higher levels of safety/ amenity for Metro passengers at the Miller Street Metro portal will result in relatively poorer CBD access outcomes for bus passengers, however bus passengers equate to only 8% of Journey to work trips in comparison to 60% by train.
  - **Objective:**
    - Maintaining relative/ appropriate levels of bus amenity for bus passengers under the “Miller Street Pedestrian Plaza” scenario
  - **Opportunity:**

- Increased opportunity for mode shift for the 20-25% of journeys between the Northern Beaches and Global Sydney that have origins/ destinations within the North Sydney CBD

### 3.1.5 Miller Street and Walker Street Plaza Scenario

As for High Intervention with the inclusion of:

- **Restricting Movements at Walker Street**
  - **NSTS Priority:**
    - Private Transport Amenity
  - **Problem:**
    - Traffic weaving between the Warringah Freeway slip lane and right turn lanes from Pacific Highway to Walker Street
  - **Objective:**
    - Provide an alternative to traffic weaving to access parking infrastructure at the southern end of Walker Street.
  - **Opportunity:**
    - Significant opportunity for public domain and walking infrastructure improvements associated with simplification of the Pacific Highway/Walker Street/Blue Street intersection. While site lines around a revised Walker Street pedestrian crossing would need to be maintained, there may be some opportunity to provide more formal taxi or kiss- n-ride facilities on the Pacific Highway around a new Walker Street Plaza.

Given the complexity of the transport network within the CBD, the majority of the intervention actions outlined above are reliant on other intervention actions. The actions have been grouped into scenarios based on the proposed cost and impact along with the interdependencies of each action as outlined above and further detailed in Table 7. In addition to the base case, four different scenarios were modelled including:

- Minimalist Intervention Scenario actions demonstrated in Figure 12;
- Miller Street Bus Interchange Scenario actions are demonstrated in Figure 13;
- Miller Street Plaza Scenario actions are demonstrated in Figure 14; and
- Miller Street and Walker Street Plaza Scenario actions are demonstrated in Figure 15.

The actions in the figures below are labelled with an ID which relates to the action description within Table 7. Table 7 provides outline of the actions proposed and their relation to the deficiencies within the current network, issues and deficiencies expected to occur due to the introduction of the metro, and opportunities as a result of the Metro project.

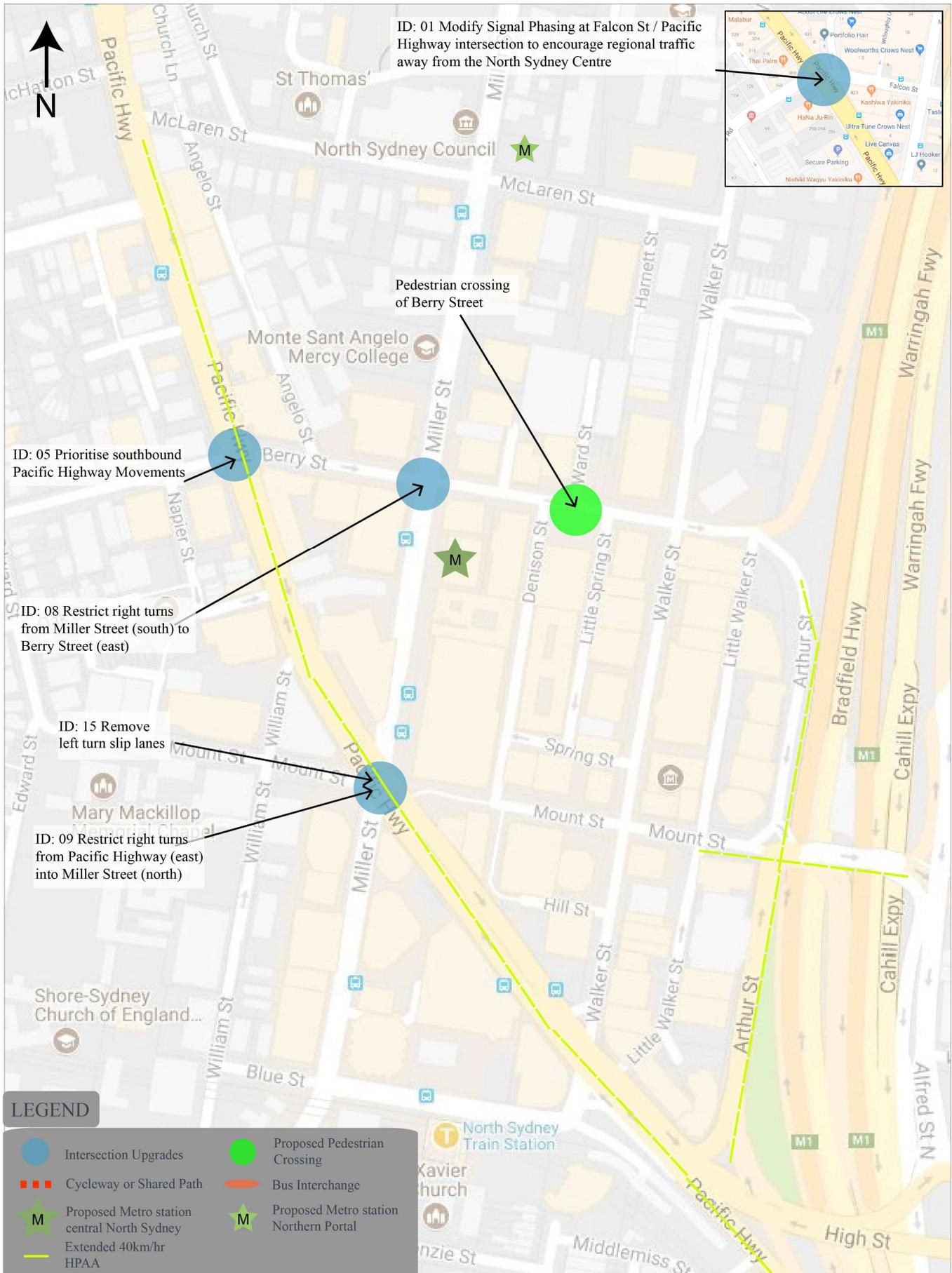


Figure 12: Minimalist Intervention Scenario actions

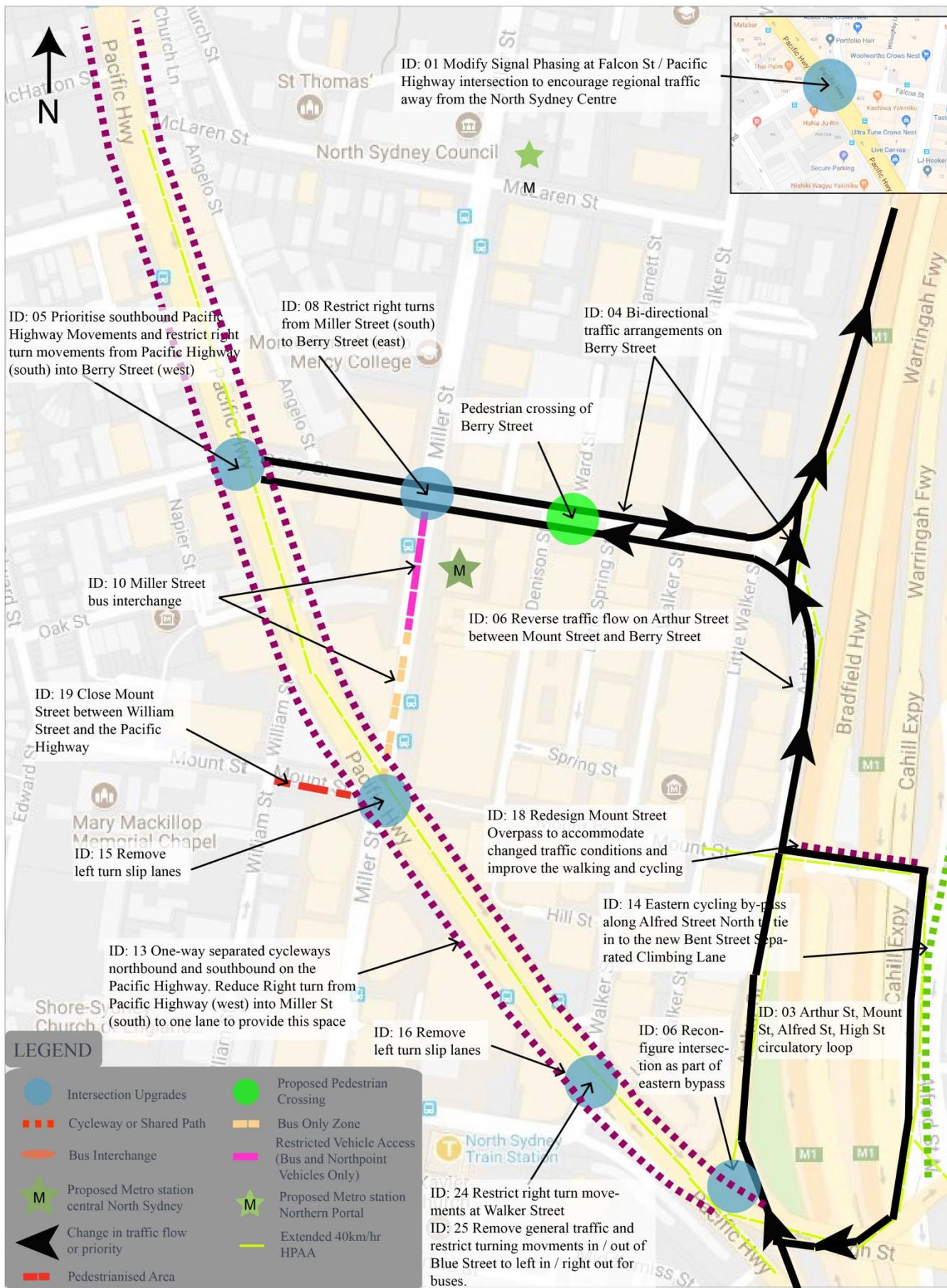


Figure 13: Miller Street Bus Interchange Scenario actions

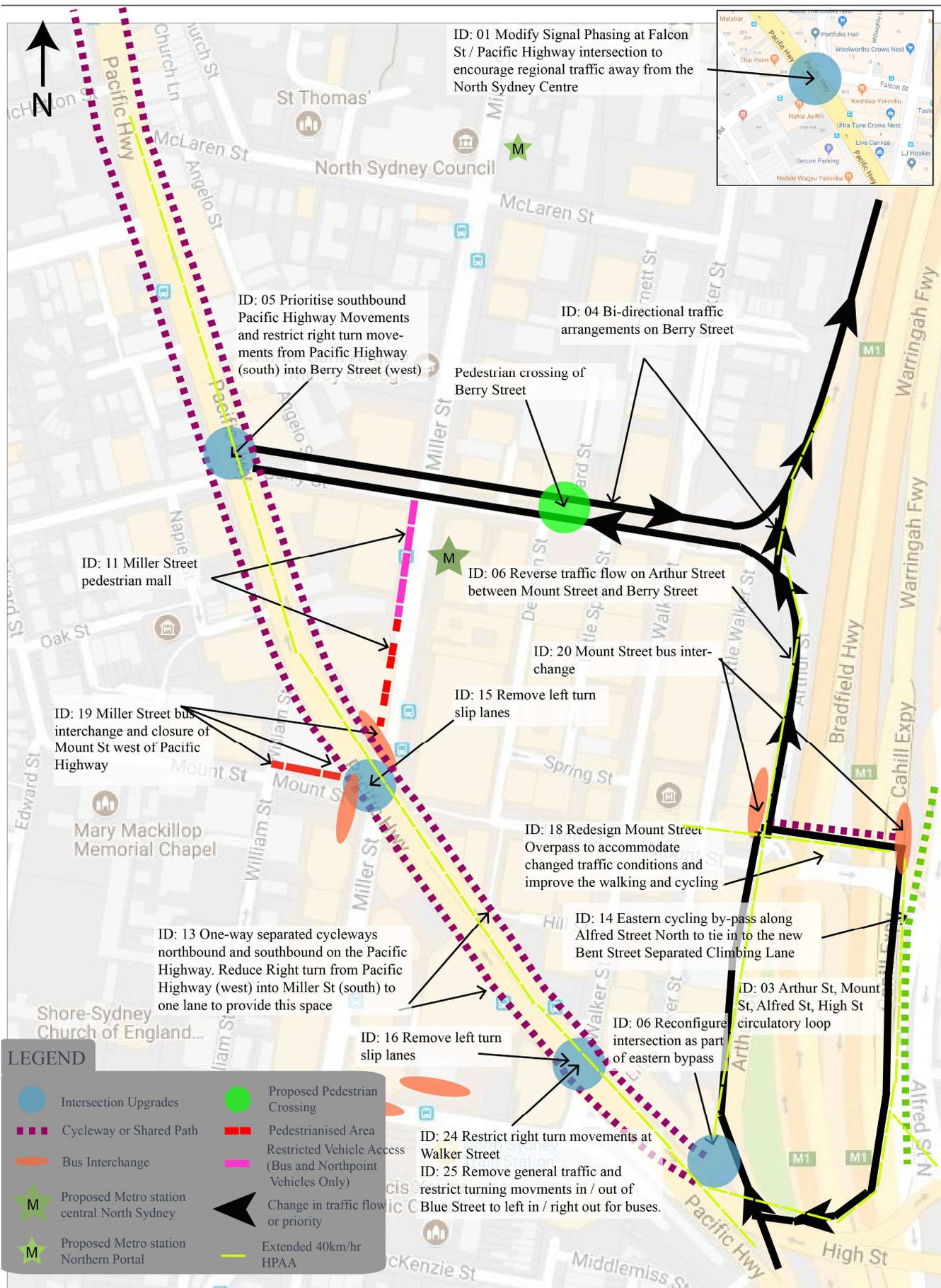


Figure 14: Miller Street Plaza actions

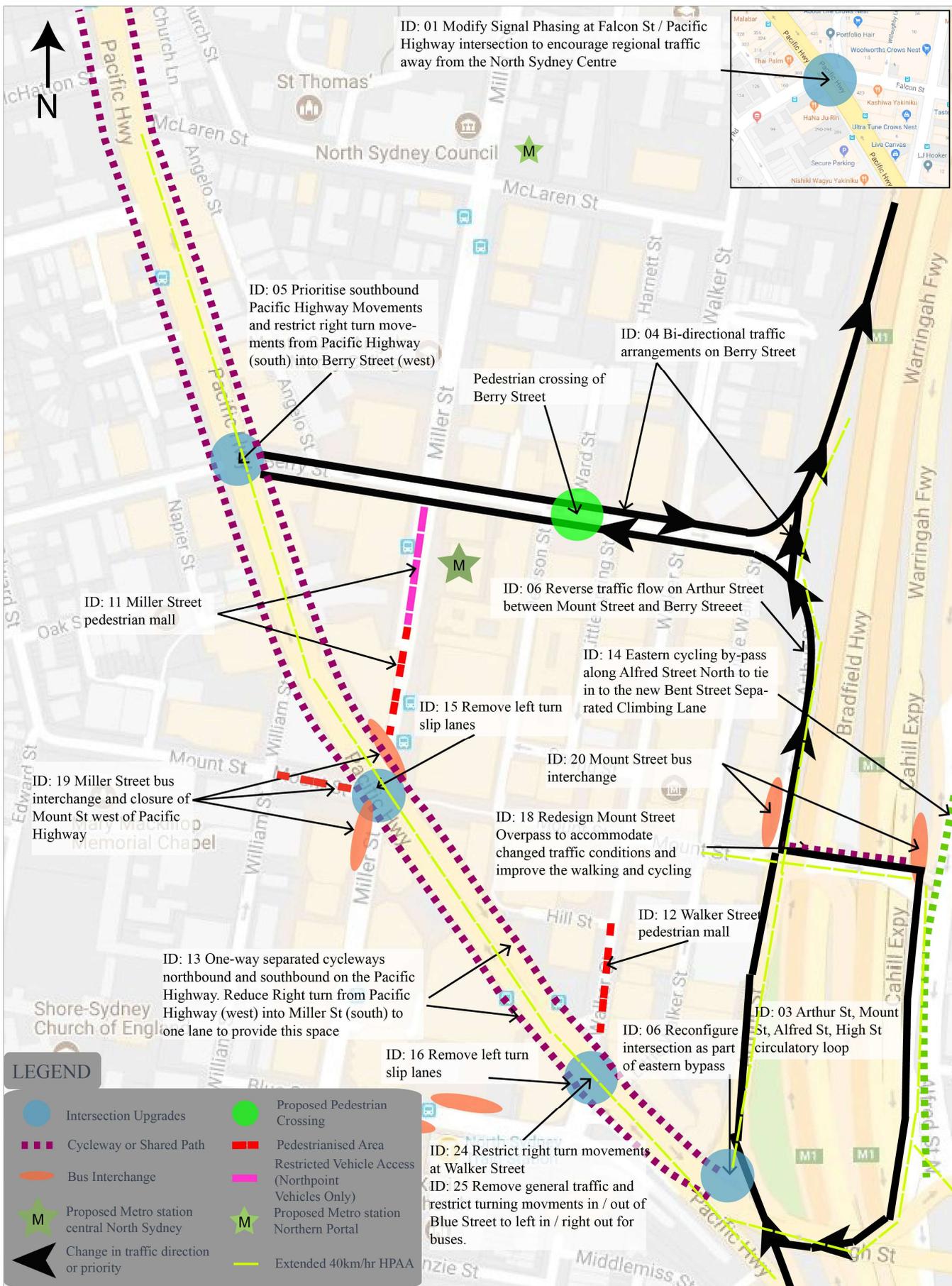


Figure 15: Miller Street and Walker Street Plaza Scenario actions

Table 7: Proposed Interventions to address transport deficiencies

Target/ Project	ID Number	Intervention / Action Description	Reliance (either Stand Alone Action OR Reliant Actions ID Number)	Impact (High / Medium / Low)	Scenario			
					Minimalist Intervention Scenario	Miller St Bus Interchange Scenario	Miller St Plaza Scenario	Miller St & Walker St Plaza Scenario
<b>NSTS Priority: Walking Safety and Amenity</b>								
Pacific Highway signal modifications	ID:01	<p>Modify Signal Phasing at the Falcon Street / Pacific Highway intersection</p> <ul style="list-style-type: none"> <li>In the AM: Prioritise the left turn (increase green time) from Pacific Highway to Falcon Street</li> <li>In the PM: Prioritise the right turn from Falcon Street to the Pacific Highway</li> </ul> <p>Originally the intent of a “northern bypass” was to include further modifications of signals along the Pacific Highway. The intent of this was to remove the approximately 7% of regional traffic that travels through the North Sydney CBD from the Pacific Highway. However, the level of congestion and delays required on the Pacific Highway to achieve this were significantly worse than the base case and considered too negative an impact on through traffic flow. Therefore, modifications were only made at the Pacific Highway / Falcon Street intersection which achieves a portion of this diversion result.</p>	Stand Alone	Low	✓	✓	✓	✓
	ID:02	<p>Re-allocate carriageway space to walking, cycling, public transport and/or on-street parking on the Pacific Highway south of Falcon Street:</p> <ol style="list-style-type: none"> <li>wider footpaths;</li> <li>separated cycle lanes;</li> <li>centrally aligned BRT bus lanes and bus stops; and</li> <li>short-term on-street parking / temporal loading zones.</li> </ol> <p>As well as discouraging the use of this section of the Pacific Highway by regional through traffic, reducing traffic capacity/road space re-allocation south of Falcon Street would also support increased trips to/from the North Sydney CBD by walking, cycling, and public transport.</p> <p>This includes the provision of one-way separated cycle lanes both northbound and southbound on the Pacific Highway.</p>	ID: 01	Medium		✓	✓	✓
Arthur St, Mount St, Alfred St,	ID:03	Creation of a traffic circulatory system via Arthur Street (northbound), the Mount Street overpass (eastbound), Alfred Street North (southbound) and the High Street overpass	ID: 01 ID: 04 ID: 06	Medium		✓	✓	✓

Target/ Project	ID Number	Intervention / Action Description	Reliance (either Stand Alone Action OR Reliant Actions ID Number)	Impact (High / Medium / Low)	Scenario			
					Minimalist Interventi on Scenario	Miller St Bus Intercha nge Scenario	Miller St Plaza Scenario	Miller St & Walker St Plaza Scenario
High St loop		(westbound) would require deletion of the single eastbound traffic lane on the High Street overpass; the Warringah Freeway-Mount Street off-ramp and Arthur Street contra-flow lane; and the Alfred Street North contra-flow lane to Whaling Road, all of which would then be converted in to clock-wise lanes to address capacity requirements within the circulatory system.	ID: 08					
The Southern (Pacific Highway) Traffic By- pass	ID:04	Discourage through traffic from using Berry Street through the re-introduction of bi-directional traffic operations on Berry Street, reallocation of signal phasing to prioritise pedestrian crossing movements on Berry street (including a signalized crossing between Dennison Street and Little Spring Street), bus movements, movements from intersecting side streets.	Stand Alone	High		✓	✓	✓
	ID:05	Intersection reconfiguration at Pacific Highway/Berry Street to support increased priority for Pacific Highway traffic by restricting right turn movements into Berry Street (east) from Pacific Highway (south).	Stand Alone	Medium	✓	✓	✓	✓
	ID:06	The Eastern (Arthur Street) Traffic By-pass (High)  Reversing the one-way system between Mount Street and Berry Street would force traffic accessing the Harbour crossings to use the Pacific Highway/Arthur Street route to access the Mount Street overpass/Warringah Freeway.  Intersection reconfiguration at Pacific Highway/Arthur Street to support increased priority for traffic accessing the CBD from Arthur Street (via Mount Street and/or Berry Street).	ID: 03 ID: 04  A re-design of the Warringah Freeway slip lane/ Pacific Highway/ High Street intersection to increase priority for traffic exiting the Warringah Freeway on to Arthur Street and entering/exiting the CBD from the east (Arthur Street) via Mount Street and Berry Street. Creation of the Eastern By-pass and associated intersection re- design may offer some scope for the provision of improved public domain, walking and cycling facilities at/near the emerging	High		✓	✓	✓

Target/ Project	ID Number	Intervention / Action Description	Reliance (either Stand Alone Action OR Reliant Actions ID Number)	Impact (High / Medium / Low)	Scenario			
					Minimalist Interventi on Scenario	Miller St Bus Intercha nge Scenario	Miller St Plaza Scenario	Miller St & Walker St Plaza Scenario
			"Tram Viaduct Vaults" precinct.					
40km/h High Pedestrian Activity Area Speed Limits	ID:07	Expand 40km/h High Pedestrian Activity Area Speed Limit  Extend the existing CBD 40km/h speed limit to cover all state and regional roads throughout the CBD core. This would include extending the existing 40km/h HPAA to Arthur Street, Pacific Highway, Mount Street, High Street and Alfred Street.	Stand Alone	Low	✓	✓	✓	✓
Prioritise local access movements over regional traffic movement on Miller Street between Berry Street and the Pacific Highway	ID:08	Encourage traffic to use the "southern traffic by-pass" (Pacific Highway-Arthur Street) by introducing a dedicated right turn phase from Miller Street (south) on to the Pacific Highway (southbound) at the Pacific Highway/Miller Street intersection.  Discourage traffic from using Miller Street as a through route by introducing a right turn restriction from Miller Street (south) on to Berry Street at the Miller Street/Berry Street intersection.	ID:01 ID:03 ID:04 ID:05	Low	✓	✓	✓	✓
	ID:09	Reduction of traffic on Miller Street by restricting right turns from Pacific Highway (east) into Miller Street (north) at the Pacific Highway / Miller Street intersection.		Medium	✓			
	ID:10	Miller Street Bus Interchange  Restrict access for general traffic* and re-allocate road space to significantly improve bus stops and support interchange between North Sydney bus routes and the Victoria Cross Metro Station.  *Northpoint traffic access maintained via Miller Street north	ID:01 ID:02 ID:03 ID:04 ID:05 ID:06 ID: 08	Medium		✓		
	ID:11	Miller Street Pedestrian Plaza Restrict all access via Miller Street. Provide for pedestrian activity south of the Northpoint vehicle crossing*. *Northpoint traffic access maintained via Miller Street north	ID:01 ID:02 ID:03 ID:04 ID:05 ID:06 ID:08 ID:19 ID:20	High			✓	✓

Target/ Project	ID Number	Intervention / Action Description	Reliance (either Stand Alone Action OR Reliant Actions ID Number)	Impact (High / Medium / Low)	Scenario			
					Minimalist Interventi on Scenario	Miller St Bus Intercha nge Scenario	Miller St Plaza Scenario	Miller St & Walker St Plaza Scenario
	ID:12	Walker Street Pedestrian Plaza Restrict all access via Walker Street.	ID:01 ID:02 ID:03 ID:04 ID:05 ID:06 ID: 08	High				✓
The Western Cycling By- pass	ID: 13	Separated Cycling Infrastructure  Provide separated cycling infrastructure on the Pacific Highway between the railway underpass to Middlemiss Street and the West Street cycle route*. This facility will consist of two uni-directional separated lanes on the Pacific Highway and is provided by reducing the right turn from the Pacific Highway into Miller Street south to a single lane.  *this project is identified as part of the North Sydney Integrated Cycling Strategy and is currently under development	ID:06	High		✓	✓	✓
The Eastern Cycling By- pass	ID: 14	Separated Cycling Infrastructure  While the “Western Cycling By-pass” will provide an alternative to cycling on Miller Street for cyclists travelling between Sydney north-west and the Harbour Bridge and so reduce pedestrian/cyclist conflict in the CBD core, it does not provide a suitable alternative for those cyclists travelling between the Bridge, Mosman and the Northern Beaches. An alternative route to the east of the CBD via the High Street overpass, Alfred Street North and the Warringah Freeway slip lane, tying in to the Ridge Street pedestrian/cycling bridge and the Military Road pedestrian/cycling underpass is, therefore, recommended.	ID:06	High		✓	✓	✓
Increase pedestrian storage capacity.	ID: 15	Remove slip lanes/ re-incorporate left turning traffic movements in to the main Pacific Highway/ Miller Street signalised intersection.	Stand Alone	Medium	✓	✓	✓	✓
	ID: 16	Remove slip lanes/ re-incorporate left turning traffic movements in to the main Pacific Highway/ Walker Street signalised intersection.	Stand Alone	Medium		✓	✓	✓
<b>NSTS Priority: Cycling Safety and Amenity</b>								
Ridge Street Cycling	ID:17	Provide higher priority local road cycling infrastructure on Ridge between the West Street cycle route and the proposed “Eastern	Stand Alone	Medium			✓	✓

Target/ Project	ID Number	Intervention / Action Description	Reliance (either Stand Alone Action OR Reliant Actions ID Number)	Impact (High / Medium / Low)	Scenario			
					Minimalist Interventi on Scenario	Miller St Bus Intercha nge Scenario	Miller St Plaza Scenario	Miller St & Walker St Plaza Scenario
Facilities		Cycling by-pass**.  *this project is identified as part of the North Sydney Integrated Cycling Strategy and is currently under development						
Mount Street Overpass Cycling Facilities	ID: 18	Provide a separated cycling facility between the proposed "Eastern Cycling By-pass" and the CBD core via the Mount Street overpass.	ID:14 Reliant on delivery of the "Eastern Cycle By-pass".	Medium		✓	✓	✓
<b>NSTS Priority: Public Transport Amenity</b>								
Pacific Highway/ Miller Street Bus Interchange	ID: 19	Bus stops to be incorporated in to the re-design of the Pacific Highway/ Miller Street intersection. These bus stops will be located at least 150m north of the Pacific Highway / Miller Street intersection on the Pacific Highway.  Simplifying the junction to a T-junction creates opportunities for re-allocation of right turn lane carriageway space to alternative uses.	ID:06 ID:11	Medium			✓	✓
Mount Street Overpass Bus Interchange	ID: 20	Bus stops/lanes to be incorporated in to the re-design of Arthur Street (reversal of the one-way system), the Mount Street overpass and Alfred Street North. Introducing a bus interchange within the Warringah Freeway corridor provides the opportunity to stop buses that currently by-pass the North Sydney CBD without adding significant time to the majority of passengers that have origins/ destinations within the Sydney CBD. Northbound routes will divert onto Arthur Street, stopping at/near Mount Street, before continuing along the reversed section of Arthur Street and re-joining the Warringah Freeway via the Berry Street slip lane. Southbound routes will divert onto Alfred Street North, via the Kirribilli slip lane, then re-join the Warringah Freeway by the redesigned Mount Street Overpass.	ID:06 ID:11	Medium			✓	✓
<b>NSTS Priority: Business Activity</b>								
Loading Bay Management	ID: 21	Changes to the traffic network offer opportunities to re-prioritise kerbside space for shared local delivery infrastructure at particular times of the day / week. As a result of the removal of vehicular traffic from some portions of	Stand Alone	Low	✓	✓	✓	✓

Target/ Project	ID Number	Intervention / Action Description	Reliance (either Stand Alone Action OR Reliant Actions ID Number)	Impact (High / Medium / Low)	Scenario			
					Minimalist Interventi on Scenario	Miller St Bus Intercha nge Scenario	Miller St Plaza Scenario	Miller St & Walker St Plaza Scenario
		roadway, the kerbside space has been reduced, however, as a result of the simplification of a number of intersections throughout the CBD there is potential for additional kerbside space to be allocated to parking and / or deliveries. This includes the northbound lane on Walker Street, north of Pacific Highway and portions of Berry Street. NSC should also consider the use of permits for loading vehicles to assist with enforcement of the use of loading zones by private vehicles.						
Out of Hours Delivery	ID: 22	The ability for operators to implement out of hours delivery where possible, similar to those used in parts of the City of Sydney, should be introduced throughout North Sydney CBD to reduce the conflict of pedestrian/delivery activity. This should occur on local roads within the CBD such as Berry Street and Walker Street.	Stand Alone	Medium	✓	✓	✓	✓

**NSTS Priority: Private Transport Safety and Amenity**

Parking Managemen t	ID: 23	This action involves the evaluation of travel demand management strategies relating to parking in the CBD. Parking rates for new developments, time and place restrictions for on-street parking, and changes to the residential parking scheme will be evaluated to determine a fair and equitable system the provided no net increase in traffic generation. Given that Single Occupant Journey to work mode share of 29% is expected to reduce to 20% as a result of Metro, increased restrictions on parking through reduced maximum parking rates and reductions of overall the provision of parking in the CBD is not expected to have a significant impact on the transport system, however, NSC should ensure that the difference between public transport fares and parking fees does not reduce. It is essential that commuters see the cost of driving (vehicle maintenance, registration, petrol, tolls and parking fees) as mores expensive than a public transport fare as this cost difference must be used to justify the slightly lessened convenience of using public transport.  In managing parking provision and rates, NSC should also ensure that short-term on-street parking is maintained to encourage saturation at approximately 85% to allow a small portion of spaces are available for visitors to the CBD to limit increased vehicular circulation for those searching for a car-park, or avoidance of the North Sydney CBD.	Stand Alone	Low	✓	✓	✓	✓
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North Sydney CBD Transport Masterplan

Target/ Project	ID Number	Intervention / Action Description	Reliance (either Stand Alone Action OR Reliant Actions ID Number)	Impact (High / Medium / Low)	Scenario			
					Minimalist Interventi on Scenario	Miller St Bus Intercha nge Scenario	Miller St Plaza Scenario	Miller St & Walker St Plaza Scenario
Stopping right turn movements between Pacific Highway and Walker Street.	ID: 24	Restricting the right turn movement in to Walker Street would limit weaving to enter at the southern end. Traffic access is maintained via Alfred Street-Mount Street with left turns out of Walker Street back on to the Pacific Highway resulting in significant simplification of Pacific Highway/Walker Street/Blue Street intersection operations.	ID: 03 ID: 06	Low		✓	✓	✓
Simplify traffic operations at the Pacific Highway/ Walker Street/ Blue Street intersection.	ID: 25	Closure to general traffic Close the eastern entry/exit to Blue Street to general traffic while maintaining left turn in and right turn out movements for buses (and taxis) accessing the North Sydney train station.	ID:06 ID:11	Medium			✓	✓

# 4 ACTION EVALUATION

The framework for the evaluation of strategies has been based on the community priorities set out in the North Sydney Transport Strategy (NSTS). These priorities represent the amalgamated vision for transport in North Sydney based on key themes from North Sydney’s Community Strategic Plan and community priorities identified through community consultation. This is a multi-criteria evaluation and the criteria are shown in Figure 16.

Community Transport Priority	Will the project:	Make Worse							Improve	NSTS Priority Rating *	TOTAL
		-3	-2	-1	0	1	2	3			
<b>Safe Travel</b>	...improve community safety by creating slow speed road environments where more vulnerable road users are protected from higher impact road users and the number of crashes and severity of injuries is minimised?									<b>0.81</b>	Score X NSTS Priority Rating
<b>Transport Security</b>	...improve personal security through improved streetscape design, increased street activity and passive surveillance?									<b>0.81</b>	Score X NSTS Priority Rating
<b>Social Wellbeing</b>	...provide social spaces where human interaction is given the highest priority and the negative impacts of traffic are minimised, promoting incidental social interaction, increasing civic pride, reducing anti-social behaviour and community policing requirements?									<b>0.65</b>	Score X NSTS Priority Rating
<b>Active Health</b>	...provide infrastructure that encourages healthy and active lifestyle/travel choices?									<b>0.65</b>	Score X NSTS Priority Rating
<b>Fair Access to Parking</b>	...reduce demand for parking and / or provide more equitable access to existing parking supply?									<b>0.59</b>	Score X NSTS Priority Rating
<b>Environmental Sustainability</b>	...encourage the use of low greenhouse gas emitting transport options?									<b>0.56</b>	Score X NSTS Priority Rating
<b>Local Environments</b>	...encourage the use of travel modes that have minimal impact on air quality, water quality and noise?									<b>0.56</b>	Score X NSTS Priority Rating
<b>Transport Affordability</b>	...encourage the use of travel options with lower social, health and economic costs and higher social, health and economic benefits?									<b>0.51</b>	Score X NSTS Priority Rating
<b>Congestion</b>	...apply travel demand management principles to minimise traffic demand and associated traffic congestion?									<b>0.44</b>	Score X NSTS Priority Rating
<b>Business Activity</b>	...increase business opportunities by improving the look/amenity of North Sydney throughout the day and in to the evening while, at the same time, reducing the whole of life cost of transport networks, including the ongoing costs associated with cleaning and maintaining assets?									<b>0.38</b>	Score X NSTS Priority Rating
<b>TOTAL = SUM / 16.35</b>											

Figure 16: Transport Planning and Management Decision Matrix

In order to successfully evaluate the strategies outlined in Table 6, strategies that have reliance’s on other actions or strategies have been evaluated together as the four scenarios outlined in Figure 12 to Figure 15. The results of the analysis of each of the four scenarios along with the base cases are outlined in Table 8. The full description of the evaluation of each of the actions is provided in Appendix 3.

Table 8: Results of Strategy Evaluation

Criteria	Desired Outcome	NSTS Priority Ranking	Base Case (2016)	Base Case (2036)	Minimalist Intervention Scenario (2036)	Miller St Bus Interchange Scenario (2036)	Miller St Plaza Scenario (2036)	Miller St & Walker St Plaza Scenario (2036)
<b>Safe Travel</b>	Improve community safety by creating slow speed road environments where more vulnerable road users are protected from higher impact road users and the number of crashes and severity of injuries is minimised	0.81	0	-0.81	0.81	1.62	1.62	1.62
<b>Transport Security</b>	Improve personal security through improved streetscape design, increased street activity and passive surveillance	0.81	0	-0.81	0	0.81	1.62	1.62
<b>Social Wellbeing</b>	Provide social spaces where human interaction is given the highest priority and the negative impacts of traffic are minimised, promoting incidental social interaction, increasing civic pride, reducing anti-social behaviour and community policing requirements	0.65	0	-0.65	0	1.3	1.95	1.95
<b>Active Health</b>	Provide infrastructure that encourages healthy and active lifestyle/travel choices	0.65	0	-0.65	0.65	1.3	1.95	1.95
<b>Fair Access to Parking</b>	Reduce demand for parking and / or provide more equitable access to existing parking supply	0.59	0	-1.18	1.18	1.18	1.18	1.18

## North Sydney Centre Transport Masterplan



Criteria	Desired Outcome	NSTS Priority Ranking	Base Case (2016)	Base Case (2036)	Minimalist Intervention Scenario (2036)	Miller St Bus Interchange Scenario (2036)	Miller St Plaza Scenario (2036)	Miller St & Walker St Plaza Scenario (2036)
<b>Environmental Sustainability</b>	Encourage the use of low greenhouse gas emitting transport options	0.56	0	-1.12	0	0.56	1.68	1.68
<b>Local Environments</b>	Encourage the use of travel modes that have minimal impact on air quality, water quality and noise	0.56	0	-1.12	0	0.56	1.12	1.12
<b>Transport Affordability</b>	Encourage the use of travel options with lower social, health and economic costs and higher social, health and economic benefits	0.51	0	-1.02	0	1.02	1.53	1.53
<b>Congestion</b>	Apply travel demand management principles to minimise traffic demand and associated traffic congestion	0.44	0	0.44	0.88	0.88	1.32	0.44
<b>Business Activity</b>	Increase business opportunities by improving the look/ amenity of North Sydney throughout the day and in to the evening while, at the same time, reducing the whole of life cost of transport networks, including the ongoing costs associated with cleaning and maintaining assets	0.38	0	-0.38	0.38	0.76	1.14	0.38
<b>OVERALL RANKING:</b>			<b>0</b>	<b>-7.3</b>	<b>3.9</b>	<b>9.99</b>	<b>15.11</b>	<b>13.47</b>

**North Sydney Centre Transport Masterplan**

The results in Table 8 indicate that the Miller Street Plaza Scenario would provide the most balanced outcome for the North Sydney Centre, providing an attractive environment which prioritises pedestrians, cyclists and amenity over private vehicle trips, while allowing business activity to continue to thrive within the Centre by providing for public transport, and loading and parking of freight and private vehicles. Therefore the Miller Street Plaza Scenario is the recommended intervention level to achieve the North Sydney Transport Strategy vision. The actions involved in this scenario include the following as demonstrated in Appendix 3.

- ID: 01 Modify Signal Phasing at the Falcon Street / Pacific Highway intersection
- ID: 02 Re-allocate carriageway space to walking, cycling and public transport on Pacific Highway
- ID: 03 Creation of a traffic circulatory system via Arthur Street (northbound), the Mount Street overpass (eastbound), Alfred Street (southbound) and the High Street overpass (westbound) to create a one-way clockwise loop
- ID: 04: Re-introduction of bi-directional traffic on Berry Street and allow for pedestrian crossings of Berry Street
- ID: 05 Intersection reconfiguration at Pacific Highway / Berry Street restricting right turn movements into Berry Street (east) from Pacific Highway (south)
- ID: 06 Eastern traffic by-pass at Arthur Street including the reversal of Arthur Street between Mount Street and Berry Street
- ID: 07 Expand the 40km/h High Pedestrian Activity Area Speed Limit
- ID: 08 Encourage traffic to use the southern bypass at Pacific Highway / Arthur Street
- ID: 11 Remove general traffic from Miller Street to provide a pedestrian plaza with access retained for the Northpoint vehicle crossing only
- ID: 13 Provision of two uni-directional separated cycling lanes on the Pacific Highway
- ID: 14 Provision of the eastern cycling bypass on Alfred Street North
- ID: 15 Remove slip lanes at the Pacific Highway / Miller Street intersection
- ID: 16 Remove slip lanes at the Pacific Highway / Walker Street intersection
- ID: 17 Provide priority local road cycling infrastructure on Ridge Street
- ID: 18 Provide separated cycling facilities on the Mount Street overpass
- ID: 19 Incorporate bus stops at the re-designed Pacific Highway / Miller Street intersection
- ID: 20 Incorporate bus stops and lanes onto the redesigned Arthur Street, Mount Street overpass and Alfred Street system
- ID: 21 Loading bay management
- ID: 22: Encourage out of hours delivery
- ID: 23 Parking management
- ID: 24 Restrict right turn movements from Pacific Highway (east) into Walker Street (north)
- ID: 25 Simplification of the traffic operations at the Pacific Highway / Walker Street / Blue Street intersection to limit Blue Street to left-in and right out movements for buses only.

**North Sydney Centre Transport Masterplan**

The four scenarios were each modelled using a VISSIM model to compare the travel time, queuing lengths and throughput volumes against a base case future scenario. This modelling was undertaken to ensure that with the proposed intervention actions in each scenario to prioritise pedestrian activity, slow the speed of traffic and encourage regional traffic to use alternative routes will continue to accommodate necessary movements of through traffic. The results of the microsimulation modelling undertaken for each scenario are shown in Table 9 and Table 10 for the AM and PM peaks respectively. The results are colour coded with green indicating the highest performing of the options and red indicating the worst performing. As demonstrated below, there is a difference between the AM and PM peak periods and congestion in each period has different impacts on the community. Significant congestion levels during the morning peak period impact on the commercial and economic outcomes of the North Sydney Centre as this impacts ability for commuters to travel to work while in the PM peak the impact is generally borne by individuals on their way home. Overall, the High intervention has the least level of congestion which is demonstrated by the level of the suppressed demand.

**Table 9: AM Peak Period Modelling Results**

AM PEAK	Base Case (2036)	Minimalist Intervention Scenario (2036)	Miller St Bus Interchange Scenario (2036)	Miller St Plaza Scenario (2036)	Miller St & Walker St Plaza Scenario (2036)
Avg delay (s)	90	193	104	98	103
Avg no. of stops	2.1	3.1	2.1	2	2.2
Avg Speed (KM/h)	16.1	8.1	15.4	16	15.4
Total Distance Travel (km)	41,950	30,865	42,628	43,143	42,922
Total Time Travel (s)	9,381,926	13,674,443	9,996,668	9,704,297	10,054,741
Suppressed demand (vehicles)	570	6,815	764	554	909

**Table 10: PM Peak Period Modelling Results**

PM PEAK	Base Case (2036)	Minimalist Intervention Scenario (2036)	Miller St Bus Interchange Scenario (2036)	Miller St Plaza Scenario (2036)	Miller St & Walker St Plaza Scenario (2036)
Avg delay (s)	85	91	111	111	131
Avg no. of stops	2	2.1	2.2	2.2	2.7
Avg Speed (KM/h)	16.7	16.1	15	14.9	13
Total Distance Travel (km)	41,448	41,476	42,770	42,738	40,484
Total Time Travel (s)	8,952,135	9,266,978	10,298,517	10,334,207	11,204,777
Suppressed demand (vehicles)	588	680	794	675	2,351

The results in Table 9 and Table 10 demonstrate that the Miller Street Plaza Scenario achieves the closest transport operation results to the base case of all of the scenarios modelled. The suppressed demand indicates the capacity of the network and the lower the result the more capacity is provided within the network. The increase in suppressed demand in comparison with the future year base case is also shown in Table 11 along with the recommendations for the North Sydney Centre Transport Masterplan. The recommended layout for the North Sydney Centre transport network is shown in Appendix 1.

Table 11: Recommendations

Scenario	Modelling Results	NSTS Score	Suppressed demand (congestion)	Recommendations
<b>Base Case (2036)</b>	Future year base case (2036) without changes to the network following the introduction of Metro	<b>-7.3</b>	AM: 570 vehicles PM: 588 vehicles	The deficiencies to all modes of transport are outlined throughout this report which demonstrates that there are significant modifications required to ensure an activated North Sydney CBD where sustainable modes of transport are encouraged.
<b>Minimalist Intervention Scenario (2036)</b>	The turn restrictions proposed within this scenario, while low cost and easily implementable, would result in significant congestion on the remaining intersections which allow full movement due to the demand which is not able to be redistributed throughout the network.	<b>3.9</b>	AM: 1096% PM: 16%	It is not recommended that this option be considered to be implemented due to the significant impact on vehicular traffic and the potential consequential impact on pedestrian and CBD amenity.
<b>Miller St Bus Interchange Scenario (2036)</b>	This scenario provides some improvements in performance at the High Street / Arthur Street / Pacific Highway. There is a moderate increase in overall congestion, however the amenity improvements are not significant within this option.	<b>9.99</b>	AM: 34% PM: 35%	It is recommended that this option be considered as an interim step towards reaching the ultimate masterplan for the North Sydney Centre. This option provides only minor improvements in the amenity for pedestrians, cyclists, public transport users.
<b>Miller St Plaza Scenario (2036)</b>	This scenario provides some improvements in performance at the High Street / Arthur Street / Pacific Highway.  While there are some increases in congestion along the Berry Street corridor in the PM peak, the public domain improvements, improvements in pedestrian safety are considered to be of significant benefit to the North Sydney CBD. The overall increase in Level of Service and congestion across the CBD is negligible as the traffic is being redistributed from the busy pedestrian areas of the central CBD to the primary arterial routes on the boundary of the CBD. Travel time results are quite similar to the base case, with the exclusion of Berry Street which will see an increase in travel time as a result of the two-way traffic and the inclusion of a pedestrian crossing.	<b>15.11</b>	AM: -3% PM: 15%	It is recommended that this option be considered to be implemented in line with the introduction of Metro to provide excellent amenity for pedestrians, cyclists, public transport users and business and CBD amenity.
<b>Miller St &amp; Walker St Plaza Scenario (2036)</b>	Under this scenario, while additional amenity outcomes are achieved for pedestrians due to the closure of Walker Street in addition to Miller Street, there is insufficient capacity in the road network to cater for through and local vehicular traffic, including buses. This is because due to the limited number of north- south routes in the area would be required to utilise Berry Street and the Pacific Highway without the inclusion of Walker Street or Miller Street in the road network. This places excessive pressure on Berry Street and the Berry Street / Miller Street and Berry Street / Pacific Highway intersections, particularly in the afternoon peak period.	<b>13.47</b>	AM: 59% PM: 300%	A significant reduction in private vehicle traffic would be necessary prior to this scenario being implemented. The closure of Walker Street results in significant traffic congestion which has the potential to negate the positive impacts of the intervention. Following significant reduction in private vehicle traffic, most likely after 2036, the closer of Walker Street may be considered by NSC.

**APPENDIX 1: RECOMMENDED TRANSPORT MASTERPLAN**

**AP01**



**NOT FOR CONSTRUCTION  
DISCUSSION PURPOSES ONLY**

REV	DESCRIPTION	BY	DATE
1	ORIGINAL ISSUE	T.B.	31.07.2018
2	FINAL ISSUE	T.B.	01.08.2018
3	FINAL ISSUE - WITH AMENDMENTS	T.B.	02.08.2018
4	FINAL ISSUE - FURTHER AMENDMENTS	T.B.	03.08.2018


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DRAWING TITLE	ROAD SPACE REALLOCATION
CLIENT	NORTH SYDNEY COUNCIL
PROJECT	TRANSPORT MASTERPLAN
LOCATION	NORTH SYDNEY

DRAWING DATE	AUGUST 2018	DRAWN BY	T.B.
ORIGINAL SIZE	A1	SCALE A3:	NTS
SCALE		CHECKED BY	H.R.
		APPROVED BY	H.R.
		PROJECT NO.	0650
		DRAWING NO.	SK05
		REV	4

**APPENDIX 2: PEDESTRIAN MODELLING**

**AP02**

## Pedestrian Storage Capacity at Intersections

This section examines the pedestrian storage capacity of the signalised intersections within the North Sydney Centre Masterplan Area. Pedestrian capacity at signalised intersections is an important safety consideration. When the pedestrian demand for an intersection exceeds its capacity, pedestrians will queue on the carriageway, interrupting the flow of traffic and placing the pedestrians at risk of collisions. The dense queue of pedestrians also inhibits the free flow of pedestrians around the intersection and can limit access to commercial premises located on the street corners.

This section will present the methodology used to determine the pedestrian storage capacity of an intersection. It will also present an analysis of the signalised intersections in the study area and propose mitigation measures to increase the capacity of these intersections.

### Methodology

This methodology is based on the principles outlined in the Highway Capacity Manual (TRB, 2000)(the manual). The methodology presented herein is a simplification of those methods presented in the manual. For the complete method, refer to the manual.

The storage area of each signalised intersection is taken as the available space at each signalised intersection that it can be reasonable expected that pedestrians could wait. For the purpose of this analysis, the storage area has been calculated from:

- The area between the kerb line and the building line;
- A distance 3 metres setback from the edge line of the pedestrian crossing pavement markings; and
- The exclusion of obstacles to pedestrian queuing.

Once the storage area for each corner of the intersection is established, the distribution of pedestrians for each movement must be determined. For the majority of the intersections in this study there was no historical data to use directly. Assumptions were made based on the desire lines presented by ARUP in the North Sydney Centre Traffic and Pedestrian Study (2014).

It can be concluded that the number of pedestrians queued at any one time is equal to the total number of pedestrians using the intersection in the peak hour, divided by the number of opportunities to cross the intersections per hour. The number of opportunities is equal to the number of signal cycles per hour.

The number of pedestrians queued per signal cycle is then compared with the Level of Service (LOS) parameters stipulated in Figure 1. For this study, an intersection that scores a LOS of E or F is considered to be over capacity, a LOS of D is considered to be at capacity, and a LOS of A, B, or C is considered to be below capacity. While a LOS of D provides enough pedestrian space to be considered safe, it does impinge on the mobility of pedestrians moving past the intersection. As such, it should be avoided wherever possible.

EXHIBIT 11-9. QUEUING AREA LOS

<p><b>LOS A</b>  <i>Average Pedestrian Space</i> &gt; 1.2 m<sup>2</sup>/p                  Standing and free circulation through the queuing area is possible without disturbing others within the queue.</p>	
<p><b>LOS B</b>  <i>Average Pedestrian Space</i> &gt; 0.9–1.2 m<sup>2</sup>/p                  Standing and partially restricted circulation to avoid disturbing others in the queue is possible.</p>	
<p><b>LOS C</b>  <i>Average Pedestrian Space</i> &gt; 0.6–0.9 m<sup>2</sup>/p                  Standing and restricted circulation through the queuing area by disturbing others in the queue is possible; this density is within the range of personal comfort.</p>	
<p><b>LOS D</b>  <i>Average Pedestrian Space</i> &gt; 0.3–0.6 m<sup>2</sup>/p                  Standing without touching is possible; circulation is severely restricted within the queue and forward movement is only possible as a group; long-term waiting at this density is uncomfortable.</p>	
<p><b>LOS E</b>  <i>Average Pedestrian Space</i> &gt; 0.2–0.3 m<sup>2</sup>/p                  Standing in physical contact with others is unavoidable; circulation in the queue is not possible; queuing can only be sustained for a short period without serious discomfort.</p>	
<p><b>LOS F</b>  <i>Average Pedestrian Space</i> ≤ 0.2 m<sup>2</sup>/p                  Virtually all persons within the queue are standing in direct physical contact with others; this density is extremely uncomfortable; no movement is possible in the queue; there is potential for panic in large crowds at this density.</p>	

Source: Adapted from Fruin (2).

Figure 1: Queuing Area LOS (Source: TRB)

## Results

### Pacific Highway / Miller Street

The pedestrian capacity for the Pacific Hwy / Miller St / Mount St intersection is shown in Figure 2. This five-way intersection is the busiest in the study area. It will see a 92% increase in peak hour pedestrian traffic, with an estimated 9600 pedestrians per peak hour using the intersection once the Victoria Cross station is complete. This increase will result in a LOS of F for the intersection.

The intersection is also the least safe for pedestrians due to the small pedestrian refuge islands (10m<sup>2</sup> each) in the north and south of the intersection. During peak periods, pedestrians will spill over the island into the surrounding lanes.

Pedestrian spillage is also a concern around the portal to the North Sydney station. There the effective width of the footpath is too narrow to allow for pedestrians to move past the intersection as well as store the pedestrians waiting to cross. There are currently fences on that corner to mitigate the risk of spillage. Based on these factors, PSA recommend that the intersection be redesigned to increase its storage capacity.

Alternatively, a mid-block pedestrian crossing could be added further north or south on the Pacific Hwy. However, as there are already two grade separated crossings to the south, one below ground and one above ground. A more thorough examination of pedestrian behaviour is recommended before proceeding with this option.

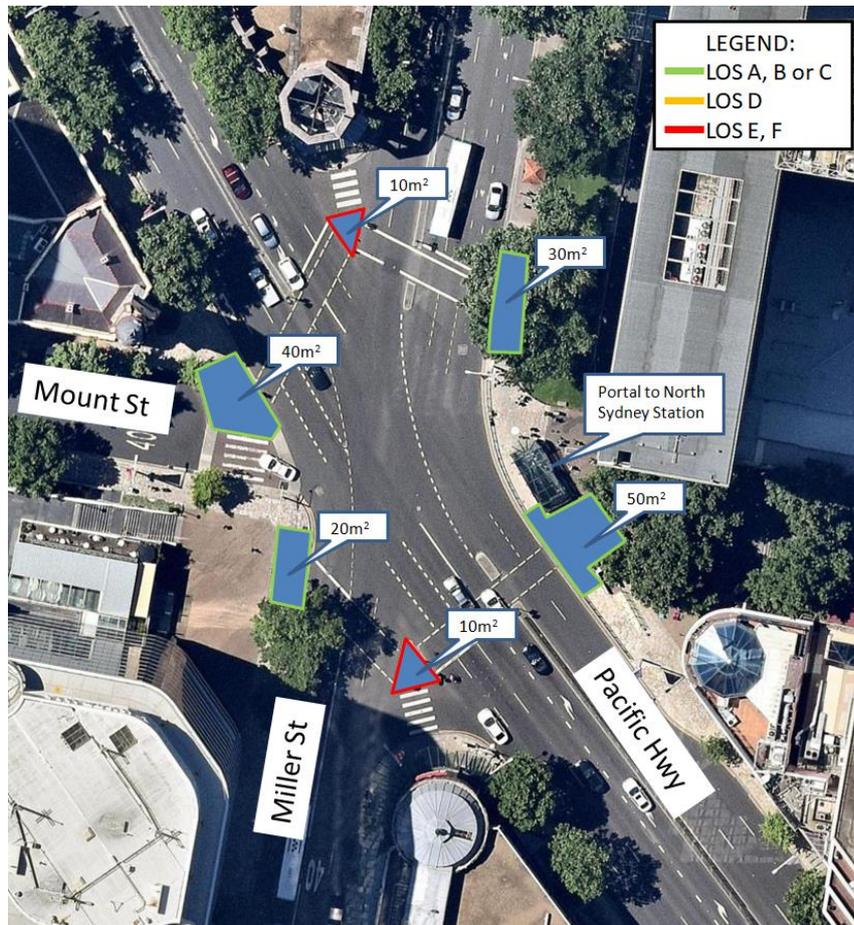


Figure 2: Pacific Hwy / Miller St / Mount St (Source: Nearmap, PSA)

### Pacific Highway / Walker Street

The pedestrian capacity for the Pacific Hwy / Walker St intersection is shown in Figure 3. This intersection will see a 41% increase in pedestrian traffic, with 4500 pedestrians per peak hour using the intersection once the Victoria Cross station is complete.

This intersection has a similar configuration to the Pacific Hwy / Miller St / Mount St intersection and, as such, presents the same problems. The refuge islands are, however, much larger at this intersection. As such, only the northern refuge island is below the required capacity. The northern corner will have a LOS of E and the other corners will have a LOS of C.

Pedestrian non compliance appears to be an issue north of this intersection as there are fences on the median strip on the Pacific Hwy. This adds to the case for another mid-block pedestrian crossing across the Pacific Hwy.

Based on these issues, PSA recommend that the northern corner of the intersection be redesigned.

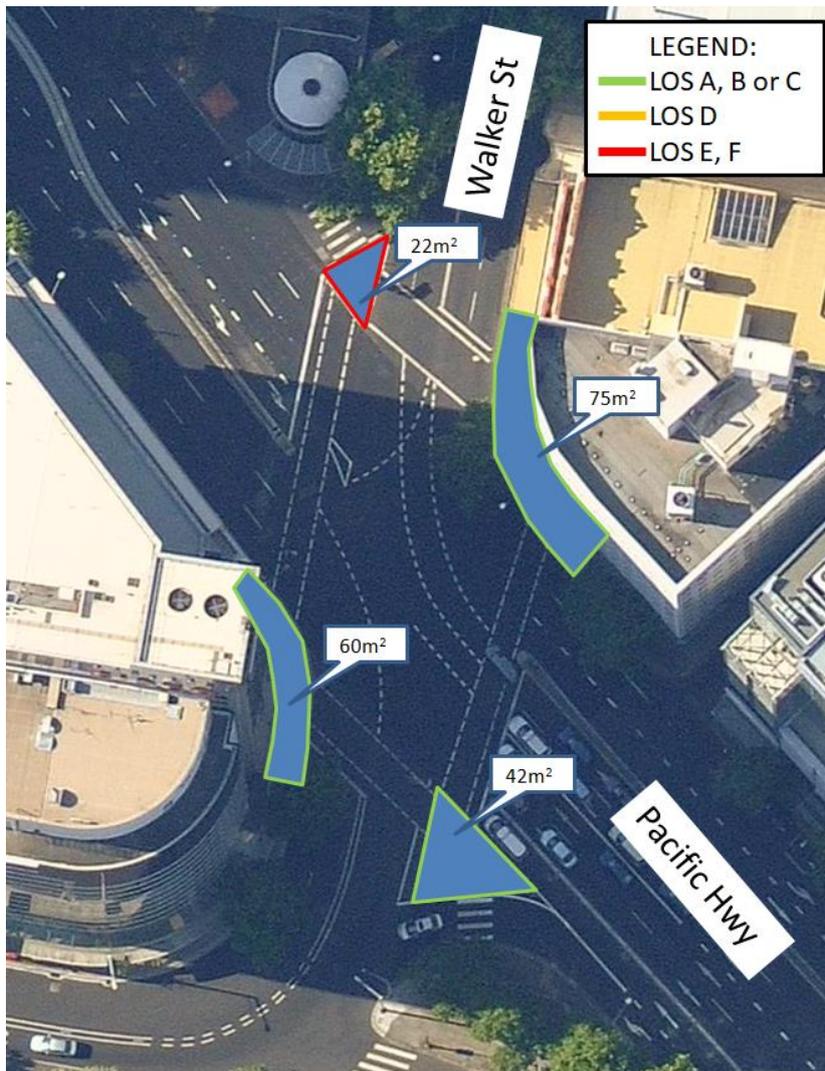


Figure 3: Pacific Hwy / Walker St (Source: Nearmap, PSA)

### Pacific Highway / Berry St

The pedestrian capacity for the Pacific Hwy / Berry St intersection is shown in Figure 4. The intersection is serviced with two signalised pedestrian crossings, one on the eastern leg and one on the southern leg. The western leg of the intersection is serviced by a zebra crossing. The intersection will see a 167% increase in pedestrian traffic, with a total of 1600 pedestrians using the intersection per peak hour once the Victoria Cross station is complete. The intersection has sufficient pedestrian capacity for this increase, resulting in a LOS of C for all holding areas.

Typically, intersections with only three crossings increase the delay experienced by pedestrians. This encourages pedestrian noncompliance with the traffic signals. Should this be observed after the Victoria Cross station is complete, another signalised crossing over the Pacific Hwy may be needed.

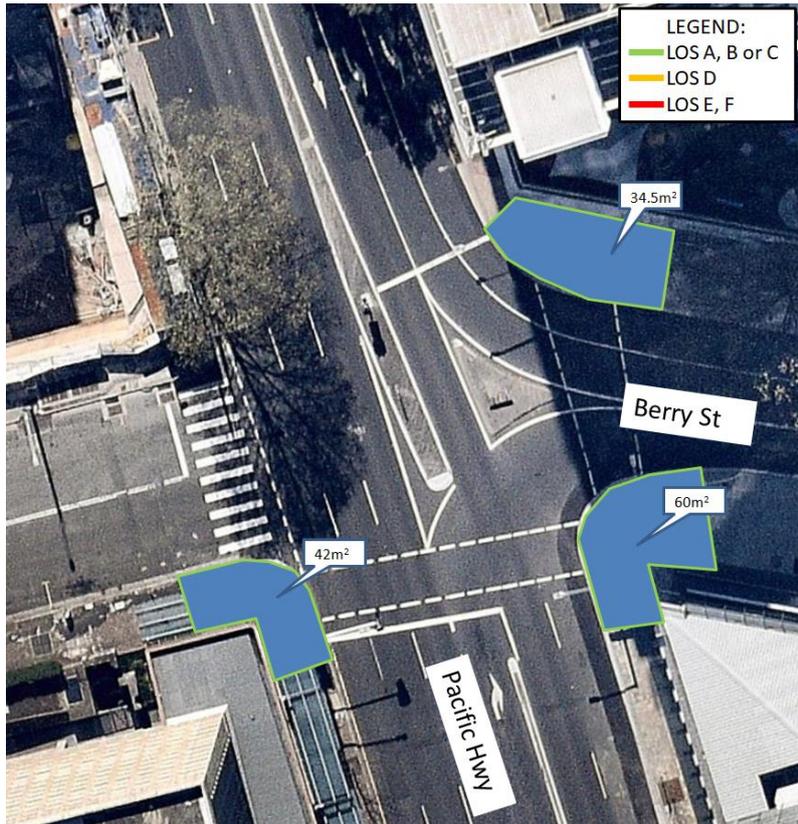


Figure 4: Pacific Hwy / Berry St (Source: Nearmap, PSA)

### Miller St / Berry St

The pedestrian capacity for the Miller St / Berry St intersection is shown in Figure 5. The intersection is serviced by four signalised crossings. The intersection will see a 61% increase in pedestrians, with 2900 pedestrians per peak hour using the intersection once the Victoria Cross station is complete. This increase in demand will reach the capacity of the north-eastern holding area. This holding area will have an LOS of D while the other holding areas will have a LOS of C.

While this analysis shows that the intersection is within an acceptable range for performance, this analysis does not take into account the fluctuations in pedestrian arrivals at the intersection. It is possible that the demand will reach LOS E or F should these fluctuations be pronounced. As this intersection is the closest to the Victoria Cross station, it is likely that the fluctuations in demand will match the arrival of trains at the station.

As such, it is recommended that the pedestrian capacity of the intersection be increased. A simple widening of the footpath may not be possible for this intersection. Another method for increasing pedestrian storage capacity is to decrease the intersection cycle time. This would increase the opportunities to cross each hour, thus increasing capacity.



Figure 5: Miller St / Berry St (Source: Nearmap, PSA)

### McLaren St / Miller St

The pedestrian capacity for the McLaren St / Miller St intersection is shown in Figure 6. The intersection will see a 213% increase in pedestrians, with 2500 pedestrians per peak hour using the intersection following the completion of the Victoria Cross Station. The intersection has sufficient pedestrian capacity and will have a LOS of C for all holding areas.

The northern portal for the Victoria Cross station will be located at the NE corner of this intersection. Pedestrians who use this portal and travel north may cross Miller St mid-block north of the intersection. This is a risk that should be monitored after the station enters operations. If this becomes an issue, fences could be erected along the footpath, or, preferably, a mid-block crossing facility could be constructed.



Figure 6: McLaren St / Miller St (Source: Nearmap, PSA)

**Mount St / Walker St**

The pedestrian capacity for the Mount St /Walker St intersection is shown in Figure 7. The intersection will see a 114% increase in pedestrians peak hour traffic, with 4700 pedestrians per peak hour using the intersection following the completion of the Victoria Cross Station. The intersection has sufficient capacity to accommodate the increase, providing a LOS of C for all holding areas.



Figure 7: Mount St / Walker St (Source: Nearmap, PSA)

### Berry St / Walker St

The pedestrian capacity for the Berry St / Walker St intersection is shown in Figure 8. The intersection will see a 67% increase in pedestrians peak hour traffic, with 1250 pedestrians per peak hour using the intersection following the completion of the Victoria Cross Station. The intersection will have sufficient capacity to accommodate this, resulting in a LOS of B for all holding areas.

The intersection consists of three signalised crossings. Pedestrians typically experience increased delay at three leg crossings. This increase in delay increases the likelihood of pedestrian noncompliance with the signals. If this behaviour is observed, a fourth crossing may need to be constructed.

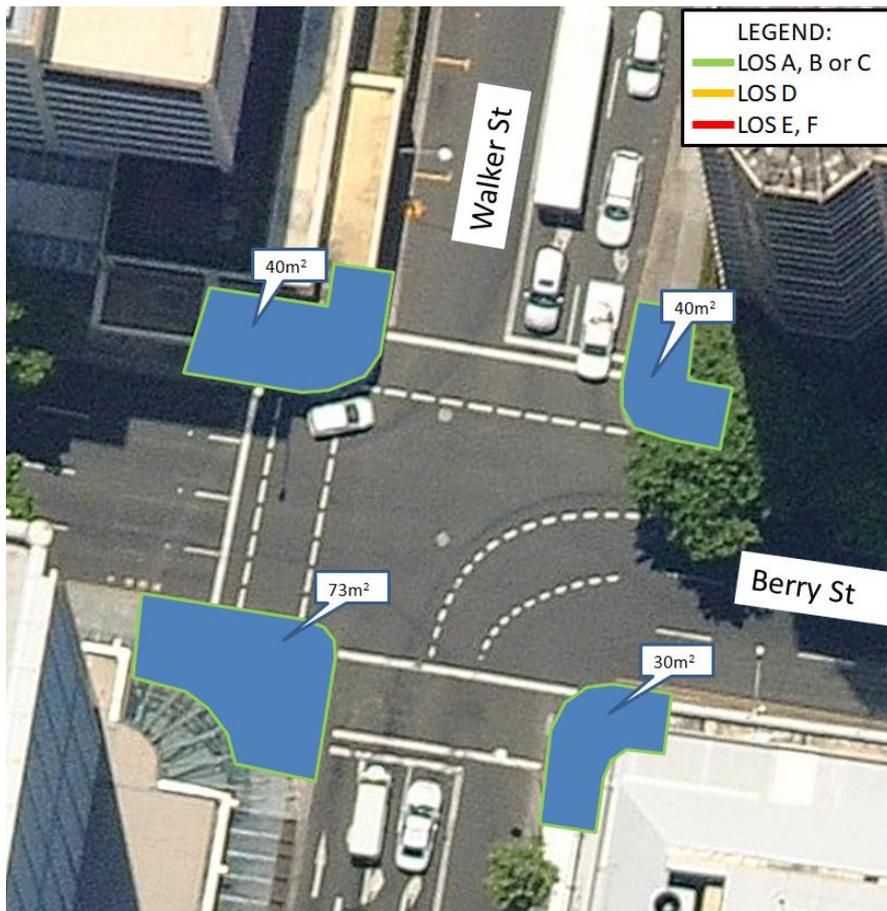


Figure 8: Berry St / Walker St (Source: Nearmap, PSA)

### Mount St / Arthur St

The pedestrian capacity for the Mount St / Arthur St intersection is shown in Figure 9. While the intersection will see a 118% increase in pedestrians peak hour traffic, with 1200 pedestrians per peak hour using the intersection following the completion of the Victoria Cross Station. The majority of this traffic will be travelling north-south, along the western side of the intersection. This traffic will be serviced by the zebra crossings and will not impinge on the LOS of the intersection. Those pedestrians using the signalised crossing will experience a LOS of A.

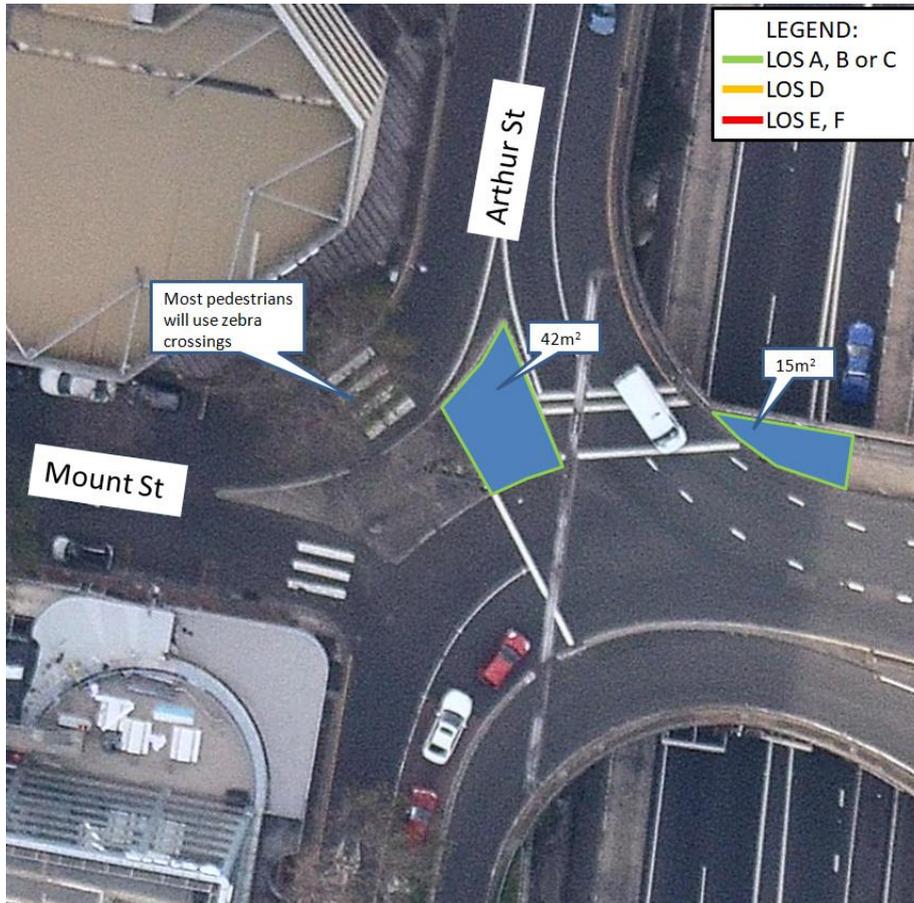


Figure 9: Mount St / Arthur St (Source: Nearmap, PSA)

### Pedestrian Capacity on Footpaths

This section examines the pedestrian capacity of the key footpaths within the North Sydney Centre Masterplan Area. The pedestrian capacity of footpaths is an important safety consideration, as well as an efficiency consideration. When the pedestrian demand of a footpath exceeds its capacity, pedestrian speed decreases and pedestrians spill onto the carriageway. This creates both a safety and efficiency issue.

This section will present the methodology used to determine the pedestrian capacity of a footpath. It will also present an analysis of the key footpaths in the study area and propose mitigation measures to increase the capacity of these footpaths.

### Methodology

The footpaths in the study area were analysed using the methods outlined in the Highway Capacity Manual (TRB, 2000)(the manual). This section will provide a synopsis of those methods. For the complete method, refer to the manual.

The first factor used to determine footpath capacity is walking speed. It is generally accepted that the adult walking speed is 1.2 metres per second. A reduction should be applied to this if the pedestrian is walking on steep grades, which is not applicable to this study. A reduction should also be applied if the pedestrian is elderly. As this analysis is concerned with pedestrians travelling to North Sydney CBD during peak hours, it has been assumed that the number of elderly pedestrians in the population is minimal. As such, the walking speed for this analysis has been taken as 1.2 metres per second.

The other key factor used to determine footpath capacity is the effective width of the footpath. This is taken as the total width of the footpath, minus the width of any obstructions to pedestrian flow. Obstructions can include signs, light poles, advertising material, bus shelters and other road furniture.

These factors, and the predicted or measured pedestrian demand, are arithmetically manipulated to determine the unit flow rate of pedestrians. This flow rate is compared with the Level of Service (LOS) parameters stipulated in Figure 10.

While this method is effective, it does not always match observed behaviours. When several pedestrians are travelling at different speeds, they tend to pool behind a slower pedestrian. This is called platooning. The best way to reflect this behaviour in LOS is to drop the value calculated in the above method by one level. For example, a footpath with a calculated LOS of B would have a LOS of C if platooning were to be considered. As platooning often occurs on streets with high volumes of pedestrians, it has been assumed that platooning will occur in the study area.

EXHIBIT 18-3. AVERAGE FLOW LOS CRITERIA FOR WALKWAYS AND SIDEWALKS

LOS	Space (m <sup>2</sup> /p)	Flow Rate (p/min/m)	Speed (m/s)	v/c Ratio
A	> 5.6	≤ 16	> 1.30	≤ 0.21
B	> 3.7–5.6	> 16–23	> 1.27–1.30	> 0.21–0.31
C	> 2.2–3.7	> 23–33	> 1.22–1.27	> 0.31–0.44
D	> 1.4–2.2	> 33–49	> 1.14–1.22	> 0.44–0.65
E	> 0.75–1.4	> 49–75	> 0.75–1.14	> 0.65–1.0
F	≤ 0.75	variable	≤ 0.75	variable

Figure 10: Level of Service for footpaths (Source: TRB, PSA)

## Results

Figure 11 summarises the LOS for the streets around the Victoria Cross station. Both Miller St and Denison St have a demand too high for their capacity. Mitigation measures will need to be implemented before the launch of Victoria Cross station to avoid safety risks.

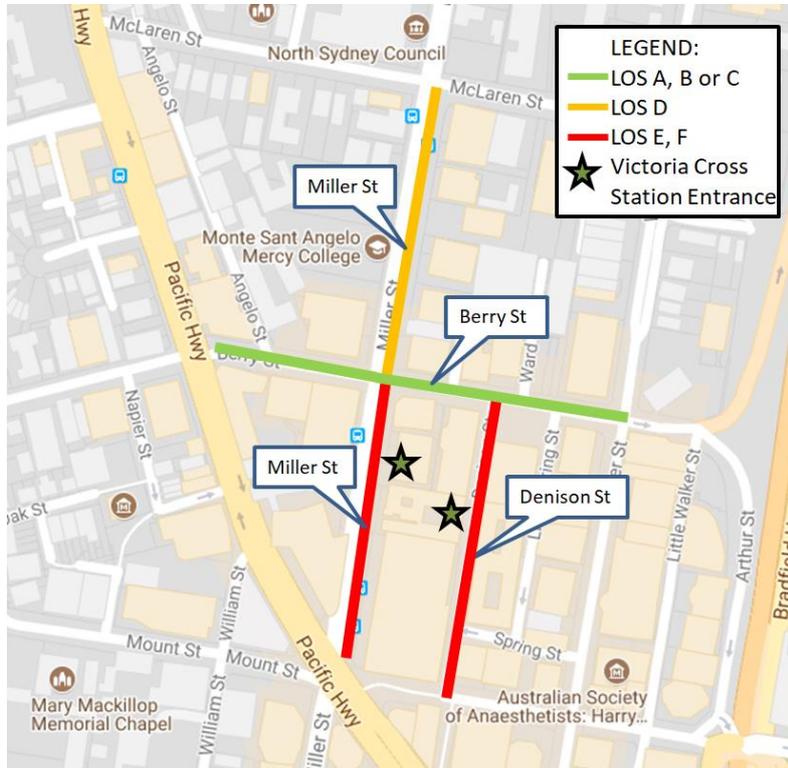


Figure 11: Footpath Level of Service (Nearmap, PSA)

## Denison St

Denison St is a low speed, one –way lane that connects Spring St with Berry St. It serves primarily as loading facilities and as access to a multi-level car park.

The southern section of Denison St is a shared zone. Parking is available on both sides of the street. This severely limits the effective width of the shared zone, limiting it to 4m. The northern section is a one-way street with footpaths on both sides. The western footpath is wide and relatively free of obstructions. It has an effective width of 3m. The eastern footpath is narrow with signage and street lighting limiting the effective width to 1m.

The Victoria Cross station will have an eastern entrance on Denison St, as shown in Figure 12. This will generate approximately 4000 pedestrians per peak hour, with the majority (90%) heading south.

Based on these numbers, the current configuration of Denison St will be unable to adequately convey this many pedestrians. Denison St will have a LOS of E, and a LOS of F when platooning is considered.

North Sydney Council have already identified this problem and have proposed mitigation measures in their Central Laneways Masterplan (2016). They have proposed that Denison St be converted to a pedestrian mall. This measure would raise the LOS to C when platooning is considered.

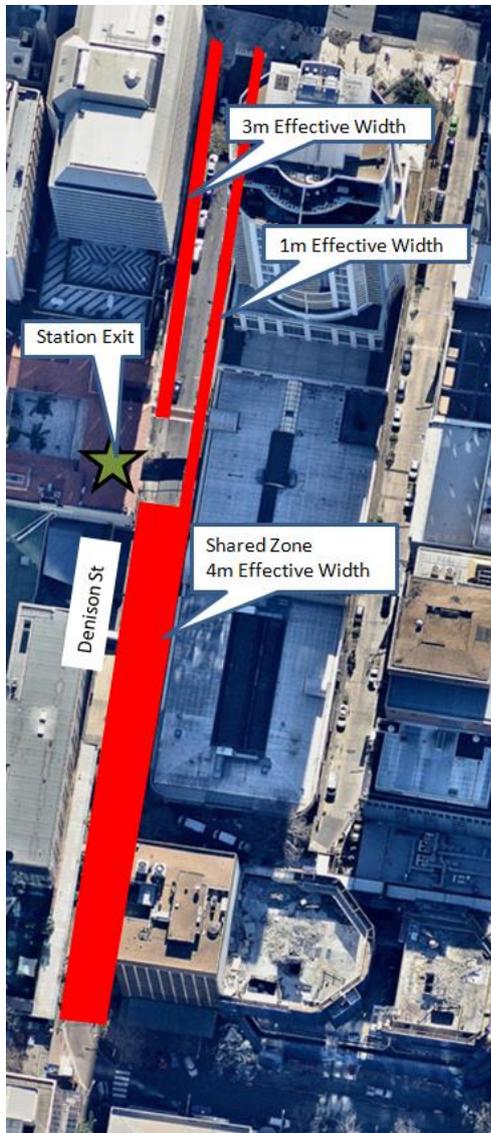


Figure 12: Denison St Pedestrian LOS (Source: Nearmap, PSA)

### Miller Street

Miller St is a two-way, four lane street and is effectively the high street for the North Sydney CBD. For the purpose of this analysis, Miller St has been divided into two sections. The southern section, shown in Figure 13, extends from the Pacific Hwy in the south to Berry St in the north. The northern section, shown in Figure 13, extends from Berry St in the south to McLaren St in the north.

The southern section of Miller St hosts many restaurants and shop fronts, as well as several high volume bus stops. The western entrance to the Victoria Cross station will be located on the eastern side of Miller St, approximately halfway between the Pacific Hwy and Berry St.

The eastern footpath is relatively free of obstructions and provides an effective footpath width of 3m. There is a choke point at the southern end of the footpath where bus shelters reduce the effective width to less than 2m. The western footpath is similarly free of obstructions with an effective width of 3m. There are bus stops on the western footpath but these do not have associated bus shelters.

Due to the high number of bus stops, large numbers of queuing passengers congregate on Miller St. These passengers effectively reduce the free flow of pedestrians to one footpath or the other during peak periods. As such, this analysis has projected 90% of the total load on each footpath.

The analysis shows that both Miller St footpaths have a LOS of E and LOS of F if platooning is considered.

Mitigation measures must be implemented to this section of Miller St if pedestrian safety is to be maintained. These measures could include:

- Relocating the bus stops to the Pacific Hwy;
- Removing the loading zones and widening the footpath; or
- Removing traffic from this section of Miller St and creating a pedestrian mall.

The northern section of Miller St has considerably less shop frontage than the southern section. The eastern footpath has minimal obstruction and an effective width of 3m. The western footpath also has minimal obstructions, save for a bus shelter at the northern end of Miller St. This bus stop imposes an effective footpath width of less than 1m. However, this obstruction is far enough away from the key entrances on Miller St that it poses no impediment to pedestrian flow.

The analysis shows that both footpaths will have a LOS of C, with a LOS of D when platooning is considered.

These values are well within the acceptable range, and no action will be required.



Figure 13: Miller St Pedestrian LOS, Southern Section (left) and Northern Section (right) (Source: Nearmap, PSA)

## Berry St

Berry St is a four lane, one-way road and is the principle avenue into the North Sydney CBD. The street frontage consists predominately of entrances to commercial towers, with some restaurants. For the purpose of this analysis, Berry St has been divided into two sections. The western section extends from the Pacific Hwy in the west to Miller St in the east. The eastern section extends from Miller St in the west to Walker St in the east.

The western section is relatively free of obstructions, with both footpaths having an effective width of 3m.

Based on a predicted pedestrian load of 1000 pedestrians per peak hour, this section has an LOS of B, and LOS of C if platooning is considered. This is well within the accepted range of performance and no action will be required.

The eastern section presents some obstructions, but both footpaths have an effective width of 3m.

Based on a predicted pedestrian load of 500 pedestrians per peak hour, this section has an LOS of A, and LOS of B if platooning is considered. This is well within the accepted range of performance and no action will be required.

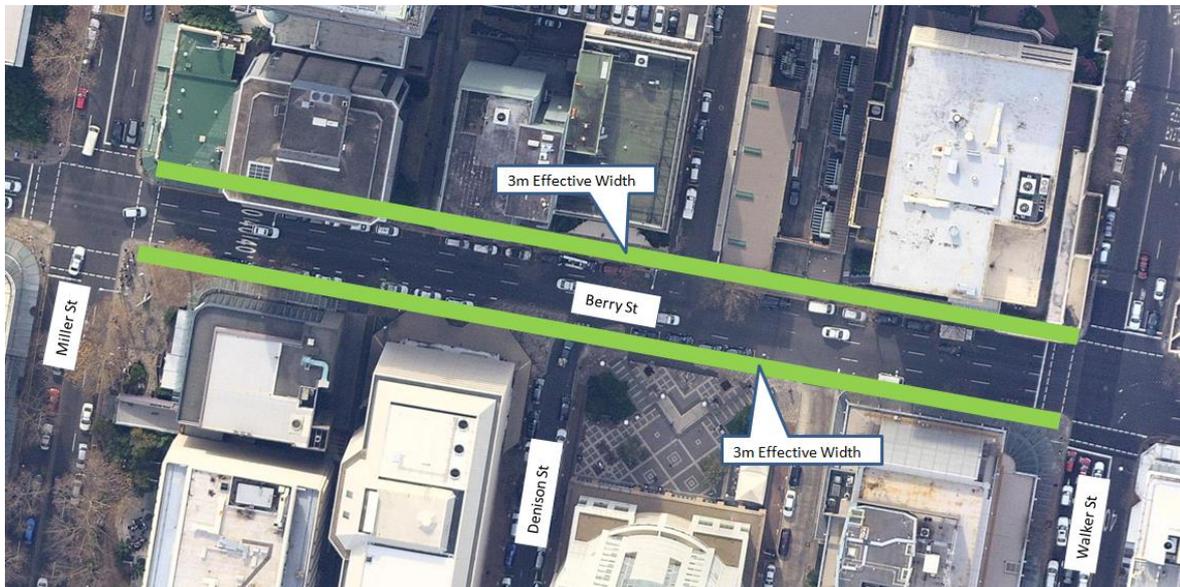


Figure 14: Berry Street LOS, Eastern Section (Source: Nearmap, PSA)



Figure 15: Berry Street LOS, Western Section (Source: Nearmap, PSA)

## APPENDIX 3: FULL EVALUATION RESULTS

AP03

Criteria	Desired Outcome	-3	-2	-1	0	1	2	3	
Safe Travel	Improve community safety by creating slow speed road environments where more vulnerable road users are protected from higher impact road users and the number of crashes and severity of injuries is minimised			Reduced road safety due to increases in onconflict in line with traffic growth	Existing 2016 - No Impact		Expanding the 40km/h speed limit area will decrease the risk of crashes and serious injuries. Removing the slip lanes at the Pacific Highway / Miller Street and Pacific Highway / Walker Street intersections mitigate a known pedestrian safety issue	Expanding the 40km/h speed limit area will decrease the risk of crashes and serious injuries. Removing the slip lanes at the Pacific Highway / Miller Street and Pacific Highway / Walker Street intersections mitigate a known pedestrian safety issue	Expanding the 40km/h speed limit area will decrease the risk of crashes and serious injuries. Removing the slip lanes at the Pacific Highway / Miller Street and Pacific Highway / Walker Street intersections mitigate a known pedestrian safety issue
	Improve personal security through improved streetscape design, increased street activity and passive surveillance			Reduced transport security as transport moves away from high volume traffic in line with traffic growth	Existing 2016 - No Impact	No Impact	Wider footpaths will lead to increased street activity and passive surveillance	Wider footpaths will lead to increased street activity and passive surveillance on the Pacific Highway. The pedestrian mall on Miller Street will also contribute to passive surveillance	Wider footpaths will lead to increased street activity and passive surveillance on the Pacific Highway. The pedestrian mall on Miller Street will also contribute to passive surveillance
Social Wellbeing	Provide social spaces where human interaction is given the highest priority and the negative impacts of traffic are minimised, promoting incidental social interaction, increasing civic pride, reducing anti-social behaviour and community policing requirements			Decreased opportunity for new public domain within the CBD	Existing 2016 - No Impact	No Impact	The changed traffic conditions on Berry Street and Miller Street will create social spaces adjacent to streets where pedestrians are given higher priority		The changed traffic conditions on Berry Street and the creation of a pedestrian mall on Miller Street, will create social spaces adjacent to streets where pedestrians are given higher priority
Active Health	Provide infrastructure that encourages healthy and active lifestyle/travel choices			Reduced active travel and associated health benefits due to growth in traffic volumes	Existing 2016 - No Impact		Reducing the speed limit to 40km/h will decrease the risk of conflicts between cyclists and motor vehicles. This will make cycling a more attractive transport mode. The addition of cycle lanes and wider footpaths south of Falcon Street will encourage active transport	Reducing the speed limit to 40km/h will decrease the risk of conflicts between cyclists and motor vehicles. This will make cycling a more attractive transport mode. The addition of cycle lanes and wider footpaths south of Falcon Street will encourage active transport	Reducing the speed limit to 40km/h will decrease the risk of conflicts between cyclists and motor vehicles. This will make cycling a more attractive transport mode. The addition of cycle lanes and wider footpaths south of Falcon Street will encourage active transport
	Reduce demand for parking and / or provide more equitable access to existing parking supply		Lowest levels of traffic congestion overall resulting in lower levels of suppressed traffic demand and less shift to from private vehicles to Metro which limits the parking demand management outcomes		Existing 2016 - No Impact		Constant review of parking management system will ensure that parking prices are fair and equitable while also ensuring that short-term parking is available	Constant review of parking management system will ensure that parking prices are fair and equitable while also ensuring that short-term parking is available	Constant review of parking management system will ensure that parking prices are fair and equitable while also ensuring that short-term parking is available
Environmental Sustainability	Encourage the use of low greenhouse gas emitting transport options		Lowest levels of traffic congestion overall resulting in lower levels of suppressed traffic demand and less shift to from private vehicles to Metro which limits the environmental benefits able to be achieved		Existing 2016 - No Impact	No Impact	The provision of footpaths and cycle lanes will encourage active transport, a low GHG transport mode		The Miller Street and Mount Street bus interchanges and the eastern and western cycling by-passes will encourage the use of sustainable transport modes
Local Environments	Encourage the use of travel modes that have minimal impact on air quality, water quality and noise		Lowest levels of traffic congestion overall resulting in lower levels of suppressed traffic demand and less shift to from private vehicles to Metro which limits the environmental benefits able to be achieved		Existing 2016 - No Impact	No Impact	Footpaths and cycle lanes promote active transport and bus infrastructure promotes public transport, both of which have a minimal impact on air and water quality		The significant improvements to active and public transport promotes the use of these environmentally friendly modes
Transport Affordability	Encourage the use of travel options with lower social, health and economic costs and higher social, health and economic benefits		Higher costs as a result of increased parking demand and environmental impacts without corresponding safety and amenity benefits		Existing 2016 - No Impact	No Impact		Centrally aligned BRT stops will promote the shift to public transport. The Miller Street bus interchange will promote a shift to public transport	The Miller Street and Mount Street bus interchanges will promote a shift to public transport. Centrally aligned BRT stops will promote the shift to public transport
Congestion	Apply travel demand management principles to minimise traffic demand and associated traffic congestion				Existing 2016 - No Impact		Significant queuing around the Pacific Highway Right Turns, however the least amount of congestion overall	The parking management system uses travel demand management to develop new rates and restrictions to parking such that there is no net increase in traffic generation. Modifications to the Pacific Highway / Walker Street and Pacific Highway / Berry Street will improve the flow of traffic in the CBD. The northern and southern traffic by-passes will reduce traffic volumes and congestion in the CBD.	The realisation of the Northern and Southern Traffic By-passes, in conjunction with parking management and improved intersection operations will drastically improve the flow of traffic in the CBD and reduce congestion. However, the closure of Walker Street reduces the number of north-south movements and therefore reduces the ability for vehicles to move around the CBD.
	Increase business opportunities by improving the look/ amenity of North Sydney throughout the day and in to the evening while, at the same time, reducing the whole of life cost of transport networks, including the ongoing costs associated with cleaning and maintaining assets			Poor business outcomes as the CBD becomes less attractive in line with traffic growth	Existing 2016 - No Impact			The changed traffic conditions on Berry Street and Miller Street will improve the amenity of these streets and facilitate their shift from links to places.	The changed traffic conditions on Berry Street and the creation of the Miller Street pedestrian mall will improve the amenity of these streets and facilitate their shift from links to places.

LEGEND:

Base Case (2016)
Base Case (2036)
Minimal Intervention Scenario (2036)
Miller Street Bus Interchange Scenario (2036)
Miller Street Plaza Scenario (2036)
Miller Street and Walker Street Plaza Scenario (2036)

## Attachment 2

### Options Analysis

#### 1. Sydney Transport Strategy's Transport Planning and Management Decision Matrix

An outline of the multi-criteria assessment for all *Masterplan* options, based on the *North Sydney Transport Strategy's Transport Planning and Management Decision Matrix* (Section 7.4), is provided below. Table 1 summarises the detailed discussion which follows.

Community Transport Priorities/ Masterplan Options	Safe Travel	Transport Security	Social Well-being	Active Health	Fair Access to Parking	Environmental Sustainability	Local Environments	Transport Affordability	Congestion	Business Activity	Overall Rating
NSTS Priority Rating	0.81	0.81	0.65	0.65	0.59	0.56	0.56	0.51	0.44	0.38	
<b>Present (2014)</b>	0	0	0	0	0	0	0	0	0	0	0
<b>Do Nothing (2036)</b>	-0.81	-0.81	-0.65	-0.65	-1.18	-1.12	-1.12	-1.02	0.44	-0.38	-7.3
<b>Minimal Interventions</b>	0.81	0	0	0.65	1.18	0	0	0	0.88	0.38	3.9
<b>Miller Street Bus Interchange</b>	1.62	0.81	1.3	1.3	1.18	0.56	0.56	1.02	0.88	0.76	9.99
<b>Miller Street Plaza</b>	1.62	1.62	1.95	1.95	1.18	1.68	1.12	1.53	1.32	1.14	15.11
<b>Miller Street and Walker Street Plaza</b>	1.62	1.62	1.95	1.95	1.18	1.68	1.12	1.53	0.44	0.38	13.47

Table 1: NSTS Combined Multi-criteria assessment results

#### 1.1 Detailed Discussion Multi Criteria Assessment Results

##### 1.1.1 Safe Travel

- “Do Nothing” and “Minimal Intervention” scenarios result in reduced road safety due to increases in conflict in line with pedestrian growth.
- The “Miller Street Bus Interchange” off-sets some of these poorer safety outcomes by reducing the impact of general traffic on pedestrians in Miller Street.
- The “Miller Street Pedestrian Mall” and the “Miller Street & Walker Street Pedestrian Mall” options result in greater safety benefits due to the separation of pedestrians, buses and general traffic within the proposed pedestrian mall/s.

### 1.1.2 Transport Security

- “Do Nothing” and “Minimal Intervention” scenarios result in reduced transport security as pedestrian activity moves away from more heavily trafficked streets.
- The “Miller Street Bus Interchange” option accommodates high levels of activity in Miller Street: walk only (7%), Rail (60%) and bus (8%) journeys but with limited opportunities for public domain improvements.
- The “Miller Street Pedestrian Mall” option results in less activity in Miller Street than the “Miller Street Bus Interchange” option: walk only (7%), Rail (60%).
- The “Miller Street & Walker Street Pedestrian Mall” splits activity, potentially too thinly, between the two new pedestrian malls.

### 1.1.3 Social Well-being

- “Do Nothing” and “Minimal Intervention” scenarios result in no opportunity for new public domain (social infrastructure) within the CBD.
- The “Miller Street Bus Interchange” offers limited opportunity for public domain (+900m<sup>2</sup>) improvements on Miller Street.
- The “Miller Street Pedestrian Mall” and the “Miller Street & Walker Street Pedestrian Mall” options provide greater public domain opportunities (3,000m<sup>2</sup> and 4,200m<sup>2</sup> respectively).

### 1.1.4 Active Health

- “Do Nothing” and “Minimal Intervention” scenarios do little to support increases in active travel (health) associated with Metro mode shift.
- The “Miller Street Bus Interchange” off-sets some of these poorer outcomes by reducing the impact of general traffic on Miller Street.
- The “Miller Street Pedestrian Mall” and the “Miller Street & Walker Street Pedestrian Mall” support active travel by separating pedestrians, buses and general traffic within the proposed pedestrian mall/s.

### 1.1.5 Fair Access to Parking

- In all scenarios, parking demand falls in line with Metro mode shift (-11%).
- The “Do Nothing” allows unlocked traffic demand to flow back in to the system by not “locking in” the parking/traffic demand management benefits of Metro mode shift.
- Significant traffic congestion associated with the “Minimal Intervention” scenario, particularly in the AM peak, result in high levels of suppressed traffic demand, increased private vehicle to Metro mode shift and improve parking demand management outcomes.
- The “Miller Street Bus Interchange” and the “Miller Street Pedestrian Mall” options result in similar levels of traffic congestion/suppressed traffic demand as the “Do Nothing” scenario in the short term, but “lock in” the traffic demand management benefits of Metro, ensuring that induced traffic demand does not expand to fill released capacity.
- The “Miller Street & Walker Street Pedestrian Mall” option results in similar levels of traffic congestion and suppressed traffic demand as the minimal intervention scenario, resulting in improved parking demand management outcomes.

### **1.1.6 Environmental Sustainability**

- In all scenarios, increased greenhouse gas emissions associated with congestion are partially off-set by the impact of congestion on traffic demand and Metro mode shift.
- The “Do Nothing” scenario creates the lowest levels of traffic congestion, lowest levels of suppressed traffic demand, lowest levels of private vehicle to Metro mode shift, resulting in the reduced emissions associated with congestion and increased emissions associated with lower levels of Metro mode shift.
- Significant traffic congestion, particularly in the AM peak, associated with the “Minimal Intervention” scenario results in high levels of suppressed traffic demand, increased private vehicle to Metro mode shift resulting in the increased emissions associated with congestion and reduced emissions associated with higher levels of Metro mode shift.
- The “Miller Street Bus Interchange” and the “Miller Street Pedestrian Mall” options result in similar levels of traffic congestion, suppressed traffic demand and environmental outcomes as the “Do Nothing” scenario.
- The “Miller Street & Walker Street Pedestrian Mall” option results in similar levels of traffic congestion, suppressed traffic demand and environmental outcomes as the minimal intervention scenario.

### **1.1.7 Local Environments**

- Congestion has more direct impacts on localised outcomes, with limited opportunity to justify increased traffic demand management/Metro mode shift outcomes against poorer air quality, water quality and noise. However, road design does have an impact on how particulate emissions and noise effect the CBD.
- Significant traffic congestion under the “Minimal Intervention” scenario is concentrated in the Berry Street corridor where narrower road cross-sections result in increased containment of particulate pollution and noise within the built form. This results in significantly poorer place making outcomes in Berry Street.
- The “Miller Street Bus Interchange”, “Miller Street Pedestrian Mall” and “Miller Street & Walker Street Pedestrian Mall” options all result in significant transfer of traffic from Berry Street to the Pacific Highway. The Pacific Highway’s much wider cross-section allows for improved dispersal of particulate emissions and noise.

### **1.1.8 Transport Affordability**

- The “Do Nothing” option results in higher costs in terms of increased parking demand and environmental impacts with no corresponding safety and amenity benefits.
- The “Minimal Intervention” option results in high costs in terms of increased congestion with minimal corresponding safety and amenity benefits.
- The “Miller Street Bus Interchange” option results in similar congestion costs to the “Do Nothing” option, higher parking and environmental costs and limited safety and amenity benefits.
- The “Miller Street Pedestrian Mall” option results in similar congestion costs to the “Do Nothing” option, higher costs in terms of increased parking demand and environmental impacts, but significant safety and amenity benefits associated with the separation of pedestrians, buses and general traffic within the proposed pedestrian mall.
- The “Miller Street & Walker Street Pedestrian Mall” option results in high costs in terms of increased congestion but significant safety and amenity benefits associated with the separation of pedestrians, buses and general traffic within the proposed pedestrian malls.

### 1.1.9 Congestion

- In all scenarios, traffic demand falls in line with Metro mode shift.
- The “Do Nothing” scenario results in reduced traffic congestion (-11%) and similar traffic distributions to existing network operations.
- The “Minimal Intervention” option (turn ban from the Pacific Highway in to Miller Street) results in significant weaving and queueing at remaining Pacific Highway right turn lanes. Resulting traffic suppression is high compared to the “Do Nothing” scenario.
- Although additional right turn bans at Walker Street and Berry Street improve traffic capacity on the Pacific Highway, the “Miller Street Bus Interchange Scenario” does not significantly reduce signal time requirements for the Pacific Highway/Miller Street intersection, which need to be maintained for the pedestrian crossing phase and bus movements to and from the northern leg of the intersection.
- The “Miller Street Pedestrian Mall” and associated Pacific Highway right turn bans result in the lowest increase in queue times across the CBD and related traffic suppression compared to the “Do Nothing” scenario.
- The “Miller Street and Walker Street Pedestrian Mall” option increases queue times to similar levels as the minimal intervention scenario due to local traffic being forced to use Berry Street/Pacific Highway to join the Warringah Freeway southbound rather than using the southern end of Walker Street.

### 1.1.10 Business Activity

- “Do Nothing” and “Minimal Intervention” scenarios result in poorer business outcomes as the CBD becomes less attractive in line with pedestrian growth and increased pedestrian/traffic conflict.
- The “Miller Street Bus Interchange” off-sets some of these poorer outcomes by reducing the impact of general traffic and increasing opportunities for new businesses on Miller Street.
- The “Miller Street Pedestrian Mall” and the “Miller Street & Walker Street Pedestrian Mall” options provide scaled opportunities to meet the public domain expectations of knowledge economy workforces/businesses.

## 2 Traffic Modelling

Traffic modelling was a key component of the Masterplan analysis, whereby different options were tested in terms of their impact on road traffic network, speeds, delays and congestion

	AM peak						PM Peak					
	Average Delay (s)	Average No. of Stops	Average Speed (km/h)	Total Distance Travelled (km)	Total Time Travelled (s)	Suppressed Demand (vehicles)	Average Delay (s)	Average No. of Stops	Average Speed (km/h)	Total Distance Travelled (km)	Total Time Travelled (s)	Suppressed Demand (vehicles)
<i>Options</i>												
<b>Do Nothing</b>	90	2.1	16.1	41,950	9,381,926	570	85	2	16.7	41,448	8,952,135	588
<b>Minimal Intervention</b>	193	3.1	8.1	30,865	13,674,443	6,815	91	2.1	16.1	41,476	9,266,978	680
<b>Miller Street Bus Interchange</b>	104	2.1	15.4	42,628	9,996,668	764	111	2.2	15	42,770	10,298,517	794
<b>Miller Street Plaza</b>	98	2	16	43,143	9,704,297	554	111	2.2	14.9	42,738	10,334,207	675
<b>Miller Street and Walker Street Plaza</b>	103	2.2	15.4	42,922	10,054,741	909	131	2.7	13	40,484	11,204,777	2,351

**Table 2:** Traffic Modelling Results

Option	NSTS Score	Suppressed Demand (Congestion)	Comment	Recommendation
<b>Do Nothing</b>	-7.3	AM: 570 vehicles PM: 588 vehicles	<ul style="list-style-type: none"> <li>declining safety and amenity</li> <li>reduced congestion</li> </ul>	Not Recommended
<b>Minimalist Interventions</b>	3.9	AM: 1096% PM: 16%	<ul style="list-style-type: none"> <li>marginal safety and amenity benefits</li> <li>significantly increased congestion</li> </ul>	Not Recommended
<b>Miller Street Bus Interchange</b>	9.99	AM: 34% PM: 35%	<ul style="list-style-type: none"> <li>safety and amenity benefits</li> <li>some increase in congestion</li> </ul>	Possible interim treatment during Metro construction
<b>Miller Street Plaza</b>	15.11	AM: -3% PM: 15%	<ul style="list-style-type: none"> <li>significant safety and amenity benefits</li> <li>marginally increased congestion</li> </ul>	Delivery in line with Victoria Cross Station Metro to maximise the health, social and economic benefits of Metro.
<b>Miller Street and Walker Street Plaza</b>	13.47	AM: 59% PM: 300%	<ul style="list-style-type: none"> <li>significant safety and amenity benefits</li> <li>significantly increased congestion</li> </ul>	Not Recommended (at this time)

**Table 3:** Combined MCA and Traffic Modelling Results

Whilst the “Do Nothing” option has positive traffic network operations benefits due to falling traffic demand associated with Metro mode shift, this option offers the worst possible outcomes for CBD safety and amenity (as per Section 5).

The Miller Street Plaza option offers a balance between the best possible safety and amenity outcomes for the CBD and the second best traffic operations outcomes, particularly as it affects AM peak traffic operations.

The “Miller Street Bus Interchange” and “Miller Street Pedestrian Plaza” options were found to result in marginal increases in traffic congestion compared to the “Do Nothing” option. In order to deliver either of these options, significant traffic interventions and changes are required on the Pacific Highway, Warringah Freeway corridor and Berry Street. Significantly greater public domain, pedestrian and Metro passenger safety/amenity benefits makes the “Miller Street Pedestrian Plaza” a better option when assessed using the full suite of *NSTS* assessment criteria. As such, this report recommends that this option be endorsed as the basis for further consultation with TfNSW/RMS and further development as part of the North Sydney CBD Public Domain Strategy.