Central Area Bus Operational Review

Final Report
November 2009
Central Area Bus Operational Review

Executive Summary

Greater Wellington Regional Council (GWRC) has commissioned Opus International Consultants to undertake an operational review of public transport (PT) on the Golden Mile between Wellington Railway Station and Kent and Cambridge Terrace as part of a package of measures to “Restore the Golden Mile” corridor and develop the PT spine.

Bus operations through the Wellington CBD and along the Golden Mile are currently unreliable with significant delays for a large number of bus services during both peak and inter peak periods. The recently approved Ngauranga to Airport (N2A) Strategy Study strengthened the need to enhance a PT corridor through the CBD with the ability to safeguard for enhanced PT in the future.

The main objectives of this review are to identify options and recommend a pathway for improving the efficiency and reliability of bus operations through the Wellington central area and along the length of the Golden Mile, particularly during peak periods. A key focus in doing this was the need to highlight key priorities and deliver affordable recommendations for the short, medium and longer term.

This study has confirmed that existing public transport delay and variability is significant and will only increase in the future without interventions or modification to the existing network operation model for bus services. Growth in PT for the study area is predicted to increase significantly (between 10 and 30 percent during peak periods) until 2016 and then maintain lower growth beyond this period through to 2026. This growth will place increased pressure on existing operation and infrastructure, highlighting the need for short to medium term enhancements to those locations in which reliability and operational conditions are poor.

The existing issues with poor legibility due to the split route arrangement (i.e. buses use different roads in each direction) through the section between Lambton Quay and Courtney Place, and the significant delay, congestion, and journey time variability in a northbound direction provide the justification for improvements to be made and are consistent with GWRC and Wellington City Council’s (WCC’s) desire to focus on this area in order to complement the wider planned improvements to the Golden Mile PT corridor. The proposal for Manners Mall not only seeks to enhance PT, but also considers public space, pedestrian routes, safety and the urban fabric of the City. The WCC project currently being considered involves opening up Manners Mall as part of a package of measures to “Restore the Golden Mile” to relieve one of the most significant bottlenecks and areas of poor legibility for bus operations. This infrastructure project has been identified as the single most significant change that could be made to enhance current bus operation and future PT provision on the Golden Mile.

The Golden Mile concept focuses on implement a comprehensive package of improvements which create dedicated bus priority facilities (bus only restrictions) and rationalisation of stops (Manners Street northbound) similar to those proposed for the Manners Mall Report. Failure to achieve the concepts identified and the design philosophy could result in less significant reductions in variability and journey time savings. Therefore it is considered essential that the Manners Mall project and other Golden Mile projects seek to maximise provision through the creation of a two way dedicated public transport spine.
Further enhancing the bus priority over the length of the Golden Mile through the introduction of bus specific measures and reallocation of road space is also considered to be viable and will provide operational benefits; however this will require further investigation and should follow the Manners Mall project and other recommended minor changes to bus stops, signal detection and traffic management restrictions.

The review of the existing bus network operational model and passenger loading and alighting patterns through the Golden Mile highlighted that peak hour bus frequencies are at the upper end of the capacity and additional capacity on the Golden Mile is needed now for the following reasons:

- High volumes of buses cause delays on the carriageway and at stops;
- Stops have insufficient capacity, bus drivers often have difficulty pulling in and out of stops and frequently block the carriageway while waiting to access the stop;
- Variation in bus occupancy and under utilisation of capacity on some routes;
- Passenger loading inefficiencies (ticketing, entry/exit limitations, bus stop design); and
- Processing cash payments and giving change on board the bus is slow.

Analysis indicated that reducing the number of buses using the Golden Mile would improve the efficiency and reliability of the bus operations. The creation of hubs outside or at the periphery of the Golden Mile has been identified as the preferred long term solution, while in the short term consideration should be given to express services serving a reduced number of stops along the Golden Mile. Both these options would require more passengers to transfer, but provided transfer locations are appropriately located and designed, would also significantly improve reliability and better meet the needs of passengers. The hubs concept would require a reconfiguration of the existing bus network with the creation of interchange locations at key locations beyond the extent of the Golden Mile, to form transfer points. Suburban routes would be required to terminate at these hubs and dedicated high frequency bus routes would need to be provided along corridors between each hub and the Golden Mile. This would result in a significant reduction in buses travelling through the Golden Mile and would provide a more even distribution of services (i.e. less bunching) thus better meeting the needs of passengers. Fewer high frequency routes would also assist in reducing passenger crowding at bus stops.

It is recommended that both the hubs concept and express service concept be further investigated and tested with the public as part of GWRC’s Wellington Public Transport Review which is currently underway. The review would need to define appropriate hub and corridor locations as well as express stop locations. Newtown would be an ideal location for a hub in the south while hubs at Johnsonville and Petone might also be desirable in the north.

Other identified operational improvements focus on introducing integrated ticketing and/or cashless ticketing on the Golden Mile, while also working towards all buses utilising both doors for loading and alighting.

The following indicative implementation programme provides a potential pathway for delivery of improvements to bus operations along the Golden Mile:
<table>
<thead>
<tr>
<th>Intervention</th>
<th>Implementation Programme</th>
<th>Cost</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land Use &amp; Integrated Transport Planning</td>
<td>Ongoing</td>
<td>Low ^</td>
<td>Operational issue that could be enhanced in DP</td>
</tr>
<tr>
<td>Real Time Information (ongoing monitoring and management)</td>
<td>Ongoing</td>
<td>High * ^</td>
<td>currently being implemented and trailed</td>
</tr>
<tr>
<td>Manners Mall Bus Priority</td>
<td>Short Term</td>
<td>High ^</td>
<td>NZTA funding allocated</td>
</tr>
<tr>
<td>Bus Stop Rationalisation (Stout Street)</td>
<td>Short Term</td>
<td>Low ^</td>
<td>Some consultation and ongoing discussion with Supreme Court</td>
</tr>
<tr>
<td>Bus Schedule Review</td>
<td>Short Term</td>
<td>Low ^</td>
<td>Communication requirement</td>
</tr>
<tr>
<td>Express Services</td>
<td>Short Term</td>
<td>Low ^</td>
<td>Formalising existing operational patterns</td>
</tr>
<tr>
<td>Integrated Ticketing</td>
<td>Medium Term</td>
<td>High * ^</td>
<td>Significant planning and wider network impacts</td>
</tr>
<tr>
<td>Cashless Ticketing on the Golden Mile</td>
<td>Medium Term</td>
<td>Medium ^</td>
<td>Communication and consultation critical</td>
</tr>
<tr>
<td>Bus Stop Layout &amp; Design Improvement</td>
<td>Medium Term</td>
<td>Medium ^</td>
<td>Some links to other projects and operational models</td>
</tr>
<tr>
<td>Parking Restrictions &amp; Enforcement Strategy</td>
<td>Medium Term</td>
<td>Low ^</td>
<td>Linked to bus improvements and relocation of road space</td>
</tr>
<tr>
<td>Investigation of Hubs (Suburban)</td>
<td>Long Term</td>
<td>High * ^</td>
<td>Significant planning and consultation. Could have significant cost savings.</td>
</tr>
<tr>
<td>Reallocation of Road Space</td>
<td>Long Term</td>
<td>High ^</td>
<td>Significant planning, design, consultation and costs.</td>
</tr>
</tbody>
</table>

**Key (indicative):**

- **Programme**
  - Short Term within the next 12 months
  - Medium Term 1-3 years
  - Long Term beyond 3 years

- **Cost**
  - Low under $0.5m
  - Medium $0.5m - $1m
  - High Greater than $1m

* Bus Operational Cost
^ Capital, Planning & Design Cost

This operational review has concluded that significant opportunity exists to enhance public transport operation on the Golden Mile through a mixture of infrastructure and operational interventions. The most significant of these interventions in the short to medium term is delivery of the Manners Mall project which will address significant bus delay, reliability and legibility issues. Longer term measures relating to the network operational model should be investigated in conjunction with GWRC plans for an Integrated Public Transport Network Framework and the current GWRC Wellington Public Transport Review.
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1 Introduction

GWRC wish to understand the operational issues associated with passenger transport services in the Golden Mile and to identify innovative and robust ways of making the services more efficient and reliable. The main objectives for the central area bus operational review are to:

- identify options and recommend a pathway for improving the efficiency and reliability of bus operations through the Wellington central area and along the length of the Golden Mile, particularly during peak periods
- focus on key issues as a priority and deliver affordable recommendations for the short, medium and longer term

Bus operations through the Wellington CBD and along the Golden Mile are currently considered to be unreliable with significant delays for a large number of bus services during peak periods.

The purpose of this project is to review the bus network and services in the central area so as to achieve efficient and reliable bus services and improve amenity values for all users along the Golden Mile. This project is intended to deliver progress towards the Ngauranga to Airport Corridor Plan and to inform the wider network planning being undertaken by GW, in particular the Wellington Public Transport Review and Integrated Public Transport Network Framework. The report will present affordable recommendations for short, medium and longer term that are focused on the key issues identified.

1.1 Strategic Context

This study builds upon the findings of several other investigations of options for improving the performance of passenger transport services within the Golden Mile Corridor. Previous studies include:

(a) Golden Mile Capacity Assessment, Opus, August 2006
(b) Ngauranga to Airport Strategy Study: Technical Report II & III, Opus, July 07 & May 08, and
(c) Restoring the Golden Mile: Taranaki Street to Willis Street, Opus, May 09.

1.1.1 Golden Mile Capacity Assessment

The Golden Mile Capacity Assessment identified a number of mechanisms that could be introduced or developed in order to improve bus priority, associated bus travel times, and capacity through the Golden Mile.

On the basis of bus reliability surveys conducted in 2002 and 2006, it was concluded that the passenger transport operations did not follow the published timetables within the
Golden Mile. Analysis of these results found that there was a large degree of variability to bus journeys on the Golden Mile.

Measured bus headways were compared against international guidelines for bus service planning\(^1\). This comparison identified that if bus headways were reduced in the Golden Mile (i.e. more buses) then service performance was likely to suffer.

The bus journey along the Golden Mile can be considered to consist of:

- free flow travel between traffic signals and bus stops;
- waiting time at traffic signals;
- waiting time for buses to enter or leave each bus stop; and
- passenger boarding and alighting time.

As a result of the assessment, further technical work was recommended to determine the attributes that offered most opportunity for improvement. It stated that the bus stopping and interchange arrangements were likely to be the primary constraint to future capacity enhancements. The report also recommended work to address delays for buses at traffic signals.

1.1.2 Ngauranga to Airport Strategy Study

A key focus of the Ngauranga to Airport Strategy Study was to look at ways to provide a high quality, reliable and frequent passenger transport system connecting and serving the proposed growth spine defined in Wellington City Council’s Urban Development Strategy. The strategy specifically investigated the interaction between passenger transport and the intensified mixed use development proposed for Newtown and Kilbirnie.

The study identified that the passenger corridor is most complex between the Railway Station and Courtenay Place (the Golden Mile) given:

- the need to be near the large number of people generators;
- the need to pass through a number of narrow streets (which are also heavily used by pedestrians);
- the over-reliance of a one-way system within the CBD; and
- the lack of a single ‘spine’ or corridor that would improve visibility and the connection between Lambton Quay and Courtenay Place.

Several alternative routes for passenger transport services within the Golden Mile were investigated as part of the study. It was concluded that the final decision regarding a preferred route should consider the competing desires to provide a route that:

- passes close to people generators (e.g. Lambton Quay); and
- operates with uninterrupted / consistent travel times usually associated with high capacity roads such as Jervois Quay.

The findings of the Ngauranga to Airport Strategy indicated that in Wellington, a meaningful increase in the number of people using public transport is likely if there is a step change in the level of service provided, particularly reduced door to door travel times, improved reliability, and a change in urban form adjacent to the public transport corridors such as high quality intensification. The report suggested that a key element to achieving this step change is to provide a dedicated public transport corridor on which a range of vehicle types could operate, including:

- Conventional buses;
- High capacity buses (e.g. Bus Rapid Transit); and
- Light rail vehicles.

These vehicle options are not mutually exclusive, as it may be desirable to use the passenger transport corridor initially with conventional buses and then add to (or replace them) with higher quality buses or light rail vehicles in the future.

If light rail or higher quality buses were used, it would likely be necessary to require passengers using conventional buses from the southern and eastern suburbs to transfer to the light rail or higher quality buses at a hub such as Newtown or Courtenay Place. Alternatively, some conventional buses could provide an express service avoiding the need for transfers. Interchanges would be required at the hub locations to provide for bus/ light rail transfers. Additional operational space and facilities would also be necessary for the storage and maintenance of the light rail vehicles.

The light rail system would have to operate at a high frequency to provide the quality of service required to achieve the step change and increase the number of people using public transport. It would also be necessary to require people to transfer from bus to light rail to prevent buses from competing with the light rail along the same route. Such competition would significantly increase the operational costs of light rail as light rail vehicles would be operating well under capacity to maintain the frequencies necessary to induce the step change. Forcing transfers between buses and light rail would also induce a significant time penalty, unless the headways for light rail are less than 3 to 5 minutes, which could discourage people from using public transport.

Providing a dedicated public transport corridor would significantly improve journey times and passenger transport mode share, but it would also reduce accessibility for general vehicles including taxis and service vehicles. In some cases removing general vehicles from city streets can reduce amenity and safety of pedestrians (e.g. personal safety issues during hours of darkness due to reduced activity) as well as street level retail activity.

1.1.3 Restoring the Golden Mile: Taranaki Street to Willis Street

The most recent investigations into bus operation within the CBD were carried out within the “Restoring the Golden Mile: Taranaki Street to Willis Street” project for Wellington City
Council. Building on the Ngauranga to Airport Strategy Study findings, WCC officers identified four alternative route options for passenger transport services operating between Taranaki Street and Willis Street. The study was designed to identify the most appropriate of the following:

- An ‘enhanced status quo’ – retaining the existing split bus routes, signalising the Wakefield pedestrian crossing, and fine tuning intersection signals to assist peak hour bus movements.
- Mercer / Wakefield / Lower Cuba / Manners East – bringing the bus routes together on these streets; or,
- Dixon Street / Willis (includes a sub-option via Victoria) – bringing the bus routes together on these streets; or,
- Manners Street re-routing via Manners Mall - bringing the bus routes together along the full length of Manners Street (the original Golden Mile route).

This technical work highlighted the strategic importance of a high quality passenger transport corridor to the entire transport network for Wellington CBD. The study concluded that the key issues for passengers using passenger transport services between Taranaki Street and Willis Street are:

- poor journey time reliability;
- indirect routings; and
- poor legibility.

This is largely because bus routes use roads which have been designed to improve overall traffic capacity with one-way roads and signalised intersections having competing demands, including pedestrians.

The study recommended that Option D or D(i), where services in both directions are routed via what is now Manners Mall, should be investigated further. The recommendation was made on the basis that it offered the most direct and legible route, with the highest benefits to bus users, and the lowest bus travel times.

### 1.2 Key Issues Identified in the Study Area

The project terms of reference provided in Appendix A highlight that bus operations through the Wellington CBD and along the Golden Mile are notoriously unreliable with a large number of buses and significant delays occurring during peak periods in particular.

This is supported by the key problems identified as part of the Ngaurangana to Airport Strategy Study:

- Road space limitations (competing demands and the desire to maintain accessibility) and delay between Manners St, Willis St and Lambton Quay (primarily northbound);
- Interaction between pedestrians and general traffic (including buses) on Dixon St adjacent to Cuba Mall;
- Delay associated with intersections at Willis St/Manners St, Mercer St/Victoria St, Manners St/Victoria St, Taranaki St/Courtney Place/Manners St; and
Central Area Bus Operational Review

- Bus stop capacity and dwell times on Manners St and Willis St.

This report reconfirms these issues and any other issues that may exist in relation to bus operation and enhancement of the Golden Mile route through the Wellington CBD.

1.3 Previous Option Development

Previous options identified as part of the Ngauranga to Airport Strategy Study (Technical Report Number 1, 2007) include:

- Consideration of two-way bus operation via Lambton Quay, Hunter St, Victoria St, Wakefield St, Cuba St, Manners St and Courtney Place;
- Use of the waterfront (two-way) and Featherston Street (Sb); and
- Future PT options such as light rail and bus rapid transit (BRT).

1.4 Background Data and Surveys

As with most transportation assessments and planning projects, the availability of good background data and historic information is critical to the success of the study. Key information utilised for this report included:

- Metlink travel information;
- GWRC bus stop numbering and service information;
- Bus operator fleet information (supplied by the operators);
- GWRC regional transportation model data (Wellington Transport Strategy Model (WTSM), 2006 Base);
- Wellington City Traffic Model (WTM, 2006 Base, SATURN);
- Bus stop audits undertaken by Opus as part of this investigation (refer Appendix B);
- Valley Flyer GPS data for the month of March 2009; and
- Detailed bus monitoring of bus occupancy, boarding and alighting passengers, journey times, and dwell times carried out by GWRC staff for this study.

Despite numerous attempts and requests to get access to Snapper for the purposes of this investigation, the data was not made available and as a result significant manual survey was undertaken. Despite the manual survey providing more comprehensive and detailed information for the Golden Mile, it fails to capture the passenger patterns, origins and destinations of users and length of passenger travel.

Despite this information not being made available, it is suggested that bus operators are required to provide as much information as possible to GWRC planners in the future to improve public transport planning for the future.
1.5 Project Aims & Objectives

The main objectives for this study are to:

(a) identify and quantify existing operational issues;
(b) recommend ways of improving efficiency and reliability;
(c) highlight the implications of alternative improvement options; and
(d) investigate potential service enhancements by addressing:

- operational models
- vehicle fleet
- bus stopping / interchange arrangements
- ticketing systems
- passenger information
- road space re-allocation
- improved traffic signalling.

The report has been structured around these objectives, however as the project has involved three key phases the report has been split into the following parts:

Part A – Background information, existing operation and future forecasts.

Part B – Key principles and design opportunities.

Part C – Route and operational improvements.
Part A – Background information, existing operation and future forecasts.
2 Existing Passenger Transport Operations

2.1 Route Configuration

Bus routes that utilise the Golden Mile can be classified as being one of four route types:

(i) through routes - these routes pass through the Golden Mile between terminus points to the north and south of the CBD;

(ii) start/end Courtenay Place - these routes pass through the Golden Mile between the end of Courtenay Place and a terminus north of the CBD;

(iii) start/end Railway Station - these routes pass through the Golden Mile between the Railway Station and a terminus south of the CBD;

(iv) partial Golden Mile - these routes only pass over only part of the Golden Mile. They access or egress the Golden Mile via Bowen Street, Brandon Street, Taranaki Street, Victoria Street or Willis Street (the only exception being Route 24 which currently exits the Golden Mile at Wakefield Street to access Oriental Bay).

Table 2.1 below summarises the routes that travel along the full length of the Golden Mile. The routes that only use a portion of the Golden Mile are summarised in Table 2.2.

### Table 2.1: Routes that Travel Full Length of the Golden Mile

<table>
<thead>
<tr>
<th>Route Type</th>
<th>Northern Terminus Point</th>
<th>Southern Terminus Point</th>
<th>Route Numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i) Through Routes</td>
<td>North of Wellington Station</td>
<td>South of Courtenay Place</td>
<td>3, 14, 20, 22, 23, 43, 44, 91</td>
</tr>
<tr>
<td>(ii) Start/End Courtenay Place</td>
<td>North of Wellington Station</td>
<td>Courtenay Place</td>
<td>13, 46, 52, 53, 54, 55, 56, 57, 58, 60, 80, 81, 83, 84, 85, 90, 92, 93</td>
</tr>
<tr>
<td>(iii) Start/End Railway Station</td>
<td>Wellington Station</td>
<td>South of Courtenay Place</td>
<td>1, 2, 4, 5, 6, 24, 25, 30, 31, 32</td>
</tr>
</tbody>
</table>

### Table 2.2: Routes that Travel on Parts of the Golden Mile

<table>
<thead>
<tr>
<th>Golden Mile Segment of Route</th>
<th>Route Numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>From/To</td>
<td></td>
</tr>
<tr>
<td>Wellington Station</td>
<td></td>
</tr>
<tr>
<td>Willis/ Victoria Street</td>
<td>7, 8, 9</td>
</tr>
<tr>
<td>Taranaki Street</td>
<td>10, 11, 21</td>
</tr>
<tr>
<td>Brandon Street</td>
<td>45</td>
</tr>
<tr>
<td>Bowen Street/The Terrace</td>
<td>17</td>
</tr>
</tbody>
</table>
2.2 Vehicle Fleet

Basic information about the bus fleet operating in Wellington CBD was provided by GWRC. Bus operating companies indicated that they tried to maintain flexibility with regard to the vehicles that operate on specific routes. They indicated that trunk routes serving the Railway Station and suburbs south of CBD wherever possible operated using trolley buses. Other than topography, road width and passenger demand, there were no other factors binding specific vehicles to a particular route. It is therefore not possible to determine from the available information whether particular bus types operate within the Golden Mile.

2.2.1 Passenger Capacity

An assessment of the existing vehicle fleet capacities has been undertaken to provide an indication of bus provision on the network. Figure 2.1 shows the number of vehicles of each size that are operated by the different bus companies.

The Go Wellington fleet is largest with appropriately 220 buses and has the biggest range of vehicle sizes with 15 percent of their fleet able to accommodate more than 75 passengers (standing capacity) and 53 percent able to accommodate more than 60 passengers. Over 30 percent of the Valley Flyer fleet can accommodate more than 75 passengers although the fleet is smaller with approximately 70 buses. The Mana / Newlands fleet has approximately 35 buses which can all accommodate more than 70 passengers.

![Figure 2.1: Wellington City Bus Fleet Capacity](image_url)
Figure 2.2 shows the capacities of the different bus types in the Go Wellington fleet. For buses with total passenger capacity of more than 60, the ratio of seated to standing passengers is relatively constant at around 65:35. Smaller buses have capacity for fewer standing passengers and the ratio of standing to seated passengers is more like 70:30. Most Go Wellington buses have front and rear doors.

**Figure 2.2: Go Wellington Vehicle Capacities**

There is less consistency in the ratio of seated passenger capacity to standing passenger capacity in the Valley Flyer fleet as shown in Figure 2.3. The seated capacity is however somewhere between 65 percent and 75 percent of the total capacity for all vehicles in the fleet. All of Valley Flyer buses operating within the Golden Mile have front door access only.

For the Mana and Newlands fleet the ratio of seated to standing passengers is around 65:35. These buses use a two door operation with the front door for entry and both doors utilised for exit.
2.2.2 Vehicle Types

The city’s vehicle fleet is varied. The Go Wellington trolley bus fleet has just been upgraded with all new trolley buses now operating and replacing the old trolley bus fleet.

Modern buses are generally more accessible with low-floor access, sometimes with the facility for buses to ‘kneel’. Modern buses also have wider internal gangways that allow wheelchair users to easily get to a designated position in which to travel. The wider gangways also provide more space in which passengers can stand.

2.3 Passenger Transport Frequency

The maximum number of buses per hour along the Golden Mile during the AM (8-9am), interpeak (IP) (12pm-1pm) and PM (5-6pm) peak periods has been calculated to be as high as 124 buses per hour in the AM peak, 56 in the IP and 123 in the PM peak periods. This data is based on the actual bus volumes from the 2006 Metlink timetable. More detailed assessment of forecast transport demands has been included in Section 4.

2.4 Bus Stops

There are nine distinct bus stop locations on the Golden Mile in each direction. Generally the stops consist of a single stopping location (flag) at front of each stop. A bus stop audit has been undertaken along the Golden Mile and is summarised in this section. Full details of the audit are provided in Appendix B, including stop number, location, proximity to other...
2.4.1 Spacing

Spacing between bus stops on the Golden Mile ranges from 100 metres to a maximum of 370 metres. The average spacing is 250 metres, significantly less than the 400m-600m spacing recommended in various international literature. Figure 2.4 below summarises the distance to the next stop for all the bus stops located on the Golden Mile.

Figure 2.4: Distance to the Next Stop on the Golden Mile
2.4.2 Bus Cages

The bus cage is the marked broken yellow box in which buses stop and vehicle parking is generally restricted. Most bus cages on the Golden Mile range between 33 metres and 54 metres in length. Several of the bus cages are shorter: the northbound stop on Courtenay Place at St. James and the southbound stop on Lambton Quay at Stout Street are both around 22 metres in length. The Lambton Quay North End and Wellington Station bus cages are also 20 to 30 metres in length however since there are multiple stops at these locations less buses are utilising each individual stop. At the other end of the scale, the Willis Street – Willbank Court and Cuba Street – St. James Smith Corner stops are 71 and 83 metres long, respectively.

Generally there are intersections, pedestrian crossings or no stopping zones located upstream and downstream of the bus cages which provide sufficient space for buses to pull in to and out of the cages easily. In locations with bus lanes, the bus bay is located within the bus lane so there is no need for the buses to pull in or out, however this impacts upon the ability of faster buses to pass slower buses.

2.4.3 Ability of Buses to Pass Other Buses

The high concentration of buses on the Golden Mile along with the constrained geometry results in delays and bunching throughout the area. All of the Golden Mile (except a short section at either end) only has a single track for trolley buses in each direction which makes it virtually impossible for trolley buses to pass each other. Additionally, multiple buses are often queued while attempting to use a single stop which creates blockages in the through lane and limits the ability for diesel buses to pass. This problem is further compounded by the narrow carriageway widths on Willis Street and Manners Street.

2.4.4 Facilities

All bus stops on the Golden Mile have seating, rubbish bins, adequate lighting and shelter for waiting passengers. The shelter is either provided by a freestanding structure or the awning of an adjacent building. Overall the facilities are in very good condition.

2.4.5 Stopping Patterns

Currently all bus routes stop at all bus stops within the Golden Mile. During the AM peak the Golden Mile bus stops are busiest (in terms of the number of buses) in the northbound direction with 124 buses between 8am and 9am (114 buses in the southbound direction). In the PM peak the Golden Mile bus stops are busiest in the southbound direction with 123 buses between 5pm and 6pm (118 buses in the northbound direction).

2.4.6 Bus Stop Summary

Detailed information relating to the bus stops on the Golden Mile has been summarised in Tables 2.4 and 2.5 below. This information highlights the significant variation between bus stop configuration, demand, infrastructure and operational conditions.
Although there are significant variations between stops on the Golden Mile, the patterns of demand in a northbound direction are relatively similar; however a couple of the southbound stops have lower demands than others, Stout Street being the most obvious example.

The variation in design and configuration is also evident; however in most cases there is a direct correlation between demand and design/provision/facilities. The fact that many of the busiest stops (both in terms of frequency and demand) have only one bus flag highlights the pressure these stops are placed under.

Opportunity also exists to improve and standardise cage lengths and kerb heights over the length of the Golden Mile.
## Table 2.3: Northbound Bus Stop Summary for the Golden Mile

<table>
<thead>
<tr>
<th>Stop Name</th>
<th>Stop Number</th>
<th>Distance between stops</th>
<th>Passenger Loading (average daily per bus)</th>
<th>Dwell time (s)</th>
<th>Cage Length (m)</th>
<th>Kerb Height (mm)</th>
<th>Footway Width (m)</th>
<th>Number of Buses using Stop (approx per hour)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Courtenay Place - Paramount</td>
<td>5000</td>
<td>96</td>
<td>1.81</td>
<td>39.3</td>
<td>53</td>
<td>280</td>
<td>3</td>
<td>89</td>
</tr>
<tr>
<td>Courtenay Place - St James</td>
<td>5002</td>
<td>300</td>
<td>1.32</td>
<td>17.9</td>
<td>22.4</td>
<td>250</td>
<td>4.4</td>
<td>87</td>
</tr>
<tr>
<td>Dixon Street - Cuba Mall</td>
<td>5004</td>
<td>363</td>
<td>1.82</td>
<td>25.4</td>
<td>47.4</td>
<td>150</td>
<td>3.9</td>
<td>97</td>
</tr>
<tr>
<td>Manners Street - Mid City Centre</td>
<td>5006</td>
<td>320</td>
<td>1.87</td>
<td>31</td>
<td>46</td>
<td>150</td>
<td>3.8</td>
<td>94</td>
</tr>
<tr>
<td>Willis Street - Grand Arcade</td>
<td>5008</td>
<td>369</td>
<td>1.97</td>
<td>21</td>
<td>53.6</td>
<td>90</td>
<td>4.4</td>
<td>112</td>
</tr>
<tr>
<td>Lambton Quay - Cable Car</td>
<td>5010</td>
<td>112</td>
<td>1.47</td>
<td>15.9</td>
<td>45</td>
<td>190</td>
<td>5.9</td>
<td>110</td>
</tr>
<tr>
<td>Lambton Quay - Farmers</td>
<td>5012</td>
<td>365</td>
<td>1.22</td>
<td>14.6</td>
<td>37</td>
<td>210</td>
<td>6.7</td>
<td>114</td>
</tr>
<tr>
<td>Lambton Quay - North End</td>
<td>5011</td>
<td>195</td>
<td>1.47</td>
<td>16.4</td>
<td>220</td>
<td>7</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>5014</td>
<td></td>
<td></td>
<td>26.7</td>
<td>190</td>
<td>6.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>5015</td>
<td></td>
<td></td>
<td>25.8</td>
<td>190</td>
<td>6.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wellington Station - Stop D</td>
<td>5016</td>
<td>195</td>
<td>0.92</td>
<td>39.7</td>
<td>200</td>
<td>3.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Molesworth Street - Stop E</td>
<td>5111</td>
<td>195</td>
<td></td>
<td>23.6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1 ARTA guidelines recommend a stop at least every 400m  
2 ARTA guidelines recommend 25 vph max per stop  
3 Desirable Kerb height is 150mm
Table 2.4: Northbound Bus Stop Summary for the Golden Mile

<table>
<thead>
<tr>
<th>Southbound</th>
<th>Stop Number</th>
<th>Distance between stops</th>
<th>Passenger Loading (average daily per bus)</th>
<th>Dwell time (s)</th>
<th>Cage Length (m)</th>
<th>Kerb Height (mm)</th>
<th>Footway Width (m)</th>
<th>Number of Buses using Stop (approx per hour)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wellington Station - Stop A</td>
<td>6000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wellington Station - Stop B</td>
<td>6001</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wellington Station - Stop C</td>
<td>5500</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lambton Quay - North End, Stop J</td>
<td>5502</td>
<td>142</td>
<td>1.31</td>
<td>1.17</td>
<td>19</td>
<td>38.2</td>
<td>190</td>
<td>5.2</td>
</tr>
<tr>
<td>Lambton Quay - Stout Street</td>
<td>5504</td>
<td>196</td>
<td>0.83</td>
<td>0.77</td>
<td>9.3</td>
<td>22.9</td>
<td>120</td>
<td>8.3</td>
</tr>
<tr>
<td>Lambton Quay - Kirkcaldie &amp; Stains</td>
<td>5506</td>
<td>197</td>
<td>1.87</td>
<td>1.24</td>
<td>17.9</td>
<td>41.5</td>
<td>140</td>
<td>6.8</td>
</tr>
<tr>
<td>Lambton Quay - ANZ Bank</td>
<td>5508</td>
<td>453</td>
<td>1.41</td>
<td>1.91</td>
<td>15.3</td>
<td>39.3</td>
<td>220</td>
<td>3.6</td>
</tr>
<tr>
<td>Willis Street - Willbank Court</td>
<td>5510</td>
<td>492</td>
<td>1.96</td>
<td>2.54</td>
<td>23.2</td>
<td>70.8</td>
<td>100</td>
<td>6.4</td>
</tr>
<tr>
<td>Cuba St - James Smith Corner</td>
<td>5512</td>
<td>178</td>
<td>1.66</td>
<td>1.99</td>
<td>25.2</td>
<td>83.4</td>
<td>130-230</td>
<td>4.7</td>
</tr>
<tr>
<td>Courtenay Pl - Courtenay Central</td>
<td>5514</td>
<td>239</td>
<td>0.79</td>
<td>1.49</td>
<td>15.2</td>
<td>37</td>
<td>150</td>
<td>3.5</td>
</tr>
<tr>
<td>Courtenay Place - Blair Street</td>
<td>5516</td>
<td>239</td>
<td>0.94</td>
<td>1.18</td>
<td>20.3</td>
<td>33</td>
<td>250</td>
<td>8.7</td>
</tr>
</tbody>
</table>

1 ARTA guidelines recommend a stop at least every 400m
2 ARTA guidelines recommend 25 vph max per stop
3 Desirable Kerb height is 150mm
2.5 Ticketing

There are various ticketing options for passengers using Metlink bus services. These are summarised in Table 2.5 and discussed in further detail below.

Table 2.5: Types of Fares

<table>
<thead>
<tr>
<th></th>
<th>Smartcards</th>
<th>Snapper</th>
<th>Transfer Tickets</th>
<th>Daily Tickets</th>
<th>Monthly Tickets</th>
<th>Cash</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mana Coach Services</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Newlands Coach Services</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Valley Flyer</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Airport Flyer</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Go Wellington</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Runciman Motors</td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Madge Coachlines</td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Classic Coaches</td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

- **Cash** can be used to purchase both single trip tickets and daily bus tickets from the driver on all services. The driver is responsible for accepting the money, giving change and issuing the ticket.

- **Smartcards** can be used on a number of services, shown in Table 2.5 above. These are credit-card sized electronic fare cards. A fare is deducted each time the card is presented upon boarding a bus. These cards give a 20 percent discount off standard cash fares and can be purchased and topped-up from bus drivers, bus depots and some operator’s websites.

- **Snapper Cards** are similar to Smartcards and are used on Go Wellington, Valley Flyer and Airport Flyer buses. Passengers must tag on and off the bus by swiping their card over and electronic reader which deducts a fare. They also offer a 20 percent discount off cash fares and are available to purchase and top-up from selected retailers as well as online. They can be also be used to pay for purchases at various retailers.

- **Transfer tickets** are only available on Mana and Newlands Coach Services for transfers to other Mana or Newlands Coach Services, transfers can only be used for travel in a continuous direction on the next available service. Snapper cards also support transfers, with varying degrees of flexibility in terms of cost to the user.

- Four different **daily bus tickets** are available for use on different bus services within the region, during different time periods and for groups or individuals. They can be purchased from the bus drivers.
Central Area Bus Operational Review

- There are also four different **monthly bus tickets** available from ticket agencies depending upon whether you travel within Zones 1-3, the Hutt Valley, or both. Some monthly passes can be used on the Valley Flyer, Mana Coach Services, Newlands Coach Service and GO Wellington services, while others are restricted to specific bus operators. Daily and monthly tickets which include both bus and train travel are also available.

- **Concession fares** are available for number of age groups. Seniors over 65 years of age are eligible for a SuperGold card allowing them to travel for free off-peak. Concession fares are available to children and students, and blind permit holders.

Special fares apply for some commuter routes, the cable car, harbour ferry, stadium shuttle and trains.

### 2.6 Scheduling

The current bus scheduling typically has multiple buses arrive at the same time, then a period of time where there are no buses scheduled. During the data collection phase of this project, instances were recorded in which over 12 buses in a row have been observed travelling on the Golden Mile in a queue. This results in a poor level of service for passengers since they often wait much longer for a bus than if the buses were evenly spaced throughout the hour. Additionally the scheduling results in significant pedestrian congestion on the footpaths which impacts other pedestrians trying to walk along the Golden Mile.

Typically, passengers will board the first bus that arrives which is going to their destination; resulting in the initial buses becoming very crowded while the following buses have much lower occupancies. Due to crowding, the initial buses take longer to load passengers at each stop which then results in delays for all the following buses.

### 2.7 Kerbside Parking Controls

Kerbside parking has the potential to hinder the operation of bus services through the central area. Delay caused from parking manoeuvres made by general traffic and from the unloading of service vehicles in the tightly constrained nature of the central city can have a profound impact on the reliability of passenger transport movements. For this reason the existing kerbside environment has been assessed along the bus corridor between the Railway Station and Courtenay Place. To simplify the analysis, the corridor has been broken down into a number of smaller sections allowing comparison in both the north and southbound directions.

#### 2.7.1 Railway Station to Willis Street

From the Railway Station until Panama Street, Lambton Quay provides designated bus lane facilities in both the north and southbound direction in addition to general vehicle lanes that are present in both directions. Due to this capacity, parking is limited to a number of designated bay areas on the outside of the bus lanes. Typically most parks along this
length are time restricted and parallel. In the northbound direction car parking is time restricted to 10 minute periods to allow for service loading and drop off activities. A taxi bay is also present just to the south of Farmers Lane. In the southbound direction longer stays are possible through paid parking. In addition two locations either side of Stout Street provide angled parks for longer term residential stays.

Beginning south of Panama Street bus only access is available in the southbound direction due to the provision of a dedicated bus way. For this reason, no southbound parking is available along the rest of Lambton Quay. No parking is provided along the short route along Hunter Street where southbound bus movements connect onto Willis Street. In the northbound direction time restricted service/drop off parking continues in the form parallel parks in bay areas. As no bus lane is available for northbound bus movements on Lambton Quay between Willis Street and Grey Street, parking movements often interfere with the operation of buses due to the constrained nature of the carriageway.

2.7.2 Willis Street to Mercer Street / Manners Street

Between Hunter Street and Manners Street, Willis Street is typically a one-way northbound operation for general vehicles with southbound travel only permitted for buses. Subsequently no southbound parking is provided apart from the southbound bus stops which are situated within the bus lane. In the northbound direction parking is provided between Manners Mall and Mercer Street in the form of designated short stay/loading zones. The majority of these cages are situated after the Mercer Street turnoff starting from outside New World on the west most kerb. A loading zone is also situated on the eastern kerb immediately following Manners Street.

2.7.3 Mercer Street / Manners Street to Taranaki Street

For this section the bus route is split with southbound buses using Wakefield Street, Cuba Street and Manners Street while northbound buses use Dixon Street and Victoria Street. Along the southbound bus routing, there is a combination of angle and parallel pay parking spaces. In the northbound direction along Dixon Street, there is a taxi stand and some parallel car parks.

2.7.4 Taranaki Street to Cambridge Terrace

With the exception of the bus cages and taxi stands, generally paid parallel parking is provided along both sides of Courtenay Place on this section of the Golden Mile.

2.8 Route Operational Model

The existing bus route operational model for Wellington and the Golden Mile is characterised by a combination of routes travelling through the Golden Mile, those terminating and starting at the Railway (Lambton Bus) Station, and those terminating and starting at Courtenay Place. This operational model is referred to in this report as the Do-Minimum in that all routes would to continue to operate as they are at present.
While this model is operational at present and changes have occurred over time, it has a number of disadvantages. Due to increased bus demand and incremental route changes over time, many buses arrive at either end of the Golden Mile at the same time resulting in bus congestion and a poor level of service for passengers wishing to travel within the Golden Mile. Too many buses at one time results in bunching and a line of buses travelling in convoy along the Golden Mile. Passenger loading is inefficient in this model since drivers cannot easily differentiate between passengers waiting for their particular route or another route and stops are not large enough to cater for the number of buses arriving. Analysis also suggests that this model may not be very cost effective and results in larger numbers of buses (and drivers) operating on the network than might be necessary (refer to section 3 which highlights the occupancy of buses and the potential to reduce journey times and variability resulting in operational savings). Clearly this is based upon historic route planning and passenger levels of service, therefore changes to this existing operational model would need to consider the implications and the reasons why the operational model is the way it is currently.

### Pros
- Easy to implement (already existing)
- Maximises passenger accessibility
- Limited need for transfers

### Cons
- Passenger loading/unloading is inefficient
- Large number of buses on the Golden Mile
- Many buses arrive at the same time resulting in a queue of buses travelling down the Golden Mile
- High operational costs and inefficiencies.
- Does not cater well for people travelling to non-CBD based destinations

The current operational model provides the basis for much of the assessment contained within this report and the opportunities which exist to enhance bus operation in the future are discussed further in section 11 of this report.

### 2.9 Summary

The existing passenger transport operation on the Golden Mile is characterised by a route configuration which has evolved over time, having the following key features;
- A corridor which is ideally suited to the provision of high quality public transport due to it being concentrated around a very high density retail and commercial activity zone.

- Poor legibility due to north and south bound routes splitting at certain locations, particularly the section between Willis Street and Taranaki Street.

- One of the highest peak time bus frequencies in New Zealand for a single corridor, which is also very high by world standards.

- Much of the route is mixed with general vehicle traffic, particularly in the northbound direction.

- High numbers of bus stop locations with a number of stops being placed under very heavy loading demand during peak periods due to schedules, ticketing, and capacity of the stop (discussed further in section 3).

- A very complex and inflexible approach to ticketing which has both advantages and disadvantages to users.

The importance of the Golden Mile PT corridor has been highlighted in a number of important strategic documents and this is further endorsed through this high level assessment. However, what is also evident is that opportunities exist to enhance the existing corridor to meet existing and future needs of passengers, operators and the wider transportation network.
3 Operational Performance Assessment

To gain a better understanding of the operational performance, it is necessary to identify sources of delay and unreliability on the Golden Mile. A bus operational survey was therefore undertaken to record:

- passenger demand at each bus stop;
- sources of delay and unreliability on the Golden Mile; and
- bus occupancy and its variation throughout the Golden Mile.

Surveyors rode various buses through the Golden Mile while recording the number of passengers boarding and alighting at each stop along with the time that the bus doors opened and closed. Data was collected for the AM, interpeak and PM periods occurring between 7-9am, 11am-1pm and 4-6pm respectively. The survey was conducted between 4 August 2009 and 18 August 2009 on Tuesdays, Wednesdays and Thursdays.

A total of 278 northbound buses and 276 southbound buses were surveyed. Each route was surveyed 1 to 7 times in each direction during each peak period. Higher frequency routes were surveyed more than lower frequency routes. 52 percent of all bus trips during the survey periods were surveyed, with 49 percent, 71 percent, 44 percent of AM, IP and PM period trips respectively surveyed.

3.1 Travel & Dwell Times

The average travel and dwell times along the Golden Mile for the northbound and southbound directions respectively are displayed in Figure 3.1 and 3.2 based upon data collected in August and September of 2009. The travel time is displayed by peak period and route type. Each graph is based on just over 200 survey records. For this analysis, routes that only partially travel on the Golden Mile have been excluded.

The largest portion of the travel time on the Golden Mile is associated with the actual travel, not the loading and unloading of passengers. The dwell time makes up between 15 percent and 30 percent of the total travel time, with the PM peak dwell time generally being significantly greater than other time periods.

There is little variation in the travel or dwell time when considering the different route types in the northbound direction. In the southbound direction there is a larger variation, especially in the dwell time for different routes.

Travel times are similar for both AM and interpeak periods; however during the PM period the dwell and travel times are longer, especially in the northbound direction. The longer dwell times in the PM period are related to more passengers boarding buses during this period. In the AM period, there are more passengers alighting on the Golden Mile than boarding. Boarding typically takes longer than alighting since only a single door can be used and bus drivers must process fare payments (for any passenger that doesn't have a Snapper card). In the northbound direction during the morning, there is an average of 0.6 people boarding per bus per stop, but in the PM this jumps to 2.4 people boarding per bus per stop.
Figure 3.1: Northbound Travel and Dwell Time by Route Type and Time Period (2009)

Figure 3.2: Southbound Travel and Dwell Time by Route Type and Time Period (2009)
Figure 3.3 and Figure 3.4, below, show the average travel speed between each of the bus stops on the route for the northbound and southbound directions respectively. It should be noted that travel speed is based upon distance travelled and time taken, excluding dwell time, however it does include the time taken to enter and exit the bus stop (up to the time when the doors open or close).

The overall average travel speed in the northbound direction ranges from a low of 9.2 km/h during the PM period to a high of 11.5 km/h during the interpeak. The lowest travel speeds were recorded on Lambton Quay between the Cable Car and Farmers bus stops. The average travel speed on this link in AM, interpeak and PM periods is 7.5km/h, 7.4km/h and 6.0km/h respectively. In the PM period, travel speeds on Courtenay Place between the Paramount and St. James stops are on average 6.0km/h. The highest average travel speed of 13.9km/h was recorded during the interpeak period between the Lambton Quay – North End stop and the Railway Station.

Average travel speeds for the southbound direction are slightly lower than for the northbound direction. The average travel speeds recorded for each segment and time period range between 7.9 km/h and 15.2 km/h. The fastest average travel speed was for the AM period between Lambton Quay (ANZ Bank) and Willis Street (Willbank Court). The slowest average travel speed occurs during the PM period between Cuba Street and Courtenay Central.
3.2 Service Efficiency and Reliability

On the Golden Mile there is a large variation in bus travel and dwell time which reduces the reliability of bus services. Unreliability is a major cause of passenger dissatisfaction. As discussed earlier, the significant difference between the PM period and other periods highlights this variability. Table 1 below highlights the average travel time by section and the range of travel times. These survey results display that the Manners Mall section is subject to the greatest variability, particularly in a northbound direction.

Table 3.1: Travel Time and Variability for the Golden Mile (2009)

<table>
<thead>
<tr>
<th>Route Section</th>
<th>Average Travel Time [Range] (min:sec)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AM</td>
</tr>
<tr>
<td>Kent/Cambridge Tce to Taranaki St.</td>
<td>1:54 [0:35-3:43]</td>
</tr>
<tr>
<td></td>
<td>NB</td>
</tr>
<tr>
<td></td>
<td>NB</td>
</tr>
<tr>
<td></td>
<td>NB</td>
</tr>
</tbody>
</table>

3.2.1 Travel Time Variability

Figure 3.5 and Figure 3.6 below presents the variability in the travel time for the northbound and southbound directions, respectively, in addition to the total travel time on the Golden Mile. The yellow bars represent the average travel time while the maroon bars represent the average plus or minus one standard deviation; meaning a passenger can expect their journey time to be within this range 68 percent of the time. Finally the purple bars represent
the mean plus or minus two standard deviations; a passenger’s journey time should be within this range 95 percent of the time.

Figure 3.5: Northbound Travel Time Variability

While the average northbound travel times for the AM and interpeak periods are roughly equal, there is a larger variation during the AM. In the AM the journey time will typically take between 6 minutes 50 seconds (410 seconds) and 19 minutes 6 seconds (1194 seconds). In the interpeak the same trip will generally take between 8 minutes 38 seconds (518 seconds) and 17 minutes 37 seconds (1057 seconds). During the PM period the average travel time and its variability is much larger than the AM or interpeak periods, typically between 9 minutes and 5 seconds (545 seconds) and 27 minutes and 12 seconds (1632 seconds).

Figure 3.6: Southbound Travel Time Variability

The average travel times for the southbound direction are typically lower than for the northbound direction. There is however still a large variation in the travel times. The large variation means buses often fail to keep to their schedule. Again there is greater unreliability in travel times in the PM period than at other times of the day. In the AM the
journey time will typically take between 4 minutes 8 seconds (248 seconds) and 17 minutes 20 seconds (1040 seconds). In the interpeak the same trip will generally take between 4 minutes 41 seconds (281 seconds) and 17 minutes 18 seconds (1038 seconds). During the PM period the average travel time and its variability is much larger than the AM or interpeak periods, typically between 5 minutes and 29 seconds (329 seconds) and 22 minutes and 8 seconds (1328 seconds).

The variation in travel time by route section was also analysed. No significant differences in the travel time variation were found for a particular section. In other words the unreliability experienced by bus passengers is a result of the cumulative effects of slight variations in travel time throughout the Golden Mile.

3.2.2 Impact of bus lanes on travel time variability

Table 3.2 below compares the average travel speeds on the Golden Mile for sections of carriageway with and without bus lanes. It shows that the average travel speeds are slightly higher where bus lanes are present. However, these benefits are not as large as one may expect due to a number of external factors:

- the buses are still required to stop at all the traffic signals;
- limited opportunities for a faster bus to pass a slower moving or stopped bus, this is especially true when considering the trolley buses;
- the buses still have some interaction with private vehicles since in a number of locations the bus lane is located between parking and/or loading zones at the kerb and the general traffic lanes; and
- the bus lanes in a number of locations (e.g. Lambton Quay) are too narrow for buses to stay within them, particularly passing areas of parking, around corners, and get held up by general traffic as they encroach into the regular traffic lanes.

<table>
<thead>
<tr>
<th></th>
<th>Northbound</th>
<th>Southbound</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Bus Lanes</td>
<td>No Bus Lanes</td>
</tr>
<tr>
<td>AM</td>
<td>11.0</td>
<td>10.7</td>
</tr>
<tr>
<td>IP</td>
<td>11.8</td>
<td>11.0</td>
</tr>
<tr>
<td>PM</td>
<td>9.4</td>
<td>8.7</td>
</tr>
</tbody>
</table>

The variation in the travel time on sections of carriageway with and without bus lanes was and also compared to test whether the provision of bus lanes improves reliability. Only a minor reduction in the travel time variation was found when considering the sections of the Golden Mile with bus lanes.
3.3 Boarding, Alighting & Occupancy

Figure 3.7 and Figure 3.8, below, summarise the average occupancy along the Golden Mile during each of the surveyed periods for the northbound and southbound directions respectively.

For the AM period in both directions, the occupancy of the buses is highest as they enter the Golden Mile and drops as passengers alight. The opposite is true for the PM, where, in general the occupancy of the buses is low as they enter the Golden Mile and increases as passenger's board. In the Interpeak, the occupancy of the buses is relatively constant with a slight peak towards the middle of the Golden Mile. This reflects the radial nature of the service patterns with buses being used to transport passengers from the suburbs to the CBD at the beginning of the working day and home at night.

Figure 3.7: Average Northbound Occupancy by Period
While the data presented above provides a good overview of the bus occupancy and general trends, it does not accurately reflect any peaks within the surveyed periods. Table 3.3 summarises the average and maximum occupancy at the busiest time and location during each period for both the northbound and southbound directions.

**Table 3.3: Average and Maximum Occupancy during the Peak times**

<table>
<thead>
<tr>
<th>Period</th>
<th>Direction</th>
<th>Peak Time</th>
<th>Busiest Stop</th>
<th>Average # Pass/Bus</th>
<th>Max # Pass/Bus</th>
</tr>
</thead>
<tbody>
<tr>
<td>AM</td>
<td>NB</td>
<td>8:10-8:30</td>
<td>Courtenay Pl - St James</td>
<td>39</td>
<td>58</td>
</tr>
<tr>
<td></td>
<td>SB</td>
<td>8:10-8:30</td>
<td>Railway Station</td>
<td>33</td>
<td>55</td>
</tr>
<tr>
<td>IP</td>
<td>NB</td>
<td>11:30-11:40</td>
<td>Willis St - Grand Arcade</td>
<td>21</td>
<td>32</td>
</tr>
<tr>
<td></td>
<td>SB</td>
<td>12:30-12:40</td>
<td>Lambton Quay - Kirkcaldie &amp; Stains</td>
<td>20</td>
<td>23</td>
</tr>
<tr>
<td>PM</td>
<td>NB</td>
<td>4:10-4:20, 5:00-5:10, 5:40-5:50 (No single distinctive peak)</td>
<td>Lambton Quay - North End</td>
<td>30</td>
<td>65</td>
</tr>
<tr>
<td></td>
<td>SB</td>
<td>5:00-5:40</td>
<td>Cuba St - St. James Corner</td>
<td>30</td>
<td>50</td>
</tr>
</tbody>
</table>

At peak times, the busiest buses are close to the maximum capacity. Overall within the Golden Mile, however there is sufficient capacity with the average occupancy around 30 to 40 passengers. This means that passengers travelling within the Golden Mile between
Courtenay Place and the Railway Station should not have difficulty finding a bus with sufficient capacity. However, passengers that need a specific bus to reach a destination beyond the Golden Mile may find their bus unreasonably full. Table 3.4 summarises the routes which had an occupancy of over 50 people during at least one survey. (An occupancy of 50 passengers, which corresponds to 6 standing passengers for an average bus.)

Table 3.4: Routes with an Occupancy Over 50 Passengers

<table>
<thead>
<tr>
<th>Period</th>
<th>Direction</th>
<th>Route</th>
<th>Origin/Destination</th>
</tr>
</thead>
<tbody>
<tr>
<td>AM</td>
<td>NB</td>
<td>2</td>
<td>Miramar (via Kilbirnie)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
<td>Lyall Bay (via Kilbirnie and Newtown)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4</td>
<td>Happy Valley (via Newtown)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5</td>
<td>Hataitai</td>
</tr>
<tr>
<td></td>
<td></td>
<td>11</td>
<td>Seatoun (via Kilbirnie and Newtown)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>20</td>
<td>Mt. Victoria Summit</td>
</tr>
<tr>
<td></td>
<td></td>
<td>25</td>
<td>Strathmore (via Kilbirnie)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>30</td>
<td>Seatoun Express</td>
</tr>
<tr>
<td></td>
<td></td>
<td>32</td>
<td>Houghton Bay Express (via Island Bay)</td>
</tr>
<tr>
<td></td>
<td>SB</td>
<td>3 and 3W</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>46</td>
<td>Karori</td>
</tr>
<tr>
<td></td>
<td></td>
<td>54</td>
<td>Broadmeadows</td>
</tr>
<tr>
<td></td>
<td></td>
<td>58</td>
<td>Churton Park</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Baylands Drive</td>
</tr>
<tr>
<td>PM</td>
<td>NB</td>
<td>3 and 3S</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>14</td>
<td>Karori</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Wilton (via Wadestown)</td>
</tr>
<tr>
<td></td>
<td>SB</td>
<td>7</td>
<td>Kingston</td>
</tr>
</tbody>
</table>

It is important to note that this is not a comprehensive list. Other routes may also experience crowding at specific times, however if they were not surveyed at that particular time it would have not been noted. Similarly, it may have been an anomaly for some routes to experience this level of occupancy. Further investigation of the route occupancy beyond the Golden Mile should be completed before adjusting service frequencies.

### 3.3.1 Northbound Boarding, Alighting & Occupancy

Figure 3.9, below, summarises the occupancy of northbound buses during the AM and PM periods for the different route types. Very few passengers alight within the Golden Mile (less than 0.2 passengers per bus per stop) during the PM period when considering the routes that start at Courtenay Place. This indicates that these routes are not being used for trips purely within the Golden Mile.

Where routes terminate at the Railway Station during the PM peak, there are some people alighting throughout the Golden Mile, but more boarding (hence the increasing occupancy). The boarding passengers are all using the bus to access the Railway Station.
For through routes, passengers board and alight throughout the Golden Mile as passengers are generally travelling to or from destinations beyond the Golden Mile.

Figure 3.9: Northbound AM and PM Occupancy by Route Type

In general, the occupancy of northbound routes in the AM decreases as the routes progress through the Golden Mile as shown in Figure 3.9. The only exception is the routes which start at Courtenay Place in the AM. Most passengers using these routes board between Courtenay Place and Manners Street. After Manners Street the number of boarding passengers is much lower and offset by alighting passengers; therefore, the occupancy shows minimal variation. For routes terminating at the Railway Station the occupancy at these stops should be zero but was not due to survey errors in this location.

During the interpeak period, the northbound occupancy is relatively low; for all route types the average occupancy is less than 20 passengers per bus. There is minimal variation in the occupancy of the through routes, with passengers both alighting and boarding at each stop. As part of the wider bus review, it would be beneficial to have details as to which stops are most frequently utilised by passengers from particular suburbs. This data was not available as part of this investigation, however Snapper data should provide sufficient information in order to draw highlight trends and conclusions. The occupancy of routes which terminate at the Railway Station declines as the buses progress through the Golden Mile. For routes which start at Courtney place, the occupancy steadily increases throughout the Golden Mile.

Surveyor errors arose due to difficulties associated with counting large numbers of passengers alighting through two different doors and the need for the surveyor to also alight. This was only an issue at the station stops and does not reflect on the overall validity of the survey.
3.3.2 Southbound Boarding, Alighting & Occupancy

Figure 3.10 summarises the southbound occupancy data for both the AM and PM period.

When examining the occupancy data for the PM, as shown in green, it becomes apparent that all route types have similar occupancies at the beginning of the Golden Mile (Railway Station), but by the time they reach the Courtenay Place end of the Golden Mile the occupancy on the terminating buses has dropped, while the occupancy on the buses continuing past the end of the Golden Mile has climbed. The through routes drop off some passengers within the Golden Mile, but they pick up more passengers than they drop off, therefore occupancy is increasing. The routes that start at the Railway Station drop off a few passengers within the Golden Mile (meaning these passengers are purely travelling within the Golden Mile), but primarily pick up passengers who are continuing past Courtenay Place.

Low numbers of passengers board the buses which terminate at Courtenay Place during both the AM and PM periods. These buses are merely dropping off passengers that were onboard the bus before it reached the Golden Mile. In the PM period an average of 0.08 passengers per bus per stop board routes which terminate at Courtenay Place compared to 2.7 and 2.4 passengers per bus per stop boarding for routes which start at the station or travel through the Golden Mile respectively. Similarly, in the AM period an average of 0.2 passengers per bus per stop board routes which terminate at Courtenay Place compared to 1.9 and 0.5 passengers per bus per stop boarding for routes which start at the station or travel through the Golden Mile respectively.

In the southbound direction in the AM period, the overall trend is a decrease in bus passengers as the bus approaches the end of the Golden Mile as shown in purple.
A large number of passengers board the routes which begin at the Railway Station in the AM period. Then very few passengers board these routes after the Railway Station. However, throughout the Golden Mile passengers are alighting which means passengers are using the bus to travel from the Railway Station to their destination within the Golden Mile.

While a few passengers board the through routes in the southbound direction during the AM period, primarily passengers are alighting from these routes.

### 3.4 Relationship between Boarding and Alighting on Efficiency or Reliability

Linear regression analysis was used to assess the impact of boarding and alighting on dwell times. Based on this analysis, the following relationship was found:

\[
\text{Dwell Time} = 5.9 \times \text{No. of Boarding Passengers} + \text{No. of Alighting Passengers} + 7.5
\]

The number of boarding passengers has a much larger impact on the dwell time than alighting passengers. To board the bus only the front door can be used and the driver must accept cash and give change for any passengers without a Snapper card. Boarding passengers may also have to wait for any alighting passengers to get off the bus first. When alighting, the passengers are able to use both doors and the process is much faster, despite Snapper passengers still needing to tag off when alighting.
In Section 3.1 the overall variability in the journey time along the Golden Mile was discussed. Figure 3.1 and Figure 3.2 showed that boarding and alighting accounted for a relatively small portion of the overall journey time. However, about half of the variability in the journey time is generated by boarding and alighting. When considering the aggregated boarding and alighting data the broad patterns of where passengers typically board and alight during each time period are clear. However, when examining individual routes the patterns are not nearly as clear since the order and spacing of buses on the Golden Mile can have a large impact. Reducing the dwell time would significantly improve the reliability of bus services on the Golden Mile.

A link between the occupancy (%) of the bus and dwell time was also found. Typically as a bus approaches capacity the dwell time increases. However, the bus occupancy does not have as large an impact on the dwell time as the number of passengers boarding and alighting.

### 3.5 Impact of Bus Type on Operations

The type of bus used can have an impact upon the efficiency and reliability of bus operations. The number of doors and fare payment method can impact upon the dwell time, while the propulsion system (electric trolley or diesel) also influences the travel time.

#### 3.5.1 Impact on Dwell Time

Buses in Wellington can be placed in one of three groups based on number of doors, and smart card payment system as summarised in Table 3.4. On the Go Wellington and Eastbourne routes passengers can use Snapper to pay their fare which requires them to ‘tag on’ when boarding then ‘tag off’ when alighting. The Mana and Newlands buses use smart cards where passengers swipe their card when boarding and tell the driver how far they are travelling. Therefore, the Mana and Newlands passengers do not need to ‘tag off’ when alighting.

<table>
<thead>
<tr>
<th>Bus Service</th>
<th>Route Numbers</th>
<th>Number of Doors</th>
<th>Payment System</th>
</tr>
</thead>
<tbody>
<tr>
<td>Go Wellington</td>
<td>1 to 46</td>
<td>2</td>
<td>Snapper</td>
</tr>
<tr>
<td>Eastbourne Routes</td>
<td>81 to 85</td>
<td>1</td>
<td>Snapper</td>
</tr>
<tr>
<td>Mana and Newlands</td>
<td>52 to 60</td>
<td>2</td>
<td>Smartcards</td>
</tr>
</tbody>
</table>

The average dwell time per bus per stop and number of passengers boarding and alighting per bus per stop for the different bus types is summarised in Table 3.5 and Table 3.6 for the northbound and southbound directions respectively. The expected dwell time, based on the linear regression equation presented in Section 3.4, is also shown in the tables.
The single door design of the Eastbourne buses was expected to have an impact on the dwell time since all passengers have to board and alight through the same door. However, based on the available data, the single door design does not appear to have an impact on the dwell time. This could be for a number of reasons:

- Generally, on Eastbourne buses, the majority of the passengers are boarding in the northbound direction and alighting in the southbound direction which reduces the potential conflict between boarding and alighting passengers using the same door. If single door buses were used on routes where passengers are typically boarding and alighting in the same direction, there may be a larger impact on the dwell time.
• Additionally, the fare payment method has a large impact on the bus dwell time. With no information on the variation in the proportion of passengers paying with cash, Snapper, or monthly tickets on the different bus types it is difficult to conclusively determine the potential impact of the number of doors on the dwell time.

The dwell time for the Mana and Newlands buses was compared to the Go Wellington buses to try and determine if the differences in fare payment systems impacted on dwell time. No trends were evident when considering the impact of passengers ‘tagging off’ while alighting from Go Wellington buses. During the PM peak in the northbound direction when a significant number of passengers are boarding the Mana and Newlands buses the dwell time is considerably longer than the expected dwell time. This could be caused by the payment system which requires each passenger (including those with a smartcard) to specify to the driver how far they are travelling. However there are a number of other factors that also vary between the Go Wellington, and Mana and Newlands operations which may also contribute to or mask the differences in dwell time due to the different payment systems. These factors include:

• the proportion of passengers using each payment method on the different bus types is unknown; and
• there are significant variations in the number of passengers boarding and alighting between the different services.

Based on the available data, ‘tagging off’ does not appear to impact on the bus dwell time, however the smart card system on the Mana and Newlands buses appears to increase the dwell time when a large number of passengers are boarding (such as in the northbound direction during the PM peak.)

3.5.2 Impact on Travel Time

To understand whether the unique characteristics of trolley buses was impacting upon their travel time, the average travel time along the Golden Mile for routes normally serviced by trolley buses was compared to the average travel time for routes which are serviced by diesel buses. Figure 3.11 and Figure 3.12 summarise the Northbound and Southbound travel times (excluding the dwell time) for Diesel and Trolley buses. By excluding the dwell time, the impact of different loading patterns does not need to be considered. For this analysis routes 1 to 3 and 5 to 11 were assumed to always be trolley buses. While for comparison routes 4, 8, 18, 20, 22 to 24, 29 to 32, 43, 45, and 46 it was assumed that diesel buses were used.

In the northbound direction the travel time for the diesel buses is slightly faster than the trolley buses during all three time periods. The travel time difference between diesel and trolley buses ranges from 9 seconds (in the interpeak) to 52 seconds (in the PM period).

In the southbound direction the travel time for the diesel buses is slightly faster than the trolley buses during all three time periods. The travel time difference between diesel and trolley buses ranges from 9 seconds (in the interpeak) to 52 seconds (in the PM period).

The southbound direction diesel buses are faster than the trolley buses during the AM period. (by 55 seconds), but in the Interpeak and PM periods trolley buses are actually faster than the diesel buses, by 25 and 20 seconds respectively.
From this analysis it is evident that diesel buses provide lower journey times (up to 11 percent) and greater flexibility in terms of operation, this is largely due to the ability to pass buses and access bus stops, while also being less susceptible to breakdowns.

**Figure 3.11: Northbound Travel Time by Bus Type**

![Northbound Travel Time by Bus Type](image)

**Figure 3.12: Southbound Travel Time by Bus Type**

![Southbound Travel Time by Bus Type](image)
3.6 Impact of Traffic and Parking on Bus Operations

Parking offence data, including the day of week, hour of offence, street where the offence occurred and the offence type (e.g. parking contrary to signs or parking on a bus stop or within 6m of a bus stop sign) for February and March 2009 was obtained. It was not possible to get a more detailed description of the location beyond the street name. So, for example, despite only a small portion of Wakefield Street being actually located on the Golden Mile, the parking offence data is for the whole length of the street.

The database initially contained approximately 2000 records. The data was filtered to remove offences which would have minimal impact on bus operations. Offences which remained on the list include:

- not parking parallel or close enough to the kerb;
- parking contrary to signs
- parking in an area designated as no parking
- parking on a pedestrian crossing
- double parking
- parking on a bus stop or within 6 metres of a bus stop sign
- parking on broken yellow lines
- parking in an area designated as a morning clearway

After the filter was applied a total of 325 offences remained for the two month period. Table 3.7 summarises the percentage of parking offences which occurred on each day of the week for the entire day and between 7am and 6pm. The weekends had very few parking offences with Saturday and Sunday together accounting for 8 percent of the total when considering the entire day. Monday to Thursday was similar with 10 to 17 percent of the parking offences occurring on each of those four days. However, there is a large spike in parking offences on Friday with 141 tickets issued accounting for 43 percent of the total. However, this spike in parking offences on Friday is due to a significant increase in tickets issued in the evening. When the data is filtered to only include offences occurring between 7am and 6pm, Friday is similar to the other weekdays.

<table>
<thead>
<tr>
<th>Day of Week</th>
<th>24-hour</th>
<th>7am - 6pm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monday</td>
<td>17%</td>
<td>25%</td>
</tr>
<tr>
<td>Tuesday</td>
<td>10%</td>
<td>14%</td>
</tr>
<tr>
<td>Wednesday</td>
<td>13%</td>
<td>16%</td>
</tr>
<tr>
<td>Thursday</td>
<td>10%</td>
<td>13%</td>
</tr>
<tr>
<td>Friday</td>
<td>43%</td>
<td>19%</td>
</tr>
<tr>
<td>Saturday</td>
<td>5%</td>
<td>8%</td>
</tr>
<tr>
<td>Sunday</td>
<td>3%</td>
<td>5%</td>
</tr>
</tbody>
</table>
In general there is good compliance with the morning clearways with only 7 recorded offences. However, there is less compliance with the parking restrictions related to bus stops. In February and March 2009, 93 tickets were issued on the Golden Mile for parking in a designated bus stop with 66 percent of the tickets being issued between 7am and 6pm on weekdays.

3.7 Summary

This assessment highlights the variability associated with the operational conditions of bus services on the Golden Mile, with the key issues being:

- There is currently significant journey variability, both in terms of time period and location over the Golden Mile, with the Manners Mall section northbound being subject to the greatest variability.
- The provision of bus lanes and bus only zones improves bus speeds and journey times, irrespective of the time period.
- A significant portion of the variability is a result of passenger loading and alighting (up to 50 percent), which is problematic during the evening peak when loading demands are highest.
- Some buses are full (survey data is insufficient to display details of suburbs in which this is the greatest problem), but overall there is spare capacity on the Golden Mile (even during the peaks within the AM, IP and PM periods).
- For terminating routes (either Railway Station or Courtenay Place) a trend exists in which pick-up largely occurs on outbound routes and drop-off largely on inbound routes exists, except at the Railway Station. For through routes there is a combination of pick-up and drop-off and therefore potential for more efficient utilisation of available capacity.
- It would appear the single door operation on Valley Flyer routes has little impact on dwell times, probably due to passengers either only boarding or alighting depending on peak period. The ticketing system would appear to have a much higher impact with Mana and Newlands dwell times being much longer where there are higher numbers of boarding passengers.

It is evident that significant opportunity exists to improve journey times, reliability and operational conditions (bus stops, schedules, bus provision) over the length of the Golden Mile.
4 Forecast Growth

4.1 Population and Land Use

The population of the Wellington Region was 449,000 at the 2006 census\(^4\) of which 179,000 people lived within Wellington City itself. By 2026, NZ Statistics forecast a population of between 440,000 to 550,000 for the region. Their forecast for the ‘low growth rate scenario’ indicates that population is expected to stabilise within the region at its present level.

Nevertheless, Wellington City is expected to grow at a faster rate than the region, and to continue growing even though the rest of the region may not. Consequently, the City can be expected to have an increasing proportion of the region’s population\(^5\) in future years. By 2026, Wellington City’s population is expected to increase between 9,000 and 43,000 depending on the growth scenario.

The Wellington CBD is the main employment centre in the region and this assessment focuses on the CBD and those people coming to and from the CBD on a daily basis, therefore it does not consider wider regional travel patterns.

Between the years of 1998 and 2002, Wellington City constructed 40 percent of its new dwellings as medium to high density compared to only 14 percent for the rest of New Zealand\(^6\). This trend is making Wellington City more compact which in turn reduces the number and length of trips people need to make. Furthermore, it is making passenger transport a more viable alternative to the private motor car and even reducing the need to own a car. Given this level of medium to high density construction in previous years, Wellington City Council plans to accommodate a significant proportion of the future population growth within intensified areas and growth nodes. Wellington City Council’s vision for growth over the next 50 years is shown in Figure 4.1.

Over 50 percent of population growth within Wellington City being expected to occur in the CBD area\(^7\) (in the form of high density apartments). Twenty five percent is expected to occur in “brownfield”\(^8\) suburban growth nodes at Johnsonville, Newtown and Kilbirnie. The remaining 25 percent growth is expected to occur in “greenfield” developments in the northern suburbs\(^9\). The suburban growth nodes at Johnsonville, Newtown and Kilbirnie form part of what has been referred to as a “growth spine” extending from Johnsonville to Kilbirnie, as shown in Figure 4.1. It is emphasised, however, that while this has been referred to as a “growth spine”, it is not intended that intensified mixed use growth will occur along the full extent of this spine. Rather, three separate growth nodes are proposed, connected by a high quality public transport corridor.

\(^4\) NZ Statistics
\(^5\) GWRC “CBD Corridor Study, Pressures and Issues”, Page 5
\(^6\) “Quality of Life in NZ Eight Largest Cities”, 2003, page 76
\(^7\) If transport costs continue to increase in future years, the region may see the present trend for apartment living in the CBD and surrounding suburbs increase in future years.
\(^8\) Brownfield is an existing developed site suitable for re-development.
Policies relating to integration of land-use and transport planning aim to support densification of development around major passenger transport corridors and interchanges. This is closely related to travel demand management strategies which aim to reduce reliance on private motor vehicles for short trips.

These population and land use changes will lead to more reliance on public transport and will impact on the future needs of the Golden Mile as a public transport spine and the operational model used for public transport services.
4.2 Traffic Demands

Traffic demand in Wellington is similar to many other parts of the country, with forecast growth of between 1-2 percent per annum. This traffic growth is predicted to occur despite
Wellington City having higher than average numbers of sustainable transport users compared to other New Zealand cities.

The forecasts displayed in Table 4.1 and 4.2 for light vehicles and heavy vehicles respectively, have been extracted from the Wellington Saturn model for the base 2006 and forecast 2016 and 2026 years under a typical medium growth and medium fuel increase prediction.

**Table 4.1: Forecast Light Vehicle Growth in Wellington (SATURN per hour trips)**

<table>
<thead>
<tr>
<th>Time Period</th>
<th>2006</th>
<th>2016 (per annum change between 2006 &amp; 2016)</th>
<th>2026 (per annum change between 2006 &amp; 2026)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AM Peak</td>
<td>41,755</td>
<td>46,183 (1.0%)</td>
<td>49,915 (0.9%)</td>
</tr>
<tr>
<td>Inter Peak</td>
<td>34,281</td>
<td>37,759 (1.0%)</td>
<td>40,917 (0.9%)</td>
</tr>
<tr>
<td>PM Peak</td>
<td>47,798</td>
<td>53,099 (1.1%)</td>
<td>57,338 (0.9%)</td>
</tr>
</tbody>
</table>

**Table 4.2: Forecast Heavy Vehicle Growth in Wellington (SATURN per hour trips)**

<table>
<thead>
<tr>
<th>Time Period</th>
<th>2006</th>
<th>2016 (per annum change between 2006 &amp; 2016)</th>
<th>2026 (per annum change between 2006 &amp; 2026)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AM Peak</td>
<td>1,436</td>
<td>2,019 (3.5%)</td>
<td>2,695 (3.2%)</td>
</tr>
<tr>
<td>Inter Peak</td>
<td>1,169</td>
<td>1,643 (3.5%)</td>
<td>2,193 (3.2%)</td>
</tr>
<tr>
<td>PM Peak</td>
<td>1,452</td>
<td>2,042 (3.5%)</td>
<td>2,729 (3.2%)</td>
</tr>
</tbody>
</table>

These changes in forecast demand display a lower than national growth of light vehicles, however significant growth in heavy vehicle movements into the future.

Under different forecast assumptions\(^\text{10}\), such as high growth and high fuel cost we would get different traffic predictions; however we would also get different sustainable transport demands. Therefore, for simplicity purposes, the medium growth and medium fuel price change has been utilised. This also closely aligns with the growth trend over recent years.

Irrespective of the assumptions, any future growth in traffic volumes will impact on public transport operation (in particularly bus) due to the use of shared road space for much of the network. Growth in traffic volumes contributes to greater congestion and as a result

\(^{10}\) Forecasts are based on GWRC WTSM model scenarios developed to look at different forecast transportation demands (e.g. growth and modal choice) and the associated costs (e.g. fuel prices and ticketing).
increases the need to restrict vehicle access and implement bus priority to maintain efficient and reliable public transport operations.

The predicted increase in traffic demand also highlights an opportunity to increase sustainable transport mode share. This will only be achieved if improvements occur to the public transport network to make it more attractive, reliable and viable for transport users.

4.3 Bus Passenger Demands

GWRC’s WTSM model has been used to determine existing and future bus passenger numbers on specific links for two hour peak periods for the current (2006) and forecast years (2016 & 2026). Full details of these outputs have been presented in Appendix C.

For modelling purposes the passenger numbers along the Golden Mile have been derived from the average passenger numbers using the current bus routes for northbound and southbound traffic between Taranaki St and Mercer St. Table 4. below shows the passenger numbers used for the bus modelling along the Golden Mile.

<table>
<thead>
<tr>
<th>Year</th>
<th>2006</th>
<th>2016</th>
<th>2026</th>
</tr>
</thead>
<tbody>
<tr>
<td>Period</td>
<td>AM</td>
<td>IP</td>
<td>PM</td>
</tr>
<tr>
<td>Northbound</td>
<td>1694</td>
<td>565</td>
<td>1327</td>
</tr>
<tr>
<td>Southbound</td>
<td>1775</td>
<td>448</td>
<td>1502</td>
</tr>
</tbody>
</table>

4.4 Forecast Bus Numbers

The forecast passenger numbers for the route were converted to bus numbers along the Golden Mile using an average bus occupancy ratio. The bus occupancy ratio was derived by taking the passenger demand from WTSM in 2006 and dividing by the number of buses along the Golden Mile in 2006 (based on the 2006 Metlink timetable) for the AM, inter peak and PM peak periods.

Table 4.3 also shows the average current (2006) and forecast bus numbers for 2016 and 2026. This table and information also differs slightly from the information presented in Section 2.3 due to the fact it uses average occupancy to calculate the bus numbers. Clearly if occupancy was increased then bus numbers could reduce significantly. However, the calculations here allow us to predict a percentage change in bus numbers which is a better indication of impacts of future demand and the degree to which interventions will be required to absolute bus numbers. The percentage increase in bus numbers is shown in Table 4. below.
Table 4.4: Number of Buses (1 hour peak)

<table>
<thead>
<tr>
<th>Year</th>
<th>2006</th>
<th>2016</th>
<th>2026</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AM</td>
<td>IP</td>
<td>PM</td>
</tr>
<tr>
<td>Northbound</td>
<td>87</td>
<td>44</td>
<td>88</td>
</tr>
<tr>
<td>Southbound</td>
<td>79</td>
<td>37</td>
<td>82</td>
</tr>
</tbody>
</table>

Table 4.5: Growth in Bus Numbers

<table>
<thead>
<tr>
<th>Year</th>
<th>2006 to 2016</th>
<th>2016 to 2026</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AM</td>
<td>IP</td>
</tr>
<tr>
<td>Northbound</td>
<td>20.5%</td>
<td>11.1%</td>
</tr>
<tr>
<td>Southbound</td>
<td>19.0%</td>
<td>12.9%</td>
</tr>
</tbody>
</table>

These significant increases in bus numbers do not take into account operational and service efficiencies that may be adopted as a result of this study or GWRC’s current Wellington Public Transport Review. As discussed earlier, if there were more passengers travelling on each bus, then the growth in bus numbers could be reduced accordingly.

The public transport spine along the Golden Mile (Golden Mile spine) already carries large numbers of buses (as discussed in Section 2.3) and is the most important component of the corridor linking Wellington Railway Station with Newtown. GWRC and WCC have identified the need to provide a more legible and passenger transport focused corridor along this spine to meet current and future transport needs.

This study takes account of future public transport demands and changes in operational conditions through the consideration of growth in bus passengers and associated reduction in personal vehicle trips. Although increases in bus demand and capacity are an important component in the Golden Mile spine, this study has also explored the need for increased service provision and whether improvements to the existing services or modifications to the route structure could result in similar or better levels of service without increasing the number of buses operating on the Golden Mile spine.
The earlier Golden Mile Capacity Assessment\textsuperscript{11} estimated the link and intersection service capacity of the Golden Mile to be 75 to 130 buses per hour. Existing bus service frequencies are close to the upper end of this capacity range.

4.5 Mode share

Mode share in Wellington and the region differs largely depending upon the origin, destination and the availability/accessibility to different transport modes and options. Despite the private motor vehicle being the dominant mode of travel in the Wellington region, train travel is also significant for long distance trips from the Hutt Valley and Kapiti Coast. For those trips which occur within Wellington City, the dominance of private motor vehicle and rail is much less significant, with bus travel and walking accounting for approximately 50 percent of total peak hour trips. This trend is summarised further in section 6, figure 6.1.

It is also important to note that all bus passengers are also pedestrians for part of their journey, as a result, particular consideration needs to be given to accessibility to and from bus stops and interchange between bus and other modes.

4.6 Forecast Transport Demands

Much of the region's population growth will happen in Wellington City and WCC is planning to focus this in Wellington CBD and growth nodes linked by a high quality public transport spine, including the Golden Mile spine. In addition to this, there is very little short term opportunity to increase vehicle capacity (including car parking space), which is also consistent with the Regional Land Transport Strategy.

Enhancements to public transport are considered to be a critical factor in the ability to support and deliver future growth in and around the Wellington CBD. This is reflected in predictions that assume a 5 percent shift in trips to the Wellington CBD from road to PT will occur by 2016. Failure to facilitate this shift would result in higher vehicle demand and increased congestion, particularly on the capacity constrained CBD road network.

The Golden Mile is an important component of the wider public transport network. There are a number of areas where the Golden Mile needs to be improved to meet future demand but wider network improvements are also vital. The current Wellington Public Transport Review is intended to address these wider network issues.

\textsuperscript{11} Completed by Opus International Consultants in August 2006
Part B – Key principles and design opportunities.
5 Key Design Criteria

The current Golden Mile corridor changes significantly in character from north to south, with different constraints and opportunities associated with the accessibility and demands of different users.

This section establishes base design criteria and identifies requirements in terms of different PT provision under the current situation and future operational models.

5.1 Key Design Criteria

The following key design criteria have been identified for the Golden Mile:

(i) PT services should operate in both directions using the same roads for passenger legibility and focused bus priority.

(ii) The PT corridor should seek to pass close to the greatest number of trip origins / destinations as possible, hereby making PT a viable mode of travel.

(iii) PT vehicles should be provided for ahead of other motorised traffic, ideally through dedicated road space for PT.

(iv) The corridor should accommodate high service frequencies and make provision for a PT spine in which there is a concentration of user demand.

(v) PT vehicles should have the ability to pass one another in appropriate locations.

(vi) The corridor should minimise the number of tight-radius turns to improve the ride quality, levels of priority and future proof for future PT modes.

(vii) The provision for PT should minimise the number of turns which conflict with traffic movements.

(viii) Bus stops should provide sufficient capacity and amenity to meet demand and needs of all users.

(ix) Pedestrian access should be supported and enhanced, however designed to minimised delay to PT where possible.

(x) The corridor needs to safeguard for future bus rapid transit (BRT) or light rail services; and

(xi) Seek to manage parking and servicing requirements through appropriate mitigation and provision which does not impact on PT operation (particularly during peak periods).

These design criteria do differ depending upon the mode of PT provided and the operational characteristics of services, however the general principles remain the same and future planners and designers should seek to apply these principles wherever possible in order to create a world class PT spine for users and those who live and work around it.
5.2 Generic Engineering Standards

In the development of an enhanced PT spine there needs to be consideration of key engineering standards. The following engineering standards have been used for the design and estimation for this project:

- **Bus Lanes** – aim for 4.2m wide (where cycles might be permitted), minimum width of 3m.

- **Bus Stops** – Minimum bus cage of 3m wide x 13m long with clearways at either end, allow at least 3m footway width (refer to specific discussion on bus stop standards in Section 7). This standard varies significantly depending upon demand and the number of bus stop flags required, however the above standard applies to each bus stop flag as minimum.

- **Other traffic lanes** – minimum of 2.75m wide, but more if possible to accommodate heavy vehicles and cyclists (ideally 3.5m in urban areas).

- **Footways** – aim for at least 3m wide, minimum of 2m wide. Each location should be tested in terms of demands and other interactions which are occurring.

- **Parking, Loading or Taxi Bays** – 2m wide.

5.3 Width of the Golden Mile Corridor and Geometric Requirements

The width of the Golden Mile corridor currently varies significantly depending location and the range of different transport demands and vehicle access provisions. The physical width of the corridor including footways ranges from approximately 30m on Lambton Quay to 16m on Willis Street.

At a high level it has been assumed that minimum geometric requirements for these proposed new forms/ mediums for passenger transport are as follow:

- Minimum width of 3.5m (excluding platforms etc)
- Minimum turning circle of 20m

Further research has been undertaken to confirm the appropriate geometric requirements for the larger/long term options such as light rail and BRT. Consideration of guided busways was also investigated and such a system is considered more suitable for rural and peri-urban environments. The research concluded that:

**Buses**

The turning circle for a normal city bus at 50km/h is 75m (using autoturn which is considered conservative but may provide higher levels of service for passengers).
The turning circle for an articulated bus at 50km/h is 75m (using autoturn which is generally quite conservative).

**Bus Rapid Transit**

Bus rapid transit systems vary significantly throughout the world; however the concept is based upon a hybrid between the flexibility offered by traditional bus and the quality and reliability associated with tram services.

Associated with BRT systems is generally a high quality PT corridor with high levels of priority for the BRT service. In order to achieve this level of service there is a requirement to ensure turning radius is maximised and allocation of road space maximised.

Generally BRT systems can operate in much the same network as traditional services, however to achieve the objectives of the BRT system it is deemed desirable to enhance the route and associated infrastructure. In reality it may be possible to operate BRT systems in a tighter environment that traditional bus services through the use of “bendy buses”, drivers which are trained and dedicated to the route and the removal of other traffic from the corridor.

Ultimately the turning circle for a BRT system at 50km/h should be designed around a 75m radius and less as speeds drop.

**Light Rail/Trams**

Light rail can have several different functions including high speed medium-long term routes as well as tracks embedded in existing urban road environments.

The requirements for high speed medium-long term routes are similar to guided busways, with large radius curves required.

Where light rail systems are installed in existing urban road environments the tracks are normally permitted to be installed at absolute minimum radii as a concession to the extreme alignment restrictions in urban areas.

Research indicates that the absolute minimum radius for light rail is around 25m, at this speed light rail is limited to 15-20kph.

The “TCRP Report 57: Track Design Handbook for Light Rail Transit” gives the following geometric requirements for light rail as described in Table 5.1.
### Table 5.1: Geometric Requirements for Light Rail

<table>
<thead>
<tr>
<th>Speed</th>
<th>Minimum Radius</th>
<th>Super-elevation required</th>
<th>Minimum length of tangent curve</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>30m</td>
<td>150mm</td>
<td>58m</td>
</tr>
<tr>
<td>30</td>
<td>45m</td>
<td>145mm</td>
<td>56m</td>
</tr>
<tr>
<td>40</td>
<td>80m</td>
<td>145mm</td>
<td>56m</td>
</tr>
<tr>
<td>50</td>
<td>120m</td>
<td>150mm</td>
<td>62m</td>
</tr>
</tbody>
</table>

### 5.4 Summary

The existing Golden Mile corridor and associated infrastructure has no clearly standardised design approach or criteria. The work recently undertaken on Lambton Quay aimed to standardise a design approach for this part of the corridor.

The Golden Mile bus priority project and associated streetscape improvement projects provide the opportunity to develop design criteria for PT and the general street environment. In doing this, GWRC and WCC should work together to ensure the principles identified in this section and the report in general are achieved and the corridor is safeguarded for future changes in PT systems (such as light rail).
6 Allocation of Road Space

Over the past 30 or 40 years, the dominance of the private motor vehicle has led to high levels of road space being allocated to the car. With increasing congestion, environmental awareness, costs, and efficient alternative transport modes, this allocation needs to be evaluated and assessed in accordance with current travel patterns and policies. Although government policy has changed through the introduction of the 2009 Government Policy Statement, the underlying legislation in the form of the LTMA still seeks to achieve an affordable, integrated, safe, responsive, and sustainable transport system. For Wellington, this is heavily reliant on existing and enhanced future public transport provision and accessibility to and from the public transport system (walking or other modes).

As part of the Ngauranga to Airport Strategy Study, there was extensive work undertaken to look at the allocation of road space and which corridors should be used for which modes, and enhancements made accordingly. The Golden Mile was identified as appropriate for public transport to have priority.

6.1 Existing Allocation of Road Space

In order to understand the role of PT on the Golden Mile corridor, an assessment of modal split has been undertaken. The assessment looked at all competing users (e.g. PT, private vehicles walking and cyclists) and helped define a road hierarchy or classification of uses. It is considered that all roads should not provide all things for all people, a certain degree of hierarchy or classification should be applied. Currently many of Wellington’s roads aim to provide for all (or a multitude) of users, with the exception of the urban motorway, which is focused on the movement of motor vehicles and small sections of bus only route such as the Mt Victoria Bus Tunnel and the section of Lambton Quay between Willis and Hunter Street.

The assessment was undertaken by using a screen line across all roads in a corridor as displayed in Figure 6.2. Such an assessment is reliant upon background travel information for all modes by passenger number or assumptions based upon national statistics.

The theory used is relatively simple and bases the allocation of road space upon the number of people moving over an identified screen line. The use of screen lines or cordons to identify the composition and associated movement of people is an approach which is being applied internationally, with Transport for London (TfL) recently developing this approach for the roads plan for London12.

This approach is a shift away from traffic management practices of the past (still used by many), which have used passenger car units (PCU) values as the basis for allocating road space to particular users. Under this approach a car equates to 1 PCU and buses 2-3 PCU's (no matter how many passengers).

---

12 Mayors Transport Strategy 2004
A simple example of the movement of people approach has been developed using cordon\textsuperscript{13} information recorded by GWRC and WCC for the purposes of monitoring changes in travel patterns and modal split within the Wellington CBD. The information displayed in Figure 6.1 provides an indication of the current number of people coming into the cordon\textsuperscript{14} during the AM peak period (2 hour) by mode. It should be noted that this information excludes rail (no direct impact on road space capacity), while an assumption of 40 percent of all rail passengers have been assumed to walk through our study area for the purposes of this exercise e.g. walking across a screen line to and from the Railway Station.

\textbf{Figure 6.1: GWRC Modal Split Information (2005)}

\begin{center}
\includegraphics[width=0.5\textwidth]{gwrmodalsplit.png}
\end{center}

This percentage split can then be applied to the available road space across a screen line in Wellington (refer Figure 6.2), using Brandon Street (east / west) as an indicative point for the following links:

- Customhouse Quay
- Featherston Street
- Lambton Quay
- The Terrace
- SH1 – Urban Motorway

\textsuperscript{13} As defined in the 2004/2005 Annual Report on the Regional Land Transport Strategy GWRC.

\textsuperscript{14} The cordon is used by GWRC to monitor changes in travel patterns coming into the CBD and includes much of the Wellington CBD as defined in the GWRC’s annual monitoring reports.
The existing use of road space and the number of people travelling over the screen line is shown in Table 6.1 below, broken down by mode, percentage split and existing meters of available road (approximately 122.5 meters). This shows significant space being allocated to general motor vehicles and walking, with limited space allocated to buses and cyclists (although in certain locations cyclists can use bus facilities within the city).

<table>
<thead>
<tr>
<th>Transport Mode</th>
<th>People Numbers</th>
<th>% People</th>
<th>Existing Road Space Allocation (m)</th>
<th>% Allocation of space</th>
<th>Theoretical Road Space Allocation (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Motor Vehicle (1.37 pax)</td>
<td>19761</td>
<td>45.63%</td>
<td>88.5</td>
<td>72.24%</td>
<td>55.90</td>
</tr>
<tr>
<td>Bus</td>
<td>12448</td>
<td>28.74%</td>
<td>6</td>
<td>4.90%</td>
<td>35.21</td>
</tr>
<tr>
<td>Walking(^{15})</td>
<td>10610</td>
<td>24.50%</td>
<td>28</td>
<td>22.86%</td>
<td>30.01</td>
</tr>
<tr>
<td>Cycling</td>
<td>488</td>
<td>1.13%</td>
<td>0</td>
<td>0.00%</td>
<td>1.38</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>43307</strong></td>
<td><strong>100.00%</strong></td>
<td><strong>122.5</strong></td>
<td><strong>100%</strong></td>
<td><strong>122.5</strong></td>
</tr>
</tbody>
</table>

\(^{15}\) Walking numbers include an assumption that 40 percent of all rail passengers walk past the screen line.
6.2 Reallocation of Road Space

The existing and theoretical allocation of road space has then been identified based on the percentage split of people by mode. The total available road space for the corridor has been displayed in Figure 6.3 in order to highlight the difference between the road space currently provided across this screen line and the potential road space that could be applied if we used an allocation based upon modal split and the movement of people.

The road space identified in any screen line assessment needs to be viewed in the local context and a certain degree of engineering judgement must be used in identifying minimum widths and provision (in accordance with engineering and safety standards). Also, where uses such as cyclists make up a very small proportion of total road space allocation does not mean that provision should not be made for them.

Figure 6.3: Wellington CBD Screen Line People Numbers by Mode

In order to determine the most appropriate form of transportation and effectively assess and classify roads, links, or corridors; a hierarchy can be used based on modal classifications and the aims and objectives of the urban form. Using this criteria, and the recommendations made in the Ngauranga to Airport Corridor Plan, the levels of treatment on the Golden Mile for bus and pedestrian provision should be further enhanced to meet the needs of those people that use the corridor and limit the allocation of space for those that have alternative corridors (e.g. cars using the Urban Motorway, Jervous Quay, Featherston Street etc).
Although bus planning may be a catalyst for such a hierarchy, other modes of transport such as car, taxi, walking, and cycling should also be considered as being important modes of transport and economic viability of retail and commercial areas needs to be maintained where appropriate.

Ultimately, this assessment highlights that the current allocation of road space to buses and bus passengers through the identified central Wellington screen line is not consistent with the level of use. Therefore changes should be made to enhance this where appropriate and these changes should link back to the underlying philosophy that the Golden Mile has been endorsed as the core PT spine for Wellington and the allocation of road space should be provided in order to complement this. The use of such an approach should also help to convey this message to those individuals and organisations that are opposed to any future plans to enhance the Golden Mile as a PT spine. This will assist in the justification and communication of the proposed projects in the future.
7 Bus Stop Layout & Spacing

Bus stop design and planning is often historical and may not resemble any of the current best practice guidance and expected passenger and operational requirements of current users. As discussed in Section 2, significant guidance and advice has been developed internationally (such as the HiTrans Best Practice Design Principles 2005) and most recently Auckland Regional Transport Authority's (ARTA) have developed a comprehensive set of guidelines for Auckland.

Although the ARTA guide provides an important piece of guidance for bus stop planning and design in NZ, it should be recognised that it was developed for Auckland and variations exist between different networks and locations throughout the world.

In general the ARTA guidelines have been used as a starting point for consideration in this assessment, however recognising other international best practice and a certain amount of practical application, the approach for this assessment has not been draconian or similar to a green field project. If a standard and associated design guide was to be applied to Wellington, GWRC would need to determine what is most appropriate for this region in consultation with the TLAs, operators and other stakeholders, however the ARTA guidelines provide a good starting point.

7.1 Design guidelines

7.1.1 Bus stop Location and Spacing

The ARTA Bus Stop Infrastructure Design Guidelines (May 2009) states that within an urban area, standard practice is to locate a bus stop every 400 metres along a bus route. This corresponds to a five-minute walking distance, which is considered by most people to be acceptable and also a policy in Wellington's Regional Public Transport Plan. However, the acceptable walking distance is dependent upon many factors including, age, weather, topography, and if the person is carrying baggage.

There are a number of other international guidelines that have been developed to provide best practice guidance, The HiTrans Best Practice Design Principles 2005 highlights the benefits, in some circumstances, of more distant spacing such as 600 metres between stops to better balance the competing needs of maximising vehicle speeds and maximising coverage.

Locating bus stops near intersections, walkways or other pedestrian paths will help maximise the number of people located within 400 metres of a bus stop while still maintaining a spacing of 400 metres between stops. However, more frequent bus stop spacing maybe appropriate in densely populated areas such as major CBD centres.

Additionally, bus stops should be located as close as possible to main shopping and business areas, transport interchanges and other main origins and destinations. Specific attention should be paid to the needs of elderly and disabled passengers.
Sufficient sightlines for oncoming vehicles, for bus drivers and pedestrians must be available at the locations proposed for any bus stops. Particular attention should be paid to corners, curves, traffic islands or intersections which could create ‘blind spots’ or block sightlines.

Bus stops should be located away from sewer and electricity pits, and be free from stormwater drains or pits. This is to prevent buses from splashing pooled water when approaching and departing the stop. The requirement to achieve (and restore) road surfaces to high standard is critical for a PT corridor of this nature and to retain ride quality and amenity.

Stops should be located in clearly visible locations away from vegetation and other objects which can be used to hide to increase perceptions of personal safety. Sufficient illumination should also be provided. Ideally stops are located near locations of existing activity such as service stations where natural public surveillance can occur.

Within the central area the main design factors for stop location should be:

- In close proximity to major passenger attractors, desire lines and interchange points, without over providing and impacting on bus journeys;
- clear and unrestricted access to the bus stop;
- a logical configuration of buses using each bus stop to avoid passenger frustration and bus accessibility issues;
- located with sufficient footway and passenger standing space to provide for both pedestrians, passengers and other road users (such as shoppers);
- be maintained to a high standard, including footway and kerbside enforcement; and
- provide enough carriageway space to allow buses to enter and exit stops without obstruction where possible.

7.1.2 Bus Stop Configuration and Capacity

The ARTA guidelines state that bus stops should be located near to and on the departure side of pedestrian crossings or intersections; however they must not be on or closer than six metres to a pedestrian crossing or intersection. By locating a bus stop immediately after a pedestrian crossing or intersection reduces the conflicts between alighting passengers using the pedestrian crossing and a bus attempting to depart the stop. Additionally, the no stopping zone associated with the crossing or intersection can be used by bus drivers as the entry taper for the stop.

There are also advantages in nearside stops particularly at controlled intersection as shorter distance for passenger to walk to cross the road and buses can take advantage of priority at the signals. On high volume bus corridors like the Golden Mile nearside stops avoid the risk of buses queuing back across the intersection blocking crossing or turning traffic.

The ARTA guidelines recommend splitting any stops serving more than 25 buses per hour to minimise bus-on-bus delay and traffic congestion. This enables buses on different routes
to serve separate stops, thus reducing bus-on-bus delay and traffic congestion\textsuperscript{16}. As mentioned earlier, the use of standards and guidelines developed for other locations may not be suitable for the Wellington context, however it does provide a starting point and the theory behind particular outcomes. For the purposes of this assessment, previous studies such as the Golden Mile Capacity Assessment (Opus 2006), highlighted that the Golden Mile is unique, however it also identified that bus stop design and operation are key contributors to delay and variability.

Both the detailed stop information presented in Section 2 and the dwell time information presented in Section 3 highlight the opportunity which exists for improvement. The appropriate interventions to achieve such improvements vary depending upon a number of key factors, these include:

- Route operation and configuration of services (as discussed in Section 2.1).
- Creation of multiple flags per stop (a minimum of two flags recommended) and associated bus cage provision per stop to improve the operation of stops and associated dwell times (refer below).
- The type of bus priority and the restrictions associated with vehicle access to the Golden Mile corridor (refer section 2).
- Local context and conditions.
- Future ticketing arrangements and types of tickets available to users (refer Section 8).

7.2 Evaluation of bus stops

In applying the principles of different guidelines and practical application based on operational conditions and an understanding of the Golden Mile, each bus stop has been assessed and recommendations made as to the current design and need for changes to be made.

It should be recognised that each bus stop should undergo a detailed assessment and design review as part of any upgrade or modification associated with a wider bus priority project.

7.2.1 Recommended use of multiple flags

The use of multiple bus stop flags has been identified as one mechanism to address the issues associated with the large number of buses and passengers arriving at one location at one time.

For multiple flag operation to be effective services going to similar destinations should be configured to stop at the same flag to provide certainty and allow users to catch different buses going to similar (but different) destinations. A two flag configuration should be arranged in such a way that it provides clarity for users and flexibility for drivers as shown in Figure 7.1. Figure 7.2 shows an indicative layout of how routes could be grouped by destination to different flags.

It is recommended that trolley routes stop at the rear flag, while other bus routes should use the front flag. This would allow diesel buses to pass the rear flag stopping trolleys required, therefore providing increased accessibility to stops and greater route flexibility. However, further work is required including consultation with operators and users to ensure most effective operations.

**Figure 7.1: Indicative Flag Configuration**

![Figure 7.1: Indicative Flag Configuration]

**Figure 7.2: Functional Grouping of Bus Routes by Flag for the Golden Mile**

![Figure 7.2: Functional Grouping of Bus Routes by Flag for the Golden Mile]
7.2.2 Recommended changes to Lambton Bus Interchange

The Lambton bus interchange provides an important transport interchange for Wellington and defines the north limit of the Golden Mile. The purpose built interchange has the following features:

- Quality connection to train station, although relatively long distance to walk but through dedicated underpass so avoid all conflict with traffic.
- Southbound almost all routes entering CBD are either commencing service at or passing through the Lambton interchange which has 4 separate stops configured in this direction.
- Northbound most routes also use the interchange although a single stop in this location serves both as drop-off for terminating routes and drop off/pick up for through routes. Some routes (4, 6, 14,17, 22, 25, 285, 30, 32, 80, 81, 84, 85, 90 and 91) travelling up Molesworth Street use an on-street stop instead approximately 50 metres from the interchange on the opposite side of the road.
- Only major route not serving the Lambton interchange is Route 3 to Karori which stops at north end of Lambton Quay before travelling up Bowen Street. Passengers can transfer to most other buses on Lambton Quay but have to walk approximately 250 metres along the street with limited cover to access the Railway Station.

The following recommendations are made in relation to the Lambton bus interchange:

- Splitting the northbound stop at Lambton interchange to separate drop-off only from pick-up/drop-off routes.
- If and when the bus interchange is redesigned, consider international best practice to ensure the bus stop environment is future enhanced and bus accessibility is maximised to reduce delay to buses and ensure safe and efficient boarding and alighting of buses.
- Maintain the first northbound stop on Lambton Quay to provide an interchange with the Railway Station for those buses from Karori.
- Enhance pedestrian connections and shelter between north end Lambton Quay bus stops and Railway Station for Route 3 (Karori transfers).
- Although desirable, it is not considered viable for Karori buses to travel through the Lambton interchange for transfer as this will add significant travel for most passengers.

7.2.3 Recommended changes for other bus stops

The results highlight that busy stops such as Willis Street and Manners Mall are already operating above their capacity and this is not only impacting on the operational efficiency of the stop, but also the entire corridor. However a number of other stops provide the opportunity to be removed or modified based upon capacity and levels of performance at present.

The information summarised in Tables 7.1 and 7.2 which identify some opportunities to remove bus stops to increase operational efficiency due to relatively low demand and close proximity to stops either side. In conjunction with the dwell time information presented in Figures 7.1 and 7.2 this provides a good understanding of the interaction of stop location,
demand, and the potential impact changes to stops might have on upstream and downstream stops.

A number of changes could be made to the design and configuration of stops in both the northbound and southbound directions, including rationalisation of some stops. These changes have been summarised in Tables 7.1 and 7.2 below.

In particular, further consideration should be given to the following bus stop changes:

- **Manners Street (Nb)** – remove the existing Manners Street stop and move the Dixon Street stop onto what is now Manners Mall adjacent to Cuba Street as part of Manners Mall being opened to buses. The new stop should be split into two flags, the existing Manners Street and Dixon Street stops should also become split stops with two flags until the Manners Street project is implemented.\(^{17}\)

- **Willis Street (Nb Grand Arcade)** – Ideally this stop should be shifted further south to better align with the Sb stop, however it is understood that the Telecom building currently being constructed would not provide sufficient footway space to accommodate such a facility. In either location, the stop should be split into two flags and the cage length increased or the parking restrictions modified.

- **Restricting traffic in Willis Street northbound** would have significant benefits for bus stop operation and the ability for buses to pass buses at both the north and south bound stops. This is currently very difficult to achieve and results in delay to those buses not picking up or dropping off passengers, particularly southbound.

- **Stout Street (Sb 5504)** – Removing this stop in favour of stops upstream and downstream of this location as this stop is not highly used and increases travel time with no improvements in accessibility.

The failure to include these aspects in the Manners Mall of completed Golden Mile project may change the overall assessment undertaken when comparing the different options for improvements discussed in Section 10 of this report. The northbound Manners Street bus stop is critical to this assessment and failure to remove this stop could:

- Results in more stops northbound than southbound (legibility).
- Removes the ability to manage buses approaching the Willis Street intersection due to the uncertain around bus stop boarding times and bus on bus delay.
- It will be very difficult and potentially unsafe for buses to pass buses.
- If the bus stop is retained in conjunction with permitted traffic in an eastbound direction this will make the situation worse due to greater for buses to pass buses due to opposing general traffic.

---

\(^{17}\) The Manners Mall project will need to ensure the proposed single bus stop location east of Cuba Street is designed to ensure the heavy demand can be accommodated (likely to be through a split stop arrangement) and the Willis Street (Grand Arcade) stop will also need to be further enhanced to address additional demand associated with the some passengers that currently use Manners Street having a desire to walk in the same direction as the bus instead of backwards.
Without undertaking detailed assessment of the route and bus stop operation it is difficult to verify the impact changes will have on the overall journey time savings, variability and safety of the corridor.

### Table 7.1: Southbound Bus Stop Changes

<table>
<thead>
<tr>
<th>Stop Name</th>
<th>Stop Number</th>
<th>Modification Recommended</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wellington Station - Stop A</td>
<td>6000</td>
<td>Bus stop island could be lengthened, however difficult given current design.</td>
</tr>
<tr>
<td>Wellington Station - Stop B</td>
<td>6001</td>
<td></td>
</tr>
<tr>
<td>Wellington Station - Stop C</td>
<td>5500</td>
<td></td>
</tr>
<tr>
<td>Lambton Quay - North End, Stop J</td>
<td>5502</td>
<td>Removal two taxi stands to provide the entire block between intersections as bus stop</td>
</tr>
<tr>
<td>Lambton Quay - Stout Street</td>
<td>5504</td>
<td>No change</td>
</tr>
<tr>
<td>Lambton Quay - Kirkcaldie &amp; Stains</td>
<td>5506</td>
<td>No change</td>
</tr>
<tr>
<td>Lambton Quay - ANZ Bank</td>
<td>5508</td>
<td>Cage extension</td>
</tr>
<tr>
<td>Willis Street - Willbank Court</td>
<td>5510</td>
<td>No change</td>
</tr>
<tr>
<td>Cuba Street - James Smith Corner</td>
<td>5512</td>
<td>Linked to Manners Mall changes (stop current sufficient in existing location).</td>
</tr>
<tr>
<td>Courtenay Place - Courtenay Central</td>
<td>5514</td>
<td>Cage extension resulting in the removal of 5 car parks.</td>
</tr>
<tr>
<td>Courtenay Place - Blair Street</td>
<td>5516</td>
<td>Cage extension resulting in the removal of loading zone/taxi stand</td>
</tr>
</tbody>
</table>

### Table 7.2: Northbound Bus Stop Changes

<table>
<thead>
<tr>
<th>Stop Name</th>
<th>Stop Number</th>
<th>Modification Recommended</th>
</tr>
</thead>
<tbody>
<tr>
<td>Courtenay Place - Paramount</td>
<td>5000</td>
<td>New paint markings only</td>
</tr>
<tr>
<td>Courtenay Place - St James</td>
<td>5002</td>
<td>Cage extension resulting in the removal of 7 car parks.</td>
</tr>
<tr>
<td>Dixon Street – Cuba Mall</td>
<td>5004</td>
<td>Cage extension resulting in the removal of loading bay</td>
</tr>
<tr>
<td>Manners Street - Mid City Centre</td>
<td>5006</td>
<td>Removed as part of Manners Mall project.</td>
</tr>
<tr>
<td>Willis Street - Grand Arcade</td>
<td>5008</td>
<td>New paint markings only</td>
</tr>
<tr>
<td>Lambton Quay - Cable Car</td>
<td>5010</td>
<td>New paint markings only</td>
</tr>
<tr>
<td>Lambton Quay - Farmers</td>
<td>5012</td>
<td>No Change</td>
</tr>
<tr>
<td>Lambton Quay - North End</td>
<td>5011</td>
<td>No Change</td>
</tr>
<tr>
<td>Wellington Station - Stop D</td>
<td>5016</td>
<td>Bus stop island could be lengthened, however difficult given current design.</td>
</tr>
</tbody>
</table>

#### 7.3 Summary of main bus stop changes recommended

This section highlights the significant opportunity which exists to enhance the bus stop design and operation over the length of the Golden Mile; despite this approximately 25
percent of stops are considered sufficient for the current demand and existing bus operation.

The review, planning, design and implementation of bus stop changes should consider changes in infrastructure and operational conditions on the Golden Mile, as recommended in Part C of this report. Irrespective of the changes to be made in the future, there are several key changes that should occur to enhance the existing operation and provide for future changes to the network, these include:

- Split stops to create a two flag configuration (including route allocation groupings by flag)
- Ensure stops are designed to ensure safe and effective access in and out.
- Implement the identified bus stop changes, including the removal of the Stout Street southbound stop (Sb 5504), northbound Manners Street (Nb 5006), and other bus stop modifications.
- Ongoing enhancement and improvement to all stops on the Golden Mile.
- Increased accessibility to and from stops for pedestrians as part of PT and general streetscape improvement projects.
8 Ticketing and Passenger Information

The dwell time of buses accounts for anywhere between 15 percent and 30 percent of the total journey time depending on the time of day based upon the surveys undertaken as part of this project. One fundamental way of reducing this dwell time and associated delay is by improving passenger loading. Ticketing and passenger information is an important component of the PT service quality while also having a significant impact on operational conditions, playing an important part in bus stop dwell times and capacity.

8.1 Integrated Ticketing

In developing an integrated and accessible transport network, integrated ticketing is one of the key mechanisms in achieving a reduction in dwell time at bus stops and increased passenger demand. Integrated ticketing is simply a ticket (irrespective of whether it is electronic and paper based) which allows people to interchange with little or no penalty for using the same ticket. This interchange could occur between buses, however ideally it would be integrated in such a way that passengers can interchange between all modes of PT without incurring a cost penalty.

The provision of integrated ticketing systems is widely used throughout the world to allow different transport models to be introduced (e.g. interchange points) and encourage use of PT in the first instance through improved linkages and reduced costs to users. Such a ticketing system is seen as being essential in order to enhance the reputation and acceptability of PT as an attractive alternative to other less sustainable modes of travel.

It should be recognised that integrated ticketing may however result in a significant increases in PT usage on particular services (e.g. bus trips to and from the rail station). This increased usage will need to be considered, with operational planning and steps taken to avoid existing PT user being put off using services due to over crowding or poor levels of service.

Integrated ticketing cannot be delivered by one agency alone, it is widely recognised\textsuperscript{18} that transport funders, providers and associated local authorities need to work together to ensure the appropriate system is developed to meet the needs of the network in which it is delivered.

8.2 Cashless and Electronic Ticketing

Cashless and electronic ticketing are not necessarily linked, however they seek to achieve a similar outcome, which is to reduce dwell time at bus stops and improve passenger loading and alighting. There is also the added convenience to passengers that removes the need to carry cash, however this is balanced by the need to have access to ticketing systems and the ability to top them up or pay for them when required.

Both cashless and electronic ticketing seek to remove the transfer of money when boarding a bus, however they could operate as very different mechanisms:

\textsuperscript{18} Developing a strategy for smart and integrated ticketing, Department for Transport 2009
**Cashless ticketing** – utilises a paper or multi ticket system, which is checked by the driver upon boarding. Tickets need to be purchased in advance at roadside dispensers, retail outlets or online.

**Electronic ticketing** - uses an e-ticket or swipe card to store credit or charge a travel cost in return for travel on PT. The Wellington Snapper system is a relatively simple electronic ticket system that is focussed on bus travel for Wellington.

There is significant research internationally[^19] highlighting the benefits of off bus ticketing and electronic ticketing systems, including work undertaken in the UK which suggests that ticket types and fare collection methods contribute to approximately 50 percent of the dwell time at stops[^20]. Other research in the same area attempts to put a time on this dwell of between 1 – 2 seconds per passenger[^21], corresponding well with the 50 percent quoted earlier.

Irrespective of what the actual saving is, the research quoted above and other related papers identified benefits of moving away from cash ticketing towards electronic or off bus ticketing systems.

The key opportunities which exist for Wellington include:

- Moving towards an integrated ticketing system to allow bus, rail and other public transport users to interchange without having to pay another fare or purchase additional tickets (can be done to limited extent with paper based monthly pass system).
- Replacing all paper tickets with electronic tickets (e.g. Snapper).
- To avoid using cash on buses along the Golden Mile. This could be achieved by installing off-bus ticketing machines at bus stops along the Golden Mile and prohibiting the use of cash at these stops.

Those ticketing systems which reduce the need for any cash or ticket exchange with the driver and allow for loading and unloading of both doors are considered to provide the greatest benefits to bus operation and users. Cashless ticketing is therefore most effective, however this does have a downside for infrequent users and tourists, creating problems gaining access to services and associated information. It is therefore recommended that cashless ticketing be limited to those stops on the Golden Mile initially with new off-bus ticketing machines that can accept cash (similar to systems recently implemented in Sydney and London). Although this will have a cost implication and will need to be flexible to cover the entire network, it is seen as an effective solution to reducing dwell time and increasing bus stop capacity.

With the introduction of electronic or non cash based ticketing systems, additional benefits can also be achieved by allowing boarding from the rear doors in addition to the traditional front door loading. It should however be noted that any system which allows passengers to

board through both doors may require random enforcement to ensure fare dodging is limited. Associated with such enforcement is a cost implication, however if it was limited to the Golden Mile only, this is likely to be relatively insignificant and could also offer added value in terms of passenger information and security.

8.3 Real Time Information

The primary objective of real time information (RTI) systems is to inform bus passengers of service information and allow them to make decisions about transport options (e.g. whether to wait and catch the bus or walk), choose a different route option or allow passengers to utilise their time doing other things while awaiting a bus (e.g. shopping). They generally provide limited benefit to bus operation or reliability; however systems developed in other parts of the world (e.g. Chelmsford, UK and Rome, Italy) are being utilised to manage bus operations and improve services.

At the core of most real time information systems is a GPS (or similar system) to track buses using a vehicle location device on every bus to keep a constant, up-to-date position of each bus. Tracking has been successfully pioneered in many major cities throughout the world to provide:

- Real time passenger information;
- Signal and route management;
- Route control mechanisms; and
- Bus monitoring.

GWRC have recently procured services to undertake the fitting of GPS and provision of bus detection, which is currently being rolled out throughout the region and is expected to result in significant benefits for bus passengers and operators through the communication of information, tracking of buses and the ability to control the speed and reliability of services through the use of signal detection and management.

The contract for deliveries has recently been awarded and is currently in the development and trial phase, with full rollout to the region’s buses in 2010.

Although such systems provide information to passengers, they need to be reliable and instil confidence. Such a system was installed in London about 10 years ago which proved to be very unreliable and signs would inform passengers that a service was arriving that then never arrived or arrived much later than the information provided. This is unlikely to be a problem under the proposed systems for Wellington as technology has improved significantly in recent years. A more significant problem for Wellington would be that RTI systems benefit from predictable journey patterns and travel times. Where there is significant variability and unreliability the RTI system cannot accurately predict when a bus service is going to arrive. It is therefore important that issues with reliability be resolved for the Wellington RTI system to work as intended. For this reason, the greatest emphasis should be placed on the Golden Mile and the provision of real time information on this corridor, with infrastructure rolled out to the suburbs and other key corridors in the future.
RTI systems can also be used to manage bus variability and driver behaviour thus adding further value to bus operations. The use of GPS can allow bus controllers to speed up or slow down buses through signal control while also tracking strange driver behaviours (e.g. stopping at a shop, spending longer than scheduled at terminus points) and drivers adopting a bunching approach (stopping at the terminus or stops until such time as one or more buses are ready to depart) to reduce the need for drivers to stop at every stop. These driver behaviours result in travel time variability, route reliability issues, and passenger annoyance and frustration.

Service operators in the UK also use GPS systems to monitor bus operational performance, breakdowns and provide a record of where improvements could be made in the future to the route (e.g. areas for enforcement and bus priority)\(^\text{22}\).

Ultimately the Wellington RTI project can be seen as the first step in delivering significant improvements for bus passengers and operators.

\(^\text{22}\) http://www.dft.gov.uk/adobepdf/245385/tic/realtimedevopment
9 Evaluation of network operational models

In order to evaluate different operational models for the Golden Mile (and the wider bus network), it was identified that a mechanism was needed in order to understand the factors that will influence patronage and public transport levels of service in the Golden Mile, these include:

- fares;
- service frequency;
- vehicle sizes; and
- interchange requirements (linked to route configuration and operational models)

This chapter provides a model that can be used to scope the impact of various combinations of the above variables. However, if the model is to be used for patronage forecasting and revenue forecasts further work would be needed to calibrate and validate the model. Much of the information referred to in this chapter is based on the Australian “National Guidelines for Transport System Management in Australia” (Australian Transport Council 2006).

The evaluation presented in this section will influence the assessment and development of operational options as presented in Section 3.

9.1 Operating Costs

Operating costs need to be considered before making any changes to the network operational model (refer Section 3). Detailed operating costs, specific to the New Zealand operating environment would be required if this was to be used to accurately predict the impact of change. As a minimum the following costs need to be included in determining operating costs:

- Peak vehicle requirements.
- Vehicle hours (in service and out of service).
- Vehicle kilometres (in service and out of service).

These costs need to include; vehicle leasing / ownership costs, on-vehicle crew costs, vehicle operating costs, overhead operating costs (administration and management); and profit.

Operating costs vary according to the vehicles used. The following vehicles are currently used for service provision within the Golden Mile:

- Trolley Buses (electric);
- Standard Buses (diesel); and
- Midi-buses (diesel).

The vehicles listed above have very different fuel and maintenance requirements with resulting difference in costs. In the future articulated buses or light rail vehicles may be
used to provide services within Wellington. Probably the largest portion of operating cost is attributable to staffing. Therefore any increase in the number of vehicles used for service delivery will incur greater staff costs even if the vehicles are already available.

Although operating costs are an important factor in any PT service or operational model, they are closely linked to the type of model that might be developed, therefore any significant variation in operating cost has been highlighted in the discussion of the model being considered (refer Section 3). Once an operational model is agreed, further work would be required to support the business case and confirm the benefits of change.

Future shifts in PT towards BRT or light rail would incur very different operating costs (both positive and negative), however again these costs should be further investigated once the justification for such a change is recognised.

9.2 Passenger Forecasting

Currently many passengers are able to travel from close to their homes to their destination within the Golden Mile without interchange. Alternative operating models could require passengers to transfer from feeder services to core trunk routes, with only these trunk routes passing through the Golden Mile. This can be a much more efficient and reliable way of operating buses but the number of passengers willing to change services will depend on a number of factors, these include:

- distance between interchange point and final destination;
- amount of time they would have to wait at the interchange point;
- quality of the interchange (e.g. don’t have to walk far, have shelter and other amenities); and
- the cost of the second part of their journey.

Passengers that consider any of the above factors too high, may decide to complete the final part of their journey by alternative means or carry out entire journey by alternative means. Wellington is lucky in that the characteristics and density of the central area are such that there is more potential for shift from bus travel to walking than for shift to other modes.

The absence of research and cross-elasticities between walking and travel by bus means that accurate forecasting is difficult. The generalised cost of alternative options may however be used as an indicator of their relative attractiveness. Generalised costs are used to quantify the attributes of a journey using a standard unit ($$) in order to compare alternative options.

9.2.1 Generalised Cost of Walking

The number of people that walk from an interchange to their final destination can be gauged by comparing the generalised cost of walking with the generalised cost of transferring and continuing by bus. The UK Department for Transport recommends that the generalised cost of walking is equal to the travel time multiplied by the value of time.
“The vast majority of people walk at speeds between 0.8 metres per second (m/s) and 1.8 m/s. A fit, healthy adult will generally travel at a mean speed of 1.5 m/s, and the aged and those with mobility impairments travel more slowly, at around 1.2 m/s.”

Generalised cost for walking may be expressed by the following formula:

\[ GC_W = V \times m \times T_F \]

Where:

- \( GC_W \) = Total Generalised Cost ($)
- \( V \) = Standard Value of Time ($ / minute) - $10.80
- \( T_F \) = Walking time (minutes)
- \( m \) = factor representing intangibles such as prevailing weather conditions, walking environment etc

9.2.2 Generalised Cost of Public Transport

The generalised cost for travel using public transport is more complicated. The National Guidelines for Transport System Management in Australia suggest the following relationship between trip variables and generalised cost:

\[ GC_{FT} = F + V \times [(T_R \times W_R) + (T_I \times W_I) + N_T \times (T_P + (T_{AT} \times W_{AT}) + (T_{WT} \times W_{WT}))] \]

The variables in this calculation are defined below. ‘W’ denotes a weighting factor for each variable.

- \( GC \) = Total Generalised Cost ($)
- \( F \) = Fare ($) $0
- \( V \) = Standard Value of Time ($) $10.80
- \( T_R \) = Unexpected Waiting or Travel Time (i.e. unreliability) (mins) 2 Mins
- \( T_I \) = in-vehicle time (mins) from survey data
- \( N_T \) = number of transfers 1
- \( T_P \) = transfer penalty reflecting inconvenience (mins) 5 Mins
- \( T_{AT} \) = access / walk time on transfer (mins) 0.5 Mins
- \( T_{WT} \) = waiting time on transfer frequency dependent

Time to walk to the first bus stop (nearest origin) and waiting time at that stop has been excluded from this calculation because it is assumed that that will remain unchanged. The key assumptions behind this are that:

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Section 3.4, Pedestrian Planning And Design Guide, NZTA, December 2007
• the level of service for feeder routes from the suburbs feeding routes the Golden Mile buses will remain constant, and
• there are no significant changes to bus stop locations within the Golden Mile (where changes are proposed it assumed that they will have minimal impact).

9.2.3 Comparison of Interchange

In order to better understand the implication of modifying route operations or forcing interchange Figure 9.1 displays the generalised costs for walking or bus travel in the Golden Mile for various scenarios. The weighting factors used were taken from the Australian guide. The weighting factors are constant between each scenario. For the purposes of this assessment bus travel speed of 11km/h was used for both bus scenarios.

The use of different bus headways is indicative in order to display the relative change between changes in bus frequency.

The green (B) and blue (C) lines show the generalised costs associated with northbound travel within the Golden Mile from the Embassy end of Courtenay Place. Generalised costs associated with a 15 minute frequency (B) are higher than for a two minute frequency (C). This is because of the additional waiting time at the interchange associated with lower frequency services. The steeper gradient for the generalised cost of walking (red (D) and pink (A)) indicates that travel distance is more important for pedestrians than for bus users.

Where the generalised cost for walking is lower than that for travel by bus, it is likely that people will walk to their final destination rather than transfer onto another bus. So if the generalised cost of walking is taken purely as the travel time multiplied by the value of time (D), then it is unlikely that any passengers would transfer from a feeder service to buses that run only within the Golden Mile.

Given the delays pedestrians must endure at major road crossings (90 second wait to cross Taranaki Street) and the sometimes poor weather conditions it seems probable that some passengers would in fact be willing to transfer between buses. The pink line shows a sensitivity test that incorporates an adjustment factor to reflect the perceived dis-benefit of walking. Using this adjustment, the generalised cost of walking is less than that for travel by bus for distances of less than 800 metres. Whilst intuitively this feels correct, additional data is needed to calibrate this model and confirm this relationship. The best forecast of the generalised cost of walking is probably somewhere between the red (D) and the pink (A) lines.
Lines B and C include costs associated with transfer from a feeder service to a route operating on the Golden Mile. This assumes that feeder buses do not penetrate further into the Golden Mile.

People that start their journey very close to the Golden Mile are less likely to travel by bus to access the Railway Station or bus interchange points at either end. Instead they are likely to walk before catching the bus or other PT mode. A cost would be attributed to time spent waiting for a bus at the beginning of their journey (access time). Access time is attributed a higher numerical weighing than transfer (interchange time), as a result people starting their journey close to the Golden Mile are likely to walk further than passengers arriving at one end by bus.

### 9.2.4 Summary

This chapter gives an indication of the scope for developing a bus operational model that includes transfers at specific locations on the Golden Mile (either end or stops within the Golden Mile). It shows that the frequency of core trunk routes, feeder routes and any shuttle service along with the distance between the interchange and the trip origin/destination are key factors that will govern patronage. This assessment shows that to be successful, any operating system that requires interchange within the Golden Mile (e.g. trunk/feeder system) would require transfers further out from the Golden Mile.
Part C – Route and Operational Improvements.
10 Route Improvements

10.1 Bus Priority Measures

This section looks at the softer and more traditional bus priority measures that could be applied to the Golden Mile or any other PT corridor in Wellington. These measures and associated assumptions have also been incorporated into the specific route based PT improvements identified later in this section.

Such bus priority measures are no longer considered a shift change, they are generally accepted principles and tools that should be applied to all PT corridors with greater than approximately 10 buses per hour (as adopted by Transport for London).

10.1.1 Signals and Bus Detection

Wellington like many other CBD areas is dominated by signal controlled intersections which provide network control and management for vehicles. These facilities are often implemented with improving safety and efficiency for all modes, however signal technology is constantly changing and new technology and interfaces with other technology is giving rise to increased opportunity to provide significant benefits for specific users. The use of advanced signal technology and associated treatment along a single bus corridor has the potential for significant journey time savings and greater adherence to timetables through route reliability.

Wellington City Council and Greater Wellington Regional Council are currently in the process of embarking on a trial project which will see route based bus management through the use of signal technology interfacing with on bus detection systems. The aim of this system is to give buses priority at signalised intersection through the allocation of additional green time, reduced green time for general traffic and pedestrians, and linking of signal intersections and other bus priority mechanisms. Other further enhancements that have been used elsewhere in the world include:

- Stage skipping – allows buses to call the phase they need in advance of the traditional signal cycle (resulting in savings of 2.5 to 6 seconds per junction / bus)
- Local extensions – ensures that if a bus is approaching a signal the phase is extended to ensure it can get through without delay (resulting in savings of 2 to 4 seconds per junction / bus)
- Bus advanced stages (already in use on Dixon Street)
- Stop and signal linkage and integration

The journey time savings that can be achieved through the introduction of such signal systems is based upon the type and level of priority which can be achieved. However, assuming that each of the 20 signal intersections on the Golden Mile has some form of treatment, taking a conservative view that 3 seconds of saving could be achieved at each location, a total of 60 seconds per bus could be achieved in either direction.
Given that an existing signal control strategy exists in Wellington, the roll out of a linked detection system focused towards buses could result in even greater savings over the entire length of the bus corridor. Such systems not only assist with improving journey times, but also help improve route reliability, including slowing buses down to ensure they remain on schedule.

10.1.2 Pedestrian Crossings

All bus passengers are pedestrians at some point in time and the provision for them is particularly important. The management of these pedestrian movements can have significant benefits for bus operation. Savings to buses and general traffic can be achieved through the introduction of signalised pedestrian control (as proposed for Courtenay Place) and associated detection mechanisms (as discussed above).

The core objective of pedestrian management is to ensure that buses are not disadvantaged by extremely high levels of service for pedestrians.

A basic calculation based on survey traffic flows and the savings identified in the literature review shows the conversion of zebra or traditional signalised pedestrian crossings to pedestrian detection signal crossings with bus priority treatment could save each bus as much as 5 seconds per crossing (Puffin – refer DTLR Traffic Advisory Leaflet 1/01, 1/02). The use of puffin crossings in NZ is currently being trialed in Lower Hutt24, proving to be extremely successful for pedestrians; however the next phase of this trial is to look at benefits to traffic and buses.

Management of pedestrians should be linked into the overall route management strategy whether it is through signal control systems or enhanced facilities adjacent to the bus corridor.

10.1.3 Parking Controls and Restrictions

The ultimate control to enhance bus operation is the restriction of general traffic from the bus corridor; however where this is not possible a consistent approach to the implementation of mechanisms to control loading and parking would provide significant benefits in the creation of a quality bus corridor.

Mechanisms which have been identified as providing benefits in terms of bus priority include the standardisation of restrictions, reduction and/or control of permitted loading and parking times and periods, and the use of shared use bays, and/or footway space for off peak loading in areas of very limited on street space.

The introduction of a loading and parking strategy could be applied over the length of the Golden Mile as part of a corridor strategy to reduce delays as a result of loading and parking activities. The consideration of such a strategy needs to target the following:

- Restricted access to bus only area at all times where possible. This could be limited to daytime hours (7am to 7pm) as a minimum.

• Creation of no parking or loading restrictions in areas where bus operation or bus stop accessibility is currently obstructed by such activities (e.g. the southern end of Lambton Quay and the Grand Arcade bus stop).
• Standardising all parking restrictions and loading hours over the length of the route to avoid peak periods (7-9am and 4-6pm as a minimum), thus reducing the interaction between parked or parking vehicles during core bus demand.

This approach would need to be complemented by appropriate and consistent levels of enforcement.

10.1.4 Enforcement

The success of any bus priority or traffic management mechanisms involving regulations is dependent upon a clear and agreed enforcement strategy. This strategy should build existing levels of enforcement and focus on compliance of measures which have been implemented to benefit bus operation.

The types of enforcement mechanisms that can be employed include:

• Route based strategy and objectives for the Golden Mile;
• Identification of hotspots and targeted enforcement of these locations;
• Increased route / area wide on street enforcement;
• Bus mounted enforcement cameras; and
• CCTV cameras to enforce and manage traffic obstructions.

The development of an enforcement strategy should focus on areas with the highest level of obstruction and seek to enhance the level of service to buses. Hotspots and compliance targets need to be identified in order to ensure the aims and objectives of the bus priority intervention are achieved (e.g. modelled delays reduced).

Wellington would benefit hugely from a strategy which took into account all traffic management mechanisms and enforcement tools, such as CCTV enforcement. It is evident from current operation of traffic and bus priority facilities, that illegal activity significantly reduces the benefits of the interventions (e.g. bus lanes and narrow links on Lambton Quay are impacted by illegal courier and truck loading and parking).

Although the scope of this work has not made it possible to quantify the true level of benefit likely to be received through the effective enforcement of traffic restrictions, it can be assumed that the existing operation of particular measures will not be met unless effective enforcement occurs.

The use of bus mounted cameras in the future may provide the evidence to confirm the extent of the people and whether changes to restrictions would provide benefits to bus operation.
10.1.5 Trolley Bus Operational Issues

The potential for trolley bus breakdowns on the corridor is a problem for the operation of all services through such a key public transport corridor. Recent improvements to the new trolley buses, allowing continued operation under battery power in the event that ‘poles’ come off the wires is a significant enhancement, however following discussion with the Wellington Cable Company, it was identified that the reduction in pinch points (those areas in which there is no opportunity to pass) on the network would enhance the operation of the entire public transport system.

This study has not considered the removal of trolley buses to reduce bus delay. However, the enhancements that are proposed for the corridor in terms of bus priority and dedicated bus space should help to limit the impact of any breakdown on the wider PT network.

10.2 Route Infrastructure Improvements

Route based infrastructure improvement plans have been based upon options considered as part of the Ngauranga to Airport Strategy and WCC Bus Priority Programme, which includes the two way operation of buses through Manners Mall and associated linkages to the north and south of this location.

10.2.1 Network Wide Bus Priority Improvements

Wellington City Council has recently developed ambitious plans to enhance the level of bus priority on many of the key strategic corridors into the Wellington CBD. The package of proposed bus priority schemes is presented in Appendix D and the Manners Mall project now has NZTA funding to develop the design and start construction once the order to revoke the pedestrian only mall has been approved. The enhancement of bus priority on the Golden Mile is one of the key projects identified in this package and the first to be implemented.

As part of work undertaken by Opus to test the impact of these improvements, it has been identified that each of these proposed bus priority improvements for specific corridors needs to be considered in more detail before proceeding to implementation. This was established through the testing of proposals based upon the planned implementation in accordance with the following indicative programme:

2009/10 to 2015/16 (anticipated to be in this priority/order)

- Golden Mile including Lambton Quay, Manners Mall, Courtenay Place (Combination of contra-flow bus lanes and full time bus lanes)
- Completion of Golden Mile and schemes for Kent/Cambridge Terrace and Taranaki Street between Courtenay Place and Buckle Street.(The latter two schemes are peak hour bus lanes)
- Peak hour bus lanes in Adelaide Road, Molesworth Street and Mulgrave Street, Bowen Street, Willis Street between Aro Street and Manners Street, The Terrace
- Newtown - Constable Street to John Street (Tidal Peak Hour lanes)
- Kilbirnie to Newtown (Tidal Peak Hour lanes)
- Thorndon - Kaiwharawhara to City (Tidal Peak Hour lanes)
- Karori Tunnel to Bowen Street (Tidal Peak Hour lanes)

**2016/17 to 2022/23 (anticipated to be in this priority/order)**

- Victoria Street
- Kilbirnie to Hataitai
- Hutt Road
- Southern end of Taranaki Street and Wallace Street
- Island Bay (John Street South)
- Balance of Karori route
- Brooklyn (Webb St South)

This programme and the intentions of this work are very important to the enhancement of PT in Wellington, and key stakeholders such as GWRC need to work with WCC to deliver these high levels of bus priority.

Based upon initial indicative testing using the 2006 Wellington SATURN for each of the forecast years 2016 and 2026, the modelling has highlighted that further work is needed to refine the designs and ensure they do not have adverse impacts on approaches to bus priority routes and corridors and also to limit the impact the proposals have on wider traffic network operation. Although this is outside of the scope of this study, it highlights that having high levels of bus priority approaching the CBD on all key corridors needs to be carefully considered and could shift the problem of bus reliability away from the CBD to the suburbs and extremities of the routes. These issues need to be addressed through the design of PT infrastructure and could be considered as part of the wider Wellington PT review.

There is no doubt that if travel demand continues to grow, then alternative provisions will be needed to accommodate this growth as general traffic capacity is limited and the opportunities for enhancements are limited. The facilitation of enhanced bus priority is critical to not only absorbing this additional trip demand, but also achieving other regional goals such as modal shift towards more sustainable modes of transport.
10.2.2 Golden Mile Operational Performance and Bus Priority Improvements

As identified above, and in earlier sections of this report, the enhancement of bus priority on the Golden Mile is a core objective of the Ngauranga to Airport Plan and other WCC and GWRC policy objectives.

In looking back at the operational performance of the existing network summarised in Section 3, it is evident that the provision of bus priority provides some benefit to bus operational conditions; however as has been discussed in Section 3.7, it is not the only issue that needs to be resolved.

As part of this assessment, testing has been undertaken to look at creating different levels of bus priority along the Golden Mile corridor in order to determine the likely impact that this will have on bus operation. These levels of bus priority are presented as options, but ideally should be considered as phases that shift PT on the Golden Mile towards a high quality PT Spine.

The three core options that were considered are:

- Option 1 – Dedicated PT corridor and significant vehicle restrictions to create a bus dedicated space and associated facilities for much of the Golden Mile corridor (refer figure 10.2).
- Option 2 – Manners Mall improvements only, with minor improvements to bus priority over the length of the Golden Mile (Refer figure 10.3)
- Option 3 – Consistent with option 1, however without the Manners Mall section of the Golden Mile project.

Consideration was given to Option 3 in order to better understand the impact this project might have on the overall Golden Mile project.

It is not deemed appropriate that the Do-Minimum or do nothing scenario be considered as an option given the excessive journey time variability and importance of the Golden Mile as a transport corridor for Wellington.

10.2.3 Enhanced Bus Priority for the Length of the Golden (Option 1)

The option to develop a high quality PT spine which is safeguarded for future PT modes such as light rail or bus rapid transit was developed as part of the Ngauranga to Airport Strategy Study. The concept of reallocated road space has been taken from the Ngauranga to Airport study and further developed to deliver a dedicated bus priority corridor as shown in Figure 10.2. In order to achieve this concept, it was essential to limit and/or restrict traffic over much of the Golden Mile corridor.

Recognising the importance of this corridor for business and commercial activity, our bus priority concept has utilised existing restrictions and areas in which traffic movements are limited (Lambton Quay west side). An example of what this might look like on Lambton Quay is displayed in Figure 10.1 below.
This bus priority concept creates a dedicated bus lanes or bus way over the entire length of the Golden Mile, including the Manners Mall, resulting in significant benefits to buses (refer Section 10.2.5). Such a proposal would result in impacts on traffic patterns and delay in certain parts of the CBD which could be mitigated through alternative traffic management and increased PT usage.

Such a corridor would also allow the delivery of a PT spine which is safeguarded for future PT demands and a better environment for pedestrians and shoppers.

**Figure 10.1: Indicative Cross Section for Lambton Quay**

10.2.4 Manners Mall Bus Priority Improvements (Option 2)

This report was intended to follow the review of the Golden Mile route between Willis Street and Taranaki Street. Work has already been assessed for WCC in detail and summarised in the Opus Report, Restoring the Golden Mile: Taranaki Street to Willis Street, 2009. The key findings of the Manners Mall assessment determined that an option to create two way working of buses on Willis Street south of Mercer Street, Manners Street (east and west) and Manners Mall should be further progressed as presented in Figure 10.3.

The proposed bus priority project for Manners Mall was considered to be the most direct and legible route, with the highest benefits to bus users, resulting in a reduction in journey times ranging from 35-162 seconds northbound in the PM peak. Greatest benefits would be achieved during the PM peak; however significant benefits are also achieved during the AM and interpeak periods. This option also offers high levels of qualitative benefits and a range of other benefits relating to the enhancement of public space and personal security. This proposal does have impacts on general traffic delay, travel times, and congestion in the CBD; which is consistent with all options considered for the Golden Mile due to the restrictions to general traffic and increased allocation of road space to buses.
Figure 10.2: Full Golden Mile Bus Priority Project – Option 1
Figure 10.3: Manners Mall Only – Option 2
10.2.5 Golden Mile Operational Performance Outputs

The WTM has been used to determine the impact of each option on bus delay at intersections, traffic distribution, travel speeds, distance travelled and delay. This in turn has allowed us to come to a conclusion about the priorities and benefits associated with each option in relation to the do minimum or do nothing scenario.

**Bus priority Assessment**

In order to assess the change in benefits and operating conditions for buses and passengers, two key options were considered given the resources and timeframes available, these included:

- Extracting changes in bus performance through the WTM, or
- Undertaking a hand calculation of bus operation through the study area, using the traffic model, existing operational data, and operational conditions to calibrate the results.

The most straightforward method would be the extraction of performance from the WTM; however it is acknowledged that this model is a strategic traffic modelling tool and has not been calibrated against bus operational conditions and performance (e.g. no consideration for bus stops, bus pre-emption etc.). Analysis undertaken for the Manners Mall assessment concluded that there was significant difference between the model and actual bus operation along the Golden Mile.

A combination of hand calculations and the use of intersection performance information extracted from the WTM have been used to determine bus delay and passenger impacts such as reliability and variability. The following methodology was used to take into account bus operation and associated bus priority:

- Calculation of total distance and optimum travel speed (assuming 30km/hr)
- Dwell time at bus stops (including pulling into and exiting the bus stop)
- Delay time at signals based on information extracted from the WTM. (This delay does not take into account bus pre-emption/detection which is considered an integral part in contributing to improved reliability, capacity and reduced delay. Depending upon the method of detection used between 10-50 percent reductions in delay can be achieved. Therefore for the purposes of this assessment we have assumed a 25 percent reduction in delay at signals associated with signal pre-emption for all options (based upon Section 10.1.1)).
- 75 percent of dwell time was removed where stops are proposed to be removed (e.g. Manners St / Stout St).
- The combination of these totals provides the total projected operating time for the option in base year (2006).
- To address the issues associated with increased traffic and increased bus frequency for forecast future years, the WTM has again been used to display the relative percentage change between travel times in the base against travel time in the forecast years by direction. It should be noted that the model takes into account changes in bus
numbers associated with significant increases in bus patronage; however it does not assume improved operating efficiencies and increases in bus occupancy (e.g. getting more passengers on each bus travelling the existing routes or corridor). Therefore this approach is considered conservative.

- This increase in future years has been applied to the base do minimum (current recorded operation) and options to provide forecast year operating conditions.
- The difference between the do minimum and options has been calculated and the relative change in travel time, passenger numbers and bus numbers has been input into the economic model to determine the relative benefits of each option.

**Bus Benefits**

A comparison of the bus journey times for each of the options is summarised in Table 10.1 and Table 10.2 below. The lower the journey time when compared to the do minimum, the better the bus benefit.

The calculation of journey time for the 2009 do minimum utilised the bus operational data recorded in August and September of 2009 to capture a sample of all routes using the Golden Mile. This data differs from the Valley Flyer GPS data used for the analysis of the Manners Mall project. Survey data collected for this project displayed higher average journey times and greater variability than the GPS data used for the Manners Mall project. This may be due to the operating characteristics of the Valley Flyer service and further highlights the problems regarding journey time variability between the AM, inter and PM peak periods, and reliability through the Golden Mile as discussed earlier in Section 3.

The Manners Mall project and associated bus priority improvements are the main contributors to benefits associated with any improvements over the length of the Golden Mile.

Figure 10.1 below shows the predicted change in travel time and the reduced variability in travel times (between different time periods) associated with the different bus priority projects for the Golden Mile. The key observation from this assessment is the significant journey time variability between northbound and southbound and between periods in the do minimum. With the introduction of the Golden Mile and the Manners Mall bus priority project, the journey times are significantly reduced, however more importantly, the variability is also significantly reduced between direction and different time periods.

Although option 1 does result in an improvement in benefit to bus operation higher than option 2, this option has a much greater impact on general traffic operation and accessibility. The wider traffic conditions assessed in the WTM displayed increases in travel time, distance travelled and a worsening in general traffic congestion as a result of the project.

The outputs of this indicative assessment highlight that much of the existing operational problems occur between Taranaki Street and Willis Street and the importance of removing variability in bus operation. Introducing dedicated bus priority and limitations to vehicle access are seen as the most effective ways to achieve this outcome.
Table 10.1: Bus Travel Time Comparison in Seconds (2009 Existing vs. 2016 Options)

<table>
<thead>
<tr>
<th>Route Section</th>
<th>Direction</th>
<th>Do minimum</th>
<th>Manners Mall Only (option 2)</th>
<th>Bus Priority Golden Mile (option 1)</th>
<th>Bus Priority Golden Mile (No Manners Mall: Option 3)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>AM</td>
<td>IP</td>
<td>PM</td>
<td>AM</td>
</tr>
<tr>
<td>Kent/Cambridge Tce to Taranaki St.</td>
<td>NB</td>
<td>95.0</td>
<td>79.0</td>
<td>111.0</td>
<td>118.7</td>
</tr>
<tr>
<td></td>
<td>SB</td>
<td>114.2</td>
<td>108.4</td>
<td>179.3</td>
<td>137.2</td>
</tr>
<tr>
<td>Taranaki St to Mercer St. (Manners Mall)</td>
<td>NB</td>
<td>327.3</td>
<td>337.0</td>
<td>426.5</td>
<td>155.2</td>
</tr>
<tr>
<td></td>
<td>SB</td>
<td>240.0</td>
<td>248.0</td>
<td>322.0</td>
<td>144.6</td>
</tr>
<tr>
<td>Mercer St. to Molesworth St.</td>
<td>NB</td>
<td>363.3</td>
<td>354.2</td>
<td>466.8</td>
<td>272.5</td>
</tr>
<tr>
<td></td>
<td>SB</td>
<td>426.0</td>
<td>445.0</td>
<td>538.0</td>
<td>326.0</td>
</tr>
</tbody>
</table>

Table 10.2: Bus Travel Time Saving in Seconds (2009 Existing vs. 2016 Options)

<table>
<thead>
<tr>
<th>Route Section</th>
<th>Difference (Do-minimum &amp; Option 2)</th>
<th>Difference (Do-minimum &amp; Option 1)</th>
<th>Difference (Do-minimum &amp; Option 1 with no Option 2)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AM</td>
<td>IP</td>
<td>PM</td>
</tr>
<tr>
<td>Kent/Cambridge Tce to Taranaki St.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NB</td>
<td>-23.0</td>
<td>-18.4</td>
<td>17.8</td>
</tr>
<tr>
<td>SB</td>
<td>-23.7</td>
<td>-45.8</td>
<td>-35.2</td>
</tr>
<tr>
<td>Taranaki St to Mercer St. (Manners Mall)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NB</td>
<td>172.2</td>
<td>180.9</td>
<td>231.4</td>
</tr>
<tr>
<td>SB</td>
<td>95.4</td>
<td>103.6</td>
<td>150.5</td>
</tr>
<tr>
<td>Mercer St. to Molesworth St.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NB</td>
<td>90.8</td>
<td>117.3</td>
<td>146.7</td>
</tr>
<tr>
<td>SB</td>
<td>100.0</td>
<td>155.6</td>
<td>101.7</td>
</tr>
</tbody>
</table>

Note: Table 10.3 displays journey time savings and those numbers which display a negative represent an increase in travel time.
10.2.6 Summary of Route Infrastructure Improvements

It is recommended that the greatest priority should be placed on the enhancement of bus priority in Manners Mall (option 2), while recognising that improvements over the length of the Golden Mile (option 1) should be focussed towards gradual restriction of traffic and increased levels of bus priority and associated provision over time as additional improvements are required to safeguard for future BRT or light rail systems.

If the Golden Mile was to be converted to bus rapid transit or light rail in accordance with the Ngauranga to Airport Study, the creation of a transport spine (similar to option 1) would be much more attractive and almost essential in some shape or form. This is largely due to the operational conditions required to achieve reliability and greater capacity on the corridor.

Although there remains uncertainty around the future of PT for the Golden Mile, both in terms of service provision and route operational models, it is important that any changes in infrastructure safeguard for future options such as BRT and light rail. Such reallocation of road space would allow for this while also allowing the removal of many of the signal intersections/crossings, and creating a much enhanced shared space corridor for PT and pedestrians (including cyclists).

This study did not aim to refine the options in any great detail. Bus priority and traffic management measures on the scale of those identified in option 1 would need further
detailed assessment and design before they could be implemented. This assessment was aimed at giving an indication as to whether this would offer significant benefit to buses, both now and in the future through the introduction of dedicated road space for PT.
11 Central Area Network Operational Models

Existing peak hour bus numbers along the Golden Mile are at the upper end of capacity. Although additional capacity on the Golden Mile is needed now, this is based upon the assumption the existing operational model exists and the associated inefficiencies with it. This chapter explores how sufficient capacity on the Golden Mile can be delivered in the short to medium term using different bus focused operational models. In the longer term, other alternatives may need to be considered to provide sufficient capacity.

Currently the unreliability and delays experienced by bus passengers on the Golden Mile are caused by a number of factors, including:

- the high volume of buses, causing delays on the carriageway and at stops;
- stops have insufficient capacity at bus stops, the bus drivers often cannot pull in and out easily and frequently block the carriageway while waiting to access the stop;
- loading is inefficient since drivers can’t tell if passengers want their bus until they have stopped and/or reached the stop flag; and
- processing cash payments and giving change on board the bus is slow.

Eight operational models have been developed and examined, including the existing do-minimum, as follows:

- Do Minimum (refer Section 2.8)
- Golden Mile Rapid Transit Spine
- Golden Mile Hubs
- Suburban Hubs
- Express Service – Pick-up/Drop-off only
- Express Service – Limited Stop
- Express Service – Parallel Route
- Wellington Station / Lambton Bus Interchange

For each operational model the following aspects were considered:

- Vehicle fleet requirements
- Bus stop Configuration and Capacity
- Interchange requirements
- Boarding, Alighting & Occupancy
- Travel & Dwell Times
- Service Efficiency & Reliability

The study has found that reducing the number of buses using the Golden Mile would improve the efficiency and reliability of the bus operations. In all of the options that were assessed there is a trade-off between the need to transfer and the provision of direct routes that minimise the need to transfer. However, it is recognised that many effective and efficient passenger transport systems around the world require passengers to transfer. It
should also be noted that such concepts are closely linked to light rail or BRT operational models.

Options which reduce the number of buses travelling on the Golden Mile result in some bus routes terminating at either end of the Golden Mile or further out (at suburban hubs). Passengers on these routes would be required to transfer to a bus which is travelling along the Golden Mile or walk to their final destination.

A general overview of each of the options followed by a summary of their pros and cons is given below. Greater levels of design and concept work have been undertaken for the Golden Mile Rapid Transit Spine due to the fact that the same design issues and opportunities can be applied to a number of the other operational models.

### 11.1 Golden Mile Rapid Transit Spine

The creation of a rapid transit spine along the Golden Mile would require that all routes terminate at Courtenay Place or the Railway Station. A single, high-frequency shuttle service would then operate along the Golden Mile spine linking Courtenay Place and the Railway Station.

For this option all buses would terminate at either end of the Golden Mile. Passengers would be required to transfer to a high frequency, dedicated Golden Mile shuttle (schematically shown in red) or walk to their destination within the Golden Mile. A high frequency shuttle service utilising dedicated vehicles which would reduce the interchange times and eliminate the need for a schedule.

Passengers travelling between destinations past either end of the Golden Mile spine would need to transfer at both ends of the spine to complete their journey. This would result in a double interchange penalty for passengers and could discourage some existing bus users away from PT.

The interchange points required for such a system are critical and could become congested and confusing if not correctly planned, designed and operated, due to large numbers of buses and passengers converging on specific locations.

Such a model could allow the rapid transit spine to be operated free and subsidised by those routes feeding into the spine, however this may result in significant capacity issues and many existing pedestrians in the CBD may choose to use a free bus instead of walking (particularly on wet and windy days).

Boarding and alighting would become more efficient through the Golden Mile; however the interchange points at either end may become congested. Drivers would be able to easily tell whether it is necessary for them to pull into every bus stop. If another bus is already at
a stop picking up passengers the driver would be able to pass the stopped bus, or only briefly pause to enable passengers to alight. This may require the shuttle service to operate using vehicles other than trolley buses; however the need to pass could be removed. This would avoid the current situation during peak periods where there is a queue of buses at each stop slowly making their way to the flag to ensure no other passengers want that particular bus route.

To further improve efficiency, dedicated buses which are suited to efficiently carrying more passengers short distances (fewer seats, wider aisle, two wide doors, and more standing room) could be used on the Golden Mile. These buses could be similar to the vehicles used for airport shuttles. Figure 11.1 shows an example of the interior of a bus which would be well suited to serving as a shuttle on the Golden Mile. It should be noted that any service configuration needs to consider the potential that this corridor may change in the future to light rail, tram or BRT. As a result the optimum location for these interchange points could facilitate this in the future.

Figure 11.1: Example Interior of a Shuttle Bus

Source: http://www.flickr.com/photos/atomictaco/3976734804/
This option provides the flexibility necessary to adjust the bus frequency to meet demand. It would also avoid queues of half empty buses travelling along the Golden Mile and any congestion would not impact bus services on the other parts of the network as they would not be required to travel through the Golden Mile. The overall reliability of suburban routes and their ability to keep to a schedule may improve since they would no longer be subject to congestion and loading delays on the Golden Mile.

Critical to this model is the need for a high quality interchange for passengers at either end of the Golden Mile and the ability of the road network to accommodate bus movements and standing areas. Options such as the creation of a bus station similar to Christchurch also exist, however this has not been investigated and is likely to be very costly in Wellington and could be limited by bus demands and frequencies on the Golden Mile.

Buses (or any other future PT service) must be able to easily turn around at either end of the Golden Mile for this option to be efficient. At Wellington Station there is already sufficient space to accommodate these movements within the bus terminus. Ideally a dedicated bus loop would also be provided at the Courtenay Place end of the Golden Mile. Figure 11.2 shows the minimum turning path for a bus turning around on Courtenay Place. There is insufficient space to accommodate such a facility without impacting on the general traffic operations and the urban environment of the area. The only possible turnaround option is for the shuttle services to turnaround using the intersection of Cambridge Terrace, Kent Terrace and Elizabeth Street.

**Figure 11.2: Courtenay Place Turning Path for Shuttle Services**

Turnaround options for the suburban services are also limited. Two options are shown in Figure 11.3 below. In Option 1, buses would use Wakefield Street, Tory Street then Courtenay Place. Alighting passengers would be dropped off on Cambridge Terrace while boarding passengers could be picked up on Courtenay Place. This would minimise the transfer distance for boarding passengers. Some kerbside parking on Wakefield Street or Tory Street would need to be changed to a bus zone to provide standing space for buses with a layover at the end of their route.
Autoturn was used to complete a preliminary check on the turning radii at the intersections. Generally, buses will be able to make the necessary turns; however, the left turn from Wakefield Street to Tory Street is problematic. For buses to be able to make this manoeuvre without crossing into the opposing lane the radius of the corner needs to be increased. At a minimum a street tree and one parking space would have to be removed along with realignment of the footpath. If this option is to be pursued, the ability of the buses to make the necessary turns should be explored in more detail.

In Option 2, buses would use Wakefield Street, Tory Street, Cable Street then Oriental Parade to turn around. A variation of this option is for buses to Chaffers Street instead of Tory Street. Two parking spaces on Chaffers Street would have to be removed to accommodate this variation. In either case, passengers would alight and board on Cambridge and Kent Terraces respectively. The transfer distance for passengers would be significant. Again some kerbside parking would need to be removed to create a space for buses with a layover at the end of their route. Based on a preliminary check, there appears to be sufficient turning radii at all the intersections to accommodate the bus movements, however, if this option is to be pursued a more in-depth check should be completed.

In this option, the transfer distance reduces the attractiveness of bus travel and the long turn around route reduces the efficiency of bus operations. Ideally, any transfer would have passengers stepping off one bus and straight onto another bus. For transfers to work services need to be reliable. The Golden Mile shuttle could run a high frequency (anything as high as 30 seconds would be consistent with current peak time bus numbers, however this could be easily adjusted to match demand and the willingness of passengers to use the service) to ensure direct interchange with little or no delay.

**Figure 11.3: Turn Around Options for Suburban Services**

As discussed earlier in Section 11.1, the interchange point is critical in any service which fails to travel through the Golden Mile due to the generalised cost and passenger's
willingness to walk. Although the option of not providing a central link has not been considered, if the central hubs (suburban turn around points) were sufficiently central (e.g. within approximately 1km of each other this could be seen as feasible, however offer poor connectivity and far lower levels of service for passengers.

<table>
<thead>
<tr>
<th>Pros</th>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td>• More efficient boarding and alighting at stops along the Golden Mile</td>
<td>• All passengers required to transfer to the shuttle bus for travel within the Golden Mile</td>
</tr>
<tr>
<td>• Reduced bus congestion</td>
<td>• Large walking distance at Courtenay Place transfer point [likely fatal flaw]</td>
</tr>
<tr>
<td>• High frequency shuttle bus services on Golden Mile</td>
<td>• The turn around for suburban routes at Courtenay Place is problematic</td>
</tr>
<tr>
<td>• Possible reliability improvements for suburban services</td>
<td>• Likely bus and passenger congestion and confusion at the transfer point as very large number of buses requiring transfer</td>
</tr>
<tr>
<td>• Shuttle bus frequency can be easily adjusted to demand</td>
<td>• Shuttle bus capacity may not be sufficient at peak times</td>
</tr>
</tbody>
</table>

The **Golden Mile Rapid Transit Spine** would have the most efficient and reliable service within the Golden Mile however all passengers would need to transfer buses or walk to reach their final destinations. The interchange between the suburban routes and shuttle service at the Courtenay Place end of the Golden Mile presents some challenges with the need to minimise walking distances by creating high quality bus terminals with central platforms and the need to provide for buses to turn around.

Many of the issues surrounding passenger interchange, route terminus and a willingness by passengers to transfer under this model are consistent for other models discussed in this section.

### 11.2 Golden Mile Hubs

The Golden Mile hubs model is similar to the rapid transit spine, with a limited number of core trunk routes (e.g. Lyall Bay to Karori) continuing to operate along the Golden Mile. Other routes would terminate at either end of the Golden Mile and require a transfer to one of the core trunk routes or a dedicated Golden Mile shuttle bus.

In this option, some routes would continue through the Golden Mile, while other routes, would terminate at either end. The buses that continue through the Golden Mile would need to be high frequency and high capacity to accommodate the additional passengers. This would not necessarily mean additional buses, but just careful consideration and adjustment of which routes
continue through the Golden Mile and which routes terminate at either end.

Relative to the Golden Mile Rapid Transit Spine option, fewer passengers would have to transfer buses and very few, if any, would have to use three different buses to reach their final destination.

Efficiencies would be gained from having fewer buses on the Golden Mile; however loading would not be as efficient as the Golden Mile Rapid Transit Spine option since drivers would continue to need to continue differentiating between passengers wanting their particular bus versus a different route. This could be addressed by splitting the bus stops so only specific routes use each stop. This would improve the efficiency and reduce the congestion at the stops.

The terminating suburban routes would need to be able to turn around at either end of the Golden Mile. Similar to the Golden Mile Rapid Transit Spine option, these routes could drop off on Cambridge Terrace before turning around using Wakefield Street, Chaffers Street and Cable Street. This would result in a long transfer distance for passengers which would reduce the attractiveness of the bus as a transport mode, making this option less viable.

As with all of these operational models, routes that currently enter/exit the Golden Mile at points like Willis St and Victoria St would continue to do so and could ultimately provide a link through the Golden Mile and out the other side or simply use the Railway Station as a terminus.

<table>
<thead>
<tr>
<th>Pros</th>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Reduced number of buses on the Golden Mile</td>
<td>• Large walking distance at Courtenay Place transfer point</td>
</tr>
<tr>
<td>• Many routes would remain the same as the current which would reduce confusion when it is implemented</td>
<td>• Some passengers forced to transfer buses to reach their final destination on the Golden Mile</td>
</tr>
<tr>
<td></td>
<td>• The turn around for suburban routes at Courtenay Place is problematic</td>
</tr>
<tr>
<td></td>
<td>• Likely bus and passenger congestion and confusion at the transfer point as very large number of buses requiring transfer (but not as many as the Golden Mile Bus Rapid Transit option)</td>
</tr>
</tbody>
</table>

The **Golden Mile Hubs** model provides more of a balance between improved operational efficiency and reliability on the Golden Mile, and less required transfers. The Golden Mile bus operation will not be as efficient and reliable as the Golden Mile Rapid Transit Spine option but many passengers will not have to transfer buses to reach their final destination. The Courtenay Place interchange is still problematic in this option.
11.3 Suburban Hubs

The Suburban Hubs model creates transfer points which are located in key locations beyond the extent of the Golden Mile and these interchange points be developed as quality facilities. Local and feeder routes would terminate at these hubs with a limited number of high frequency trunk routes connecting these hubs and providing service along the Golden Mile.

In the suburban hub operational model suburban hubs would be developed at key locations beyond the extent of the Golden Mile. Feeder services would provide service between the local neighbourhoods and each suburban hub. High frequency trunk routes would connect the suburban hubs and provide service along the Golden Mile.

Possible locations for the suburban hubs include Ngauranga, Karori, Newtown, the Basin Reserve, and Kilbirnie. A detailed analysis of the optimal locations for these hubs would need to be completed as part of the wider Wellington Public Transport Review currently being undertaken by GWRC.

Some passengers would need to transfer buses, but the possible inconvenience of the transfer would be offset by improved bus frequencies and high quality interchange facilities at each of the hub locations. The further out the transfer the lesser perceived inconvenience to passengers, assuming a high quality link can be provided between these hubs (refer Sections 9 and 11 on generalised cost evaluation).

Within this operational model, the number of buses utilising the Golden Mile can be reduced which would improve the operational efficiency and reliability. Hypothetically, if there were 3 suburban hubs located south of Courtenay Place and 3 suburban hubs located north of the Railway Station and there was direct service between each hub this would result in a total of 9 different routes. With bus headway of five minutes on each of these routes, there would be just over 100 buses per hour per direction on the Golden Mile.

One of the key requirements of this model is the need to create high quality bus interchange points (stations) at the suburban hubs and then reconfigure services which are not running through to the CBD in such a way that they provide a regular and high quality link to and from the suburban hub. These interchange points would ideally be located in areas with high convergence of existing routes, high population density and bus demand, while also having sufficient space to allow safe and efficient turn around and storage on buses.

Possible locations which have been identified include Newtown in the south and points such as Johnsonville and Petone in the north. The uncertainty around the interchange and location of this hub location highlights that the concept needs further investigation which could influence to operational model and viability. As a result, the operational model may
result is a hybrid of the suburban hubs and Golden Mile hubs concept (e.g. suburban hubs to the south and Lambton Bus Interchange as Golden Mile hub to the north), thus reducing costs and utilising existing facilities and service operation. This would also reduce potential competition with rail corridors.

In the future, if additional capacity is needed on the corridor, higher capacity articulated buses or light rail could be introduced on the trunk routes.

Legibility of the bus services within the Golden Mile would be improved with less than 10 distinct routes operating in the corridor compared to the current operation with approximately 35 different routes.

<table>
<thead>
<tr>
<th>Pros</th>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Reduces the number of buses on the Golden Mile</td>
<td>• Passengers may have to transfer buses, but this can be managed by the provision of high quality facilities and high frequency transfers</td>
</tr>
<tr>
<td>• Provides high frequency on core trunk routes</td>
<td>• Potential for significant capital cost at the outset.</td>
</tr>
<tr>
<td>• Improved legibility with fewer routes travelling through the Golden Mile</td>
<td>• Consultation and communication required. This could be done as part of the Wellington Public Transport Review.</td>
</tr>
<tr>
<td>• Compatible with future high quality PT spine concept, including BRT and LRT</td>
<td></td>
</tr>
<tr>
<td>• Reduced perceptions of inconvenience to transfer</td>
<td></td>
</tr>
<tr>
<td>• Reduced operating cost</td>
<td></td>
</tr>
</tbody>
</table>

The Suburban Hubs model reduces the number of buses on the Golden Mile while balancing required transfers by locating the hubs beyond the extents of the Golden Mile. This option would improve the legibility of bus services within the Golden Mile with a limited number of routes within the area. Similar to the Golden Mile hubs concept, this requires interchange points and facilities for buses to terminate and turn around.

11.4 Express Service Options

Within the Express Service option there are two sub-options: pick-up/drop-off only and limited stop. Both of these options are discussed in more detail below.

11.4.1 Express Service – Pick-up / Drop-off Only

Through running bus routes would be maintained but commuter and longer distance routes terminating at Courtenay Place would drop-off only on the inbound trip and pick-up only on the outbound trip.

In this option, the bus routing would remain the same as the existing scenario and there would be no change to through routes (shown in green to the right). However, buses that currently terminate at Courtenay Place or the Railway Station (shown in blue and purple)
would become express services through the Golden Mile. On the inbound trip, express buses would only drop off passengers within the Golden Mile and on the outbound trip these buses would only pick up passengers.

This Express Service – Pick-up / Drop-off only option eliminates the need for passengers to transfer to a second bus to travel within the Golden Mile. However, there is no reduction in the number of buses on the Golden Mile; bunching of buses will continue to occur.

Currently very few passengers board buses which are terminating at the end of the Golden Mile. The only exception is passengers who are travelling to the Railway Station. This option essentially formalises the way the bus routes currently operate on the Golden Mile, but would introduce some efficiencies with split stops and all-door loading. The express services may still experience delays on the Golden Mile due to limited passing opportunities due to the use of trolley buses and bus stops blocking through buses in the bus only sections.

Bus stops would need to be split into multiple flags (two recommended) with clear branding to differentiate routes which allow pick-up and drop-off and express routes which are pick-up or drop-off only. The dwell times for the express routes, especially the drop-off only segments will be lower than the other routes. To further reduce the dwell time for the express routes, all-door loading can be used on the pick-up/drop-off only segments since there are no passengers trying to go in the opposite direction. Trolley buses would be unsuitable for express routes as they have limited ability to pass (most trolley routes would be the all-stopping through routes anyway). Bus stops would need to be large enough to enable buses to fully pull into each stop so as not to block the carriageway for express buses.

<table>
<thead>
<tr>
<th>Pros</th>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Passengers are not required to transfer buses to travel within the Golden Mile</td>
<td>• No reduction in the number of buses on the Golden Mile</td>
</tr>
<tr>
<td>• Quicker journey times for passengers on the express routes</td>
<td>• Passing opportunities are limited</td>
</tr>
<tr>
<td>• More efficient bust operations</td>
<td>• Reduced legibility since only some buses allow pick-up and drop-off</td>
</tr>
</tbody>
</table>

The Express Service - Pick-up / Drop-off Only model essentially formalises how the existing system is operating and introduces some efficiencies by splitting stops and introducing all-door boarding on the express routes. For this option to be effective, sufficient opportunities for faster buses to pass other slower buses must be provided including stops large enough to accommodate all queuing buses such that the carriageway way is not blocked and limited use of trolley buses.
11.4.2 Express Service – Limited Stop

Through running bus routes would be maintained but commuter and longer distance routes terminating at Courtenay Place would only stop at limited locations within the Golden Mile.

The Express Service - Limited Stop option would create a two tier stopping system with minor and major stops within the Golden Mile. Local bus routes would continue to operate in their current configuration stopping at all bus stops. Commuter and regional buses (potentially routes 30-32 and 59-99) would have a limited express stopping pattern in the Golden Mile and would only stop at major stops. This option would not introduce any additional bus transfers for passengers; however passengers on the regional routes may have to walk further to reach their final destination.

It may also be possible to implement express routes across much of the regular network (particularly those high frequency/demand routes) to provide a wide distribution of express and traditional bus services. This two-tier network approach is consistent with best practice in places around the world (e.g. London and Toronto). Such a system could be investigated further as part of the Wellington Public Transport Review.

For this option to be effective it is necessary that buses serving express routes be able to pass buses on regular routes. Careful examination of which routes are served by trolley buses is required. Even with careful scheduling of trolley buses, passing opportunities would still be limited due to the single lane sections and bus stops being located in bus lanes.

<table>
<thead>
<tr>
<th>Pros</th>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td>• No additional transfers for passengers</td>
<td>• No reduction in the number of buses</td>
</tr>
<tr>
<td>• More efficient bus operations of regional routes</td>
<td>• Longer walk distances for some passengers on the express routes</td>
</tr>
<tr>
<td>• Quicker journey times for passengers on express routes</td>
<td></td>
</tr>
<tr>
<td>• Potential to develop two-tier express network</td>
<td></td>
</tr>
</tbody>
</table>

The Express Service – Limited Stop model introduces some efficiency to the regional routes by minimising the number of locations where they stop; however these passengers are disadvantaged by longer walking distances to their destination. Minimal improvement or change to the operation of the local routes is expected with this option. For this option to be effective, sufficient opportunities for faster buses to pass other slower buses must be provided.
11.4.3 Express Service – Parallel Route

Express services would have reduced stops and use a corridor away from the Golden Mile to reduce bus congestion on the Golden Mile.

The operation of an express service which utilises another corridor away from the Golden Mile has the benefit that routes such as Jervois Quay and Customhouse Quay have significant capacity and are set up to achieve traffic throughput. Such an option would therefore need to shift away from the Golden Mile at a location such as Taranaki Street in the south and Whitmore Street in the north in order to get passengers between Courtney Place and the Railway Station, with limited stops (or no stops in between).

Shifting some routes to a parallel corridor would increase the walking distance for many passengers and reduce the attractiveness and legibility of the bus system. Also, with the constrained geometry and a plethora of one-way streets in the CBD there is no logical corridor to use.

This concept was considered as part of the work on the Ngauranga to Airport Strategy Study and it was established that the greatest cluster of demand (based upon density of population and work space) was along the Golden Mile corridor. It was also considered that certain streets should be prioritised for certain uses and avoided a mixture of all streets for all things. As a result of this, the Golden Mile PT spine was established, with the focus being placed upon the enhancement and prioritisation of this corridor for PT.

<table>
<thead>
<tr>
<th>Pros</th>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Good for those buses that currently travel the Golden Mile picking up few passengers and getting caught in delays.</td>
<td>• Away from the principle desire line of users.</td>
</tr>
<tr>
<td>• Those passengers travelling through the Golden Mile would have slightly faster journey times based upon current operating conditions on the Golden Mile.</td>
<td>• Limited demand between Courtney Place and Railways Station (and visa versa).</td>
</tr>
<tr>
<td>• Reduction in buses on the Golden Mile.</td>
<td>• Lack of bus priority and subject to even greater variability.</td>
</tr>
<tr>
<td></td>
<td>• The inclusion of a bus stop(s) could impact on traffic flow.</td>
</tr>
<tr>
<td></td>
<td>• Poor passenger legibility.</td>
</tr>
</tbody>
</table>

The Express Service – Parallel Route model has been examined as part of the Ngauranga to Airport Strategy, but was not recommended due to the reduced legibility, lack appropriate alternative corridor and high concentration of people along the Golden Mile corridor. This position is further supported in this assessment.
11.5 Wellington Station / Lambton Bus Interchange

The existing Lambton Bus Interchange would be enhanced and all buses currently terminating at Courtenay Place would terminate at the Wellington Station / Lambton Bus Interchange. Through routes would remain unchanged.

- In the Wellington Station / Lambton Bus Interchange option the Lambton Bus Interchange would serve as a transit hub. Routes that currently travel through the Golden Mile or terminate at the Railway Station would remain unchanged. Routes that currently terminate at Courtenay Place would now terminate at the Railway Station. This option would minimise the number of people who would need to transfer buses, but it would not have a large impact on reducing the number of buses on the Golden Mile since many of the routes that currently terminate at Courtenay Place are lower frequency routes.

- This option avoids a bus loop or turnaround route for suburban buses at the Courtenay Place end of the Golden Mile.

A similar arrangement to this option (using Brandon Street) has been used in the past and there was a significant increase in ridership when replaced with the current operational model, so this option is unlikely to improve ridership.

<table>
<thead>
<tr>
<th>Pros</th>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Some reduction in the number of buses on the Golden Mile</td>
<td>May not sufficiently address the issues to provide significant benefits</td>
</tr>
<tr>
<td>Many passengers would not need to transfer buses</td>
<td>Previously tried and it wasn’t working</td>
</tr>
</tbody>
</table>

The Wellington Station Interchange model option would result in a slight reduction in the number of buses travelling on the Golden Mile which would produce some improvements to the operational efficiency and reliability of the remaining routes. The benefits of the slight decrease in the volume of buses may not outweigh the inconvenience of the forced bus transfer for some passengers. This option has been tried in the past and was changed to the current operational model since it wasn’t working.

11.6 Vehicle Fleet Requirements

Wellington’s existing public transport fleet has been discussed in Section 2.2. Vehicle factors that contribute to the successful public transport operations include:

- Capacity (under what conditions),
- Ability to load and unload passengers quickly,
• Accessibility for elderly and those with special needs (e.g. prams and wheelchair accessibility),
• Manoeuvrability (at stops and along the corridor),
• Storage,
• Reliability (has been an issue with trolleys in the past),
• Environmental conditions and outputs, and
• Cost and efficiency.

The specific vehicle requirements for different operational models have been mentioned earlier where applicable. There are some key vehicle requirements that would help to improve operation, irrespective of operational model:

• Vehicle capacity should match demand for the times in which that capacity is required (this may result in different bus types and sizes being used on the same route over different time periods)
• Vehicles on routes with high demand over the Golden Mile only (i.e. passengers travel for short distances) should have greater allocation of space for standing passengers.
• Vehicles should have a minimum of two doors, with the flexibility to allow loading and unloading from both doors if ticket systems permit (this is not so important for commuter routes where generally alighting only in the am peak and boarding only in the pm peak).
• Vehicles should have low emission standards and reduced noise pollution.

The Ngauranga to Airport Strategy Study played a major role in determining the future strategy for Transportation in Wellington City (refer section 1). The Study identified the route between the Wellington Railway Station and Newtown via the Golden Mile and the Basin Reserve as a key public transport spine. This current review looked at vehicle options for the public transport spine and concluded that buses or bus rapid transit were desirable as a short to medium term solution, while safeguarding infrastructure improvements to provide flexibility in the future for services such as light rail or trams.

Given the recent investment in the trolley network this review assumed trolley operations continuing at least in the short to medium term. The existing trolley service does have limitations both in terms of route configuration and operational flexibility but also has some similarities to light rail and other fixed infrastructure systems that can provide more development certainty and can help drive land use outcomes and high patronage (refer section 4 relating to land use and transport integration). Trolley buses also have very low local emissions and use sustainable energy (depending on the source of the electricity generation).
11.7 Summary

Based on the preceding analysis in this section and the earlier findings, it is recommended that the existing bus operational model be changed. This change should take the form of short term modifications to the existing operational model with the implementation of express drop off and pick up services on the Golden Mile. Such a change will largely formalise existing operation, however consideration should also be given to the identification of increased limited stop services from key interchange points such as Courtney Place, Willis Street and the Railway Station.

Longer term the Suburban Hub operational model is considered to be the preferred option which would provide sufficient capacity on the Golden Mile while improving the corridor’s reliability and efficiency. It should also be noted that such a model would work best with future plans and desires for a high quality PT spine using light rail or BRT services.

It is evident that this analysis and assessment provides the starting point for a more detailed investigation into the wider bus operational network model and associated interchange points. This concept and variations of it should be considered as GWRC completes the Wellington Bus Review and further develops IPTNP in the future.
12 Implementation Pathway

12.1 Approach

This study has identified a number of measures that could and should be implemented along the Golden Mile, while also feeding into a wider bus operational review of public transport. These measures have been split into the following groups:

- Integrated land use and transport planning
- Network operational models
- Operating conditions and infrastructure

In order to provide a credible implementation pathway, there was a need to develop criteria against which improvement measures could be assessed and priorities determined. Consideration has also been given to planning, implementation, timeframes, cost, disruption, logistics and contractual issues where possible. To determine whether proposals meet the objectives of the project, they have been assessed against their ability to address existing or future operational issues and improve efficiency and reliability.

A number of the measures for improvement or opportunities for enhancement are linked. For example, if enhancements are made to the ticketing regime to reduce dwell times, this may alleviate the need to change bus stop configuration.

12.2 Integrated Land Use and Transport Planning

The issue of land use planning and integrated transport is critical to the success of a good public transport system and much of Wellington’s success in encouraging the use of public transport has been based upon the densely developed CBD and clear transport corridors extending from it.

Recent changes and trends in land use through the growth in apartment living and the development of suburban centres are as a result of WCC policies and the development of integrated transport plans.

Despite these changes, traffic demand continues to grow and increased pressure exists to provide more vehicle capacity in and around Wellington. However recent studies such as the Ngauranga to Airport Strategy Study highlight that the ability to provide additional road capacity is limited and should be balanced against the provision of enhanced public transport provision.

Although there is no specific implementation pathway for this principle, if economic development is to continue and Wellington is to remain as a successful and vibrant place to live and work, it is essential that we maintain and enhance a public transport system which is well integrated with land use planning proposals. WCC, GWRC and other key stakeholders will need to work closely to ensure development and transport planning seeks to achieve an acceptable balance and for future generations.
This may be achieved through the RLTS, RPS and District Plan rules and control mechanisms to encourage lesser controls (such as parking or relaxed development standards) in areas which are well served by public transport corridors such as at the Golden Mile.

12.3 Operational Conditions and Infrastructure

The following interventions have been identified as mechanisms to assist bus priority and develop a long term PT corridor for the Golden Mile, resulting in benefits for passengers and operators.

12.3.1 Reallocation of Road Space

The Manners Mall project is considered the first phase in achieving a step change in bus priority through the reallocation of road space and provision of greater PT priority on the Golden Mile. This project should provide the catalyst for a number of other opportunities which have been identified for the entire Golden Mile. Evidence suggests that dedicated bus provision improves bus reliability and reduces journey times (e.g. Sb on Willis Street). Assessment undertaken as part of this project indicates that projects that create dedicated bus way on Lambton Quay and Courtney Place would have a major impact on traffic patterns throughout the CBD. Further work is needed to quantify the impact of such proposals with any degree of certainty.

It is suggested that further planning and design work be undertaken in the form of a schemes assessment for the entire Golden Mile corridor to confirm the most effective options for prioritising PT. It will be critical that any planning and design safeguards for the future potential operation of light rail or BRT.

12.3.2 Route Configuration – Manners Mall

The proposed improvements for bus operation between Willis Street and Taranaki Street (Manners Mall) not only improve journey times, but will also address travel time variability through the provision of dedicated bus space and priority, improve legibility, and rationalise bus stops. The delivery of this project as a package of measures is critical to the success of the project and the restoration of the Golden Mile.

It should be noted that although the Manners Mall project is predicted to operate effectively under the current operational model, any reduction in bus numbers could result in even greater benefits for public transport users through a reduced number of buses and more even scheduling. Modifications to the proposed design philosophy will result in a reduction in the benefits for the project and could impact on the safety and public acceptance of wider improvements to the Golden Mile project.

12.3.3 Bus Stop Rationalisation and Relocation

The Golden Mile has a number of bus stops that are closely spaced and which have limited demand. We identified two stops that could be removed. Other stops could be relocated to optimise the spacing and hence performance.
Some bus stop changes should occur as part of the Manners Mall project (e.g. Manners Street northbound), while more detailed assessment of the Golden Mile corridor should seek to utilise the information collected for this study and review the need and location of certain stops.

The Stout Street stop should be removed following appropriate planning and consultation. Other recommended stop changes would occur between Willis Street and Taranaki Street and are linked to the Manners Mall project. This project seeks to remove the northbound Manners Street stop and replace the Dixon Street and Lower Cuba Street stops with adjacent stops on either side of Cuba Street.

The Supreme Court has a desire to relocate the stop between Whitmore and Ballance Street for safety reasons; however this is not considered desirable from a passenger demand and interchange point of view. We recommend that the stop should remain in the existing location.

12.3.4  Bus Stop Layout and Design Improvements

Under the current delivery model, each of the bus stops on the Golden Mile is placed under significant pressure in terms of the number of buses per stop during peak periods. It is therefore seen as imperative to make a number of improvements to the existing stop arrangement and design.

The implementation should focus on splitting stops to include a minimum of two flags for all major stop locations and ensuring that cage (bus stopping areas) lengths complement this stop configuration. Consideration should also be given to have trolley services located on the rear flag in order to reduce the impact on other services.

Other improvements such as kerb heights, relocation of street furniture and enhanced provision of information and passenger facilities should also be incorporated into these changes where possible.

12.3.5 Parking Restrictions and Enforcement

Evidence suggests that parking restrictions and enforcement are not a significant issue currently; however with the introduction of increased bus priority this may become an increasing problem in the future. As a result, it is recommended that parking restrictions should be reviewed as part of the bus stop layout and improvements project, with an enforcement strategy developed and adopted by WCC.

It will be important to continue monitoring and management of such an enforcement strategy in the future to ensure the levels of enforcement are achieving the desired levels of compliance.

12.3.6 Cashless Ticketing on the Golden Mile

Dwell times at bus stops are significantly increased by cash fare ticketing at bus stops in the Golden Mile. Therefore the removal of cash fare ticketing in favour of electronic ticketing and off bus ticketing is desirable. Such improvements will have a small impact on
operation and passenger service initially; however it will provide wider benefits for the network and users in the future.

12.3.7 Integrated Ticketing

The delivery of an integrated ticketing system is essential to any operational model that increases or forces the need to interchange.

Improved integrated ticketing could be linked to the suburban hub or express service models indentified previously and being implemented at the same time. Although integrated ticketing is essential for bus to bus interchange, it may increase demand for rail to bus interchange, which could result in significant increases in demand, and impact on existing bus users through increased loading.

12.3.8 Real Time Information and Bus Detection

The installation of GPS and provision of bus detection equipment is currently being rolled out by GWRC and WCC and is expected to result in significant benefits through the communication of information, tracking of buses and the ability to control the speed and reliability of services through the use of signal detection and management.

The contract for deliveries has recently been awarded and is currently in the development and trial phase, with full implementation on the region’s buses in 2010.

12.3.9 Other Operational Improvements

The use of multiple door loading is something which should be investigated in conjunction with different ticketing regimes for the Golden Mile. Delivery timeframes could be closely linked to that for cashless ticketing. These improvements would have benefits through reduced dwell time and increased bus stop capacity; but there would also be an ongoing cost through the need for on board ticket enforcement within the Golden Mile itself.

12.4 Network Operational Models

The existing bus schedule and operational model appears to have evolved over time and does not reflect operating conditions or bus stop capacity. It is suggested that all bus schedules should be reviewed in the short term in order to get a better profile of bus movement through the Golden Mile (particularly for those longer distance services that have a higher dwell time at key stops).

The introduction schedules that allow a one minute headway at each stop in conjunction with splitting of bus stops would provide for approximately 120 buses using the current bus operational model.

Although this will require planning, agreement with bus operators and public information, it should be a relatively simple process to implement and result in improvements for majority of bus users. The impact on bus operations outside the CBD will also need to be considered.
It is also important to understand the importance of route reliability in achieving any accuracy associated with schedules. Although changes to schedules may have an impact at one end of the route (the start), without high levels of bus priority and reduced variability, schedules will not be maintained.

The shift from the current operational model to one which is based upon fewer buses passing through the Golden Mile is a desirable solution that would address a number of the existing and forecast operating conditions. The use of the Suburban Hub model is considered the best option to achieving this, however such a model will require significant change to the entire Wellington Bus network, including:

- Integrated ticketing
- Creation of effective transport hubs
- Significant consultation and publicity
- Contract review and renewal

As a short term operational improvement, it is considered that the modification of the existing operational model to reduce the number of stops in the Golden Mile will help to improve operational efficiency, reliability of buses using the Golden Mile. It may also be desirable to focus on the pick up out of the CBD in the PM peak and drop off into the CBD during the AM peak, thus reducing the dwell time for key routes during peak periods.

This model has a number of linkages to other improvement measures and will require some other measures to be implemented, these include:

- Acceptance that some people will need to change buses
- Greater need for bus priority to ensure directional priority is given to buses during the PM outbound and AM inbound
- Bus stop enhancements could be reduced in the short term.
- These changes to the existing operational model should be addressed through the current Wellington PT review being undertaken by GWRC.

### 12.5 Summary

It is evident that the pathway to implementation will need to be balanced between achieving the objectives of the project and influencing factors such as delivery timeframes, cost, disruption, logistics and contractual issues.

In order to summarise linkages between possible improvements and a delivery model, matrix has been developed and presented in Table 12.1 based upon the information available and an indicative understanding of how long changes may take to plan, design, communicate and then deliver. It should be noted that this has not been agreed with key stakeholders and should be used as guidance only.

Table 12.1 below includes indicative costs for each of the interventions based upon the current state of information and knowledge. Bus operational costs have been assumed to apply to contract changes, but if changes could be made at times in which contracts are
due to be negotiated, there could be significant savings for GWRC. These could be achieved through the efficiencies associated with a net reduction in the number of buses and distance travelled on the network. Following further investigation, planning and design around preferred operational changes, a business case would need to be developed to ensure the total benefits out way any cost implications associated with the change to the existing operation.

Table 12.1: Indicative Implementation Programme

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Implementation Programme</th>
<th>Cost</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land Use &amp; Integrated Transport Planning</td>
<td>Ongoing</td>
<td>Low</td>
<td>Operational issue that could be enhanced in the WCC District Plan</td>
</tr>
<tr>
<td>Real Time Information (ongoing monitoring and management)</td>
<td>Ongoing</td>
<td>High</td>
<td>Currently being implemented and trialed</td>
</tr>
<tr>
<td>Manners Mall Bus Priority</td>
<td>Short Term</td>
<td>High</td>
<td>NZTA funding allocated</td>
</tr>
<tr>
<td>Bus Stop Rationalisation (Stout St)</td>
<td>Short Term</td>
<td>Low</td>
<td>Some consultation and ongoing discussion with Supreme Court</td>
</tr>
<tr>
<td>Bus Schedule Review</td>
<td>Short Term</td>
<td>Low</td>
<td>Communication requirement</td>
</tr>
<tr>
<td>Express Services</td>
<td>Short Term</td>
<td>Low</td>
<td>Formalising existing operational patterns</td>
</tr>
<tr>
<td>Integrated Ticketing</td>
<td>Medium Term</td>
<td>High</td>
<td>Significant planning and wider network impacts</td>
</tr>
<tr>
<td>Cashless Ticketing on the Golden Mile</td>
<td>Medium Term</td>
<td>Medium</td>
<td>Communication and consultation critical</td>
</tr>
<tr>
<td>Bus Stop Layout &amp; Design Improvement</td>
<td>Medium Term</td>
<td>Medium</td>
<td>Some links to other projects and operational models</td>
</tr>
<tr>
<td>Parking Restrictions &amp; Enforcement Strategy</td>
<td>Medium Term</td>
<td>Low</td>
<td>Linked to bus improvements and relocation of road space</td>
</tr>
<tr>
<td>Investigation of Hubs (Suburban)</td>
<td>Long Term</td>
<td>High</td>
<td>Significant planning and consultation. Could have significant cost savings.</td>
</tr>
<tr>
<td>Relocation of Road Space</td>
<td>Long Term</td>
<td>High</td>
<td>Significant planning, design, consultation and costs.</td>
</tr>
</tbody>
</table>

Key (indicative):
Programme

- Short Term within the next 12 months
- Medium Term 1-3 years
- Long Term beyond 3 years

Cost

- Low under $0.5m
- $0.5m - $1m
- High Greater than $1m

* Bus Operational Cost
^ Capital, Planning & Design Cost
13 Conclusions

Wellington has a very effective and well used public transport system and future growth in population and changes in land use are predicted to place even greater pressure on the existing transport network and future provision of public transport services.

Despite the very high levels of public transport demand and the predictions that this will increase in the future, it is important to ensure standards do not slip, passengers are offered a quality system and efficiencies are achieved to ensure additional demand can be accommodated. This will not only provide benefits for existing and future public transport users, but also assist in delivering the targets in the Government Policy Statement for Transport 2009 which seeks to reduce congestion and get traffic moving on key strategic corridors, through a modal shift away from private motor vehicles.

This project has concluded that there are a number of key bus operational issues that occur within the Golden Mile and the wider bus network that are influenced by a range of contributing factors. These key areas in which operational issues exist include:

- The bus network operational model is inefficient and results in additional operational costs.
- Poor reliability and excessive journey times, particularly in area between Taranaki Street and Willis Street.
- Some buses running full while others run relatively empty.
- Passenger and driver legibility issues.
- Lack of coordination and scheduling of existing services.
- Bus stop capacity and configuration of services.
- Inconsistent bus stop spacing.
- Poor ticketing and lack of passenger flexibility.
- Inconsistent parking and access restrictions with no clear bus priority enforcement strategy.
- Limitations in bus access to bus stops impacting on dwell times.
- Limitations in the ability for the Golden Mile to provide for future high quality PT services such as bus rapid transit or light rail.
- Delay and variability associated with signals and pedestrian crossing facilities.
- Possibility to improve passenger information and bus stop facilities.

Despite all of these issues which exist the Wellington network is a lot better than most other cities in NZ. It should also be understood that GWRC, WCC and NZTA are currently involved in a number of projects which aim to address some of these issues, including:

- WCC Manners Mall Bus Priority Project
- WCC Wider Wellington Bus Priority Project for key bus corridors.
- GWRC Real Time Information System
- GWRC and WCC Signal Detection Trail
- GWRC Integrated Public Transport Network Plan (IPTNP)
- GWRC Wellington Public Transport Review
• NZTA Basin Reserve Scheme Assessment
• Snapper Electronic Ticketing

These significant public transport projects and the commissioning of this report highlights the commitment that GWRC has to enhancing public transport operation in Wellington and the Golden Mile in the future.

These conclusions confirm that the potential that exists for significant improvements to public transport operation on the Golden Mile. GWRC and other key stakeholders should continue the work they are currently doing to enhance this, while also looking to undertake a complete review of the network operation model and other mechanisms highlighted in the Implementation Pathway earlier (Section 11).

Recognising the increases in PT demand in the future and the limitations which exist in terms of traffic capacity for the Wellington CBD, future proofing for enhanced PT provision is considered a key ingredient to any long term operational model or significant infrastructure improvement.
14 Recommendations

It is recommended that GWRC should work with key stakeholders and the bus companies to continue the PT improvement projects that are currently ongoing in the Golden Mile and the wider network, while also developing a work programme consistent with the implementation pathway suggested. This should include the following as having highest priority:

(a) Manners Mall Bus Priority Project Design and Implementation

(b) Express Service Model Implementation and Bus Schedule Review as part of the Wellington PT Review

(c) Bus Stop Improvements, Rationalisation and Parking Restrictions

(d) Integrated Ticketing and/or Cashless Ticketing on the Golden Mile

(e) Investigation of a Hubs (Suburban or similar) Service Model.

(f) Investigation of Increased Reallocation of Road Space

In order to confirm the viability and interaction between these different projects and interventions, it is recommended that GWRC develop a Golden Mile simulation model to clearly display the interaction between bus scheduling, headways, interchange, bus stop interaction and interactions with other vehicles and infrastructure. It is recommended that this model be used to validate the findings presented in this report and previous work undertaken for the PT Spine and associated bus operational changes.

It is also recommended that measures are taken to improve the availability of data from bus operators, recognising the success of any good operation or future plan is the ability to monitor and improve. Current contract limitations appear to make this difficult to achieve and as a result this significantly impacts on the ability to carry out effective future planning and decision making.

The investigation, planning, design, consultation, and delivery of this programme should involve engagement with the following parties:

(a) Wellington City Council,

(b) Bus operators

(c) Public transport user groups

(d) NZTA

(e) Public and bus passengers

(f) Directly affected properties and businesses.
For those projects which involve major physical improvements to the Golden Mile transport spine, a scheme assessment or investigation similar to the one carried out for Manners Mall should be undertaken, with associated application for funding to proceed with detailed design and implementation. Those projects with a lesser impact should be discussed with WCC and bus operators to determine the most appropriate mechanism to ensure planning, design and delivery occurs to achieve the desired outcome.