Data Report

Subject	Data Report
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1 Introduction

Let's Get Wellington Moving is a joint initiative between Wellington City Council, Greater Wellington Regional Council and the NZ Transport Agency (the project partners). Together, we're working with the people of Wellington to deliver an integrated transport system that supports their aspirations for how Wellington City looks, feels and functions.

We are following a robust process drawing on three key streams of information:

- feedback received from the people of Wellington through comprehensive public engagement
- data collected on current travel patterns and recent trends
- transport activity and Wellington's economy

2 Purpose & context

This report summarises the data that has been collected for Let's Get Wellington Moving, together with data that is collected annually by the programme partners. It provides multi-modal insights in relation to current travel patterns and recent trends.

This data has been used by the project partners to:

- understand travel patterns and network performance, identify current pressures and issues, informing the Case for Change
- inform the development of a suite of transport modelling tools that will provide information to support decision making

The purpose of this report is to provide a visual and factual representation of some of the data that has been collected, together with some of the insights that can be drawn from this data, so that people know what information is being used to support the work that is being undertaken and the decisions that are being made.

Going forwards, this data will provide an evidence base that will form the foundation of any case for change and help establish the existence and scale of any problems worthy of action.

It should be noted that the data presented in this report represents only a selection of the data that has been collected for Let's Get Wellington Moving. In most instances, this data relates one point in time rather than a length of time and should be used and interpreted appropriately, namely to understand broad travel patterns and characteristics rather than providing a precise level of detail as this would ignore the fact that day to day variability is inherent in a lot of the datasets that have been collected. Limitations regarding the data and any of the assumptions used in this report are highlighted where relevant, so that the reader can understand the confidence that can be placed in the data itself.

The insights in this report are purposefully factual and are not used to support opinions or to identify solutions at this stage in the process.

3 Structure of report

The majority of the data was collected in March 2016, the primary purpose of this data collection exercise being to inform the development of a new suite of transport models that will be used to support decision making associated with Let's Get Wellington Moving.

- **Chapter 4** looks at travel patterns and trends from the Wellington CBD Cordon Survey and Census Journey to Work data
- **Chapter 5** presents motor vehicle, public transport, pedestrian and cyclist volumes along selected corridors heading towards the Wellington CBD
- **Chapter 6** uses modelled motor vehicle and public transport volumes from transport models to provide a very high level visual representation of traffic volumes and public transport volumes along all major roads and public transport routes in Wellington City
- **Chapter 7** uses traffic count data, PT patronage data and PT boardings / alighting data from the Real Time Passenger Information (RTPI) network to show how light vehicle and heavy vehicles traffic volumes, pedestrian volumes and public transport boardings / alightings vary by time of day
- **Chapter 8** presents travel speeds and travel speed variability for a selection of routes on the road network, with the data obtained from a network of Bluetooth detectors that are operational around the city, to understand how travel speeds and travel speed variability vary by route and time of day
- **Chapter 9** summarises public transport travel times and travel speeds on selected routes and along selected corridors, derived from Real Time Passenger Information (RTPI) data, to understand how public transport travel speeds and travel speed variability vary by route and time of day
- **Chapter 10** presents pedestrian travel times for selected routes through Wellington CBD, providing an indication of the delays that pedestrians are likely to experience
- **Chapter 11** summarises weekend public transport patronage relative to weekday public transport patronage
- **Chapter 12** shows the number of persons passing through selected surveyed intersections in Wellington CBD, by mode and time of day, to understand the temporal, spatial and modal differences in the number of persons on the network
- **Chapter 13** summarises conflicts between persons trying to cross Vivian Street, Karo Drive and Whitmore Street and persons in cars travelling along these three respective roads

- **Chapter 14** shows turning movements to / from Vivian Street and Karo Drive to help understand which are the significant movements that occur on this part of the network and how traffic patterns and flows change by time of day
- **Chapter 15** looks at people approaching Wellington from the north on SH1 and leaving Wellington to the north on SH1 to understand the locations at which they exit / join the motorway network and how these travel patterns vary by time of day and direction
- **Chapter 16** uses Automated Number Plate Recognition (ANPR) data to track vehicles through the network and better understand the routes that vehicles take through the network
- **Chapter 17** presents information relating to the modal share of trips to / from Wellington International Airport and the proportion of vehicles on Cobham Drive that are travelling to / from the airport
- **Chapter 18** presents results from capacity and queue length surveys undertaken at selected locations on the network to better understand queue duration
- **Chapter 19** presents a series of figures showing heavy commercial vehicles (tricks) on the network, in both absolute numbers and as a percentage of total vehicles, to understand how HCV volumes on the network vary both spatially and temporally
- **Chapter 20** summarises crash statistics, by mode, obtained from the NZTA Crash Analysis System (CAS) and focussing on Wellington CBD

Data from a number of different sources is presented in this report.

Unless otherwise stated, the following conventions apply to the data:

- data presented relates to March 2016 unless otherwise stated
- data relates to persons, as opposed to vehicles, unless otherwise stated
- 'motor vehicles' refer to cars, light trucks, heavy trucks, taxis, motorbikes
- the following factors (obtained from survey data[1] and research[2]) are used to convert the number of motor vehicles to the number of motor vehicle occupants – 1.35 (AM peak), 1.40 (Inter-peak), 1.35 (PM peak), 1.85 (weekend)

[1] http://www.gw.govt.nz/assets/Wellington-Cordon-data-report-2016.pdf
[2] http://www.pinnacleresearch.co.nz/research/survey/vehicle_occupancy.pdf

4 Travel patterns and trends

This section of the report presents analysis of historic trends in relation to understand travel patterns and characteristics.

The data comes from a number of sources and covers a range of time periods:

- Wellington CBD cordon survey – multi-modal (motor vehicle, PT, pedestrian, cycle) volumetric data spanning the period 2002 to 2016 and covering the AM peak only between 7am and 9am
- Census journey to work data – multi-modal (motor vehicle, PT, pedestrian, cycle) analysis of journey to work trips across the region in 2001 and 2013
- Traffic volume data – highway traffic volumes for selected locations on the state highway network in Wellington over the period 2002 to 2016, covering weekdays (6am to 8pm) and weekends (6am to 8pm)
- Congestion data from two sources:
    - the NZ Transport Agency travel time surveys (2003 to 2014) covering selected routes over the AM peak (7am to 9am), Inter-peak and PM peak (4pm to 6pm)
    - Tom-Tom annual congestion monitoring data from 2008 to 2015.

4.1 Wellington CBD Cordon survey

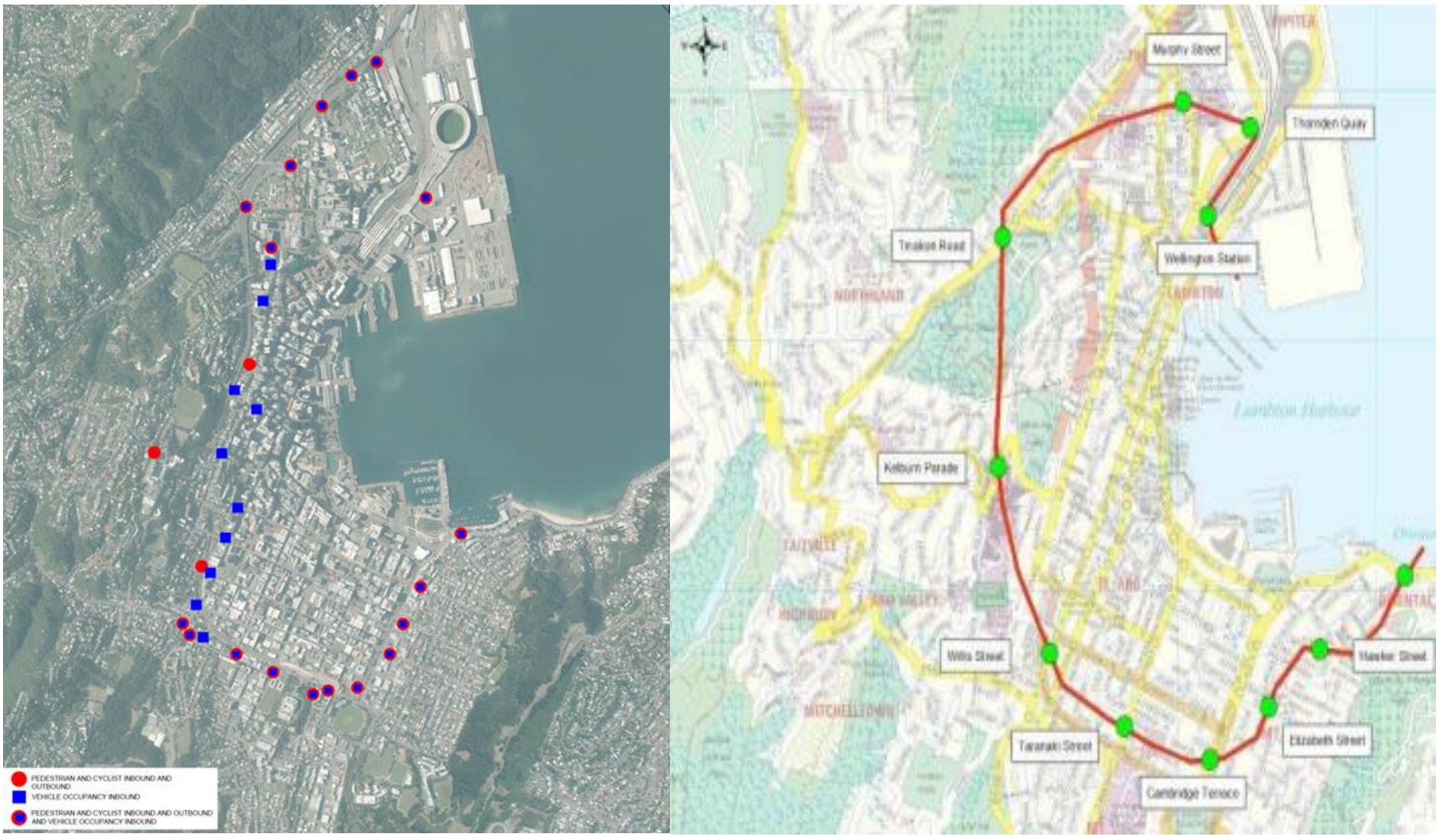
A series of annual surveys are undertaken primarily during the AM peak (7am to 9am) in March by Greater Wellington Regional Council (public transport patronage surveys) and Wellington City council (vehicle occupancy, pedestrian and cyclists surveys) to count the number of persons travelling inbound and crossing a cordon around the Wellington CBD.

This data only captures travel patterns during the relatively small 7am to 9am time series, excluding the Inter-peak, PM peak, off-peak and the increasingly important AM pre-peak (prior to 7am); therefore any multi-modal assessment of change through time will only be able to consider the 7am to 9am time period.

Whilst data presented later in this report covers the broader AM peak, Inter-peak, PM peak and Saturday time periods, the limitations regarding the cordon survey data should be understood when using and interpreting the data.

Figure 1 below shows the cordon crossing locations.

Figure 1 Wellington CBD Cordon survey crossing locations – motor vehicle occupants, pedestrians, cyclists (left), public transport passengers (right)



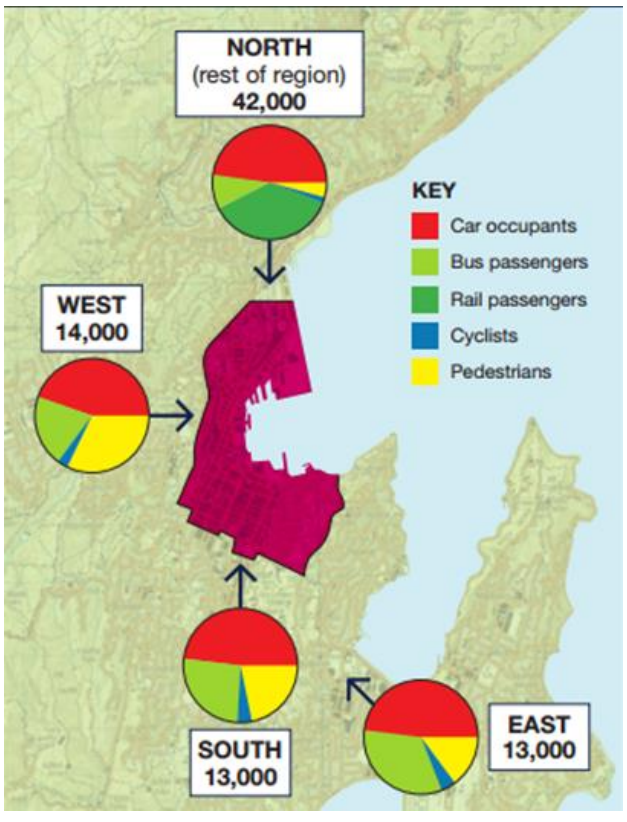
4.1.1 High level travel patterns and modal share

Figure 2 below shows the number persons crossing this cordon in March 2016, categorised by mode and their broad area of origin (which is defined from the location at which they cross the cordon).

The areas in **Figure 2** correspond to the following:

- **North** – persons originating from Khandallah, Johnsonville, Northern Suburbs, Hutt Valley, Tawa, Porirua, Kapiti, Wairarapa
- **West**– persons originating from Kelburn, Northland, Karori, Wadestown
- **South** – persons originating from Aro Valley, Berhampore, Island Bay, Newtown
- **East** – persons originating from Kilbirnie, Hataitai, Lyall Bay, Miramar

Figure 2 Persons crossing Wellington CBD cordon, 2016, by mode and area of origin



	Motor vehicle occupants	Rail passengers	Bus passengers	Pedestrians	Cyclists	Total
North	21,500	15,500	4,000	1,000	500	**42,000**
South	6,500	0	3,000	3,500	500	**13,000**
East	7,500	0	3,000	2,000	500	**13,000**
West	5,500	0	3,000	5,000	500	**14,000**
	41,000	**15,500**	**13,000**	**11,500**	**2,000**	**82,000**

The data shows the following:

- over 82,000 people cross the CBD cordon (inbound) every morning between 7am and 9am
- car occupants account for around 50% of all persons crossing the cordon
- rail mode share is greatest (40%) crossing the cordon from the north
- bus mode share is greatest from the east (30%)
- pedestrian mode share is greatest coming in from the west (35%)

In summary, modal share patterns varies from one area to the next, with the highest bus, pedestrian and rail mode share occurring in different areas.

4.1.2 Change in cordon crossing volumes through time

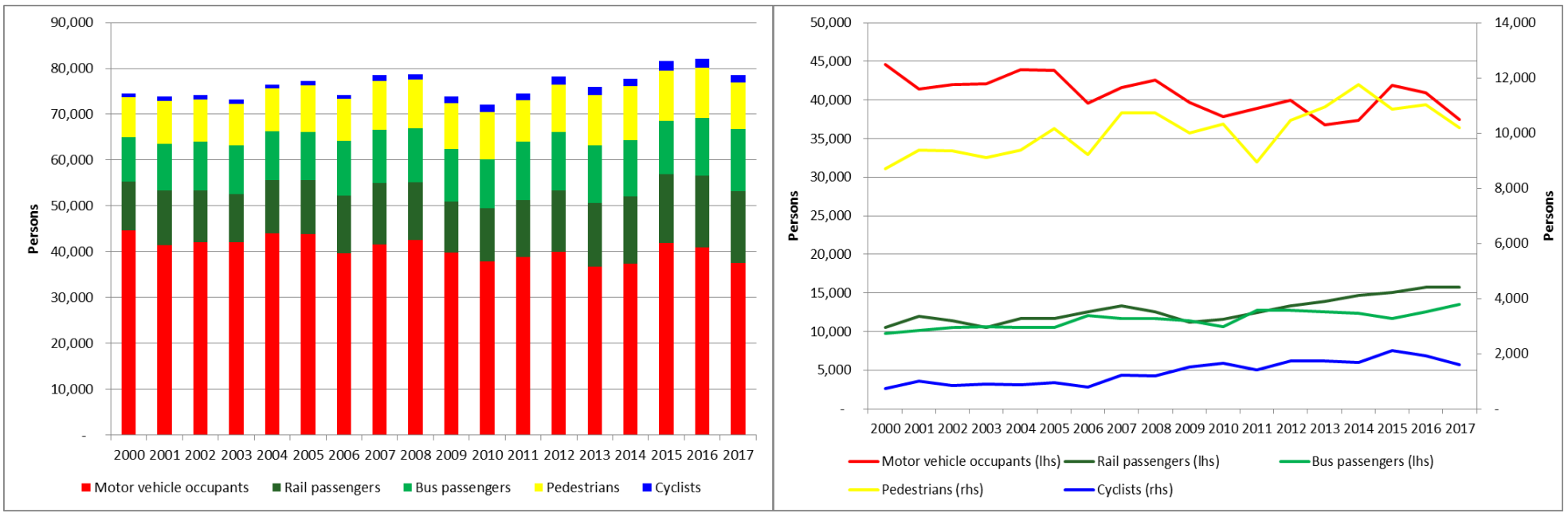
The Wellington CBD cordon survey has been undertaken every March since 2001. The survey:

- represents a snap-shot[3] of travel patterns from one point in time
- is subject to variability caused by road works, one off incidents, weather conditions (particularly in relation to cyclists and pedestrians) and general day to day variability
- does not show what changes might be happening outside of the surveyed 7am to 9am time period

Notwithstanding these limitations, the survey does provide a useful source of historic data that can be used to understand changes in travel patterns and characteristics through time.

Figure 3 below summarises the number of persons crossing the Wellington CBD cordon in the AM peak (inbound, 7am to 9am) between 2001 and 2017. It shows cumulative cordon crossing volumes by mode (left) and the cordon crossings my mode (right).

Figure 3 Number of persons crossing Wellington CBD cordon, inbound AM peak (7am to 9am), 2001 to 2017



The data shows the following:

- the general trend shows that the number of persons crossing the CBD cordon has increased between 2000 and 2017
  - due to the one-off nature of this survey, however, there are variations within this broad trend that are likely to be attributable to day to day variability and other factors such as weather conditions
  - there was a dip in total cordon crossings between 2009 and 2011

[3] Vehicle occupancy, bus and rail surveys are undertaken on one day only; pedestrian and cycle surveys are undertaken for one whole week, with average values presented in this report.

- within the overall trend, the number of motor vehicle occupants[4] crossing the cordon has maintained a largely downward trend between 2000 and 2017, whilst PT passengers (particularly rail in the last few years) has maintained a largely upward trend
- persons crossing the cordon on foot or bike have increased, with cyclists numbers having almost doubled (from a relatively low base)

Table 1 below provides further detail, showing for each year between 2001 and 2017 the absolute number of persons crossing the cordon in the AM peak, inbound, by mode, together with the modal share.

Table 1 Persons crossing Wellington CBD cordon, 2001 to 2017, Inbound, 7am to 9am, by mode

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Motor vehicle occupants	44,700	41,400	42,000	42,100	44,000	43,800	39,600	41,600	42,600	39,700	37,900	38,900	39,900	36,800	37,400	41,900	40,900	37,500
Rail passengers	10,600	11,900	11,400	10,600	11,700	11,700	12,500	13,300	12,600	11,200	11,600	12,400	13,400	13,900	14,600	15,100	15,700	15,700
Bus, ferry, cable car passengers	9,800	10,100	10,500	10,600	10,500	10,500	12,100	11,700	11,700	11,400	10,700	12,800	12,800	12,600	12,300	11,700	12,500	13,500
Pedestrians	8,700	9,400	9,300	9,100	9,400	10,200	9,200	10,700	10,700	10,000	10,300	8,900	10,500	11,000	11,800	10,900	11,000	10,200
Cyclists	700	1,000	800	900	900	1,000	800	1,200	1,200	1,500	1,600	1,400	1,700	1,700	1,700	2,100	1,900	1,600
Total	**44,700**	**41,400**	**42,000**	**42,100**	**44,000**	**43,800**	**39,600**	**41,600**	**42,600**	**39,700**	**37,900**	**38,900**	**39,900**	**36,800**	**37,400**	**41,900**	**40,900**	**37,500**
Motor vehicle occupants (ms)	59.9%	56.1%	56.7%	57.4%	57.5%	56.8%	53.4%	53.0%	54.1%	53.8%	52.6%	52.2%	51.0%	48.4%	48.1%	51.3%	49.8%	47.8%
Rail passengers (ms)	14.2%	16.2%	15.4%	14.4%	15.4%	15.2%	16.9%	16.9%	16.0%	15.2%	16.0%	16.7%	17.1%	18.3%	18.8%	18.5%	19.1%	20.0%
Bus, ferry, cable car passengers (ms)	13.2%	13.7%	14.2%	14.5%	13.7%	13.6%	16.3%	14.9%	14.8%	15.5%	14.8%	17.2%	16.3%	16.6%	15.9%	14.3%	15.3%	17.2%
Pedestrians (ms)	11.7%	12.7%	12.6%	12.4%	12.3%	13.2%	12.4%	13.7%	13.6%	13.5%	14.3%	12.0%	13.4%	14.4%	15.1%	13.3%	13.4%	13.0%
Cyclists (ms)	1.0%	1.4%	1.1%	1.2%	1.1%	1.2%	1.1%	1.6%	1.5%	2.0%	2.3%	1.9%	2.2%	2.3%	2.1%	2.6%	2.3%	2.0%

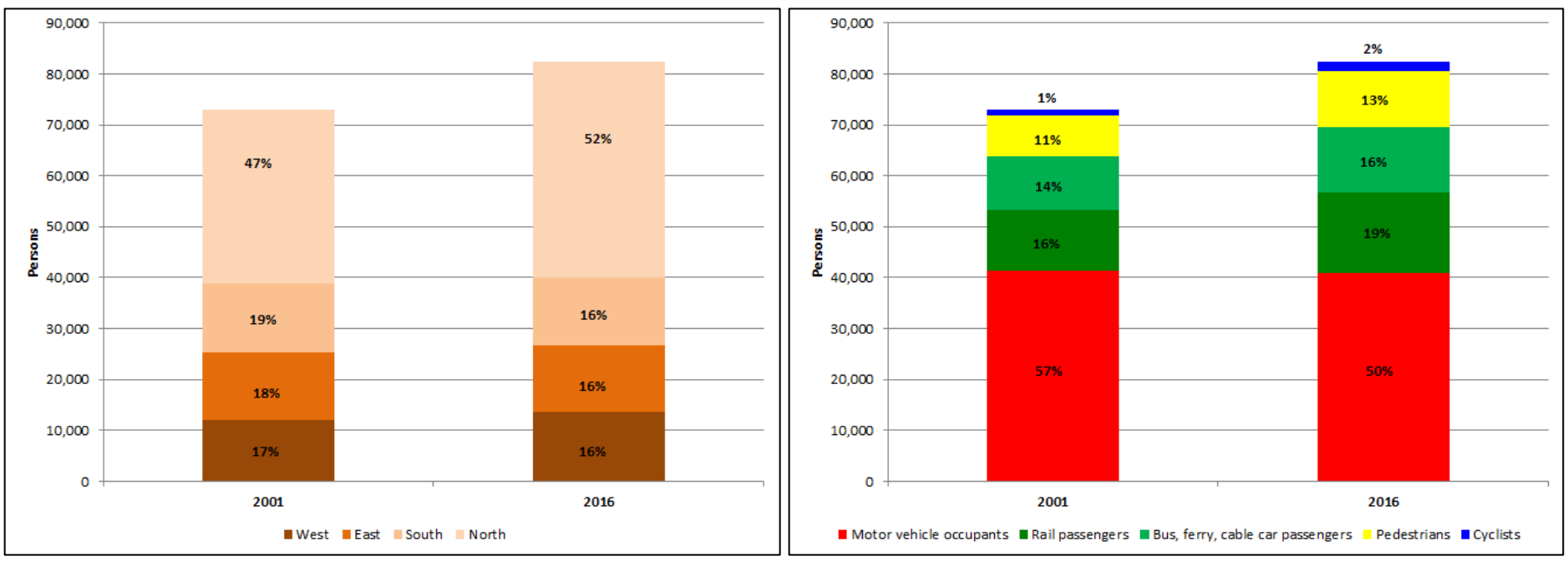
This information tells us the following:

- Car occupant modal share has fallen from around 60% in 2000 to below 50%
- Rail passenger mode share has increase from 14% to 20%, whilst bus mode share has increased from 13% to 17% in the most recent survey
- Pedestrian mode share has increased from around 12% to 14% / 15% (recent years have been lower due to inclement weather rather than any downward trend)
- Cycle mode share has increased from 1% to over 2%

4.1.3 Comparison of 2001 and 2016 cordon crossing data

Figure 4 below provides further detail and summarises the change in persons crossing the Wellington CBD cordon in the AM peak between 2001 and 2016 by origin area[5] (left) and mode of travel (right). The percentage figures on each chart represent the percentage of total trips crossing the cordon that can be attributed to each origin area (left) and mode (right).

Figure 4 Change in persons crossing Wellington CBD cordon, 2001 to 2016, by origin area (left) and mode of travel (right)



The data shows the following:

- between 2001 and 2016, the majority of the growth in persons crossing the CBD cordon can be attributed to people coming in from the north; in 2001, 47% of people crossing the cordon came in from the north, a figure that has risen to 52% in 2016
- the number of motor vehicle occupants crossing the cordon has increased slightly between 2001 and 2016, although in percentage times car passengers crossing the cordon has decreased from 57% of all crossings (2001) to 50% (2016)
- PT cordon crossing volumes have increased significantly between 2001 and 2016 (rail growth has been greater than bus growth)
- pedestrian and cycle cordon crossing volumes have increased significantly (the latter from a relatively low base)

4.1.4 Multi-modal volumes along selected corridors

This section goes to a greater level of detail, with **Figure 5** showing the number of persons crossing the cordon, by mode, at selected locations.

[4] Persons in cars, light trucks, heavy trucks, taxis, motorcycles
[5] North, South, East, West as per Figure 2

Figure 5 Persons crossing Wellington CBD cordon, inbound, AM peak 2016 (7am to 9am) by mode and corridor

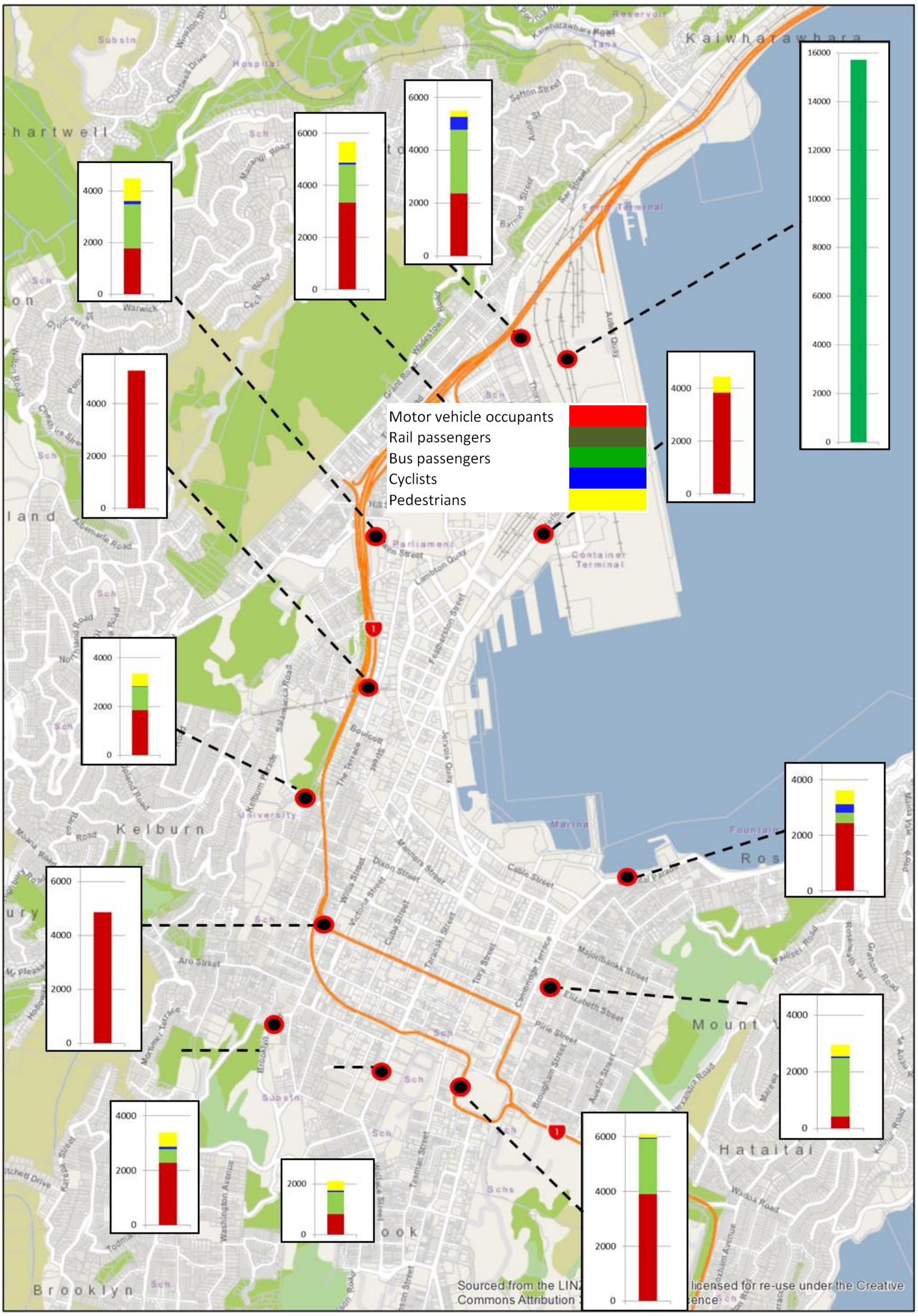


Figure 5 shows the following:

- over 15,000 people arrive into Wellington each morning by train
- Aotea Quay, Terrace off-ramp, Vivian Street and Buckle Street are the busiest motor vehicle occupant crossing points, with between 4,000 and 5,000 persons in motor vehicles passing these points in the AM peak
- over half of all persons crossing the cordon on Thorndon Quay and Glenmore Street do so by bus, cycle or on foot
- the busiest bus corridors – Elizabeth Street (eastern suburbs), Adelaide Road (southern suburbs), Glenmore Street (Karori) and Thorndon Quay (Northern suburbs) – each transport around 2,000 bus passengers heading towards the CBD between 7am and 9am

Figure 6 below provides an approximate breakdown of the 15,000 persons arriving into Wellington station in the AM peak (March 2016) by line. It shows that the Hutt Valley (6,000) and Kapiti (6,500) lines account for the majority of rail passenger arrivals, with the Johnsonville line (1,500) and Wairarapa line (1,000) accounting for the remainder.

Figure 6 Number of rail passengers arriving into Wellington during the morning peak (7am to 9am) by line, March 2016

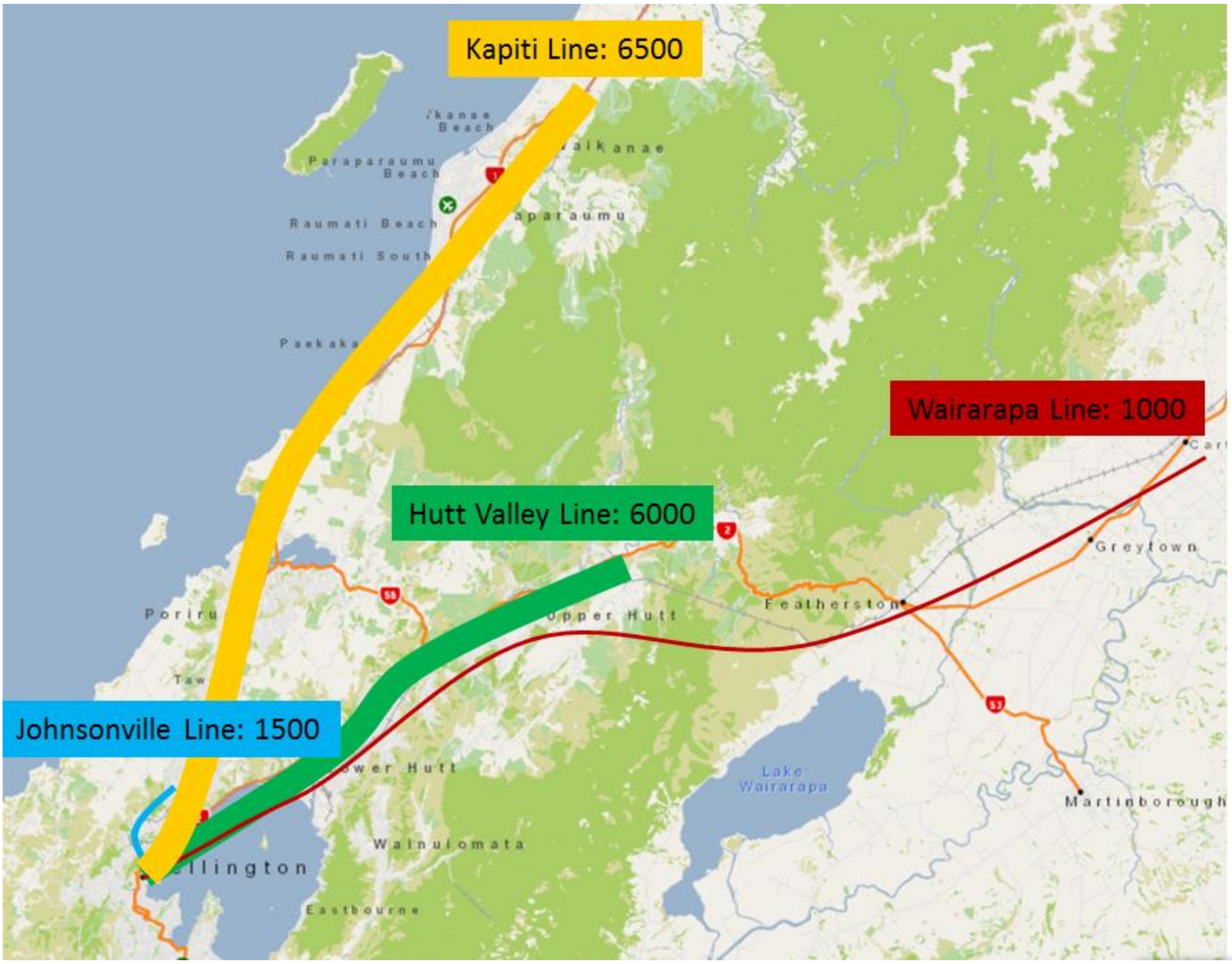


Figure 7 shows the number of inbound cyclists / pedestrians crossing the CBD cordon in March 2016 at all surveyed locations[6]. The height of the bar graphs are proportionate to the number of people observed heading inbound between 7am and 9am at the relevant locations (cyclists = blue, pedestrians = yellow).

Figure 7 Pedestrians and cyclists crossing CBD cordon, inbound, AM peak March 2016 (7am to 9am)

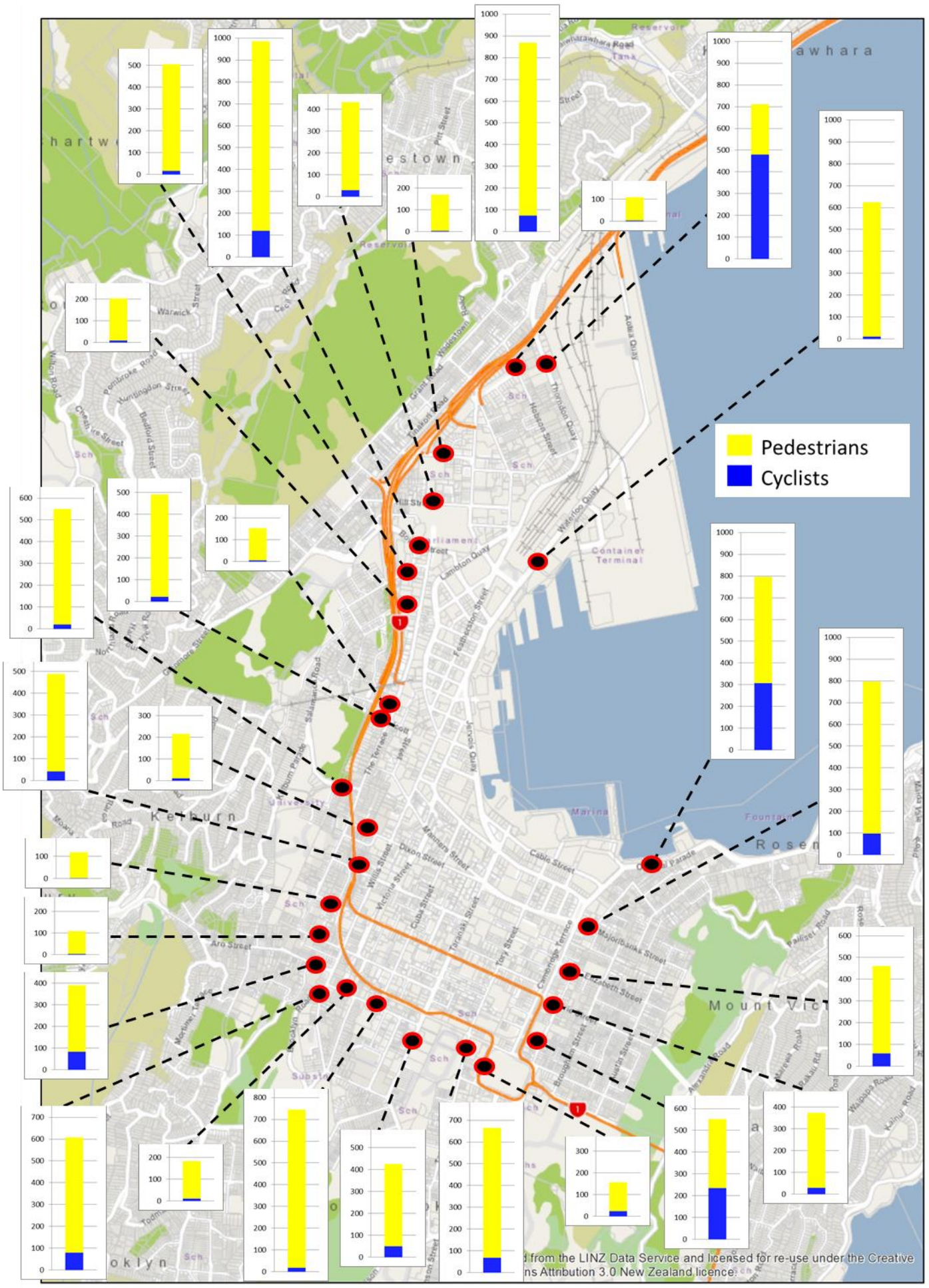


Figure 7 shows the following:

- over 11,000 pedestrians and 2,000 cyclists cross the Wellington CBD cordon, inbound, in the AM peak
- Thorndon Quay (~400), Adelaide Road (~250) and Oriental Parade (~300) are the busiest cycle corridors into the CBD between 7am and 9am
- Majoribanks Street (650), Tasman Street (500, Cuba Street (700), Glenmore Street (800) and Murphy Street / Molesworth Street (700) are the crossing points that see the highest pedestrian volumes

4.2 Census Journey to Work (JTW)

The Census is undertaken every 5 years, the most recent dates being 2001, 2006 and 2013[7]. One section of the Census asks people about their journey to work, obtaining information such as mode of travel, origin (home) and destination (place of work), providing a rich source of consistent data that can be used to understand historic changes in travel patterns.

For the purpose of the analysis presented in this report we have split the region into 6 sectors:

- Wellington east (Miramar, Hataitai, Lyall Bay, Kilbirnie)

[6] Figures are an average over 5 weekdays
[7] Re-scheduled from 2011 due to Christchurch earthquake.

- Wellington south (Island Bay, Berhampore, Brooklyn, Newtown, Mt Cook)
- Wellington west (Karori, Northland, Wadestown)
- Wellington north (Ngaio, Khandallah, Johnsonville, Newlands, Churton Park, Tawa)
- Rest of region (Lower Hutt, Upper Hutt, Porirua, Kapiti, Wairarapa)
- Wellington CBD (Te Aro, Wellington Central, Thorndon)

4.2.1 Analysis of 2013 Census JTW

Figure 8 below show 2013 journey to work trips from **all origins within the region** to **destinations within Wellington City**, categorised by mode[8]. The size of each symbol is proportionate to the number of journey to work trips made to destinations within a particular area (i.e. 7,500 journeys are made to workplaces in North Wellington) and the colours correspond to the proportion of trips made by a particular mode (i.e. majority of the 7,500 journeys to workplaces in North Wellington are made by car).

Figure 8 Journey to work trips from all origins within region to destinations within Wellington City, by mode of travel.

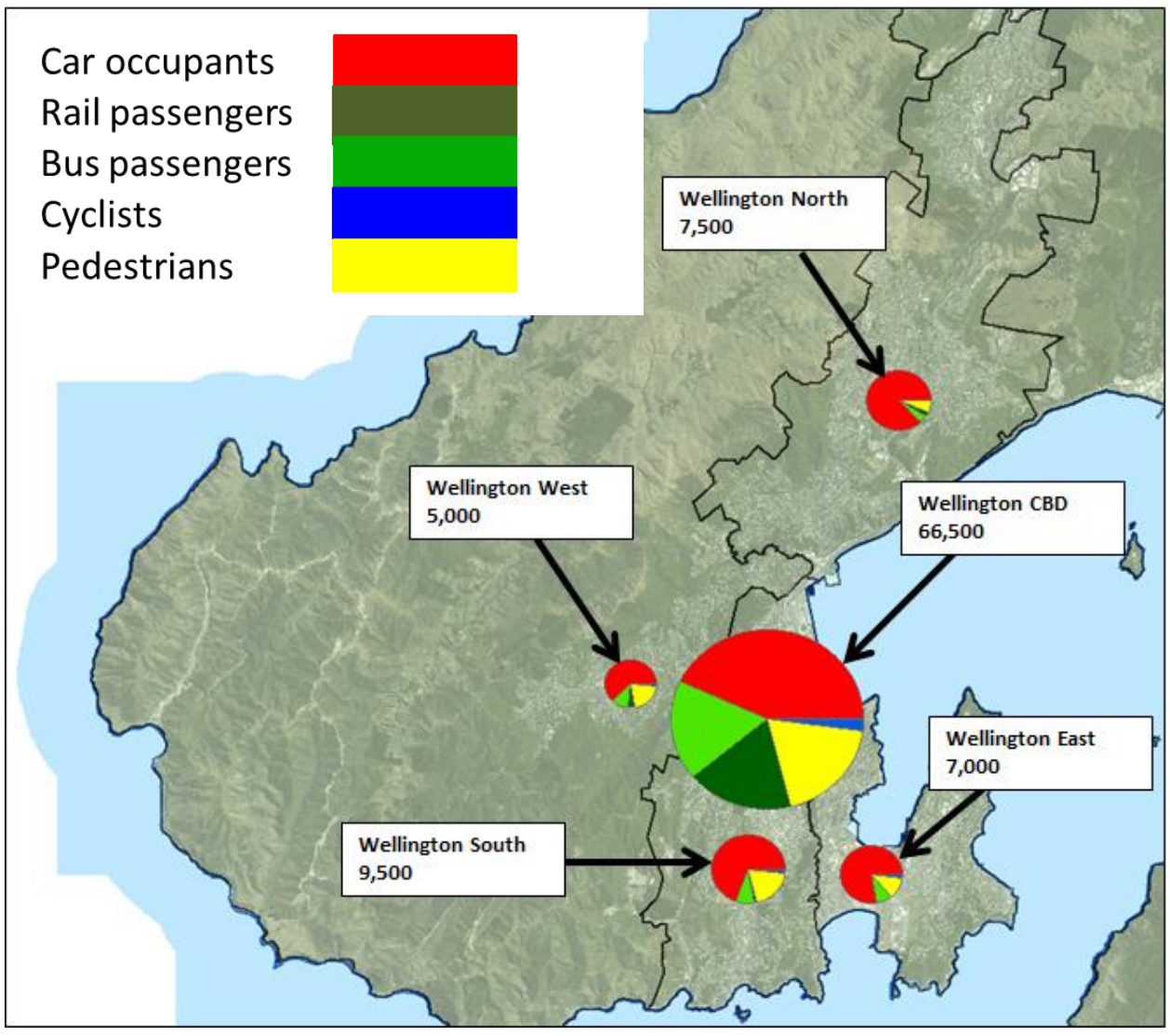


Figure 8 shows the following:

- Wellington CBD is the dominant destination for journey to work trips terminating within Wellington City
- over half of all journey to work trips to Wellington CBD are made by non-car modes (PT 35% , Walking 15%, Cycling 3%, Car 47%)
- car is the dominant mode of travel for journey to work trips to destinations outside of Wellington CBD, with walking the second most popular mode

Figure 9 below shows journey to work trips by origin sector, categorised according to whether the journey to work involves a routes that crosses through Wellington CBD (**red**) or does not involve a route that crosses the CBD (**blue**).

Trips that would cross the CBD are defined as follows:

- north Wellington / rest of region to south / east Wellington (and vice-versa)
- west Wellington to south / east Wellington (and vice-versa)

Whilst approximate, this approach is considered appropriate for the purpose of identifying at a very high level the number / proportion of journey to work trips that are likely to involve travel across Wellington CBD (likely routes being the Inner City Bypass and Waterfront for vehicles and the Golden Mile for public transport).

[8] Wellington City = Wellington City Territorial Authority; this analysis excludes journeys to work in destinations in other TAs across the region

Figure 9 Journey to work trips by origin sector and routing – cross CBD or not crossing CBD

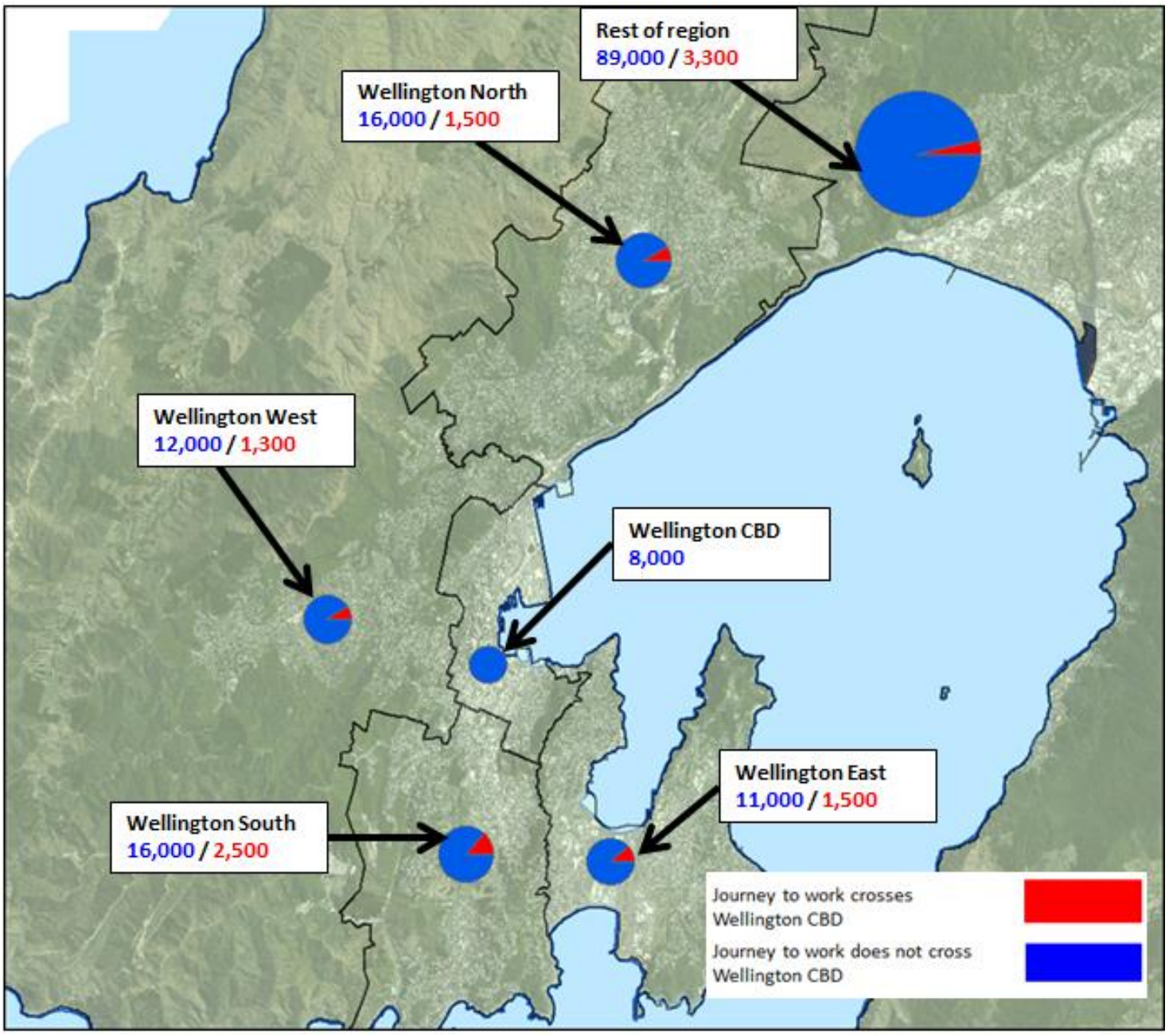


Figure 9 shows the following:

- only a very small proportion of journey to work trips originating in west Wellington (1,300), north Wellington (1,500) and the rest of the region (3,300) involve a trip through Wellington CBD to their final destination
- a slightly higher proportion of trips originating from east Wellington (1,500) and south Wellington (2,500) involve a cross-city trip to reach their final destination
- overall, about 13,000 journeys to work within the region involve a trip across Wellington CBD out of over 162,000daily journey to work trips across the region

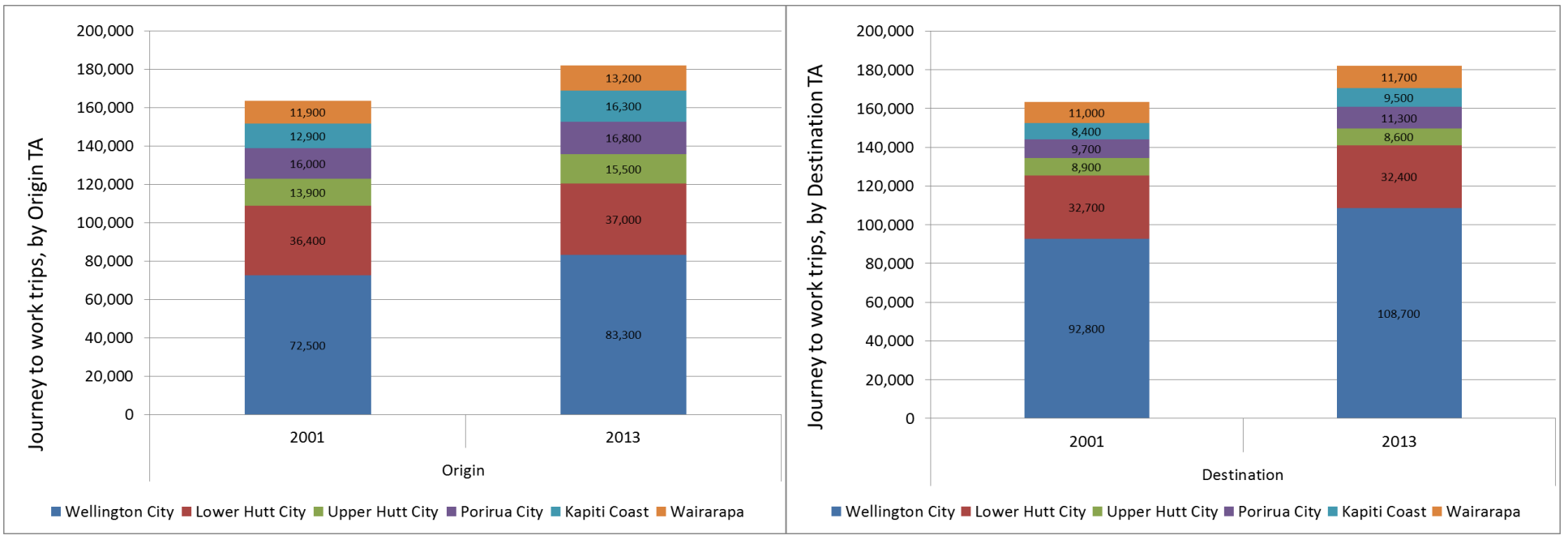
4.2.2 Comparison of 2001 and 2013 Census JTW

This section compares the 2001 and 2013 Census journey to work data to understand how travel patterns have changed through time. Whilst it is acknowledged that the Census only provides a snap-shot from one day and was last undertaken 4 years ago, it is the richest, most comprehensive source of nationally consistent observed data available relating to work travel patterns and consequently can provide value in understanding these travel patterns and changes through time.

Origin and destinations

Figure 10 below shows the change in journey to work trips categorised by the territorial authority (TA) within which the origin (home) and destination (work) of a particular journey is located.

Figure 10 Journey to work trips by origin area (left) and destination TA (right), 2001 and 2013



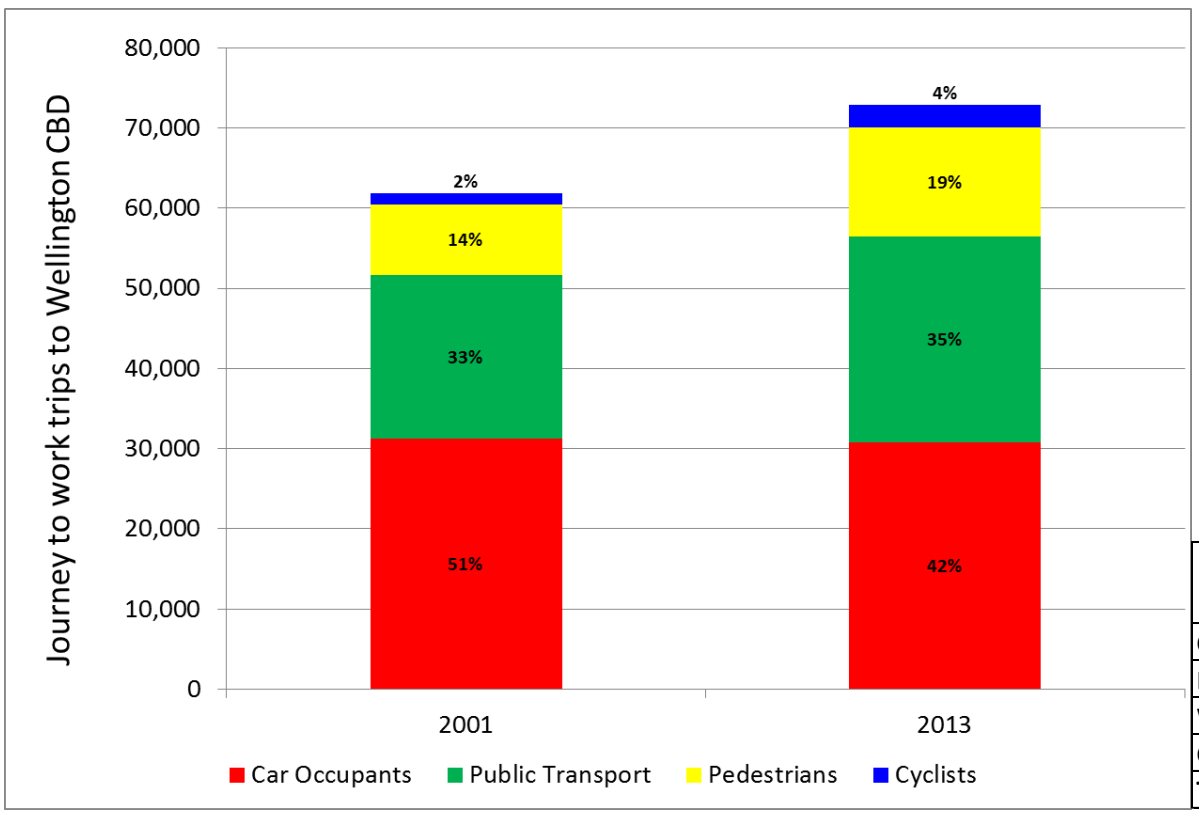
The origin data shows that there has been a 19,000 increase in journey to work trips within the region between 2001 and 2013, with Wellington City having accounted for around 11,000 of this increase with the rest of the region accounting for the remaining 8,000.

In terms of destinations, there has been around a 15,000 increase in persons travelling to work in Wellington City, accounting for around 80% of the 19,000 increase in journey to work trips between 2001 and 2016.

Modal share of journey to work trips to destinations in Wellington CBD

Figure 11 below shows the change in journey to work trips to Wellington CBD by mode between 2001 and 2013. The percentage figures represent the percentage of total JTW trips made by a particular mode.

Figure 11 Journey to work trips to Wellington CBD by mode, 2001 and 2013 (mode share in brackets)



	2001	2013	Absolute differences	Percentage difference
Car	31,400	30,800	-600	-2%
PT	20,400	25,600	5,200	20%
Walk	8,800	13,400	4,600	34%
Cycle	1,400	3,000	1,600	53%
Total	**62,000**	**72,800**	**10,800**	**15%**

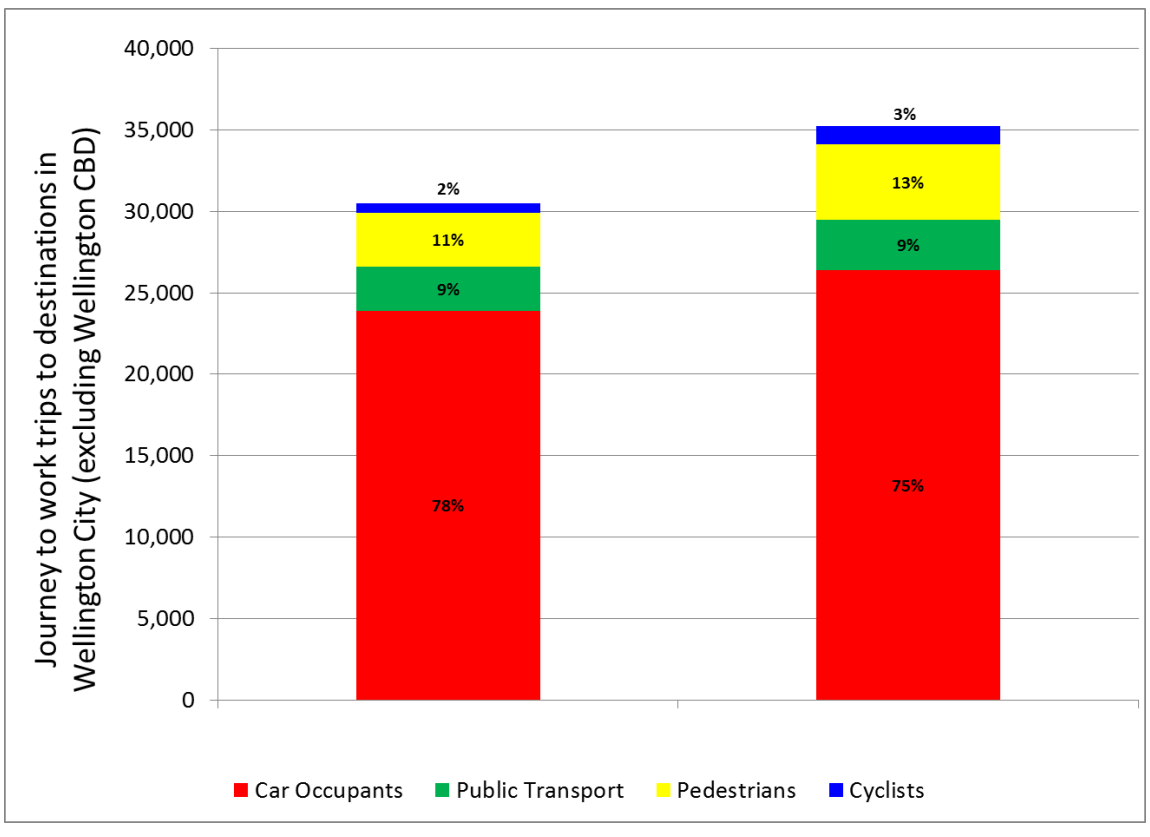
It shows the following:

- no growth in car JTW trips to Wellington CBD between 2001 and 2013
- PT (5,200) and active modes (walking 4,600 and cycling 1,600) account for all 10,800 additional JTW trips to Wellington CBD between 2001 and 2013
- in percentage terms, walking and cycling have seen 34% and 53% growth respectively in journey to work trips to Wellington CBD

Modal share of journeys to work to destinations in Wellington City (excluding CBD)

Figure 12 below shows changes in journey to work trips to destinations in Wellington City (excluding Wellington CBD) by mode between 2001 and 2013. The percentage figures represent the percentage of total JTW trips made by a particular mode.

Figure 12 Journey to work trips to destinations in Wellington City (excluding Wellington CBD) by mode, 2001 to 2013 (mode share in brackets)



	2001	2013	Absolute differences	Percentage difference
Car	23,800	26,400	2,600	10%
PT	2,600	3,200	600	19%
Walk	3,400	4,600	1,200	26%
Cycle	600	1,200	600	50%
Total	**30,400**	**35,400**	**5,000**	**14%**

It shows the following:

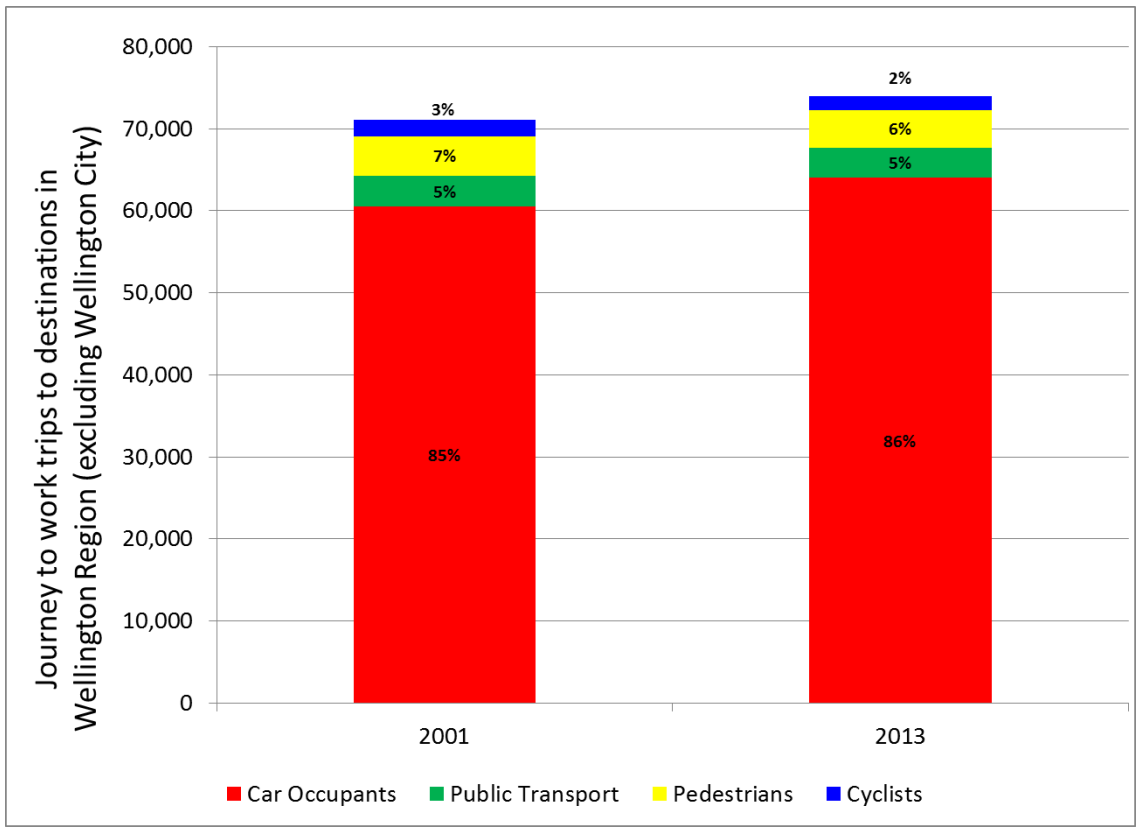
- a 14% growth in journey to work trips to places of work within Wellington City (but excluding Wellington CBD)
- car (2,600), active modes (walking 1,200 and cycling 600) and PT (600) account for the 5,000 increase in journey to work trips
- in percentage terms, walking and cycling trips have increased the most between 2001 and 2013, followed by PT and car

- overall, however, car trips account for the majority (75% in 2013) of journey to work trips to destinations in Wellington City (excluding Wellington CBD)

Modal share of journey to work trips to destinations in Wellington Region (excluding Wellington City and CBD)

Figure 13 below shows journey to work trips to destinations in the Wellington region (excluding Wellington City and Wellington CBD) in 2001 and 2013. The percentage figures represent the percentage of total JTW trips made by a particular mode.

Figure 13 Journey to work trips to destinations in Wellington Region (excluding Wellington City and Wellington CBD), 2001 and 2013 (mode share in brackets)



	2001	2013	Absolute differences	Percentage difference
Car	60,600	64,000	3,400	5%
PT	3,800	3,600	-200	-6%
Walk	4,800	4,600	-200	-4%
Cycle	2,000	1,600	-400	-25%
Total	**71,200**	**73,800**	**2,600**	**4%**

It shows the following:

- an overall 4% growth in journey to work trips to destinations within Wellington region (excluding Wellington City) between 2001 and 2013
- car (3,400 increase) is the only mode that contributes to this increase; other modes see slight decreases
- overall, 86% of journey to work trips to destinations within the Wellington Region (excluding Wellington City and Wellington CBD) are undertaken by car

Car, PT, pedestrian and cyclist percentage share (modal share) of all journey to work trips

Table 2 below summarises the change in journey to work trips across the region between 2001 and 2013, together with the respective modal shares for both years.

Table 2 Change in journey to work trips across the Wellington Region, 2001 to 2013, by mode

	2001 journey to work trips		2013 journey to work trips		Absolute difference – 2001 to 2013	Percentage difference – 2001 to 2013
	Number	Modal share	Number	Modal share		
Car occupant	115,800	71%	121,200	67%	5,400	4%
PT	26,800	16%	32,400	18%	5,600	17%
Pedestrian	17,000	10%	22,600	12%	5,600	25%
Cyclist	4,000	2%	5,800	3%	1,800	31%
Total	163,600	100%	182,000	100%	18,400	10%

Table 2 shows the following:

- journey to work trips have increased by 10% (18,400) between 2001 and 2013
  - car occupant, PT and pedestrian journey to work trips within the region have seen similar increases in absolute terms
  - in percentage terms, however, car occupant trips have increase by 4%, PT by 17% and pedestrian by 25%
- cycling trips increased by the greatest amount in percentage terms (31%) from a relatively low base
- car mode share of journey to work trips has decreased from 71% to 67%, with PT, pedestrian and cyclist mode share increasing

Summary of Census journey to work analysis

Summarising the analysis presented in this section:

- 60% of the growth in journey to work trips between 2001 and 2013 is associated with trips to destinations in Wellington CBD, 30% associated with destinations in Wellington City (excluding CBD) and 10% associated with destinations outside of Wellington City
- all of the net 15% (10,000) growth in journey to work trips to Wellington CBD has been accounted for by PT and active modes
- the net increase in journeys to work to other areas of Wellington City (5,000) is split evenly between car and other modes

- the small net increase (2,600) in journeys to work in destinations outside of Wellington City is entirely accounted for by the private car; there has actually been a contraction (800) in journeys to work to destinations outside of Wellington City made by other modes

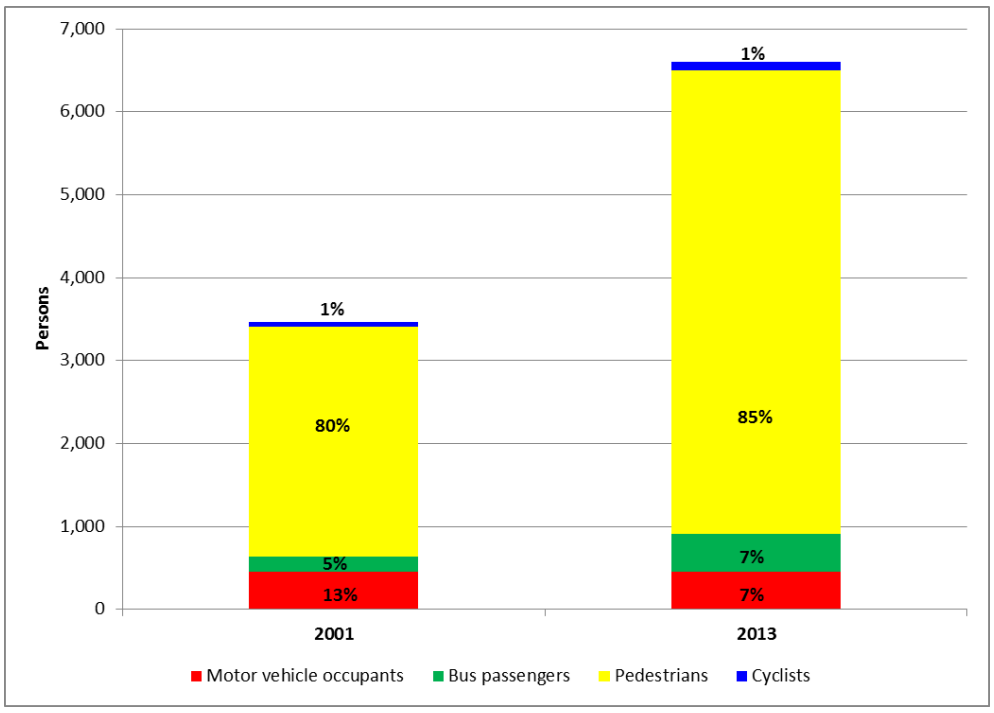
4.2.3 Journey to work trips within Wellington CBD

Whilst the Wellington CBD cordon survey data and high level Census journey to work data provides a wealth of information regarding the number of persons entering or passing through the CBD, it does not capture movements within the CBD itself.

When analysed at a higher level of granularity, however, the Census journey to work data gives us an indication of the number of people who live in the Wellington CBD and work in Wellington CBD and the mode that they choose for their commute.

Figure 14 below shows the number of persons living and working in Wellington CBD[9] in 2001 and 2013 and the mode that they use to travel to work.

Figure 14 Journey to work trips within Wellington CBD, 2001 and 2013 (mode share in brackets)



The data shows the following:

- the number of persons living and working in the CBD has almost doubled between 2001 and 2013 from around 3,500 to 6,500
- walking accounts for the majority (over 80%) of journeys to work, with PT (7%) and car (7%) accounting for relatively few journey to work trips

4.3 Change in state highway traffic volumes through time

This section summarises changes traffic volumes between 2002 and 2016 for selected locations on the state highway network, as obtained from the NZ Transport Agency's Traffic Monitoring System (TMS).

The specification and coverage of the data that is presented is as follows:

- represents annual average counted vehicle volumes (cars, light vehicles, heavy vehicles, buses)
- is aggregated to an hourly level (with further aggregation undertaken for presentational purposes)

Two-way average daily traffic volume data has been obtained from loop counters embedded in the road. Whilst this provides a continuous 24/7 flow of data for most locations, this method can be susceptible to miscounting particularly under low traffic flow conditions and is also dependent upon contractors loading the data into the NZTA TMS database at regular intervals in order that it can be used for analysis.

Due to these data gaps, data for the following locations / years / months is presented for the purpose of understanding changes in trends through time.

- Petone to Ngauranga (SH2)- 2002 to 2016, average of May and November
- Ngauranga Gorge (SH1) - 2002 to 2016, average of May and November
- Terrace Tunnel - 2002 to 2016, average of May, June, July and September
- Ruahine Street - 2011 to 2016, average of May to November

The data is presented as follows:

- Average weekday traffic volumes (by time period)
- Average Saturday traffic volumes (10am to 4pm)
- Average Sunday traffic volumes (10am to 4pm)

4.3.1 High level summary of change through time

In order to place the changes in traffic volumes in context, **Table 3** below shows the change in population that has occurred over the period 2002 to 2016:

Table 3 Change in Wellington City and regional population, 2001 to 2016

Year	2001 Population	2016 Population	Absolute Difference	% Difference
Wellington City	164,000	207,000	+43,000	26%
Rest of region	259,000	294,000	+35,000	14%
Wellington Region	423,000	501,000	+78,000	18%

[9] Defined as Te Aro, Lambton Quay, Thorndon Census area units

The data shows the following:

- the population of Wellington City has increased by 43,000 between 2001 and 2016, and has seen a faster rate of increase (26%) than the corresponding rate of increase in population for the rest of the region during the same period (18%)
- overall, the regional population has grown by 78,000 (18%) between 2001 and 2016

Table 4 below shows changes in traffic volumes between 2002 and 2016 (Petone to Ngauranga, Ngauranga Gorge) and from 2011 to 2016 (Terrace Tunnel, Ruahine Street), expressed as values, percentage differences and compound annual growth (CAGR) over the reported period.

Table 4 Two-way traffic volumes at selected state highway locations in Wellington City – weekday, Saturday, Sunday

	Weekday (6am to midnight)				Saturday (10am to 4pm)				Sunday (10am to 4pm)			
	2002	**2016**	**% diff**	**CAGR**	**2002**	**2016**	**% diff**	**CAGR**	**2002**	**2016**	**% diff**	**CAGR**
State Highway 2 Petone to Ngauranga (two-way)	43,250	41,850	-3%	-0.2%	16,900	17,300	2%	0.2%	17,400	18,950	9%	0.6%
State Highway 1 Ngauranga Gorge (two-way)	40,650	43,050	6%	0.4%	18,100	18,350	1%	0.1%	18,650	20,850	12%	0.7%
	2011	**2016**	**% diff**	**CAGR**	**2011**	**2016**	**% diff**	**CAGR**	**2011**	**2016**	**% diff**	**CAGR**
Terrace Tunnel (two-way)	40,250	41,350	3%	0.5%	19,200	19,400	1%	0.2%	21,550	22,550	5%	0.9%
Ruahine Street (two-way)	29,750	30,950	4%	0.8%	14,400	14,850	3%	0.6%	16,600	17,350	5%	0.9%

At a high level the data shows the following:

- small decrease in total weekday two-way traffic volumes between 2002 and 2016 on State Highway 2 and a 6% increase in traffic volumes along SH1 (Ngauranga Gorge) over the same period
- limited growth (3% to 4%) in weekday traffic volumes between 2011 and 2016 on Ruahine Street and Terrace Tunnel between 6am and 9am
- little growth in Saturday traffic volumes (10am to 4pm) across all surveyed sites
- 9% and 12% increases in Sunday traffic volumes on SH2 and SH1 respectively between 2002 and 2016 and a 5% increase in Sunday traffic volumes on Ruahine Street and through the Terrace Tunnel between 2011 and 2016

Table 5 below focusses on changes in weekday traffic volumes, by time of day, between 2002 and 2016 (Ngauranga Gorge, Petone to Ngauranga, Terrace Tunnel) and 2011 to 2016 (Ruahine Street). All volumes relate to peak direction, expect Ruahine Street which relates to two-way volumes.

Table 5 Peak direction weekday traffic volumes at selected state highway locations in Wellington City by time of day, 2002 to 2016 (except Ruahine Street, 2011 to 2016)

	AM Peak Period					PM Peak Period			
	6am to 7am	**7am to 9am**	**9am to 10am**	**Total – 6am to 10am**		**3pm to 4pm**	**4pm to 6pm**	**6pm to 7pm**	**Total – 3pm to 7pm**
State Highway 2 Petone to Ngauranga – peak direction (AM = SB, PM = NB)	100%	-15%	-8%	**1%**		3%	-9%	-6%	**-6%**
	4.7%	-1.1%	-0.5%	**-0.1%**		0.2%	-0.7%	-0.4%	**-0.4%**
State Highway 1 Ngauranga Gorge – peak direction (AM = SB, PM = NB)	104%	-9%	3%	**8%**		17%	2%	-5%	**3%**
	4.9%	-0.6%	0.2%	**0.5%**		1.0%	0.1%	-0.3%	**0.2%**
Terrace Tunnel – peak direction (AM = SB, PM = NB)	65%	0%	16%	**15%**		14%	1%	10%	**6%**
	3.4%	0.0%	1.0%	**0.9%**		0.8%	0.1%	0.6%	**0.4%**
Ruahine Street (two-way)	24%	7%	5%	**9%**		0%	0%	0%	**0%**
	4.4%	1.3%	0.9%	**1.7%**		0.0%	0.0%	0.0%	**0.0%**

The data shows the following:

- traffic volumes during all peak period time slices on SH2 have declined slightly between 2002 and 2016; the exception is during the AM peak between 6am and 7am where persons travelling in this time period has increased by 100% and during the PM peak between 3pm and 4pm where there has been a slight 4% increase in traffic volumes
- a traffic volumes on SH1 at Ngauranga Gorge in the AM peak have increased by 104% between 2002 and 2016 during the 6am to 7am time period; there is also a corresponding (smaller) 17% increase in northbound traffic volumes between 2002 and 2016 during the 3pm to 4pm period
- across the 4 hour morning peak and evening peak periods, traffic growth rates for both SH1 (Nguaranga Gorge) and SH2 (Petone to Ngauranga) between 2002 and 2016 have been relatively modest, with the most significant growth rate (8% or 0.5% per annum) seen on SH1 (Ngauranga Gorge) heading inbound in the morning peak
- AM peak traffic volumes through the Terrace Tunnel have increased by 15% between 2002 and 2016, with the largest increase (65%) occurring between 6am and 7am and no increase between 7am and 9am[10]
- along Ruahine Street, AM peak traffic volumes have grown by 7% between 7am and 9am but by 24$ during the 6am to 7am period; there has been no growth over this period across the entire 4hr PM peak period[11]

[10] Note, some of this increase will be due to the opening of the Inner-City bypass in 2006/07 (resulting in reassignment of traffic from the waterfront) as opposed to organic traffic growth resulting from an increase in car trips

[11] Due to the format of the data we are unable to disaggregate the traffic volumes by direction (i.e. NB vs SB)

Overall, data from the 4 locations shows that the significant increases in traffic volumes through time have been mainly confined to the fringes of the peak periods, such as during the 6am to 7am pre-peak period or 3pm to 4pm pre-peak period; traffic volumes between 7am and 9am / 4pm to 6pm have remained largely unchanged or, at a number of locations, decreased between 2002 and 2016.

Table 6 below focusses on changes in weekday traffic volumes, by time of day, between 2002 and 2016 (Ngauranga Gorge, Petone to Ngauranga, Terrace Tunnel) and 2011 to 2016 (Ruahine Street). All volumes relate to the counter-peak direction.

Table 6 Counter-peak direction weekday traffic volumes at selected state highway locations in Wellington City by time of day, 2002 to 2016 (except Ruahine Street, 2011 to 2016)

	AM Peak Period					PM Peak Period			
	6am to 7am	7am to 9am	9am to 10am	Total – 6am to 10am		3pm to 4pm	4pm to 6pm	6pm to 7pm	Total – 3pm to 7pm
State Highway 2 Petone to Ngauranga – counter peak direction (AM = NB, PM = SB)	43%	5%	0%	**7%**		-7%	-4%	-13%	**-7%**
	2.4%	0.3%	0.0%	**0.5%**		-0.5%	-0.3%	-0.9%	**-0.5%**
State Highway 1 Ngauranga Gorge – counter peak direction (AM = NB, PM = SB)	80%	15%	5%	**17%**		9%	2%	-4%	**2%**
	4.0%	1.0%	0.3%	**1.1%**		0.6%	0.1%	-0.3%	**0.1%**
Terrace Tunnel – counter peak direction (AM = NB, PM = SB)	100%	21%	13%	**25%**		13%	20%	19%	**18%**
	4.7%	1.3%	0.8%	**1.5%**		0.8%	1.2%	1.2%	**1.1%**

The rate of increase in counter-peak direction traffic volumes is greater than the rate of increase in peak direction traffic volumes.

The data shows that, contrary to the peak direction, counter-peak direction traffic volumes have increased at all locations with the exception of SH2, Petone to Ngauranga, in the PM peak. Similar to the peak direction, the percentage increases in the AM peak are greatest in the 6am to 7am pre-peak (though volumes are relatively low compared to the 7am to 9am peak period).

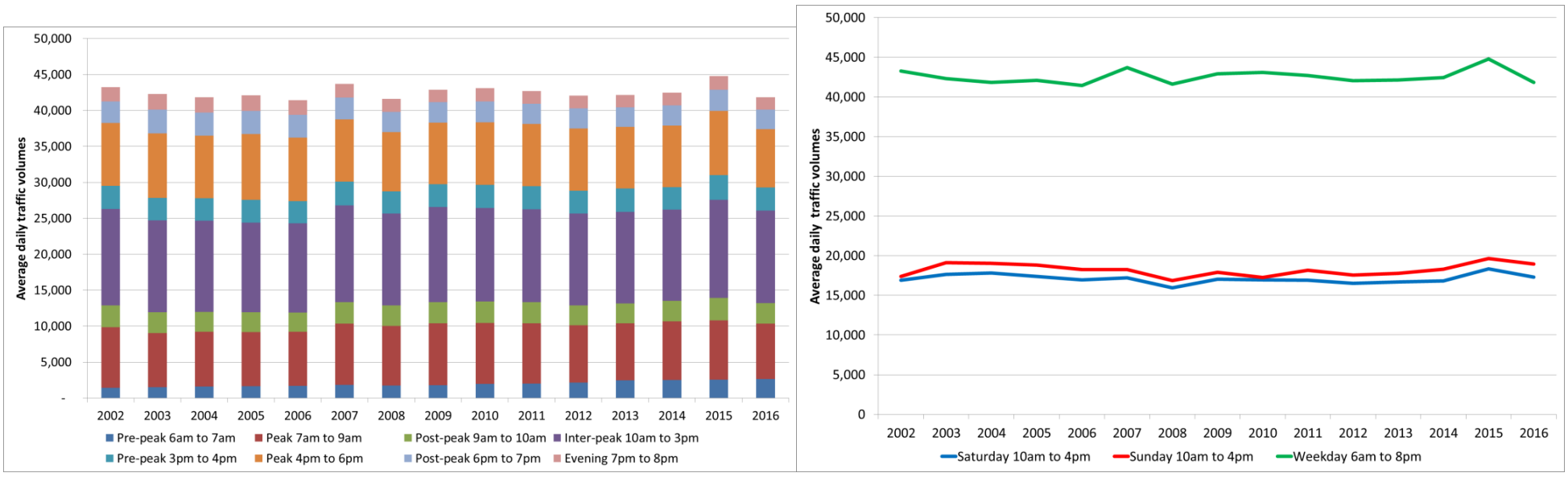
4.4 Detailed summary of change through time

This section shows changes in traffic profiles by weekday time of day and day of the week.

4.4.1 SH2 – Petone to Ngauranga

Figure 15 below shows changes in traffic volumes through time for weekday time periods (left) and weekday totals, Saturday and Sunday (right).

Figure 15 SH2 Petone to Ngauranga – changes in two-way traffic volumes by time period and day of week, 2002 to 2016

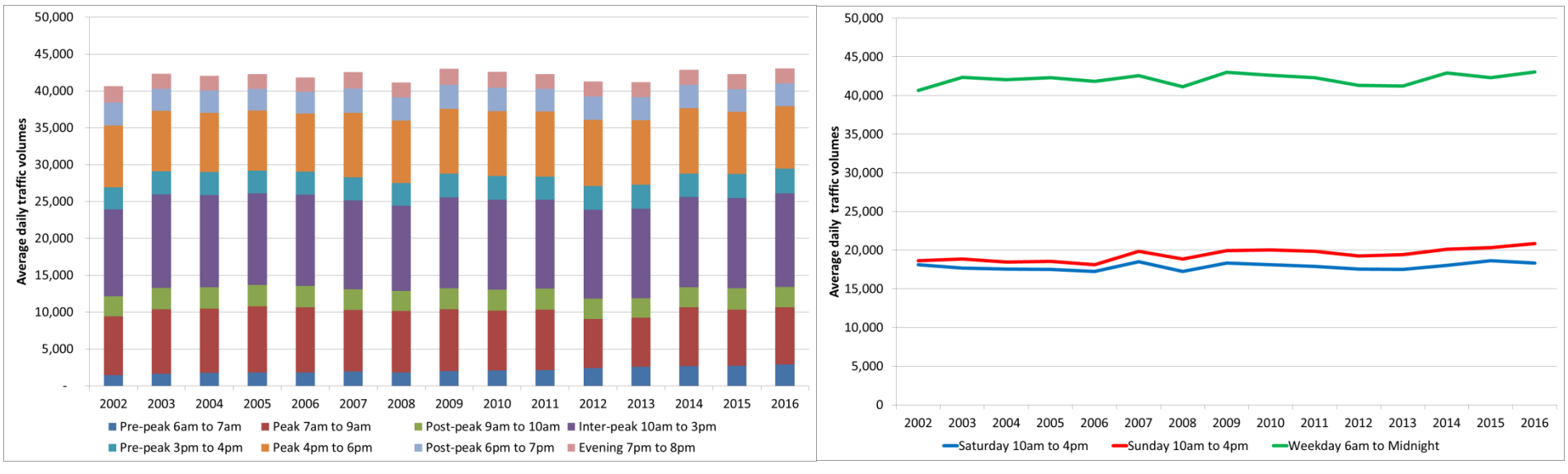


Overall there has been a slight decline in average daily weekday traffic volumes between 2002 and 2016, though weekend volumes have risen slightly.

4.4.2 SH1 – Ngauranga Gorge

Figure 16 below shows changes in traffic volumes through time for weekday time periods (left) and weekday totals, Saturday and Sunday (right).

Figure 16 SH1 Ngauranga Gorge – changes in two-way traffic volumes by time period and day of week, 2002 to 2016

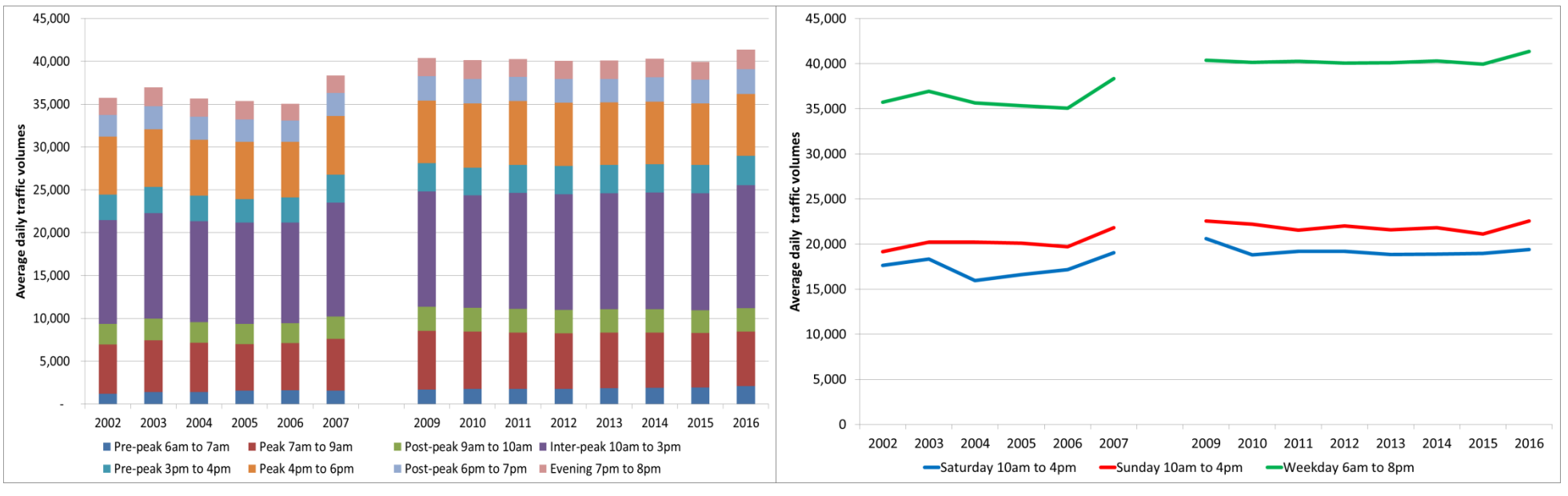


Overall there has been a slight increase in SH1 two-way weekday and weekend traffic volumes between 2002 and 2016 (the weekend increase is more pronounced).

4.4.3 SH1 – Terrace Tunnel

Figure 17 below shows changes in traffic volumes through time for weekday time periods (left) and weekday totals, Saturday and Sunday (right).

Figure 17 SH1 Terrace Tunnel – changes in two-way traffic volumes by time period and day of week, 2002 to 2016

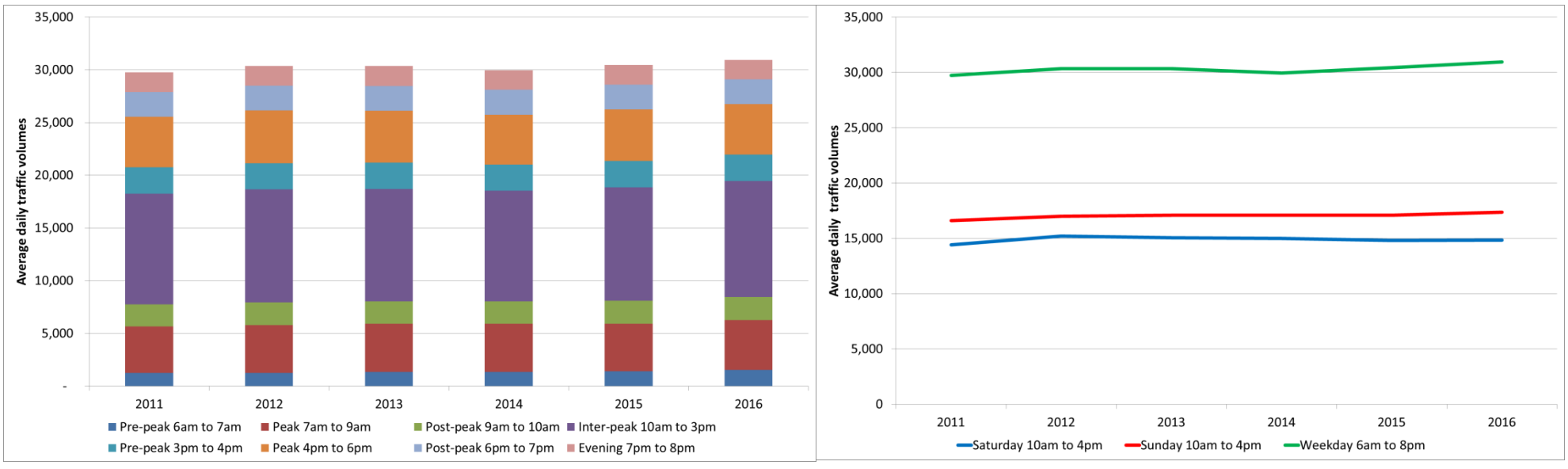


The increase in average daily traffic volumes from 2006 to 2007 is primarily due to the opening of the Inner City Bypass in March 2007; from 2009 to 2016, average daily traffic volumes through the Terrace Tunnel have remained broadly flat.

4.4.4 SH1 – Ruahine Street

Figure 18 below shows changes in traffic volumes through time for weekday time periods (left) and weekday totals, Saturday and Sunday (right).

Figure 18 SH1 Ruahine Street – changes in two-way traffic volumes by time period and day of week, 2002 to 2016



4.5 Variation in traffic volumes by time of day

Figures 19 to **Figure 21** below show two-way traffic volumes at selected locations, obtained from tube count data in March 2016, expressed as a percentage of traffic volumes observed during the busiest weekday two hour period.

Figure 19 Weekday two-way traffic volumes, by hour, expressed as percentage of busiest weekday hour

Start time	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00
End time	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	0:00
Aotea Quay	7%	5%	4%	5%	10%	17%	45%	91%	89%	72%	55%	59%	62%	60%	68%	76%	96%	100%	74%	45%	35%	31%	24%	15%
Brooklyn Road	5%	3%	2%	2%	3%	7%	25%	77%	99%	64%	54%	56%	57%	58%	63%	71%	85%	100%	80%	56%	43%	33%	23%	12%
Glenmore Street	3%	2%	1%	1%	2%	9%	27%	81%	100%	69%	55%	55%	59%	56%	63%	74%	85%	89%	77%	58%	40%	33%	23%	10%
Hutt Road	3%	2%	2%	2%	3%	8%	29%	84%	100%	70%	60%	61%	66%	64%	67%	74%	83%	82%	55%	36%	25%	18%	14%	7%
Oriental Parade	9%	3%	2%	3%	10%	14%	21%	69%	98%	68%	52%	54%	57%	57%	64%	78%	100%	96%	77%	49%	35%	38%	27%	14%
Ruahine Street	0%	0%	0%	0%	0%	16%	68%	99%	86%	92%	89%	86%	88%	91%	100%	100%	93%	93%	99%	85%	62%	18%	10%	5%
Salamanca Road	7%	4%	2%	3%	4%	10%	28%	71%	98%	94%	80%	79%	84%	80%	84%	87%	99%	100%	88%	68%	54%	43%	35%	18%
SH2 (Petone to Ngauranga)							61%	92%	88%	68%	60%	62%	64%	65%	70%	80%	100%	96%	67%	43%				
SH1 (Johnsonville to Ngauranga)							65%	94%	84%	66%	58%	58%	61%	62%	70%	80%	98%	100%	73%	50%				
SH1 (Terrace Tunnel)							53%	84%	82%	71%	71%	73%	76%	76%	83%	90%	100%	90%	76%	60%				

The weekday comparison shows the following:

- that the 'busiest' hour for two-way traffic volumes is generally found between 4pm and 6pm in the evening
- there are two notable exceptions:
  - Glenmore Street and Hutt Road where the busiest hour is between 8am and 9am
  - Ruahine Street where the busiest hour is actually between 2pm and 4pm (equal)
- Inter-peak two-way traffic volumes are typically between 55% and 65% of traffic volumes in the busiest hour, with the following exceptions
  - Ruahine Street and Salamanca Road where inter-peak traffic volumes are between 80% and 95% of those in the busiest hour
  - Terrace Tunnel, where Inter-peak traffic volumes are 70% to 75% of those in the busiest peak hour
- AM peak 6am to 7am, traffic volumes are:
  - between 60% and 65% of busiest hour volumes on SH2 (Petone to Ngauranga) and SH1 (Ngauranga Gorge and Terrace Tunnel)
  - around 45% of busiest hour volumes along Aotea Quay
  - 53% of busiest hour volumes through the Terrace Tunnel but 68% on Ruahine Street
  - between 20% and 30% of busiest hour volumes on all other local road arterials

Figure 20 Saturday two-way traffic volumes, by hour, expressed as percentage of busiest weekday hour

Start time	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00
End time	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	0:00
Aotea Quay	15%	10%	9%	6%	7%	8%	16%	33%	36%	48%	57%	69%	71%	76%	75%	74%	68%	65%	61%	40%	32%	29%	35%	25%
Brooklyn Road	16%	10%	6%	5%	4%	5%	9%	20%	39%	60%	74%	79%	81%	85%	83%	84%	83%	80%	63%	51%	41%	33%	33%	22%
Glenmore Street	9%	6%	4%	3%	3%	5%	13%	25%	41%	67%	78%	90%	95%	87%	91%	85%	82%	79%	64%	46%	32%	29%	29%	19%
Hutt Road	6%	4%	4%	3%	4%	4%	7%	15%	29%	51%	63%	75%	71%	70%	63%	61%	54%	42%	30%	23%	17%	13%	14%	10%
Oriental Parade	10%	6%	4%	3%	3%	3%	8%	20%	34%	45%	70%	89%	92%	92%	91%	92%	83%	78%	64%	46%	35%	28%	26%	15%
Ruahine Street	26%	16%	7%	9%	18%	18%	30%	53%	75%	88%	102%	98%	93%	99%	98%	99%	94%	97%	79%	58%	43%	37%	34%	23%
Salamanca Road	22%	21%	13%	10%	8%	6%	11%	21%	43%	62%	72%	77%	81%	99%	74%	96%	78%	82%	67%	54%	44%	37%	43%	34%
SH2 (Petone to Ngauranga)							18%	29%	40%	53%	61%	68%	72%	72%	70%	67%	67%	63%	51%	36%				
SH1 (Johnsonville to Ngauranga)							21%	32%	45%	57%	66%	71%	74%	75%	72%	71%	72%	70%	58%	40%				
SH1 (Terrace Tunnel)							22%	39%	59%	73%	82%	85%	85%	84%	82%	84%	85%	81%	67%	48%				

The Saturday traffic volume profiles show the following:

- between 10am and 6pm, Ruahine Street traffic volumes are generally close to (and over between 10am and 11am) the busiest hour two-way traffic volumes from the AM peak
- local arterials – Oriental Parade, Brooklyn Road, Glenmore Street, Salamanca Street – generally have two-way traffic volumes between 11am and 5pm that are between 80% and 95% of busiest weekday hour traffic volumes
  - Glenmore Street and Hutt Road where the busiest hour is between 8am and 9am
  - Ruahine Street where the busiest hour is actually between 2pm and 4pm (equal)
- SH2 (Petone to Ngauranga), SH1 (Ngauranga Gorge) and Aotea Quay Saturday traffic volumes during the day range between 60% to 75% of traffic volumes during the busiest weekday hour
- Terrace Tunnel weekend traffic volumes are higher, at between 80% and 85% of busiest weekday hour traffic volumes

Figure 21 Sunday two-way traffic volumes, by hour, expressed as percentage of busiest weekday hour

Start time	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00
End time	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	0:00
Aotea Quay	18%	13%	13%	13%	12%	7%	12%	25%	26%	41%	52%	66%	73%	77%	74%	72%	66%	66%	43%	33%	33%	24%	18%	11%
Brooklyn Road	15%	11%	9%	6%	6%	4%	7%	16%	33%	54%	69%	77%	91%	87%	80%	87%	79%	71%	59%	38%	37%	25%	17%	9%
Glenmore Street	13%	7%	6%	3%	2%	3%	8%	16%	31%	54%	73%	82%	95%	89%	90%	86%	82%	80%	58%	42%	39%	25%	17%	8%
Hutt Road	6%	5%	3%	3%	3%	4%	5%	8%	16%	33%	47%	56%	60%	59%	64%	58%	47%	43%	29%	20%	19%	14%	8%	4%
Oriental Parade	12%	7%	6%	5%	4%	4%	6%	14%	26%	49%	64%	80%	87%	90%	96%	92%	88%	72%	59%	43%	34%	33%	24%	14%

Ruahine Street	19%	10%	7%	8%	17%	14%	20%	32%	54%	77%	94%	104%	102%	98%	101%	102%	101%	98%	85%	67%	61%	5%	1%	1%
Salamanca Road	26%	20%	19%	13%	10%	6%	8%	15%	35%	57%	71%	82%	84%	84%	77%	75%	71%	70%	54%	47%	44%	32%	21%	14%
SH2 (Petone to Ngauranga)							11%	17%	26%	43%	52%	61%	68%	70%	69%	67%	66%	58%	45%	33%				
SH1 (Johnsonville to Ngauranga)							13%	20%	31%	51%	59%	67%	73%	73%	72%	71%	71%	64%	52%	40%				
SH1 (Terrace Tunnel)							14%	23%	39%	61%	75%	82%	88%	85%	81%	83%	83%	79%	64%	49%				

The Sunday traffic volume profiles are broadly similar to the Saturday traffic volume profiles with the following differences:

- On Sundays, traffic volumes start to build up around 1hr later than on Saturdays
- Between 11am an 5pm, with the exception of 1pm to 2pm, two-way traffic volumes exceed weekday busiest hour traffic volumes

4.6 Analysis of historic congestion indicators

Data is presented below from a two sources – the NZ Transport Agency travel time surveys (2003 to 2014) and Tom-Tom annual congestion monitoring data from 2008 to 2015.

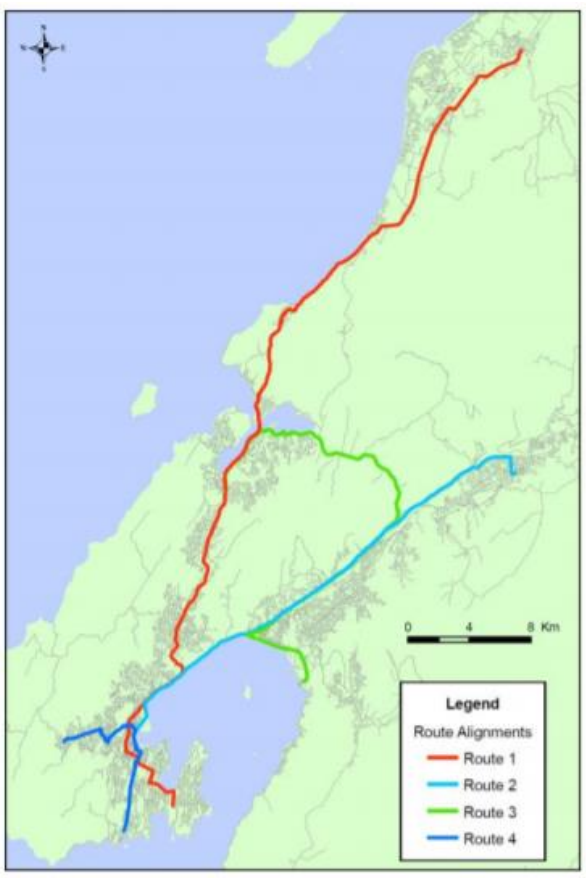
Whilst it is acknowledged that there are many different ways that congestion can be measured and that data from these sources focus only on either a small proportion of the region's road network (strategic routes, as defined for monitoring purposes in RLTP) or a specific segment of users (owners of Tom-Tom devices) they provide an indication of how congestion has changed through time.

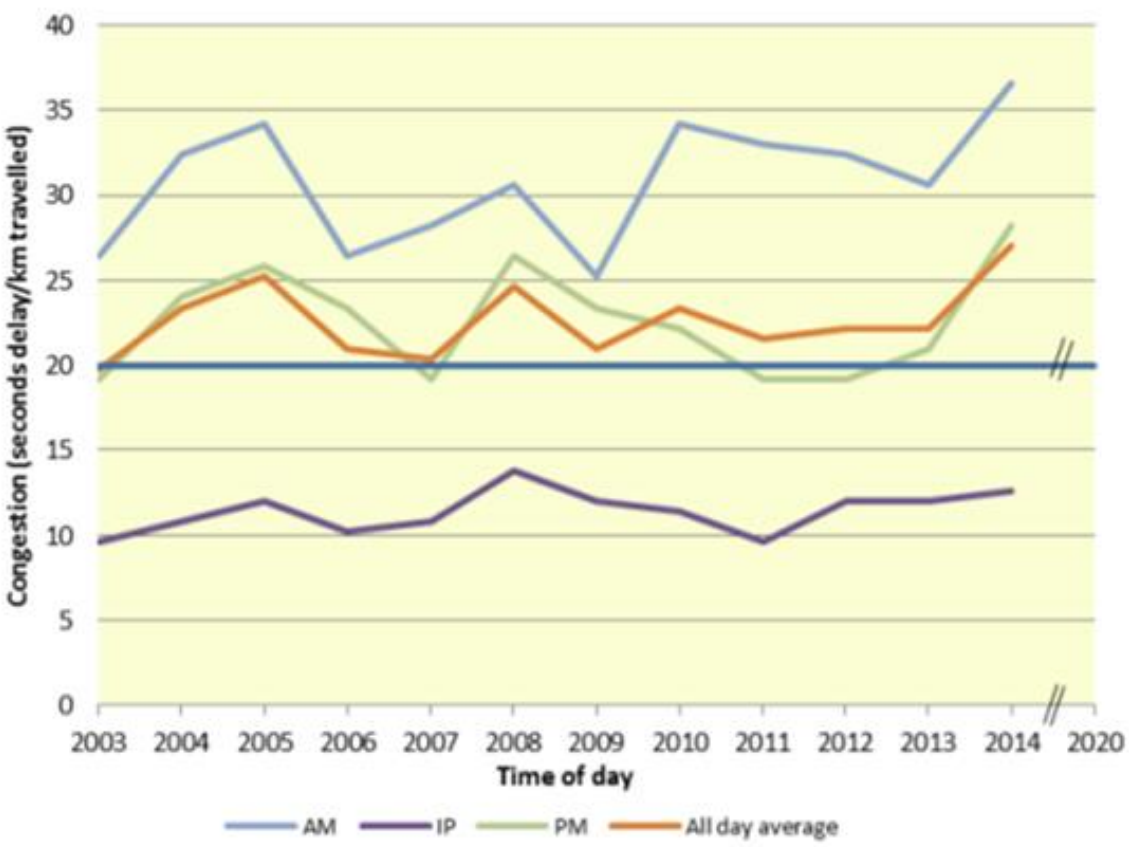
4.6.1 Annual NZ Transport Agency travel time surveys

Figure 22 below shows morning peak period (AM), inter-peak period (IP) and afternoon peak period (PM) congestion, together with a composite indicator of all-day average congestion (measured in seconds delay per kilometre travelled).

This data was obtained from the NZ Transport Agency's March travel time surveys that cover selected routes across region's strategic road network, with the data collected manually by cars undertaking a number of journeys on each route during the required time periods. Monitoring by this method was discontinued in 2014.

Figure 22 Regional travel time performance network (left) and average congestion (seconds delay/km travelled) by the time of day (right)





The data shows the following:

- peak period congestion has not increased in a linear fashion:
  - there was an initial sharp increase in congestion between 2003 and 2005
  - congestion then dropped, remaining at or below 2005 levels until 2013
  - there was a further significant increase in congestion between 2013 and 2014
- between 2008 and 2014:
  - congestion has increased from 26s to 36s per kilometre (AM peak) and 20s to 27s (PM peak)
  - Inter-peak congestion has also increased, but at a slower rate (compared to peak congestion), increasing from 10s to around 12s per kilometre
  - all day congestion has increased from 20s (2008) to 26s per kilometre in 2014
- AM peak congestion is worse the PM peak congestion, which itself is worse than inter-peak congestion
- Average all-day congestion is comparable to average PM peak congestion

4.6.2 Tom-Tom congestion indicator

Technology firm Tom-Tom measures congestion across 360 cities worldwide and compiles a congestion index. This measure of congestion is developed by obtaining travel time data from people's Tom-Tom devices, deriving off-peak (assumed to be free-flow) and peak period travel times for a particular route and calculating the "percentage increase in overall travel times compared to free-flow (uncongested) conditions".

For example, a journey that takes 60 minutes under free-flow conditions but takes 75 minutes during peak periods would have a score of 25% (15 additional minutes / 60 minutes free-flow time).

There are, however, a number of limitations with this methodology:

- it focusses on differences between peak and off-peak travel times, so cities where there is a lot of all-day congestion could perversely score well as there will not be much difference between peak and off-peak
- it only focuses on one mode (car) and looks at vehicles rather than people
- it does not account for fact that the speeds at which roads most effectively move the most traffic can actually be slightly below free-flow
- it only uses data from Tom-Tom devices and could potentially be biased towards major routes and miss people using less congested routes
- smaller cities with shorter travel distances can look disproportionately bad – i.e. a 60 min journey (free-flow conditions) where congestion delays you by an additional 30 minutes would get a score of 50%, whereas a 15 min journey (free-flow conditions) where congestion delays you for an additional 15 minute would score 100%

Whilst these limitations suggest that the index values themselves should be used with caution, the same methodology has been used for a number of years (2008 onwards) and the results provide a good indicator of congestion trends over the last 10 years within the Wellington Region.

Table 7 below shows the Tom-Tom congestion index for Wellington between 2008 and 2016[12]

Table 7 Tom-Tom Wellington congestion index, 2008 to 2016

Year	Congestion index (% increase in travel time at peak periods compared to free-flow
2008	25
2009	26
2010	26
2011	25
2012	25
2013	27
2014	29
2015	30
2016	34

The data shows the following:

- the congestion index was relatively unchanged between 2008 and 2015, fluctuating between 25% and 26%
- from 2012, the index gradually rose from 25% to 30% in 2014
- there was a significant jump in congestion over the last year (2015 and 2016) from 30% to 34%

The data generally reinforces the travel time survey data findings, namely that congestion levels increased in 2013 and 2014 after a number of relatively flat years.

5 Public Transport Capacity

5.1 Bus network

The Wellington CBD cordon survey (2016) captured 333 buses entering the Golden Mile between 7am and 9am carrying just over 12,000 people.

The surveys estimate passenger volumes (seated and standing) on all services passing selected points; the services can be matched with reported bus capacities (seated and standing) to develop a picture of the volume / capacity ratio of services on certain corridors. Whilst it is only a point survey undertaken on a specific day, therefore representing observations from one point in time, it provides a valuable source of information regarding bus patronage trends.

Table 8 below shows, for each corridor, the number of persons (in both absolute terms and as percentage of total corridor volume) who are travelling on buses where:

- Seated V/C ratio is greater than 85% when crossing the CBD cordon, a level above which people started to perceive congestion and might decide to stand even if seats are available
- Seated V/C ratio is above 100% when crossing the CBD cordon, meaning that the service is full and that some people are likely to be required to stand
- Total V/C ratio (seated + standing capacity combined) exceeds 85% when crossing the CBD cordon, broadly resulting in 10 or more people

Table 8 Summary of bus volumes, capacity and volume / capacity ratios, by corridor, 2016

					Persons on services where….					
					Seated V/C ratio greater than 85%		Seated V/C ratio greater than 100%		Total V/C ratio greater than 85%	
	Seated	Standing	Total	% of total	Absolute	% of total	Absolute	% of total	Absolute	% of total
Oriental Parade	300	65	365	18%	215	59%	215	59%	170	47%
Elizabeth Street	1,828	194	2,022	10%	1,348	67%	610	30%	308	15%
Cambridge Terrace	1,901	151	2,052	7%	1,427	70%	1,059	52%	215	10%
Taranaki Street	812	75	887	8%	453	51%	329	37%	57	6%
Willis Street	765	126	891	14%	582	65%	582	65%	289	32%
Salamanca Street	518	30	548	5%	349	64%	186	34%	48	9%
Bowen Street	1,189	357	1,546	23%	1,486	96%	1,384	90%	926	60%
Murphy Street	1,116	64	1,180	5%	600	51%	353	30%	114	10%
Thorndon Quay	2,386	108	2,494	4%	1,190	48%	701	28%	128	5%
Total	**10,815**	**1,170**	**11,985**	**10%**	**7,650**	**64%**	**5,419**	**45%**	**2,255**	**19%**

[12] https://www.tomtom.com/en_gb/trafficindex/city/wellington

It shows the following:

- around 1,170 people were observed standing on buses crossing the Wellington CBD cordon; this equates to 10% of total people crossing the cordon in the AM peak by bus
- around 2/3rd of people travel on services where the seated V/C ratio is greater than 85% on the approach to Wellington CBD, a level above which people start to perceive crowding
- around 45% of people travel on services where V/C ratios exceed 100% (requiring people to stand) on the approach to Wellington CBD; this figure varies from one corridor to another
    - on Thorndon Quay (buses from Johnsonville, Newlands), Murphy Street (buses from Hutt Valley) Elizabeth Street (buses from eastern suburbs), Salamanca Street (buses from Kelburn / Karori) and Taranaki Street, between 28% and 37% of people travel on services where the V/C ratio exceeds 100% on the approach to Wellington CBD
    - the figure is between 50% and 65% for Oriental Parade, Cambridge Terrace and Willis Street and 90% for Bowen Street (services from Karori)
- over 900 people travel on services from Karori down Bowen Street in the AM peak that have total V/C ratios greater than 85%, implying that 10 or more people would be required to stand on each of the affected services

When aggregated across all corridors, the V/C ratio of services crossing the Wellington CBD cordon (inbound) in the AM peak is 84%.

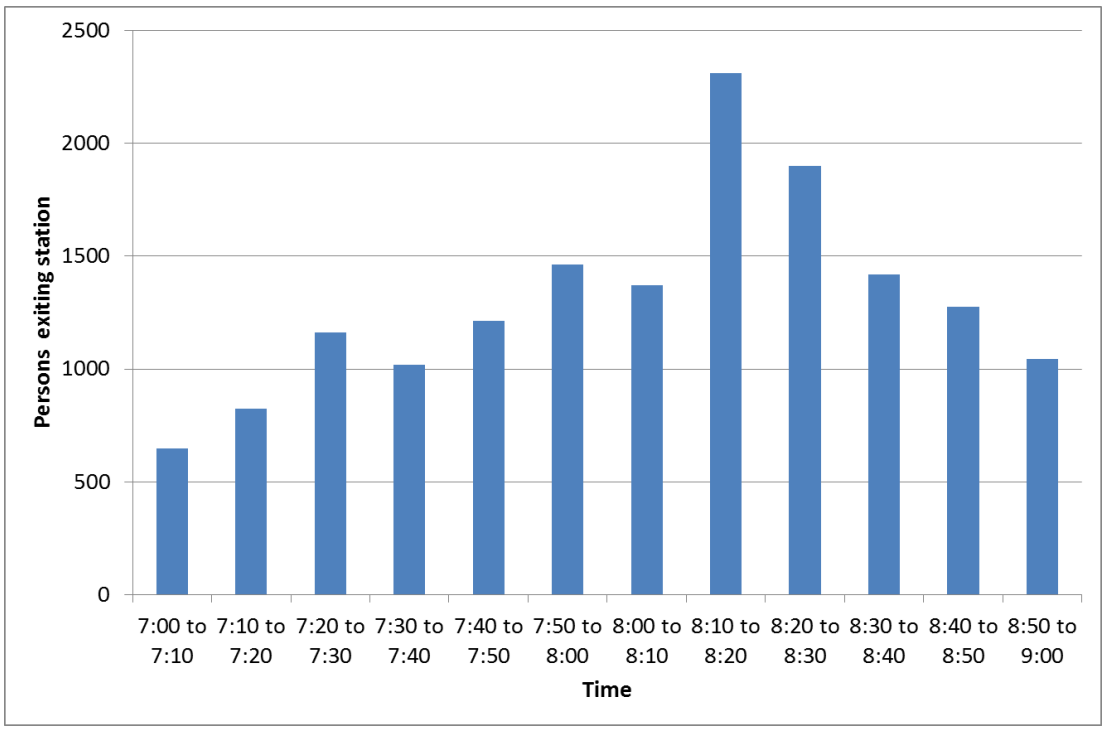
5.2 Context – rail network

Around 15,000 people currently alight from rail services every weekday morning at Wellington Station between 7am and 9am. Total available seated capacity of services arriving into Wellington Station during this time period is around 19,000, with total capacity (seated plus standing) of around 31,000.

Whilst this figures show that there is spare capacity (both seated and total) across the network on all lines during the peak period (7am to 9am), some services during the peak of the peak already operate at capacity and have people standing on arrival at Wellington Station.

Figure 23 below show the profile of alightings at Wellington Station between 7am to 9am, with a noticeable 'peak within the peak' between 8.10am and 8.30am, the period during which service loadings will be at their highest and people will be most likely to be standing.

Figure 23 AM Peak alightings at Wellington Rail Station, 7am to 9am



6 Highway and Public Transport traffic volumes

6.1 Visual representation of highway and public transport traffic volumes

This section presents highway and public transport volumes on the network for the following time periods:

- AM peak – 7am to 9am
- Inter-peak – average 2hr period between 11am and 1pm
- PM peak – 4pm to 6pm

The diagrams below are produced from transport models and relate to a 2013 base year.

Given that the base data is 4 years old, combined with the fact that in some locations the modelled outputs might vary from observed reality, the main purpose of this analysis is to provide a visual indication of the busiest locations on the road and public transport networks during the AM peak, Inter-peak and PM peak, as opposed to providing detailed numbers relating to traffic volumes and public transport patronage.

The traffic volumes are a combination of persons in vehicles (assumed occupancy[13] of 1.35 during AM peak and PM peak, 1.4 during Inter-peak) and trucks. Public transport volumes only include people.

Figure 24 AM peak motor vehicle occupant volumes (left) and public transport patronage (right), 2013 base year

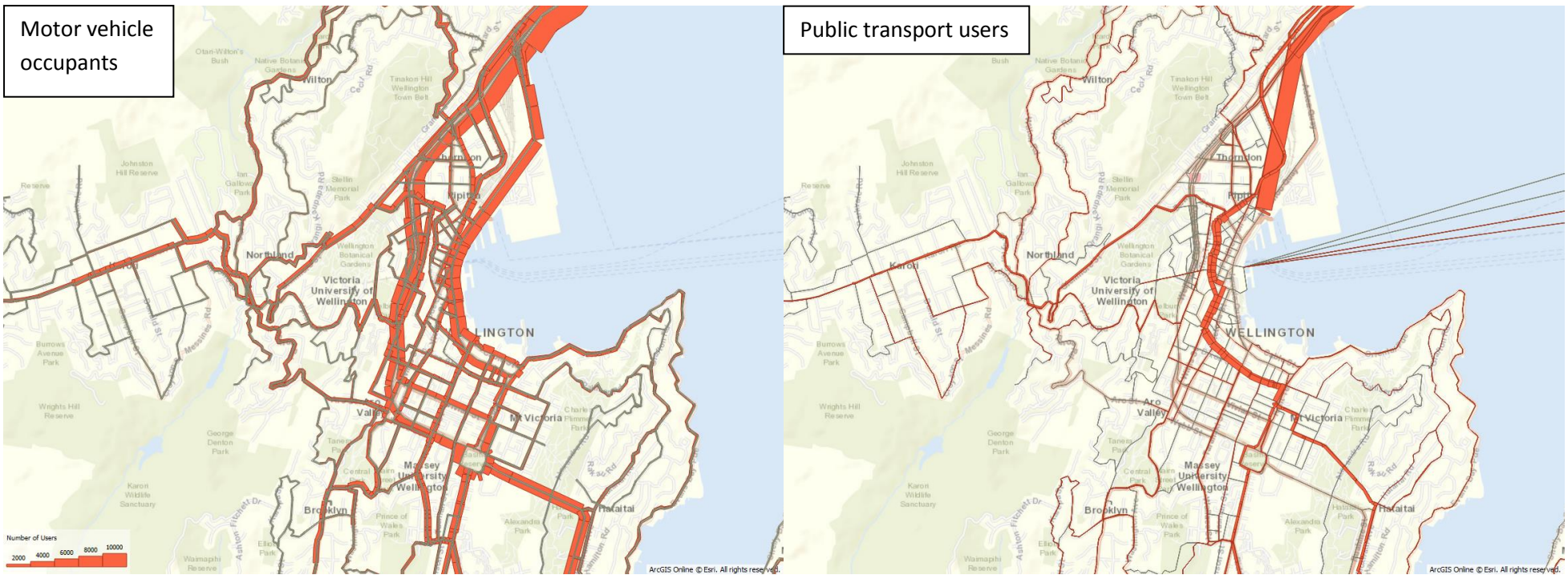


Figure 24 shows the following:

- motor vehicle volumes are greatest heading towards Wellington CBD from the north, along Aotea Quay inbound, through Mt Victoria Tunnel and through Te Aro
- PT volumes are greatest heading into Wellington by train and along Golden Mile

Figure 25 Inter-peak motor vehicle occupant volumes (left) and public transport patronage (right) , 2013 base year

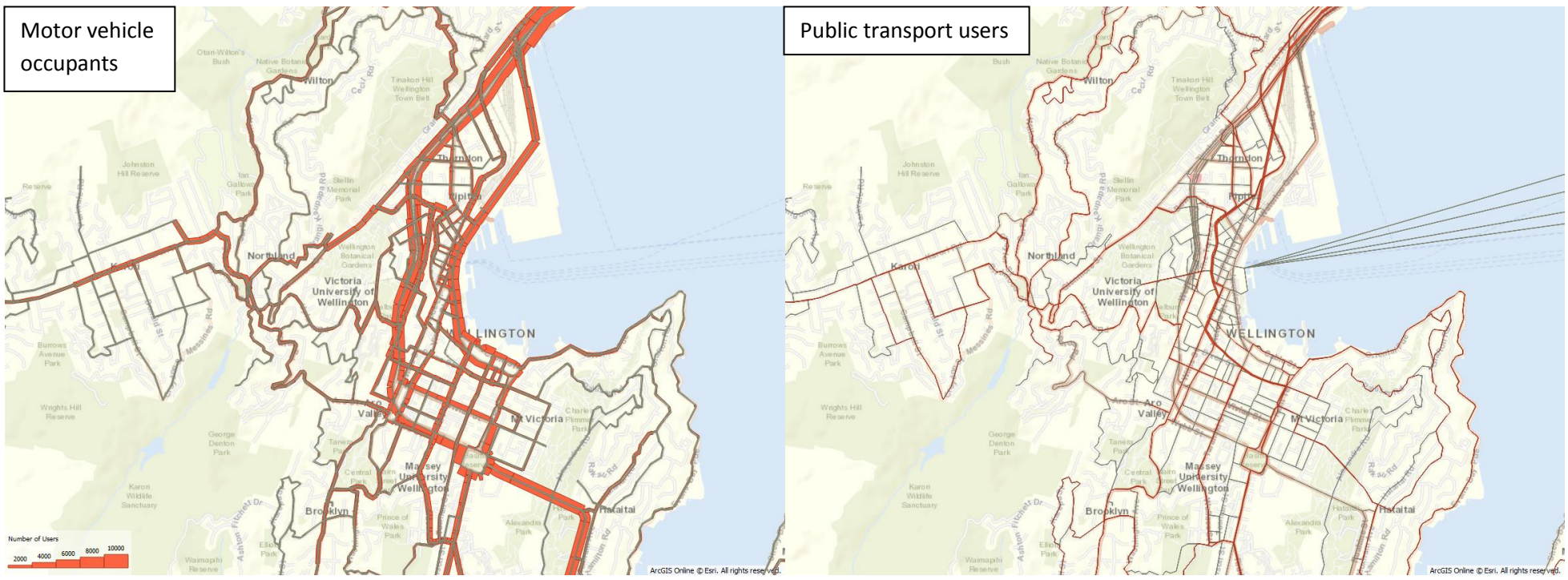


Figure 25 shows the following:

- motor vehicle volumes are greatest on SH1 and Aotea Quay
- compared to the AM peak, PT volumes are lower across the whole network

[13] http://www.pinnacleresearch.co.nz/research/survey/vehicle_occupancy.pdf

Figure 26 PM peak motor vehicle occupant volumes (left) and public transport patronage (right) , 2013 base year

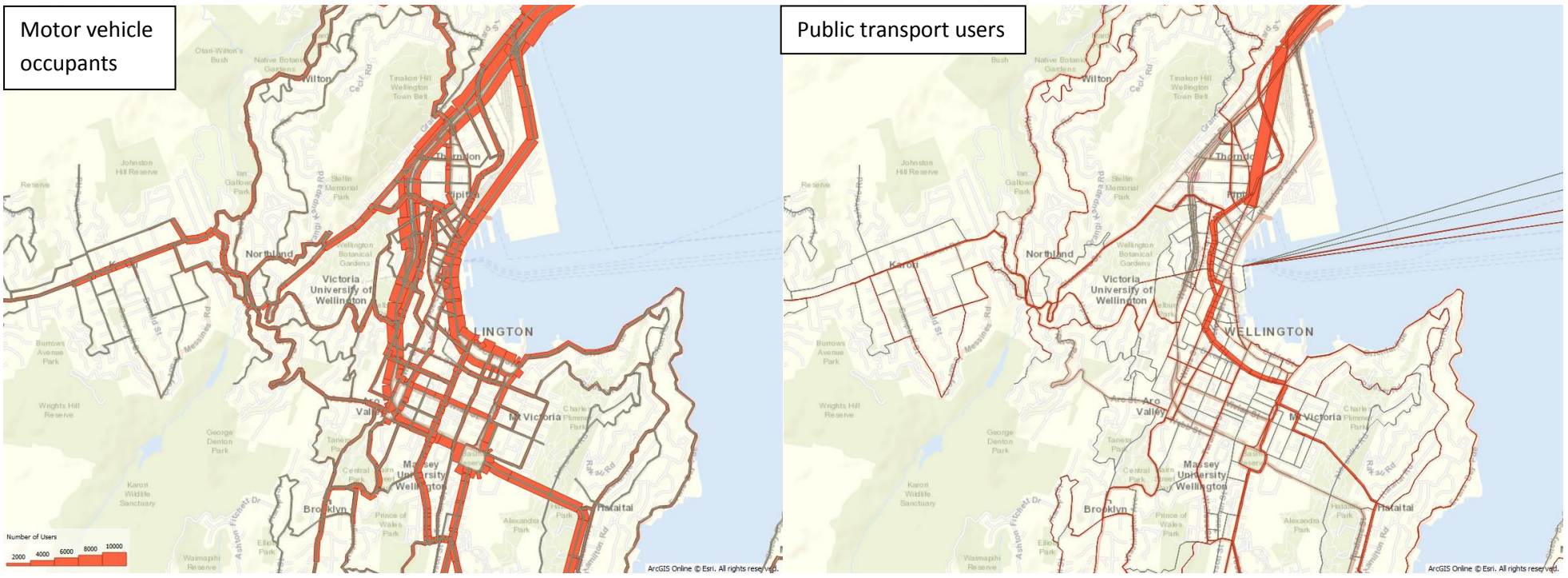


Figure 26 shows the following:

- PM peak travel patterns generally show the reverse of what is happening in the AM peak
- highway volumes greatest heading out of Wellington CBD to the north, along Aotea Quay outbound, Mt Victoria Tunnel and through Te Aro
- PT volumes greatest heading out of Wellington by train and along the Golden Mile

6.2 Observed motor vehicle traffic volumes for selected links

Figure 27 below shows observed highway motor vehicle traffic volumes (excluding buses) for selected links, derived from traffic counts undertaken in March 2016. The data represents a 2hr time period (AM 7am to 9am, Inter-peak 12 noon to 2pm, PM peak 4pm to 6pm).

Figure 27 Observed motor vehicle traffic volumes for selected links, March 2016

Location	Direction	AM peak	Inter- peak	PM peak
		2016 observed motor vehicle traffic volumes		
Mt Victoria tunnel	Eastbound	2500	2500	2900
	Westbound	3000	2800	2200
SH1 Terrace off ramp	Southbound	3500	900	1400
SH1 Terrace Tunnel (Exit to Vivian street)	Eastbound	3100	2800	2800
SH1 Terrace Tunnel (Entrance from Karo Drive)	Westbound	3800	3300	4700
Thorndon Quay (south of Tinakori Road)	Southbound	1700	900	600
	Northbound	400	800	1300
Hutt Road between Ngaio and Ngauranga (North of Onslow)	Southbound	2400	1400	1200
	Northbound	1000	1700	3200
Hutt Road between Ngaio and Aotea (South of Kaiwharawhara Rd)	Southbound	4600	1800	1500
	Northbound	1200	2100	4100
Oriental Parade	Westbound	1700	1200	1500
	Eastbound	1600	1400	2100
Kent and Cambridge Terraces (South of Vivian Street)	Southbound	3900	3800	3900
	Northbound	1300	1400	1400
Wakefield Street (approach to Taranaki Street)	Westbound	3100	2700	3300
Cable Street (outside Te Papa)	Eastbound	3400	3000	4100
Aotea Quay (North of Hinemoa Street)	Southbound	4000	1900	2200
	Northbound	1400	2100	4000
Waterloo Quay (South of Whitmore Street)	Southbound	3600	2300	3000
	Northbound	2800	3000	4400
Customhouse Quay (South of Hunter Street)	Southbound	3800	2800	4100
	Northbound	3300	3100	3900
Taranaki Street North of Karo Drive	Southbound	1500	1500	1700
	Northbound	1200	1000	900
Taranaki Street South of Karo Drive	Southbound	1200	1300	1400
	Northbound	1300	1100	1200
Victoria Street North of Karo Drive	Southbound	1200	1700	2700
Adelaide Road South of Basin Reserve	Southbound	1200	1400	1300
	Northbound	1900	1900	1900
Willis Street Karo Drive to Vivian Street	Northbound	1900	1400	1300
Willis Street Ghuznee street to Manners Street	Northbound	1100	1300	1200
	Southbound	300	300	400
SH1 Willis Street to Victoria Street	Eastbound	3500	3400	2600
Vivian Street: Victoria Street to Taranaki Street	Eastbound	3400	3100	2900
Vivian Street: Tory Street to Cambridge Terrace	Eastbound	2700	2500	2500
Karo Drive Arras Tunnel	Westbound	3300	3300	3100
Karo Drive: Taranaki Street to Victoria Street	Westbound	3800	3600	4000

7 Traffic profiles at selected locations

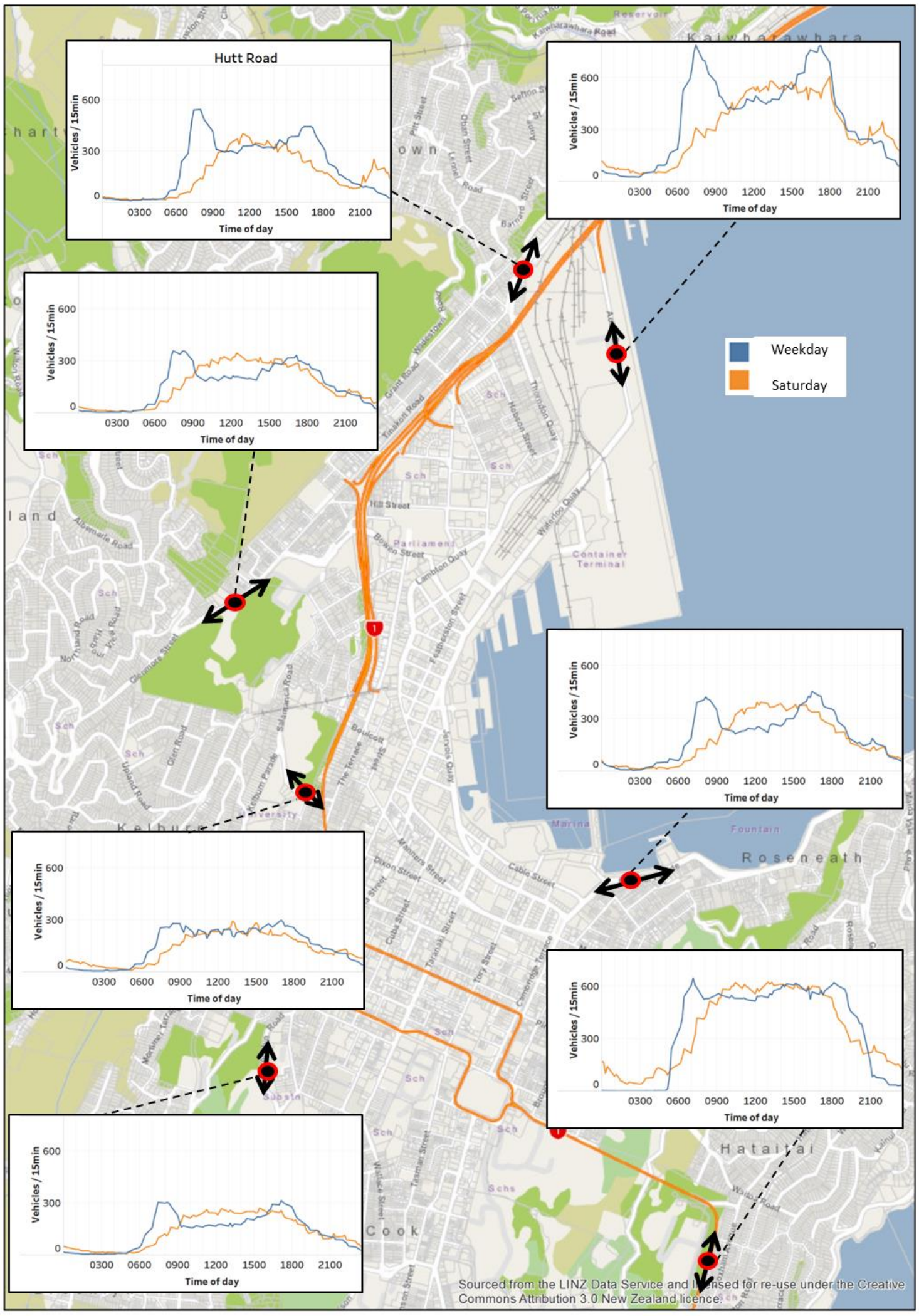
This section looks at changes in vehicle (light vehicle and trucks), public transport, pedestrian and cycle volumes by time of day for selected locations, using data obtained from the following sources:

- automated traffic counts that were undertaken at selected locations around Wellington City in March 2016 – this data covers a two week period (7th to 20th March, 2016) and has been segmented into weekday data (Monday to Friday) and Saturday data for the purpose of this analysis
- public transport boarding / alighting data for stops along the Golden Mile, obtained from Electronic Ticket Machine (ETM) data obtained in March 2016
- rail alightings at Wellington station during the AM peak (7am to 9am) in March 2016
- pedestrian volumes at selected locations, obtained from manual classified video counts undertaken in March 2016, together with pedestrian volumes along the Golden Mile and Waterfront obtained from Wellington City Council annual pedestrian surveys undertaken in March 2016

7.1.1 Light vehicle traffic volume profiles

Figure 28 below shows light vehicle (cars, small vans, taxis, excludes trucks) traffic profiles by 15 minute period for selected locations on the network for an average weekday and average Saturday in March 2016.

Figure 28 Light vehicle profiles by 15 minute time slice, March 2016, weekday average and Saturday



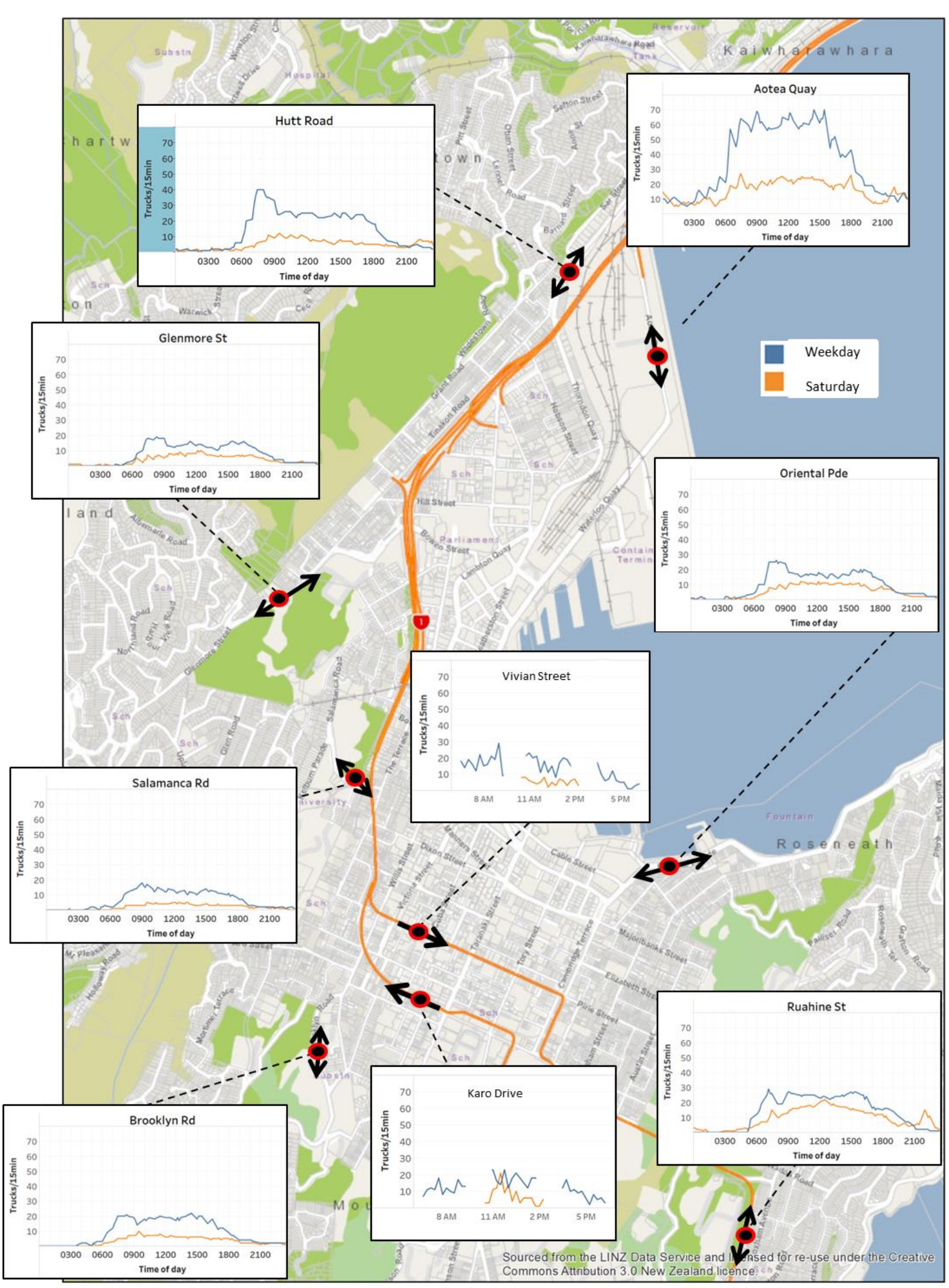
The data shows the following:

- weekday volumes (light vehicles/ 15min) show a marked peak in the morning (AM peak) and in the afternoon (PM peak), although the size of this peak (relative to the off-peak) varies from one location to the next:
  - Aotea Quay, Hutt Road and Oriental Parade have pronounced peaks (particularly the AM peak)
  - Mt Victoria Tunnel shows very little variation between peak and off-peak two way traffic volumes
- the AM peak tends to be sharper and shorter, whereas the PM peak is generally longer and less pronounced
- weekend two–way traffic volumes are generally higher than corresponding inter-peak (9am to 3pm) two-way traffic volumes
- at certain locations such Oriental Parade and Glenmore Street, weekend two-way traffic volumes are almost equal to weekday peak period traffic volumes
- SH1 sites, Vivian Street and Karo Drive were derived from a different data set (Classified Turn Counts) and hence show peak period data only. These two sites were included to provide a more complete picture across the network

7.1.2 Heavy commercial vehicle (trucks) profiles

Figure 29 below shows heavy commercial vehicle profiles 15 minute period for selected locations on the network for an average weekday and average Saturday in March 2016.

Figure 29 Heavy commercial vehicle profiles by 15 minute time slice, March 2016, weekday average and Saturday



The data shows the following:

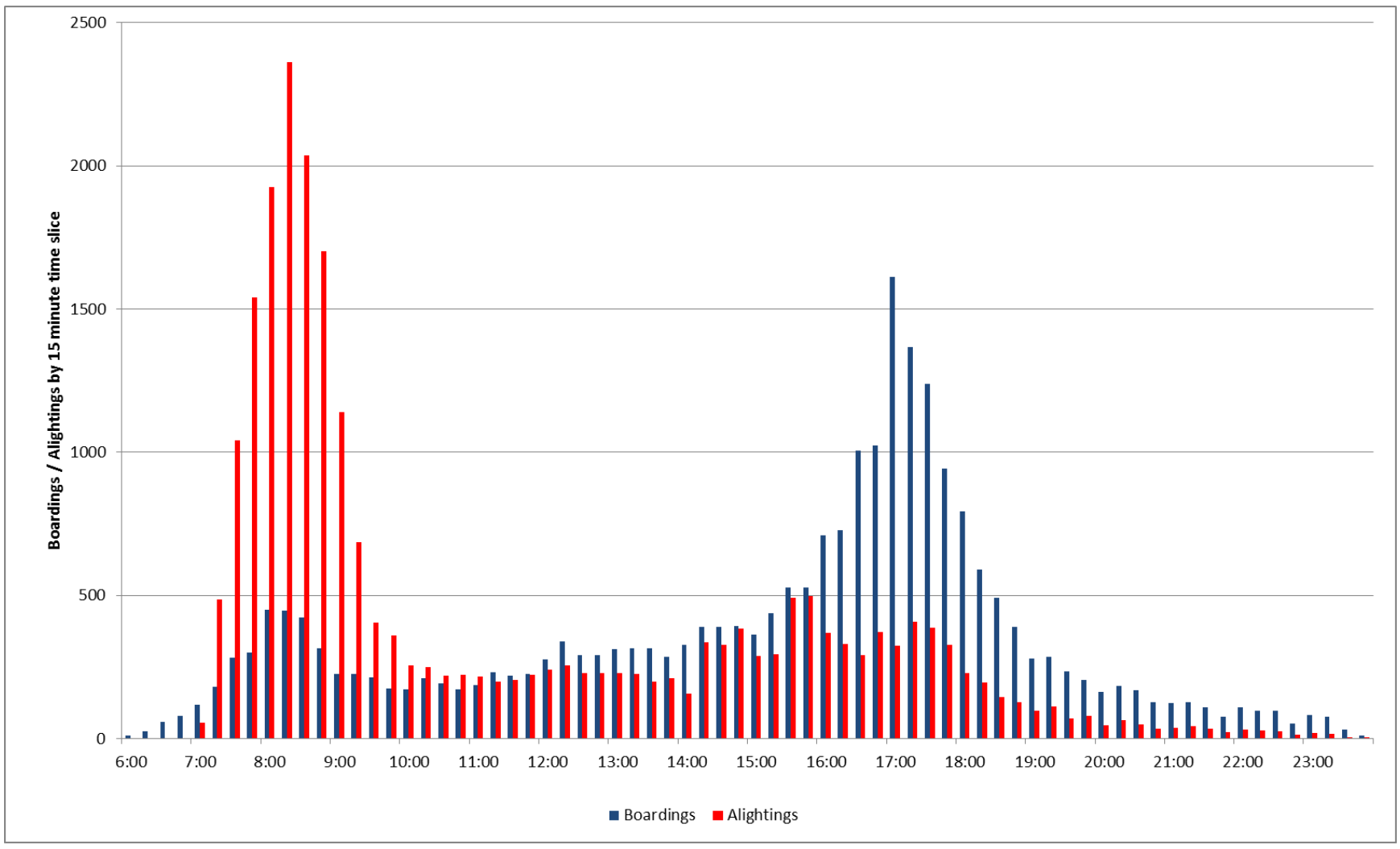
- the pattern of two-way HCV volumes is fairly similar across all of the selected sites:
  - weekday volumes average between 15 – 25 HCVs per 15 minute period during the AM peak and Inter-peak before volumes tail off in the PM peak
  - Saturday volumes are significantly lower, averaging between 5 and 10 HCVs per 15 minute period between around 9am and 6pm
- the notable exception during weekdays is Aotea Quay – two-way HCV volumes average between 60 and 70, a direct result of port traffic using Aotea Quay

7.1.3 PT Boarders and Alighters along Golden Mile

Figure 30 below shows bus boarders / alighters along the Golden Mile (Wellington Station to Courtenay Place) by 15 minute interval from 6am to midnight.

This data is obtained from Electronic Ticket Machine (ETM) data that was processed for the purpose of validating modelled public transport boardings and alightings. The data captures people using a bus to travel to / from and within the CBD (i.e. Courtenay Place to Wellington Station).

Figure 30 Bus boarders and alighters at all bus stops along the Golden Mile by 15 minute time period



The data shows the following:

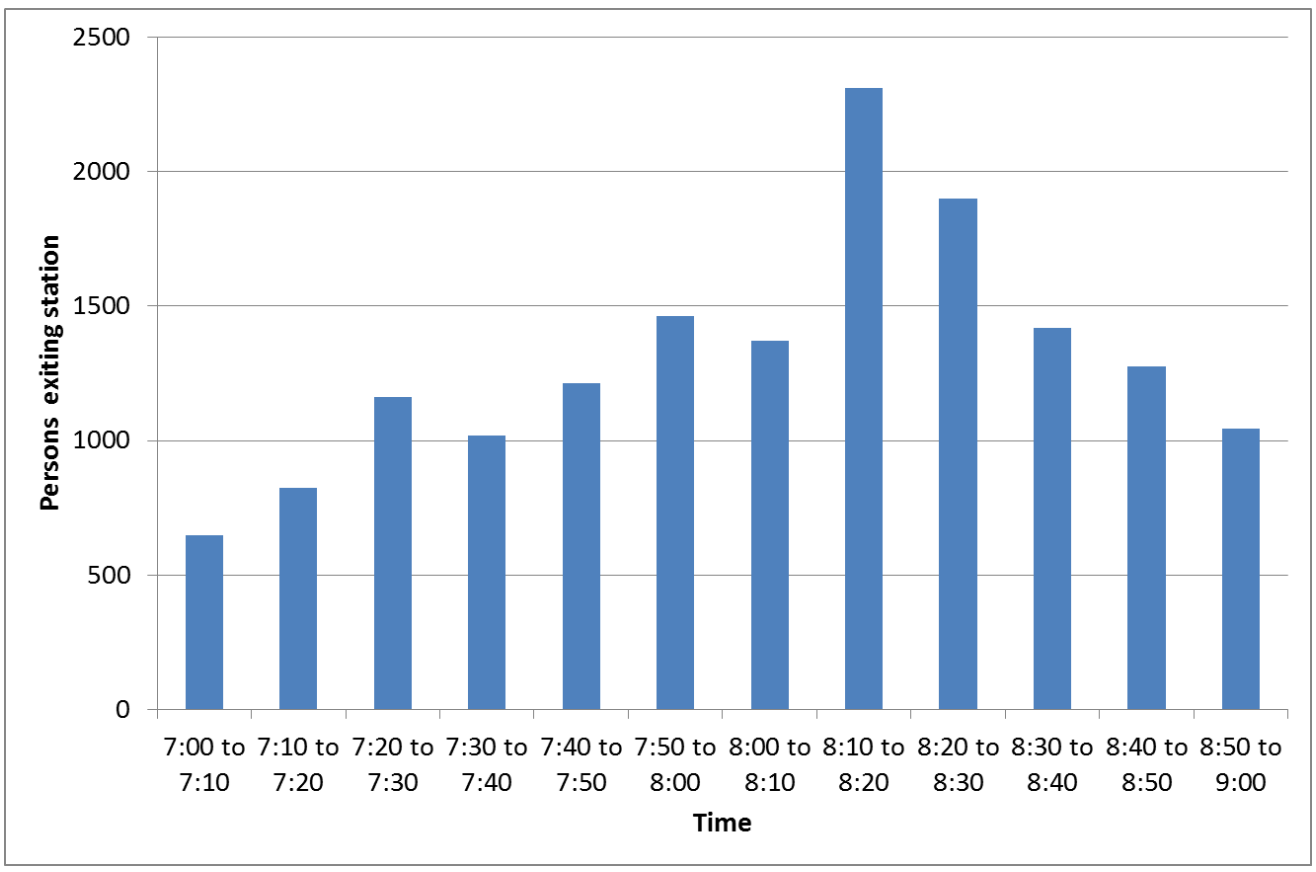
- there is a spike in bus alighters during the AM peak period between 7.30am and 9.30am, with the 15 minute period from 8:15am to 8.30am the busiest (over 2,250 alighters).
- bus boardings / alighters average around 250/300 ever 15 minutes between around 10am and 2pm, before rising gradually between 2pm and around 4pm to 500 boardings / alighters every 15 minutes.
- compared to the AM peak there is a less pronounced spike in boarders in the PM peak between 4pm and 6.30pm, with the 15 minute period between 5pm and 5.15pm the busiest (over 1500 boardings).
- After 6.30pm the number of boarders tail off from 250 per 15 minute time period towards zero at midnight.

7.1.4 Rail passenger boardings and alightings at Wellington Station

7.1.4.1 AM peak alightings at Wellington Station

Figure 31 below shows the number of people observed exiting Wellington Railway Station on foot every 10 minutes during the AM peak between 7am and 9am, obtained from the March 2016 cordon survey. Whilst it is acknowledged that this figure might include persons walking through Wellington station on their way to work, it is likely that the majority of people observed would have recently alighted from rail services arriving at Wellington Railway Station

Figure 31 Persons existing Wellington Rail Station, 7am to 9am



The data shows that persons existing the station every 10 minutes rises from around 650 (7am to 7.10am) to around 1400 (8am to 8.10am), before a noticeable peak between 8:10am and 8:30 am during which over 4,000 people exit the station. Nearly 50% of people exiting the station between 7am and 9am do so between 7.50am and 8.30am.

The survey counted people exiting the station at four main points – main exit (towards Bunny Street), exit towards underpass / bus station, station ramps (towards Westpac stadium concourse/ Port) and Platform 9 (towards Westpac car park / BNZ building).

The data shows that 45% (7,250) of those people exiting the station in the AM peak do so via the main entrance, 50% (7,750) via the subway towards the bus station / Molesworth Street / Murphy Street and the remaining 5% (500) via the station ramps to the north or towards the BNZ building.

7.1.4.2 Final destination of persons alighting from rail services at Wellington Station in AM peak

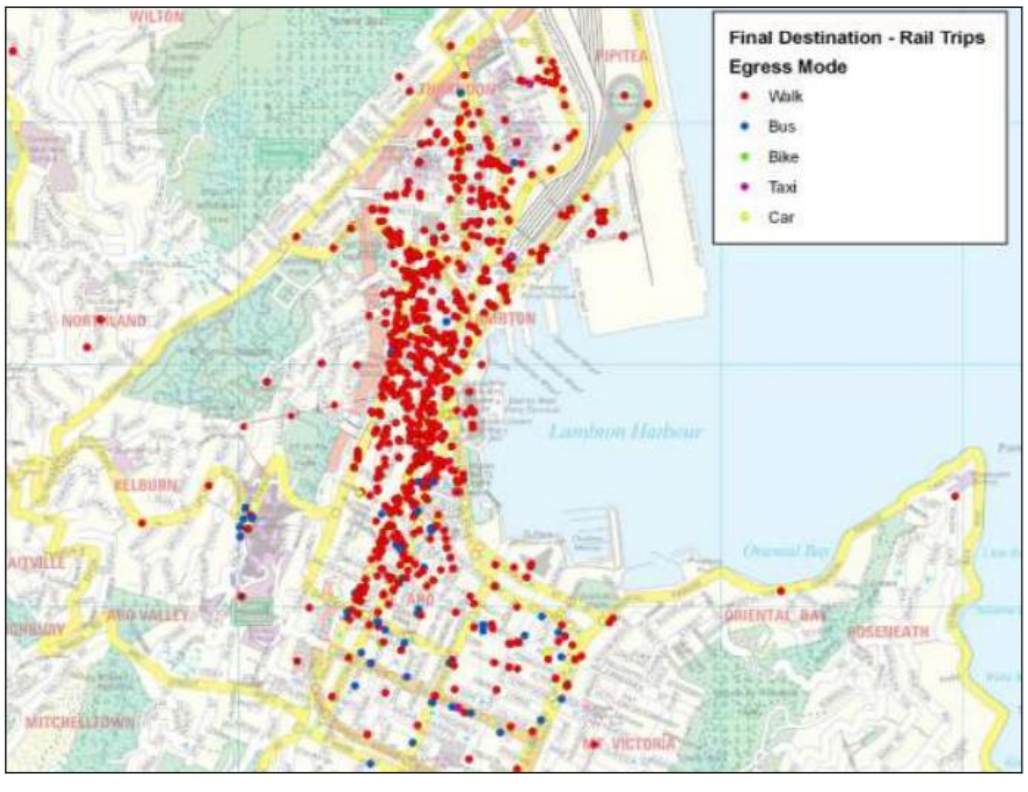
In terms of persons exiting the station towards the underpass, the cordon survey itself is unable to differentiate between people walking in that direction and using the underpass / exits around the bus station to walk to destinations nearby and people walking in that direction to take a bus towards their onward destination.

Comprehensive rail surveys were undertaken in 2011 to inform the development of the Wellington Public Transport Model. These surveys asked rail passengers a range of questions, including their final destination (i.e. where they are heading to after alighting from rail services at Wellington station) and the mode of travel that they use to get to this destination.

The survey showed that 90% of persons arriving into Wellington by train walk to their final destination, with the remaining 10% taking the bus. If applied to current peak patronage figures (15,500 arrivals into Wellington station between 7am and 9am) this would equate to around 1,500 people alighting from a train and taking the bus to reach their final destination.

Figure 32 below is a map showing the final destination (place of work or study) for persons alighting from rail services at Wellington station in the AM peak, categorised by mode.

Figure 32 Final destination of persons alighting from rail services at Wellington Station, AM peak, 7am to 9am, March 2011



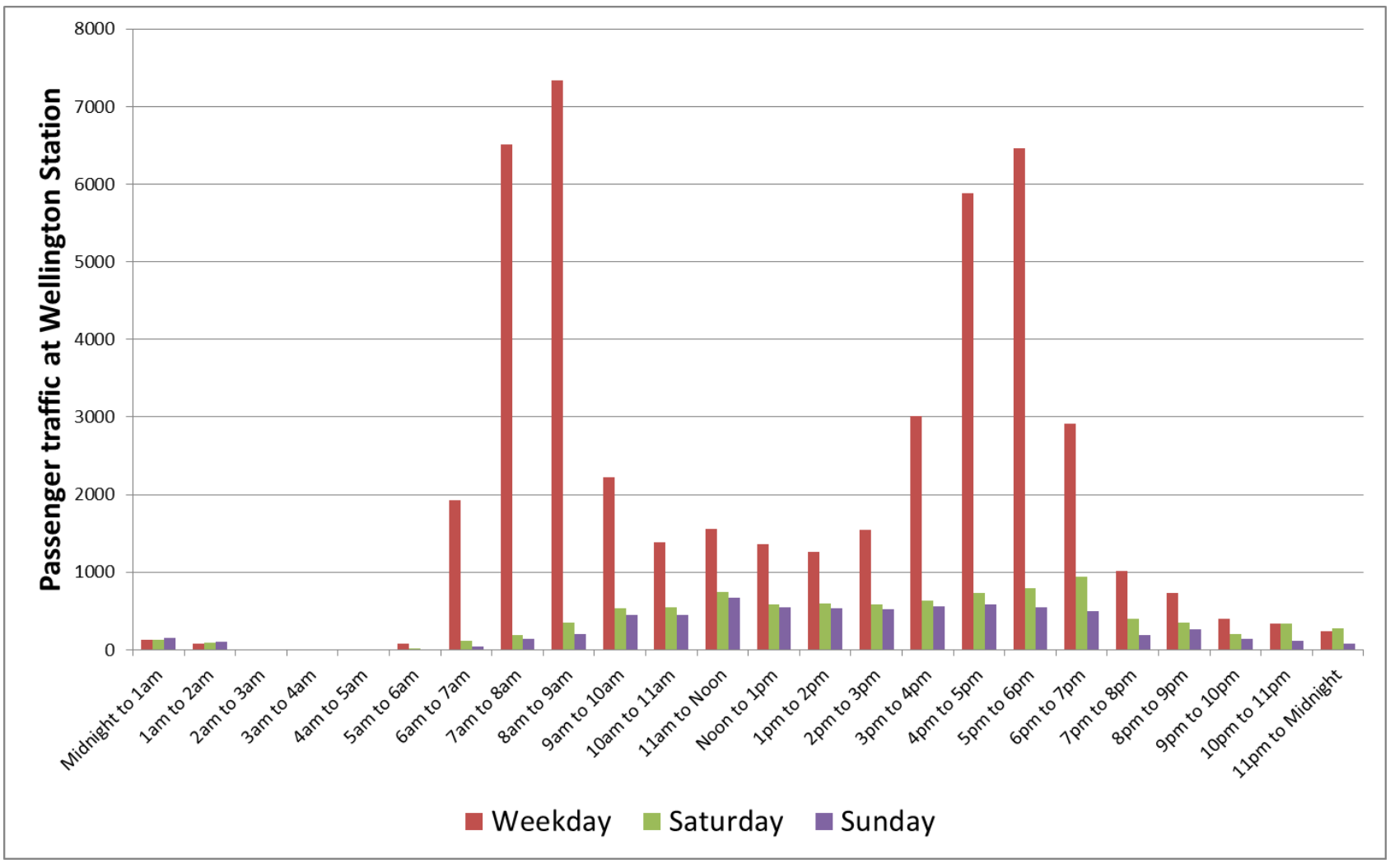
It shows that most people who alight from rail services at Wellington Railway Station travel relatively short distances to their final destination, with many destinations clustered around Lambton Quay, the Terrace and the northern part of Willis Street; walking is the primary mode for these short trips.

Relatively few people alight from rail services at Wellington Railway Station and travel onwards to destinations south and east of Ghuznee Street / Victoria Street. Of those that do travel further, walking is still the preferred method of travel but taking the bus is more popular than for destinations closer to the station.

7.1.4.3 Passenger traffic at Wellington Station

Figure 33 below shows passenger traffic (boardings and alightings combined) at Wellington station for an average weekday, Saturday and Sunday during FY 2016/2017

Figure 33 Average weekday passenger traffic at Wellington Station (boardings and alightings combined), 2016/17



The data shows the following:

- a sharp peak in passenger traffic during the AM peak (6,000 to 7,500 persons per hour)
- a slightly less pronounced peak in the PM peak (6,000 persons per hour between 4pm and 4pm)
- almost twice as much traffic in the PM peak shoulder periods (3pm to 4pm, 6pm to 7pm) compared to the AM peak shoulder periods (6am to 7am, 9am to 10am)
- inter-peak passenger traffic averaging between 1,250 and 1,500 persons per hour between 10am and 3pm (15% to 20%) of peak values
- Saturday and Sunday passenger traffic volumes average between 500 and 750 persons per hour between 9am and 7pm

Overall, around 95% of passenger traffic (boardings and alightings) at Wellington station during an average week occurs during weekday hours, with Saturday / Sunday combined only accounting for around 5% of total passenger traffic.

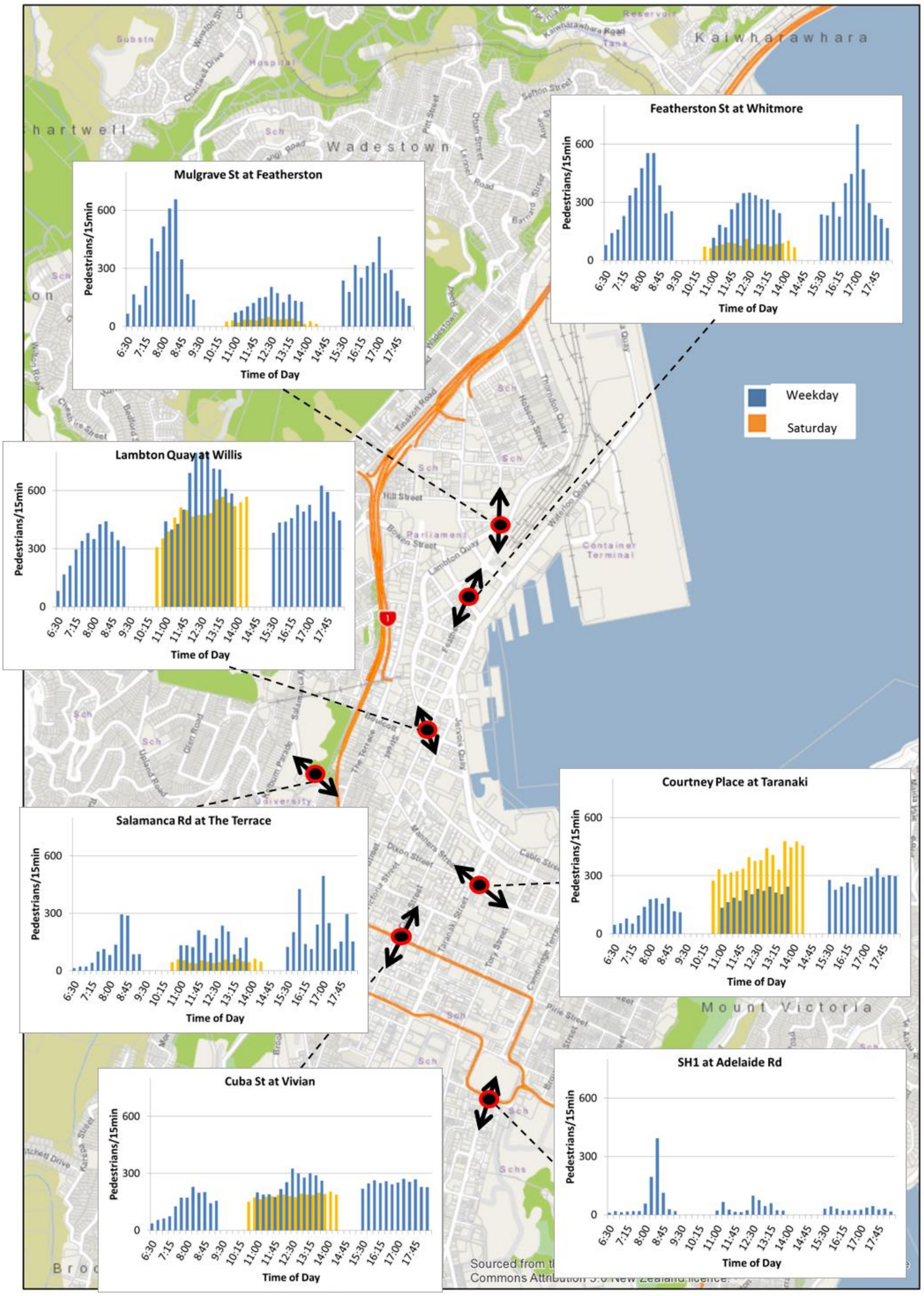
7.1.5 Walking

Figure 34 below shows two-way pedestrian volumes at selected locations around Wellington CBD.

Data was collected from 6:30am to 9:30am, 11:00am to 2:00pm and 3:30pm to 6:30pm only during one weekday in March 2016 and from 10.30am to 2.30pm on one Saturday in March 2016. The exception is the waterfront site, where pedestrian volumes are averaged across five working days to capture the AM peak (7am to 9am) and Inter-peak (noon to 2pm).

Whilst it is accepted that the lack of survey data covering a full 24hr period is a potential limitation, the data does provide a good indication of how pedestrian volumes change throughout the day.

Figure 34 Two-way pedestrian volumes at selected locations in Wellington CBD, weekdays and Saturdays



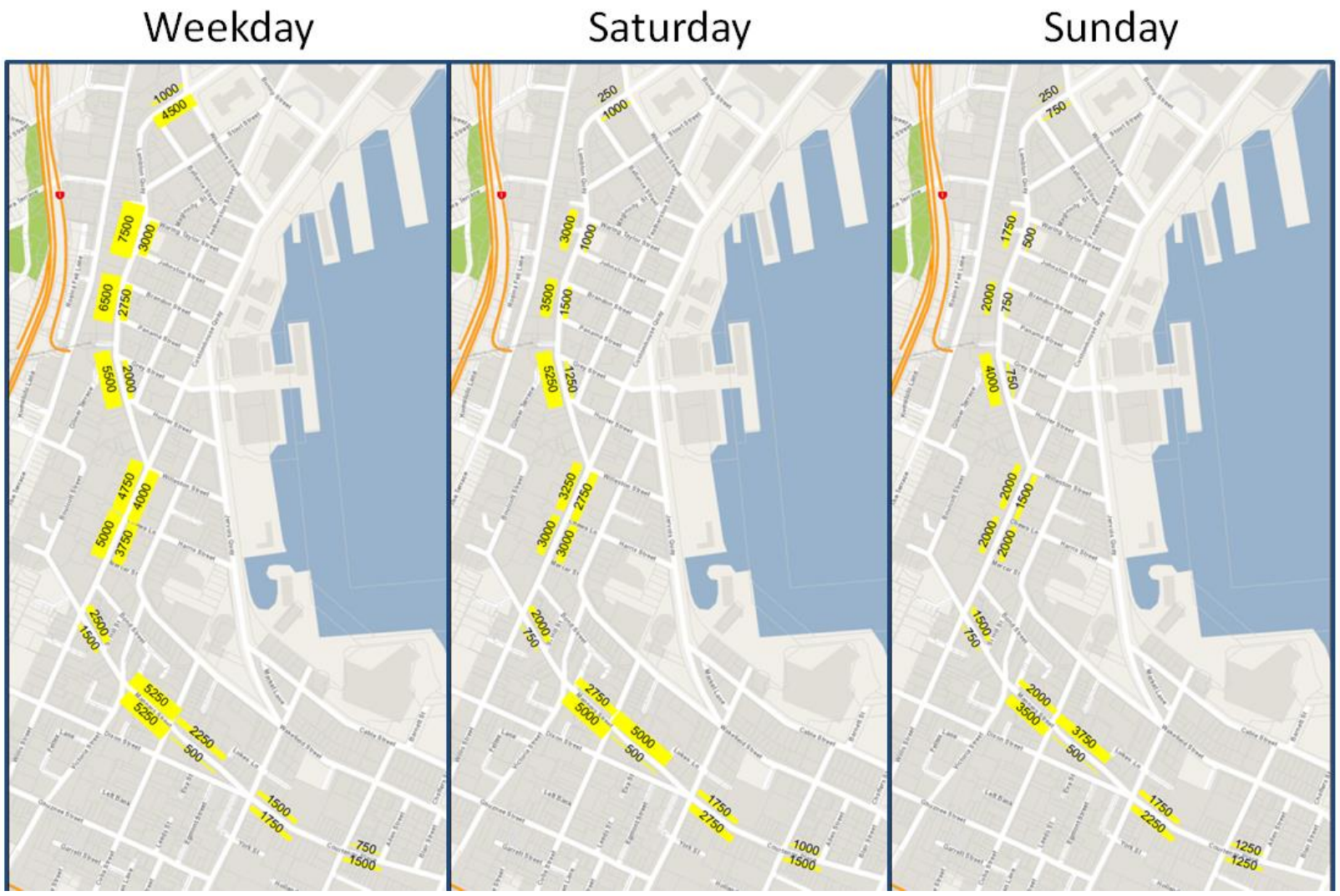
The data shows the following:

- Featherston Street at its intersection with Whitmore Street has the high pedestrian volumes during the AM peak and PM peak (up to 600 pedestrians every 15 minutes) due to people walking between Wellington Railway Station / Bus Station and destinations within the central city
- the Lambton Quay / Willis Street site shows high pedestrian volumes (over 700 pedestrians per 15 minute period) during the middle of the day
- pedestrian volumes crossing Taranaki Street to / from Courtenay Place increase steadily throughout the weekday but are greater still at weekends, averaging over 300 pedestrians per 15 minute period
- between 200 to 300 people cross Vivian Street every 15 minutes at Cuba Street
- the Basin Reserve site (Rugby Street, east of Adelaide Road) shows a very sharp peak in the morning due to the nearby schools (it is likely that the corresponding peak in the other direction occurs during the un-surveyed period between 2pm and 3.30pm)

7.1.6 Pedestrians along Golden Mile

Figure 35 below shows two-way pedestrian volumes along various sections of the Golden Mile between 12 noon and 2pm on a weekday (average over 5 days), Saturday and Sunday in March 2016.

Figure 35 Pedestrian volumes along Golden Mile (12 noon to 2pm)



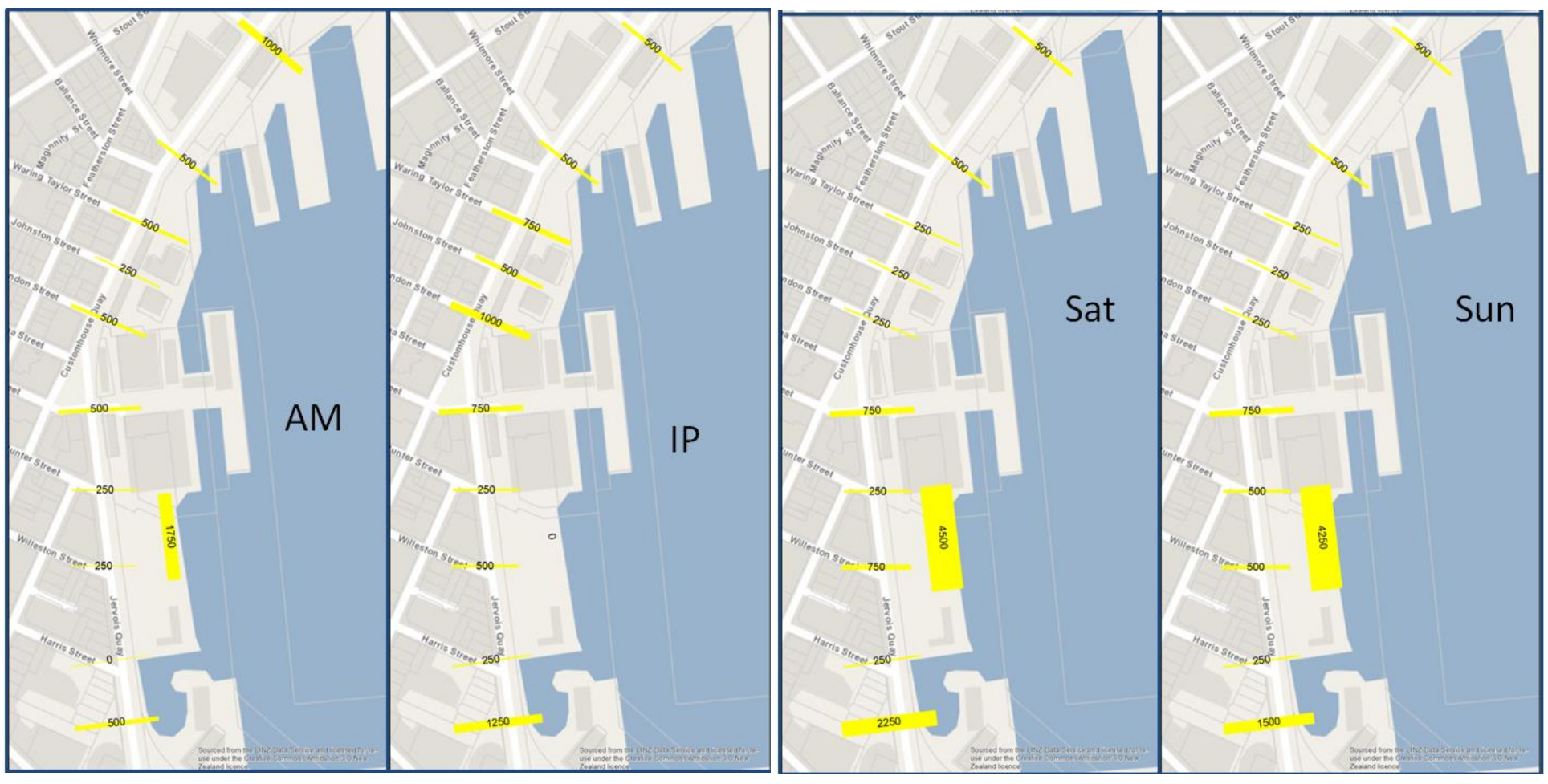
The data shows the following:

- On Lambton Quay, pedestrian volumes are generally between 3 and 5 times greater on the western side compared to the eastern side
- Along Willis Street and Manners Mall, volumes are similar on both sides of the road
- Along Courtenay Place, pedestrian volumes on the southern side are slightly greater than on the northern side
- Peak pedestrian volumes along the western side of Lambton Quay peak at 6,500 during the Inter-peak, 5,250 on Saturdays and 4,000 on Sundays
- Along Lambton Quay and Willis Street, Inter-peak pedestrian volumes are highest followed by Saturday and Sunday
- From Cuba Street eastwards towards Courtenay Place, Saturday / Sunday pedestrian volumes are equal to (and at some locations higher than) corresponding Inter-peak pedestrian volumes

7.1.7 Pedestrians crossing Quays and along Waterfront

Figure 36 below shows two-way pedestrian volumes at 10 locations crossing the Quays and at one location along the Waterfront, between 7am to 9am in the AM peak and 12 noon and 2pm on a weekday (average over 5 days), Saturday and Sunday in March 2016

Figure 36 Pedestrian volumes crossing Quays and along Waterfront (12 noon to 2pm)



The data shows the following:

- during the AM peak the Bunny Street crossing, connecting Wellington Railway station and the waterfront route, is the busiest (1,000 pedestrians), with other crossings seeing pedestrian volumes of between 250 and 500 over the 2hr period
- in the Inter-peak, the City to Sea Bridge (1,250) is the busiest pedestrian crossing location, followed by Queens Wharf (1,000), Waring Taylor Street (750) and Hunter Street (750)
- on Saturdays, the City to Sea Bridge is used by 2,250 pedestrians over a two hour period, with Queen Wharf crossing the next busiest; Sunday shows a similar patterns, with the City to Sea Bridge being the busiest crossing location
- Waterfront pedestrian volumes (outside of Fergs Kayaks on Queens Wharf) average 1,750 in the AM peak but exceed 4,000 between 12 noon and 2pm on both Saturday and Sunday

8 Travel speeds and travel speed variability

Across Wellington City, there is a network of Bluetooth detectors that can track Bluetooth enabled devices through the network.

Data was obtained from this network of travel time sensors for the whole of March 2016, from which median travel times were calculated between selected pairs of sensors every 15 minute time period[14].

Whilst Bluetooth systems provide a wealth of data, there are potential limitations that can result in some data points being erroneous (i.e. someone could travel along a route but stop off at an intermediate point, such as school drop-off, providing an erroneously long travel time).

For the purpose of this analysis

- for median travel time to be estimated there have to be a minimum of 5 Bluetooth devices tracked during a particular 15 minute period, in order to smooth any irregularities and erroneous journeys that might be picked
- data has been manually checked to identify and remove any noticeable outliers

Notwithstanding the checking that has been undertaken, Bluetooth data sets contain a huge amount of data and it is therefore possible that a small number erroneous data points could be included in the data that is presented, having been missed during the cleaning process. This is not of critical importance, however, as the main purpose of the data is to identify broad trends and patterns rather than to estimate precise travel times and speeds.

Whilst the weekday data is more comprehensive that the Saturday data, by virtue of there being 20 weekdays in March with data compared to only 4 Saturdays, both data sets improve our understand of travel speeds and travel speed variability at both a spatial and temporal level.

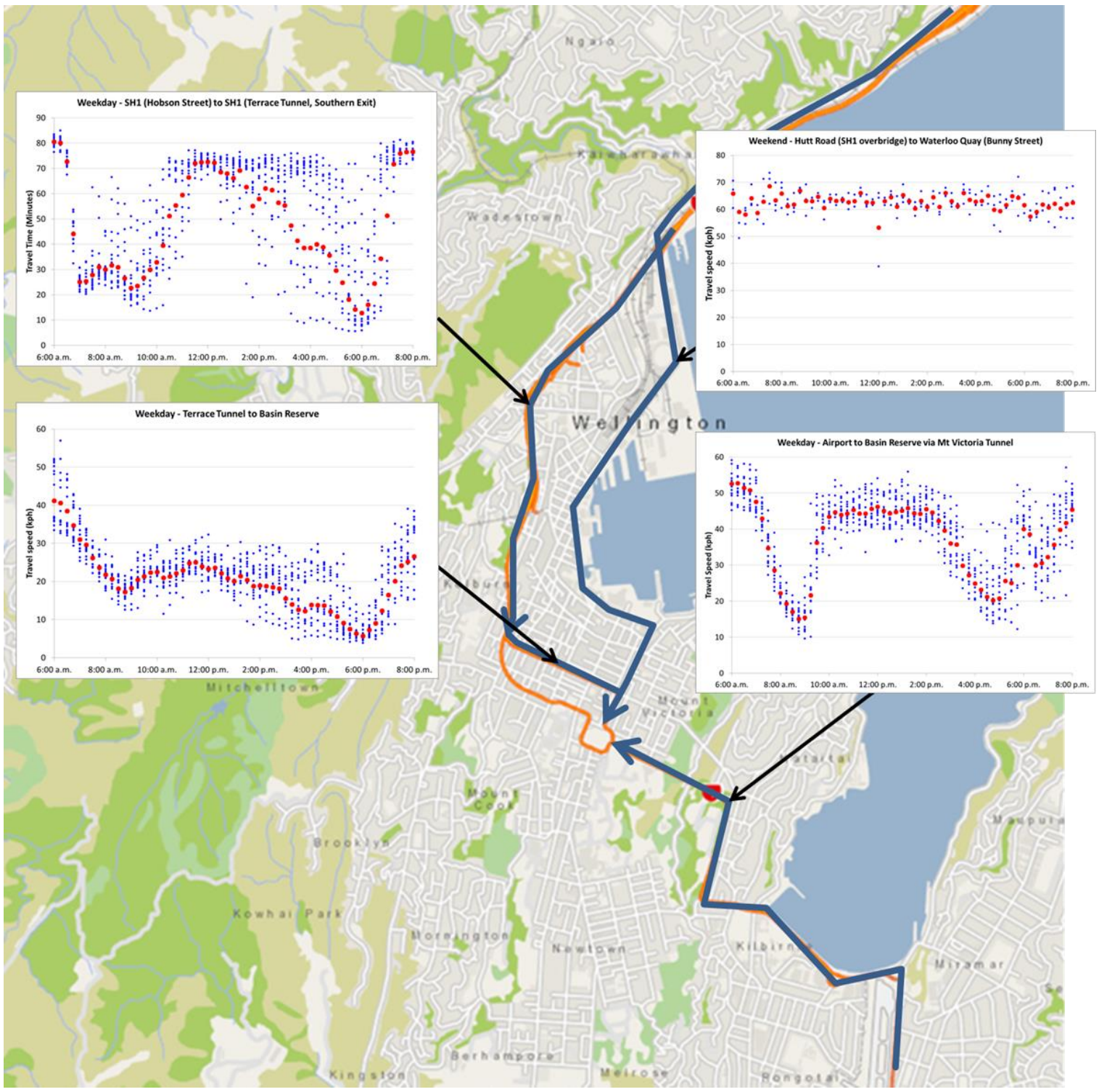
The graphs in this section can be interpreted as follows:

- **blue dots** represent the median travel speed by 15 minute time period across all surveyed days (20 weekdays, 4 weekends)
- **red dots** represent the 'median' of the blue dots – for example, if there were 20 median values ranging from 1 to 20 then the 'median of this set of medians' would be 10.

8.1.1 Longer route travel speeds and travel speed variability

Figure 37 below shows weekday highway travel speeds and travel speed variability for selected longer distance routes.

Figure 37 Weekday state highway travel speeds and travel speed variability



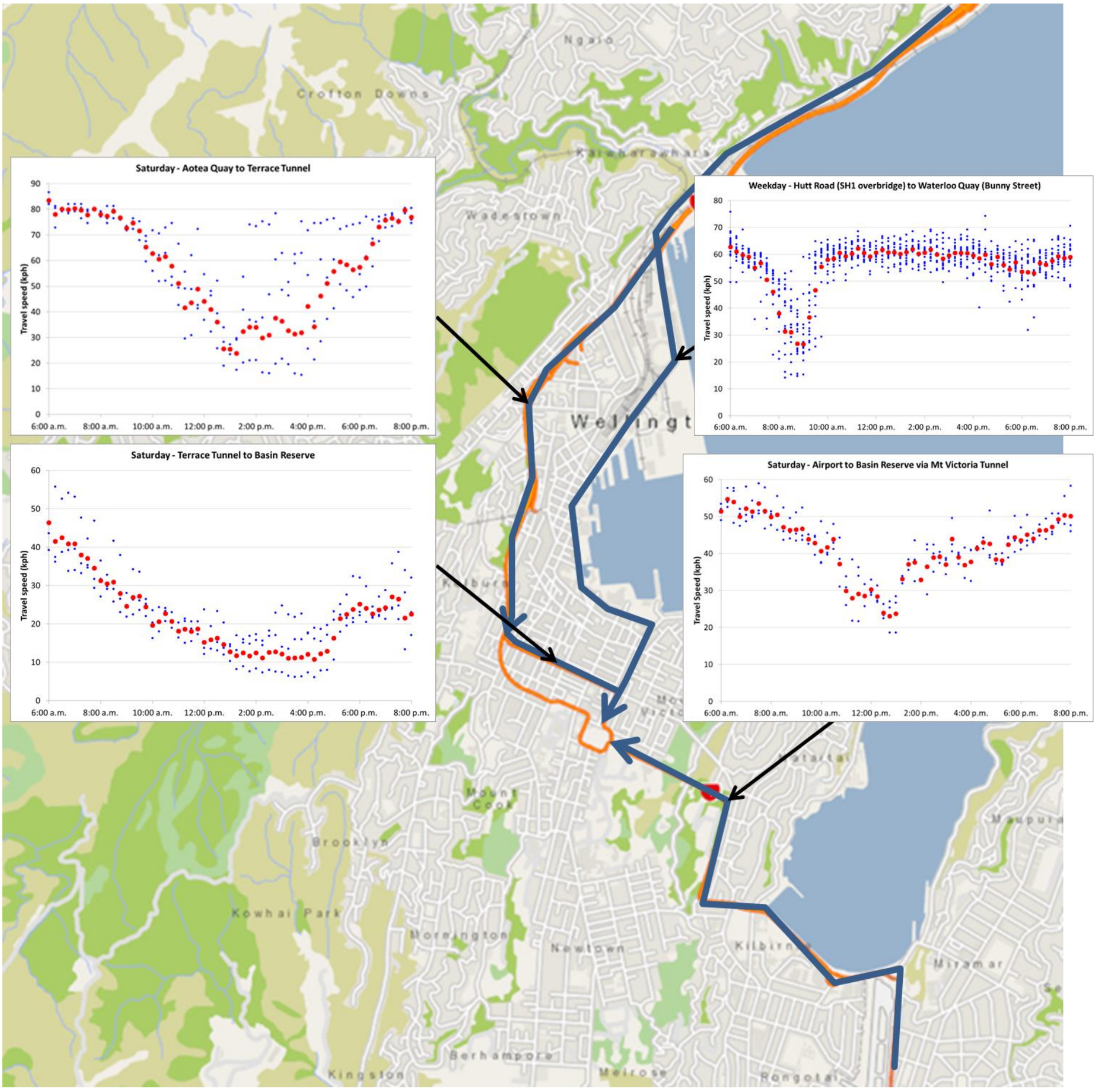
[14] There is a minimum threshold of 3 observed Bluetooth devices before a median can be calculated

The weekday data shows the following:

- average travel speed between Hobson Street overbridge and the eastern portal of Terrace Tunnel (Sh1) shows the following pattern:
    - speeds drop from 80kph prior to 6.30am to between 25kph and 30kph between 6.30am and 9.30am
    - they rise slowly back to an average of between 60kph and 80kph during the inter-peak (noon to 2pm) before gradually dropping back to an average of between 15kph and 20kph in the PM peak
    - in the PM peak and, to a lesser extent the AM peak, there is a high level of day to day travel speeds variability - for example, on some days average travel speeds drop back to 20kph or so at 2pm, whilst on other days travel speeds can stay at between 70kph and 80kph until 4pm to 5pm
- between the Terrace Tunnel and Basin reserve
    - average travel speeds drop from around 40kph at 6am to 20kph at 8am and remain in the 20kph to 25kph range between 8am and 3pm
    - from 3pm to 6pm, average travel speeds drop to a low of less than 10kph before rising again back up to 30kph at 8pm
    - there is relatively little variability in travel speeds between 6am and 2pm but increased travel speed variability between 2pm and 6pm
- between the Airport and Basin Reserve
    - average travel speeds drop from 50kph prior to 6.30am to a low of less than 20kph between 8.30am and 9am before climbing quickly back to an average of around 45kph which is maintained till around 2pm
    - in the PM peak, average travel speeds drop to around 20kph and show significantly more variability than in the AM peak where, whilst speeds are slow, they are fairly predictable
- along Aotea Quay between the Hutt Road overbridge and Waterloo Street, average travel speeds drop from 60pkh to a low of 30kph between 8am and 9am before rising back to 40kph and staying within the 40kph to 50kph range for the remainder of the day

Figure 38 below shows corresponding weekend travel speeds.

Figure 38 Weekend state highway travel speeds and travel speed variability



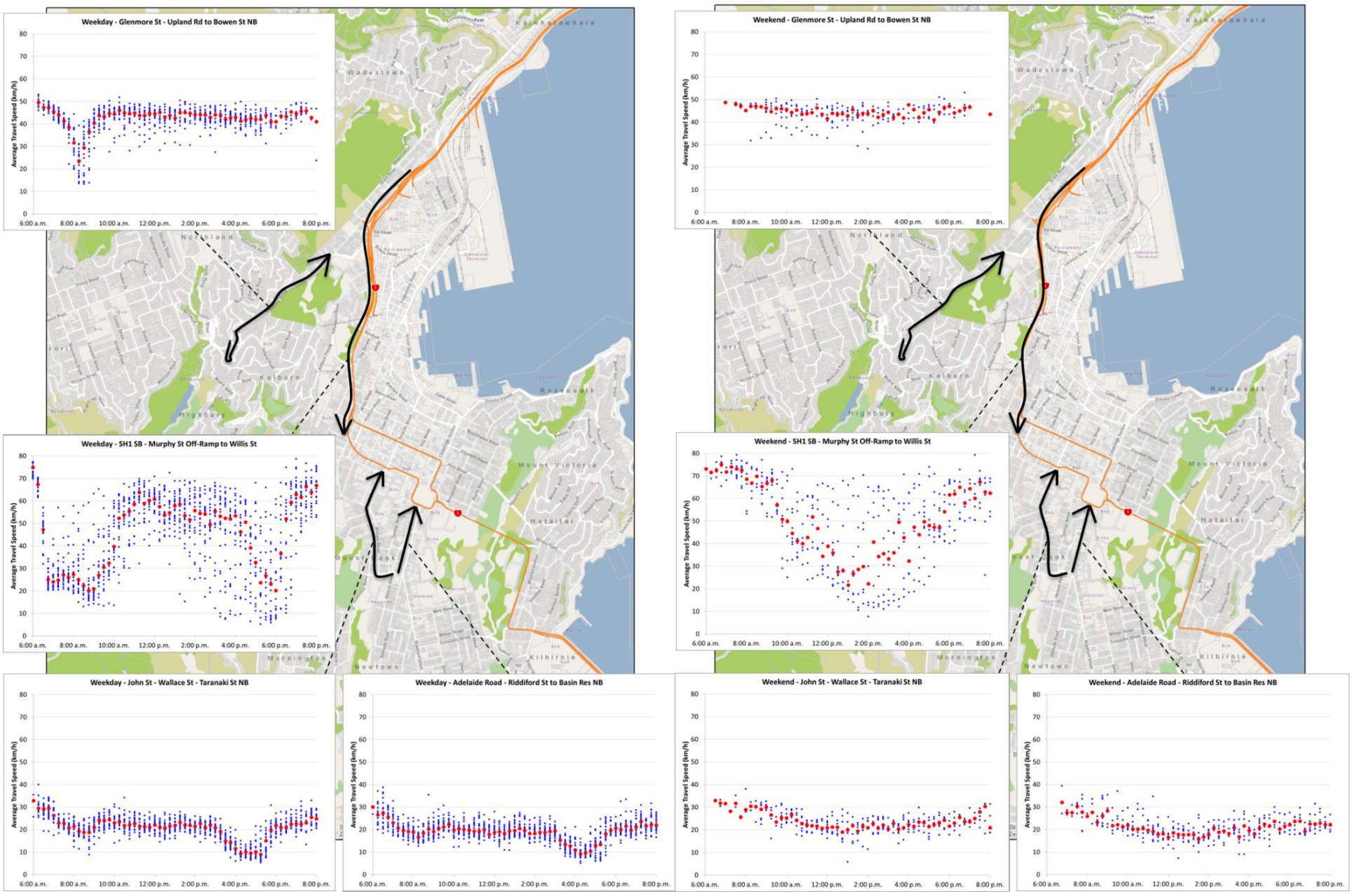
The following can be drawn from the data:

- in general, average weekend travel speeds on most routes show a similar pattern to comparable weekday travel speeds
- between Hobson Street overbridge and the Terrace Tunnel eastern portal
    - average travel speeds slowly decline from 80kph prior to 9am to 30kph around midday, staying in the 30kph to 40kph range until 5pm
    - despite there being relatively few observations, average travel speeds can vary significantly from one Saturday to the next
- travel speeds between the Terrace Tunnel and Basin Reserve sit in the 10kph to 15kph range for the majority of the afternoon between midday and 5pm
- average travel speeds between the Airport and Basin reserve drop from around 40kph at 10am to between 20kph and 30kph until 2pm
- travel speeds on Aotea Quay between Hutt Road and Waterloo Street stay in the 60kph to 70kph range of the majority of Saturday

8.1.2 Shorter route travel speeds and travel speed variability

Figure 39 and **Figure 40** show inbound travel speeds for selected shorter routes for both weekday and Saturdays

Figure 39 Weekday and weekend travel speeds inner city inbound



A variety of observations can be made from looking at the various routes:

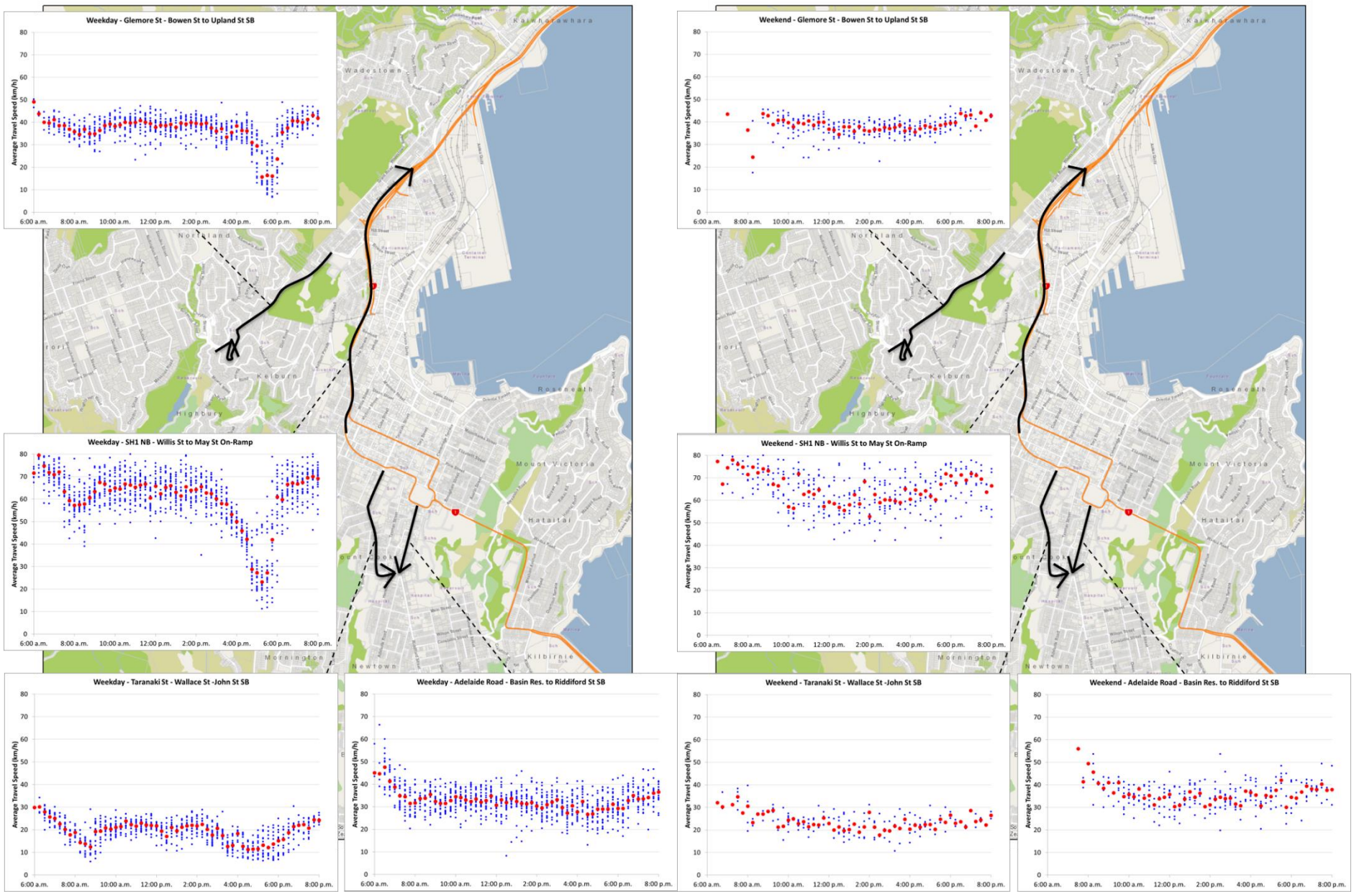
Weekday

- Travel speeds on Glenmore Street dip from an average of 40kph to 50kph throughout most of the day to between 20kph to 30kph (and occasionally as low as 15kph) for a short period in the AM peak
- Adelaide Road and Wallace Street average travel speed are relatively low (20kph to 30kph) throughout the day, with the dip in average travel speed in the PM peak (to around 10kph on both routes) more significant than the slight reduction in average travel speeds in the AM peak
- Between Murphy Street and Willis Street, average travel speeds drop to around 20kph in the AM peak before gradually climbing back up to 60kph in the Inter-peak before dropping again to around 20kph in the PM peak; this route shows a large amount of day to day travel speed variability

Weekend

- Average travel speeds on Wallace Street and Adelaide Road sit in the 20kph to 30kph range whilst average travel speeds on Glenmore Street sit between 40kph and 50kph
- Average travel speeds between Murphy Street and Willis Street range from 30kph to 40kph from around 10am to 4pm and show significant variability throughout the whole day

Figure 40 Weekday and weekend travel speeds inner city outbound



The data shows the following:

Weekday

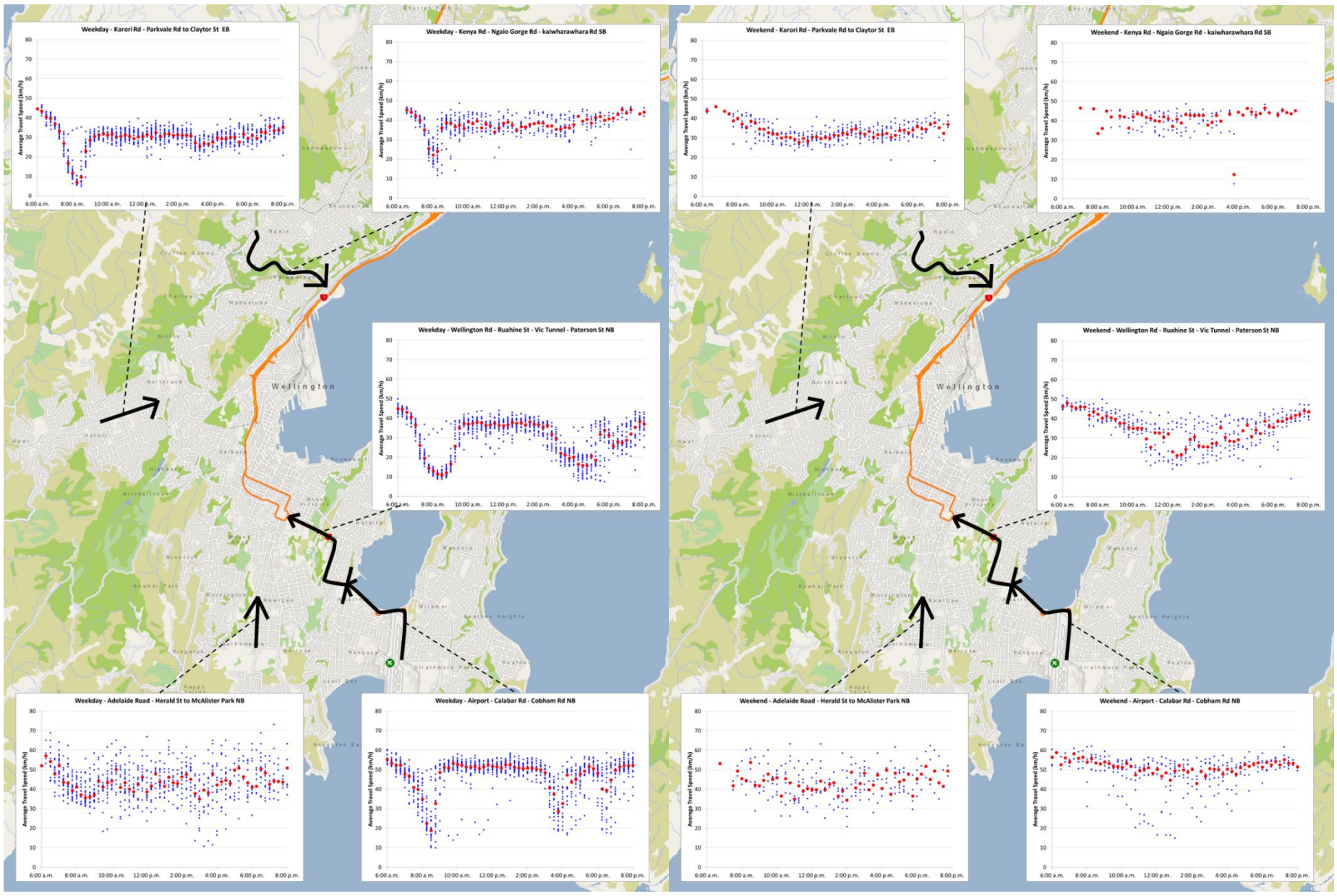
- Travel speeds on Glenmore Street dip from an average of 40kph to 50kph throughout the majority of the day to less than 20kph for a short period during the PM peak
- average travel speeds on Taranaki Street (20kph to 25kph during off-peak, 10kph to 15kph during peak) are lower than average travel speeds on the parallel Adelaide Road (30kph to 40kph) although Adelaide Road does appear to have more variable travel speeds compared to Taranaki Street
- travel speeds between Willis Street and May Street (SH1) are in the 60kph to 70kph range with the exception being the PM peak when they drop sharply to around 20kph / 30kph between 5pm and 6pm

Weekend

- As per the weekday, southbound average travel speeds on Taranaki Street and lower than southbound average travel speeds on Adelaide Road
- Travel speeds on SH1 (Willis Street to May Street) show a significant amount of day to day variability but generally sit in the 50kph to 70kph range

Figure 41 shows inbound travel speeds for selected shorter routes for both weekday and weekends (Saturday) whilst **Figure 42** show the corresponding outbound travel speeds.

Figure 41 Weekday and weekend travel speeds, wider city, inbound



The data shows the following:

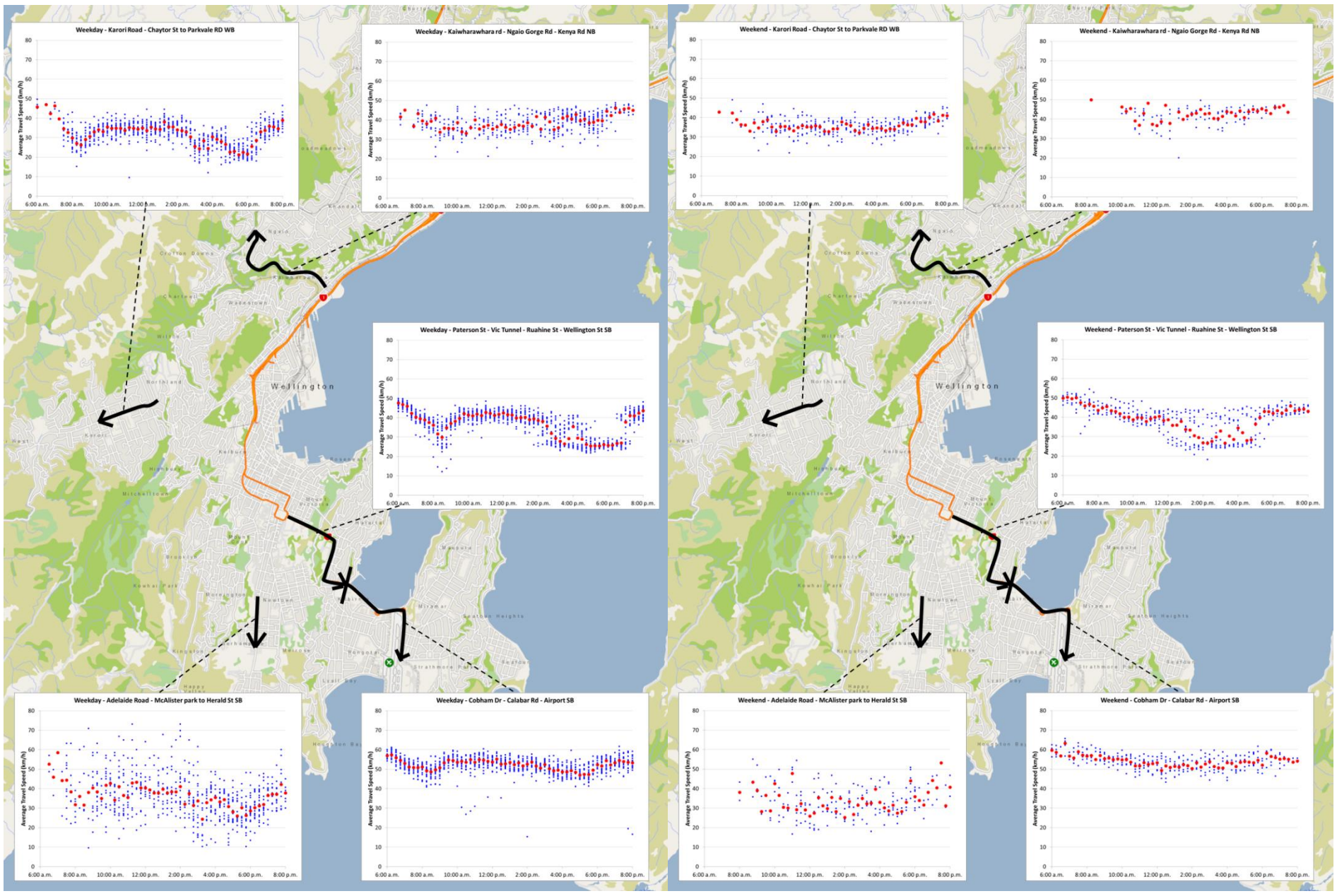
Weekday

- Karori Road (towards Birdwood Road / Chaytor Street intersection) and Ngaio Gorge Road both show a short lived but pronounced dip in average travel speeds in the AM peak
- average travel speeds from the Airport to Cobham Drive range from 50kph to 60kph except during the AM peak (7am to 9am) when they can drop to between 10kph and 20kph and during the PM peak when they can drop to between 20kph and 40kph; during both peak periods there is significant day to day travel speed variability
- between Wellington Road and Patterson Street (Basin Reserve), average travel speeds of around 40kph consistently drop to between 10kph to 20kph during the AM peak between 7am and 9am and between 20kph to 25kph during the PM peak

Weekend

- Weekend average travel speeds across all routes show less variability throughout the day compared to the weekday travel speeds
- between Wellington Road and Patterson Street (Basin Reserve), average travel speeds drop from between 40kph to 50kph prior to 8am to between 20kph and 30kph for the period between midday and around 6pm in the evening

Figure 42 Weekday and weekend travel speeds - wider city, outbound



The data shows the following:

Weekday

- average travel speeds across all routes show a small dip during the AM peak and a more pronounced dip during the PM peak
- outbound travel speeds appear slightly higher and are less variable, compared to comparable inbound travel speeds / travel speed variability presented in Figure 33

Weekend

- as per weekday travel speeds, the weekend outbound routes are faster and less variable compared to the weekend inbound travel speeds

9 Public transport travel speeds

The Real Speed Passenger Information (RTPI) system tracks busses in real-time using GPS technology and provides a wealth of information that can be used to monitor and understand bus travel speeds / speeds and variability at both a route and corridor level.

Data was obtained from the RTPI during a 2 week period in March 2016 and is summarised according to the following focus areas:

- Golden Mile travel speeds and variability
- travel speeds and variability on selected corridors
- travel times and variability for selected routes

9.1 Golden Mile

The Golden Mile is the busiest bus corridor in the city. **Figure 43** below shows the directions from which 12,000 bus passengers converge on the Golden Mile in the AM peak period (7am to 9am). The majority enter the Golden Mile from the south / east (4,600), north (3,600) and west (2,500) with Taranaki Street and Willis Street accounting for lesser volumes (900 and 800 passengers respectively) coming from the southern suburbs.

Figure 43 Bus passengers converging on the Golden Mile in the AM peak period (7am to 9am)

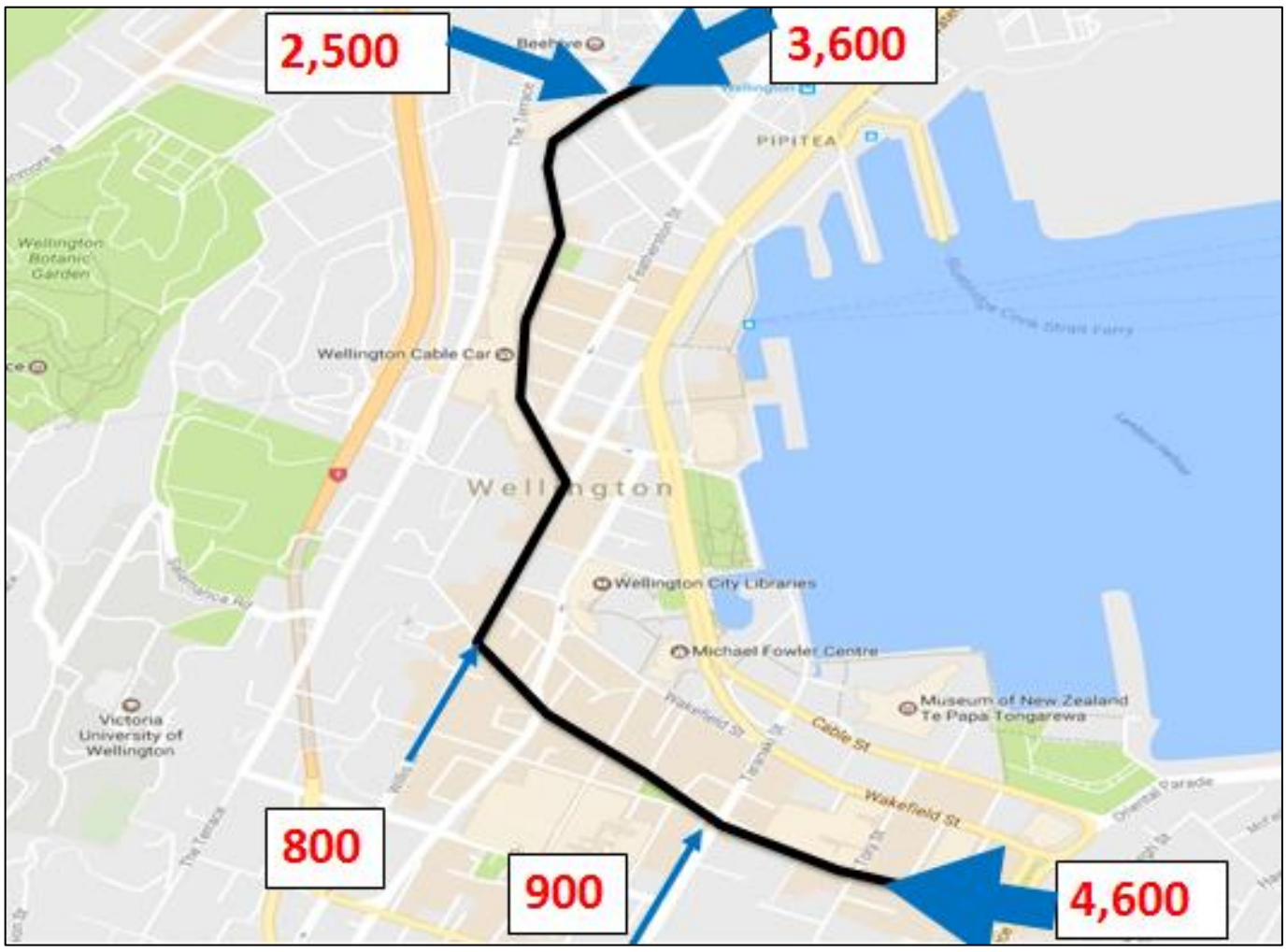
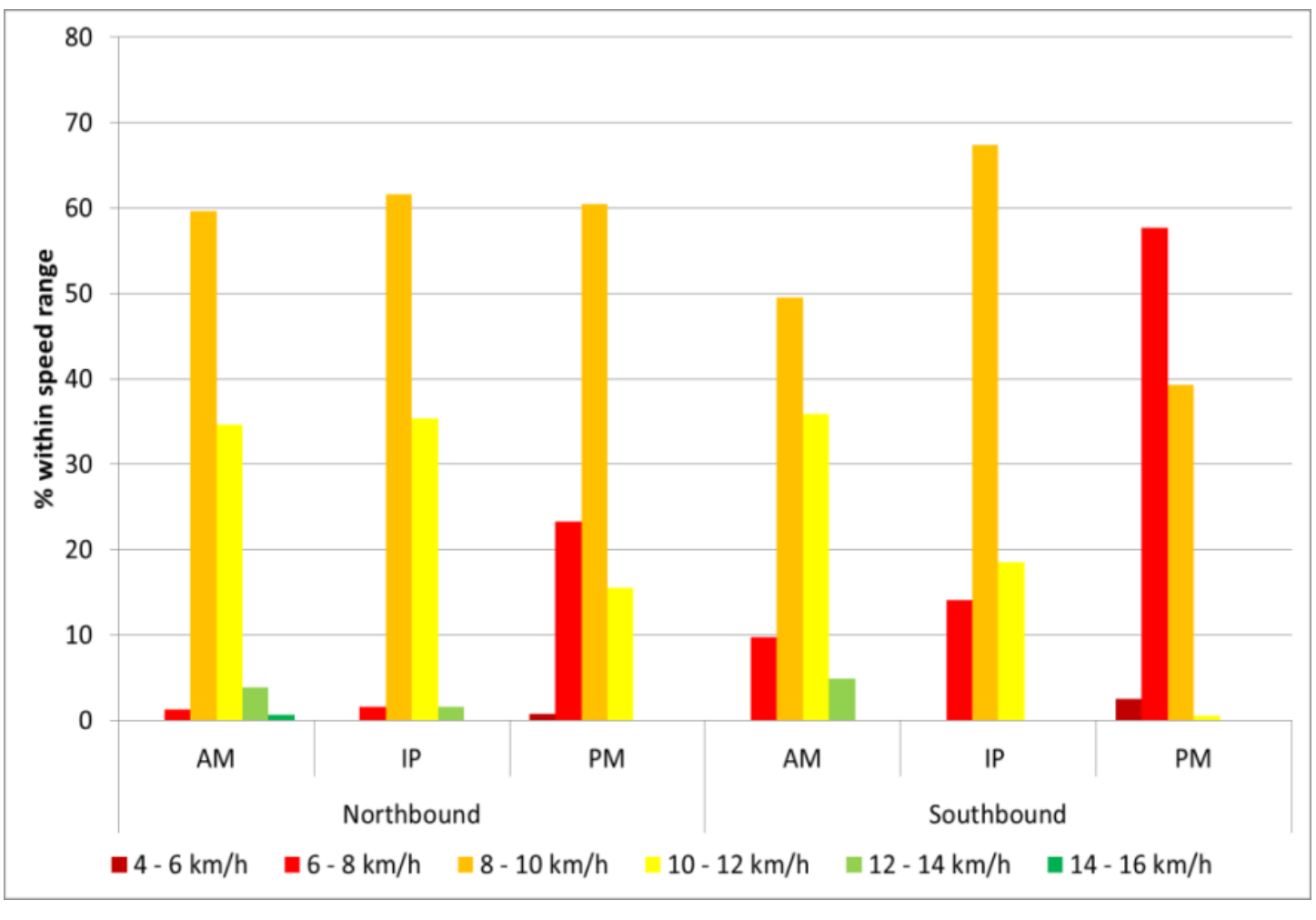


Figure 44 below shows travel speed variability along the Golden Mile, by direction, obtained from analysis of observed travel times on Routes 1 and 2.

Figure 44 Golden Mile travel speeds, Route 1 and 2



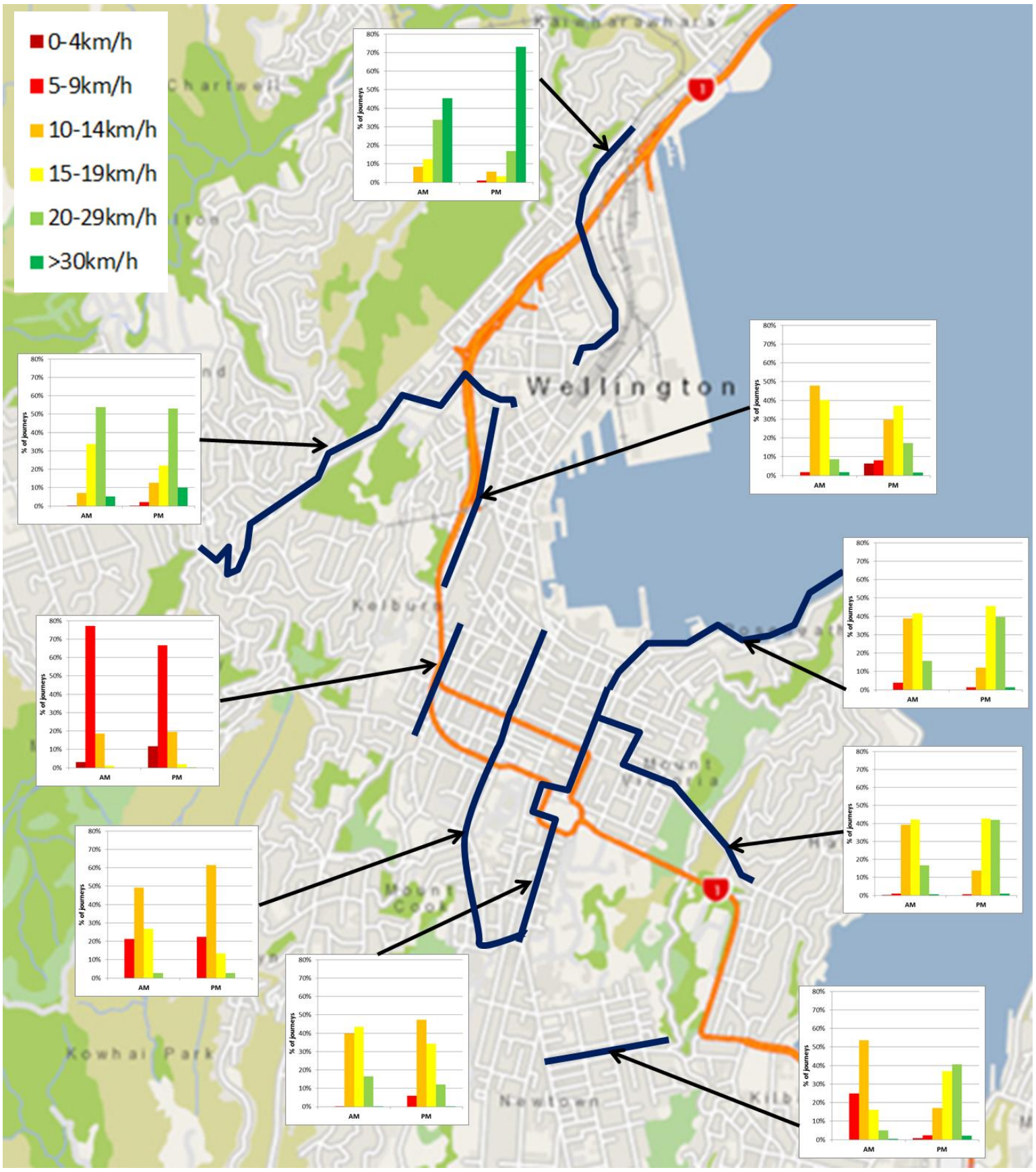
It shows that:

- in the northbound direction
  - around 60% of observed services have average travel speeds in the range 8kph to 10kph
  - the remainder are in the 10kph to 12kph range, except in the PM peak when they are evenly split between 10/12kph and 6/8kph
- in the southbound direction
  - between 50% and 60% of services fall into the 8-10kph speed bracket
  - around 10% of services in the AM peak and Inter-peak have average travel speeds of 10-12kph
  - in the PM peak, around 60% of services have average travel speeds of between 6kph to 8kph
  - the remaining 40% of PM peak services sit in the 8-10kph bracket, with a small proportion falling into the slowest 4-6kph bracket
- southbound average travel speeds are worse than northbound average travel speeds
- PM peak travel speeds are worse than AM peak travel speeds, with increased bus stop dwell times due to higher numbers of boarding passengers in the PM peak compared to the AM peak (boarders take longer to process) being one of the contributory factors

9.1.1 Public transport travel speeds– selected corridors

Figure 45 below shows the range of travel speeds that are observed from analysis of all services operating on selected corridors during a 2 week period in March. AM peak travel speeds represent the peak inbound direction, while PM peak travel speeds relate to the peak outbound direction.

Figure 45 Bus travel speeds on selected corridors by time period (AM inbound, PM outbound)



The data shows the following:

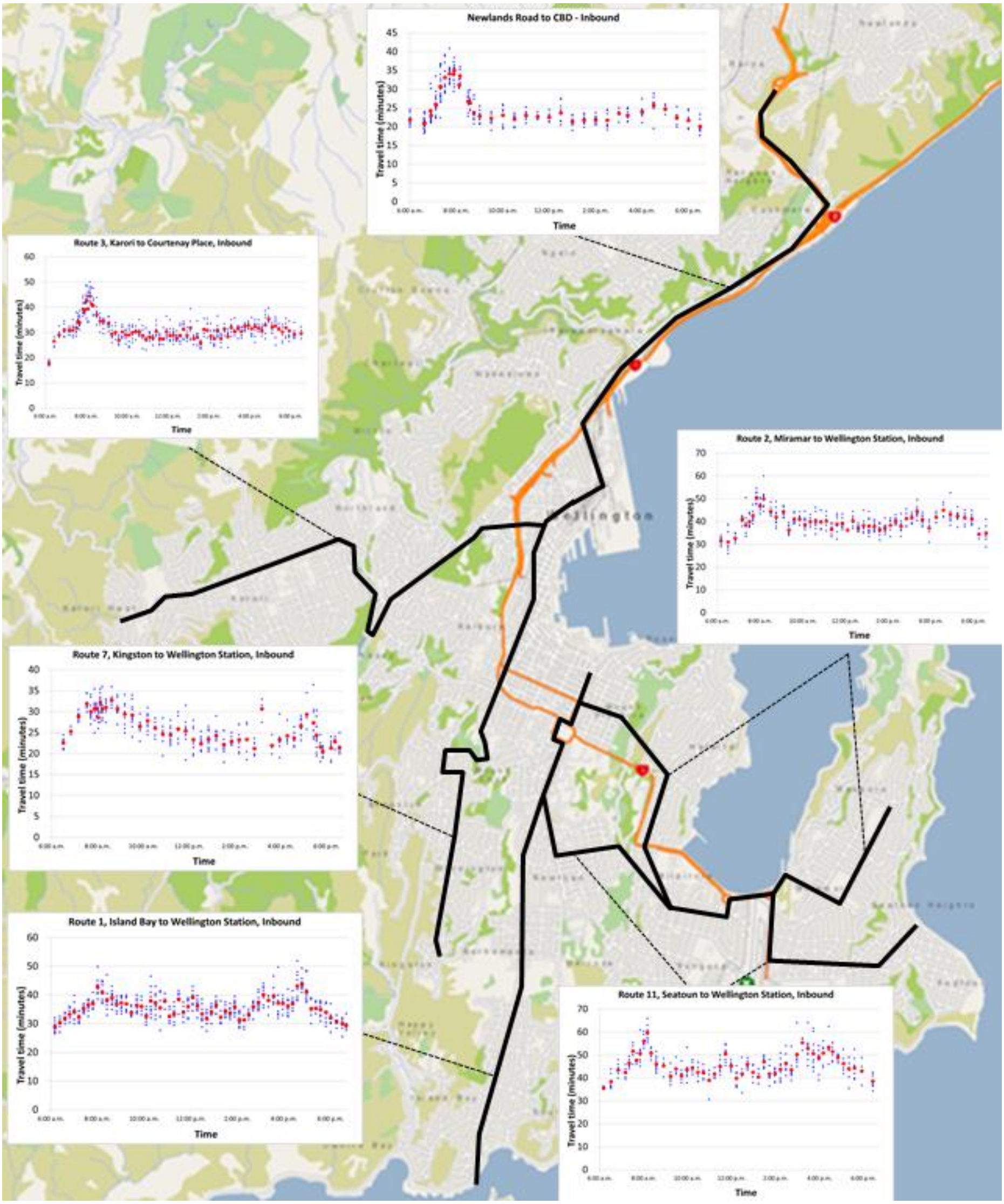
- travel speeds are variable across all corridors in both the AM peak (inbound) and PM peak (outbound)
- Glenmore Street and Thorndon Quay corridors have relatively fast travel speeds, with the majority of services in both directions running at between 20 and 30+kph
- Adelaide Road, Oriental Parade and Hataitai corridors show travel speeds in the range 10kph to 20kph (inbound and 15kph to 25kph (outbound)
- Constable Street travel speeds are slower in the AM peak (inbound) than PM peak (outbound)

- Around 20% of all journeys on Taranaki Street travel at between 5kph and 9kph
- Willis Street (inbound) and Victoria Street (outbound) is the worst corridor for bus travel speeds, with the majority of services running at between 5kph and 9kph during peak periods

9.2 Public transport travel times – Routes

Figure 46 and **Figure 47** below shows public transport travel times and travel time variability by route and direction respectively. The **red dot** represents the average travel time (across a 2 week period in March) whilst the **blue dots** represent the range of observed travel times for a particular services during that 2 week period.

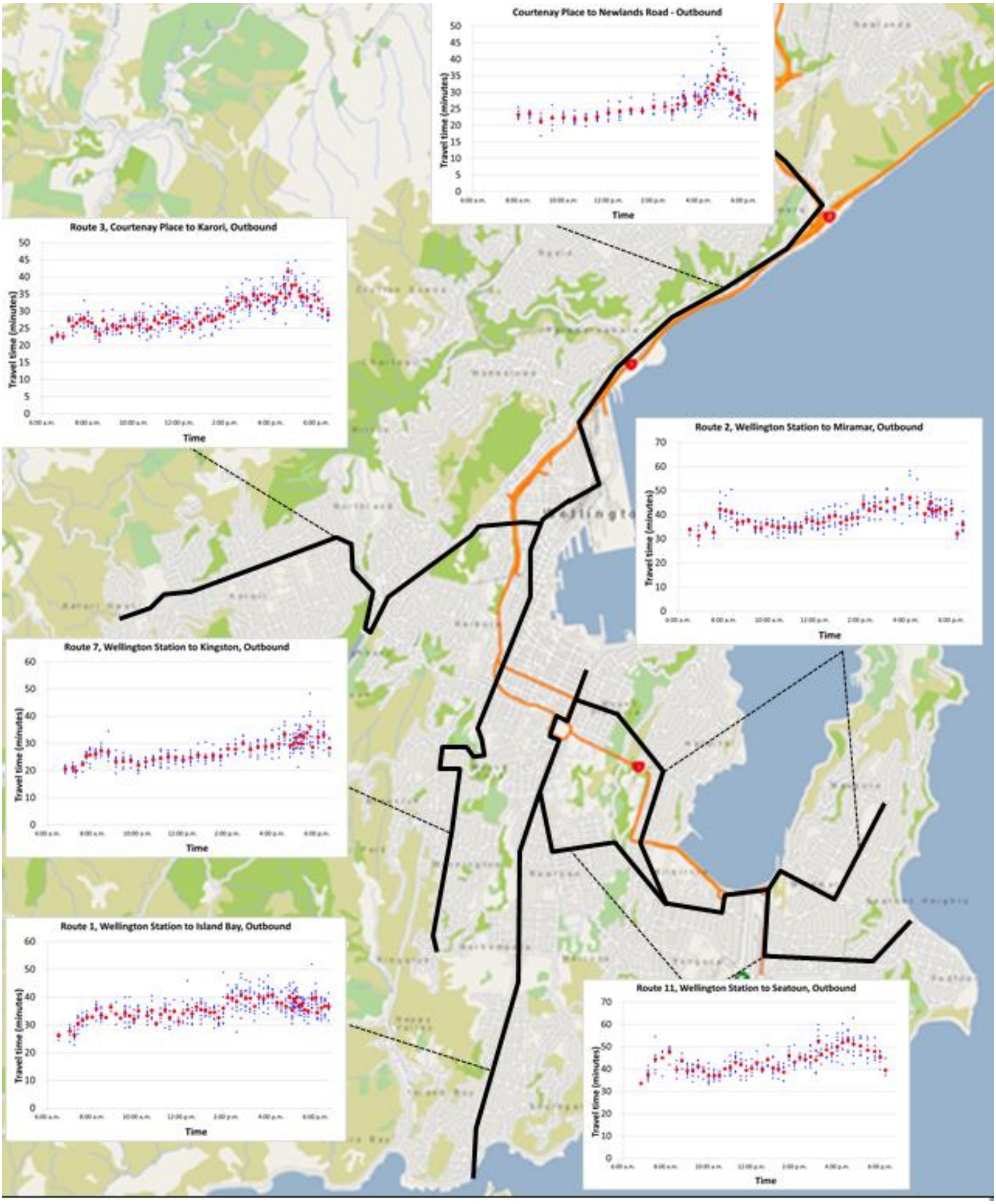
Figure 46 Public transport travel times and travel time variability, inbound



The inbound data shows that across all routes:

- travel times for a particular journey can vary by between 5 to 10 minutes (and for some routes, greater than 10 minutes) from one day to the next
- journeys at peak times (7am to 9am) take between 5 to 10 minutes longer on average compared to journeys during off-peak periods – this difference between peak / off-peak is most pronounced for Route 3 (Karori to Courtenay Place) and services from Newlands to Courtenay Place via Hutt Road

Figure 47 Public transport travel times and travel time variability, outbound



The outbound data shows that across all routes:

- travel times for a particular route at a particular time can vary by between 5 to 15 minutes from one day to the next, with variability worst during the peak periods
- journeys at peak times (4pm to 6pm) can take 10 to 15 minutes longer than during corresponding off-peak periods

10 Pedestrian travel times

This section looks at pedestrian travel times for selected routes and pedestrian delays at selected intersections. The outputs produced are developed from assumptions relating to average pedestrian travel speeds (stated below) and average delays at intersections for pedestrian obtained from actual signal plans that have been used to develop the revised suite of transport modelling tools.

Average point to point pedestrian travel times are approximate and a function of:

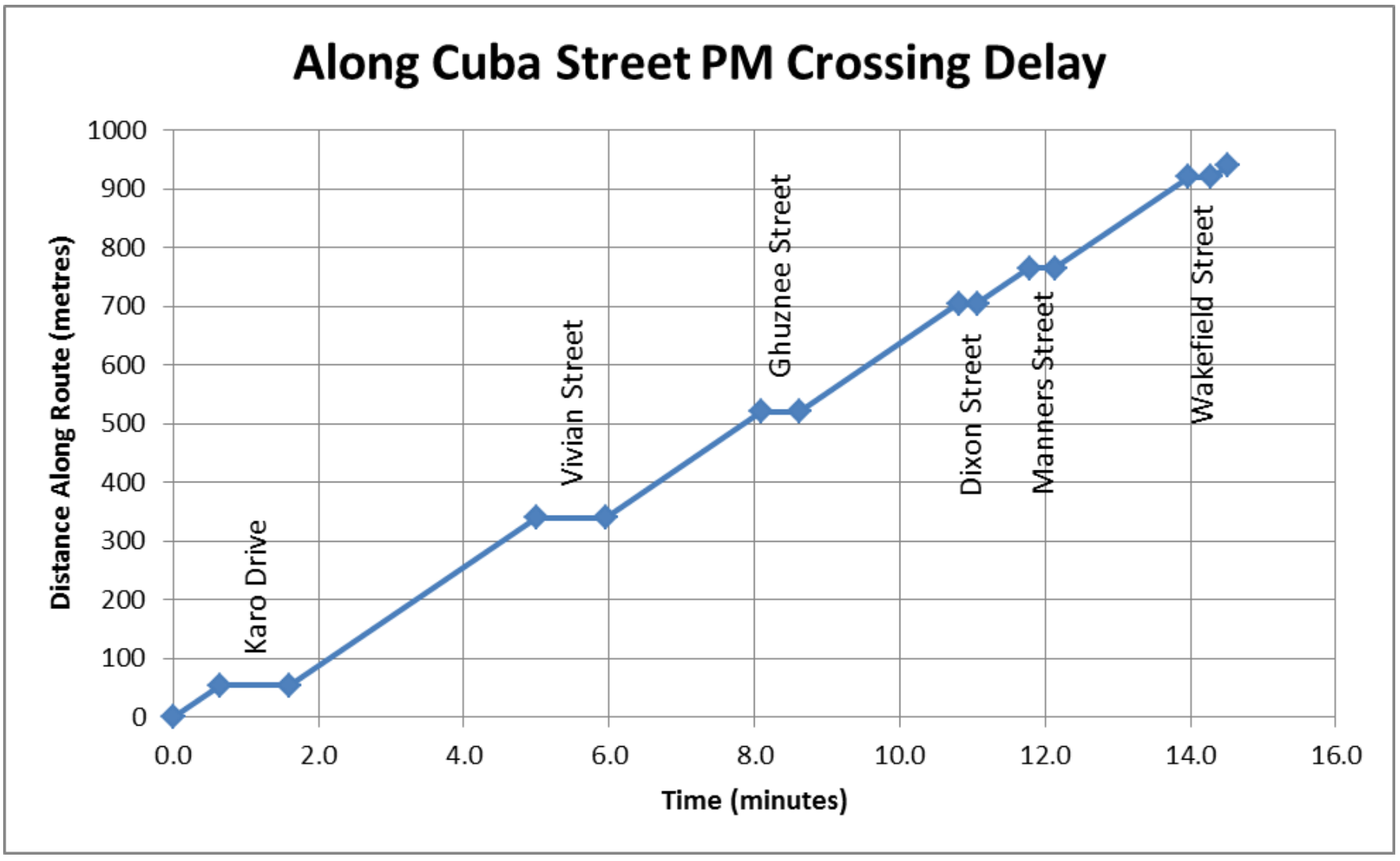
- distance
- average walking speed
- time spent waiting to cross at signalised pedestrian crossings

Whilst pedestrian travel times can also be a function of mid-block delays due to pedestrian density, for the purpose of this analysis it is assumed that high pedestrian density causes no delays, pedestrians walk at an average speed of 1.4m/s and arrive 'randomly' at signalised crossings along the route thus experiencing average wait times at signalised intersections.

10.1 Cuba Street

Figure 48 and **Figure 49** show pedestrian travel times for Webb Street to Wakefield Street (down Cuba Street) in the PM peak.

Figure 48 Evening peak signalised crossing delay for pedestrians along Cuba Street

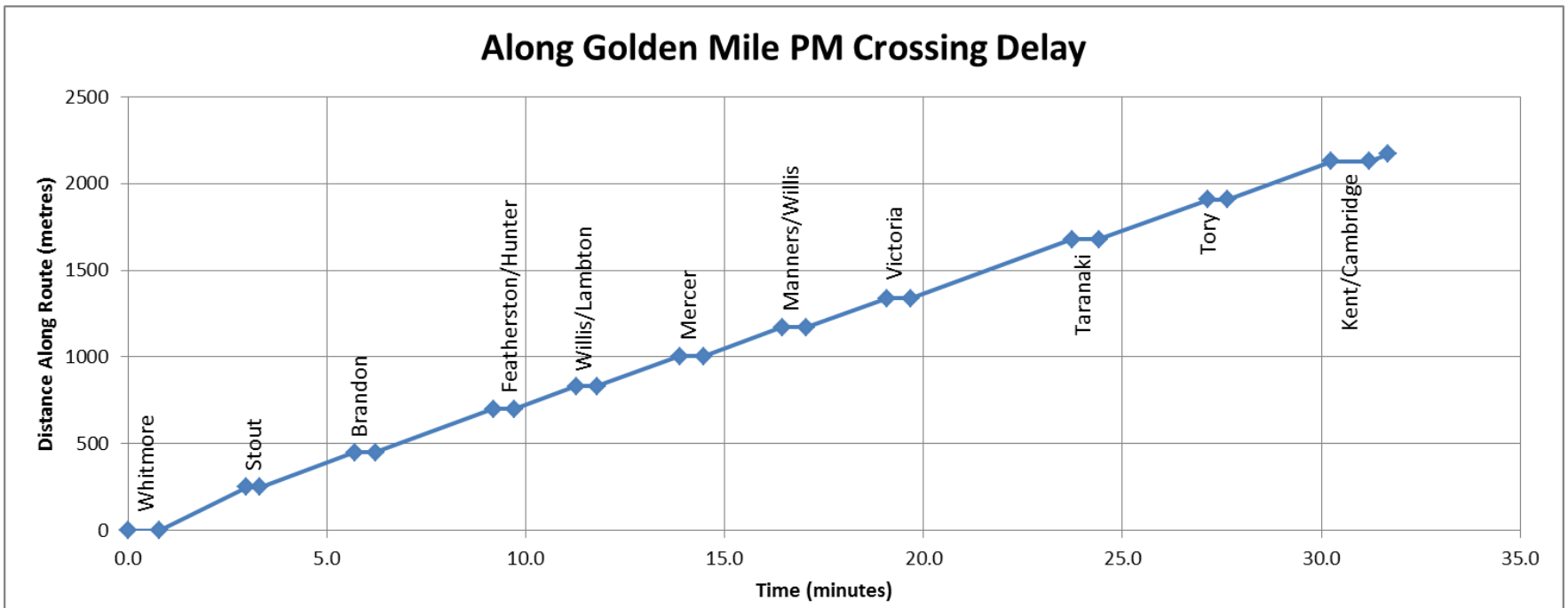


It shows that it would typically take 14.5 minutes to walk along Cuba Street in the evening peak, with crossing delay accounting for approximately 3.3 minutes of that time.

10.2 Pedestrian Signalised Crossing Delay

Figure 49 show pedestrian travel times along the length of the Golden Mile (Kent Terrace to Bowen Street) in the PM peak.

Figure 49 Evening peak signalised crossing delay for pedestrians along the Golden Mile



It shows that it would typically take around 32 minutes to walk along the Golden Mile in the evening peak, with crossing delay accounting for approximately 6m30s minutes (20%) of that time. In the morning peak and inter-peak this reduces slightly to around 6 minutes.

Pedestrians will be delayed at each intersection along the Golden Mile by, on average, by 20, 19, and 21 seconds in the AM peak, Inter-peak and PM peak respectively.

10.3 Waterfront intersection delays for pedestrians

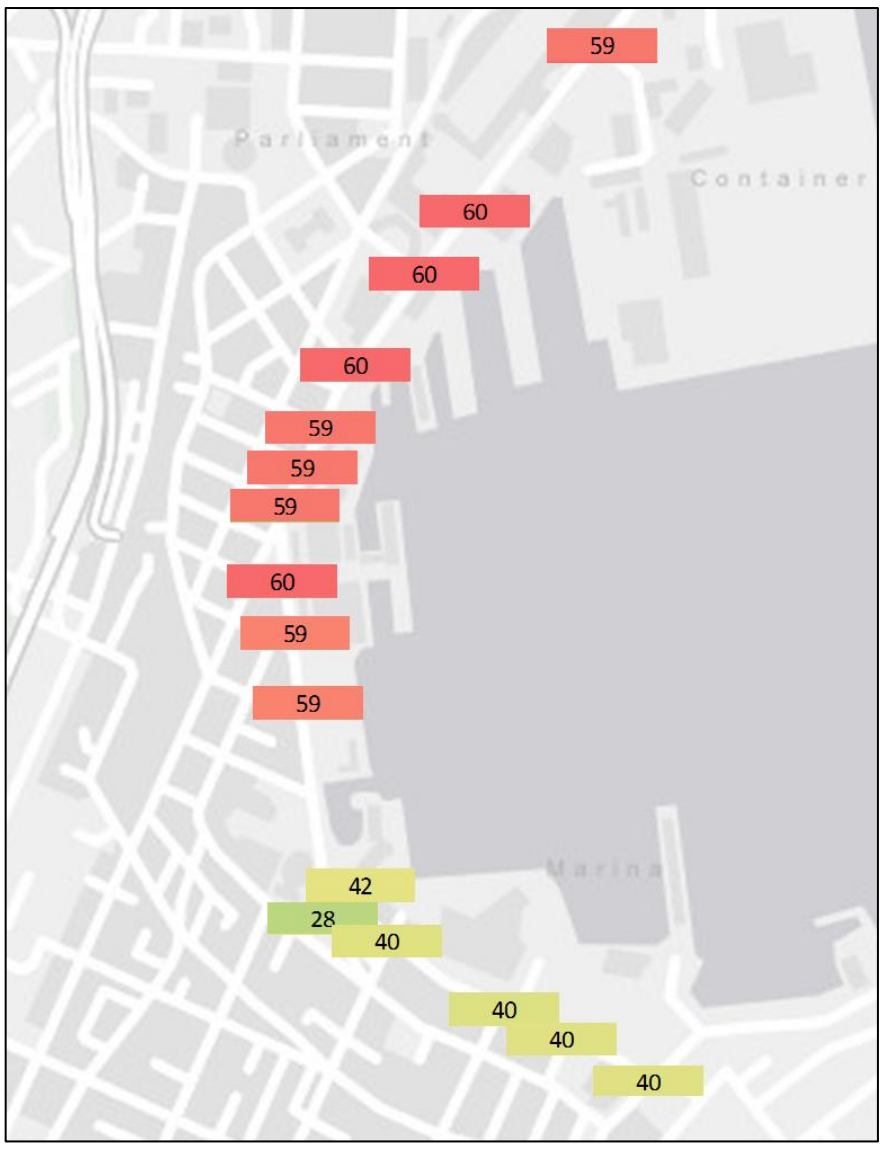
Figure 50 shows the evening peak average pedestrian crossing delays for all signalised intersections along the waterfront (Cable Street to Bunny Street).

It shows that for the northern section of the waterfront route, average delays are around 60 second in the evening peak, a function of the long intersection cycle time (120s) in the evening peak. Corresponding delay figures for the AM peak and Inter-peak (not shown below) are slightly lower as the intersection cycle time is lower in these time periods compared to the PM peak.

Intersections along the southern section of the Waterfront Route (Cable Street) have lower average delays of around 40 seconds in the PM peak than the northern section, due to these intersections having shorter cycle times (compared to those along Jervois / Customhouse Quay).

Signal plans show that there is little difference intersection cycle times between the AM peak, Inter-peak and PM peak, meaning that pedestrian delays during all time periods are relatively similar.

Figure 50 Evening peak average signalised crossing delay for pedestrians on the Waterfront route



11 Public transport patronage- weekend

Table 9 below shows weekly public transport patronage, by mode separately, broken as follows:

- Weekday – off-peak and peak
- Weekend – Saturday and Sunday

Table 9 Public transport boardings by time period and mode

Time Period	Bus	Rail
Weekday	**85%**	**95%**
Peak	45%	70%
Off-peak	40%	25%
Weekend	**15%**	**5%**
Sat	10%	2.5%
Sun	5%	2.5%

The data shows that the majority of rail boardings (95%) and bus boardings (85%) occur during weekdays. Weekend rail boardings are split evenly between Saturday and Sunday whilst there are approximately double the number of bus boardings on Saturday compared with Sunday.

Weekday bus boardings are split relatively evenly between the peak and off-peak, whereas approximately 75% of weekday rail boardings occur during peak periods.

12 Intersection volumes

Figure 51 and **Figure 52** below show the number of persons, including pedestrians using signalised pedestrian crossings, passing through selected intersections in Wellington CBD by mode.

The time periods for this analysis are as follows:

- AM peak – 6.30am to 9.30am (3hr)
- Inter-peak – 10.30am to 1.30pm (3hr)
- PM peak – 3.30pm to 6.30pm (3hr)
- Saturday – 11am to 2pm (3hr)

The motor vehicle, pedestrian and cyclist data comes from video traffic counts undertaken in March 2016. All movements are captured for this analysis, including pedestrians using signalised crossings. As some pedestrians may be observed crossing two intersection arms (i.e. people wanting to cross an intersection diagonally) they will technically be doubled-counted.

AM peak, Inter-peak and PM peak bus patronage is derived from bus volumes obtained from the Wellington Public Transport Model (which is itself derived from observed ticket machine boarding / alighting data) and verified against AM peak (inbound) and PM peak (outbound) bus volumes obtained from annual bus cordon surveys around Wellington CBD.

Saturday bus patronage is assumed to be a fixed proportion (66%) of inter-peak bus patronage with this factor derived from analysis of hourly inter-peak and Saturday patronage for selected routes. Whilst it is acknowledged that weekend public transport patronage is an area of weakness regarding the quality of observed data available, for the purpose of this high-level analysis the approach taken is considered appropriate.

The motor vehicle occupancy values, used to estimate the number of persons in motor vehicles, have been derived from the annual Wellington CBD vehicle occupancy[15] cordon data and published research relating to changes in car occupancy by time of day / day of week.

- AM peak – 1.35
- Inter-peak – 1.40
- PM peak – 1.35
- Saturday – 1.80

Whilst it is acknowledge that there are limitations to the approach for estimating total persons passing through selected intersections by mode, the analysis provides a high-level summary of spatial and temporal changes in network usage by mode.

The scale is the same for all four maps. The area of each circle corresponding to a particular intersection is proportionate to the number of persons passing through the intersection – bigger the circle, more people passing through the intersection.

[15] http://www.pinnacleresearch.co.nz/research/survey/vehicle_occupancy.pdf

Figure 51 Number of persons passing through intersections, by mode (AM peak and Inter-peak)

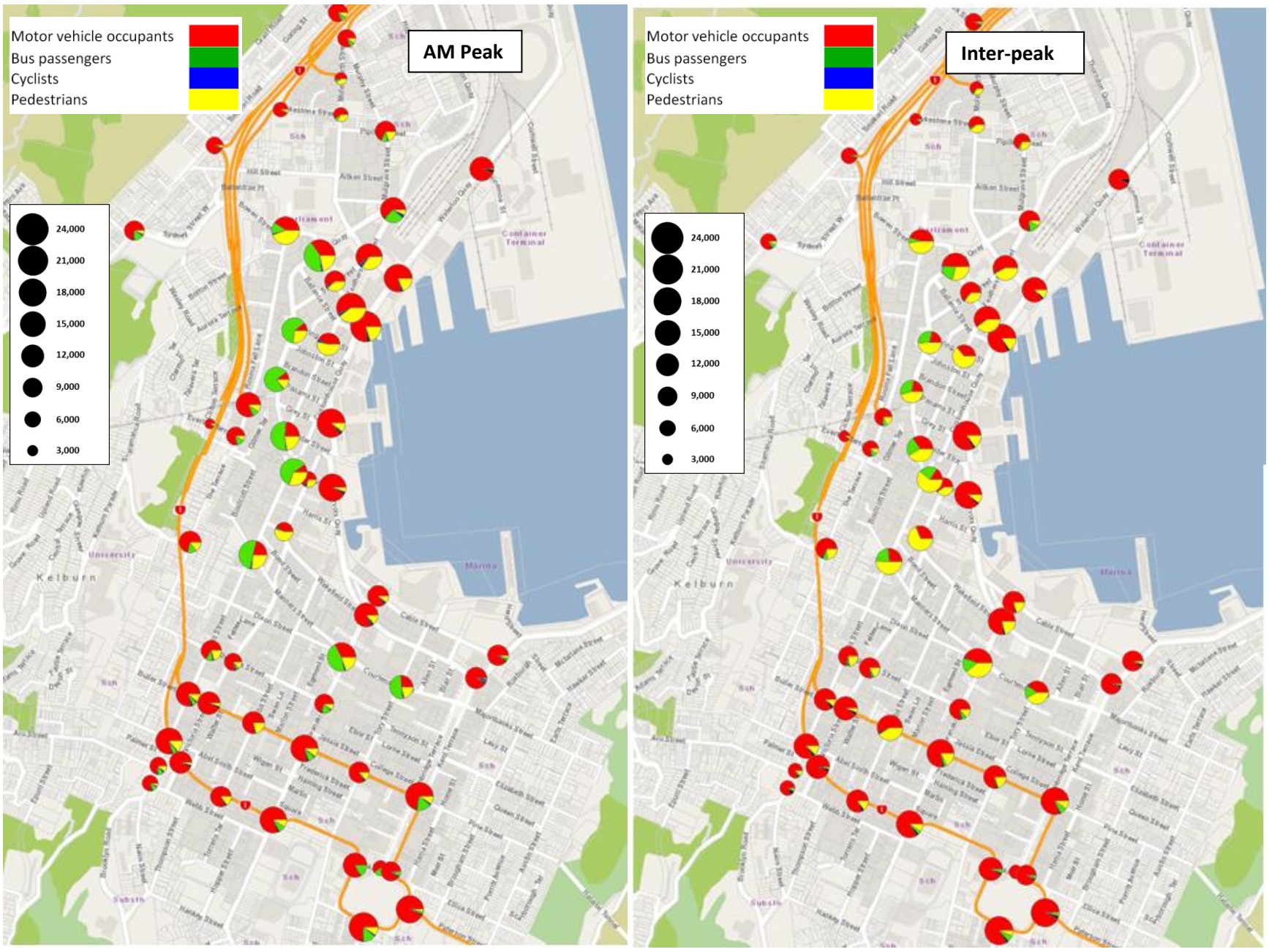
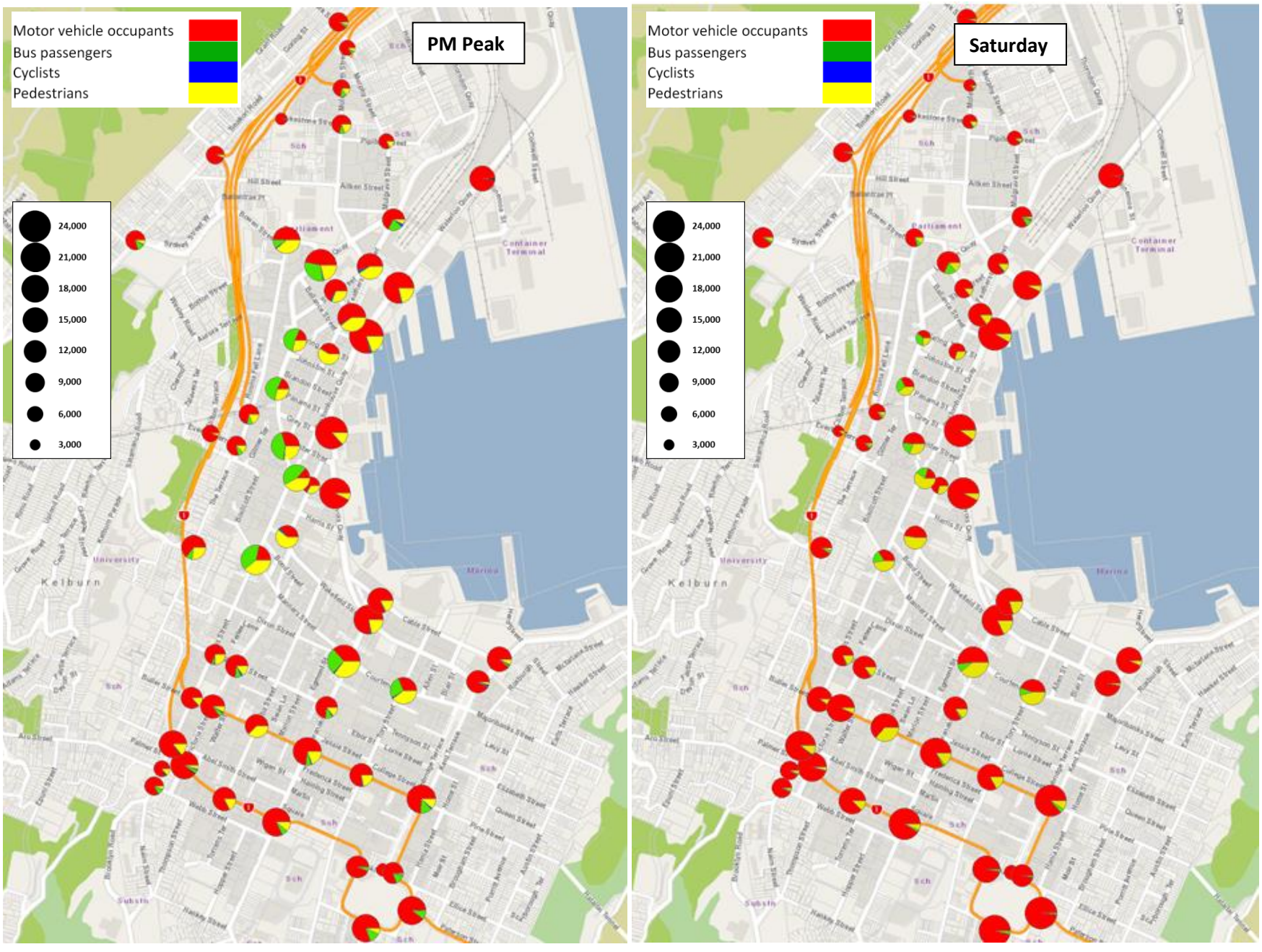


Figure 52 Number of persons passing through intersections, by mode (PM peak and Saturday)



The following general comments relating to differences between time periods can be made:

- bus patronage accounts for between 35% and 50% of people passing through intersections along the Golden Mile in the AM peak and PM peak but accounts for a much lower proportion of people in the Inter-peak and on Saturday
- pedestrians account for between 25% and 50% of persons passing through intersections towards the north of the CBD (Lambton Quay, Wellington Station area) in the AM peak, Inter-peak and PM peak; pedestrian volumes in northern sector of the CBD are much lower on Saturday
- pedestrian activity on Saturday is focussed on the southern sector of the CBD (Te Aro area)
- across the whole of the CBD, people in cars account for a greater proportion of total persons passing through intersections on Saturday compared to the weekday AM peak, Inter-peak and PM peak, in part due to higher vehicle occupancies on Saturday compared to on weekdays

13 Conflicts

The following series of maps show persons crossing selected intersections in certain directions (identified by arrows) by mode and for all time periods. The purpose of these maps is to highlight selected conflicts between crossing movements.

The areas of the network and conflicts that this analysis focusses upon are as follows:

- motor vehicles / pedestrians / bus passengers / cyclists crossing Vivian Street / Karo Drive that conflict with cars travelling along Vivian Street / Karo Drive
- pedestrians crossing the Quays (Customhouse / Jervois) which conflict with the dominant car movements along the Quays
- pedestrians / bus passengers crossing from the Railway station towards Lambton Quay / Featherston Street conflicting with cars on Whitmore Street
- all people passing through intersections along the Golden Mile, to highlight the proportion of people passing through the intersections along the Golden Mile by mode

The time periods for this analysis are as follows:

- AM peak – 6.30am to 9.30am (3hr)
- Inter-peak – 10.30am to 1.30pm (3hr)
- PM peak – 3.30pm to 6.30pm (3hr)
- Saturday – 11am to 2pm (3hr)

13.1.1 Karo Drive & Vivian Street

Figure 53, **Figure 54, Figure 55** and **Figure 56** below show combined north-south / south-north volumes of people crossing Vivian Street and Karo Drive, with the same scale used for all time periods.

For each time period, the accompanying table shows the following:

- for each intersection, **pie charts** show the number of persons crossing Vivian Street / Karo Drive by mode (northbound and southbound directions combined)
- the corresponding number of **persons in cars** travelling along Vivian Street / Karo Drive is annotated on each figure and shown as a grey line
- a **tabular summary** is provided showing the total number of persons crossing Vivian Street / Karo Drive (aggregated across all intersections) by mode in both absolute terms and as a percentage of the overall total

It should be noted that the number of persons in cars using part or all of Vivian Street / Karo Drive is likely to be higher than the numbers quoted for the selected locations below as traffic on these roads will comprise both through trips (i.e. Terrace Tunnel to Kent / Cambridge Terrace) and vehicles turning onto the road at a particular intersection and then off at another (i.e. southbound on Victoria Street, left onto Vivian Street, right onto Taranaki Street).

Whilst this is a limitation of the analysis (which is also common to the Waterfront / Station conflict analysis presented in subsequent sections) the purpose of providing this figure is to give the reader an indication of the level of conflict at any point along Vivian Street / Karo Drive between state highway traffic (predominantly people in cars) and persons crossing the state highway.

Figure 53 Volumes crossing Vivian Street and Karo Drive (persons) conflicting with persons in cars on Vivian Street and Karo Drive – AM peak (6.30am to 9.30am)

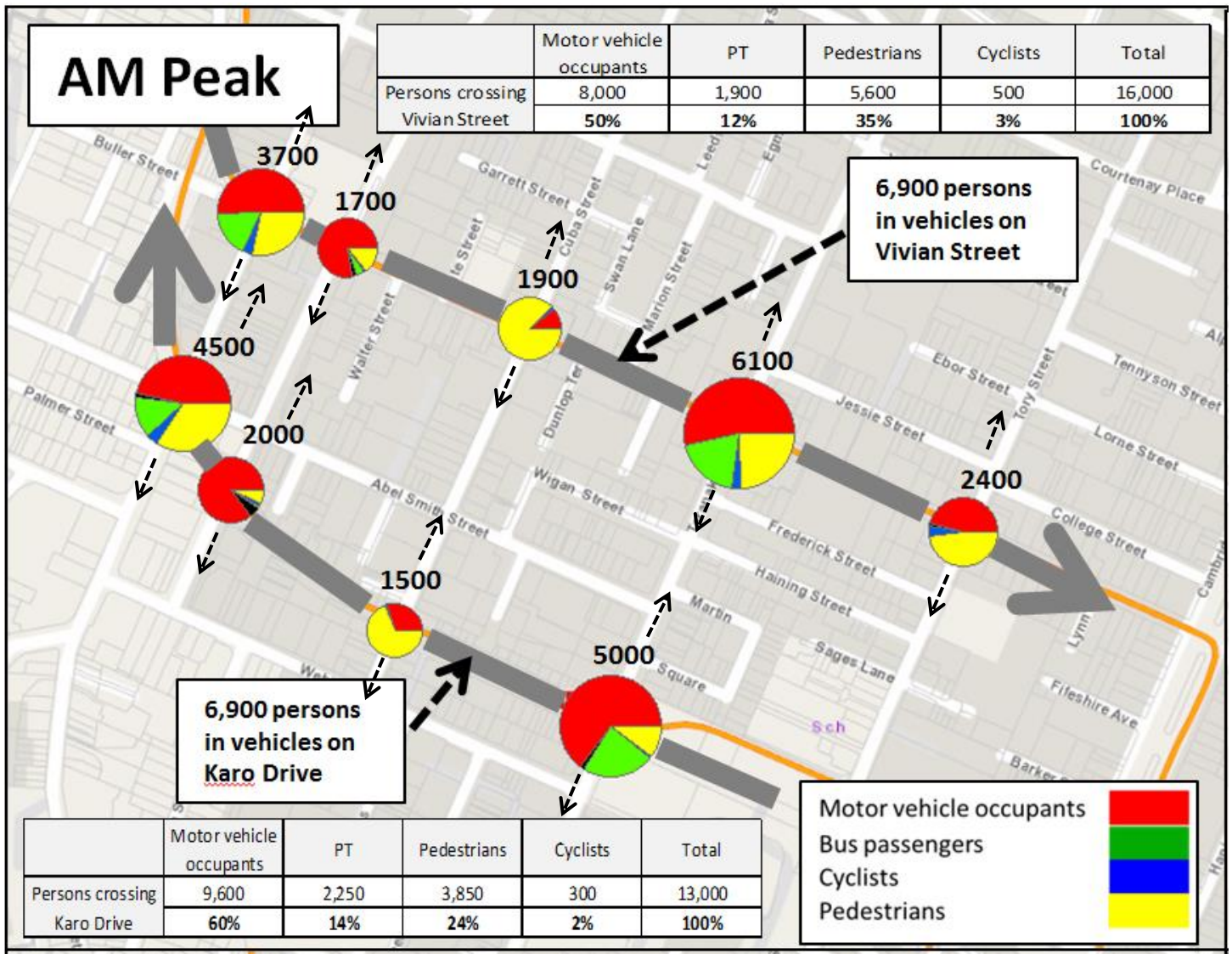


Figure 54 Volumes crossing Vivian Street and Karo Drive (persons) conflicting with persons in cars on Vivian Street and Karo Drive – Inter-peak (11am to 2pm)

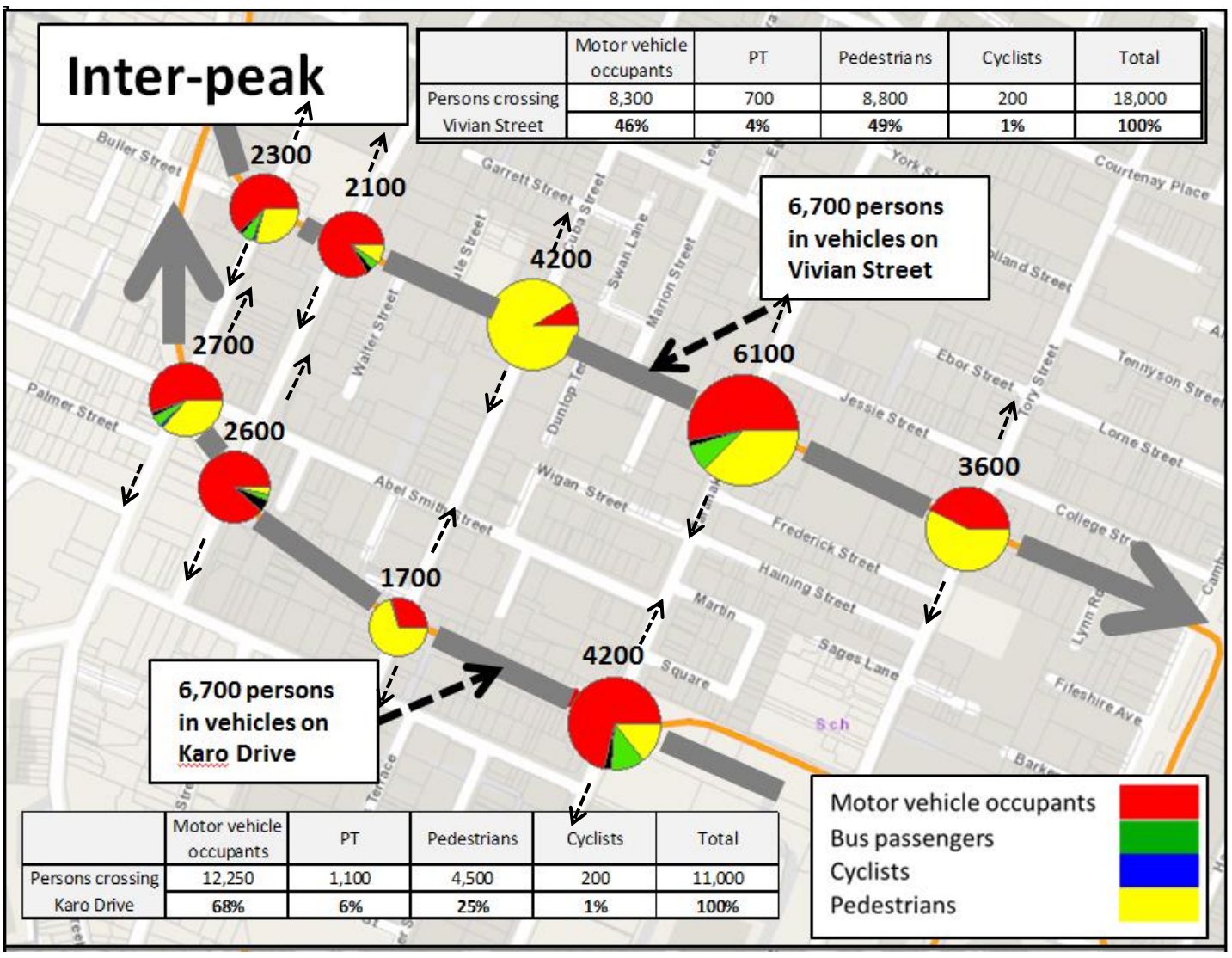


Figure 55 Volumes crossing Vivian Street and Karo Drive (persons) conflicting with persons in cars on Vivian Street and Karo Drive – PM peak (3.30pm to 6.30pm)

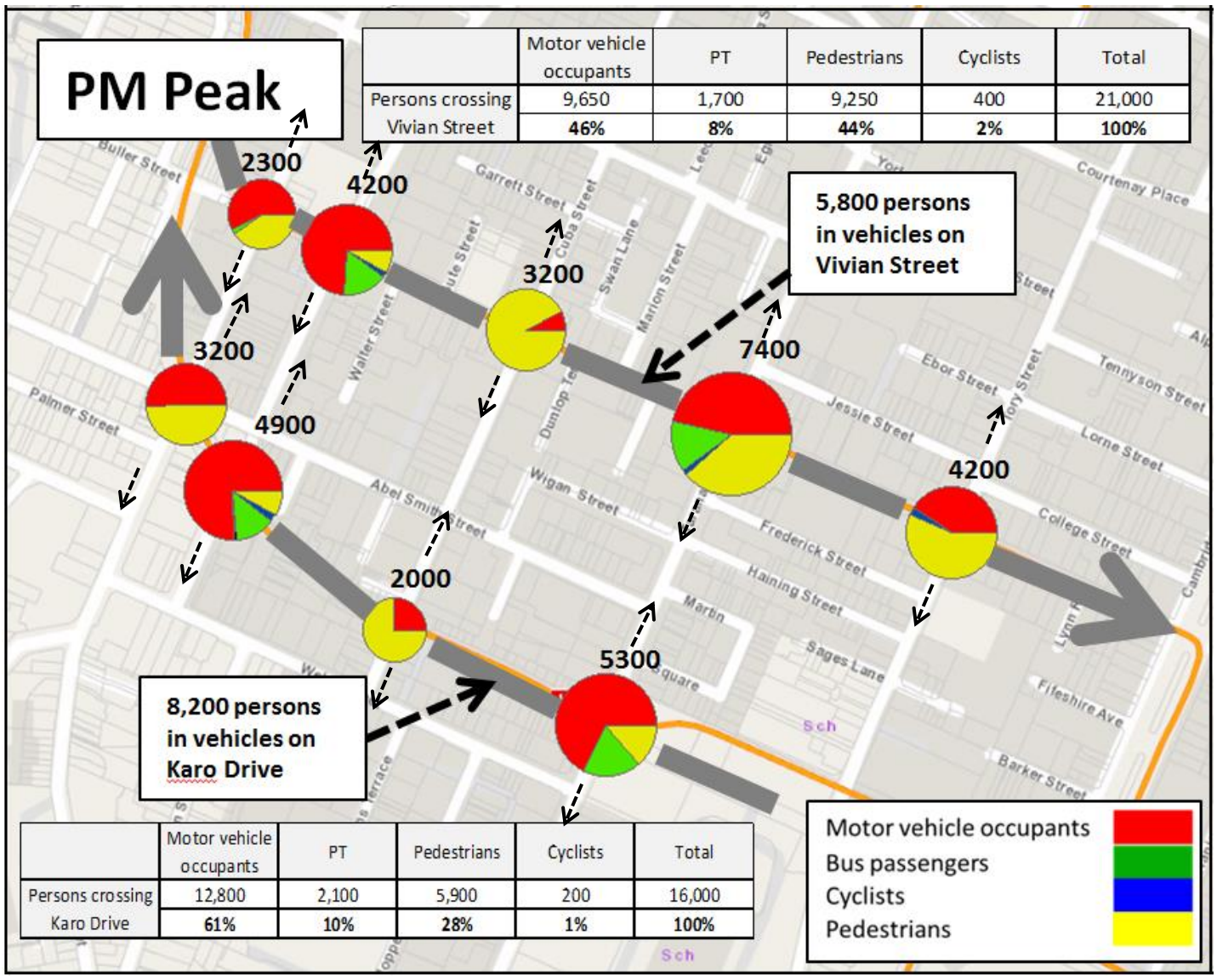
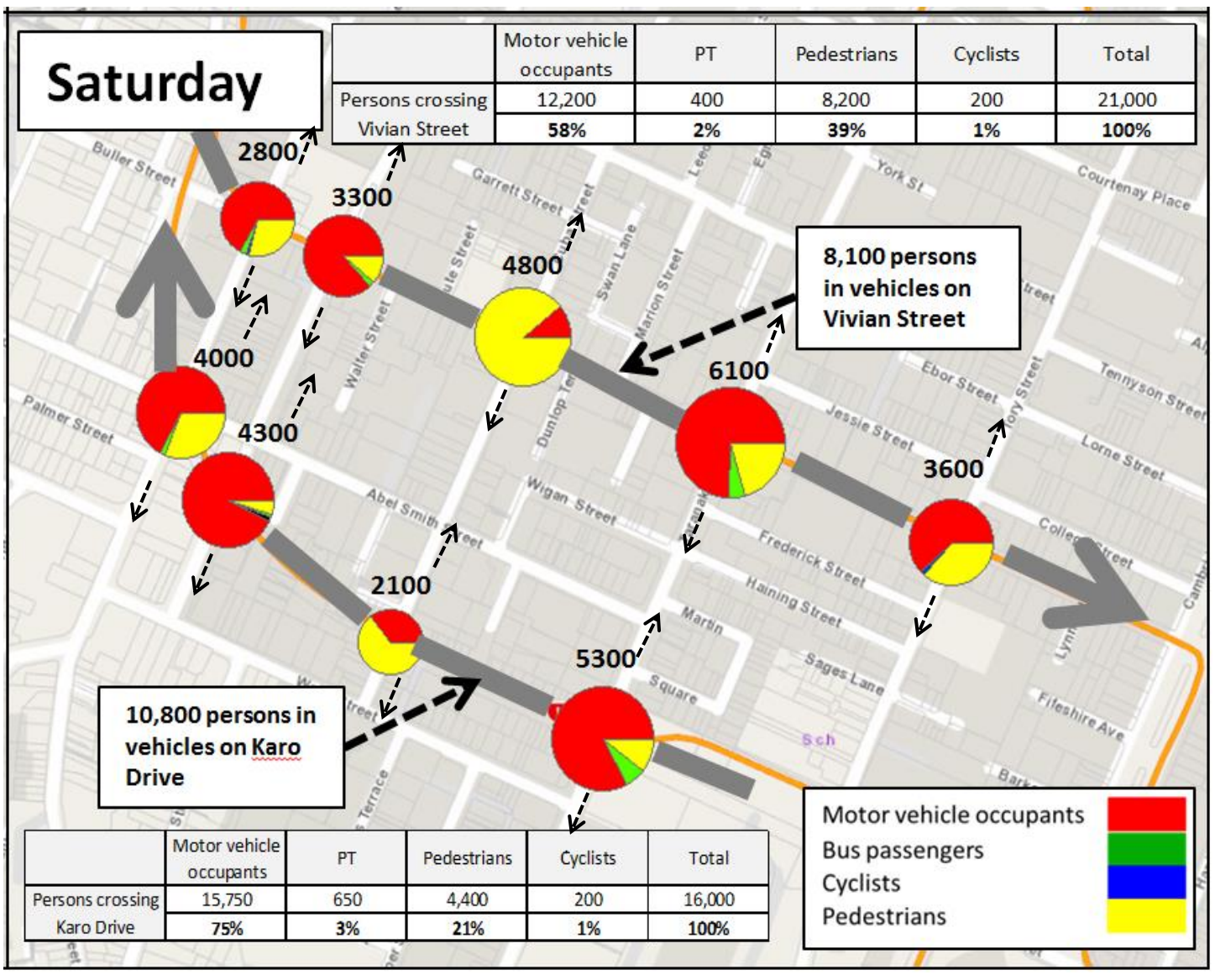


Figure 56 Volumes crossing Vivian Street and Karo Drive (persons) conflicting with persons in cars on Vivian Street and Karo Drive – Saturday (11am to 2pm)



The data shows the following:

- depending on the time period, between 16,000 and 21,000 people cross Vivian Street and 13,000 to 16,000 cross Karo Drive whilst at any one section of Vivian Street / Karo Drive there could be between 5,800 and 10.800 persons travelling in cars
- Taranaki Street has the largest number of persons crossing the state highway and is, along with Victoria Street, the main crossing point for persons in vehicles
- pedestrians account for 35% of persons crossing Vivian Street in the AM peak, with this percentage rising closer to 50% in the Inter-peak and 45% in the PM peak
- pedestrians account for a lower percentage of people crossing Karo Drive (between 20% to 30%) compared to Vivian Street
- Willis Street / Victoria Street and Taranaki Street are the major public transport crossing points, with approaching 25% of persons cross the state highway at these points during peak periods doing so by public transport

- pedestrians account for over 80% of people crossing the state highway at the intersection of Vivian Street / Cuba Street, with volumes greatest during the Inter-peak and on Saturdays

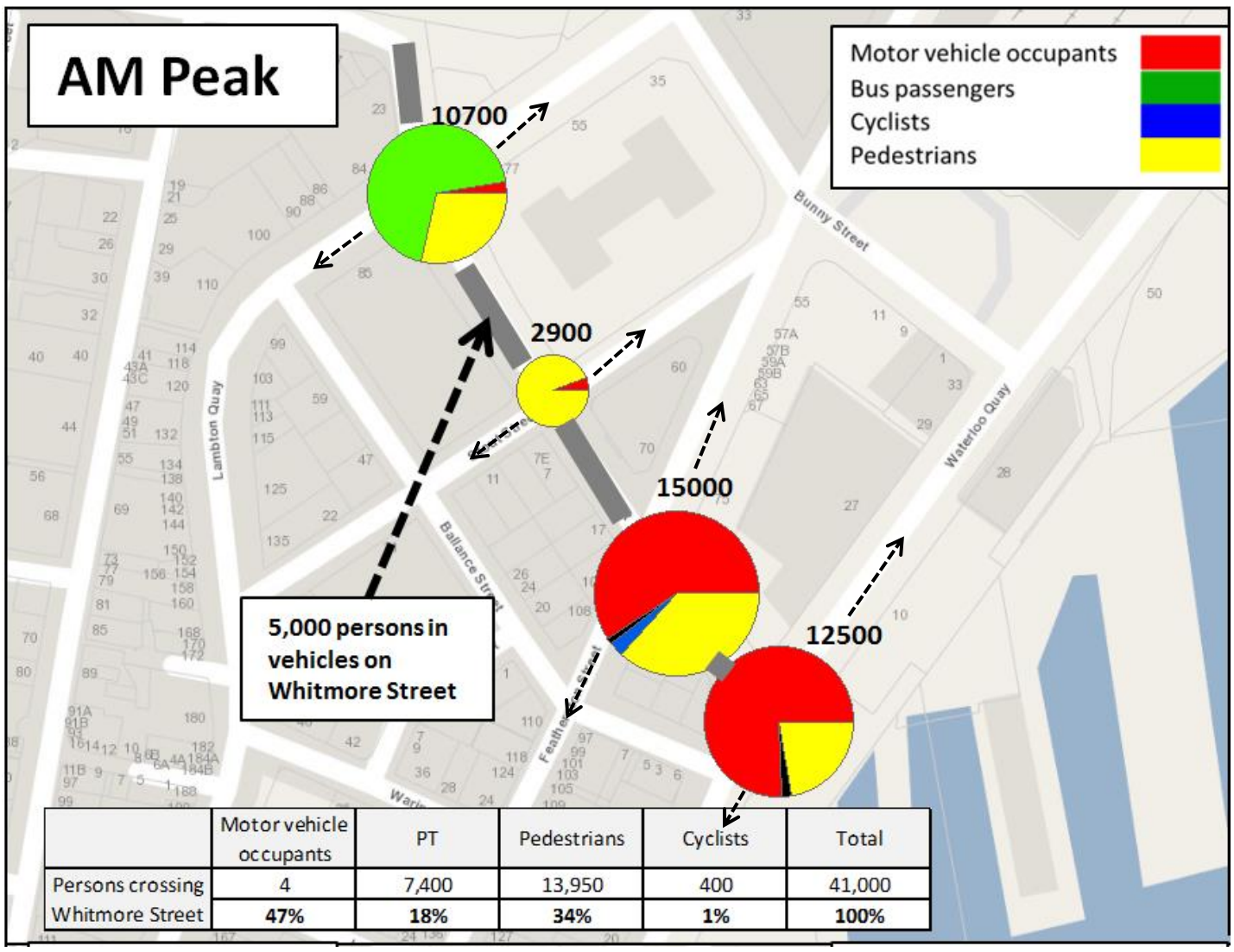
13.1.2 Whitmore Street

Figure 57, Figure 58, Figure 59 and **Figure 60** below show combined north-south / south-north volumes of people crossing Whitmore Street between Bowen Street (north) and Kumutoto Wharf (south). The same scale used for all time periods.

For each time period, the accompanying table shows the following:

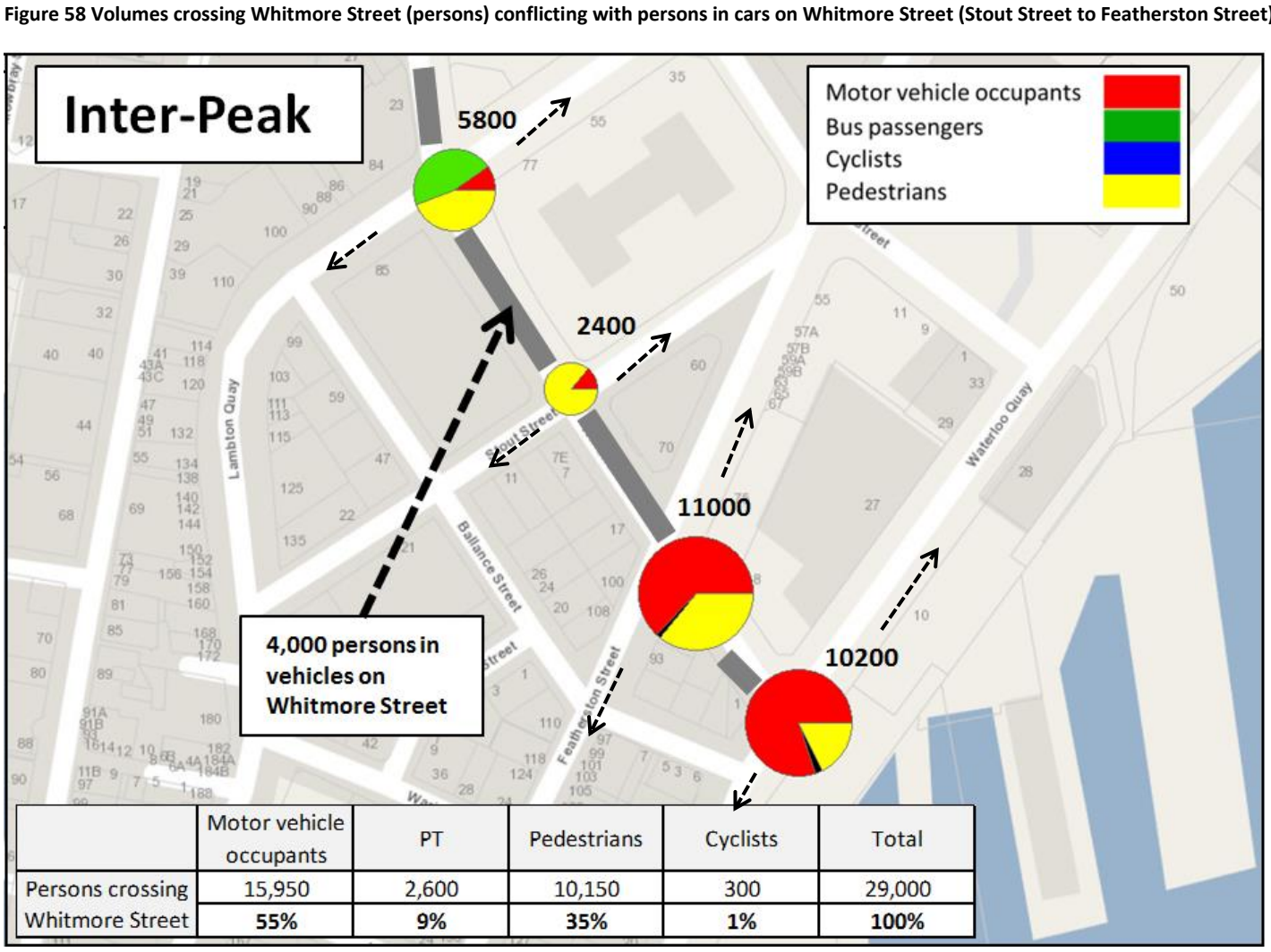
- for each intersection, **pie charts** show the number of persons crossing Whitmore Street by mode (northbound and southbound combined)
- the corresponding number of **persons in cars** travelling along Whitmore Street (between Stout Street and Featherston Street, westbound and eastbound combined) is annotated on each figure
- a **tabular summary** is provided showing the total number of persons crossing Whitmore Street (aggregated across all intersections) by mode in both absolute terms and as a percentage of the overall total

Figure 57 Volumes crossing Whitmore Street (persons) conflicting with persons in cars on Whitmore Street (Stout Street to Featherston Street), AM peak, 6.30am to 9.30am



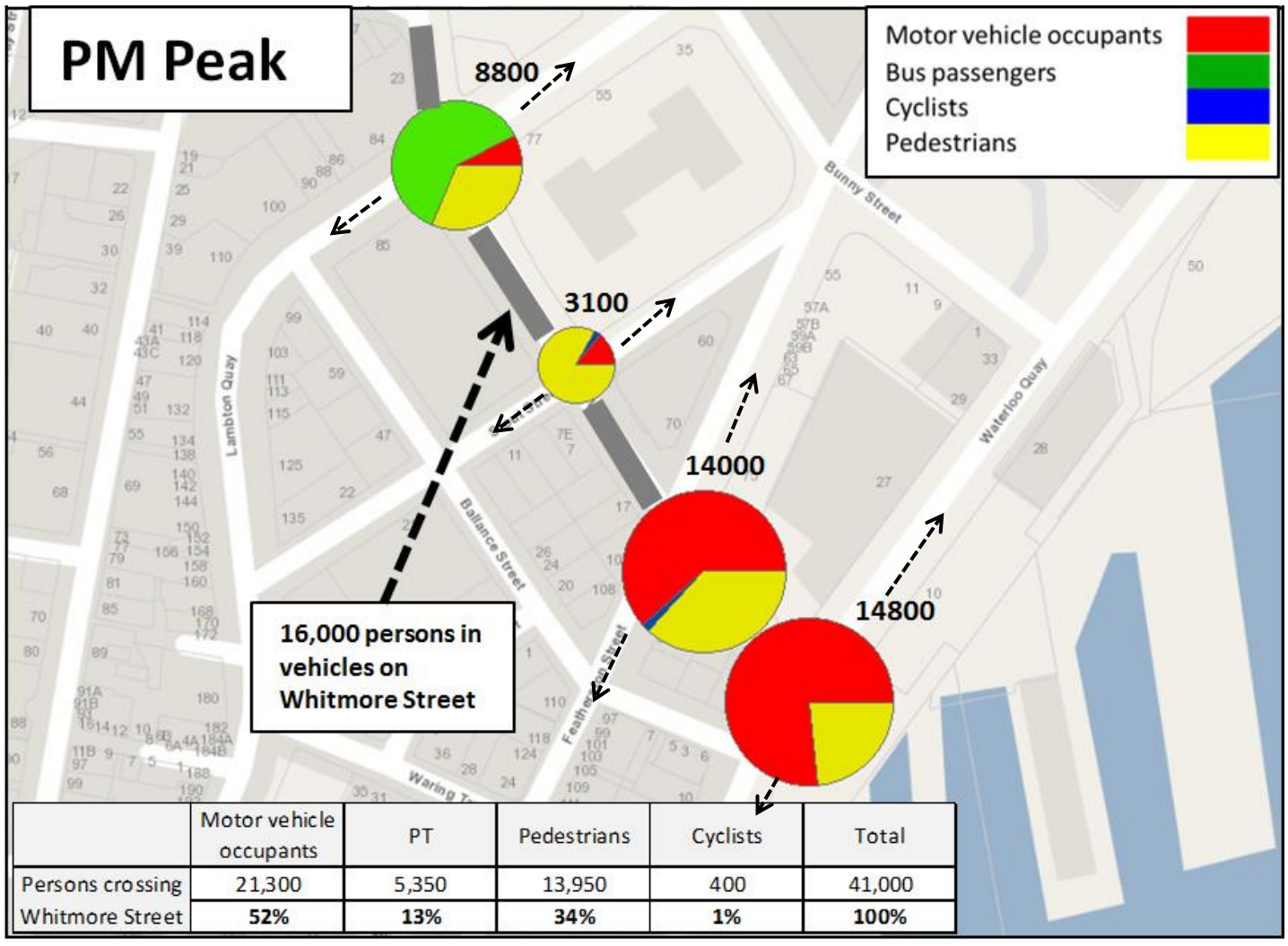
	Motor vehicle occupants	PT	Pedestrians	Cyclists	Total
Persons crossing Whitmore Street	4	7,400	13,950	400	41,000
	47%	**18%**	**34%**	**1%**	**100%**

Figure 58 Volumes crossing Whitmore Street (persons) conflicting with persons in cars on Whitmore Street (Stout Street to Featherston Street), Inter-peak, 11am to 2pm



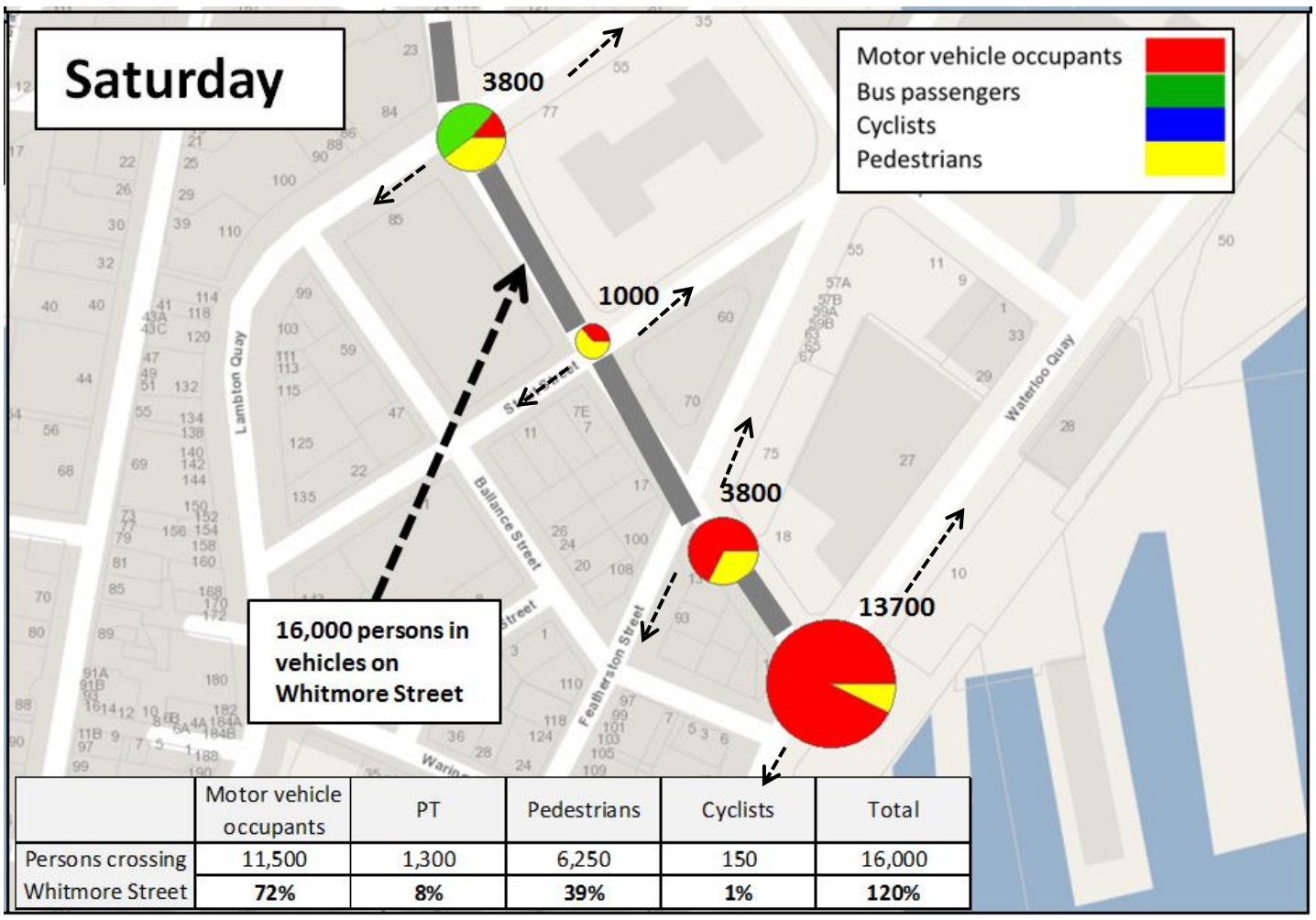
	Motor vehicle occupants	PT	Pedestrians	Cyclists	Total
Persons crossing Whitmore Street	15,950	2,600	10,150	300	29,000
	55%	**9%**	**35%**	**1%**	**100%**

Figure 59 Volumes crossing Whitmore Street (persons) conflicting with persons in cars on Whitmore Street (Stout Street to Featherston Street) , Evening peak, 3.30pm to 6.30pm



	Motor vehicle occupants	PT	Pedestrians	Cyclists	Total
Persons crossing	21,300	5,350	13,950	400	41,000
Whitmore Street	**52%**	**13%**	**34%**	**1%**	**100%**

Figure 60 Volumes crossing Whitmore Street (persons) conflicting with persons in cars on Whitmore Street (Stout Street to Featherston Street), Saturday, 11am to 2pm



	Motor vehicle occupants	PT	Pedestrians	Cyclists	Total
Persons crossing	11,500	1,300	6,250	150	16,000
Whitmore Street	**72%**	**8%**	**39%**	**1%**	**120%**

The data shows the following:

- depending on the time period, between 29,000 and 41,000 people cross Whitmore Street
- depending on thee time period, there are 4,000 to 16,000 people in cars at any one point on Whitmore Street
- in the AM peak, the ratio of persons crossing Whitmore Street to persons in cars travelling along Whitmore Street is 8:1, whereas on Saturday the ratio would be 1.3:1
- during peak periods, buses (13% to 18%) and pedestrians (34%) in combination account for the majority of persons crossing Whitmore Street
- over 13,000 pedestrians cross Whitmore Street in the AM peak and PM peak periods respectively, with Featherston Street the dominant pedestrian crossing location (although Lambton Quay and Customhouse Quay still have significant pedestrian crossing volumes)
- there are fewer pedestrians and persons on buses crossing Whitmore Street on Saturdays, with car the dominant mode for persons crossing Whitmore Street on Saturdays

13.1.3 Golden Mile

Figure 61 and **Figure 62** below show the total number of persons passing through intersections along the Golden Mile, categorised by mode.

Figure 61 Persons passing through intersections along Golden Mile

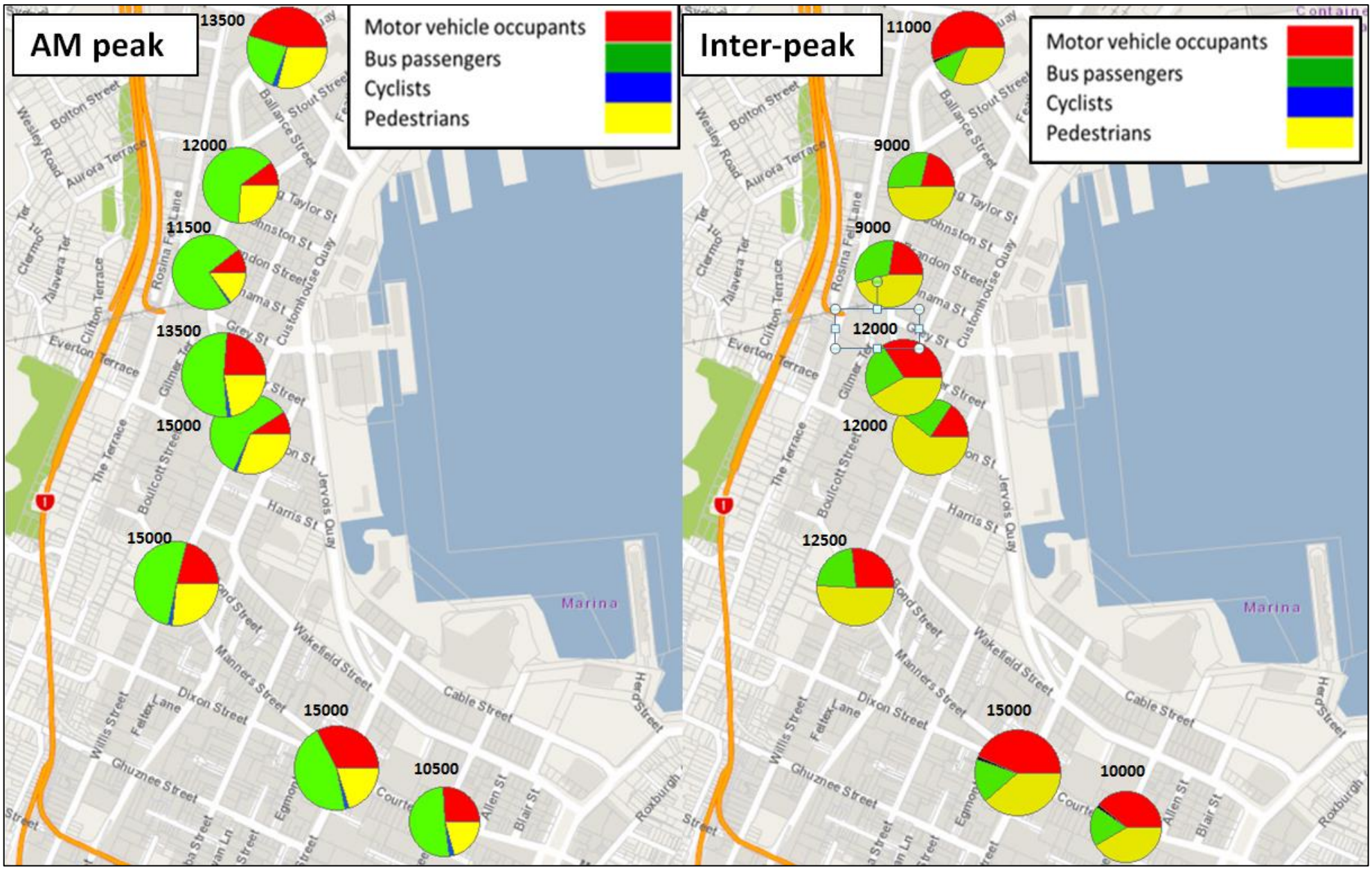
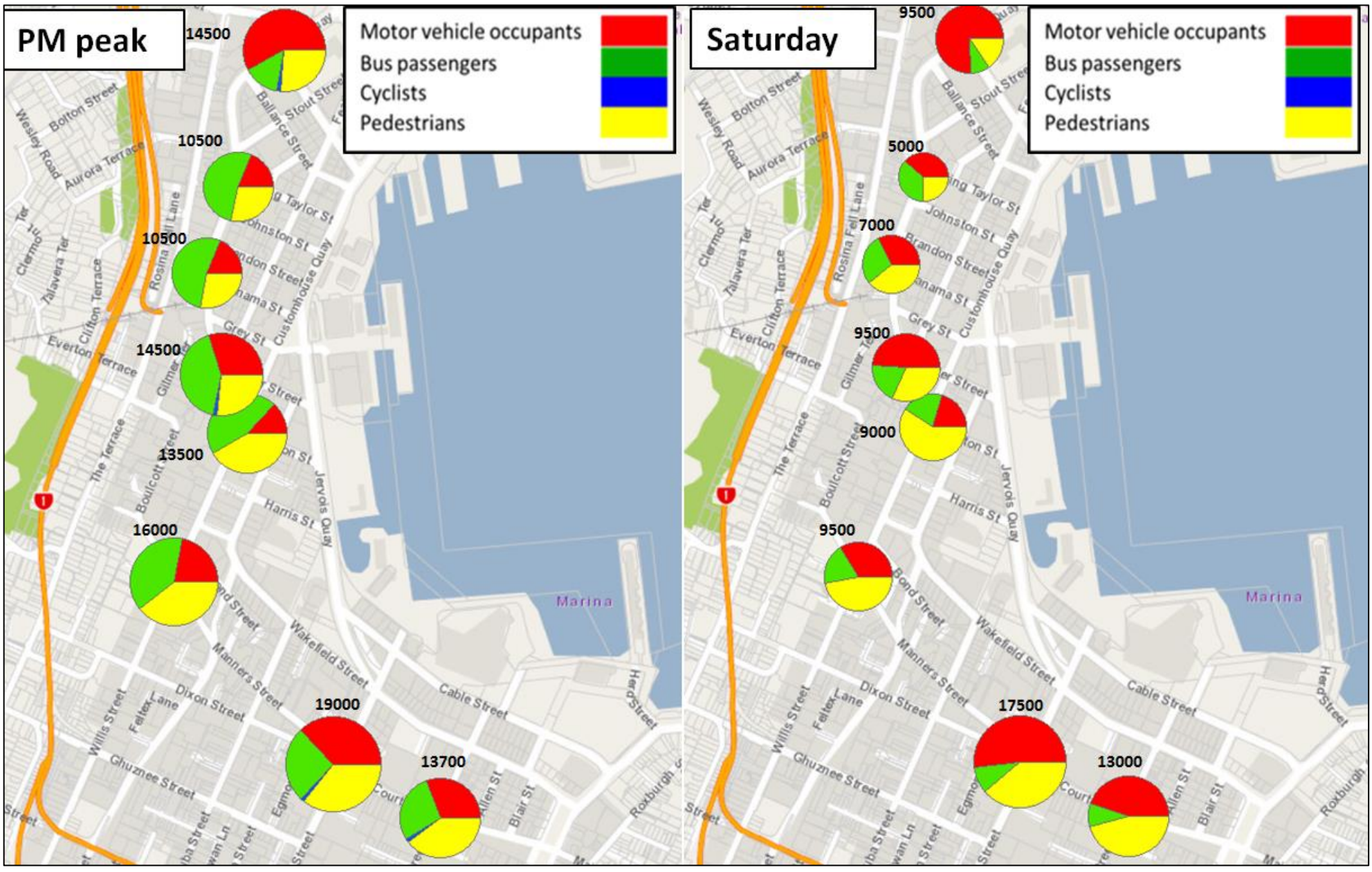


Figure 62 Persons passing through intersections along Golden Mile



The data shows the following:

- in the AM peak, bus passengers account for the majority of persons passing through most intersections on the Golden Mile (except Whitmore Street / Bowen Street)
- pedestrians account for the majority of people passing through intersections on the Golden Mile during the Inter-peak, with pedestrians accounting for between 60% and 70% of persons passing through intersections in the heart of the CBD (Willis Street / Lambton Quay)
- compared to the AM peak, bus passengers account for a smaller proportion of people passing through intersections in the PM peak with pedestrians accounting for a higher proportion
- combined bus passengers and pedestrians account for the majority of persons passing through intersections along the Golden Mile across all weekday time periods and on Saturdays
- compared to weekdays, on Saturdays bus passengers account for a smaller proportion of people passing through intersections and cars account for a slightly higher proportion

14 Turning movements

This section shows the following:

- Number of persons in vehicles making selected turning movements onto / off Vivian Street and Karo Drive (numbers in black)
- Total persons in vehicles along each section of Vivian Street and Karo Drive (numbers in red)

The figures are presented for the following time periods:

- AM peak, 6.30am to 9.30am (3hr), assumed vehicle occupancy of 1.35
- Inter-peak, 11am to 2pm (3hr), assumed vehicle occupancy of 1.40
- PM peak, 3.30pm to 6.30pm (3hr), assumed vehicle occupancy of 1.35
- Saturday, 11am to 2pm (3hr), assumed vehicle occupancy of 1.80

The traffic volumes are obtained from traffic counts undertaken on one particular day in March, with the numbers presented below derived from this count data and the aforementioned vehicle occupancy assumptions. The figures presented below are purposefully rounded so that they do not imply a level of precision that is not supported by the limitations of the underlying data; the size of the arrows is proportionate to the number of people making the respective turning movement.

The main purpose of this analysis is to represent current data on the network, enabling relative comparisons between different locations / time periods to be drawn and travel patterns / characteristics to be identified.

14.1.1 Vivian Street

Figure 63, Figure 64, Figure 65 and **Figure 66** below shows turning volumes (persons) to / from Vivian Street, together with the volumes (persons) travelling by motor vehicle along each section of Vivian Street. The red boxes represent people in cars along the different sections of Vivian Street.

Figure 63 Turning volumes associated with Vivian Street – AM peak

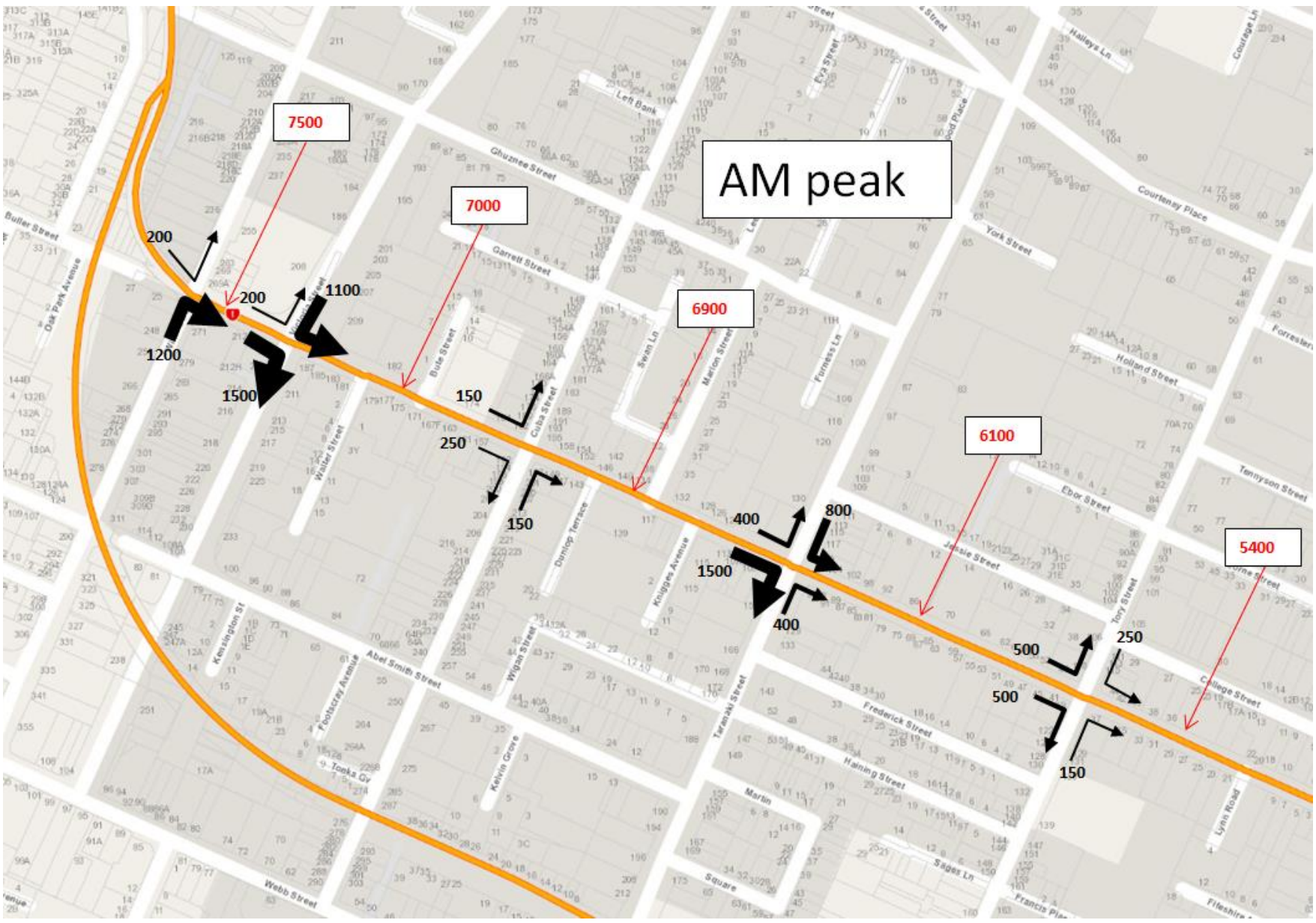


Figure 64 Turning volumes associated with Vivian Street – Inter-peak

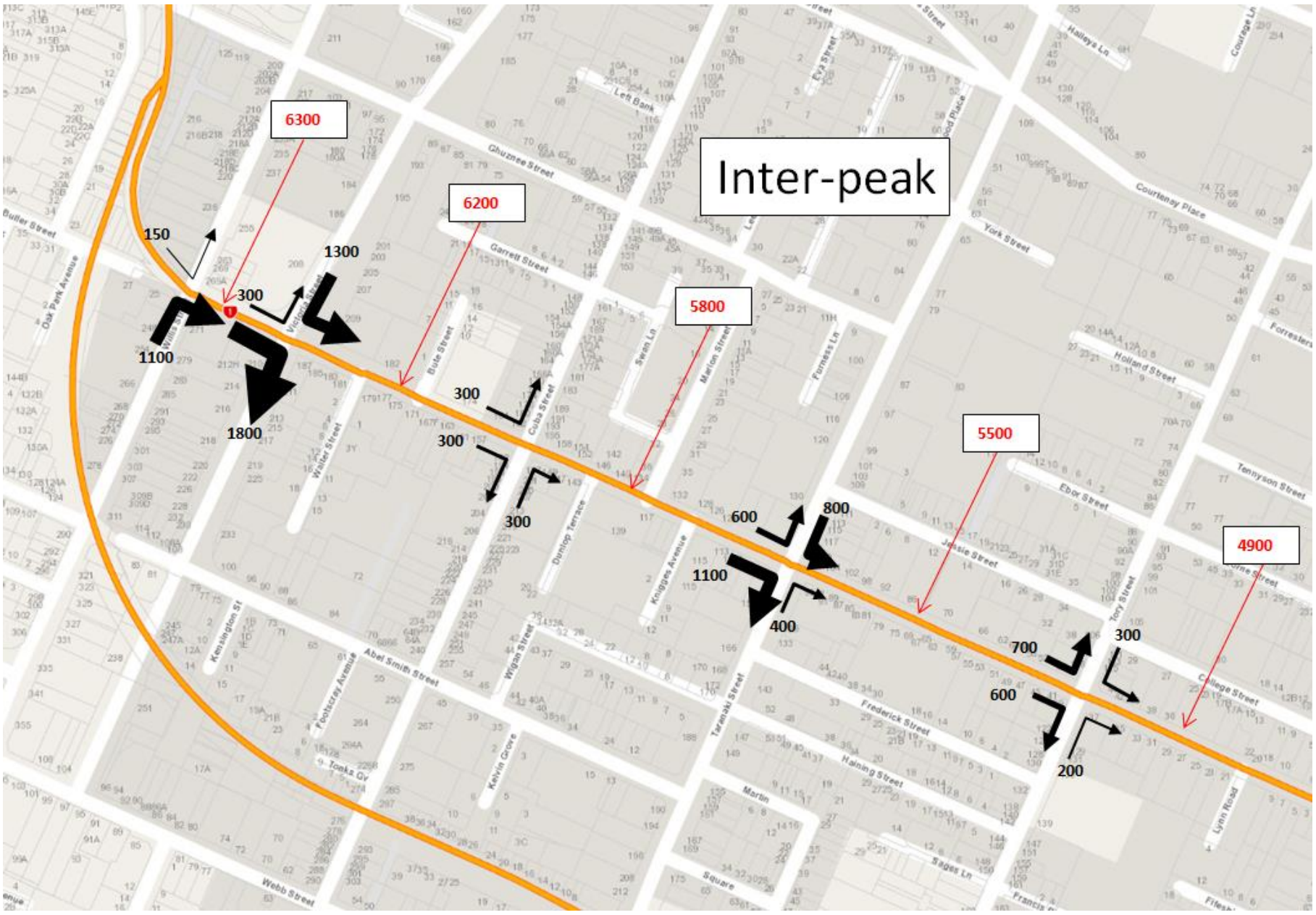


Figure 65 Turning volumes associated with Vivian Street – PM peak

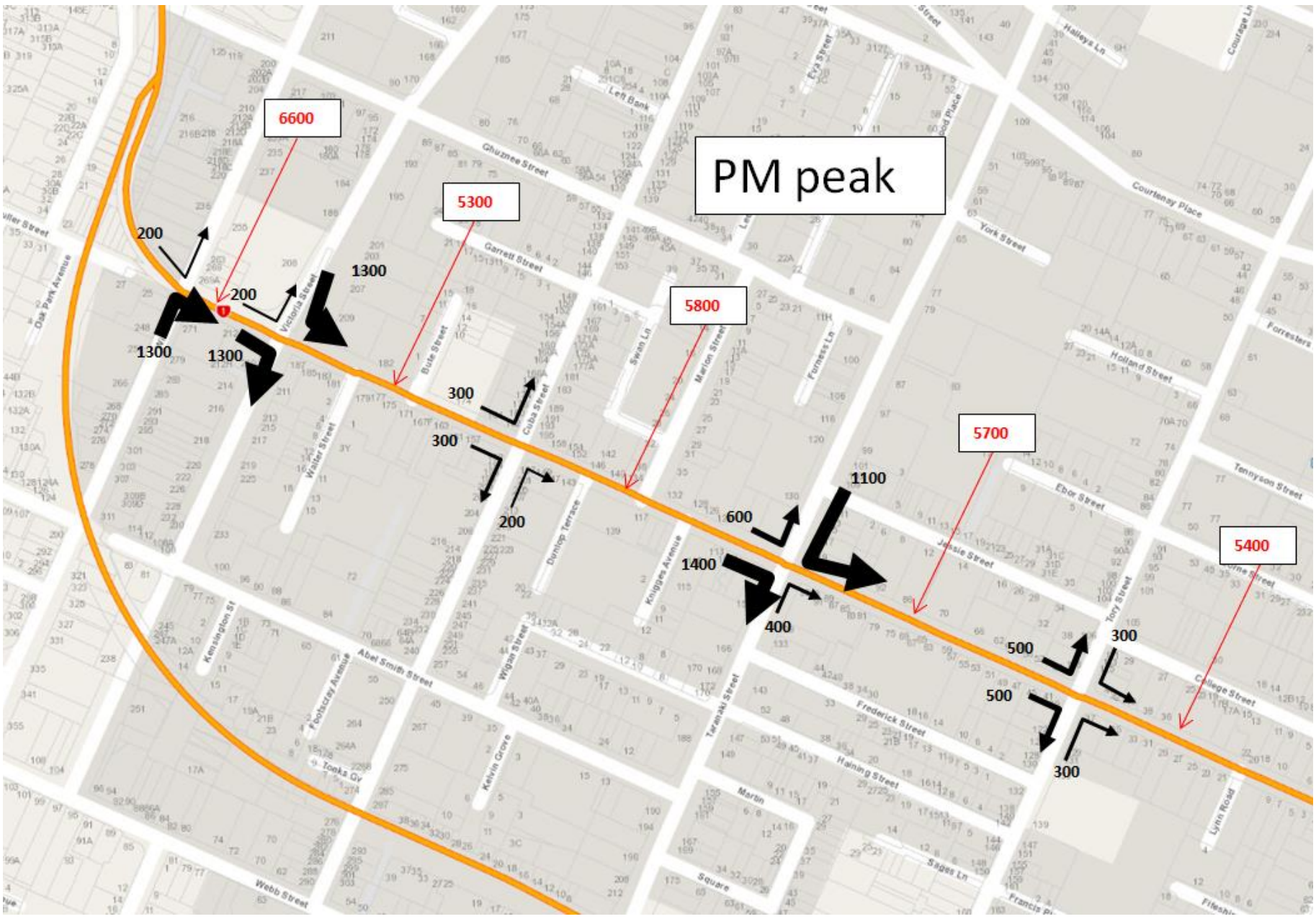


Figure 66 Turning volumes associated with Vivian Street – Saturday

The following insights can be drawn from the data:

- looking across all time periods, the numbers of persons in cars on Vivian Street declines as you progress from the Terrace Tunnel to Kent / Cambridge Terrace; this is because the number of vehicles turning onto Vivian Street is greater than the number of vehicles turning off Vivian Street
- the heaviest turns onto Vivian Street are the right turn from Willis Street and left turn from Victoria Street
- the heaviest turns off Vivian Street are the right turn into Victoria Street and the right turn into Taranaki Street
- turning volumes associated with Cuba Street are low across all time periods
- turning volumes to / from Tory street are greater in the Inter-peak / Saturday compared to the AM peak and PM peak
- more people turn off Vivian Street to the south than turn off to the north (towards CBD)
- more people turn onto Vivian Street from the north compared to from the south (exception being Willis Street)
- overall, the number of persons in vehicles on Vivian Street is greatest on Saturday (due to higher vehicle occupancies at weekends) following by the AM peak; Inter-peak and PM peak traffic volumes are broadly similar

14.2 Karo Drive

Figure 67, Figure 68,Figure 69 and **Figure 70** below shows turning volumes (persons) to / from Karo Drive, together with the volumes (persons) travelling by motor vehicle along each section of Vivian Street. The red boxes represent people in cars along the different sections of Karo Drive

Figure 67 Turning volumes associated with Karo Drive, AM peak (6.30am to 9.30am)

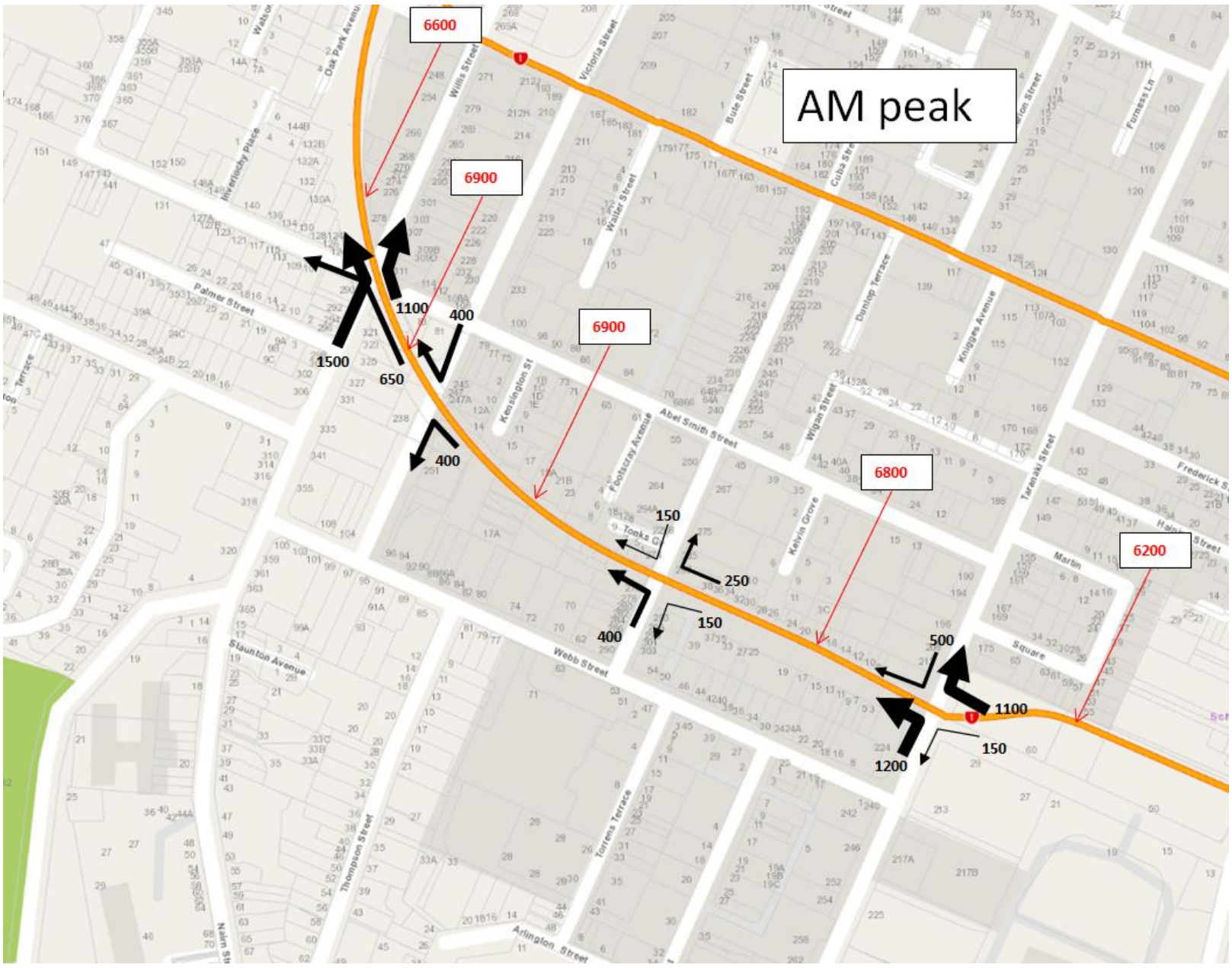


Figure 68 Turning volumes associated with Karo Drive, Inter-peak (11.00 am to 2.00pm)

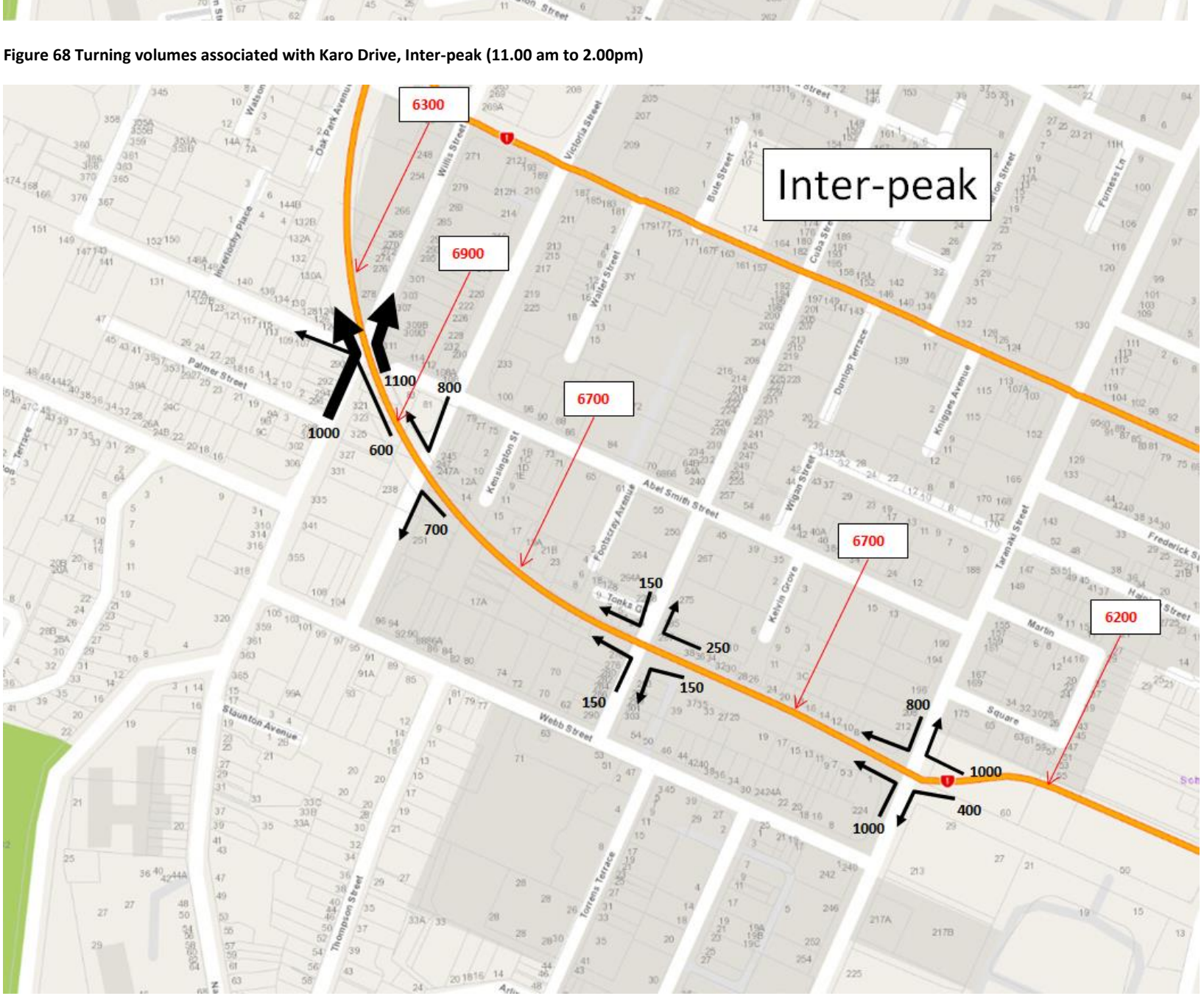


Figure 69 Turning volumes associated with Karo Drive, PM peak (3.30pm to 6.30pm)

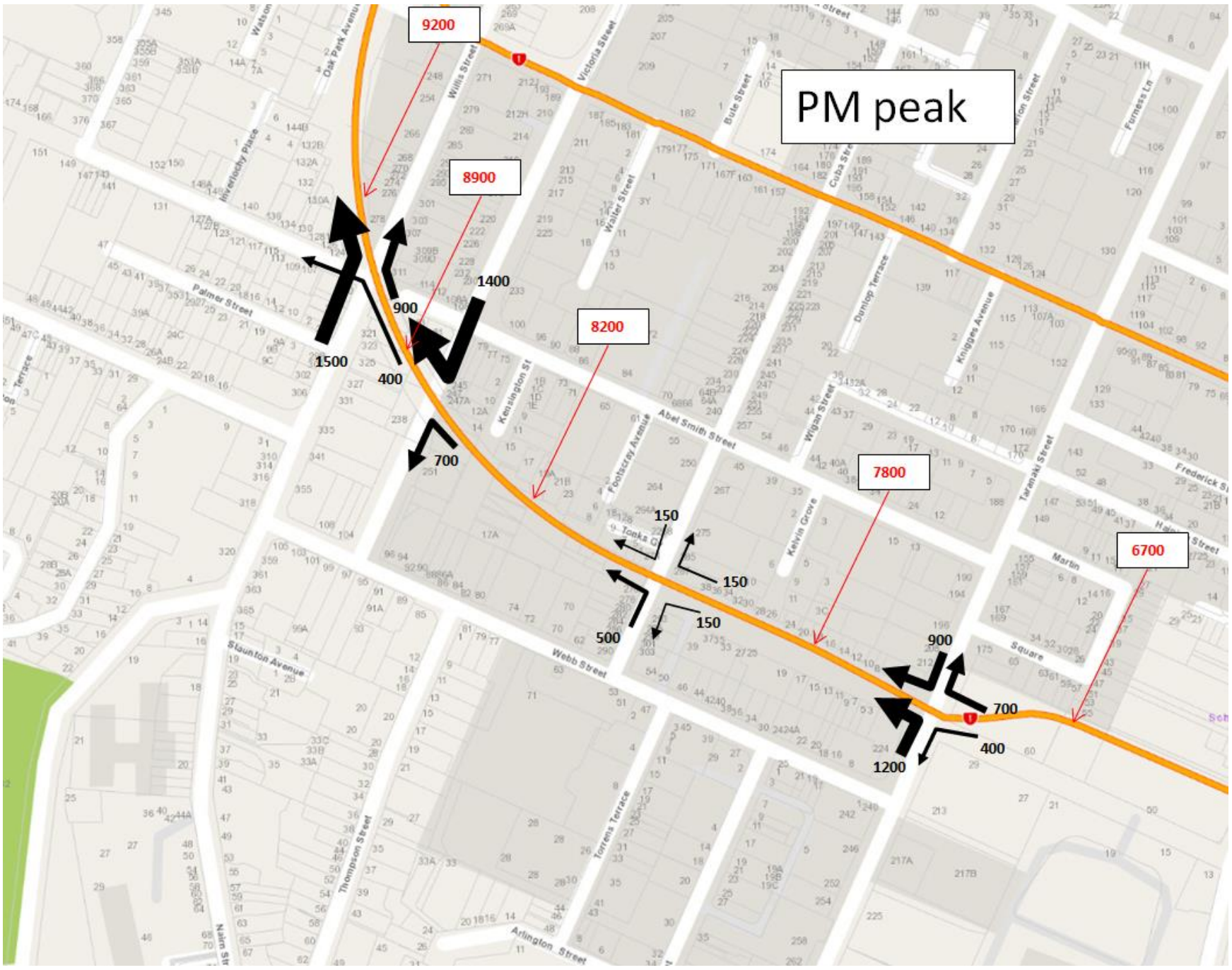
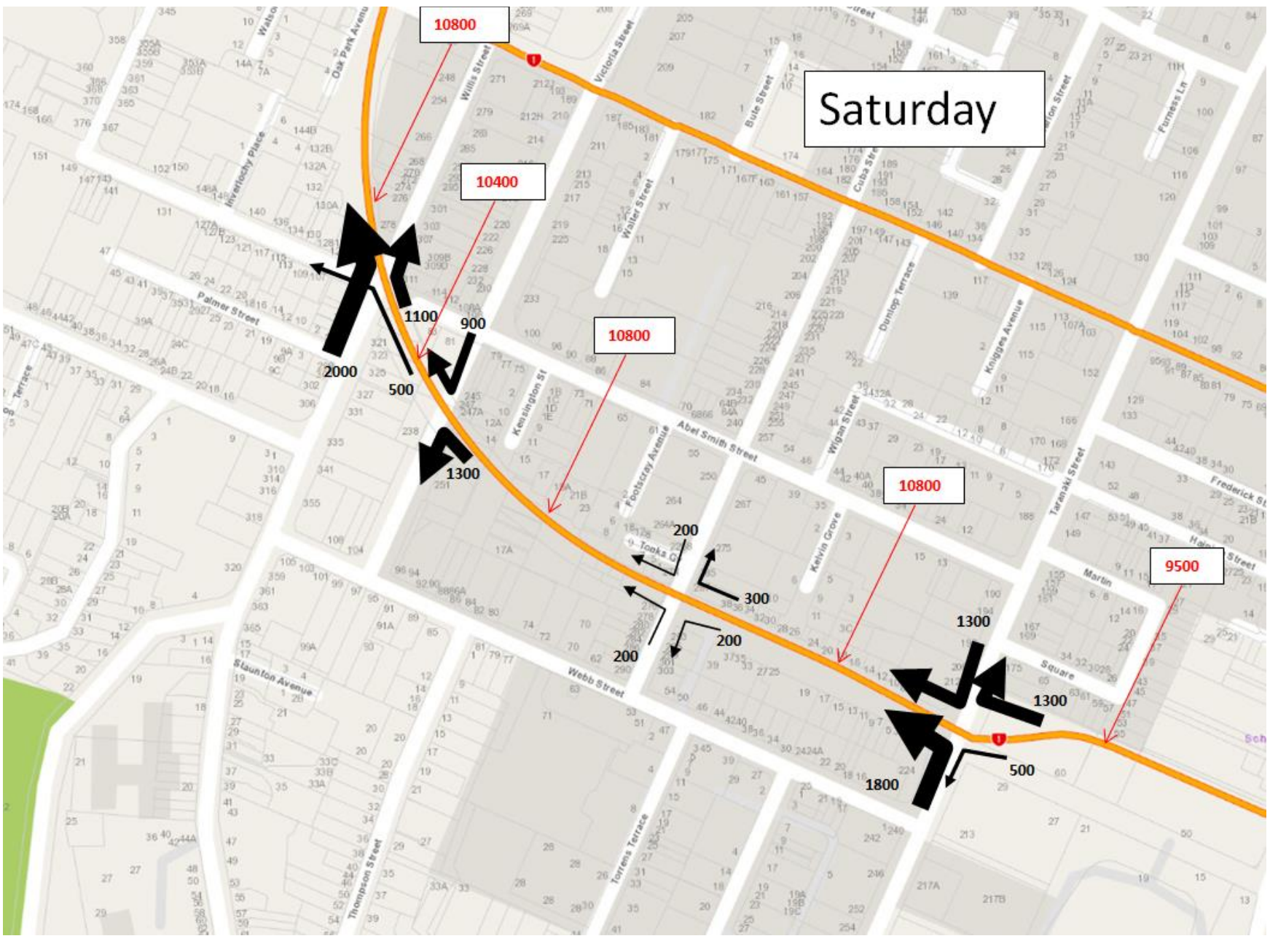


Figure 70 Turning volumes associated with Karo Drive, Saturday (11.00 am to 2.00pm)



The following insights can be drawn from these figures:

- traffic volumes on Karo Drive increase from Arras Tunnel towards Willis Street in the PM peak, with persons turning onto Karo Drive greater than persons turning off Karo Drive
- the travel patterns are more balanced during the AM peak, Inter-peak and Saturday with a broadly equal number of persons turning off Karo Drive as there are turning onto Karo Drive
- the number of persons in vehicles on Karo Drive is greatest on Saturdays (10,400 between Victoria Street and Willis Street) due to higher vehicle occupancies following by the PM peak (8,900) and AM peak / Inter-peak (9,000 each)
- the right turns from Karo Drive to Taranaki Street and Willis Street are heavily used in the AM peak but less heavily used at other times
- the right turns from Taranaki Street and Victoria Street are heaviest in the PM peak
- the left turn from Taranaki Street onto Karo Drive is relatively heavily used during all time periods and a significant number of people in cars turn left from Karo Drive onto Victoria Street on Saturdays
- turning movements are relatively low across all time periods at the Cuba Street / Karo Drive intersection

15 People approaching Wellington from the north on SH1 and leaving Wellington to the north on SH1

This section focuses on people approaching Wellington from the north (SH1) and leaving Wellington to the north (SH1) to understand the points at which motor vehicles exit / join SH1.

Figure 71, Figure 72 and **Figure 73** shows the following for the AM peak (6.30am to 9.30am), Inter-peak (11am to 2pm) and PM peak (3.30pm to 6.30pm):

- number of people travelling **southbound** on SH1 in a motor vehicle between Ngauranga Gorge and Aotea Quay and the proportion / number of these people who leave SH1 at the various exit points between Aotea Quay and the Terrace Tunnel.
- number of people travelling **northbound** on SH1 in a motor vehicle between Aotea Quay and Ngauranga Gorge and the proportion / number of these people who join SH1 at the various joining points between Terrace Tunnel and Aotea Quay

Figure 71 AM peak (6.30am to 9.30am) – exit points for traffic on SH1 southbound approaching Aotea Quay (left) and joining points for traffic on SH1 northbound past Aotea Quay (right)

Figure 71 shows the following:

- of the 21,500 people in motor vehicles travelling south between Ngauranga and Aotea Quay in the AM peak, around 25% continue to exit the Terrace Tunnel onto Vivian Street; the remainder exit between Aotea Quay and Terrace off-ramp, with the Terrace off-ramp the most popular exit
- looking at people in motor vehicles heading northbound between Aotea Quay and Ngauranga Gorge, nearly 50% of these people come through the Terrace Tunnel and a further 25% join SH1 at Aotea Quay

Figure 72 Inter-peak (11am to 2pm) – exit points for traffic on SH1 southbound approaching Aotea Quay (left) and joining points for traffic on SH1 northbound past Aotea Quay (right)

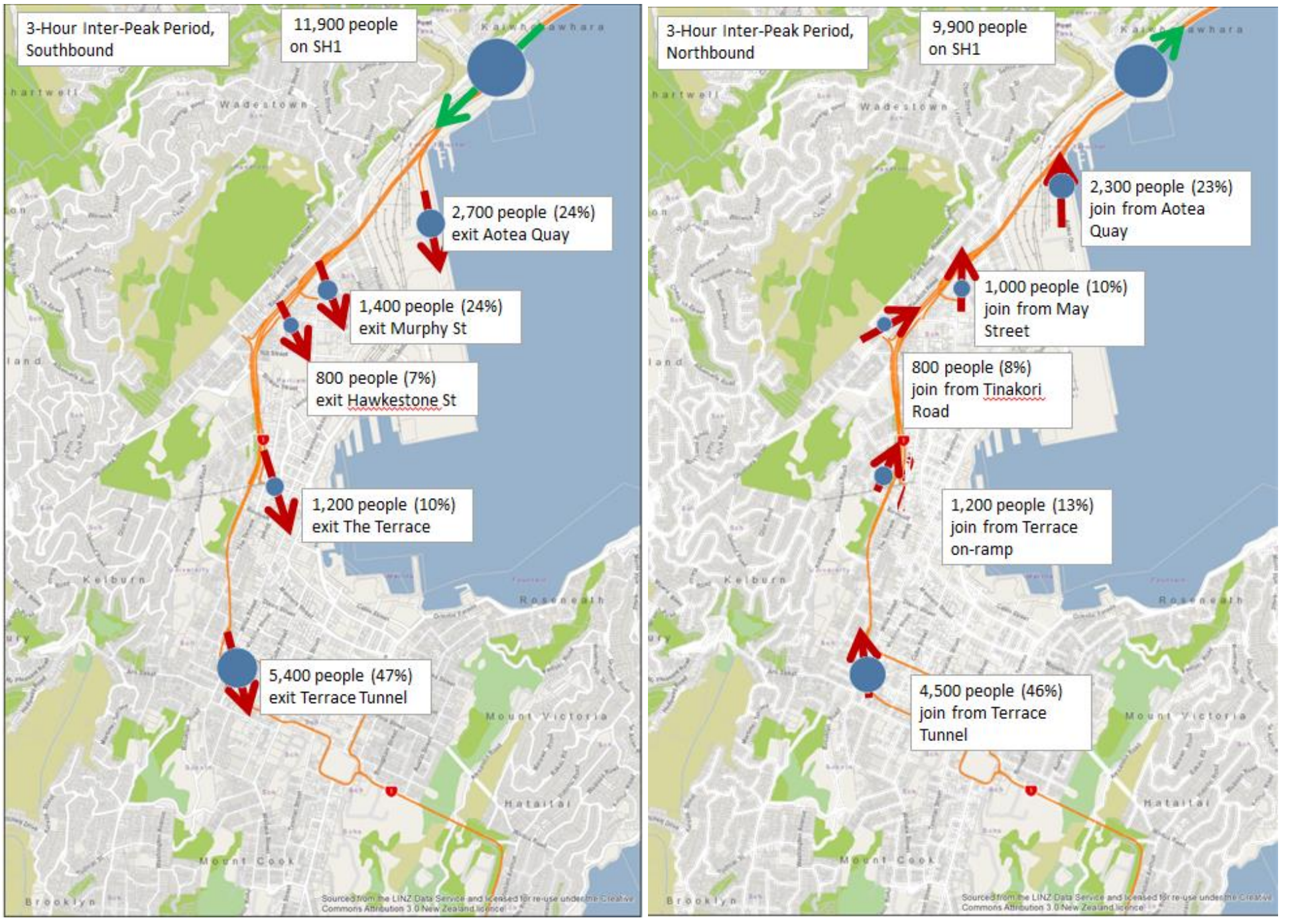
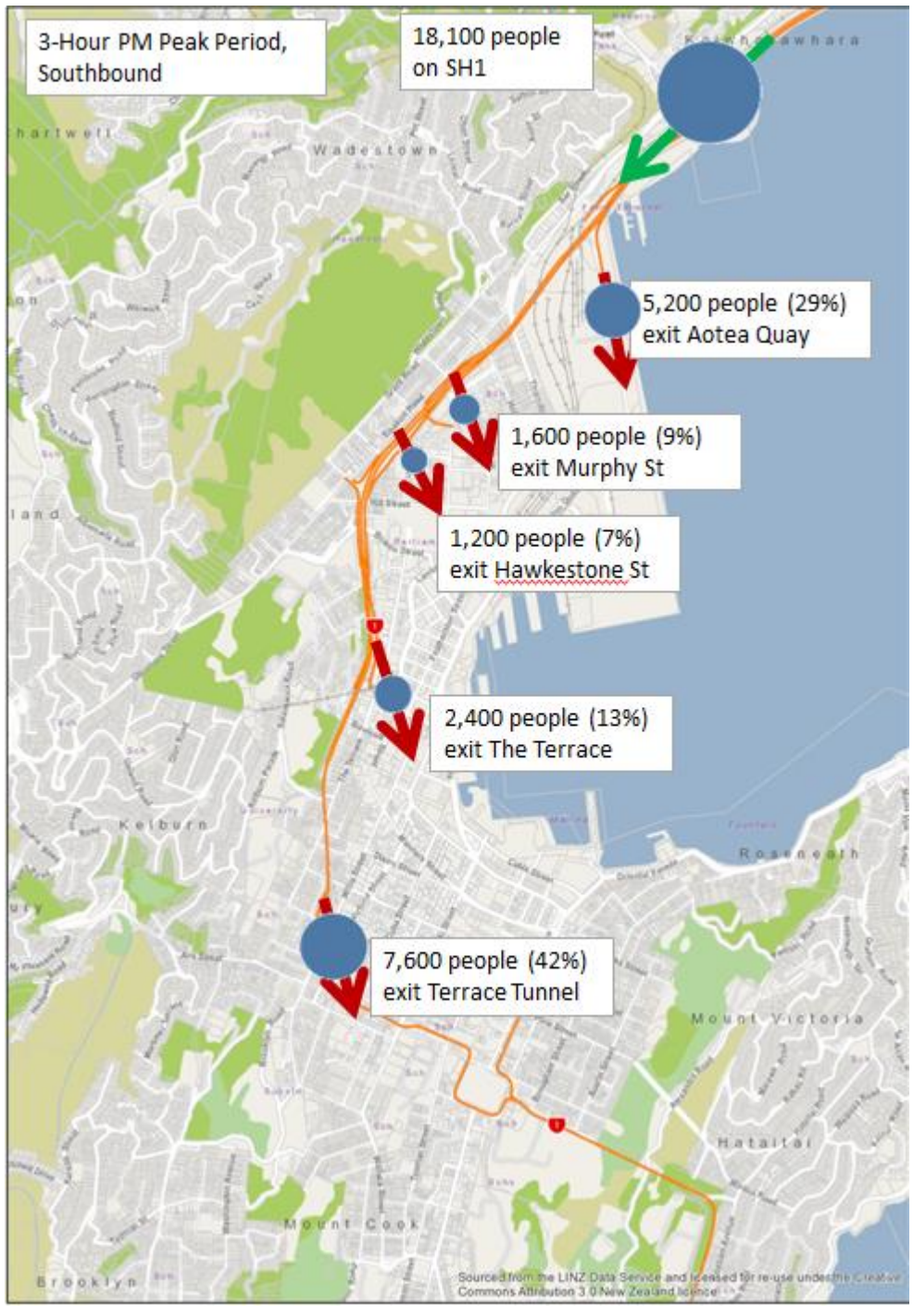


Figure 72 shows the following:

- of the 11,900 people in motor vehicles travelling south between Ngauranga and Aotea Quay in the AM peak, around 50% continue through the Terrace Tunnel and a further 25% exit at Aotea Quay; only 10% exit at the Terrace off-ramp (compared to 30% in the AM peak)
- looking at people in motor vehicles heading northbound between Aotea Quay and Ngauranga Gorge, nearly 50% of these people come through the Terrace Tunnel and a further 25% join SH1 at Aotea Quay

Figure 73 PM peak (3.30pm to 6.30pm) – exit points for traffic on SH1 southbound approaching Aotea Quay (left) and joining points for traffic on SH1 northbound past Aotea Quay (right)



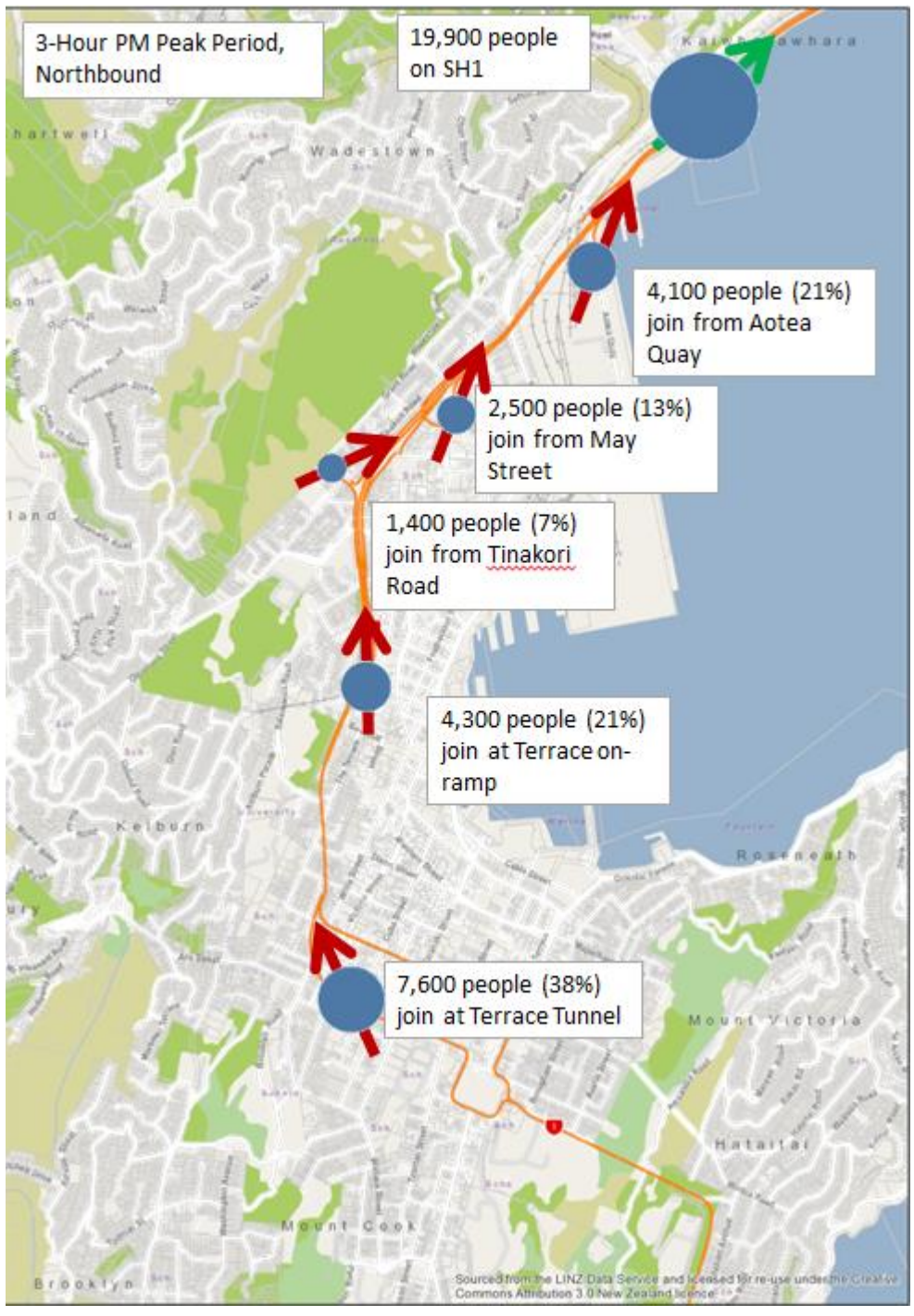


Figure 73 shows the following:

- of the 18,100 people in motor vehicles travelling south between Ngauranga and Aotea Quay in the PM peak, around 40% continue through the Terrace Tunnel and a further30% exit at Aotea Quay
- looking at people in motor vehicles heading northbound between Aotea Quay and Ngauranga Gorge, nearly 40% of these people come through the Terrace Tunnel and a further 20% join at the Terrace on-ramp and Aotea Quay on-ramp respectively

Figure 74 Saturday (11am to 2pm) – exit points for traffic on SH1 southbound approaching Aotea Quay (left) and joining points for traffic on SH1 northbound past Aotea Quay (right)

Figure 74 shows the following:

- of the 14,500 people in motor vehicles travelling south between Ngauranga and Aotea Quay on a Saturday, around 45% continue through the Terrace Tunnel
- looking at people in motor vehicles heading northbound between Aotea Quay and Ngauranga Gorge, nearly 50% of these people come through the Terrace Tunnel and a further 25% join at the Aotea on-ramp; only 25% combined come from terrace on-ramp, Tinakori Road and May Street (Molesworth Street) on-ramp

16 Network routings

A network of 11 automated number plate recognition (ANPR) sites were surveyed during a weekday in August 2016 and a Saturday in October 2016 to provide insights into travel patterns and routings within the Wellington City CBD.

The figures in this section summarise the ANPR data at selected locations and provide insights relating to:

- the proportion of vehicles captured at a particular location that have been **previously** captured elsewhere
- the proportion of vehicles captured at a particular location that are **subsequently** captured elsewhere

In terms of the data itself, whilst ANPR technology is reliable, it is not 100% accurate as number plates can be missed or mis-read. Therefore when intepreting and presenting the information, the following has been assumed:

- based upon limited evidence from the ANPR survey, it is assumed that 10% of vehicles that are classified as‘unmatched” between an origin and destination are actually missed by the equipment;
- the remaining ‘unmatched’ records are actually successfully matched by the origin / destination camera but will have an origin / destination point that is not captured by the network of cameras
- the origin / destination of such records is documented as ‘other’
- the data and proportions are adjusted accordingly

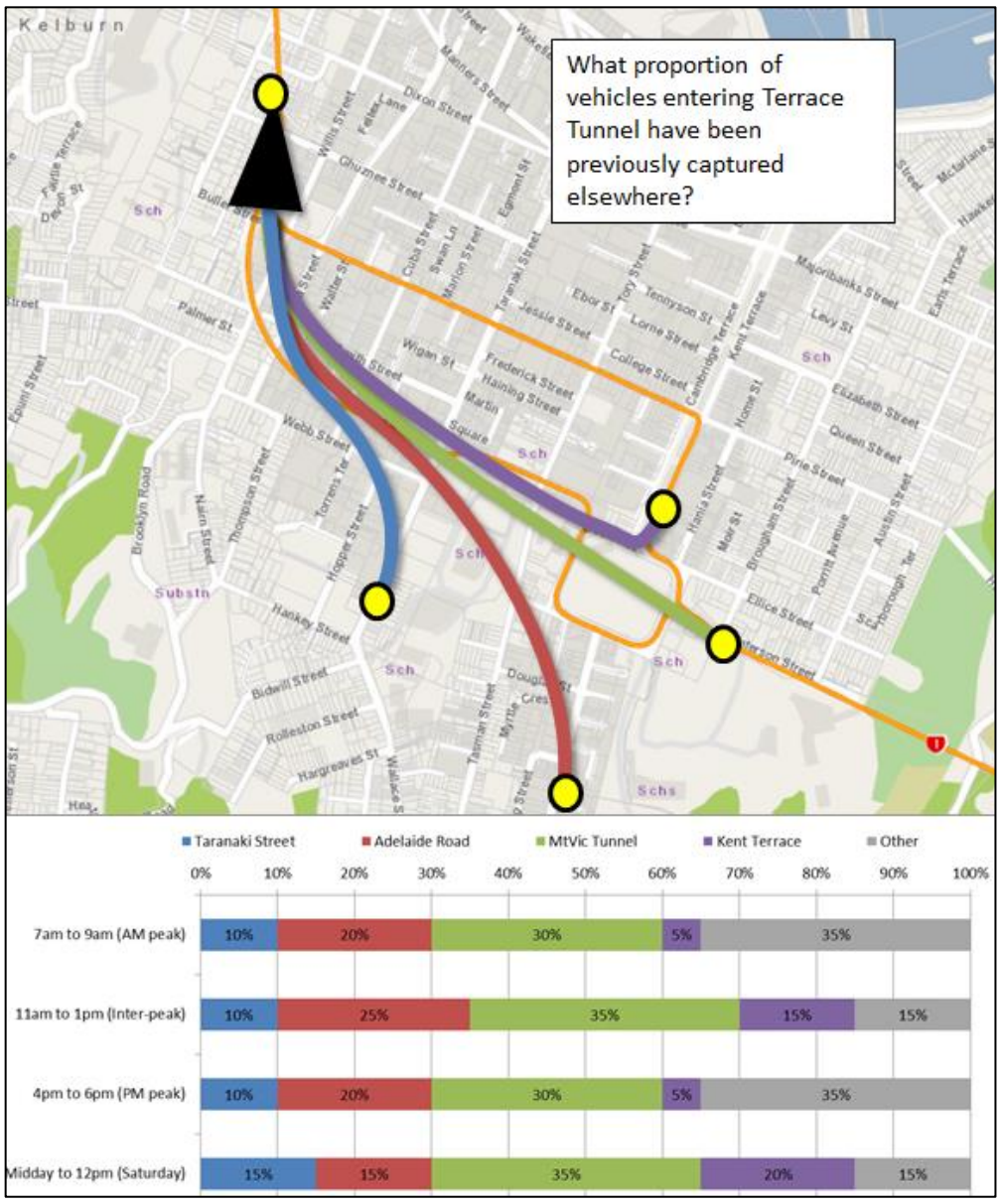
Taking into account the limitations with the technology highlighted above, the proportions reported in this document are purposefully rounded to the nearest 5 pecentage points; furthermore, the data only represents one weekday / weekend and it is acknowledged that travel patterns will vary from one day to the next.

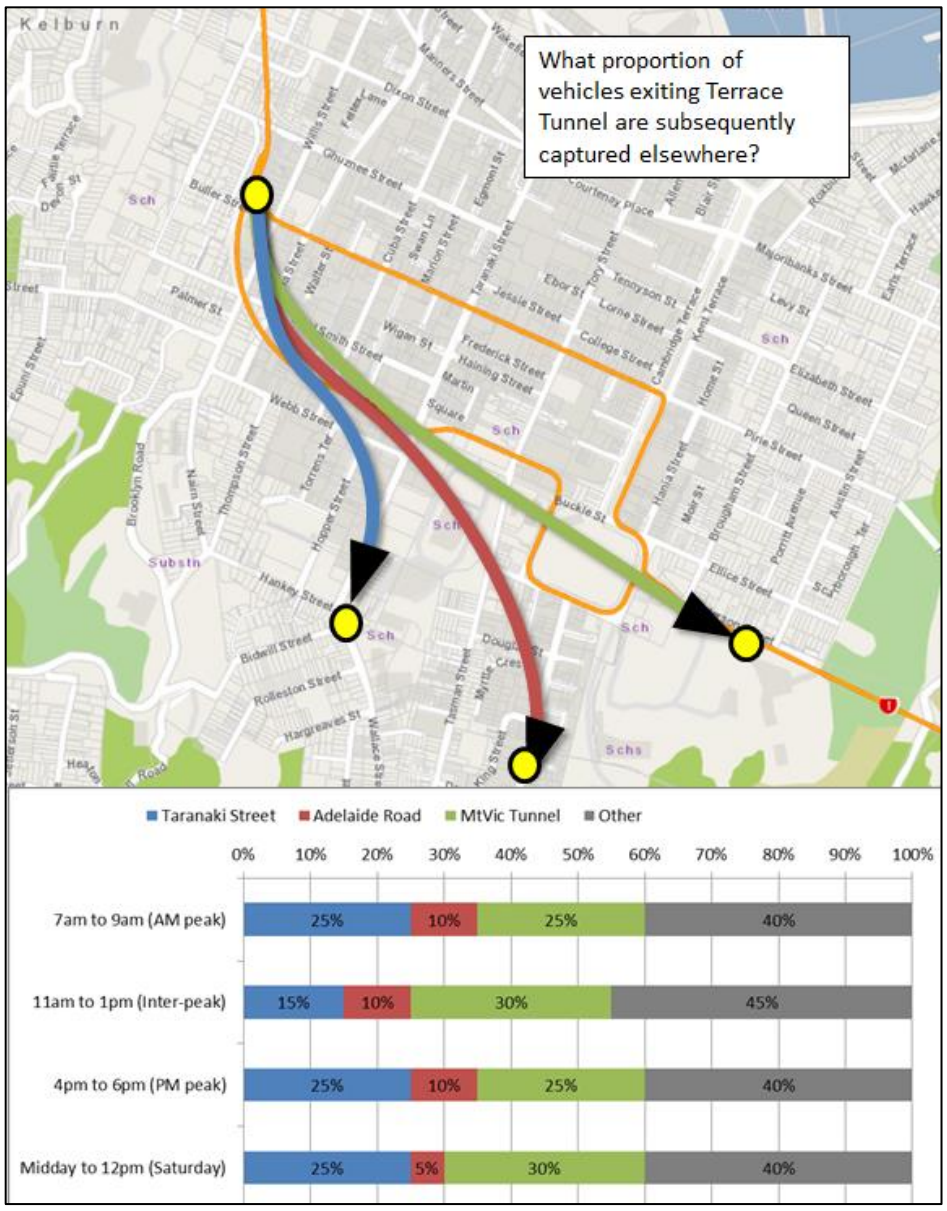
Notwithstanding these limitations, the ANPR data provides valuable insights into travel patterns across Wellington CBD and how they change from one time period to another.

16.1.1 Terrace Tunnel

Figure 75 below shows the proportion of traffic entering the Terrace Tunnel that has been previously captured elsewhere and the proportion of vehicles exiting the Terrace tunnel that are subsequently captured elsewhere.

Figure 75 Terrace Tunnel – tracking of vehicles by Automated Number Plate Recognition (ANPR), vehicle entering Terrace Tunnel (left), vehicle exiting Terrace Tunnel (right)





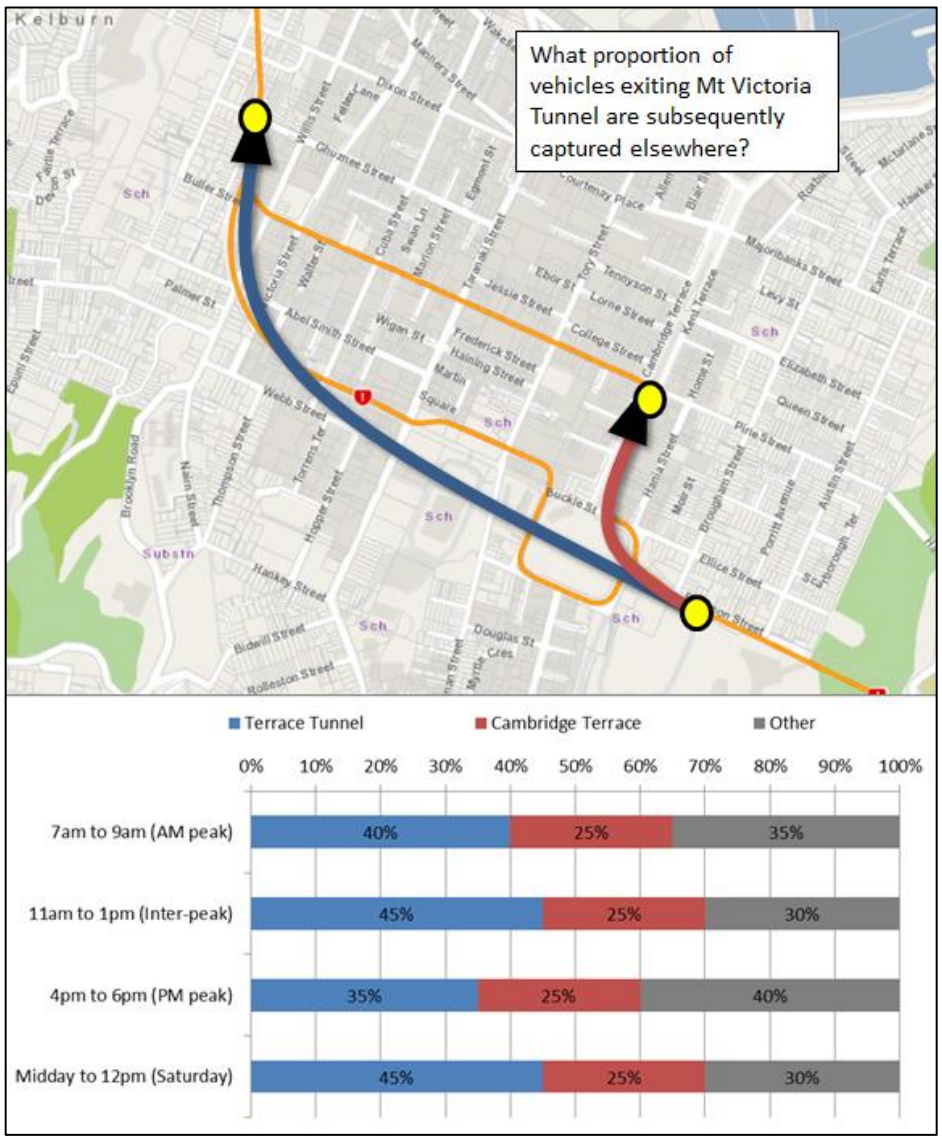
The following can be observed:

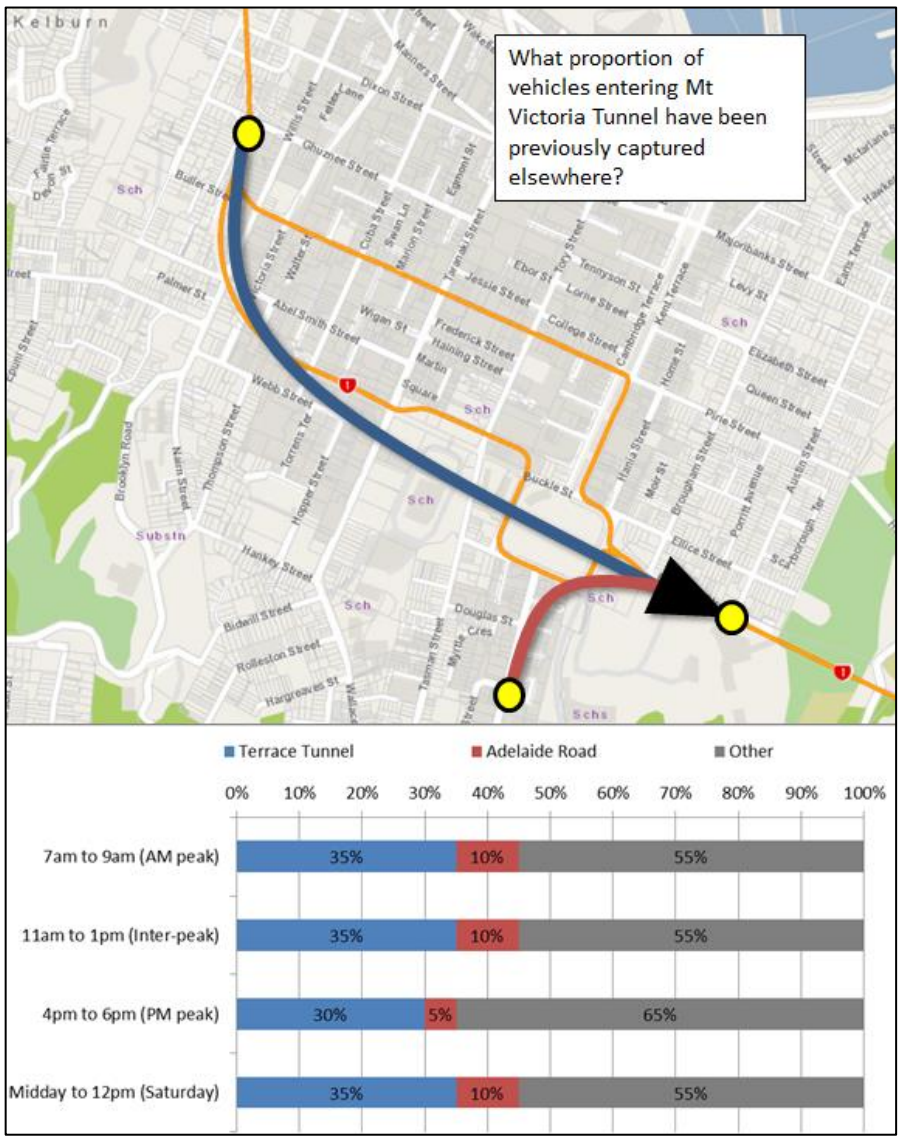
- across all time periods, approximately 25% to 30% of vehicles observed exiting Terrace Tunnel (southbound) are also observed entering the Mt Vic Tunnel, with a corresponding figure of 30% to 35% in the opposite direction (vehicles observed entering Terrace Tunnel are also observed exiting Mt Victoria Tunnel)
- the proportion of vehicles captured entering the Terrace Tunnel at peak times that have previously been captured at Adelaide Road (between 15% to 25%) is greater than the proportion of vehicles captured exiting the Terrace Tunnel at peak times that are also captured on Adelaide Road (5% to 10%)
- conversely, the proportion of vehicles captured entering the Terrace Tunnel at peak times that have previously been captured at Taranaki Street (10% to 15%) is less than the proportion of vehicles captured exiting the Terrace Tunnel at peak times that are also captured on Taranaki Street (15% to 25%)
- a significant proportion of vehicles captured entering the Terrace Tunnel (35%) at peak times are not captured elsewhere, meaning that they are probably coming from origins in the CBD and Brooklyn; this proportion is lower however during the Inter-peak and on Saturdays (15%)
- similarly, between 40% and 45% of traffic exiting the Terrace Tunnel is not captured elsehwhere, meaning it is probably going towards Brooklyn or the CBD

16.1.2 Mt Victoria Tunnel

Figure 76 below shows the proportion of traffic entering Mt Victoria Tunnel that has been previously captured elsewhere and the proportion of vehicles exiting Mt Victoria Tunnel that are subsequently captured elsewhere.

Figure 76 Mt Victoria Tunnel – tracking of vehicles by Automated Number Plate Recognition (ANPR) exiting Mt Victoria Tunnel (left) and entering Mt Victoria Tunnel (right)





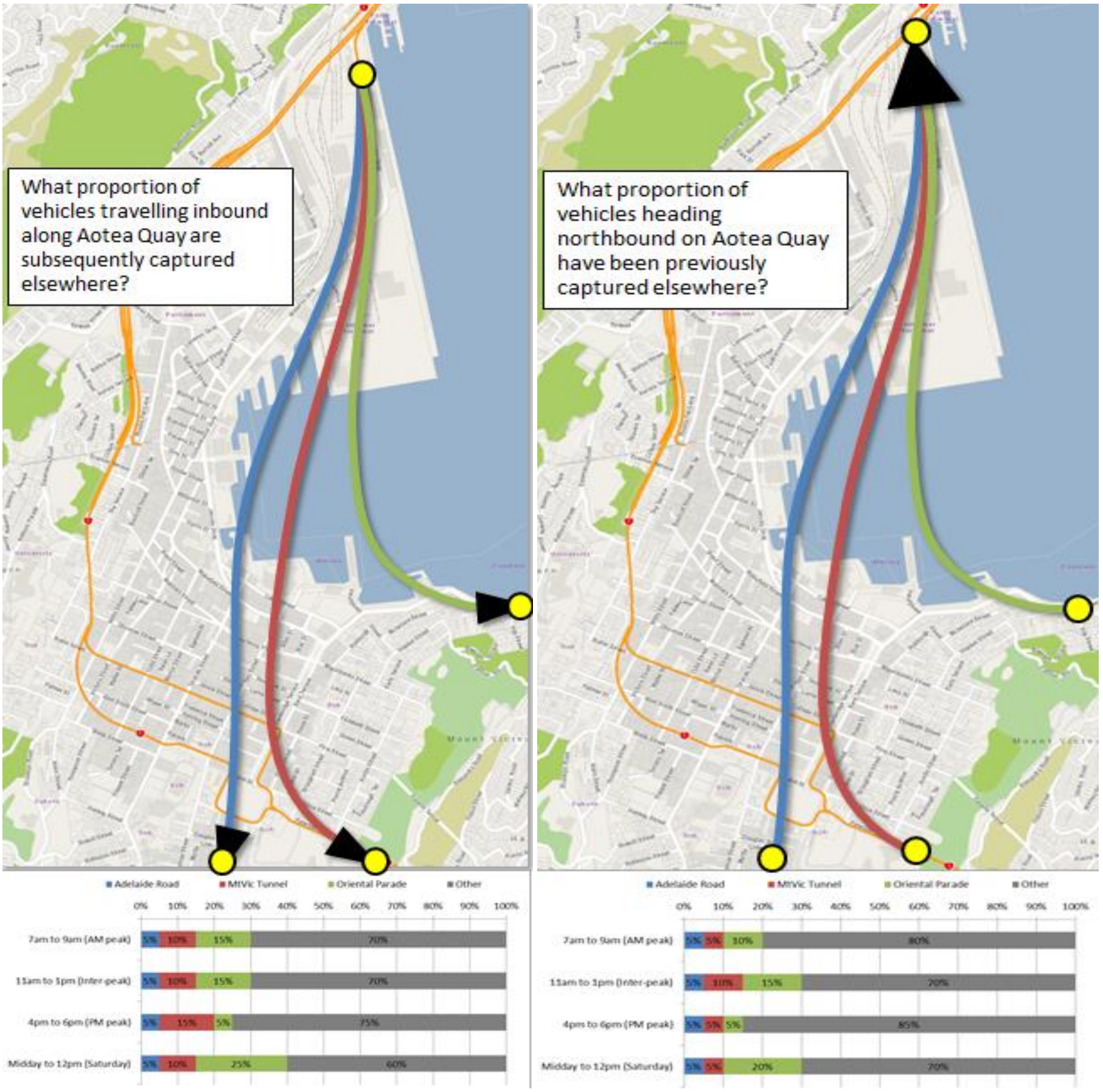
The following car be observed:

- depending on the time period, approximately 30% to 35% of vehicles entering Mt Victoria Tunnel are also observed exiting the Terrace Tunnel, whilst 35% to 45% of vehicles observed exiting Mt Victoria Tunnel are also observed entering Terrace Tunnel
- around 25% of vehicles exiting Mt Victoria Tunnel head towads Cambridge Terrace, whilst only 5% of vehicles entering Mt Victoria Tunnel come from Adelaide Road

16.1.3 Aotea Quay

Figure 77 below shows the proportion of traffic observed heading outbound (northbound) on Aotea Quay that has been previously captured elsewhere and the proportion of vehicles heading inbound (southbound) on Aotea Quay that are subsequently captured elsewhere.

Figure 77 Aotea Quay– tracking of vehicles by Automated Number Plate Recognition (ANPR), vehicle heading inbound (left) and outbound (right)



The following car be observed:

- during the AM peak, around70% of vehicles on Aotea Quay off-ramp (inbound) are not observed elsewhere and likley to terminate in the CBD, with a correspdonding 80% of vehicles observed heading northbound on Aotea Quay on-ramp in the PM peak not observed elsewhere (and likely to originate from the CBD)
- at weekends and during the Inter-peak, a higher proportion of vehicles are observed at the Aotea Quay ramps and also observed subsequently / previously at other locations
- on Saturdays, 25% of vehicles heading along Aotea Quay (inbound) are also observed heading eastboundalong Oriental Parade
- 20% of vehicles observed heading westbound on Oriental Parade on Saturdays are also observed heading northbound on Aotea Quay
- between 10% to 15% of vehicles heading southbound on Aotea Quay are also observed entering Mt Victoria Tunnel; the corresponding proportion in the other direction (vehicles observed heading northound on Aotea Quay that have come from the terrace Tunnel) is lower at around 5%

16.2 Basin Reserve Turning Movements

Figure 78, Figure 79, Figure 80 and **Figure 81** shows:

- for each approach arm at the Basin Reserve, the proportion of all observed vehicles coming from the other arms
- for each exit arm, the proportion of vehicles going to each of the other arms

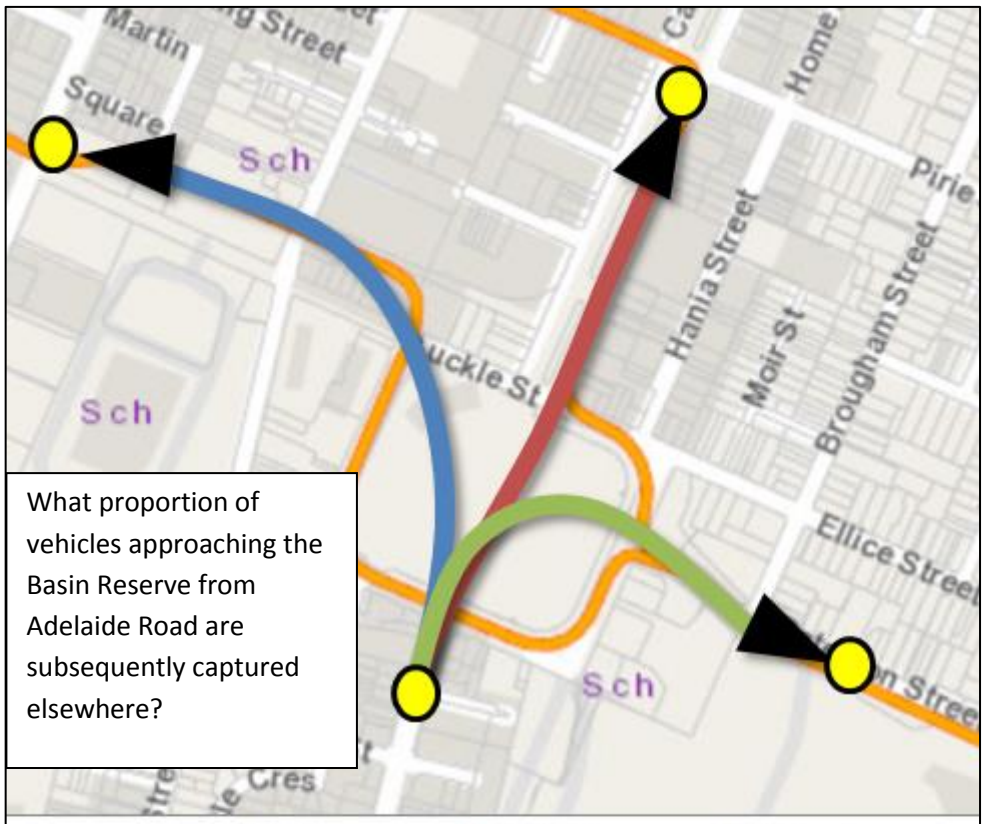
Whilst ANPR technology is reliable, it is not 100% accurate as number plates can be missed or mis-read. When analysing around the Basin Reserve – effectively a closed system – it showed than between 5% and 15% of vehicles were 'unmatched' meaning that the cameras did not capture them correctly or they left the system using alternative routes not covered by the cameras.

The only roads not captured by the cameras – Rugby Street (to / from Tasman Street) and Elice Street / Hania Street are relatively lightly trafficked and, based on previously collected traffic count data, would only account for 2% or 3% of total traffic volumes around the Basin reserve.

Given this information, it was decided that the 'unmatched' records could be assumed to be a result of the cameras not correctly identifying / matching number plates and therefore re-allocatedproportionately across atll camera according to observed distributions (it was assumed that all cameras have an equal probability of not matchign vehicles).

This approach is appropriate given the purpose of the ANPR data is to provide a high level indication of traffic patterns and movements around the Basin Reserve rather than specific, detailed information regarding traffic flows.

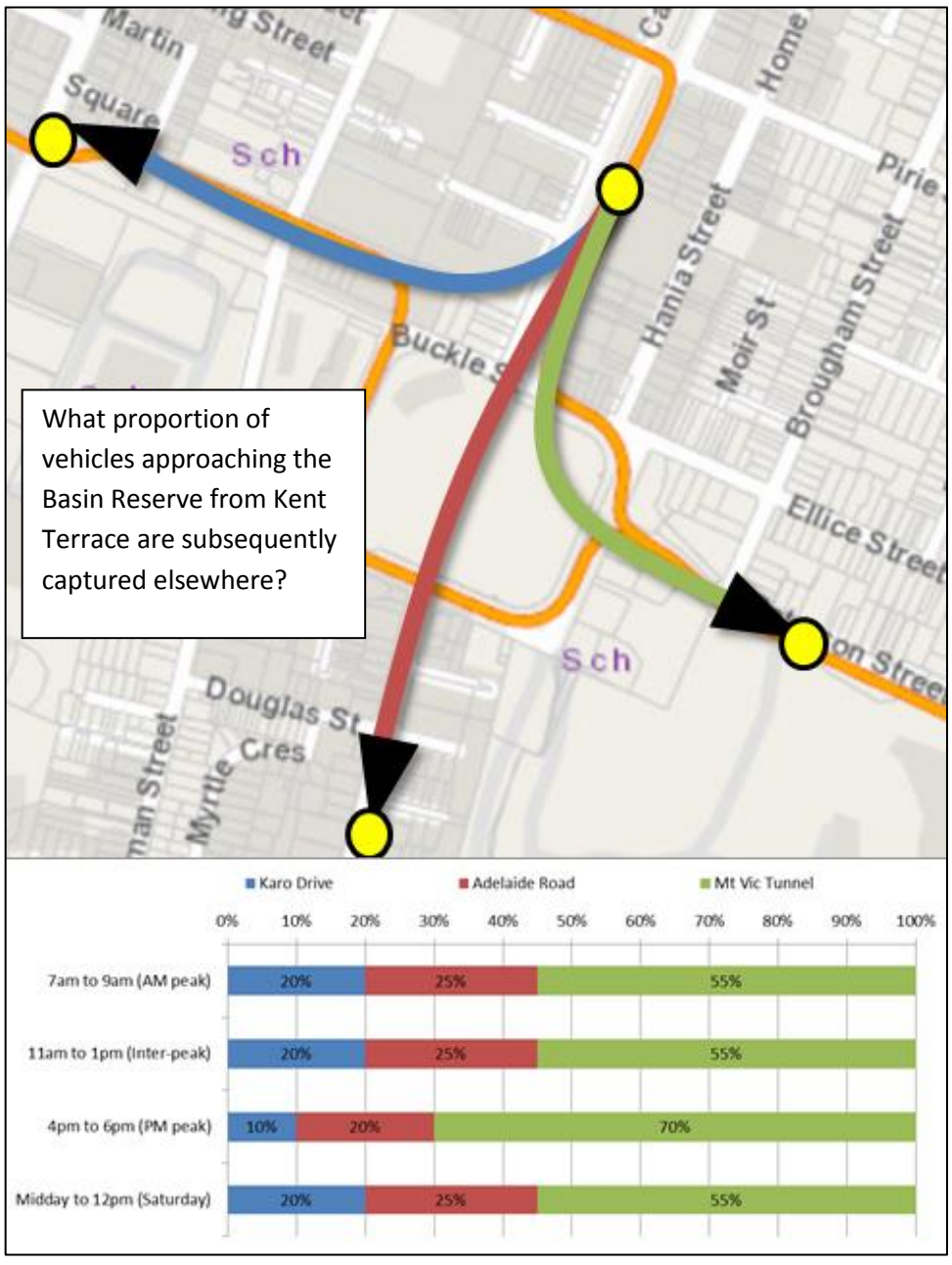
Figure 78 ANPR turning proportions at the Basin Reserve – Adelaide Road

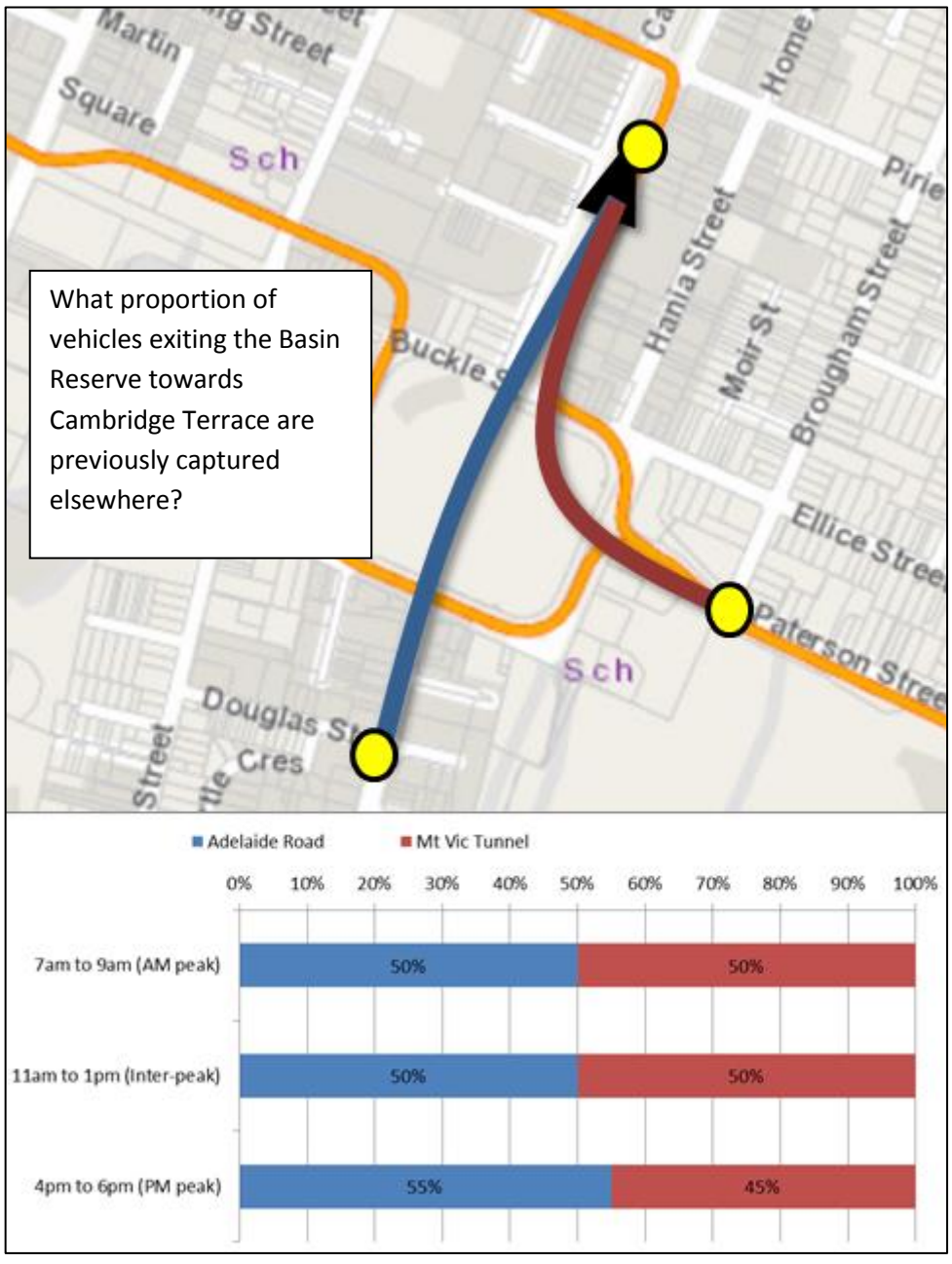


The Adelaide Road turning proportions show the following:

- Looking at motor vehicles approaching the Basin reserve from the south along Adelaide Road on a weekday, depending on time period between 50% and 55% of vehicles head towards Buckle Street, 35% to 40% head towards Cambridge Terrace and only 10% to 10% head towards Mt Victoria Tunnel
- on a Saturday, the proportion of vehicles heading from Adelaide Road to Buckle Street (75%) is greater than during a weekday whilst the proportion heading towards Cambridge Terrace (15%) is lower
- in the other direction, between 80% and 85% of vehicles on Adelaide Road come from Kent Terrace

Figure 79 ANPR turning proportions at the Basin Reserve – Kent / Cambridge Terrace

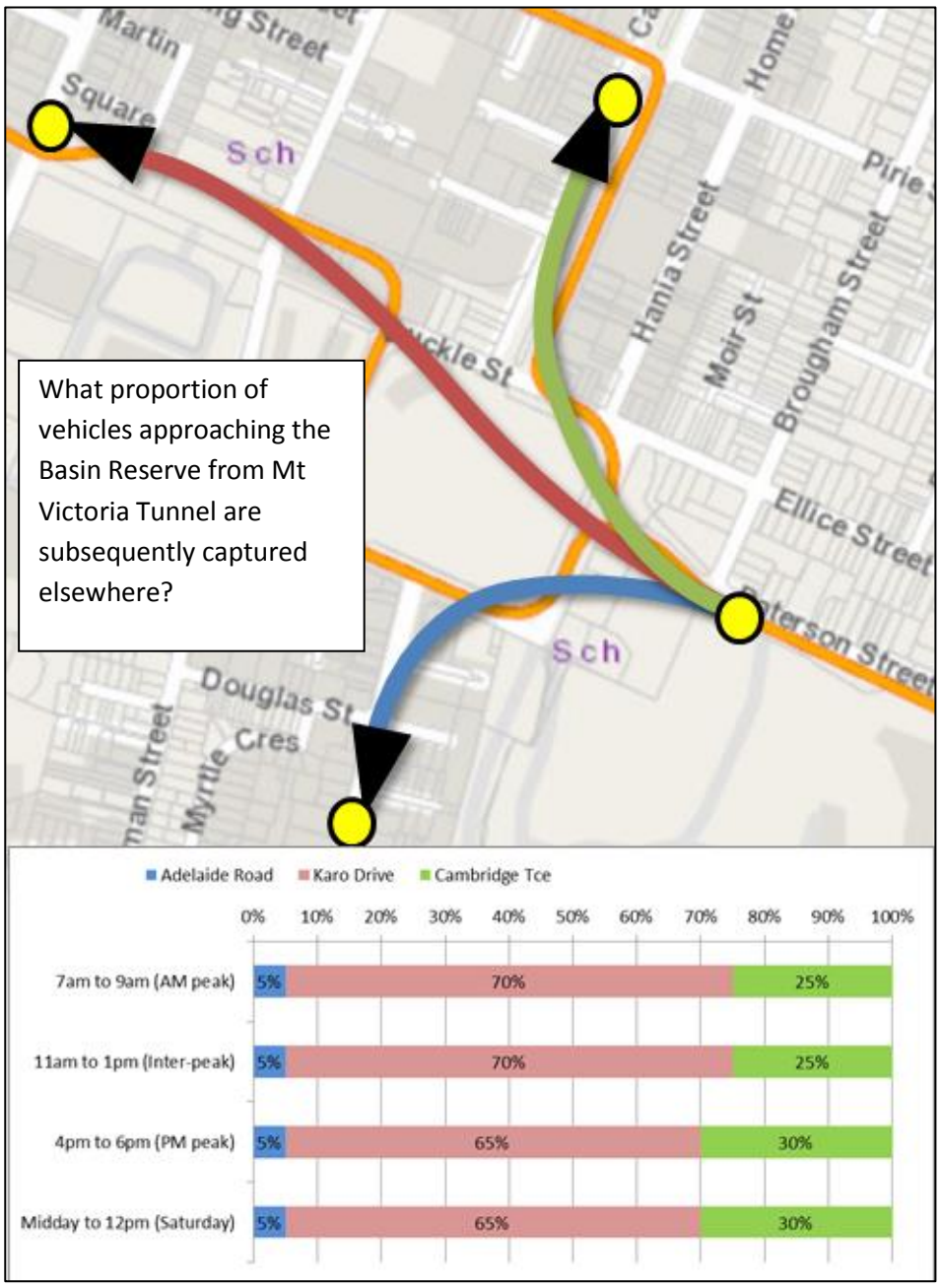


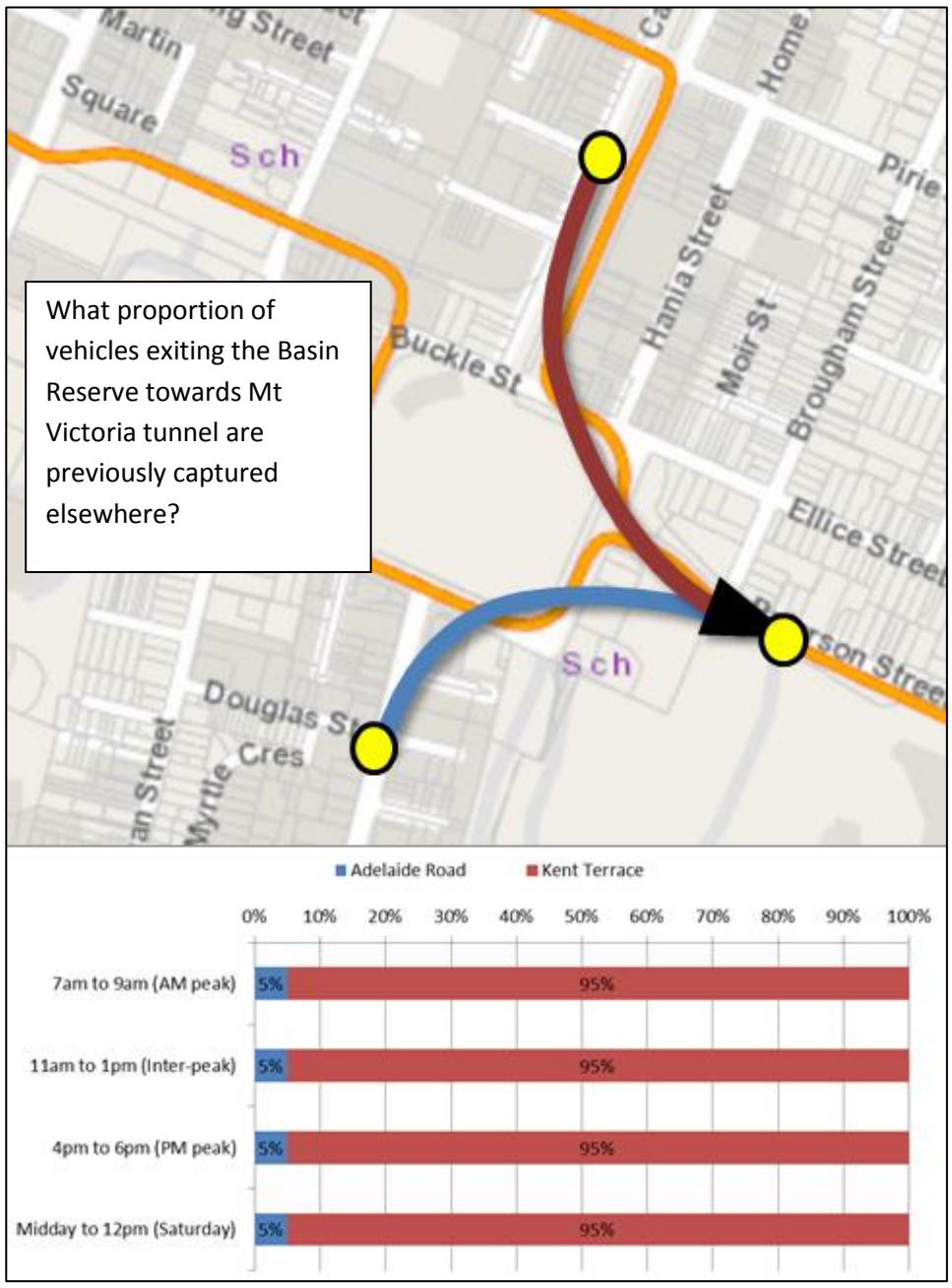


The figures show the following:

- around 55% to 70% of motor vehicles travelling towards the Basin Reserve on Kent Terrace are heading towards Mt Victoria Tunnel, with 20% to 25% heading towards Newtown and between 10% and 20% heading towards Buckle Street
- in the other direction, motor vehicles observed on Cambridge Terrace are relatively evenly split between those that come from Adelaide Road and Mt Victoria Tunnel

Figure 80 ANPR turning proportions at the Basin Reserve – Mt Victoria Tunnel

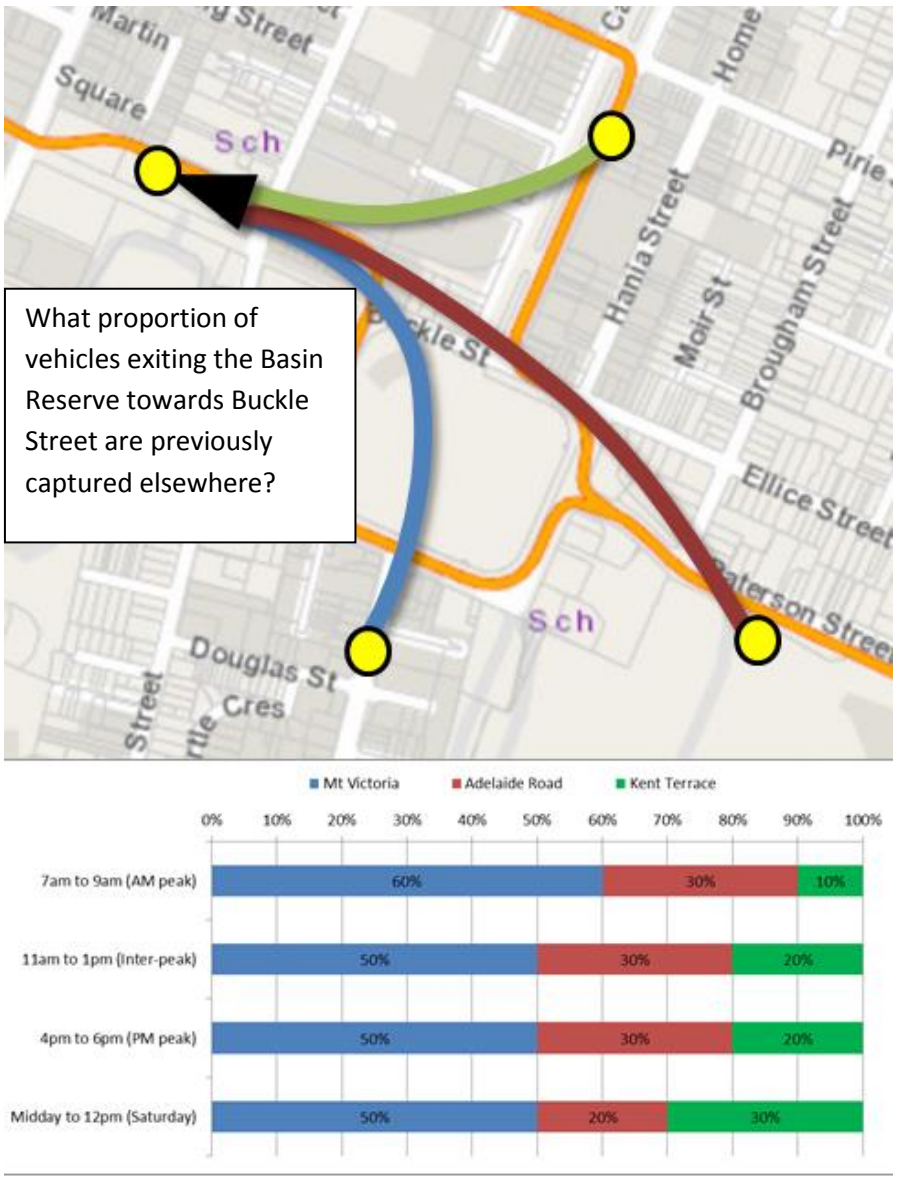




The figures show the following:

- between 65% and 70% of vehicle exiting Mt Victoria Tunnel are heading towards Karo Drive; the remainder head towards Cambridge Terrace (25% to 30%) with around 5% heading towards Adelaide Road in each time period
- in the other direction, 95% of vehicles heading through Mt Victoria Tunnel come from Kent Terrace and only 5% come from Adelaide Road

Figure 81 ANPR turning proportions at the Basin Reserve – Buckle Street



The figures show the following:

- depending on the time period, between 50% and 60% of traffic on Buckle Street comes from Mt Victoria Tunnel, 20% to 30% come from Adelaide Road and between 10% and 30% come from Kent Terrace

17 Wellington International Airport

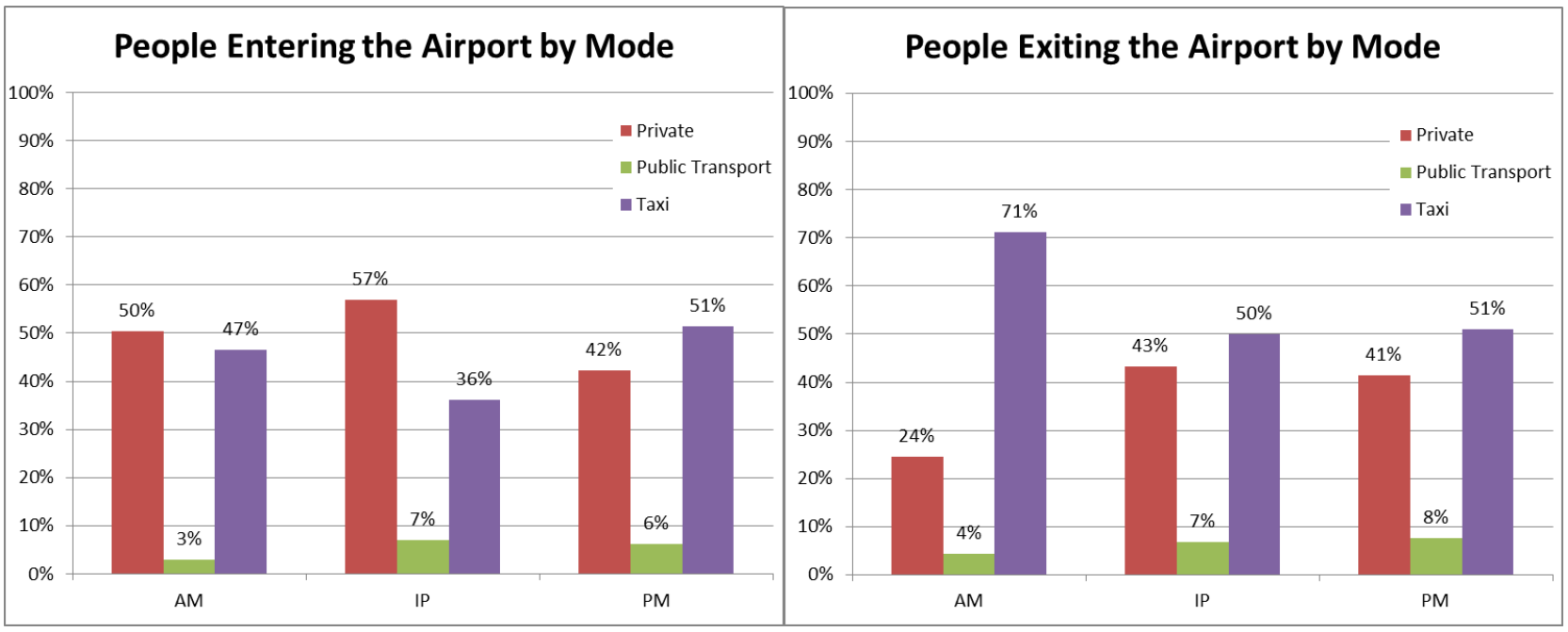
The majority of the 5.5 million air passenger trips made to / from Wellington International Airport in 2016 will also have a corresponding trip accessing the airport prior to departure or leaving the airport after arrival into Wellington.

This section provides insights relating to:

- the modal preferences of air passengers travelling to / from the airport
- the contribution that Airport related trips make to the overall numbers of vehicles on selected parts of the network

Figure 82 shows modal split for airport access / egress trips derived from a 2011 survey undertaken for the development of the Wellington Public Transport Model. The AM peak is 7am to 9am, Inter-peak 11am to 1pm and PM peak 4pm to 6pm and the proportions relate to air passengers only (i.e drivers of cars that drop people off are not accounted for).

Figure 82 2011 Mode share of people entering/exiting Wellington Airport



It is acknowledged that the age of this data is a limitation; since 2011, airport passenger numbers have increased by 25%

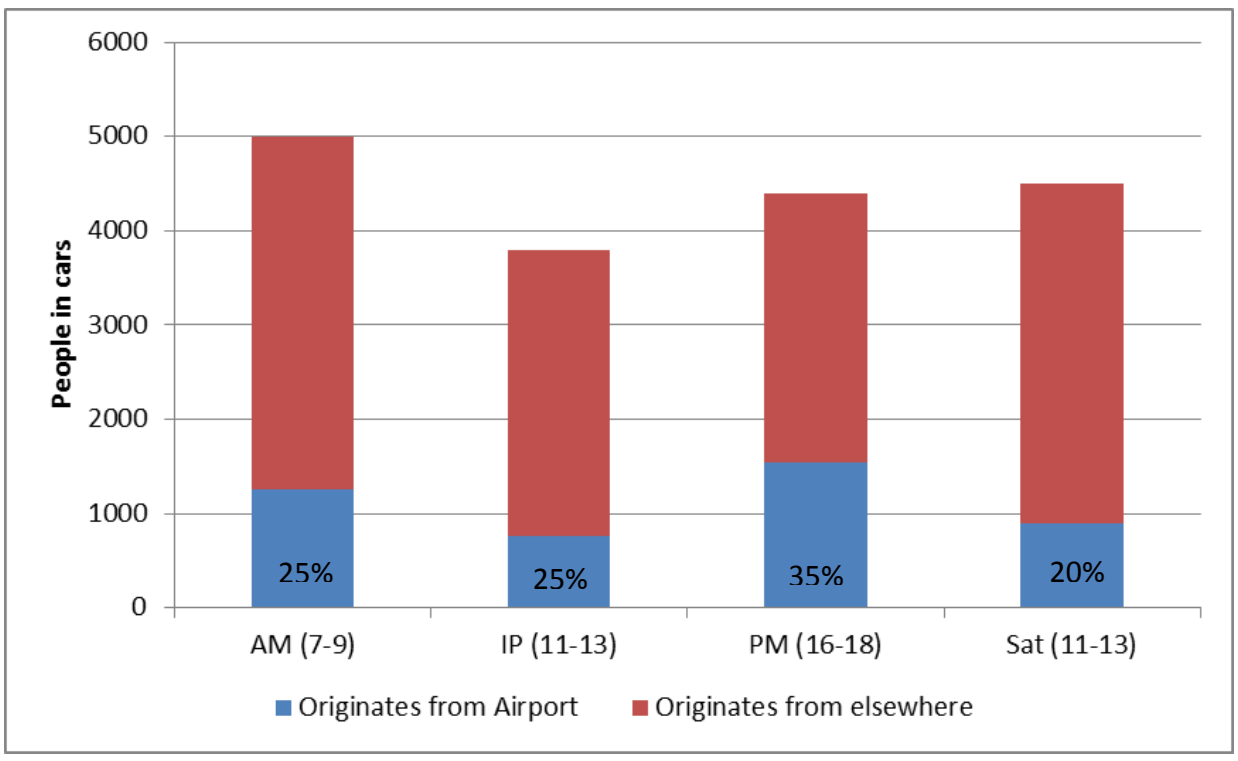
Peak time bus passenger numbers on the Airport Flyer have increased by 50% over the same period[16], partly as a result of increased service frequencies and a more direct routing that cuts travel times. Whilst this is likely to mean is that the 2016 public transport mode share to / from Wellington Airport might be higher than shown above, this change would not change the interpretation of general travel patterns relating to travel to / from Wellington Airport based upon the 2011 data.

This analysis shows the following:

- during peak times, an equal number of persons arriving at Wellington Airport use a private car or taxi to continue their onwards travel
- looking at passengers arriving at Wellington Airport, around 70% exit the airport by taxi in the AM peak
- public transport mode share is low throughout the whole day

Figure 83 shows the proportion of traffic on Cobham Drive between the Calabar Road and Troy Street roundabout heading inbound (towards the city) broken down by place of origin – Airport and elsewhere.

Figure 83 Proportion of traffic on Cobham Drive originating from Wellington Airport

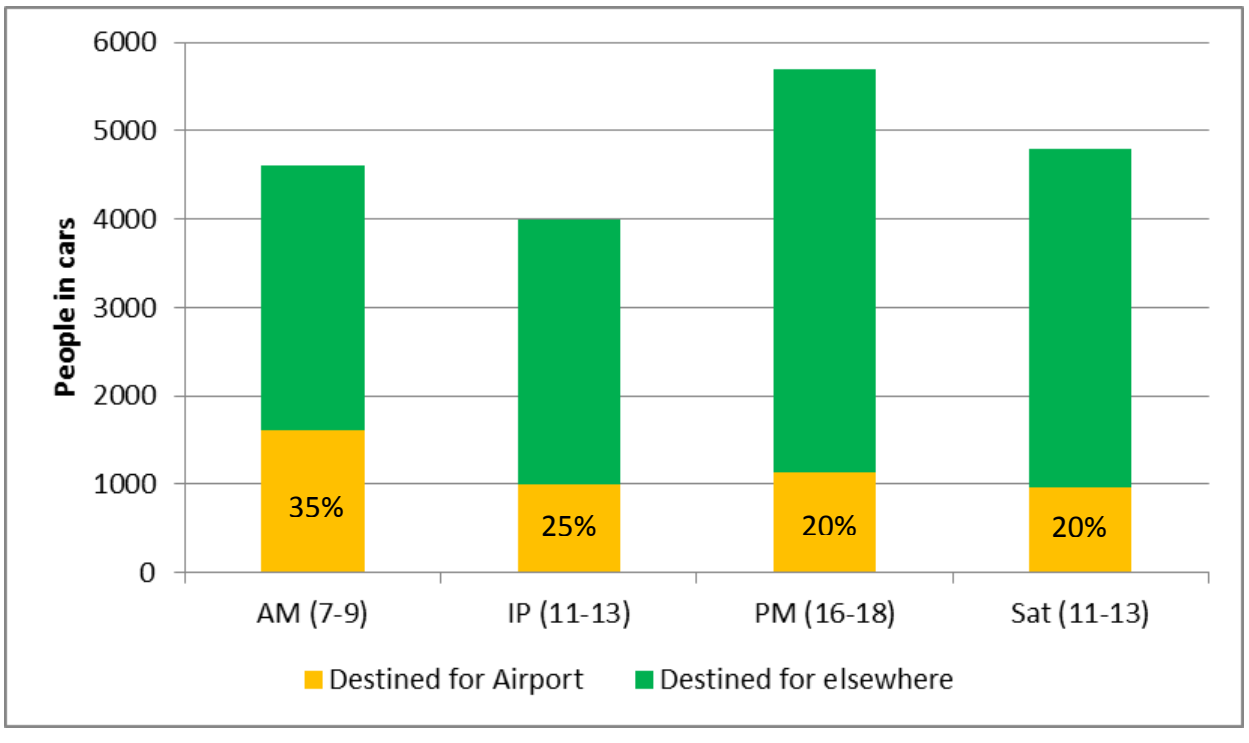


It shows that depending on the time period, between 20% and 35% (800 to 1500) of westbound traffic on Cobham Drive originates from the airport.

Figure 84 shows the proportion of traffic on Cobham Drive between the Troy Street roundabout and Calabar Roundabout heading towards the Airport / Miramar Peninsula, categorised by destination – Airport or elsewhere.

Figure 84 Proportion of traffic on Cobham Drive bound for Wellington Airport

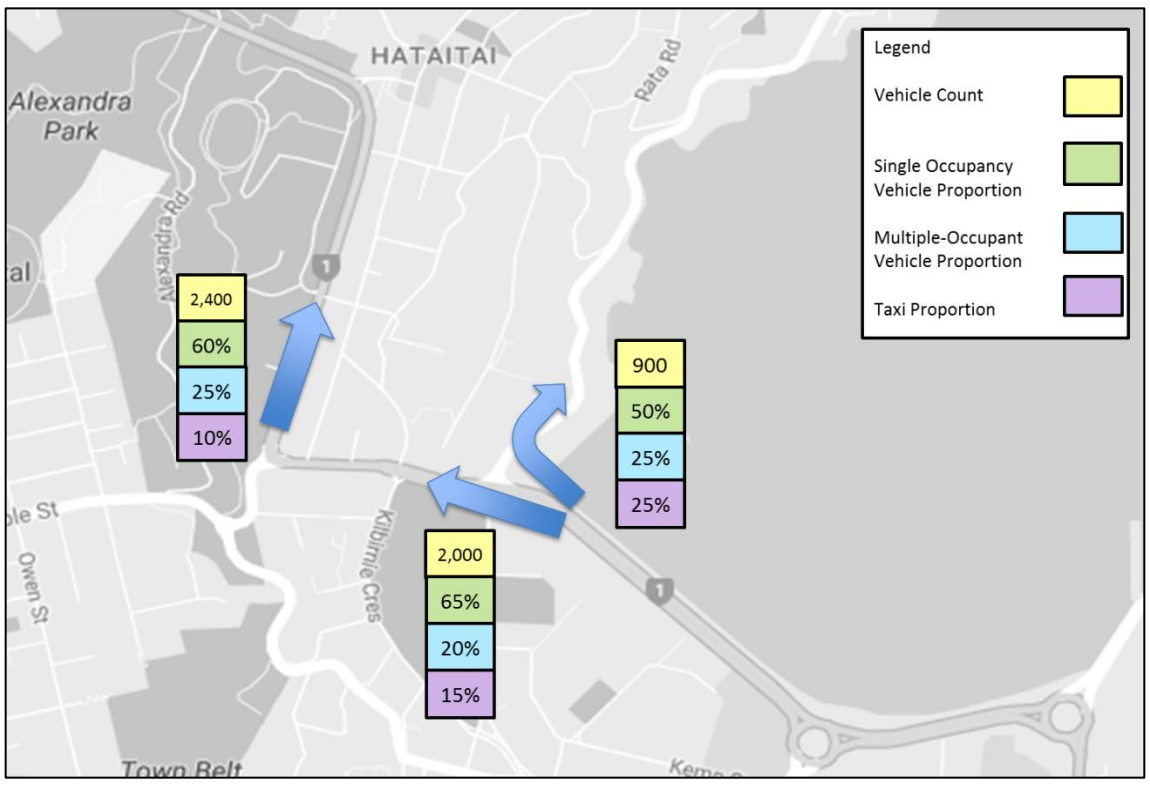
[16] Source: Wellington CBD PT Cordon Survey



It shows that depending on the time period, between 20% and 35% (100 to 1500) of eastbound traffic on Cobham Drive originates from the airport.

Figure 85 below shows taxis (vehicles not persons) as a proportion of total vehicles on Cobham Drive, Evans Bay Parade and Ruahine Street as a percentage of total vehicles in the AM peak between 7am and 9am.

Figure 85 Airport Corridor AM peak vehicle occupancy counts – 7am to 9am



It shows that

- around 15% of vehicles heading on Cobham Drive through the Evans Bay intersection during the AM peak are taxis.
- around 25% of vehicles turning right from Cobham Drive to Evans Bay Parade between 7am and 9am are taxis. This figure can rise to over 35% during certain 15 minute time periods during the peak periods that coincide with multiple flight arrivals).
- along Ruahine Street, around 12% of vehicles heading towards Mt Victoria Tunnel in the AM peak are taxis.

18 Heavy Commercial Vehicles

Figure 86 Figure 87 Figure 88 and Figure 89 below shows Heavy Commercial Vehicles (Trucks) as a percentage of all vehicles (left hand figure) and in absolute numbers (right hand figure) across 3hr observed time periods in the AM peak (6.30am to 9.30am), Inter-peak (11am to 2pm), PM peak (3.30pm to 6.30pm) and Saturday (11am to 2pm).

Figure 86 Heavy Commercial Vehicles, AM peak – as a percentage of all vehicles (left) and absolute numbers (right)

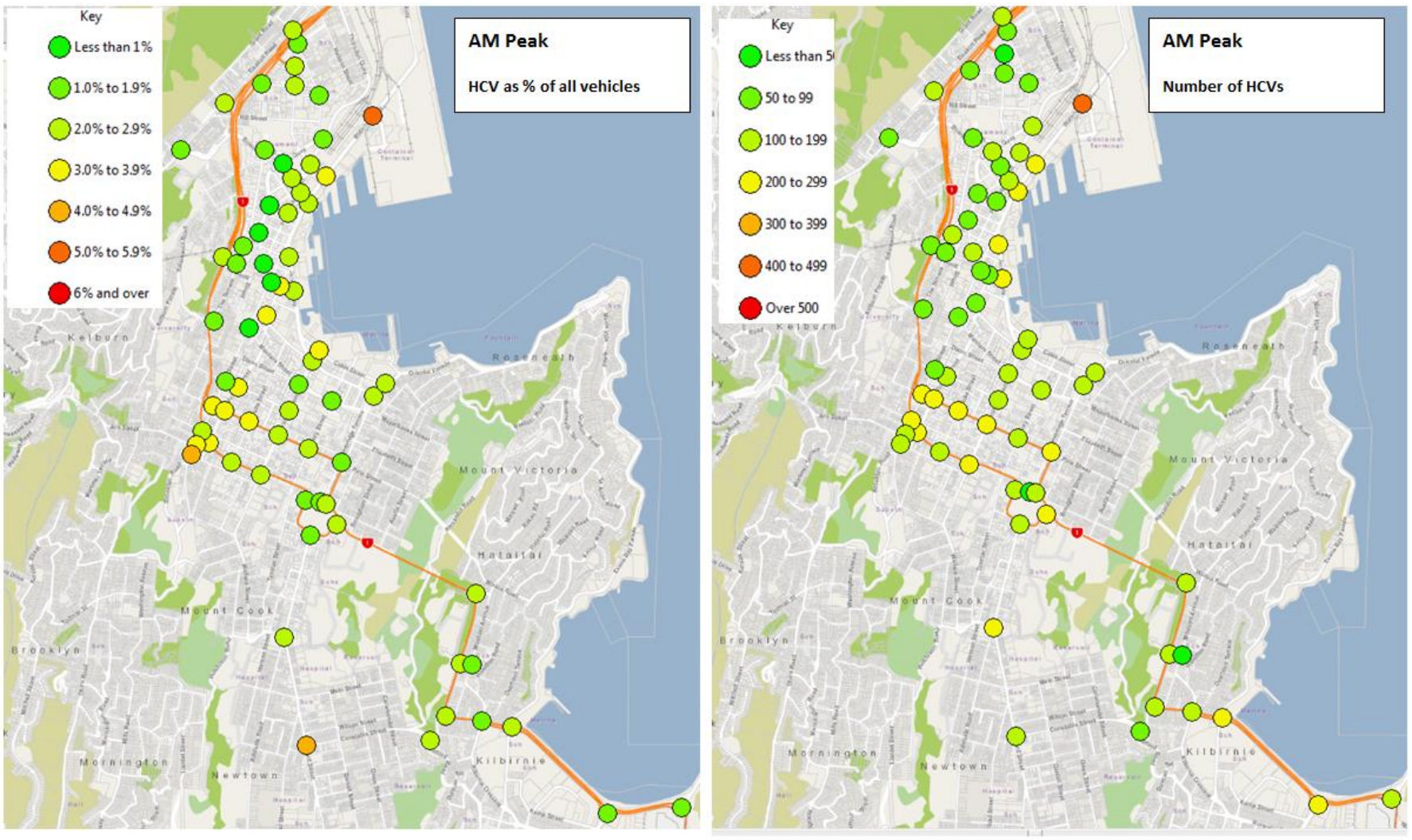


Figure 87 Heavy Commercial Vehicles, Inter-peak – as a percentage of all vehicles (left) and absolute numbers (right)

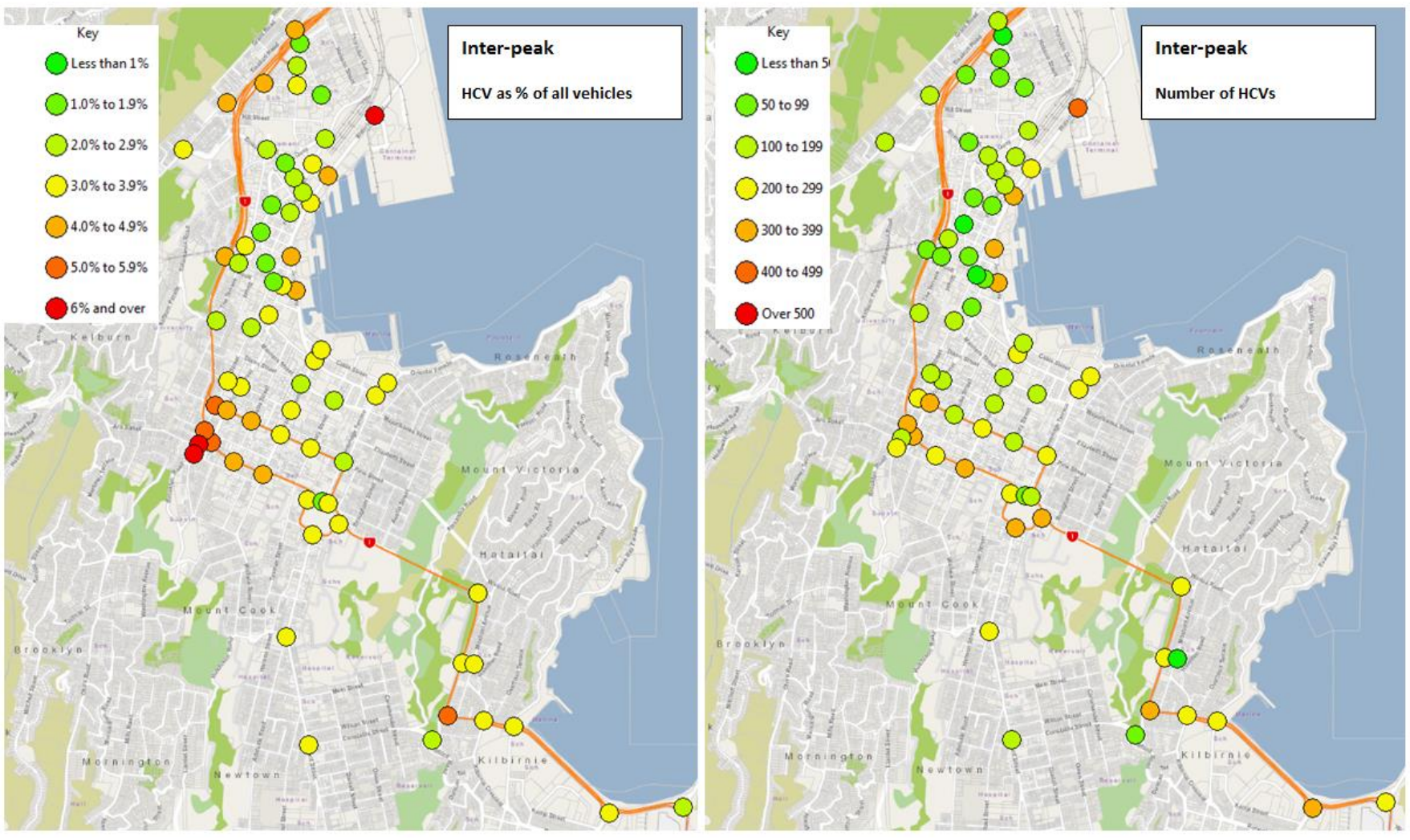


Figure 88 Heavy Commercial Vehicles, PM peak – as a percentage of all vehicles (left) and absolute numbers (right)

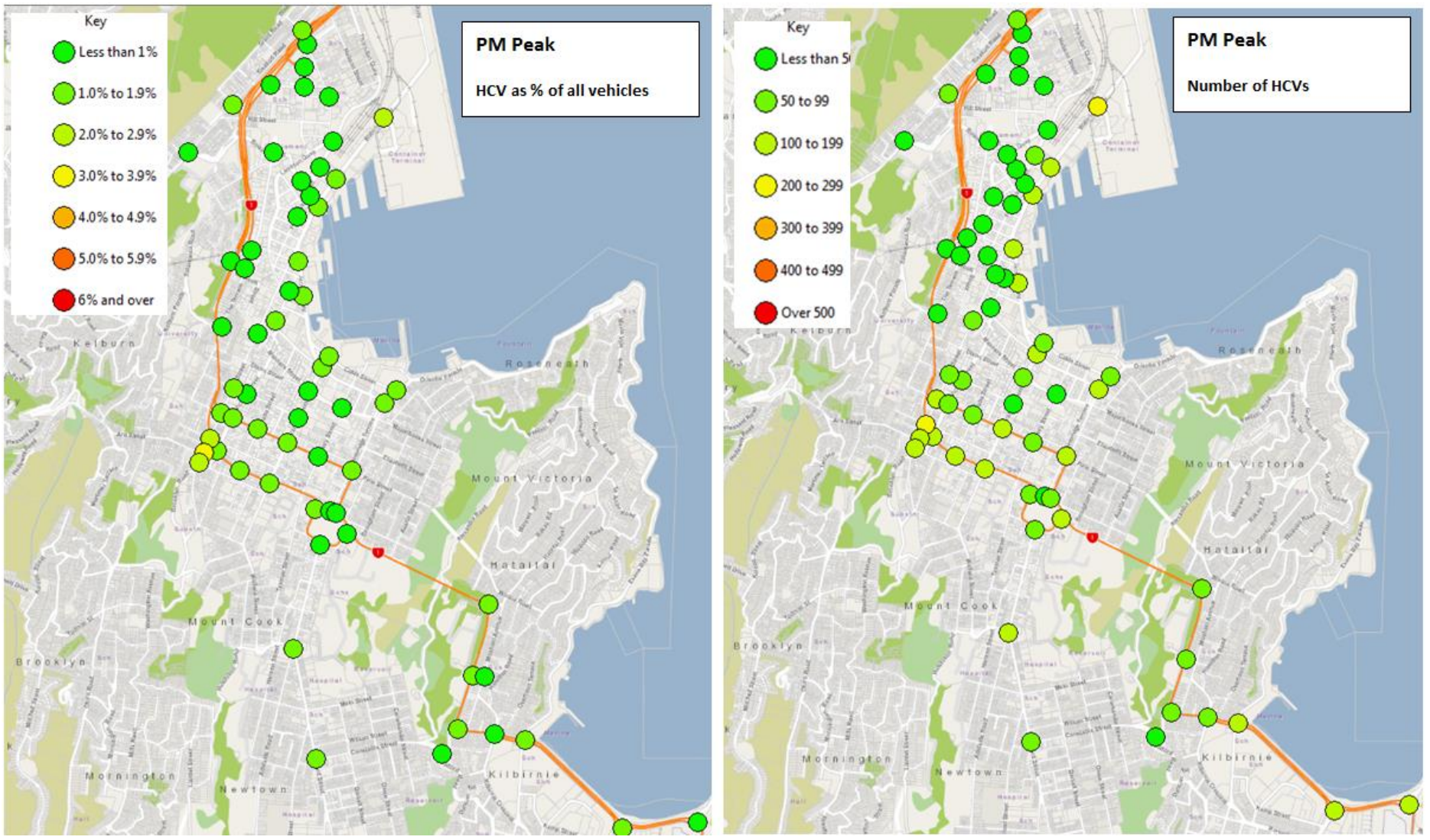
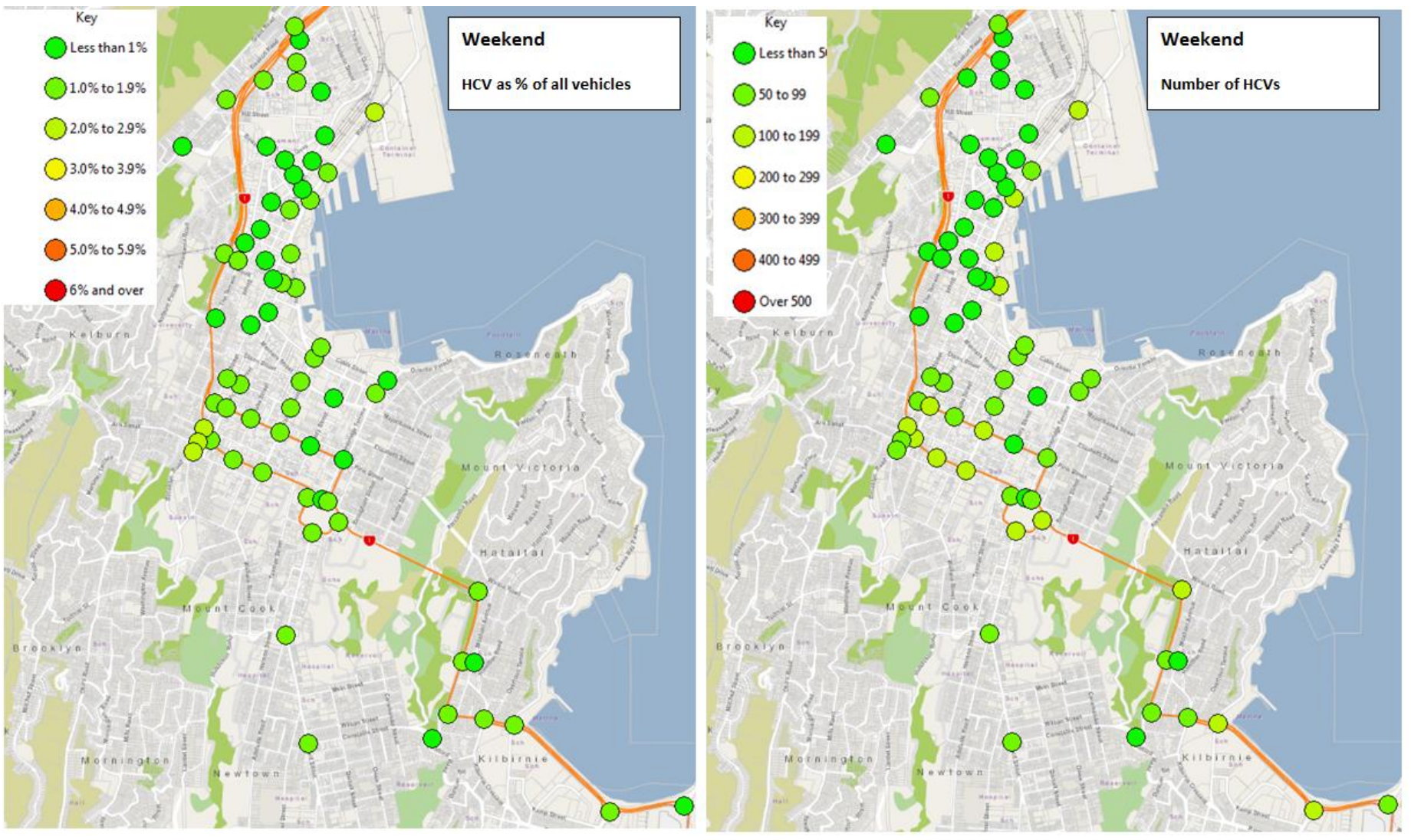


Figure 89 Heavy Commercial Vehicles, Weekend – as a percentage of all vehicles (left) and absolute numbers (right)



In summary

- HCVs account for a relatively small proportion of total vehicles at the selected locations in and around Wellington CBD
- During the AM peak, HCVs typically account for between 1% and 3% if all vehicles at most locations, the exception being SH1 between Mt Victoria Tunnel and Wellington Airport in the PM peak where 4% to 6% of vehicles at some intersections are HCVs
- HCVs as a proportion of total vehicles is slightly higher in the Inter-peak
- The AM peak and Inter-peak have higher truck volumes than the PM peak and weekend
- During the AM peak and Inter-peal, selected intersections along Karo Drive, Vivian Street, Aotea Quay and Ruahine Street see between 300 and 400 HCVs passing through them (average of 100 to 135 per hour)
- The busiest intersection for HCVs is the entrance to Centreport off Aotea Quay which sees 400 to 500 trucks during the AM peak and Inter-peak (average of 135 to 165 per hour)

19 Highway capacity analysis

Traffic volume data at two locations on the highway network – southbound approach to Terrace Tunnel and westbound approach to Mt Victoria Tunnel – has been combined with observed capacity surveys and cross referenced against observed travel speed surveys to understand queue formation at these important entry points into the CBD

19.1 Capacity surveys

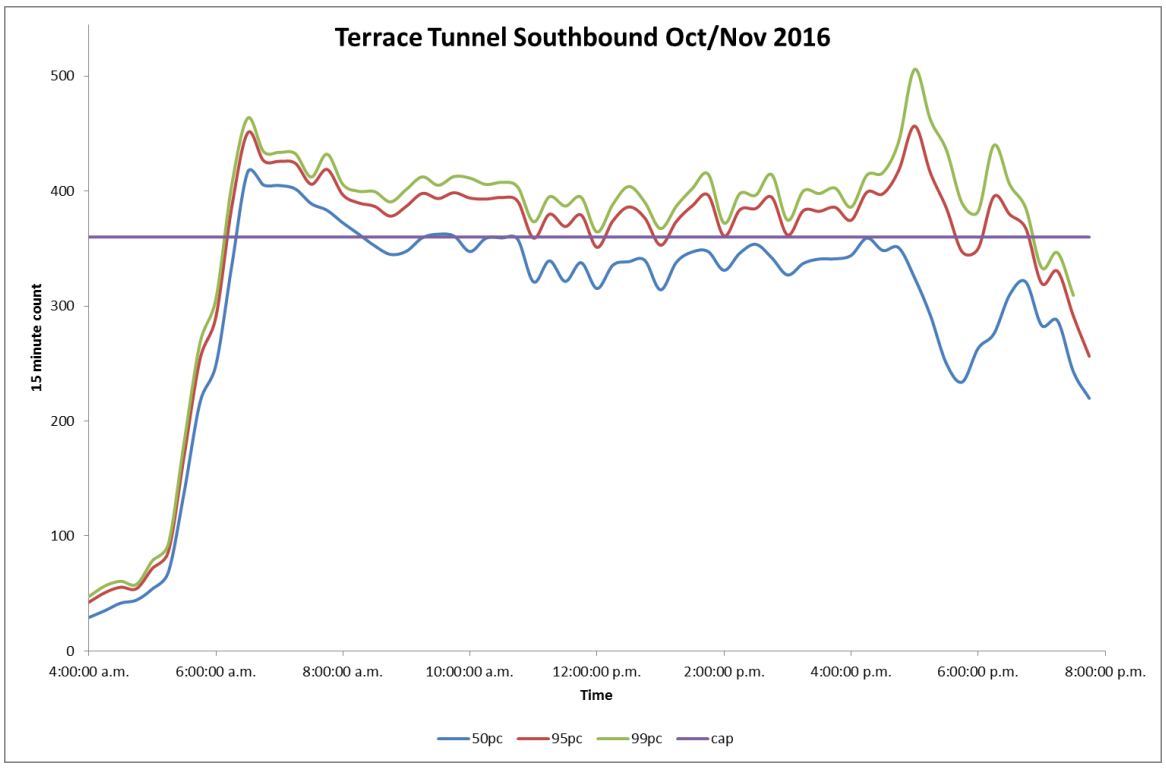
Figure 90 below provides a summary of traffic volumes counted in 15 minute intervals in the Terrace Tunnel southbound for the month of February and the first two weeks of March 2016.

The mean traffic volume profile (**blue line, 50 percentile**) is shown along with a 95 and 99 percentile synthesised profiles:

- a 50th percentile curve is the mean curve and traffic volumes will be greater than this curve 122.5 working days a year
- a 95 percentile curve will be exceeded 12.3 working days a year
- a 99 percentile curve will be exceeded 2.5 working days a year.

In combination this data provides a range of observed traffic volumes and a probability that of where observed traffic volumes might sit within this range on one particular day.

Figure 90 Terrace Tunnel Southbound Profiles February/March 2016



The data shows that traffic volumes (by 15 minute time slice) increase from around 5.30am to a peak around 6.30am of over 400 vehicles per 15 minutes (1,600 vehicles per hour). This is over the calculated capacity of the tunnel itself (360 vehicles per 15 minutes or 1440 vehicles per hour) represented by a **purple line**.

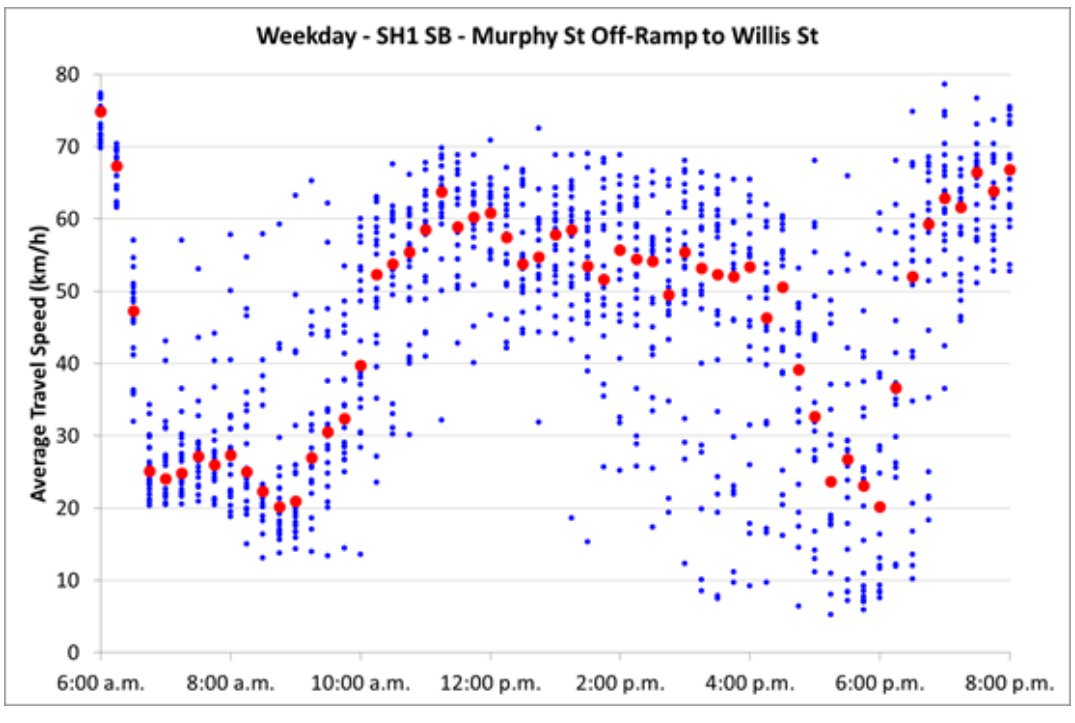
Following this peak, volumes decline to around 360 vehicles per 15 minutes at 9am (the capacity of the tunnel) and remain between 300 and 350 vehicles per 15 minutes from 11am to 4pm before dipping significantly between 4pm and 5pm, climbing back between 5pm and 6pm before tailing off past 7pm.

Observations relating to the formation of queues, whilst only undertaken on one particular day in March, show that the drop in traffic volumes at 6.30am is a result of queue propagation back from the Terrace Tunnel merge at 6.30am that on the day of survey continued to a greater or lesser extent until 10am.

Whilst accepting that there is a high degree of variability in relation to traffic volumes from one day to the next (as evidenced by the 95th percentile figures above) that will result in the length / severity of the queue varying from one day to the next, this evidence shows that between 6.30am and 9.30am (and often for a longer period) the Terrace Tunnel operates at capacity, resulting in queueing and slow, variable travel times.

Figure 91 below shows observed travel speeds and travel speed variability for a route on SH1 between Murphy St off-ramp and the intersection of Vivian Street / Willis Street, including travel through the Terrace Tunnel. It shows quite clearly how travel speeds drop significantly around 6.30am, recover slightly by 10am but still remain highly variable until the PM peak when speeds drop again.

Figure 91 Travel speeds and travel speed variability, Murphy Street off-ramp to Willis Street



Slow and unreliable travel times are likely to result in a number of behavioural responses:

- people re-time their journeys to avoid queuing (travelling prior to 6.30am)
- people accept that there will be queuing
- people choose alternative routes; data presented previously in this report from the automated number plate recognition (ANPR) surveys shows that some vehicle approaching Wellington on SH1 from the north and heading towards the Airport will choose to travel via Aotea Quay to avoid congestion caused by the Terrace Tunnel.

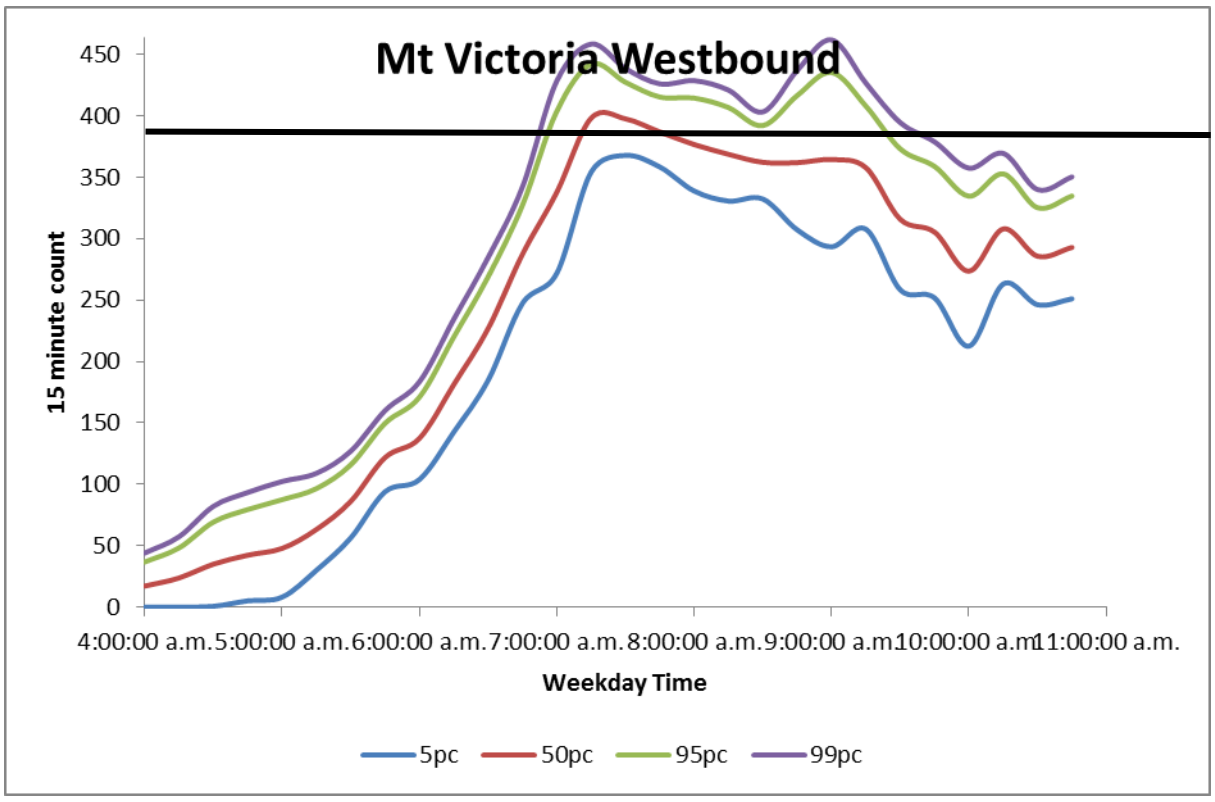
19.2 Mt Victoria Tunnel Westbound

Figure 92 below shows a summary of traffic volumes counted in 15 minute intervals at the Mt Victoria Tunnel westbound for the last two weeks of October and the month of November 2016.

The mean traffic volume profile (**blue line, 50 percentile**) is shown along with a 95 and 99 percentile synthesised profiles:

- a 50th percentile curve is the mean curve and traffic volumes will be greater than this curve 122.5 working days a year
- a 95 percentile curve will be exceeded 12.3 working days a year
- a 99 percentile curve will be exceeded 2.5 working days a year.

Figure 92 Mt Victoria Tunnel Westbound Profiles February/March 2016



The data shows that traffic volumes increase steadily from 6 am (125 vehicles per 15 minutes) to 7am (over 350 vehicles per 15 minutes) at which time traffic volumes are equal to the observed capacity of the tunnel (1400 to 1500 vehicles per hour to 350 to 375 vehicles per 15 minute period).

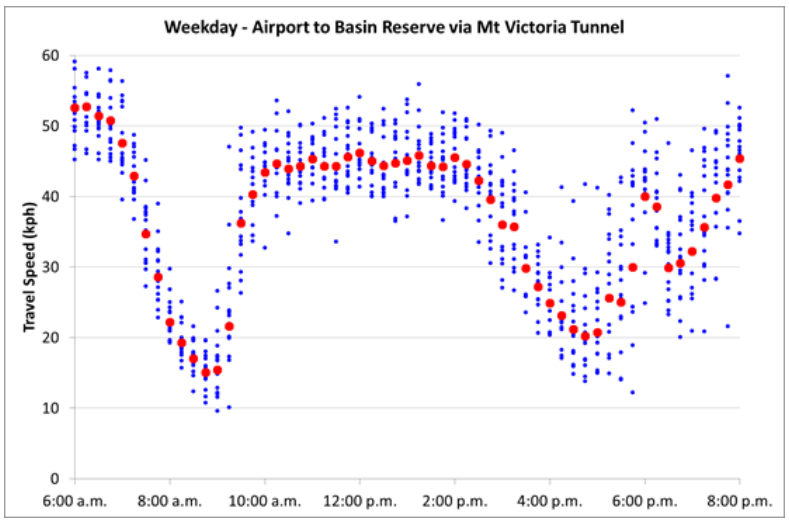
On an average day, represented by the 50th percentile, traffic volumes remain at or near capacity between 7am and 9am; on certain days, however, traffic volumes can exceed the capacity of the tunnel between 6.30am and 9.30am.

Observations relating to the formation of queues, whilst only undertaken on one particular day in March, show that from 7am onwards traffic is slow moving along Ruahine Street and through Mt Victoria Tunnel but rarely stationary. This is a function of the merge from 2 lanes to 1 lane at Wellington Road, combined with the two closely spaced sets of signals, creating a small bottleneck that regulates the amount of traffic released onto Wellington Road and Ruahine Street.

Whilst accepting that there is a high degree of variability in relation to traffic volumes from one day to the next (as evidenced by the 95th percentile figures above) that will result in the length / severity of the queue varying from one day to the next, this evidence (combined with travel times presented earlier in the report) show that the Mt Victoria Tunnel is a constraint on the network and that during peak periods, traffic volumes are generally at or near capacity, resulting in slow moving traffic and unreliable travel times.

Figure 93 below shows observed travel speeds and travel speed variability for a route on SH1 between the Airport and Basin Reserve via Mt Victoria Tunnel

Figure 93 Travel speeds and travel speed variability, Murphy Street off-ramp to Willis Street



It shows quite clearly how travel speeds drop off around 7am, recover by 10am, remain relatively constant during the inter-peak (with some variability) before dropping again in the PM peak.

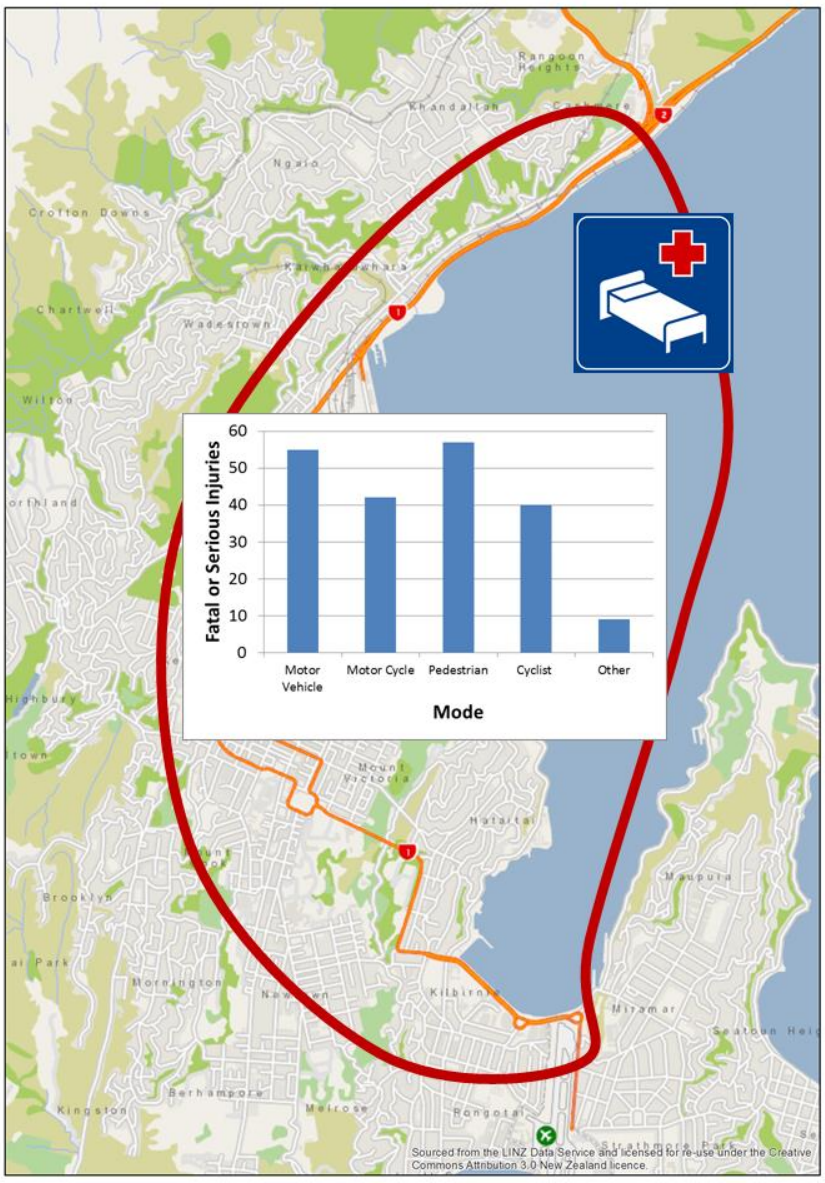
This constraint results in vehicles choosing alternative routes, as evidenced by:

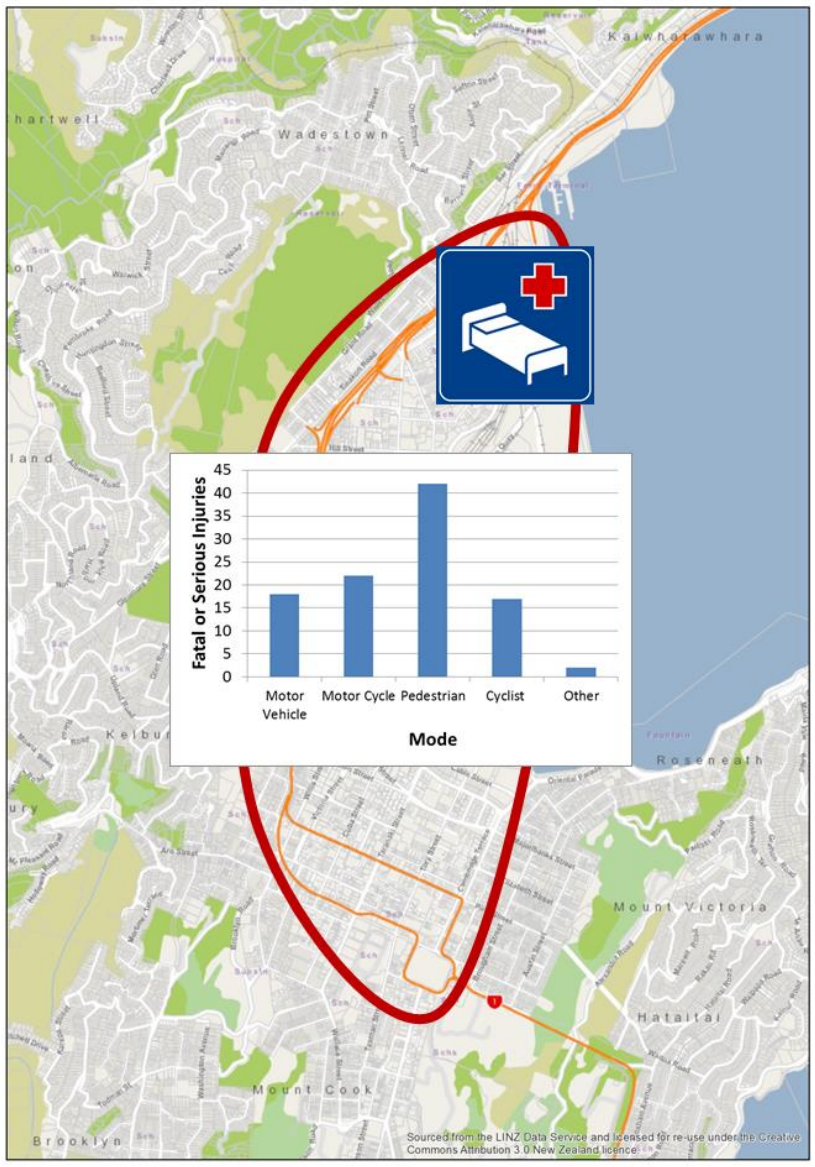
- analysis presented previously in this report that shows around 25% of vehicles turning right form Cobham Drive onto Evans Bay Parade in the AM peak are taxis that will probably choose this route to head into the CBD because the travel times are more reliable
- automated number plate recognition (ANPR) analysis shows some vehicles travelling from SH1 (from the north) towards the Airport will use the Waterfront route and Evans Bay Parade instead of the more direct route via the terrace Tunnel, Vivian Street and Mt Victoria Tunnel

20 Road safety

Figure 94 below shows crashes resulting in fatal or serious injuries over the 5 year period of 2012 to 2016, sourced from NZTA's Crash Analysis System (CAS). There are two focus areas – Wellington CBD (area bounded by SH1 and Kent / Cambridge Terrace) and an area slightly wider including Wellington's inner suburbs, SH1 towards the Airport, Newtown and SH1 / Hutt Road as far as Ngauranga Gorge.

Figure 94 2012 to 2016 Fatal or serious injuries within the LGWM study area





The data confirms and quantifies:

- Few people in cars are injured within the inner city, where speeds are relatively low
- Most pedestrians are injured within the inner city, where pedestrian density is high
- Considering the relatively low number of trips of cyclists and motorcycle riders, their risk of injury is high in comparison with the other modes

Figure 95 shows locations of these crashes, colour coded by mode. Again, we observe the concentration of pedestrian injuries in the inner city and additionally, the following accident hot spots can be observed:

- Willis St, between Dixon St and Mercer St. All road users, but especially pedestrians
- Taranaki St, south of SH1
- Hutt Road, north of Kaiwharawhara for cyclists
- SH1 near Terrace off-ramp / Clifton Terrace on-ramp

Figure 95 Locations of crashes resulting in fatal or serious injuries, 2012 to 2016