City of Hobart

Davey and Macquarie Streets Options Review

July 2018

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Appendix A – Range of Potential Treatments

1. Introduction

GHD was engaged by the City of Hobart, in collaboration with the Department of State Growth, to review opportunities for providing bus priority and other improvements for the Macquarie Street and Davey Street corridor through the Hobart CBD.

The project has involved a review of previous studies and investigations, as well as the strategic context in which this corridor sits.

A workshop was held with officers from the City of Hobart and Department of State Growth to facilitate a shared understanding of:

- The existing conditions in the corridor;
- The physical and operational constraints that apply to any changes to the corridor; and
- To discuss a Road User Hierarchy, which was used to identify potential conflict points where the operational needs of one mode might be in opposition to the operational needs of another mode.

Various potential options have been identified for improving bus priority and reliability, including improving priority for the different travel modes which could have flow on effects to buses. Potential implications on other modes are also identified to provide context to what it will mean to all users to include bus priority on Davey and Macquarie.

1.1 Purpose of this report

The purpose of this report is to summarise previous work relating to the Macquarie Street / Davey Street corridor, to develop strategic objective for the management of various user groups in the corridor, and to identify a range of options for providing bus priority and otherwise managing travel demand by various modes in light of the opportunities and constraints that exist.

2. Background and Strategic Context

There are a number of strategic planning documents that have been prepared by State and Local Government in recent years that provide relevant background for this project. A summary of key documents is provided below.

Hobart Principal Bicycle Network (2008)

Hobart City Council endorsed the Principal Bicycle Network in April 2008. Included in the plan were proposed on-road routes on Macquarie Street, Davey Street and Collins Street.

These routes are also identified in the State Government's Principal Urban Cycling Network for Hobart (2011).

Sustainable Transport Strategy 2009-2014 (2009)

The Sustainable Transport Strategy 2009-2014 was adopted in-principle by Hobart City Council in 2009, and is underpinned by a vision for a less car dependent, emission reduced, more equitable and cheaper transport system for Hobart's residents and visitors. The Sustainable Transport Strategy nominated seven goals:

A. Provide high quality Sustainable Transport Infrastructure;

B. Educate staff, residents and visitors about Sustainable Transport for Hobart;

C. Increase take-up of Sustainable Transport Options and arrest growth in vehicle numbers on key arterial roads;

D. Manage parking supply to promote and support Sustainable Transport;

E. Promote Integrated Land Use and Transport Planning;

F. Create an appropriate forum for Greater Hobart Councils to pursue Sustainable Transport opportunities; and

G. Pursue policy and institutional reforms within the Council and the State Government.

One of the actions identified in the Strategy was the creation of a morning peak hour bus and bike lane on Macquarie Street.

The City of Hobart has prepared an updated draft Transport Strategy (which incorporates Sustainable Transport actions) which is yet to be considered by the Council.

Southern Integrated Transport Plan (2010)

In this plan, released by the Department of Infrastructure, Energy and Resources in 2010, Macquarie / Davey Streets are highlighted as one of "four key metropolitan links" in the freight and passenger network.

One of the identified actions was to "investigate and implement, if feasible, extension of the Southern Outlet Bus Lane through Macquarie Street".

Congestion in Greater Hobart (2011)

This document outlines the Department of Infrastructure, Energy and Resources' approach to congestion in Hobart. Projects identified included:

- Southern Outlet bus lane;
- Macquarie Street clearway; and
- Upgrade of Macquarie Street / Southern Outlet junction.

Inner City Action Plan (2012)

The Inner City Action Plan, prepared by the City of Hobart, provides considerations and recommendations of actions arising from the report by Gehl Architects “Hobart 2010 – Public Spaces and Public Life: A city with People in Mind”. Of the 15 priority projects identified, the following are relevant to the Macquarie Street / Davey Street corridor:

AP02 – redesigning the bus mall – Collins Street to Macquarie Street

AP03 – pedestrian and cyclist access – Lower Elizabeth Street

Positive Provision Policy for Cycling Infrastructure: Mainstreaming the Provision of Cycling Facilities as Part of Transport Projects and Maintenance of Cycling Space (2013)

This policy from the Department of Infrastructure, Energy and Resources provides a tool for ensuring that making provision for cycling is considered and objectively evaluated at the commencement of scoping of State Government transport projects.

Key elements include:

- Where the State Government undertakes major projects on the Principal Urban Cycling Networks, provision will be made for cycling;
- Where the State Government undertakes road upgrades or improvements on routes identified on the Principal Urban Cycling Networks, provision will be made for cycling if the upgrade involves road widening, lane duplication and lane widening; and
- Decisions not to provide for cycling in these cases require approval from the Department executive.

Hobart Capital City Strategic Plan 2015-2025 (2015)

Relevant strategic objectives from Council’s strategic plan include:

- Vibrant City Centre and suburban precincts;
- A fully accessible and connected city environment;
  - Infrastructure improvements to enhance road safety;
  - Support use of public transport;
  - Implement Principal Bicycle Network;
  - Review network operation of city streets and adopt a network operating plan; and
- A people-focussed city with well-design and well managed urban and recreational spaces.

Southern Tasmania Regional Land Use Strategy (2016)

Released by the State Government, the Southern Tasmania Regional Land Use Strategy outlines, amongst other things, how urban development will be managed in Greater Hobart. Relevant features include:

- Strategic Direction – integrated approach to planning and infrastructure
  - New development should make use of existing capacity
- Strategic Direction – Network of vibrant and attractive activity centres
  - Provide greater opportunities for integrating land use with transport
- Focus areas
  - Public transport corridors for reliability and frequency
  - Improve walking and cycling infrastructure and linkages
  - Address car parking as a key determinant of car based travel
  - Increasing residential densities around designated transit corridors
  - Consolidating residential development in rural areas into key settlements

Growth areas that would potentially feed traffic demand on Macquarie Street and Davey Street are shown in Figure 2.1.

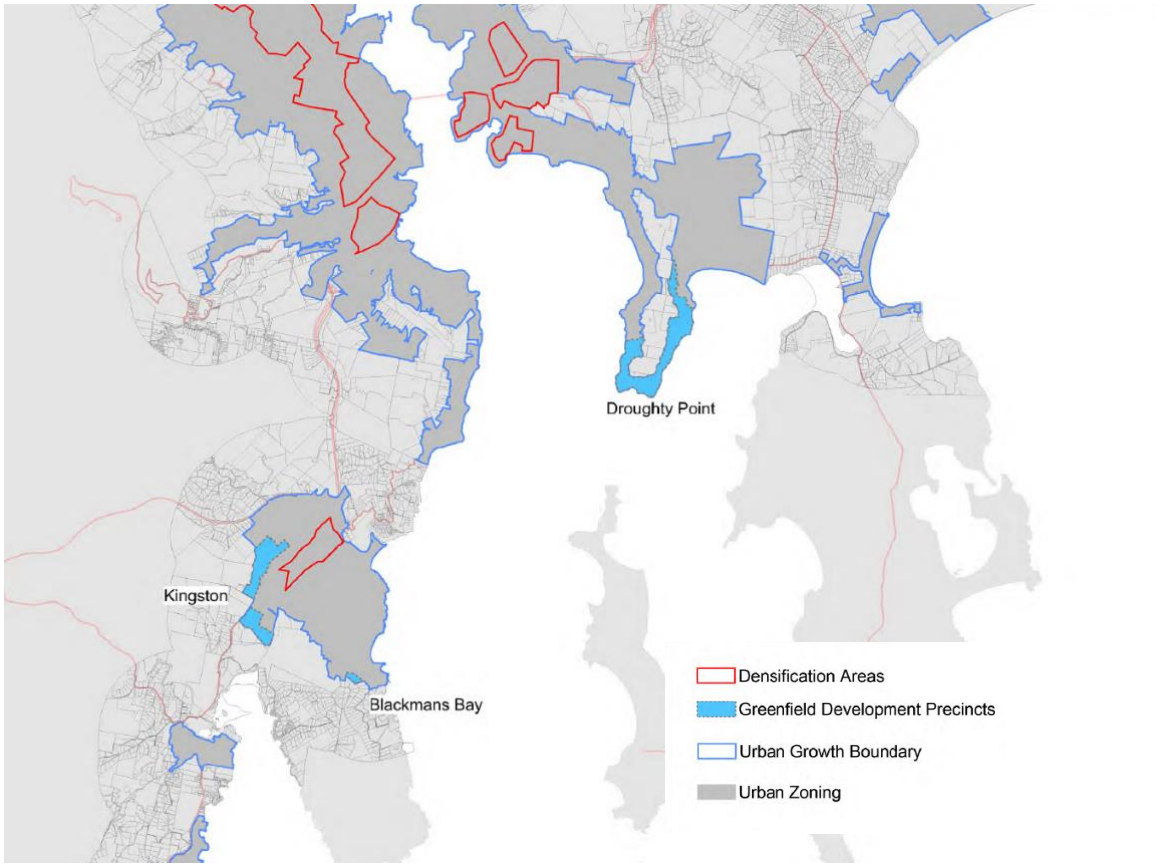


Figure 2.1 Urban Growth Areas (Southern Tasmania Regional Land Use Strategy

Hobart Traffic Congestion Traffic Analysis (2016)

This report was prepared by the Department of State Growth in response to unusual congestion events which occurred during February and March 2016. It found that Macquarie Street recorded the most significant impacts associated with heavy congestion, and that evening peak hour throughput reduced compared to previous years.

Recommendations included:

- Extend existing and create new clearways to reduce side friction and increase storage for turning vehicles;
- Removal of pedestrian crossings at key conflict points to reduce vehicle delays; and
- Review CBD access routes.

City to Cove (2017)

City of Hobart commissioned this review of pedestrian connectivity between the CBD and the waterfront. Various potential treatment concepts were investigated, including grade separated facilities, footpath widening, and other treatments. Key findings included:

- Providing an accessible path of travel is a particular challenge in this location, due to existing gradients, particularly on Murray Street;
- There may be opportunity to take advantage of the grade difference between Morrison Street and Davey Street by providing a pedestrian tunnel to connect between Brooke Street and Franklin Square (subject to further investigation);
- Lowering of Elizabeth Street under Macquarie Street was also identified, either for buses, pedestrians and cyclists, or pedestrians and cyclists only; and
- Lowering of Macquarie Street was not considered feasible, due to the short block lengths and downhill gradient at the northern end of Macquarie Street.

Hobart Traffic Origin-Destination Report (2017)

Analysis of origin-destination survey data (collected in May 2016) by the Department of State Growth, indicates that during the weekday peak periods, most trips are to, rather than through, the city (see further discussion in Section 3.4.2).

Hobart Transport Vision (2018)

Key elements of the vision, released by Infrastructure Tasmania, include:

- Macquarie Street transit priority;
- Davey Street prioritised to minimise delays for through traffic;
- Improve pedestrian and cycle access between city and waterfront;
- Macquarie Street transit priority lanes;
- Grade separation of junctions (e.g. Elizabeth Street);
- Underground transit centre; and
- Use of ITS to manage the network.

3. Existing Conditions

3.1 Physical Description

Macquarie Street and Davey Street form a one-way pair, running from the south-west to the north-east, through the Hobart CBD. They form the major road connection between the suburbs and towns south of Hobart with the remainder of Tasmania. In the absence of alternative routes (the best potential alternative, Sandy Bay Road, also accesses onto Macquarie and Davey Streets) they therefore they have a critical access and through traffic function.

There are 10 major blocks along each corridor within the study area, with traffic signal control at all major intersections.

Typical cross section elements are shown in Figure 3.1 (mid-block sections) and Figure 3.2 (approaching intersections). Each street has 3-4 general traffic lanes, with on-street parking on both sides of the road at many locations. Turn lanes are provided at some intersections. Kerb bulbing is also in place at some intersections to increase the amount of space for pedestrians to wait when crossing the road, as well as to reduce the time required to complete the crossing.

However the road reserve width (property boundary to property boundary) varies significantly from block to block, making provision of a consistent traffic arrangement difficult. Figure 3.3 and Figure 3.4 show the variability in reserve width along the two streets. In some places the reserve width is less than 20m, while it can be as wide as 26m. As detailed in Table 3.1, by way of context, the desirable width requirements for 3 lanes of traffic would be in the order of 10.5m (3.5m per lane), with footpaths on both sides of the road (minimum width approximately 2.5m each). Additional width is required for on-street parking (approximately 2.2m per road edge, 2.5-3.0m where a bus stop is required) and/or turn lanes at intersections, creating a total required corridor width of at least 20m for a 3 lane road and 23.5m for a 4 lane road. In some parts of the corridor, particularly where pedestrian activity is high, a wider footpath may be required, requiring a wider corridor.

Table 3.1 General Lane Widths

Lane Type	General Space Requirements	Desirable Width	Notes
General Traffic	3.0-3.5m per lane	3.5m per lane	A desirable width of 3.5m is required for heavy vehicles, a narrower width has the potential for heavy vehicles to encroach on adjacent lanes
Parking	2.2m – 3.0m per lane	2.2m per lane	If a bus stop is required a width of 3m is required to allow vehicles to pass
Footpath	2.5m minimum per footpath	2.5m minimum per footpath	In areas of high pedestrian activity 2.5m may not be sufficient to allow pedestrians to be safely stored on the footpath, in such instances a wider footpath would be required.

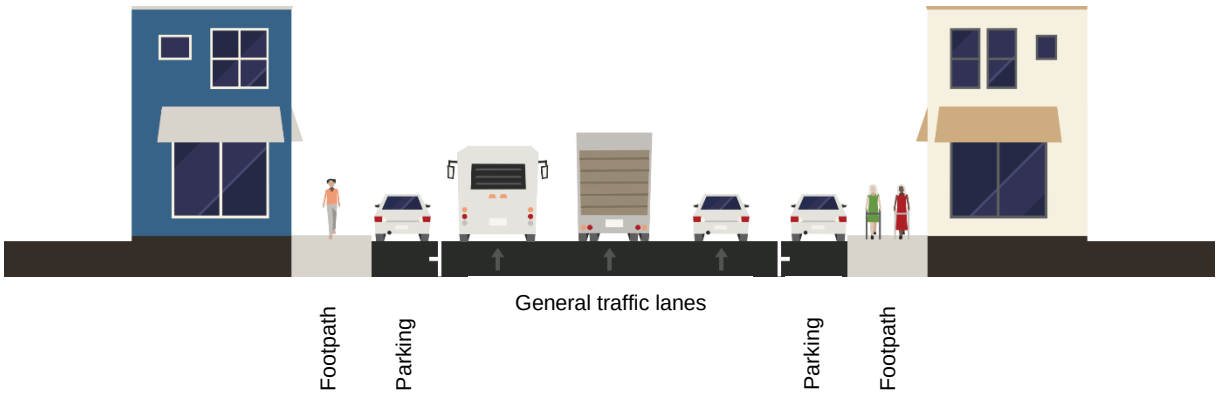
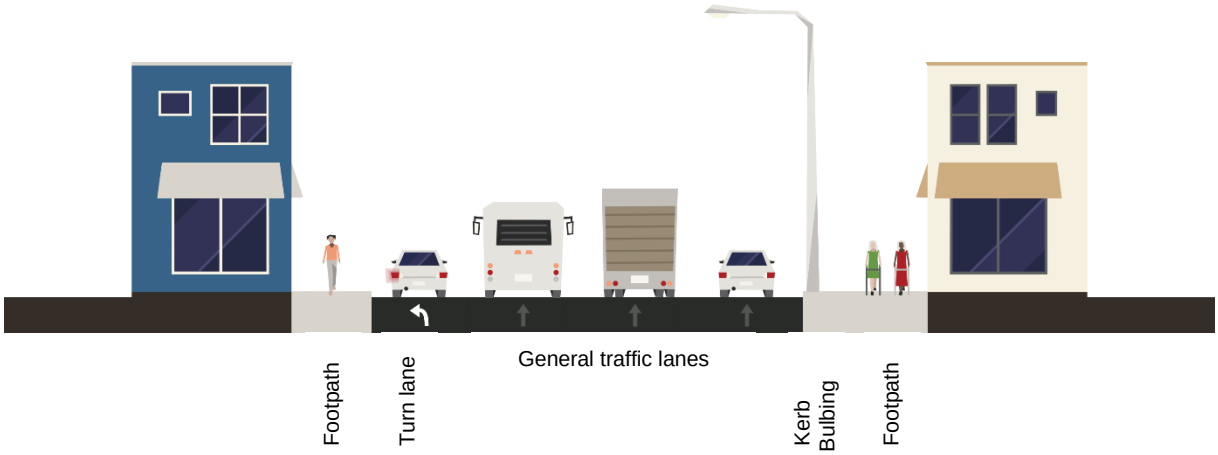


Figure 3.1 Typical Cross Section Elements – Mid-block



Left turn example shown

Figure 3.2 Typical Cross Section Elements – Approaching Intersections

In parts of the corridor, particularly at the southern end of both Macquarie and Davey Streets, the camber of the road is relatively steep and the far edges of both sides of the road may not be suitable for general traffic or buses. It is also noted that the width generally allocated to on-street parking is not sufficient to accommodate a general traffic lane. It is therefore in most cases not feasible to simply remove on-street parking in order to create an additional traffic lane while maintaining the existing lane alignment, particularly one that is wide enough to accommodate buses and/or other heavy vehicles. That said, there is potentially enough width to create an additional traffic lane if parking on both sides of the road were removed, and the alignment of the remaining lanes adjusted. However the treatment provided at intersections, especially where turn lanes are present, may mean the additional capacity cannot be maintained through the intersection. Whilst combined through and turn lanes could be considered, turning traffic could be delayed by pedestrian activity across the side road, which would reduce the capacity advantage for through traffic.

The desirable width of a traffic lane is 3.5m, which is sufficient to accommodate heavy vehicles, including trucks and buses, without encroachment into the adjacent lane. Narrower lanes may work in some circumstances, but there may be a trade-off with traffic capacity and/or safety.

Existing lanes in parts of both Macquarie and Davey Streets are in some cases significantly less than 3m wide, and this can result in capacity inefficiencies and road safety issues (particularly where narrow lanes are adjacent to on-street parking).

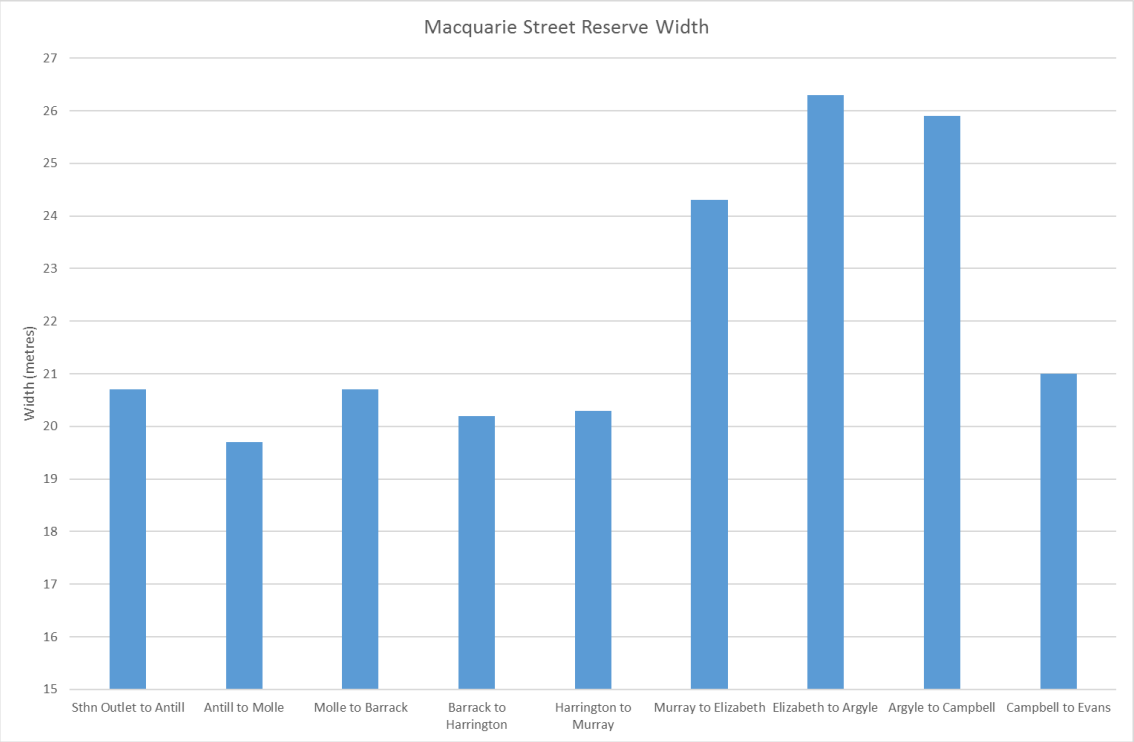


Figure 3.3 Macquarie Street Reserve Width

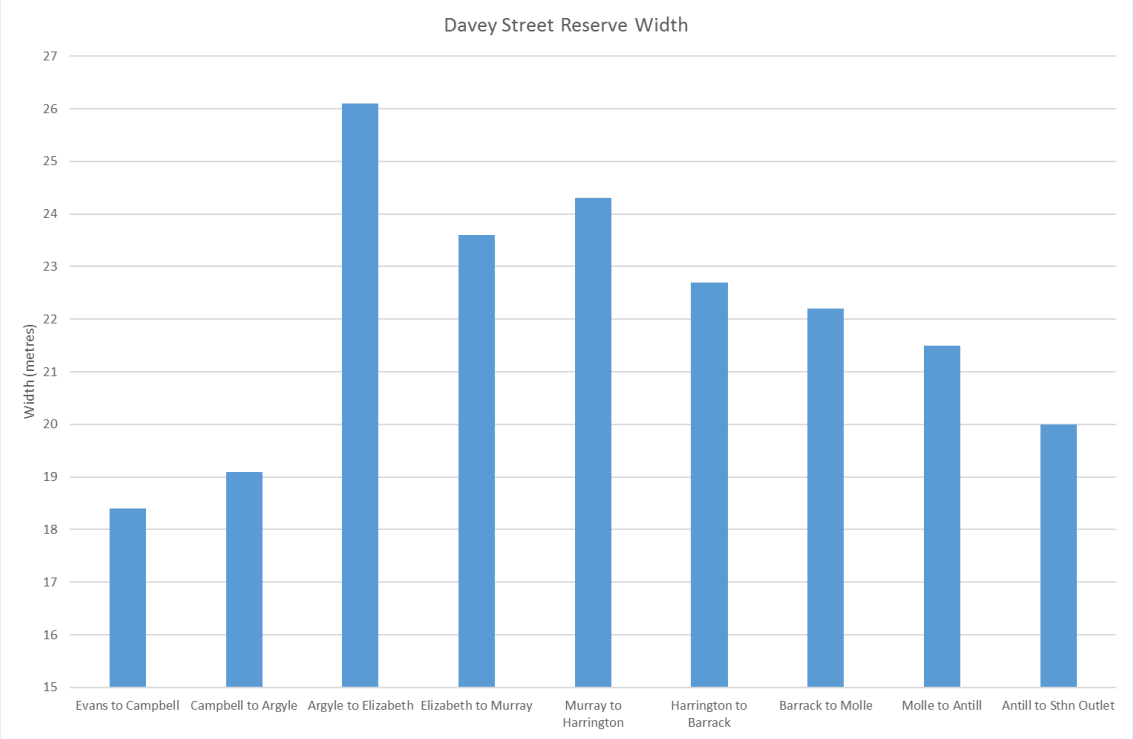


Figure 3.4 Davey Street Reserve Width

3.1.1 Clearways

At some locations along the corridor, on-street parking is prohibited at certain times of the day. Generally, this occurs on approach to intersections, where there is a high left or right turn volume and additional queuing space is required in peak periods. These locations include:

- Macquarie Street
  - Approach to Molle Street (left turn) – AM Peak
  - Approach to Harrington Street (left turn) – AM Peak
  - Approach to Murray Street (right turn) – PM Peak
- Davey Street
  - Approach to Sandy Bay Road (left turn) – AM Peak
  - Approach to Harrington Street (right turn) – AM and PM Peak
  - Approach to Southern Outlet (right turn) – PM Peak

3.2 Land Use

Land use is a key generator of travel activity, including general traffic, parking, pedestrians, public transport and cycling. Significant land uses in the study area are shown in Figure 3.5.

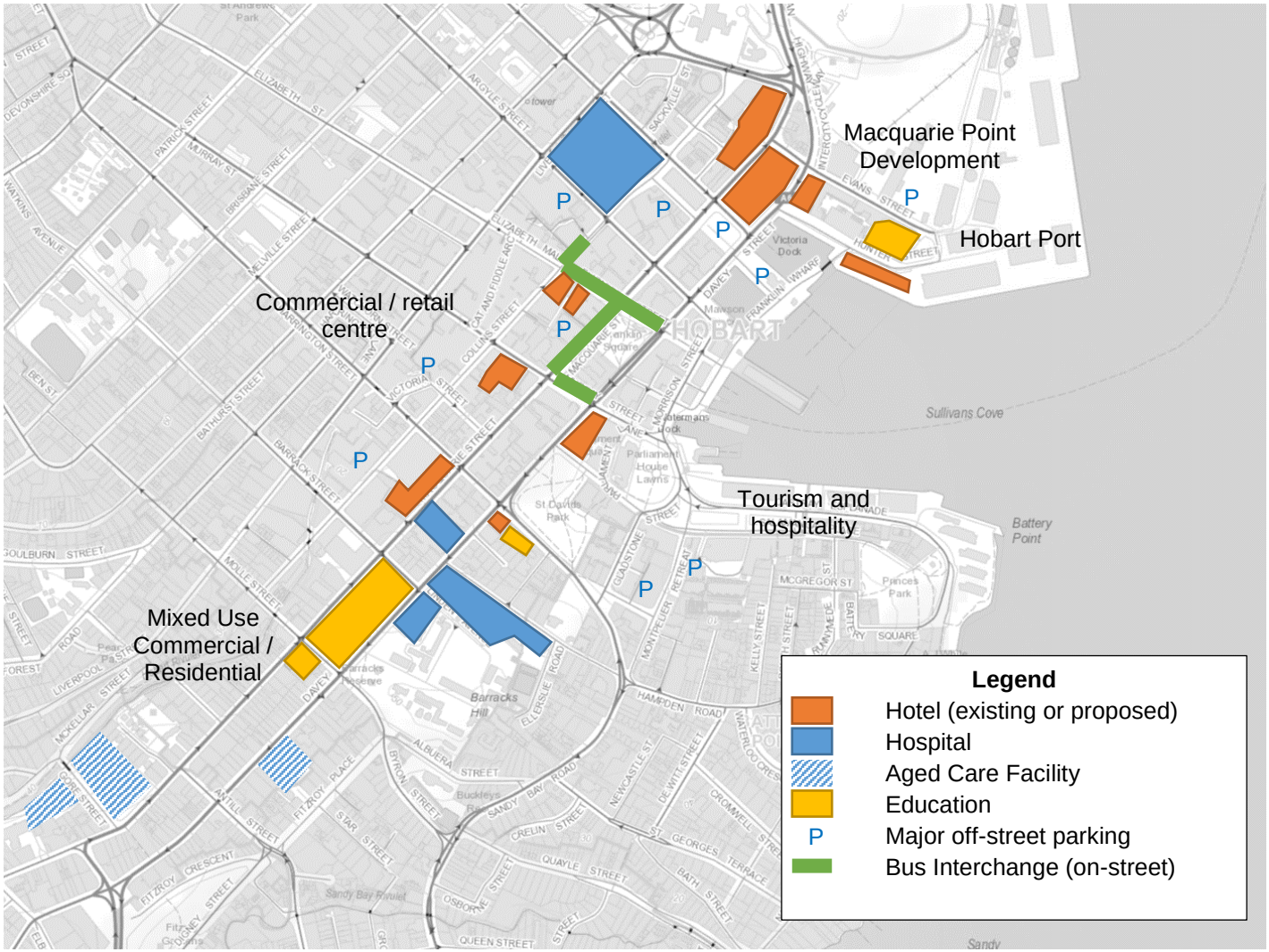


Figure 3.5 Key Land Uses

3.3 Traffic Volumes

3.3.1 Theoretical Capacity

The nominal theoretical capacity of a single lane of traffic on a major urban arterial roadway, such as Macquarie Street and Davey Street, is approximately 1,000 vehicles per hour per lane. In urban situations capacity is determined largely by the amount of green time allocated to the major road movement at traffic signals. This capacity will be reduced where there is a high volume of heavy vehicles, or where lane widths are narrow such that some vehicles may encroach into the adjacent lane.

On this basis, the nominal theoretical capacity of three traffic lanes is 3,000 vehicles per hour, and four traffic lanes is 4,000 vehicles per hour.

3.3.2 Peak Hour

Peak period traffic counts were undertaken by the Department of State Growth for intersections along the corridor in May 2016. Peak hour volumes in each block are summarised in Table 3.2 (Macquarie Street) and Table 3.3 (Davey Street). It is noted that peak hour traffic volumes on Macquarie Street and Davey Street have not, in general, grown in recent years, although daily volumes and the wider peak period volumes have increased. This is a result of peak spreading, where the duration of peak conditions increases, although the peak hour volume does not.

Table 3.2 Macquarie Street Peak Hour Volumes

Location	AM Peak Hour	PM Peak Hour
Southern Outlet (northbound)	2,828	1,704
Approaching Antill Street	2,831	1,792
Approaching Molle Street	3,261	2,171
Approaching Barrack Street	2,599	1,893
Approaching Harrington Street	2,580	1,926
Approaching Murray Street	2,448	2,115
Approaching Elizabeth Street	2,354	2,324
Approaching Argyle Street	2,395	2,360
Approaching Campbell Street	2,183	2,499
Approaching Evans Street	2,071	2,560
Approaching Tasman Highway / Brooker Highway	2,020	2,738

Table 3.3 Davey Street Peak Hour Volumes

Location	AM Peak Hour	PM Peak Hour
Approaching Evans Street	3,075	2,312
Approaching Campbell Street	2,922	2,352
Approaching Argyle Street	3,390	3,287
Approaching Elizabeth Street	3,214	3,162
Approaching Murray Street	3,049	3,044
Approaching Harrington Street	3,320	3,819
Approaching Barrack Street	2,227	3,028
Approaching Molle Street	2,984	4,109
Approaching Antill Street	2,210	3,849
Approaching Southern Outlet	1,508	3,051

Locations that are currently operating at or near their nominal capacity include:

- Macquarie Street
  - Approaching Antill Street (AM)
  - Approaching Molle Street (AM)
- Davey Street
  - Approaching Campbell Street (AM)
  - Approaching Argyle Street (AM and PM)
  - Approaching Harrington Street (PM)
  - Approaching Molle Street (PM)
  - Approaching Antill Street (PM)

3.3.3 Daily Traffic Profiles

An indication of the daily profile of activity on the corridor can be gained from examining the profile of one of the major feeder routes for the corridor, the Southern Outlet.

Figure 3.6 shows that for northbound traffic the weekday morning peak (7-9am) is significantly higher than any other time in the week. Weekend peak volumes are similar to weekday volumes outside of the peak period. Figure 3.7 shows that in the southbound direction, the profile is almost identical, but with the major peak during weekday afternoons. The afternoon peak is slightly longer than the morning peak (3 hours, compared to 2 hours in the morning), reflecting the influence of after-school traffic as well as end-of-workday traffic. These graphs indicate that capacity issues are generally isolated to the weekday AM and PM peak periods.

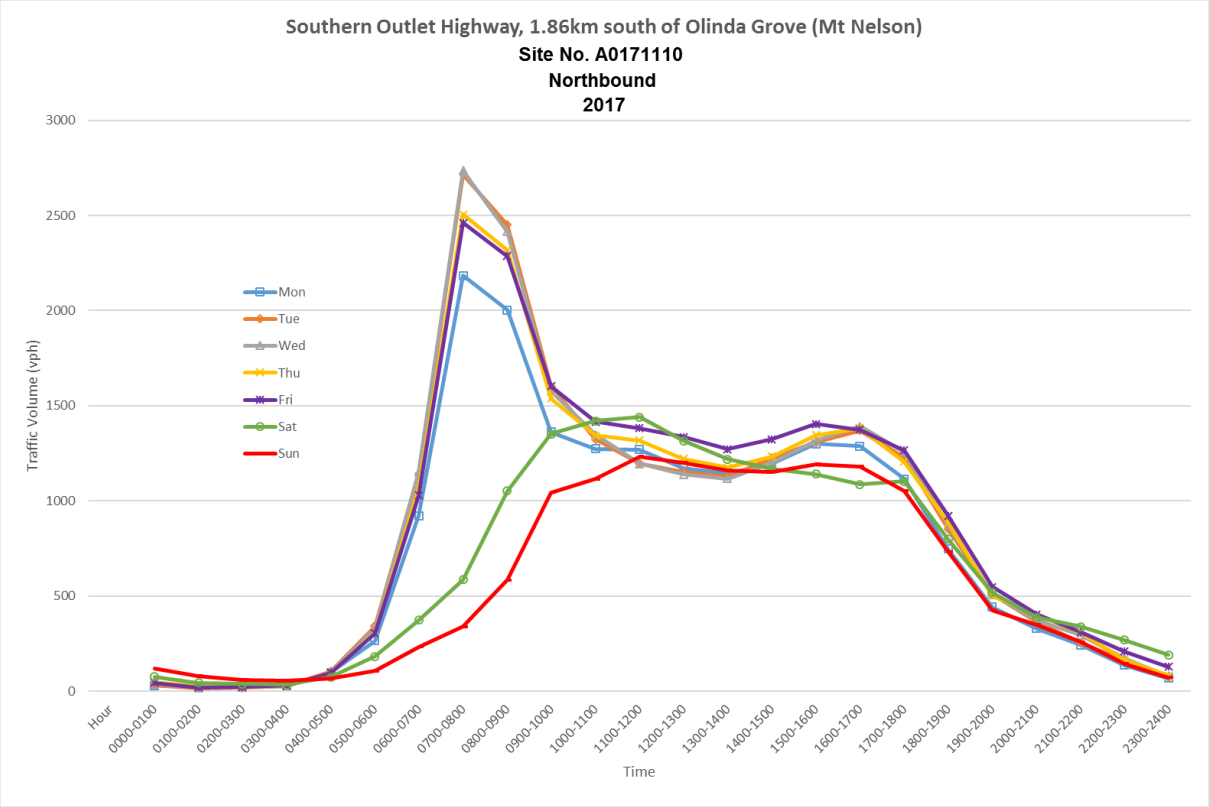


Figure 3.6 Daily Traffic Profile Southern Outlet Northbound

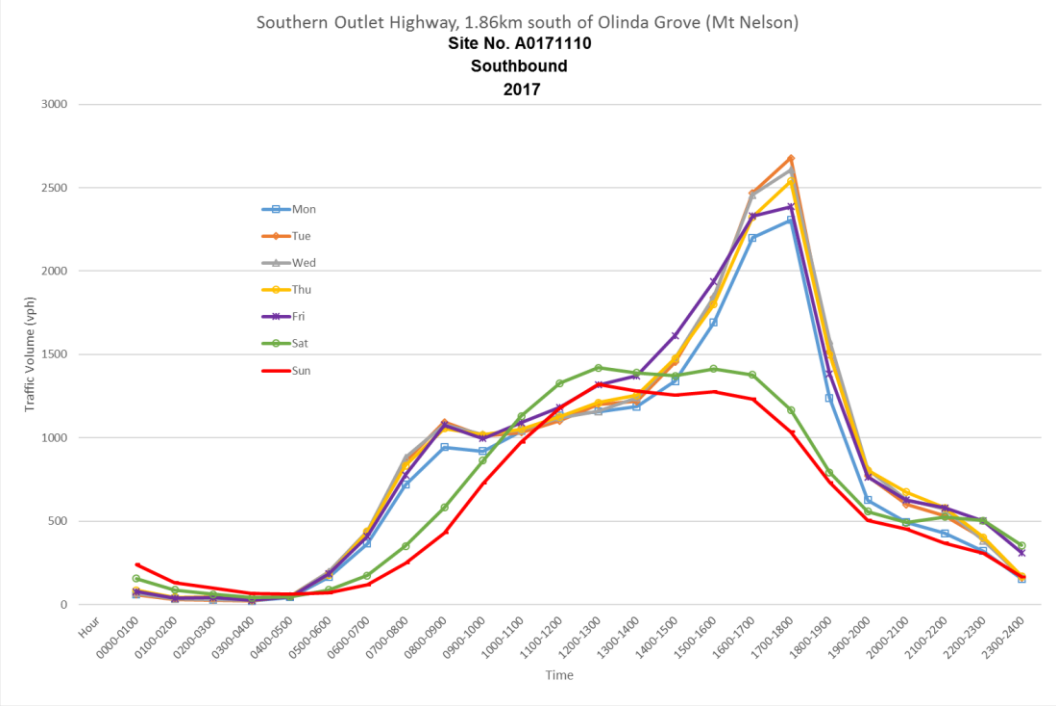


Figure 3.7 Daily Traffic Profile Southern Outlet Southbound

3.4 Origin-Destination Patterns

A survey of origins and destinations in the corridor was undertaken in 2008. Whilst a more recent survey has been undertaken in 2016, the former survey provides a more detailed view of the corridor, as it includes all of the major approaches to Macquarie and Davey Streets. The 2016 survey, by comparison, looked at a wider area around the CBD. However, where the two surveys can be directly compared, the results are generally consistent, suggesting that there has not been a major change in travel patterns.

3.4.1 2008 Survey

The results of the 2008 Origin-Destination survey are summarised in the following figures for Davey Street and Macquarie Street. Each figure shows the composition of traffic in each mid-block section of the corridor, based on the origin of that traffic. Due to the age of the data, the raw numbers have not been used, but a consistent scale has been applied to each figure, based on the northbound traffic volume on the Southern Outlet approaching Davey Street during the AM peak period.

Some key points to note from each of these figures on Macquarie Street include:

- From Figure 3.8 (Macquarie Street AM Peak)
  - At the northern end of the corridor, less than half of the traffic composition has come all the way from the Southern Outlet. It is likely that some of this traffic enters the CBD via the Brooker Highway, or accesses parking areas at the Domain.
  - The volume on the corridor increases at Antill Street, Barrack Street, and to a lesser extent Campbell Street.
  - The volume on the corridor decreases at Molle Street, Harrington Street, Murray Street and Argyle Street.
  - There is a relatively large volume entering the corridor at Barrack Street and leaving again via Harrington Street.
  - At Harrington Street, a large volume leaving Macquarie Street is replaced by a large volume joining from Sandy Bay Road. A similar effect is seen at Argyle Street.
- From Figure 3.9 (Macquarie Street PM)
  - The volume on the corridor increases at Antill Street, Barrack Street and to a lesser extent Argyle and Campbell Streets.
  - The volume on the corridor decreases at Molle Street, with minimal changes at other locations.
  - At Harrington Street, a large volume leaving Macquarie Street is replaced by a large volume joining from Sandy Bay Road. A similar effect is seen at Argyle Street.

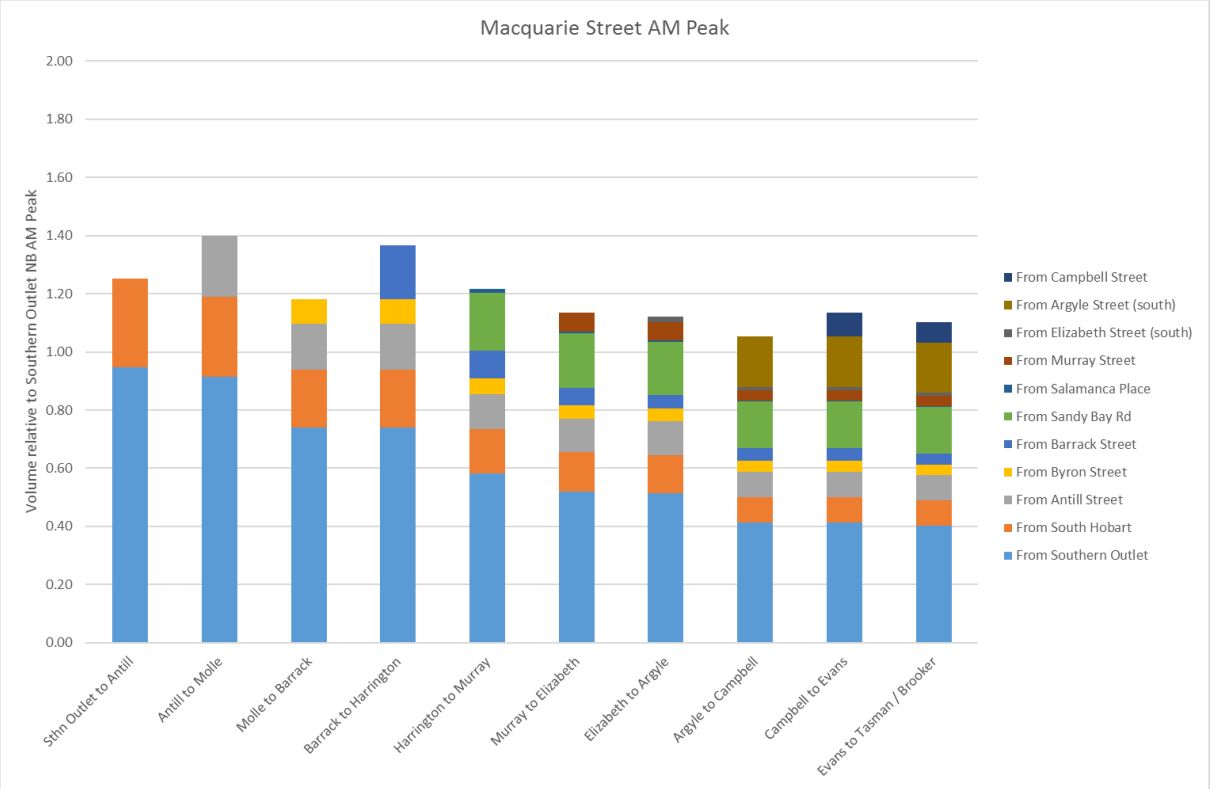


Figure 3.8 Macquarie Street AM Peak Origin-Destination Breakdown

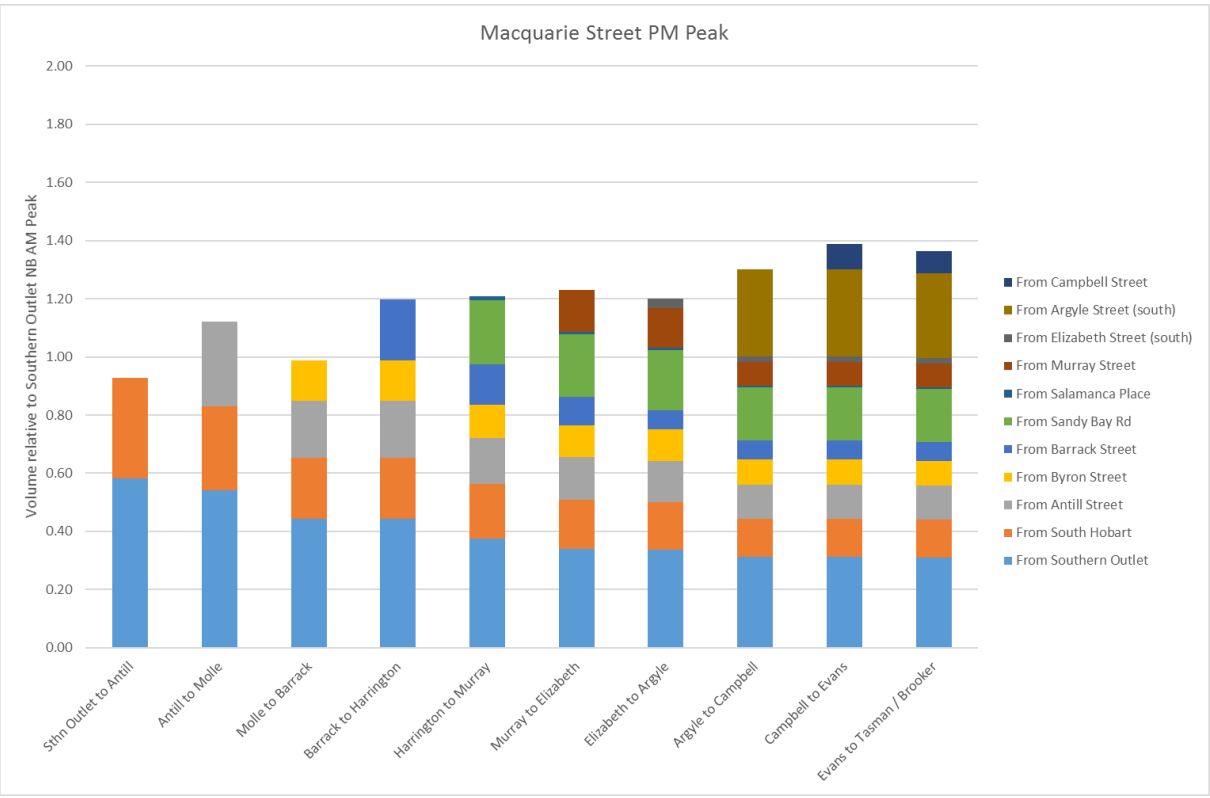


Figure 3.9 Macquarie Street PM Peak Origin-Destination Breakdown

Some key points to note from each of these figures on Davey Street include:

- From Figure 3.10 (Davey Street AM peak)
  - The volume on the corridor increases at Campbell Street, Barrack Street and to a lesser extent Murray Street.
  - The volume on the corridor decreases significantly at Sandy Bay Road / Harrington Street, and at Antill Street, with smaller decreases at Evans Street, Argyle Street, Elizabeth Street and Molle Street.

- From Figure 3.11 (Davey Street PM peak)
  - The volume on the corridor increases at Campbell Street and Murray Street, with a substantial increase at Barrack Street
  - The volume on the corridor decreases significantly at Sandy Bay Road / Harrington Street, Molle Street and Antill Street, with smaller decreases at Evans Street, Argyle Street and Elizabeth Street.

The origin-destination data shows that there is not a homogenous cohort of traffic travelling along the full length of each corridor, although there is some traffic that does this. Rather, there is significant traffic leaving and joining the corridor at various locations along its length, and the volumes carried fluctuate accordingly.

This demonstrates the difficulty of providing traffic signal coordination, and other measures focused on the improvement of the through movement along each route, even without considering technical constraints such as varying block lengths. With such a high volume of traffic turning on and off Davey and Macquarie Street along its length, there is a significant need to accommodate cross-corridor movements of traffic and pedestrians, at a similar level to which through traffic is accommodated.

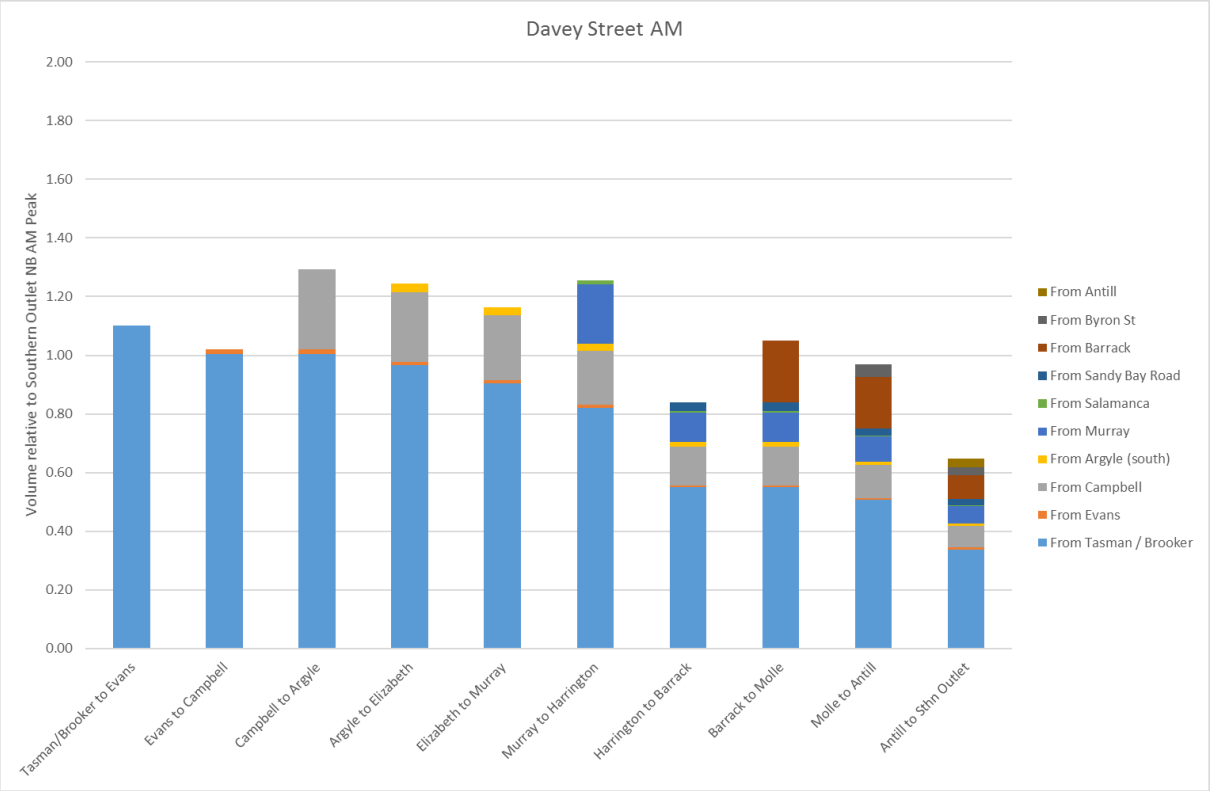


Figure 3.10 Davey Street AM Peak Origin-Destination Breakdown

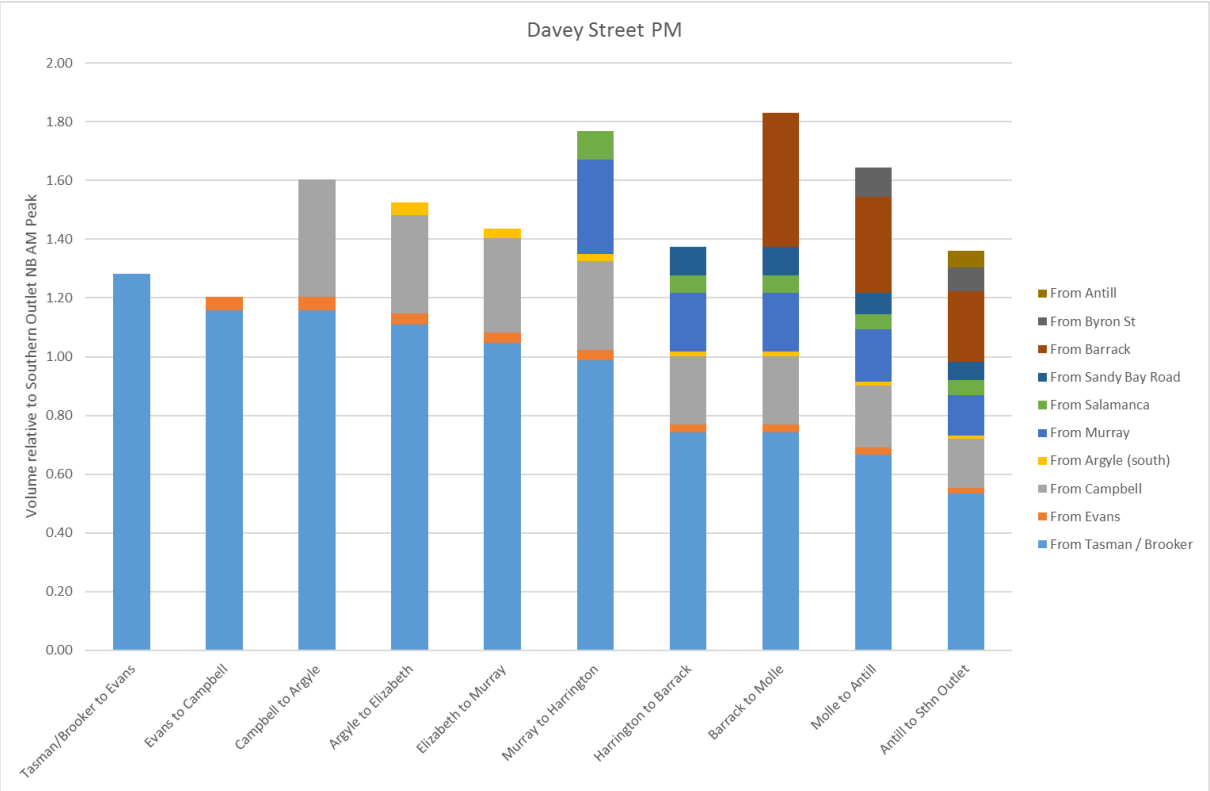


Figure 3.11 Davey Street PM Peak Origin-Destination Breakdown

3.4.2 2016 Survey

The 2016 Origin-Destination Survey looked at a wider cordon than the 2008 survey, with the area considered extending between the Tasman Bridge, the Southern Outlet, Sandy Bay Road, the Brooker Highway, New Town Road, Augusta Road and Mount Stuart Road. As such, the level of specific detail regarding Macquarie Street and Davey Street is limited. Key statistics from the survey include:

- In the morning peak period, only 17% of traffic heading towards the city on the Southern Outlet and Sandy Bay Road travelled through to the eastern shore and northern suburbs. In the afternoon peak period, 18% of traffic returning to the Southern Outlet or Sandy Bay Road came from these areas.
- Trips from the eastern shore to the southern suburbs make up only 9% of all trips crossing the Tasman Bridge in the morning peak, and 8% in the afternoon.
- Trips from the northern suburbs to the southern suburbs make up only 8% (morning) and 10% (afternoon) of trips from the northern suburbs entering the CBD area.
- The majority of trips that come into inner Hobart each morning and afternoon do not travel through the CBD, but rather stop within it.

This data confirms the general findings of the 2008 survey, with relatively low proportions of traffic travelling through the CBD. The large volumes of traffic having a destination within inner Hobart also reinforces the complexity of traffic movements in the CBD area, given the range of potential locations for car parking and other destinations.

3.5 Bus Activity

Bus volumes on the corridor, between Southern Outlet and Elizabeth Street, are presented in Figure 3.12 and Figure 3.13. Note that these are scheduled general access buses only, from Metro and private operators and that each bus movement has the ability to carry up-to 70 people (articulated buses have a higher capacity still). Other bus movements in the corridor will include school buses and out-of-service movements (e.g. repositioning to start a new service).

The Department of State Growth have advised that there are 7 school buses using Macquarie Street in the morning, and 5 in the afternoon. There are 8 school buses using Davey Street in the morning peak, and 5 in the afternoon.

Whilst most buses join or depart the corridor at the Southern Outlet (28 in the AM peak, equating to a potential 1960 people movements, which is similar to the number of individual vehicles in the peak hour), there are also frequent services along Antill Street and Sandy Bay Road.

Most services are from the southern suburbs terminate in Macquarie Street between Murray Street and Trafalgar Place. Some services continue to Glenorchy or the Eastern Shore, and travel via Harrington Street, Collins Street and Elizabeth Street.

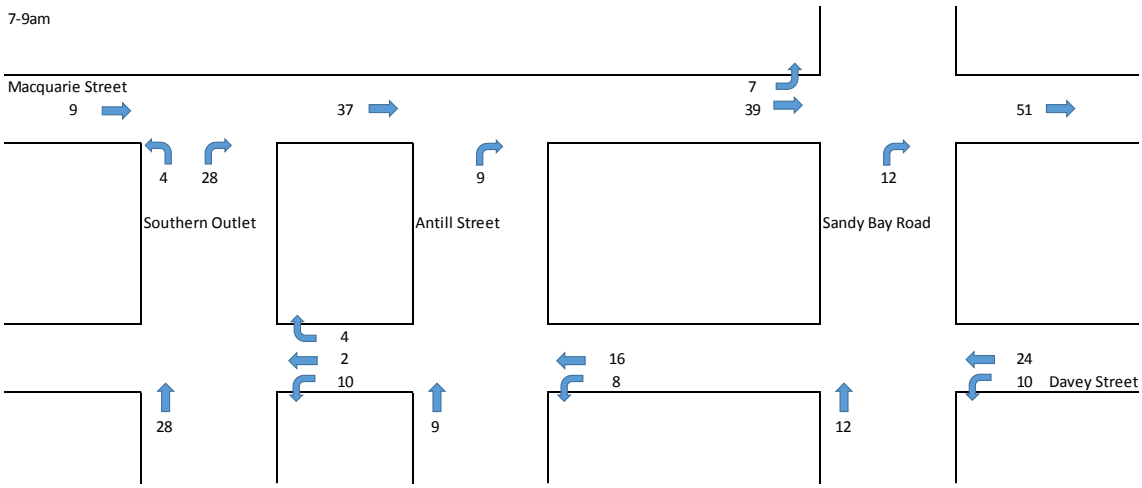


Figure 3.12 General Access Bus Volumes 7-9am weekdays

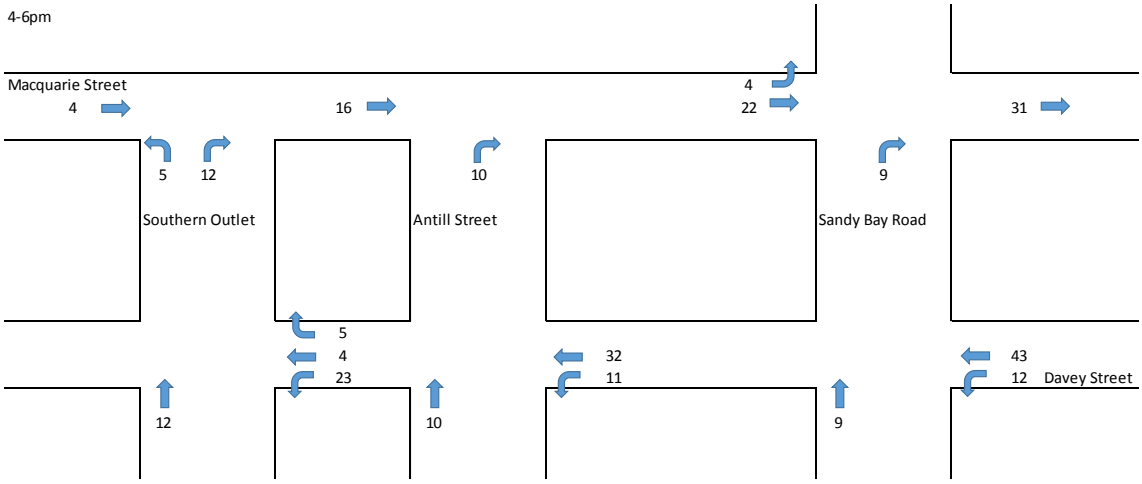


Figure 3.13 General Access Bus Volumes 4-6pm weekdays

From the Elizabeth Street Bus Mall, most services to the Northern Suburbs turn into Macquarie Street and turn left again into Argyle Street. Services to the Eastern Shore and Brooker Highway continue along Macquarie Street.

A contra-flow lane on Macquarie Street, between Elizabeth Street and Murray Street, provides for buses heading towards the southern suburbs.

Although there are few in-service bus routes that travel along Davey Street north of Elizabeth Street, this route is used for the repositioning of buses ready to make an outbound journey.

Bus layover areas are provided on the right hand side of Macquarie Street, between Argyle Street and Campbell Street, and Davey Street between Argyle Street and Elizabeth Street.

3.5.1 Bus Stop Locations

In the section of the corridor between the Southern Outlet and the central bus interchange area, the spacing of bus stops is relatively close, with as little as 180m between stops. Existing bus stops, and the distance between them, are show in Figure 3.14. Typical spacing of bus stops should generally be closer to 400m.

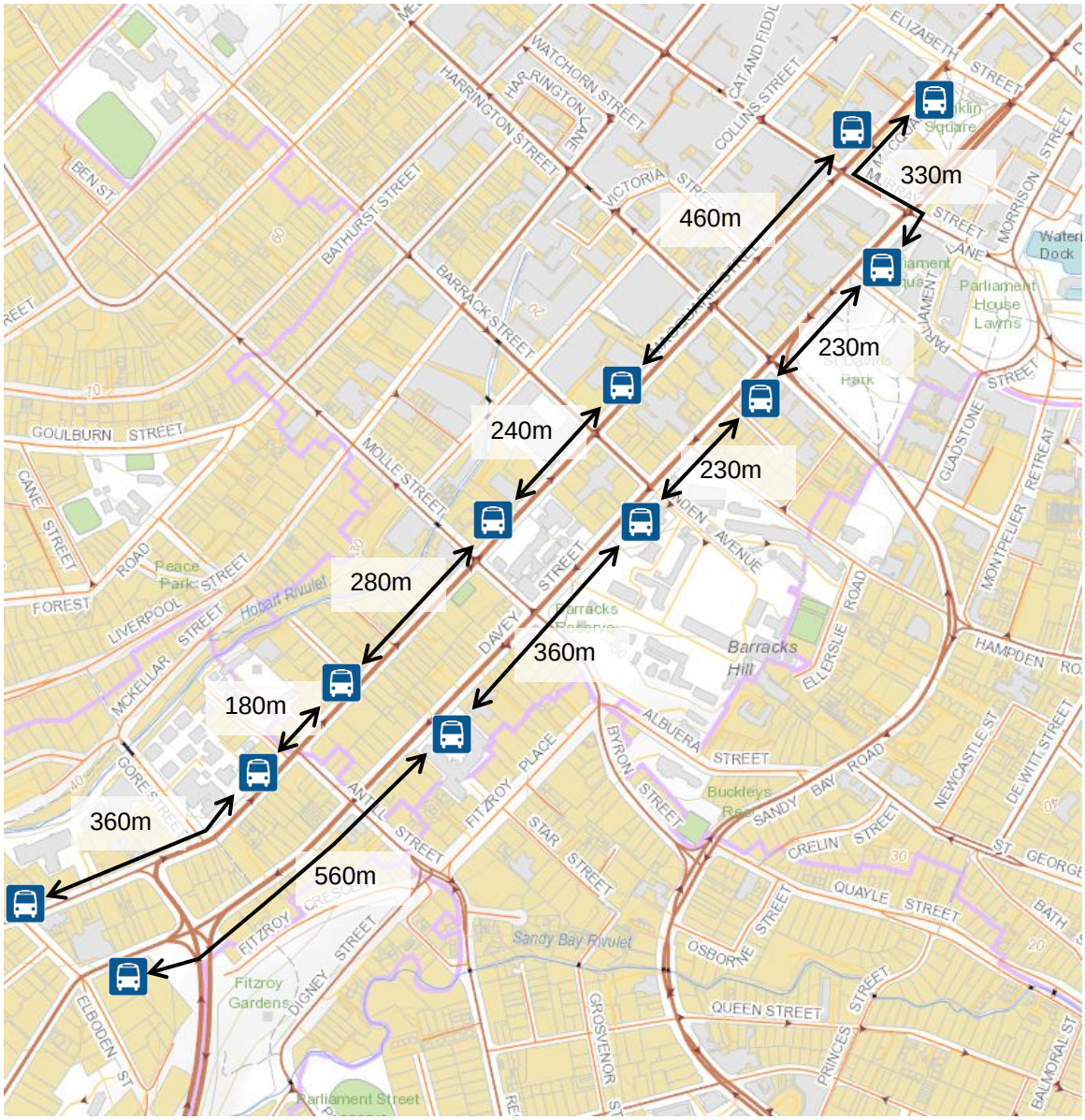


Figure 3.14 Bus Stop Spacing Between Southern Outlet and Elizabeth Street

3.6 Pedestrian Volumes

There is limited data on pedestrian volumes available. The 2010 report by Gehl Architets "Hobart Public Space and Public Life" includes some data on pedestrian movement, as summarised in Figure 3.15 and Figure 3.16.

Of note from this data are the relatively high volumes of pedestrians using Macquarie Street south of Harrington Street, which is similar to the volume recorded closer to the heart of the CBD, and also on Davey Street along the waterfront. Also notable is the high volume crossing the corridor at Murray Street, and the very high volume in the Elizabeth Street bus mall.

Figure 3.15 Pedestrian volumes (2010) 8am-6pm weekday

Figure 3.16 Pedestrian volumes (2010) 8am-6pm Saturday

3.6.1 Pedestrian Countdown Timers

Pedestrian countdown timers have recently been installed at several intersections along the corridor, and in other locations in the Hobart CBD. These give pedestrians an indication of the remaining time before traffic will start conflicting with the pedestrian movement. They are suitable only on intersection approaches where there is no traffic filtering through the pedestrian crossing. The one-way streets in Hobart create several opportunities where countdown timers could be considered.

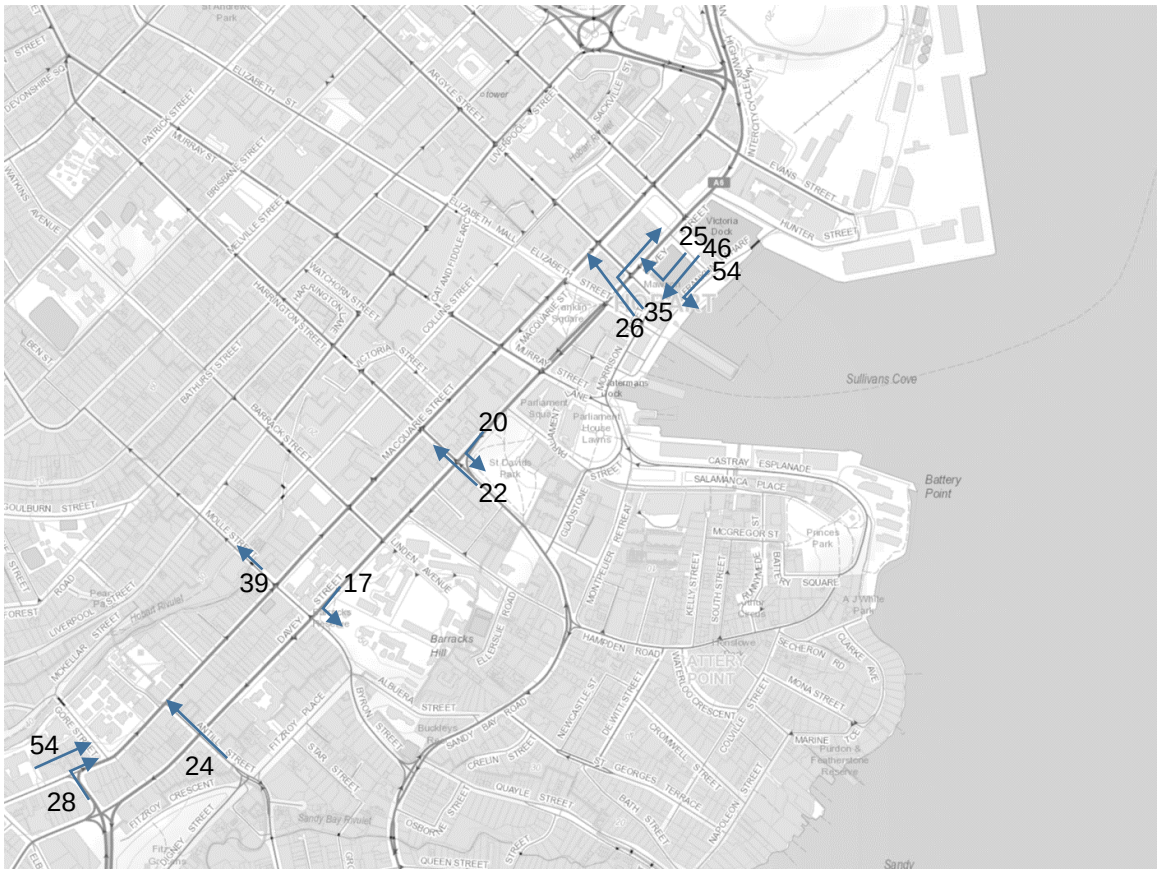
Evaluation of a trial of pedestrian countdown timers, conducted by UTAS, indicated limited road safety benefits, but found that countdown timers did improve pedestrian amenity.

3.7 Bicycle Volumes

City of Hobart supplied data from the 2016 Super Tuesday count of bicycle activity in the corridor. Note that not all intersections were surveyed, and so the results in Figure 3.17 are only for the major movements at locations where data is available.

It can be seen that there is a reasonable volume of cyclists using Macquarie Street in the morning peak, either from South Hobart or Antill Street. Some will turn off the corridor at Molle Street, but from the data it can be estimated that almost 70 cyclists continue on Macquarie Street past Molle Street. It is likely that a similar pattern would occur in reverse in the afternoon.

The intersection of Davey Street and Argyle Street is also a focus of cyclist activity, being the point where the intercity cycleway and Morrison Street shared path facilities meet.



Source: Super Tuesday Counts, 1st March 2016, supplied by City of Hobart

Figure 3.17 Bicycle Volumes, 7-9am

3.8 Crash History

The crash history for Macquarie and Davey Streets was obtained from the Department of State Growth for the five-year period 2013-2017.

Overall, there were 399 crashes recorded on Macquarie Street, an average of 80 per year. The vast majority (83%) resulted in property damage only, with only 2 serious injury crashes and 1 fatal crash.

On Davey Street, there were 344 crashes over the same period (average 68 per year), with 81% resulting in property damage only, 5 serious injury crashes and 1 fatality.

Table 3.4 and Table 3.5 summarise the crash history on a block-by-block basis. Figure 3.18 and Figure 3.19 show the density of crashes in Macquarie Street and Davey Street respectively.

It can be seen that the most common crash type involves vehicles from the same direction (rear-end type crashes), representing 62% of crashes along both Macquarie Street and Davey Street. However, in some locations this proportion is much higher, including:

- Macquarie Street
  - Between Murray and Elizabeth Streets (76%)
  - Between Campbell Street and Evans Street (79%), and Evans Street and the Tasman Highway / Brooker Highway (86%)
- Davey Street
  - Between Evans and Campbell Streets (77%)
  - Between Argyle and Elizabeth Streets (80%)

A high proportion of crashes involve manoeuvring vehicles (such as entering or leaving parking), with 11% of the total in Macquarie Street and 8% of the total in Davey Street. Concentrations of manoeuvring crashes are observed in:

- Macquarie Street
  - Between Barrack and Murray Streets
  - Between Argyle and Campbell Streets
- Davey Street
  - Between Harrington and Barrack Streets

Six percent of crashes on Macquarie Street involved a vehicle hitting another vehicle or object parked/abandoned and encroaching on the roadway (on path). Seventeen of the 22 “On Path” crashes on Macquarie Street, and 10 of the 13 “On Path” crashes on Davey Street, relate to a vehicle impacting either a parked car or car door, and are indicative of the narrow lanes in place on some of the corridor. Concentrations of this type of crashes, on Macquarie Street between Antill and Molle Streets, and on Davey Street between Harrington and Barrack Streets, indicate this issue in those locations. These are also locations where the road reserve width is reduced, compared to the previous block, as illustrated in Figure 3.3 and Figure 3.4.

There were concentration of intersection-type crashes at Macquarie Street / Barrack Street, and Davey Street / Harrington Street.

Table 3.4 Macquarie Street Crash History 2013-2017

Crash Type	Overall		Southern Outlet to Antill		Antill to Molle		Molle to Barrack		Barrack to Harrington		Harrington to Murray	
	No.	% of street total	No.	% of block total	No.	% of block total	No.	% of block total	No.	% of block total	No.	% of block total
Manoeuvring *(e.g. parking, leaving driveway)*	45	11%	3	10%	1	3%	4	7%	6	16%	18	32%
Off path on curve *(e.g. loss of control)*	5	1%	0	0%	0	0%	0	0%	1	3%	0	0%
Off path on straight *(e.g. loss of control)*	11	3%	1	3%	2	6%	1	2%	1	3%	1	2%
On path *(e.g. impact with parked vehicle)*	22	6%	3	10%	7	20%	1	2%	1	3%	5	9%
Overtaking	4	1%	0	0%	0	0%	1	2%	0	0%	1	2%
Passenger and miscellaneous *(e.g. fell from vehicle, object struck vehicle)*	4	1%	1	3%	1	3%	2	4%	0	0%	0	0%
Pedestrian *(e.g. crossing road, standing on roadway)*	18	5%	2	7%	0	0%	2	4%	3	8%	4	7%
Vehicles from adjacent directions *(e.g. at intersections)*	41	10%	1	3%	3	9%	19	35%	2	5%	5	9%
Vehicles from opposing directions *(e.g. head-on)*	2	1%	0	0%	0	0%	0	0%	0	0%	0	0%
Vehicles from same direction *(e.g. rear-end, side-swipe)*	247	62%	18	62%	21	60%	25	45%	24	63%	22	39%
Total	**399**	**100%**	**29**	**100%**	**35**	**100%**	**55**	**100%**	**38**	**100%**	**56**	**100%**

Crash Type	Overall		Murray to Elizabeth		Elizabeth to Argyle		Argyle to Campbell		Campbell to Evans		Evans to Tasman / Brooker	
	No.	% of street total	No.	% of block total	No.	% of block total	No.	% of block total	No.	% of block total	No.	% of block total
Manoeuvring *(e.g. parking, leaving driveway)*	45	11%	1	3%	2	4%	5	17%	1	7%	4	6%
Off path on curve *(e.g. loss of control)*	5	1%	0	0%	3	7%	1	3%	0	0%	0	0%
Off path on straight *(e.g. loss of control)*	11	3%	2	7%	1	2%	1	3%	0	0%	1	1%
On path *(e.g. impact with parked vehicle)*	22	6%	0	0%	2	4%	1	3%	1	7%	1	1%
Overtaking	4	1%	1	3%	0	0%	1	3%	0	0%	0	0%
Passenger and miscellaneous *(e.g. fell from vehicle, object struck vehicle)*	4	1%	0	0%	0	0%	0	0%	0	0%	0	0%
Pedestrian *(e.g. crossing road, standing on roadway)*	18	5%	1	3%	4	9%	1	3%	0	0%	1	1%
Vehicles from adjacent directions *(e.g. at intersections)*	41	10%	0	0%	2	4%	5	17%	1	7%	3	4%
Vehicles from opposing directions *(e.g. head-on)*	2	1%	2	7%	0	0%	0	0%	0	0%	0	0%
Vehicles from same direction *(e.g. rear-end, side-swipe)*	247	62%	22	76%	31	69%	14	47%	11	79%	59	86%
Total	**399**	**100%**	**29**	**100%**	**45**	**100%**	**29**	**97%**	**14**	**100%**	**69**	**100%**

Table 3.5 Davey Street Crash History 2013-2017

	Overall		Tasman / Brooker to Evans		Evans to Campbell		Campbell to Argyle		Argyle to Elizabeth		Elizabeth to Murray	
Crash Type	No.	% of street total	No.	% of block total	No.	% of block total	No.	% of block total	No.	% of block total	No.	% of block total
Manoeuvring *(e.g. parking, leaving driveway)*	29	8%	0	0%	1	5%	6	13%	2	8%	3	11%
Off path on curve *(e.g. loss of control)*	2	1%	0	0%	0	0%	0	0%	1	4%	0	0%
Off path on straight *(e.g. loss of control)*	4	1%	1	9%	0	0%	0	0%	0	0%	0	0%
On path *(e.g. impact with parked vehicle)*	13	4%	0	0%	1	5%	1	2%	0	0%	0	0%
Overtaking	1	0%	0	0%	0	0%	0	0%	1	4%	0	0%
Passenger and miscellaneous *(e.g. fell from vehicle, object struck vehicle)*	1	0%	0	0%	0	0%	0	0%	0	0%	1	4%
Pedestrian *(e.g. crossing road, standing on roadway)*	14	4%	0	0%	1	5%	1	2%	1	4%	2	7%
Vehicles from adjacent directions *(e.g. at intersections)*	62	18%	3	27%	2	9%	8	17%	0	0%	6	22%
Vehicles from opposing directions *(e.g. head-on)*	6	2%	1	9%	0	0%	0	0%	0	0%	0	0%
Vehicles from same direction *(e.g. rear-end, side-swipe)*	212	62%	6	55%	17	77%	31	66%	20	80%	15	56%
Total	**344**	**100%**	**11**	**100%**	**22**	**100%**	**47**	**100%**	**25**	**100%**	**27**	**100%**

	Overall		Murray to Harrington		Harrington to Barrack		Barrack to Molle		Molle to Antill		Antill to Southern Outlet	
Crash Type	No.	% of street total	No.	% of block total	No.	% of block total	No.	% of block total	No.	% of block total	No.	% of block total
Manoeuvring *(e.g. parking, leaving driveway)*	29	8%	5	7%	5	19%	4	10%	1	3%	2	5%
Off path on curve *(e.g. loss of control)*	2	1%	0	0%	0	0%	0	0%	0	0%	1	3%
Off path on straight *(e.g. loss of control)*	4	1%	0	0%	0	0%	0	0%	2	5%	1	3%
On path *(e.g. impact with parked vehicle)*	13	4%	4	6%	2	8%	1	3%	2	5%	2	5%
Overtaking	1	0%	0	0%	0	0%	0	0%	0	0%	0	0%
Passenger and miscellaneous *(e.g. fell from vehicle, object struck vehicle)*	1	0%	0	0%	0	0%	0	0%	0	0%	0	0%
Pedestrian *(e.g. crossing road, standing on roadway)*	14	4%	1	1%	1	4%	3	8%	2	5%	2	5%
Vehicles from adjacent directions *(e.g. at intersections)*	62	18%	16	24%	5	19%	8	20%	7	18%	7	18%
Vehicles from opposing directions *(e.g. head-on)*	6	2%	0	0%	1	4%	0	0%	1	3%	3	8%
Vehicles from same direction *(e.g. rear-end, side-swipe)*	212	62%	42	62%	12	46%	24	60%	23	61%	22	55%
Total	**344**	**100%**	**68**	**100%**	**26**	**100%**	**40**	**100%**	**38**	**100%**	**40**	**100%**

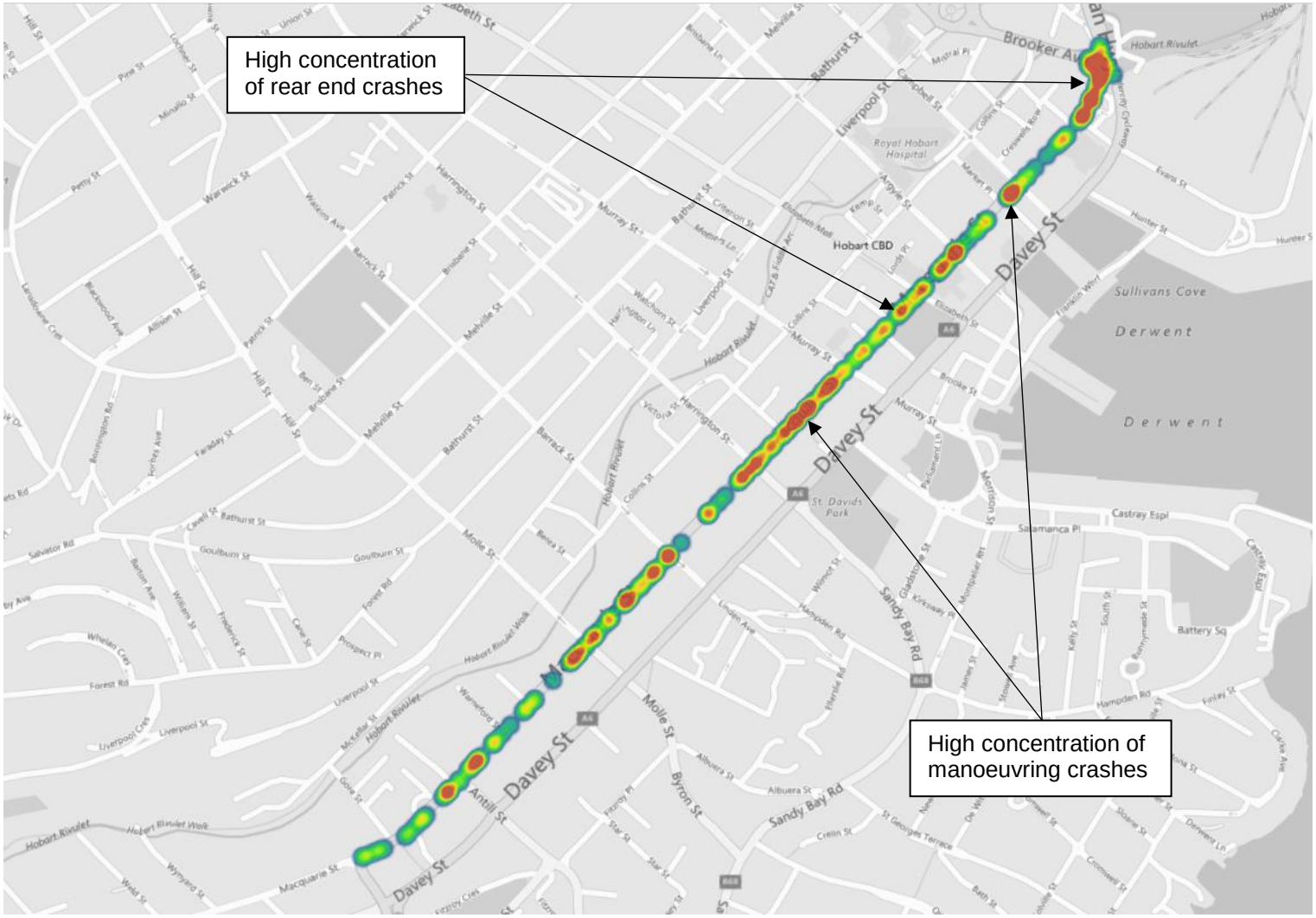


Figure 3.18 Macquarie Street Crash Density

Figure 3.19 Davey Street Crash Density

4. Strategic Objectives

A workshop was held on the 17th of April 2018 to discuss the Strategic Objectives for each mode. These then guided discussion of the aspirational Road User Hierarchy (discussed in Section 5) and how this would be utilised to generate bus priority.

Pedestrians

An attractive and safe pedestrian network that promotes walking

- Routes in areas of high pedestrian activity
- Key pedestrian desire lines into and within key destinations

Cycling

Cycling is seen as an attractive mode of transport catering for all levels of ability

- Cycling routes are coherent and legible

Public Transport

Public transport network is connected into and within activity areas, so that it is an efficient, connected, reliable and viable alternative to other modes of transport

- Key routes provide efficient and safe access into and within the CBD

General Traffic

Provide traffic routes that manage conflict with other modes and land use

- Provide travel time reliability and predictability

Freight

Freight access across the network

- Routes provide regional connections and connectivity between local, commercial and industrial areas

Place / Parking / Corridor Edge

Although not a transport mode, there was discussion at the workshop regarding the importance of the edge of the corridor, which has relevance for various reasons. The edge of the corridor features such elements as on-street parking, bus stops (and associated furniture), public seating, footpaths and landscaping.

There is a strong relationship between land uses adjacent to the corridor and the nature of the transport network within that corridor. For instance, the volume, speed and proximity of vehicular traffic affects the amenity that may be experienced by a particular land use. The high heritage value of many properties along the corridor was noted in this context, and heritage values may preclude certain actions in some locations.

Accessibility to and from a land use can be affected by the availability, or otherwise, of on-street parking, a bus stop, or a footpath of adequate width. Some land uses will value the ability of people (e.g. customers) to walk to the location, rather than drive and park. For other land uses, the opposite will be true, and in many cases a balance between pedestrian access and parking access is important. Additionally, loading zones can be valuable for certain types of land use.

It was also noted that property owners may have a strong sense of ownership of the corridor edge adjacent to their property, and sometimes a perception of entitlement. This sense of ownership needs to be considered when making decisions around the nature of the corridor and the allocation of space.

5. Road User Hierarchy

The workshop discussed and identified a strategic road user hierarchy for the study area, based on allocating priority routes for each mode. Figure 5.1 and Figure 5.2 show the nominated priority routes for peak and inter-peak periods respectively.

- The full length of Macquarie and Davey Streets are priority routes for general traffic (including freight)
- Parts of both streets are also priority routes for buses, pedestrians and cyclists, with these priority routes generally being in parallel
- There are also locations where priority routes for various modes cross or intersect with the main thoroughfares. Pedestrian priority routes across the corridor at Murray Street and Elizabeth Street in particular result in potential conflict between allocation of priority for each mode.
- At an individual intersection level (not shown), there is potential conflict between movements, either within modes (e.g. through movement on Macquarie Street vs right turn from Harrington Street / Sandy Bay Road) or between modes (e.g. general traffic left turn from Macquarie Street into Molle Street vs through movement for bicycles)

Understanding the specific needs and operating priorities of various modes that use the corridor is critical to the identification of treatments for bus priority that are likely to be successful and accepted by the broader community.

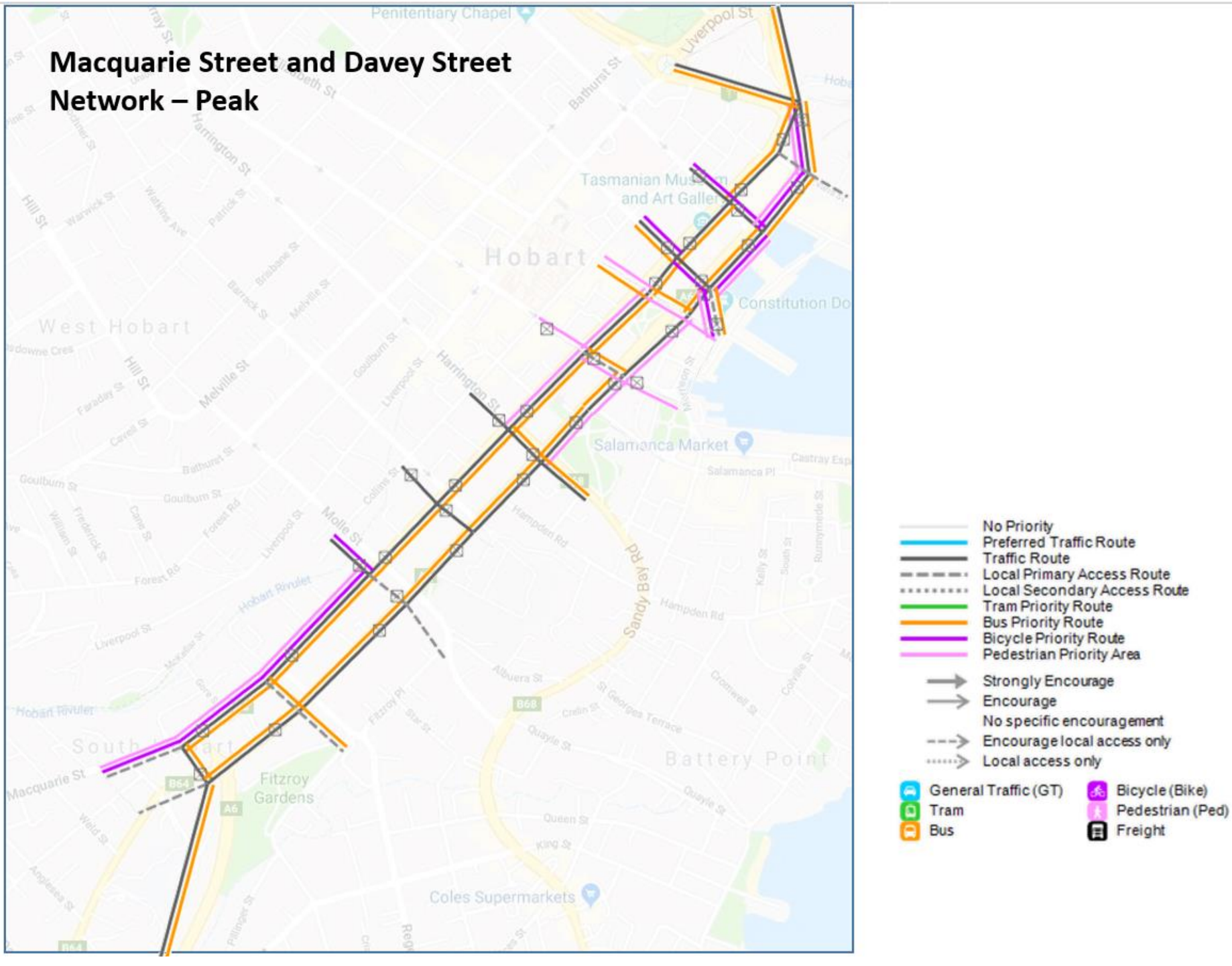


Figure 5.1 Priority Routes – Peak

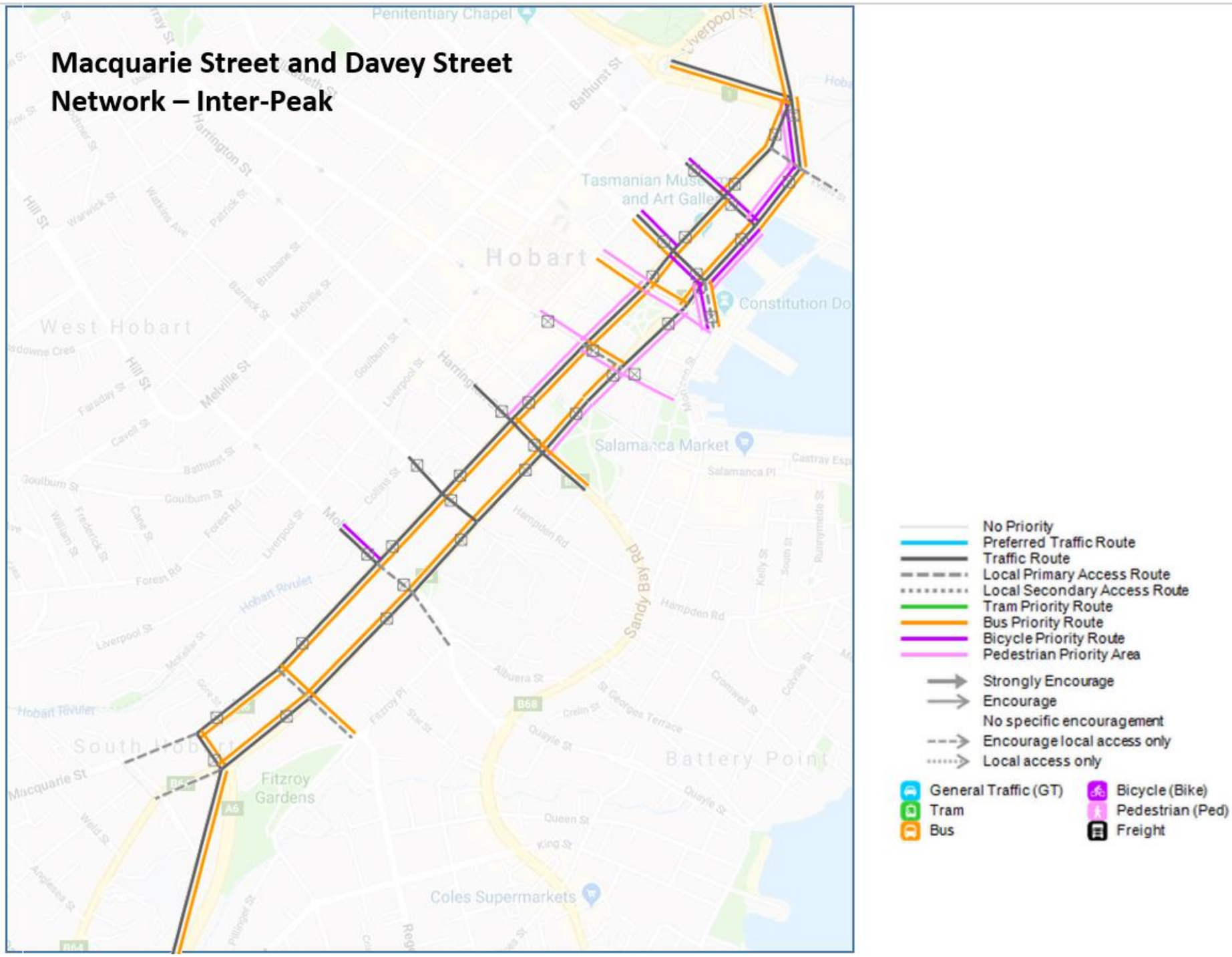


Figure 5.2 Priority Routes – Inter Peak

Based on the discussion at the Workshop, and observations of existing conditions, it is apparent that the corridor can effectively be divided into three zones, each with a slightly different operational focus:

- Zone 1: Southern Outlet to Barrack Street
  - Longitudinal movement focus (traffic, bus, bikes and pedestrians)
- Zone 2: Barrack Street to Argyle Street
  - Maintain provision for longitudinal movement, particularly traffic and buses
  - Additional focus on cross-corridor movement and interaction with adjacent land use (pedestrian accessibility)
- Zone 3: Argyle Street to Brooker / Tasman
  - Longitudinal movement focus (traffic and bus in particular, with pedestrians and cyclists on the existing intercity cycleway shared path)

These are shown in Figure 5.3, and reflect the effect of adjacent land uses and activity centres, and connections to the arterial and sub-arterial road network.

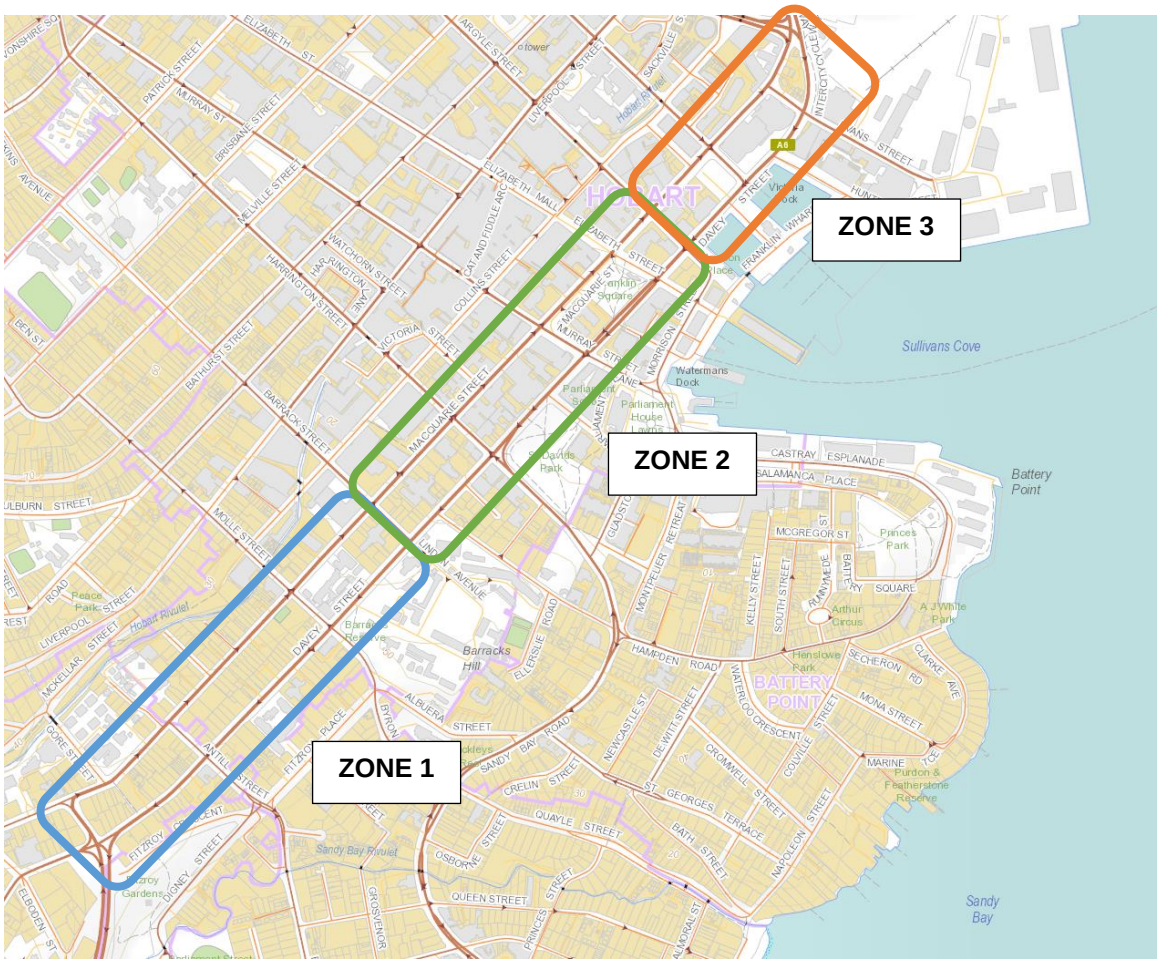


Figure 5.3 Operational Focus Zones

The Workshop discussed and identified priority routes for each transport mode, as well as corridor 'edge' and the kerbside. The 'edge' space is often used for on-street parking, but it was noted that there can be a conflict between parking provision, public transport (movement and bus stops) and amenity (which may be related to the adjacent land use). Key locations where the kerbside was viewed as important were also highlighted.

These include:

- Side Roads off Macquarie Street where parking can be prioritised
  - Gore Street
  - Ispahan Street
  - Warneford Street
  - Denison Lane
- Surrounding St Michael's Collegiate School (pick-up and drop-off activity)
- Macquarie Street (both sides) between Murray Street and Elizabeth Street, for bus pick-up and drop-off activity (bus interchange)
- Elizabeth Street (north sides) between Morrison Street and Collins Street, for bus pick-up and drop-off activity (bus interchange)
- Macquarie Street RHS between Argyle Street and Campbell Street, for bus layover
- Davey Street outside Hotel Grand Chancellor, for taxi rank

6. Opportunities and Constraints

6.1 Strategic Opportunities and Constraints

Without specific and significant reduction in peak hour demand for general traffic, it is desirable to maintain the existing number of general traffic lanes during peak periods[1], as any significant reduction in general traffic capacity would be expected to have adverse impacts for individual road users, at least in the short term. Further investigation is required to confirm whether such adverse impacts on individuals would also result in unacceptable operation at a network level.

It is likely, therefore, that any bus priority measures, such as a bus lane, would need to be in addition to the existing 3-4 lanes provided for general traffic.

Removal of on-street parking represents one opportunity for creating additional space, although in most locations the parking lane is not of sufficient width to be replaced directly with a bus lane. It may be necessary to consider removing parking on both sides of the road, and reallocating lanes across the available road width. The number of lanes available during off-peak periods may need to be reduced, compared to the existing provision (which in general does not change between peak and off-peak periods). Given the significantly reduced traffic demand outside of peak periods, this is not expected to result in significant congestion, although this should be tested through traffic modelling.

The operation of traffic signals in the corridor could be reviewed, to ensure that SCATS (the software used to manage phase lengths, timing and coordination between intersections) is coded appropriately for current conditions, and the operational needs of various road users (e.g. traffic moving along the corridor, crossing the corridor, and pedestrians).

Traffic modelling should also be used to test various changes in traffic signal operation prior to implementation.

It is noted that the width of the road reserve, as well as the current road carriageway, varies considerably along the corridor, making a consistent treatment along the full length of each of Macquarie and Davey Streets difficult to implement. This may result in treatments being applied inconsistently, with resulting inefficiencies and reduced effectiveness.

The difference in demand at various times of the day and week creates the opportunity to have different regimes in place for different times. For instance, during peak periods the focus could be on longitudinal movement, while at other times cross-corridor movement of pedestrians, particularly in Zone 2, could be prioritised. However where longitudinal movement conflicts with cross-corridor movement (in both location and time of day) this represents a constraint that requires a separate resolution.

Technology such as lane control systems could be used to allocate certain lanes to certain road users, at various times of the day. For instance, overhead gantries could be used to open or close lanes (such as in advance of an incident, or to create an emergency vehicle lane), provide advice to motorists of delays or road safety messages, or various other traffic management functions.

An overview of potential priority measures for various user groups is provided in Appendix A.

[1] There may be some specific locations where there is spare capacity in peak periods, but in general removal of a lane for general traffic would impact the vehicle-carrying capacity of the corridor.

6.2 Specific Opportunities and Constraints

The following sections outline specific opportunities and constraints along the corridor, on a block-by-block basis. The listed issues reflect discussion at the Workshop, as well as separate considerations by GHD.

6.2.1 Macquarie Street

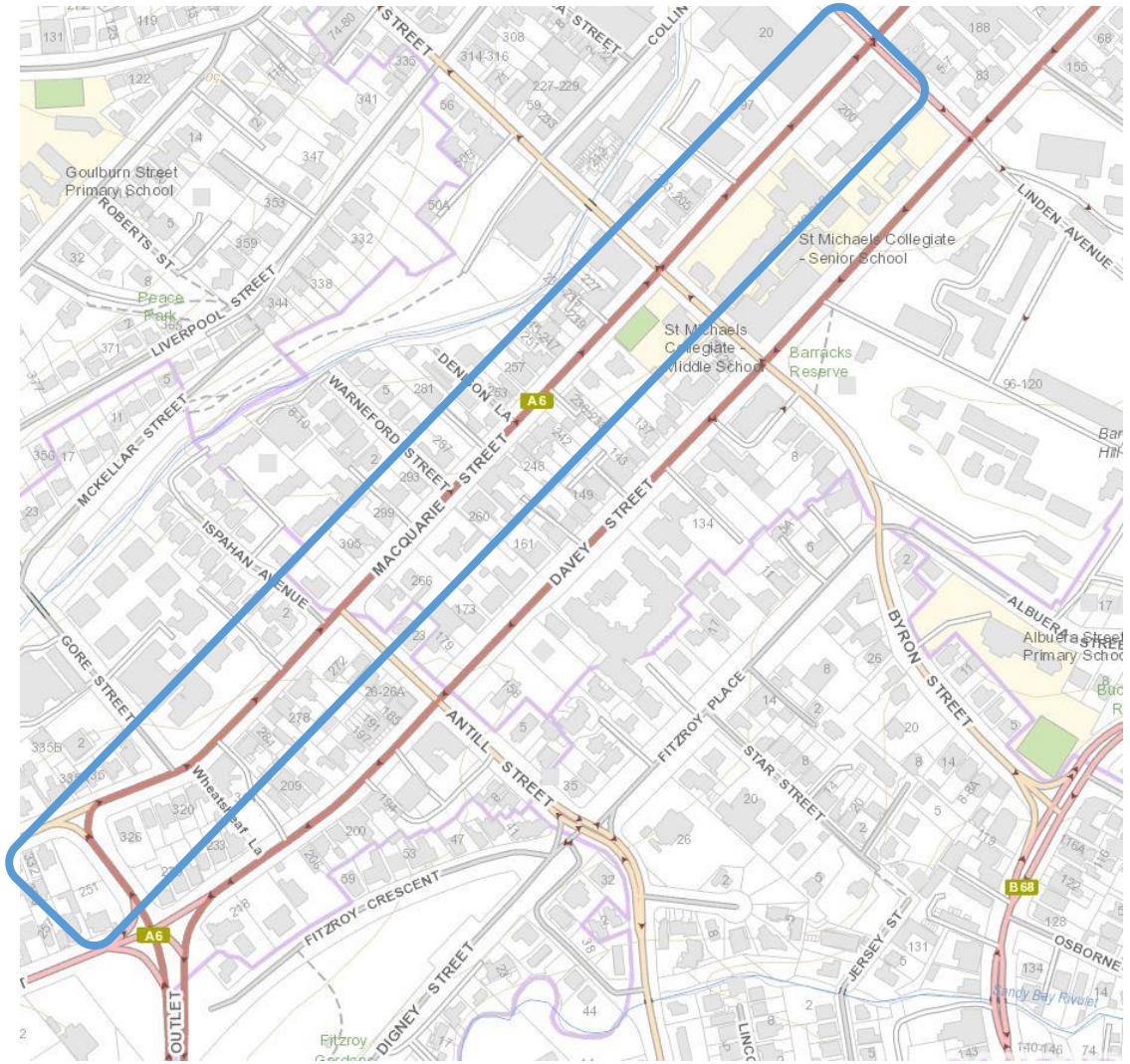
Zone 1 (Longitudinal Movement Focus)

Block	General Cross Section	Road User Priorities	Opportunities	Constraints
Southern Outlet to Antill Street	20.7m reserve 2 x footpath 2 x parking 3 x traffic lanes	General traffic Freight Buses Bicycles Pedestrians	LHS adjacent land use has off-street car parking, so less reliant on on-street parking On-street parking in Gore Street and Ispahan Avenue	Some residences on RHS do not have off-street parking Consulting rooms and other businesses on RHS generate parking demand (including during peak)
Antill Street to Molle Street	19.7m reserve 2 x footpath 2 x parking 3 x traffic lanes	General traffic Freight Buses Bicycles Pedestrians (including crossing at Molle Street)	Existing clearway on LHS approaching Molle Street in AM peak On-street parking in Warneford Street	Some residences on LHS do not have off-street parking Steep road camber (especially on LHS) Some residences on RHS do not have off-street parking High left turn movement into Molle Street in AM peak, limiting benefit of combined bus/turn lane Frequent issues with parking in clearway and queue extending beyond clearway length
Molle Street to Barrack Street	20.7m reserve 2 x footpath 2 x parking 3 x traffic lanes	General traffic Freight Buses	Potential for bus stop consolidation	School drop-off / pick-up activities utilise on-street parking

In Macquarie Street Zone 1 the removal of on-street parking, at least during peak periods, warrants further investigation. This may create sufficient space for an additional traffic lane to be created. The high left turn volume into Molle Street in the AM peak is a particular constraint, which means that a kerbside bus lane may not be the optimum location.

Feasible bus priority measures in this section may include:

- Peak period Bus Lane
- Combined Bus / Bike lane
- T2 Lane
- Bus priority at traffic signals
- Bus stop consolidation / revised stopping patterns
- Kerb outstand / in-lane bus stop



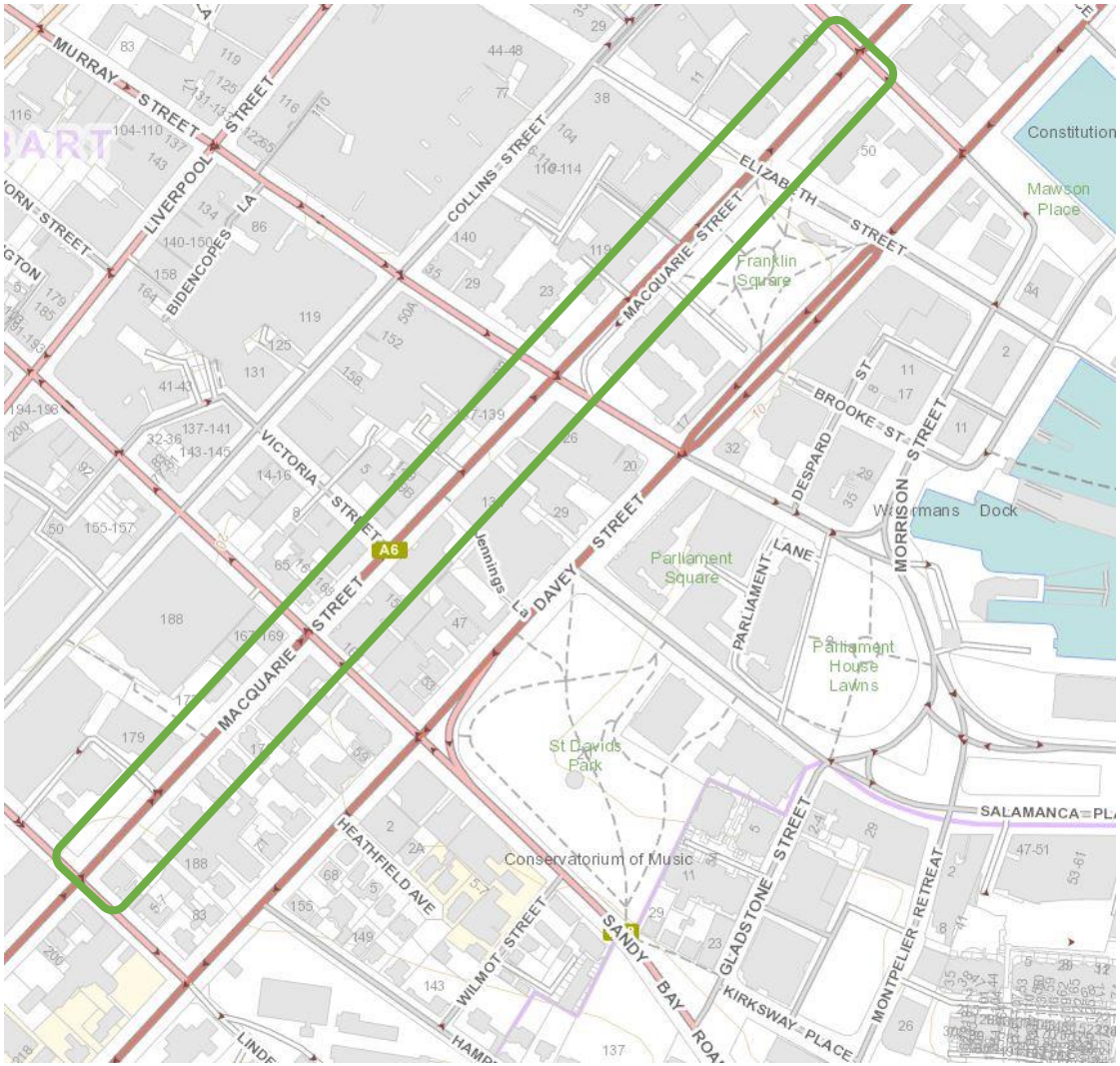
Zone 2 (Activity Focus)

Block	General Cross Section	Road User Priorities	Opportunities	Constraints
Barrack Street to Harrington Street	20.2m reserve 2 x footpath 2 x parking 3 x traffic lanes *(2 x footpath* *1 x parking* *4 x traffic lanes in AM peak)*	General traffic Freight Buses Pedestrians (LHS)	Existing clearway on LHS in AM peak Hotels (existing and proposed) on LHS have off-street parking and drop-off areas Close to CBD with opportunities for off-street car parking e.g. Centrepoint	Hospital, consulting rooms, etc generate parking demand Land uses on RHS do not have off-street parking Frequent issues with parking in clearway
Harrington Street to Murray Street	20.3m reserve 2 x footpath 2 x parking 3 x traffic lanes	General traffic Freight Buses Pedestrians (RHS and crossing at Murray Street)	Close to CBD with opportunities for off-street car parking e.g. Centrepoint	High crash rate from manoeuvring Service Tas and other land uses on RHS generate high parking turnover Interaction with Victoria Street intersection High pedestrian demand at Murray Street High right turn volumes in Murray Street (across the day) Capacity of Murray Street midblock downstream limits right turn volumes into Murray Street
Murray Street to Elizabeth Street	24.3m reserve 2 x footpath 1 x parking / bus stop 3 x traffic lanes 1 x contra-flow bus lane	General traffic Freight Buses Pedestrians (including crossing at Elizabeth Street)		Heart of bus CBD operations High pedestrian demand at Elizabeth Street On-street parking on LHS serves key land uses e.g. NDIS office Loading zones on LHS Interaction with Trafalgar Place intersection
Elizabeth Street to Argyle Street	26.3m reserve 2 x footpath 4 x traffic lanes	General traffic Freight Buses	No parking on either side of road	

In Macquarie Street Zone 2 the removal of on-street parking during peak periods warrants further investigation, both from a capacity and road safety perspective. Provision for buses and pedestrian movement and waiting areas in the vicinity of the Elizabeth Street intersection is a high priority. Retention of the contra-flow bus lane between Elizabeth Street and Murray Street is also a necessary feature for the current bus network.

Feasible bus priority measures in this section may include:

- Peak period Bus Lane (Barrack Street to Argyle Street) with in-lane bus stops between Murray Street and Elizabeth Street
- Bus priority at traffic signals



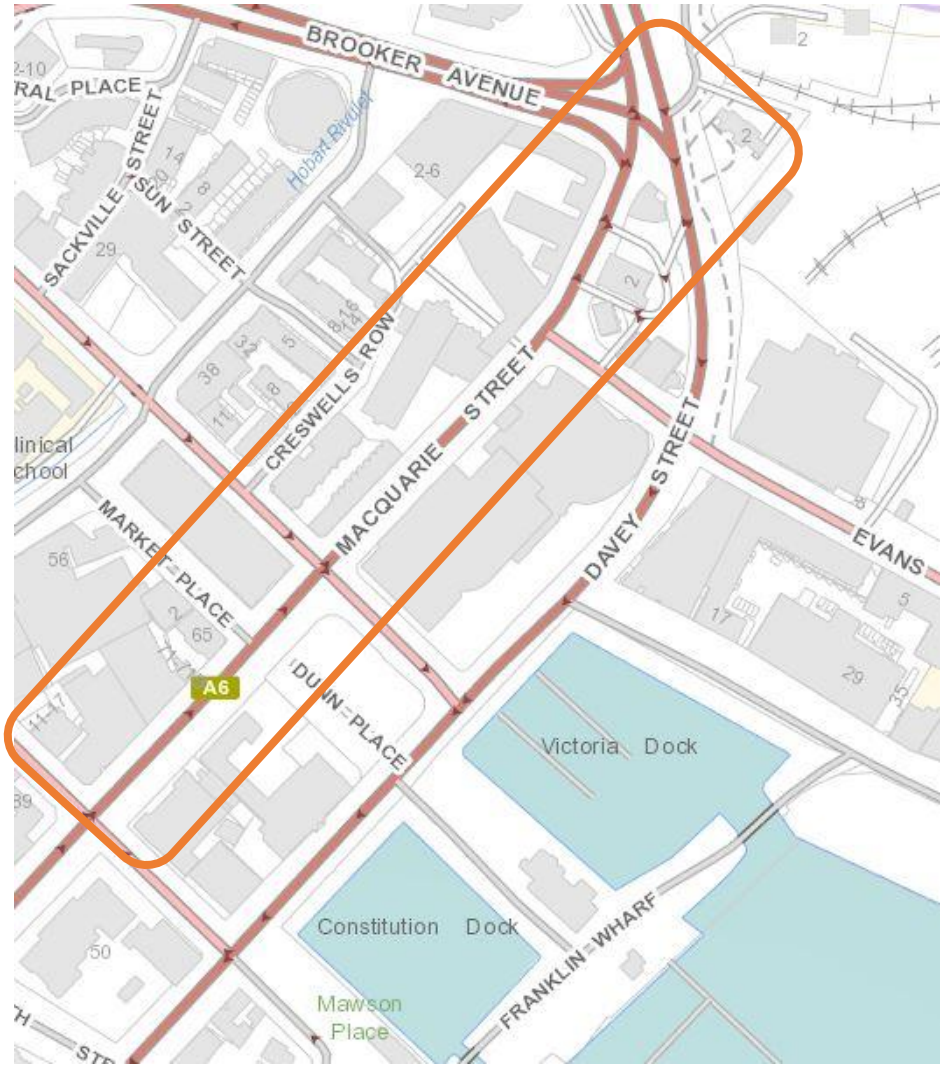
Zone 3 (Longitudinal Movement Focus)

Block	General Cross Section	Road User Priorities	Opportunities	Constraints
Argyle Street to Campbell Street	25.9m reserve 2 x footpath 2 x parking / bus layover 4 x traffic lanes	General traffic Freight Buses	Low demand for on-street parking Additional traffic lane added	Bus layover area on RHS Interaction with Market Place
Campbell Street to Evans Street	21m reserve 2 x footpath 2 x parking 4 x traffic lanes	General traffic Freight Buses	Inactive street frontages for adjacent land uses on both sides	Hotel access on LHS Access to hotel carpark on RHS Narrow right hand lane adjacent to parking
Evans Street to Tasman Highway / Brooker Highway	2 x footpath 4 x traffic lanes	General traffic Freight Buses	Inactive street frontages for adjacent land uses on both sides No parking on either side of road	Commercial site access on RHS Combined through and left turn lane

In Macquarie Street Zone 3, there is generally good opportunity for reallocation of road space where necessary, with relatively low demand for on-street parking, and a wide corridor, particularly between Argyle Street and Campbell Street. However provision of bus priority in this section is complicated by the variety of destinations of buses using this section (including out-of-service buses). Further, traffic flow in this section is generally good, except when a downstream incident obstructs capacity (e.g. on the Tasman Bridge or approaches).

Although unlikely to be a priority in the short term, feasible bus priority measures in this section may include:

- Peak period Bus Lane (Argyle Street to Campbell Street)
- T2 Lane (Argyle Street to Campbell Street)
- Bus priority at traffic signals
- Kerb outstand / in-lane bus stop (currently in place Campbell Street to Evans Street)



6.2.2 Davey Street

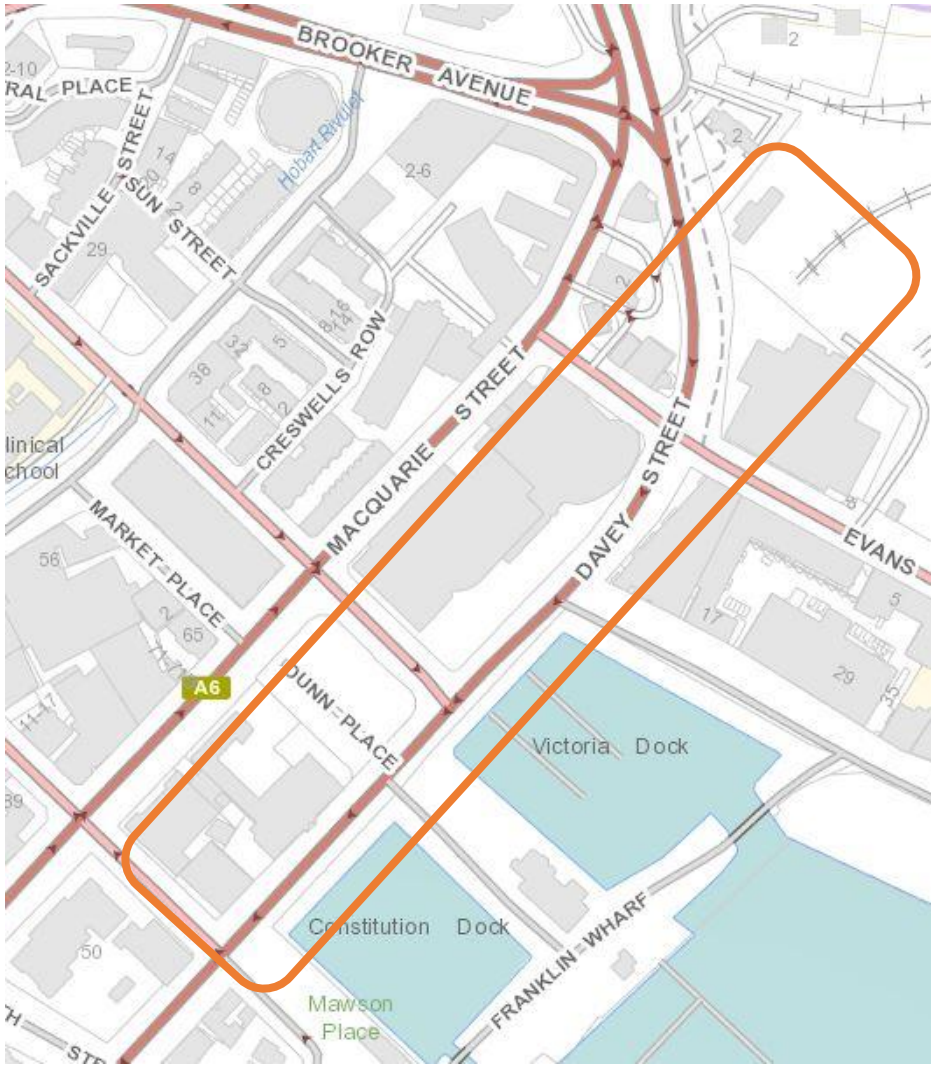
Zone 3 (Longitudinal Movement Focus)

Block	General Cross Section	Road User Priorities	Opportunities	Constraints
Tasman Highway / Brooker Highway to Evans Street	1 x shared path 4 x traffic lanes 1 x footpath	General traffic Freight Buses Pedestrians Cyclists	Macquarie Point redevelopment Existing shared path No parking on either side	Property access on RHS Heavy vehicle access to port
Evans Street to Campbell Street	18.4m reserve 1 x shared path 3 x traffic lanes 1 x parking 1 x footpath	General traffic Freight Buses Pedestrians (including crossing at Campbell Street) Cyclists	Shared path on LHS	Taxi rank for hotel on RHS Hotel driveway entry and exit on RHS Zero Davey bus zone on LHS
Campbell Street to Argyle Street	19.1m reserve 1 x shared path 3 x traffic lanes 1 x parking 1 x footpath	General traffic Freight Buses Pedestrians Cyclists	No parking on LHS No active street frontages on RHS Shared path on LHS	Kerb bulbing at Museum entrance on RHS Interaction with off-street parking on both sides

In Davey Street Zone 3, the major pedestrian and cyclist activity is accommodated outside the road reserve. There is some on-street parking on the right hand side of the road, which could be considered for removal in peak periods. However the width gained is unlikely to be sufficient for an additional full-width traffic lane / bus lane. Further, with very few in-service buses using this section of the corridor, provision of bus priority in the form of a bus lane, or similar, may not be seen as a palatable reallocation of space. Buses which do use this section of road will generally be turning right into Argyle Street or Elizabeth Street, and therefore mixing with general traffic also turning right (into Argyle Street only) presents a potential conflict.

Feasible bus priority measures in this section may include:

- Bus priority at traffic signals
- Extended right turn lane approaching Argyle Street



Zone 2 (Activity Focus)

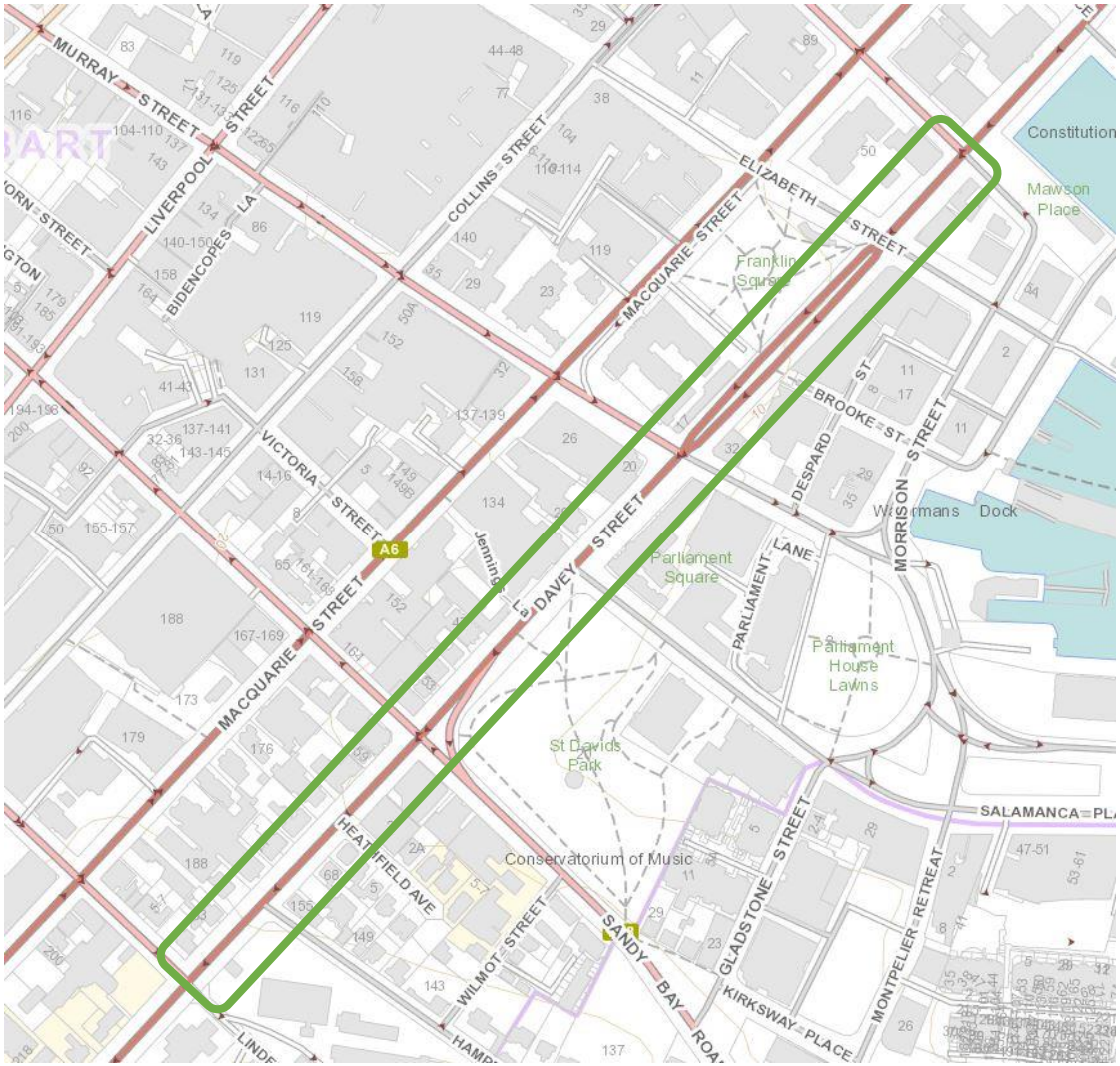
Block	General Cross Section	Road User Priorities	Opportunities	Constraints
Argyle Street to Elizabeth Street	26.1m reserve 2 x footpath 4 x traffic lanes 1 x parking	General traffic Freight Buses		Short block length reduces queue storage capacity Travel and Information Centre on LHS generates demand for parking
Elizabeth Street to Murray Street	23.6m reserve 1 x footpath 1 x parking 4 x traffic lanes	General traffic Freight Pedestrians (crossing at Murray Street and Franklin Square (future grade separation))	Potential future grade separated pedestrian crossing to Franklin Square Relatively low peak period demand for on-street parking on LHS	Split level roadway with limited carriageway width and heritage constraints Uneven gradient on pedestrian crossing at Murray Street
Murray Street to Sandy Bay Road	24.3m reserve 2 x footpath 2 x parking 4 x traffic lanes	General traffic Freight Buses	Off-street footpaths available in St David Park, and through Parliament Square (once construction complete) No active street frontage along LHS at St David Park Most land uses on RHS have off-street parking Potential for bus stop consolidation	High left turn volume into Sandy Bay Road Pedestrian conflict with left turning traffic Delays for right turns into Harrington due to limited mid-block capacity and forward sight lines. Interaction with Salamanca Place Combined through and right turn lane
Sandy Bay Road to Barrack Street	22.7m reserve 2 x footpath 2 x parking 4 x traffic lanes	General traffic Freight Buses	Relatively low demand for parking on LHS in PM peak On-street parking in Heathfield Avenue and Hampden Road	Uphill grade means cyclists reduce speed and may obstruct following traffic

Within Davey Street Zone 2, there is significant diversity in the nature of the corridor, and the types of movements that are to be accommodated. For instance, between Elizabeth Street and Murray Street there are very few bus movements, but the section between Murray Street and Sandy Bay Road / Harrington Street is used by all buses departing the CBD for the southern suburbs.

The split level roadway between Elizabeth Street and Murray Street is a particular constraint, with limited opportunity to reallocate road space in this section. One option, however, may be the peak-period removal of on-street parking on the left hand side of the road, to create an uphill bike lane (particularly between Elizabeth Street and Murray Street). Although used by only a small number of cyclists, the impacts of a slow moving cyclist on general traffic flow can be significant. Further, due to the narrow footpath width in this location, riding on the footpath is not permitted.

The section between Murray Street and Barrack Street features on-street parking on both sides of the road, and narrow traffic lanes. Feasible bus priority measures may include:

- Peak period Bus Lane
- Combined Bus / Bike lane
- T2 Lane
- Bus priority at traffic signals
- Bus stop consolidation / revised stopping patterns
- Kerb outstand / in-lane bus stop



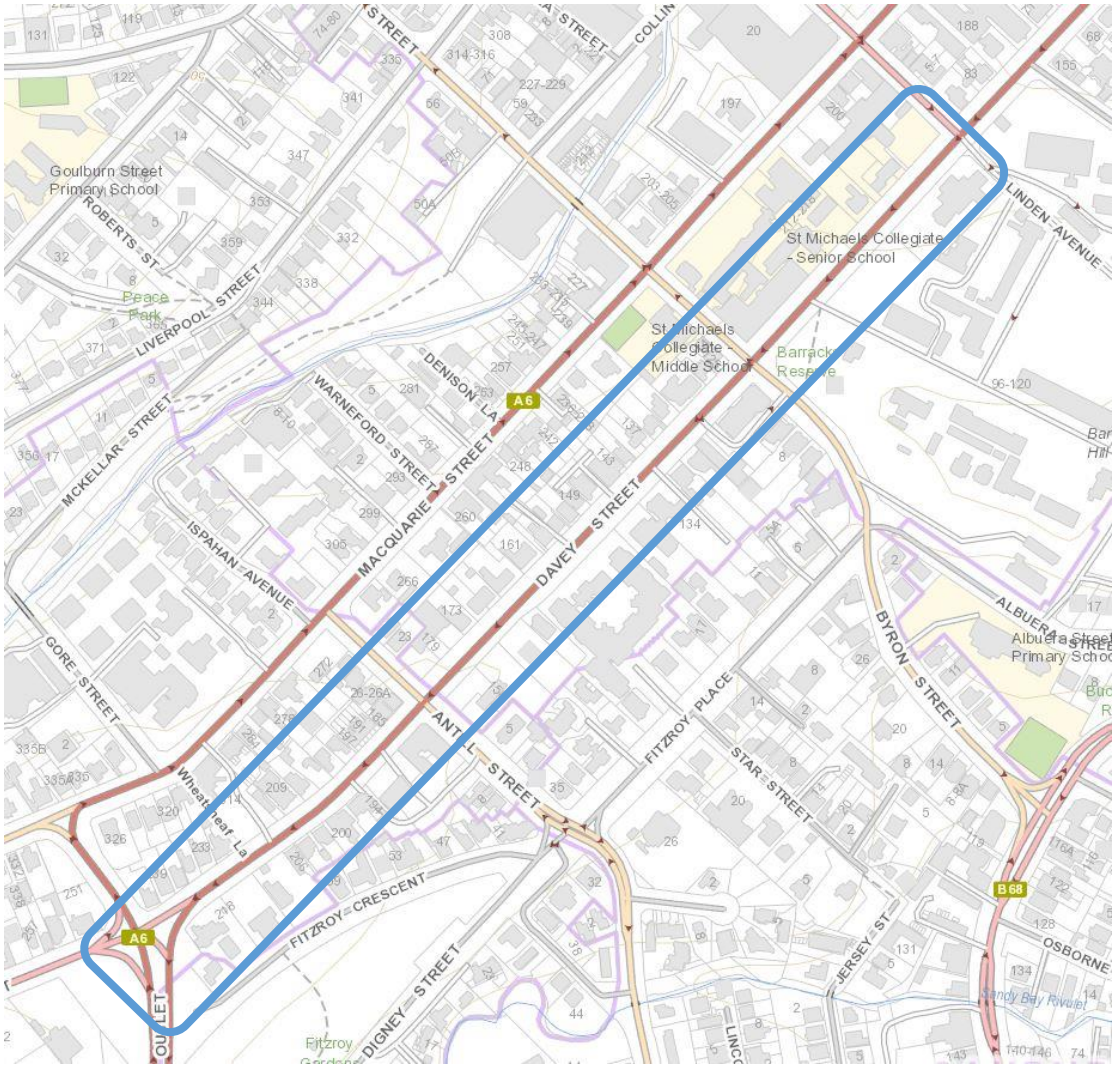
Zone 1 (Longitudinal Movement Focus)

Block	General Cross Section	Road User Priorities	Opportunities	Constraints
Barrack Street to Molle Street	22.2m reserve 2 x footpath 2 x parking 4 x traffic lanes	General traffic Freight Buses	Low-activity street frontage land use on LHS	School drop-off / pick-up activities utilise on-street parking Narrow right hand lane adjacent to parking
Molle Street to Antill Street	21.5m reserve 2 x footpath 2 x parking 4 x traffic lanes	General traffic Freight Buses	Land uses on LHS have off-street parking	Left-turn only lane into Antill Street Some land uses on RHS don't have off-street parking
Antill to Southern Outlet	20.0m reserve 2 x footpath 2 x parking 3 x traffic lanes	General traffic Freight Buses	Low parking demand on LHS in PM peak	Land uses on both sides without off-street parking Pedestrian volume crossing Southern Outlet slip lane to Fitzroy Gardens

In Davey Street Zone 1, traffic generally flows well except where access to the Southern Outlet is obstructed either by an incident, or more regularly by the mis-coordination of the signalised pedestrian crossing of the access to the Southern Outlet. The high volume turning left into Antill Street creates potential for conflict between buses using the kerbside lane and turning traffic. Removal of on-street parking during peak periods, particularly on the left hand side of the road, warrants further investigation. Consideration could also be given to extending the right turn lane approaching the Southern Outlet (access to South Hobart) by peak period parking removal. This would benefit South Hobart bus services.

Feasible bus priority measures may include:

- Peak period Bus Lane
- Combined Bus / Bike lane
- T2 Lane
- Bus priority at traffic signals
- Bus stop consolidation / revised stopping patterns
- Kerb outstand / in-lane bus stop



7. Conclusions

Macquarie Street and Davey Street are critical links in the Greater Hobart transport network, with important functions related to the movement of general traffic, public transport, pedestrians, cyclists and freight.

The objective of this report is to identify potential options for providing bus priority along Macquarie Street and Davey Street. These have been identified through considering the needs of different road user groups within the study area, and the physical and operational constraints that apply.

A review of existing conditions show a number of key features of the corridor:

- Varying road reserve width, affecting lane widths, footpath widths and the availability of on-street parking;
- High northbound traffic volumes on weekday mornings, and returning southbound on weekday afternoons, with relatively low volumes at other times;
- Varying origins and destinations of traffic using the corridor, with only a small proportion travelling the full length of each corridor. There are locations where significant volumes of traffic join and leave the corridor;
- High volumes of bus activity, with the Hobart Central Bus Interchange focussed around the Elizabeth Street intersection, and major bus routes along the length of Macquarie Street, and the southern section of Davey Street. Bus activity includes general access routes, school services, and out-of-service buses;
- Pedestrian and cyclist volumes in the corridor are also significant, particularly in the central section between Barrack Street and Argyle Street. There are both movements along and across the corridor; and
- Crashes are a frequent occurrence throughout the corridor, with a very high proportion of rear-end type crashes. Most crashes result in property damage only.

Due to the highly directional nature of traffic volumes during the weekday peak periods (and relatively low volumes on the corridor at other times) it is apparent that the need for bus priority is greatest on Macquarie Street during the weekday AM peak period. Whilst Davey Street in the PM peak also experiences high volumes, the need for bus priority may be less pronounced.

It is expected that, without significant works, removal of on-street parking on one or both sides of the road will not on its own create additional space which could be reallocated for a bus lane or additional traffic lane. Creation of an additional lane will require a revised cross section, with a reduced capacity in off-peak periods if on-street parking is to be maintained, and reconfiguration of intersections along the corridor. It is possible that benefits gained from an extra lane at midblock locations could be offset by inefficiencies at intersections.

There are, however a number of potentially feasible bus priority measures that could be considered, including re-arrangement of lanes to provide a peak period bus or T2 lane, and off-peak parking.

In the short term, potential actions may include:

- Review SCATS signal settings and optimisation along the corridor
- Rationalise bus stops and/or bus stopping patterns
- Extend clearways (peak periods) for turn capacity (queue storage)
  - Macquarie Street approaching Molle, Harrington and Murray,

– Davey Street approaching Sandy Bay Road, Harrington, Molle, Antill and Southern Outlet

These are expected to be generally straight forward to implement, and will make an immediate difference to the operation of the corridor and the reliability of bus operations.

Beyond these actions, peak period parking removal at key locations should be investigated, with the space reallocated to another use. Other bus priority measures, as discussed in this report, should also be investigated, along with supporting infrastructure and technology changes.

Appendices

Appendix A – Range of Potential Treatments

There are a range of potential treatments that could be applied in order to improve priority for the various modes using the corridor.

Pedestrian Priority

- Footpath widening
  - Provide additional capacity for movement of pedestrians
  - May also be used to separate different path users (e.g. stationary people interacting with the environment at that point, people waiting to cross the road, or people moving along the path)
- Kerb bulbing
  - Provide additional waiting area at intersections and crossing points
  - May reduce overall pedestrian crossing times, which has benefits for traffic signal operation through reduced minimum green times
- Green waves for pedestrian travel times
  - Rather than the coordination of traffic signals being based on vehicle travel times from one intersection to the next, the coordination is based on typical pedestrian travel times
  - Reduces pedestrian waiting times, particularly where signal cycle times are high
- Landscaping to provide separation from adjacent traffic
  - Separation of the footpath from adjacent moving traffic
  - Used where moving traffic is located adjacent to the footpath, with no separation through parking or other means
- Scramble Crossings
  - Dedicated pedestrian phase at traffic signals, to allow crossing in any direction
  - Usually applied at locations of high pedestrian activity and pedestrian priority
- Grade separated pedestrian crossings
  - Allow pedestrians to avoid having to wait at signals, or for a break in traffic flow
  - Providing an accessible path of travel can be difficult, particularly in hilly locations where long access ramps may be required
  - On Macquarie and Davey Streets, a minimum height clearance of 7m is required for any overhead obstruction
  - Will not necessarily remove all demand for at-grade pedestrian crossings, depending on surround land use, accessibility, perceived travel time to traverse compare to at-grade crossing, and connections to other paths

Bike Priority

- Off-road exclusive bicycle path (within the road corridor)
  - Suitable for high volumes of cyclist activity, where separation from general traffic and pedestrians is desirable
  - Unlikely to be feasible in this context
- On-road segregated bicycle lanes – median or similar separation
  - Provide physical separation of cyclists from adjacent traffic lanes

  - Can provide for one-way or two-way cyclist movement
  - Requires additional space compared to other on-road lanes
- On-road exclusive bicycle lane
  - dedicated lane, usually on the outer edge of the traffic lanes
  - Separated from adjacent traffic lanes by linemarking only
  - available for cyclists at all times
- On-road peak period exclusive bicycle lane
  - similar to on-road exclusive bicycle lanes, although in operation during specified times only
  - When bicycle lane is not operational, space is often reallocated for on-street car parking
- On-road bicycle/car parking lane
  - widened left lane that can accommodate on-street parking and a bicycle lane of sufficient width to avoid car doors opening and adjacent moving traffic
- Wide kerbside lane
  - Widened left lane that can accommodate cyclists riding on the far left hand side, and a lane of general traffic adjacent
  - Does not provide specific bike priority
- Narrow kerbside lane
  - Cyclists must ride within the general traffic stream
  - Rider safety and comfort affected by traffic volume, composition and speed
- Green waves for cyclist travel times
  - Rather than the coordination of traffic signals being based on vehicle travel times from one intersection to the next, the coordination is based on typical cyclist travel times

Bus Priority

Improvements to general traffic flow, will generally improve bus reliability as well. However if bus *priority* is desired, then specific bus priority measures will be needed.

Some bus priority measures that have been applied in other locations are described below.

Road Space Priority – Bus

- Dedicated busways / transitways
  - Requires the creation of separate roadways for bus only use, either parallel to an existing roadway, or in a separate corridor
  - Unlikely to be feasible in this context
- Bus-only streets
  - Allocation of certain street (or sections of these streets) for use by buses only. In Hobart, the Elizabeth Street Bus Mall is an example of a bus only (with exceptions) street
  - Requires availability of an alternative route for general traffic
  - In this context, a parallel street such as Collins Street could be considered as a bus-only or bus-priority street

- Bus Only Lanes and Bus Lanes (full time / peak period)
  - Dedicated lanes on existing roadways
  - Bus Only lanes can be used only by buses
  - Bus Lanes can also be used by other authorised vehicles, such as taxis and bicycles
- Queue jumps
  - A short length of bus lane on approach to traffic signals, to allow buses to bypass queued general traffic.
  - Only feasible if general traffic queues are short enough to allow buses to access short length bus lane
- T2 / High Occupancy Vehicle Lane
  - Use of the lane is restricted to vehicles carrying a minimum number of people (typically 2 or 3)
  - Requires adequate enforcement of restrictions (manual observation, or technology solution which may not be as reliable), and appropriate penalties.
  - Buses are able to use the lane, which will have less general traffic in it and therefore travel time benefits are expected.

Signal priority measures

- Passive priority (green wave)
  - Providing signal coordination along bus routes to minimise buses having to stop at red lights
  - Coordination is generally determined by the needs of general traffic, and so providing coordination for buses may result in adverse outcomes for other traffic
  - Difficult to achieve where bus stops create irregular bus travel times
- Bus vehicle detection
  - Buses are detected on approach to traffic signals and the green phase for general traffic is extended, or triggered, in response
- Automatic Vehicle Location
  - Buses are tracked via GPS and traffic signals automatically adjusted to provide green phases when buses are approaching signals
- B-Phase
  - signal phase for buses only, generally in advance of other traffic
- Bus-only turn movements
  - Allowing buses to make manoeuvres otherwise prohibited for general traffic e.g. right turns

Stop Priority

- Kerb outstands
  - Where the left hand traffic lane is separate from the adjacent footpath, involves extension of the footpath to the outer edge of the traffic lane
  - Buses stop within the traffic lane, and do not need to wait for a gap in traffic to proceed from the stop
  - Can result in delays for following vehicles in the same lane, including other buses
- Relocation of stops to departure side of intersection

  - Reduces the likelihood of a bus stopping at the bus stop, and then also having to stop at the traffic signals
- Parking removal
  - Allows easier access to and from bus stops
- Bus stop consolidation / changes in stopping patterns
  - Reduces the number of times an individual bus is required to stop on any journey

Traffic Priority

- Additional traffic lanes – mid-block
  - Provide additional carrying capacity for traffic
  - Limited benefit without additional capacity at intersections
- Additional traffic lanes – intersections
  - Provision of additional lanes for through or turning traffic
  - Turn lanes allow separation of traffic waiting to turn, from through traffic
  - Additional through lanes increase the volume of traffic that can proceed through the intersection during each green signal phase
  - Additional lanes on sides roads can be used to minimise the amount of green time required to be allocated to side road traffic, therefore maximising the time available for main road traffic
- Lane widening
  - Narrow lanes can result in inefficiencies in lane utilisation, as drivers may maintain an offset from traffic in adjacent lanes
  - Heavy vehicles in particular can have a significant impact if lanes are too narrow
- Signal coordination
  - Coordination of traffic signal timing to minimise delays for traffic moving along or crossing a particular route
  - Signal coordination has already been applied on Macquarie Street and Davey Street, focussed on providing for through traffic.
  - Can increase travel times for cross traffic if not specifically considered in the signal coordination plan.
- On-street parking removal
  - Removal of on-street parking can be used to create additional space for other road users.
  - Where the parking lane is wide enough, a general traffic lane, or turn lane, could be introduced.
  - A parking ban during times of high traffic activity can minimise inefficiencies in lane utilisation caused by narrow lanes
- Pedestrian crossing consolidation / removal
  - Delays for turning traffic can be reduced by removing any conflicting pedestrian phases
- T2 / High Occupancy Vehicle Lane
  - Use of the lane is restricted to vehicles carrying a minimum number of people (typically 2 or 3)

– Requires adequate enforcement of restrictions (manual observation, or technology solution which may not be as reliable), and appropriate penalties.

The impacts on each of the above measures on the various travel modes relevant to this corridor are summarised in Table 7.1.

Table 7.1 shows the road user groups that will generally benefit from each of the treatments identified above. It is noted that some treatments may only receive a marginal benefit from a particular treatment, for such a situation no benefit is indicated in the table, although this will depend on specific circumstances and the design of the particular treatment.

Table 7.1 Typical Treatment Measures and Impacts on Other Modes

	Pedestrians	Cyclists	Buses	General Traffic
Pedestrian Priority				
Footpath widening	✓			
Kerb bulbing	✓			
Green waves for pedestrians	✓			
Landscaping Separation	✓			
Scramble Crossings				
Grade separation	✓			
Bike Priority				
Off-road exclusive bicycle path		✓		
On-road segregated bicycle lanes		✓		
On-road bicycle lane		✓		
On-road peak period bicycle lane		✓		
On-road bicycle/car parking lane		✓		
Wide kerbside lane		✓		
Narrow kerbside lane				
Green waves for cyclists		✓		
Bus Priority				
Dedicated busways / transitways			✓	
Bus-only streets			✓	
Bus Only Lanes and Bus Lanes			✓	
Queue jumps			✓	
Passive priority (green wave)				✓
Bus vehicle detection			✓	
Automatic Vehicle Location			✓	
B-Phase			✓	
Bus-only turn movements			✓	
Kerb outstands	✓		✓	
Departure-side stops			✓	
Parking removal			✓	
Bus stop consolidation			✓	
Traffic Priority				
Additional traffic lanes – mid-block				
Additional traffic lanes – intersections			✓	✓
Lane widening			✓	✓
Signal coordination				✓
On-street parking removal		✓		✓
Pedestrian crossing removal			✓	✓

✓ Generally positive impact

Other Treatments

This section discusses, at a high level, previously-suggested measures for the corridor, as well as other measures identified as part of this study.

Clearways – Mid-Block Sections

In the Macquarie Street and Davey Street corridor, on-street parking can reduce the capacity of the adjacent through lane due to the narrowness of these lanes, and the propensity of drivers to try and avoid being too close to vehicles in the parallel lane. Removal of parking can result in

improved capacity, although the benefits are marginal unless an additional traffic lane can be created at intersections. The greatest benefit is likely to be where existing lanes are narrow, and removal of on-street parking reduces the likelihood of drivers encroaching into the adjacent lane to avoid side-swiping parked vehicles.

There may be opportunity to remove on-street parking from various parts of the corridor, at least during peak periods. However in most cases, the additional space gained will not be sufficient (on its own) to allow an additional lane of general traffic, or a bus lane.

The removal of parking without reallocation of that space to another use, such as through creation of a bus and/or bike lane, or an additional traffic lane, risks being unpopular with the community, who may not see any benefit to their individual circumstances. There are also likely to be risks with enforcement of parking restrictions, as people may not see an obvious reason for the restriction (given parking may be permitted at other times and the space is not seen as being used for anything else), which will dilute the benefits.

For these reasons, removal of parking from mid-block sections requires specific investigation and planning, including the design of any modifications to signage and/or kerb infrastructure.

Clearways – Turn Lane Extensions

Turn lanes allow traffic waiting to turn right, or left, to be separated from through traffic in adjacent lanes. Where the volume of turning traffic is high, and/or this traffic experiences regular delays, an extended queuing area can be of significant benefit for through traffic. During peak times, removal of parking can increase the amount of turning traffic that can be stored, clear of the adjacent through lanes.

Clearways – Combined Bus and Bike Lane

In the short-medium term, full-time removal of parking is unlikely to be feasible, or warranted (refer to discussion in Section 3.3 about the daily profile of traffic activity). However peak period restrictions may be appropriate to allow the temporary reallocation of road space.

One potential treatment associated with the removal of on-street parking is a combined bus and bike lane, where there is sufficient width. In parts of the corridor, where the camber of the road at the kerb is not suitable for buses, this may be a good use of space that would otherwise not be utilised.

However, the required width of a combined bus and bike lane will not necessarily match the existing parking lane width, nor the combined width of the parking lane and adjacent traffic lane (A typical bus/bike lane is 4.5m, parking width is generally 2.2m and a traffic lane is ideally 3.5m). This may result in an inefficient use of roadspace. It may be that peak-period parking needs to be removed from both sides of the road, replaced with a full-width traffic lane or combined bus and bike lane, and when parking is permitted during off-peak periods the number of available traffic lanes reduced compared to the existing provision (which does not change between peak and off-peak conditions).

Turns off the corridor

Turns off either Macquarie Street or Davey Street, particularly left turns, create potential for a number of different conflicts:

- With pedestrians crossing the side street, whose presence reduces the time available for traffic to turn
- With following traffic, which is forced to slow to allow traffic seeking to turn to decelerate and manoeuvre into a turn lane or navigate a turn

- With cyclists, who generally prefer to ride in the left-most lane, and therefore may need to continue straight ahead while other traffic turns left in front of them
- With buses, which need to be in the left lane to utilise bus stops either upstream or downstream of an intersection, and therefore can be mixed with traffic seeking to turn left

Major turn movements off the corridor occur at

- Macquarie Street
  - Molle Street (left turn)
  - Harrington Street (left turn)
  - Murray Street (right turn)
  - Argyle Street (left turn)
  - Brooker Highway (left turn)
- Davey Street
  - Sandy Bay Road (left turn)
  - Molle Street (left turn)
  - Antill Street (left turn)
  - Southern Outlet (left turn)

Potential treatments may include changes to signal phasing (e.g. dedicated turn phases, or delayed starts for pedestrian protection), lengthening turn lanes (to allow deceleration to occur within the turn lane, rather than in the through traffic lane), continuous lanes for through traffic (i.e. left turning traffic may need to cross a bike or bus lane to enter a left turn lane), or providing additional turn capacity by allowing turns from multiple lanes.

Slip lanes, or continuous left turn lanes, can provide a higher capacity for traffic than other left turn treatments, although with potential downsides. Existing issues in the corridor associated with this type of treatment include:

- Davey Street left turn into Sandy Bay Road
  - Conflict with pedestrians crossing slip lane. The “flashing amber” signal for left turn traffic is confusing to both drivers and pedestrians. The resulting caution exercised by drivers reduces the capacity of this turn, and creates upstream congestion issues
- Macquarie Street left turn into Brooker Highway
  - The approach to this location features lane changing manoeuvres as traffic seeks to get into the appropriate lane for their destination (Brooker Highway or Tasman Highway), with a high rate of rear-end type crashes (see Section 3.8). Occasional pedestrians crossing the Brooker Highway lanes are not expected by drivers, who may brake suddenly in response.
- Davey Street left turn into Southern Outlet
  - Dual left turn lane allows for a high capacity and high speed turn onto the Southern Outlet. However, occasional pedestrian movements across the left turn lanes obstruct traffic flow. The pedestrian crossing of the left turn lanes is not well coordinated with the other phases at the intersection, and does not provide a minimum clearance time for Southern Outlet bound traffic between pedestrian calls, resulting in inefficiencies.

Bus Stop Optimisation

As discussed in Section 3.5.1, some bus stops are located relatively close to each other. Consolidation of stops to increase spacing in some locations may be a possibility.

There is the opportunity, also, to optimise bus stopping patterns, to reduce delays associated with stopping, and re-entering the traffic stream. For instance, it may be appropriate to limit the number of stops made by buses coming from or going to the Southern Outlet, with remaining stops serviced by South Hobart and Antill Street routes.

Traffic Signal Optimisation

The operational needs of the corridor vary between peak and off-peak times, as well as between the morning peak and the afternoon peak. It is appropriate to review the operation of traffic signals along the corridor to ensure that they are facilitating an appropriate balance between competing modes and user groups, and providing efficient operation.

A review should consider, amongst other things:

- Cycle times
- Phase lengths
- Offsets (time between intersections)
- Phasing (e.g. turn phases, pedestrian protection, phase ordering)

These issues should be reviewed in the context of the road user hierarchy described in Section 5, and with regard to the strategic objectives outlined in Section 4. It is noted that different traffic signal operations for different times of the day and week may be entirely appropriate, reflecting the varying needs and demand characteristics at various parts of the corridor.

Lane widths

Any specific provision for bus priority would need to ensure that adequate lane widths are available for bus operations, considering both clearance to adjacent traffic, but also to roadside infrastructure such as poles and street furniture.

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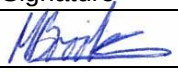
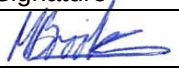
Document Status

Revision	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	T. Bickerstaff	M. Brooks		M. Brooks		2/07/18

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